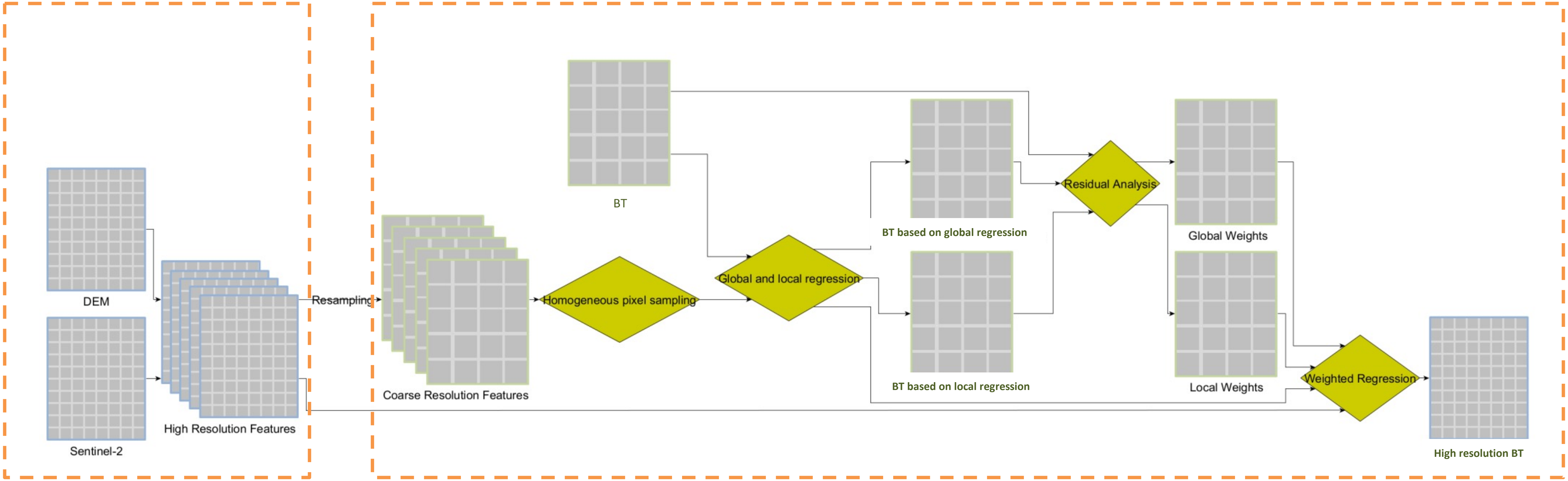
Simulating high spatial-temporal land surface temperature at scale

Henk Pelgrum, Karlis Zalite, Steven Wonink, Annemarie Klaasse

Introduction

- ETLook used in FAO Water Productivity Open-access Portal (WaPOR) at different scales
- NDVI, albedo and LST are inputs to ETLook
- Image enhancement algorithms as a solution to adapt existing thermal space missions to agricultural applications
- e.g. data miner sharpener (DMS) by Gao et al. (2012)
- and implementation of this algorithm in Python as described by Guzinski et al. (2019)

