Use of NWCSAF NWC/GEO software package with MSG, Himawari-8/9 and GOES-13/16 satellites

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NWC/GEO v2018.1

- Latest version of NWCSAF NWC/GEO software for geostationary satellites (v2018.1), to be released in Autumn 2019, is able to run with:
  - MSG satellites (with images every 15 or 5 minutes)
  - Himawari-8/9 satellites (with images every 10 minutes)
  - GOES-13/15 satellites (with images every 30 or 15 minutes)
  - GOES-16 satellite (with images every 15 or 10 minutes)

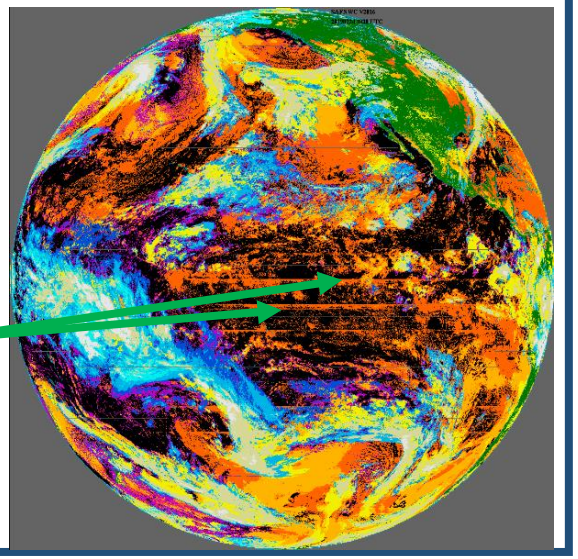
  giving the option to calculate NWC/GEO products all throughout the world.

The extension to GOES-17 is also in the working plan.
However, with the "problems in the cooling system of ABI Imager":

➔ The filtering of noisy data using available "quality flags" is not efficient for the moment.

➔ Significant noise occurs in NWC/GEO products with GOES-17.

➔ A decision has been taken by NWCSAF Project Team to wait for the official extension to GOES-17 satellite.



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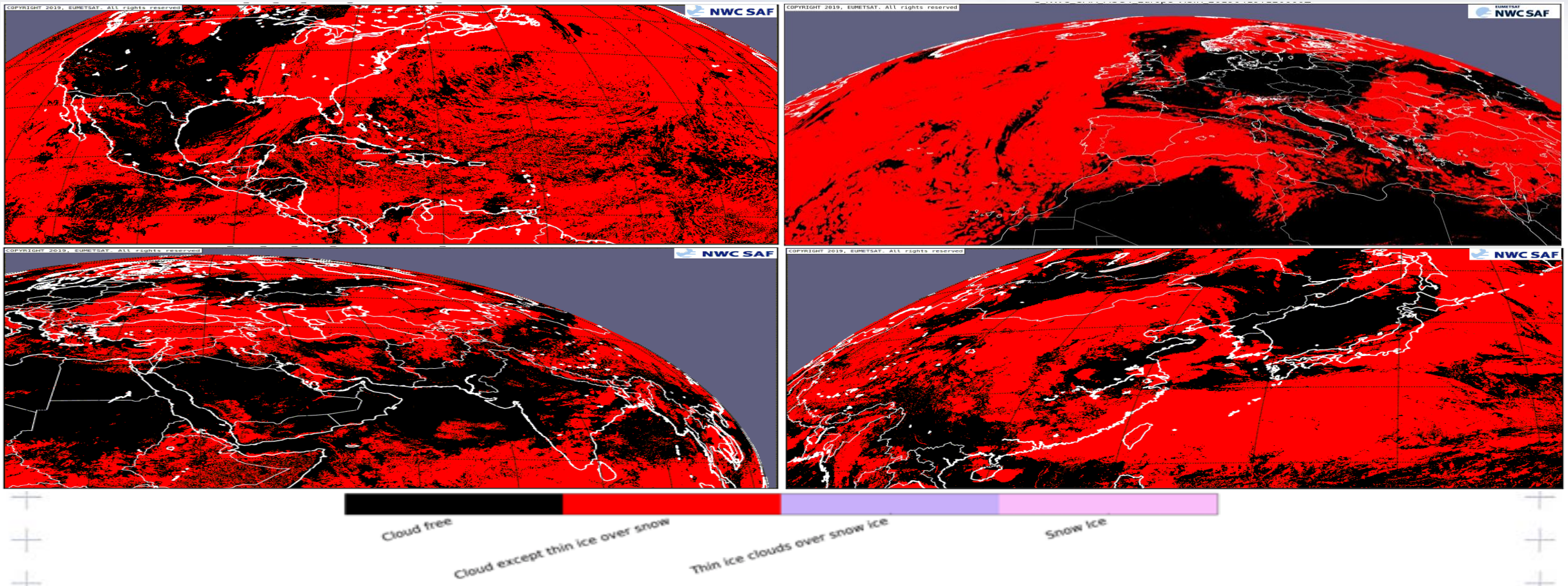
  giving the option to calculate NWC/GEO products all throughout the world.

➔ This talk is especially dedicated to possible users of NWC/GEO software in new areas covered by Himawari and GOES satellites.

➔ Examples of NWC/GEO products are going to be shown in all possible regions:
- Europe and Africa with MSG.
- West Asia with MSG/IODC.
- East Asia, West Pacific with Himawari-8.
- Americas with GOES-16.

Examples for the same moment with all satellites:
19 April 2019 at 12:00 UTC.

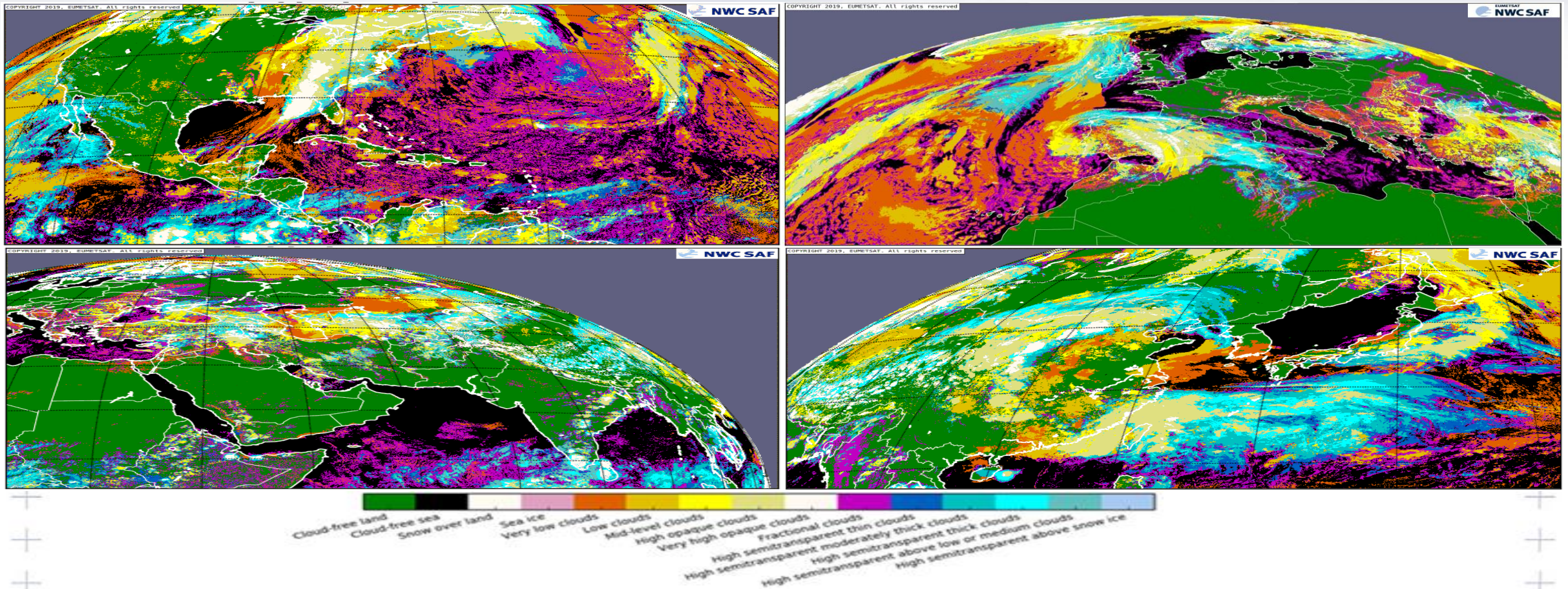
NWC/GEO Clouds: Cloud mask



CMa – Cloud Mask: cloud detection, and snow detection during daytime.

