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Sub-seasonal atmospheric predictability: understanding the role of diabatic outflow (SPREADOUT)

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Slower components of the climate system, such as the stratosphere or tropical convection, are potential sources for predictability in the midlatitudes on sub-seasonal time scales of 10-60 days. However, beyond two weeks the skill of current sub-seasonal numerical weather prediction models is generally low. The research project SPREADOUT aims to shed light on how physical and dynamical processes related to synoptic weather systems affect sub-seasonal forecast skill and therefore might hinder exploiting potential sources of predictability.

Large-scale flow patterns, so-called weather regimes, govern the character of weather in the midlatitudes over continent-size regions. In the Atlantic-European region these explain most of the atmospheric variability on sub-seasonal time scales. Many regimes are characterized by blocking anticyclones. Latent heat release in ascending air streams, so-called warm conveyor belts (WCBs), injects air into the upper troposphere. Such diabatic outflow often amplifies the waviness of the jet stream, resulting in ridge building and ultimately in blocking. In this presentation we elucidate the role of diabatic outflow for sub-seasonal predictability of Atlantic-European weather regimes. A specific focus lays on the European Blocking regime, with a pronounced block over western Europe and the North Sea region.

First, we discuss the representation and forecast skill of year-round Atlantic-European weather regimes in 20 years of ensemble reforecast from the Subseasonal-to-Seasonal prediction project data base. Next, we employ the novel AI-based diagnostic “ELIAS 2.0” to identify WCB footprints in the same reforecast dataset. This allows, for the first time, for a systematic evaluation of WCB forecast skill in a NWP model. Interestingly for both, regimes and diabatic WCB outflow, skill vanishes on average already in week 2. We find that European blocking has least skill and show that this is predominantly related to a poor representation of diabatic outflow that helps establishing and maintaining the regime life cycle. Finally we discuss sensitivities of WCB representation to the ensemble configuration and the potential role of WCB activity in establishing teleconnections from remote regions.

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