Field trends from UAV imaging

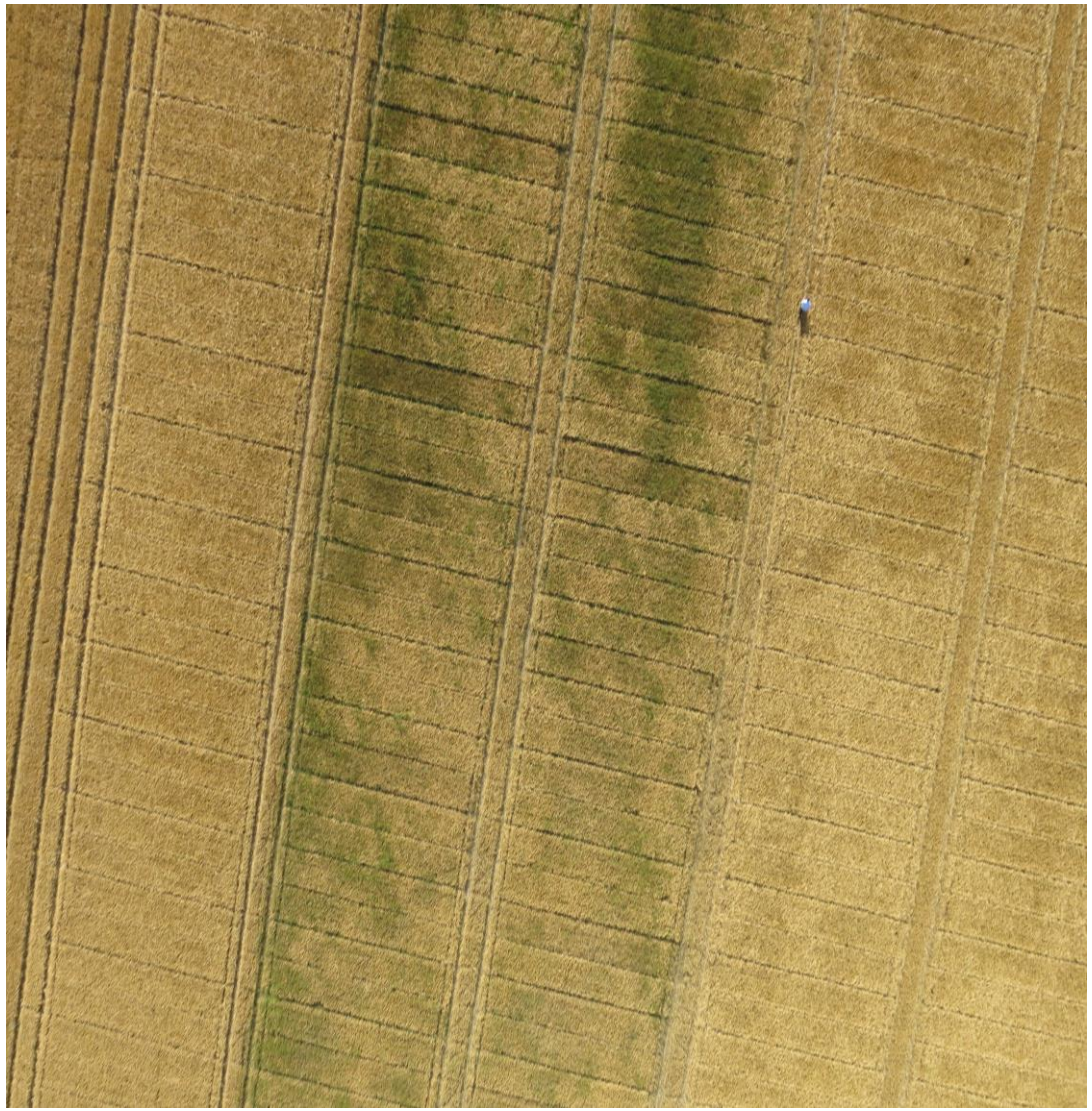
NPPN – 6P3, WP2

Signe M. Jensen & David Redek
PLEN, KU
smj@plen.ku.dk

KØBENHAVNS UNIVERSITET

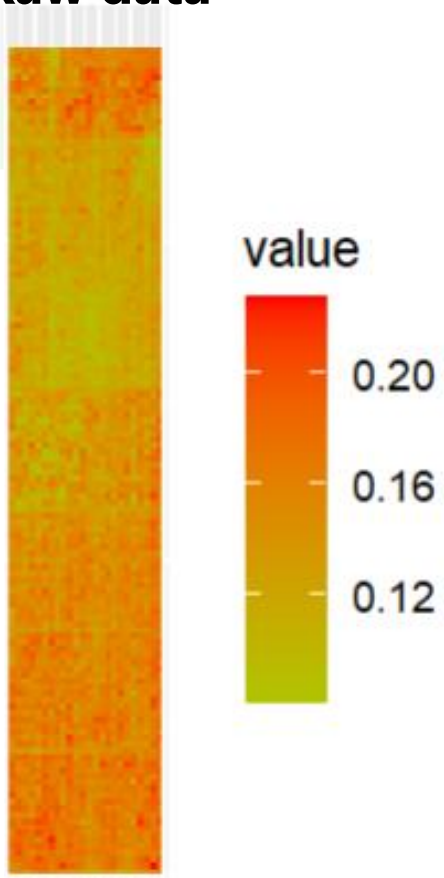
Background

$$Y_i = G_i \times E_i \times M_i + error_i$$



Normalized Excess Green index as example

Raw data



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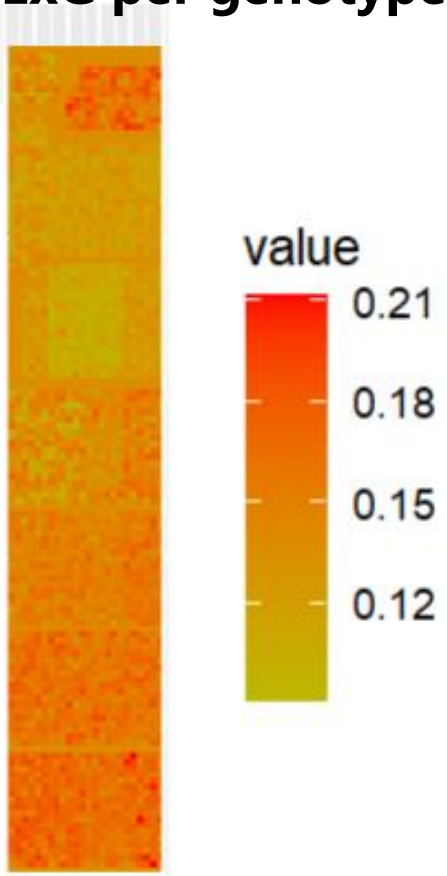
Expected ExG per genotype



