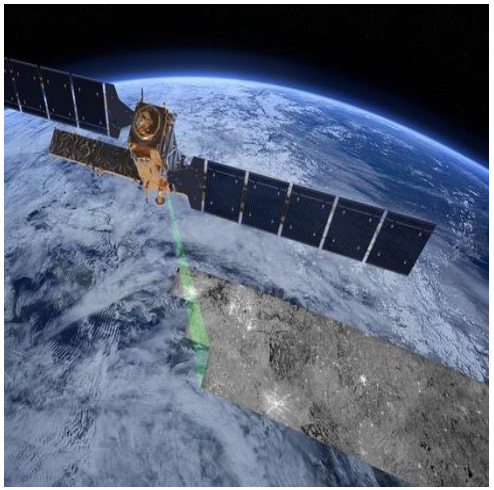
A platform to sthrengthen collaboration between water and agriculture fields

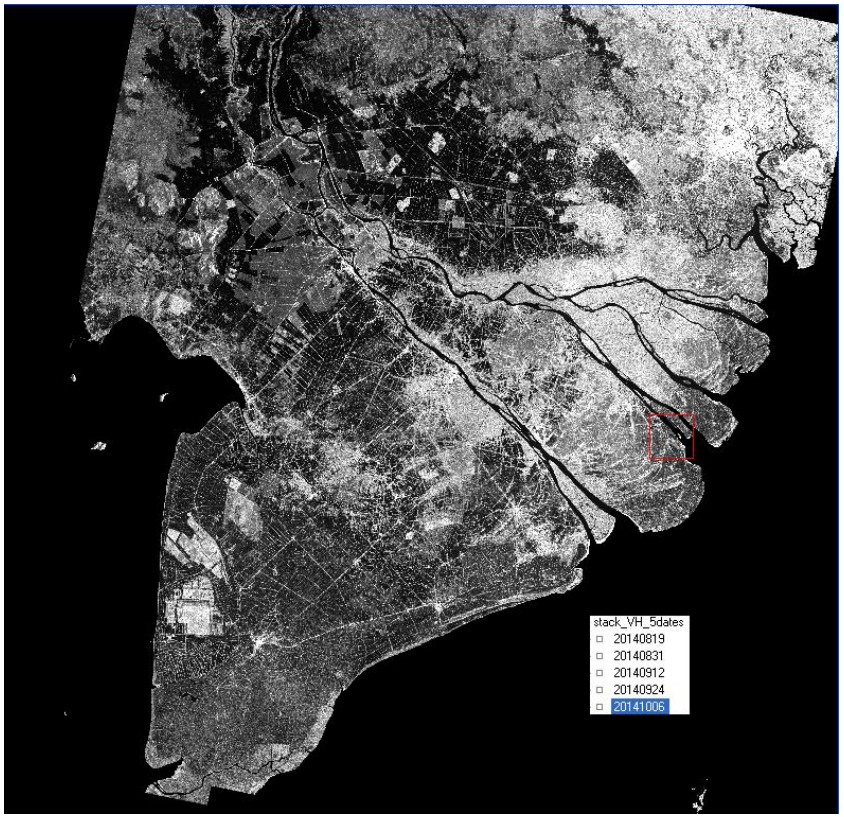
On behalf of Asia-Rice (TG5)

