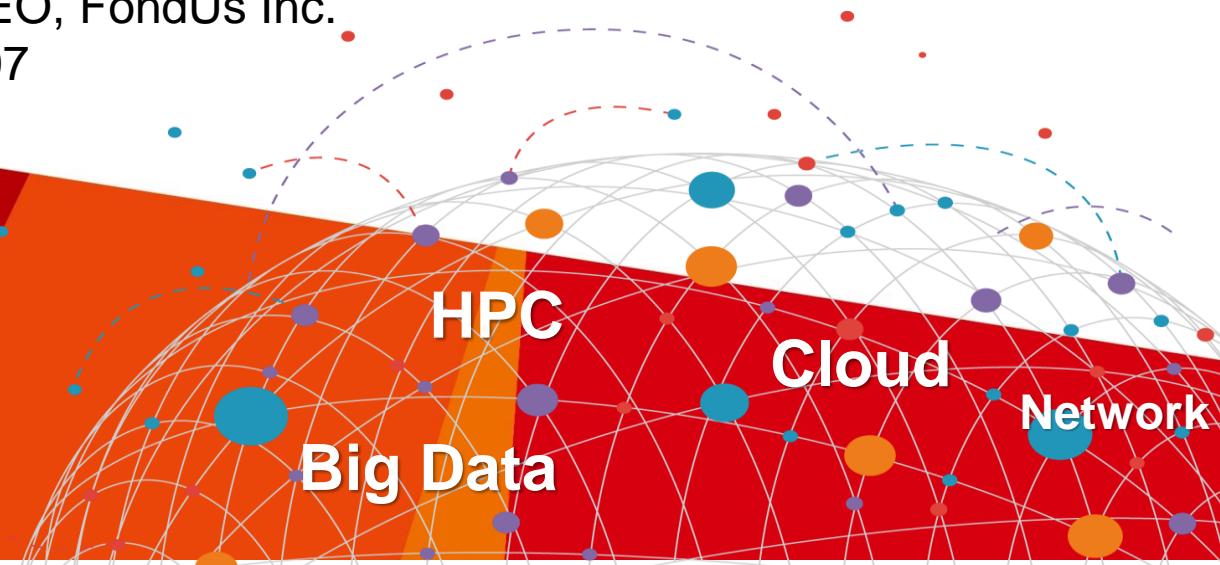


A model oriented interlink among platforms of IoT, AI, and FEWS

Che-Hao Chang,
Associate Professor, National Taipei University of Technology
chchang@ntut.edu.tw

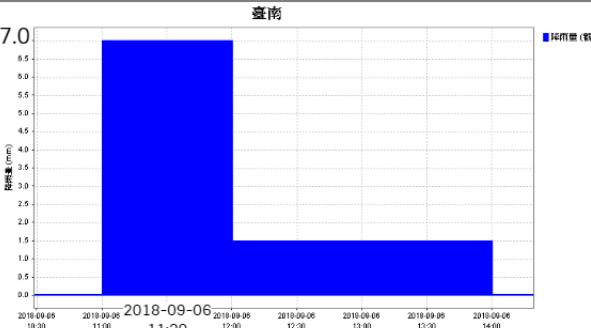
Chih-Tsung Hsu, Shiang-Jen Wu, Researcher, NCHC
Jhih-Cyuan Shen, CEO, FondUs Inc.
DSD Delft, 2019/11/07



