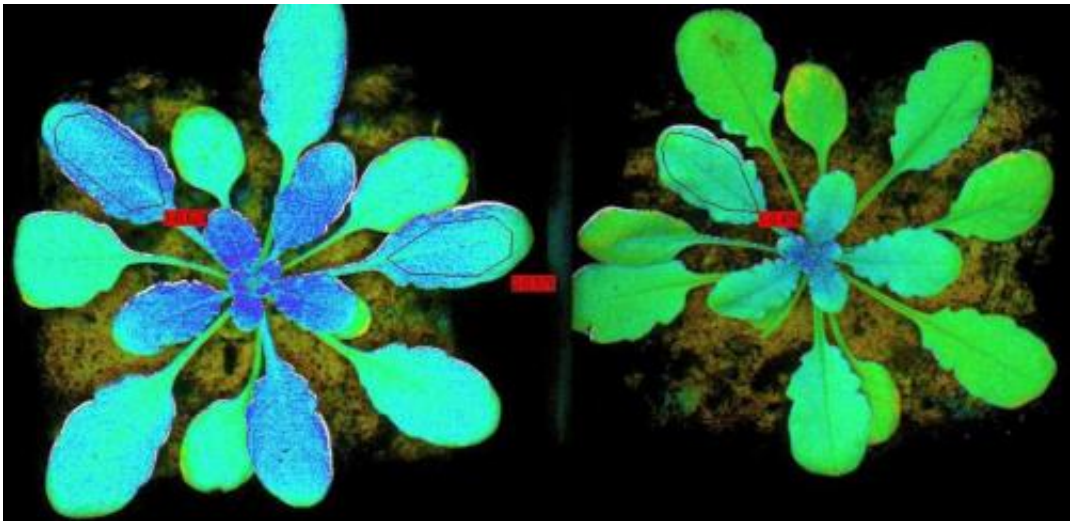
Glowing plants a sign of health

February 12 2014



Fluorescence is a near-infrared light that is emitted from the core of a plant's photosynthetic machinery, after absorption of sunlight by plant chlorophyll. It reflects the efficiency of photosynthesis and the health of vegetation. The new Hyplant airborne instrument has demonstrated that plant fluorescence can be imaged from an aircraft, potentially paving the way for a new ESA satellite mission called FLEX. Credit: U. Rascher, Forschungszentrum Jülich

Radiant skin is considered a sign of good health in humans, but plants also glow when they are well. A potential new ESA satellite could use this fluorescence to track the health and productivity of vegetation worldwide.

The Florescence Explorer, or FLEX for short, is a candidate for ESA's eighth Earth Explorer. It aims to provide global maps of vegetation

fluorescence, which can be used to work out actual photosynthetic activity.

This information would improve our understanding of the way carbon moves between plants and the atmosphere and how it affects the carbon and water cycles.

In addition, by offering new information that can be used to improve the management of water and fertilisers, FLEX could also improve agricultural productivity.

After the chlorophyll in a plant has absorbed sunlight, the core of the photosynthetic machinery gives off a red glow – fluorescence. This reflects how efficiently the plant is photosynthesising, or how well it is 'breathing' and, therefore, how healthy it is.

However, measuring plant fluorescence is a challenge. As with most new satellite technology, a concept first has to be tested from an aircraft to demonstrate that it works before anyone thinks of building and launching an instrument into space.

Until recently, an airborne sensor was not available to map the fluorescence over large areas. In fact, for years it was a challenge to detect this relatively small glow outside of the laboratory and over agricultural fields and forests.

But Germany's Forschungszentrum Jülich research centre and Finland's Specim company have now developed and thoroughly tested the novel Hyplant airborne sensor.

The Hyflex campaign was carried out to determine whether fluorescence from vegetation could be detected from the air using a novel sensor called Hyplant. This campaign, which spanned two years, supports the development of ESA's candidate Earth Explorer FLEX mission. Credit: U. Rascher, Forschungszentrum Jülich

As part of the campaign, it has mapped different types of vegetation all over Europe and even over parts of the USA.

Hyplant has two 'imaging spectrometers' – essentially cameras that see at different wavelengths.