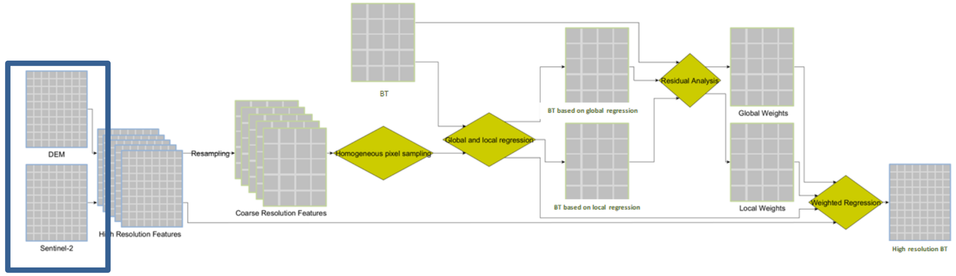
Thermal sharpening

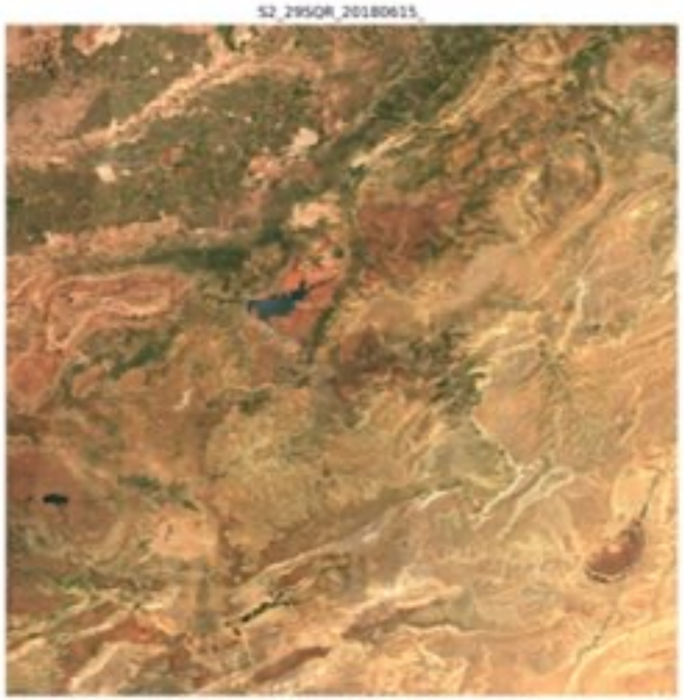


Feature selection and data preparation

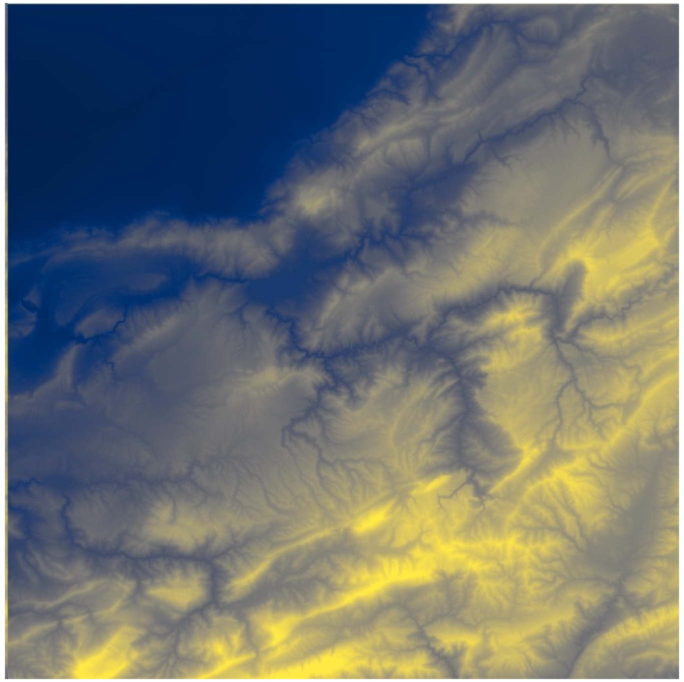
PyDMS application

High resolution inputs



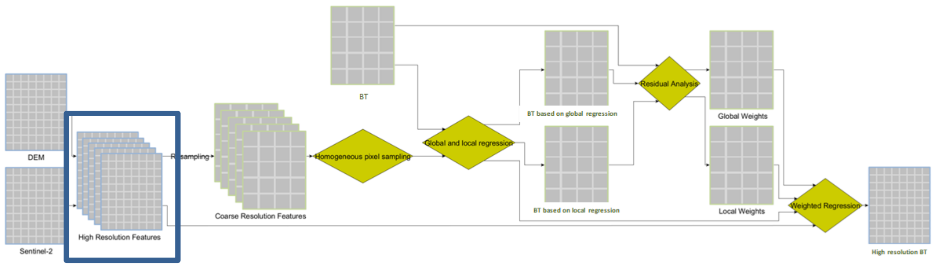


Sentinel-2 resampled to 100m



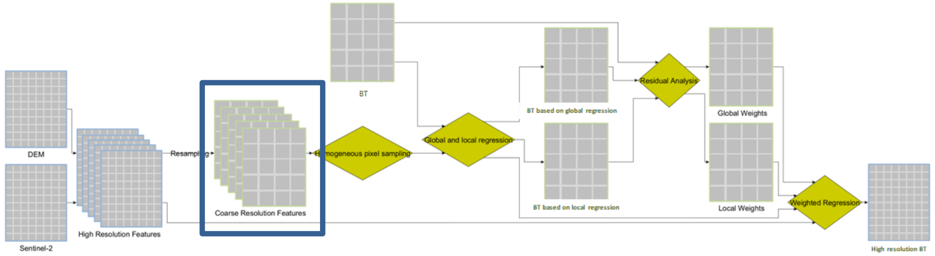
Copernicus DEM resampled to 100m

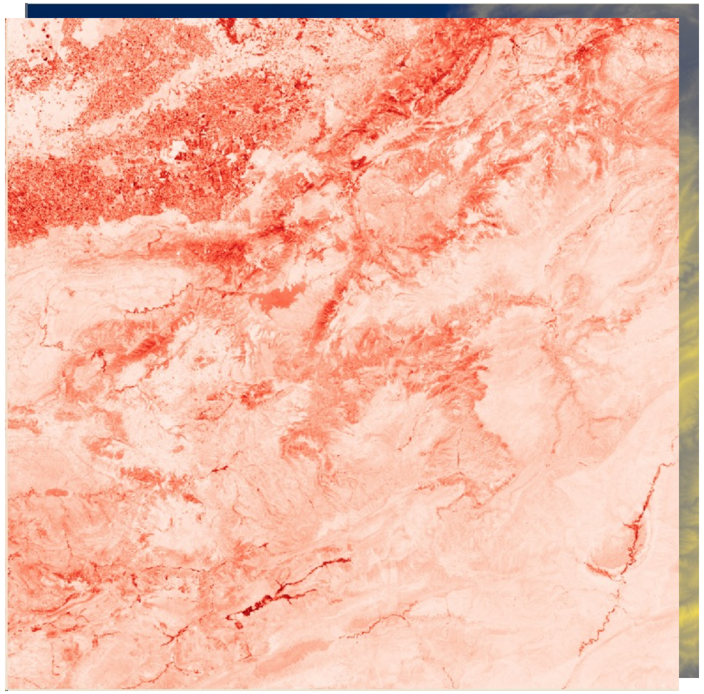
Features



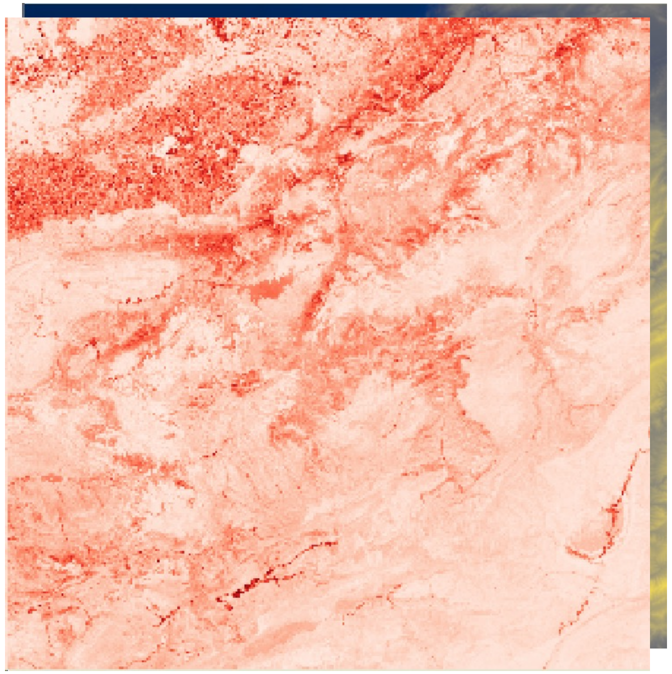
- Sentinel-2 Bands 2 and Band 8 (Blue and NIR)
- Elevation related features
  - Slope
  - Aspect
  - Elevation
- Sentinel-2 based indices:
  - MNDWI (Modified Normalized Difference Water Index) (SWIR1, green)
  - NMDI (Normalized Multiband Drought Index) (NIR, SWIR1, SWIR2)
  - VARI_RED_EDGE (Visible Atmospherically Resistant Index Red Edge) (blue, red edge, red)
  - BI (bare index) (NIR, SWIR2, Red, Blue)
  - PSRI (plant senescence reflectance index) (blue, red, red edge)
- In total more than 50 features have been considered for use

Resampling of features



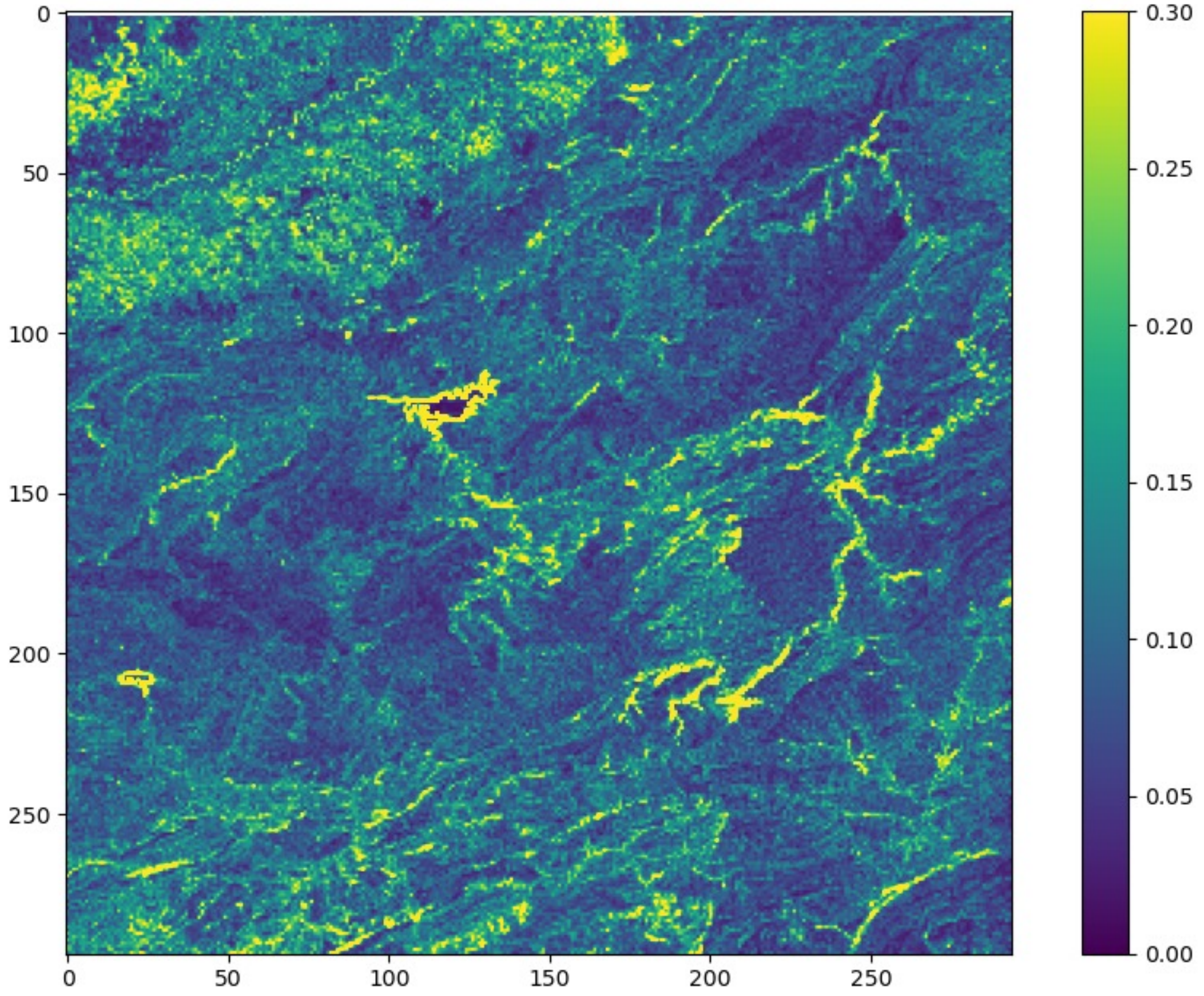


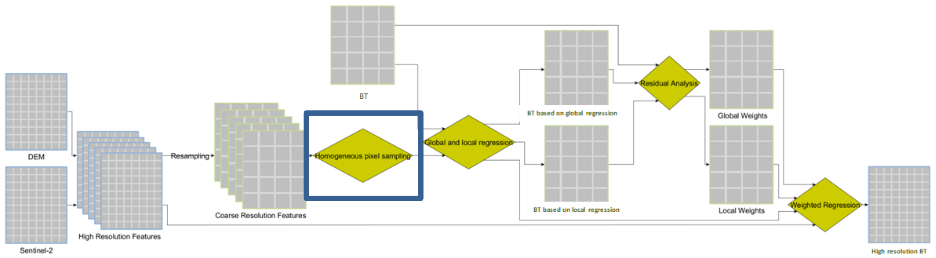
BI (bare soil index)
feature 100 m



BI (bare soil index)
feature 375 m

Pixel sampling



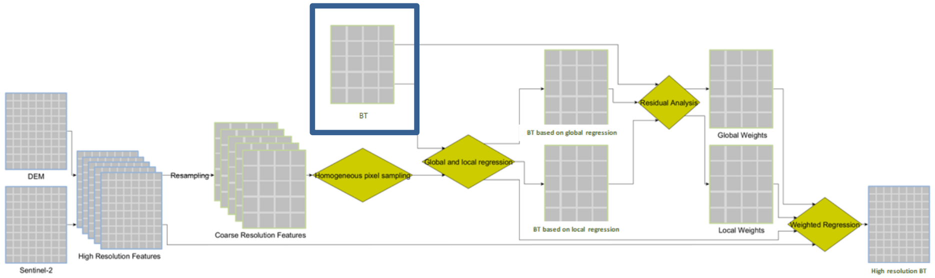


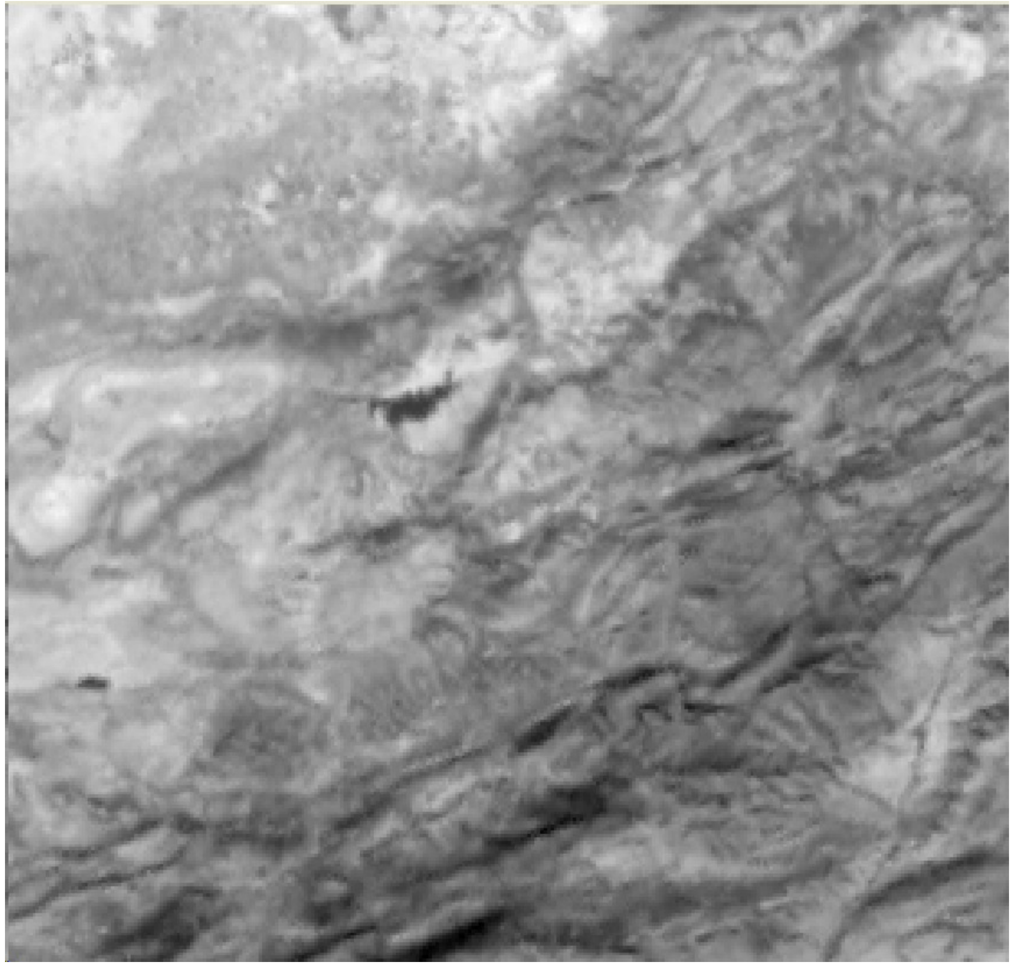
Based on Coefficient of Variance of multiple input features.