Uncertainties in Hydrosystem

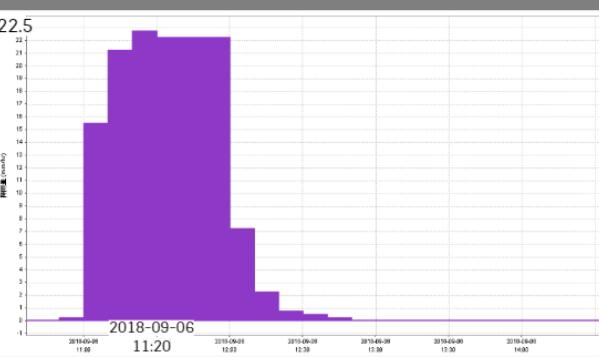
High Spatial Uncertainty

Gauge Tainan

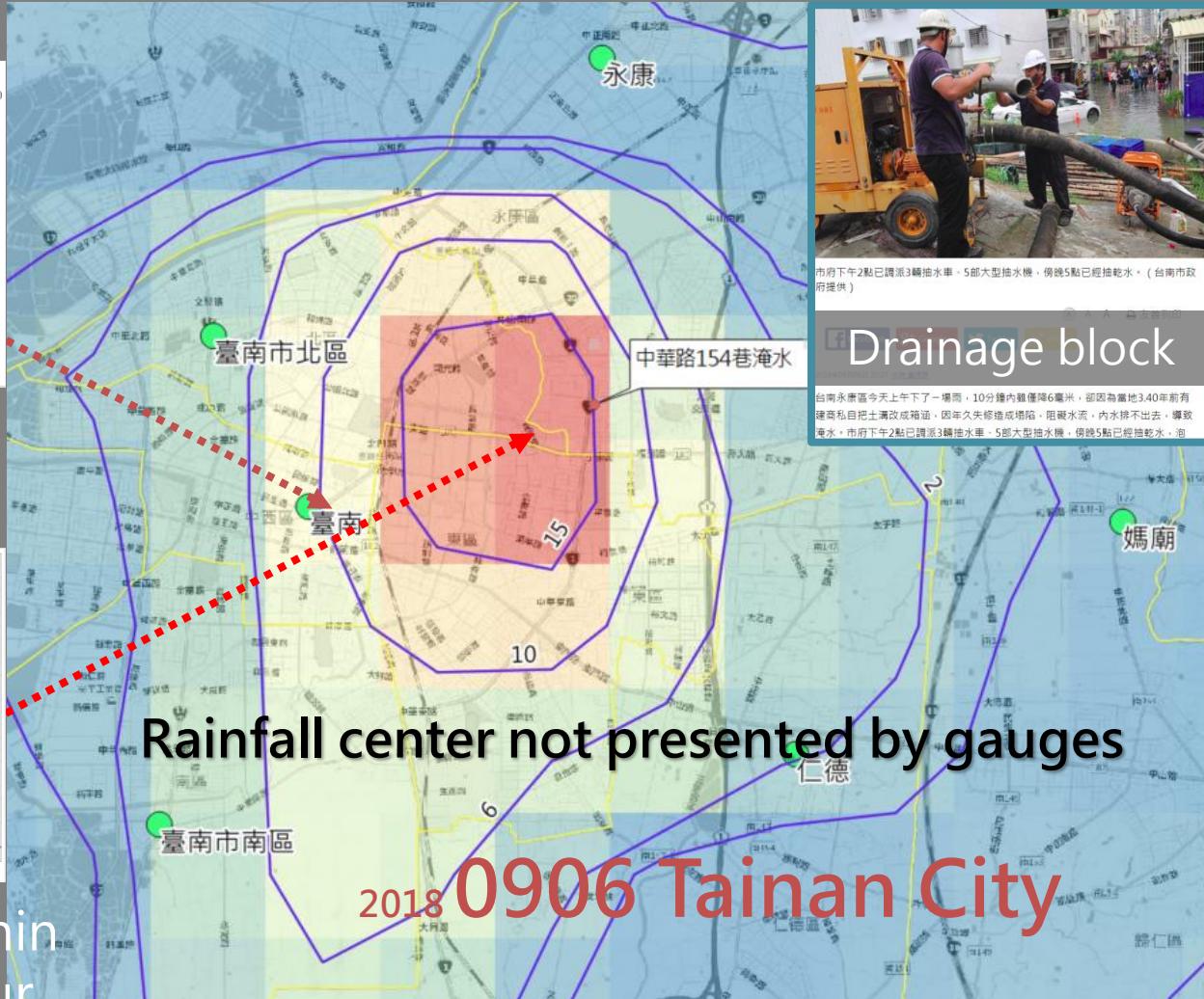


Max 7mm/hr

Radar Observation



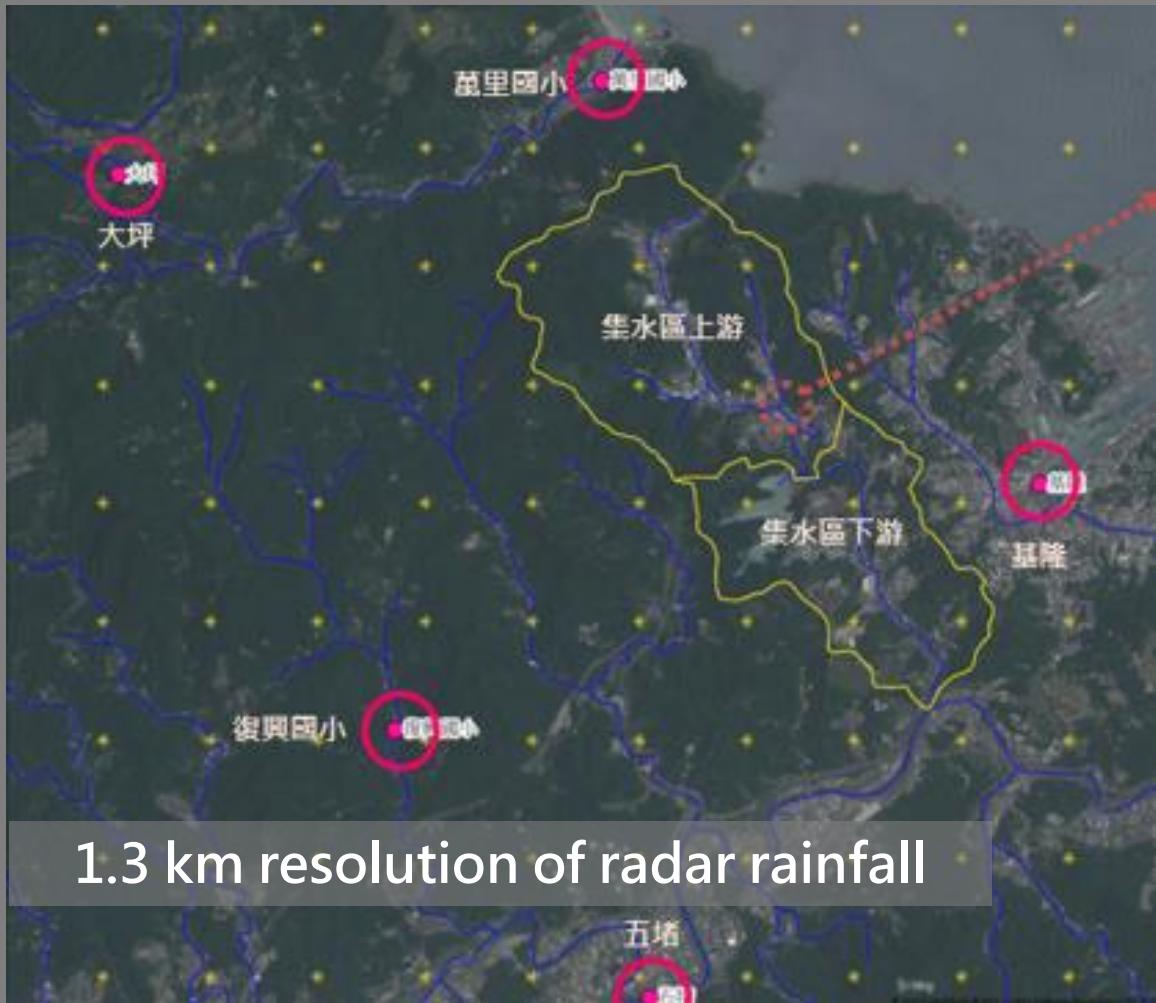
Max 22.5mm/hr in 10min
19.21mm/hr in an hour



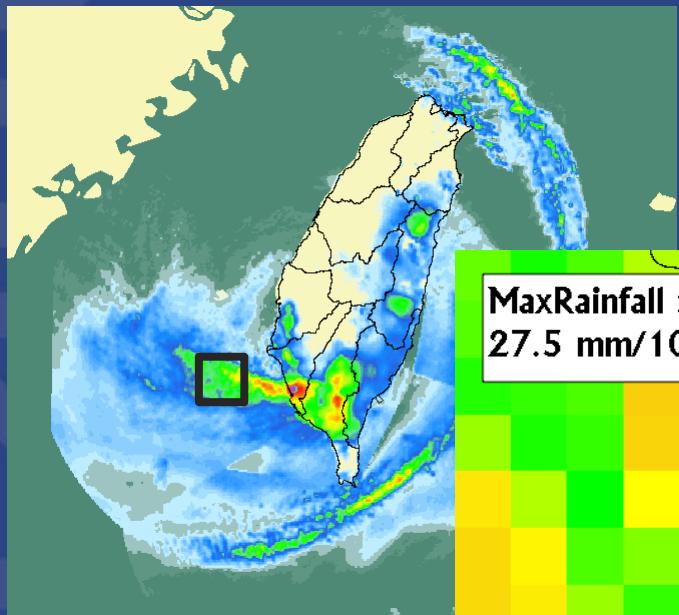
Drainage block

台南永康區今天上午下了一場雨，10分鐘內僅降6毫米，卻因為當地3.40年前有建商私自把土溝改成箱涵，因年久失修造成堵陷，阻礙水流，內水排不出去，導致淹水。市府下午2點已調派3輛抽水車、5部大型抽水機，傍晚5點已經抽乾水。(台南市政府提供)

