

Forecasting of Storm Surge and Wave along Taiwan Coast

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106 年天氣分析及預報會議

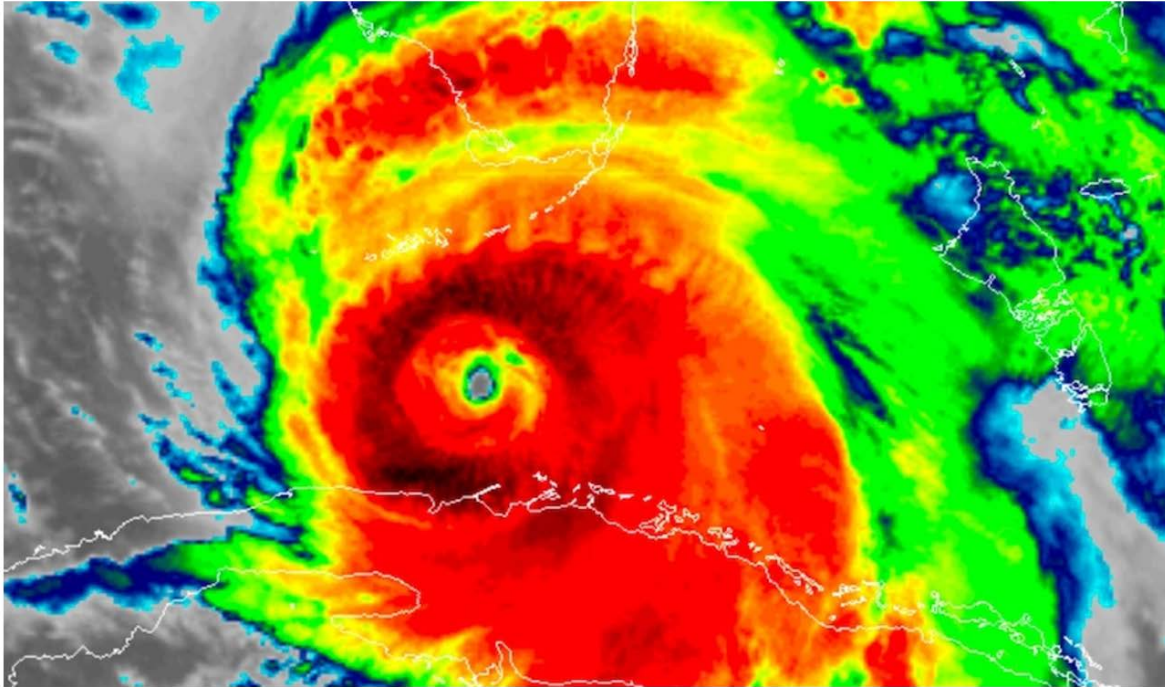
中央氣象局

September 13, 2017

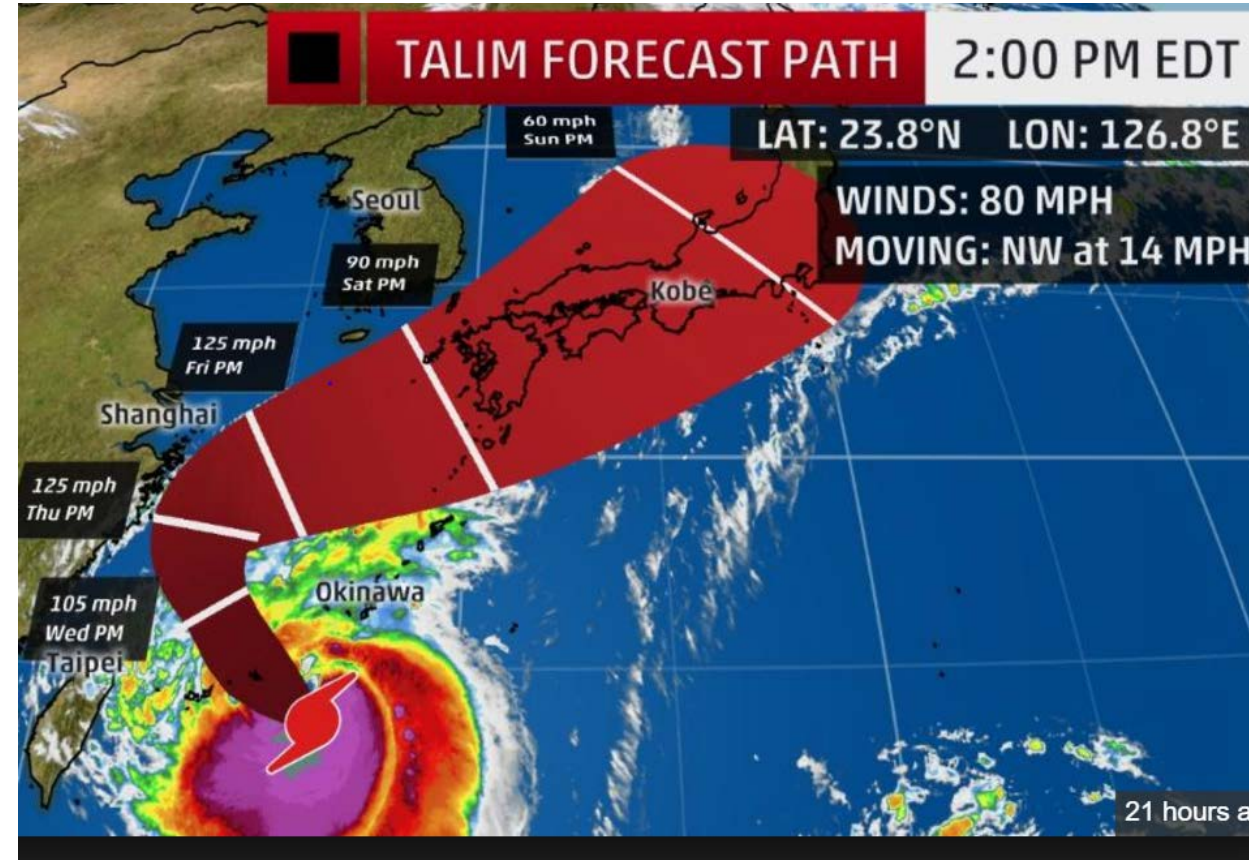
難兄難弟：Florida and Taiwan

Irma Slams the Keys; Florida's Southwest Coast at Risk of Major Storm Surge

Bob Henson · September 10, 2017, 2:58 AM EDT



IRMA

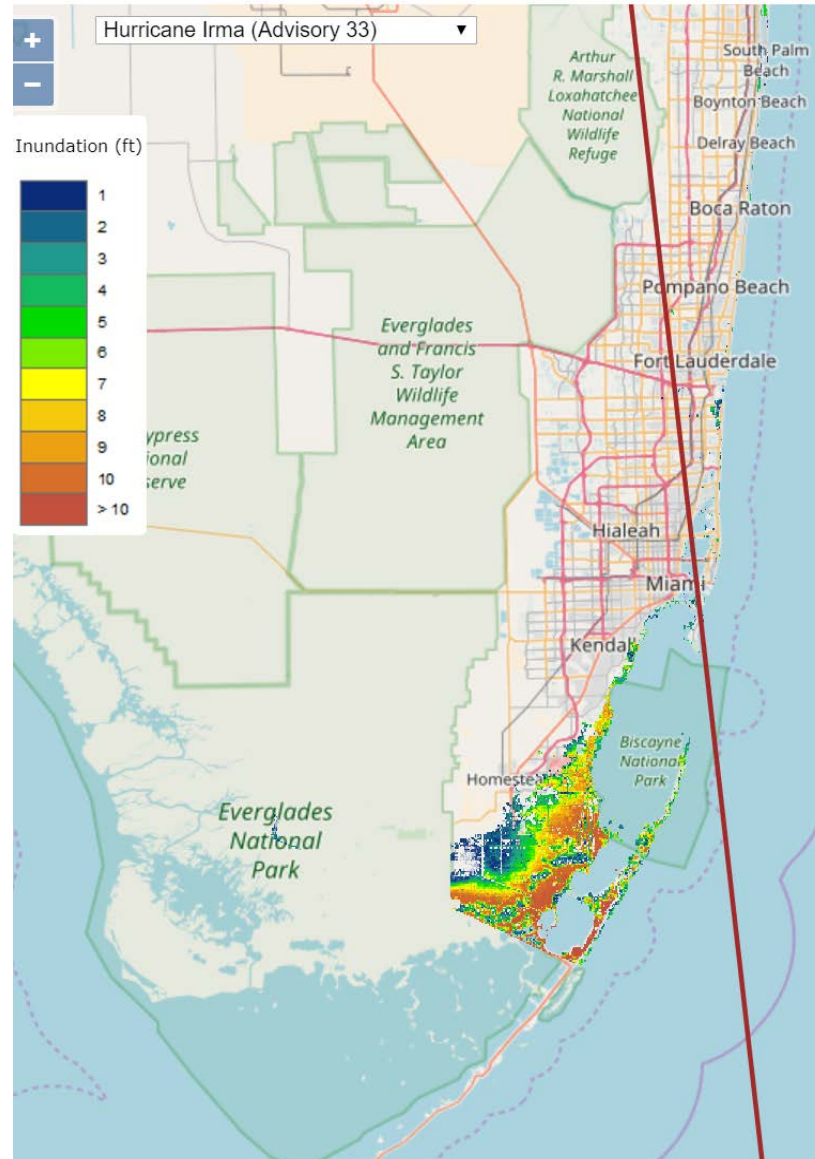


TALIM

As the track moves westward, surge/inundation risk change

09/07/2017

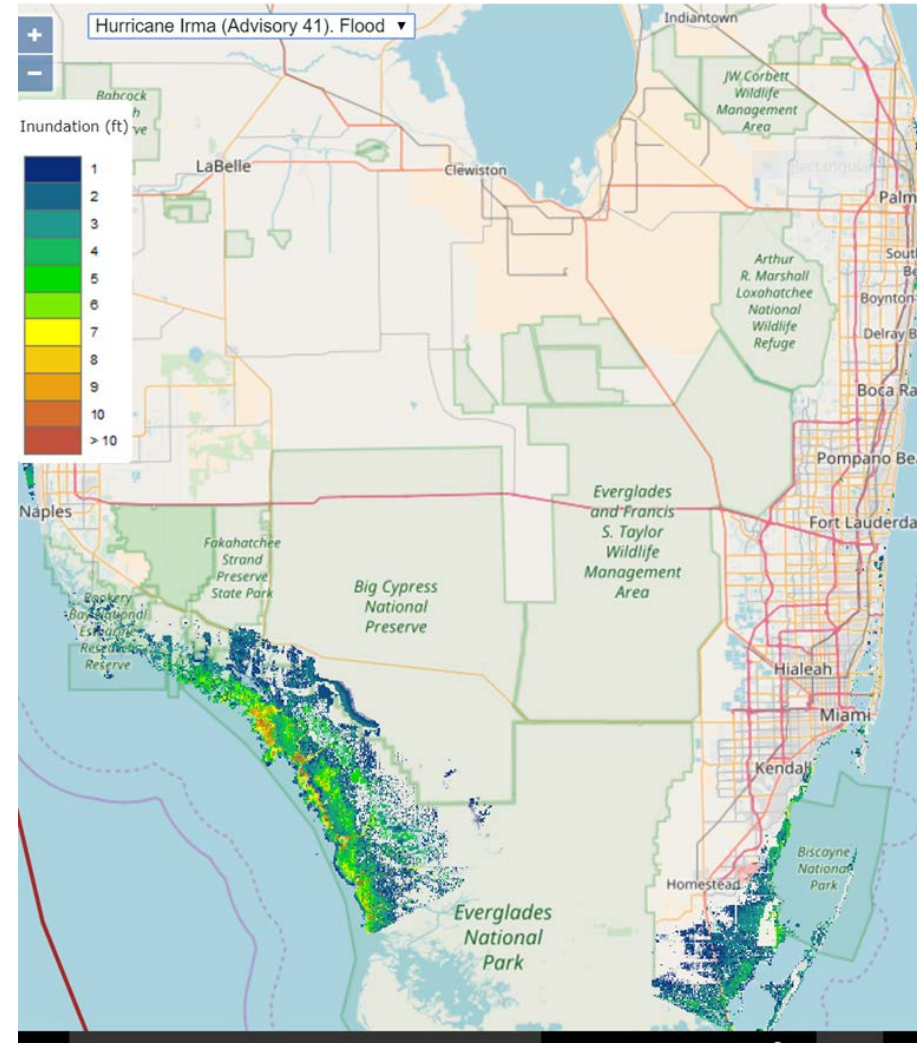
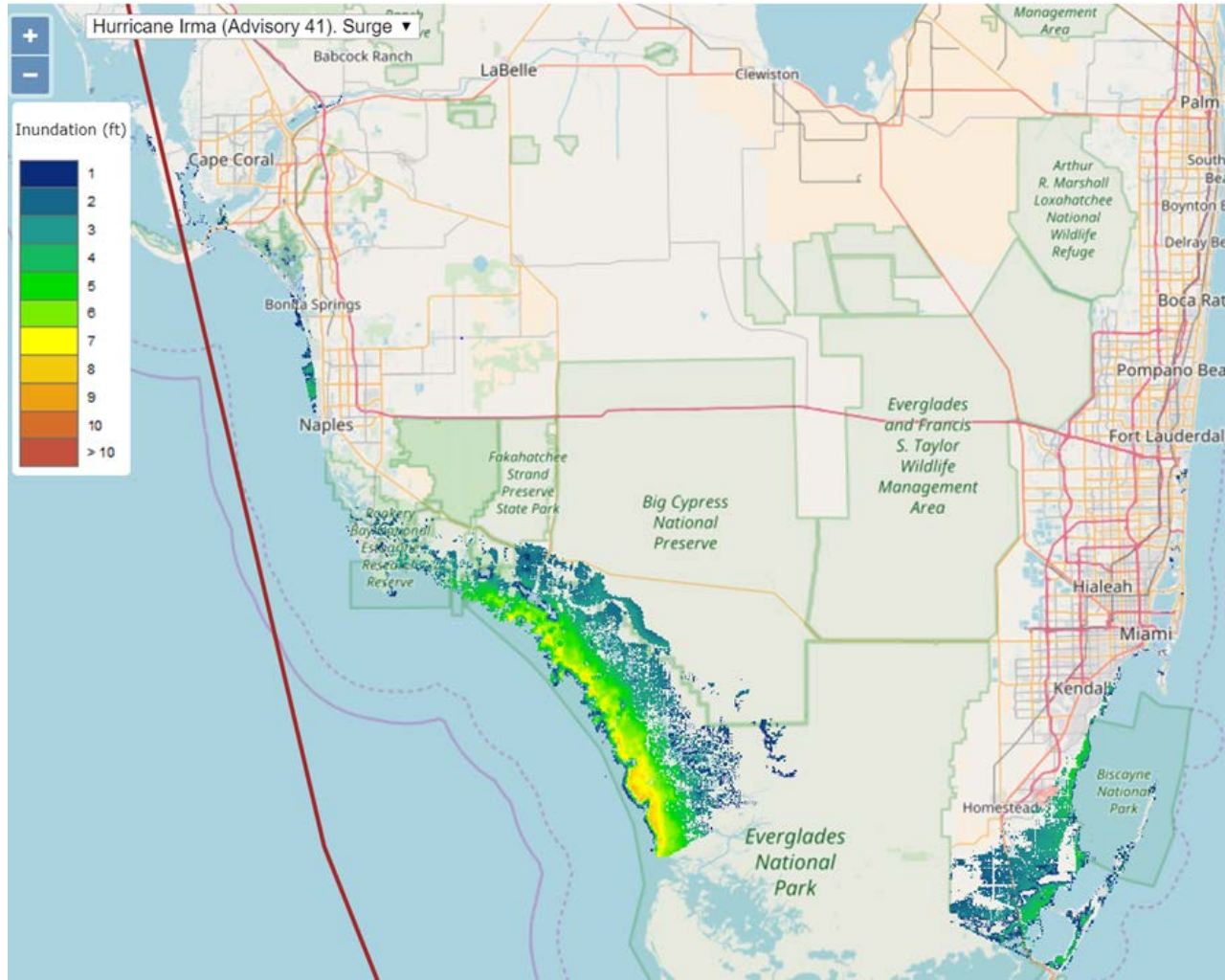
0900UTC



Advisory 33

