

# **EXPLORING ENVI® SARSCAPE:** **AGRICULTURE**

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# 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

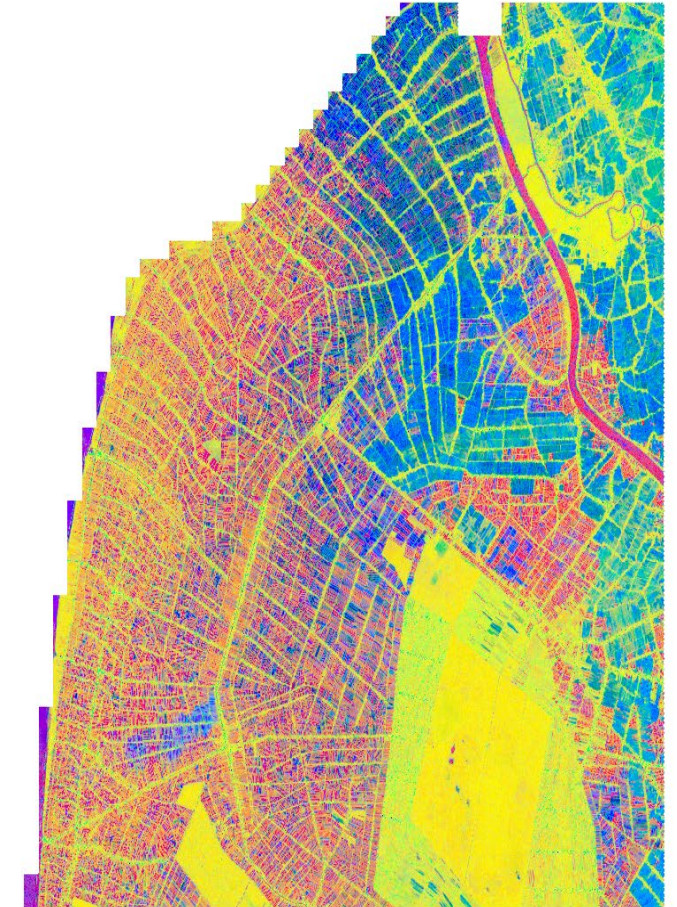


TerraSAR-X Data over Fields

# 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.

