Driven by science

ESA’s Earth Explorer missions are developed in direct response to priorities identified by the scientific community. Carrying novel technologies, each satellite in the series is developed to improve our understanding of how the planet works as a system and the impact that human activity is having on natural Earth processes.

By providing timely and accurate profiles of the world’s winds along with information on aerosols and clouds, the Aeolus mission will not only advance our understanding of atmospheric dynamics, but will also provide much-needed information to improve weather forecasts. This state-of-the-art mission will also contribute to climate research.

Breakthrough laser technology

The Aeolus satellite carries a single instrument – a Doppler wind lidar called Aladin. This sophisticated instrument is designed to probe the lowermost 30 km of the atmosphere to provide profiles of wind, aerosols and clouds along the satellite’s orbital path. Comprising a powerful laser, a large telescope and a very sensitive receiver, Aladin is the first wind lidar in space.

The laser system emits short powerful pulses of ultraviolet light down into the atmosphere. The telescope collects the light that is backscattered from air molecules, particles of dust and droplets of water. The receiver analyses the Doppler shift of the backscattered signal to determine the wind speed at various altitudes below the satellite.

Understanding Earth’s wind

It goes without saying that accurate weather forecasts are important both for commercial activities such as farming, fishing, construction, transport, energy exploitation and, of course, for generally planning our daily affairs.

Although weather forecasts have advanced considerably in recent years, meteorologists urgently need reliable global wind-profile data to improve the accuracy of forecasts even further.

Currently, wind information is either derived from temperature observations and is hence low resolution, or is measured directly but does not cover the whole globe.

The World Meteorological Organization has, therefore, identified the lack of direct global wind profile measurements as one of the major deficits in the current Global Observing System.

By filling this gap, Aeolus will improve weather forecasts and climate modelling along with considerable socio-economic benefits. In particular, better forecasts of extreme weather events will be of importance.

Reliable knowledge of Earth’s wind fields will also advance our knowledge of atmospheric energy, water, aerosol and chemistry cycles.
Beyond wind

Long-term records of aerosol and cloud properties are needed to further our understanding of climate change. NASA’s CloudSat and Calipso satellites currently supply data on these important variables, but these missions will soon come to an end. The further provision of aerosol and cloud information from Aeolus will help bridge the gap until ESA’s dedicated cloud, aerosol and radiation mission, EarthCARE, is launched.

Facts and figures

- Launch: 2018
- Launcher: Vega
- Orbit: altitude of around 320 km; Sun-synchronous
- Mission life: 3 years
- Satellite: cubic platform and cylindrical instrument structure, weighing 1360 kg (including 266 kg fuel)
- Instrument: direct detection Doppler wind lidar, Aladin, operated at 355 nm; separate detection of molecular and particle backscatter (high-spectral resolution)
- Power: 2.4 kW deployable solar array (2×3 panels) with GaAs cells; 84 Ah Li-ion battery
- Mission control: ESA’s European Space Operations Centre (ESOC) in Darmstadt, DE
- Communication: ground stations in Kiruna, SE (telemetry); Svalbard, NO, and Troll, AQ (science data)
- Data processing: Tromsø, NO, managed by ESA’s Centre for Earth Observation (ESRIN) in Frascati, IT
- Wind profile retrieval: European Centre for Medium-Range Weather Forecasts (ECMWF) in Reading, UK
- Project and commissioning: managed at ESA’s European Space Research and Technology Centre (ESTEC) in Noordwijk, NL
- Operations: managed at ESA’s Centre for Earth Observation (ESRIN) in Frascati, IT

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Wind forecast produced by a weather model. Observations from Aeolus will greatly improve such forecasts.

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