Limited Gauges Distribution

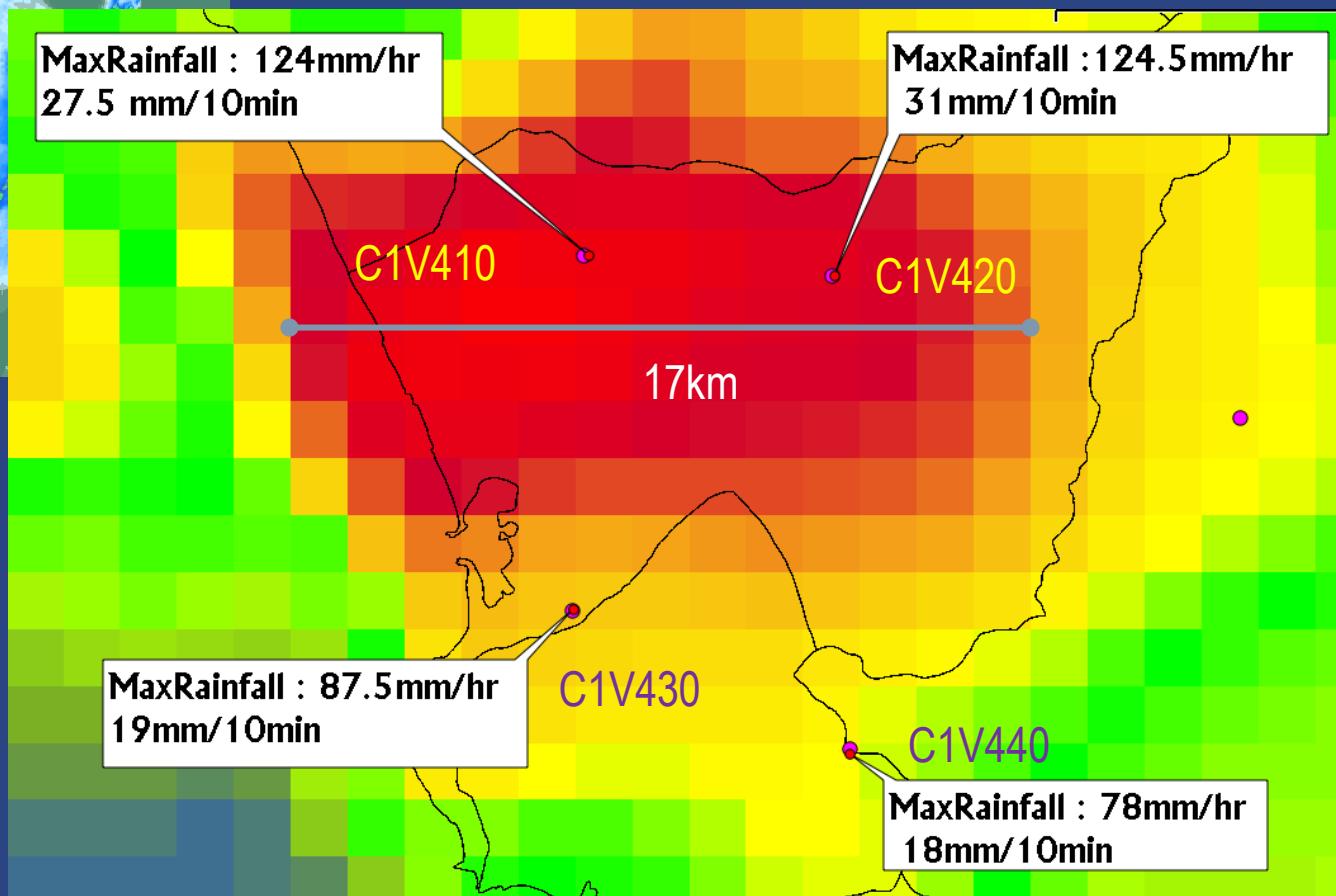


High Intensity in Short Duration

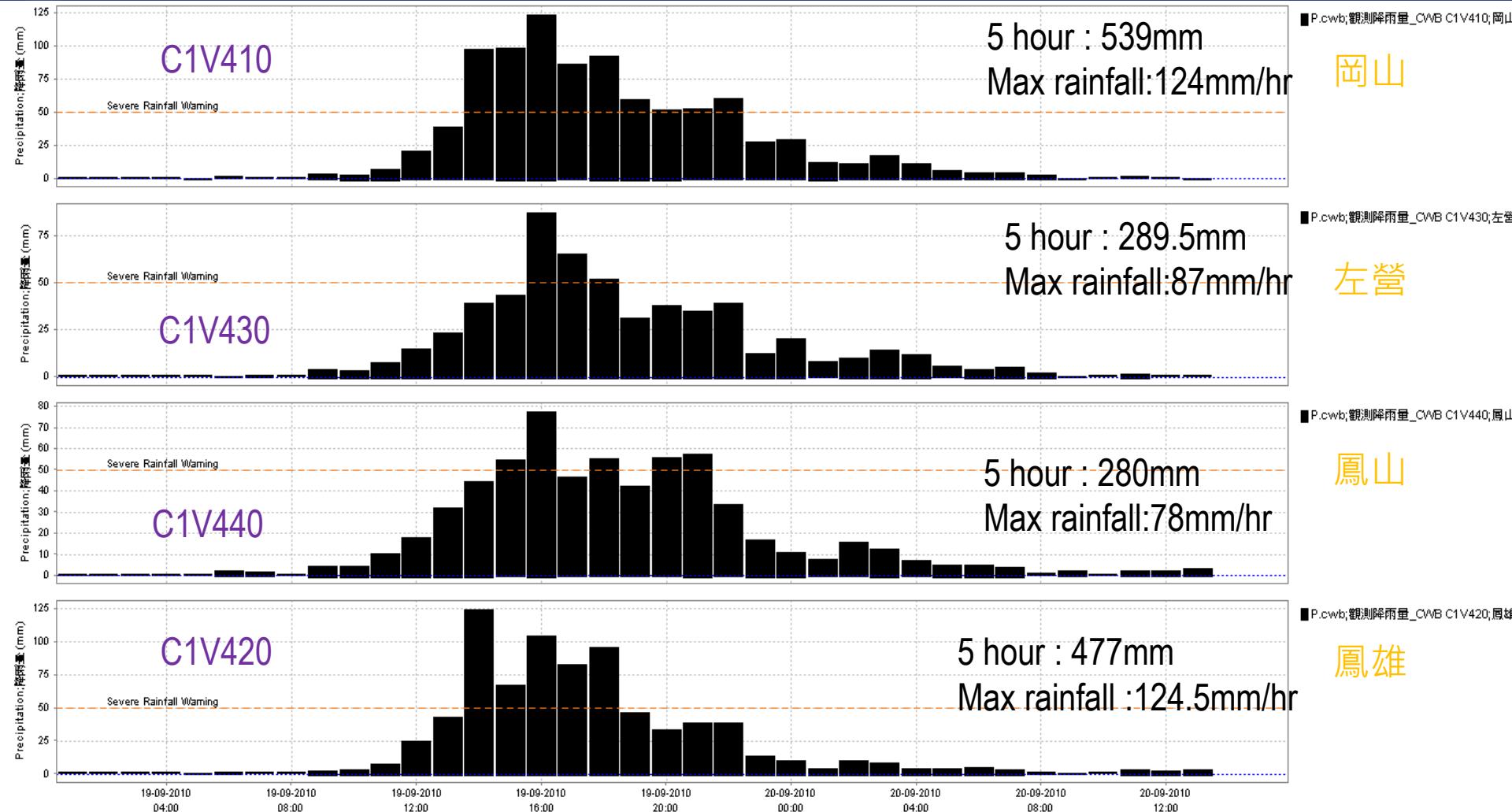


Unit :mm/10min

>= 0
>= 2
>= 6
>= 10
>= 15
>= 20
>= 30
>= 40
>= 50
>= 70
>= 90
>= 110



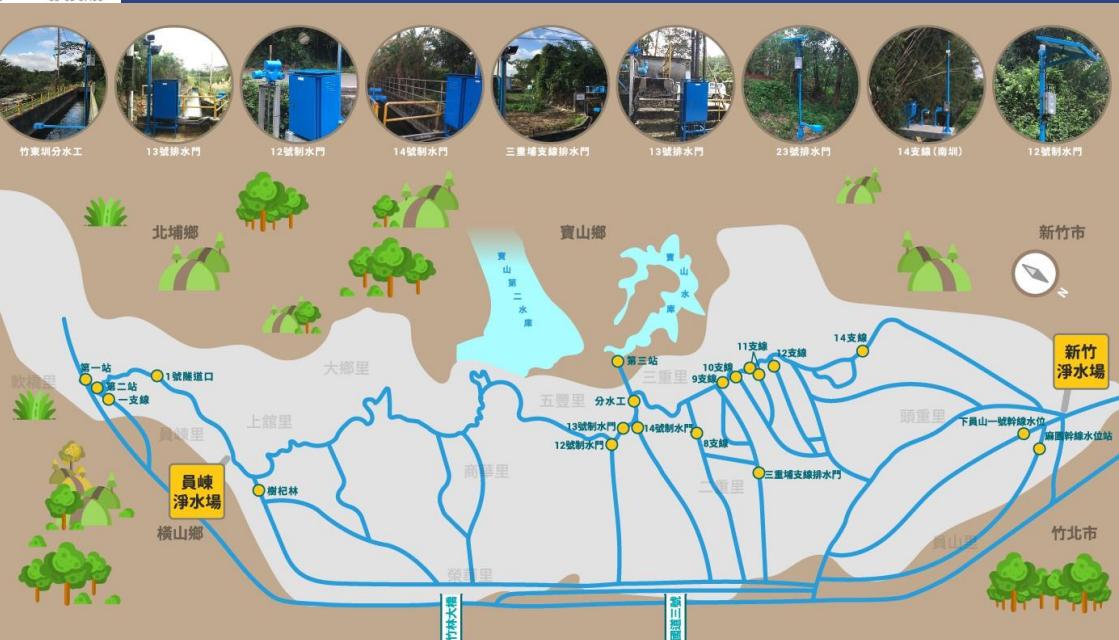
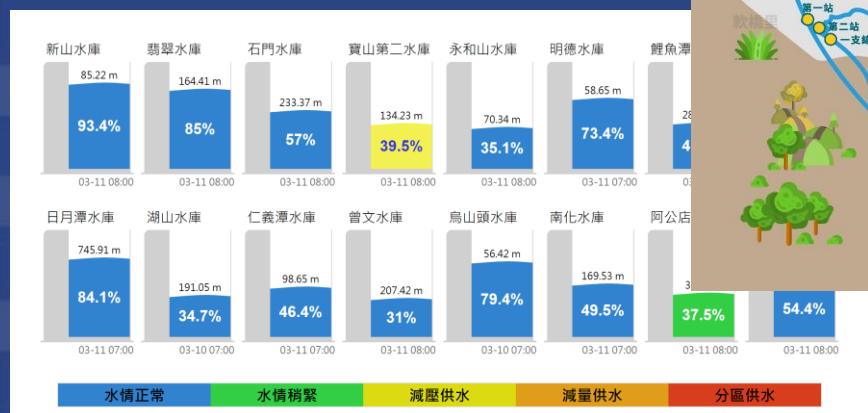
EXTREME RAINFALL IN KAOHSIUNG TYPHOON FANAPI 20100919



