

Research Group “Data Science and Statistics”

Head: Nikolaus Umlauf (Nikolaus.Umlauf@uibk.ac.at)

Introduction

Data Science and Statistics is nowadays an immensely important part of mastering a wide range of scientific problems, from biological, ecological, economic, medical, physical, psychological etc.

Especially keywords like **big data**, **artificial intelligence** and **machine learning** fall into this research area, but also **software** development and its maintenance are more important than ever.

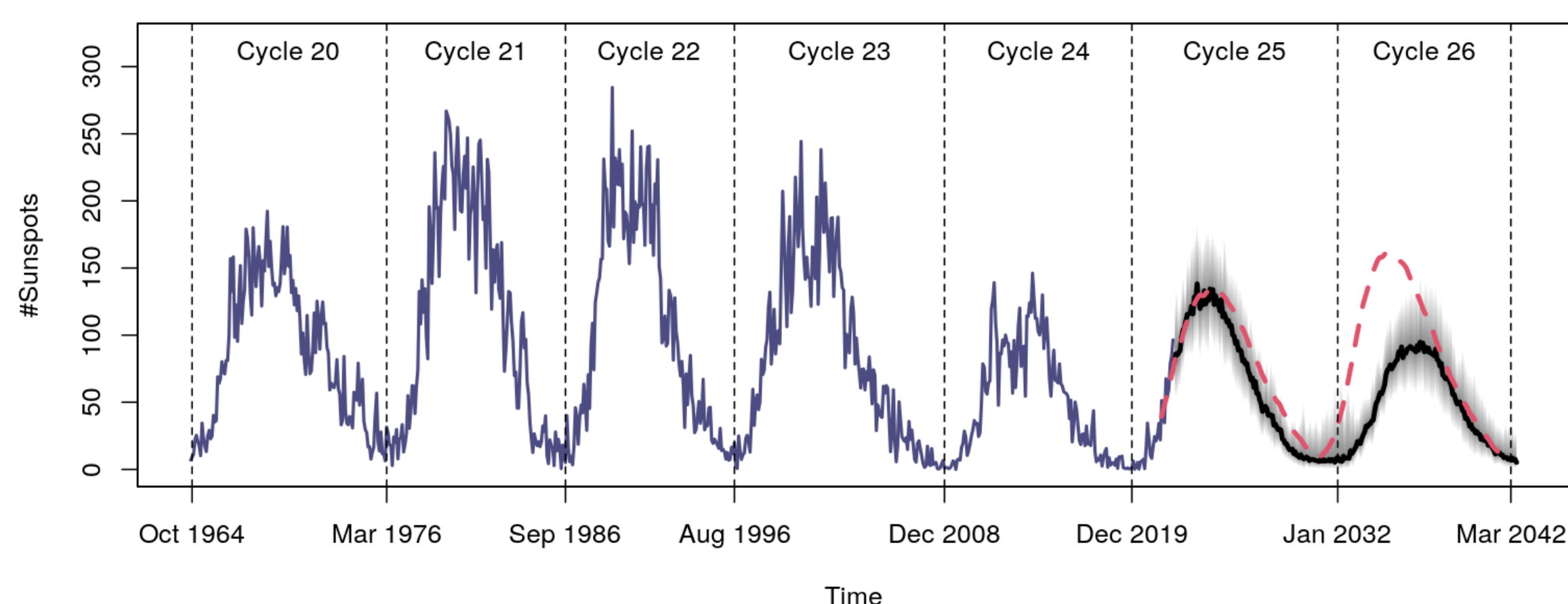
The Data Science and Statistics research group will provide a cross-disciplinary platform to connect all those who want to interact and exchange ideas in this extremely dynamic environment and are interested in collaborative projects, from method development to applications and software.

- A platform for interdisciplinary research collaborations that organizes regular exchanges among members and international researchers.
- Consulting services on all topics related to Data Science and Statistics.
- Organize workshops on the latest developments in this very dynamic field of research.

