NWP SAF

NWPSAF 1D-Var
Product Specification

Version 1.0

22nd August 2014

NWP SAF 1D-Var Product Specification

This documentation was developed within the context of the EUMETSAT Satellite Application Facility on Numerical Weather Prediction (NWP SAF), under the Cooperation Agreement dated 29 June 2011, between EUMETSAT and the Met Office, UK, by one or more partners within the NWP SAF. The partners in the NWP SAF are the Met Office, ECMWF, KNMI and Météo France.

Change record			
Version	Date	Author/changed by	Remarks
0.1	17/02/14	P. Weston	First version, based on the Met Office 1D-Var product specification
0.2	21/05/14	P. Weston	Modified after testing of NWPSAF 1D-Var v1.0 beta
0.3	22/05/14	P. Weston	Updated following comments from S. Keogh
0.4	29/05/14	P. Weston	Updated with new header, new document ID, new copyright statement and changed font following comments from B. Conway
0.5	13/06/14	P. Weston	Updated following comments from D. Faucher
1.0	22/08/14	P. Weston	Version valid for NWPSAF 1D-Var v1.0

Table of Contents

1   INTRODUCTION

This document defines the specification for version 1.0 of the NWPSAF 1DVar (one dimensional variational analysis) scheme, in accordance with the requirements of the NWPSAF. The Product Specification describes the deliverable from the point of view of the user.

2   PURPOSE

The NWPSAF 1DVar scheme is a stand-alone retrieval package for nadir-viewing passive sounding satellite instruments. The code contains the merged capabilities of the previously supported Met Office, SSMIS and ECMWF 1DVar schemes. It is reasonably flexible and may be used with many different sounding instruments with minimal changes.

The philosophy behind the development of this code is to produce a flexible, stand-alone 1DVar retrieval system that may be used for a wide variety of situations. It is anticipated that users may want to remove routines that are superfluous to their requirements (or alternatively simply take selected routines) before using this code.

3   FUNCTIONALITY

The aim of this deliverable is to produce retrieved atmospheric states based on the following inputs:

- Observed satellite radiances from the ATOVS, ATMS, AIRS, IASI, CrIS or SSMIS instruments and their associated error covariances
- Background (a priori) atmospheric state (one per observation or one for all observations) and associated error covariances

Also required is a user supplied radiative transfer model. RTTOV (versions 7, 8.7, 9.3, 10.2 and 11.1), Gastropod and RTIASI are supported by default.

The atmospheric parameters that may be retrieved are limited by whether a suitable background and error covariances are available and whether the parameter is supported by the radiative transfer model.

