WEB-BASED DISPLAYS OF MSG DATA AND PRODUCTS FOR THE USE OF FORECASTERS AT AEMET-SPAIN: APPLICATIONS TO CONVECTION AND FOG / LOW STRATUS

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Abstract

The ATAP/MSG real-time intranet page eases access, of any user in AEMET, to Meteosat imagery and channel differences or RGB combinations, and products from SAF in Support to Nowcasting and Very short-range forecasting (NWCSAF) and derived products or adapted presentations. It also provides direct comparison to reference data (in-situ and other remote-sensing observations, NWP forecast fields) and link to its dedicated tools, and to other data in external web links (e.g. MODIS and other satellites). Page development is focused on purpose, phenomena or application-oriented structure. Dedicated entries now operational are: Synoptic diagnosis, Convection, Fog/low stratus, Aviation –Icing and Lee wave, and Atmospheric dust. Activity is also beneficial to identify needs and weaknesses and to steer page evolution itself. As a goal, it should provide good input to refine operational routines in weather diagnosis, monitoring, and nowcasting.

Recent developments included upgrade of the Fog/low stratus entry and the new Convection entry, both operational in 2010. Apart from surface-elevation relative Cloud top height product (CTTH of NWCSAF) as a complement to Cloud type CT product information, Fog/low stratus entry now includes further information and utilities as is simultaneous display of product and channel data. Rather than a product list, the new entry for Convection is based on a more meteorological approach, with subentries and prior classification of products according to specific purpose or stage: A priori conditions, Initiation and Characterization (including very short-term tendencies) of convection. Beyond its practical interest to forecasters, this scheme has shown to be useful to improve the display and use of Meteosat data and NWCSAF products (better time-differences of air mass products for a priori conditions; for characterization, more direct comparison of available products on precipitation and convection), to optimize the non-satellite data content (e.g. low level NWP wind grids needed for a priori conditions; or just Echo top and PPI to summarize radar reference data, for characterization), to identify weaknesses (as in the initiation stage, still too much lying on HRV imagery only, rapid-scan when available) or where new products are desirable; and is better suited for page evolution (users can also access the experimental page, e.g. to see sub products not yet operational from the new NWCSAF PGE13 product).

NEW OPERATIONAL ENTRY FOR CONVECTION WITH SUBENTRIES FOR EACH PHASE OR PURPOSE

Subentry 1 - Ingredients:

In the basic display are shown simultaneously, the most a-priori relevant NWCSAF air mass products:

- SAI – Stability Analysis Imagery (Lifted Index).
- TPW – Total Precipitable Water (Total water-vapor content)
- LPW - Layer Precipitable Water, Low and Middle layers (1013-840hPa and 840-437hPa).

As reference, Numerical Weather Prediction (NWP, HIRLAM Model) fields of Lifted index and PW, close in time to last satellite data (+3/+6h forecasts) are available as selectable overlays. As well as dynamic information not in NWCSAF (at least not at this stage of the phenomena): surface, 850 and 700hPa wind field pattern (conditions for low level convergence and organizing vertical shear).
Figure 1: 29/07/10 8:45UTC. Ingredients, Main display, left-right and up-down: TPW, LPW mid layer, SAI (LI), LPW low layer. Standard color table / ranges (just for SAI: color contrast reinforced in the range 1º to -1º). HIRLAM forecast fields of Precipitable Water, Lifted Index and surface wind –now and +3h- overlays, are activated. As for page interface features in this or other figures, see final text in “Other considerations”.

Basic display includes last and loop of last 4 images (one hour), for better interpretation of current time, while a better overview of tendency of each product is provided in a complementary display:

- SAI instability: change in 24h –day to day, since 6:00UTC –in the day, last 3h -rapid changes.
- TPW, low and mid layers LPW water-vapor content: change in the last 12, 6 and 3h.

