GOBIERNO DE ESPAÑA
VICEPRESIDENCIA CUARTA DEL GOBIERNO
MINISTERIO PARA LA TRANSICIÓN ECOLÓGICA Y EL RETO DEMOGRÁFICO
AEMet Agencia Estatal de Meteorología
EUMETSAT

NWC SAF
Support to Nowcasting and Very Short Range Forecasting

NWCSAF/High Resolution Winds AMV Software for Geostationary and Polar satellites Status in 2021

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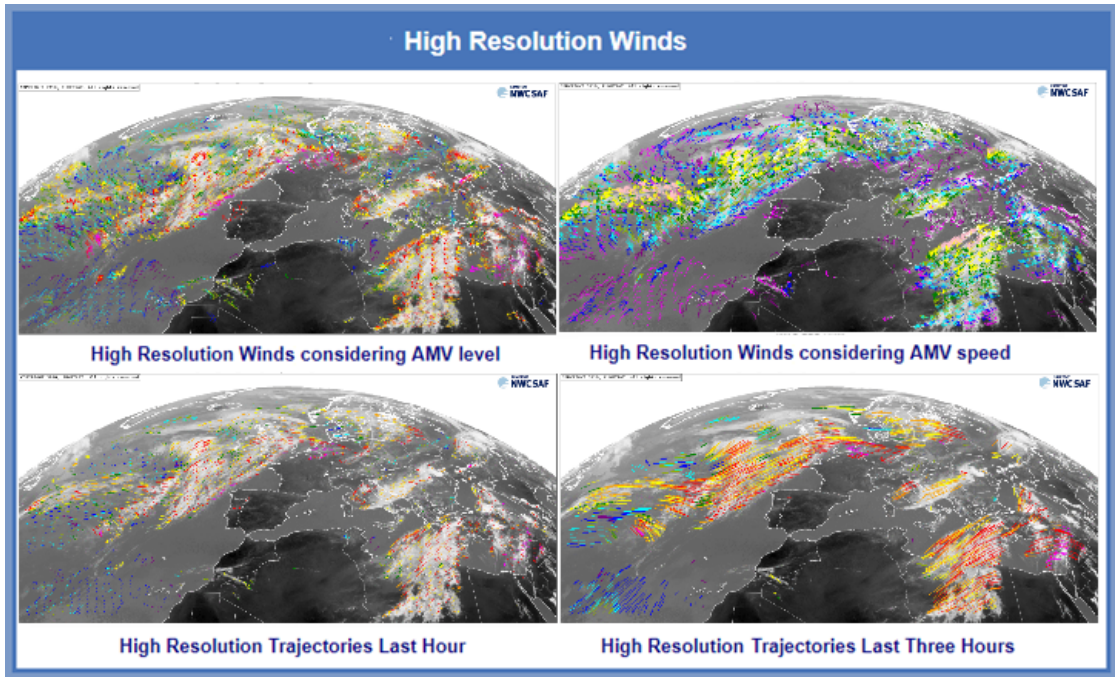
Fifteenth International Winds Workshop

Javier García-Pereda (NWCSAF/AEMET)
Nina Håkansson (NWCSAF/SMHI)

NWC/GEO-High Resolution Winds v2018.1

- **High Resolution Winds software** provides a detailed calculation of **"Atmospheric Motion Vectors (AMVs)"** and **"Trajectories"**, inside the NWCSAF Software packages for Meteorological Services and Researchers.

- **Latest version** released in **January 2020** (NWC/GEO v2018.1 Software package for geostationary satellites).



Example of High Resolution Winds from NWCSAF Helpdesk (nwc-saf.eumetsat.int) for 1 June 2019 1200Z, MSG-4

NWC/GEO-High Resolution Winds v2018.1

Updates included in HRW v2018.1:

1. Implementation of the "New IWWG AMV BUFR" output (sequence 310077)

2. Adaptation of HRW algorithm to GOES-16 satellite:

➔ Adaptation equivalent to Himawari-8/9,

using the same satellite channels

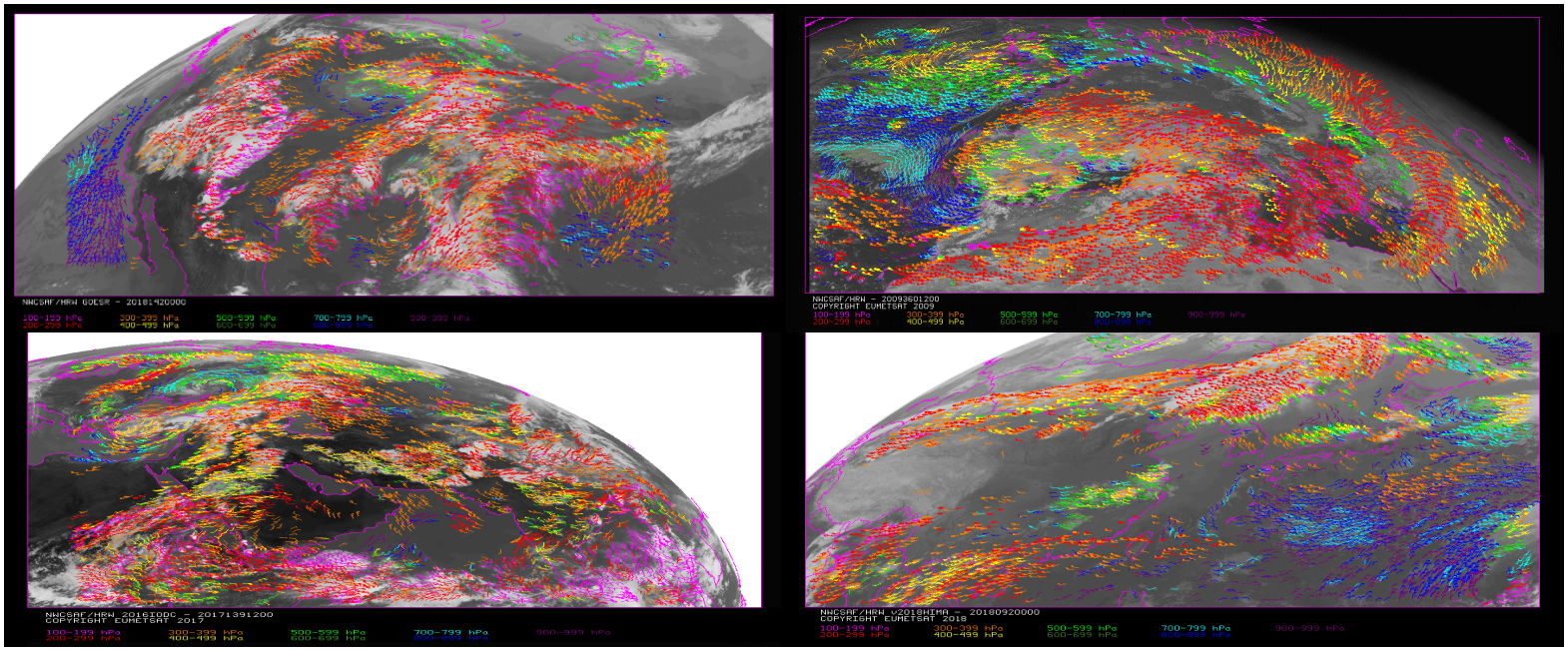
(VIS06, VIS08, WV062, WV070, WV074, IR112).

➔ Satellite input data: GOES-R NetCDF from NOAA.

NWC/GEO-High Resolution Winds v2018.1

Options for AMV calculation in HRW v2018.1:

- **MSG-1/4** (AMVs every 15 or 5 min.)
- **Himawari-8/9** (AMVs every 10 min.)
- **GOES-13/15** (AMVs every 30 or 15 min.)
- **GOES-16** (AMVs every 15 or 10 min.)



