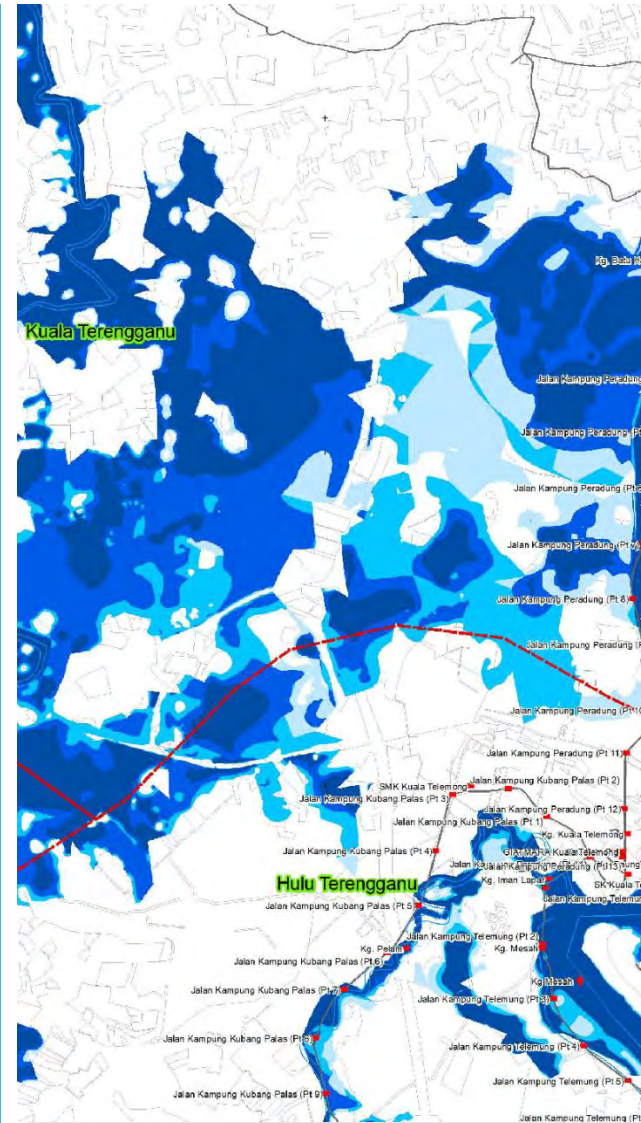


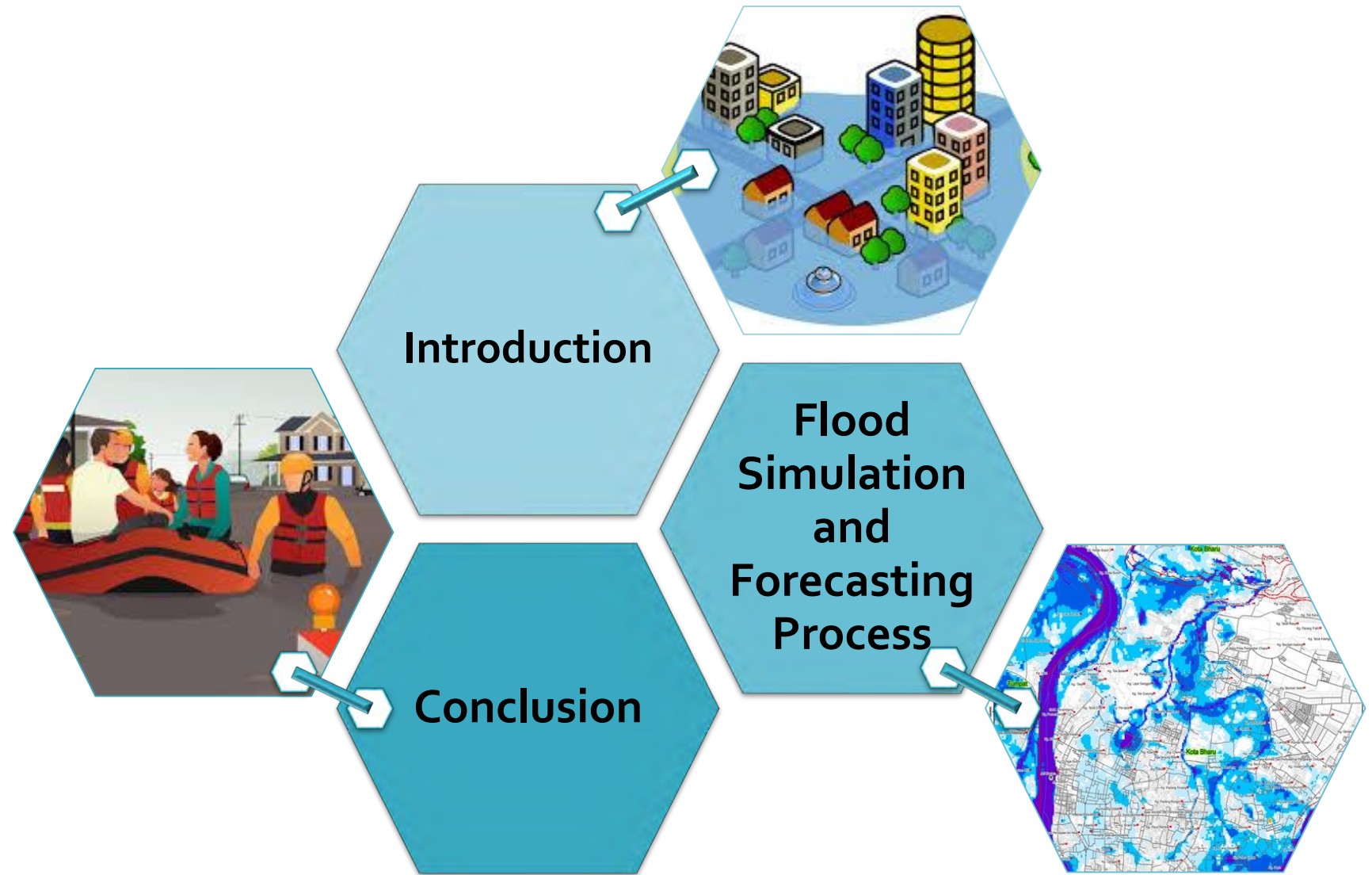
Flood Risk Management Case Visit in Malaysia

- *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



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



Forecasts at a glance..

