105年天氣分析與預報研討會

Simulating Storm Surge and Inundation along the Coast of Taiwan during Typhoon Fanapi in 2010 and Soulik in 2013

報告人：陳旻技士/中央氣象局海象測報中心

105年10月05日

生活有氣象

Weather+ Service Observation Climate Forecasts Satellite Earthquakes Marine Radar Astronomy

內容大綱

(一)前言
(二) ACMS模式簡介
(三) Fanapi ,Soulik 模擬結果
(四)結論

計畫架構

- 強化臺灣海象暨氣象災防環境監測計畫104-109
  - 其他子計畫
  - 建構臺灣海象及氣象災防環境服務系統106-109
    - 其他子計畫
    - 建置近岸區域海象預報整合系統

Weather+ Service Observation Climate Forecasts Satellite Earthquakes Marine Radar Astronomy

3

計畫目標與效益

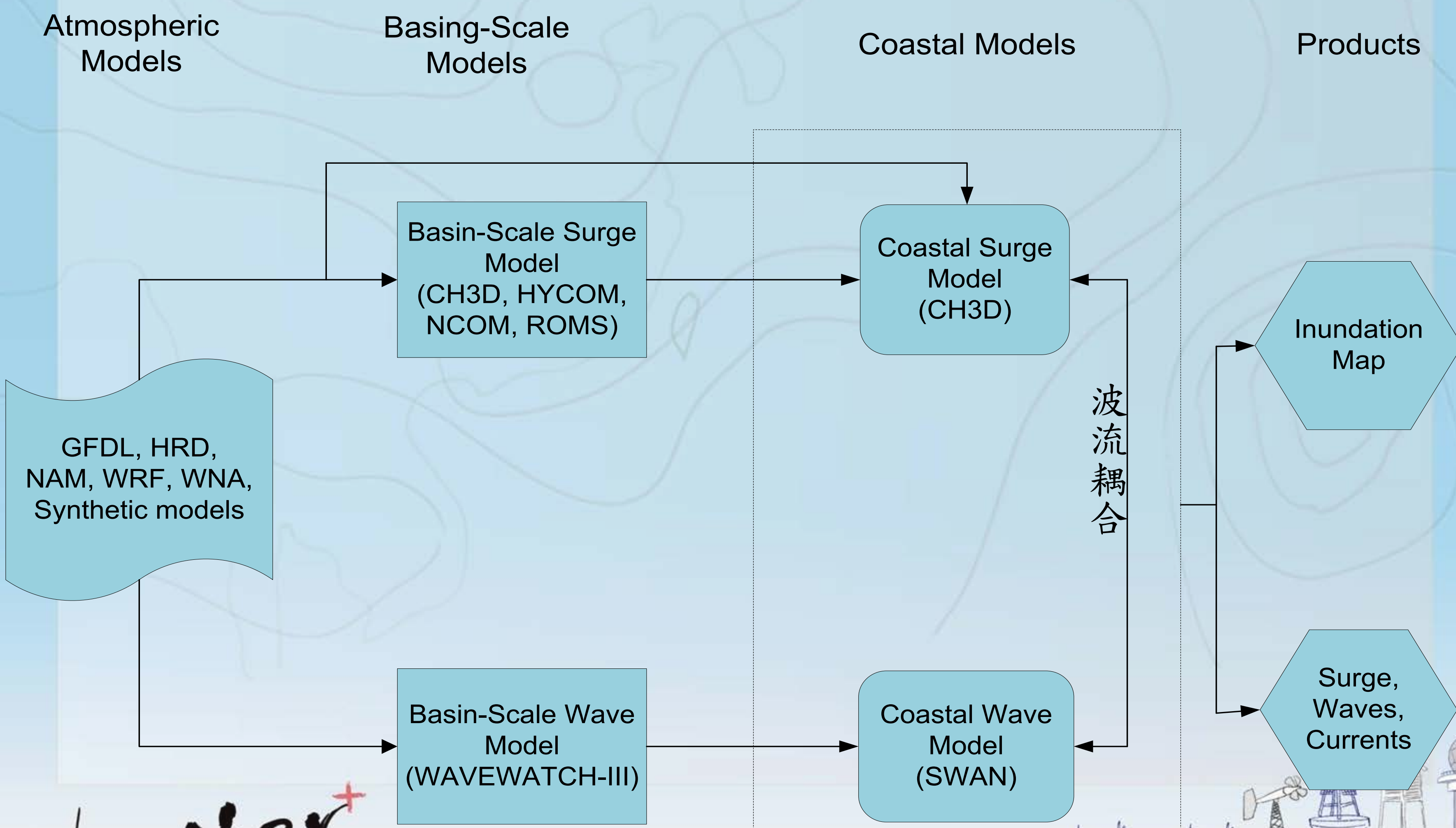
- 目標
  - 發展波潮流偶合預報技術
  - 發展暴潮系集預報技術落實防災氣象整合資訊實作計畫
- 效益
  - 建置百公尺級近岸海象資訊整合系統，海岸災害預警時間可提前5天。
  - 提升本局近岸海域海象預報技術與能力

