On the relationship between coherence and crop phenology: case study of Metaponto plain (Basilicata, Italy)

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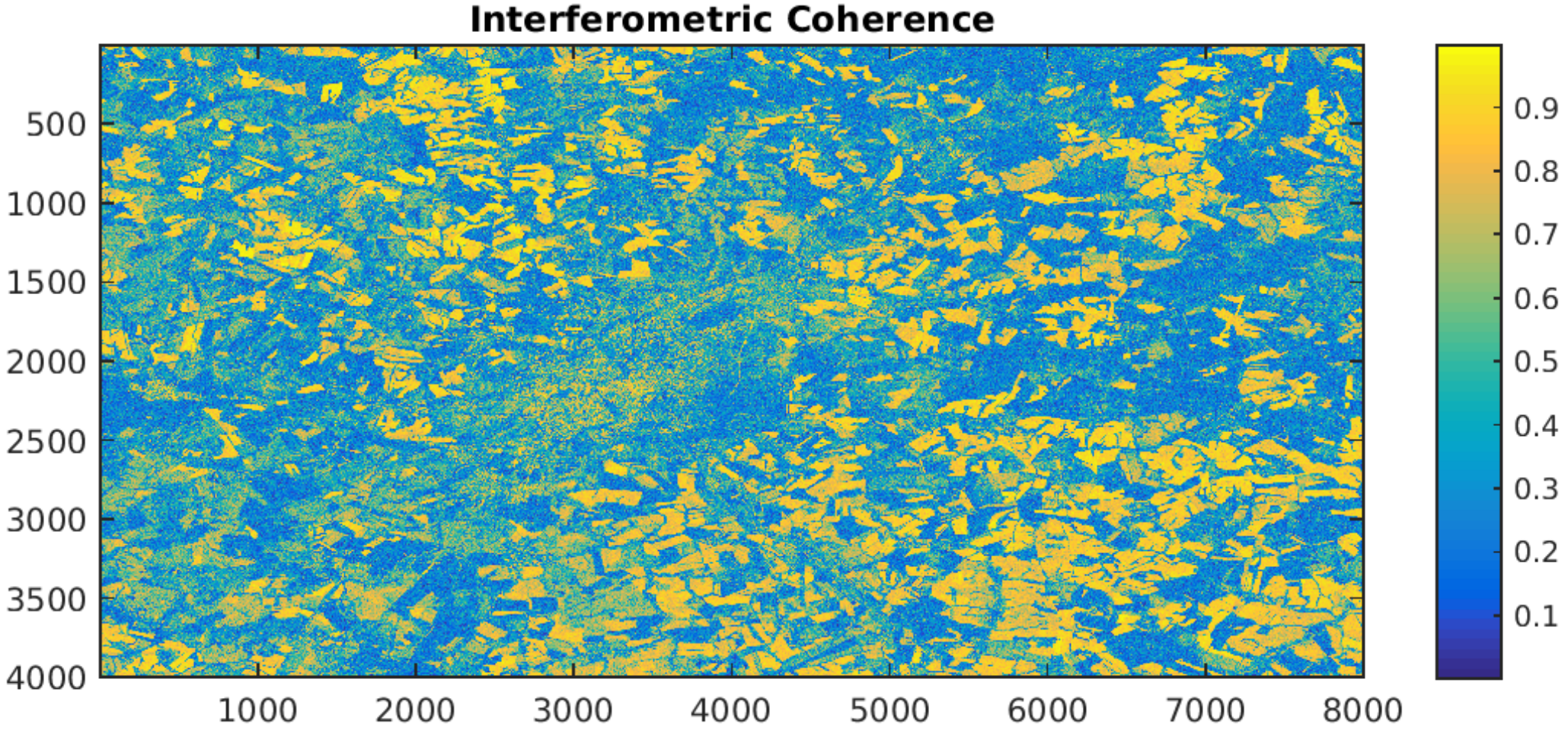
Motivation

- ✓Can the seasonal beahaviour of C-band interferometric SAR coherence be used to extract crop information over agricultural fields?

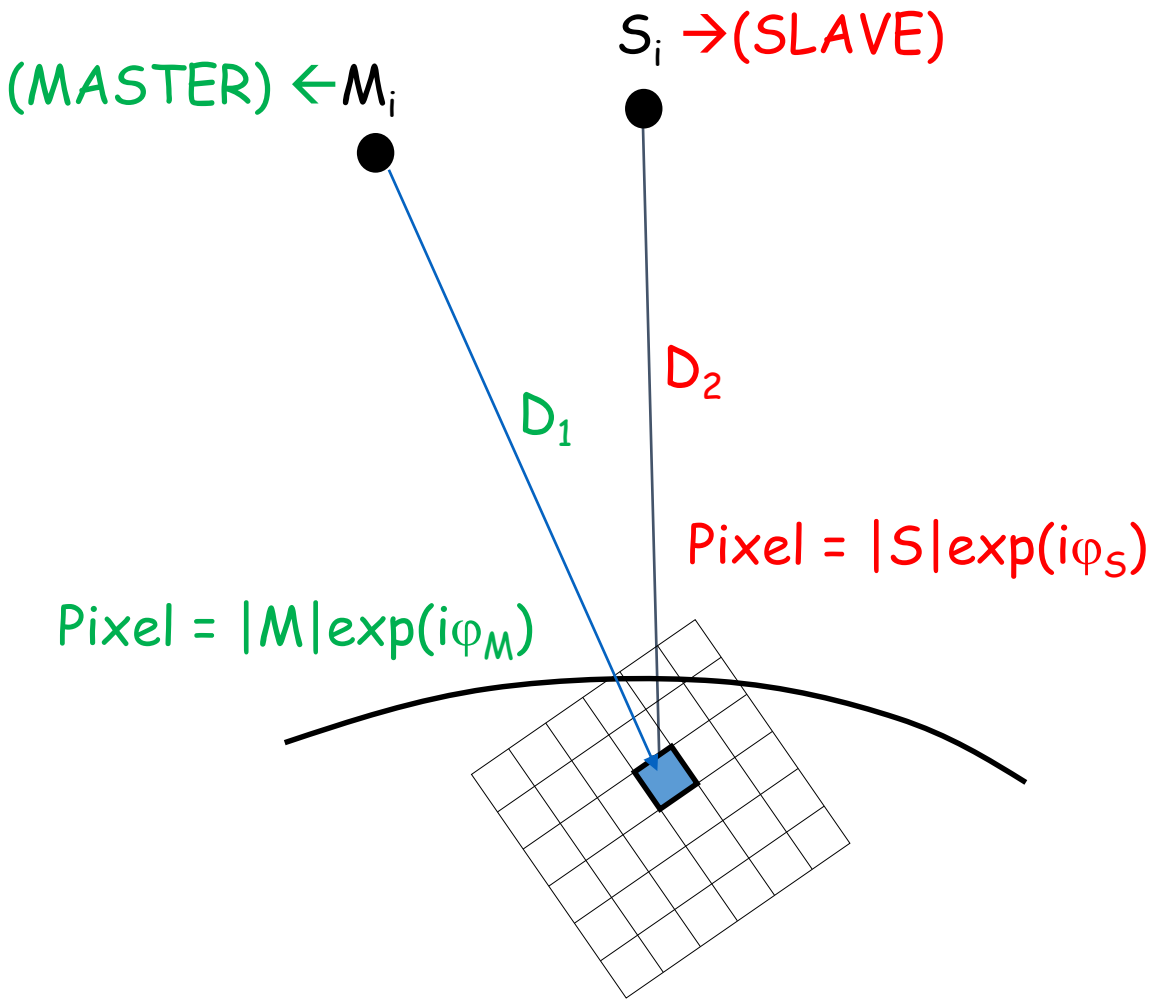
- ✓Over bare soils, can C-band interferometric SAR coherence be a further tool to studye the evolution of soil moisture?

