# Deltares

enabling delta life

Quang Nam Province

# Flood Forecasting and Warning for Hoi An, Vietnam

## Delft-FEWS International User Days 2022


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(Deltares)

Bas Stengs
(Deltares)

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- Deliverables
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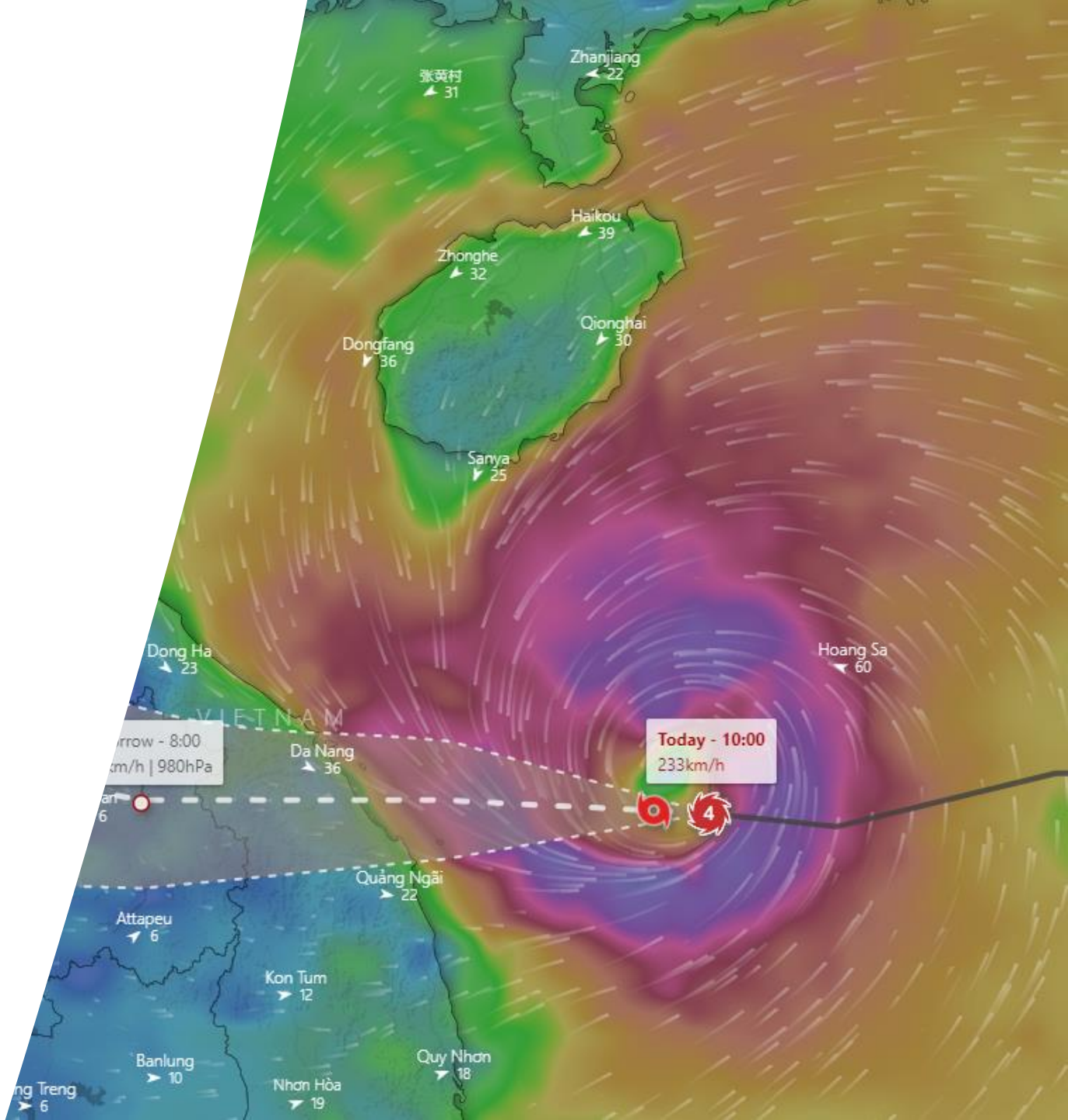
- Q&A

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# Project Summary

# Project synopsis

| | |
|---|---|
| **Title:** | Development and Implementation of Flood Forecasting and Warning System for Hoi An and VGTB Basin |
| **Part of:** | GRANT 0462-Vie: “Urban Environment and Climate Change Adaptation” |
| **Objectives:** | To improve **forecasting and warning services** for natural hazards (floods, storm surges, landslides), |
| | To strengthen the **crisis dissemination** in the region |
| | To develop a **Decision Support System** to support reservoir operation and other measures to reduce floods, drought and salinity intrusion. |
| **Period:** | 05 March 2018 – 30 September 2022 (4.5 years) |
| **Client:** | Quang Nam Project Management Unit of Transport Construction Works |
| **Budget:** | +/- 1.8 million EURO (+/- 44 billion VND) (excl. tax) |
| **Funding:** | Financed on a grant basis by the Urban Climate Change Resilience Trust Fund under the Urban Financing Partnership Facility and administered by ADB. |
| **Consortium:** | Joint Venture Deltares/HaskoningDHV/SUEZ-SAFEGE and Institute of Water Resources Planning (Hanoi) as subcontractor. |

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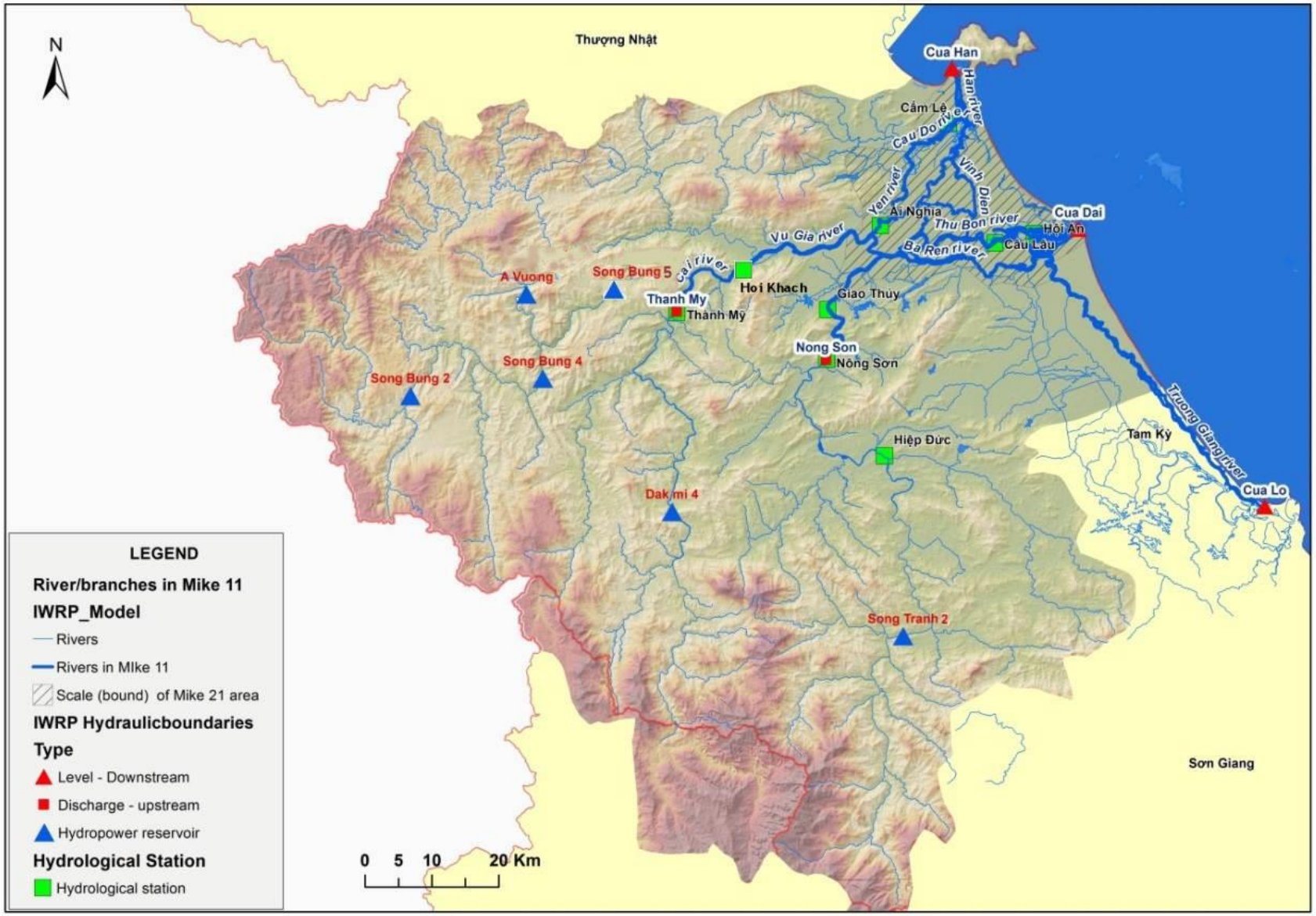
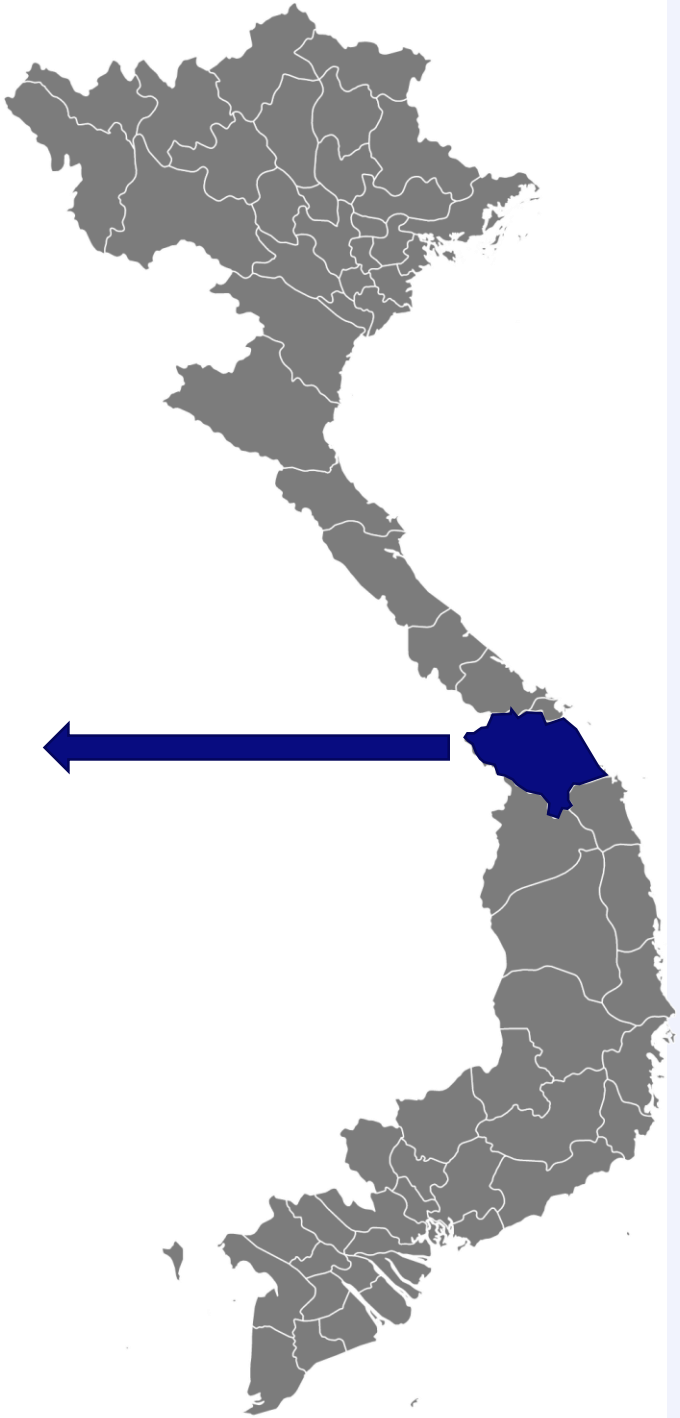
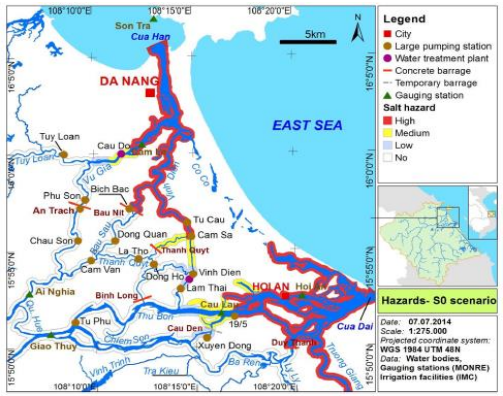
# Study area: Vu Gia Thu Bon river basin

