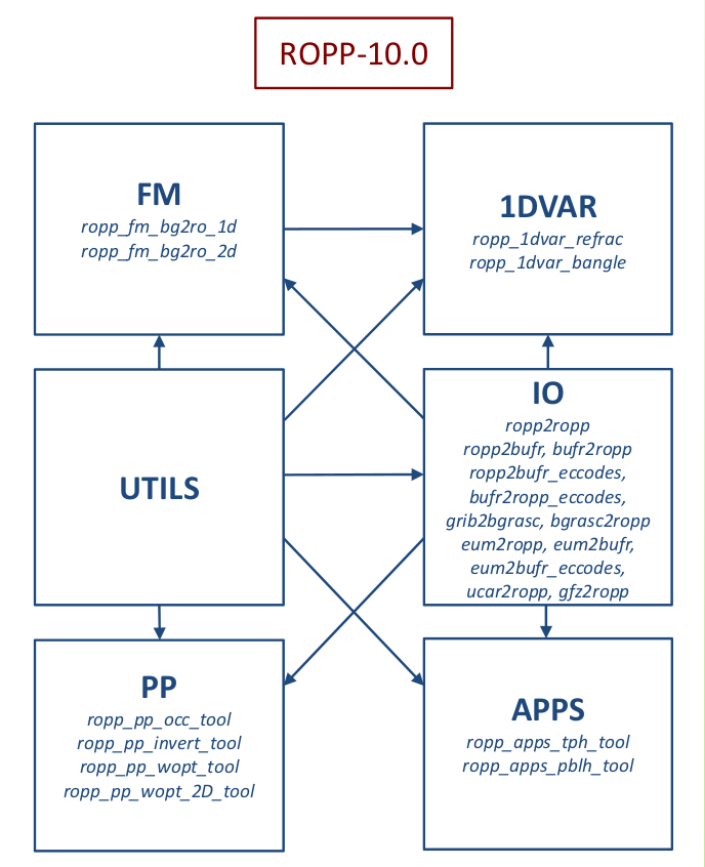
The Radio Occultation Processing Package (ROPP)

Ian Culverwell, on behalf of
The ROM SAF Project Team

What is ROPP?

- ROPP is a comprehensive software package, primarily intended to help users prepare radio occultation data for assimilation in NWP systems
- It is a collection of software modules (provided as source code), supporting build scripts, data files and documentation
- It is a deliverable of the ROM SAF, a decentralised processing centre under EUMETSAT
- First release (v1.0) March 2007; latest release (v10.0) February 2021
- ROPP releases are (currently) managed by the Met Office (UK)

