Lead Author: Deltares	Peer Reviewer: GeoVille

WEATHER

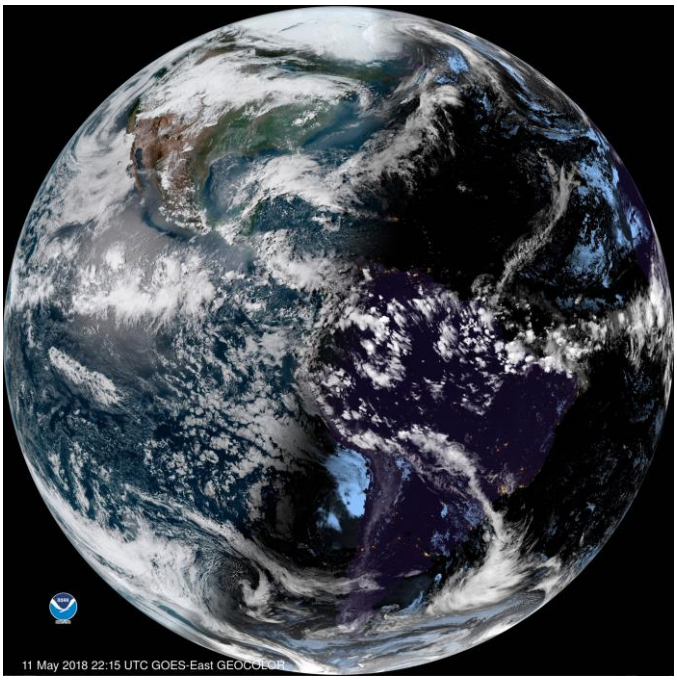


Image taken from GOES weather satellite

PRODUCT DESCRIPTION

Category

☐ Topographic information	☐ Surface deformation
☐ Impact assessment	☐ Precision ortho-images
☐ Change detection / continuous monitoring	☐ Terrain information
☐ Land cover / use	☒ Water quantity & quality
☐ Near surface geology	

Uses

Exploration – Weather to know whether sites are accessible by foot or by helicopter. Understanding weather is critical to allow safe access to exploration sites.

Design, Construction & Operations – Weather

Closure and Aftercare – Weather

Challenges addressed

Exploration – Weather

Permitting Process – Weather/Climate

Development and Operations – Weather

Closure and Aftercare – Weather

Geo-information requirements

E-5 – Weather

P-13 - Weather/Climate

DO-29 – Weather

CA-12 – Weather

Description

Weather satellites are available in geostationary orbit (focusing on one geographical region), in Low Earth Observation orbit (LEO, sun-synchronous), and High Earth Observation orbit (HEO, sun-synchronous can be used for frequent Earth observation of high latitudes or for the purpose of space weather). The geostationary satellites are further away from the earth's surface and have thus a lower spatial resolution, whereas the non-geostationary satellites are closer to the earth's surface with its higher spatial resolution. However, the geostationary satellites can monitor more frequent throughout time. Currently, geo-stationary satellites provide continuous view of about 1/3 of the Earth's surface. Full coverage of all longitudes, excluding polar regions, requires six fairly-spaced satellites, nominally stationary over 0°, 60°E, 120°E, 180°, 120°W and 60°W.

The weather satellites don't give only insight in cloud-cover but also can provide information about: humidity, smoke, precipitation, aerosols, sea ice, snow cover, winds, lightning and sea surface/atmospheric/surface temperature. Depending on the spectral channel different parameters can be detected at different spatial resolutions. Precipitation is also observed with Precipitation radar satellites. Besides these sensor types also microwave (sun-synchronous, 3 orbits), multi-purpose meteorological (multispectral, visible and infrared, sun-synchronous and geo-stationary) imagers are frequently used for weather assessment: sea surface temperature, aerosols, land surface temperature, cloud properties and wind tracks.

The weather satellites observe and monitor, where the results are used for research, modelling and prediction. Based on the observed meteorological parameters climate services (short-term, medium-term and long-term forecasting) are being developed. Weather observations and forecasts can be expected to be available in several formats: continuous (in case of geo-stationary satellites), 3-hourly, daily.

Known restrictions / limitations

Weather satellites are used in weather models to forecast weather. The forecasting can take some time and because it is modelled uncertainty in quantity/quality occur.

