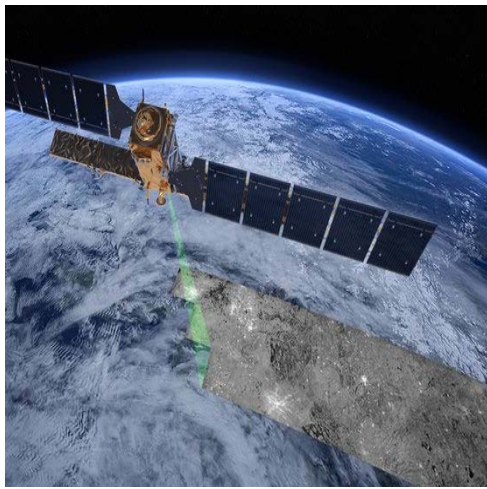


# **A platform to strengthen collaboration between water and agriculture fields**

On behalf of Asia-Rice (TG5)

Thuy Le Toan

CESBIO, Toulouse, France

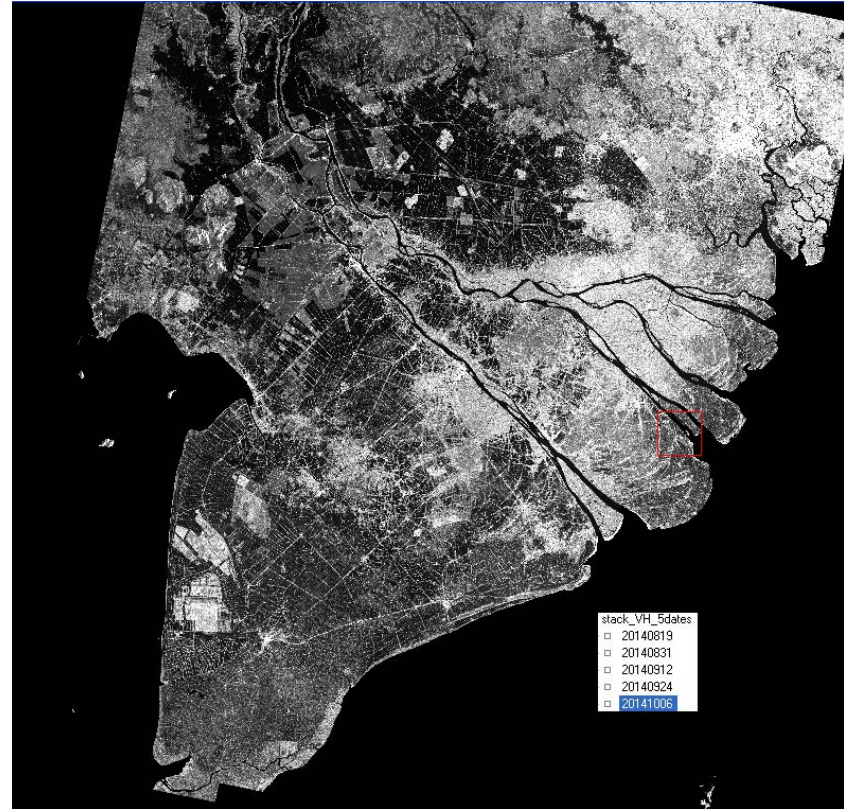


## Sentinel-1 to observe the Mekong basin



### C-Band SAR data continuity

- Repeat Cycle: 12 days, 6 days with 1A & 1B
- Multimode, resolution 5-20m, swath width up to 250-400 km
- Open and Free access of data
- Preprocessing tools and Analysis Ready Data (ARD) available

