53rd Session of UN-COPUOS, Vienna / June 9-18, 2010

LAPAN

INDONESIAN NATIONAL INSTITUTE OF AERONAUTICS AND SPACE

The Applications of Satellite Remote Sensing on Climate Change and Food Security in Indonesia

Dr. Erna Sri Adiningsih
Aerospace Analysis and Information Center

LAPAN

INDONESIAN NATIONAL INSTITUTE OF AERONAUTICS AND SPACE

Outline

- The Importance of Climate Change and Food Security
- Climate Change Studies using Satellite Data
- Remote Sensing Satellites for Food Security
- Satellite Development for Remote Sensing and other Applications
- International Cooperation
- Concluding Remarks

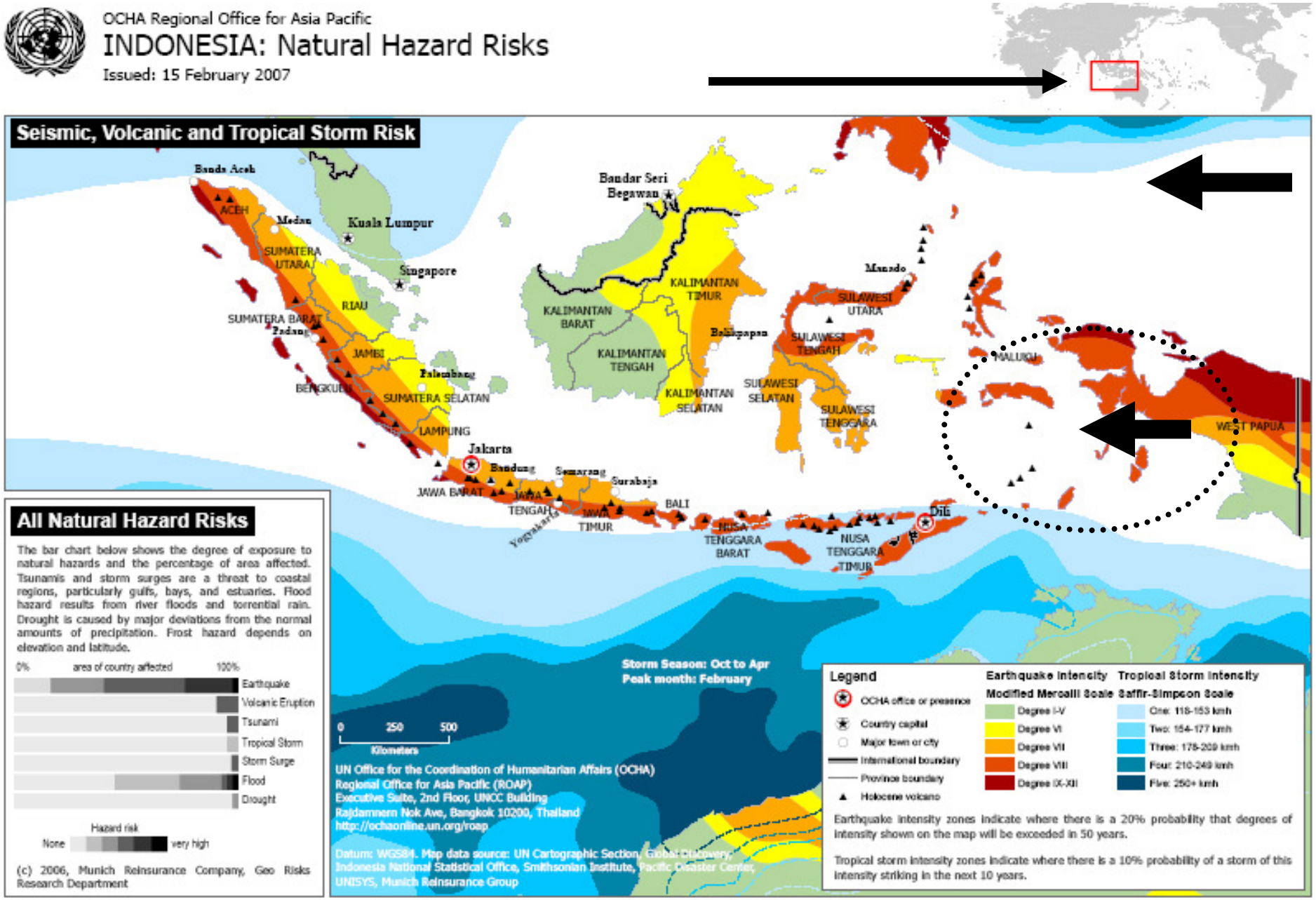
LAPAN

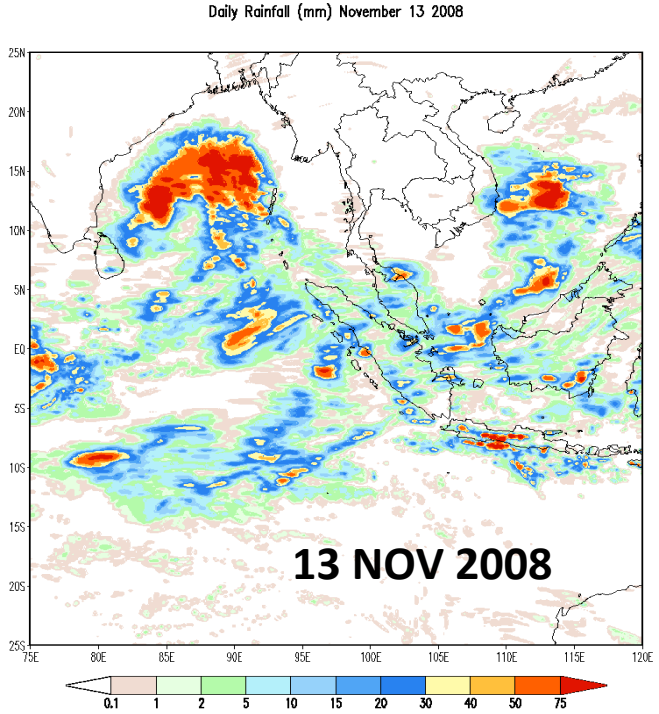
INDONESIAN NATIONAL INSTITUTE OF AERONAUTICS AND SPACE

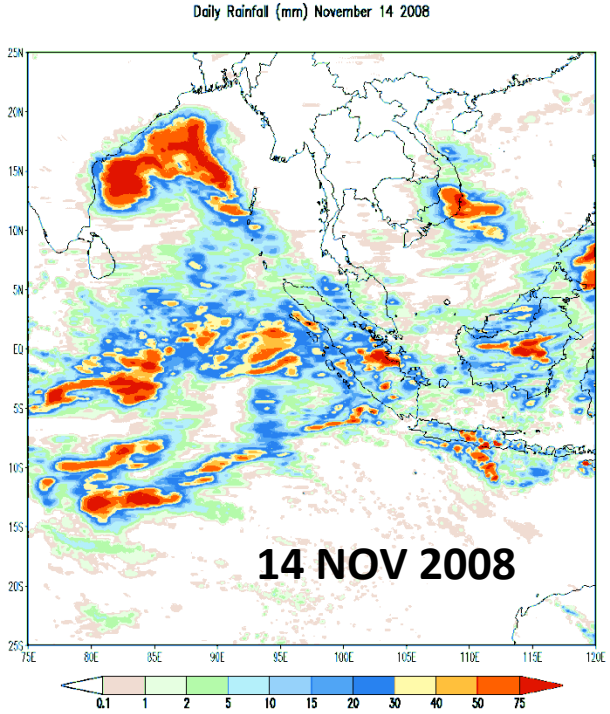
Why climate change & food security issues are very important for Indonesia?

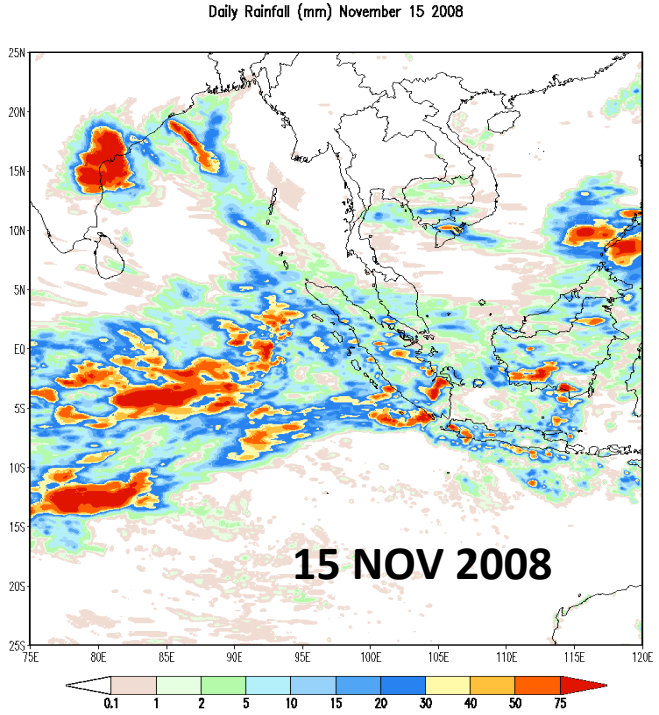
1. Climate change has been a fact (based on long term observation), not a presumable condition.
2. Climate change (& variability) has profound impacts on various sectors → agriculture, fishery, forestry, water management, health, water-related disasters (floods, droughts, landslides), coastal environment, etc.
3. Among those, agriculture is the most vulnerable sector → food supply will be affected under increasing demand due to population growth → threats food security.

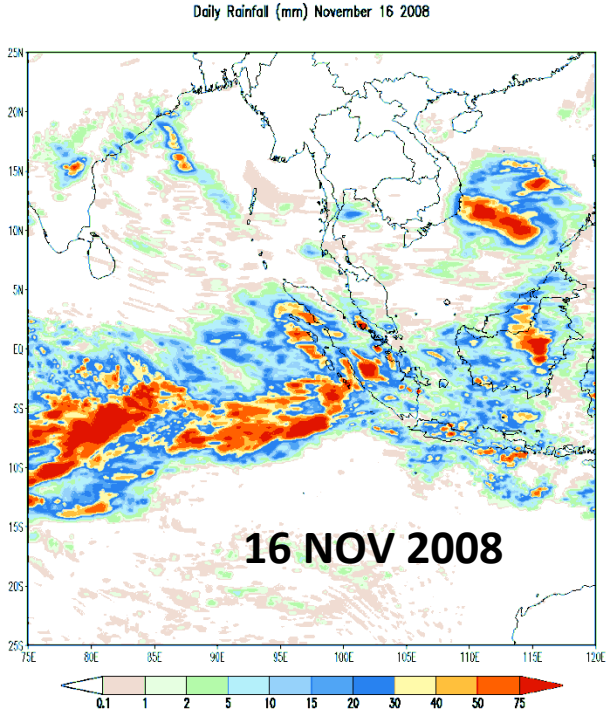
Climate Hazards in Indonesia

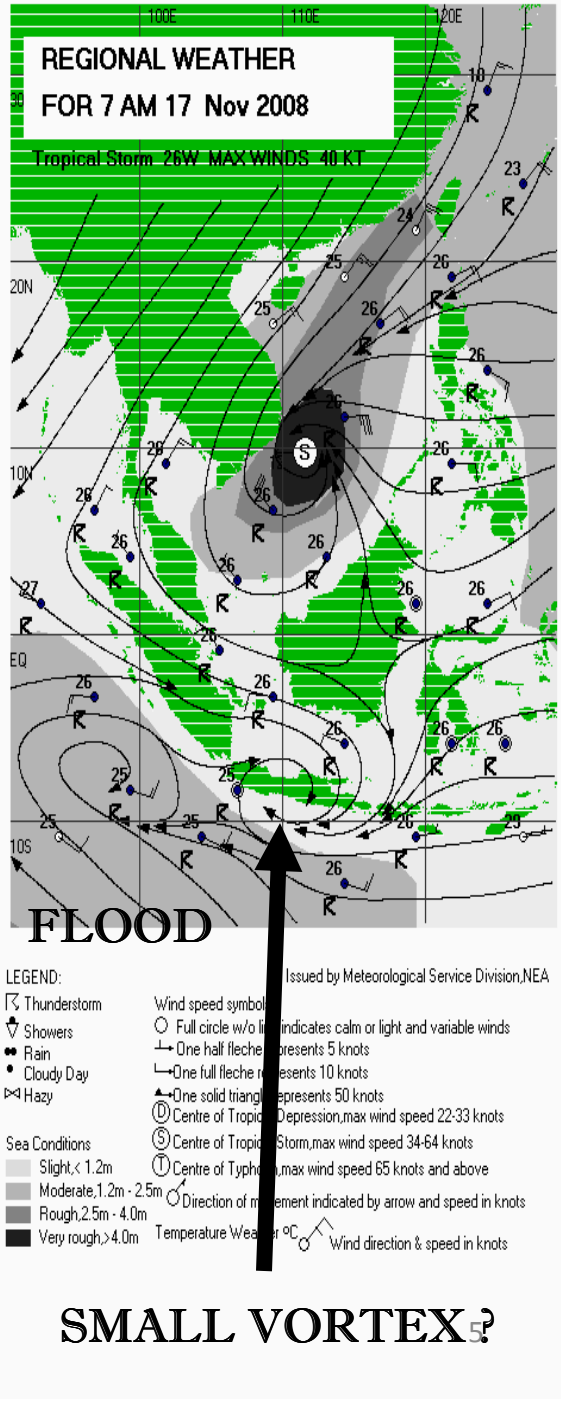



Daily Rainfall (mm) November 13 2008
13 NOV 2008
0.1 1 2 5 10 15 20 30 40 50 75


Daily Rainfall (mm) November 14 2008
14 NOV 2008
0.1 1 2 5 10 15 20 30 40 50 75


Daily Rainfall (mm) November 15 2008
15 NOV 2008
0.1 1 2 5 10 15 20 30 40 50 75


Daily Rainfall (mm) November 16 2008
16 NOV 2008
0.1 1 2 5 10 15 20 30 40 50 75


REGIONAL WEATHER
FOR 7 AM 17 Nov 2008
Tropical Storm 26W MAX WINDS 40 KT
FLOOD
SMALL VORTEX?
LEGEND:
Issued by Meteorological Service Division,NEA
Thunderstorm
Showers
Rain
Cloudy Day
Hazy
Sea Conditions
Slight,< 1.2m
Moderate,1.2m - 2.5m
Rough,2.5m - 4.0m
Very rough,>4.0m
Wind speed symbol
Full circle w/o li indicates calm or light and variable winds
One half fleche presents 5 knots
One full fleche r esents 10 knots
One solid triangl epresents 50 knots
Centre of Tropic Depression,max wind speed 22-33 knots
Centre of Tropic Storm,max wind speed 34-64 knots
Centre of Typho ,max wind speed 65 knots and above
Direction of m ement indicated by arrow and speed in knots
Temperature Wea r °C
Wind direction & speed in knots

- We hadbig floods over Jakarta in early February, 2007. Then, continue d in February, 2008 and 2009.
- In that time, 40-70% of Jakarta was under water, up to 4 meters deep in some areas.
- At least 100 people been killed.
- Almost 340,000 forced from their homes.
- How about recently ?

