The NWCSAF/GEO software package for the MSG/IODC satellite service

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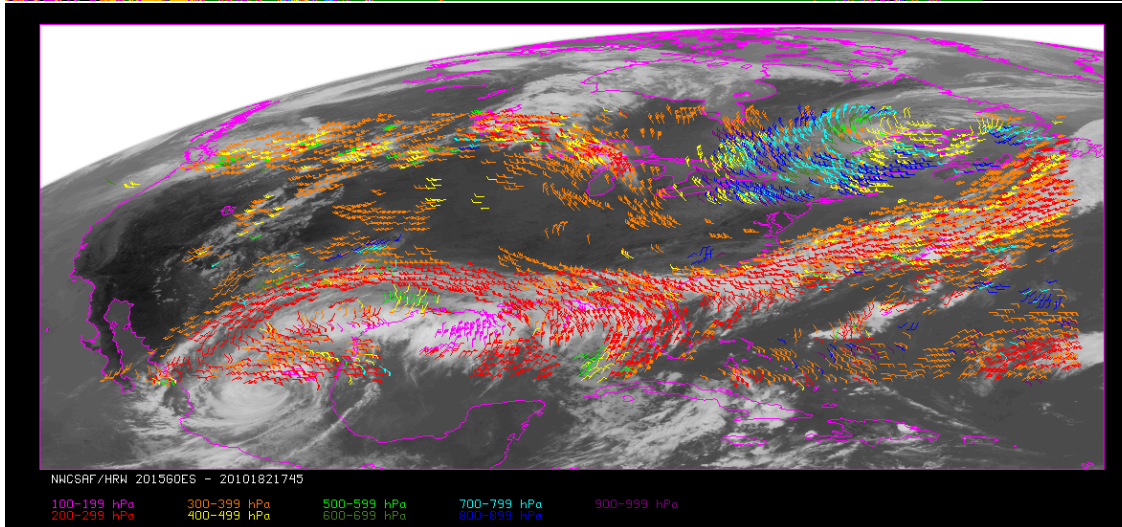
About the NWC SAF

- The <u>Satellite Application Facility on support to Nowcasting (NWC SAF)</u> is a **Consortium** between **Eumetsat** and several **Nat. Met. Services**:
  - AEMET – Agencia Estatal de Meteorología (Spain)
  - Météo France
  - SMHI – Meteorological and Hydrological Institute (Sweden)
  - ZAMG – Central Institute for Meteorology and Geodynamics (Austria)
  - NMA – National Meteorological Administration (Romania).

- Its main <u>objective</u> is:
  - To **provide operational services to enhance** the Nowcasting and Very short range Weather forecasting.
  - This is **achieved by**
    - i) **Developing/maintaining software packages** calculating in real time Meteorological products from Geostationary/Polar satellite data.
    - ii) **Supporting users** on their production and use.

About the NWC SAF

- **The latest NWCSAF geostationary software package (NWC/GEO v2016) is able to calculate its products:**
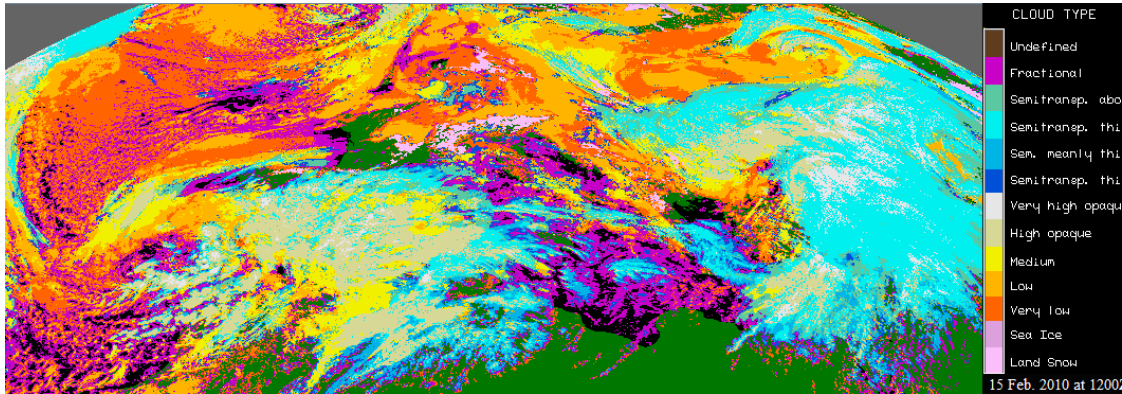
with MSG
satellite series

with GOES-13/14/15
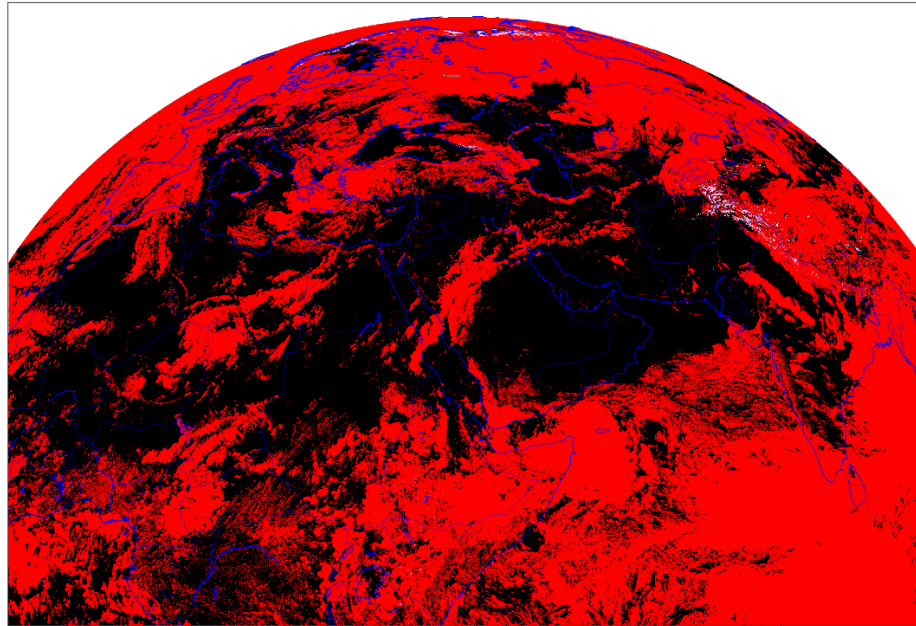satellite series
(Clouds and Winds
products)

About the NWC SAF

- With the new **MSG-1/IODC service**, **operational since February 2017**, all NWC/GEO v2016 products can be calculated in this new area, extending the use of NWC/GEO software to:
  - **Western half of Russia**
  - **The whole Middle East**
 - **Indian Subcontinent, Tibet, Western Indochina**.
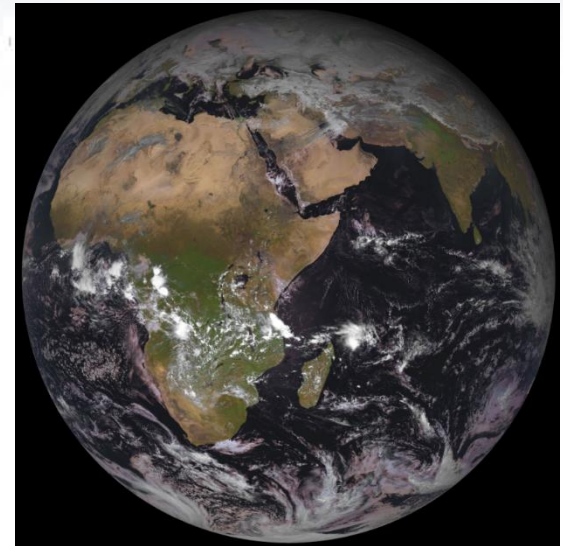
➔ **Through this presentation, with examples for 29 May 2017 12:00Z for all products, users of meteorological satellite data in these areas can know what they can do with NWC/GEO software**

