IoT Flood Sensors in FEWS-Taiwan and Citizen Science

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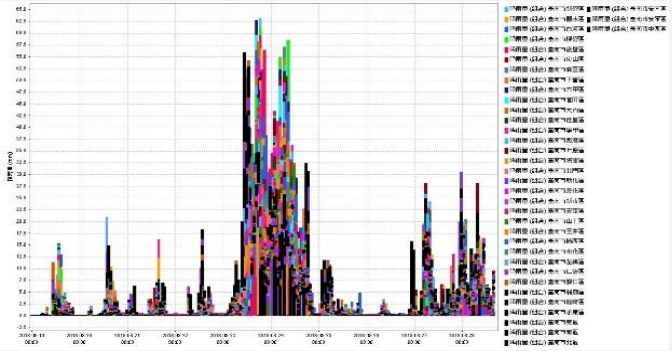
Delft-FEWS User day 2020.11.09

Main item

- The main causes of flood in Taiwan
- Operational Flood inundation Forecasting
- IoT Flood Sensors
- Model Verification and Validation

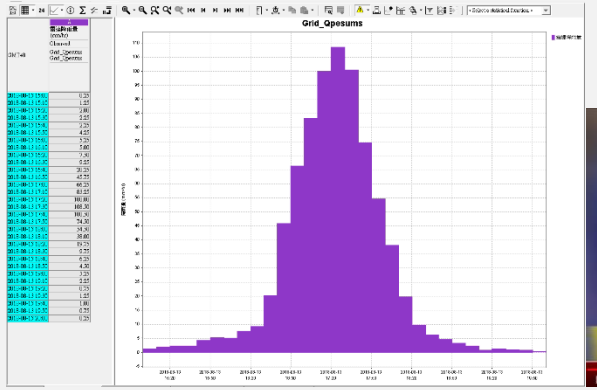
The Main Causes of Flood in Taiwan

- **Typhoon and Monsoon Heavy Rainfall**
- **Short Duration Intense Rainfall**
- **Urban and Rural Drainage System**
  - **Exceed the Capacity**



Town Area Average Rainfall
Accumulated : 780-950mm/2day
Maximum: 92-121mm/hr

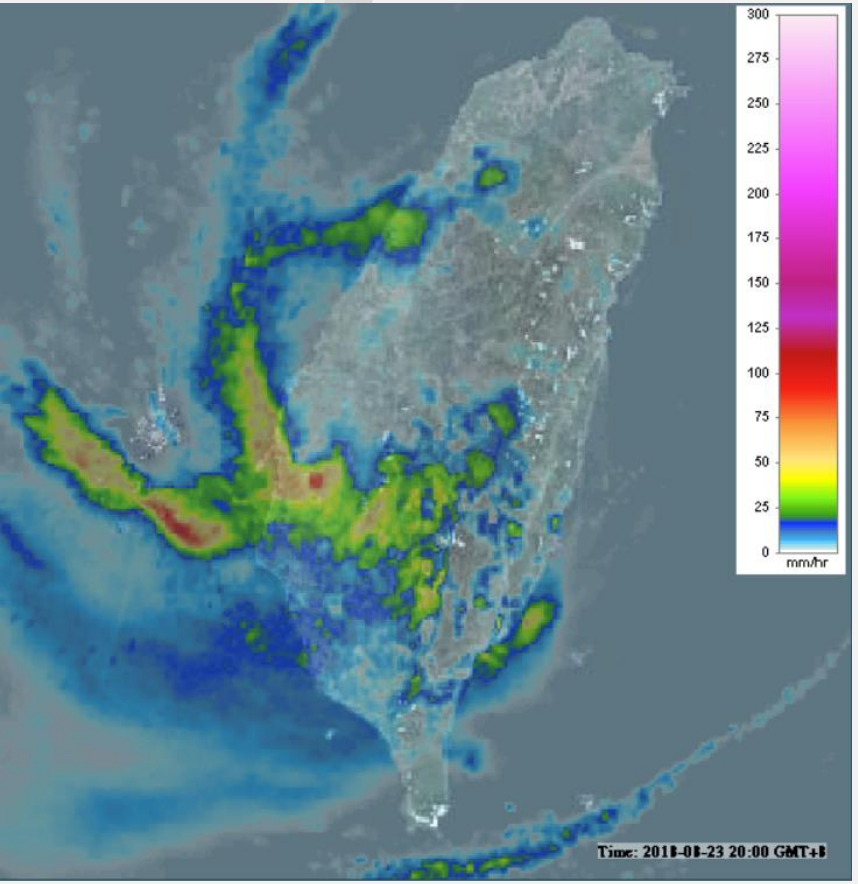
@PTS



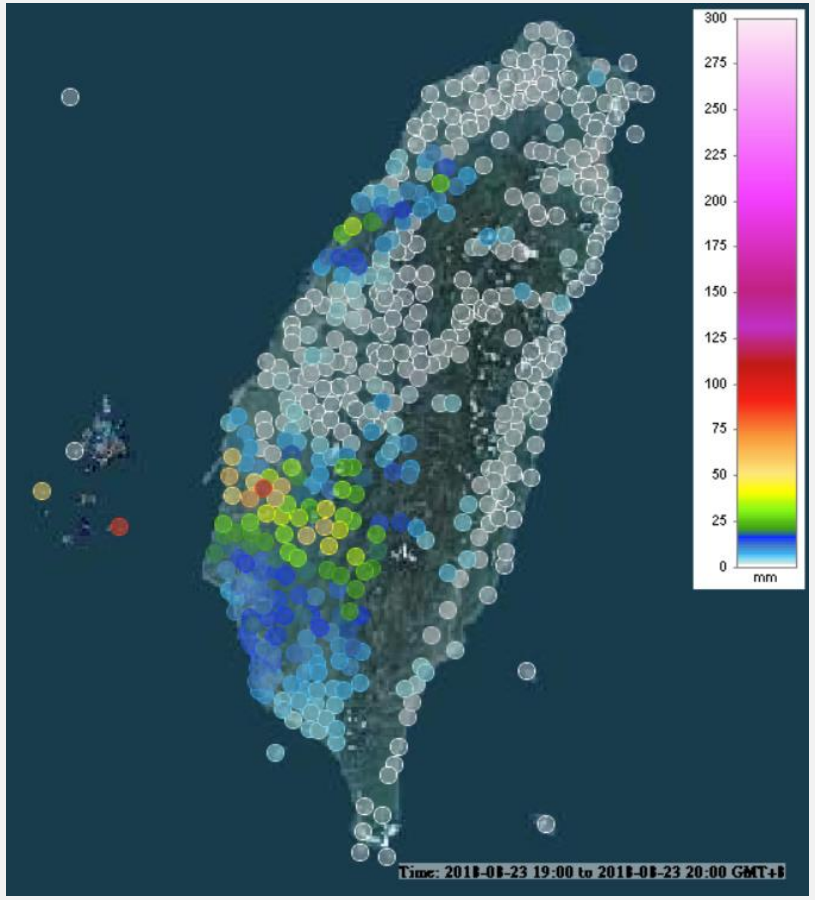
Radar Rainfall
10min Max: 108mm/hr
1hr Max: 87.8mm

