

Introduction to NWC/GEO Products for Nowcasting Applications

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- **Remote Sensing Data for Nowcasting**
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What is Now casting

- Description of the **current state of the atmosphere**
- Very short-range prediction of atmospheric evolution over the **next few hours**

Forecast Time Ranges

- **Nowcasting:** Description of the current atmospheric state and prediction of atmospheric conditions up to **2 hours ahead**
- **Very Short-Range Forecasting:** Prediction of atmospheric conditions up to **12 hours ahead**
- **Short-Range Forecasting:** Prediction of atmospheric conditions from **12 to 72 hours ahead**
- **Medium-Range Forecasting:** Prediction of atmospheric conditions from **72 to 240 hours ahead**
- **Extended-Range Forecasting:** Forecasts for **10 to 30 days ahead**, usually expressed as **anomalies and averages relative to the climatological conditions** over the forecast period

What is NWC SAF?

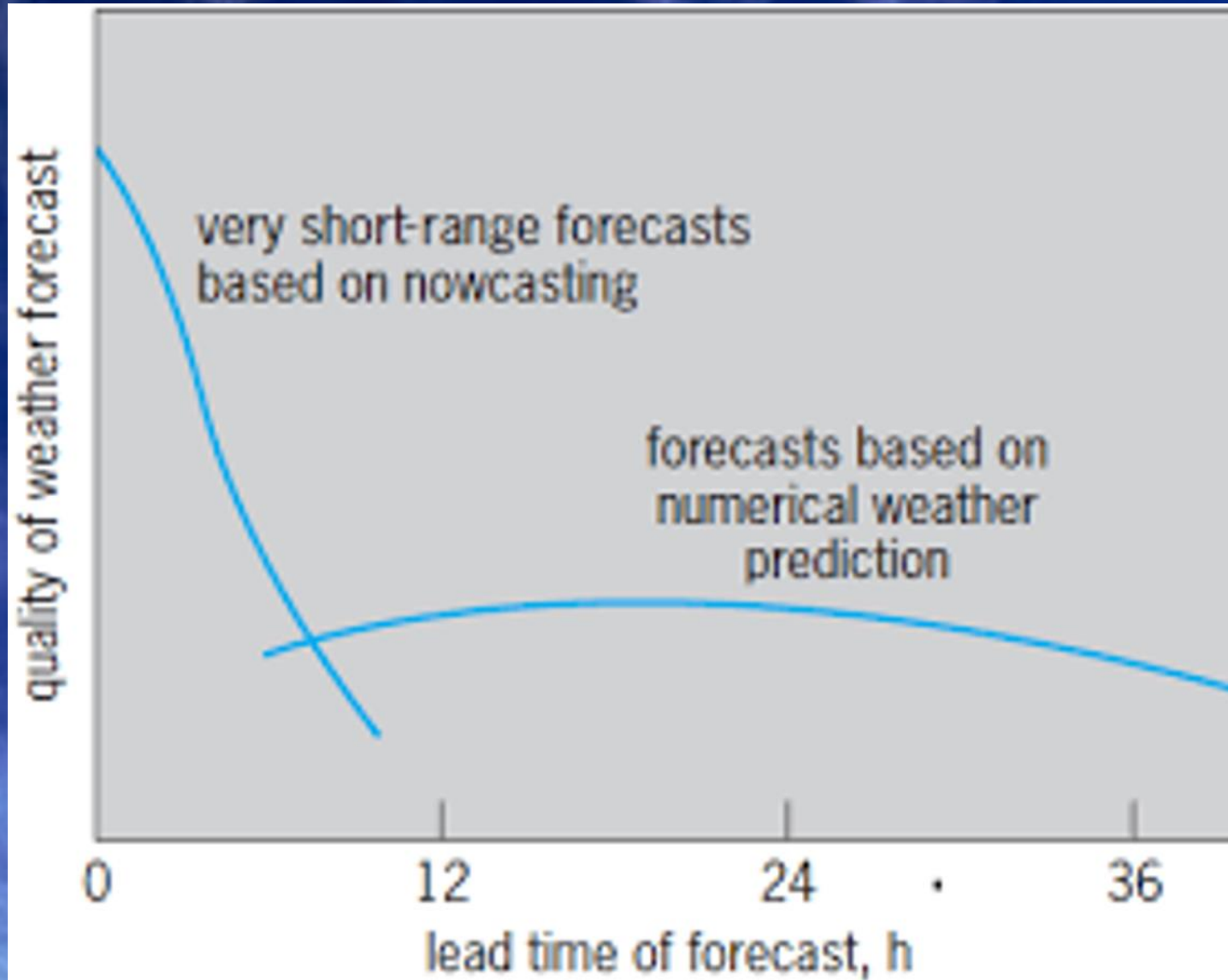
- A EUMETSAT Satellite Application Facility dedicated to Nowcasting
- Develops and provides software for satellite-based nowcasting
- Supports operational forecasting and monitoring of high-impact weather
- Provides near-real-time meteorological information derived from satellite observations

