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Appendix 1: Multi-hazard Loss Estimation Methodology (HAZUS) flood model version 2.0 instructions for geographic information systems technicians

A. Flood Model - Riverine only

Determine Watershed

1. Utilize the U.S. Environmental Protection Agency website:

    http://cfpub.epa.gov/surf/locate/index.cfm to identify watershed(s) in which the

    community is located. If the community crosses multiple watersheds, use the

    watershed image and county image to identify the watershed in which the

    community is located. If it remains too difficult to identify the community

    location, proceed to the next step.

2. Utilize the "place" and the U.S. Geological Survey (USGS) unique hydrologic unit

    code (HUC) "HUC layer" shape files and identify the city or county. Detailed

    definitions of HUCs can be found at http://water.usgs.gov/GIS/huc.html. Using

    this information, identify the watershed in which the targeted community is

    located.

Create a study region

3. Create a watershed region in the Multi-hazard Loss Estimation Methodology

    (HAZUS) after the watershed is determined. Select "flood hazard only."

4. Open the region in HAZUS.

5. Go to the "Geo-processing options" dialog box. Uncheck the "enable" button for

    "background processing."

6. Add "basemap.../streets," then "hide" the layers.

Specify hazard type

7. For "Hazard" "Flood Hazard Type" click on "Riverine only."

Identify and import the USGS Digital Elevation Model (DEM) data files for the study region

8. Go to "Hazard" "user data." Click on the "DEM" tab.

9. Download the USGS National Elevation Dataset (NED) available online at
   http://data.geocomm.com/catalog/US/group146.html

10. Select the appropriate USGS Digital Elevation Model (DEM) dataset. These are available online at http://data.geocomm.com/dem/demdownload.html Select "Vertical units" "Meters" and "Vertical datum" "NAVD88." Click "OK." Once the DEM processing is complete, the map displays the "RegionDEM" layer.

Create a stream network

11. Go to "Hazard" "develop stream network."

12. Enter "drainage area" "10" (more streams show for smaller numbers such as 2; less streams show for larger numbers such as 100; the range is 0.25-400).

Define a scenario

13. Select "Hazard," then "Scenario," then "New," and then "Create a new scenario."

14. Add a title and description of your choice.

15. Select the "flood hazard objects" button (+). Click reaches of interest on the map (it will highlight). Click "save," then click "OK".

16. Turn off "RegionDEM." Turn on "basemap."

17. Perform a screen capture. In MicroSoft Windows^{TM}, click [Alt] + [Print Screen]. Paste into Paint^{TM} and crop. In the Apple Mac Bootcamp^{TM}, click [FN] + [Option] + [Shift] + [F11]. Save the screen capture as "ReachSelection.jpg."

18. Turn on "RegionDEM." Turn off "basemap."

Run the hydrologic analysis

19. Select "Hazard," then "riverine," then "hydrology" (HAZUS analyzes the discharge-frequency relationship for each reach in the scenario).

Delineate the floodplain

20. Select "Hazard," then "riverine," then "delineate floodplain."

21. Select analysis type: click "Single return period."

    a. To illustrate a scenario showing present flood risk for the target community, ensure that the "Single return period" "years" column is set to the default value, "100."

    b. To illustrate a scenario showing anticipated future flood risk for the target community, set the "Single return period" "years" column to the value, "500."

22. Click "OK." [This is a time consuming step.] The analysis adds the floodplain boundary (boundarypolygon) and flood depth grid ("rpd100_r" or "rpd500_r"). Take screenshots (see step 16) to illustrate the size of the flood depth grid for participants during the flood risk management meeting.

23. Turn off "RegionDEM" and turn on "basemap." Set the "transparency" of "rpd100_r" or "rpd500_r" to 40%.

24. Perform a screen capture (refer to step 16). Save as "Floodplain.jpg."

25. Click "Save."

26. Turn on "RegionDEM" and turn off "basemap."

Run the analysis

27. Select "Analysis" "run."

28. Under "Analysis" "options," select all the options that apply to the situation. [The

analysis will take about 15 minutes to complete.]

29. Click "Save."

30. Go to "Results" menu "view current scenario results by," and adjust the setting:

    a. To illustrate a scenario showing present flood risk for the target community, ensure that the column is set to the default value, "100-year flood."

    b. To illustrate a scenario showing anticipated future flood risk for the target community, set the column to the value, "500-year flood."

31. Go to "Results" menu "summary reports."

32. Go to "other reports," then "global summary report" and click "view." Select highlights from the "global summary report" and illustrate in graphs to show participants during the flood risk management meeting.

Map the damage

33. Go to "Results" "General Building Stock" and select the option of interest for viewing.

34. Select the column of interest for viewing.

35. Click "Map" to view polygons in Environmental Science Research Institute (ESRI) ArcMap™.

36. Use a "transparency" setting of 40% to view "damaged census tracts" and "flood depth grid."

37. Classify data using categories that best illustrate relative damage, such as "no damage," "low-level damage," and "high-level damage." Take screenshots to illustrate the damage in geographic information systems (GIS) format for participants during the flood risk management meeting.

Pre-meeting checklist of items from the analysis to transfer to the flood risk management meeting presentation:

- Take screenshots to illustrate the size of the flood depth grid (step 17).

- Select highlights from the "global summary report" and illustrate in graphs (step 32).

- Take screenshots to illustrate the damage in GIS format (step 37).

B. Flood Model – Combined riverine and coastal locations where a storm surge is not anticipated. (If a storm surge is anticipated, proceed to "C. Combined riverine and coastal with storm surge.")

Determine Watershed

See Section A steps 1 and 2.

Create a study region

See Section A steps 3, 4, 5 and 6.

Specify hazard type

7. For "Hazard" "Flood Hazard Type," click on "Riverine and Coastal."

Identify and import the DEM data files for the study region

See Section A steps 8, 9 and 10.

Create a stream network

See Section A steps 11 and 12.

Define a scenario

See Section A steps 13 and 14.

15. To select reaches, choose "all" [allow time to run overnight]. If there are error

messages for some reaches, delete problem reaches and re-run.

See Section A steps 16, 17 and 18.

Run the hydrologic analysis

See Section A step 19.

Delineate the floodplain

20. Select "coastal shorelines" and make a box to select all. The "shoreline limits"

wizard displays. Click "next" to accept the default shoreline limits.

21. Information for 100- and 500-year flood conditions for the community of interest is

found at: https://www.rampp-team.com/public.htm. Find the Flood Insurance Study

(FIS) for the county and read the maximum reported for the 1% (100-year flood) and

0.2% (500-year flood) "coastal stillwater elevation." Stillwater elevation is the

projected elevation of floodwaters in the absence of waves resulting from wind or

seismic effects (FEMA 2014a). When illustrating a present flood risk scenario, use

the 1% (100-year flood) information. When illustrating an anticipated future flood

risk scenario, use the 0.2% (500-year flood) information. Ensure the vertical datum

matches what is reported in the FIS.

22. Click "Apply to all segments."

23. Click "Finish."

24. Turn off "RegionDEM." Turn on "basemap."

25. Perform a screen capture. In MicroSoft Windows^{TM}, click [Alt] + [Print Screen].

Paste into Paint^{TM} and crop. In the Apple Mac Bootcamp^{TM}, click [FN] + [Option] +

[Shift] + [F11]. Save the screen capture as "Shoreline.jpg."

26. Turn on "RegionDEM." Turn off "basemap."

27. Select "Hazard," then "riverine," then "delineate floodplain."

28. Select analysis type: click "Single return period."

   a. To illustrate a scenario showing present flood risk for the target community,

       ensure that the "Single return period" "years" column is set to the default value,

       "100."

   b. To illustrate a scenario showing anticipated future flood risk for the target

       community, set the "Single return period" "years" column to the value, "500."

29. Click "OK." [This is a time consuming step.] The analysis adds the floodplain

boundary (boundarypolygon) and flood depth grid ("rpd100_r" or "rpd500_r"). Take screenshots (refer to step 26) to illustrate the size of the flood depth grid for participants during the flood risk management meeting.

30. Turn off "RegionDEM" and turn on "basemap." Set "transparency" setting of "rpd100_r"or "rpd500_r" to 40%.

31. Perform a screen capture (refer to step 24). Save as "Floodplain.jpg."

32. Click "Save."

33. Turn on "RegionDEM" and turn off "basemap."

Run the analysis

34. Select "Analysis" "run."

35. Under "Analysis" "options," select all the options that apply to the situation. [The analysis will take about 15 minutes to complete.]

36. Click "Save."

37. Go to "Results" menu "view current scenario results by," and adjust the setting:

    a. To illustrate a scenario showing present flood risk for the target community, ensure that the column is set to the default value, "100-year flood."

    b. To illustrate a scenario showing anticipated future flood risk for the target community, set the column to the value, "500-year flood."

38. Go to "Results" menu "summary reports."

39. Go to "other reports," then "global summary report" and click "view." Select highlights from the "global summary report" and illustrate in graphs to show participants during the flood risk management meeting.

Map the damage

40. Go to "Results" "General Building Stock" and select the option of interest for viewing.

41. Select the column of interest for viewing.

42. Click "Map" to view polygons in ESRI ArcMap^{TM}.

43. Turn off "RegionDEM" and turn on "basemap." Use a "transparency" setting of 40% to view "damaged census tracts" and "flood depth grid."

44. Classify data using categories that best illustrate relative damage, such as "no damage," "low-level damage," and "high-level damage." Take screenshots to illustrate the damage in GIS format for participants during the flood risk management meeting (refer to step 24).

Pre-meeting checklist of items from the analysis to transfer to the flood risk management meeting presentation:

- Take screenshots to illustrate the size of the flood depth grid (step 25 and 29).

- Select highlights from the "global summary report" and illustrate in graphs (step 39).

- Take screenshots to illustrate the damage in GIS format (step 44).

C. Combined riverine and coastal with storm surge

Create a study region

1. Create a region in HAZUS. Select both "hurricane" and "flood" hazard.

2. Open the region in HAZUS. Select the "hurricane" option.

3. Go to the "Geo-processing options" dialog box. Uncheck the "enable" button for "background processing."

Define an historical hurricane scenario

4. Based on exploratory interviews with key leaders in each community (Appendix 5), an historic storm was identified that most flood risk management meeting participants were likely to remember. Find the height of the storm surge in this flood event for the target community using external data from the National Oceanic and Atmospheric Administration (NOAA) Weather Center historic inundation tables available online at http://tidesandcurrents.noaa.gov/historic_tide_tables.html).

5. Go to "Hazard" and select "scenario." Options "probabilistic" and "historic" are available. The storm surge model does not support "probabilistic" or "H*Wind Import."

6. Select "historic" and click "next." This opens a database that lists all the historic storms that made landfall in the USA as a category 3 or higher event between 1900 and 2010:

7. Click "Region Filter." This removes from view in the HAZUS table all the storms in the database that did not impact the target study region:

	Year	Name	Peak Gust (mph)	States Affected	Landfall States
1	1933	UN-NAMED-1933-8	70	DC PA NJ NC MD DE VA	NC
2	1945	UN-NAMED-1945-9	134	CT SC PA NY NJ NH NC ME MD MA GA FL DE VA	FL
3	1949	UN-NAMED-1949-2	139	T SC PA NY NJ NH NC ME MD MA GA FL DE WV VA	FL
4	1954	HAZEL	135	CT DC SC PA NY NJ NC MD MA DE WV VA	SC
5	1955	CONNIE	91	DC SC PA NY NJ NC MD DE VA	NC

8. If the historic storm identified in step 4 (above) is listed in the HAZUS table (step 7), select that storm and run the "Storm Surge Model" using the "Historic Hurricane" scenario (proceed to step 9 below). If this storm is NOT listed in HAZUS, run the "Storm Surge Model" using a "Probabilistic Hurricane" scenario and use external data from the NOAA website (refer to step 4) for the parameters (Proceed to "D. Probabilistic Hurricane Scenario" below).

9. HAZUS "Storm Surge Model" using the "Historic Hurricane" scenario:

   This process begins with the "historic" analysis in the "hurricane model" followed by the "coastal surge hazard" analysis in the "flood model." Once these two analyses are completed, a combined analysis is run and the combined losses are displayed.

10. Go to "Make this scenario active for analysis?" and select "Yes." Click "next" and then "finish." The analysis will estimate losses from this historic storm calculated in year 2000 U.S. dollars.

Run the analysis

11. "Analysis" options for storm surge include:

   a. "Deep water and near shore wave models" (This simulates the storm surge when deep water and near shore waves are coupled).

   b. "Near shore wave model only" (This simulates the storm surge with near shore waves using both the NOAA Sea, Lake and Overland Surges from Hurricanes (SLOSH) and Simulating Waves Near-shore (SWAN) models).

c. "No waves" (This simulates the storm surge only, without the addition of wave action).

Select the "Analysis" option that is the best fit for the characteristics of the storm surge, given the community's location.

12. Click "Analysis" "run."

13. Input "initial water level" in feet above (positive) or below (negative) mean sea level. To do this, use the most recent tide tables for the community available at: http://tidesandcurrents.noaa.gov/tides11/. Click on the "Predictions" link for the community. To determine the highest tide reported for the most recent annual tide data:

a. Copy January through December data for the most recent year listed and paste into a MicroSoft Excel™ spreadsheet. Copy the data using [Cntrl]+[a]. In Excel™, select "Data" "Text to Columns." Choose "Delimited." Click "Next." Uncheck the tab and check space and "finish." There are four columns of tide height data.

b. Enter the function [=max()] into the empty cell at the bottom of the data for each column of tide heights. From these four columns, select the highest tide height.

c. Enter this tide height in HAZUS for "initial water level."

14. Complete the analysis.

<u>Switch the hazard type to flood</u>

15. The Coastal Surge Model must be completed before switching to the Flood Model. Go to "Coastal Surge Status" under the "Analysis" menu. Confirm that the coastal surge hazard analysis is complete. Click "OK."

16. Save.

17. From the standard toolbar, click the "Switch Hazard" button: and select "flood." Alternatively, select "File" "switch hazard" and select "flood." ESRI ArcMap™ will close and then reopen in the flood model. The flood study region now displays.

18. Go to the "Geo-processing options" dialog box. Uncheck the "enable" button for "background processing."

19. Add "basemap.../streets," then "hide" the layers.

Specify hazard type

20. For "Hazard" "Flood Hazard Type" select "Riverine and Coastal" [Coastal Surge placeholder] option and click "OK."

21. Identify and import the USGS DEM data files for the study region

22. Go to "Hazard" "user data." Click on the "DEM" tab.

23. Download the USGS NED available online at

http://data.geocomm.com/catalog/US/group146.html

24. Select the appropriate DEM dataset. These are available online at

http://data.geocomm.com/dem/demdownload.html Select "Vertical units" "Meters" and "Vertical datum" "NAVD88." Click "OK." Once the DEM processing is complete, the map displays the "RegionDEM" layer.

Create a stream network

25. Go to "Hazard" "develop stream network."

26. Enter "drainage area" "10."

Create a new scenario: riverine and coastal reaches

27. Go to the U.S. Census Bureau website: http://www.census.gov/geo/maps-

data/data/tiger.html and search for the target community. Download into HAZUS the Topologically Integrated Geographic Encoding and Referencing (TIGER) files for important "PLACES" within the community.

28. Select "Hazard," then "Scenario," then "New," and then "Create a new scenario."

29. Add a title and description of your choice.

30. To select reaches, choose "all" (allow time to run overnight). If there are error messages for some reaches, delete the problem reaches and re-run. Click "save," then click "OK".

31. Turn off "RegionDEM." Turn on "basemap."

32. Perform a screen capture. In MicroSoft Windows^{TM}, click [Alt] + [Print Screen]. Paste into Paint^{TM} and crop. In the Apple Mac Bootcamp^{TM}, click [FN] + [Option] + [Shift] + [F11]. Save the screen capture as "RiverAndCoastalReaches.jpg."

33. Turn on "RegionDEM." Turn off "basemap."

Run the hydrologic analysis

34. Select "Hazard," then "riverine and coastal," then "hydrology."

Delineate the floodplain

35. Select "coastal shorelines" and make a box to select all. The "shoreline limits" wizard displays. Click "next" to accept the default shoreline limits.

36. Information for 100- and 500-year flood conditions for the community of interest is found at: https://www.rampp-team.com/public.htm. Find the FIS for the county and read the maximum reported for the 1% (100-year flood) and 0.2% (500-year flood) "coastal stillwater elevation" (FEMA 2014a). When illustrating a present flood risk scenario, use the 1% (100-year flood) information. When illustrating an anticipated

future flood risk scenario, use the 0.2% (500-year flood) information. Ensure the vertical datum matches what is reported in the FIS.

37. Click "Apply to all segments."

38. Click "Finish."

39. Turn off "RegionDEM." Turn on "basemap."

40. Perform a screen capture (refer to step 32). Save the screen capture as "CoastalReaches.jpg."

41. Turn on "RegionDEM." Turn off "basemap."

Run the analysis

42. Select "Analysis" "run."

43. Under "Analysis" "options," select all the options that apply to the situation. When prompted to enter a flood date, enter August 15 (This is required to calculate losses to agriculture). [The analysis will take about 15 minutes to complete.]

44. Click "Save."

45. Go to "Results" menu "view current scenario results by," and adjust the setting:

    a. To illustrate a scenario showing present flood risk for the target community, ensure that the column is set to the default value, "100-year flood."

    b. To illustrate a scenario showing anticipated future flood risk for the target community, set the column to the value, "500-year flood."

46. Go to "Results" menu "summary reports."

47. Go to "other reports," then "global summary report" and click "view." Select highlights from the "global summary report" and illustrate in graphs to show participants during the flood risk management meeting.

<u>Map the damage</u>

48. Go to "Results" "General Building Stock" and select the option of interest for viewing.

49. Select the column of interest for viewing.

50. Click "Map" to view polygons in ESRI ArcMap^{TM}.

51. Turn off "RegionDEM" and turn on "basemap." Use a "transparency" setting of 40% to view "damaged census tracts" and "flood depth grid."

52. Classify data using categories that best illustrate relative damage, such as "no damage," "low-level damage," and "high-level damage." Take screenshots to illustrate the damage in GIS format for participants during the flood risk management meeting (refer to step 32).

<u>Pre-meeting checklist of items from the analysis to transfer to the flood risk management meeting presentation:</u>

- Take screenshots to illustrate the size of the flood depth grid (steps 32 and 40).

- Select highlights from the "global summary report" and illustrate in graphs (step 47).

- Take screenshots to illustrate the damage in GIS format (step 52).

D. Probabilistic Hurricane Scenario

1. Create a region in HAZUS. Select both "hurricane" and "flood" hazard.

2. Open the region in HAZUS. Select the "hurricane" option.

3. Go to the "Geo-processing options" dialog box. Uncheck the "enable" button for "background processing."

Define an historical hurricane scenario

4. Based on exploratory interviews with key leaders in each community (Appendix 5), an historic storm was identified that most flood risk management meeting participants were likely to remember. Find the height of the storm surge in this flood event for the target community using external data from the NOAA Weather Center historic inundation tables available online at http://tidesandcurrents.noaa.gov/historic_tide_tables.html).

5. Go to "Hazard" and select "scenario" option "probabilistic." Click "next."

Run the analysis

6. In the "Analysis Options" dialog box, click "Select All."

7. Click "Analysis" "run" [Time Consuming]

8. Input "initial water level" in feet above (positive) or below (negative) mean sea level. To do this, use the most recent tide tables for the community available at: http://tidesandcurrents.noaa.gov/tides11/. Click on the "Predictions" link for the community. To determine the highest tide reported for the most recent annual tide data:

   a. Copy January through December data for the most recent year listed and paste into a MicroSoft Excel^{TM} spreadsheet. Copy the data using [Cntrl]+[a]. In

Excel^{TM}, select "Data" "Text to Columns." Choose "Delimited." Click "Next."
Uncheck the tab and check space and "finish." There are four columns of tide height data.

b. Enter the function [=max()] into the empty cell at the bottom of the data for each column of tide heights. From these four columns, select the highest tide height.

c. Enter this tide height in HAZUS for "initial water level."

9. Complete the analysis.

Switch the hazard type to flood

10. From the standard toolbar, click the "Switch Hazard" button: and select "flood." Alternatively, select "File" "switch hazard" and select "flood." ESRI ArcMap^{TM} will close and then reopen in the flood model. The flood study region now displays.

11. Go to the "Geo-processing options" dialog box. Uncheck the "enable" button for "background processing."

12. Add "basemap.../streets," then "hide" the layers.

Specify flood hazard type

13. Note that the coastal surge option is not available for a probabilistic hurricane scenario so when exiting out of the hurricane scenario to another "flood hazard type," one of the following options must be selected: "Riverine only" or "Riverine and coastal." Choose the option that best matches the location of the community and click "OK."

Identify and import the USGS DEM data files for the study region

14. Go to "Hazard" "user data." Click on the "DEM" tab.

15. Download the USGS NED available online at

http://data.geocomm.com/catalog/US/group146.html

16. Select the appropriate DEM dataset. These are available online at

   http://data.geocomm.com/dem/demdownload.html Select "Vertical units" "Meters"

   and "Vertical datum" "NAVD88." Click "OK." Once the DEM processing is

   complete, the map displays the "RegionDEM" layer.

Create a stream network

17. Go to "Hazard" "develop stream network."

18. Enter "drainage area" "10."

Run the hydrologic analysis

19. Go to "Hazard," then select the flood hazard type appropriate for the target

   community (refer to step 13). Click "hydrology."

Delineate the floodplain

20. This process will differ depending on the flood hazard type selected for the

   community (step13).

   a. For "Riverine only," refer to section "A. Flood Model - Riverine Only"

      steps 20 through 26.

   b. For "Riverine and coastal," refer to section "B. Flood Model – combined riverine

      and coastal locations where a storm surge is not anticipated" steps 20 through 33.