<https://aces.coastal.ufl.edu/Irma/>

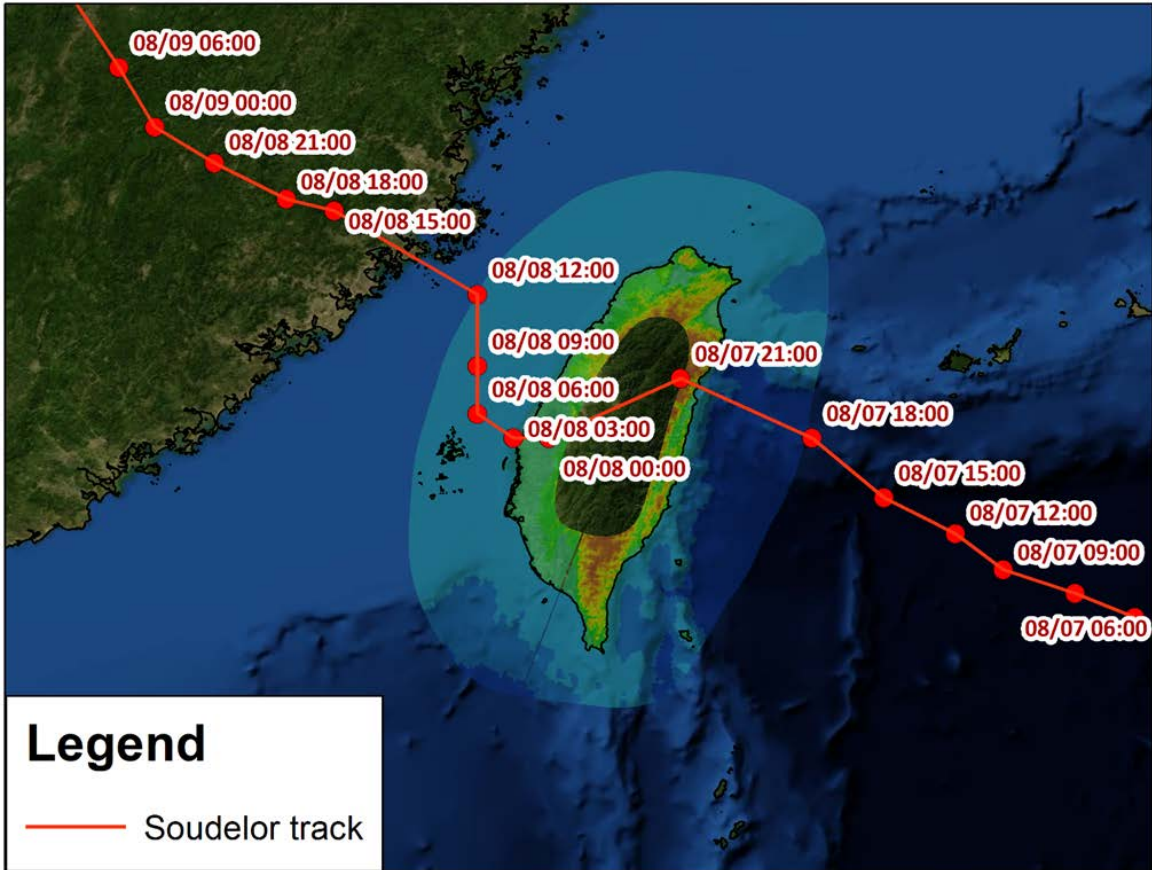
Advisory 41: Surge (Left) and Flooding (Right) 09/09/2017 0900UTC



Abstract

This paper describes the application of a coupled surge-wave modeling system CH3D-SWAN for simulating storm surge and wave along Taiwan coast. The modeling system has been used for simulating storm surge and wave in the U.S., Arabian Gulf, and Taiwan. This paper presents the hindcasting of Typhoon Soudelor in 2015 and the forecasting of the typhoon season in 2016 with Typhoon Megi as an example. Performance of the forecasting system and future forecasting effort is discussed.