Similar validation for all satellites;
slightly better,
with more positive BIAS,
for Himawari & GOES-16

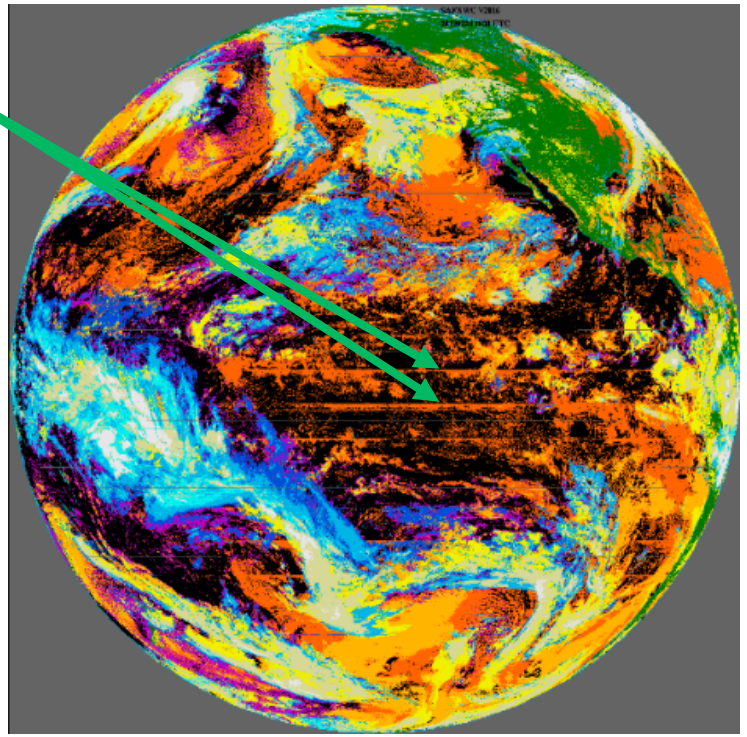
NWC/GEO-HRW v2018.1 AMVs	MSG-2 Jul'09-Jun'10 Europe	GOES-13 Jul'10-Jun'11 CONUS	Himawari-8 Mar'18-Aug'18 China-Korea-Japan	GOES-16 May'19-Jul'19 CONUS (Mode 6)
NC	1097907	608690	1197466	1283683
SPD [m/s]	17.23	22.43	21.46	20.49
NBIAS (ALL LAYERS)	-0.07	-0.05	+0.05	+0.05
NMVD (100-1000 hPa)	0.32	0.28	0.28	0.28
NRMSVD	0.39	0.36	0.35	0.34

NWC/GEO-High Resolution Winds v2018.1

The extension to additional GOES-R satellites is also in the working plan.

However, with the problems in the cooling system of GOES-17/ABI Imager:

- ➔ Significant noise can occur in the satellite images and NWCSAF products.
- ➔ Filtering of noisy data is needed using available "quality flags".
- ➔ The extension to GOES-17 is going to be implemented in the following update during 2021.



(Example of noisy NWCSAF/Cloud type for GOES-17 satellite)

NWC/PPS-HRW (Adaptation to polar satellites)

A requirement from NWCSAF users exists to extend NWCSAF/High Resolution Winds to polar satellites:

➔ **European Nordic weather services**
wish more wind data for NWP assimilation at high latitudes,
with a stringent timeliness requirement of 15 minutes!

➔ **No other dataset of winds from polar orbiting satellites**
can satisfy this timeliness requirement.

NWC/PPS-HRW (Adaptation to polar satellites)

Considering this:

➔ **HRW has being extended to calculate AMVs and Trajectories**
from reprojected polar images in static regions of different sizes,
in a similar way to what is being done for geostationary satellites.

➔ **Several polar satellites/instruments are considered for this:**

- NOAA & Metop/AVHRR-3
- S-NPP & JPSS/VIIRS
- EOS/MODIS

In later versions also:

- FY-3/Mersi-2
- EPS-SG-A/MetImage

➔ **The quantity and quality of AMVs is maximized**
optimizing the best pair of images for each calculation considering:

- The time separation between images.
- The percentage of common scanning in the static processing region.

NWC/PPS-HRW (Adaptation to polar satellites)

NWC/PPS-HRW is based on an adaptation of NWC/GEO-HRW v2018.1 code.

HRW code kept as an only software element valid for both software packages (NWC/GEO and NWC/PPS), but installed with two different "makefiles".