Run the analysis

21. Select "Analysis" "run."

22. Under "Analysis" "options," select all the options that apply to the situation. When

   prompted to enter a flood date, enter August 15 (This is required to calculate losses

   to agriculture). [The analysis will take about 15 minutes to complete.]

23. Click "Save."

24. Go to "Results" menu "view current scenario results by," and adjust the setting:

    a. To illustrate a scenario showing present flood risk for the target community, ensure that the column is set to the default value, "100-year flood."

    b. To illustrate a scenario showing anticipated future flood risk for the target community, set the column to the value, "500-year flood."

25. Go to "Results" menu "summary reports."

26. Go to "other reports," then "global summary report" and click "view." Select highlights from the "global summary report" and illustrate in graphs to show participants during the flood risk management meeting.

Map the damage

27. Go to "Results" "General Building Stock" and select the option of interest for viewing.

28. Select the column of interest for viewing.

29. Click "Map" to view polygons in ESRI ArcMap™.

30. Turn off "RegionDEM" and turn on "basemap." Use a "transparency" setting of 40% to view "damaged census tracts" and "flood depth grid."

31. Classify data using categories that best illustrate relative damage, such as "no damage," "low-level damage," and "high-level damage." Take screenshots to illustrate the damage in GIS format for participants during the flood risk management meeting. Perform a screen capture. In MicroSoft Windows™, click [Alt] + [Print Screen]. Paste into Paint™ and crop. In the Apple Mac Bootcamp™, click [FN] + [Option] + [Shift] + [F11]. Save the screen capture as

"DamageMap.jpg."

Pre-meeting checklist of items from the analysis to transfer to the flood risk management meeting presentation:

- Take screenshots to illustrate the size of the flood depth grid

    o For "Riverine only" refer to step 22 in section "A. Flood Model – Riverine Only."

    o For "Riverine and coastal" refer to steps 25 and 29 in section "B. Flood Model – combined riverine and coastal locations where a storm surge is not anticipated."

- Select highlights from the "global summary report" and illustrate in graphs (step 26).

- Take screenshots to illustrate the damage in GIS format (step 31).

Based on exploratory interviews with key leaders in each community (Appendix 5), an historic storm was identified that most flood risk management meeting participants were likely to remember. To verify the date of the historic storm, the geographic information systems technician went to the National Oceanic and Atmospheric Administration (NOAA) National Weather Service hurricane database at http://www.nhc.noaa.gov/data/ (NOAA 2014). The date given for the storm during the exploratory interview was entered. For a named hurricane, if the date was correct, the database lists the name of the storm. If the date given did not have a storm associated with it, other dates were searched to identify the correct information for the named storm. If the storm occurred outside of the time period June through November, it is considered a winter storm. These are not named (NOAA 2014). If a summer storm did not reach sufficient strength, it is not named (NOAA 2014). For these, the date given in the interview was used to search the database to verify that a storm occurred at that time. If a storm was not listed for that date, dates close to the one given in the interview were searched to locate the nearest record of a large storm. That storm was used to represent the historic storm in the stakeholder-built computer-assisted decision support system (DSS) model.

An approximate height of the flood stage during the historic flood event was needed in order to model the storm in the stakeholder-built DSS. For non-tidal riverine communities, U.S. Geological Survey (USGS) stream gauge information was used

(USGS 2013). For tidal river and bay communities, NOAA National Ocean Service (NOS) tidal gauge stations were used (NOAA 2011). For communities with both tidal and non-tidal areas, both stream and tidal gauges were used. Data collection for approximately two-thirds of the stream gauges was discontinued after September 30, 2005 (USGS 2013). More recent storms have fewer functioning gauges monitoring the flood stages. Therefore, the gauges were more likely to be located distant from the target community. When the nearest functioning gauge was located outside the target community, the following criteria were used for choosing a gauge(s) to represent flood stages in the community during the historic event:

- Proximity to the community

- Topography

- Elevation

- Geology/soil type

- Hydrology (non-tidal riverine, tidal river, tidal bay)

- Upstream and adjacent land use

To locate the nearest functioning USGS stream gauge:

1. Install Google Earth^{TM}.

2. Go to the USGS website: http://waterwatch.usgs.gov/index.php?id=stategage

3. Select the state in which the community is located.

4. Upload to Google Earth^{TM} the Keyhole Markup Language (KML) gauges file for the selected state.

5. On the top left corner of the Google Earth™ window, type "[town and state address]" in the search box. Click "enter" on the keyboard.

6. Google Earth™ will "fly" to the address. Use the tools on the upper right side of the

   Google Earth™ window to move around the Google™ map of the community to

   locate the nearest stream gauge(s). The gauges are identified by small red symbols.

   Click on the gauge symbol to view a pop-up window that displays the station

   number, the station name, the first date of data collection, the last date of data

   collection (as of September 30, 2005), and the number of days in the dataset

   (Appendix Figure 1). The last date of data collection will be prior to September 30,

   2005 for discontinued stream gauges. Conversely, the last date of data collection for

   active gauges will be shown as September 30, 2005, even when data are still

   currently being collected (USGS 2013). Click on the station number in the pop-up

   window to access up-to-date information regarding all stream-flow data collected at

   the site. Choose the gauge closest to the target community that was active at the time

   of the historic flood event modeled.

Appendix Figure 1: U.S. Geological Survey (USGS) stream gauge information available through a Keyhole Markup Language gauges file uploaded from the USGS website: http://waterwatch.usgs.gov/index.php?id=stategage to Google

EarthTM
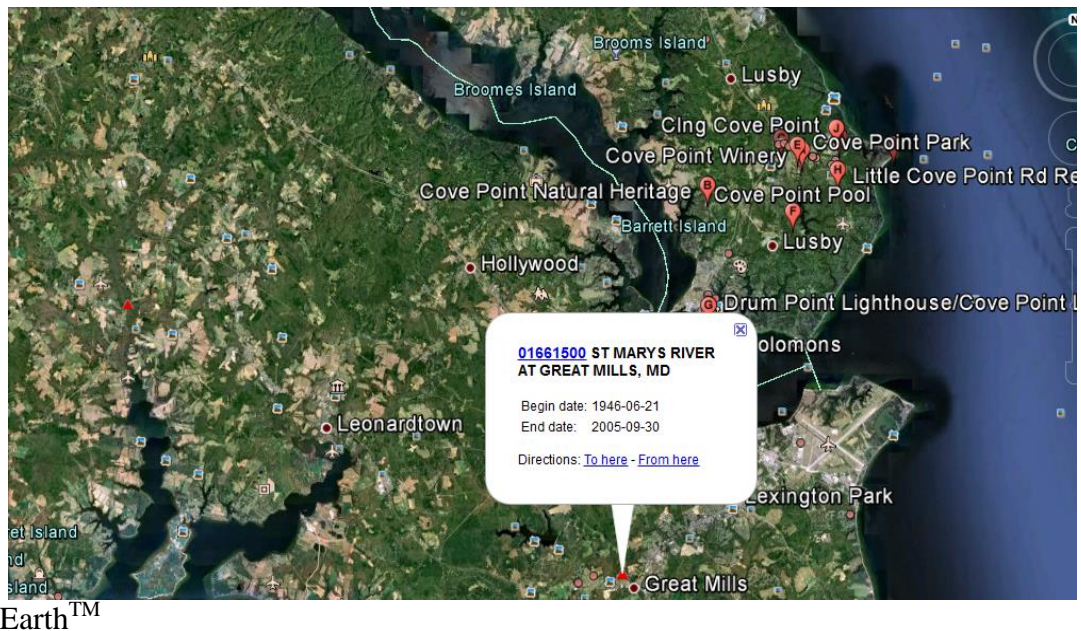
7. If all of the gauges viewed in step 6 were inactive during the historic storm, search using the website Google MapsTM at https://www.google.com/maps to find the names of nearby streams. Then go to the USGS website "Peak Streamflow for the Nation" at

http://nwis.waterdata.usgs.gov/nwis/peak?search_criteria=state_cd&submitted_form =introduction. Enter the state and submit. Do not change the default selections.

a. Under "products," select "Extremes."

b. Select "Station Extremes" and change the dates to "1953-Present."

c. Use "Rank #1" "highest elevation in feet."

All sites in the selected state will then be listed. Search for the names of nearby streams in this list with a gauge that was active during the storm. Record the gauge site number.

8. Go to the USGS website http://waterwatch.usgs.gov/index.php?id=wwchart_ftc2 and enter the gauge site number obtained in step 6 or 7 (above).

9. Perform a screen capture of the active stream gauge imbedded in Google Earth^{TM} (Appendix Figure 1). In MicroSoft Windows^{TM}, click [Alt] + [Print Screen]. Paste into Paint^{TM} and crop. In the Apple Mac Bootcamp^{TM}, click [FN] + [Option] + [Shift] + [F11]. Save the screen capture as "[stream gauge location].jpg." Include the screen capture in the flood risk meeting presentation.

10. Use the "toolkit" on the USGS website http://waterwatch.usgs.gov/index.php?id=wwchart_ftc2 to build a flood-tracking chart for the stream gauge selected to represent the flood stage for the historic storm in the stakeholder-built model. Perform a screen capture of the chart. Include this in the meeting presentation.

To locate the nearest functioning NOAA NOS tidal gauge station:

1. Go to the NOAA Weather Center historic inundation tables available online at http://tidesandcurrents.noaa.gov/historic_tide_tables.html.

2. Use the search bar located in the website's left side column to find the nearest active NOS gauge station for the historic storm to be modeled.

   a. Click on the state within the website's USA map. The state will be automatically entered in the "zoom to region" search box and the website will zoom to the state.

   b. Each tidal gauge is represented by a red symbol. Go to the gauge nearest the target community. Click on the symbol to view a pop-up window that

displays a list of information categories (Appendix Figure 2). Click on "Datums."

c. In "Datums" for the selected tidal gauge, scroll to "Highest Observed Water Level" and "Highest Observed Water Level Date and Time." If this matches the date of the historic storm to be modeled, use the water level information to set the flood stage elevation in the stakeholder-built model. If this does not match, return to the pop-up window for the gauge symbol on the website map. Click "Water levels." Set the units to "feet." Set the dates to include that of the historic storm to be modeled. Click "plot." Hover the cursor over the highest peak in the graph. The observed water level will appear. Record the information to use in the stakeholder-built model.

d. If the gauge provides feedback indicating it was not active during the historic storm, go to the next best gauge using the criteria listed earlier and repeat step c. Repeat on nearby gauges until at least one provides data for the historic storm flood stage. Record the information to use in the stakeholder-built model.
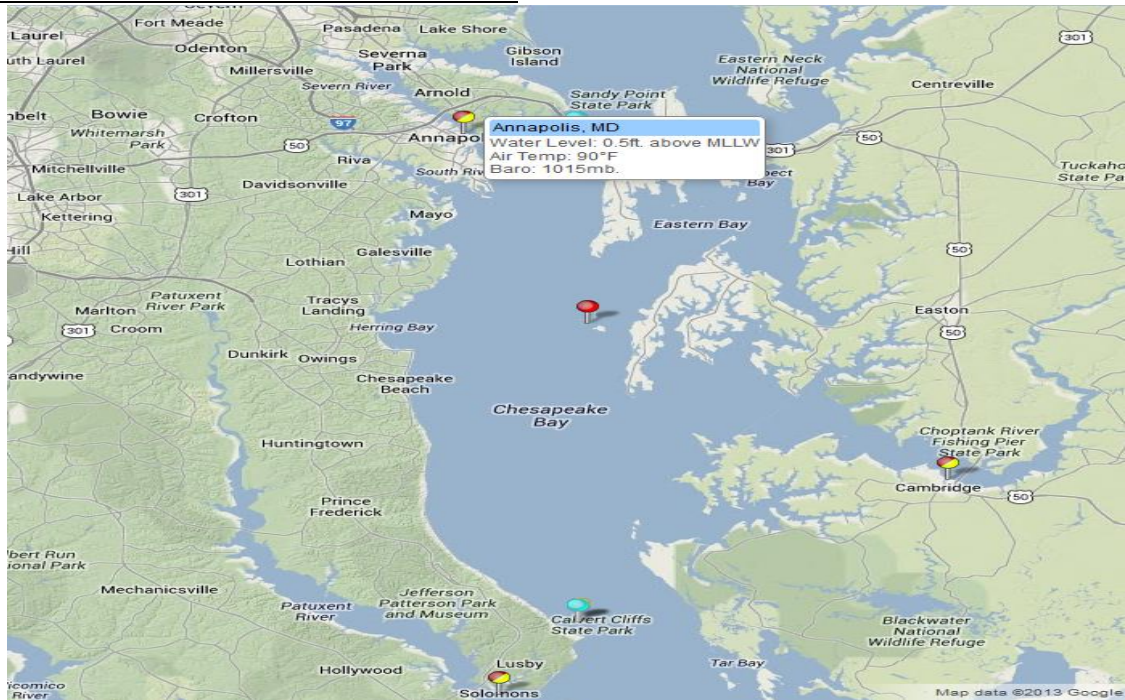
3. Perform a screen capture of the NOAA NOS tidal gauge station with the associated pop-up window (Appendix Figure 2). In MicroSoft Windows™, click [Alt] + [Print Screen]. Paste into Paint™ and crop. In the Apple Mac Bootcamp™, click [FN] + [Option] + [Shift] + [F11]. Save the screen capture as "[tidal gauge location].jpg." Include the screen capture in the flood risk meeting presentation.

4. Use the information in the "water levels" section of the NOAA Weather Center website http://tidesandcurrents.noaa.gov/historic_tide_tables.html to build a flood-tracking chart for the tidal gauge selected to represent the flood stage for the historic storm in the stakeholder-built model. Perform a screen capture. Include this in the meeting presentation.

Pre-meeting checklist of items from the analysis to transfer to the flood risk management meeting presentation:

- Take screenshots to illustrate the location of the stream and/or tidal gauge(s) used in the model. See step 9 in the stream gauge location instructions. See step 3 in the tidal gauge location instructions.

- Build flood-tracking chart(s) for the stream and/or tidal gauge(s) selected to represent the flood stage for the historic storm. Take screenshot(s) flood-tracking chart(s). See step 10 in the stream gauge location instructions. See step 4 in the tidal gauge location instructions.

Appendix 3: Participant Post Survey Part I

UNIVERSITY OF MARYLAND

Unique participant code:S_____

Post-Survey Part I

Please circle one:
The data on my community's flood risk I received during this meeting was:
    a. very trustworthy
    b. somewhat trustworthy
    c. not trustworthy

Please respond to the best of your ability:

1.   I live in an area that is _____ to experience a flood that results in damage to my property.
    a. Likely
    b. Unlikely
    c. I am unsure

2.   Steps that my community and I <u>could</u> take to protect my property from flood damage include:

3. Steps my community and/or I already put in place or plan to do that reduce flood risk include:

(There's more space on the back of this page.)

Appendix 4: Participant Post Survey Part II

UNIVERSITY OF MARYLAND

Unique participant code: S_____

Post-Survey Part II

For each statement, select one option:

1. If I continue to use my current property for the next 50 years, I anticipate the risk of experiencing a flood event from extreme precipitation will:
   a) Increase
   b) Decrease
   c) Remain the same
   d) I'm not sure

2. I plan to purchase flood insurance to cover the cost of structural damage to my property.
   a) Yes
   b) No
   c) I'm not sure if I need to do this
   d) I already did this
   e) I do not own my structure

3. I plan to purchase flood insurance to cover the cost of damage to the contents of my building.
   a) Yes
   b) No
   c) I'm not sure if I need to do this
   d) I already did this

4. I plan to move valuables and important documents to a place safe from floods.
   a) Yes
   b) No
   c) I'm not sure if I need to do this
   d) I already did this

5. I plan to arrange for regular clearing of debris from storm drains to prepare for a flood event.
   a) Yes
   b) No
   c) I'm not sure if I need to do this
   d) I already did this

1

University of Maryland

Post-Survey Part II   Unique participant code: S_____

6.   I plan to arrange for the planting and/or preservation of forest buffers adjacent to
      my community's waterways (streams, rivers, lakes, bay, etc.).
      a) Yes
      b) No
      c) I'm not sure if I need to do this
      d) I already did this

7.   I plan to determine the accessibility of local roads or alternative routes that are
      elevated above the base flood level.
      a) Yes
      b) No
      c) I'm not sure if I need to do this
      d) I already did this

Next Step:
**You have completed the survey. Please place Post-Survey Part II and your
index card with your participant code in the PINK envelope provided. Thank
you very much for participating.**

<u>Appendix 5: Exploratory interview protocol and questions asked of key community informants prior to conducting flood risk management meetings during which data was collected.</u>

The interview was conducted over the phone or in-person, according to the preference of the key community informant being interviewed. Minor changes in the introductory protocol were made if an introductory email exchange preceded the interview. The interview was completed prior to the flood risk management meeting during which data-collection was conducted.

Unique community code: <u>EU</u>

Unique key informant code <u>E</u>

Exploratory interview protocol:

Introduction: "Hello, this is [name of interviewer] of the University of Maryland. May I speak with [use the informant's name supplied by the city or county municipal flood risk management planners]. [If they express an interest in being addressed by a different version of their name, do so in all future references during the interview.] I am a University of Maryland graduate student interested in improving methods of communicating information about flood risk to [name their community] and other similar communities in the mid-Atlantic region. We are planning to hold a flood risk management meeting in [name their community] on [date]. [Name the city or county municipal flood risk planner or other city or county representative that recommended the key informant for this interview] recommended I contact you. I am interested in gaining some insight into [name their community]'s perception of flood risk and their interest in initiating flood risk reduction action. This information will be helpful during the [name their community] flood risk management meeting where our research team will test the

effectiveness of a method that uses a computer-assisted decision support system in

combination with collaborative learning to communicate information about flood risk

and encourage risk reduction action by the [name their community] community. [Define

the research terminology if requested by the interviewee. Describe the specific

computer-assisted decision support system assigned to this community if requested.

Provide more details about the meeting, if requested by the interviewee]. [Name the city

or county municipal flood risk planner or other city or county representative that

recommended the key informant for this interview] recommended you as a member of

[name the community] who is knowledgeable about the perceptions of flood risk in your

neighborhood. Do you mind if I ask you some questions about the [name the

community] community's perceptions of flood risk?

1. What experiences has [name the community] had with flooding?

2. Were you living in [name the community] during any of these floods?

3. How memorable are these flooding events to most living in [name the community]?

4. How knowledgeable do you think most are about their risk of flooding?

5. How reliable do you think most in your community consider the science behind flood risk analysis to be?

6. Do you think most people in [name the community] are aware of risk reduction options available to them?

7. If I randomly chose [name the community] residents and asked them what risk reduction options are available to them, what do you think they would likely include in their list?

8. How much time and money do you think most people living in [name the community] are interested in dedicating to flood risk reduction?

9. How much experience do most residents of [name the community] have with collaborative discussions as a method of addressing community issues?

10. How much experience do most residents of [name the community] have with computer simulations as a method of addressing community issues?

11. How familiar are most [name the community] residents with [computer programs that use geographic information systems (GIS) technology or Google Earth™, depending on the computer-assisted decision support system to which the community is assigned]?

Closing statements: Thank you for taking the time to share your insights with me. I look forward to seeing you at the [name the community] flood risk management meeting on [date].

Immediately following the interview: Record characteristics of the key informant detected during the interview to use as cues to recognize the individual during the community flood risk management meeting.

Appendix 6: Follow-up interview protocol and questions

Conduct the interview within seven days of the community flood risk management meeting.

Introduction: "Hello. This is [Name of interviewer] of the University of Maryland. Is this [or may I speak with] [name of participant]? I am calling about the follow-up interview for the flood risk modeling project in which you and your community participated on [date] at [meeting location]. There are 4 questions that will take 5-15 minutes to answer. Do you have time to do the interview now?"

"Excellent. Here's the first question:"

or

"When would be a better time to contact you?"

Interview questions: [Define terms used in the questions below if requested by the participant. Describe the purpose of the follow-up interview, if requested. Repeat the statements as often as the participant requests.]

"Please choose the phrase that best completes the following statements:

1.   The data presented during the discussion of my community's flood risk was:
   a) very trustworthy
   b) somewhat trustworthy
   c) not trustworthy

2.   If I continue to use my current property for the next 50 years, I anticipate the risk of experiencing a flood event from extreme precipitation will:
   a) Increase
   b) Decrease
   c) Remain the same
   d) I'm not sure

3. Steps that my community and I could take to protect my property from flood damage include:

4. Flood reduction actions I and/or my community already put in place or plan to do

   that reduce flood risk include:"

   Interview Summary: "Thank you for participating in your [name of community]

flood risk management meeting and this follow-up interview."

Appendix 7: Training of research assistants

Prior to the flood risk management meetings, four research assistants were trained to use a national geographic information systems (GIS) software computer-assisted decision support system (DSS) represented by the Federal Emergency Management Agency (FEMA) Multi-hazard Loss Estimation Methodology (HAZUS) and the stakeholder-built DSS method. This training qualified them to serve as GIS technicians. Their duties included constructing model scenarios prior to the community meetings, answering technical questions asked by the participants during the meetings, and providing technical support when stakeholders were building their own models. The technicians were expected to provide her/his laptop capable of running the HAZUS software.