ROPP has a modular structure

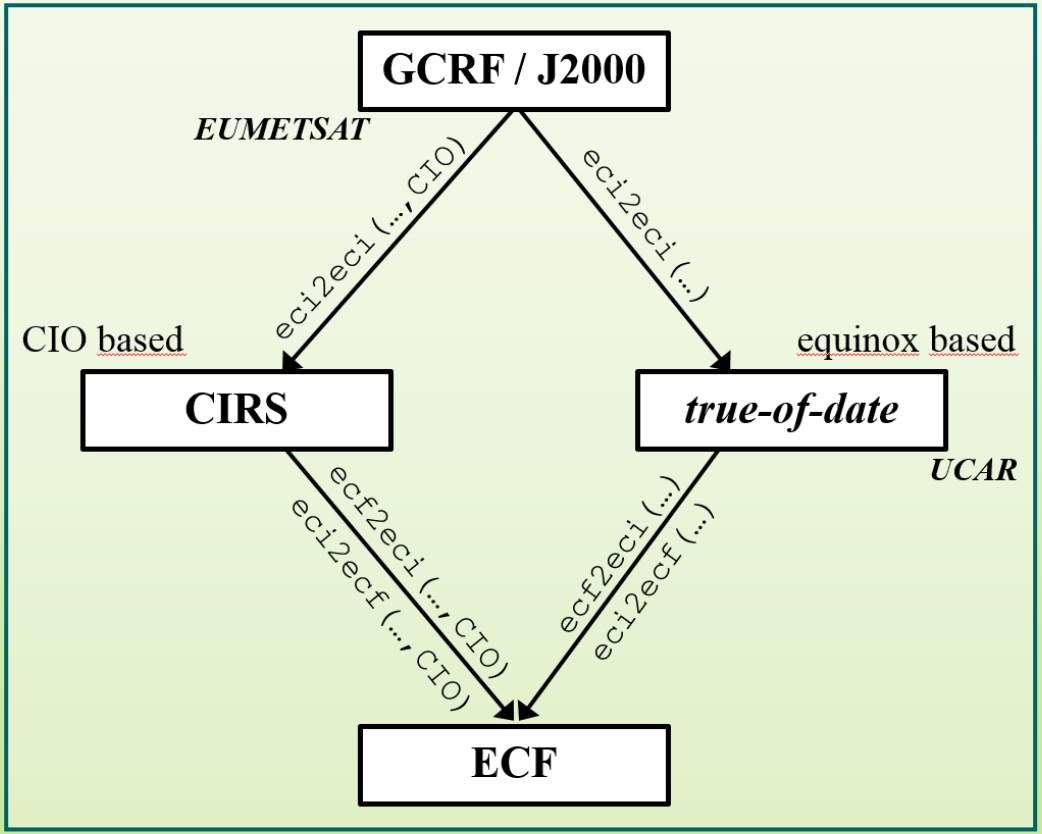


ROPP UTILS module

Low level service utilities

- QC and range-checking tools
- ECI ↔ ECEF coordinate conversion routines
- Geopotential ↔ geometric height conversion routines
- Date/time conversions
- Unit conversions

ROPP UTILS: coordinate transformation example



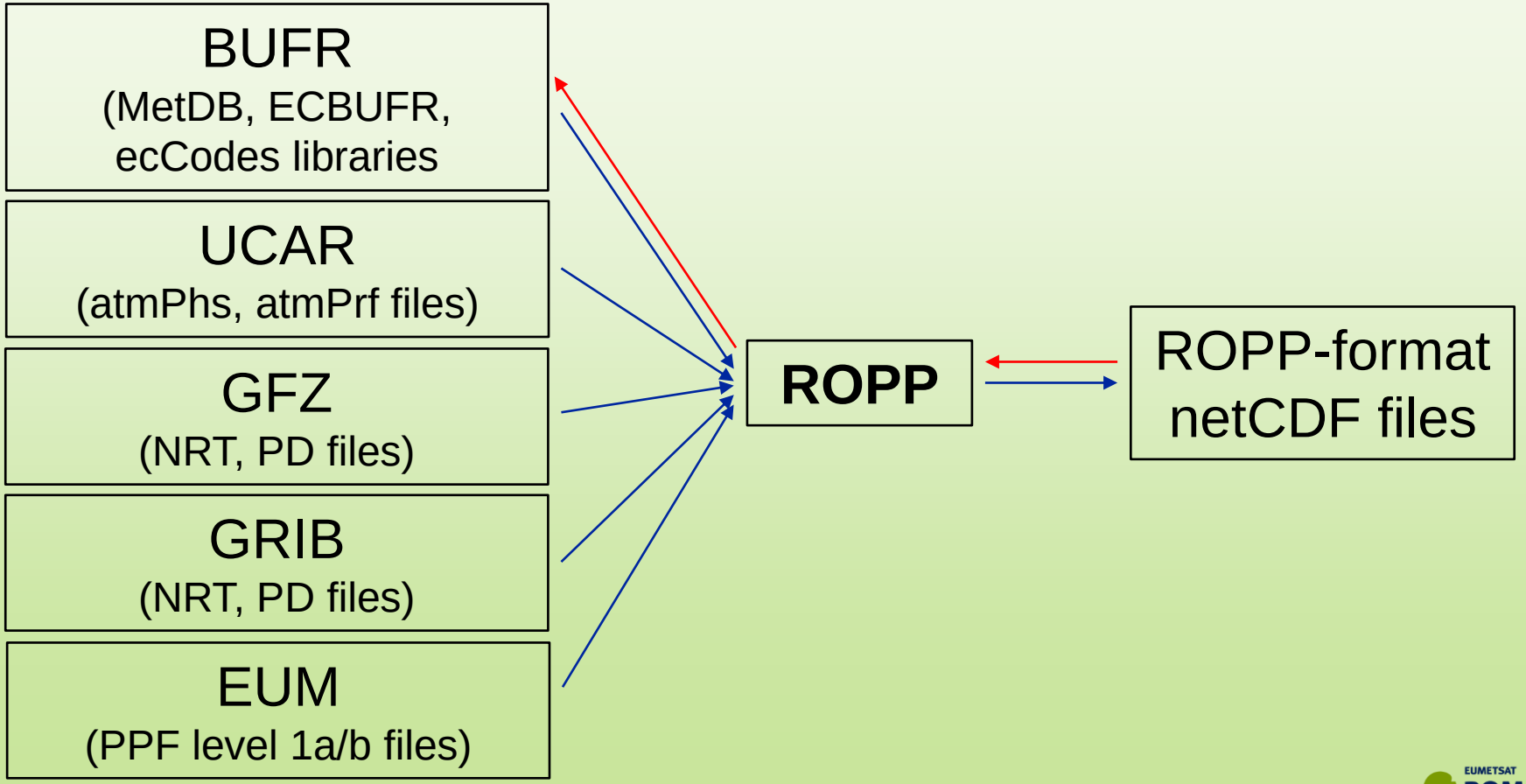
(Hans Gleisner, DMI)

