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Fact Sheet

ESA Earth Observation Mission: *Aeolus* measures the wind

On 21/08/2018 the European Space Agency ESA will launch the scientific Earth observation mission, *Aeolus*. The development of this first of its kind satellite and its high-precision laser instrument includes Swiss cutting-edge technology. *Aeolus* will in the future enable researchers to determine global wind profiles and contribute to further improve weather forecasts as well as climate models.

In addition to the Earth observation satellites for meteorology and those for the EU's Global Monitoring for Environment and Security System "Copernicus/GMES", ESA is also developing a series of scientific missions (*Earth Explorers*) that will contribute to a better understanding of the Earth system and its processes. *Earth Explorers* also make it possible to test new observation techniques in space. Following the launch of the *Earth Explorer* satellites *GOCE* (Earth's gravity field), *SMOS* (soil moisture), *CryoSat-2* (ice masses) and *Swarm* (Earth's magnetic field) in recent years, *Aeolus* is the fifth *Earth Explorer* mission. Further missions are under development to study the Earth's radiation balance, to record the global biomass and carbon deposits and to determine the photosynthetic activity of the vegetation.

Aeolus, the wind mission

The main task of *Aeolus* is to determine global wind profiles in the atmosphere. The wind is a central component of the atmospheric exchange and essentially governs our weather and climate. Reliable and timely availability of global wind data helps to improve our understanding of atmospheric dynamics, the transport of energy, water, aerosols, and chemical and other particles in the atmosphere. Furthermore, knowledge of the wind speed is of central importance for weather forecasting. For example, global wind profiles enable a more accurate determination of the input variables into the forecast models, which in turn improves the forecasts. *Aeolus* data will also be used in air quality models to predict the distribution of dust and other particles in the air. The data recorded by *Aeolus* will be received by the Svalbard ground station (Norway). Following pre-processing, the information will be sent to the European Center for Medium-Range Weather Forecasts (ECMWF) as well as to ESA's Earth Observation Center ESRIN for processing. The data will then be available to all users. MeteoSwiss will also integrate these new wind measurements into its numerical weather forecast in the medium term as part of the assimilation of satellite data with the view that this will improve its forecasts.

Aeolus' payload consists of the instrument *ALADIN* (*Atmospheric Laser Doppler Instrument*). *ALADIN* emits lights pulses into the atmosphere in the ultraviolet range (355 nm). It then registers the signal that is scattered back by molecules, aerosols, dust or other particles in the atmosphere. Vertical profiles – up to a height of 30 km – of the horizontal wind, can be derived from the Doppler-shifted pulses. To capture the backscattered light, a 1.5 m telescope weighing a mere 55 kg is used. *ALADIN* measures around 100 wind profiles per hour with an accuracy of 1-2 m / s. It is the first wind lidar in space, which is built in Europe.

ADM Aeolus (artistic presentation) © ESA

The launch of *Aeolus* from the European launch center in Kourou (French Guiana) is scheduled for 21 August 2018 (start time: 23:20 Swiss time). A Vega launcher will bring the satellite of approximately 1.36 ton into a sun-synchronous orbit at a height of 320 km. After a test-phase, *Aeolus* will be operational for three years.

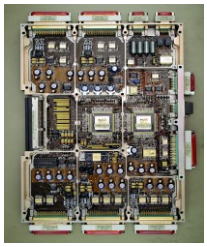
Swiss contribution in *Aeolus*

The main contractor for the development of *Aeolus* is Airbus Defence and Space. Swiss actors contributed as follows:

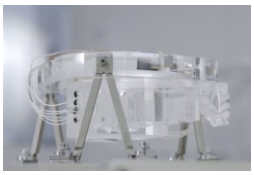
- → APCO Technologies SA has developed a specific mechanical equipment set for the safe handling of the satellite during integration. It also provided the container for its safe transport.
- → Connova AG built the primary structure for the *ALADIN* instrument which is a key component: it carries the high-precision laser system as well as electronic units and must therefore meet high stability requirements while being the lightest possible.
- → RUAG Space Switzerland built the entire structure of the satellite. It also developed the mechanism for switching between the two laser sources. For this purpose, it positions a prism into the light path or not, with a precision to the nearest micrometer. Furthermore, the company built the precision mechanism and its associated electronics, which move a flap to cover the receiver optics so that it is not dazzled during the emission of light pulses. This mechanism has to operate almost permanently and move the flap at a frequency of 100 Hz. Here too, the high demands placed on precision and, in particular, on low power consumption were the challenge.
- → Syderal SA developed the *ALADIN* Control and Data Management (ACDM) electronic unit. It provides functions for the synchronization between the laser pulses and the data acquisition, for the thermal regulation and for command and data processing.
- → Thales Alenia Space Switzerland AG built the Mie and Rayleigh spectrometer for the *ALADIN* instrument. It involves complex optical assemblies that are thermally stabilized with an accuracy of 1 mK and thus contribute significantly to the correct functioning of the instrument.

Integration Trolley © APCO

Switching mechanism © RUAG



ACDM © Syderal



Rayleigh Spektrometer
© TAS Switzerland AG

Thanks to this involvement – made possible by Switzerland's contribution to ESA's Earth observation programme – and to the experience and expertise gained, Swiss actors will also be able to play an active role in future development activities in the ESA Earth observation programme.

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