

The EUMETSAT  
Network of  
Satellite  
Application  
Facilities



**ROM SAF**

Radio Occultation Meteorology

## **ROM SAF CDOP-2**

# **Report on the Fourth ROM SAF User Survey**

**Version 1.0**

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Danish Meteorological Institute (DMI)  
European Centre for Medium-Range Weather Forecasts (ECMWF)  
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## **ROM SAF**

The Radio Occultation Meteorology Satellite Application Facility (ROM SAF) is a decentralised processing center under EUMETSAT which is responsible for operational processing of GRAS radio occultation data from the Metop satellites and radio occultation (RO) data from other missions. The ROM SAF delivers bending angle, refractivity, temperature, pressure, and humidity profiles in near-real time and offline for NWP and climate users. The offline profiles are further processed into climate products consisting of gridded monthly zonal means of bending angle, refractivity, temperature, humidity, and geopotential heights together with error descriptions.

The ROM SAF also maintains the Radio Occultation Processing Package (ROPP) which contains software modules that will aid users wishing to process, quality-control and assimilate radio occultation data from any radio occultation mission into NWP and other models.

The ROM SAF Leading Entity is the Danish Meteorological Institute (DMI), with Cooperating Entities: i) European Centre for Medium-Range Weather Forecasts (ECMWF) in Reading, United Kingdom, ii) Institut D'Estudis Espacials de Catalunya (IEEC) in Barcelona, Spain, and iii) Met Office in Exeter, United Kingdom. To get access to our products or to read more about the ROM SAF please go to: <http://www.romsaf.org>

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# 1. Introduction

During spring 2015 the ROM SAF conducted its 4th web-based user survey, hereinafter US4. This report documents the results and conclusions of the survey. The purpose of US4 was to get user feedback in general and more specifically on reception and use of the ROM SAF products. An additional aim was to get ideas and input regarding future products, relevant for the CDOP-3 phase. A summary of the main results can be found in Chapter 2.

Previous ROM SAF user surveys were held in the end of 2002 (US1), in the beginning of 2006 (US2) and January 2010 (US3): <http://www.romsaf.org/surveys.php>

## 1.1 About the 4th user survey

The fourth ROM SAF User Survey (US4) was launched on May 11, 2015, where 1076 emails were sent out to recipients around the world. The list of recipients was put together from various lists of current and former ROM SAF users and collaborators, NWP and climate researchers, conference and workshop participants, and from the ionosphere community. Naturally, not all email addresses were up-to-date and the initial string of emails generated of the order of 20 error messages and a few responses from persons indicating no interest in the topics. After cleaning and correcting the original list, a reminder email was sent out on May 21. The cleaned list of recipients contained 1073 relevant names. By June 10, 49 answers had been received.

In order to capture potential requirements from ground-based (GB) GNSS support, the US4 survey was extended by separately targeting a known list of email addresses from the E-GVAP supplier and user community. The additional answers from this second part of the US4 survey are included in the discussions and conclusions below.

## 2. Summary of results

The complete survey report with detailed numbers and answers formulated by users are found below in Annex 1. Here we highlight some of the most relevant results.

### 2.1 General user characteristics

In Table 1 which is repeated from Annex 1, the answering user's interests and cross interests are shown. The 49 users who have responded to the first part of the survey can be categorized as primarily 24 climate users and 18 NWP users, out of which 10 users characterize themselves as Limited Area Model (LAM) users. 12 users specifically indicate LAM assimilation as their field. A handful of the climate users are also involved in NWP assimilation. We note that the 9 users who recognize themselves as "operational meteorology"-people are actually NWP modellers. Finally there are a minor but not insignificant amount of "instrument" (8) and "other applications" (7) users. In the following sections we monitor the distributions on these seven groups in each question.

Answer	Total	NWP	LAM	OPR	CLI	INS	OTH	NOI
a) NWP assimilation	18	18	10	8	5	1		
b) NWP local area model assimilation	12	10	12	5	6			
c) Operational meteorology	9	8	5	9	2		1	
d) Climate research and atmospheric sciences	24	5	6	2	24	4	2	
e) Instruments, engineering & operations	8	1			4	8	1	
f) Other applications, please specify	7			1	2	1	7	1
g) Not interested	3						1	3
Not answered	2							

**Table 1.** Partitioning of participants on different fields of work. Note that the partitioning is not exclusive. E.g. a total of 18 persons are NWP people, 5 of these are also climate-users. The abbreviations are defined in Q1 in Annex 1.

The interests in ROM SAF products (Q1.2) are coarsely distributed as 21 (NRT), 17 (Climate) and 15 (Offline). It is noticeable that only 15 of the 24 climate users intend to use ROM SAF climate products, meaning that the rest use or intend to use NRT/Offline or ROPP solely. Approximately half of the answering users (intend to) use the ROPP software. That may be considered as a majority of the active users.

### 2.2 NRT/Offline Products

We note that 10 answering users have used NRT refractivity data and 7 are planning to do so. Remarkably 7 users seem to have used temperature data and 6 intend to do so. These

users are mainly “science oriented” rather than “operationally” oriented, as is also the case for users of the other NRT 1D-Var products.

Also related to this 17 answering users say that they prefer to get the data from the website while only 7 prefer EUMETCAST and 3 prefer GTS.

*BUFR:*

Bending angle in BUFR is used by 12. Generally people (12) are satisfied with the BUFR template, but there are 3 suggestions. See Q 2.5 in Annex 1.

*Future products:*

Remarkably many users express their interest in derived non-profile NRT products. Presumably many of these do not really need NRT timeliness, since they may not be fully aware the question is specific NRT related. Most of them are climate user. See Q 2.6 in Annex 1:

*NRT / Offline Future products interest:*

Gravity wave parameters	14
Tropopause height and temperature	21
Planetary boundary layer height	14
AMSU equivalent temperature	7

A total of 20 users find NRT timeliness crucial (mostly NRT and LAM users of course).

The answers to the open “future plans” question (Q 2.7) are a bit mixed but it is possible to conclude that a handful of users state that they expect to use NRT/Offline data continuously in an operational setup. Note that the users have never seen any offline data, so to them the distinction between NRT and Offline does not mean a lot.

## 2.3 Climate

Considering the large amount of climate users, few users seem to use gridded climate data. For instance 7 answering users indicate that they have downloaded ROM SAF gridded temperature. The climate users interests are equally distributed on latitude and altitude, slightly dominated by tropical tropopause research. They are generally satisfied with the monthly time resolution. Remarkably 9 users express interest in future tropopause, 9 users express interest in planetary boundary layer products and 12 indicate interest in an unspecified “climate quality” water vapour product. Of course a majority (20 users) are interested in uncertainty estimates.

## 2.4 ROPP

*Usage*

Q 4.1 in Annex 1 shows that the ROPP users are distributed fairly equally between NWP and climate. Unfortunately the presentation does not allow us to count the total of ROPP users among the answering users. A good guess might be obtained by subtracting the 21 not answering Q 4.1 from the total of 49 answering users. No ROPP packages stick out as

“not used” in questions Q 4.2-4, however the ROPP\_1DVAR module is only used regularly by four answering users (not including DMI).

### *Environment*

Details about dependencies, platform and compiler preferences are best viewed in Q 4.6. However, surprisingly many (9) works with ROPP on a Windows/Cygwin platform. No users seem to be dissatisfied with the installation process, but there are a few specifically mentioned loose threads in the answers chapter 4 Q 4.10, which could be followed up. The relevant users can be tracked down.

### *Future functionality*

Besides a few singular wishes, that might be worth considering, the answers of Q 4.11, regarding desires for future features, are distributed like this:

NWP model vertical grids (other than for existing ECMWF and Met Office):	5
Climate processing/analysis:	8
Space Weather:	11
Ground-based GNSS	10

The following question (Q 4.12) is addressing GB GNSS specifically. It is noticed that there is at least a handful of users who express interest in basically all of the proposed GB GNSS functionalities.

