

NWC/GEO v2016 Engineering Workshop

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- **INTRODUCTION**
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- **INTRODUCTION**
 - General project overview and objectives

- NWC SAF develops and maintains SW packages to generate satellite derived products on support to Nowcasting for GEO and Polar Satellites
- **New release** of a GEO SW package: **GEO v2016** (25 November 2016) available in www.nwcsaf.org after login.

Objectives of the Workshop:

- This Workshop intends to present the new SW package GEO v2016 and to give support to the users to overcome possible difficulties with the installation and operation of the new SW package
- Special attention is given to the new NetCDF output format

- I already use GEO v2016
- I use older versions
- I am new to NWC SAF GEO/MSG



doodle.com/poll/8zzea25gkxzaw9hc

- **MAIN CHANGES/IMPROVEMENTS of GEO v2016 RESPECT to MSG v2013**
 - Technical changes
 - Improvements in existing products
 - New products
 - Adaptation to GOES-N

SW package main components are Task Manager, NWCLIB and PGEs

- Some minor improvements in the Task Manager
- A new version of the NWCLIB that unifies common functions have been implemented.
- The new NWCLIB adds the capability to process data from satellites other than MSG.
- The radiative transfer model RTTOV, used to generate some of the products, has been upgraded to version 11.2
- NetCDF has been adopted as new data output format with the objective of making it more user friendly.

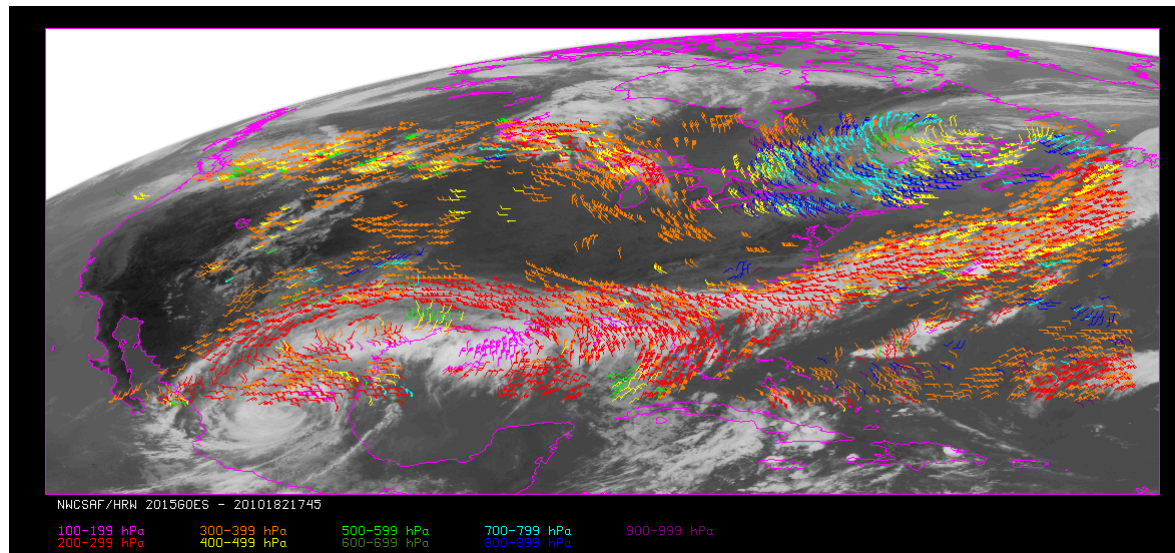
Improvements in existing products



- Cloud Mask: Use of radiative transfer model RTTOV on line to improve some thresholds, reduction of fire/cloud confusion.
- Probability of precipitation and convective Rainfall rate derived from cloud microphysics products have been re-calibrated to be adapted to the new NWC SAF Cloud Microphysics product
- Water content and Instability Indices (SphR): product name has been changed to iSHAI (imaging satellite Humidity and Instability). New additional outputs will be available: total column ozone and skin temperature.
- High Resolution winds: a pressure level correction in the “CCC height assignment method” has been included. It is physically based on the cloud depth and makes use of the new parameters provided by new NWC SAF Cloud Microphysics (CMIC) product
- Rapidly Developing Thunderstorms: more optional inputs, improvement of cell motion and expansion rate, forecast (+1h) of the cells, additional convective attributes.

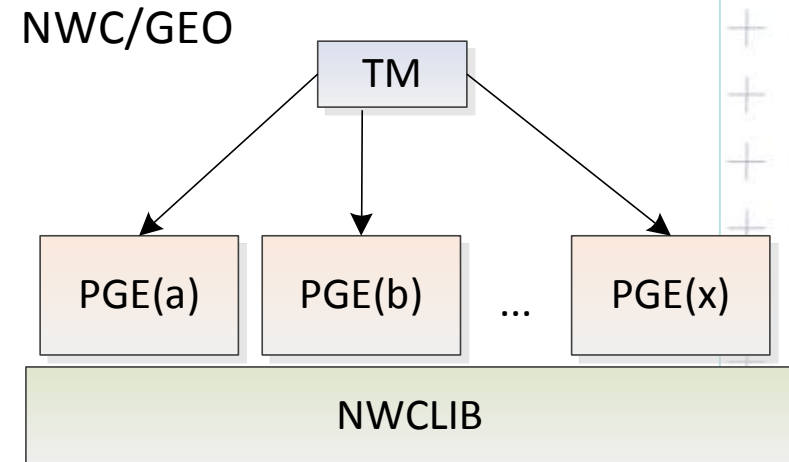
- **CMIC (Cloud Microphysics):** Day time Cloud microphysical properties are generated: cloud water path, effective radius and optical depth. In GEO v2016 day and night time Cloud Phase is an output of CMIC and not of CT. **Operational status.**
- **CI (Convection Initiation):** Probability of a cloudy pixel to become a thunderstorm in a given following period range. **Demonstrational status** (not generated in the default configuration, it has to be set).
- **ASII-NG (automatic Satellite Image Interpretation-New Generation):** probability of occurrence of meteorological phenomena. First release GEOv2016: probability of occurrence of tropopause folding, **demonstrational status** (not generated in the default configuration, it has to be set).
- **EXIM (Extrapolated Imagery):** extrapolation of MSG images and NWC SAF products using the NWC SAF HRW winds. Product **in development**, to be delivered to the users at a later stage.

- GOES-N data are read with a tool implemented by Météo-France (available in the NWC SAF website www.nwcsaf.org) and transformed to a format readable by the NWCLIB.
- Cloud Mask, Cloud Type, Cloud Top Temperature and Height, High Resolution Winds and EXIM products have been technically adapted to process GOES-N data.
- High Resolution Winds product has been fully validated to process GOES-N data.



NWC/GEO High Resolution Winds v2016 AMV output example in the Continental United States region (1 July 2010 1745Z, GOES13 satellite)

- The NWC/GEO application implements the functionalities required to generate the GEO committed products detailed in the NWCSAF Product Requirements Document including
 - task scheduling,
 - reading and extraction of input, auxiliary and control data,
 - re-mapping, calibration, collocation, ... of any input data (when required) and,
 - execution of the algorithms required for the generation, quality control and formatting of each of the NWC/GEO products.
- High-level design of the NWC/GEO based on three main components to simplify the development and maintenance of both engineering and scientific components of the system
 - Task Manager: Process Orchestration
 - NWCLIB: General purpose library: common functions
 - PGEs: Product Generator Elements



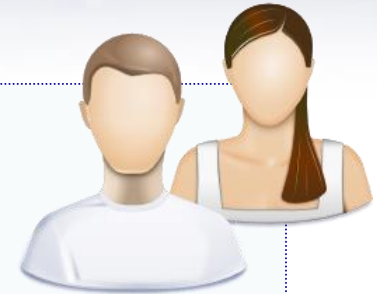
- **Task Manager**
 - Interface between the user and NWC/GEO application
 - Initialise and set-up of the system according to the configuration
 - Drive and optimise the execution of the PGEs
 - Execute pre-processing tasks required by the PGEs
 - Schedule the execution of the PGEs according to their dependencies and priorities
 - Monitor the processing and logs information and statistics
 - Execute other programmable activities defined by the user
- **NWCLIB**
 - The NWC/GEO library implementing common functionality for different PGEs
 - Mainly focussed in engineering aspects (reading of input data, navigation,)
- **PGEs**
 - Implements the scientific algorithms in charge of extracting the Meteorological Products
 - Coded as stand-alone applications, supported by the NWCLIB functions
 - Common External Interface

```
<PGE_name> <YYYY-MM-DDThh:mm:ssZ> <region conf. file> <model conf. file>
```

- **NWC/GEO users and roles**

- *System Administrator*

- Install the NWC/GEO application
- Provide real-time data (SEVIRI, NWP and Auxiliary data) to the system
- Define operative policy (data storage, data delivery, backups, ...)
- Configure the system from a SW point of view according to the previous operative policy.
- Initiate, monitor and terminate the NWC/GEO application.