Thuy Le Toan

CESBIO, Toulouse, France



Sentinel-1 to observe the Mekong basin

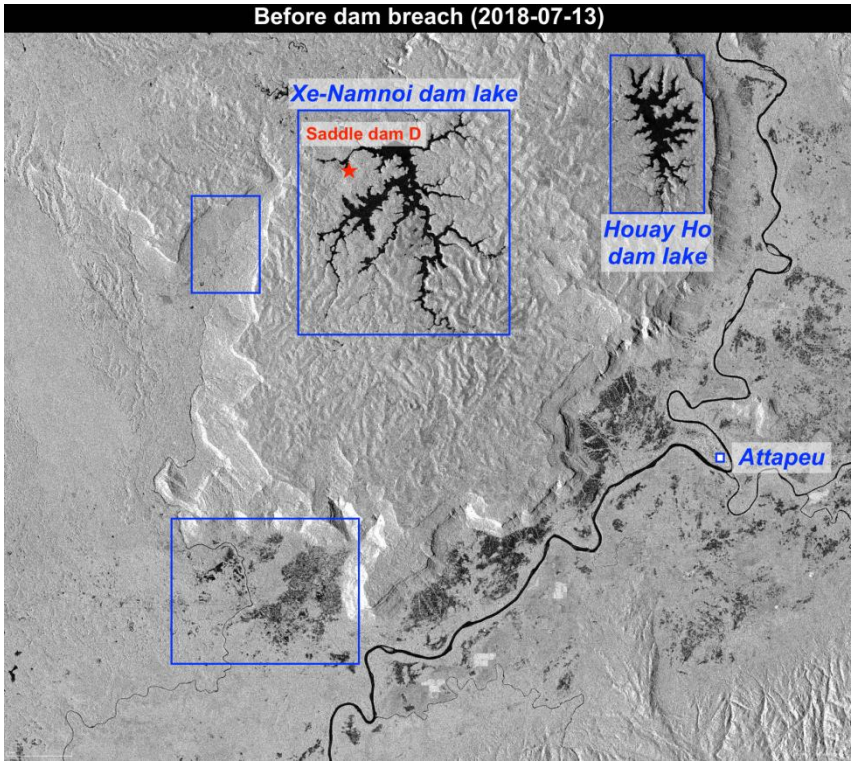


C-Band SAR data continuity

- 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

Data available for applications including
Rice monitoring
Flood monitorig

Following the dam breaching in Lao PDR



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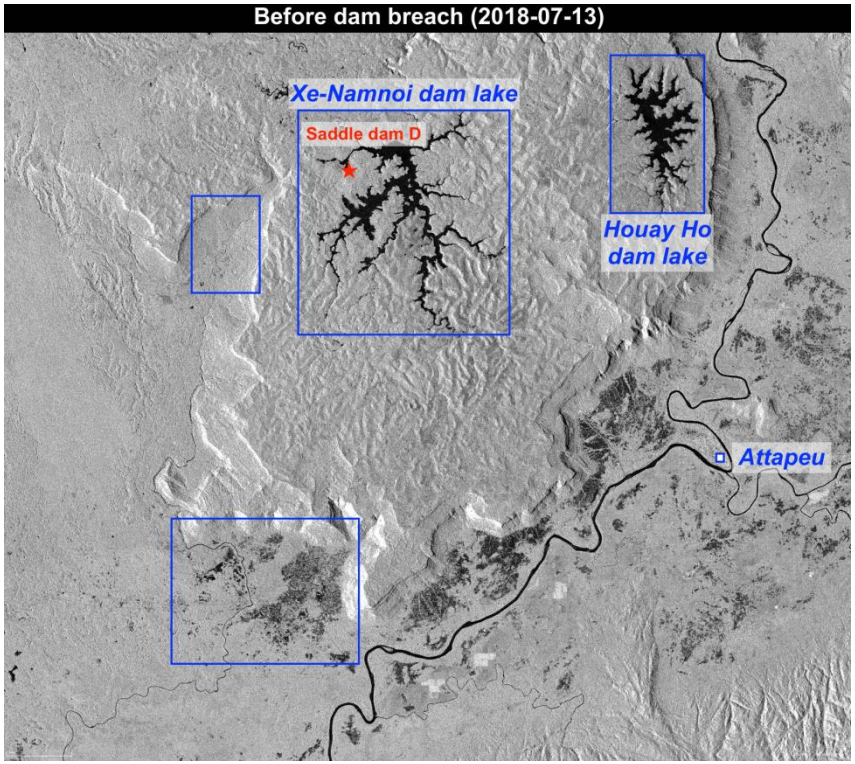
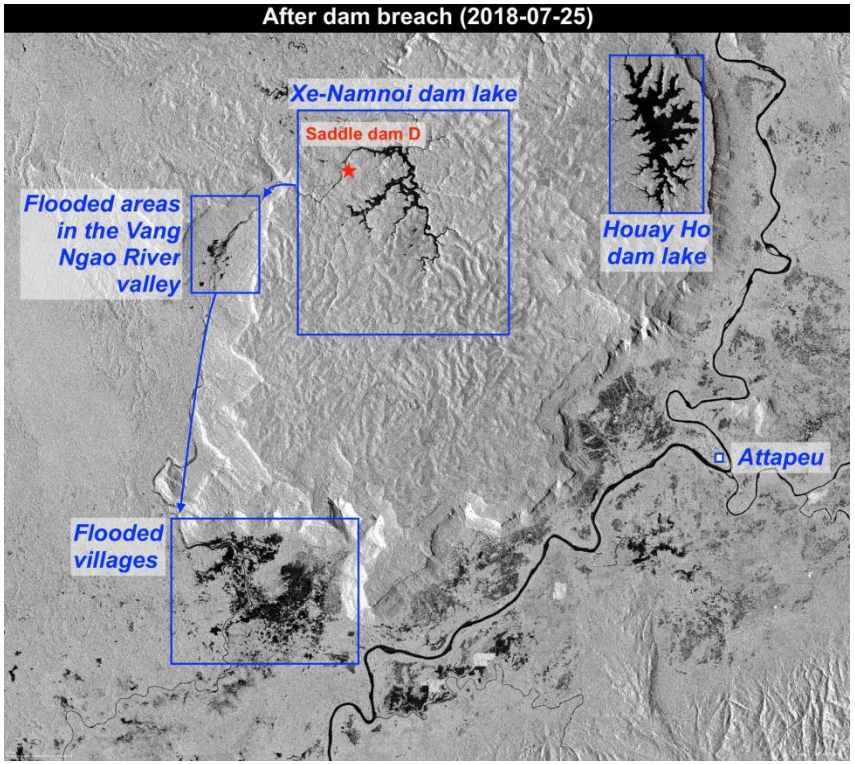


