SPECIAL PROJECT PROGRESS REPORT

Progress Reports should be 2 to 10 pages in length, depending on importance of the project. All the following mandatory information needs to be provided.

Reporting year

2014

Project Title:

Atmospheric waves in the middle atmosphere measured by the ALIMA lidar onboard the research aircraft HALO

Computer Project Account:

SPDEKAIF

Principal Investigator(s):

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Natalie Kaifler

Affiliation:

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Name of ECMWF scientist(s) collaborating to the project
(if applicable)

Start date of the project:

2014

Expected end date:

2016

Computer resources allocated/used for the current year and the previous one
(if applicable)
Please answer for all project resources

		Previous year		Current year	
		Allocated	Used	Allocated	Used
High Performance Computing Facility	(units)			100000	0
Data storage capacity	(Gbytes)			40	0

Summary of project objectives
(10 lines max)

The objective of the project is to study atmospheric waves using the ALIMA instrument (short for Airborne LIDAR for the Middle Atmosphere). The lidar will measure atmospheric density, temperature and disturbances caused by atmospheric waves between 10 and 120 km using different scattering mechanisms. A prototype for the new instrument will be built and tested on ground before ALIMA is certified for operations on the research aircraft HALO. Atmospheric gravity waves are excited near ground level, e.g. by flow over mountains and propagate throughout the atmosphere up to thermospheric altitudes (> 100 km). Gravity waves interact with the background flow by convective or dynamic instabilities and are subject to selective filtering. They contribute significantly to the energy budget of the atmosphere and play a major role in the vertical coupling of the atmosphere. ECMWF wind data will be used to determine critical layers where gravity waves are filtered.

Summary of problems encountered (if any)
(20 lines max)

Summary of results of the current year (from July of previous year to June of current year)
This section should comprise 1 to 8 pages and can be replaced by a short summary plus an existing scientific report on the project

The ALIMA project was started in June 2013. In a first step, a ground-based Sodium-Rayleigh lidar system was designed, integrated, tested and is now in operation during a measurement campaign for gravity waves. As the instrument just began acquiring data, we did not make use of ECMWF data yet. Calculations of critical levels based on ECMWF data is planned for the second half of 2014.

First atmospheric test measurements by the Rayleigh lidar system were carried out at Oberpfaffenhofen, Germany, in January-April 2014. The lidar comprises an Innolas Nd:YAG Laser with 12 W output power at 532 nm, a telescope, a receiver, data acquisition hardware and software. For testing, the lidar was set up in the dome on the roof of the Institute of Atmospheric Physics at the DLR site in Oberpfaffenhofen (Fig. 1, left). Rayleigh signal was received up to 93 km altitude and temperature profiles could be obtained in the altitude range 30-75 km (Fig. 2). The distortions visible in the temperature profile shown in Fig. 2 are signatures of gravity waves.

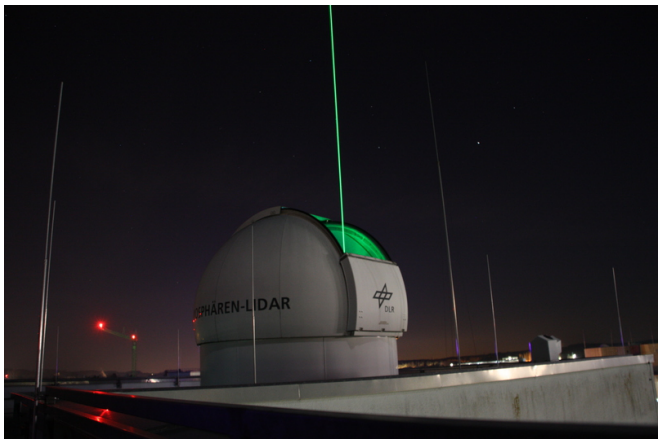

Fig. 1: Rayleigh lidar at Oberpaffenhofen.

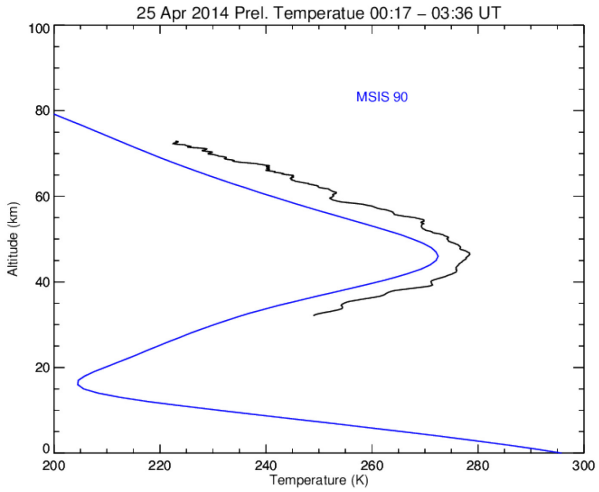

Fig. 2: Measured temperature profile

A customized 8-foot-container to be used as mobile home for the lidar system was designed and built. It consists of two compartments, one temperature- and humidity-controlled compartment for the laser and electronics, and one for the telescopes with a hatch in the roof. The container was shipped to New Zealand in support of the DEEPWAVE gravity wave measurement campaign in April 2014. Field measurements in the scope of DEEPWAVE are scheduled for the time frame June-September 2014.

Fig. 3: The lidar container at Oberpaffenhofen.

Fig. 4: The Rayleigh lidar at Lauder, New Zealand.

As of 30 June 2014, 80 hours of measurement data were acquired. Gravity wave signatures are extracted from temperature variances measured by the Rayleigh lidar system in 25-80 km altitude. We plan to use ECMWF wind- and temperature fields to determine atmospheric conditions which cause selective filtering of gravity waves in the stratosphere. The analysis of gravity wave transmission is based on the model developed by Kaifler (2014).

Literatur

Kaifler, B. Thermal structure and gravity waves in the Antarctic middle atmosphere observed by lidar, 2014.

List of publications/reports from the project with complete references

Summary of plans for the continuation of the project

(10 lines max)

The Rayleigh lidar system will be operated at Lauder, New Zealand, until September 2014 and it will then be shipped back to the Institute of Atmospheric Physics in Oberpfaffenhofen, Germany, for integration of the sodium lidar. The lidar system will be tested on ground and participate in upcoming field measurement campaigns. It will also serve as a test model for the airborne ALIMA instrument. Analysis of the data acquired during the DEEPWAVE field campaign in June-September 2014 will continue throughout 2015 as part of a PhD project. Work on improvement of the gravity wave model which is used to calculate gravity wave propagation from the lower stratosphere into the mesosphere will also continue.