分年工作項目

- 105年
  - 分析、評估與選定可使用之海氣象觀測資料
  - 建立一個暴潮模式測試平台，分析比較國內外不同暴潮模式
  - 引進與發展波潮流偶合技術
- 106年
  - 舉辦小型研討會與國內近岸暴潮及波浪專家學者交流
  - 比較重要暴潮模式之精確度及效率
- 107年
  - 用雛形模式來模擬三個過去的颱風
  - 用雛形近海海象災防整合預報系統，進行三個月的連續預報運作測試
  - 發展與建置高效率暴潮溢淹統計系集機率預報系統
- 108年
  - 近海海象災防整合預報系統作業模式之建置
  - 近海海象災防整合預報系統作業模式之作業測試
  - 國內培訓或發展不同氣候變遷情況下近岸暴潮海水倒灌與溢淹風險評估
  - 發展不同氣候變遷情況下近岸暴潮海水倒灌與溢淹風險評估

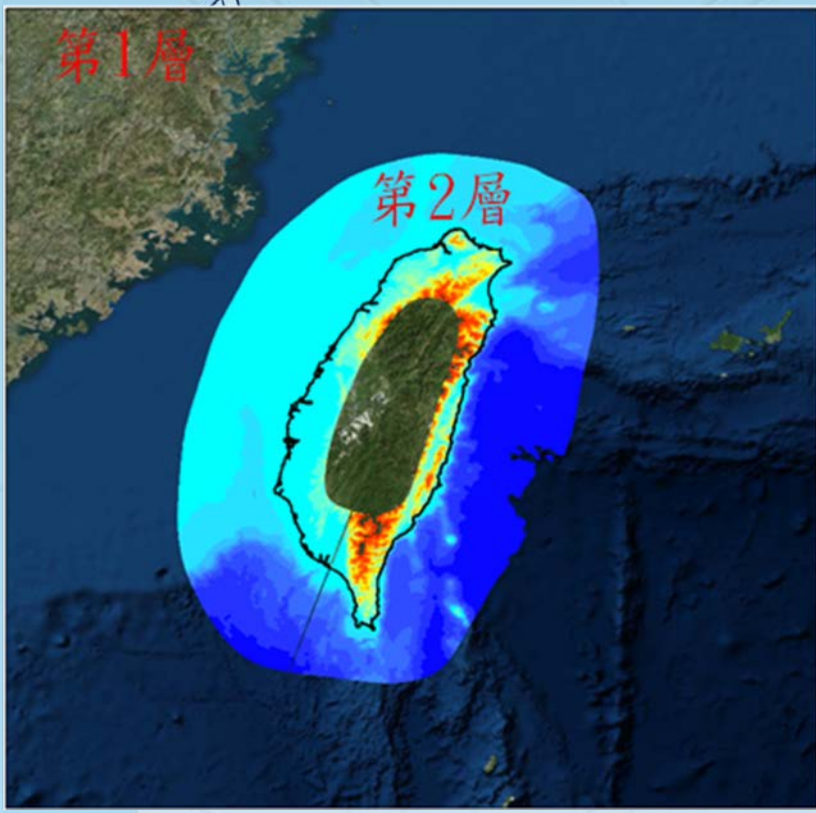
Weather Service Observation Climate Forecasts Satellite Earthquakes Marine Radar Astronomy

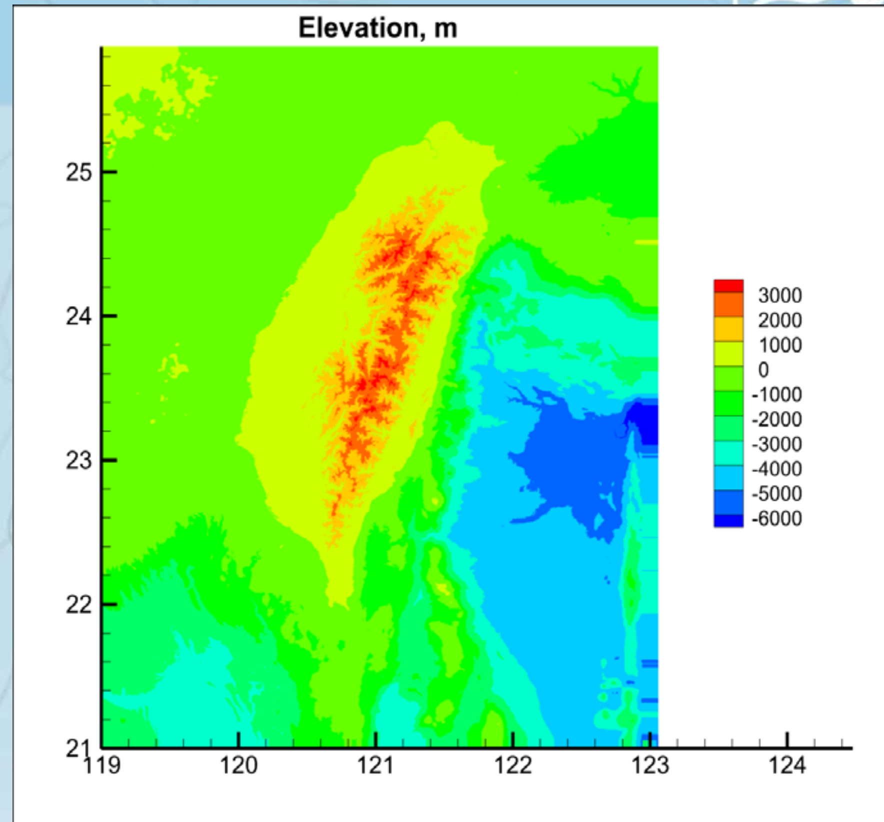
Advanced Coastal Modeling System (ACMS) 結構圖



Weather Service Observation Climate Forecasts Satellite Earthquakes Marine Radar Astronomy