NWC/GEO Clouds: CMa

S_NWC_CMA_MSG1_India-VISIR_20170529T120000Z
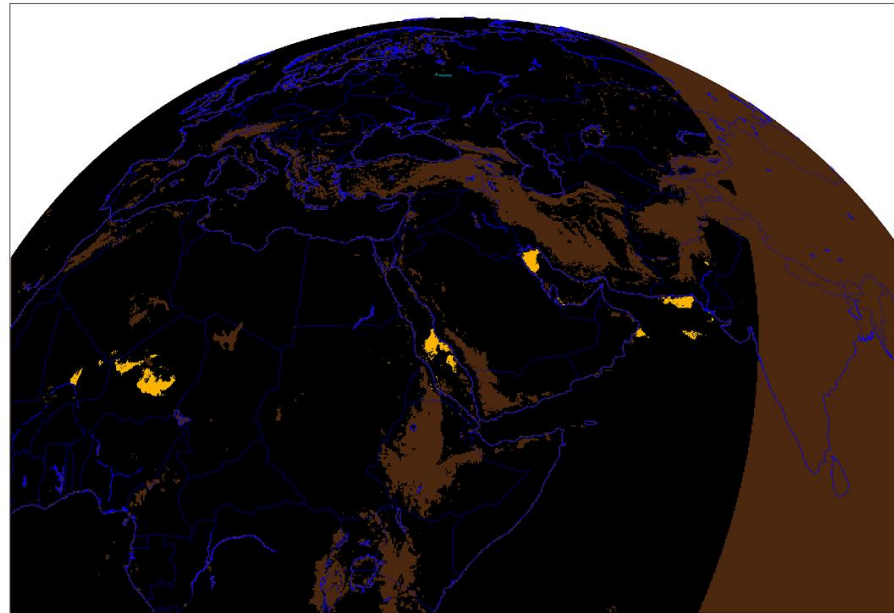
NWC GEO CMA Cloud and Snow Mask

Cloud free | Cloud (except thin ice over snow) | Thin ice clouds over snow/ice | Snow/ice
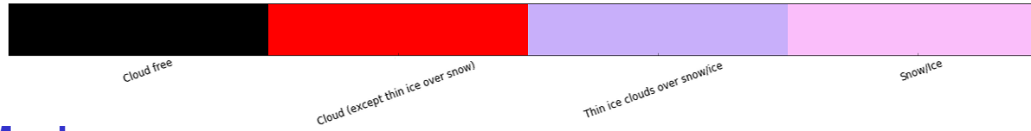
CMa – Cloud Mask

- **Product for Cloud detection**.
- **Also for Snow detection** during daytime.

NWC/GEO Clouds: CMa

S_NWC_CMA_MSG1_India-VISIR_20170529T120000Z

NWC GEO CMA Dust Detection

| No dust | Dust | Undefined |
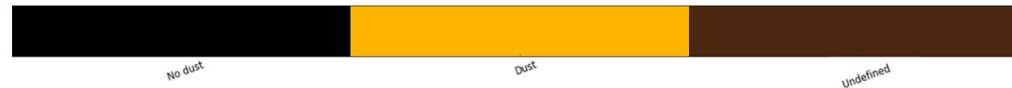
CMa – Cloud Mask

- **Flags for "Dust cloud" and "Volcanic ash"**

  also provided, except at twilight.

NWC/GEO Clouds: CT

S_NWC_CT_MSG1_India-VISIR_20170529T120000Z

NWC GEO CT Cloud Type
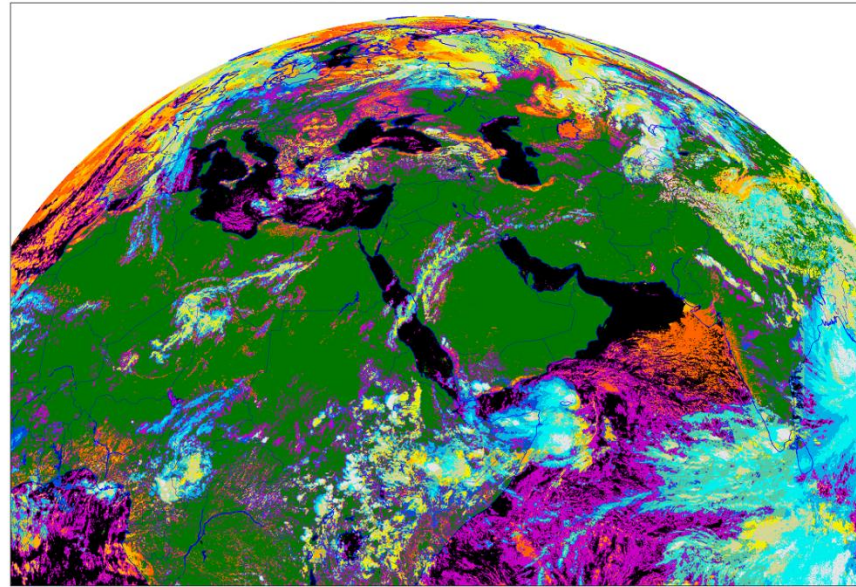
Cloud-free land | Cloud-free sea | Snow over land | Sea ice | Very low clouds | Low clouds | Mid-level clouds | High opaque clouds | Very high opaque clouds | Fractional clouds | High semitransparent thin clouds | High semitransparent meanly thick clouds | High semitransparent thick clouds | High semitransparent above low or medium clouds | High semitransparent above snow/ice
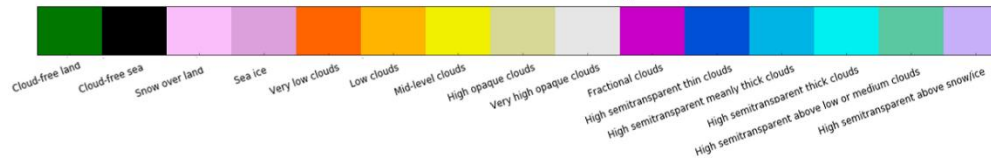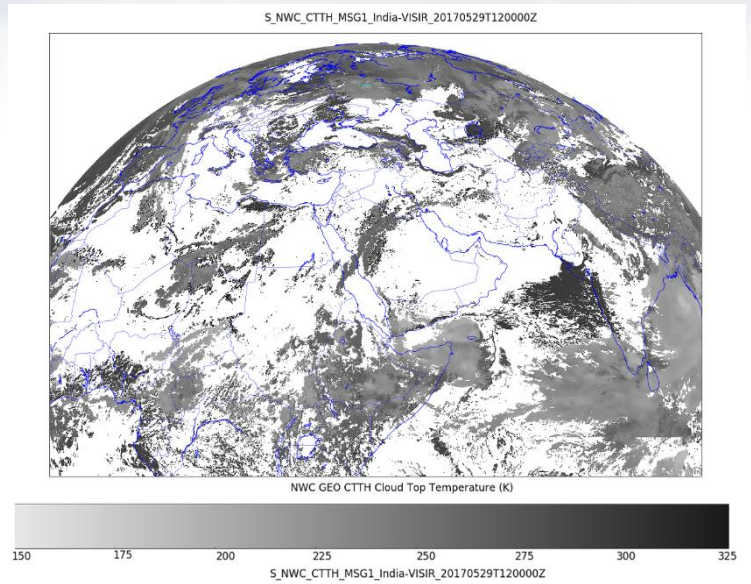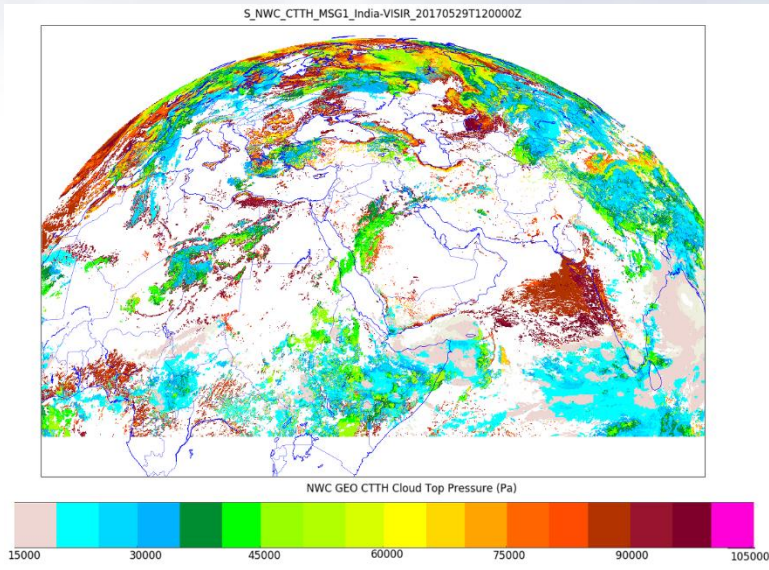
CT – Cloud Type