This is the CV of B8 of Sentinel-2

Pixels with low CV are considered homogeneous and will be sampled for the regression

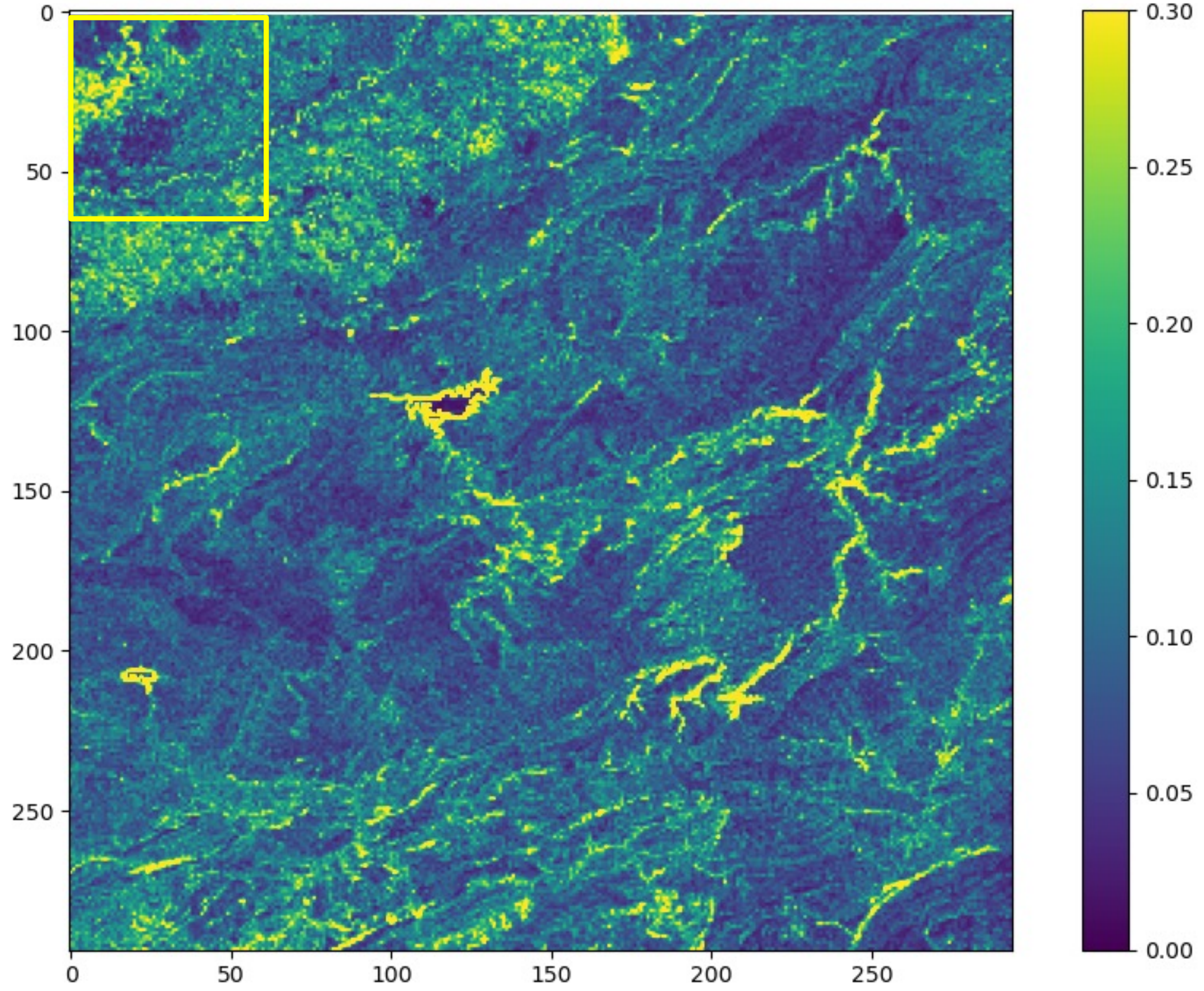
BT inputs

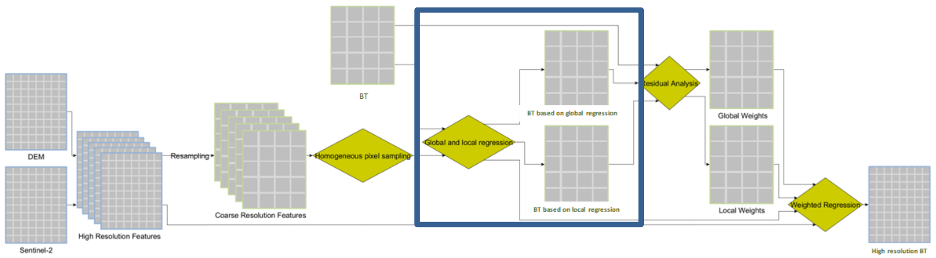




VIIRS BT I5 image
Oct 6 2019

Regression

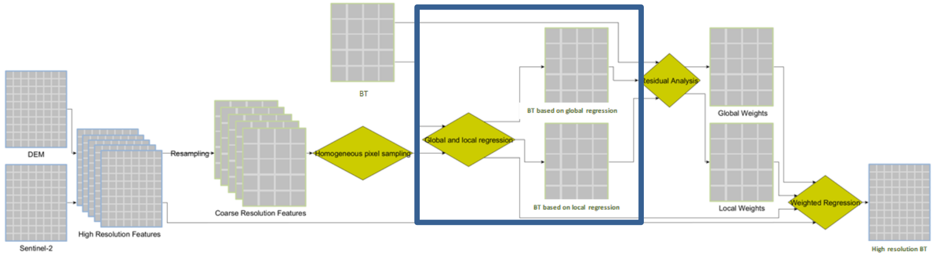




Regression takes place in moving windows (local regression)

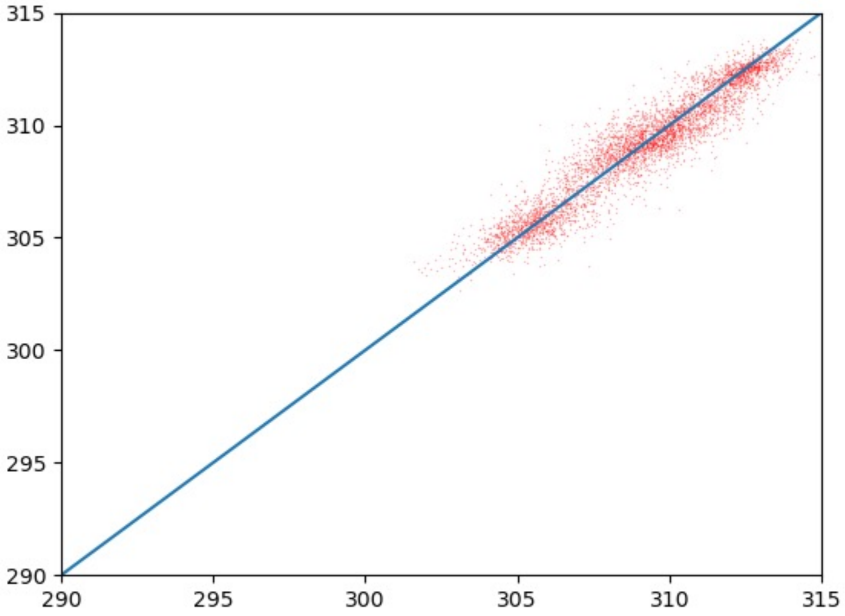
And for the whole image (global regression)

Global vs Local Regression

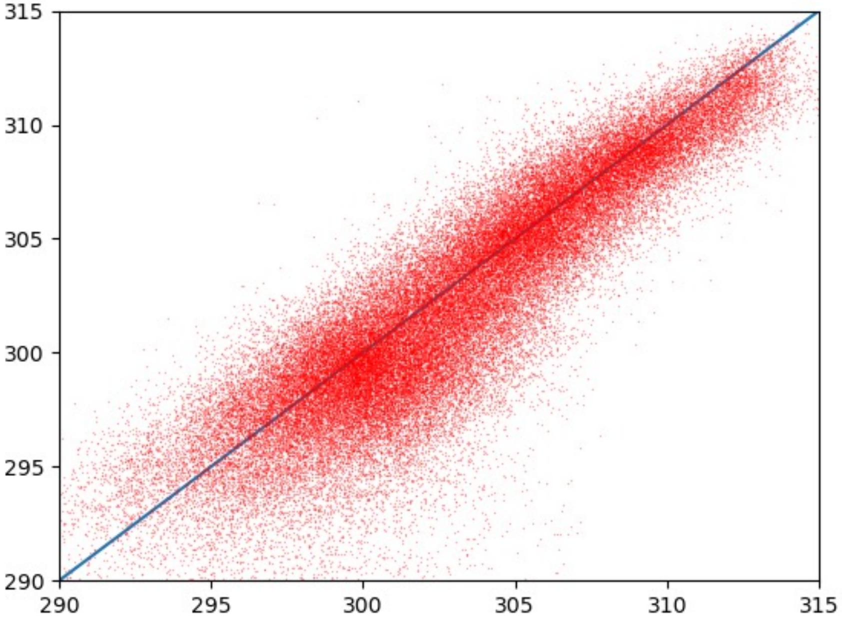


Regression takes place in moving windows (local regression).

