

Minutes of Meeting

Meeting Name	:	IRSMAG May 2019 minutes
Meeting Reference	:	EUM/RSP/MIN/19/1085121, v1
Meeting Date	:	16-17 May 2019
Meeting Location	:	EUMETSAT, Darmstadt
Minuted by	:	Bertrand Theodore/Dorothee Coppens
Participants	:	See table below
Distribution	:	Participants
Attachments	:	None

List of participants:

Name	Institute
MAG co-chairs	
Herve Roquet	Météo-France
Bojan Bojkov	EUMETSAT
MAG secretary	
Dorothee Coppens	EUMETSAT
MAG members	
Nigel Atkinson	MetOffice - UK
Claude Camy-Peyret	IPSL
Pierre-François Coheur	ULB
Nadia Fourrie	Météo-France
Antonia Gambacorta	NOAA
Christina Koepken-Watts	DWD
Miguel A. Martinez	AEMET
Tony McNally	ECMWF
Johannes Orphal	KIT
Dave Tobin	CIMSS
EUMETSAT + ESA representatives	
Daniel Lamarre	ESA
Tobias Guggenmoser	ESA
Thomas August	EUMETSAT
Gary Fowler (partially)	EUMETSAT
Stefano Gigli (partially)	EUMETSAT
Jochen Grandell	EUMETSAT



Tim Hultberg	EUMETSAT
Domenico Schiavulli	EUMETSAT
Bertrand Theodore	EUMETSAT
Invited Talk	
Vincent Henri-Peuch	ECMWF



IRS MAG Meeting Agenda

Thursday 16 May	- STG/AFG meeting room	
13:00 - 13:15	Welcome and agenda	Co-chairs
13:15 – 13:45	Revue of on-going actions	Co-chairs
Instrument, brea	dboard and level-1	
14:00 - 14:30	Instrument update and performances (including the Non-Conformity performance)	Daniel Lamarre (15+15)
14:30 – 15:15	ATBD L1 evolutions – version for internal CCB	Bertrand Theodore (30+15)
15:15 – 15:45	Update on the IRS L1 prototype restructuring + status	Bertrand Theodore (20+10)
15:45 – 16:15	Presentation of the study on geolocation accuracy (Action M6.5)	Domenico Schiavulli (15+15)
<u> 16:15 – 16:30</u>	Coffee break	
Discussion on IR	S Test data	
16:30 - 17:00	Presentation of the test data plan (Action M6.6)	Domenico Schiavulli (15+15)
17:00 - 17:30	To revisit old presentation on the needs for L1 and L2 test data (Action M6.7)	T. McNally/C. Koepken-Watts (15+15)
17:30 - 18:00	Presentation of desirable test data/parameters from the IRS Engineering Model (Action M6.8)	Johannes Orphal/Claude Camy- Peyret (15+15)
18:00 - 18:15	ECMWF test data generation and preliminary runs	Bertrand Theodore (10+5)
18:15 - 18:30	Wrap-up	
19:30	Dinner at the restaurant Collins in Darmstadt	

Friday 17 May - Co	ouncil meeting room	
9:00 - 9:15	Welcome	Co-chairs
Atmospheric com	position - CAMS	
9:15 - 10:00	Invited talk on CAMS	Vincent-Henri Peuch (ECMWF) (30+15)
10:00 - 10:30	IRS capabilities for Atmospheric composition, and to identify where developments are needed	Pierre Coheur (20+10)
10:30-10:45 Coffe	e break	
IRS L2 activities		
10:45 - 11:15	Characterization and Error Analysis of PWLR Profiles	Tim Hultberg (15+15)
11:15 – 11:45	On-going studies at EUM and future plans	Thomas August (15+15)
11:45 - 12:00	ECMWF L2 assimilation study	Tony McNally (10+5)
12:00 – 13:00: Lui	nch break at EUMETSAT	
13:00 - 13:15	Proposal for technical and communication for the PC basis update (Action M5A9bis)	Thomas August (10+5)
13:15 – 13:30	L2 retrievals assimilation for regional/convection resolving models (Action M5.A10)	Thomas August (10+5)
13:30 - 14:30	Science plan – outlines of each chapter	Book captains (5+5 each)
GIIRS data		
14:30 - 14:45	GIIRS products quality assessment	Dave Tobin (15)
14:45-15:00	GIIRS data – users feedback	Tony McNally (15)
15:00 - 15:30	Wrap-up	
15:30	End of meeting	



Introduction - co-chairs

Introduction of the meeting.

On-going actions – co-chairs

Action #	Action item description	Comments
Action.M6.1	To distribute the final version of the L1PS (PDR version) to the MAG when available.	Closed : the document has been distributed.
Action.M6.2	To keep a list of test data/parameters from the IRS Engineering Model (EM) needed in line with industry data availability.	Open
Action.M6.3	To distribute the final version of the roadmap for the development of hyperspectral infrared products to the MAG, and investigate the possibility to make it available to a wider audience (e.g. via EUMETSAT website).	Closed : the roadmap has been distributed to the MAG members. EUMETSAT is however not comfortable in making it fully public so it will not be published on the web.
Action.M6.4	To invite somebody from the CAMS community (VH. Peuch?) at the next meeting to discuss the needs for atmospheric composition products derived from IRS.	Closed, VH. Peuch has been invited to the meeting
Action.M6.5	To circulate results of the study on geolocation accuracy.	Closed: this will be presented during the meeting
Action.M6.6	To present the test data plan to the MAG.	Closed: this will be presented during the meeting
Action.M6.7	To revisit Tony McNally and Christina Koepken-Watts's old presentations on the needs for L1 and L2 test data and report to the MAG as a follow-up of M5.A23.	Closed: this will be presented during the meeting
Action.M6.8	To merge the views of Claude Camy- Peyret and Johannes Orphal into a single list of desirable test data/parameters from the IRS Engineering Model (EM) as follow-up of M5.A15.	Closed: this will be presented during the meeting
Action.M6.9	To write a small text to emphasize the requirement for NRT access to ALTIUS products for assimilation purposes, and their potential contribution to validation campaigns.	Closed: this will be presented during the meeting
Action.M6.10	To make available to the MAG the latest version of the MTG EURD (v4).	Closed: the document has been distributed.
Action.M6.11	To come up with a draft of each chapter (Dorothee Coppens, Johannes Orphal, Christina Koepken-Watts, Pierre Coheur, Claude Camy-Peyret, Tony	Closed: this will be presented during the meeting