The national GIS software DSS training included Environmental Science Research Institute (ESRI)^{TM} certifications for successful completion of the following series of ESRI ArcGIS 10^{TM} and ESRI^{TM} HAZUS modules:

Getting Started with GIS for ArcGIS 10: 3 modules

Learning ArcGIS Desktop (for ArcGIS 10): 8 modules

Turning Data into Information Using ArcGIS 10: 6 modules

Getting Started with HAZUS-MH 2.0: 1 module

Introduction to the HAZUS-MH 2.0 Flood Model: 1 module

Integrating User Supplied Data into the HAZUS-MH 2.0 Flood Model: 1 module

Loss Estimation Using the HAZUS-MH 2.0 Flood Model: 1 module

Understanding HAZUS-MH 2.0 Flood Model Results: 1 module

Introduction to the HAZUS-MH 2.0 Inventory: 1 module

Introduction to Using HAZUS-MH to Assess Losses from a Riverine Flood

Hazard (for ArcGIS 9.3.1/HAZUS-MH MR5): 1 module

Introduction to the HAZUS-MH 2.0 Hurricane Model: 1 module

Introduction to the HAZUS-MH 2.0 Storm Surge Model: 1 module

Understanding HAZUS-MH 2.0 Hurricane Model Results: 1 module

Introduction to the HAZUS-MH 2.0 Comprehensive Data Management System:

1 module

The GIS technicians were trained to prepare in advance of the meetings maps of three flood risk scenarios: past, present, and future risk. Images of these maps were included in presentations during the community flood risk management meetings. Detailed protocols they followed for constructing the maps using the national GIS software DSS method are located in Appendix 1.   Detailed protocols they followed for constructing the maps using the stakeholder-built DSS method are located in Figures 7, 9, and 11 and Appendix 2.

The four GIS technicians also received training in problem-based collaborative-learning and student-centered teaching techniques. Training sessions included a series of practice sessions designed to familiarize the researchers with development and presentation of the materials. This qualified them to serve as meeting facilitators.

The cross-training of four individuals as both GIS technicians and meeting facilitators was the minimum needed to provide staff at all ten community flood risk management meetings. The meeting dates and times were set by the community organizers and the researchers were part-time employees required to arrange their

schedules to accommodate the communities. The cross-training assured that at least one researcher would be available for every meeting to fill the role of either GIS technician or meeting facilitator.

The four cross-trained researchers and two additional research assistants were trained as meeting assistants. They assisted the meeting facilitator and/or GIS technician as needed during the meetings (Appendix 8). At each flood risk management meeting, one researcher served as the GIS technician and one as the meeting facilitator. Meetings had zero to two meeting assistants in attendance.

In addition, the researchers were trained to code stakeholders' survey responses and enter the data into spreadsheets (Microsoft 2007). These entries were checked by the lead researcher for accuracy. The response codes were modified for use in Statistic Analysis System^{TM} (SAS) 9.3 SAS^{TM} software (SAS 2012) by the project's Principal Investigator and lead researcher.

Appendix 8: Meeting assistant protocol for the flood risk management meetings

Before the meeting:

1. For the stakeholder-built computer-assisted decision support system (DSS), install on laptops:

   a) Google Earth^{TM}

   b) Federal Emergency Management Agency (FEMA) National Flood Hazard Layer (NFHL) keyhole markup language zipped (KMZ) file.

2. As the community participants enter, encourage them to fill out a name tag.

3. Approach the first three people that come to the meeting and ask them if they are willing to do a follow-up interview:

   a) Say: "Do you mind participating in a follow up interview? Within a week following this meeting, you will be contacted and asked four questions in a phone interview lasting five to fifteen minutes. Would you be willing to participate?"

   b) If they ask what the questions are, say "you will be asked questions that you will come across in the survey this evening"

   c) If they agree, give them a pencil with a post-it note wrapped around it.

   d) Ask them to show the note-wrapped pencil when survey packets are distributed.

4. Following the lead researcher's introduction, hand out consent forms and surveys to the follow-up interview participants identified by their note-wrapped pencils.

5. Help hand out survey packets and pencils to the rest of the participants.

6. As participants are completing the consent forms, check with them to be sure they sign their initials at the top of each page.

7. If participants request, assist in reading the consent form and survey questions.

8. Answer questions participants have about the consent form and surveys.

9. Assist the participants with placing the surveys and consent forms in the envelopes labeled for each. As they submit their consent form, MAKE SURE THEY INITIAL THE TOP OF EVERY PAGE.

10. As consent forms are collected from those that agree to participate in follow-up interviews, write the day(s) of the week and time(s) they selected to be contacted on the back of a "FloodModeling" business card so they remember their selections and are prepared for a call from the interviewer.

During the meeting:

1. Walk around the room with index cards, pencils and a card-deposit box. Offer these to anyone that indicates they have questions they prefer to write (rather than present verbally).

2. Submit the completed index-card questions to the meeting facilitator for inclusion in the discussion.

3. For the stakeholder-built DSS, assist participants with:

   a) Google Earth^{TM} re-installation.

   b) FEMA NFHL KMZ file re-installation.

   c) Reading the model-building instructions.

   d) Typing information in Google Earth^{TM} dialog boxes.

e) Instructions on the use of the Google Earth^{TM} navigation tools. CAUTION: DO NOT NAVIGATE FOR THEM.

f) Instructions on the use of the Google Earth^{TM} drawing tool. CAUTION: DO NOT DRAW THE PATH FOR THEM.

4. Check the last page of the consent form to see if anyone asked NOT to be photographed. Take photos of meeting participation EXCEPT any who requested NOT to be photographed.

After the meeting:

1. Give out the surveys.

2. If participants request, assist in reading the survey questions.

3. Answer questions participants have about the surveys.

4. Assist participants with placing the surveys in the envelopes labeled for each.

5. Accept the return of pencils, if offered.

6. Thank participants for attending.

Appendix 9: Institutional Review Board (IRB) Approval

The project involved (1) interaction with human subjects and (2) the collection of identifiable private data on living individuals. Therefore the project required training in social and behavioral research with human subjects by the individual leading the data-collection, V.B.K. Olsen, prior to the start of data-collection; and review and approval of the project by the University of Maryland College Park (UMCP) Institutional Review Board (IRB), College Park, Maryland. Prior to the initiation of data-collection, the UMCP IRB approved the project on 03 May 2012. The expiration date is presently 01 May 2015. Project status is "active." A copy of the UMCP IRB approval is located on the website: https://www.irbnet.org, IRBNet ID #322647-7, Research Institution: University of Maryland College Park (UMCP), College Park, MD, Title: The Effectiveness of a Computer-Assisted Decision Support System using Realistic Interactive Visualization as a Learning Tool in Flood Risk Management, Principal Investigator (P.I.): Bahram Momen, Ph.D. Examples of consent forms are available upon request. Prior to the initiation of research, V.B.K. Olsen completed " Social & Behavioral Research - Basic/Refresher Curriculum" through the Collaborative Institutional Training Initiative (CITI 2012).

To protect the identities of the participating communities and individuals:

1. Participants' names and information about the location of their community were recorded on the IRB-approved consent form only. A randomly-generated number was used as a unique identification code on each survey. Each community was given a randomly-generated number used as a unique identification code on the surveys.

2. The consent forms are stored separately from the surveys. Originals are stored in

locked file cabinets. Digital copies are stored in password-protected files.

3. The demographic information was transcribed from the original surveys to a

database. The database does not contain individual identification of communities or

participants, only the randomly-assigned codes.

Appendix 10: Participant Pre-Survey Part I: demographic information

UNIVERSITY OF MARYLAND

Unique participant code: S_____

Pre-Survey Part I

In each table, please circle the one category that best describes you:

Gender

Female
Male

Age[1]

18-20 years
21-44 years
45-64 years
65 years and over

Race[2]

White
Black or African American
American Indian and Alaska Native
Asian
Native Hawaiian and Other Pacific Islander
Some other race
Two or more races

Educational Attainment[3]

Less than high school graduate
High school graduate (incl. equivalency: GED)
Some college, Associate degree, and/or 1-3 year professional certification
Bachelor's degree and/or four-year professional certification
Master's degree and/or six-year professional certification
Doctorate degree and/or seven-year+ professional certification

[1] United States Census Bureau (USCB). (2011). "Current Population Survey" Retrieved 01-Feb-2011 from http://www.census.gov/cps/data/

[2] USCB. (2009). "2005-2009 American Community Survey: Race" Retrieved 23-May-2011 from http://factfinder.census.gov/

[3] USCB. (2000). "United States Census 2000: Educational Attainment" Retrieved 23-May-2011 from http://factfinder2.census.gov/

University of Maryland

Pre-Survey Part I   Unique participant code: S_____

Language

English as the primary language
English as a second language
Not fluent in English

Annual Household Income[4]

Less than $10,900
$10,900 to $14,999
$15,000 to $24,999
$25,000 to $34,999
$35,000 to $49,999
$50,000 to $74,999
$75,000 to $99,999
$100,000 to $149,999
$150,000 to $199,999
$200,000 or more

Property ownership (circle all that are applicable)

Homeowner
Home Renter
Other type of residency (please specify):
Business property owner
Business property renter

AUSCB. (2009). "2005-2009 American Community Survey: Income in the Past 12 Months" Retrieved 23-May-2011 from http://factfinder.census.gov/

Next Steps:
1.   Please place the University Consent Form in the WHITE envelope provided.
2.   Please place Pre-Survey Part I in the GREEN envelope provided.
3.   Please pick up the BLUE Pre-Survey Part II with the unique participant code assigned to you on your Pre-Survey Part I.

Appendix Table 1: U.S. Census Bureau demographic data

Demographic attribute	Maryland	Virginia	Delaware	Pennsylvania	West Virginia	District of Colombia	FEMA Region III by population	FEMA Region III by proportion
Total population	5,773,552	8,001,024	897,934	12,702,379	1,852,994	601,723	29,829,606	100
Gender by population								
Male	2,791,762	3,925,983	434,939	6,190,363	913,586	284,222	14,540,855	--
Female	2,981,790	4,075,041	462,995	6,512,016	939,408	317,501	15,288,751	--
Gender by proportion								
Male	--	--	--	--	--	--	--	48.75
Female	--	--	--	--	--	--	--	51.25
Error								0
Age by population								
19 and younger	1,518,444	2,088,267	233,463	3,162,892	439,160	123,353	7,565,579	--
20 to 44 years	1,945,687	2,776,355	290,931	4,001,249	576,281	270,174	9,860,677	--
45 to 64 years	1,593,500	2,168,278	243,340	3,569,368	541,074	139,600	8,255,160	--
65 and over	710,147	976,125	130,200	1,981,571	298,332	69,198	4,165,573	--
Adult population (USCB ages 20-over 65)							22,281,410	--
Age by proportion								
19 and younger	--	--	--	--	--	--	--	25.36
20 to 44 years	--	--	--	--	--	--	--	33.06
45 to 64 years	--	--	--	--	--	--	--	27.67
65 and over	--	--	--	--	--	--	--	13.96
Adult population by proportion (USCB ages 20-over 65)								75
Error								0.5
Adult population by proportion (USCB ages 20-over 65)	--	--	--	--	--	--	--	100
20 to 44 years	--	--	--	--	--	--	--	44.26
45 to 64 years	--	--	--	--	--	--	--	37.05
65 and over	--	--	--	--	--	--	--	18.70
Error								0.01
Race by population								
White	3,417,943	5,576,714	635,737	10,504,867	1,741,814	231,663	22,108,739	--
Black or African American alone	1,697,424	1,560,200	190,362	1,359,155	59,296	311,091	5,177,527	--
Asian	317,545	432,055	28,734	342,964	11,118	21,060	1,153,477	--
Two or more races	138,565	200,026	19,755	215,940	31,501	17,450	623,237	--
American Indian and Alaska Native alone	17,321	24,003	2,694	12,702	3,706	1,805	62,231	--
Native Hawaiian and other Pacific Islander	0	8,001	0	0	0	602	8,603	--
Some other race	184,754	200,026	19,755	254,048	3,706	24,671	686,958	--
Race by proportion								
White	--	--	--	--	--	--	--	74.12
Black or African American alone	--	--	--	--	--	--	--	17.36
Asian	--	--	--	--	--	--	--	3.87
Two or more races	--	--	--	--	--	--	--	2.09
Total for "other"								2.54
American Indian and Alaska Native alone	--	--	--	--	--	--	--	0.21
Native Hawaiian and other Pacific Islander	--	--	--	--	--	--	--	0.03
Some other race	--	--	--	--	--	--	--	2.30
Error								0.30

Educational attainment by population								
Less than high school graduate	687,053	1,040,133	114,038	1,536,988	322,421	77,622	3,778,255	--
High school graduate (including equivalency)	1,512,671	2,048,262	284,645	4,776,095	759,728	117,336	9,498,736	--
Some college, no degree or Associate degree	1,495,350	2,128,272	248,728	3,010,464	444,719	102,895	7,430,427	--
Bachelor's degree	1,148,937	1,616,207	149,955	2,095,893	201,976	134,786	5,347,754	--
Graduate or professional degree	929,542	1,136,145	101,467	1,295,643	126,004	169,084	3,757,884	--
Educational attainment by proportion								
Less than high school graduate	--	--	--	--	--	--	--	12.67
High school graduate (including equivalency)	--	--	--	--	--	--	--	31.84
Some college, no degree or Associate degree	--	--	--	--	--	--	--	24.91
Bachelor's degree	--	--	--	--	--	--	--	17.93
Graduate or professional degree	--	--	--	--	--	--	--	12.60
Error								0.30
Language by population								
English only speakers	4,838,237	6,848,877	787,488	11,432,141	1,810,375	514,473	26,231,591	--
Language other than English	935,315	1,152,147	110,446	1,270,238	42,619	87,250	3,598,015	--
Language by proportion								
English only speakers	--	--	--	--	--	--	--	87.94
Language other than English	--	--	--	--	--	--	--	12.06
Error								0
Annual household income by population								
Less than $10,000	288,678	456,058	49,386	889,167	190,858	63,181	1,937,328	--
$10,000 to $14,999	190,527	344,044	37,713	724,036	144,534	28,281	1,469,135	--
$15,000 to $24,999	392,602	672,086	81,712	1,409,964	272,390	46,333	2,875,086	--
$25,000 to $34,999	433,016	696,089	87,100	1,346,452	229,771	45,731	2,838,159	--
$34,999 to $49,999	646,638	1,016,130	121,221	1,778,333	276,096	68,596	3,907,015	--
$50,000 to $74,999	1,021,919	1,440,184	174,199	2,400,750	327,980	90,860	5,455,892	--
$75,000 to $99,999	802,524	1,056,135	123,915	1,587,797	190,858	67,995	3,829,224	--
$100,000 to $149,000	1,039,239	1,224,157	135,588	1,549,690	150,093	82,436	4,181,203	--
$150,000 to $199,999	479,205	544,070	49,386	520,798	37,060	45,129	1,675,647	--
$200,000 or more	467,658	560,072	39,509	482,690	31,501	63,181	1,644,611	--
Annual household income by proportion								
Less than $10,000	--	--	--	--	--	--	--	6.49
$10,000 to $14,999	--	--	--	--	--	--	--	4.93
$15,000 to $24,999	--	--	--	--	--	--	--	9.64
$25,000 to $34,999	--	--	--	--	--	--	--	9.51
Income less than 435,000								30.57
$34,999 to $49,999	--	--	--	--	--	--	--	13.10
$50,000 to $74,999	--	--	--	--	--	--	--	18.29
$75,000 to $99,999	--	--	--	--	--	--	--	12.84
$100,000 to $149,000	--	--	--	--	--	--	--	14.02
$150,000 to $199,999	--	--	--	--	--	--	--	5.62
$200,000 or more	--	--	--	--	--	--	--	5.51
Error								0.5
Home ownership by population								
Home owner	3,897,148	5,376,688	647,410	8,840,856	1,360,098	252,724	20,374,923	--
Renter	1,876,404	2,624,336	250,524	3,861,523	492,896	348,999	9,454,683	--
Home ownership by proportion								
Home owner	--	--	--	--	--	--	--	68.30

| Renter | -- | -- | -- | -- | -- | -- | -- | 31.70 |
| Error | | | | | | | | 0 |

Appendix 11: Analyses of participant survey demographic data

1. Univariate analysis

To find where the demographic differences between the Federal Emergency Management Agency (FEMA) Region III population and the communities participating in this study's flood risk management meetings were significant, the proportions at each level within each demographic characteristic for the ten-community aggregate were calculated. Then, for each demographic characteristics: gender, age, race, language spoken, educational attainment, household income, and home ownership, the 95% confidence interval (CI) was calculated. The CI was the range of values for the proportions for each demographic level that would be expected to contain the population value, given a population size of 29,829,606 and a sample size of 10 communities within which there were 98 participants. Statistic Analysis System (SAS) 9.3 SurveyMeans Procedure was used for this analysis. The code for this procedure is:

```
PROC IMPORT OUT= WORK.a
   DATAFILE= "[insert location of digital data file, preferably an MS Excel^TM
workbook]
   DBMS=EXCEL REPLACE;
   RANGE="[insert location of digital workbook data sheet]$"
        GETNAMES=YES;
        MIXED=NO;
        SCANTEXT=YES;
        USEDATE=YES;
        SCANTIME=YES;
RUN;
proc sort data=a;
by EU;
run;
proc surveymeans data=a total=29829606 missing;
class gender age race edu lang income own;
var gender age race edu lang income own;
ods output statistics=b;
run;
```

2. Multivariate cluster analysis

A multivariate analysis was performed to describe all levels of all seven demographic characteristics simultaneously for each of the ten communities in which a flood risk management meeting was conducted and for the population in the FEMA Region III. A unit that represents the aggregate of all ten communities was included in the analysis. The multivariate analysis grouped these in clusters based on their overall demographic similarity. The Statistic Analysis System^{TM} (SAS) TREE Procedure: Ward's Minimum Variance Cluster Analysis (SAS 2012) was used for this multivariate analysis. The SAS code for this analysis is:

```
PROC IMPORT OUT= WORK.A
    DATAFILE= "[insert location of digital data file, preferably an MS Excel™
    workbook]"
    DBMS=EXCEL REPLACE;
    RANGE="[insert location of digital workbook data sheet]$"
        GETNAMES=YES;
        MIXED=NO;
        SCANTEXT=YES;
        USEDATE=YES;
        SCANTIME=YES;
RUN;
proc print data=a; run;
proc cluster data=a m=ward ccc outtree=b;
var F M elder middle B W AA BS HS MSDr ENG Hi low mid
midHi veryHi OWN RENT young A midLow multi pov less;
id eu;
run;
axis1 order=(0 to 1 by 0.2);
proc tree data=b vaxis=axis1;
copy eu;
run;
```

This clustering procedure produces a tree-type data set containing one observation for each observation in the input data set, plus one observation for each cluster of two or more observations. That is, one observation for each node of the cluster tree. The total number of output observations is usually equal to N, where N is the number of input

observations. In this analysis, N = 12, one observation for each community, one for the

unit representing the ten-community aggregate, and one representing the FEMA Region

III population. The density methods used in this SAS procedure might produce fewer

output observations when the number of clusters cannot be reduced to one per pair of

input observations. In this run, output observations equaled input observations.

3. Multidimensional preference analysis

Principal component analysis was performed to address the interrelationships

among the demographic characteristics. A multidimensional preference analysis based

on the first two principal components was performed to illustrate relationships between

each of the ten communities, the FEMA Region III population, and vectors of each of

the levels of the original demographic characteristics. SAS Principal Component

Analysis for Principal Components 1 and 2 was used for this analysis. The SAS code is:

```
PROC IMPORT OUT= WORK.a
DATAFILE= "[insert location of digital data file, preferably an MS Excel™
workbook]"
DBMS=EXCEL REPLACE;
RANGE="[insert location of digital workbook data sheet]$"
      GETNAMES=YES;
      MIXED=NO;
      SCANTEXT=YES;
      USEDATE=YES;
      SCANTIME=YES;
RUN;
proc cluster data=a m=ward ccc outtree=b;
var F M elder middle B W AA BS HS MSDr ENG Hi low mid
midHi veryHi OWN RENT young A midLow multi pov less;
id eu;
run;
axis1 order=(0 to 1 by 0.2);
proc tree data=b vaxis=axis1;
copy eu;
run;
data b;
set a;
```

```
if eu ne'10 EU';
run;
proc prinqual data=b plots=all;
transform monotone (F -- less);
id eu;
run;
```

A. Participant pre- and post-survey analysis of written responses to a multiple-choice question measuring participants' combined knowledge of past and present flood risk (Survey Part I Question #1in Appendix 3)

1. Each participant recorded their address on the University of Maryland Institutional Review Board (IRB)-approved consent form. Participant addresses from the consent forms were transcribed to a database using only the community and participant randomly-generated codes for identification. No community or participant names were entered in the database.

2. The addresses were then grouped together by community and geocoded.

3. For the national geographic information systems (GIS) software computer-assisted decision support system (DSS), address geocoding was completed using Environmental Science Research Institute ArcGis10^{TM}. The protocol for that geocoding is as follows:

    a) For historic (past) flood risk mapping, a Federal Emergency Management Agency (FEMA) Multi-hazard Loss Estimation Methodology (HAZUS) model of the historic flood event illustrated for participants during their flood risk management meeting was constructed (Appendix 1). The geocoded addresses were then added to the HAZUS model. Each of the participant locations was recorded with regard to whether or not it fell within the floodplain. This location was then coded and entered in the participant survey database (Data are available upon request). A HAZUS historic model was constructed for each of the communities selected to receive that DSS.

b) For present flood risk mapping, a HAZUS model illustrating the FEMA 1% annual return period was produced for each of the communities (Appendix 1). The geocoded addresses were then added to the HAZUS model. Each of the participant locations was recorded as in or out of the floodplain. This location was then coded and entered in the participant survey database (Data are available upon request).