- Used as a complement to visible images during the day.
- More useful during the night, due to difficulties to identify some low cloud types in IR images.

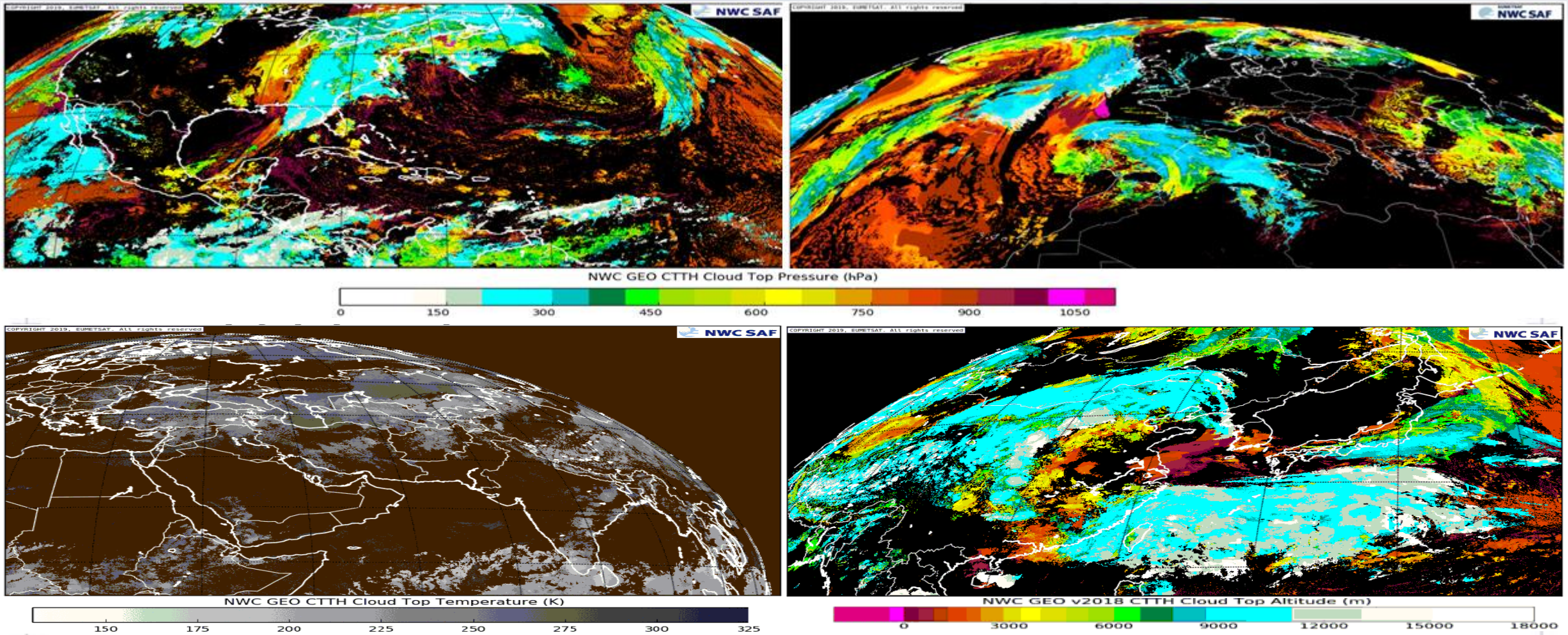
NWC/GEO Clouds: Cloud type



CT – Cloud type

- **Cloud classification** based on the "opacity/transparency" and "level of the cloud top". (Ex: "Cb" classified as "high opaque cloud").

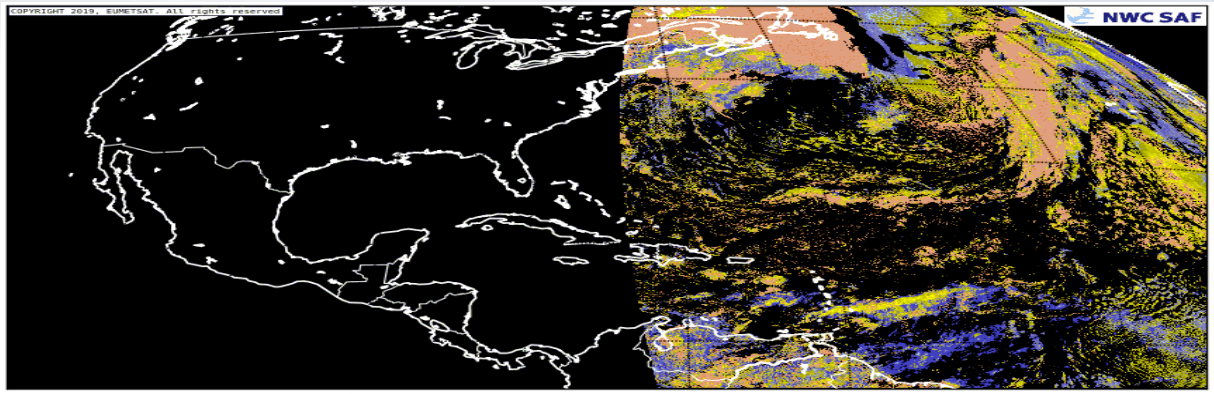
NWC/GEO Clouds: Cloud top pres/temp/height

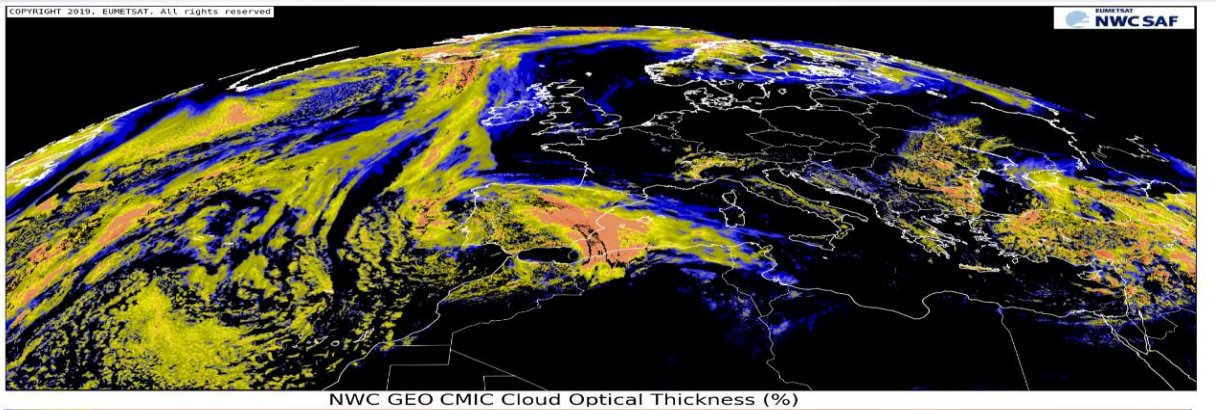


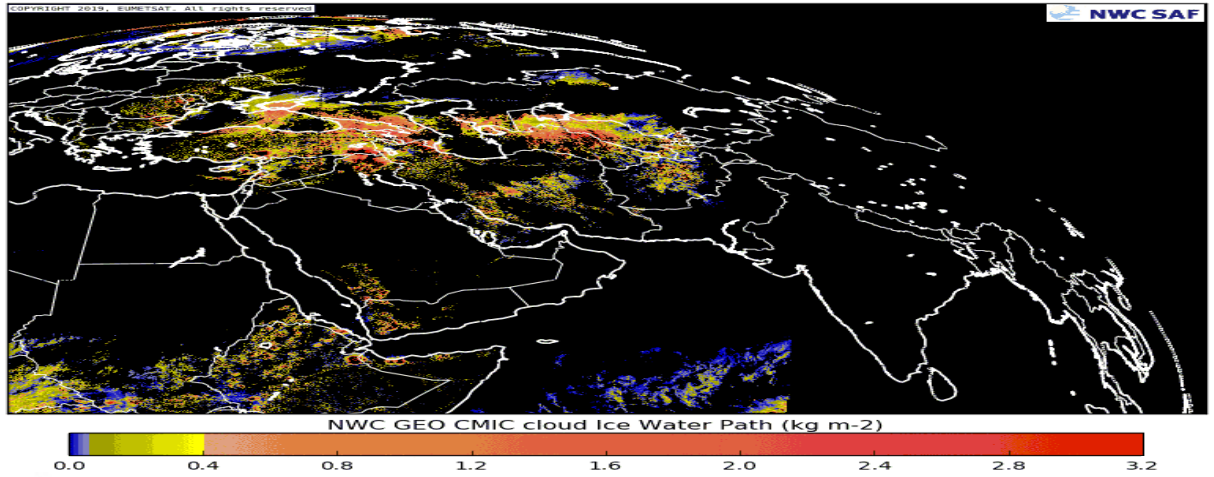
CTTH: Cloud top pressure (up), temperature (down left) and height (down right).

