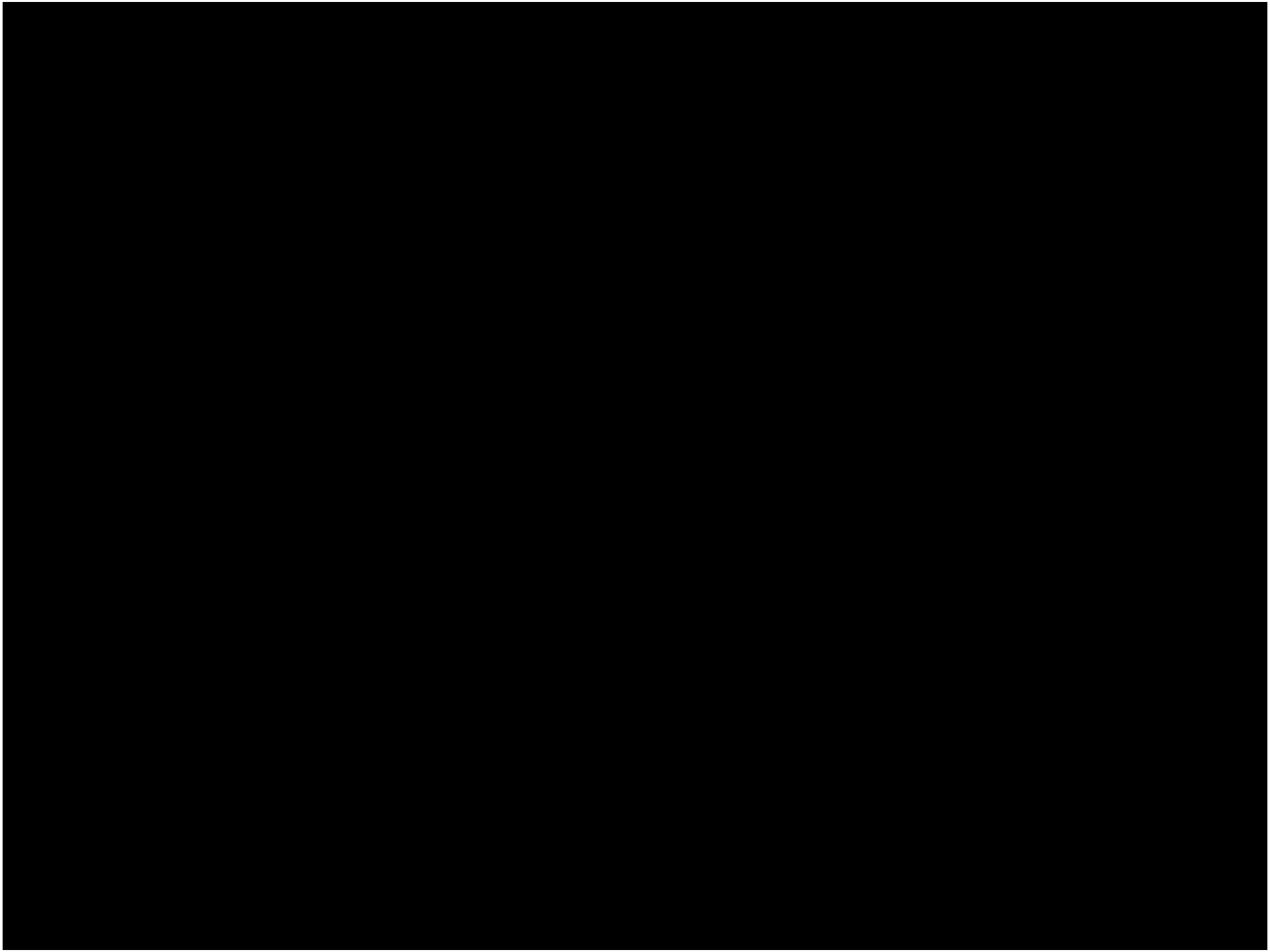
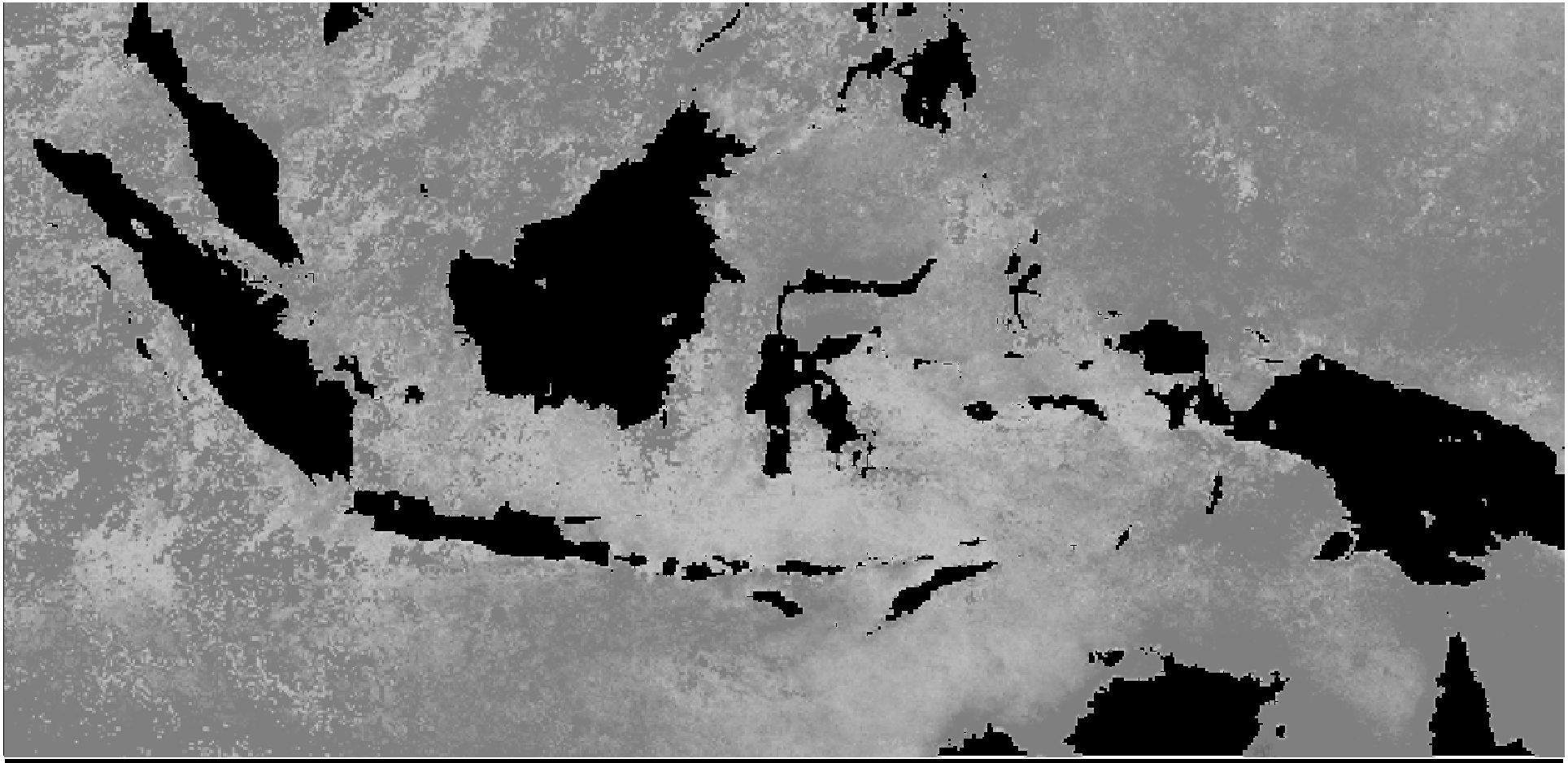




Overview of Climate Services in Indonesia

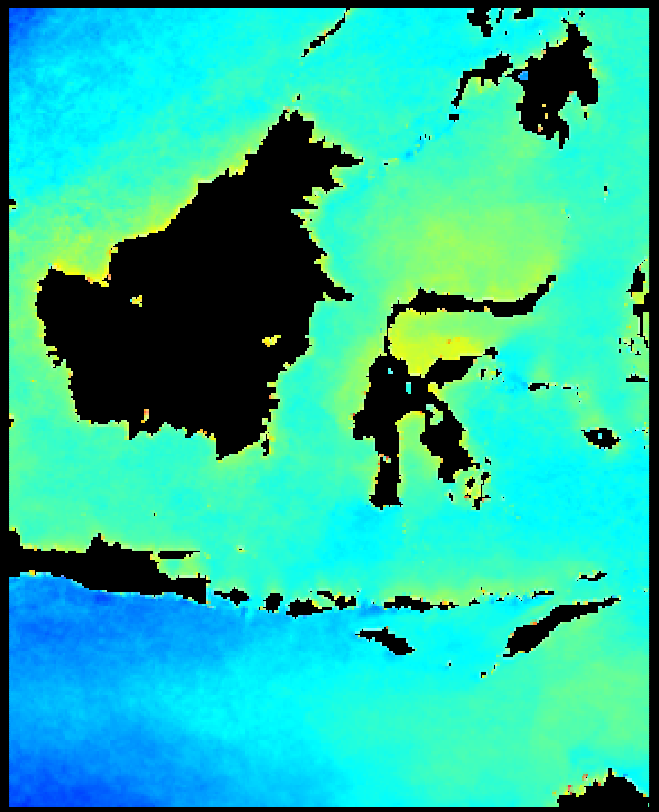
Ardhasena Sopaheluwakan

BMKG

Presented at the 2011 WMO RA-V Regional Seminar. Honiara, Solomon Islands, 2 November 2011

Outline

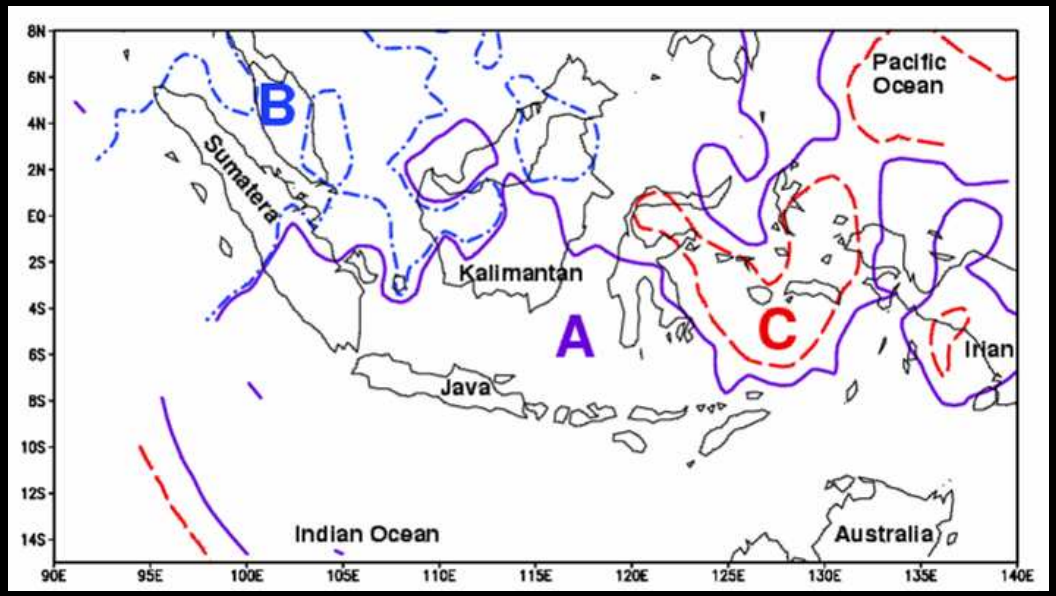
- Climatological settings
- Current capacities for climate services
- Current status of climate services

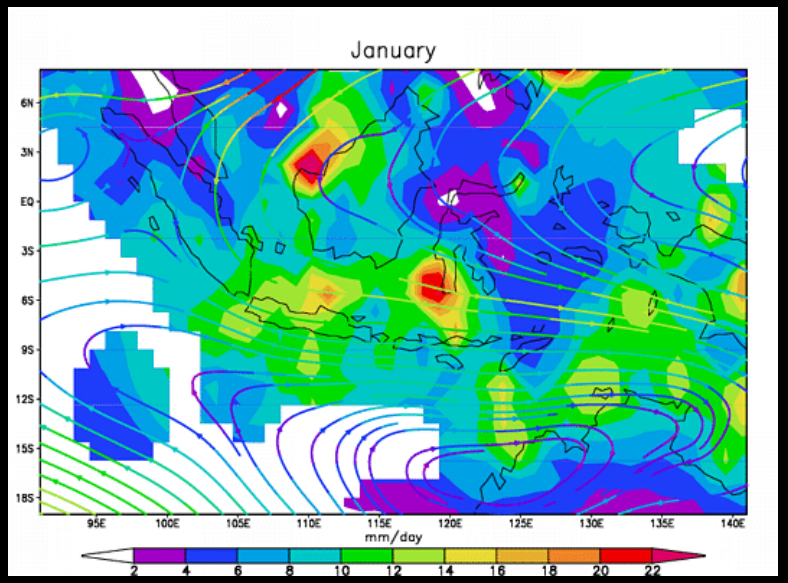


Climatological settings

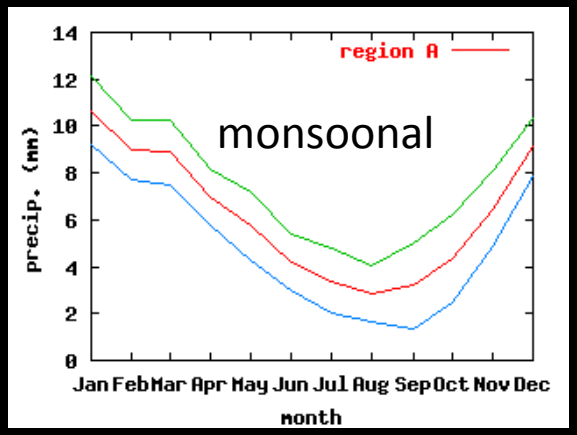
Climatology of regional rainfall

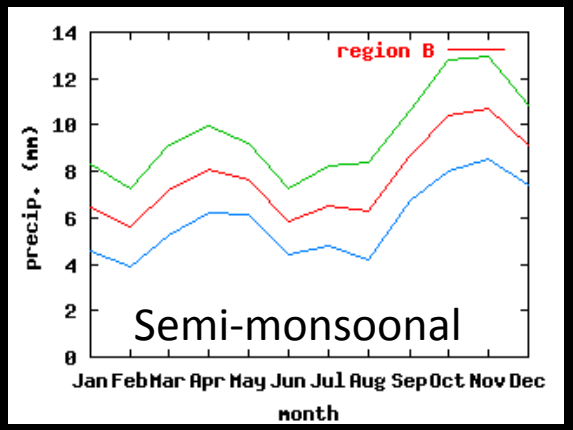
- Mainly monsoonal
- Three distinct rainfall climate regions

