Conveying Uncertainty to the Public:
How NWS and Media Attempt to Overcome Communication Challenges

Florida Governor’s Hurricane Conference
May 14, 2014
<table>
<thead>
<tr>
<th>Scientific term</th>
<th>Public meaning</th>
<th>Better choice</th>
</tr>
</thead>
<tbody>
<tr>
<td>enhance</td>
<td>improve</td>
<td>intensify, increase</td>
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<tr>
<td>aerosol</td>
<td>spray can</td>
<td>tiny atmospheric particle</td>
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<td>positive trend</td>
<td>good trend</td>
<td>upward trend</td>
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<td>positive feedback</td>
<td>good response, praise</td>
<td>vicious cycle, self-reinforcing cycle</td>
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<td>theory</td>
<td>hunch, speculation</td>
<td>scientific understanding</td>
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<td>uncertainty</td>
<td>ignorance</td>
<td>range</td>
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<td>error</td>
<td>mistake, wrong, incorrect</td>
<td>difference from exact true number</td>
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<td>bias</td>
<td>distortion, political motive</td>
<td>offset from an observation</td>
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<tr>
<td>sign</td>
<td>indication, astrological sign</td>
<td>plus or minus sign</td>
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<td>values</td>
<td>ethics, monetary value</td>
<td>numbers, quantity</td>
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<tr>
<td>manipulation</td>
<td>illicit tampering</td>
<td>scientific data processing</td>
</tr>
<tr>
<td>scheme</td>
<td>devious plot</td>
<td>systematic plan</td>
</tr>
<tr>
<td>anomaly</td>
<td>abnormal occurrence</td>
<td>change from long-term average</td>
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</table>
No Forecast is Perfect, But No Excuse

• General public and decision-makers need the most accurate information possible days before a storm arrives.
• Forecast accuracy can be quite low even in the 2-3 day range when important decisions need to be made.
• Nevertheless, meteorologists are responsible for conveying the likelihood of a particular event occurring in clear and concise language.
Using Probabilistic Information to Convey Level of Confidence

- Probabilities can help in conveying highly uncertain meteorological information in a way that is **USEFUL**, **RELEVANT** and **UNDERSTOOD** to the user.

- However...
- Converting probabilistic data to language people can understand and apply. Have to avoid only using probabilities. Values have to have a meaning.

(Ex. *40% chance of hurricane force winds* = *HURRICANE CONDITIONS EXPECTED*).

- Communication to users via diverse methods and formats.
Workshop Format

• **Rob Molleda** (Warning Coordination Meteorologist) from NWS Miami will speak on ways the NWS is using probabilistic data to convey a clear and informative message.

• **Bryan Norcross** (Senior Hurricane Specialist) and **Michael Lowry** (Hurricane Specialist/Storm Surge Expert) from The Weather Channel will offer their experience and expertise in conveying hurricane information to TV viewers.
NWS Efforts in Conveying a Clear and Informative Message

2014 Florida Governor’s Hurricane Conference

Rob Molleda
Warning Coordination Meteorologist
NWS Miami/South Florida Forecast Office
Lots of Information

• Each piece of information has a meaning and purpose, but what does it mean to someone who has to make a decision?
Cone of Uncertainty

- Size of cone is determined by average 5-year track error.
- Statistically, it is the area that has a 2 in 3 chance of the storm’s center moving over.
- One size fits all
Bottom Line: The cone *only* depicts probable track of the *center* of the tropical cyclone.

- It says nothing about wind impacts
- It says nothing about storm surge impacts
- It says nothing about rainfall and/or flooding impacts
- It says nothing about tornado impacts
- It says nothing about rip currents and waves
Probabilities Can Help

- Based on thousands of “scenarios” which produce a range of possibilities.
- Reflect % of scenarios which produce the indicated condition (e.g. TS force winds).
- Take into account actual storm conditions.
Wind Speed Probabilities

- Can be used as decision making aid by planners. Available in various forms aimed to answer specific questions.
- Provide objective measure of uncertainty that can be used to create new targeted products.
- Used to enhance forecast information during tropical cyclones (Expressions of Uncertainty).
Probabilities Can Help

Even here...probabilities have to be explained and translated into clear and common language.