- *Scientific Administrator*

- Establish the scientific configuration of the NWC/GEO (region, PGEs and PGE-specific configuration, ...)
- Analyse the scientific contents of the products and receive analysis, comments and suggestions from the (its) final users in order to improve the quality and usefulness of the products.

- *Final User*

- Receive and exploit NWC/GEO output products

- **NWC/GEO OUTPUT PRODUCTS**
 - Products of the NWC/GEO v2016
 - NWC/GEO Output Products Format

Product Processors Group	PGE Identifier	Product Name
Cloud	GEO-CMA	GEO Cloud Mask
	GEO-CT	GEO Cloud Type
	GEO-CTTH	GEO Cloud Top Temperature and Height
	GEO-CMIC	GEO Cloud Microphysics
Precipitation	GEO-PC	GEO Precipitating Clouds
	GEO-CRR	GEO Convective Rainfall Rate
	GEO-PPh	GEO Precipitation from Cloud Physical Properties: Precipitating Clouds from Cloud Physical Properties Convective Rainfall Rate from Cloud Physical Properties
iSHAI	GEO-iSHAI	GEO imaging Satellite Humidity And Instability
Wind	GEO-HRW	GEO High resolution winds
	GEO-ASII	GEO Automatic Satellite Image Interpretation
Automatic Satellite Image Interpretation	GEO-ASII-NG	GEO Automatic Satellite Image Interpretation - New generation
	GEO-CI	GEO Probability of Convection Initiation
Convection	GEO-RDT-CW	GEO Convection Warning

- NWC/GEO products (except GEO-ASII)
 - coded in netCDF format using the netCDF-4 software (HDF-5 based) and taking advantage of the definition of User data types and structures of the Enhanced Data Model
 - Compliant with netCDF Climate and Forecast (CF) Convention
 - Compliant with netCDF Attribute Convention for Dataset Discovery (ACDD)
- In addition, NWC/GEO HRW can also be produced in *BUFR* format
- NWC/GEO products use the following naming convention

Size	1		3		any		any		any		14		any
Field	S	_	SAF	_	ProdName	_	SatID	_	RegionID	_	Date/Time	.	Ext

- **Examples**
 - S_NWC_CMA_MSG3_Europe-VISIR_20160804T123000Z.nc Cloud Mask
 - S_NWC_ASII-SAT_MSG3_Europe-VISIR_20160804T123000Z.buf ASII-SAT in BUFR format

• Data Model for NWC/GEO products in netCDF

- **Dimensions:** for all Variables (e.g. number of pixels in X,Y, number of winds, ...)
- **Attributes:** General information of the product (e.g name, description, geo-localization, ...)
- **Variables:** Each containing different parameters of the products (e.g Cloud Mask, TPW, quality flag, ...)
 - Quantitative Geophysical Retrieval (e.g. CRR intensity)
 - Categorized Value (e.g. CRR rainfall class)
 - Flag
 - Product-specific Quality Flag variables (e.g. `crr_status_flag`)
 - Common Geophysical and Processing Conditions `<pge>_conditions`
 - Common Quality indicators `<pge>_quality`
 - **Palette:** A 2D array containing the RGB indices to use in a graphical representation of the product
 - **Geo-reference information**
 - Latitude and Longitude variables: 2D variables (optional)
 - `nx` and `ny` variables: 1D variables, X (Easting) and Y (northing)

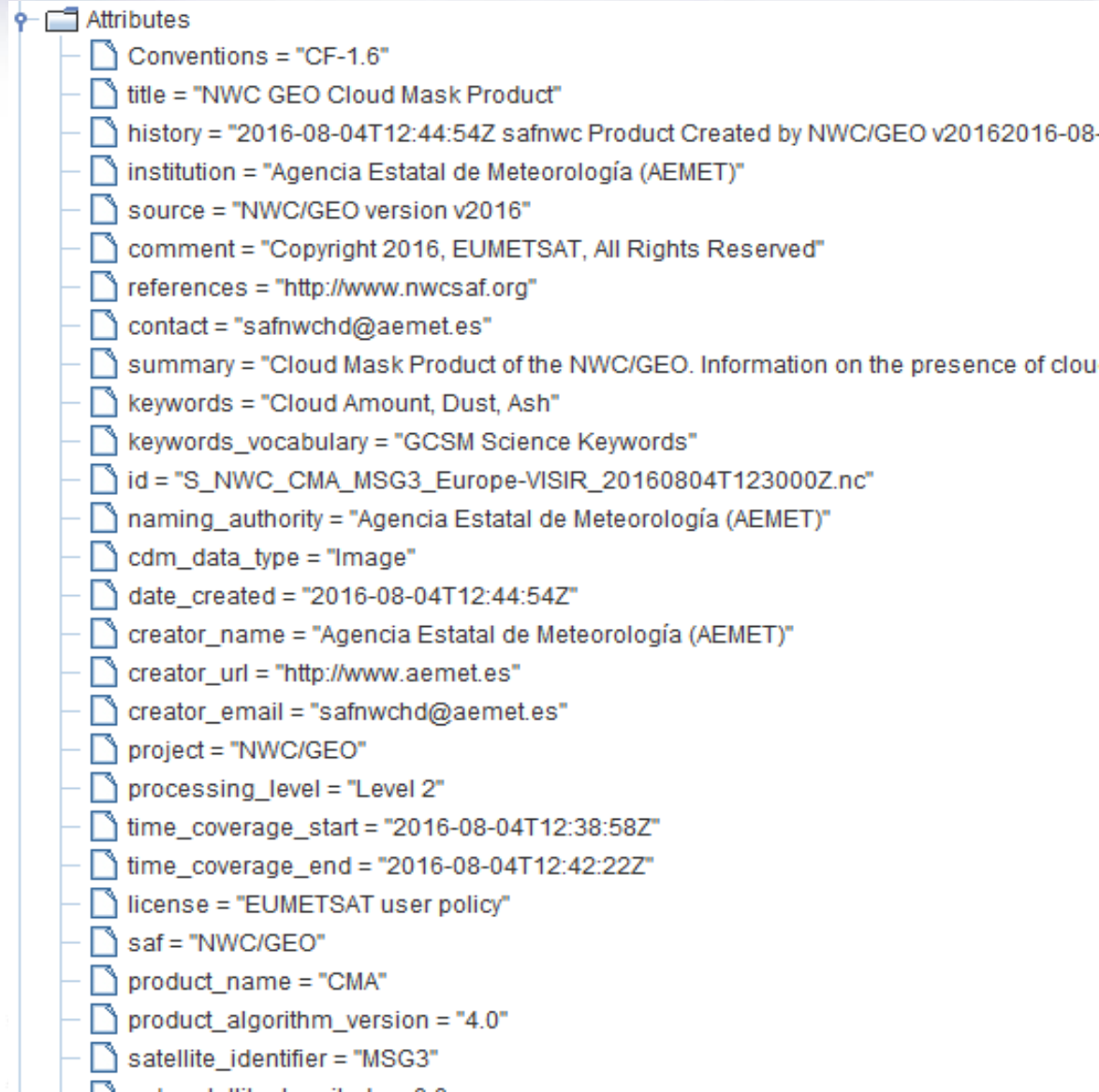
```
+-dimensions
+-attributes
+-variables:
|- byte crr(ny,nx);
|- short crr_intensity(ny,nx);
|- short crr_accum(ny,nx);
|- short crr_status_flag(ny,nx);
|- short crr_conditions(ny,nx);
|- short crr_quality(ny,nx);
|- float lat(ny,nx);
|- float lon(ny,nx);
|- float ny(ny,nx);
|- float nx(ny,nx);
|- byte crr_pal(256, 3);
|- byte crr_intensity_pal(256, 3);
```

