

A nudging procedure to assimilate analyses of cloud and precipitation in a version of HIRLAM.

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Abstract

A nudging procedure is developed which combines a 3-D cloud analysis and a precipitation analysis with a forecast model (HIRLAM) to improve the quality of short range predictions of cloud cover and precipitation.

The method which is based on modifying the tendencies of specific humidity and cloud condensate is general and does not depend on any specific parameterization package. The tendency modification becomes automatically inactive when the model cloud cover and precipitation approach the analysed fields. The assimilation is thought to act on top of an already existing analysis procedure for other parameters, e.g. based on variational data assimilation. In operational practice the assimilation phase may start from such pre-existing analysis. For moisture variables this might be avoided if a new assimilation is starting from a moisture analysis or forecast obtained with the ‘nudging’ scheme.

1-D simulations of both cloud build-up and cloud dissipation show that the scheme works well and shows considerable skill in matching an analysed cloud cover profile. For the scheme to be successful it needs to modify the atmosphere such that the time scale of adjustment is shorter than the time scales to be forecasted. In short range weather prediction this means that significant adjustments must be possible within one hour. The experiments show that the impact of cloud cover modifications for low level clouds is sometimes 18 hours or more in situations with a weak dynamical forcing. For high clouds the lifetime of cloud cover modifications tends to be somewhat shorter. The results for assimilating precipitation intensity also show good fit to a precipitation analysis during the assimilation period.

The first tests on 3-D forecast cases have shown a positive impact on cloud cover (up to about 12 hours in forecast mode for one case) The relative improvements obtained depend on the overall modification of the 3-D structures of the main forecast variables during the assimilation period and on the magnitude of dynamical forcing. Convective situations appear to be particularly difficult because of the fast development of clouds. The nudging scheme and the preliminary experience have been documented (Sass and Petersen, 2002).

References

Sass, B. and Petersen, C. (2002). Short range atmospheric forecasts using a nudging procedure to combine analyses of cloud and precipitation with a numerical forecast model. *DMI Sci. Rep. 02-01*, pages 1–37.