Aeolus – The first satellite to study wind on a global scale is in orbit

Only two weeks have gone by since it went into orbit on 22 August, but the **Aeolus** satellite has already sent the first data on wind in our atmosphere. This revolutionary mission, the first of its kind, accomplished by the **European Space Agency** (ESA), has exceeded all expectations, transmitting the first data even though its life in space has only just begun.

The Arianespace **Vega** VV 12 rocket with the European Aeolus satellite on board was launched on 22 August 2018, after a delay of 24 hours due precisely to strong winds at high altitude above the spaceport at Kourou, in French Guyana.

Take-off of the Vega launching rocket with the Aeolus satellite on board, on 22 August 2018 from the Kourou spaceport (Copyright ESA – S. Corvaja)

Aeolus, named after the *keeper of the winds* in Greek mythology, is the first satellite mission designed to acquire wind profiles in the Earth's atmosphere on global scale. These observations, supplied almost in real time, will be used to improve the accuracy of the numerical forecasts used in the meteorological and climate fields and will help us improve our understanding of dynamics and tropical processes important for climate variability.

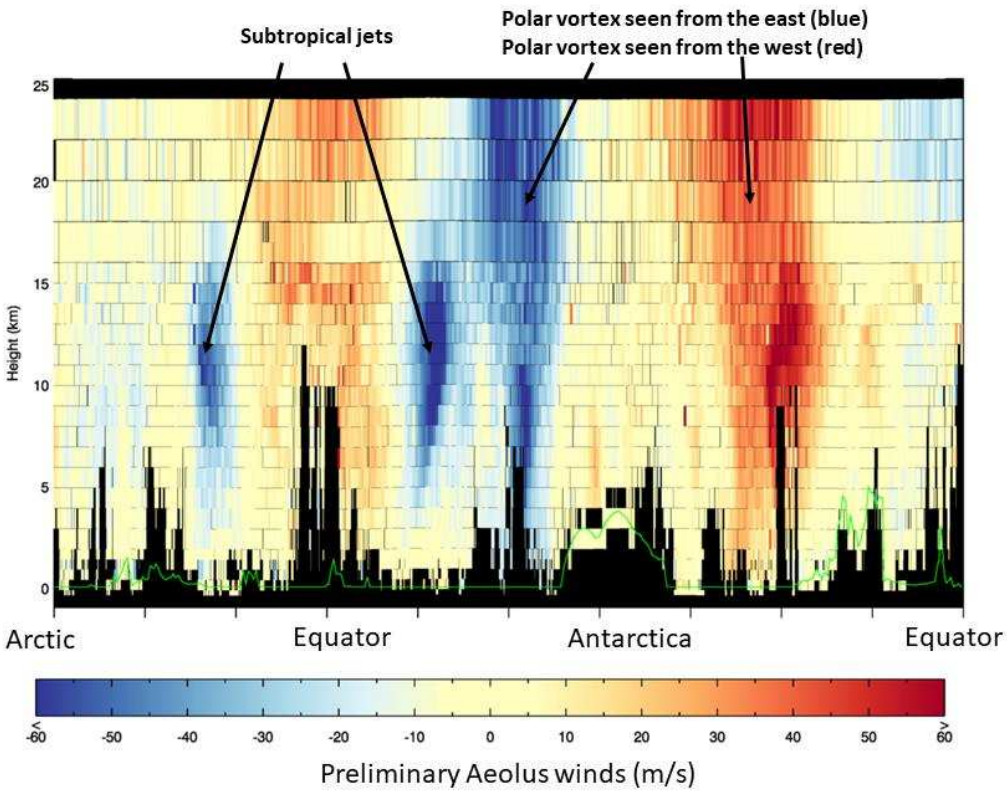
Its data therefore go to fill one of the major gaps in the earth observation system: the lack of direct and global wind measurements. In fact, currently, the majority of direct observations on wind are obtained from radiosondes launched daily from stations on earth, located prevalently in the northern hemisphere. Information on wind from the field in remote regions, above oceans, in the tropics and in the southern hemisphere are for the most part indirect.