@eranews50

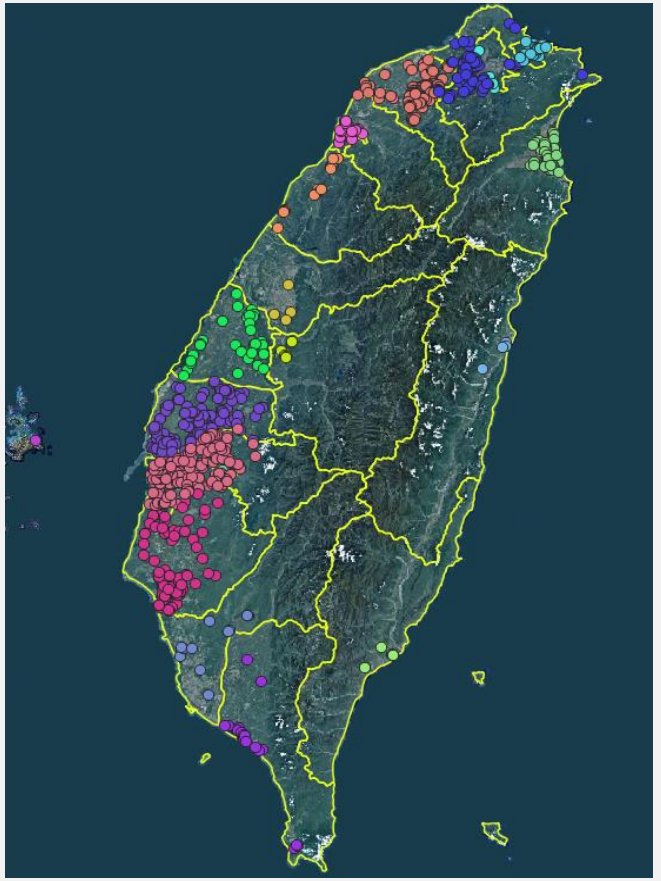
Observation Data Source



Radar station
10 station



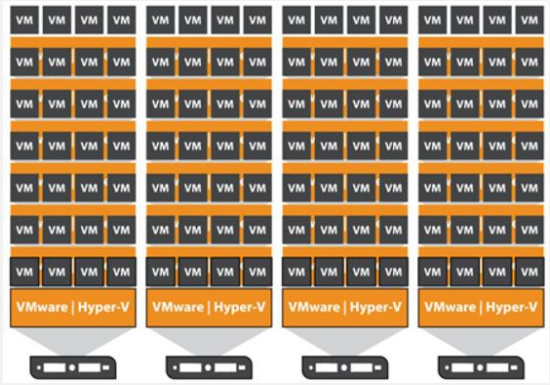
RainGauge
1016 gauges

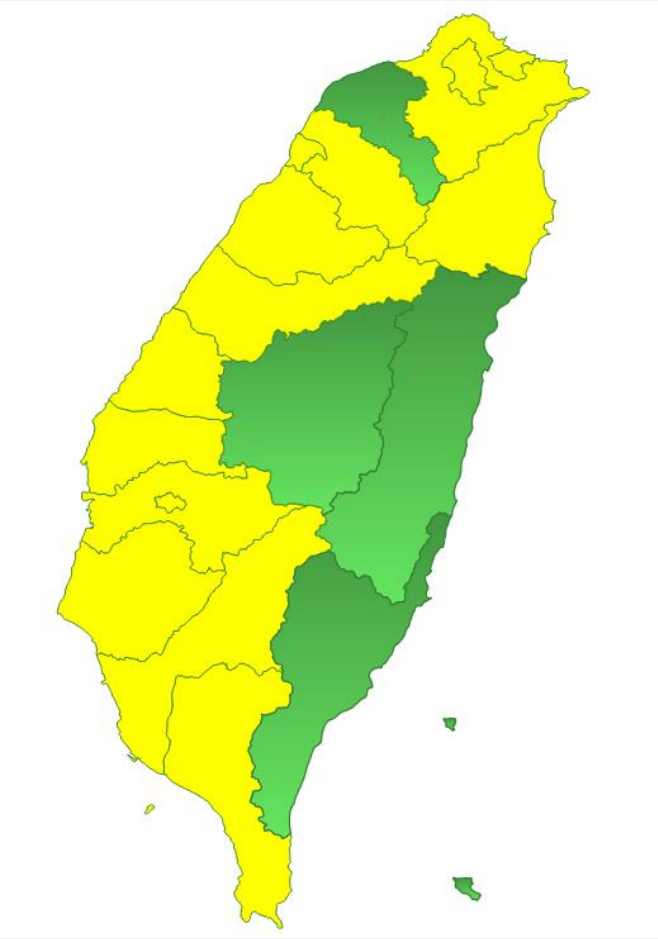


IoT Flood Sensors
1205 gauges

Operational Flood inundation Forecasting

- Operational forecasting system(24/7)
  - Every 3hr Provide The Next 6hr Forecast
  - VM : 120 (FFS+MC+Archive)
- Taiwan 19 Area
  - This year 15 Areas
  - Next year 4 Areas
- SOBEK
  - 57 sobek projects
  - RR(SCS)+1D+2D