• **Product for a cloud classification,**
based on the "opacity/transparency of the cloud"
and the "level of the cloud top"
(f.ex. "Cb" classified as "high opaque cloud").

NWC/GEO Clouds: CTTH

S_NWC_CTTH_MSG1_India-VISIR_20170529T120000Z

NWC GEO CTTH Cloud Top Pressure (Pa)

15000 30000 45000 60000 75000 90000 105000

S_NWC_CTTH_MSG1_India-VISIR_20170529T120000Z

NWC GEO CTTH Cloud Top Temperature (K)

150 175 200 225 250 275 300 325

S_NWC_CTTH_MSG1_India-VISIR_20170529T120000Z

NWC GEO CTTH Cloud Top Altitude (m)

0 3000 6000 9000 12000 15000
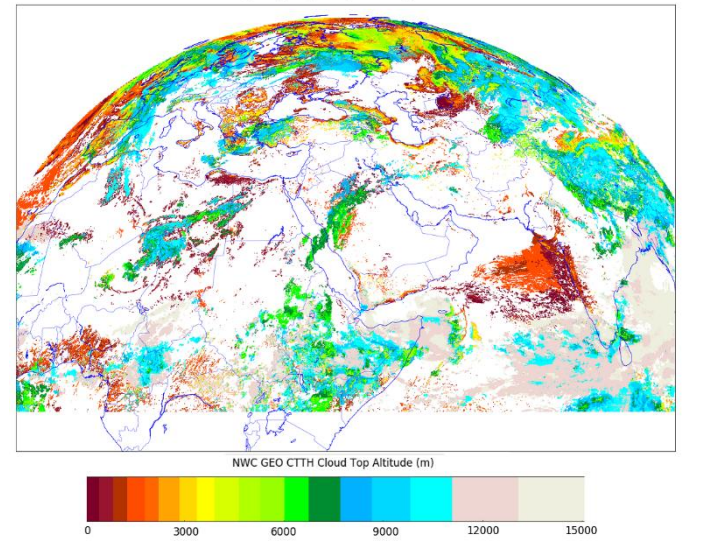
CTTH – Cloud Top Pressure (left), Temperature (right) and Height (down).
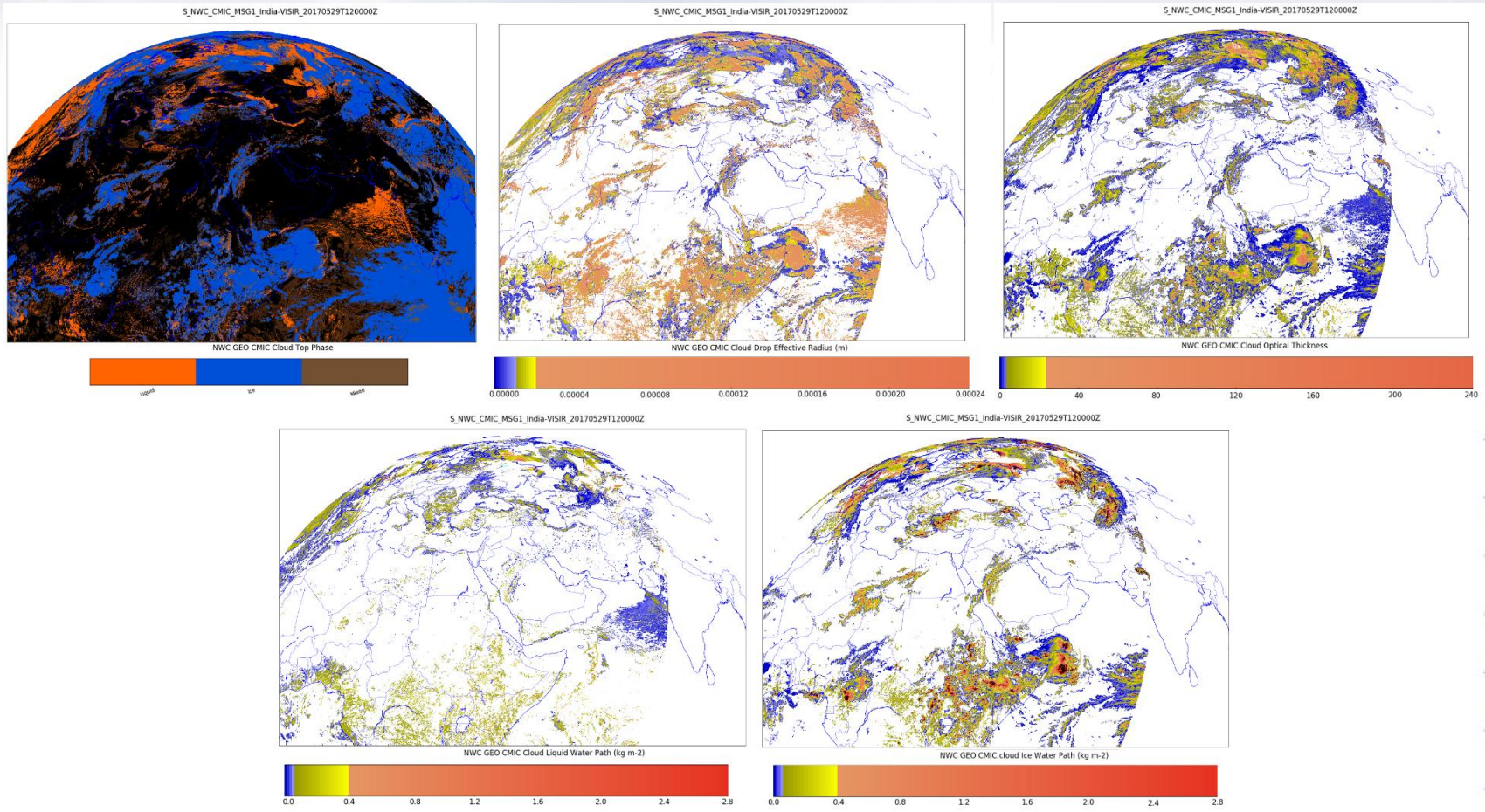
NWC/GEO Clouds: CMIC
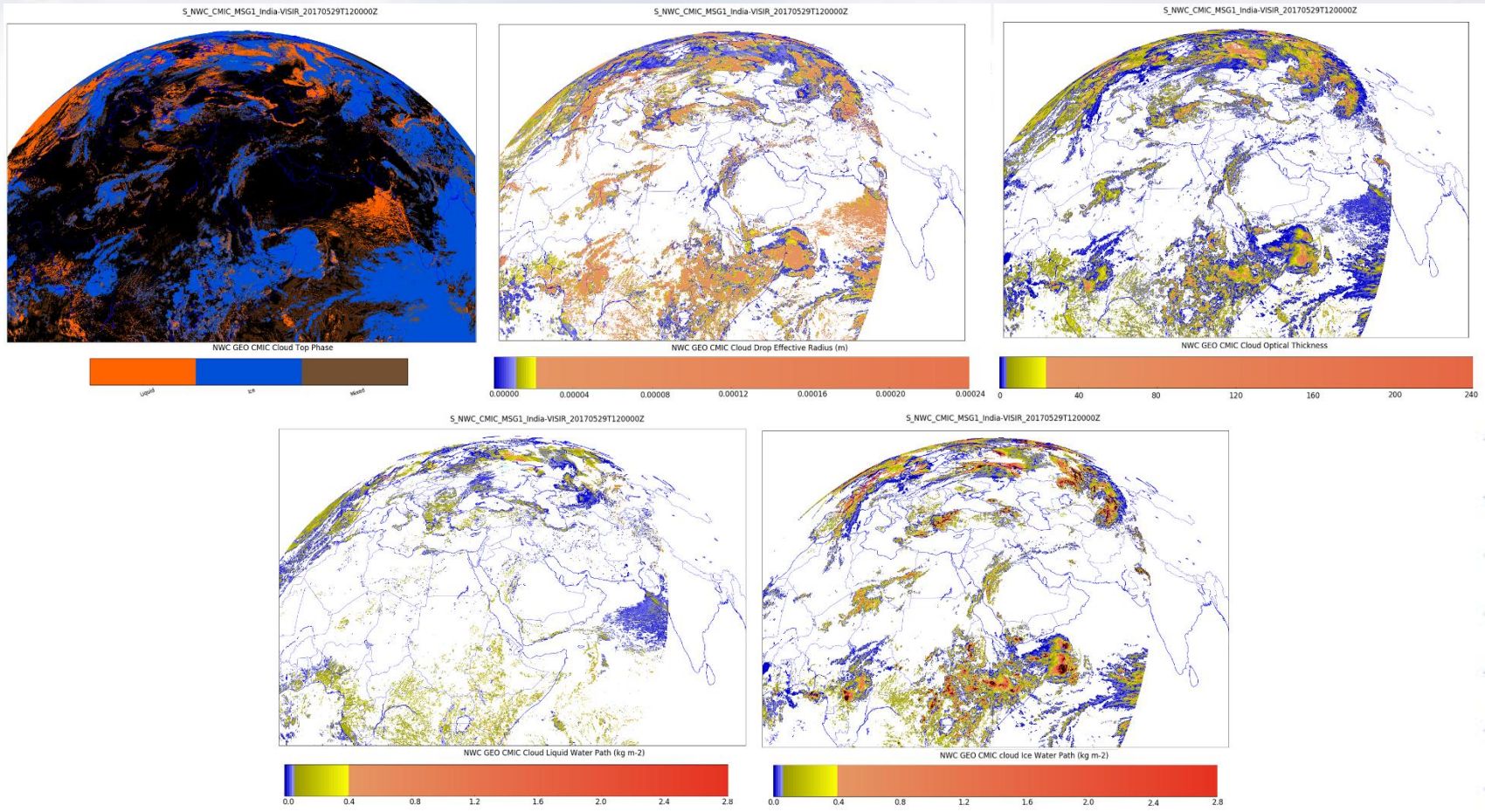
CMIC - Cloud Microphysics, providing next parameters:

"Cloud phase" (up left), "Effective radius" (up centre), "Cloud optical thickness" (up right),

