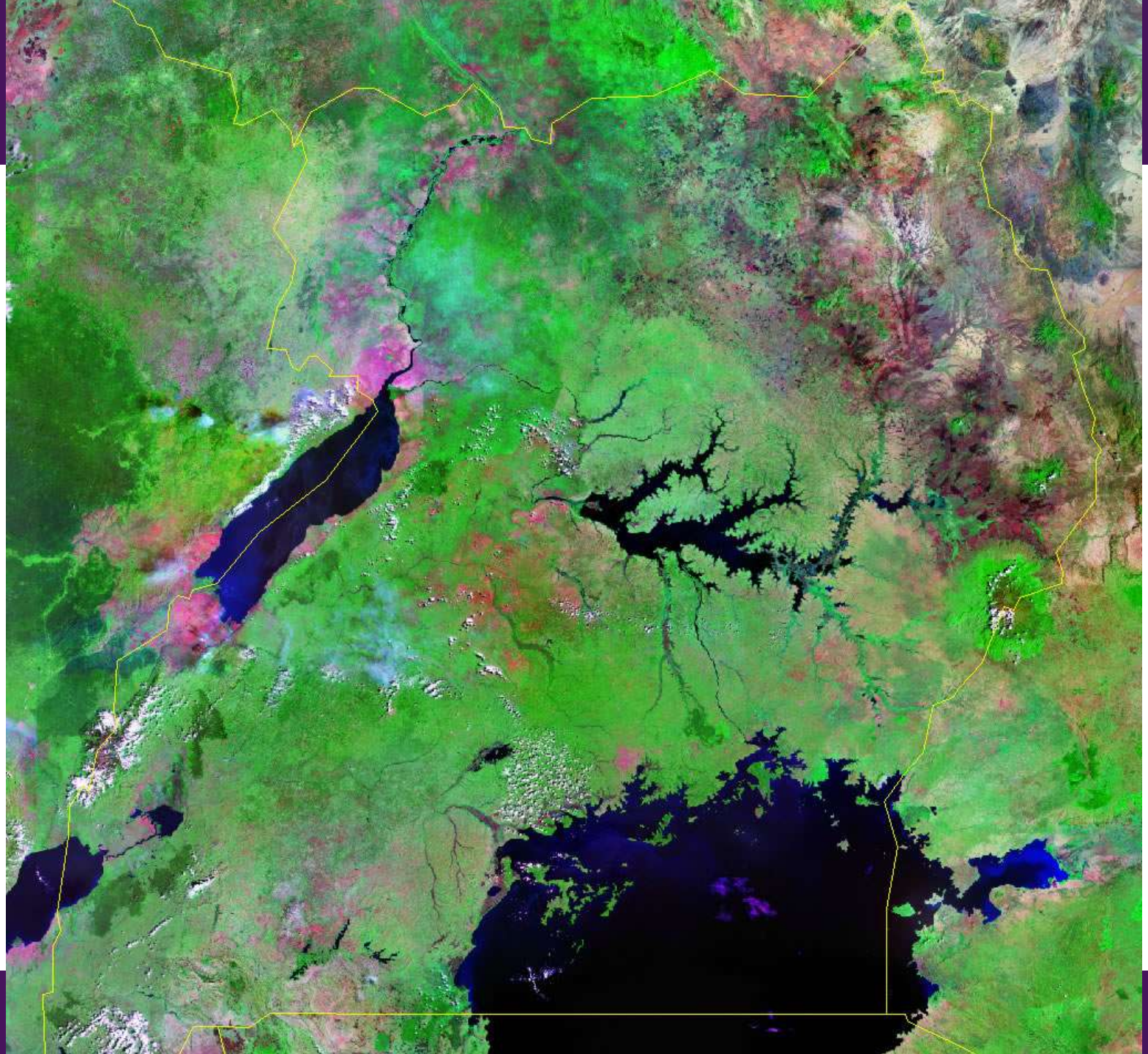
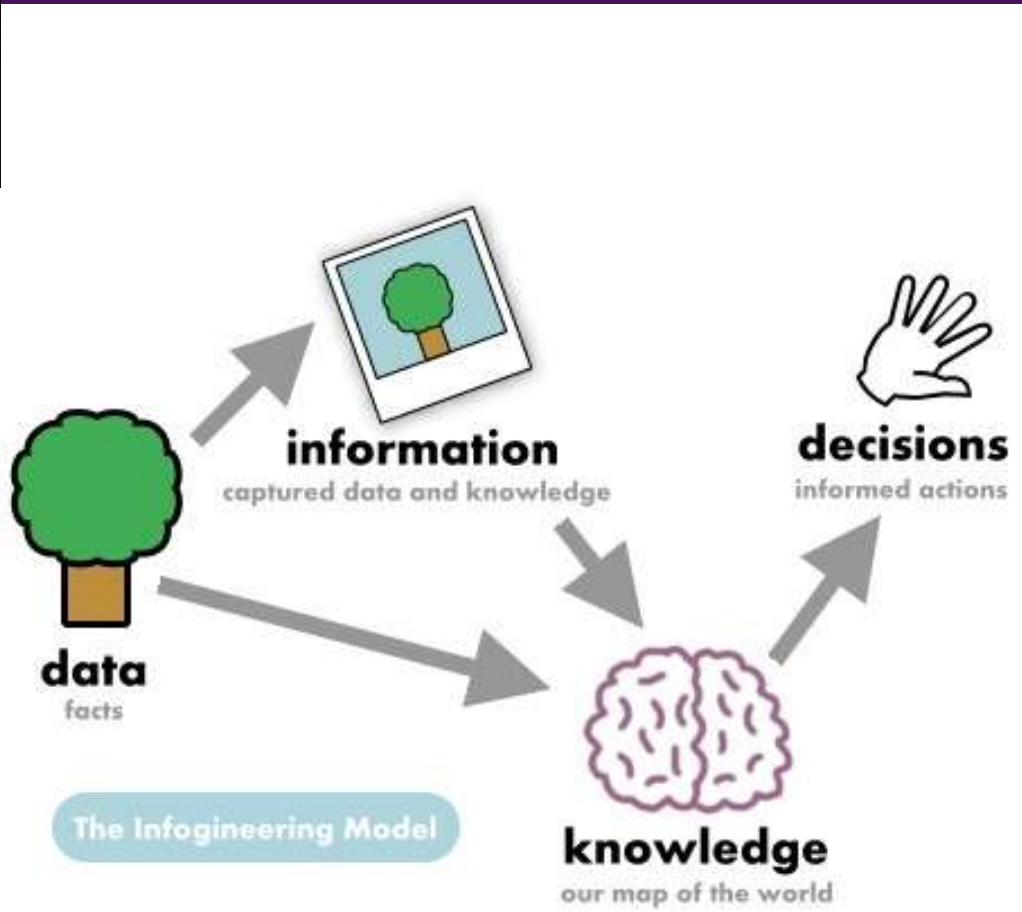
Food security & Satellite information services

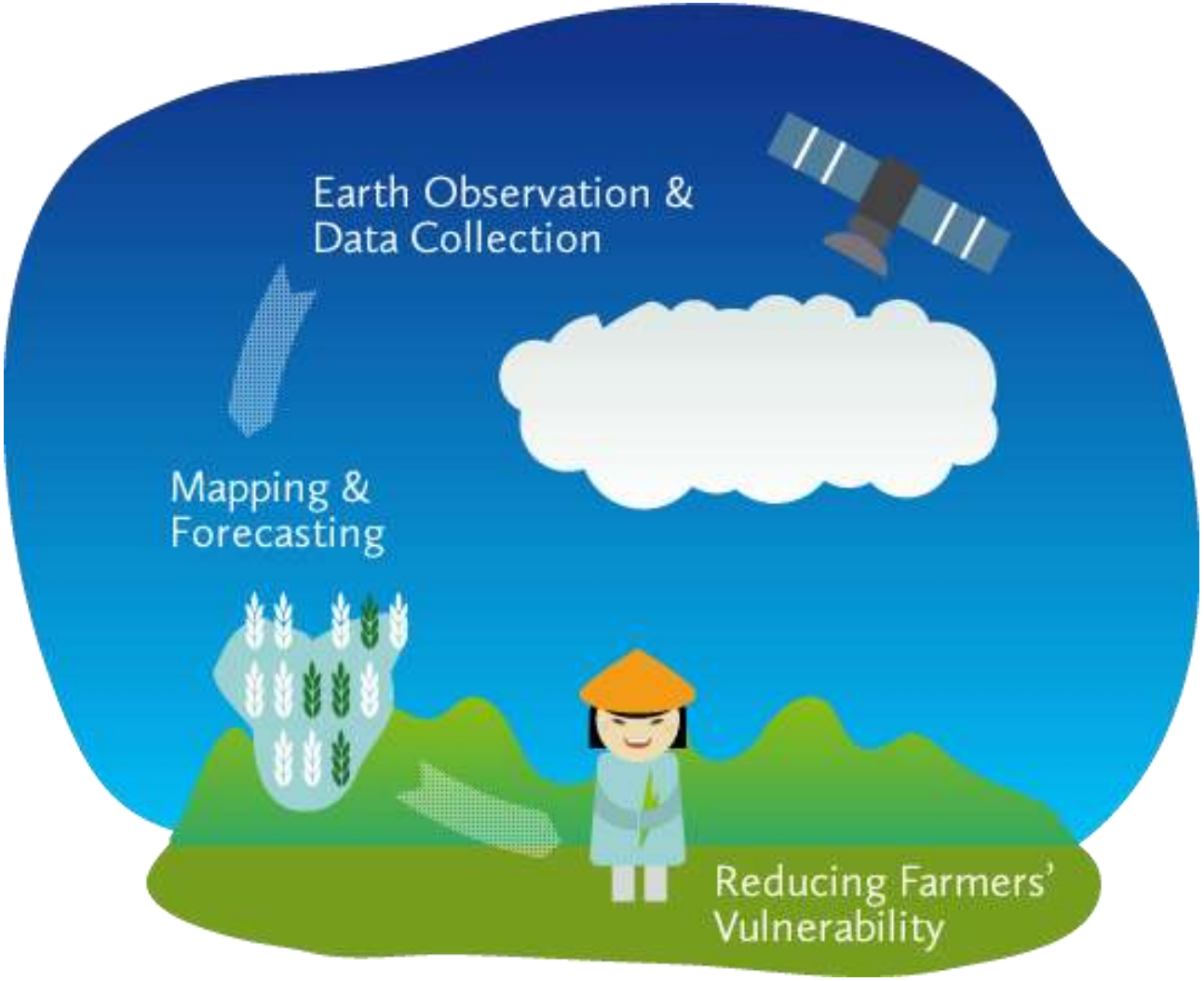
Mark Loos

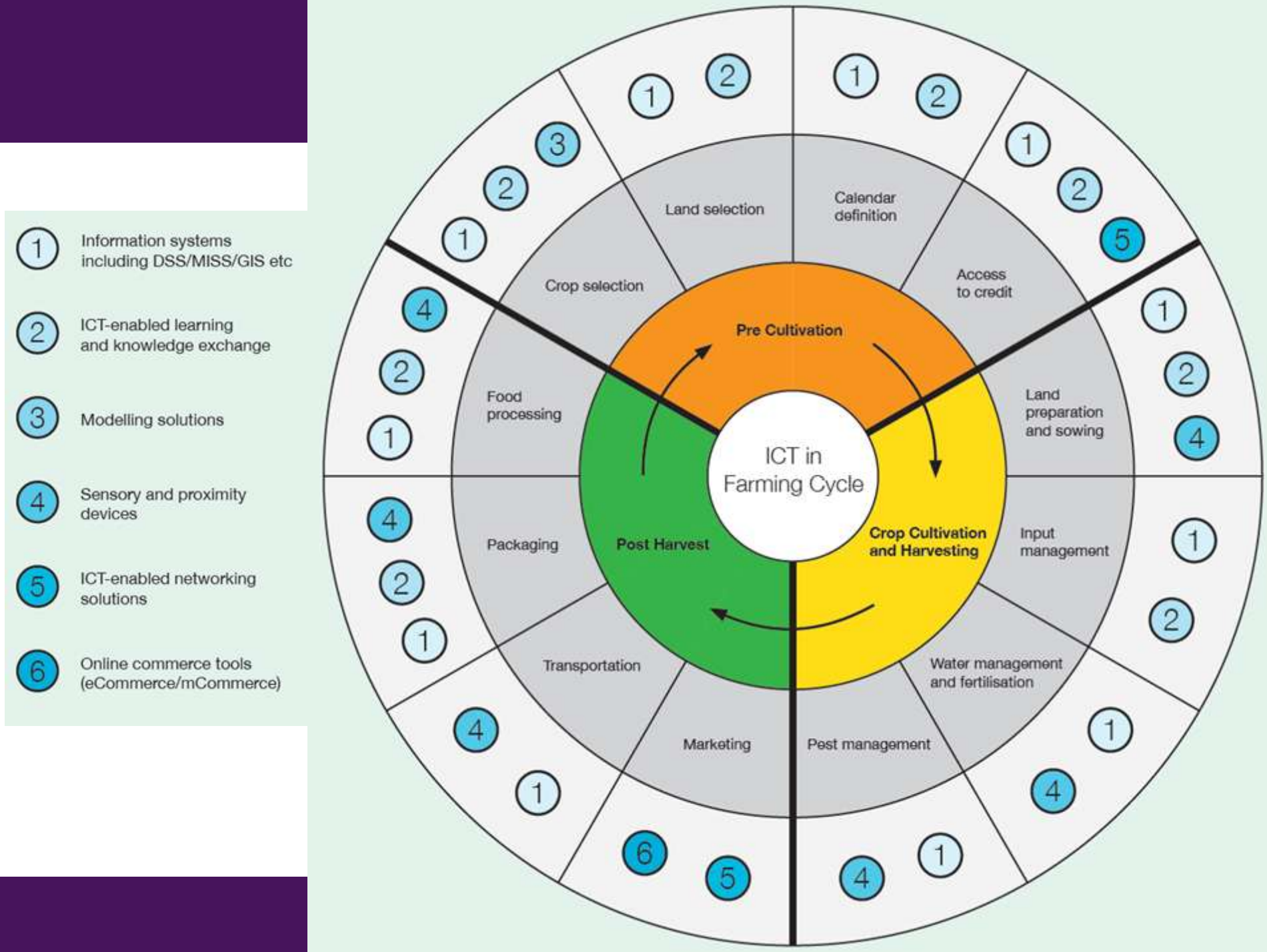
Netherlands Space Office (NSO)