Track of Soudelor in 2015 and Megi in 2016

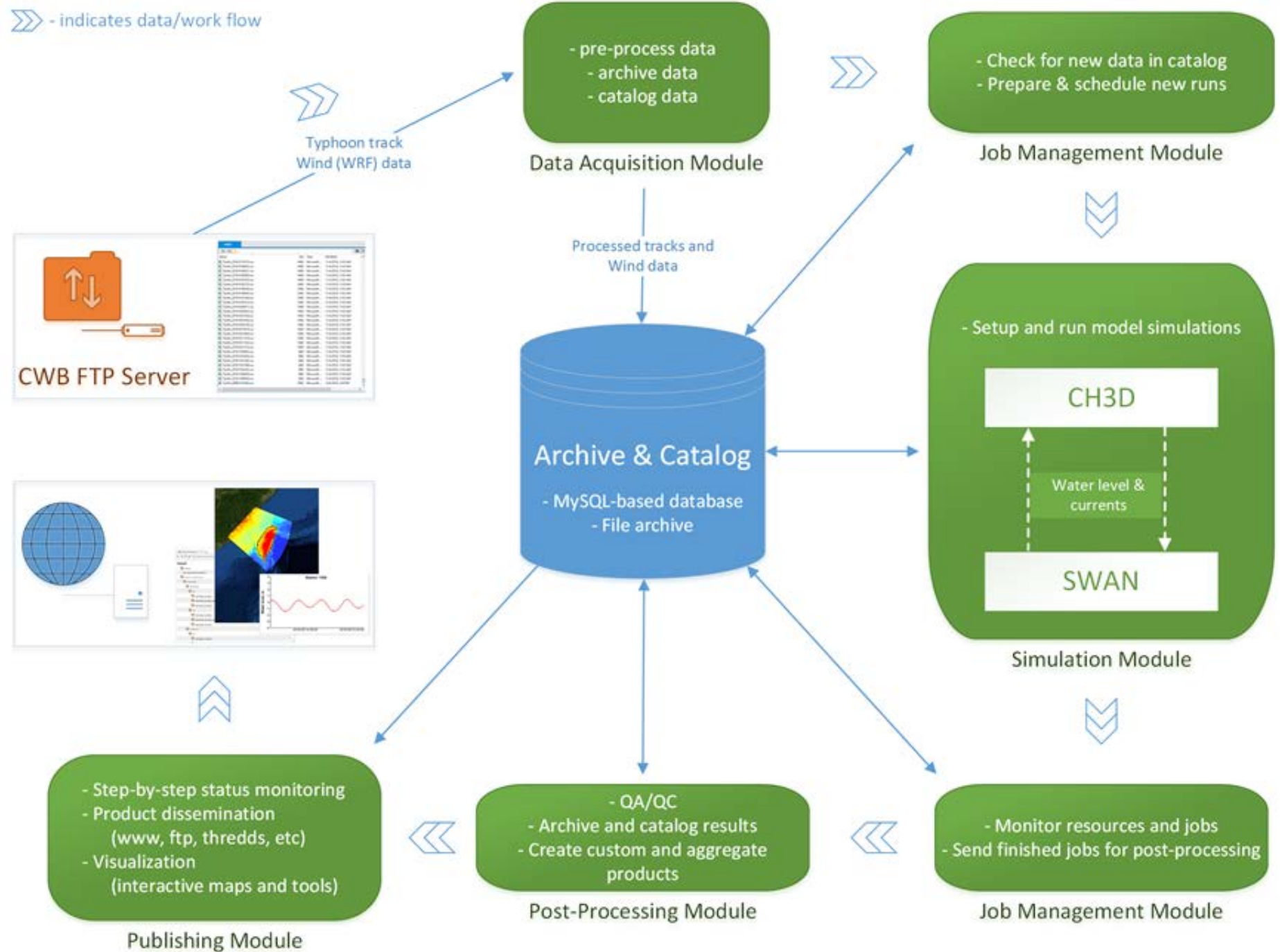


ACMS-TW (Advanced Coastal Modeling System – TW)

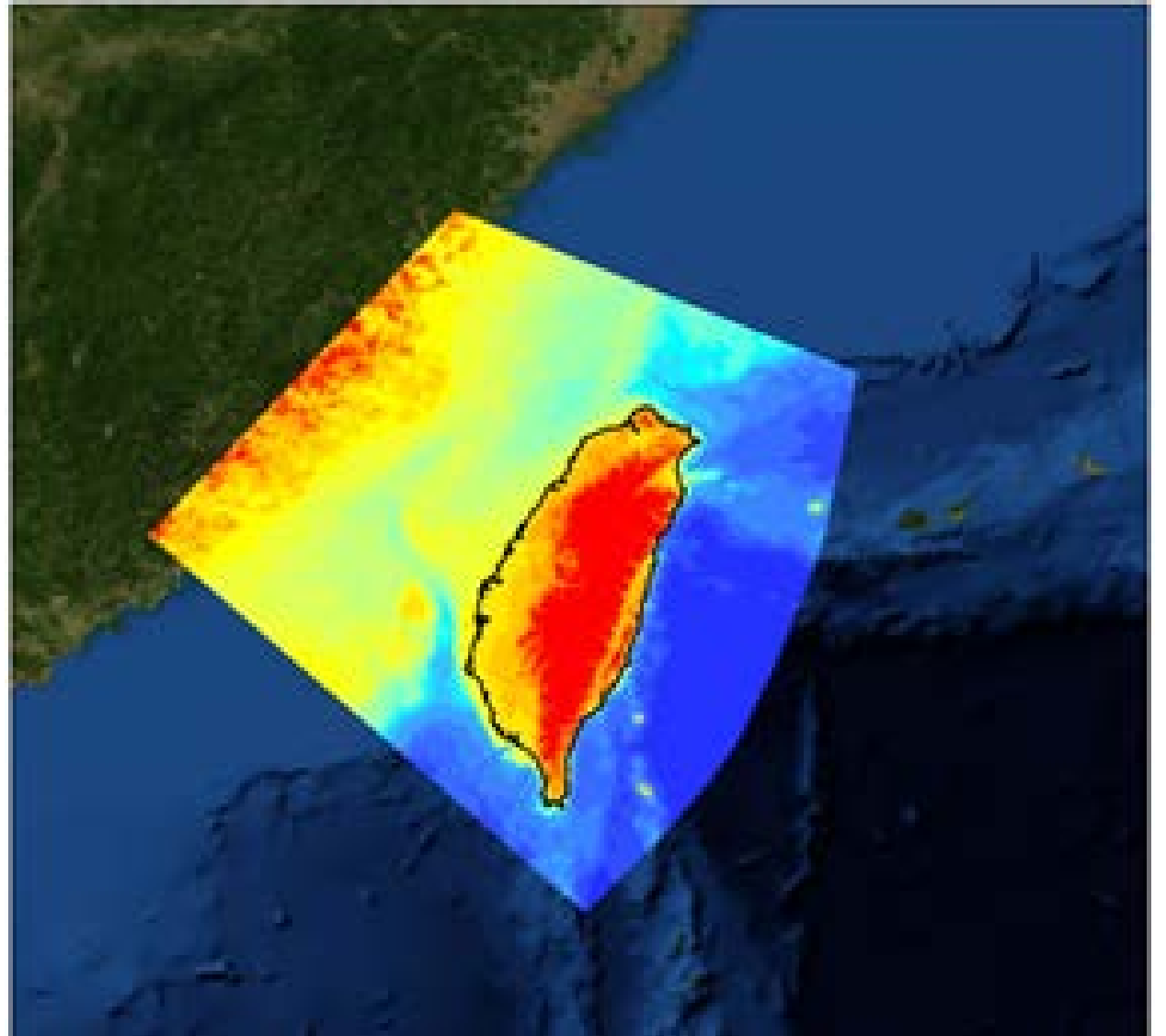
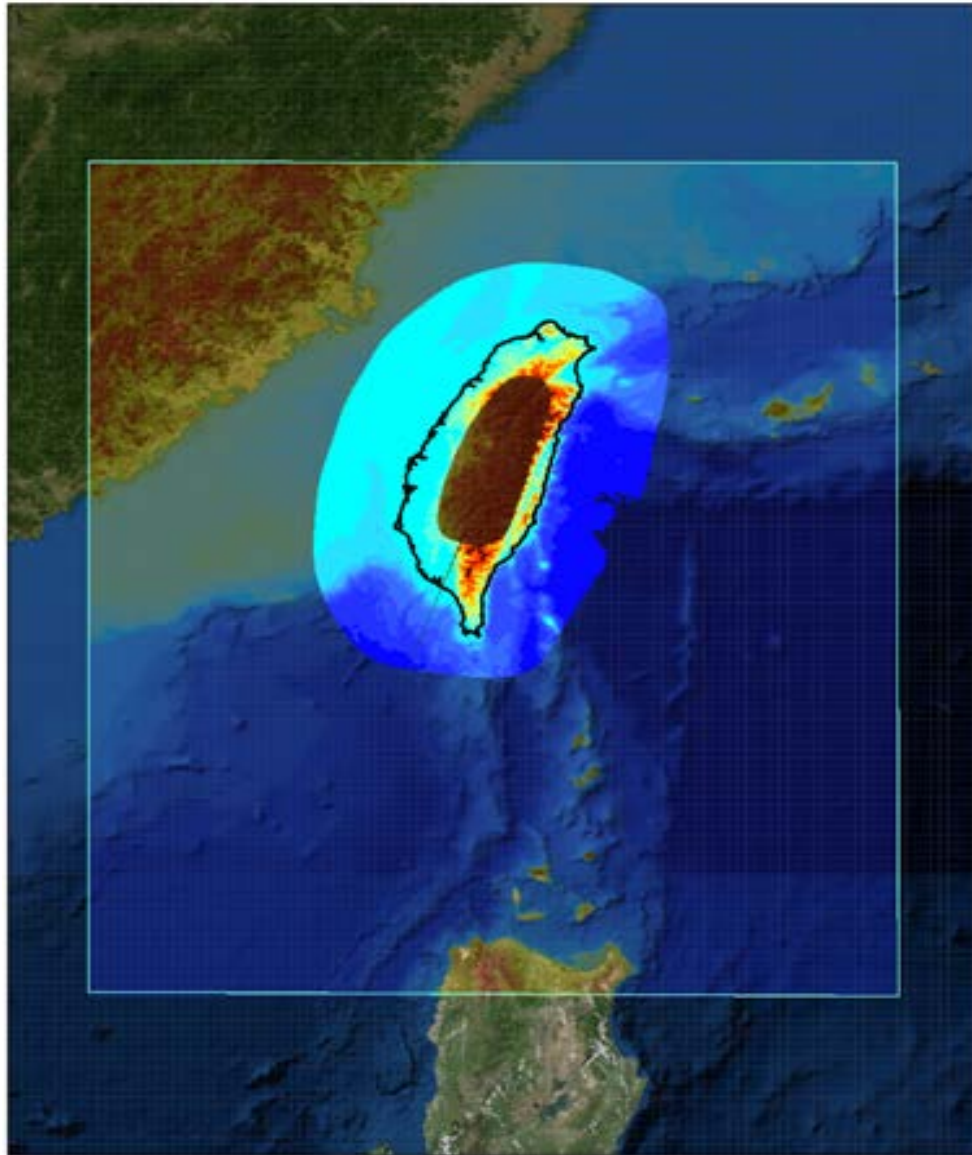
- Coupled Hydrodynamic/Wave Models (CH3D/SWAN)
- Tidal constituents + atmospheric pressure open boundary condition
 - Tidal constituents are derived from TPXO model and further adjusted to properly fit the measured data
- Wind and atmospheric pressure forcing (CH3D)
- Wind forcing (SWAN)

