NWCSAF/MSG Clear Air Products: PGE13 SEVIRI Physical Retrieval product (SPhR)

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  - Preparing clear air techniques in MTG era

Framework of PGE13 SPhR in the NWC SAF

NWC SAF develop software packages for MSG (NWCSAF/MSG) and polar satellites (NWCSAF/PPS) to calculate nowcasting related products.

The **NWC SAF/MSG package** has several type of products

- MSG Cloud products
- **MSG Clear air products:**
  PGE13 SPhR SEVIRI Physical Retrieval product
- Precipitation and convection products
- Wind product
- MSG conceptual models

PGE13 SPhR images in NRT from NWCSAF/MSG reference system

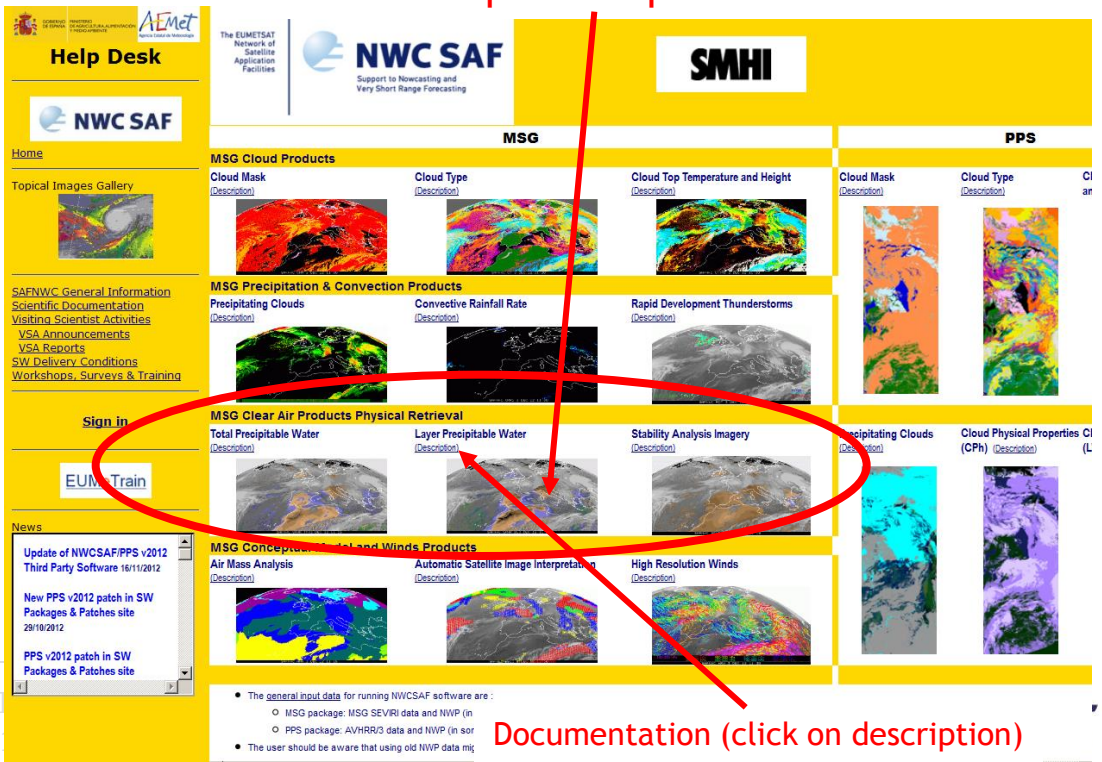
Near real time images of the main outputs of PGE13 SPhR product are available in the Nowcasting SAF web server.

Whole documentation is available in the NWC SAF web.

Images and loops on near real time from the reference system are available in the NWCSAF Help Desk open area

Note: the images on NWCSAF web server are generated with PGE13P option

http://www.nwcsaf.org



Documentation (click on description)

PGE13 SPhR algorithm

The base algorithm was provided by **Dr. Jun Li of CIMSS-Wisconsin.**

http://www.ssec.wisc.edu/~junl/

The NWCSAF/MSG PGE13 SPhR (SEVIRI Physical Retrieval) product has a two steps algorithm. It is a combination of one statistical and one optimal estimation algorithm:

First step:

- Use of a non linear regression to built First Guess.

Second step:

- a **physical retrieval** algorithm (optimal estimation) with some improvements over the classical approach:
  - Use of EOFs to reduce the dimension of matrix and reduce the computation time:

    2 EOFs for T, 3 EOFs for q and 1 EOF for T_{skin}
  - Use of a regularization parameter (also called smoothing factor) introduced for convergence and solution stability.

PGE13P First Guess non-linear regression

$$Z = \sum_{j=1}^{N} A_j \cdot Tb_j + \sum_{j=1}^{N} B_j \cdot Tb_j^2 / 250 + C \cdot p_s + D \cdot latitude + E \cdot p_{land} + \sum_{l=1}^{ntemp} F_{tl} \cdot T_l + \sum_{l=1}^{nq} G_{wl} \cdot \log(q_l) + H_0$$

Where:

Z is: T or q at every 43 RTTOV pressure levels or Skin temperature

Tb is the **SEVIRI bias corrected brightness temperature**

In training is RTTOV BT from NWP(T+0) for each zenith angle (every degree)

T and ***q*** are background NWP forecast temperature and specific humidity profile at the 43 RTTOV pressure levels respectively

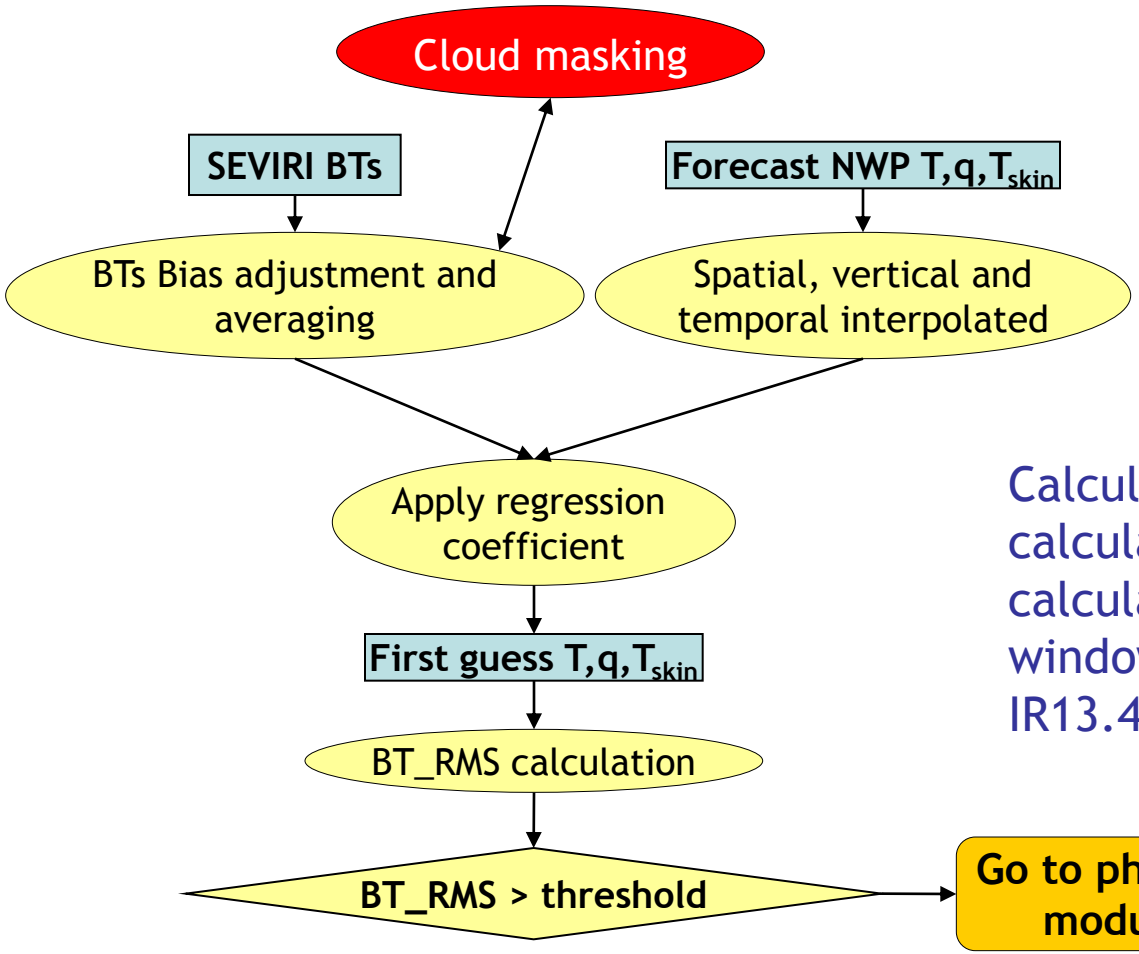
ntemp = 27 (RTTOV pressure levels > 100 hPa)

nq = 20 (RTTOV pressure levels > 286.6 hPa)

P_s is the surface pressure

The FG regression coefficients file contains 76 regression coefficients for every parameter. Each regression corresponds to one local zenith angle ranging from 0 to 75 degrees

Flow chart of PGE13 SPhR



The algorithm is a combination of one statistical and one optimal estimation algorithm.

Calculation of *BT_RMS* is based in the calculation of BT_{RTTOV} from FG and to calculate the distance on the non-window channel (WV6.2, WV7.3 and IR13.4) between BT_{SEVIRI} and BT_{RTTOV}

Based on Jun Li algorithm from CIMSS Wisconsin and similar to GOES-R algorithm

Full details are available in the PGE13 Algorithm Theoretical Basis Document on the NWCSAF Help-Desk Web page

Physical retrieval module (1/2)

Physical retrieval module is based on the minimization of a cost function. The First-Guess profile **X** (*temperature and q profile at the 43 RTTOV pressure levels*) is modified. The modification **δX** is based on the ($BT_{seviri\_bias\_corrected}$ - BT_{RTTOV}) weighted by the jacobian **F'**.

$$J(X) = [Y^m - F(X)]^T E^{-1} [Y^m - F(X)] + [X - X^b]^T \gamma B^{-1} [X - X^b]$$

Measurements

Forward Model

Measurement Error

Background

Background Error

Regularization parameter is introduced to balance the contributions from background and satellite observations in solution. It is adjusted dynamically in the iterations (Li and Huang 1999; Li et al. 2000)

With Quasi-Newton Iteration

$$\delta X_{n+1} = (F_n^{'T} \cdot E^{-1} \cdot F_n^{'} + \gamma B^{-1})^{-1} \cdot F_n^{'T} \cdot E^{-1} \cdot (\delta Y_n + F_n^{'} \cdot \delta X_n)$$

RTTOV-9.3 is used for forward model $BT_{RTTOV}=F(X)$ and Jacobian calculations $F'=(\partial BT/\partial X)$

Physical retrieval in EOFs space(2/2)

Since there are correlations among atmospheric variables at different levels, only a limited number of variables are needed to explain the vertical structure variation of an atmospheric profile (Smith, 1976).

$$X - X^b = \Phi A \quad \text{where} \quad A = (\alpha_1, \alpha_2, ..., \alpha_M) \quad \text{and} \quad \Phi = \begin{bmatrix} \Phi_T & 0 & 0 \\ 0 & \Phi_q & 0 \\ 0 & 0 & \Phi_{T_s} \end{bmatrix}$$

Using profile eigenvectors (2 EOFs for T, 3 EOFs for q, and 1 EOF for T_{skin})

Iteration form:

$$A_{n+1} = (\tilde{F}_n^{'T} \cdot E^{-1} \cdot \tilde{F}_n^{'} + \gamma B^{-1})^{-1} \cdot \tilde{F}_n^{'T} \cdot E^{-1} \cdot (\delta Y_n + \tilde{F}_n^{'} \cdot A_n)$$

$$A_0 = 0 \quad \text{where} \quad \tilde{F}' = F^{'} \cdot \Phi$$

Back to profile representation:

$$\delta X = \Phi \cdot A$$

EOFs representation reduces the dimension of matrix and reduces the computation time.

PGE13 modes depending on background NWP data input on version 2013

NWP GRIB files in the range [*t+0, t+24]* hours forecast are needed.

Background NWP must be spatial, temporal and vertically interpolated to get NWP data collocated with SEVIRI data at 43 RTTOV levels.

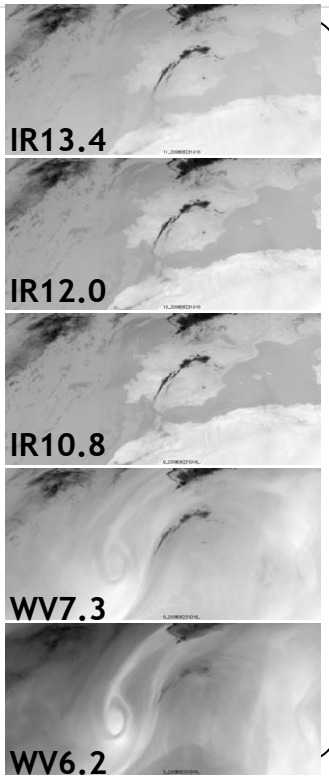
In version 2013 PGE13 SPhR there are two optional modes of execution that depend in the kind of NWP GRIB files used:

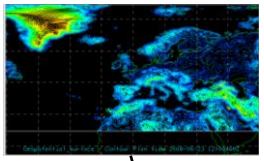
- **PGE13P** mode: it uses NWP GRIB files at fixed pressure levels
- **PGE13Hyb** mode: it allows now **only ECMWF GRIB files at hybrid pressure levels**

PGE13P mode: The **default mode** is an update of the 2010 version. It uses the NWC SAF library for the NWP background management. **This default mode only allows to use NWP GRIB files on fixed pressure levels as input.** The order of NWP interpolations is spatial, temporal and vertical interpolation to 43 RTTOV pressure levels (in the case of ECMWF the number of fixed pressure levels is just only 15 fixed pressure levels). Spatial and temporal interpolation are made outside of the PGE13 P

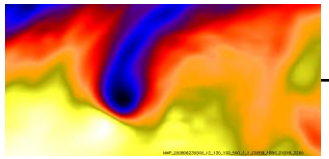
PGE13 SPhR inputs and outputs scheme on version with fixed pressure level

HRIT images

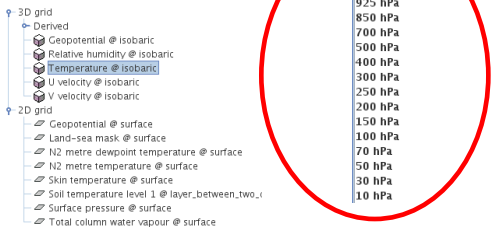




Spatial interpolation (AllMapping)



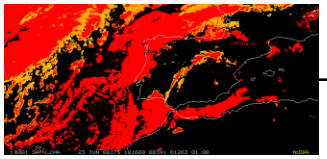
15 levels in ECMWF case



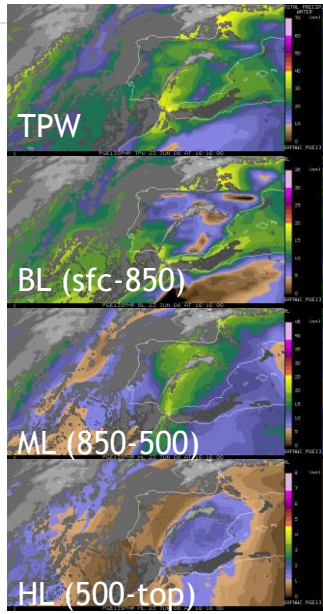
PGE13
YYYYMMDDhhmm region config_file

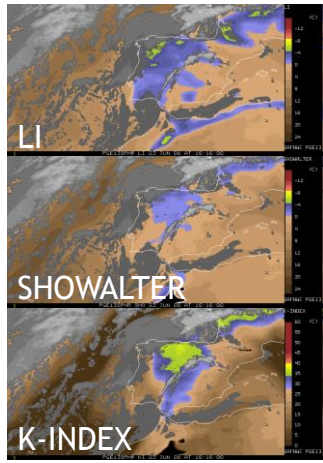
Ancillary and coefficients
Lon, lat, zenith
Bias correction, regression, EOF, etc

PGE01 Cloud Mask



H5





+ differences (phy. Ret -NWP)

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 (NWC SAF PGE01).

