THIN ICE

THE INSIDE STORY OF CLIMATE SCIENCE

Produced and directed by David Sington and Simon Lamb

Co-produced by Catherine Fitzgerald

International Sales Contacts

Dox Productions
84 Addison Gardens
London W14 0DR
United Kingdom
David.Sington@tvdox.com

Blueskin Films
PO Box 27261
Wellington 6141
New Zealand
catherinef@blueskinfilms.co.nz

HTTP: //THINICECLIMATE.ORG/   *FACEBOOK/THINICE*   *thiniceclimate@vuw.ac.nz*

FACT SHEET

Directors / Producers	David Sington and Simon Lamb
Co-Producer	Catherine Fitzgerald
Executive Producers	Peter Barrett Philip England

Featuring

- Myles Allen
- Cliff Atkins
- Nancy Bertler
- Martin Blunt
- Neil Bowles
- Martin Brasier
- Wallace Broecker
- Lionel Carter
- Niki Davey
- Daniel Dixon
- Katie Dugger
- Gavin Dunbar
- Sir Lloyd Geering
- David Harwood
- Matthew Huber
- Philip Jones
- Brian Karl
- Fabian Moeller
- & Daniel Koseli
- Anders Levermann
- Adrian Macey
- Martin Manning
- Paul Mayewski
- Malte Meinshausen
- Hugh Mortimer
- Timothy Naish
- Scott Nodder
- Lisa Northcote
- Raymond Pierrehumbert
- Alexander Pyne
- James Rae
- Stefan Rahmstorf
- Katja Reidel
- Rosalind Rickaby
- Elisabeth (Liz) Sikes
- Craig Stevens
- Craig Stewart
- Lonnie Thomson
- Michael Williams
- Tony Williams

Cinematographer	Simon Lamb
Editor	David Fairhead
Music	Philip Sheppard
Production Companies	Dox Production Ltd Victoria University of Wellington Oxford University
Technical	High Definition (1080p) Stereo
Length	73 minutes

SYNOPSIS

In recent years climate science has come under increasing attack, so geologist Simon Lamb took his camera to find out what is really going on. For over three years he followed scientists from a wide range of disciplines at work in the Arctic, Antarctic, Southern Ocean, New Zealand, Europe and the USA. They talk about their work, their hopes and fears with a rare candour and directness. This creates an intimate portrait of the global community of researchers racing to understand our planet's changing climate, and provides a compelling case for rising CO2 as the main cause.

Thin Ice - the inside story of climate science - is a unique project: a film about climate science made by a scientist.

FROM THE DIRECTORS

David Sington: "*THIN ICE has been a fascinating and unusual project to be involved with. Although I went on the shoot to Antarctica (what an amazing experience that was!), most of the material in the film was shot by Simon over a three-year period without any involvement from me. When Simon asked me if I would be willing to put all this material together, I was at first a little skeptical, but I soon realized that he had managed to capture something unique. Perhaps because they were talking to a fellow scientist, all the contributors spoke with a relaxed confidence and candour that meant that not only did their science come across with rare clarity, but their personalities and engagement with their work did as well. So I gathered the top-flight team that has worked with me on many of my most successful films, especially the brilliant film editor David Fairhead and equally brilliant composer Philip Sheppard. We quickly realized that Simon's own journey had to be part of the story (not something that had been in his mind when he filmed!). I think the final result is probably the most scientifically informative documentary ever made about climate change. I hope it also has a subtle emotional undertow which makes it an enjoyable and ultimately rather moving film to watch.*"

Simon Lamb: "*The main message of the film is that climate scientists are like any other scientists, and they can be trusted because their quest is to understand the planet's climate as fully and accurately as possible. ...Science has given us a great gift, the ability to look into our future and shape it. The film does not set out to tell the audience what we should do about climate change, but rather, what we know about it.*"

The film chronicles my personal journey to find out directly from climate scientists why they think that our emissions of carbon dioxide and other greenhouse gases are changing the planet's climate. In fact, the film is almost entirely in the words of the scientists, and I am really only the 'glue' that holds what they say together. However, by watching the film, you not only find out what the scientists think, you also see for yourself the research being carried out, whether it be on the polar plateau in Antarctica, at -40°C, or in a storm on the Southern Ocean, or back in the laboratory.