- Two wind fields:
 - CWB forecast track + parametric hurricane wind model
 - TWRF wind fields (since 2017 season)

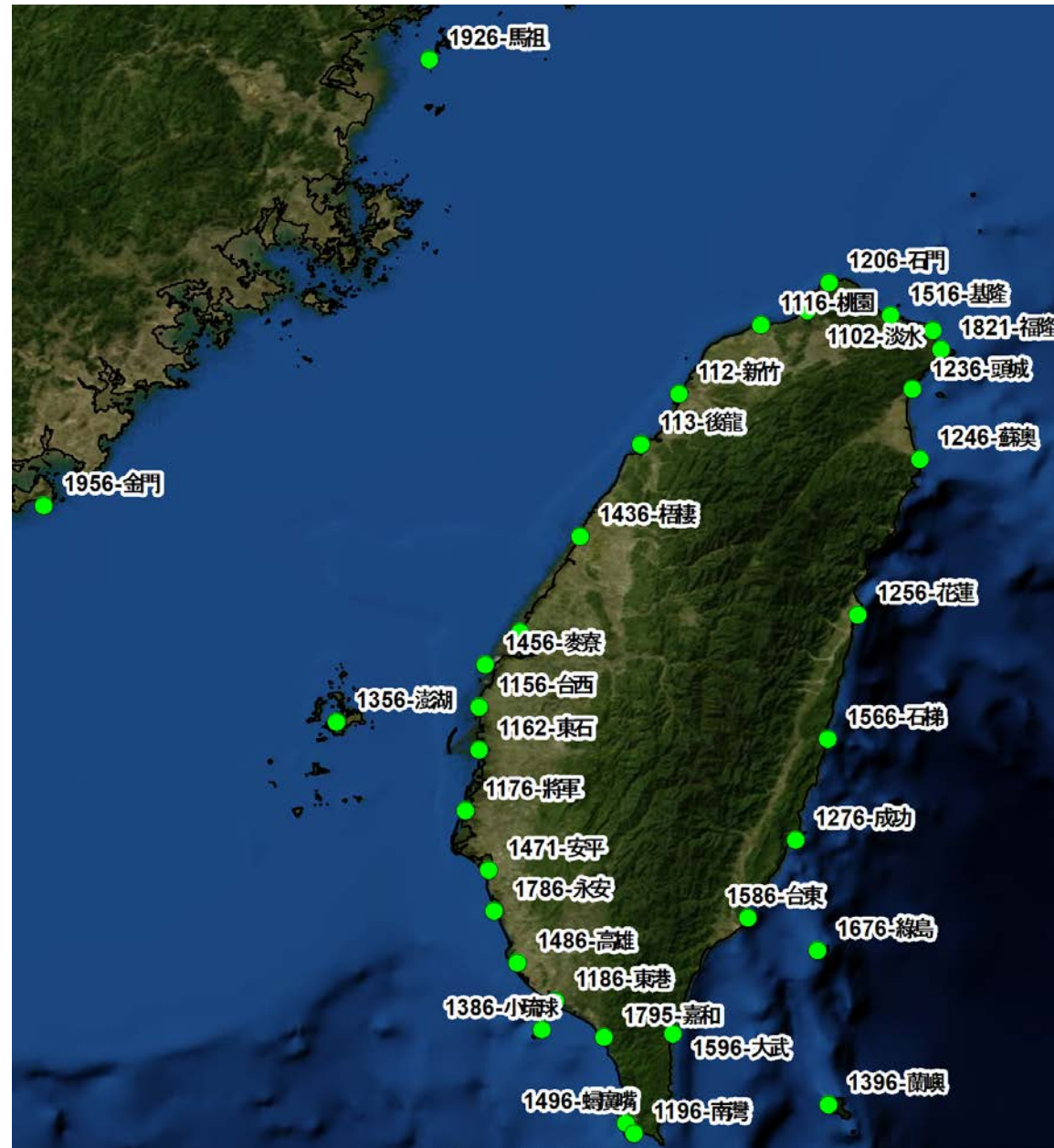
106 年系統

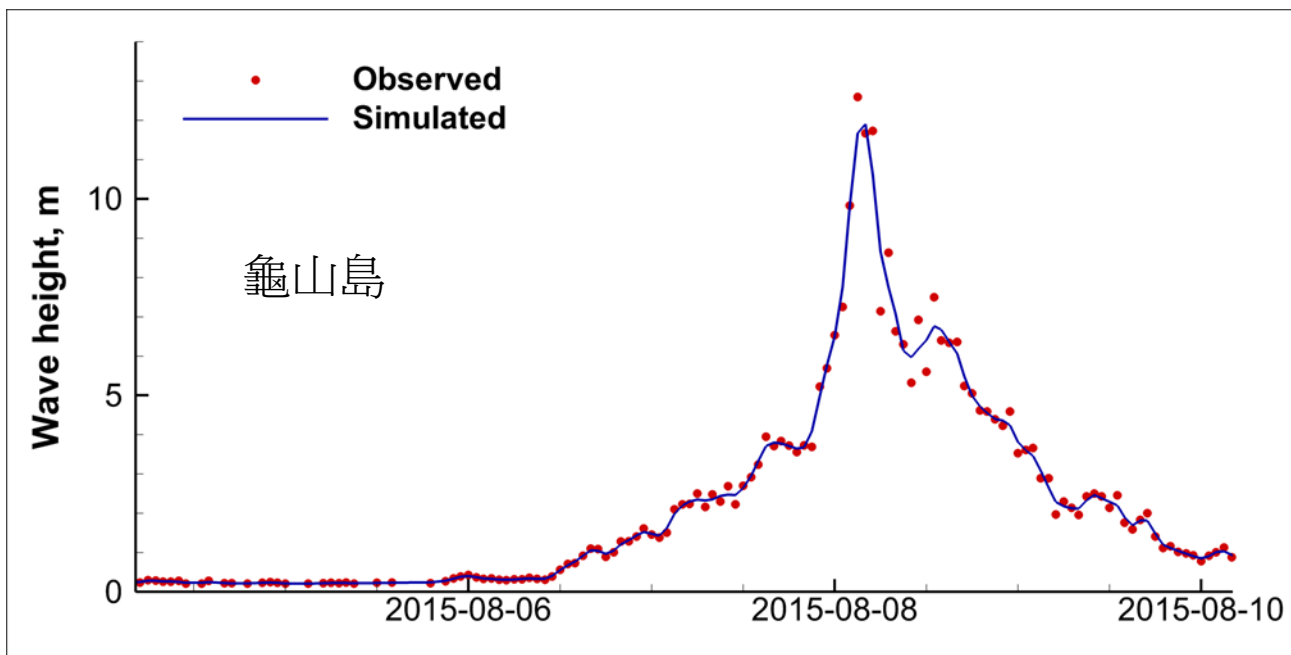


Model Domain for ACMS-TW (2016 and 2017)