Lifecycle stage and demand

Exploration	Environmental Assessment & Permitting	Design, Construction & Operations	Mine Closure & Aftercare
■■■	■	■■■■	■■■

General: Weather is important to mining industries in all stages of the mining life cycle, because it can provide insight in safe access and emergency access.

Exploration: sites are often in remote parts of the world and may need to be accessed by foot on ephemeral tracks or indeed by helicopter. Understanding the weather is critical to allow safe access to exploration sites.

Design, Construction & Operations: Weather is important to mining industries as severe weather can interrupt production and operators may need to implement emergency plans for certain weather events such as rainstorms / hurricanes / extreme cold.

Closure and Aftercare: Weather continues to be an important factor post closure. The most important individual parameter will be precipitation as it will directly influence the water balance in the site. Closure plans should be designed and implemented to cater for storm events (most jurisdictions will require one analyse weather post closure is less important than it would have been when the site was in operation, as the site should be capable of dealing with all-weather scenarios without the need for additional preparations. Weather data is also important in a post closure scenario to assess revegetation factors, particularly in more arid environments. In a post closure scenario the main area of interest will be relating to the TSF and WRD's and any other remaining infrastructure as such the area of interest will be in the order of 1km2 to 10km2. There are too many individual weather parameters to detail. Post closure precipitation is the key parameter - mm/day is the desired resolution. In a post closure scenario, access to daily weather data is sufficient.

Geographic coverage

Depending on the satellite, regional or global. Global coverage is available

EARSC Thematic Domain

Domain	*Atmosphere and Climate*
Sub-domain	*Meteorology*
Product description	*Forecast weather*

PRODUCT SPECIFICATIONS

Input data sources

There are many weather satellites which are bundled in the World Meteorological Organisations (WMO) global network of Meteorological Satellites (WIGOS). The geostationary satellites focus on one specific geographical region, whereas the sun-synchronous are polar-orbiting and cover (almost) the globe.

Operational within WIGOS

Geostationary

- *GOES 14,15,16,17 (NOAA/NASA)*
- *Meteosat 8,9,10,11,12 (EUMETSAT/ESA)*
- *INSAT – 3D, 3DR (ISRO)*
- *Electro-L N2 (RosHydroMet)*
- *FENGYUN 2F, 2G, 2H, 4A (CMA)*
- *COMS (KMA/KARI)*
- *GEO-KOMSPAT-2A (KMA/KARI)*
- *Himawari-8 (JMA)*

Sun-synchronous

- *NOAA 15,18,19,20, 5th generation (NOAA/NASA)*
- *Metop-A, B, C (EUMETSAT/ESA)*
- *Meteor-M N2 (RosHydroMet)*
- *FENGYUN 3B, 3C,3D (CMA/NRSCC)*
- *SNPP (NOAA/NASA)*
- *DMSP – F16,F17,F18 (DoD/NOAA)*

Other

- *Terra*
- *PROBA-1*
- *Aqua*
- *Coriolis*
- *Aura*
- *CALIPO, CLoudSat*
- *Sentinel*
- *OceanSat*
- *GOSAT*

Planned:

- *FENGYUN – 4th generation (CMA/NRSCC)*
- *EUMETSAT POLAR SYSTEM – 2nd generation*
- *METEOSAT – 3rd generation (MTG)*
- *Meteor-M N2-4*
- *EPS-SG (EUMETSAT/ESA)*

Below will follow a few of the commonly used satellites:

Satellite	*GOES*	*FENGYUN*	*METEOSAT*	*Metop*	*NOAA-POES*	*Himawari-8*
Status	In operation	In operation	In operation	In operation	In operation	In operation
Operator	NOAA/ NASA	CMA/NRSCC	EUMETSAT/ ESA	EUMETSAT/ ESA	NOAA	JMA
Data availability	Public	Public	Public	Public	Public	Public
Resolution (m)	1km, 2km	250 m – 1.25 km	3 km	1 km	1 km	1-2 km
Coverage	137.2 W, 128 W, 105 W, 75.2 W,	79 E, 99.5 E, 105 E, 112 E, Global	0 E, 3.5 E, 9.5 E, 41.5 E	Global	Global	140.7 E
Frequency (days)	10, 30, 40 minutes	15 minutes	3 times per day	3 times per day	3 times per day	10 minutes
Launch year	2010-2018	2012-2018	2005-2016	2006 / 2012 / 2018	1998/2005/2009	2014
Website	link	link	link	link	link	link

Minimum Mapping Unit (MMU)

n/a (the product is directly based on the input data; the smallest unit is 1 pixel, see above for spatial resolution of pixel size)

Accuracy / constraints

Thematic accuracy:

Atmosphere and Climate – Meteorology 80-90%.

