

NWC SAF end of CDOP 3 and CDOP 4 Plans

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Convection Working Group

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Online meeting



Outline

- Introduction to the Nowcasting SAF (NWC SAF)
 - Concept
 - GEO and PPS products, supported satellites
- End CDOP 3 plans
 - More recent developments
 - Collaboration with IARAI
- CDOP 4 plans:
 - MTG day-1 software
 - New Products planned for GEO
 - Plans for polar satellites
 - European Weather Cloud
 - NWCSAF services & Training



NWCSAF concept

- ✓ To ensure the optimum use of meteorological satellite data in Nowcasting and Very Short Range Forecasting
- ✓ The NWC SAF develops and maintains SW Packages (for GEOstationary and POLAR Satellites) <u>freely distributed</u> to registered users to generate satellite products with a direct application in Nowcasting

✓ User support



nwc-saf.eumetsat.int



NWCSAF Products for Geostationary Satellites

Continuous monitoring, space resolution and illumination conditions good for low and middle latitudes

NWCSAF GEO v2018, upgraded in January 2020 (GEO v2018.1)

Supported Satellites

- MSG primary satellite
- MSG Rapid Scan Service
- IODC
- Himawari 8
- GOES-N (Clouds and HRW)
- GOES-16



Current NWCSAF Products for Geostationary Satellites

Cloud products: CMA, CT, CTTH, CMIC(cloud phase, cloud optical thickness, liquid water path, ice water path, effective radius) Precipitation Products: Probability of Precipitation (PC and PC-Ph) and Convective Rainfall Rate (CRR and CRR-Ph) Stability Product: iSHAI (stability indices, Precipitable water in low, mid and high Layers, skin temperature, total ozone, differences with NWP) Convection Products: CI (probability of a cloud to become a convective cell) and RDT-CW (identification, characterization and tracking of convective cells)

Winds: HRW (high resolution winds at various levels, trajectories) Image Extrapolation: EXIM (extrapolation of satellite images and NWCSAF products)

Automatic Image Interpretation: ASII, ASII-TF (probability of presence of tropopause folding), ASII-GW (probability of presence of gravity waves)





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Current NWCSAF products for Polar Satellites

Relatively good coverage for high latitudes

NWCSAF PPS v2018 (last upgrade in March 2021 PPS v2018.4)

Supported Satellites: Metop, NOAA, NPP, JPSS, EOS, FY-3D

Cloud Products: Cloud Mask (Cma), Cloud Type (CT), Cloud Top temperature and Height (CTTH), Cloud Microphysics (CPP) and Cloud Probability Cloud-prob

Precipitation Product:

Probability of precipitation PC (to be discontinued)



NWCSAF PPS Products

Cloud Products



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End CDOP 3 Plans

We have new developments/improvements that could be released to the users in new NWC SAF SW versions (not initialy planned).

These improvements will be included in MTG day-1 and EPS SG A day-1 SW packages and we are discussing with EUMETSAT the possibility to released them during 2021

- Main improvements in a possible GEO release in 2021 (TBC):
 - New version of precipitation products from microphysical properties (see presentation from J.A. Lahuerta)
 - Some improvements in Convection Products (see presentation from M. Claudon)
 - Support to GOES-17 and Himawari-9, support to Himawari in HRIT format
 - "Early execution" (start generation of products when data for the region of interest has been received)



End CDOP 3 Plans

- Main improvements in a possible version PPS v2021 (TBC)
 - Beta version of HRW for polar satellites (user's request, to be assimilated in numerical models)
 - Improved version of Cma-Prob

14th June 2019, 09:00 UTC

Winds from VIS06 and IR108

METOPB, slot 20190614T090056Z and METOPC, slot 20190614T083029Z

J. García-Pereda, AEMET



NWCSAF/HRW - 20191650900 COPYRIGHT EUMETSAT 2019

> VISOG PPS HIGH AMV® IR108 PPS HIGH AMV® VISOG PPS LOW AMV® IR108 PPS LOW AMV®



End of CDOP 3 Plans. Collaboration with IARAI

IARAI Institute of Advance Research in Artificial Intelligence (https://www.iarai.ac.at/)

IARAI has experience organizing competitions to solve problems using ML. New competition in collaboration with NWC SAF has been announced:

Wheater4cast competition

"The goal is a short-term prediction (8 hours in 15 minute intervals) of the selected weather products The weather movies consist of multi-channel images encoding the cloud properties, temperature, turbulence, and rainfall, based on meteorological satellite data obtained in collaboration with AEMET/NWC SAF" We have provided 1 year of NWC SAF GEO products.