How do we do this?
Tropical Cyclone Potential Impact Graphics

- Provides information on what to prepare for in clear, non-scientific language.
- Based on latest storm information and accounts for range of potential scenarios. Reasonable amount of error built in.
Tropical Cyclone Potential Impact Graphics

- Available on weather.gov within 30-45 minutes of NHC and local NWS office tropical storm/hurricane advisories. In .png and .kml formats.

- Local and regional scale.

- Describes level and extent of potential impact (what to prepare for) for each storm hazard: WIND, SURGE, FLOODING, TORNADOES.
Potential Impact Graphics

Potential Tropical Cyclone Impacts (TCI) -- Experimental

**Potential for Extreme Impact:** Aggressive preparations should be made for the threat of catastrophic wind damage. If realized, expect structural damage to buildings, with some having complete wall and roof failures. Complete destruction of mobile homes. Numerous large signs and trees blown down. Numerous roads impassable due to large debris. Many bridges and other access routes to/from barrier islands also impassable. Widespread power outages. Descriptions are consistent with damage caused by major hurricane force winds of Category 5, 4, or 5 intensity (e.g., sustained winds 111 mph or greater) in hardest hit places.

**Potential for High Impact:** Aggressive preparations should be made for the threat of major wind damage. If realized, expect significant damage to roofing material, siding, doors, fences, and windows of buildings, but with some occurrences of structural damage. Considerable damage to mobile homes. Many large signs and trees blown down with further damage to standing trees. Many roads impassable due to large debris. Several bridges and other access routes to/from barrier islands also impassable. Widespread power outages. Descriptions are consistent with damage caused by strong hurricane force winds of Category 2 intensity (e.g., sustained winds 96 to 110 mph) in hardest hit places.

**Potential for Moderate Impact:** Preparations should be made for the threat of moderate wind damage. If realized, expect significant damage to mobile homes, especially if unanchored. Some damage to roofing material, siding, doors, fences, and windows of buildings. Several large signs and trees blown down, especially shallow-rooted and diseased trees. Some roads impassable due to large debris. Scattered power outages, but widespread in areas with above ground lines. Descriptions are consistent with damage caused by hurricane force winds of Category 1 intensity (e.g., sustained winds 74 to 95 mph) in hardest hit places.

**Potential for Low but Concerning Impact:** Preparations should be made for the threat of minor to locally moderate wind damage. If realized, expect damage to unanchored mobile homes, porches, carports, and awnings along with some damage to shingles and siding. Large branches broken off trees, but several shallow-rooted and diseased trees blown down. Unsecured light-weight objects easily blown about and become dangerous projectiles. Dangerous driving conditions on bridges and other elevated roadways, especially for high profile vehicles. A few roads impassable due to large debris. Scattered power outages, especially in areas with above ground lines. Descriptions are consistent with damage caused by tropical storm force winds (e.g., sustained winds 39 to 73 mph) in hardest hit places.

**Potential for Little to No Impact:** Preparations are not needed as appreciable damage is unlikely. However, breezy to windy conditions may still occur.
Tropical Cyclone Potential Impact Graphics

Available in .png and .kml formats
Potential for High Impact: Aggressive preparations should be made for the threat of major inland flood damage from heavy rain. If realized, expect several inland locations to experience major fresh water flooding with highest (flash) flood waters capable of causing rivers and tributaries to overflow their banks in multiple places. Small streams, creeks, canals, and ditches become dangerous rivers. Widespread rapid inundation covers both primary and secondary roads. Streets and parking lots become rivers of moving water. Storm drains and retention ponds overflow. Flood waters may affect buildings and homes and could prompt many evacuations and road closures. Rescues may be necessary. Descriptions are consistent with damage caused by heavy rain where highest totals well exceed amounts conducive for (flash) flooding.
Potential Impact Graphics

Experimental
TROPICAL CYCLONE IMPACTS - DECISION SUPPORT

Combined Hazards Threat Graphic for
Graphic for THIS IS A TEST
Graphic last updated 20-Jul-2012 1:37 PM EDT
Be Sure to Refresh your Browser

Tropical Cyclone Hazards Potential Impacts
Specific to South Florida

Storm: THIS IS A TEST.
Issued: July 20, 2012
KML version Imported into Google Earth
Clicking on a point on the map brings up the potential impact description for that particular location (in this example, South Beach).

Click on colors on image for a description of potential impacts.

**Potential Impact - Moderate**

**Threat** - A significant threat to life and property, the likelihood for combined storm surge and astronomical tide resulting in sea water inundation of 4 to 6 feet.

