



Netherlands Space Office (NSO)



food security & satellite information services



Joost van Uum

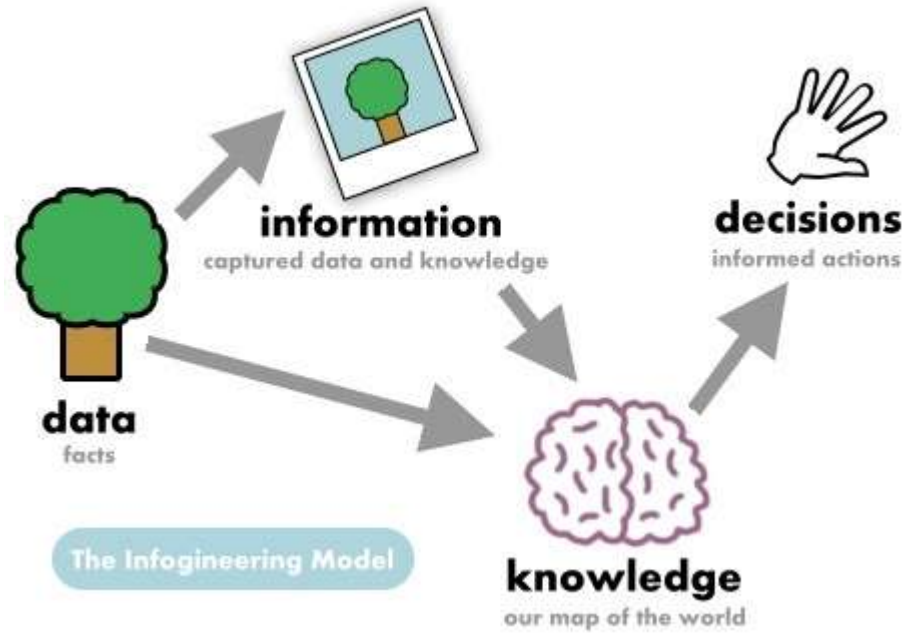
Netherlands Space Office (NSO)





Effects of climate change on  
Food & water security

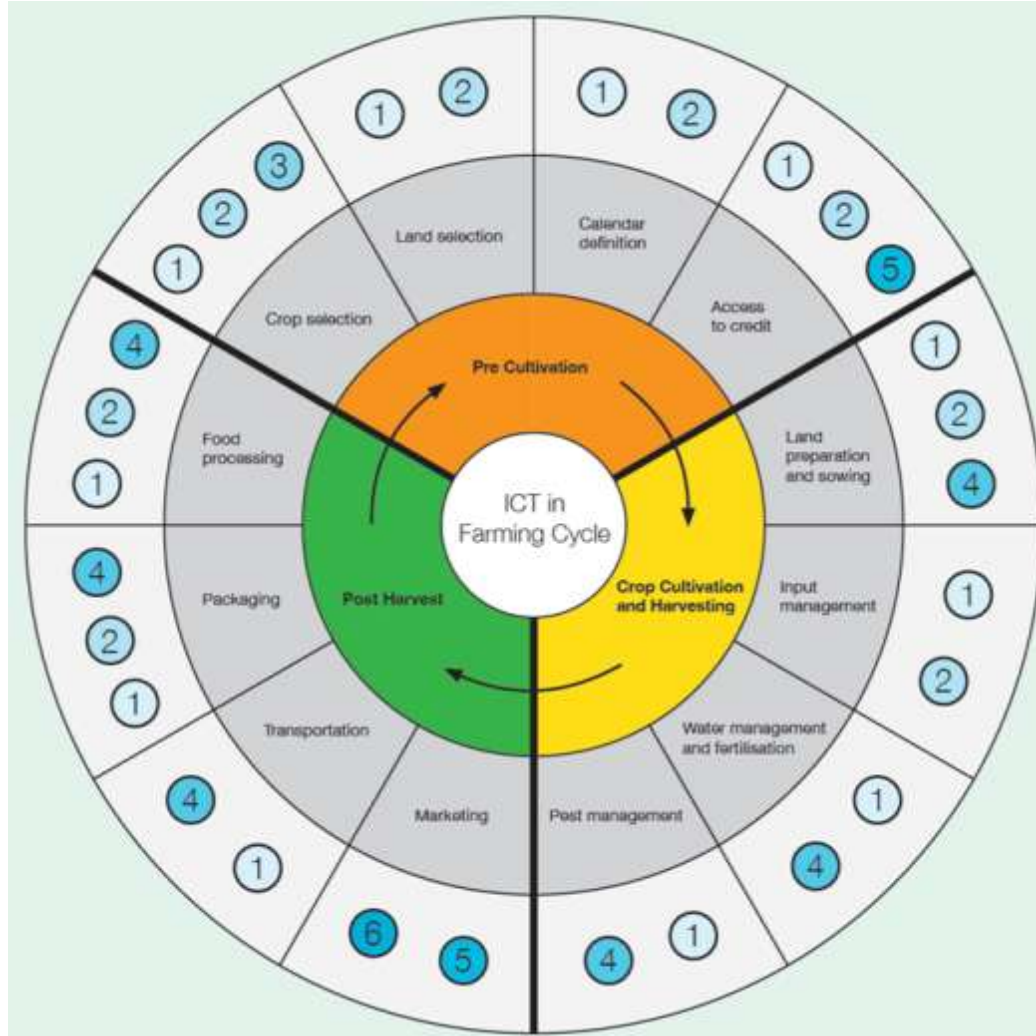








- 1 Information systems including DSS/MISS/GIS etc
- 2 ICT-enabled learning and knowledge exchange
- 3 Modelling solutions
- 4 Sensory and proximity devices
- 5 ICT-enabled networking solutions
- 6 Online commerce tools (eCommerce/mCommerce)