- **Data Model for NWC/GEO products in netCDF - Attributes**

- General Information about the product
- Self-explanatory product
- Satisfy CF and ACDD netCDF conventions

See the DOF^(*) document for a full list and detailed description of all attributes used NWC/GEO products

^(*) *NWC/CDOP2/GEO/AEMET/SW/DOF, section 4.3*

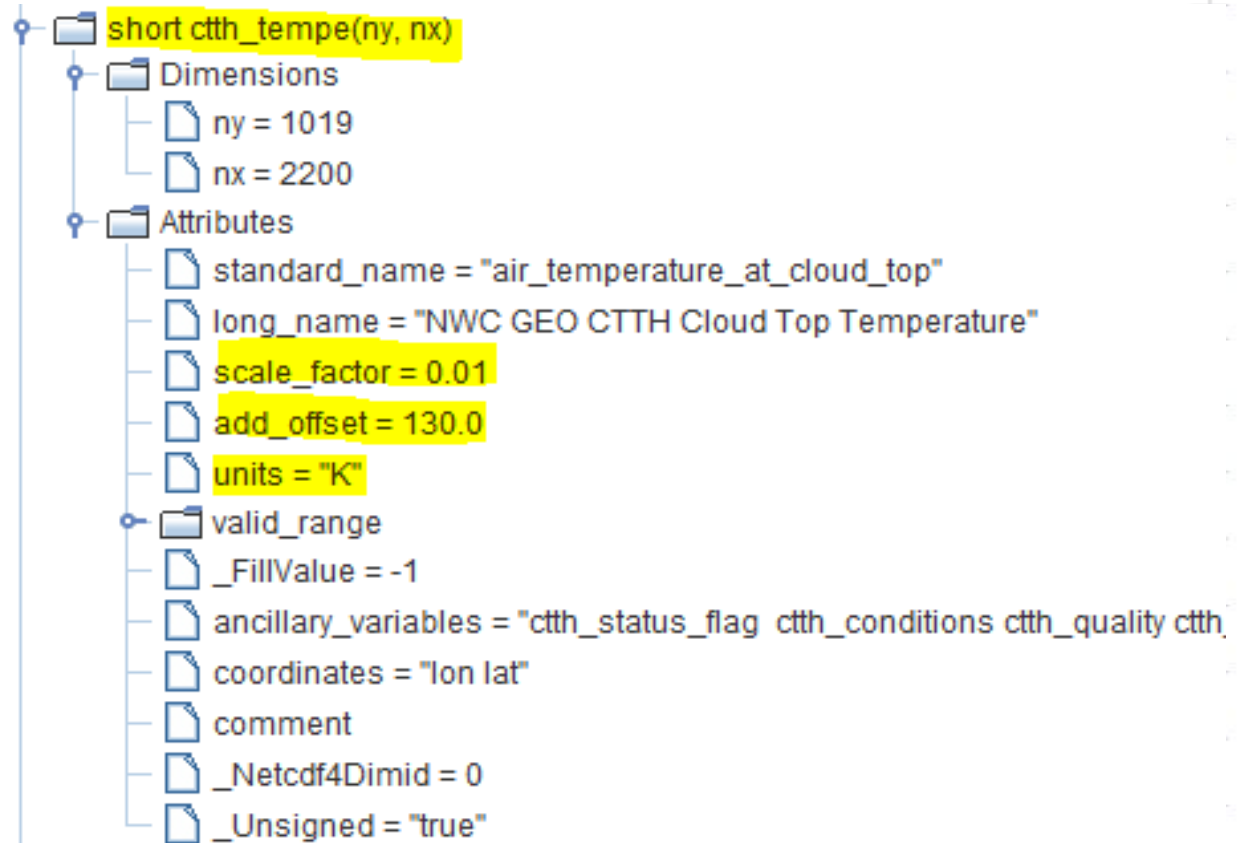


A screenshot of a netCDF file's metadata attributes. The list includes:

- Conventions = "CF-1.6"
- title = "NWC GEO Cloud Mask Product"
- history = "2016-08-04T12:44:54Z safnwc Product Created by NWC/GEO v20162016-08-04"
- institution = "Agencia Estatal de Meteorología (AEMET)"
- source = "NWC/GEO version v2016"
- comment = "Copyright 2016, EUMETSAT, All Rights Reserved"
- references = "http://www.nwcsaf.org"
- contact = "safnwhcd@aemet.es"
- summary = "Cloud Mask Product of the NWC/GEO. Information on the presence of cloud"
- keywords = "Cloud Amount, Dust, Ash"
- keywords_vocabulary = "GCSM Science Keywords"
- id = "S_NWC_CMA_MSG3_Europe-VISIR_20160804T123000Z.nc"
- naming_authority = "Agencia Estatal de Meteorología (AEMET)"
- cdm_data_type = "Image"
- date_created = "2016-08-04T12:44:54Z"
- creator_name = "Agencia Estatal de Meteorología (AEMET)"
- creator_url = "http://www.aemet.es"
- creator_email = "safnwhcd@aemet.es"
- project = "NWC/GEO"
- processing_level = "Level 2"
- time_coverage_start = "2016-08-04T12:38:58Z"
- time_coverage_end = "2016-08-04T12:42:22Z"
- license = "EUMETSAT user policy"
- saf = "NWC/GEO"
- product_name = "CMA"
- product_algorithm_version = "4.0"
- satellite_identifier = "MSG3"

• Data Model for NWC/GEO products in netCDF - Variables - Product Specific

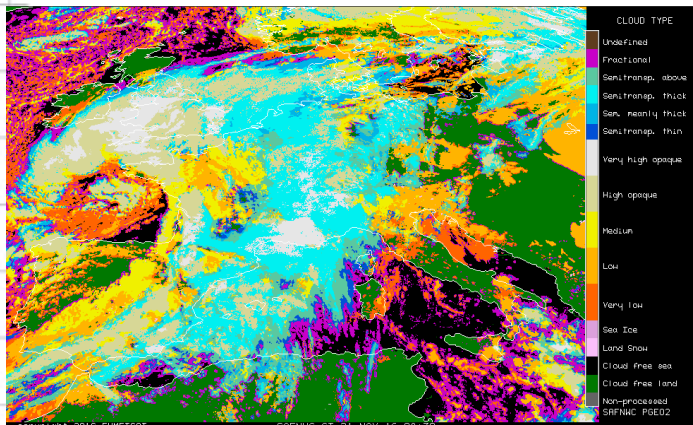
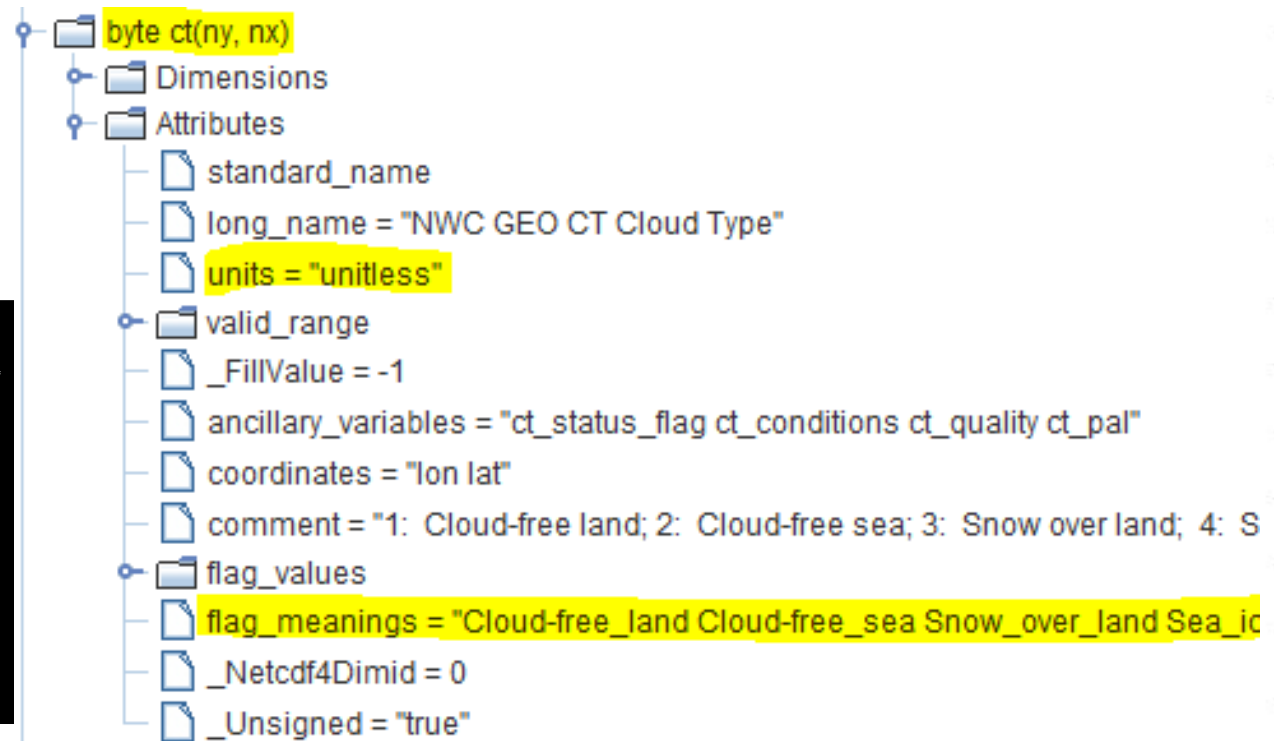
- Store product-specific data computed by the PGE
- 3 different data types are identified
 - Quantitative data
 - float values, stored as scaled unsigned short variables
 - Original float data are retrieved using both scale_factor and add_offset attributes of the variable