Climate Change Impacts

Prolonged Droughts

More Frequent Weather Extremes

Fires and GHG Emission

Food Security

INDONESIAN NATIONAL INSTITUTE OF AERONAUTICS AND SPACE

LAPAN

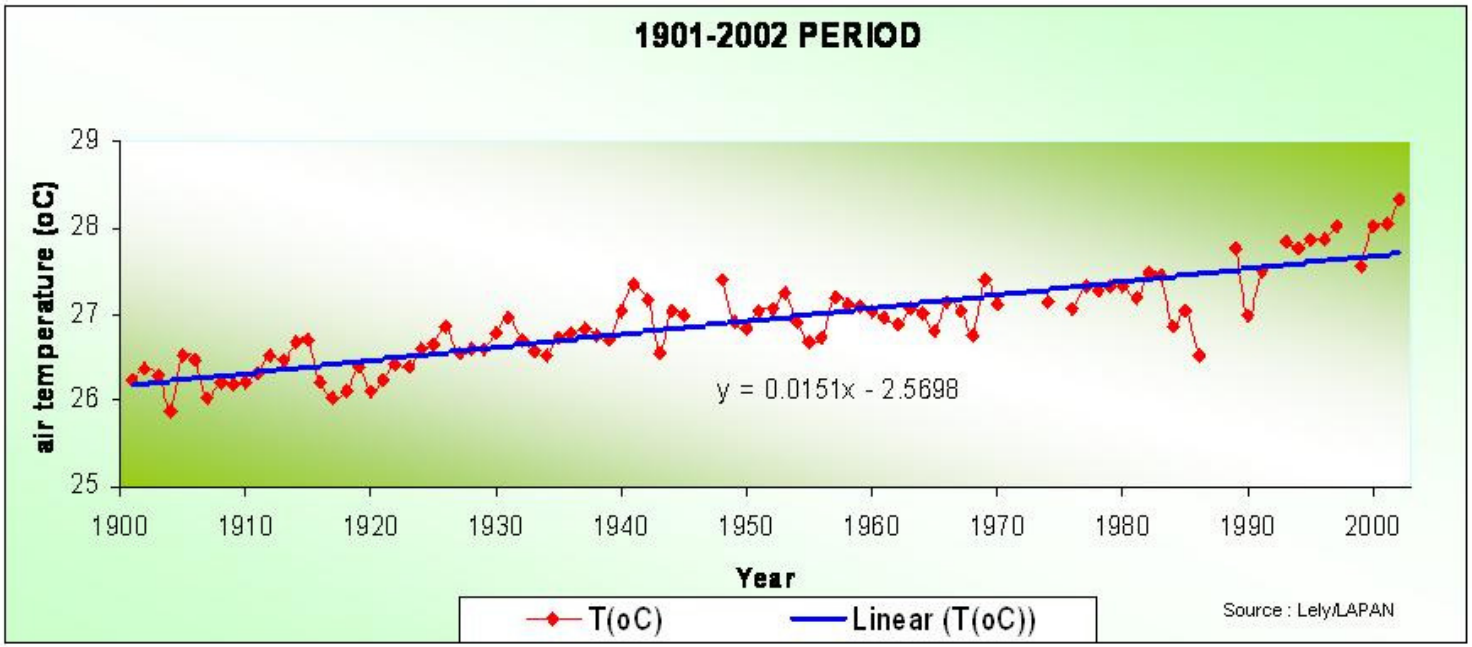
INDONESIAN NATIONAL INSTITUTE OF AERONAUTICS AND SPACE

CLIMATE CHANGE AND IMPACTS

LAPAN

INDONESIAN NATIONAL INSTITUTE OF AERONAUTICS AND SPACE

Time Series of Annual Air Temperature and Trend in Jakarta for 100 Years (1901-2002 PERIOD)



Climate Change Impact Studies

- Climate impacts on rainfall pattern, fire risks, food crop production, terrestrial ecosystems, coastal zone ecosystem, water level, water-related hazards.
- Remote sensing data from existing satellites are very essential for those studies.

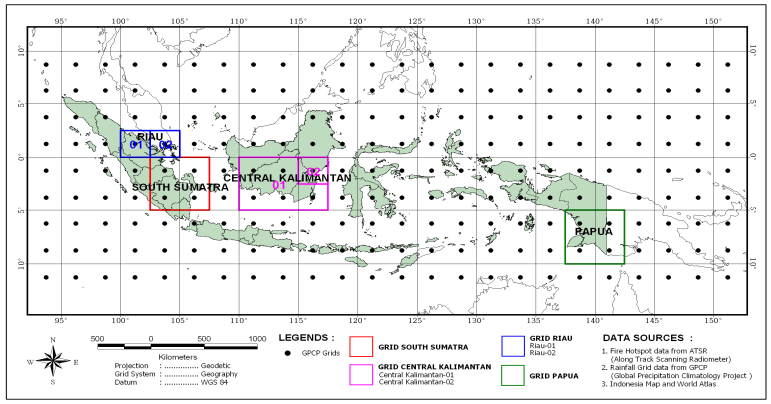
INDONESIAN NATIONAL INSTITUTE OF AERONAUTICS AND SPACE

Droughts, Fires and Haze Monitoring: Climate Extreme & GHG Emission

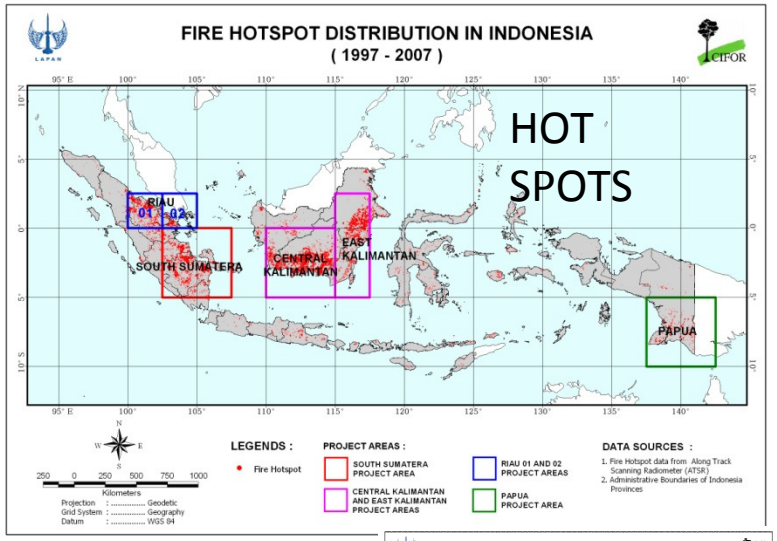
Fires in peat lands in Central Kalimantan

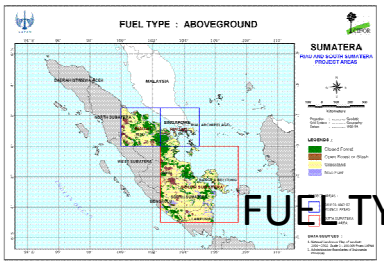
INDONESIAN NATIONAL INSTITUTE OF AERONAUTICS AND SPACE

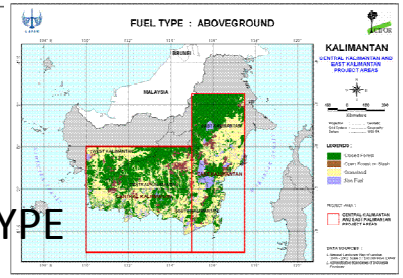
Climate Impact on Fire Risks



GPCP Grid Rainfall Data

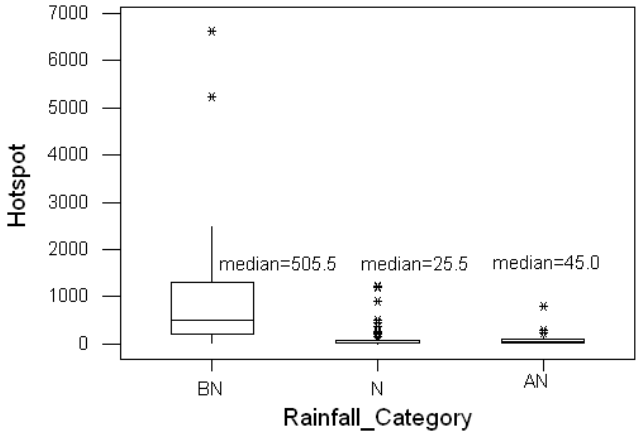






FUEL TYPE

STATISTICAL RESULTS



Rainfall vs No.of Hotspot in Indonesia (Lag-0)

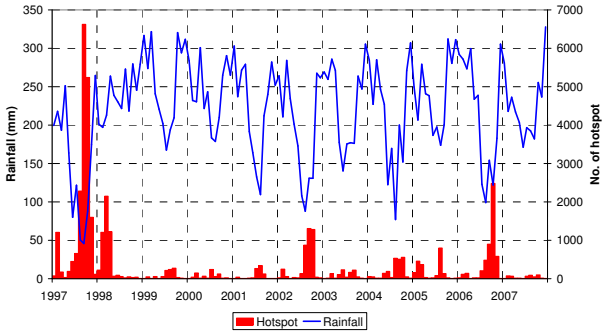


Table of Fire Risks

Rainfall Category	Low (hotspot<400)	Moderate (400<hotspot<800)	High (800<hotspot<2000)	Very high (hotspot >2000)
Below Normal	0.423	0.231	0.154	0.192
Normal	0.935	0.016	0.032	0.016
Above Normal	0.943	0.057	0.000	0.000

INDONESIAN NATIONAL INSTITUTE OF AERONAUTICS AND SPACE

LAPAN

INDONESIAN NATIONAL INSTITUTE OF AERONAUTICS AND SPACE

CLIMATE CHANGE MITIGATION ACTIONS

Indonesia's Pledge for Emission Reduction –

Quotes from the President Speech

- "We are devising an energy mix policy ... that will reduce our emissions by 26 percent by 2020 . With international support, we are confident we can reduce emissions by as much as 41 percent."
- "We are also looking into the distinct possibility of committing a billion tons of CO2 reduction by 2050.We will change the status of our forests from that of a net emitter sector to a net [carbon] sink sector by 2030."

President Yudhoyono first announced this pledge at the G20 summit in Pittsburgh, September 2009 then reiterated it at COP 15/CMP 5 in Copenhagen, December 2009

REMOTE SENSING SATELLITES COULD PROVIDE BETTER SPATIAL INFORMATION ON GHG & FORREST STATUS

CHALLENGES FOR SATELLITE DEVELOPMENT AND APPLICATIONS

LAPAN

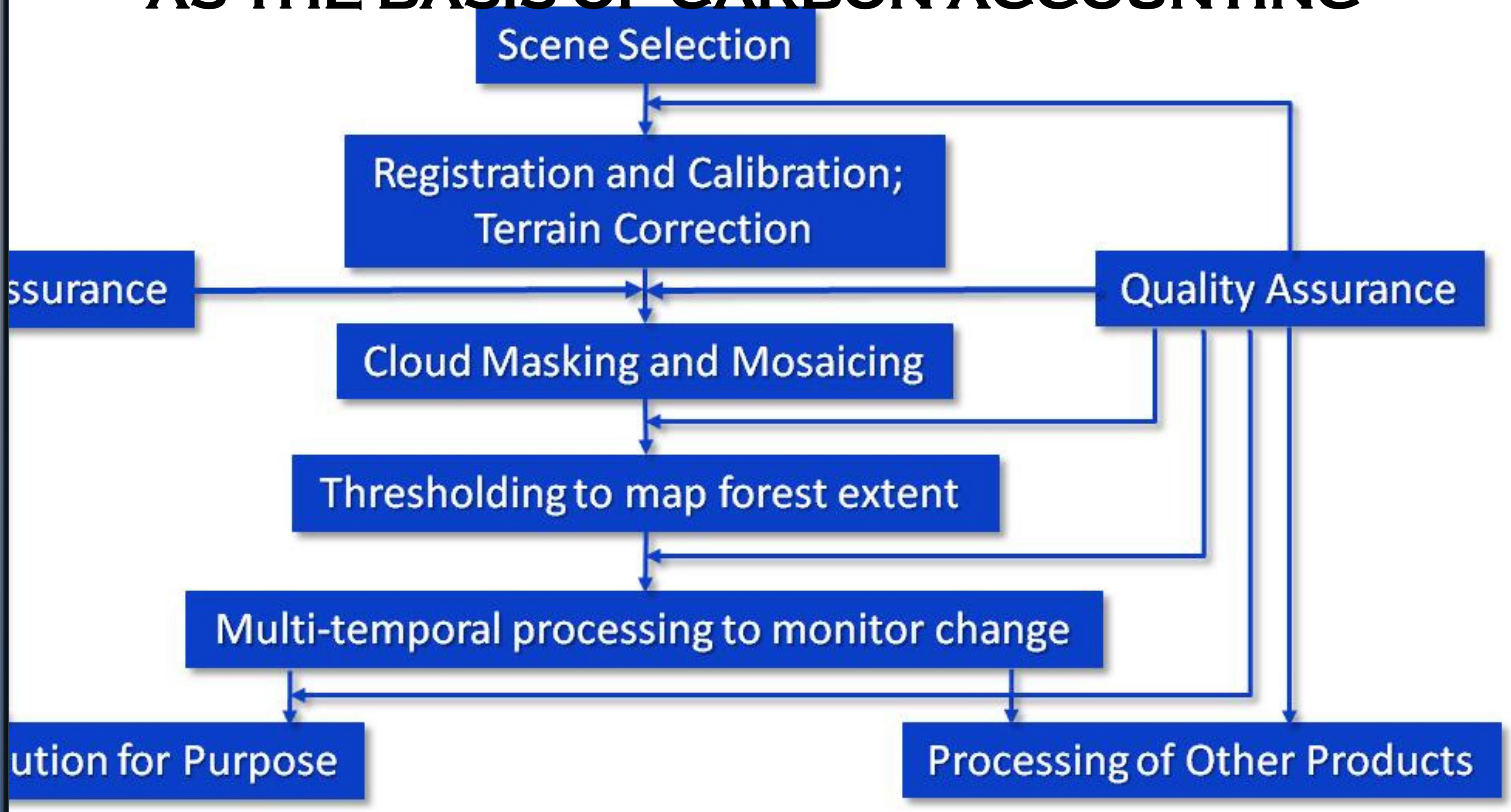
INDONESIAN NATIONAL INSTITUTE OF AERONAUTICS AND SPACE