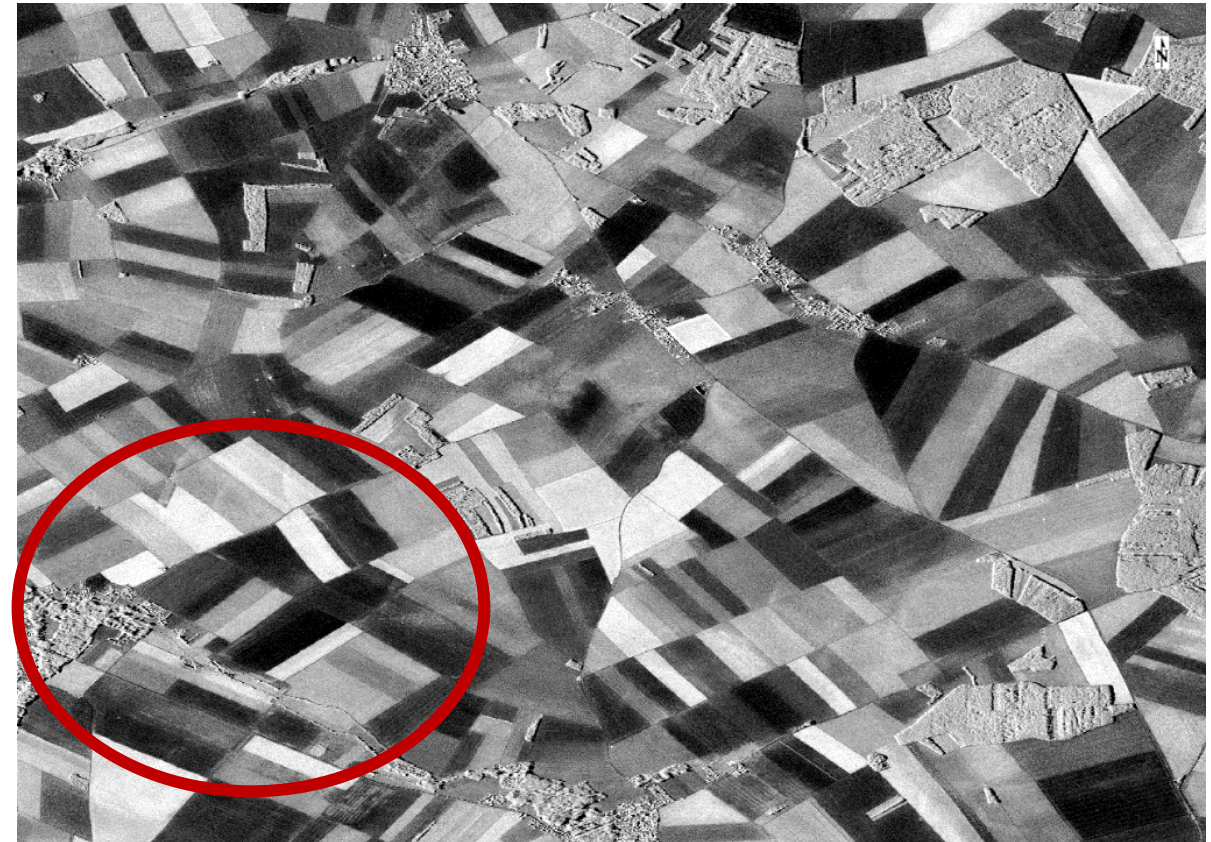




# Optical and SAR



Sentinel-2, June 20, 2018

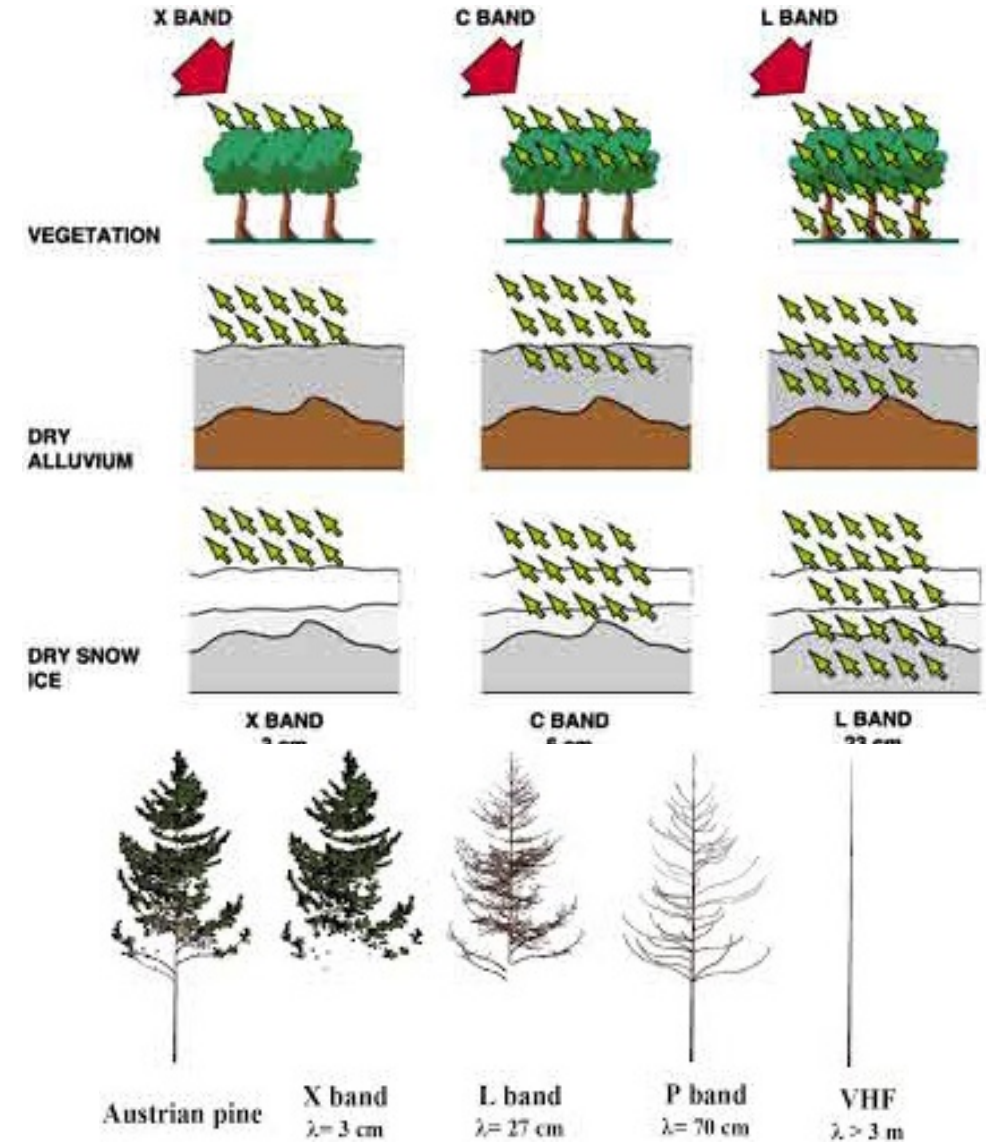


TerraSAR-X, June 18, 2018

# 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



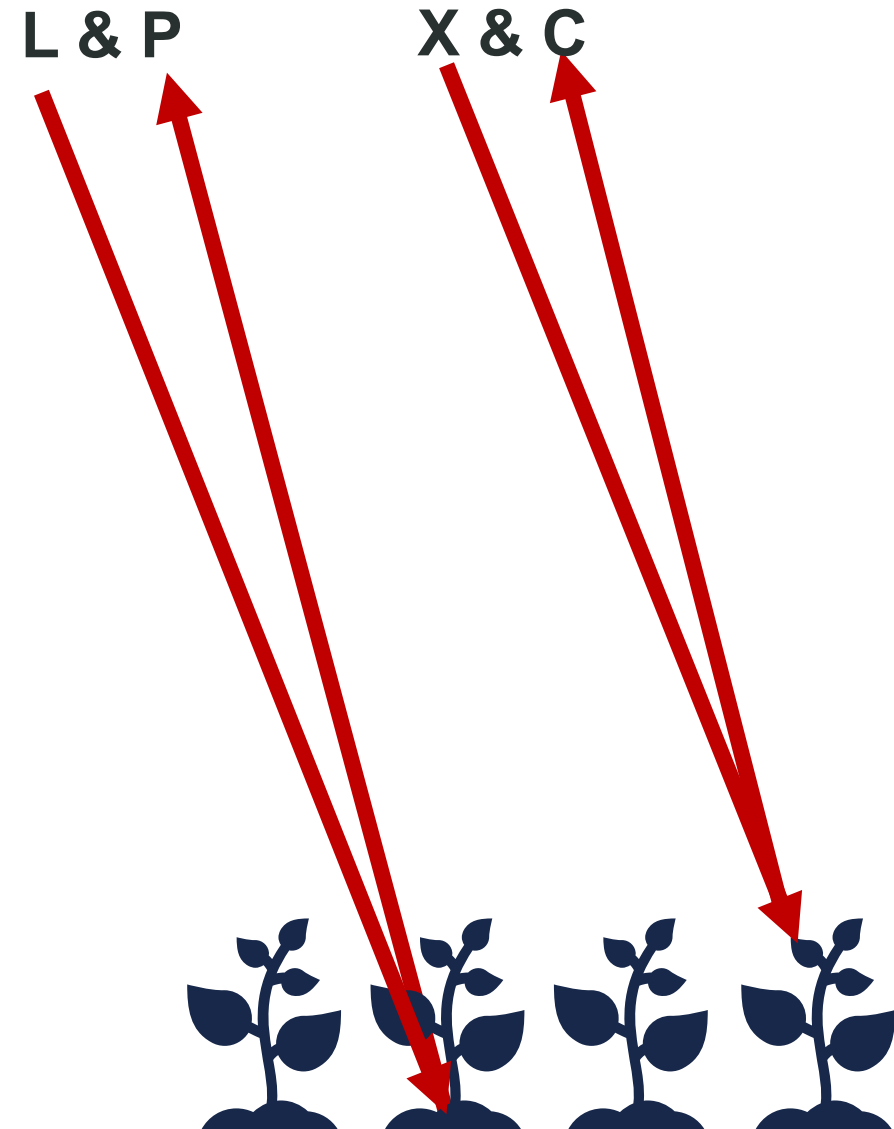