## **2.5 User Services**

Generally users (18) are satisfied with the helpdesk, and basically no one suggest changes. However, what sticks out is that climate users in particular appear to be quite unaware of the monitoring pages. Only two relevant users have actually used it. The user notifications are appreciated by NWP/LAM users, and should probably just be continued as is.

## **2.6 Miscellaneous**

The last section contains sporadic and specific questions which can hardly be summarized. It can be noted though that there is significant interest in the ionosphere products, and large interest in collocated radiosonde data (24 users). The reflection flag, which we know can be difficult to interpret, has also great interest; it should be noted that this may not be correctly interpreted by the users. Finally there is a question about the interest in alternative 1D-Var approaches which find very little support. This is strange because a lot of users indicate interest in a "climate-quality" water-vapour product. It may be that the question is phrased a bit wrong, since the user is prompted for a reference if he/she answers positively which might make some users quit the survey right there.



## 2.7 Conclusions

The fourth user survey had not as many participants as the third survey (78). Only about 5% of the targeted users have answered. US4 does however provide valuable information which will be used in CDOP-3. Especially we note that new proposed products, e.g. gravity wave parameters, boundary layer products, climate quality water vapor, collocated radiosondes and certain ionosphere products, are of considerable interest for users. Additionally there are also many detailed answers, not reported here, which will be of importance in the technical design of future products.

Below we list the main conclusions for future reference (UW4-Concl-nn).

*UW4 Conclusions:*

- Conclusion 1.** The 49 users who have responded to the survey can be categorized as primarily 24 climate users and 18 NWP users.
- Conclusion 2.** 15 of the 24 climate users intend to use ROM SAF climate products.
- Conclusion 3.** Approximately half of the answering users (intend to) use ROPP software.
- Conclusion 4.** 7 users seem to have used temperature data and 6 intend to do so.
- Conclusion 5.** 17 answering users say that they prefer to get the data from the website while only 7 prefer EUMETCAST and 3 prefer GTS.
- Conclusion 6.** Bending angle in BUFR is used by 12 of the answering users.
- Conclusion 7.** Remarkably many users express their interest in derived non-profile NRT products: Gravity wave parameters (14), Tropopause height and temperature (21), Planetary boundary layer height (14), AMSU equivalent temperature (7).
- Conclusion 8.** A total of 20 users find NRT timeliness crucial.
- Conclusion 9.** A handful of users state that they expect to use NRT/Offline data continuously in an operational setup.
- Conclusion 10.** 7 answering users indicate that they have downloaded ROM SAF gridded temperature.
- Conclusion 11.** 12 indicate interest in an unspecified “climate quality” water vapour product.
- Conclusion 12.** 20 users are interested in uncertainty estimates.
- Conclusion 13.** No users seem to be dissatisfied with the ROPP installation process.

- Conclusion 14.** Interest in future ROPP functionality: NWP model vertical grids (other than for existing ECMWF and Met Office) (5), Climate processing/analysis (8), Space Weather (11), Ground-based GNSS (13).
- Conclusion 15.** Generally users (18) are satisfied with the helpdesk.
- Conclusion 16.** Generally users are satisfied with the user notifications.
- Conclusion 17.** Only two relevant users have actually used the climate monitoring pages.
- Conclusion 18.** Generally there is interest in all proposed ionosphere products (8-14 users).
- Conclusion 19.** There is large interest in collocated radiosonde data (24 users).
- Conclusion 20.** A large group of 24 users has answered yes to whether they want a flag to identify the presence of signals reflected off the Earth surface.
- Conclusion 21.** There were a total of 14 users<sup>1</sup> interested in ROPP including support for ground-based GNSS. Requirements were evenly spread across support for Q/C, various distribution file formats, a forward model and 1D-Var.

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<sup>1</sup> This number (14 users) is based on the present survey (US4) plus the extended survey (US4-GB) conducted through October 2015 where a selected group of ground-based GNSS users from the E-GVAP community were contacted.

## ANNEX 1. FULL USER SURVEY 4 REPORT

### 1. User characteristics

(More than one answer possible)

Answer	Total	NWP	LAM	OPR	CLI	INS	OTH	NOI
a) NWP assimilation	18	18	10	8	5	1		
b) NWP local area model assimilation	12	10	12	5	6			
c) Operational meteorology	9	8	5	9	2		1	
d) Climate research and atmospheric sciences	24	5	6	2	24	4	2	
e) Instruments, engineering & operations	8	1			4	8	1	
f) Other applications, please specify	7			1	2	1	7	1
g) Not interested	3						1	3
Not answered	2							

q11\_f:

- Space Weather
- Please note that my connection with RO missions is through precise orbit determination, i.e supporting RO, not using RO products itself
- Satellite product validation
- weather satellites
- We use the RO data in our NWP, and I subscribe to the help desk for monitoring purposes. What to know if RO data is or will be missing, deterioration of quality of RO data
- I'm not a user. I was involved in the ROM-SAF as STG representative in the ROM-SAF Steering Group
- Geodetic modelling of atmospheric and ionospheric errors in GNSS positioning,
- I was involved in Development and Test of GRAS at Astrium

### 1.2. Which (if any) RO product type(s) do you use/plan to use?

(More than one answer possible)

Answer	Total	NWP	LAM	OPR	CLI	INS	OTH	NOI
a) Near-Real Time (NRT) products (disseminated less than 3 hours after measuring time)	21	14	10	7	8	2	4	
b) Offline products (optimally processed profiles available less than 30 days after measuring)	15	6	4	3	12	5	1	
c) Climate products (gridded monthly zonal means of RO profiles)	17	5	3	1	15	2		
d) No plans to use RO products	5	2		1		1	1	2
Not answered	8	1	1	1	1	2	2	1

**1.3. Are you using/planning to use the Radio Occultation Processing Package (ROPP) Software?**

Answer	Total	NWP	LAM	OPR	CLI	INS	OTH	NOI
a) -Yes, and I use it/will use it for	24	9	7	4	13	5	2	
b) -No	19	7	5	3	11	3	3	2
Not answered	6	2		2			2	1

q13\_a:

- As a developer/tester.
- RO operator in the LETKF (research mode only)
- comparison with EGOPS/OPSv5.6
- Tools & Utilities, possibly also the ROPP forward models
- research
- Assimilation of RO
- BA assimilation
- Up to now only for forward modelling aspects.
- NWP assimilation, forward and adjoint operators
- purely research propose
- To process excess phase and refractivity for atmospheric and ionospheric study
- local model assimilation
- my research on RO assimilation for NWP
- Atmospheric Dynamics
- understanding of evaluation of the GRAS Measurement data

**2. Current and coming operational NRT and offline RO profile products**

Q2.1. Have you obtained any of the ROM SAF NRT products (Refractivity/Temperature/Specific Humidity/Pressure) (formal product id:GRM-01/02/03/04/05/40/41/42/43/44)?

