Developing Hi-sAFe-machine learning hybrid approach as a field-specific decision support system for agroforestry systems

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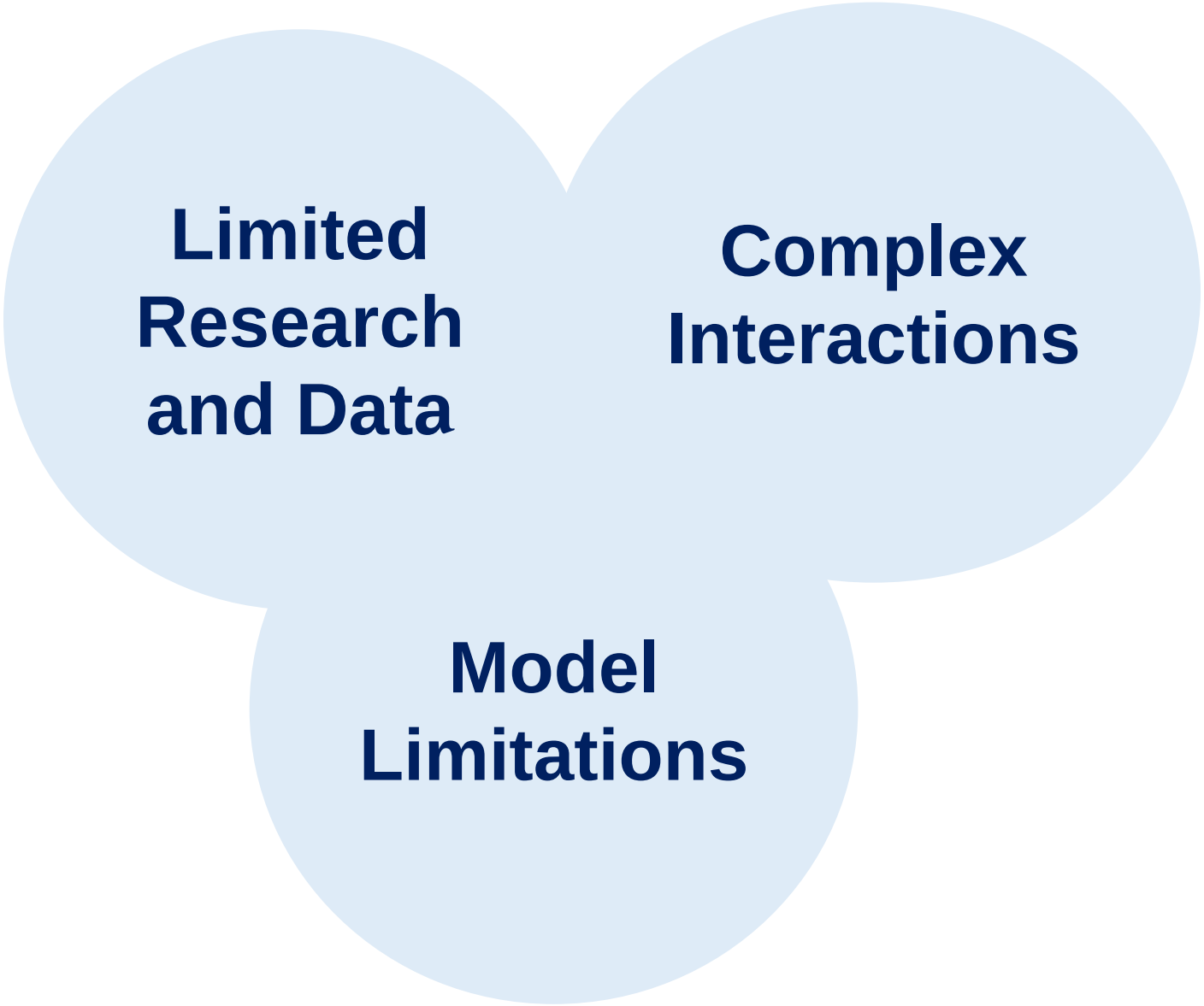
18th Congress of the European Society for Agronomy in Rennes, France

