GEO SMART ASIA 2016

17-19 OCT, 2016

APPLYING BIG DATA ANALYTICS (BDA) TO DIAGNOSE HYDRO-METEOROLOGICAL RELATED RISK DUE TO CLIMATE CHANGE

MOHD ZAKI M AMIN
National Hydraulic Research Institute of Malaysia
Ministry of Natural Resources & Environment

OCT. 19, 2016

NAHRIM

1 **OVERVIEW OF CLIMATE RELATED DISASTER**

2 **SETTING THE SCENE – CLIMATE CHANGE AND BDA**

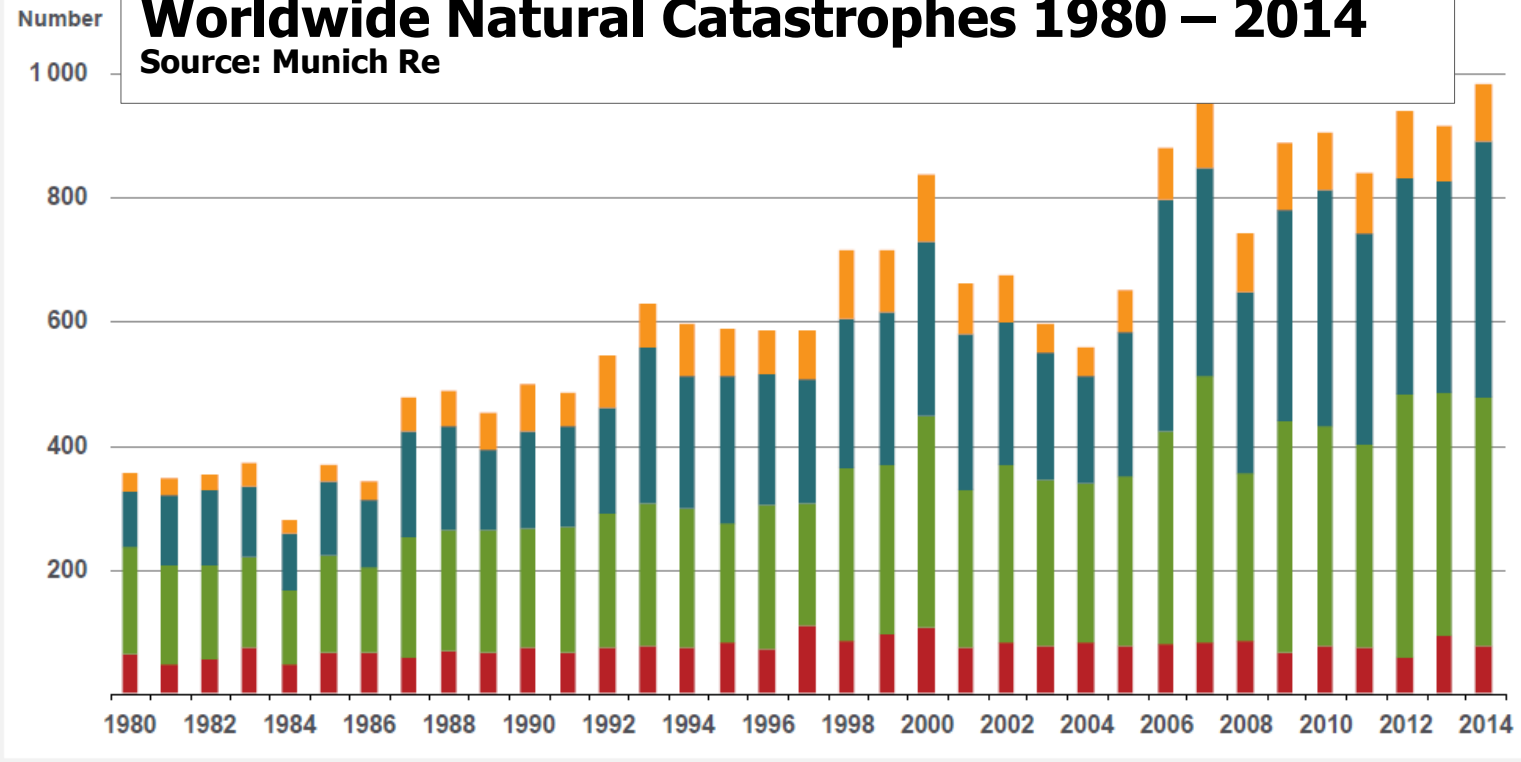
3 **BIG DATA ANALYTICS (BDA) – PROOF OF CONCEPT**

4 **POTENTIAL IMPACT OF CC – BDA FINDING**

5 **WAY FORWARD**

Worldwide Natural Catastrophes 1980 – 2014

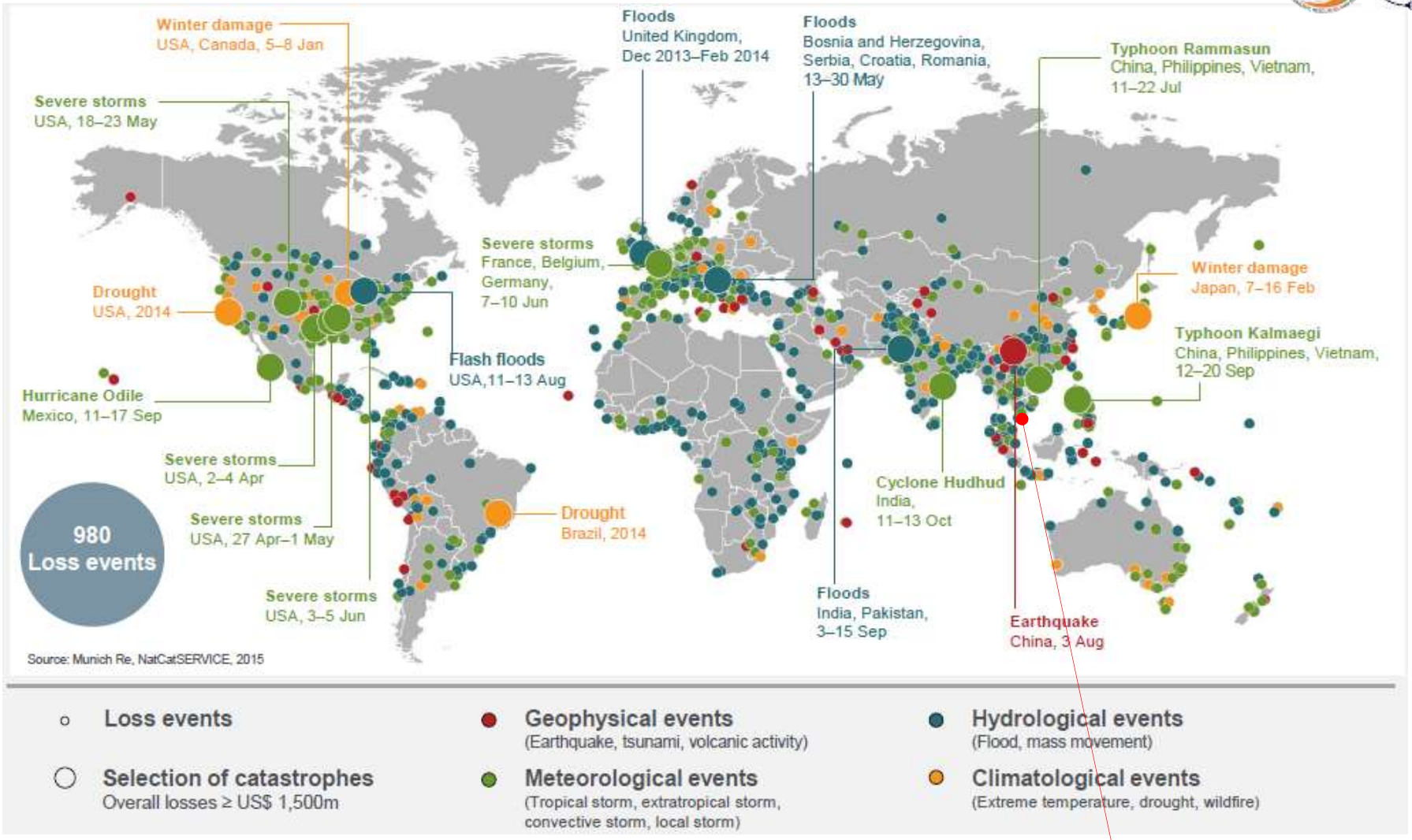
Source: Munich Re



© 2015 Münchener Rückversicherungs-Gesellschaft, Geo Risks Research, NatCatSERVICE – As at January 2015

Loss Event Worldwide 2014

Geographical overview



Floods
East Coast of PM
Dec 14-31, 2014

Kelantan-Pahang Floods, Malaysia Dec 14-24, 2014..

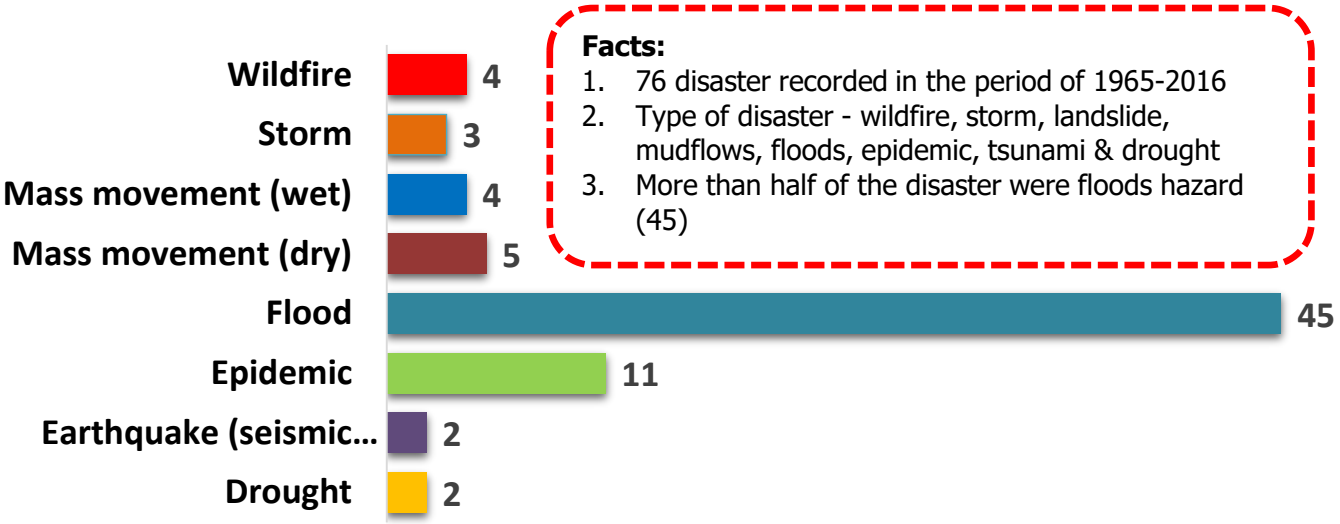
Continuous heavy downpour & upstream flooding..