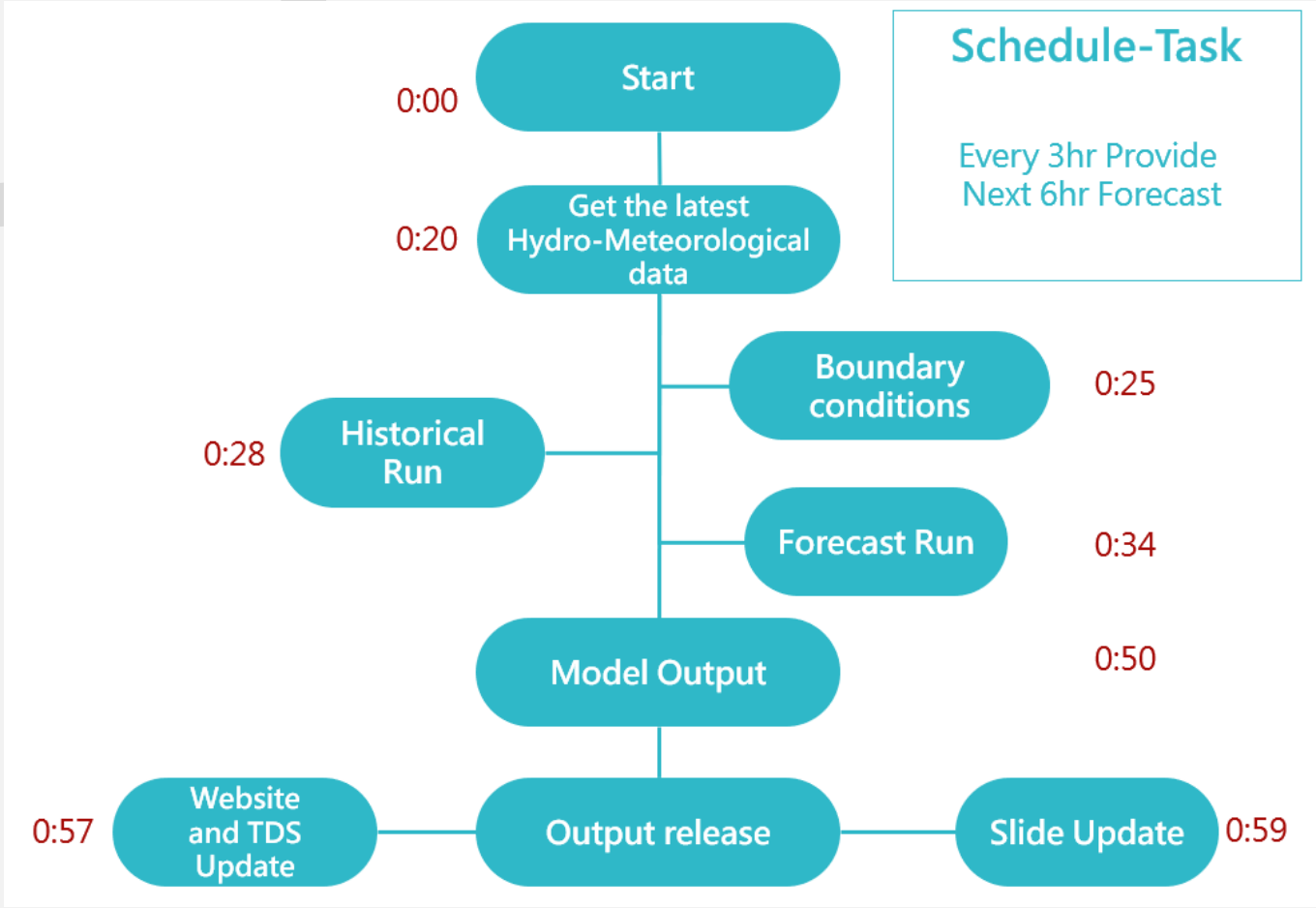


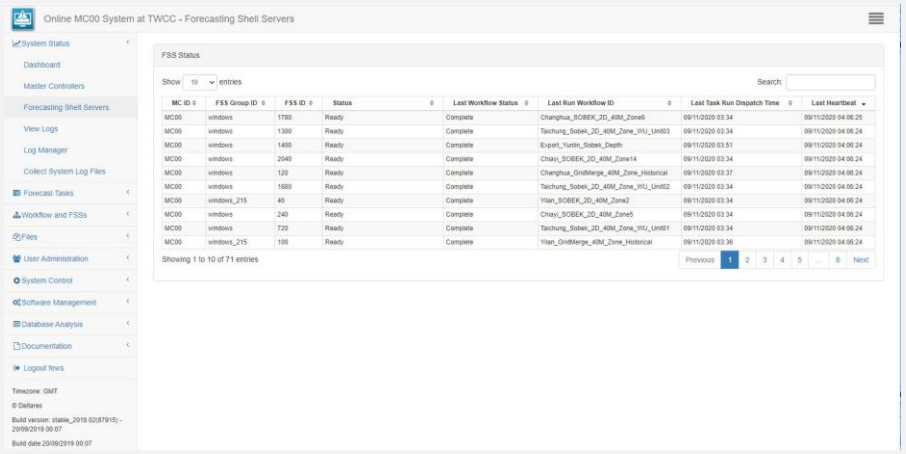
This year(15 area)

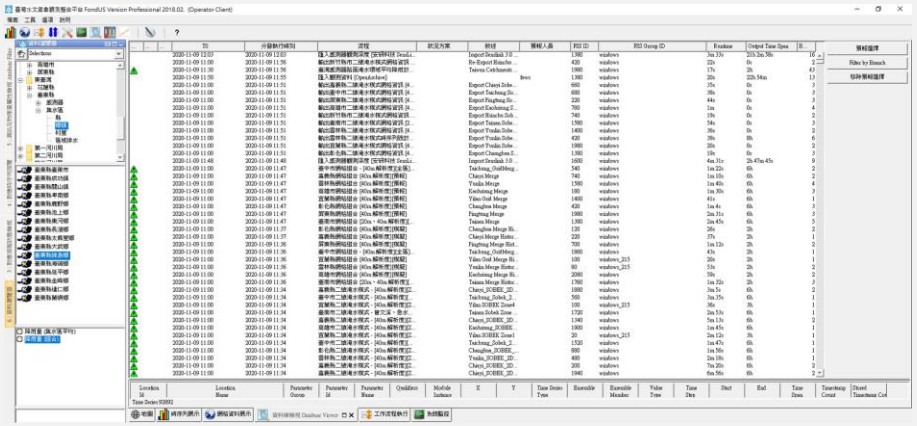
Next year(4 area)