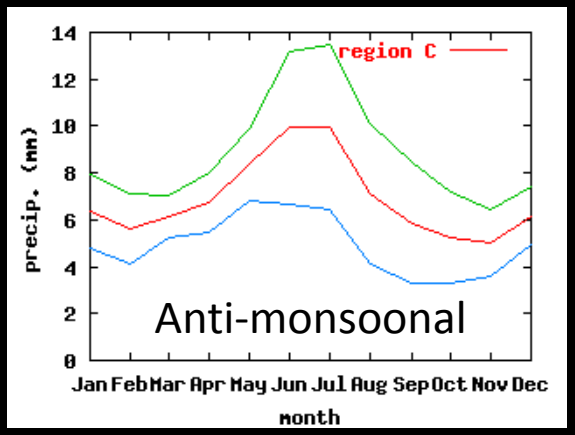




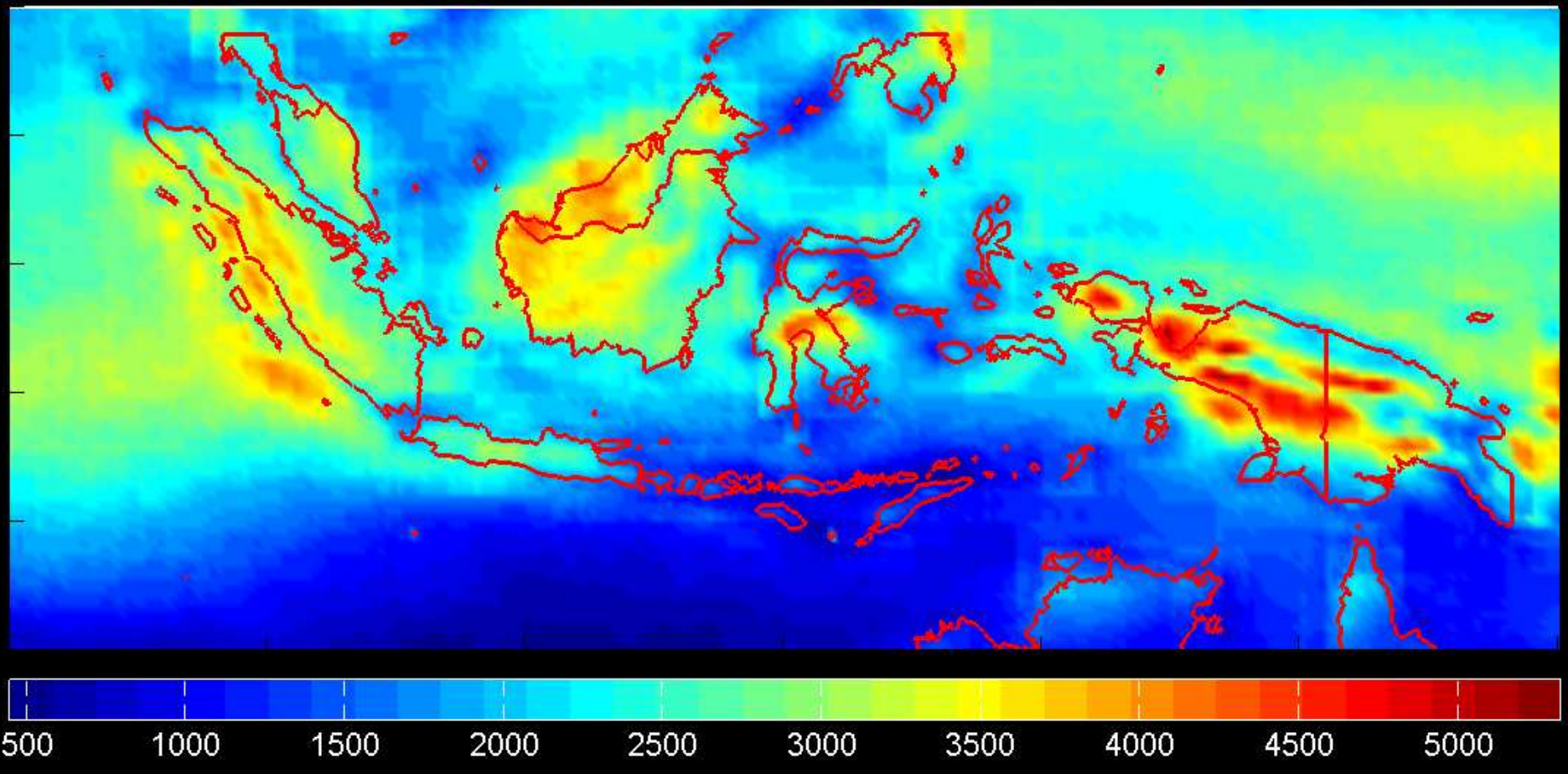
Aldrian and Susanto 2003





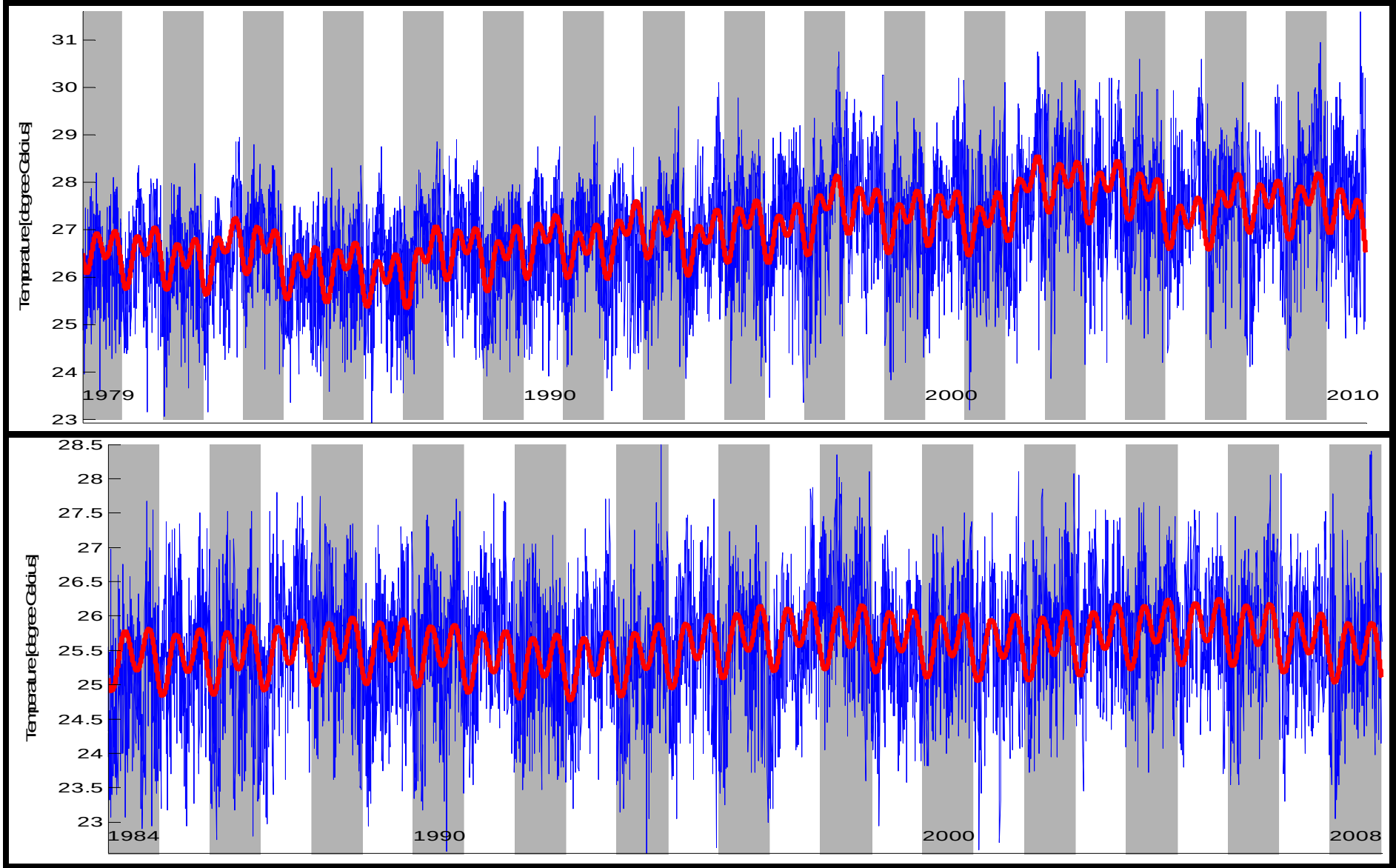


Yearly rainfall



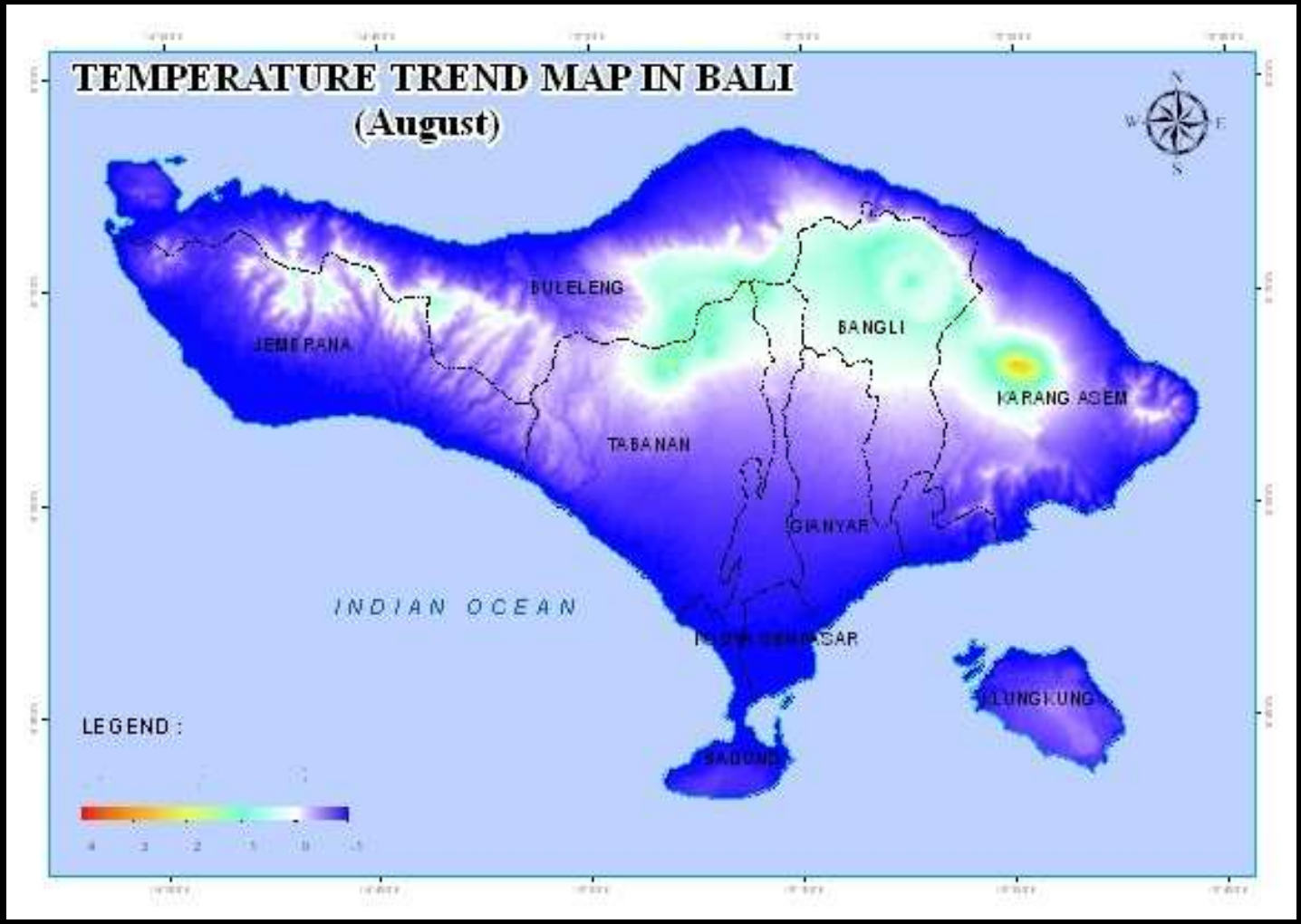
Badan Meteorologi Klimatologi dan Geofisika

Long term trends – avrg. land temperature



Top: Pondok Betung – Jakarta ; Bottom: Darmaga – Bogor

Trend maps – average temperature



Other (major) islands are in progress …

Badan Meteorologi Klimatologi dan Geofisika

Major users sectors of climate services

- Agriculture
- Forestry
- Health
- Water resources
- Energy
- Fisheries
- Transportation
- Tourism

