iSHAI and PGE00
key tools for preconvective monitoring and for the preparation of the MTG era

Miguel A. MARTINEZ, Xavier Calbet

AEMET

mmartinezr@aemet.es

iSHAI on NWC SAF framework

iSHAI (imager Satellite Humidity and Instability)

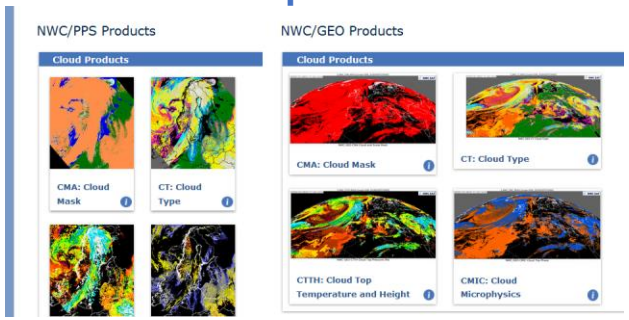
Former PGE13 SPhR(SEVIRI Physical Retrieval)

http://nwc-saf.eumetsat.int
http://www.nwcsaf.org/

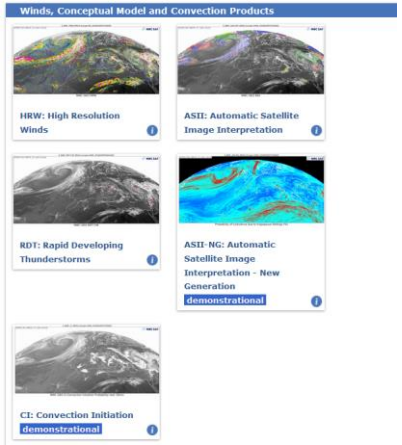
iSHAI

Satellite Humidity and Instability Products

Cloud products

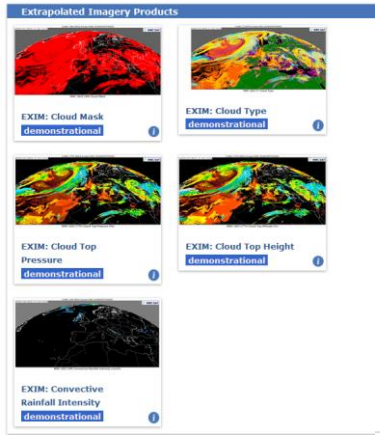


Satellite Winds, Conceptual Model and Convection Products



Precipitation Products

Extrapolated Imagery Products



iSHAI and PGE00 description

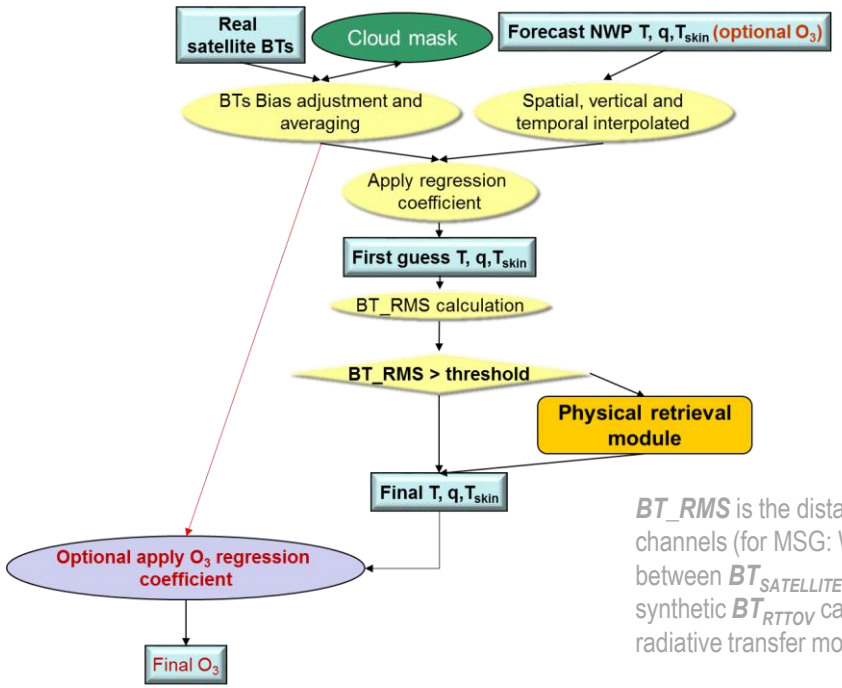
PGE00 is currently an AEMET internal tool

iSHAI algorithm is a combination of statistical and physical retrieval algorithms. Only on clear air pixels (or NxN boxes) it is made:

First step: uses a set of non linear regressions to built a First Guess profile from collocated background NWP temperature, humidity and ozone profiles and bias corrected satellite BTs.

Second step: physical retrieval with use of EOFs to reduce the dimension of matrix and reduce the computation time.

In MSG: 2 EOFs for T, 3 EOFs for q and 1 EOF for T_{skin}



BT_RMS is the distance in absorption channels (for MSG: WV6.2, WV7.3 y IR13.4) between $BT_{SATELLITE}$ (bias corrected) and synthetic BT_{RTTOV} calculated with the radiative transfer model RTTOV

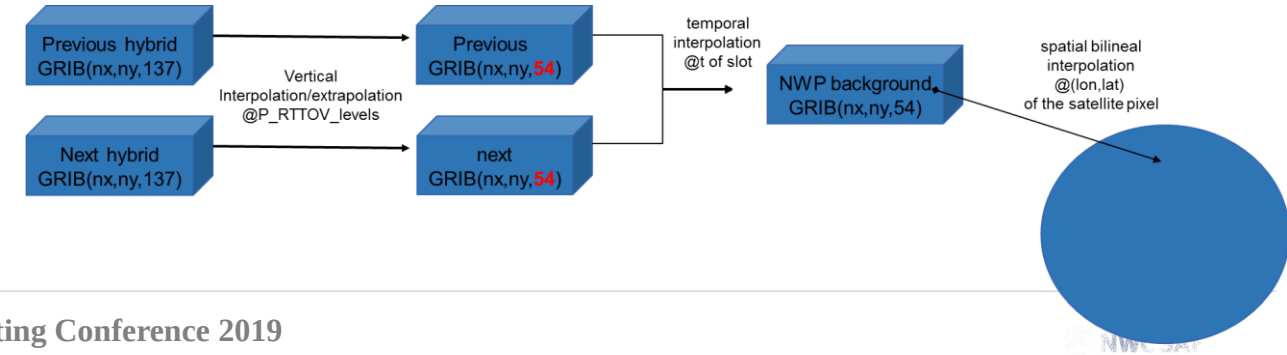
PGE00 is a simplified version of the NWP interpolation and RTTOV management of iSHAI. It is can be used as:

- NWP 4D *(presure, time, longitude, latitude)* interpolator of NWP GRIB files to satellite positions
- RTTOV BTs simulator for bias BT correction, iSHAI validation and testing, etc

GEO-PGE00-VISIR uses RTTOV-12.1. It can be used to make **high quality simulation of clouds for both Visible and IR** channels:

- 4D interpolation of T, q, O3, **CC, CLWC, CIWC, u, v** profiles on hybrid levels of ECMWF GRIB files.
- Call to RTTOV direct using the **clouds** and solar options
- Emissivities and BRDF from RTTOV atlases.

It can be used ECMWF GRIB files in hybrid levels.



See the iSHAI Algorithm Theoretical Basis document (ATBD) available on the website of the NWCSAF. The algorithm is similar to that used by NOAA for the GOES-R. The base algorithm was provided by Dr. Jun Li of CIMSS-Wisconsin.

iSHAI inputs and outputs scheme on version 2018

ABI GOES-R: WV6.2, WV6.9, WV7.3, IR13.3, IR10.4, IR11.2, IR12.3, IR9.6

AHI Himawari: WV6.2, WV7.0, WV7.3, IR13.3, IR10.4, IR11.2, IR12.3, IR9.6

SEVIRI MSG: WV6.2, WV7.3, IR13.4, IR10.8, IR12.0, IR9.7

Real satellite BTs

NWP

Cloud Mask

GEO-iSHAI-v40
YYYY-MM-DDThh:mm:00Z region config_file

Coefficients files: Bias BT correction, regression FG, EOF, …
Ancillary fields: longitude, latitude, zenith angle, land-sea mask, …

netCDF

- TPW
- BL (sfc-850)
- ML (850-500)
- HL (500-top)

Precipitable water at several layers

- LI
- SHOWALTER
- K-INDEX

Stability indices

- TOZ

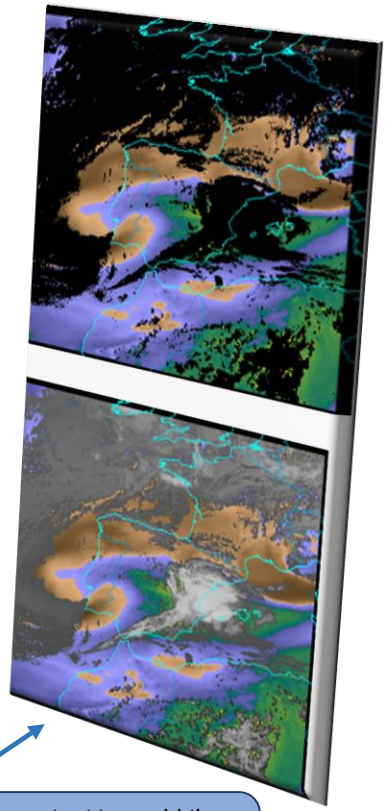
Total Ozone

- Tskin

\+ **Differences fields (iSHAI – NWP)**

\+ **Quality Flags:** residual, status, conditions fields.

\+ **Configurable IR BT degraded to 7 bits only in cloudy pixels.**



The IR image is important to avoid the "black holes" in the display of the fields. It helps to get the consistency in loops.

Optional output

(T, q, ozone) profiles and SKT in binary files.
✓ Arrays of structures.

SAFNWC/MSG Task Manager synchronizes the execution of the products and the first product that is generated upon the arrival of a new image is the cloud mask.

Process map

Only available in clear air pixels

Real satellite images

NWP GRIBs

iSHAI

GRIB in P levels of any model.
Supports use of ECMWF GRIB at hybrid levels.

2D outputs: precipitable water at several layers, stability indexes, TOZ, SKT

Differences with NWP model:
2D fields differences calculated versus the background NWP field.

3D outputs: T, q, O_3 profiles
- Normalized 3D arrays

*optional output

Generated in all pixels.

NWP GRIBs

PGE00

2D outputs: precipitable water at several layers, stability indexes, TOZ, SKT

3D outputs: T, q, O_3 profiles
- Normalized 3D arrays

Better with ECMWF GRIB files at hybrid levels.

PGE00 files can be precomputed before the nominal time.

Synthetic images with/without clouds

RGBs: synthetic and blended with real satellite data

Meteorological applications ..

Interactive use: McIDAS-V,...

netCDF

binary

bin2nc

netCDF

bin2AREA

McIDAS AREA

Meteorological applications

+

Graphical applications

WEB

iSHAI outputs 10th August 2016
Precipitable water, instability indices, total ozone and skin temperature

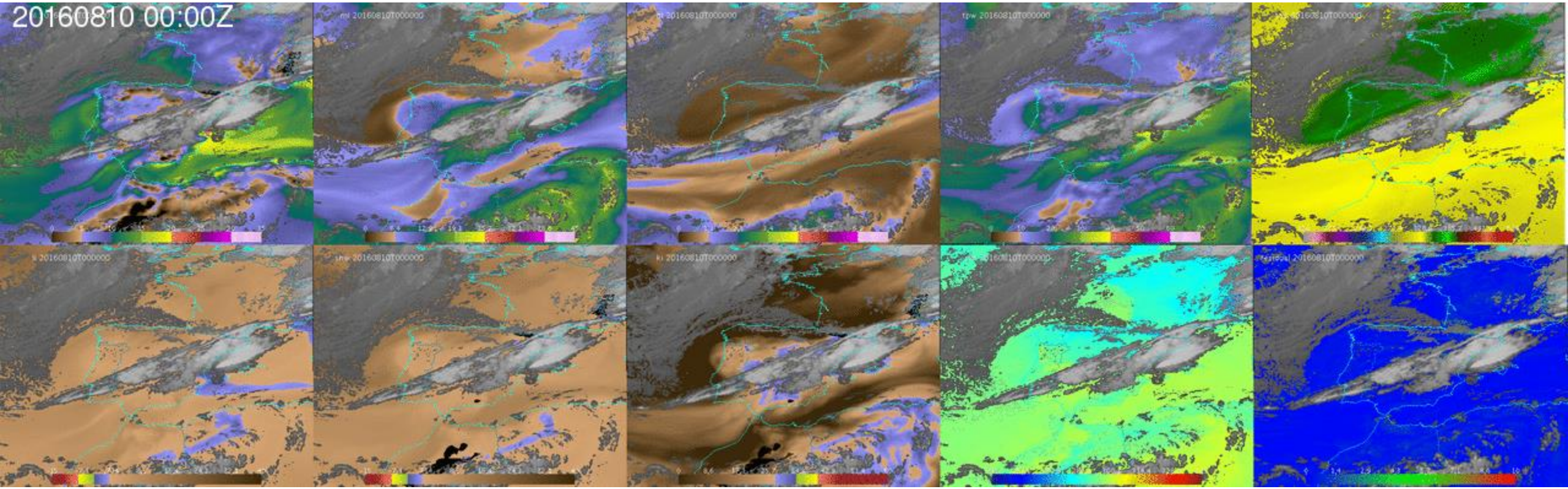
BL
Precipitable Water in Boundary Layer (P_{sfc}- 850hPa)

ML
Precipitable Water in Middle Layer (850-500 hPa)

HL
Precipitable Water in High Layer (500-0.1 hPa)

TPW
Total Precipitable Water in all Layers (P_{sfc}- 0.1 hPa)

TOZ
Total Ozone (P_{sfc}-0.0 hPa)



LI
Lifted Index

SHW
Showalter Index

KI
K-Index

SKT
Skin Temperature

Residual
Square root of sum ($BT_{SEVIRI} - BT_{RTTOV}$)

iSHAI reprocessed: FOR= 1x1;
BT_RMS_THRESHOLD=0 and 1 iteration

NWP: ECMWF GRIBs on hybrid levels from run 00Z every 1 hour spatial resolution 0.125 ˚ x 0.125˚

The individuals images has been generated with McIDAS-V in batch mode after generation of bundle files and importing color palettes.

See loop on NWC SAF web page

Difference of iSHAI precipitable water, instability indices, total ozone and skin temperature with background NWP: 10th August 2016

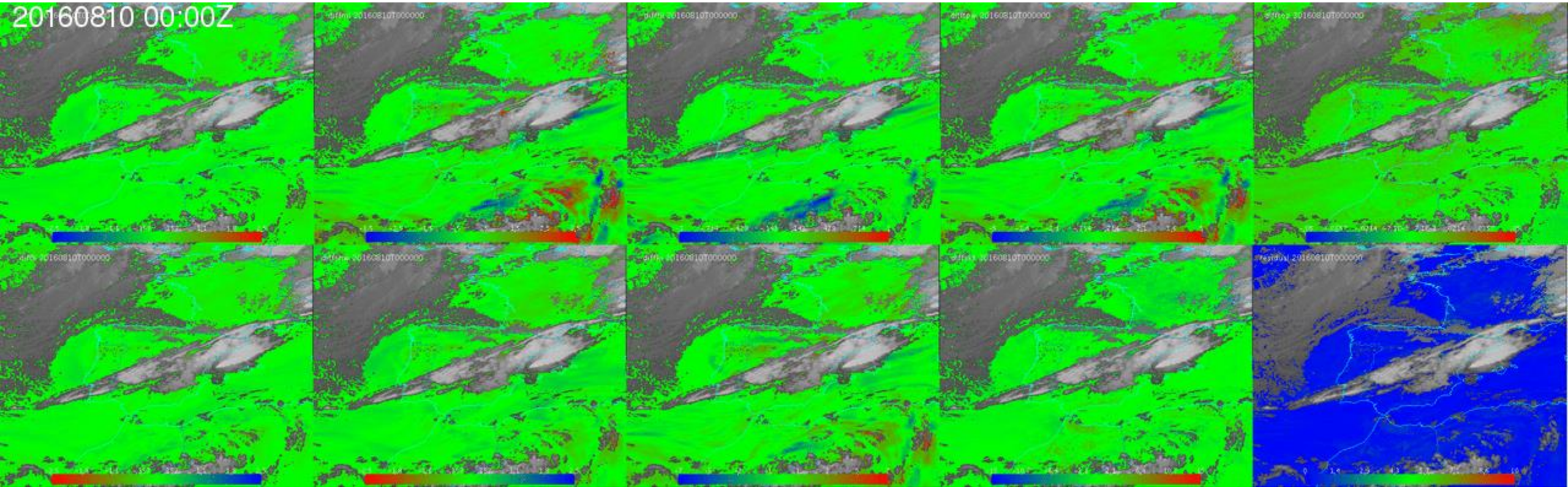
diffBL
Precipitable Water in Boundary Layer (P_{sfc}- 850hPa)

diffML
Precipitable Water in Middle Layer (850-500 hPa)

diffHL
Precipitable Water in High Layer (500-0.1 hPa)

diffTPW
Total Precipitable Water in Middle Layer (P_{sfc}- 0.1 hPa)

diffTOZ
Total Ozone (P_{sfc}-0.0 hPa)



diffLI
Lifted Index

diffSHW
Showalter Index

diffKI
K-Index

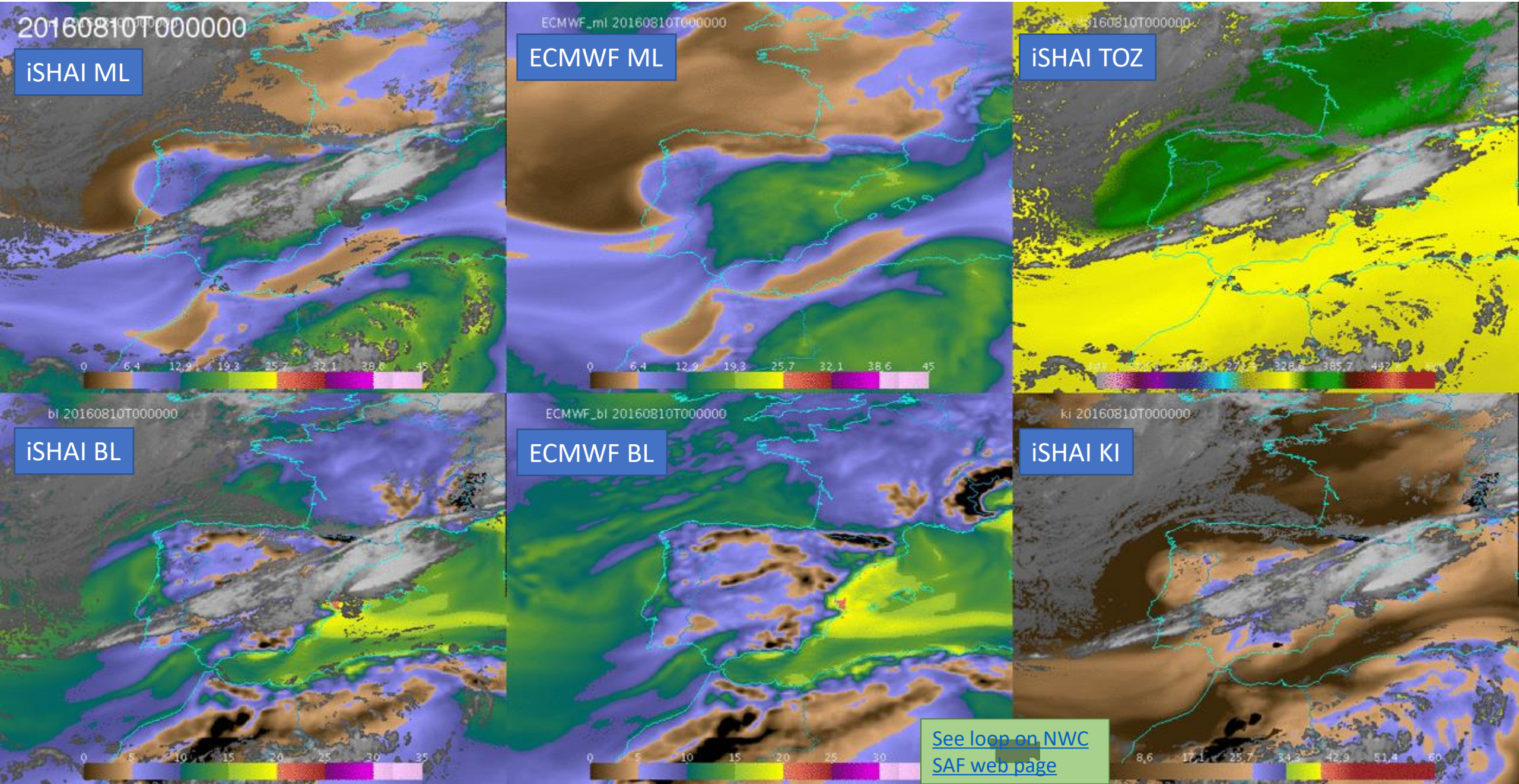
diffSKT
Skin Temperature

Residual
Square root of sum ($BT_{SEVIRI} - BT_{RTTOV}$)

