Development of the Nearshore Wave Prediction System (NWPS)

OSIP 06-093

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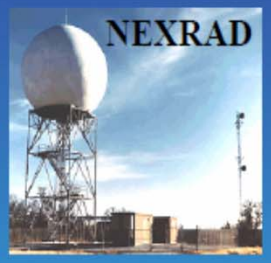
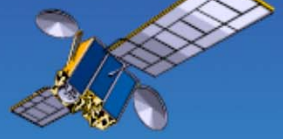
Outline

1. AWIPS and present NCEP wave products
2. Local high-resolution wave modeling system (NWPS)
3. Wave partitioning
4. Wave-current interaction
5. Development and verification
6. Conclusions

Background: Advanced Weather Interactive Processing System (AWIPS)



GOES/POES/NPOESS



169 separate AWIPS systems at
137 geographical locations

NCEP
Models

AWIPS
Communications

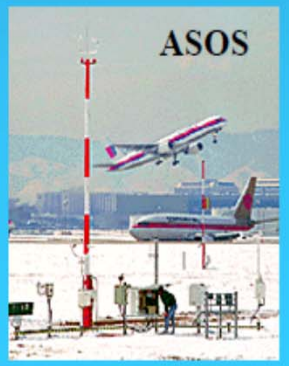
Warnings

Watches

Advisories

Forecasts

Buoys,
River Gauges



AWIPS Workstations and Servers

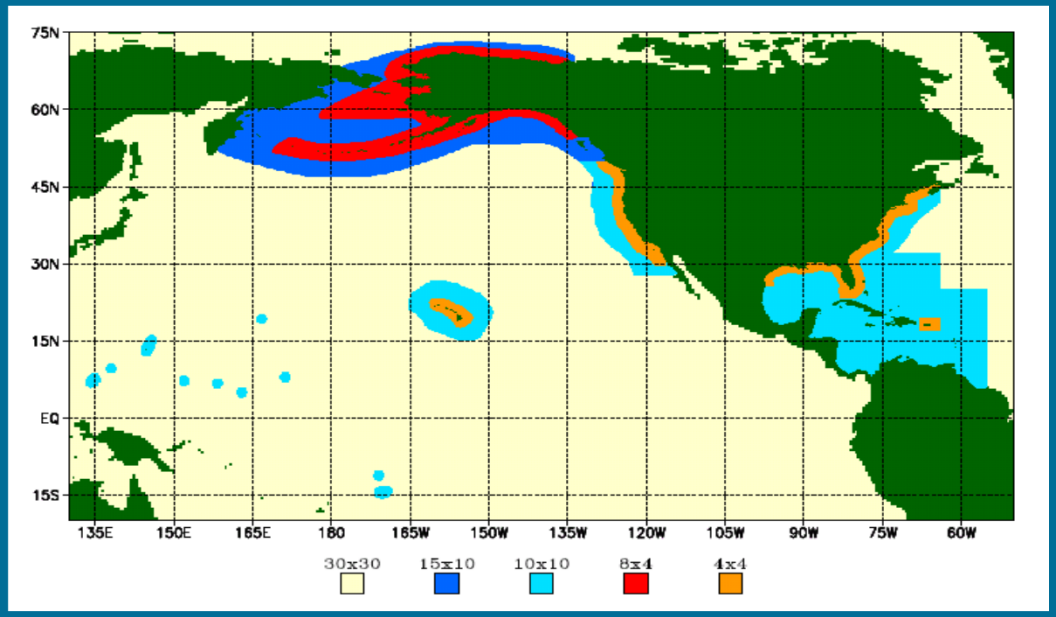
~900 Workstations (total)
~1200 Servers (total)

Service provided to
3066 US Counties
24 hrs/day,
365 days/yr.

Credit: Deirdre Jones (NWS/OST)

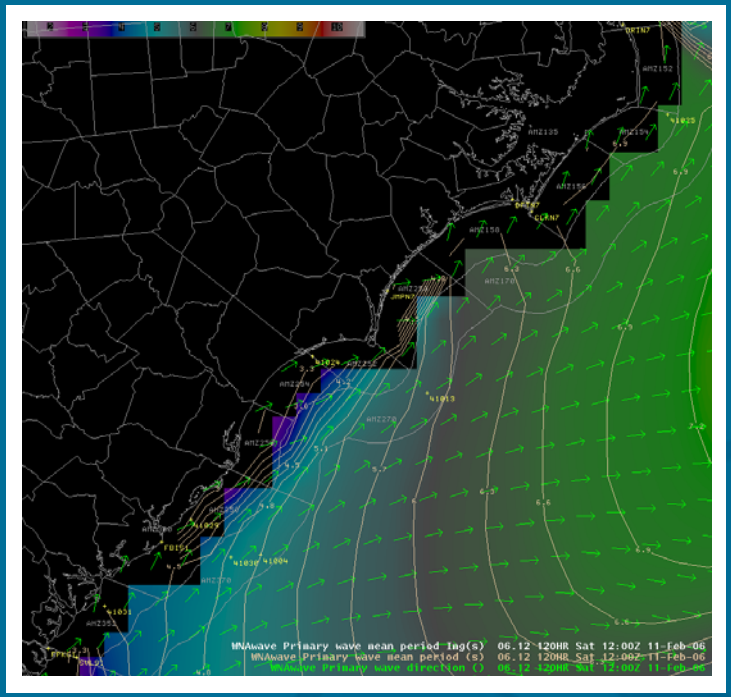
Present NCEP WWIII wave products

Current WWIII global grid mosaic



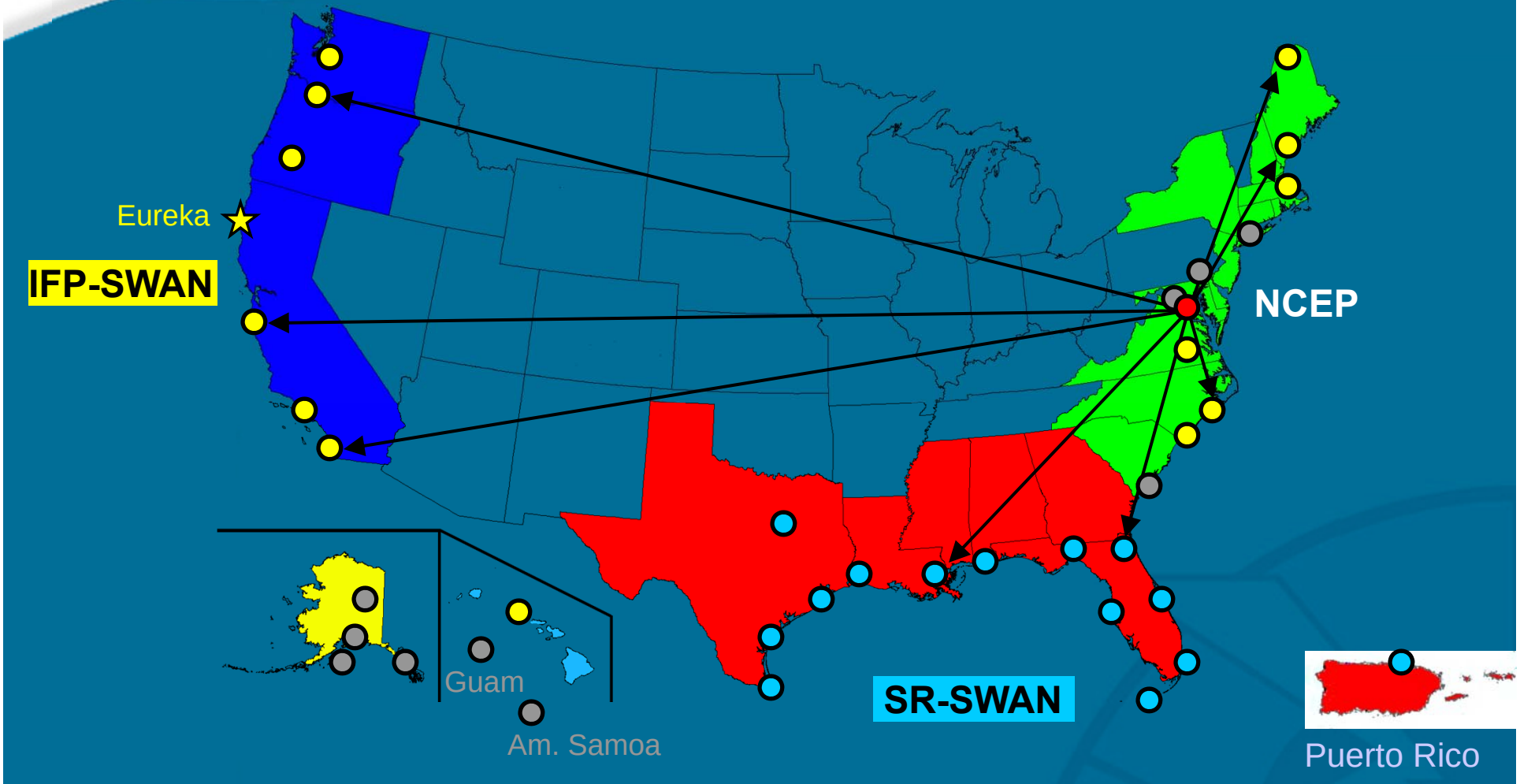
Max. coastal resolution = 4 arc min (7.5 km)