> many properties & infrastructures destroyed..

25 deaths..

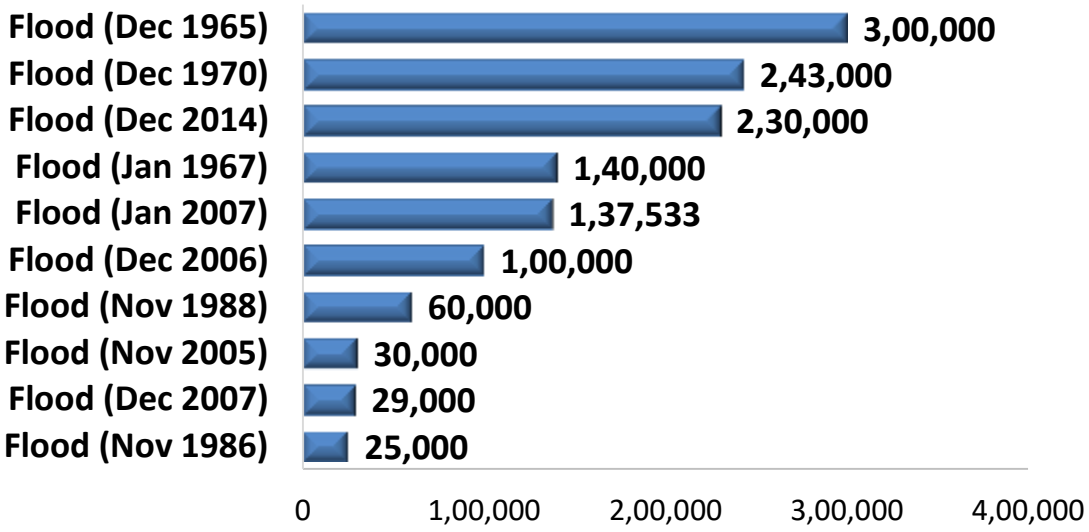
FLOOD-HIT AREAS IN PENINSULAR MALAYSIA

Natural Disaster in Malaysia



Facts:

1. 76 disaster recorded in the period of 1965-2016
2. Type of disaster - wildfire, storm, landslide, mudflows, floods, epidemic, tsunami & drought
3. More than half of the disaster were floods hazard (45)



UN World Conference on Disaster Risk Reduction

2015 Sendai Japan

Priorities for Action

Focused action within and across sectors by States at local, national, regional and global levels

Priority Action 1	Priority Action 2	Priority Action 3	Priority Action 4
Understanding disaster risk	**Strengthening disaster risk reduction for resilience**	**Investing in disaster risk reduction for resilience**	**Enhancing disaster preparedness for effective response, and to "Build Back Better" in recovery, rehabilitation and reconstruction**

Roles of Stakeholders

Civil society, volunteers, organized voluntary work organizations and community-based organizations to participate (In particular, women, children and youth, persons with disabilities, and older persons)	Academia, scientific and research entities and networks to collaborate	Business, professional associations and private sector financial institutions to collaborate	Media to take a role in contributing to the public awareness raising

- Seven concrete global targets were specified
- The targets include important policy focuses, such as **mainstreaming DRR**, prior investment, "Build Back Better", multi-stakeholders' involvement, people-centered approach, and women's leadership

Global Targets

⊖ The number of deaths
⊖ The number of affected people
⊛ Economic loss
④ Damage to medical and educational facilities
⑤ National and local strategies
⑥ Support to developing countries
⑦ Access to early warning information

1 OVERVIEW OF CLIMATE RELATED DISASTER

2 SETTING THE SCENE – CLIMATE CHANGE AND BDA

3 BIG DATA ANALYTICS (BDA) – PROOF OF CONCEPT

4 POTENTIAL IMPACT OF CC – BDA FINDING

5 WAY FORWARD

Big Data Analytics – Initiative by the Government

14 November 2013

The Prime Minister has announced the Big Data Analytics initiatives in Malaysia while chairing the 25th MSC Malaysia Implementation Council Meeting (ICM) to address the current challenges through the use of BDA technology. MAMPU has been appointed as BDA project leader for the Public Sector.

19 November 2014

Flagship Application Coordination Committee (FCC) Meeting agreed of the need to develop expertise and BDA Centre of Excellence

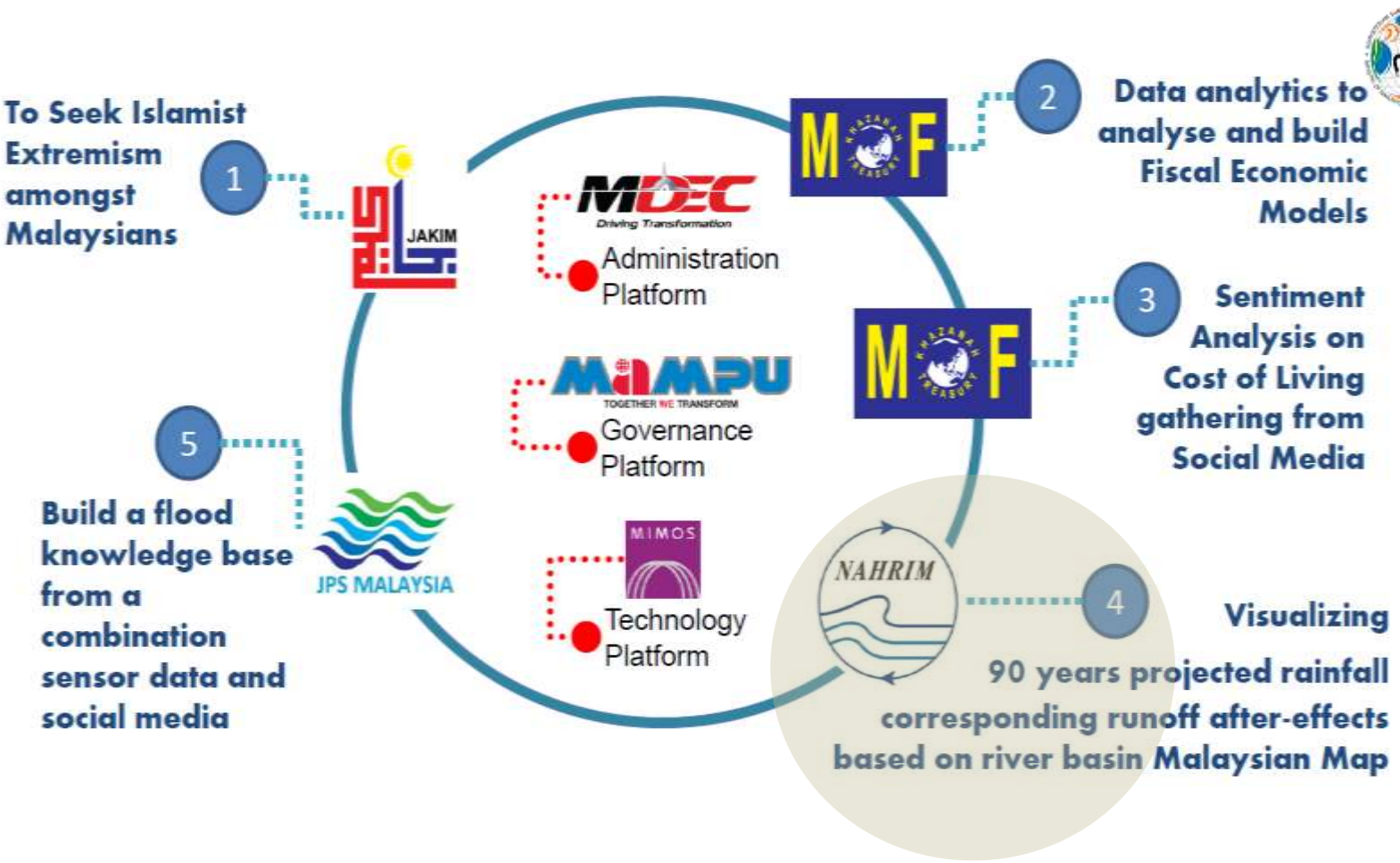
25 January 2015

MAMPU, MDEC and MIMOS signed a MOU implement a strategic collaborative work through BDA-Digital Government Open Innovation Network (BDA-DGOIN)

23 April 2015

MAMPU-MDEC-MIMOS launched the BDA-DGL. Four (4) government agencies participating in Proof-of-Concept BDA initiatives were recognized

MAMPU – MALAYSIAN ADMINISTRATIVE MODERNIZATION AND MANAGEMENT PLANNING UNIT
MDEC – MALAYSIA DIGITAL ECONOMY CORPORATION
MIMOS – GOVERMENT OWNED COMPANY (GOC)