CARBON ACCOUNTING AND CLIMATE CHANGE IMPACT ANALYSIS USING SATELLITE IMAGERIES

Indonesia's National Carbon Accounting System (INCAS)

IN COOPERATION WITH AUSTRALIA

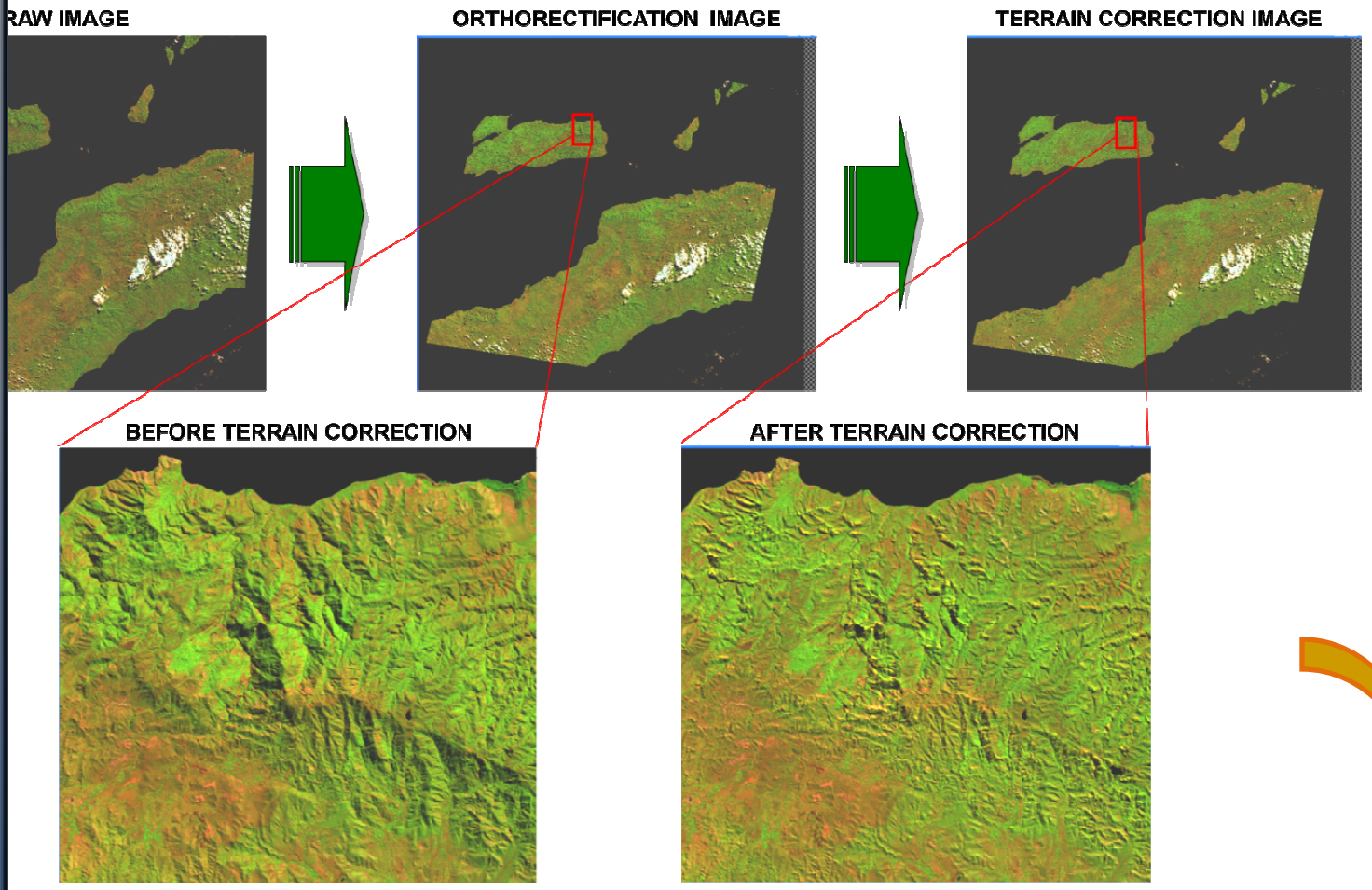
VEGETATION COVER CHANGE AS THE BASIS OF CARBON-ACCOUNTING



INDONESIAN NATIONAL INSTITUTE OF AERONAUTICS AND SPACE

Indonesia's National Carbon Accounting System (INCAS)

Sample results of Landsat ortho & terrain corrected As the basic maps for carbon accounting



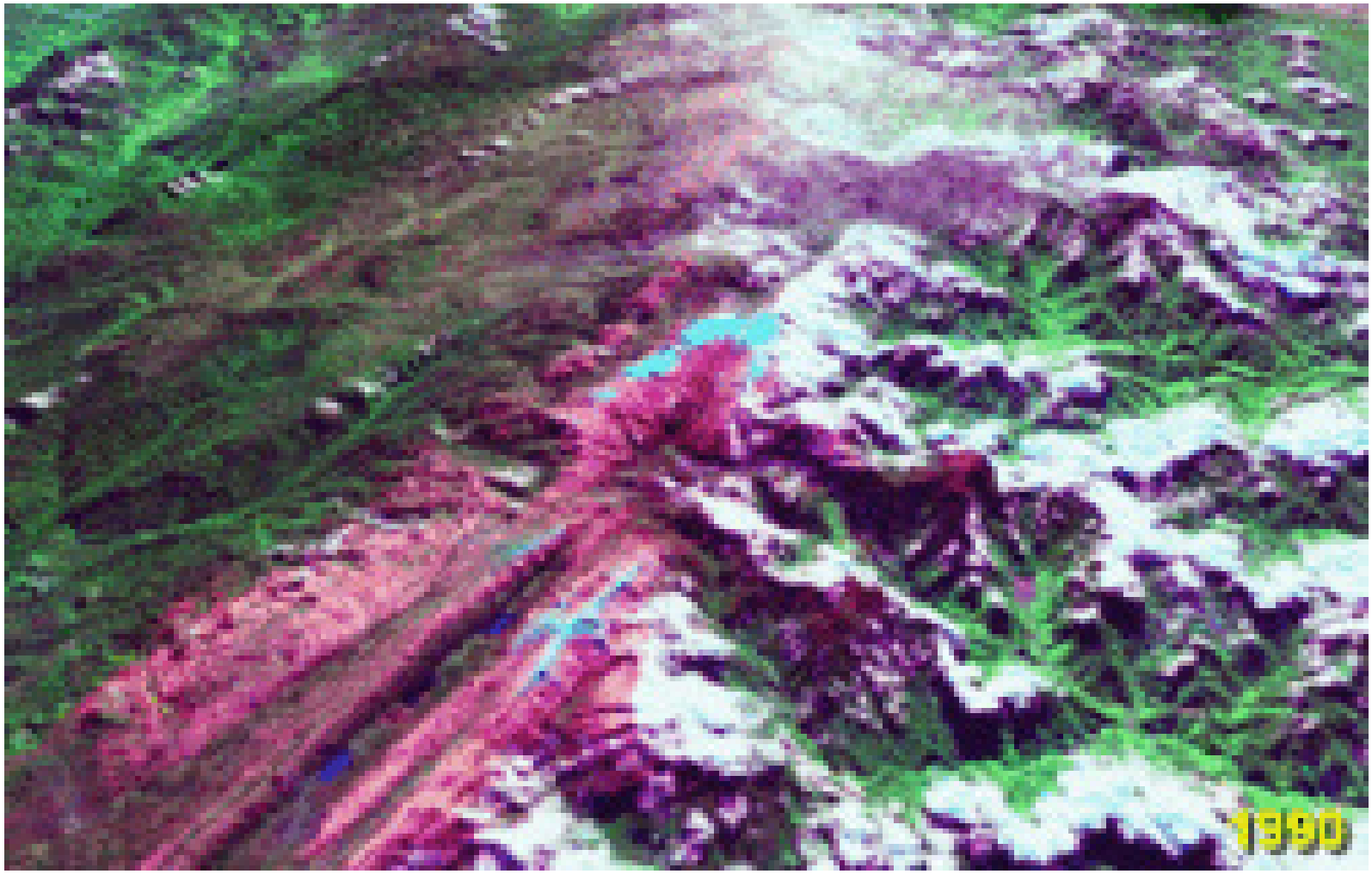
Carbon Stock Calculation & Accounting

INDONESIAN NATIONAL INSTITUTE OF AERONAUTICS AND SPACE

LAPAN

INDONESIAN NATIONAL INSTITUTE OF AERONAUTICS AND SPACE

Detecting Climate Change Impacts



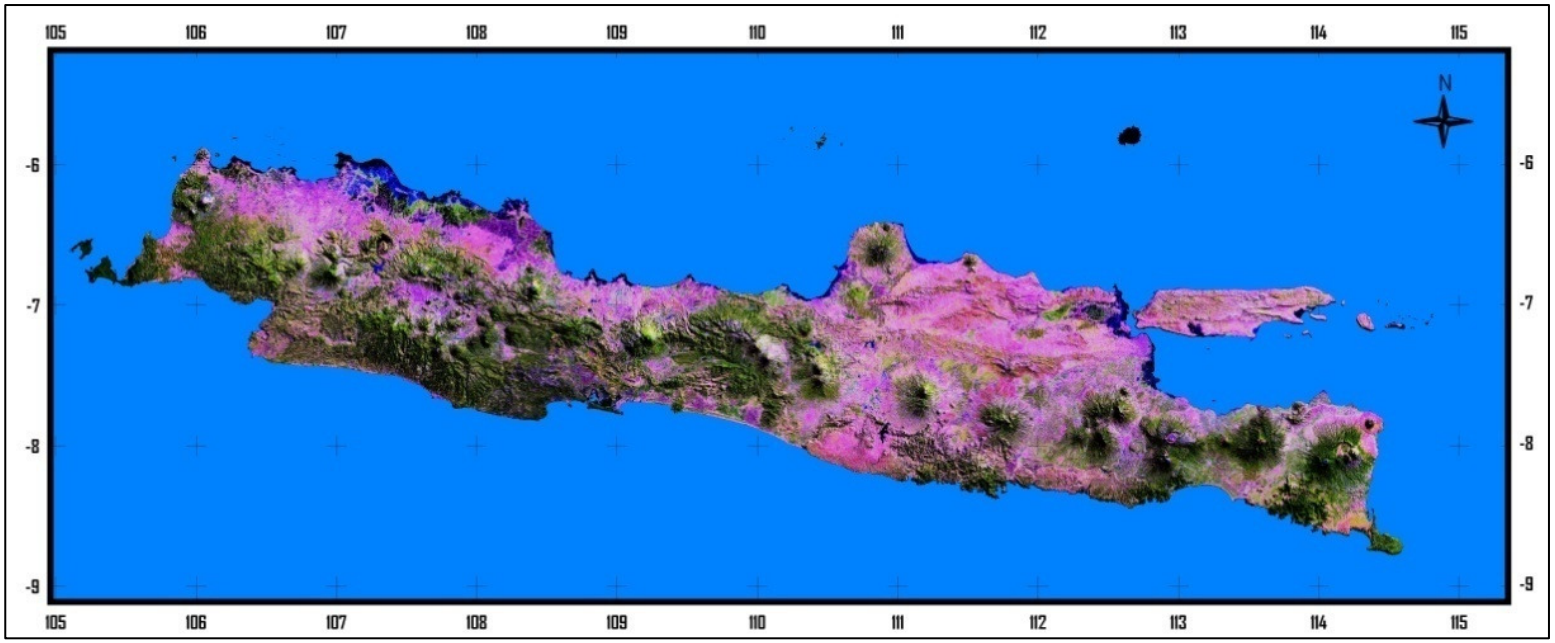
Snow Cover Change over Jayawijaya Mountain – Papua
1990 - 2003