And for the whole image (global regression)



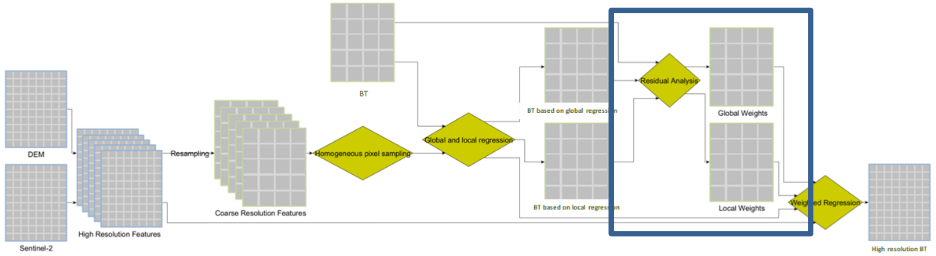
Local regression

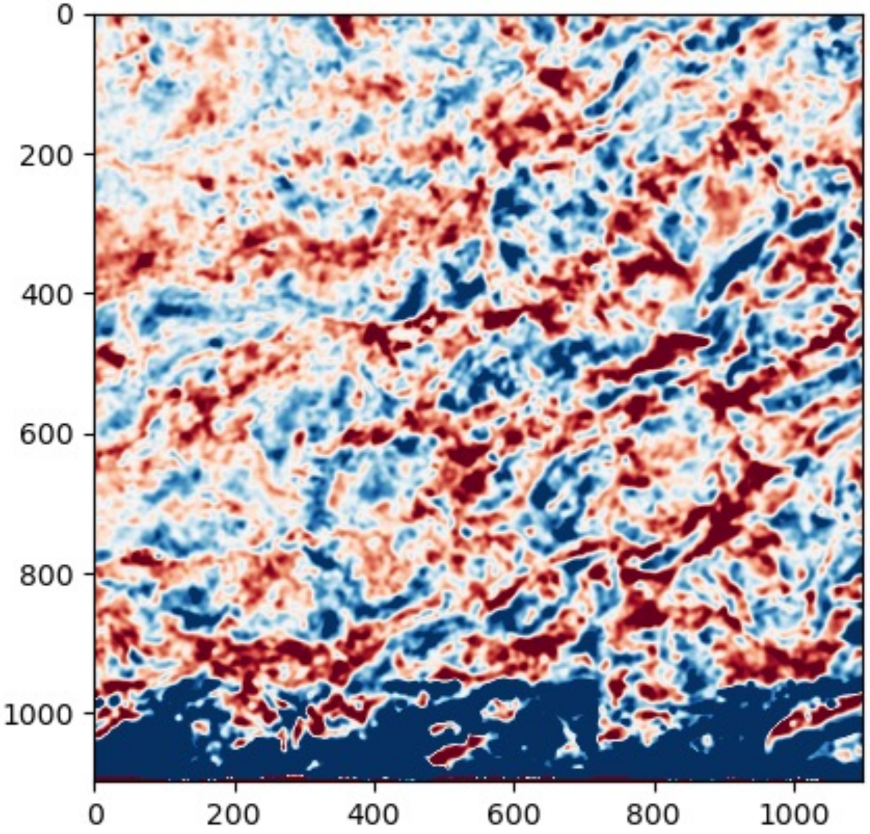


Global regression

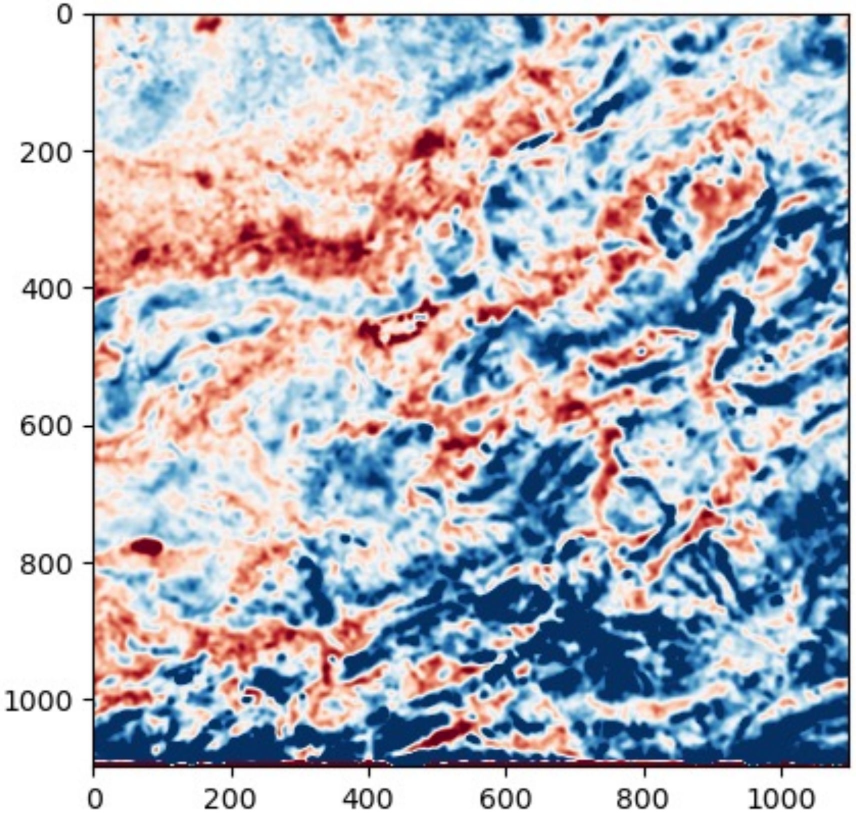
Residual analysis

Red: Negative residual
White: Zero residual
Blue: Positive residual



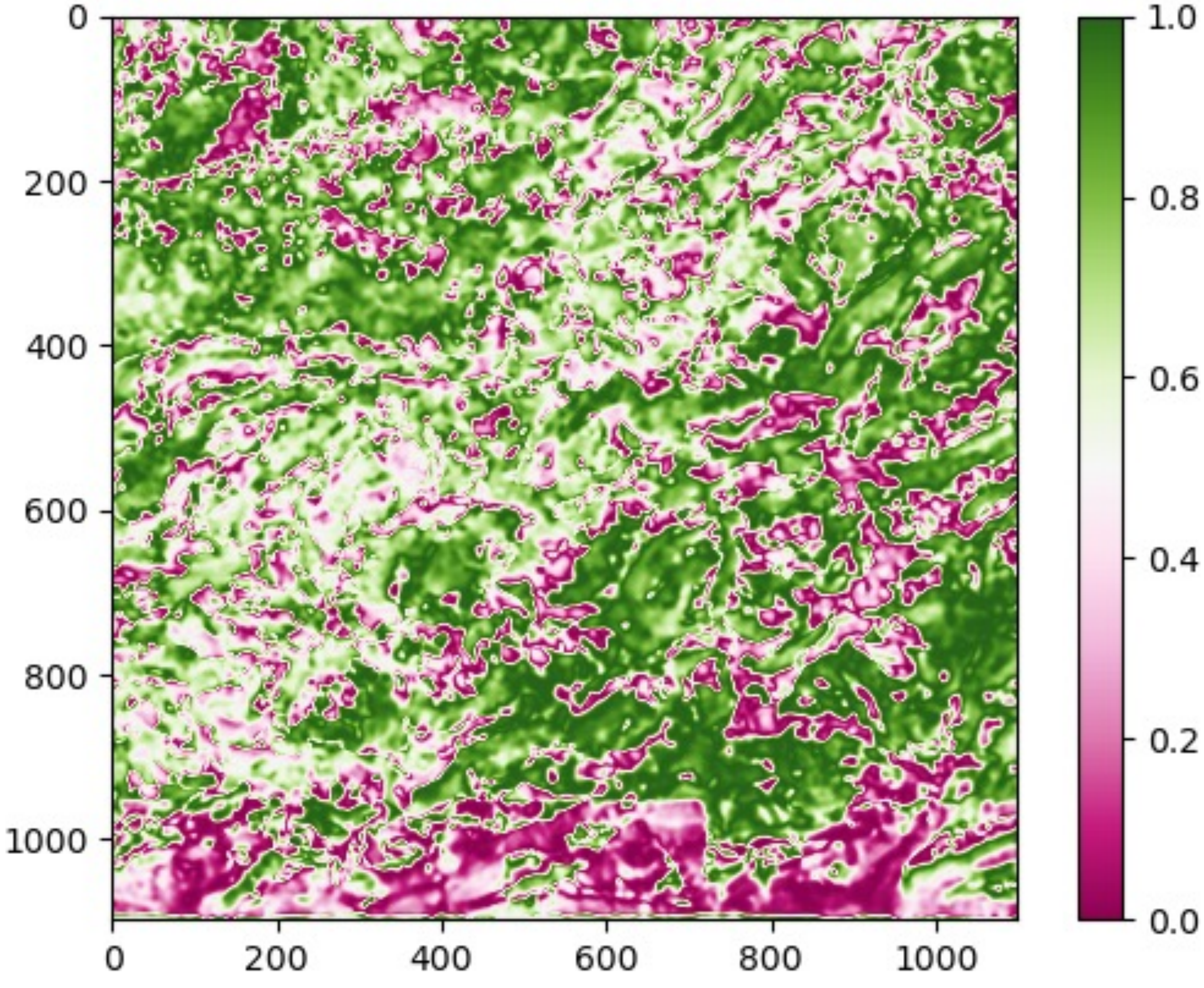


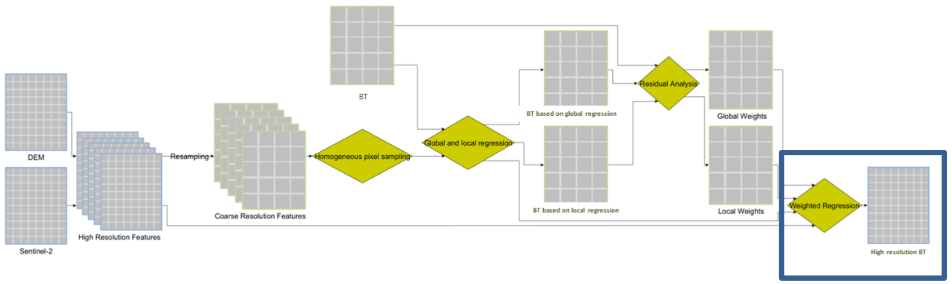
Windowed residual



Full residual

Weighted regression



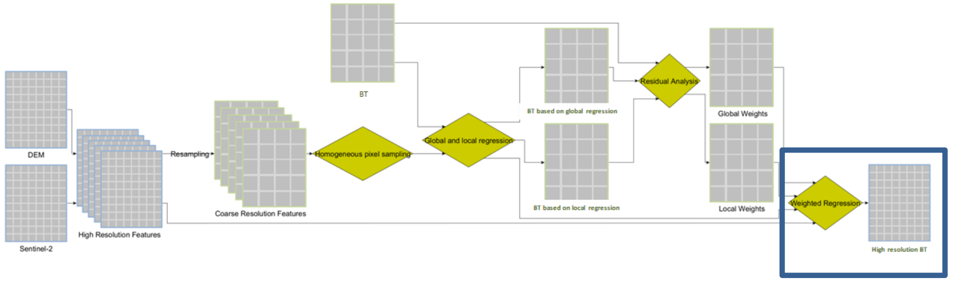


Weights for the windows:

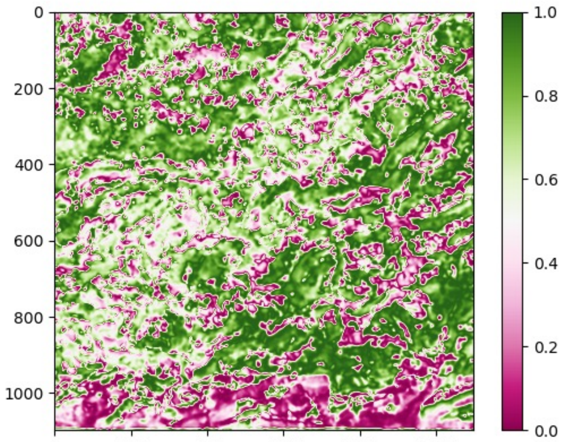
Green: more weights for the local regression