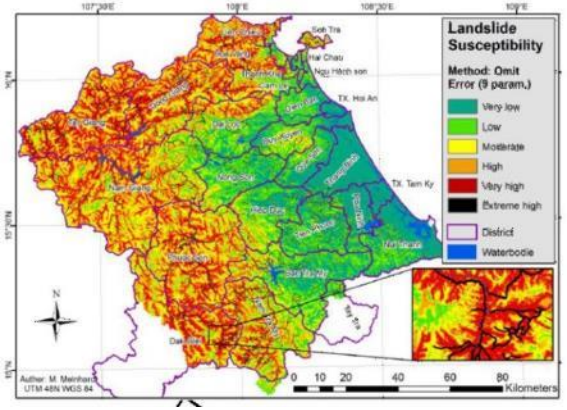


# Challenges and issues addressed in the study

- River floods
  - in last 10 years accumulated flood damages of about 20 M US$ in Hoi An
  - Flooding occurs several times per year for several days
- Storm surges (up to 1.2 meter above the regular tides)
- Landslides (over 800 historical landslides recorded)
- Droughts and water shortages (e.g.in 2014)
- Salinity intrusion (water diversion / reservoir operation)
- Reservoir operation & management (10 big reservoirs up to 1.279 Mw; 36 small – medium reservoirs 50% operational and 50% under construction up to 560 Mw)
- Institutional embedment: Having various institutes and authorities work together in times of crisis’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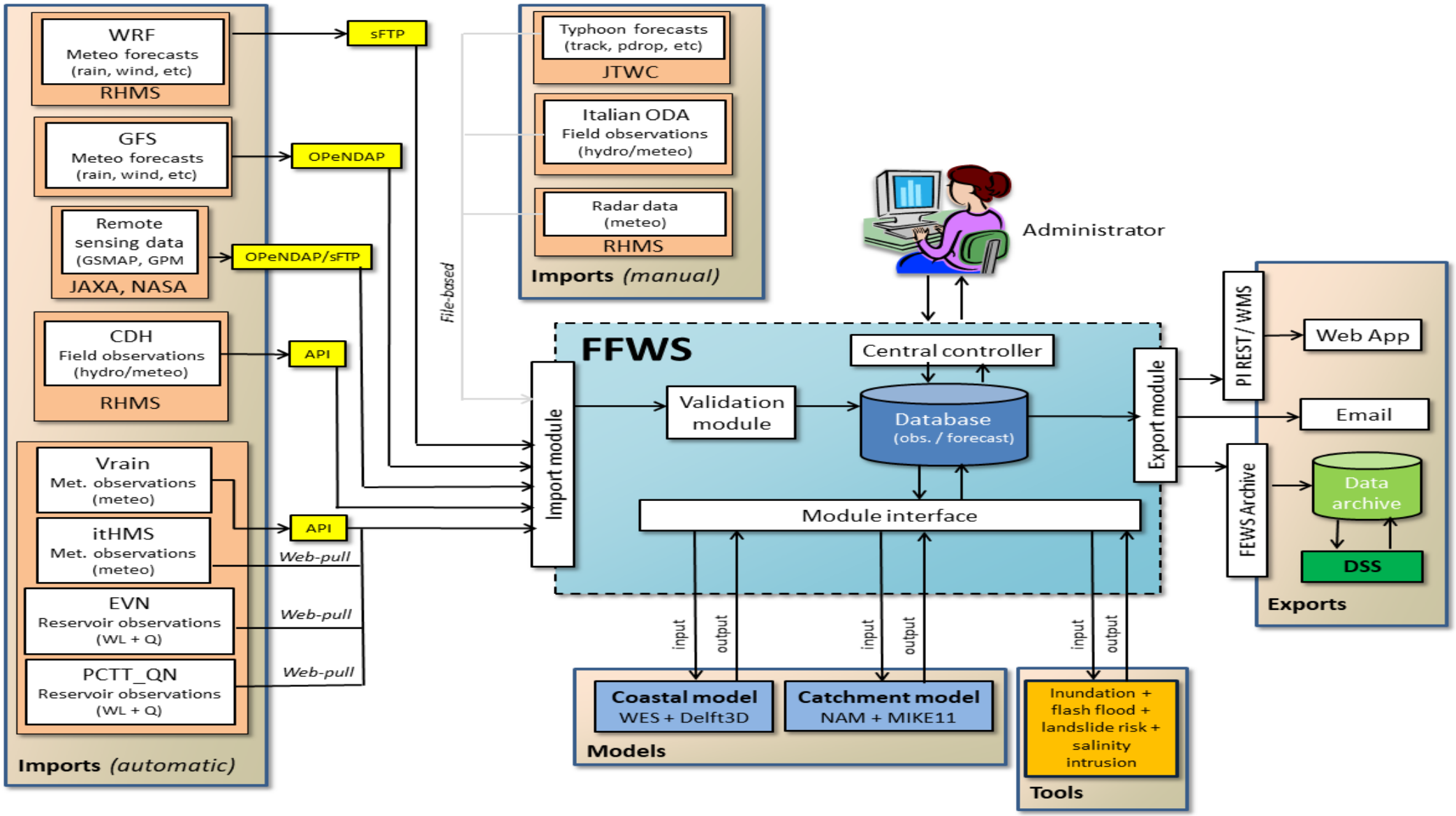
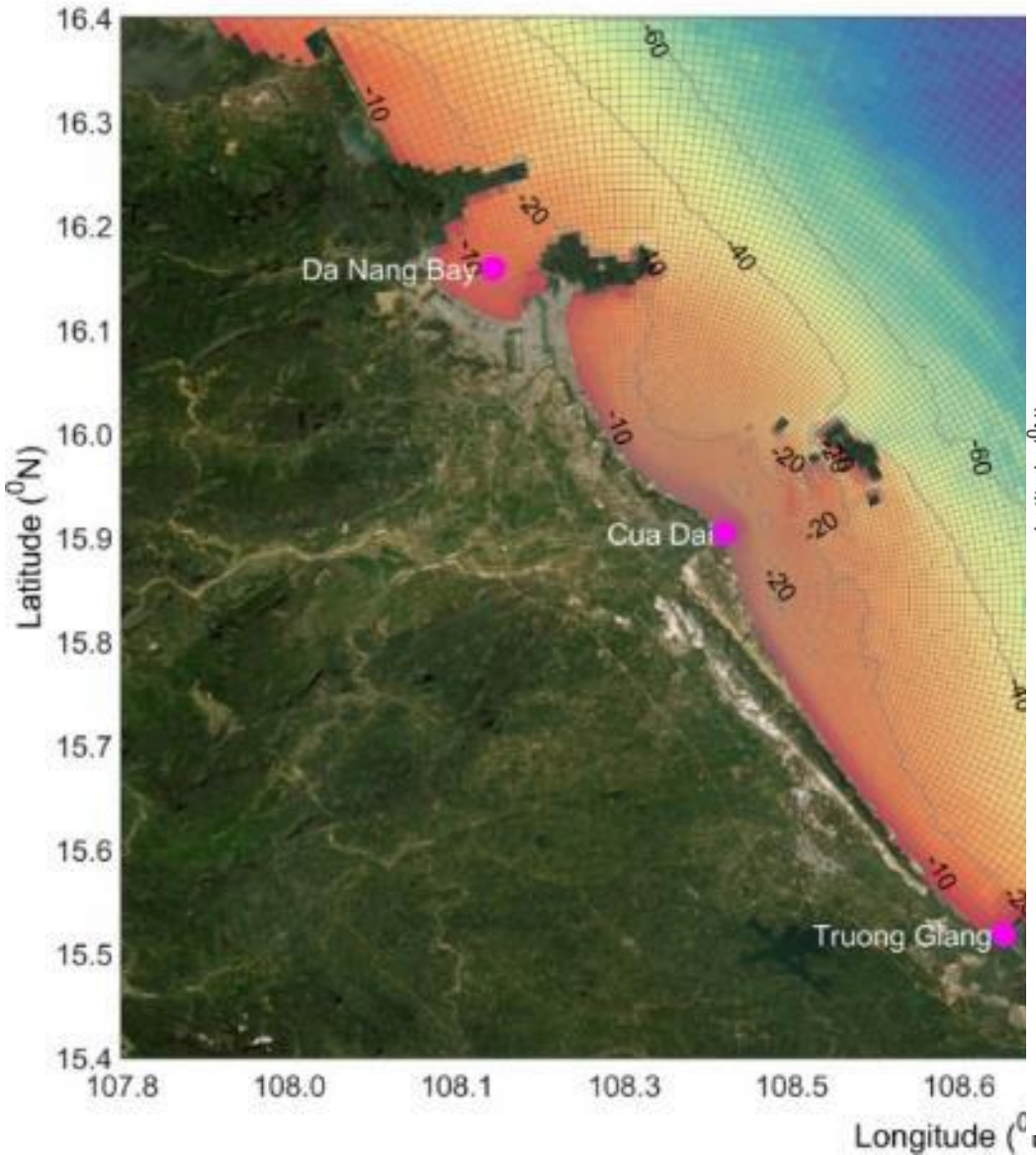
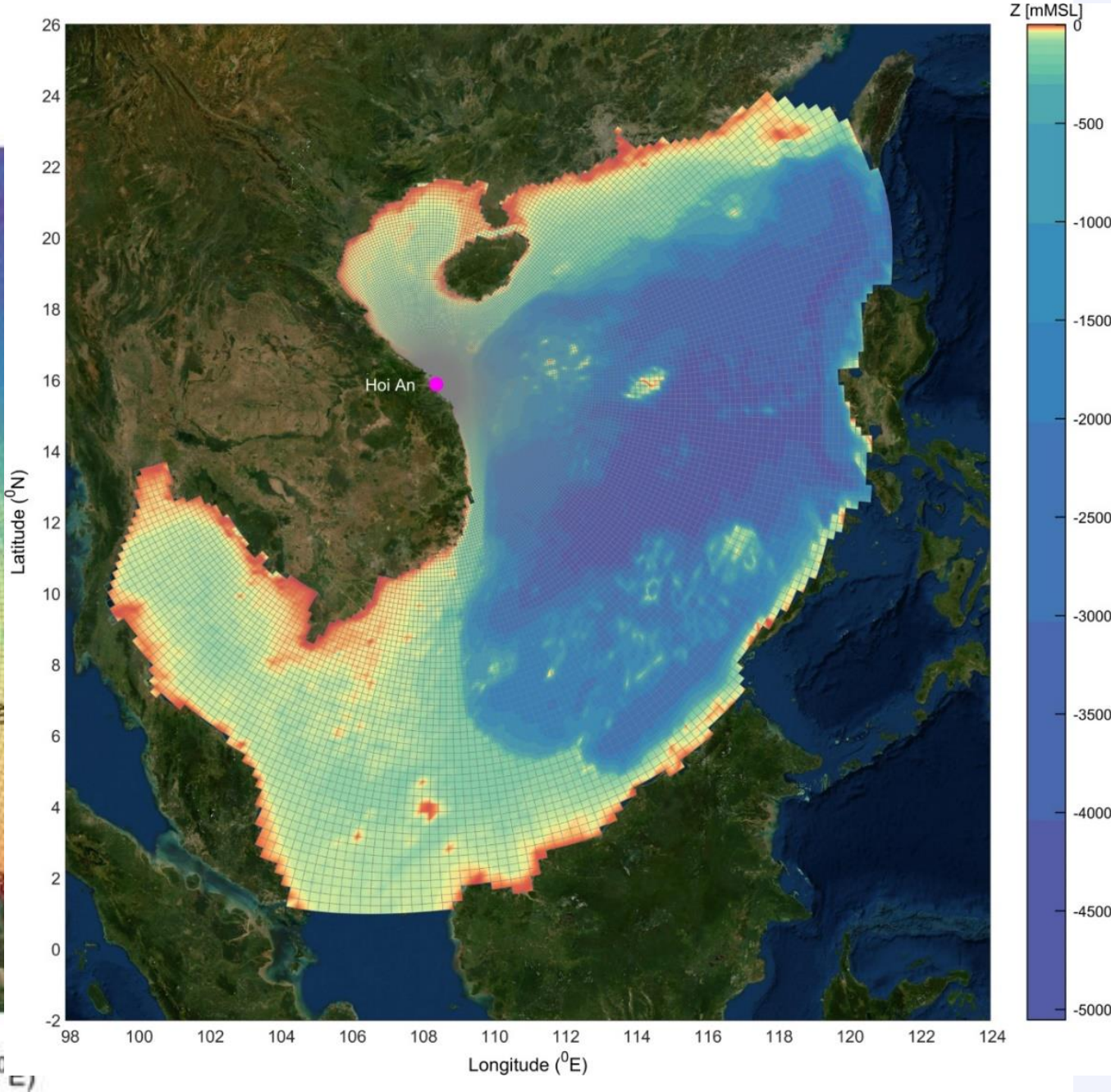
# Deliverables