Effects of climate change on Food & water security


information
captured data and knowledge
decisions
informed actions
data
facts
The Infogineering Model
knowledge
our map of the world


Earth Observation &
Data Collection
Mapping &
Forecasting
Reducing Farmers'
Vulnerability


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)
ICT in Farming Cycle
Pre Cultivation
Crop Cultivation and Harvesting
Post Harvest
Land selection
Calendar definition
Access to credit
Land preparation and sowing
Input management
Water management and fertilisation
Pest management
Marketing
Transportation
Packaging
Food processing
Crop selection

1. Information systems including DSS/MISS/GIS etc
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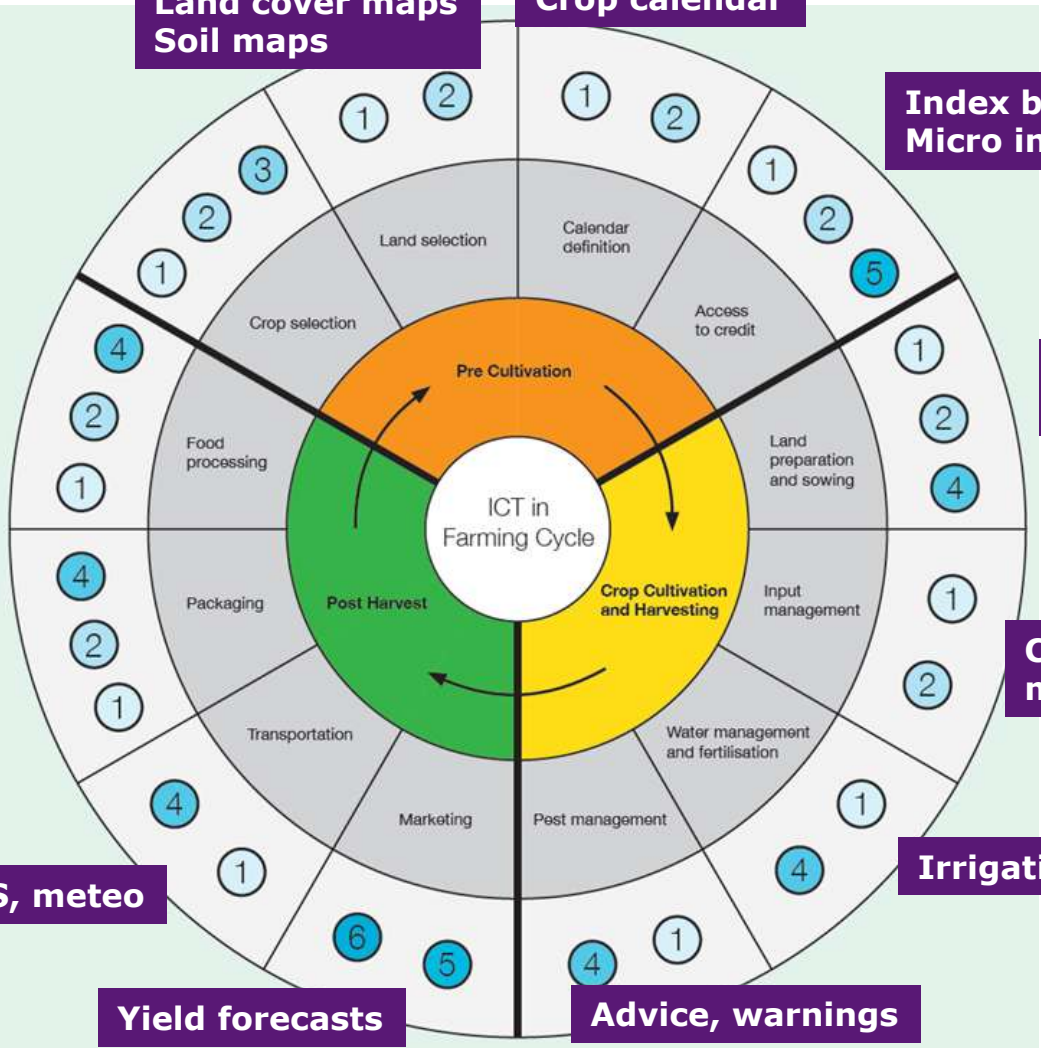

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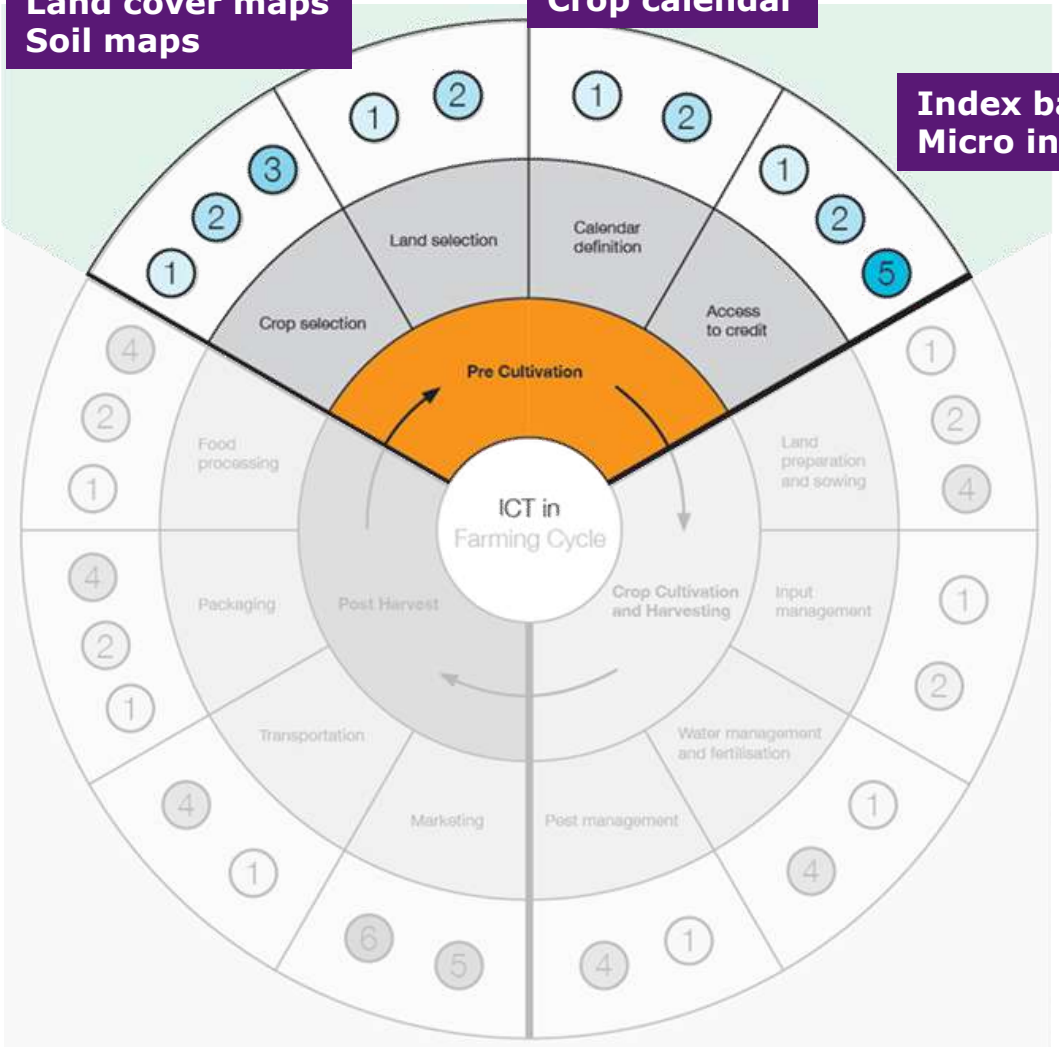
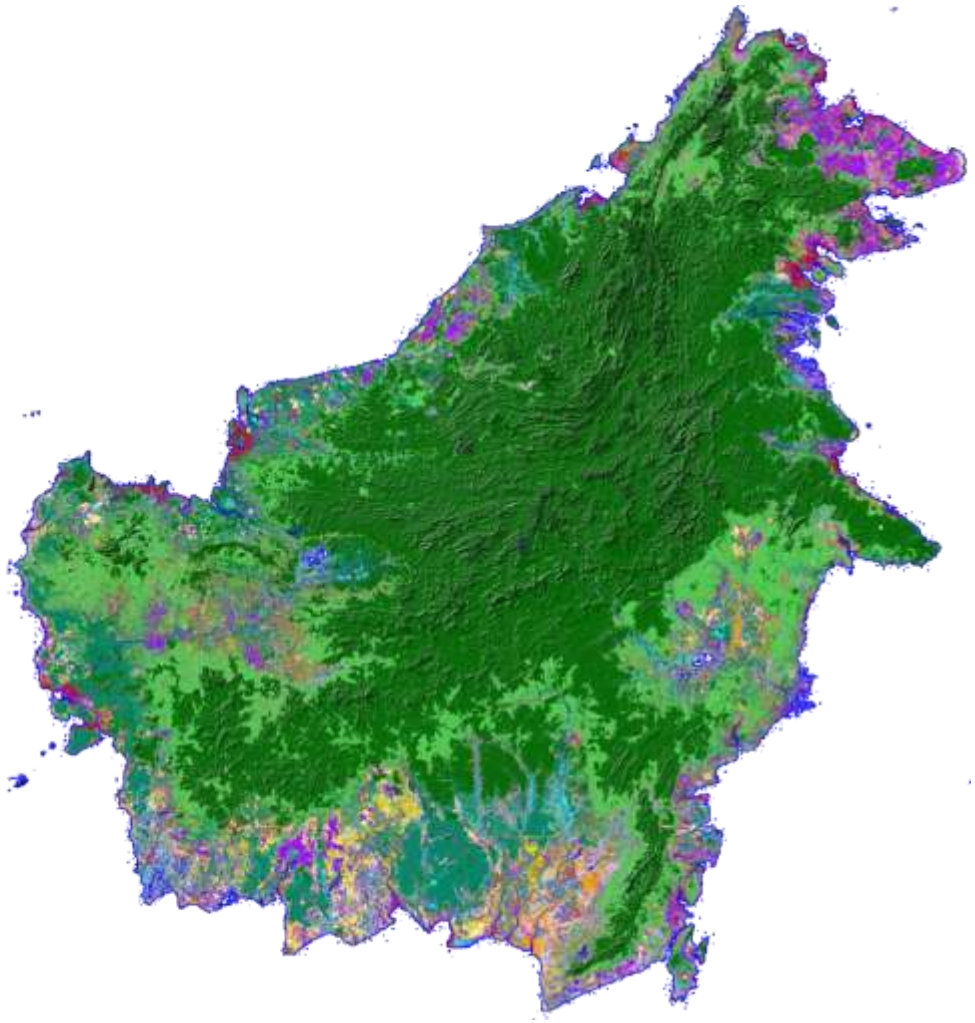
Land cover maps
Soil maps