# Band Effects



**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)**

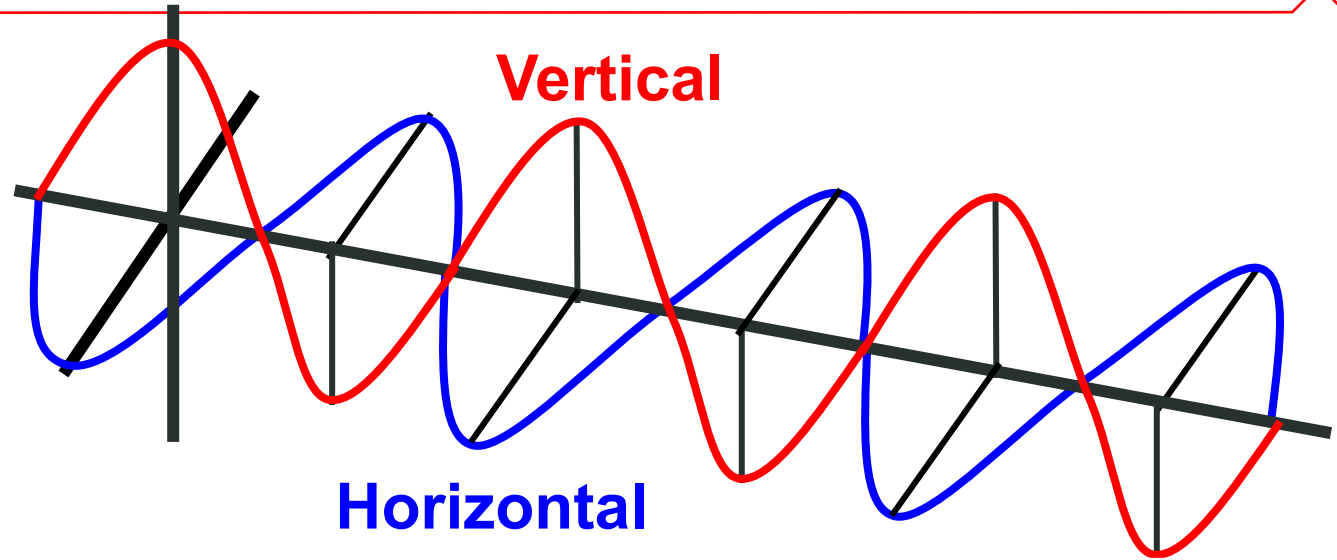


# Polarization Choices



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

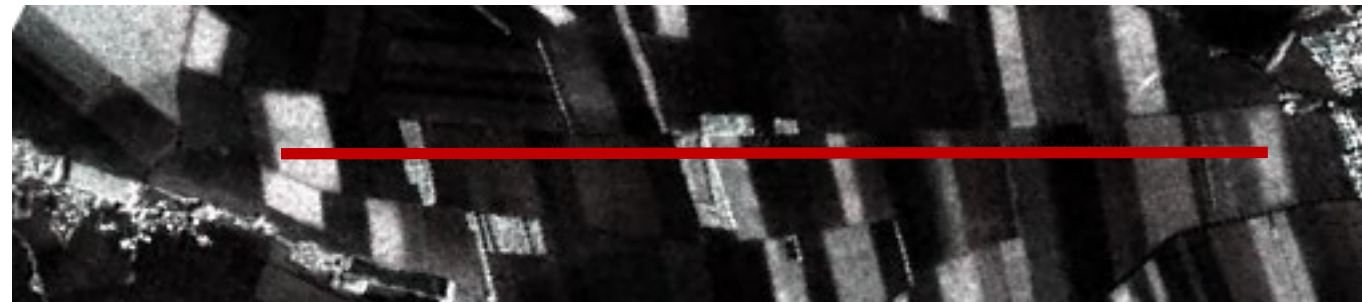
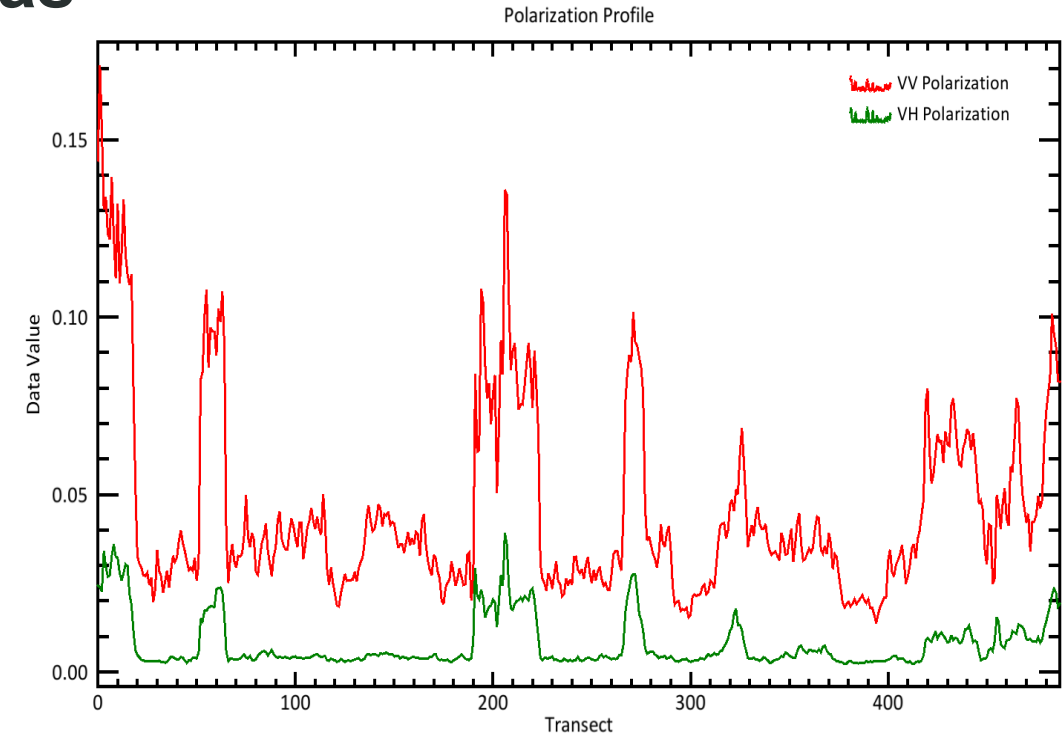
# Polarization Effects