Main PGE13 configurable options and parameters (PGE13 SPhR Model Configuration File)

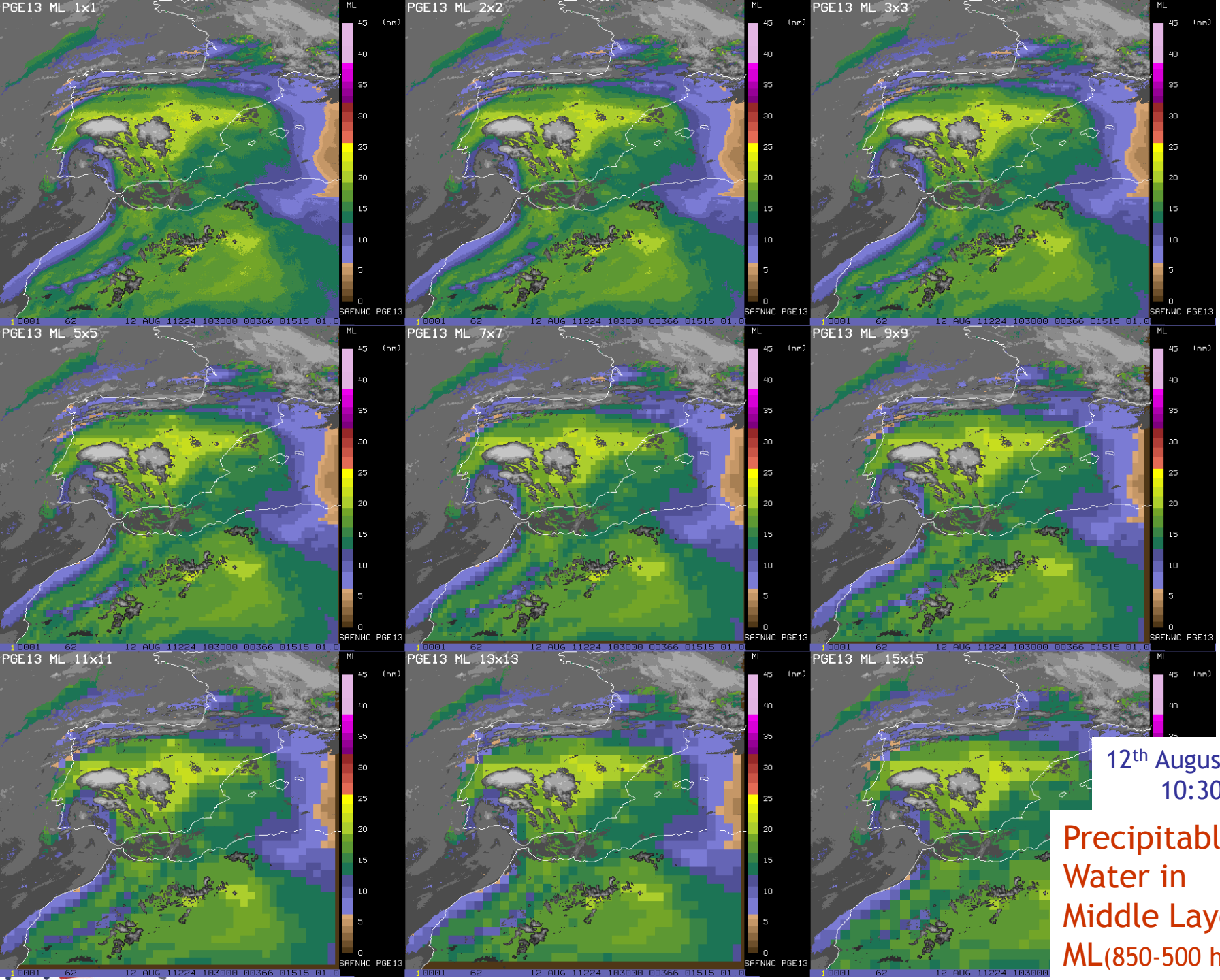
The PGE13 is highly modular and configurable. In the execution the third parameter is an ASCII file with all the processing options. The main options are:

- The Field Of Regard (FOR) size for processing in boxes of M x M pixels (*default 3 x 3*).
- Method to calculate the BTs of the MxM window. a) the mean of all clear pixels b) the SEVIRI BTs of the warmest clear pixel at the IR10.8
- ***BT_RMS_THRESHOLD*** and ***MAX_RESIDUAL*** keywords. They control the level of the desired error between the bias corrected SEVIRI BTs and the RTTOV BTs.
- Number of iterations. Maximum number of iterations is 3 iterations.
- The name of all coefficients files are keywords in the configuration files.
- SEVIRI BT bias corrections coefficients
- **Writing of temperature profile, specific humidity profile and skin temperature at clear processed Fields of Regards (M x M pixels) or for all pixels are the options are activated through editing the PGE13 Model Configuration File (extension .cfm).**

Full details in the Product User Manual Document available on the NWCSAF Help-Desk Web page

FOR (Field of Regards) or box size

- Retrieval of atmospheric temperature and moisture profiles as well as surface skin temperature for a clear sky pixel on FOR oe boxes of MxM pixels.
- A window of 3x3 have been considered as default.
- **The size of FOR (MxM) is one parameter in the configuration file**
- The users can select the size of FOR (MxM size of the window) depending on the size of the region to process and the machine characteristics.



12th August 2011
10:30Z

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

PGE13 SPhR training and validation dataset

The base algorithm was adapted to use NWP SAF RTTOV as radiative transfer model and all the coefficients has been calculated using the PGE13 training and validation dataset.

To build a training and validation dataset with the MSG data, ECMWF NWP model and radiosounding profiles is an important task. This task is based in a continuous task of reprocessing at 00 UTC and 12 UTC with PGE13 only over a list of points (RAOB positions and a grid of 1ºx1º). Binary files allows to create a dataset of (T,q) profiles collocated with SEVIRI radiances, etc. **Now the dataset contains profiles from January 2008.**

The coefficients of version 2013 have been updated and calculated with profiles from 2012 year of the PGE13 validation and training dataset. Also the emissivity atlases have been updated using IREMIS datasets of 2012. Writing of validation reports and training of new tuned physical retrieval coefficients is the other main use.

New PGE13Hyb mode in version 2013

The **new PGE13Hybrid module** is an major update of the code to **allow the use of ECMWF GRIB files on hybrid levels as background NWP input.**

The whole management of the NWP is made inside of the PGE13 code and no preprocessing of the NWP GRIB from ECMWF is needed.

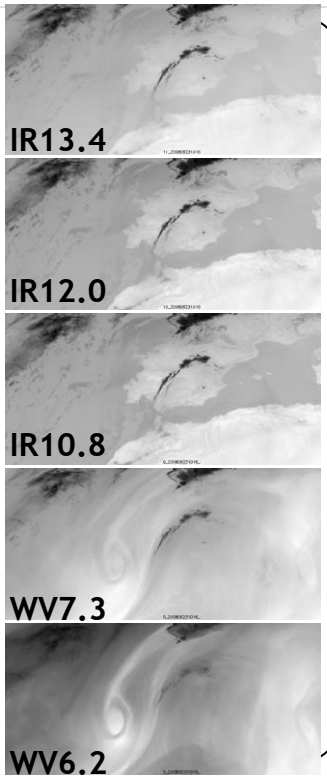
The change from PGE13P mode to PGE13Hyb mode is made changing in the PGE13 configuration file the keyword "NWP_EXEC_MODE" is fixed to "*HYB*". Full details in the PGE13 Program User Manual (PUM document)

The order of NWP interpolations is first vertical (interpolation to the 43 RTTOV pressure levels from hybrid levels that in the case of ECMWF the number of hybrid pressure levels is now 137 (before June 2013 the number was 91)), second temporal and third spatial.

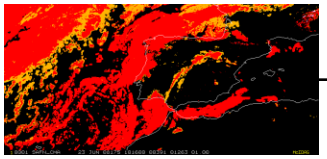
PGE13Hyb mode has high quality in the background NWP input
=> higher quality in the PGE13Hyb outputs than in PGE13P ones
=> other kinds of applications are possible.

PGE13 SPhR inputs and outputs scheme on PGE13Hyb version

HRIT images



PGE01 Cloud Mask



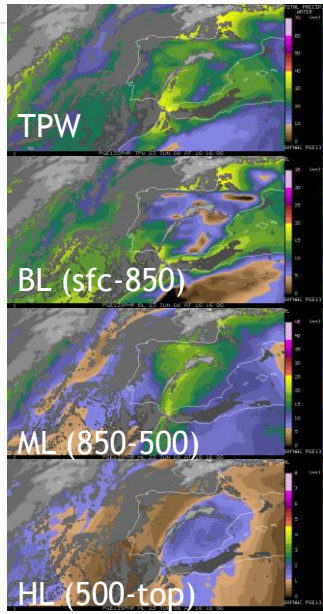
ECMWF Hybrid levels from version 2013

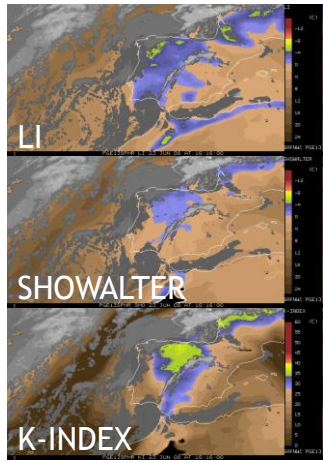
Vertical, temporal and spatial interpolation inside PGE13Hyb

PGE13
YYYYMMDDhhmm region config_file

Ancillary & coefficients
Lon, lat, zenith
Bias correction, regression, EOF, etc

H5





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 (NWC SAF PGE01).

+ differences (phy. Ret -NWP)

Main changes and advantages of PGE13Hyb distributed with version 2013

The humidity profile is directly read from the ECMWF GRIB files on specific humidity avoiding the conversion from Relative humidity.

The whole coefficients of **the new PGE13Hybrid module** have been calculated using **profiles only from hybrid levels GRIBs** from 2012 year of the PGE13 validation and training dataset. The training dataset has been built using only T/q profiles from hybrid levels (91 levels in 2012) interpolated to the 43 RTTOV pressure levels.

The profile is now complete in all the levels. This avoid the extrapolation above the highest available top pressure level and all the 43 levels are independent. Thus it is possible to calculate the regression directly using the 43 levels. The limits of T for pressure > 100 hPa and q for pressure > 286.6 hPa in the default mode have been removed.This allows a higher quality in the background NWP.

The spatial interpolation is only made at the clear Fields of Regards minimizing the memory needed.

The code has been rewritten using Fortran-90 and C structures. It will allow a better maintenance and future improvements.

PGE13Hyb First Guess non-linear regression

$$Z = \sum_{j=1}^{N} A_j \cdot Tb_j + \sum_{j=1}^{N} B_j \cdot Tb_j^2 / 250 + C \cdot p_s + D \cdot latitude + E \cdot p_{land} + \sum_{l=1}^{43} F_{tl} \cdot T_l + \sum_{l=1}^{43} G_{wl} \cdot \log(q_l) + H \cdot T_{skin} + G_o$$

Where:

Z is: T or q at any of the 43 RTTOV pressure levels or Skin temperature

Tb is the **SEVIRI bias corrected brightness temperature**

In training is RTTOV BT from NWP(t+00 analysis) for each zenith angle (every degree)

T and ***q*** are background NWP forecast temperature and specific humidity profile **at the 43 RTTOV pressure levels** respectively

P_s is the surface pressure

T_{skin} is the skin temperature from the background NWP

The FG regression coefficients file contains 76 regression coefficients for every parameter. Each regression corresponds to one local zenith angle ranging from 0 to 75 degrees

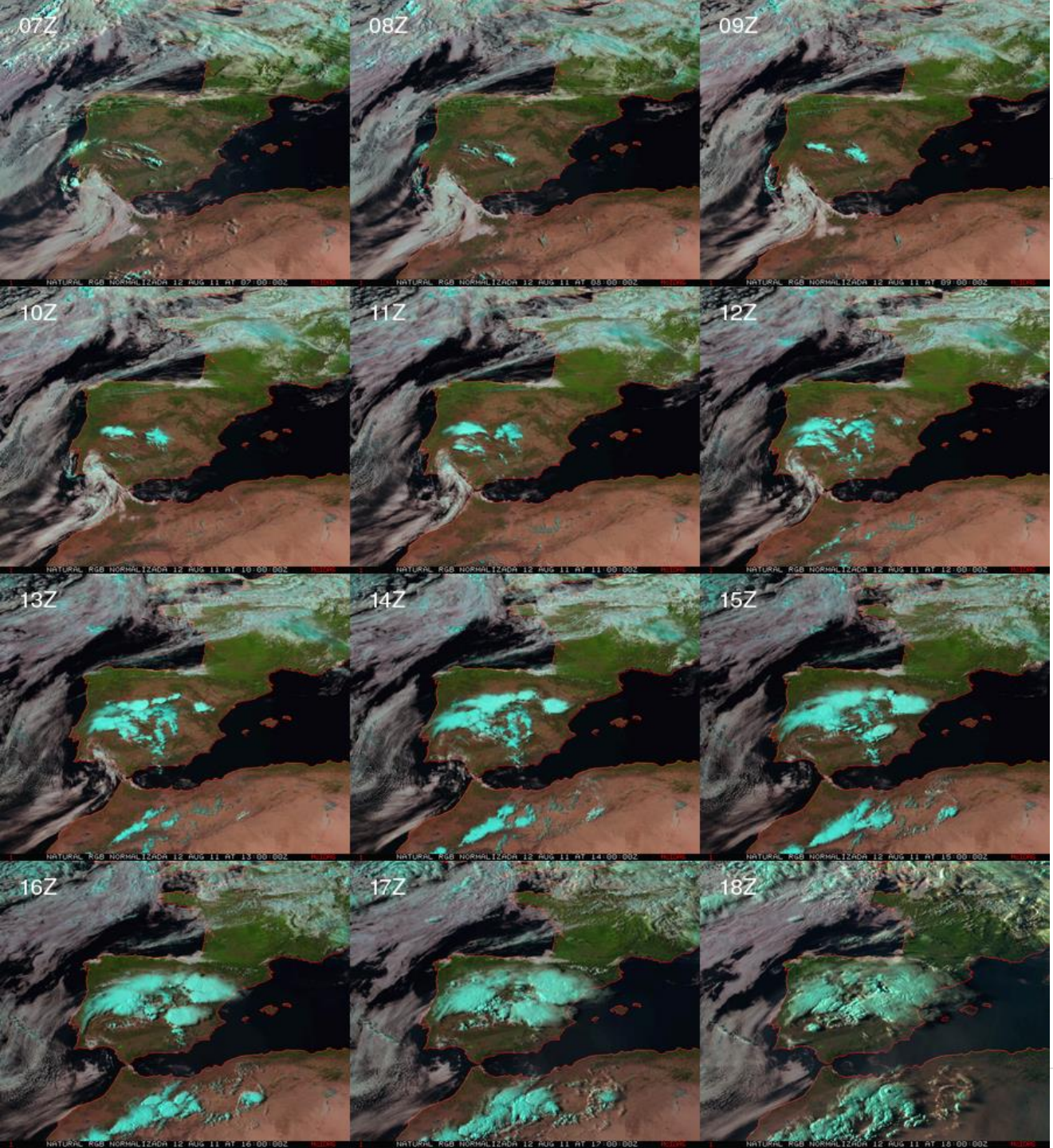
Case study

12th August 2011

Convection on Iberian Peninsula.

It is a good idea to have the possibility to show the differences with the background NWP.