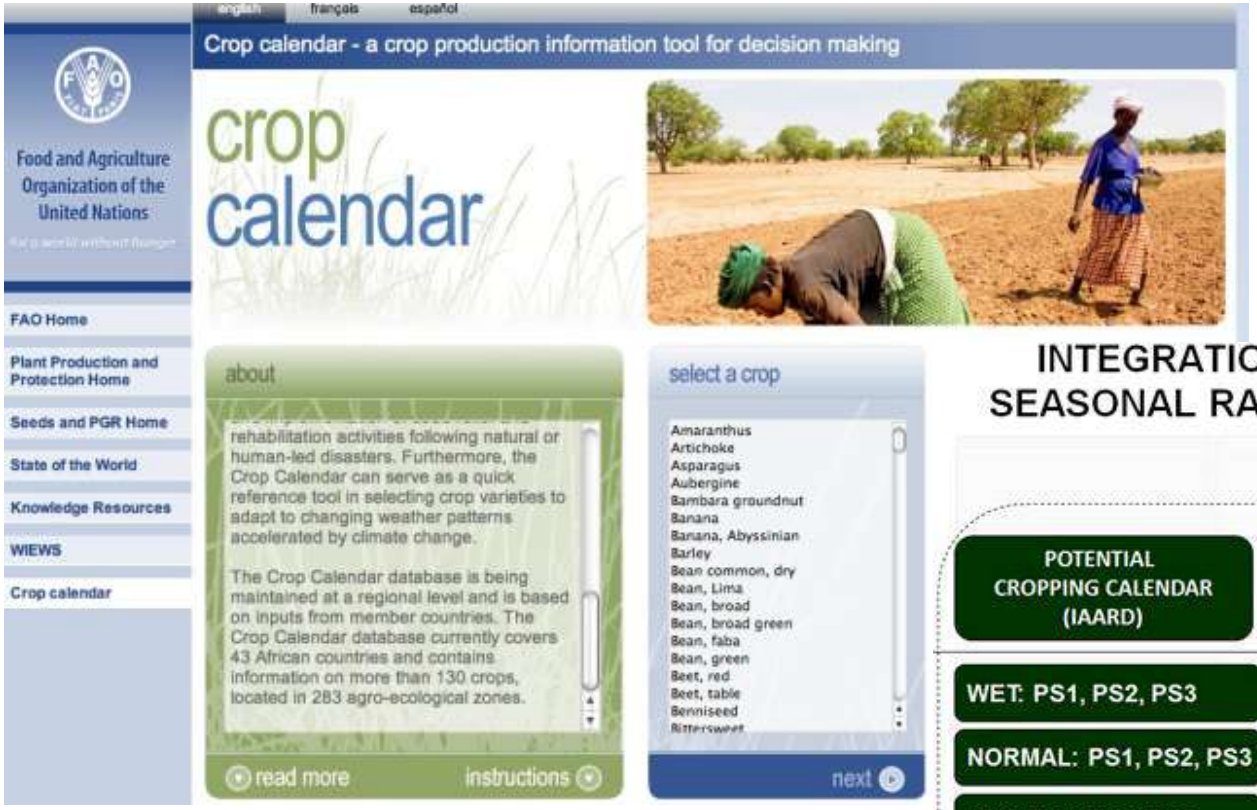
Crop calendar

Index based
Micro insurance



Kalimantan Land cover map (radar)
(SarVision)



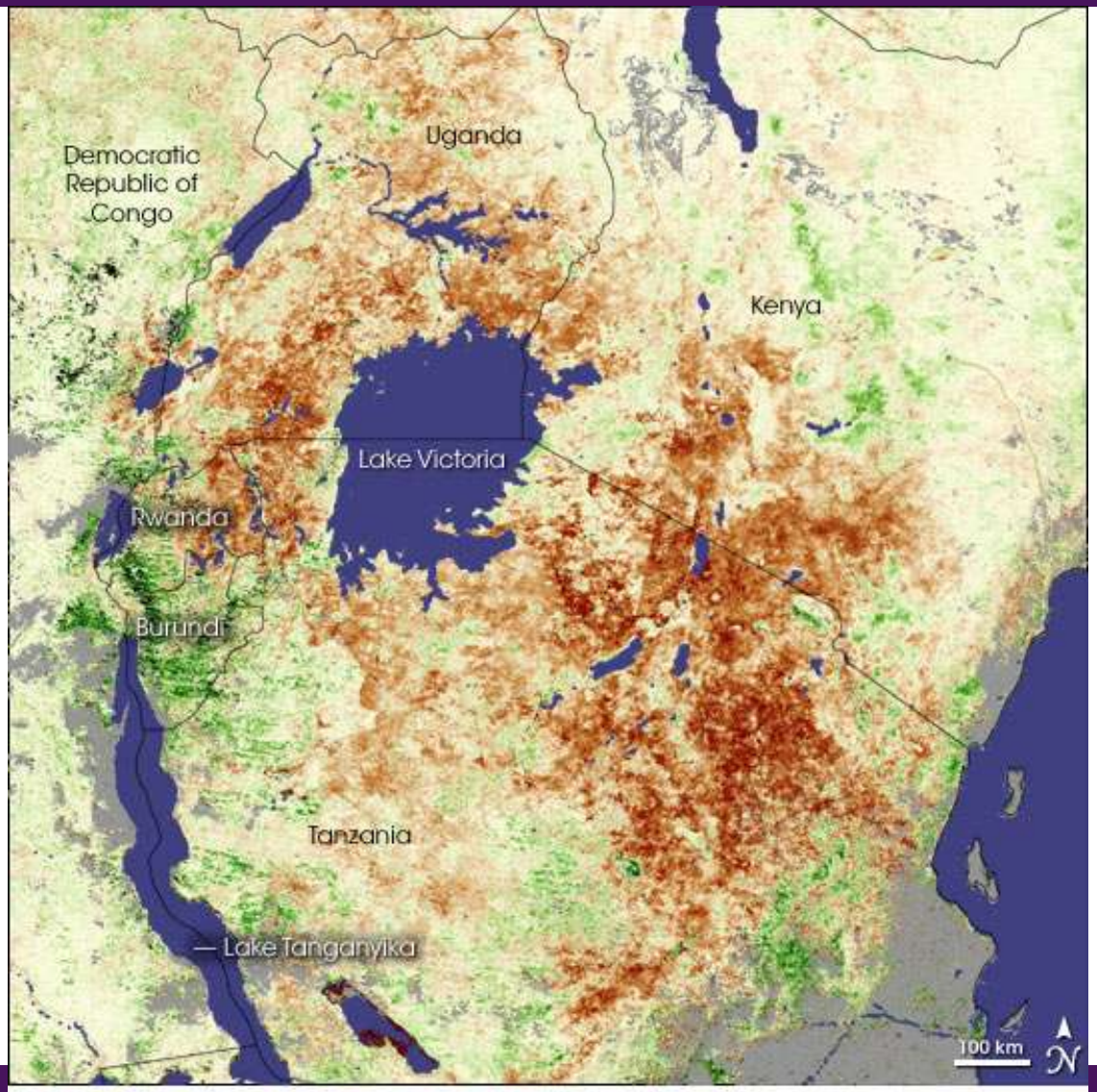


INTEGRATION OF CROPPING PATTERNS, SEASONAL RAINFALL AND SATELLITE IMAGE ANALYSIS

POTENTIAL CROPPING CALENDAR (IAARD)	SEASONAL RAINFALL PREDICTION (BMKG)	DROUGHT IMAGE ANALYSIS (ICALRD)
WET: PS1, PS2, PS3	FORECAST OF MONTHLY RAINFALL (mm/month)	NDVI
NORMAL: PS1, PS2, PS3		VCI
DRY: PS1, PS2, PS3	PROSPECT OF BEGINNING OF SEASON	KBDI
Data Used: Rainfall Data	PROSPECT OF SEASON TYPE (WET, NORMAL, DRY)	VHI

Data Used:
- MODIS,
- MTSAT
- AMSER-E
- ALOS AVNIR-2 & PALSAR (acq before May 2011)

Drought in Uganda, 2005



Drought in Uganda, 2005

Vegetation anomaly of 2005 compared to 2000-2004
Brown: drier
Green: thicker, healthier

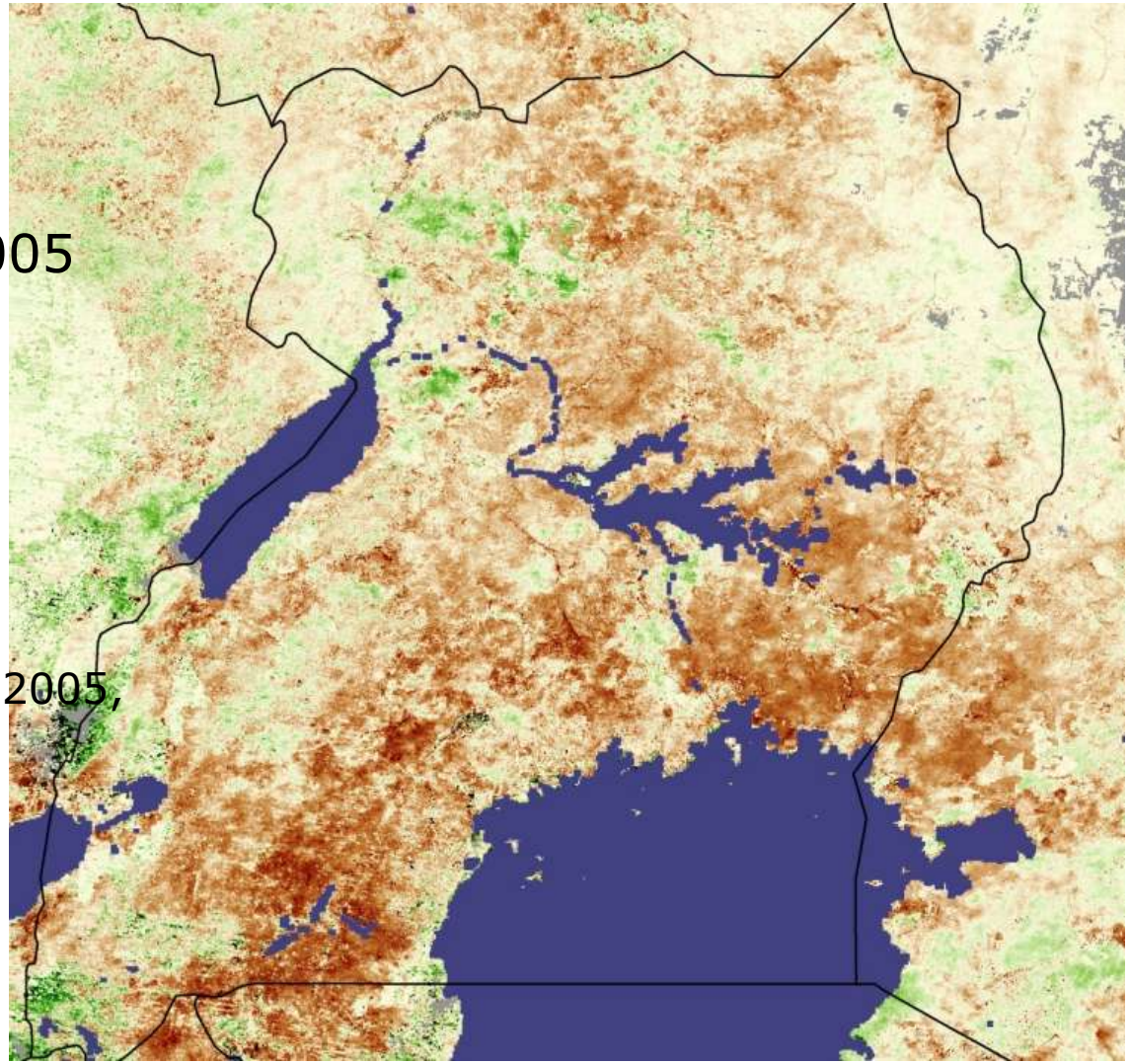
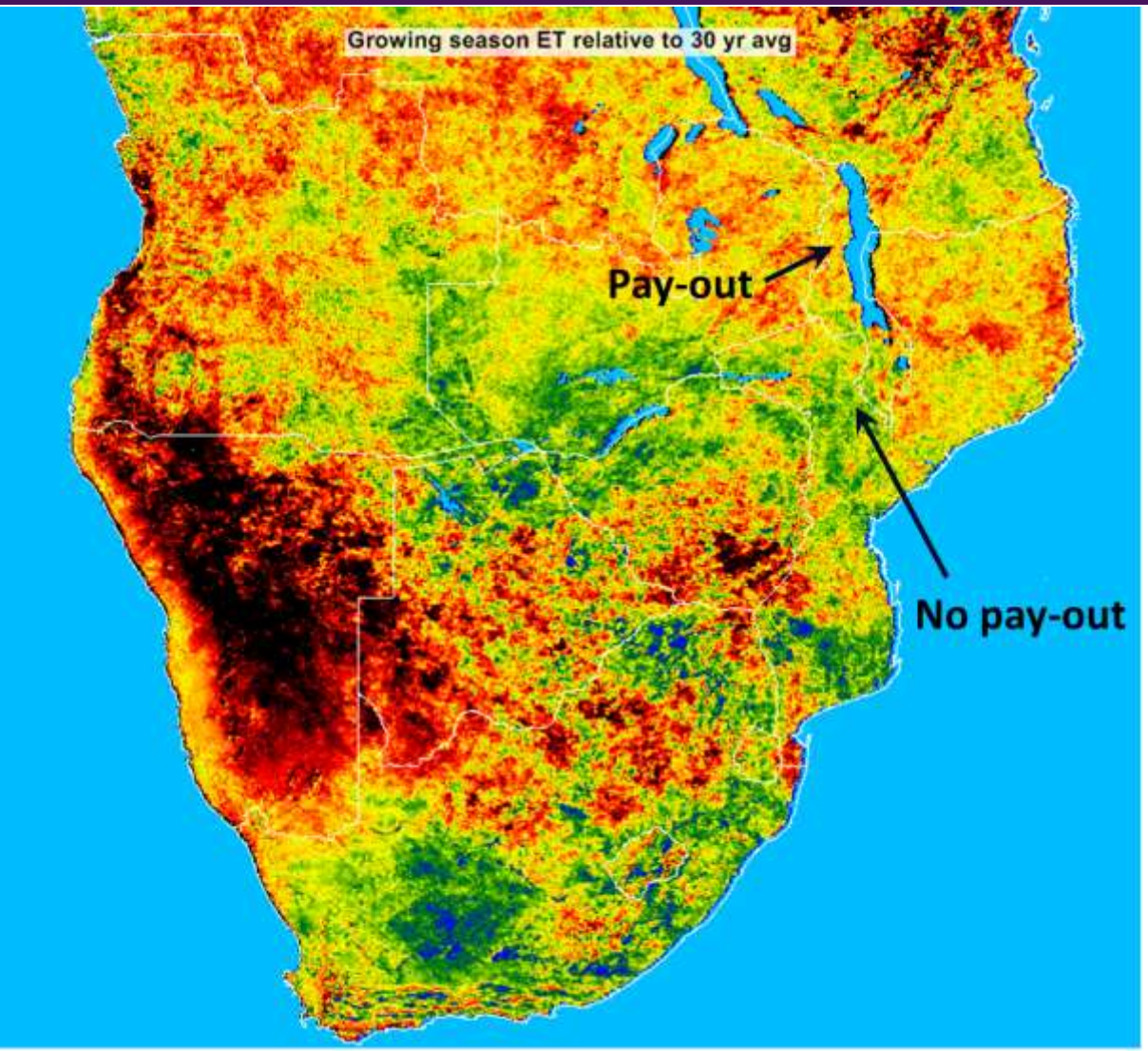