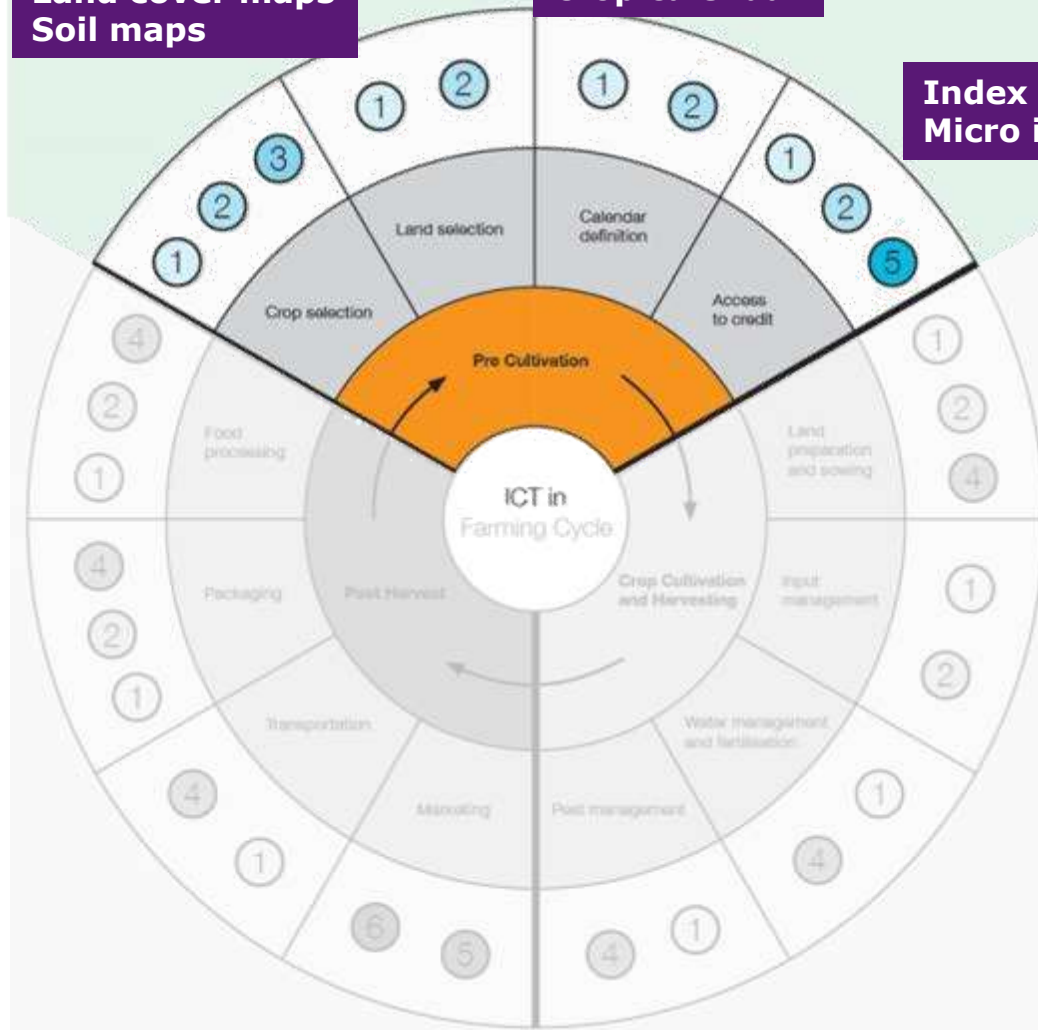


Land cover maps  
Soil maps

Crop calendar

Index based  
Micro insurance

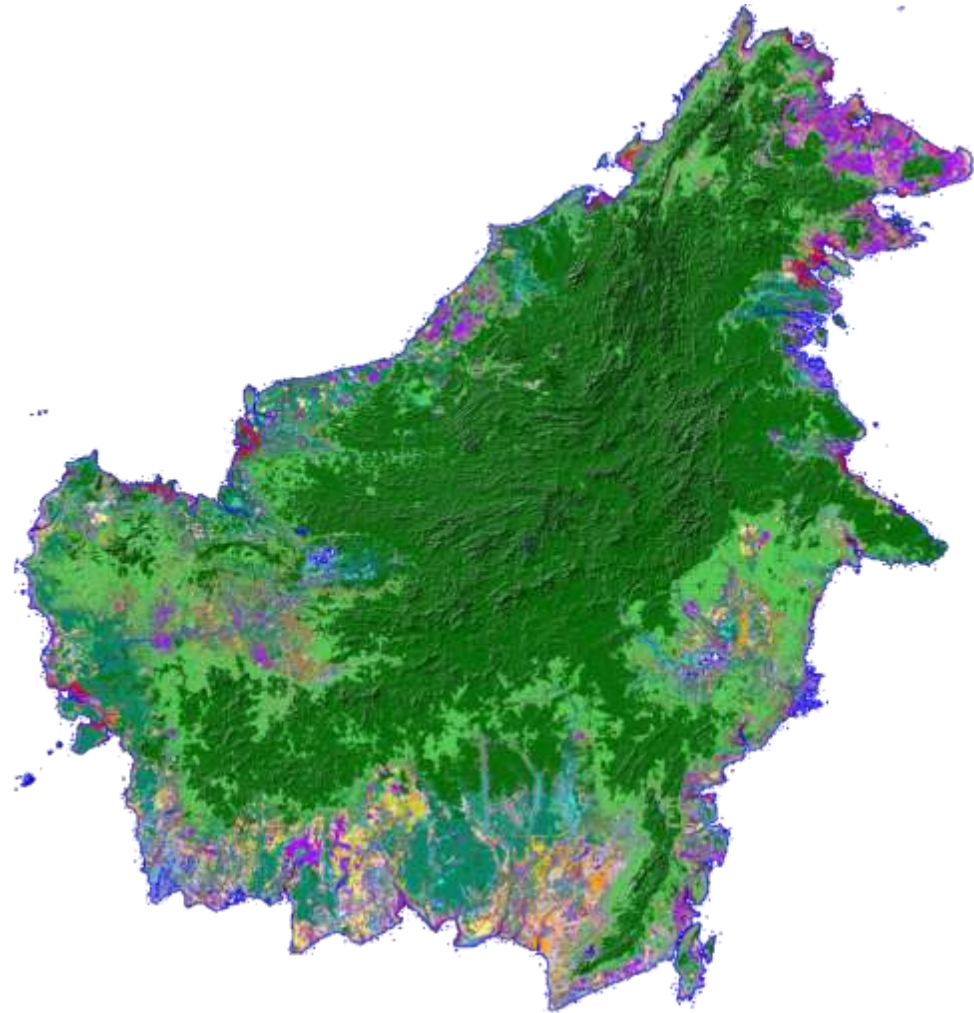
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# Land cover maps

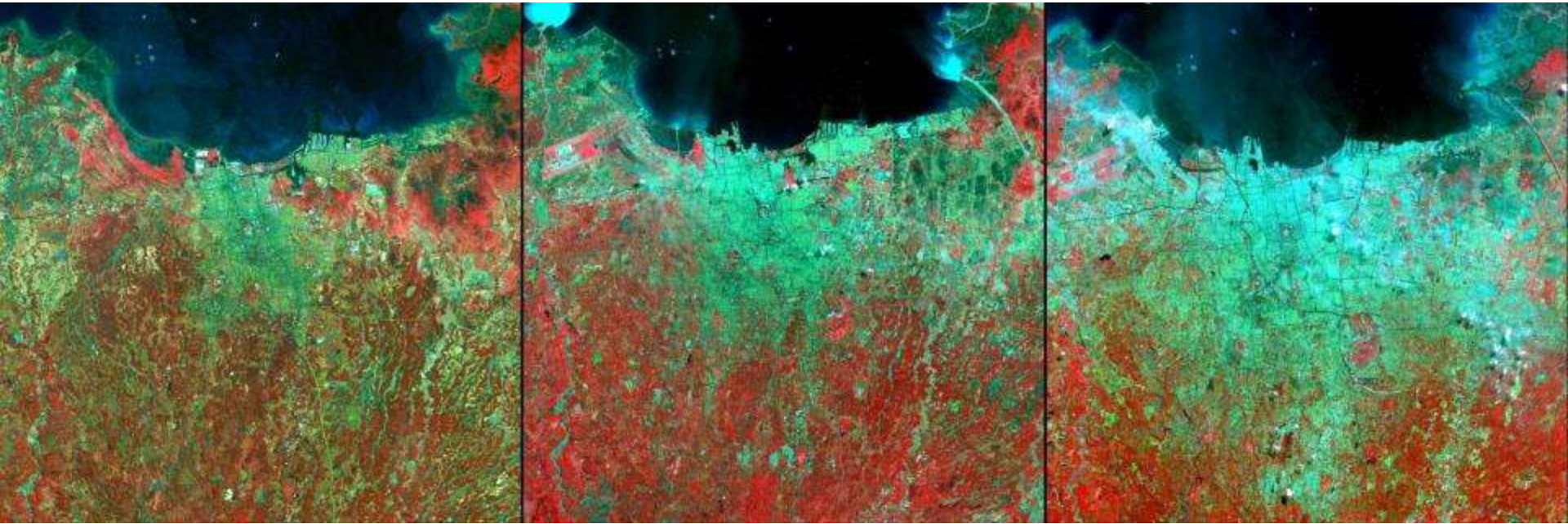
## Kalimantan Land cover map (radar) (SarVision)







# Land cover maps



1976

1989

2004





# Crop calendar



Crop calendar - a crop production information tool for decision making

**crop calendar**

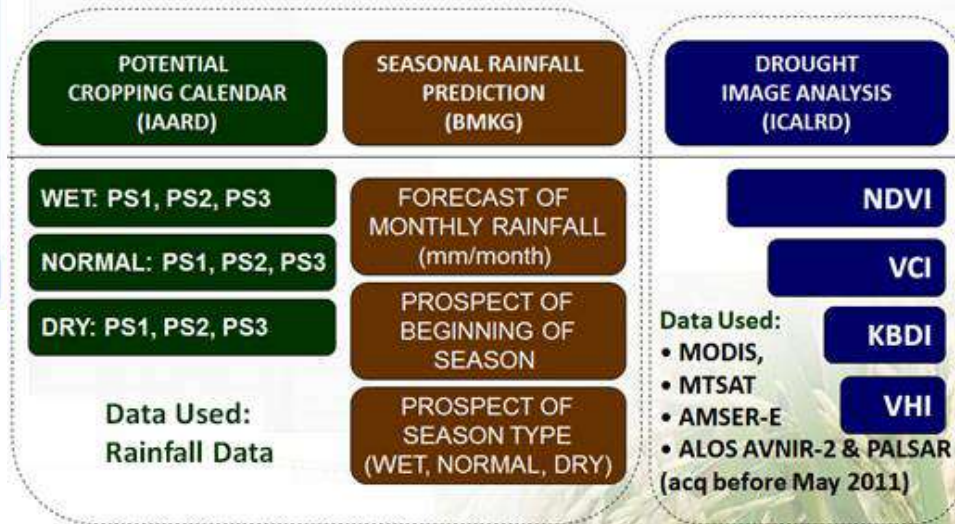
rehabilitation activities following natural or human-led disasters. Furthermore, the Crop Calendar can serve as a quick reference tool in selecting crop varieties to adapt to changing weather patterns accelerated by climate change.

The Crop Calendar database is being maintained at a regional level and is based on inputs from member countries. The Crop Calendar database currently covers 43 African countries and contains information on more than 130 crops, located in 283 agro-ecological zones.

**select a crop**

- Amaranthus
- Artichoke
- Asparagus
- Aubergine
- Bambara groundnut
- Banana
- Banana, Abyssinian
- Barley
- Bean common, dry
- Bean, Lima
- Bean, broad
- Bean, broad green
- Bean, faba
- Bean, green
- Beet, red
- Beet, table
- Benniseed
- Bitterweet

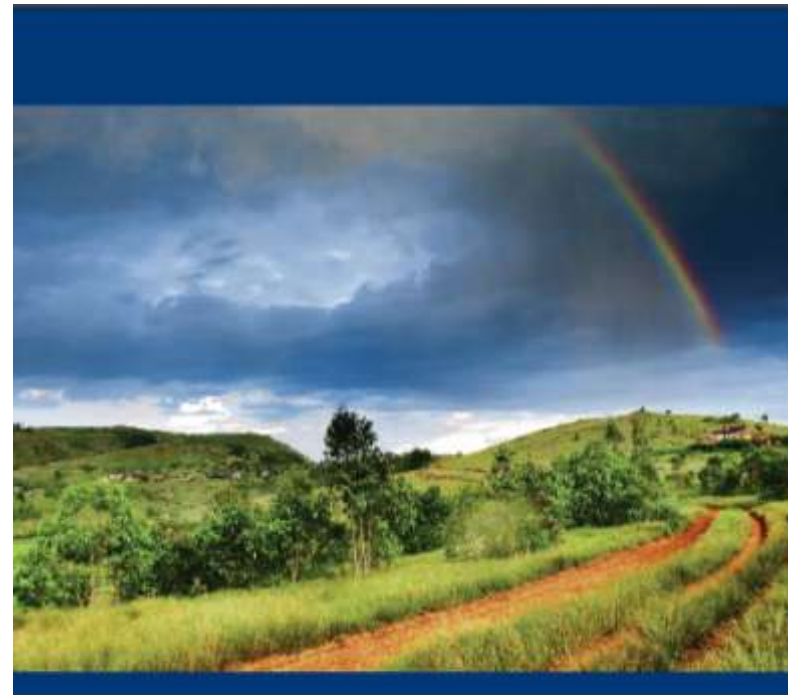
## INTEGRATION OF CROPPING PATTERNS, SEASONAL RAINFALL AND SATELLITE IMAGE ANALYSIS





# Micro insurance

- Many pilot projects
- Examples:
  - Kilimo Salama
  - Planet Guarantee (EARS FESA project)
  - Micro Insure
  - and others
- Technically feasible
- Increased mobile use → reach farmers



Weather Index-based Insurance  
in Agricultural Development  
**A Technical Guide**