Desired nearshore application



Required nearshore resolution < 500 m

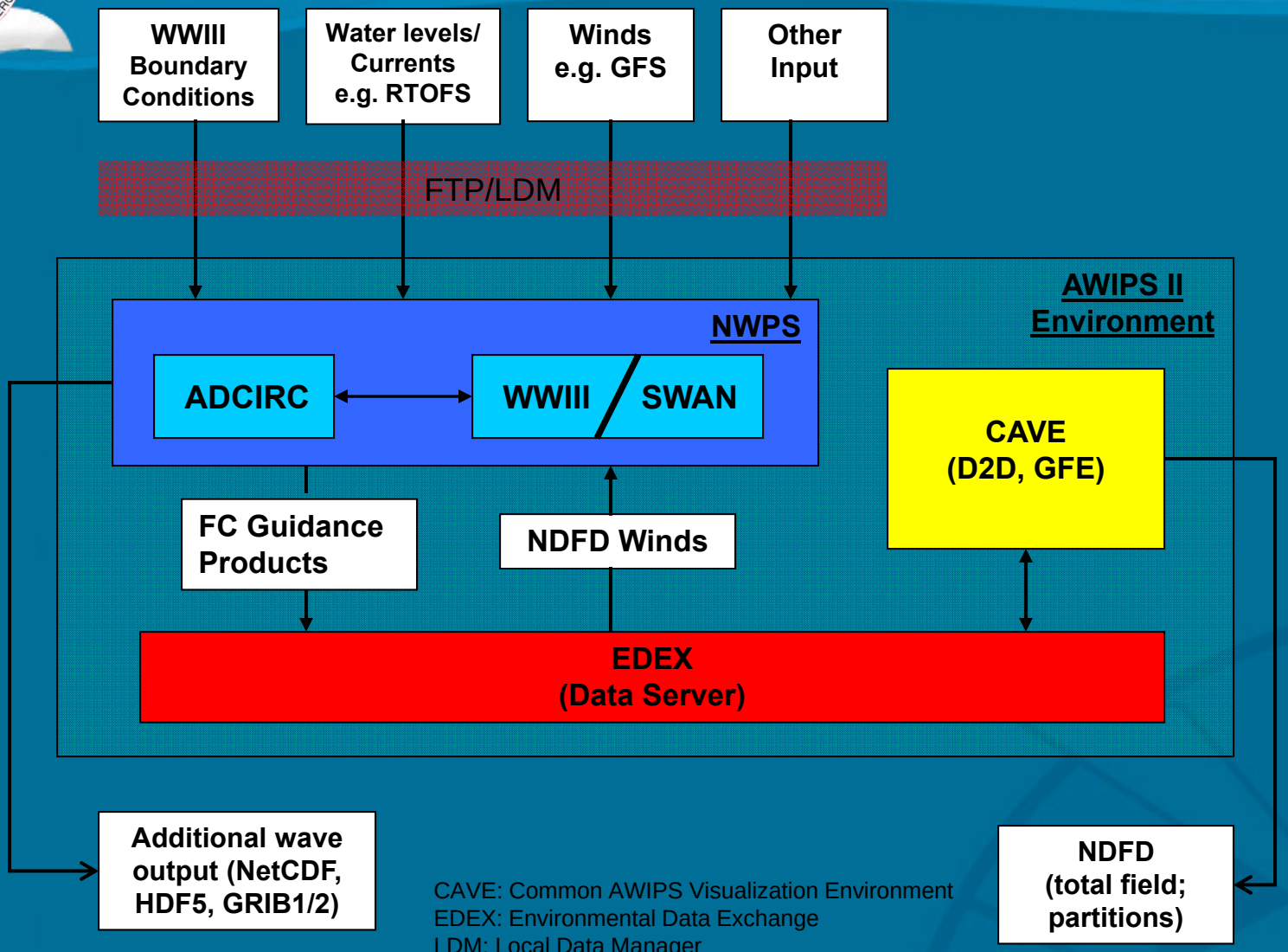
Decentralized nearshore computing



The Nearshore Wave Prediction System (NWPS)

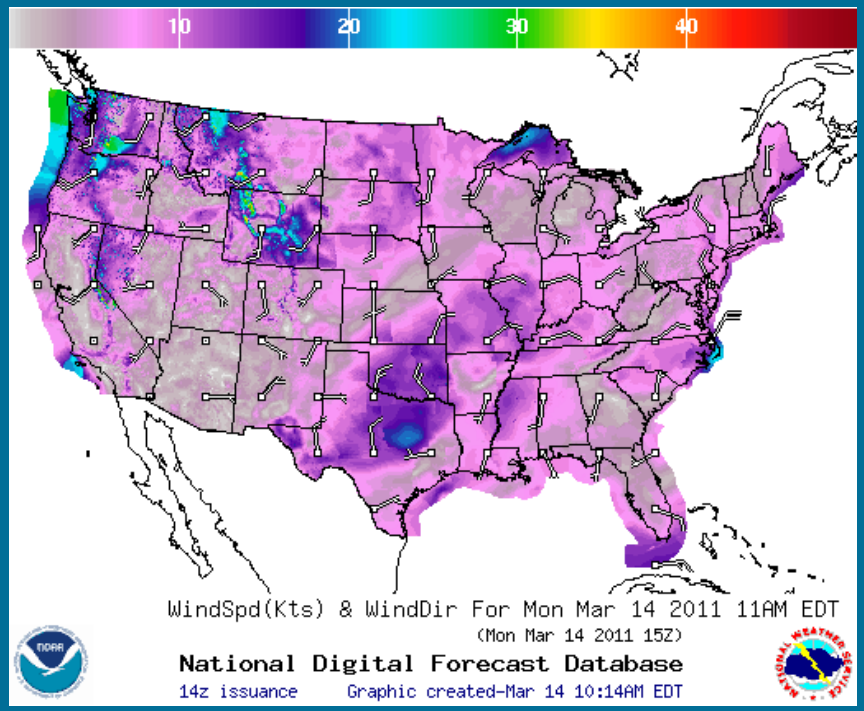
- Run locally, routinely/on-demand, using SWAN or nearshore WWIII
- Based on IFP-SWAN and SR-SWAN.
- Be included in the AWIPS II baseline for sustainability.
- Address regionally-specific high impact issues in the nearshore (surf breaking, wave-current interaction, etc.).
- Driven by forecaster-developed winds from GFE (AWIPS II), and external sources (e.g. WWIII, RTOFS/ESTOFS).
- Include wave partitioning to enable using output directly in the development of gridded wave forecasts.
- Future two-way coupling to coastal circulation model (ADCIRC).

