EGU General Assembly 2020

ROTHAMSTED RESEARCH

Cranfield University

Winter wheat growth dynamics and their relationship with the field productivity using Sentinel-1 SAR polarimetry

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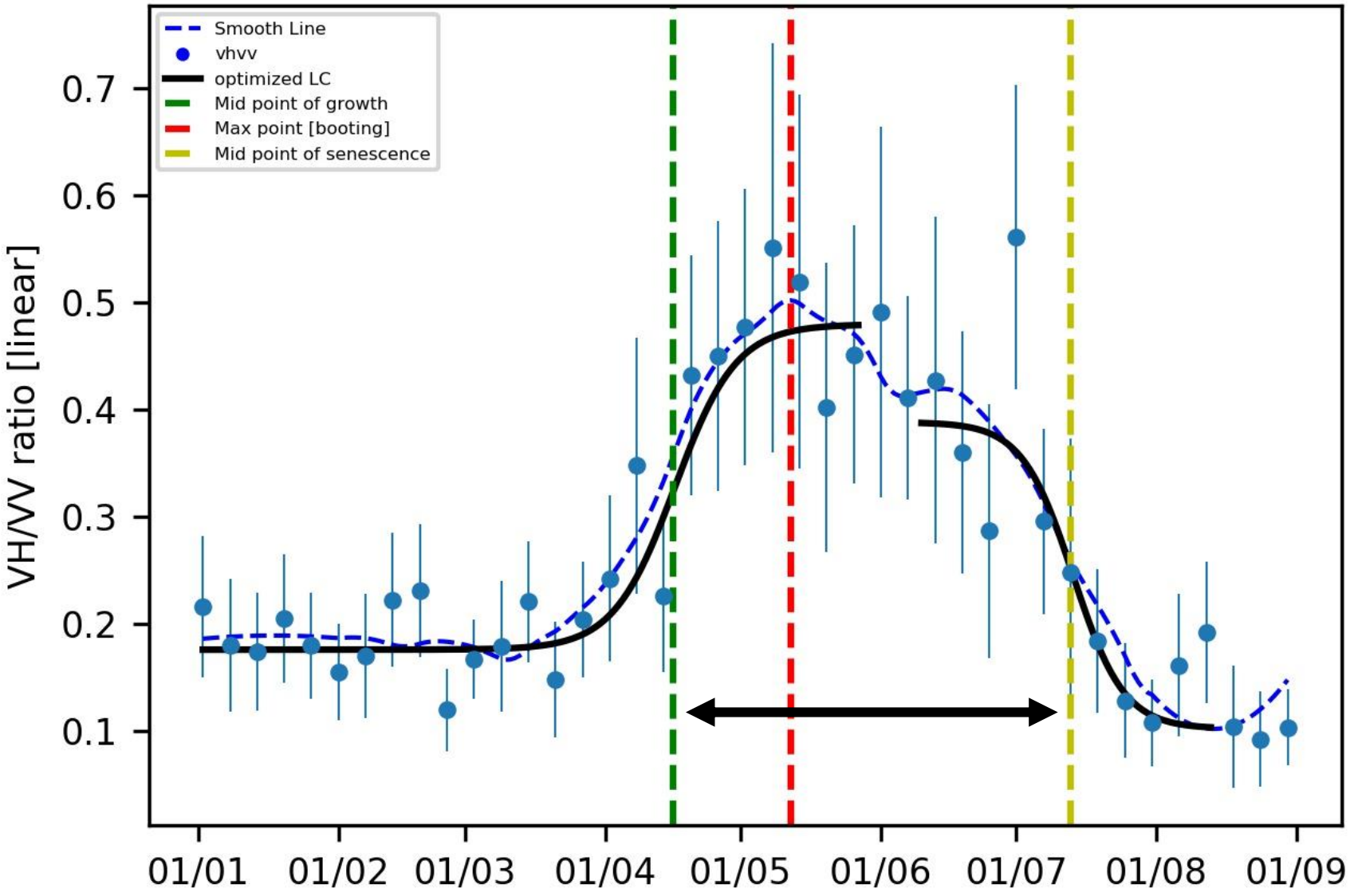
Objectives

A. Develop a method for deriving features from Sentinel-1 time-series (VH/VV ratio) to define **crop productivity indicators (CPIs)**.