This new mission is the fifth in the family of the ESA Earth Explorers and it transports the first instrument of its kind, a **LIDAR Doppler** (English acronym for *Light Detection and Ranging*) called Aladin, using a completely new approach to measure wind from space. LIDAR is an active remote sensing instrument and, unlike its “cousin” radar that uses radio

waves, it uses, in the visible or near infrared. Aladin, which uses laser technology, can collect information on wind speed, turbulence and forecast unforeseen gusts.

Many aspects of our lives are influenced by weather. It goes without saying that accurate forecasts are important for commercial enterprises in such areas as farming, fishing, building and transport. In extreme circumstances, knowing what the weather will bring may also save lives. While weather forecasting has improved considerably over the past few years, having reliable data on the global wind profile will further increase precision.

The initial data

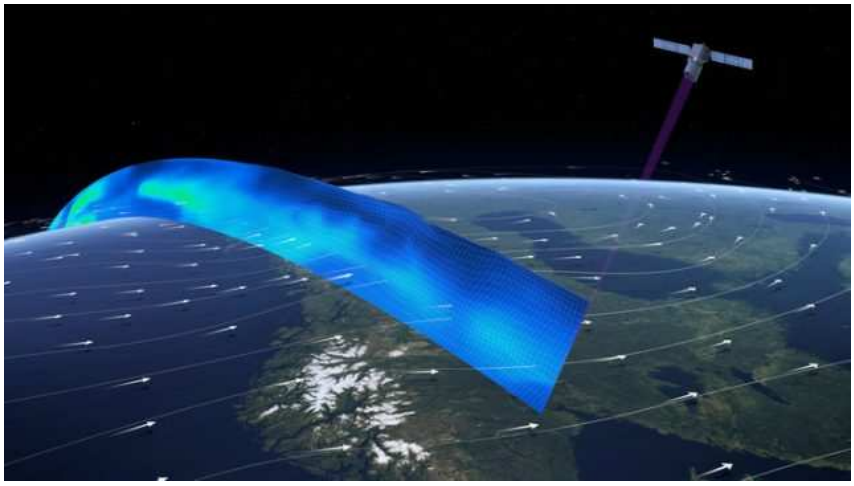


The initial data on wind received from the Aeolus satellite. The plot shows large-scale easterly and westerly winds between the Earth's surface and the lower stratosphere, including subtropical jets streams (shown in blue) and the polar vortex above the Antarctica (shown in blue and red). The general direction of the wind is always the same along the polar vortex, but since the measurement is linked to the satellite's observation direction, the colour changes from blue to red while the satellite crosses the Antarctic continent. (Copyright ESA/ECMWF)

Florence Rabier, Director-General of the European Centre for Medium-Range Weather Forecasts (ECMWF), states: "*We always knew that Aeolus would be an exceptional mission, but these first results have really impressed us. The satellite hasn't even been in orbit a month yet, but the results so far look extremely promising. Aeolus looks set to provide some of the most substantial improvements to our weather forecasts that we've seen over the past decade.*"

The initial wind data sent by Aeolus and shown in the plot produced by ECMWF are from one orbit. It is possible to see large-scale easterly and westerly winds between the Earth's surface and the lower stratosphere, including subtropical jets streams (fast flowing, narrow, meandering air currents that form at high altitude and can reach very high speeds) and strong winds called the Stratospheric Polar Vortex (in blue and red), around the South Pole. The scientific community is very keen to study the Polar Vortex, since it plays a very important role in the depletion of the ozone layer over the South Pole.

Characteristics of the satellite



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The satellite, with an overall weight of 1360 kg, flies along a polar orbit at an altitude of 320 km above the Earth's surface. This is a relatively low orbit and a compromise between the needs for collecting measurements and those for maintaining fuel consumption at a minimum. Aeolus takes approximately one and a half hours to complete an orbit around the Earth and is able to cover the whole globe in seven days, providing wind profiles up to an altitude of 30 km.

The measurements it takes will also be used in air quality models to improve forecasts on dust and other particles suspended in the air that have an impact on public health.

The data are transmitted to a ground station in Svalbard, in Norway, and then sent to the processing centre: here the measurements collected by the instrument are transformed into wind profiles. These processed data are then sent to the various meteorological offices to be used in weather forecasts.

by Lucia Laurenza