# FEWS-Hoi An

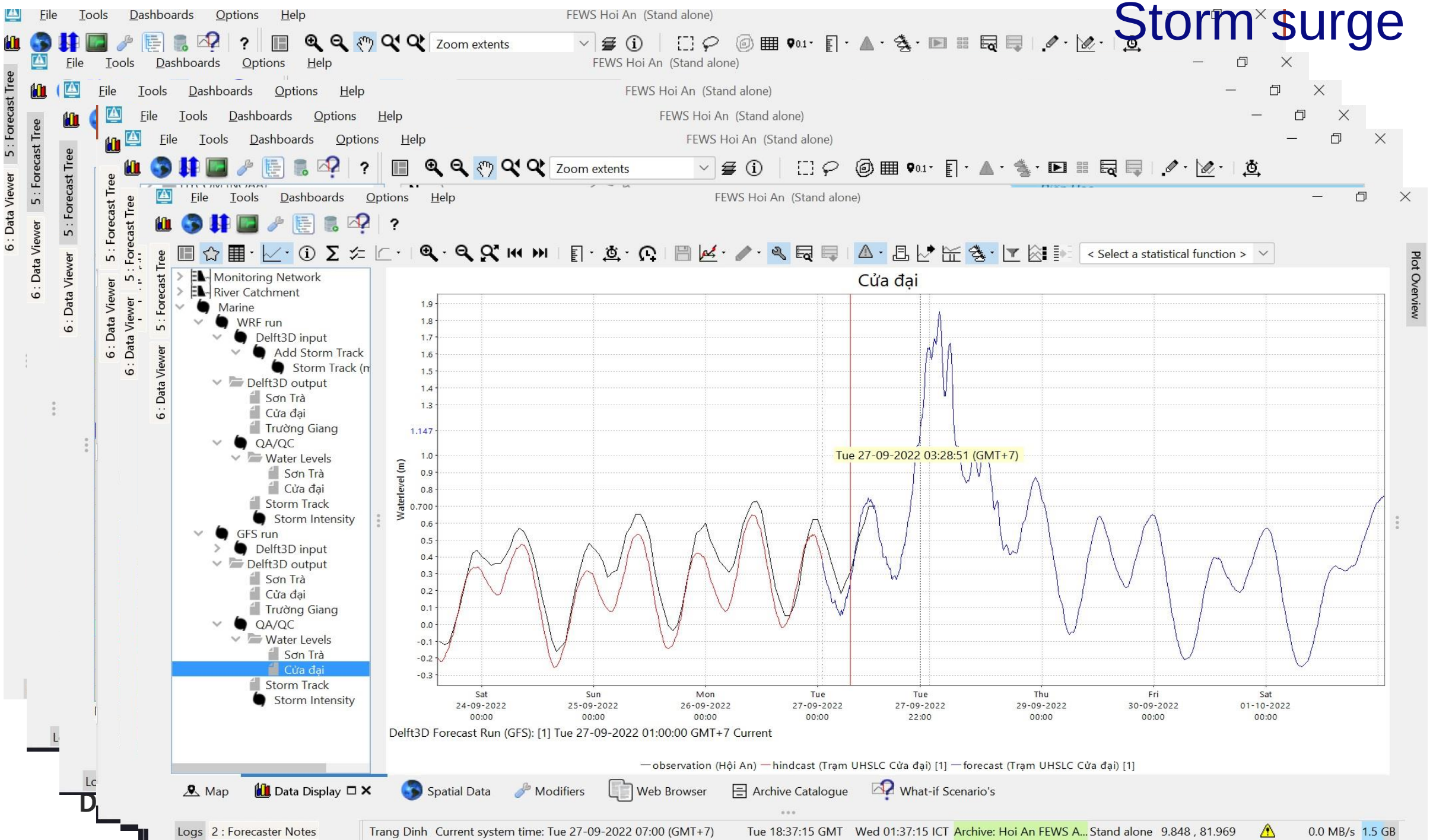

WRF
Meteo forecasts
(rain, wind, etc)
RHMS
GFS
Meteo forecasts
(rain, wind, etc)
Remote
sensing data
(GSMAP, GPM
JAXA, NASA
CDH
Field observations
(hydro/meteo)
RHMS
Vrain
Met. observations
(meteo)
itHMS
Met. observations
(meteo)
EVN
Reservoir observations
(WL + Q)
PCTT_QN
Reservoir observations
(WL + Q)
Imports (automatic)
sFTP
OPeNDAP
OPeNDAP/sFTP
API
API
Web-pull
Web-pull
Web-pull
File-based
Typhoon forecasts
(track, pdrop, etc)
JTWC
Italian ODA
Field observations
(hydro/meteo)
Radar data
(meteo)
RHMS
Imports (manual)
Administrator
FFWS
Import module
Validation
module
Central controller
Database
(obs. / forecast)
Module interface
Export module
input
output
input
output
input
output
Coastal model
WES + Delft3D
Catchment model
NAM + MIKE11
Models
Inundation +
flash flood +
landslide risk +
salinity
intrusion
Tools
PI REST / WMS
FEWS Archive
Web App
Email
Data
archive
DSS
Exports