ABOUT THE PRODUCTION

Thin Ice is a joint initiative between Oxford University, United Kingdom, Victoria University of Wellington, New Zealand, and London-based DOX Productions. Both Universities have active programmes with world-wide networks of collaborators in climate change and related research. For Oxford see www.climateprediction.net and www.eci.ox.ac.uk, and for VUW see www.victoria.ac.nz/antarctic and www.victoria.ac.nz/climate-change.

The project began over a cup of coffee at a Climate Change and Governance conference in Wellington in March 2006. Simon Lamb (then at Oxford) was concerned by attacks being made on the integrity of climate scientists and wondered just how good their science really was, and so Peter Barrett (Victoria) suggested that he make a film about climate science with the help of his friend David Sington (DOX Productions).

The aim from the outset was to hear directly from climate scientists themselves about their research, rather than having the science filtered through journalists, politicians, activists or campaigners. In the end, the film took Simon to four continents, the Southern Ocean, and introduced him to scientists working in field as diverse as physics, paleontology, oceanography, and computer science. He approached his subjects as a properly skeptical scientific colleague, willing to be convinced, but not taking anything on trust. As a result the finished film, which was put together by David Sington, lays out with unusual clarity how scientists go about collecting the evidence that links CO_2 and climate change, and why that evidence makes them so confident in their conclusion that mankind is warming the Earth. The team behind the project believes that it is only with a firm understanding of the science that we are equipped to make informed choices about what we should do, individually and collectively, to deal with the challenges of man-made climate change.

ABOUT THE WEB SITE

The website http://thiniceclimate.org serves not just to support the film, but to add on-going background and resources for the community of interest which builds around the film and its issues.

It hosts Facebook and Twitter conversations and provides over 30 short (2 to 8 minute) video clips, taken from 120 hours of interviews and grouped in themes, which expand on key aspects of the film. The Meet the People page provides biographies of the ~30 scientists and the production team.

PEOPLE IN THE PRODUCTION TEAM

SIMON LAMB: Director/Producer/Photographer

Simon gained his PhD in Geology at Cambridge University in 1984, and went on to study the origin of mountains in New Zealand, Tibet and the Andes. He was at Oxford University for 22 years, first as a Royal Society Research Fellow, and then University Lecturer and Fellow of St Anne's and St Cross Colleges. He has a major interest in communicating his subject to a wide audience, and has been closely involved in television science documentaries, both as scientific adviser and producer, including the BBC Horizon programme 'The Man who Moved the Mountains', and the eight part BBC Earth Story series. Simon has also written two popular science books, one for the *Earth Story* series (with David Sington), and most recently *The Devil in the Mountain* on his research in the Andes. He is currently Associate Professor in Geophysics at Victoria University of Wellington.
www.victoria.ac.nz/sgees/about/staff/simon-lamb

DAVID SINGTON: Director/Producer

David met Simon Lamb at University when he was looking for a cameraman for his first film. They made several films together before they graduated, Simon to become a scientist, David to join the BBC where he began a career that would make him one of the UK's most respected documentary filmmakers. He has filmed on every continent on the planet, from the Amazon to the Antarctic. His films have helped to free the innocent, convict the guilty and have changed government policy. The highlight of his time at the BBC was *Earth Story*, an eight-part exploration of the Earth sciences that is still widely regarded as one of the best science series ever made. In 1999 he left to form DOX Productions, whose films have now been seen in cinemas and on television screens in over 50 countries and have won dozens of awards, including a Grierson Award and two WildScreen Pandas. Highlights include the feature documentaries *In the Shadow of the Moon* (which has sold nearly a million DVDs) *The Flaw,* and most recently *The Churchills* for Channel 4.
http://www.tvdox.com/people.html

DAVID FAIRHEAD: Editor

David Fairhead has edited many different genres of films and programmes since he began in 1984. However the mainstay of his work has been in science and history documentaries. He has edited 18 films for the BBC's Horizon, the world's longest running science series, and innumerable other films and programmes, including the BBC's *Timewatch*, *The Planets*, *Seven Wonders of the Industrial World*, and Channel 4's *Equinox* strand. In 2006 he edited David Sington's film *In the Shadow of the Moon*, a feature documentary about the Apollo astronauts, which won the Audience Award for best International Documentary at Sundance in 2007. This was followed by *The Flaw*, an analysis of the 2008 financial crash, which also premiered at Sundance. His latest feature doc is *McCullin*, a powerful film about the war photographer Don McCullin. He has been working on *Thin Ice* with David Sington and Simon Lamb for over two years.
http://www.imdb.com/name/nm1406508/

