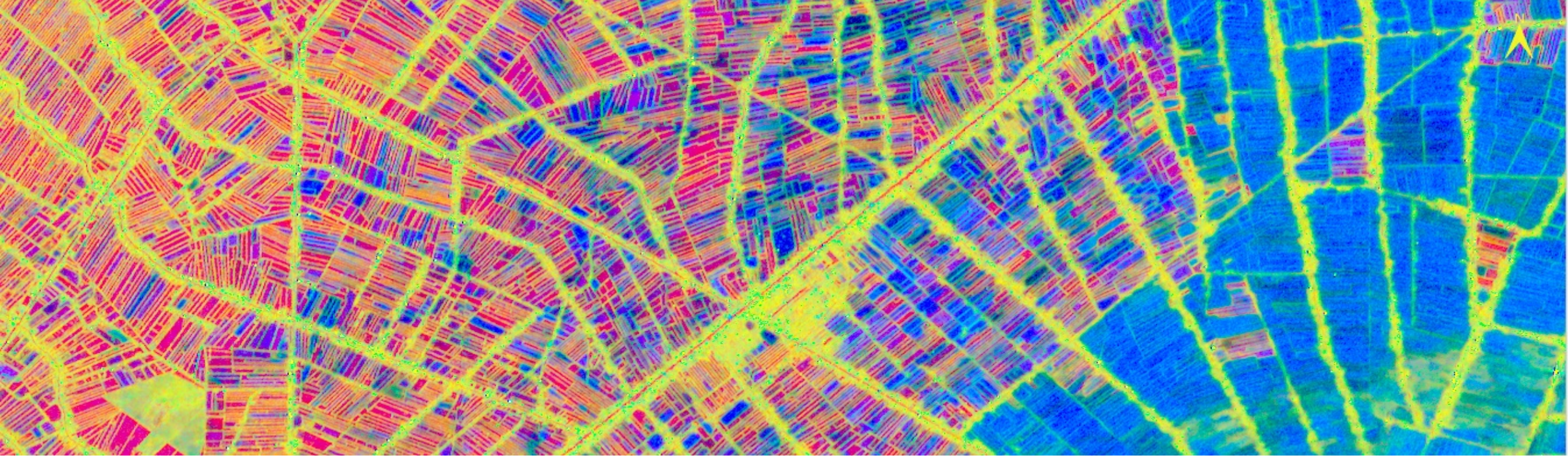

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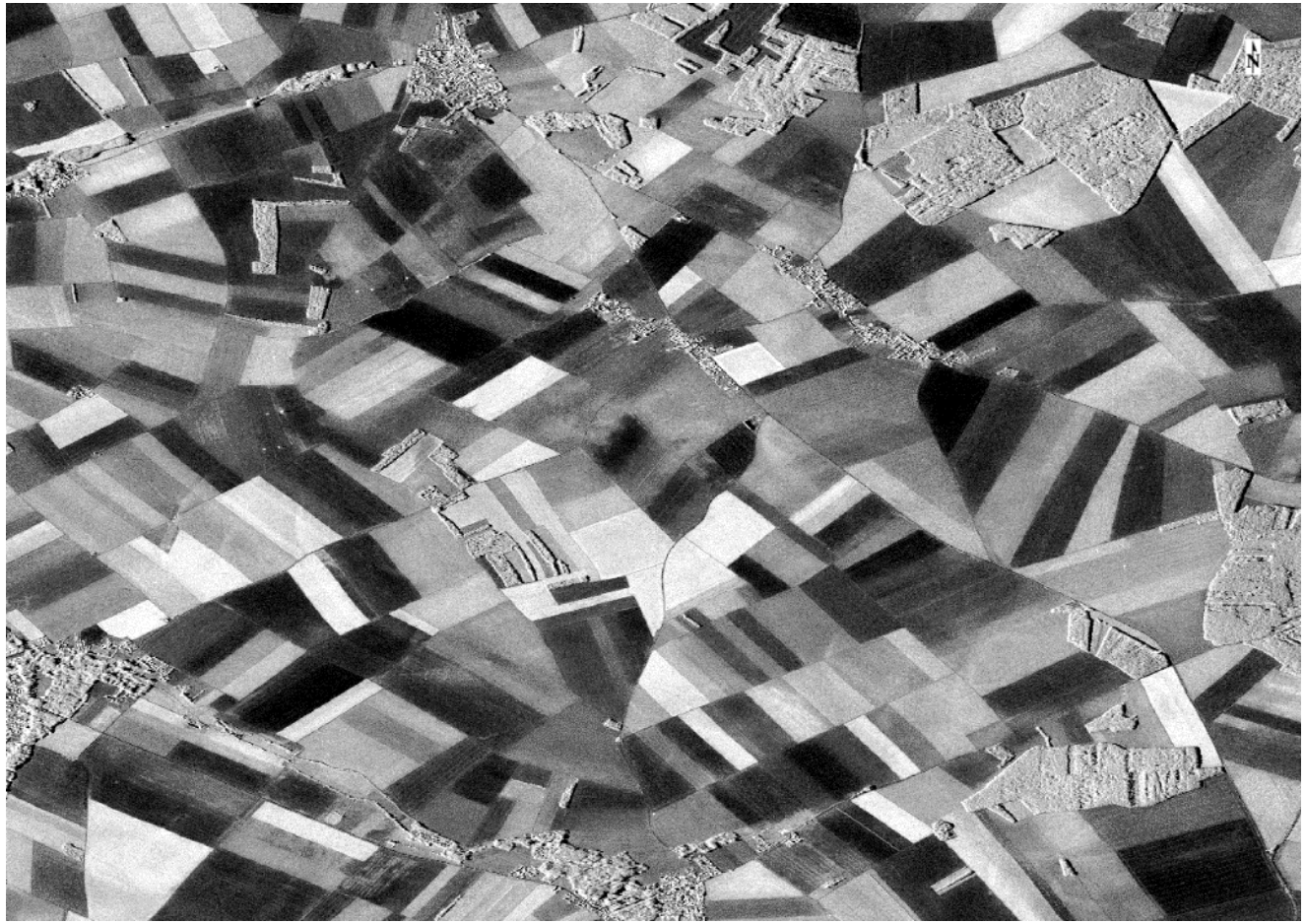
EXPLORING ENVI® SARSCAPE: AGRICULTURE

Megan Gallagher
Solutions Engineer

Agriculture Overview

- SAR intensity processes can be used to monitor and track agriculture.
- The ability to see through clouds gives us constant monitoring, and the unique wave responses give us information on the crop growth, soil moisture, and kind of crop
- We will be looking at rice growth in Vietnam, and crop types in Boise, Idaho