4. The protocol for stakeholder-built geocoding was as follows:

a) Google Earth™ and the FEMA "Stay Dry" KMZ version 2.4 or 3.0 specifically used in the community meeting were downloaded and opened. FEMA's "Stay Dry" KMZ displays in raster format the 1% annual return period for flood events (FEMA 2014d). Participant addresses, grouped together by community, were individually entered into Google Earth™ and zoomed in to an elevation less than 4000 feet distance from the ground (see Figures 7, 9 and 11).

b) For present flood risk mapping, if the participant's address fell within an area of high or moderate risk in FEMA's "Stay Dry" KMZ (Figure 30D), it was considered to be in the 1% annual return period floodplain. If the participant address fell within an area of low risk or was outside of the floodplain all together, it was considered to be out of the 1% annual return period floodplain. This information was coded and recorded in the participant survey database (Data are available upon request).

c) For historic (past) flood risk mapping, a model of the historic flood event illustrated for participants during their flood risk management meeting was constructed in Google Earth™ using Google Earth™ drawing tools (Figure

30B). Each of the participant locations was recorded with regard to whether or not it fell within the floodplain. This location was then coded and entered in the participant survey database (Data are available upon request).

5. Responses to the question were transferred from the original pre- and post-surveys (Appendices 3 and 4) and coded (Appendix Table 2) into the appropriate columns of the participant survey database (Data are available upon request).

Appendix Table 2: Database codes assigned to pre- and post-survey responses indicating participants' combined knowledge of past and present flood risk

Survey Part 1 #1: "I live in an area that is _____ to experience a flood that results in damage to my property."		
Multiple-choice responses	If, according to the model scenarios used in the flood risk management meeting to illustrate past (historic) and/or present risk, the property was in the floodplain, then the response was coded as:	If, according to the model scenarios used in the flood risk management meeting to illustrate past (historic) and/or present risk, the property was outside the floodplain, then the response was coded as:
a. Likely	1	-1
b. Unlikely	-1	1
c. I am unsure	0	0
If a participant did not provide a street address, the designation of "missing data" was entered in the database.		

6. To analyze the effects of the two DSS methods on combined past and present flood risk learning outcomes with pre-survey knowledge of flood risk as a covariate, the Statistic Analysis System^{TM} (SAS) code for the GLIMMIX Procedure was:

```
PROC IMPORT OUT= WORK.a
        DATAFILE= "[insert Microsoft^TM Excel workbook containing Data Table]"
        DBMS=EXCEL REPLACE;
        RANGE="[insert Microsoft^TM Excel worksheet containing Data Table]$";
          GETNAMES=YES;
          MIXED=NO;
          SCANTEXT=YES;
          USEDATE=YES;
```

```
        SCANTIME=YES;
RUN;
proc print data=a;
run;
data b;
set a;
if fp1q1a=1 then fp1q1a=2;else;
if fp1q1a=0 then fp1q1a=1;else;
if fp1q1a=-1 then fp1q1a=0;else;

if fp1q1b=1 then fp1q1b=2;else;
if fp1q1b=0 then fp1q1b=1;else;
if fp1q1b=-1 then fp1q1b=0;else;
run;
proc print data=b;
run;
proc glimmix data=b;
class method eu rep;
model fp1q1a= method| fp1q1b/dist=nb solution;
random method*rep;
lsmeans method/pdiff;
run;
```

Appendix Table 3 highlights the results of this analysis.

Appendix Table 3: Effects of computer-assisted decision support system (DSS) methods on combined past and present flood risk learning outcomes with pre-survey knowledge of flood risk as a covariate.

Effect	P value: two-tailed analysis	P value: one-tailed analysis
DSS method	0.29	0.15
Pre-survey	0.004	
Pre-survey*DSS	0.27	

Legend:
DSS method = national geographic information systems (GIS) software DSS or stakeholder-built DSS method
Pre-survey = knowledge of past and present flood risk as measured on the pre-survey
Pre-survey*DSS = interaction between the DSS method used and pre-survey knowledge

Because the interaction was not significant ($P > 0.26$), that calculation was removed

from the analysis. The SAS code for the GLIMMIX Procedure was:

```
PROC IMPORT OUT= WORK.a
        DATAFILE= "[insert Microsoft^TM Excel workbook containing Data Table]"
        DBMS=EXCEL REPLACE;
```

```
        RANGE="[insert Microsoft^TM Excel worksheet containing Data Table]$";
          GETNAMES=YES;
          MIXED=NO;
          SCANTEXT=YES;
          USEDATE=YES;
          SCANTIME=YES;
RUN;
proc print data=a;
run;
data b;
set a;
if fp1q1a=1 then fp1q1a=2;else;
if fp1q1a=0 then fp1q1a=1;else;
if fp1q1a=-1 then fp1q1a=0;else;

if fp1q1b=1 then fp1q1b=2;else;
if fp1q1b=0 then fp1q1b=1;else;
if fp1q1b=-1 then fp1q1b=0;else;
run;
proc print data=b;
run;
proc glimmix data=b;
class method eu rep;
model fp1q1a= method fp1q1b/dist=nb;
random method *rep;
lsmeans method /pdiff;
run;
```

Appendix Table 4 highlights the results of this analysis. Results indicate there was no

significant effect (P > 0.36) of the DSS method on the combined past and present flood

risk learning outcomes. The pre-survey responses had a positive significant effect (P <

0.01) on the post-survey responses. This indicated those who entered the meeting with

some prior knowledge of their past and present flood risk, left the meeting knowing

more than those entering the meeting with no prior knowledge.

Appendix Table 4: Effects of computer-assisted decision support system (DSS) methods on combined past and present flood risk learning outcomes with pre-survey knowledge of flood risk as a covariate and interaction calculation removed

Effect	P value: two-tailed analysis	P value: one-tailed analysis
DSS method	0.75	0.37
Pre-survey	0.004	

Legend:
DSS method = national geographic information systems (GIS) software DSS or stakeholder-built DSS method
Pre-survey = knowledge of past and present flood risk as measured on the pre-survey

There was no significant difference ($P > 0.74$) between the two DSS methods in their effect on combined past and present flood risk learning outcomes. To find whether or not there was a significant increase in combined past and present flood risk learning outcomes as a result of participation in the flood risk management meetings, a t-test was performed. This analysis pooled responses from meetings using the two DSS methods and analyzed the difference between pre- and post-survey responses. The SAS 9.3 PROC TTEST Procedure code was:

```
PROC IMPORT OUT= WORK.a
    DATAFILE= "[insert Microsoft Excel™ workbook containing Data Table]";
    DBMS=EXCEL REPLACE;
    RANGE="[insert Microsoft Excel™ worksheet containing Data Table]$";
        GETNAMES=YES;
            MIXED=NO;
            SCANTEXT=YES;
            USEDATE=YES;
            SCANTIME=YES;
RUN;
proc print data=a; run;
proc ttest data=a;
paired FP1Q1A*FP1Q1B;
run;
```

Results showed a significant increase ($P < 0.04$) in combined past and present flood risk learning outcomes as a result of participation in the flood risk management meetings (Appendix Table 5).

Appendix Table 5: Analysis of the difference in combined past and present flood risk learning outcomes as a result of participation in the flood risk management meetings using written pre- and post-survey responses to a multiple-choice question

N	Mean difference between pre-and post-survey responses	Standard Deviation	DF	t Value	P value: two-tailed analysis	P value: one-tailed analysis
89	0.17	0.92	88	1.73	0.09	0.04

B. Participant pre- and post-survey analysis of written responses to a multiple-choice question measuring participants' knowledge of anticipated future flood risk (Survey Part II Question #1in Appendix 4)

Follow section A steps 1 and 2, above.

3. For the national GIS software DSS, address geocoding was completed using Environmental Science Research Institute (ESRI) ArcGis10™. For mapping of anticipated future flood risk, a HAZUS model illustrating the FEMA 0.2% annual return period was produced for each of the communities selected to receive that DSS (Appendix 1). The geocoded addresses were then added to the HAZUS model. Each of the participant locations was recorded as in or out of the floodplain. This location was then coded and entered in the participant survey database (Data are available upon request).

4. The protocol for stakeholder-built geocoding was as follows:

   a) Follow section A step 4a above.

   b) For mapping anticipated future flood risk, a model was constructed following the instructions in Figure 11. Each of the participant locations was recorded as in or out of the floodplain. This location was then coded and entered in the participant survey database (Data are available upon request).

5. Responses to the question were transferred from the original pre- and post-surveys

    (Appendix 4) and coded (Appendix Table 6) into the appropriate columns of the

    participant survey database (Data are available upon request).

Appendix Table 6: Database codes assigned to pre- and post-survey responses indicating participants' knowledge of anticipated future flood risk

Survey Part 1I #1: "If I continue to use my current property for the next 50 years, I anticipate the risk of experiencing a flood event from extreme precipitation will:"		
Multiple-choice responses	If, according to the model scenario used in the flood risk management meeting to illustrate anticipated future risk, the property was in the floodplain, then the response was coded as:	If, according to the model scenarios used in the flood risk management meeting to illustrate anticipated future risk, the property was outside the floodplain, then the response was coded as:
a. Increase	1	-2
b. decrease	-2	1
c. Remain the same	-1	1
d. I am unsure	0	0
If a participant did not provide a street address, the designation of "missing data" was entered in the database.		

6. To analyze the effects of the two DSS methods on anticipated future flood risk

    learning outcomes with pre-survey knowledge of flood risk as a covariate, the SAS

    code for the GLIMMIX Procedure was:

```
PROC IMPORT OUT= WORK.a
      DATAFILE= "[insert Microsoft™ Excel workbook containing Data Table]"
      DBMS=EXCEL REPLACE;
      RANGE="[insert Microsoft™ Excel worksheet containing Data Table]$";
        GETNAMES=YES;
        MIXED=NO;
        SCANTEXT=YES;
        USEDATE=YES;
        SCANTIME=YES;
RUN;
proc print data=a;
run;
```

```
data b;
set a;
if fp2q1a=1 then fp2q1a=3;else;
if fp2q1a=0 then fp2q1a=2;else;
if fp2q1a=-1 then fp2q1a=1;else;
if fp2q1a=-2 then fp2q1a=0;else;

if fp2q1b=1 then fp2q1b=3;else;
if fp2q1b=0 then fp2q1b=2;else;
if fp2q1b=-1 then fp2q1b=1;else;
if fp2q1b=-2 then fp2q1b=0;else;
run;
proc print data=b;
run;
proc glimmix data=b;
class method eu rep;
model fp2q1a= method| fp2q1b/dist=nb solution;
random method *rep;
lsmeans method /pdiff;
run;
```

 Appendix Table 7 highlights the results of this analysis.

Appendix Table 7: Effects of computer-assisted decision support system (DSS) methods on learning outcomes for understanding of future flood risk with pre-survey knowledge of flood risk as a covariate

Effect	P value: two-tailed analysis	P value: one-tailed analysis
DSS method	0.37	0.19
Pre-survey	0.014	
Pre-survey*DSS	0.33	

Legend:
DSS method = national geographic information systems (GIS) software DSS or stakeholder-built DSS method
Pre-survey = knowledge of future flood risk as measured on the pre-survey
Pre-survey*DSS = interaction between the DSS method used and pre-survey knowledge

Because the interaction was not significant ($P > 0.32$), that calculation was removed

from the analysis. The SAS code for the GLIMMIX Procedure was:

```
PROC IMPORT OUT= WORK.a
       DATAFILE= "[insert Microsoft™ Excel workbook containing Data Table]"
       DBMS=EXCEL REPLACE;
       RANGE="[insert Microsoft™ Excel worksheet containing Data Table]$";
          GETNAMES=YES;
```

```
                MIXED=NO;
                SCANTEXT=YES;
                USEDATE=YES;
                SCANTIME=YES;
RUN;
proc print data=a;
run;
data b;
set a;
if fp2q1a=1 then fp2q1a=3;else;
if fp2q1a=0 then fp2q1a=2;else;
if fp2q1a=-1 then fp2q1a=1;else;
if fp2q1a=-2 then fp2q1a=0;else;

if fp2q1b=1 then fp2q1b=3;else;
if fp2q1b=0 then fp2q1b=2;else;
if fp2q1b=-1 then fp2q1b=1;else;
if fp2q1b=-2 then fp2q1b=0;else;
run;
proc print data=b;
run;
proc glimmix data=b;
class method eu rep;
model fp2q1a= method fp2q1b/dist=nb;
random method *rep;
lsmeans method /pdiff;
run;
```

Appendix Table 8 highlights the results of this analysis. Results indicate there was no

significant effect (P > 0.36) of the DSS method on the anticipated future flood risk

learning outcomes. The pre-survey responses had a positive significant effect (P < 0.01)

on the post-survey responses. This indicated those who entered the meeting with some

prior knowledge of their anticipated future flood risk, left the meeting knowing more

than those entering the meeting with no prior knowledge.

Appendix Table 8: Effects of computer-assisted decision support system (DSS) methods on learning outcomes for understanding of future flood risk with pre-survey knowledge of flood risk as a covariate and calculation of interaction removed

Effect	P value: two-tailed analysis	P value: one-tailed analysis
DSS method	0.73	0.37
Pre-survey	0.01	

There was no significant difference ($P > 0.72$) between the two DSS methods in their

effect on anticipated future flood risk learning outcomes. To find whether or not there

was a significant increase in anticipated future flood risk learning outcomes as a result of

participation in the flood risk management meetings, a t-test was performed. This

analysis pooled responses from meetings using the two DSS methods and analyzed the

difference between pre- and post-survey responses. The SAS 9.3 PROC TTEST

Procedure code was:

```
PROC IMPORT OUT= WORK.a
       DATAFILE= "[insert Microsoft Excel^TM workbook containing Data Table]";
       DBMS=EXCEL REPLACE;
       RANGE="[insert Microsoft Excel^TM worksheet containing Data Table]$";
         GETNAMES=YES;
         MIXED=NO;
         SCANTEXT=YES;
         USEDATE=YES;
         SCANTIME=YES;
RUN;
proc print data=a; run;
proc ttest data=a;
paired FP2Q1A*FP2Q1B;
run;
```

Results showed a significant increase ($P < 0.01$) in anticipated future flood risk learning

outcomes as a result of participation in the flood risk management meetings (Appendix

Table 9).

Appendix Table 9: Analysis of the difference in anticipated future flood risk learning outcomes as a result of participation in the flood risk management meetings using written pre- and post-survey responses to a multiple-choice question

N	Mean difference between pre-and post-survey responses	Standard Deviation	DF	t Value	P value
89	0.35	0.13	88	2.77	0.007

C. Other factors related to community flood risk management meetings that had the potential to influence flood risk learning outcomes

In sections A and B step 6, above, participant responses to pre-surveys were analyzed as a covariate to the post-survey responses. However, there were other factors related to community flood risk management meetings that had the potential to influence flood risk learning outcomes among participants (Appendix Table 10). These were also analyzed as covariates. The statistical program, SAS 9.3 GLIMMIX Procedure, used in these analyses allowed the inclusion of only one covariate per analysis. Each factor listed in Appendix Table 10 was tested independently of the others to evaluate whether or not each had a significant influence on the post-survey responses. Appendix Table 10 summarizes the results of this series of analyses. Details of each analysis follow.

Appendix Table 10: Factors that may influence the effect of the computer-assisted decision support systems on flood risk learning outcomes: Potential covariates in the analyses

Factors (Potential covariates) that may influence performance of the computer-assisted decision support system (DSS)	When a DSS was used to communicate combined past and present flood knowledge	When a DSS was used to communicate anticipated future flood risk knowledge
Participants' prior geographic information system (GIS) experience	Not significant (P > 0.98)	Not significant (P > 0.85)
Individuals serving as the meeting facilitator	Not significant (P > 0.27)	Not significant (P > 0.47)
Individuals serving as the meeting GIS technician	Not significant (P > 0.20)	Not significant (P > 0.79)
Number of meeting assistants in attendance	Not significant (P > 0.49)	Not significant (P > 0.22)
Municipal planning department representative in attendance	Not significant (P > 0.45)	Not significant (P > 0.46)

1. Data Analyses: Influence of prior geographic information systems (GIS) experience of meeting participants on their learning outcomes for flood risk knowledge

On the pre-survey, meeting participants were asked to report their experience with GIS prior to the start of the flood risk management meeting. Categories included: no prior GIS knowledge, some prior GIS knowledge, and a high level of prior GIS knowledge.

To analyze the effects of the two DSS methods on combined past and present flood risk learning outcomes with participant pre-survey self-reporting of previous experience with GIS as a covariate, the SAS code for the GLIMMIX Procedure was:

```
PROC IMPORT OUT= WORK.a
    DATAFILE= "[insert Microsoft™ Excel workbook containing Data Table]"
```

```
        DBMS=EXCEL REPLACE;
        RANGE="[insert Microsoft$^{TM}$ Excel worksheet containing Data Table]$";
                GETNAMES=YES;
                MIXED=NO;
                SCANTEXT=YES;
                USEDATE=YES;
                SCANTIME=YES;
RUN;
proc print data=a;
run;
data b;
set a;
if fp1q1a=1 then fp1q1a=2;else;
if fp1q1a=0 then fp1q1a=1;else;
if fp1q1a=-1 then fp1q1a=0;else;
run;
proc glimmix data=b;
class GIS method eu rep;
model fp1q1a= method| GIS/dist=nb solution;
random method*rep;
lsmeans method/pdiff;
run;
```

Appendix Table 11 highlights the results of this analysis.

Appendix Table 11: Effects of computer-assisted decision support system (DSS) methods on learning outcomes for combined understanding of past and present flood risk with geographic information systems (GIS) background of participants as a covariate

Effect	P value: two-tailed analysis	P value: one-tailed analysis
DSS method	0.52	0.26
GIS	0.99	
GIS*DSS	0.69	

Legend:
DSS method = national GIS software DSS or stakeholder-built DSS method
GIS = participant's knowledge of geographic information systems (GIS) prior to the
  start of the flood risk management meeting: Level 0 = no prior GIS knowledge, Level
  1 = some prior GIS knowledge, Level 2 = high level of prior GIS knowledge
GIS*DSS = interaction between the DSS method used and participant's prior
  knowledge of GIS

Because the interaction was not significant ($P > 0.68$), that calculation was removed

from the analysis. The SAS code for the GLIMMIX Procedure was:

```
PROC IMPORT OUT= WORK.a
    DATAFILE= "[insert Microsoft™ Excel workbook containing Data Table]"
    DBMS=EXCEL REPLACE;
    RANGE="[insert Microsoft™ Excel worksheet containing Data Table]$";
        GETNAMES=YES;
        MIXED=NO;
        SCANTEXT=YES;
        USEDATE=YES;
        SCANTIME=YES;
RUN;
proc print data=a;
run;
data b;
set a;
if fp1q1a=1 then fp1q1a=2;else;
if fp1q1a=0 then fp1q1a=1;else;
if fp1q1a=-1 then fp1q1a=0;else;
run;
proc print data=b;
run;
proc glimmix data=b;
class GIS method eu rep;
model fp1q1a= method GIS/dist=nb;
random method *rep;
lsmeans method /pdiff;
run;
```

Appendix Table12 highlights the results of this analysis. Results indicate there was no

significant effect ($P > 0.47$) of the DSS method on learning outcomes for combined

understanding of past and present flood risk. The participants' prior experience with GIS

had no significant effect on the learning outcomes ($P > 0.98$).

Appendix Table 12: Effects of computer-assisted decision support system (DSS) methods on learning outcomes for combined understanding of past and present flood risk with geographic information systems (GIS) background of participants as a covariate. Interaction calculation removed.

Effect	P value: Two-tailed analysis	P value: one-tailed analysis
DSS method	0.97	0.48
GIS	0.99	

Legend:
DSS method = national GIS software DSS or stakeholder-built DSS method
GIS = participant's knowledge of geographic information systems (GIS) prior to the
  start of the flood risk management meeting: Level 0 = no prior GIS knowledge, Level
  1 = some prior GIS knowledge, Level 2 = high level of prior GIS knowledge

To analyze the effects of the two DSS methods on future flood risk learning outcomes with participant pre-survey self-reporting of previous experience with GIS as a covariate, the SAS code for the GLIMMIX Procedure was:

```
PROC IMPORT OUT= WORK.a
        DATAFILE= "[insert Microsoft™ Excel workbook containing Data Table]"
        DBMS=EXCEL REPLACE;
        RANGE="[ insert Microsoft™ Excel worksheet containing Data Table]$";
          GETNAMES=YES;
          MIXED=NO;
          SCANTEXT=YES;
          USEDATE=YES;
          SCANTIME=YES;
RUN;
proc print data=a;
run;
data b;
set a;
if fp2q1a=1 then fp2q1a=3;else;
if fp2q1a=0 then fp2q1a=2;else;
if fp2q1a=-1 then fp2q1a=1;else;
if fp2q1a=-2 then fp2q1a=0;else;
run;
proc glimmix data=b;
class GIS method eu rep;
model fp2q1a= method | GIS/dist=nb solution;
random method*rep;
lsmeans method /pdiff;
run;
```

Appendix Table 13 highlights the results of this analysis.

Appendix Table 13: Effects of computer-assisted decision support system (DSS) methods on learning outcomes for understanding future flood risk with geographic information systems (GIS) background of participants as a covariate

Effect	P value: two-tailed analysis	P value: one-tailed analysis
DSS method	0.57	0.29
GIS	0.86	
GIS*DSS	0.67	

Legend:
DSS method = national GIS software DSS or stakeholder-built DSS method
GIS = participant's knowledge of geographic information systems (GIS) prior to the
  start of the flood risk management meeting: Level 0 = no prior GIS knowledge, Level
  1 = some prior GIS knowledge, Level 2 = high level of prior GIS knowledge
GIS*DSS = interaction between the DSS method used and participant's prior
  knowledge of GIS

Because the interaction was not significant ($P > 0.66$), that calculation was removed

from the analysis. The SAS code for the GLIMMIX Procedure was:

```
PROC IMPORT OUT= WORK.a
        DATAFILE= "[insert Microsoft^TM Excel workbook containing Data Table]"
        DBMS=EXCEL REPLACE;
        RANGE="[ insert Microsoft^TM Excel worksheet containing Data Table]$";
           GETNAMES=YES;
           MIXED=NO;
           SCANTEXT=YES;
           USEDATE=YES;
           SCANTIME=YES;
RUN;
proc print data=a;
run;
data b;
set a;
if fp2q1a=1 then fp2q1a=3;else;
if fp2q1a=0 then fp2q1a=2;else;
if fp2q1a=-1 then fp2q1a=1;else;
if fp2q1a=-2 then fp2q1a=0;else;
run;
proc print data=b;
run;
proc glimmix data=b;
class GIS method eu rep;
model fp2q1a= method GIS/dist=nb;
```

random method*rep;
lsmeans method /pdiff;
run;

Appendix Table 14 highlights the results of this analysis. Results indicate there was no

significant effect (P > 0.41) of the DSS method on learning outcomes for understanding

anticipated future flood risk. The participants' prior experience with GIS had no

significant effect on the follow-up interview responses (P > 0.90).