ROPP IO module

Support routines for reading and writing RO datafiles

- ROPP has an internal netCDF-based data structure
- Can read ROPP, BUFR, UCAR, GFZ, GRIB and EUM formats
- Can write ROPP and BUFR formats
- Contains profile thinning, inverting, extracting and merging algorithms

ROPP IO: dataset conversions

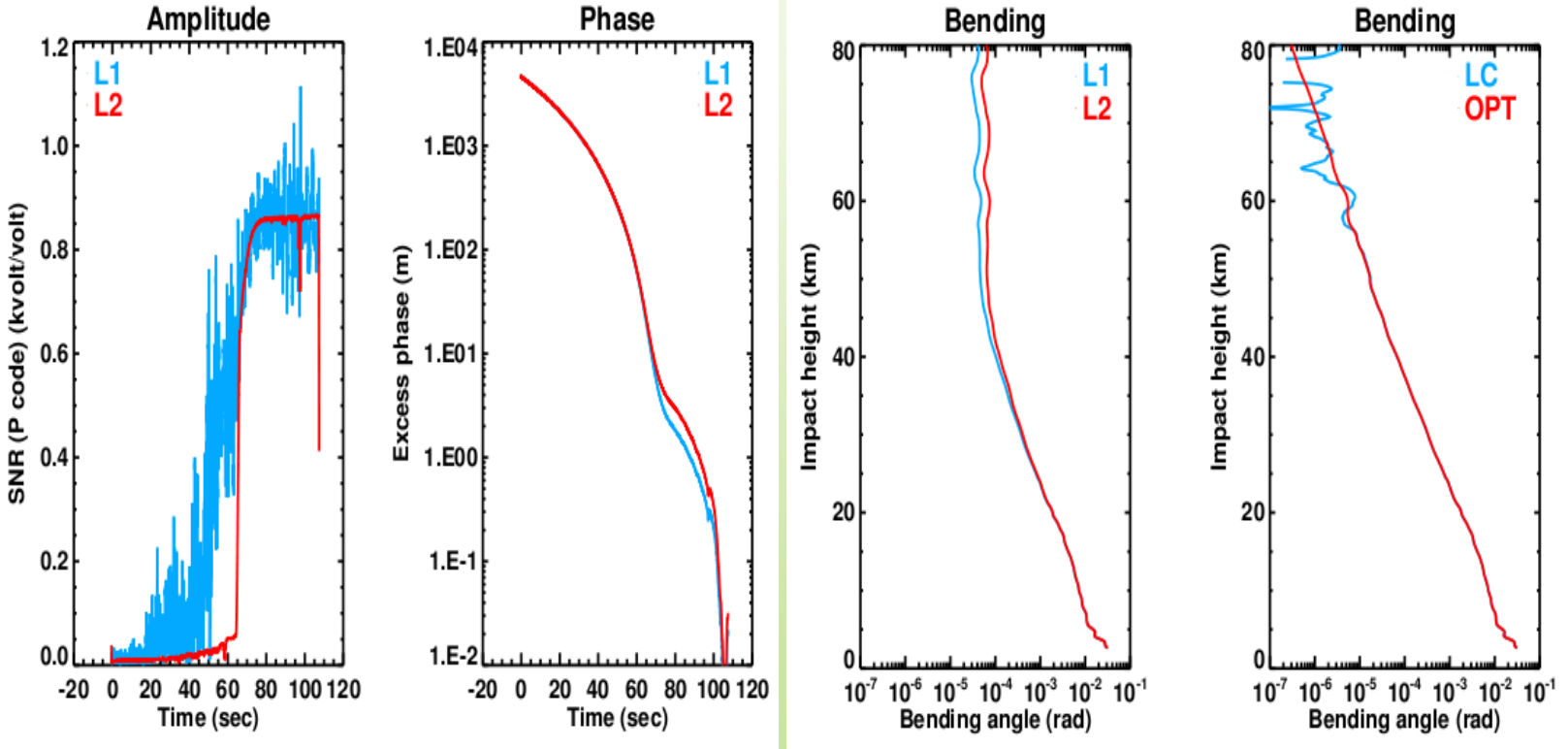