Motivation

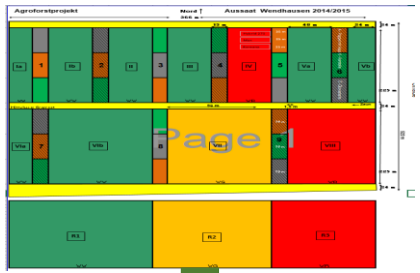
- ✓The need of developing robust AF-DSS to simulate complex interactions of crop and tree growth across seasons
- ✓Hi-sAFe, a new 3D process-based model offering a comprehensive framework, but still has some limitations
- ✓Hybridizing Hi-sAFe with machine learning techniques may help overcome these limitations

Current limitations



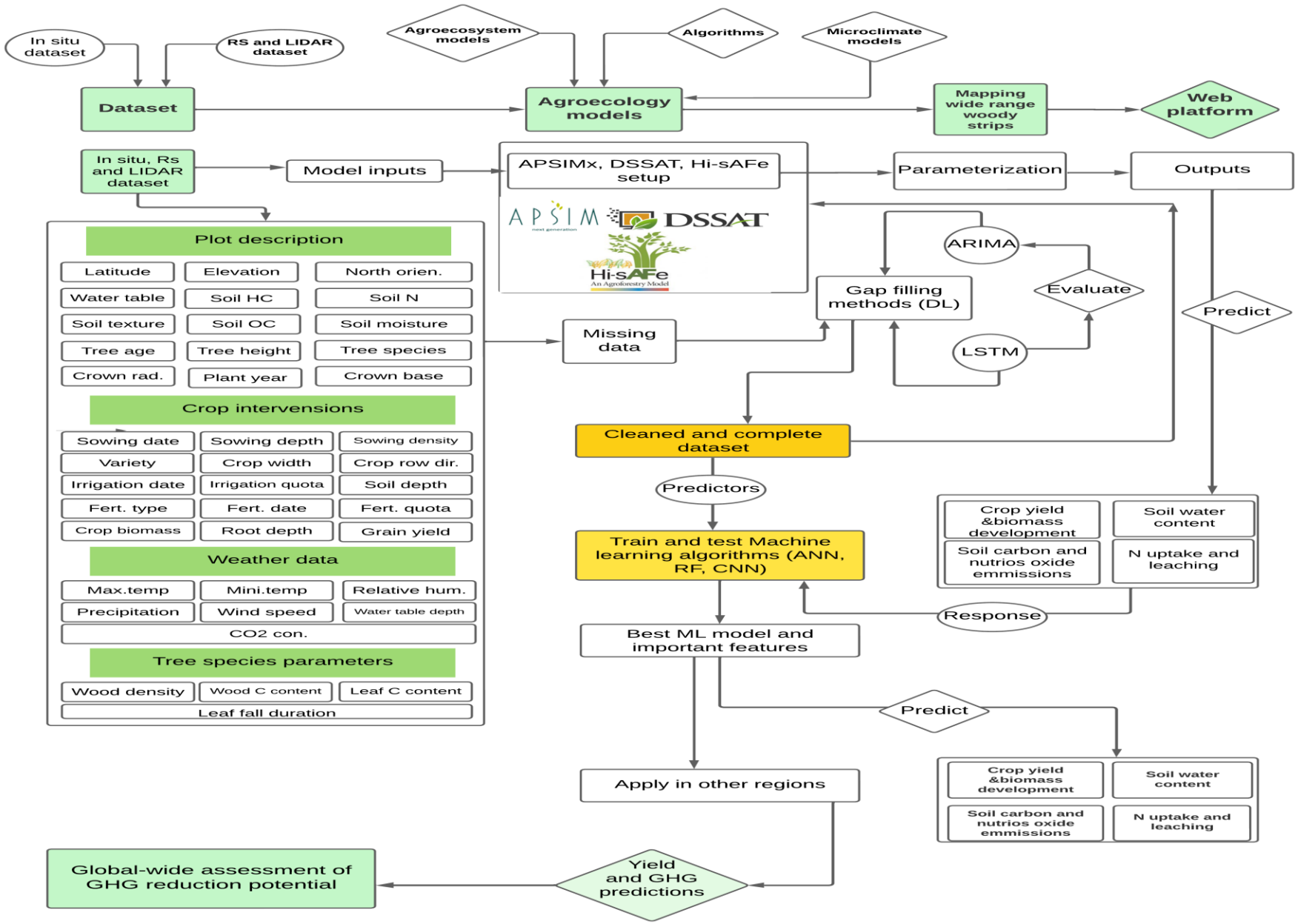
The conceptual approach to solve them

- ✓Using AF diverse dataset from Wendhausen (old and ongoing)
- ✓Parameterizing Hi-sAFe 3D model for AF and MC
- ✓Integrate ML with Hi-sAFe 3D model (hybridization)



Hi-sAFe
An Agroforestry Model

The hybridization approach



Why hybridization?