NWPS system architecture

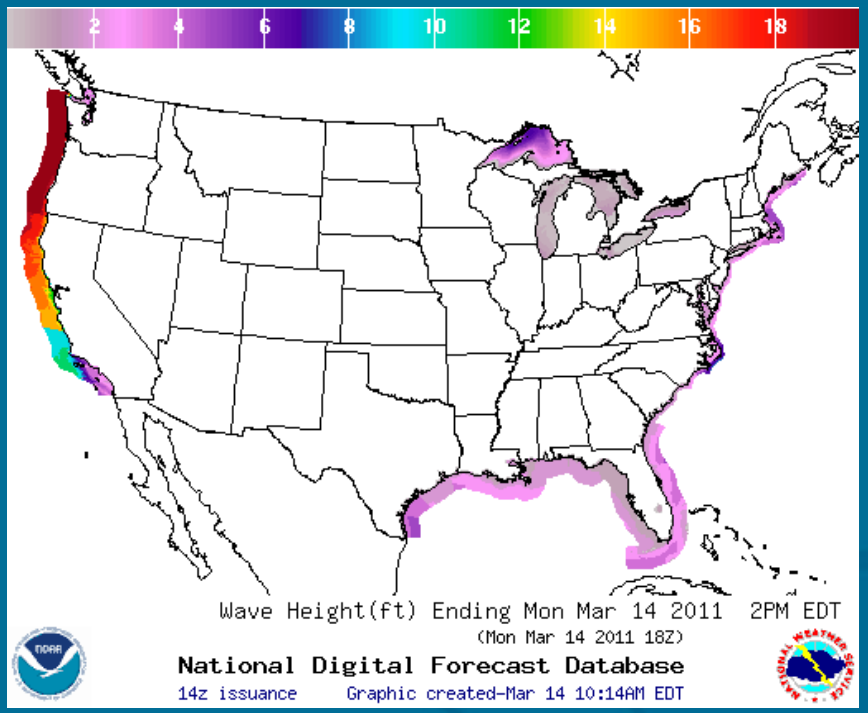


CAVE: Common AWIPS Visualization Environment
EDEX: Environmental Data Exchange
LDM: Local Data Manager

National Digital Forecast Database (NDFD)



Wind speed and direction (Kts) (CONUS region)

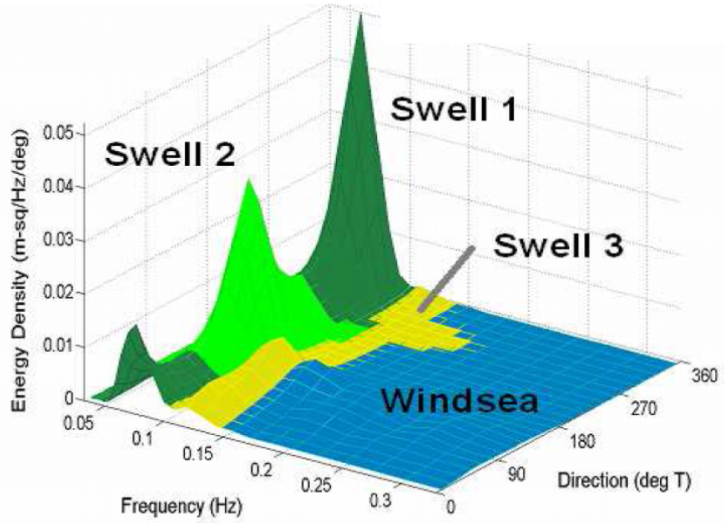


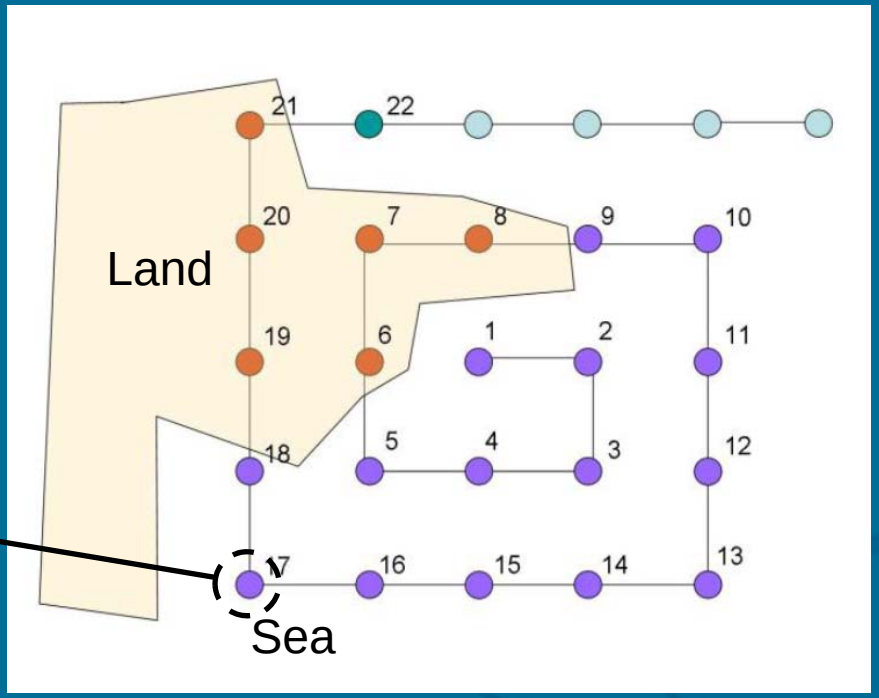
Significant wave height (ft)

Features: Wave partitioning

Hanson and Phillips (2001); Tracy et al. (2007); Devaliere et al. (2009)

Directional wave spectrum





- Partitioning in local geographic space
- Spatial and temporal tracking

Features: Wave partitioning (2)

Tracy et al. (2007)

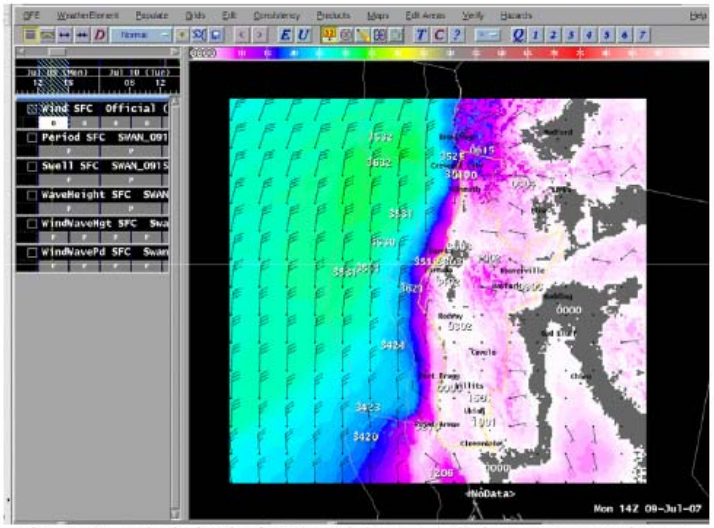
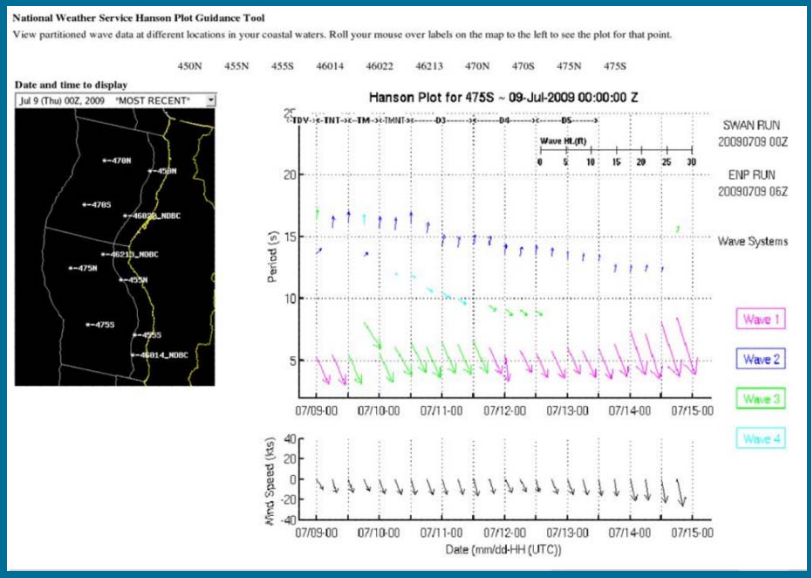