Examples of Sentinel-1 InSAR coherence over agricultural fields



Interferometric SAR coherence

$$\gamma = \frac{\left|\sum_i M_i \cdot S_i^*\right|}{\sqrt{\sum_i |M_i|^2 \cdot \sum_i |S_i|^2}}$$



M_i = MASTER image

S_i = SLAVE image

Contributes to InSAR coherence

$$\gamma = \gamma_N \bullet \gamma_S \bullet \gamma_T \bullet \gamma_V$$

γ_N = noise decorrelation

$$\gamma_S = 1 - \alpha \cdot \frac{B_{perp}}{tan\vartheta}$$

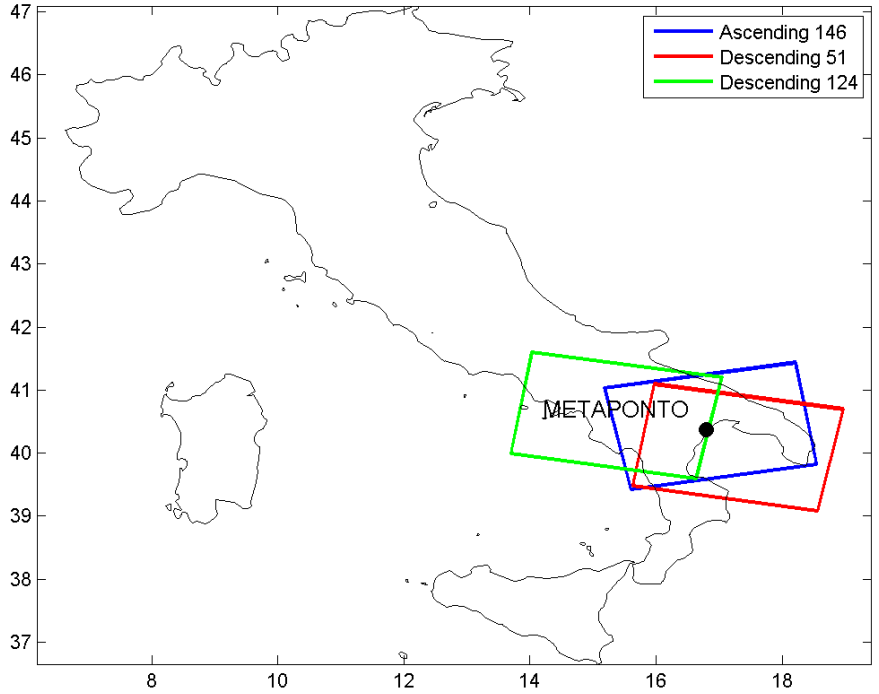
(In the case of flat area as the Metaponto plain)

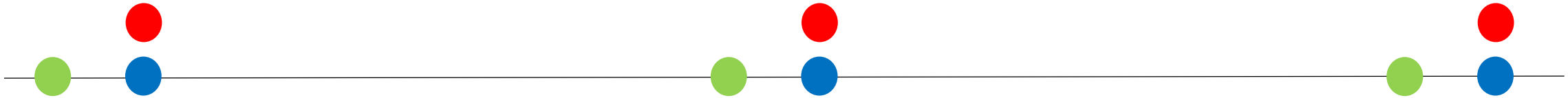
ϑ = incidence angle; α = constant depending radar wavelength, range distance and range resolution.

γ_T = temporal decorrelation

γ_V = volume decorrelation

Data: Sentinel-1 images (both VV and VH polarizations)