Best algorithms/models developed within the competition will be published and made available to us.



End of CDOP 3 Plans. Collaboration with IARAI



EXIM product from NWC SAF will be used as a reference to evaluate the developed ML models

A Workshop proposal to present and promote the competition has been submitted to the International Conference on Machine Learning (<u>https://icml.cc/</u>, July 2021)



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End of CDOP 3 Plans. Collaboration with IARAI http://weather4cast.ai/





Weather4cast 2021

AEMet

The goal of the competition is a short-term prediction of selected weather products based on meteorological stellites data obtained in collaboration with ABMET/NWC SAF. Following recent success of our Traffic4cast competitions at NeurIPS in 2019 and 2020, this challenge presents weather forecast as a video frame prediction task. The weather movies consist of multi-channel images encoding the cloud properties, temperature, truchulence, and rainfall. The images are recorded at 15 minute intervals through the entire year: Each pixel in the images represents the area of about 4 km x 4 km, and each region contains 256 x 256 pixels. The regions span varying landscapes including mountains, deserts, islands and seas, and others. The training and validation data contain observations in various earth regions and the test data include additional new regions. The challenge is to predict the encoded weather products in all regions. The competition outcomes are expected to go beyond methodological advances in weather forecasting and video frame prediction. The challenge offers realworld benchmark for few shot and transfer learning and allows testing multi-sensor data fusion. Learn more...

We are looking forward to the outcome of the competition We plan to continue collaboration with IARAI for future ML/AI applications to satellite meteorology.

NWC SAF



Continue development/implementation of NWC SAF SW for MTG day-1 (CDOP 2-CDOP 3-CDOP 4)

MTG day-1 SW is an evolution of current NWC SAF GEO software

So far MTG day-1 SW has been tested mainly with MTG testdata. As NWC SAF GEO SW supports GOES/ABI and Himawari/AHI sensors, similar to MTG/FCI, we are confident that MTG day-1 software will be ready in time.



Himawari CT 27 February 2018 5UTC. MétéoFrance

MTG day-1 products:

- will benefit from the higher spatial and temporal resolution of MTG
- Used of the new channels in some products
- Use of MTG/LI data within the RDT-CW product
- More recent developments (new precipittion products, "early execution")
- Updated NetCDF format (CF Compliance) (presentation from L. Lliso)

Full exploitation of the new MTG capabilities will come in the following NWC SAF MTG versions



CDOP 4 Plans. New Products. Lightning products

MTG-I satellite includes a lightning sensor LI



A description of MTG-LI and L2 LI products distributed by EUMETSAT can be found in the following presentation by Bartolomeo Viticchie:

https://www.nwcsaf.org/Downloads/Workshop2020/Presentations/Session_I/6.NWCSAF_MTG-LI_Viticchie_UsersWS2020.pdf

EUMETSAT will provide L2 LI products:

- Gridded products (imaging information)
 - flash_accumulation, accumulated_flash_area, flash_radiance
 - in FCI grid, accumulated in 30 seconds
- "Point" products
 - groups and flashes
 - accumulated in 10 seconds



CDOP 4 Plans. GEO new Products. Lightning products

NWC SAF Lightning products. Developed by NWC SAF team at NMA (Romania)

LiStack

- accumulation of EUMETSAT L2 LI gridded products in the user's defined time period
- with the **option of parallax correction**
- for the user's area of interest

To monitor the lightning activity Equivalent GLM lightning products are the more used GLM products Not available in MTG day-1, to be released soon after it in a dedicated release

LiJump

- Lightning jump detection
- image –like product

To be released in SW version following MTG day-1 (around 2026). To be used inside RDT-

CW product once it is available.



