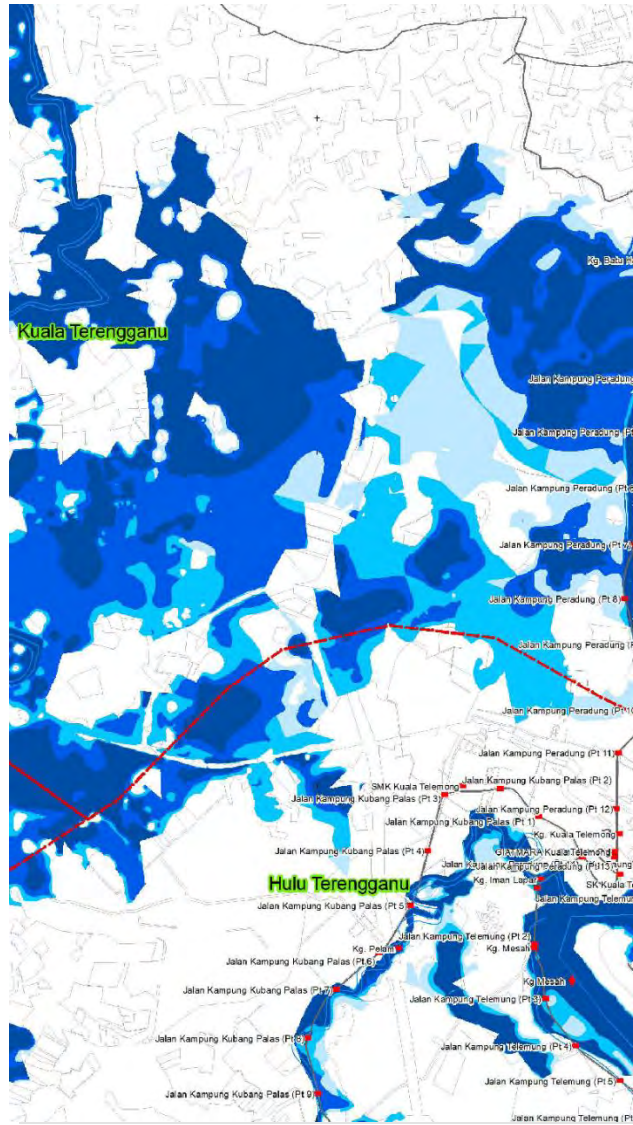
Flood Risk Management Case Visit in Malaysia

- *An overview of Hydrodynamic Flood Forecasting Operation and Simulation*

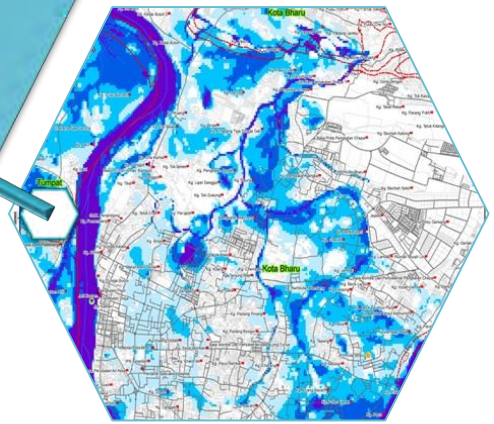
National Flood Forecasting and Warning Centre (PRABN)
Department of Irrigation and Drainage, Malaysia (JPS)



Presentation Outline

Introduction

Flood Simulation and Forecasting Process



Conclusion

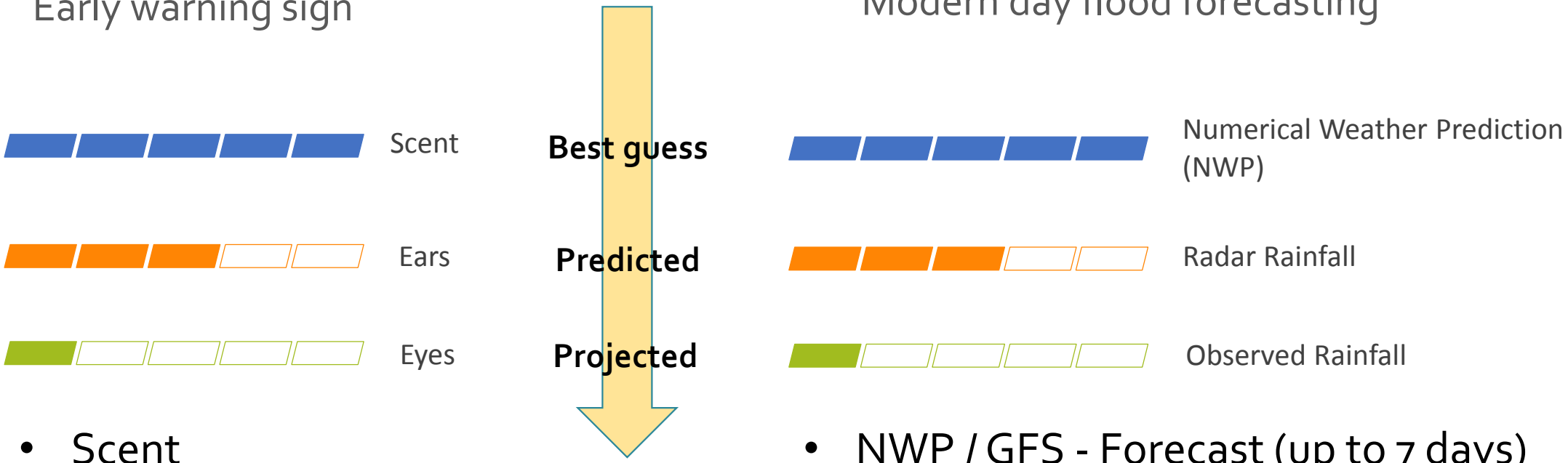
Hydrodynamic Flood Forecasting Model

What do we expect?

- Capable of modelling complex condition
- Capture near to real catchment condition
- Extended flood forecasting lead time / response
- Accurate & informative flood warning dissemination
- Skilled and experienced flood forecaster

Kuala Krai, 2014

Forecasts at a glance..



- Scent
- Hearing
- Vision

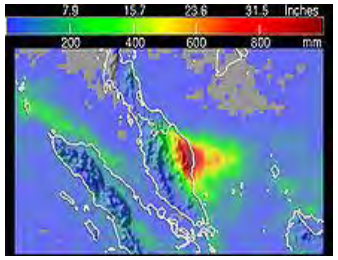
- NWP / GFS - Forecast (up to 7 days)
- Radar - Nowcast
- Observed Rainfall - Hindcast

Key Components of Hydrodynamic Flood Forecasting

Data Input

1 Rainfall and Catchment Information

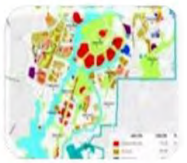
How much rain is likely to fall and what are the possible catchment losses?