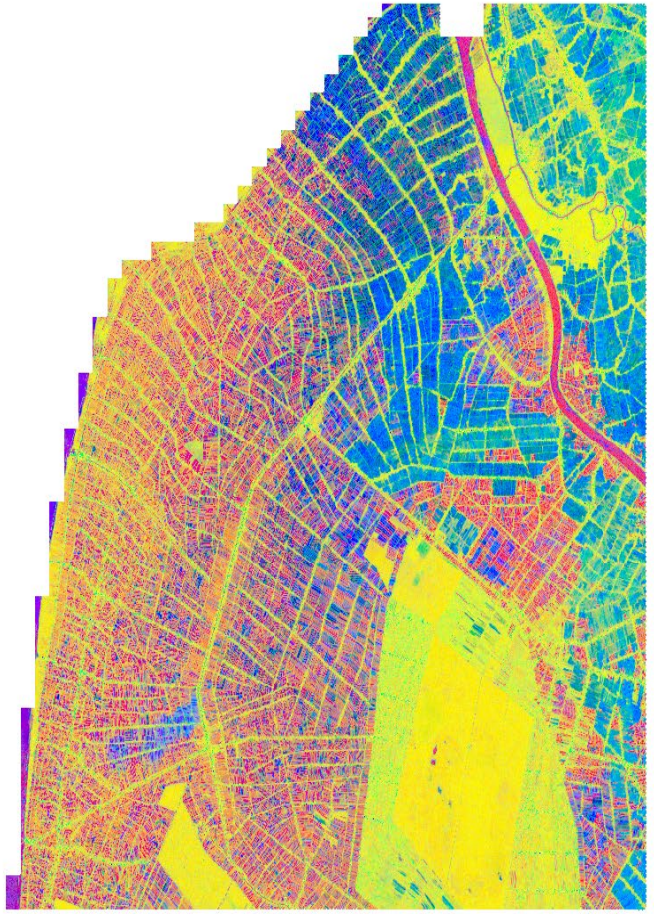


TerraSAR-X Data over Fields

AIRBUS

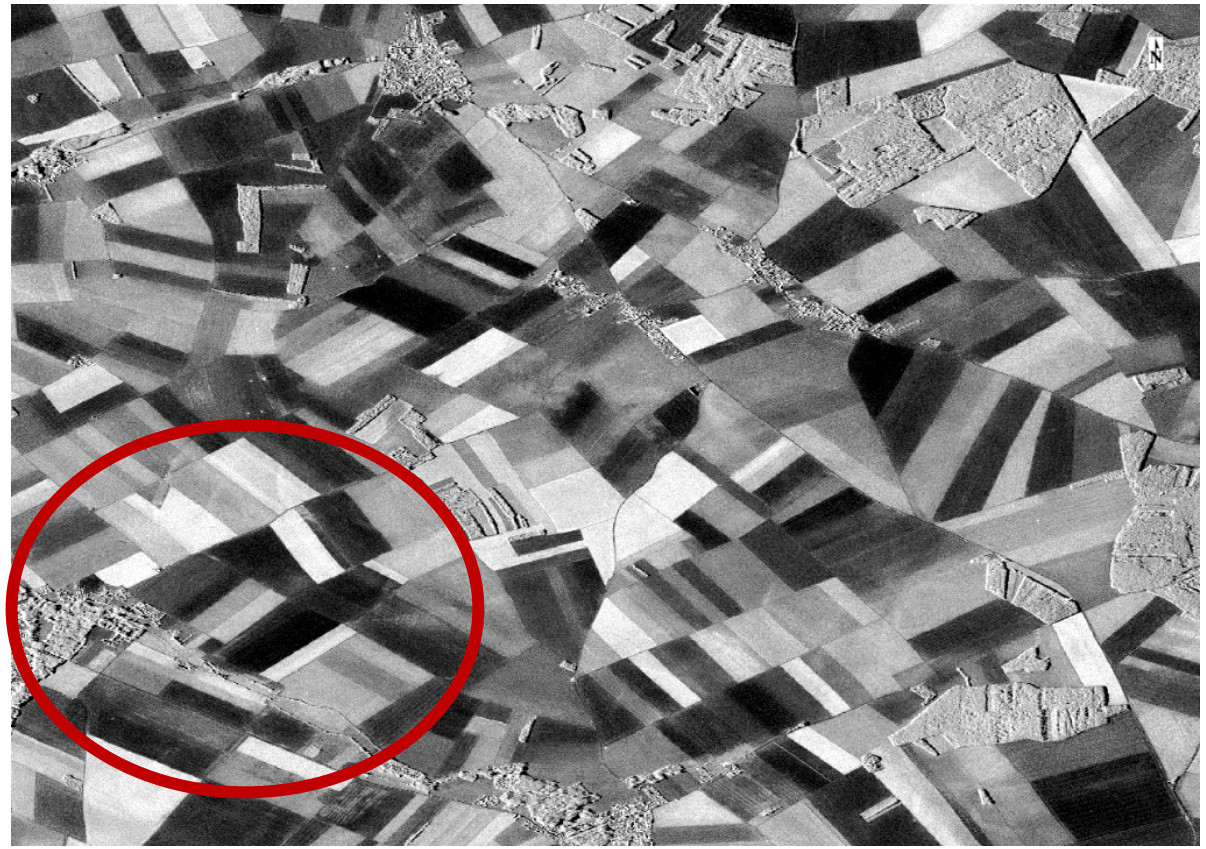
Rice Growth in Vietnam

- Rice is the dominant crop in Vietnam, especially in the Mekong River Delta, where our area of interest lies
- It's growth cycles and stages are not static, meaning it can change from field to field, and year to year.
- Vietnam grows "wet" rice, meaning that fields are flooded instead of dry, which has unique SAR signal responses.



Optical and SAR

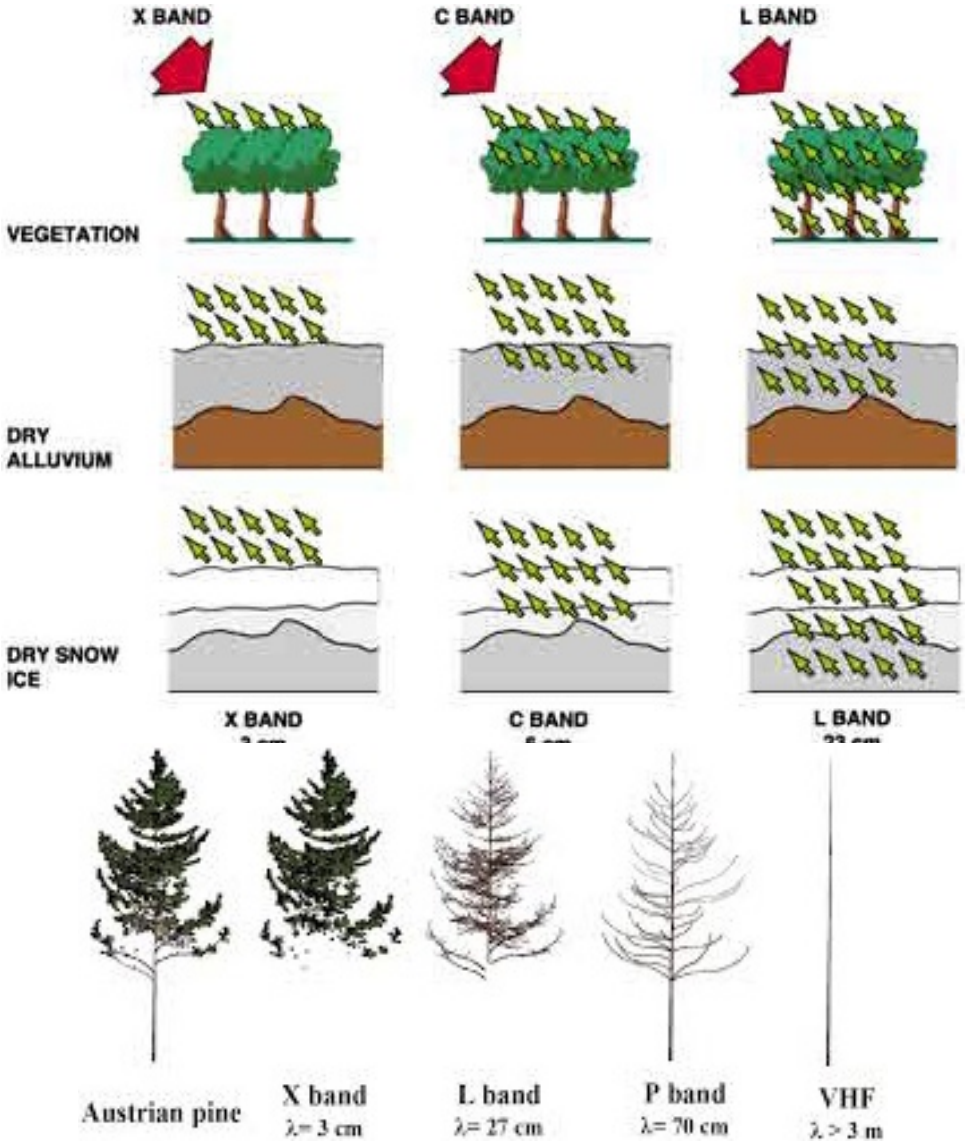
Sentinel-2, June 20, 2018



TerraSAR-X, June 18, 2018

Radar Band Frequency

Band	Frequency	Applications
VHF	300 kHz - 300 MHz	Foliage/ground penetration, biomass
P	300 MHz - 1 GHz	Biomass, soil moisture, ground penetration
L	1 - 2 GHz	Agriculture/forestry, soil moisture, ground penetration
S	3-4 GHZ	Agriculture, biomass, ocean
C	4 - 8 GHz	Ocean, agriculture, general surface investigation
X	8 - 12 GHz	Ocean, agriculture, general surface investigation (high resolution)
Ku	14 - 18 GHz	Glacial/ice, snow cover
Ka	27 - 47 GHz	Glacial/ice, very high resolution imagery