- **Data Model for NWC/GEO products in netCDF - Variables - Product Specific**

- **Categorized Values**

- qualitative meteorological information at pixel level in form of classes
- Meaning of different classes is provided in the attribute *flag_meanings*



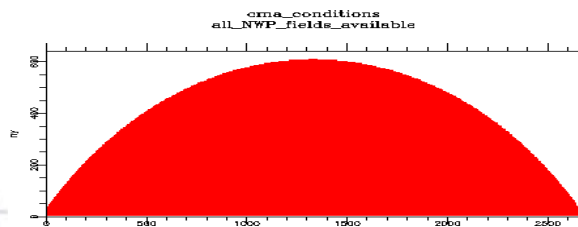
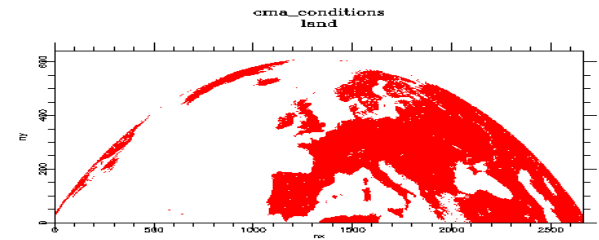
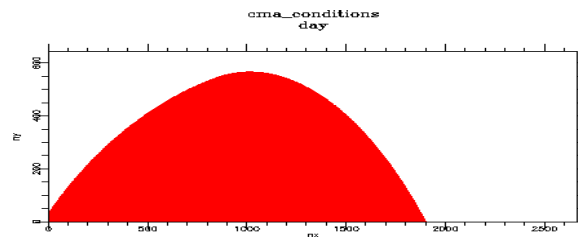
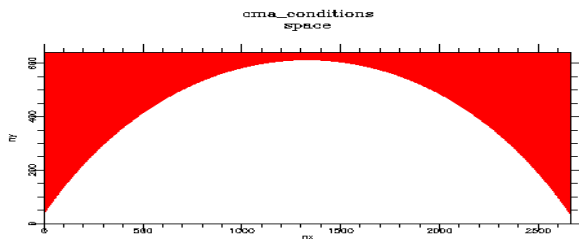
- Data Model for NWC/GEO products in netCDF - Variables - Product Specific**

- Flags**

- Flag Variables include status codes and Boolean conditions information
- A single variable can contain information about several conditions
- Specific data for all different conditions are retrieved using the data of the attributes flag_mask, flag_values and flag_meanings

- Example: cma_conditions specification for NWC/GEO-CMA product

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Aux_data_av	Prod_av		NWP_data_av		Sat_data_av		N/A	N/A	Land/Sea		Sunglint	Illumination		space	



- **Data Model for NWC/GEO products in netCDF - Variables - Common Quality variables**

- All Image-like products include 2 common quality variables

- **<pge>_conditions:** Stores common geophysical and processing conditions

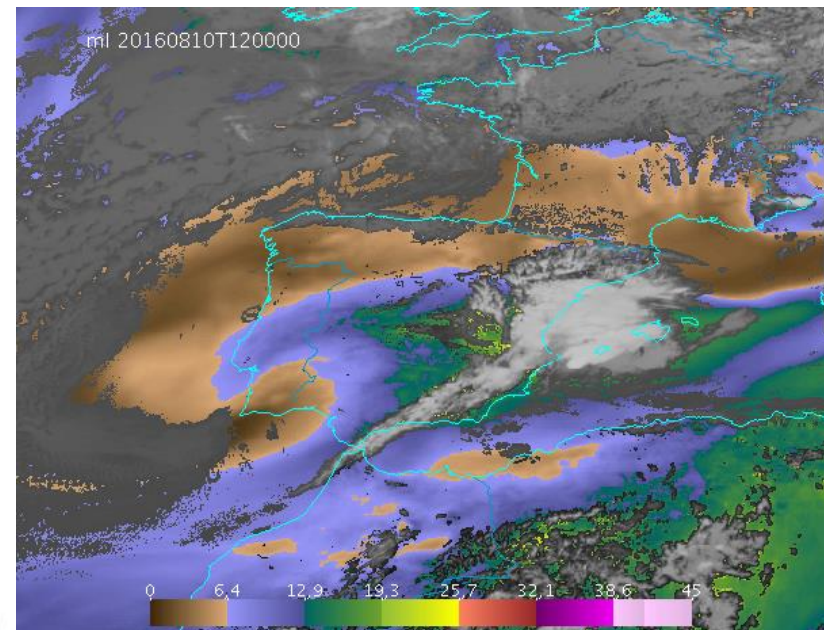
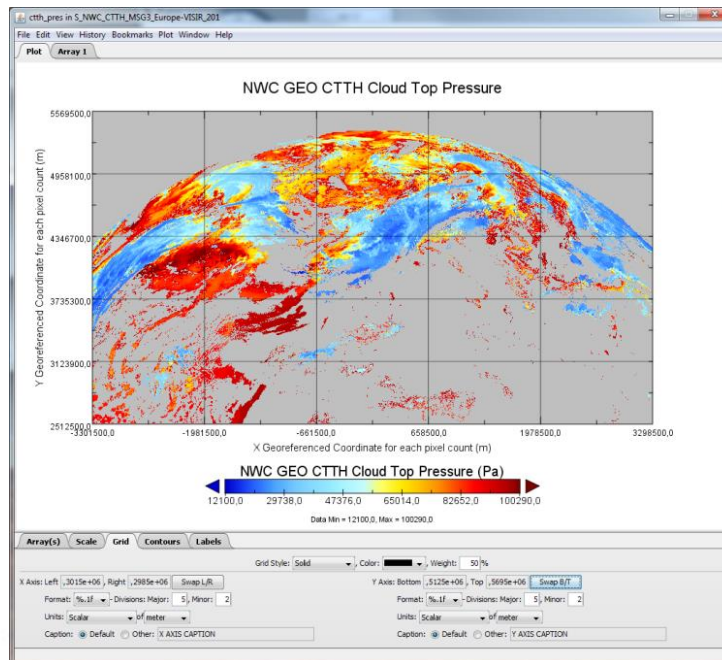
<pge>_conditions		
Field	Size (bits)	Description
Space	1	Set to 1 for space pixels
Illumination	2	Defines the illumination condition
Sunglint	1	Set to 1 if Sunglint
Land_Sea	2	Defines the land/sea/coast condition
Satellite_input_data	2	Describes the Satellite input data status
NWP_input_data	2	Describes the NWP input data status
Product_input_data	2	Describes the Product input data status
Auxiliary_input_data	2	Describes the Auxiliary input data status

- **<pge>_quality:** Stores common quality indicators

<pge>_quality		
Field	Size (bits)	Description
Nodata	1	Set to 1 if pixel is NODATA
Internal_consistency	1	Set to 1 if an internal consistency check has been performed
Temporal_consistency	1	Set to 1 if a temporal consistency check has been performed
Quality	3	Retrieval Quality N/A; Good; Questionable; Bad, Interpolated

- In addition, all image-like products contain a flag variable that stores pge-specific information about the pge processing status (**<pge>_status_flag**). Its fields will depend on the PGE.