16 May @04:56

15 May @05:04

16 May @16:48

22 May @04:56

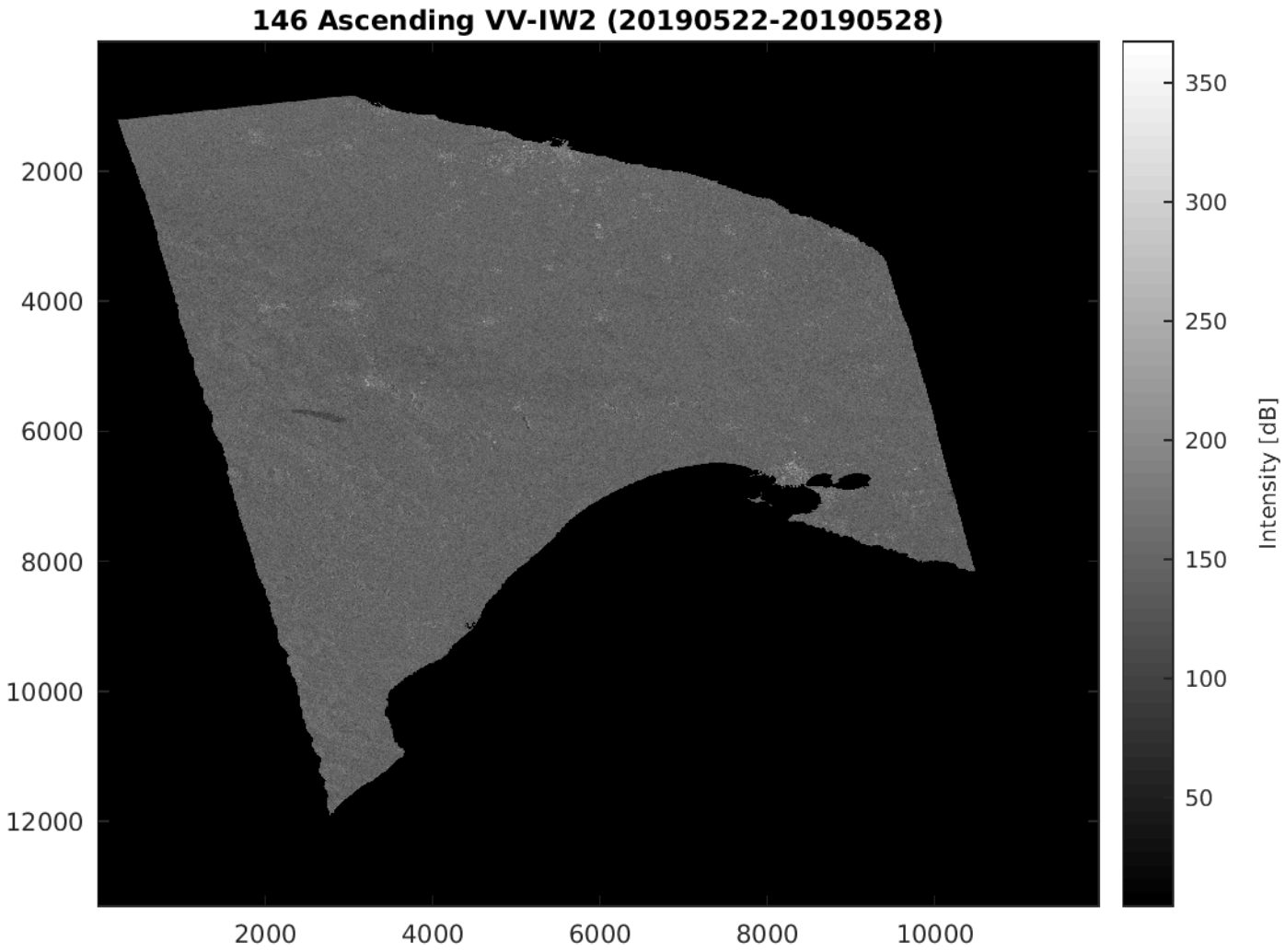
21 May @05:04

22 May @16:48

28 May @04:56

27 May @05:04

28 May @16:48


146 Ascending VV-IW2 (20190522-20190528)
2000
4000
6000
8000
10000
12000
2000
4000
6000