- ➔ **Two different "executables" are so produced.**
- ➔ **However, 90% of the code is exactly the same for both implementations!**

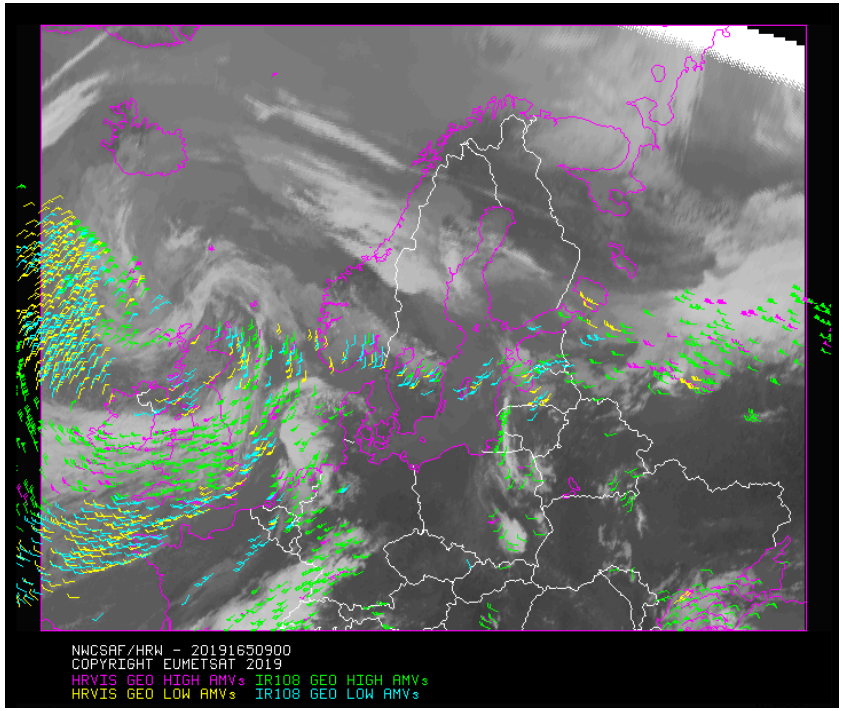
This way, results for NWC/PPS-HRW in perfect consonance with those for NWC/GEO-HRW!

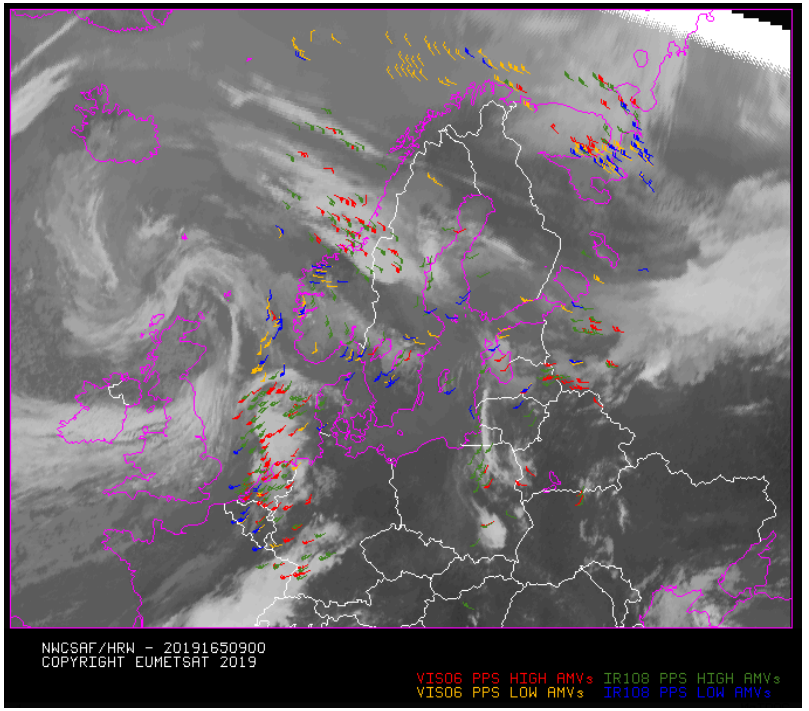
HRW outputs will be exactly equivalent for both geostationary and polar options.

