>Lauder

Project shines light on 'gravity waves'

An international project mapping atmospheric waves to improve climate modelling and weather forecasting has had parts of its research conducted from the Niwa site in Lauder for the past month. Leith Huffadine reports.

EVERY cloudless night for the past month, a vivid green beam of light has glowed upwards into the starry skies above Lauder, Central Otago.

The light, a laser, is emitted from a white, eight-foot shipping container on the National Institute of Water and Atmospheric Research (Niwa) site and is created by firing 100 pulses of light a second, in 6m lengths, into the sky, and is sometimes accompanied by another green laser.

Such is its presence in the night sky, the laser can be seen from distances of about 4km-5km away in the surrounding Manuherikia Valley.

Niwa atmospheric scientist Ben Liley said he was not sure whether farmers from the area thought the laser meant scientists at the facility were trying to talk to aliens, or the other way around.

In reality, the laser, or "lidar" (light detection and ranging), is a key instrument in an international research project, called Deepwave, studying atmospheric "gravity waves".

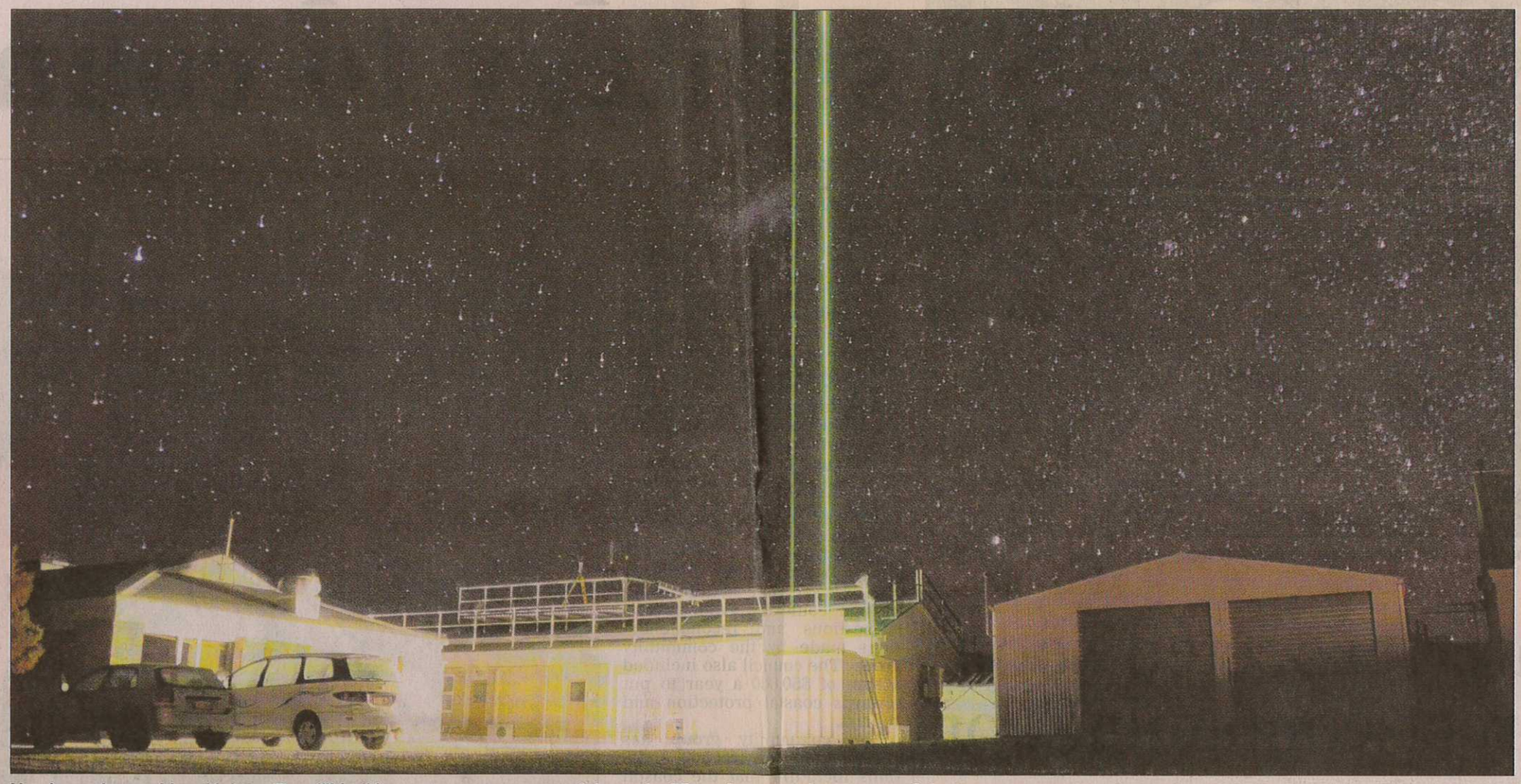
The project has been operating from seven sites across New Zealand, including Lauder, since early June.