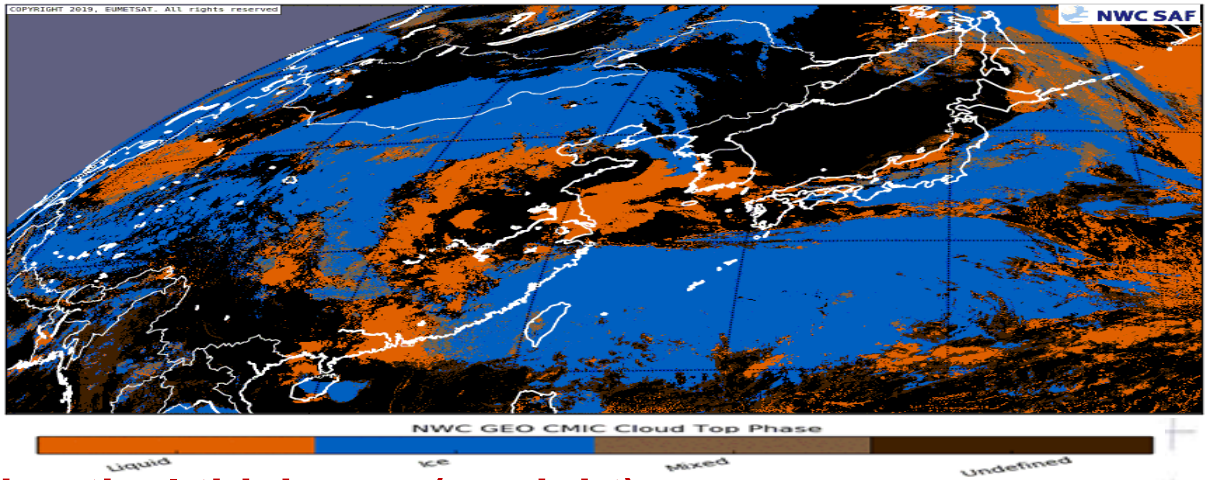
- "Fractional clouds" not having CTTH outputs.

NWC/GEO Clouds: Cloud microphysics





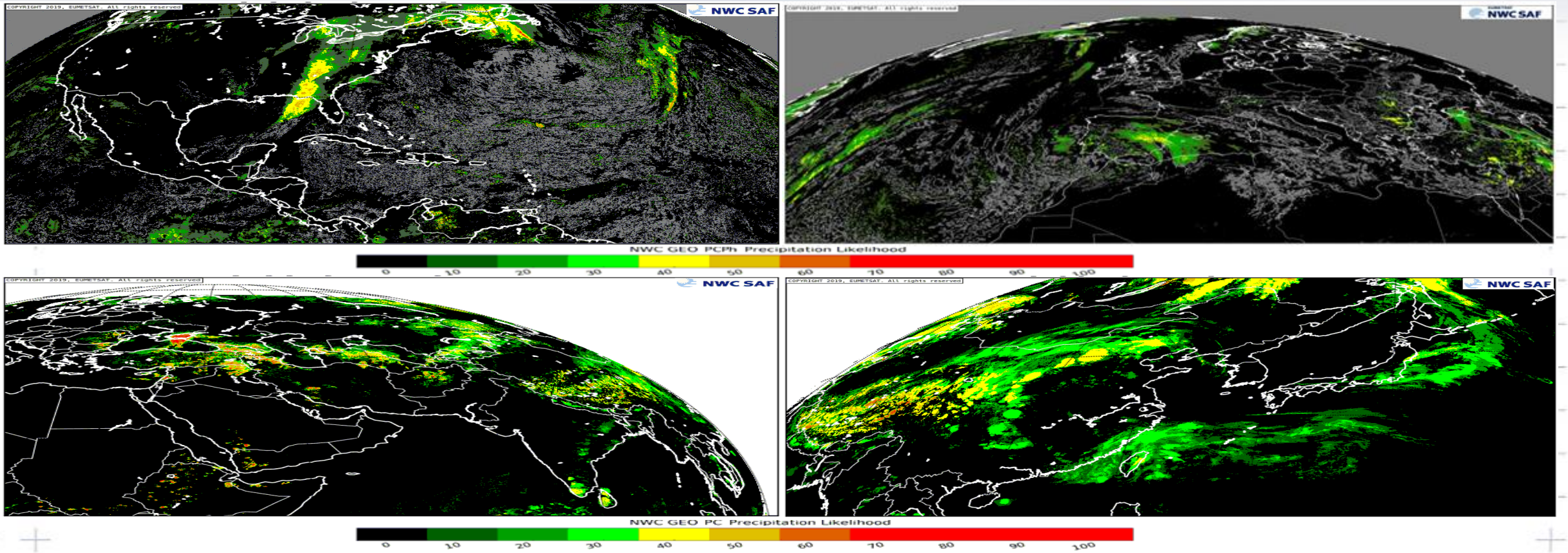




CMIC: Cloud drop effective radius (up left) Cloud optical thickness (up right), Liquid/Ice water path (down left), Cloud top phase (down right).

- Only “Cloud top phase” parameter available for night, twilight, mixed/undefined phase.

NWC/GEO Precipitation: Prob. Precipitation

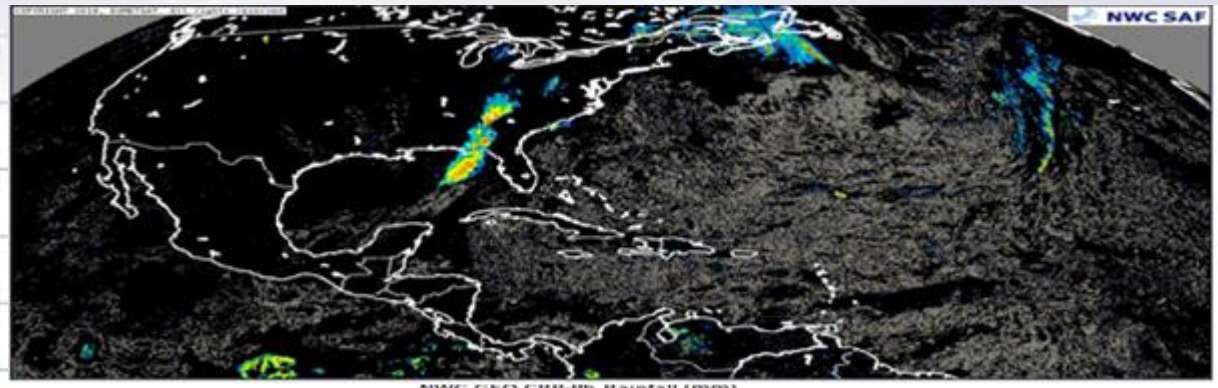


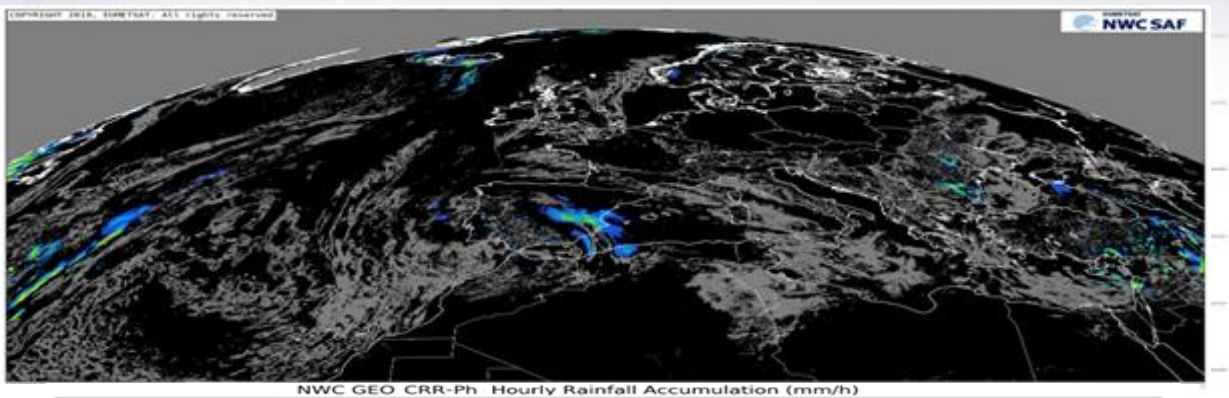
PC – Precipitating Clouds (down) and

PCPh – Precipitating Clouds based on Cloud Microphysics (up)

- **Probability of precipitation** for all precipitation, but working better for convective precipitation.
- Useful when radar not available, with preference for PCPh product.

