Towards Ensemble Based Flood Forecasting
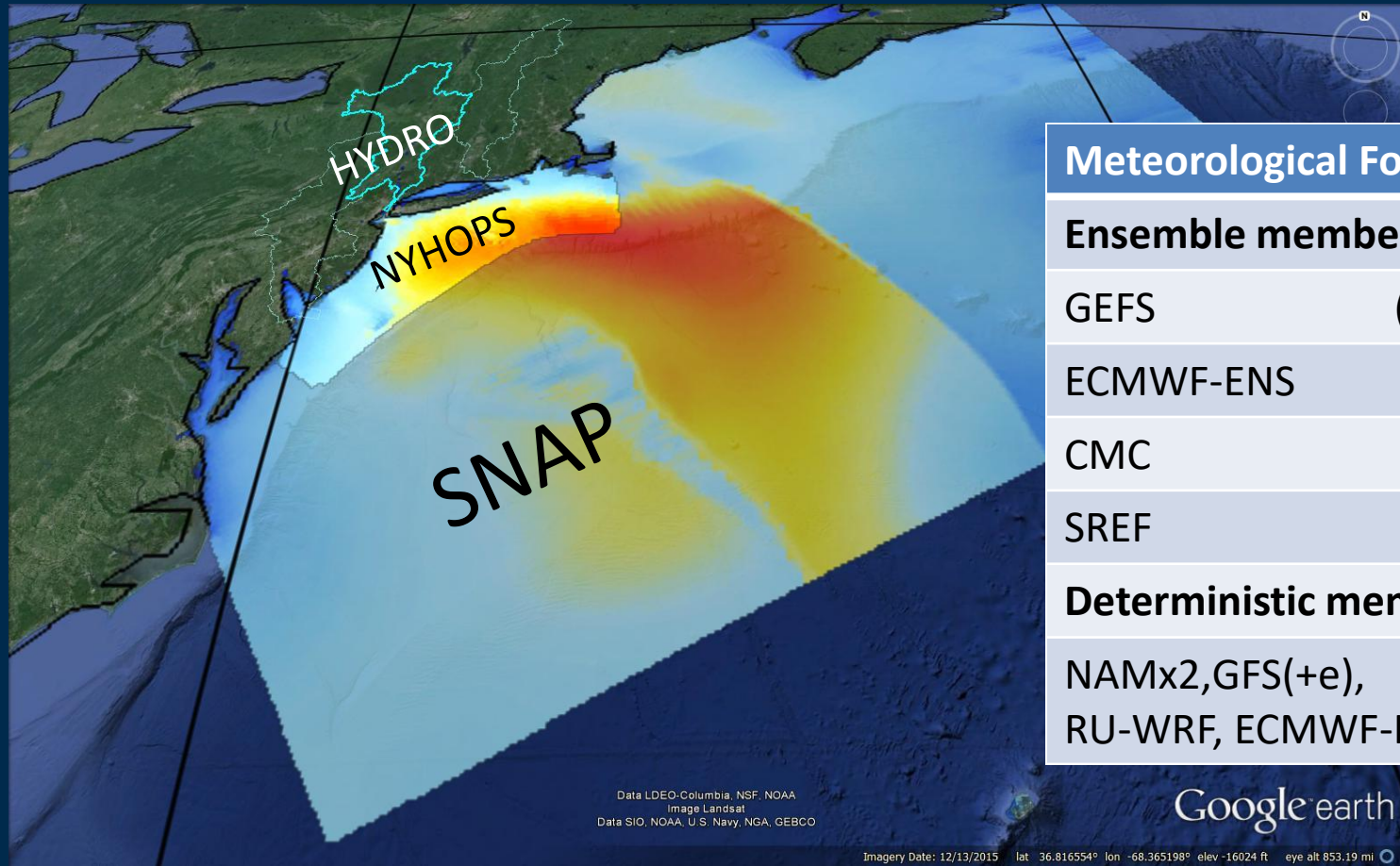
Nickitas Georgas, Justin Schulte ….