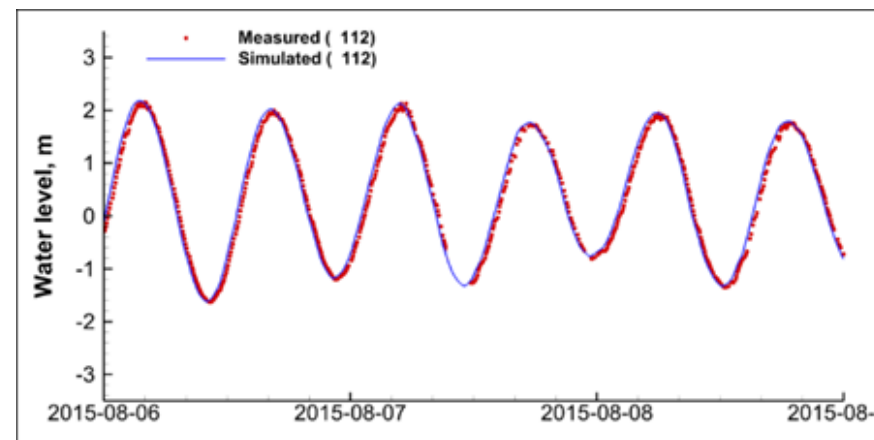


Water Level Data / Model Output Stations

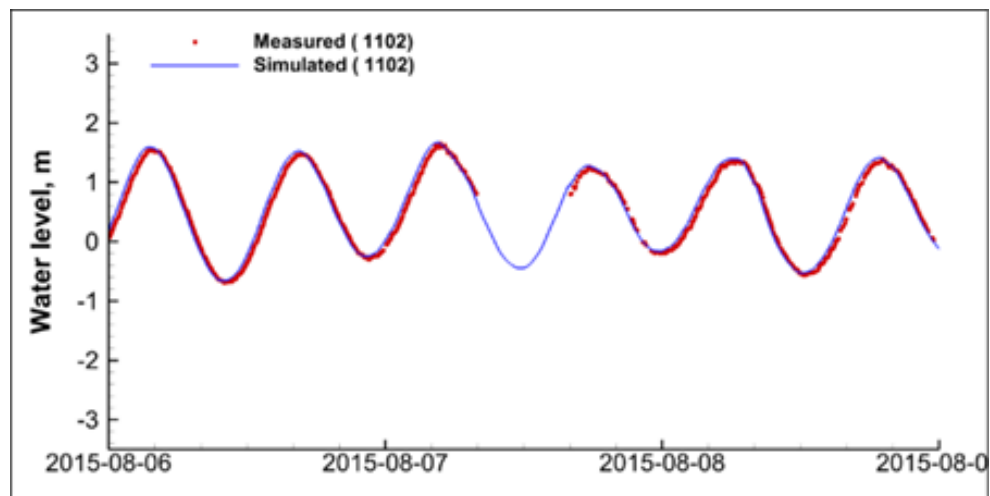




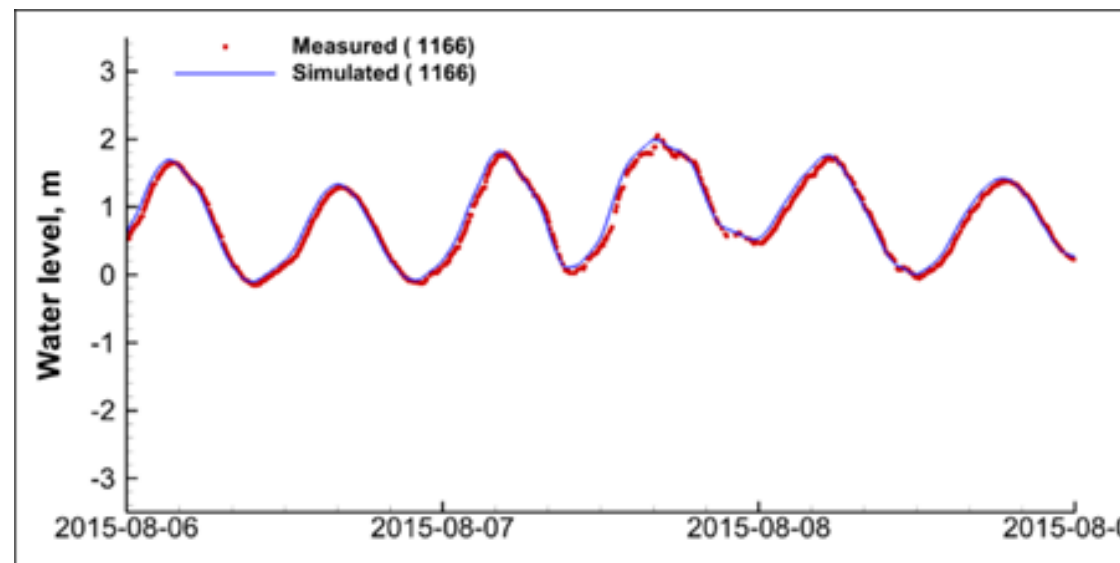
蘇迪勒



新竹



淡水



梧棲

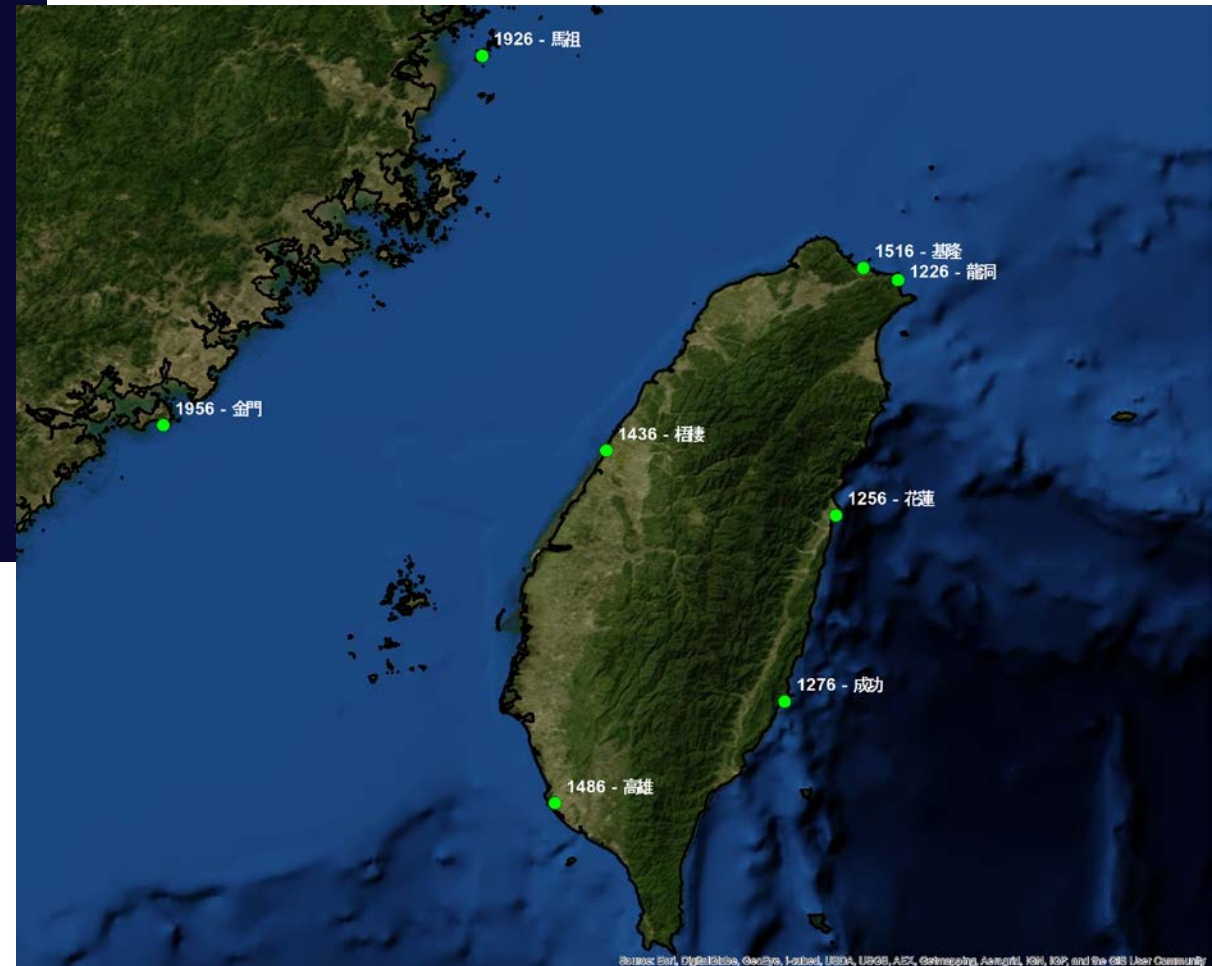
Summary of 2016 Forecasting

- System uptime → 78% during July-September.
- Tide prediction → 3-10% error.
- Water level prediction error:
 - Nowcast → 5.8-13.5%
 - 6 hour forecast → 9.8-17.4%
 - 12-hour forecast → 11.4-18.2%
 - 24-hour forecast → 20.3-31.4%
- Error = relative root-mean-square error (RRMSE)
= RMSE / local maximum surge or tide.
- Wave forecast compared well with observed data at wave stations.