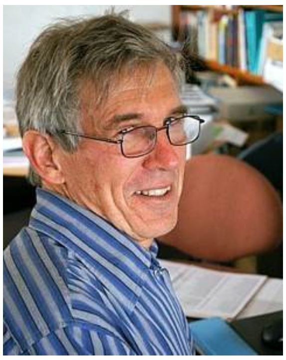
PHILIP SHEPPARD: Composer

Philip Sheppard is a composer specializing in film soundtracks as well as large-scale theatre projects and live events. He is also a virtuoso cellist and a Professor at the Royal Academy of Music. He regularly writes and plays with UNKLE and has been featured as a guest artist with numerous rock musicians including Scott Walker, Jeff Buckley, David Bowie, Jarvis Cocker, Jimmy Page and Pretty Lights. His latest film, *Love, Marilyn* starring Uma Thurman, Glenn Close and Viola Davis premiered at Sundance. His other film scores include *In the Shadow of the Moon*, *Sergio*, *Manhunt*, *Bobby Fischer Against The World* and *First Orbit*. His theatre commissions include *In-I* starring Juliette Binoche & Akram Khan, *Sacred Monsters* starring Sylvie Guillem & Akram Khan, *The Elephant Vanishes* - Theatre de Complicité, *Many* - Ballets du Rhin & Thomas Noone, and the Paris Fashion Week show for Alexander McQueen. Philip was commissioned to rescore the national anthems of all 205 countries competing in the London 2012 Olympics.

www.PhilipSheppard.com

CATHERINE FITZGERALD: Co-Producer

Since establishing Blueskin Films Ltd in 2002 Catherine has produced a slate of international award winning films working with new and recognised talent and contributed creatively to the production of many more. Her most recent international success has been as producer of the Samoan-language drama *O le Tulafale* (The Orator), for which an award winning world premiere at the 2011 Venice Film Festival, launched it internationally to on-going acclaim. Her background since graduating from the University of Otago comprises her own creative work and academic achievements in English literature and history of criticism; expertise and experience in innovative policy development, strategic planning and management in film, broadcasting, new technologies and the tertiary education sectors. She is also currently Executive Chair, NZ Film Festivals Trust.



PETER BARRETT: Executive Producer

Peter was studying geology at Auckland University when a chance trip to Antarctica led him to a life-long interest in its climate history. Initially he studied the Late Paleozoic Gondwana strata in the Transantarctic Mountains. However since 1975 he has led a series of offshore drilling projects for a history of Antarctic climate and ice sheet behaviour since its inception around 34 million years ago. In recent years he has become interested in the perspective that climate change on geological time scales provides for future human-induced climate change. After gaining a PhD from Ohio State University in 1968, he returned to New Zealand to become Founding Director, Antarctic Research Centre, Victoria University of Wellington (1972-2007). From 1998-2004 he was New Zealand's representative on the Antarctic Treaty System's Committee on Environmental Protection. He was elected an Honorary Fellow of the Geological Society of London in 2011.

http://www.victoria.ac.nz/sgees/about/staff/peter-barrett

PHILIP ENGLAND: Executive Producer

Philip has worked with colleagues and students on many aspects of the birth, evolution and death of mountain belts for over thirty years. He began by working on the history of metamorphism in the Alps, and more recently has worked on the mechanics of mountain growth in Asia, particularly Tibet. The need for new data to test his ideas about continental deformation led him into geodesy, and he has been involved in programmes to measure the deformation of the continental crust in Greece, Turkey, and New Zealand. More recently, he has been working on the thermal structure of the upper mantle beneath arc volcanoes. Philip graduated D Phil from University of Oxford in 1976 and returned later as lecturer and then Professor. He was elected to the Royal Society in 1999, and awarded the Murchison Medal of the Geological Society of London in 2004.
http://www.earth.ox.ac.uk/people/profiles/academic/philip