Figure 13. Wind plot (July 9, 2007) for area offshore from Eureka, CA



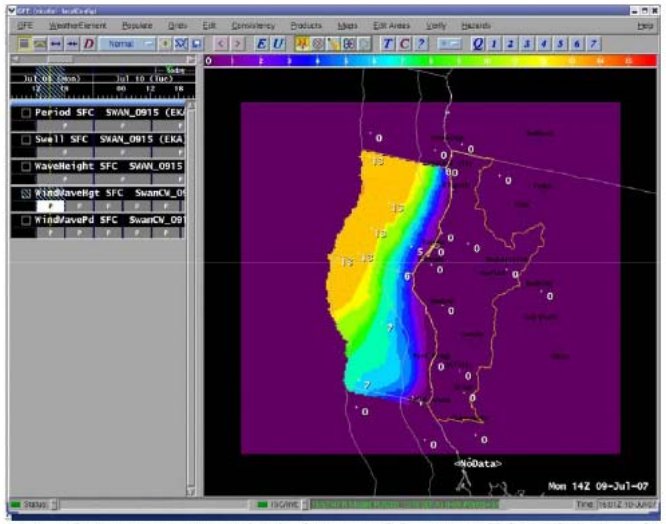


Figure 14. Wind wave contour plot (July 9, 2007) for area offshore from Eureka, CA.

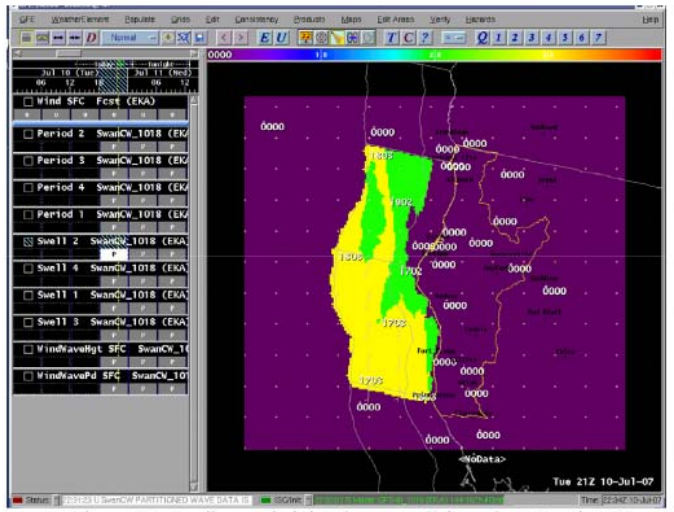
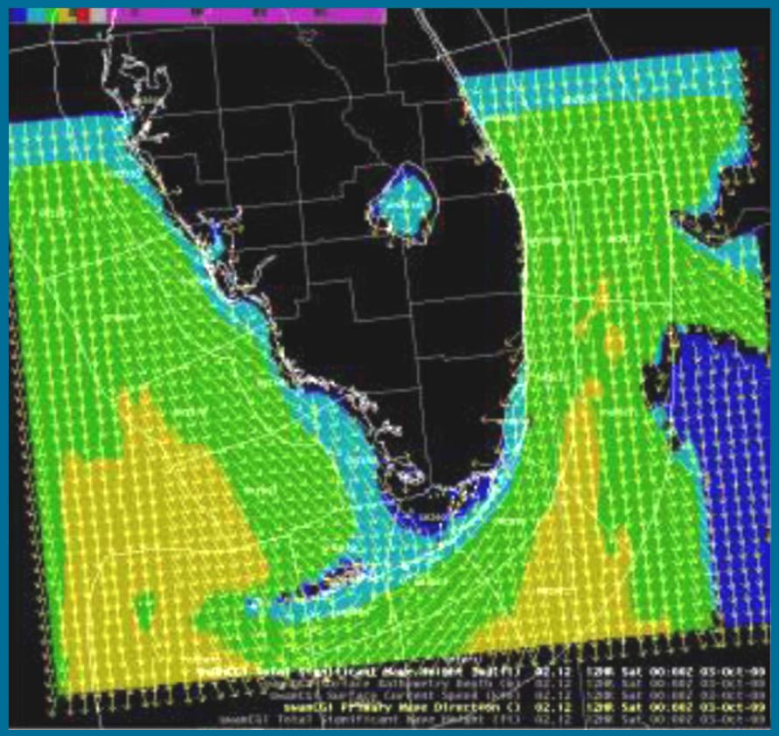


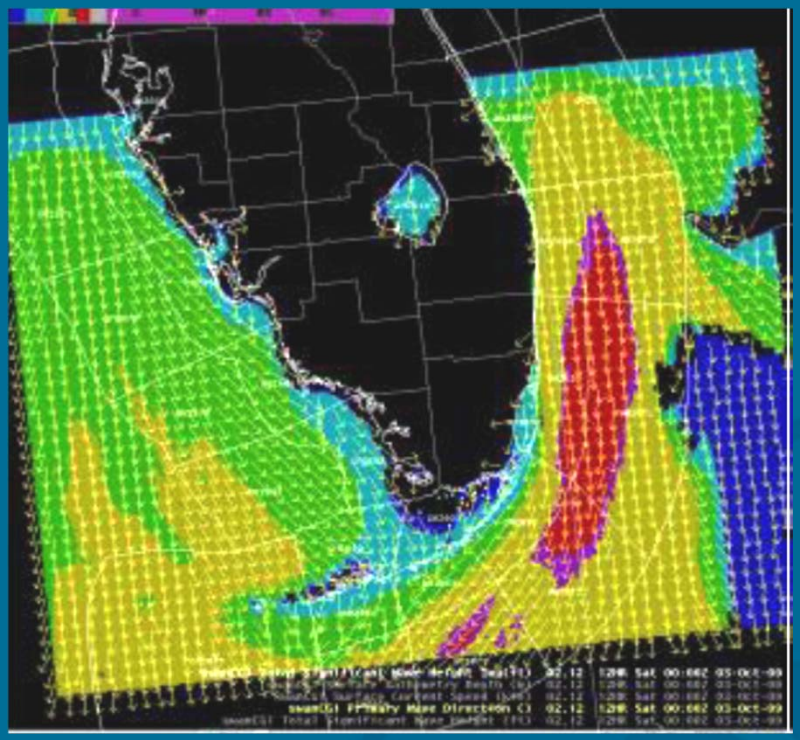
Figure 15. Swell wave heights for area offshore from Eureka, CA

