Topic 2b - Observing vegetation and mapping land use change

This rather stunning location here at London's historic Kew Gardens reminds us of the diversity of plant life there is on. And Kew is a very interesting example, because this is one of the places where some of that diversity is first collected, and stored, and studied. And of course, in the past we've had to do that by visiting places and collecting things. Whereas, these days using satellite data we can collect samples of this huge diversity of plant life on Earth from space.

That's particularly true in the optical domain. Optical remote sensing is what allows us to probe the photosynthetic operation of plants, the mechanism that drives the productivity of plants, how it captures sunlight, uses it to grow, uses it to develop new plant matter. So optical remote sensing is allowing us to understand this breadth, this diversity of plant life on Earth.

Optical remote sensing is something that allows us to go out and collect information about plants without actually having to visit those locations, to probe the processes of photosynthesis that drive the production of plant life on Earth, the development of new material and new plant growth on earth. So now we can get this big picture overview of the diversity of life on Earth, but from space.

The ability to capture image data over long periods of time, and to come back and revisit locations on the Earth's surface over and over again is one of the key benefits of remote sensing from satellites, particularly in the optical part of the spectrum. A major application for this has been looking at deforestation. It's one of the early, very, very strong areas where remote sensing was able to show us, and identify areas where deforestation was occurring, and also enable us to quantify these changes, both very rapidly and to be able to revisit these areas.

So one area of dramatic interest is obviously the Amazon. So if I look behind me here, this image here is an aggregation from the Global Forest Watch project, where they have processed Landsat data over the last 30 years to produce these stunning maps of quantified forest loss over the period of image data. So this example here is showing forest loss at 30 metre resolution.

So what I mean by that is each of the pixels in this image is 30 metres. So it's showing forest loss at 30 metre spatial resolution over the time period 2000 to 2015. So in 15 years every single one of these little pink spots here, every one of these pixels is an area where the forest is gone. So this is the forest loss over the last 15 years as quantified by stacking up and processing 15 years worth of Landsat data.

So deforestation-- this occurs for a range of different reasons. We know it occurs due to legal logging, due to illegal logging, due to people using forests for firewood, for shelter, due to chopping down and changing land use from forest to agriculture. Now it's one of the most important aspects of forest loss at the moment, is that in areas like the Amazon, but also many other areas, forest is lost in a conversion from one type of land use-- forest, which is unproductive agriculturally, to productive agriculture, whether that be cattle grazing, or oil palm plantation, or arable crops.

So again, this ability to revisit these places in space and time, are enabling us to look at how those particular different impacts are resulting in forest loss. So this kind of image data collected over time, and processed-- and we can do this fairly simply in the sense that optical image data just shows us where forest is or isn't. Where it's been lost, we see these changes fairly accurately, just by looking at the image data themselves, and doing some relatively simple processing.

On the other hand, we can look in different parts of the spectrum, not just the visible part of the spectrum, in the near-infrared part of the spectrum, where vegetation is very strongly reflective. And that enables us to pick out finer details of where vegetation is lost, or even gained in some cases. So we may lose forest, but we may gain crops. We may gain oil palm plantations. Those will also show up as vegetation. So we need to be able to distinguish between one type of vegetation and another.

This ability to capture data in the optical part of the spectrum, and in particular the visible shortwave part of the spectrum, the bit that our eyes respond to, the bit that chlorophyll absorbs, is one of the key reasons why optical remote sensing data is so useful. That very narrow part of the spectrum, between about 400 and 700 nanometers, the bit that chlorophyll responds to, drives life on earth largely. This whole process of photosynthesis is based on the ability of plants to absorb that part of the sun's radiation.

If we want to know about the living bit, and how that is responding to change, how that's responding to climate, how we are able to manage it, can we say more about this? Can we use satellite data to help us understand and manage this in the best way possible? Then we need to look in the optical part of the spectrum, because this is the bit that tells us most-- not the only bit. But this is the bit that tells us the most about the bit that is living and driving our ability to exploit vegetation, and the land surface.

And when we talk about land use of course, the word use implies anthropogenic man-made. What use is being made of these parcels of land? How is that land use changing over time?

Here's an example-- a very, very striking one-- again from the Global Forest Watch project, using Landsat data that's been processed over several decades to arrive at a map of land use-- in this case a very specific land use. This is oil palm. So 15 years ago there would be no oil palm in this area of Malaysia or in Kalimantan here. Now we can see that there are large chunks of this area that are covered in oil palm-- commercially very, very important crop. But it also results in the loss of primary rain forest.

So therein if you like, lies some of the issues that we have to confront with remote sensing data. We see now that it's covering a very, very large area of what was primary rain forest in the tropics. We have to look at that and think if this is sensible use of land. Is this something that we want to be investing in or not? Is this something we want to encourage or not? But One thing we see straight away-- if we're able to use satellite data, we can start to look at monitoring these kind of areas of oil palm plantation.