	McNally)	
Action.M5A2	To compare the performances of the different uniformisation methods	Open
Action.M5A9	To provide answer to the RIDs raised on the IRS L1 ATBD	Closed . Follow-up action: distribute the answer to the MAG members
Action.M5A10	To establish which NWP centres envisage to assimilate retrievals for regional/convection resolving NWP	Open . This will be discussed during the meeting.
Action.M5A9bis	To prepare a proposal for the technical and communications procedure to be followed if an update of the global PC basis is necessary in IRS operations. The proposal should be circulated to IRS-MAG members for feedback.	Closed: this will be presented during the meeting

Before starting with the presentations, Johannes Orphal wants to state that:

- Erik Kretschmer, who has developed the L1PP, has been hired by KIT on a permanent position and is available to answer any question
- A light version of GLORIA is being developed so that it can fly on a wider range of platforms/aircrafts.

Bojan Bojkov states that the actions/answers to the action must be circulated one week before the meeting. Action.M7.A1



Presentations	Actions/Recom.
16 May 2019	
MTG-IRS – Development status & performances update – Daniel Lamarre	
$(\underline{\mathbf{ESA}})$	
Summary	
IRS development status	
• IRS Structural and Thermal Model (STM) available and undergoing various tests	
• Core spectrometer (CS) is almost ready, slight (2 weeks) delay due to	
excessive straylight	
• Flat-EM, proto-Flight Model and FM2 are being produced, still a lack of	
LWIR detectors (only 1 available vs. 3 MWIR)	
Performance overview	
• Radiometric performances	
 NEd1 better than the requirements even in the worst case except below 710 cm-1 	
• Below 710 cm-1 the NEdT and the accuracy don't meet the	
requirements event in the nominal case.	
o These estimations do not take into account the excessive straylight" issue	
\circ Radiometric stability	
 Mid-term (24 hours): compliant with the requirement in 	
band 1, not compliant in band 2 (0.2 vs. 0.1K).	
• Long term (over satellite lifetime): between 0.2 and	
0.25K except at 700 cm-1 (but still better than the 0.3K	
requirement) \mathbf{P} adjument is uniformity not compliant at the hand advect $> 0.4K$	
• Radiometric uniformity not compliant at the band edges: $>0.4K$ below 720 cm 1 and $>0.6K$ above 2100 cm 1 slightly non	
20 cm^{-1} and 20.0 K above 2100 cm ⁻¹ , slightly holi-	
Geometric performances:	
• Spatial sampling distance: 90% within 200m of nominal value	
outliers due to optical distortion and/or sub-pixel deselection	
• LoS stability: 380m RMS, performances driven by μvibrations	
• Absolute spatial knowledge error: <1.2km	
Coregistration:	
 Intra-band: 350m in the worst case 	
 Inter-band: typically 540m, 1120m in the worst case 	
• Integrated energy:	
• The original requirement stating that 67% of the IE must be	
within 4x4km has been waived. The new requirement is that 92%	
industry is compliant	
 It must be noted that this does not mean that the spatial resolution 	
is 12km: the FWHM of the PSF increases from 4.2 to 4.8km	
• In-field straylight non-compliant by a factor of 2, sun straylight nearly	
compliant except in MWIR, compliant when correction is applied.	
Several components of the space segment are being validated this year, some	



quite fragile such as the detector or the pointing mechanism.	
Discussion: Dorothee Coppens: comment on the MOPD: it is band dependent and the value is not exactly the one indicated on one of the slides. Daniel Lamarre: I need to check to confirm	Action.M7.A3: ESA to check the max OPD of the instrument and its
Dorothee Coppens: Is there any info on the instrument chromatism? Expected evoluation in time?	band dependency
Daniel Lamarre: There are no news for the moment and there won't be any until the characterization of the PFM. It is not expected that the pattern will evolve in time. For ESA, chromatism is a closed issue. Will provide more info on the model used to generate the values provided to EUMETSAT in 2018.	Action.M7.A3bis: ESA to provide information on the model used to generate the
Claude Camy-Peyret: If the footprint is 5km at nadir, what will it be at mid- latitude? Daniel Lamarre: this is a purely geometrical computation, the value is probably of the order of 6km.	chromatism values already provided to EUMETSAT
Johannes Orphal: what about the electronics? Daniel Lamarre: no problems have been identified with the Data Processing Unit. This part of the project turned out to be the easiest one.	
Domenico Schiavulli: what about the schedule? The instrument CDR is still planned this summer? Daniel Lamarre: yes, the IRS CDR starts this summer. Data pack will be at EUMETSAT by the end of July, collocation meeting @OHB by mid-October.	
Domenico Schiavulli: Would it be possible to have the NedT values in digital version? (i.e. not simply a graph) Daniel Lamarre: yes.	
Herve Roquet: what about the test data from the EM that have been mentioned at the meeting last November 2018? Daniel Lamarre: yes, this is possible to provide some data, probably this year (2019). Simply provide a list of the needs, in principle there are no problems to provide them to you.	Action.M7.A3ter: Provide EUMETSAT with engineering model test data as soon as they are available
<u>ATBD L1 evolutions – Bertrand Theodore</u>	
 Summary The IRS L1 ATBD will evolve along four lines: L1 spectral sampling Monitoring Optimization of the spectral calibration correction Scene heterogeneity The instrument spectral sampling will be kept up to the L1 product: it is linked to the maxOPD that is 0.829 and 0.828cm in LWIR and MWIR 	