Features: RTOFS water level and current ingest

Sign. wave height without Gulf Stream data



Sign. wave height with Gulf Stream data



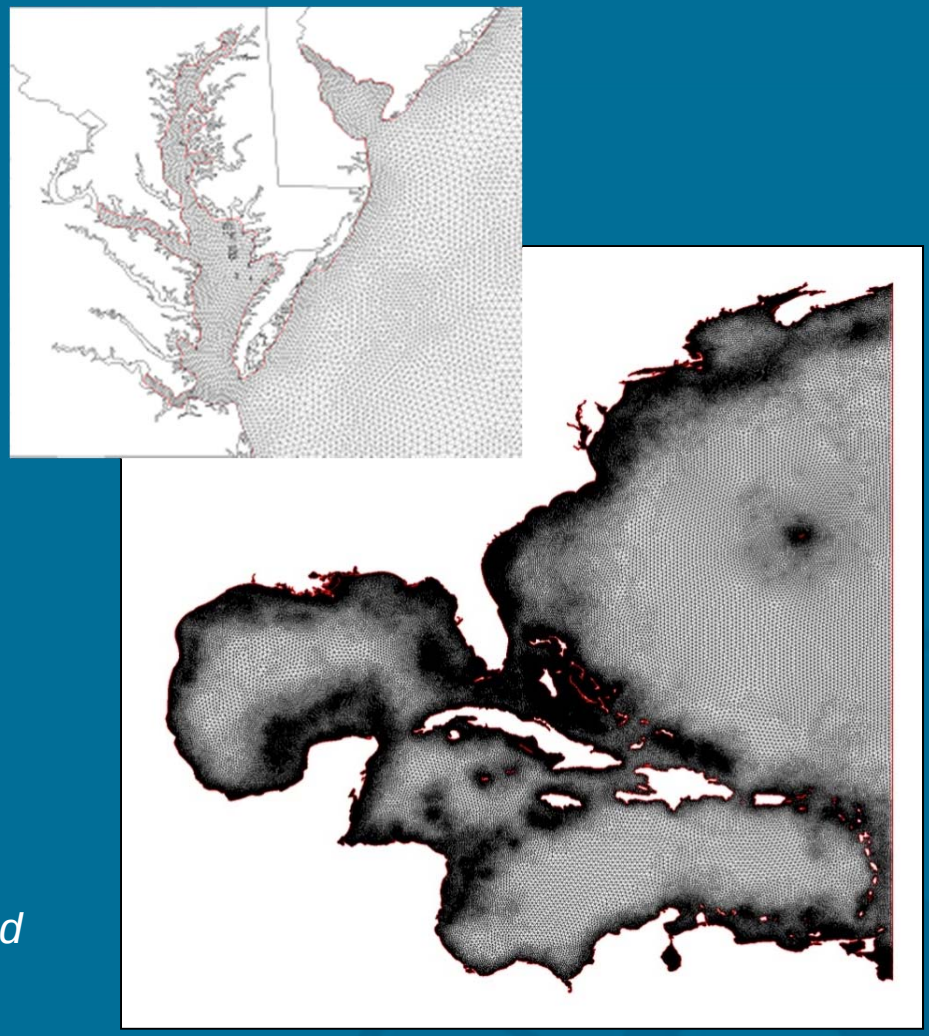
Future: Operational BCs from ESTOFS

(Funakoshi et al. 2010)

East Coast 2001 tidal database grid (EC2001)

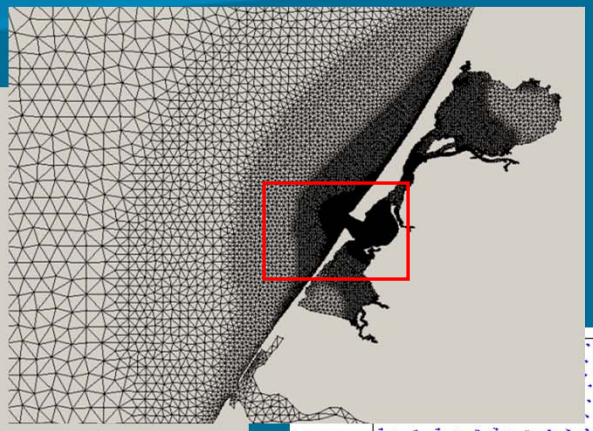
- **254,565 nodes**
- **Coastal resolution ≈ 3 km**
- **Specified the tidal boundary forcing at 60° W**
- **Previously adapted to produce EC2001_NOS tidal database**
  - *Update of EC2001 tidal database*
  - *Barotropic ADCIRC model*
  - *Tidal forcing from TPXO 6.2 global tide model*
  - *365 day run analyzed for NOS' primary suite of 37 constituents*

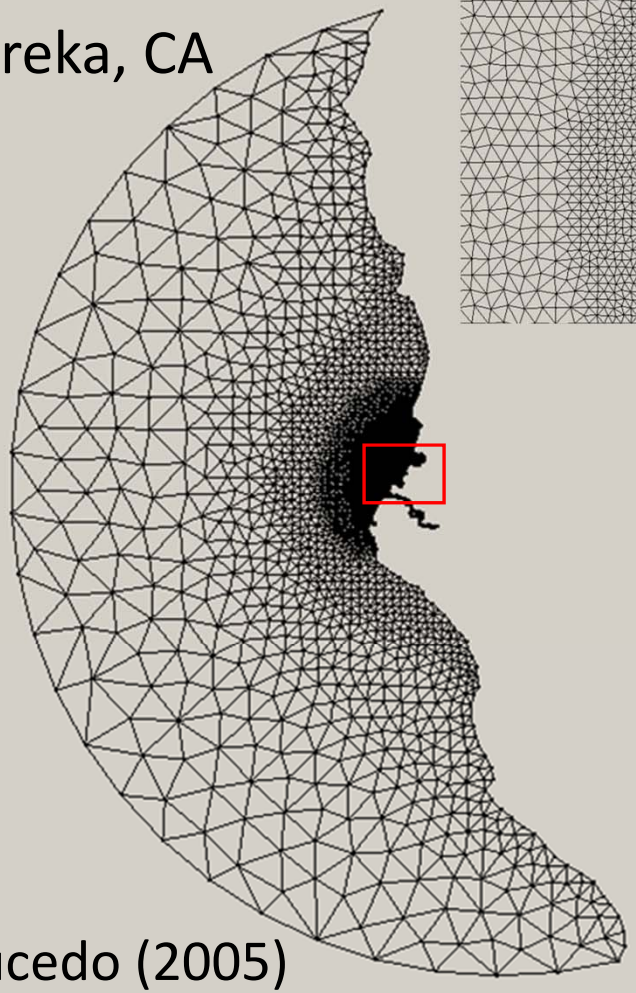
  Added:
  - *Meteorological forcing from GFS (wind shear, inverse barometric effect)*