Drought And Water Distribution



NCDR watch



Hsinchu Science Park: 2016 Revenue over 30,000 million USD
 Boston Red Sox 2016 payroll : 208 million USD

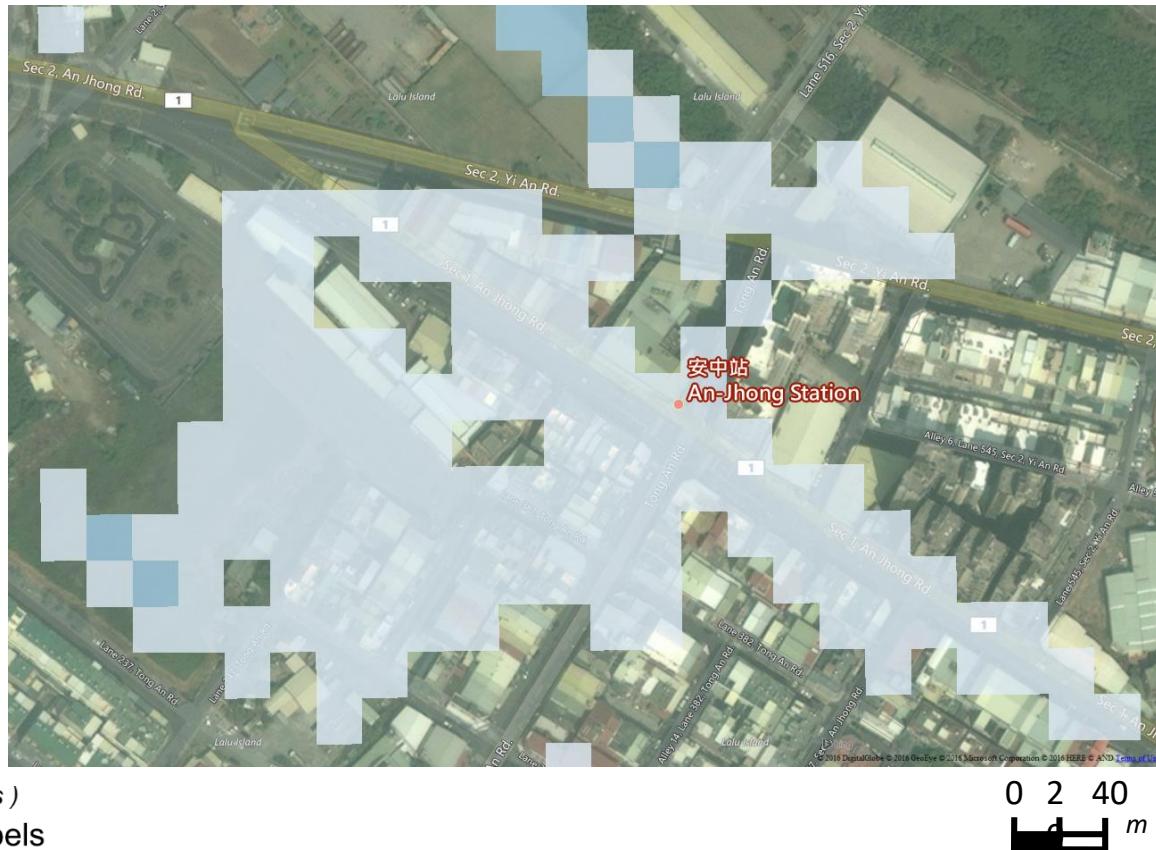
Sensors & Model Simulation

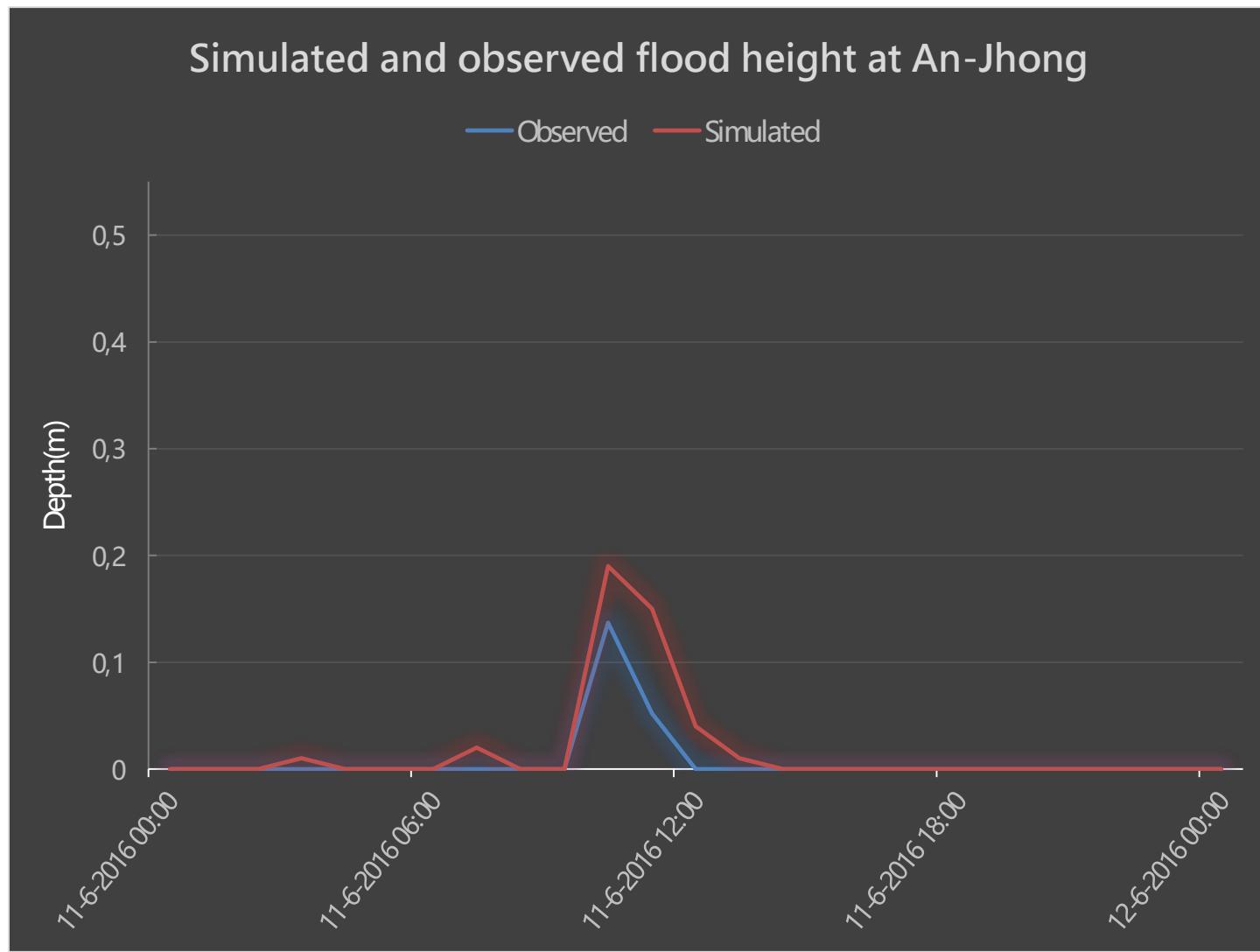
Deal with Uncertainty:
Sensors, sensors, and sensors
From points to area





Flood Grid at An-Jhong









Flood Grid at Chao-Huang-Gong Station



Simulated and observed flood height at Chao-Huang-Gong



IoT Sensors

IoT Techs bring us..

- Energy Harvesting technology
- Low power chip
- Low power WAN
- New Battery technology
- Industrial standard chip but consumer product price.