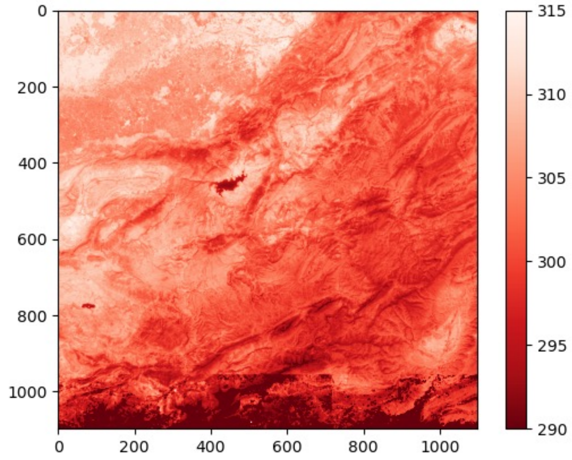
Purple: more weights for the global regression

Result

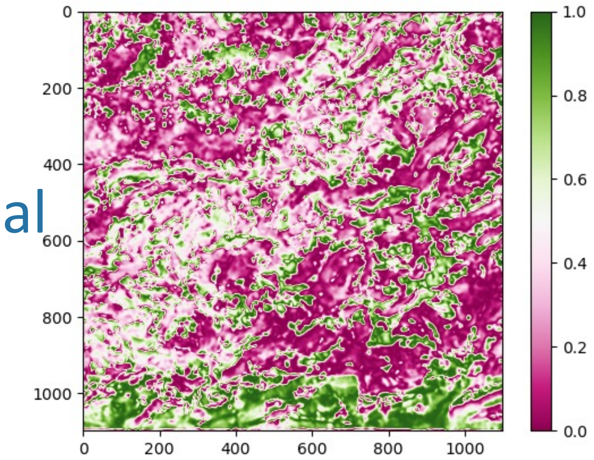


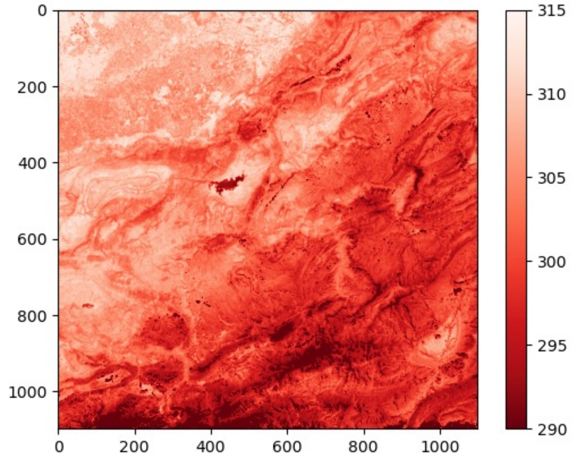
Local





Global

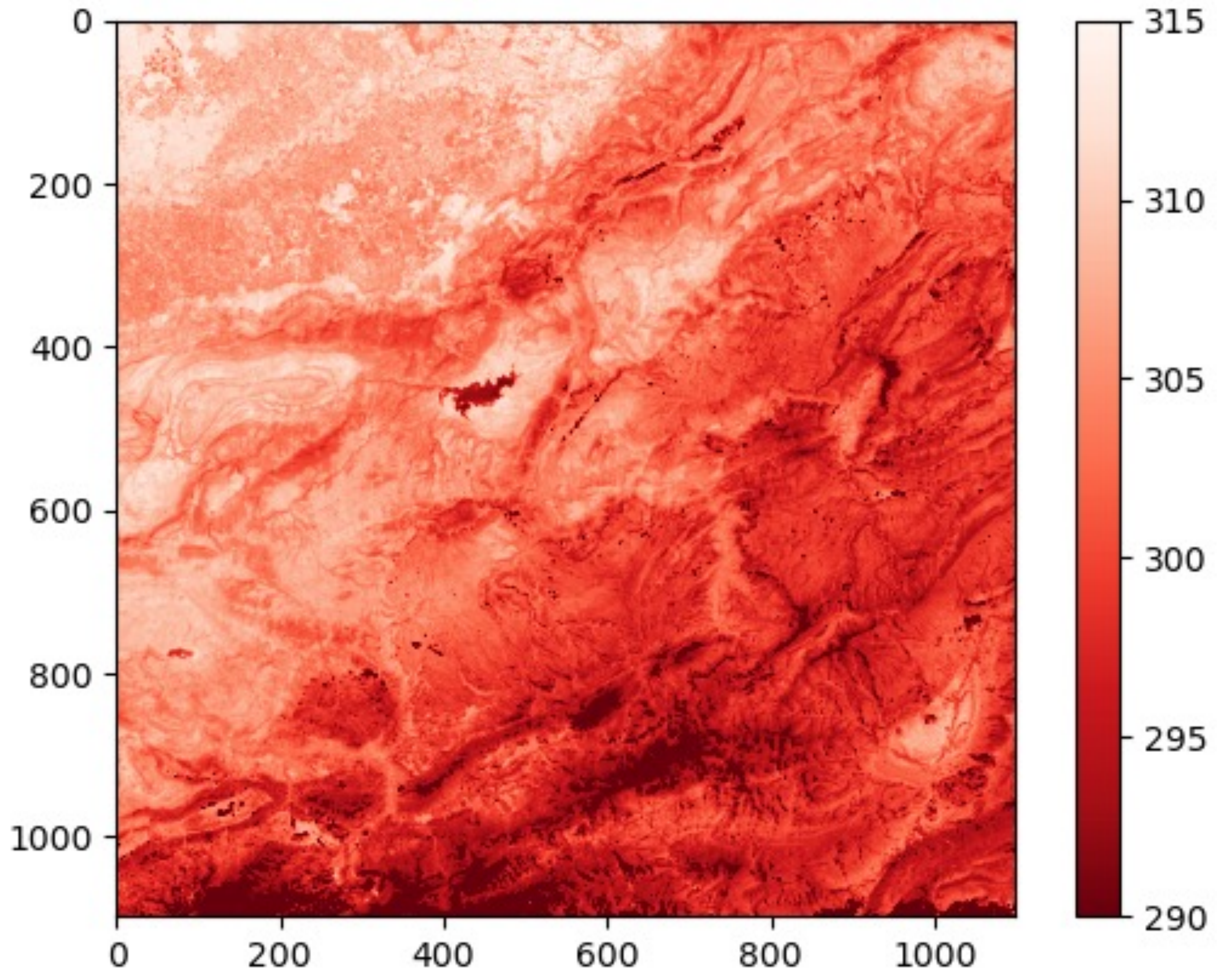


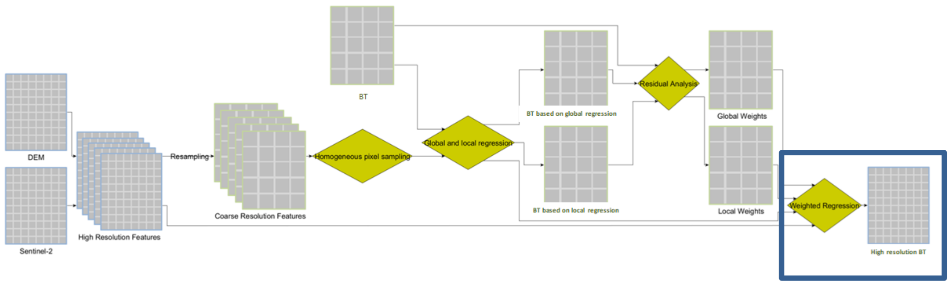


Weights

Prediction

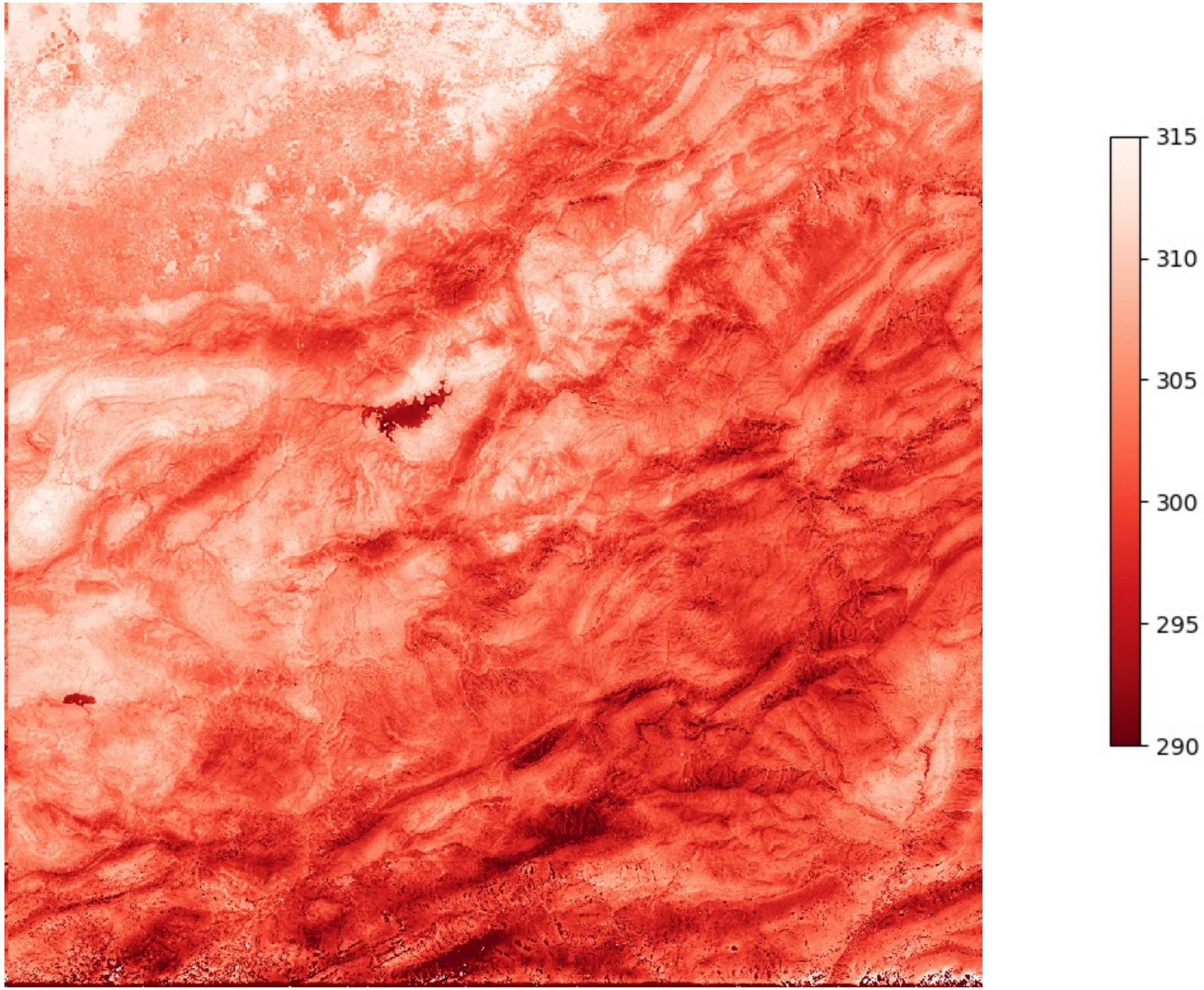
Result (without residual correction)