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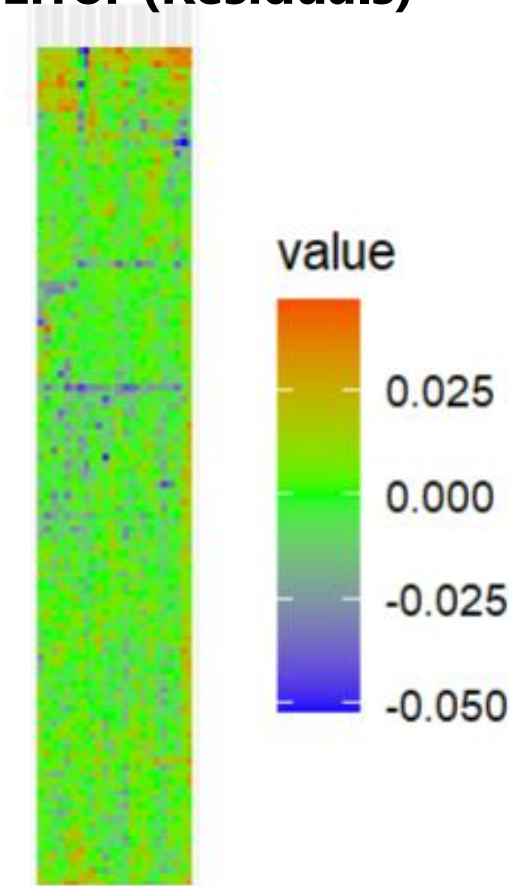
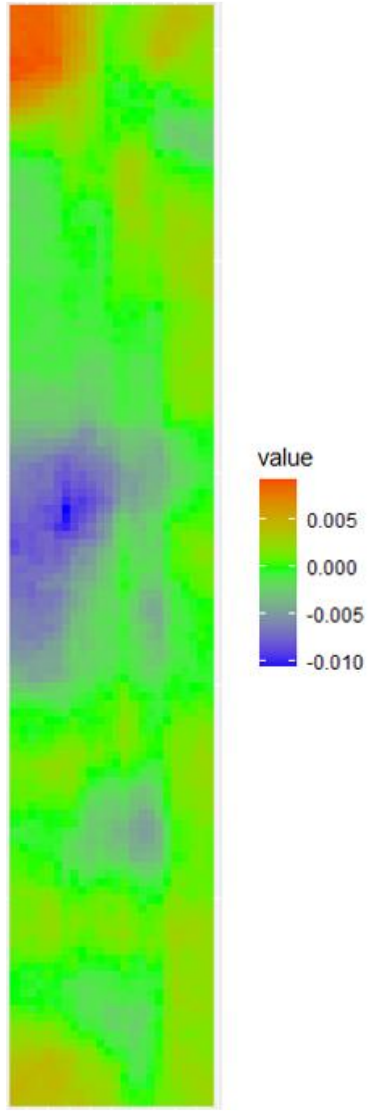
Error (Residuals)



Smoothing the residuals

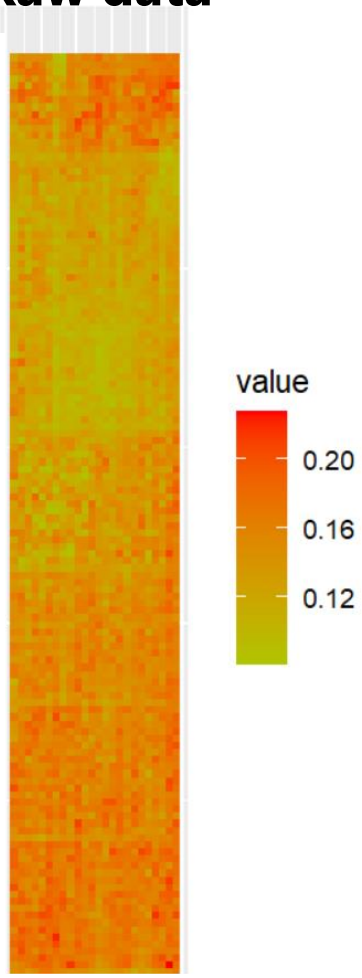
K-nearest neighbours (KNN)

- Locally averaging adjacent subfields
- Requires manually setting the number of neighbours, k
- This approach is sensitive to the border cultivars separating sub-experiments.