→ Time for Up-scaling



World Food  
Programme



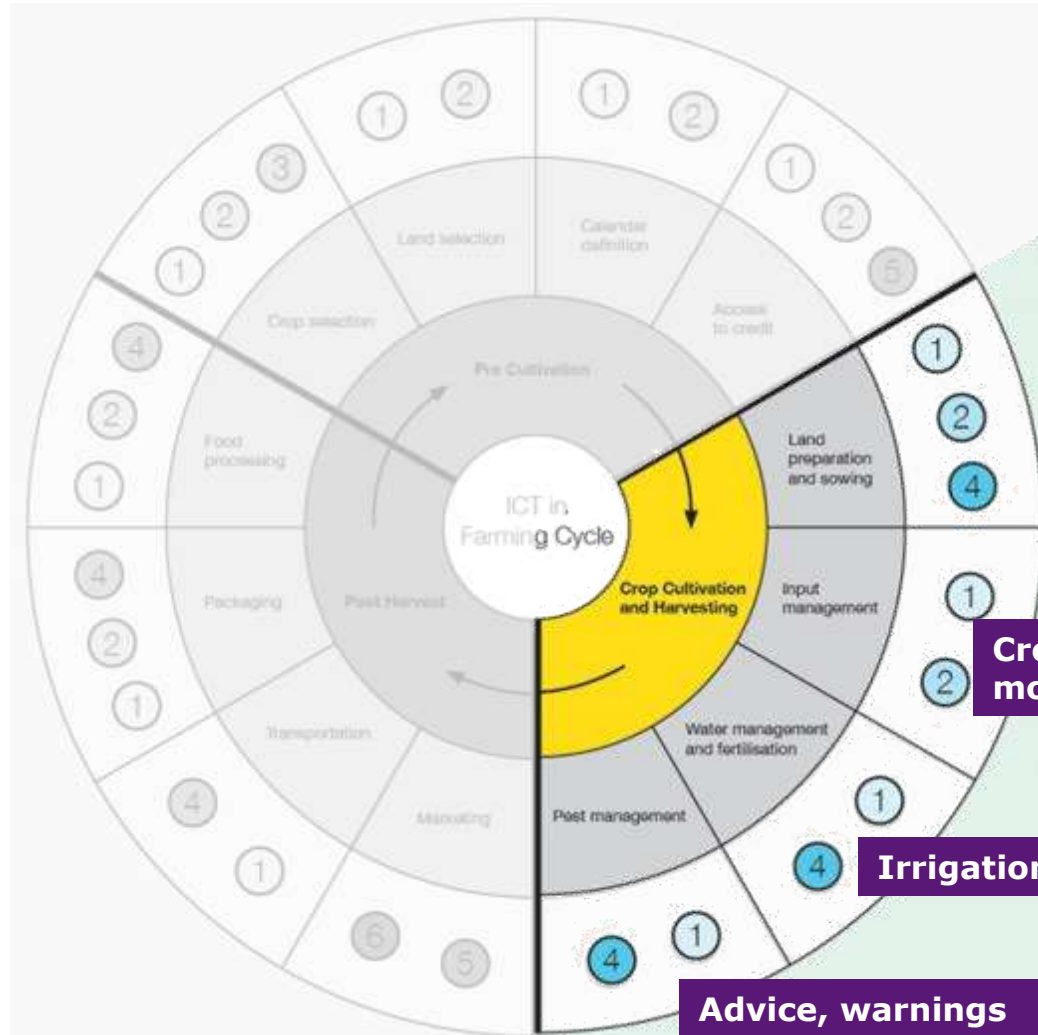
Enabling poor rural people  
to overcome poverty

[http://www.ifad.org/ruralfinance/pub/WII\\_tech\\_guide.pdf](http://www.ifad.org/ruralfinance/pub/WII_tech_guide.pdf)





- ① Information systems including DSS/MISS/GIS etc
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Land cover maps  
Soil maps

Crop growth  
monitoring

Irrigation advice

Advice, warnings



# Crop growth monitoring



Cloud  
free  
radar  
image





# Crop growth monitoring

Sugar beet at 25m resolution every  
24 days

22/04/2012



## Radar analysis

Bare soil



# Crop growth monitoring

Sugar beet at 25m resolution every  
24 days

16/05/2012



## Radar analysis

Bare soil  
Emergence





# Crop growth monitoring

Sugar beet at 25m resolution every  
24 days

09/06/2012



## Radar analysis

Bare soil  
Emergence  
Increment



# Crop growth monitoring

Sugar beet at 25m resolution every  
24 days

03/07/2012



## Radar analysis

Bare soil  
Emergence  
Increment  
**Closure**





# Crop growth monitoring

Sugar beet at 25m resolution every  
24 days

07/10/2012



## Radar analysis

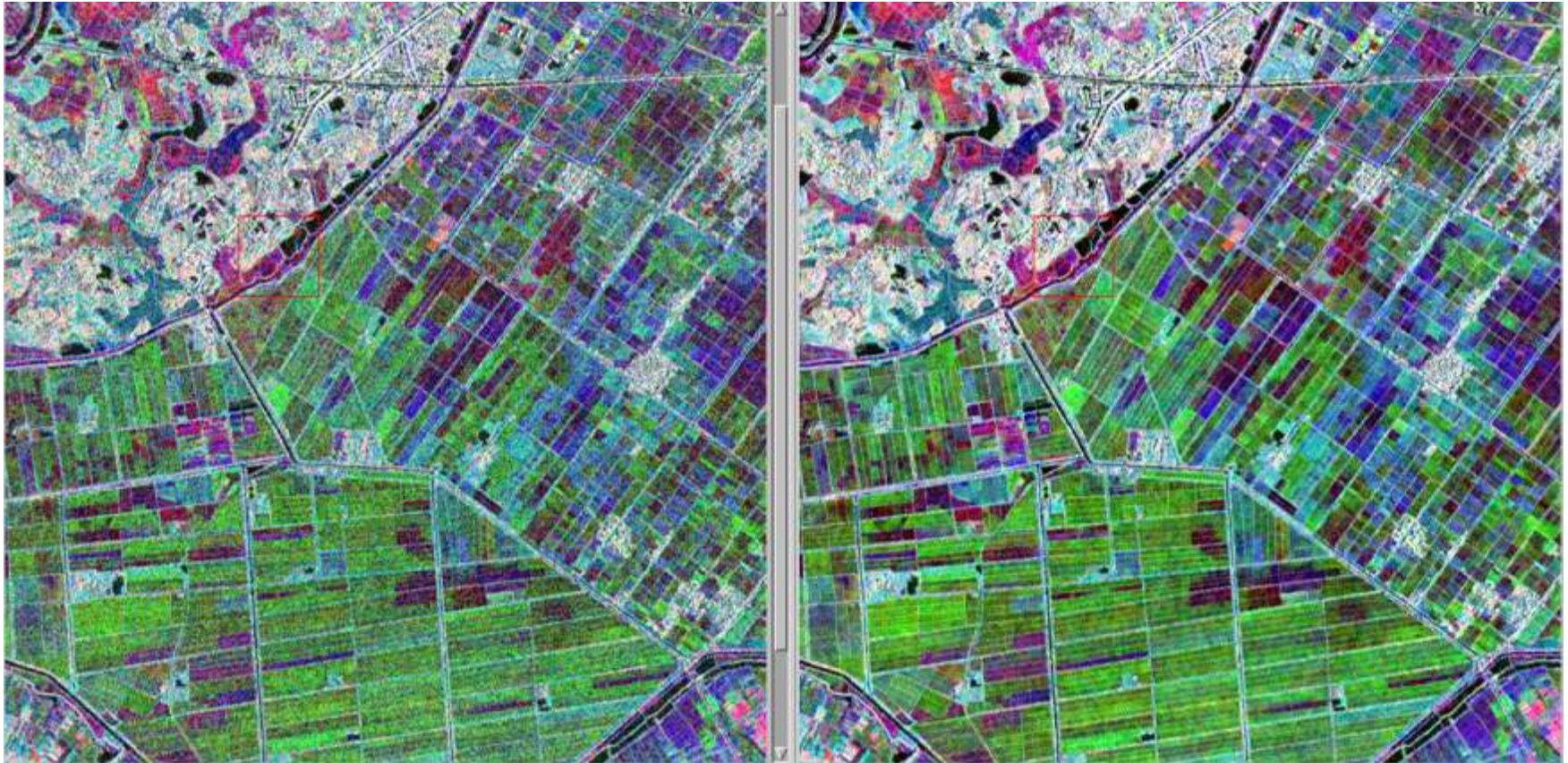
Bare soil  
Emergence  
Increment  
Closure  
**Harvest**





# Crop growth monitoring

Rice at 5m resolution every 5-11 days



Sharp results: Multi-temporal filtering

5m detail suitable for monitoring of small farms



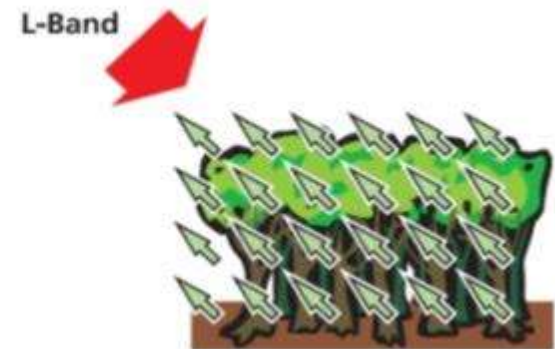
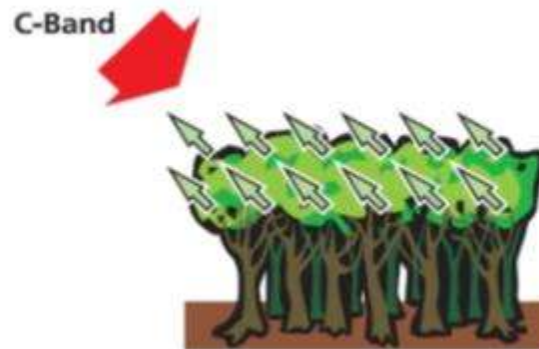
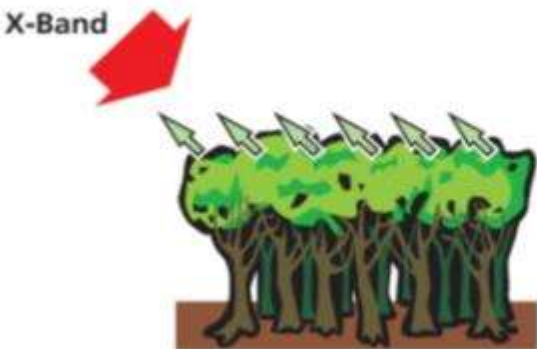


# Crop growth monitoring

1998

50 km

Deforestation





# Irrigation advice



The crop has no water stress when the soil moisture is above the critical level and below the field capacity

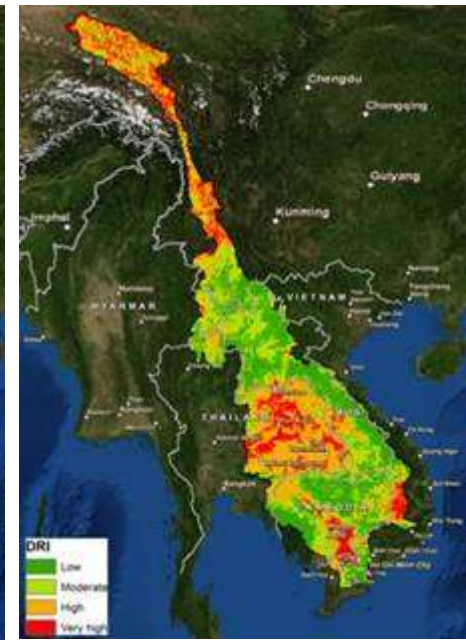
When the soil moisture drops below the critical line, irrigation is advised