MODEL DOMAIN





水平網格大小在50-300 米間。海岸往外海
80-100 公里。 海岸往陸地 30-40 公里

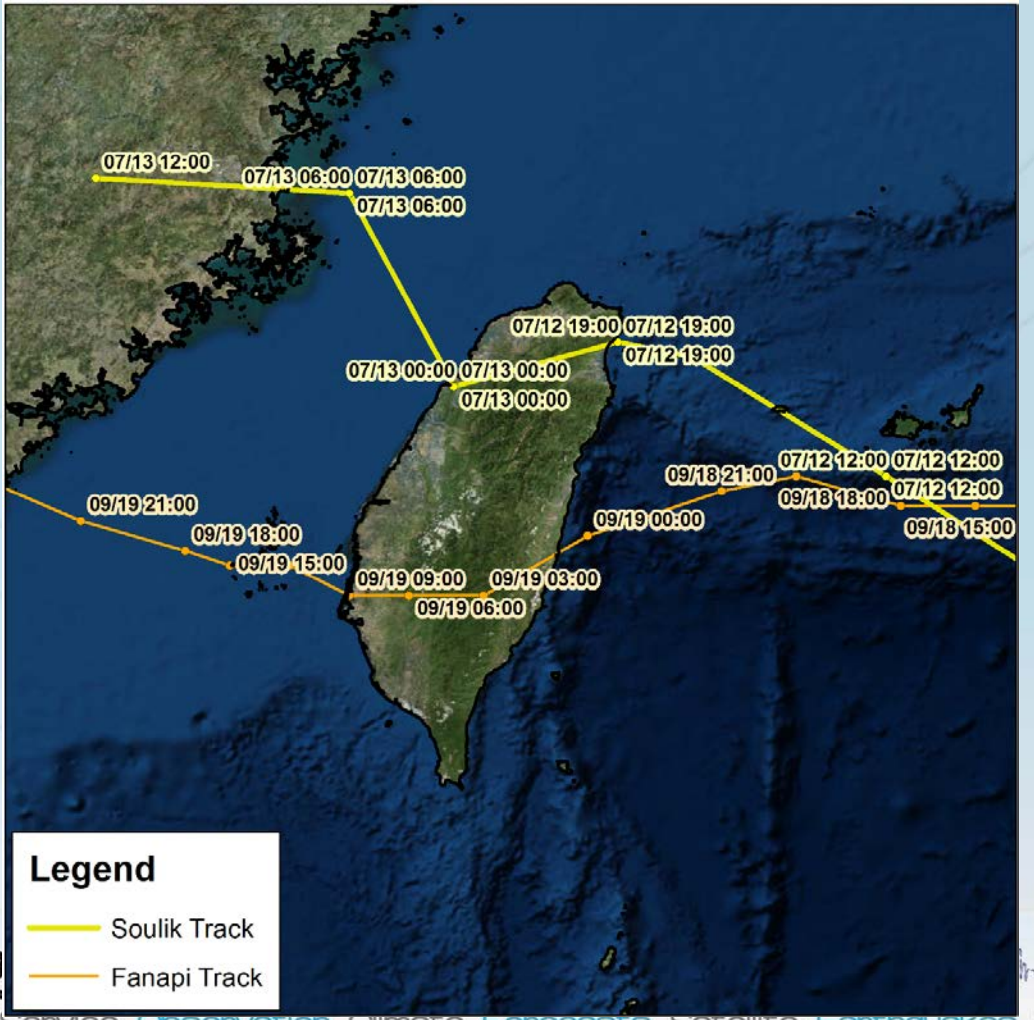
CWB提供之陸地及海岸地形高度圖（200米解析度）

國內外模式比較

Modeling System	**CH3D-SSMS**	**SLOSH**	CWB-1	CWB-2/NCU
Surge Model	**CH3D**	**SLOSH**	ADI	COMCAT
Model Formulation	Finite Difference/ Finite Volume	Finite Difference	Finite Difference	Finite Difference
Horizontal Model Grid	Structured Boundary-fitted Non-orthogonal Curvilinear	Structured Orthogonal Curvilinear	Structured Spherical-Polar	Structured Spherical-Polar Rectangular
Dimensionality	2D / 3D	2D	2D	2D
Wave Model	SWAN		No	No
Regions Applied	East Coast Gulf Coast	East Coast Gulf Coast	taiwan	taiwan
Wind Fields	Real/ Parametric	Parametric	NFS, JMA, NCEP	TWRF

(三) Fanapi ,Soulik 模擬結果

Best tracks of typhoons Fanapi (2010) and Soulik (2013) passing over Taiwan.



Estimated contributions of different components (2013 Soulik)