Spatial accuracy:

The satellites connected to the WIGOS network will be reviewed for their consistency, specified spatial and temporal resolution and timeliness. Different weather products (E.g. clouds, precipitation, temperature have different spatial accuracies).

Accuracy assessment approach & quality control measures

The satellites connected to the WIGOS network will be reviewed for their consistency, specified spatial and temporal resolution and timeliness. Different weather products (E.g. clouds, precipitation, temperature have different spatial accuracies).

Timeliness

Usually near real-time available. The weather forecast uses the weather satellites for their model forecasts and are usually also near real-time available.

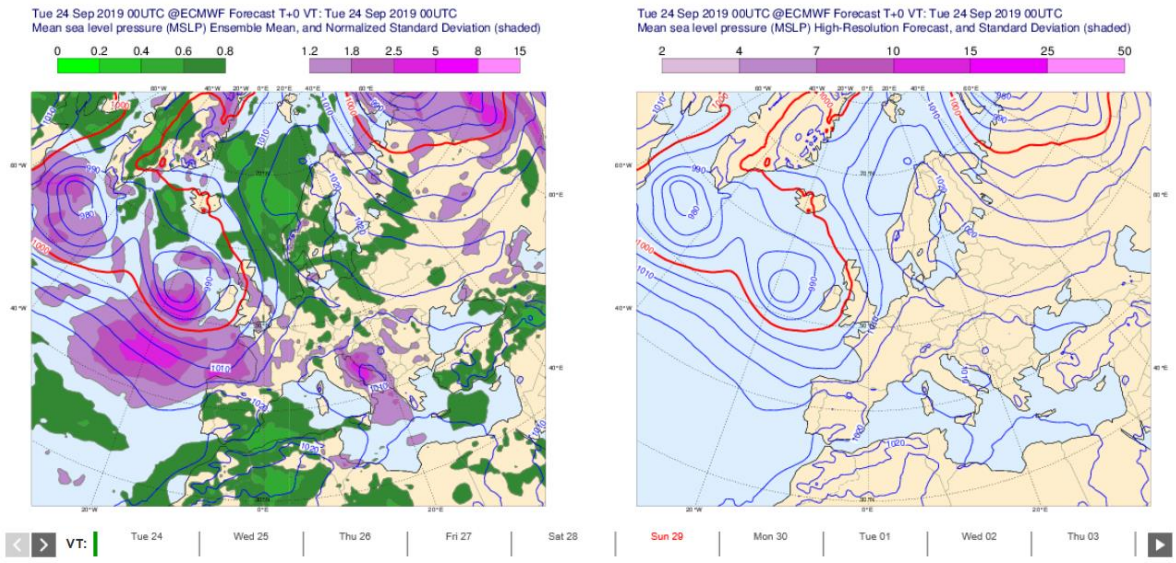
Availability

Data is typically freely available through the open data policy of the different space agencies. See for an overview of the frequently used satellites the table above.

Delivery / output format

Typically the datasets are delivered in NetCDF format. The processed data in weather forecasts are also typically available in NetCDF and in web interfaces.

Use Case



Source: ECMWF

Weather satellites are used for medium term forecasting. For example using the ECMWF ensemble model, which provides forecasts of mean se level pressure (MSLP) over Europe in high resolution.

Author(s): Margreet van Marle

Document Title: Weather

# of Pages: 5

Circulation: Internal – Project consortium and industry partners
External – ESA

REVISION LOG

(to be filled out by authors/reviewers/word processors)

Revision				Description
Number	**Date**	**Revised By**	**Approved By**	
Version 0.1	August 16, 2019	Margreet van Marle		Provision of first Word version
Version 0.2	September 23, 2019	Margreet van Marle		Provision of reviewed Word version