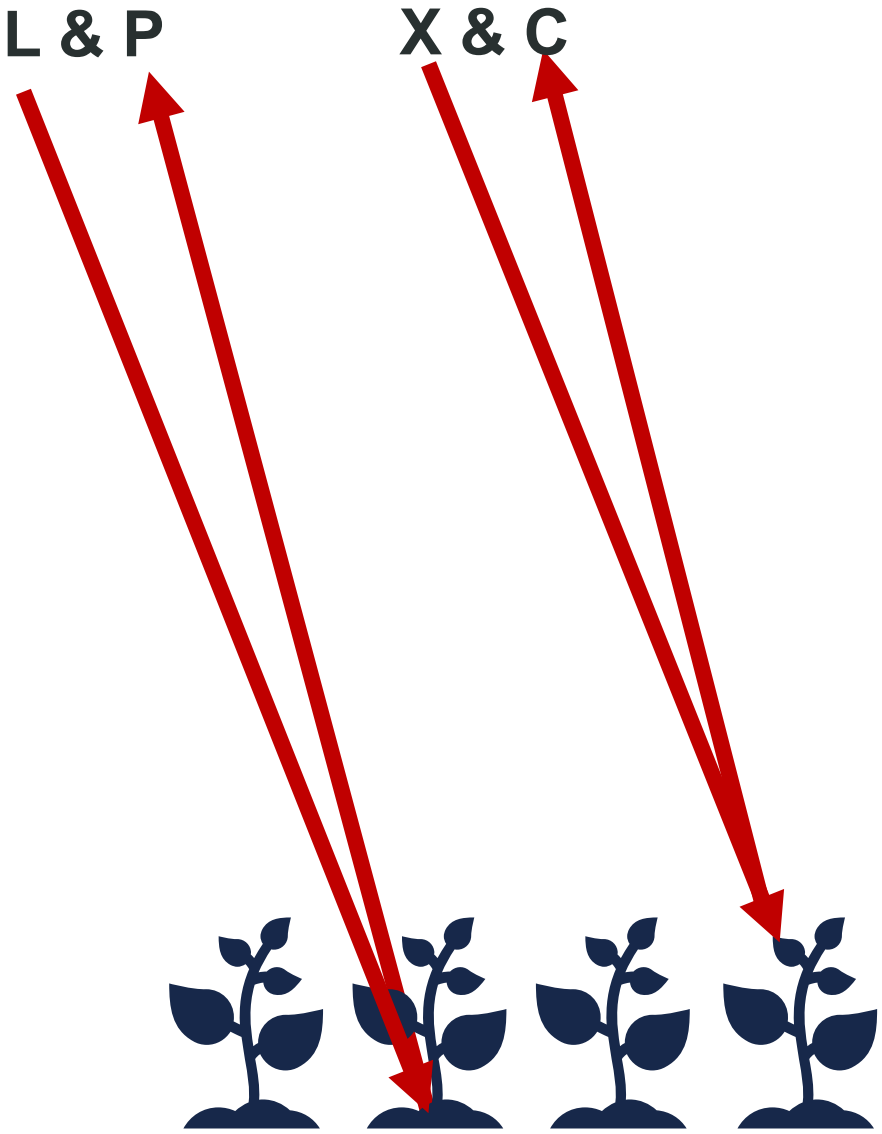


Band Effects

L and P band have longer wavelengths and are dominated by soil backscatter. They are used mainly for soil moisture and information on thicker vegetation.

C and X band interact mainly with the canopy.

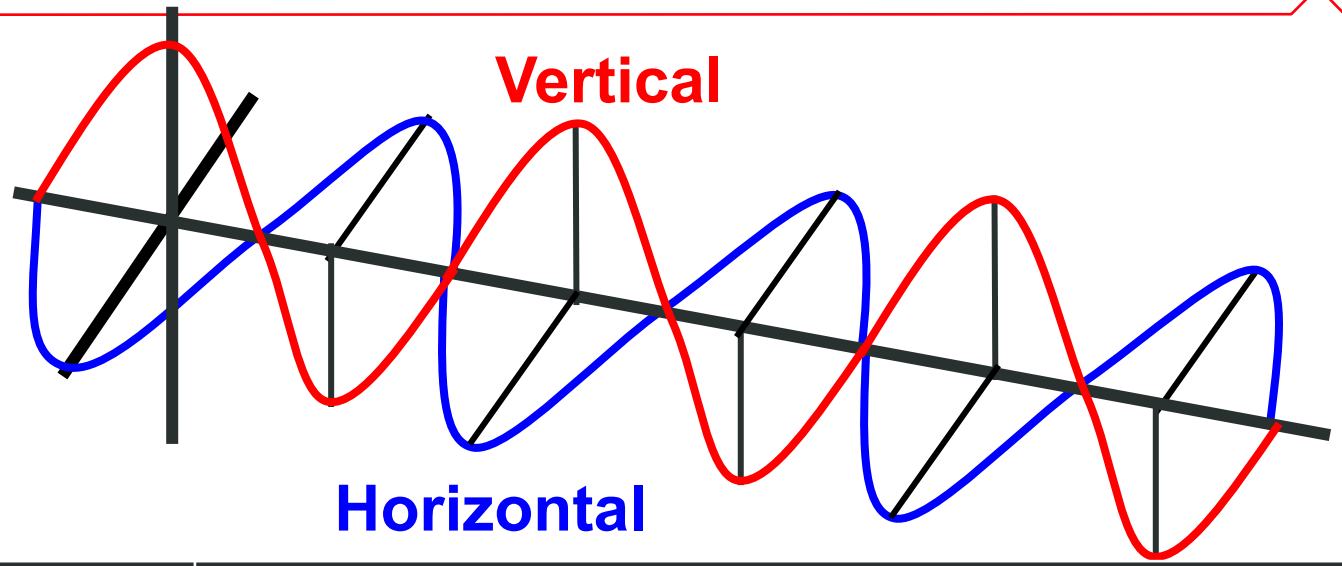
X band works well with broad leafed plants (e.g. Corn and soybeans) while both X and C work well with narrow leafed plants (most grains)



Polarization Choices

SAR satellites have multiple polarizations, from single pole (such as only VV or VH) to quad-pole (which returns all variations)

Each polarization interacts differently with the surface it hits, adding information to the scene



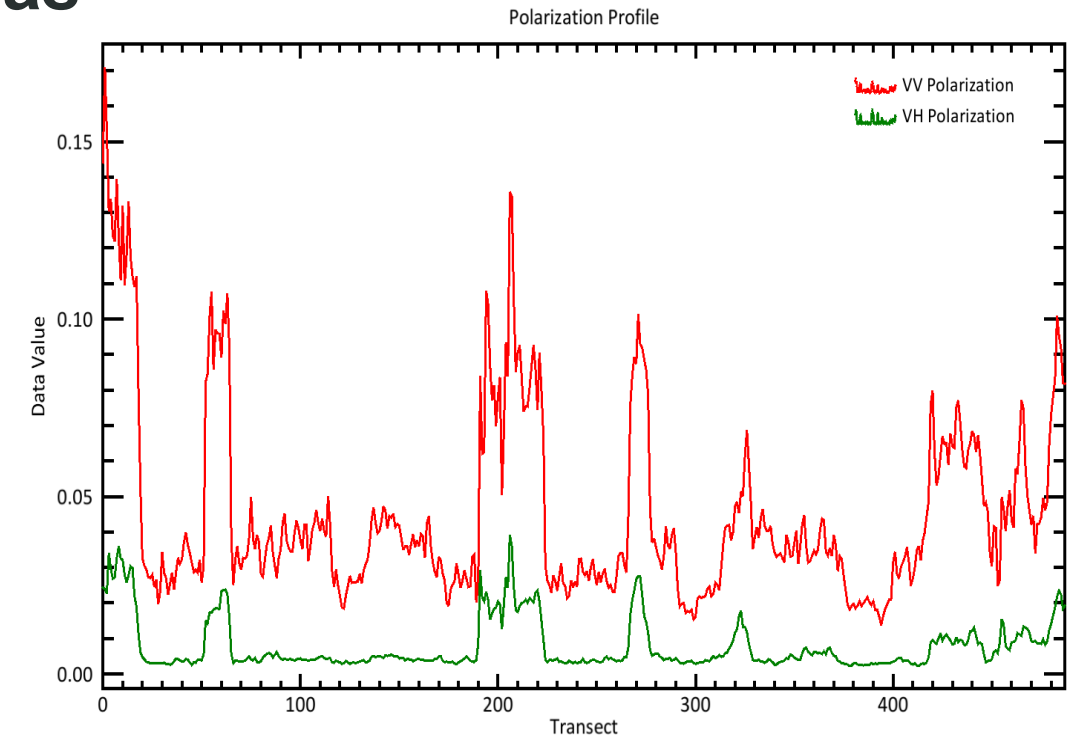
Polarization	Physical Meaning
VV	Vertical wave, outgoing and incoming
HH	Horizontal wave, outgoing and incoming
VH	Vertical Wave outgoing, Horizontal Wave incoming
HV	Horizontal Wave outgoing, Vertical Wave incoming

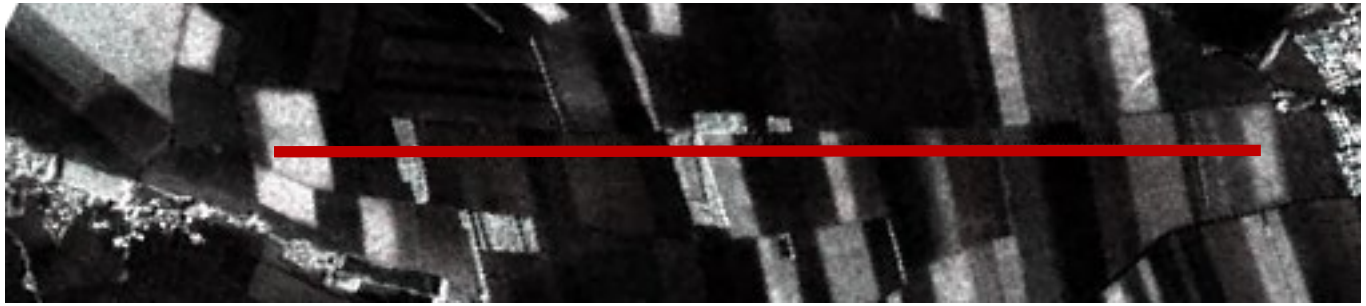
Polarization Effects

Quad Polarized (VV, HH, VH, and HV) has the most information for full understanding of vegetation.