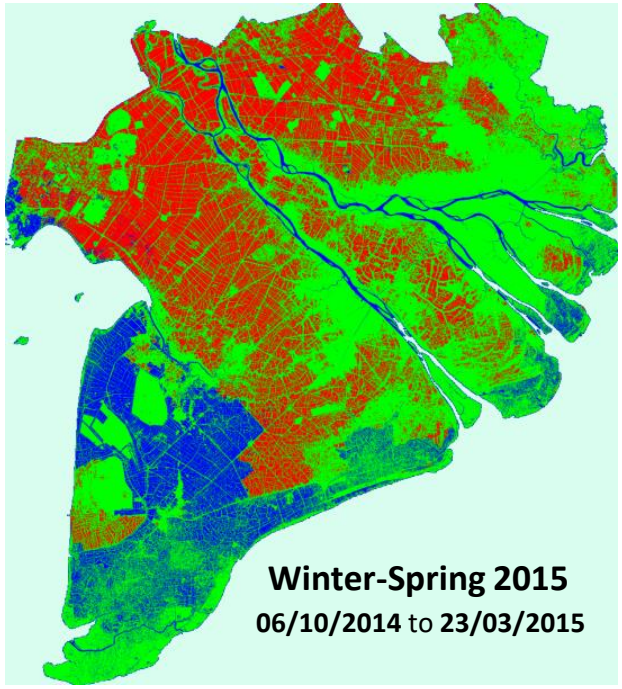


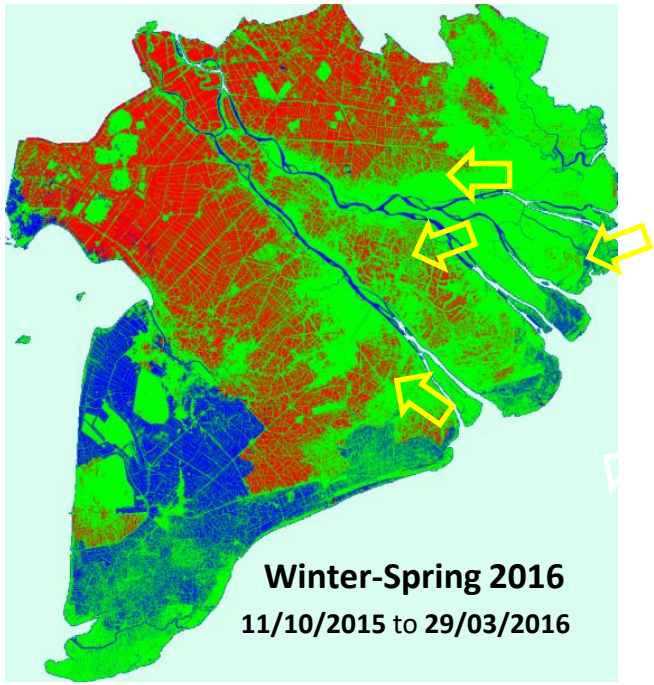
Beyond food security, rice crop is closely linked to climate change, water and environment

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

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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 ±5 -10 cm from soil surface.