Operational Flood inundation Forecasting

- Forecast Shell Server : 71 vm

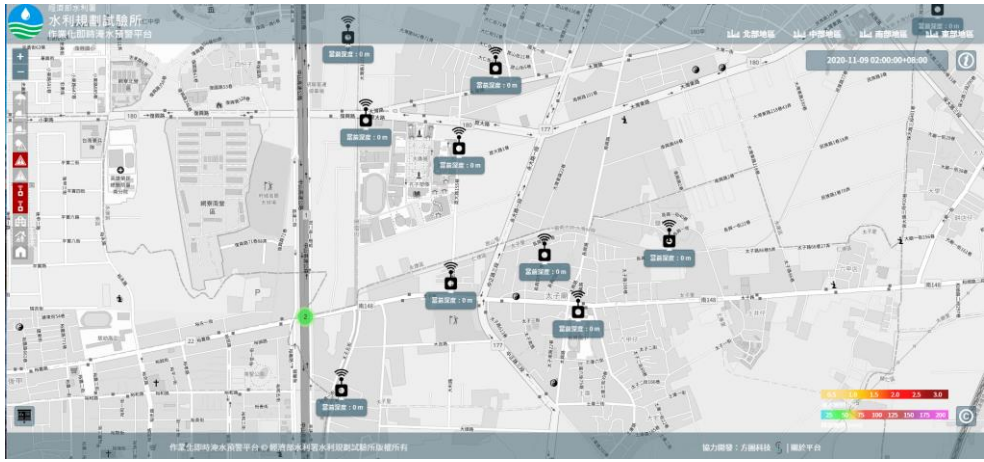






IoT flood sensor

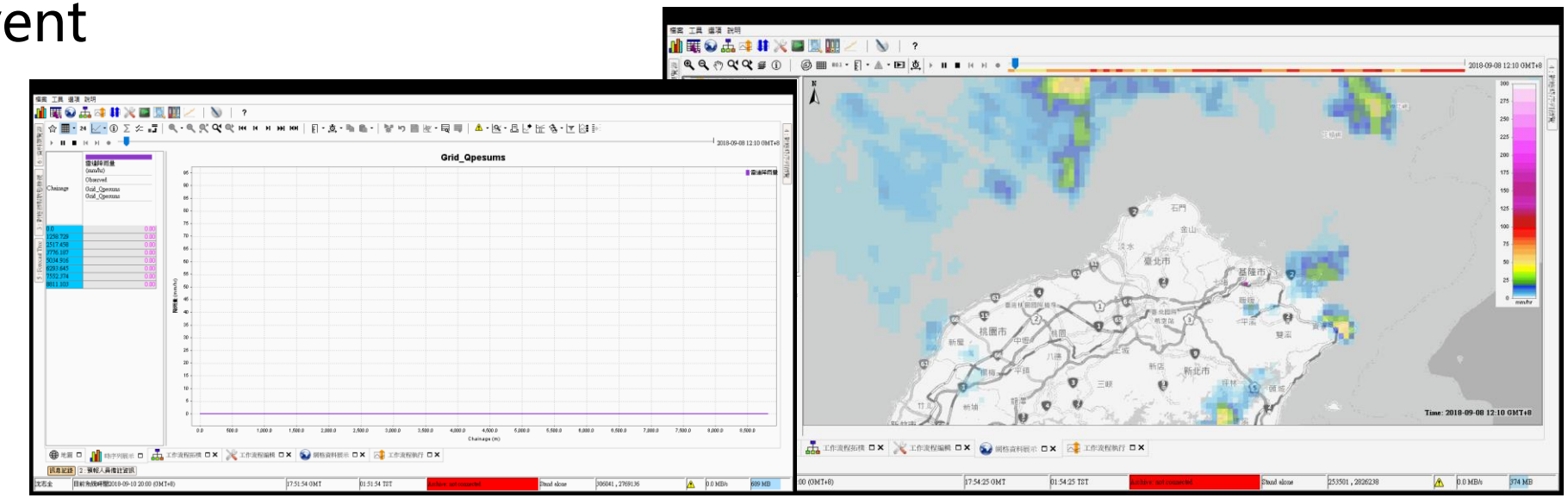
- Data source from
  - WRA and County and City Government
- Flood Data monitoring and check
- Confirmation of Flooding(Time, Area, Depth)
- Compare the Results of Model Run



IoT flood sensor

Complete spatial and temporal rainfall distribution information and flooding high water marks

2018908 Event



Rainfall profile (along the road)

MRT Dongmen station

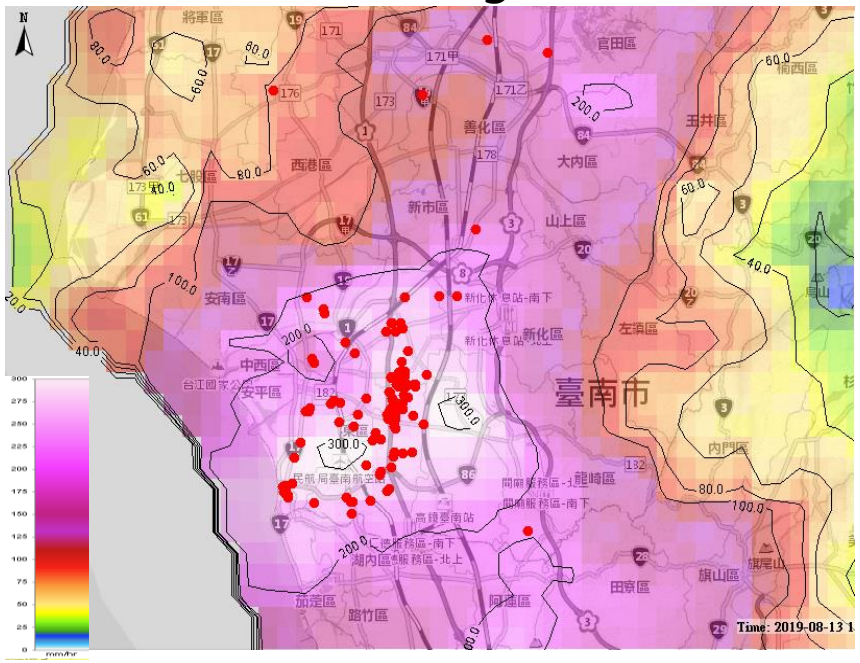
Xinsheng S. Rd.

