New ESA Sensor Could Lead To Better Understanding Of The Carbon Cycle

July 7 2005

Scientists from across Europe convened at the Barrax test site near Albacete, Spain, to join the chase for an elusive signal emitted by vegetation, which may just hold the key to mapping photosynthesis at a global scale from space.

Currently, the approach to monitoring vegetation from space is based on images that record sunlight reflected from the Earth's surface.

Using this technique, optical satellite images generally contain information on how much vegetation is on the surface. For example, whether a field is bare, partly covered or completely covered with crops - and about potential photosynthetic activity of the vegetation cover.

To understand more about photosynthetic activity occurring in plants at the very moment the observations take place, it would be better to measure solar induced fluorescence, which is directly related to actual photosynthetic activity.

Solar induced fluorescence occurs when part of the energy absorbed by chlorophyll in vegetation is re-emitted at longer wavelengths as fluorescence.

This would provide a direct measurement of the vegetation's ability to absorb atmospheric carbon dioxide, which, if mapped at global scales, would lead to greatly improving our understanding of the carbon cycle and climate change.

However, measuring fluorescence from space is challenging. The signal is very weak compared to reflected sunlight, and special instrumentation and techniques are required.

In addition, little is known about the characteristics of the fluorescence signal over natural vegetation. While it is routinely used in laboratories to study photosynthetic activity, measuring fluorescence levels outside has never been done on a large scale, or at least until now.

Indeed, the first SENT2FLEX (Sentinel-2 Fluorescence Experiment) campaign, which took place 30 May to 4 June 30, 2005 provided a historical first – the first dedicated airborne fluorescence measurements.

It represented the accumulation of a long preparation phase and extensive collaboration between research organizations. It first started with ESA supporting the development of a dedicated airborne fluorescence measuring instrument called AIRFLEX.

The instrument was developed under an ESA contract by the LURE Photosynthesis and Remote Sensing team in Paris, France led by Dr. Ismael Moya.

The German Space Agency (DLR) flight department based in Oberpfaffenhofen, Germany was responsible for both the integration of the AIRFLEX instrument into a Cessna Caravan plane, the chosen host for the instruments, and for the execution of the flights.

Efforts to prepare for the SENT2FLEX campaign this last month were especially intense. Three airborne instruments installed in two planes had to be organized.

In addition to the AIRFLEX instrument in the DLR Caravan plane, two additional imagining sensors, the CASI-1500 from ITRES Research

(Canada) and AHS from the Spanish National Institute for Aerospace Technology (INTA), were also installed in the INTA CASA 200 plane.

Last but not least, teams had to be equipped and organized on the ground. These teams collected independent information at ground level at the same time as the aircrafts flew over the test site.

Typically, soil and vegetation characteristics, their reflectance properties and atmospheric properties were measured at a number of locations.

It was with some relief that, after all these preparations, the first successful acquisitions were made in the air and on the ground on 30 May 2005.

Even more exciting was the report from the AIRFLEX team the next day stating that the fluorescence signal could be identified and was providing information about different land cover types in the test site.

"For the first time we can look at how the fluorescence signal over vegetation varies from one field to the next and take a hard look at what it is telling us about the vegetation in each field", said an enthusiastic Ismael Moya from LURE.

"After all the work developing the instrument and preparing the campaign this is extremely rewarding."

Jose Moreno, from the University of Valencia, Spain added, "We are now convinced we can measure the weak fluorescence signal so the next step is to make use of the fluorescence signal at the relevant spatial scales.

"In fact, fluorescence alone already provides quite significant information about plant photosynthesis, but to map $CO2$ assimilation at global scale, the fluorescence information must be assimilated in dynamic models of vegetation together with other data sources.

"The SENT2FLEX dataset provides all the elements to understand fluorescence signal variations and practical usage of such innovative measurements mapping photosynthesis."

In total, three days of data were collected. Additional measurements are planned for this July when the condition of the vegetation will be quite different.

Overall, these campaigns will lead to a unique dataset, one that documents the elusive fluorescence signal over different land cover types and under various conditions.

Perhaps the signal has lost some of its elusiveness? In any case, a major step to help define novel ways of measuring photosynthesis from space has just been taken.

Citation: New ESA Sensor Could Lead To Better Understanding Of The Carbon Cycle (2005, July 7) retrieved 26 April 2024 from https://phys.org/news/2005-07-esa-sensor-carbon.html