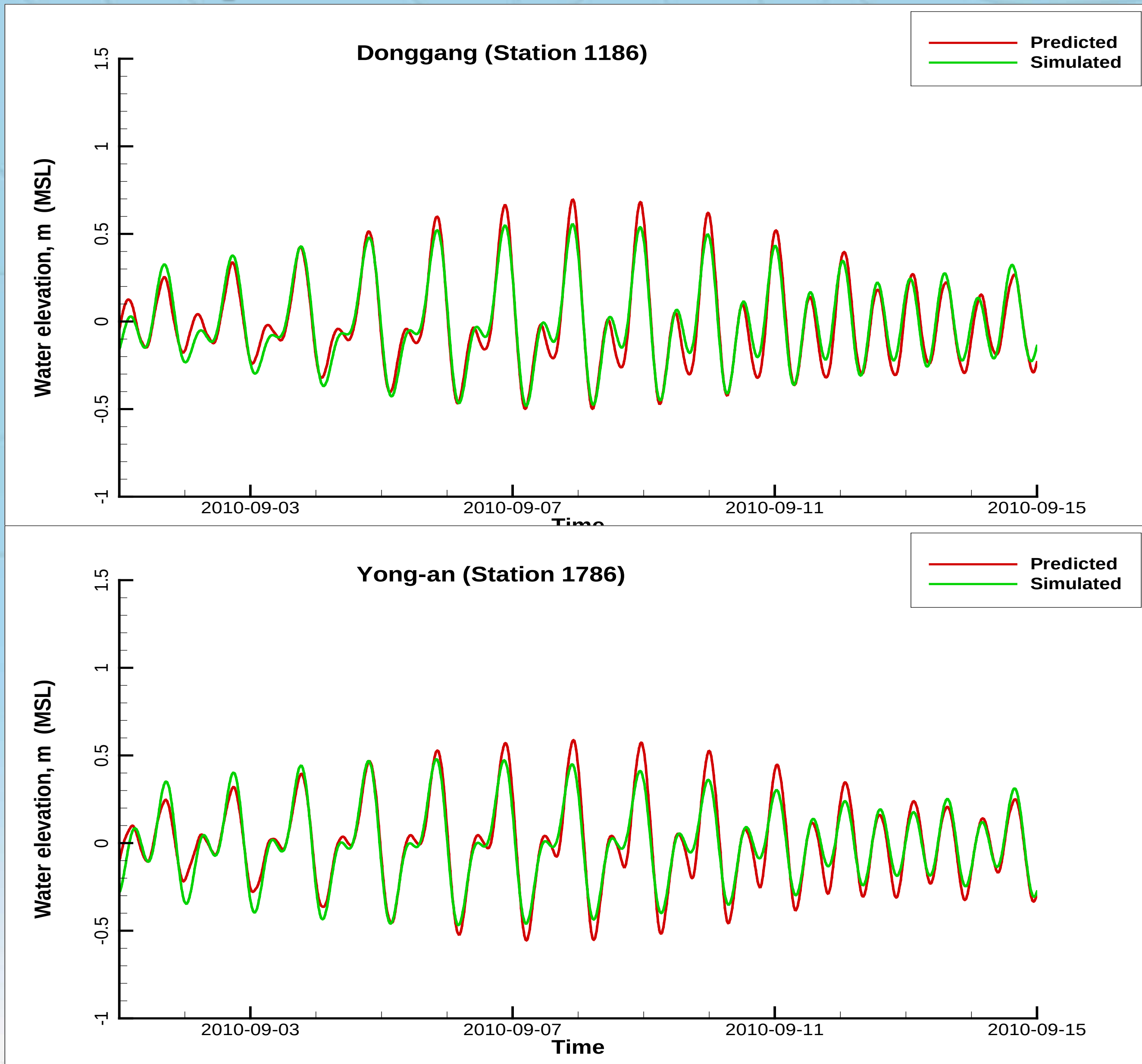
Station	Tide (m)	Surge (m)	Wave Setup (m)
Hualien	0.85	0.22	0.01
Jiangjun	1.07	0.03	0.00
Kaohsiung	0.59	0.01	0.00
Keelung	0.55	0.53	0.08
Longdong	0.14	1.14	0.20
Suao	0.85	0.25	0.03

RUN1:simulations which include the forcing of wind, tides, and waves
RUN2:run with wind and tidal forcing but without coupling to the wave model, to determine the water level due to wind and tide.
RUN3:running ACMS with tidal forcing only without any wind and wave effect, to estimate the water level due to tides only.

RUN1 - RUN2 = wave setup,
RUN1 – RUN3 = total surge,
RUN2 – RUN3 = wind surge

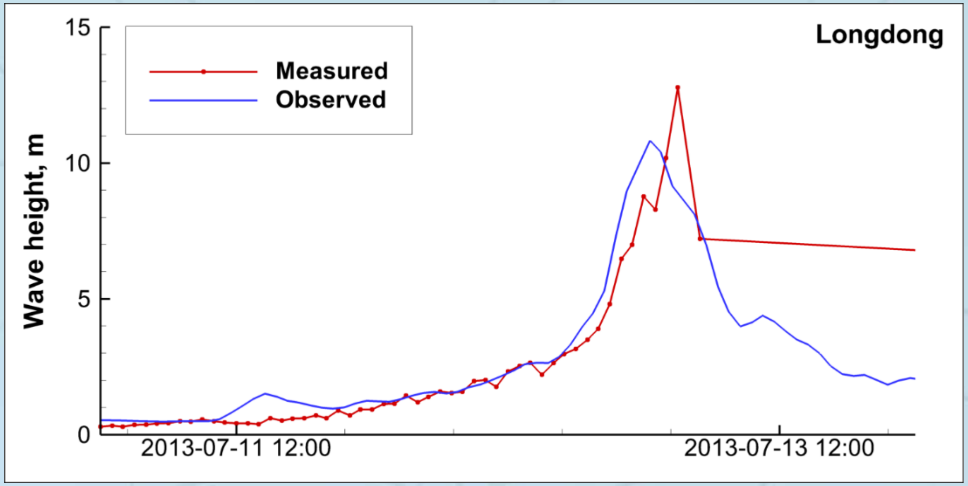
Weather Service Observation Climate Forecasts Satellite Earthquakes Marine Radar Astronomy