- Product data can be easily visualized and accessed using:
 - standard netCDF tools, for example:
 - Panoply (<http://www.giss.nasa.gov/tools/panoply/>)
 - ncBrowse (<http://www.epic.noaa.gov/java/ncBrowse/>)
 - netCDF API (<http://www.unidata.ucar.edu/software/netcdf/>)
 - tools for meteorological data analysis, for example:
 - McIDAS-V (<http://www.ssec.wisc.edu/mcidas/software/v/>)
 - IDV (<http://www.unidata.ucar.edu/software/idv/>)



- **INSTALLATION**
 - Pre-conditions
 - Installation procedure
 - Basic configuration

- The NWC/GEO application has been developed and tested in the following Linux RHEL platforms.

	Intel/Linux	Intel/Linux
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	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



The installation and compilation of the NWC/GEO applications package needs around 65 Gbytes of free disk space, but additional space is required to run the package in an operational mode (A minimum 50 additional GB is strongly suggested)

- Also properly installed and tested in the following not supported/committed platforms

	RHEL7.2	SUSE11	Debian8
O.S	RHEL Server 7.2 (Maipo)	SUSE 11 SP4 64 bits	Debian GNU/Linux 8 (jessie)
CPU	1x Intel(R) Core(TM) CPU i5-4590 @ 3.30GHz	2x Intel(R) Core(TM) CPU i5-4590 @ 3.30GHz	2x Intel(R) Xeon(R) CPU E5-2670 v2 @ 2.50GHz
Arch	x86_64	x86_64	x86_64
Memory	2GB	2GB	2GB
Disk	25GB	50 GB	25GB
Shell	sh;ksh	bash; ksh	sh;ksh
Compilers	GCC compilers 4.8.5 gcc; gfortran; g++	GCC compilers 4.8.3 gcc; gfortran; g++	GCC compilers 4.9.2 gcc; gfortran; g++
gzip	gzip 1.5	gzip 1.3.12	gzip 1.6
make	GNU Make 3.82	GNU Make 3.81	GNU Make 4.0



- Proper installation, operations and support in other Linux flavours cannot be assured.
- User can contribute to the SAFNWC community giving feedback about the operation of the NWC/GEO in other Linux distributions

The execution of the NWC/GEO with a large number of pressure levels requires increasing the maximum number of opened files, typically set to 1024 in standard Linux installations.

If the maximum number of opened files, obtained executing

```
$ ulimit -n
```

is below 2048, increase it following the next procedure:

- Edit, as root, the file `/etc/security/limits.conf`
- Add the following lines at the end of the file

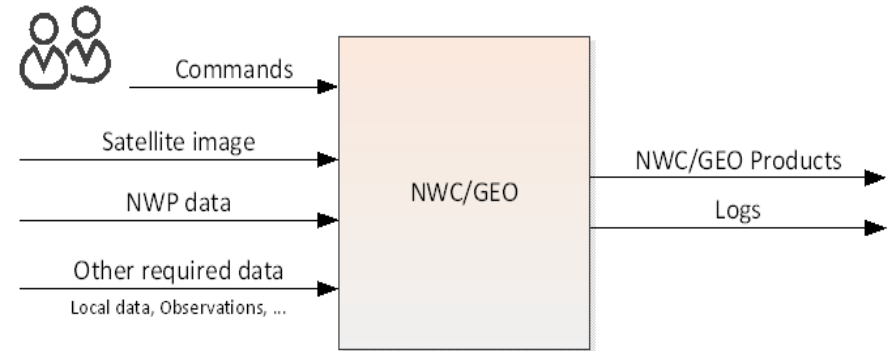
```
* hard nofile 8192
```

```
* soft nofile 2048
```

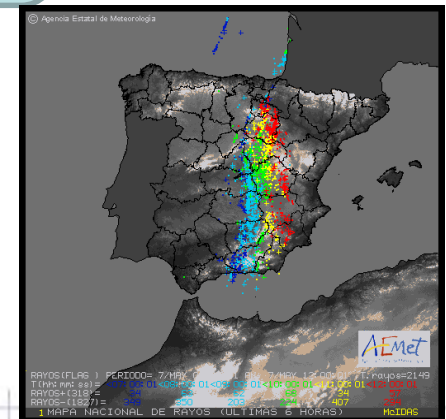
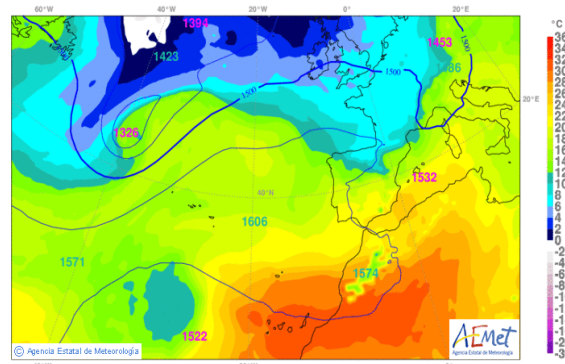
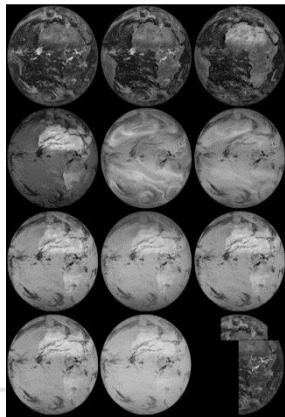
- Reboot the system
- Check that the maximum number of opened files has been set to 2048:

```
$ ulimit -n  
2048
```

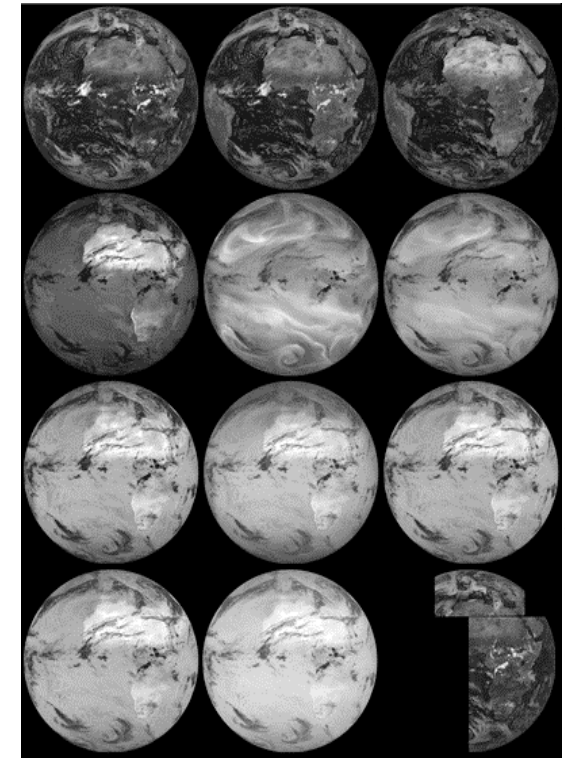
- NWC/GEO output products are generated using, as input data
 - Satellite Images from supported GEO satellites
 - NWP data
 - Optionally, local data and observations
 - Lightning data
 - Operational Sea Surface Temperature and Sea Ice Analysis OSTIA data



• The user is responsible for the provision of all required input data in appropriate format and in time for the production of NRT (or reprocessed) NWC/GEO products