 respectively. Because the sampling is then a rational number, the format specification will be updated to provide in the product the index of each sample and the user will then be able to compute the wavenumber scale to the precision he/she wishes. The monitoring section has been completely reshuffled distinguishing between the online and the offline functions. The importance of having so-called "external calibrations" is emphasized. It is proposed to merge the spectral calibration correction with the uniformization to optimize the L1 processing and avoid oversampling every single spectrum. Finally, a heterogeneity index is introduced. To do so however, it is necessary to assess the performances of the imager mode. It turned out that the images are single snapshot of the interferogram baseline i.e. hampered by: Noise Spectral content Interferogram baseline being not a constant Furthermore the images are not processed on-board i.e. the non-linearity is not removed. The calibration performances/concept are thus doubtful and investigations are needed. Discussion: All: Discussion on the image calibration Would it possible to acquire images over more interferogram samples ? → no 	Action.M7.A4: Circulate the INR ATBD and any other supporting documentation on the image navigation and registration to the MAG members
Dorothee Coppens clarified that merging the spectral calibration with the uniformization is not in the IPS L1 baseline	
dimonifization is not in the fixs E1 baseline.	
<u>Update on the status of the IRS L1 prototype – Bertrand Theodore</u>	
 Summary EUMETSAT has received in July 2018 a prototype of the L1 processor: the L1RP. It turned out however not to be perfectly aligned with the processing specifications On the other hand, EUMETSAT has got for a long time IRASS that includes a L1 processor. It is also not aligned with the L1PS (the PS was written after IRASS was delivered) but some parts could be very useful and as a performance tool it is easily customizable. It has thus been decided to merge both concepts, taking the best of the two and including at the same time the SRF estimation model. As simple as it sounds, it will last until spring 2020 to have a complete running validated prototype. 	
Discussion	
Hervé Roquet asked if the PC compression is part of it. DCo clarified that this is indeed the plan and that a prototype exists as separate S/W	
MTG IRS Inter-band Co-registration Assessment – Domenico Schiavulli	



Summary:

<u>Summary.</u>	
 This is a follow-up of action M6.A5 assigned to EUMETSAT to provide more information on the accuracy of the geolocation. Reminder: the difference between the geolocation of the two bands will be stored in a static file available to the users. Once the (lat,lon) of a given pixel is given in one band, the user will be able (using a method described in the IRS data user guide) to compute the position of the same pixel in the other band either: By converting the (lon,lat) in (az,el), to linearly interpolate and then to convert back to (lon,lat) By a 2D-interpolation of the (lon,lat) of the neighbouring pixels By assigning the same (lat,lon) to both pixels The three approached have been implemented and compared on simulated data. It turned out that: The (az,el)-interpolation needs more operations than the others and the gain in accuracy is limited The (lat,lon)-interpolation is simpler but yields large errors Further assessment needed using an accurate model of the IRS LoS and comparing results with actual on-ground measurements 	
Discussion: Bojan Bojkov: presenting the results on a kilometric scale is misleading; they should be presented in relative pixels instead. We should be careful not to open the door to bad press by presenting results showing a difference of 45km at the edge of the disk Domenico Schiavulli: that's right. Anyway the exercise will be re-done after the instrument CDR when the design of the instrument is fixed.	
Tobias Guggenmoser: question to level-2 people: do you use both bands simultaneously? Or in other words do you need the geolocation to be the same? Claude Camy-Peyret: if you want to retrieve water-vapour you have to ensure that the footprint is the same. For some other species however the bands can be used independently.	Action M7.A5: ESA to provide by August 2019 info on the status of the geolocation accuracy
Herve Roquet: so in summary we have a geo-location, with a given accuracy, and a deregistration. Can the IRS-PP deal with it? Nigel Atkinson: It is on the list of features to be included so yes, in principle the IRS-PP could deal with it.	Action M7.A6: MAG members to
Tony: There is no requirement that the two bands are co-located but we must know where they are. Either it is not a problem then we stop discussing it or it is and then we have to plan for the worst. Can we accelerate finding out whether it is a problem or not? Daniel Lamarre: this will be clarified in the weeks to come	assess whether the pixel geolocation accuracy is an issue or not for their applications
MTG IRS IFC Test Plan – Domenico Schiavulli (answer to action M6.A6)	
Summary:	