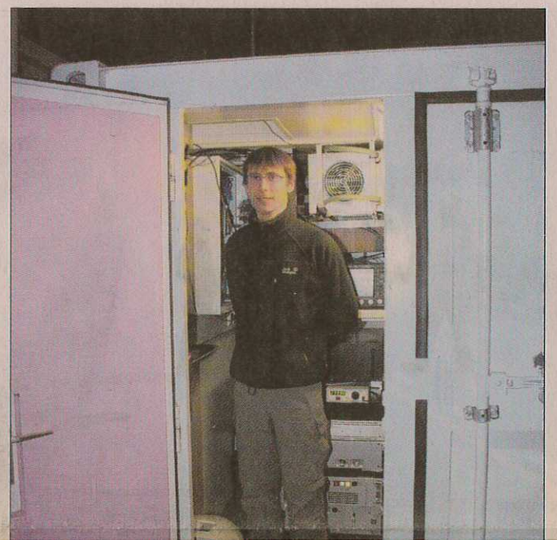
German Aerospace Centre (DLR) atmospheric scientist Bernd Kaifler said the main purpose of the work was to understand how energy travels in the atmosphere.

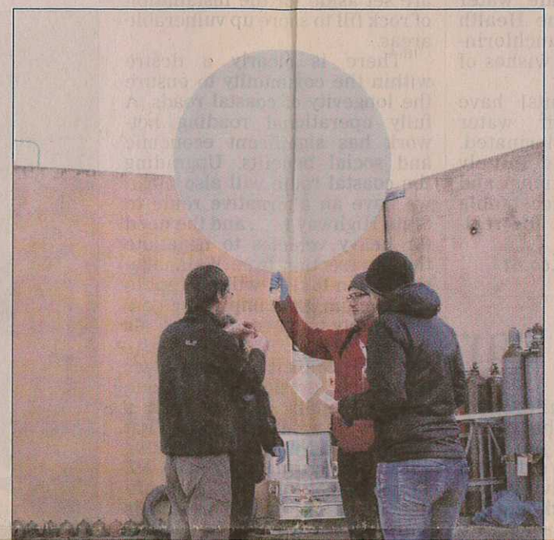
"We want to be able to improve weather forecast models and how climate models work, and improve basic understanding of what is going on in the atmosphere."

The research was also important because if scientists could use the information to help prove global warming was a real problem, then it could be used to convince politicians to change their attitudes towards the issue, he said.

"The main motivation is







Up above the world so high . . . Two "lidar" instruments operate at night at the Niwa site at Lauder, as part of the Deepwave project. Below, from left: Atmospheric scientist Dr Bernd Kaifler, of Germany, inside the portable container which contains a lidar brought to the Lauder site for the project; Dr Kaifler and German scientists Benedikt Ehard (centre) and Sonja Gisinger prepare a balloon and radiosonde for launch; then release the balloon and radiosonde in order to collect temperature, pressure and humidity data. PHOTOS: LEITH HUFFADINE

Instruments used

Lidar (light detection & ranging)

- This device works by shining a powerful laser into the atmosphere at about 100 pulses per second.
- A telescope then collects the light from the laser scattered back by aerosols, air molecules, cloud particles and whatever else is in the atmosphere.
- The collected light is then analysed to determine factors such as air density [pressure] and temperature.
- Gravity waves can be studied using the lidar because they change in temperature slightly, and the temperature variations can be used to determine the wave signal.
- The lidar is used in a range of about 20km-90km above the earth's surface.
- The instrument, worth about $500,000, is housed a portable eight-foot shipping container and was constructed for the Deepwave experiment.

Aerosol lidar

- A Japanese-New Zealand run instrument which operates in the same manner as the regular lidar. It measures aerosols and is used for deriving temperature profiles in the atmosphere.

Balloons with radiosondes

- Balloons launched from the site carry a device called a radiosonde, used to measure temperature, pressure and humidity.
- Measurements are then transmitted back to the ground by a radio.
- The balloons climb to a bursting height of about 35km above the earth's surface at a rate of about 3m-5m per second, and can travel horizontally up to 100km, depending on winds.
- When balloons reach their bursting height, because of the decreased air pressure at altitude, they will have expanded to about eight times their original size.
- The vertical lift of the balloons can be controlled by the amount of helium they are filled with.
- During periods of intensive observation a balloon will be launched about every three hours.

Aeroplanes

- During the Deepwave project, two planes based in Christchurch have been flying across the Tasman and Southern Oceans, and the Southern Alps on predetermined flight paths.
- The two planes, a German "Falcon 20" aircraft and an American "G-5" aircraft, are equipped with measuring instruments.
- The German craft has a downward-facing lidar, and instruments to measure traces of ozone or oxygen, while the American craft has two upward-facing lidar measuring

facing lidar measuring temperature and an "airglow imager", which detects light in the infrared range when the skies are dark.

Together, the instruments used in the Deepwave project make it possible to cover what is going on in the atmosphere above New Zealand.

because we are living in a changing world and we want to ascertain what is happening now, in the near future, and in 100 years. To this end we need to understand the atmosphere.