NWC/GEO Precipitation: Convective Rainfall



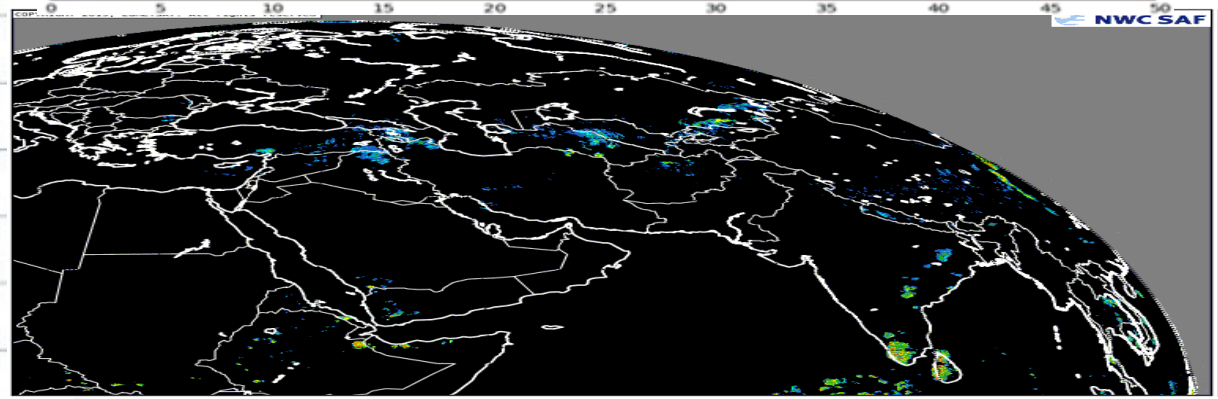


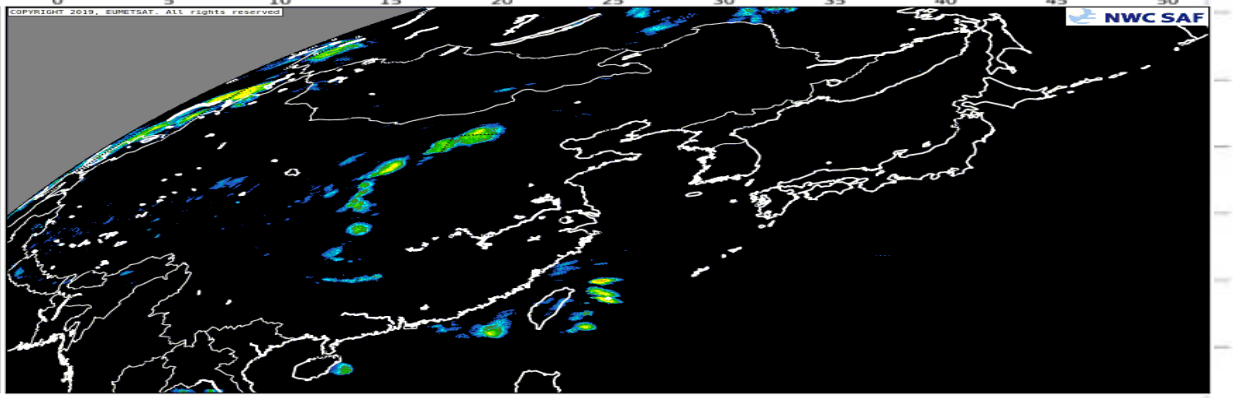
NWC GEO CRR-Ph Rainfall (mm)

0 5 10 15 20 25 30 35 40 45 50

NWC GEO CRR-Ph Hourly Rainfall Accumulation (mm/h)

0 5 10 15 20 25 30 35 40 45 50





NWC GEO CRR Rainfall (mm)

0 5 10 15 20 25 30 35 40 45 50

NWC GEO CRR Hourly Rainfall Accumulation (mm/h)

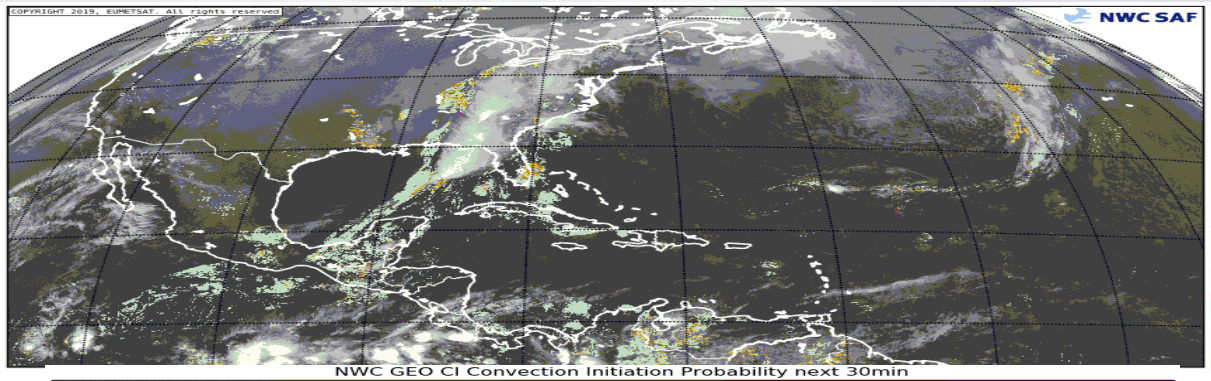
0 5 10 15 20 25 30 35 40 45 50

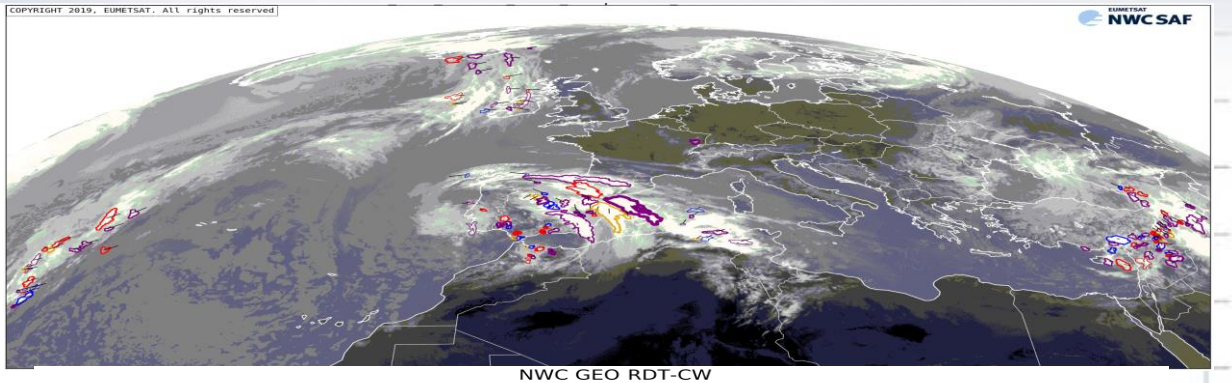
CRR – Convective Rainfall Rate (down) and

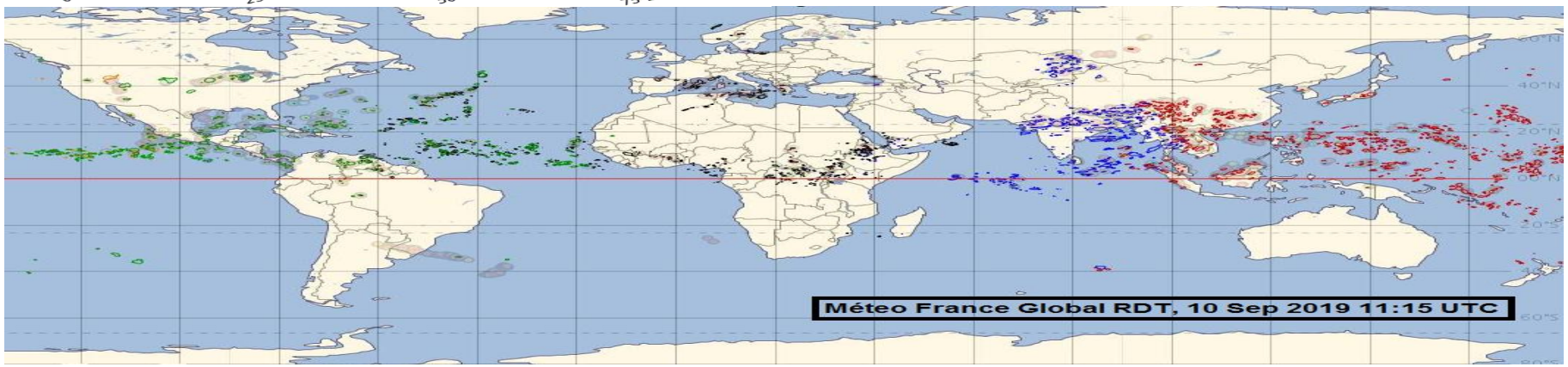
CRPh – Convective Rainfall Rate based on Cloud Microphysics (up)

- Instant values of precipitation (left) and Hourly values of precipitation (right).
- Useful when radar not available, with preference for CRPh product.

