

## Master Thesis

### Long-term variability and trends of compound precipitation and wind extreme events in Europe using a large ensemble of regional climate model simulations

#### Description:

Heavy precipitation events causing floods and severe wind gusts related to strong winter cyclones are among the costliest natural hazards in Europe. Typically, both extremes are considered separately not only in meteorological investigations but also from an insurance perspective. Hence, it is evident, that the spatial and/or temporal coincidence of such extreme events might cause even higher damages and losses. While there is a detectable positive trend in precipitation in Europe over the past century, no or at least very weak signals can be found for wind speeds or gusts when treated separately.

Main aim of this study is the analysis of the co-occurrence of precipitation and wind extremes in Europe both in space and time. These compound events should be analyzed in terms of the long-term temporal evolution, the temporal variability, and also from a statistical perspective such as probability of occurrence, recurrence, intensity, etc. The analysis should be complemented investigating the larger scale weather regimes. Cross-correlations should be investigated between the occurrence of compound precipitation-wind-extremes and the underlying dominating weather regime. The possibility of deriving an index describing the “compoundness” should be examined.

For this purpose, the LAERTES-EU regional climate model ensemble should be used and the results should be compared with reanalysis data and/or observations. LAERTES-EU consists of over 12000 simulation years covering the period 1900-2028. It has been demonstrated in the past, that LAERTES-EU is suitable for such kind of statistical analysis showing high significance and robustness. To reduce model uncertainty, a bias-correction needs to be performed on the wind speed and/or gust data. For precipitation, bias-corrected LAERTES-EU data is already available.

Ideally, one major outcome of this study beside the scientific results is a toolbox of easy applicable code to apply the methodology to other climate model data.

#### References:

<https://www.nature.com/articles/s41467-023-37847-5>

<https://www.sciencedirect.com/science/article/pii/S2212094721000165>

<https://rmets.onlinelibrary.wiley.com/doi/10.1002/joc.6829>

#### Contact:

Dr. Alexandre Ramos, [alexandre.ramos@kit.edu](mailto:alexandre.ramos@kit.edu), Dr. Florian Ehmele, [florian.ehmele@kit.edu](mailto:florian.ehmele@kit.edu), Prof. Joaquim Pinto, [joaquim.pinto@kit.edu](mailto:joaquim.pinto@kit.edu)