Selection of Recent Applications

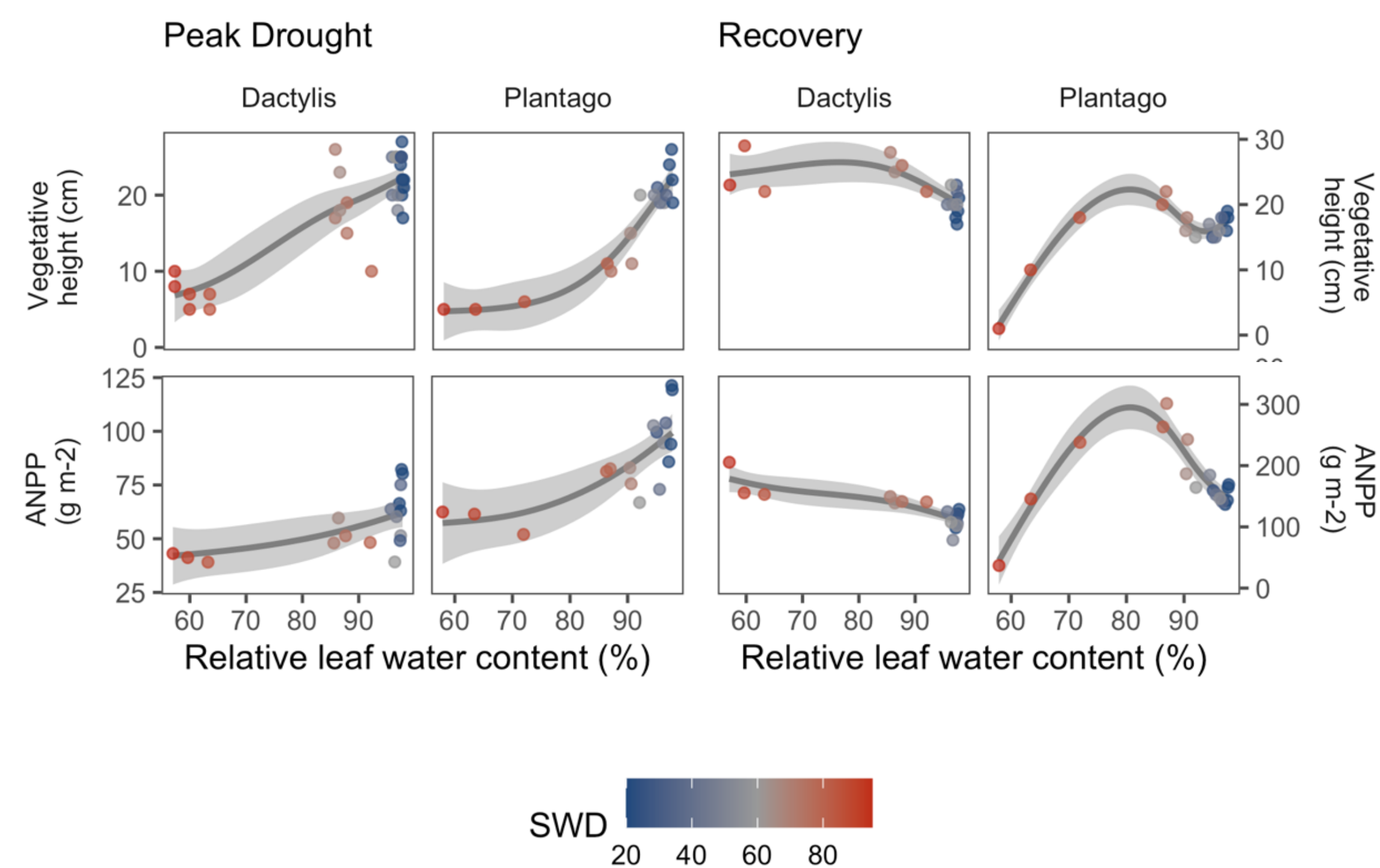
Astrophysics:

State-of-the-Art Machine Learning for Solar Activity Prediction.