# Coastal model (Delft3D)



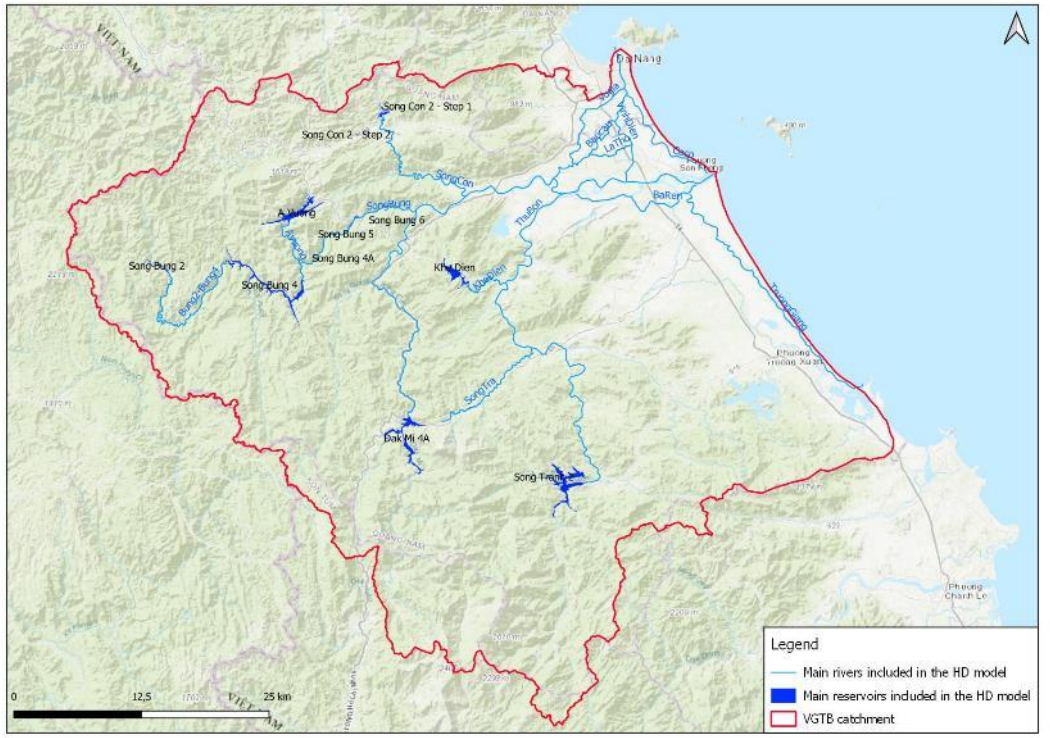



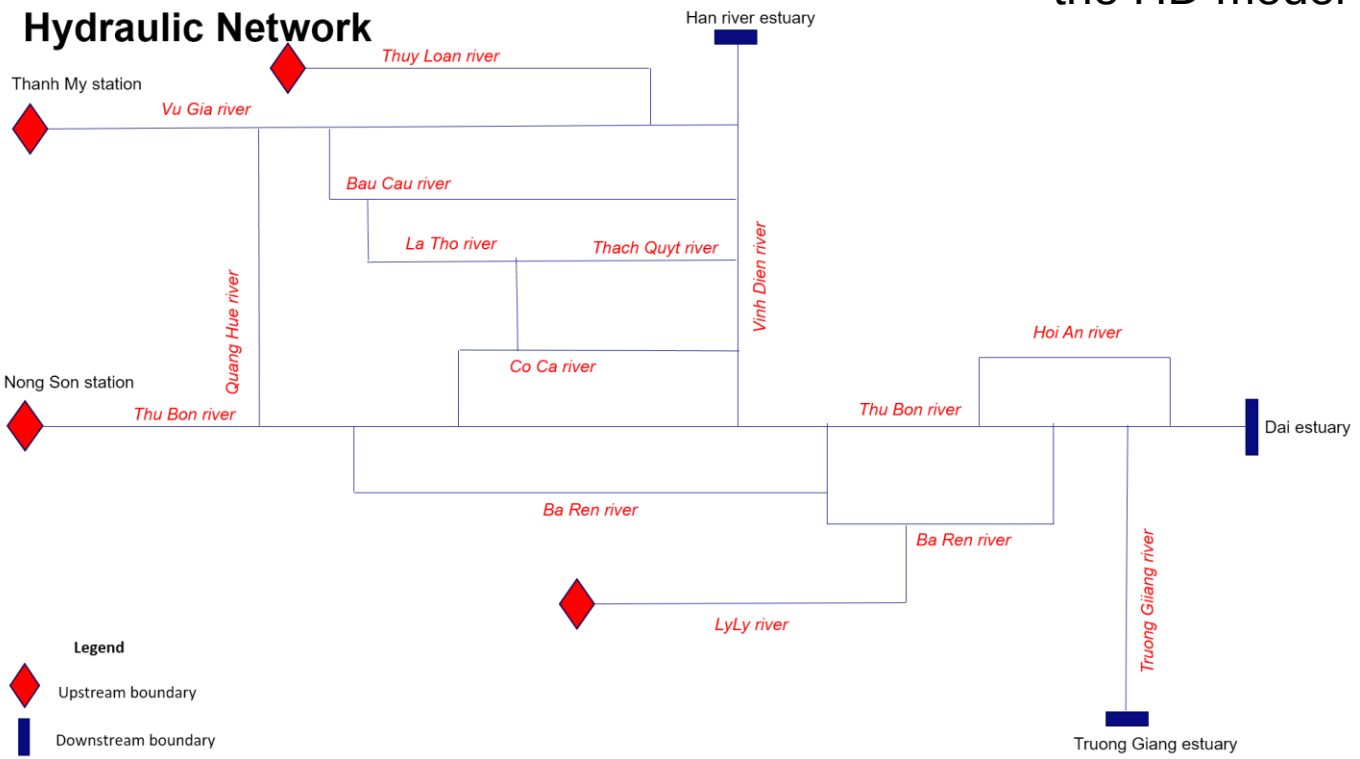
# Storm surge


File Tools Dashboards Options Help
FEWS Hoi An (Stand alone)
Zoom extents
< Select a statistical function >
Monitoring Network
River Catchment
Marine
WRF run
Delft3D input
Add Storm Track
Storm Track (n
Delft3D output
Sơn Trà
Cửa đại
Trường Giang
QA/QC
Water Levels
Sơn Trà
Cửa đại
Storm Track
Storm Intensity
GFS run
Delft3D input
Delft3D output
Sơn Trà
Cửa đại
Trường Giang
QA/QC
Water Levels
Sơn Trà
Cửa đại
Storm Track
Storm Intensity
Cửa đại
Waterlevel (m)
1.147
Tue 27-09-2022 03:28:51 (GMT+7)
Sat 24-09-2022 00:00
Sun 25-09-2022 00:00
Mon 26-09-2022 00:00
Tue 27-09-2022 00:00
Tue 27-09-2022 22:00
Thu 29-09-2022 00:00