**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





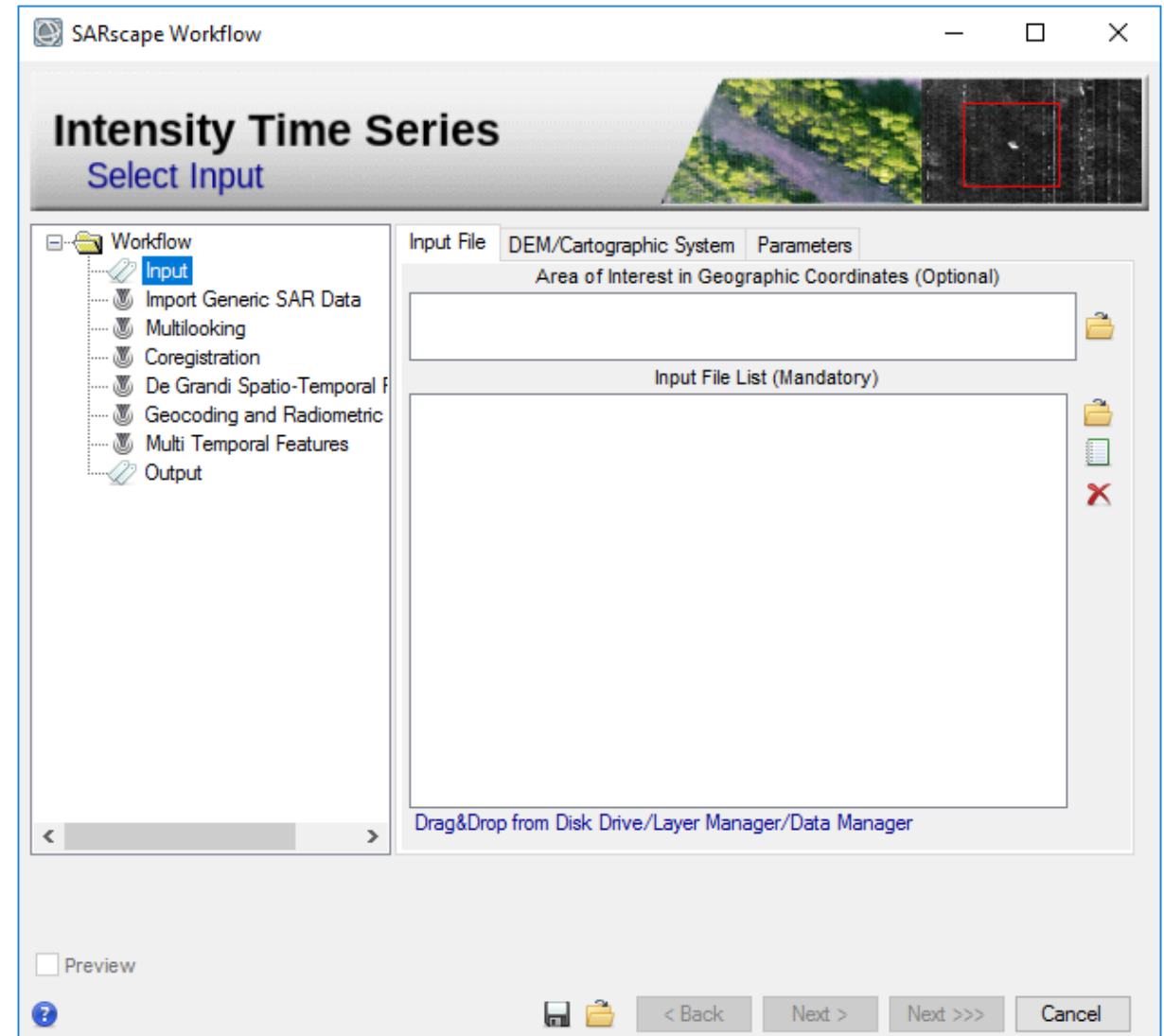
# Intensity Time Series



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

11 images are used between June 1<sup>st</sup>, 2021, to September 29<sup>th</sup>, 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

The screenshot shows the SARscape Workflow interface for the 'Intensity Time Series Multilooking' step. The workflow tree on the left includes: Workflow, Input, Import Generic SAR Data, **Multilooking**, Coregistration, De Grandi Spatio-Temporal Filtering, Geocoding and Radiometric Calibration, Multi Temporal Features, and Output. The main parameters table is as follows:

Principal Parameters	
Main Parameters	
Multilooking Method	Time Domain
Range Looks	4
Azimuth Looks	1
Grid Size for Suggested Looks	15

At the bottom of the window, there is a 'Preview' checkbox, a help icon, and navigation buttons: '< Back', 'Next >', 'Next >>>', and 'Cancel'.