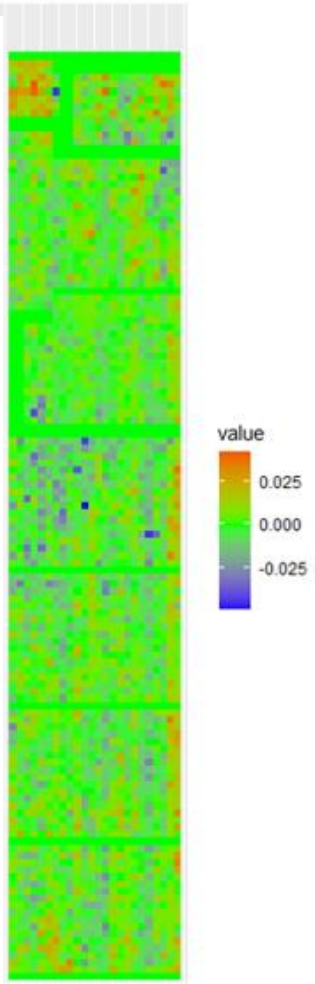
KNN residual smoothing workflow

Raw data



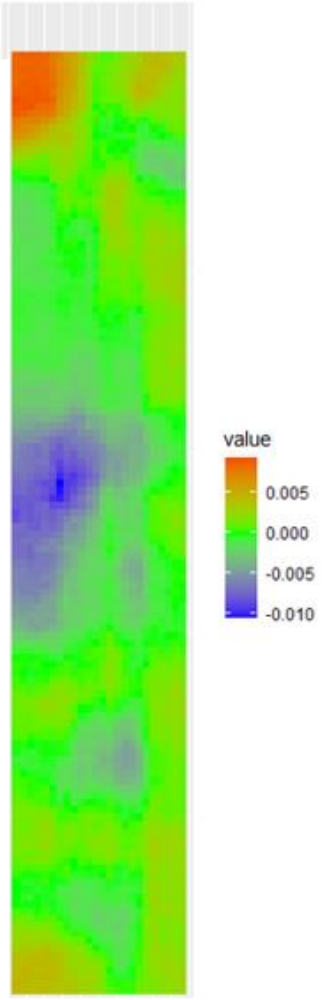
Calculating the residuals

Residuals

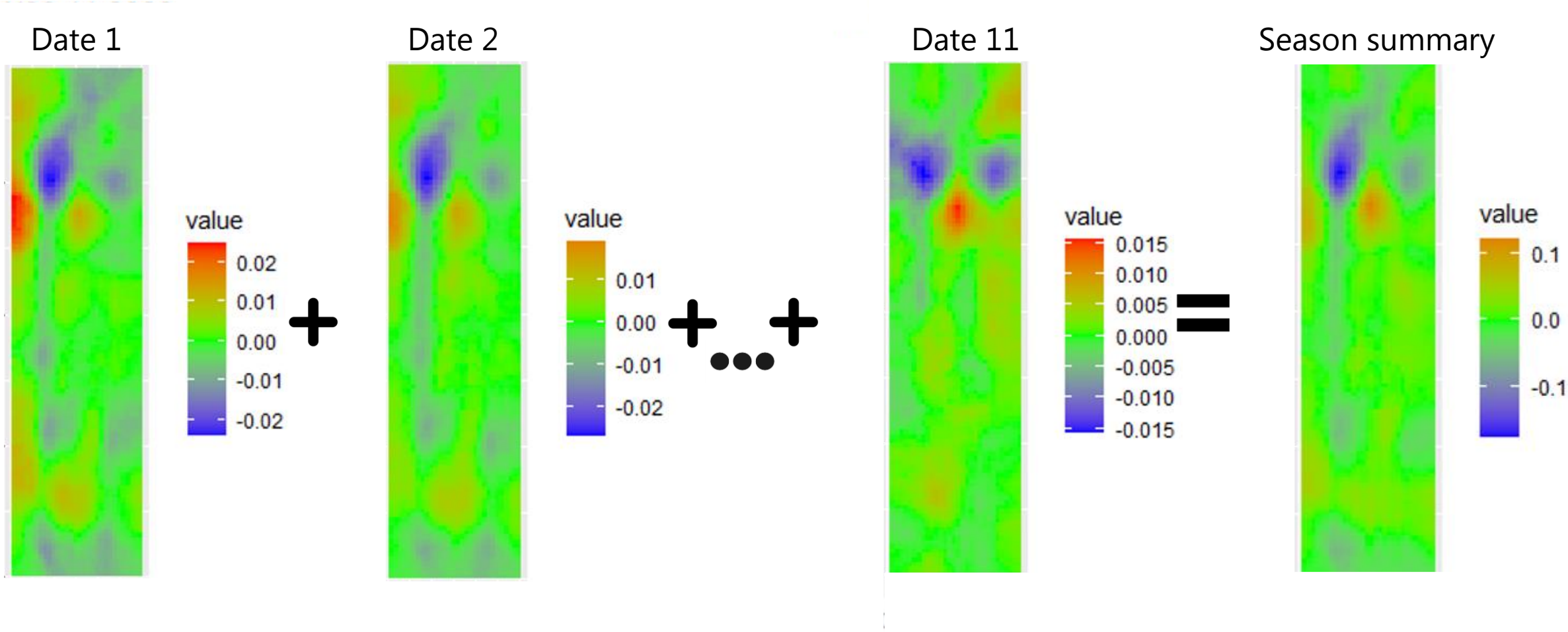


KNN Smoothing

Field characteristics



Field trends over the season



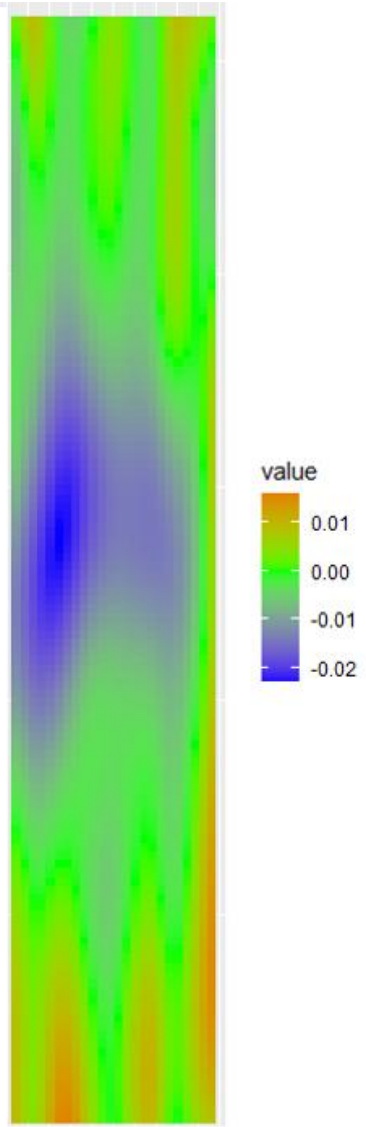
A second approach

- Spatial analysis of a trial using P-splines to model field trends