**Refractivity:**

Answer	Total	NWP	LAM	OPR	CLI	INS	OTH	NOI
a) -Yes, and I use(d) it for:	10	5	4	2	4	1	1	
b) -Yes, but I do/did not use it because:	3	1	1		1		1	
c) - No, but I plan to use it for:	7	1	1		7	1	1	
d) - No	19	8	4	4	8	4	2	2
Not answered	10	3	2	3	4	2	2	1

q211\_a:

- To assess its quality against model fields (not for assimilation). Also, the refractivity background departures can highlight model-specific problems, sometimes more clearly than bending angle departures.
- data assimilation in operational system

- Assimilation of bending angle with QC test on N
- Satellite product validation
- reference for own algorithm for data processing, comparison with radiosonde
- assimilation
- Climate research and atmospheric sciences
- Climate research

q211\_b:

- We assimilate bending angle
- I used products from COSMIC website directly
- I use it only form information

q211\_c:

- precipitable water estimation as well as temperature and pressure profiles
- Academic research
- local model assimilation

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**Temperature:**

Answer	Total	NWP	LAM	OPR	CLI	INS	OTH	NOI
a) -Yes, and I use(d) it for:	7	2	1		5	1	1	
b) -Yes, but I do/did not use it because:	5	2	1		2		1	
c) -No, but I plan to use it for:	6		1		6	2		
d) -No	19	10	6	6	6	3	2	2
Not answered	12	4	3	3	5	2	3	1

q212\_a:

- Satellite product validation
- comparison with radiosonde
- atmospheric sciences
- Climate research

q212\_b:

- It is preferable to assimilate raw data (refractivity/bending angle) rather than retrievals.
- We assimilate bending angle directly
- I used products from COSMIC website directly
- I use it only form information

q212\_c:

- Satellite validation and atmospheric science studies
- compare stratosphere temperature with that obtained by infrared sensors

- Academic research
- local model assimilation

**Humidity:**

Answer	Total	NWP	LAM	OPR	CLI	INS	OTH	NOI
a) -Yes, and I use(d) it for:	5	2			3	1		
b) -Yes, but I do/did not use it because:	4	2	1		1		1	
c) -No, but I plan to use it for:	6		1		6	1		
l) -No	21	10	6	6	8	4	2	2
Not answered	13	4	4	3	6	2	4	1

q213\_a:

- Satellite product validation
- atmospheric sciences
- Climate research

q213\_b:

- It is preferable to assimilate raw data (refractivity/bending angle) rather than retrievals.
- We assimilate bending angle directly
- I used products from COSMIC website directly
- I use it only form information

q213\_c:

- compare upper atmopshere humidity with that obtained by infrared sensors
- Academic research
- local model assimilation

**Pressure:**

Answer	Total	NWP	LAM	OPR	CLI	INS	OTH	NOI
a) -Yes, and I use(d) it for:	7	2	1		5	1	1	
b) -Yes, but I do/did not use it because:	3	1			1		1	
c) -No, but I plan to use it for:	5		1		5			
d) -No	20	10	6	6	7	4	2	2
Not answered	14	5	4	3	6	3	3	1

q214\_a:

- Satellite product validation

- comparison with radiosonde
- atmospheric sciences
- Climate research

q214\_b:

- It is preferable to assimilate raw data (refractivity/bending angle) rather than retrievals.
- I used products from COSMIC website directly
- I use it only form information

q214\_c:

- local model assimilation

**Surface Pressure:**

Answer	Total	NWP	LAM	OPR	CLI	INS	OTH	NOI
a) -Yes, and I use(d) it for:	4	1			4		1	
b) -Yes, but I do/did not use it because:	2	1	1				1	
c) -No, but I plan to use it for:	4		1		4			
d) -No	23	11	6	6	8	5	2	2
Not answered	16	5	4	3	8	3	3	1

q215\_a:

- Satellite product validation
- atmospheric sciences
- Climate research

q215\_b:

- We assimilate bending angle directly
- I use it only form information

q215\_c:

- Academic research
- local model assimilation

**2.2. If you have used any of the ROM SAF-products listed on product overview page, how did you get it?  
 (More than one answer possible)**

Answer	Total	NWP	LAM	OPR	CLI	INS	OTH	NOI
a) Via GTS (RMDCN)	3	3	2	2				
b) Via EUMETCast	1							
c) Via the ROM SAF website	12	4	2	2	6	1	1	
d) Other:	2	1	1		1		1	
Not answered	33	12	8	6	17	7	5	3

q22\_d:

- FTP
- GRAS data is supplied to the NAVY via bent pipe through NOAA
- COSMIC webpage

**2.3. If you plan to use any of the ROM SAF-products listed on product overview page, how do you prefer to get it?  
 (More than one answer possible)**

Answer	Total	NWP	LAM	OPR	CLI	INS	OTH	NOI
a) Via GTS (RMDCN)	3	3	2	1				
b) Via EUMETCast	7	3	3	1	1	2		
c) Via the ROM SAF website	17	3	3	1	12	4	2	
d) Other:	2	1	1		1		1	
Not answered	26	11	6	7	11	4	4	3

q23\_d:

- FTP
- GTS is also useful, and other GNSS-RO sensors we obtain via GTS, redundancy here is beneficial for operations
- local server if existing

**2.4 The ROM SAF BUFR file disseminated over GTS contains both the ROM SAF profile products and a copy of the EUMETSAT Central Facilities bending angle product. Please indicate if you are using the bending angle product contained in this BUFR file:**

Answer	Total	NWP	LAM	OPR	CLI	INS	OTH	NOI
a) -Yes.	12	8	4	4	3	1		
b) -No.	17	4	4		13	2	3	2
Not answered	20	6	4	5	8	5	4	1

**2.5. RO data from GRAS, COSMIC, GRACE and TerraSAR-X is provided in NRT to NWP users in WMO BUFR format over the GTS. Is the content of the current BUFR template meeting your needs?**



Answer	Total	NWP	LAM	OPR	CLI	INS	OTH	NOI
a) -Yes.	15	7	5	3	7	1		
b) -No. I would like to see this extra information included in a potential extended BUFR template:	3	3	1	2				
c) -(not applicable)	13	3	3		10	2	2	2
Not answered	18	5	3	4	7	5	5	1

q25\_b:

- Detailed metadata for each level
- Spectral width, or an uncertainty estimate of the bending angle in the product
- Some info on POD (i.e. orbit + clock)

**2.6. Future products:**

*In the future the ROM SAF is planning to disseminate an extended suite of products. Please indicate whether any of these parameters would be of interest for you as NRT or Offline:*

Answer	Total	NWP	LAM	OPR	CLI	INS	OTH	NOI
a) Tropopause height and temperature	21	9	6	2	14	4		
b) Planetary boundary layer height	14	5	4	1	11	2	1	
c) AMSU equivalent temperature	7	3	2		5	2		
d) Gravity wave parameters	14	6	6	1	10	2	1	
Not answered	23	7	3	6	6	3	6	3

**2.7. What are the future plans for the use of ROM SAF NRT and Offline data. E.g., do you expect to use the data continuously in an operational setup?**

Answer	Total	NWP	LAM	OPR	CLI	INS	OTH	NOI
I assume that we use NRT data in data assimilation cycling if proven beneficial	1	1	1	1				
I expect to use the data for dedicated validation/intercomparison studies	1				1	1		
I would like to use excess phases operationally	1		1		1			
Ionosphere specification	1	1	1	1	1			
No	2	1	1				1	1
Non-operational, but NRT (within 48 hours) collection for short-term and long-term validation of Satellite temperature/moisture retrievals.	1				1		1	
Not in the near future	1	1		1				

The Met Office will continue to use the EUMETSAT-generated bending angles operationally, and perform monitoring against the ROM SAF-generated refractivity products.	1	1							
Yes	3	1	2	1	2				
Yes, we operationally really on the GRAS sensors and the ROPP has been a robust and efficient tool for NWP data assimilation requirements.	1	1	1						
no	2	1	1	1	1				
ocasional use	1	1			1				
yes	2				1	1			
yes, for integrity monitoring of space weather	1				1	1	1		
Not answered	30	9	4	4	14	5	4	2	

**2.8. Is the Near Real Time (timeliness) crucial for your usage of the products?**

Answer	Total	NWP	LAM	OPR	CLI	INS	OTH	NOI
a) -Yes	20	12	9	5	9	2	2	
b) -No	14	2	2	1	11	2	2	1
Not answered	15	4	1	3	4	4	3	2

**2.9. Please make a note if you have concerns or preferences regarding the products that you believe we should be aware of:**

Answer	Total	NWP	LAM	OPR	CLI	INS	OTH	NOI
1. benefit (the more data, the better). 2. timeliness	1	1	1	1				
Availability within 24 hours (rather than 3 hours) would fit our requirements.	1				1		1	
N/A	1	1		1				
Use of GRAS data in the lower troposphere would be beneficial.	1	1	1					
no	1				1			
Not answered	44	15	10	7	22	8	6	3

**3. Climate products and reprocessed data-sets**

The RO technique gives bending angles, which are processed into vertical profiles of atmospheric

refractivity and further into temperature, pressure, and humidity. Using the globally distributed RO profiles, various climate products consisting of gridded monthly zonal means are obtained (formal product id: GRM-17/18/19/20/21/22/23, GRM-53/54/55/56/57/58/59 and GRM-93/94/95/96/97/98/99). The ROM SAF climate data describe the monthly mean state of the atmosphere in the form of zonal averages, i.e. averages over all longitudes in 5-degree latitude bands.