- ✓Filling the missing data
- ✓Simplifying Hi-sAFe Model optimization and Outputs
- ✓Hybridization can bridge the gaps in Hi-sAFe's current limitations
- ✓Developing microclimate model

Why microclimate model?

- ✓Improved accuracy by capturing fine-scale environmental variations
- ✓Consider the effect of humidity and wind reductions (Hi-sAFe limitation)
- ✓Validate Hi-sAFe microclimate observations (Moisture, ET…)
- ✓The potential of generating microclimate variables from macroclimate stations

The specific challenges

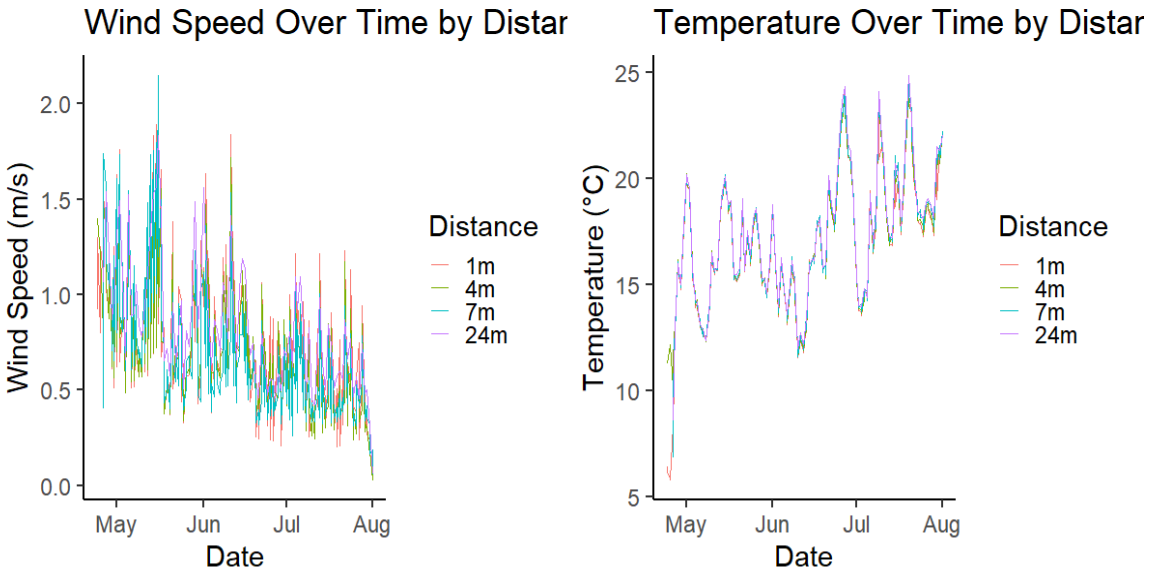
- ✓Collecting high quality and real time AF, MC and microclimate dataset
- ✓Complexity of parameterization
- ✓Integration of Advanced Monitoring Technologies