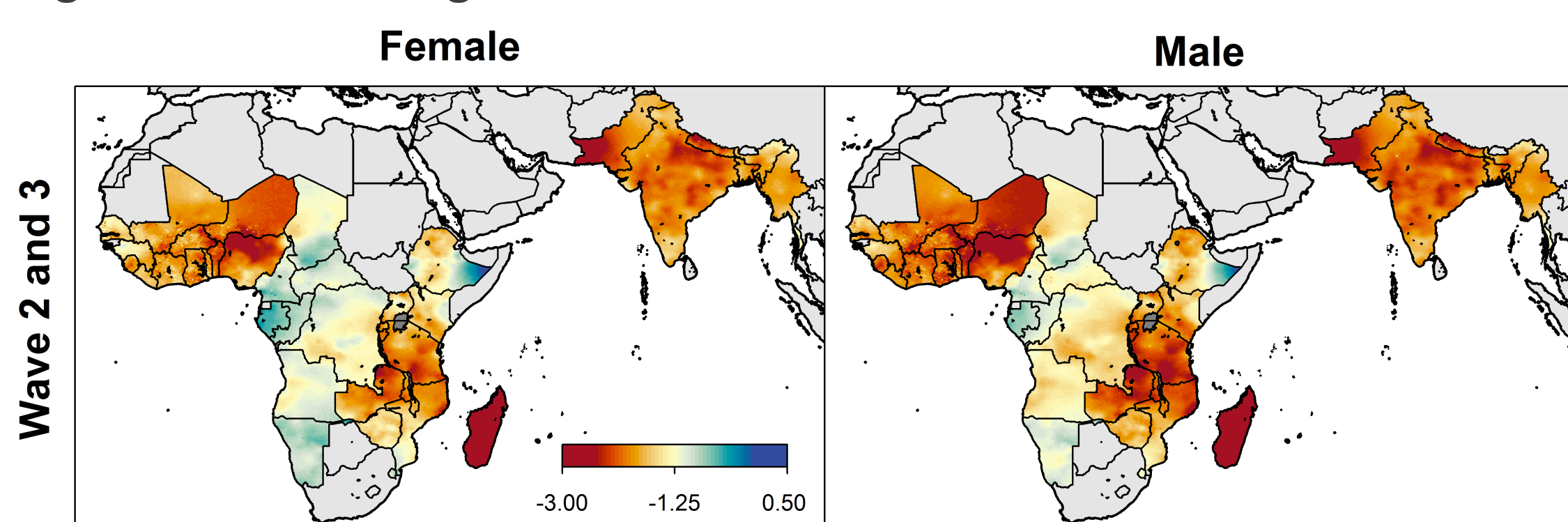
Biology:

Statistical Inference to Explain Plant Resistance and Recovery Relationships.



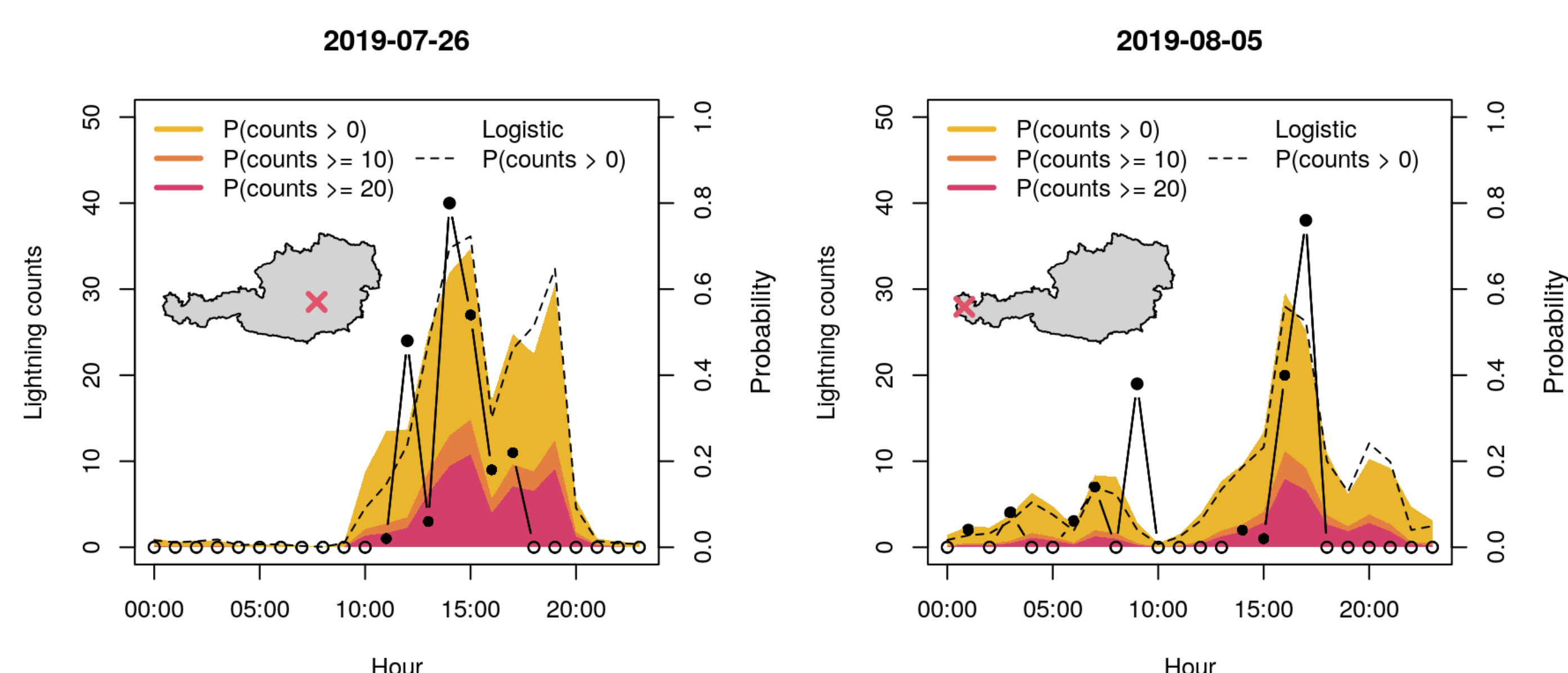
Global Health:

Explaining and Monitoring Childhood Malnutrition and Infectious Diseases.