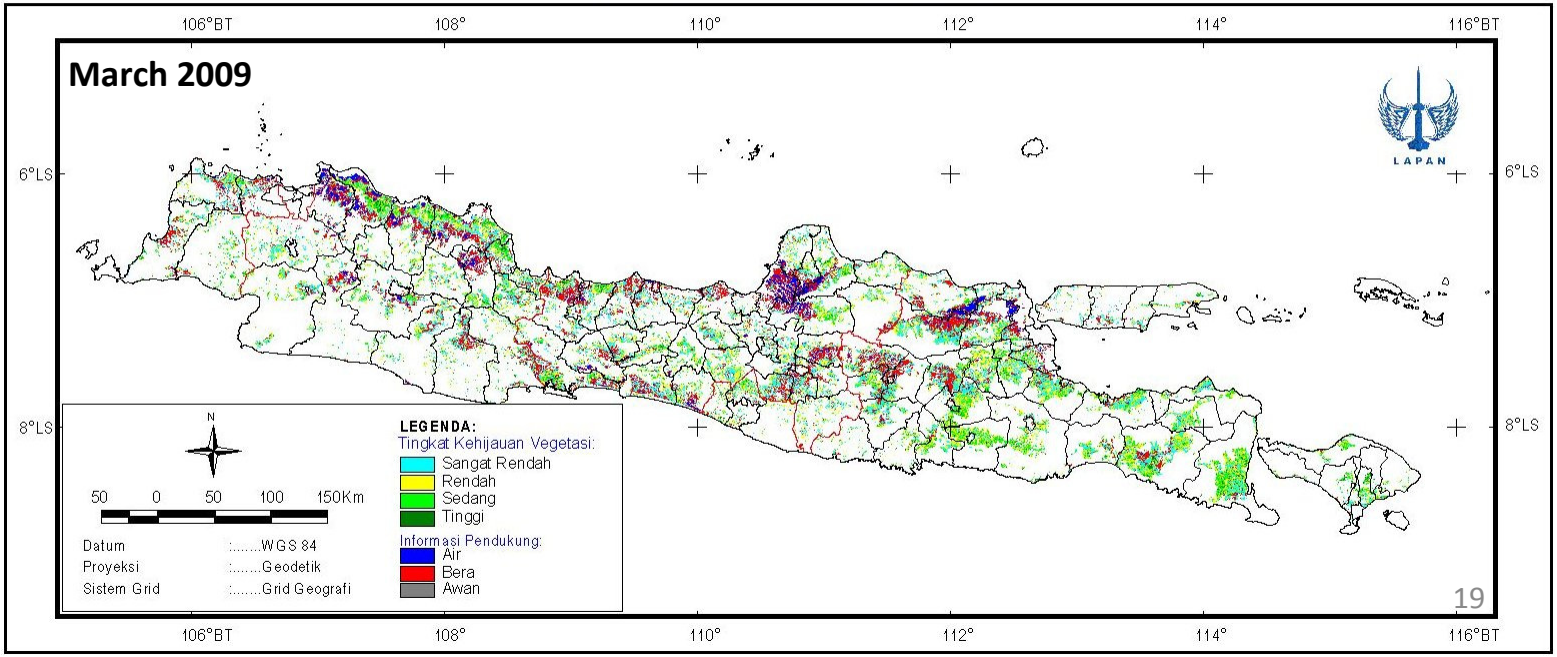
LAPAN

INDONESIAN NATIONAL INSTITUTE OF AERONAUTICS AND SPACE

CLIMATE AND CROP MONITORING TO SUPPORT FOOD SECURITY

RICE CROP GROWTH MONITORING IN JAVA ISLAND (MONTHLY USING MODIS DATA)





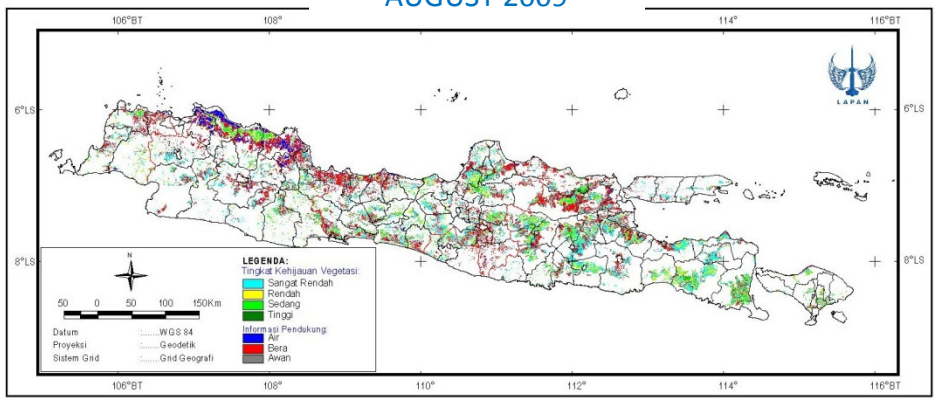
INDONESIAN NATIONAL INSTITUTE OF AERONAUTICS AND SPACE

LAPAN

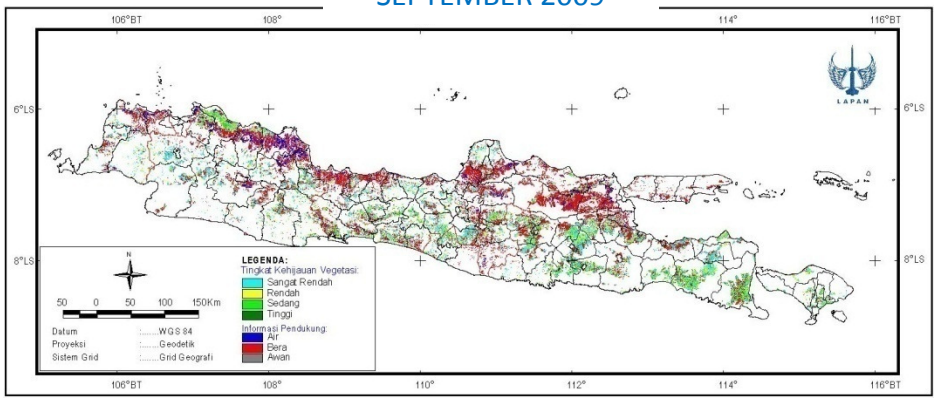
INDONESIAN NATIONAL INSTITUTE OF AERONAUTICS AND SPACE

RICE CROP GREENNESS INDEX MONITORING USING MODIS DATA (MONTHLY)

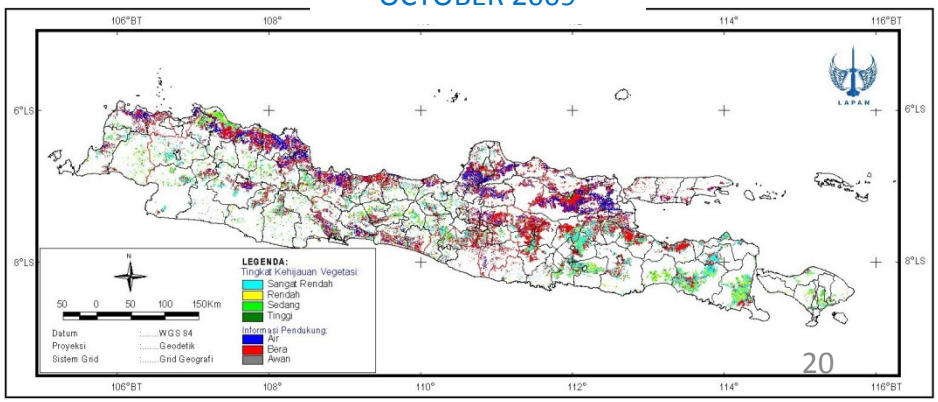
AUGUST 2009



SEPTEMBER 2009



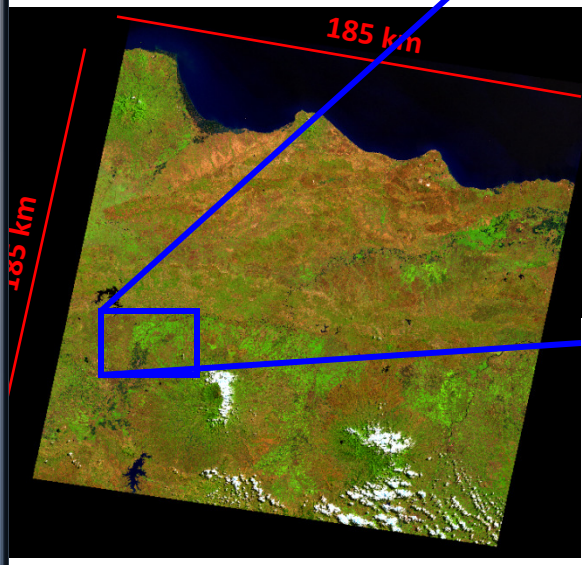
OCTOBER 2009

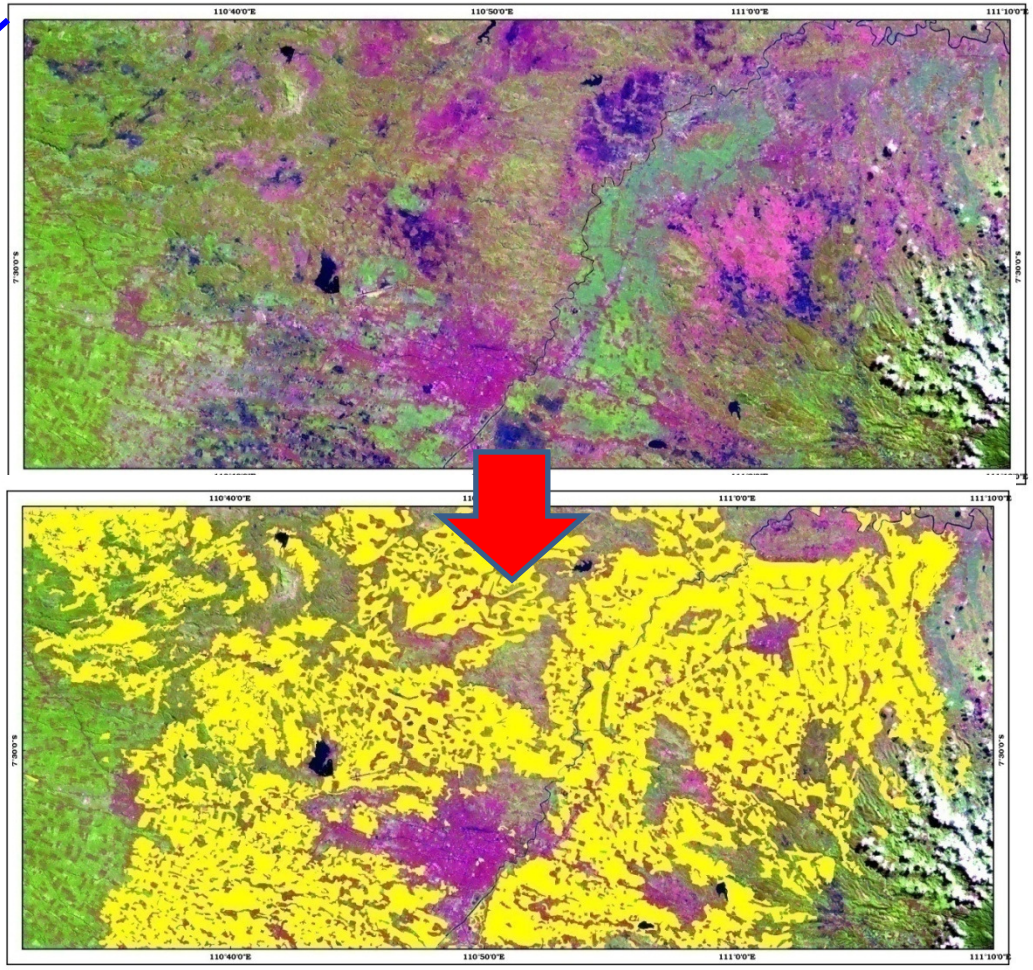


LAPAN

INDONESIAN NATIONAL INSTITUTE OF AERONAUTICS AND SPACE

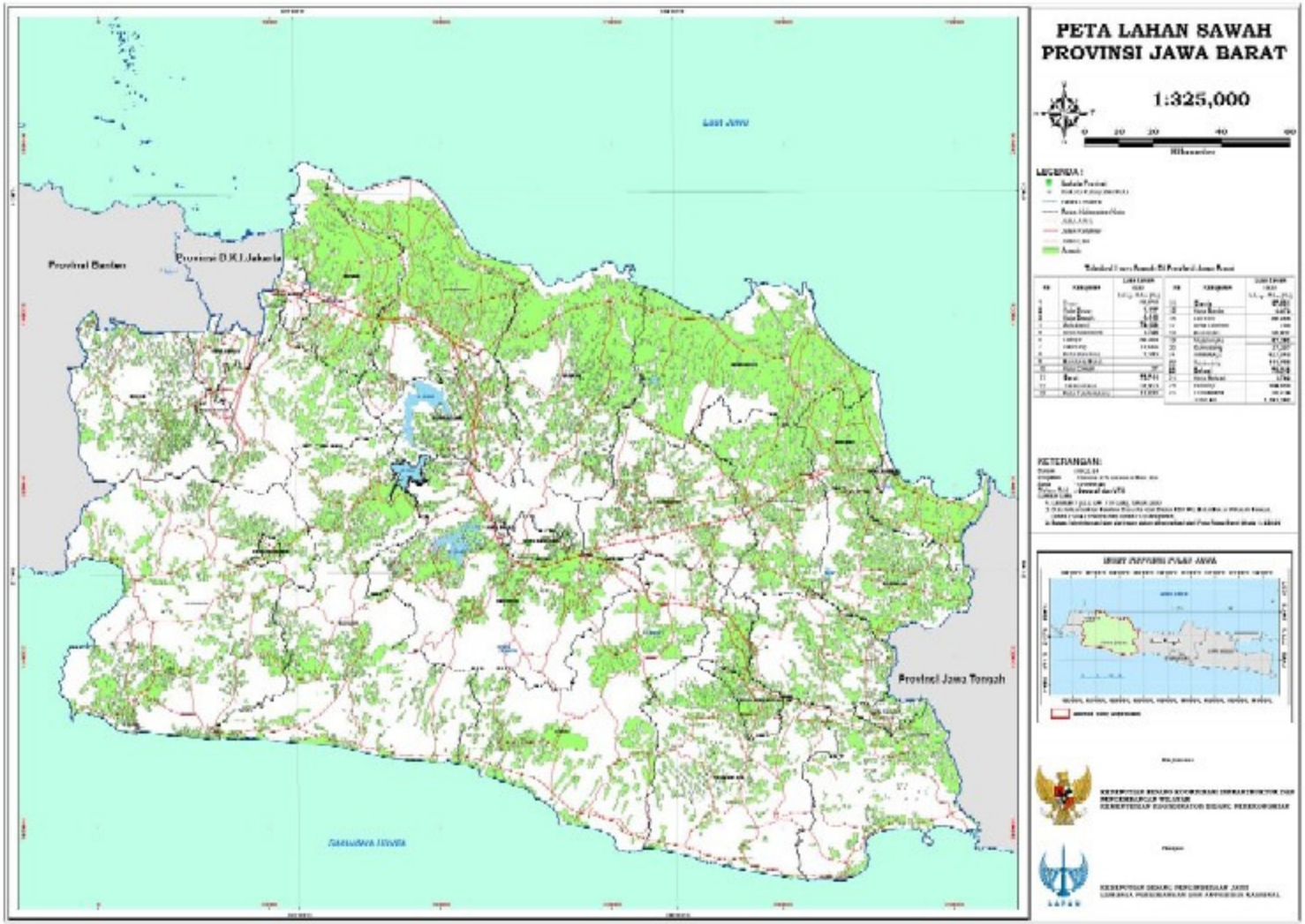
RICE FIELD INVENTORY USING SATELLITE IMAGERIES