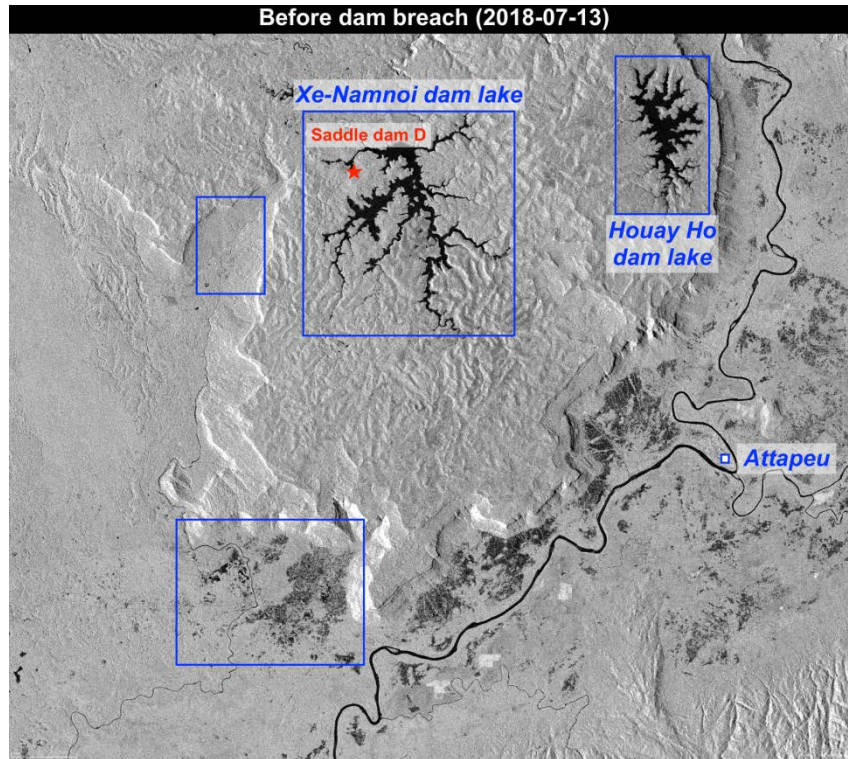


stack\_VH\_5dates  
□ 20140819  
□ 20140831  
□ 20140912  
□ 20140924  
□ 20141006

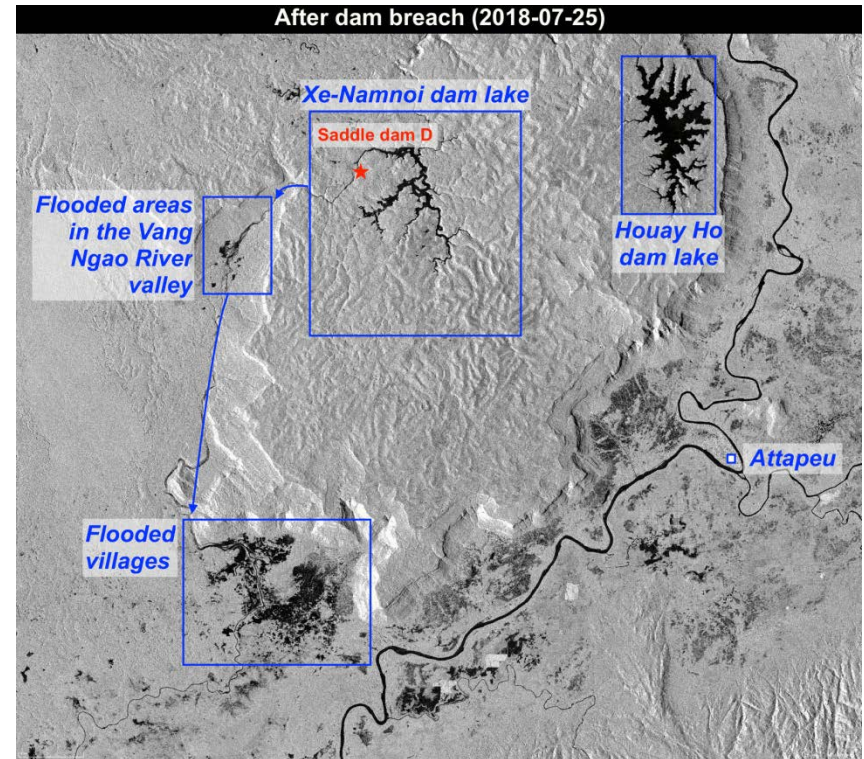
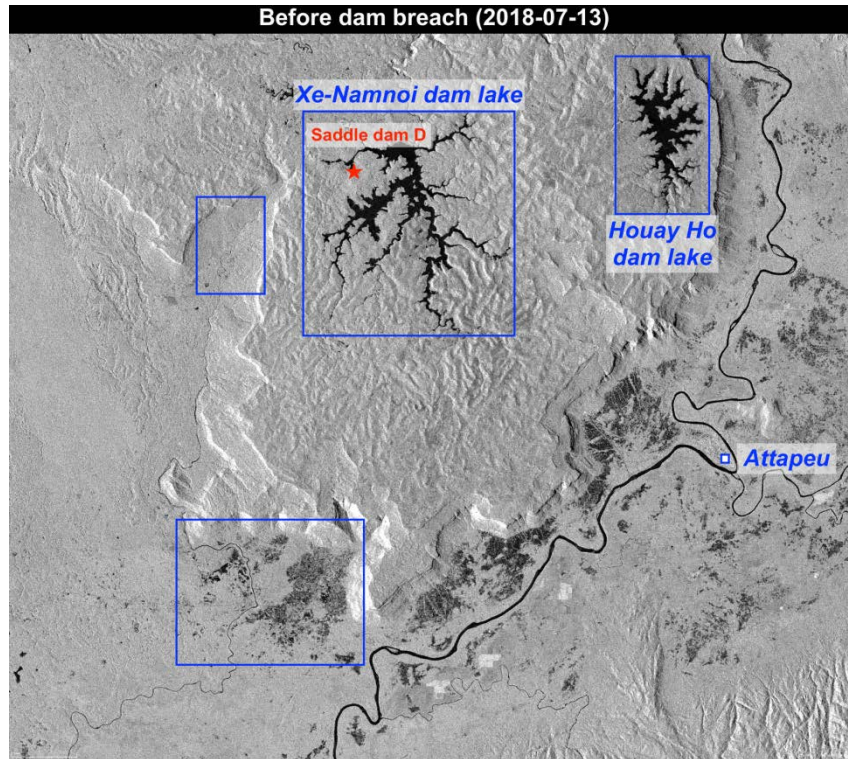
Data available for applications including  
Rice monitoring  
Flood monitoring