AWD

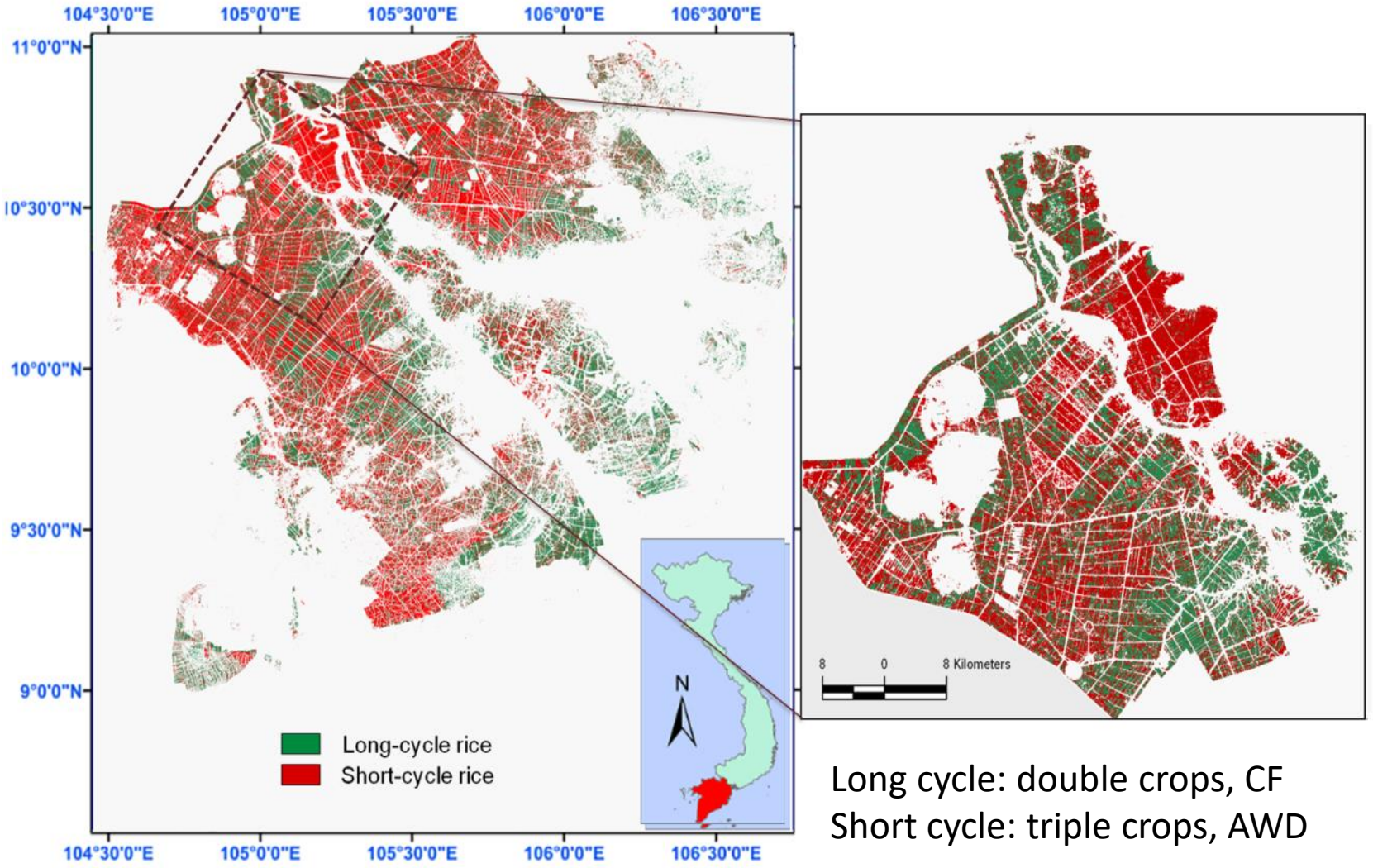
Biogeochemical Implications:

- 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



Long cycle: double crops, CF
Short cycle: triple crops, AWD

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)