See example of detection of NWP disagreements in Martinez 2013.
http://www.eumetsat.int/website/wcm/idc/idcplg?IdcService=GET_FILE&dDocName=PDF_CONF_P_S3_04_MARTINEZ_V&RevisionSelectionMethod=LatestReleased&Rendition=Web

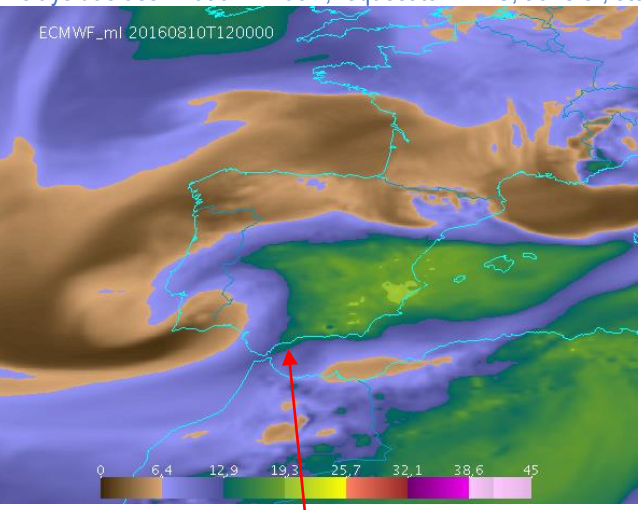
See loop on NWC SAF web page

Example of combined use of iSHAI and PGE00: 10th August 2016

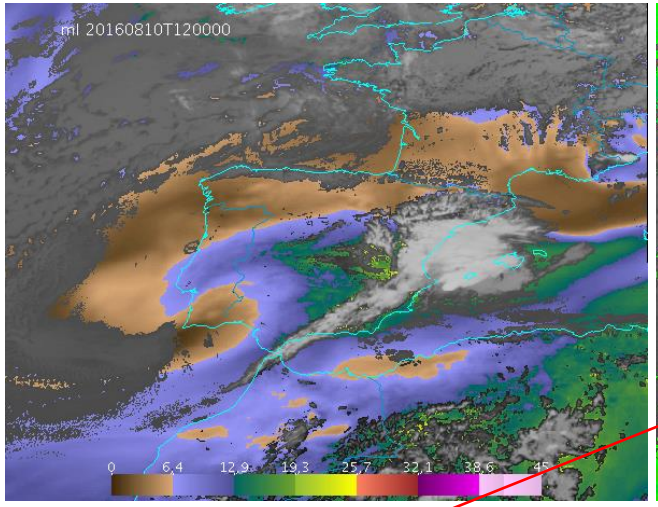


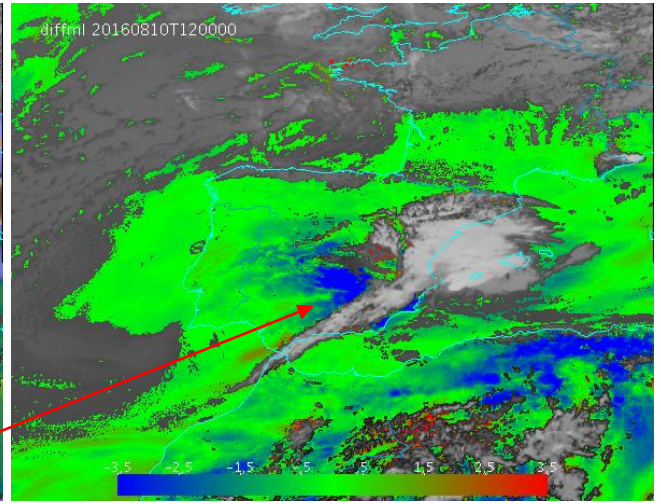
Availability time of ML fields (precipitable water in Middle Layer (850-500 hPa))
10th August 2016 at 12:00Z

ECMWF: *t+12* forecast from 00Z run
Available later than 7:00Z
Delays due assimilation window, request to MARS, transfer, etc



NWCSAF MSG iSHAI fields
Available round 25 minutes after nominal hour

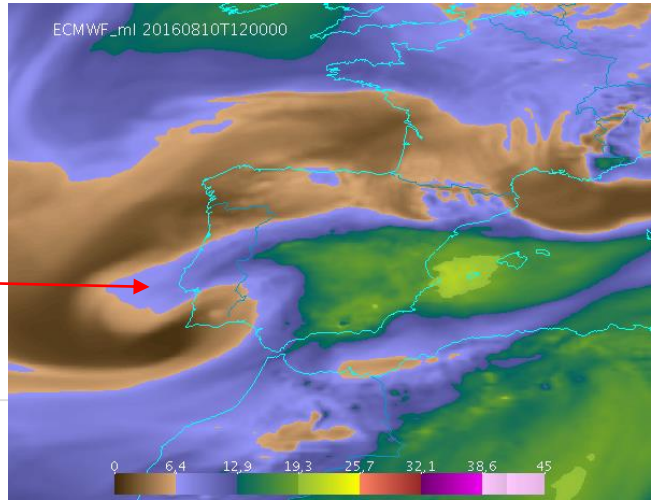




7:30Z 12:30Z 18:30Z

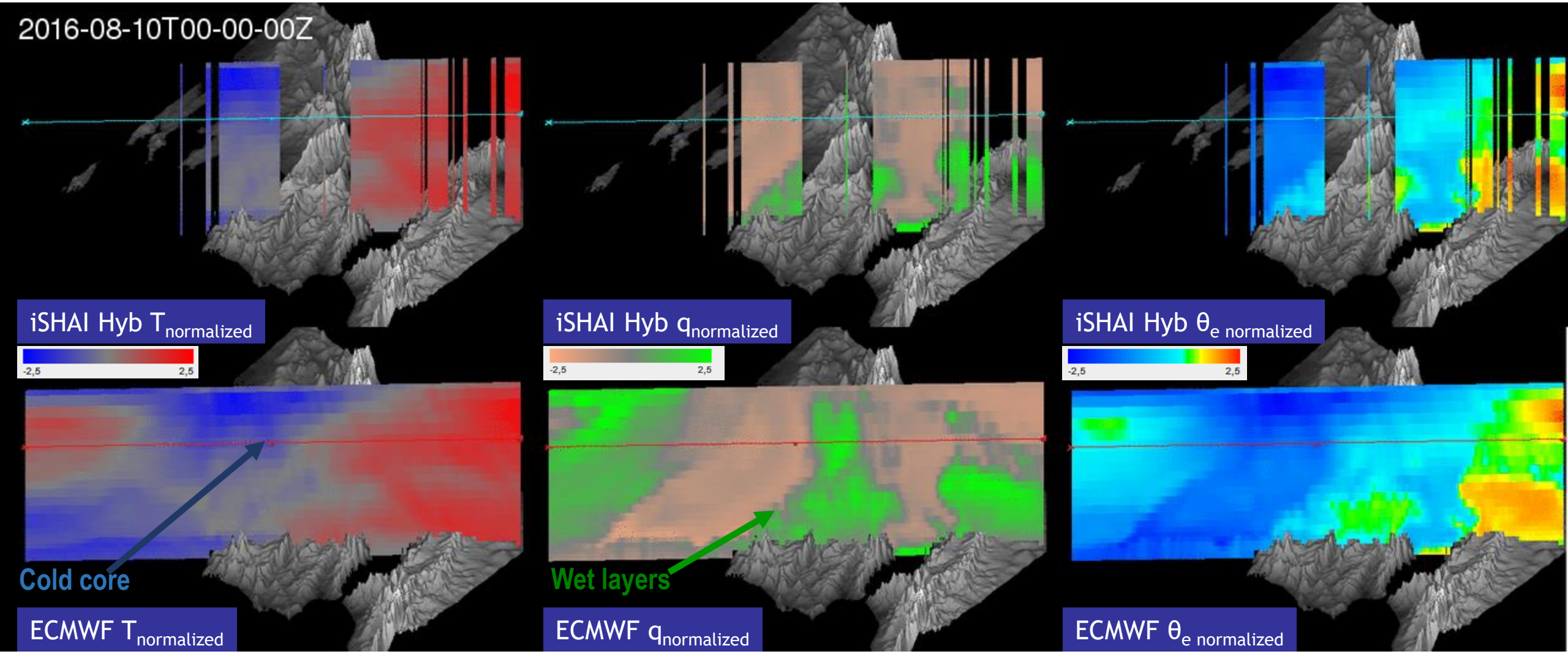
There is little overestimation of the humidity between *t+12* forecast and analysis

ECMWF: analysis (*t+00*) from 12Z run
Available later than 18:00Z
Delays due assimilation window, request to MARS, transfer, etc



Since 2014 the ECMWF presents overestimation of the ML in convective cases

Normalized 3D vertical cross sections

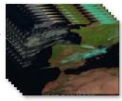


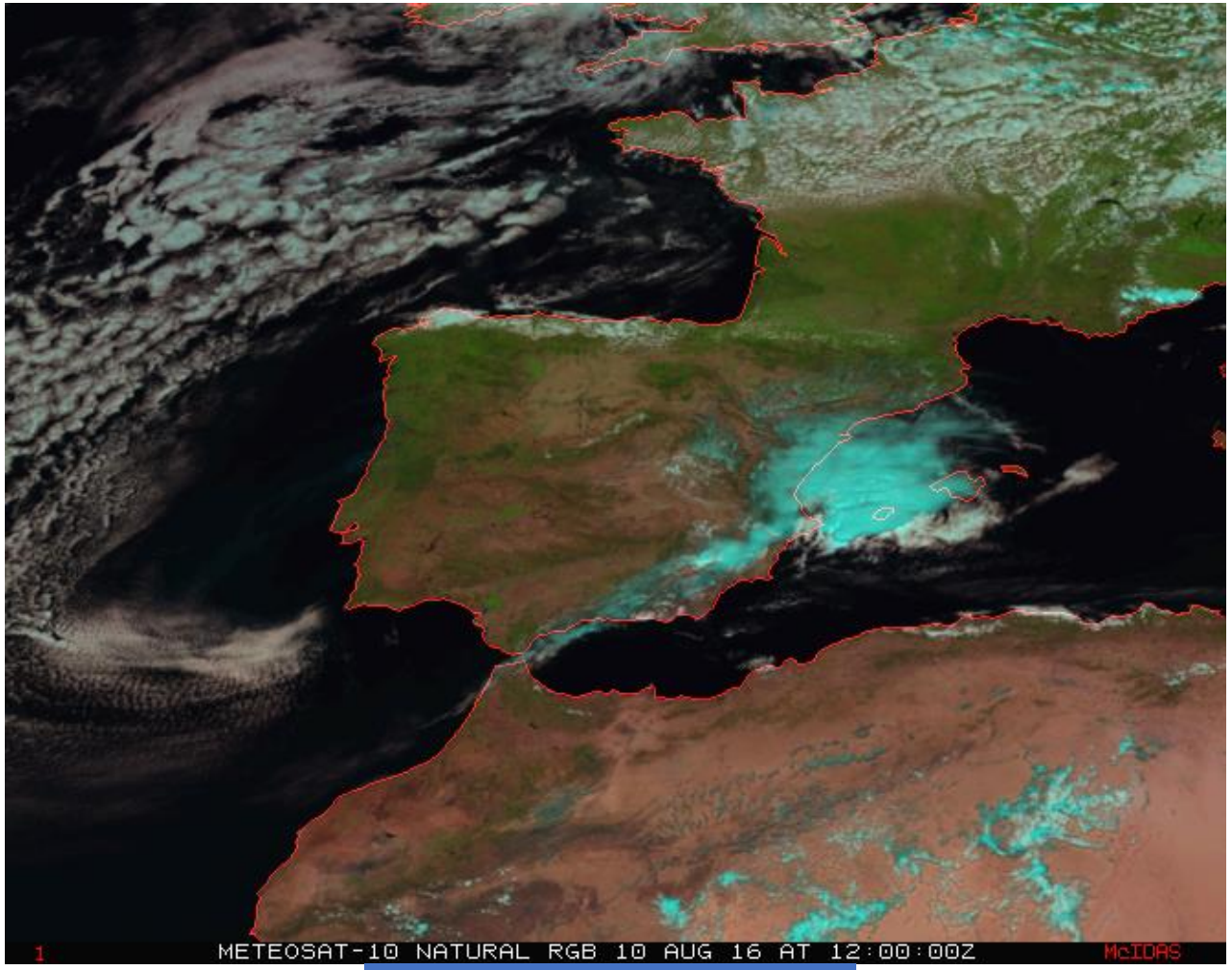
Normalized representation to highlight the presence of wet/dry layers and warn/cold layers looking for the presence of anomalies. Normalized 3D arrays after calculation the mean and standard deviation on the analysis at every layer and then create the normalized 3D cube subtracting the mean and dividing by the standard deviation at every layer.