**3.1. Have you obtained any of the ROM SAF gridded climate products (Bending Angle, Refractivity, Temperature, Specific humidity and Geopotential height)? (More than one answer possible)**

Answer	Total	NWP	LAM	OPR	CLI	INS	OTH	NOI
a) Bending angles for:	4	2	1	1	2			
b) Refractivity for:	6	2	1	1	4			
c) Temperature for:	7	2			6			
d) Specific humidity for:	4	2			3			
e) Geopotential heights at fixed pressure levels for:	3	2			2			
f) None	20	6	5	3	11	4	4	2
Not answered	20	9	6	5	6	4	3	1

q31\_a:

- data assimilation
- Climate research
- Study of bending angles in low heights

q31\_b:

- data assimilation
- Climate research

q31\_c:

- Climate research

q31\_d:

- Climate research

**3.2. Which time resolutions of climate data are you most interested in? (More than one answer possible)**

Answer	Total	NWP	LAM	OPR	CLI	INS	OTH	NOI
a) Month to season	19	6	4	1	15	2		
b) Season to year	4	2	2		3			
c) Other:	1	1			1			

d) None	9	3	2	3	3	2	4	2
Not answered	21	9	6	5	6	4	3	1

q32\_c:

- perhaps daily if possible

**3.3. Which atmospheric layers are you most interested in?  
 (More than one answer possible)**

Answer	Total	NWP	LAM	OPR	CLI	INS	OTH	NOI
a) Troposphere	17	7	4	2	12	3	1	
b) Upper troposphere/lower stratosphere (UTLS)	19	7	6	2	13	3		
c) Stratosphere	11	5	4		8	2		
d) Other:	2	2	2	1	2			
e) None	6	1		1	2	1	3	2
Not answered	18	8	5	5	3	3	3	1

q33\_d:

- ionsphere
- Ionosphere
- Ionosphere

**3.4. Which geographical regions are you most interested in?  
 (More than one answer possible)**

Answer	Total	NWP	LAM	OPR	CLI	INS	OTH	NOI
a) Polar regions (60N-90N,60S-90S)	11	4	4	1	7	2		
b) Mid latitudes (30N-60N,30S-60S)	20	8	6	3	14	3		
c) Low latitudes (30S-30N)	15	6	4	1	11	3	1	
d) Other:	2	1	1		1			
e) None	6	1		1	2	1	3	2
Not answered	17	7	4	4	4	3	3	1

q34\_d:

- global
- equatorial

**3.5. Climate data can be provided alone, or together with uncertainty estimates. Would you use uncertainty estimates if provided?**

Answer	Total	NWP	LAM	OPR	CLI	INS	OTH	NOI
a) -Yes	20	9	6	4	14	3		
b) -No	4				2		1	1
c) -Perhaps:	2				2			
Not answered	23	9	6	5	6	5	6	2

**3.6. Which (if any) climate products would you be interested in using in future? And for which purpose? (More than one answer possible)**

Answer	Total	NWP	LAM	OPR	CLI	INS	OTH	NOI
a) Bending angles for:	6	5	3	1	3			
b) Refractivity for:	9	4	2	1	6	1		
c) Temperature for:	16	7	4	2	11	1		
d) Specific humidity for:	13	6	3	1	9	1		
e) Geopotential heights at fixed pressure levels for:	8	4	2		6	1		
f) Geopotential heights at fixed dry-pressure levels for:	6	3	1		5			
g) Dry temperature / dry pressure for:	9	5	2	1	6	1		
h) None	6	2	1	2	2		1	2
Not answered	27	9	7	5	11	7	6	1

q36\_a:

- Reanalysis runs

q36\_b:

- calibration
- for GNSS tomography

q36\_c:

- climate studies over Amazonian region
- model validation, if running forward operator is not feasible
- Atmospheric dynamics
- Dynamical motions

q36\_d:

- climate studies over Amazonian region
- Trends
- model validation, if running forward operator is not feasible

**3.7. The ROM SAF is planning to develop gridded data sets of derived products. Which climate products would you be interested in using in future? And for which purpose?**

Answer	Total	NWP	LAM	OPR	CLI	INS	OTH	NOI
a) Planetary boundary layer height for:	9	4	1	1	6			
b) AMSU equivalent temperature for:	5	1	1		4	1		
c) Gravity wave parameters for:	9	4	1	1	5	2	1	
Not answered	35	13	10	8	14	6	6	3

q37\_a:

- model validation

q37\_c:

- model evaluation and calibration

**3.8. The ROM SAF is considering to develop a "climate-quality" water-vapour product for instance based on a targeted 1D-Var approach. Would you be interested in such a product?**

Answer	Total	NWP	LAM	OPR	CLI	INS	OTH	NOI
a) -Yes	12	4	2		9	2		
b) -No	9	3	2	2	4	1	1	2
Not answered	28	11	8	7	11	5	6	1

q38\_yes\_requirements:

- global water-cycle change
- Thorough uncertainty estimation
- Refractivity

q38\_recomendations\_development\_RO\_climate:

- Just be honest about possible error sources, and where product has highest confidence and reliability

**3.9. Briefly describe the context (Model evaluation, process studies, validation of other datasets) in which you use/plan to use ROM SAF climate data:**

Answer	Total	NWP	LAM	OPR	CLI	INS	OTH	NOI
a) Context description	5	2	1		2	2		
b) Not used for these purposes	9	2	1	2	5	1	1	2
Not answered	35	14	10	7	17	5	6	1

q39\_a:

- validation of other datasets
- Validation of other data set (infrared sensors)
- no active projects at this time, but are being asked in the future to do model reanalysis runs and the climate data could prove to be very useful

#### 4. The Radio Occultation Processing Package (ROPP) Software

4.1. How would you best describe your interest in ROPP?  
 (Select all that apply)

Answer	Total	NWP	LAM	OPR	CLI	INS	OTH	NOI
a) NWP/Nowcasting	14	12	9	6	5	1		
b) Climate research	11	4	3	1	11			
c) Atmospheric science	17	6	5	1	14	3	1	
d) Operational production	9	4	3	1	3	4	1	
e) Instruments, engineering and data simulation	7	3	1	2	2	4	1	
Not answered	21	5	3	3	8	3	6	3

q41\_f:

- Other researches in geodesy

4.2. Which modules from the software package ROPP have you downloaded?  
 (Select all that apply)

Answer	Total	NWP	LAM	OPR	CLI	INS	OTH	NOI
a) ROPP_UTILS	16	7	3	3	8	3		
b) ROPP_IO	16	8	4	4	7	3		
c) ROPP_PP	13	5	3	2	7	3		
d) ROPP_FM	12	6	4	3	5	3		
e) ROPP_1DVAR	10	6	4	3	4	2		
f) None	11	4	4	1	7	2	2	1
Not answered	21	6	4	4	9	3	5	2