NWC/GEO Convection: Prob. & Characteristics







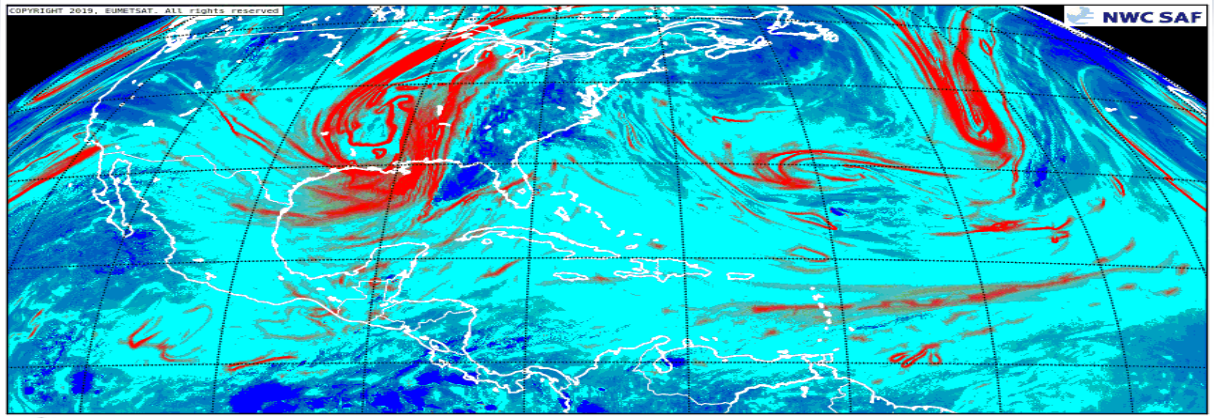
CI – Convection Initiation (up left)

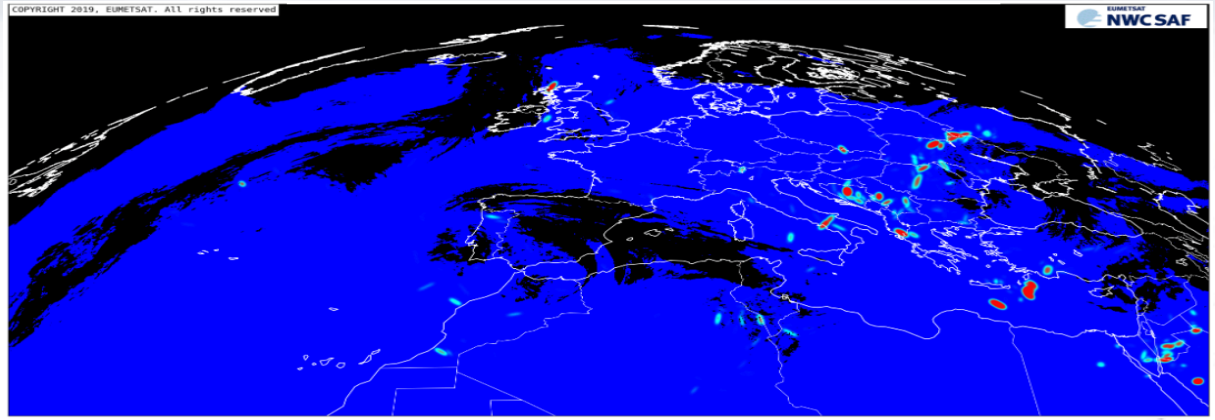
➔ Probability of a "cloudy pixel" to become a thunderstorm in 15-60 minutes.

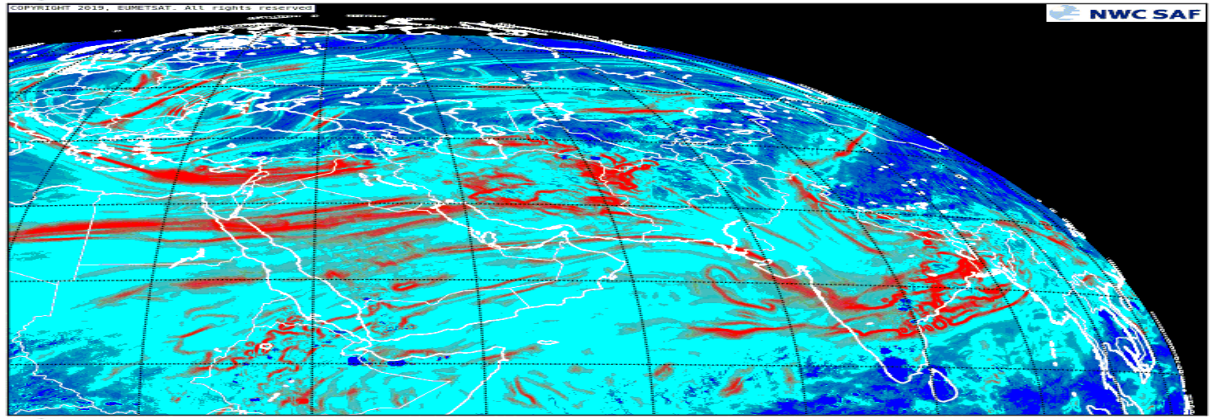
RDT – Rapid Developing Thunderstorms (up right) monitors and tracks each "convective cell":

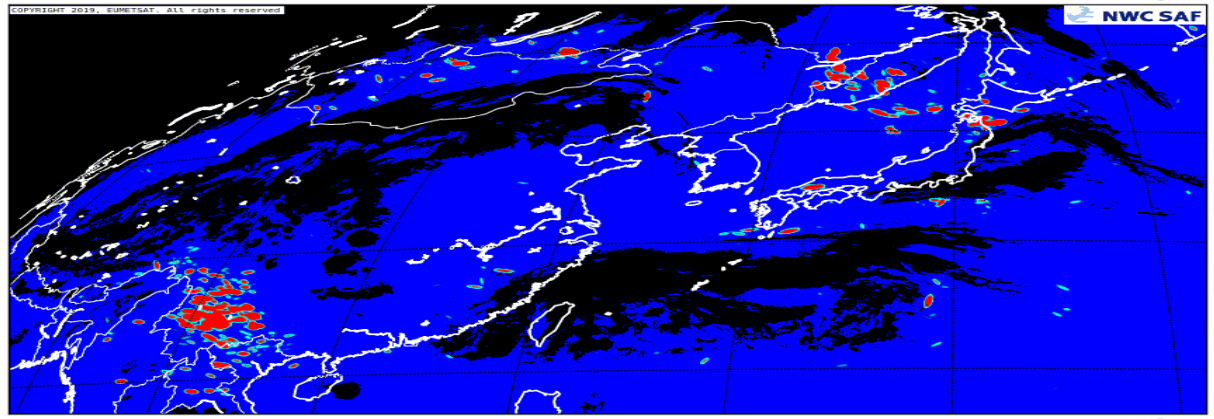
➔ Trend, displacement, severity, convectivity, rainfall/lightning activity, temperature, pressure,...