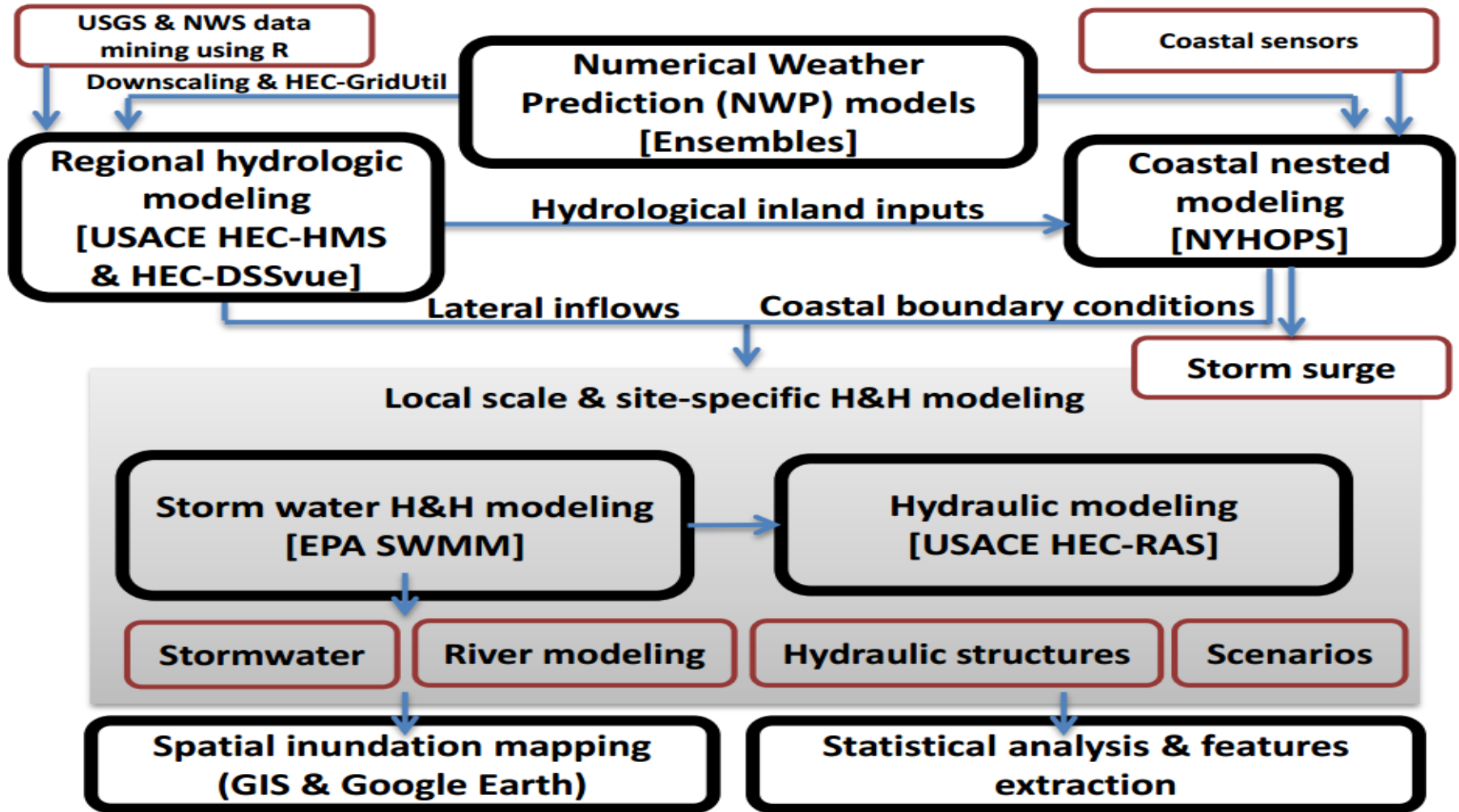
7th NCEP ensemble forecasting workshop
6/15/2016