**4.3. Which ROPP modules have you built and evaluated for your application?  
 (Select all that apply)**

Answer	Total	NWP	LAM	OPR	CLI	INS	OTH	NOI
a) ROPP_UTILS	12	6	2	2	4	2	1	
b) ROPP_IO	13	7	3	3	5	2	1	
c) ROPP_PP	9	3	2	2	5	2	1	
d) ROPP_FM	11	6	4	3	3	3	1	
e) ROPP_1DVAR	6	2	1	2	2	2	1	
f) None	12	4	4	1	9	1	2	1
Not answered	22	6	4	4	10	4	4	2

**4.4. Which ROPP modules do you use regularly or routinely?  
 (Select all that apply)**

Answer	Total	NWP	LAM	OPR	CLI	INS	OTH	NOI
a) ROPP_UTILS	9	4	2	1	4	2		
b) ROPP_IO	8	4	2	1	3	2		
c) ROPP_PP	6	2	1	1	3	2		
d) ROPP_FM	5	3	2	1	1	2		
e) ROPP_1DVAR	3	1		1	1	2		
f) None, but I intend to use one or more modules in the future:	8	2	3	1	5	2	2	
g) None, and I do not intend to use ROPP routinely because:	7	2	1	1	3		1	1
Not answered	25	10	6	6	12	4	4	2

q44\_f:

- ROPP-FM and ROPP-1DVAR
- I have ROPP-5.0 however it is in Fortran and I Have no Compiler

q44\_g:

- ROPP is not part of the Met Office DA system, but the algorithms are closely aligned (shared heritage).
- someone else is doing pre-processing I suppose.

**4.5. Which external dependencies, if any, do you use with ROPP?**

Answer	Total	NWP	LAM	OPR	CLI	INS	OTH	NOI
--------	-------	-----	-----	-----	-----	-----	-----	-----



a) netCDF. If so, which version?	20	9	4	4	14	3	1
b) MetDB BUFR. If so, which version?	3	2		1	1		
c) ECMWF BUFR. If so, which version?	5	3		2	1	1	
d) GRIB_API	6	4		2	3	1	
e) HDF5	10	5	2	1	6	1	
Not answered	26	8	7	5	9	5	3

q45\_a:

- 4.1.3
- 4.1.3
- 4.3
- 4
- do not know
- 4.3.3.1
- can't remember the version of the format
- 4.1.3

q45\_b:

- 19.0.00

q45\_c:

- 000387
- 387
- 19.1.2

**4.6. Operationally: Which operating system(s) and distributions (e.g "Ubuntu") are, or would be, mainly used for building and running ROPP?:  
 (Select all that apply)**

Answer	Total	NWP	LAM	OPR	CLI	INS	OTH	NOI
a) Linux & distribution:	16	8	5	3	8	3		
b) Unix (including HP-UX, AIX, SunOS) & distribution:	2	1				1		
c) Windows/Cygwin & distribution:	9	2	2		6	2	2	
d) OS X / Mac & distribution:	1	1			1			
Not answered	26	8	7	6	12	4	5	3

q46\_a:

- Ubuntu
- Debian, openSUSE
- SLES
- ubuntu

- SUSE Linux Enterprise Server 11; Red Hat Enterprise Linux Client release 5.11; Red Hat Enterprise Linux Server release 6.4
- CentOS
- CentOS
- 3.2.0

q46\_b:

- AIX (there are no plans to use ROPP operationally).

q46\_c:

- win8
- Windows

q46\_d:

- yosemety

**4.7. Operationally: Which Fortran compiler(s) are, or would be, mainly used for building ROPP?:  
 (Select all that apply)**

Answer	Total	NWP	LAM	OPR	CLI	INS	OTH	NOI
a) Intel (ifort)	6	4	3	1	2	1		
b) NAGWare (nagfor)	1				1	1		
c) Portland Group (pgf95)	5	2	2	1	2		1	
e) GFortran	7	4	2	2	3	1		
f) G95	3	1		1	2			
g) IBM (xlf95)	1	1						
h) Other (please specify):	2	2		1				
Not answered	30	10	7	6	14	5	6	3

q47\_h:

- There are no plans to use it operationally, but soon the Met Office will migrate to a Cray.
- Cray (crayftn)

**4.8. Research and Development: Which operating system(s) and distributions (e.g "Ubuntu") are, or would be, mainly used for building and running ROPP?:  
 (Select all that apply)**

Answer	Total	NWP	LAM	OPR	CLI	INS	OTH	NOI
a) Linux & distribution:	17	8	4	3	7	4	1	

b) Unix - including HP-UX, AIX, SunOS & distribution:	3	1	1		1	2		
c) Windows/Cygwin & distribution:	9	4	2	1	6	2	1	
d) OS X / Mac & distribution:	1	1			1			
Not answered	26	8	7	6	11	3	5	3

q48\_a:

- Red Hat 6
- Debian, openSUSE
- openSUSE, SLES
- ubuntu
- scientific linux
- sorry cannot access OPS at this time
- CentOS
- 3.2.0

q48\_b:

- Solaris 11 x86

q48\_c:

- win8
- Windows

q48\_d:

- yosemety

**4.9. Research and Development: Which Fortran compiler(s) are, or would be, mainly used for building ROPP?:**  
 (Select all that apply)

Answer	Total	NWP	LAM	OPR	CLI	INS	OTH	NOI
a) Intel (ifort)	9	5	3	1	4	3		
b) NAGWare (nagfor)	2				2	2		
c) Portland Group (pgf95)	5	3	3	1	2			
d) SUN (sunf95)	1				1	1		
e) GFortran	10	6	3	3	4	2		
f) G95	4	1		1	3	1		
g) IBM (xlf95)	1	1	1					
Not answered	30	9	7	6	14	4	7	3

**4.10. Did the installation/testing of ROPP go smoothly or were there any problems?  
 (Select one)**

Answer	Total	NWP	LAM	OPR	CLI	INS	OTH	NOI
a) -Installation and testing went smoothly	13	6	4	2	7	2		
b) -There were one or more problems, but I solved it myself by:	1	1		1				
c) -There were one or more problems, I wrote to the Helpdesk about it, and got a satisfactory solution	1	1						
Not answered	34	10	8	6	17	6	7	3

q410\_b:

- Detection of NetCDF provided with system, include paths

q410\_further\_comments:

- configure's "--with-xyz" options should behave more like with other packages
- We use ROPP indirectly. The installation/testing has been done at ECMWF.
- I have not install the software
- Need to verify
- I could not install but I did not write to helpdesk for help

**4.11. Is there any functionality that you would like to be added to ROPP? (But note that the ROM SAF is not committing to implement any/all suggestions.) We are contemplating including support in the following categories; please indicate specific items, tools or RO-based products that you would use for:**

Answer	Total	NWP	LAM	OPR	CLI	INS	OTH	NOI
a) NWP model vertical grids (other than for existing ECMWF and Met Office):	5	4	2	2	1			
b) Climate processing/analysis:	8	2	1		6	1		
c) Space Weather:	11	4	2	1	6	3	1	
d) Ground-based GNSS: (See also the next Question [and/or give a link to a separate page])	10	5	3	1	4	3	1	
e) Other:	2	1		1		1		
Not answered	32	11	8	6	16	4	6	3

q411\_a:

- Height-based vertical grid (with given heights of half-levels)

q411\_c:

- TEC profile

q411\_d:

- precipitable water vapor

q411\_e:

- Capability to process reflectometry data from future missions
- Additional PP modules to convert Level 0 to Level 1a

**4.12. Ground-based GNSS (GBG) has many similarities with radio occultation, having the same signal source, physical atmospheric interactions but with a different geometry. The ROM SAF has plans to take on responsibility for the maintenance (and potential future development) of the current Met Office 'GWV' and 'GWVBUFR' packages supporting E-GVAP and similar projects in order to ensure formal support. However, such support by the ROM SAF would depend on there being sufficient user community requirement for a 'GBG' module or separate package (but we are not committing to implement any/all suggestions). We therefore wish to establish whether you would require (and use) any of the following (existing or potential future) functionality:**