8000
10000
350
300
250
200
150
100
50
Intensity [dB]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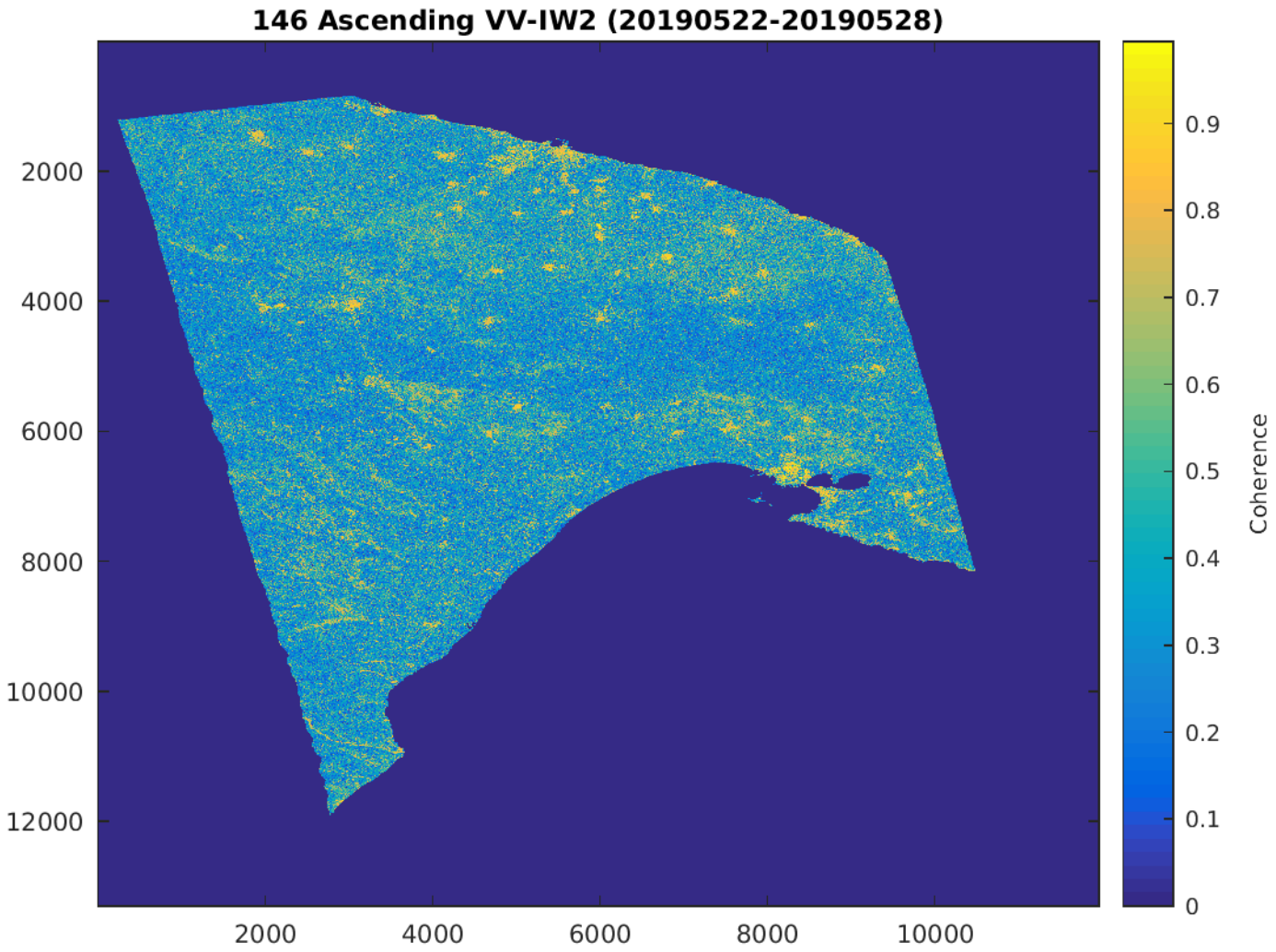
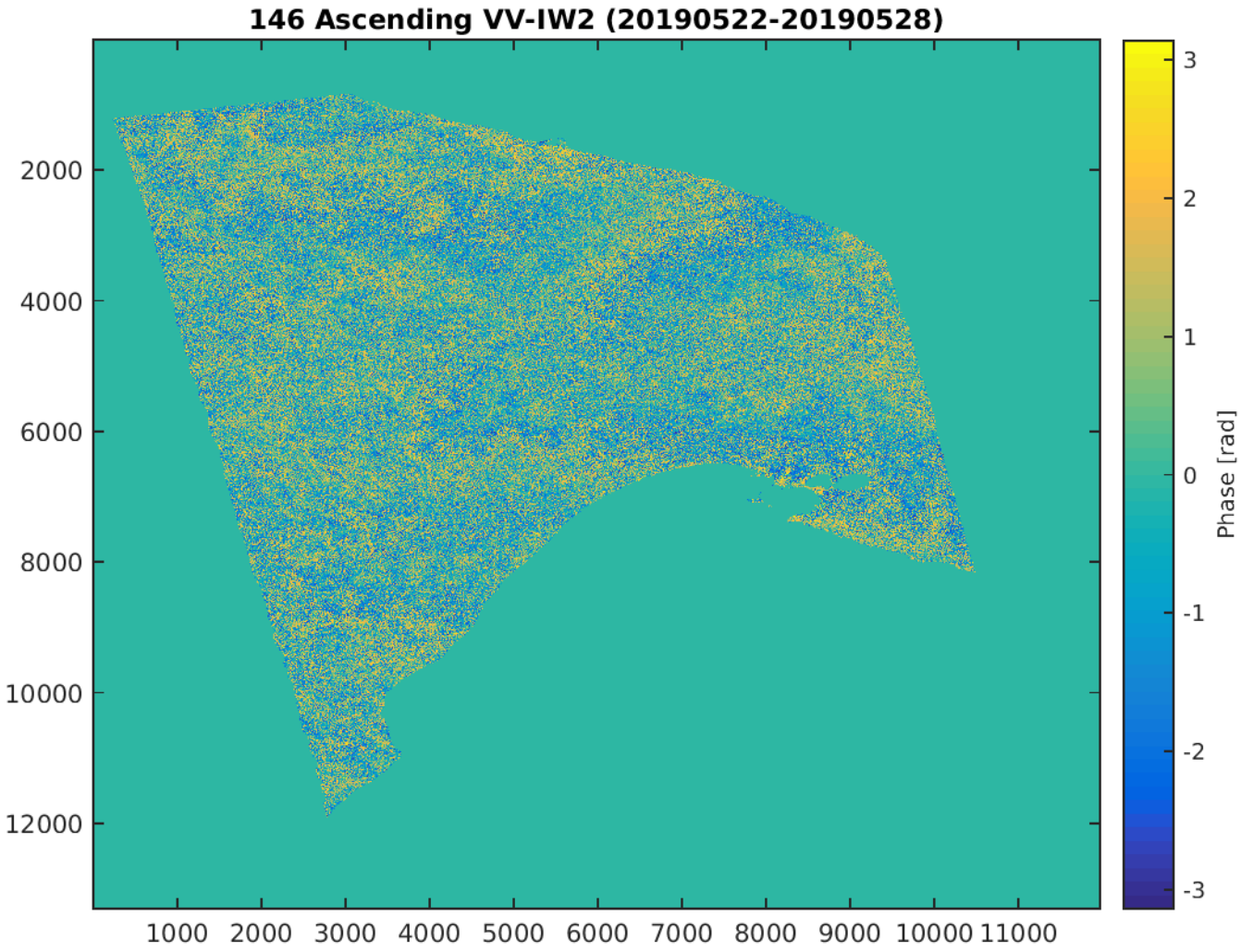
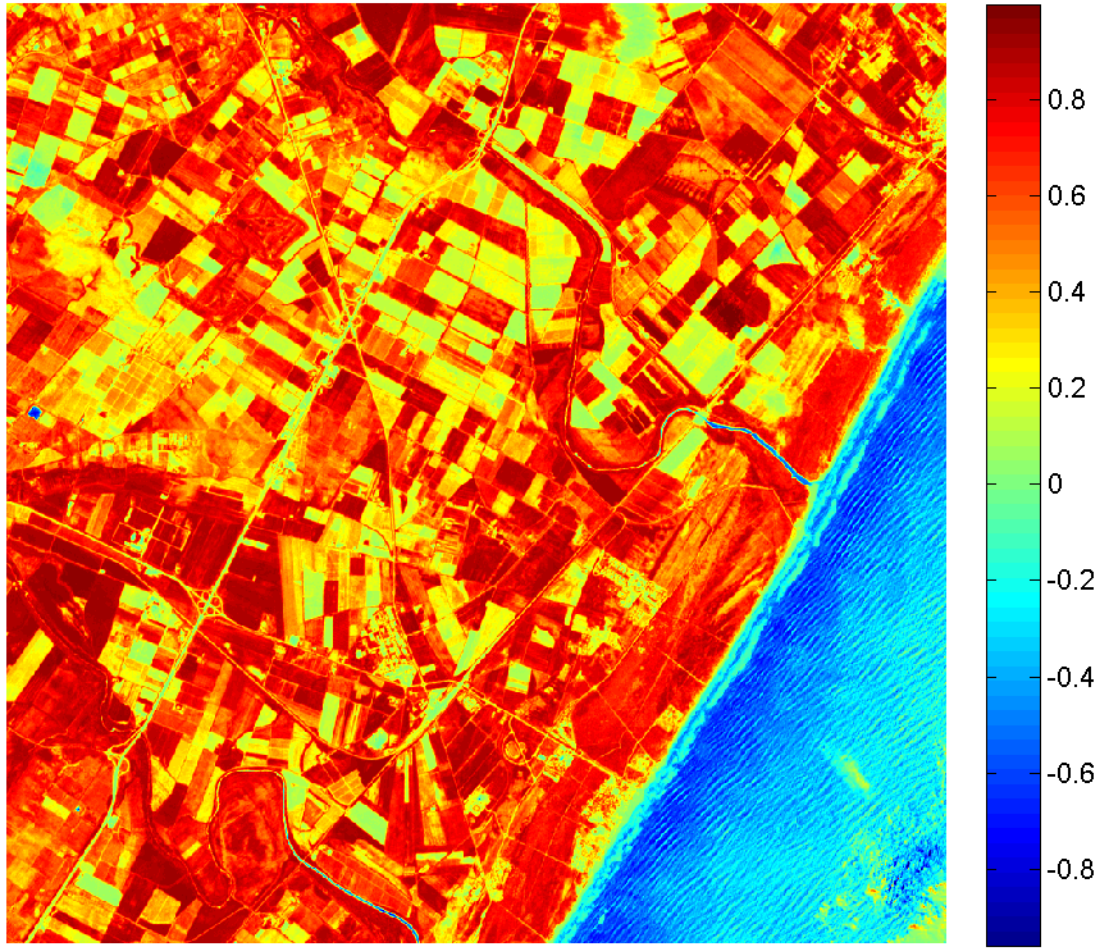
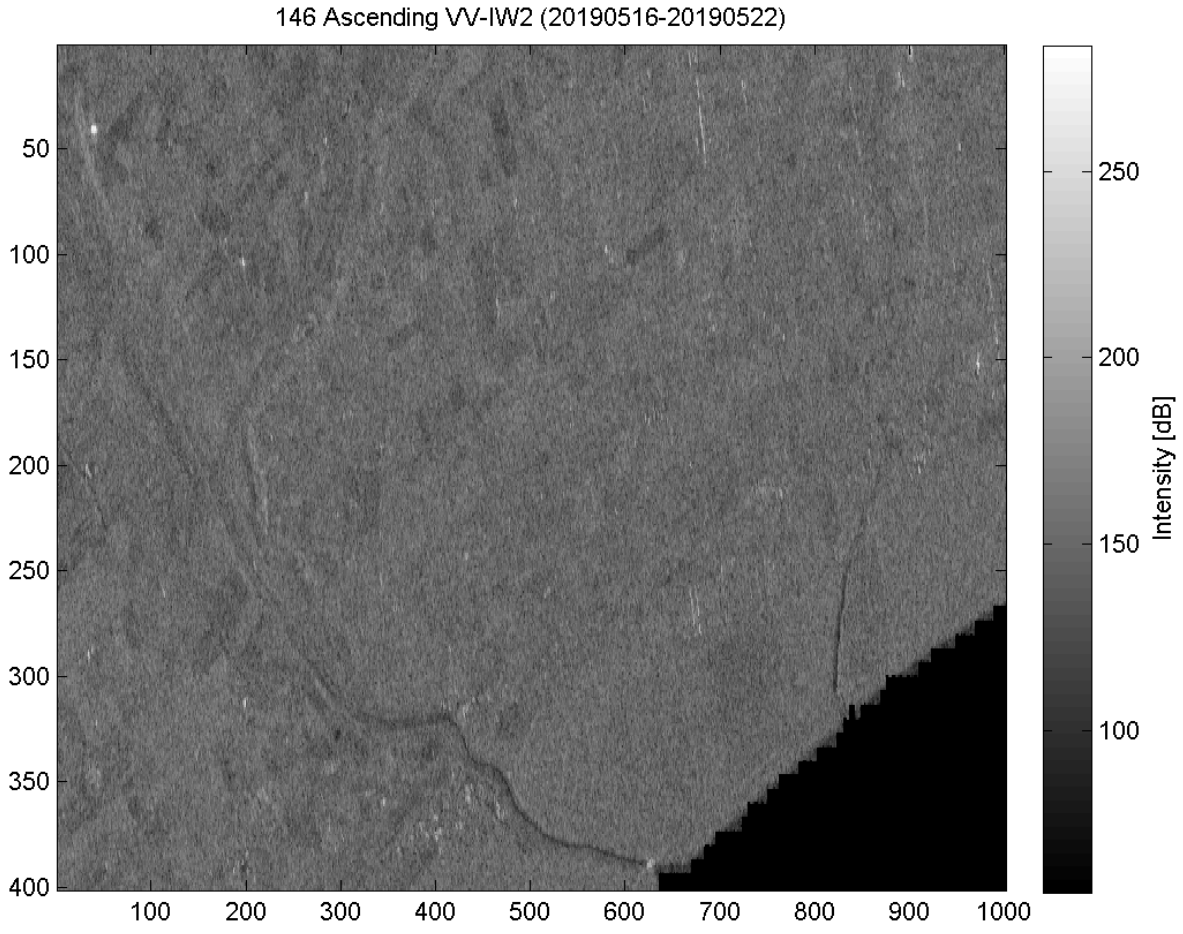