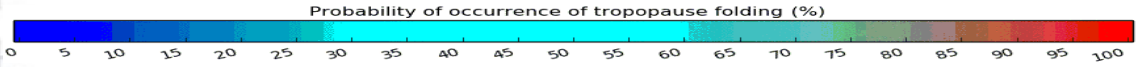
NWC/GEO Turbulence: Tropopause folding & Waves

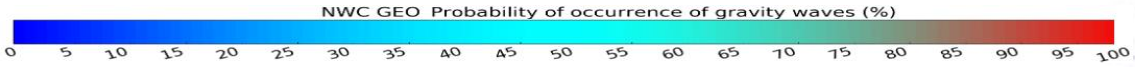










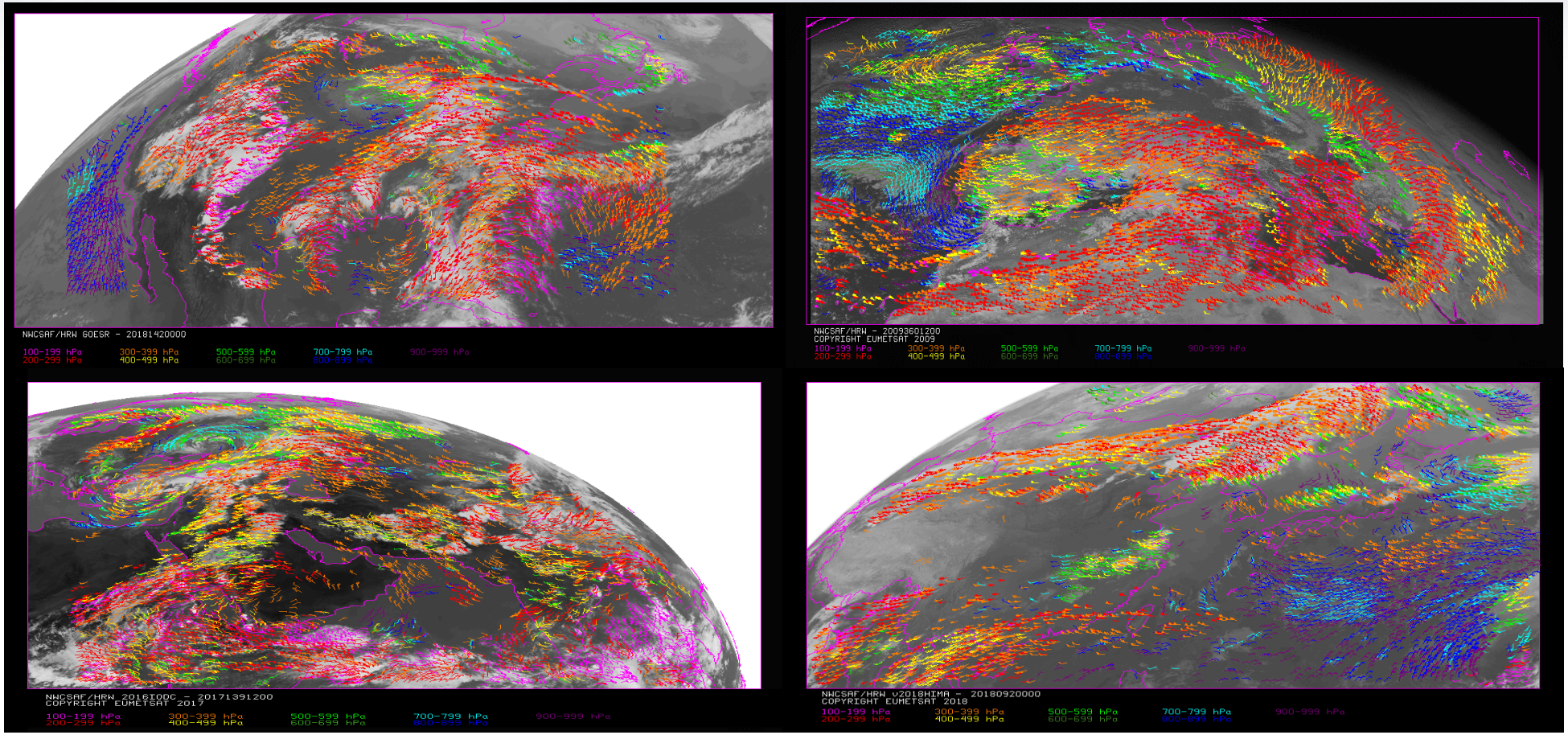


Two products related to "Clear air turbulence (CAT)" and relevant for aviation users:

ASII-TF – Tropopause folding (left), with downward intrusion of stratospheric air in the troposphere.

ASII-GW – Gravity/Mountain waves (right).

NWC/GEO Winds



Cases here for different moments, showing the maximum densities of AMVs

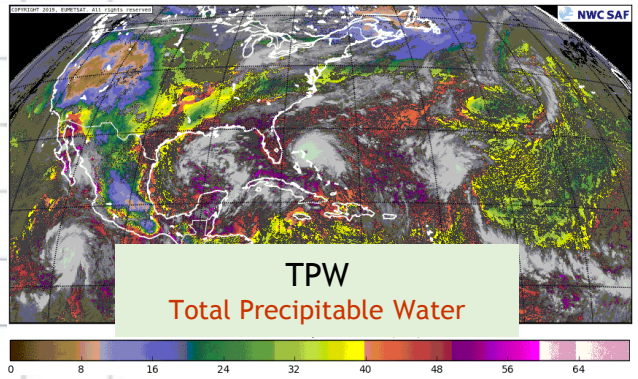
HRW – High Resolution Winds. "Atmospheric Motion Vectors (AMVs)" and "Trajectories".

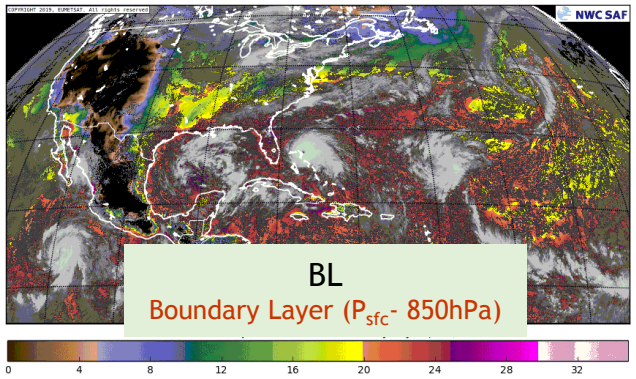
- Wind observations at all tropospheric levels, and especially over oceans and remote areas.
- Validated for all satellite series (MSG, Himawari-8/9, GOES-13/15, GOES-16) with equivalent results.

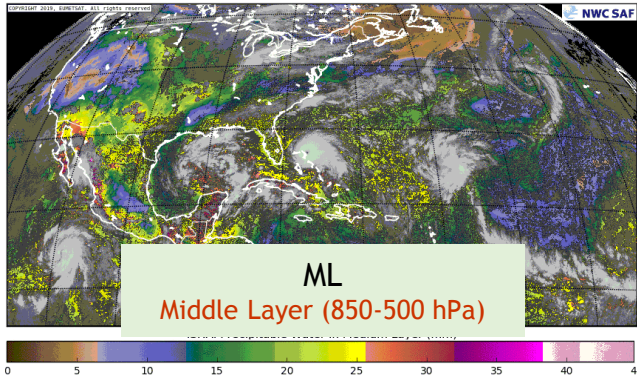
NWC/GEO Clear Air Humidity and Instability

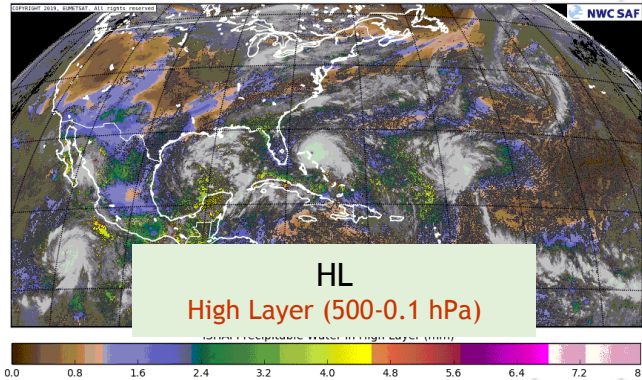
iSHAI – imaging Satellite Humidity and Instability. Provides for "clear air pixels":

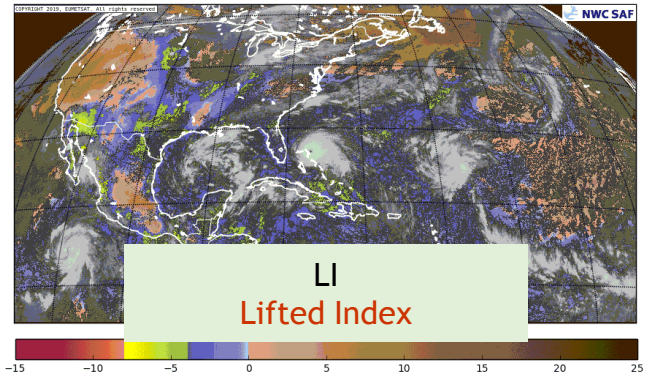
- **Precipitable water** for Total column, and for Boundary Layer, Medium Layer and High Layer.
- **Instability indices**: LI, KI, Showalter.

