Interview: David Crisp

Due to launch 23 February, NASA's Orbiting Carbon Observatory (OCO) will measure carbon dioxide in the Earth's atmosphere with a precision high enough to detect the origin and fate of carbon emissions. Principal investigator David Crisp talks to **Anna Barnett** about hopes and expectations for the programme.

What can a dedicated carbon-monitoring satellite tell us that current monitoring programs can't?
From ground-based monitoring stations, we know that slightly less than half the carbon dioxide put into the atmosphere in the last 50 years has actually stayed there. But there aren't enough ground stations to tell us where the carbon sinks are. About a quarter is being absorbed by the oceans and by trees, but we don't know where the rest is going. Now, one might worry about whether these sinks will continue to be sinks. It'd be nice if we could study them and determine whether they're going to continue to do us this wonderful favour.

In space, we can observe the entire Earth using the same instrument. Because we're analysing sunlight we can't work at night, and we have trouble with clouds — we need clear skies to measure CO_2 at the surface. We'll use modelling to adjust for this, but there will almost certainly be important gaps. The OCO will provide millions of additional measurements every two weeks, but we still need other techniques.

The OCO beat out 32 other proposals in a NASA contest for low-cost Earth science missions. What made it such a good buy?
One clear advantage was that it didn't require any inventions to make it work. In the 1990s NASA had been looking at measuring carbon dioxide with high-powered lasers that weren't yet practical for use in space. So in 2000, a group of us started looking for existing technologies. We decided to measure reflected sunlight in the near-infrared part of the spectrum — just slightly redder than the reddest red your eye can pick up — a different band than what's been used for a lot of Earth-monitoring science.

So will the OCO take new kinds of measurements?
Yes. For example, the AIRS instrument on the Aqua platform, which will be flying behind OCO by about three minutes, uses thermal infrared measurements to monitor CO_2 today at the altitudes where it's most efficient as a greenhouse gas — about 5 to 15 kilometres, up where airplanes fly. But by the time the CO_2 reaches that altitude, it may have travelled a few countries over. To look for sources and sinks, we needed a technique that was very sensitive near the surface. We also had to learn how to make this measurement excruciatingly accurate — OCO has to measure about one part per million out of 385 parts per million, or 0.3 per cent — about three times better than our best current space-based measurements of a trace gas. This is hard.

Will the OCO provide policy-relevant information? Can the data be used to monitor national emissions, for example?
We're certainly hoping that, in the long term, measurements like those made by OCO can contribute to policy. But OCO was not developed for that purpose. This is a two-year exploratory science mission, and our objective as scientists is to develop the technique. The hope is that, having proven that a space-based measurement of CO_2 can be accurate enough, we'll have a way to do long-term monitoring in the future, using subsequent instruments.

OCO was greenlighted in 2001, and the launch was originally scheduled for 15 December 2008. Why was it delayed?
We had everything in place for that launch — the satellite was sitting there waiting at the launch site — but we're using a brand new launch vehicle, and NASA felt they had to put it through an extensive certification program. Assuming we get off the pad later in February, we'll be in our orbit around 1 April, and then we'll start checking the instrument against ground-based validation stations dotted around the world. We're not expecting to deliver data until October — it will probably take us that long to get all the bugs out.

Japan recently launched the Greenhouse gases Observing Satellite, or GOSAT. Is there collaboration between the programmes?
We've been working closely together since 2004 on plans to cross-check our


DAVID CRISP

NASA's David Crisp at Mauna Loa Observatory, Hawaii.

data sets. OCO and GOSAT are both measuring CO_2, but with dramatically different systems. The OCO will complete about 14.5 orbits a day. Along each track we make about 39,000 measurements at 12 hertz, every two-and-a-half kilometres. That can actually resolve cities and freeways from adjacent forested areas. Over a 16-day period, we make 8 million measurements and map out the Earth with about 1.5° longitude between the tracks, which is about 150 kilometres at the equator.

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The GOSAT team wanted to cover the whole Earth within three days. Their tracks are much further apart, and to compensate they have something that I couldn't afford to add to my low-cost spacecraft: their scanner moves left and right as it flies down the track. Over those three days they make 56,000 measurements over a wider swath than OCO. But in one 100-minute orbit we collect close to the number of measurements they use to map the entire planet. We essentially cover the Earth twice with different resolving powers, so we can combine the two data sets to get a much higher-resolution picture.

Earth monitoring is often pointed to as a neglected, underfunded field. Do you agree, and is it likely to improve or get worse?
Even though NASA makes more observations of the Earth than all other space nations combined, Earth observations are a poor stepchild here. I think that will change in the coming years as programmes like OCO prove their worth in a policy environment, as well as in a scientific context. If we can identify sources and sinks of CO_2, I'm sure we're going to discover some low-hanging fruit for policymakers. If nothing else, we will better understand the processes that are controlling CO_2 in our atmosphere today, and we might be able to understand how those processes evolve and how much time we have to adapt. OCO is just one of a host of valuable Earth science measurements being made. So we're hoping that as that's realized, our national agencies will make a larger investment.

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Update

On 24 February, NASA's Orbiting Carbon Observatory crashed into the ocean near Antarctica following a launch failure. Officials from the US space agency said that the fairing—a protective covering surrounding the satellite—did not separate properly, preventing the OCO from reaching orbit. NASA is establishing an investigation board to determine the root cause of the malfunction.