PGE13 outputs should be used together with other sources of information as RGB images, RADAR images, lightning detectors, etc



Normalized natural RGB images

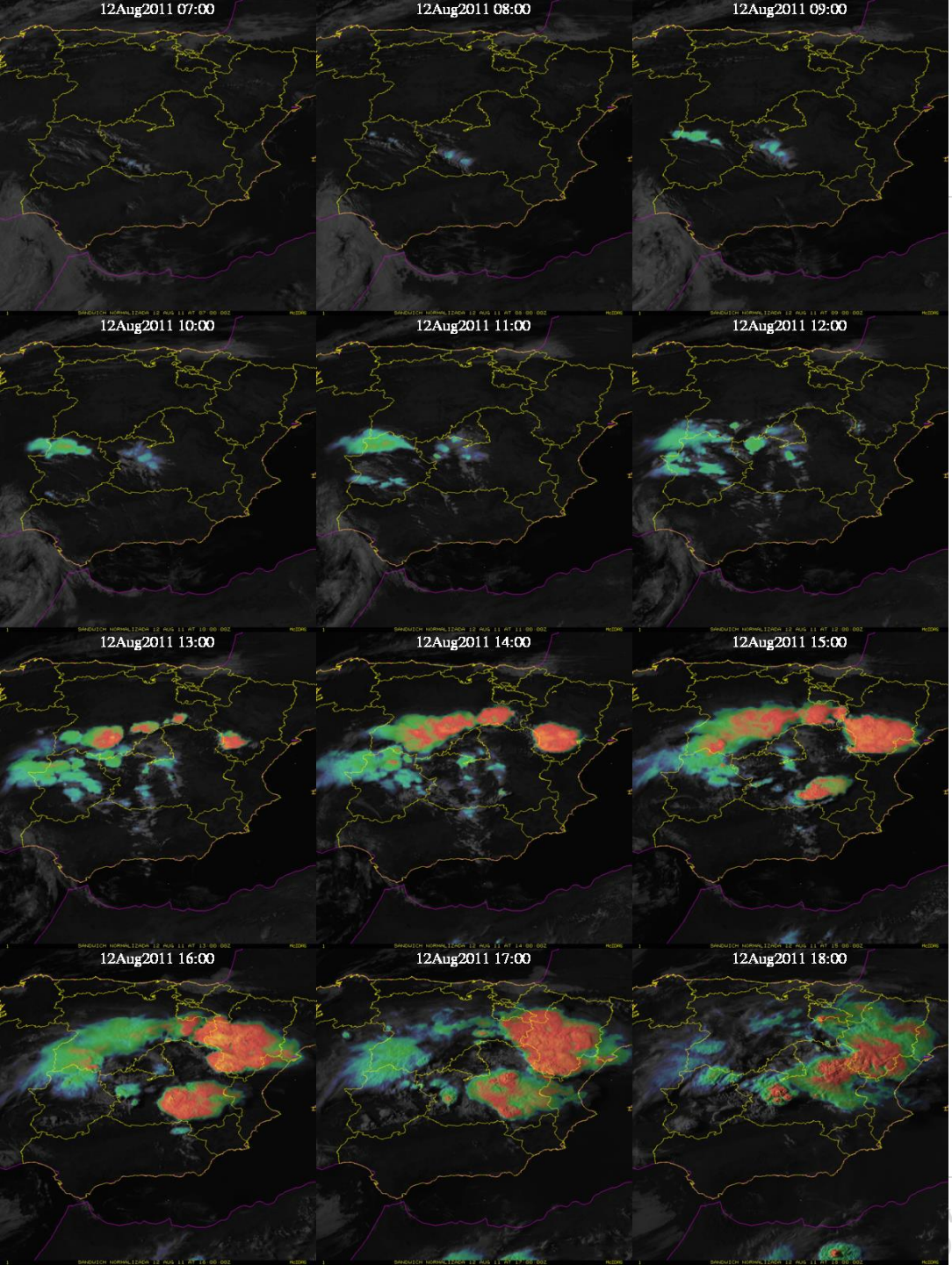
12th August 2011

Strong convection in northern Iberian plateau and in the Sistema Central and Iberica Mountains

	MSG	Range	γ
RED	IR1.6	0 - 100%	1.0
GREEN	VIS0.8	0 - 100%	1.0
BLUE	VIS0.6	0 - 100%	1.0

The VIS channels have been normalized in order to enhance the contrast at twilights.

The VIS channels radiances have been normalized to same sun zenith angle position using an AEMET McIDAS command.



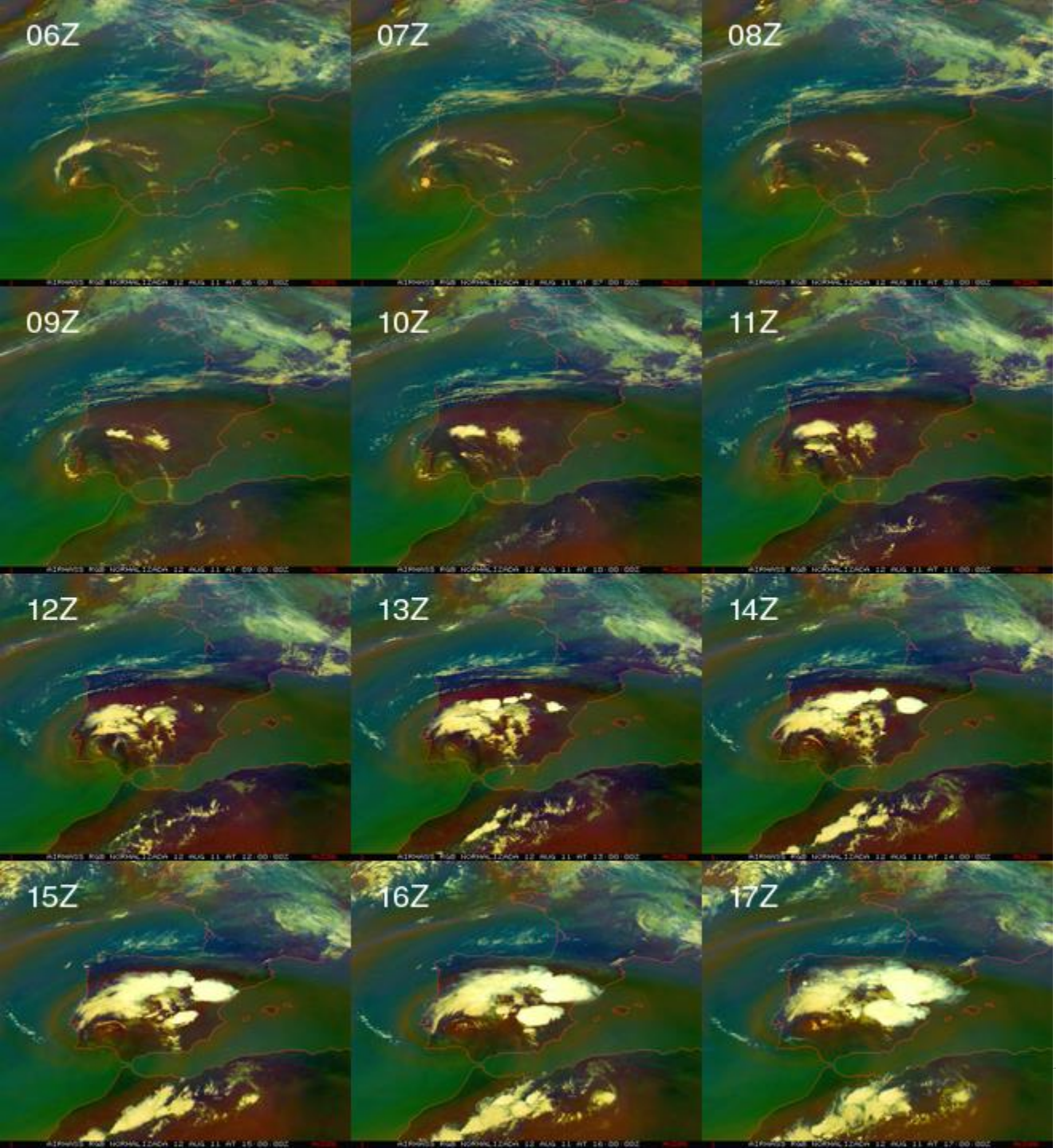
Sandwich RGB images

12th August 2011

Strong convection in northern Iberian plateau and in the Sistema Central and Iberica Mountains

Very cold temperatures and presences of overshooting can be shown in the loop of images.

The HRV channel radiances have been normalized to same sun zenith angle position using an AEMET McIDAS command.



Airmass RGB images

12th August 2011

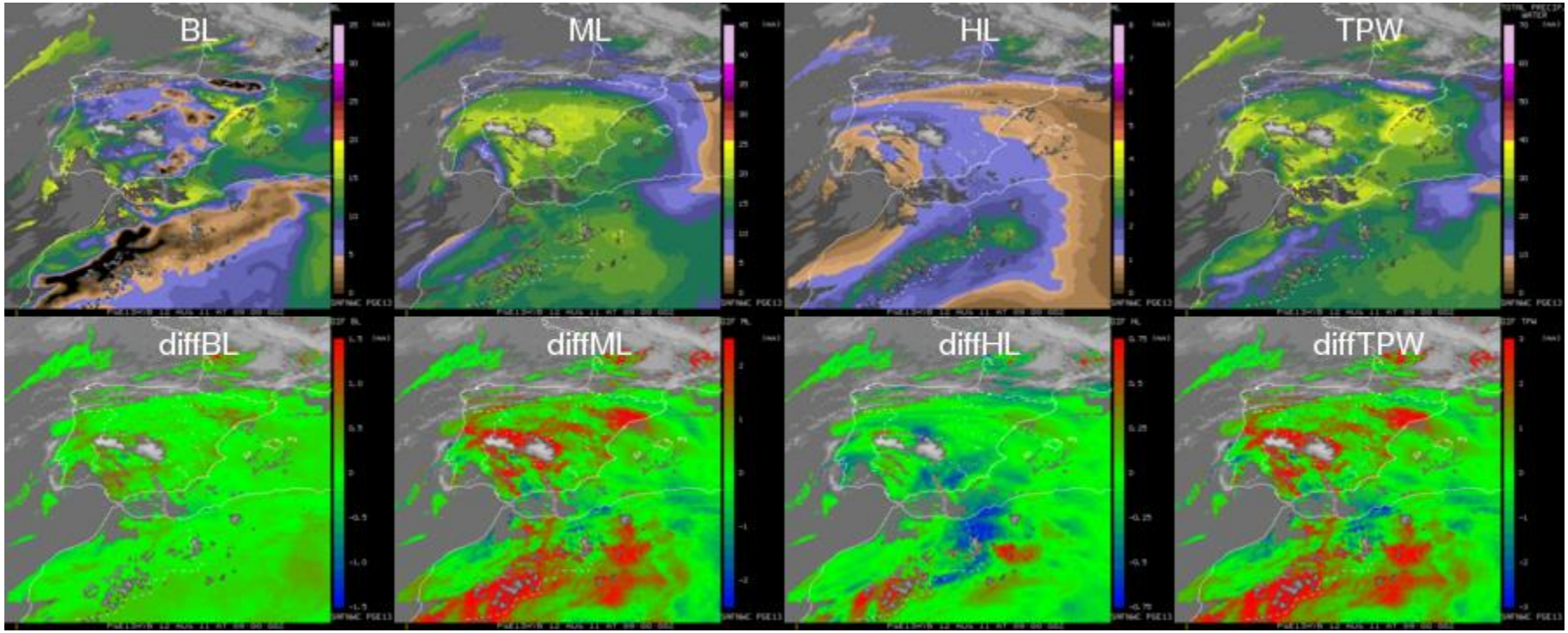
Strong convection in northern Iberian plateau and in the Sistema Central and Iberica Mountains

Cold air core approaching to the north Castilla plateau from Lisbon

NWC SAF

EUMETSAT

PGE13SPhR outputs: Precipitable fields



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

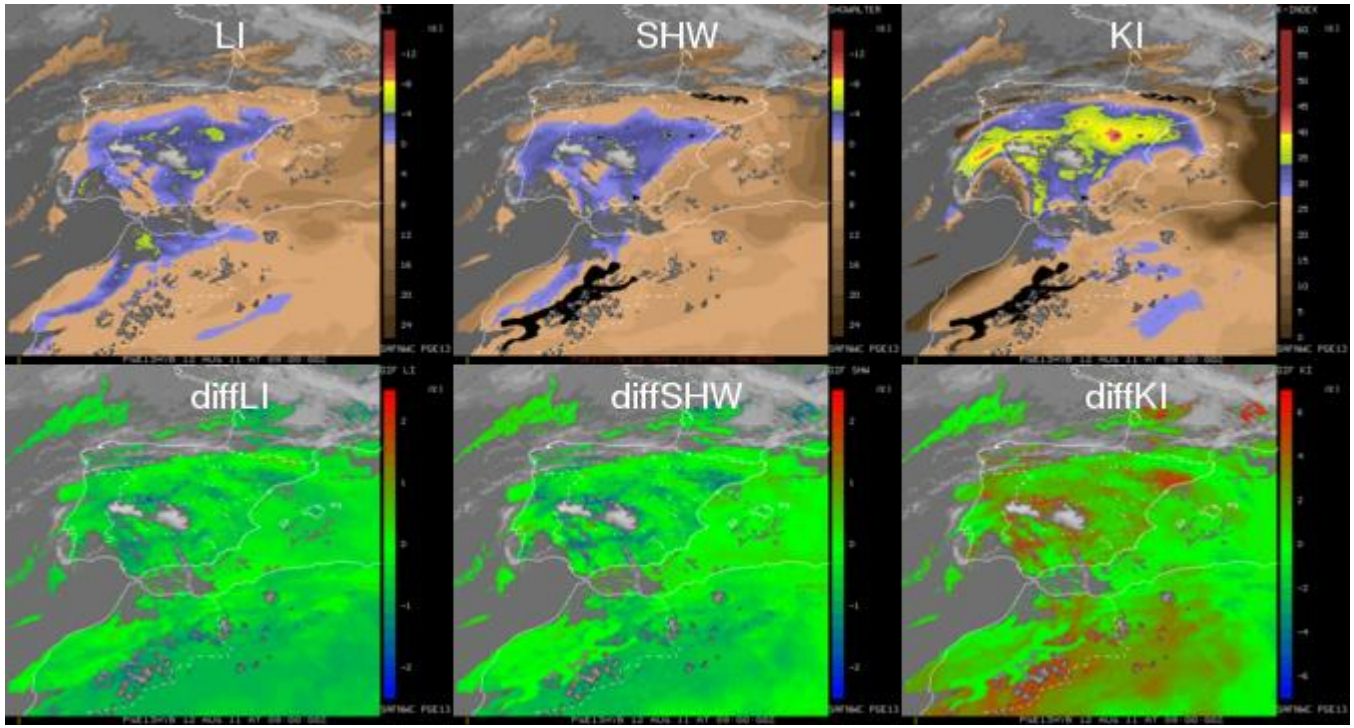
ML
Precipitable Water in Middle Layer (850-500 hPa)

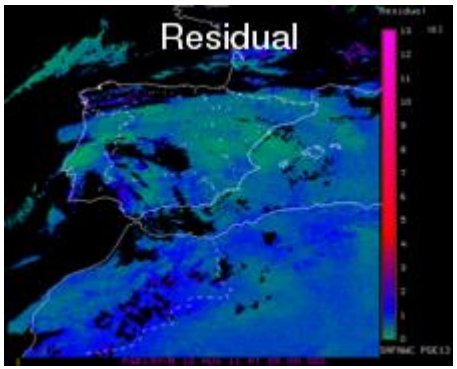
HL
Precipitable Water in High Layer (500-0.1 hPa)

TPW
Total Precipitable Water in Middle Layer (Psfc-0.1 hPa)

12th August 2011 9:00 UTC

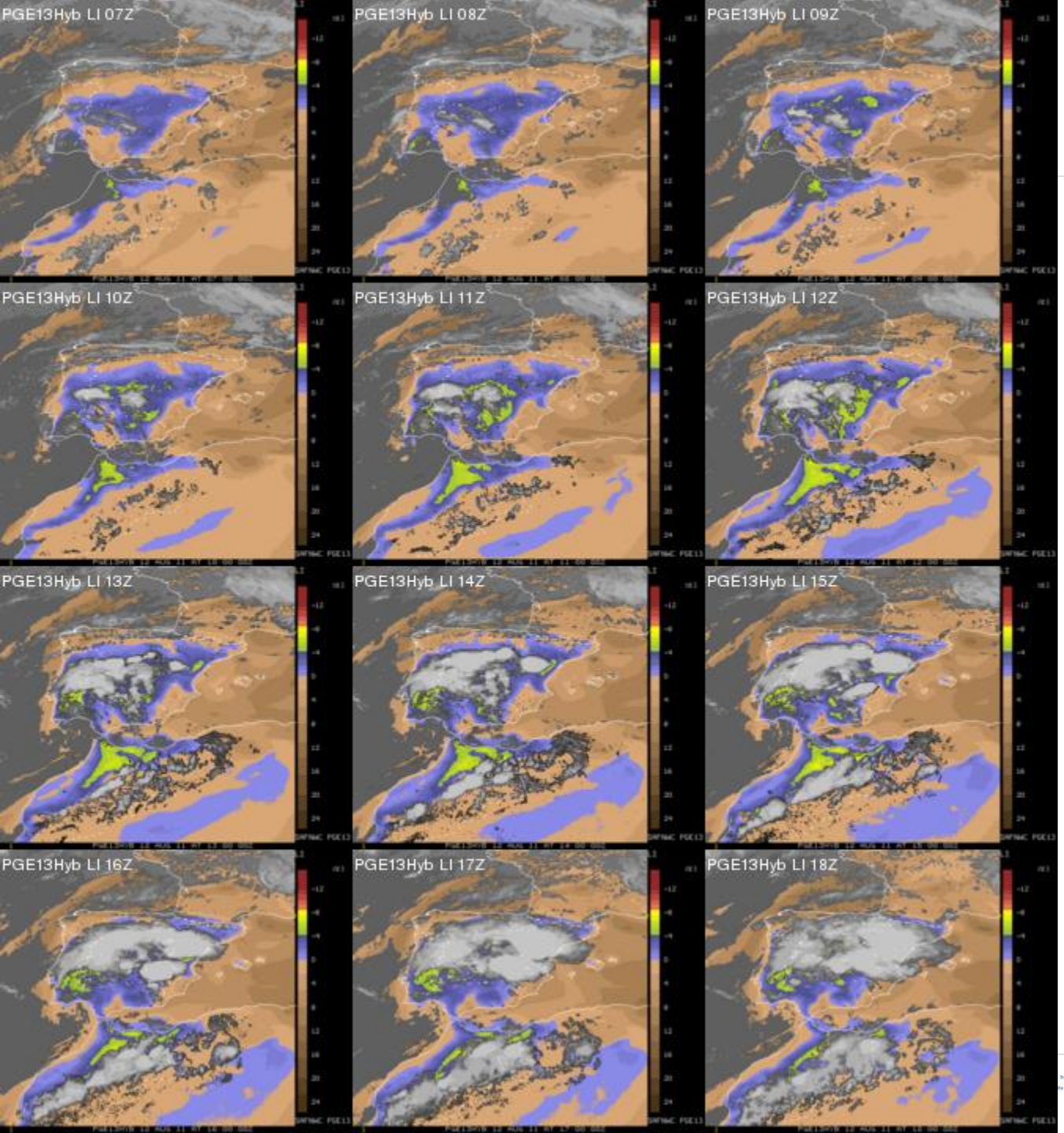
PGE13SPhR outputs: instability indices and residual fields