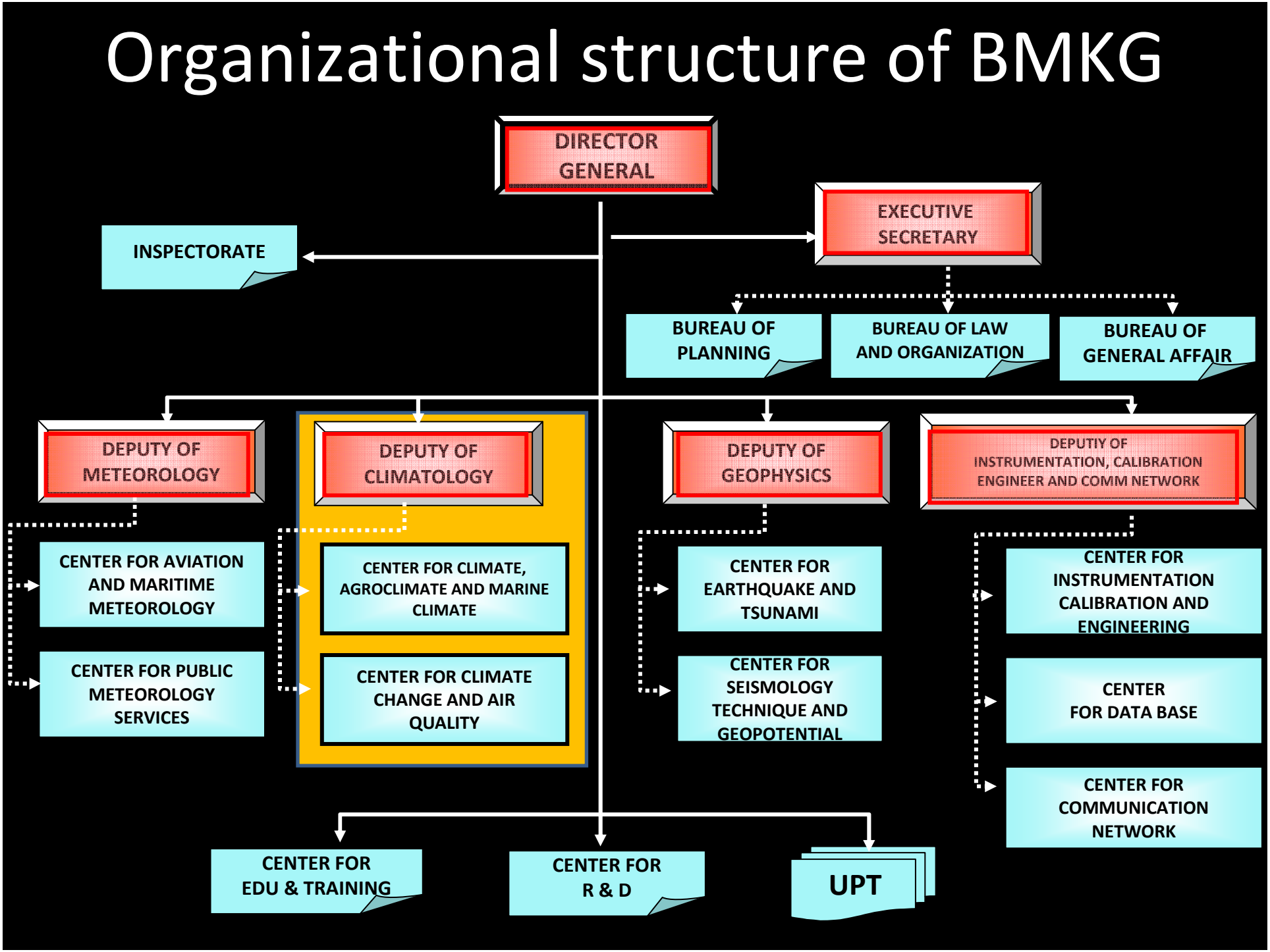
Current capacities for climate services

NATIONAL LAW NO. 31/2009 ON METEOROLOGY, CLIMATOLOGY, AND GEOPHYSICS

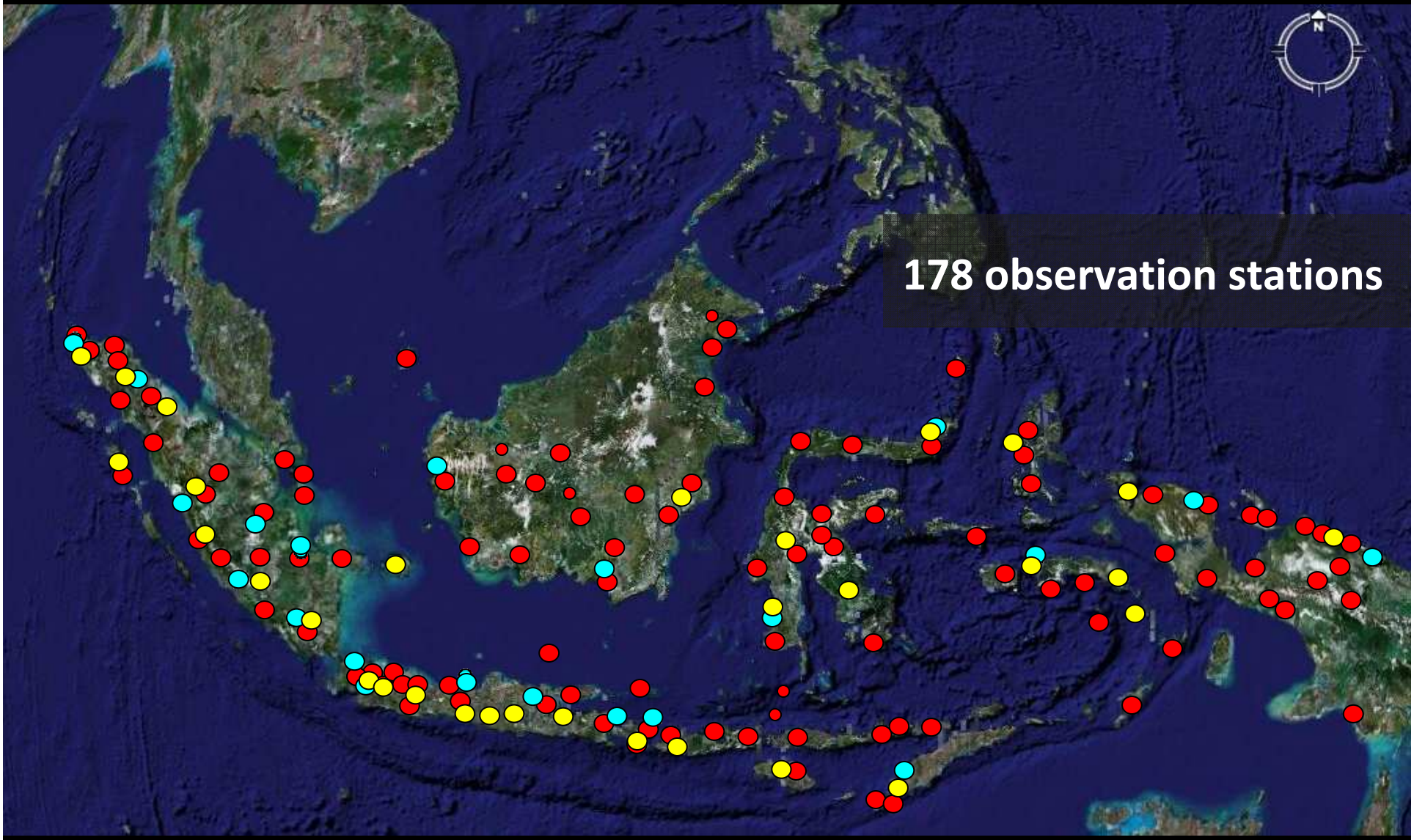
SEQUENCE OF CHAPTERS

CHAPTER	X	CLIMATE CHANGE ✓
CHAPTER	XI	INTERNATIONAL COOPERATION
CHAPTER	XII	RESEARCH, ENGINEERING, AND DEVELOPMENT ✓
CHAPTER	XIII	HUMAN RESOURCES
CHAPTER	XIV	RIGHTS AND PARTICIPATION OF THE PEOPLE
CHAPTER	XV	PENAL PROVISIONS
CHAPTER	XVI	TRANSITIONAL PROVISIONS
CHAPTER	XVII	CLOSING PROVISIONS