Dual Pol (VV & VH or HH & HV) is still able to discern major differences.

Polarization	Mainly impacted by
HH	Surface Scattering* very small roughness
HV/VH	Volume Scatter
VV	Vegetation Structure



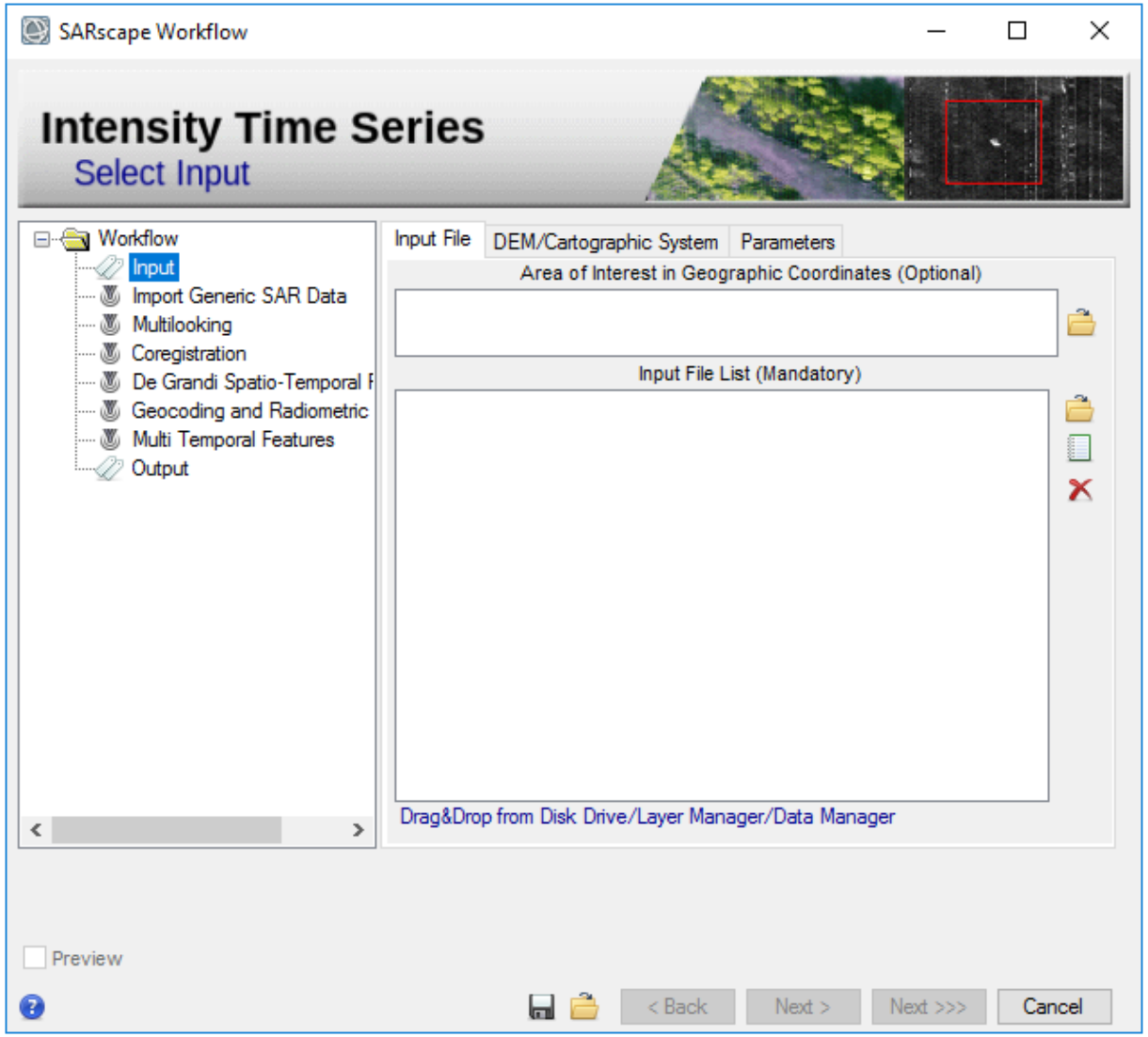


Intensity Time Series

Intensity Time Series (ITS) tracks the changes over time to the imagery reflectance.

11 images are used between June 1st, 2021, to September 29th, 2021

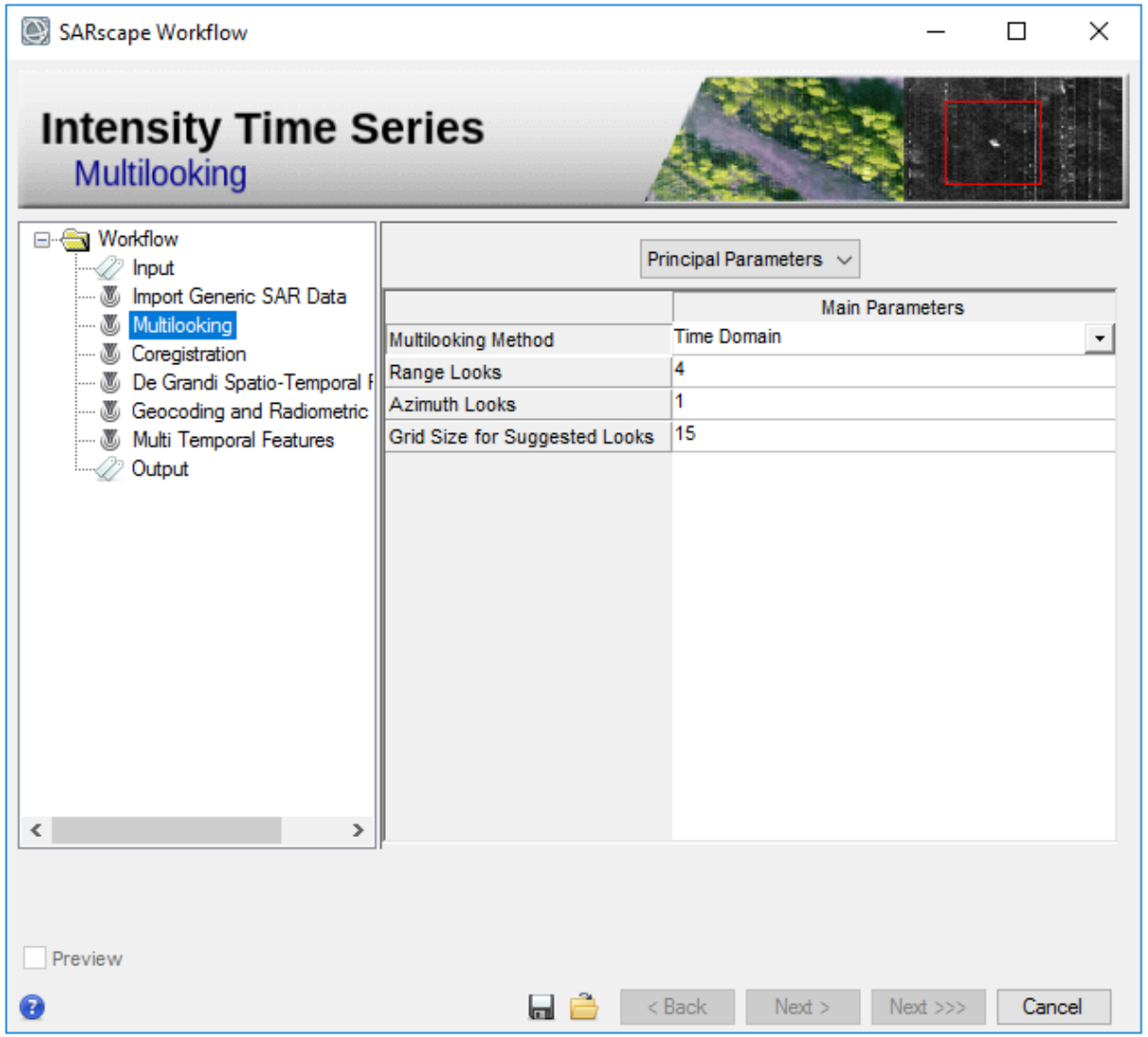
- **Input**
- **Import Generic SAR Data**
- Multilooking
- Coregistration
- De Grandi Spatio-Temporal Filtering
- Geocoding and Radiometric Calibration
- Multi Temporal Features
- Output