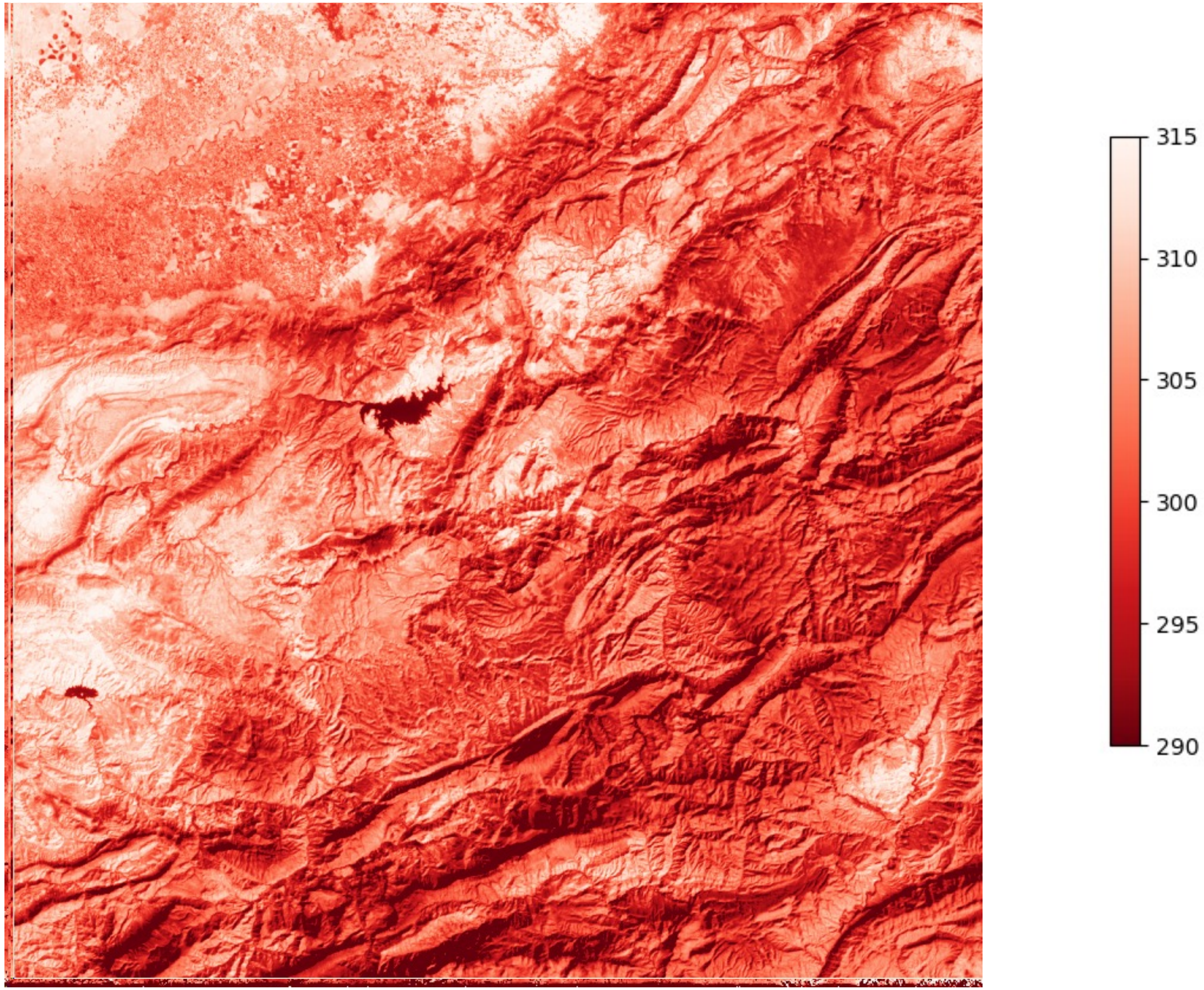


This image is corrected again for residuals based on a comparison with the resampled low resolution LST, to correct biases in the result

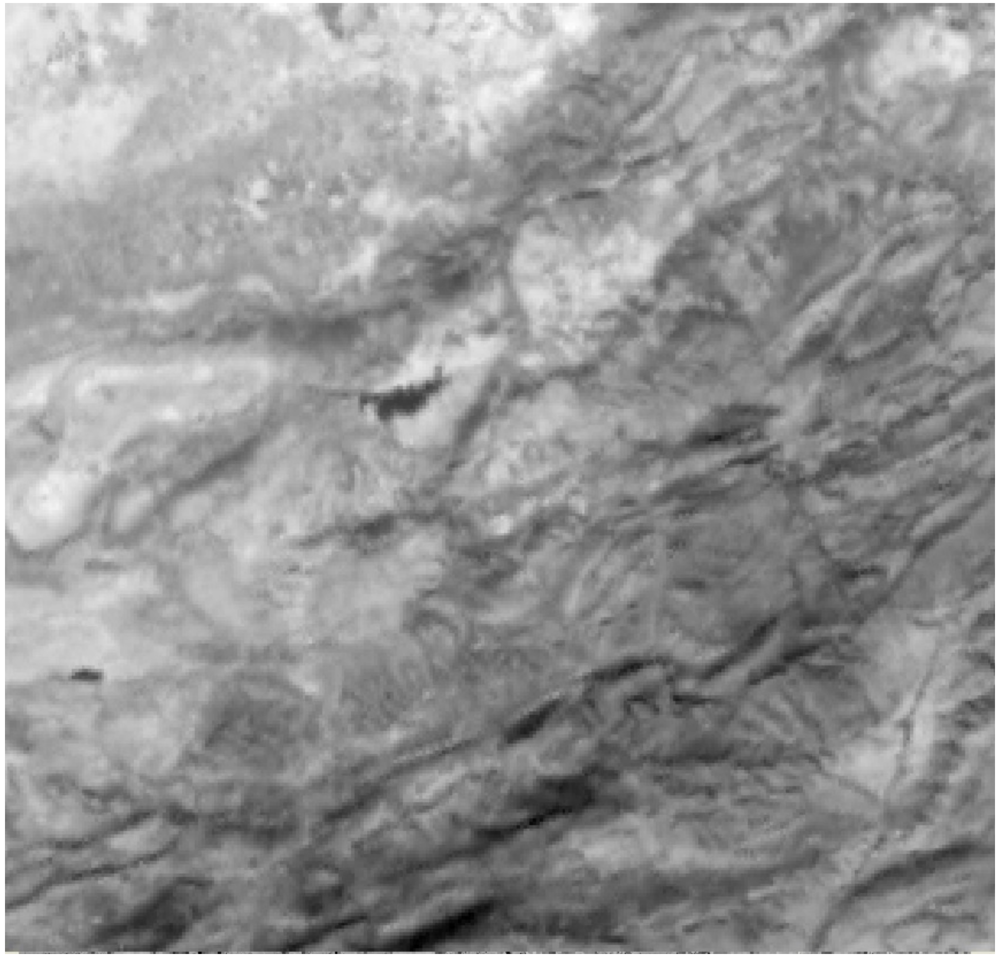
Final Result (with residual correction)