# Advice and warning

## Hazard & Risk Analysis



Vulnerability Index  
Distance  
to river

Vulnerability Index  
Population density

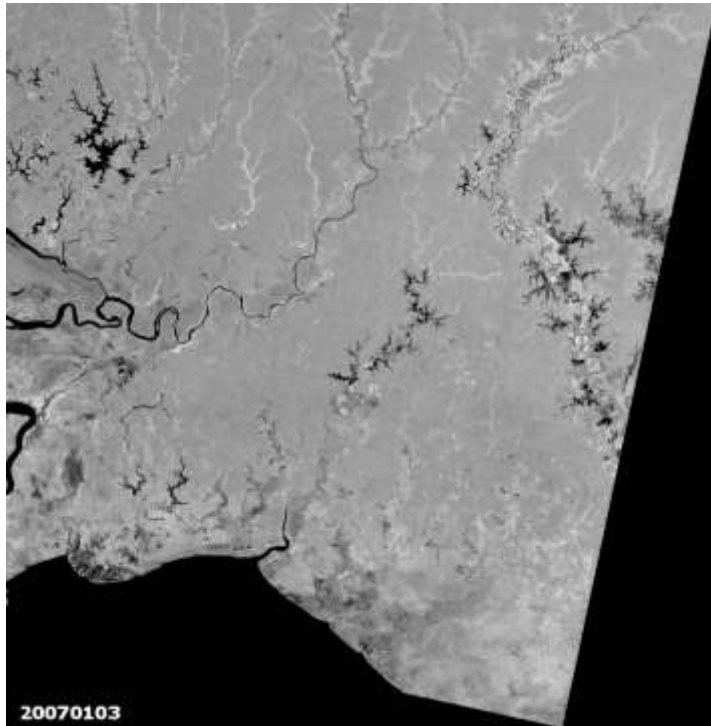
Vulnerability Index  
Precipitation

Drought  
Risk Map

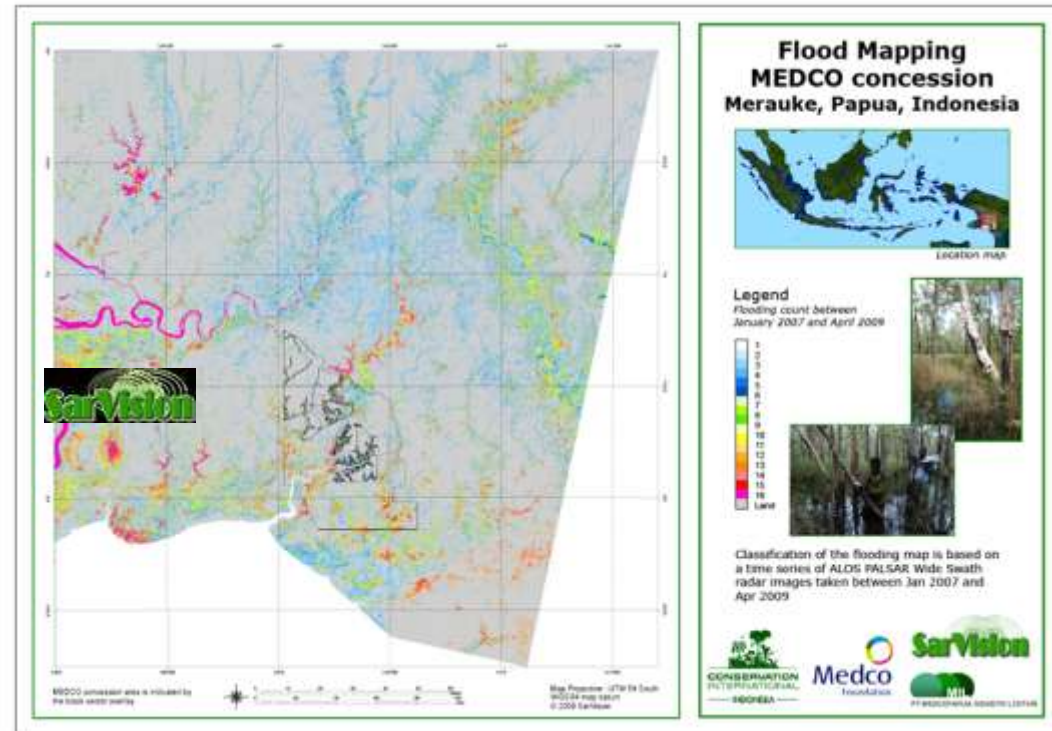


# Advice and warning

## Flood Mapping (radar)



Actual



All weather, looking through clouds and canopy

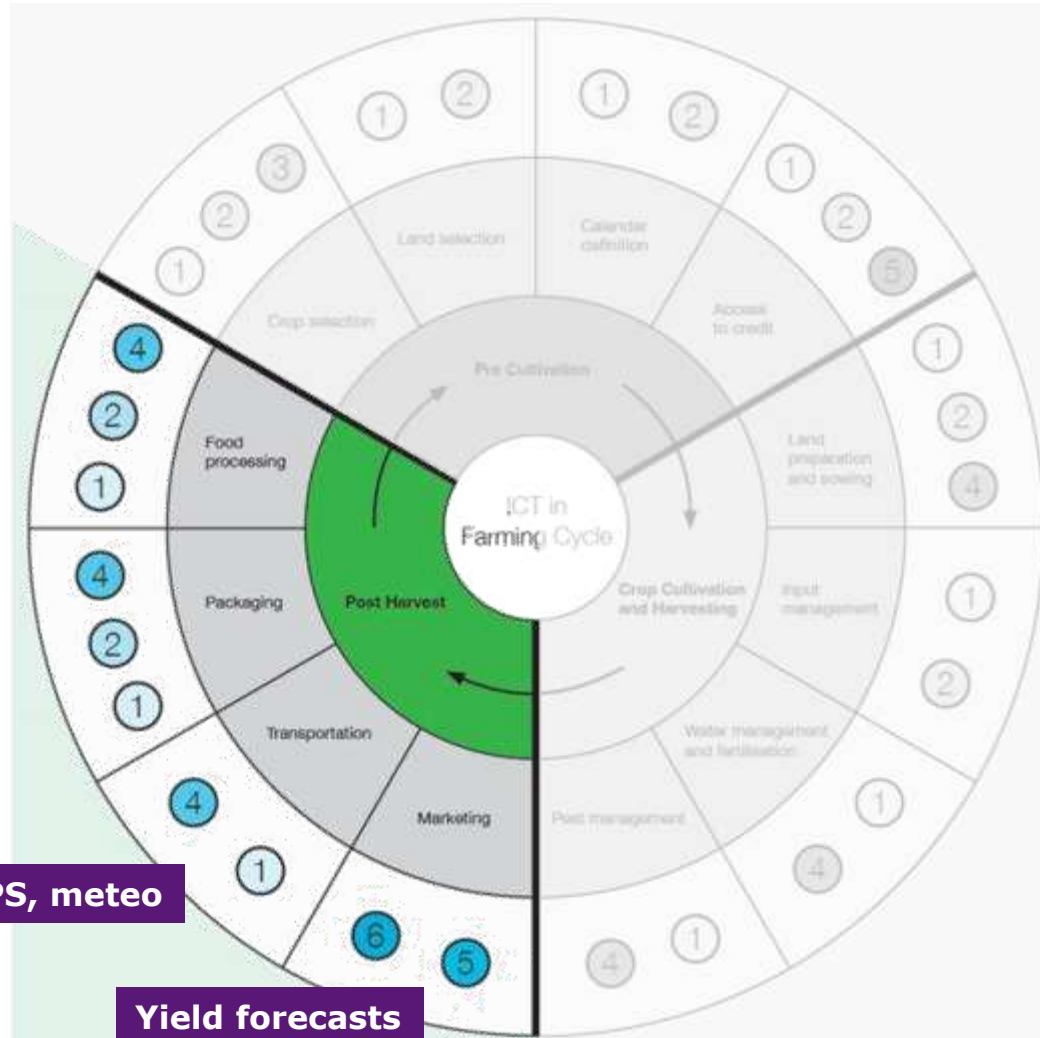
Average





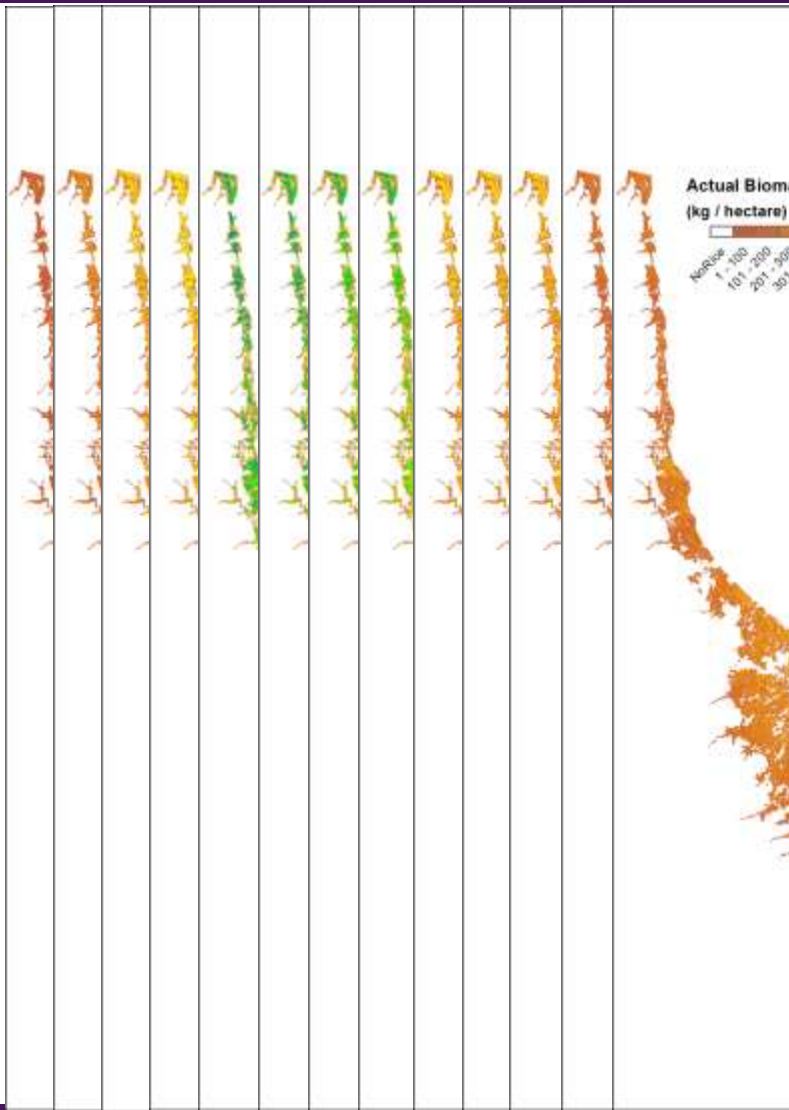


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# Yield forecast



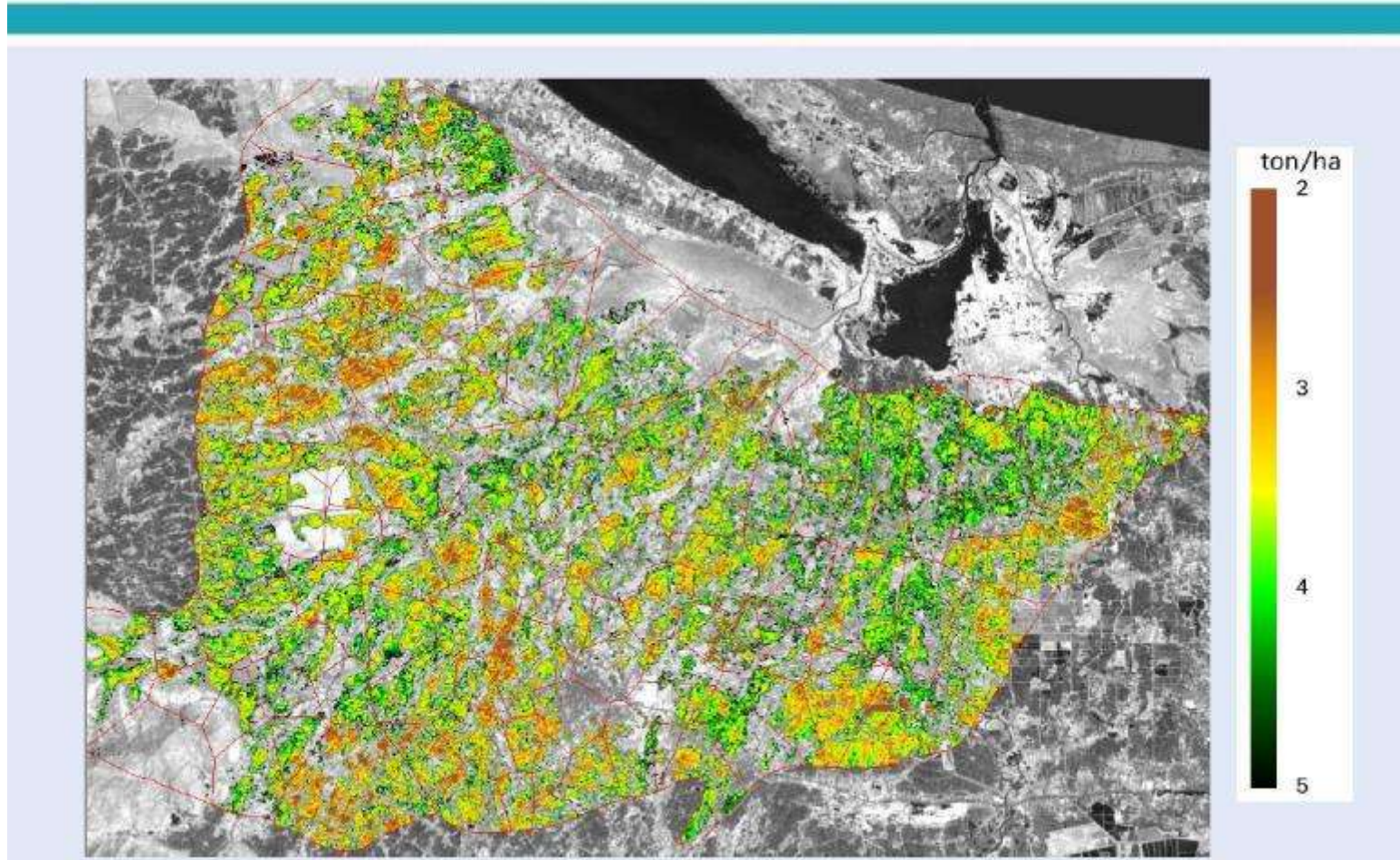