Lifted Index Showalter Index K Index

12th August 2011 9:00 UTC

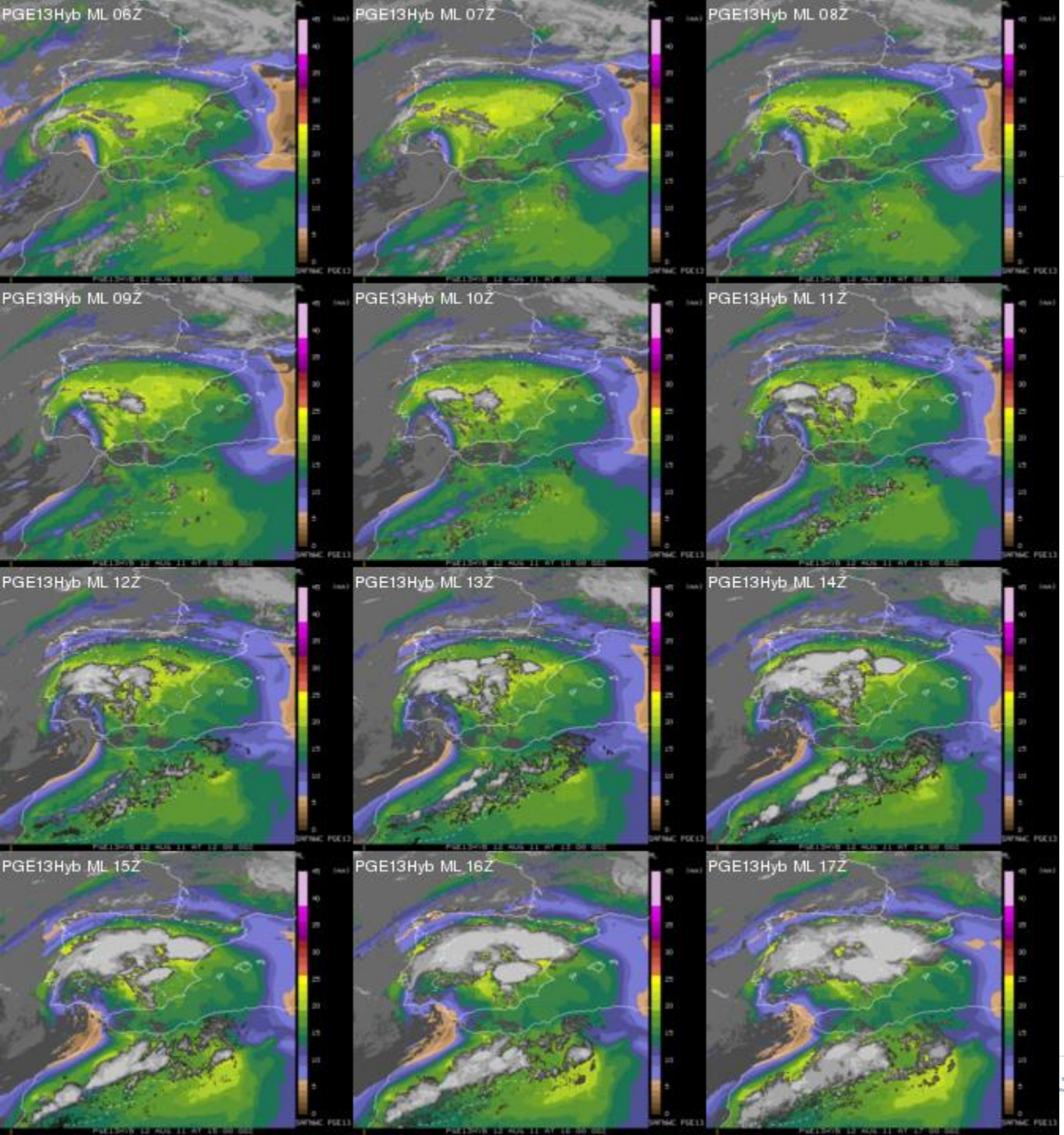


PGE13Hyb SPhR_LI

12th August 2011

Lifted Index

Reprocessed with 2013 PGE13 Hybrid module using ECMWF Hybrid and 1x1 FOR



PGE13Hyb SPhR_ML

12th August 2011

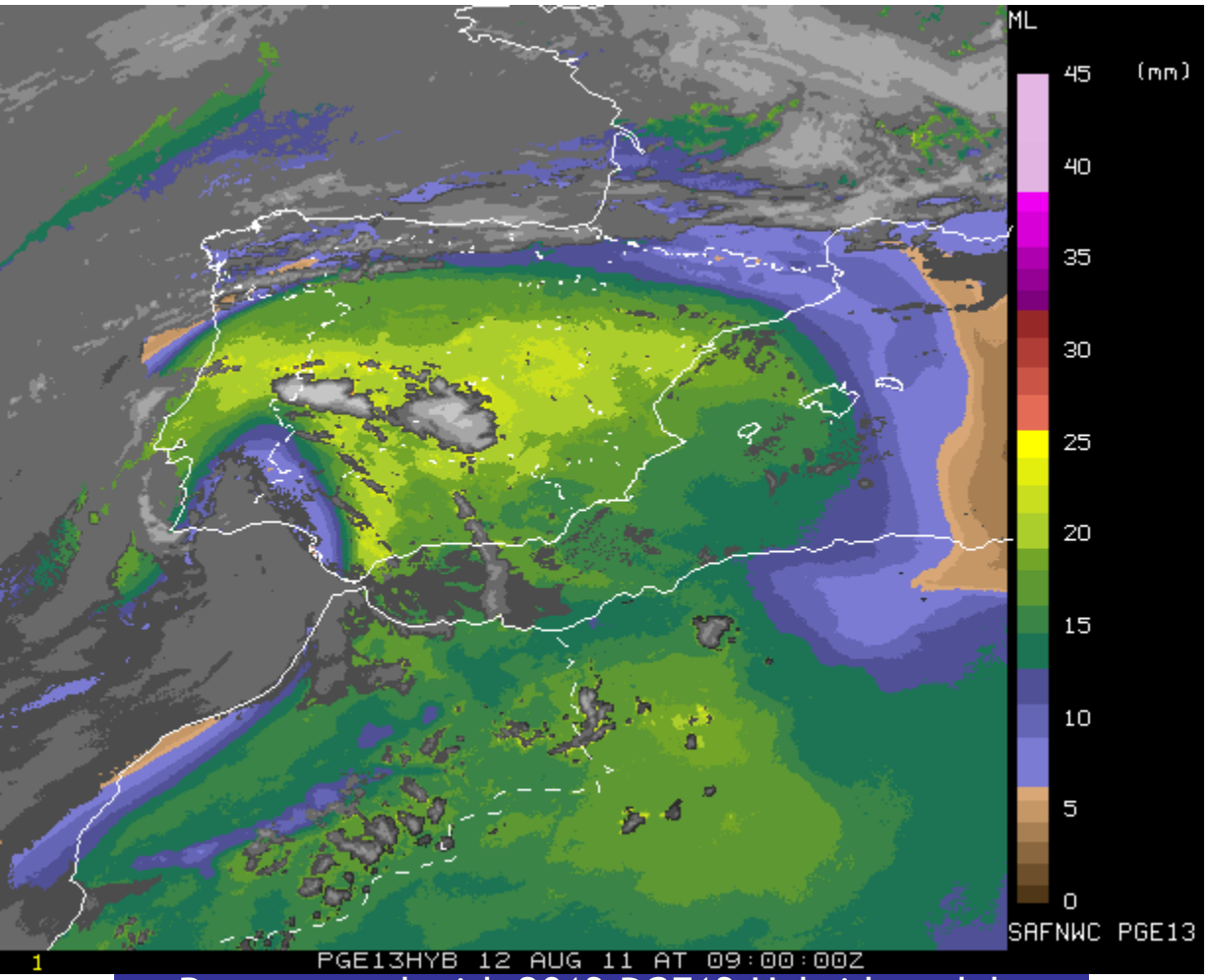
Medium layers are very important (at least in Spain) to determine the region where convection could be triggered.

This is the layer with highest value add from satellite

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

Reprocessed with 2013 PGE13 Hybrid module using ECMWF Hybrid and 1x1 FOR

NWCSAF/MSG SPhR_ML



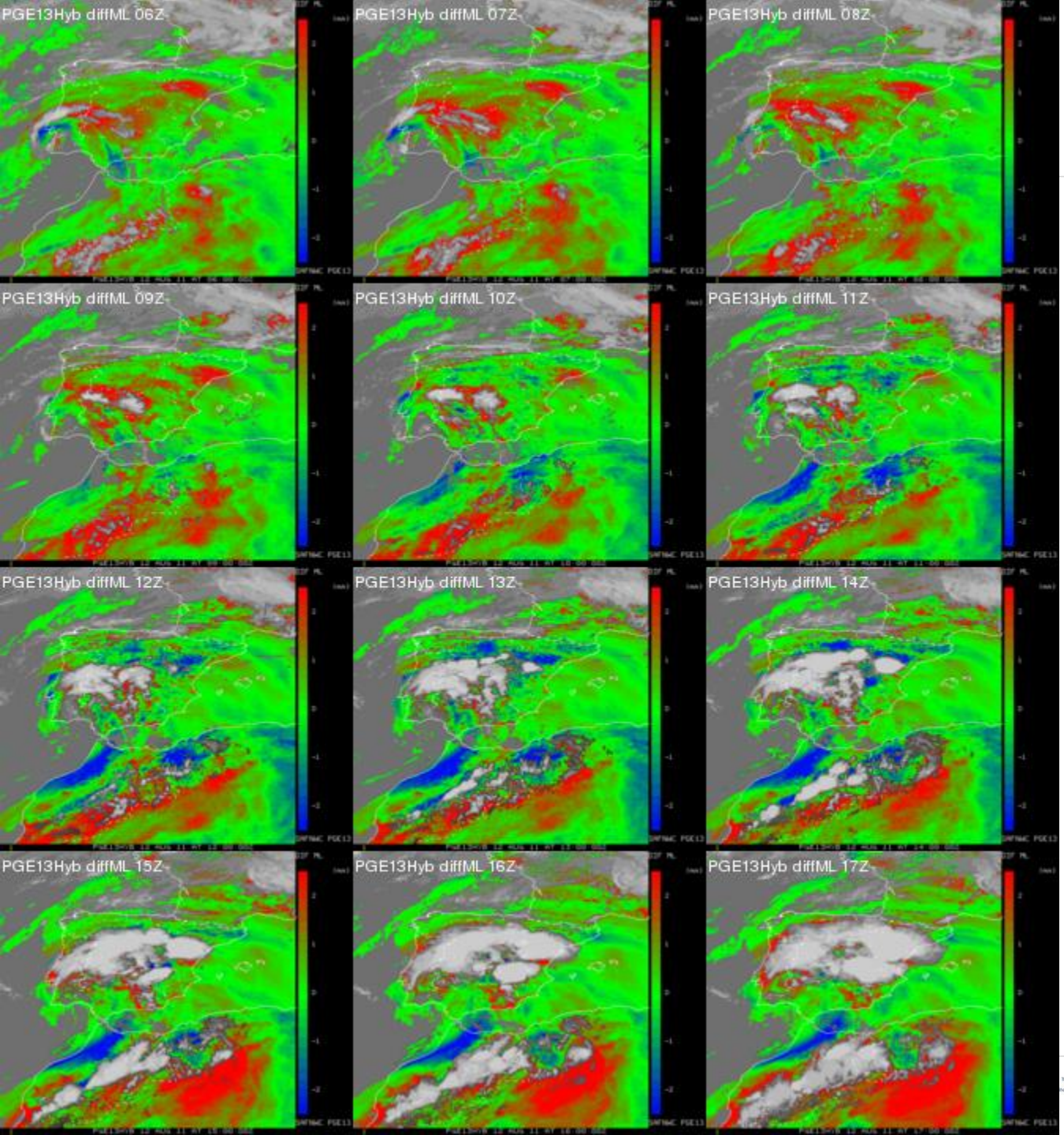
Reprocessed with 2013 PGE13 Hybrid module using ECMWF Hybrid and 1x1 FOR

12th August 2011

Medium layers are very important (at least in Spain) to determine the region where convection could be triggered.

This is the layer with highest value add from satellite

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



PGE13Hyb SPhR_DIFFML

($ML_{retrieval}$-ML_{NWP})

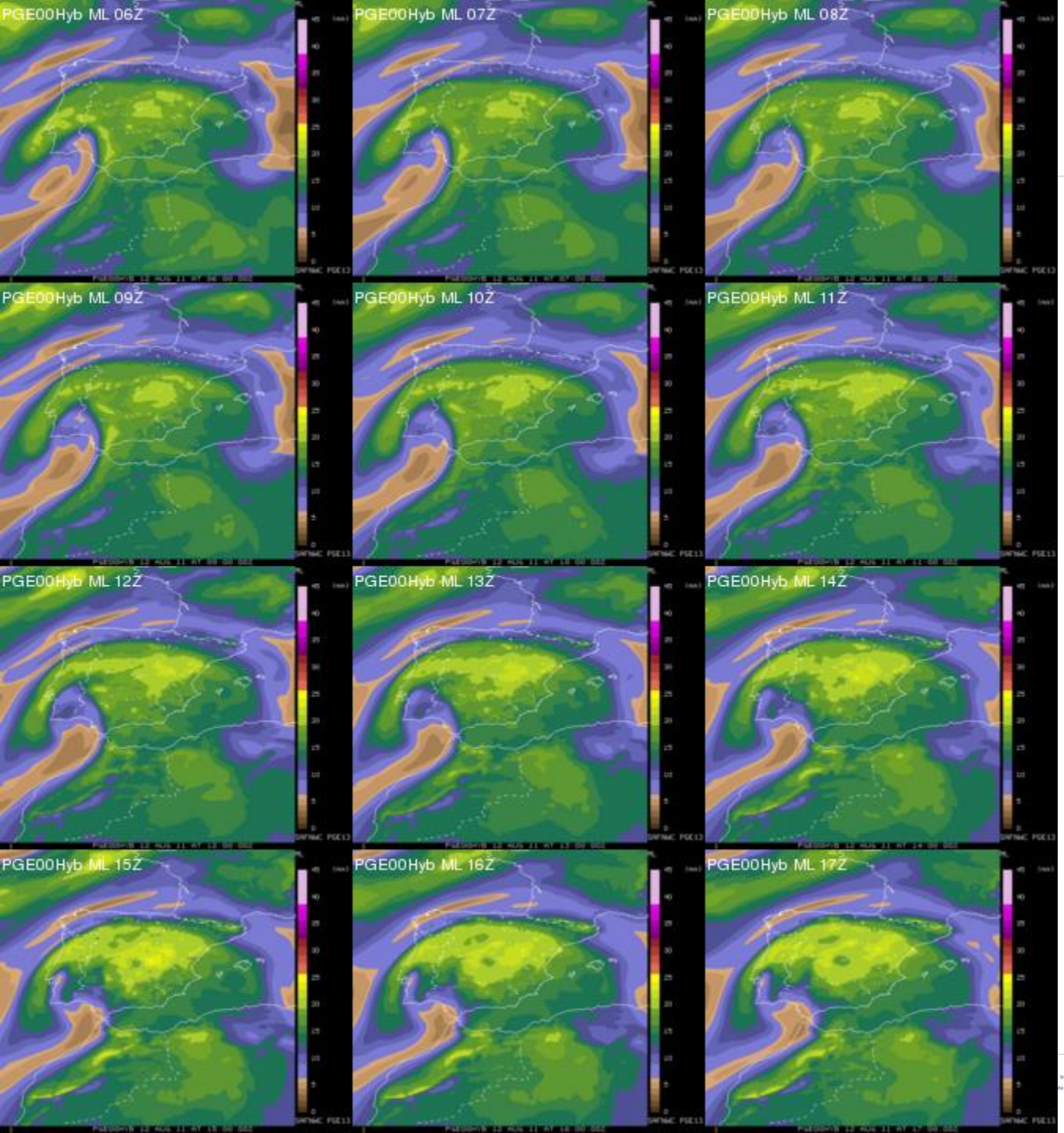
12th August 2011

Medium layers are very important (at least in Spain) to determine the region where convection could be triggered.