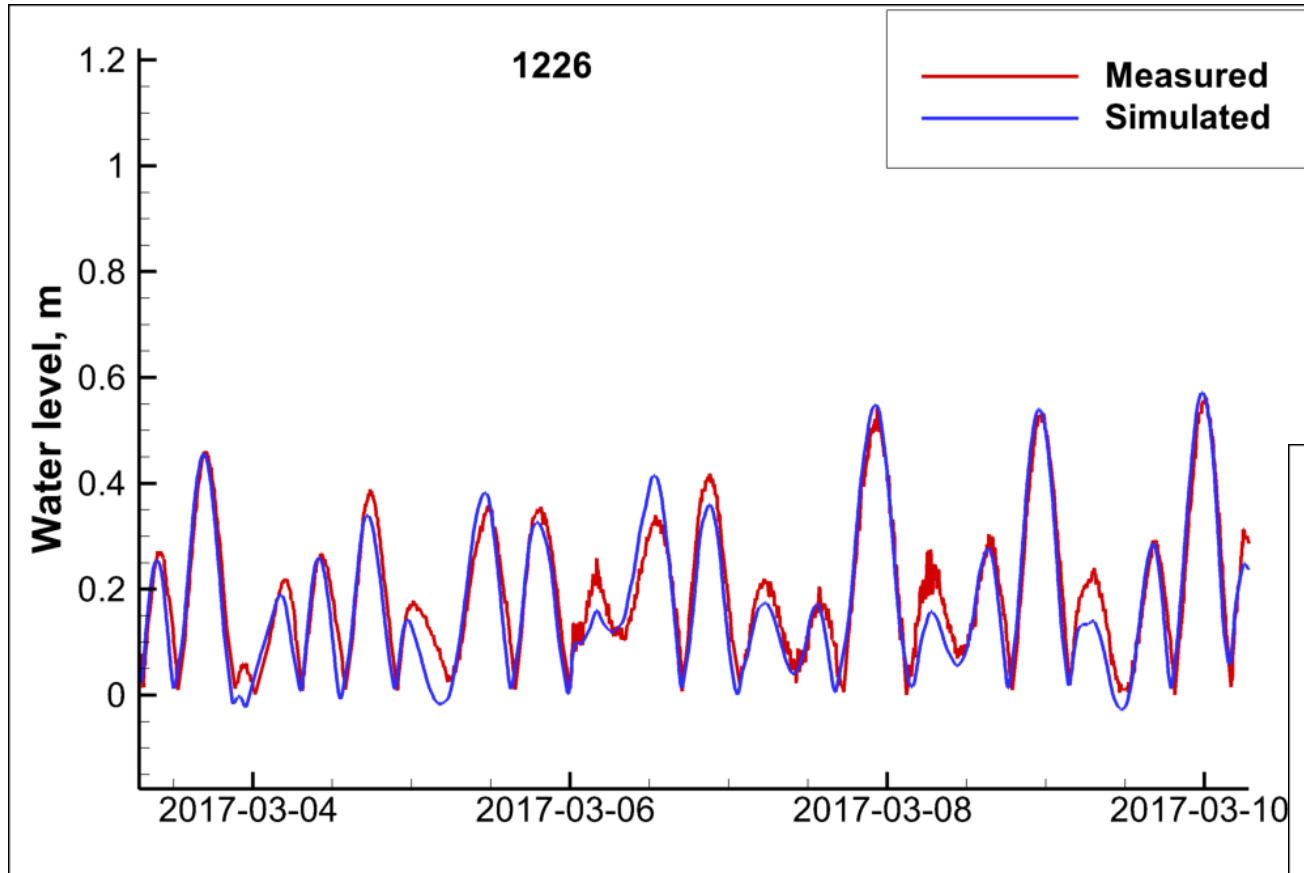
Accuracy and Efficiency

- The forecast error of water level increases quickly for 24-hour forecast, probably due to the quick decline of typhoon track/intensity forecast accuracy between 12-24 hours.
- This suggests the need to significantly improve the accuracy of typhoon intensity and track forecast.
- The TWRF forecast in 2017 will be significantly more accurate than before, it should be interesting to see if the 3-km grid resolution can resolve the typhoon dynamics with sufficient accuracy.
- The forecasting system was run efficiently using an Intel-based PC with the Intel® Core™ i7-3770 CPU @ 3.40 Ghz (4 cores/8 threads) with 32GB RAM. Wall time varies between 0.8 and 1.8 hours for each forecast cycle.