Fri 30-09-2022 00:00
Sat 01-10-2022 00:00
Delft3D Forecast Run (GFS): [1] Tue 27-09-2022 01:00:00 GMT+7 Current
observation (Hội An)
hindcast (Trạm UHSLC Cửa đại) [1]
forecast (Trạm UHSLC Cửa đại) [1]
Map
Data Display
Spatial Data
Modifiers
Web Browser
Archive Catalogue
What-if Scenario's
Logs
2 : Forecaster Notes
Trang Dinh Current system time: Tue 27-09-2022 07:00 (GMT+7)
Tue 18:37:15 GMT
Wed 01:37:15 ICT
Archive: Hoi An FEWS A...
Stand alone
9.848 , 81.969
0.0 MB/s
1.5 GB
5 : Forecast Tree
6 : Data Viewer
Plot Overview

# River model (MIKE 11)

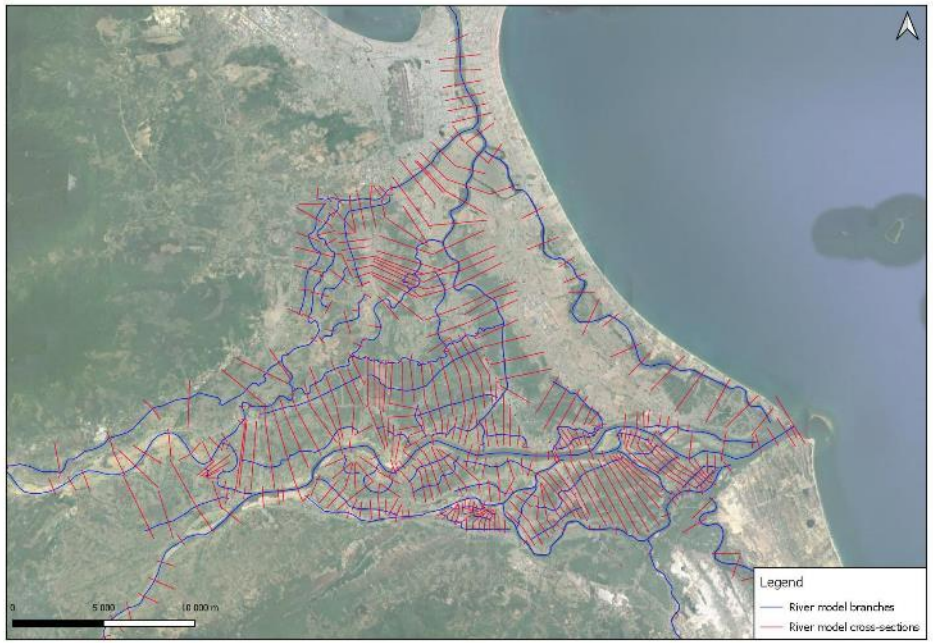
main rivers and reservoirs included in the HD model



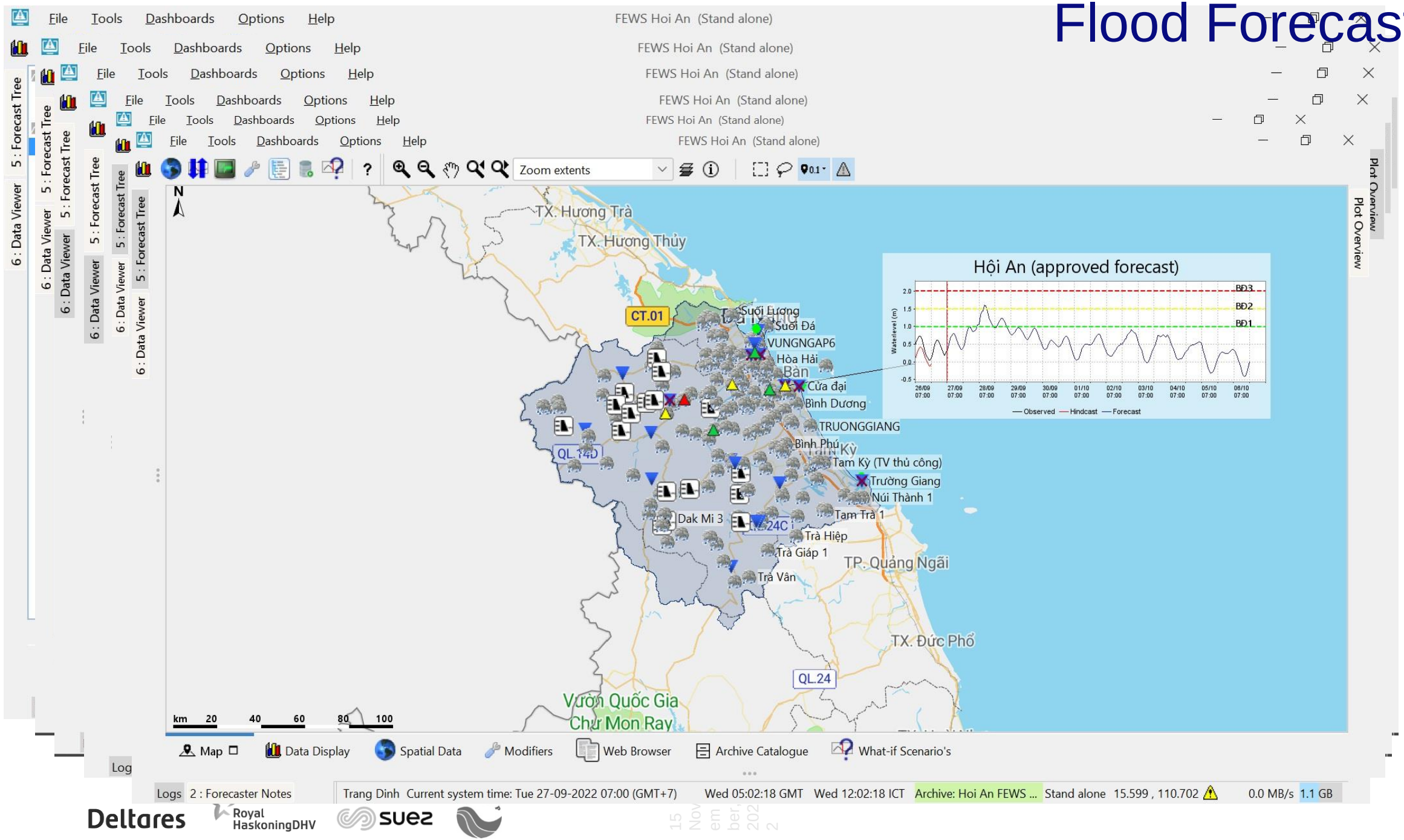




Flood maps are produced using quasi-2D Model (GIS based)