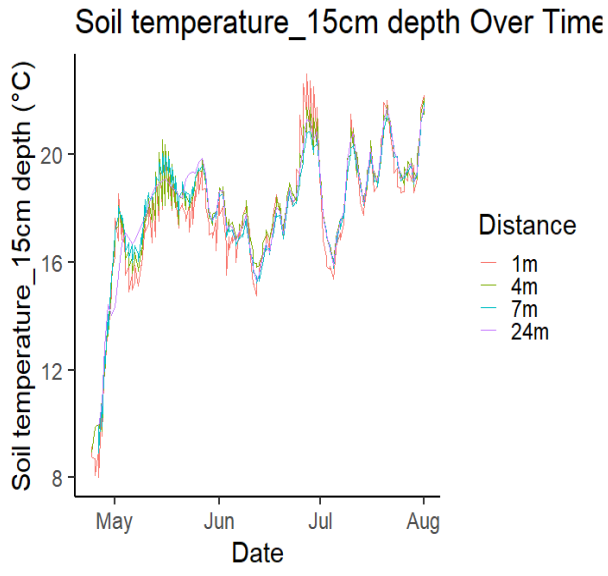
Data is the bottleneck, thus we are very interested to engage with AFS experts and potentially utilize their datasets for improving our AFS models

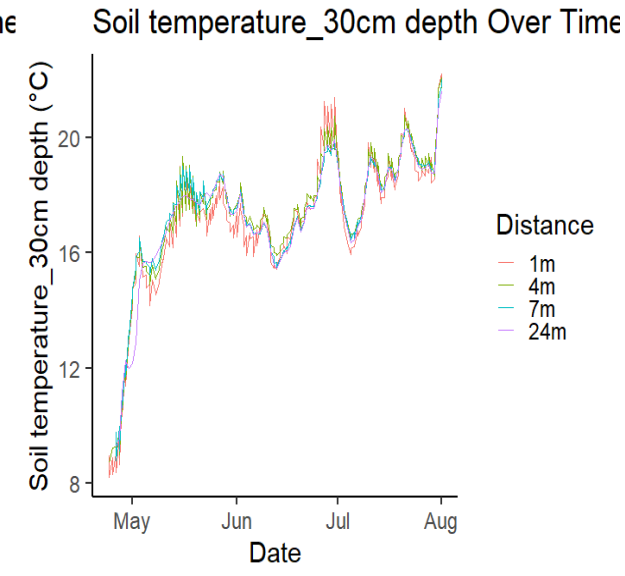
The progress (ongoing AF experiments)

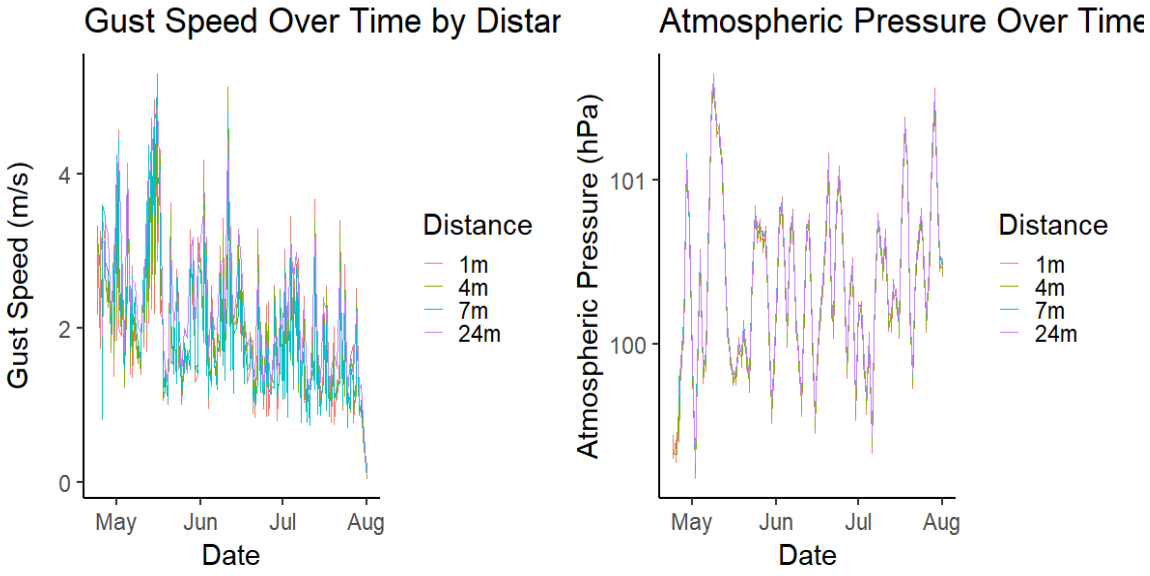
- ✓Parameterizing Hi-sAFe using old and limited dataset from Wendhausen
- ✓Designing and initiating a new AF experiment in Wendhausen
- ✓Installing microclimate sensors at different spaces from tree
- ✓Analyzing real-time dataset from climate sensors