- <https://www.theweathernetwork.com/us/news/articles/app-and-volunteer-army-improving-tidal-forecasts/90256>



Flooding data has already been used to calibrate a new water-level inundation sensor in Norfolk's Hague. (Courtesy of Virginia Institute of Marine Science)

鹿耳門
Microwave



北安
Microwave + LoRa Relay



三崁店
Microwave + LoRa Relay



Sensors
(Within LoRa Range)

安污 Control Center

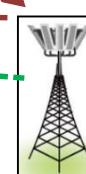
鯤鯓

Microwave + LoRa Relay

Support Channel
NB-IoT

NB-IoT

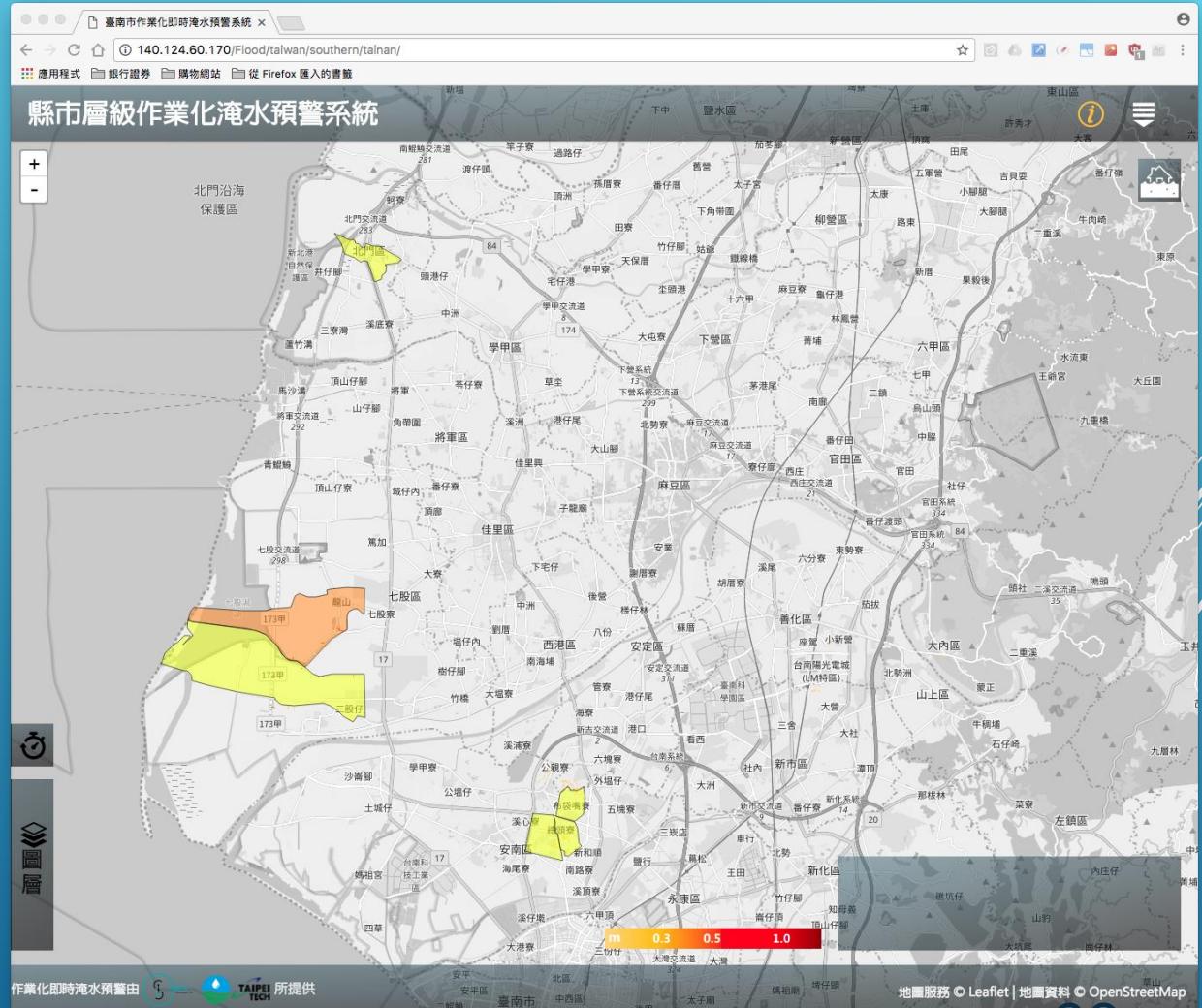
Sensors
(Outside LoRa Range)
Only Channel



NB-IoT/3G/4G
Cell Tower

OPERATIONAL FLOOD EARLY WARNING SYSTEM FEWS_TAIWAN

- ▶ Every 1 hr provide next 3 hrs flood nowcast
- ▶ Every 2 hr provide next 6-8 hrs flood nowcast .