NWC SAF Software Packages

- NWC/GEO — for geostationary satellite observations
- NWC/PPS — for polar-orbiting satellite observations

“In this presentation, we focus on NWC/GEO, the geostationary-satellite component of NWC SAF.”

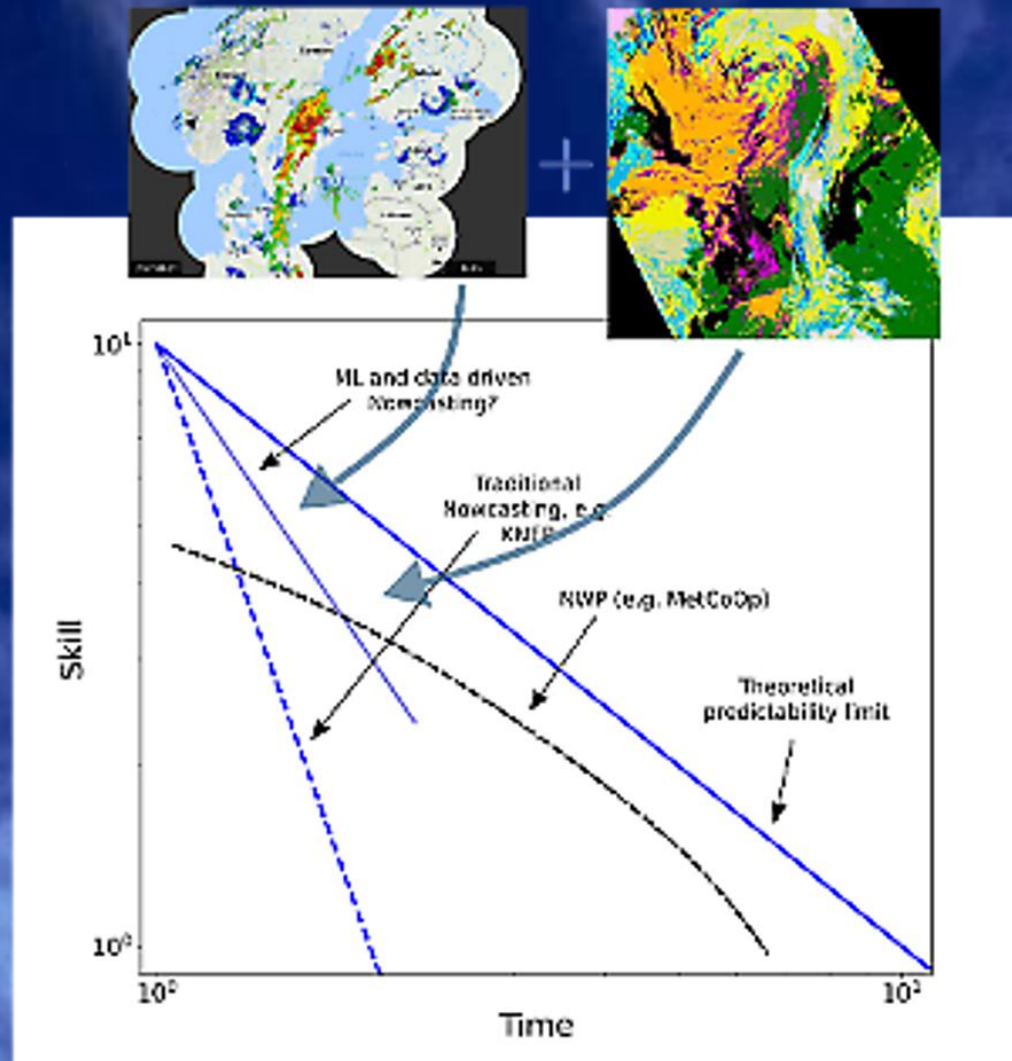
Forecast Skill as a Function of Lead Time