CDOP 4 Plans. GEO new Products. Lightning products

Other ideas that will be considered:

Current Visiting Scientist Activity with Eric Bruning to explore other lightning products for MTG/LI to be included in the NWC SAF SW

Forecast of lightning activity (ML/AI technique)

- A deep learning algorithm for GOES already available https://cimss.ssec.wisc.edu/satellite-blog/archives/38136
- Users seem to be interested in the implementation of a similar product for MTG
- Not included in CDOP 4 proposal
- We are considering a collaboration to explore this line



CDOP 4 Plans. GEO new Products. ASII-ICE

ASII-NG extended by an additional subproduct **ASII-ICE.** Implemented by NWC SAF team at ZAMG

Detection of in-flight icing (="ASII-ICE"), comprising

• high-altitude ice crystals (HAIC) detection and

Following algorithm in

de Laat, A., Defer, E., Delanoë, J., Dezitter, F., Gounou, A., Grandin, A., Guignard, A., Meirink, J. F., Moisselin, J.-M., and Parol, F. (2017): Analysis of geostationary satellite-derived cloud parameters associated with environments with high ice water content. Atmos. Meas. Tech., 10, 1359-1371 (https://doi.org/10.5194/amt-10-1359-2017).

icing potential based on supercooled water droplet detection.

following algorithm based in

Smith, W. L. Jr., P. Minnis, C. Fleeger, D. Spangenberg, R. Palikonda, and L. Nguyen (2012): Determining the flight icing threat to aircraft with single-layer cloud parameters derived from operational satellite date. *J. Appl. Meteor. Climatol.*, 51, 1794–1810 (https://doi.org/10.1175/JAMC-D-12-057.1).

Main application: Aviation community

Not commited for MTG day-1, provided as demonstrational in MTG day-1 SW



CDOP 4 Plans. GEO new Products. ASII-ICE



NASA product icing potential based on supercooled water droplet detection

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CDOP 4 Plans. GEO new Products. IRS products

New instrument IRS on board MTG-S

First infrared hyperspectral sounder in a geostationary satellite for Europe

Two presentations at CWG about NWC SAF IRS products:

- "Preparation of MTG era: developing of imager and sounder nowcasting tools", M.A. Martínez, AEMET, Wednesday 7th, 8:15 UTC
- "Sounding MTG-IRS products from EUMETSAT's NWC SAF", X. Calbet, AEMET, Thursday 8, 13:00 UTC

Delivered as Day-2 products in GEO-S software

We aim to integrate GEO-I and GEO-S SW packages to exploit the synergies of FCI, LI and IRS instruments

We plan to dedicate some effort in CDOP-4 to study the use of MTG-IRS data to improve current NWCSAF GEO-I products



CDOP 4 Plans. Polar satellites

Continue development/implementation of NWC SAF SW for EPS SG A day-1 (CDOP 3-CDOP 4)

HRW product for polar satellites to become operational

Continue improvement of the products

NWCSAF PPS-MW: products from microwave sensors in EPS-SG B satellite (MWI and ICI) EPS-SG A satellite (MWS): Ice Water Path (IWP), Liquid Water Path (LWP) and Precipitation Rate (PR)



CDOP 4 Plans. European Weather Cloud.

https://www.europeanweather.cloud/

The European Weather Cloud (EWC) is a joint effort of ECMWF and EUMETSAT to set up a distributed Cloud Computing infrastructure to serve the European Meteorological Infrastructure and its users.

- NWC SAF tenancy in the European Weather Cloud
- NWC SAF GEO SW installed.
- When the Satellite and NWP data are available, the NWC SAF products can be generated at the Cloud
- Benefits from the Cloud:
 - It is a platform to deploy/access different kind of data
 - It can easy the collaboration between Meteorological Services and other Institutions
- Applications:
 - For training purposes
 - As a development environment for new nowcasting products/tools.

We are in contact with EUMETSAT and aim to contribute to these applications



NWC SAF services. (nwc-saf.eumetsat.int)

Last but not least: We will continue and even improve within our possibilities

the services to our users.

- From the web site:
 - Access to the NRT NWCSAF GEO and PPS product images (Reference Systems)
 - Access to GEO product images archive
 - Description of the products. Guide for forecasters and Aviation guide
 - Some general information and documentation
 - <u>For registered users</u>: <u>Download of NWCSAF SW packages and other</u> tools, user support via a ticketing system, access to a broader information and documentation
- Participating in and/or organizing training activities/testbeds/outreach activities to explain, promote and easy the use of the NWC SAF products



Thank you very much for your attention

More information at **nwc-saf.eumetsat.int**

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