Intensity Time Series - Multilooking

Multilooking averages over the scene in the azimuth and range directions to create square pixels of specific resolutions. It also helps remove speckle which you can do over time or frequency

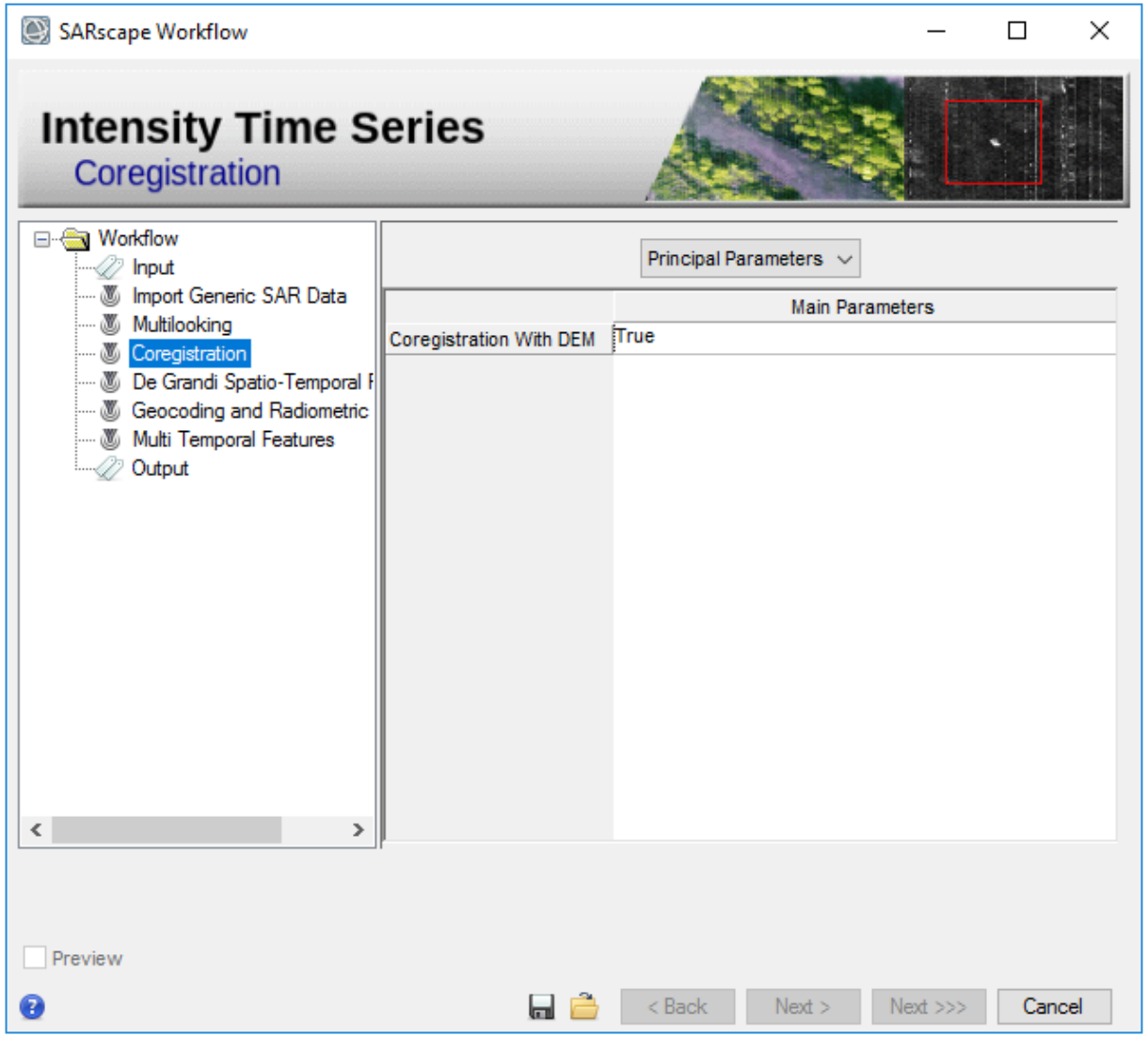
- Input
- Import Generic SAR Data
- **Multilooking**
- Coregistration
- De Grandi Spatio-Temporal Filtering
- Geocoding and Radiometric Calibration
- Multi Temporal Features
- Output



Intensity Time Series - Coregistration

Coregistration aligns the images on top of each other and to the provided DEM for true geo-referencing

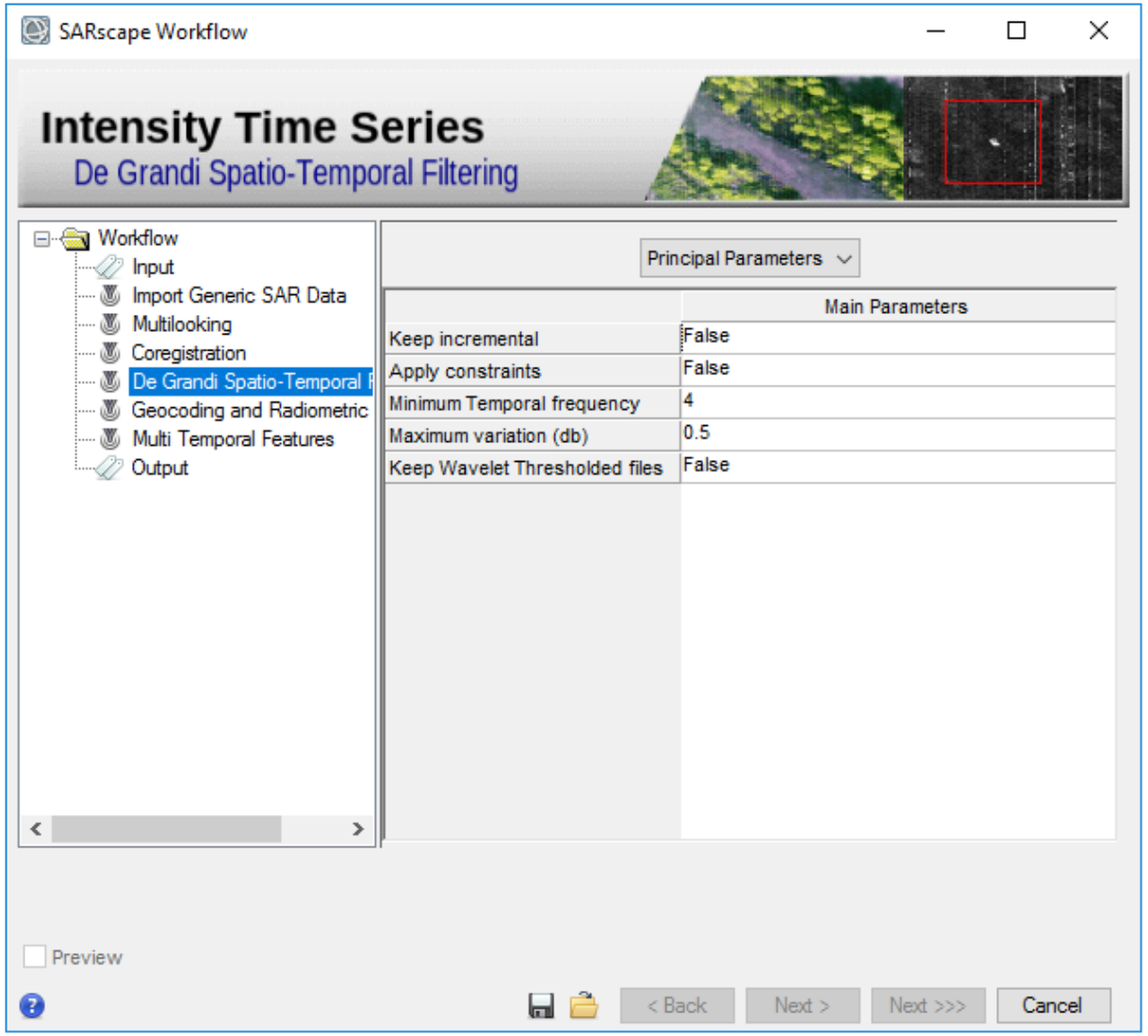
- Input
- Import Generic SAR Data
- Multilooking
- **Coregistration**
- De Grandi Spatio-Temporal Filtering
- Geocoding and Radiometric Calibration
- Multi Temporal Features
- Output



Intensity Time Series - Filtering

Filtering helps reduce noise and speckle, De Grandi Spatio-Temporal filtering does this both in the images over space and time, greatly reducing all noise.