Meteorology:

Giga Data Probabilistic Forecasting of Lightning Counts.



Software Selection

bamlss:

Umlauf, N., Klein, N., Simon, T., and Zeileis, A. *bamlss*: A Lego toolbox for flexible Bayesian regression (and beyond). *Journal of Statistical Software*, 100(4):1-53, 2021. doi:10.18637/jss.v100.i04, url: <http://bamlss.org/>

BayesX & R2BayesX:

Umlauf, N., Adler, D., Kneib, T., Lang, S., and Zeileis, A. Structured additive regression models: An R interface to *BayesX*. *Journal of Statistical Software*, 63(21):1-46, 2015. doi:10.18637/jss.v063.i21, url: <http://BayesX.org/>

colorspace:

Zeileis, A., Fisher, J.C., Hornik, K., Ihaka, R., McWhite, C.D., Murrell, P., Stauffer, R., Wilke, C.O. *colorspace*: A toolbox for manipulating and assessing colors and palettes. *Journal of Statistical Software*, 96(1), 1-49, 2020. doi:10.18637/jss.v096.i01, url: <https://hclwizard.org/>

exams:

Zeileis, A., Umlauf, N., and Leisch, F. Flexible generation of e-learning exams in R: Moodle quizzes, OLAT assessments, and beyond. *Journal of Statistical Software*, 58(1):1-36, 2014. doi:10.18637/jss.v058.i01, url: <https://www.r-exams.org/>

partykit:

Hothorn, T., Zeileis, A. *partykit*: A modular toolkit for recursive partytioning in R. *Journal of Machine Learning Research*, 16, 3905-3909, 2015. url: <https://www.jmlr.org/papers/v16/hothorn15a.html>, <http://partykit.r-forge.r-project.org/partykit/>

Collaborations

Selection of Recent Publications:

- Ehrensperger, G., Hell, T., Mayr, G.J., Simon, T. Identifying lightning processes in ERA5 soundings with deep learning, 2022. Submitted to *Journal of Advances in Modeling Earth Systems*.
- Umlauf, N., Klein, N. Distributional adaptive soft regression trees, 2022. Submitted to *Journal of Machine Learning Research*. doi:10.48550/ARXIV.2210.10389
- Ingrisch, J., Umlauf, N., Bahn, M. Functional thresholds alter the relationship of plant resistance and recovery to drought. *Ecology* 2022. doi:10.1002/ecy.3907
- Van Passel, J., Keersmaecker, W., Bernardino, P.N., Jing, X., Umlauf, N., Meerbeek, K., and Somers, B. Climatic legacy effects on the drought response of the amazon rainforest. *Global Change Biology*, 2022. doi:10.1111/gcb.16336
- Günther, I., Harttgen, K., Seiler, J. et al. An index of access to essential infrastructure to identify where physical distancing is impossible. *Nat Commun*, 13, 3355, 2022. doi:10.1038/s41467-022-30812-8
- Morgenstern, D., Stucke, I., Simon, T., Mayr, G.J, Zeileis, A. Differentiating lightning in winter and summer with characteristics of the wind field and mass field. *Weather and Climate Dynamics*, 3(1), 361-375, 2022. doi:10.5194/wcd-3-361-2022
- Tutzer, R., Röck, S., Walde, J., Haug, J., Brinkmeier, B., Aufleger, M., Unfer, G., Führer, S., Zeiringer, B. A physical and behavioral barrier for enhancing fish downstream migration at hydropower dams: the flexible FishProtector. *Water* 2022, 14, 378. doi:10.3390/w14030378

Selected Research Projects:

- Umlauf, N., Seiler, J., Lang, S., Harttgen, K. Probabilistic machine learning, FWF. (ongoing)
- Zeileis, A., Mayr, G.J. Cold-season thunderstorms in Europe, FFG. (ongoing)
- Simon, T., Mayr, G.J, Zeileis, A. Multivariate probabilistic forecasting of weather using joint distributional regression, FWF.
- Zeileis, A., Mayr, G.J. Probabilistic nowcasting of wind profiles, FFG.
- Zeileis, A., Mayr, G.J. Forecasting alpine snow amounts for the safety of people, infrastructure and transport, FWF.