Early warning sign

 Scent

 Ears

 Eyes

- Scent
- Hearing
- Vision

Best guess

Predicted

Projected

Modern day flood forecasting

 Numerical Weather Prediction (NWP)

 Radar Rainfall

 Observed Rainfall

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

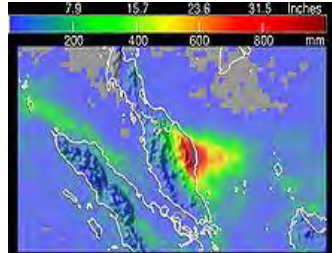
Key Components of Hydrodynamic Flood Forecasting

Data Input

1

Rainfall and Catchment Information

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



2

Hydrologic Process

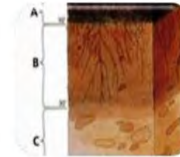
Convert rainfall into runoff at discrete locations in the catchment



CATCHMENT AREA



LAND USE



SOIL



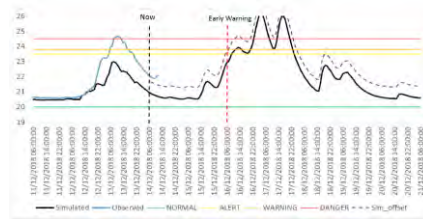
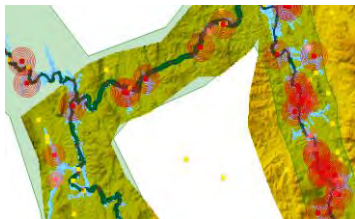
RAIN

Output Result

4

Flood Outcomes

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



3

Hydraulic Process

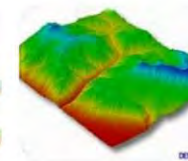
Convert catchment surface runoff into river discharge through a stream and on a floodplain (forecast flood levels)



