# We Hear From

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Anil Kumar Ghosh

## Satellite Merlin Observes the Methane Content in the Earth's Atmosphere

The satellite Merlin should finally provide the scientists the total picture of methane content in earth's atmosphere and its development. The researchers will investigate the methane molecule with the help of laser-rays at a height of 500 km above the earth's surface.

Methane acts upon the climate 25 times stronger than carbon dioxide. In addition to that it raised the methane content in the atmosphere in the early period clearly stronger than the CO2 portion. However the distribution and the behavior of green house gases in the atmosphere are unknown. Beyond 2020 a French-German climate mission in cosmos will bring light in darkness literally. On the research satellite Merlin a Lidar (Light detecting and ranging) is installed which wants to track down methane with the help of laser. Similarly as with a radar the reflections of light impulse give disclosure on the searched for object.

The technical challenges fix in the dimensions as that goes with Merlin. The satellite should on its solar synchronized earth's orbit determine the methane content of the atmosphere with an accuracy of less than 0,003 ppm (parts per million). On an average the airlayer of the planets contains 1,8ppm methane.

On the earth and in the air Lidar (light detecting and ranging) are already in operation in manifold manner. The pallet (range of colors) reaches from the speed measurements of police on the apparatus for tracking down dangerous air vortex behind the aircrafts upto the instruments which investigate the composition of air out of the flying laboratory and can determine wind velocities of larger distance.

According to application differing methods are applied and the duration of the light or its frequency is measured. For the investigation of tracking gas and according to methane in the atmosphere the Lidar sends out two laser impulses of varying wavelengths. Out of the varying strength absorption of both the rays the researchers can then conclude the concentration of the searched gases.

In cosmos, these highly efficient instruments so far are only seldom to find. Since 2006 the American space travel agency NASA and its French counterpart CNES with the satellite Lidar investigate calypso aerosol in

the atmosphere. European space agency with the help of satellites ADM Aerobus wants to determine the earth encompassing wind velocities in differing layers of the air cover. Merlin moves forward straight in kingclass of Lidar. The satellite is a joint venture project of German Centre for Air travel and Space travel (DLR) which is responsible for Lidar instrument and which also for satellite platform qualified CNES. "The challenge lies in the extreme accuracy which such instrument requires" says Christian Wührer, expert for optical instrumentation and Merlin system engineer, Airbus Defence and Space in Laufkirchen where the Lidar will be developed and constructed.

Technically expressed one of the biggest challenges sounds so. The transmitted laser rays which have a diameter of 65mm at the satellite, on the way to earth surface, each ray expands to a diameter of 100mm. The reflections back in cosmos will be received from a telescope of 700mm diameter, just 0,00000000000336% of the transmitted light.

Wührer explains this in a simple example, "When we compare the quantity of the light with the total quantity of water of Lake Constance, the reflected light corresponds to the content of an Espresso cup. And then in that the scientists search for the information regarding the methane molecule.

Both the laser rays are emitted with a pulsrate of 20 Hz and have a wave length of 1645,552 nm – 1645.846 nm respectively. The difference of 0.294 nm is of decisive dimension. One of the wavelengths is absorbed by the methane molecules and the other is not. For all other effects in the atmosphere the reflection of the laser rays is identical so that we can conclude on the concentration of the methane molecules out of the quotient of measured energy on the reflected rays, explains Wührer.

An additional challenge lies with the alignment of satellite platform. Merlin is not set up exactly vertical to the earth's surface, rather should be inclined at 1°. We must guarantee the inclination to 0.1° accuracy says Wührer. In order to achieve that. Merlin take hold up attack of the stars to some extent. From the station in cosmos, signals are transmitted to the definite stars and compares the observed position with a stored picture and regulates itself so long as both the pictures agree. The previous knowledge on the methane content of the atmosphere is based on important things such as instant photos which are snapped from the aircrafts or balloons with air measurement probe. It gives certainly the passive measuring satellites which can rather only evaluate values during the day while they are assigned for the observation on the sunlight.

The exact knowledge of the methane phenomenon is however long overdue. Since the beginning of industrial revolution, the methane component in the atmosphere has doubled. It is a sign that this process is strengthened as a consequence of the climate change through the thawing of permafrost regions. Beyond 2020 the climate researchers will experience more on the theme methane because of Merlin. Whether the satellite, however, then will be operational, is still open. DLR and CNES (France)are in search for a carrier rocket which can place the 400 kg satellite on a desired orbit along with other payloads.

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*Source:* VDI nachrichten, 31 Juli 2015, Nr 31/32, Technik & Wirtschaft, Seite 19