B. Use the CPIs for estimating **crop development and productivity**.

C. Upscale this information on spatio-dynamic remote sensing data to monitor crops at farm scale.

Methodology to define CPIs from time-series characteristics at field scale



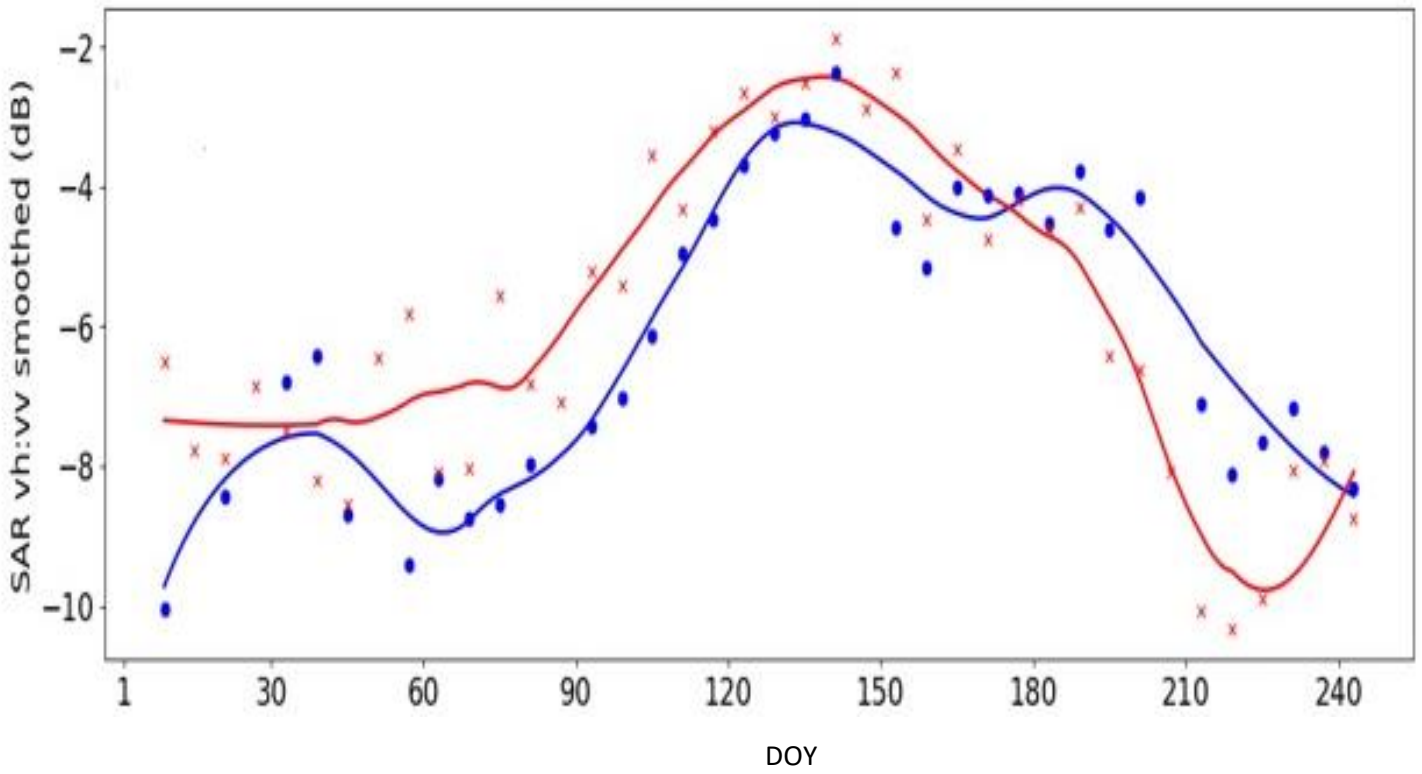
The focus of the analysis is the parameterisation of the winter wheat temporal VH/VV ratio curve assuming logistic development in the construction and senescence period (**black lines** in figure).