"Liquid water path" (down left), "Ice water path" (down right)

NWC/GEO Clouds: CMIC

CMIC - Cloud Microphysics

- **Only "Cloud phase" parameter available**
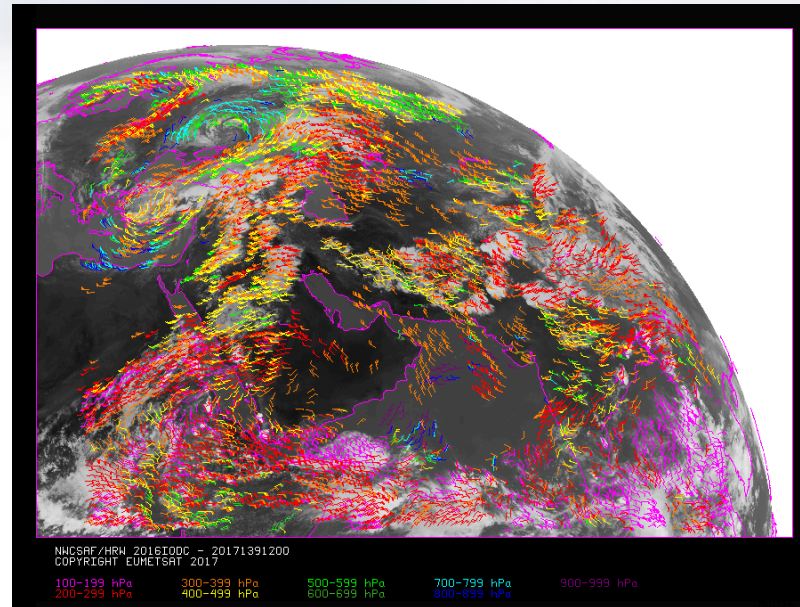 **for night, twilight, and mixed/undefined phase.**

NWC/GEO Clouds

NWC/GEO Cloud products

have specifically been tuned and validated

for MSG1 satellite in the IODC service.

➜ **For more information on this,**

please consider the following talk by Gaëlle Kerdraon (Météo France):

"Meteosat-8, an opportunity for NWC SAF Cloud products over Indian Ocean"

NWC/GEO Winds: HRW

NWCSAF/HRW 2016IODC – 20171391200
COPYRIGHT EUMETSAT 2017

100-199 hPa   300-399 hPa   500-599 hPa   700-799 hPa   900-999 hPa
200-299 hPa   400-499 hPa   600-699 hPa   200-299 hPa

HRW – High Resolution Winds

- Calculates "Atmospheric Motion Vectors" and "Trajectories",
  used as an important source of wind observations over oceans and remote areas.