This is the layer with highest value add from satellite

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

Reprocessed with 2013 PGE13 Hybrid module using ECMWF Hybrid and 1x1 FOR



PGE00Hyb ML

12th August 2011

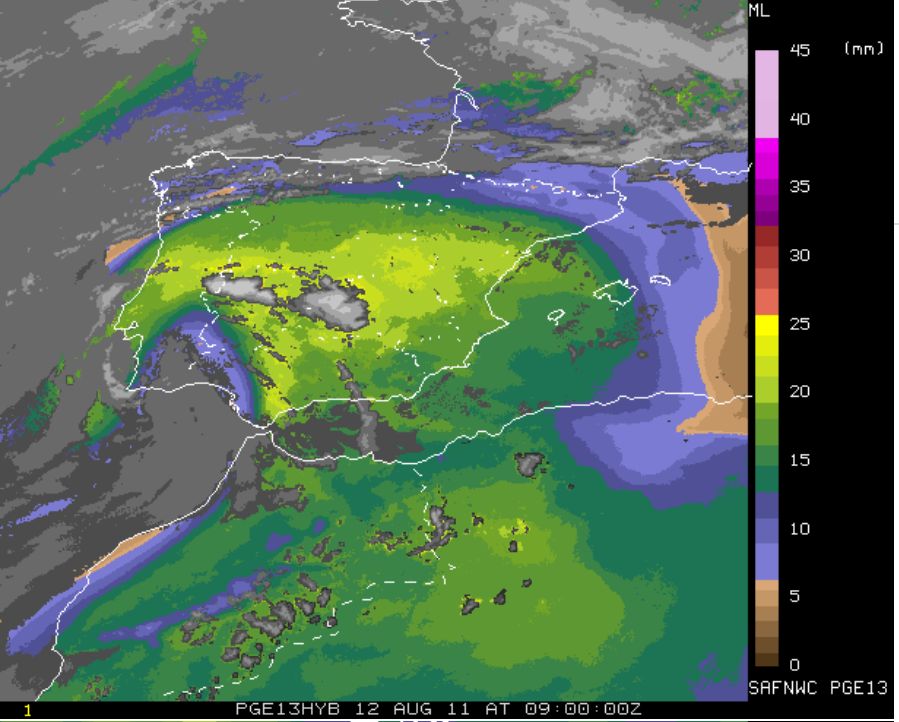
PGE00Hyb internal tool: to get the parameters calculated directly from ECMWF GRIB files interpolated temporal, vertically and spatially to get ML from collocated with PGE13Hyb ML image.

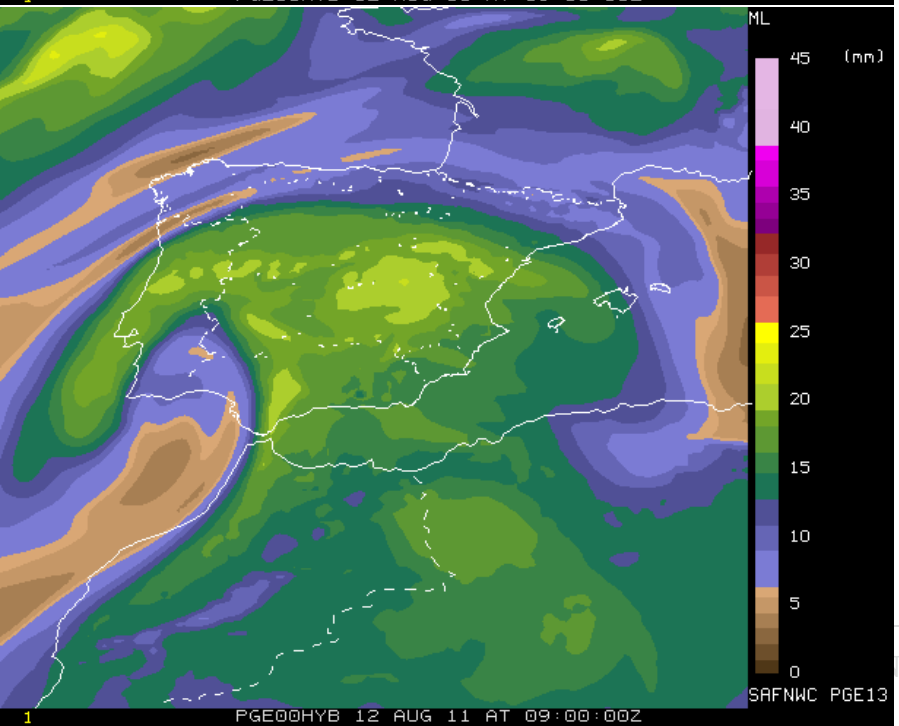
Precipitable Water in Middle Layer ML(850-500 hPa)

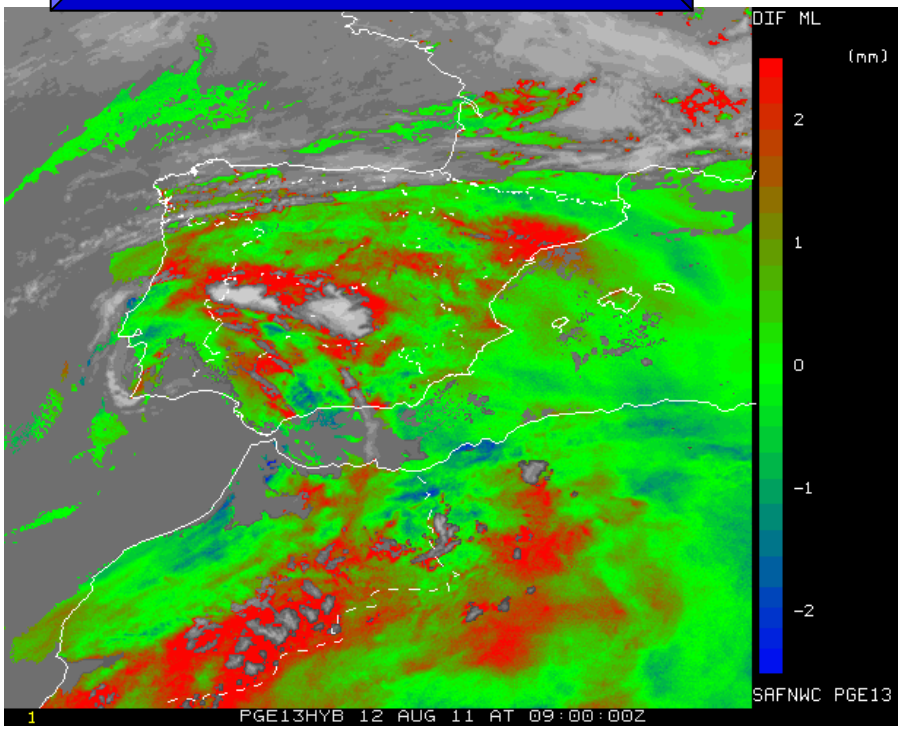
Reprocessed with 2013 PGE00 Hyb using ECMWF Hybrid and 1x1 FOR

Difference of precipitable water field in Middle levels

12th August 2011 9:00 UTC







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

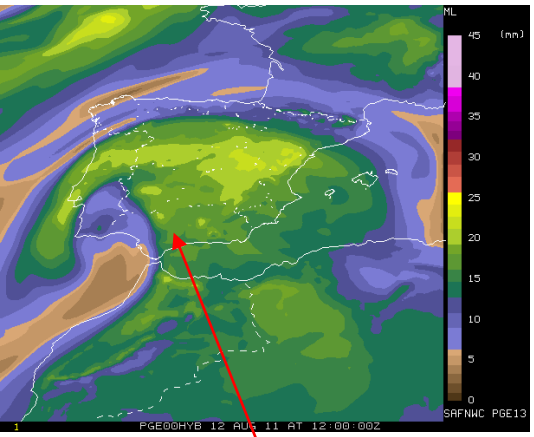
Availability time of Precipitable Water in Middle Layer ML(850-500 hPa) images for 12th August 2011 at 12:00

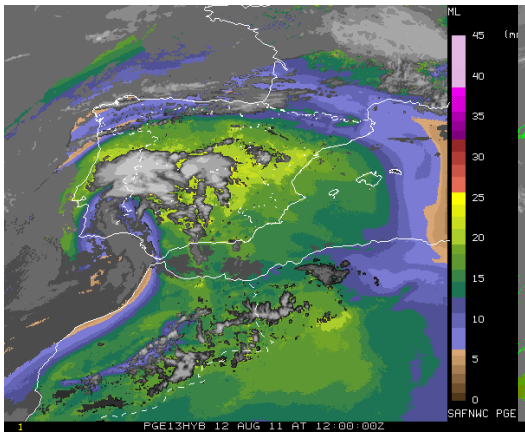
t+12 forecast from 00Z run of ECMWF

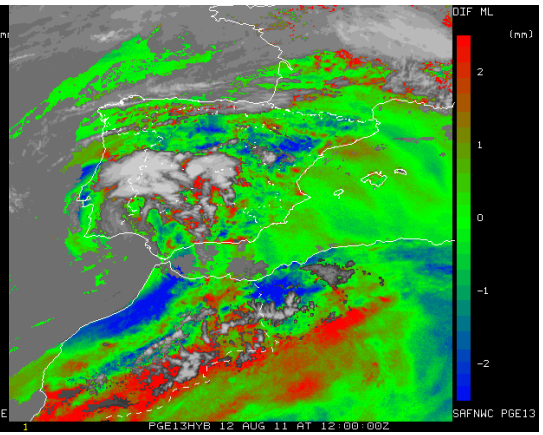
Available after window assimilation, execution, call to MARS, transfer, etc later than 7Z

NWCSAF MSG PGE13

Available round 25 minutes after nominal hour







7:30Z

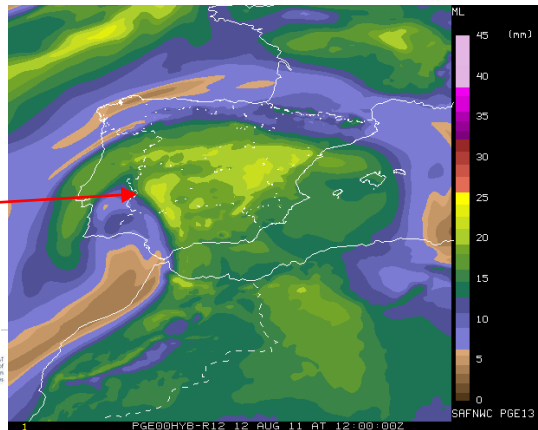
12:30Z

19:30Z

There is a change on the strength of the humidity between t+12 forecast and analysis

analysis (t+0) from 12 run of ECMWF

Available after window assimilation, execution, call to MARS, transfer, etc later than 18Z



Conversion of PGE13 binary files to NetCDF format

As an **optional output**, the intermediate retrieved profiles of temperature and humidity resulting from the physical retrieval module and the profiles from the NWP model interpolated at 43 RTTOV levels may be written as optional output on binary format.

The users can activate it in the ASCII configuration file. Then the binary files will be written in the $SAFNWC/tmp directory. This allows users to debug their local implementation, to get access to the retrieved temperature and humidity profiles and to compare them with the background NWP profiles.

It was written in 2010 an IDL procedure to convert to NetCDF format the optional PGE13 binary files. This NetCDF files can be used on IDV and McIDAS-V (same structure that for IASI L2 and heritage of WRF outputs). It would be easy migration to C or Fortran. The longitude and latitude are added from the *$SAFNWC/tmp* directory

It is supported as best effort basis.

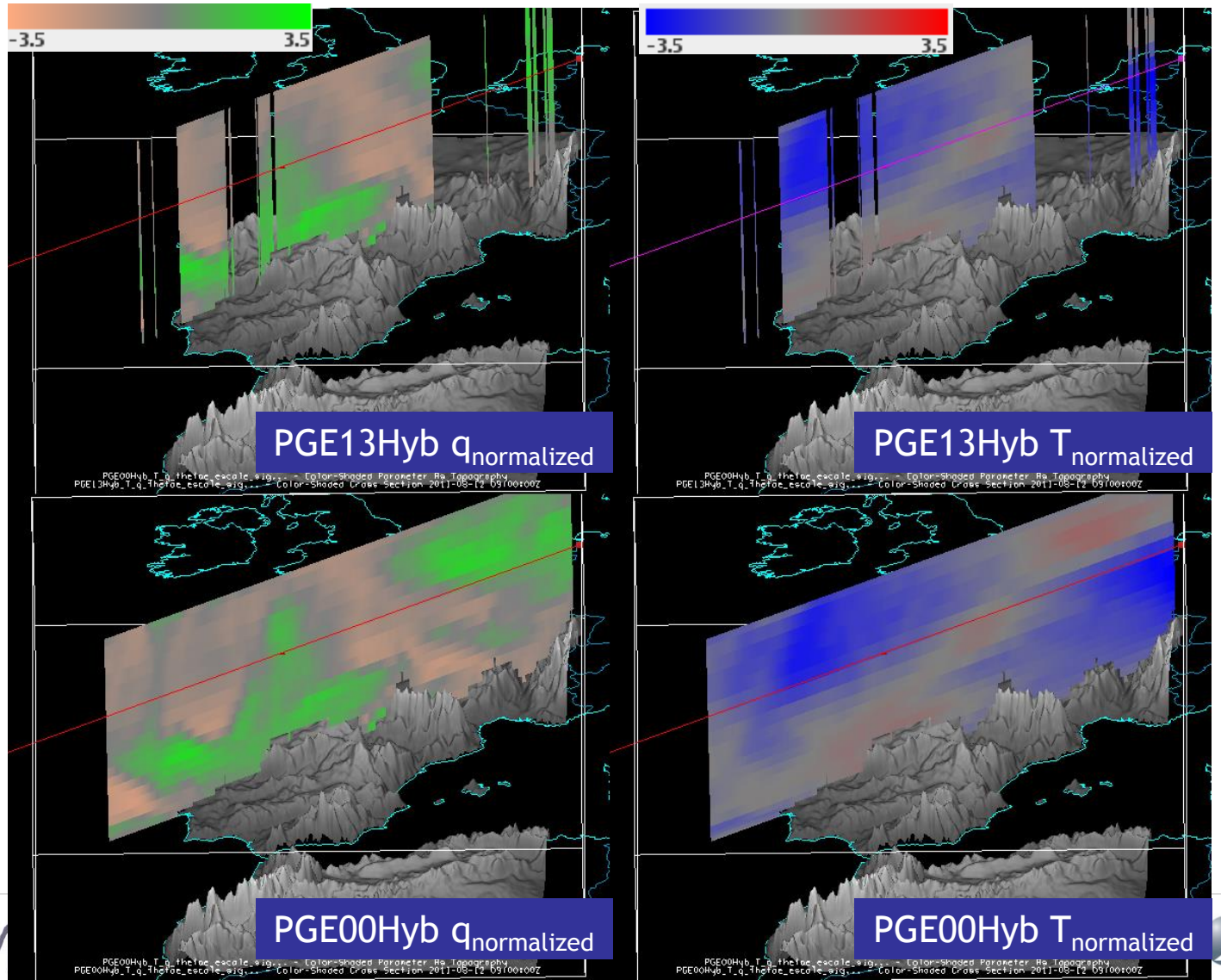
MCIDAS-V	http://www.ssec.wisc.edu/mcidas/software/v/
IDV	http://www.unidata.ucar.edu/software/idv/

Normalization of T and q 3D arrays

The T and q 3D array could be normalized.

For normalize them it is subtracted the mean on the level and divided by the standard deviation on the level for one slot.

Ideas for use of normalized T and q 3D arrays. Comparison with background NWP



Example of interactive use with McIDAS-V .