 Presentation of the IRS IFCT verification and validation (V&V) activities which correspond to: Pre-launch: 	
Instrument performances verification	
 Processing performances verification 	
 Operational processor implementation verification. 	
including generation of test data	
• Post-launch	
 Commissioning 	
• Concerning the test data generation EUMETSAT will receive the Payload	
Data Consister (DDC) in 2020 that will be able to consiste level 0 data	
Data Generator (1 DG) in 2020 that will be able to generate level-0 data	
files. A list of scenarios has been defined for its acceptance review that	
can serve as a basis for further test data generation.	
• Test data for the V&V of the IRS L1 operational processor will have to be	
concreted by Echryory 2020 for y1 December 2020 for y2 For I 2, this	
generated by rebruary 2020 for v1, Determoer 2020 for v2. For L2, this	
is still to be defined.	
• A discussion of the commissioning test plan has started. The definition of	
the tools/tests to be used/performed is due by the end of 2019.	
Discussion:	
Dorothee Coppens: what is the content of the PDG?	
Domenico Schiavulli: there are three modules:	
 Scane generator (DING) 	
• Instrument and on-board processing simulator (DMAN)	
• Data formatting (DFPG)	
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• Two level of L1 test data identified:	
• PC scores possibly with the corresponding raw spectra	
• Raw radiances	
• Tests can be split into 3 categories:	
• Products format checking: products for which the format is close	
to the final content but without real geophysical content	
• Tests of the data processing algorithms: need realistic	
geophysical situation and instrument characteristics	
controlled atmospheric condition (possibly from a high resolution	
model) and full use of the instrument characteristics.	
The latter is probably not needed for NWP/NWC users	
NB: at some point before launch a full data stream for final	
infrastructure and processing tests should be set up.	
• L1 needs for technical testing:	
• Final format	
• Several dwells over Europe, possibly full disk for global NWP	
• Period TBD but several consecutive time slots, e.g. 24h-data 1	
year before launch and 1-2 weeks worth of data about 3-6 months	
• I 1 needs for NWC: subset of the previous important is to have a couple	
of dwells over Europe and several consecutive slots. Input data should	
originate from high-resolution NWP fields	
• L2 needs for technical testing: very similar to L1	
• L2 needs for evaluation: it is suggested to use the GRUAN simulator: IRS	
simulations based on selected RS data	
	Action M7.A7:
Discussion:	dwell of IRS I 1B
Tony McNally: the problem of test data generation is not sufficiently addressed:	PCs which was
this will represent a massive processing effort generating a huge amount of data	mentioned at the
Gary Fowler: there is a team at EUMETSAT to address this issue.	SWG-46 by the
Bojan Bojkov: this is part of the MTGUP! (along with EPS-SG-Up) activity	end of Q3/2019 to
which next meeting will take place in Autumn 2019 with the participation of	the MAG
ECMWF.	members
Nigel Atkinson: it has been suggested some time ago that a dwell will be	
provided to the user, has this been done?	Decommondation
Jochen Grandell: no it has not, the Data Release Board has not been held yet	M7 D1.
Christina Koepken-Watts: transfer to small centres is also very important	EUMETSAT to
To any MaNallan them is not encoded with size and any tool date for the second The	allocate more
Tony McNally: there is not enough priority given on test data for the users. The moment when ELIMETS AT will start generating them and users receiving them	resources and give
could be the start of our problems!	a higher priority
Herve Roquet: there is clearly a lot of work to be done on that issue and the	on test data
MAG recommends that it is given the attention it requires.	generation.
Pierre-François Coheur commented that if only T/q/O3 are included, AC cannot	
participate in the preparation really. Other realistic spectra including e.g. SO_2	
and NH ₃ should be included.	



Tony McNally: two datasets should be generated for the users: one with sensible geophysical content, one for mass production. The test data provided by ECMWF to EUMETSAT include only T and q as dynamical variable but could incorporate trace gases available at ECMWF from CAMS.	
<u>List of desirable test data from the IRS EM – Claude Camy-Peyret (answer to action M6.A8)</u>	
 Summary: The presentation is merging the views of Johannes Orphal and Claude Camy-Peyret on the subject as a follow-up of action M5.A15. The work performed with these data does not aim at duplication the analyses performed by industry and ESA This would be rather used to get an independent estimate of the radiometric noise and spectral responsivity. A list of data is proposed along with analyses that could be performed. Discussion: Daniel Lamarre: At first sight, this looks possible. Note that measurements performed with the blackbody will not be performed with the actual blackbody of the instrument. The raw measurements are oversampled are must be processed along with metrology data. Tobias Guggenmoser: Raw data represent a large volume, especially taking into account the metrology. Claude Camy-Peyret: People are willing to work on this; the datacube should be properly defined. 	Action.M7.A2: Communicate on the possible availability of the engineering model test data listed by Claude Camy- Peyret answer to Action.M6.A8
 <u>Summary:</u> In November 2018, ECMWF has proposed to help generating IRS test data using their experimental high spatial resolution model. Since then, a full dwell (LAC3 dwell5) has been generated at a spectral resolution of 10⁻³ cm-1. They have been generated at ECMWF using LBLRTM. Effect of slanted view is not taken into account; T and q are dynamically modelled, trace gases distribution is realistic but is not a dynamical variable. This dataset is huge: 25600 files, each of them is 126 Mb so 8.6 Tb in total. The files are useable as input of IRASS. 1 dwell requires 8 days computing time. 	
 computation of a run disk of even a EAC is not possible. But is it necessary? The scope of the tests to be performed guides the definition of the data to be generated, for example: Assessing the spectral/radiometric performances does not necessarily require a full LAC not even a full dwell Assessing the data flow/timeliness does not require accurate geophysical simulation 	



Discussion: Tony McNally commented that the computing time is not driven by the spatial resolution but rather by running LBLRTM in full resolution as it is not vectorised. K-CARTA or LBLRTM at degraded spectral resolution could be an alternative. Pierre-François Coheur commented that the temporal sampling, i.e. having a representative diurnal variability of the target atmospheric species, is more important for Atmospheric Composition (AC) than spatial coverage. AC teams could work out the generation of synthetic radiances themselves if provided with high spatial/temporal resolution realistic state vectors. Tony McNally however replied that the chemical outputs from CAMS cannot be generated at these spatial resolutions, they would have to be interpolated.	Action.M7.A8: all MAG members to provide a detailed description of requirements on test data for scientific and functional purposes
Requirements for NRT access to ALTIUS products – Claude Camy-Peyret	
(answer to action M6.A9)	
Summer	
• There are currently discussion between ESA and BIRA IASB on the	
funding of the ALTIUS ground segment	
Possible actions:	
o Wait	
 EUMETSAT to contact ESA for a status of the discussions 	
\circ MAG+EUMETSAT to write a formal letter of support to	
ALTIUS and ESA	
• NWP centres (at least ECMWF) are ready to test the assimilation of ALTIUS O3 but there should be a commitment that the data is delivered in NRT	
• A possible content of the message is proposed.	
• There is an opportunity for joint validation campaigns using a large spectrum of instruments and models	
• This could be the starting point for an intensive year of ozone	
observations. An international ozone year could be proposed for the	
years 2022-2023, a time when the impact of the Montreal protocol	
5110010 07 17-2557550.	
Discussion:	
Tobias Guggenmoser: what is the MAG role in this?	
Tony McNally: we had a presentation about ALTIUS during the last MAG and	
we have an interest in this: ALTIUS could be very useful for the validation of IDS standard arous soundings are not always worful. The MAC could then	
encourage ELIMETS AT to be pro-active in supporting this activity	
encourage DowiDrowr to be pro-active in supporting this activity.	
Pierre Coheur: I am not very optimistic on what IRS will provide in term of O3	
sounding. For that, it will be better to rely on IASI and IASI-NG.	
Thomas August: the specificity of MTG is the high temporal coverage; ozone	
fields derived from IRS measurements will be a plus to understand the	
atmospheric dynamics as ozone is a tracer in the stratosphere. Herve Roquet: I am not sure the MAG is the right forum to propose an ozone.	
year. Summarizing the three propositions:	