Source: Adapted from Browning (1980); reproduced in Bojinski et al. (2023).

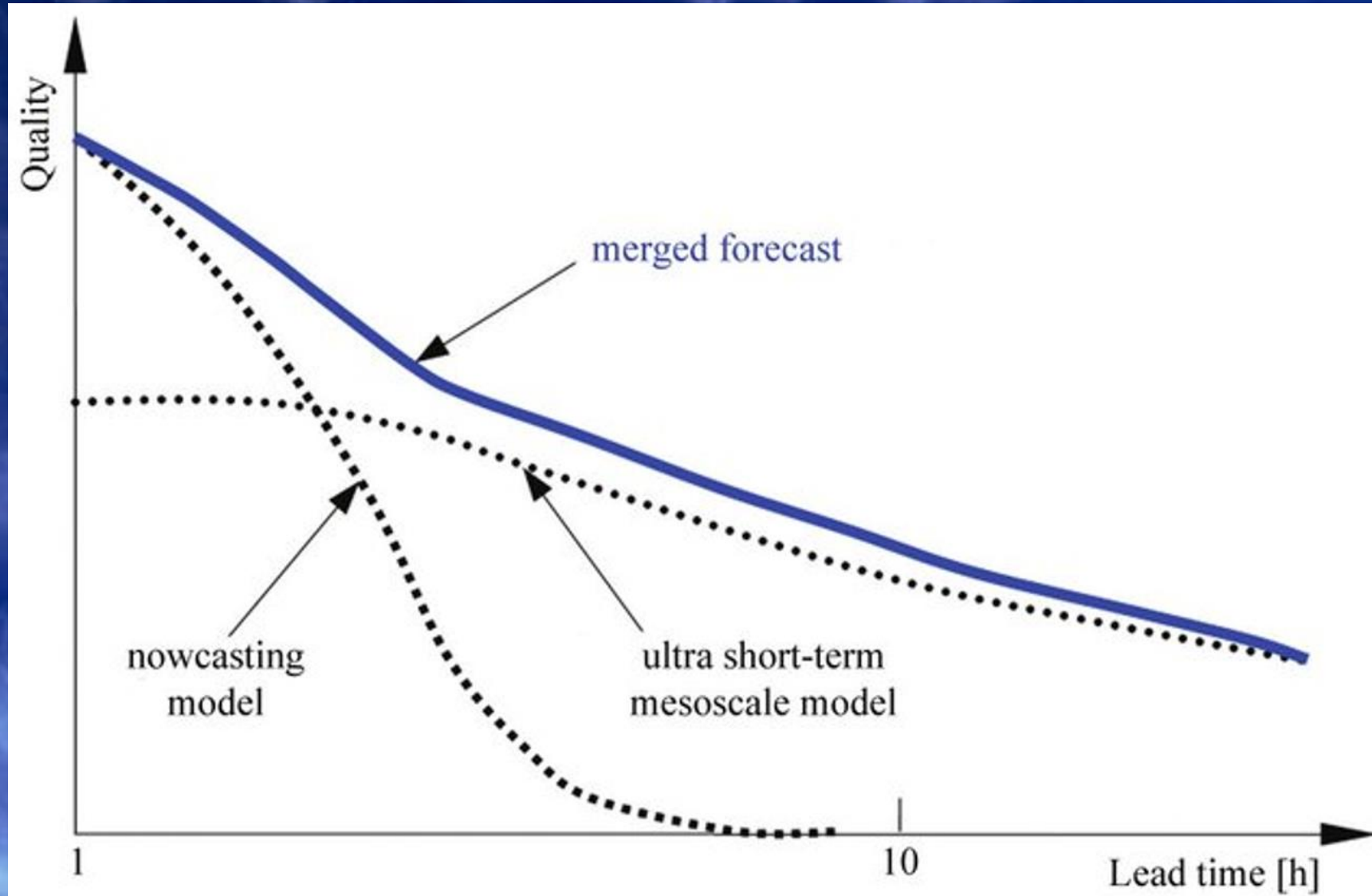
Forecast Skill of Nowcasting, ML, and NWP with Lead Time