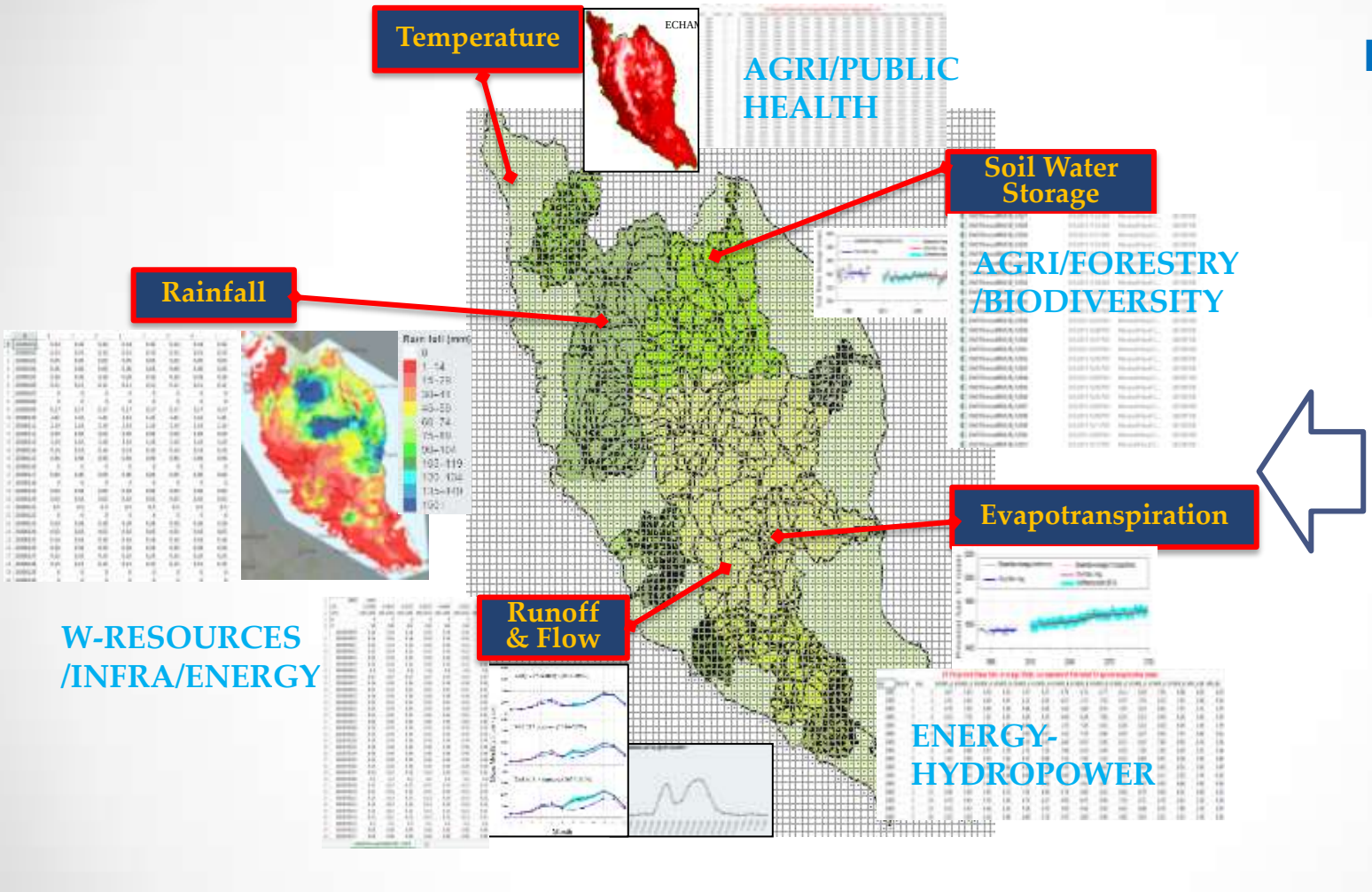
Project Objective

To develop a **BDA related system** that will be able to assist NAHRIM in **visualizing and analyzing** almost **1450 simulation-years** of grid-based projected hydro-climate data for Peninsular Malaysia

Studies & Reports

- Climate change impact on the hydrologic regime and water resources for Peninsular Malaysia (NAHRIM, 2006)
- Climate change impact on the hydrologic regimes, water resources and landuse for Sabah & Sarawak (NAHRIM, 2010)
- Study of the impact of climate change on sea level rise at Peninsular Malaysia and Sabah & Sarawak (NAHRIM, 2010)
- **Climate change impact on the hydrologic regime and water resources for Peninsular Malaysia (NAHRIM, 2014)**