- 2-dimensional polynomial explicitly modelling spatial dependence within a (complex) mixed model

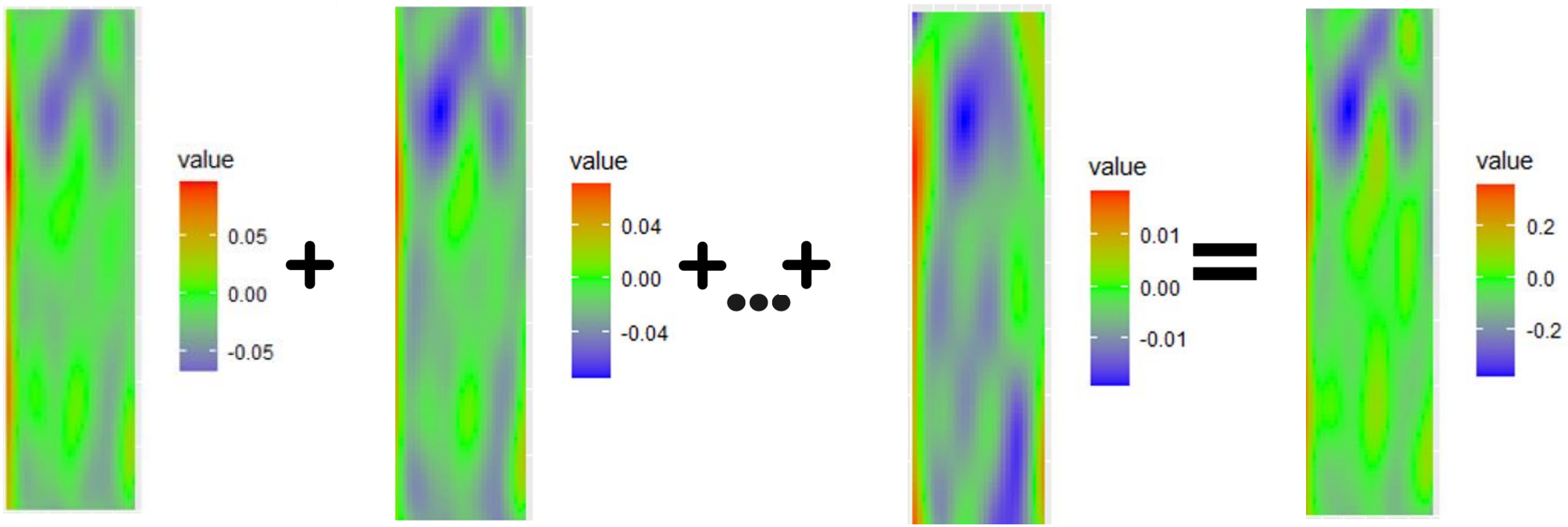
$$\boldsymbol{y} = f\,(\boldsymbol{u}, \boldsymbol{v}) + \boldsymbol{x}_d\beta_d + \boldsymbol{Z}_r\boldsymbol{c}_r + \boldsymbol{Z}_c\boldsymbol{c}_c + \boldsymbol{\varepsilon},$$

- Less sensitive to the border cultivars separating sub-experiments.