ROPP PP module

Pre-processing routines

- Geometric and wave optics (CT2) processing
- Ionospheric correction
- Statistical optimisation
- Wave optics propagators

ROPP PP: excess phase processing example

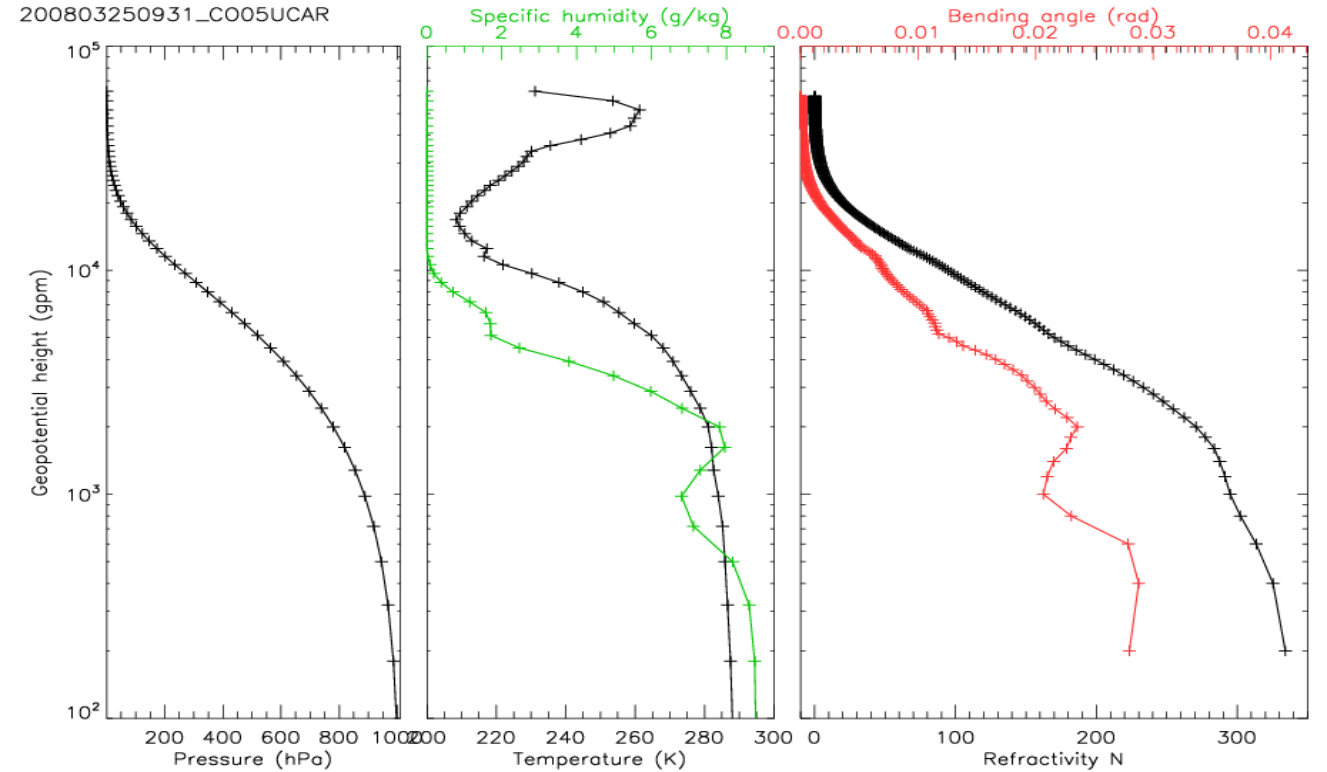


ROPP FM module

Forward models (compute refractivity and bending angle from background fields)