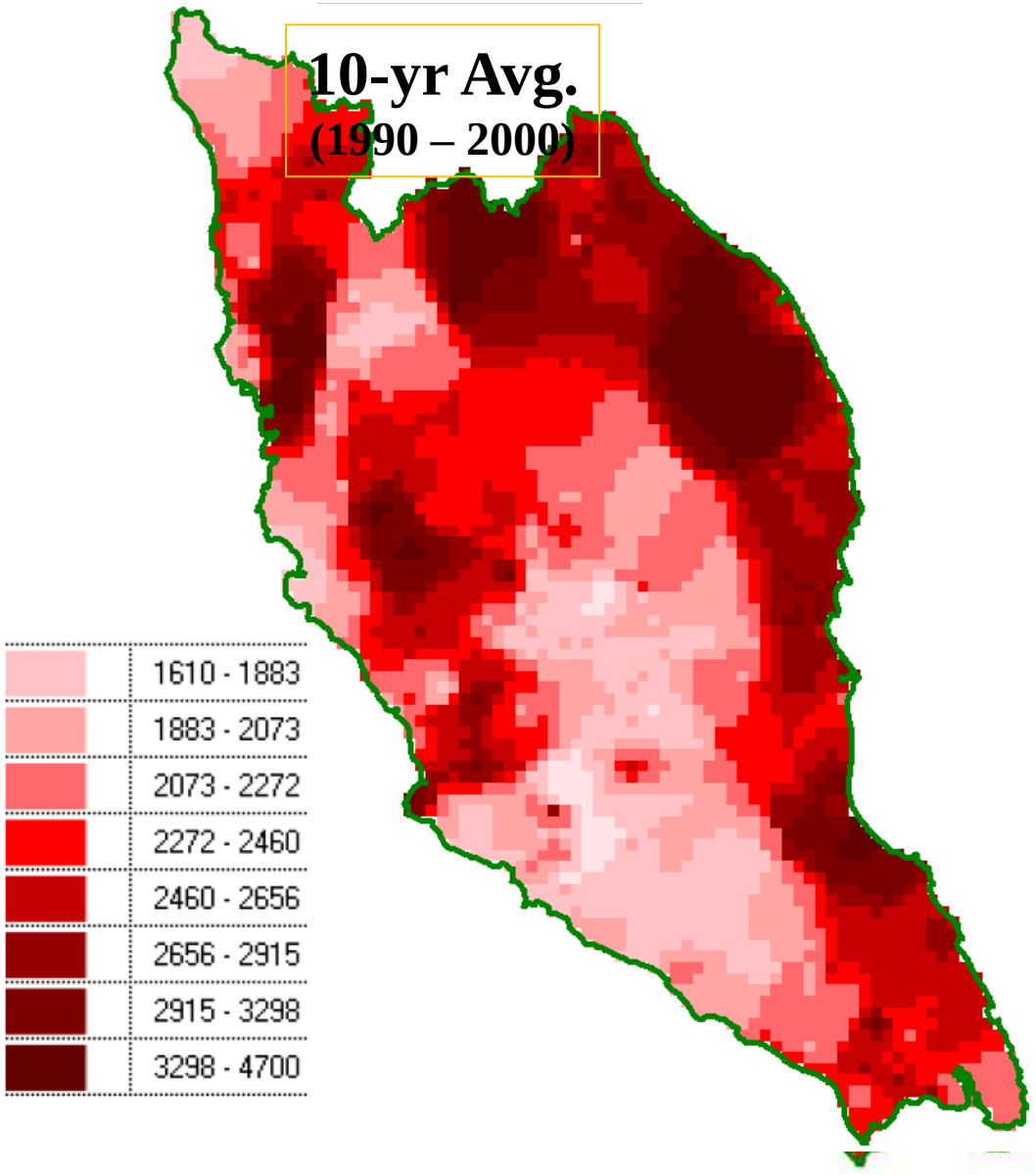
Main Data Output



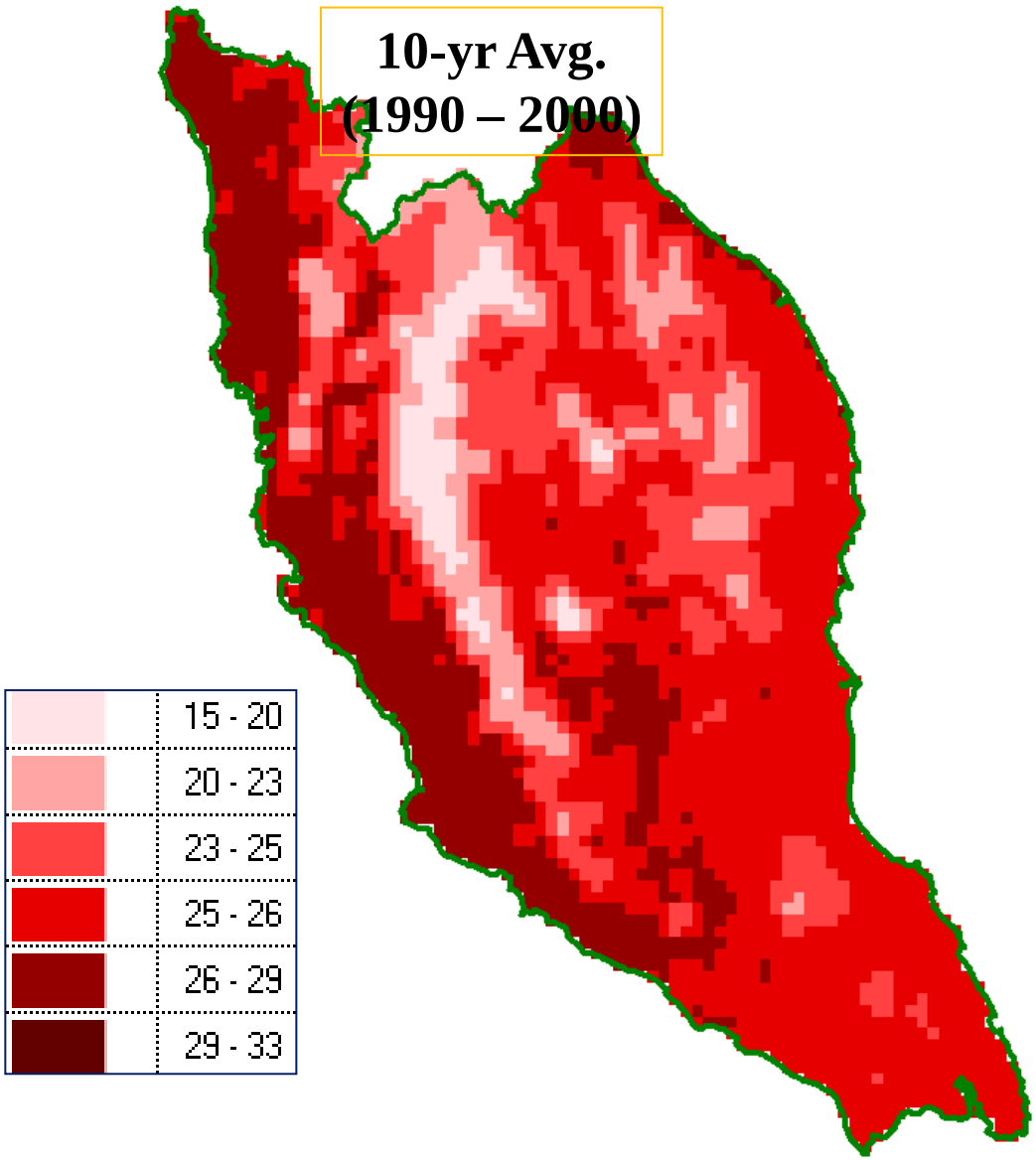
HPC SYSTEM

- covers 3,888 grids @ 6x6 km area & basin scale
  - 5 main data/parameters
- Historical and future period of 1970-2000 & 2010-2100
  - 1450 simulation – year in hourly increments

….precipitation change….



….air temperature change….



1 OVERVIEW OF CLIMATE RELATED DISASTER

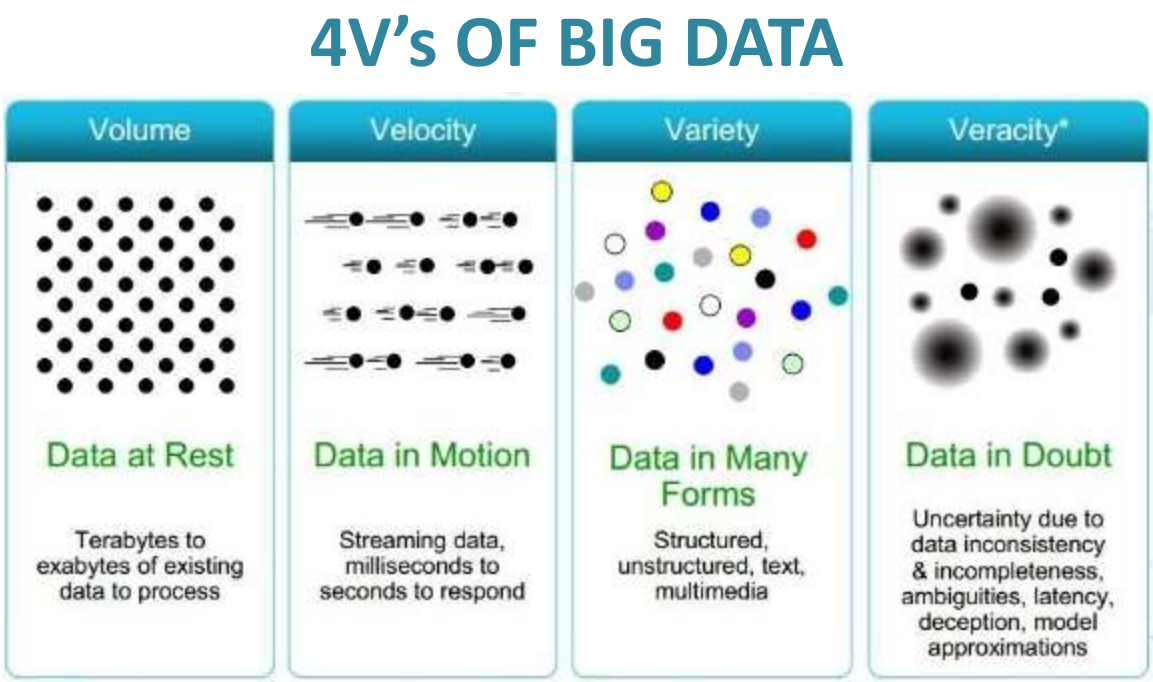
2 SETTING THE SCENE – CLIMATE CHANGE AND BDA

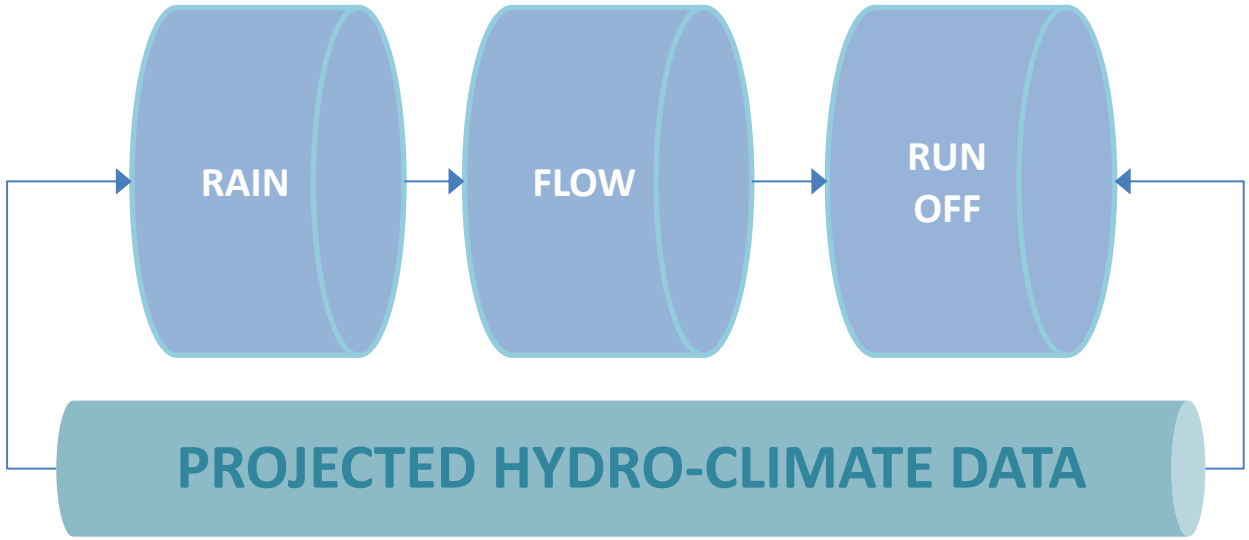
3 BIG DATA ANALYTICS (BDA) – PROOF OF CONCEPT

4 POTENTIAL IMPACT OF CC – BDA FINDING

5 WAY FORWARD

Big data analytics is the process of examining large data sets to **uncover hidden patterns, unknown correlations**, market trends, customer preferences and other useful business information (source: whalts.com)

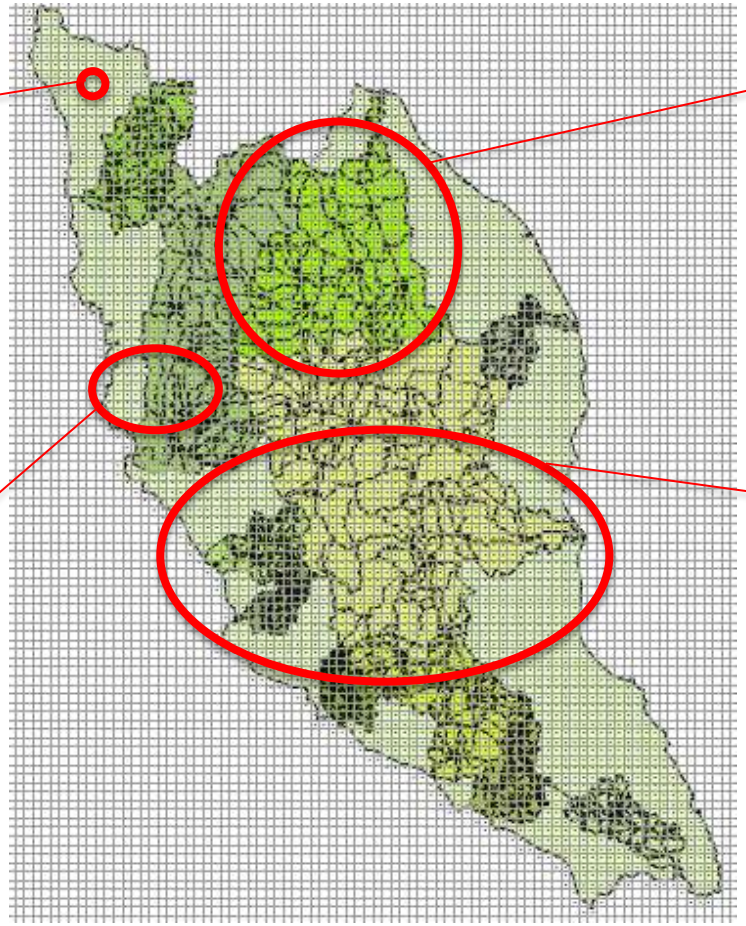




BUSSINESS CASE

VISUALISE
3,888 grids for Peninsular Malaysia (6x6 km area)