Appendix Table 14: Effects of computer-assisted decision support system (DSS)
methods on learning outcomes for understanding anticipated future flood risk with
geographic information systems (GIS) background of participants as a covariate.
Interaction calculation removed.

Effect	P value: two-tailed analysis	P value: one-tailed analysis
DSS method	0.84	0.42
GIS	0.91	

Legend:
DSS method = national GIS software DSS or stakeholder-built DSS method
GIS = participant's knowledge of geographic information systems (GIS) prior to the start of the flood risk management meeting: Level 0 = no prior GIS knowledge, Level 1 = some prior GIS knowledge, Level 2 = high level of prior GIS knowledge

2. Data Analyses: Influence of meeting personnel variables on participants' learning outcomes for flood risk knowledge

   To analyze the effects of the two DSS methods on past and present flood risk

learning outcomes with the individuals serving as the meeting facilitator as the

covariate, the SAS code for the GLIMMIX Procedure was:

```
PROC IMPORT OUT= WORK.a
        DATAFILE= "[insert Microsoft™ Excel workbook containing Data Table]"
        DBMS=EXCEL REPLACE;
        RANGE="[insert Microsoft™ Excel worksheet containing Data Table]$";
          GETNAMES=YES;
          MIXED=NO;
          SCANTEXT=YES;
          USEDATE=YES;
          SCANTIME=YES;
RUN;
proc print data=a;
run;
data b;
```

```
set a;
if fp1q1a=1 then fp1q1a=2;else;
if fp1q1a=0 then fp1q1a=1;else;
if fp1q1a=-1 then fp1q1a=0;else;
run;
proc glimmix data=b;
class facil method eu rep;
model fp1q1a= method | facil/dist=nb solution;
random method*rep;
lsmeans method /pdiff;
run;
```

Appendix Table 15 highlights the results of this analysis. Results indicate there was no

significant effect (P > 0.34) of the DSS method on learning outcomes for combined

understanding of past and present flood risk. The individual functioning as the meeting

facilitator had no significant effect on learning outcomes for combined understanding of

past and present flood risk (P > 0.27). There was no significant interaction between the

DSS method and the individual functioning as the meeting facilitator (P > 0.52).

Appendix Table 15: Effects of computer-assisted decision support system (DSS)
methods on learning outcomes for combined understanding of past and present flood
risk with individual serving as meeting facilitator as a covariate

Effect	P value: two-tailed analysis	P value: One-tailed analysis
DSS method	0.69	0.35
facilitator	0.28	
facilitator *DSS	0.53	

Legend:
DSS method = national geographic information systems (GIS) software DSS or stakeholder-built DSS method
facilitator = individual serving as meeting facilitator
facilitator *DSS = interaction between the DSS method used and the individual serving as meeting facilitator

To analyze the effects of the two DSS methods on anticipated future flood risk

learning outcomes with the individuals serving as the meeting facilitator as the

covariate, the SAS code for the GLIMMIX Procedure was:

```
PROC IMPORT OUT= WORK.a
        DATAFILE= "[insert Microsoft^TMExcel workbook containing Data Table]"
        DBMS=EXCEL REPLACE;
        RANGE="[insert Microsoft^TM Excel worksheet containing Data Table]$";
          GETNAMES=YES;
          MIXED=NO;
          SCANTEXT=YES;
          USEDATE=YES;
          SCANTIME=YES;
RUN;
proc print data=a;
run;
data b;
set a;
if fp2q1a=1 then fp2q1a=3;else;
if fp2q1a=0 then fp2q1a=2;else;
if fp2q1a=-1 then fp2q1a=1;else;
if fp2q1a=-2 then fp2q1a=0;else;
run;
proc glimmix data=b;
class facil method eu rep;
model fp2q1a= method | facil/dist=nb solution;
random method*rep;
lsmeans method /pdiff;
run;
```

Appendix Table 16 highlights the results of this analysis. Results indicate there was no

significant effect (P > 0.30) of the DSS method on learning outcomes for understanding

of anticipated future flood risk. The individual functioning as the meeting facilitator had

no significant effect on learning outcomes for understanding of anticipated future flood

risk (P > 0.47). There was no significant interaction between the DSS method and the

individual functioning as the meeting facilitator (P > 0.47).

Appendix Table 16: Effects of computer-assisted decision support system (DSS) methods on learning outcomes for understanding of anticipated future flood risk with individual serving as meeting facilitator as a covariate

Effect	P value: two-tailed analysis	P value: One-tailed analysis
DSS method	0.62	0.31
facilitator	0.48	
facilitator *DSS	0.48	

Legend:
DSS method = national geographic information systems (GIS) software DSS or
  stakeholder-built DSS method
facilitator = individual serving as meeting facilitator
facilitator *DSS = interaction between the DSS method used and the individual serving
  as meeting facilitator

To analyze the effects of the two DSS methods on combined past and present

flood risk learning outcomes with the individuals serving as the GIS technician as the

covariate, the SAS code for the GLIMMIX Procedure was:

```
PROC IMPORT OUT= WORK.a
      DATAFILE= "[insert Microsoft^TM Excel workbook containing Data Table]"
      DBMS=EXCEL REPLACE;
      RANGE="[insert Microsoft^TM Excel worksheet containing Data Table]$";
        GETNAMES=YES;
        MIXED=NO;
        SCANTEXT=YES;
        USEDATE=YES;
        SCANTIME=YES;
RUN;
proc print data=a;
run;
data b;
set a;
if fp1q1a=1 then fp1q1a=2;else;
if fp1q1a=0 then fp1q1a=1;else;
if fp1q1a=-1 then fp1q1a=0;else;
run;
proc glimmix data=b;
class tech method eu rep;
model fp1q1a= method | tech/dist=nb solution;
random method*rep;
lsmeans method /pdiff;
run;
```

Appendix Table 17 highlights the results of this analysis. Results indicate there was no

significant effect (P > 0.42) of the DSS method on learning outcomes for combined

understanding of past and present flood risk. The individual functioning as the meeting

GIS technician had no significant effect on learning outcomes for combined

understanding of past and present flood risk (P > 0.20). The sample size was not large

enough to measure the effects of interaction between the DSS methods and the

individuals serving as the meeting GIS technician.

Appendix Table 17: Effects of computer-assisted decision support system (DSS)
methods on learning outcomes for combined understanding of past and present flood
risk with the individual serving as meeting geographic information systems (GIS)
technician as a covariate

Effect	P value: two-tailed analysis	P value: one-tailed analysis
DSS method	0.86	0.43
GIS tech	0.21	

Legend:
DSS method = national GIS software DSS or stakeholder-built DSS method
GIS tech= individual serving as meeting GIS technician

To analyze the effects of the two DSS methods on anticipated future flood risk

learning outcomes with the individuals serving as the GIS technician as the covariate,

the SAS code for the GLIMMIX Procedure was:

```
PROC IMPORT OUT= WORK.a
        DATAFILE= "[insert Microsoft^TM Excel workbook containing Data Table]"
        DBMS=EXCEL REPLACE;
        RANGE="[insert Microsoft^TM Excel worksheet containing Data Table]$";
            GETNAMES=YES;
            MIXED=NO;
            SCANTEXT=YES;
            USEDATE=YES;
            SCANTIME=YES;
RUN;
proc print data=a;
run;
data b;
set a;
if fp2q1a=1 then fp2q1a=3;else;
if fp2q1a=0 then fp2q1a=2;else;
```

```
if fp2q1a=-1 then fp2q1a=1;else;
if fp2q1a=-2 then fp2q1a=0;else;
run;
proc glimmix data=b;
class tech method eu rep;
model fp2q1a= method | tech/dist=nb solution;
random method*rep;
lsmeans method /pdiff;
run;
```

Appendix Table 18 highlights the results of this analysis. Results indicate there was no

significant effect (P > 0.37) of the DSS method on learning outcomes for understanding

of anticipated future flood risk. The individual functioning as the meeting GIS

technician had no significant effect on learning outcomes for understanding of

anticipated future flood risk (P > 0.79). The sample size was not large enough to

measure the effects of interaction between the DSS methods and the individuals serving

as the meeting GIS technician.

Appendix Table 18: Effects of computer-assisted decision support system (DSS)
methods on learning outcomes for understanding of anticipated future flood risk with the
individual serving as the meeting geographic information systems (GIS) technician as a
covariate

Effect	P value: two-tailed analysis	P value: one-tailed analysis
DSS method	0.76	0.38
GIS tech	0.80	

Legend:
DSS method = national GIS software DSS or stakeholder-built DSS method
GIS tech= individual serving as meeting GIS technician

To analyze the effects of the two DSS methods on past and present flood risk

learning outcomes with the number of meeting assistants available during a meeting as

the covariate, the SAS code for the GLIMMIX Procedure was:

```
PROC IMPORT OUT= WORK.a
        DATAFILE= "[insert Microsoft™ Excel workbook containing Data Table]"
        DBMS=EXCEL REPLACE;
        RANGE="[insert Microsoft™ Excel worksheet containing Data Table]$";
          GETNAMES=YES;
          MIXED=NO;
```

```
            SCANTEXT=YES;
            USEDATE=YES;
            SCANTIME=YES;
RUN;
proc print data=a;
run;
data b;
set a;
if fp1q1a=1 then fp1q1a=2;else;
if fp1q1a=0 then fp1q1a=1;else;
if fp1q1a=-1 then fp1q1a=0;else;
run;
proc glimmix data=b;
class assist method eu rep;
model fp1q1a= method | assist/dist=nb solution;
random method*rep;
lsmeans method /pdiff;
run;
```

Appendix Table 19 highlights the results of this analysis. Results indicate there was no

significant effect ($P > 0.07$) of the DSS method on learning outcomes for combined

understanding of past and present flood risk. The number of meeting assistants available

during a meeting had no significant effect on learning outcomes combined

understanding of past and present flood risk ($P > 0.49$). There was no significant

interaction between the DSS method and the number of meeting assistants available

during a meeting ($P > 0.06$).

Appendix Table 19: Effects of computer-assisted decision support system (DSS) methods on learning outcomes for combined understanding of past and present flood risk with the number of meeting assistants available during a meeting as a covariate

Effect	P value: two-tailed analysis	P value: one-tailed analysis
DSS method	0.17	0.08
# of assistants	0.99	0.50
# of assistants *model	0.07	

Legend:
DSS method = national geographic information systems (GIS) software DSS or
  stakeholder-built DSS method
# of assistants = number of meeting assistants available during a meeting
# of assistants *DSS = interaction between the DSS method used and the number of
  meeting assistants available during a meeting

To analyze the effects of the two DSS methods on anticipated future flood risk

learning outcomes with the number of meeting assistants available during a meeting as

the covariate, the SAS code for the GLIMMIX Procedure was:

```
PROC IMPORT OUT= WORK.a
        DATAFILE= "[insert Microsoft^TM Excel workbook containing Data Table]"
        DBMS=EXCEL REPLACE;
        RANGE="[insert Microsoft^TM Excel worksheet containing Data Table]$";
           GETNAMES=YES;
           MIXED=NO;
           SCANTEXT=YES;
           USEDATE=YES;
           SCANTIME=YES;
RUN;
proc print data=a;
run;
data b;
set a;
if fp2q1a=1 then fp2q1a=3;else;
if fp2q1a=0 then fp2q1a=2;else;
if fp2q1a=-1 then fp2q1a=1;else;
if fp2q1a=-2 then fp2q1a=0;else;
run;
proc glimmix data=b;
class assist method eu rep;
model fp2q1a= method | assist/dist=nb solution;
random method*rep;
lsmeans method /pdiff;
run;
```

Appendix Table 20 highlights the results of this analysis. Results indicate there was no

significant effect (P > 0.47) of the DSS method on learning outcomes for understanding

of anticipated future flood risk. The number of meeting assistants available during a

meeting had no significant effect on learning outcomes for understanding of anticipated

future flood risk (P > 0.22). There was no significant interaction between the DSS

method and the number of meeting assistants available during a meeting (P > 0.86).

Appendix Table 20: Effects of computer-assisted decision support system (DSS)
methods on learning outcomes for understanding of anticipated future flood risk with the
number of meeting assistants available during a meeting as a covariate

Effect	P value: two-tailed analysis	P value: one-tailed analysis
DSS method	0.95	0.48
# of assistants	0.46	0.23
# of assistants *DSS	0.87	

Legend:
DSS method = national geographic information systems (GIS) software DSS or
  stakeholder-built DSS method
# of assistants = number of meeting assistants available during a meeting
# of assistants *DSS = interaction between the DSS method used and the number of
  meeting assistants available during a meeting

To analyze the effects of the two DSS methods on combined past and present

flood risk learning outcomes with the presence of a municipal planning department

representative during a meeting as the covariate, the SAS code for the GLIMMIX

Procedure was:

```
PROC IMPORT OUT= WORK.a
       DATAFILE= "[insert Microsoft™ Excel workbook containing Data Table]"
       DBMS=EXCEL REPLACE;
       RANGE="[insert Microsoft™ Excel worksheet containing Data Table]$";
          GETNAMES=YES;
          MIXED=NO;
          SCANTEXT=YES;
          USEDATE=YES;
          SCANTIME=YES;
RUN;
proc print data=a;
run;
data b;
```

```
set a;
if fp1q1a=1 then fp1q1a=2;else;
if fp1q1a=0 then fp1q1a=1;else;
if fp1q1a=-1 then fp1q1a=0;else;
run;
proc glimmix data=b;
class CityCo method eu rep;
model fp1q1a= method | CityCo/dist=nb solution;
random method*rep;
lsmeans method /pdiff;
run;
```

Appendix Table 21 highlights the results of this analysis. Results indicate there was no

significant effect (P > 0.36) of the DSS method on learning outcomes for combined

understanding of past and present flood risk. The municipal planning department

representative availability during a meeting had no significant effect on learning

outcomes for combined understanding of past and present flood risk (P > 0.45). There

was no significant interaction between the DSS method and the municipal planning

department representative availability during a meeting (P > 0.35).

Appendix Table 21: Effects of computer-assisted decision support system (DSS)
methods on learning outcomes for combined understanding of past and present flood
risk with municipal planning department representative availability during a meeting as
a covariate

Effect	P value: two-tailed analysis	P value: one-tailed analysis
DSS method	0.75	0.37
CityCo	0.94	0.46
CityCo*DSS	0.36	

Legend:
DSS method = national geographic information systems (GIS) software DSS or
  stakeholder-built DSS method
CityCo = municipal planning department representative availability during a meeting
  (yes = a representative was present, no = a representative was not present)
CityCo*DSS = interaction between the DSS method used and the availability of a
  municipal planning department representative during a meeting

To analyze the effects of the two DSS methods on anticipated future flood risk

learning outcomes with the presence of a municipal planning department representative

during a meeting as the covariate, the SAS code for the GLIMMIX Procedure was:

```
PROC IMPORT OUT= WORK.a
        DATAFILE= "[insert Microsoft^TM Excel workbook containing Data Table]"
        DBMS=EXCEL REPLACE;
        RANGE="[ insert Microsoft^TM Excel worksheet containing Data Table]$";
           GETNAMES=YES;
           MIXED=NO;
           SCANTEXT=YES;
           USEDATE=YES;
           SCANTIME=YES;
RUN;
proc print data=a;
run;
data b;
set a;
if fp2q1a=1 then fp2q1a=3;else;
if fp2q1a=0 then fp2q1a=2;else;
if fp2q1a=-1 then fp2q1a=1;else;
if fp2q1a=-2 then fp2q1a=0;else;
run;
proc glimmix data=b;
class CityCo method eu rep;
model fp2q1a= method | CityCo/dist=nb solution;
random method*rep;
lsmeans method /pdiff;
run;
```

Appendix Table 22 highlights the results of this analysis. Results indicate there was no

significant effect ($P > 0.46$) of the DSS method on learning outcomes for understanding

of anticipated future flood risk. The municipal planning department representative

availability during a meeting had no significant effect on learning outcomes for

understanding of anticipated future flood risk ($P > 0.46$). There was no significant

interaction between the DSS method and the municipal planning department

representative availability during a meeting ($P > 0.56$).

Appendix Table 22: Effects of computer-assisted decision support system (DSS) methods on learning outcomes for understanding of anticipated future flood risk with municipal planning department representative availability during a meeting as a covariate

Effect	P value; two-tailed analysis	P value; one-tailed analysis
DSS method	0.93	0.47
CityCo	0.93	0.47
CityCo*DSS	0.57	

Legend:
DSS method = national geographic information systems (GIS) software DSS or stakeholder-built DSS method
CityCo = municipal planning department representative availability during a meeting (yes = a representative was present, no = a representative was not present)
CityCo*DSS = interaction between the DSS method used and the availability of a municipal planning department representative during a meeting

<u>Appendix 13: Analyses of the effect of two computer-assisted decision support systems,</u>
<u>a national geographic information systems (GIS) software and the stakeholder-built, on</u>
<u>flood risk management meeting participants' knowledge of flood risk-reduction options</u>

A. Participant pre- and post-survey analysis of written responses to an open-ended question measuring flood risk management meeting participants' knowledge of flood risk-reduction options (Survey Part I Question #2 in Appendix 3)

1. Information was transferred from the original pre- and post-surveys (Appendix 3) and coded into the appropriate columns of the participant survey database (Data are available upon request). The database does not contain individual identification of communities or participants, only the randomly-assigned codes.

2. Pre-survey Part 1 Question #2 (Appendix 3) responses were coded and transferred to the participant survey database as follows:

   a) Each phrase in a participant's response that described a single flood risk-reduction activity recommended by the Federal Emergency Management Agency (FEMA) (FEMA 2011c) counted as one response. A complete list of responses is located in Table 6. Each cell in the table represents one correct answer.

   b) If the participant did not receive or did not submit Part I of the Pre-survey, the response was recorded as missing data. If the participant submitted the survey, but did not write a response to this question, the response was recorded as "0" correct answers.

   c) Pre-survey Part 1 Question #2 asks, "Steps that the community and I <u>could</u> take to protect the property from flood damage include__". Pre-survey Part I Question #3 asks, "Steps that the community <u>and/or</u> I <u>already put in place or plan to do</u> to reduce flood risk include____" If Pre-survey Part I Question #3 includes answers not included in Pre-survey Part 1 Question #2 then those answers were added to

the total number of responses for Pre-survey Part 1 Question #2. It is reasonable to think the participant knew the risk-reduction options they listed as actions they "already put in place or plan to do" are also items that could be included as risk-reduction options in the answer to Pre-survey Part 1 Question #2.

d) The total number of correct answers given by each participant was entered in the participant survey database.

3. Post-survey Part 1 Question #2 (Appendix 3) responses were coded and transferred to the participant survey database as described in step 2, above, with the following changes:

a) Where the post-survey responses were different from the pre-survey responses for a participant, the pre-responses were added to the new post-responses when recording the total for the post-responses. It is reasonable to think the participant did not forget their previous knowledge during the two-hour meeting, but instead thought the researchers were interested only in having them record new knowledge on their post-survey.

b) Where the post-surveys were the same responses as those on the pre-surveys, the same number of responses was recorded in both the pre- and post-survey columns in the database.

c) Where the post-surveys included both the pre-survey responses and new post-survey responses, responses written on the post-survey were recorded as the total number.

4. To analyze the effects of the two DSS methods on learning outcomes for flood risk-reduction options with pre-survey knowledge of flood risk-reduction options as a

covariate, the Statistic Analysis System[TM] (SAS) code for the GLIMMIX Procedure

was:

```
PROC IMPORT OUT= WORK.a
      DATAFILE= "[insert Microsoft Excel™ workbook containing Data Table]"
      DBMS=EXCEL REPLACE;
      RANGE="[insert Microsoft Excel™ worksheet containing Data Table]$";
         GETNAMES=YES;
         MIXED=NO;
         SCANTEXT=YES;
         USEDATE=YES;
         SCANTIME=YES;
RUN;
proc print data=a; run;
proc glimmix data=a;
class method eu rep;
model RQ2A= method| RQ2B/dist=nb solution;
random method*rep;
lsmeans method/pdiff;
run;
```

 Appendix Table 23 highlights the results of this analysis.