ARD preparation and transfer to VN

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

International partners

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

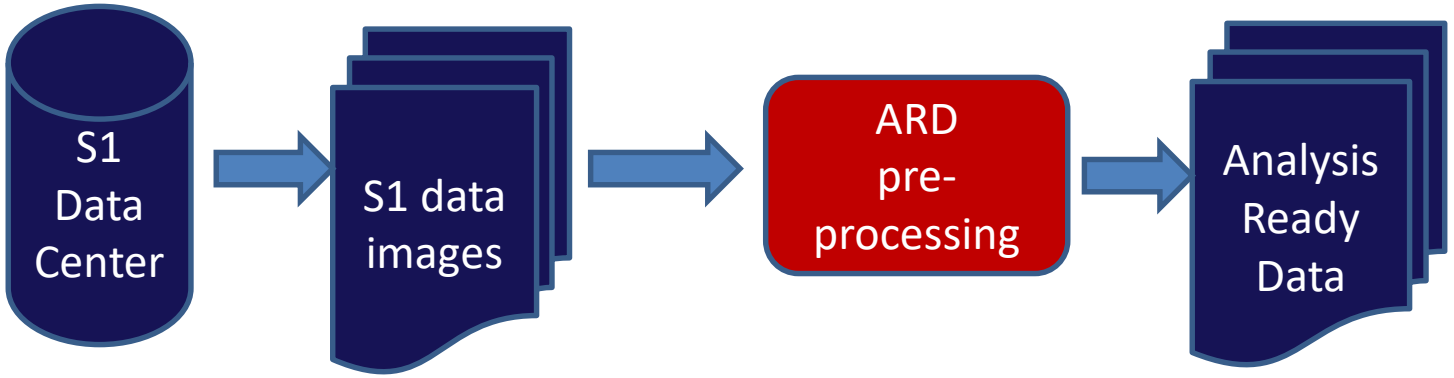
Application domains

- 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



S1 images ready to use in Datacube

https://peps.cnes.fr

Ground projected image (GRD) .SAFE format

Python script

S1toARD.py

https://scihub.copernicus.eu

Metadata for Datacube

S1 images metadata for Datacube ingestion (.yaml file)

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

ARD pre-processing

Python script S1toARD.py

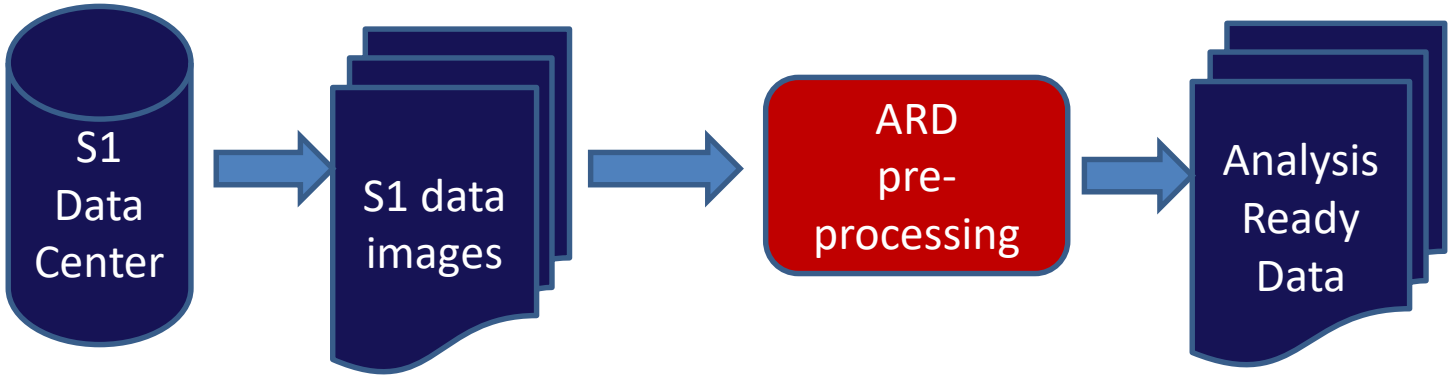
Currently using SNAP software

But performance improvement can be achieved using OrfeoToolBox

ORFEO ToolBox cnes

Gamma0 calibration	Convert digital number in images into physical valu
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
Orthorectification	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 Datacube