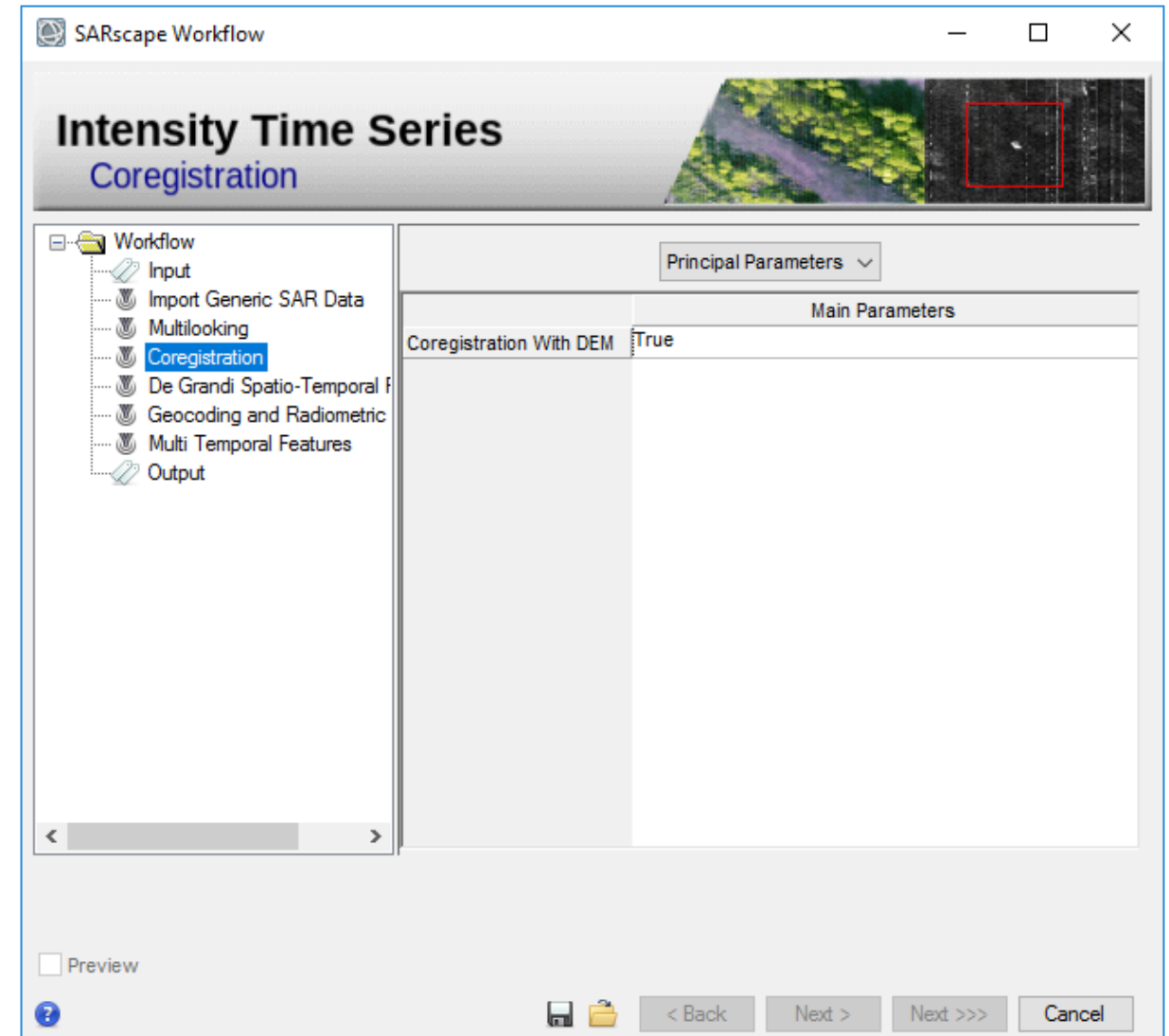


# Intensity Time Series - Coregistration



**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

The screenshot shows the SARscape Workflow interface for the 'Intensity Time Series' step, specifically 'De Grandi Spatio-Temporal Filtering'. The workflow tree on the left lists the following steps: Input, Import Generic SAR Data, Multilooking, Coregistration, **De Grandi Spatio-Temporal Filtering** (highlighted), Geocoding and Radiometric Calibration, Multi Temporal Features, and Output. The 'Principal Parameters' section is expanded to show the 'Main Parameters' table:

Main Parameters	
Keep incremental	False
Apply constraints	False
Minimum Temporal frequency	4
Maximum variation (db)	0.5
Keep Wavelet Thresholded files	False

At the bottom of the interface, there is a 'Preview' checkbox, a help icon (?), and navigation buttons: '< Back', 'Next >', 'Next >>>', and 'Cancel'.



# 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

The screenshot shows the SARscape Workflow interface. The title bar reads 'SARscape Workflow'. The main window title is 'Intensity Time Series' with the subtitle 'Geocoding and Radiometric Calibration'. On the left, a workflow tree shows steps: Input, Import Generic SAR Data, Multilooking, Coregistration, De Grandi Spatio-Temporal Filtering, **Geocoding and Radiometric Calibration** (highlighted), Multi Temporal Features, and Output. The right pane shows the 'Principal Parameters' for this step, with a 'Main Parameters' section containing the following table:

Main Parameters	
X Grid Size	15
Y Grid Size	15
Radiometric Calibration	True
Scattering Area	Local Incidence Angle
Radiometric Normalization	True
Normalization Method	Cosine Correction
Local Incidence Angle	False
Original Geometry Products	False
Output type	Linear

At the bottom of the window, there is a 'Preview' checkbox (unchecked), a help icon (?), a save icon, a folder icon, and navigation buttons: '< Back', 'Next >', 'Next >>>', and 'Cancel'.