DETECT
Extreme rainfall and runoff projection data for 90 years

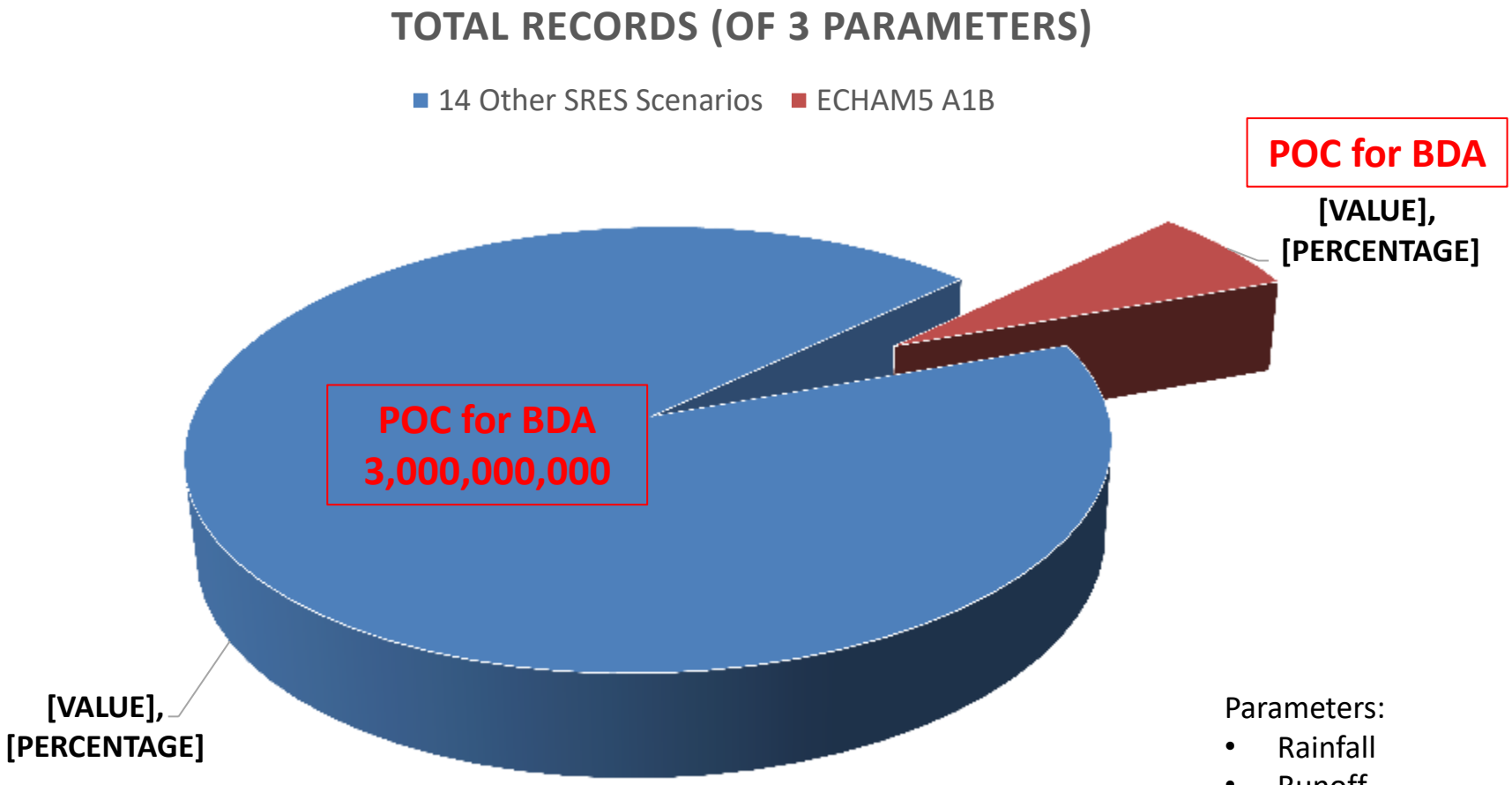


IDENTIFY
Flood flow 11 river basins and 12 states in Peninsular Malaysia

TRACE
Drought episode from weekly to annual rainfall data for 90 years

Visual Analysis for
190 million records

DATA USED (VOLUME)



Parameters:

- Rainfall
- Runoff
- Streamflow

POC Data Warehouse Infrastructure

Data Acquisition

CC Projected data (Rainfall, Runoff, Streamflow & etc.)