RIVER ALIGNMENT



RIVER CROSS SECTION



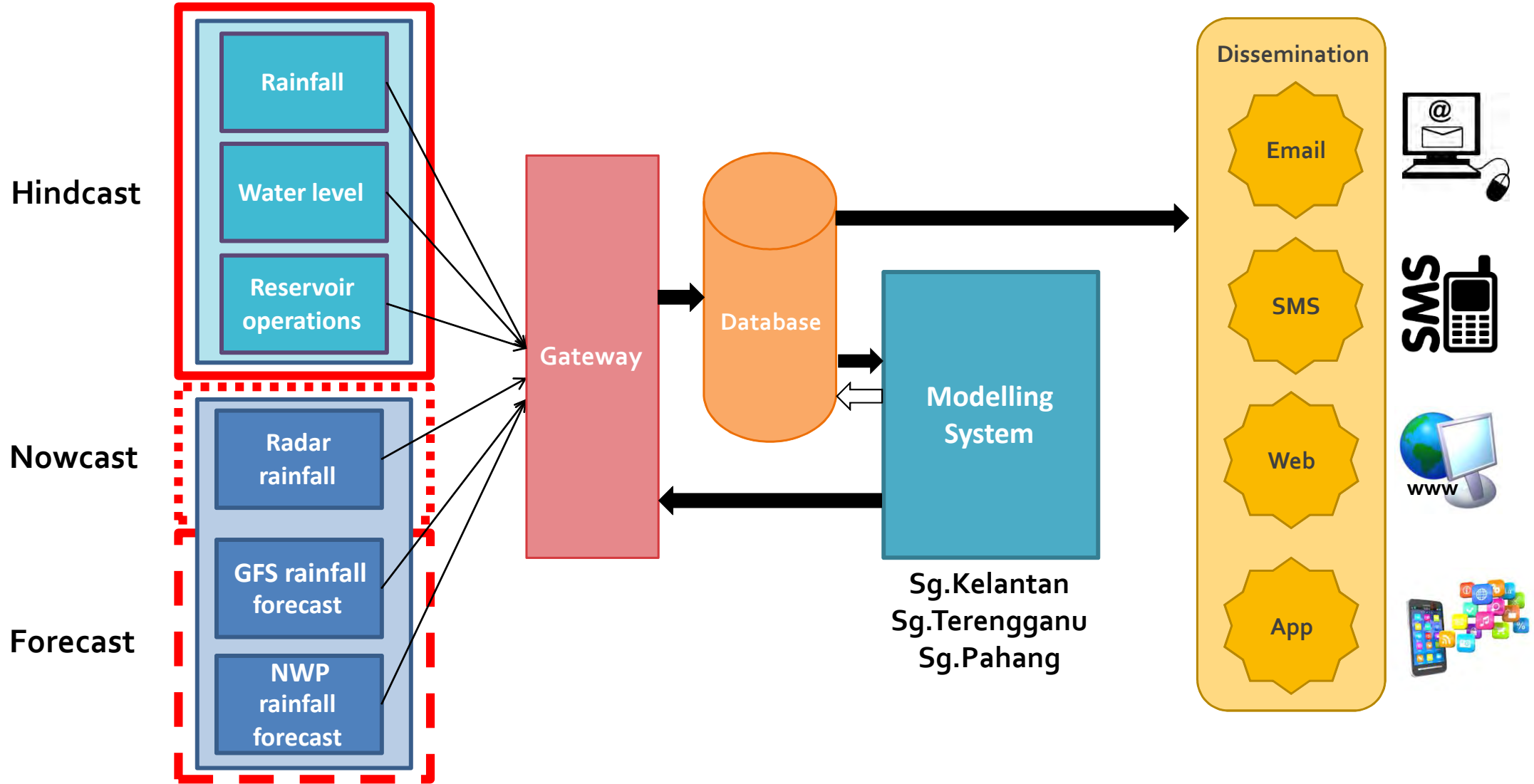
3D MODEL GROUND SURFACE



STRUCTURE

Flood Model Simulation

Overview of NaFFWS Components



1. Input Data

2. Model Simulation

3. Output



Daily Flood Forecast Operation

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



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

JABATAN METEOROLOGI MALAYSIA
KEMENTERIAN TENAGA, SAINS, TEKNOLOGI, ALAM SEKITAR & PERUBAHAN IKLIM

MET Malaysia

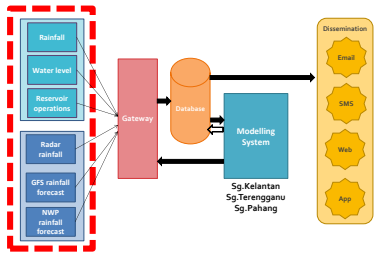
Amaran Cuaca Waspada

Masa dikeluarkan:
3:00 petang; 31 Disember 2018

Hujan lebat dijangka berlaku 2 Januari 2019 – 3 Januari 2019
Kelantan (Tumpat, Pasir Mas, Kota Bharu, Jeli, Tanah Merah, Bachok, Machang, Pasir Puteh dan Kuala Krai)
• Terengganu (Besut, Setiu, Kuala Nerus, Hulu Terengganu, Kuala Terengganu dan Marang)

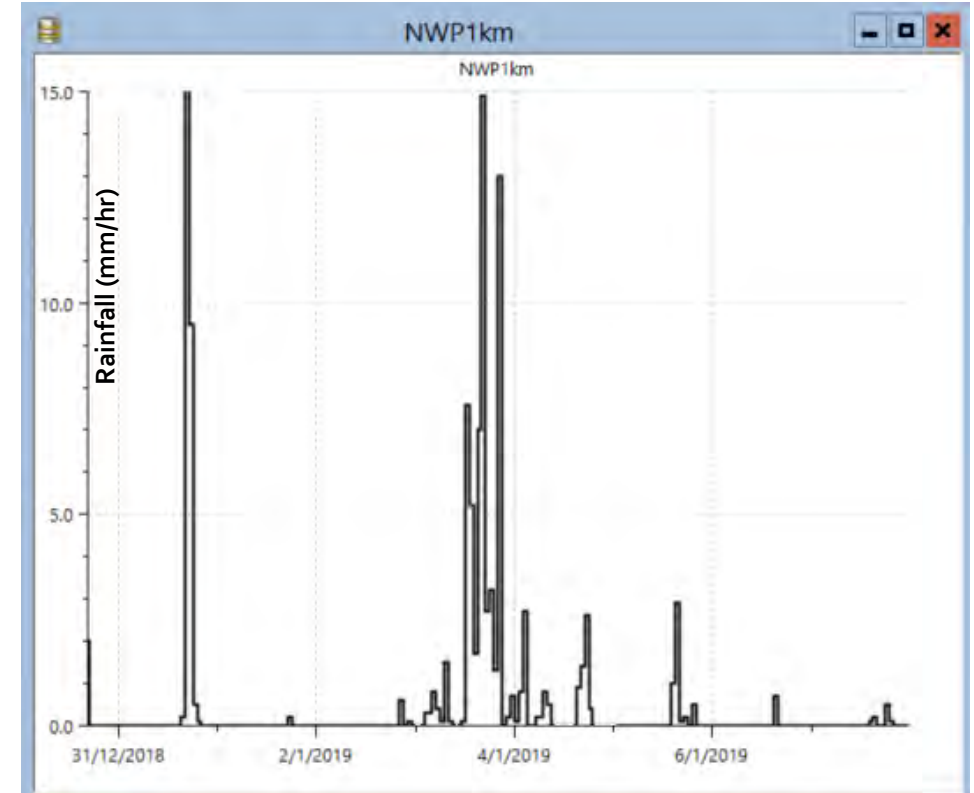
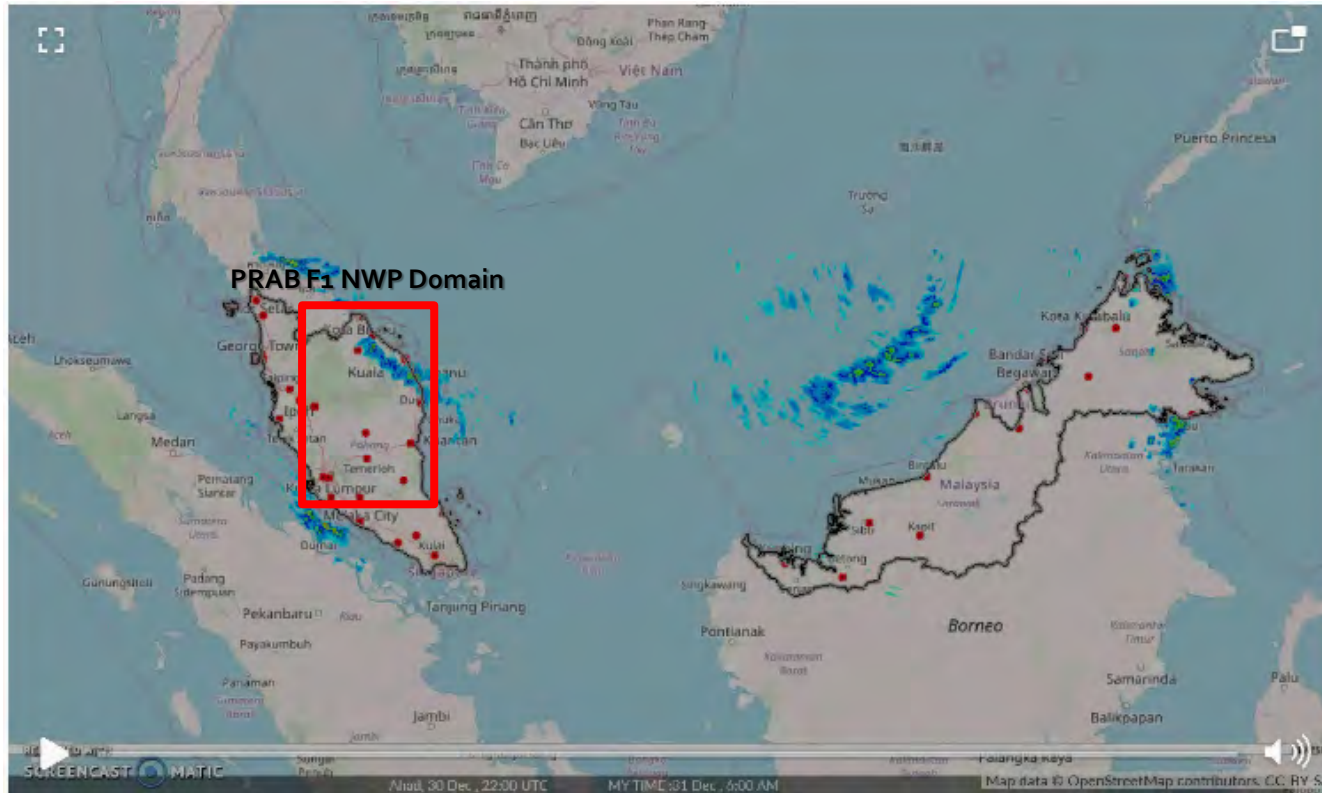
Flood forecaster will monitor possible storm event based on weather satellite imagery provided by MMD website & windy.com