# 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 your 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

The screenshot shows the SARscape Workflow interface. The main window title is "SARscape Workflow". The current process is "Intensity Time Series" with the sub-process "Multi Temporal Features". The workflow tree on the left shows the following steps: Input, Import Generic SAR Data, Multilooking, Coregistration, De Grandi Spatio-Temporal Filtering, Geocoding and Radiometric Calibration, **Multi Temporal Features** (highlighted), and Output. The "Principal Parameters" section is expanded to show "Main Parameters".

Main Parameters	
Mean	True
Std	True
Median	False
Gradient	True
Max	True
Min	True
Span Difference	False
Max Increment	False
Max Decrement	False
Span Ratio	False
Max Ratio	False
Min Ratio	False
MuSigma	True
Coefficient of Variation	True
Generate Dates	True
Mode	False

At the bottom of the dialog, there is a "Preview" checkbox (unchecked), a help icon (?), and navigation buttons: "Back", "Next >", "Next >>>", and "Cancel".







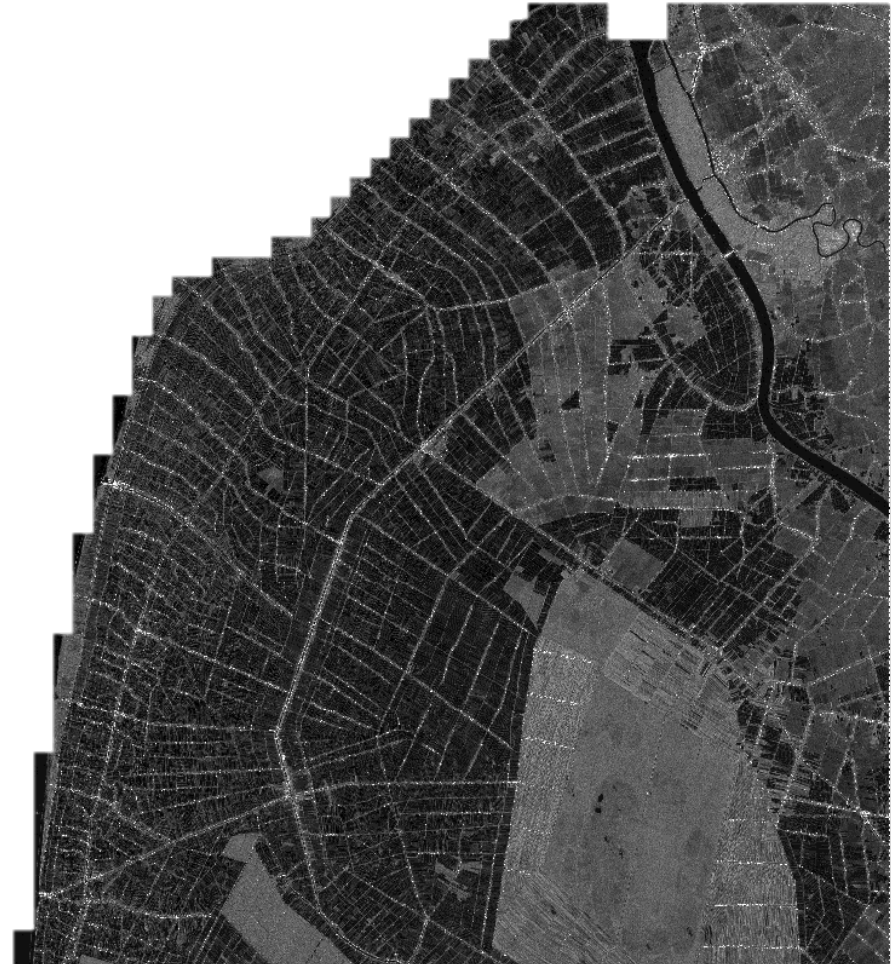
# Standard Intensity Image



**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**



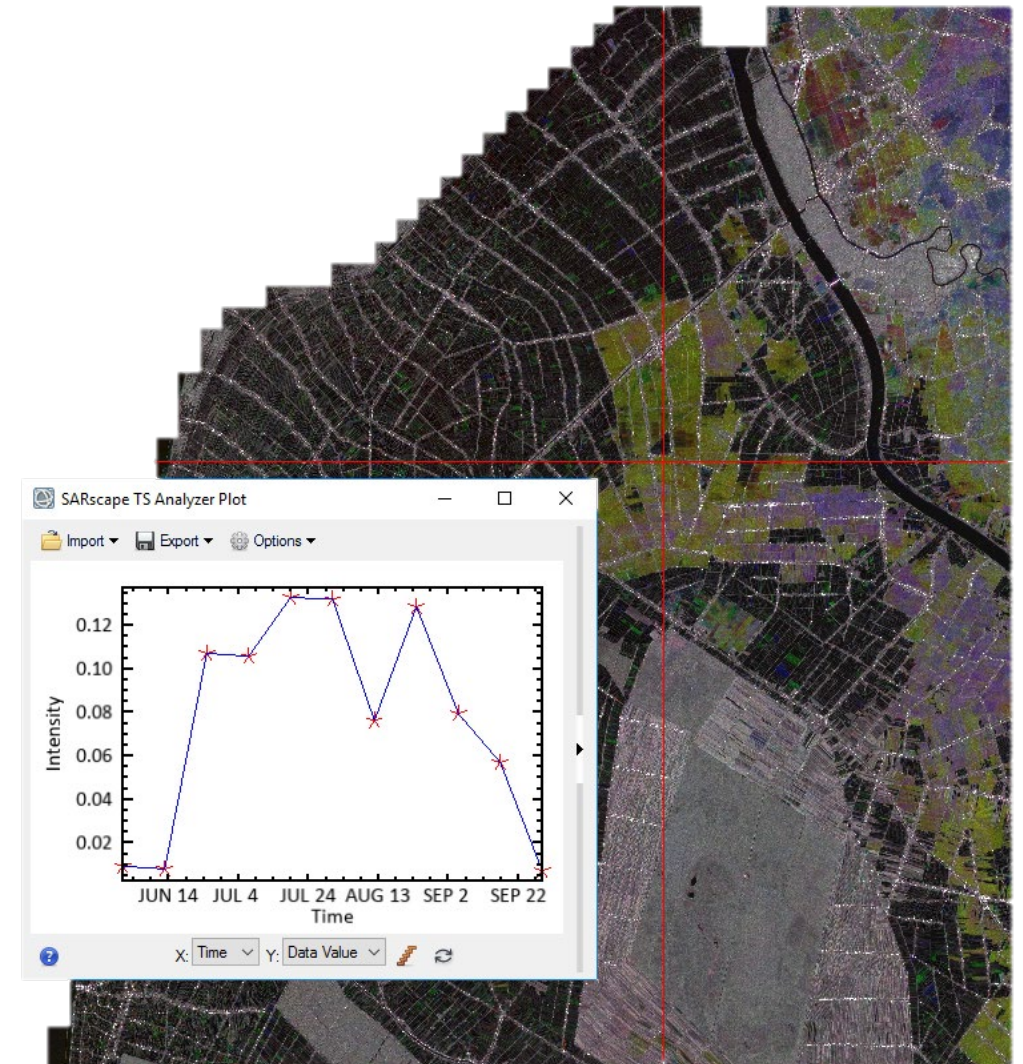