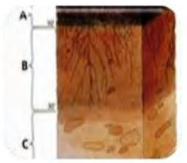
2 Hydrologic Process

Convert rainfall into runoff at discrete locations in the catchment

CATCHMENT AREA



LAND USE



SOIL

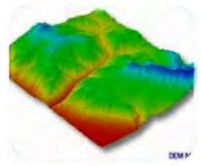
RAIN

3 Hydraulic Process

Convert catchment surface runoff into river discharge through a stream and on a floodplain (forecast flood levels)

RIVER ALLIGNMENT

RIVER CROSS SECTION



3D MODEL GROUND SURFACE

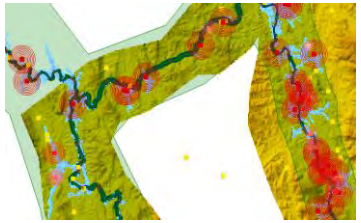
STRUCTURE

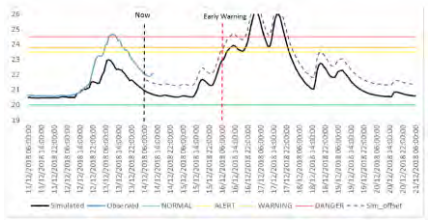
Flood Model Simulation

Output Result

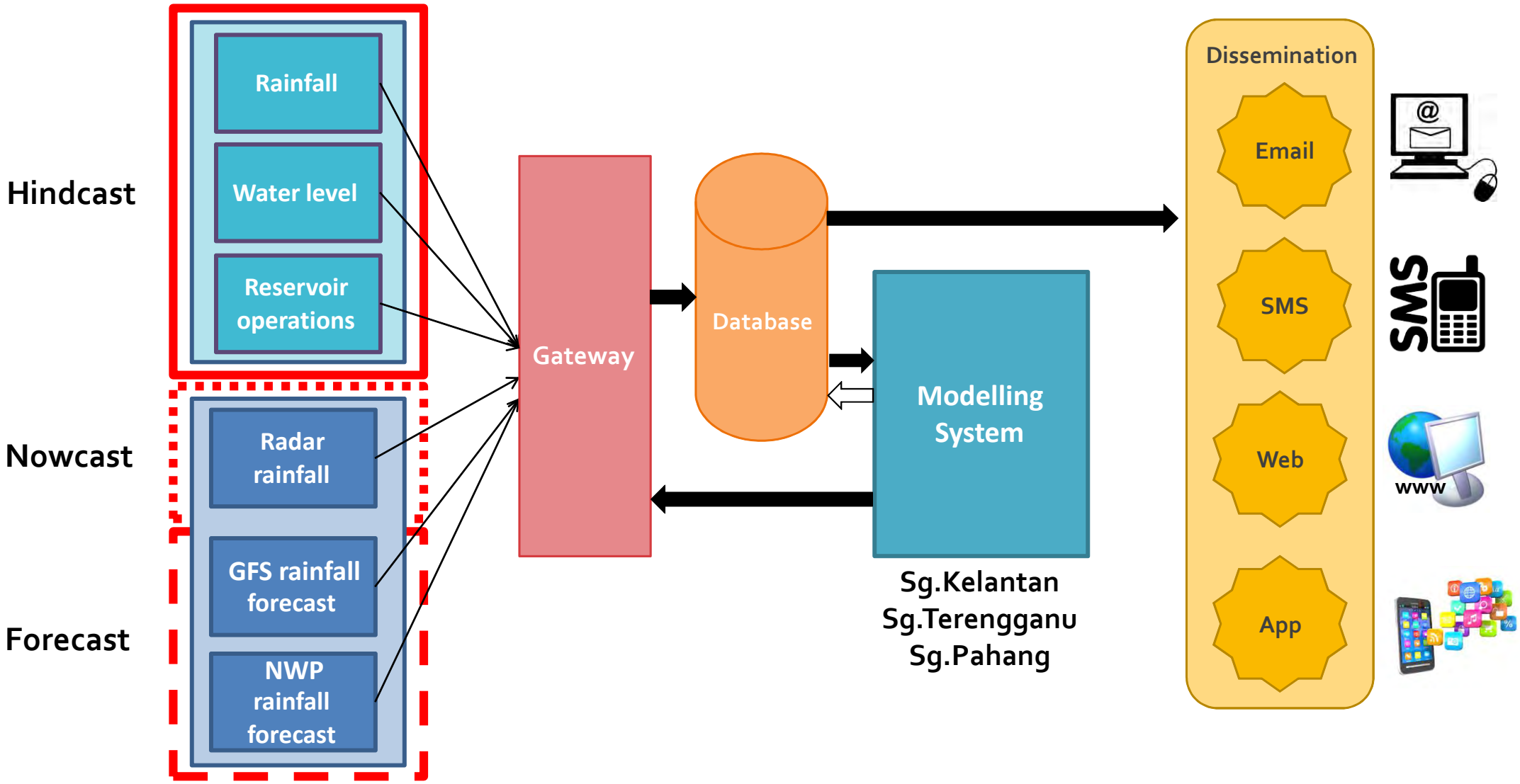
4 Flood Outcomes

The possible impact of the forecast flooding & warning dissemination to various stakeholders to manage/plan flood emergency operations