 The letter of support to ALTIUS is fully ok The possibility of having joint validation campaigns is of course interesting but it is up to EUMETSAT to decide on the opportunity to perform validation campaigns for Cal/Val activities On the suggestion of having an ozone year: it is a stimulating idea however having a letter signed by the MAG does not seem realistic Tony McNally: the MAG could on the other hand emphasize that by the time IRS will fly, there will be a deficiency in ozone campaigns so it is important to plan such activities in support to the mission. Thomas August: I am not sure that the MAG can send a letter: the role of the MAG is to advise EUMETSAT that can then decide to send such a letter. 	Action M7.A9: Claude Camy- Peyret/Tony McNally/Christina Koepken-Watts to draft a letter of support to ALTIUS
15.14 2010	
1/ May 2019	
<u>CAMS: a consistent, quality-controlled information on atmospheric</u>	
composition worldwide vincent-Henri Peuch	
Summary:	
Overview of the Copernicus Atmosphere Monitoring Service:	
• CAMS operational service has started in 2014 and reaches now the end of	
its first operational phase. An extension of the service beyond 2020 has	
been proposed and CAMS could become a permanent program of the	
EU.	
• Copernicus is a portfolio of various services related to the monitoring of	
change monitoring	
• CAMS is not only about observations but also modelling: the idea is to	
combine the best of both worlds to remedy for example to the gaps	
between observations by blending them with models.	
• CAMS is an ensemble of services: O3 layer, radiative forcing, solar	
radiation, global reanalyses. CAMS deals with a large input data volume	
(70 satellite data streams) and leaves the user run the last mile	
• The elements of the service includes:	
• The IFS model	
• Satellite/in-situ observations • Multi model ensemble over Europe whose boundary conditions	
are given by the IES each of them with different description of	
the chemical processes which permits to give an uncertainty on	
the forecast	
• Emphasis on the validation/verification: routine plots, quarterly reports	
• Main products:	
• twice daily global analyses+forecast at 120h (40km spatial	
o daily regional analyses+forecast at 96h over Europe (10km	
resolution)	
\circ global analyses of CO2 and CH4 at 9km, delayed mode	
• monitoring of the O3 layer, replacing NASA	



 reanalysis 2003-2017 	
• emissions including automated info from ship emissions but also	
volcanoes etc	
 pollen forecasts 	
• The CAMS toolbox has been developed allowing to assess what is the	
impact if the emissions from a given source are cut (for a given	
meteorological situation)	
 CAMS is also present on the WMO and EEA websites, on many smartphone applications but is also used at local level with applications such as the assessment of the impact of road traffic change or the quantity of solar radiation at a given location (among many others) Contribution of GEO sounding to CAMS: GEO main advantage is the high time sampling that could allow disentangling complex processes (conversely to LEO that can sample a given area only twice a day) Other requirements (in general): Near surface Specific pollutants: PM10/2.5/1, O3, NO2, SO2 + CO, NH3 Regarding IRS, the key parameters are: CO in the lower troposphere Aerosols (dust, volcanic ash) Lowermost O3 (but it's probably difficult for IRS so a combined product with S-4 would be useful) PAN etc for fires and transport of pollutants CO2, CH4 and N2O 	
• Spatial resolution as fine as possible: 10 km	
• Temporal resolution in the order of 1-3h max.	
<u>Discussion</u> : Antonia Gambacorta: are the validation reports available? Vincent-Henri Peuch: yes, they are on the CAMS website	
<u>nups://aunosphere.copernicus.eu/</u>	
Thomas August: Similarly, are the validation dataset available? Vincent-Henri Peuch: CAMS has no mandate to distribute observations. However, on a case-by-case basis, this may be possible but this would of course require the agreement of the PI of the related instrument(s).	
Claude Camy-Peyret: what is the resolution over the globe? 40 of 10km? Vincent-Henri Peuch: at global scale the resolution is 40x40km	
Claude Camy-Peyret: what about unexpected sources? Vincent-Henri Peuch: if the source is observed (whatever the mean), it will be picked up by the assimilation system even if the latter does not include this source. But of course it is better to have the source described in the model: the system cannot invent sources from nothing.	
IRS canabilities for Atmospheric composition Pierre Cohour	
LING CADADITITIES TO FALTIOSOTICTIC CONDUSTITUT == FICTIC CONCID	1



Summary:

- Hyperspectral sounding of the atmosphere inherits from a long series of US instruments from IMG to TES but then came IASI with its large continuous spectral coverage and low noise, even if the spectral and spatial resolution are "medium". We now have more than 15 years of global measurements.
- When IRS is put in perspective with IASI(-NG), two main weaknesses appear:
 - o narrower spectral range i.e. IRS will miss CH₄, N₂O, SO₂, HDO
 - Coarser spectral resolution and larger noise that means a reduced vertical and surface sensitivity
- But there are opportunities:
 - Continuous coverage of the Earth surface over the disk
 - Higher spatial resolution
 - High temporal sampling
- This could be an advantage for the measurement of CO and O3 column, NH3. However IRS seems to be of little added value for O3
- In summary, tropospheric chemistry seems to be out of reach with IRS. On the other hand, a significant contribution can be expected in areas implying rapidly varying processes; for example, fires monitoring will probably a great application for IRS. Some studies should be performed, for example:
 - Benefit from synergies (IR/UV; LEO/GEO IASI-NG and IRS; Nadir/limb)
 - $\circ~$ Possibility with IRS to infer the diurnal cycle of pollution for O_3, CO, NH_3, dust
 - Capability of IRS to detect point sources, for short-lived maybe also for long-lived species (CO₂? Others?). Oversampling ?
 - Added value of IRS for large scale processes
 - o Etc...

Discussion:

Tobias Guggenmoser: what about synergy, would it be possible to use IASI or IASI-NG to detect SO2 (that cannot be detected by IRS) and then use IRS to track it?

Pierre-Francois Coheur: yes this can be envisaged

Tony McNally: with IRS, we have the opportunity to wait for a clear scene conversely to IASI that passes twice a day over a given point that is not necessarily clear at that time. In one day of IRS, we will have more observation that in 1 month of IASI.

Pierre-Francois Coheur: it is true that the temporal and spatial resolutions of IRS will be beneficial to atmospheric chemistry.

Vincent-Henri Peuch: what about CO, is IRS able to observe it?

Pierre-Francois Coheur: IRS noise is quite high, the simulations shown in the slide have been performed with 0.8K i.e. at the level of the noise requirement in the CO region. But the simulation should be re-done using the latest instrumental characteristics.



Claude Camy-Peyret: at least this shows the interest of having a good SNR in the CO band (in MWIR) Pierre-Francois Coheur: we need realistic test data at the actual resolution of the instrument (temporal, spatial and spectral). It is important, even if it is difficult to generate, in order to assess what can be done for which applications.	
Bojan Bojkov: do you have plans/a roadmap to work on this? Pierre-Francois Coheur: no.	
Herve Roquet: how to deal with PCs is an important question. How should this be tackled? A dedicated dataset?Dorothee Coppens: we have a study foreseen for the familiarization of users with PCs.Pierre-Francois Coheur: anyway this is not something we should look now as we don't know yet what we are going to getTim Hultberg: at least the ability of the current system to cope with PCs is easy to test	
Bojan Bojkov: the synergy between different instrument is difficult to implement operationally; this is something the science plan should address Vincent-Henri Peuch: the synerg and how to assimilate different species (separately/together) etc are indeed questions to address.	
Characterization and Error Analysis of PWLR Profiles Tim Hultberg	
 Summary: Computation of averaging kernels/covariance matrices is possible for statistical retrievals (not only for optimal estimation). The formalism to do so is given in the presentation Examples of the temperature and humidity averaging kernels for two classes corresponding more or less to clear and cloudy scenes are presented Applying the formalism to the estimation of the PWLR null space gives sensible results: the error estimate using forecasts as prior in PWLR is lower than in the case of a forecast-free PWLR. In conclusion, the error characterization of statistical retrievals is easy to obtain 	
Discussion: Claude Camy-Peyret: how are the classes defined? Are they simply the distinction between clear/cloudy? Tim Hultberg: no, there are hundreds or even thousands of classes, these are rather clusters of observations. Regarding the example presented in the slide, the classes are called clear/cloudy but this does not necessarily mean that they correspond to clear/cloudy scenes, it's probable but this has not been checked.	
Tobias Guggenmoser: how well do the classes separate? Tim Hultberg: in general they don't differ much with each other but it can	



happen that there are discontinuities	
Tobias Guggenmoser: how do you decide the number of classes?	
Tim Hultberg: mostly by trial and error	
On-going studies at EUMETSAT and future plans Thomas August	
Summary	
• Several on-going studies:	
• Assimilation of IASI L2 T/q profiles at Meteo-France. Since last	
MAG:	
 Improved error characterization 	
 Extended study period 	
• Use of IASI L2 v6.4	
 Evaluation against objective external references shows 	
comparable scores wrt assimilation of L1 Evaluation difficult for isolated case studies	
 Evaluation difficult for isolated case studies Final presentation in June 2019 	
\circ Assimilation of IASI L2 T/q profiles at ECMWF:	
 Approaching end of initial study 	
 See next presentation by Tony McNally 	
 Instability monitoring using IASI L2 as proxy for IRS 	
 T/q routinely ingested at OMSZ, Hungary 	
Presentation of test cases	
• ESSL: started in January 2019	
 Monitoring facility adapted to IASLL2 	
 Set of convective parameters to be displayed selected 	
 Ready for testbed-2019 and interaction with forecasters 	
• Study to be started very soon: Retrievals at high satellite zenith angle	
• Planned studies:	
 Assimilation of reconstructed radiances in NWP 	
• Use of reconstructed radiances for atmospheric chemistry	
• Validation/monitoring hyperspectral soundings using	
campaigns/GRUAN	
Discussion:	Action.M7.A10:
Antonia Gambacorta: what is meant by pseudo-soundings?	Plan a slot during
Thomas August: in AROME, radio-soundings are assimilated assuming no error	the next meeting
correlation between levels. IASI-L2 profiles are treated as soundings i.e. without	to discuss what
error correlations either	would be the
	of layers to
Bojan Bojkov: How the users are comfortable with 137 levels products?	retrieve
has definitely be optimized in terms of number of layers and is running on much	meaningful
less levels	atmospheric
Dorothee Coppens: at EUMETSAT, RTTOV is typically run with 101 levels.	information
Bojan Bojkov: How many number of levels would be ok then? Should we do	