model river branches and cross-sections in the downstream floodplain



# Flood Forecasts

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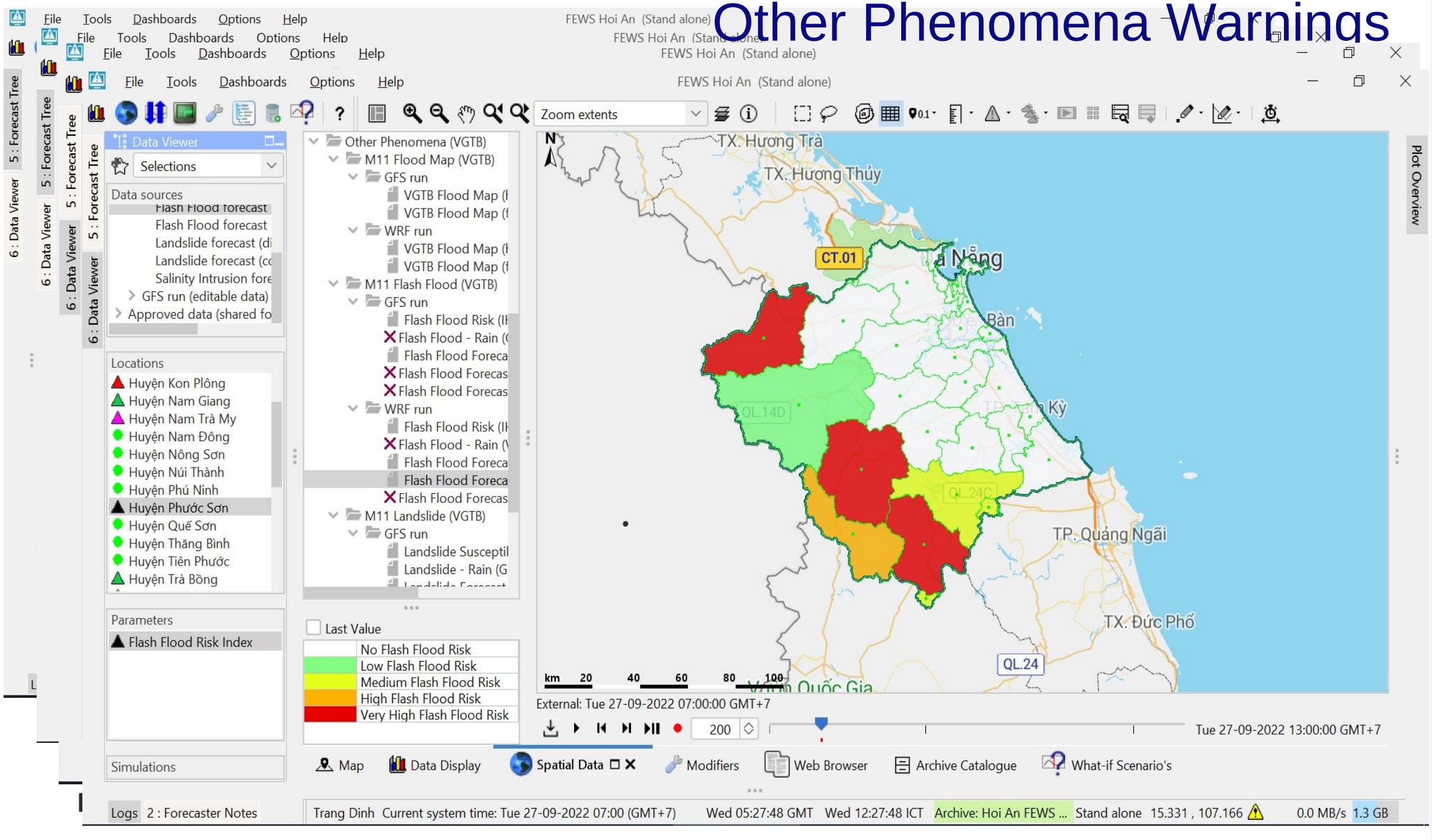
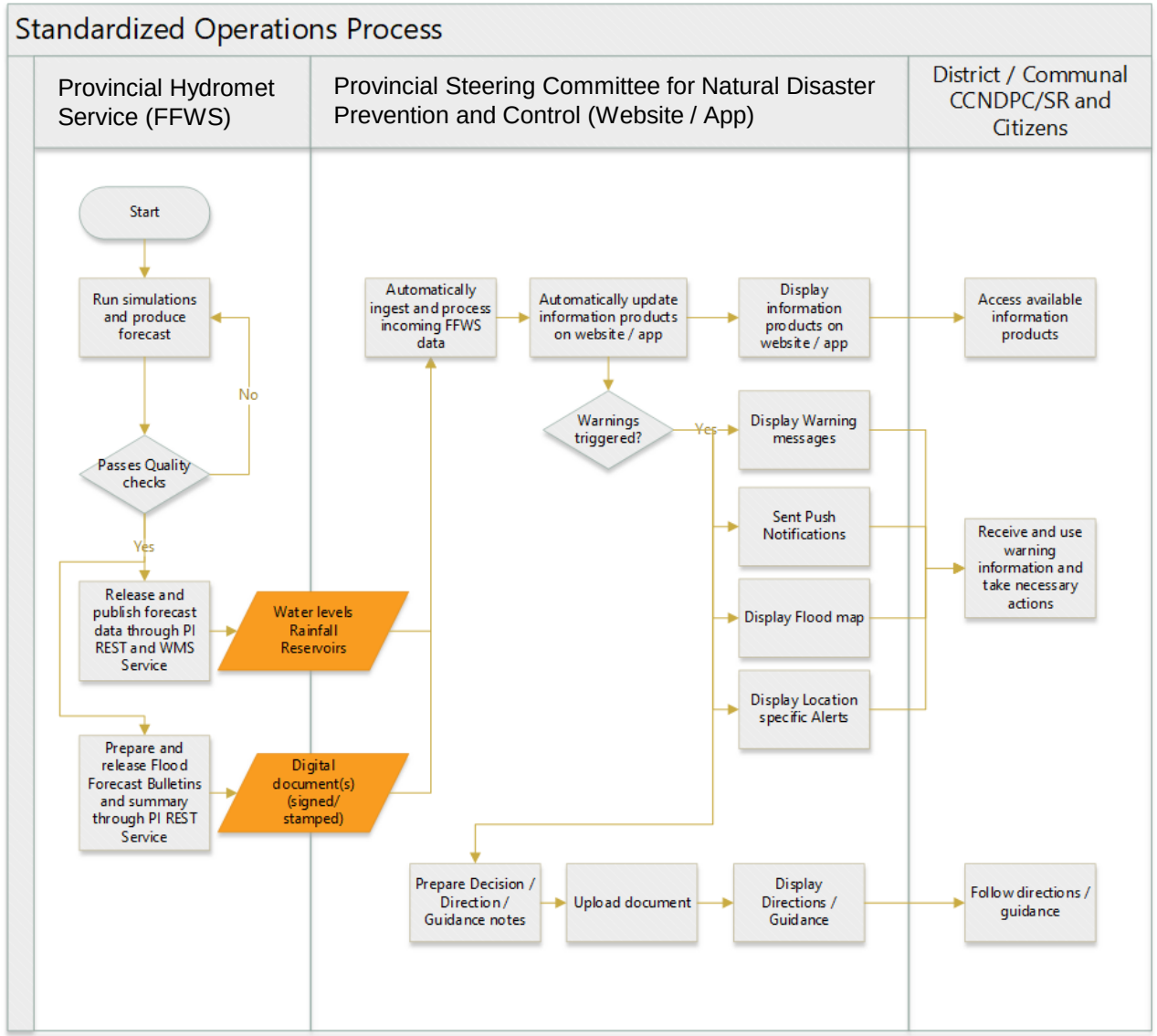
# Other Phenomena Warnings



# Flood warning and crisis communication system

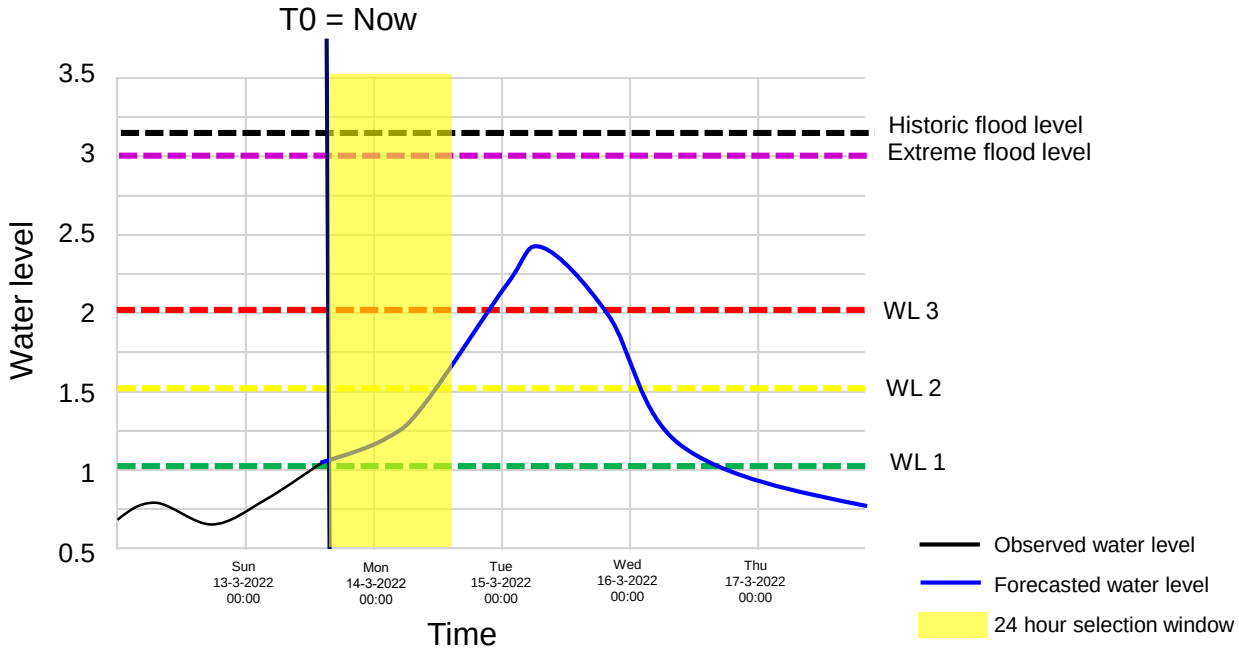
## Improved standardized process for early Warning Services to the general public

- Provide transparent and **public access** to Early Warning Products via **website and mobile app**
- Enable flood forecast and warning dissemination by showing and **pro-actively communicate warnings** occuring within the next 24 hours;
- Allow users to see the **locations** of meteorological (rainfall) stations, hydrological stations, reservoirs;
- Provide users to ability to **interactively explore a 2D flood map** to see what potential water depth will at a specific location during a flood event;
- Enable users to see **timeseries** of observed and forecasted waterlevels, observed rainfall and observed parameters for reservoirs;
- Allow users to **submit location specific feedback** on a flood / emergency situation
- Provide users with **official flood and warning bulletins** including disaster levels and guidance/recommendations for communities, citizens, business to take precautions and mitigation actions.