These data can be used through:
 - Assimilation in Meteorological applications.
 - Direct use in operational nowcasting:
    * The monitoring and watch of dangerous wind situations.
    * The verification of the general circulation, small scale wind and wind singularities.

NWC/GEO Winds: HRW

NWC/GEO High Resolution Winds product has been **validated** in the period May-Aug 2017 in the new regions covered by IODC service (Russia, Middle East, Indian Subcontinent):

| GEO-HRW-v2016 AMVs (May – Aug 2017 IODC)	Cloudy HRVIS	Cloudy VIS06	Cloudy VIS08	Cloudy WV62	Cloudy WV73	Cloudy IR108	Cloudy IR120	Clear Air	All AMVs
N	5672	32404	26558	99237	124270	113839	115579	41587	559146
SPD [m/s]	16.52	10.59	10.62	19.68	17.64	15.64	15.79	15.92	16.33
NBIAS (ALL LAYERS)	-0.00	-0.14	-0.14	-0.03	-0.09	-0.09	-0.08	-0.08	-0.07
NMVD (100-1000 hPa)	0.27	0.36	0.36	0.29	0.31	0.32	0.32	0.36	0.32
NRMSVD	0.33	0.45	0.44	0.35	0.38	0.39	0.39	0.45	0.39

Comparing with the validation in the European region (MSG2, Jul 2009 – Jun 2010):

GEO-HRW-v2016 AMVs (Jul 2009-Jun 2010 Europe)	Cloudy HRVIS	Cloudy VIS06	Cloudy VIS08	Cloudy WV62	Cloudy WV73	Cloudy IR108	Cloudy IR120	Clear Air	All AMVs
N	31630	97221	87177	256951	331831	313072	317120	48509	1483511
SPD [m/s]	16.64	10.51	10.48	22.78	20.80	18.53	18.67	16.64	18.70
NBIAS (ALL LAYERS)	-0.04	-0.14	-0.15	-0.04	-0.07	-0.09	-0.08	-0.00	-0.08
NMVD (100-1000 hPa)	0.29	0.41	0.42	0.26	0.28	0.29	0.29	0.32	0.30
NRMSVD	0.35	0.49	0.49	0.32	0.35	0.35	0.35	0.39	0.36

- **Differences in error parameters smaller than a 15%, sometimes with decreases (VIS channels), sometimes with increases (IR/WV channels).**

- **AMVs inside the "target accuracy threshold".**

   ➔ **So, using NWC/GEO High Resolution Winds with MSG-1/IODC service is fully justified.**
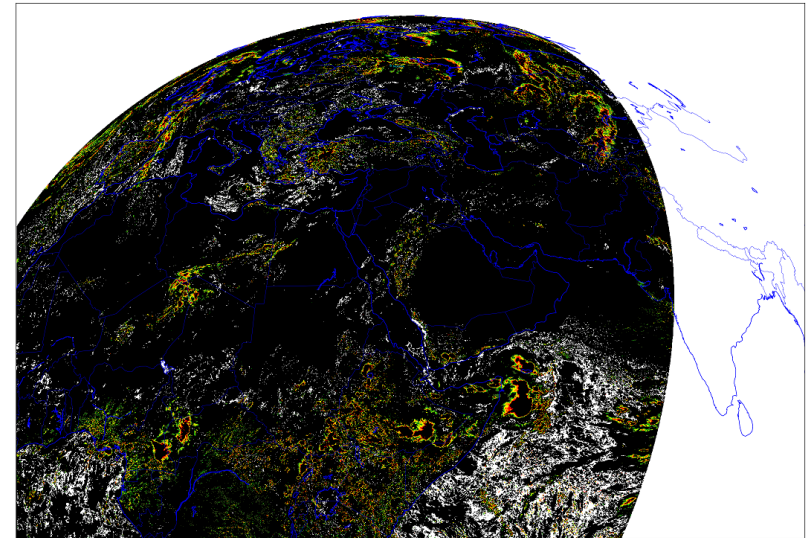
NWC/GEO Precipitation: PC, PCPh

S_NWC_PC_MSG1_India-VISIR_20170529T120000Z
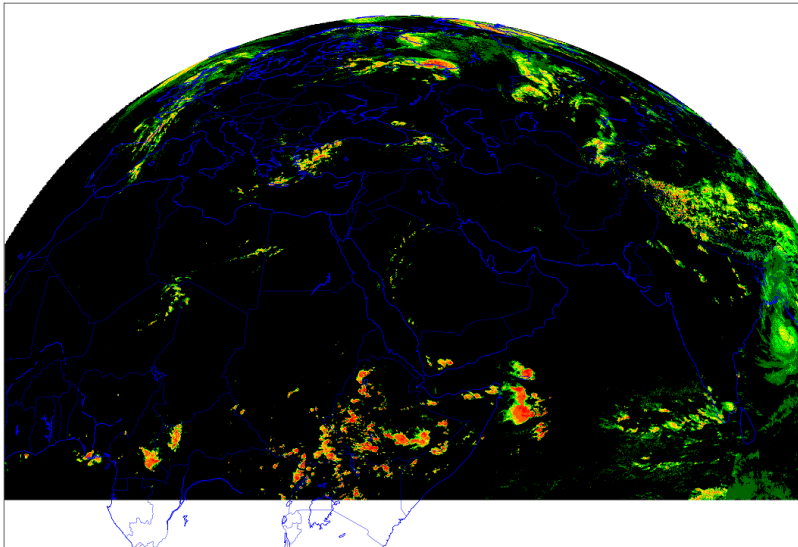
NWC GEO PC Total Precipitation Likelihood Class

S_NWC_PC-Ph_MSG1_India-VISIR_20170529T120000Z

NWC GEO PC-Ph Precipitating Clouds

PC – Precipitating Clouds (left) and

PCPh – Precipitating Clouds based on Cloud Microphysics (right)

provide the "Probability of precipitation" for all kinds of precipitation,

although they work better for convective precipitation.

- **The second product (PCPh) is a better product,** but it is only available during day.