Generated with McIDAS-V

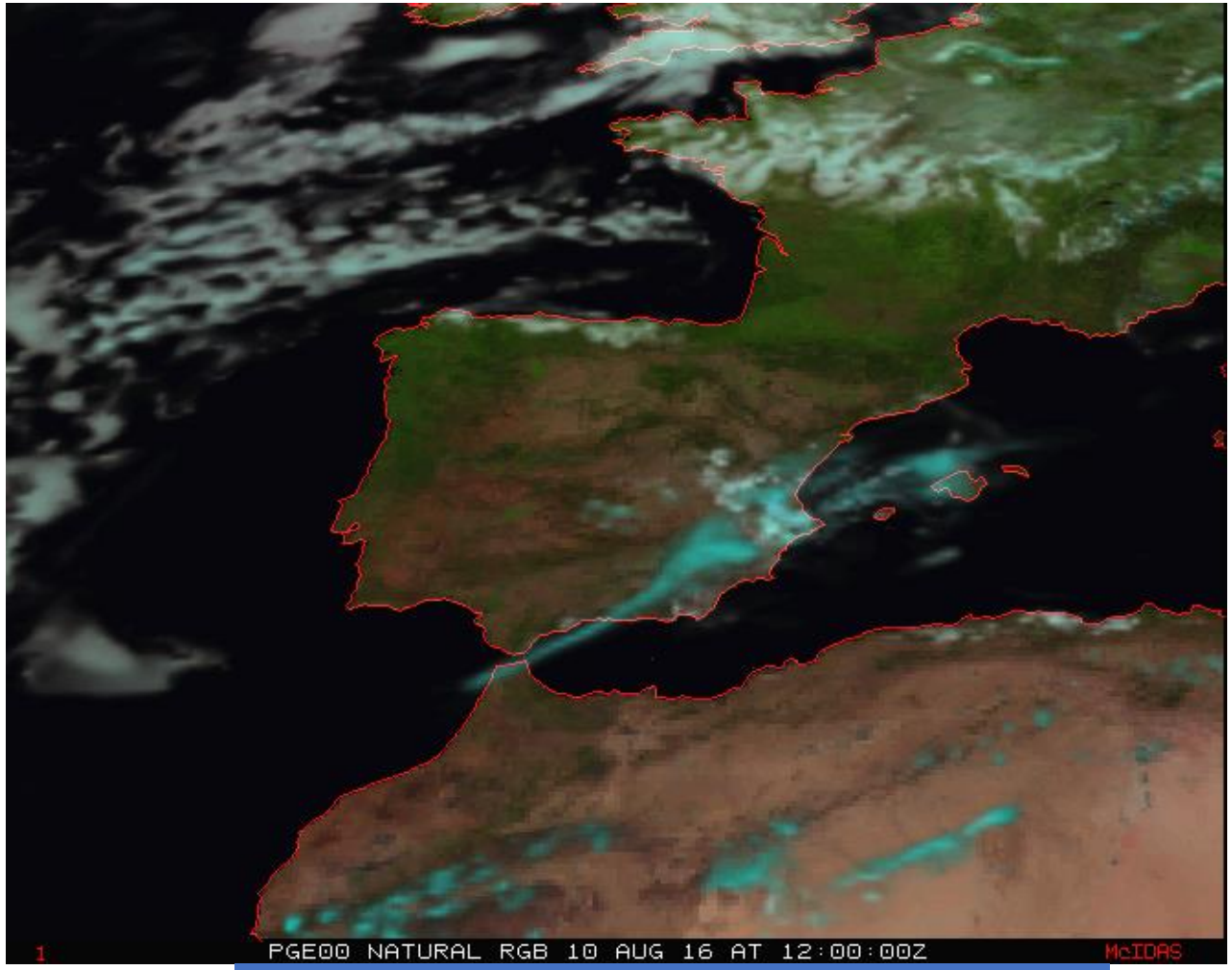
See loop on NWC SAF web page

Comparison of PGE00-VISIR synthetic and real RGBs from MSG





MSG real natural RGB



MSG synthetic PGE00-VISIR natural RGB

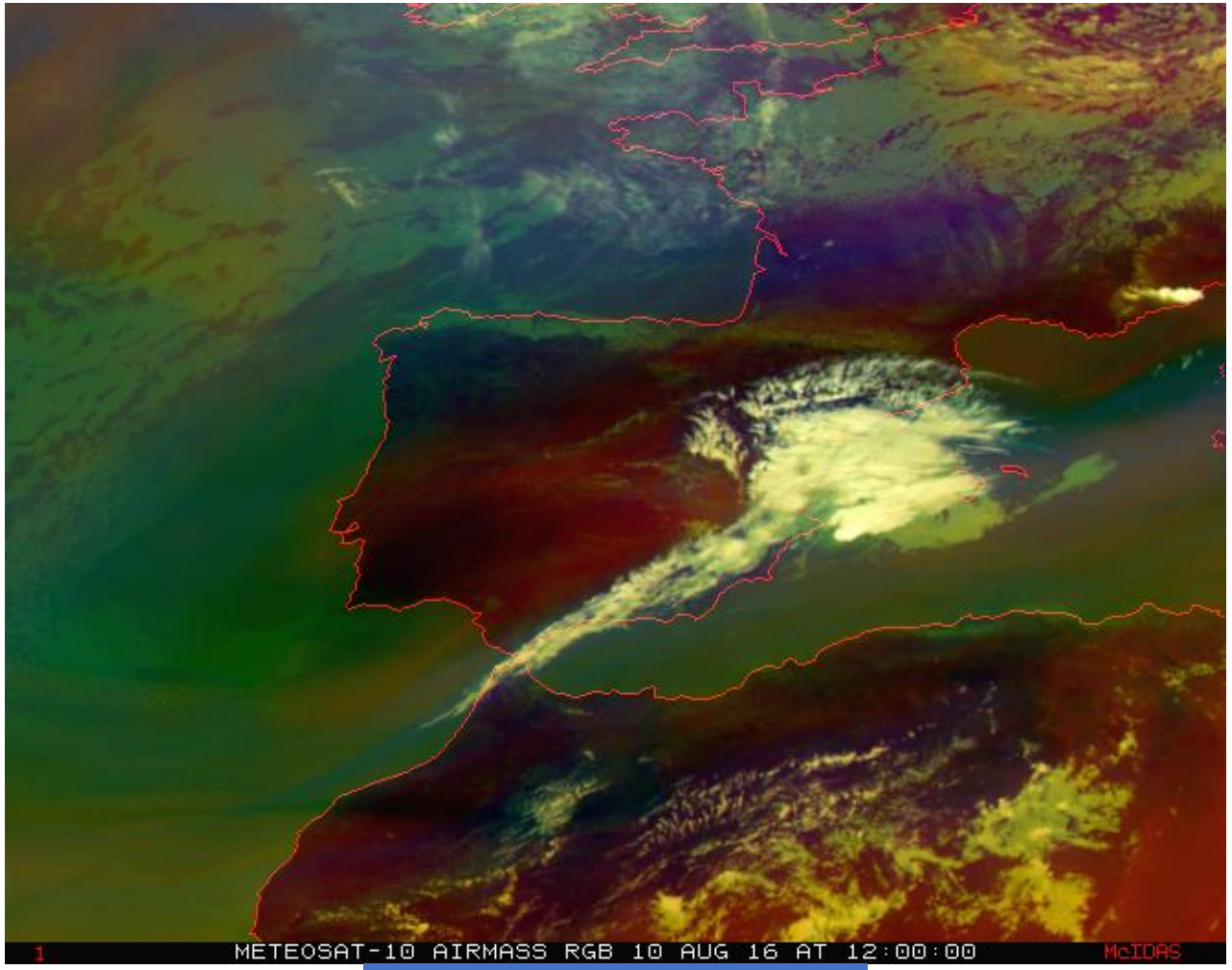
See loop on NWC SAF web page

At night the solar zenith angle is fixed to 75 º

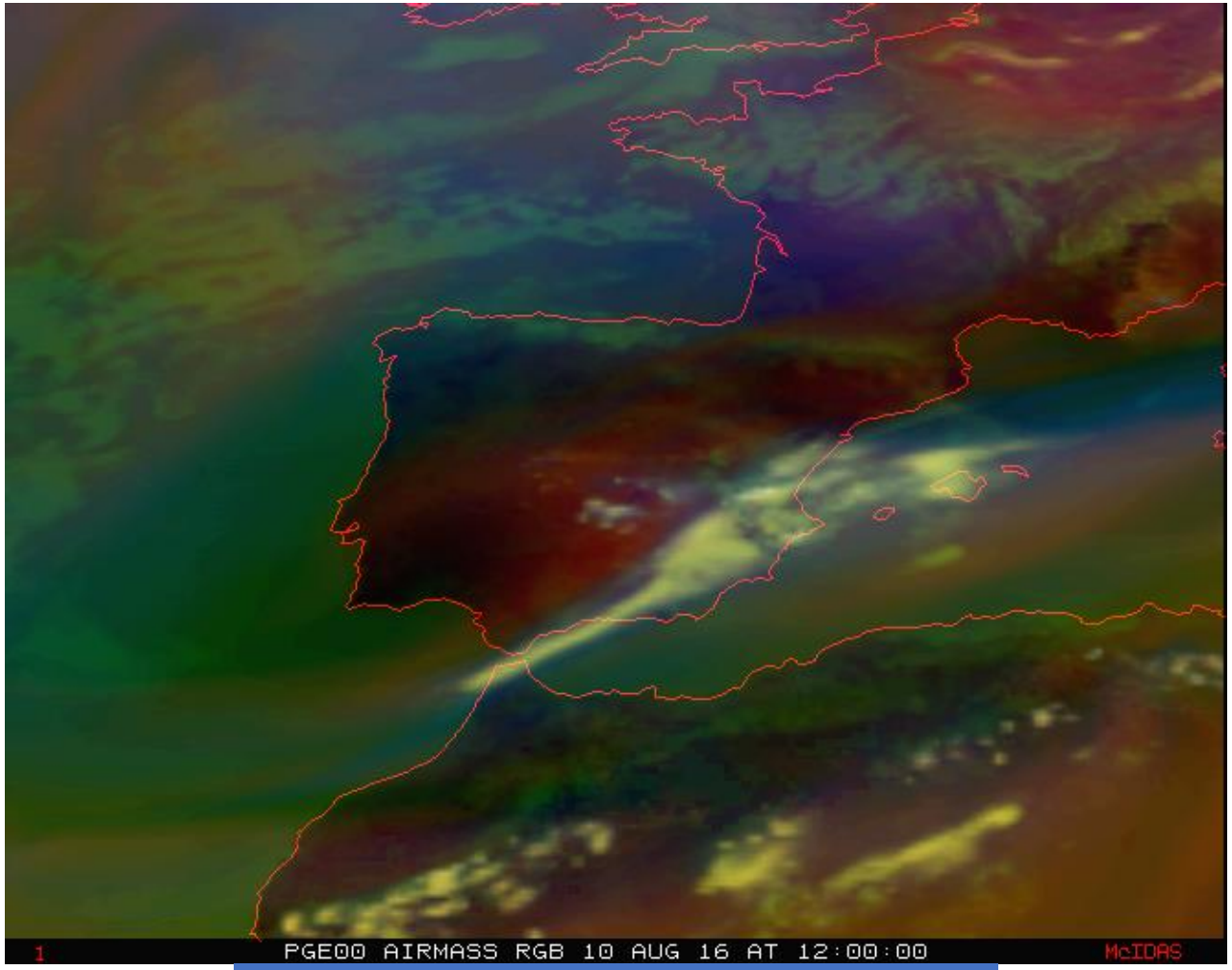
ECMWF 10th August 2016 12Z
t+12 **from 10th August 2016 run 00Z**

NRT generation on AEMET intranet:

Comparison of PGE00-VISIR synthetic and real RGBs from MSG



MSG real airmass RGB



MSG synthetic PGE00 airmass RGB

ROJO	WV6.2-WV7.3	[-25,0]
VERDE	IR9.7-IR10.8	[-40,5]
AZUL	WV6.2	[243,208]

See loop on NWC SAF web page

ECMWF 10th August 2016 12Z
t+12 **from 10th August 2016 run 00Z**

NRT generation on AEMET intranet:

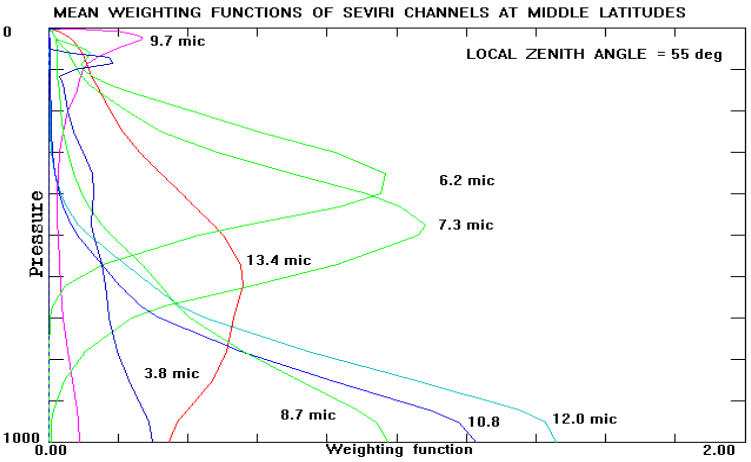
Search of new RGBs using synthetic BTs: improved airmass RGB

BTs of two simulations of the IR9.7 channel are used:

a) **clearIR97$_{RTTOV}$:** synthetic RTTOV IR9.7 BTs using the original ECMWF profiles with the **profile of T, q and ozone in each pixel**.

b) **meanO3_clearIR97$_{RTTOV}$**: synthetic RTTOV IR9.7 BTs in clear air mode using the original ECMWF profiles with the profile of T and q in each pixel **but using as ozone profile for all the pixels the average value of the ozone in each level.**

The influence of the content and ozone profile on the IR9.7 channel is clearly shown in **the difference (clearIR97$_{RTTOV}$ - meanO3_clearIR97$_{RTTOV}$)**



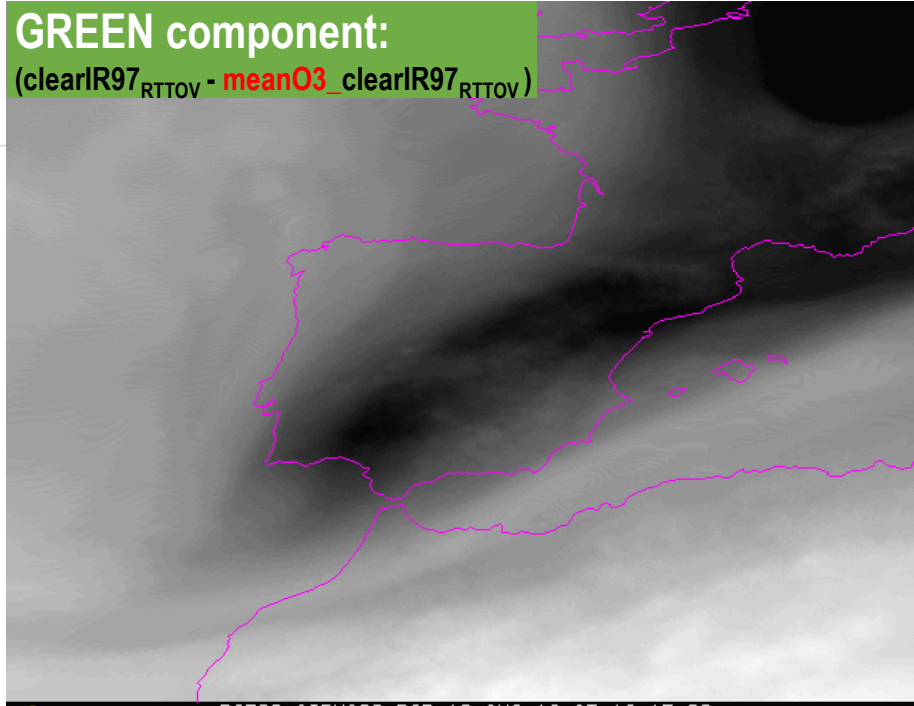
If this difference is used in the green layer of the new airmass RGB, the presence of the ozone intrusion is highlighted in darker color and the surface can not be seen.

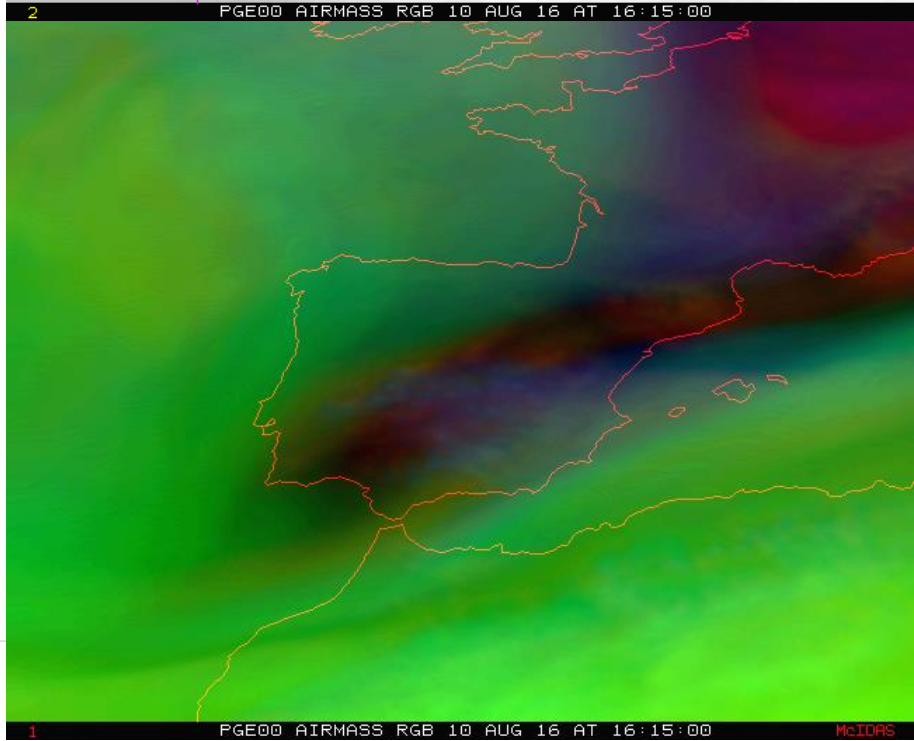
Original airmass RGB

RED	WV6.2-WV7.3	[-25,0]
GREEN	IR9.7-IR10.8	[-40,5]
BLUE	WV6.2	[243,208]

Improved airmass RGB

RED	WV6.2-WV7.3	[-25,0]
GREEN	clearIR97$_{RTTOV}$ - meanO3_clearIR97$_{RTTOV}$	[-4,4]
BLUE	WV6.2	[243,208]





Search new RGBs using blended real&synthetic images: blended (real&synthetic) air mass RGB

When BTs of real images are used, it is also necessary to correct the difference between the BTs of RTTOV and real BTs in the IR9.7 channel using a regression of the difference between the real BTs and RTTOV between the IR10.8 channel and IR9.7.

The **GREEN component** proposed for real images includes also **a regression** from the difference real and RTTOV in **IR10.8** and IR9.7.

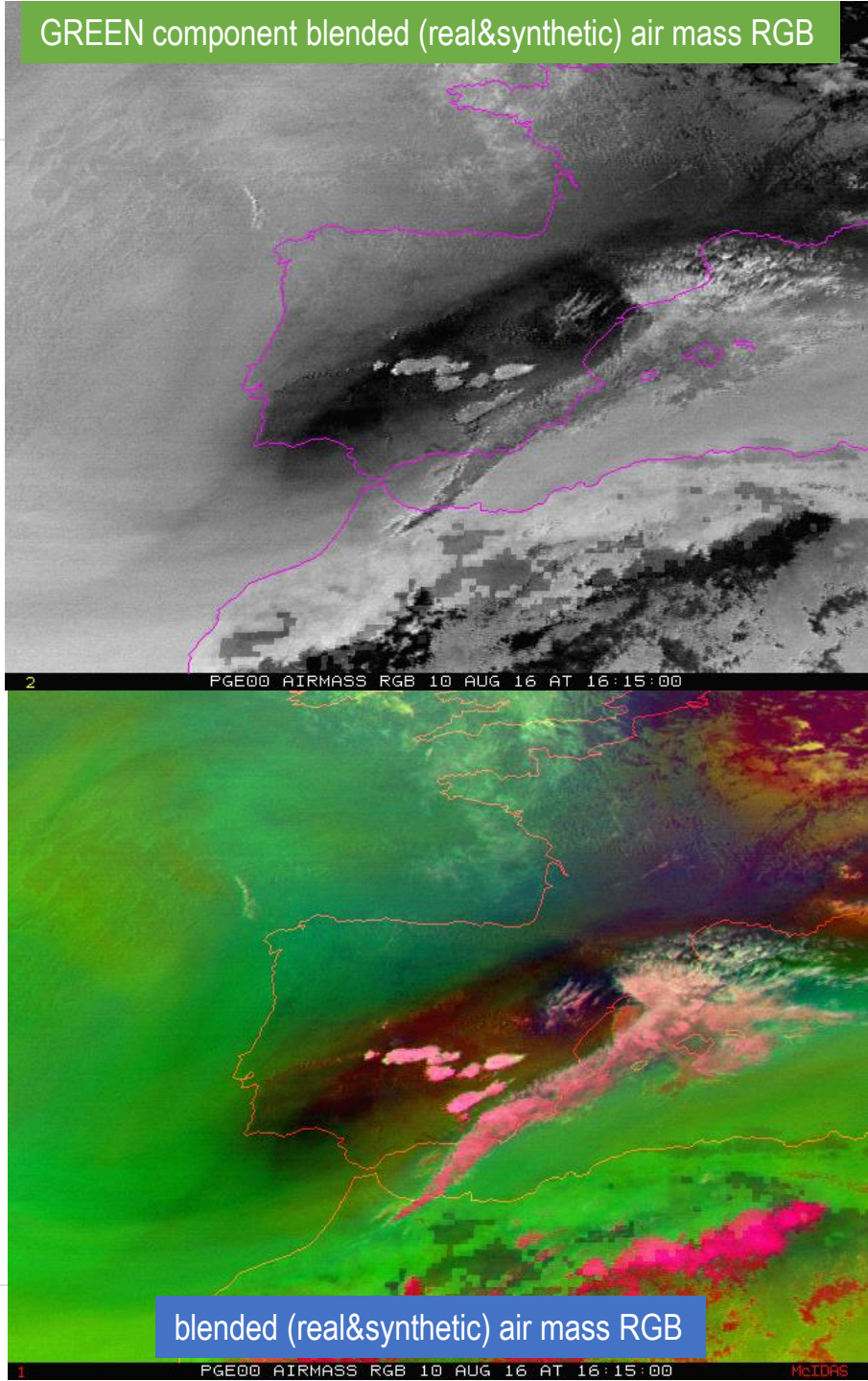
$$(BT_{IR9.7} - meanO3\_clearIR97_{RTTOV}) \; - \; (0.54*(BT_{IR10.8} - meanO3\_clearIR108_{RTTOV}) + 0.18)$$

Differences due to ozone contribution

Correction of the differences between real and NWP skin temperatures and emissivities

blended (real&synthetic) air mass RGB

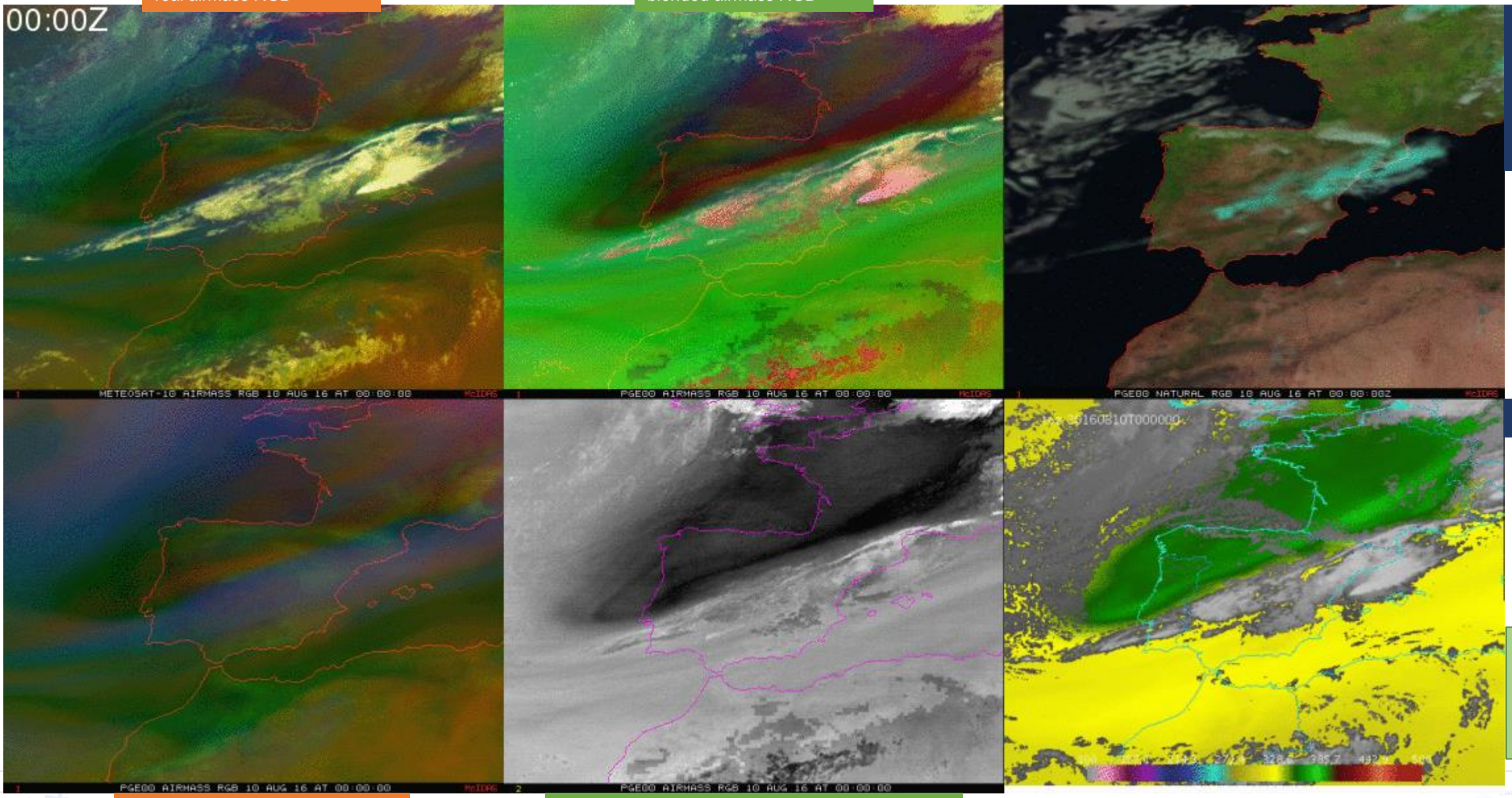
RED	WV6.2-WV7.3	[-25,0]
GREEN	(BTIR97- meanO3_clearIR97$_{RTTOV}$) -(0.54*(BTIR108 - meanO3_clearIR108$_{RTTOV}$) +0.18)	[-4,4]
BLUE	WV6.2	[243,208]