MEDIA RELEASES/ PRESS REPORTS TO DATE

VUW Media Release 11 March 2013
http://www.victoria.ac.nz/home/about/newspubs/news/newslatest#a171246

Press reports

NZ TV3 11 March 2013
http://www.3news.co.nz/Climate-change-film-gives-voice-to-scientists/tabid/1160/articleID/289874/Default.aspx

CHINA 12 March 2013
Xinhua News Agency: http://news.xinhuanet.com/english/sci/2013-03/11/c_132224903.htm
Shanghai Daily: http://www.shanghaidaily.com/article/article_xinhua.asp?id=130144
Sina.com: http://english.sina.com/technology/2013/0310/570119.html
Chinese government website: http://www.china.org.cn/world/Off_the_Wire/2013-03/11/content_28203482.htm
TMC News: http://www.tmcnet.com/usubmit/2013/03/11/6980925.htm

NZ Herald 18 March 2013
http://www.nzherald.co.nz/nz/news/article.cfm?c_id=1&objectid=10871842

A SYNOPSIS OF THE SCIENCE PRESENTED IN THIN ICE BY SIMON LAMB - 22 MARCH 2013

Introduction

Simon Lamb is a geologist and also a keen cinematographer. He has become concerned at the unprecedented attack on climate scientists by climate sceptics and the media, who have accused the scientists of fraud. Therefore he decided to make a film recording his experiences with climate scientists as they explain why they think humans are changing the planet's climate through our emissions of greenhouse gases, such as carbon dioxide. This conclusion has been challenged by many in our society, including some scientists, because it has profound implications for our future.

Ice cores in Antarctica

Only scientists and their support staff are allowed to live and work in Antarctica. One of the main topics of research is climate science. It turns out that snow and ice are extraordinarily good recorders of local climate. For example, the temperature at which the snow formed is recorded in the chemistry of the snow. Each year, a new layer of snow accumulates, burying the previous year's snow. Eventually, the deeper layers are compressed and turned into ice.

By drilling into the ice, it is possible to go back in time, year by year, and see a record of past climatic conditions in Antarctica. In addition, bubbles in the ice contain samples of the ancient atmosphere. t These reveal that the level of carbon dioxide in the atmosphere varies with time in a regular way over the last 800,000 years – eight glacial-interglacial cycles. These variations correlate closely with the temperature of the atmosphere: when the level of carbon dioxide was high, the temperature was much warmer than when the level of carbon dioxide was lower.

This strong correlation between atmospheric temperature and the level of carbon dioxide is one of the most important results to come out of Antarctic science. It is highly suggestive, but does not prove on its own, that rising levels of carbon dioxide are causing the warming.

Carbon dioxide in the atmosphere today

The composition of the atmosphere is routinely measured at a few 'clean air' monitoring sites around the world. The most important one in the southern hemisphere is at Baring Head in New Zealand, and it provides an accurate and continuous record over the past 40 years of the composition of the cleanest air on the planet, blowing from Antarctica and the Southern Ocean.

These measurements clearly show that the concentration of carbon dioxide in the atmosphere is rising year by year. At the time of filming (2008) this was around 385 ppm (parts per million), increasing by about 2 ppm each year. At the same time, the concentration of oxygen in the atmosphere is steadily decreasing - this is exactly what one would predict if the rise in carbon dioxide is a result of the widespread burning of fossil fuels by human society, because combustion involves combining oxygen and carbon to make carbon dioxide. However, the decrease in oxygen is barely noticeable because of the overall much higher concentration of oxygen in the atmosphere (~20%), compared to that of carbon dioxide (0.03%).

The physics linking carbon dioxide and atmospheric temperature

If you ask an atmospheric physicist to predict what would happen if you increased the level of so-called 'greenhouse gases', such as carbon dioxide, in the atmosphere, they would tell you that you will get a warming. This conclusion is based on scientific principles in physics that have been known for over a hundred years, because carbon dioxide is well-known as a strong absorber of infrared radiation.

