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Assimilation of visible data: Experiments with convective-scale NWP

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Observations in the visible range contain a wealth of information which is in many ways complementary to measurements from thermal infrared and microwave sounders. Radiances or reflectances in the visible can see low clouds and fog as well as small scale clouds and also provide data of cloud characteristics themselves. Therefore these data, represent an important data source for assimilation.
Also, for convective-scale NWP, convective precipitation and cloud cover are among the most challenging user-relevant predicted variables. Therefore, given the availability of geostationary imager data at high spatial and temporal resolution, we see great potential for improving the representation of these processes through assimilating visible channels. The aim is to better represent convective situations already at the stage of convective initiation where clouds usually form at low levels and at small scales as well as low cloud situations like winter stratus. Using visible channels for this purpose is enabled through the new fast and accurate forward operator MFASIS (Scheck et. al, 2016), which has recently also been implemented into RTTOV.
The current work is part of the development of a seamless forecasting system with the aim to transition smoothly from observation based nowcasting to short range NWP. Assimilation experiments use the SEVIRI/MSG 0.6 µm channel with the Kilometre scale ENsemble Data Assimilation (KENDA) based on an Local Ensemble Transform Kalman Filter formulation (LETKF, Schraff et. al, 2016). Experiments are done with the COSMO model as well as the new limited area version of ICON (ICON-LAM), currently being implemented at DWD. The focus is on the improvement obtained for cloud cover, precipitation and surface variables. Furthermore, we discuss various assimilation challenges related to vertical localization and ambiguities of the observations, as well as gaussianity of first guess departures and non-linearity of the forward operator.
Additionally to the convective-scale assimilation, visible reflectances are also used with the global ICON model. As a first step, this part of the work focuses on analysing and further improving the MFASIS operator and its RTTOV implementation over the full range of atmospheric situations and on evaluating model clouds using visible channels.

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