Filling a gap in current forecasting skill
on the short spatial and temporal scales



Source: Conceptual schematic based on the literature on nowcasting, machine learning, and NWP.

Seamless Blending of Nowcasting and NWP



Jan Szturc et al., Meteorology, Hydrology and Water Management, 2018.

Key Data Sources by Forecast Range

- **Up to 12 hours:** **Remote sensing observations + NWP** are crucial for nowcasting and very short-range forecasting.
- **12–240 hours:** **NWP/EPS output** becomes the primary source of forecast information.

EUMETSAT Satellite Application Facilities (SAFs)

SAFs are specialized centers within EUMETSAT Member States and partner organizations that develop satellite-based products and services for specific user communities.

<https://www.eumetsat.int/about-us/satellite-application-facilities-safs>

Meet the SAFs



AC SAF

Atmospheric Composition Monitoring

The AC SAF processes satellite data on ozone, other trace gases, aerosols and ultraviolet data.

[Learn more about AC SAF](#)



OSI SAF

Ocean and Sea Ice

The OSI SAF provides comprehensive information on the ocean-atmosphere interface.

[Learn more about OSI SAF](#)



NWC SAF

Nowcasting and Very Short Range Forecasting

Nowcasting is a weather forecast for the next few hours, based on current information.

[Learn more about NWC SAF](#)



CM SAF

Climate Monitoring

The CM SAF generates and archives high-quality climate datasets.

[Learn more about CM SAF](#)



NWP SAF

Numerical Weather Prediction

The NWP SAF supports the interface between satellite data and European activities in NWP.

[Learn more about NWP SAF](#)



H SAF

Operational Hydrology and Water Management

The H SAF generates and archives datasets and products for operational hydrological applications.

[Learn more about H SAF](#)



LSA SAF

Land Surface Analysis

The LSA SAF exploits remotely-sensed data on land, land-atmosphere interactions and biosphere applications.

[Learn more about LSA SAF](#)



ROM SAF

Radio Occultation Meteorology

The ROM SAF generates and archives high-quality GNSS Radio Occultation (RO) data for NWP.

[Learn more about ROM SAF](#)

Main Objectives of the NWC SAF

- **Provide an advanced, robust, and reliable system** for national meteorological services, scientific institutions, and meteorological users in EUMETSAT Member States worldwide, supporting operational and research activities in **nowcasting and very short-range forecasting**.
- **Develop and provide two software packages:**
 - **NWC/GEO** — for geostationary satellites
 - **NWC/PPS** — for polar-orbiting satellites
- **Provide user support and knowledge transfer**, helping end users make maximum use of the software and facilitating the transfer of expertise from the **NWC SAF consortium** to users.

NWC SAF is led by AEMET (Spain), with a project team comprising Météo-France and the national meteorological institutes of Austria, Sweden, and Romania.