1



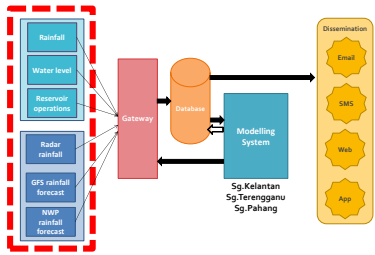
PRAB System: Input Data

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

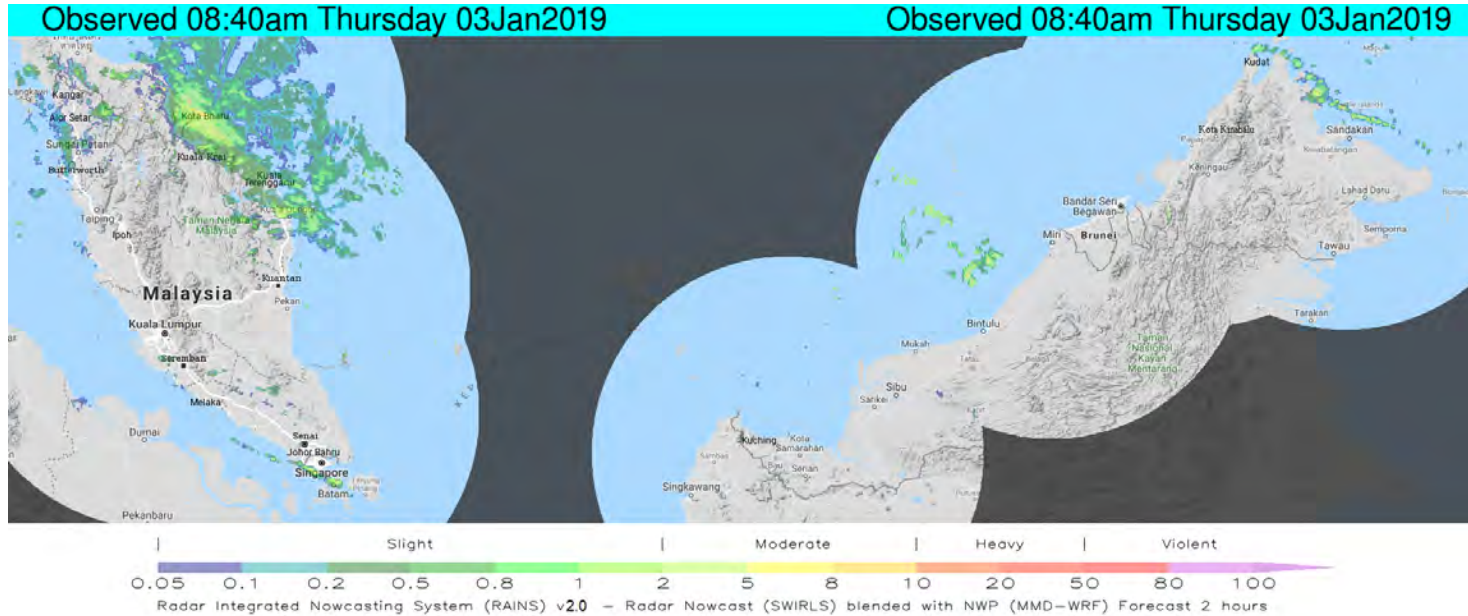


Spatial rainfall data (NWP/GFS/Radar) & telemetry gauge rainfall as the main data input to the model