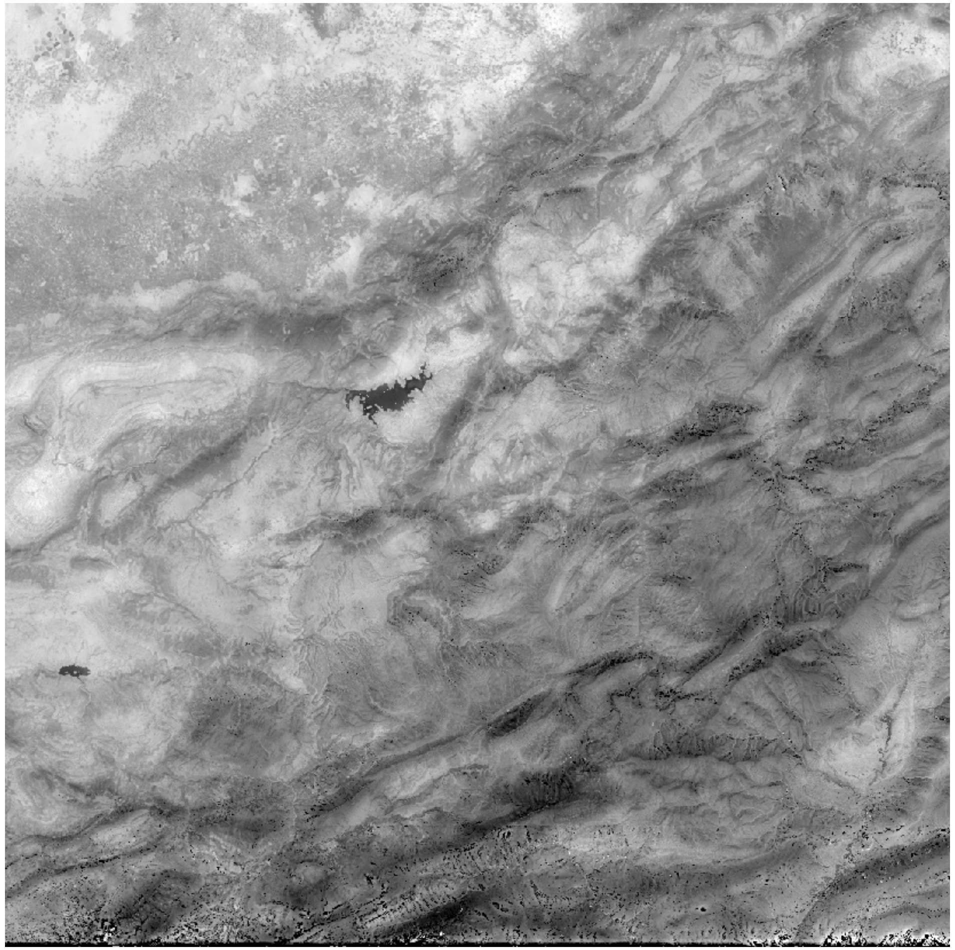
Comparison with Landsat data



VIIRS – 6 October 2019



Original 375 m image



Sharpened 100 m image

BT to LST

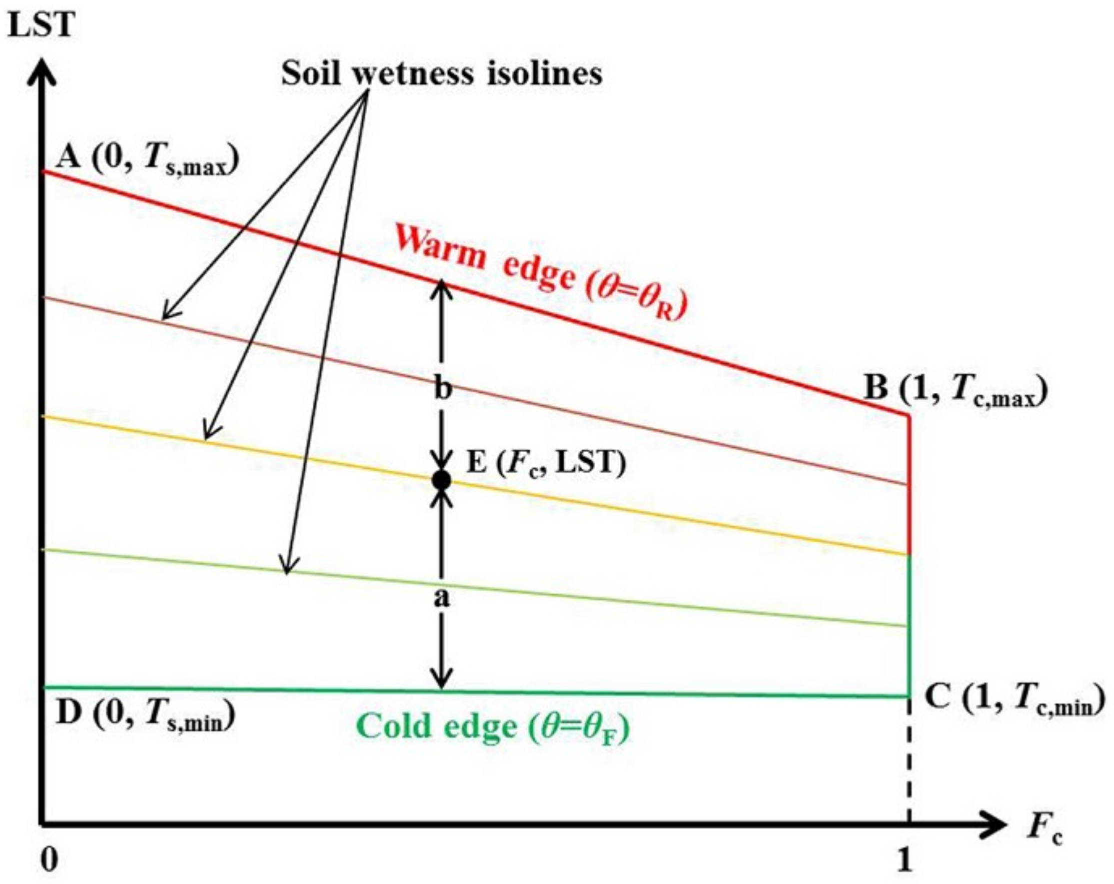
- Brightness temperature is converted to LST via Single Channel Algorithm (Munez et al., 2009)

IEEE TRANSACTIONS ON GEOSCIENCE AND REMOTE SENSING, VOL. 47, NO. 1, JANUARY 2009 339

Revision of the Single-Channel Algorithm for Land Surface Temperature Retrieval From Landsat Thermal-Infrared Data

Juan C. Jiménez-Muñoz, Jordi Cristóbal, José A. Sobrino, Guillem Sòria, Miquel Ninyerola, and Xavier Pons

LST to SM



Remote Sens. **2015**, *7*, 8250-8270; doi:10.3390/rs70708250

OPEN ACCESS

remote sensing

ISSN 2072-4292

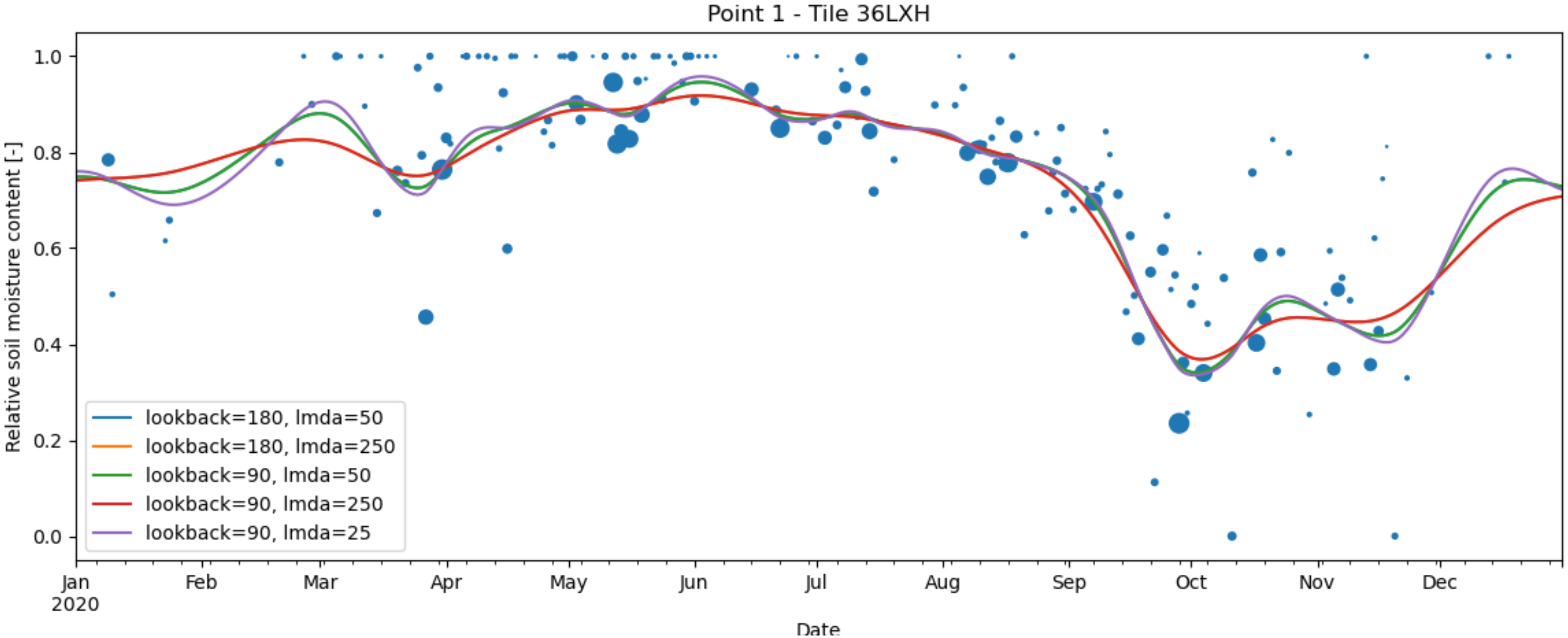
www.mdpi.com/journal/remotesensing

Article

Estimation of Surface Soil Moisture from Thermal Infrared Remote Sensing Using an Improved Trapezoid Method

Yuting Yang [1,2,*], Huade Guan [1,3], Di Long [4], Bing Liu [5], Guanghua Qin [6], Jun Qin [7] and Okke Batelaan [1,3]