Appendix Table 23: Effects of computer-assisted decision support system (DSS)
methods on learning outcomes for understanding of flood risk-reduction options as
measured by post-survey responses to an open-ended question with pre-survey
knowledge of flood risk-reduction options as a covariate

Effect	P value: two-tailed analysis	P value: one-tailed analysis
DSS method	0.62	0.30
Pre-survey	<.0001	
Pre-survey*DSS	0.43	

Legend:
DSS method = national geographic information systems (GIS) software DSS or stakeholder-built DSS method
Pre-survey = knowledge of flood risk-reduction options as measured on the pre-survey
Pre-survey*DSS = interaction between the DSS method used and pre-survey knowledge

Because the interaction was not significant (P > 0.42), that calculation was removed

from the analysis. The SAS code for the GLIMMIX Procedure was:

```
PROC IMPORT OUT= WORK.a
      DATAFILE= "[insert Microsoft Excel™ workbook containing Data Table]"
```

```
        DBMS=EXCEL REPLACE;
        RANGE="[insert Microsoft Excel^{TM} worksheet containing Data Table]$";
          GETNAMES=YES;
          MIXED=NO;
          SCANTEXT=YES;
          USEDATE=YES;
          SCANTIME=YES;
RUN;
proc print data=a; run;
proc glimmix data=a;
class method eu rep;
model RQ2A= method RQ2B/dist=nb;
random method*rep;
lsmeans method/pdiff;
run;
```

Appendix Table 24 highlights the results of this analysis. Results indicate there was no

significant effect (P > 0.34) of the computer-assisted decision support system (DSS)

method on the learning outcomes for understanding of flood risk-reduction options. The

pre-survey responses had a positive significant effect (P < 0.01) on the post-survey

responses. This indicated those who entered the meeting with prior knowledge of flood

risk-reduction options, left the meeting with more knowledge of flood risk-reduction

options than those entering the meeting with no prior knowledge of flood risk-reduction

options.

Appendix Table 24: Effects of computer-assisted decision support system (DSS)
methods on learning outcomes for understanding of flood risk-reduction options as
measured by post-survey responses to an open-ended question with pre-survey
knowledge of flood risk as a covariate. Interaction calculation removed.

Effect	P value: two-tailed analysis	P value: one-tailed analysis
DSS method	0.92	0.35
Pre-survey	<.0001	

Legend:
DSS method = national geographic information systems (GIS) software DSS or
stakeholder-built DSS method
Pre-survey = knowledge of flood risk-reduction options as measured on the pre-
survey

There was no significant difference (P > 0.91) between the two DSS methods in their

effect on learning outcomes for understanding of flood risk-reduction options. To find

whether or not there was a significant increase in learning outcomes for understanding

of flood risk-reduction options as a result of participation in the flood risk management

meetings, a t-test was performed. This analysis pooled responses from meetings using

the two DSS methods and analyzed the difference between pre- and post-survey

responses. The SAS 9.3 PROC TTEST Procedure code was:

```
PROC IMPORT OUT= WORK.a
     DATAFILE="[insert Microsoft Excel™ workbook containing Data Table]"
     DBMS=EXCEL REPLACE;
     RANGE="[insert Microsoft Excel™ worksheet containing Data Table]$";
            GETNAMES=YES;
            MIXED=NO;
            SCANTEXT=YES;
            USEDATE=YES;
            SCANTIME=YES;
RUN;
proc print data=a; run;
proc ttest data=a;
paired RQ2A*RQ2B;
run;
```

Results showed a significant increase (P < 0.01) in learning outcomes for understanding

of flood risk-reduction options as a result of participation in the flood risk management

meetings (Appendix Table 25).

Appendix Table 25: Analysis of the difference in learning outcomes for flood risk-reduction options as a result of participation in the flood risk management meetings using written pre- and post-survey responses to an open-ended question

N	Mean difference between pre-and post-survey responses	Standard Deviation	DF	t Value	P value
99	1.73	0.18	98	9.58	< .0001

B. Other factors related to community flood risk management meetings that had the potential to influence learning outcomes for flood risk-reduction options

In sections A, above, participant responses to pre-surveys were analyzed as a covariate to the post-survey responses. However, there were other factors related to community flood risk management meetings that had the potential to influence learning outcomes for flood risk-reduction options (Appendix Table 26). These were also analyzed as covariates. The statistical program, SAS 9.3 GLIMMIX Procedure, used in these analyses allowed the inclusion of only one covariate per analysis. Each factor listed in Appendix Table 26 was tested independently of the others to evaluate whether or not each had a significant influence on the post-survey responses. Appendix Table 26 summarizes the results of this series of analyses. Details of each analysis follow.

Appendix Table 26: Factors related to community flood risk management meetings that had the potential to influence learning about flood risk-reduction options among participants: Potential covariates to the computer-assisted decision support systems.

Factors that may influence performance of the computer-assisted decision support systems: Potential covariates	Significant effects
Participants' prior geographical information systems (GIS) experience	Not significant ($P > 0.65$)
Individuals serving as the meeting facilitator	Not significant ($P > 0.32$)
Individuals serving as the meeting GIS technician	Not significant ($P > 0.34$)
Number of meeting assistants in attendance	Not significant ($P > 0.41$)
Municipal planning department representative in attendance	Yes ($P < 0.03$)
Type of community: rural, suburban or urban	Not significant ($P > 0.76$)
Quality of the facility (providing a distraction-free environment)	Not significant ($P > 0.09$)

1. Data Analyses: Influence of prior geographic information systems (GIS) experience of meeting participants on their understanding of flood risk-reduction options

On the pre-survey, meeting participants were asked to report their experience with GIS prior to the start of the flood risk management meeting. Categories included:

no prior GIS knowledge, some prior GIS knowledge, and a high level of prior GIS

knowledge. To analyze the effects of the two DSS methods on learning outcomes for

flood risk-reduction options with participant pre-survey self-reporting of previous

experience with GIS as a covariate, the SAS code for the GLIMMIX Procedure was:

```
PROC IMPORT OUT= WORK.a
        DATAFILE= "[insert Microsoft^TM Excel workbook containing Data Table]"
        DBMS=EXCEL REPLACE;
        RANGE="[ insert Microsoft^TM Excel worksheet containing Data Table]$";
                GETNAMES=YES;
                MIXED=NO;
                SCANTEXT=YES;
                USEDATE=YES;
                SCANTIME=YES;
RUN;
proc print data=a; run;
proc glimmix data=a;
class GIS method eu rep;
model RQ2A= method| GIS/dist=nb solution;
random method*rep;
lsmeans method/pdiff;
run;
```

Appendix Table 27 highlights the results of this analysis.

Appendix Table 27: Effects of the computer-assisted decision support system (DSS)
methods on learning outcomes for understanding flood risk-reduction options measured
by survey responses to an open-ended question with geographic information systems
(GIS) background of participants as a covariate

Effect	P value two-tailed analysis	P value one-tailed analysis
DSS method	0.85	0.43
GIS	0.66	
GIS*DSS	0.87	

Legend:
DSS method = national GIS software DSS or stakeholder-built DSS method
GIS = participant's knowledge of geographic information systems (GIS) prior to the
start of the flood risk management meeting: Level 0 = no prior GIS knowledge, Level
1 = some prior GIS knowledge, Level 2 = high level of prior GIS knowledge
GIS*DSS = interaction between the DSS method used and participant's prior
knowledge of GIS

Because the interaction was not significant (P > 0.86), that calculation was

removed from the analysis. The SAS code for the GLIMMIX Procedure was:

```
PROC IMPORT OUT= WORK.a
    DATAFILE= "[insert Microsoft™ Excel workbook containing Data Table]"
    DBMS=EXCEL REPLACE;
    RANGE="[ insert Microsoft™ Excel worksheet containing Data Table]$";
        GETNAMES=YES;
        MIXED=NO;
        SCANTEXT=YES;
        USEDATE=YES;
        SCANTIME=YES;
RUN;
proc print data=a; run;
proc glimmix data=a;
class GIS method eu rep;
model RQ2A= method GIS/dist=nb;
random method*rep;
lsmeans method/pdiff;
run;
```

Appendix Table 28 highlights the results of this analysis. Results indicate there was no

significant effect (P > 0.39) of the DSS method on learning outcomes for understanding

flood risk-reduction options. The participants' prior experience with GIS had no

significant effect on learning outcomes for understanding flood risk-reduction options (P

> 0.67).

Appendix Table 28: Effects of the computer-assisted decision support system (DSS)
methods on learning outcomes for understanding flood risk-reduction options measured
by survey responses to an open-ended question with geographic information systems
(GIS) background of participants as a covariate. Interaction calculation removed.

Effect	P value two-tailed analysis	P value one-tailed analysis
DSS method	0.80	0.40
GIS	0.68	

Legend:
DSS method = national GIS software DSS or stakeholder-built DSS method
GIS = participant's knowledge of geographic information systems (GIS) prior to the
start of the flood risk management meeting: Level 0 = no prior GIS knowledge, Level 1
= some prior GIS knowledge, Level 2 = high level of prior GIS knowledge

2. Data Analyses: Influence of flood risk management meeting personnel on meeting participants understanding of flood risk-reduction options

To analyze the effects of the two DSS methods on learning outcomes for flood

risk-reduction options with the individual serving as meeting facilitator as a covariate,

the SAS code for the GLIMMIX Procedure was:

```
PROC IMPORT OUT= WORK.a
        DATAFILE= "[insert Microsoft Excel™ workbook containing Data Table]"
        DBMS=EXCEL REPLACE;
        RANGE="[insert Microsoft Excel™ worksheet containing Data Table]$";
            GETNAMES=YES;
            MIXED=NO;
            SCANTEXT=YES;
            USEDATE=YES;
            SCANTIME=YES;
RUN;
proc print data=a; run;
proc glimmix data=a;
class facil method eu rep;
model RQ2A= method| facil/dist=nb solution;
random method*rep;
lsmeans method/pdiff;
run;
```

Appendix Table 29 highlights the results of this analysis.

Appendix Table 29: Effects of the computer-assisted decision support system (DSS) methods on learning outcomes for understanding flood risk-reduction options measured by survey responses to an open-ended question with the individual serving as meeting facilitator as a covariate

Effect	P value: two-tailed analysis	P value: one-tailed analysis
DSS method	0.41	0.21
facilitator	0.28	
facilitator *DSS	0.30	

Legend:
DSS method = national geographic information systems (GIS) software DSS or stakeholder-built DSS method
facilitator = individual serving as meeting facilitator
facilitator *DSS = interaction between the DSS method used and the individual serving as meeting facilitator

Because the interaction was not significant (P > 0.29), that calculation was

removed from the analysis. The SAS code for the GLIMMIX Procedure was:

```
PROC IMPORT OUT= WORK.a
        DATAFILE= "[insert Microsoft Excel^TM workbook containing Data Table]"
        DBMS=EXCEL REPLACE;
        RANGE="[insert Microsoft Excel^TM worksheet containing Data Table]$";
            GETNAMES=YES;
            MIXED=NO;
            SCANTEXT=YES;
            USEDATE=YES;
            SCANTIME=YES;
RUN;
proc print data=a; run;
proc glimmix data=a;
class facil method eu rep;
model RQ2A= method facil/dist=nb;
random method*rep;
lsmeans method/pdiff;
run;
```

Appendix Table 30 highlights the results of this analysis. Results indicate there was no

significant effect (P > 0.38) of the DSS method on learning outcomes for understanding

flood risk-reduction options. The individual functioning as the meeting facilitator had no

significant effect on learning outcomes for understanding flood risk-reduction options (P

> 0.32).

Appendix Table 30: Effects of the computer-assisted decision support system (DSS) methods on learning outcomes for understanding flood risk-reduction options measured by survey responses to an open-ended question with the individual serving as meeting facilitator as a covariate. Interaction calculation removed.

Effect	P value two-tailed analysis	P value one-tailed analysis
DSS method	0.78	0.39
facilitator	0.33	

Legend:
DSS method = national geographic information systems (GIS) software DSS or stakeholder-built DSS method
facilitator = individual serving as meeting facilitator

To analyze the effects of the two DSS methods on learning outcomes for flood risk-reduction options with the individual serving as meeting GIS technician as a covariate, the SAS code for the GLIMMIX Procedure was:

```
PROC IMPORT OUT= WORK.a
        DATAFILE= "[insert Microsoft^{TM} Excel workbook containing Data Table]"
        DBMS=EXCEL REPLACE;
        RANGE="[insert Microsoft^{TM} Excel worksheet containing Data Table]$";
          GETNAMES=YES;
          MIXED=NO;
          SCANTEXT=YES;
          USEDATE=YES;
          SCANTIME=YES;
RUN;
proc print data=a; run;
proc glimmix data=a;
class tech method eu rep;
model RQ2A= method| tech/dist=nb solution;
random method*rep;
lsmeans method/pdiff;
run;
```

Appendix Table 31 highlights the results of this analysis. Results indicate there was no significant effect (P > 0.41) of the DSS method on learning outcomes for understanding of flood risk-reduction options. The individual functioning as the meeting GIS technician had no significant effect on learning outcomes for understanding of flood risk-reduction options (P > 0.34). The sample size was not large enough to measure the

effects of interaction between the DSS methods and the individual serving as the

meeting GIS technician.

Appendix Table 31: Effects of the computer-assisted decision support system (DSS) methods on learning outcomes for understanding flood risk-reduction options measured by survey responses to an open-ended question with the individual serving as meeting geographic information systems (GIS) technician as a covariate

Effect	P value two-tailed analysis	P value one-tailed analysis
DSS method	0.84	0.42
GIS tech	0.35	

Legend:
DSS method = national GIS software DSS or stakeholder-built DSS method
GIS tech= individual serving as meeting GIS technician
GIS tech*DSS = interaction between the DSS method used and the individual serving as meeting GIS technician

To analyze the effects of the two DSS methods on learning outcomes for flood

risk-reduction options with the number of meeting assistants available during a meeting

as a covariate, the SAS code for the GLIMMIX Procedure was:

```
PROC IMPORT OUT= WORK.a
        DATAFILE= "[insert Microsoft^TM Excel workbook containing Data Table]"
        DBMS=EXCEL REPLACE;
        RANGE="[ insert Microsoft^TM Excel worksheet containing Data Table]$";
            GETNAMES=YES;
            MIXED=NO;
            SCANTEXT=YES;
            USEDATE=YES;
            SCANTIME=YES;
RUN;
proc print data=a; run;
proc glimmix data=a;
class assist method eu rep;
model RQ2A= method| assist/dist=nb solution;
random method*rep;
lsmeans method/pdiff;
run;
```

Appendix Table 32 highlights the results of this analysis.

Appendix Table 32: Effects of the computer-assisted decision support system (DSS) methods on learning outcomes for understanding flood risk-reduction options measured by survey responses to an open-ended question with the number of meeting assistants available during a meeting as a covariate

Effect	P value two-tailed analysis	P value one-tailed analysis
DSS method	0.74	0.37
# of assistants	0.65	0.33
# of assistants *DSS	0.65	
Legend: DSS method = national geographic information systems (GIS) software DSS or stakeholder-built DSS method # of assistants = number of meeting assistants available during a meeting # of assistants *DSS = interaction between the DSS method used and the number of meeting assistants available during a meeting		

Because the interaction was not significant $(P > 0.64)$, that calculation was

removed from the analysis. The SAS code for the GLIMMIX Procedure was:

PROC IMPORT OUT= WORK.a
      DATAFILE= "[insert Microsoft^{TM} Excel workbook containing data in Data
      Table 1]"
      DBMS=EXCEL REPLACE;
      RANGE="[insert Microsoft^{TM} Excel worksheet containing data in Data Table
      1]$";
        GETNAMES=YES;
        MIXED=NO;
        SCANTEXT=YES;
        USEDATE=YES;
        SCANTIME=YES;
RUN;
proc print data=a; run;
proc glimmix data=a;
class assist method eu rep;
model RQ2A= method assist/dist=nb;
random method*rep;
lsmeans method/pdiff;
run;

Appendix Table 33 highlights the results of this analysis. Results indicate there was no

significant effect $(P > 0.46)$ of the DSS method on learning outcomes for understanding

of flood risk-reduction options. The number of meeting assistants available during the

meeting had no significant effect on learning outcomes for understanding of flood risk-

reduction options (P > 0.41).

Appendix Table 33: Effects of the computer-assisted decision support system (DSS) methods on learning outcomes for understanding flood risk-reduction options measured by survey responses to an open-ended question with the number of meeting assistants available during a meeting as a covariate. Interaction calculation removed.

Effect	P value two-tailed analysis	P value one-tailed analysis
DSS method	0.94	0.47
# of assistants	0.84	0.42

Legend:
DSS method = national geographic information systems (GIS) software DSS or stakeholder-built DSS method
# of assistants = number of meeting assistants available during a meeting

To analyze the effects of the two DSS methods on learning outcomes for flood

risk-reduction options with the municipal planning department representative

availability during a meeting as a covariate, the SAS code for the GLIMMIX Procedure

was:

```
PROC IMPORT OUT= WORK.a
        DATAFILE= "[insert Microsoft^TM Excel workbook containing Data Table]"
        DBMS=EXCEL REPLACE;
        RANGE="[insert Microsoft^TM Excel worksheet containing Data Table]$";
          GETNAMES=YES;
          MIXED=NO;
          SCANTEXT=YES;
          USEDATE=YES;
          SCANTIME=YES;
RUN;
proc print data=a; run;
proc glimmix data=a;
class CityCo method eu rep;
model RQ2A= method| CityCo/dist=nb solution;
random method*rep;
lsmeans method/pdiff;
run;
```

Appendix Table 34 highlights the results of this analysis.

Appendix Table 34: Effects of computer-assisted decision support system (DSS) methods on learning outcomes for understanding of flood risk-reduction options with municipal planning department representative availability during a meeting as a covariate

Effect	P value: two-tailed analysis	P value: one-tailed analysis
DSS method	0.84	0.42
CityCo	0.05	0.03
CityCo*DSS	0.86	

Legend:
DSS method = national geographic information systems (GIS) software DSS or stakeholder-built DSS method
CityCo = municipal planning department representative availability during a meeting (yes = a representative was present, no = a representative was not present)
CityCo*DSS = interaction between the DSS method used and the availability of a municipal planning department representative during a meeting

Because the interaction was not significant ($P > 0.85$), that calculation was removed from the analysis. The SAS code for the GLIMMIX Procedure was:

```
PROC IMPORT OUT= WORK.a
      DATAFILE= "[insert Microsoft^TM Excel workbook containing Data Table]"
      DBMS=EXCEL REPLACE;
      RANGE="[insert Microsoft^TM Excel worksheet containing Data Table]$";
         GETNAMES=YES;
         MIXED=NO;
         SCANTEXT=YES;
         USEDATE=YES;
         SCANTIME=YES;
RUN;
proc print data=a; run;
proc glimmix data=a;
class CityCo method eu rep;
model RQ2A= method CityCo/dist=nb;
random method*rep;
lsmeans method/pdiff;
run;
```

Appendix Table 35 highlights the results of this analysis. Results indicate there was no significant effect ($P > 0.37$) of the DSS method on learning outcomes for understanding of flood risk-reduction options. When municipal planning department representatives were available during the meeting to answer participants' questions about local flood

risk-reduction options, they had a positive significant effect on learning outcomes for

understanding of flood risk-reduction options ($P < 0.03$).

Appendix Table 35: Effects of the computer-assisted decision support system (DSS) methods on learning outcomes for understanding of flood risk-reduction options with municipal planning department representative availability during a meeting as a covariate. Interaction calculation removed.

Effect	P value: two-tailed analysis	P value: one-tailed analysis
DSS method	0.77	0.38
CityCo	0.05	0.03
Legend: DSS method = national geographic information systems (GIS) software DSS or stakeholder-built DSS method CityCo = municipal planning department representative availability during a meeting (yes = a representative was present, no = a representative was not present)		

3. Data Analyses: Influence of the characteristics of the meeting facility on participants' understanding of flood risk-reduction options

   To analyze the effects of the two DSS methods on learning outcomes for flood

risk-reduction options with the location of meeting facilities as a covariate, the SAS

code for the GLIMMIX Procedure was:

```
PROC IMPORT OUT= WORK.a
        DATAFILE= "[insert Microsoft™ Excel workbook containing Data Table]"
        DBMS=EXCEL REPLACE;
        RANGE="[insert Microsoft Excel™ worksheet containing Table Data]$";
            GETNAMES=YES;
            MIXED=NO;
            SCANTEXT=YES;
            USEDATE=YES;
            SCANTIME=YES;
RUN;
proc print data=a; run;
proc glimmix data=a;
class place method eu rep;
model RQ2A= method| place/dist=nb solution;
random method*rep;
lsmeans method/pdiff;
run;
```

Appendix Table 36 highlights the results of this analysis.

Appendix Table 36: Effects of the computer-assisted decision support system (DSS) methods on learning outcomes for understanding of flood risk-reduction options with the location of meeting facilities as a covariate

Effect	P value two-tailed analysis	P value one-tailed analysis
DSS method	0.92	0.46
place	0.85	
place*DSS	0.50	

Legend:
DSS method = national geographic information systems (GIS) software DSS or stakeholder-built DSS method
place = location of meeting facilities
place*DSS = interaction between the DSS method used and the location of the meeting facilities

Because the interaction was not significant (P > 0.49), that calculation was

removed from the analysis. The SAS code for the GLIMMIX Procedure was:

```
PROC IMPORT OUT= WORK.a
        DATAFILE= "[insert Microsoft™ Excel workbook containing Data Table]"
        DBMS=EXCEL REPLACE;
        RANGE="[insert Microsoft Excel™ worksheet containing Data Table]$";
            GETNAMES=YES;
            MIXED=NO;
            SCANTEXT=YES;
            USEDATE=YES;
            SCANTIME=YES;
RUN;
proc print data=a; run;
proc glimmix data=a;
class place method eu rep;
model RQ2A= method place/dist=nb;
random method*rep;
lsmeans method/pdiff;
run;
```

Appendix Table 37 highlights the results of this analysis. Results indicate there was no

significant effect (P > 0.38) of the DSS method on learning outcomes for understanding

of flood risk-reduction options. The location of the meeting facilities had no significant

effect on learning outcomes for understanding of flood risk-reduction options (P > 0.76).

Appendix Table 37: Effects of the computer-assisted decision support system (DSS) methods on learning outcomes for understanding of flood risk-reduction options with the location of the meeting facilities as a covariate. Interaction calculation removed.