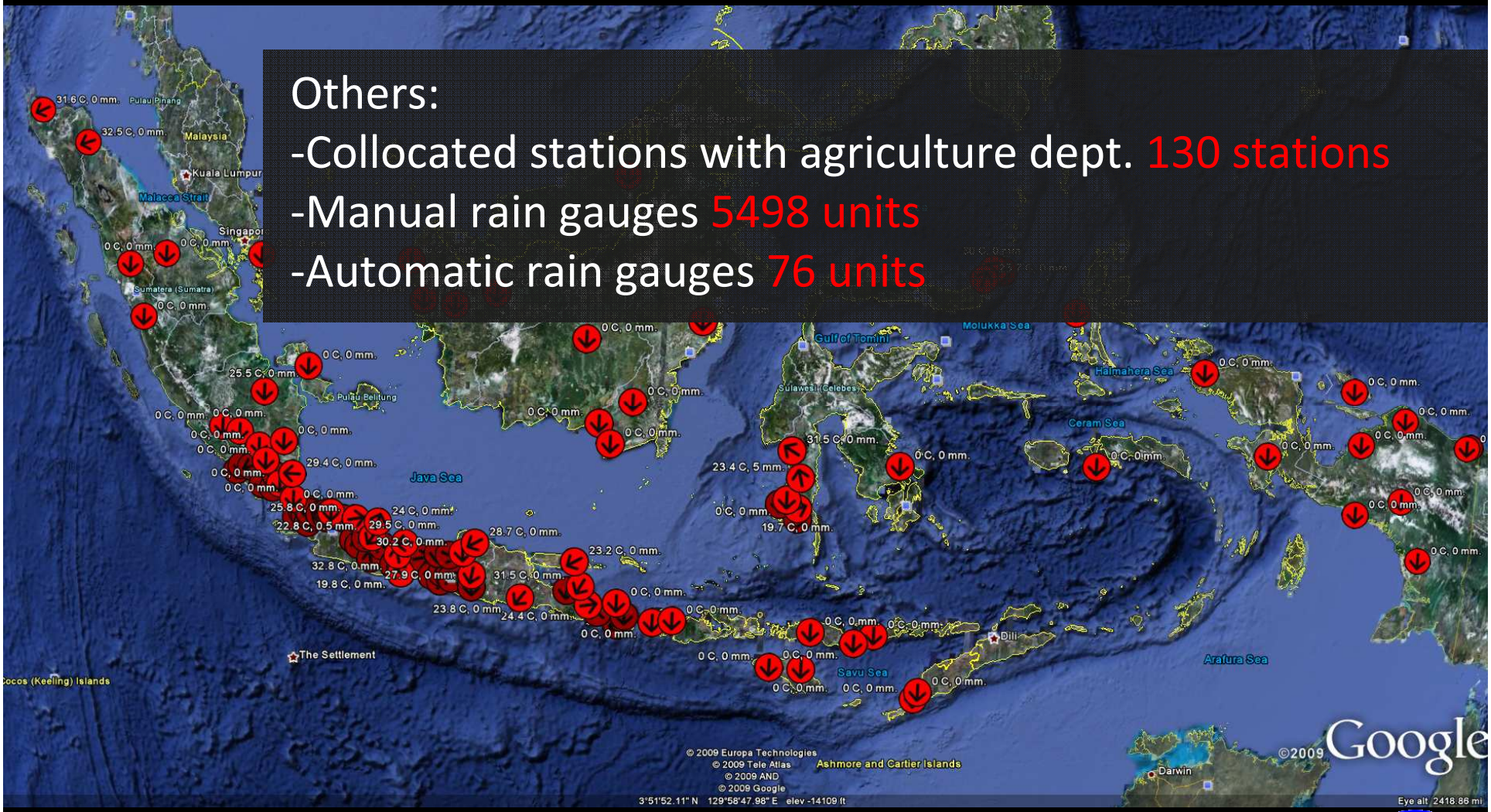
Organizational structure of BMKG



Observational Networks – BMKG stations



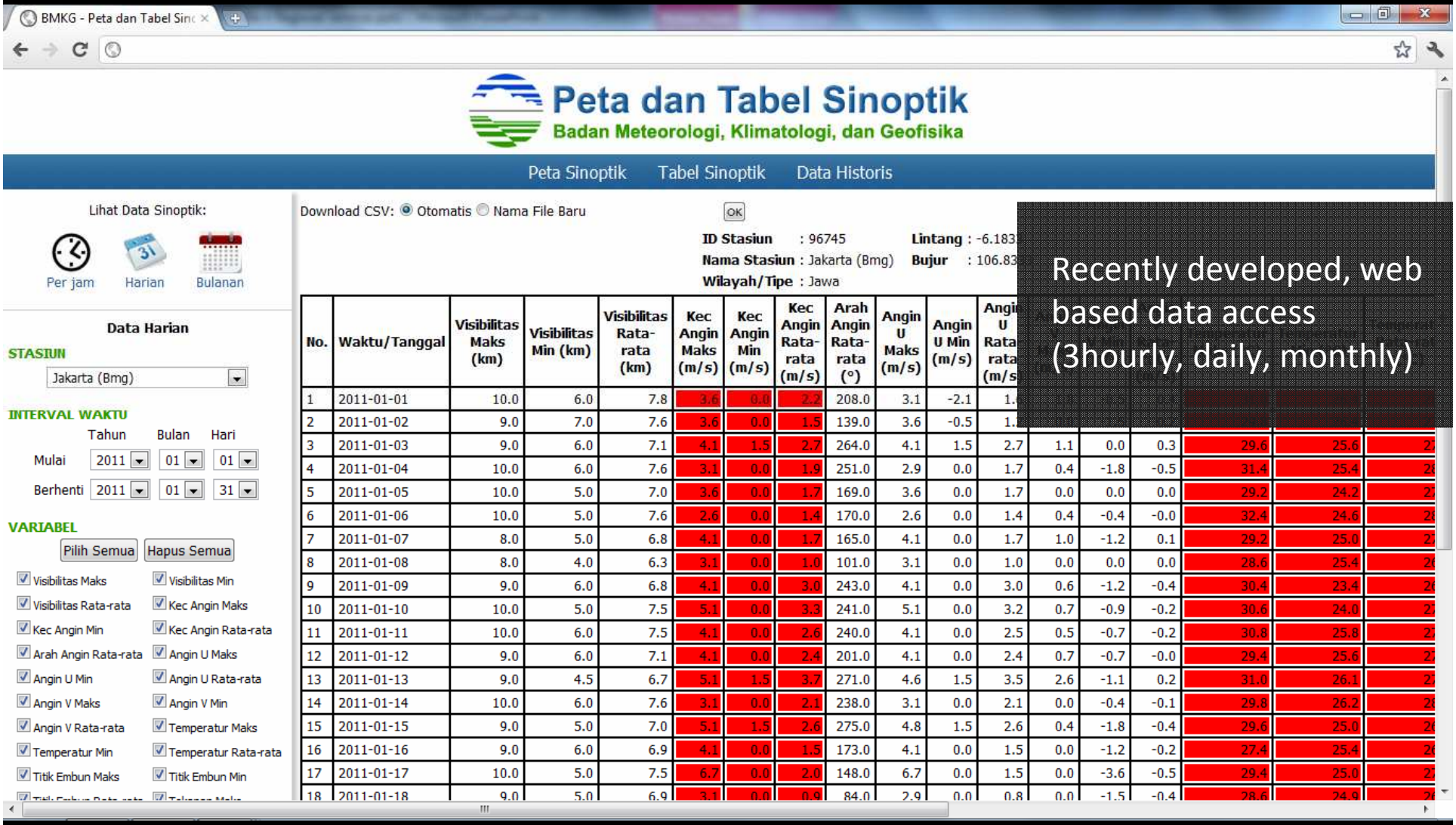
Observational Networks –
Automatic Weather Stations 157 units



Badan Meteorologi Klimatologi dan Geofisika

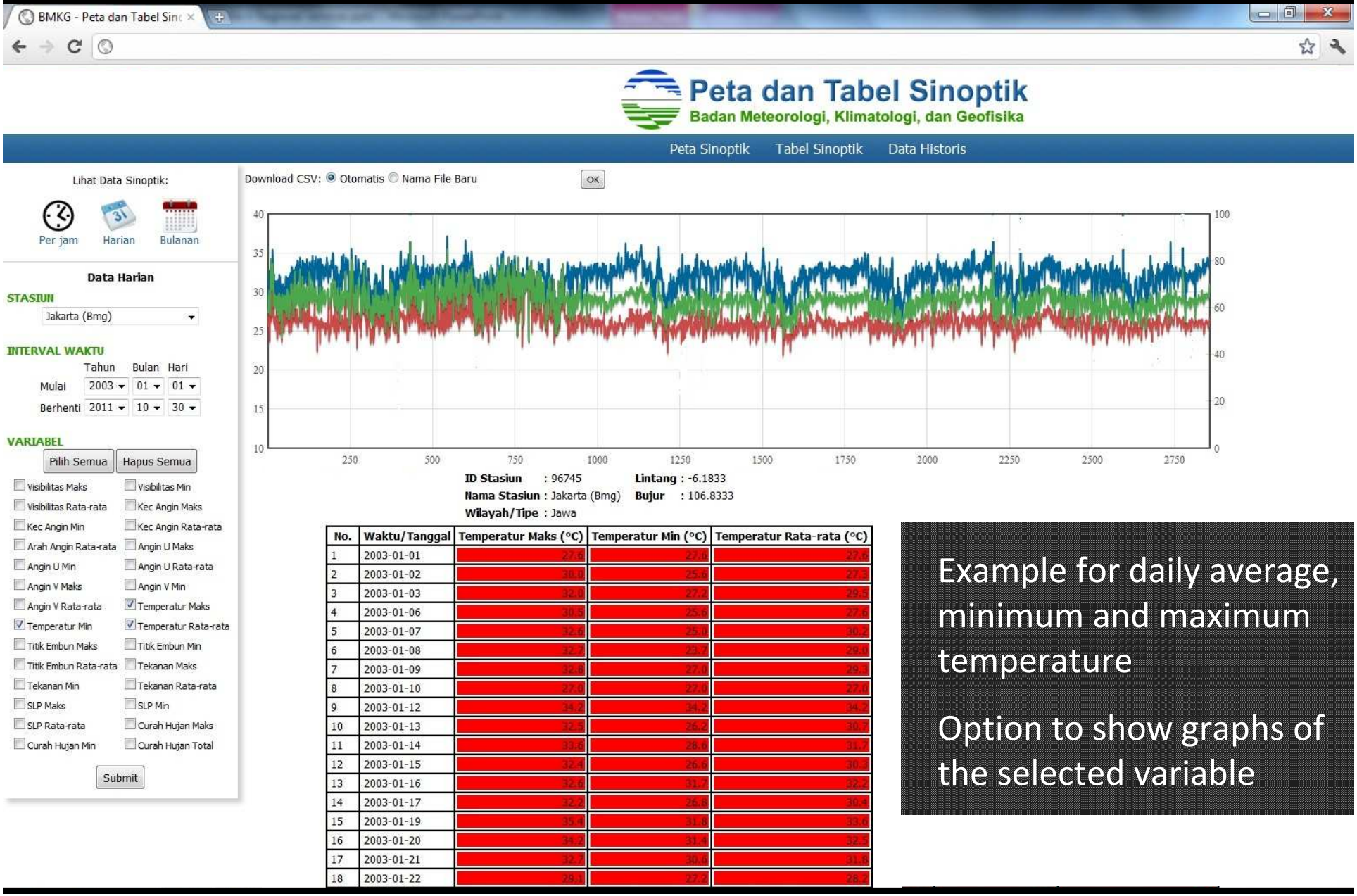
Current status of climate services

Data access & dissemination – web based



No.	Waktu/Tanggal	Visibilitas Maks (km)	Visibilitas Min (km)	Visibilitas Rata-rata (km)	Kec Angin Maks (m/s)	Kec Angin Min (m/s)	Kec Angin Rata-rata (m/s)	Arah Angin Rata-rata (°)	Angin U Maks (m/s)	Angin U Min (m/s)	Angi U Rata rata (m/s					
1	2011-01-01	10.0	6.0	7.8	3.6	0.0	2.2	208.0	3.1	-2.1	1.					
2	2011-01-02	9.0	7.0	7.6	3.6	0.0	1.5	139.0	3.6	-0.5	1.					
3	2011-01-03	9.0	6.0	7.1	4.1	1.5	2.7	264.0	4.1	1.5	2.7	1.1	0.0	0.3	29.6	25.6
4	2011-01-04	10.0	6.0	7.6	3.1	0.0	1.9	251.0	2.9	0.0	1.7	0.4	-1.8	-0.5	31.4	25.4
5	2011-01-05	10.0	5.0	7.0	3.6	0.0	1.7	169.0	3.6	0.0	1.7	0.0	0.0	0.0	29.2	24.2
6	2011-01-06	10.0	5.0	7.6	2.6	0.0	1.4	170.0	2.6	0.0	1.4	0.4	-0.4	-0.0	32.4	24.6
7	2011-01-07	8.0	5.0	6.8	4.1	0.0	1.7	165.0	4.1	0.0	1.7	1.0	-1.2	0.1	29.2	25.0
8	2011-01-08	8.0	4.0	6.3	3.1	0.0	1.0	101.0	3.1	0.0	1.0	0.0	0.0	0.0	28.6	25.4
9	2011-01-09	9.0	6.0	6.8	4.1	0.0	3.0	243.0	4.1	0.0	3.0	0.6	-1.2	-0.4	30.4	23.4
10	2011-01-10	10.0	5.0	7.5	5.1	0.0	3.3	241.0	5.1	0.0	3.2	0.7	-0.9	-0.2	30.6	24.0
11	2011-01-11	10.0	6.0	7.5	4.1	0.0	2.6	240.0	4.1	0.0	2.5	0.5	-0.7	-0.2	30.8	25.8
12	2011-01-12	9.0	6.0	7.1	4.1	0.0	2.4	201.0	4.1	0.0	2.4	0.7	-0.7	-0.0	29.4	25.6
13	2011-01-13	9.0	4.5	6.7	5.1	1.5	3.7	271.0	4.6	1.5	3.5	2.6	-1.1	0.2	31.0	26.1
14	2011-01-14	10.0	6.0	7.6	3.1	0.0	2.1	238.0	3.1	0.0	2.1	0.0	-0.4	-0.1	29.8	26.2
15	2011-01-15	9.0	5.0	7.0	5.1	1.5	2.6	275.0	4.8	1.5	2.6	0.4	-1.8	-0.4	29.6	25.0
16	2011-01-16	9.0	6.0	6.9	4.1	0.0	1.5	173.0	4.1	0.0	1.5	0.0	-1.2	-0.2	27.4	25.4
17	2011-01-17	10.0	5.0	7.5	6.7	0.0	2.0	148.0	6.7	0.0	1.5	0.0	-3.6	-0.5	29.4	25.0
18	2011-01-18	9.0	5.0	6.9	3.1	0.0	0.9	84.0	2.9	0.0	0.8	0.0	-1.5	-0.4	28.6	24.9

Data access & dissemination – web based

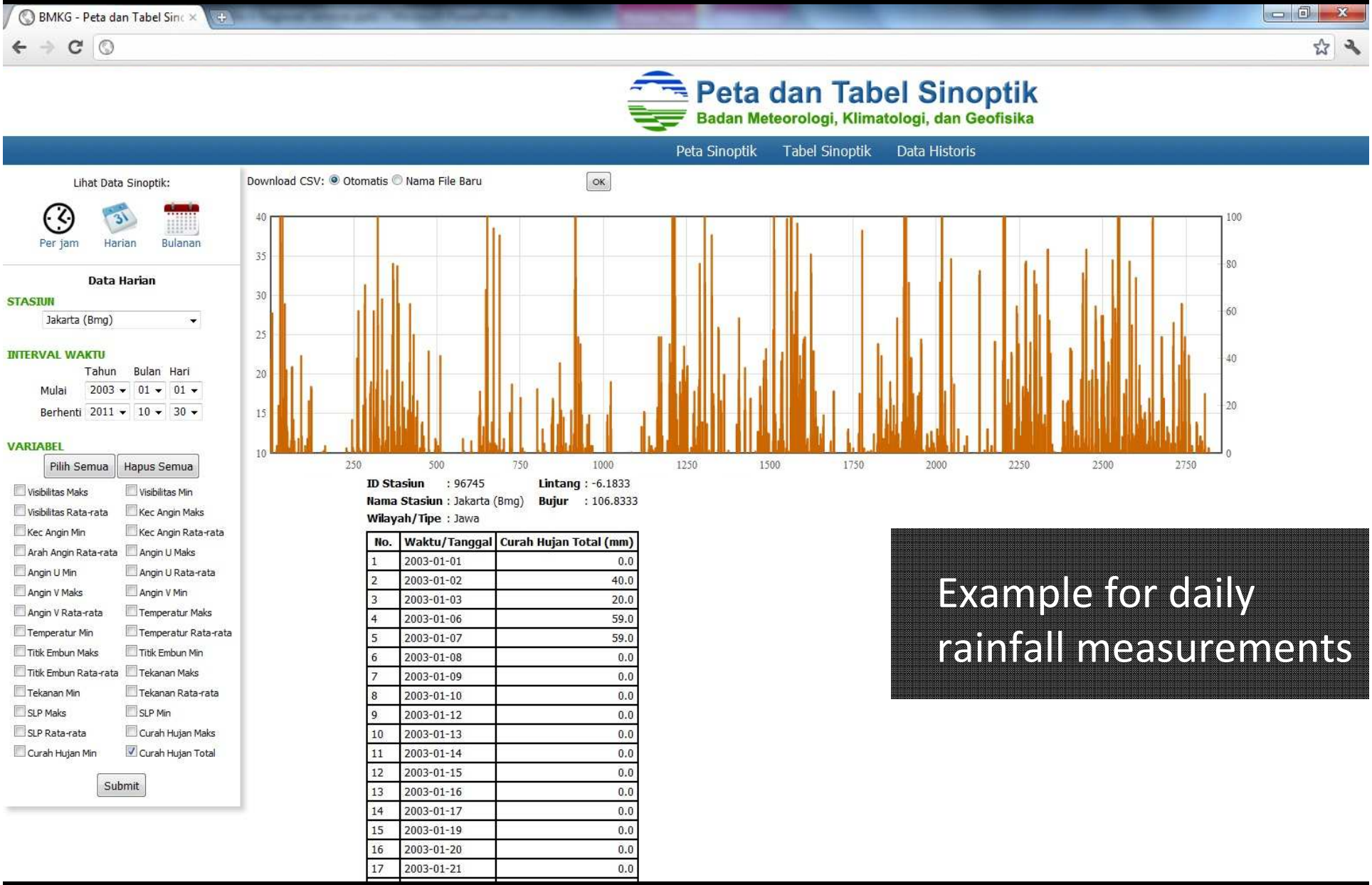


No.	Waktu/Tanggal	Temperatur Maks (°C)	Temperatur Min (°C)	Temperatur Rata-rata (°C)
1	2003-01-01	27.6	27.6	27.6
2	2003-01-02	30.0	25.6	27.3
3	2003-01-03	32.0	27.2	29.3
4	2003-01-06	30.5	25.6	27.6
5	2003-01-07	32.6	25.8	30.2
6	2003-01-08	32.7	23.7	29.4
7	2003-01-09	32.8	27.0	29.3
8	2003-01-10	27.0	27.0	27.0
9	2003-01-12	34.2	34.2	34.2
10	2003-01-13	32.5	26.2	30.3
11	2003-01-14	33.6	28.8	31.2
12	2003-01-15	32.4	26.6	30.3
13	2003-01-16	32.6	31.7	32.2
14	2003-01-17	32.2	26.8	30.4
15	2003-01-19	35.4	31.8	33.6
16	2003-01-20	34.2	31.4	32.3
17	2003-01-21	32.7	30.6	31.6
18	2003-01-22	29.1	27.2	28.2