Data Cleansing & Integration

Mi-Galactica

Extraction Process

Staging

Data

Meta Data

Transform and Load

Data Repository

Mi-Galactica

GPU Parallel Columnar Data Store

PostgreSQL

User Authentication Data

Analytics

Presentation

Users

Data Scientists

Administrators

CSV RAW CSV

Multi-Core CPU

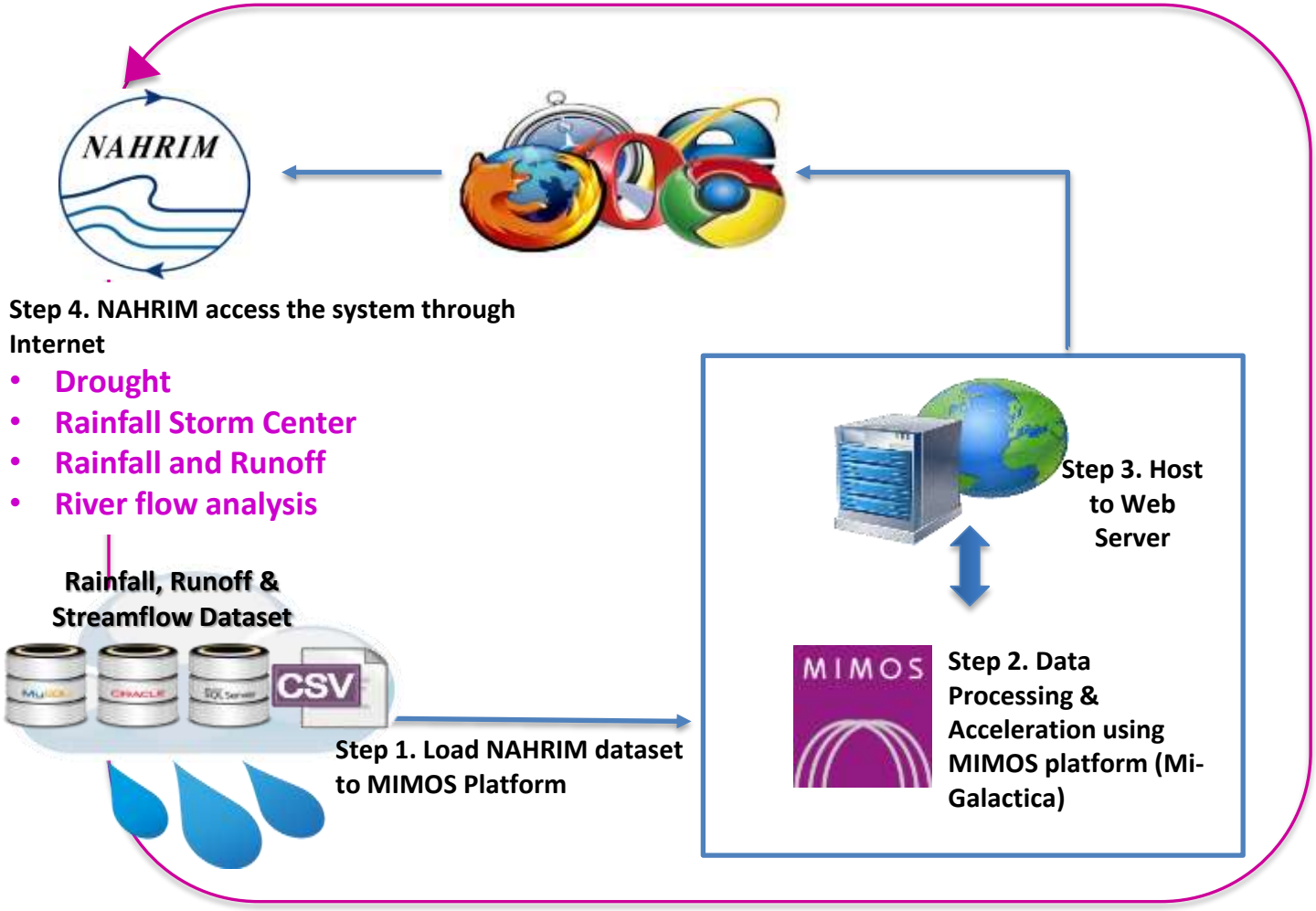
Many-Core GPU

Secured by a centralized authentication platform, Mi-UAP

BIG *Volume of Data*

Powered by accelerated heterogeneous computing platform, Mi-Galactica

System Overview



1 OVERVIEW OF CLIMATE RELATED DISASTER

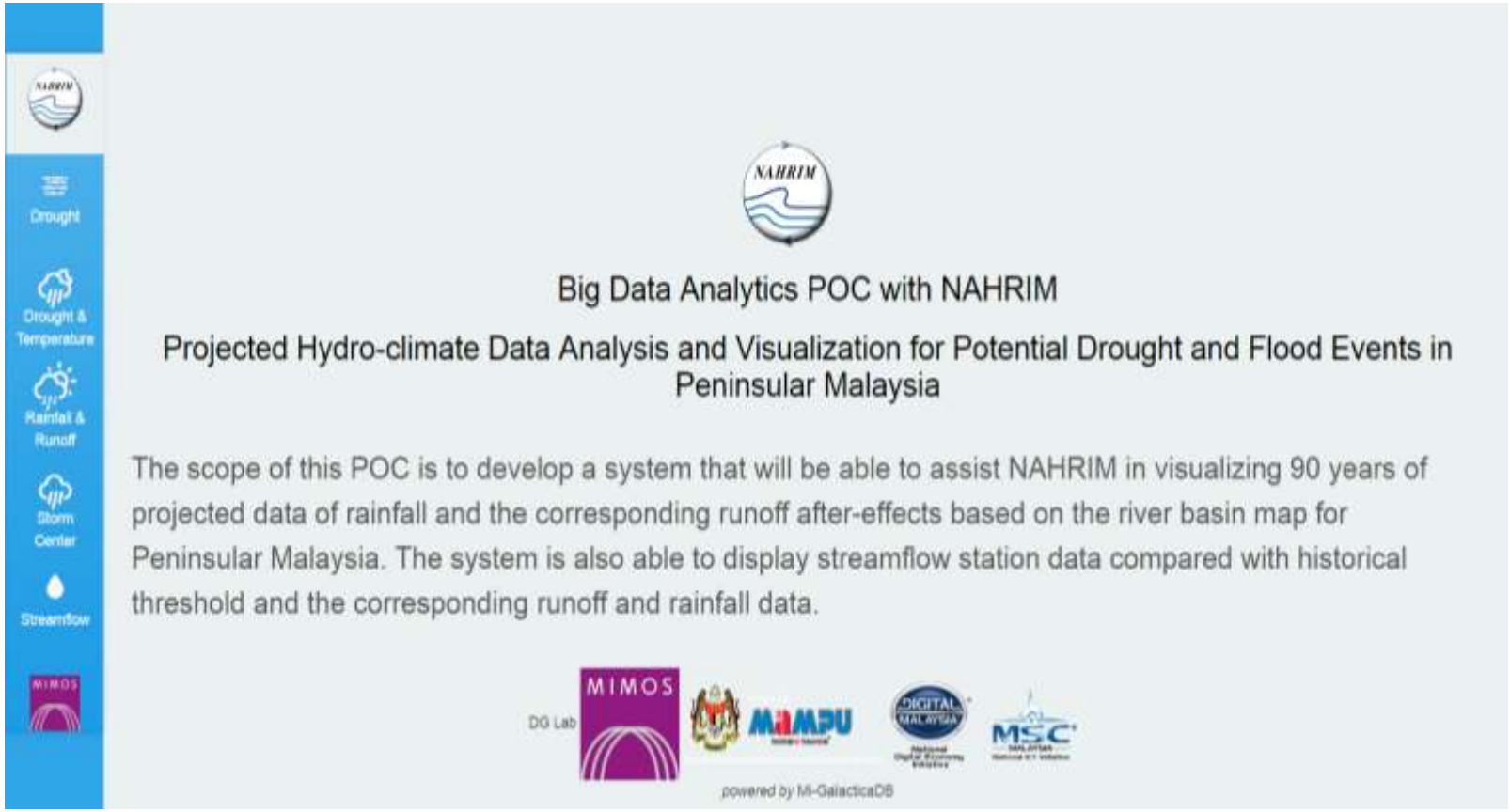
2 SETTING THE SCENE – CLIMATE CHANGE AND BDA