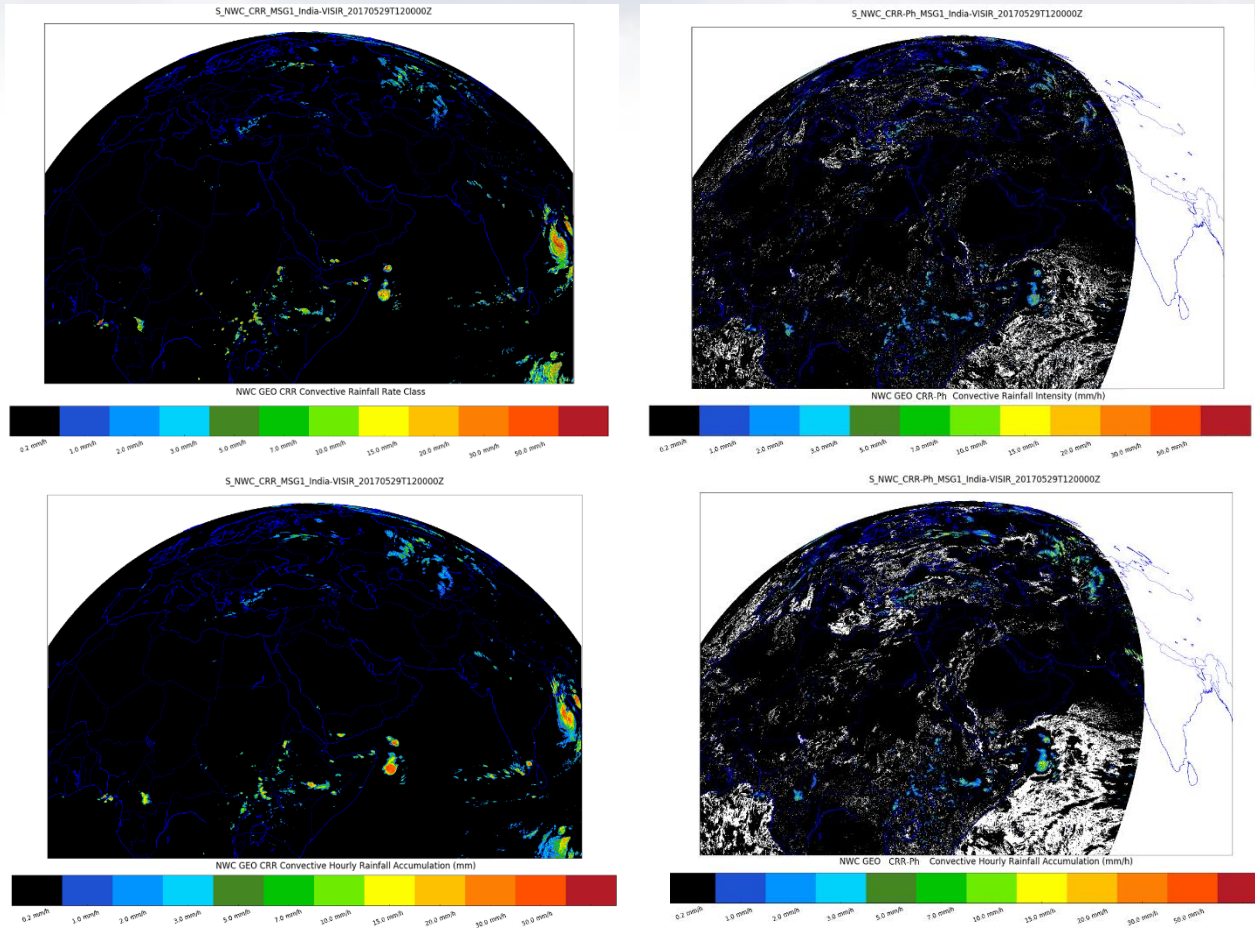# NWC/GEO Precipitation: CRR, CRPh
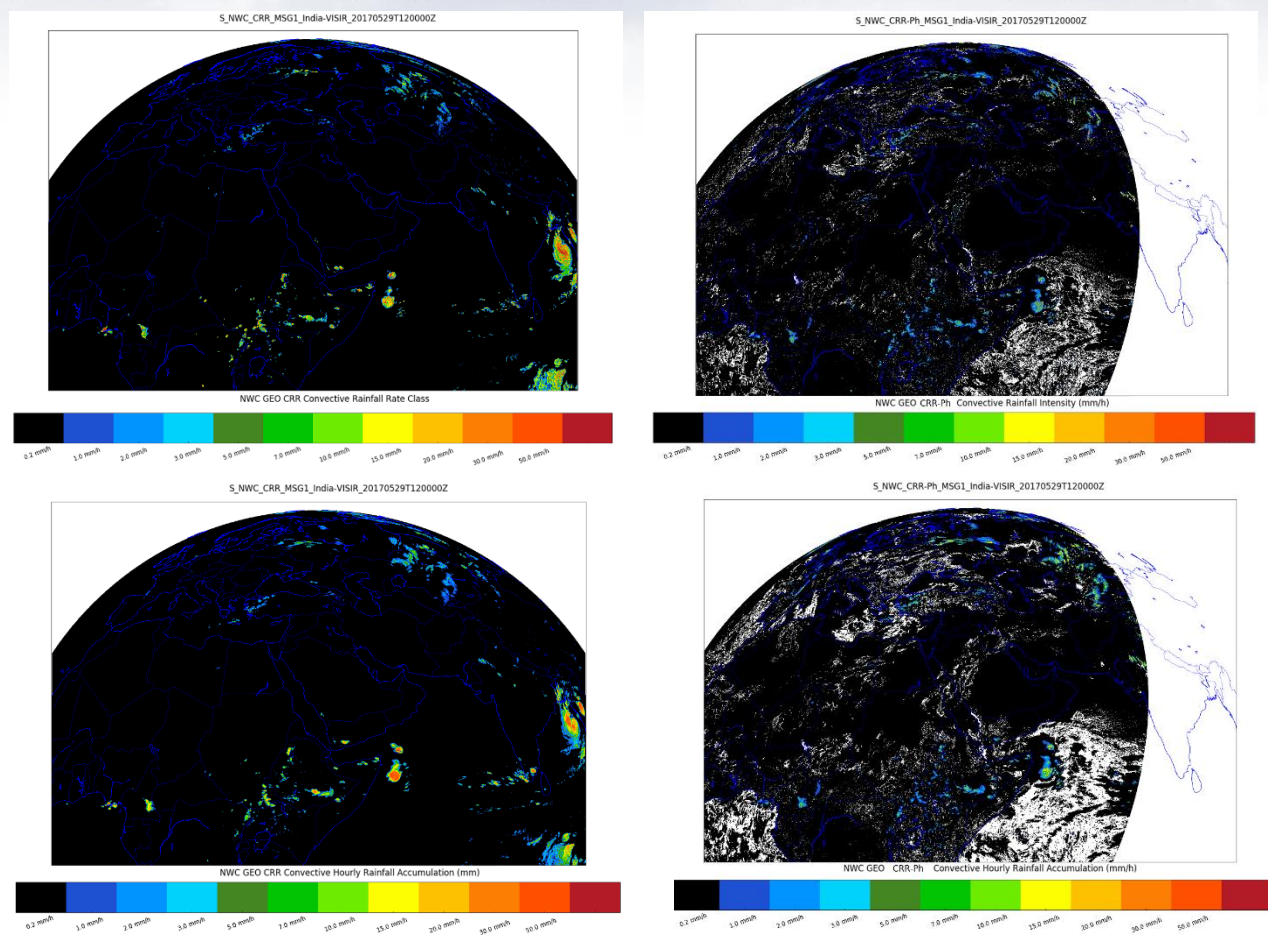
CRR – Convective Rainfall Rate (left) and

CRPh – Convective Rainfall Rate Clouds based on Cloud Microphysics (right)