Image: February 18 - March 5, 2005, before the rains started



Malawi: Maize index insurance (EARS)

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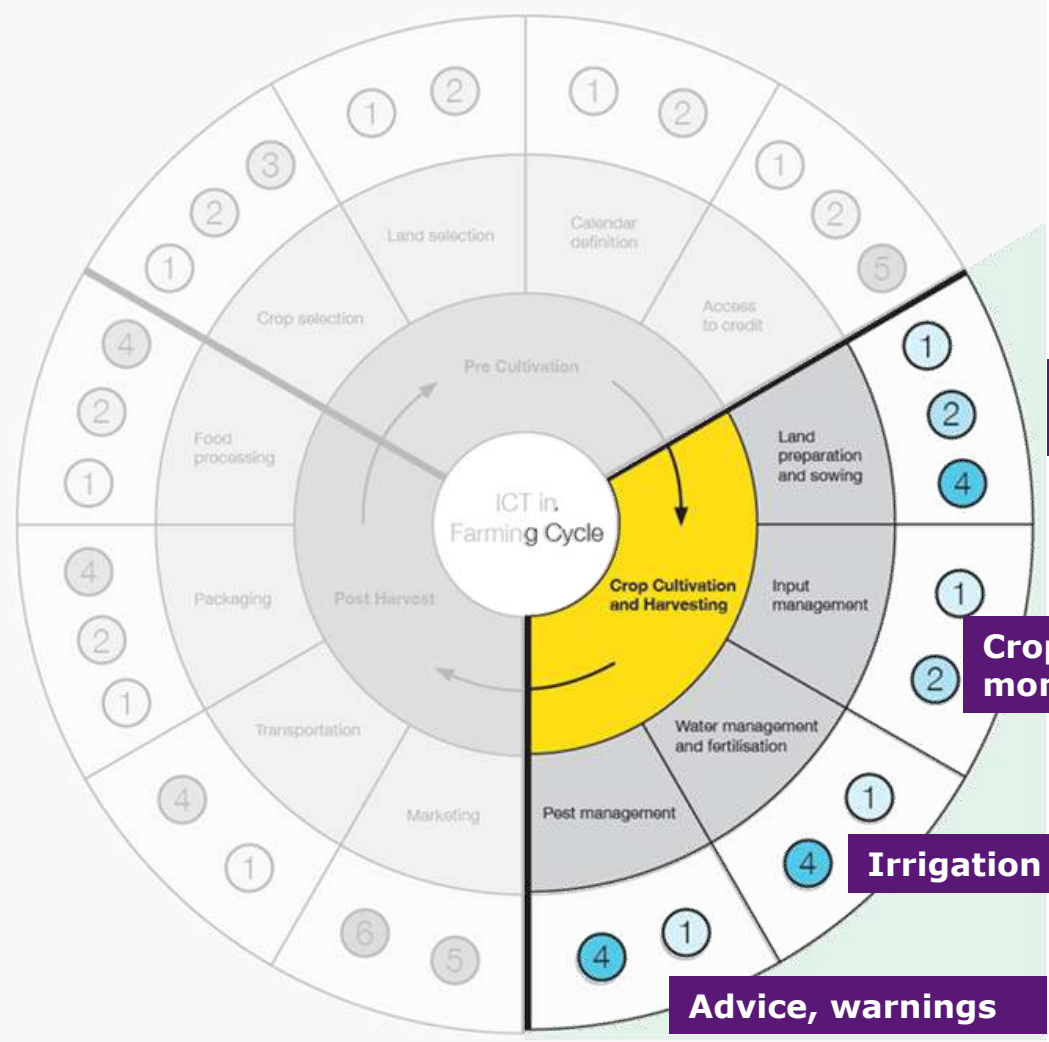


Land cover maps
Soil maps

Crop growth monitoring

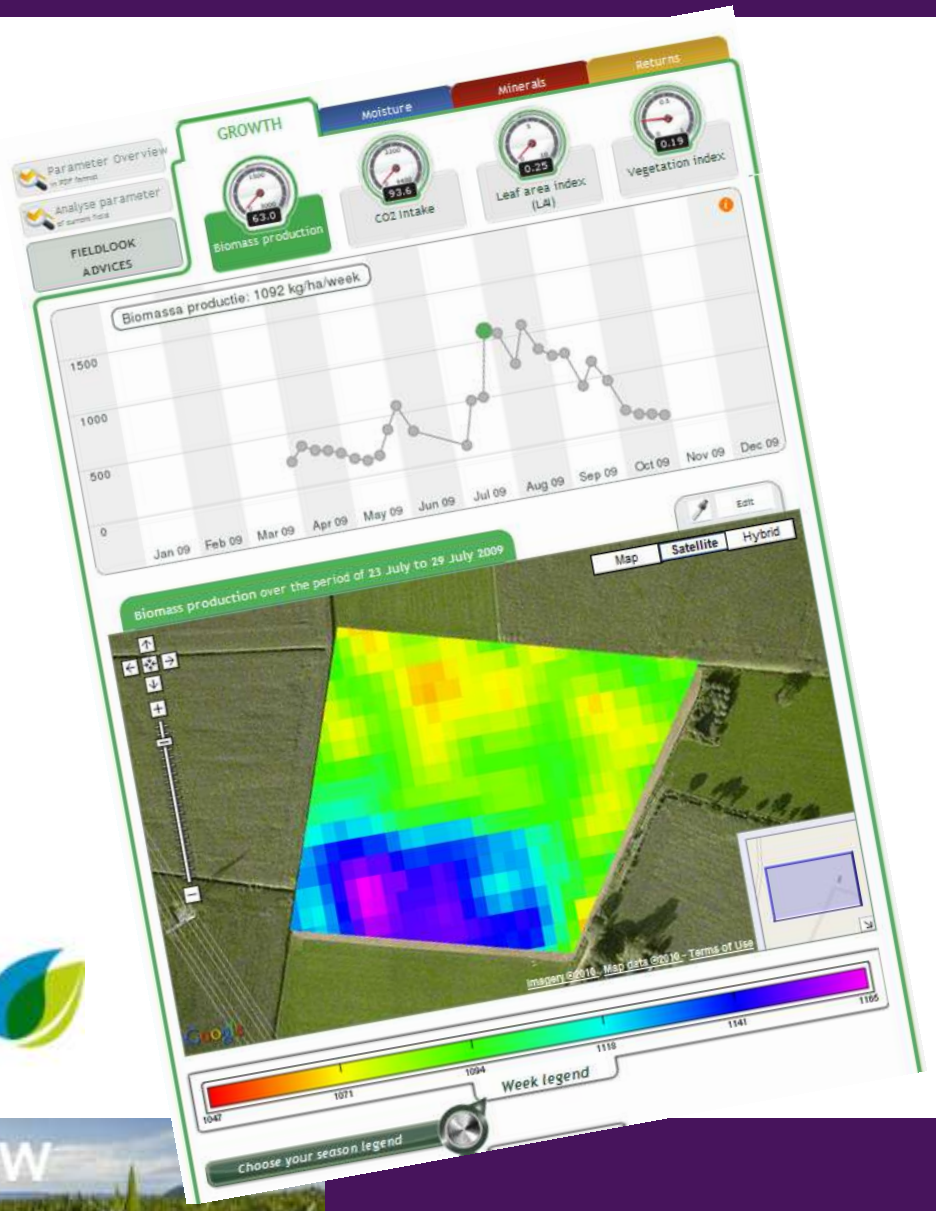
Irrigation advice

Advice, warnings

FieldLook

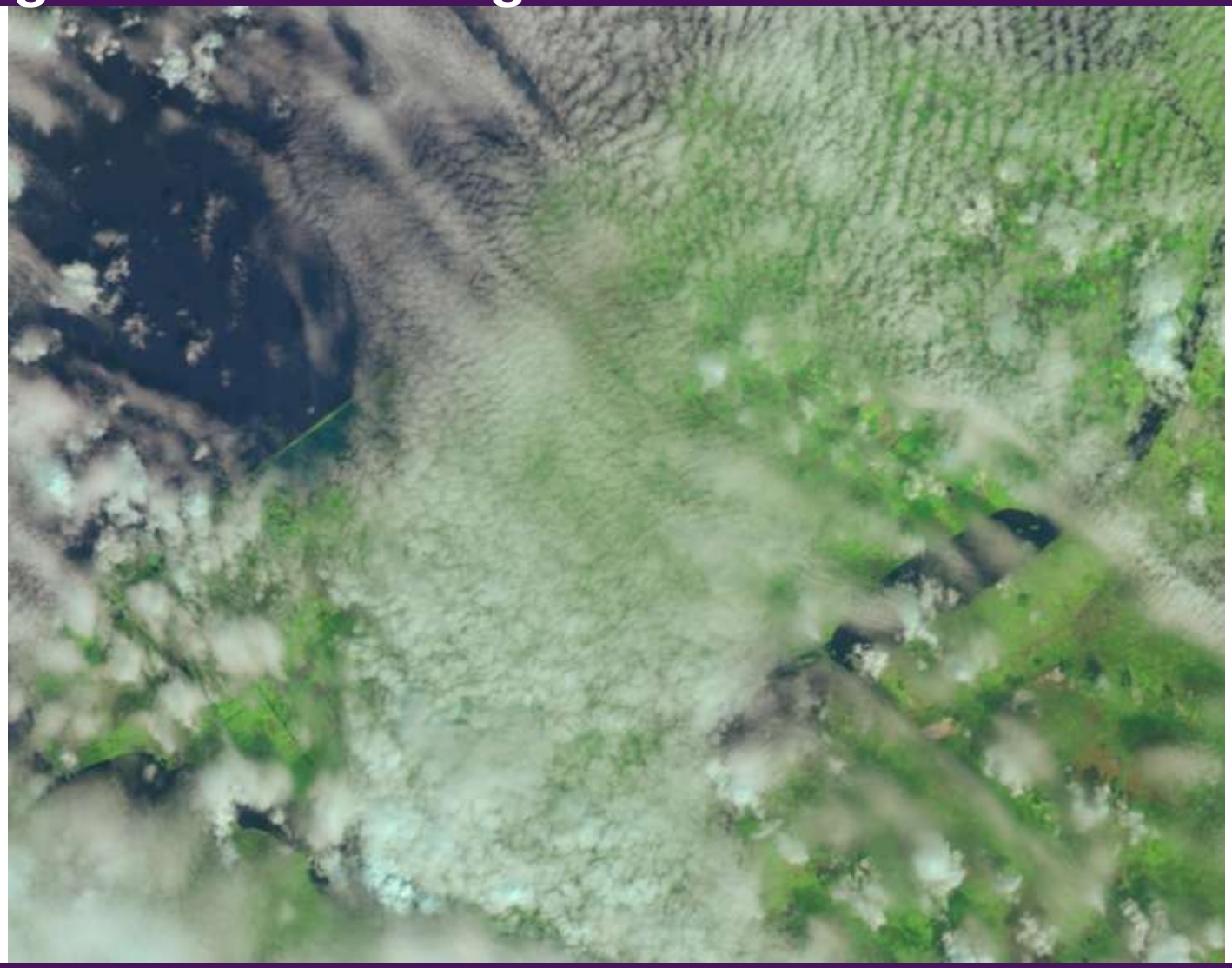
Online, weekly updated, for all types of crops