# Automated decision rules to trigger Early Warning Communication

**Input: Observed and forecasted Water levels at Hoi An Station**

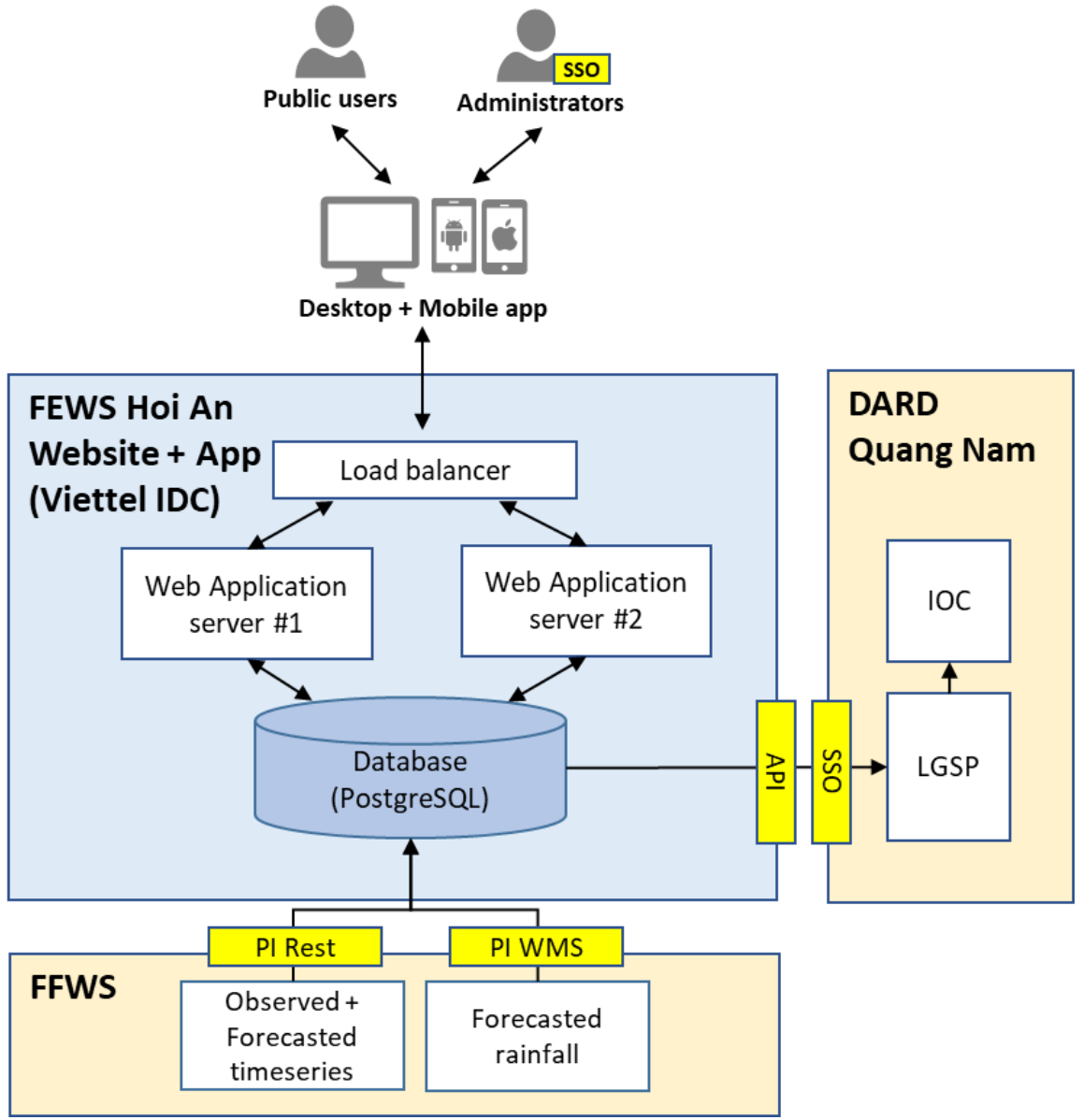


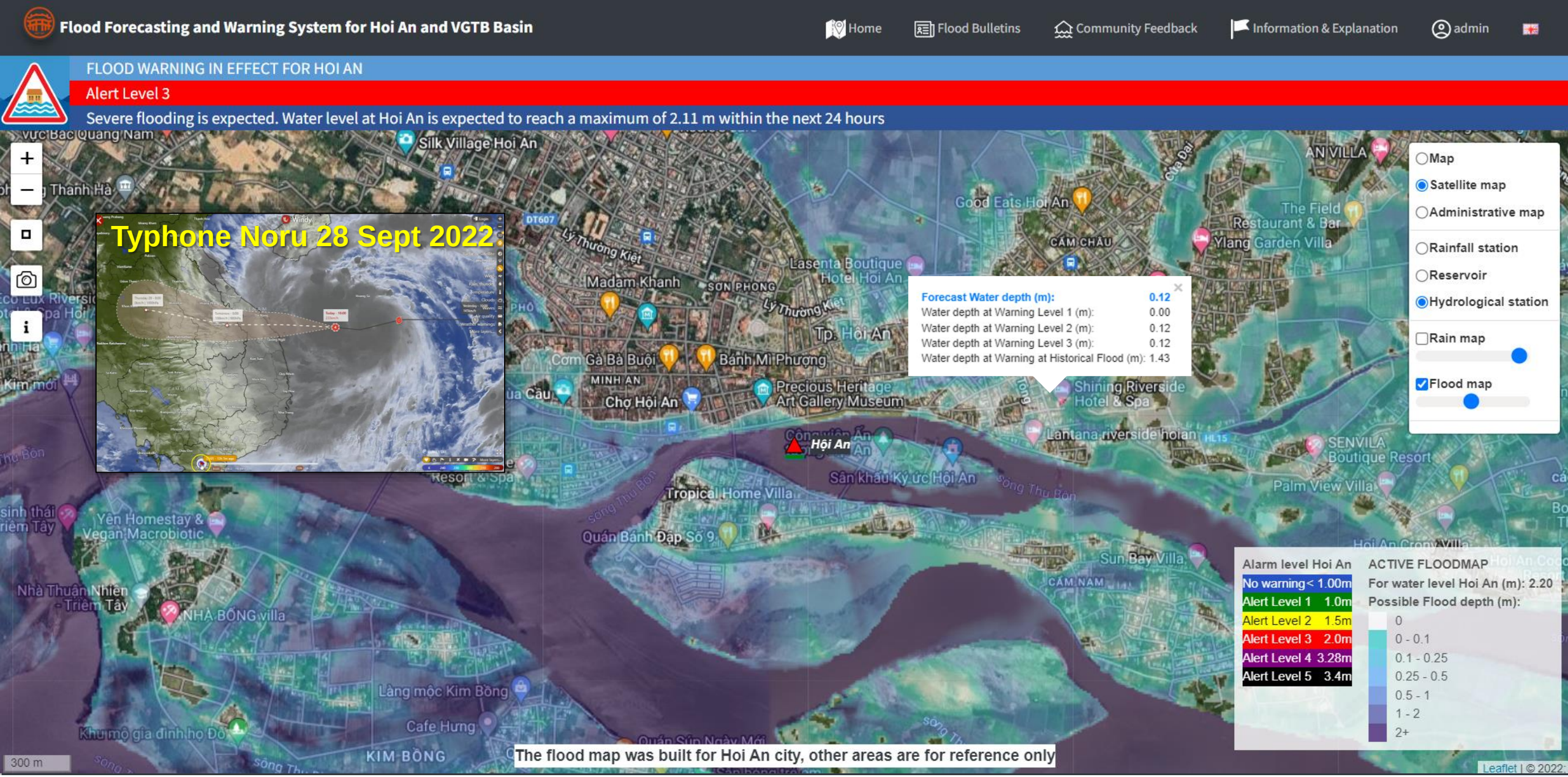

| Purpose | Automatic decision rule |
|---|---|
| **Update map symbols Hydrological stations** | If forecasted water level at <hydrological station> exceeds <station specific alarm level> within the next 24 hours then update the hydro station icon |
| **Display Flood warning** | If forecasted water level at Hoi An Station exceeds <specifc alarm level> within the next 24 hours then show flood warning alert message on landing page. |
| **Issue and sent Push notification** | If forecasted water level at Hoi An Station exceeds <specifc alarm level> within the next 24 hours then send push notification with predefined warning message. |
| **Activate flood map** | If forecasted water level at Hoi An Station is within range of 1,00 and 3,50 m+MSL than activate and show flood map showing the flood depths associated with the maximum water level that is forecasted in the next 24. |

# Flood warning and crisis communication system

**Solution Architecture and**

**HA (High Availability) configuration**






# FFWS Hoi An Website - Waterlevels

Flood Forecasting and Warning System for Hoi An and VGTB Basin

Home | Flood Bulletins | Community Feedback | Information & Explanation | admin

FLOOD WARNING IN EFFECT FOR HOI AN

Alert Level 2

Moderate flooding is expected. Water level at Hoi An is expected to reach a maximum of 1.94 m within the next 24 hours


H. Đông Giang
H. Tây Giang
H. Đại Lộc
TP. Hội An
H. Nông Sơn
H. Thăng Bình
H. Quế Sơn
H. Hiệp Đức
H. Phước Sơn
H. Núi Thành
H. Bắc Trà My
QL.14G
QL.14D
QL.40B
QL.1A
CT.01