Loop of Blended airmass RGB and others

real airmass RGB

blended airmass RGB



Synthetic (night) and real (day) natural RGB images

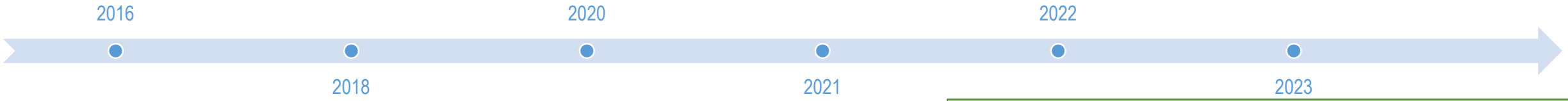
iSHAI TOZ

[See loop on NWC SAF web page]

Clear synthetic airmass RGB

GREEN component blended airmass RGB

SHAI roadmap



iSHAI (imager **S**atellite **H**umidity **A**nd **I**nstability)
sSHAI (sounder **S**atellite **H**umidity **A**nd **I**nstability)

MTG

IRS
- sSHAI
- sSHAI_ES
- quickIRSL1

iSHAI FCI

PGE13
iSHAI MSG

iSHAI AHI

iSHAI ABI

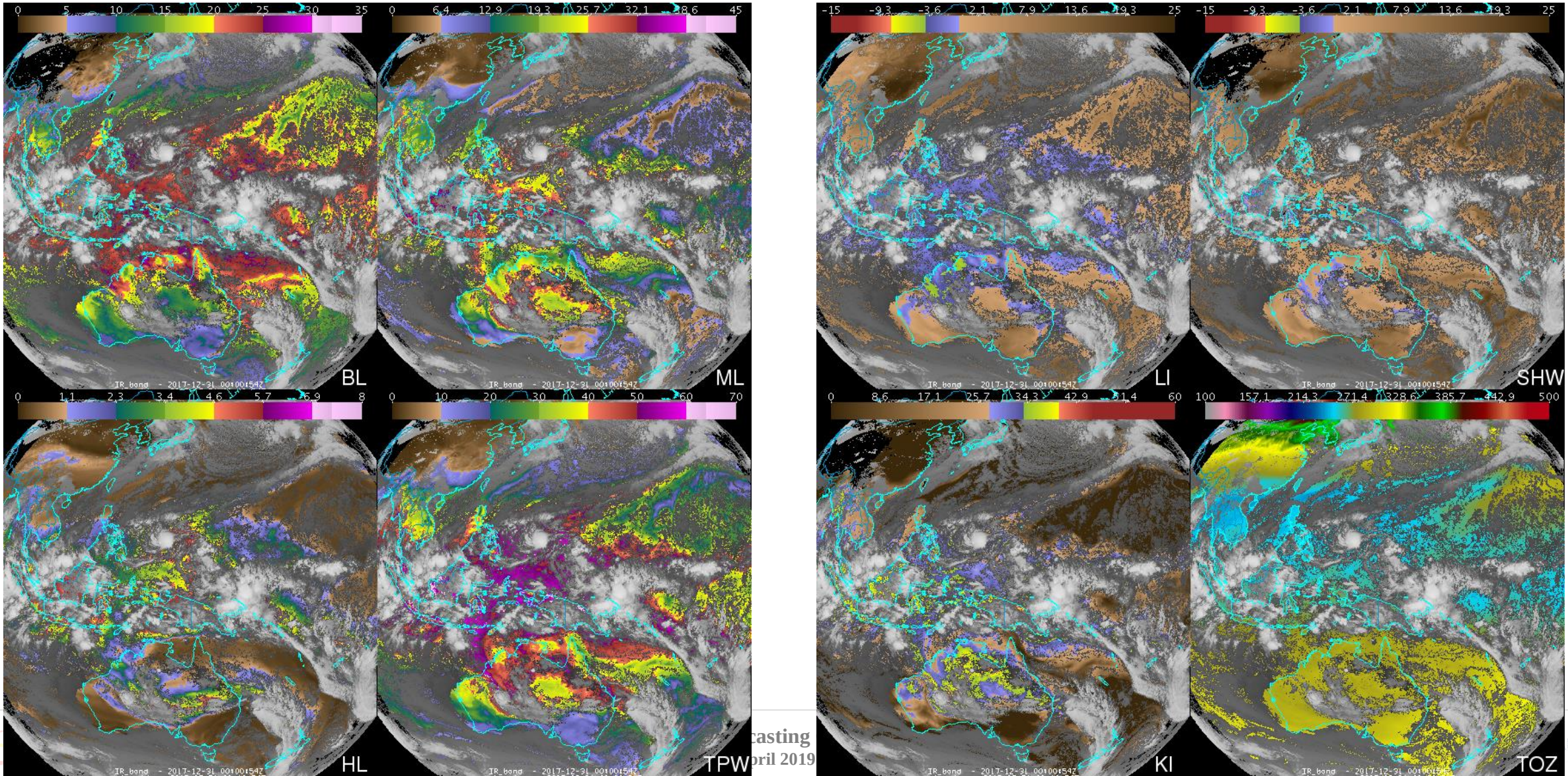
PGE00

Synthetic MSG RGBs

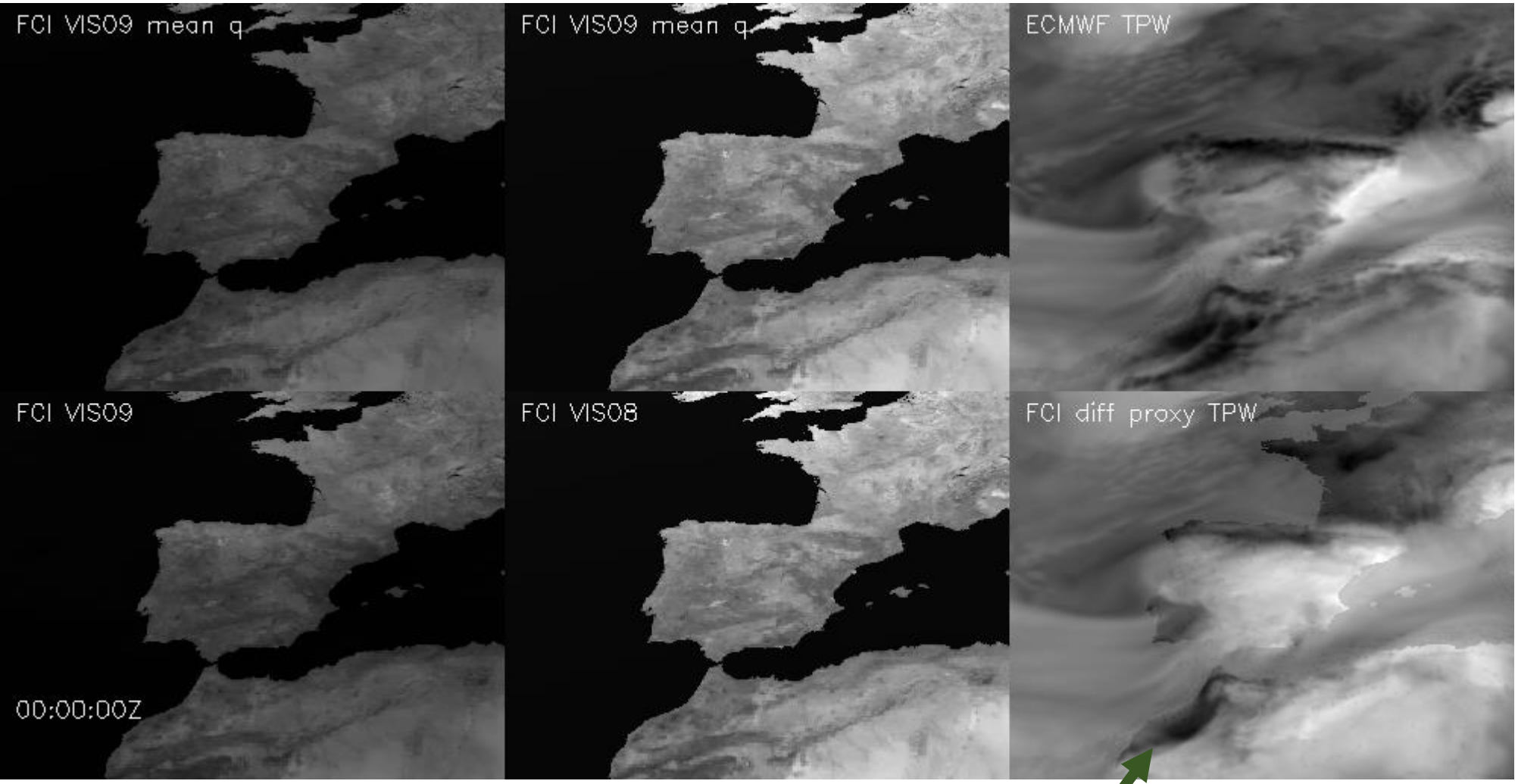
Synthetic MTG FCI RGBs

Support of Himawari-AHI on v2018

GEO-iSHAI AHI example on 2017-12-31 00Z



TPW with blended technique from MTG-FCI VIS0.9



MTG-FCI VIS0.9 is a WV absorption channel in VIS range. Thus, it is of interest in convection

Developing of new RGBs with this channel will help to validate the iSHAI product.

Not foreseen developments in CDOP-3 proposal.

Opportunity target since PGE00 with RTTOV-12.1 developments allows simulation with high quality in IR and VIS

(Log(VIS0.9) -Log(VIS0.9mean_q)) - (Log(VIS0.8) -Log(VIS0.8mean_q))

See loop on NWC SAF web page

NWC SAF products and services for MTG-IRS

NWC SAF provides software for use of satellite data in Nowcasting.

NWC-SAF products are generated locally by users => No bandwidth constraints on local generated products.

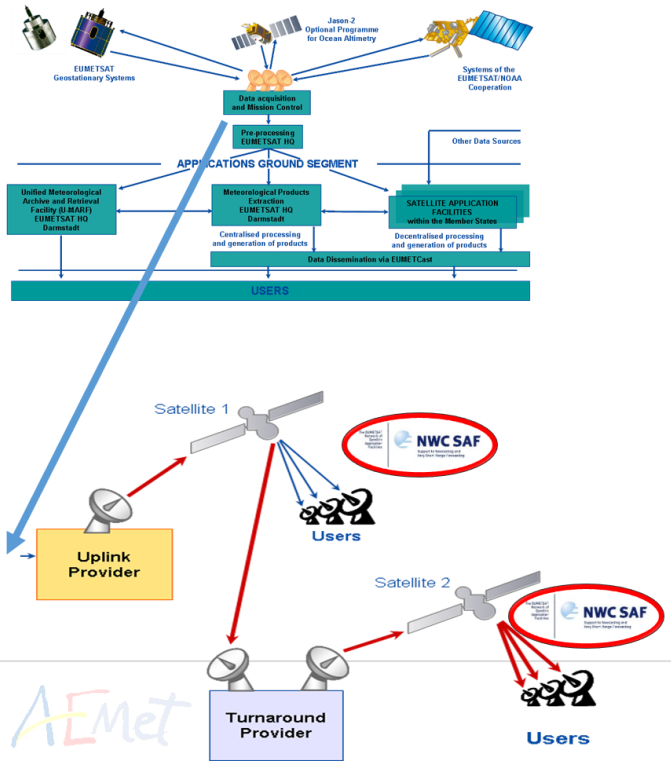
NWC-SAF is the SAF nearest to users. It works in the users side of the EUMETCast

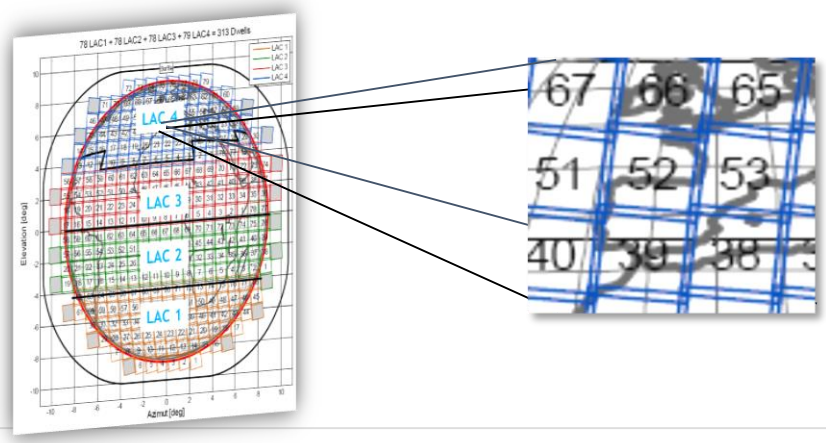
Plan for MTG: to offer a user friendly software to manage the FCI, LI and IRS L1 data and to generate L2 Nowcasting products. **The main objective is to explore the synergies and differences of MTG-FCI and MTG-IRS products and the background NWP.** They will be prepared during CDOP-3 and they will be available at Day-2.

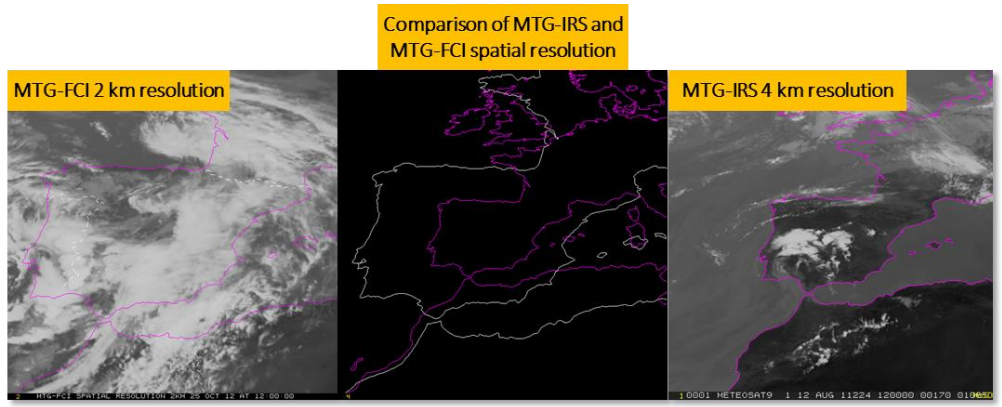
Key point: NWCSAF as integration and reprojection tool:

MTG-IRS will have the half of spatial resolution of MTG-FCI. MTG-IRS will explore in "dwells" of 160x160 pixels at 4x4 km **resolution with no reprojection on a common GEO grid.**

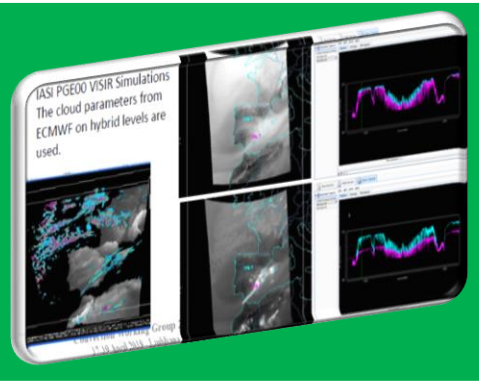
Thus, to cover a region ***it is needed of one re-projection and joining of dwell files tool to get one user interest region***. The default projection will be regions on MTG-FCI projection with FCI IR or half of FCI IR resolution.





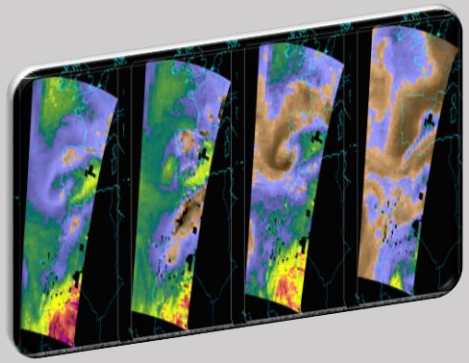


qIRS: Quick IRS product



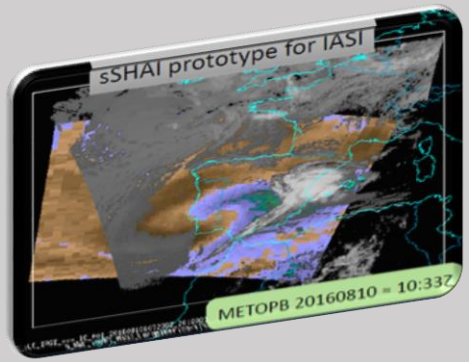
qIRS: Quick IRS product

- **Principal Components to BTs conversion and IRS L1 images generation on NWC SAF region:** PC to BTs at dwells, combination and reprojection of users selected MTG-S L1 BTs from dwells to user NWC SAF defined regions.
- Generation of IRS L1 imagery related products; as example RGB images.



sSHAI_ES: sounder Satellite Humidity And Instability from Eumetsat Secretariat

- **EUMETSAT Secretariat(ES) MTG-IRS L2 service:** combination and reprojection of 2D and 3D fields from dwells to user NWC SAF defined regions; calculation of nowcasting parameters (TPW, LPW and instability indices) at dwells. Add fields as IR images on cloudy pixels.



sSHAI: sounder Satellite Humidity And Instability from NWC SAF

- Local NWCSAF MTG-IRS L2 product generation. Locally executed light CPU algorithms for retrieval of T, q profiles using as input local NWP models.
- Calculation of nowcasting parameters (TPW, LPW and Instability indices) at dwells. Combination and reprojection of dwells to user NWC SAF defined regions

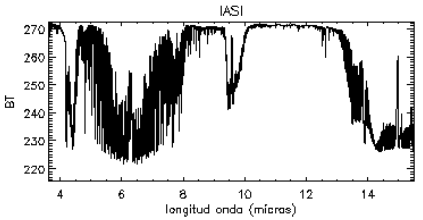
Start point 2010: MTG-IRS and IASI RGBs with MSG RGBs heritage

Which is the synthetic IASI channel nearest to every synthetic MSG IR channel?