The way that this warming effect actually operates is usually incorrectly explained by non-scientists, leading to confusion. In fact, what happens is that the Earth receives energy from the Sun, and high up in the atmosphere radiates that energy back into space as infrared radiation. The hotter something is, the more energy it radiates. And so the temperature higher up in the atmosphere – at an altitude of about 5 km - determines the rate at which this energy is radiated out into space. Thus, in the long term, this temperature is set by the requirement that the atmosphere must reach an energy balance such that the amount of energy radiated out into space equals the amount received by the Earth from the Sun.

As we emit more and more carbon dioxide into the atmosphere, the concentration of greenhouse gases in the atmosphere steadily increases, constantly pushing up the radiating level - where the atmosphere loses energy into space - to higher and higher altitudes. However, it is well known that the atmosphere also gets colder as you go higher, decreasing by about 6°C for every kilometre in altitude. This is primarily controlled by the rising and sinking (referred to as convection) of the main constituents of the atmosphere (nitrogen, oxygen and water vapour). So, as the radiating level rises, it becomes colder. But a colder radiating level emits less energy into space, tipping the atmosphere's energy balance so that now more energy is being received from the Sun than is being lost to space. As a response, the atmosphere must warm up until the new radiating level is hot enough to re-establish an overall energy balance. In fact, a rise in the radiating level of only about 300 metres is enough to cause about 2°C of global warming, and this why global temperatures are so sensitive to our greenhouse gas emissions!

Measuring global warming

Measurements since 1957 show that the level of greenhouse gases such as carbon dioxide is rising year by year. On this account our basic physical understanding of the atmosphere would predict a significant warming. So, is the atmosphere warming?

Daily temperatures are routinely recorded all round the world. Several international science organisations have been compiling this data to look for global trends in temperature over the last 150 years or so. By averaging temperature measurements all round the world, including the surface of the oceans, these organisations have found essentially the same result. This is that average temperature varied little until it began to rise in the 1920s, since when there has been an overall warming of about 0.8°C, with a slight cooling in the 1950s to 1970s, but strong warming in the last three decades.

Extending these records further back in time is more difficult, but estimates from tree rings, peat bogs, corals and written records indicate that in the last thousand years, the 20th century has been the warmest, and the 17th century was the coldest.

Warming in the Arctic

The temperature records show that the fastest warming place on the planet today is the Arctic. This is confirmed by the testimony of the Sami people of northern Norway, who live very close to the environment. They have noticed that it has become much warmer in winter, with even rain in December now, and also it is much windier. The thickness of the ice on frozen rivers is much reduced, and trees are starting to grow on the tundra, affecting the ability of reindeer to dig in the snow for lichen in winter.

The role of the ocean

Two thirds of the surface of the Earth is ocean. The oceans play a huge role in the link between our emissions of carbon dioxide and global warming. This is for two main reasons.

Firstly, as the scientists explain, for the surface of the planet to warm, the oceans must warm as well. At the moment the oceans are absorbing an enormous amount of heat and this is delaying the final warming caused by the increase level of carbon dioxide and other greenhouse gases. In fact, the observed global warming over the past 30 years or so is between half and two thirds of the expected warming, once the oceans heat up. Thus, warming from past emissions will continue for some decades.

Secondly, the oceans absorb carbon dioxide from the atmosphere, either through direct mixing of ocean water and air, or through the growth of marine algae... At the moment the oceans are absorbing about a third of the carbon dioxide we are emitting, but scientists are unclear whether it will continue to do so in the future as the oceans become warmer and more acidic.

Computer models

Climate scientists are making predictions about future warming with computer models. These use mathematical equations to represent our physical understanding of the atmosphere and ocean, the role of life, as well as future possible scenarios for human greenhouse gas emissions.

A key parameter is the sensitivity of the climate to our emissions, expressed in terms of expected global warming for a doubling in the level of carbon dioxide in the atmosphere. With our current scientific understanding, this sensitivity is constrained to be somewhere between 1°C and 5°C of global warming for a doubling of carbon dioxide in the atmosphere, with a middle value of about 3°C per doubling .This means that if we continue with our emissions today, by the end of the 21st century carbon dioxide levels could be between two and four times the pre-industrial values, and global average temperature could be as much as 6°C higher (11°F).

Geological climate (paleoclimate) record

One way to improve our understanding of the sensitivity of the climate to greenhouse gas emissions is to look at past climates when the level of these gases was higher or lower.