146 Ascending VV-IW2 (20190522-20190528)
2000
4000
6000
8000
10000
12000
2000
4000
6000
8000
10000
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
Coherence

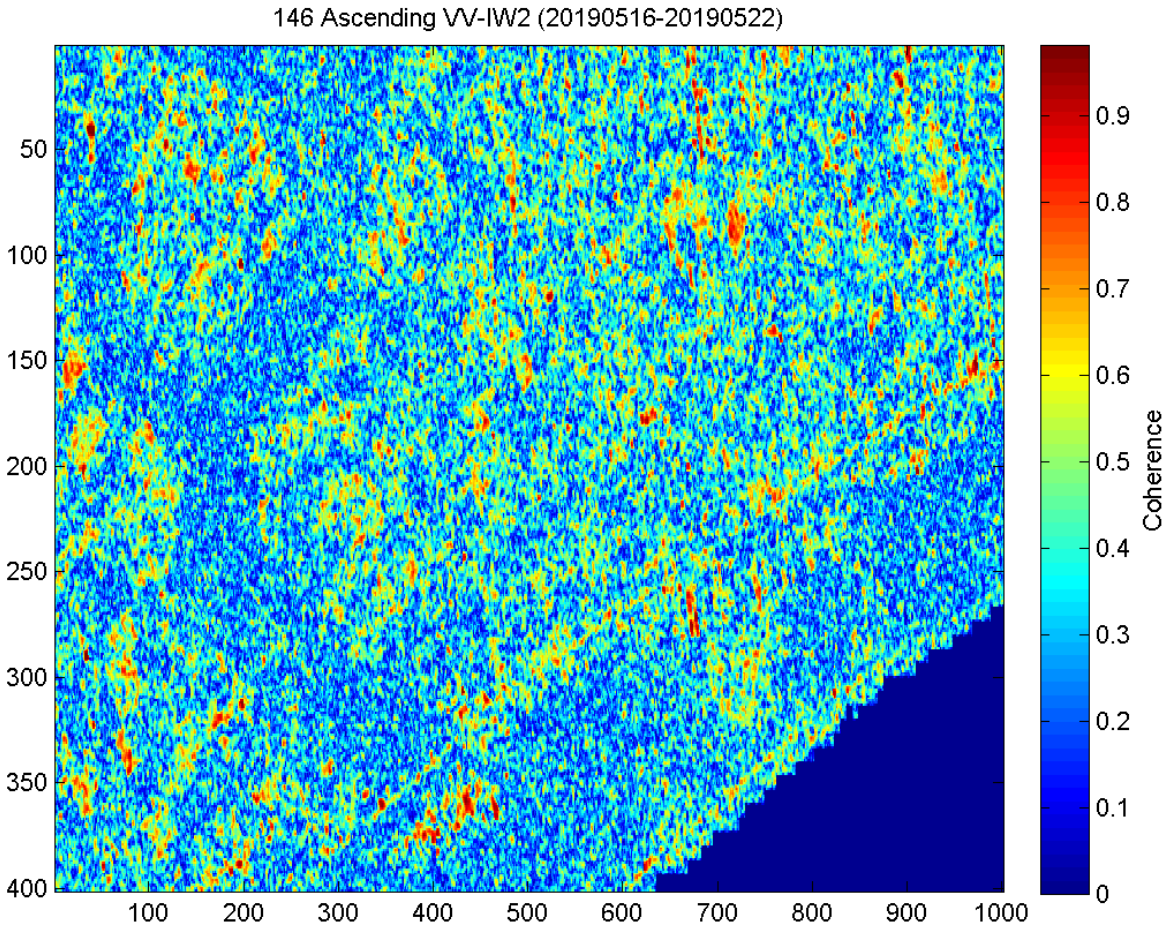

146 Ascending VV-IW2 (20190522-20190528)
2000
4000
6000
8000
10000
12000
1000
2000
3000
4000
5000
6000
7000
8000
9000
10000
11000
3
2
1
0
-1
-2
-3
Phase [rad]

