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Impacts of Radiometric Uncertainty on the Estimation of Land Surface Phenology Metrics

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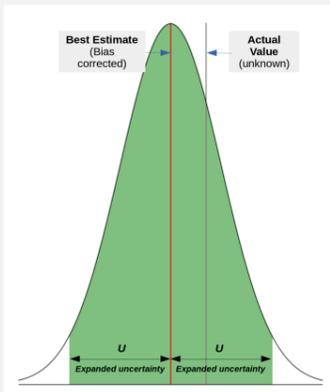
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1 Background

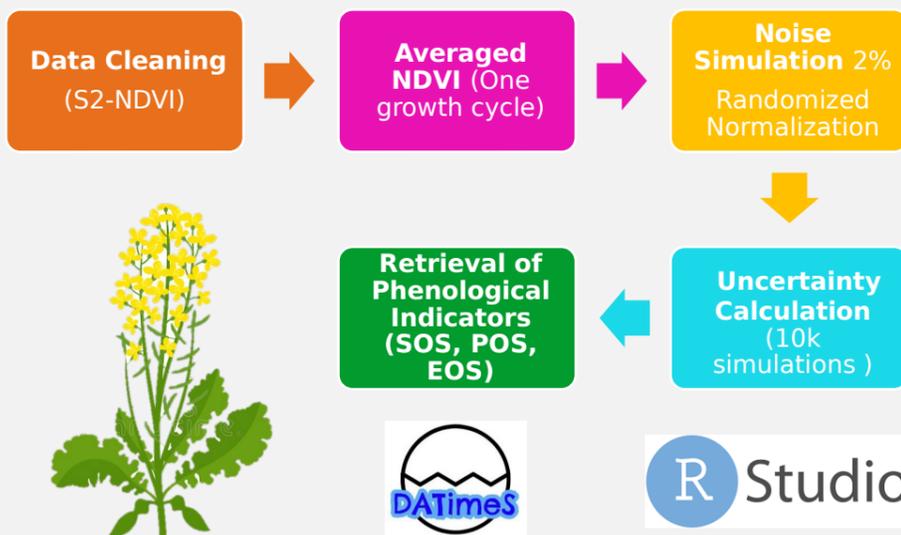
Any measurement is only complete with a statement about its uncertainty. Uncertainty is the amount of doubt about a measured value. This also applies to measured radiance values in the case of optical Sentinel-2 satellite imagery. However, uncertainty not only affects pixel radiance readings, but also propagates into higher level products such as Land Surface Phenology (LSP).

2 Materials and Methods

- Radiometric Uncertainty is assumed to follow a Gaussian distribution

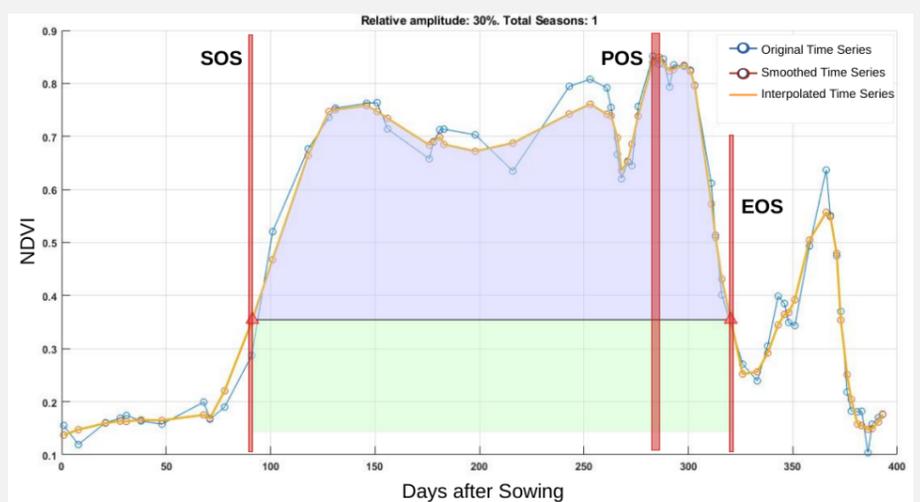


- Sentinel-2 NDVI time series (64 scenes) of a Winter Rapeseed parcel in Northern Bulgaria to study the effect of (assumed) 2% propagated radiometric uncertainty in NDVI derived over an entire growing season
- 10 000 time series scenarios (Monte Carlo simulations) used to assess the impact of radiometric uncertainty on the timing of
 - Start of Season (SOS) → leaf development
 - End of Season (EOS) → senescence of plants
 - Peak of Season (POS) → maximum greenness



4 Results and Discussion

Radiometric Uncertainty has an impact on LSP metrics



Extracted LSP metrics for a single growing season of winter rapeseed. The red bars indicate the uncertainty range (single standard deviation) for the SOS, POS and EOS.

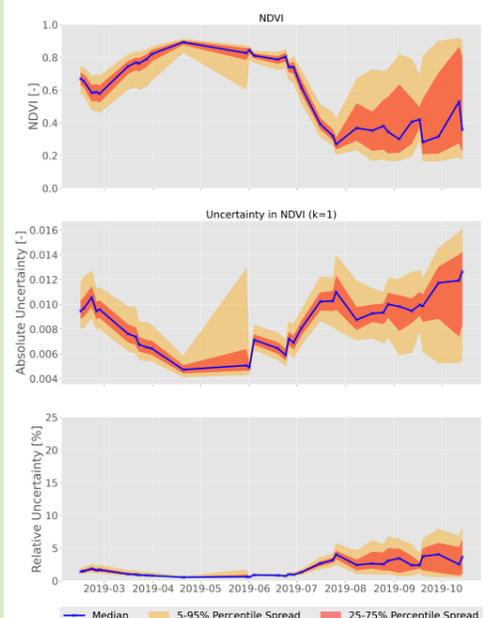
Standard deviation of metrics among all scenario runs was ~1day.

However, 2% relative uncertainty in NDVI readings is just a rough guess and uncertainty is most likely not stable over time!

5 Outlook

- Use ESA SNAP L1C Radiometric Uncertainty Toolbox¹ to get realistic estimates of radiometric uncertainty
- Implement «Law of Uncertainty Propagation»² for proper propagation of radiometric uncertainty into LSP metrics
- Latest results suggest that NDVI uncertainty might be even higher than 2% and is not constant over time

Rapeseed NDVI Uncertainty



This work is the result of a students project at the SENSECO COST Action Summer School «EO-SENSE 2.0» held in Plovdiv, Bulgaria, September 2021

<https://www.senseco.eu/>

Code and Data on GitHub



¹Gorroño, J. Et al.. A Radiometric Uncertainty Tool for the Sentinel 2 Mission. Remote Sens. 2017, 9, 178.

<https://doi.org/10.3390/rs9020178>

²JCGM 100: 2008. Expression of Measurement Data—Guide to the Expression of Uncertainty in Measurement. 2008. https://www.bipm.org/documents/20126/2071204/JCGM_100_2008_E.pdf/cb0ef43f-baa5-11cf-3f85-4dcd86f77bd6