Exploring the science of climate

Observations, theories and climate models

Narrator:
In Antarctica scientists have been looking into the snow for clues to changes in carbon dioxide levels. Air is trapped in falling snow. Over thousands of years layers of snow build up, forming a record of the changes in the air over time. The ice cores show that carbon dioxide levels have been changing for many thousands of years. There is natural variation in the concentration of carbon dioxide, and when compared with the record of temperature change there is an obvious correlation. But which is the cause, and which the effect? We now have theories of natural causes of change. And we have theories of human causes of change. If these two theories are combined and run as computer models, they make predictions that should match the data – but do they?

Trevor Davies:
There are natural factors which might have produced this warming, but we're now confident that in the climate response to this global warming we are picking up, we are identifying the fingerprint of man's contribution.

Geoff Jenkins:
When we ran the global climate model that we built here, when we looked at the climate monitoring, the actual observations, we saw about half a degree, and we simulated the rate of change of temperature over the last hundred years. We ended up with a change of temperature of something like one degree Celsius that we would be expected to see. There was obviously a mismatch there and that was a bit worrying. What was done here for the first time was to not only take account of the changing climate due to carbon dioxide, but to also look at another effect on climate.

Mick Kelly:
We now know that there is a human volcano that we're emitting into the atmosphere sulphur dioxide pollution, and this causes sulphate aerosols to be formed in the atmosphere, and they have a very direct effect on the energy balance. They're bright, they're shiny, they reflect the incoming solar energy back into space. But then there's a secondary effect because they're also very powerful as cloud condensation nuclei, they create clouds, they form new clouds, and it just so happens that it's the kind of cloud that also cause cooling, that interacts with the energy balance and cools the surface of the planet.

Geoff Jenkins:
When we incorporated those effects into the climate model we immediately got a much better agreement between the observed temperatures that we've seen and those which were modelled by the climate model, and that was very good to see. It doesn't guarantee that we're getting it right by a long shot, there must be an element of luck in this, but at least it makes us a bit happier that we don't have the large sorts of discrepancies that we had before.

Narrator:
The refined computer models reinforce the theory that industrial pollution is affecting the climate, but no theory and no model is ever complete.

Mick Kelly:
It's the height of scientific arrogance to believe that we could ever simulate such a complex system in a computer model. We do our best, and we have to use all the tools of the trade in order to predict the climate future, so I'm not saying for a moment that we shouldn't be modelling, but we should be aware of the limitations of our models, particularly when we're using the results to guide policy.

Geoff Jenkins:
In many cases scientists believe that they've got things just about right and then surprises happen, so things happen in the atmosphere which remind us of our ignorance of a lot of the basic processes that are going on, and we do always have to have that at the back of our minds.

Keith Briffa:
If we work together we can get a much clearer picture of helping each other how to disentangle our own records. We can see how our different ideas support each other, we can get a good indication of when the data sets differ very strongly from each other and, in fact, it's only by using interdisciplinary science that we can indicate to ourselves and to the public how confident we are in the interpretation of our records.