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

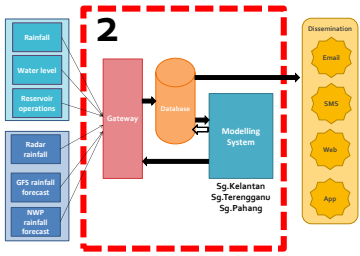
TERENGGANU : Rainfall On-Line Data (mm)

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
5232055	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

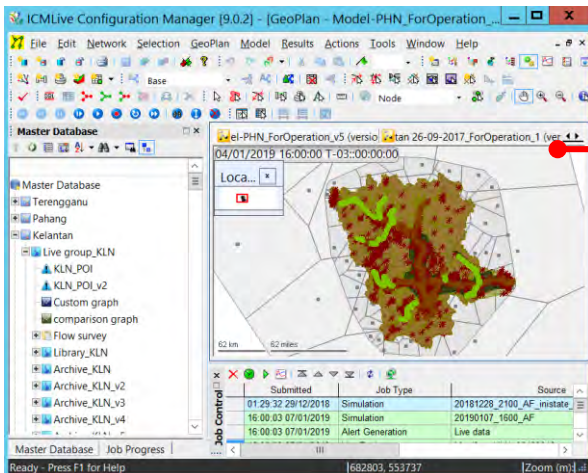
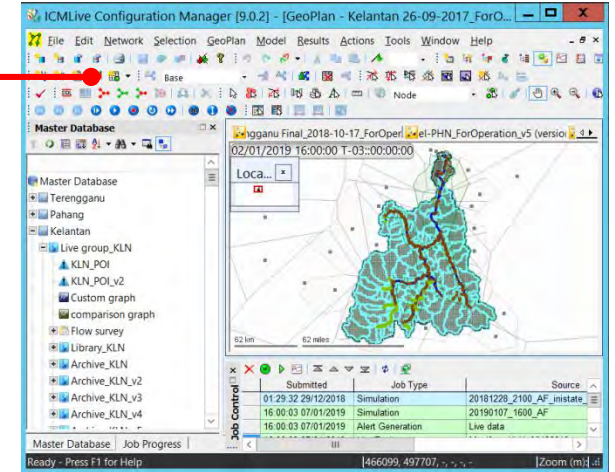
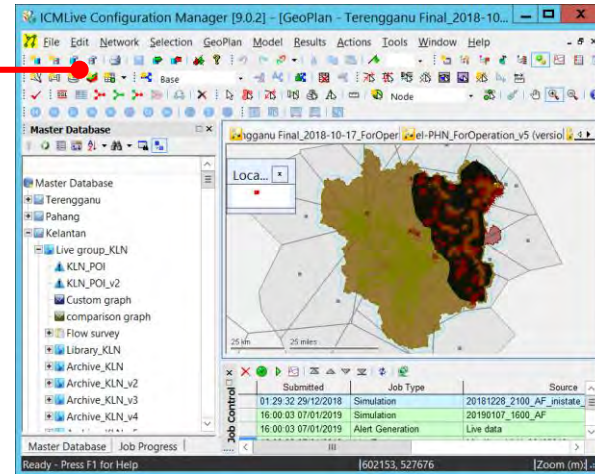
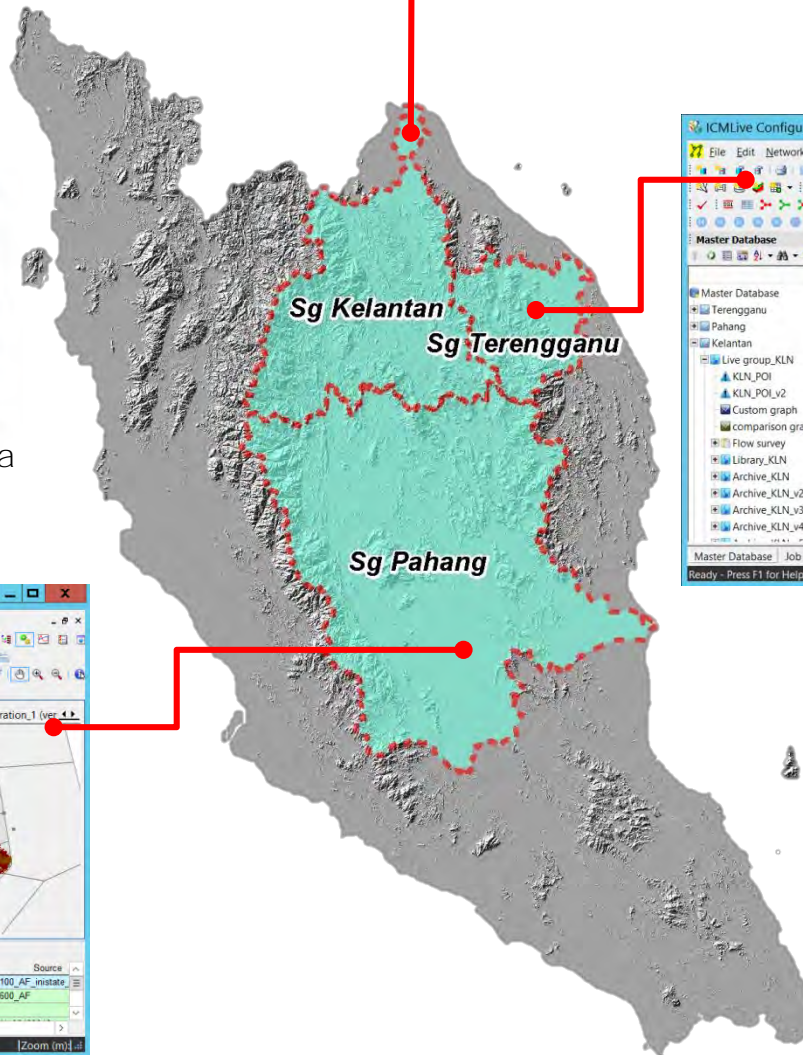
PRAB System: Model Simulations