Answer	Total	NWP	LAM	OPR	CLI	INS	OTH	NOI
a) COST-format file I/O and Q/C:	3	1			2	1	1	
b) GBG BUFR encoder:	5	2	1	2	2	2	1	
c) GBG BUFR decoder:	4	2	1	2	2	1	1	
d) netCDF converter:	8	2	1	2	5	2	1	
e) GBG Forward model (to derive ZTD from e.g. radiosonde or NWP model profiles):	7	3	2	2	2	3	1	
f) 1D-Var retrieval:	5	2		1	2	2	1	
Not answered	37	14	10	7	18	5	6	3

## 5. User Services

**5.1. How important is the ROM SAF Helpdesk function for your use of RO data and ROPP?**

Answer	Total	NWP	LAM	OPR	CLI	INS	OTH	NOI
a) -Important	18	7	5	3	13	4	1	
b) -Useful, but not very important	9	5	3	4	3		2	
c) -Unimportant/have not used it yet	5	1	2	1	2		1	2
Not answered	17	5	2	1	6	4	3	1

**5.2. Is there any functionality that you would like to be added to the ROM SAF Helpdesk?**

Answer	Total	NWP	LAM	OPR	CLI	INS	OTH	NOI
I cannot tell any thing right now	1				1			
No	1							
None	1	1		1				
what is important is the information of quality and disponibility of products	1			1			1	
Not answered	45	17	12	7	23	8	6	3

**5.3. Have you used the NRT Monitoring page on the ROM SAF website?**

Answer	Total	NWP	LAM	OPR	CLI	INS	OTH	NOI
a) -Yes, and I found it useful because:	12	8	5	4	3	1	1	
c) -No, but I plan to use it	6	2	1	1	4	2		
d) -No	14	3	3	2	11	1	2	2
Not answered	17	5	3	2	6	4	4	1

q53\_a:

- For operational NWP it is important to assess the quality of the assimilated observations, new instruments and also to assess model changes.
- I work with data assimilation and all the information are always very useful.
- Regular use
- We can compare with our own statistics
- Comparing with our results
- sanity check our operational GNSS-RO assimilation

**5.4. Have you used the Climate Monitoring Page on the ROM SAF website?**

Answer	Total	NWP	LAM	OPR	CLI	INS	OTH	NOI
a) -Yes, and I found it useful because:	3	2	1		2			
c) -No, but I plan to use it	8	2	2	1	5	2		
d) -No	20	8	6	5	11	1	2	2
Not answered	18	6	3	3	6	5	5	1

**5.5. Is there any functionality that you would like to be added to the ROM SAF Monitoring pages?**

Answer	Total	NWP	LAM	OPR	CLI	INS	OTH	NOI
I cannot tell any thing right now	1				1			
N/A	1	1		1				
Option to select/view two or more plots simultaneously, e.g. for comparison of	1	1		1				

satellites

no	1					1			
Not answered	45	16	12	7	22	8	7	3	

**5.6. Have you subscribed to the ROM SAF NRT User Notification Service (mail group)?**

Answer	Total	NWP	LAM	OPR	CLI	INS	OTH	NOI
a) -Yes, and I find it useful because:	11	6	4	3	4	1	1	
b) -Yes, but I do not find it useful because:	1				1			
d) -No, but I plan to sign up for it	5	1		1	4	2	1	
e) -No	12	3	3		8	1	1	2
Not answered	20	8	5	5	7	4	4	1

q56\_a:

- Warnings are very useful.
- I work with data assimilation and all the information are always very useful.
- Important for operational users
- Alerts are useful when NRT products are not available
- It keeps me informed of changes/upgrades to ROM SAF NRT.
- sanity check data outages origination

q56\_b:

- I am not actively using the products.

**6. Expert background and interest**

Only for those familiar with the RO techniques. Otherwise, you may skip these questions and submit directly.

**EPS Second Generation (EPS-SG):**

**6.1. For EUMETSAT's new EPS-SG program the ROM SAF is planning to develop new products. Please indicate whether you are interested in some of the following products:**

Answer	Total	NWP	LAM	OPR	CLI	INS	OTH	NOI
a) AMSU equivalent Temperature	7	3	2	1	4	1		
b) Gravity Wave parameters	11	6	4	2	7	2	1	
c) Phase	13	7	5	3	8	1	2	
d) Amplitude	12	6	4	2	8	1	2	
e) DCB calibration	9	4	2	1	6	2	1	
f) Electron density	12	6	4	2	8	2	1	
g) S4 index	10	4	2	2	6	1	2	

h) TEC between GPS and receiver	14	6	4	3	9	2	2
i) Scintillation maps	8	3	2	1	5	1	2
Not answered	30	10	6	6	13	5	5

q61\_j:

- GNSS-R

**Miscellaneous:**

**6.2. Would you be interested in collocated radiosonde profiles to be included in the level 2 profiles?**

Answer	Total	NWP	LAM	OPR	CLI	INS	OTH	NOI
a) -Yes	24	6	5	3	18	6	1	
b) -No	4	3	1	1				
Not answered	21	9	6	5	6	2	6	3

**6.3. The ROM SAF has the possibility to provide RO data with a flag to identify the presence of signals reflected off the Earth surface. Would you possibly be interested in such a flag?**

Answer	Total	NWP	LAM	OPR	CLI	INS	OTH	NOI
a) -Yes	24	9	6	4	14	5	2	
b) -No	4	3	2	1	1			
Not answered	21	6	4	4	9	3	5	3

**6.3.1. Would it add value to provide the flag in the NRT dissemination?**

Answer	Total	NWP	LAM	OPR	CLI	INS	OTH	NOI
c) -Yes	18	8	4	4	11	4	1	
d) -No	3	2	1		1			
Not answered	28	8	7	5	12	4	6	3

**6.4. The ROM SAF NRT temperature, humidity, and pressure products are derived via a traditional 1D-Var approach in which the observations (refractivity) and the background (ECMWF forecast fields) are weighted according to assumed observation and background error covariances. If you are a potential user of the ROM SAF temperature, specific humidity, and pressure products (either for NRT or research/climate applications), please indicate which error covariance assumptions would be your preference:**

**A: For NWP and meteorology**

Answer	Total	NWP	LAM	OPR	CLI	INS	OTH	NOI
a) -I prefer products based on a traditional	10	6	4	2	5	1		



1D-Var approach

b) -I prefer products based on a different approach. Please describe shortly the approach, e.g., with a reference to a paper or other:	2	1	1	1	2			
c) -I do not intend to use these products for NWP	9	2	1	1	6	1	1	
Not answered	28	9	6	5	11	6	6	3

**B: For climate research and atmospheric sciences**

Answer	Total	NWP	LAM	OPR	CLI	INS	OTH	NOI
a) -I prefer products based on a traditional 1D-Var approach	14	6	4	1	9	2	1	
b) -I prefer products based on a different approach. Please describe shortly the approach, e.g., with a reference to a paper or other:	2	1	1	1	2			
c) -I do not intend to use these products for climate or atmospheric research	3	1		1	1			
Not answered	30	10	7	6	12	6	6	3

**6.5. Is there anything regarding the ROM SAF products that you would like to address which is not covered by the survey?**

Answer	Total	NWP	LAM	OPR	CLI	INS	OTH	NOI
AOSG, SAC Bopal Campus, Bopal, Ahmedabad-380058	1	1	1					
I cannot tell any thing right now	1				1			
I did not answer to most questions, as my main used is to get info from the help desk in an operational environment	1			1			1	
Is the tdry product declared "official" yet? If not, are there plans to make it official?	1				1		1	
N/A	1	1		1				
No	1							
None	1				1			
Np	1				1	1	1	
have not yet used any data	1							
no	1				1			
Not answered	39	16	11	7	19	7	4	3

## **ANNEX 2. COPY OF COVER LETTER**

Dear ....