RICE FIELDS

SPATIAL INFORMATION ON RICE FIELD STANDARD AREAS



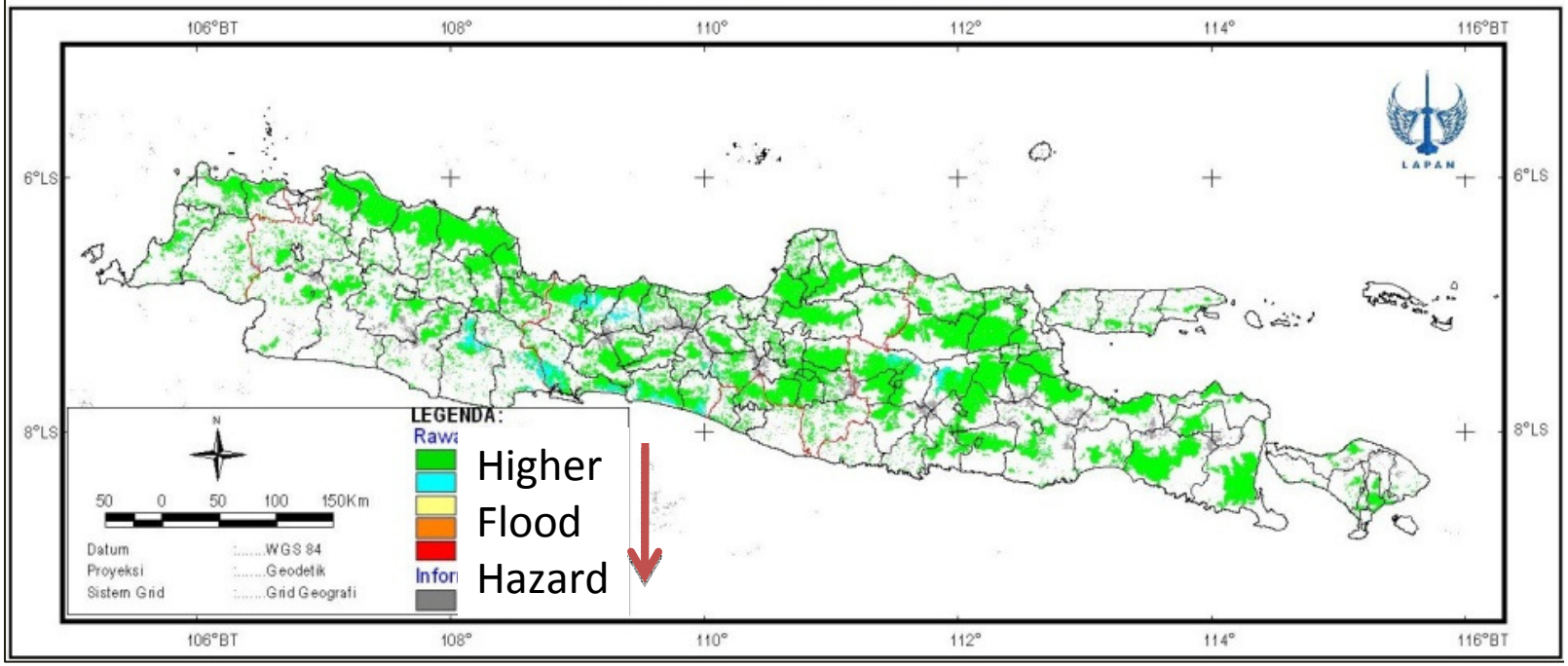
RICE FIELDS

AS THE BASIS FOR RICE FIELD MONITORING

INDONESIAN NATIONAL INSTITUTE OF AERONAUTICS AND SPACE

FLOOD MONITORING OF RICE FIELDS

FLOOD HAZARD OF RICE FIELDS IN JAVA&BALI ISLANDS (06-13 MARCH 2010)

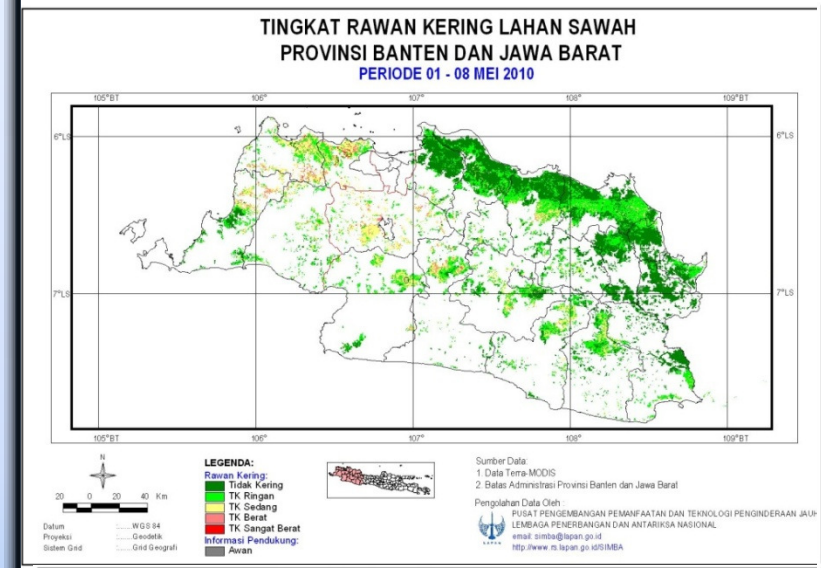


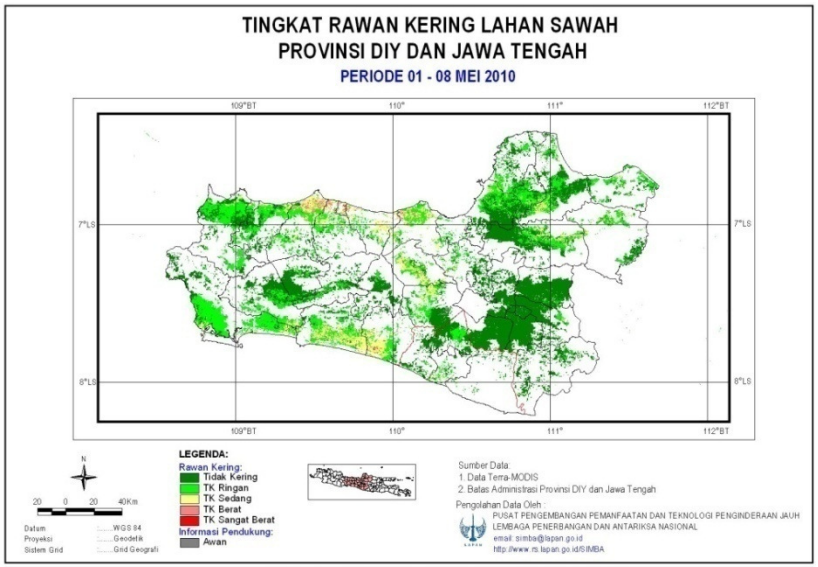
INDONESIAN NATIONAL INSTITUTE OF AERONAUTICS AND SPACE

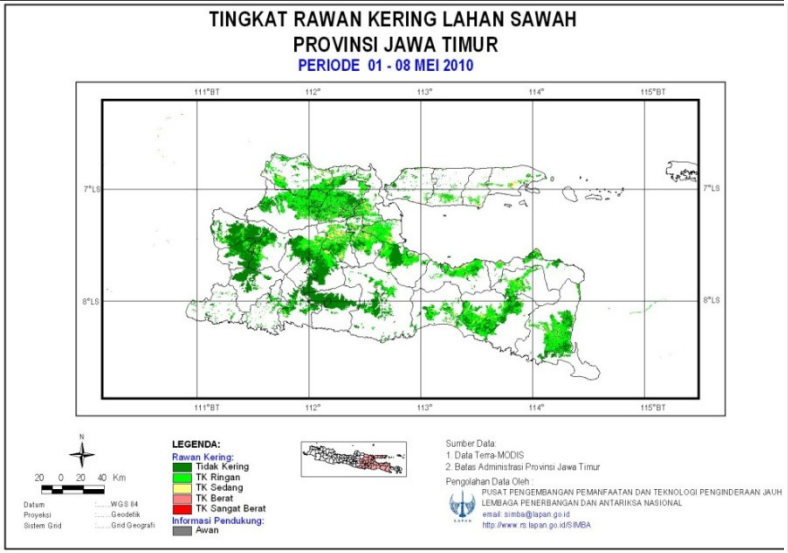
LAPAN

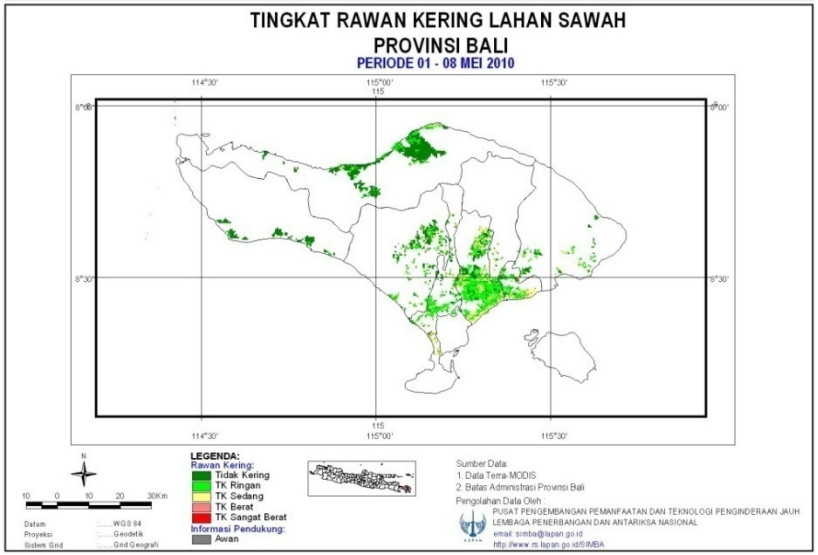
INDONESIAN NATIONAL INSTITUTE OF AERONAUTICS AND SPACE