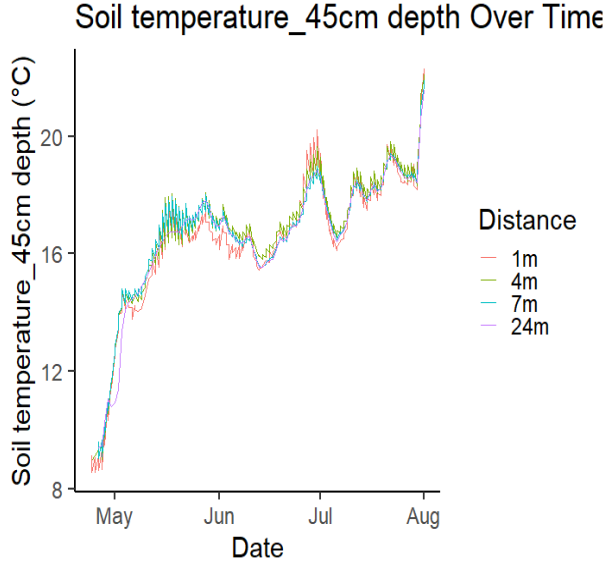
Microclimate Results

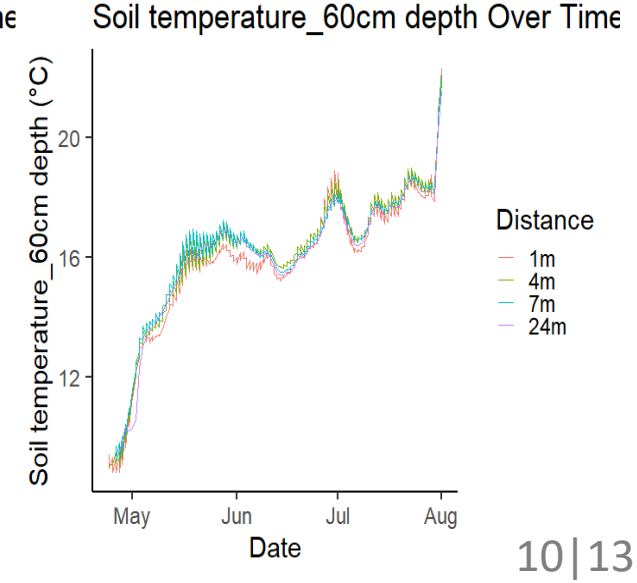




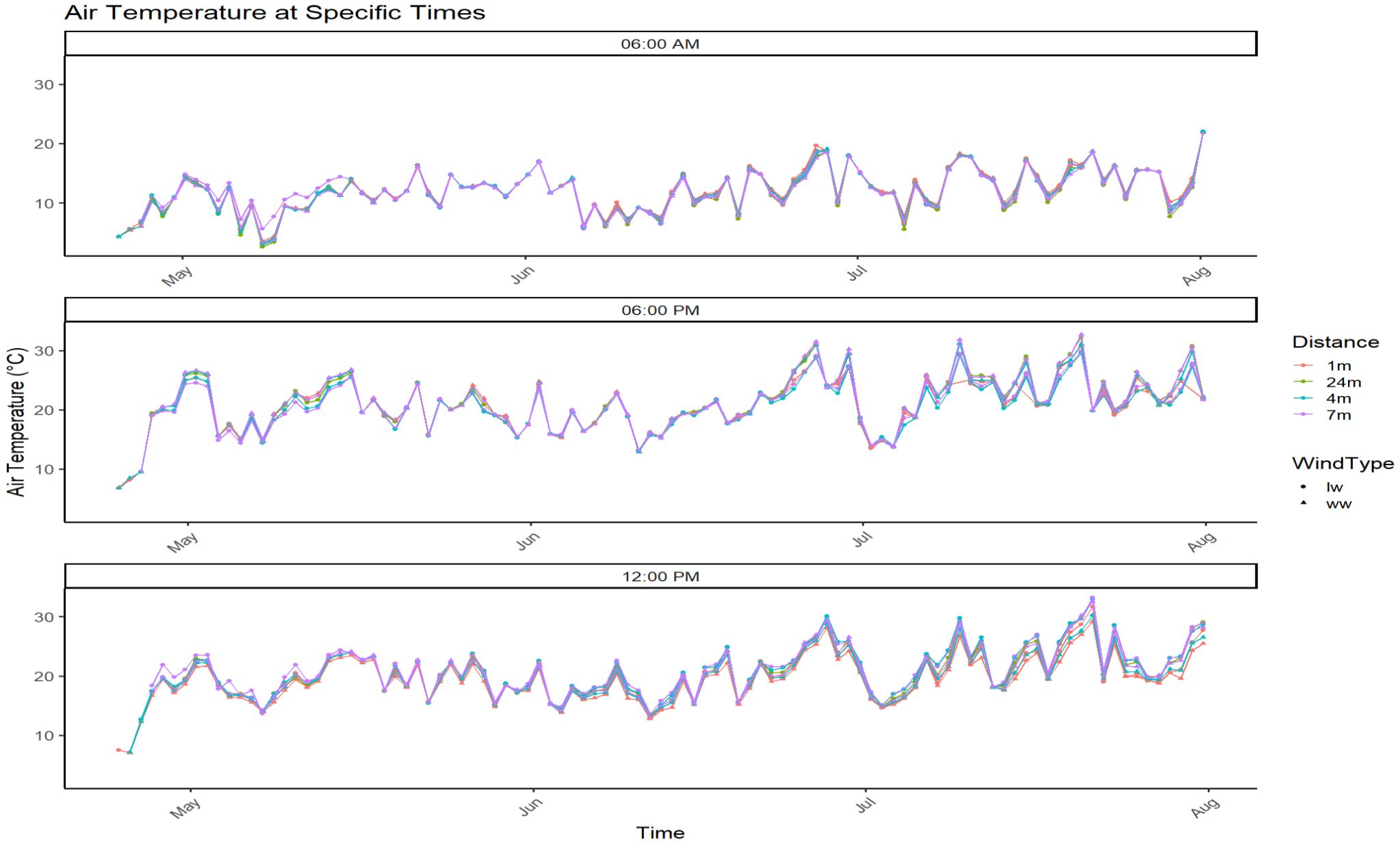




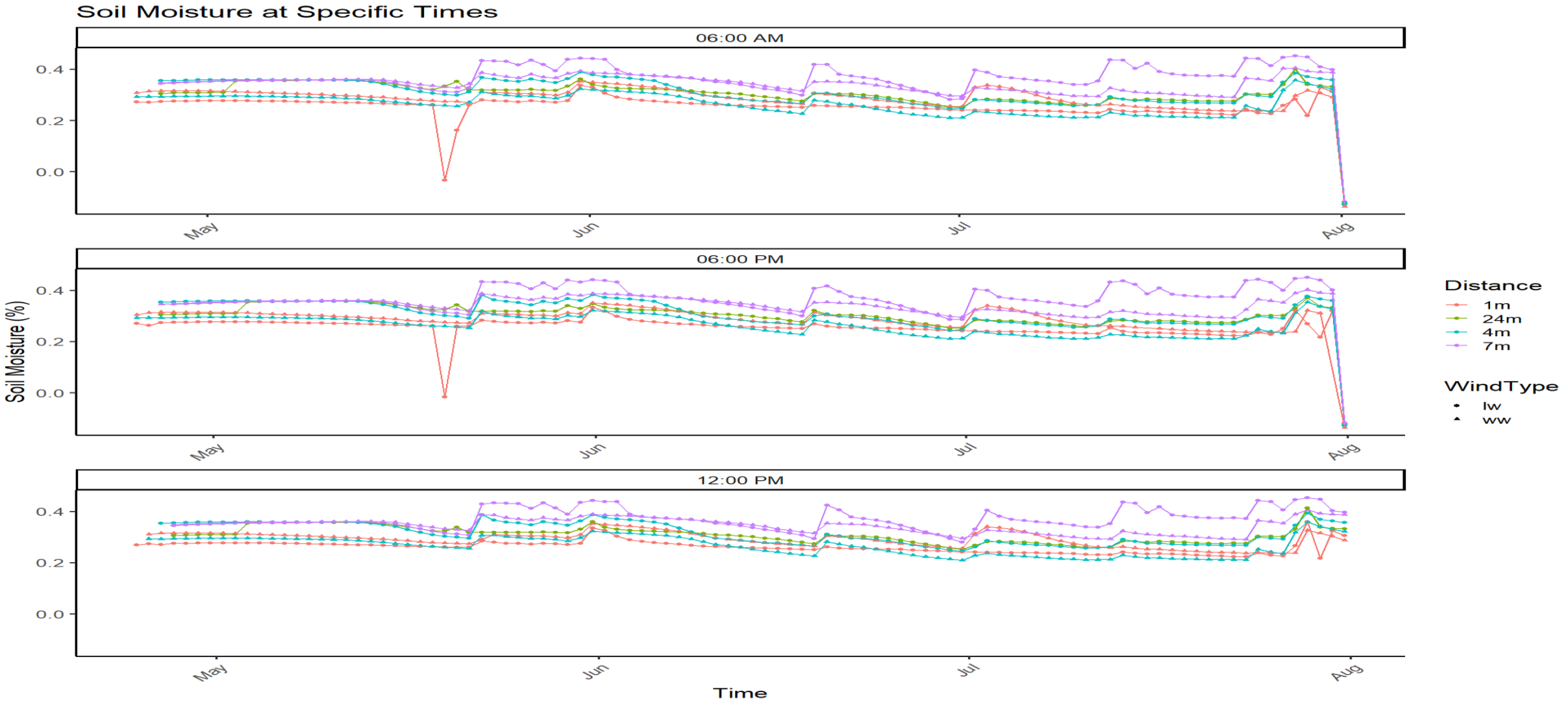




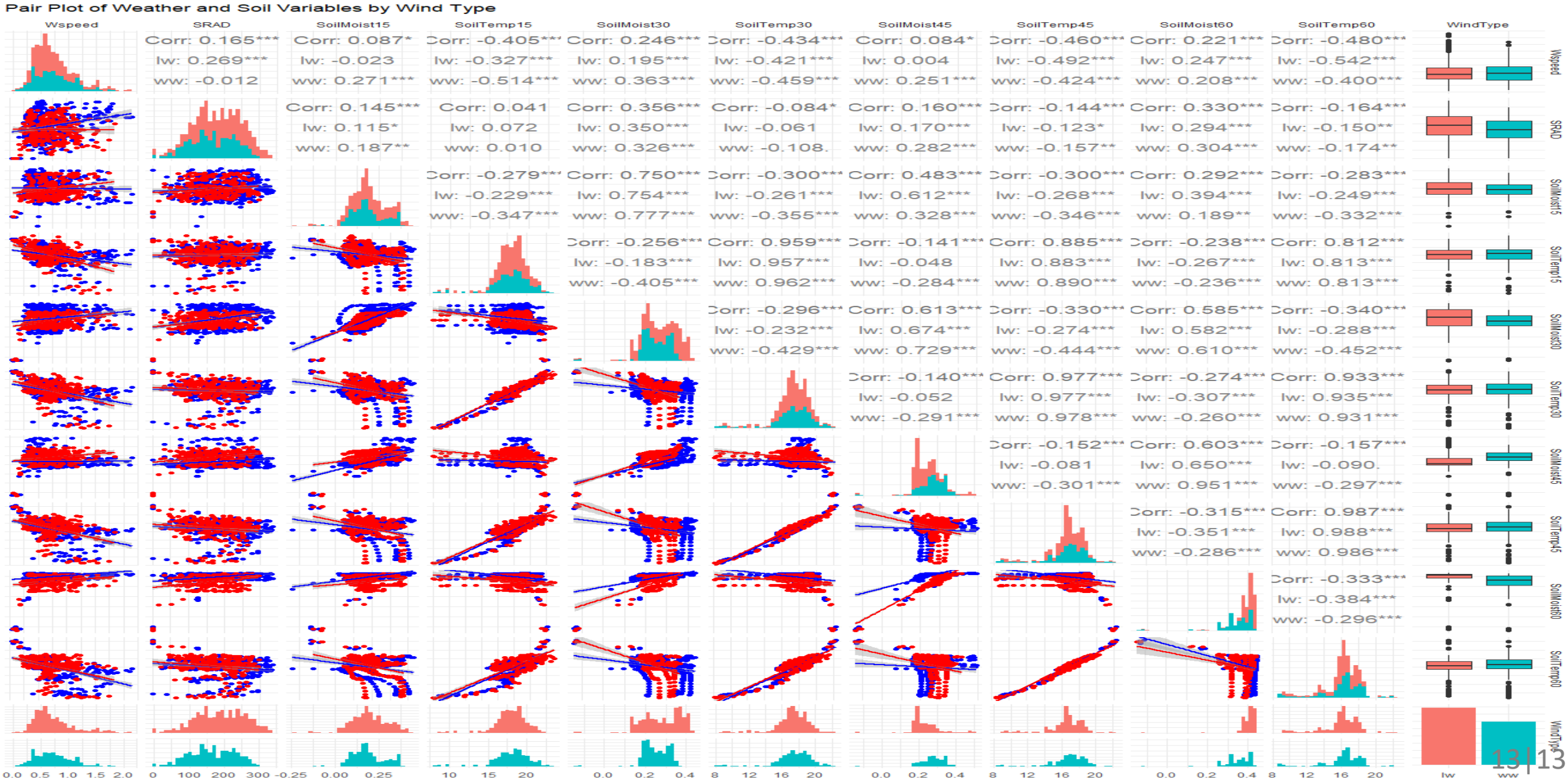
Effects of hourly time, distance and wind



Soil moisture over time



Effect of Wind Type and Distance



Acknowledgments

- ✓ *This research is funded by the German Federal Ministry of Food and Agriculture (BMEL) in the frame of the KlimAF project (FKZ 2822KLI006)*
- ✓ *A special thanks goes to Marie Gosme and the INRA French team members, the developers of Hi-sAFe, for their pioneering work and ongoing support, which has been instrumental in advancing our research and understanding of agroforestry systems.*

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With support from

Federal Ministry of Food and Agriculture

by decision of the German Bundestag

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Any Questions