Actual Biomass Production





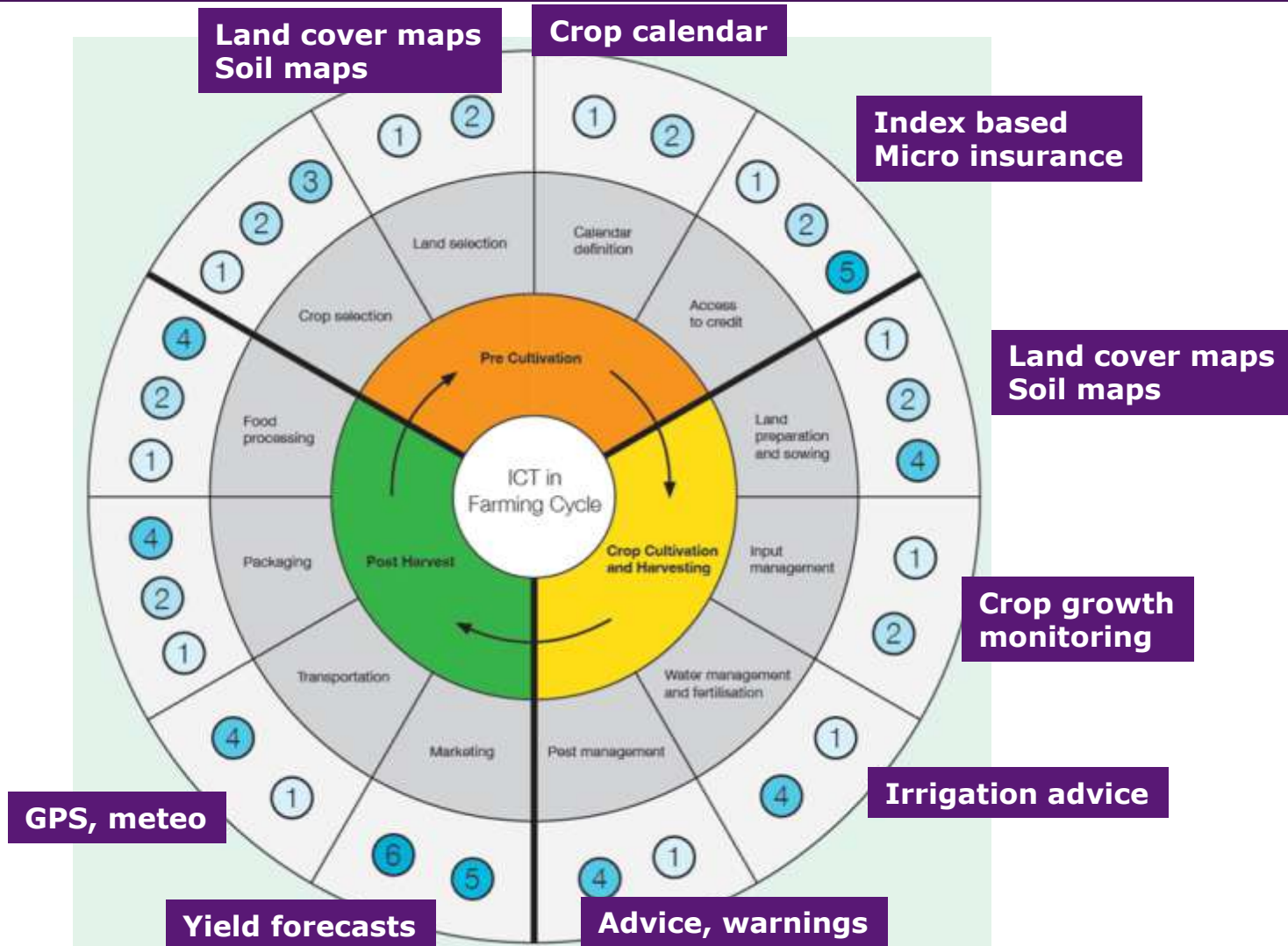
# Yield forecast

## Rice Yield maps





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Online, weekly updated,  
for all types of crops

# Field Look

## • Growth

- biomass production (kg/ha)
- CO2 intake (kg/ha)
- leaf area index LAI (m<sup>2</sup> leaf/m<sup>2</sup> ground)
- vegetation index NDVI

## • Moisture

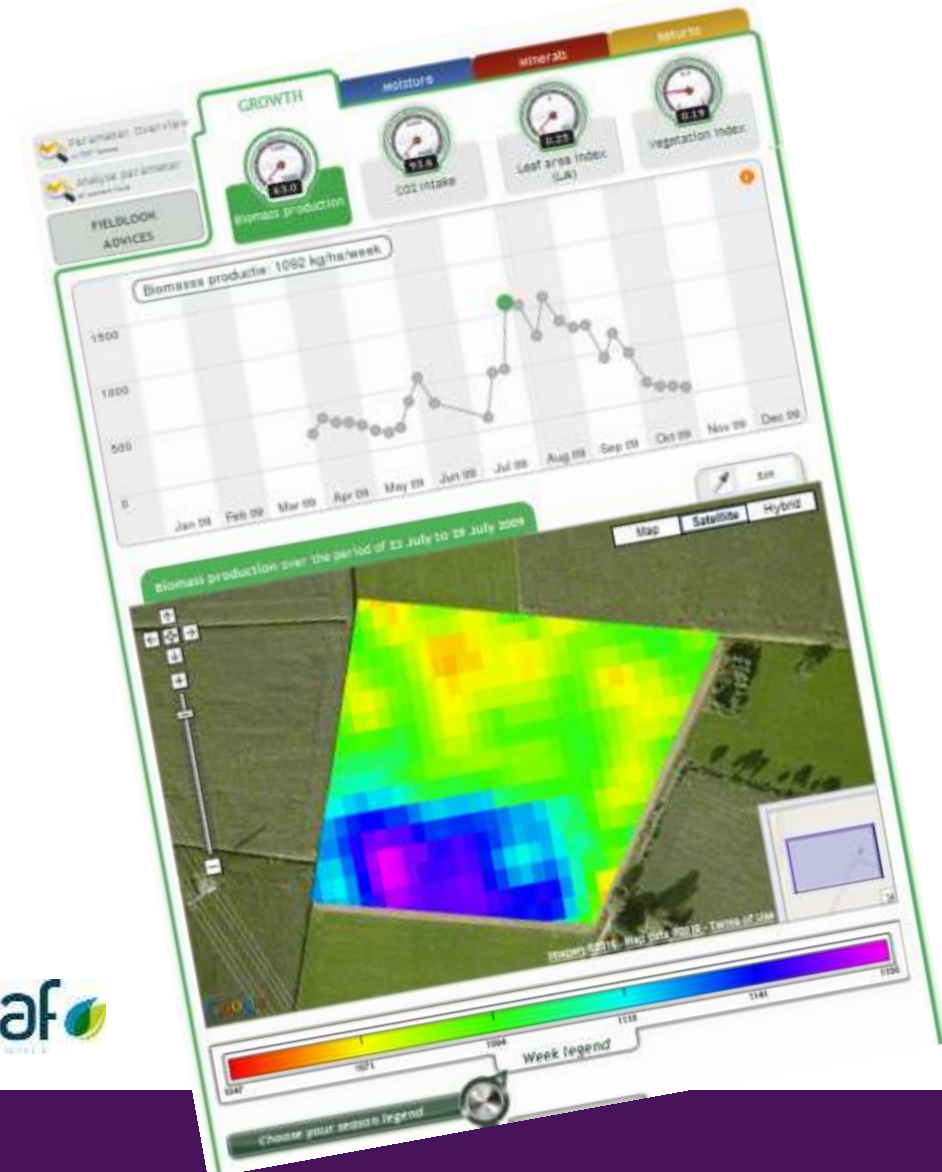
- evaporation shortage (mm/week)
- current evaporation (mm/week)
- surplus rain (mm/2 weeks)
- reference evaporation