Telemetry
Radar
NWP
GFS



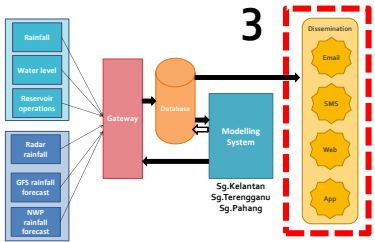
JPS Forecast Data Center (FDC)



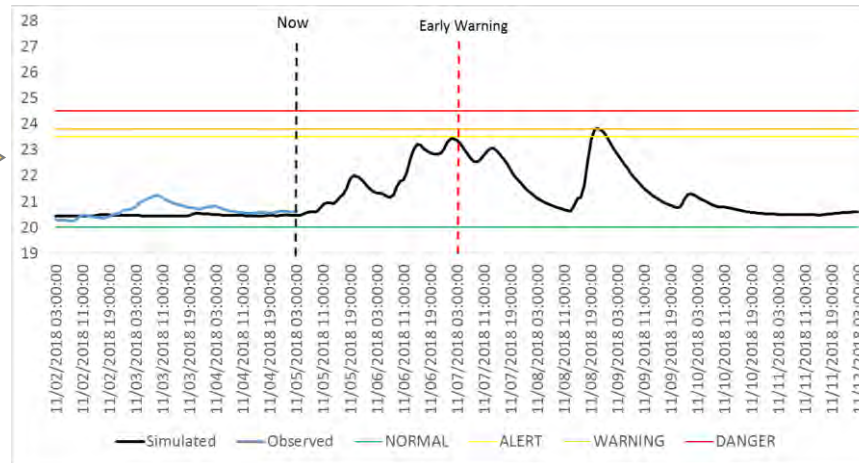
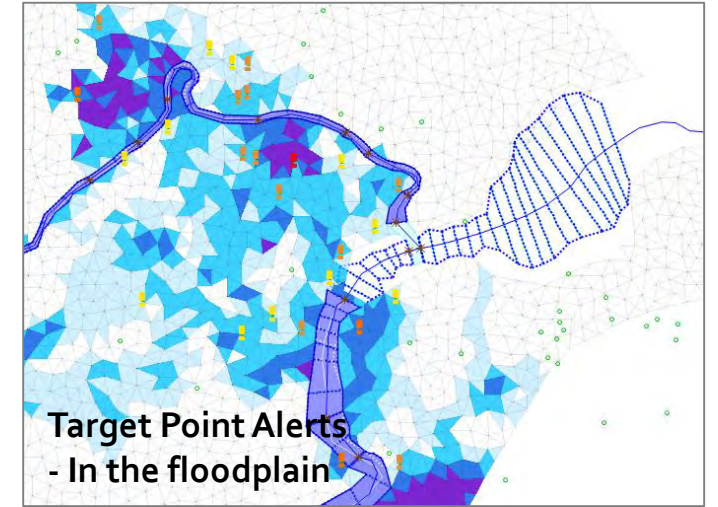
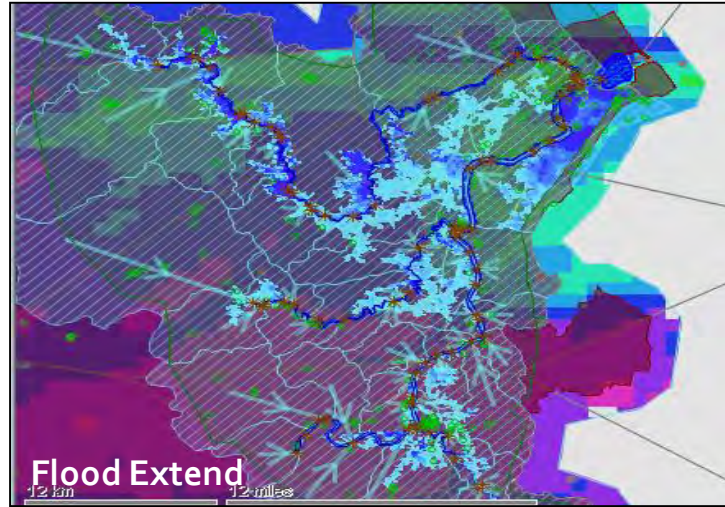
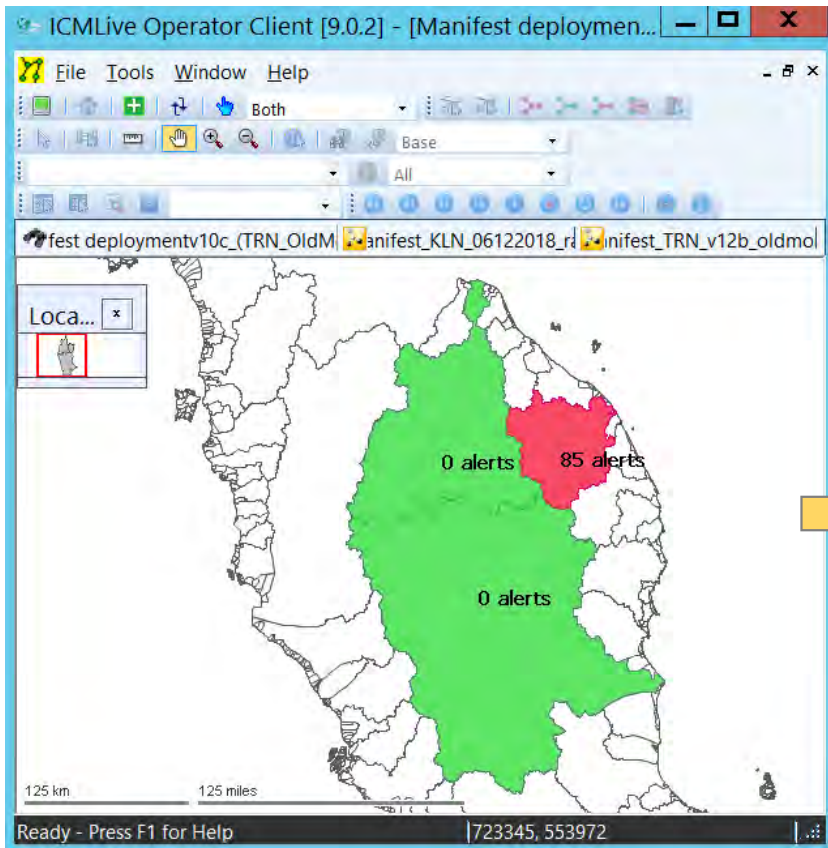
Run Time Origin of 2D Flood Model