Future: Local circulation modeling

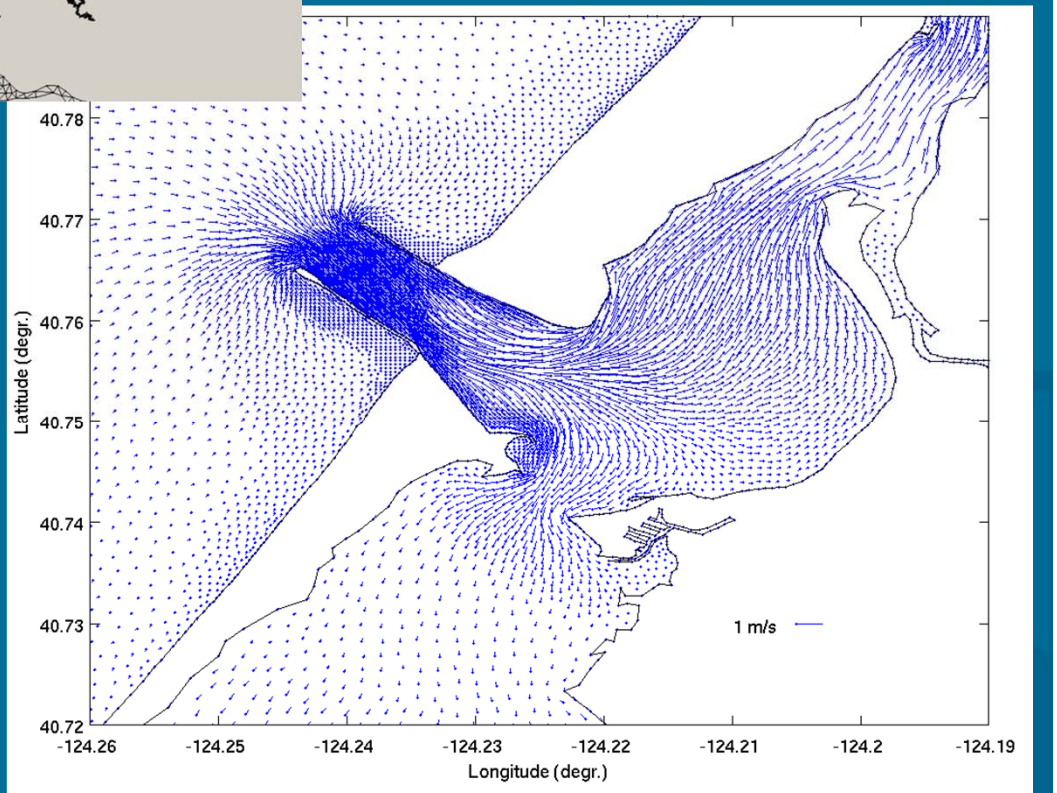
Eureka, CA



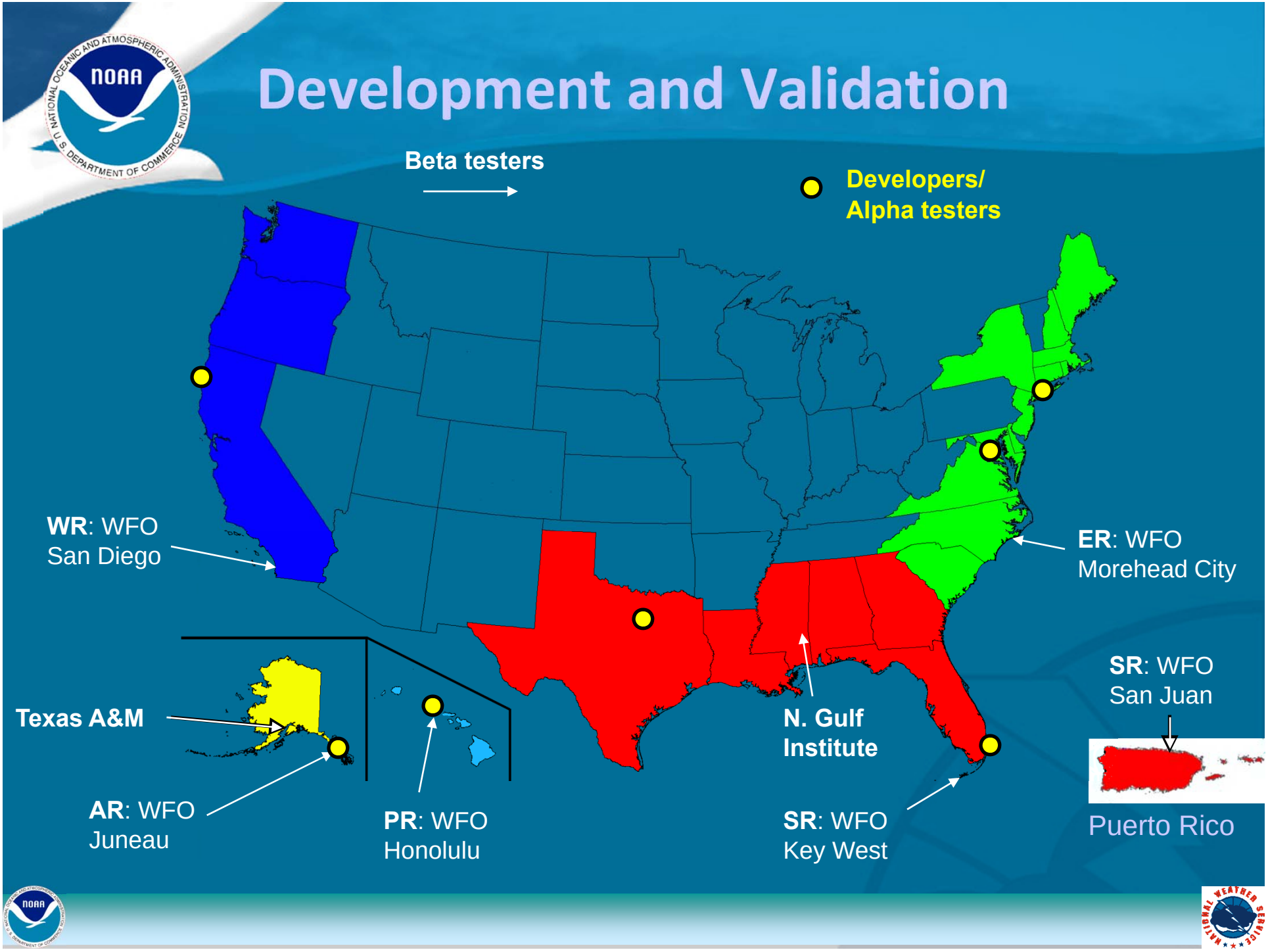


Saucedo (2005)

WWIII-ADCIRC
tight coupling,
e.g. Dietrich et al. (2010)