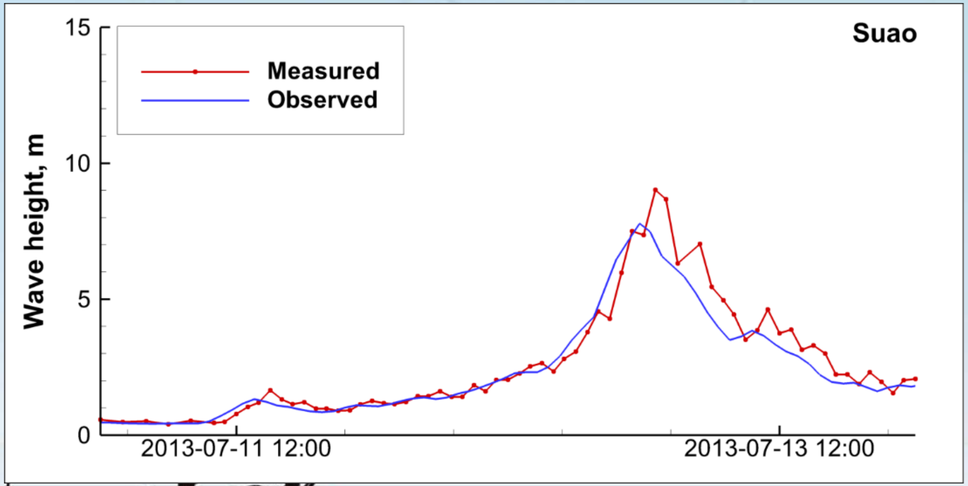
Fanapi: tide simulation



Marine Radar Astronomy

Soulik: wave simulation

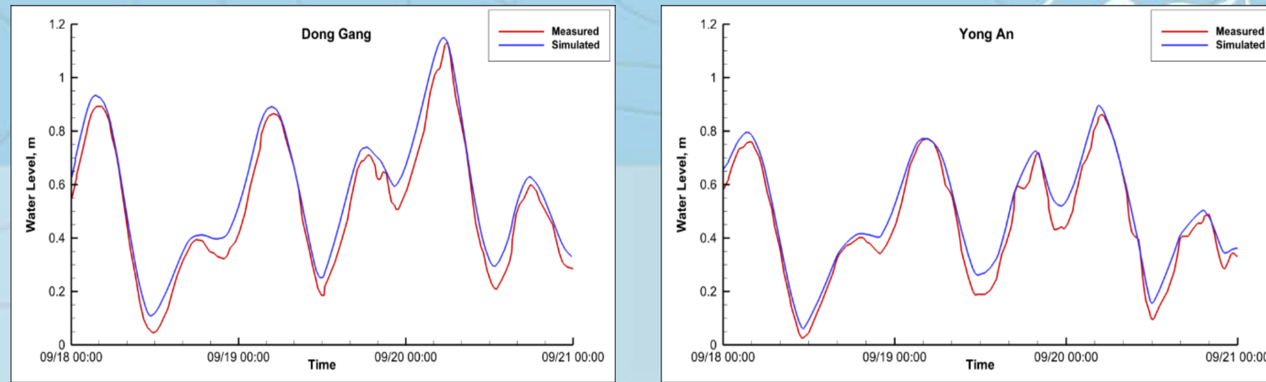




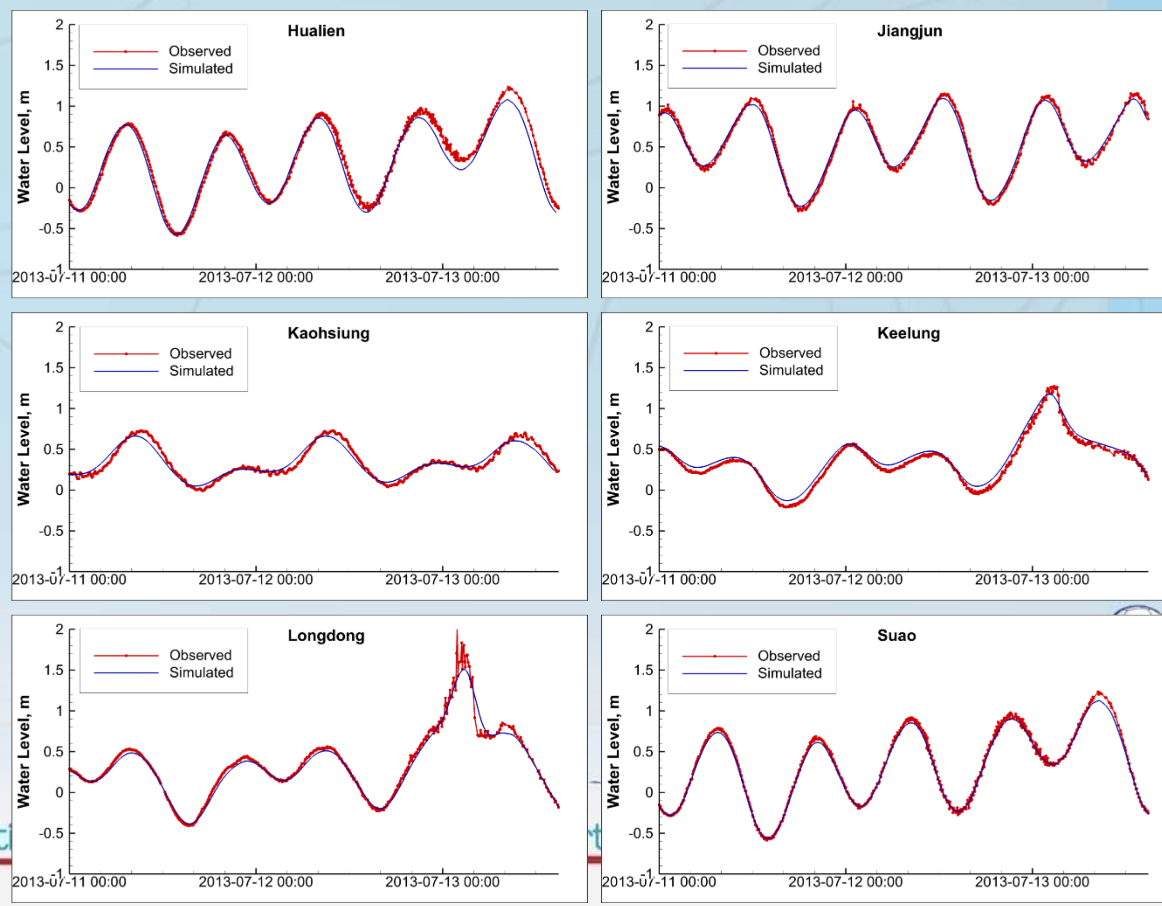
Simulated waves using the SWAN model agree well with observed data