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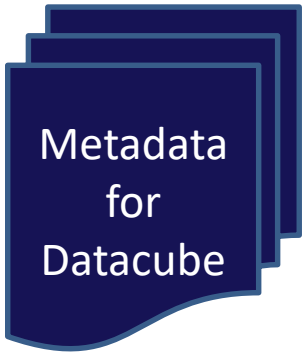

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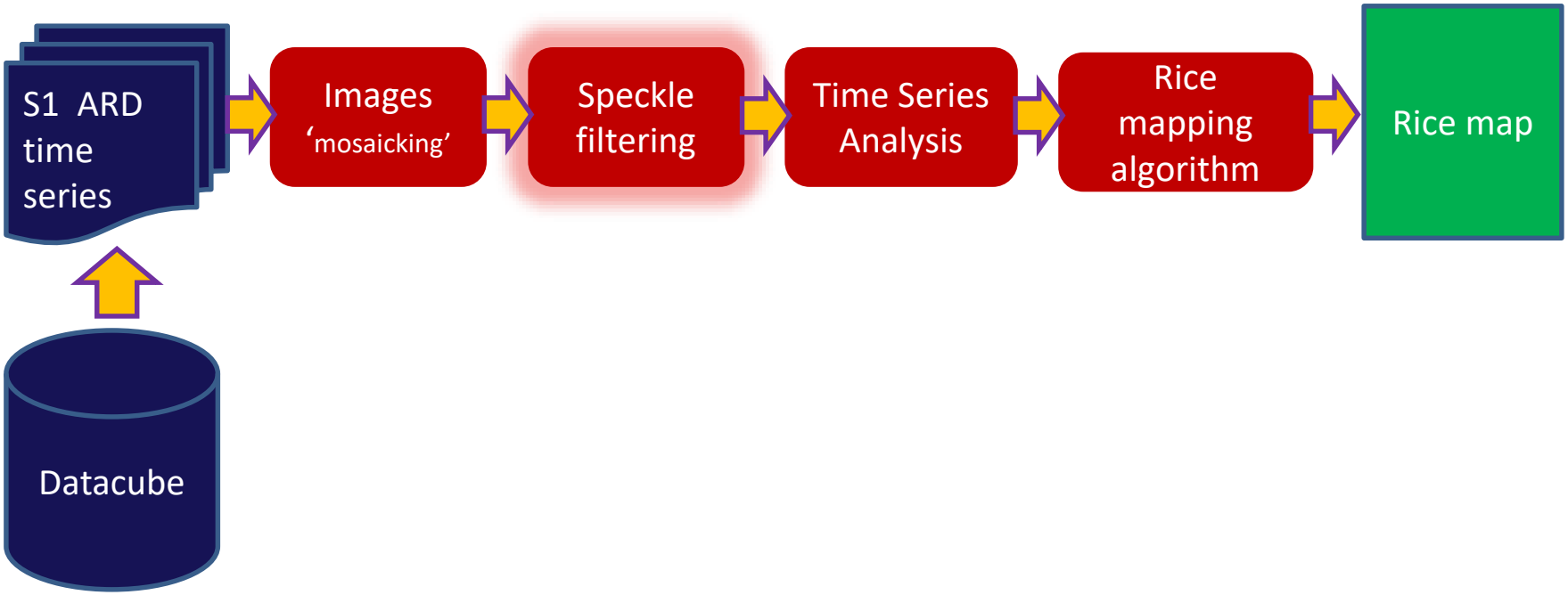
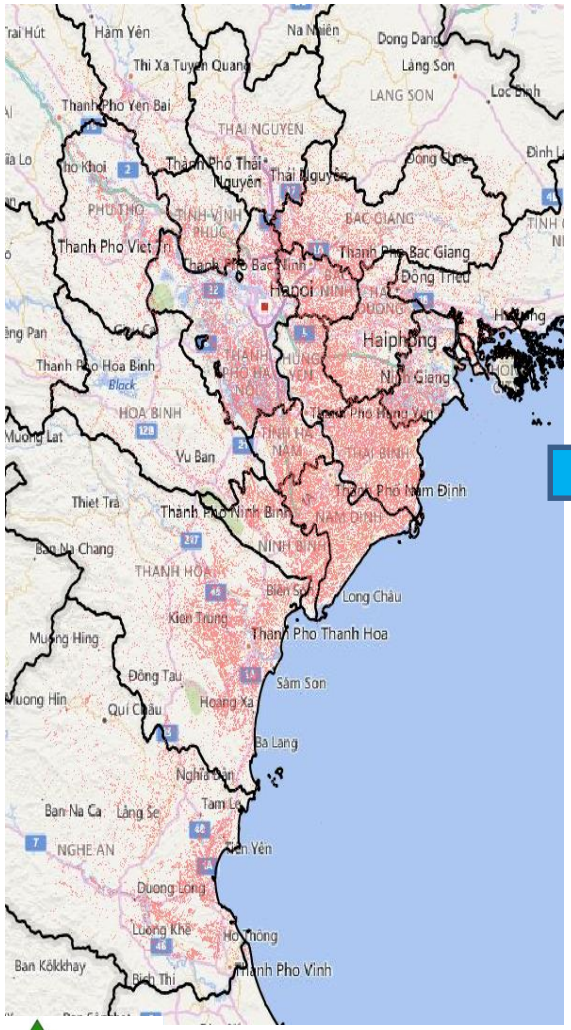
Rice mapping with Datacube