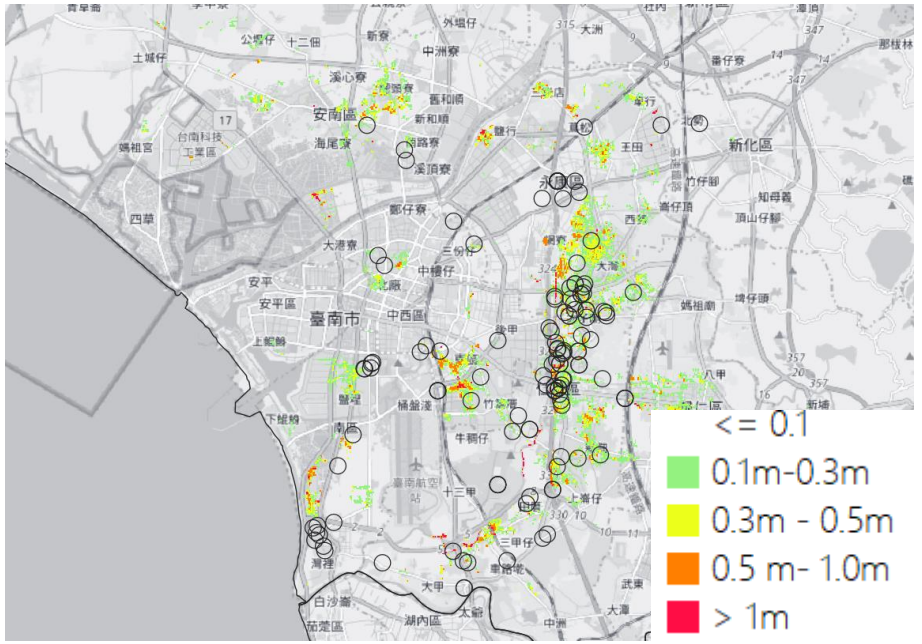
MRT Daan Forest Park station

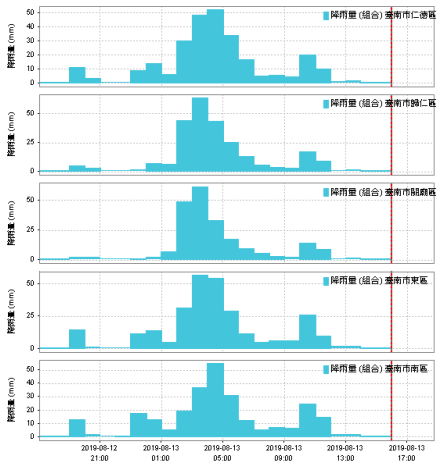
IoT flood sensor

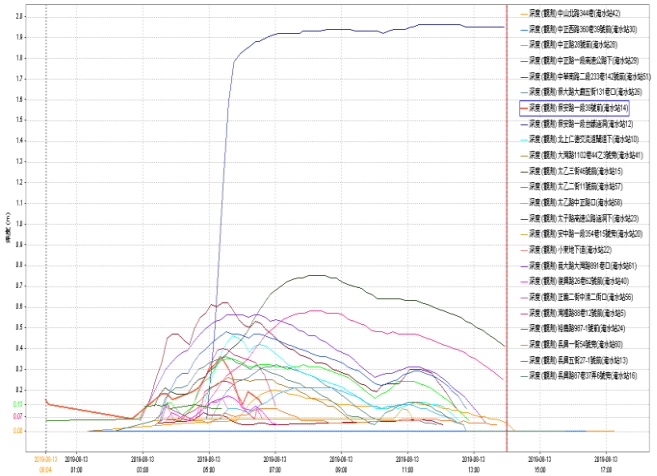
Get the Complete IoT flood sensor flooding observation data (Location ,Time, depth)

20190813 Event







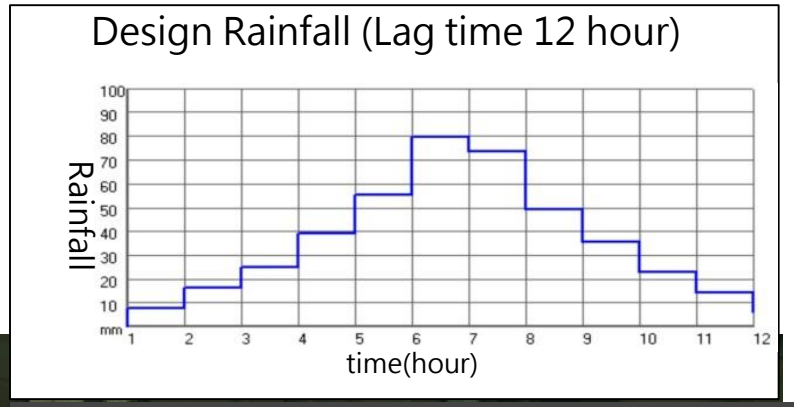


[photo：](#) CNA

IoT flood Sensor

Depth and Flooding Area Relation

Get the Complete model flooding simulation results
- Area, Depth, Volume



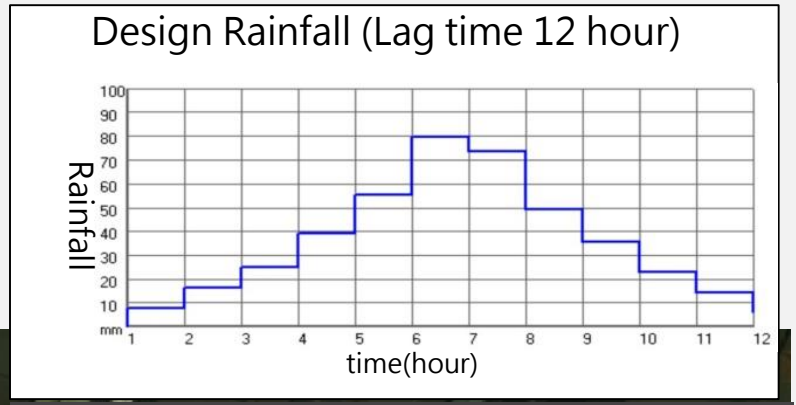
return period: 200yr

time (hour)	4
IoT sensor depth (cm)	30
Simulation Area (ha)	1.96
Simulation Volume (m^3)	4,508

IoT flood Sensor

Depth and Flooding Area Relation

Get the Complete model flooding simulation results
- Area, Depth, Volume



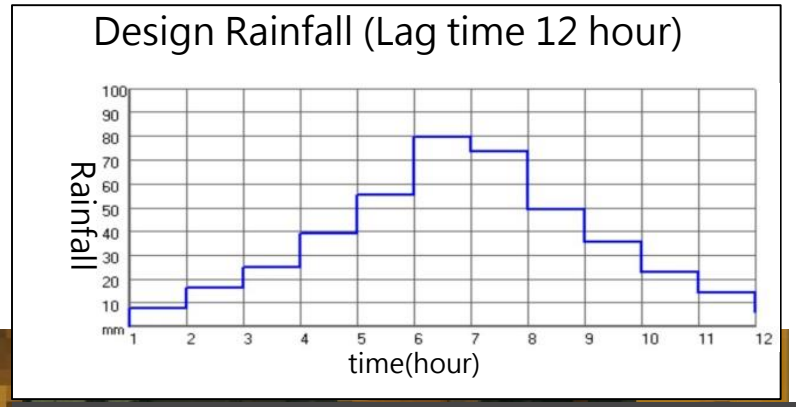
return period: 200yr

time (hour)	5
IoT sensor depth (cm)	50
Simulation Area (ha)	7.45
Simulation Volume (m^3)	17,657