Effect	P value two-tailed analysis	P value one-tailed analysis
DSS method	0.77	0.39
place	0.77	
Legend: DSS method = national geographic information systems (GIS) software DSS or stakeholder-built DSS method place = location of meeting facilities		

To analyze the effects of the two DSS methods on learning outcomes for flood

risk-reduction options with the quality of meeting facilities as a covariate, the SAS code

for the GLIMMIX Procedure was:

```
PROC IMPORT OUT= WORK.a
        DATAFILE= "[insert Microsoft Excel™ workbook containing Data Table]"
        DBMS=EXCEL REPLACE;
        RANGE="[insert Microsoft Excel™ worksheet containing Data Table]$";
           GETNAMES=YES;
           MIXED=NO;
           SCANTEXT=YES;
           USEDATE=YES;
           SCANTIME=YES;
RUN;
proc print data=a; run;
proc glimmix data=a;
class room method eu rep;
model RQ2A= method| room/dist=nb solution;
random method*rep;
lsmeans method/pdiff;
run;
```

Appendix Table 38 highlights the results of this analysis.

Appendix Table 38: Effects of the computer-assisted decision support system (DSS) methods on learning outcomes for understanding of flood risk-reduction options with the quality of the meeting facility as a covariate

Effect	P value two-tailed analysis	P value one-tailed analysis
DSS method	0.35	0.18
room	0.09	
room*DSS	0.12	

Legend:
DSS method = national geographic information systems (GIS) software DSS or stakeholder-built DSS method
room = quality of the meeting facilities
room*DSS = interaction between the DSS method used and the quality of the meeting facilities

Because the interaction was not significant (P > 0.11), that calculation was removed

from the analysis. The SAS code for the GLIMMIX Procedure was:

```
PROC IMPORT OUT= WORK.a
        DATAFILE= "[insert Microsoft Excel™ workbook containing Data Table]"
        DBMS=EXCEL REPLACE;
        RANGE="[insert Microsoft Excel™ worksheet containing Data Table]$";
           GETNAMES=YES;
           MIXED=NO;
           SCANTEXT=YES;
           USEDATE=YES;
           SCANTIME=YES;
RUN;
proc print data=a; run;
proc glimmix data=a;
class room method eu rep;
model RQ2A= method room/dist=nb;
random method*rep;
lsmeans method/pdiff;
run;
```

Appendix Table 39 highlights the results of this analysis. Results indicate there was no

significant effect (P > 0.10) of the DSS method on learning outcomes for understanding

of flood risk-reduction options. The quality of the meeting facility had no significant

effect on learning outcomes for understanding of flood risk-reduction options ($P > 0.09$).

Appendix Table 39: Effects of the computer-assisted decision support system (DSS) methods on learning outcomes for understanding of flood risk-reduction options with the quality of the meeting facilities as a covariate. Interaction calculation removed.

Effect	P value two-tailed analysis	P value one-tailed analysis
DSS method	0.22	0.11
room	0.10	
Legend: DSS method = national geographic information systems (GIS) software DSS or stakeholder-built DSS method room = quality of the meeting facilities		

Appendix 14: Analyses of the effect of two computer-assisted decision support systems, a national geographic information systems (GIS) software and the stakeholder-built, on the intent of flood risk management meeting participants to initiate flood risk-reduction action

A. Participant pre- and post-survey analysis of written responses to an open-ended question (Survey Part I Question #3 in Appendix 3)

1. Information was transferred from the original surveys (Appendix 3) and coded into the appropriate columns of the participant survey database (Data are available upon request). The database does not contain individual identification of communities or participants, only the randomly-assigned codes.

2. Pre-survey Part 1 Question #3 (Appendix 3) responses were coded and transferred to the participant survey database as follows:

   a) Each phrase in a participant's response that described a single flood risk reduction activity recommended by the Federal Emergency Management Agency counted as one response. A complete list of responses is located in Table 6. Each cell in the table represents one correct answer.

   b) If the participant did not receive or did not submit Part I of the Pre-survey, the response was recorded as missing data. If the participant submitted the survey, but did not write a response to this question, the response was recorded as "0" correct answers.

   c) The total number of correct answers given by each participant was entered in the participant survey database.

3. Post-survey Part 1 Question #3 (Appendix 3) responses were coded and transferred to the participant survey database as described in step 2, above, with the following changes:

a) Where the post-survey responses were different from the pre-survey responses for a participant, the pre-responses were added to the new post-responses when recording the total for the post-responses. It is reasonable to think the participant did not forget their previous knowledge during the two-hour meeting, but instead thought the researchers were interested only in having them record new knowledge on their post-survey.

b) Where the post-surveys were the same responses as those on the pre-surveys, the same number of responses was recorded in both the pre- and post-survey columns in the database.

c) Where the post-surveys included both the pre-survey responses and new post-survey responses, responses written on the post-survey were recorded as the total number.

4. To analyze the effects of the two DSS methods on intent of participants to initiate flood risk-reduction actions with pre-survey intent to take action as a covariate using written survey responses to the open-ended question, the Statistic Analysis System™ (SAS) code for the GLIMMIX Procedure was:

```
PROC IMPORT OUT= WORK.a
        DATAFILE= "[insert Microsoft Excel™ workbook containing Data Table]"
        DBMS=EXCEL REPLACE;
        RANGE="[insert Microsoft Excel™ worksheet containing Data Table]$";
           GETNAMES=YES;
           MIXED=NO;
           SCANTEXT=YES;
           USEDATE=YES;
           SCANTIME=YES;
RUN;
proc print data=a; run;
proc glimmix data=a;
class method eu rep;
model iP1Q3A= method| iP1Q3B/dist=nb solution;
```

```
random method*rep;
lsmeans method/pdiff;
run;
```

Appendix Table 40 highlights the results of this analysis. Results indicate there was no

significant effect (P > 0.11) of the DSS method on the intent of meeting participants to

initiate risk-reduction actions. The pre-survey responses had a positive significant effect

(P < 0.01) on the post-survey responses. This indicated those who entered the meeting

with intentions of initiating risk-reduction actions, left the meeting planning to initiate

more actions than those entering the meeting with no prior intentions to take action.

There was no significant interaction between pre-survey responses and the DSS method

(P > 0.13). This indicated the influence of the pre-survey responses on the post-survey

responses was similar for meetings using both of the DSS methods.

Appendix Table 40: Effects of computer-assisted decision support system (DSS)
methods on initiation of flood risk-reduction actions as measured by post-survey
written responses to an open-ended survey question with pre-survey responses as a
covariate

Effect	P value two-tailed analysis	P value one-tailed analysis
DSS Method	0.23	0.12
Pre-survey	0.0004	
Pre-survey*DSS	0.14	

Legend:
DSS method = national geographic information systems (GIS) software DSS or
stakeholder-built DSS method
Pre-survey = self-reported intention to initiate flood risk-reduction actions as measured
on the pre-survey
Pre-survey*DSS = interaction between the DSS method used and pre-survey reported
intentions to initiate action

When the interaction was removed, the difference between the DSS methods in their

effect on the initiation of flood risk-reduction actions was not significant (P > 0.46). To

find whether or not there was a significant increase in intent to take action to reduce risk

as a result of participation in the flood risk management meetings, a t-test was

performed. This analysis pooled responses from meetings using the two DSS methods

and analyzed the difference between pre- and post-survey responses. The SAS 9.3

PROC TTEST Procedure code was:

```
PROC IMPORT OUT= WORK.a
        DATAFILE= "[insert Microsoft Excel™ workbook containing Data Table]"
        DBMS=EXCEL REPLACE;
        RANGE="[insert Microsoft Excel™ worksheet containing Data Table]$";
            GETNAMES=YES;
            MIXED=NO;
            SCANTEXT=YES;
            USEDATE=YES;
            SCANTIME=YES;
RUN;
proc print data=a; run;
proc ttest data=a;
paired iP1Q3A*iP1Q3B;
run;
```

Results showed a significant increase (P < 0.01) in intent to take action to reduce risk as

a result of participation in the flood risk management meetings (Appendix Table 41).

Appendix Table 41: Analysis of the difference in intent to take action to reduce risk as a result of participation in the flood risk management meetings using written pre- and post-survey responses to an open-ended question

N	Mean difference between pre-and post-survey responses	Standard Deviation	DF	t Value	P value
99	0.92	1.43	98	6.38	<.0001

B. Analysis of follow-up interview responses to the open-ended question with pre-survey responses as a covariate

1. Information was transferred from the original Pre-survey Part 1 Question #3

   (Appendix 3) responses and interview responses (4th question in Appendix 6) and

   coded in the appropriate columns of the participant interview database (Data are

   available upon request). The database does not contain individual identification of

   communities or participants, only the randomly-assigned codes.

2. Pre-survey Part 1 Question #3 (Appendix 3) responses were coded and transferred

    to the participant interview database as described in section A, step 2 a, b and c,

    above.

3. The 4th question in the follow-up interview list of questions (Appendix 6) responses

    were coded and transferred to the appropriate column of the participant interview

    database according to section A, step 3, above.

4. To analyze the effects of the two DSS methods on intent of participants to initiate

    flood risk-reduction actions using follow-up interview responses to the open-ended

    question with pre-survey intent to take action as a covariate, the SAS code for the

    GLIMMIX Procedure was:

```
PROC IMPORT OUT= WORK.a
        DATAFILE= "[insert Microsoft Excel™ workbook containing Data Table]";
         DBMS=EXCEL REPLACE;
        RANGE=""[insert Microsoft Excel™ worksheet containing Data Table]";
          GETNAMES=YES;
          MIXED=NO;
          SCANTEXT=YES;
          USEDATE=YES;
          SCANTIME=YES;
RUN;
proc print data=a; run;
proc glimmix data=a;
class method eu rep;
model iP1Q3i= method| iP1Q3B/dist=nb solution;
random method*rep;
lsmeans method/pdiff;
run;
```

Appendix Table 42 highlights the results of this analysis.

Appendix Table 42: Effects of computer-assisted decision support system (DSS) methods on initiation of flood risk-reduction actions as measured by interview responses to an open-ended question with pre-survey responses as a covariate

Effect	P value two-tailed analysis	P value one-tailed analysis
DSS method	0.55	0.27
Pre-survey	0.89	
Pre-survey*DSS	0.32	

Legend:
DSS method = national geographic information systems (GIS) software DSS or stakeholder-built DSS method
Pre-survey = self-reported intention to initiate flood risk-reduction actions as measured on the pre-survey
Pre-survey*DSS = interaction between the DSS method used and pre-survey reported intentions to initiate action

Because the interaction was not significant ($P > 0.31$), that calculation was removed

from the analysis. The SAS code for the GLIMMIX Procedure was:

```
PROC IMPORT OUT= WORK.a
      DATAFILE= "[insert Microsoft Excel™ workbook containing Data Table]";
      DBMS=EXCEL REPLACE;
      RANGE=""[insert Microsoft Excel™ worksheet containing data in Table]";
        GETNAMES=YES;
        MIXED=NO;
        SCANTEXT=YES;
        USEDATE=YES;
        SCANTIME=YES;
RUN;
proc glimmix data=a;
class method eu rep;
model iP1Q3i= method iP1Q3B/dist=nb;
random method*rep;
lsmeans method/pdiff;
run;
```

Appendix Table 43 highlights the results of this analysis. Results indicate there was no

significant effect of the DSS method on the intent of meeting participants to initiate risk-

reduction actions ($P > 0.13$). The pre-survey responses did not have a significantly effect

on follow-up interview responses ($P > 0.88$).

Appendix Table 43: Effects of computer-assisted decision support system (DSS) methods on initiation of flood risk-reduction actions as measured by interview responses to an open-ended question with pre-survey responses as a covariate. Interaction calculation removed.

Effect	P value two-tailed analysis	P value one-tailed analysis
DSS method	0.27	0.14
Pre-survey	0.89	

Legend:
DSS method = national geographic information systems (GIS) software DSS or stakeholder-built DSS method
Pre-survey = self-reported intention to initiate flood risk-reduction actions as measured on the pre-survey

There was no significant difference ($P > 0.26$) between the two DSS methods in their effect on participants' intent to take action. To find whether or not there was a significant increase in intent to take action to reduce risk as a result of participation in the flood risk management meetings, a t-test was performed. This analysis pooled responses from meetings using the two DSS methods and analyzed the difference between pre-survey responses and follow-up interview responses. The SAS 9.3 PROC TTEST Procedure code was:

```
PROC IMPORT OUT= WORK.a
    DATAFILE= "[insert Microsoft Excel™ workbook containing Data Table]";
     DBMS=EXCEL REPLACE;
    RANGE="[insert Microsoft Excel™ worksheet containing Data Table]";
        GETNAMES=YES;
        MIXED=NO;
        SCANTEXT=YES;
        USEDATE=YES;
        SCANTIME=YES;
    RUN;
    proc print data=a; run;
    proc ttest data=a;
    paired iP1Q3i*iP1Q3B;
    run;
```

Results showed a significant increase ($P < 0.01$) in intent to take action to reduce risk as a result of participation in the flood risk management meetings (Appendix Table 44).

Appendix Table 44: Analysis of the difference in intent to take action to reduce risk as a result of participation in the flood risk management meetings using written pre-survey and follow-up interview responses to an open-ended question

N	Mean difference between pre-and post-survey responses	Standard Deviation	DF	t Value	P value
27	2.30	1.90	26	6.29	<.0001

C. Participant pre- and post-survey analysis of written responses to six multiple-choice questions (Survey Part II Questions #2 - #7 in Appendix 4)

1. Each participant recorded their address on the University of Maryland Institutional Review Board-approved consent form (Appendix 9). Participant addresses from the consent forms were transcribed to a database using only the community and participant randomly-generated codes for identification. No community or participant names were entered in the database.

2. The addresses were then grouped together by community and geocoded (Data are available upon request).

3. For the national GIS software computer-assisted decision support system (DSS), address geocoding was completed using Environmental Science Research Institute (ESRI) ArcGis10™. The protocol for that geocoding was as follows:

   a) For historic (past) flood risk mapping, a Federal Emergency Management Agency (FEMA) Multi-hazard Loss Estimation Methodology (HAZUS) model of the historic flood event illustrated for participants during their flood risk management meeting was constructed (Appendix 1). The geocoded addresses were then added to the HAZUS model. Each of the participant locations was recorded with regard to whether or not it fell within the floodplain. This location was then coded and entered in the participant survey database. A HAZUS

historic model was constructed for each of the communities selected to receive that DSS.

b) For present flood risk mapping, a HAZUS model illustrating the FEMA 1% annual return period was produced for each of the communities (Appendix 1). The geocoded addresses were then added to the HAZUS model. Each of the participant locations was recorded as in or out of the floodplain. This location was then coded and entered in the participant survey database.

c) For mapping of anticipated future flood risk, a HAZUS model illustrating the FEMA 0.2% annual return period was produced for each of the communities (Appendix 1). The geocoded addresses were then added to the HAZUS model. Each of the participant locations was recorded as in or out of the floodplain. This location was then coded and entered in the participant survey database.

4. The protocol for stakeholder-built geocoding was as follows:

a) Google Earth™ and the FEMA "Stay Dry" KMZ version 2.4 or 3.0 specifically used in the community meeting were downloaded and opened. FEMA's "Stay Dry" KMZ displays in raster format the 1% annual return period for flood events (FEMA 2014d). Participant addresses, grouped together by community, were individually entered into Google Earth™ and zoomed in to an elevation less than 4000 feet distance from the ground (see Figures 7, 9 and 11).

b) For present flood risk mapping, if the participant's address fell within an area of high or moderate risk in FEMA's "Stay Dry" KMZ (Figure 30D), it was considered to be in the 1% annual return period floodplain. If the participant

address fell within an area of low risk or was outside of the floodplain all

together, it was considered to be out of the 1% annual return period floodplain.

This information was coded and recorded in the participant survey database.

c) For historic (past) flood risk mapping, a model of the historic flood event

illustrated for participants during their flood risk management meeting was

constructed in Google Earth^{TM} using Google Earth^{TM} drawing tools (Figure 7

and Appendix 2). Each of the participant locations was recorded with regard to

whether or not it fell within the floodplain. This location was then coded and

entered in the participant survey database.

d) For mapping anticipated future flood risk, a model was constructed following the

instructions in Figure 11. Each of the participant locations was recorded as in or

out of the floodplain. This location was then coded and entered in the participant

survey database.

5. Each of the six multiple-choice survey questions described one specific risk-

reduction action and participants were asked whether or not they had implemented

the action or planned to do so in the future (Appendix 4). A participant's response to

each multiple-choice question was recorded as a risk-reduction action if the choice

she/he made in response to the question was appropriate given the flood risk to their

property as indicated by the model used during the meeting. Therefore, answering

"yes" to every question, indicating they would initiate action in all situations, was

not recorded as an appropriate risk-reduction action unless their property was shown

to be at risk to flooding according to the model. The total number of appropriate

risk-reduction actions for all six multiple-choice responses were summed for each

participant and entered in the participant survey database (Data are available upon

request).

6. To analyze the effects of the two DSS methods on intent of flood risk management

meeting participants to initiate risk-reduction actions using written multiple-choice

post-survey responses with pre-survey responses as a covariate, the SAS code for the

GLIMMIX Procedure was:

```
PROC IMPORT OUT= WORK.a
       DATAFILE= "[insert Microsoft Excel^TM workbook containing Data Table]"
       DBMS=EXCEL REPLACE;
       RANGE="[insert Microsoft Excel^TM worksheet containing Data Table]$";
         GETNAMES=YES;
         MIXED=NO;
         SCANTEXT=YES;
         USEDATE=YES;
         SCANTIME=YES;
RUN;
proc print data=a; run;
proc glimmix data=a;
class method eu rep;
model isumA= method| isumB/dist=nb solution;
random method*rep;
lsmeans method/pdiff;
run;
```

 Appendix Table 45 highlights the results of this analysis.

Appendix Table 45: Effects of computer-assisted decision support system (DSS)
methods on initiation of flood risk-reduction actions as measured by post-survey
written multiple-choice responses with pre-survey responses as a covariate

Effect	P value two-tailed analysis	P value one-tailed analysis
DSS method	0.61	0.31
Pre-survey	0.003	
Pre-survey*DSS	0.59	
Legend: DSS method = national geographic information systems (GIS) software DSS or stakeholder-built DSS method Pre-survey = self-reported intention to initiate flood risk-reduction actions as measured on the pre-survey		

Pre-survey*DSS = interaction between the DSS method used and pre-survey reported intentions to initiate action

Because the interaction was not significant (P > 0.58), that calculation was removed

from the analysis. The SAS code for the GLIMMIX Procedure was:

```
PROC IMPORT OUT= WORK.a
      DATAFILE= "[insert Microsoft Excel™ workbook containing Data Table]"
      DBMS=EXCEL REPLACE;
      RANGE="[insert Microsoft Excel™ worksheet containing Data Table]$";
         GETNAMES=YES;
         MIXED=NO;
         SCANTEXT=YES;
         USEDATE=YES;
         SCANTIME=YES;
      RUN;
      proc print data=a; run;
      proc glimmix data=a;
      class method eu rep;
      model isumA= method isumB/dist=nb;
      random method*rep;
      lsmeans method/pdiff;
      run;
```

Appendix Table 46 highlights the results of this analysis. Results indicate there was no

significant effect (P > 0.48) of the DSS method on the intent of meeting participants to

initiate risk-reduction actions. The pre-survey responses had a positive significant effect

(P < 0.01) on the post-survey responses. This indicated those who entered the meeting

with intentions of initiating risk-reduction actions, left the meeting planning to initiate

more actions than those entering the meeting with no prior intentions to take action.

Appendix Table 46: Effects of computer-assisted decision support system (DSS) methods on initiation of flood risk-reduction actions as measured by post-survey written multiple-choice responses with pre-survey responses as a covariate. Interaction calculation removed.

Effect	P value two-tailed analysis	P value one-tailed analysis
DSS method	0.98	0.49
Pre-survey	0.003	
Legend:		

DSS method = national geographic information systems (GIS) software DSS or stakeholder-built DSS method
Pre-survey = self-reported intention to initiate flood risk-reduction actions as measured on the pre-survey

There was no significant difference (P > 0.97) between the two DSS methods in their

effect on participants' intent to take action. To find whether or not there was a

significant increase in intent to take action to reduce risk as a result of participation in

the flood risk management meetings, a t-test was performed. This analysis pooled

responses from meetings using the two DSS methods and analyzed the difference

between pre- and post-survey responses. The SAS 9.3 PROC TTEST Procedure code

was:

```
PROC IMPORT OUT= WORK.a
        DATAFILE= "[insert Microsoft Excel™ workbook containing Data Table]";
        DBMS=EXCEL REPLACE;
        RANGE="[insert Microsoft Excel™ worksheet containing Data Table]$";
        GETNAMES=YES;
          MIXED=NO;
          SCANTEXT=YES;
          USEDATE=YES;
          SCANTIME=YES;
RUN;
proc print data=a; run;
proc ttest data=a;
paired isumA*isumB;
run;
```

Results showed a significant increase (P < 0.01) in intent to take action to reduce risk as

a result of participation in the flood risk management meetings (Appendix Table 47).

Appendix Table 47: Analysis of the difference in intent to take action to reduce risk as a result of participation in the flood risk management meetings using written pre- and post-survey responses to six multiple-choice questions

N	Mean difference between pre-and post-survey responses	Standard Deviation	DF	t Value	P value
89	0.74	2.44	88	2.87	0.005

D. Other factors related to community flood risk management meetings that had the potential to influence intent to initiate flood risk-reduction actions among participants

In sections A, B and C, above, participant responses to pre-surveys were analyzed as a covariate to the post-survey and follow-up interview responses. However, there were other factors related to community flood risk management meetings that had the potential to influence intent to initiate flood risk-reduction actions among participants (Appendix Table 48). These were also analyzed as covariates. The statistical program, SAS 9.3 GLIMMIX Procedure, used in these analyses allowed the inclusion of only one covariate per analysis. Since the pre-survey responses had no significant effect on the interview responses ($P > 0.88$), this factor was removed from the interview analyses and replaced by each of the other factors as the potential covariate. Each factor listed in Appendix Table 48 was tested independently of the others to evaluate whether or not each had a significant influence on the interview responses. Appendix Table 48 summarizes the results of this series of analyses. Details of each analysis follow.