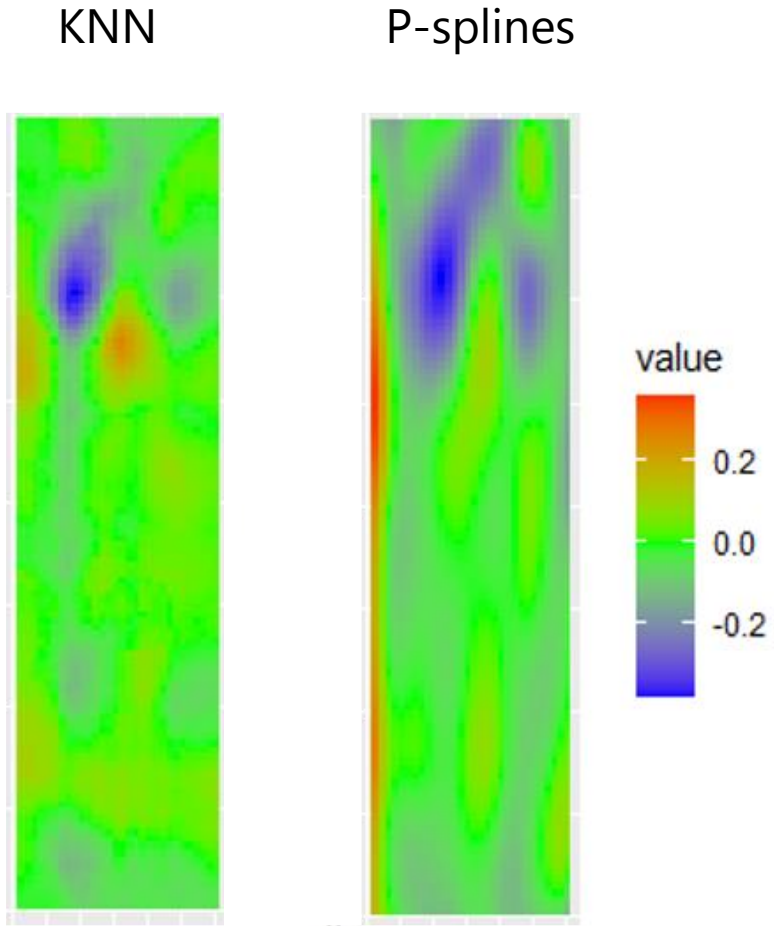
Rodríguez-Álvarez et al. (2018)