Figures 1 and 2 overleaf illustrate the functionality of the package.
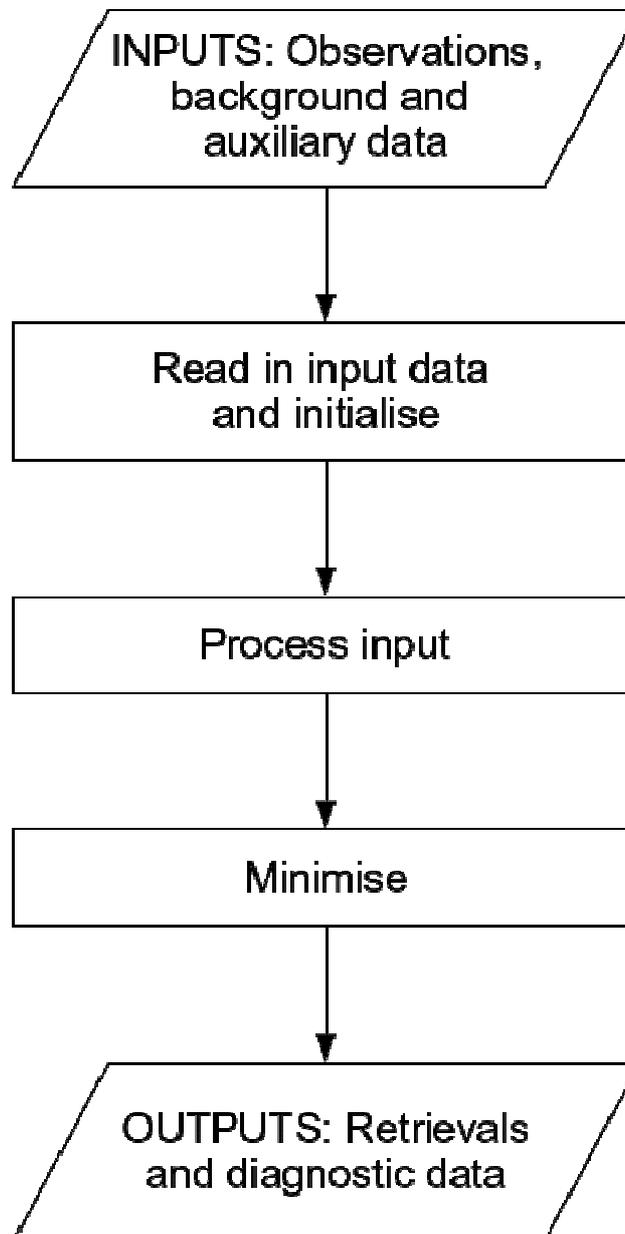
Figure 1: Overview
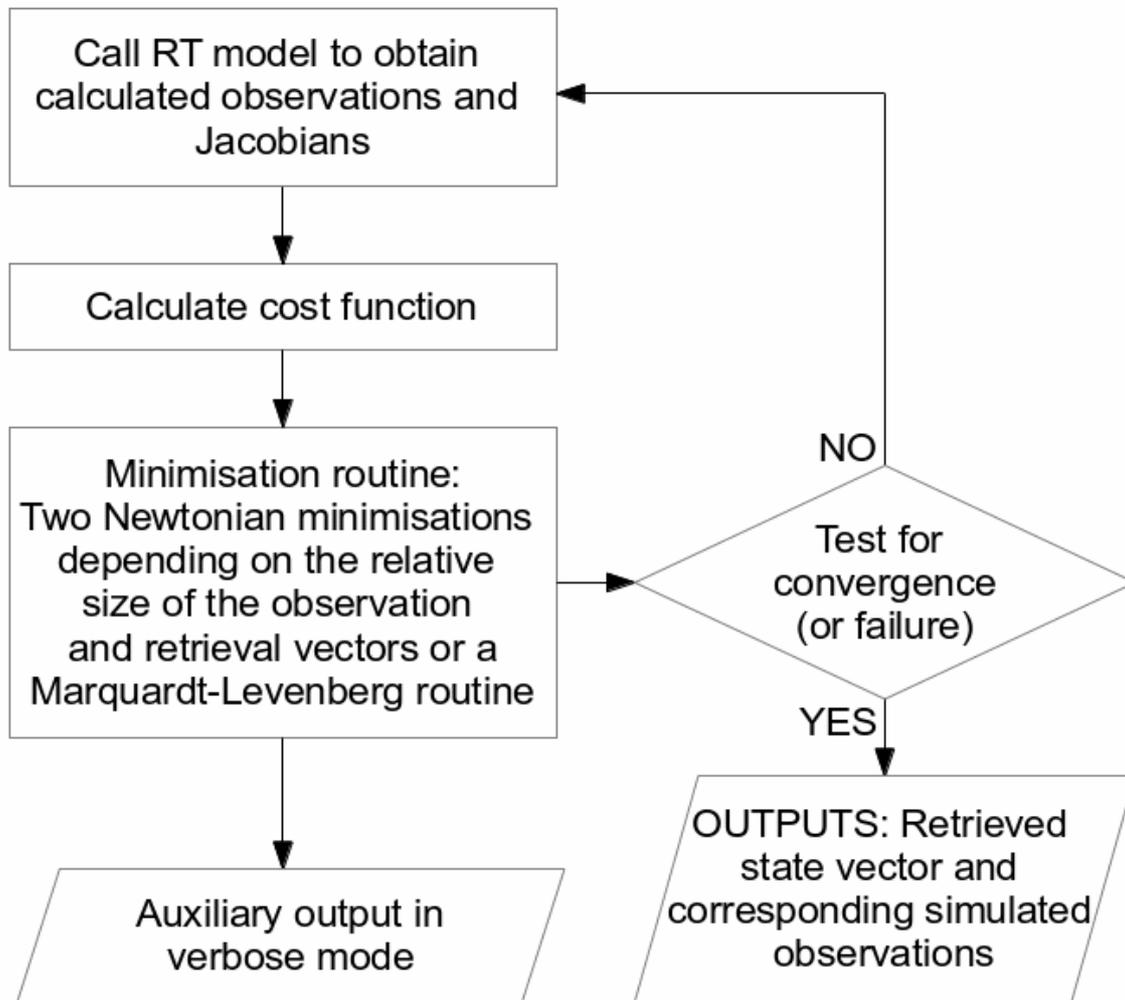
Figure 2: Minimization and output