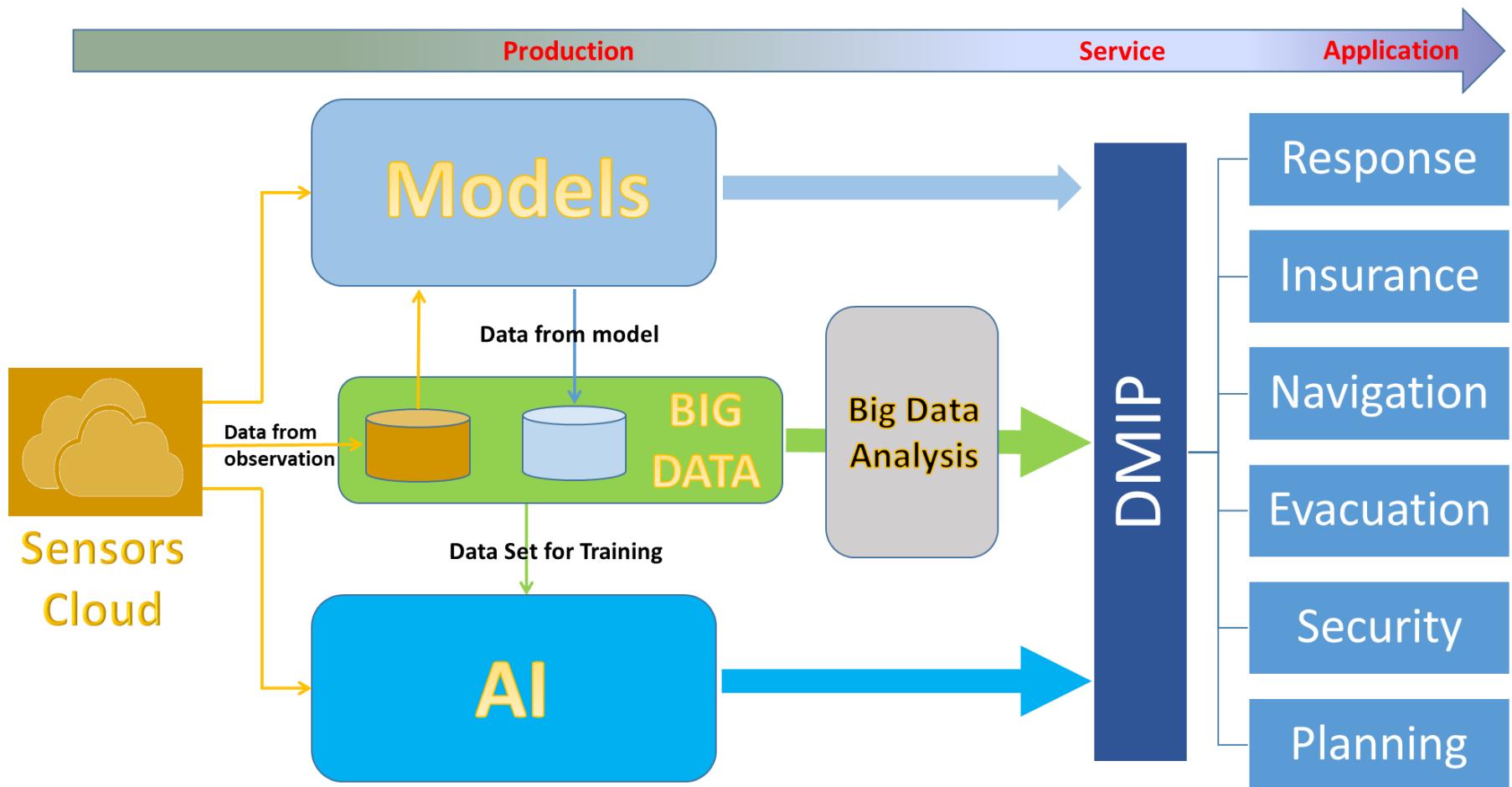
Interlink among Platforms

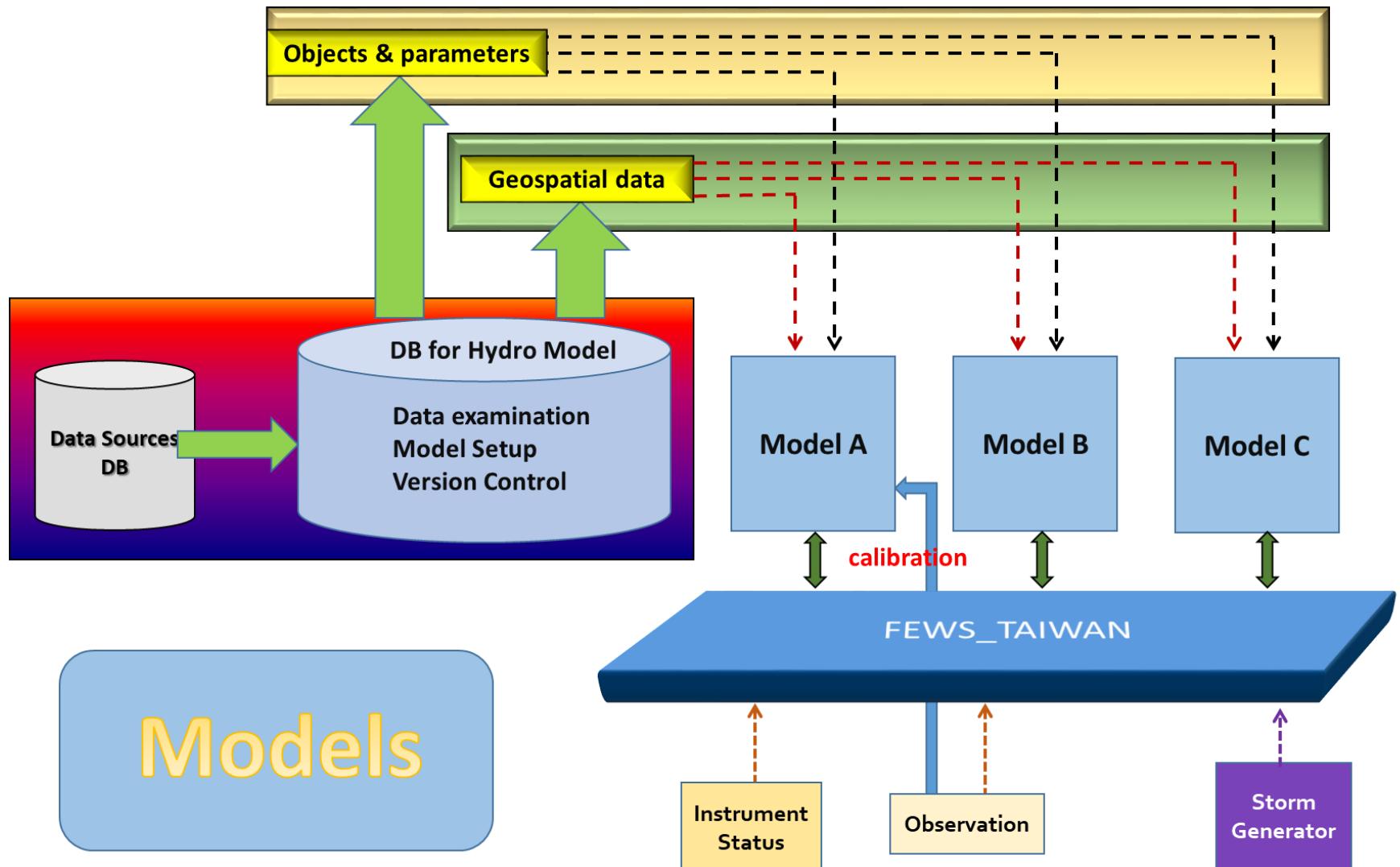
Model update:

Smart Model Management

Quick response:

AI assist

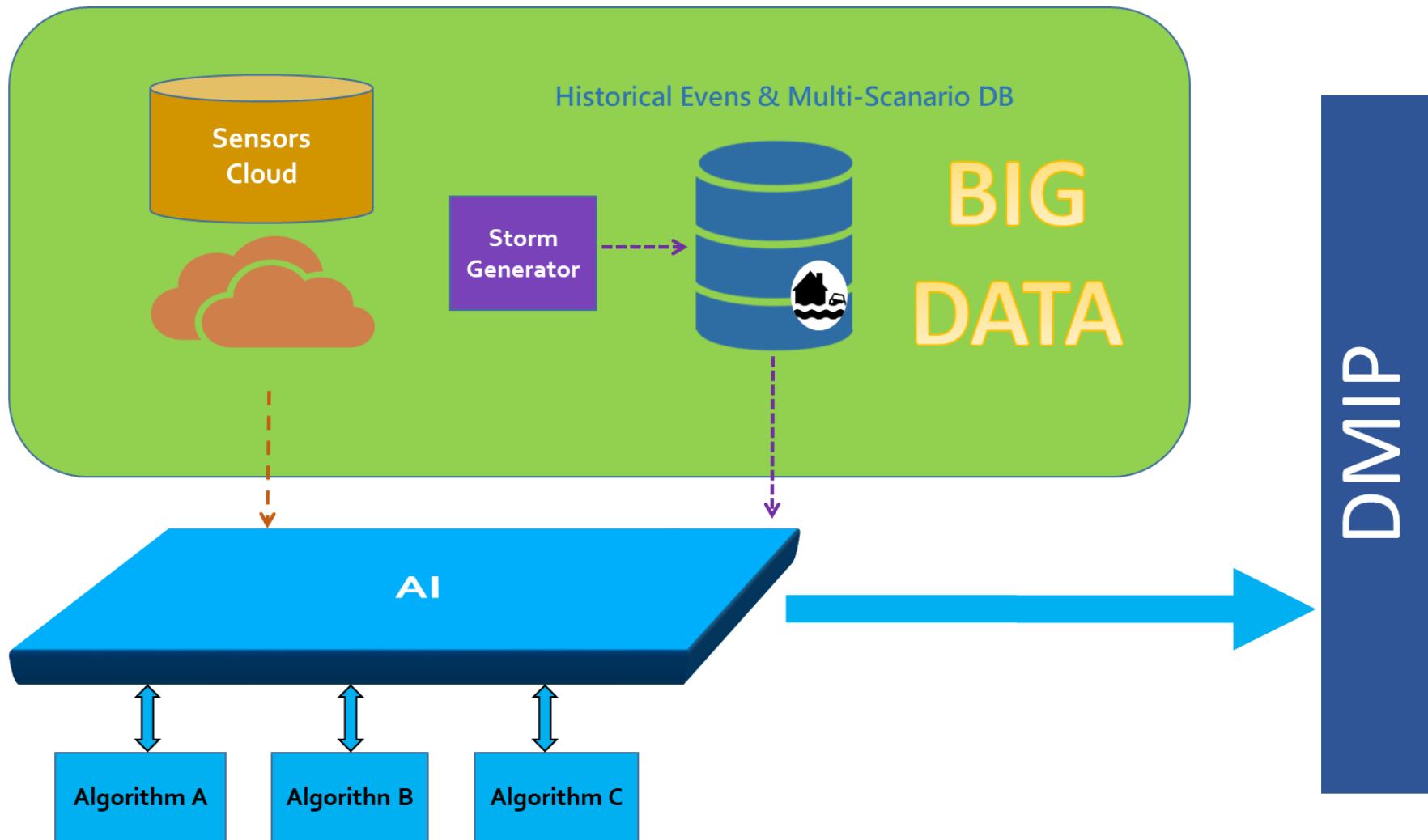




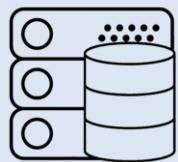


Sensors Cloud

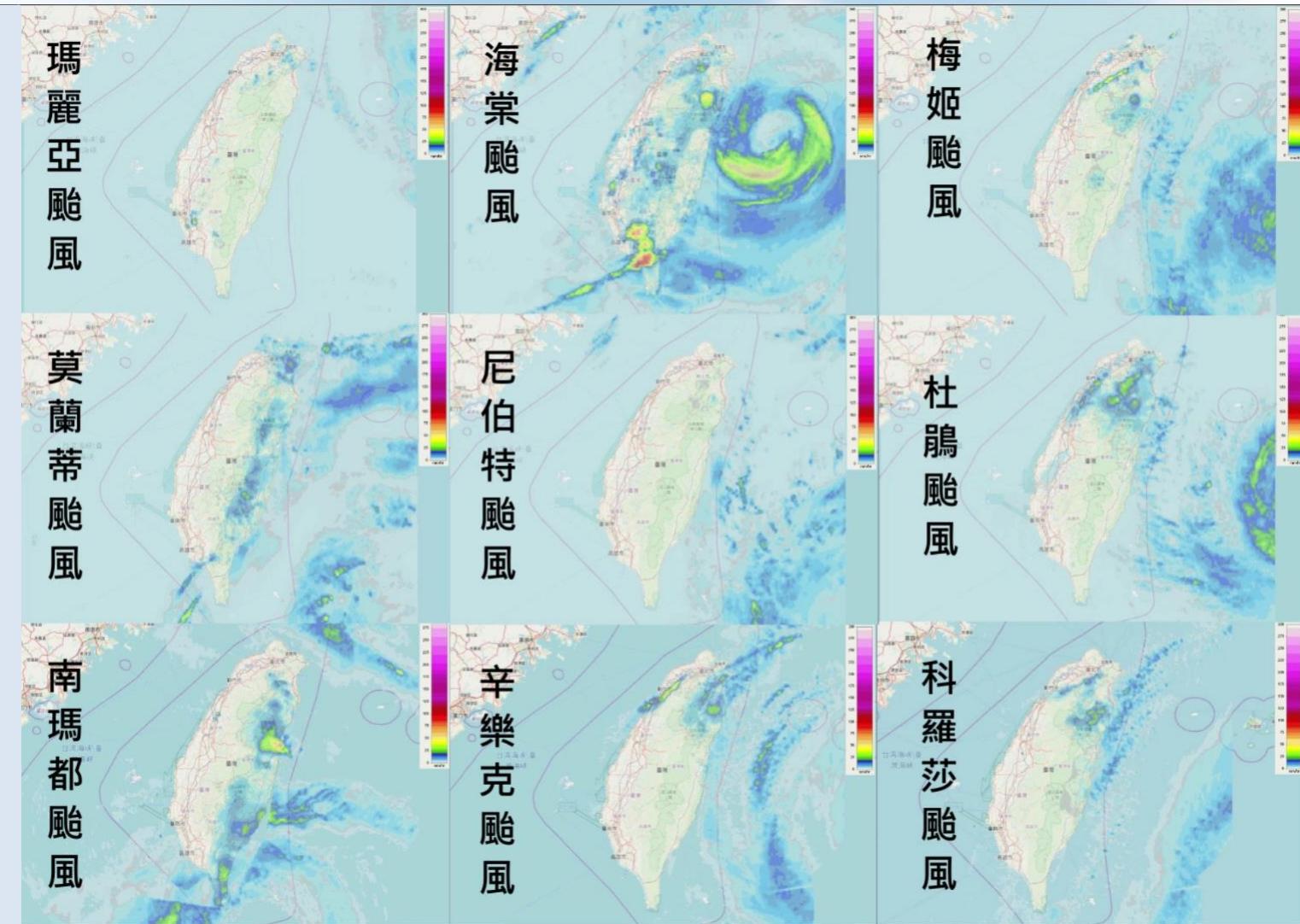
- > 1000 rain gauges
- > 400 water level gauges
- >1000 flood sensors and even more
 - (x,y,depth,t) from voice, video, messages
- Smart water meters



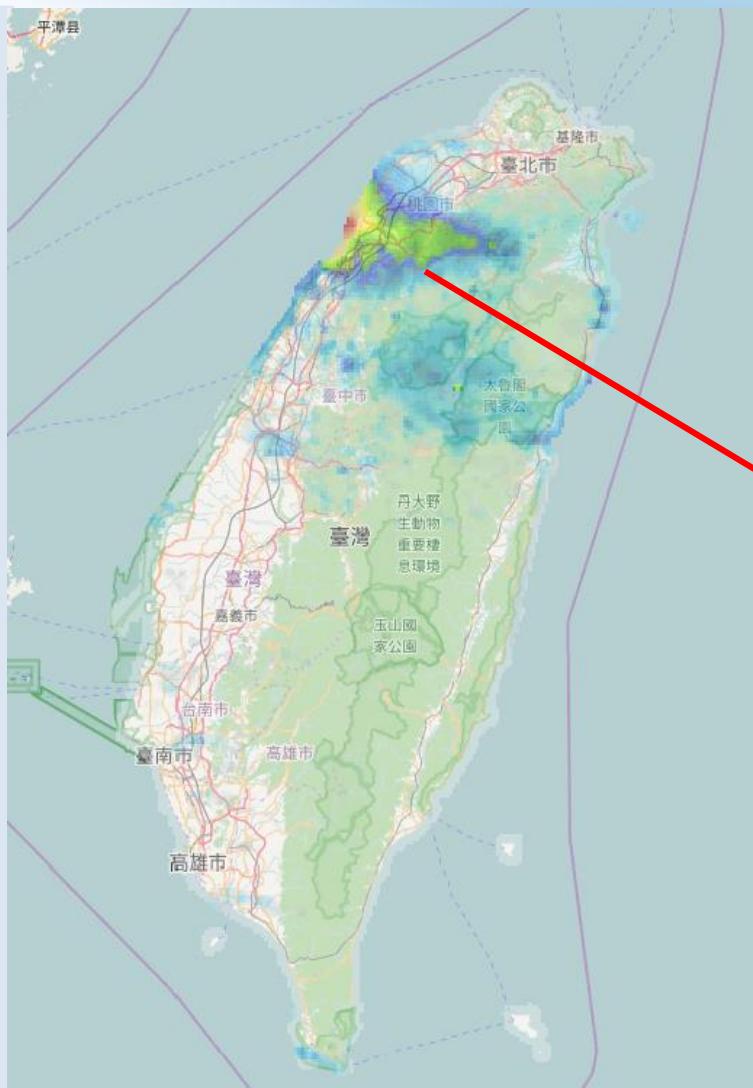
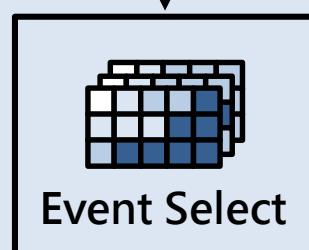
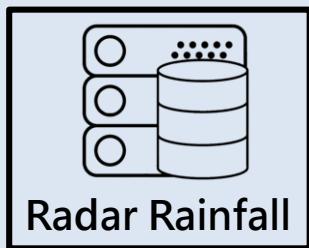
Storm
Generator



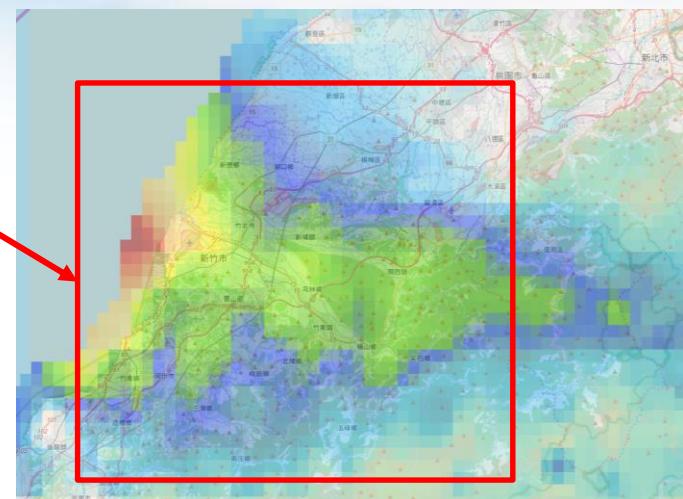
Radar Rainfall



Storm Generator

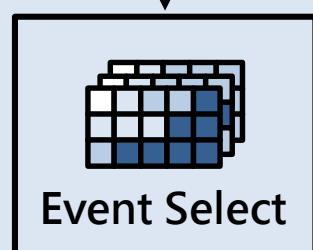
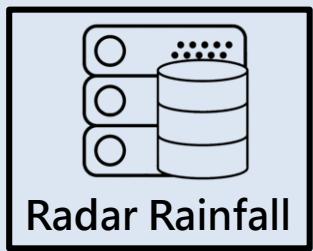