- ➔ **Someone already using NWC/GEO-HRW can use NWC/PPS-HRW very quickly.**

NWC/PPS-HRW (Adaptation to polar satellites)

Example for 14/June/2019 09:00Z, comparing AMVs obtained by NWC/GEO-HRW algorithm and NWC/PPS-HRW algorithm:



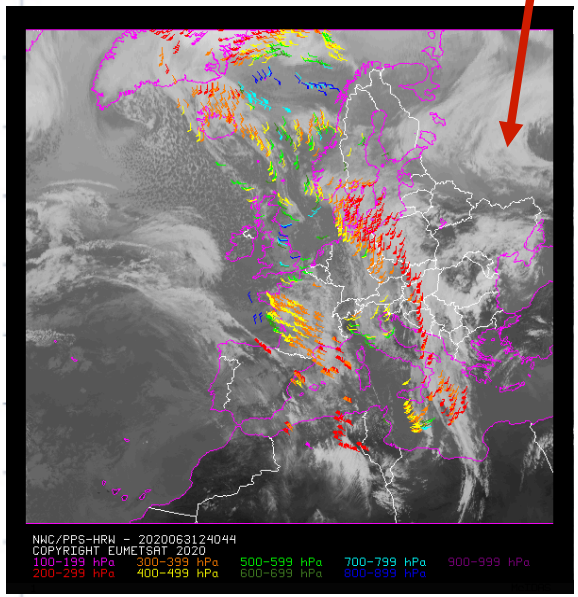


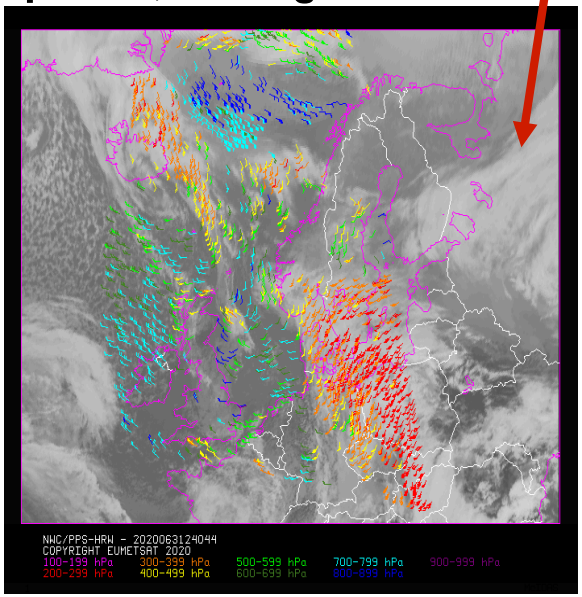
For NWC/GEO-HRW, the "satellite zenith angle" defines a geographical limit for the AMV calculation.

For NWC/PPS-HRW, there are no geographical limits for AMV calculation, but the AMV temporal/spatial density is smaller (calculating AMVs only with VIS06/IR108 channels).

NWC/PPS-HRW (Adaptation to polar satellites)

A 3 month period in two regions with two different pixel resolutions (5 km per pixel "Europe" and 1 km per pixel "Scandinavia") has been used for development, testing and validation





Basic VIS06 & IR108 AMVs	NWC/PPS-HRW v7.P AMVs Feb'20-Apr'20, 11:00 - 13:00 UTC: Scandinavia region	NWC/PPS-HRW v7.P AMVs Feb'20-Apr'20, 11:00 - 13:00 UTC: Europe region	NWC/GEO-HRW v6.1 AMVs Jul'09-Jul'10, 12:00Z: Europe and Mediterranean region
NC	254911	444646	566718
SPD [m/s]	31.10	27.36	22.19
NBIAS (HIGH LAYER)	+0.01	-0.07	-0.05
NMVD (100-400 hPa)	0.31	0.30	0.26
NRMSVD	0.38	0.36	0.32
NC	125570	126301	276959
SPD [m/s]	19.41	15.71	13.91
NBIAS (MEDIUM LAYER)	+0.01	-0.04	-0.08
NMVD (400-700 hPa)	0.38	0.41	0.36
NRMSVD	0.47	0.50	0.44
NC	112808	73809	254230
SPD [m/s]	11.70	9.37	9.79
NBIAS (LOW LAYER)	-0.00	-0.00	-0.09
NMVD (700-1000 hPa)	0.36	0.44	0.42
NRMSVD	0.43	0.51	0.50
NC	493289	644756	1097907
SPD [m/s]	23.69	23.02	17.23
NBIAS (ALL LAYERS)	+0.01	-0.06	-0.07
NMVD (100-1000 hPa)	0.33	0.32	0.32
NRMSVD	0.42	0.39	0.39