Example for daily average, minimum and maximum temperature

Option to show graphs of the selected variable

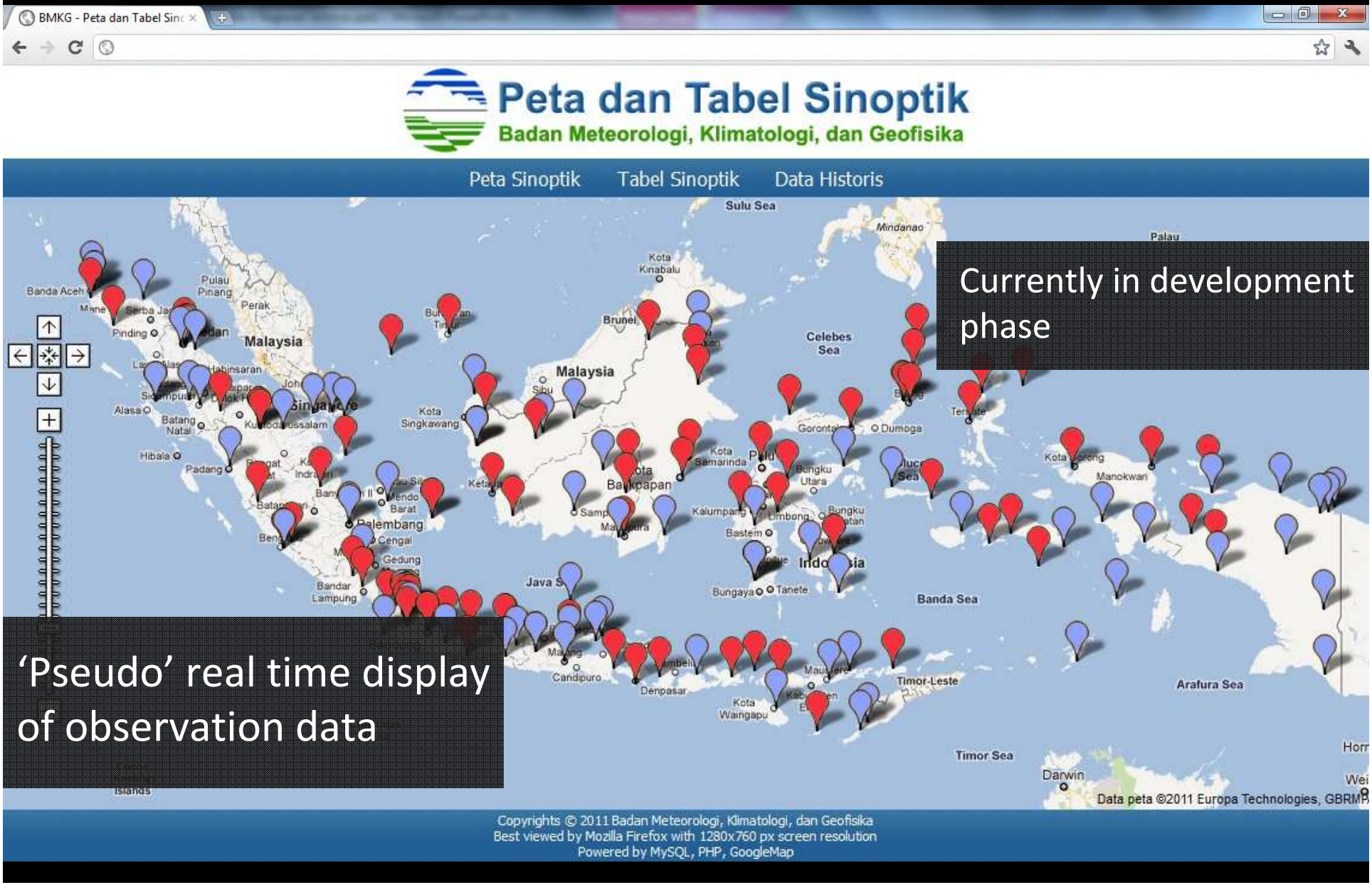
Data access & dissemination – web based



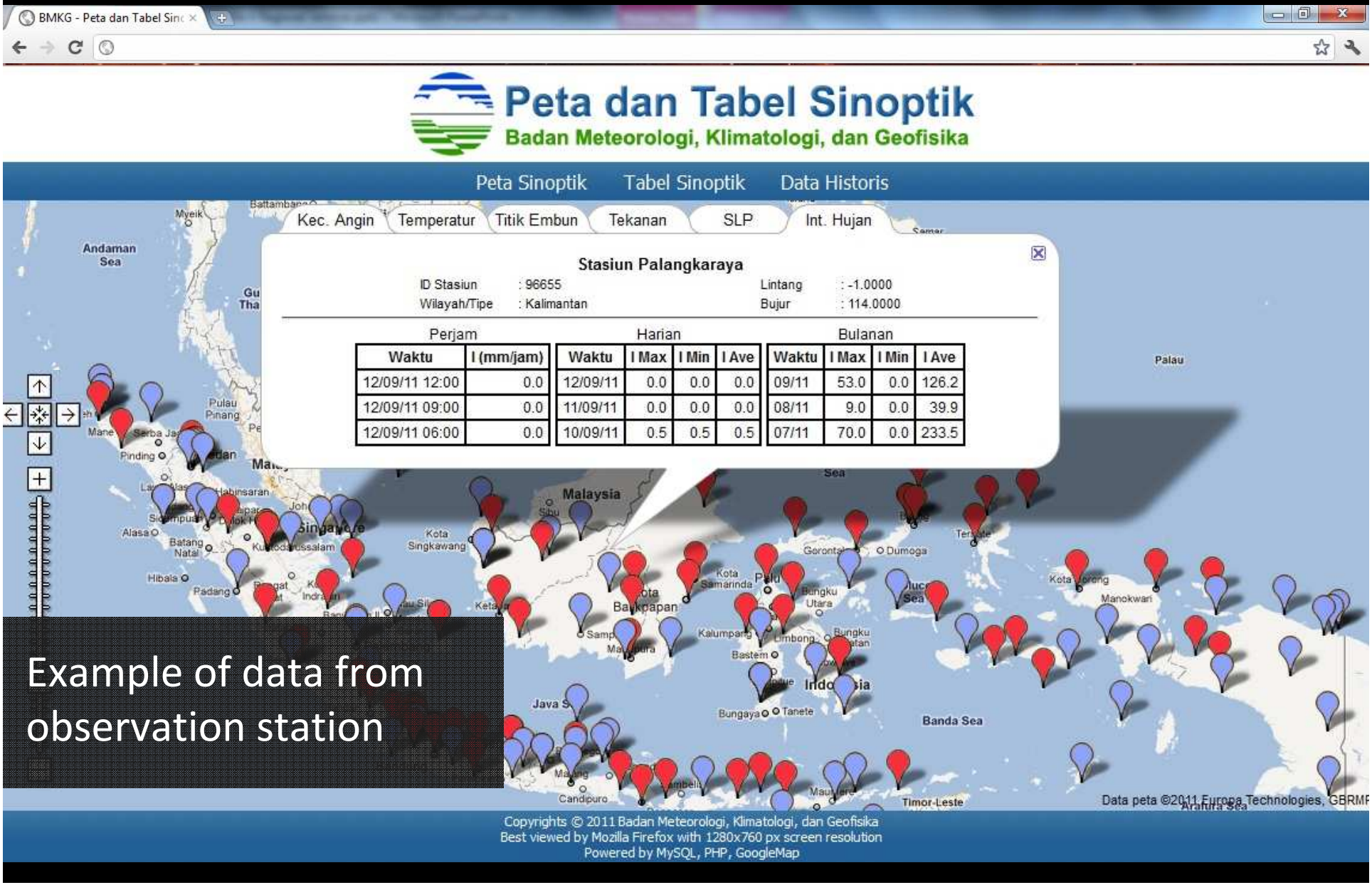
No.	Waktu/Tanggal	Curah Hujan Total (mm)
1	2003-01-01	0.0
2	2003-01-02	40.0
3	2003-01-03	20.0
4	2003-01-06	59.0
5	2003-01-07	59.0
6	2003-01-08	0.0
7	2003-01-09	0.0
8	2003-01-10	0.0
9	2003-01-12	0.0
10	2003-01-13	0.0
11	2003-01-14	0.0
12	2003-01-15	0.0
13	2003-01-16	0.0
14	2003-01-17	0.0
15	2003-01-19	0.0
16	2003-01-20	0.0
17	2003-01-21	0.0

Example for daily rainfall measurements

Data access & dissemination – web based



Data access & dissemination – web based



Example of data from observation station

Historical data digitation – with KNMI

BMKG

KNMI

DIDAH project

Home |

- Home
- Didah project description
- Documents
- News items (archive)
- Data and indices
- Staff
- Links (to related projects)

Digitisas

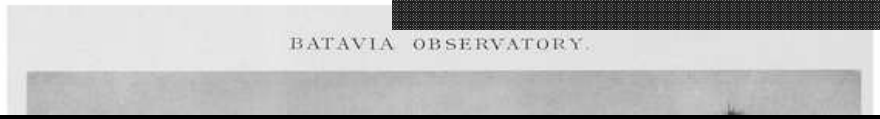
Digitisasi Data Historis (DiDaH) is a two-year project (2010-20
climate data from Indonesia over the period 1850-present. Did
Indonesia (BMKG) and the Netherlands (KNMI).

The main deliverables of Didah are:

1. Digitized data (plus metadata)
2. Website on indices of extremes for the region
3. Capacity building (workshops, exchange of scientists).

DARE

DAta REscue from the colonial era, some data dating back to late 18th century



Routine products (1)

- Forecast of rainy and dry season onset
- Forecast of monthly rainfall (up to 3 month lead time)
- Soil moisture information
- Agroclimate suitability map
- ENSO & IOD indices forecast
- Short range Sea Surface Temperature forecast

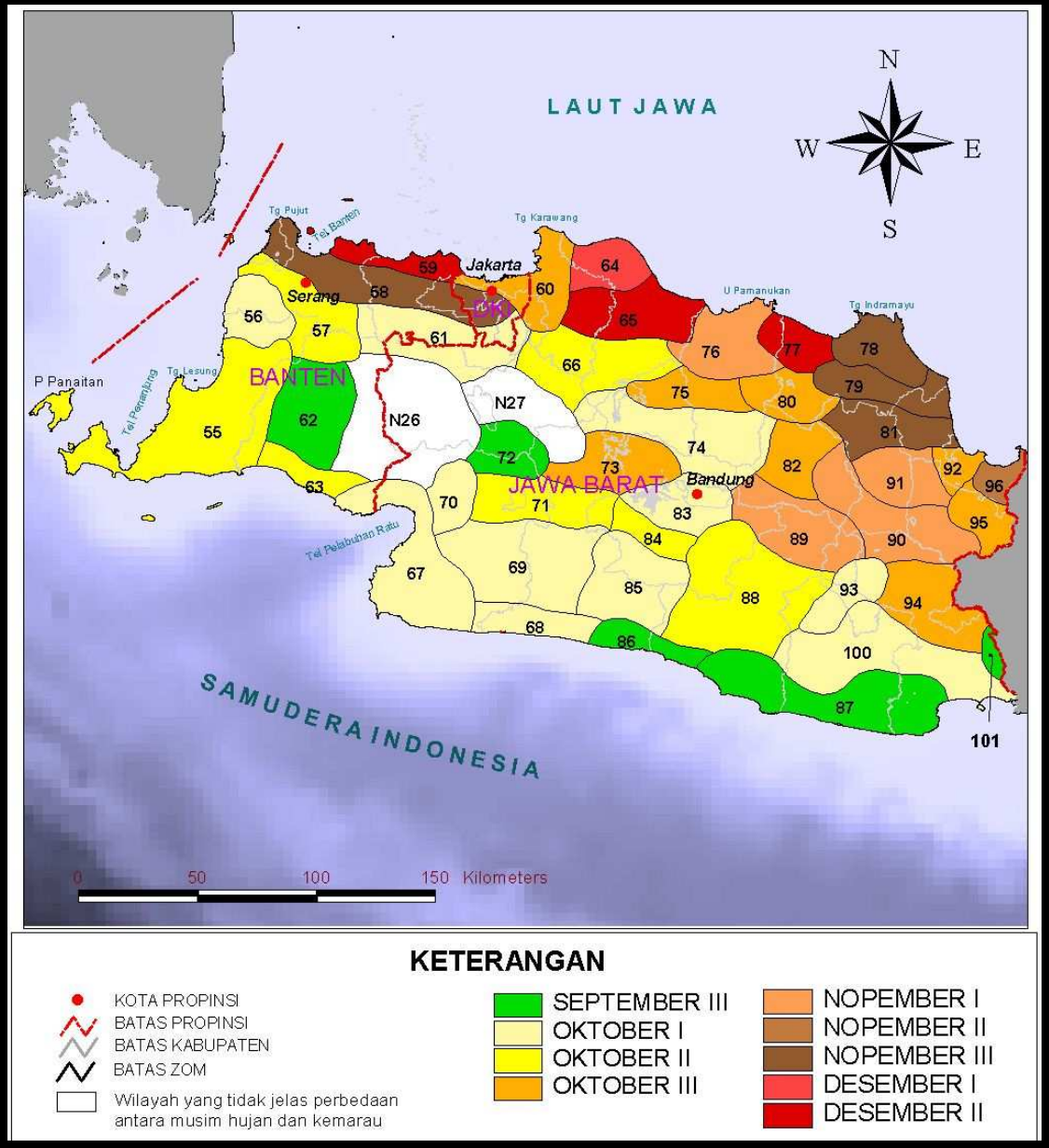
Routine products (2)