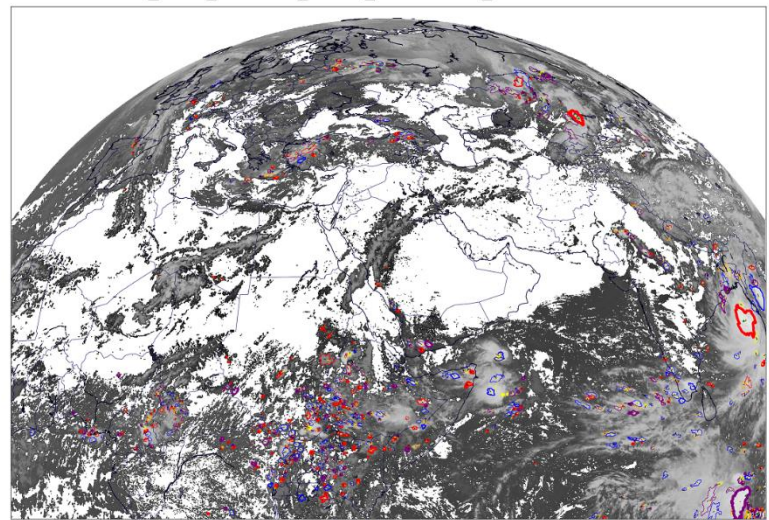provide "Instant values of precipitation" (up) and "Hourly values of precipitation" (down)

NWC/GEO Precipitation: CRR, CRPh

- **Values are only suitable for convective situations.**

- **The second product (CRPh) is a better product,** but it is only available during day.
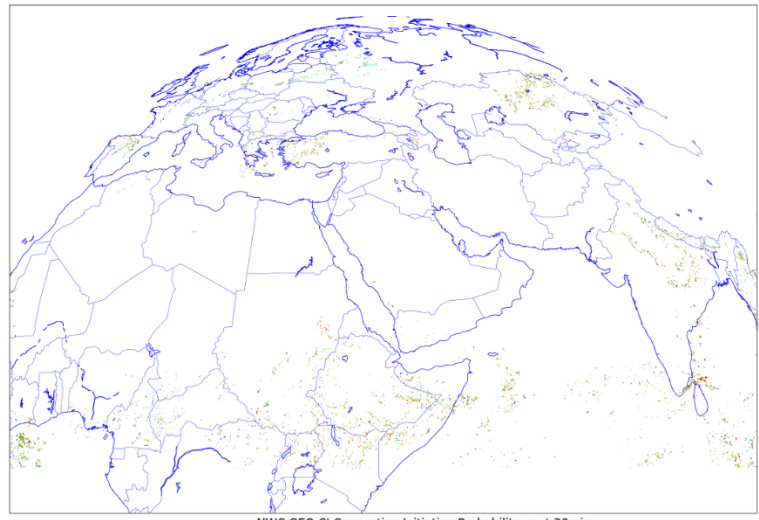
NWC/GEO Convection: RDT, CI

RDT - Rapid Developing Thunderstorms (left)

identifies, monitors and tracks each "Convective cell" with many properties

➔ Trend, displacement, severity, convectivity, rainfall and lightning activity, temperature, pressure,…

CI – Convection Initiation (right)

defines the probability of a Cloudy pixel to become a thunderstorm
in a period later in the future (30 minutes).

NWC/GEO Clear Air: iSHAI

iSHAI – imaging Satellite Humidity and Instability product
provides in Clear air pixels, and based on
Satellite Observations, First Guess Regressions & Physical Retrieval

Humidity fields (TPW and precipitable water for the Boundary/Medium/High layer).
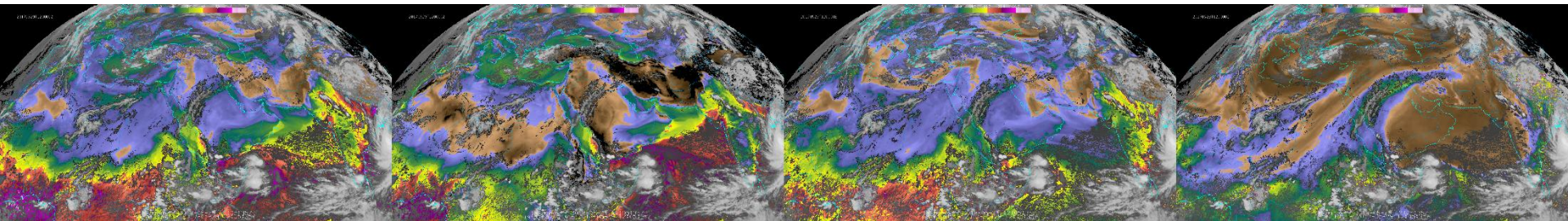
TPW	BL	ML	HL
Total Precipitable Water	Boundary Layer (P_{sfc}- 850hPa)	Middle Layer (850-500 hPa)	High Layer (500-0.1 hPa)

2017/05/29 12:00Z   **Stability indices: LI, Showalter, KI (left, centre, right)**

LI	SHW	KI
Lifted Index	Showalter Index	K-Index

NWC/GEO Clear Air: iSHAI

Difference fields between iSHAI products and the background NWP model
are also provided, and they will help very much
for the detection of elements of the forecast not detected by the NWP model.

Humidity fields (TPW and precipitable water for the Boundary/Medium/High layer).

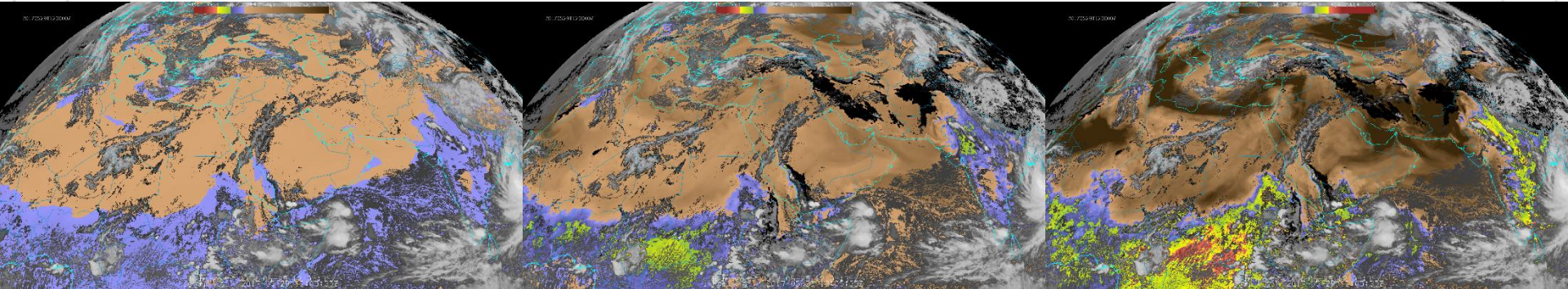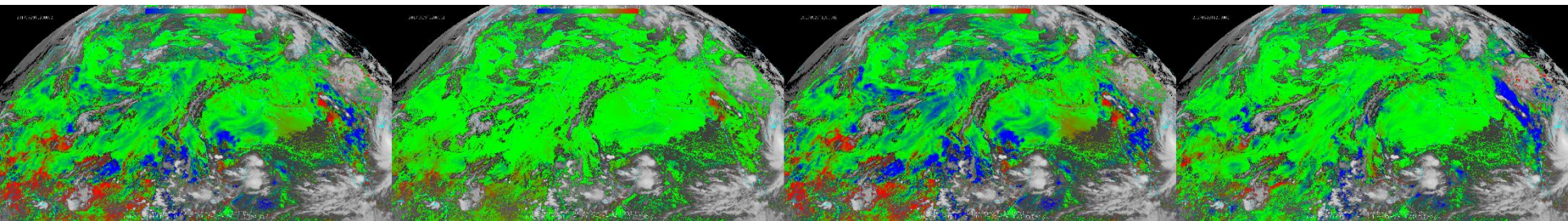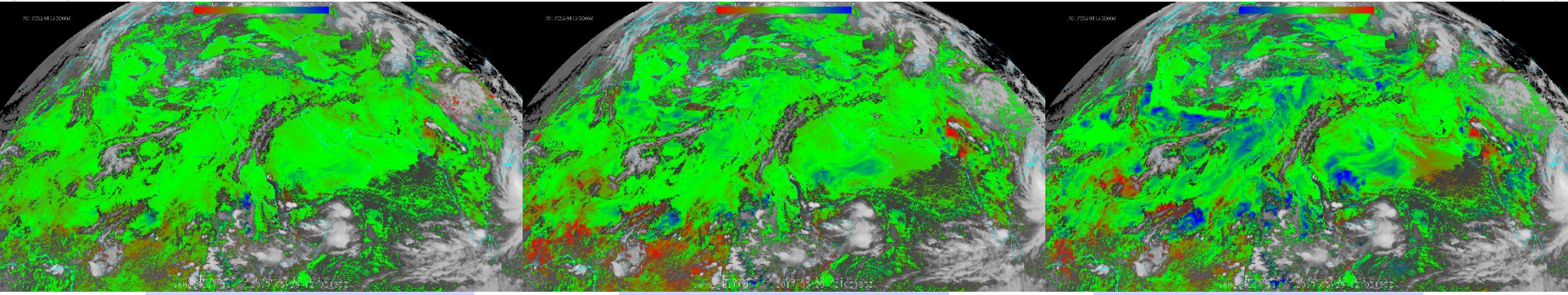| diffTPW	diffBL	diffML	diffHL
Total Precipitable Water	Boundary Layer (P$_{sfc}$- 850hPa)	Middle Layer (850-500 hPa)	High Layer (500-0.1 hPa)