some further analysis on what would be the optimal number of levels?	
\rightarrow This should be discussed at the next meeting	
<u>MTG-IRS L2 data (IASI proxy) assimilation into the ECMWF model –</u>	
Tony McNally	
Summory	
• Two types of impact testing have been performed:	
• Two types of impact testing have been performed.	
show an impact	
• Full 4D-Var NWP system: operational quality so impact not	
easily visible	
• In both cases only clear scenes IASI radiances and L2 are used.	
• In the depleted system, assimilation of IASI-L2 temperature profiles was	
clearly detrimental, conversely to the assimilation of IASI-L2 humidity	
profiles. The same effect is also visible in the full system, although to a	
lesser extent.	
• The assimilation of the temperature profiles is not giving satisfactory	
results probably because the systems (both the depleted and the full ones)	
are already accurate and assimilation does not bring any new information	
• An accurate description of the observation error is essential	
• The magnitude of the impact is very sensitive to the error correlation of the	
L2 retrievals; this topic will be studied in a 6 months extension phase.	
Discussion: Claude Camy-Peyret: how are the error correlations estimated? Tony McNally: they are estimated using the classical method in use at ECMWF to estimate the radiance error correlations. We know they are not correct, it's the purpose of the study extension to improve this aspect of the problem	
Dave Tobin: does the system includes assimilation of CrIS and AIRS? Tony McNally: yes, the full system includes assimilation of all satellite data. In the depleted system, only conventional observations and AMSU-A are assimilated	
Thomas August: during the extension phase, the practical aspects of the use of the covariance matrix will be studied, not so much the impact of it given the limited duration.	
Thomas August also mentioned that, in the absence of observation operators, the	
more satisfactory results of assimilating humidity may come from the fact that	
the vertical scales of the information in the model and in the IASI products are	
more consistent than for temperature.	
Tim Hultberg suggested that the unsatisfactory results for the assimilation of the temperature profiles could be related to the fact that averaging kernels were not taken into account.	
Answers to actions M5.A9bis and M5A.10 – Thomas August	



Summary:

The presentation aims at answering two actions that have been raised during the MAG5:

• M5.A9bis: Proposal of an update procedure for the IRS eigenvectors

- IRS PC products consist in:
 - Scores along static global eigenvectors (core basis)
 - A limited set (5) of eigenvectors and scores of the residuals computed for each dwell
- Updates to the static core basis are needed to include new spectral signatures (in case of rare events e.g. volcanoes...)
- Such a change would be managed like any other changes to operational products, including:
 - relevant notification period: 3 months is proposed
 - the provision of test data
- The hybrid approach does not require frequent updates. But planned regular updates are foreseen with a frequency that has to be adjusted upon need but that could be annual.
- M5.A10: To establish which NWP centres envisage to assimilate retrievals for regional/convection resolving NWP
 - This is a question that have been raised to SWG in 2014, to which only the Met Office has answered: "The Met Office currently have no plans to assimilate retrieved T and q profiles from MTG-IRS for regional or convective-scale NWP"
 - However, surveys have been conducted more recently (2016 and 2019) on the usage of Metop data for regional NWP:
 - 18 countries have answered, of which 8 have indicated use of IASI-EARS L2 profiles for NWP
 - This showed that there is currently little to no operational assimilation of hyperspectral retrievals for regional NWP; few plans exist, however. Furthermore, user awareness is growing since EARS-IASI L2 is in pilot phase (November 2017) and since studies are on-going at ECMWF and Meteo-France.

Discussion:

Herve Roquet: is there a way to label a given set of eigenvectors? Thomas August: yes, there are under configuration control

Tony McNally: raised again the concern of NWP centres have about EUMETSAT performing ad-hoc updates of the eigenvector basis used in the operational dissemination of PC scores to users. If EUMETSAT decide that an update is absolutely necessary (e.g. because something in the atmosphere has changed rendering the previous eigenvector basis sub-optimal) then there must necessarily be an impact on the radiances that users will reconstruct from the new PC scores. If this is the case, the proposed 3 month notice period (with parallel dissemination of old and new scores) may not be sufficient to perform the necessary testing NWP centres will need to do, especially if re-calibration of the observation error covariances (to reflect the new data) is required. Moreover, it must be appreciated that updates such as these and the required parallel testing place a significant extra work burden on NWP centres who are already stretched

Action.M7.A11:

ECMWF	to
present c	oncerns
regarding	the
update of	the PC
core basis	

Action.M7.A12:

as a follow-up of action M5.A10, EUMETSAT to contact the leading entities of European regional