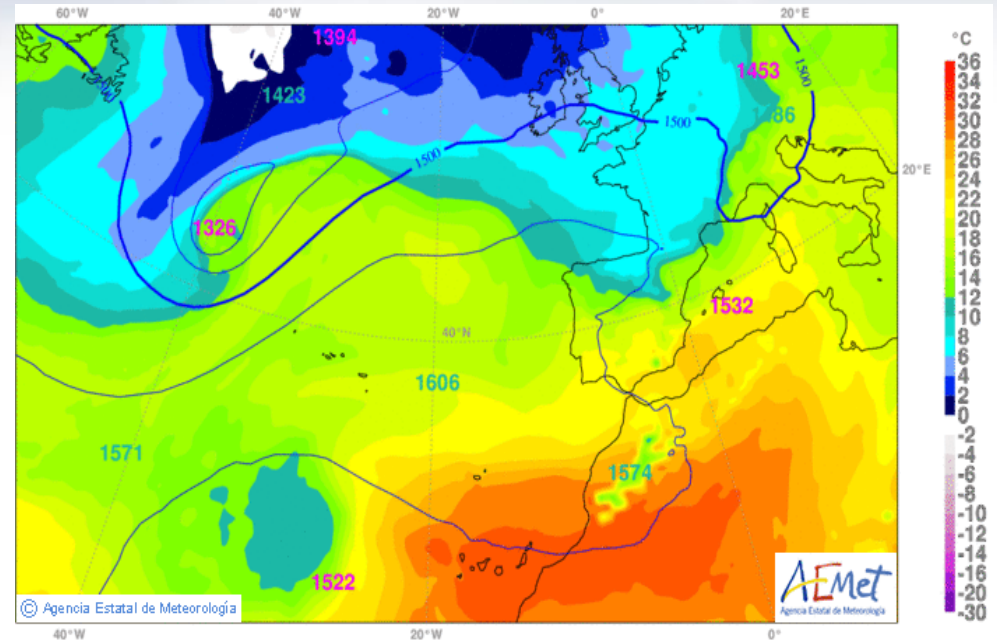


- All input data are stored in different directories inside \$SAFNWC/import directory. The user is allowed to link these directories if input data are received and stored in other systems and/or directories.
- **Satellite Data**
 - Current NWC/GEO v2016 only supports
 - **MSG SEVIRI DATA**, in native L1.5 HRIT, segmented, un-encrypted and de-compressed format
 - **GOES-N** (GOES 13, 14 and 15) in common FSD format (netCDF), as described in section 4.2.2 of the NWC/CDOP2/GEO/AEMET/SW/ICD/1
 - NWC/GEO v2016 only supports the generation of HRW product using GOES-N data
 - The NWC/GEO also provide the *SAT2NC tool*, developed by Météo-France, allowing to convert GOES GVAR files in FSD format, compliant with NWC/GEO v2016.
See details in the User Manual for the SaAT2NC tool
NWC/CDOP2/GEO/AEMET/SW/UM/SAT2NC
 - Input Satellite must be available in \$SAFNWC/import/Sat_data.
 - The NWC/GEO is only able to process a single satellite (according to the configuration)



• NWP Data

- NWC/GEO support NWP data:
 - GRIB1 or GRIB2 format
 - All NWP fields related to a defined model run time and forecast term included in a single grib file
 - NWP fields in REGULAR_LL or ROTATED_LL projections
 - NWP data provided in pressure levels
Note: iSHAI can make use of NWP data in Hybrid Levels



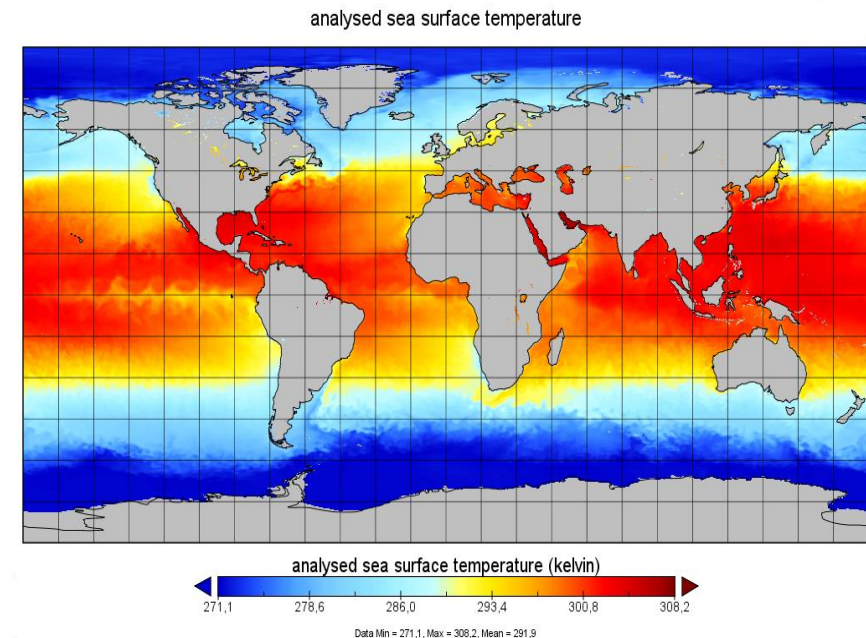
- Input NWP data must be available in \$SAFNWC/import/NWP_data
- The NWC/GEO is able to manage NWP data coming from different centres via configuration
- The NWC/GEO is only able to process a single NWP provider (according to the configuration)

- **Lightning Data**

- Optional data for GEO-CRR, GEO-PPh and GEO-RDT-CW
- Lightning data files coded in ASCII format (See NWC/CDOP2/GEO/AEMET/SW/ICD/1, section 4.4.1)
- Lightning data shall be made available to the NWC/GEO application in the directory \$SAFNWC/import/Obs_data/Lightning

- **OSTIA Data**

- OSTIA daily SST analysis, optional input for the generation of NWC/GEO Cloud Products
- Data available after registration in www.myocean.eu.org
See full details in NWC/CDOP2/GEO/AEMET/SW/ICD/1, section 4.4.2
- Input OSTIA data shall be made available to the NWC/GEO application in the directory \$SAFNWC/import/Obs_data/OSTIA



- Files with NWC/GEO IR bias BT correction coefficients are now common
NWC/GEO coefficients:
 - They will be provided periodically on best effort basis. The idea is to provide them on a monthly basis or after decontamination or special events.
 - The default is to use ECMWF and the operational MSG satellite.
 - The process to generate them is based in the iSHAI training and validation construction dataset.
- The name of the files contains the satellite and the period. Example:
 - S_NWC_BIAS-BT_MSG3_ECMWF_2016-07-01T00:00:00Z_2016-07-31T23:59:59Z.txt
- The NWC SAF web server is renewing and the final URL will be announced later.
 - *It must be taken care with the “:” character it used Windows PC to download the files.*
- The files must be downloaded and copied to the directory
 - *SAFNWC/import/Aux_data/Common/BIAS-BT*
- Bias files are used in the processing of iSHAI and are optional for cloud products.

- NWC/GEO SW Distribution**

- NWC/GEO SW application distributed in a set of separated packages
 - Mandatory packages, required to run the NWC/GEO (SW)
 - Optional packages according to the satellite to process (DATA)



Type	Package ID	Description	Size
SW	CODE-COTS	Third party software (libraries) required by the NWC/GEO	1.6 GB
SW	CODE-SYSTEM	Source code of the NWC/GEO application, including default configuration files	400 MB
DATA	DATA-MSGx_+000.0	Auxiliary data to generate MSG-based NWC/GEO products using MSG 0 deg (primary) service	7.3 GB
DATA	DATA-MSGx_+009.5	Auxiliary data to generate MSG-based NWC/GEO products using MSG 9.5 deg (Rapid Scan) service	7.4 GB
DATA	DATA-MSG1_+041.5	Auxiliary data to generate MSG1-based NWC/GEO products using MSG1 41.5 deg (IODC) service	5.8 GB
DATA	DATA-GOES13_-075.0	Auxiliary data to generate GOES13-based NWC/GEO products	2.6 GB
DATA	DATA-GOES14_-105.0	Auxiliary data to generate GOES14-based NWC/GEO products	2.6 GB
DATA	DATA-GOES15_-135.0	Auxiliary data to generate GOES15-based NWC/GEO products	1.9 GB

- The NWC/GEO Application is distributed by the NWCSAF through the Helpdesk

• NWC/GEO SW Installation

- The procedure to install the NWC/GEO SW is fully described in **section 3.2** of the **User's Manual**

- Main steps are hereafter delineated:

1. Define a set of environment variables, and store them in the .profile

2. Create the root directory for the NWC/GEO application (typically \$HOME/NWCGEO)

3. Install the COTS

1. Untar the CODE-COTS distribution

```
% cd $SAFNWC
```

```
% tar xvzf <source>/NWC-CDOP2-GEO-AEMET-SW-CODE-COTS_v<cots_version>.tgz
```