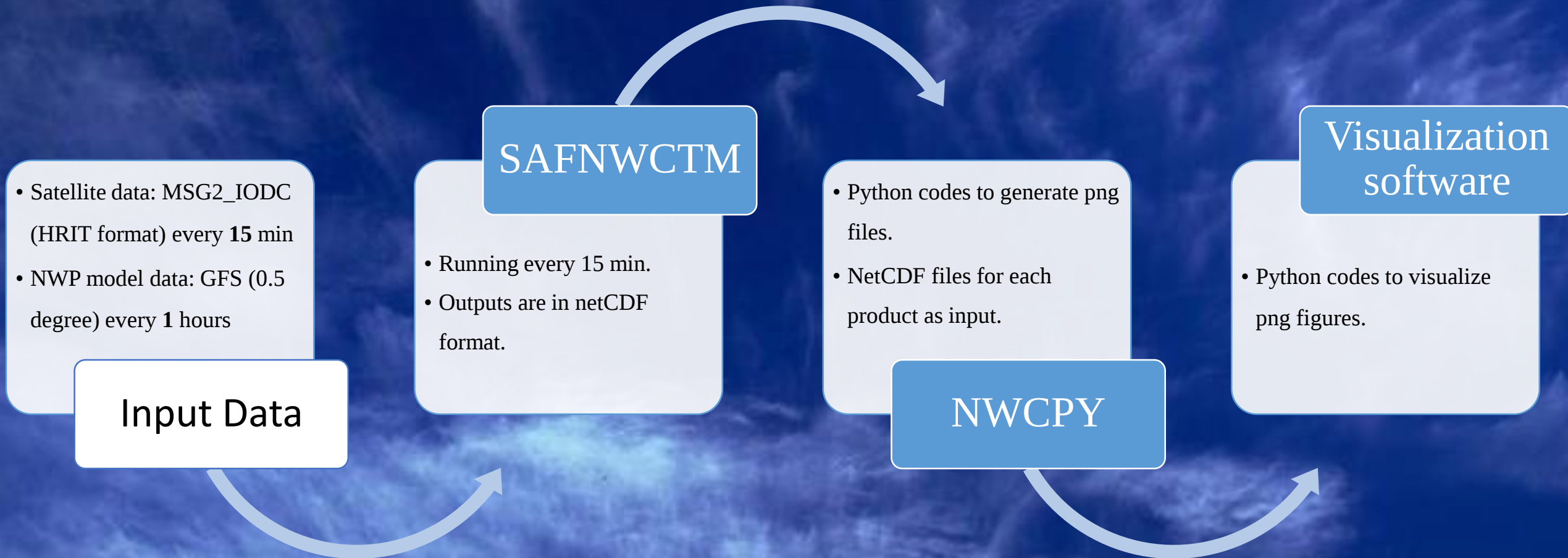
NWC/GEO Input Data

- Although input-data requirements vary depending on the product generation process, the main input data can generally be categorized as:
- **Satellite data:** Meteosat, GOES, Himawari, INSAT,
- **Numerical Weather Prediction (NWP) data:** Multiple fields at the surface and pressure levels
- **Climatological and surface data:** Land-use/land-cover and surface emissivity information
- **Auxiliary satellite data:** Metop, NOAA

NWC/GEO: User Setup and Data Requirements

- **Register as a user** — free and online
- **Download the software** from the NWC SAF website
- **Install the software**
- **Configure the system**, including:
 - Selected satellite
 - Products to be generated
 - Geographic area of interest
- **Provide the required input data**:
 - **Satellite data** — HRIT MSG or MTG files
 - **Numerical Weather Prediction (NWP) data** — e.g., ECMWF or GFS

NWC/GEO Software Components



# PNG files Generated Every 15 Minutes	Product
3	ASII
3	CI
3	CMA
5	CMIC
2	CRR
2	CRRPh
2	CT
4	CTTH
12	HRW
216	EXIM
7	iSHAI
1	PC
1	PCPh
1	RDT
262	Total