It is clear from the geological record that the planet’s climate has been far from stable, but has swung between warm and cold periods. These marked changes in climate through history are the strongest evidence we have that there is not some stabilizing mechanism that keeps the climate constant, and so we should expect future climate change from both human and natural causes. The geological record shows there is a strong correlation between past climates and the level of carbon dioxide in the atmosphere.

For example, 50 million years ago, there were crocodiles, tortoises and palm trees near the North Pole. Deposits of the carbon dioxide-sensitive mineral nahcolite (sodium bicarbonate) at this time show that the level of carbon dioxide in the atmosphere was over 800 ppm, at least twice that of today. Computer models of these past climates strongly suggest that climate sensitivity is at the high end of current estimates, in the range 4 to 5°C per doubling of carbon dioxide in the atmosphere.

Vision of the future

Our geological past gives an idea of the sort of climates we are heading for in the future if we continue as we are doing with our greenhouse gas emissions.

Thus, when the level of carbon dioxide was only marginally higher than today, reaching around 400 ppm (compared to about 385 ppm today), with global temperatures 2 to 3°C higher, evidence suggests the West Antarctic ice sheet and most likely the Greenland ice sheet did not The water currently locked up in these two ice sheets alone is equivalent to about a 12 metre rise in sea level, with the East Antarctic ice sheet holding another 52 metres. Sea level rise is likely to be one of the most dramatic long-term consequences of global warming. Scientists expect about a metre of sea level rise by the end of the 21st century, if we continue with our current emissions of greenhouse gases.

As the oceans continue to absorb CO2 they will become more acidic, making life impossible for many marine organisms. In addition, there will be changes in rainfall on land, with the wetter regions becoming wetter and the drier regions drier. For example, the monsoon of Asia is projected to be more intense, contributing to flooding and erosion.

However, desert regions, such as the Sahel in Africa or the interior of Australia, are likely to expand. Ultimately, the planet is on course for climates last experienced about 50 million years ago, when crocodiles lived at the North Pole and there were no large bodies of permanent ice anywhere on the planet. It seems unlikely that much of the natural world we know will survive this change. What it means for human society is impossible to say.

SIMON LAMB, THIN ICE CO-PRODUCER / DIRECTOR AND PHOTOGRAPHER Q&A WITH JAMIE MORTON, NZ HERALD, 8 MARCH, 2013

1) Can you provide a brief description of the film and what it's about?

The film is called *Thin Ice* and runs for 73 minutes. It is part of a wider project to communicate the science of climate change to a wide audience (see our website www.thiniceclimate.org).

The film chronicles my personal journey to find out directly from climate scientists why they think that our emissions of carbon dioxide and other greenhouse gases are changing the planet's climate. In fact, the film is almost entirely in the words of the scientists, and I am really only the 'glue' that holds what they say together. However, by watching the film, you not only find out what the scientists think, you also see for yourself the research being carried out, whether it be on the polar plateau in Antarctica, at -40°C, or in a storm on the Southern Ocean, or back in the laboratory.

2) I understand there's background on the website around this, but what was it that compelled or drove you to make this film?

As a scientist - geologist, in fact - I felt that the unprecedented attacks on climate scientists, with accusations of fraud and a hoax, were bringing all of science into disrepute, so I wanted to see for myself what climate scientists were like, what sort of research they did, and what they think. However, I was not expecting this to turn into a personal journey lasting nearly six years!

3) Four continents were visited and many researchers were interviewed - from all of this, could you list some of your most alarming or interesting findings from around the world?

Yes, I spanned the globe, visiting Antarctica and northernmost Norway, with New Zealand and Europe somewhere in between. My visit to the Arctic really opened my eyes to the reality of global warming. Temperature records show that this is one of the fastest warming places on the planet, but these results have been contested by some climate sceptics. Yet, you only have to talk to the local inhabitants - for example, the Sami people of northern Norway - to realise that they know it is warming rapidly from their own observations. It struck me that people who live close to the environment are as good as long term temperature records at detecting climatic trends, and they are all saying the same thing!