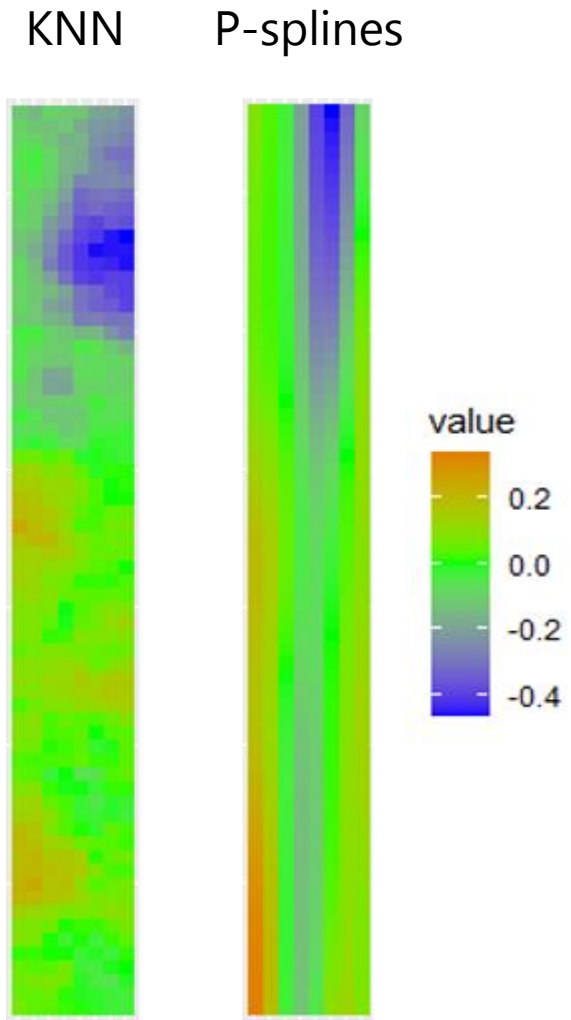


Field trends over the season, P-splines approach



Comparing methods, season summaries

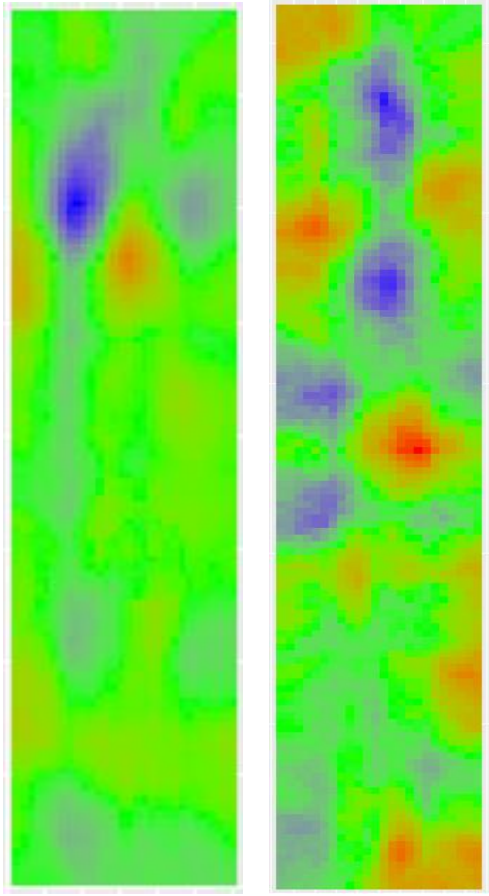




Spatial trends based on yield measurements

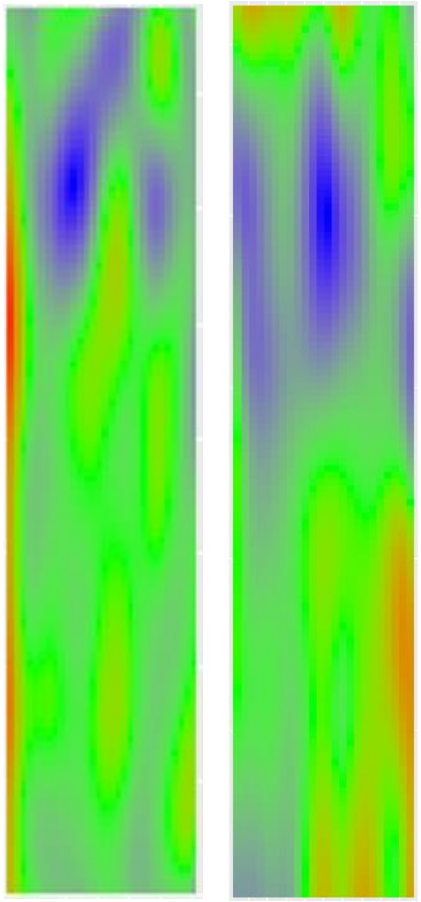
Season ExG summary

Yield



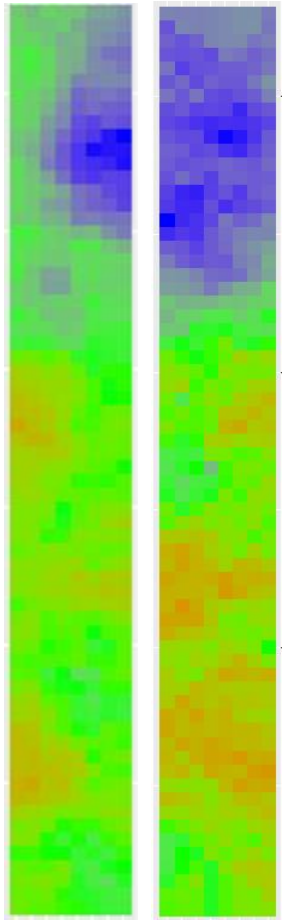
Season ExG summary