GRIB ECMWF

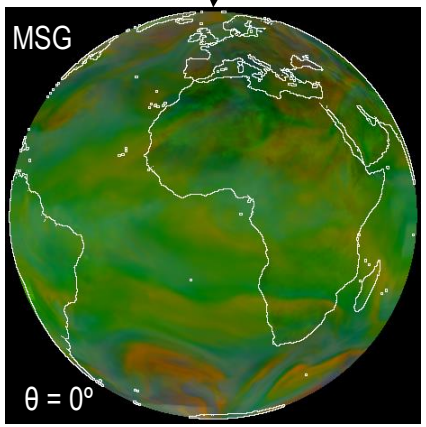
IASI RTTOV coefficients

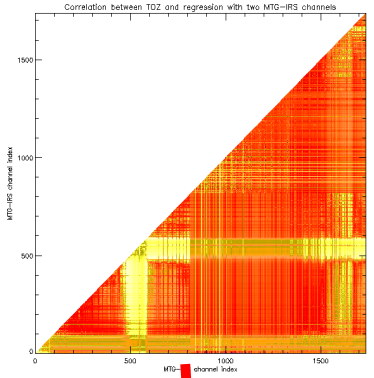
IASI 8461 channels



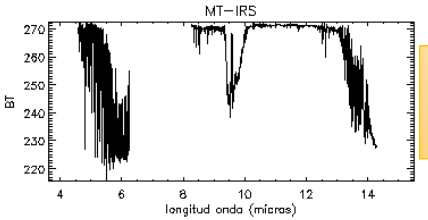
correlation analysis between synthetic RTTOV IASI or MTG-IRS and MSG-SEVIRI channels

MSG RTTOV coefficients



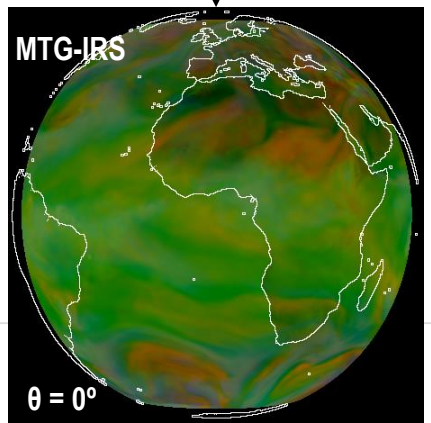


Conversion IASI to IRS



IRS 1738 channels in two bands

IRS 1738 channels



MSG channel	IASI equivalent Channel position (0-based)	IASI wavelength
ir39	7706	3.88878
wv62	5060	5.23560
wv73	2679	7.60601
ir87	1828	9.07441
ir97	1543	9.70167
ir108	1063	10.9800
ir120	733	12.0736
ir134	5659	~~4.85496~~

Search of IASI or MTG-IRS channels with lower mean square error and greatest correlation versus MSG-SEVIRI channels using the ECMWF analysis of 25th May 2009 at 12Z for MSG full disc region and RTTOV-9.3

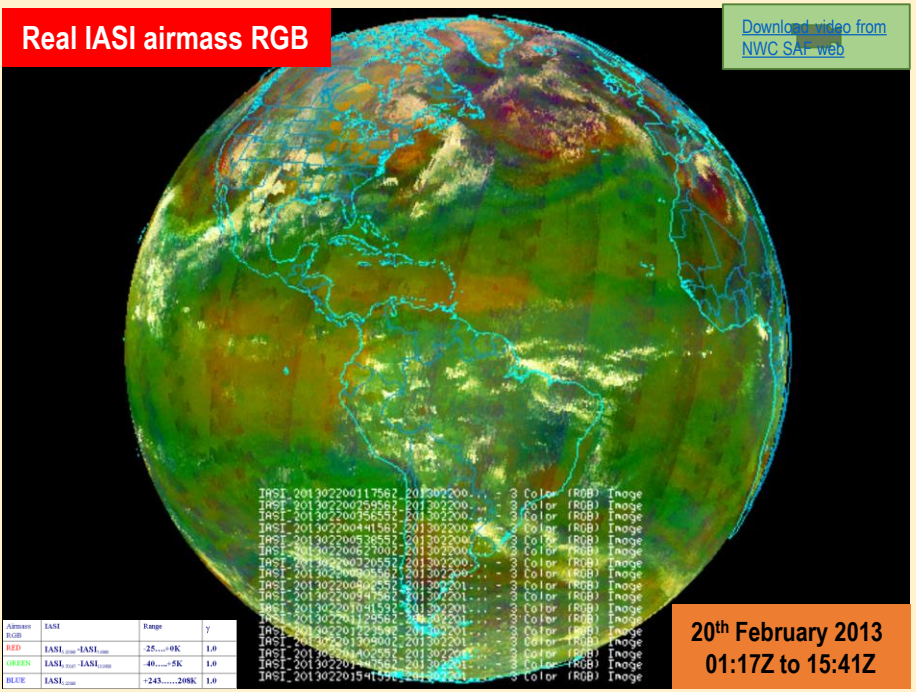
See paper on 2010 Cordoba EUMETSAT Conference "Use of synthetic RGB images in training " Miguel A. Martinez, X. Calbet, J. Prieto, S- Tjemkes for details.

qIRS: Quick IRS product

Early examples with real IASI images: using converters from IASI L1 to netCDF

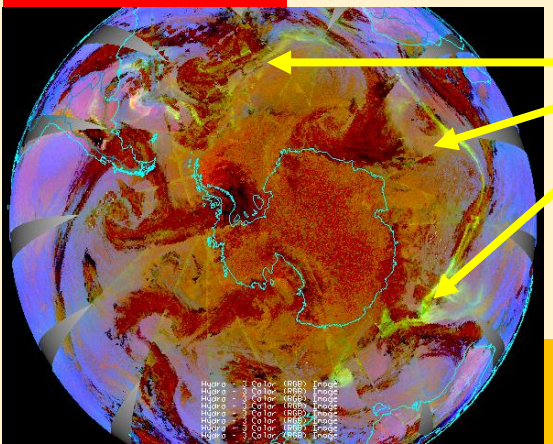
Real IASI airmass RGB

Download video from NWC SAF web



20th February 2013
01:17Z to 15:41Z

Real IASI dust RGB

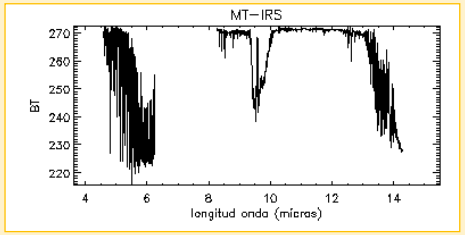


Volcanic ash

Eruption from the Puyehue-Cordon Volcano
9th June 2011 22:24Z

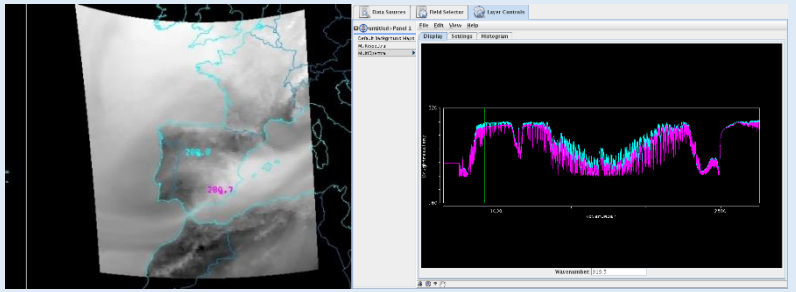
top to down quick looks

IR absorption peaks on [650 cm^{-1}, 824 cm^{-1}]

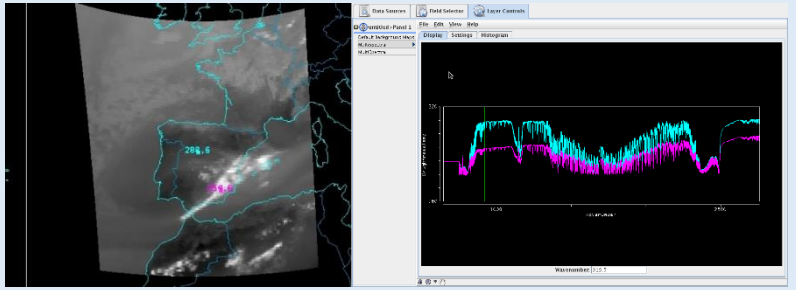


Examples with synthetic IASI images: using PGE00 to simulate IASI L1 spectra, convert to netCDF and display with McIDAS-V.

Clear air IASI PGE00 VISIR simulations:



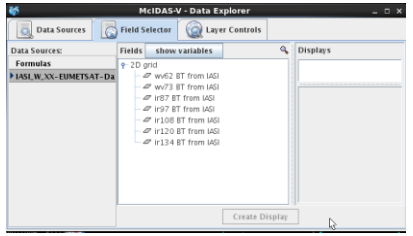
Cloudy air IASI PGE00 VISIR simulations:



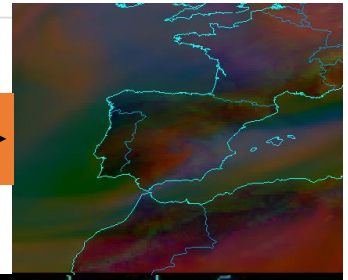
The cloud parameters from ECMWF on hybrid levels are used.

Comparison of PGE00-VISIR synthetic and real RGBs from IASI

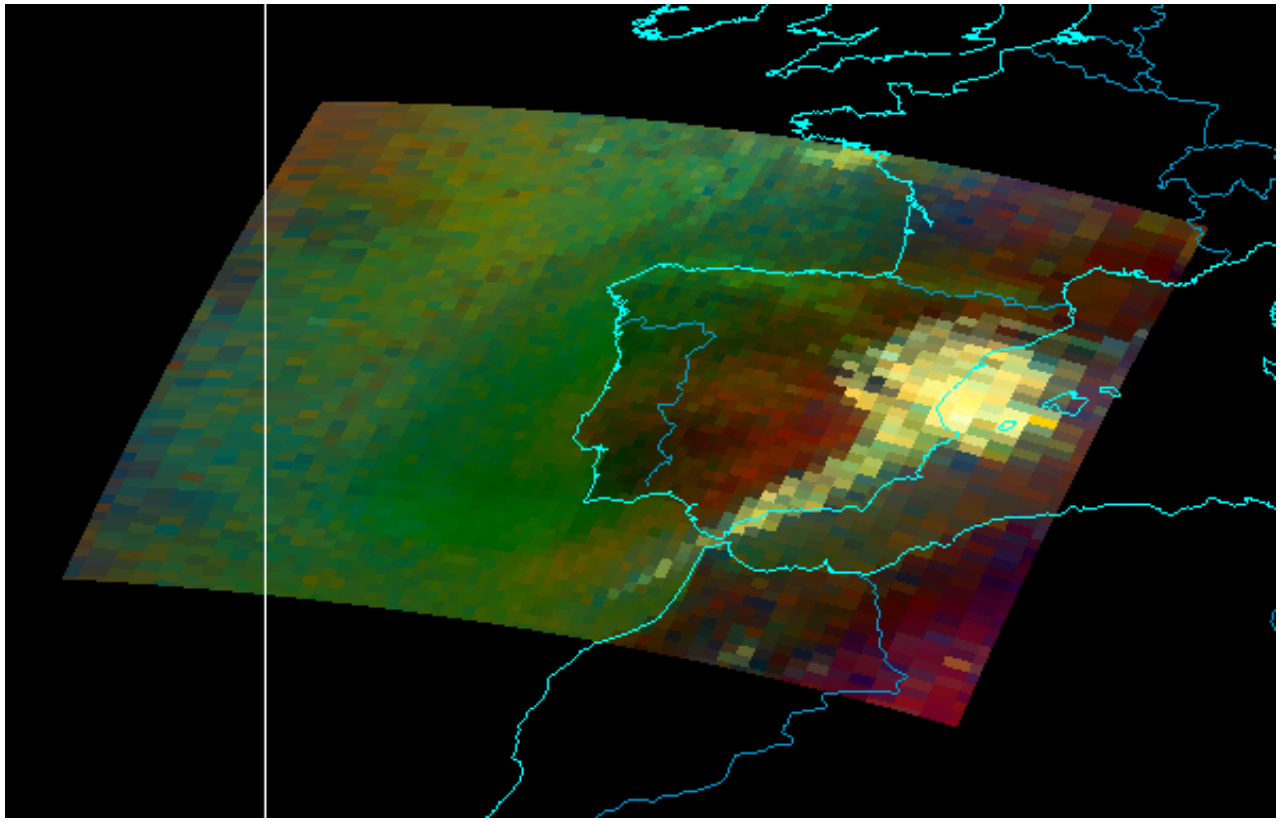
IASI RGB images generated with McIDAS-V after generation of netCDF files with just the channels needed; one click.