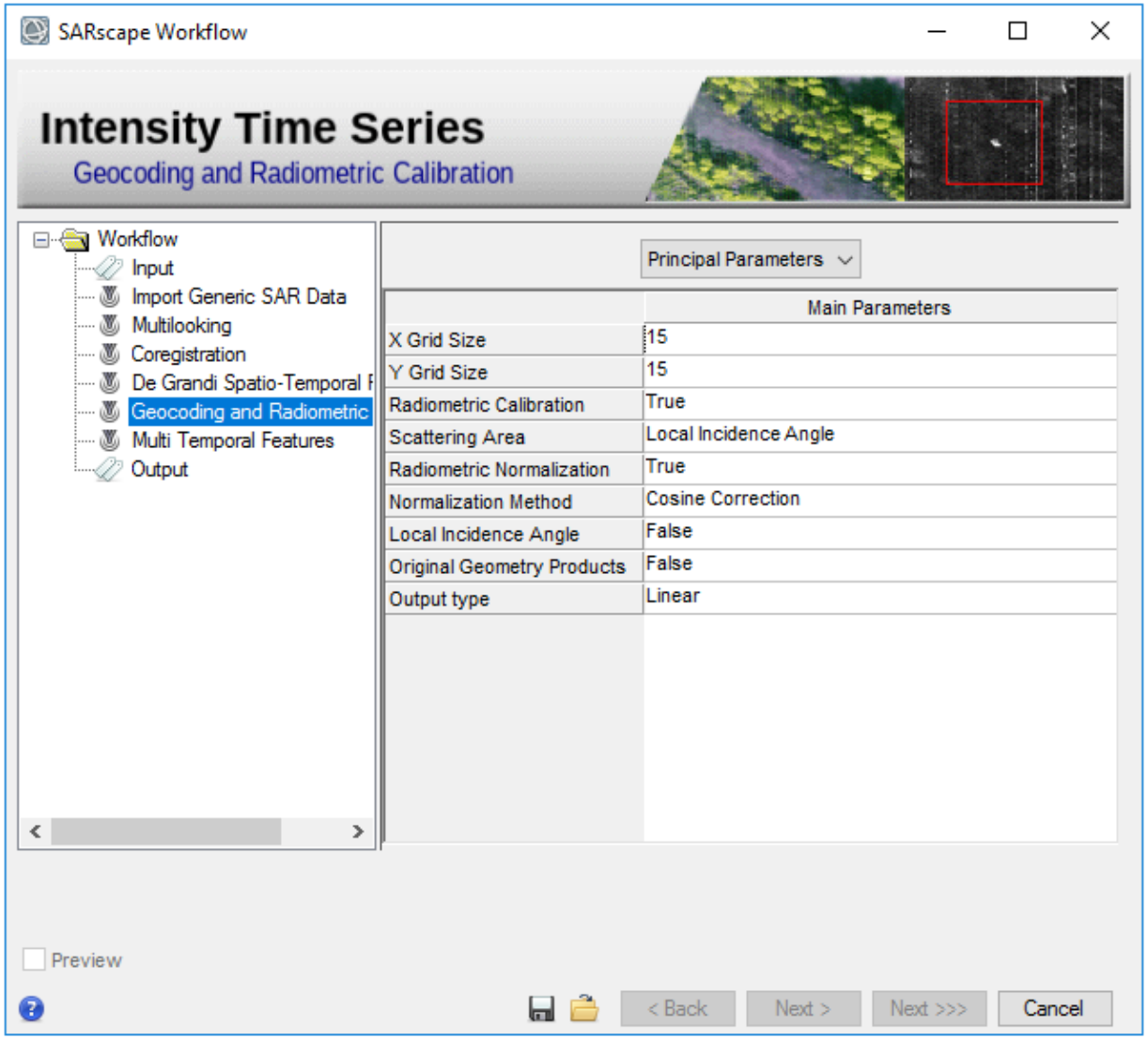
- Input
- Import Generic SAR Data
- Multilooking
- Coregistration
- **De Grandi Spatio-Temporal Filtering**
- Geocoding and Radiometric Calibration
- Multi Temporal Features
- Output



Intensity Time Series - Geocoding

Geocoding and Radiometric Calibration place the imagery where it needs to be on the Earth's surface and corrects for any radiometric shifts between images.

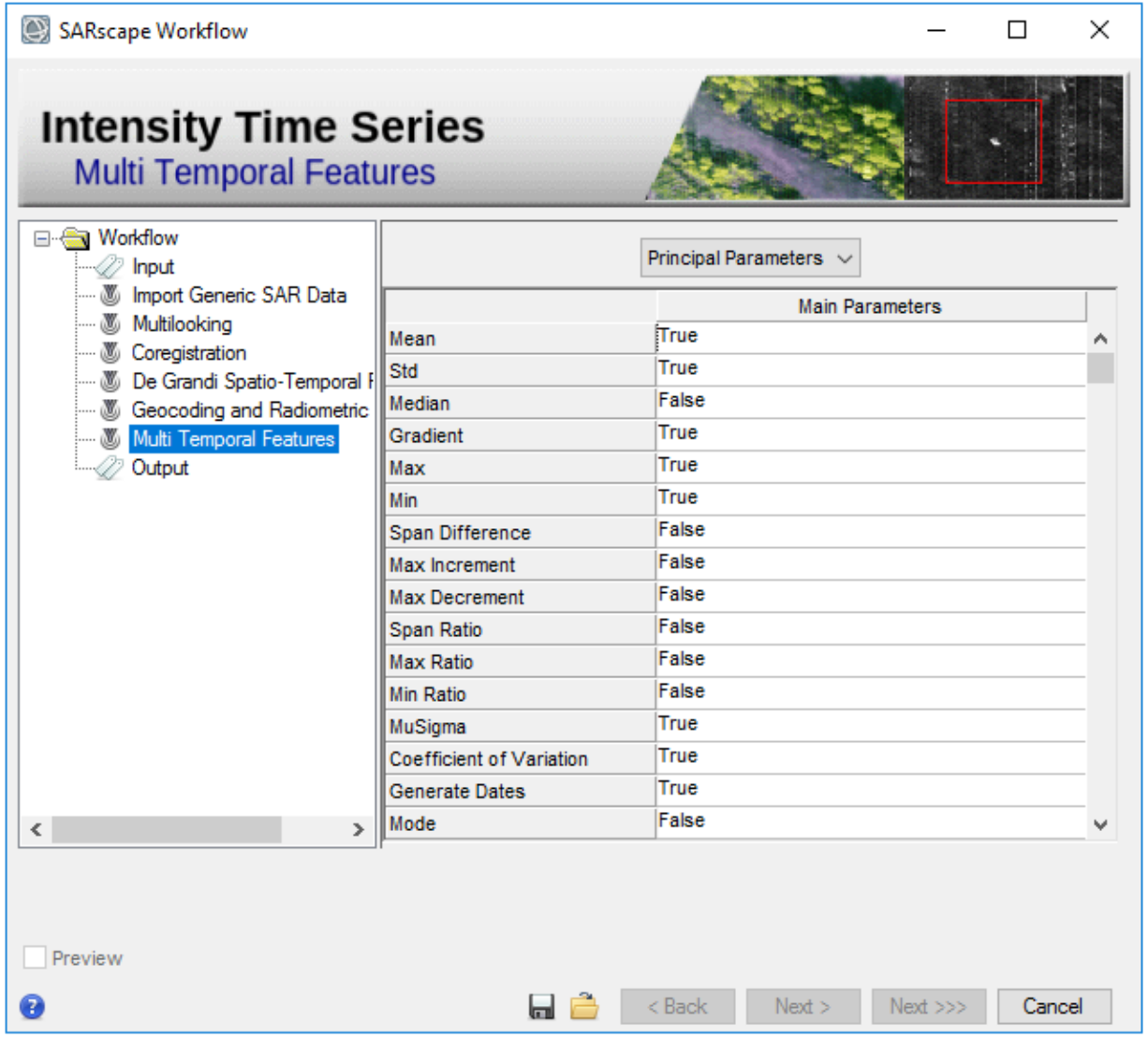
- Input
- Import Generic SAR Data
- Multilooking
- Coregistration
- De Grandi Spatio-Temporal Filtering
- **Geocoding and Radiometric Calibration**
- Multi Temporal Features
- Output



Intensity Time Series – Multi Temporal Features

Multi Temporal Features allows you to choose what statistics you want as outputs for the process. Each statistic will be applied to you stack of data to show total change.