3 BIG DATA ANALYTICS (BDA) – PROOF OF CONCEPT

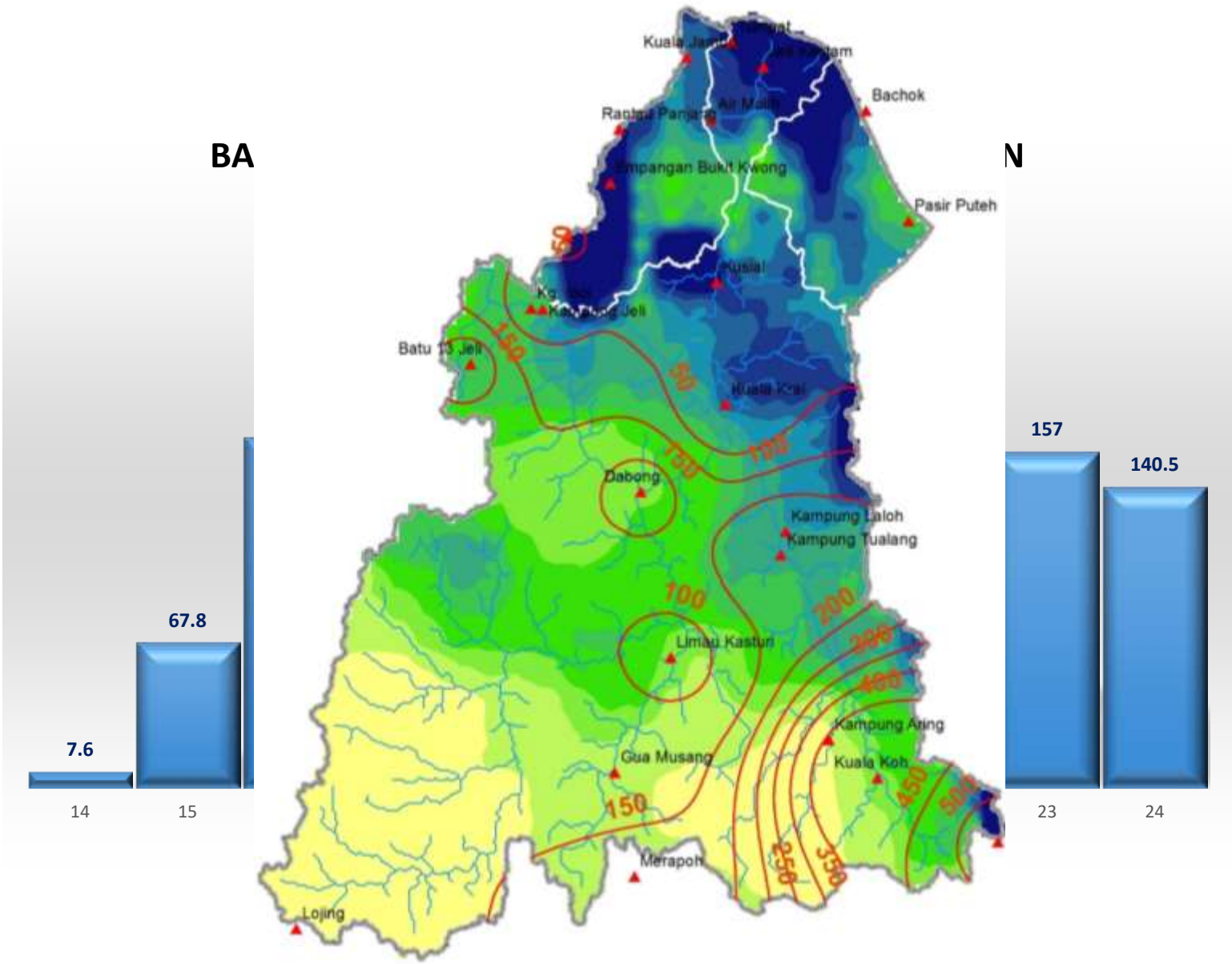
4 POTENTIAL IMPACT OF CC – BDA FINDING

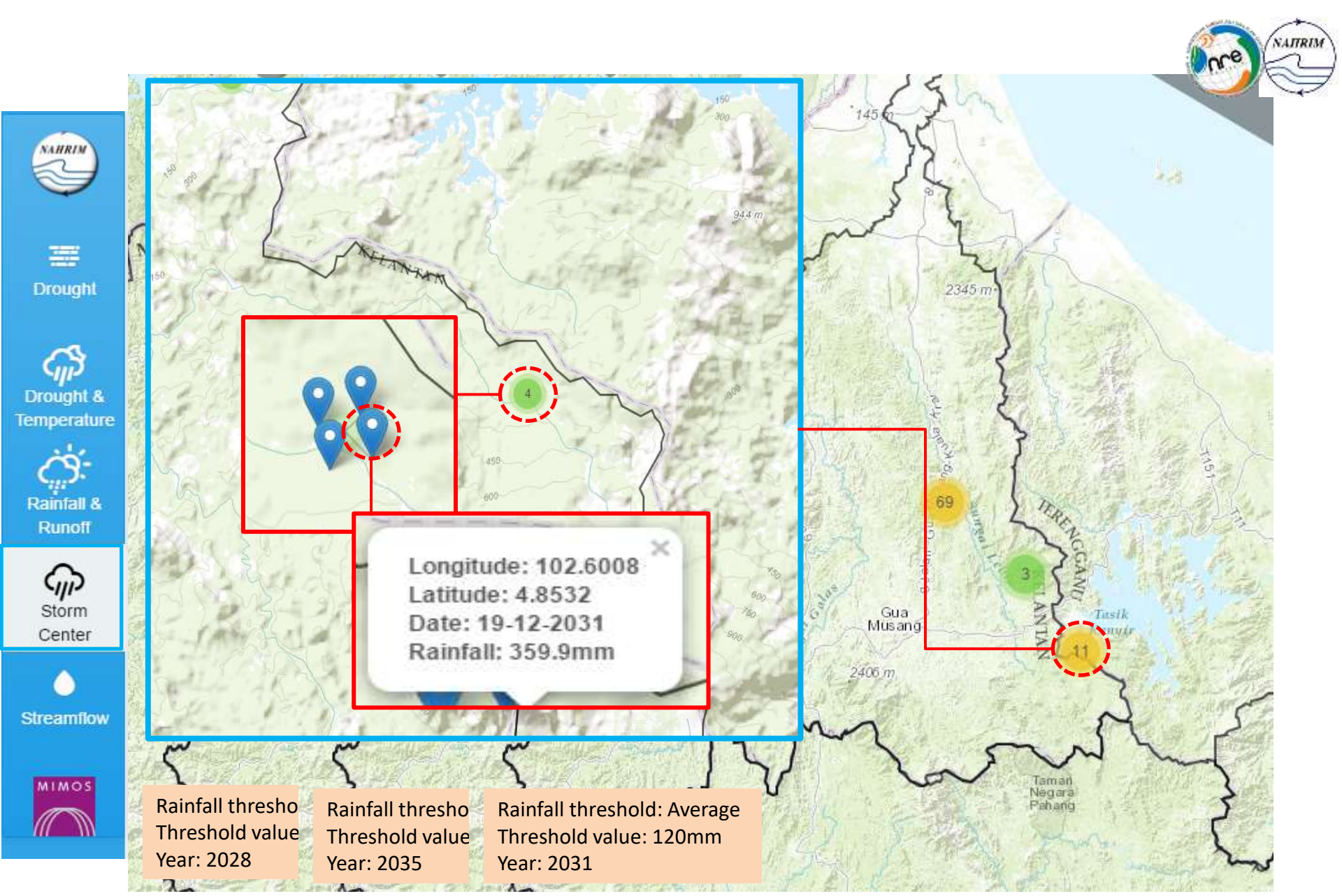
5 WAY FORWARD

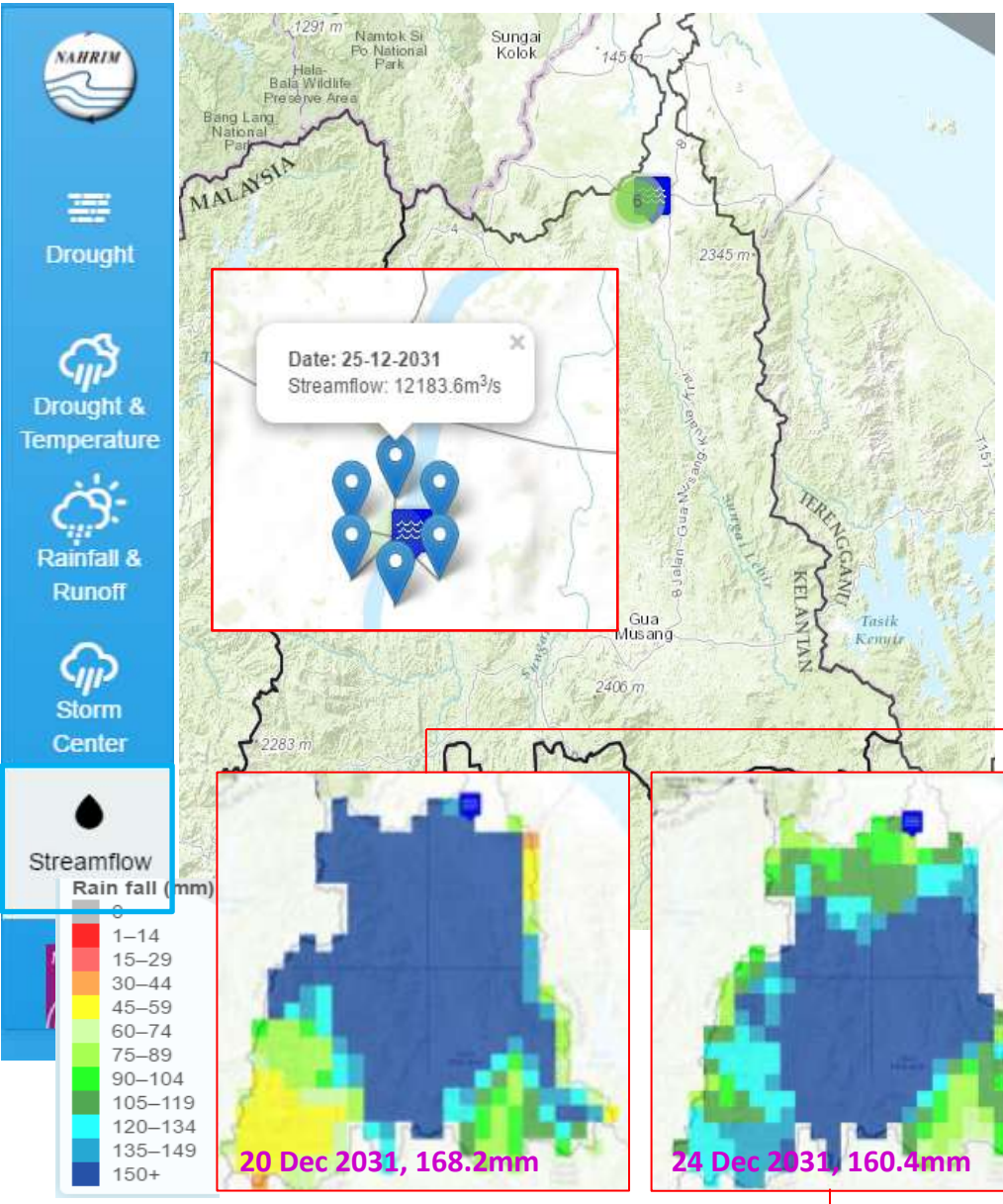
PROJECTED HYDROCLIMATE DATA ANALYSIS & VISUALISATION FOR POTENTIAL DROUGHT & FLOOD EVENTS IN PENINSULAR MALAYSIA

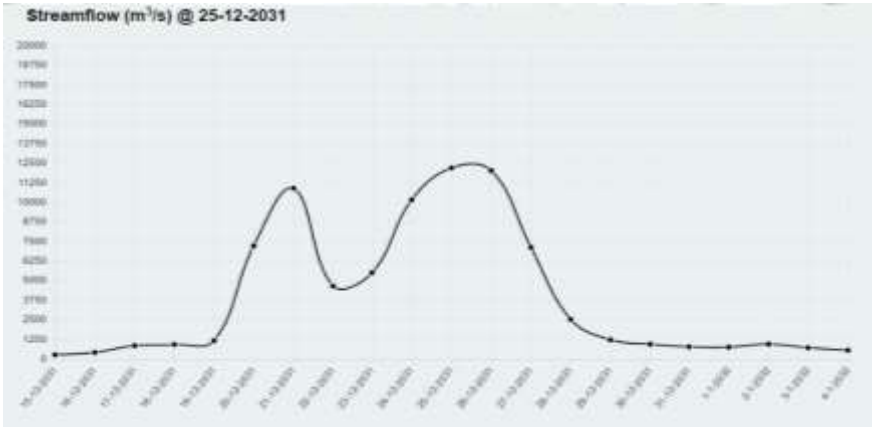


FLOOD EVENT DEC 2014 – STORM PATTERN

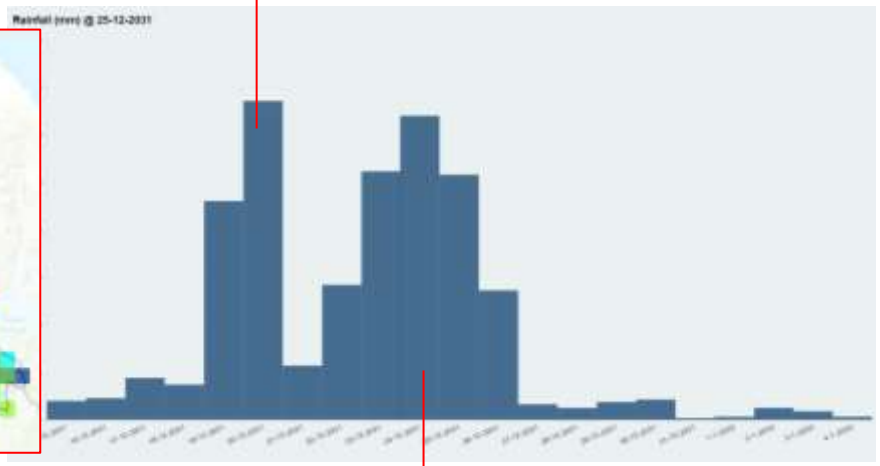



NAHRIM
Drought
Drought & Temperature
Rainfall & Runoff
Storm Center
Streamflow
MIMOS
4
69
3
11
Longitude: 102.6008
Latitude: 4.8532
Date: 19-12-2031
Rainfall: 359.9mm
Gua Musang
Taman Negara Pahang
TERENGGANU
2345 m
2406 m
944 m
Rainfall thresho
Threshold value
Year: 2028
Rainfall thresho
Threshold value
Year: 2035
Rainfall threshold: Average
Threshold value: 120mm
Year: 2031


NAHRIM
Drought
Drought & Temperature
Rainfall & Runoff
Storm Center
Streamflow
Rain fall (mm)
0
1–14
15–29
30–44
45–59
60–74
75–89
90–104
105–119
120–134
135–149
150+
Namtok Si Po National Park
Hala-Bala Wildlife Preserve Area
Bang Lang National Park
Sungai Kolok
MALAYSIA
1291 m
145 m
2345 m
2406 m
2283 m
Gua Musang
TERENGGANU
KELANTAN
Tasik Kenyir
Date: 25-12-2031
Streamflow: 12183.6m³/s
20 Dec 2031, 168.2mm
24 Dec 2031, 160.4mm


