

NWPSAF 1D-Var User Manual

Peter Weston, Met Office, Exeter, UK

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This software and documentation was developed within the context of the EUMETSAT satellite Application Facility (NWP SAF). The partners in the NWP SAF are the Met Office, ECMWF, KNMI, and Météo-France.

Appendix C. Cloudy Retrievals

If the parameters `Cloud_Top_Pressure` and `Cloud_Fraction` are requested to be retrieved in the [Retrievals.NL](#) namelist, the 1DVar retrieval performed is slightly different. In this case the internal logical variable `CloudyRetrieval` is set to `.TRUE.` Note that this cloud retrieval is using the simple, grey cloud approximations that have been present in all versions of RTTOV and not the later RTTOVCLD code. RTTOVCLD has not been implemented in this 1DVar code as yet.

The differences in processing when cloudy retrievals are used are:

- B-matrix elements for cloud top pressure and cloud fraction are not required, whereas for any other parameter a corresponding B-matrix element is mandatory. If these B-matrix elements are missing, the cloud top pressure and cloud fraction elements are large, i.e., there is no *a priori* knowledge of these parameters.
- A minimum residual cloud parameter retrieval step is used to improve the first guess cloud top pressure and cloud fraction. This is a simple method with no *a priori* information considered and no channel weighting (e.g., due to observational error differences). The method is described in Eyre and Menzel (QJRMS **28**, p267-275, 1989). The channels specified for [cloud detection](#) are used here (there is no cloud detection if clouds are being retrieved).
- An additional cost function term is available to ensure (without imposing hard limits) that the cloud parameters do not go beyond their physically reasonable limits. This is done through the [NWPSAF_AdditionalCost_Cloud](#) subroutine. The form of the additional cost function value is proportional to the cube of the amount by which the retrieved value exceeds the boundary (appropriately scaled for cloud fraction).

It is recommended that Marquardt-Levenberg minimisation is used for cloudy retrievals.

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