- Input
- Import Generic SAR Data
- Multilooking
- Coregistration
- De Grandi Spatio-Temporal Filtering
- Geocoding and Radiometric Calibration
- **Multi Temporal Features**
- Output



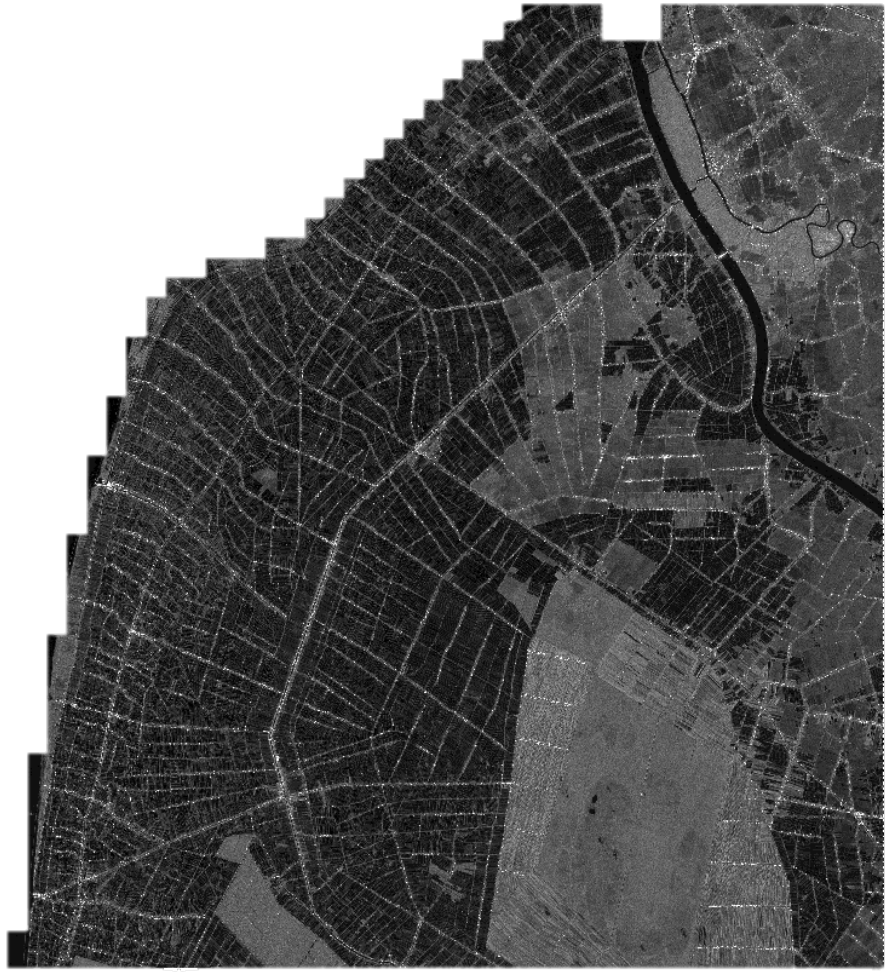

N

Standard Intensity Image

A standard intensity image output can be used for looking at changes in a single scene over fields themselves.

If you have in situ information you can look at things such as biomass, and soil moisture.

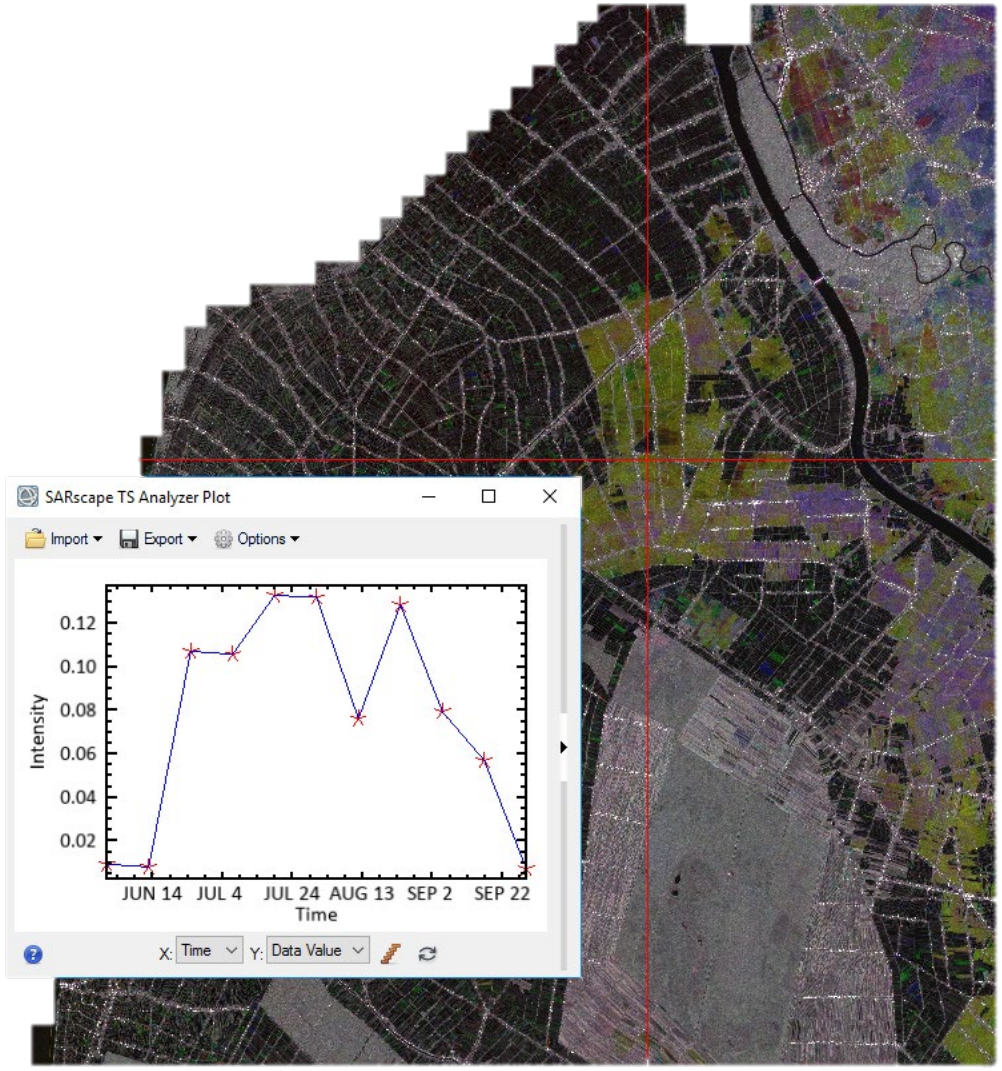
Variation in fields can be seen with higher resolution for monitoring of specific crops



Intensity Change Over Time

With multiple intensity images, you can track the changes in the growth of the field.