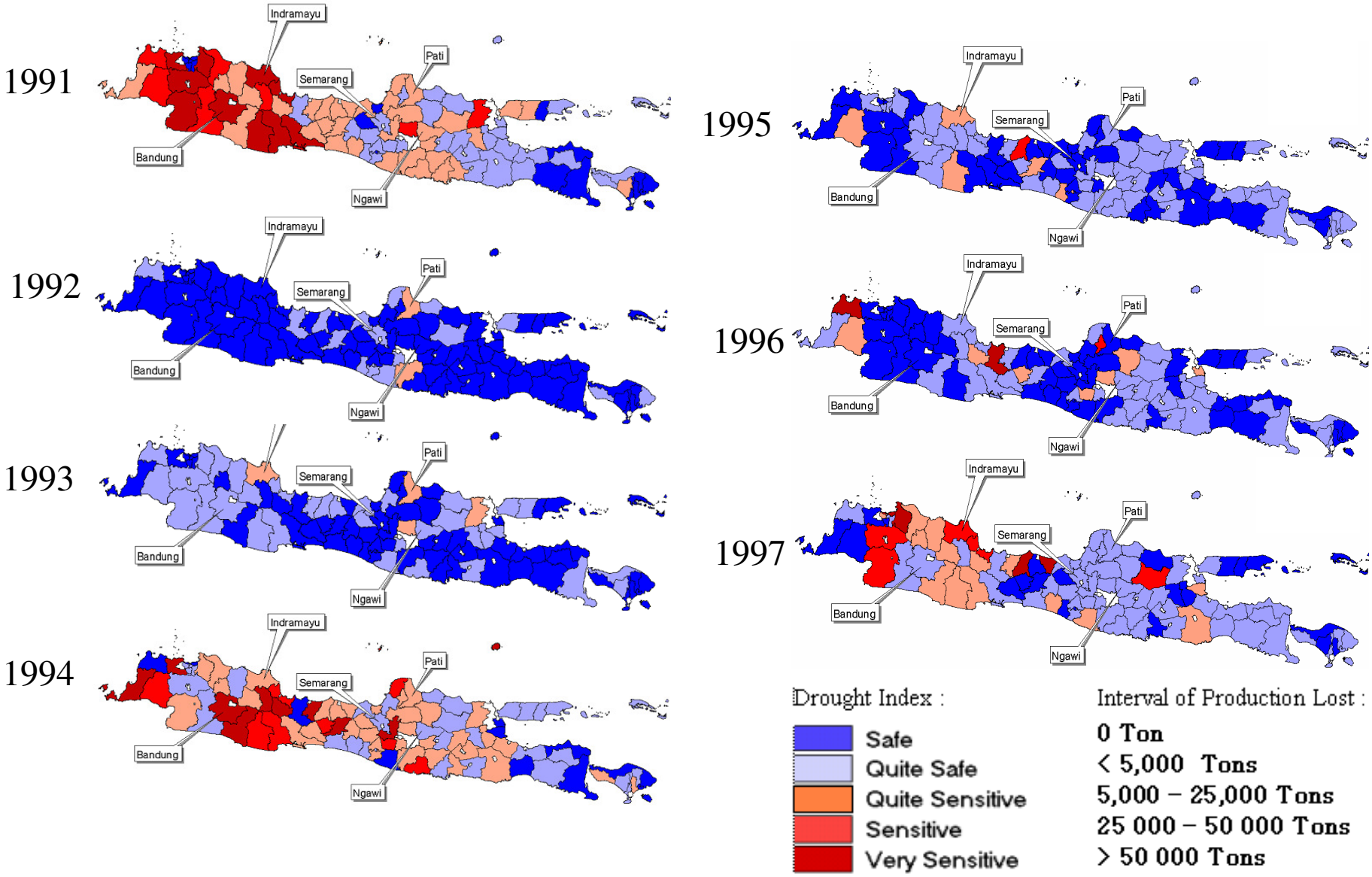
DROUGHT MONITORING OF RICE FIELDS





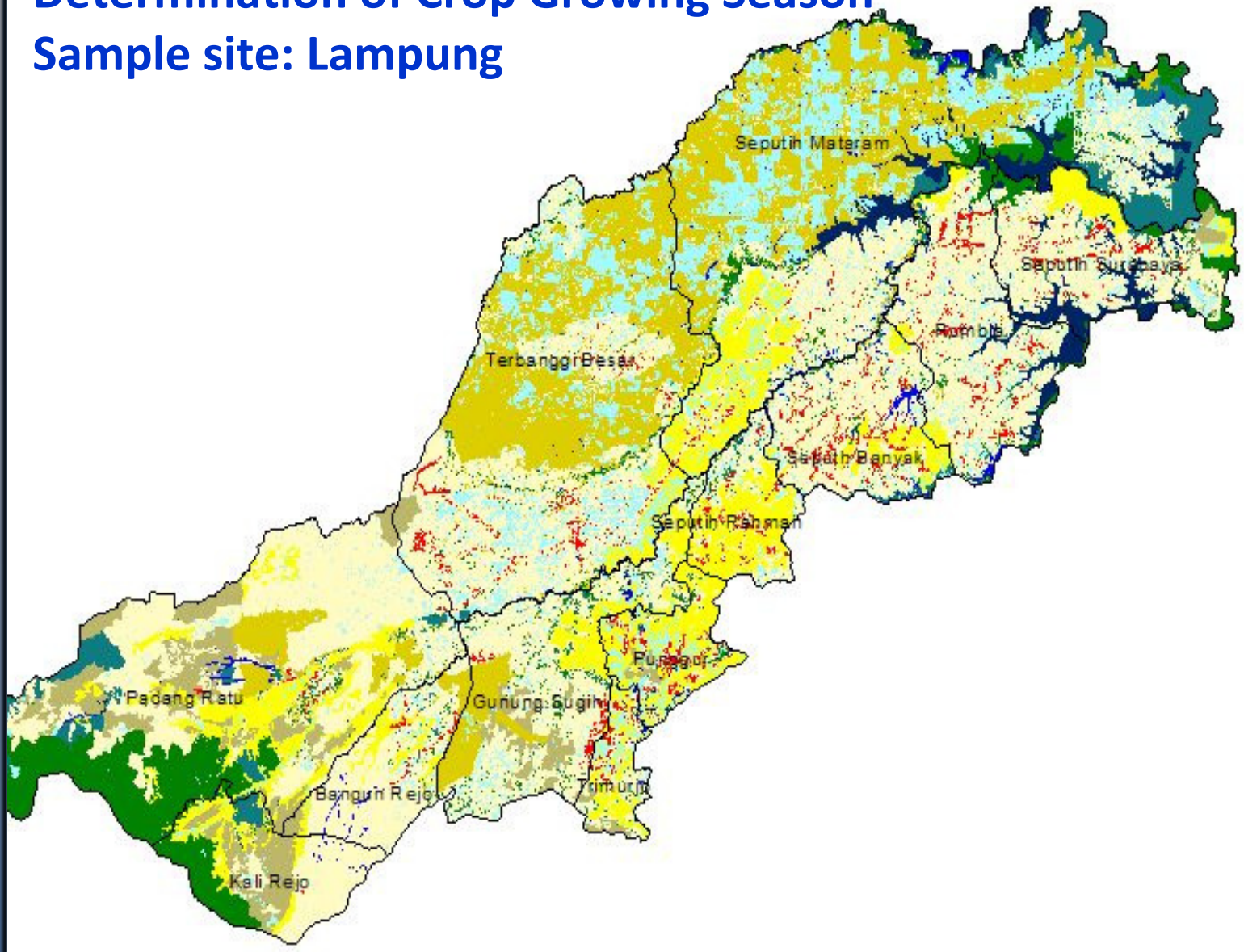






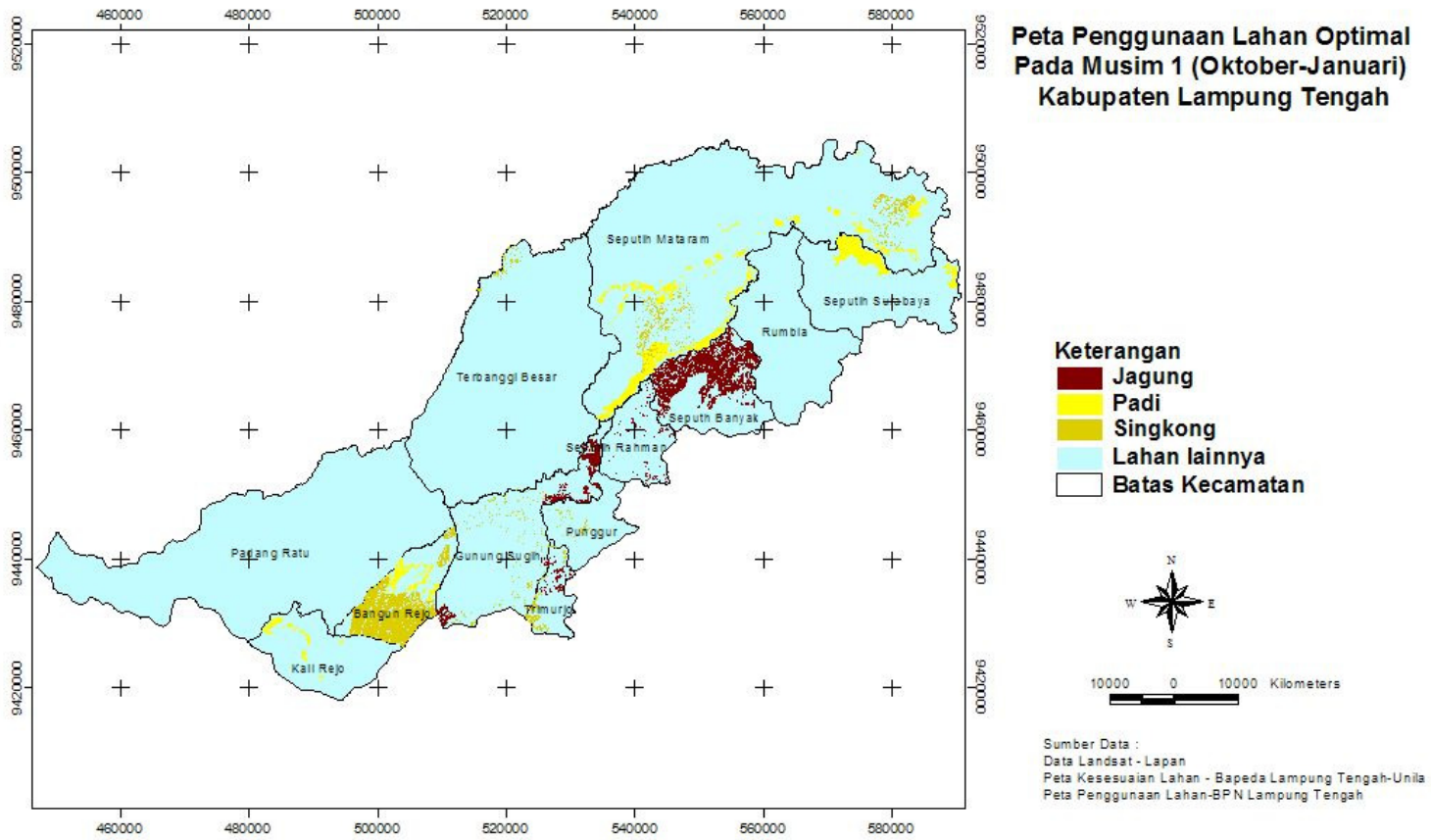
Drought index and rice production loss by district (Drawn from field data provided by Directorate of Plant Protection, Boer *et al*, 2002)

Optimization of Land Management for Determination of Crop Growing Season Sample site: Lampung



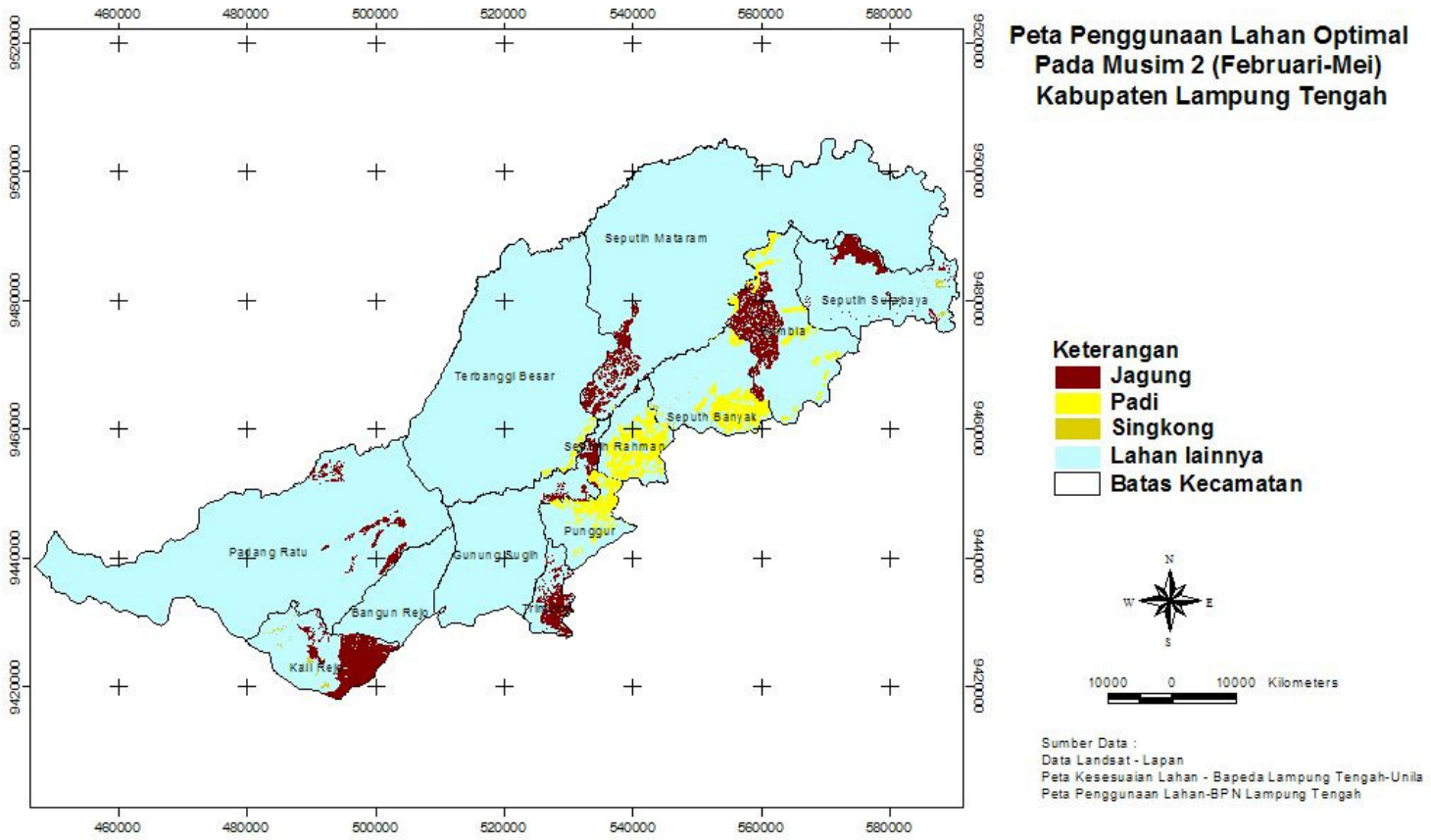
INDONESIAN NATIONAL INSTITUTE OF AERONAUTICS AND SPACE

