Operational Storm Surge Modeling/Forecasting at the National Hurricane Center

Jamie Rhome
Storm Surge Specialist
NHC Storm Surge Unit
Success

what people think it looks like
Operational Perspective
Forecast Uncertainty

NHC Official Intensity Error Trend
Atlantic Basin

![Graph showing forecast error trend over years for different time intervals. The graph compares the error for 24, 48, 72, 96, and 120 hours.](image)
Hurricane Advisory – Approximately 12 hr. before landfall

NHC TRACK ERROR 12 hr. OUT

133 mph, 933 mb.
Rmax = 25 mi (forecast)

Surge Based on NHC - 12 hr. Advisory
Actual Hurricane Track 30 mi. E of -12 hr. Advisory Forecast Track

TRACK FORECAST

ACTUAL TRACK

133 mph, 933 mb.
Surge Based on NHC Storm Best Track

R_{max} = 40 \text{ mi}
RMW = 25 mi., “Average” Size
Ensemble Products

- MOM
  - Worst case by storm category

- MEOW
  - Worst case by scenario

- Probabilistic
  - Storm-specific
### NHC’s Operational Timeline

<table>
<thead>
<tr>
<th>Time</th>
<th>Task/Duty</th>
</tr>
</thead>
<tbody>
<tr>
<td>T+0:00 (i.e. 0000, 0600, 1200, and 1800 UTC)</td>
<td>Forecast process begins</td>
</tr>
<tr>
<td>T+1:00</td>
<td>New hurricane model guidance (ATCF trackers) available</td>
</tr>
<tr>
<td>T+1:00-2:00</td>
<td>Working official forecast available from hurricane forecasters, initial storm surge simulations begin</td>
</tr>
<tr>
<td>T+2:00</td>
<td>NWS coordination call, initial storm surge guidance due</td>
</tr>
<tr>
<td>T+2:30-3:00</td>
<td>Final storm surge simulations and guidance due, psurge initiated</td>
</tr>
<tr>
<td>T+3:30</td>
<td>Psurge runs complete, product disseminated</td>
</tr>
<tr>
<td>T+3:00-6:00</td>
<td>Briefings, decision support</td>
</tr>
</tbody>
</table>

**Bottom line:** Storm surge models must run within the operational timeline to be useful.
Operational Modeling Requirements

- Properly incorporates meteorological uncertainty
  - ensemble or probabilistic
- Meets varying user needs
- Meets operational time constraints
  - provides an answer in minutes not hours
- Applicable over multiple storms and all areas
- Can be operated within current operational infrastructure
- Results can be easily disseminated through current operational channels/mechanisms
- Must be robust/stable!
NHC Storm Surge Unit

ncep.nhc.ssmia@noaa.gov
(305) 229-4448

Jamie Rhome
Dr. Cristina Forbes
Michael Lowry
Tarah Sharon
Jeff Pereira
William Booth

Website: http://www.nhc.noaa.gov/ssurge
Model Details:
- Explicit finite difference scheme
- 2-D
- Includes inland inundation (wetting/drying)
- Arakawa B grid
  - Can use polar, hyperbolic, or elliptical grids
  - Telescopic grids centered on area of interest allowing highest resolution near center
  - Sub-grid scale elements such as barriers and gaps

SLOSH does not explicitly resolve:
- Breaking waves/wave run-up (experimental SLOSH + SWAN being evaluated)
- Astronomical tide
  - Experimental SLOSH + tide currently being tested
- Normal river flow and rain
Concluding Remarks

- Deterministic approaches do not account for hurricane forecast uncertainty (track, intensity, size, forward speed) and are therefore of limited use for real-time forecasting at NHC.
- NHC wishes to produce total water level forecasts but currently lacks necessary guidance to do so.
  - Addition of waves especially desired but computationally expensive.
- Timeliness is critical.
  - Models must run in minutes, not hours, to fit within current operational time constraints.
Storm Surge Does Not Fit Into a Single Box

Storm surge/inundation

Atmospheric Sciences

Oceanography
SLOSH in the Pacific

Oahu

Kauai

Hawaii

Maui
Decision Support Wedge