Development and Validation

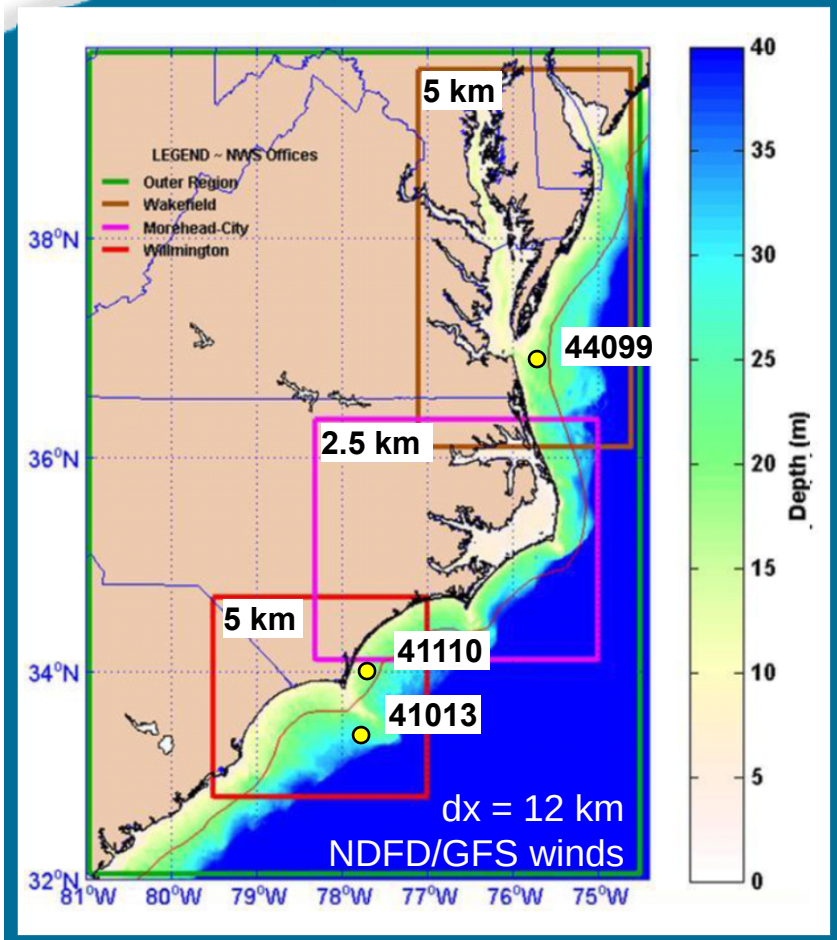


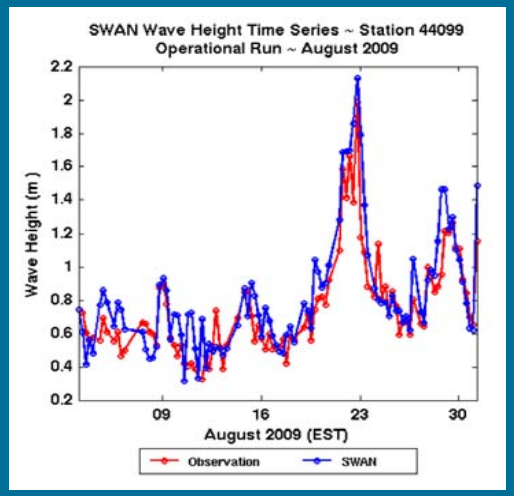
Activities and Milestones

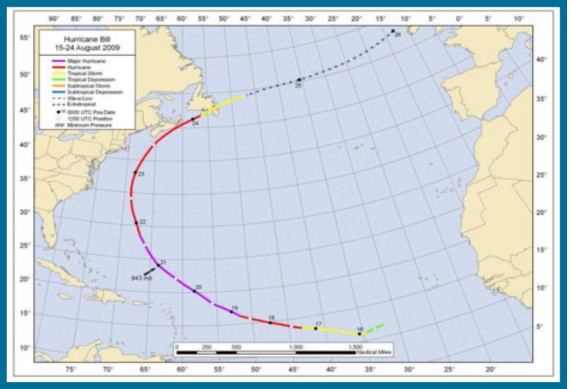
Phase	Task \ Calendar-quarter	11 Q1	11 Q2	11 Q3	11 Q4	12 Q1	12 Q2	12 Q3	12 Q4	2013
I.1	Set up SVN repository at NCEP									
I.2	SWAN command file update									
I.3	RTOFS in SWAN									
I.4	Inclusion of 1D SPEC files									
I.5	Partitioning in SWAN									
I.6	AWIPS II compatibility									
II	Alpha-I testing									
III	Addition of Nearshore WWIII									
IV	Alpha-II testing & documentation									
V	Beta testing									
VI	Nat. Roll-Out of NWPS v.1									

Historic validation: IFP-SWAN, ER

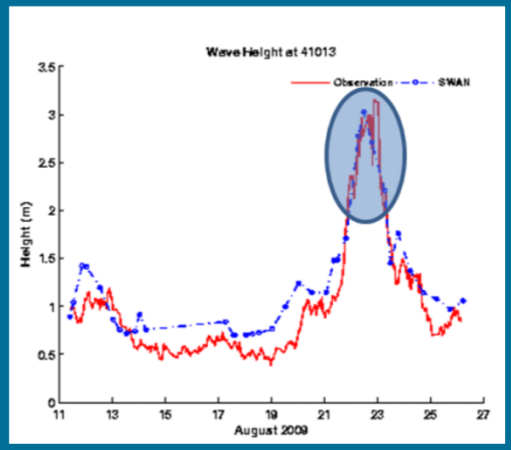
Willis et al. (2010): WFO Wakefield, Morehead C., Wilmington

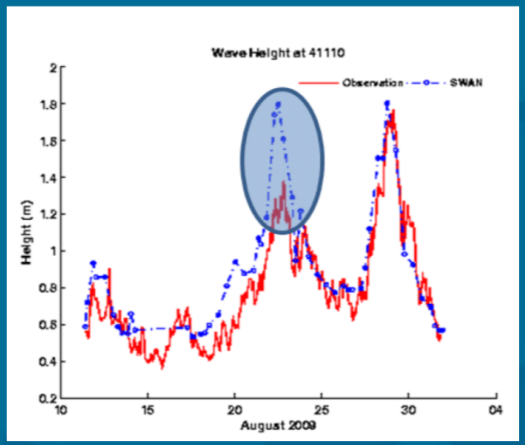






H. Bill best track (NHC)

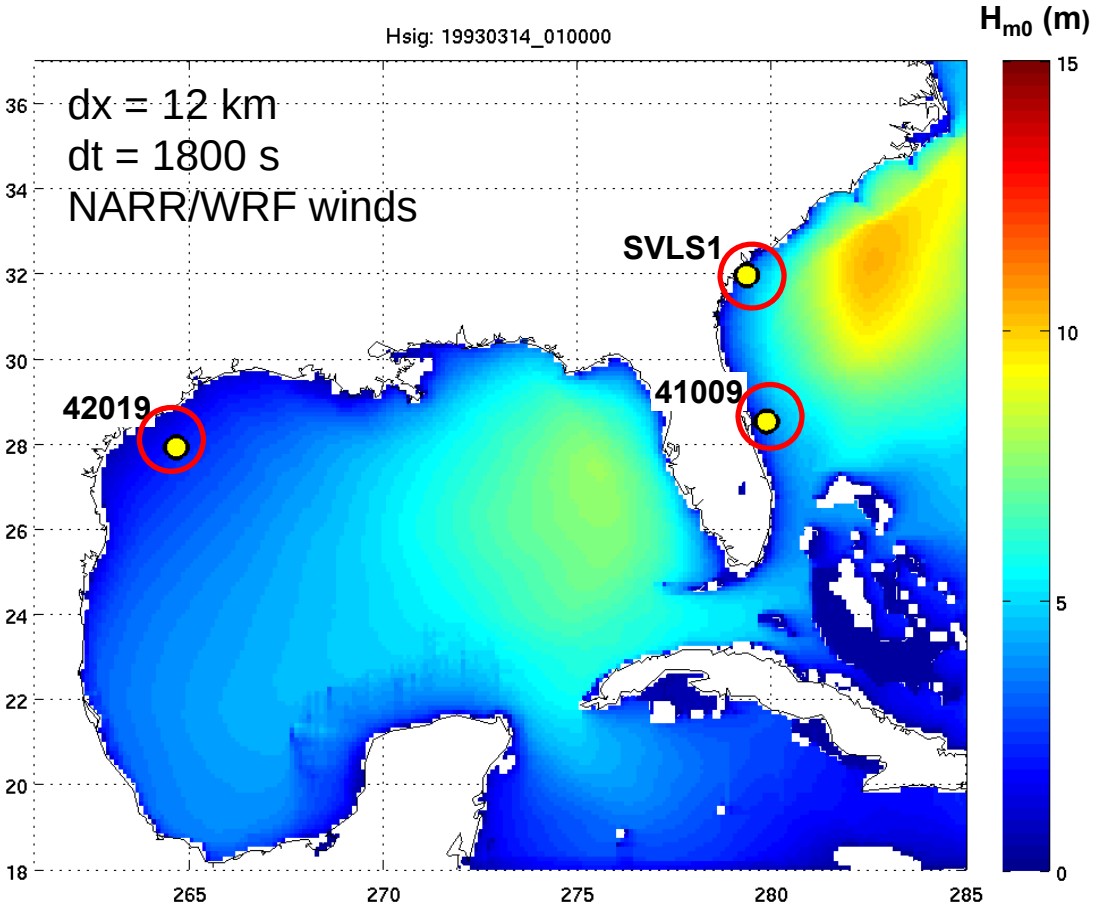




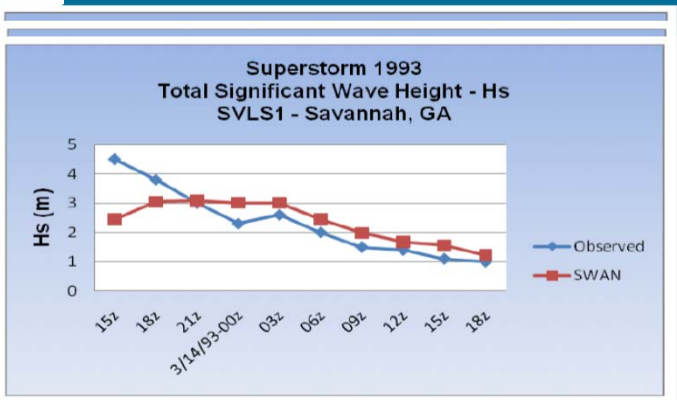
Stationary runs, Hurricane Bill, August 09