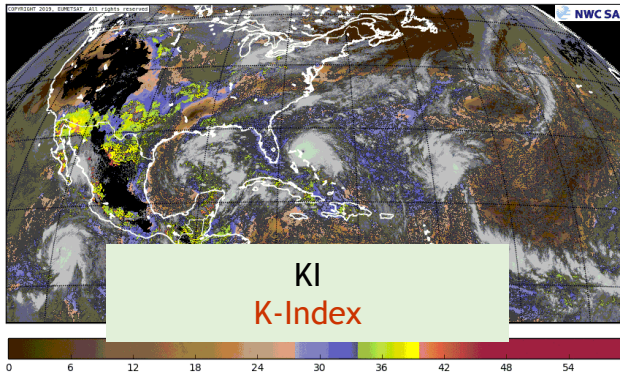


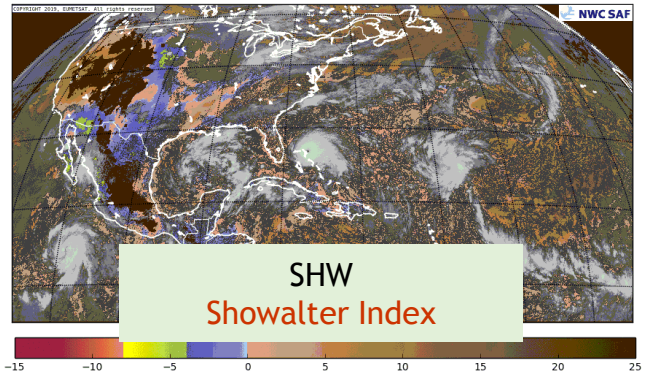












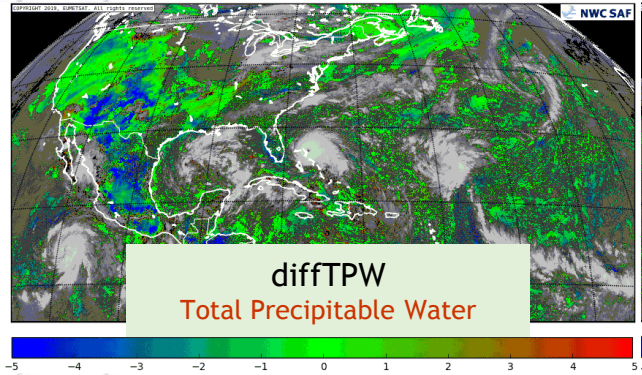
(Examples shown for 1 September 2019 16:30 UTC with GOES-16, when Hurricane Dorian made landfall in Bahamas)

NWC/GEO Clear Air Humidity and Instability

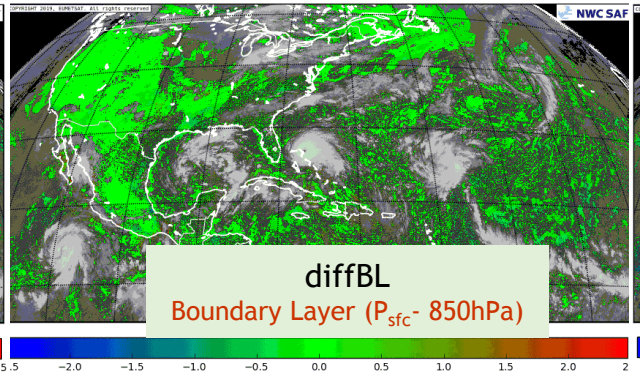
iSHAI – imaging Satellite Humidity and Instability.

- Difference fields between iSHAI products and the background NWP also provided,

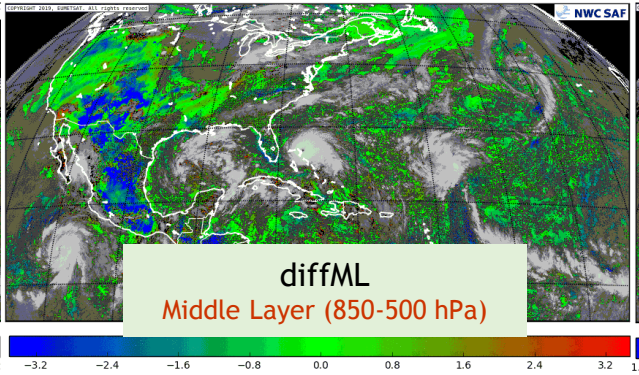
helpful for the detection of forecast elements not seen by the NWP model



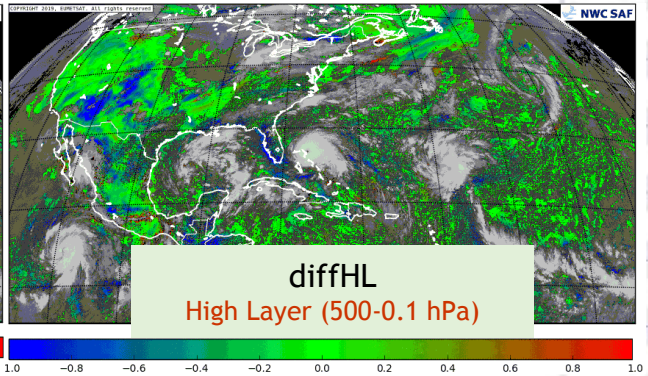
diffTPW
Total Precipitable Water



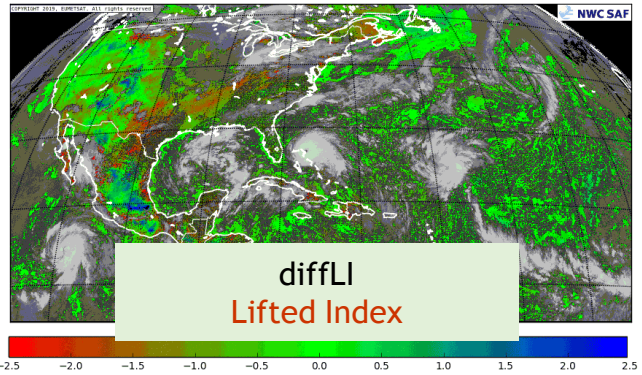
diffBL
Boundary Layer (P_{sfc}- 850hPa)



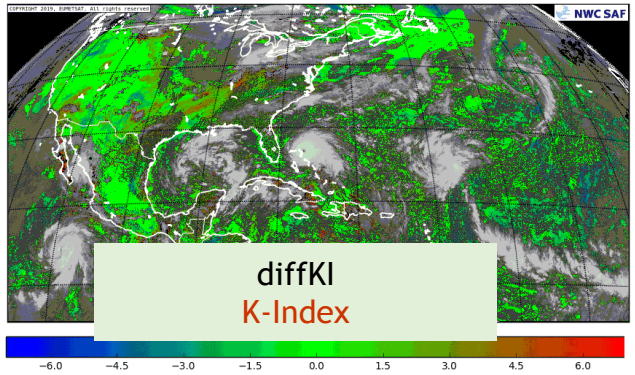
diffML
Middle Layer (850-500 hPa)



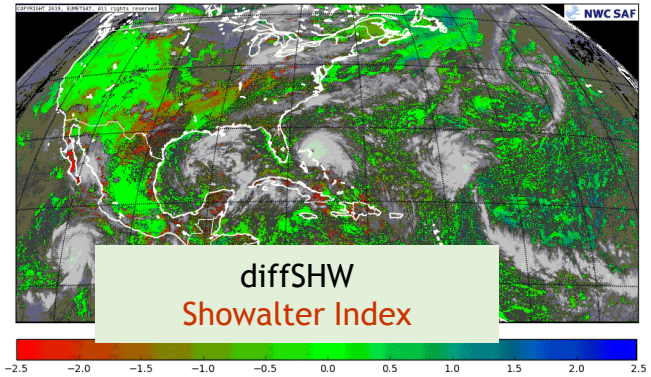
diffHL
High Layer (500-0.1 hPa)



diffLI
Lifted Index



diffKI
K-Index



diffSHW
Showalter Index

(Examples shown for 1 September 2019 16:30 UTC with GOES-16, when Hurricane Dorian made landfall in Bahamas)