2. Execute:

```
% cd COTS
```

```
% ./cots.ksh make install
```

4. Install the NWC/GEO application

1. Untar the CODE-SYSTEM distribution

```
% cd $SAFNWC
```

```
% tar xvzf <source>/NWC-CDOP2-GEO-AEMET-SW-CODE-SYSTEM_v<sys_version>.tgz
```

2. Execute:

```
% cd src
```

```
% ./nwcgeo_v2016.ksh make install
```

3. Update the information about the originating center in the file \$SAFNWC/config/prodio_conf_file. For example:

```
% cd $SAFNWC/config
```

```
% vi prodio_conf_file
```

```
INSTITUTION Agencia Estatal de Meteorología (AEMET)
```

```
URL http://www.aemet.es
```

```
EMAIL safnwchd@aemet.es
```

```
LATLON YES
```





















5. Install the appropriate auxiliary data according to the selected satellite

1. Untar the appropriate DATA-<SATELLITE> distribution:

```
% cd $SAFNWC
```

```
% tar xvzf <source>/NWC-CDOP2-GEO-AEMET-SW-DATA-<Satellite>_v<version>.tgz
```

Installation Procedure - Directory Structure

 \$SAFNWC	
 bin	Executable files
 <u>config</u>	Configuration files
 COTS	Software from 3 rd party vendors
 export	Outputs products generated for each PGE
 <PGE>	One directory per PGE
 LOG	Contain the Product Log Files. A file per region/slot execution containing PGE-specific log messages.
 help	Help files
 import	Directory with input data
 <u>Aux_data</u>	Auxiliary files for PGEs (static files)
 Common	Common or widely used auxiliary data
 <PGE Family>	PGE or Processor Family specific auxiliary files.
 <u>NWP_data</u>	Directory for input NWP GRIB files
 <u>Obs_data</u>	Directory for other input data (dynamic data) as for example, observations and product from other sources (in-situ data, soundings, satellite products, ...) An appropriate subdirectory structure will be defined to store and manage different kind of data
 <u>Sat_data</u>	Directory for input satellite data
 include	Application header files
 lib	Directory for NWC/GEO libraries
 logs	Directory storing the logs of the NWC/GEO application
 <u>src</u>	Application source code
 <u>tmp</u>	Temporary files

NWC/GEO Basic Configuration

After installation of the software, basic configuration of the NWC GEO comprises the following steps:

1. Install the Default Configuration for a selected satellite
2. Configuration of the Processing Region(s) by editing/creating the Region Configuration File(s) (*.cfg), one per region.
3. Configuration of the PGEs to be generated (in each processing region) by editing/creating a Run Configuration File (*.cfr) per region
4. Update the default System Configuration file (*.cfs) to include the previously defined Run Configuration File(s).
5. Check that all input files are available in the correct directories
6. Initiation of the NWC/GEO

Next slides show more detail about each one of these steps:

1. Satellite Configuration

- The NWC/GEO provides the following default configurations to operate the NWC/GEO application with different satellites and different operational schemas

ID	Satellite	Satellite Operation	NWC/GEO Operational Mode
MSG_PS_RT	MSG series	Primary Service: 0deg, 15min	Real Time
MSG_RSS_RT	MSG series	Rapid Scan Service: +7.5deg, 5min	Real Time
MSG_PS_OFFLINE	MSG series	Primary Service: 0deg, 15min	Reprocessing
GOES13_CONUS_RT	GOES13	CONUS, 30min	Real Time
GOES13_NH_RT	GOES13	NH, 15min	Real Time
GOES13_CONUS_OFFLINE	GOES13	CONUS, 30min	Reprocessing
GOES14_CONUS_RT	GOES14	CONUS, 30min	Real Time
GOES14_NH_RT	GOES14	NH, 15min	Real Time
GOES15_CONUS_RT	GOES15	CONUS, 30min	Real Time
GOES15_NH_RT	GOES15	NH, 15min	Real Time

- Installation of the Default Configuration for a selected satellite :

```
% cd $SAFNWC/config/<ID>  
% make
```

2. Configuration of the Processing Region

- Define the Region Configuration File(s) (\$SAFNWC/config/*.cfg) describing the geographical region(s) to generate the NWC/GEO Products

Keyword	Description	Type	Possible Value(s)
REGION_ID	Short ID of the region used to name the product files	char[]	User-defined string
REGION	A longer description of the region. It will be included in the header of the output product	char[]	User-defined string
REGION_CENTRE ⁽¹⁾	Coordinates of the centre of region to be processed in degrees. Order is latitude, longitude	float[2]	latitude: from -90.0 to +90.0 longitude: from -180.0 to +180.0
REGION_SIZE ⁽¹⁾	Size of region to be processed, in kilometres. Order is size in line, column directions Use special case "0 0" to define "full disk"	float[2]	two floats greater than zero, or 0 0 to define full disk
REGION_UL ⁽¹⁾	Coordinates of the Upper-Left corner of region to be processed in degrees. Order is latitude, longitude	float[2]	latitude: from -90.0 to +90.0 longitude: from -180.0 to +180.0
REGION_BR ⁽¹⁾	Coordinates of the Bottom-Right corner of region to be processed in degrees. Order is latitude, longitude	float[2]	latitude: from -90.0 to +90.0 longitude: from -180.0 to +180.0

⁽¹⁾ Region is defined using (REGION_CENTRE, REGION_SIZE) or (REGION_UL, REGION_BR) keywords



3. Configuration of the PGEs to be generated (in each processing region)

- Define a Run Configuration File (\$SAFNWC/config/*.cfr) per selected region, each one defining the list of PGEs to be generated in each region (Use the default Run configuration File as template)

Keyword	Description	Type	Possible Value(s)
REG_CONF	Name of the region configuration file	char[]	filename
PS_PGES	Identifier of PGEs to be run for this region	char[]	Any combination of PGE Identifiers as defined in the PGE Configuration File (See section 6.1.1 in the NWC/GEO SW/UM)
MODEL_CONF_<PGEid>	Name of the model configuration file for PGE <PGEid>. There must be a MODEL_CONF_<PGEid> line for each PGE included in the PS_PGES and for other PGEs not included but required as input for the selected PGEs according to the PGE dependencies.	char[]	filename

- As Model Configuration File per PGE (*.cfm), use the default configuration files provided in the NWC/GEO distribution, or check the scientific documentation (Scientific User Manuals) for details about the content of the Model Configuration files for all different PGEs



4. Update of the System Configuration File

- Update the default System Configuration file (\$SAFNWC/config/*.cfs) to include the Run Configuration File(s) previously defined

Keyword	Description	Type	Possible Value(s)
Operational Parameters			
REAL_TIME	Specifies the operational mode as REAL_TIME or OFF_LINE	char[]	TRUE (REAL_TIME) FALSE (OFF_LINE)
SORT_KEY	Configures the criteria used for ordering the PGE-related tasks. Tasks can be ordered by REGION priority or by PGE priority	char[]	REGION PGE
NB_PROCESS	Number of concurrent processes. TM will execute, if possible, a maximum of n PGEs concurrently, taking into account the dependencies between the Products.	Integer	>0
Processing Regions			
REGION	Starts a block containing the specification of a processing region. This block is repeated for each processing region. The block ends with 'REGION_END'.	-	(VOID)
RUN_CONF	Name of run configuration files (see section 6.3 in the NWC/GEO SW/UM) Files are expected to be in the \$SAFNWC/config directory.	char[]	filename
PRIORITY	Priority of the processing of each region.	integer	>0 (1: Higher priority)
REGION_END	Ends a REGION block	-	(VOID)
Monitor and Program Definitions files			
[MONITOR_FILE]	File name for the Monitor Definition File used to initialise the list of monitoring tasks (see section 6.6.1 in the NWC/GEO SW/UM)	char[]	filename
[PROGRAM_FILE]	File name for the Program Definition File used to initialise the list of programmed tasks (see section 6.7.1 in the NWC/GEO SW/UM)	char[]	filename
Output Devices			
[LOG_FILE]	Name for the TM Log File. File will be created in the \$SAFNWC/logs directory	char[]	filename
[PRINT_TTY]	Terminal device to display A_PrintScreen and A_Bell actions	char[]	tty device



5. Check that all inputs are available in the correct directories

- Satellite data must be available in `$(SAFNWC)/import/Sat_data`
- Input NWP data must be available in `$(SAFNWC)/import/NWP_data`
- Optional lightning data shall be available in the directory `$(SAFNWC)/import/Obs_data/Lightning`
- Optional OSTIA data shall be available in the directory `$(SAFNWC)/import/Obs_data/OSTIA`