"We are affected by the atmosphere because we are living in it. Everyone is."

The atmosphere was changing, and would continue to change, but exactly how was what the project was designed to find out, Dr Kaifler said.

The project would focus on gravity waves caused by the movement of air forced upward into the atmosphere by mountains after the air had travelled across the ocean.

"What we are studying in New Zealand in particular is mountain waves, but also other waves from thunderstorms over the ocean, which have different characteristics. The main reason we came to New Zealand is because during the winter time the gravity waves can propagate very high into the atmosphere."

> "We are affected by the atmosphere because we are living in it. Everyone is"
>
> — German Aerospace Centre atmospheric scientist Bernd Kaifler

In the summer, the waves "broke" lower in the atmosphere, meaning they were not as suitable to study.

The South Island was a good location for the research because of the north-south orientation of the Southern Alps, the nearby oceans and winter circulation patterns in the atmosphere.

Reliable westerly winds and the position of the southern circumpolar jet stream over the alps led to the development of strong gravity waves.

As the waves moved up into the atmosphere, they transported energy.

Discerning how energy was transported by the waves aided in the understanding of how the atmosphere worked, Dr Kaifler said.

During the study, several methods of measuring the atmosphere were involved, including the use of three methods at the Lauder site — the lidar, an aerosol lidar and balloons carrying devices called radiosondes, used to measure temperature, pressure and humidity.

Airborne operations were based out of Christchurch.

"By bringing together all these instruments it is possible to measure the atmosphere from Earth's surface to about 100km [in altitude]," Dr Kaifler said.

"The instruments we have here are really state-of-the-art technology. The instruments on the aircraft have been designed for this purpose, and the lidar system is quite advanced technology which only just became available."

Beginning at Niwa's Lauder site in early June, the project is set to finish on Monday.

Scientists from the United Kingdom, Germany, France, the United States, Australia and New Zealand are working together on the project, which is funded in part by American institutions the National Science Foundation, the Office of Naval Research and the Naval Research Laboratory.

Work had originally been planned to take place in South America, but some facilities had not been adequate, so the study was moved to New Zealand.

Once the work was completed, it would take over a year to analyse the data, Dr Kaifler said.

"We have some compelling results now but before we can publish in a scientific journal we have to have a formal basis and it takes some time to validate the instruments against other instruments to make sure they are accurate; and the data stock needs to be calibrated [for accuracy]."

During the project, scientists from Germany have been living in accommodation at the Niwa facility.

Dr Kaifler said the work often demanded that they were awake all night, operating instruments and releasing balloons in subzero temperatures.

Mr Liley said it had been "very interesting" having the Deepwave team at Lauder, and the scientists had enjoyed their time in Central Otago.

Operation of the lidar had returned some "very good" results, he said.

"They have been very pleased with what they have observed."

Dr Kaifler said the next similar study would possibly be carried out in late 2015, at locations somewhere in Scandinavia.

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Welcome addition to Lauder research station

Different skies . . . The newest employee at Niwa's Lauder research station, atmospheric scientist Dave Pollard, of the United Kingdom. PHOTO: LEITH HUFFADINE

By LEITH HUFFADINE

DAVE Pollard's last job was working for a defence contractor in the United Kingdom using underwater microphones to listen to passing ships and submarines.

He is now the latest employee at the National Institute of Water and Atmospheric Research (Niwa) site in Lauder, after moving to New Zealand with his wife to work as an atmospheric scientist.

Mr Pollard said he was an observational scientist, taking measurements and interpreting results, and his work at Niwa would be focused on measuring gases in the atmosphere by their absorption of solar radiation.

The information collected would be supplied to climate-change scientists and used to validate climate models to confirm what was happening in the atmosphere.

"We can see what is happening to different gases and try to figure out what is happening [in the atmosphere]. It's a bit of a detective story sometimes."

The position, which he had taken up about a month ago, had previously been based in Wellington, but his location on site made it easier to work with the instruments he used to take various scientific measurements.

Niwa atmospheric scientist Ben Liley said the position was the second created since job cuts in 2012.

Earlier in the year, Dr Richard Querel, of Canada, also an atmospheric scientist, had joined Niwa staff.

Having Mr Pollard at the Lauder research station would increase the amount of work the site could complete.

"To a large extent what we can do here is limited by what measurements we can take and the people we have who have the right skills to understand the data," Mr Liley said.

Mr Pollard would be a valuable addition to the staff, and those at Niwa were pleased he had joined them, Mr Liley said.

Mr Pollard said the Niwa facility at Lauder was well known in the science community.

"I have started using the L&P line — it is world famous in atmospheric science."

He was also a fan of making science accessible to the public, particularly in relation to climate and weather, he said.

Mr Pollard, whose contract is permanent, said he looked forward to living in Central Otago.

He studied in the United Kingdom and holds an undergraduate master's in physics and a master of science in weather and climate modelling.