NWC/GEO Extrapolated Imagery

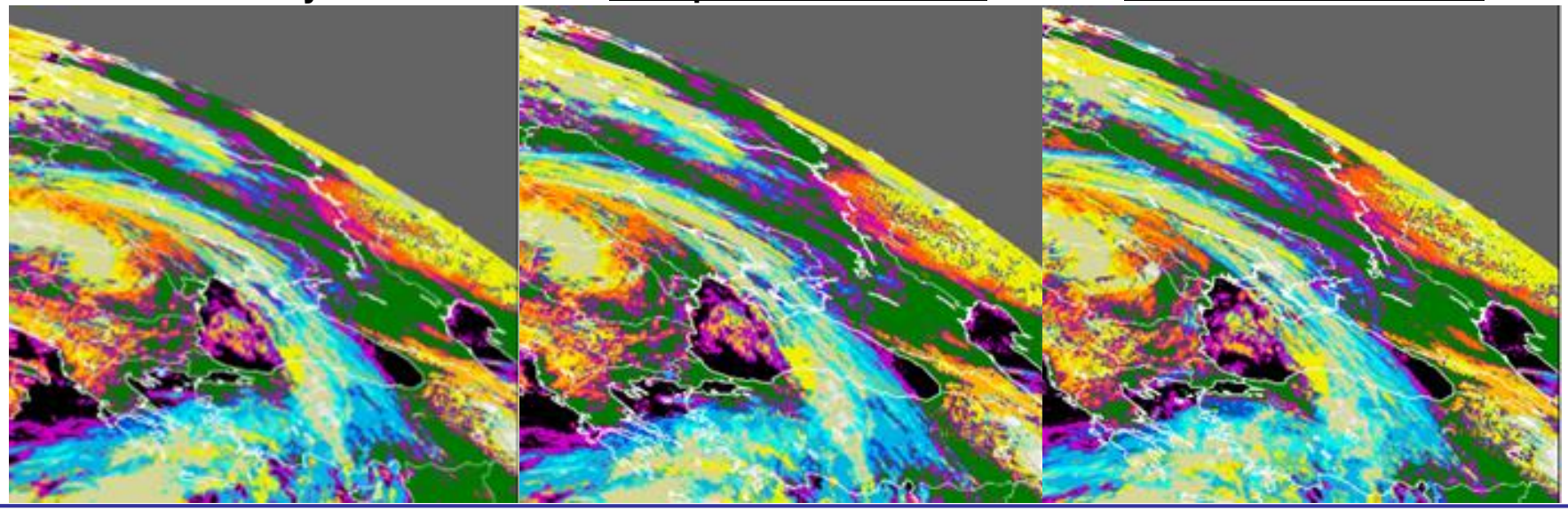
EXIM – Extrapolated Imagery

- **Kinematic extrapolation up to 1 hour of satellite images and NWCSAF Cloud & Precipitation products.**
- **Possible for all satellites;**

an example of NWC/GEO Cloudy Type EXIM output with MSG-4 satellite shown here:

Extrapolation compared to Observation

Observation 21/May/2019 09:00Z | **Extrapolation for 10:00Z** | **Observation for 10:00Z**



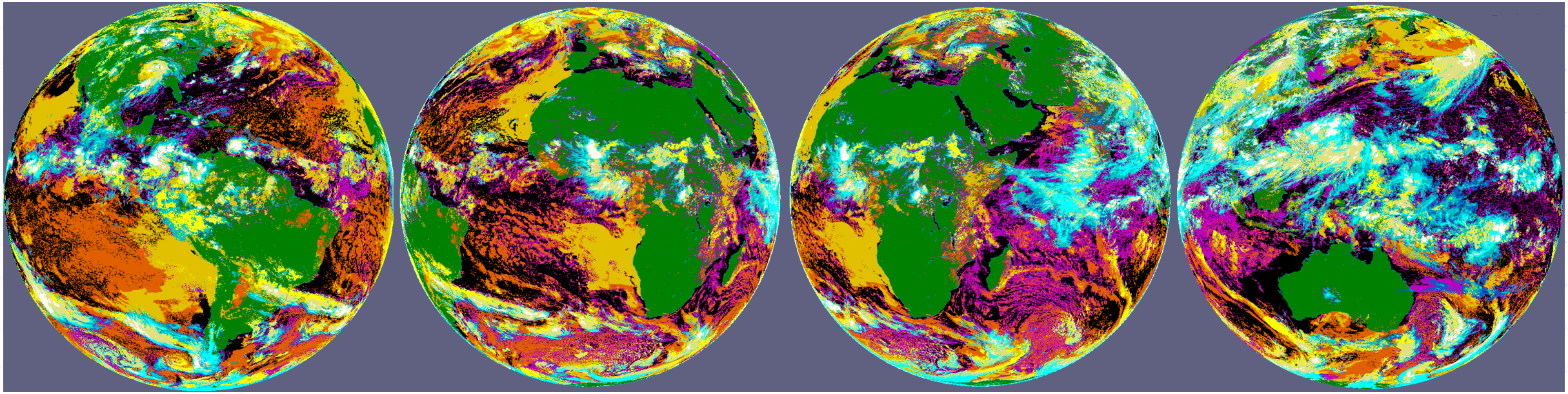
NWC/GEO Usability in all satellite regions

The region where NWC/GEO products are calculated is fully configurable

inside the full satellite disk, for MSG, Himawari-8/9 and GOES-16 satellites.

The option is available to calculate NWC/GEO v2018.1 products globally or in a specific location

(taking into account the gap existing for the moment with GOES-17 satellite).



(Example of NWC/GEO Cloud Type for all regions, 15 Jul 2019 at 09:00 UTC)

NWC/GEO Software use

In case of interest to use NWCSAF software packages:

➔ All National Meteorological Services
within Eumetsat Member/Cooperating States
are automatically considered potential users.

➔ Other Organisations and Individuals may also apply to
become users of NWCSAF software packages.

All applicants have become NWCSAF users without restrictions up to now, with:

> 240 users from all around the world (Europe, Africa, Americas, Asia, Oceania)

All types of institutions:

- National Meteorological Services
- Universities
- Research institutions
- Public service providers
- Public and private companies

NWC/GEO Software installation

Software Delivery is authorized to users through the Licence Agreement,
to be signed by EUMETSAT (represented by AEMET) and the applicant User.

Once the Licence Agreement is signed,
Access Credentials to the "NWCSAF Help Desk" Restricted Area are provided,
where the NWCSAF software packages can be downloaded:

nwc-saf.eumetsat.int

The installation takes then only 3 steps, which need less than ONE HOUR to be ready:

+ Download and decompress the software files
  (2 different software tar files + 1 Auxiliary dataset for each satellite used).
+ Update a few variables in the ".profile file".
+ Run the installation command.

Nothing else is needed. All software/libraries/additional elements to run and visualize NWCSAF NWC/GEO software package are installed and ready to run with this!

NWC/GEO Software installation

Hardware resources needed to run NWC/GEO Software package are small and relatively easy to obtain:

Environments used for development/testing of NWC/GEO v2018 software package.

	Environment used for development and testing	Environment used for testing
Operative System	Linux RHEL release 6.4 (Santiago)	Ubuntu 18.04.1 LTS
CPU	4 x Intel® Core™ CPU i5-4590 @ 3.30 Ghz	8 x Intel® Xeon ® CPU E5-2650 v3 @ 2.30 Ghz
Architecture	x86_64	x86_64
Memory	16 GB	16 GB
Disk	500 GB	500 GB
Shells	bash; ksh	sh; ksh
Compilers	GCC compilers 4.4.7 gcc; g++; gfortran	GCC compilers 7.3.0 gcc; g++; gfortran
gzip	gzip 1.3.12	gzip 1.6
make	GNU Make 3.81	GNU Make 4.1

Other environments like SUSE and Debian are not officially supported, but some NWCSAF users have also tested them successfully.

Conclusions

NWC/GEO software has been extended to geostationary satellites all around the world (MSG, Himawari-8/9, GOES-13/16).

It can be useful for many meteorological applications in all regions in National Meteorological Services, Universities, Public and private institutions,…

Registering as NWCSAF users and downloading the software is so suggested.

Contact me today afterwards for any additional doubt/question on

- NWCSAF and NWC/GEO software package.
- How to get it and install it.
- How to run and visualize its products.

More information can also be obtained:

- Through the NWCSAF website: nwc-saf.eumetsat.int
- Through the email address: safnwchd@aemet.es