Ideas for new instability indexes

Since interactive tools and new hardware could calculate any index from T and q profiles the possibility to use profiles and differences θ_e as instability indices could be studied following R. Petersen (U. Wisconsin) ideas.

$$\theta_e = T_e \left(\frac{p_0}{p}\right)^{\frac{R_d}{c_p}} \approx \left(T + \frac{L_v}{c_p} r\right) \left(\frac{p_0}{p}\right)^{\frac{R_d}{c_p}}$$

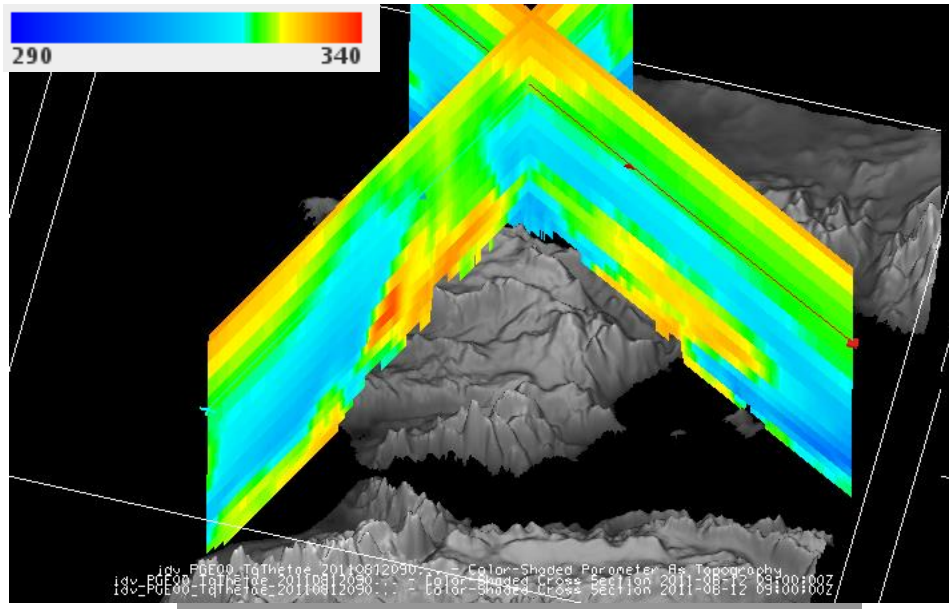
R. Petersen propose **$\theta_{e\ 850} - \theta_{e\ 500}$ as one instability index** and he has establish a relation with LI from parcel at 850 hPa (Showalter Index).

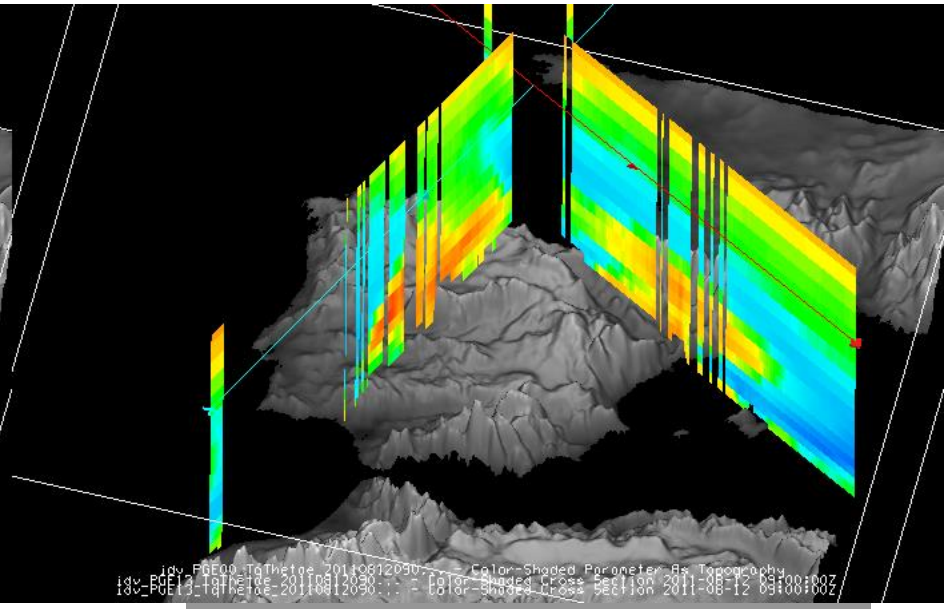
The idea is develop this 2D field and to have the possibility to uses the 3D structure with interactive tools on cross vertical section, profiles or 2D field.

Objective: Determine sources of lower-level moisture/heat

• Equivalent Potential Temperature (θe) combines information about the temperature and moisture content (thermal energy) of air

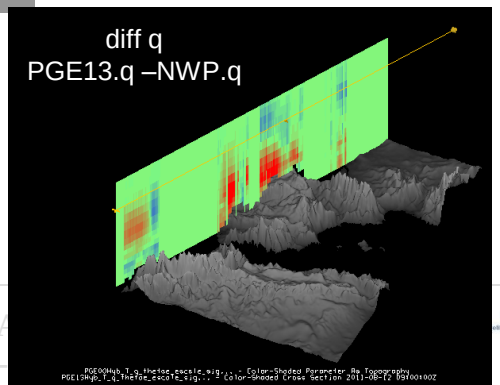
θ_e vertical cross comparison of ECMWF and PGE13 physical retrieval

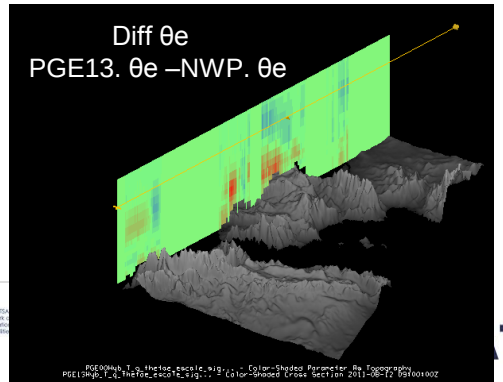




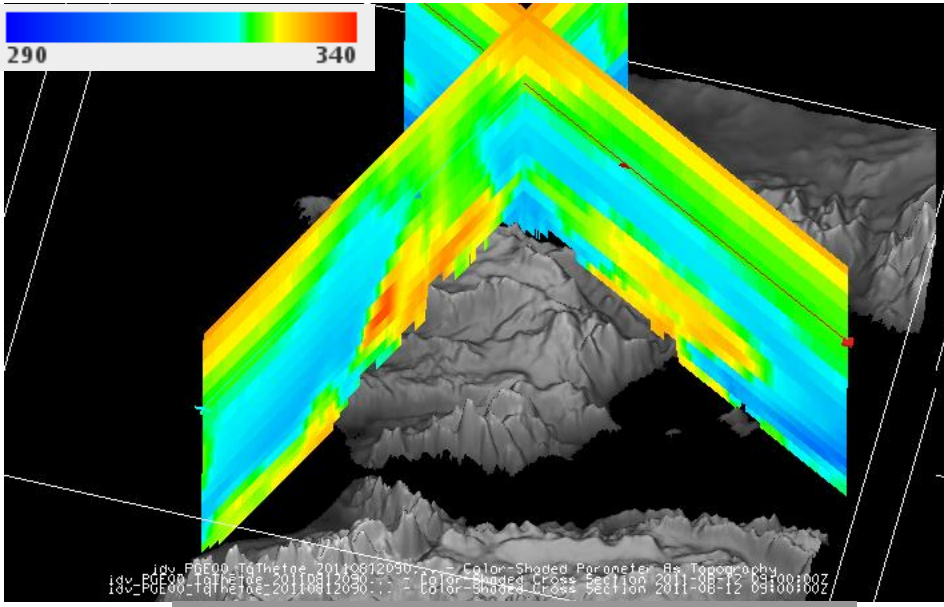
θ_e from ECMWF hybrid levels spatial, time and vertical interpolated to the 43 RTTOV pressure levels

θ_e from 2013 PGE13 Hybrid version

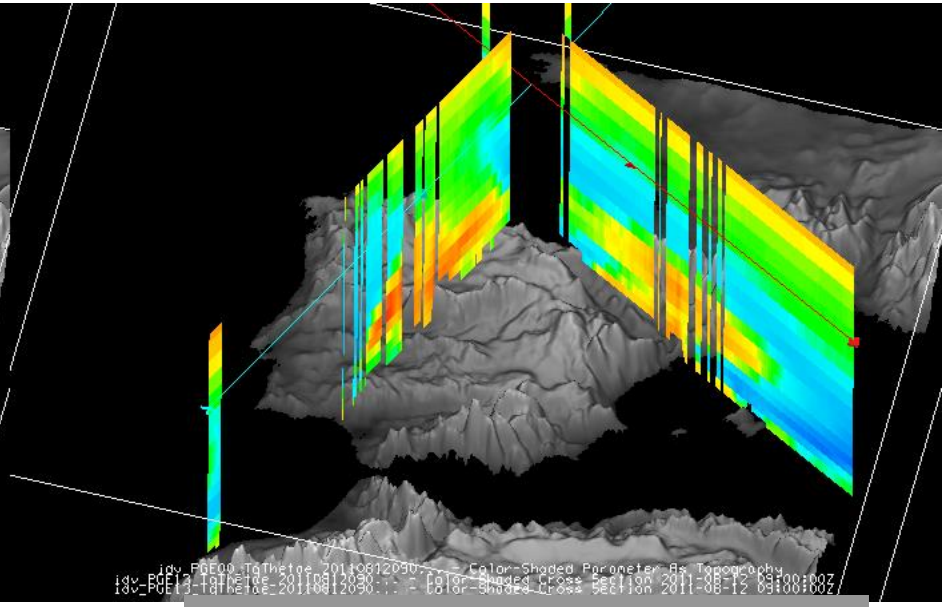




θ_e vertical cross comparison of ECMWF and PGE13 physical retrieval



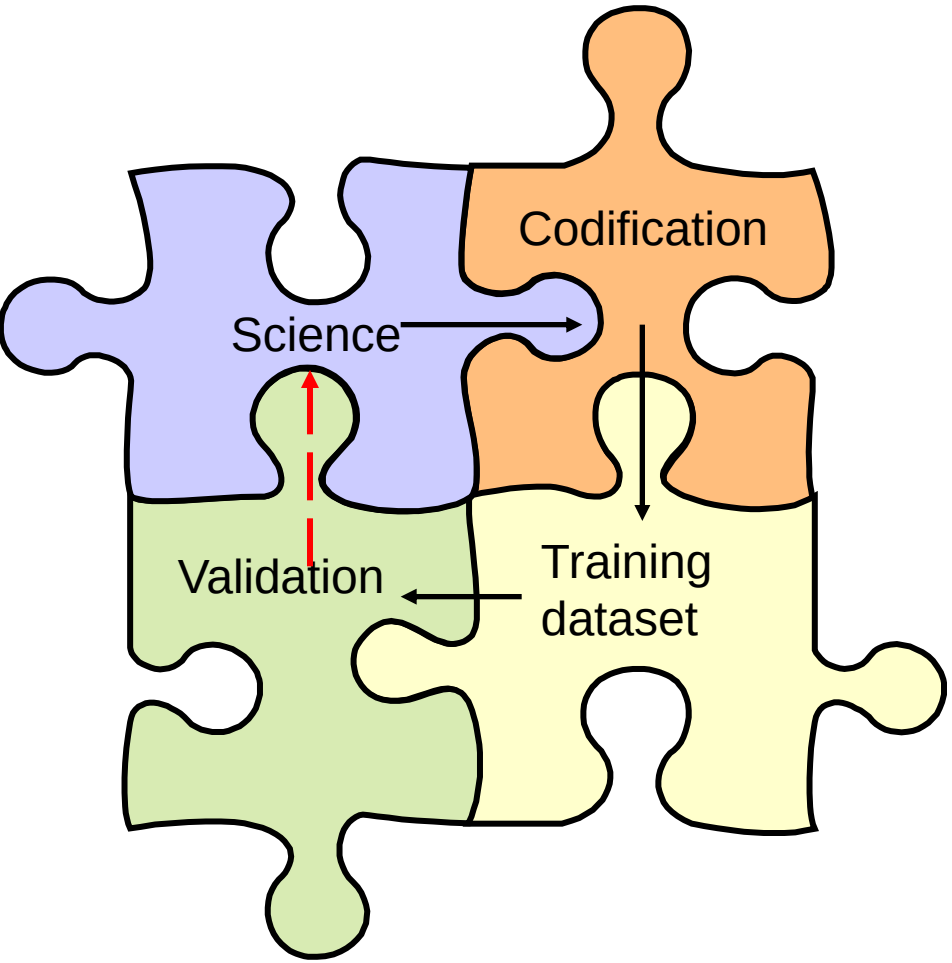
θ_e from ECMWF hybrid levels spatial, time and vertical interpolated to the 43 RTTOV pressure levels



θ_e from 2013 PGE13 Hybrid version

Example of interactive use of PGE13Hyb and PGE00Hyb binary files converted to netCDF using McIDAS-V .

Generation of PGE13 training and validation dataset



Availability of the PGE13 SPhR code and the training dataset generation allows to improve the science for next versions and for MTG era.

Future versions of PGE13 SPhR

Background hybrid
ECMWF

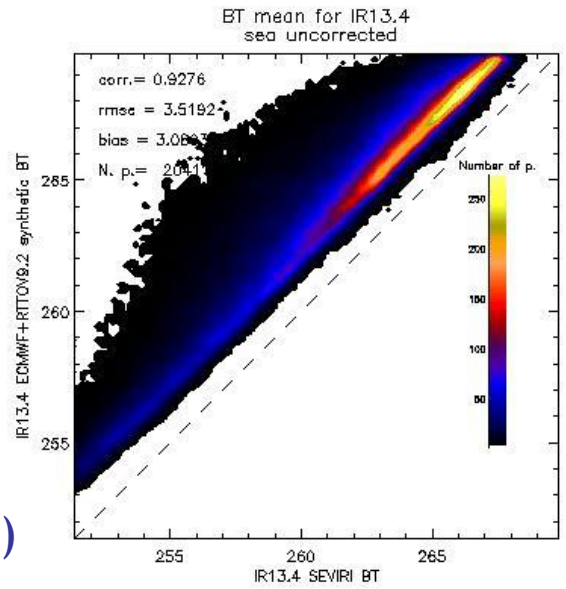
PGE13 bias BT correction

The dataset for PGE13 BT bias correction is built after reprocessing with ECMWF analysis for 00Z and 12Z the 00Z and 12Z SEVIR images with window size of 25x25 and options: a) SEVIRI BTs of the warmest clear pixel at the IR10.8 and b) save of binary profiles at clear FOR. Only pixels over sea are used for BT bias correction or monitoring.