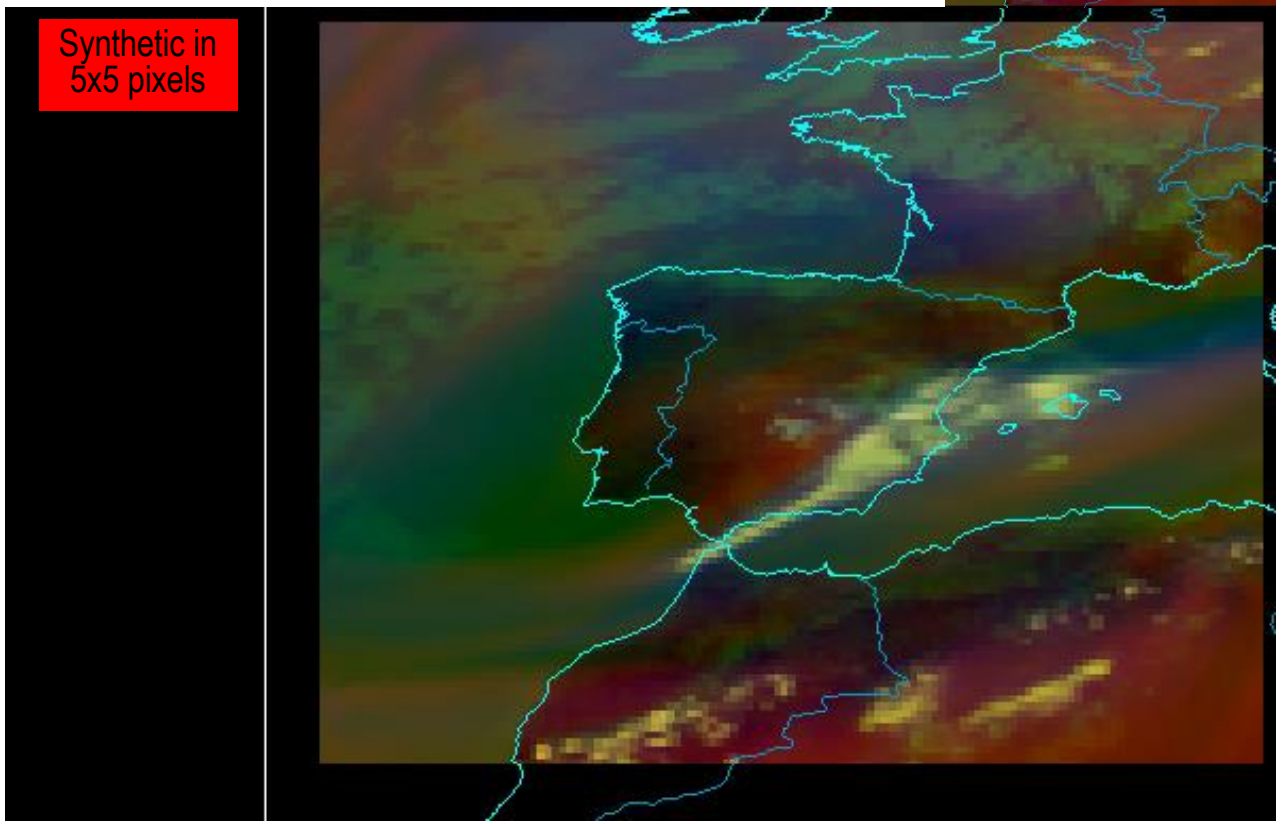


Synthetic IASI RGB images on clear air



Synthetic in 5x5 pixels





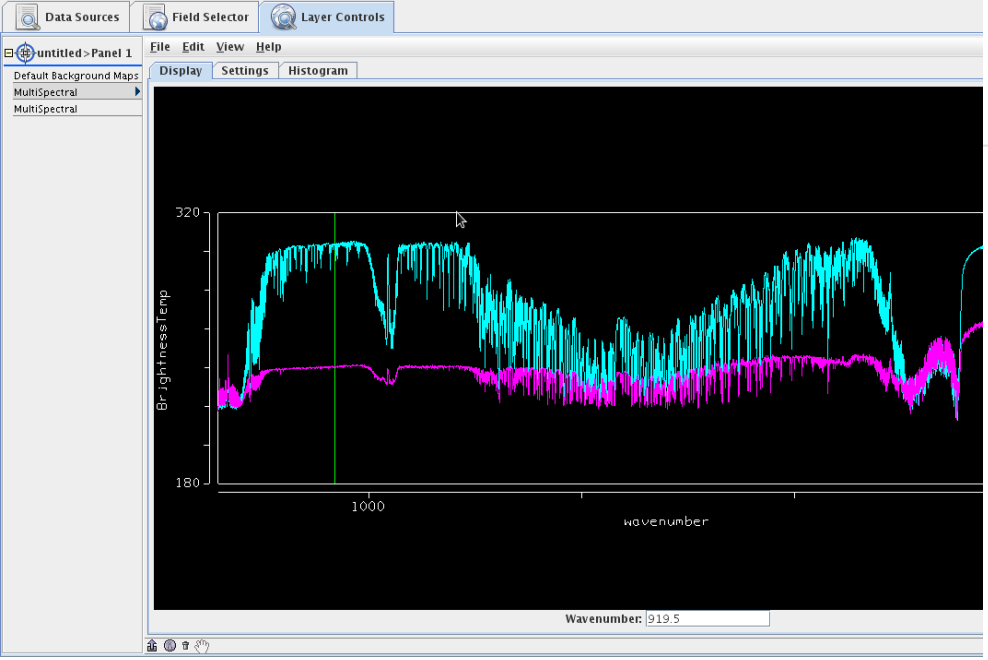
IASI real airmass RGB

IASI METOP-B Image 2016-08-10T10:32Z

IASI synthetic PGE00 airmass RGB

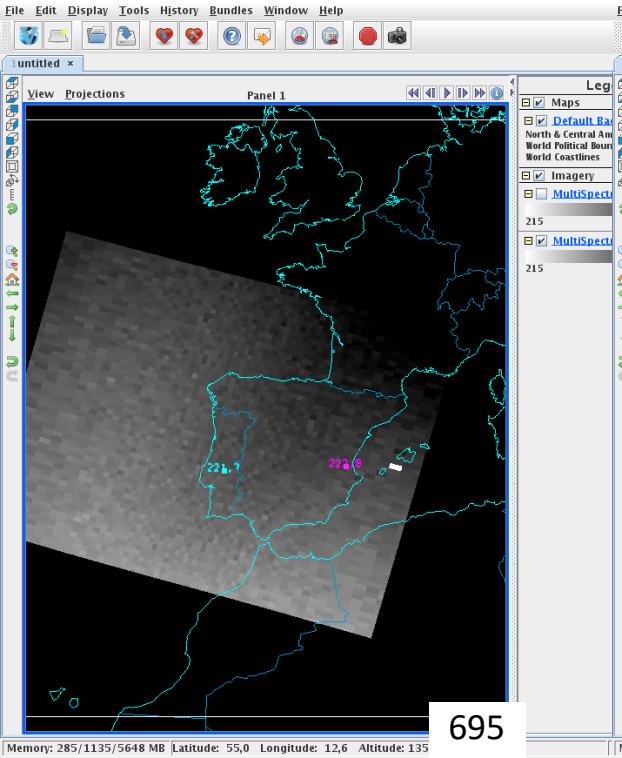
ECMWF 10th August 2016 **12Z**

t+12 **from 10th August 2016 run 00Z**

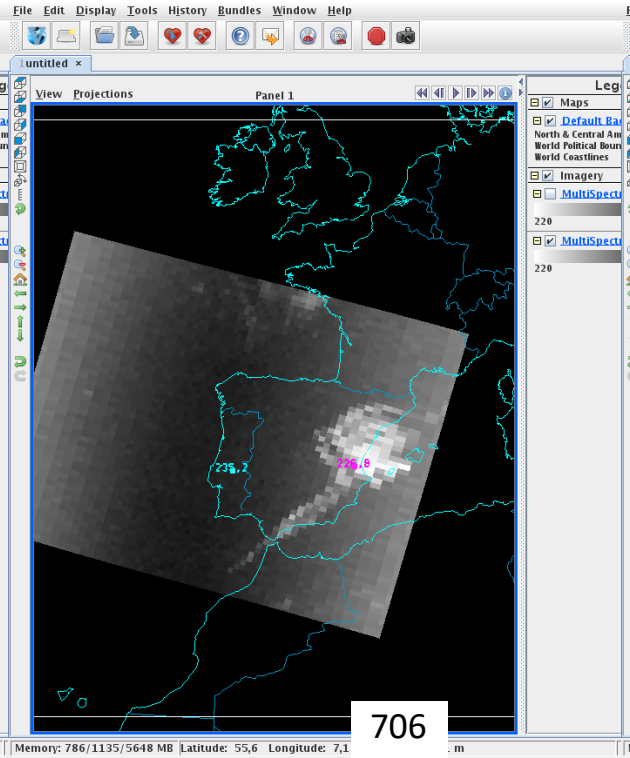


Real IASI METOP-B Image

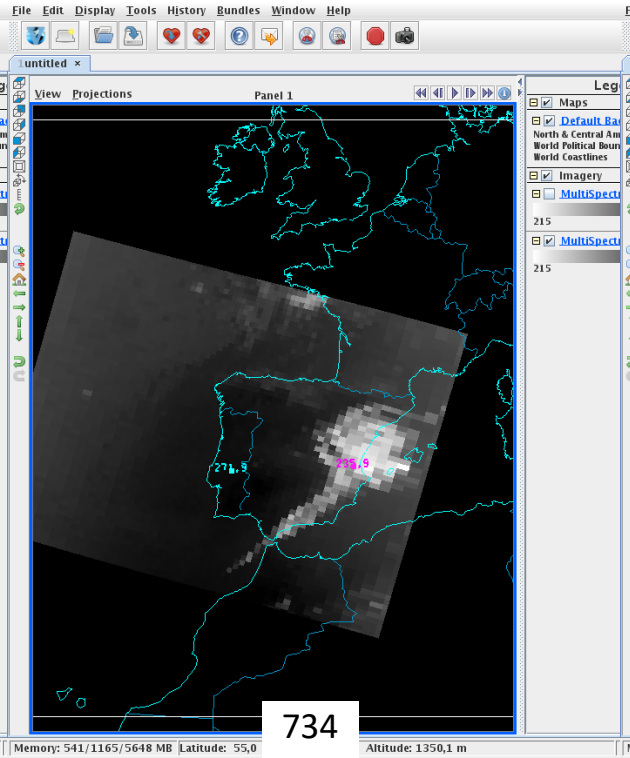
2016-08-10T10:32:26Z



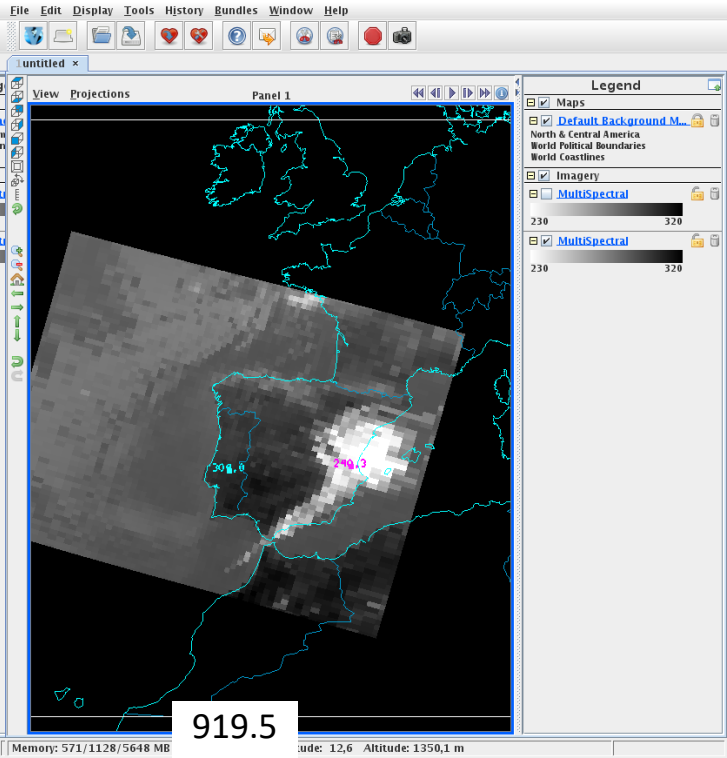
695



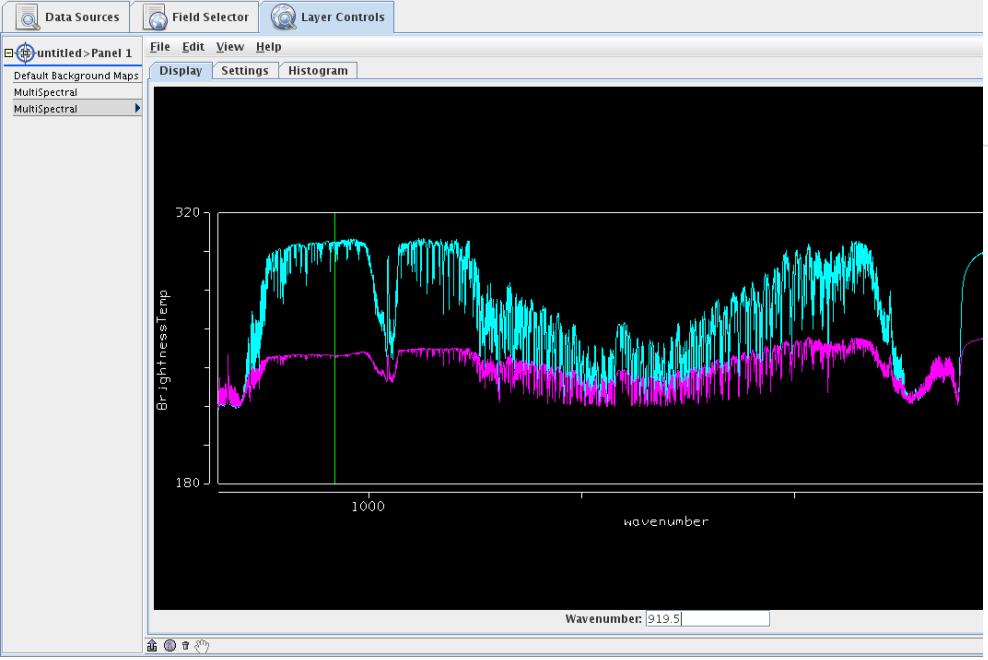
706



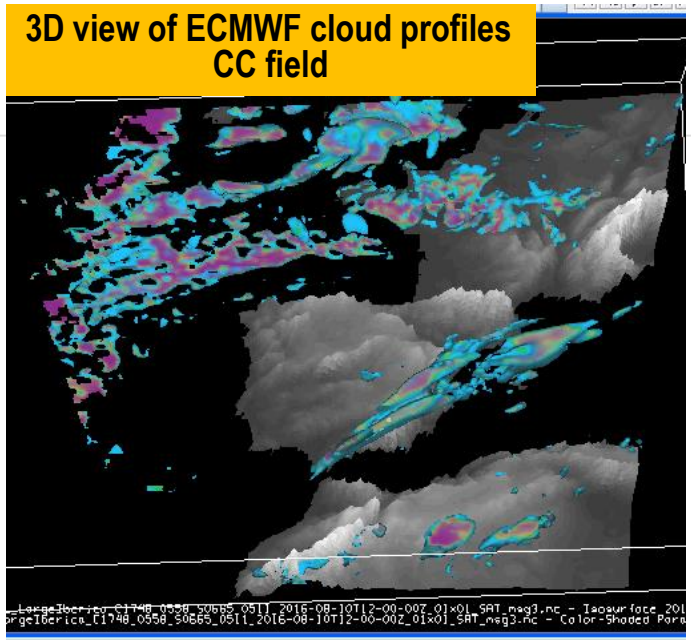
734



919.5



3D view of ECMWF cloud profiles CC field

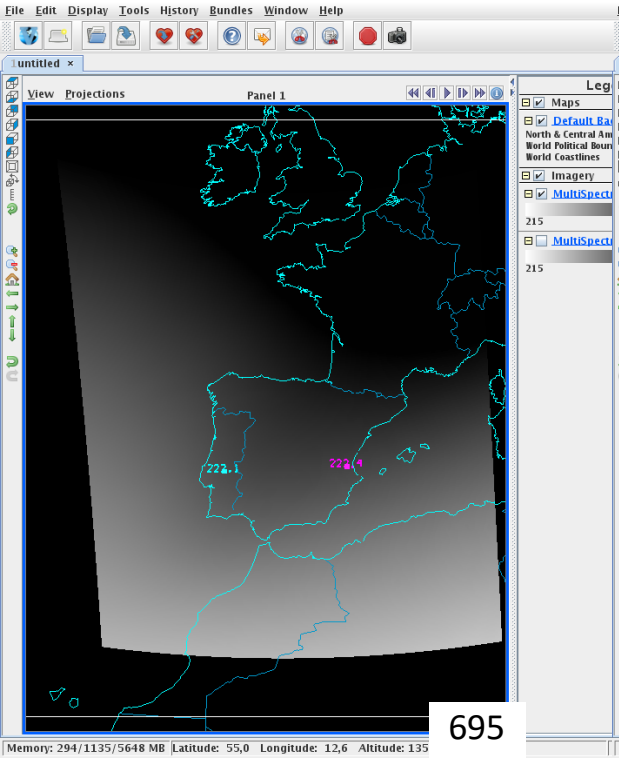


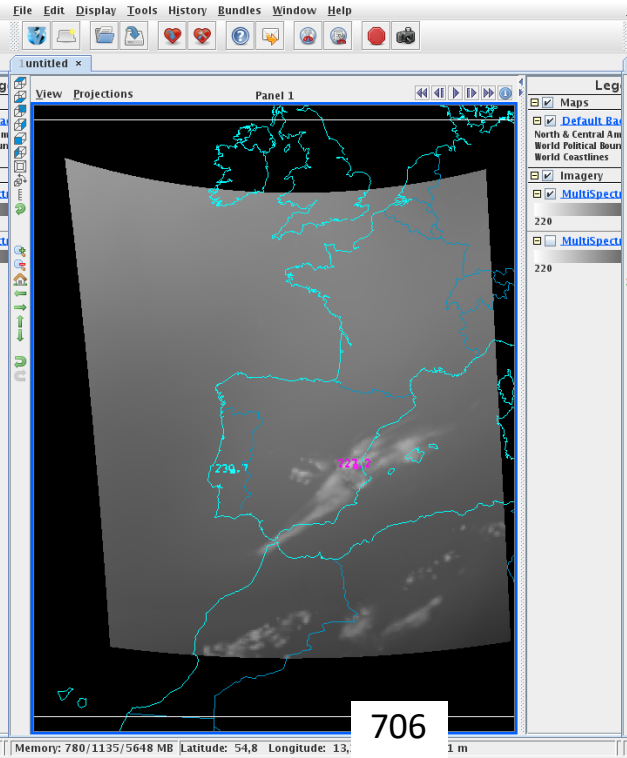
IASI Synthetic RTTOV-12.1

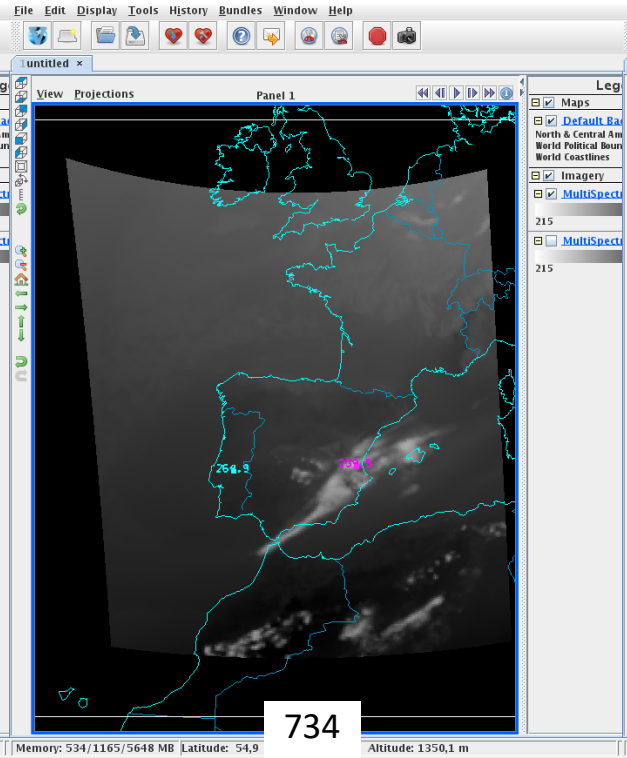
2016-08-10T12:0:00Z
From ECMWF *t+12*

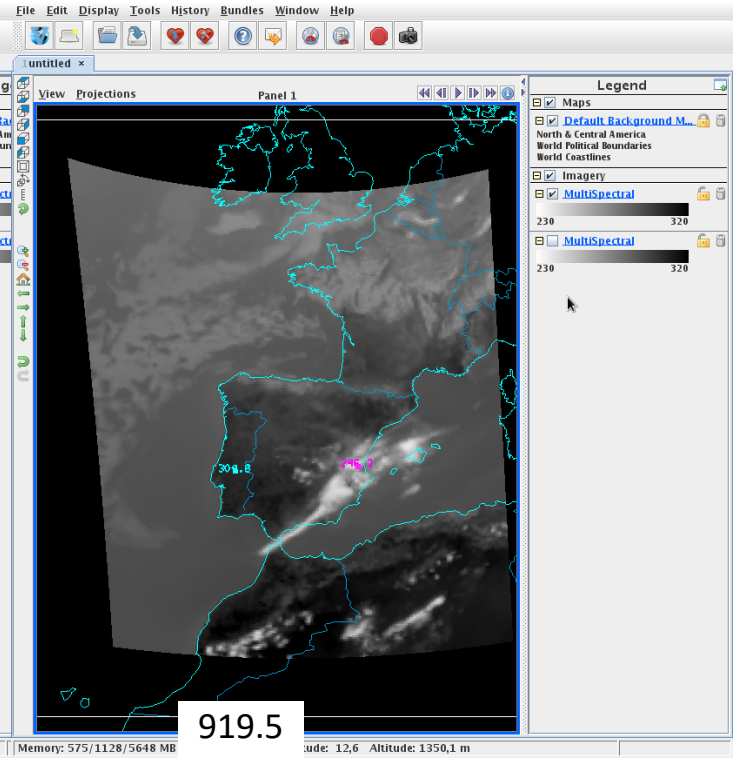
Calculated with SEVIRI zenith angles 5x5 pixels

IASI PGE00 VISIR Simulations
The cloud parameters from ECMWF on hybrid levels are used.

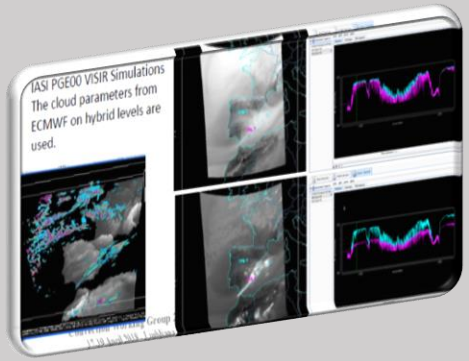






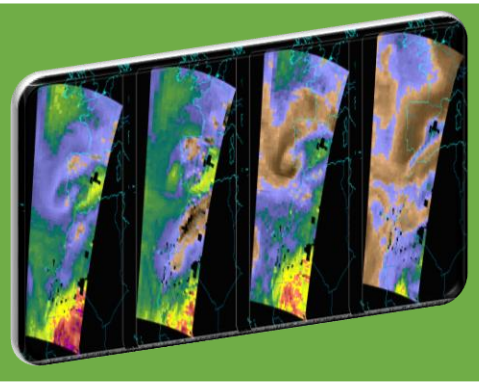


NWC SAF services for MTG-S IRS



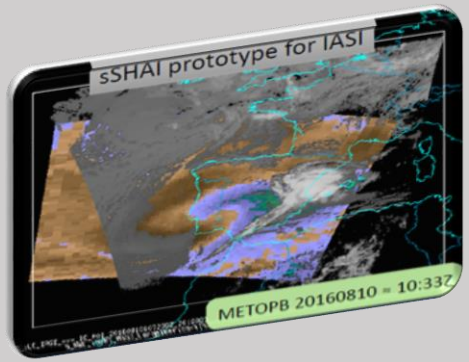
qIRS: Quick IRS product

- **Principal Components to BTs conversion and IRS L1 images generation on NWC SAF region:** PC to BTs at dwells, combination and reprojection of users selected MTG-S L1 BTs from dwells to user NWC SAF defined regions.
- Generation of IRS L1 imagery related products; as example RGB images.



sSHAI_ES: sounder Satellite Humidity And Instability from Eumetsat Secretariat

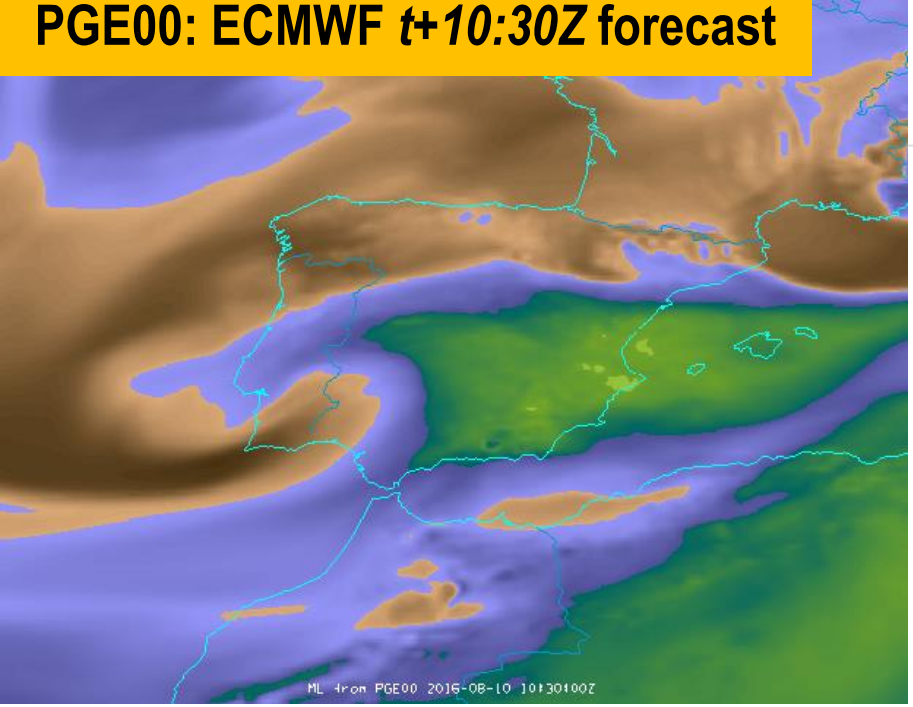
- **EUMETSAT Secretariat(ES) MTG-IRS L2 service:** combination and reprojection of 2D and 3D fields from dwells to user NWC SAF defined regions; calculation of nowcasting parameters (TPW, LPW and instability indices) at dwells. Add fields as IR images on cloudy pixels.