IoT flood Sensor

Depth and Flooding Area Relation

Get the Complete model flooding simulation results
- Area, Depth, Volume

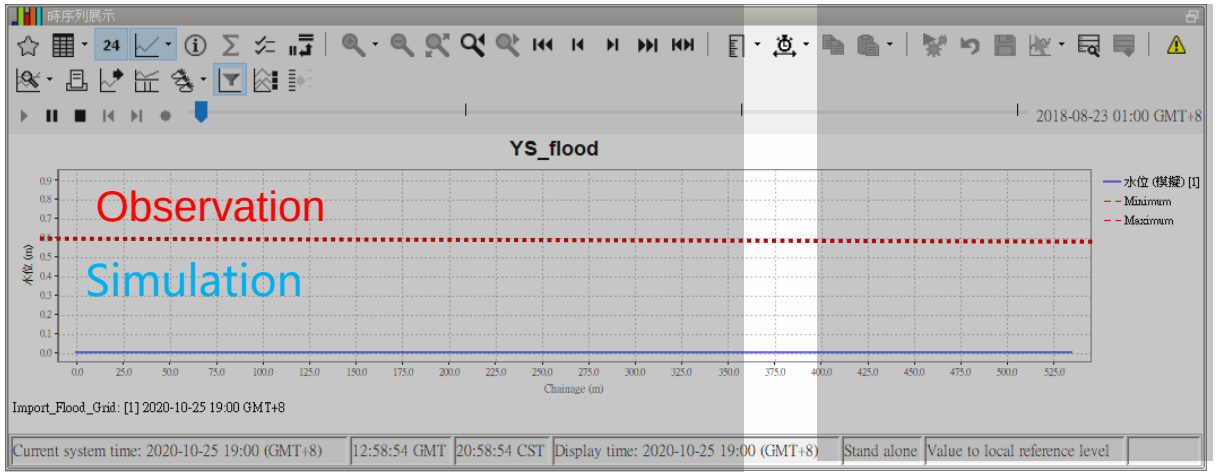


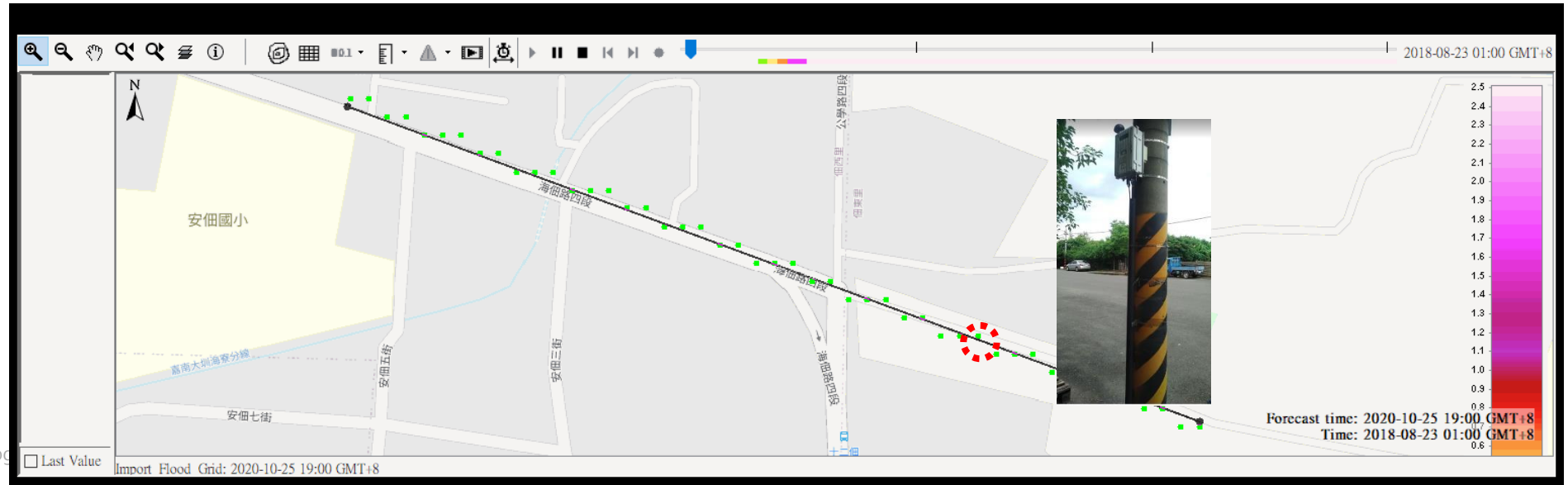
return period: 200yr

IoT flood Sensor

Verification with Real event

20180823 Event

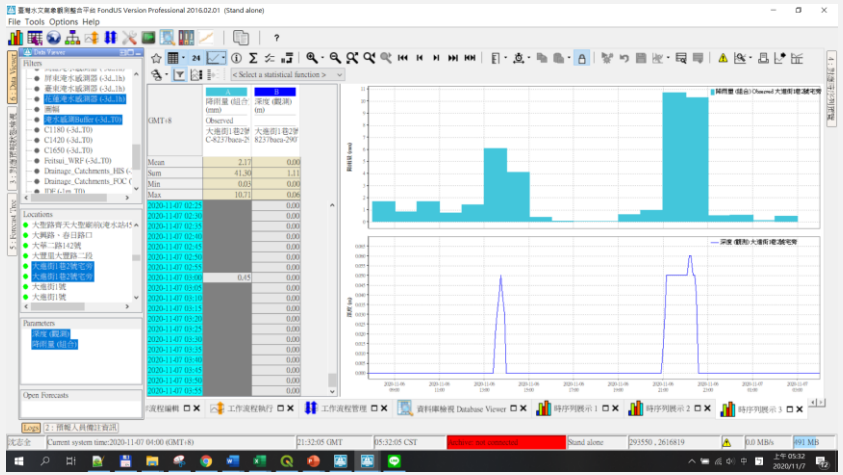


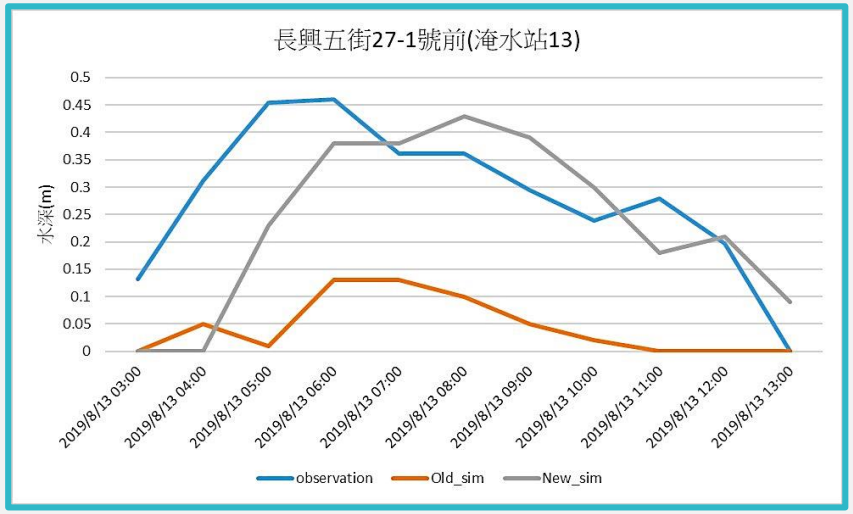


Model Verification and Validation

- Regular model data update **Verification**
- For Every Year flood event data **Validation**

- Archive Event IO Development
  - **The convenient way to get simulation and observation for the event**
- Citizen Science
  - **Crowdsourcing could collect more event information**