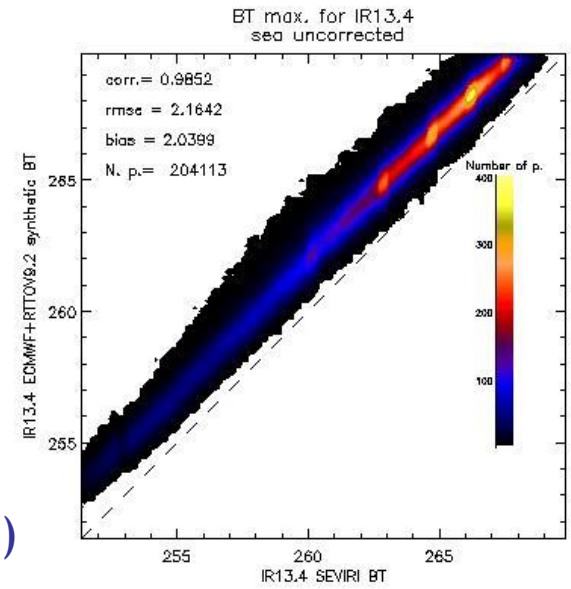
FOR methods: MEAN or warmest@IR10.8

- Two methods to calculate the FOR brightness temperatures have been implemented:
  - (1) Mean of all clear pixels inside the FOR
  - (2) The IR10.8 warmest clear pixel inside the FOR

(1)

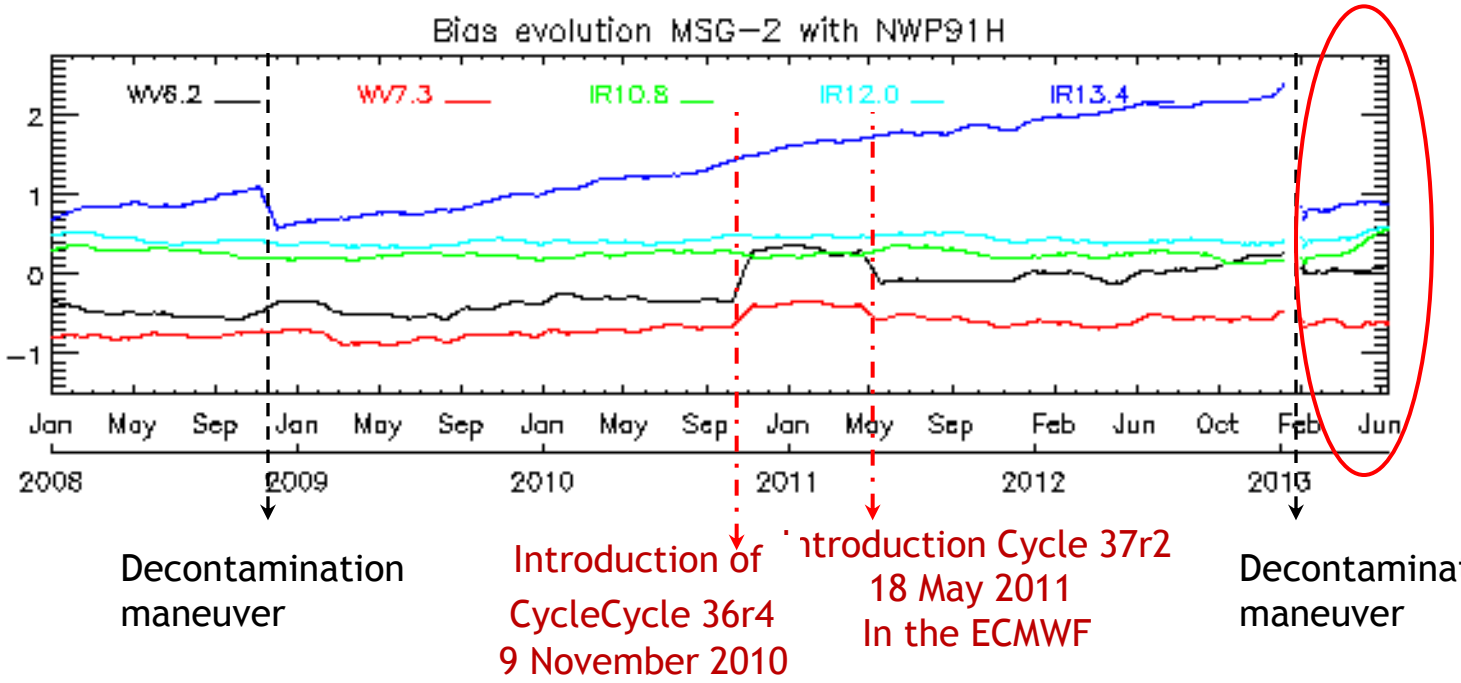


(2)



Use of PGE13 dataset to monitoring bias BT for MSG-2 (since January 2008)

PGE13Hyb MSG-2



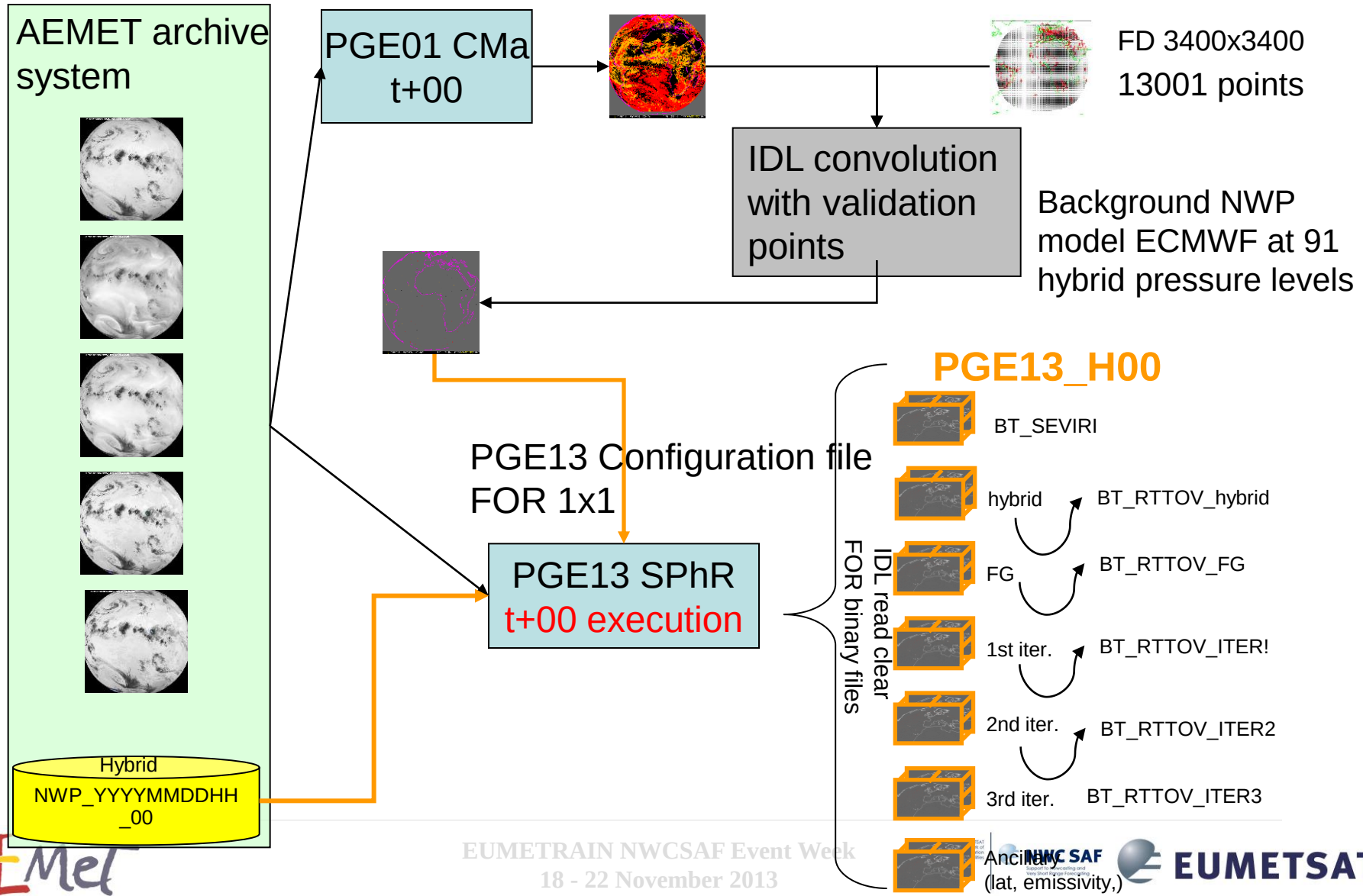
Evolution of the bias correction between BT_SEVIRI and synthetic BT_RTTOV over sea pixels. Differences between a mean value before and after the bias correction calculated for a "moving" window of one month for five SEVIRI channels. In version 2013 the bias BT correction for MSG-2 have been calculated after decontamination maneuver in March 2013. **It is strongly recommended to update the software.** In other case copy the *BT_GLOBAL_OFFSET_** and *BT_GLOBAL_OFFSET_** lines of the default *safnwc_pge13_msg2.cfm*

Background hybrid
ECMWF

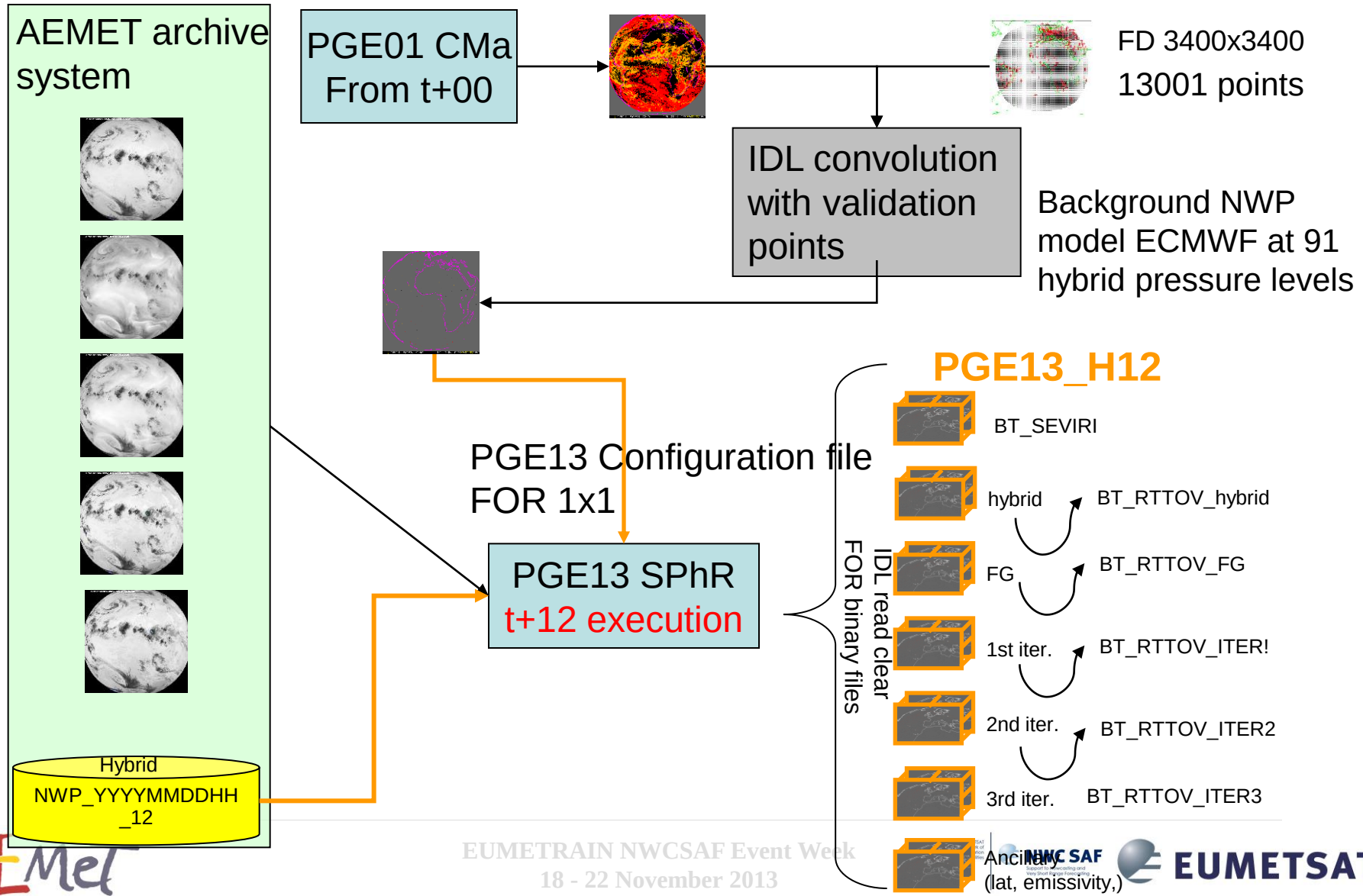
PGE13 validation dataset

The 1 out of 2 observations of 2012 not used to build the training dataset have been used.

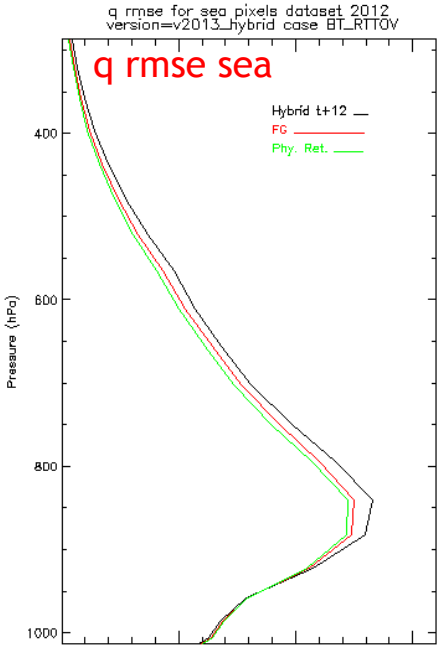
Reprocessing with the new FG regression and bias correction as 2013 version

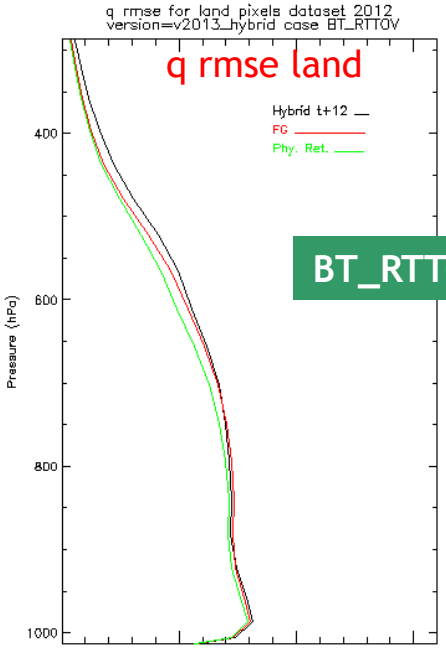


Reprocessing with the new FG regression and bias correction as 2013 version



Vertical analysis of q rmse

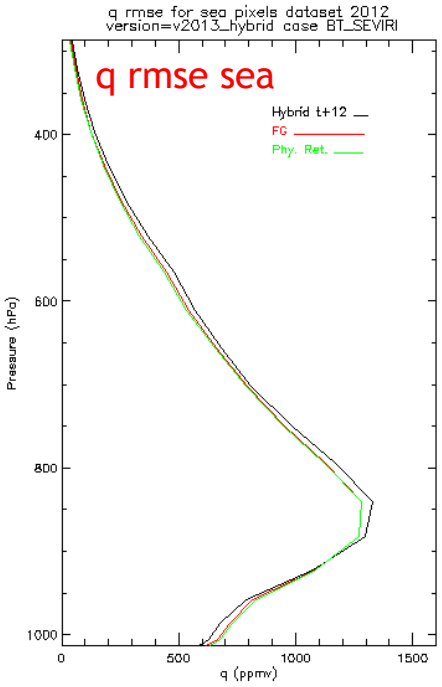


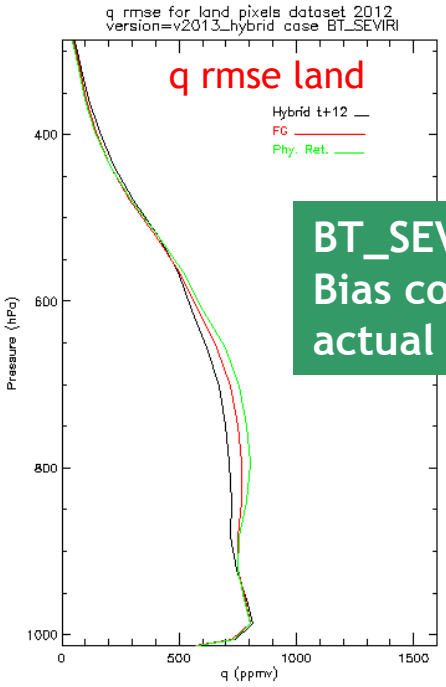


BT_RTTOV case

⇦

RMSE of q profiles at different steps compared with ECMWF analysis hybrid profiles over sea pixels in the Full Disk region after screening using synthetic RTTOV BTs





BT_SEVIRI case
Bias corrected actual SEVIRI BTs

⇦

RMSE of q profiles at different steps compared with ECMWF analysis hybrid profiles over sea pixels in the Full Disk region after screening using actual bias corrected SEVIRI BTs

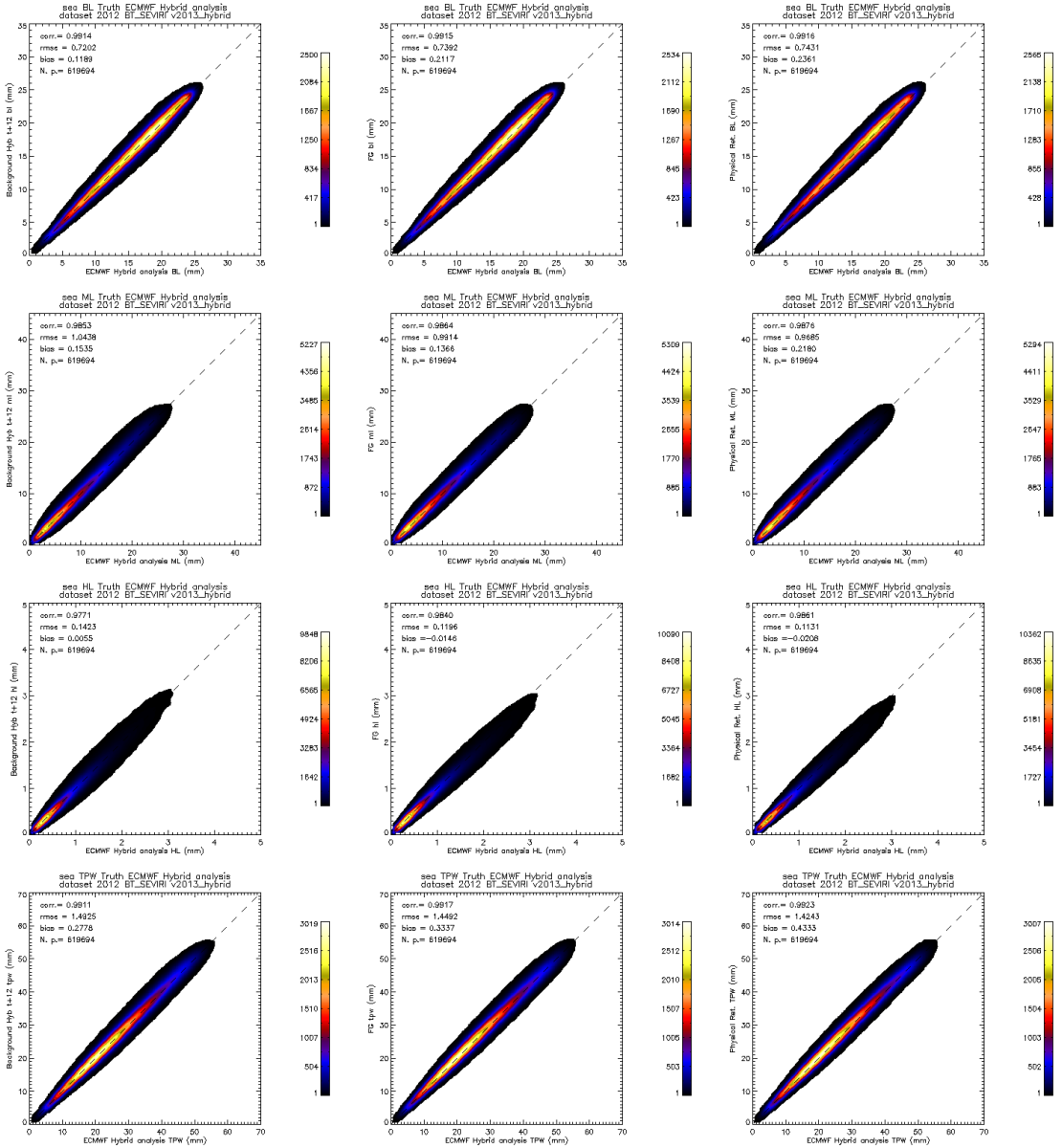
Background NWP model ECMWF at 91 hybrid pressure levels from 2012.