Figure 2: Day and time as fig. 1. Display of SAI tendencies: in 24h, since 6z, last 3h, and current (time/space cloud filtering is used see text below, compare masking to fig. 1 to see results). SAI enhancement as in fig. 1, same color table is used for time changes with specific numerical range, indicated in the scale in panel upper-left. Note, similar criteria but different intervals see text, are applied to equivalent for PW tendencies.
NWCSAF air mass products being only computed in cloud-free areas and cloudiness even more limiting for time-differences, time and spatial reduction of cloud masking is applied prior to generate the tendencies; for each product, where possible:

- Cloud-affected pixels are replaced by the mean value of (up to 8) unaffected contiguous.
- The cloud-affected maximum pixel value in the last 3 images is selected.

As for the future, it will be studied to provide “time-normalized” SAI tendency in-the-day, for a more objective interpretation. And PGE13-SPhR product (Martinez&Li, 2009) is expected to be soon operational (NWCSAF version 2010), including similar to SAI, TPW and LPW sub products but certainly of better quality, whose adaptation on the entry should be straightforward; it is also foreseen to introduce the use of its to-guess differences. Of course, PGE13 profiles will allow a wide set of possibilities later to be studied, with probably a better understanding on satellite contribution (PGE13 involves physical retrieval of temperature and humidity profiles, a guess with NWP profiles, etc.) and on product validity and applicability.

**Figure 3**: day and time as fig. 1. Display of experimental LI from PGE13-SPhR, similar to SAI see fig. 1 left-lower panel (unless parcel initial lifting conditions is a mixed boundary-layer instead of ground for SAI). Note in green instability pattern in mountainous region central-east Spain, not in HIRLAM model NWP LI field, nor in SAI.

Subentry 2 – Initiation:

Based on HRV channel (at the rapid-scan cycle when available):

- A “general approach”: Peninsula and Balearic Islands, last image at reduced resolution. For regional format selection. And as overlay, last low and very low level NWCSAF wind product HRW (> 700hPa), e.g. for convergence flow patterns in cumulus fields.
- “Regional formats” at full resolution, loop of last 4 images. Selectable overlays: radar-composite PPI image, plotting of lightning-network detections in 10’ updated every minute.

For this early convective stage, Meteosat (or a geostationary satellite) is able to anticipate the other data sources through observation of developing or extending cumuliform cloudiness. No objective product is yet proposed in the NWCSAF. Nevertheless, as promising work is on-going in this area for the Convective Initiation (Mecikalsky&al., 2008, Siewert&al., 2009, for MSG) and interest of users has been expressed, it can be expected to be available in the future. In the meantime, simplifications (e.g. those based on IR cooling rates plus cloud product information), are being studied for the page here.
Figure 4 (background): Day as fig. 1, 10:30UTC. Initiation, General approach with display of HRW low wind (<700hPa) product, on HRV (at around 2km resolution). Winds are in general, rather insufficient for the purpose (for example North-east of Peninsula, probable q.c. rejections), expected to increase in next NWCSAF versions. Clicking over opens a loop of the full-resolution HRV appropriate regional format + (switchable) last radar + last 10’ lightning strokes: e.g. figure 5 (insert), detail of “Northwest” format for 1/09/10, 7:00UTC (dislike the other figures -archived case,- regional formats are not yet archived with the page given data volume): There are 4 regional formats for full and quite redundant coverage (plus Canary Islands, in a separate, equivalent and complete page).

Subentry 3: Characterization

Main display is the “Multiproduct” multiple overlay (last and last hour) where all data are switch on/off overlay layers, a wide number of combinations are possible, with NWCSAF precipitation and convection (presentation adapted, e.g. simplified range for PC and CRR) as basis or default:

- PC - Precipitation probability (general background on precipitating systems).
- CRR - Convective precipitation Rate.
- RDT - Convective objects features.

Channel color enhanced are there as overlays, for IR10.8 and WV6.2-IR10.8 difference or “warm pixels”. HRV channel high resolution formats are in a separate display, with high level NWCSAF HRW winds.