Streamflow (m³/s) @ 25-12-2031

December 2014



NAHRIM

Drought

Drought & Temperature

Rainfall & Runoff

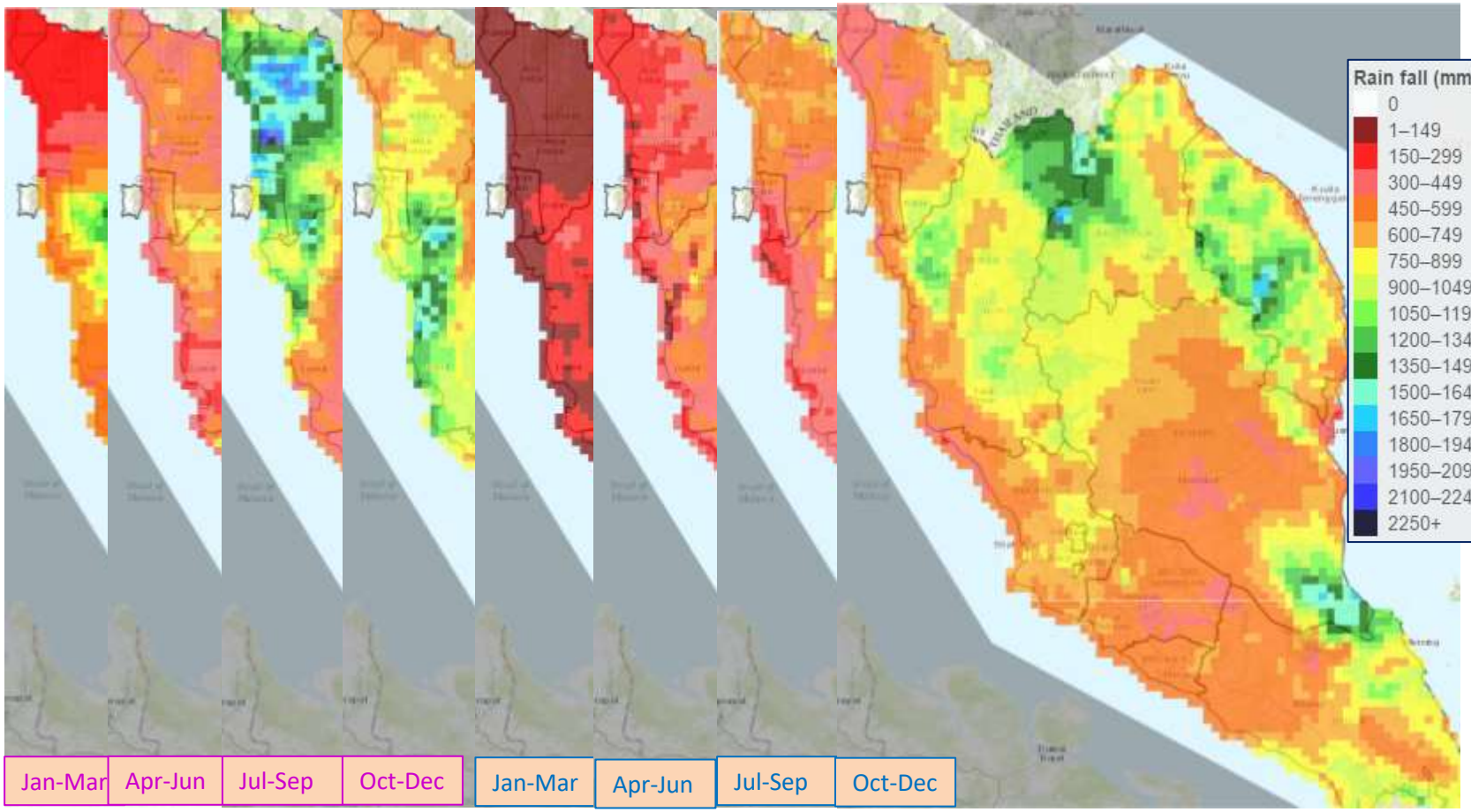
Storm Center

Streamflow

MIMOS

2016

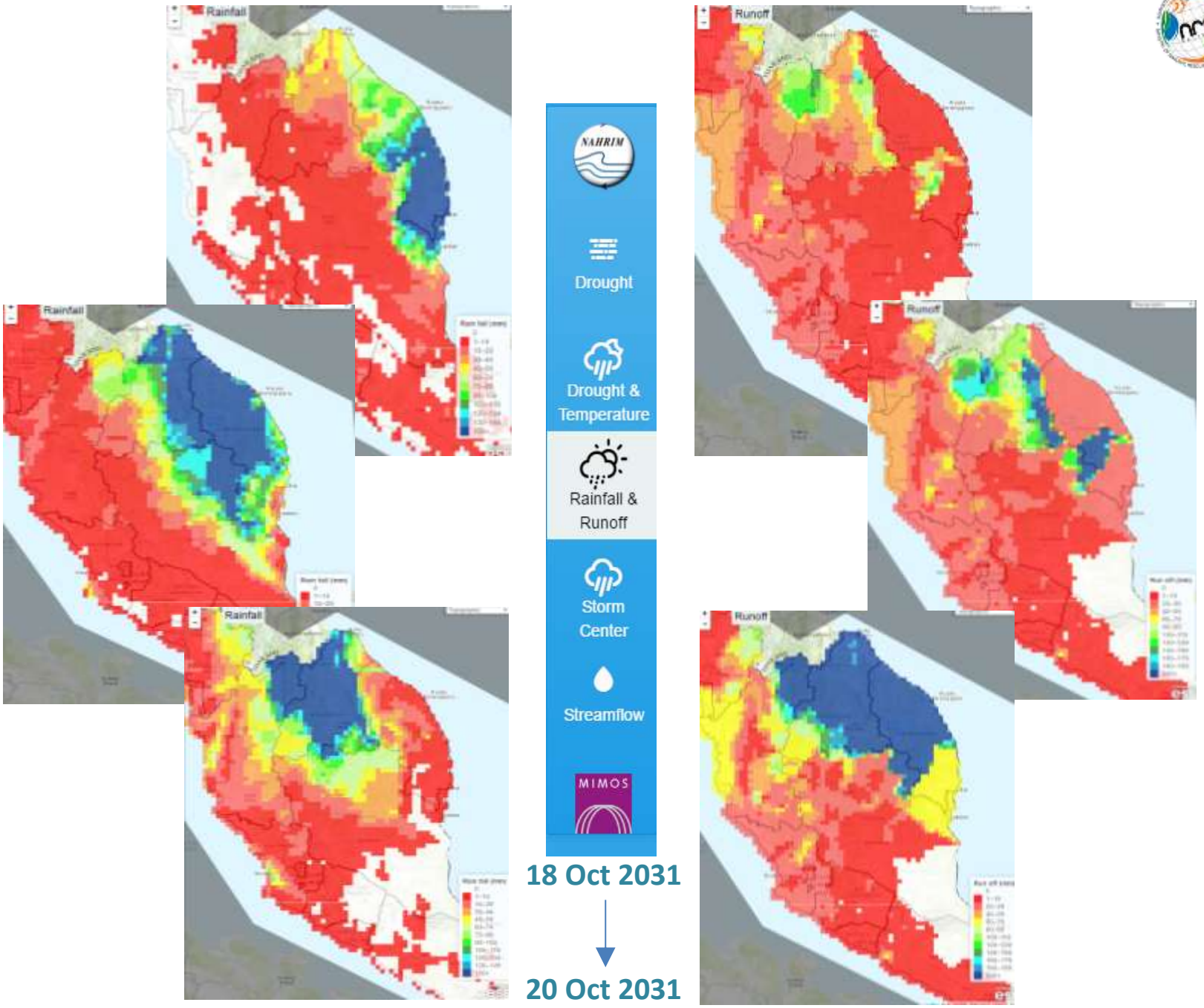
2024



2010-2100

RAINFALL

RUNOFF



1 OVERVIEW OF CLIMATE RELATED DISASTER

2 SETTING THE SCENE – CLIMATE CHANGE AND BDA

3 BIG DATA ANALYTICS (BDA) – PROOF OF CONCEPT

4 POTENTIAL IMPACT OF CC – BDA FINDING

5 WAY FORWARD

Way Forward

BDA - POC

VISUALISE - IDENTIFY

Climate Change Factor (CCF)

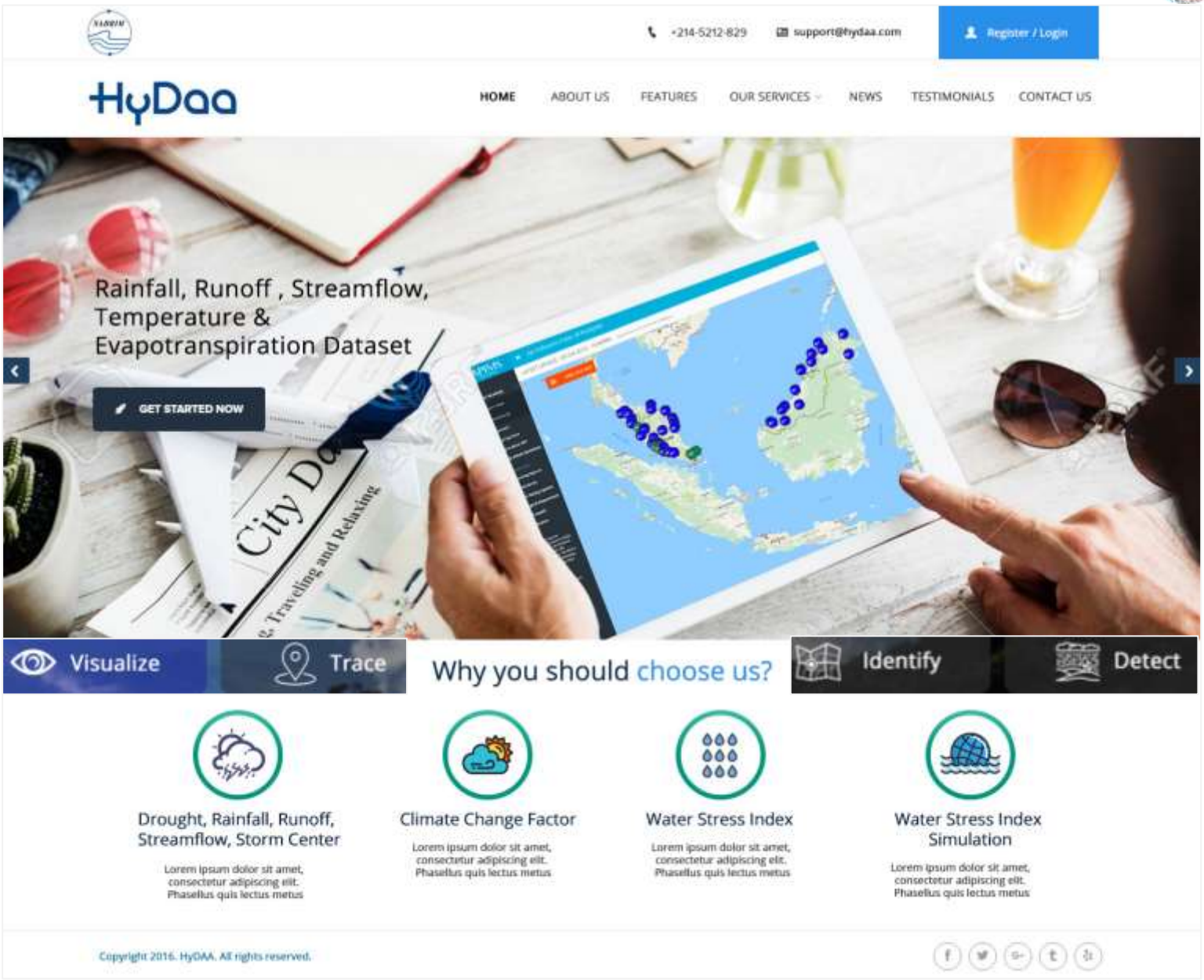
Water Stress

DEGREE 0F VULNERABILITY

Water - DSS

DASHBOARD OF ADAPTATION SIMULATION

Benefits

- Sharing of data to harness the vast potential data
- Sharing information makes decision making more efficient
- Improved decision making process through data linkahes, data mining, data analytics and predictive analytics
- Decision making is more proactive and timely manner

Hydro-climate Data analysis accelerator