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Spatial covariance functions for the combination of in-situ temperature observations and surface temperature fields from numerical models

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Nowadays the atmospheric state close to the Earth surface is simultaneously observed by several different measuring system and at the same time numerical models simulations cover a wide range of applications from weather prediction to climatological reanalysis.
Given a specific application where the local-scale plays an important role, the combination of in-situ observations with model data to be used as input meteorological forcing might lead to better final results compared to observations or model output taken individually. That's the case for applications such as snow- and hydrological modelling, air pollution modelling or high-resolution climatological studies, just to mention some. Furthermore, the comparison between observations and model outputs might help in setting up automatic quality control routines aimed at identifying suspect observations.

Our objective is the estimation of temperature close to the surface and the work we present is a preliminary step for the combination of in-situ hourly/daily observations and the corresponding model data within a Bayesian statistical theoretical framework, where model data is considered as the prior information.

The in-situ temperature observations are measured by MET Norway's network of meteorological stations. We consider instantaneous temperature -sampled at hourly time intervals- and daily mean temperature.

The model data used as background field comes from two different numerical prediction systems. First, AROME 2.5, which is an high resolution (2.5 Km) numerical weather prediction model operationally available at MET Norway. Second, the Norwegian Reanalysis Archive (NORA10), which is a dynamical downscaling of ERA-40 to a spatial resolution of 10–11 km based on the High-Resolution Limited Area Model (HIRLAM) available at MET Norway.

The Optimal Interpolation scheme constitute a robust and efficient method to combine information provided that the spatial covariance functions for the error matrices are properly modelled. We investigate the spatial covariance functions both for daily and hourly temperature by using three-dimensional analytical correlation functions based on combination of Gaussian functions. In particular, we focus on the estimation of minimum-scale correlation parameters. We will discuss the benefit of this combined approach both on average and for significant case studies, such as in the presence of wintertime thermal inversions.