One ranges from blue to the mid-infrared for broad coverage. The second covers from red to near-infrared, and splits up the wavelengths finely to pick out the fluorescence.

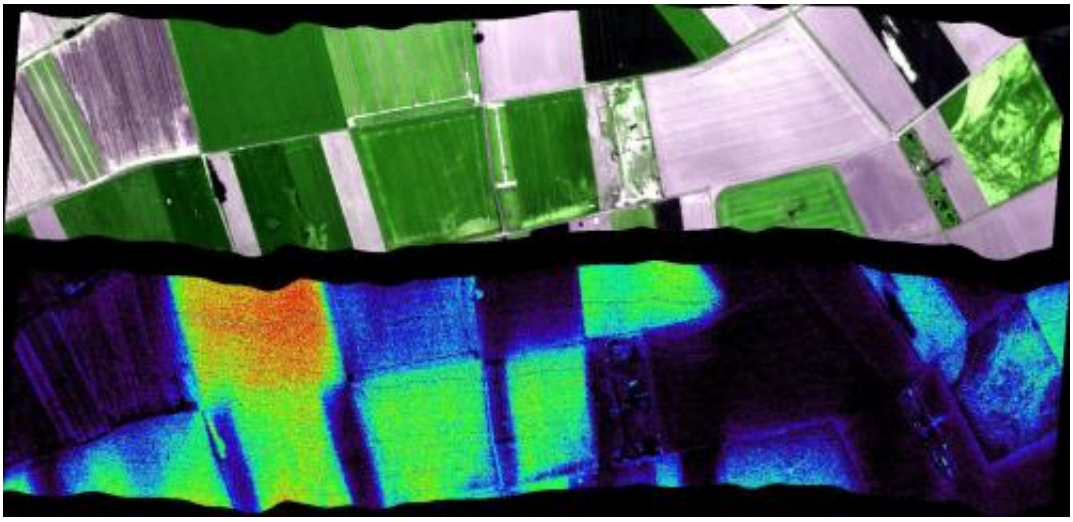
With more than 100 aircraft passes recorded in 2012, the data have now

been turned into fluorescence maps with consistent results.

ESA campaign coordinator Dirk Schüttemeyer notes, "Hyplant has given us a proven airborne demonstrator that allows us to fully exploit the potential of the FLEX candidate mission.

"We are now looking forward to analysing measurements over forests and to address vegetation health applications and products."

As the image above shows, the highest fluorescence was seen in sugar beet, which is a twice-yearly crop that is still green with a dense healthy canopy in October. The results show that it is one of the most photosynthetically active crops at this time of the year.



The image shows fluorescence from different types of vegetation. It was captured by a novel airborne sensor called Hyplant to support the development of ESA's candidate Earth Explorer FLEX mission. The highest fluorescence values (bright yellow–green) were found in sugar beet. These results show how the FLEX satellite mission could provide global maps of vegetation fluorescence, which can be used to retrieve the actual photosynthetic activity. In turn, this would not only improve our understanding of the amount of carbon stored in plants and their role in the carbon and water cycles, but could potentially also be

important for helping to optimise agricultural productivity. Credit: U. Rascher, Forschungszentrum Jülich

By comparison, apple orchards, natural pine and mixed forests fluoresce less. Areas that lack vegetation such as bare soil, roads and buildings do not fluoresce at all.

Matthias Drusch, ESA's mission scientist for FLEX, said, "For the first time, we have a scientific proof of concept that we can indeed retrieve fluorescence estimates from airborne measurements over a range of agricultural plant types.

"Potentially, this new type of observation technique can make a significant contribution to 'phenotyping', meaning the observation of a plant characteristics and traits, and applications including precision farming and guided breeding."

The instrument will next be used to see how it can address these kinds of applications. The focus will be on forested areas and agricultural fields and new remotely sensed products that describe the makeup of plants such as varying chemical composition driven by leaf pigments.

A dedicated workshop on the latest developments will be held on 22–24 April at France's CNES space agency in Paris.

As well as FLEX, the CarbonSat mission, which aims to quantify and monitor atmospheric carbon dioxide and methane, is being studied in parallel for the selection of ESA's eighth Earth Explorer.

Provided by European Space Agency