Using Temporal Variability to Improve Spatial Mapping

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Abstract. Processing massive amounts of spatio-temporal data to provide estimates of the current (hidden) spatial state is challenging, even for the Kalman filter. A large number of spatial locations observed through time quickly leads to an overwhelmingly high-dimensional statistical model. We demonstrate how a spatio-temporal random effects (STRE) component can reduce the model to one of fixed dimension (with a very fast estimation procedure), resulting in a method we call fixed rank filtering (FRF). This is compared to successive, purely spatial predictions based on an analogous spatial random effects (SRE) model, and the value of exploiting temporal dependence to improve spatial prediction is demonstrated. A remote-sensing dataset of aerosol optical depth (AOD) from the Multi-angle Imaging Spectro-Radiometer (MISR) instrument is analyzed using FRF, which results in rapid production of optimal, gap-filled, filtered predictions of AOD values along with their prediction standard errors. This talk presents joint research with Tao Shi and Emily Kang.