2017/05/29 12:00Z

Stability indices: LI, Showalter, KI (left, centre, right)

diffLI	diffSHW	diffKI
Lifted Index	Showalter Index	K-Index

NWC/GEO Image Interpretation: ASII & ASII-NG

S_NWC_ASII-NG_MSG1_India-VISIR_20170529T120000Z
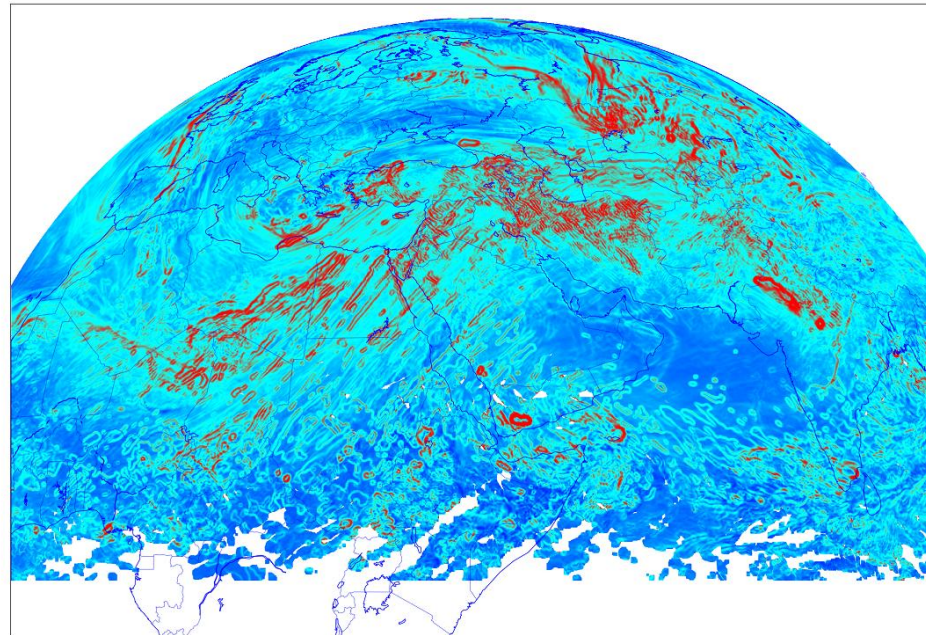
Probabity of turbulence at tropopause foldings (%)

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%
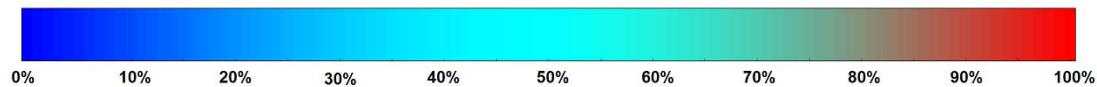
ASII (Automatic Satellite Image Interpretation)
- **Describes the Satellite image in terms of conceptual models (Fronts, Waves, Cloud structures,…)**

ASII-NG (Automatic Satellite Image Interpretation – New Generation)
- **Detects atmospheric features interesting for some meteorological users (Tropopause folding/Clear air turbulence for aviation users).**

NWC/GEO Software installation

In case of interest on using NWC SAF software):

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

+ **All other Organisations may also apply to** become user of NWC SAF Software.

This is done contacting through email:

safnwchd@aemet.es

All applicants have become users of NWC/GEO software (without restriction up to now!), with:

- **> 100 Institutions from all around the world** (Europe, Africa, Americas, Asia,…)
- **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 their Licence Agreement,** to be signed by EUMETSAT (represented by AEMET) and the applicant User.

Once the Licence Agreement is signed,
Access Credentials to the NWC SAF Help Desk Restricted Area are provided,
where **the NWC SAF software package can be downloaded:**

http://www.nwcsaf.org

The installation takes then only 3 steps, which need less than ONE HOUR to be ready:
+ **Define a few variables in the "profile file"** and **activate them.**
+ **Download and decompress the software elements.**
+ **Run the installation scripts.**
+ **Include two small updates needed for the use with MSG1/IODC service.**

Nothing else is needed. All software/libraries/products/additional elements 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,
under next supported Linux/Red Hat environments:

	RHEL51	RHEL64
O.S	RHEL release 5.1 Tikanga	RHEL release 6.4 Santiago
CPU	2x Intel(R) Xeon(R) CPU E5-2670 v2 @ 2.50GHz	4x Intel(R) Core(TM) CPU i5-4590 @ 3.30GHz
Arch	x86_64	x86_64
Memory(1)	4 GB	8 GB
Disk	500 GB	500 GB
Shell	bash; ksh	bash; ksh
Compilers	GCC compilers 4.1.2; gcc; g++; gfortran	GCC compilers 4.4.7 gcc; g++; gfortran
gzip	gzip 1.3.5	gzip 1.3.12
make	GNU Make 3.81	GNU Make 3.81

Supported NWC/GEO environments

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

NWC/GEO Software installation

NWC/GEO software has proved to be useful for many applications

(case studies, specific use of the products, etc.)

in NMSs, SAFs, public and private institutions,…

Registering as NWCSAF users and downloading the software

is suggested for those who still do not know it

> Specially for new users in the new areas covered
> by MSG1/IODC service!
> (Russia, Middle East, Indian Subcontinent…)

Feedback is welcome,

specially from users of NWC SAF products with this new MSG1/IODC service!

NWC/GEO Software installation

For any additional doubt/question on
  - **NWCSAF**
  - **How to get it and install NWC/GEO software package**
  - **How to run and visualize its outputs**

do please contact me today afterwards.

Javier García Pereda
jgarciap@aemet.es
www.nwcsaf.org