 to maintain the operational assimilation of the wider satellite network. Tony requested more clear justification of exactly why updates would be needed, more details on the diagnostics that will be performed (at EUMETSAT) to measure the impact of the PC update (including inter-channel correlations) and an assurance that updates will be performed infrequently and only if absolutely critical and necessary - the definition of this to be guided by the MAG Tim Hultberg: replied that Updates would be needed to capture new directions of atmospheric signal, not captured in the first PCs. This could be due to rare events such as volcanic eruptions and wild fires or possibly increasing (or decreasing) levels of some atmospheric gases, exactly as it was presented by Thomas August. The impact of a PC update on the reconstructed radiances is very small (much smaller than, for example, the difference between the four IASI detectors) and is orthogonal to the directions of the atmospheric signal. No recalibration of the observation error covariance would be needed. The impact is fully determined by the two reconstruction projections (the old and the new, both of which are known) and is therefore very easy to characterize. 	NWP consortia as well as NOAA to know about their plans to assimilate L2 products – Summary to be presented at the next MAG
<u>IRS science plan – Book captains</u>	
 Presentations of the status of the various chapters: Chapter 1: Rationale for IRS and system description → Dorothee Coppens just started, very draft, no contributors Chapter 2: Cross-cutting challenges → Johannes Orphal not yet started Chapter 3: Support for operational meteorology → Christina Koepken-Watts presented some slides on the content of the chapter along with a written draft Chapter 4: Support for AC monitoring and forecasting → Pierre Coheur presented some slides: he sent a draft to the MAG secretariat, the chapter is quite advanced Chapter 5: Support for future climate science → Claude Camy-Peyret exposed his views on this section in a presentation: Tony McNally emphasizes the importance of traceability, supported by Herve Roquet who mentions that the contribution from EUMETSAT should insist on the question of traceability and instrument stability Chapter 6: Scientific process studies → Tony McNally. The pertinence of this chapter will be assessed when the rest of the document is finished. The document should end with future perspectives. 	
Discussion: Herve Roquet: we should aim at writing a short document, this is to be kept in mind Pierre-Francois Coheur: we should then define the content of the document, the number of pages etc The document should not be a compilation of chapters that do not relate to each other and we should avoid for example recalling in	
	1



each chapter the description of the mission Tony McNally: indeed, the introduction belongs to chapter 1 and the principles enounced in this part should not be recalled in the other parts. Either we want it to be a readable document or a reference one but both are not possible. If we want to be brief we should focus on what is special with IRS and the rest should be removed. Pierre-Francois Coheur: I have tried to do so and it is the main problem: you always have to recall some principles/history. Nigel Atkinson: we could then leave what each book captain consider as important and consider a shorter version for later Herve Roquet: there is then two strategies: first write a draft and then discussion with the other contributors or the other way around. We should aim at a 20 pages document.	Action.M7.A13: Circulate a draft of each section of the science plan by the end of September so that it can be discussed during the next MAG meeting
GIIRS L1B assessment Dave Tobin	
 Summary: Most of the work presented here has been performed by B. Knuteson GIIRS data are received at CIMSS with a 15 minutes latency. The processing that has been applied is not very clear. Occasionally very bad spectra, not useable Comparison with CrIS has nonetheless be performed using SNOs. It showed: Large, time and detector dependent, radiometric differences (especially in the region 720-740 cm-1) Obvious spectral calibration errors of the order of 500 ppm in LW and 150 ppm in MW Recent communications with CMA suggest that new L0-L1B calibrations will be put in place soon 	
Dave Tobin: no we don't.	
<u>Using the ECMWF model + IASI to evaluate FY-4A GIIRS</u> Christopher Burrows and Tony McNally	
 <u>Summary:</u> FY-4A products exhibit some very serious data problemsmostly extreme variations between dwells Applying a constant shift of 0.325 cm⁻¹ across the entire GIIRS spectrum significantly improves agreement with ECMWF model simulations and IASI observations FY-4A assimilation experiments to follow 	
Discussion: Herve Roquet: is the SRF part of the data? Tony McNally: no it is not, we are running blind, we don't even know the apodisation function that has been used.	



IRSMAG May 2019 minutes

AOB None

Ideas for the next meeting: Next MAG will be held in November 2019 in Paris.



Recommendations:

List of Recommendations	
Recom M7.R1	EUMETSAT to allocate more resources and give a higher priority on test data generation.



Actions:

List of Actions				
Action #	Action item description	Due date	Actionee	
Action.M7.A1	Circulate the status of the actions a week before the MAG meeting	Next MAG	MAG secretariat	
Action.M7.A2	Communicate on the possible availability of the engineering model test data listed by Claude Camy-Peyret answer to Action.M6.A8	Next MAG	ESA	
Action.M7.A3	Provide EUMETSAT with engineering model tests data as soon as they are available	ASAP	ESA	
Action.M7.A3bis	Check the max OPD of the instrument and its band dependency	ASAP	ESA	
Action.M7.A3ter	Provide information on the model used to generate the chromatism values already provided to EUMETSAT	ASAP	ESA	
Action.M7.A4	Circulate the INR ATBD and any other supporting documentation on the geo-location to the MAG members	June 19	EUM	
Action.M7.A5	Provide information on the status of the IRS pixels geolocation accuracy	August 19	ESA	
Action.M7.A6	Assess whether the IRS pixels geolocation accuracy is an issue or not for their applications	Next MAG	MAG members	
Action.M7.A7	Distribute the existing dwell of simulated IRS L1B PCs which was mentioned at the SWG-46 to the MAG members	Q3/2019	EUM	
Action.M7.A8	Provide a detailed description of requirements on test data for scientific and functional purposes	Next MAG	All MAG members	
Action.M7.A9	Draft a letter of support to ALTIUS	ASAP	Claude Camy- Peyret/Christina Koepken- Watts /Tony McNally	
Action.M7.A10	Plan a slot in the agenda of the next meeting to discuss what would be the optimized number of layers to retrieve meaningful information of the atmosphere	A month before next MAG	MAG members and Tim Hultberg	
Action.M7.A11	Present concerns regarding PC updates	ASAP	Tony McNally	
Action.M7.A12	As a follow-up of action M5.A10, EUMETSAT to contact the leading entities of European regional NWP consortia as well as	Next MAG	MAG secretariat	



	NOAA to know about their plans to assimilate L2 products – Summary to be presented at the next MAG				
Action.M7.A13	Circulate a first version of each section of the science plan	End of Sept	Book captains of the sections of the science plan		
Previous actions still open					
Action.M5.A2	To compare the performances of the different uniformisation methods	Next MAG	Nigel Atkinson/Doro thee Coppens		
Action.M6.A2	To keep a list of test data/parameters from the IRS Engineering Model (EM) needed in line with industry data availability.	Next MAG	EUM		

"by next MAG" should be circulated 2 to 3 weeks before the meeting latest.