ngeorgas@stevens.edu; Stevens Institute of Technology, Hoboken, NJ

Meteorological Forcing	
Ensemble members	
GEFS	(21)
ECMWF-ENS	(51)
CMC	(21)
SREF	(26)
Deterministic members	
NAMx2,GFS(+e), RU-WRF, ECMWF-HRES.	

Data LDEO-Columbia, NSF, NOAA
Image Landsat
Data SIO, NOAA, U.S. Navy, NGA, GEBCO

Google earth

Imagery Date: 12/13/2015   lat 36.816554° lon -68.365198° elev -16024 ft   eye alt 853.19 mi

NYHOPS 3D 125-member Ensemble linked to offshore SNAP & HYDRO-river ensembles

Integrated Prediction Framework

Practical Application
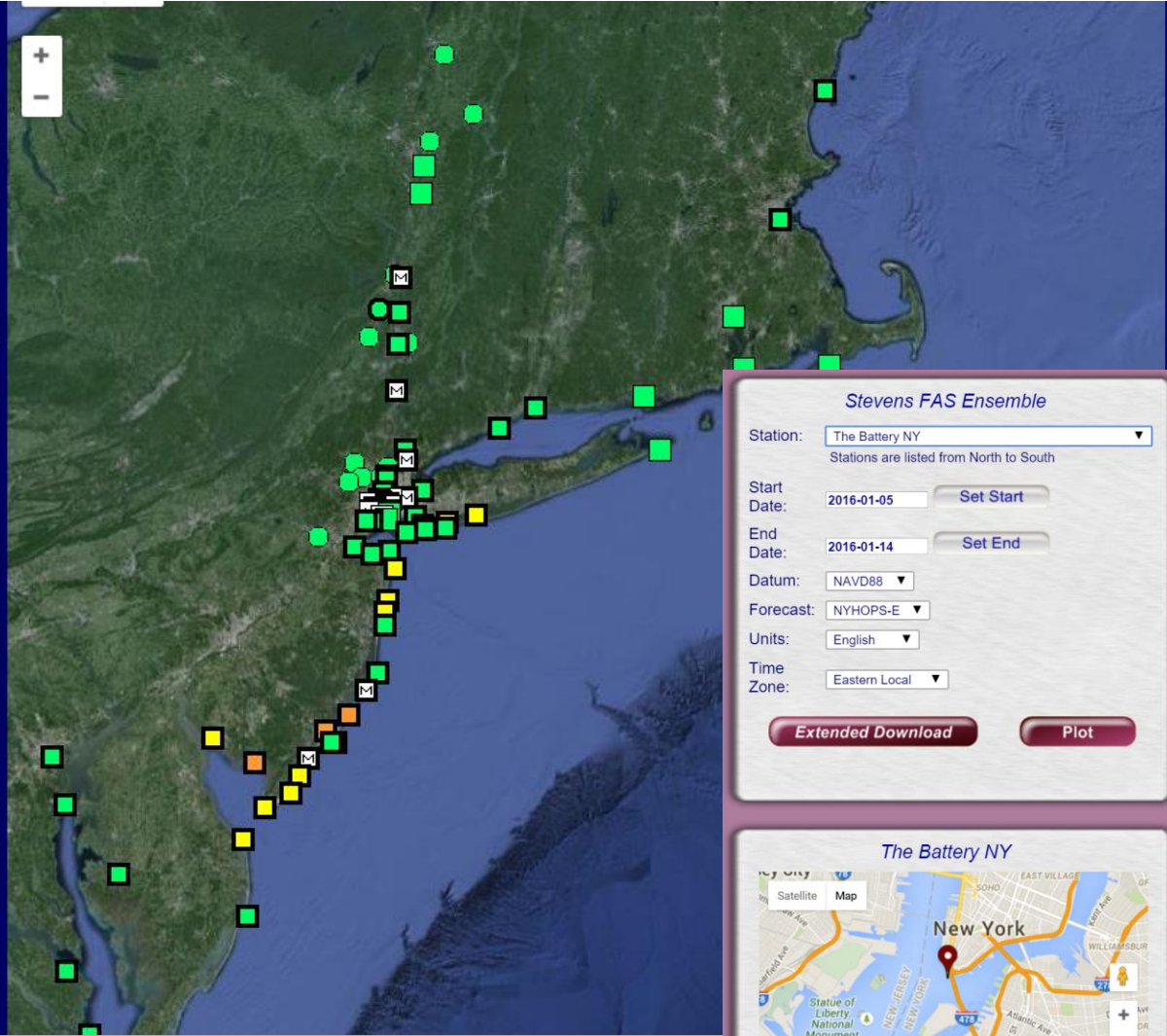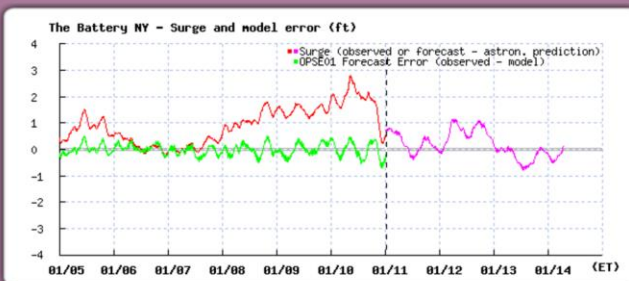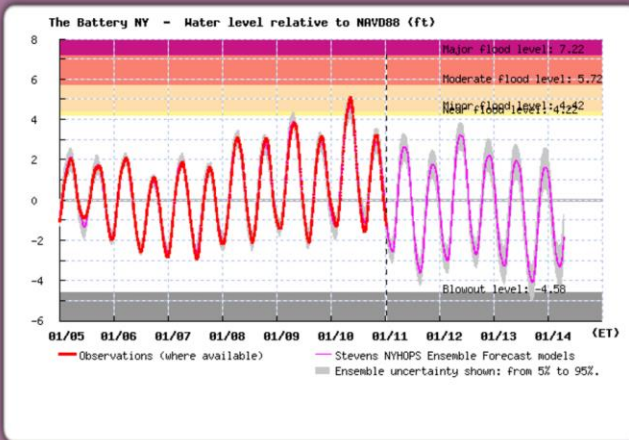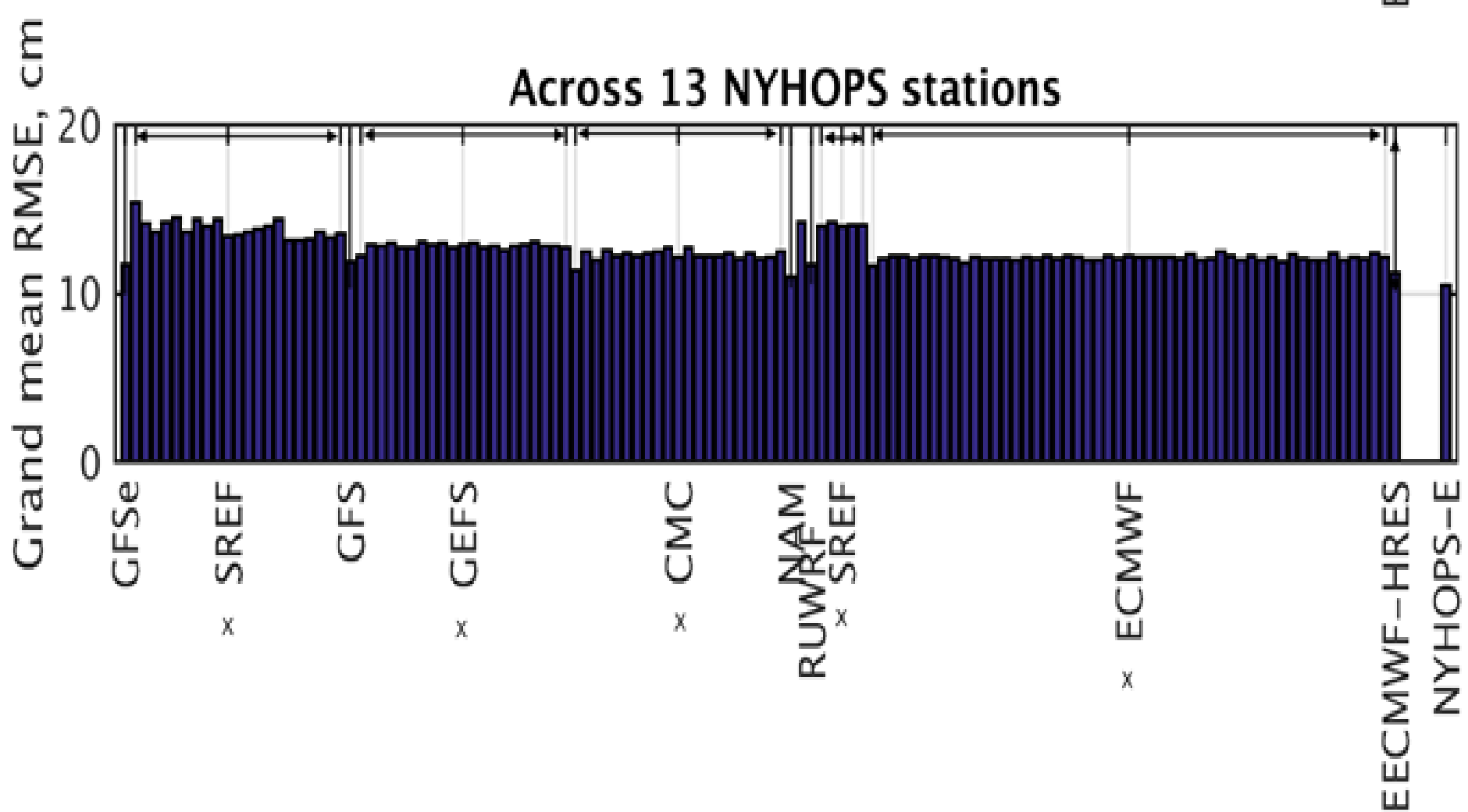
www.stevens.edu/SFAS
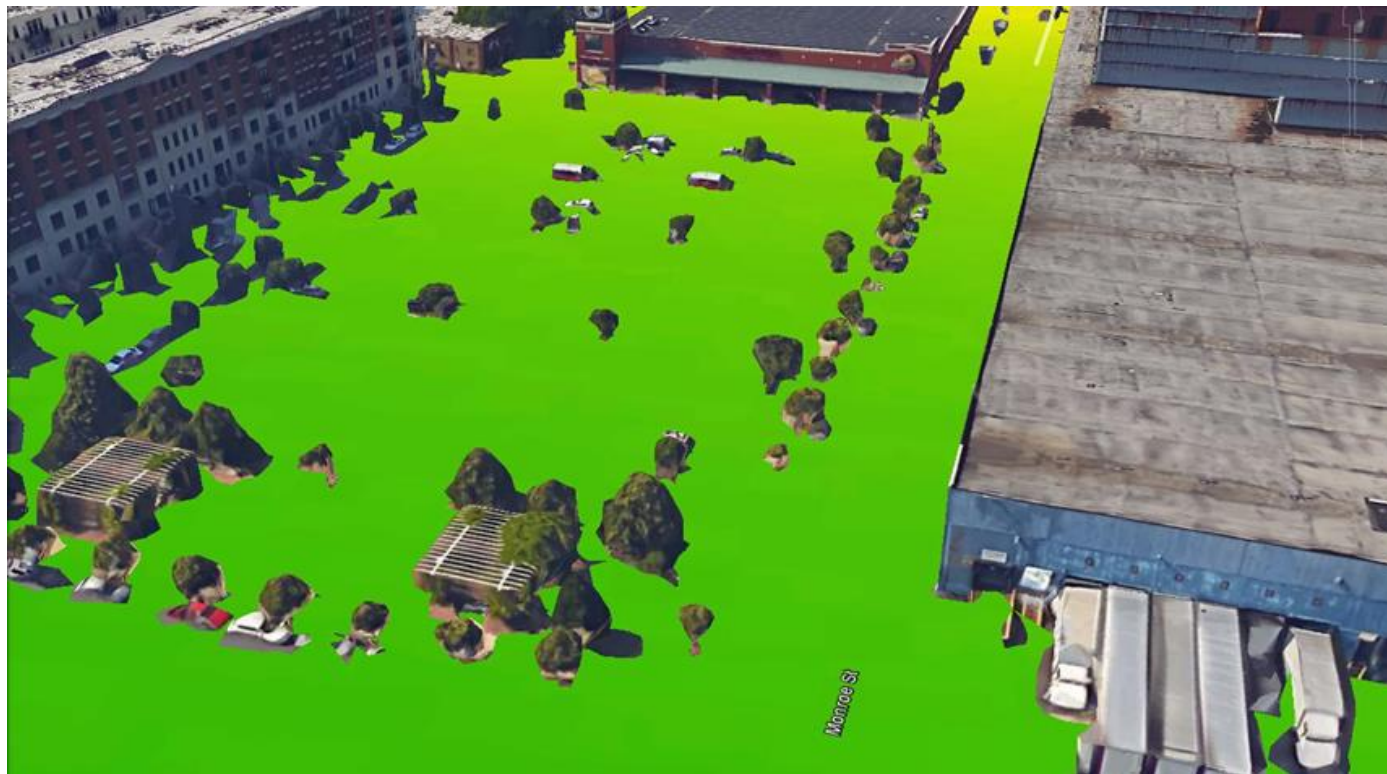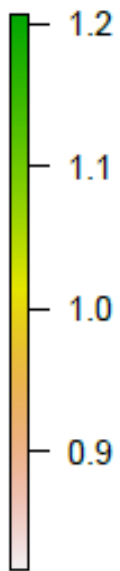
Local Scale Application-Irene Reforecast