You are receiving this email ...

We are writing to advise you of a User Survey conducted by the Radio Occultation Meteorology Satellite Application Facility (ROM SAF).

The ROM SAF is a decentralized facility under EUMETSAT which runs an operational radio occultation (RO) system. We are conducting this survey in order to gather information and recommendations from users related to possible future RO products and activities to be pursued by the ROM SAF in coordination with EUMETSAT.

The ROM SAF is responsible for delivering bending angle, refractivity, temperature, pressure, humidity profiles, and other radio occultation data in near-real time and offline for NWP and climate users. The offline profiles are further processed into climate products consisting of e.g. gridded monthly means of bending angle, refractivity, temperature, humidity, and geopotential heights. The ROM SAF also maintains the ROPP (Radio Occultation Processing Package) software package for users wishing to process, quality-control, and assimilate radio occultation data from any radio occultation mission into NWP and other models. For more information please consult our website <http://www.romsaf.org>.

The results of the User Survey will be compiled into a report which will be made available from our website.

If you wish to participate, please follow this link:  
<http://www.romsaf.org/usersurveys/us4/>

The User Survey will close on May 20, 2015.

We look forward to hearing from you.

Yours sincerely  
Kent B. Lauritsen  
ROM SAF Manager

We apologize if you receive this user survey request more than once.

If you wish to be removed from this mailing list, please reply to this email with the word "remove" in the Subject Line.

## **ANNEX 3. User Survey 4 as it appeared on the webpage**

### **ROM SAF User Survey 4**

#### QUESTIONNAIRE

The ROM SAF is part of EUMETSAT's network of Satellite Application Facilities (SAFs). The objective of the ROM SAF is to deliver operational RO products from the GRAS instruments on board the three Metop satellites and from other RO data for Numerical Weather Prediction (NWP) and climate applications. A second objective is to deliver the ROPP (Radio Occultation Processing Package) software package, containing modules for processing and assimilation of RO data into NWP models. If you are not familiar with the RO principle, you may also want to read this short introduction.

The ROM SAF has delivered operational NRT (near-real time) refractivity products since 2009, and temperature, humidity and pressure products since July 2014. We would like to determine the interest in, and use of, RO products, and whether the data are as expected by their users. Hence, this questionnaire tries to build a picture of the current, planned, and expected use of the products. Because the users of RO data are from a wide range of fields, with different types of interest and expertise, we divide the survey into six parts. You may skip any part of the survey to save time if you feel that it is irrelevant for your use. Thank you for taking the time to complete this questionnaire!

Name: \*  
Email Address: \*  
Affiliation \*  
Current position: \*  
\*mandatory fields

#### **1. User characteristics**

1.1. How would you best describe your interests in or use of RO data?:

(More than one answer possible)

NWP assimilation

NWP local area model assimilation

Operational meteorology

Climate research and atmospheric sciences

Instruments, engineering & operations

Other applications, please specify:

Not interested

1.2. Which (if any) RO product type(s) do you use/plan to use?

(More than one answer possible)

NRT products (disseminated less than 3 hours after measuring time)

Offline products (optimally processed profiles available less than 30 days after measuring)

Climate products (gridded monthly zonal means of RO profiles)

No plans to use RO products

1.3. Are you using/planning to use the Radio Occultation Processing Package (ROPP) Software?

Yes, and I use it/will use it for  
No

## 2. Current and coming operational NRT and offline RO profile products

2.1. Have you obtained any of the ROM SAF NRT products (Refractivity/Temperature/Specific Humidity/Pressure) (formal product id:GRM-01/02/03/04/05/40/41/42/43/44)?

Refractivity:

Yes, and I use(d) it for:

Yes, but I do/did not use it because:

No, but I plan to use it for:

No

Temperature:

Yes, and I use(d) it for:

Yes, but I do/did not use it because:

No, but I plan to use it for:

No

Humidity:

Yes, and I use(d) it for:

Yes, but I do/did not use it because:

No, but I plan to use it for:

No

Pressure:

Yes, and I use(d) it for:

Yes, but I do/did not use it because:

No, but I plan to use it for:

No

Surface Pressure:

Yes, and I use(d) it for:

Yes, but I do/did not use it because:

No, but I plan to use it for:

No

2.2. If you have used any of the ROM SAF-products listed on product overview page, how did you get it?

(More than one answer possible)

Via GTS (RMDCN)

Via EUMETCast

Via the ROM SAF website

Other:

2.3. If you plan to use any of the ROM SAF-products listed on product overview page, how do you prefer to get it?

(More than one answer possible)

Via GTS (RMDCN)

Via EUMETCast

Via the ROM SAF website

Other:

2.4 The ROM SAF BUFR file disseminated over GTS contains both the ROM SAF profile products and a copy of the EUMETSAT Central Facilities bending angle product. Please indicate if you are using the bending angle product contained in this BUFR file:

Yes.

No.

2.5. RO data from GRAS, COSMIC, GRACE and TerraSAR-X is provided in NRT to NWP users in WMO BUFR format over the GTS. Is the content of the current BUFR template meeting your needs?

Yes.

No. I would like to see this extra information included in a potential extended BUFR template:

(not applicable)

2.6. Future products:

In the future the ROM SAF is planning to disseminate an extended suite of products. Please indicate whether any of these parameters would be of interest for you as NRT or Offline:

Tropopause height and temperature  
Planetary Boundary Layer Height  
AMSU equivalent temperature  
Gravity wave parameters

2.7. What are the future plans for the use of ROM SAF NRT and Offline data. E.g., do you expect to use the data continuously in an operational setup?

2.8. Is the Near Real Time (timeliness) crucial for your usage of the products?

Yes  
No

2.9. Please make a note if you have concerns or preferences regarding the products that you believe we should be aware of:

### 3. Climate products and reprocessed data-sets

The RO technique gives bending angles, which are processed into vertical profiles of atmospheric refractivity and further into temperature, pressure, and humidity. Using the globally distributed RO profiles, various climate products consisting of gridded monthly zonal means are obtained (formal product id: GRM-17/18/19/20/21/22/23, GRM-53/54/55/56/57/58/59 and GRM-93/94/95/96/97/98/99). The ROM SAF climate data describe the monthly mean state of the atmosphere in the form of zonal averages, i.e. averages over all longitudes in 5-degree latitude bands.

3.1. Have you obtained any of the ROM SAF gridded climate products (Bending Angle, Refractivity, Temperature, Specific humidity and Geopotential height)?

(More than one answer possible)

Bending angles for:

Refractivity for:

Temperature for:

Specific humidity for:

Geopotential heights at fixed pressure levels for:

None

3.2. Which time resolutions of climate data are you most interested in?

Month to season

Season to year

Other:

None

3.3. Which atmospheric layers are you most interested in?

(More than one answer possible)

Troposphere

Upper troposphere/lower stratosphere (UTLS)

Stratosphere

Other:

None

3.4. Which geographical regions are you most interested in?

(More than one answer possible)

Polar regions (60N-90N,60S-90S)

Mid latitudes (30N-60N,30S-60S)

Low latitudes (30S-30N)

Other:

None

3.5. Climate data can be provided alone, or together with uncertainty estimates. Would you use uncertainty estimates if provided?

Yes

No

Perhaps:

3.6. Which (if any) climate products would you be interested in using in future? And for which purpose?

(More than one answer possible)

Current products

Bending angles for:

Refractivity for:

Temperature for:

Specific humidity for:

Geopotential heights at fixed pressure levels for:

Future Products

Geopotential heights at fixed dry-pressure levels for:

Dry temperature / dry pressure for:

None

3.7. The ROM SAF is planning to develop gridded data sets of derived products. Which climate products would you be interested in using in future? And for which purpose?