Sentinel-2 images (05 May 2019) ➔ NDVI map

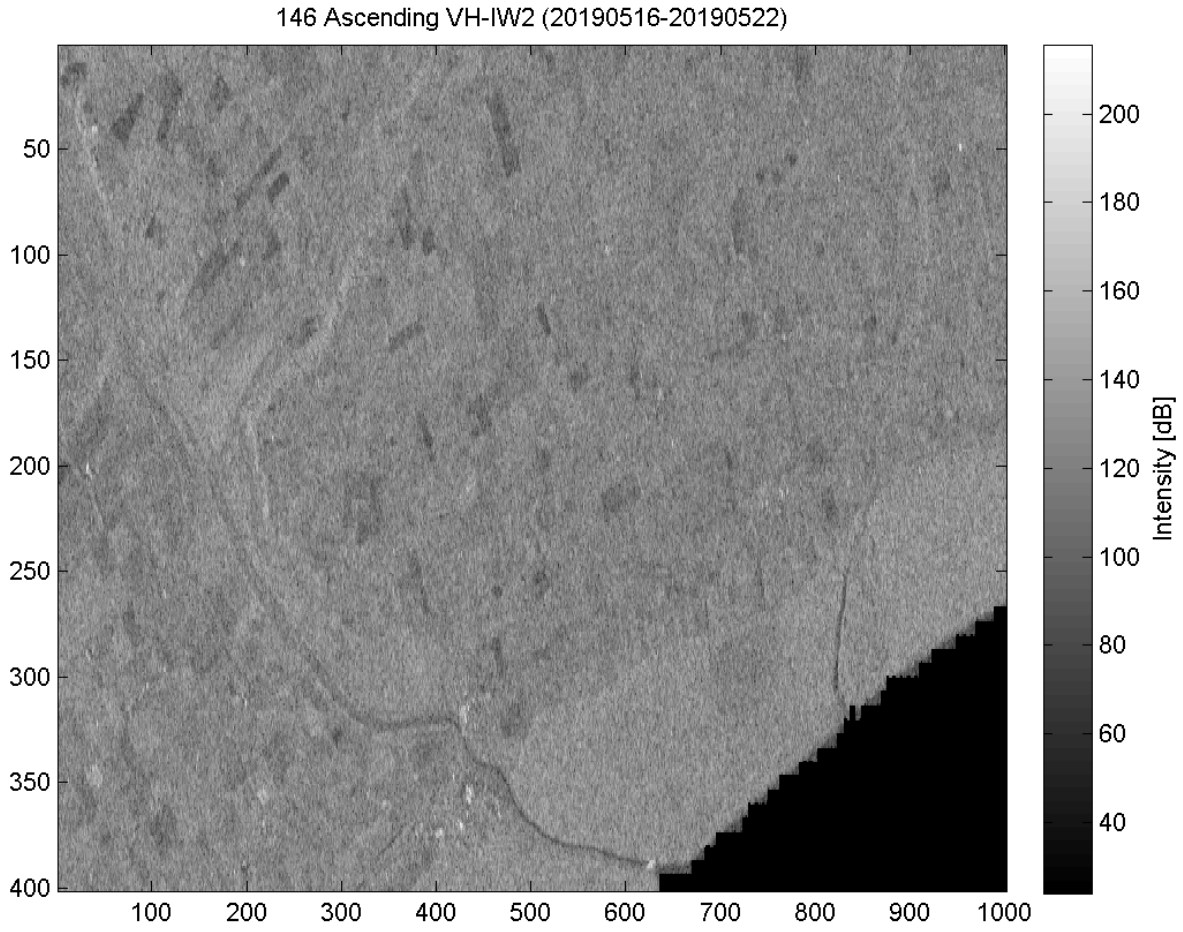


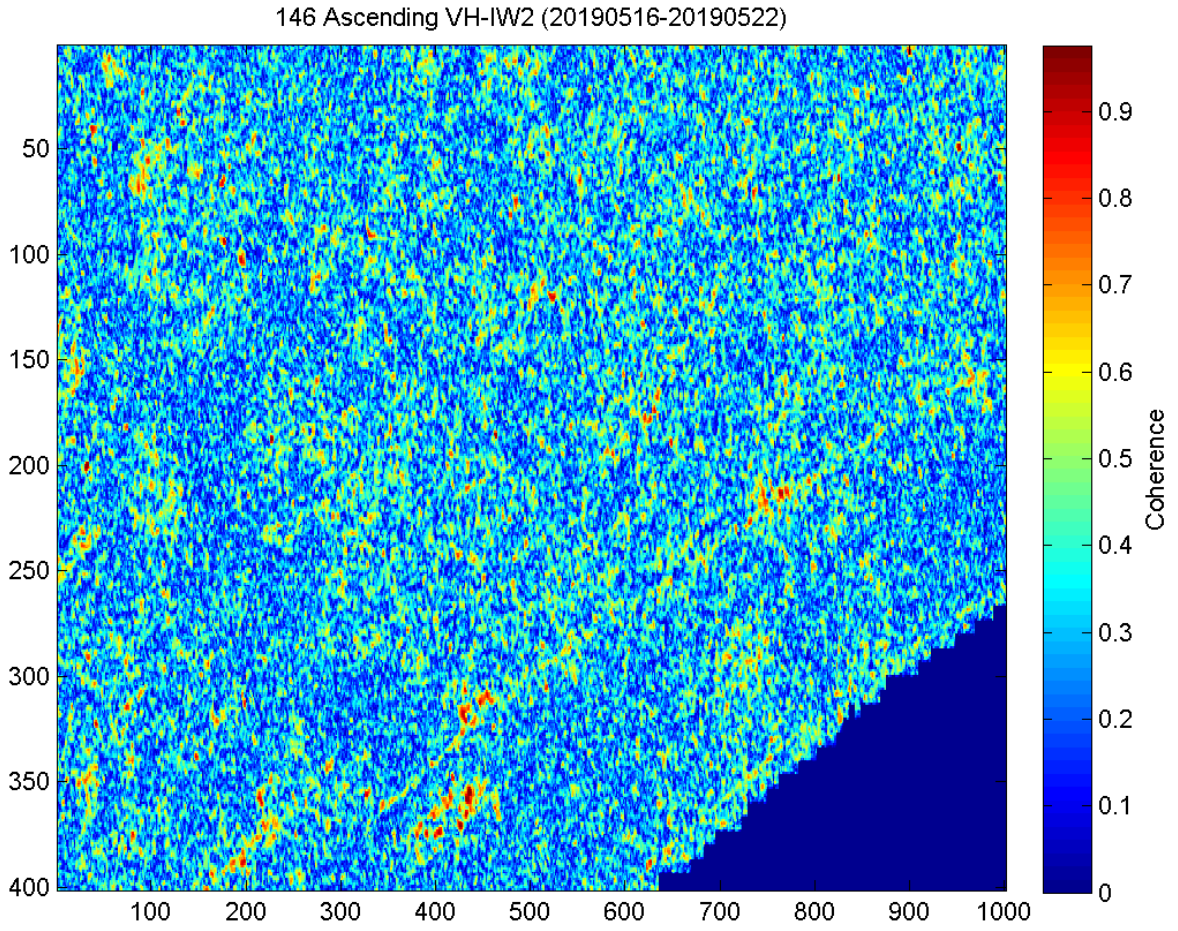
First results



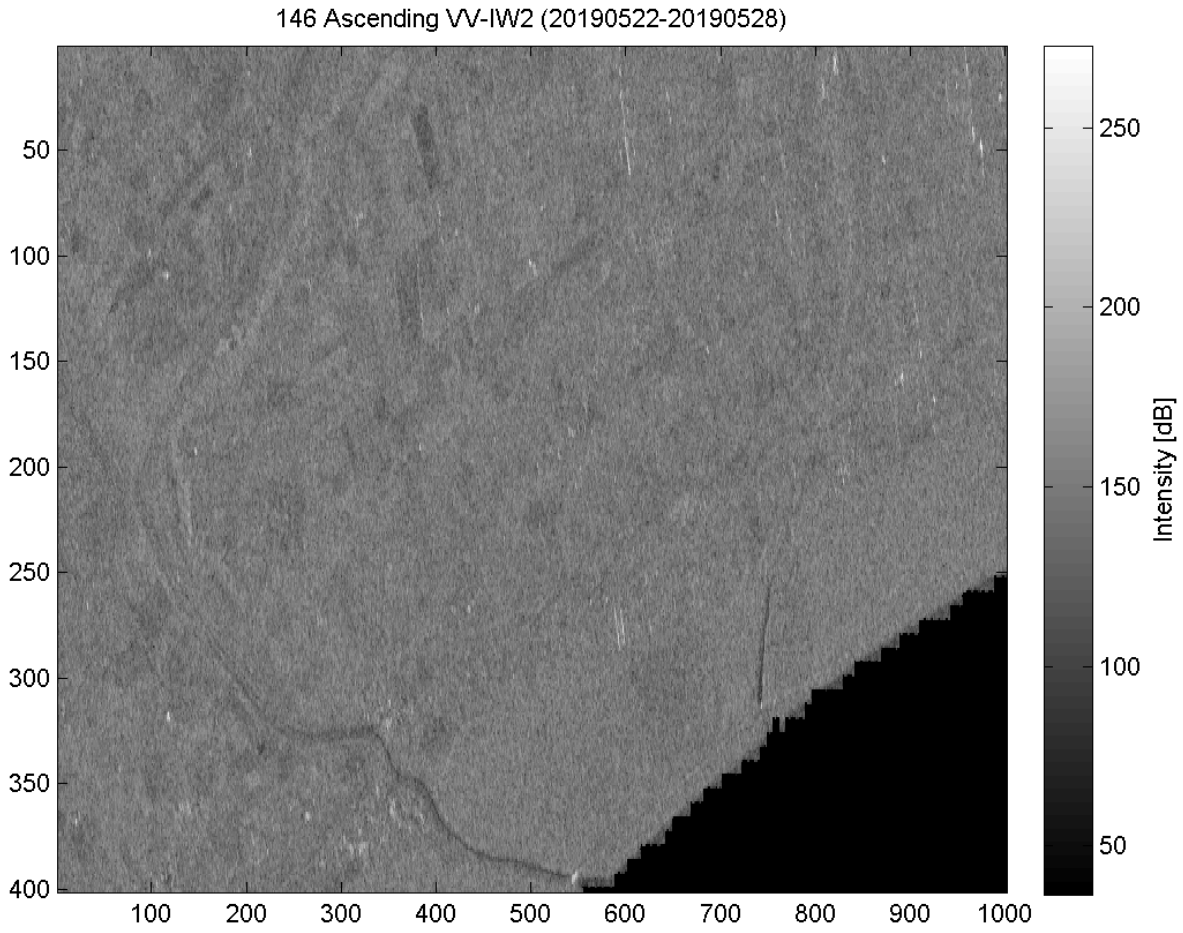


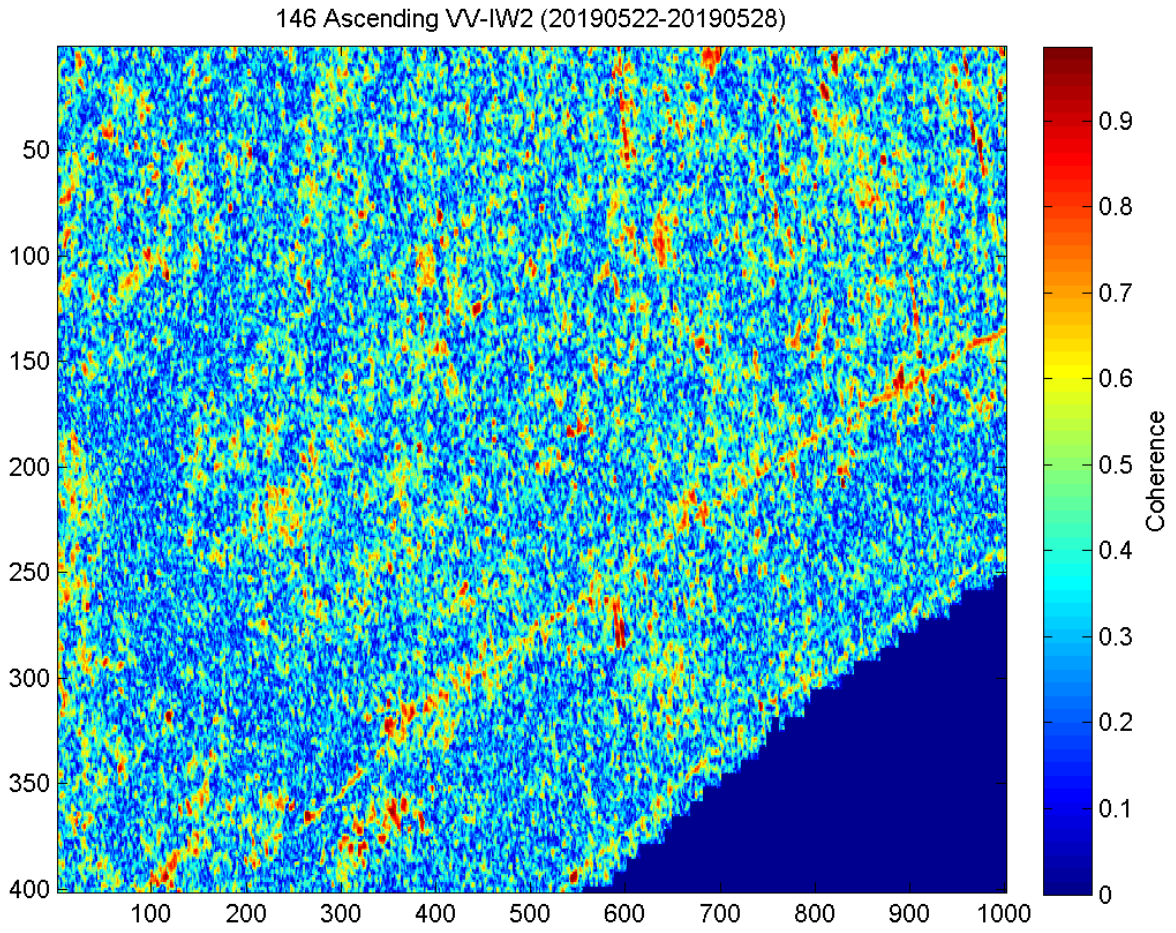