Appendix Table 48: Factors related to community flood risk management meetings and their influence on intent to initiate flood risk-reduction actions among meeting participants: Potential covariates to the follow-up interview responses

Factors that may influence performance of the computer-assisted decision support system	Significant effects on intent to initiate flood risk-reduction actions among meeting participants
Participants' prior geographical information system (GIS) experience	Not significant ($P > 0.68$)
Individuals serving as the meeting facilitator	Not significant ($P > 0.76$)
Individuals serving as the meeting GIS technician	Not significant ($P > 0.86$)
Number of meeting assistants in attendance	Not significant ($P > 0.12$)

Municipal planning department representative in attendance	Not significant ($P > 0.14$)
Type of community: rural, suburban or urban	Not significant ($P > 0.85$)
Quality of the facilities (providing a distraction-free environment)	Yes ($P < 0.02$)

1. Data Analyses: Influence of prior geographic information systems (GIS) experience of meeting participants on their intent to initiate flood risk-reduction actions

On the pre-survey, meeting participants were asked to report their experience with GIS prior to the start of the flood risk management meeting. Categories included: no prior GIS knowledge, some prior GIS knowledge, and a high level of prior GIS knowledge. Of those participating in the follow-up interviews, none reported having a high level of prior GIS knowledge. Therefore, this study did not evaluate the influence of a high level of prior GIS experience on the effectiveness of the two DSS methods in increasing intent of flood risk management meeting participants to take action to reduce risk.

To analyze the effects of the two DSS methods on the intent of meeting participants to initiate flood risk-reduction actions using follow-up interview responses with participants' prior experience with GIS as a covariate, the SAS code for the GLIMMIX Procedure was:

```
PROC IMPORT OUT= WORK.a
      DATAFILE= "[insert Microsoft^TM workbook containing Data Table]"
      DBMS=EXCEL REPLACE;
      RANGE="[insert Microsoft^TM worksheet containing Data Table]$";
         GETNAMES=YES;
         MIXED=NO;
         SCANTEXT=YES;
         USEDATE=YES;
         SCANTIME=YES;
```

```
RUN;
proc print data=a; run;
proc glimmix data=a;
class method eu rep;
model iP1Q3i= method| GIS/dist=nb solution;
random method*rep;
lsmeans method/pdiff;
run;
```

Appendix Table 49 highlights the results of this analysis.

Appendix Table 49: Effects of computer-assisted decision support system (DSS) methods on initiation of flood risk-reduction actions as measured by interview responses to an open-ended question with participants' self-reported prior geographic information systems (GIS) experience as a covariate

Effect	P value two-tailed analysis	P value one-tailed analysis
DSS method	0.28	0.14
GIS	0.49	
GIS*DSS	0.50	

Legend:
DSS method = national GIS software DSS or stakeholder-built DSS method
GIS = participant's self-reported experience with geographic information systems (GIS) prior to the start of the flood risk management meeting: Level 0 = no prior GIS knowledge, Level 1 = some prior GIS knowledge, Level 2 = high level of prior GIS knowledge
GIS*DSS = interaction between the DSS method used and self-reported participants' prior experience with GIS

Because the interaction was not significant, that calculation was removed from the

analysis. The SAS code for the GLIMMIX Procedure was:

```
PROC IMPORT OUT= WORK.a
    DATAFILE= "[insert Microsoft^TM workbook containing Data Table]"
    DBMS=EXCEL REPLACE;
    RANGE="[insert Microsoft^TM worksheet containing Data Table]$";
        GETNAMES=YES;
        MIXED=NO;
        SCANTEXT=YES;
        USEDATE=YES;
        SCANTIME=YES;
    RUN;
    proc print data=a; run;
    proc glimmix data=a;
    class method eu rep;
```

```
model iP1Q3i= method GIS/dist=nb;
random method*rep;
lsmeans method/pdiff;
run;
```

Appendix Table 50 highlights the results of this analysis. Results indicate there

was no significant effect (P > 0.08) of the DSS method on the intent of meeting

participants to initiate risk-reduction actions. The participants' prior experience with

GIS had no significant effect on the follow-up interview responses (P > 0.68).

Appendix Table 50: Effects of computer-assisted decision support system (DSS)
methods on initiation of flood risk-reduction actions as measured by interview
responses to an open-ended question with participants' self-reported prior geographic
information system (GIS) experience as a covariate. Interaction calculation removed.

Effect	P value two-tailed analysis	P value one-tailed analysis
DSS method	0.19	0.09
GIS	0.69	

Legend:
DSS method = national GIS software DSS or stakeholder-built DSS method
GIS = self-reported participants' prior experience with geographic information
systems (GIS)

2. Data Analyses: Influence of meeting personnel variables on participants' intent to
   initiate risk-reduction actions

The influence of the individual serving as the meeting facilitator on the

effectiveness of the two DSS methods was analyzed. For this, the effects of the two DSS

methods on participants' intent to initiate flood risk-reduction actions were measured

using follow-up interview responses with the individual functioning as meeting

facilitator as a covariate. The SAS code for the GLIMMIX Procedure was:

```
PROC IMPORT OUT= WORK.a
      DATAFILE= "[insert Microsoft^{TM} workbook containing Data Table]"
      DBMS=EXCEL REPLACE;
      RANGE="[insert Microsoft^{TM} worksheet containing Data Table]$";
         GETNAMES=YES;
         MIXED=NO;
         SCANTEXT=YES;
         USEDATE=YES;
```

```
        SCANTIME=YES;
RUN;
proc print data=a; run;
proc glimmix data=a;
class facil method eu rep;
model iP1Q3i= method| facil/dist=nb solution;
random method*rep;
lsmeans method/pdiff;
run;
```

Appendix Table 51 highlights the results of this analysis.

Appendix Table 51: Effects of computer-assisted decision support system (DSS)
methods on intent of participants to initiate flood risk-reduction actions as measured by
interview responses to an open-ended question with the individual functioning as the
meeting facilitator as a covariate

Effect	P value two-tailed analysis	P value one-tailed analysis
DSS method	0.24	0.12
facilitator	0.75	
facilitator *DSS	0.51	

Legend:
DSS method = national GIS software DSS or stakeholder-built DSS method
facilitator = individual serving as meeting facilitator
facilitator *DSS = interaction between the DSS method used and the individual serving as meeting facilitator

Because the interaction was not significant ($P > 0.23$), that calculation was removed

from the analysis. The SAS code for the GLIMMIX Procedure was:

```
PROC IMPORT OUT= WORK.a
      DATAFILE= "[insert Microsoft^TM workbook containing Data Table]"
      DBMS=EXCEL REPLACE;
      RANGE="[insert Microsoft^TM worksheet containing Data Table]$";
         GETNAMES=YES;
         MIXED=NO;
         SCANTEXT=YES;
         USEDATE=YES;
         SCANTIME=YES;
      RUN;
      proc print data=a; run;
      proc glimmix data=a;
      class facil method eu rep;
      model iP1Q3i= method facil/dist=nb;
      random method*rep;
      lsmeans method/pdiff;
```

run;

Appendix Table 52 highlights the results of this analysis. Results indicate there was no

significant effect (P > 0.13) of the DSS method on the intent of meeting participants to

initiate risk-reduction actions. The individual functioning as the meeting facilitator had

no significant effect on the follow-up interview responses (P > 0.76).

Appendix Table 52: Effects of computer-assisted decision support system (DSS)
methods on intent of participants to initiate flood risk-reduction actions as measured by
interview responses to an open-ended question with the individual functioning as the
meeting facilitator as a covariate. Interaction calculation removed.

Effect	P value two-tailed analysis	P value one-tailed analysis
DSS method	0.28	0.14
facilitator	0.77	
Legend: DSS method = national geographic information systems (GIS) software DSS or stakeholder-built DSS method facilitator = individual serving as meeting facilitator		

The influence of the individual serving as the meeting geographic information

systems (GIS) technician on the effectiveness of the two DSS methods was analyzed.

For this, the effects of the two DSS methods on participants' intent to initiate flood risk-

reduction actions were measured using follow-up interview responses with the

individual functioning as meeting GIS technician as a covariate. The SAS code for the

GLIMMIX Procedure was:

```
PROC IMPORT OUT= WORK.a
        DATAFILE= "[insert Microsoft™ workbook containing Data Table]"
        DBMS=EXCEL REPLACE;
        RANGE="[insert Microsoft™ worksheet containing Data Table]$";
          GETNAMES=YES;
          MIXED=NO;
          SCANTEXT=YES;
          USEDATE=YES;
          SCANTIME=YES;
        RUN;
        proc print data=a; run;
        proc glimmix data=a;
```

```
class tech method eu rep;
model iP1Q3i= method| tech/dist=nb solution;
random method*rep;
lsmeans method/pdiff;
run;
```

Appendix Table 53 highlights the results of this analysis. Results indicate there was no significant effect (P > 0.33) of the DSS method on the intent of meeting participants to initiate risk-reduction actions. The individual functioning as the meeting GIS technician had no significant effect on the follow-up interview responses (P > 0.86). The sample size was not large enough to measure the effects of interaction between the DSS methods and the individual serving as the meeting GIS technician.

Appendix Table 53: Effects of computer-assisted decision support system (DSS) methods on intent of participants to initiate flood risk-reduction actions as measured by interview responses to an open-ended question with the individual functioning as the meeting geographic information systems (GIS) technician as a covariate

Effect	P value two-tailed analysis	P value one-tailed analysis
DSS method	0.67	0.34
GIS technician	0.87	
Legend: DSS method = national GIS software DSS or stakeholder-built DSS method GIS technician = individual serving as meeting geographic information systems (GIS) technician		

The influence of the number of meeting assistants available during the meeting on the effectiveness of the two DSS methods was analyzed. For this, the effects of the two DSS methods on participants' intent to initiate flood risk-reduction actions were measured using follow-up interview responses with the number of meeting assistants available during the meeting as a covariate. The SAS code for the GLIMMIX Procedure was:

```
PROC IMPORT OUT= WORK.a
        DATAFILE= "[insert Microsoft™ workbook containing Data Table]"
```

```
        DBMS=EXCEL REPLACE;
        RANGE="[insert Microsoft^TM worksheet containing Data Table]$";
           GETNAMES=YES;
           MIXED=NO;
           SCANTEXT=YES;
           USEDATE=YES;
           SCANTIME=YES;
        RUN;
        proc print data=a; run;
        proc glimmix data=a;
        class assist method eu rep;
        model iP1Q3i= method| assist/dist=nb solution;
        random method*rep;
        lsmeans method/pdiff;
        run;
```

Appendix Table 54 highlights the results of this analysis.

Appendix Table 54: Effects of computer-assisted decision support system (DSS) methods on intent of participants to initiate flood risk-reduction actions as measured by interview responses to an open-ended question with the number of meeting assistants available during the meeting as a covariate

Effect	P value two-tailed analysis	P value one-tailed analysis
DSS method	0.27	0.14
# of assistants	0.28	0.14
# of assistants *DSS	0.19	

Legend:
DSS method = national geographic information systems (GIS) software DSS or stakeholder-built DSS method
# of assistants = the number of meeting assistants available during the meeting
# of assistants *DSS = interaction between the DSS method used and the number of meeting assistants available during the meeting

Because the interaction was not significant ($P > 0.18$), that calculation was removed

from the analysis. The SAS code for the GLIMMIX Procedure was:

```
PROC IMPORT OUT= WORK.a
        DATAFILE= "[insert Microsoft^TM workbook containing Data Table]"
        DBMS=EXCEL REPLACE;
        RANGE="[insert Microsoft^TM worksheet containing Data Table]$";
           GETNAMES=YES;
           MIXED=NO;
           SCANTEXT=YES;
           USEDATE=YES;
           SCANTIME=YES;
```

```
RUN;
proc print data=a; run;
proc glimmix data=a;
class assist method eu rep;
model iP1Q3i= method assist/dist=nb;
random method*rep;
lsmeans method/pdiff;
run;
```

Appendix Table 55 highlights the results of this analysis. Results indicate there was no

significant effect (P > 0.09) of the DSS method on the intent of meeting participants to

initiate risk-reduction actions. The number of meeting assistants available during the

meeting had no significant effect on the follow-up interview responses (P > 0.12).

Appendix Table 55: Effects of computer-assisted decision support system (DSS)
methods on intent of participants to initiate flood risk-reduction actions as measured by
interview responses to an open-ended question with the number of meeting assistants
available during the meeting as a covariate. Interaction calculation removed.

Effect	P value two-tailed analysis	P value one-tailed analysis
DSS method	0.20	0.10
# of assistants	0.26	0.13
Legend: DSS method = national geographic information systems (GIS) software DSS or stakeholder-built DSS method # of assistants = the number of meeting assistants available during the meeting		

The influence of the presence of a municipal planning department representative

during the meeting on the effectiveness of the two DSS methods was analyzed. For this,

the effects of the two DSS methods on participants' intent to initiate flood risk-reduction

actions were measured using follow-up interview responses with the presence of a

municipal planning department representative during the meeting as a covariate. The

SAS code for the GLIMMIX Procedure was:

```
PROC IMPORT OUT= WORK.a
      DATAFILE= "[insert Microsoft™ workbook containing Data Table]"
      DBMS=EXCEL REPLACE;
      RANGE="[insert Microsoft™ worksheet containing Data Table]$";
         GETNAMES=YES;
         MIXED=NO;
```

```
      SCANTEXT=YES;
      USEDATE=YES;
      SCANTIME=YES;
   RUN;
   proc glimmix data=a;
   class method CityCo eu rep;
   model iP1Q3i= method| CityCo/dist=nb solution;
   random method*rep;
   lsmeans method/pdiff;
   run;
```

Appendix Table 56 highlights the results of this analysis.

Appendix Table 56: Effects of computer-assisted decision support system (DSS)
methods on intent of participants to initiate flood risk-reduction actions as measured by
interview responses to an open-ended question with the presence of a municipal
planning department representative during the meeting as a covariate

Effect	P value two-tailed analysis	P value one-tailed analysis
DSS method	0.29	0.15
CityCo	0.31	0.16
CityCo*DSS	0.79	

Legend: DSS method = national geographic information systems (GIS) software DSS or stakeholder-built DSS method CityCo = the presence of a municipal planning department representative during the meeting CityCo *DSS = interaction between the DSS method used and the presence of a municipal planning department representative during the meeting

Because the interaction was not significant (P > 0.78), that calculation was removed

from the analysis. The SAS code for the GLIMMIX Procedure was:

```
PROC IMPORT OUT= WORK.a
      DATAFILE= "[insert Microsoft™ workbook containing Data Table]"
      DBMS=EXCEL REPLACE;
      RANGE="[insert Microsoft™ worksheet containing Data Table]$";
        GETNAMES=YES;
        MIXED=NO;
        SCANTEXT=YES;
        USEDATE=YES;
        SCANTIME=YES;
      RUN;
      proc glimmix data=a;
      class method CityCo eu rep;
```

```
model iP1Q3i= method CityCo/dist=nb;
random method*rep;
lsmeans method/pdiff;
run;
```

Appendix Table 57 highlights the results of this analysis. Results indicate there was no

significant effect (P > 0.13) of the DSS method on the intent of meeting participants to

initiate risk-reduction actions. The presence of a municipal planning department

representative during the meeting had no significant effect on the follow-up interview

responses (P > 0.14).

Appendix Table 57: Effects of computer-assisted decision support system (DSS) methods on intent of participants to initiate flood risk-reduction actions as measured by interview responses to an open-ended question with the presence of a municipal planning department representative during the meeting as a covariate. Interaction calculation removed.

Effect	P value two-tailed analysis	P value one-tailed analysis
DSS method	0.28	0.14
CityCo	0.29	0.15

Legend:
DSS method = national geographic information systems (GIS) software DSS or stakeholder-built DSS method
CityCo = the presence of a municipal planning department representative during the meeting

3. Data Analyses: Influence of the characteristics of the meeting facility on participants' intent to initiate risk-reduction actions

The influence of the location of the meeting facility on the effectiveness of the

two DSS methods was analyzed. For this, the effects of the two DSS methods on

participants' intent to initiate flood risk-reduction actions were measured using follow-

up interview responses with the location of the meeting facility as a covariate. The SAS

code for the GLIMMIX Procedure was:

```
PROC IMPORT OUT= WORK.a
    DATAFILE= "[insert Microsoft^TM workbook containing Data Table]"
    DBMS=EXCEL REPLACE;
    RANGE="[insert Microsoft^TM worksheet containing Data Table]$";
```

```
        GETNAMES=YES;
        MIXED=NO;
        SCANTEXT=YES;
        USEDATE=YES;
        SCANTIME=YES;
    RUN;
    proc glimmix data=a;
    class method place eu rep;
    model iP1Q3i= method| place/dist=nb solution;
    random method*rep;
    lsmeans method/pdiff;
    run;
```

Appendix Table 58 highlights the results of this analysis. Results indicate there was no

significant effect ($P > 0.18$) of the DSS method on the intent of meeting participants to

initiate risk-reduction actions. The location of the meeting facilities had no significant

effect on the follow-up interview responses ($P > 0.85$) and there was no significant

interaction between the DSS method and the location of the meeting facilities ($P > 0.10$).

Appendix Table 58: Effects of computer-assisted decision support system (DSS)
methods on intent of participants to initiate flood risk-reduction actions as measured by
interview responses to an open-ended question with the location of the meeting facilities
as a covariate

Effect	P value two-tailed analysis	P value one-tailed analysis
DSS method	0.38	0.19
Location	0.86	
Location*DSS	0.11	

Legend:
DSS method = national geographic information systems (GIS) software DSS or stakeholder-built DSS method
Location = the location of the meeting facilities
Location*DSS = interaction between the DSS method used and the location of the meeting facilities

The influence of the quality of the meeting facility on the effectiveness of the

two DSS methods was analyzed. For this, the effects of the two DSS methods on

participants' intent to initiate flood risk-reduction actions were measured using follow-

up interview responses with the quality of the meeting facility as a covariate. The SAS

code for the GLIMMIX Procedure was:

```
PROC IMPORT OUT= WORK.a
      DATAFILE= "[insert Microsoft™ workbook containing Data Table]"
      DBMS=EXCEL REPLACE;
      RANGE="[insert Microsoft™ worksheet containing Data Table]$";
         GETNAMES=YES;
         MIXED=NO;
         SCANTEXT=YES;
         USEDATE=YES;
         SCANTIME=YES;
      RUN;
      proc glimmix data=a;
      class method room eu rep;
      model iP1Q3i= method| room/dist=nb solution;
      random method*rep;
      lsmeans method/pdiff;
      run;
```

Appendix Table 59 highlights the results of this analysis.

Appendix Table 59: Effects of computer-assisted decision support system (DSS) methods on intent of participants to initiate flood risk-reduction actions as measured by interview responses to an open-ended question with the quality of the meeting facility as a covariate

Effect	P value two-tailed analysis	P value one-tailed analysis
DSS method	0.13	0.07
Room	0.15	
Room*DSS	0.15	

Legend:
DSS method = national geographic information systems (GIS) software DSS or stakeholder-built DSS method
Room = the quality of the meeting facilities
Room*DSS = interaction between the DSS method used and the quality of the meeting facilities

Because the interaction was not significant ($P > 0.14$), that calculation was

removed from the analysis. The SAS code for the GLIMMIX Procedure was:

```
PROC IMPORT OUT= WORK.a
      DATAFILE= "[insert Microsoft™ workbook containing Data Table]"
      DBMS=EXCEL REPLACE;
```

```
        RANGE="[insert Microsoft^TM worksheet containing Data Table]$";
            GETNAMES=YES;
            MIXED=NO;
            SCANTEXT=YES;
            USEDATE=YES;
            SCANTIME=YES;
        RUN;
        proc glimmix data=a;
        class method room eu rep;
        model iP1Q3i= method room/dist=nb solutions;
        random method*rep;
        lsmeans method/pdiff;
        run;
```

Appendix Table 60 highlights the results of this analysis. Results indicate there was a

significant effect ($P < 0.01$) of the DSS method on the intent of meeting participants to

initiate risk-reduction actions when the quality of the facility was included in the

analysis as a covariate. The quality of the facility in which the meeting was held also

had a significant effect ($P < 0.02$). The stakeholder-built DSS method maximized the

performance of the meeting under all facility conditions.

Appendix Table 60: Effects of computer-assisted decision support system (DSS) methods on intent of participants to initiate flood risk-reduction actions as measured by interview responses to an open-ended question with the quality of the meeting facilities as a covariate. Interaction calculation removed.

Effect	method	room	Estimate	Standard Error	P value
method	national GIS software DSS		-1.03	0.35	0.03
method	stakeholder-built DSS		0	.	.
room		good	0.74	0.32	0.03
room		mid	1.55	0.50	0.007
room		poor	0	.	.

Effect	P value two-tailed analysis	P value one-tailed analysis
DSS method	0.03	0.01
room	0.02	

Legend:
DSS method = national geographic information systems (GIS) software DSS or stakeholder-built DSS method
room = quality of the facility in which meeting was held

good = air conditioning was comfortable, visibility of the presentation was good for all participants, and the acoustics were good for projecting the voice of the meeting facilitator throughout the room

mid = Some room conditions were good. Others were not.

poor = no air conditioning or poor circulation, visibility of the presentation was poor for some or all participants, and the acoustics were poor for projecting the voice of the meeting facilitator throughout the room.