

CIFDP-I

Coupling of Wave and Hydrodynamic Models for Predicting Coastal Inundation: A case study in Jakarta and Semarang



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2017



OUTLINE

- Background
- Overview of CIFDP
- Coupling of Wave and Hydrodynamic Models
- Integrated into Flood Early Warning System (FEWS)
- Next Steps
- Summary



- Indonesia as archipelagic countries is very prone to coastal hazard
- Coastal flooding is associated with extreme wave events, tropical cyclones, and high tides
- Persisting threat of Tsunami
- Increased risk of coastal inundation due to sea level rise + land subsidence. As a Sample in Jakarta and Semarang City (northern coast of Java)







Western coast of Sumatera (May -2007)



Western coast of Sumatera (May 2007)



BMKG WARNING FOR STORM SURGE AND COASTAL INUNDATION AT SOUTHERN OF JAVA (8-10 JUNE 2016)

BASED ON BMKG – OFS

BMKG WARNING MAP



Storm tide occurred in 7th – 8th June, 2016 combination of **Spring Tide** and Propagation of **High Swell** generated from Mascarene High (Subtropical High) on Indian Ocean Western of Australia.

According to data from the National Agency for Disaster Management (BNPB) there werec23 cities in Java and Bali affected by the this storm tide.



COASTAL INUNDATION FORECASTING DEMONSTRATION PROJECT (CIFDP)

www.jcomm.info/CIFDP







Site Visit Semarang 2013



Workshop 2017



CIFDP – SYSTEM DESIGN





MODEL DIAGRAM

Atmospheric Forcing WRF 10km / GFS 0.5 ° WRF 3 Km. ECMWF 0.125 SWAN -SWAN-WW3-Global WW3-Indonesia JKT & SMRG Waves Model PANTURA **Hydrodynamic** Coupled Wave-Hydrodynamic Model model Delt3D-Delft3D-regional Pantura region storm surge (SCS) model JKT & SMRG Waters Local Tide **FEWS (Flood Early Warning System)** GFS (NOAA) BMKG Hourly Rainfall Telemetry (ARG, AWS) **BMKG Limited Area Model (WRF)** PUPR Hourly Rainfall Telemetry (ARG) not yet BMKG 10 Min RADAR (C-Band) t complemented ECMWF BMKG 10 Min Satellite Precipitation ē In progress PUPR Water Level Model Upstream Boundary **BMKG Data Base** FLOOD MODEL SOBEK 2.13 In progress Inundation Map



Model Scheme for Coastal Inundation

1.Coupled Wave-Hydrodynamic Model
1.1 Nested Wavewatch III (WW3) – SWAN model
1.2 Coupled Delft3d Flow – SWAN
Output: Tide + Storm Surge + Wave

2. Integrated with Delft FEWS and SOBEK Model Output: Coastal Inundation Maps



SIMULATION TEST

- Event: Coastal Flooding at Jakarta: June 5 -6, 2016
- Atmospheric Forcing (wind 10 m, pressure) : NCEP Final Analysis (0.5^o x 0.5^o)



Boundary conditions for these models are derived from the South China Sea (SCS) model for the storm surge and the Pantura (Northern coast of Java) region for the storm surge and wave signal.

Tidal components are also prescribed at the open boundaries of the detail model to obtain as accurately as possible forecast of total water level at Semarang and Jakarta to allow for proper flood forecast.



SIMULATION TEST (SURGE BOUNDARY & WAVE SIGNAL)

Storm surge is computed by the SCS model. The results are fed to the Pantura area, and

nested to the detail region (Jakarta & Semarang)





Wave Signal form WW3 Model (Resolution: 0.0625° x 0.0625°)

SIMULATION TEST (COUPLED DELFT3D FLOW + SWAN MODEL)



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Surge Boundary Condition + Wave Signal **Coupled Delft3d Flow + Swan Model**



SIMULATION TEST (INTEGRATED WITH DELFT FEWS AND SOBEK MODEL)

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Total Water Level : Tide + Storm Surge + Wave





INUNDATION MAP RESULT: (JUNE 05-06, 2016)





PRELIMINARY MODEL VALIDATION (1)

Observation vs Surge SCS vs Tide+Surge+Wave



Computed water level at the port Entrance of Jakarta by the Jakarta detail flooding model that includes tide, surge and wave set-up compared to observations.



PRELIMINARY MODEL VALIDATION (2) - JAKARTA

Model CIFDP-I

Obs:Tide Gauge

Astronomical Tide Prediction





PRELIMINARY MODEL VALIDATION (2) - SEMARANG

Model CIFDP-I

Obs: Tide Gauge





NEXT STEPS

- The grid will be refined (at the moment it is approximately 150 m),
- Bathymetry and DEM (Digital Elevation model) will be updated (new dataset),
- Coastal protection structures (in the form of weirs and thin dams) and river discharges boundary condition for local model Jakarta and Semarang will be added.



- The simulation results compare favorably with observed water level, quantified by the RMSE of 6.6 cm and 7.8 cm for Jakarta and Semarang domain respectively.
- The remaining challenges in further development is to refine the models resolution and to improve the bathymetry and DEM.



THE TECHNICAL CONFERENCE "TOWARD AN INTEGRATED MET-OCEAN MONITORING, FORECASTING, AND SEVICES SYSTEM" 23-24 OCTOBER 2017 5TH SESSION OF THE WMO-IOC JOINT TECHNICAL COMMISSION FOR OCEANOGRAPHY AND MARINE METEOROLOGY (JCOMM-5) 25 – 29 OCTOBER 2017

Bali, Indonesia



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