**Minimum Action** - Prepare for the likelihood of moderate coastal flood damage.

**Potential Impact** - A moderate impact to communities in the specified area. If realized, people within the threatened areas who failed to heed official evacuation orders will have needlessly placed their lives in danger. Coastal flood waters capable of causing major beach erosion. Several coastal communities will likely be damaged, with structures not raised or protected by a seawall being subject to significant flooding, especially during high tide. Surge and tide waters accentuated by wind waves breaching dunes and seawalls in some locations to result in structural damage to some shoreline buildings, mainly in historically vulnerable spots. A few sections of near-shore escape roads weakened or washed out, especially in historically vulnerable low spots. Damage to marinas, docks, and piers. Some small craft broken away from moorings, especially in unprotected anchorages.

**Lake Okeechobee Surge Impact** - A storm surge which combined with current lake level could possibly result in total lake water level of 20 to 25 feet. No impact expected inside dike protection. Likelihood of major impact outside dike with Kreamer, Tony, Ritta, and Observation Islands, as well as areas around the Pahokee Recreational Area, in the southeast and south end of the lake completely submerged. Islands around the Okeee Tantle Recreation Area near the mouth of the Kissimmee River completely submerged. Likelihood of some inundation outside dike protection on Curry Island, including portions of State Road 78 and secondary roads south of Lakeport.
Impact Graphics Imported into Google Earth

Potential Impact - High
Threat - A critical threat to life and property; the reasonable chance for highest rainfall totals to well exceed amounts conducive for (flash) flooding.

Minimum Action - Prepare for the possibility of major inland flooding.

Potential Impact - If realized, a high impact to communities within the specified area. Isolated locations may experience major inland flooding, among scattered locations of minor to considerable inland flooding. Widespread inundation of streets and roads, many becoming totally impassable. Water entering buildings, potentially causing significant damage. Considerable damage to crops.
Why These Graphics and Why are They Useful...

• With tropical storms and hurricanes, it’s all about **impacts**.
  – Helping people to execute their disaster plan according to the **potential impacts** for which they should be making responsible preparation.
  – Potential Impact Graphics depict the worst of all **plausible impacts and scenarios**.
  – This is NOT crying **wolf** or assuming the worst case of all scenarios.
Expected Vs Potential Impact

Consider this scenario:

Again, we have an idea of where and when, but what about WHAT?
Expected Vs Potential Impact

Expected Vs Potential

Wind Hazard
Applications

• Impact Graphics
  – Briefings
  – Can be used as decision making aid by planners.
  – Communicate to the public graphically degree of preparation needed.
  – Can be used by EM and Media along with NWS to help communicate the bottom line message to the public.

* Trend analysis of this information from advisory to advisory is also vital.
Question to Ponder...

• Which statement has more potential to mislead?

- There’s a 40% chance of hurricane conditions in the next 24 hours.

- Hurricane conditions are expected within the next 24 hours.

These mean essentially the same thing!!
• 72 hours before potential impact onset, the chance of tropical storm force winds near Lake Okeechobee is just under 30%.

• How is this conveyed in plain language?
Operational in 2014
Individual Probabilities Not Applied Uniformly

Pay particular attention to trends in probabilities over time. Also, a 30% chance of tropical storm force winds 72 hours out is a lot different than the same chance 12 hours before.
To access storm relevant information, click on an icon for an active storm. You will be presented with two options: 1) Access to current National Hurricane Center products on a given storm and 2) Access to information relative to your location in terms of threat and potential impacts to you. This information comes from your local National Weather Service Offices.

Note: Also, click anywhere on map to view your point and click forecast. Open in new tab and use same tab for any other point and click.
Note: Also, click anywhere on map to view your point and click forecast. Open in new tab and use same tab for any other point and click.
Thank You

Comments or Questions?

Robert.Molleda@noaa.gov
Florida Governor’s Hurricane Conference

Conveying Uncertainty to the Public

Bryan Norcross
May 14, 2014
What is CERTAIN?

What is UNCERTAIN?
Advisory Info

Certain or Uncertain?