Theoretical Work

Forcing Model Inter-comparison (Georgas et al., 2016)

Best hindcast-trained weighted-averaging technique?

Pairwise t test on -48hrs and -72hrs forecasts before Sandy shows:
* No statistically significant difference among hindcast-based averaging methods.

- Bayesian modeling averaging

- Weight by correlation coefficient

- Weight by Root-square mean error

- **All methods performed equally well!**

Latest Theoretical Work: The Road to Better Forecasts

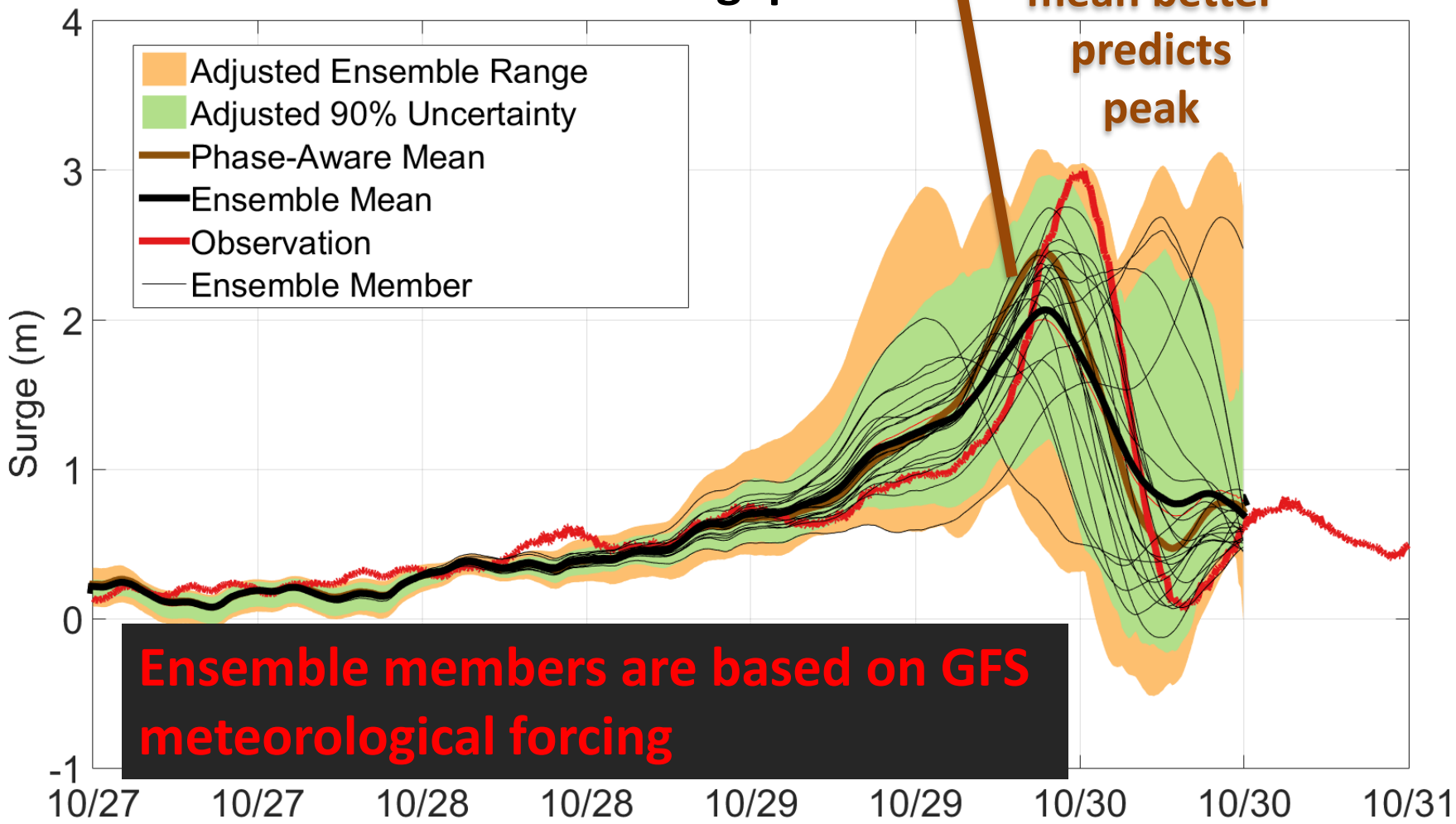Ensemble mean underestimates peak surge → Creation of phase-aware ensemble forecasting → Detailed comparisons using reforecasts → Operationalize
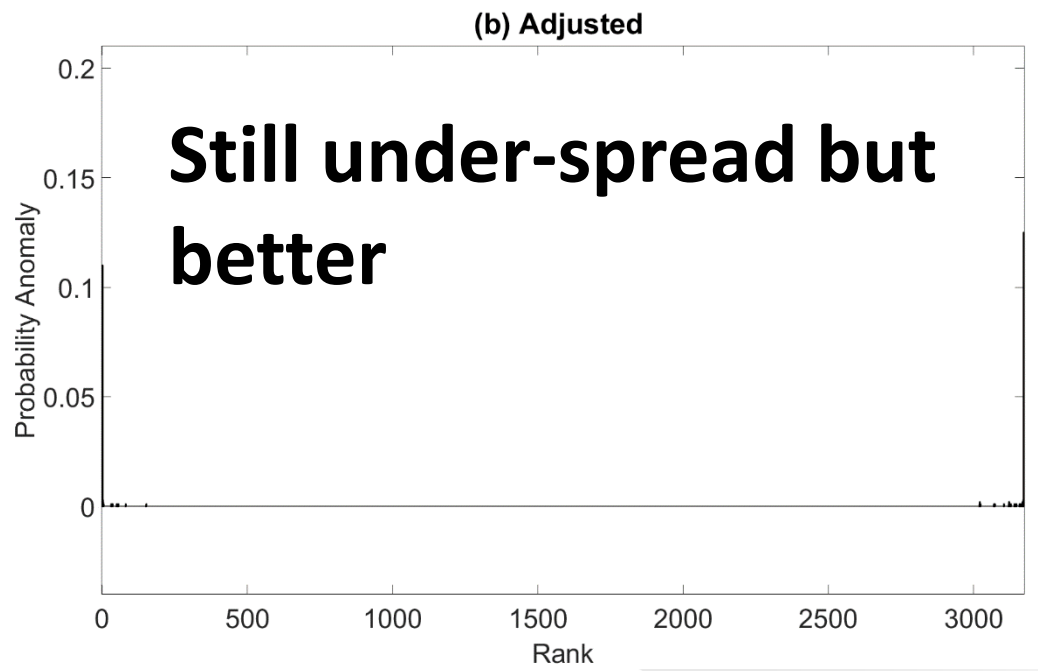
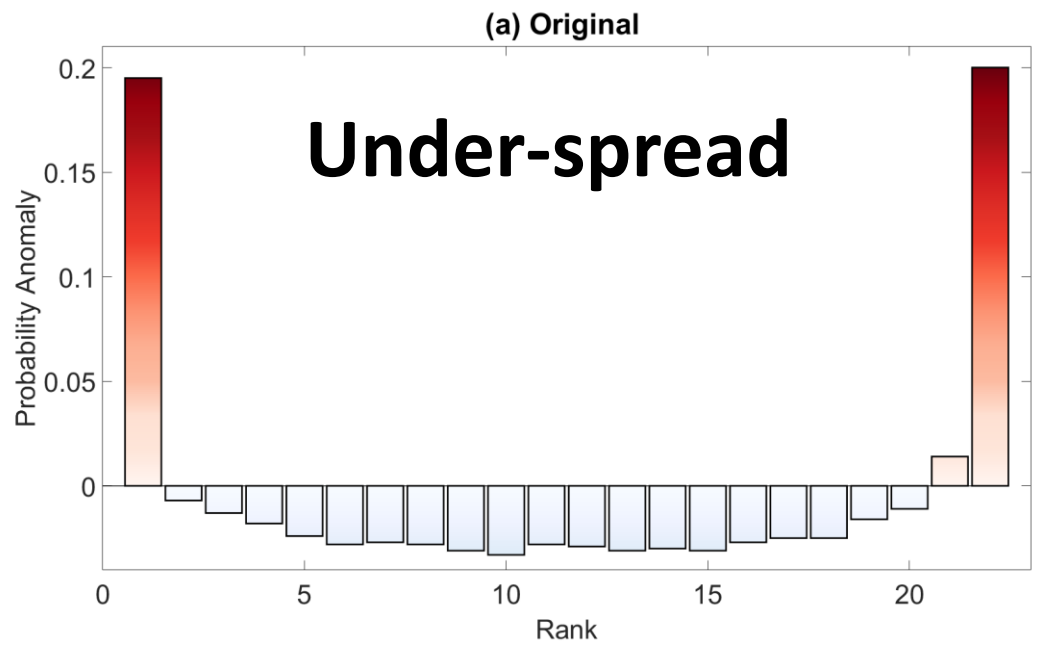Bridgeport