To generate a rice map using Sentinel-1 time series

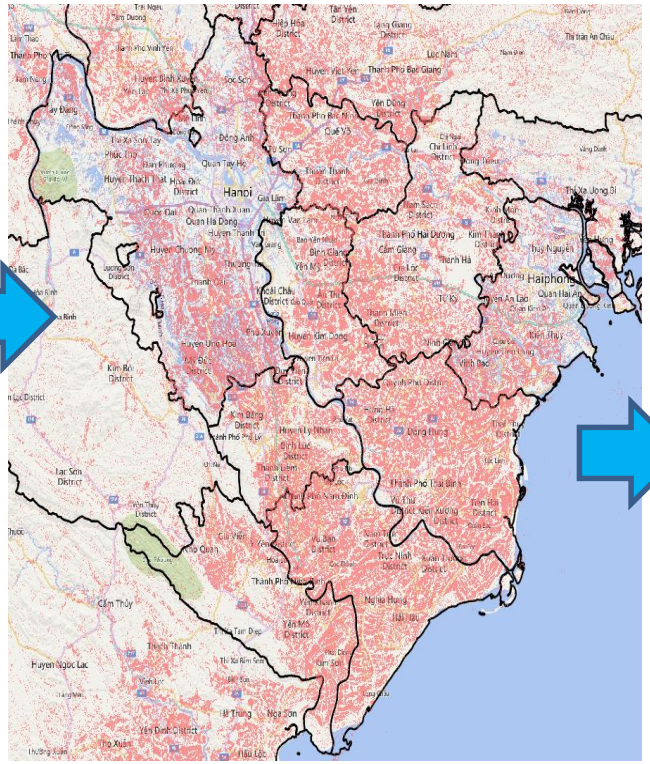


Demonstration of Rice mapping using VN Datacube

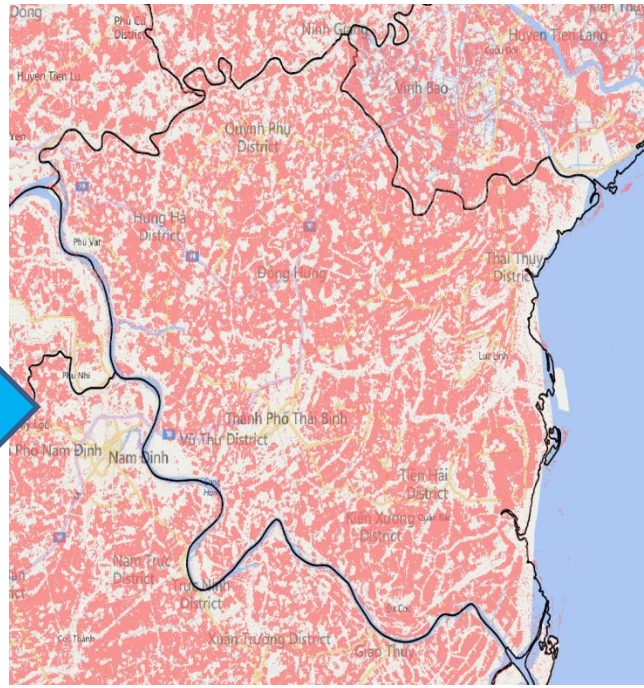


Northern Vietnam

Red River Delta



Thai Binh Province



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

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Way forward

to better link water and agriculture ?