➔ **NWC/PPS-HRW AMV validation is inside the "Target accuracy" for all layers in both validation regions.**

➔ **Comparing with NWC/GEO-HRW AMVs:**

- **NMVD/NRMSVD values are similar or slightly higher (up to 15%)**
- **Vertical distribution of AMVs and AMV validation behave similarly (better for high levels and worse for low levels).**

NWC/PPS-HRW (Adaptation to polar satellites)

The plan for this work is:

➔ **Delivery of a "beta version of NWC/PPS-HRW"**
for evaluation, testing and applicability
- Release to users throughout 2021.
- Prepared since Summer 2019 by
Javier García-Pereda (AEMET, Spain) & Nina Håkansson (SMHI, Sweden).

➔ **Delivery of the "first official version of NWC/PPS-HRW"**
inside NWCSAF/CDOP4 phase (> 2022).

With both NWC/GEO-HRW and NWC/PPS-HRW:

➔ The user is going to be able to obtain AMVs with the same algorithm
in all corners of the world with a high update frequency.

➔ This is better than what other AMV products can do,
due to the larger number of processable satellites,
and can be important for example for
Global NWP assimilation and Climatic studies.

Other developments with HRW up to 2022

(Up to the end of current NWCSAF/CDOP3 phase)

I. NWC/GEO-HRW for MTG-Imager.

➔ The experience with Himawari-8/9 and GOES-R is very helpful for this adaptation.

➔ Currently, main difficulties related to:

- The optimal use for AMV extraction of High resolution channels VIS06 and VIS08.
- Better distribution of AMVs at medium and low levels.

II. Optimization of HRW code.

Plans for NWCSAF/CDOP4 phase (2022-2027)

Plans for the following years have been agreed

with Eumetsat inside "NWCSAF/CDOP4 phase (2022-2027) Proposal":

I. Improvements due to updates in NWCSAF/Cloud products:

- ➔ Stratiform and cumuliform cloud separation
- ➔ Improvements in CTTH and CMIC products
- ➔ Better assessment of multilayer clouds and semitransparent clouds.

II. Improvements suggested by NWCSAF users:

- ➔ Inclusion of "Error in the AMV displacement" as defined by Graeme Kelly/MetOffice.
- ➔ Inclusion of "Aeronautical units (flight level)" in the AMVs for use by aviation.

Plans for NWCSAF/CDOP4 phase (2022-2027)

III. Possible implementation of "stereo height assignment"

➔ Considering the parallax displacement of an AMV observed by two geostationary satellites in two different locations.

We keep the interest of having
collaboration of experts in this task for the implementation
through a "NWCSAF Visiting Scientist Activity"
(f.ex. James Carr, Dong Wu,…)

IV. Implementation of the NOAA/NESDIS "nested tracking"

➔ Considering several tracers of smaller size inside a large tracer.

Plans for NWCSAF/CDOP4 phase (2022-2027)

V. Further studies related to winds from hyperspectral retrievals (MTG-Sounder radiances or T/q profiles)

➔ From the several working groups in this area
it seems clear that
the "optical flow" perspective is winning the deal.

➔ A feasibility study has also been recommended
to the NWCSAF to check
how worthwhile it still is to calculate AMVs with MTG-Sounder data.

NWCSAF/HRW as "Stand-alone AMV software"

Due to its characteristics and its ease to be obtained/understood/run locally,

NWCSAF/HRW was proposed at previous "International Winds Workshops"

as "Stand-alone AMV calculation software"

available for all AMV researchers and users.

Its good validation results by independent studies

(2014/2018 AMV intercomparisons)

and its usability with many satellites in all areas of the world

should be enough to convince any researchers about the use of NWCSAF/HRW.

For any further need or help, do not hesitate to contact me

Thank you very much for listening!

Javier García-Pereda

<jgarciap@aemet.es>