- Forward operators, gradients, tangent linear and adjoint models
- Supports models on hybrid-sigma (e.g. ECMWF) or geopotential (e.g. Met Office) levels
- Generate bending angles from 1D (profile) or 2D (slice) background fields

ROPP FM: ECMWF background procesing example

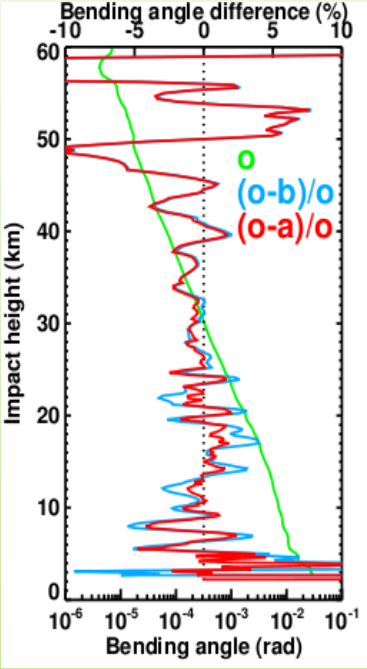


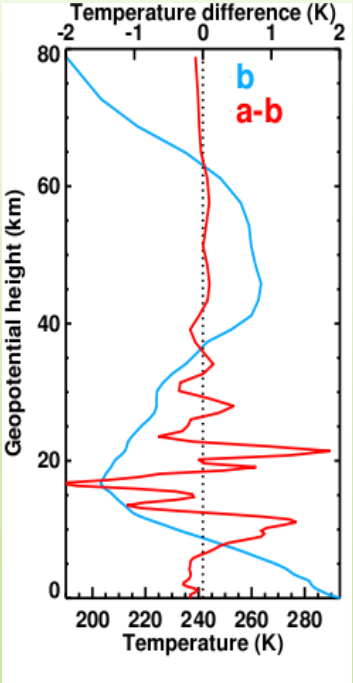
ROPP 1DVAR module

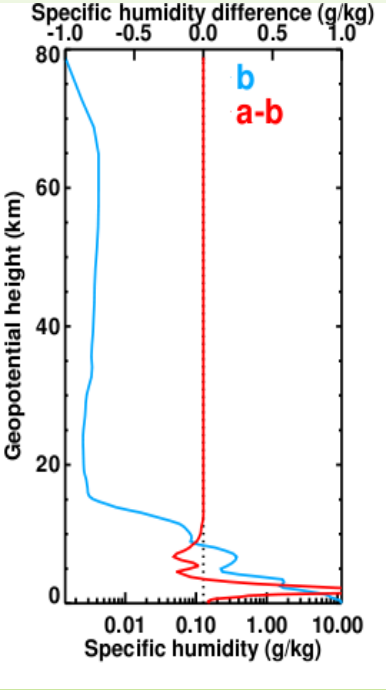
1D variational retrieval of using RO observables and model backgrounds

- Can use refractivity or bending angle
- Can use ECMWF or Met Office backgrounds
- Quality control
- A variety of error covariance models
- Diagnostic output