Map
Satellite map
Administrative map
Rainfall station
Reservoir
Hydrological station
Rain map
Flood map

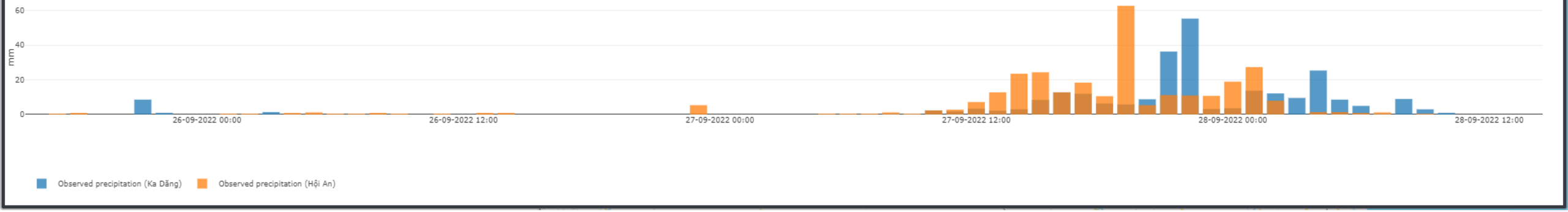
| Alarm level Hoi An | |
|---|---|
| No warning | < 1.00m |
| Alert Level 1 | 1.0m |
| Alert Level 2 | 1.5m |
| Alert Level 3 | 2.0m |
| Alert Level 4 | 3.28m |
| Alert Level 5 | 3.4m |

Accumulated rainfall in the past 24 hour (mm):
No data
No rain
Light rain (< 16 mm)
Moderate rain (16 – 50 mm)
Heavy rain (51 – 100mm)
Very heavy rain (>100mm)

10 km

Leaflet | © 2022; Vmap

Ka Dăng x Hội An x




# FFWS Hoi An Website - Rainfall

Flood Forecasting and Warning System for Hoi An and VGTB Basin

Home | Flood Bulletins | Community Feedback | Information & Explanation | admin

FLOOD WARNING IN EFFECT FOR HOI AN

Alert Level 2

Moderate flooding is expected. Water level at Hoi An is expected to reach a maximum of 1.94 m within the next 24 hours


Za Hung
A Vuong
Song Bung 6
Song Bung 5
Song Bung 4A
Song Bung 2
Song Bung 4
QL.14D
H. Nam Giang
Khe Dien
H. Nông Sơn
H. Thăng Bình
H. Quế Sơn
CT.01
H. Hiệp Đức
Song Tranh 4
QL.1A
H. Phước S
Dak Mi 4A
Dak Mi 4C
Song Tranh 3
QL.40B
H. Núi Thành
H. Lý S
Dak Mi 3
Dak Mi 2
H. Bắc Trà My
Song Tranh 2
QL.24C
H. Bình Sơn
H. Trà Bồng
QL.40B
QL.24B

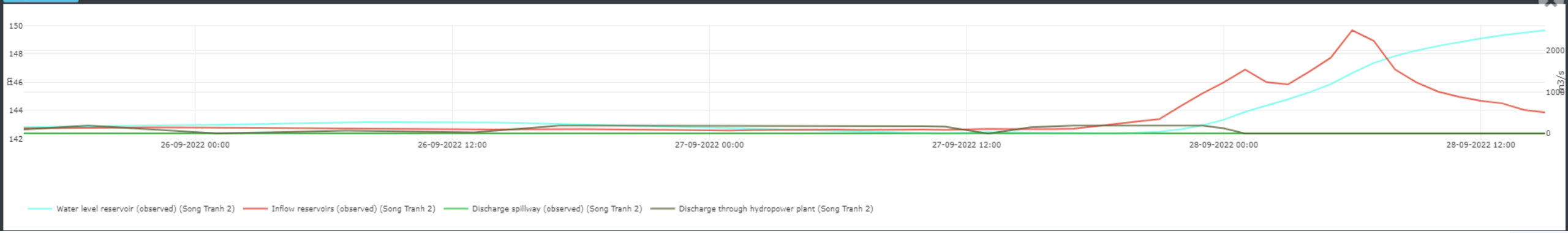
Map
Satellite map
Administrative map
Rainfall station
Reservoir
Hydrological station
Rain map
Flood map

Alarm level Hoi An
No warning < 1.00m
Alert Level 1 1.0m
Alert Level 2 1.5m
Alert Level 3 2.0m
Alert Level 4 3.28m
Alert Level 5 3.4m

10 km

Leaflet | © 2022; Vmap

Song Tranh 2 x

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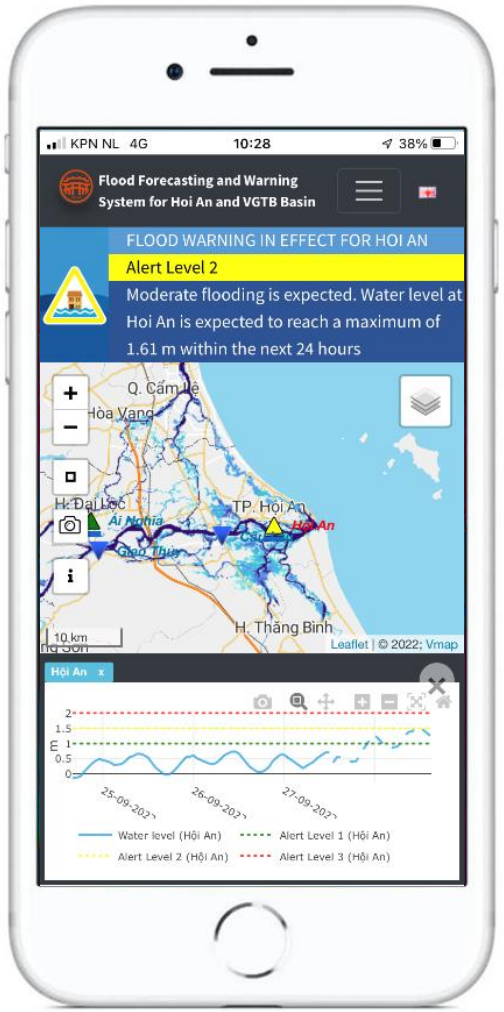
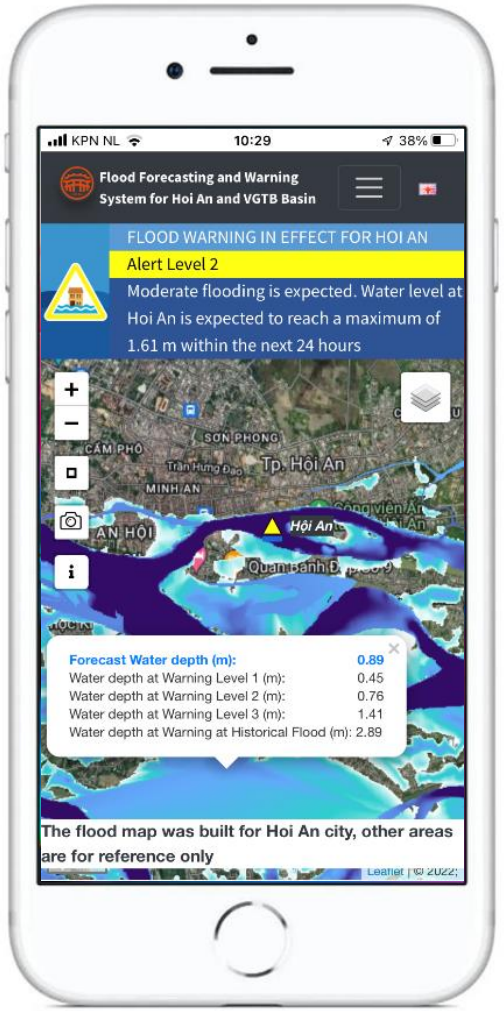
# FFWS Hoi An Website - Reservoirs

# Hoi An FFWS Mobile application




**Forecasted water levels**




**Flood depths**


**Push Notifications**

# Collaboration and Future Improvements

# Collaboration

- Update model adapter for MIKE 11 2022 in FEWS: together with DHI Denmark
- Webservice: in collaboration with HaskoningDHV and a local software developer, Adetech, to develop a website and mobile app for the province. The data from FEWS Hoi An is also integrated into LGSP, IOC and Smart App of Quang Nam Province.
- O&M support: O&M support is intended to be provided  by local team in collaboration with SCALE JSC for backend system, Deltares Vietnam Office for frontend and Adetech for web/mobile app services
- Flood map library: spatial flood forecast greatly helps disaster management
- Co-Creation with local FEWS community, by involving them in:
  - Hosting the FEWS test environment
  - Assisting with FEWS S&M
  - Assisting with the FEWS training (fully in Vietnamese)
- Collaboration found with various end users: Governmental agencies, local communities and districts,

# Future Operations & Improvements

- Improve the rainfall accuracy: by integrating data from weather radar
- Upgrade flood forecasting system to multi-hazard warning system: with two new focus on landslide and flash flood
- Update the method and accuracy of real – time flood map:
- Accurate prediction of rainfall remains the bottleneck…could be improved with rainfall forecasting models or improved radar data analysis…(but this was beyond the scope of this project)


Xin cảm ơn!
Thank you!
Câu hỏi?
Any Questions?