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	-	-

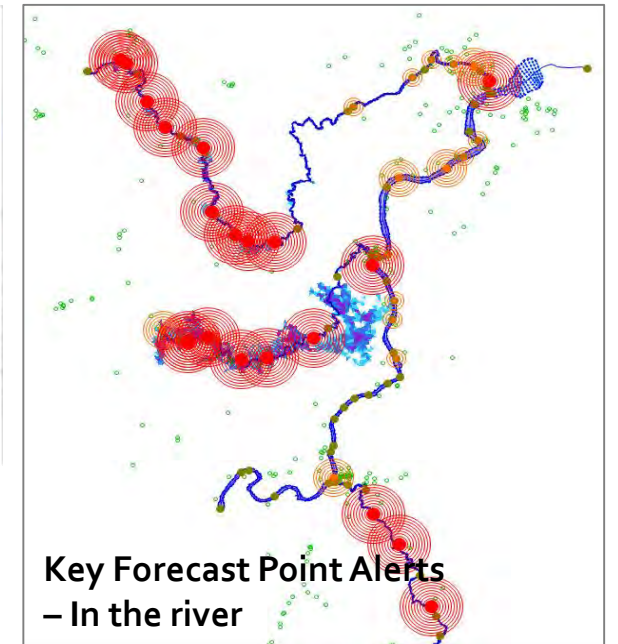




PRAB System: Result Output & Interpretations

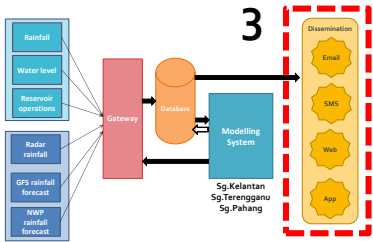


Forecast water level at telemetry station shows possible heavy storm event 7 days in advance



Key Forecast Point Alerts - In the river





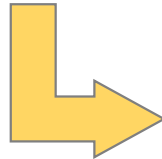
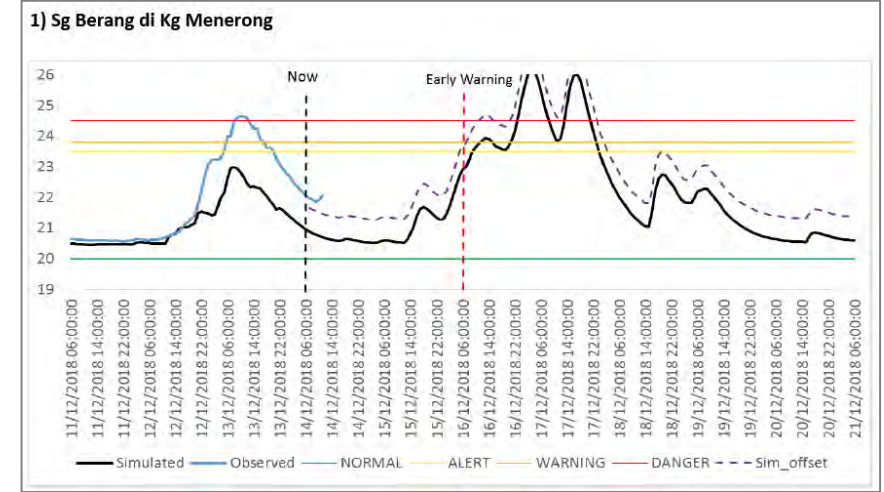
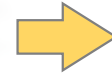
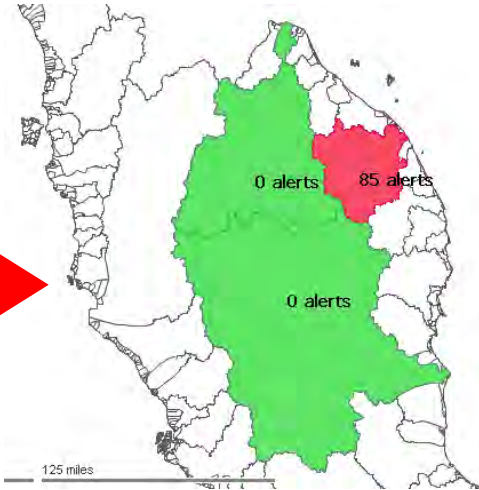
PRAB System: Result Output & Interpretations

JABATAN METEOROLOGI MALAYSIA
KEMENTERIAN TENAGA, SAINS, TEKNOLOGI, ALAM SEKITAR & PERUBAHAN IKLIM

Amaran Cuaca Buruk

Masa dikeluarkan:
11:00 pagi; 13 Disember 2018

- Hujan lebat dijangka berterusan** sehingga 14 Disember 2018
Terengganu (Kuala Nerus, Hulu Terengganu, Kuala Terengganu, Marang, Dungun dan Kemaman) • Pahang (Kuantan, Pekan dan Rompin)
- Hujan lebat dijangka berlaku** sehingga 14 Disember 2018
Kelantan (Tumpat, Pasir Mas, Kota Bharu, Bachok dan Pasir Puteh) • Terengganu (Besut dan Setiu) • Pahang (Jerantut dan Maran) • Johor (Mersing dan Kota Tinggi)