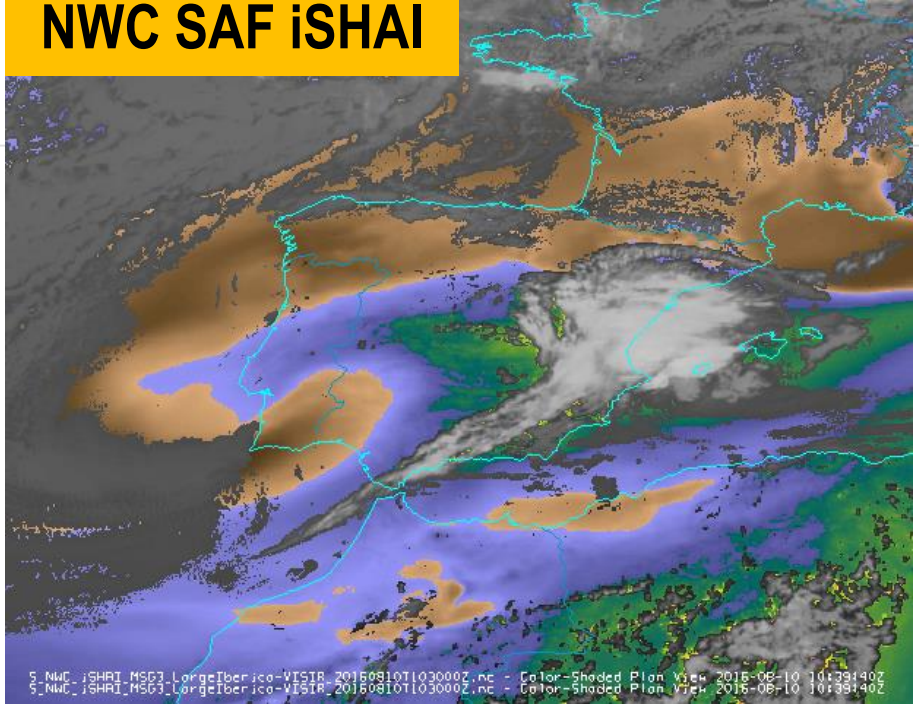
sSHAI: sounder Satellite Humidity And Instability from NWC SAF

- Local NWCSAF MTG-IRS L2 product generation. Locally executed light CPU algorithms for retrieval of T, q profiles using as input local NWP models.
- Calculation of nowcasting parameters (TPW, LPW and Instability indices) at dwells. Combination and reprojection of dwells to user NWC SAF defined regions

PGE00: ECMWF *t+10:30Z* forecast



NWC SAF iSHAI



sSHAI_ES: sounder SHAI from Eumetsat Secretariat

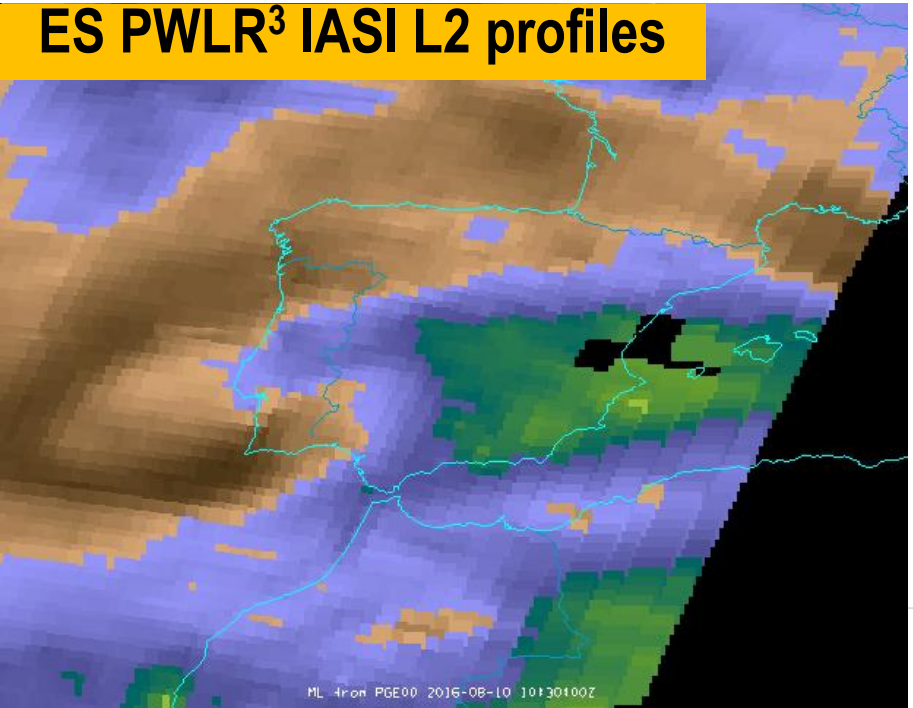
Used a IASI file converter prototype:

- Subsetting the interest region
- Reorder the IASI detectors
- Calculated relative humidity profile
- Calculated the same NWCSAF parameters (TPW, LPW and stability indices)

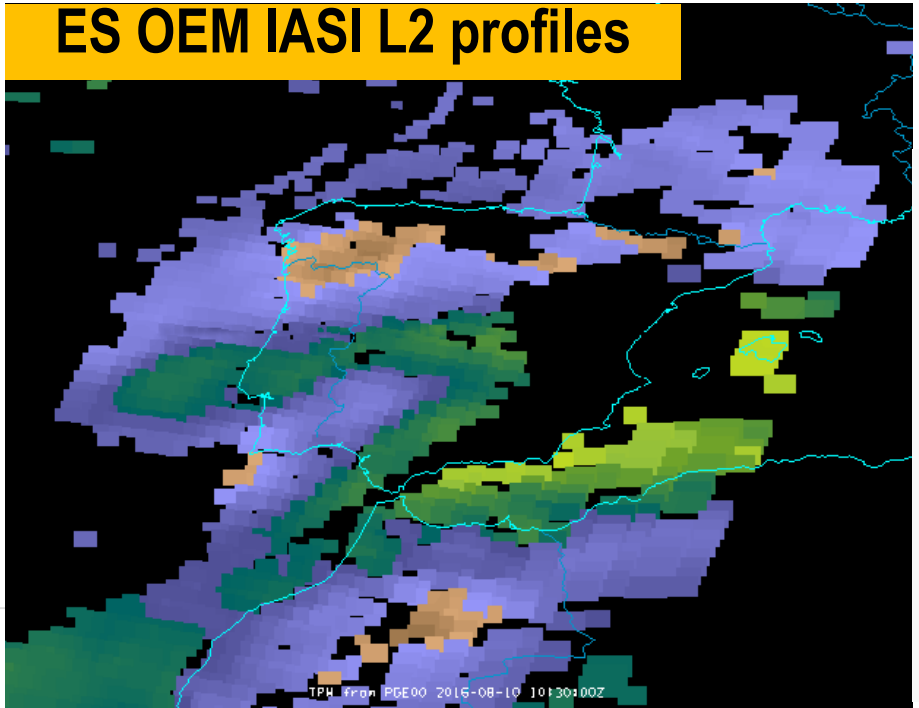
ML

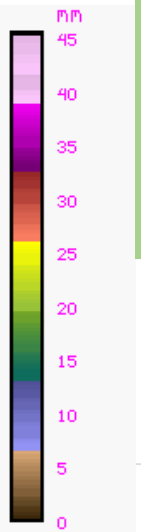
Precipitable Water in Middle Layer (850-500 hPa)

ES PWLR^3 IASI L2 profiles



ES OEM IASI L2 profiles



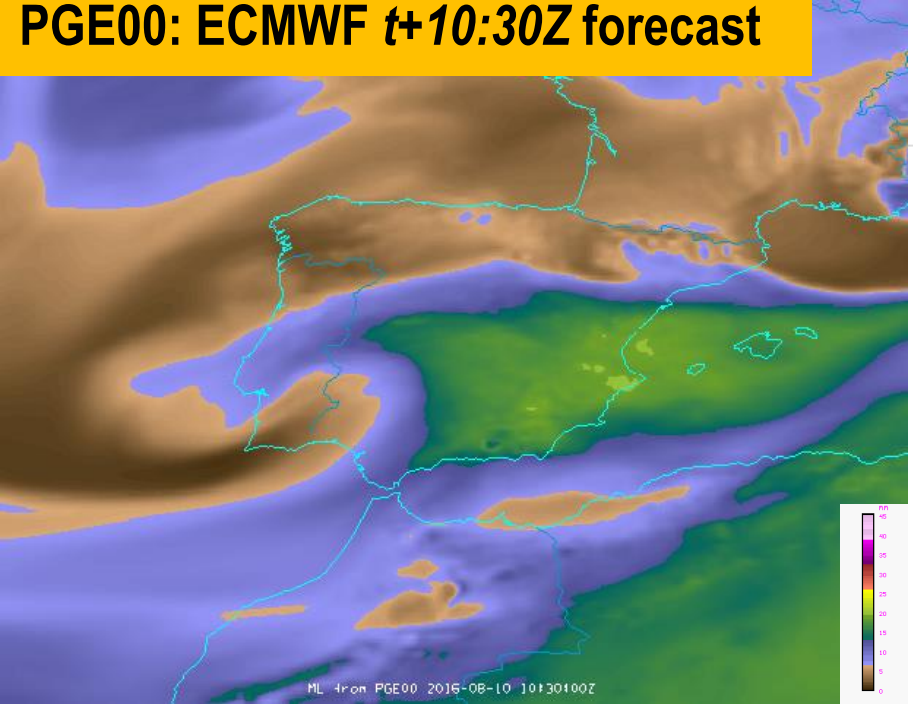


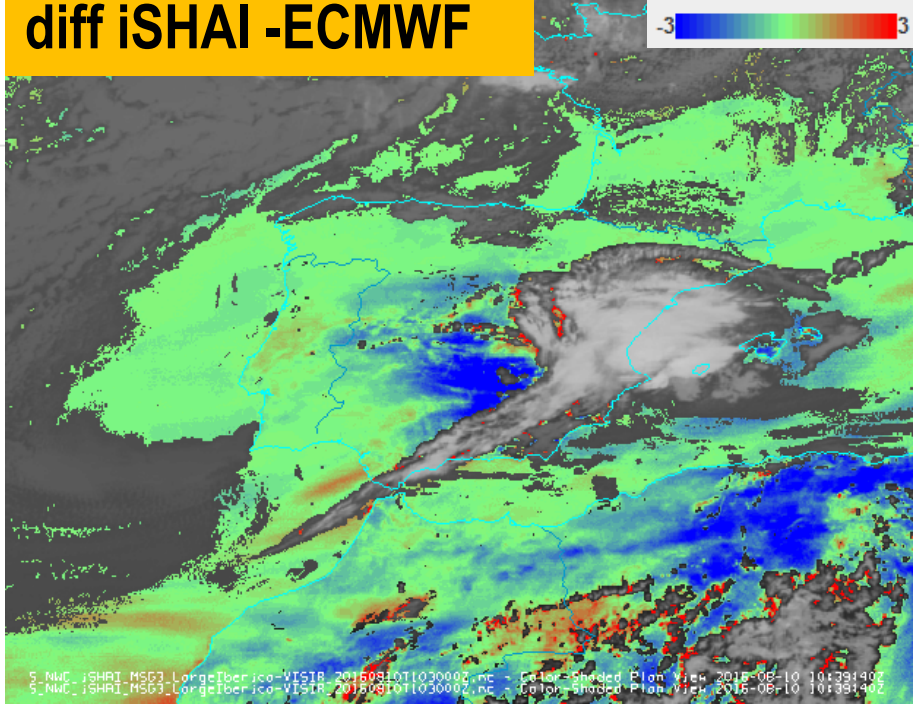
It is well represented on the IASI L2 from UMARF and agrees with iSHAI ML

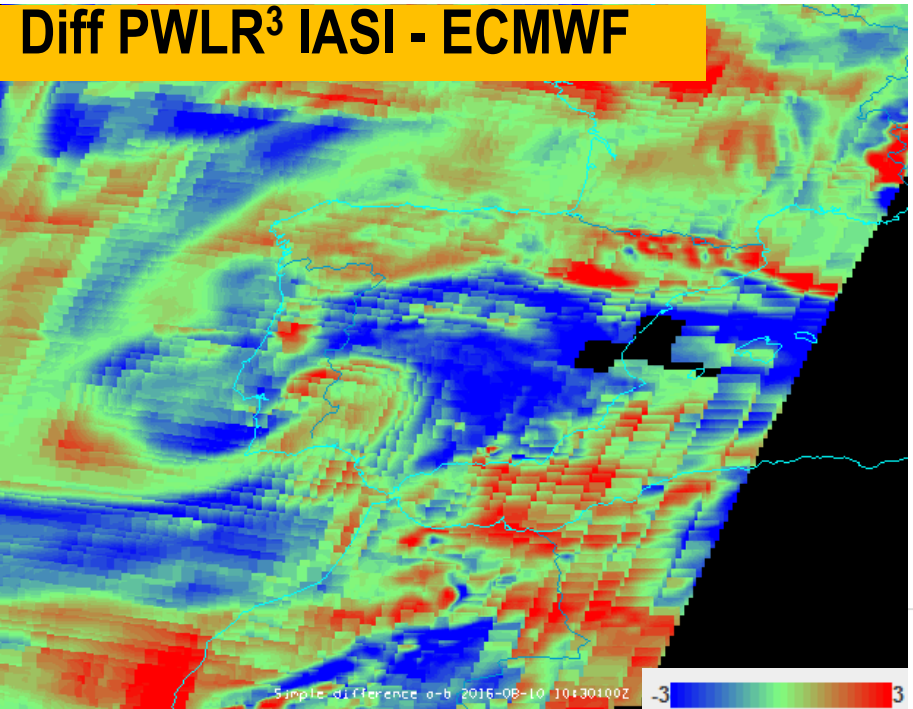
Difference ML with ECMWF

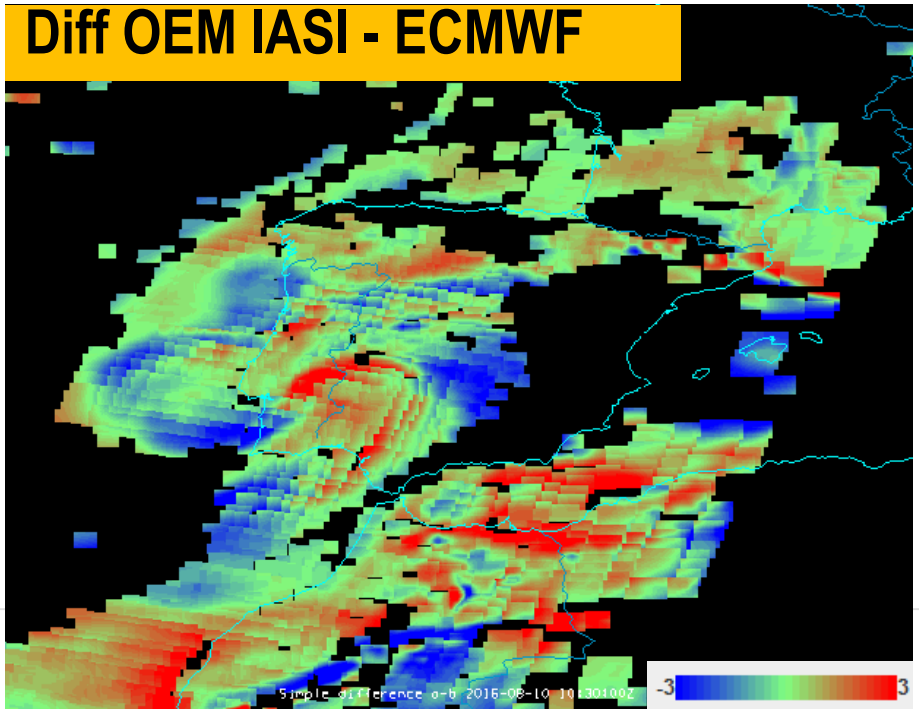
ML Precipitable Water in Middle Layer (850-500 hPa)

The difference ML fields agrees on overestimation on ML in the ECMWF in the region of interest at Betica region.

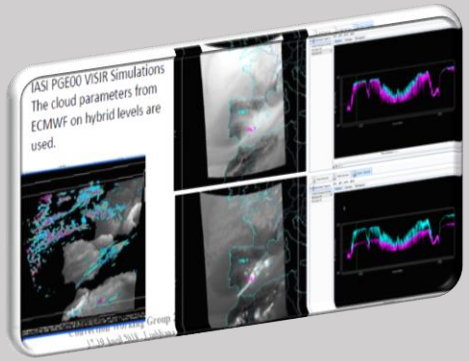






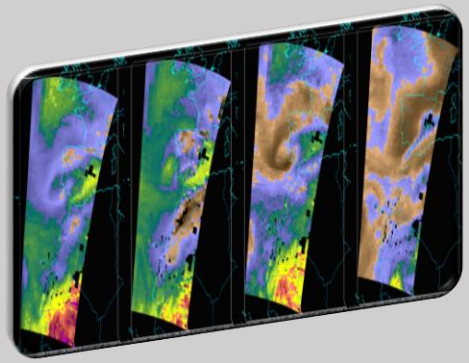


NWC SAF services for MTG-S IRS



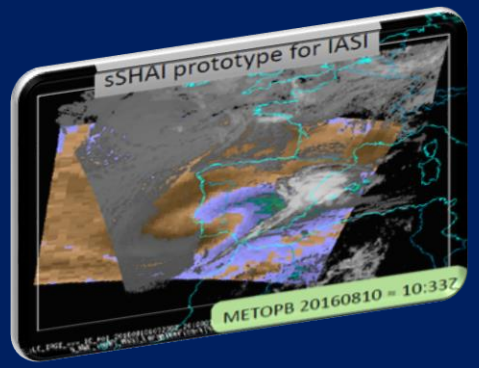
qIRS: Quick IRS product

- **Principal Components to BTs conversion and IRS L1 images generation on NWC SAF region:** PC to BTs at dwells, combination and reprojection of users selected MTG-S L1 BTs from dwells to user NWC SAF defined regions.
- Generation of IRS L1 imagery related products; as example RGB images.



sSHAI_ES: sounder Satellite Humidity And Instability from Eumetsat Secretariat

- **EUMETSAT Secretariat(ES) MTG-IRS L2 service:** combination and reprojection of 2D and 3D fields from dwells to user NWC SAF defined regions; calculation of nowcasting parameters (TPW, LPW and instability indices) at dwells. Add fields as IR images on cloudy pixels.

