The Arctic Weather Satellite - a small satellite concept to improve Arctic and global weather forecasts through millimeter and sub-millimeter microwave sounding

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Mission overview

Preparations are underway at the European Space Agency (ESA) for the **Arctic Weather Satellite**, a small satellite (120 kg) in sun-synchronous orbit aimed at improving Arctic and global weather forecasts. It features a cross-track scanning microwave (MW) radiometer with temperature and humidity sounding capabilities in the traditional 54 and 183 GHz bands, complemented with a new channel set in the 325 GHz humidity band. The latter will provide enhanced information on humidity as well as ice clouds.

Planned launch: 2024

Mission lifetime: 5 years

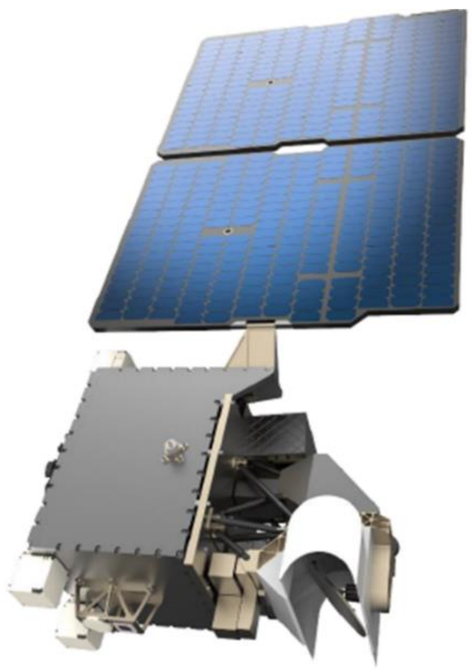
Prime contractors: Mission: OHB (SE); instrument: Omnisys (SE); ground segment: Thales Alenia Space (FR)

The satellite is a prototype for a **potential future constellation**, to complement the backbone core observing missions such as EPS-SG or JPSS. It will address the need for higher temporal sampling from MW sounding instruments for Numerical Weather Prediction, beyond the data available from the backbone missions.

See also: **www.esa.int/aws**

Satellite

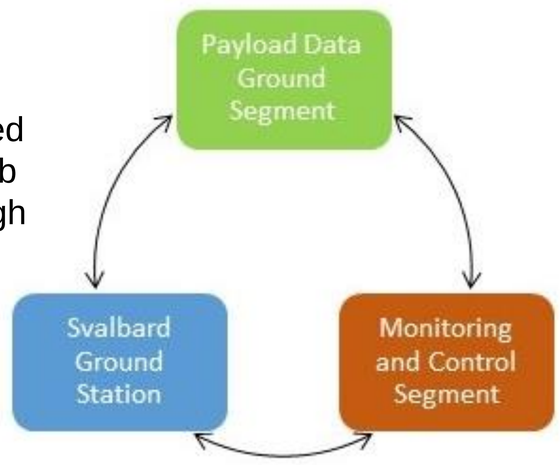
- Three-axis stabilised, 120 kg,
- Dimensions: 1.1 m x 0.7 m x 0.8 m
- Power consumption: 120 W (deployable, fixed-angle solar arrays)
- Electric propulsion for orbit control
- Orbit: 595 km, sun-synchronous, ECT tbd
- Mission control: Tromsø and Svalbard (NO)



Data flow

Global science data will be downlinked to Svalbard (NO), processed to level 1b and distributed in near-real-time through Eumetsat's **EUMETCast** system.

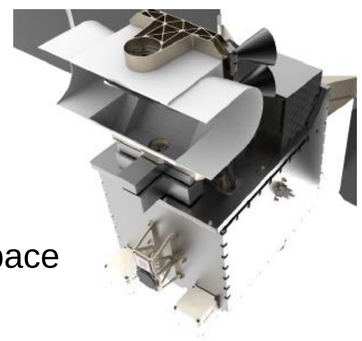
Direct Data Broadcast will also be available in L-band for regional particularly time-critical applications.



Future constellation

Requirements and further aspects of the potential future constellation of AWS satellites are currently being developed together with EUMETSAT, in dialogue with representatives from the user community. This constellation will be designed to significantly improve the temporal sampling available from MW sounders over the polar regions and globally, and it will complement the backbone core observing missions such as EPS-SG or JPSS.