# Following the dam breaching in Lao PDR . . .



# Following the dam breaching in Lao PDR . . . .

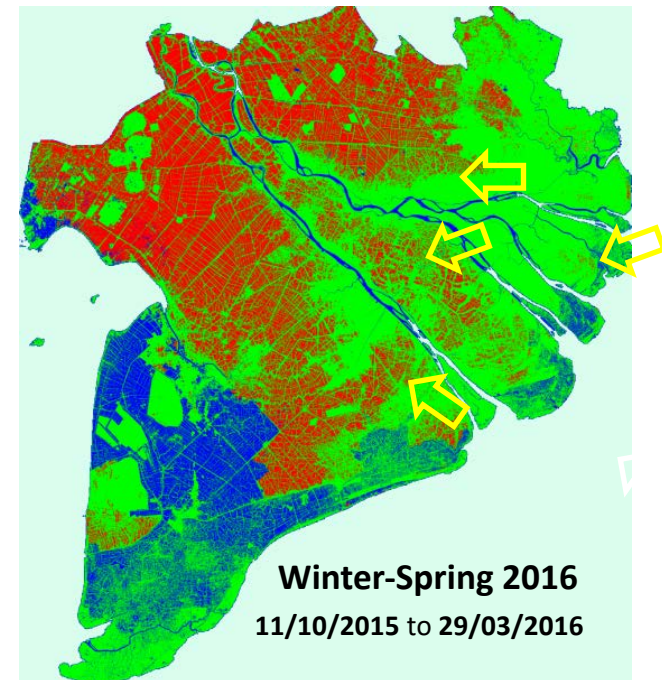
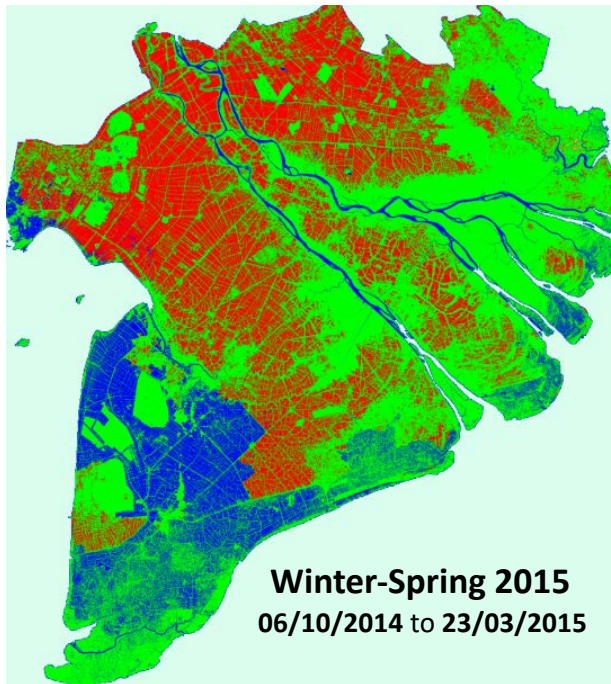


# **Beyond food security, rice crop is closely linked to climate change, water and environment**

## **Rice production is affected by climate change**

- Drought, which damage the crop at reproductive phase
- Salinity intrusion, in particular in lowland South East Asia,
- Floods and cyclones, in increasing number

# Early estimate of variation in rice planted area



➡ Decrease of **16.7%** of Winter-Spring rice harvested area in Mekong River Delta 2016 compared to 2015 (by March 2016, 1.39M ha estimated vs 1.67M ha in March 2015, or decrease of **276,000 ha**) caused by **shortage of water** and **saline intrusion** (El Niño effect)