Overview of NaFFWS Components



Modified after HRW, 2018

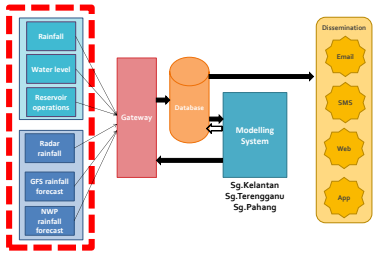
Daily Flood Forecast Operation

Weather Satellite Imagery (IR) Himawari - 28/12/2018

http://bencana.met.gov.my/bencana/satellite.html

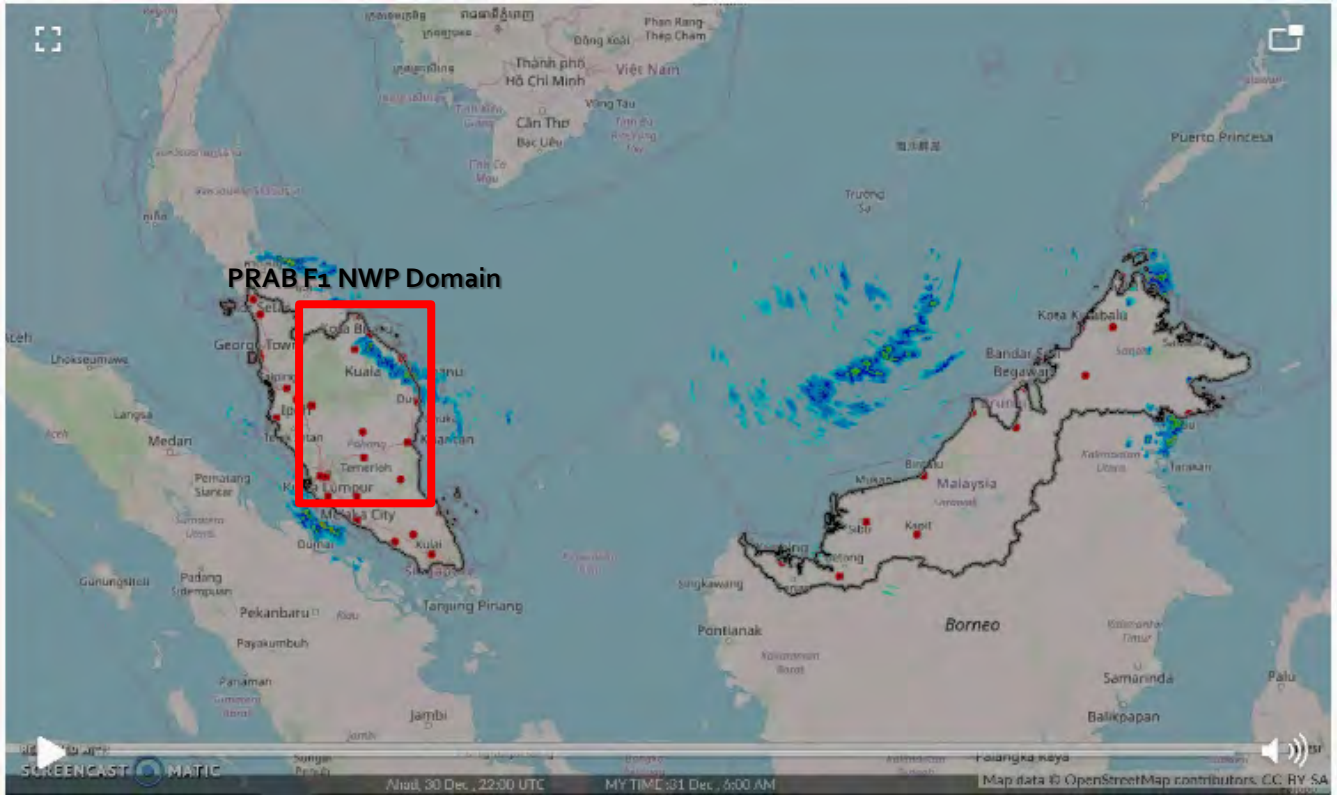
Flood forecaster will monitor possible storm event based on weather satellite imagery provided by MMD website & windy.com

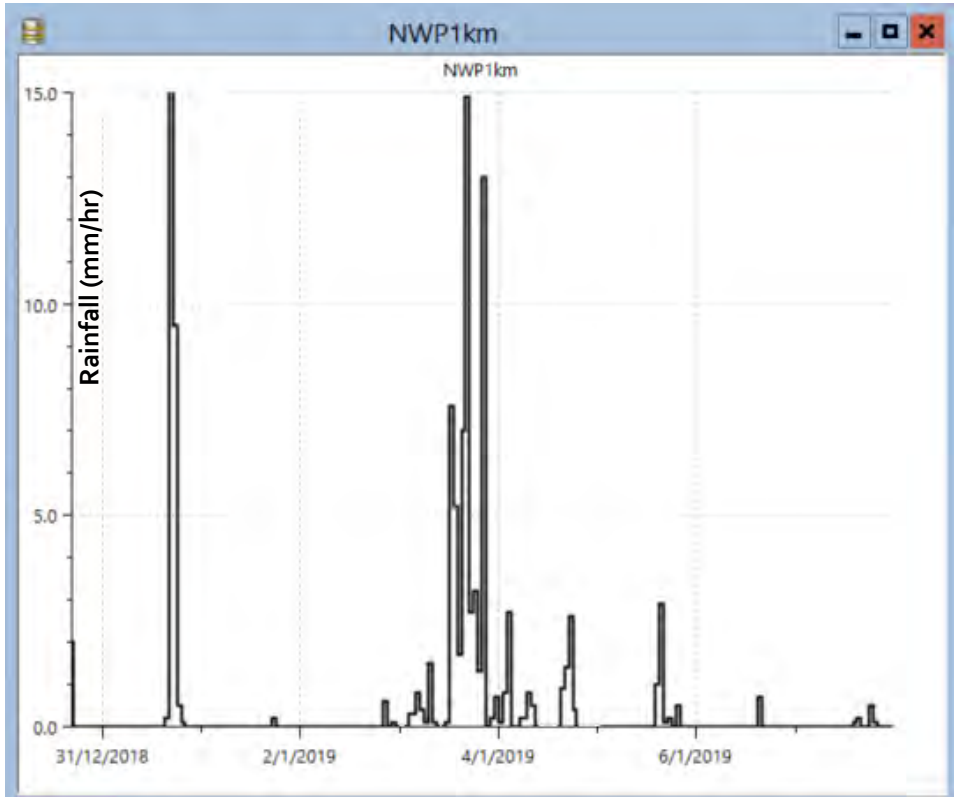
1



PRAB System: Input Data

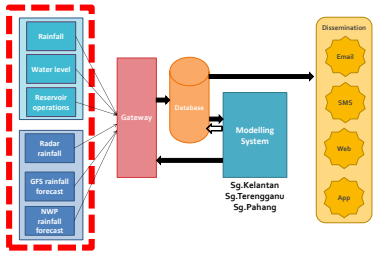
NWP Forecast Rainfall Data (MMD) 31/12/2018 – 6/1/2019