- *Return period map of maximum rainfall*
- *Climatology of rainfall, temperature, wind*
- *Climatology of rainy and dry season onset*
- *Maps of shifts of rainy and dry season onset*
- *Vulnerability map to drought for rice producing provinces*
- *Climate Field School for farmers in crop producing provinces*
- *…*

Forecast of rainy season onset

Released yearly on September

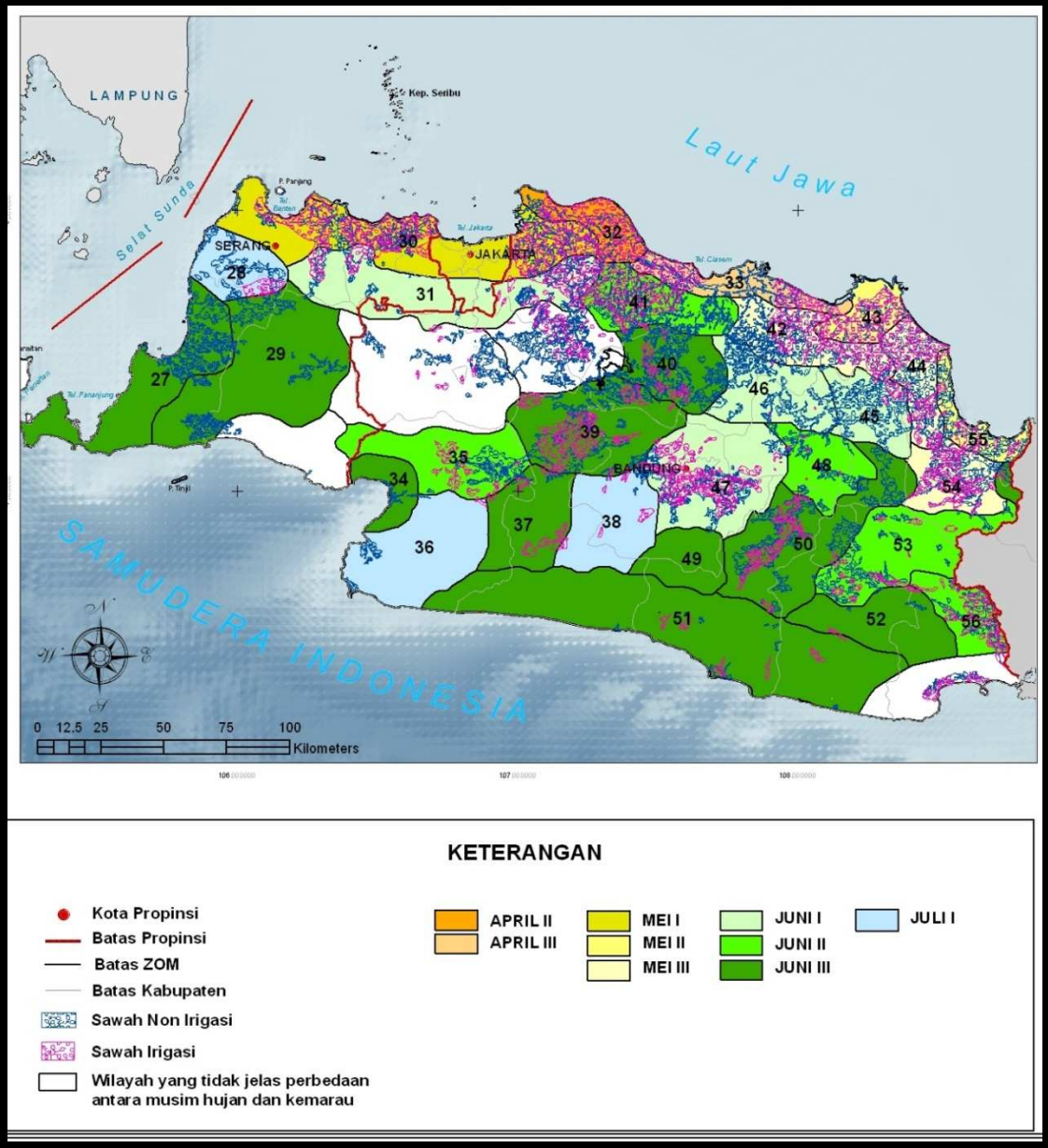
Example: onset of rainy season 2011



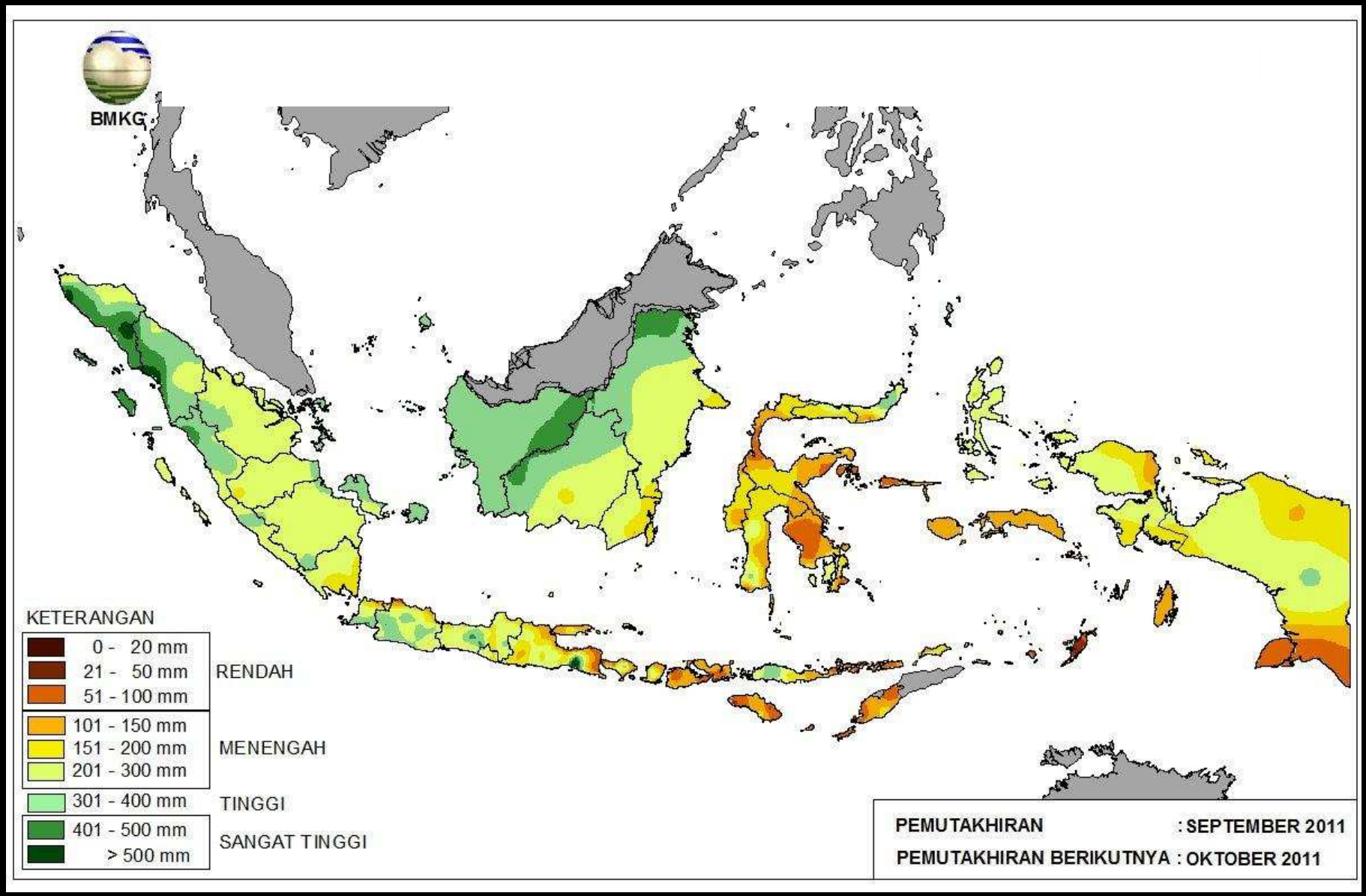
Forecast of dry season onset

Released yearly on March

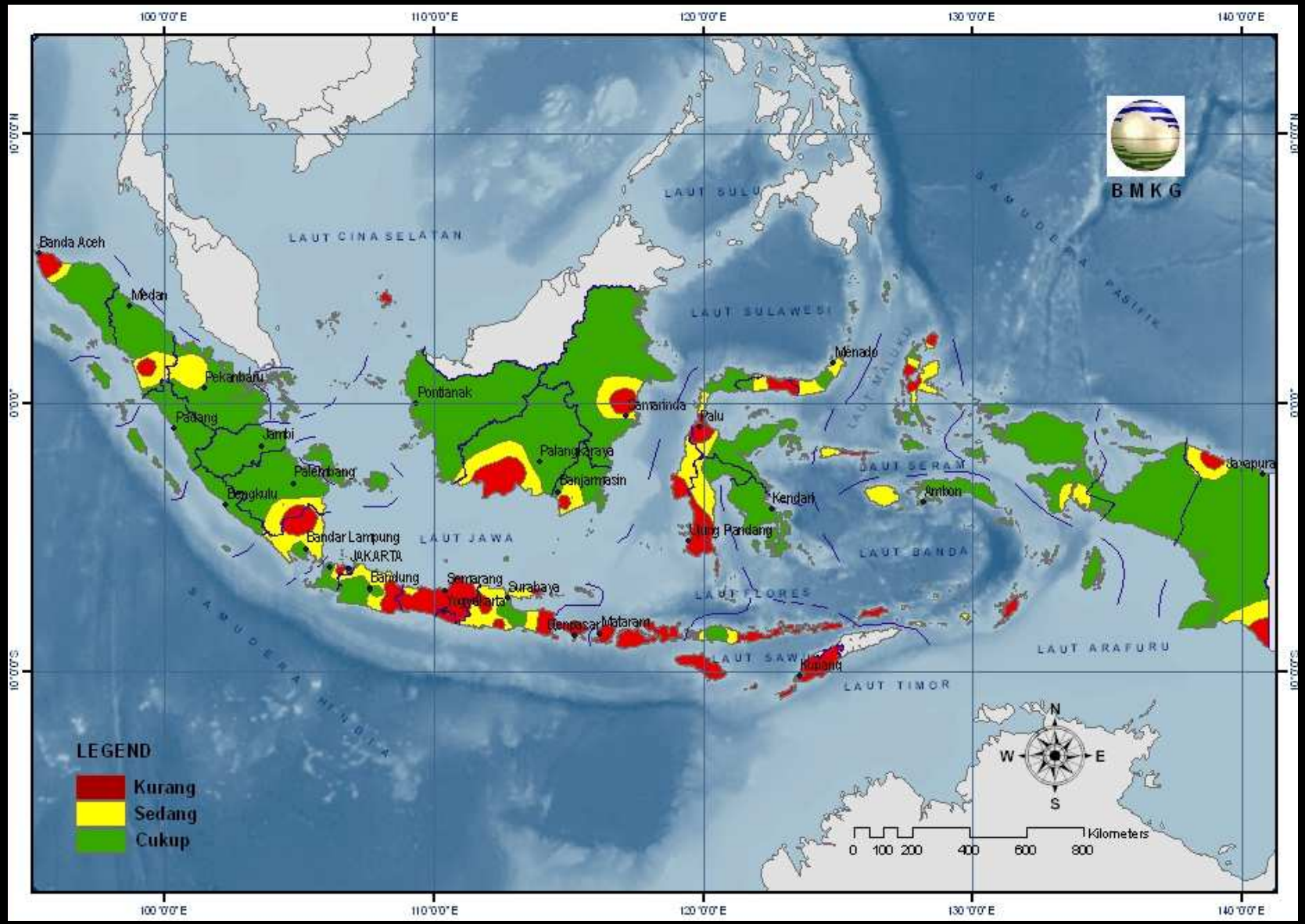
Example: onset of dry season 2011



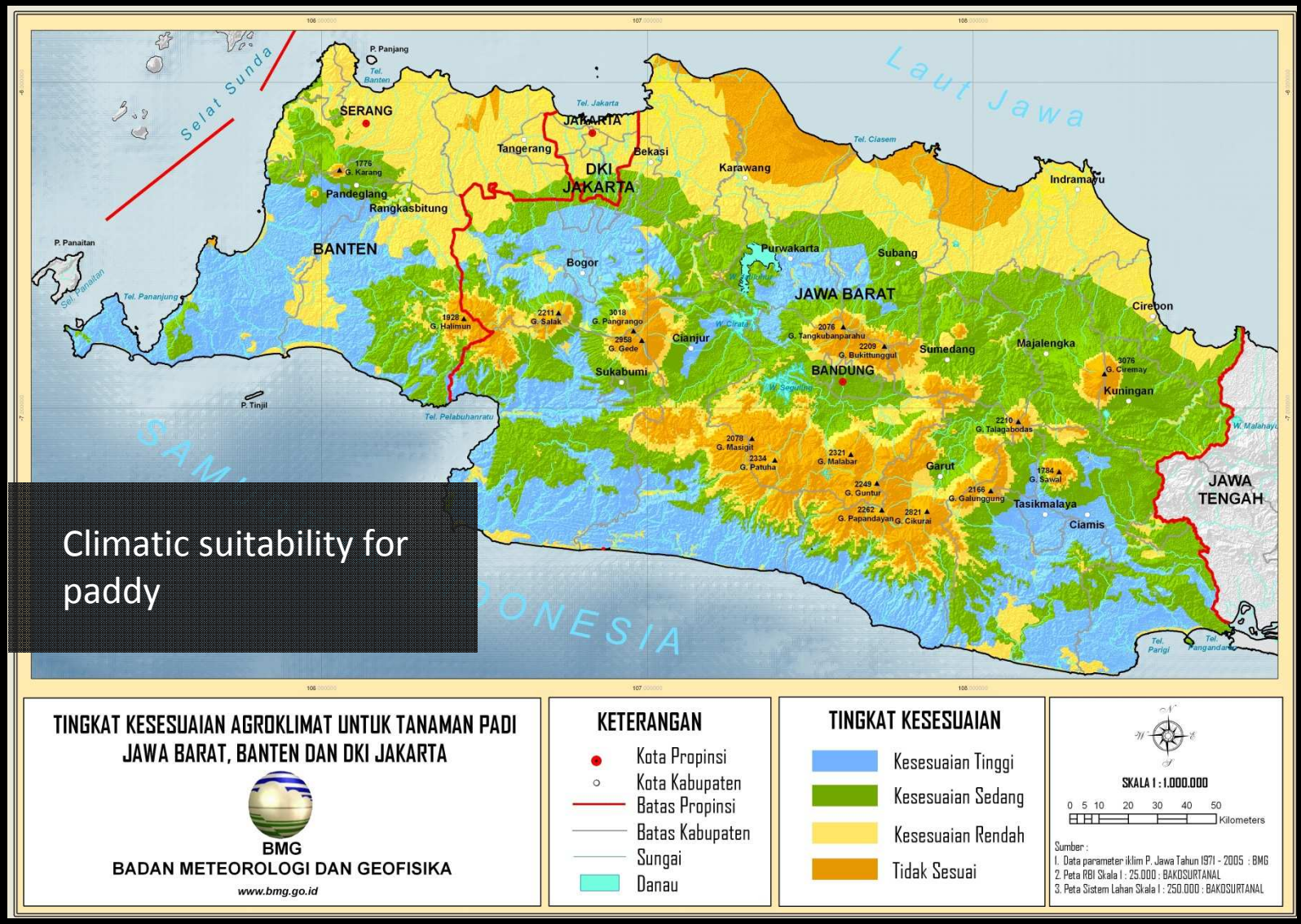
Forecast of monthly rainfall for November 2011



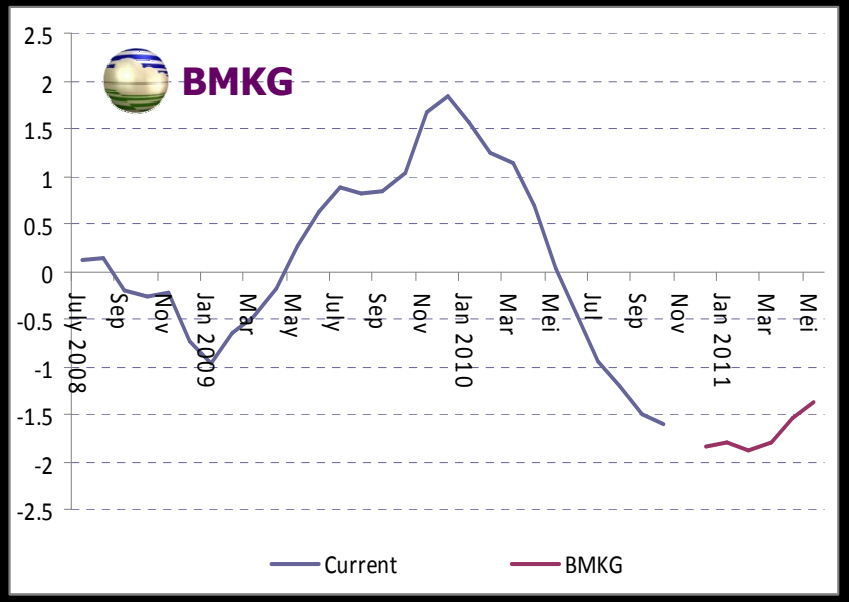