ROPP 1DVAR: bending angle retrieval example





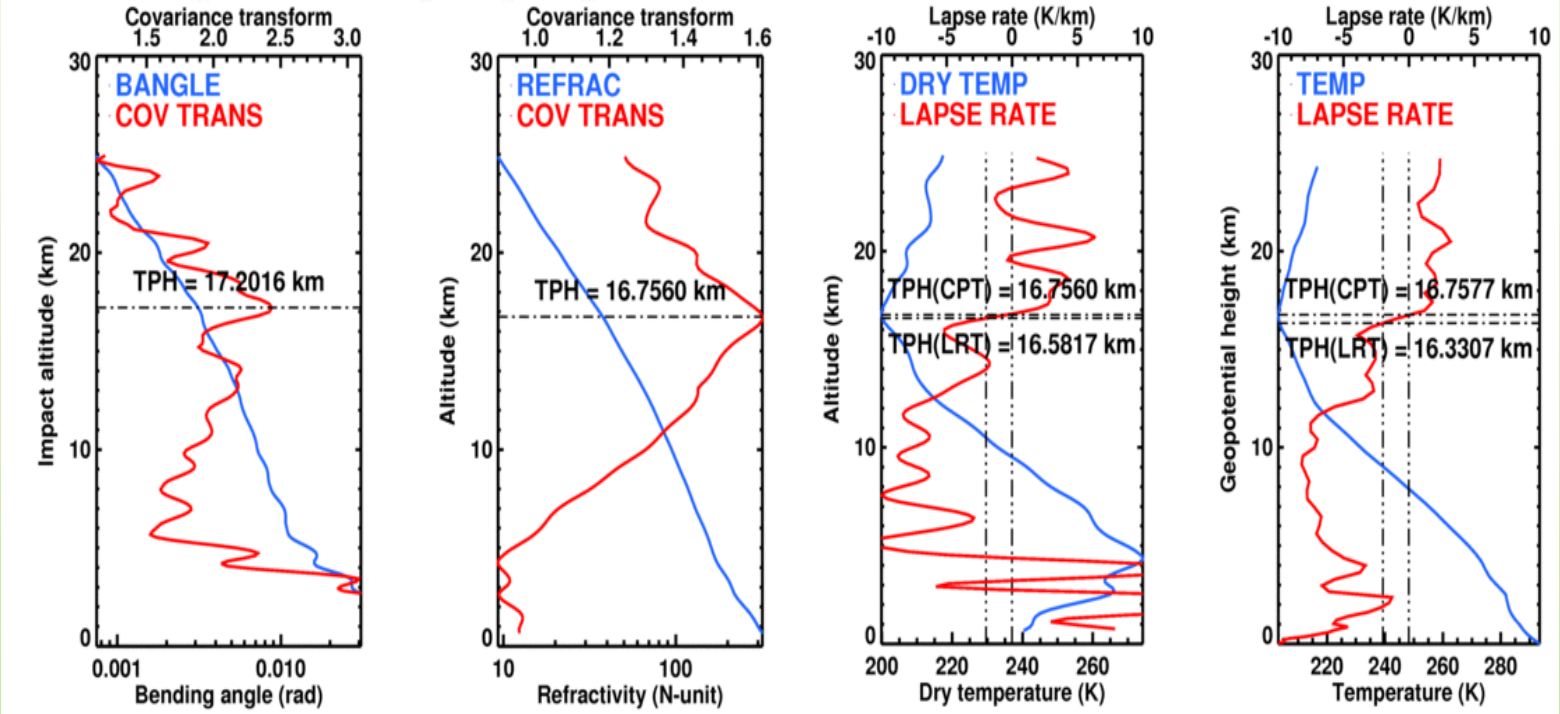


ROPP APPS module

Applications

- Tropopause height diagnostics
- Planetary boundary layer height diagnostics

ROPP APPS: tropopause height example



ROPP development

- Overseen by the ROM SAF Steering Group
- Large developments: governed by Work Packages, agreed in advance by EUMETSAT as part of contract for each 5 year ‘development phase’
- Medium developments: raised at ROPP Coordination Group; prioritised by Project Team; decided (in case of conflict) by the Steering Group
- Small developments: undertaken as part of general release management
- Development (currently) carried out in an svn-based trac system
- There is a helpdesk for user enquiries/requests

ROPP release management

- Various development branches merged into a prototype release
- This undergoes beta review by experts from outside the ROM SAF
- Updated code passed through Test Folder, to ensure robustness and to assess performance across different compilers and platforms
- Supporting documentation is written, including Release Notes, Change Log, User Guides, Reference Manuals, …
- Suitability of code, documentation etc for release is assessed in a Delivery Readiness Review
- Approved (or not approved) for release by ROM SAF Steering Group