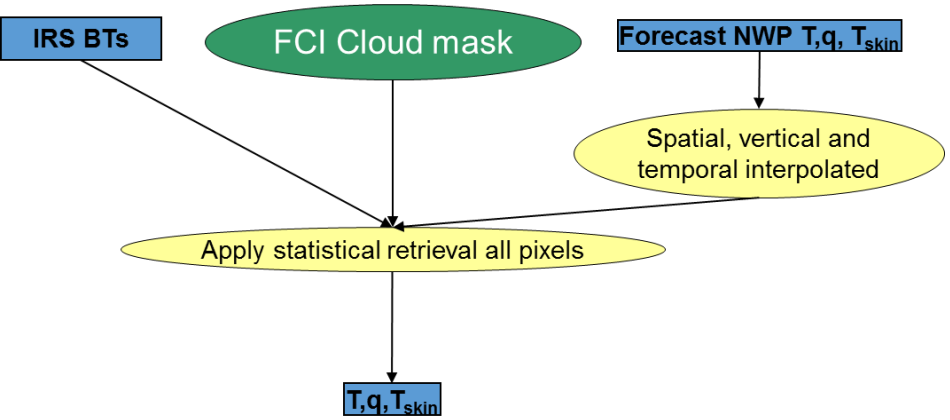


sSHAI: sounder Satellite Humidity And Instability from NWC SAF

- Local NWCSAF MTG-IRS L2 product generation. Locally executed light CPU algorithms for retrieval of T, q profiles using as input local NWP models.
- Calculation of nowcasting parameters (TPW, LPW and Instability indices) at dwells. Combination and reprojection of dwells to user NWC SAF defined regions

sSHAI: sounder SHAI from NWC SAF

- **Retrievals will be based on a fast non-linear regression method** as Kernel Ridge Regression (KRR)
- **Background will be user provided local NWP model forecasts** or climatology
- Retrievals for clear or partly cloudy scenes
- Humidity in layers and instability indices will be derived
- Outputs for every processed “dwell” will re-projected into user defined MTG FCI regions

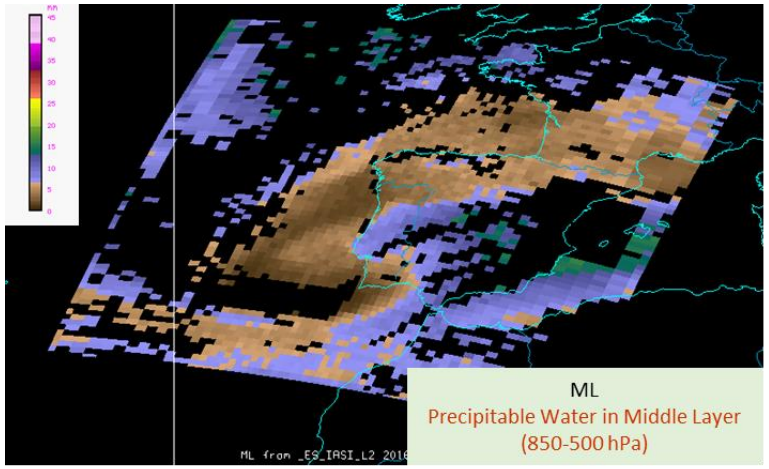


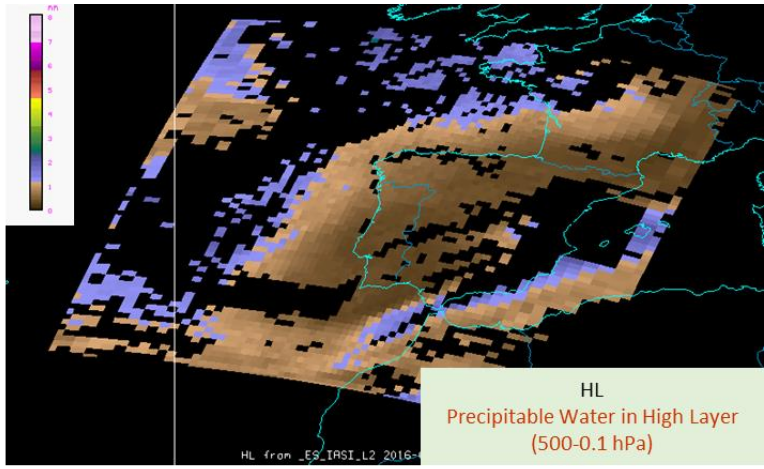
More details will be published in NWC SAF web in a special web page for MTG-IRS activities (in preparation).

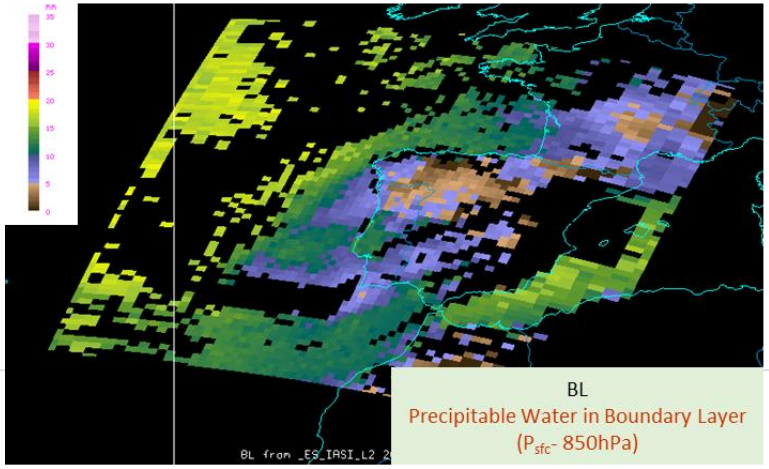
Early example of new prototype provided by Xavier Calbet and Niobe Peinado.

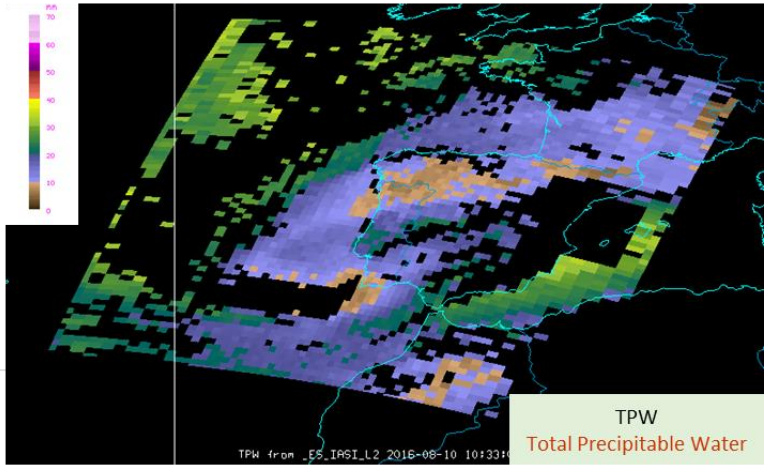
KRR trained using as predictors IASI L1 against the analysis NWP from the previous day. But executed used as input only IASI radiance.
Trained to produce profile till pixel has 80% of clouds.

It will be started soon the developing of the version using as first-guess local NWP models.

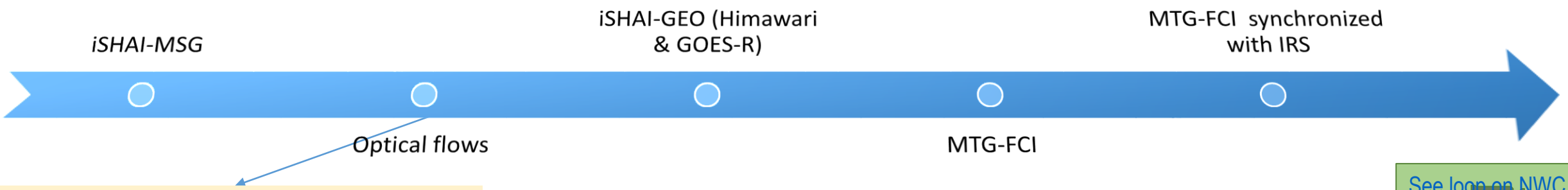








Use of iSHAI and PGE00 for optical flow



ISHAI and ECMWF collocated fields have a high spatial and temporal resolution.

Then, they are ideal to explore the use of gradients and trends between consecutive images in forecasting.

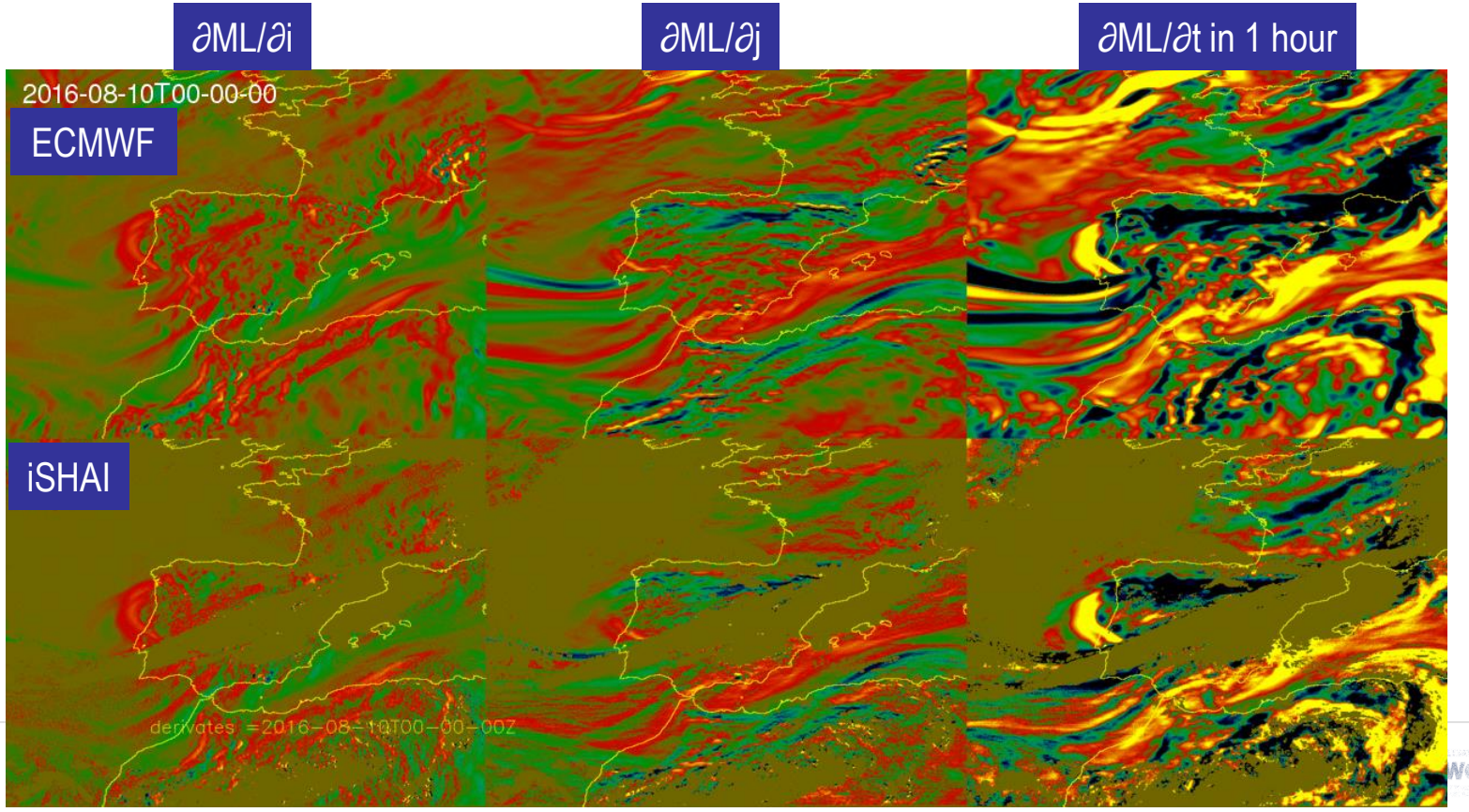
Another use it is to investigate the generation of optical flows.

$$\partial ML/\partial t + u*\partial ML/\partial i + v*\partial ML/\partial j \approx 0$$

PGE00-VISIR includes writing of NWP (u,v) wind components. McIDAS-V can use to display interactively hodograph and wind vertical cross-sections.

Collaboration with Ralph Petersen (U. Wisconsin) for use of iSHAI outputs in Nearcast.

See loop on NWC SAF web page



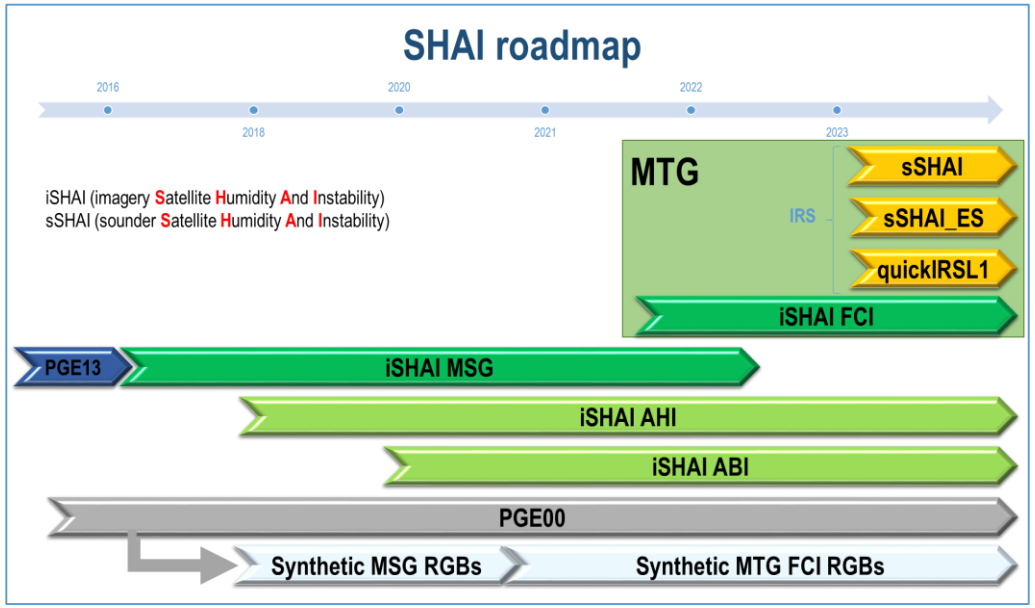
Summary

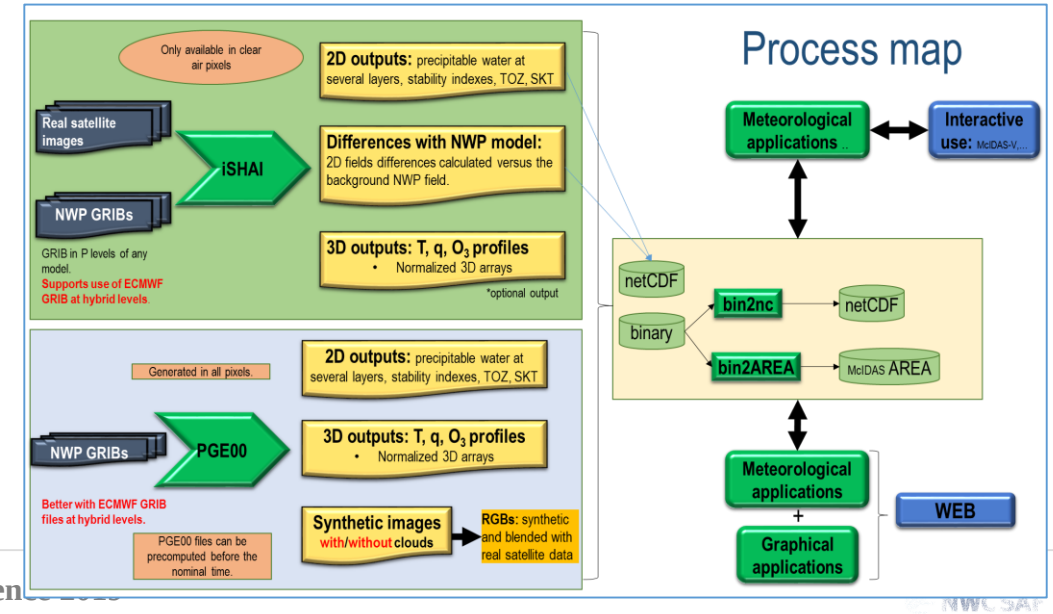
The combined use of iSHAI and PGE00 allows to improve the monitoring of key ingredients in pre-convective situations.

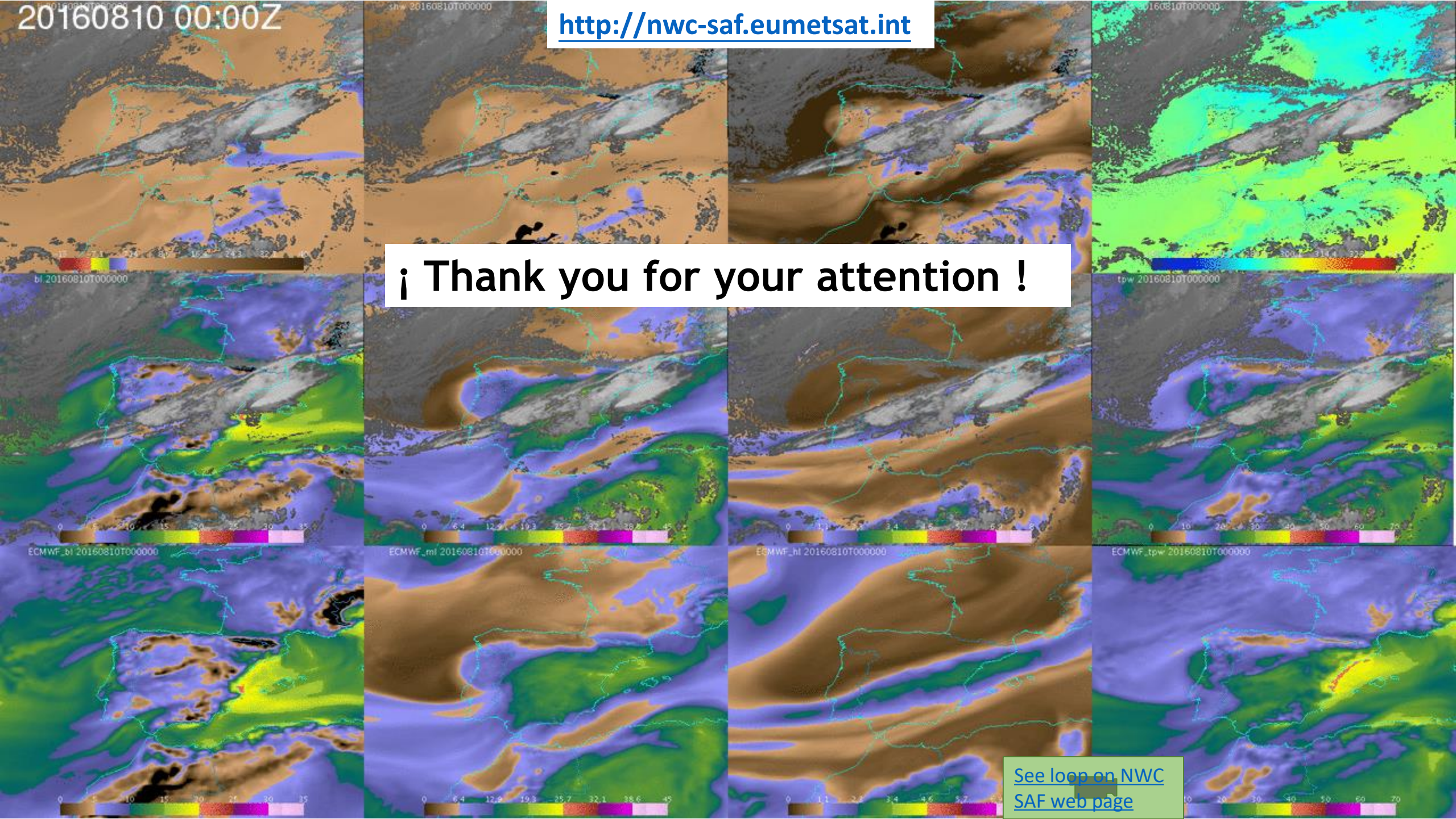
The evolution from iSHAI MSG to SHAI family will allow to exploit the synergy of MTG-FCI, MTG-IRS and NWP for the monitoring of key ingredients in pre-convective situations.

Research to operations (R2O):

- ✓ it is needed that software and processing chains must be available. R2O needs also that user's tools and automatic graphical processing should be able to use iSHAI and PGE00 files. Here it has been used McIDAS-V as demonstrator tool for interactive comparison and 3D use of proxy IRS-L2 and comparison with NWP.
- ✓ A lot of slight different products will be generated: it should be needed to develop some kind of integration tools using as artificial intelligence algorithms (Machine-Learning, Fuzzy-logic,…) for integration of L1 and L2 products.
- ✓ A high number of slight different products with different times generation allows be used for seamless nowcasting systems.






20160810 00:00Z
http://nwc-saf.eumetsat.int
¡ Thank you for your attention !
See loop on NWC SAF web page