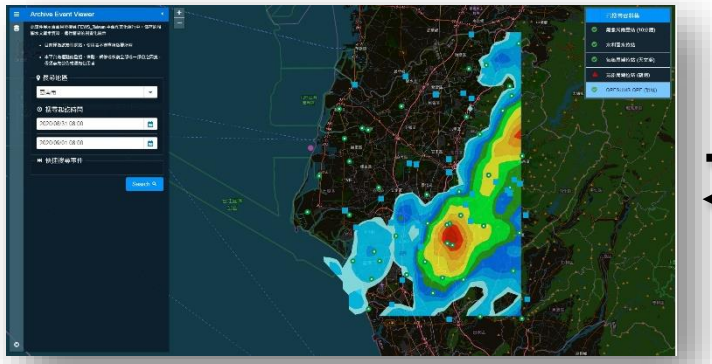




Model Verification and Validation

-Archive Event IO Development

- Open Archive 2018.02
- Microservices



Event Viewer UI

request

response

Gateway

Service

response

request

Authorization

Cloud Center

Archive-Event-IO

Workflow

Search Service

Reader Service

Search

Read

Update

Scan

Elasticsearch

Archive APP

Open Archive

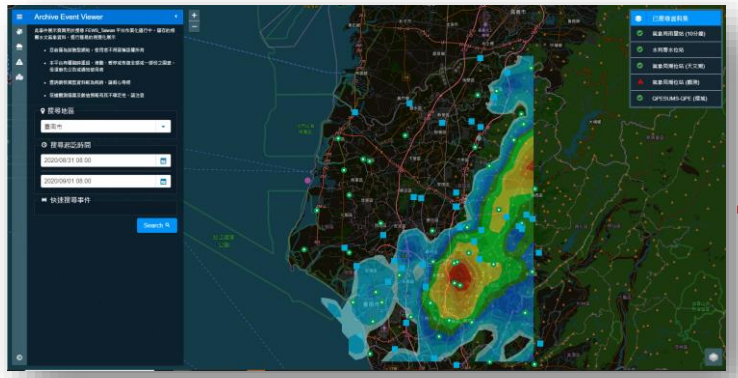
Storage

THREDDS

Model Verification and Validation

-Archive Event IO Development

- Base on microservices
  - Search for Elasticsearch : Location Id ,time…
  - Reader for TDS reading、transformation、Clip..
- Workflow for base service
- **Package Service for different application**
- General REST Client module



Event Viewer UI

other Client

REST API

REST Client

Backend

Workflow

Search Service

Search

Elasticsearch

Reader Service

Read

TDS

Storage

THREDDS

Package Service

Package

Model Verification and Validation
-Archive Event IO Development

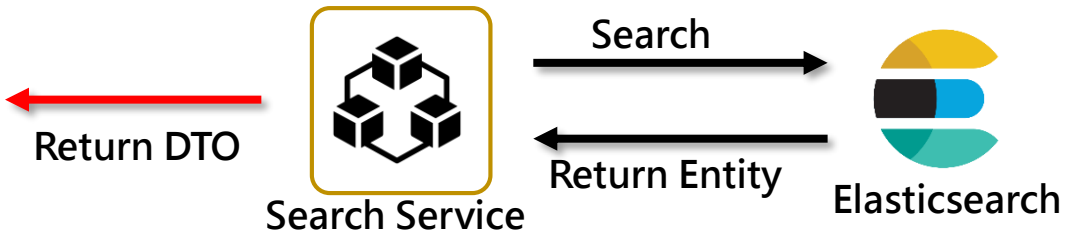
Search Service

- Localization **Taiwan time zone** to Archive UTC0
  - For different user
- Search Meta-fields from Elasticsearch

- Search by **time-range, locationId, file Name**
  - Observations：time-range by **start, end**
  - External Forecasts：time-range by **timezero**
  - Simulations time-range by **timezero**


```
[
  {
    "areaId": "Taiwan",
    "start": 1598832000000,
    "end": 1598917800000,
    "timeSeries": [
      {
        "locationId": "Grid_Qpesums_TaiwanBufferZone",
        "parameterId": "P.radar",
        "archiveParameterId": "precipitation_radar",
        "moduleInstanceId": "Import_Qpesums",
        "timeStepId": "SETS10",
        "qualifierIds": "QPE",
        "ensembleId": "none",
        "ensembleMemberId": "none",
        "timeSeriesType": 0
      }
    ],
    "fileSize": 1540653,
    "recordTime": 1602937830000,
    "creationTime": 1599176118000,
    "timeSeriesValueType": 1,
    "sourceId": "CWB",
    "metaDataFile": "2020/08/Taiwan/31/observed/metaData.xml",
    "netCDF": "2020/08/Taiwan/31/observed/QPESUMS_QPE_BufferZone.nc"
  }
]
```


QPESUMS-QPE Meta-fields DTO

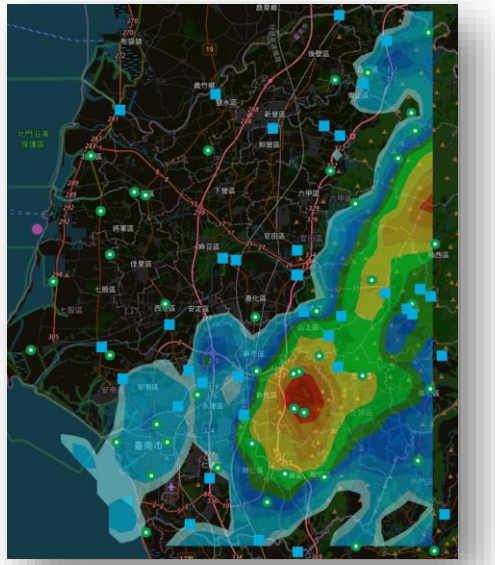


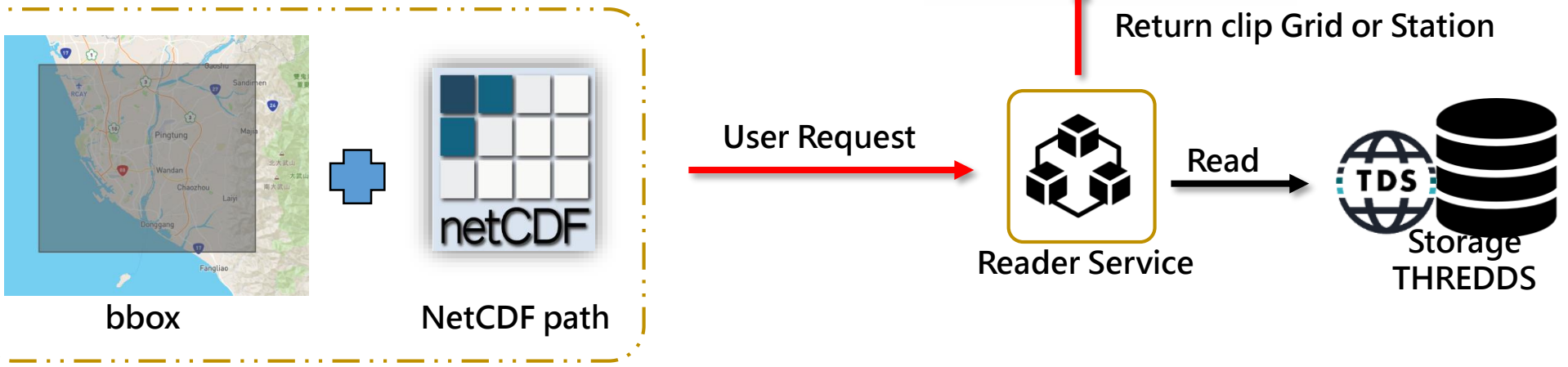
Model Verification and Validation

-Archive Event IO Development

Reader Service

- Read the NetCDF from THREDDS
  - Read by **relative path**
  - **Bounding clips** by user request
- Mapping to JSON format
  - Grid type dataset → Compress Grid Stack
  - Station type dataset → PI-JSON