ROPP TEST: test folder summary example

PASS **FAIL** **NOT APPLICABLE**

ROPP10.0 Test Folder Results

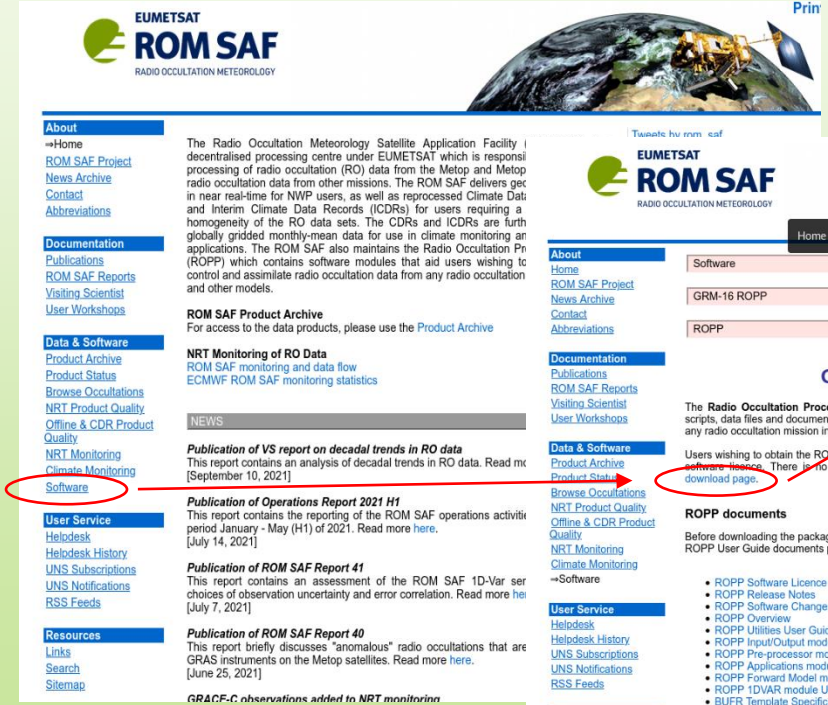
PASS FAIL UNSURE NOT RUN

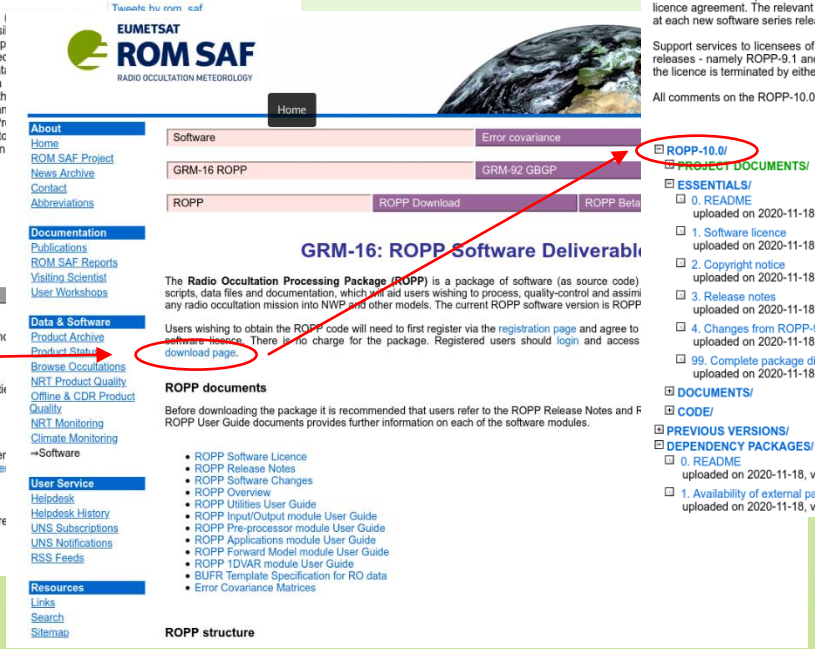
	CC-QU-03						MT-IO-						IT-FM-									IT-1DVAR-								IT-PP-							IT-APPS-		RT-??-01				
	UT	IO	FM	1D	PP	AP	01	02	03	04	05	OP	01	02	03	04	05	06	07	08	OP	01	02	03	04	05	06	07	OP	01	02	03	04	05	06	07	01	02	IO	FM	1D	PP	AP
gfortran_linux																																											
ifort17_linux																																											
ifort16_linux																																											
nagfor61_linux																																											
pgf95_linux																																											
g95_linux																																											
ftn_linux (Cray)																																											
gfortran_cygwin																																											

Regression test failure, expected because of changes to the tangent/occultation point calculations

Accessing ROPP

https://www.romsaf.org/





ROPP summary

- ROPP is a comprehensive software package, primarily intended to help users prepare radio occultation data for assimilation in NWP systems
- It is a collection of software modules (provided as source code), supporting build scripts, data files and documentation
- It is a deliverable of the ROM SAF, a decentralised processing centre under EUMETSAT
- First release March 2007; latest release February 2021
- ROPP releases are (currently) managed by the Met Office (UK)