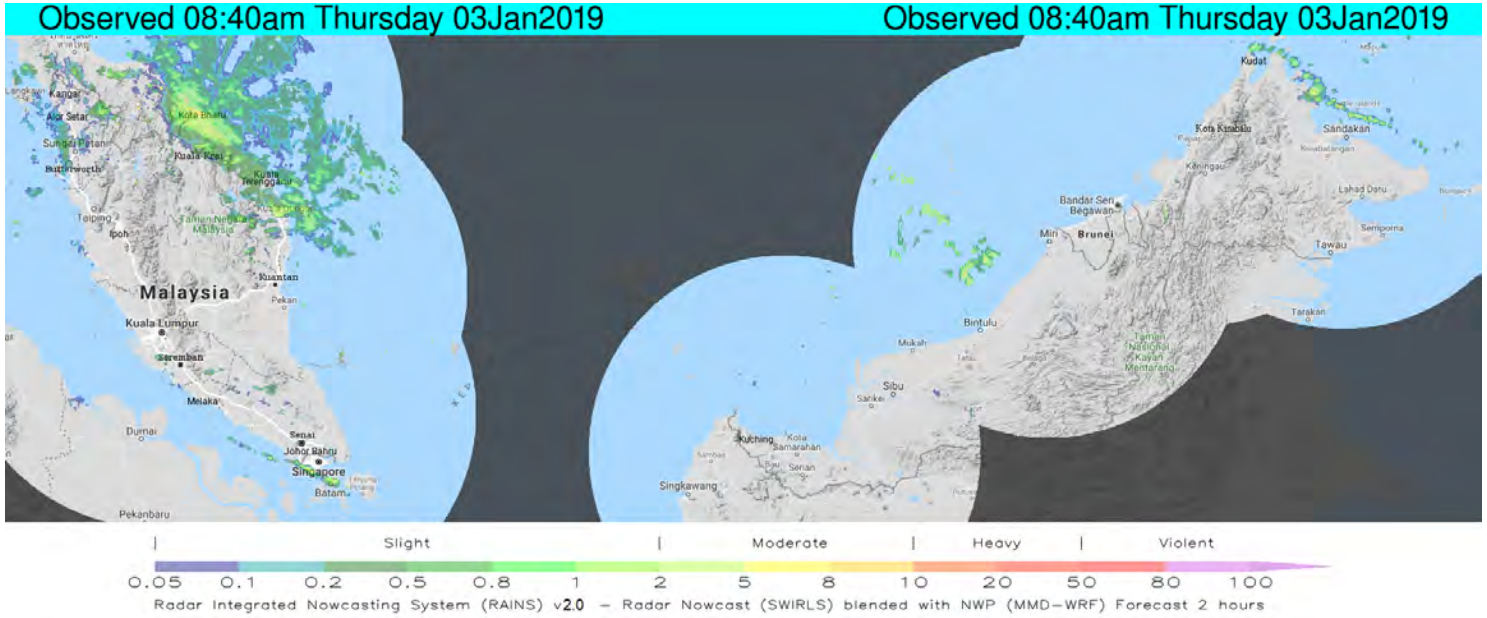


Spatial rainfall data (NWP/GFS/Radar) & telemetry gauge rainfall as the main data input to the model

1



PRAB System: Input Data



https://api.met.gov.my/static/images/swirl-latest.gif

THE OFFICIAL WEB OF PUBLIC INFOBANJIR
DEPARTMENT OF IRRIGATION AND DRAINAGE MALAYSIA

HOME | RAINFALL | WATER LEVEL | ABOUT US | CONTACT US | FLOOD CAMERA | OTHER LINK

State : TERENGGANU District : All Station : All

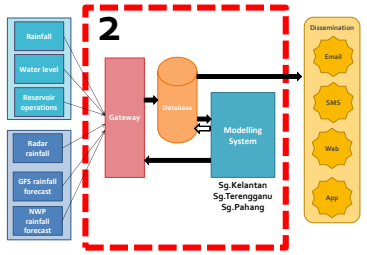
TERENGGANU : Rainfall On-Line Data (mm)

Station ID	Station Name	District	Last Update	Daily Rainfall (mm)						Rainfall (mm) Since Midnight 04/01/2019	Last 1Hr Rainfall
				29/12/2018	30/12/2018	31/12/2018	01/01/2019	02/01/2019	03/01/2019		
5424001	Kg.Keruak	Besut	4/1/2019 08:45	0	3	0	0	7	18	0	0
5127011	Kenyir Elephant Village (KEV)	Hulu Terengganu	4/1/2019 08:45	0	8	0	0	17	7	0	0
5232065	JPS Marang	Marang	4/1/2019 08:00	0	1	19	0	11	26	0	0
5331047	Universiti Malaysia Terengganu	Kuala Terengganu	4/1/2019 08:00	0	0	18	0	37	49	0	0
6170004	Kg Tok Adis	Kuala Terengganu	4/1/2019 08:00	0	0	11	0	13	23	0	0
6130005	Felda Mengkawang	Hulu Terengganu	4/1/2019 08:30	0	-9999	-9999	-9999	-9999	1	0	0
5524001	Kg.La	Besut	4/1/2019 08:45	0	5	1	0	9	24	1	0
5625003	Paya Peda	Besut	4/1/2019 08:00	0	2	2	0	18	31	2	0
5724003	Jam.Jerteh	Besut	4/1/2019 08:45	0	0	4	0	4	42	1	0
5626001	Institut Pertanian Tok Dor	Besut	4/1/2019 08:00	0	0	21	11	22	45	0	0
5625011	Sek.Keb. Kg Jabi	Besut	4/1/2019 08:45	0	9	5	2	20	35	1	0
5426003	Kg.Besut	Setiu	4/1/2019 08:45	0	2	4	1	18	12	0	0
5527024	Jambatan Permaisuri	Setiu	4/1/2019 08:45	0	0	10	3	36	15	1	0

http://publicinfobanjir.water.gov.my/

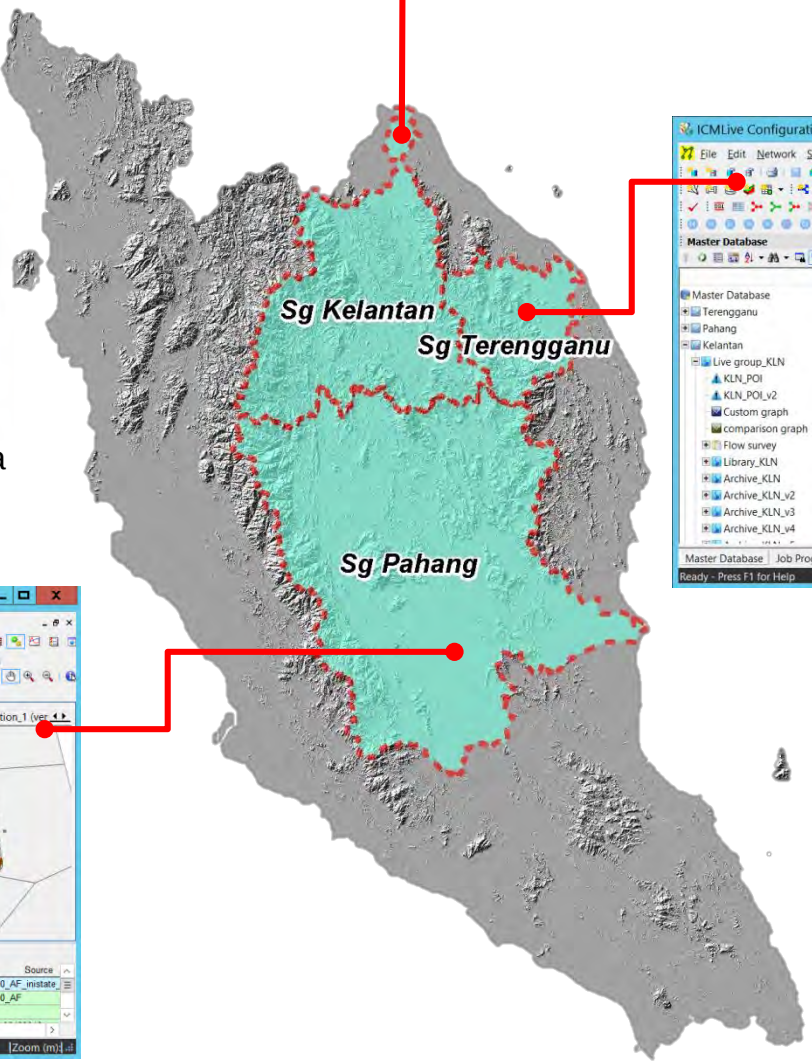
Flood forecaster will monitor observed / nowcast radar data & gauged rainfall / water level data (telemetry) based on MMD website & publicinfobanjir