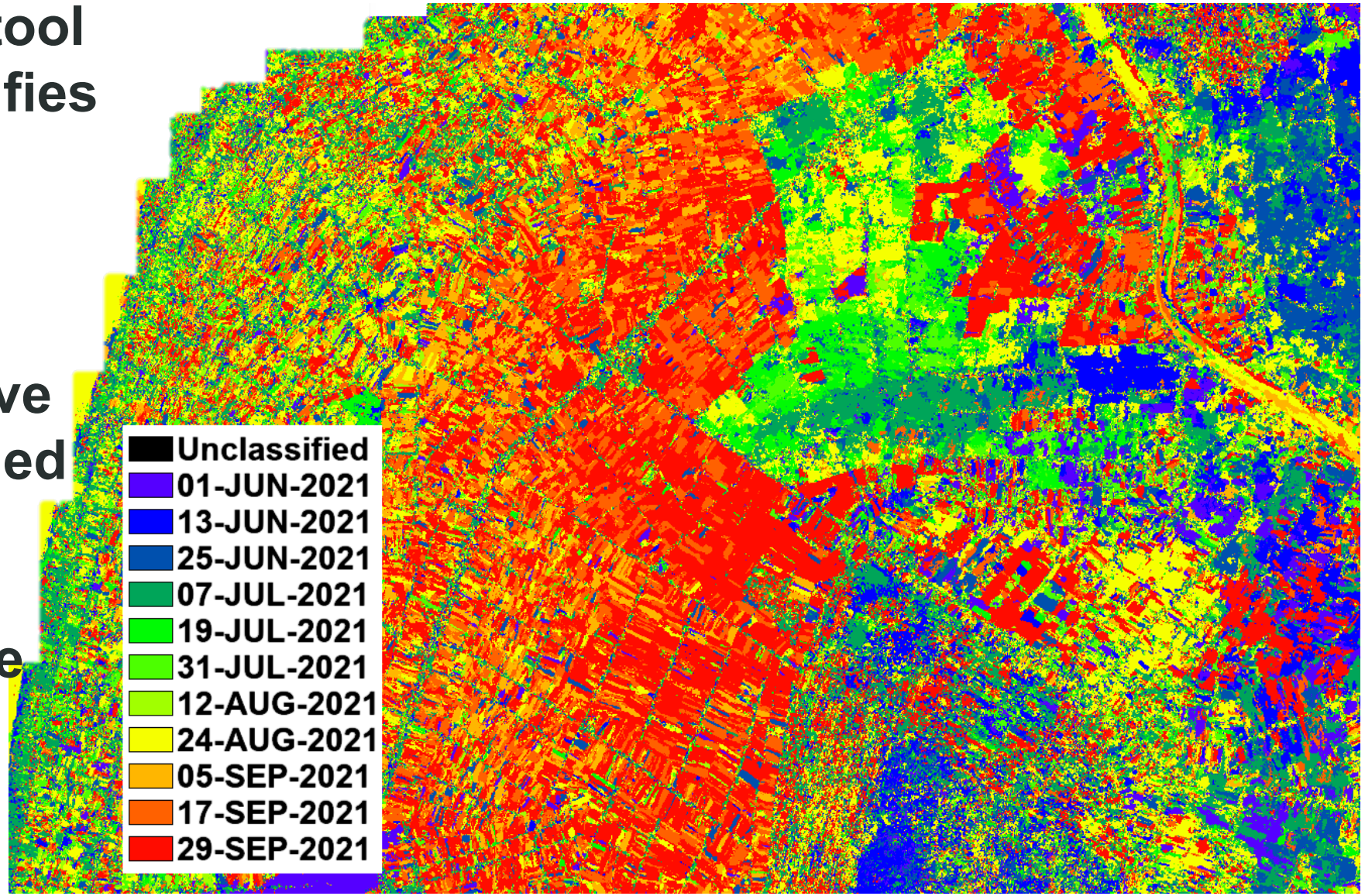
For example, with rice fields flooding begins first, which has a very low reflectance. As the plants grow and sprout the reflectance will increase, with possible changes having to do with moisture and growth stages.



Max Date

The SARscape ITS tool automatically classifies areas by significant statistical features.

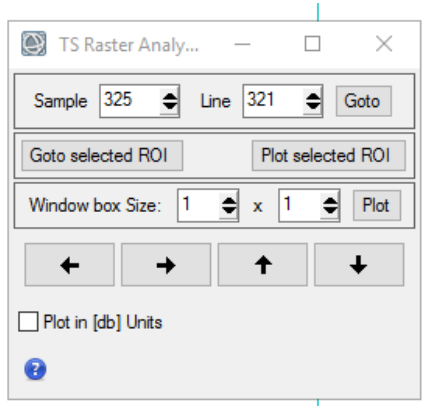
For example, we have all the fields classified for their max reflectance data, showing us possible peak growth

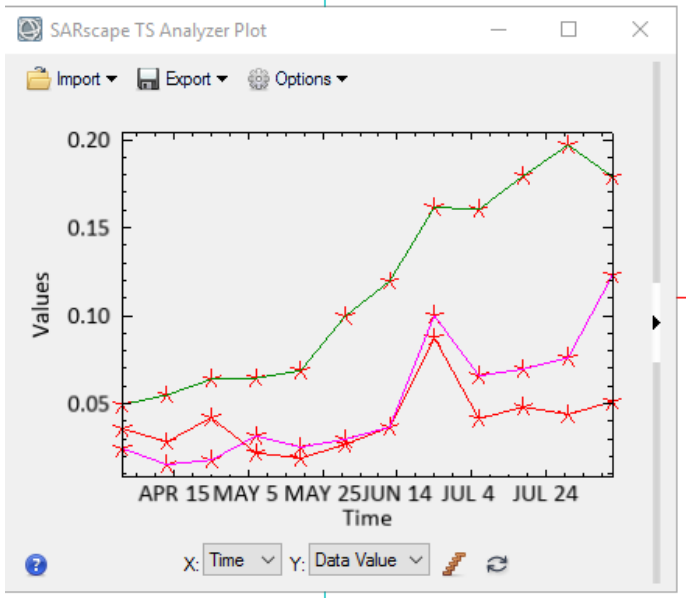


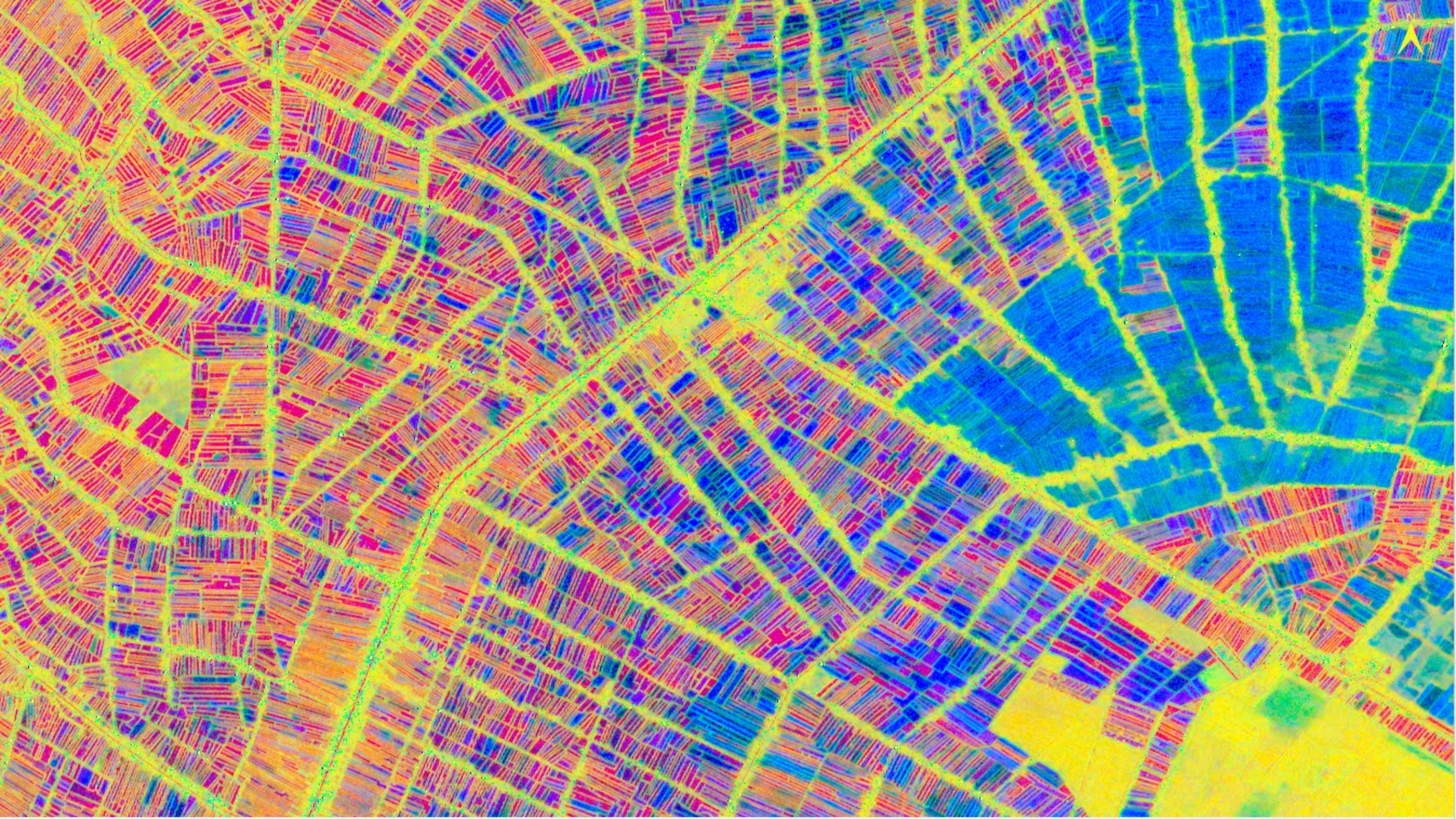
Multiple Crop types

If you have multiple fields, you can also use ITS to create signatures of their growth over time.

This can be used to track, or even classify the fields.







Thank you!

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