Typhoon Nesat in 2017

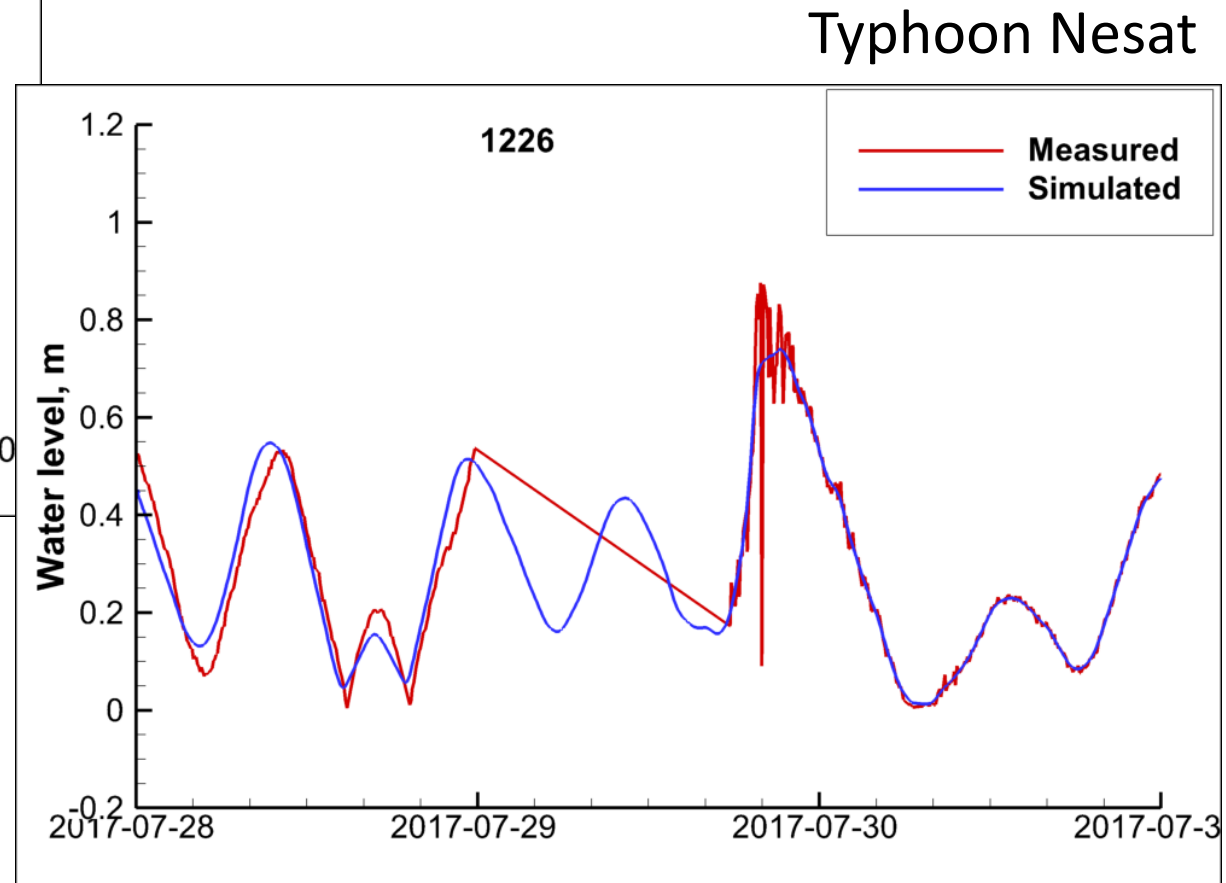


Simulated Water Level at Station 1226 – 龍洞

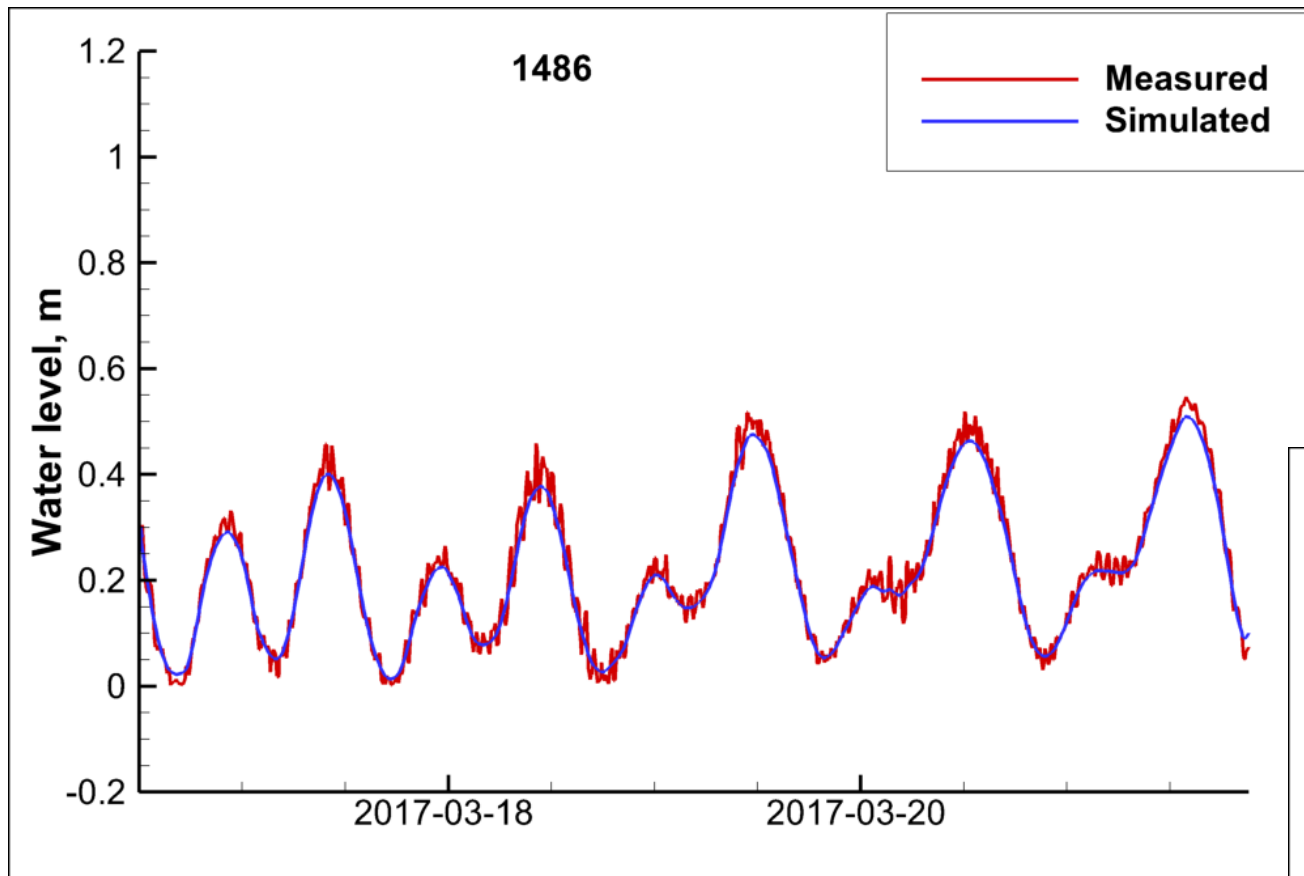


Tide-dominated

RMSE = 0.32m

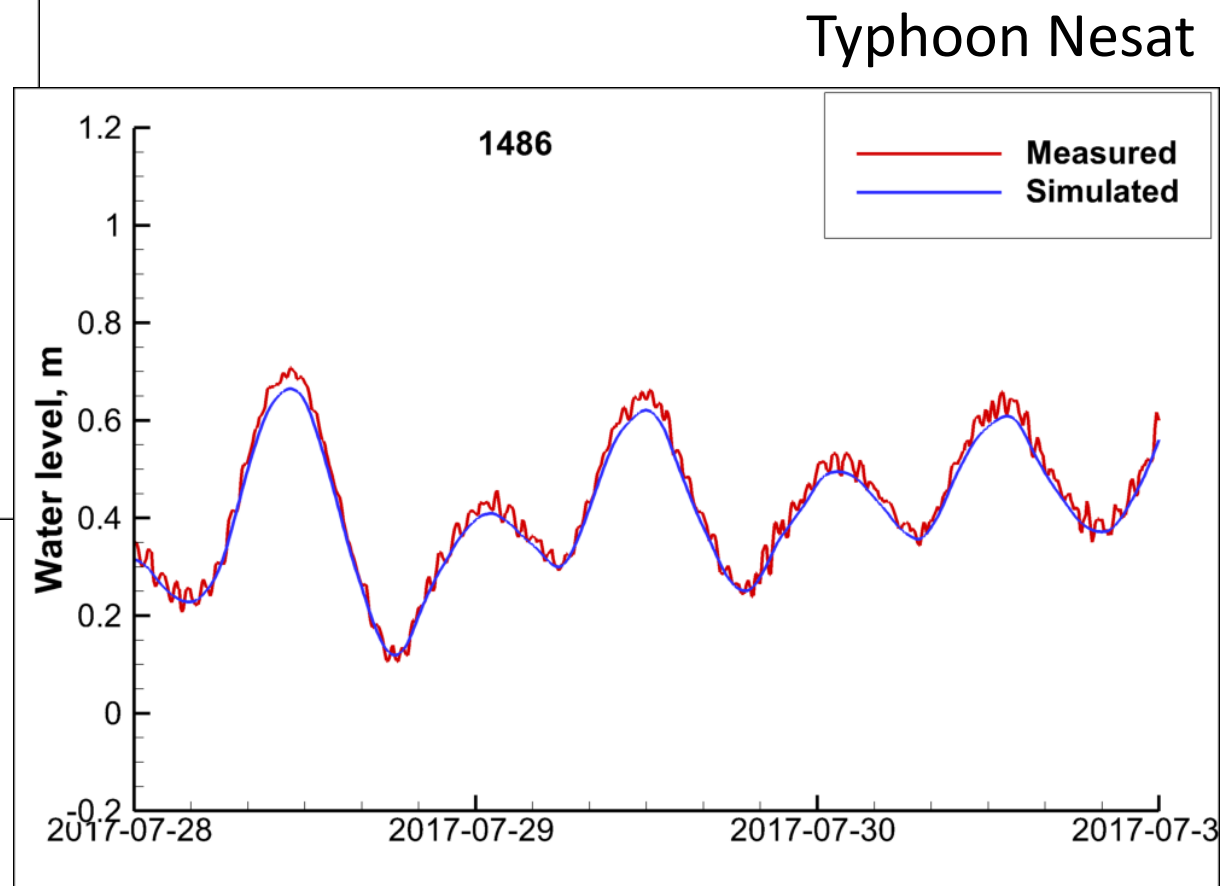


Simulated Water Level at Station 1486 – 高雄

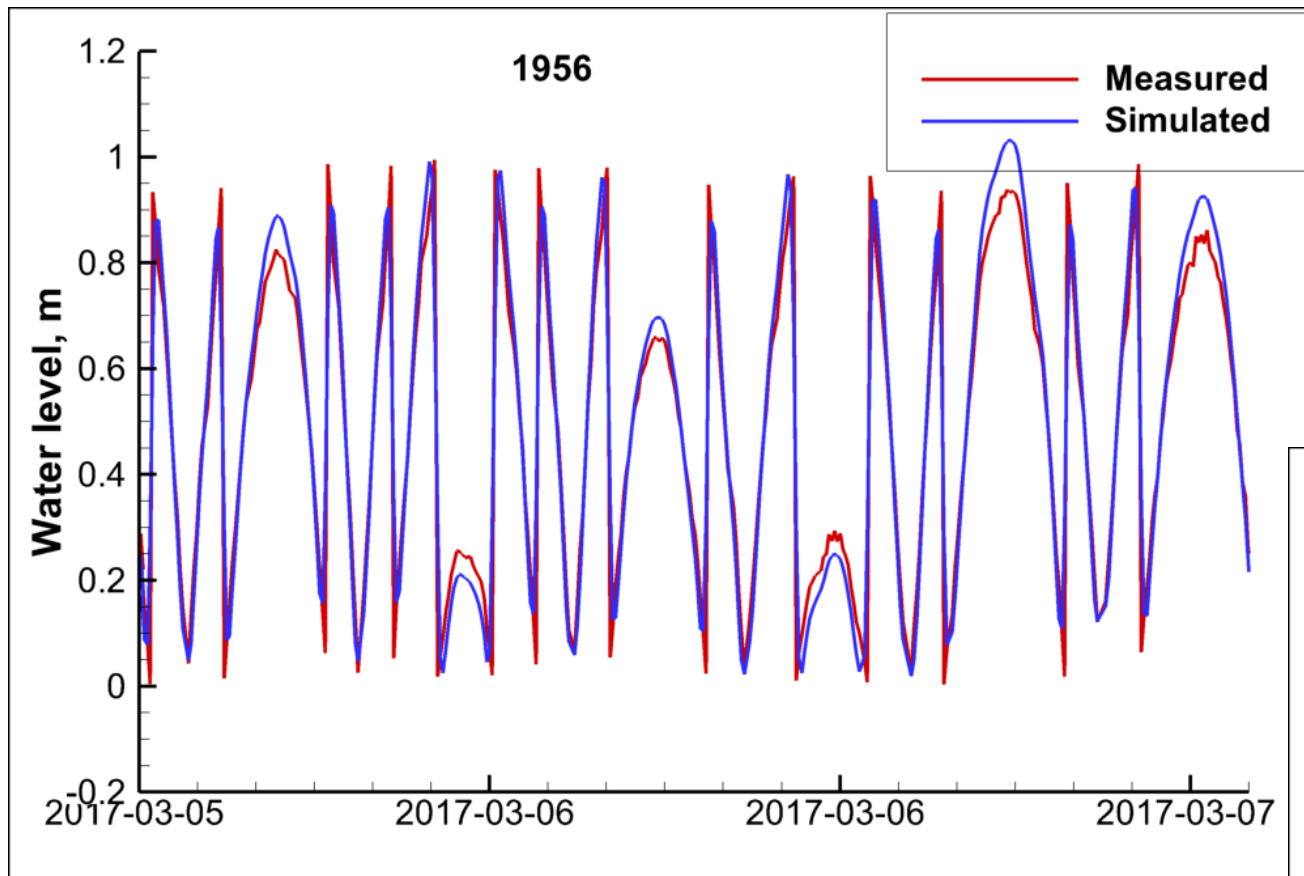


Tide-dominated