Soil moisture information



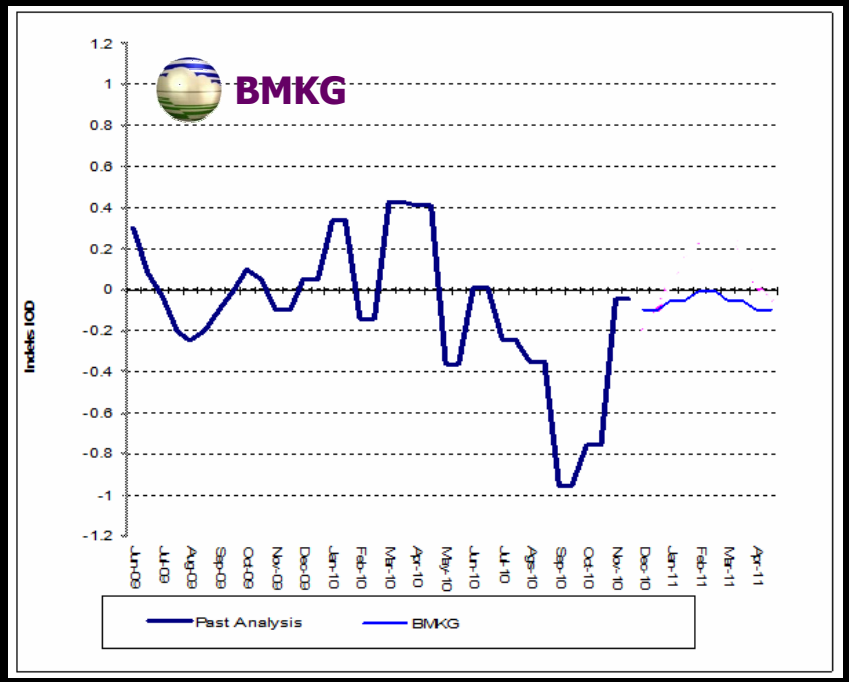
Agriculture suitability map



Nino 3.4 index forecast



IOD index forecast



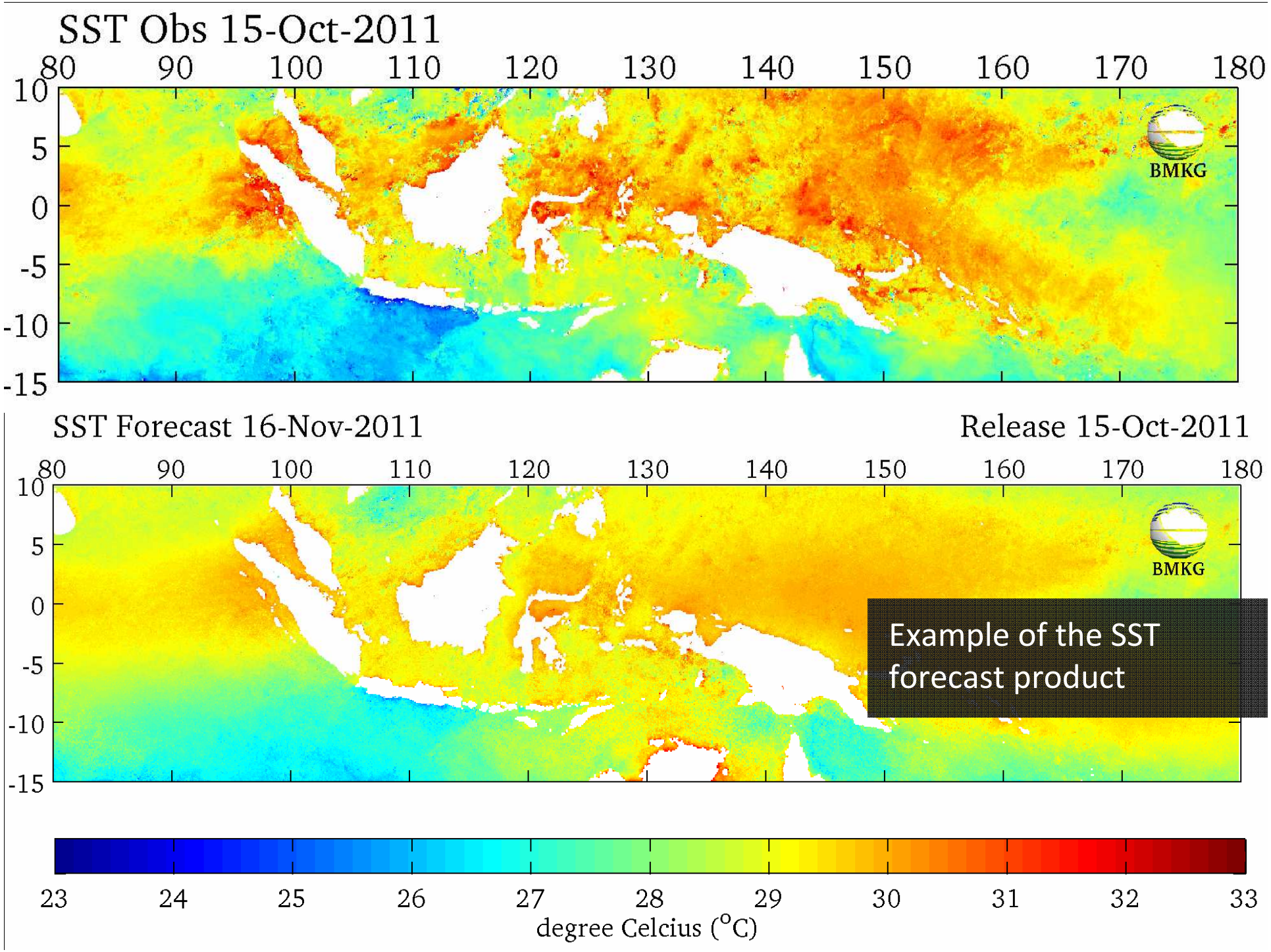
Monthly SST forecast

- Data from **Terra**/Moderate Resolution Imaging Spectroradiometer (**MODIS**), IR band
- Coverage: **Feb, 2000 - present**
- Spatial resolution: **9km**
- Time series / statistical based forecasting

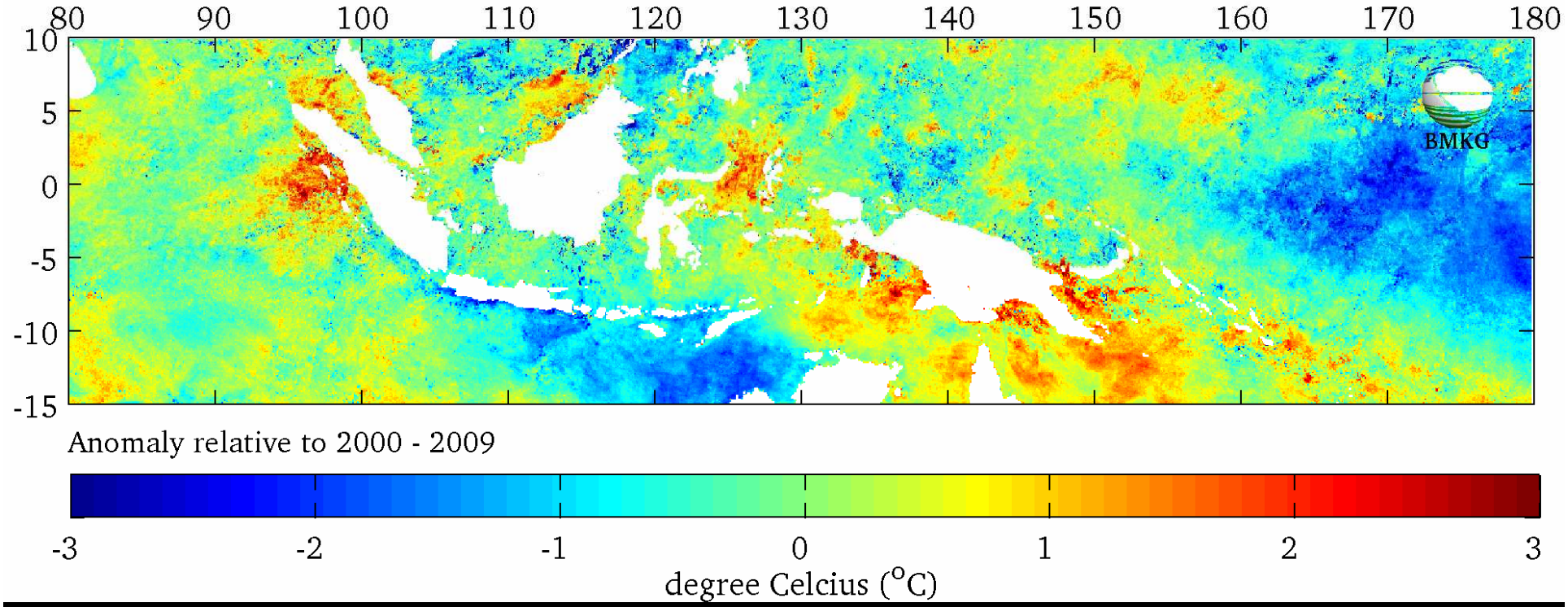
Implementation

- Updated weekly
- The forecast code is implemented in a computing **cluster** environment:
- **Forecast** up to 1 month lead time
- **SST anomaly**
- Automatic **image & Google earth KMZ generation**
- Automatic dissemination through **email** and **web**