Phase-aware mean better predicts peak

Legend:
- Adjusted Ensemble Range
- Adjusted 90% Uncertainty
- Phase-Aware Mean
- Ensemble Mean
- Observation
- Ensemble Member

Surge (m)

Ensemble members are based on GFS meteorological forcing

(a) Original

Under-spread

(b) Adjusted

Still under-spread but better

Sandy forecasts across 8 stations and 3 lead times

Peak Error Comparison
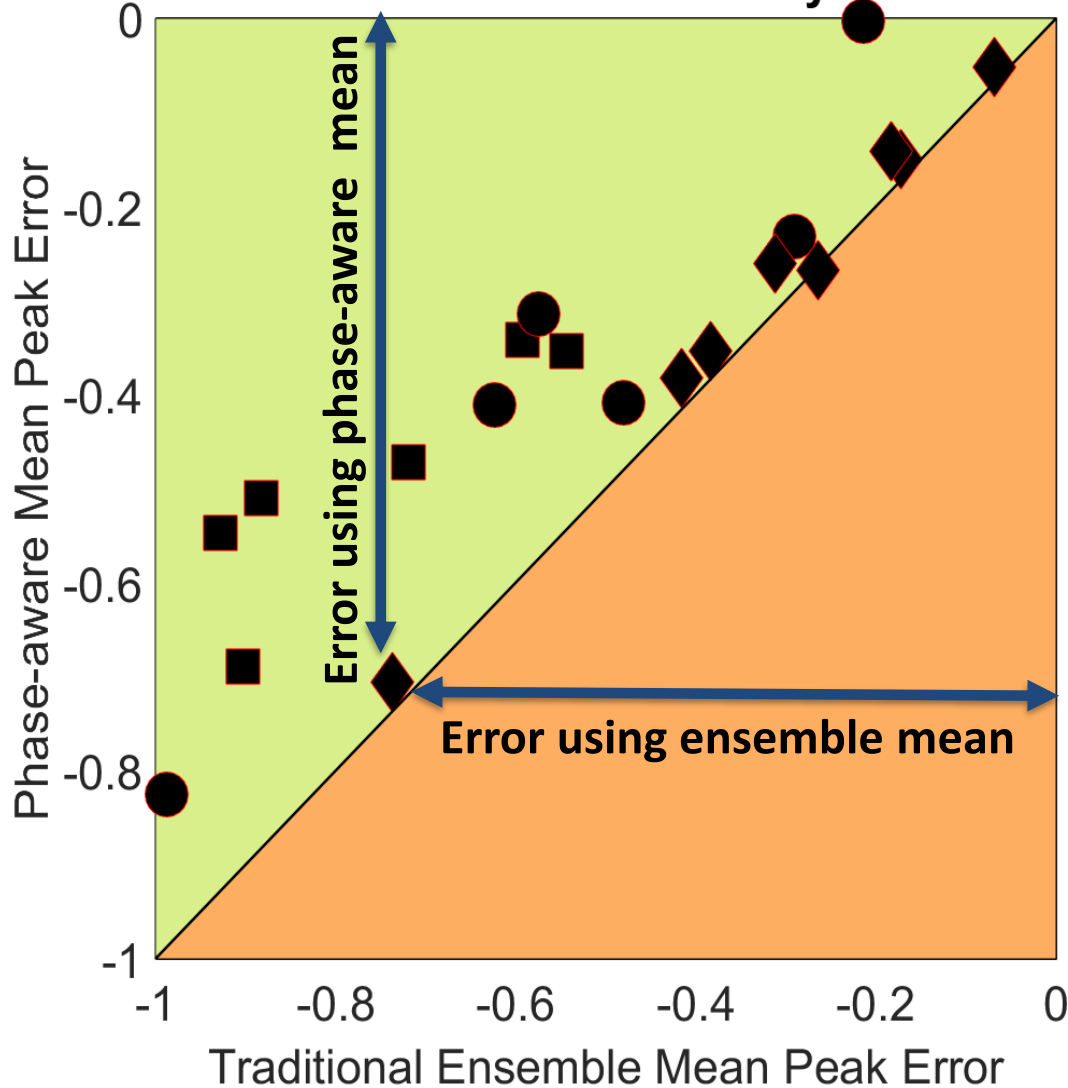
Phase-aware mean performs better than the ensemble mean, especially for forecasts three days out

Summary

- Stevens Institute's integrated prediction framework consists of inland and coastal flood forecasts, regional to local-scale modeling, and spatial inundation mapping

- New statistical methods are being developed to provide better ensemble forecasts

- Future work will include the application of phase-aware ensemble forecasting to forecast hydrographs

References

- N. Georgas, A. Blumberg, T. Herrington, T. Wakeman, F. Saleh, D. Runnels, A. Jordi, K. Ying, L. Yin, V. Ramaswamy, A. Yakubovskiy, O. Lopez, J. McNally, J. Schulte, and Y. WangThe Stevens Flood Advisory System: Operational H^3E flood forecasts for the Greater New York / New Jersey Metropolitan Region, Accepted to Special Issue of the International Journal of Safety and Security Engineering, 2016.

- Schulte, J. A. and Nickitas, G.: Theory and Practice of Phase-aware Ensemble Forecasting, In Preparation.