Soil moisture smoothing



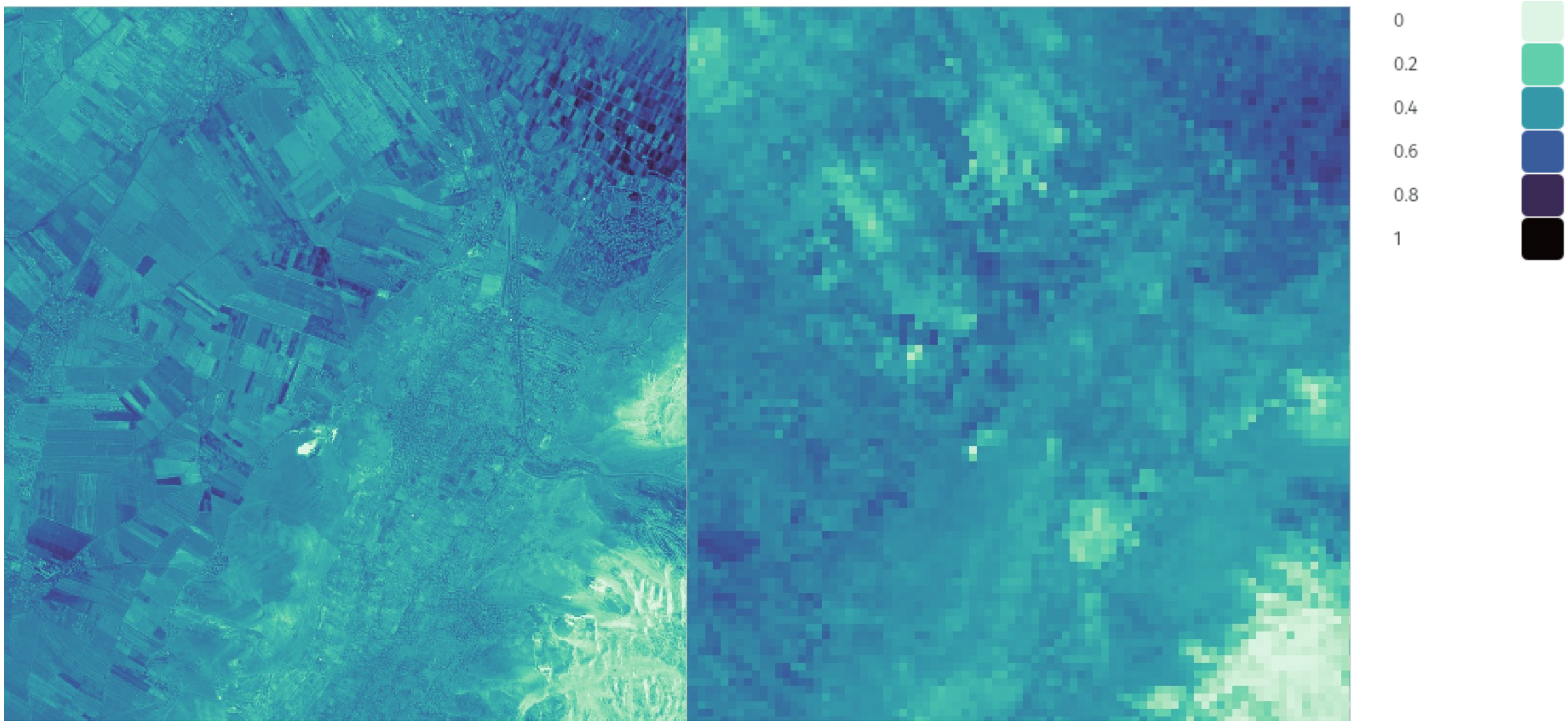
Applying Whittaker smoothing

Weights are based on distance to cloud and viewing angle

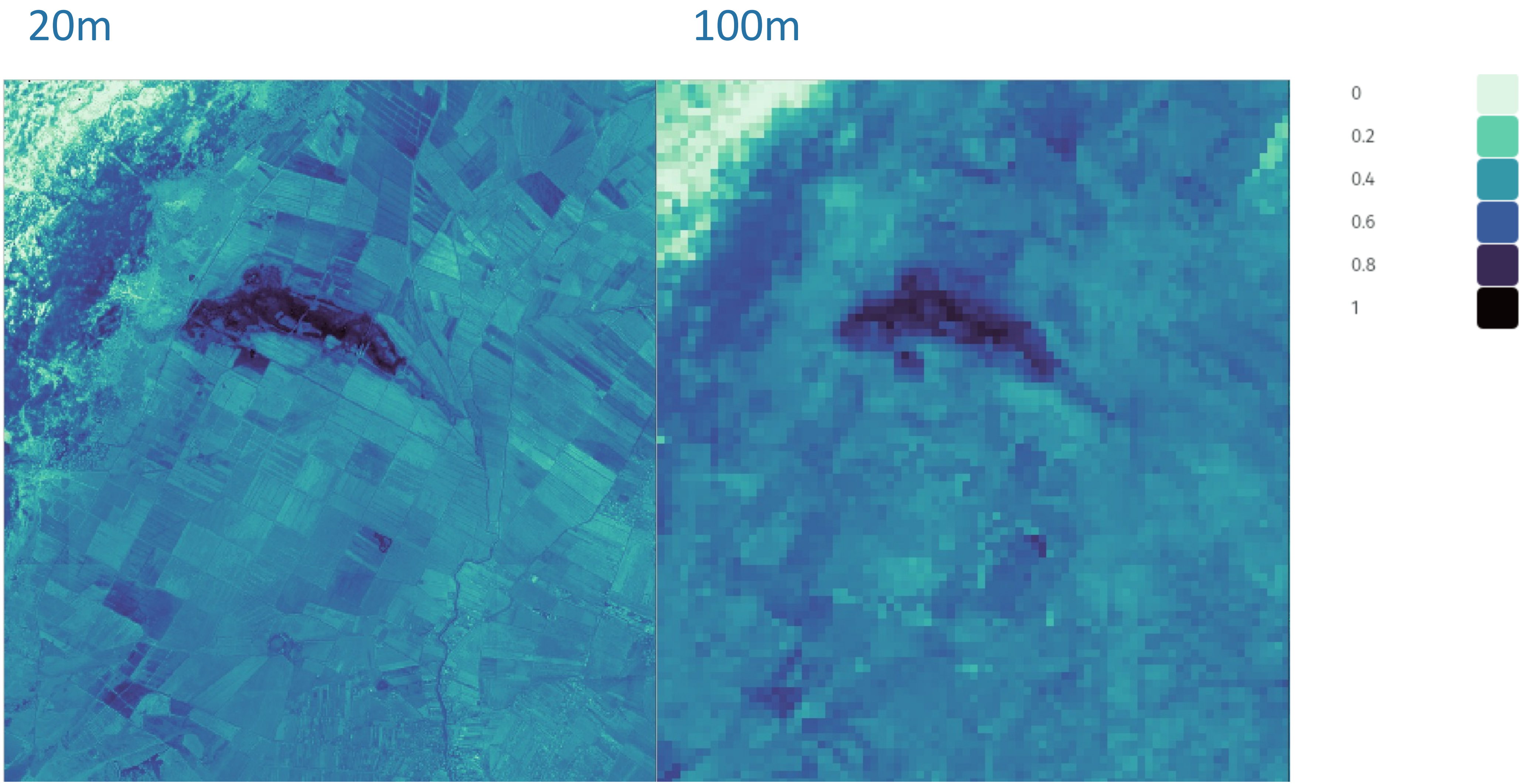
100m vs 20m

20m

100m

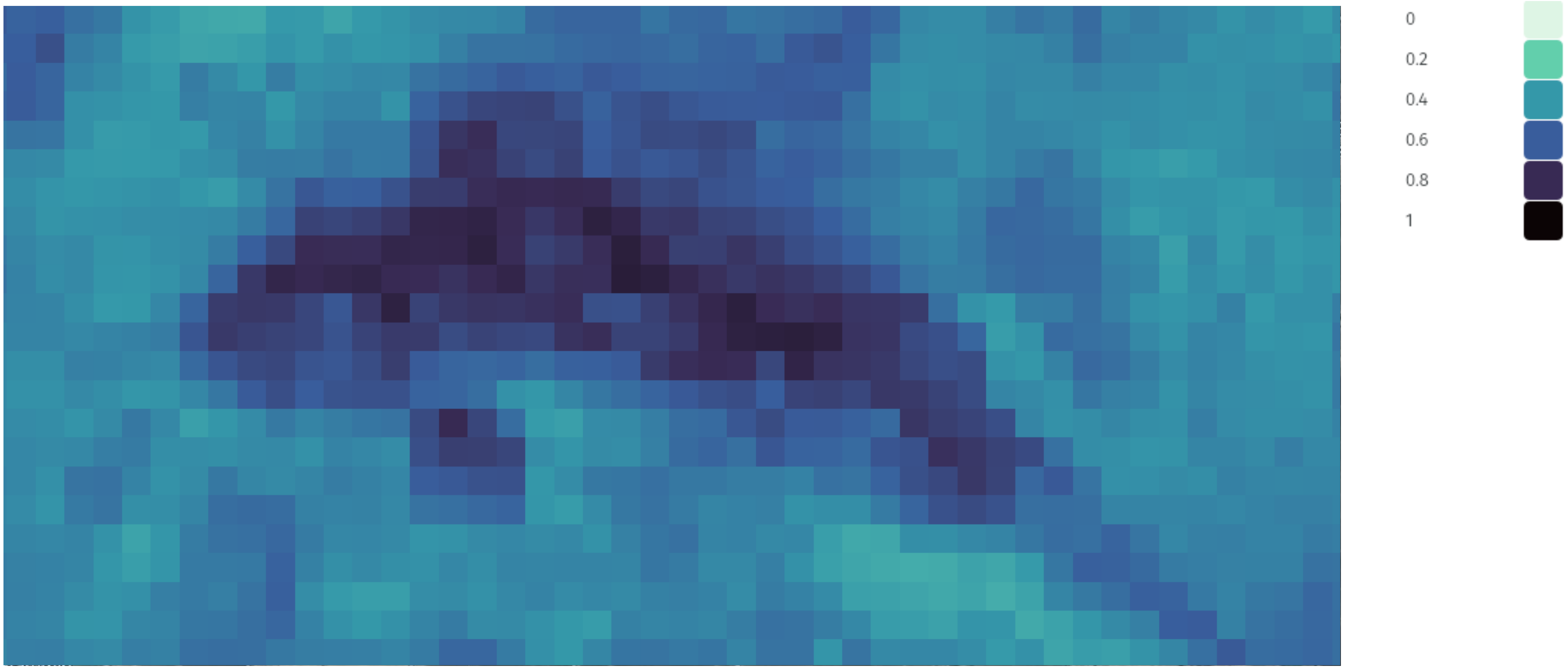


100m vs 20m



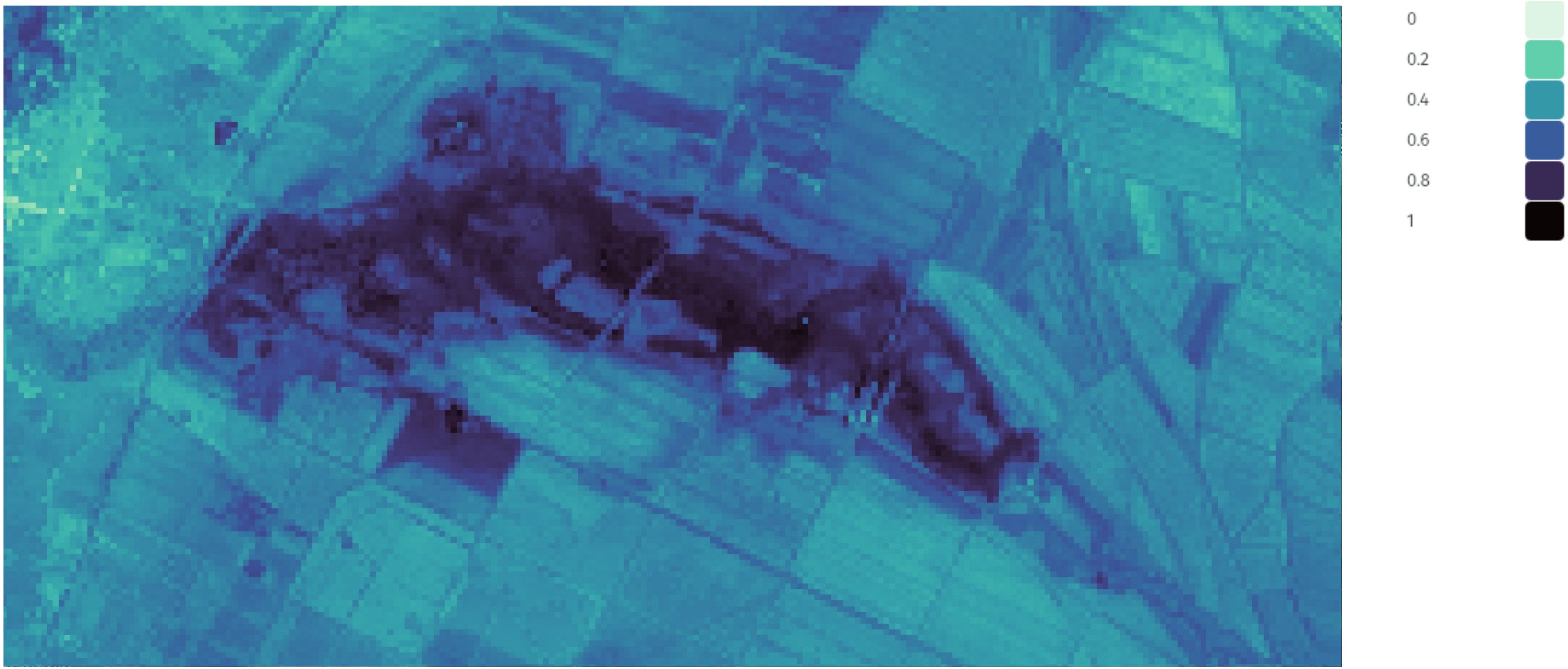
relative soil moisture content root zone [-]

Close-up 100m



relative soil moisture content root zone [-]

Close-up 20m



Thank you!

Karlis.Zalite@eleaf.com