Important CPIs derived

Mid point of Growth
Max Timing (booting stage)
Mid point of Maturation
Duration (time between mid points)

Time-series seasonal differences

2018 vs 2019

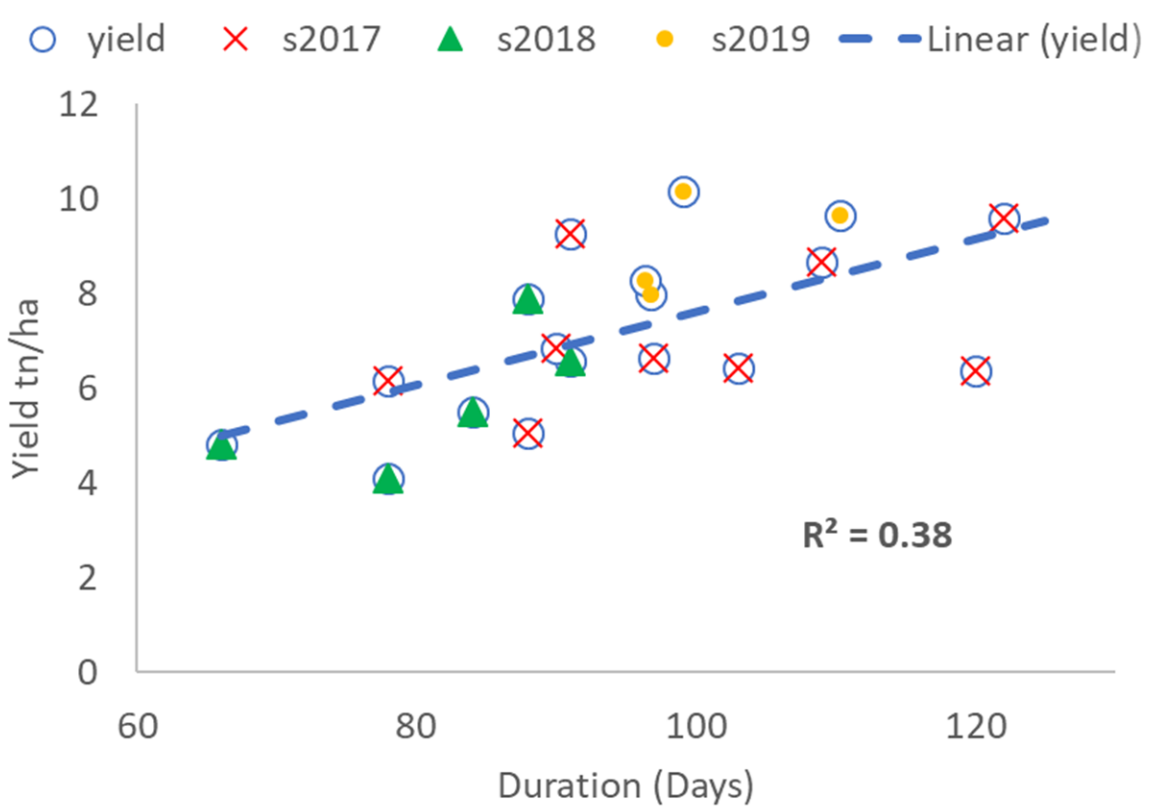


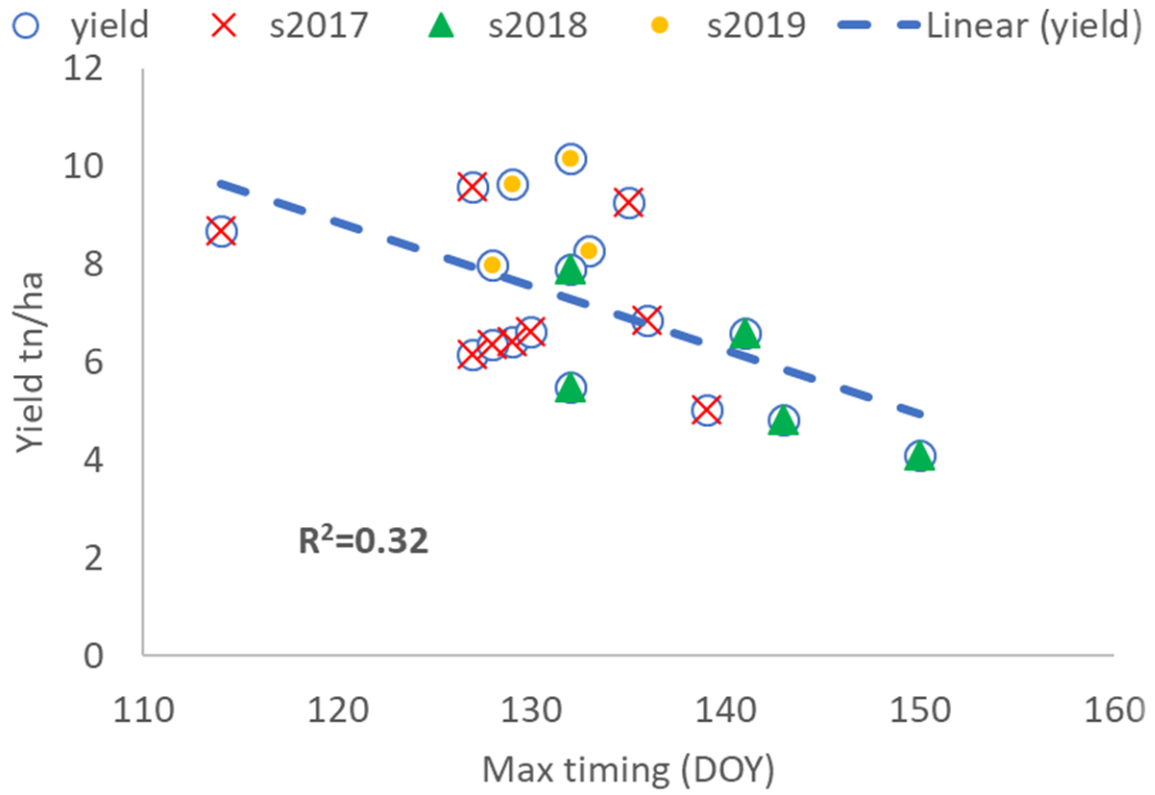
Key crop development stages of w. wheat

Info	2018	2019
Drilled	27/09	09/10
Stem Elongation	19/04	16/04
Booting	17/05	17/05
flowering	08/06	03/06
Fruit development	21/06	25/06
Ripening	09/07	17/07
Senescence	31/07	01/08
Yield (t/ha)	**7.9**	**8.28**

Time shift in crop development due to different seasonal weather patterns and management of wheat fields.
Drought conditions at the end of 2018 growing season affected the crop development and yield.

Time indicators correlation with yield





Time related features had the highest correlation value in correlation matrix when directly correlated with the yield. There is a trend but the correlation of individual CPIs is weak. Future work will focus on CPIs combination to increase the predictive power.

Conclusions

- ✓ Use of Sentinel-1, SAR, C-band, VH/VV ratio for agriculture applications. **Key crop development stages** are recognised using the dynamic SAR VH/VV backscatter *f*eatures extraction.

- ✓ The correlation analysis of CPIs shows that the **timing is important** for the correlation with the yield as it will define the photosynthetic period of the plant.

- ✓ **Weather** conditions between seasons affect the key development stages

- ✓ The most sensitive indicators are the **time of booting stage** and the **duration of the high vegetation** with the yield.

- ✓ Future work will focus on **CPIs combinations** to increase the predictive power to yield.

- ✓ This can be a useful **diagnostic tool** for crop development differences across the wheat fields by mapping CPIs across the agricultural landscape.

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