# Intensity Change Over Time



**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.**



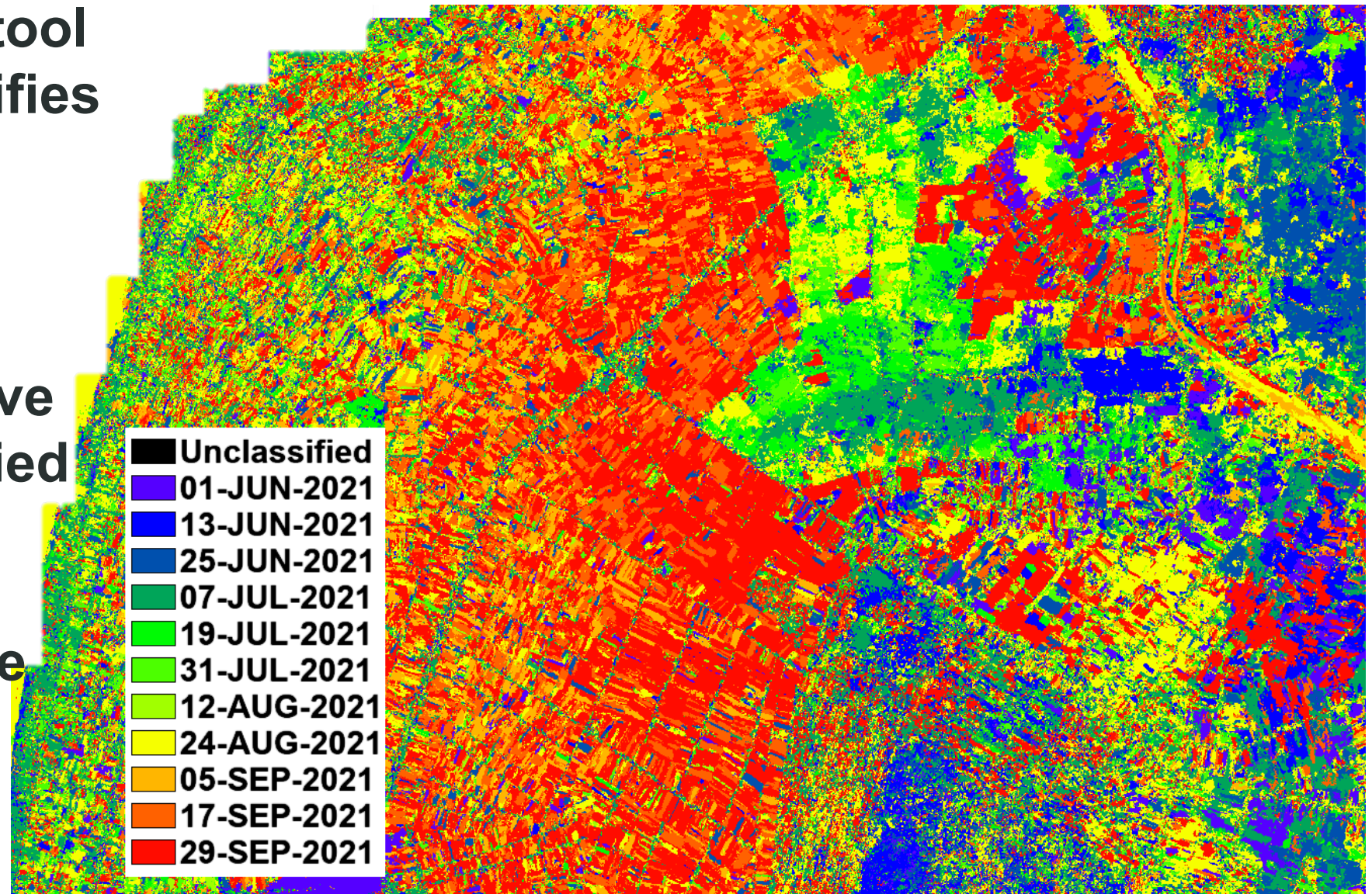


# Max Date



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



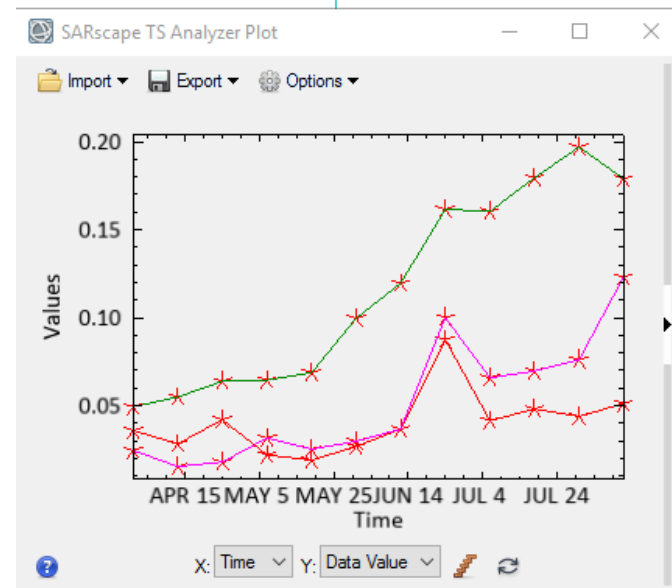
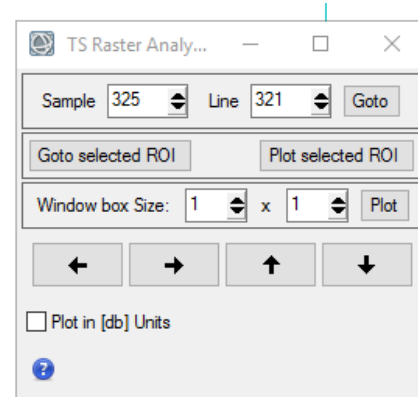


# Multiple Crop types

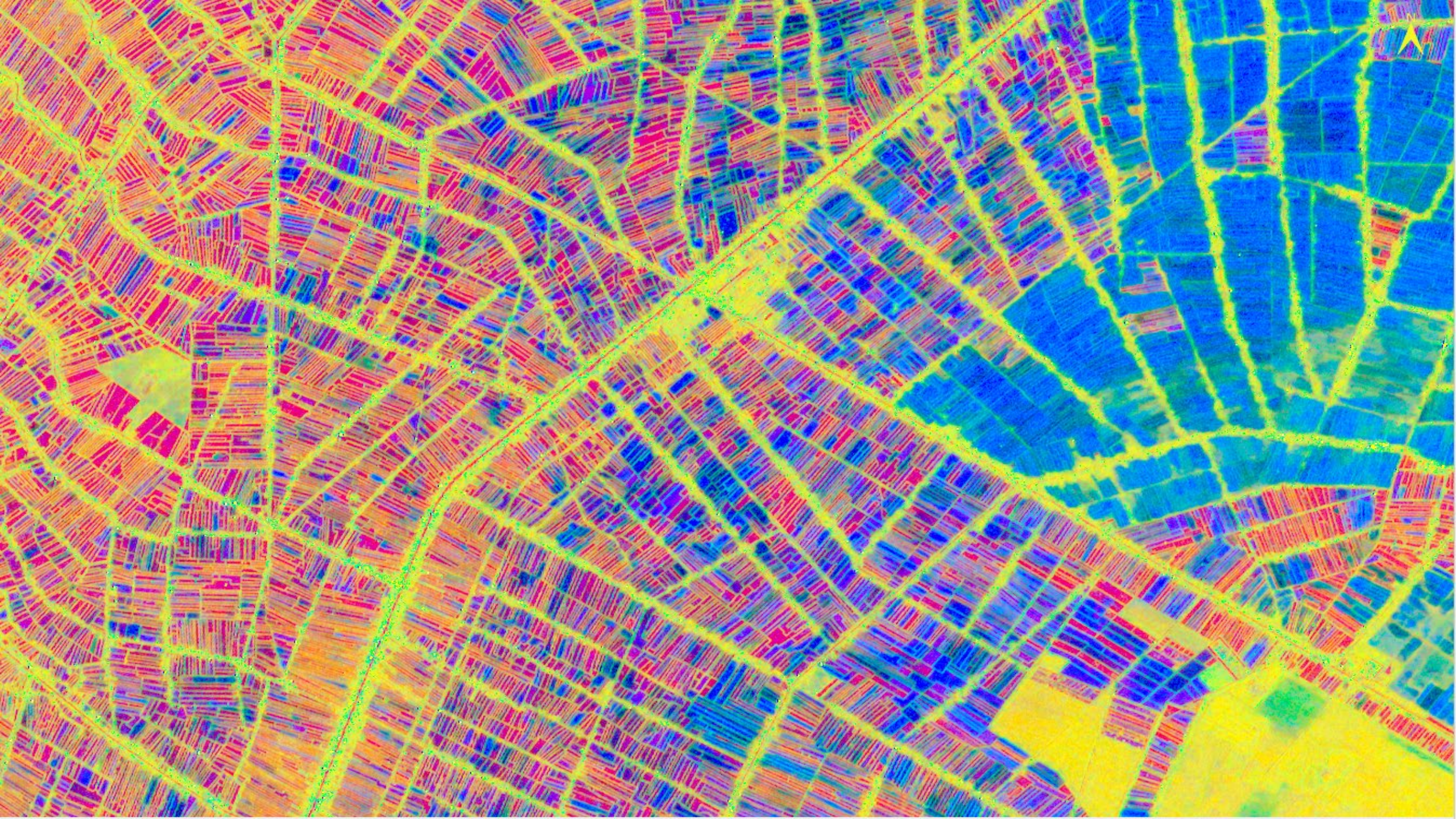


If you have multiple fields, you can also use ITS to create signatures of their growth over time.

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









# Thank you!



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