## Other reportings:

- UNSCAP June 2016 : Damaged Winter-Spring paddy area in MRD of **234,260 ha**
- VN Statistics Office 2017: **17,6%** of Winter 2016 rice planted area in MRD affected by drought and saline intrusion or **224,552 ha**

# Beyond food security, rice crop is closely linked to climate change, water and environment

## Rice production is affected by climate change

- Drought, which damage the crop at reproductive phase
- Salinity intrusion, in particular in lowland South East Asia,
- Floods and cyclones, in increasing number

## Increase rice production → increases use of water resources

- Irrigated rice receives an estimated 34–43% of the total world's irrigation water.
- increasing water scarcities in major river basins,
- retreating groundwater levels in areas where more water is being pumped for irrigation than can be replenished.

# Rice , water consumption and GHG emissions

## *Water management scenarios:*

1. **Continuous flooding (CF):** 5-12 cm from initial flooding to 5 days prior to harvest
2. **Alternate wetting and drying (AWD):** Water table fluctuates  $\pm 5$  -10 cm from soil surface.



AWD

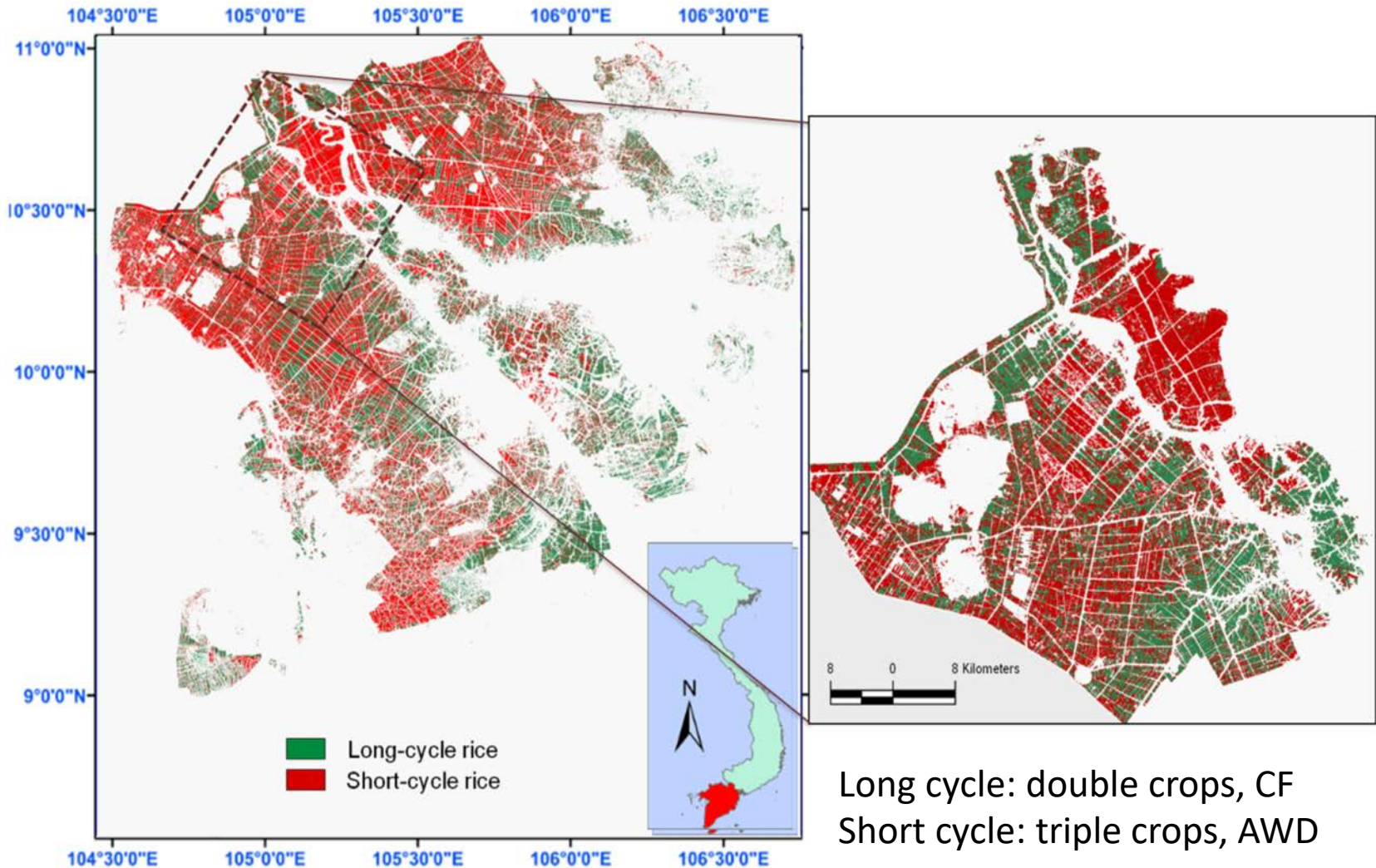
## ***Biogeochemical Implications:***

- Improve soil aeration;
- Stimulate root/shoot development;
- Increase soil mineralization.