ICMLive Operator Client [9.0.2] - [Manifest_TRN_v12b_oldmodel]

File Tools Window Results Help

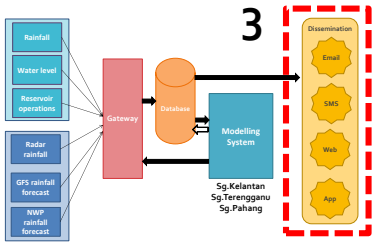
Run operations:
New run
New run with current
Simulate run
Compare with other
Verification run
Select another run
Manage run in library

Run properties:

Alert definition ID	Sim	Target ID	Target type	Priority	Category	Onset time	End time	Peak value	Units	Peak time
BERGFP0004_Danger	Live data	Kg Pengkalan Ajal, Kg	Node 1	1	FP	13-01-2019 at 04:00	13-01-2019 at 22:00			
BERGFP0002_Danger	Live data	Kg Paya Besar	Node 1	1	FP	05-01-2019 at 00:00	15-01-2019 at 00:00			
TELEKF0002_Danger	Live data	Kg Padang Setar	Node 1	1	KFP	05-01-2019 at 00:00	15-01-2019 at 00:00			
NRUSFP0004_Danger	Live data	Kg Bukit Nenas 2	Node 1	1	FP	09-01-2019 at 15:00	10-01-2019 at 17:00			
BERGFP0003_Danger	Live data	Kg Felera Pasir Pelata	Node 1	1	FP	06-01-2019 at 12:00	08-01-2019 at 06:00			
BERGFP0003_Danger	Live data	Kg Felera Pasir Pelata	Node 1	1	FP	13-01-2019 at 02:00	15-01-2019 at 00:00			

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. Tengawang, 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.**

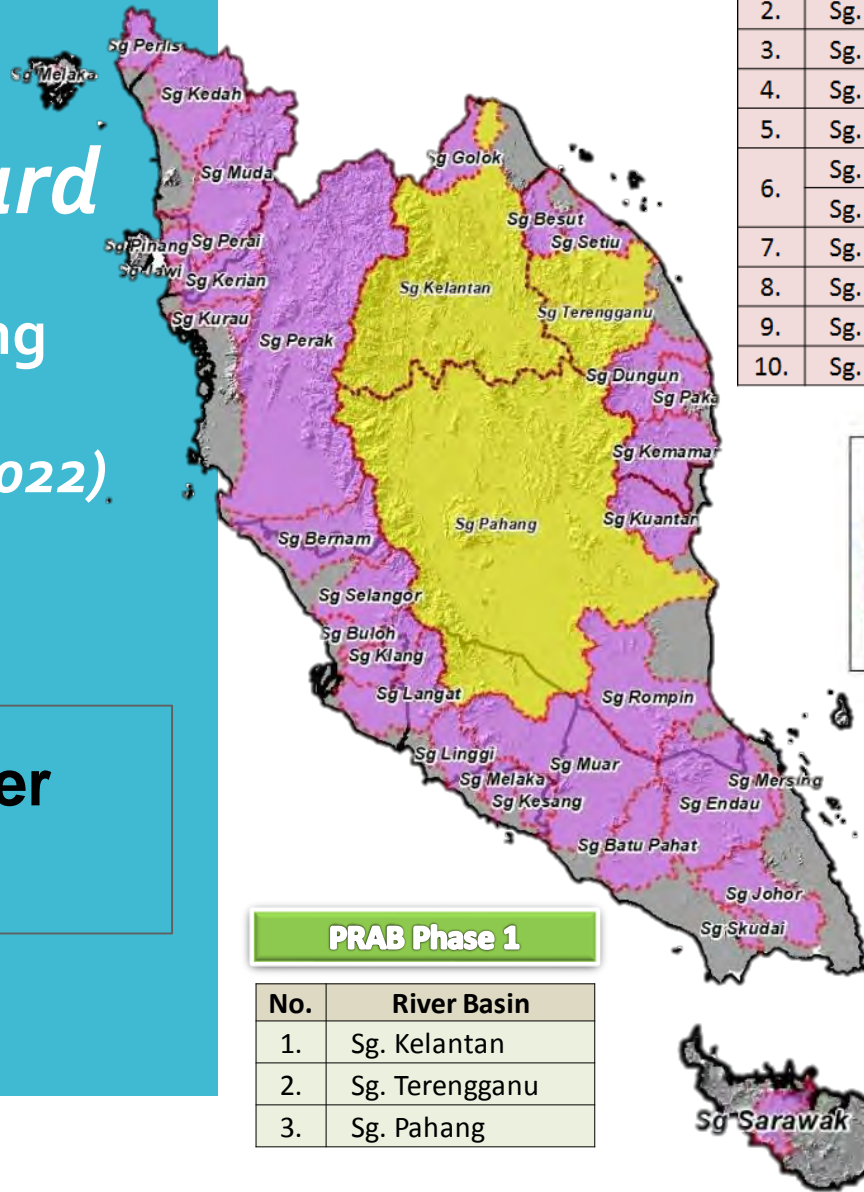


**Monitor the possible flood
 event & update flood warning
 if necessary (time to flooding,
 extend of floods, & list of
 possible flooded area)**

Way Forward

Flood Forecasting Model Coverage (Completion in 2022)

41 main river basins



PRAB Phase 1

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

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		

Petunjuk

- PRAB (Fasa 1)
- PRAB (Fasa 2)
- Sempadan Negeri

Btg Rajang

Trusan Kinabatangan

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.



Thank You