- **Growth**
  - biomass production (kg/ha)
  - CO2 intake (kg/ha)
  - leaf area index LAI (m2 leaf/m2 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 leafs (kg/ha)
- **Yield**
  - Fruit Yield
  - Root Yield
  - Dry matter content
  - Sugar Yield
  - Protein content



eleaf
FACTS FROM SPACE

Crop growth monitoring



Typical optical satellite image

SarVision
wielaard@sarvision.nl

Crop growth monitoring

Cloud free radar image

SarVision
wielaard@sarvision.nl

Crop growth monitoring

Sugar beet at 25m resolution every 24 days

22/04/2012

Radar analysis

Bare soil

SarVision
wielaard@sarvision.nl

Crop growth monitoring

Sugar beet at 25m resolution every 24 days

16/05/2012

Radar analysis

Bare soil

Emergence

SarVision

wielaard@sarvision.nl

Crop growth monitoring

Sugar beet at 25m resolution every 24 days

09/06/2012

Radar analysis

Bare soil

Emergence

Increment

SarVision

wielaard@sarvision.nl

Crop growth monitoring

Sugar beet at 25m resolution every 24 days

03/07/2012

Radar analysis

Bare soil
Emergence
Increment
Closure

SarVision
wielaard@sarvision.nl

Crop growth monitoring

Sugar beet at 25m resolution every 24 days

07/10/2012

Radar analysis

Bare soil
Emergence
Increment
Closure
Harvest

SarVision
wielaard@sarvision.nl

Crop growth monitoring

Rice at 5m resolution every 5-11 days

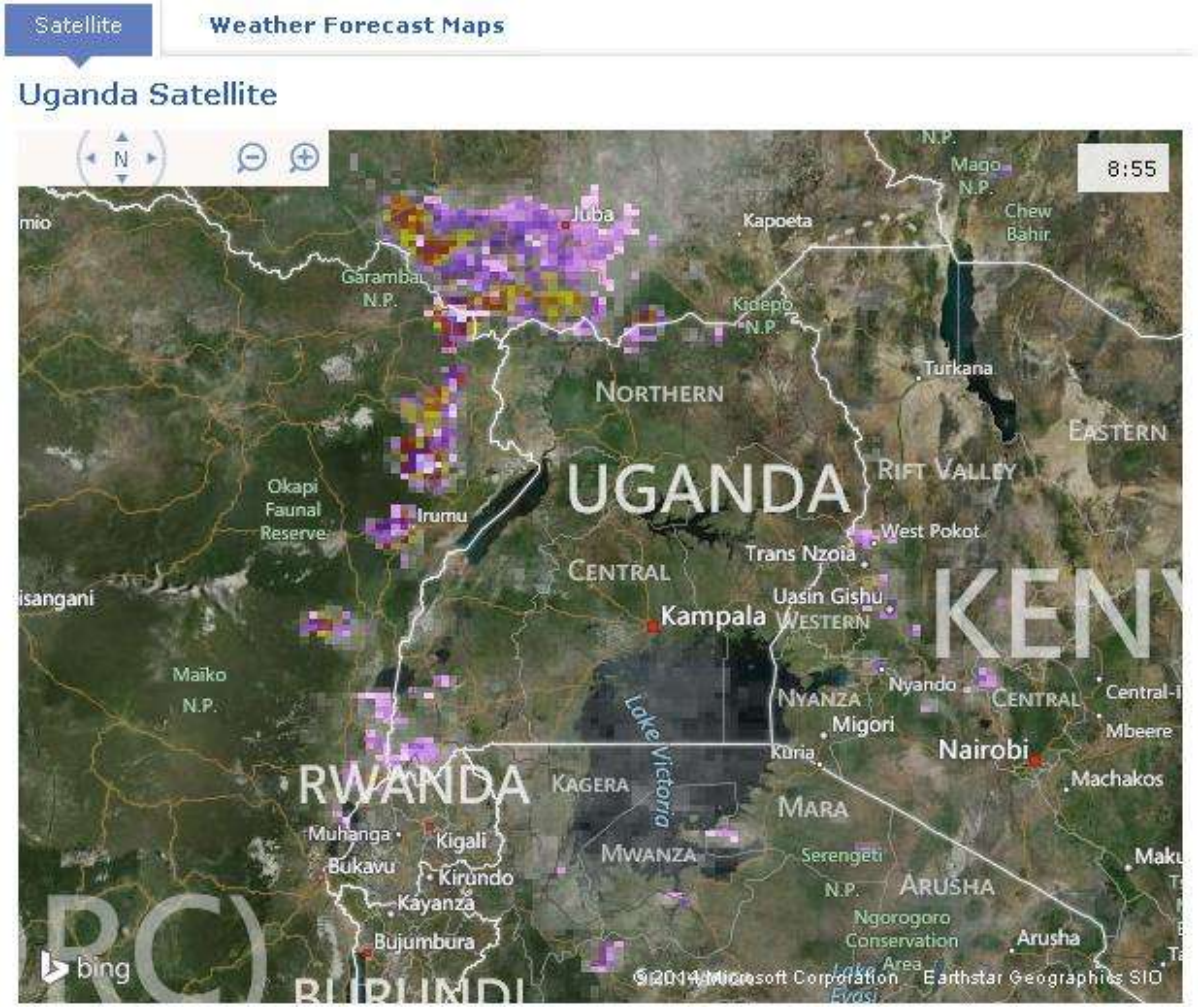
Sharp results: Multi-temporal filtering

5m detail suitable for monitoring of small farms

SarVision

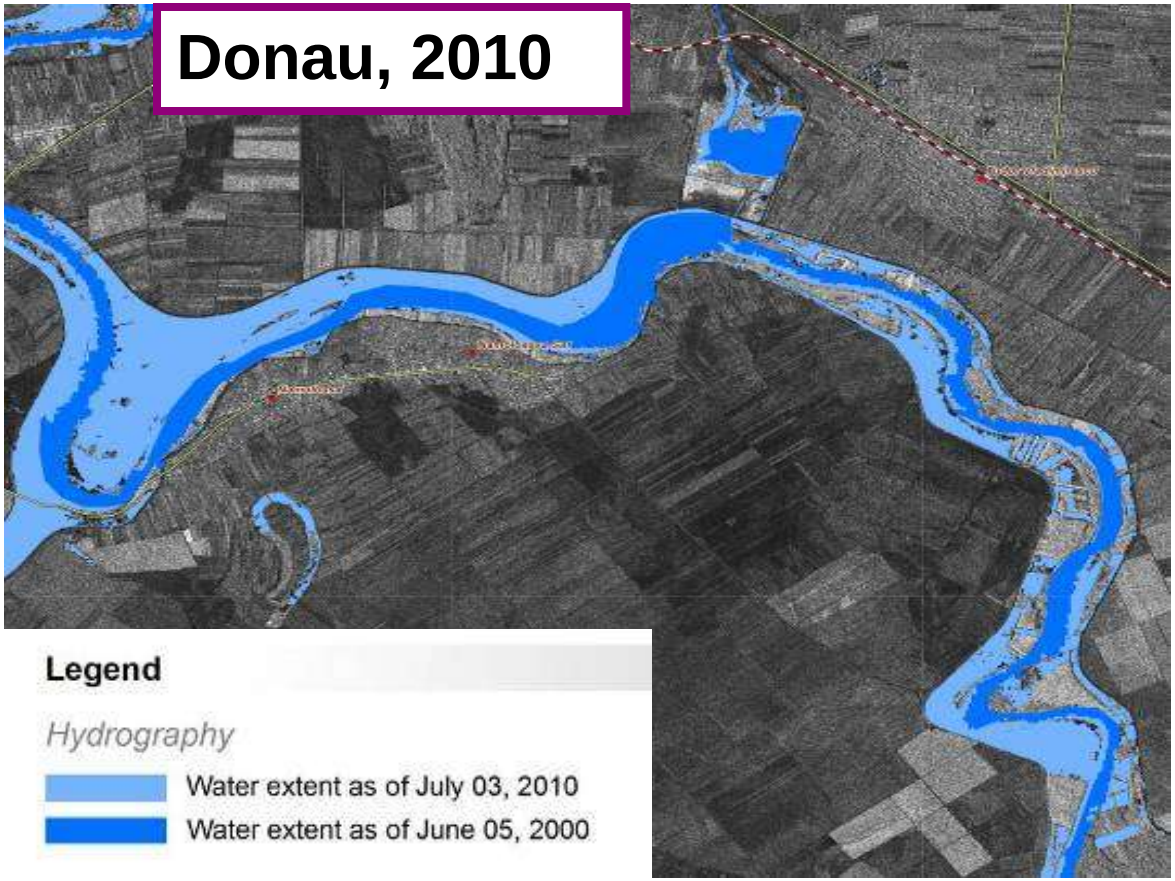
ASTRIUM

Rain radar



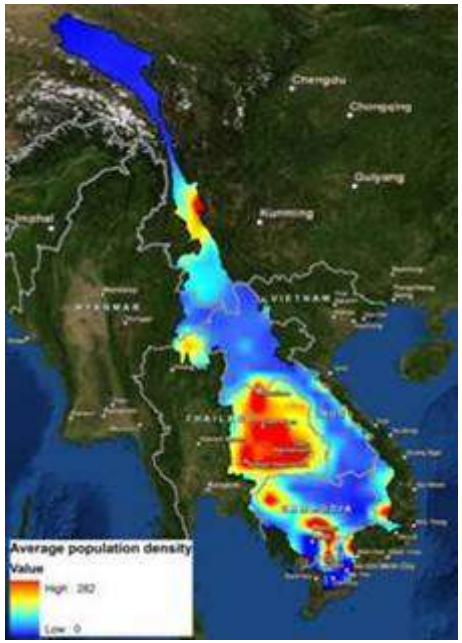
Source: AccuWeather.com

Flood monitoring

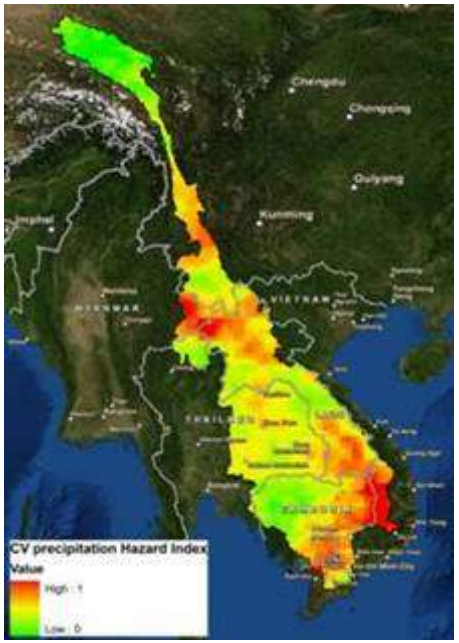


Hazard & Risk Analysis

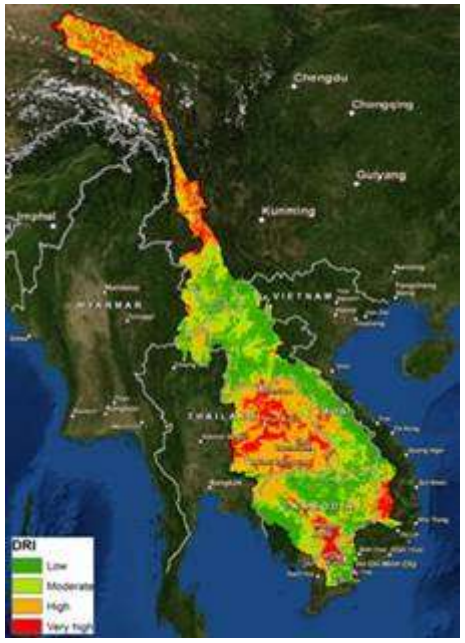
Vulnerability Index
Distance
to river



Vulnerability Index
Population density



Vulnerability Index
Precipitation



Drought
Risk Map

FutureWater

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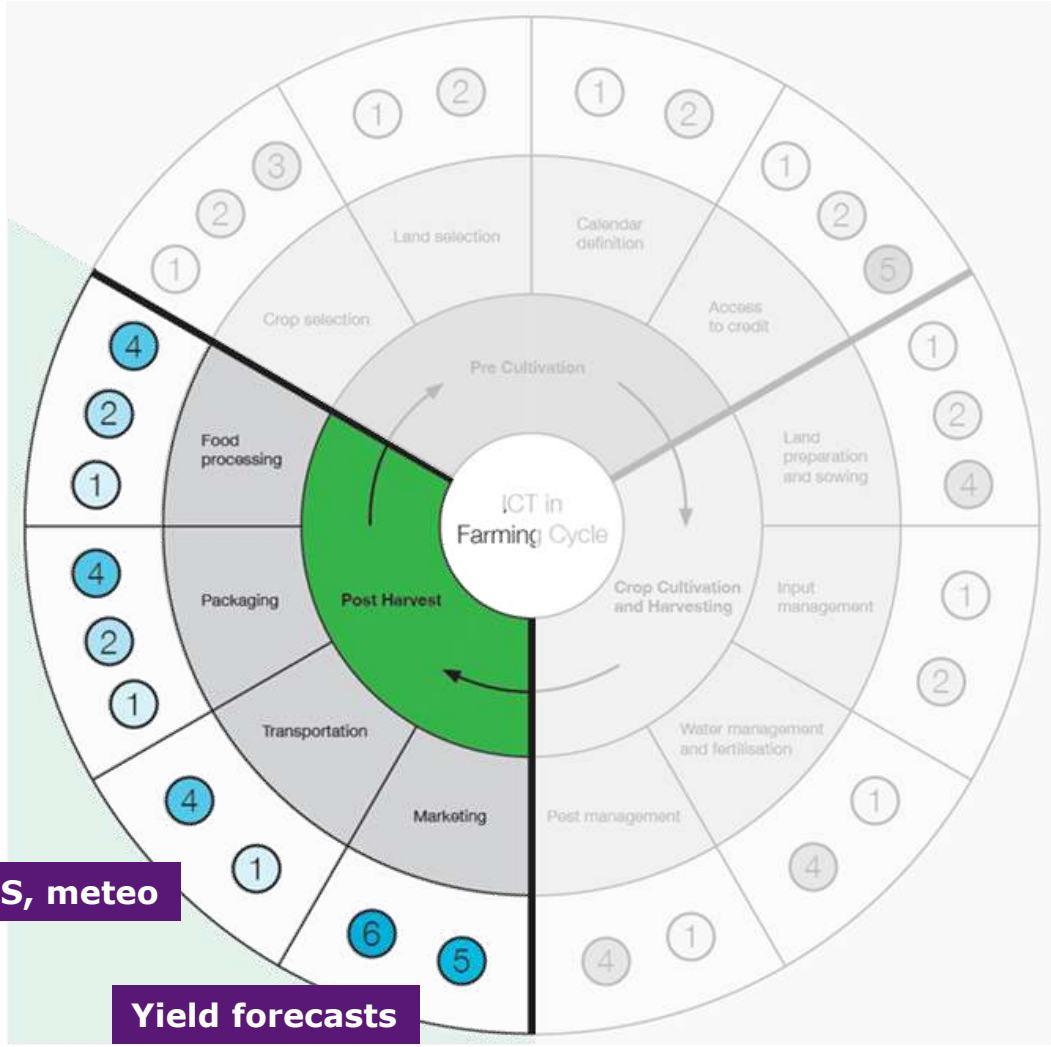
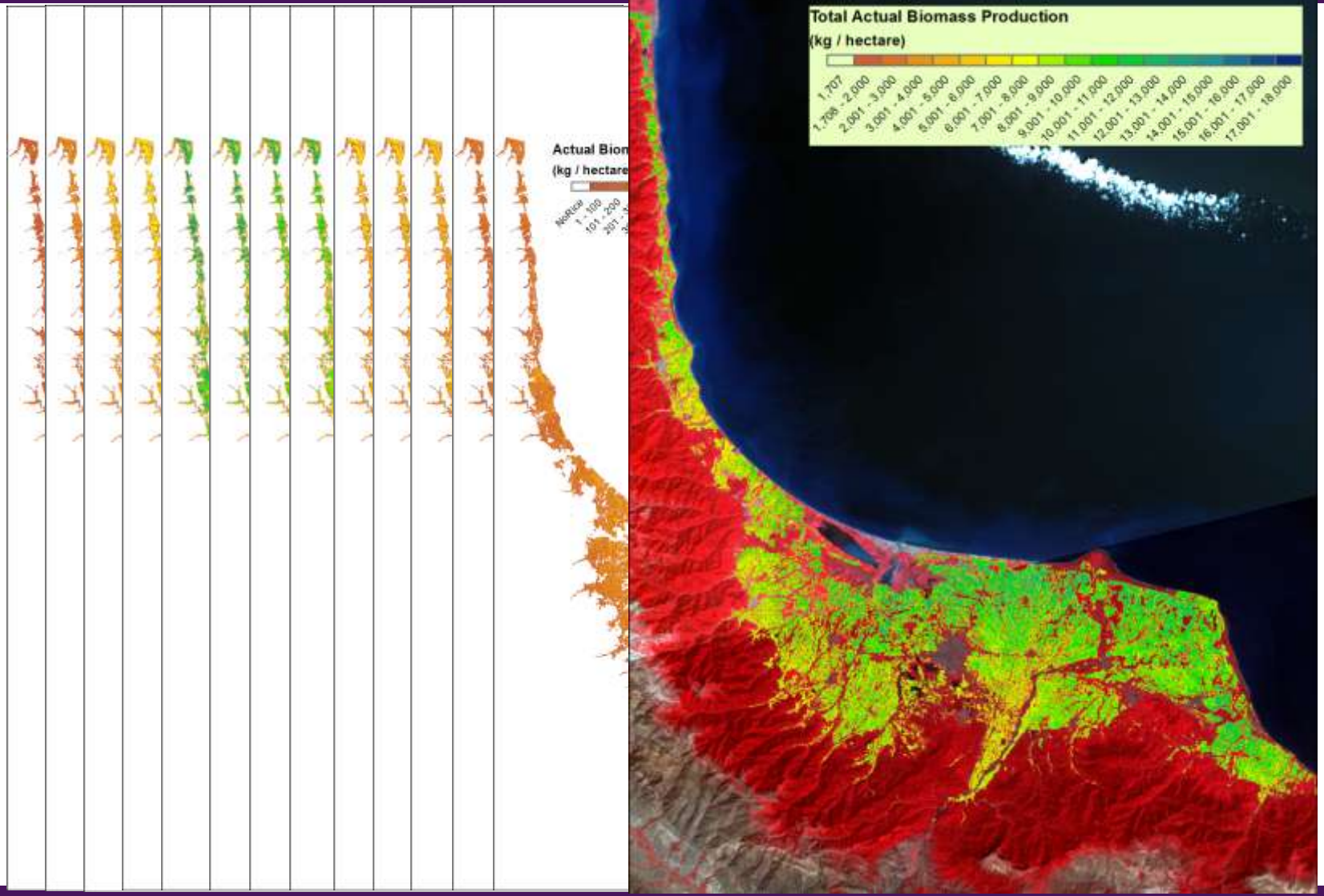