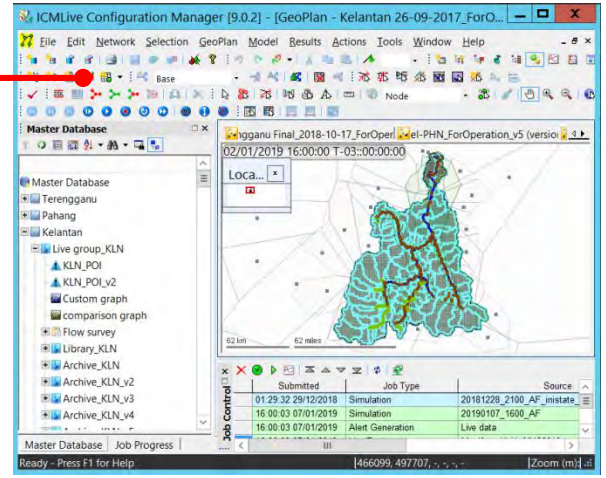
PRAB System: Model Simulations

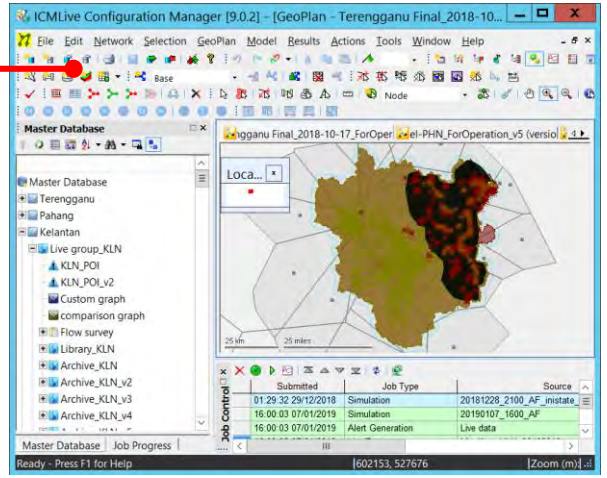


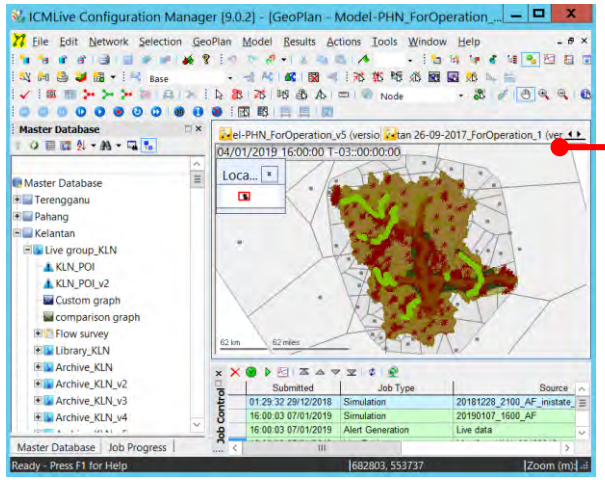
Telemetry
Radar
NWP
GFS

JPS Forecast Data Center (FDC)