## ***Consequences:***

- Increase crop yield;
- Decrease water consumption;
- Alter GHG emissions.

# Rice planted with short cycle and long cycle varieties



# Beyond food security, rice crop is closely linked to climate change, water and environment

**Rice fields are major generator of methane and nitrous oxide**, responsible for 25% of the total budget of global methane emissions from agriculture.

**Environmental issues** increases with rice production :

Excessive use of fertilizers and pesticides that pollute waterways and kill beneficial wildlife,

As a task group, TG5 particularly addresses

SDG 2: *End hunger, achieve food security and improved nutrition and promote sustainable agriculture*, but also

SDG 6: *Clean and accessible water for all*

SDG 13 :*Take urgent action to combat climate change and its impacts*

SDG 15: *Protect, restore and promote sustainable use of terrestrial ecosystems.*

# Vietnam Data Cube official release

6 March 2018, Hanoi



CEOS support over past 18 months



## ODC deployment and capacity

- Software and training (SEO, CSIRO)
- Hardware and maintenance (IMSG)
- Strategic support (Symbios)

## International partners

- CEOS SEO, CSIRO
- USGS
- JAXA, RESTEC
- CNES, CESBIO

## ARD preparation and transfer to VN

- Landsat (USGS, SEO)
- ALOS, PALSAR (JAXA/ RESTEC)
- Sentinel-1 (SEO, CSIRO, CNES/CESBIO)
- ASTER DEM (SEO))

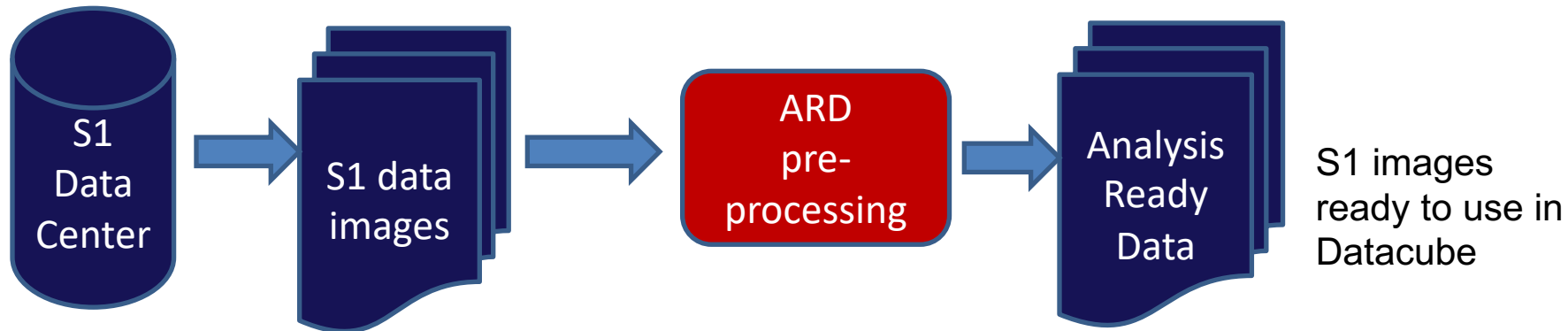
## Application domains

- Forests (GFOI)
- **Rice (Asia-Rice, JAXA/RESTEC, CNES/CESBIO)**
- Water extent and quality and mangroves (Mekong, MRC)