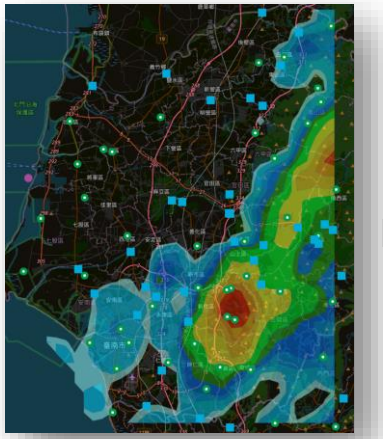
Model Verification and Validation

-Archive Event IO Development

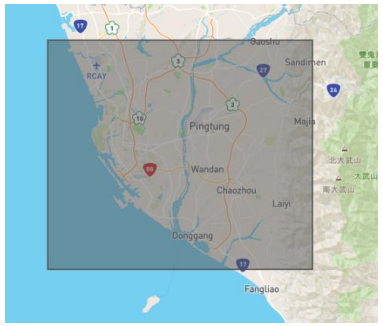
Workflow

- Workflow Process of Archive Event IO
- Combine base service like FEWS workflow
- Search Meta-fields from Search Service
- Mapping to Meta-fields to query Reader Service

- Package Service (eq: download dataset, analysis)



Return clip Grid or Station



bbox

Time Range

User Request

Workflow

Search Service

Search

Elasticsearch

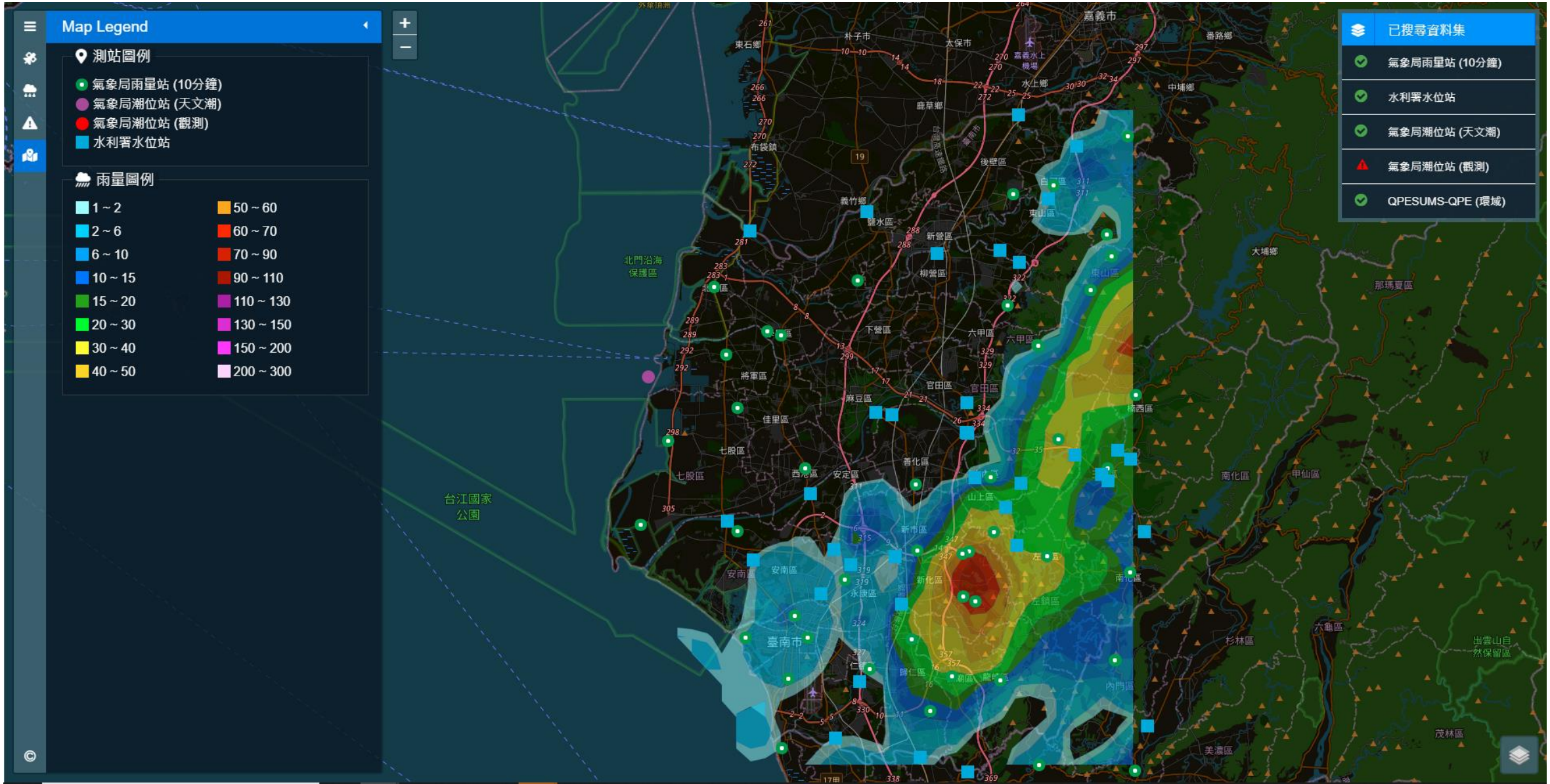
Reader Service

Read

TDS

Storage
THREDDS

Event View UI Layer

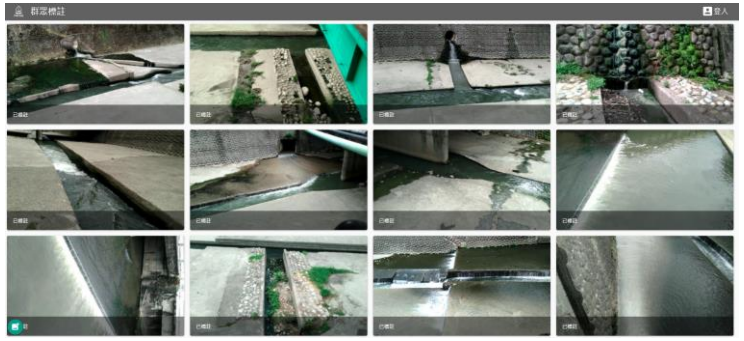


Model Verification and Validation

-Citizen Science

- For the Model Verification and Validation
- Crowdsourcing commutag
  - Flooding (High-Water Mark and tag)
  - Water Quality
- Photo
  - The event about Who, What, When, What, Why

Flooding



Water Quality

Dashboard

Opensource https://commutag.agawork.tw/

Share and Cooperation

Dr. Jhih Cyuan Shen
coop.shen@gmail.com
https://www.facebook.com/coop.shen
https://twitter.com/JhihCyuan
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Fondus Technology

- ✓ We has complex Natural Hazard data.
- ✓ We are happy to share experiences.
- ✓ Open and Cooperation could make the Hazard Prevention more complete.

FondUS Technology Co., Ltd. 方圖科技

TAIPEI TECH

NCHC

Water Resources Agency
Water Resources Planning Institute

Thank you for your patience.