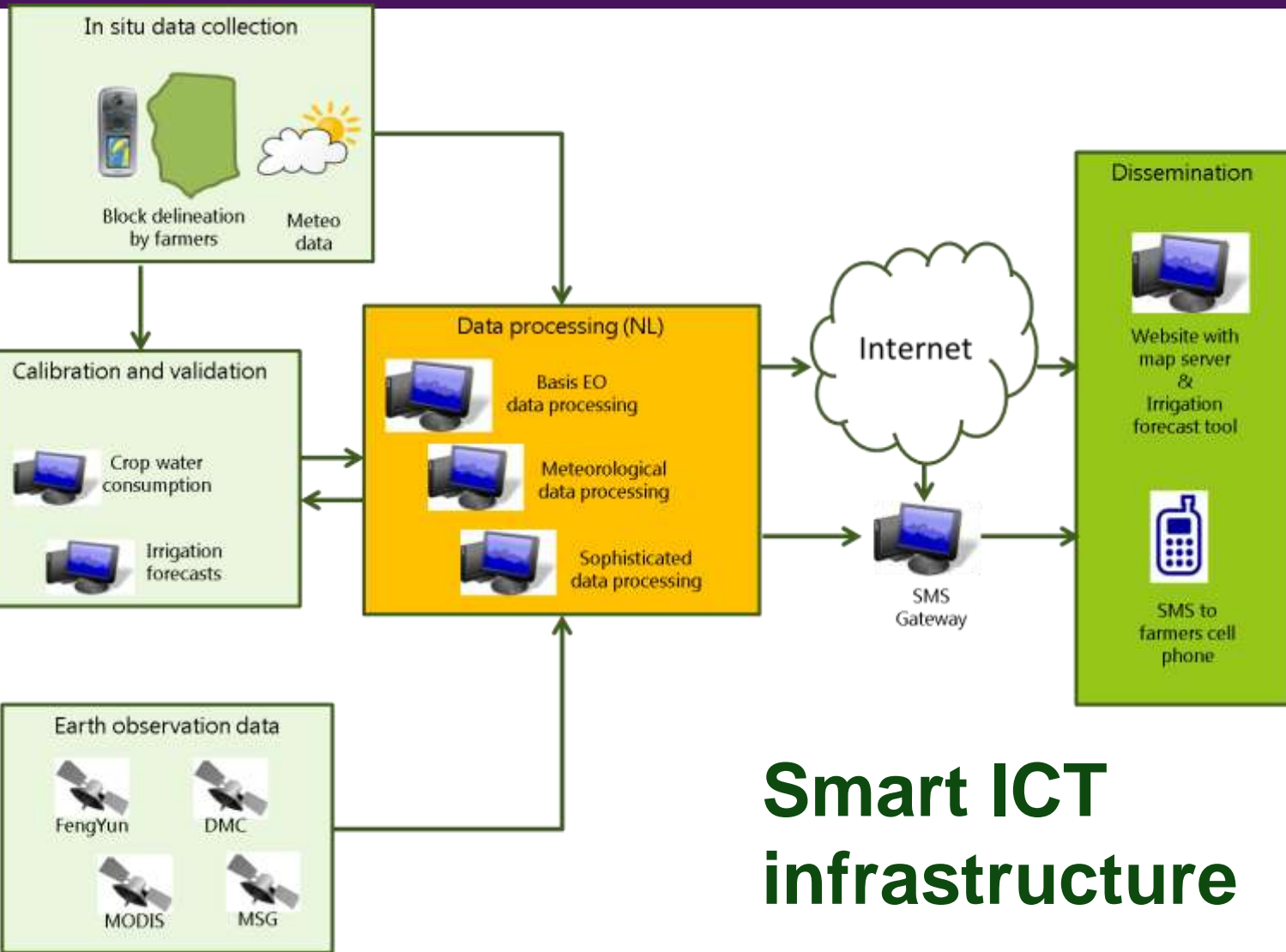
## • Minerals

- Nitrogen content in the top leaf layer (kg/ha)
- Nitrogen content in all leaves (kg/ha)

## • Yield

- Fruit Yield
- Root Yield
- Dry matter content
- Sugar Yield
- Protein content





# Smart ICT infrastructure

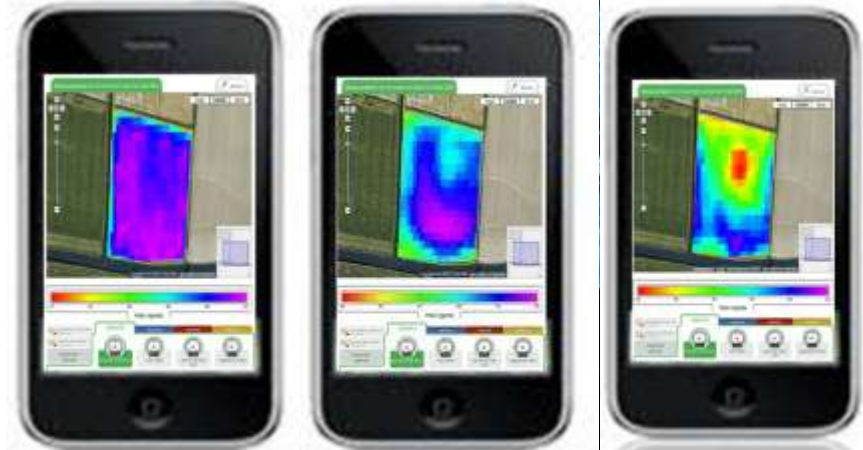






# Possible service provision

- Crop calendars
  - Weather information
  - Mapping
  - Monitoring (e.g. vegetation growth)
  - Irrigation / nutrient supply advices
- 
- Stand alone
  - Integrated in value chain services
  - Complementary to micro-insurance