# Building Analysis Ready Data (ARD) for Sentinel-1 on Datacube

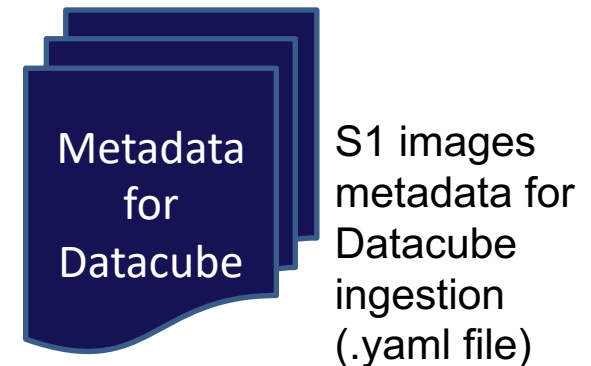
- **What is ARD ?**
  - S1 data need to be pre-processed before use for applications.
- **What is the purpose of this pre-processing ?**
  - The pre-processing consists in applying operations to obtain ready-to-use data for users, considering all types of application.
- **Which operations are done during the pre-processing ?**
  - Considering the wide range of applications of the S1 data in the Datacube, we suggest to do at least the following operations:
    - Calibration , Thermal noise removal, Terrain correction, Orthorectification
    - Metadata generation for datacube ingestion
  - Speckle filtering is not included in ARD because filtering techniques depends on the application

# Building Analysis Ready Data (ARD) for Sentinel-1 on Datacube – Application on Rice monitoring



Ground projected  
image (GRD)  
.SAFE format

Python script  
S1toARD.py





# Building Analysis Ready Data (ARD) for Sentinel-1 on Datacube

ARD  
pre-  
processing

Gamma0  
calibration

Convert digital number in images into physical values

Python script  
S1toARD.py

Currently using  
SNAP software



But performance  
improvement can  
be achieved using  
OrfeoToolBox

Thermal noise  
removal

Remove the instrument thermal noise from images

Terrain  
correction

Apply geometric and radiometric correction  
using SRTM Digital Elevation Model to correct  
topographic effects on images

Orthorectificati  
on

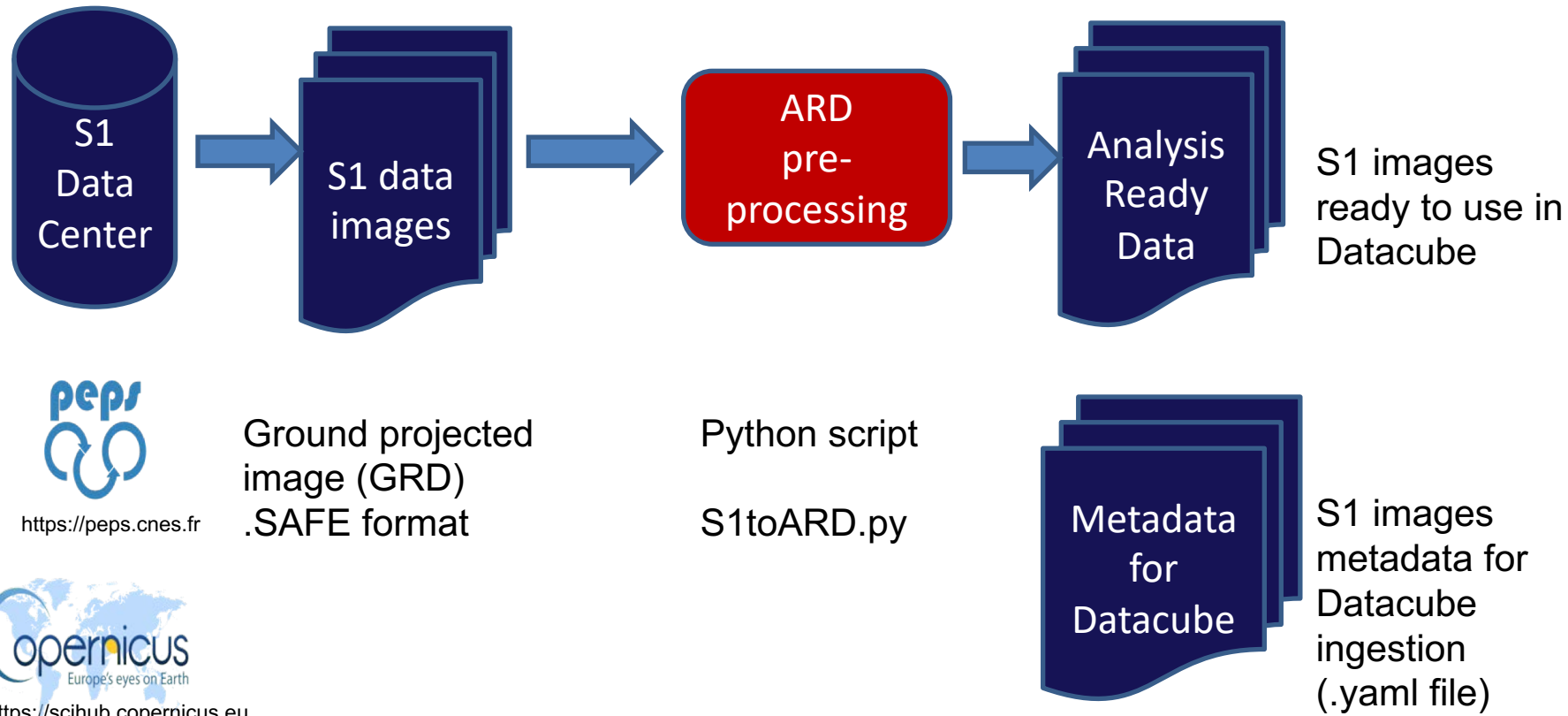
Project images in the requested coordinates  
system:

EPSG: 4326

WGS84 (longitude, latitude in degrees)  
with 10x10 meters pixel size

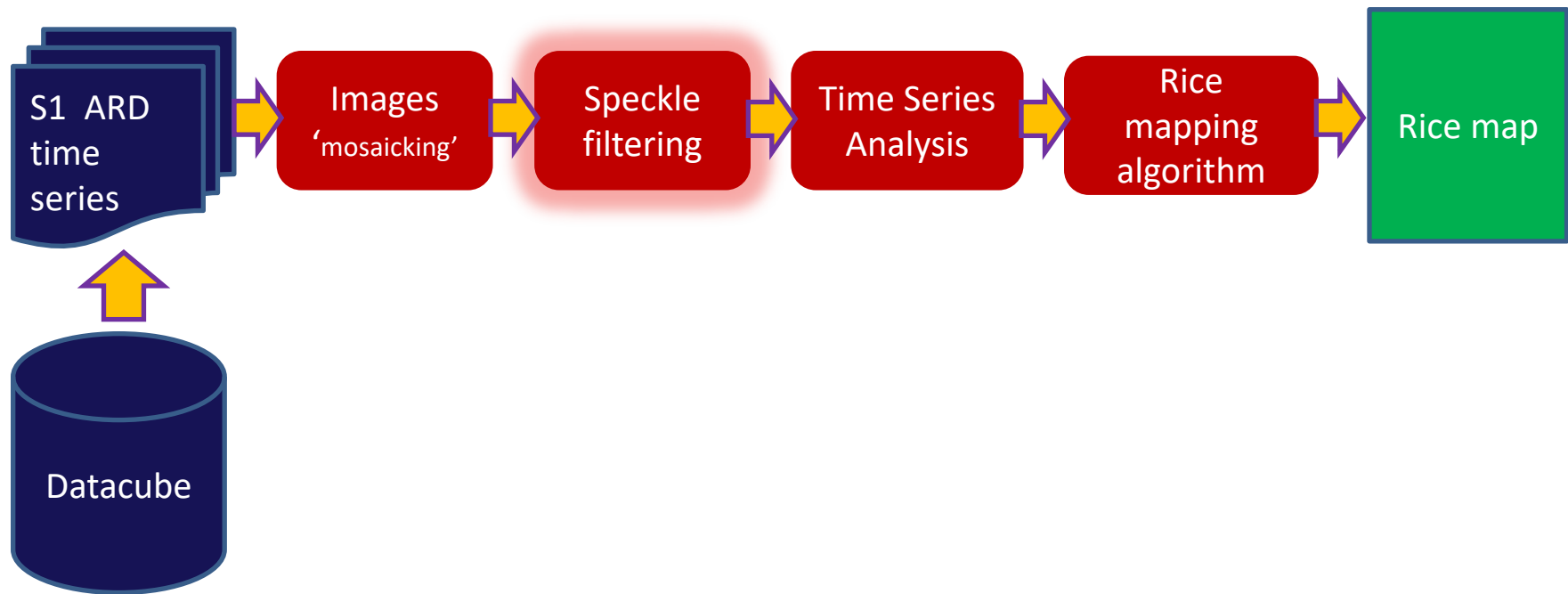


# Building Analysis Ready Data (ARD) for Sentinel-1 on VN Databcube

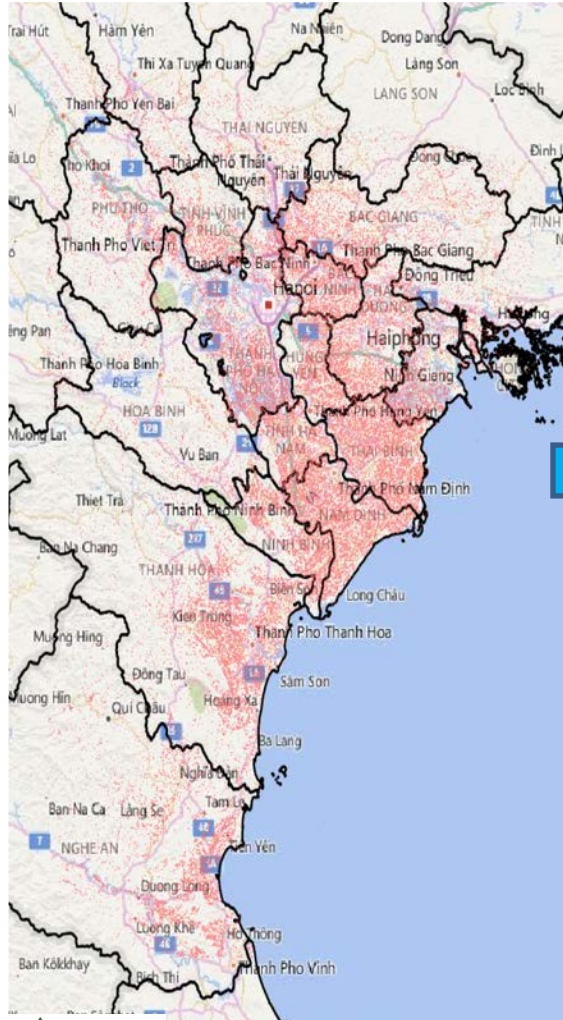


## Rice mapping with Datacube

To generate a rice map using Sentinel-1 time series