After screening of 5% pixels with the largest distance between RTTOV_BT and SEVIRI BT on non-window channels

SEA pixels: LPW and TPW 2D histograms for period 2012

(even pixels i.e. half of the hybrid PGE13 validation dataset)

NWP from hybrid FG regression Physical Retrieval



Background NWP model ECMWF at hybrid pressure levels

⇦ BL 2D histograms over sea validation points

⇦ ML 2D histograms over sea validation points

⇦ HL 2D histograms over sea validation points

Full details are available in the PGE13 hybrid Scientific Report document on the NWCSAF Help-Desk Web page

⇦ TPW 2D histograms over sea validation points

Week

Conclusions

PGE13 SPhR provides useful spatial and temporal information; especially to detect disagreement between the background NWP model and the PGE13 SPhR outputs based on MSG observations. The best results are obtained for humidity in medium layers due to the contribution of the two MSG water vapor channels.

PGE13Hyb is available from version 2013. It allows the use as background NWP input of ECMWF GRIB files on hybrid levels.

- This is the first step in the use of better NWP GRIB files in the NWC SAF.
- The performance is better. The increase of the vertical information in the background NWP (has been done after “majors” modifications in the code) management and better results are obtained.
- Although, MSG has limited information to improve the vertical information of the background NWP a certain degree of vertical value add can be obtained. This can be exploited with 3D display tools.

Validation and datasets generation is a continuous and important task.

It must be created a set of web pages in the NWC SAF web server for PGE13 SPhR product where cases studies, best effort tools, monitoring of the BT bias correction, etc should be available.

Future developments in clear air products

In the CDPOP-2 the software for nowcasting products will be continuously improved and updated for MSG processing.

The software for Nowcasting products will be migrated to other GEO satellites (GOES-R, Himarawari)

Optical flows: It will explore the spatial and temporal resolution (gradients and trends between consecutive images) to obtain humidity flows/winds at different layers based on "optical flow" algorithm (collaboration with F.J Tapiador U. Castilla-La Mancha). *PGE00 will be used to test before with synthetic images.*

Preparation for MTG:

MTG-FCI: The software will be prepared for MTG-FCI. Same IR channels that SEVIRI. 2km horizontal resolution with 10 minutes temporal resolution

MTG-IRS: High resolution spectra (1738 channels) with 4km spatial resolution, 30 minutes temporal resolution in LAC4.

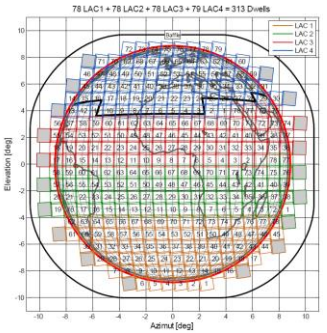
- *Studies for Clear Air products extension to MTG-IRS*
- *Studies for RGBs image from MTG-IRS*

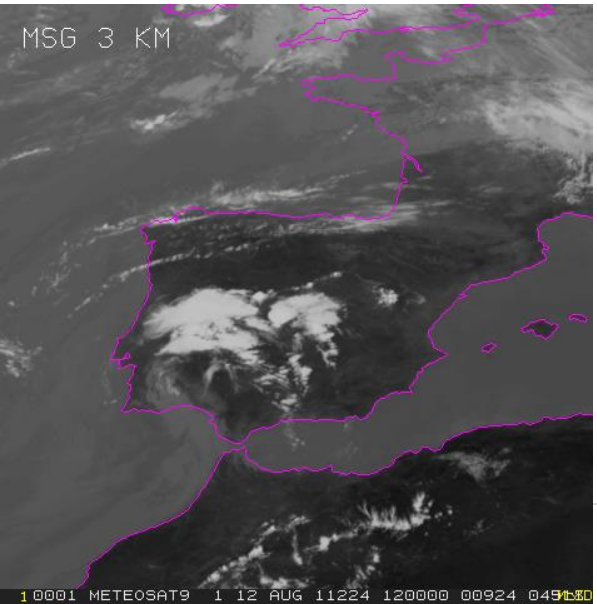
PGE13 like products on future MTG era

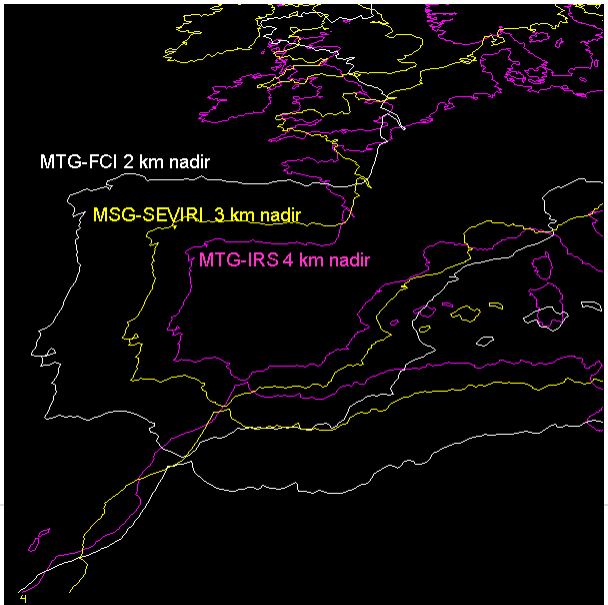
MTG-IRS will have the half of spatial resolution of MTG-FCI. It should be needed to have some software to exploit the synergies of both.

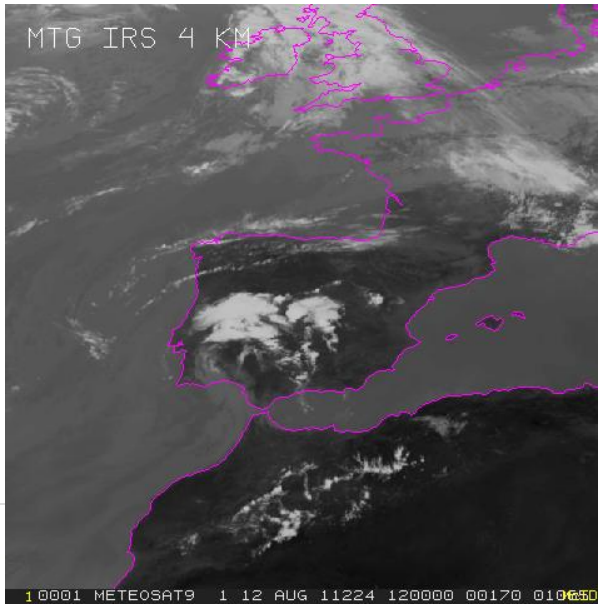
IRS: Infrared Sounder. Improved vertical Moisture structures from IRS. Temperature and humidity profiles with better vertical resolution.

- Increase independent layers of moisture information
- From 2-3 to 6-8 layers
- Provide information closer to earth's surface



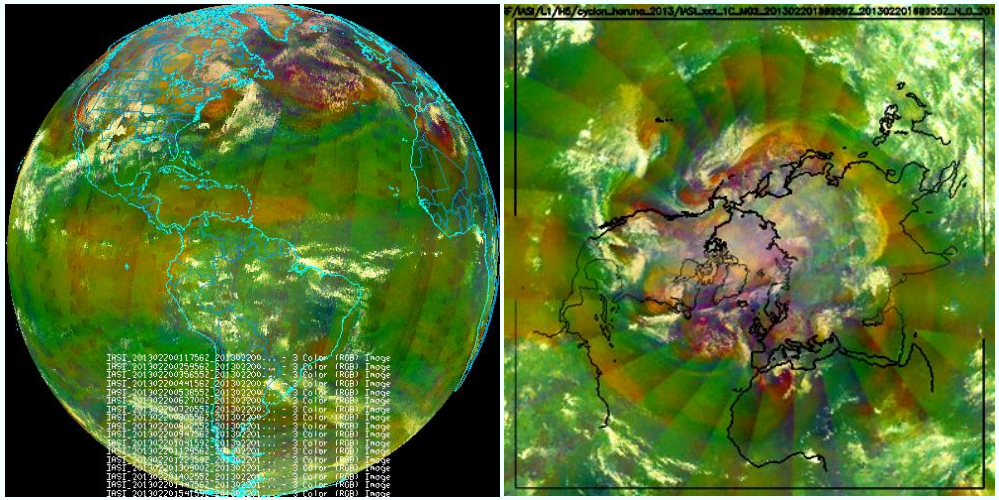






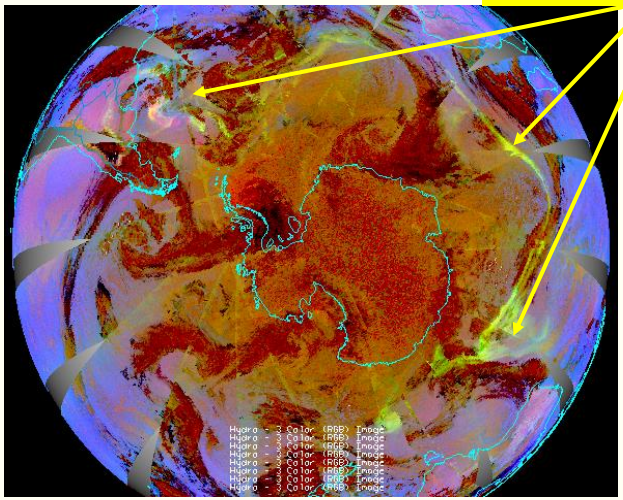
RGB images with IASI channels nearest to MSG channels as proxy of future MTG-IRS RGB images

IASI airmass RGB



METOP-A and METOP-B IASI global airmass RGB for day 20th February 2013 morning (cyclone Haruna near Madagascar case study) using McIDAS-V Globe display (left) and IDL with transparent PNGs for polar displays (right)

IASI dust RGB



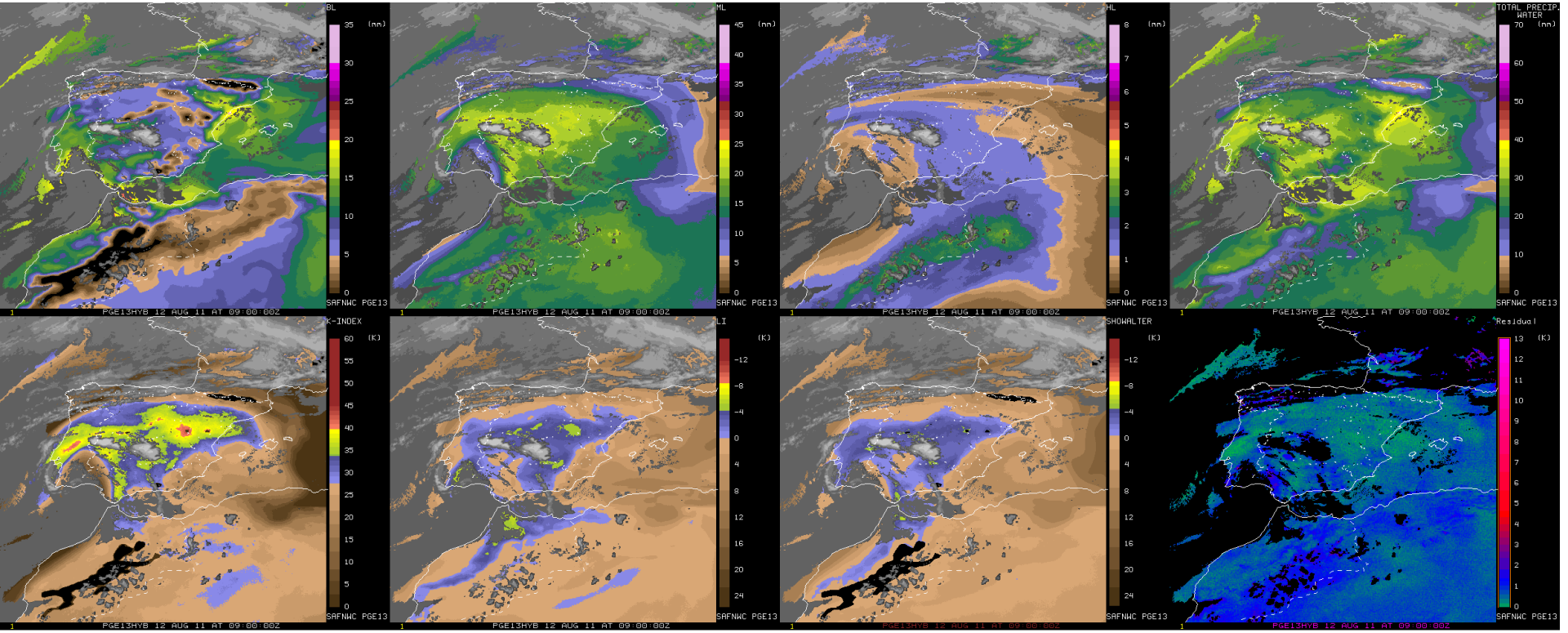
IASI dust RGB showing the volcanic ash and SO2 from the eruption of Chilean Puyehue-Cordon-Caulle Volcano using IASI L1 HDF-5 files from 9th June 2011 22:24Z to 10th June 2011 10:35 and McIDAS-V globe display.

Search of new RGBs is a priority. Activities in the framework of MIST group.

References

- ✓ Algorithm Theoretical Basis Document for PGE13 “SEVIRI Physical Retrieval Product”
- ✓ Product User Manual for “PGE13 SEVIRI Physical Retrieval”
- ✓ Li, J. and Huang, H.-L., 1999: Retrieval of atmospheric profiles from satellite sounder measurements by use of the discrepancy principle. *Appl. Optics, Vol. 38, No. 6, 916-923.*
- ✓ Li, J.; et al., 2000. Global soundings of the atmosphere from ATOVS measurements: The algorithm and validation. *J. Appl. Meteorol., Vol 39, pp 1248 – 1268.*
- ✓ Martinez; Miguel A. 2013. Improvements in version 2013 of the NWCSAF/MSG PGE13 SEVIRI Physical Retrieval (SPHR) product. *Proc. of the 2013 EUMETSAT Conference, Vienna, Austria.*
- ✓ Martinez, M.A.; Calbet, X. 2013. Innovative ideas for using the hyperespectral level 1 data of the next geostationary MTG-IRS in nowcasting. *Proc. of the 2013 EUMETSAT Conference, Vienna, Austria.*

mmartinezr@aemet.es



¡ Thanks for your attention !