RMSE = 0.32m

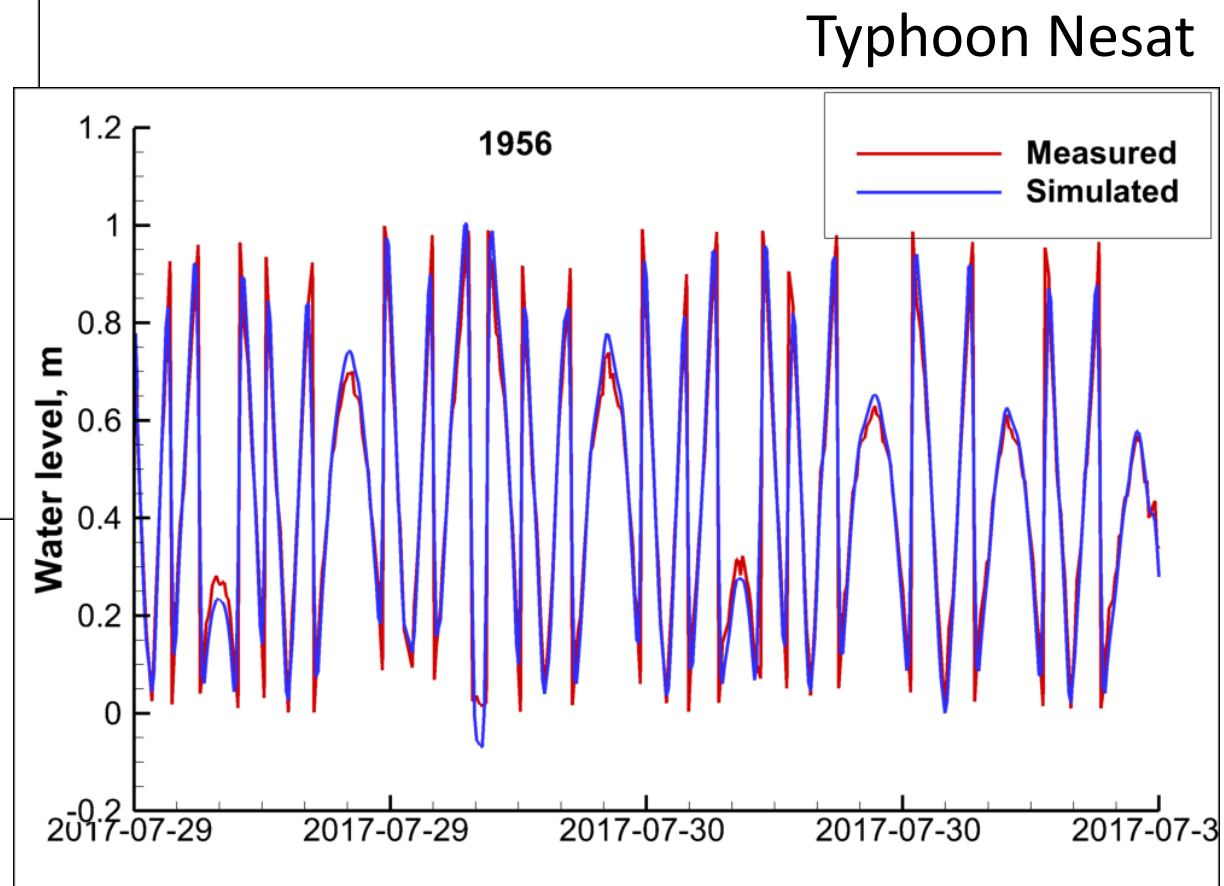


Simulated Water Level at Station 1956 – 金門

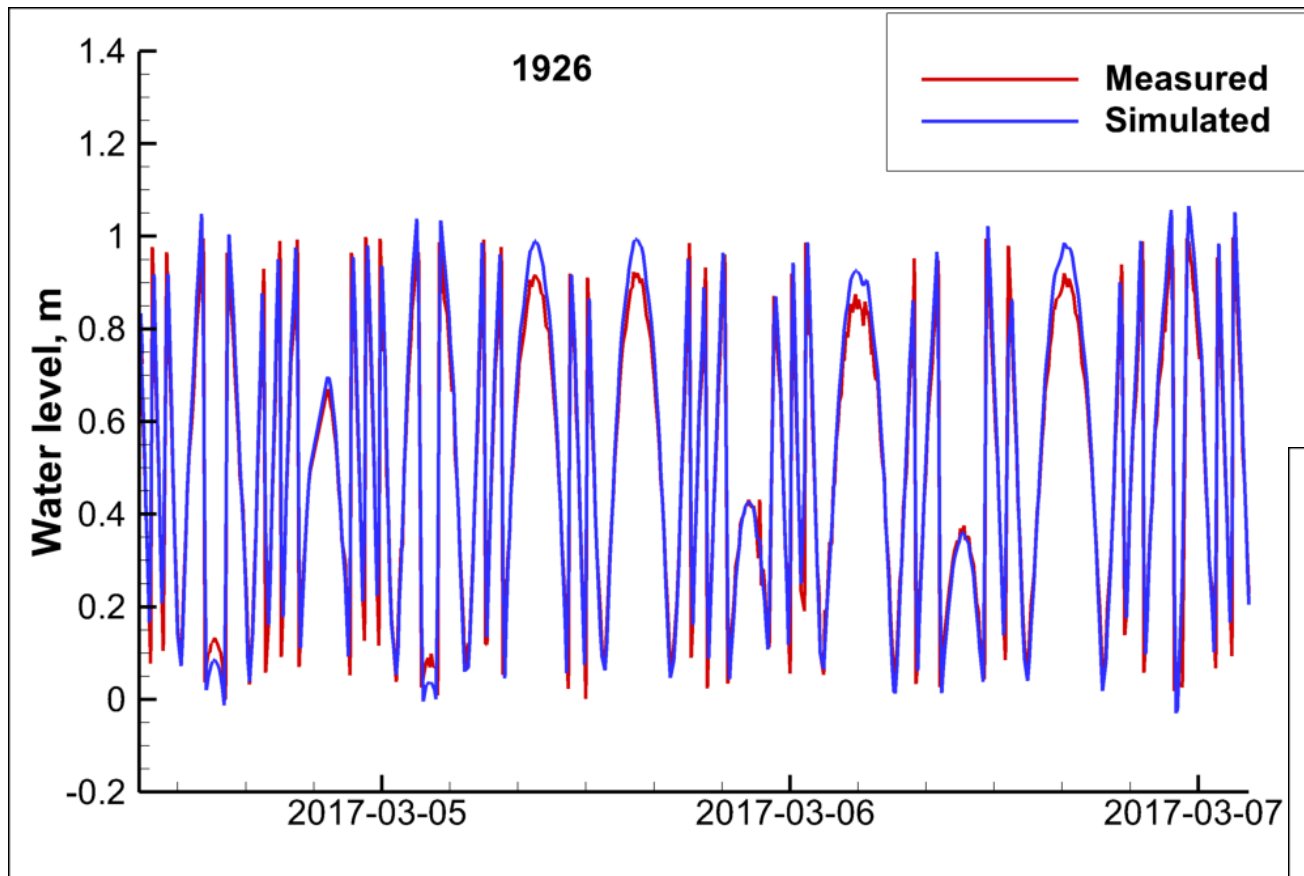


Tide-dominated

RMSE = 0.46m

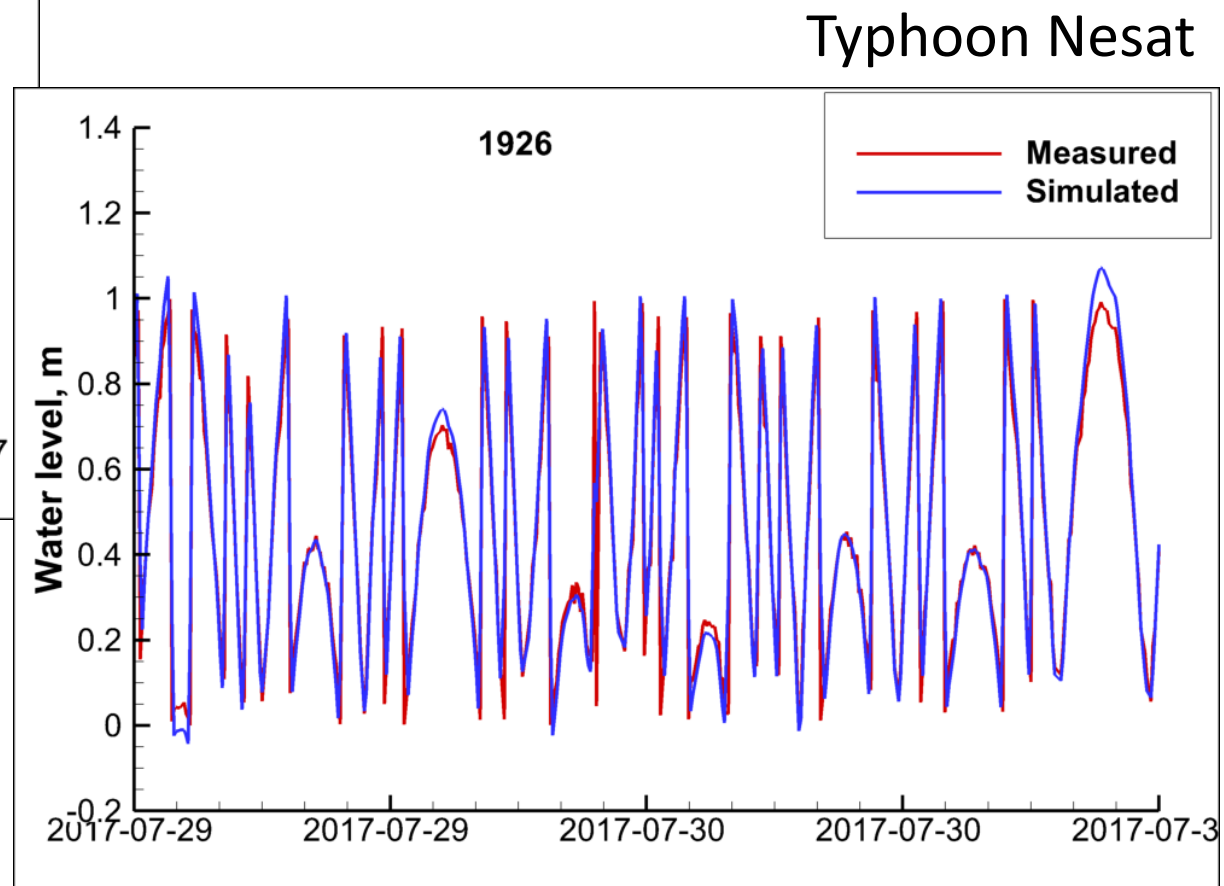


Simulated Water Level at Station 1926 – 馬祖



Tide-dominated

RMSE = 0.43m



Simulated Waves during Typhoon Nesat