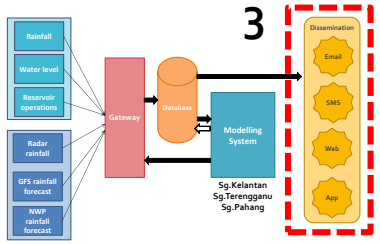


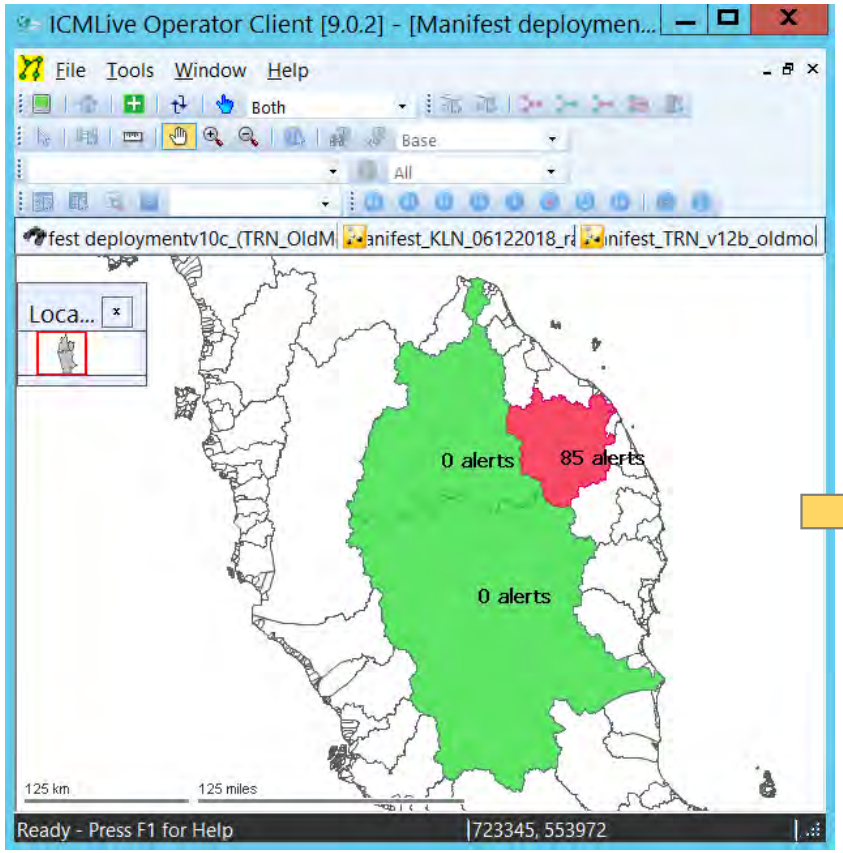


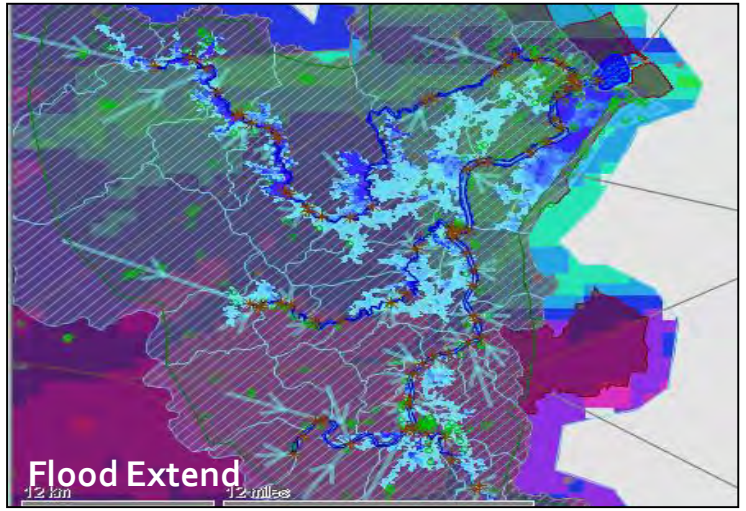


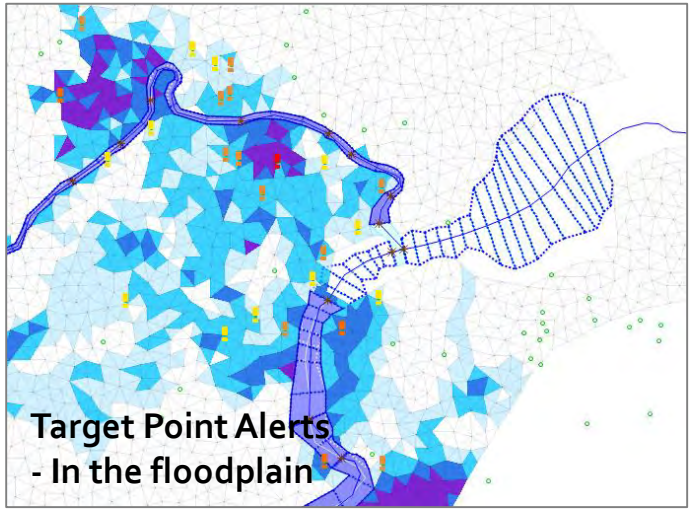
Run Time Origin of 2D Flood Model		
Sg.Terengganu (every 3 hours)	**Sg.Kelantan (every 8 hours)**	**Sg.Pahang (every 8 hours)**
0000; 0300	0000	0000
0600; 0900	0800	0800
1200; 1500	1600	1600
1800; 2100	-	-

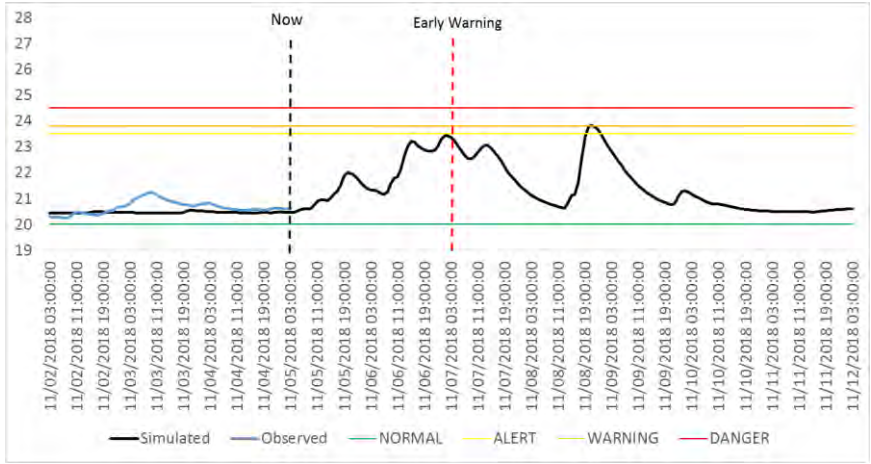
PRAB System: Result Output & Interpretations



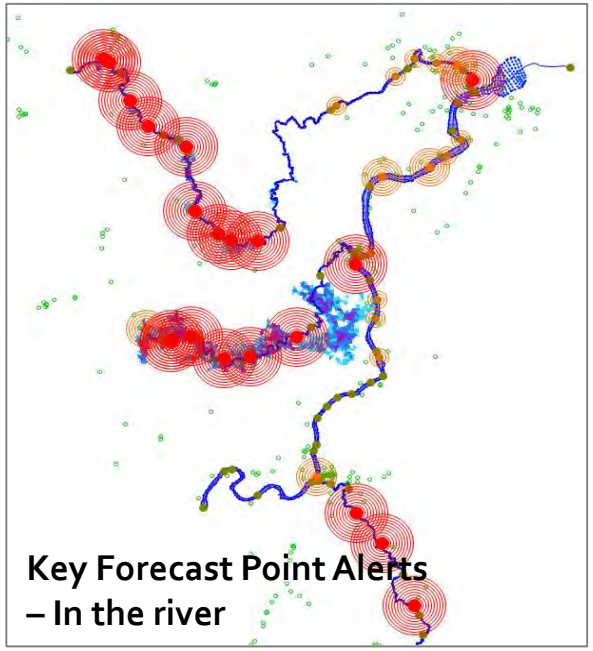


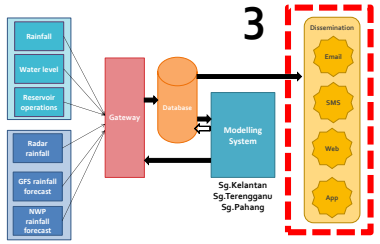




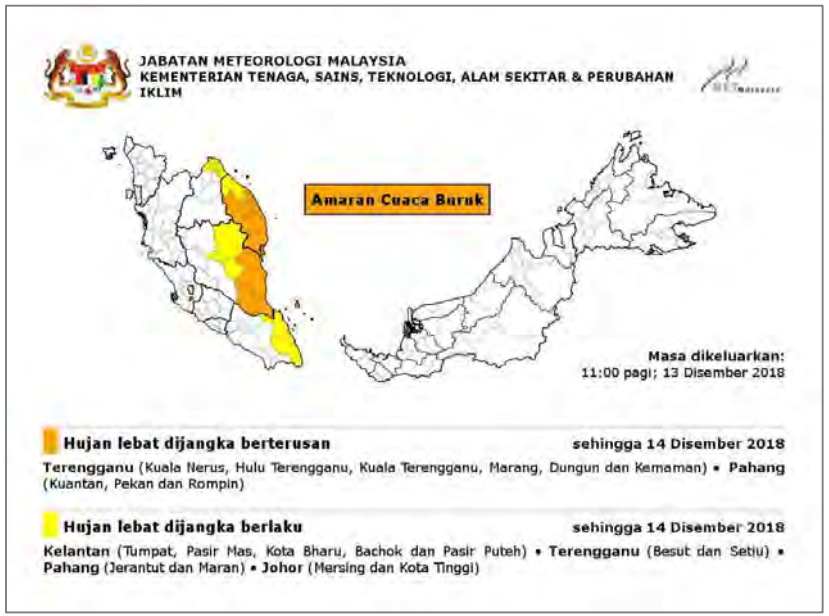


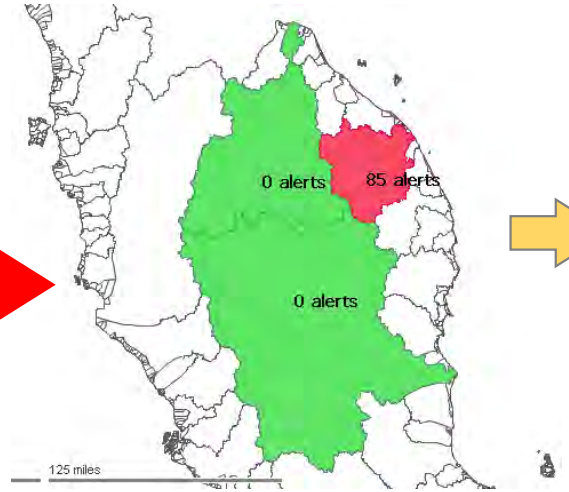
Forecast water level at telemetry station shows possible heavy storm event 7 days in advance