Extract Radar Rainfall
By data and location

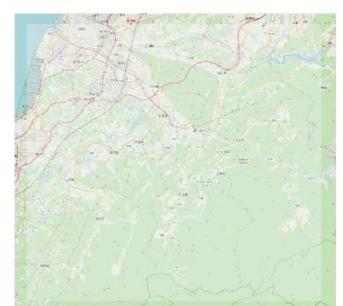
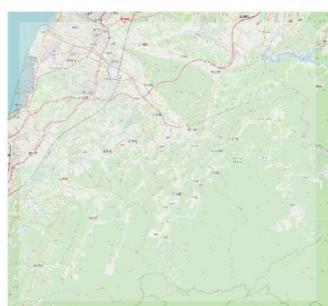
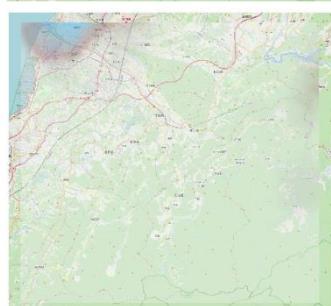
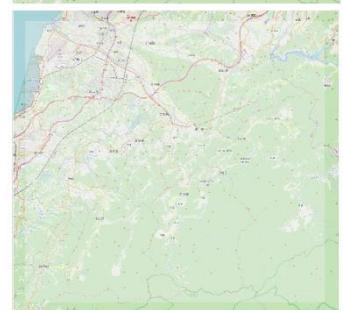
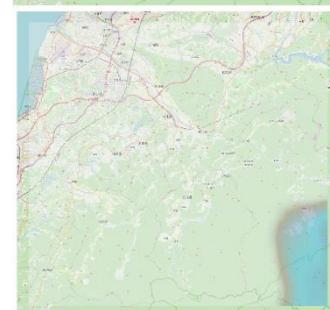
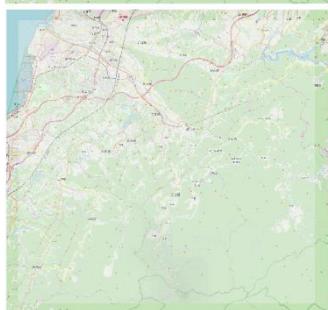
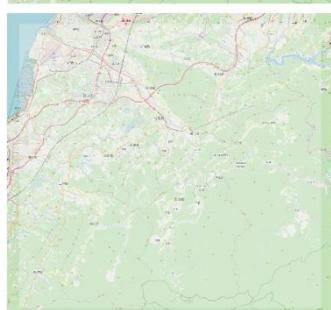
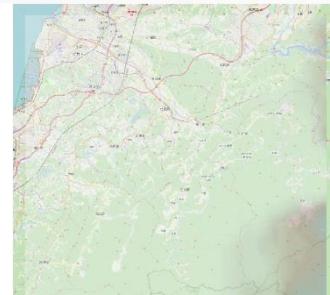
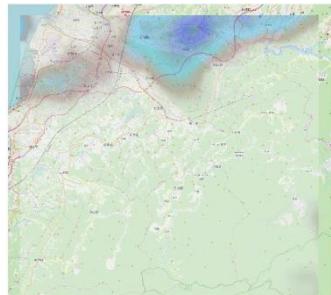


Radar Rainfall historical DB
2006~2018

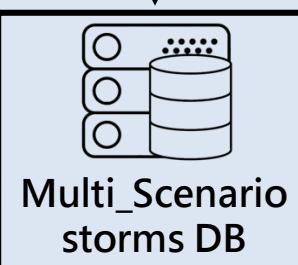
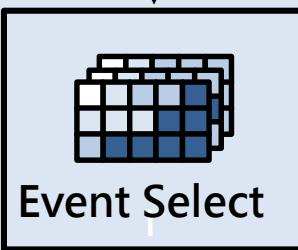
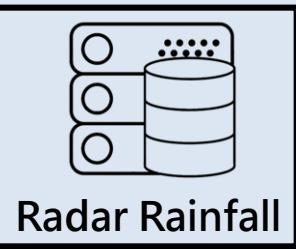
Storm Generator



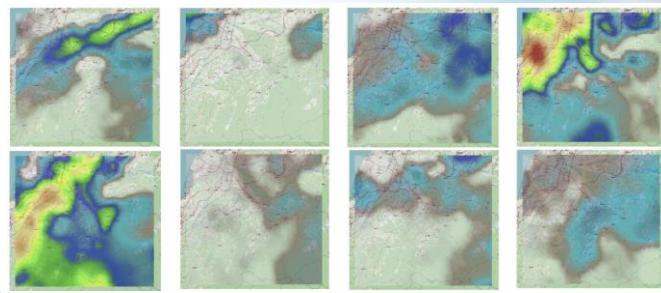
Historical Storm Events



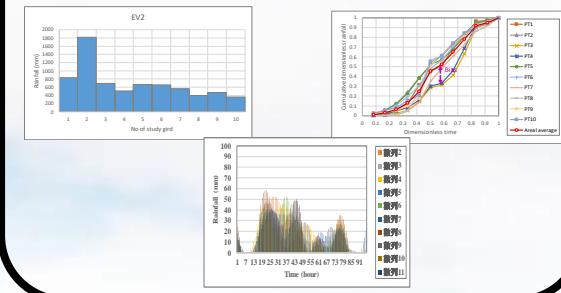
Storm Generator



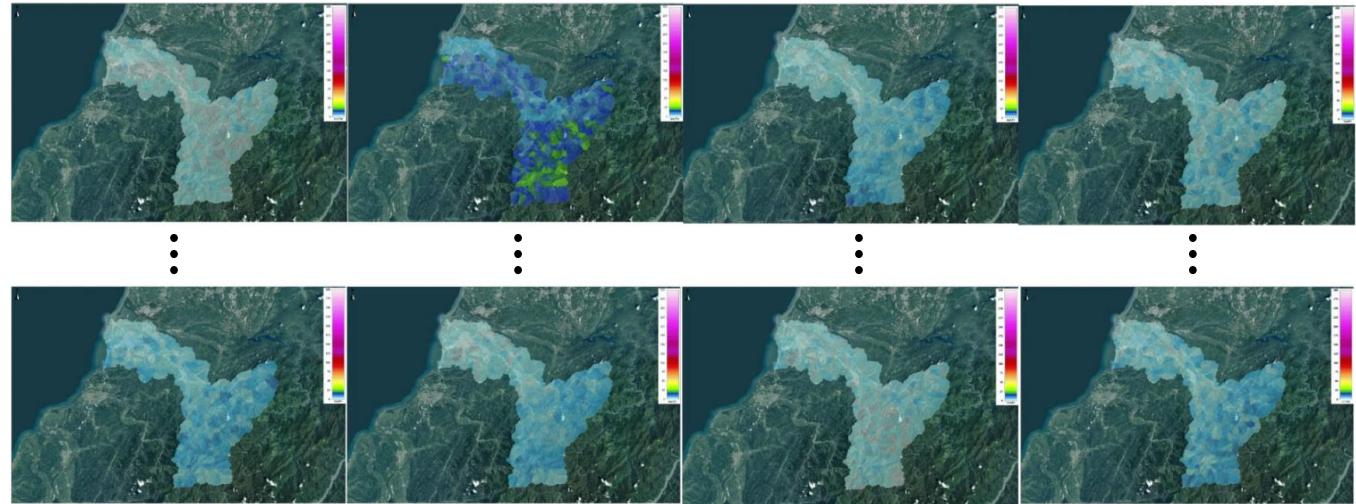
Historical Events



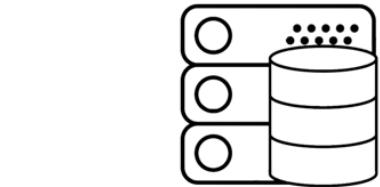
Spatiotemporal Randomness



Multi-Scenario Generation



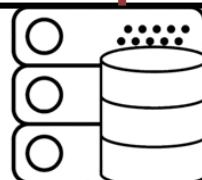
TWCC



Database of multi-spatiotemporal storms



Arrange the VM for simulations



Database of inundation simulations



2D rainfall-runoff-inundation simulation



⋮

⋮

⋮

⋮

Framework