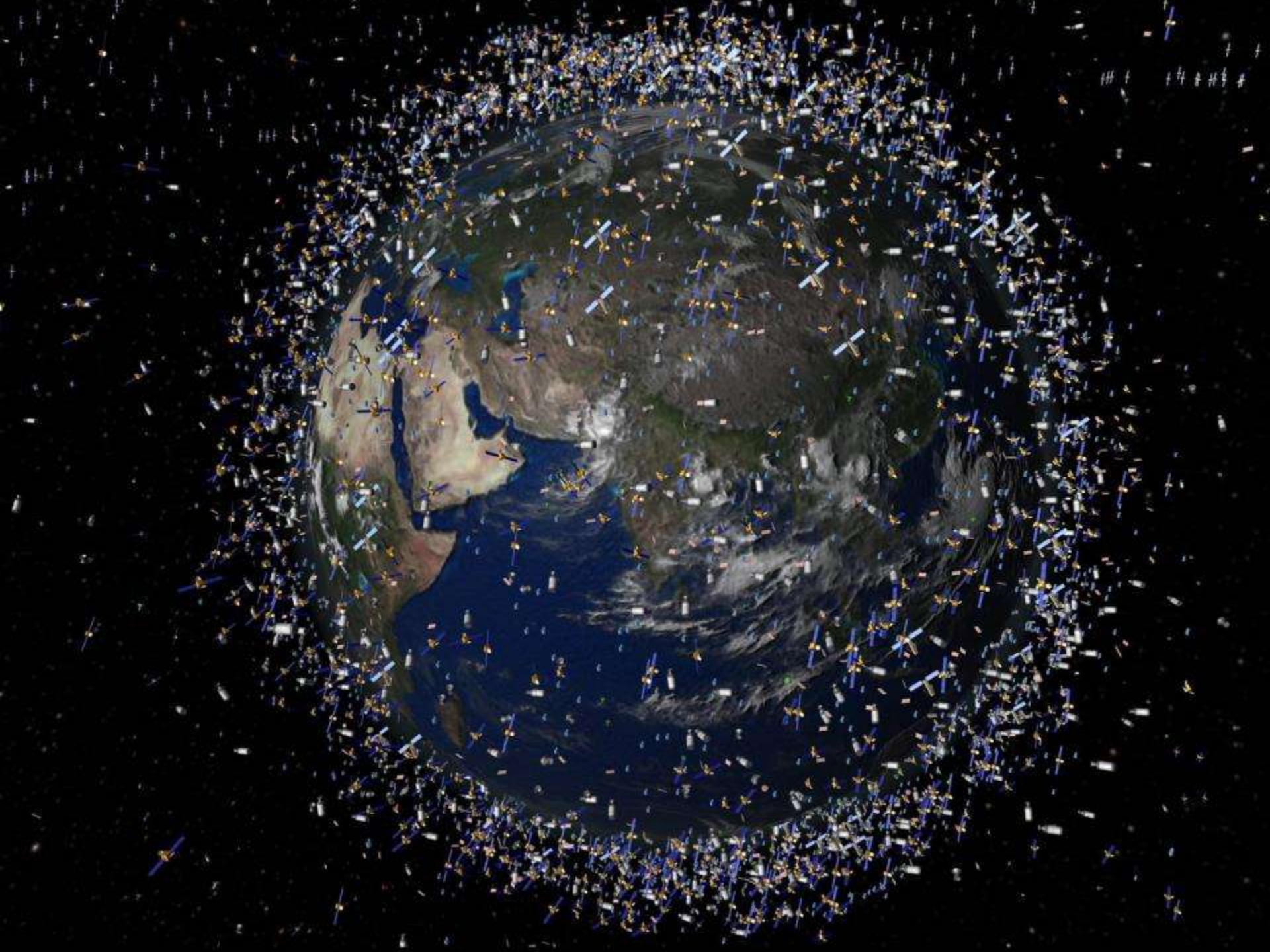


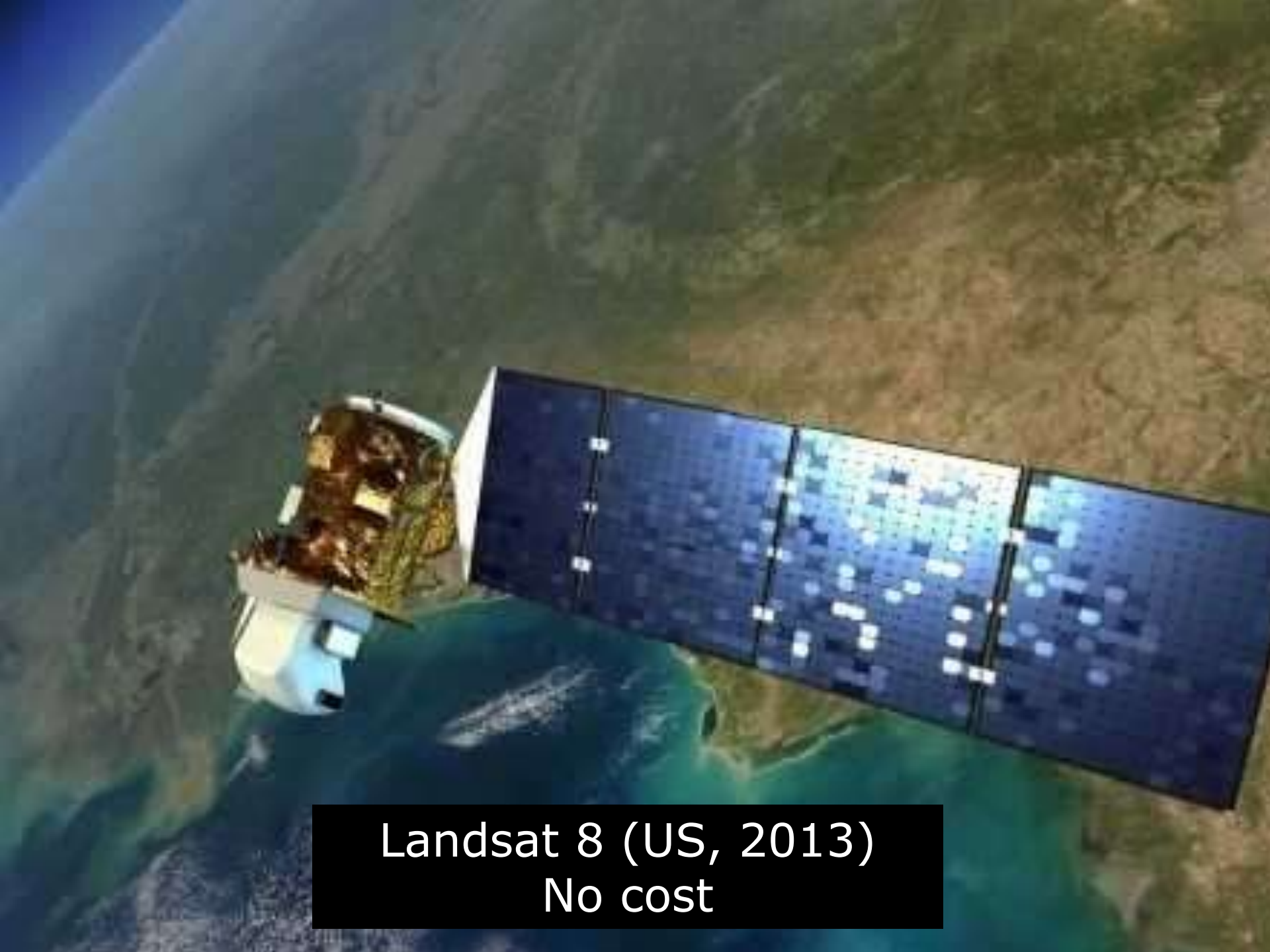


## Why based on satellite data?

- Objective, consistent, cross border
- No or few (local) monitoring infrastructure
- 25+ years time series (geostationary satellite, Landsat)
- Many new satellites (to be) launched, no or low cost







Landsat 8 (US, 2013)  
No cost



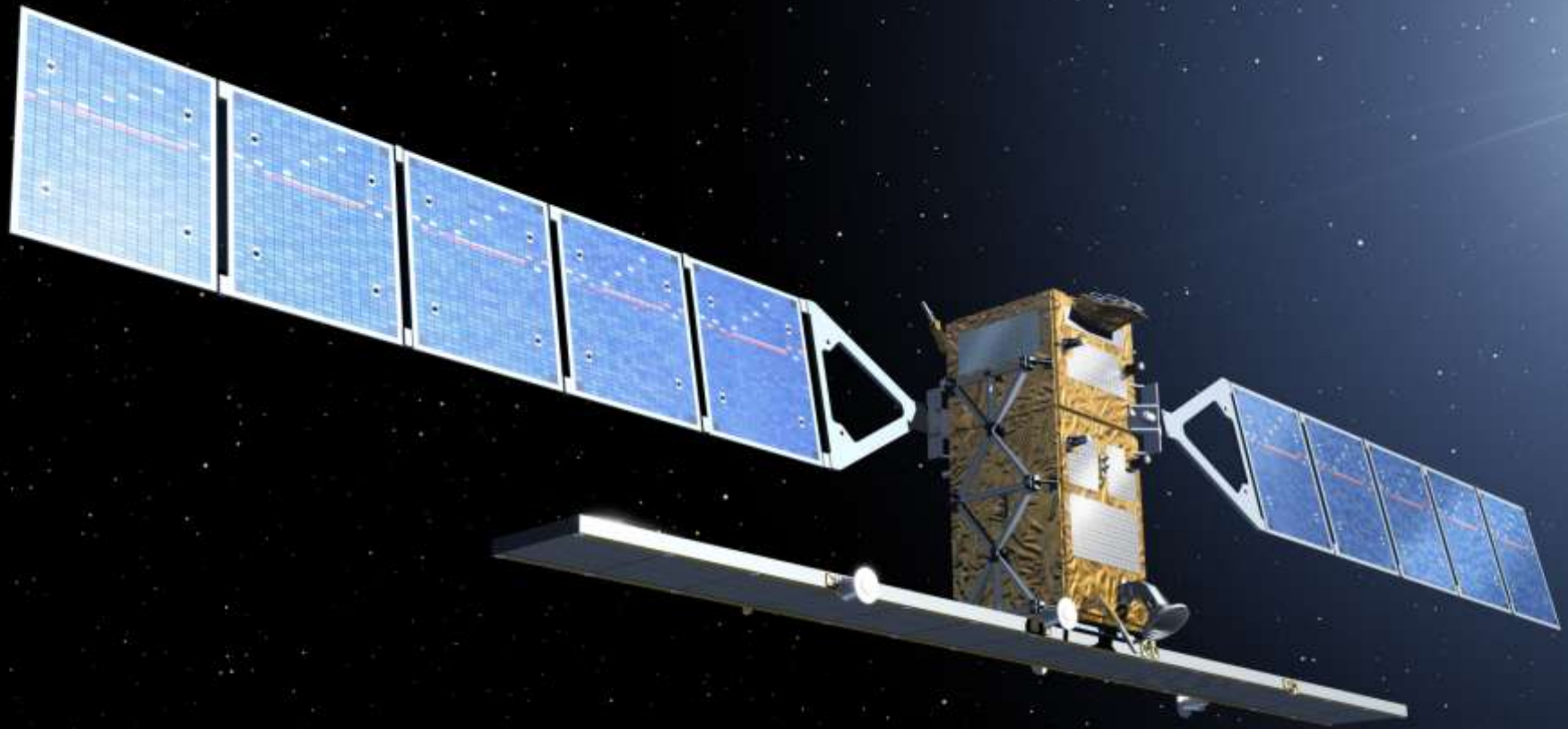


Planet Labs (2014)