Simulated water levels coupled ACMS in 3-D mode

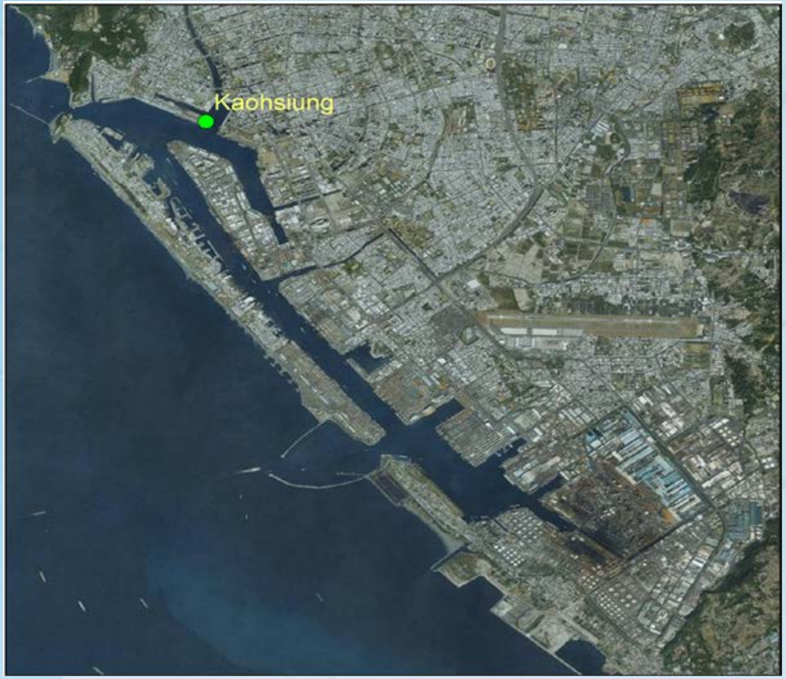
Fanapi

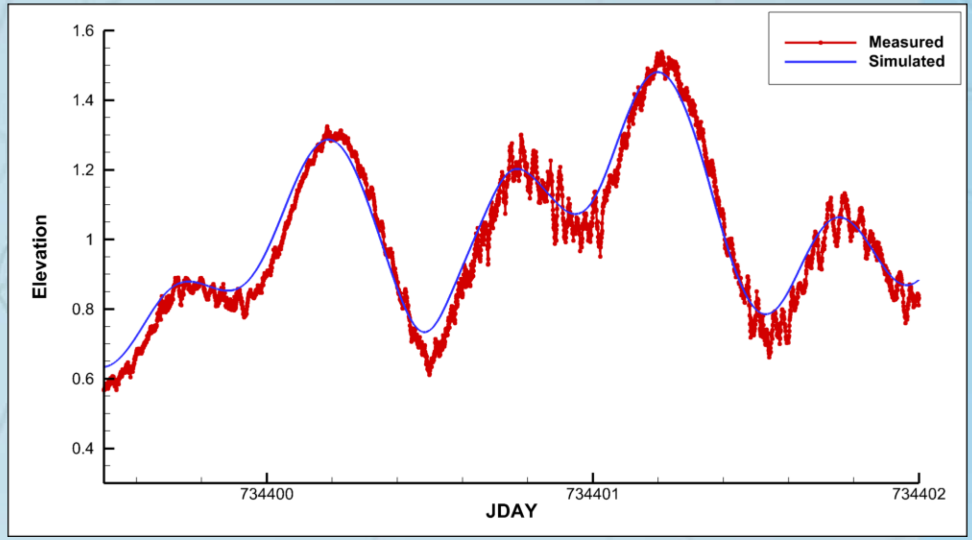


Soulik

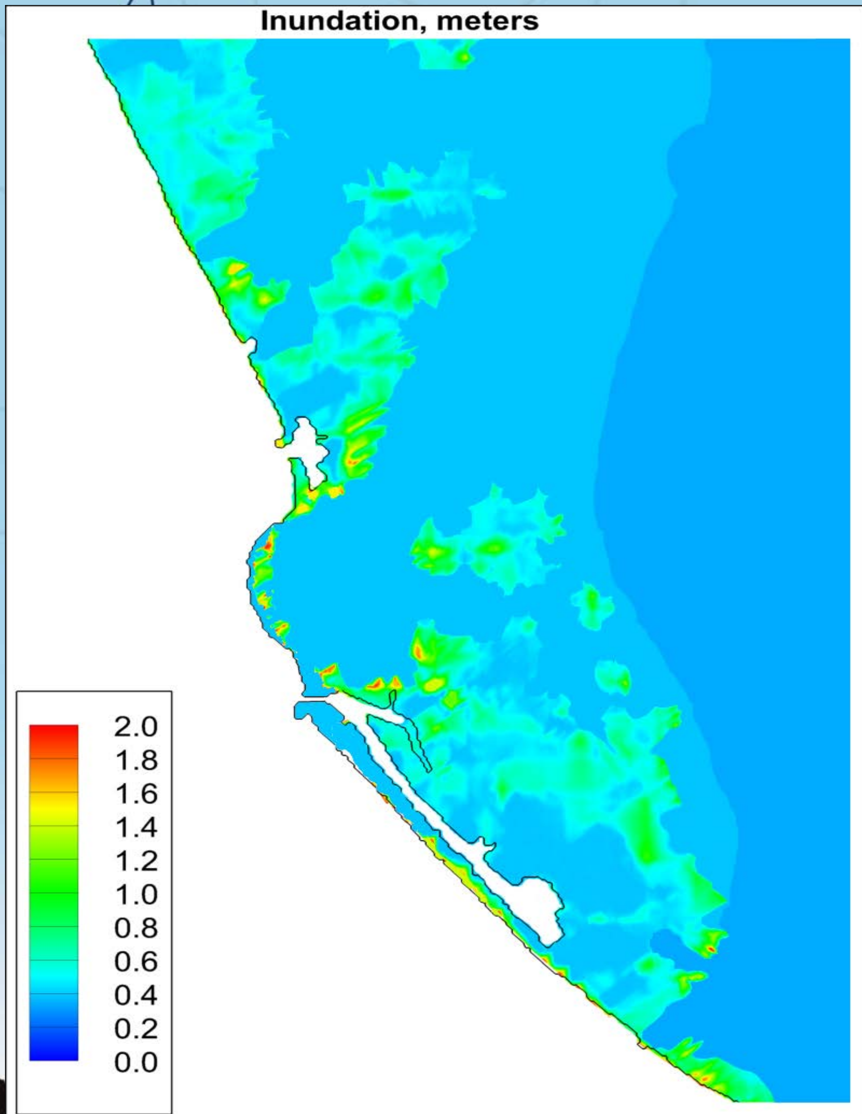


simulated water level at Kaohjsiung station using TW-KS grid

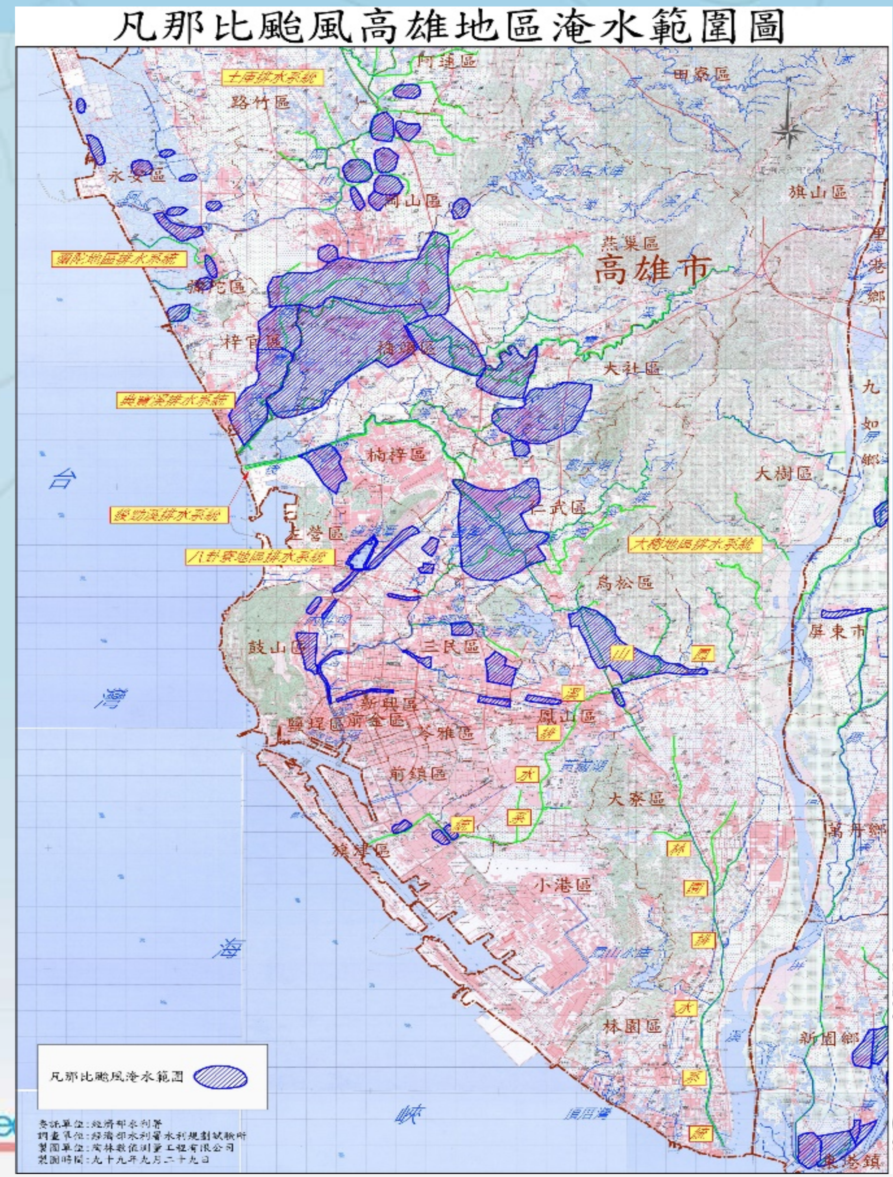




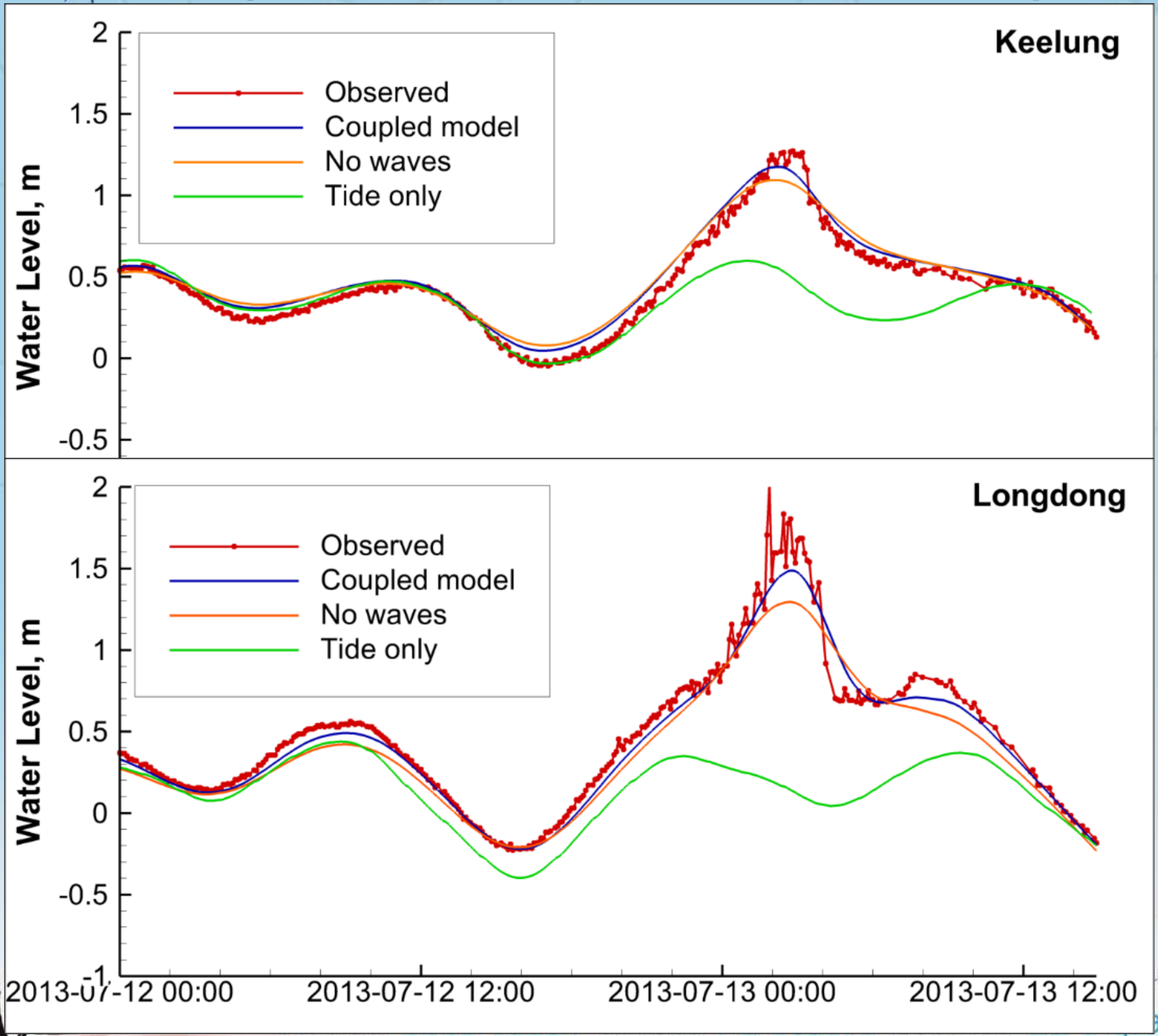
Simulated inundation map for Kaohsiung Area during Typhoon Fanapi



Map of observed flooding during Fanapi (from MOE 2010)



Comparison of contributions of different components to the total water(Soulik)



tides,
surge and
wave setup

Conclusions:

1.Storm surge and coastal inundation over Taiwan has been successfully simulated for Typhoons Fanapi (2010) and Soulik (2013) using ACMS which is based on the CH3D curvilinear-grid hydrodynamics model coupled to SWAN wave model using two coastal grids coupled to a coarse (500 m) model grid.

2.Analysis of contributions of astronomical tides, wind-induced surge and wave setup to the total water level shows that wave setup can contribute almost 20% to the total water level.

3.Model simulated coastal inundation can be improved by acquiring more and better precipitation data as well as river and flow data or connecting the model to a watershed model which would provide the runoff of water which is currently missing.

4.Due most likely to climate change impacts, precipitation in recent typhoons has increased dramatically. Climate change also affects the frequency of occurrence and intensity of typhoon, as well as sea level rise, and hence storm surge and coastal inundation

報 告 完 畢
敬 請 指 導