Understanding Climate Extremes and their impact on the energy sector

As climate change accelerates, extreme weather events increasingly challenge both the resilience of critical infrastructure and the stability of energy systems. This abstract presents two interdisciplinary research projects - EnergAIze, EnergyProtect - that address the impact of adverse weather and climate extremes on renewable energy potential, energy demand, and impact on infrastructure across Austria.

EnergAIze focuses on enhancing the spatial and temporal resolution of climate projections through physics-informed AI, enabling more accurate downscaling of climate and weather data to support energy transition planning. The project aims to generate computationally efficient, high-resolution datasets and ensembles that improve predictions of extremes, which affect both renewable energy availability and efficiency.

EnergyProtect builds on this foundation by identifying present and future hotspots of vulnerability in energy and transport infrastructure. Using machine learning for pattern recognition of extreme events and dynamic downscaling of CMIP6 simulations to convection-permitting scales (~2 km), the project assesses changes in the intensity and frequency of adverse weather. The goal of the generated data and knowledge is to support stakeholders through scenario-based risk assessments and actionable recommendations for adaptation.

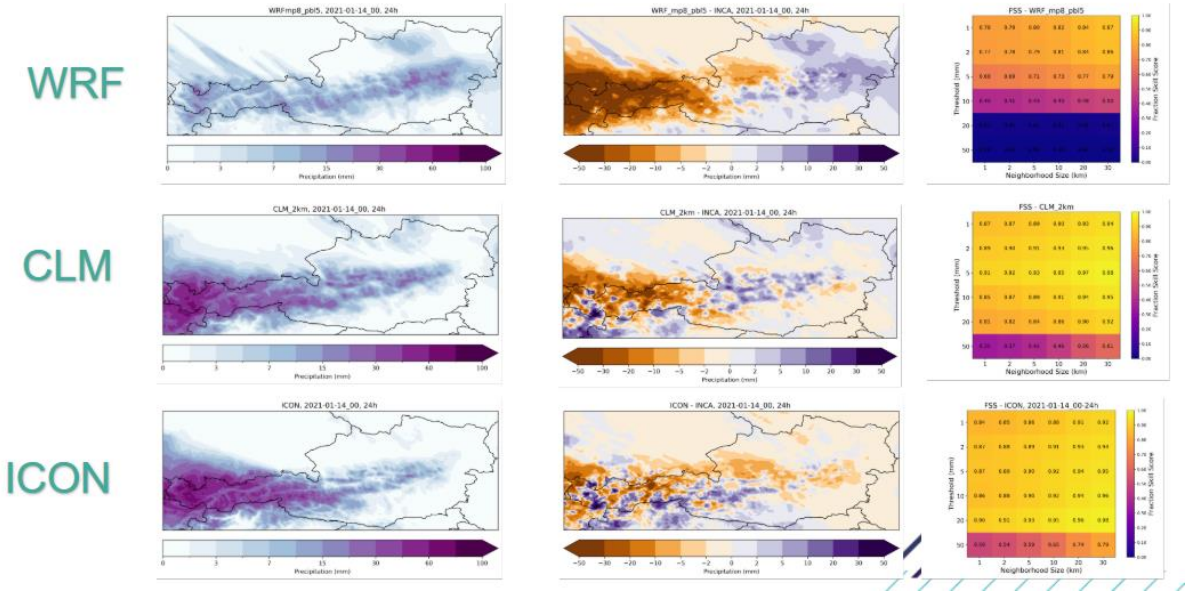

Figure 1: Verification of the applied RCM's for an extreme precipitation event in 2021. Left absolute daily precipitation sum, middle difference to INCA and right FSS score.