Yield



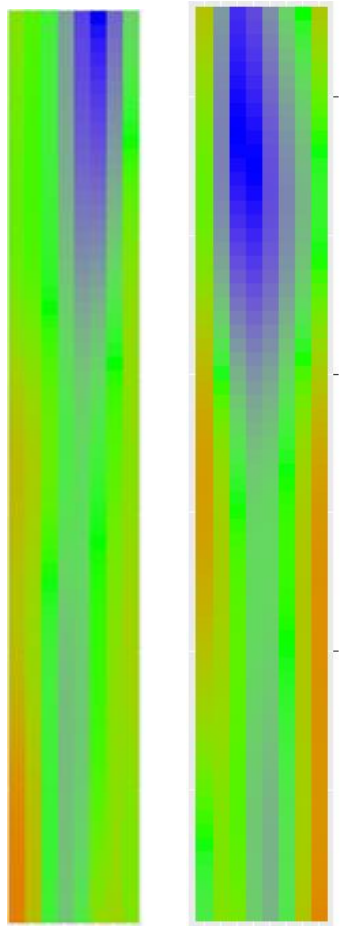
Season ExG summary

Yield

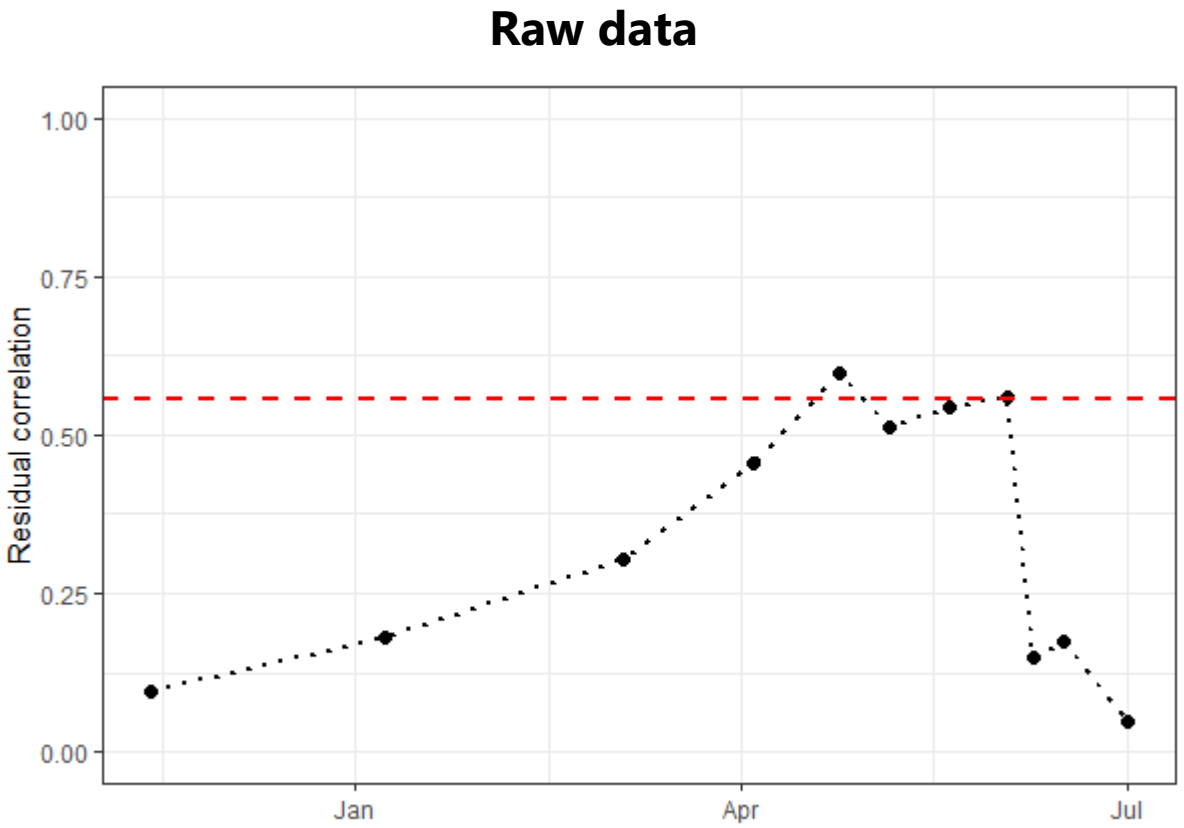


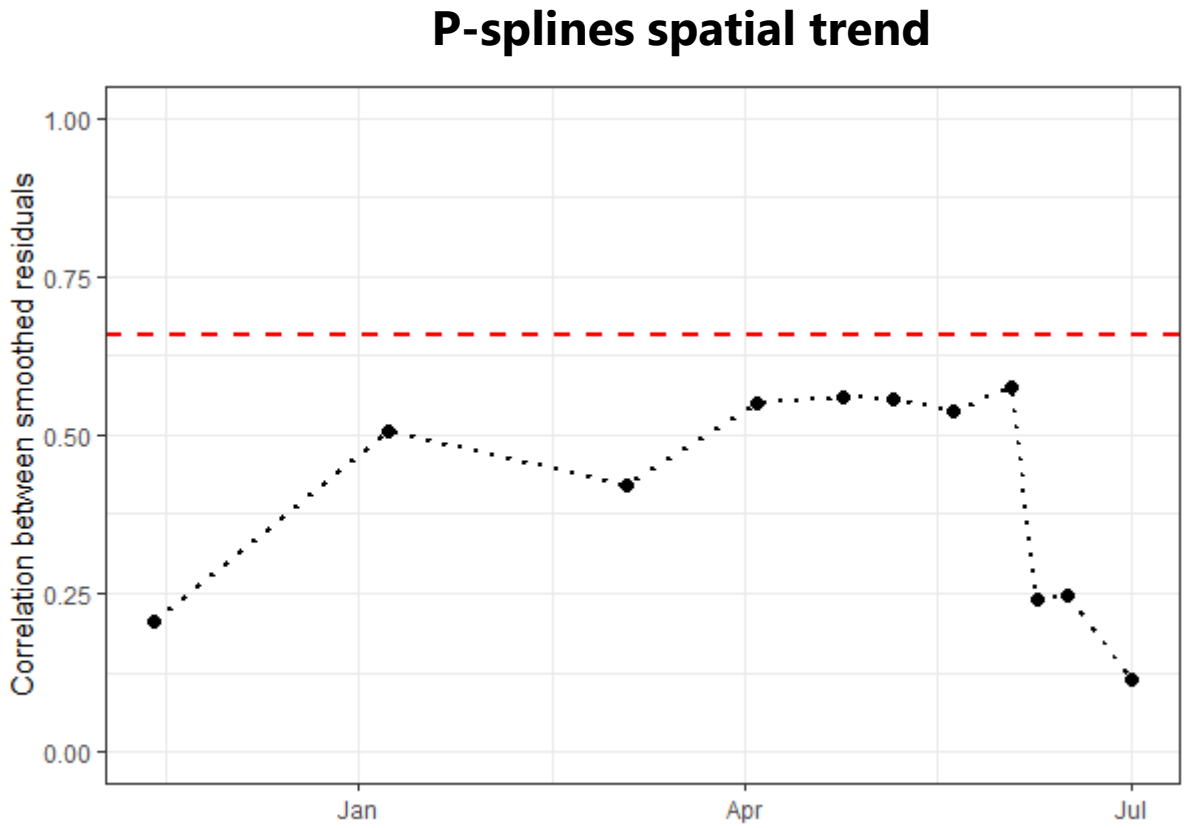
Season ExG summary

Yield

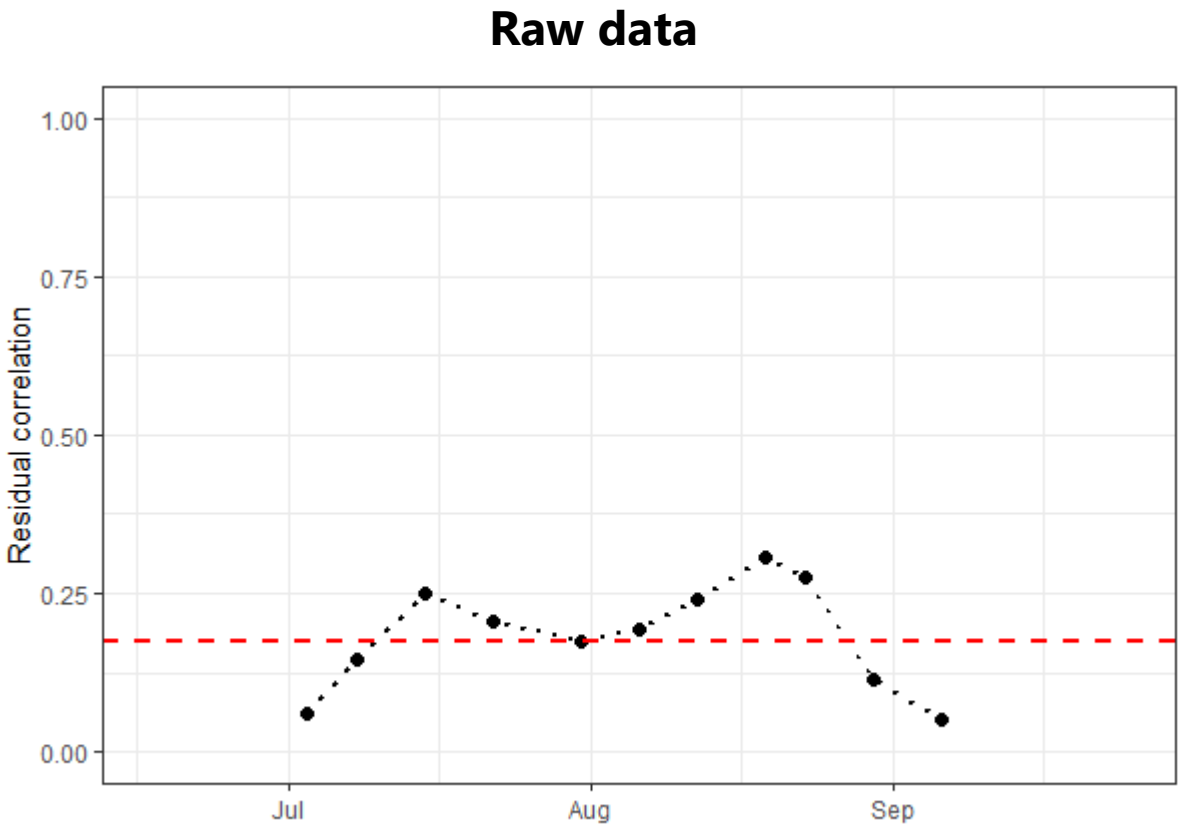


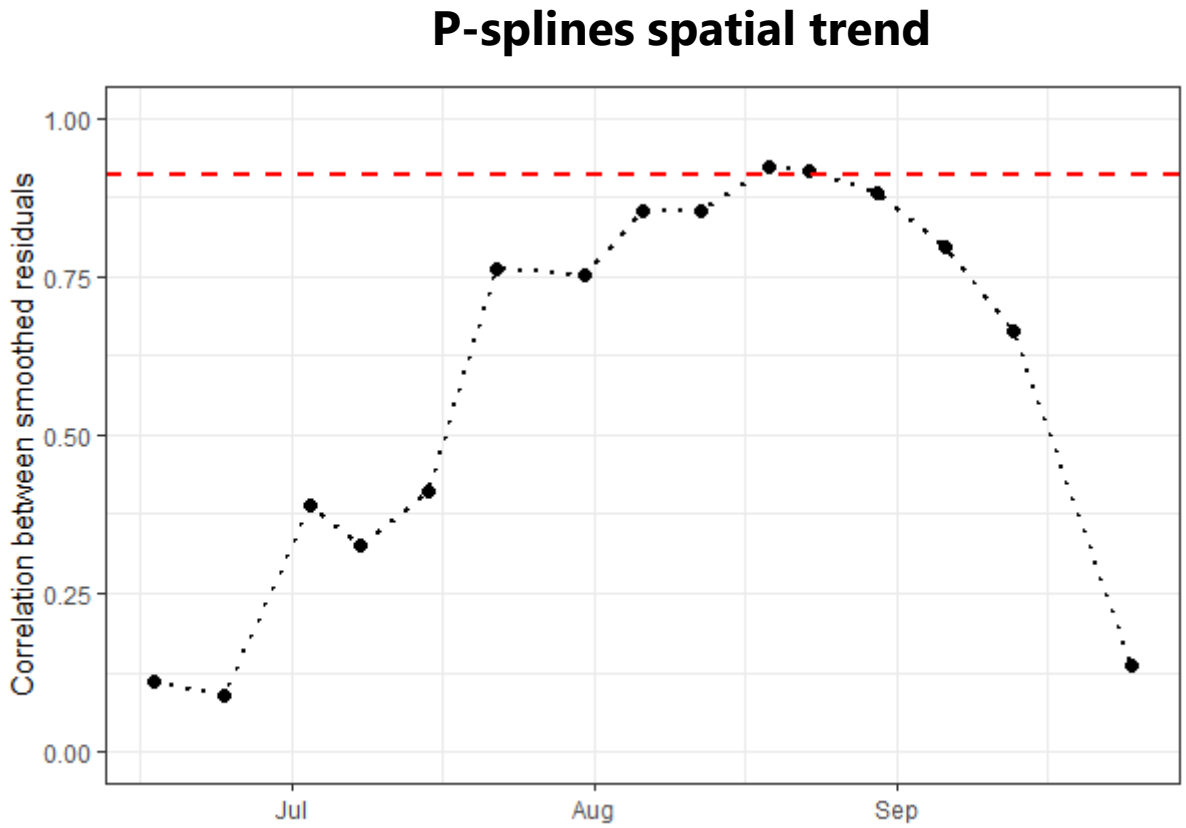
Field trends in ExG vs yield





Field trends in ExG vs yield, another example





Where to go from here

- Design of experiments
- Data analysis
- Build in to PlotCut3

References

- Rodríguez-Álvarez, M. X., Boer, M. P., van Eeuwijk, F. A., & Eilers, P. H. C. (2018). Correcting for spatial heterogeneity in plant breeding experiments with P-splines. *Spatial Statistics*, *23*, 52–71. https://doi.org/10.1016/j.spasta.2017.10.003