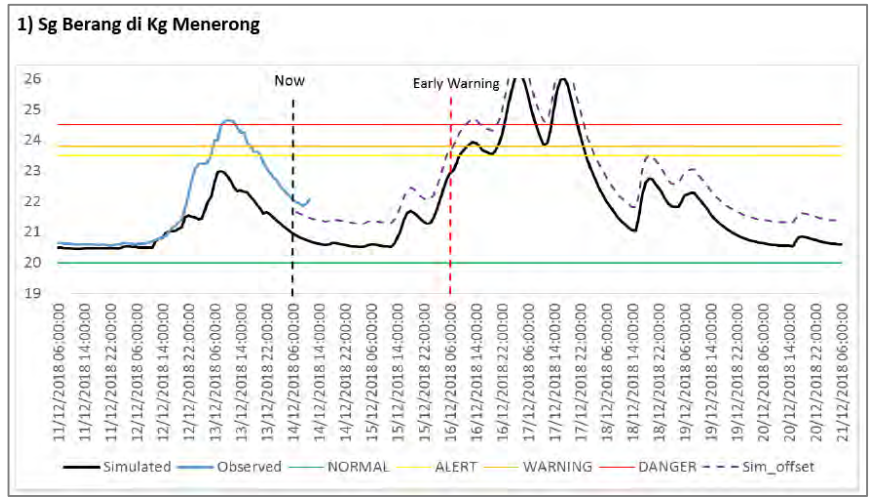


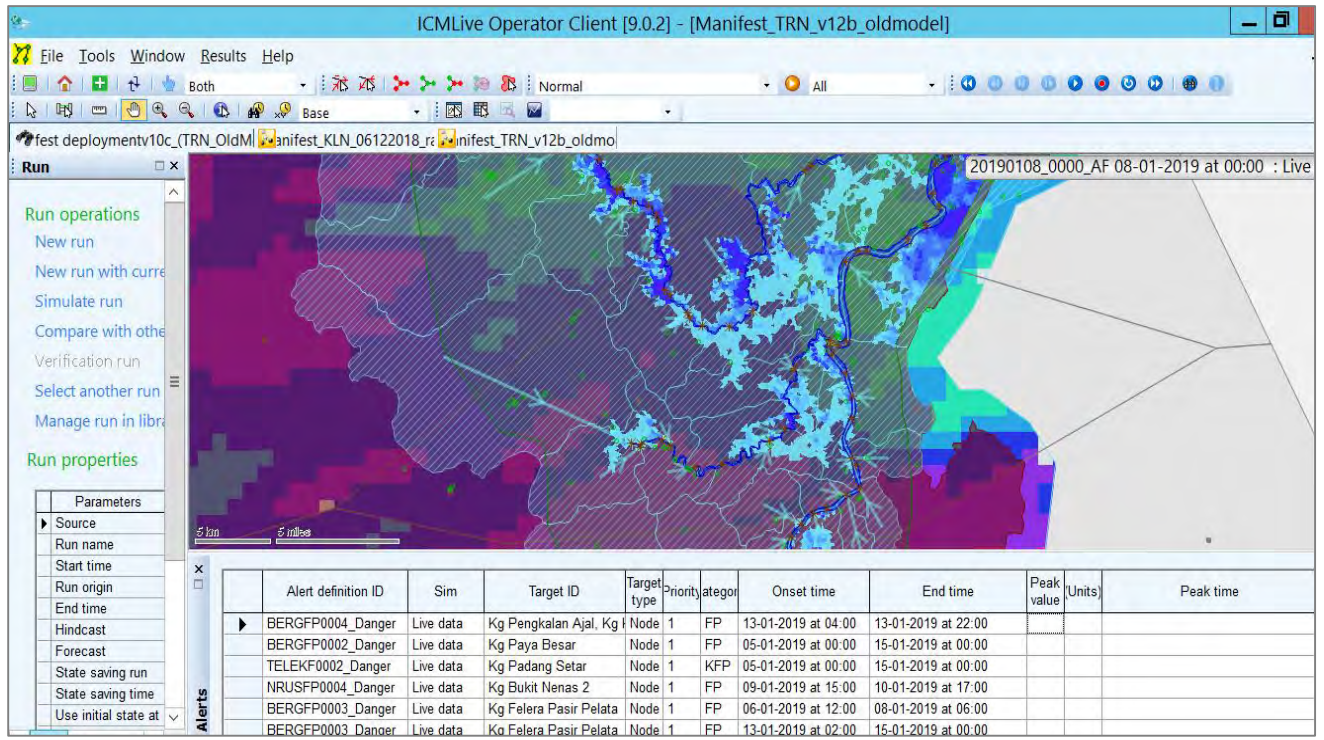


PRAB System: Result Output & Interpretations

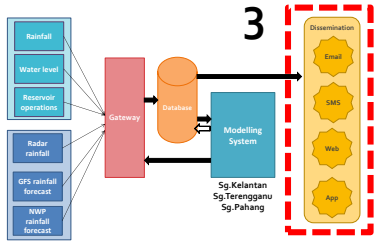








Interpretation of possible flood event by forecaster, *State Hydrology Officer* (PHN) and PRABN Operation Director before dissemination of flood warnings



PRAB System: Alert & Warning Dissemination

JABATAN PENGAIRAN DAN SALIRAN
KEMENTERIAN AIR, TANAH DAN SUMBER ASLI

AMARAN BANJIR
LEMBANGAN SUNGAI TERENGGANU

Dikeluarkan pada **14 Disember 2018; 7.00 malam**

Susulan Amaran Cuaca Waspada oleh Jabatan Meteorologi Malaysia bertarikh 14 Disember 2018 pada jam 1.00 petang, Jabatan Pengairan dan Saliran meramalkan banjir akan berlaku bermula 16 Disember 2018 mulai pada jam 12.00 tengahari di lokasi-lokasi seperti berikut:

Negeri	*Lembangan Sungai*	*Sungai*	*Daerah*	*Lokasi Dijangka Banjir*
Terengganu	Sungai Terengganu	Sg.Berang	Hulu Terengganu	Kg. Pengkalan Ajal, Kg. Paya Besar, Kg. Batu 24, Kg. Menerong, Bukit Balik Hidung, Kg. Pasir Pelata, Kg. Kua, Kg. Padang Stor, Kg. Lubuk Periuk, Kg.Cheting, Kg. Pelandan, Kg. Penih, PPSK Gunung Menerong
Terengganu	Sungai Terengganu	Sg.Telemong	Hulu Terengganu	Kg. Teris, Kg. Tok Lawit, Kg. Tengkawang, Kg. Kuala Ping, Kg. Kepah, Kg.Matang, Kg.Nibong, Kg.Paloh Nyior, Kg.Bukit Tadok

Semua penduduk terutamanya di kawasan yang dijangka banjir diminta berwaspada dan sentiasa berhubung dengan Pusat Kawalan Operasi Banjir yang berhampiran. Maklumat dan amaran akan disalurkan kepada agensi pengurusan bencana, media dan orang awam melalui laman web publicinfobanjir.water.gov.my, facebook: PublicInfoBanjir dan twitter @JPS_InfoBanjir.