Lightning network recent detections are also shown in Multiproduct by default, as basic convective reference. Other overlays are radar-composite Echo Top and PPI products, as reference on precipitation.
Figures 6 (detail, insert) and 7 (background): day as fig. 1, 11:45UTC and 12:15UTC. Characteristics subentry. Multiproduct default display. In increasing “display level”: PC product (3 classes >20%, similar to standard color table but dim colors); CRR product (4 significant classes see color scale in fig. 7); RDT product (conv. cell contours with rough dev. stage, see legend right lower corner fig. 7, includes displacement of “old” cells -not here) 30’ lightning strokes/polarity (in 5’ intervals) (notice important change e.g. in RDT, page for the most is only archived at 30’ interval often too long for convection, 15’ available only in real time).

Figure 8 (left): default display as fig. 6 plus Echo Top radar overlay. Note the coastal cell / structure, supported (fig. 6) by very recent lightning strokes, but not confirmed by radar mosaic, probably missing radar data at this time/location. Figure 9 (right): default display as fig. 6 + IR10.8 overlay, Convection Working Group 1 color table: yellow, coldest here, is about 215K).

Meteosat and NWCSAF products are useful for a good continuity in the monitoring of the convection characteristics. But some problems in the subentry are the not complete simultaneity or geo-coincidence of the diverse data. There are also limitations in the visualization (e.g. fixed order of overlapping layers). Other enhancements in the subentry are being considered, as could be the use of EUMETSAT recommended RGB microphysics combinations, and/or of new NWCSAF cloud products or sub products, as water phase.
UPGRADED OPERATIONAL ENTRY FOR FOG/LOW STRATUS

Basic subentry displayed CT – Cloud Type NWCSAF product for the low and very low cloud classes, with IR10.8 information; other complementary subentries were channel-based displays depending on the moment of the day. Upgrades now operational are:

- Complementary or alternative to CT (and in the same subentry) display of CTTH - Cloud-height product, relative to ground-elevation (color table applied below 1000m). Small windows show elevation related information, to locally help the interpretation of the products (Fernández-Serdán, 2008, note that the error described for missed CTTH = 0 m pixels, is now corrected).
- CT, CTTH or surface observations can be now directly compared to HRV channel (or IR10.8-R3.9 difference night-time), locally displayed in a small cursor-controlled roaming window (similar to elevation information).
- CT product is now part, as another panel, of the complementary channel-based subentry for the conflictive twilight intervals of the day (noticing also evident CT improvement in these conditions).
- Together with Current weather / visibility, there is now an additional overlay of information from surface observations: Temperature/humidity/wind, available at more locations and also informative on possible fog; even if less precise, “interesting values” are also remarked e.g. very high humidity in yellow otherwise green.

![Image](image.png)

**Figures 10 (insert) and 11 (background):** 24/07/10, 5:45UTC. Default display of CT (detail) and (masking CT), CTTH overlay activated, with IR10.8 whereas either for-the-purpose not significant: CT classes are low (yellowish) and very low (reddish, brightness according to IR10.8). CTTH is relative to “highest terrain” (cloud top < 1000m, see scale in the image): it certainly adds complementary information to CT. Right-side, 3 small windows for local information (centered at the roaming small square-box in main display): Down, HRV (day-time). Up, mean elevation (left) and differences or “slope” (right, same CTTH color code), at the MSG 3km basic resolution (from a better-resolution ground elevation database).
OTHER CONSIDERATIONS

The development of user-oriented applications is essential to take advantage of NWCSAF products. But it also reveals needs for product improvement, and for new products (planned in NWCSAF, requested for or that could be requested); and of course for quality improvement, product-dependently.

The efficient use of these applications is quite related to a good information/training: each new visualization has a quite elaborated, comprehensive documentation sheet attached. And new means are being used, as short practical videos (e.g. on Camtasia Studio SW).

Displaying features in the applications, as overlays or loops, are implemented on freely available tools: AniS (JAVA based, progressively replaced by FlAniS, Flash based), while images are first generated in McIDAS (all from SSEC, Univ. of Wisconsin) 3. Even if in the future, most tasks will be moved to the NinJo system (planned to replace McIDAS in operations in forecasting units at AEMET), likely web-based displays will still be maintained as a useful complement.

REFERENCES


1. NWCSAF: [http://www.nwcsaf.org](http://www.nwcsaf.org)
2. Convection Working Group: [http://convection.satreponline.org](http://convection.satreponline.org)