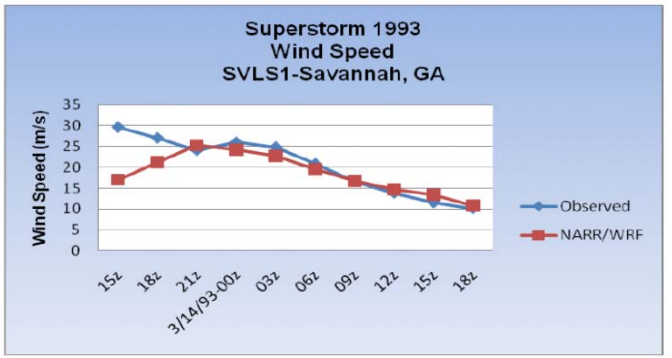
Historic validation: SR-SWAN, SR

Settelmaier et al. (2011): March 12-14, 1993 “Storm of the Century”



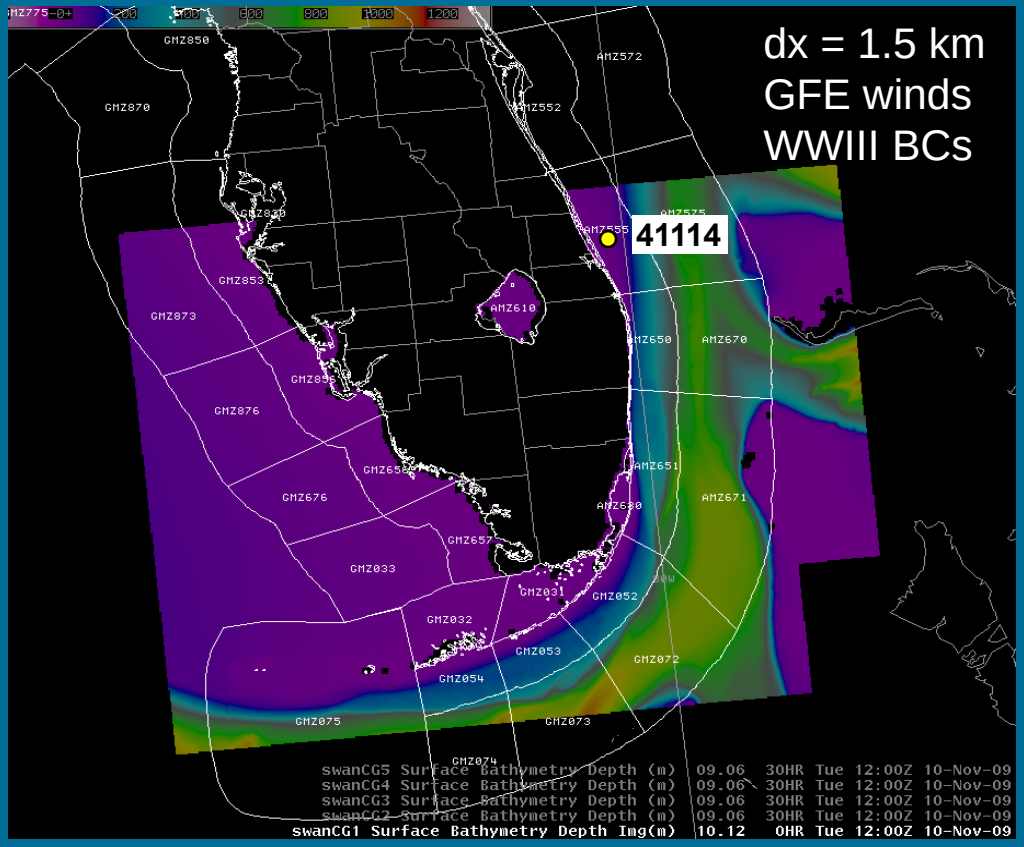
Non-stationary run

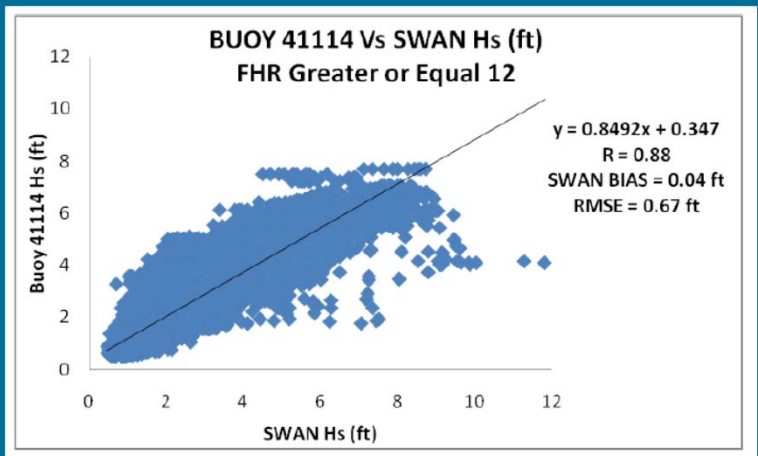


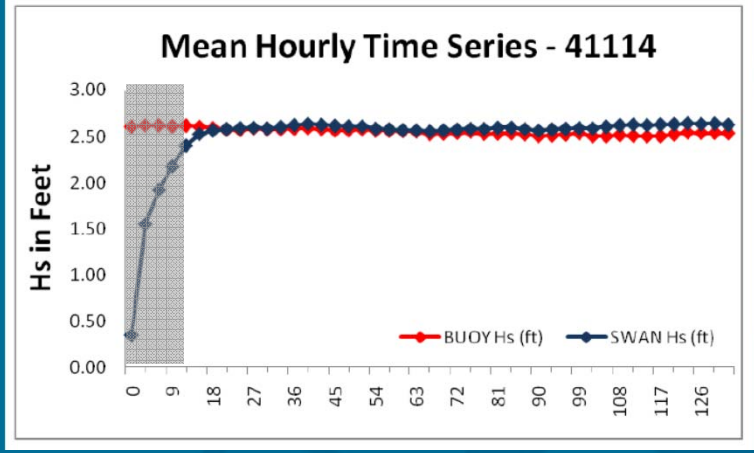


Historic validation: SR-SWAN, SR

Settelmaier et al. (2011): WFO Miami







Non-stationary runs

Analysis of Apr-Oct 10 season

Conclusions

1. NWPS: Local high-resolution wave modeling, standardized on the AWIPS II baseline.
2. Capture local, site-specific physical processes. Enable a spiral development between regions and NCEP.
3. Wave partitioning as input to gridded wave forecasts.
4. Water level and current ingest (RTOFS and ESTOFS).
5. Future: Local, coupled circulation and inundation modeling (WWIII-ADCIRC).
6. Good performance in historic validation studies.

References

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