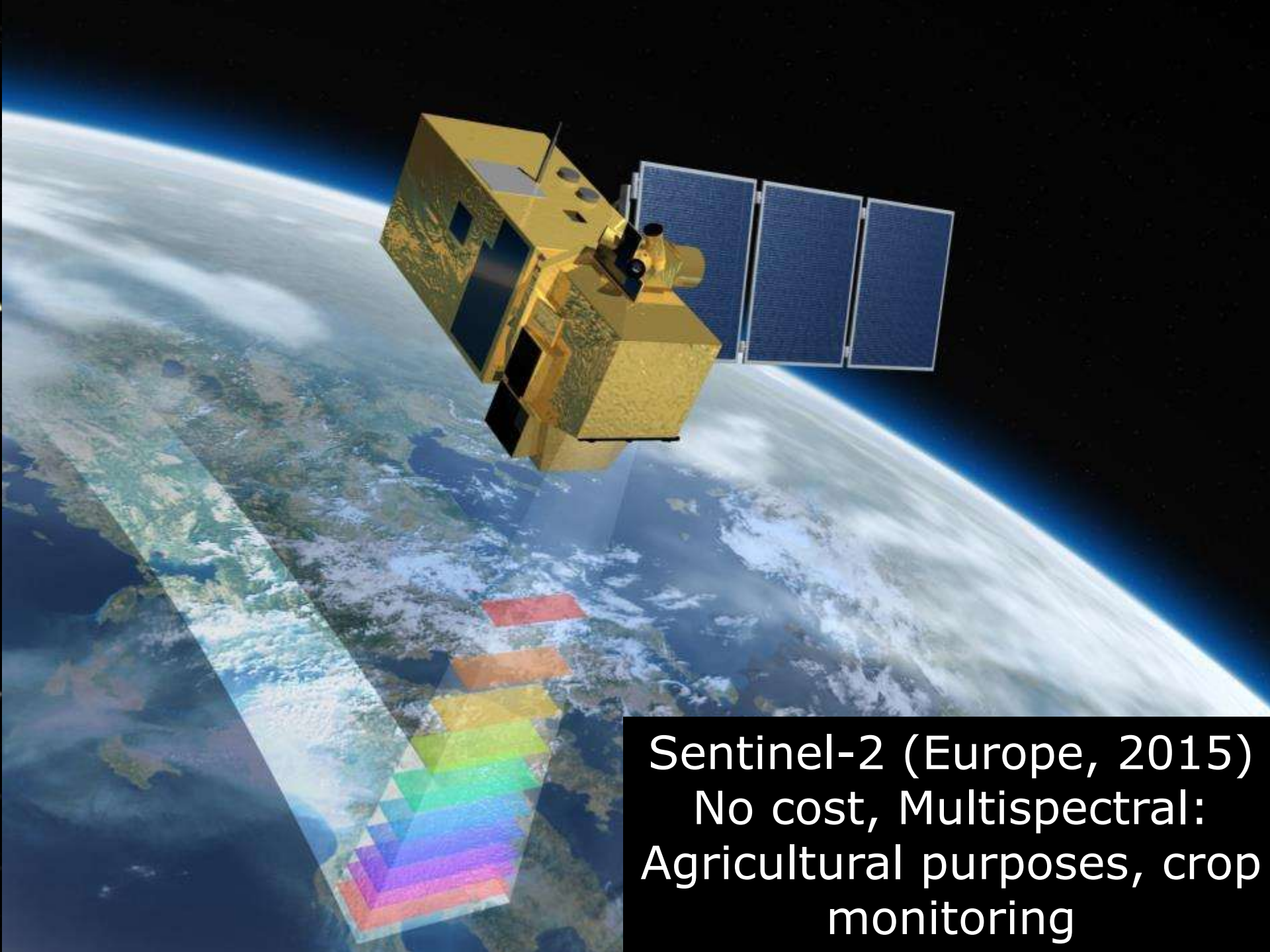
Skybox (2014)

Constellation  
High revisit time  
Commercial  
Low cost



Sentinel-1 (Europe, 2014)  
No cost  
Looking through clouds, day & night





Sentinel-2 (Europe, 2015)  
No cost, Multispectral:  
Agricultural purposes, crop  
monitoring

High resolution  
VNIR satellites

Worldview-2

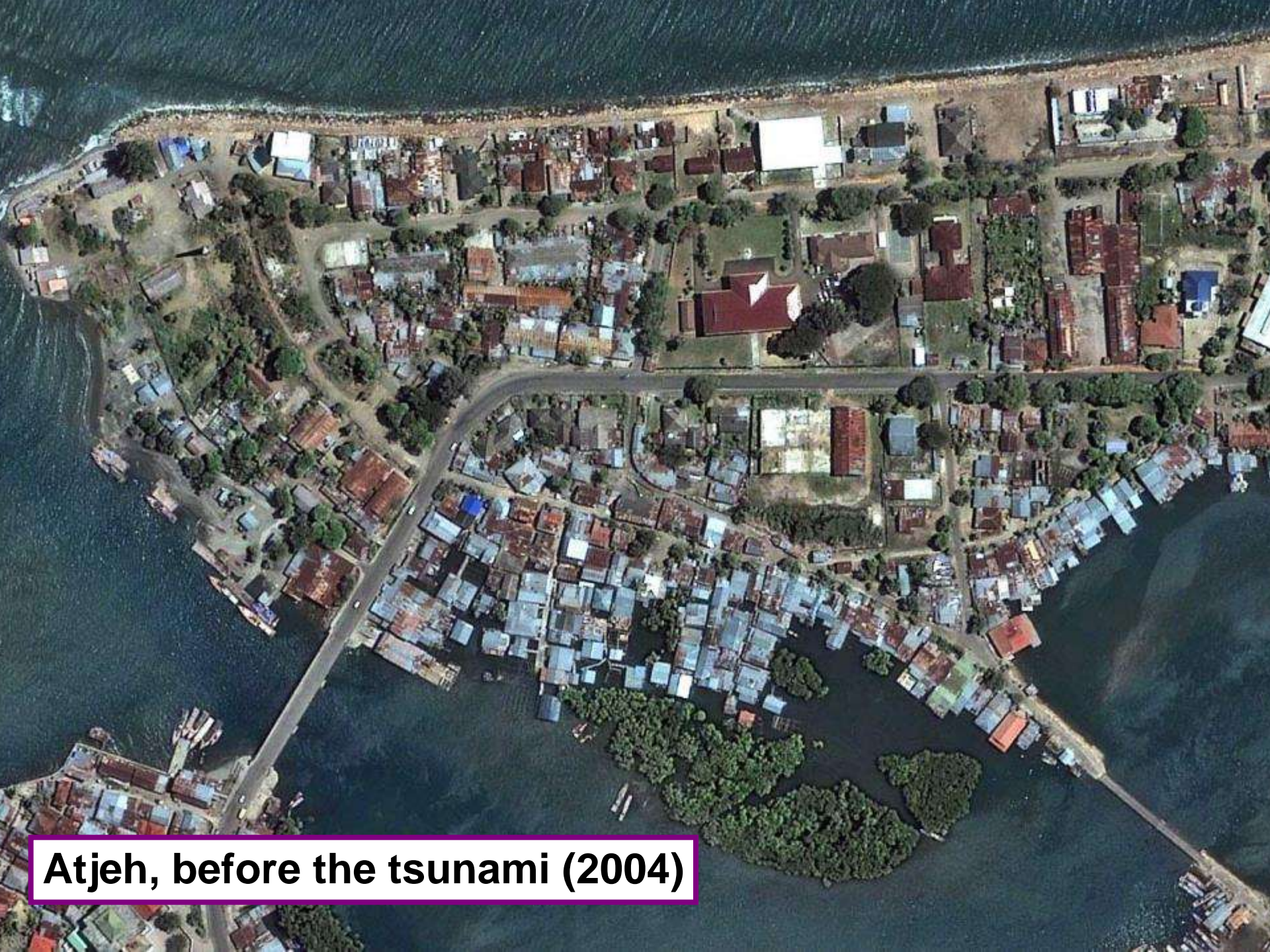






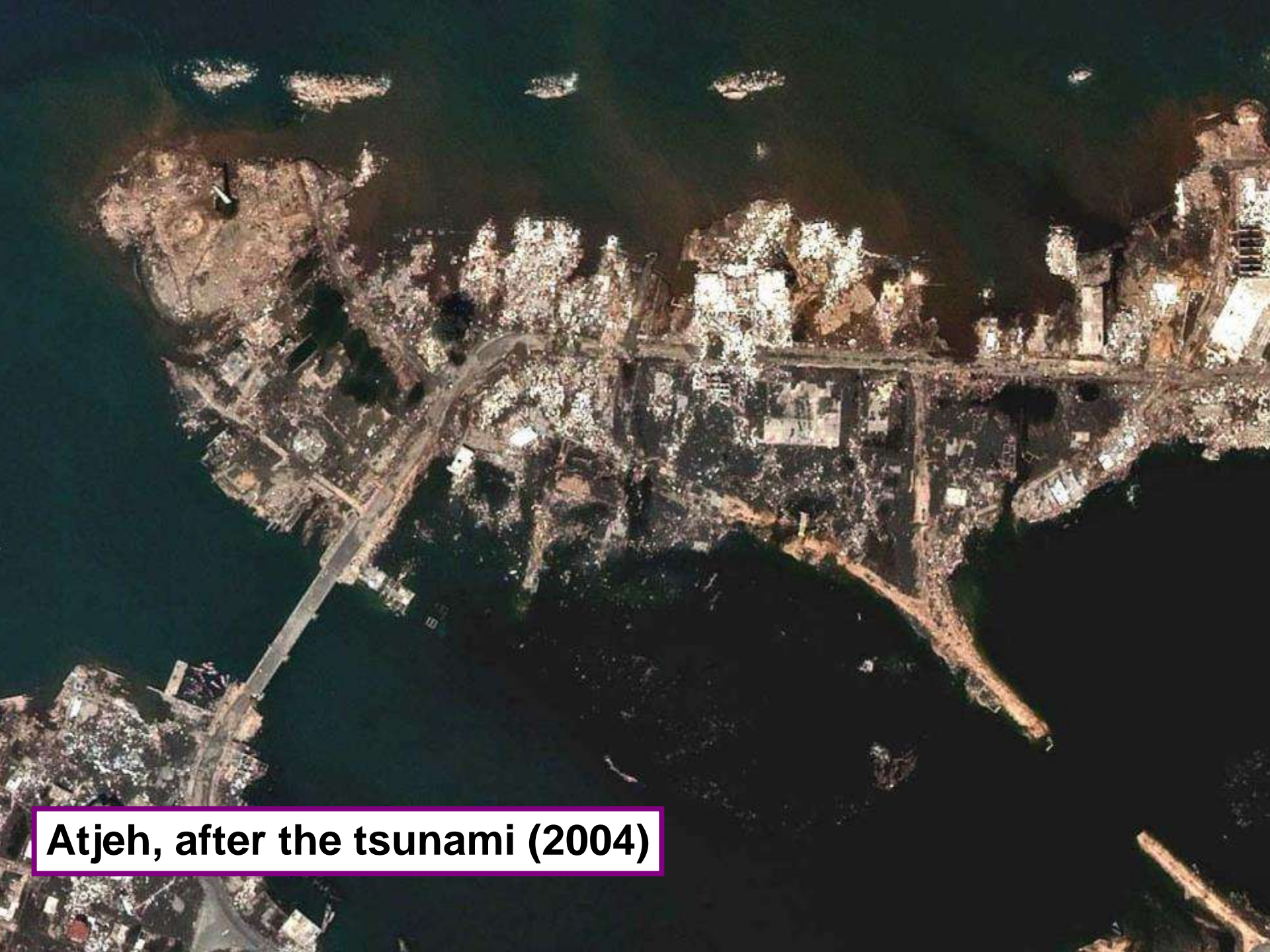
**Optical images : 50 cm resolution**





**Atjeh, before the tsunami (2004)**





**Atjeh, after the tsunami (2004)**



**Thank you for your  
attention**





# Mobile/ICT applications

## Mobile Applications for Agriculture and Rural Development

Christine Zhenwei Qiang, Siou Chew Kuek\*, Andrew Dymond and Steve Esselaar

ICT Sector Unit  
World Bank

December 2011

Figure 1. Results Generated by Mobile Applications for Agricultural and Rural Development