Dikeluarkan oleh:
Pusat Ramalan Dan Amaran Banjir Negara (PRABN)
Jabatan Pengairan dan Saliran, Malaysia

No. Rujukan: JPS-PRABN-TRG-141218-1900

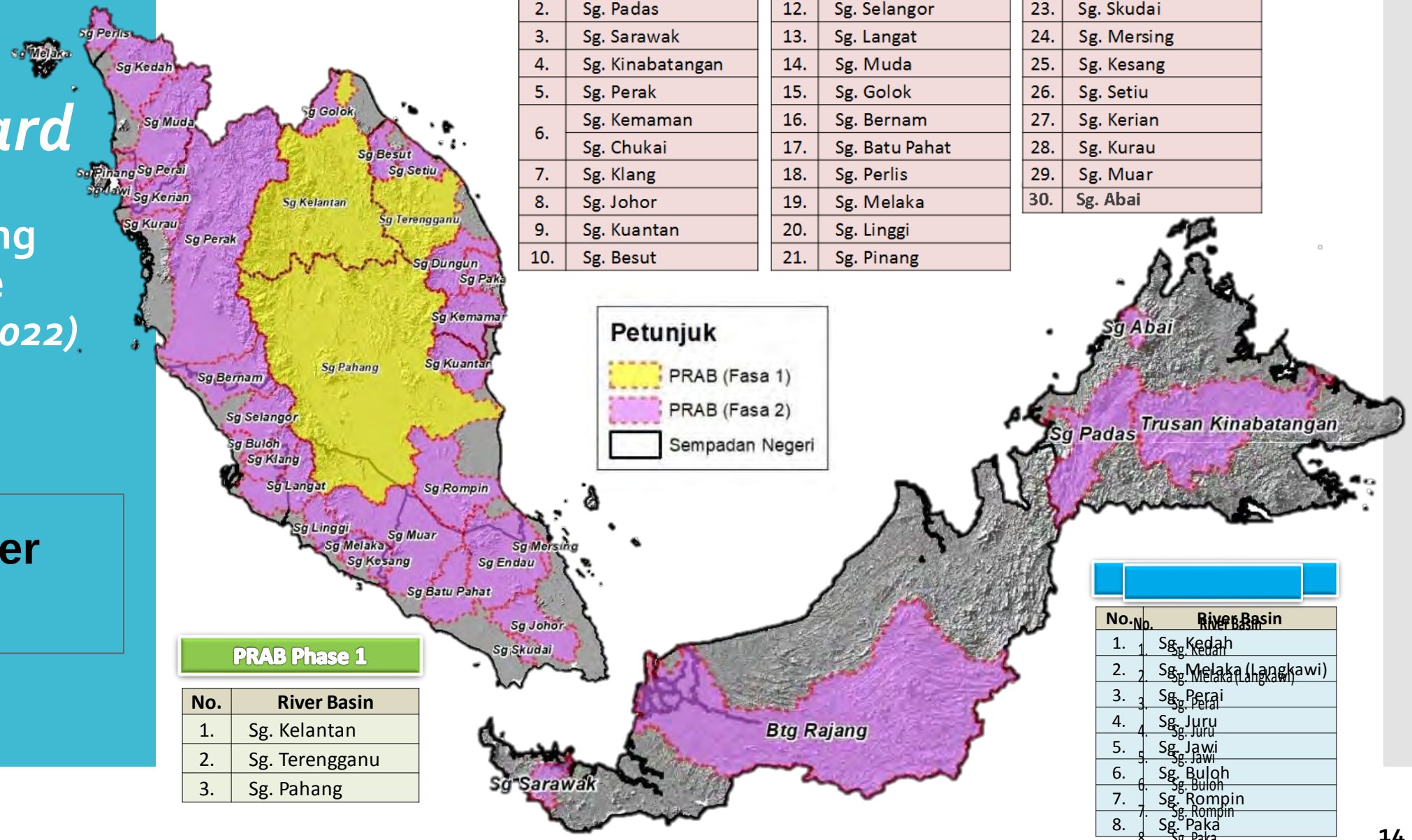
Disseminate flood warning to NADMA and related stakeholders via email, WhatsApp, etc.

Monitor the possible flood event & update flood warning if necessary (time to flooding, extend of floods, & list of possible flooded area)

Way Forward

Flood Forecasting Model Coverage *(Completion in 2022)*

41 main river basins



PRAB Phase 2

No.	River Basin	No.	River Basin	No.	River Basin
1.	Batang Rajang	11.	Sg. Dungun	22.	Sg. Endau
2.	Sg. Padas	12.	Sg. Selangor	23.	Sg. Skudai
3.	Sg. Sarawak	13.	Sg. Langat	24.	Sg. Mersing
4.	Sg. Kinabatangan	14.	Sg. Muda	25.	Sg. Kesang
5.	Sg. Perak	15.	Sg. Golok	26.	Sg. Setiu
6.	Sg. Kemaman	16.	Sg. Bernam	27.	Sg. Kerian
	Sg. Chukai	17.	Sg. Batu Pahat	28.	Sg. Kurau
7.	Sg. Klang	18.	Sg. Perlis	29.	Sg. Muar
8.	Sg. Johor	19.	Sg. Melaka	30.	Sg. Abai
9.	Sg. Kuantan	20.	Sg. Linggi		
10.	Sg. Besut	21.	Sg. Pinang		

PRAB Phase 1

No.	River Basin
1.	Sg. Kelantan
2.	Sg. Terengganu
3.	Sg. Pahang

No.	River Basin
1.	Sg. Kedah
2.	Sg. Melaka (Langkawi)
3.	Sg. Perai
4.	Sg. Juru
5.	Sg. Jawi
6.	Sg. Buloh
7.	Sg. Rompin
8.	Sg. Paka

Conclusion

- Flood forecasting model as a tool → Alerts can be generated automatically, but still need human touch & forecaster soft touch and experience;
- Forecast rainfall data need to be updated and recalibrate with gauge rainfall data → to improve the forecasted rainfall data before being used as input to the flood forecasting model;
- Updating of hydrodynamic flood models and model fine-tuning → continuous process.

Saint Bernard, Southern Leyte, Philippines

Thank You