

Atmospheric rivers as moisture sources for extreme precipitation events

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Research field “Physical climate science: Uncertainties about changes in precipitation in a changing climate”

Research question 2 | Cluster 1

Links to showcases Maraun 1, Kirchengast 1, Steiner 2, Birk 1, Sass 1

Background: Recent work (e.g., Lavers and Villarini, 2013, Waliser and Guan, 2017) has demonstrated the importance of “Atmospheric Rivers” (AR) as moisture sources for extreme precipitation events. ARs—long, narrow filaments of large water vapor transport—are associated with many extreme precipitation events and floodings at extratropical latitudes, including Europe, where they have been shown to penetrate far inland (Lavers and Villarini, 2013). While the integrated water vapor content of ARs can be measured with microwave and infrared sounders, the vertical structure is less well known. We have recently shown (Rieckh et al., 2017) that data from the GPS radio occultation (RO) technique are well suited to determine the vertical structure of water vapor features.

Goal: In this PhD thesis we will examine: (1) How can we improve our knowledge about ARs by combining data from different sources? (2) To what extent do ARs contribute to extreme precipitation in central Europe? (3) Is there a clear connection between ARs and extreme precipitation in Austria? (Such connections have been established for Switzerland and (southern) Germany, but little research has been done for Austria).

Methods and disciplinary background: Ongoing work in our research group (Lucas Oppeneiger, MSc thesis under preparation) demonstrates that GPS RO data can indeed be used to detect ARs—and their vertical structure. We will use different satellite data sets and reanalyses to get a better picture of the global distribution of ARs. Then we will use these data to determine the impact of ARs on extreme precipitation in central Europa, Austria, and the focus-region South East Styria.

References:

- Lavers, D. A., and G. Villarini (2013) The nexus between atmospheric rivers and extreme precipitation across Europe, *Geophys. Res. Lett.*, 40, 3259–3264, DOI:10.1002/grl.50636.
- Waliser, D. and B. Guan (2017) Extreme winds and precipitation during landfall of atmospheric rivers, *Nature Geoscience*, 10, 179–183, DOI:10.1038/ngeo2894
- Rieckh, T., R. Anthes, W. Randel, S.-P. Ho, and U. Foelsche (2017): Tropospheric dry layers in the Tropical Western Pacific: Comparisons of GPS radio occultation with multiple data sets, *Atmospheric Measurement Techniques* 10, 1093–1110. DOI:10.5194/amt-10-1093-2017.