Optimal Crop Growing Season for October-January: Maize, Rice, Cassava, Others



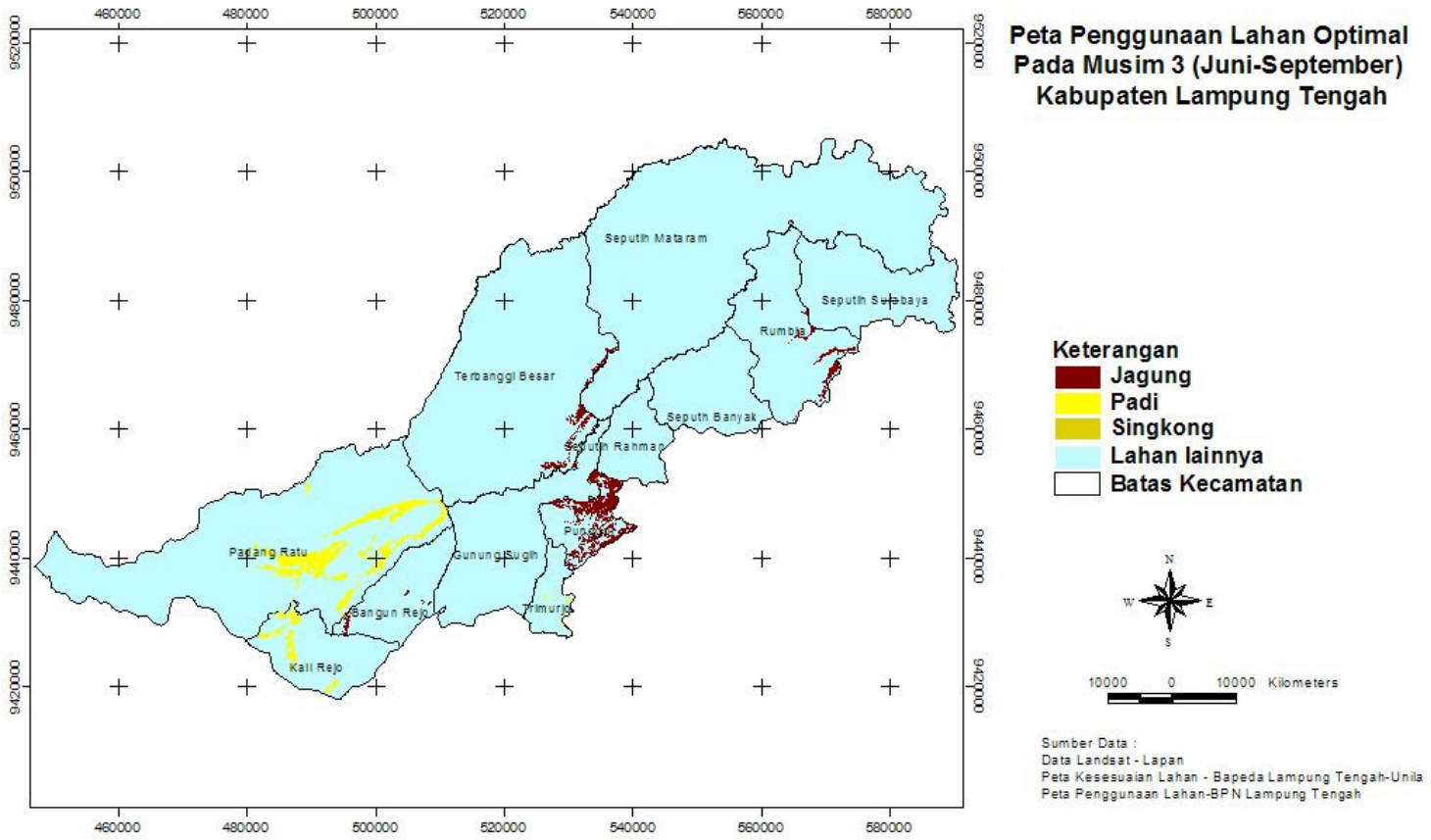
INDONESIAN NATIONAL INSTITUTE OF AERONAUTICS AND SPACE

Optimal Crop Growing Season for October-January: Maize, Rice, Cassava, Others



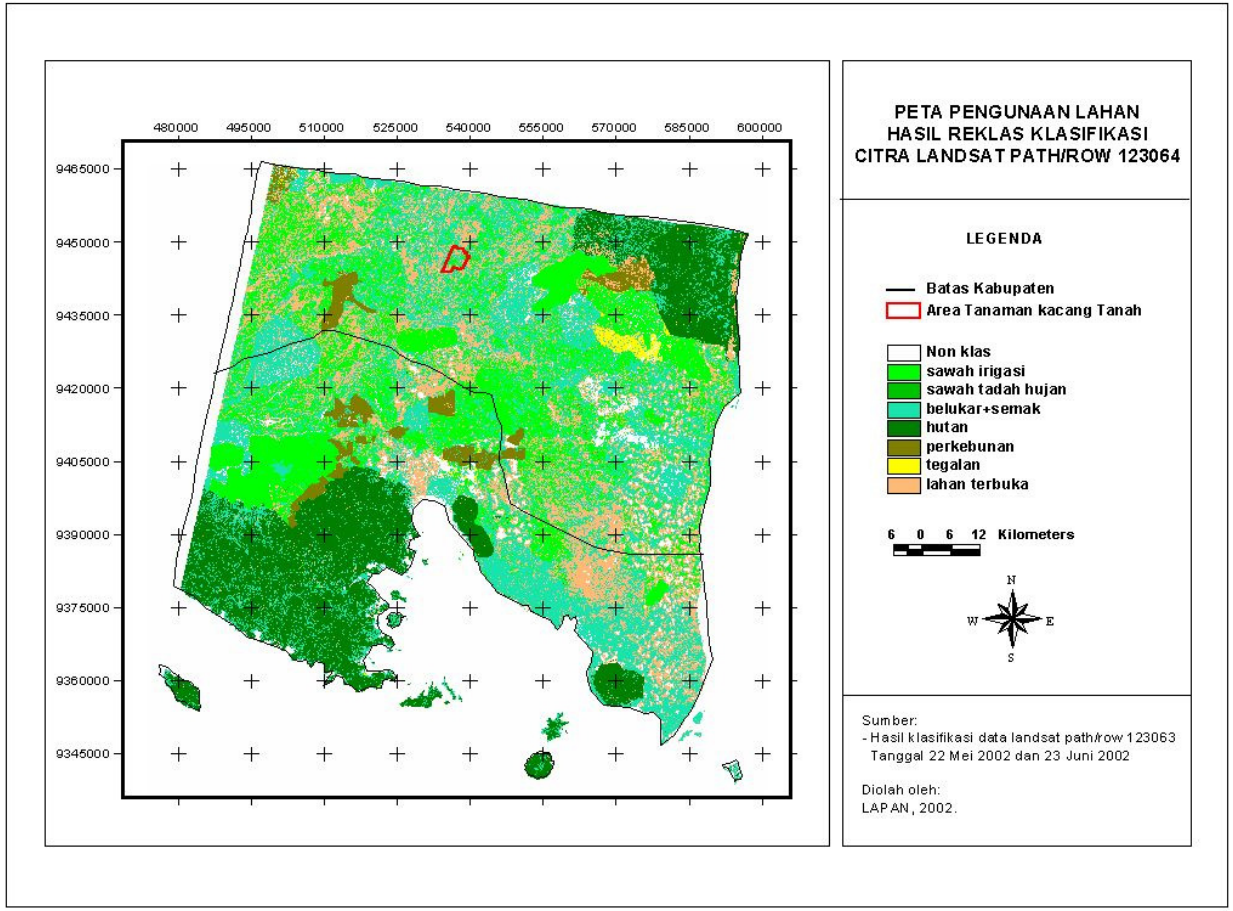
INDONESIAN NATIONAL INSTITUTE OF AERONAUTICS AND SPACE

Optimal Crop Growing Season for October-January: Maize, Rice, Cassava, Others



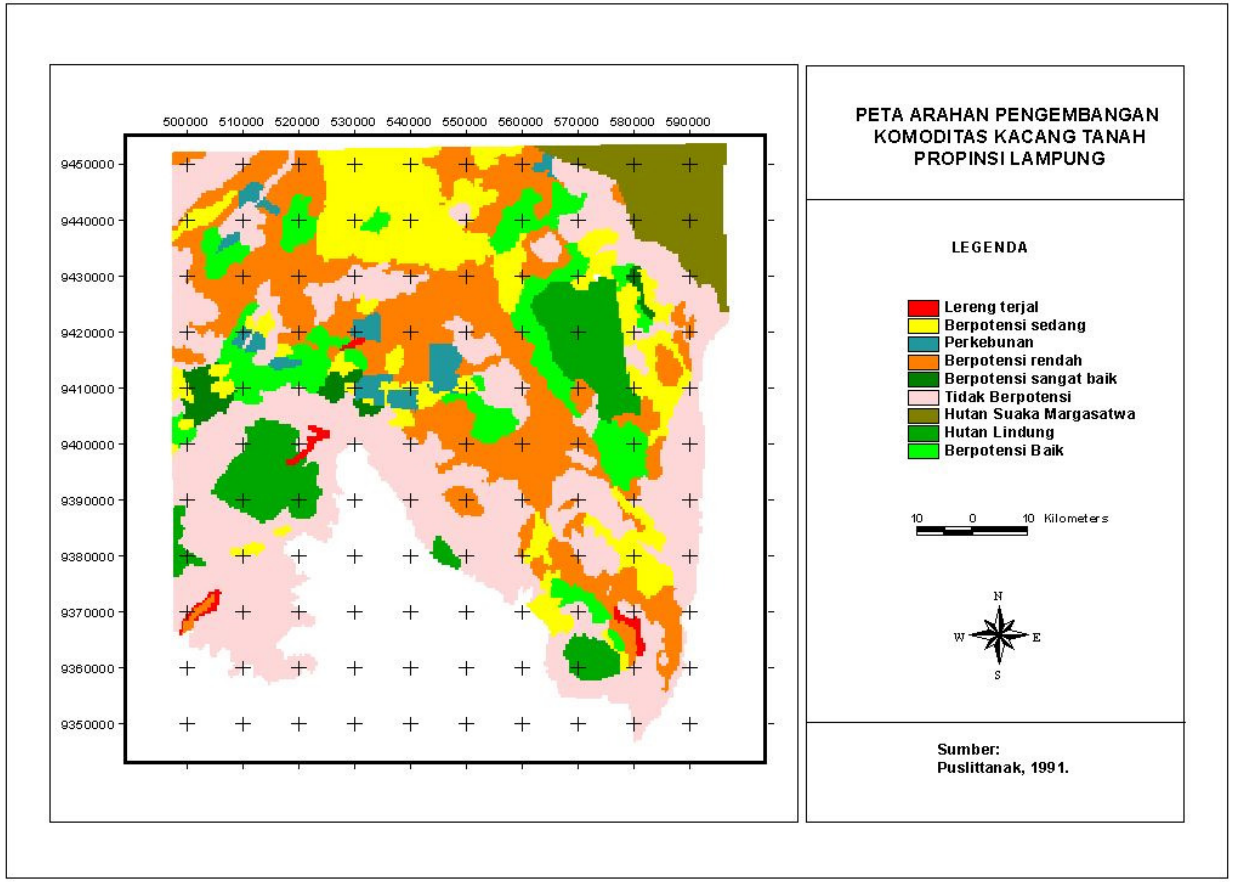
INDONESIAN NATIONAL INSTITUTE OF AERONAUTICS AND SPACE

Zonation & Monitoring of Peanut Crop: In Lampung



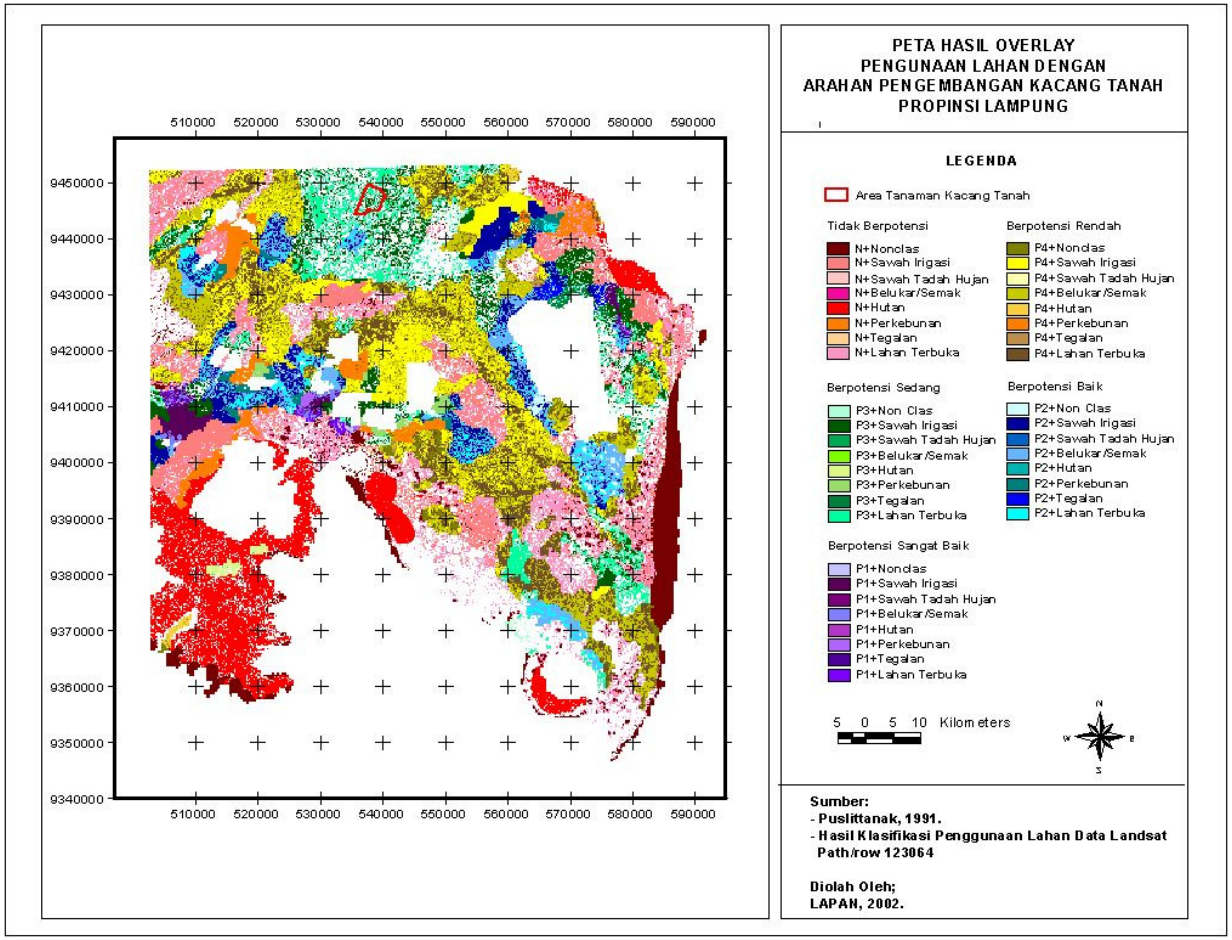
INDONESIAN NATIONAL INSTITUTE OF AERONAUTICS AND SPACE