GPS, meteo

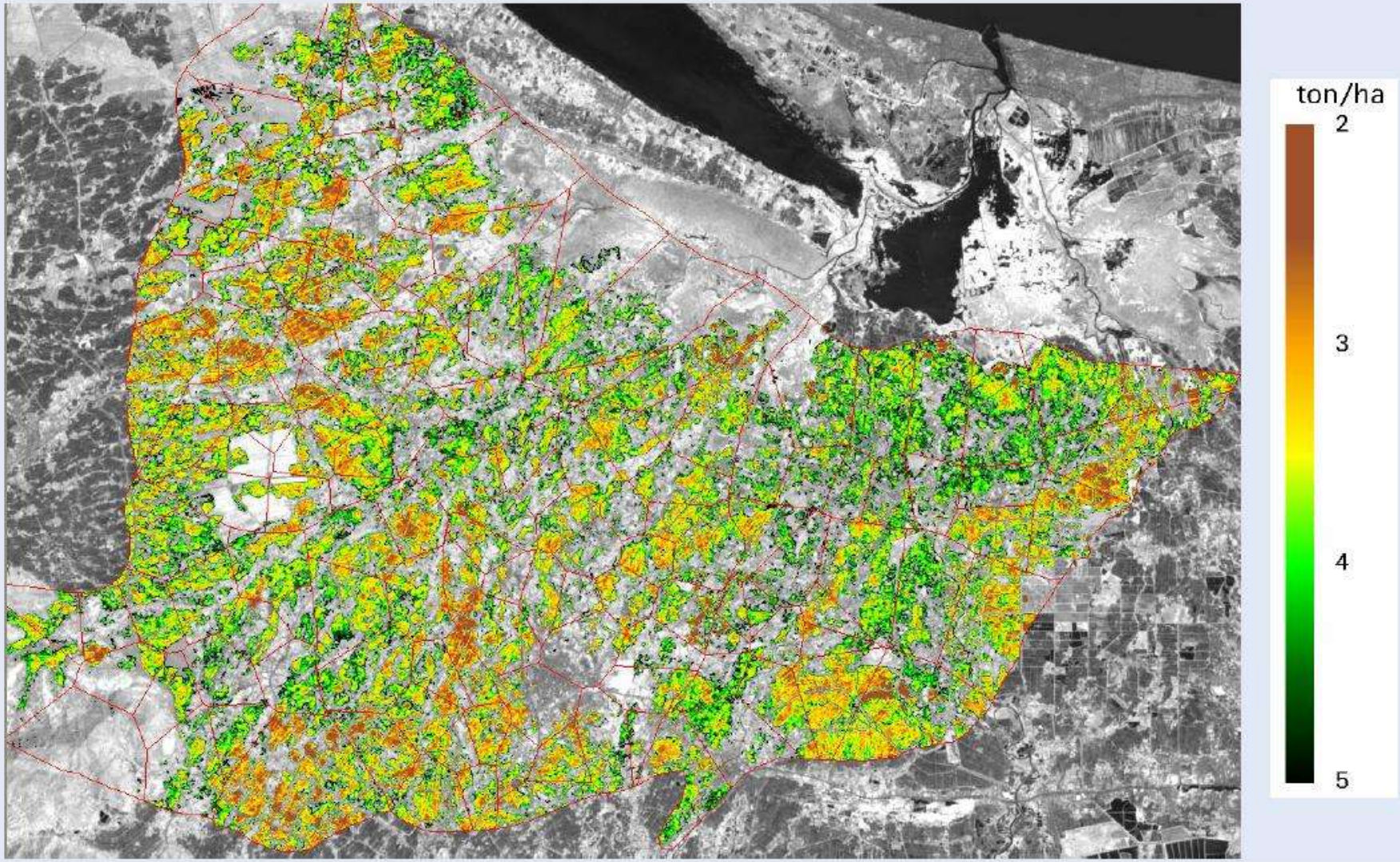
Yield forecasts

Yield forecast

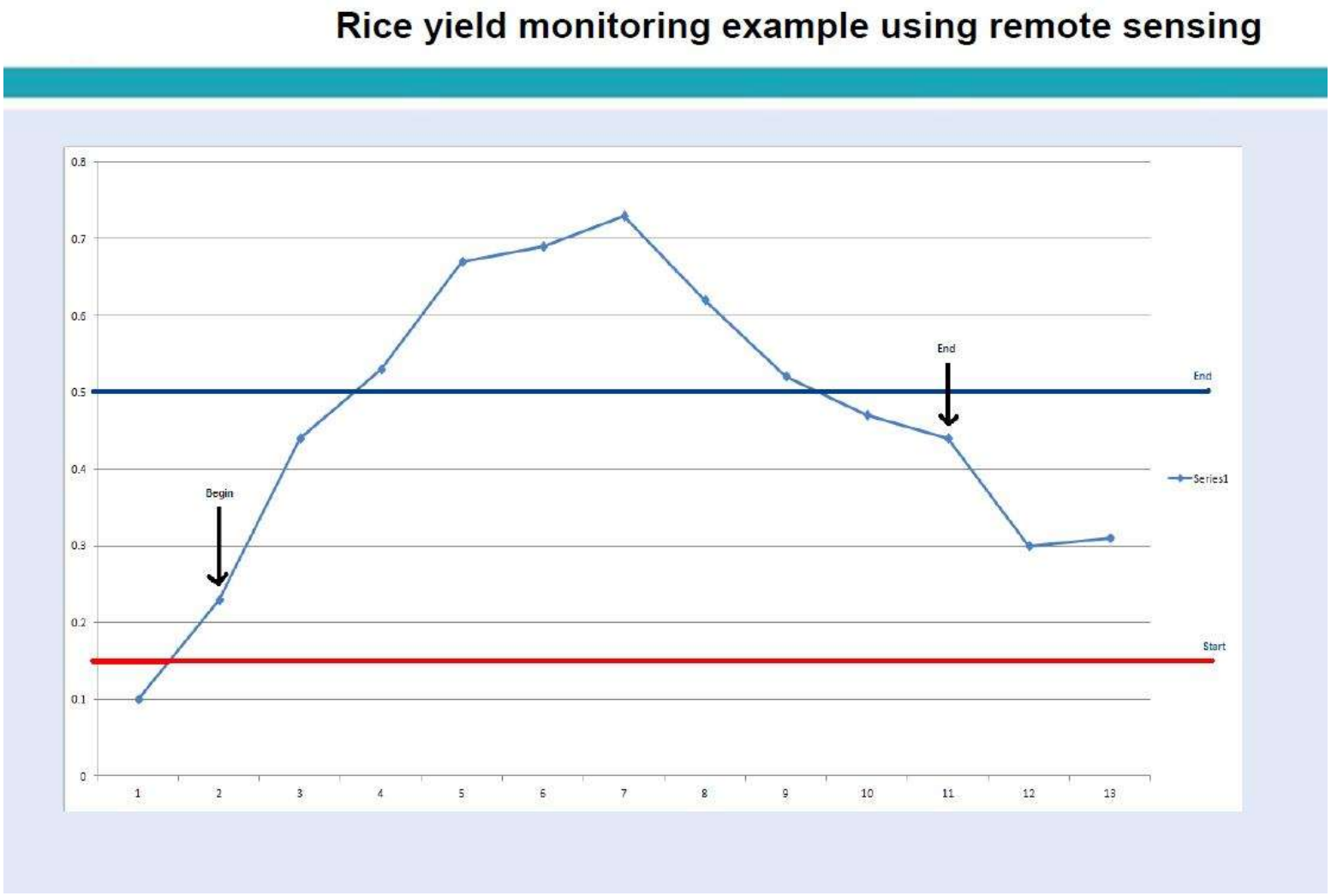


GSM: Actual Biomass Production

Rice Yield maps



Yield forecast



Why based on satellite data?

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

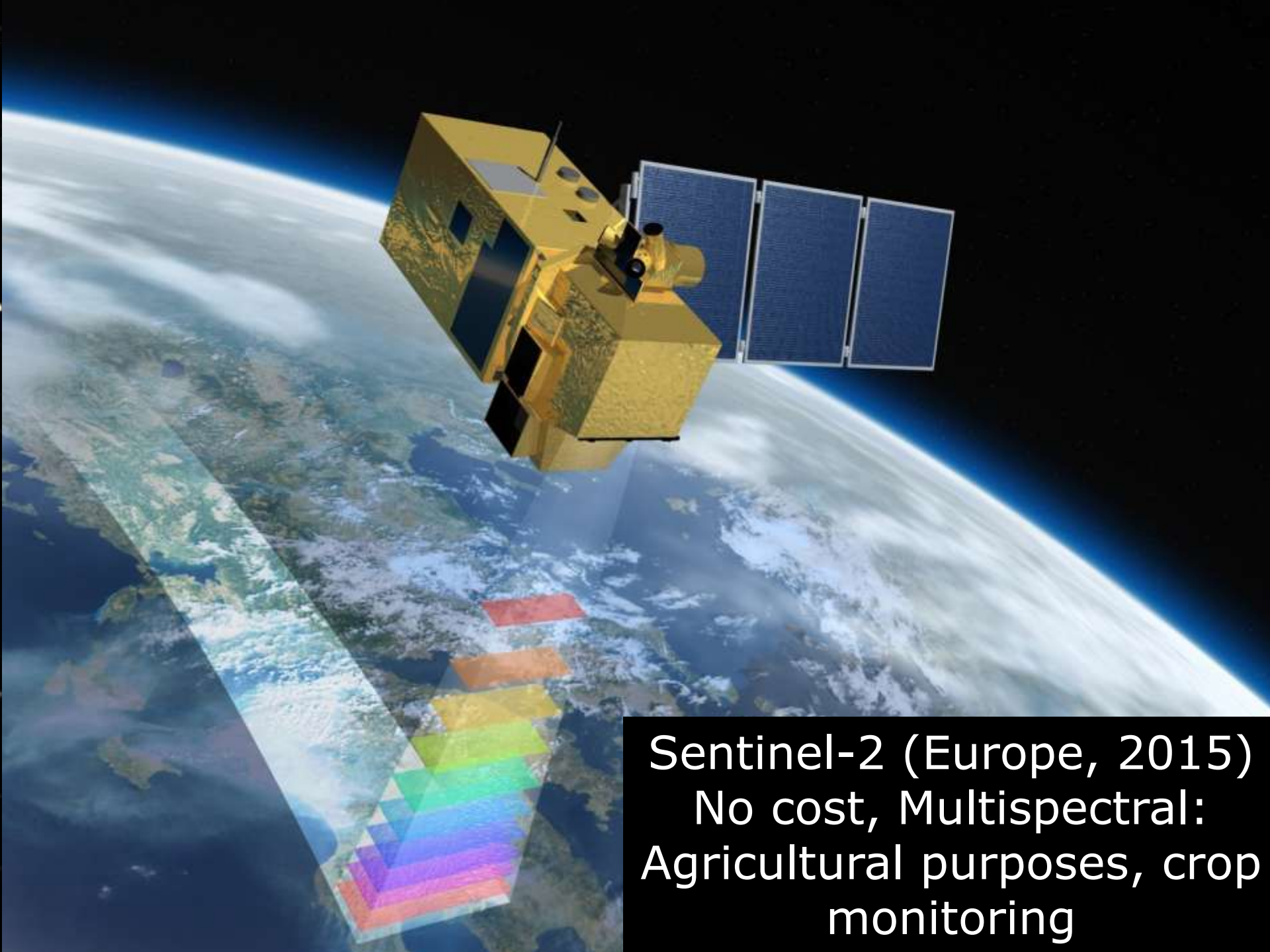

Landsat 8 (US, 2013)
No cost

Planet Labs (2014)

Skybox (2014)

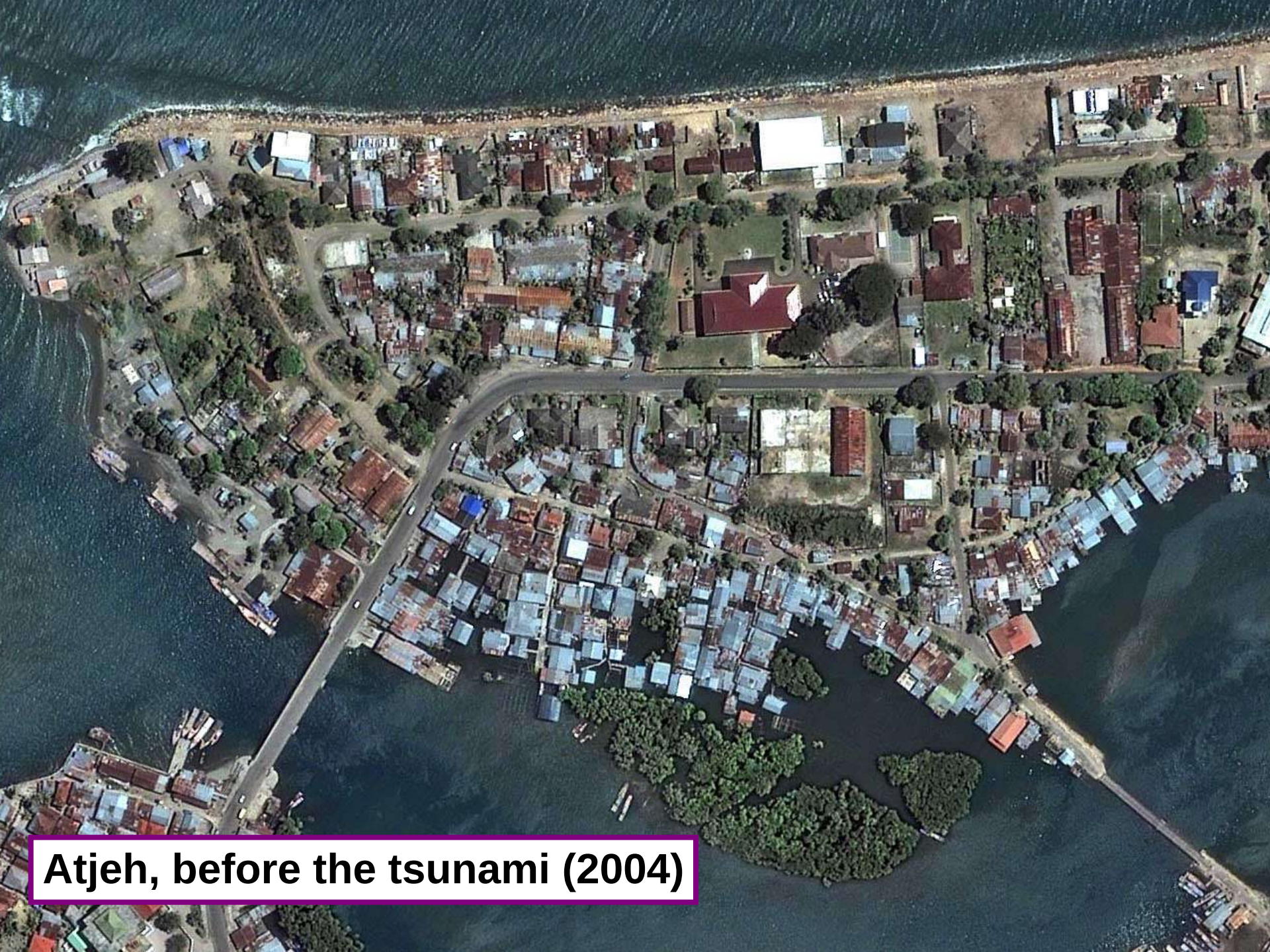
Constellation
High revisit time
Commercial
Low cost