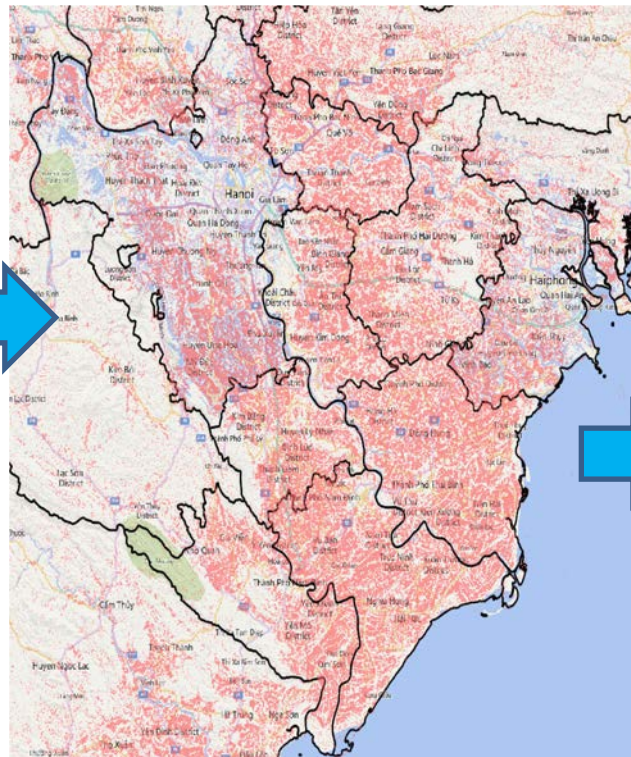


# Demonstration of Rice mapping using VN Datacube

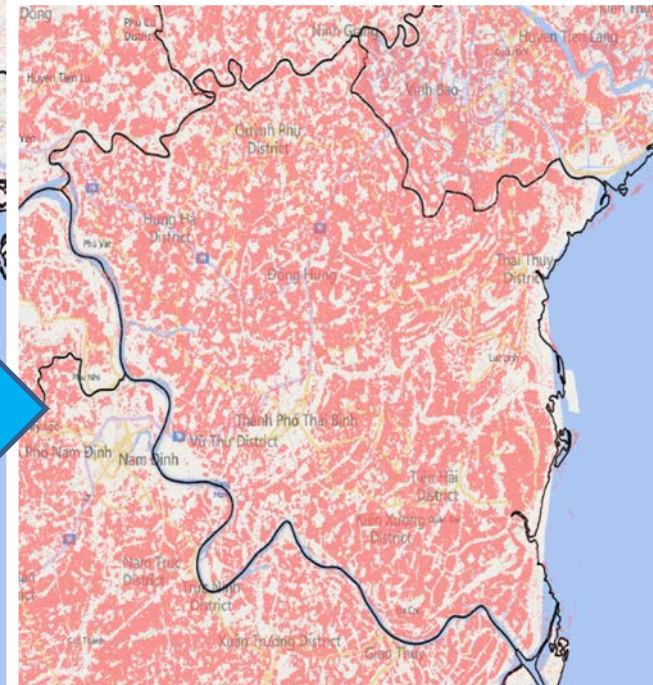


Northern Vietnam

Red River Delta



Thai Binh Province



**Winter-Spring 2017 rice map generated from S1 data using VN DataCube**

# Way forward to better link water and agriculture ?