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Greenhouse gases

Accounting from above

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Two new satellites will monitor carbon-dioxide emissions

Reuters

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SOMETIMES it is worth looking at the big picture. That is the idea behind monitoring greenhouse gases from space. In January the Japanese space agency, JAXA, launched *Ibuki*, the first satellite dedicated to monitoring carbon dioxide and methane. Later this month the American space agency, NASA, is due to launch the Orbiting Carbon Observatory (OCO), which is also designed to monitor carbon dioxide.

The new satellites will work as carbon accountants by keeping a close eye on how the Earth breathes and returning regular audits. *Ibuki*, which means "breath" in Japanese, orbits the Earth approximately every 100 minutes at an average altitude of 667km. It will gather data from 56,000 points around the globe with two detectors. One is a spectrometer that measures sunlight reflected from the Earth's surface. Both carbon dioxide and methane absorb energy from sunlight and both leave a unique signature that can be measured to detect changes in intensity. JAXA says *Ibuki* can detect carbon-dioxide changes of around one part per million, which is akin to detecting the change in salinity produced by four drops of salt water in a 200-litre bathtub of water. The second detector takes readings of clouds and other aerosols in the Earth's atmosphere that can reflect or absorb radiation.

OCO will similarly study carbon dioxide and also oxygen signatures in reflected sunlight. It will fly at an average altitude of 705km and orbit the Earth about every 99 minutes. Once launched, OCO will form part of a loose group of American satellites called the "A-train". These carry instruments that complement one another in helping to provide a fuller picture of the Earth's carbon and water.

The carbon cycle

With the additional data that the satellites provide, researchers hope finally to shed light on the Earth's complicated carbon cycle. The concentration maps produced by *Ibuki* and OCO will help in understanding where carbon dioxide enters the atmosphere and where it gets absorbed. Today, most big man-made carbon-dioxide emitters, such as a large power station, are known about and their outputs are measured. But there are global phenomena, such as forest fires, where the carbon-dioxide contributions are not fully understood. There are also some ecosystems, such as the boreal forests of Canada and Siberia and the Amazon rainforest, which are huge absorbers of carbon dioxide, but which are changing rapidly because of temperature increases and deforestation.

Researchers think that the carbon cycle turns over about 330 billion tonnes of carbon dioxide each year. Oceans absorb about half this. Earth-based measurements suggest there is a large unaccounted-for surface "sink" of atmospheric carbon dioxide, but its location is fiercely debated. The reason for this is the paucity of data over the tropics, where many of world's dense (and highly inaccessible) rainforests are situated. The satellites will be able to look in detail there.

Although these data will not be as accurate as those taken on the ground, what they lack in precision will be more than made up for in coverage. It is believed that atmospheric carbon-dioxide concentrations have increased from about 280 parts per million to around 370 parts per million since the start of the Industrial Revolution. How much of this is because of human action is still a matter of conjecture, but it is widely accepted to be significant.

Ibuki and OCO should provide a better idea of what happens to carbon dioxide once it is produced. Some researchers, such as Paul Palmer at the University of Edinburgh, in Scotland, think satellites could also monitor the effect of policies such as carbon trading to see if they can rein in emissions. The new birds really would then become carbon accountants.