Recommended Crop Development: Peanut



INDONESIAN NATIONAL INSTITUTE OF AERONAUTICS AND SPACE

Land Suitability Assessment: Potential Development Area for Peanut



INDONESIAN NATIONAL INSTITUTE OF AERONAUTICS AND SPACE

LAPAN

INDONESIAN NATIONAL INSTITUTE OF AERONAUTICS AND SPACE

Problems & Challenges

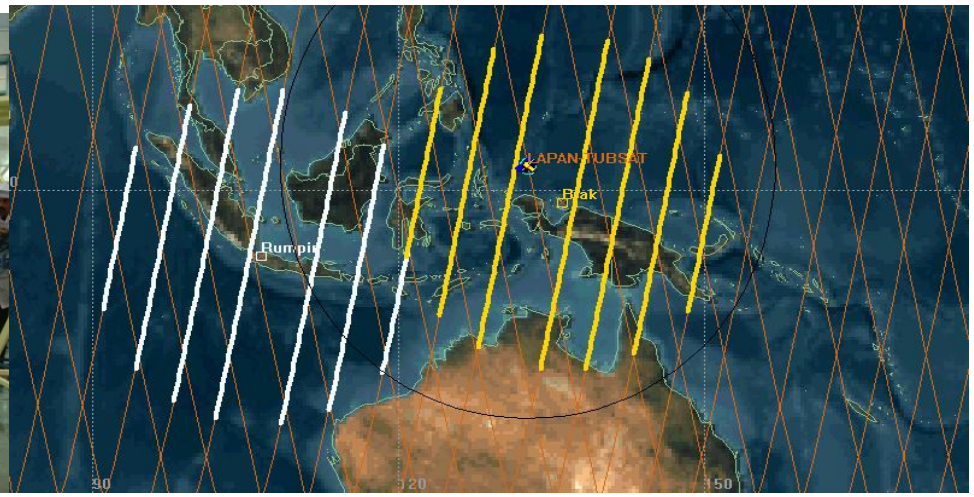
- Climate in Indonesia is very dynamic seasonally.
- High cloud cover in Indonesia → few cloud free images from existing polar orbital satellites (optical & radar), due to low temporal resolution.
- Geostationary satellites → provide high temporal resolution, but low spatial resolution.
- Need adequate spatial resolution as well as temporal resolution (repetition) → Near Equator Orbital Satellites → most existing remote sensing satellites are polar
- Satellite development to fulfill the need

LAPAN

INDONESIAN NATIONAL INSTITUTE OF AERONAUTICS AND SPACE

National Satellite Development Programme

LAPAN-TUBSAT Satellite



LAPAN Tubsat Orbit over Indonesia

LAPAN Tubsat Development & Operation

LAPAN Tubsat over Bromo Mountain

INDONESIAN NATIONAL INSTITUTE OF AERONAUTICS AND SPACE

LAPAN

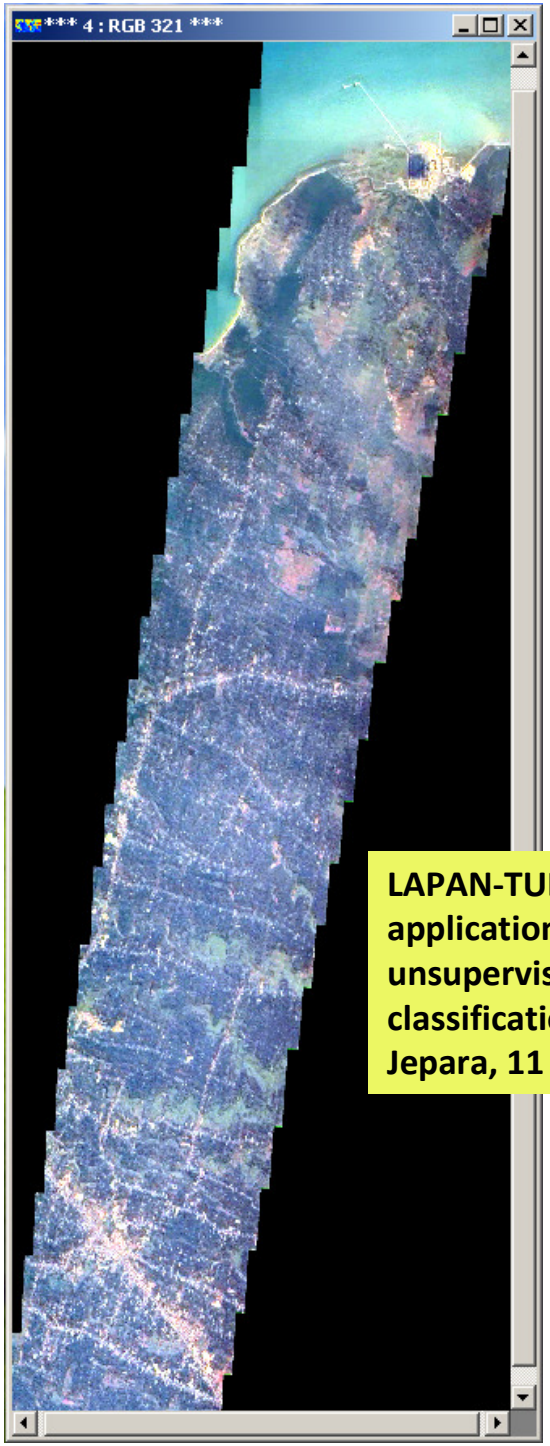
INDONESIAN NATIONAL INSTITUTE OF AERONAUTICS AND SPACE

Satellite Utilization in Indonesia

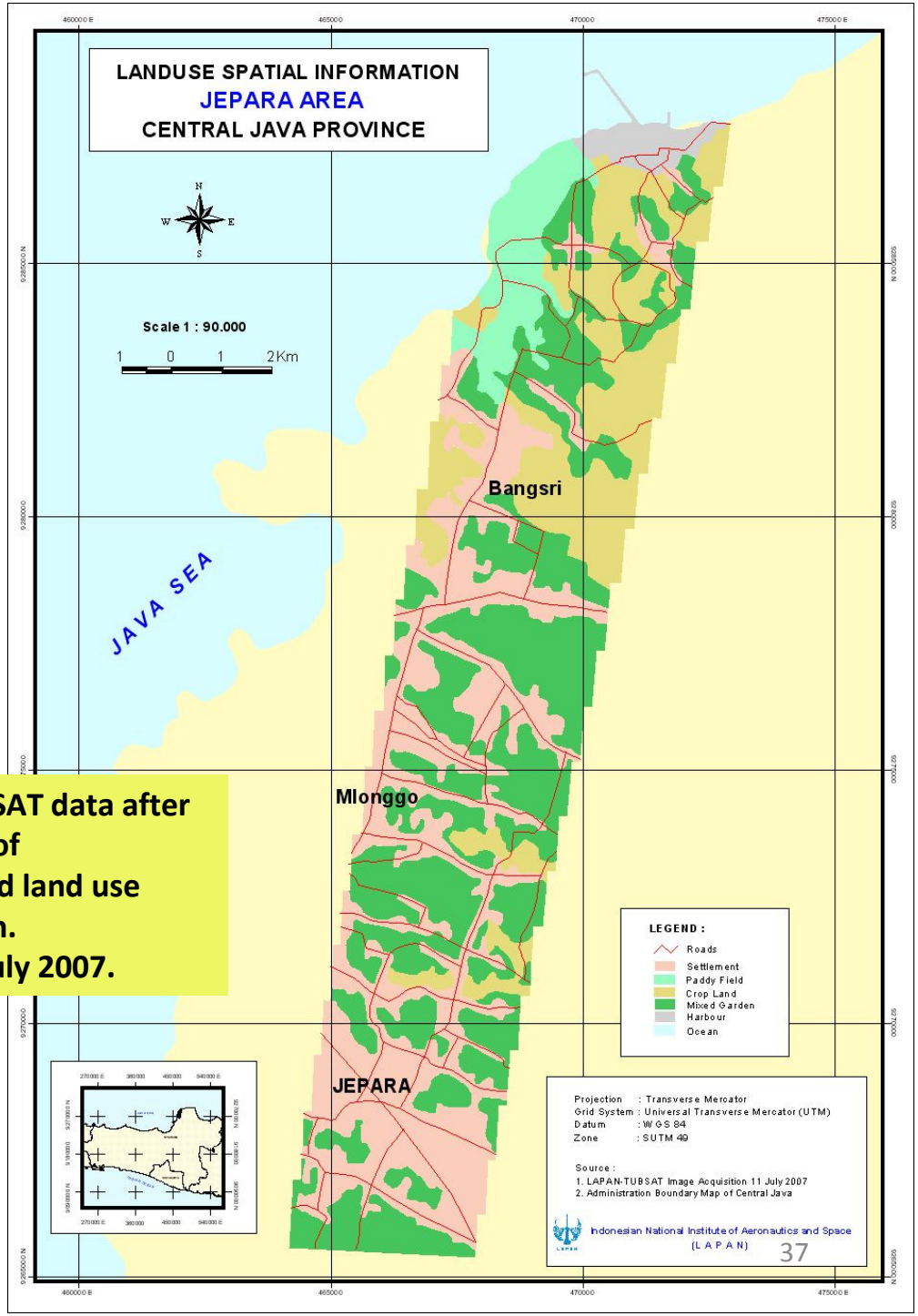
A video stitch image frame generated from video data recording. The resulting is an RGB composite color photo image of the location observed by the video streaming data. The image frame clearly show urban land use from spatial resolution and color separation. Some sea water attributes could also be observed.

LAPAN

INDONESIAN NATIONAL INSTITUTE OF AERONAUTICS AND SPACE



LAPAN-TUBSAT data after application of unsupervised land use classification.
Jepara, 11 July 2007.



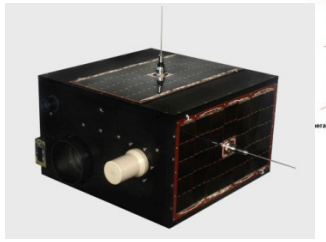
SATELLITE DEVELOPMENT FOR VARIOUS APPLICATIONS

2007 | 2008 | 2009 | 2010 | 2011 | 2012

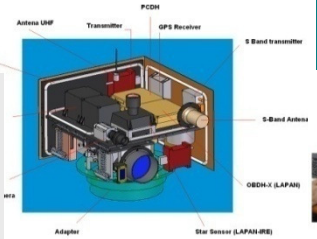
Surveillance & Earth Observation

Communication & Earth Observation

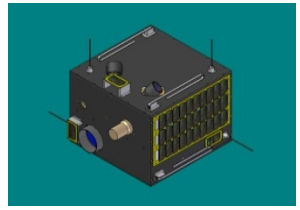
SATELLITE



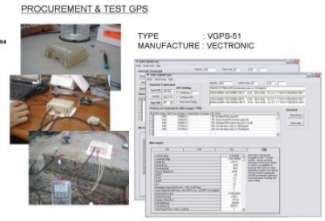
- LAPAN-A1 (LAPAN-TUBSAT)



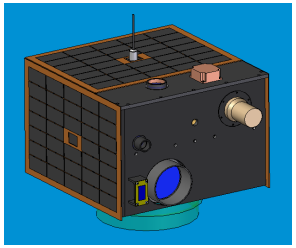
- Design of LAPAN-A2
- Component Procurement & Test (I) of L-A2



- LAPAN-ORARI



- Component Procurement and Assembly of LP-A2 & AMSAT-ID



- Satellite Level System Test
- Launch Preparation

- Launch of LAPAN-A2 & LAPAN-ORARI

- CDR and Component Procurement of LAPAN-B1

LAPAN A1 OPERATIONS AND APPLICATION DEVELOPMENT

LAPAN A2 DEVELOPMENT AND LAUNCHING

OTHER SATELLITES DESIGN & DEVELOPMENT INCLUDING NEO & LEO

LAPAN

LAPAN

INDONESIAN NATIONAL INSTITUTE OF AERONAUTICS AND SPACE

What are the needs?

More space-based observation, more repetitive times, cloud free .

Access to existing earth observation satellites which have special characteristics for better observations such as for climate parameters, GHG & biomass.

Data in near-real-time condition, such as GPM/GSMap satellite data observation.

Enhanced capacity building: educational program/training course for satellite meteorology/climatology, hyper-spectral data processing & analysis.

More international collaborations.

LAPAN

INDONESIAN NATIONAL INSTITUTE OF AERONAUTICS AND SPACE

Concluding Remarks

- Climate change and food security are important issues in Indonesia to address.
- Space technology, remote sensing satellites in particular, are very beneficial for observations related to climate change parameters, impacts and mitigation actions, as well as adaptation to climate change.
- However, there are still limitations in the use of remote sensing satellite. Therefore, satellite development programs in Indonesia will be enhancing and challenging.
- International cooperation needs to be strengthened for better access to existing satellite data and enhanced capacity building.