4   INPUTS/OUTPUTS

When running the NWPSAF_1DVar executable the following inputs (all compatible with the instrument of choice) are required:

- Radiative transfer coefficients file
- Background error covariance matrix
- Observation error covariance matrix
- Channel choice file
- Retrieval namelist
- Control namelist
- Observations file
- Background profile

and the following outputs are generated:

- Analysis error covariance matrix
- Minimisation logs
- Retrieved brightness temperatures for each channel in the channel choice file
- Retrieved profiles of temperature, humidity and ozone on the number of levels defined by the background profile

In addition the user can optionally supply other inputs such as:

- Emissivity atlas

The user can also optionally request other outputs such as:

- Retrieved cloud top pressure, cloud fraction, surface wind speed and cloud liquid water profiles

For more information on customising the inputs and outputs see the user guide and readme file.

5 SYSTEM REQUIREMENTS

5.1 Language

The majority of the code is written in Fortran 90. The code is capable of compilation on a range of Fortran 90 and 95 compilers. A list of compilers which the code has been tested with can be found in the Portability document.

The accompanying GUI is written in Python (version 2.6) and uses the PyGTK (version 2.0), numpy (version 1.4.1) and matplotlib (version 0.99.1.1) packages to build the GUI windows and produce plots of the outputs.

Shell scripts are based on the Korn shell.

5.2 Supported platforms

The Met Office 1DVar code has been installed and is currently supported on a couple of UNIX-based platforms, IBM and PC (Linux). The code is sufficiently standard that it should work on other platforms with only minor code or configuration changes.

5.3 Performance

The performance of the 1DVar scheme is limited by the radiative transfer model. Therefore, the number of iterations required for minimisation determines the CPU time. This number of iterations may be optimised for a given application through the careful

choice of minimisation method (three are provided) and convergence criteria, all of which are adjustable by the user.

6   LIMITATIONS

This code is designed as a general research tool but it is unlikely that every eventuality can be covered without additional work by the user. The most obvious limitation is that there is no pre-processing before the minimisation stage to produce a good first guess (with the exception of minimum residual code used in the cloudy retrieval section) as this is not generally necessary in an NWP context.

Note that when using any radiative transfer model version other than RTTOV-10 or RTTOV-11, the 1D-Var code is not currently designed to support interpolation from user-defined profile levels. Therefore, retrievals may only be performed on the level set defined by the RTTOV coefficients in use.

7   LIST OF REQUIREMENTS

This section details specific requirements to be addressed in the NWPSAF 1DVar version 1.0 Test Plan.

7.1   The Release Note accompanying the package shall list the contents of the package and how to unpack the software.

7.2   NWPSAF 1DVar v1.0 shall be successfully built, following instructions in the readme file and manual. Where the user requires, it shall be possible to link external libraries to the NWPSAF 1DVar, including a radiative transfer model as well as netCDF and HDF5 libraries to allow extended functionality.

7.3   The software shall compile and run on a range of UNIX platforms including Linux PC and AIX.

7.4   The test runs for each instrument shall be run using the test script and NWPSAF_1DVar executable or test mode of the GUI with the compilers and radiative transfer model coefficients files specified in the readme file and produce identical results to those found in the Sample_Output folder. This is the requirement that the code can perform 1D-Var retrievals for the ATOVS, ATMS, AIRS, IASI, CrIS and SSMIS instruments.

7.5   NWPSAF 1DVar v1.0 shall replicate the functionality of the Met Office, SSMIS and ECMWF 1D-Var schemes.

7.6   NWPSAF 1DVar v1.0 shall have an accompanying GUI which can be used to run the code and produce plots of some of the outputs.