Planetary boundary layer height for:

AMSU equivalent temperature for:

Gravity wave parameters for:

Other for:

3.8. The ROM SAF is considering to develop a "climate-quality" water-vapour product for instance based on a targeted 1D-Var approach. Would you be interested in such a product?

Yes

No

If yes, which requirements would such a product need to meet seen from your point of view?

Do you have recommendations regarding the development of a RO climate quality water vapor product?

3.9. Briefly describe the context (Model evaluation, process studies, validation of other datasets) in which you use/plan to use ROM SAF climate data:

Not used for these purposes

#### **4. The Radio Occultation Processing Package (ROPP) Software**

4.1. How would you best describe your interest in ROPP?

(Select all that apply)

NWP/Nowcasting

Climate research

Atmospheric science

Operational production

Instruments, engineering and data simulation

Other:

4.2. Which modules from the software package ROPP have you downloaded?

(Select all that apply)

ROPP\_UTILS

ROPP\_IO

ROPP\_PP

ROPP\_FM

ROPP\_1DVAR

None



4.3. Which ROPP modules have you built and evaluated for your application? (Select all that apply)

ROPP\_UTILS  
ROPP\_IO  
ROPP\_PP  
ROPP\_FM  
ROPP\_1DVAR  
None

4.4. Which ROPP modules do you use regularly or routinely?  
(Select all that apply)

ROPP\_UTILS  
ROPP\_IO  
ROPP\_PP  
ROPP\_FM  
ROPP\_1DVAR

None, but I intend to use one or more modules in the future:

None, and I do not intend to use ROPP routinely because:

4.5. Which external dependencies, if any, do you use with ROPP?

netCDF. If so, which version?  
MetDB BUFR. If so, which version?  
ECMWF BUFR. If so, which version?  
GRIB\_API  
HDF5

4.6. Operationally: Which operating system(s) and distributions (e.g "Ubuntu") are, or would be, mainly used for building and running ROPP?:

(Select all that apply)  
Linux & distribution  
Unix (including HP-UX, AIX, SunOS) & distribution  
Windows/Cygwin & distribution  
OS X / Mac & distribution  
Other (please specify):

4.7. Operationally: Which Fortran compiler(s) are, or would be, mainly used for building ROPP?:

(Select all that apply)  
Intel (ifort)  
NAGWare (nagfor)  
Portland Group (pgf95)

SUN (sunf95)  
GFortran  
G95  
IBM (xlf95)  
Other (please specify):

4.8. Research and Development: Which operating system(s) and distributions (e.g "Ubuntu") are, or would be, mainly used for building and running ROPP?: (Select all that apply)

Linux & distribution  
Unix - including HP-UX, AIX, SunOS & distribution  
Windows/Cygwin & distribution  
OS X / Mac & distribution  
Other (please specify):

4.9. Research and Development: Which Fortran compiler(s) are, or would be, mainly used for building ROPP?:

(Select all that apply)

Intel (ifort)  
NAGWare (nagfor)  
Portland Group (pgf95)  
SUN (sunf95)  
GFortran  
G95  
IBM (xlf95)  
Other (please specify):

4.10. Did the installation/testing of ROPP go smoothly or were there any problems?

(Select one)

Installation and testing went smoothly  
There were one or more problems, but I solved it myself by:  
There were one or more problems, I wrote to the Helpdesk about it, and got a satisfactory solution  
There were one or more problems, I wrote to the Helpdesk about it, but did not get a satisfactory solution, because:

*Further comments:*

4.11. Is there any functionality that you would like to be added to ROPP? (But note that the ROM SAF is not committing to implement any/all suggestions.) We are contemplating including support in the following categories; please indicate specific items, tools or RO-based products that you would use for:

NWP model vertical grids (other than for existing ECMWF and Met Office):  
Climate processing/analysis:

Space Weather:

Ground-based GNSS: (See also the next Question [and/or give a link to a separate page])

Other:

4.12. Ground-based GNSS (GBG) has many similarities with radio occultation, having the same signal source, physical atmospheric interactions but with a different geometry. The ROM SAF has plans to take on responsibility for the maintenance (and potential future development) of the current Met Office 'GWV' and 'GWVBUFR' packages supporting E-GVAP and similar projects in order to ensure formal support. However, such support by the ROM SAF would depend on there being sufficient user community requirement for a 'GBG' module or separate package (but we are not committing to implement any/all suggestions). We therefore wish to establish whether you would require (and use) any of the following (existing or potential future) functionality:

COST-format file I/O and Q/C:

GBG BUFR encoder:

GBG BUFR decoder:

netCDF converter:

GBG Forward model (to derive ZTD from e.g. radiosonde or NWP model profiles):

1D-Var retrieval:

Other:

## 5. User Services

5.1. How important is the ROM SAF Helpdesk function for your use of RO data and ROPP?

Important

Useful, but not very important

Unimportant/have not used it yet

5.2. Is there any functionality that you would like to be added to the ROM SAF Helpdesk?

5.3. Have you used the NRT Monitoring page on the ROM SAF website?

Yes, and I found it useful because:

Yes, but I did not find it useful because:

No, but I plan to use it

No

5.4. Have you used the Climate Monitoring Page on the ROM SAF website?

Yes, and I found it useful because:

Yes, but I did not find it useful because:

No, but I plan to use it  
No

5.5. Is there any functionality that you would like to be added to the ROM SAF Monitoring pages?

5.6. Have you subscribed to the ROM SAF NRT User Notification Service (mail group)?  
Yes, and I find it useful because:

Yes, but I do not find it useful because:

Yes, and additionally I would like to suggest the following:

No, but I plan to sign up for it  
No

## 6. Expert background and interest

Only for those familiar with the RO techniques. Otherwise, you may skip these questions and submit directly.

EPS Second Generation (EPS-SG):

6.1. For EUMETSAT's new EPS-SG program the ROM SAF is planning to develop new products. Please indicate whether you are interested in some of the following products:

AMSU equivalent Temperature

Gravity Wave parameters

*Ionosphere products:*

Would any of the following products be of interest to you either as NRT, Offline or Climate data?

Phase

Amplitude

DCB calibration

Electron density

S4 index

TEC between GPS and receiver

Scintillation maps

*Other:*

Are there any activities related to the EPS Second Generation that you would like to see taken on by the ROM SAF ?

*Miscellaneous:*

6.2. Would you be interested in collocated radiosonde profiles to be included in the level 2 profiles?

Yes  
No

6.3. The ROM SAF has the possibility to provide RO data with a flag to identify the presence of signals reflected off the Earth surface. Would you possibly be interested in such a flag?

Yes  
No

6.3.1. Would it add value to provide the flag in the NRT dissemination?

Yes  
No

6.4. The ROM SAF NRT temperature, humidity, and pressure products are derived via a traditional 1D-Var approach in which the observations (refractivity) and the background (ECMWF forecast fields) are weighted according to assumed observation and background error covariances. If you are a potential user of the ROM SAF temperature, specific humidity, and pressure products (either for NRT or research/climate applications), please indicate which error covariance assumptions would be your preference:

A: For NWP and meteorology

I prefer products based on a traditional 1D-Var approach

I prefer products based on a different approach. Please describe shortly the approach, e.g., with a reference to a paper or other:

I do not intend to use these products for NWP

B: For climate research and atmospheric sciences

I prefer products based on a traditional 1D-Var approach

I prefer products based on a different approach. Please describe shortly the approach, e.g., with a reference to a paper or other:

I do not intend to use these products for climate or atmospheric research

6.5. Is there anything regarding the ROM SAF products that you would like to address which is not covered by the survey?

Thank you very much for taking the time to complete this survey!