TROPICAL STORM CHANTAL

5:00PM EDT

LAT: 15.2°N
LON: 63.7°W

270 MI SE OF SAN JUAN PUERTO RICO

WINDS: 65 mph
PRESSURE: 1006 mb
MOVING: WNW at 26 mph
Forecast Cone

Where is the center most likely to be?
## Wind Speed Odds
### The Uncertainty Factor

<table>
<thead>
<tr>
<th>Wind Range (mph)</th>
<th>12 hour for 2 AM Tue</th>
<th>24 hour for 2 PM Tue</th>
<th>36 hour for 2 AM Wed</th>
<th>48 hour for 2 PM Wed</th>
<th>72 hour for 2 PM Thu</th>
<th>96 hour for 2 PM Fri</th>
<th>120 hour for 2 PM Sat</th>
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</thead>
<tbody>
<tr>
<td>Dissipated</td>
<td>&lt;1%</td>
<td>1%</td>
<td>2%</td>
<td>3%</td>
<td>11%</td>
<td>28%</td>
<td>30%</td>
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<tr>
<td>Tropical Depression (&lt;39)</td>
<td>5%</td>
<td>8%</td>
<td>8%</td>
<td>13%</td>
<td>29%</td>
<td>38%</td>
<td>37%</td>
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<tr>
<td>Tropical Storm (39-73)</td>
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<td>78%</td>
<td>68%</td>
<td>57%</td>
<td>53%</td>
<td>32%</td>
<td>32%</td>
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<td>Hurricane (all categories)</td>
<td>4%</td>
<td>13%</td>
<td>23%</td>
<td>27%</td>
<td>7%</td>
<td>2%</td>
<td>1%</td>
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<td>- Category 1 (74-95)</td>
<td>3%</td>
<td>12%</td>
<td>19%</td>
<td>22%</td>
<td>7%</td>
<td>2%</td>
<td>1%</td>
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<td>- Category 2 (96-110)</td>
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<td>1%</td>
<td>3%</td>
<td>4%</td>
<td>1%</td>
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<td>- Category 4 (130-156)</td>
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<tr>
<td>- Category 5 (&gt;156)</td>
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<tr>
<td>Forecast Maximum Wind</td>
<td>50 mph</td>
<td>60 mph</td>
<td>65 mph</td>
<td>70 mph</td>
<td>50 mph</td>
<td>35 mph</td>
<td>35 mph</td>
</tr>
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</table>
The Shrinking Cone
More certain or less certain?
Impact Cone
Where will the winds blow?
Watches & Warnings
Certain or Uncertain?
Invest Areas
Uncertainty abounds
Pre-depression Systems
5-day development areas

Tropical Cyclone Formation Potential for the Five-Day Period Ending at 8:00 pm EDT 25 Sep 2012
Chance of Cyclone Formation in 5 Days:  
- Low < 30%
- Medium 30-50%
- High > 50%

X indicates current disturbance location; shading indicates potential formation area.
Storm Surge or Not
Storm Surge
Old: Height Above Normal Tide

“NORMAL” TIDE
Storm Surge

Old: Height Above Normal Tide

“NORMAL” TIDE
Storm Surge
New: Flooding Above the Highest Tide
New Storm Surge Forecast Map
Possible inundation areas

Potential Storm Surge Flooding*
Through 2 AM Friday August 24th - Advisory #X
- Blue: Up to 3 feet above ground
- Yellow: Greater than 3 feet above ground
- Orange: Greater than 6 feet above ground
- Red: Greater than 9 feet above ground

* Displayed flooding values indicate the water depth that has about a one-in-ten (10%) chance of being exceeded.
Storm Surge Maps
FAQ
New Storm Surge Forecast Map vs. Evacuation-Zone Maps

FAQ

What is the difference between the new storm surge forecast maps and the current evacuation maps?

The new storm surge forecast maps show areas where flooding is possible based on the specific storm model being used. Evacuation maps are based on historical data and population statistics for the area. The new storm surge maps are meant to provide a more dynamic view of the potential impact of a storm, while evacuation maps are more static and rely on past data.

Are evacuations advisable for everyone?

No, evacuations are not advisable for everyone. They are only recommended for people who live in areas that are expected to be flooded. It is important for people to follow the advice of local authorities and evacuate if they are told to do so.

Will the storm surge forecasts be updated?

Yes, the forecasts will be updated as new information becomes available. It is important for people to stay informed and be prepared for changes in the forecast.

What factors influence the accuracy of the forecasts?

The accuracy of the forecasts is influenced by many factors, including the size and strength of the storm, the location of the coast, and the topography of the land. It is important for people to pay attention to the forecasts and be prepared for the potential impact of a storm.