Instrument payload



- Cross-track scanning MW radiometer
- Scan-rate: 45 RPM
- Four feedhorns, four receivers
- Calibration: On-board blackbody target and cold space

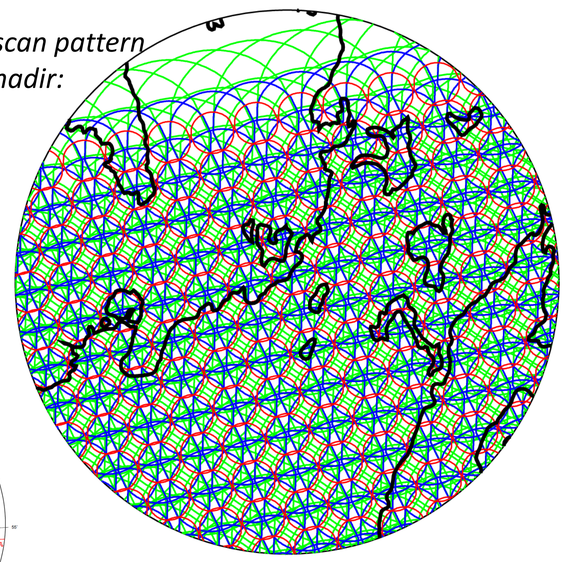
Table 1: Main channel characteristics of AWS:

Frequency (GHz)	Bandwidth (MHz)	Sample NEDT (K)	Footprint (km)	Utilisation
50.3	180	<0.6	≤ 40	T-sounding
52.8	400	<0.4	≤ 40	T-sounding
53.246	300	<0.4	≤ 40	T-sounding
53.596	370	<0.4	≤ 40	T-sounding
54.4	400	<0.4	≤ 40	T-sounding
54.94	400	<0.4	≤ 40	T-sounding
55.5	330	<0.5	≤ 40	T-sounding
57.290344	330	<0.6	≤ 40	T-sounding
89.0	4000	<0.3	≤ 20	Window
165.5	2800	<0.6	≤ 10	Window, humidity
176.311	2000	<0.7	≤ 10	Q-sounding
178.811	2000	<0.7	≤ 10	Q-sounding
180.311	1000	<1.0	≤ 10	Q-sounding
181.511	1000	<1.0	≤ 10	Q-sounding
182.311	500	<1.3	≤ 10	Q-sounding
325.15±1.2	800	<1.7	≤ 10	Q-sounding/ice clouds
325.15±2.4	1200	<1.4	≤ 10	Q-sounding/ice clouds
325.15±4.1	1800	<1.2	≤ 10	Q-sounding/ice clouds
325.15±6.6	2800	<1.0	≤ 10	Q-sounding/ice clouds

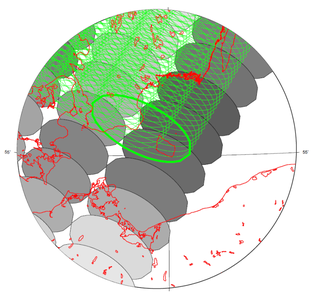
Scan-pattern:

- Max. scan angle: 54.42º
- Swath width: ~ 2000 km
- 115 pixels per scan; contiguous sampling for 165.5-325 GHz channels, over-sampling for the other channels

AWS scan pattern near nadir:



AWS FOVs (green) for 50 GHz channels at the edge of the swath compared to AMSU-A (grey):



50 – 54 GHz , 40 km near nadir
89 GHz , 20 km near nadir
166/183 325 GHz , 10 km near nadir

Applications

Key application areas for AWS and a potential future constellation are:

- **Numerical Weather Prediction**, in global and regional systems: These show continued benefit from further all-weather sounding capabilities such as the ones provided by AWS. The AWS constellation will not only improve the representation of temperature, humidity and clouds, but by supplying frequent observations it will also add information on winds by enabling tracing of humidity or cloud structures.
- **Nowcasting:** The high-temporal resolution of the AWS constellation will revolutionise nowcasting in the polar regions.
- **Climate:** AWS observations will also support research into processes relating to climate change which occurs at a higher pace in the Arctic compared to other parts of the world.