First results



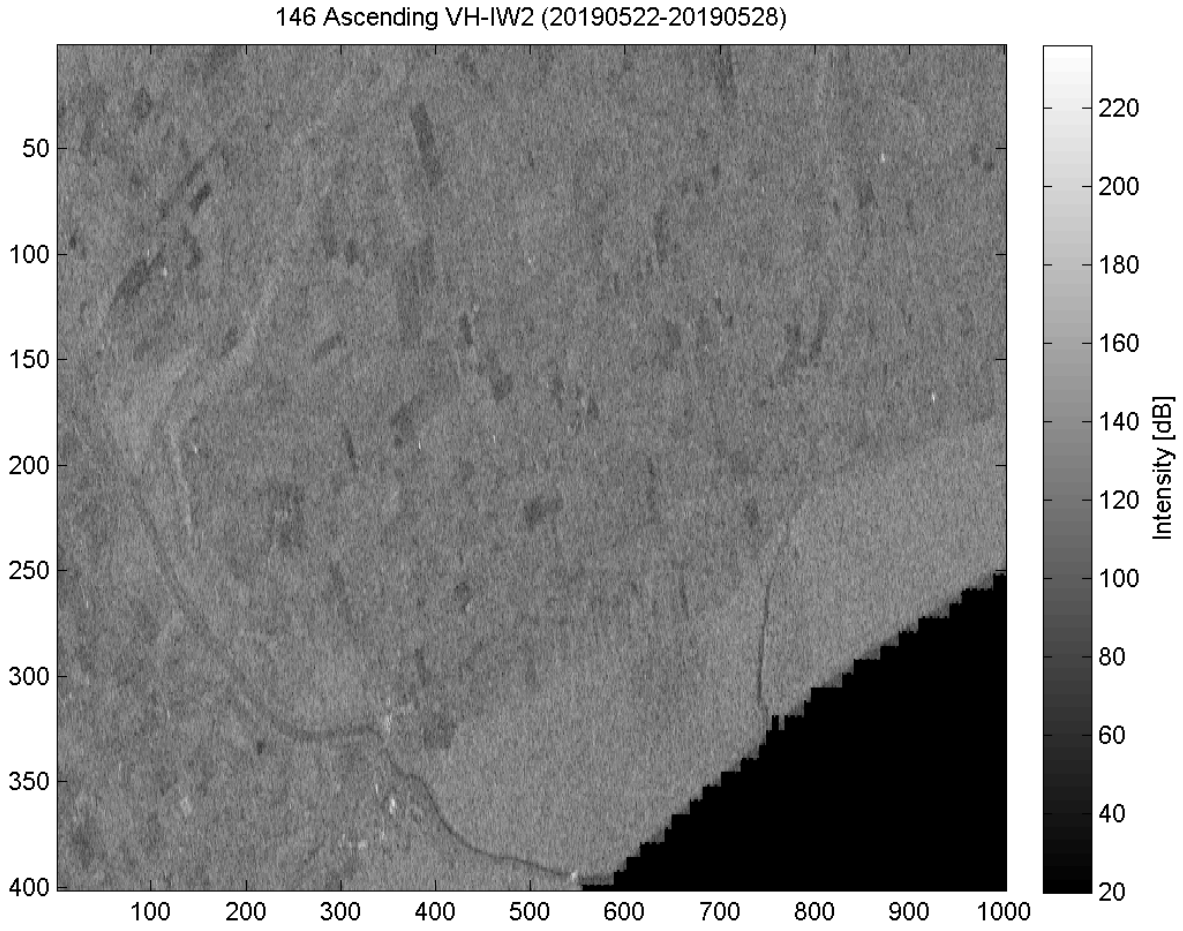


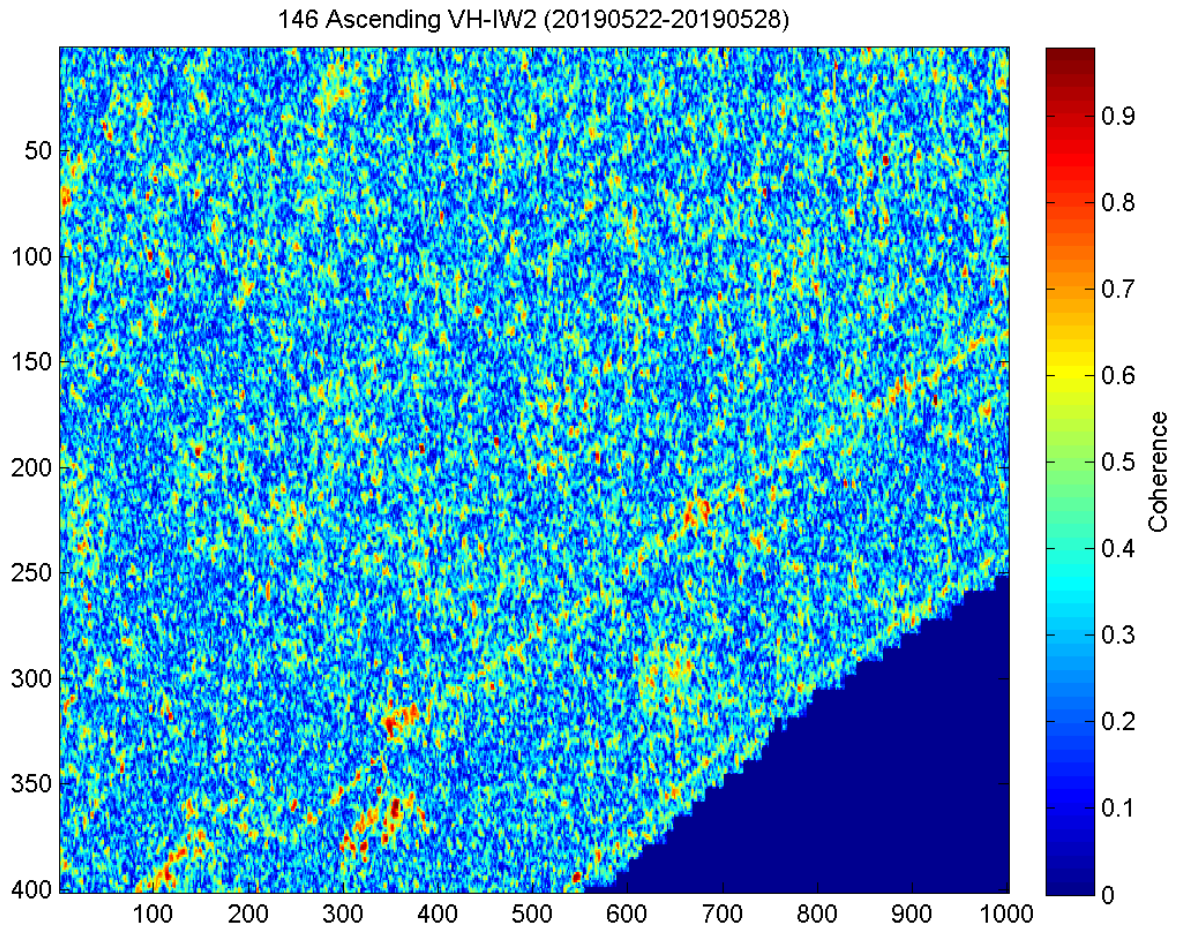
First results





First results





Future work

- ✓ Complete the interferometric processing of a 2-year time series of Sentinel-1 images over the study area;
- ✓ Apply a multivariate analysis to the time-series of InSAR coherence maps;
- ✓ Acquire in-situ measurement of soil moisture and phenological parameters.