



Forecasting Cold Winter Temperatures in Finland with the Aila AI Weather Model

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Advances in data-driven artificial intelligence (AI) weather models are transforming how national meteorological services produce forecasts. The Finnish Meteorological Institute (FMI) has developed Aila, a regional AI model inspired by Met Norway's Bris AI model and built using the Anemoi framework - an open European initiative that integrates machine learning techniques with meteorology. Aila has been trained on 40 years of European Centre for Medium-Range Weather Forecasts (ECMWF) global historical ERA5 reanalysis data and about three years of high-resolution Harmonie analyses over the Scandinavian region, utilizing the computational power of the LUMI supercomputer. The model's graph-based neural network architecture enables enhanced spatial resolution and improved representation of atmospheric processes over Northern Europe.

This study focuses on evaluating Aila's performance during cold winter conditions in Finland, a key challenge for numerical weather prediction models. Prolonged low-temperature episodes are often governed by persistent high-pressure systems and strong temperature inversions that prove difficult to forecast accurately. Using case studies from recent winters, we evaluate Aila's skill in forecasting 2-meter temperatures during cold spells by comparing its predictions against FMI's operational forecast products and observations.

The results demonstrate that the AI-based Aila model achieves competitive accuracy in temperature forecasts during challenging cold weather conditions while providing substantial computational efficiency compared to traditional numerical approaches. Future development efforts will focus on implementing a multi-decoder approach where the Aila model will be fine-tuned using observational data to better capture extreme cold temperatures and improve forecast reliability.