At the other end of the Earth, the research in Antarctica brought home to me the vulnerability of the great ice sheets to future global warming. For example, I filmed the deep drilling into the rocks beneath McMurdo Sound, which shows that a few million years ago, when the level of carbon dioxide in the atmosphere was only marginally higher than today, the ice in West Antarctica must have completely disappeared, with at least 5 metres of sea level rise and huge impacts on the ocean circulation and life in the southern ocean. This is a clear indication of the sort of future we are currently heading for with our global emissions.

4) When it comes to the finer points, climate science must be a difficult area to effectively communicate - and perhaps simplify - so the average viewer could understand it. How have you gone about making the film easily understandable?

One thing that became clear very early on in the filming is that the best people to explain climate science are climate scientists themselves! They have a deep understanding of their subject, and they explain it amazingly clearly and simply. The main problem in terms of putting all this together in a film is to pace and order the explanations, so the audience has the time to absorb and understand the important points, as well as giving the audience at times a rest and an opportunity to enjoy the extraordinary places where the scientists are actually working.

For much of the filming, it was just me on my own and the scientists. For interviews, I would often just set the camera on a tripod, and clip a radio microphone to the shirt front of the scientist, and then start a conversation. This, I think, provided a very unthreatening and relaxed environment for the scientists, helping them to open up and talk about their work in an amazingly intimate and lucid way.

Perhaps the most difficult science to film was on board New Zealand's deep water research vessel, the RV Tangaroa, as it was tossed around in the storms of the southern ocean. I think I was continuously sea sick for 10 days, trying to operate a camera on a heaving ship - the g-forces involved as the ship rose and fell made it almost impossible at times to pan or tilt the camera!

However, the most difficult science to put across in the film was the scientifically correct explanation of the so-called 'greenhouse effect', which lies at the heart of our understanding of global warming. This is usually explained incorrectly in popular accounts of global warming, giving climate sceptics a field day in terms of undermining public confidence in climate science. If you speak to atmospheric physicists, who really understand how the atmosphere works, you find the correct

explanation is rather different, and beautifully simple. But because a film works in 'real' time, the explanation needs to be put across in a way that engages the audience and is crystal clear at all times. To this end, we created a sort of conversation between four scientists, who all give parts of the explanation as well as being engaged in activities that help the explanation along (i.e. giving a class to some students, operating a spectrometer or launching a weather balloon). And fantastic space shuttle film of the Earth from space helps to put our atmosphere in perspective. Our aim was to make the culmination of this scientific understanding one of the high points of the film, giving the audience a real sense of achievement and empowerment.

5) If there's any message you'd like to instil in those watching the film, what would it be?

The main message of the film is that climate scientists are like any other scientists, and they can be trusted because their quest is to understand the planet's climate as fully and accurately as possible. This is an example of science at its best, not worst. Science has given us so many good things, so why distrust just one branch of science because it might be giving us an uncomfortable message. In fact, it has given us a great gift, the ability to look into our future and shape it. The film does not set out to tell the audience what we should do about climate change, but rather, what we know about it.

6) Finally, how did NZ factor into the project (what connections were there both in terms of Kiwi scientists interviewed and the relevance of our country to the scope of the film and climate change/science in general)?

Much to my surprise, not being a native New Zealander, New Zealand scientists play a remarkably important role on the international stage in understanding the planet's climate and how it might change. For a country of only four million people, New Zealand punches way above its weight in climate science, fielding world experts in many aspects of the subject, as well as having major players in many of the international bodies dealing with climate issues. And it was a great help operating out of the Antarctic Research Centre at Victoria University, because this has an international reputation for excellence in Antarctic research. I had no problem finding scientists and research projects close to home that were central to our understanding of climate science. And New Zealand scientists were always able to put me in contact with scientists elsewhere in the world, helping me on my journey of understanding.

For example, New Zealanders are involved in a number of big international science projects in Antarctica, understanding the role of greenhouse gases in past climates. Baring Head, just outside Wellington, is the most important clean air monitoring station in the southern hemisphere, working together with the Scripps Institute of Oceanography in California to monitor the year by year changes in the level of carbon dioxide and other greenhouse gases in the atmosphere. And the *RV Tangaroa* is used by New Zealand scientists together with oceanographers and biologists from all round the world. This work plays an important role in understanding the southern ocean and how it might respond to and affect climate change.