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Flow-dependent error covariance matrix determination with a multi-analysis model-perturbed ensemble forecast system.

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A novel methodology to calculate the background error covariance matrix (B) is presented to optimise a 1DVAR system designed for the assimilation of temperature and humidity profiles from SEVIRI radiance observations in the high-resolution limited area model-COSMO.

The error covariance matrix consists of a blend between a constant matrix and spatially localised flow-dependent components. The constant matrix is produced using a standard approach where statistics of model-departures are calculated at different forecast times. The flow-dependent matrices are instead post-processing products of an ensemble forecast system based on multi-model initial and boundary conditions and perturbations of physical parametrizations' parameters. This latter model error contribution is both temporally and spatially variable. The model domain is, in fact, divided into "$islands''$ of uniform error as classified by means of a metric which takes into account both the ensemble spread and the vertical satellite sensitivity. B-matrices calculated over the identified "$islands''$ provide the desirable spatial localisation of model errors. Moreover, the flow-dependency of error structures is ensured by performing this calculation at the beginning of each assimilation cycle.

The positive impact of this new error covariance matrix determination is demonstrated in one-dimensional experiments using both model departure statistics and comparing the final analysis to independent observations from collocated radiosondes. Moreover, a case study three dimensional model integration shows that the inclusion of flow-dependent components in the B-matrix can be important for improving the perfor-

mance of the 1DVAR algorithm and the forecast of precipitation events.