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

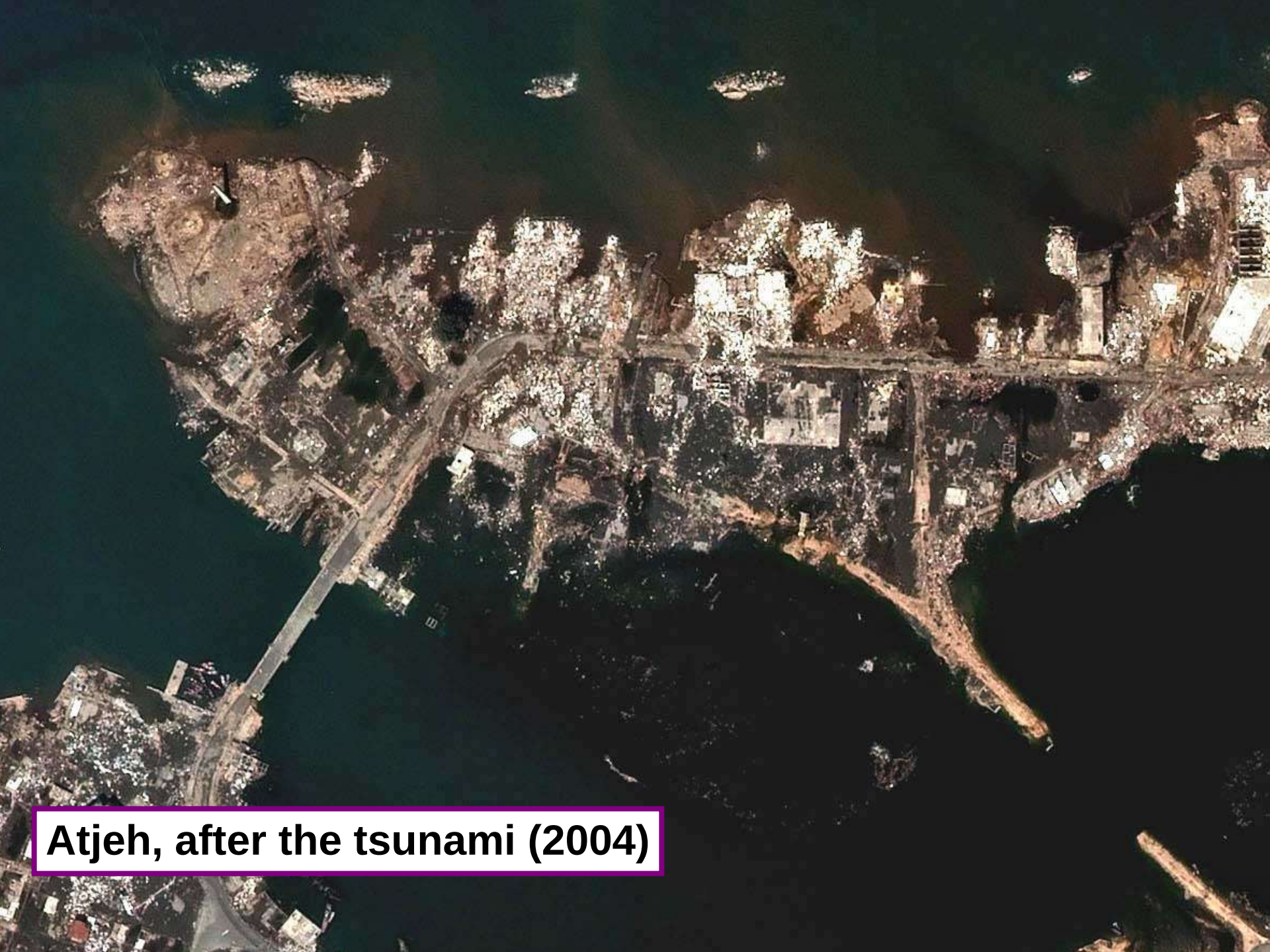

Sentinel-2 (Europe, 2015)
No cost, Multispectral:
Agricultural purposes, crop
monitoring


High resolution
VNIR satellites
Worldview-2


Optical images : 50 cm resolution



Atjeh, before the tsunami (2004)



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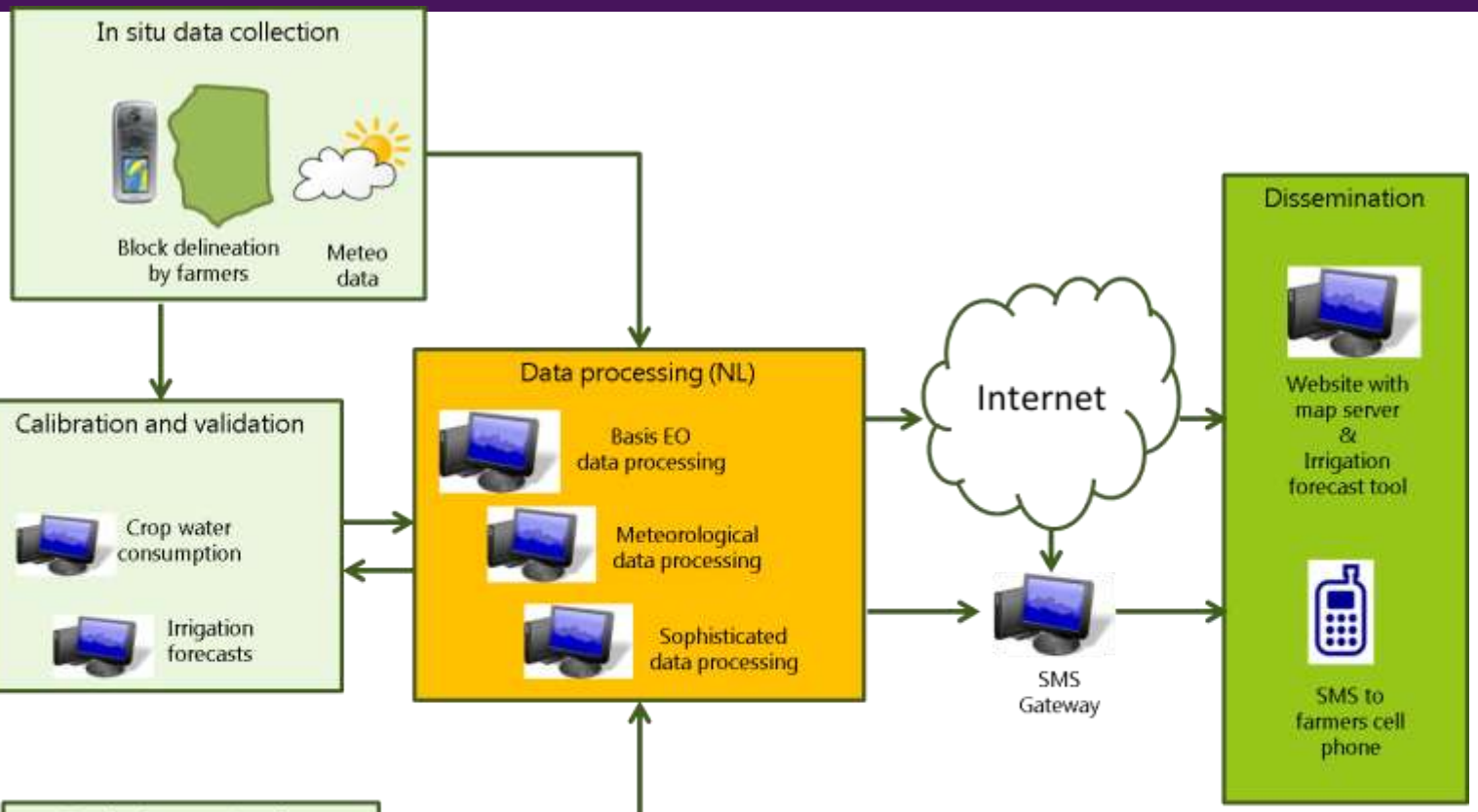
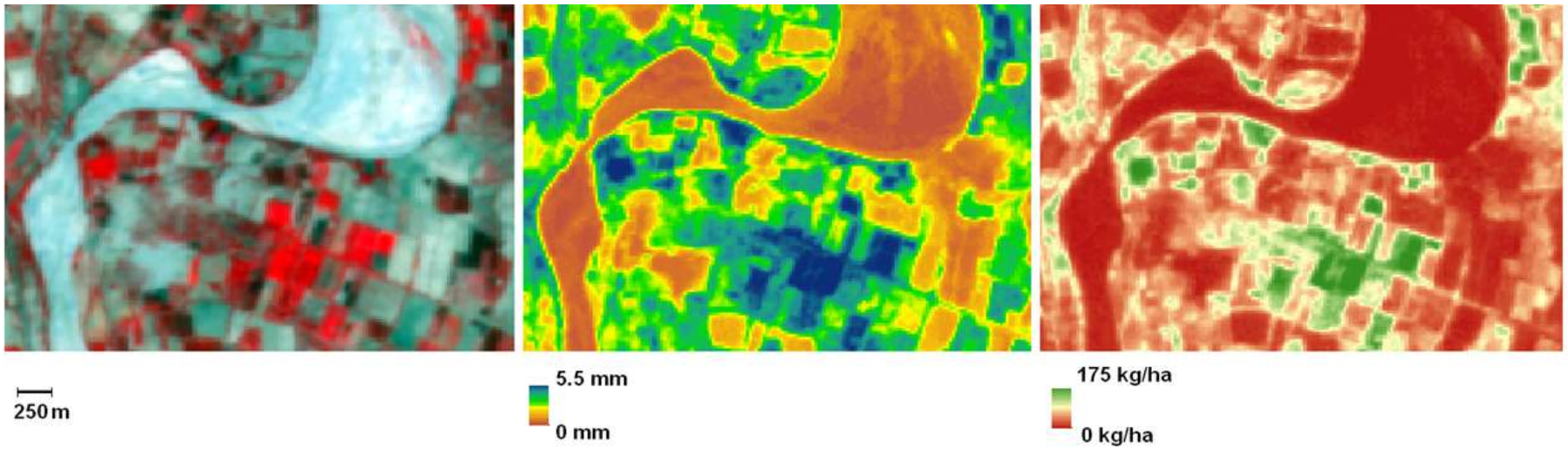


Smart ICT infrastructure

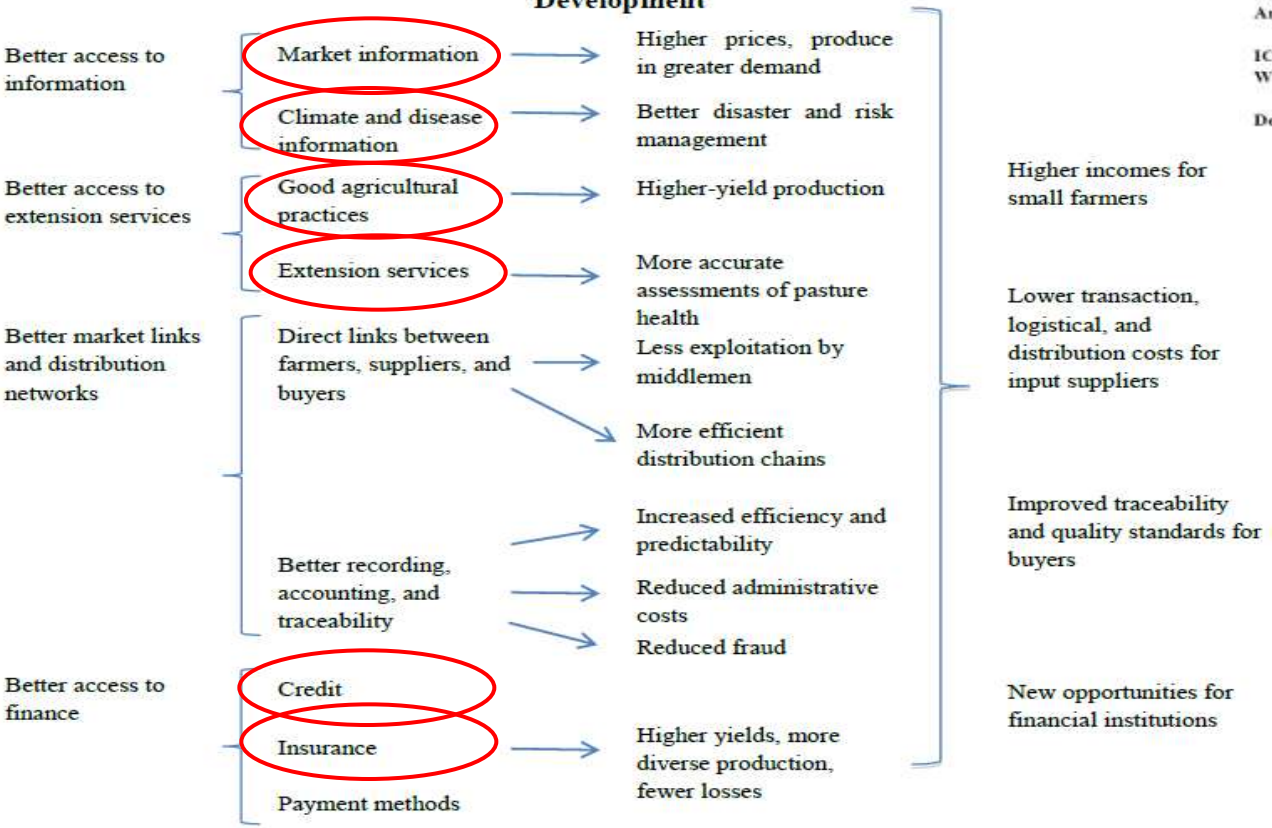
Thank you for your attention



Example: Raw satellite data (L), derived daily evapotranspiration (M) and biomass production (R).

Mobile/ICT applications

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



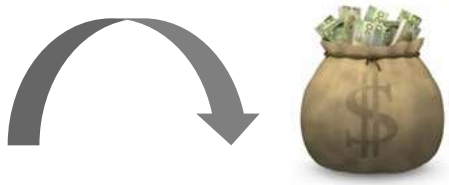
Mobile Applications for Agriculture and Rural Development

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

ICT Sector Unit
World Bank

December 2011

Advisory



Insurance/finance

Possible service provision – financial

Possible financial services may include, e.g.:

Index-based insurance
Credit/loans

- Weather information
- Climate information
- Soil mapping
- Crop yields
- Monitoring (e.g. vegetation growth)
- Crop forecasts

World Food Programme IFAD

http://www.ifad.org/ruralfinance/pub/WII_tech_guide.pdf

Possible service provision – advice

Possible advisory services may include, e.g.:

- 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

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

Irrigation advice