6. Initiation of the NWC/GEO

- Start the NWC/GEO TM using the following command:

```
% SAFNWCTM [system_configuration_file] [-d] [-s] [-r]
```

where

- `system_configuration_file` is the name of the system configuration file (`xxx.cfs`) to be loaded at start-up; it must exist in the `$$SAFNWC/config` directory. The TM automatically loads the `safnwc.cfs` as default if the user does not provides any file.
- `-d` option activates the debug mode. In this mode, TM logs some more messages in the Log File for debugging purposes.
- `-s` option initializes the TM in suspended mode. The TM in suspended mode does not command the generation of new NWC/GEO products, but all other functionality (User command, Monitoring activities and Programmed activities) works as in the non-suspended mode. The ‘`tm resume`’ user command must be used to begin the the production of NWC/GEO products.
- `-r` option skip the initial remapping of NWP data located in `$$SAFNWC/import/NWP_data` directory

This option can be used if the TM is stopped for a while and re-started again with the same configuration. In that case, currently remapped NWP data will be available in the `$$SAFNWC/tmp` directory and the initial remapping process can be skipped.

After initiation of the NWC SAF:

- If the chosen NWC/GEO default configuration operates in **Real Time mode**, the application is ready to process, as soon as they are available, new incoming SEVIRI/GOES-N data and generate the full set of NWC/GEO products in the default area (depending on the satellite and satellite mode)
- If the chosen NWC/GEO default configuration operates in **Reprocessing mode** (offline mode), the application automatically schedules the processing of all satellite products already available in the \$SAFNWC/import/Sat_data directory

In both cases:

- Output products will be generated in \$SAFNWC/export/<PGE_name> directories.
- Logs can be found in \$SAFNWC/logs directory.

Real Time processing features:

- Only new satellite files received after startup are monitored and processed. In order to wait for the arrival of all segments, the execution of the slot is delayed 30 seconds after receiving the epilogue file (EPI).
- In the case of MSG satellites, an automatic check of the incoming satellite data is performed. This check changes configuration between satellites (MSGx), but only for MSG Nominal and RSS dissemination modes. No automatic change is performed between satellites in PAR mode or between modes.
- Task Manager monitors the reception of new NWP data, and commands the remapping of new incoming NWP files.
- Latest slot is processed first
- Real Time mode includes default monitoring and programmed activities to clean directories and remove obsolete files and products:
 - Removes files in \$SAFNWC/import/Sat_data directory not accessed in the last 75 minutes
 - Removes files in \$SAFNWC/import/NWP_data directory not accessed in the last 36 hours
 - Removes files in \$SAFNWC/export directory not accessed in the last 75 minutes.
 - Removes obsolete files in \$SAFNWC/tmp directory:
 - N_NWC_NWP_*: Not accessed in the last 36 hours
 - CLD_*: Not accessed in the last 8 days
 - Other: Not accessed in the last 75 minutes

Reprocessing features:

- All files stored in the \$SAFNWC/import/Sat_data are processed after startup
- All required NWP input files must be available in \$SAFNWC/import/NWP_data directory before startup of the reprocessing.
- Offline tasks don't check for changes in the satellite data. It is assumed that the system is configured according to the satellite data previously stored in \$SAFNWC/import/Sat_data.
- Because it is assumed that all Satellite data is already stored in the appropriate directory, the delay in the processing of the slot is removed (set to 0)
- Slots are processed sequentially (according to acquisition time)
- No cleaning tasks are performed.
- NWC/GEO predefined Satellite Configuration Files contain the satellite specific information in the moment the software has been released. Operator must check that sat_conf_file is compliant with the satellite status in the date to be reprocessed, paying special attention to the key SAT_REF_LONG, which needs to be in accordance with the satellite location in the date to be processed.

- **NWC/GEO OPERATIONS**
 - Advanced configuration
 - Operation procedures

- Monitoring activities**

- Task Manager is able to keep a list of events to be monitored and a list of actions to be executed if a monitored value exceeds a user-defined nominal range.

Monitor Definition File

Keyword	Description	Type	Possible Value(s)
MONITOR_FILE	Name of the file describing each monitoring task. Repeated as necessary	char[]	filename



Monitor Task Definition File

Keyword	Description	Type	Possible Value(s)
MON_METHOD	The monitor method to be used.	char[]	See Table 22 in the NWC/GEO SW/UM
MON_PARAMETER	If needed, parameter(s) to be used by the monitor method (See Table 22 in the NWC/GEO SW/UM)	char[]	
MON_THRESHOLD	If needed, range (min, max) defining the nominal behaviour (See Table 22 in the NWC/GEO SW/UM)	Float[2]	min < max
MON_STEP	If needed, monitor rate time (in seconds) (See Table 22 in the NWC/GEO SW/UM)	Integer	≥ 0
MON_TIMEOUT	If needed, sleeping time after trigger the event (in seconds). If TIMEOUT = -1 the monitoring task is automatically removed after the first trigger. (See Table 22 in the NWC/GEO SW/UM)	Integer	≥ 0
MON_ACTION	Definition of the action to be executed according to the result of the monitoring activity. Repeated as necessary	char[]	See section 8 in the NWC/GEO SW/UM

- Programmed activities**

- Task Manager is able to maintain a list of events to be executed at a fixed time.

Monitor Definition File

Keyword	Description	Type	Possible Value(s)
PROGRAM_FILE	Name of the file describing each programmed task. Repeated as necessary	char[]	filename



Monitor Task Definition File



Keyword	Description	Type	Possible Value(s)
PRG_TIME	Programmed date and time for the beginning of the execution. The value field must contain the following format: hh:mm:ss [dd-mm-yyyy] Current date is assumed if dd-mm-yyyy field is not present.	chain of character hh:mm:ss [dd-mm-yyyy]	
PRG_REPEAT	Repeating time cycle. Use the format dd hh:mm:ss If this value is set to 0 (0d 00:00:00) the task is automatically removed after the first execution	chain of character dd hh:mm:ss	
PRG_ACTION	Definition of the action to be executed at the programmed time. Repeated as necessary	chain of characters	See section 8 in the NWC/GEO SW/UM

- **NWC/GEO monitoring and control (the tm user's interface)**

- Display information about the status of the system

```
% tm status
```



- List of monitoring activities configured in the system (and management of monitoring activities)

```
% tm monitor [OPTIONS]
```



- List of programmed activities configured in the system (and management of programmed activities)

```
% tm program [OPTIONS]
```



- List of scheduled activities (PGEs) (and management of scheduled processes)

```
% tm schedule [OPTIONS]
```



- Stop NWC GEO application

```
% tm quit
```

• *The NWC/GEO log file*

- The NWC/GEO generates a log file storing all messages produced by all different components of the NWC/GEO
 - The Process Manager (TM)
 - Product Generator Elements (PGES)
- Log file is stored in \$SAFNWC/logs directory
- Name of the log file provided in the System Configuration File (LOG_FILE keyword)
- Default configuration includes a programmed activity to generate daily log files (*safnwc_prg_logchange.pdt*)
- Log messages are produced with the following format:

```
PRG_TIME      00:00:00
PRG_REPEAT    1d 00:00:00
#
PRG_ACTION    A_LogFile safnwc_tm_system_time.log
```

<DateTime> <Sender> <Version> <PID> <Type> <Message>

```
2016-08-09T00:14:47Z TM 3.0 14253 [I] Adding the Slot 2016-08-09T00:00:00Z to the schedule list
2016-08-09T00:14:47Z TM 3.0 1601 [I] ScheduleExecuteTask: Process 1601 created: Executing
                               /home/safnwc/NWCGEO/bin/GEO-CMA-v40 2016-08-09T00:00:00Z Europe.cfg safnwc_CMA.cfm
2016-08-09T00:14:47Z GEO-CMA 4.0 1601 [I] GEO-CMA.exe start for slot: 2016-08-09T00:00:00Z region: Europe.cfg
2016-08-09T00:18:28Z TM 3:.0 14253 [I] Region Europe, Slot 2016-08-09T00:00:00Z; Processing has concluded
```

- Questions?
- Use the Helpdesk
- Thanks for your attention!