Badan Meteorologi Klimatologi dan Geofisika

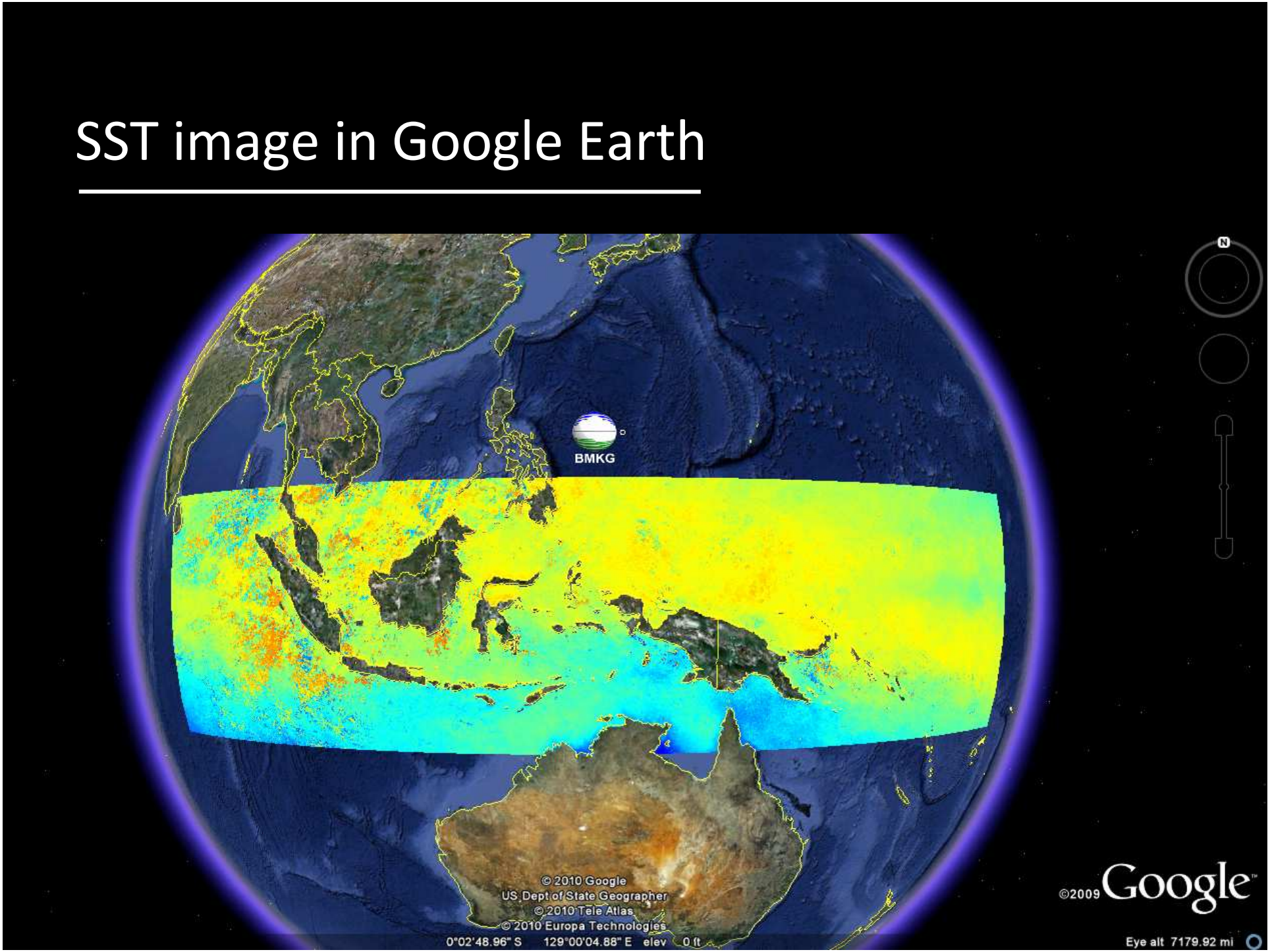

SST Obs 15-Oct-2011
80 90 100 110 120 130 140 150 160 170 180
10 5 0 -5 -10 -15
BMKG
SST Forecast 16-Nov-2011
Release 15-Oct-2011
80 90 100 110 120 130 140 150 160 170 180
10 5 0 -5 -10 -15
BMKG
Example of the SST forecast product
23 24 25 26 27 28 29 30 31 32 33
degree Celcius (°C)

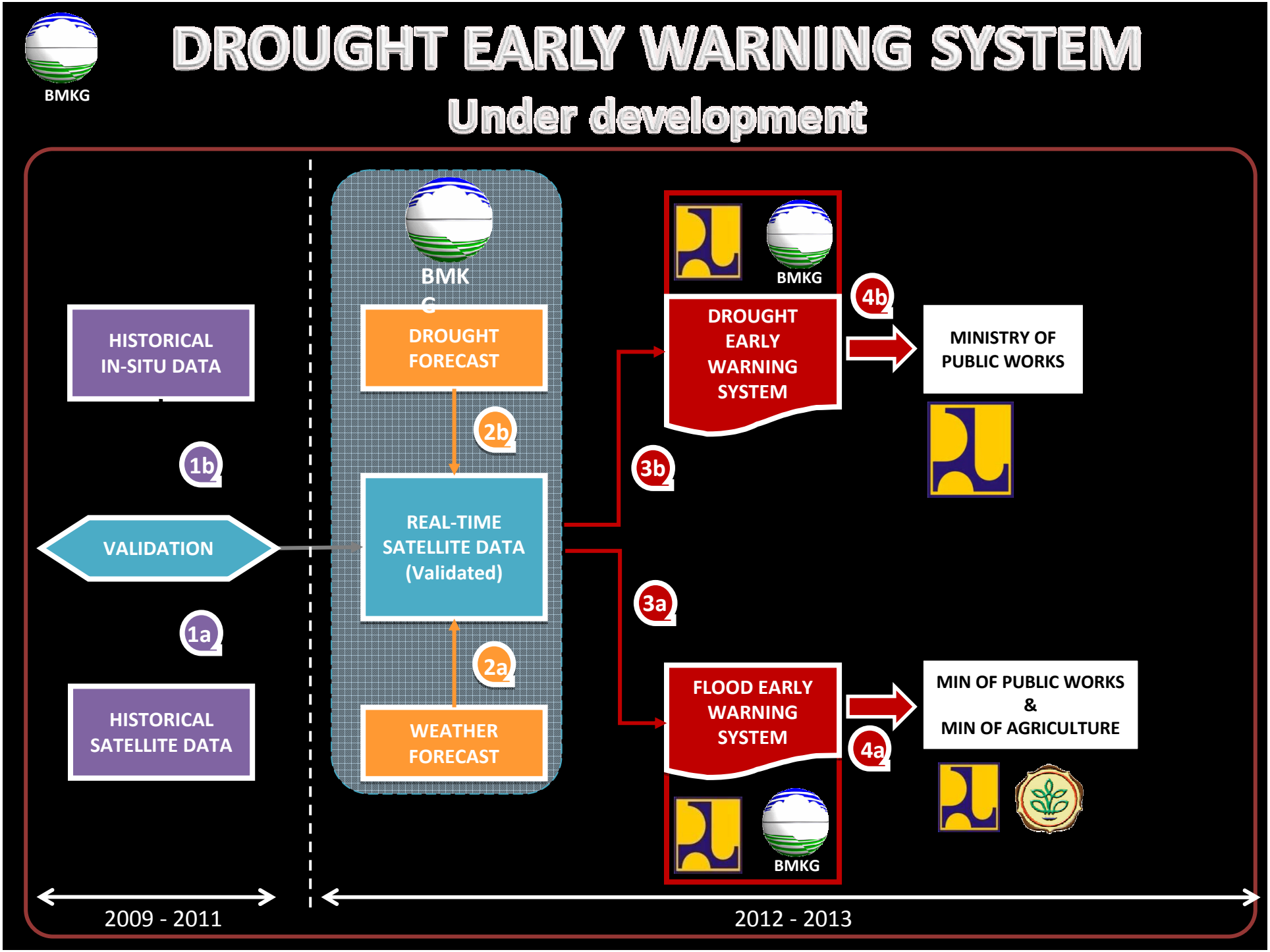
SST Anom 15-Oct-2011



Badan Meteorologi Klimatologi dan Geofisika

SST image in Google Earth




BMKG
DROUGHT EARLY WARNING SYSTEM
Under development
HISTORICAL IN-SITU DATA
1b
VALIDATION
1a
HISTORICAL SATELLITE DATA
BMK
G
DROUGHT FORECAST
2b
REAL-TIME SATELLITE DATA (Validated)
2a
WEATHER FORECAST
3b
3a
BMKG
DROUGHT EARLY WARNING SYSTEM
4b
MINISTRY OF PUBLIC WORKS
FLOOD EARLY WARNING SYSTEM
4a
BMKG
MIN OF PUBLIC WORKS & MIN OF AGRICULTURE
2009 - 2011
2012 - 2013

Needs

- Ocean observations
- Operational coupled ocean & regional atmosphere model (weather and climate)
- Capacity building for downscaling techniques
- Capacity building for tailoring climate information to users
- …

Thank you for your attention

…

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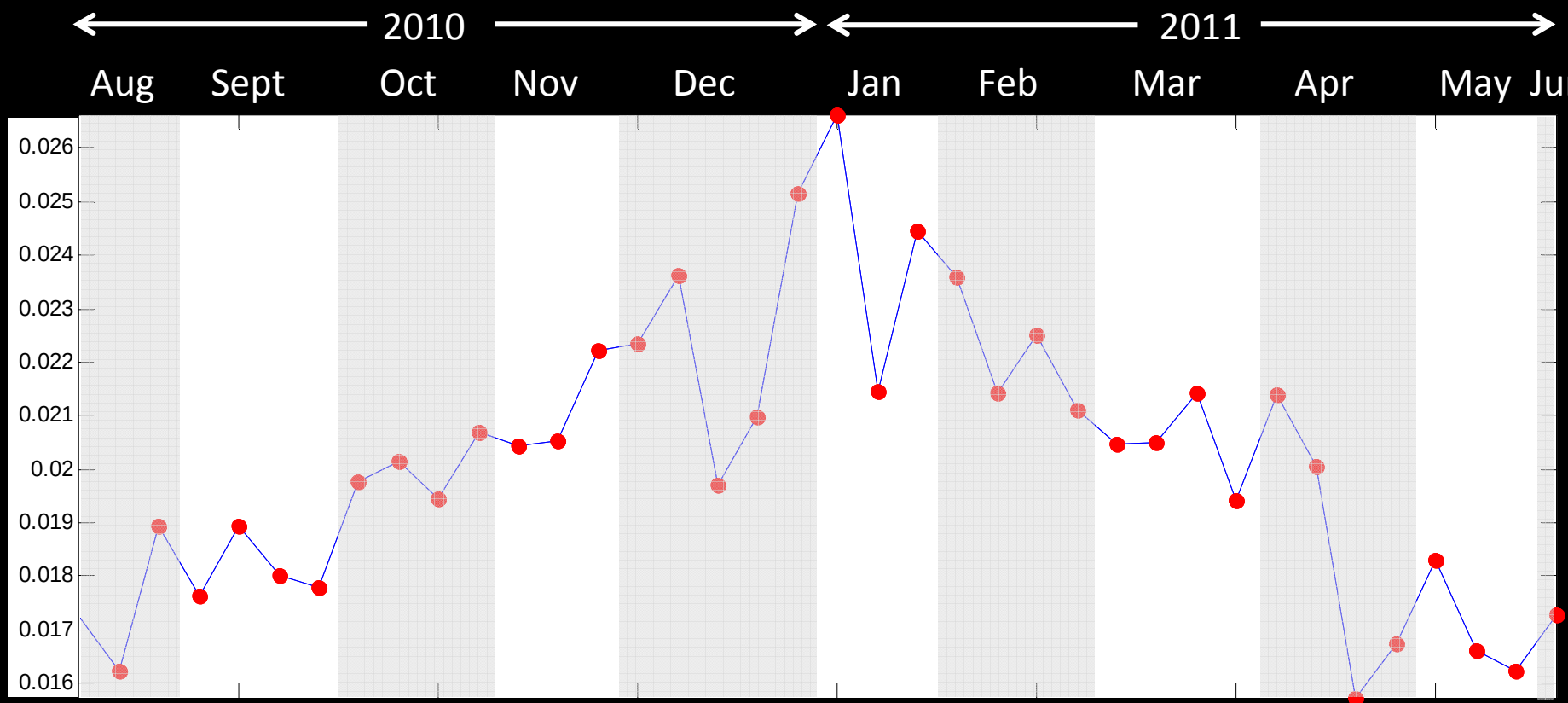
Center for Climate Change and Air Quality
Agency for Meteorology Climatology and Geophysics
ardhasena@bmkg.go.id

Badan Meteorologi Klimatologi dan Geofisika

Error analysis

- Normalized (non-dimensional) absolute error (norm. L^1 error).

$$E = \frac{\iint_\Omega \left| SST_{obs}(x,y) - SST_{for}(x,y) \right| d\Omega}{\iint_\Omega SST_{obs}(x,y)\, d\Omega}$$



Average normalized error between 1.5% - 2.5%

Badan Meteorologi Klimatologi dan Geofisika

2010 ...

- High rainfall rate over Indonesia throughout the year
- Floods even in the normal dry period
- High SST anomaly > 1^{o}C

- WMO: Record high average land and sea surface temperature

Data access & dissemination – web based

Observational Networks –

Automatic Weather Stations 159 units

Others:

- -Co–hosted stations with agriculture dept. 130 stations
- -Manual rain gauges 5498 units
- -Automatic rain gauges

Badan Meteorologi Klimatologi dan Geofisika