Installation of Satellite data

- 1) MTG I1 Primary Service...L1c....Near Real Time.....(+000.0 deg)
- 2) MTG I1 Primary Service...L1c....Reprocessing(+000.0 deg)
- 3) MSG Primary Service.....HRIT...Near Real Time.....(+000.0 deg)
- 4) MSG Primary Service.....HRIT...Reprocessing.....(+000.0 deg)
- 5) MSG Rapid Scan Service...HRIT...Near Real Time.....(+009.5 deg)
- 6) MSG IODC Service.....HRIT...Near Real Time.....(IODC)
- 7) MSG IODC Service.....HRIT...Reprocessing(IODC)
- 8) GOES16....M6.....GOESR..Near Real Time.....(-075.0 deg)
- 9) GOES16....M6.....GOESR..Reprocessing.....(-075.0 deg)
- 10) GOES17....M6.....GOESR..Near Real Time.....(-137.0 deg)
- 11) GOES17....M6.....GOESR..Reprocessing.....(-137.0 deg)
- 12) GOES18....M6.....GOESR..Near Real Time.....(-137.0 deg)
- 13) GOES18....M6.....GOESR..Reprocessing.....(-137.0 deg)
- 14) GOES19....M6.....GOESR..Near Real Time.....(-075.0 deg)
- 15) GOES19....M6.....GOESR..Reprocessing.....(-075.0 deg)
- 16) Himawari-08.....HSD....Near Real Time.....(+140.7 deg)
- 17) Himawari-08.....HSD....Reprocessing.....(+140.7 deg)
- 18) Himawari-08.....EHH....Near Real Time.....(+140.7 deg)
- 19) Himawari-08.....EHH....Reprocessing.....(+140.7 deg)
- 20) Himawari-08.....FSD....Near Real Time.....(+140.7 deg)
- 21) Himawari-08.....FSD....Reprocessing.....(+140.7 deg)
- 22) Himawari-09.....HSD....Near Real Time.....(+140.7 deg)
- 23) Himawari-09.....HSD....Reprocessing.....(+140.7 deg)
- 24) Himawari-09.....EHH....Near Real Time.....(+140.7 deg)
- 25) Himawari-09.....EHH....Reprocessing.....(+140.7 deg)
- 26) Himawari-09.....FSD....Near Real Time.....(+140.7 deg)
- 27) Himawari-09.....FSD....Reprocessing.....(+140.7 deg)

Please select the satellite to configure in the NWC/GEO

1. Primary Products

Products that do not depend on other NWC/GEO products

Category	Product	Acronym
Cloud	Cloud Mask	CMA
Precipitation	Precipitating Clouds	PC
Precipitation	Convective Rainfall Rate	CRR
Precipitation	Precipitating Clouds – Physical	PCPh
Precipitation	Convective Rainfall Rate – Physical	CRRPh
Humidity / Instability	Satellite Humidity and Instability	iSHAI
Convection	Convection Initiation	CI
Conceptual Models	ASII – Tropopause Folding	ASII-TF
Conceptual Models	ASII – Gravity Waves	ASII-GW
Conceptual Models	ASII – Icing	ASII-ICE

2. Derived Products

Products that use one or more other NWC/GEO products as inputs

Category	Product	Depends on
Cloud	Cloud Type	CMA
Cloud	Cloud Top Temperature & Height	CMA, CT
Cloud	Cloud Microphysics	CMA, CT, CTTH
Winds	High Resolution Winds	CT, CTTH
Extrapolated Imagery	EXIM	HRW
Convection	RDT-CW	CT, CMIC, CTTH, CRRPh, HRW <i>(depending on configuration)</i>

- **NWC/GEO is continuously developed and updated; therefore, the algorithms, product specifications, and product portfolio may evolve between software versions.**

NWC/GEO Product Generation Process

- **Extract spectral information** from the satellite channels
 - IR: brightness temperatures (BT)
 - VIS/NIR: reflectances
- **Derive spectral features**
 - BT differences between IR channels
 - Reflectance ratios between VIS/NIR channels
- **Compare these spectral features with dynamic thresholds**, considering surface type, solar elevation angle, and NWP profiles.
- **Make pixel-level decisions** using decision trees or similar classification methods.
- **Apply spatial and temporal consistency checks.**
- **Perform quality control and provide confidence information.**

How Does NWC/GEO Support Nowcasting?

- 📡 📡 Satellite observes a developing storm
- 🖥️ NWC/GEO generates meteorological products
e.g., rainfall rate, cloud properties, convection indicators
- 📡 📡 Forecaster analyzes the products and assesses potential impacts
- ⚠️ 📢 Warnings are issued to the public, when necessary

Observe → Generate → Analyze → Warn