T1.1-P10

CORAL – An autonomous middle atmosphere lidar in southern Argentina

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Introduction

CORAL is a high-power Rayleigh backscatter lidar designed for profiling the middle atmosphere from 10 to 100 km altitude. In November 2017, it was deployed to Rio Grande, Tierra del Fuego, Argentina, close to the IMS infrasound station IS02. The region is known for the world's highest stratospheric gravity wave activity. Gravity waves cause significant temperature and wind fluctuations in the middle atmosphere, which can affect the acoustic waveguides. In 2016, CORAL was already installed at the IMS infrasound station IS26 in southern Germany. The collocated measurements of infrasound and temperature have been used to assess numerical weather prediction models for analyzing infrasound detections (see also poster T1.1-P6). Here, the measurement principle of CORAL and gravity wave observations in Argentina are presented.

Compact Rayleigh Autonomous Lidar (CORAL)

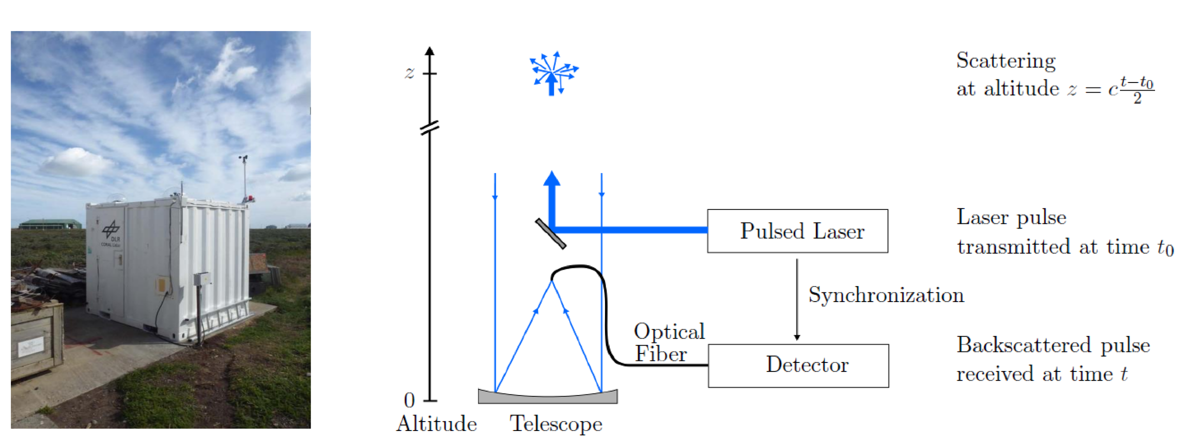


Fig. 1: The CORAL lidar collects backscattered laser light (532 nm, 14 W power, 100 Hz repetition rate) by a 70 cm telescope in three height-cascaded channels. It is integrated into an 8-foot container at EARG station in Rio Grande and operates autonomously using local weather data and forecasts.

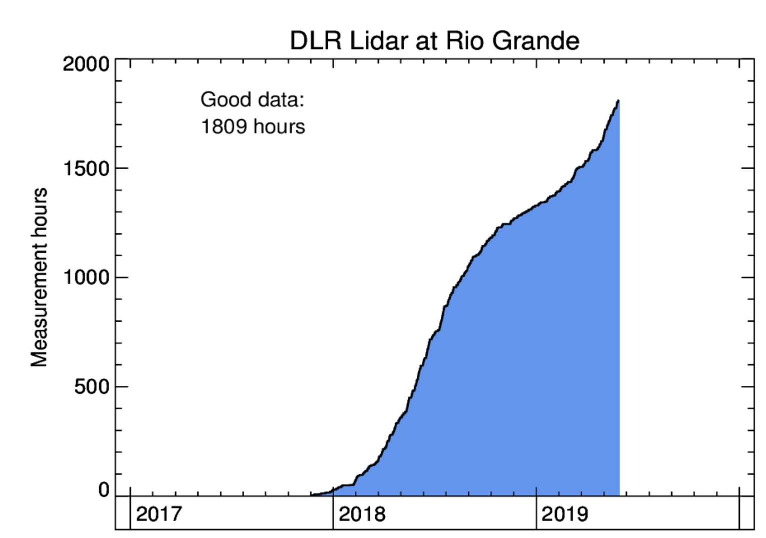
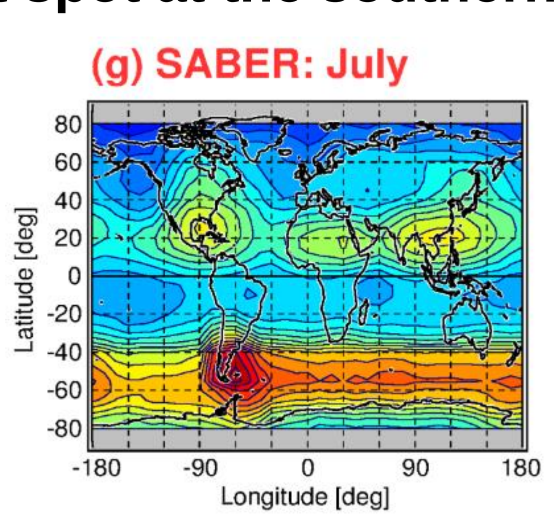


Fig. 2: CORAL accumulated more than 1,800 h of high-resolution data. Measurements are obtained on two out of three nights and last up to 15 h per night during winter, and are shorter during summer.

The gravity wave hot spot at the southern tip of South America

Fig. 3: The worlds largest stratospheric gravity wave sources are measured by satellites at the southern tip of South America (from Ern et al., ESSD, 2018).



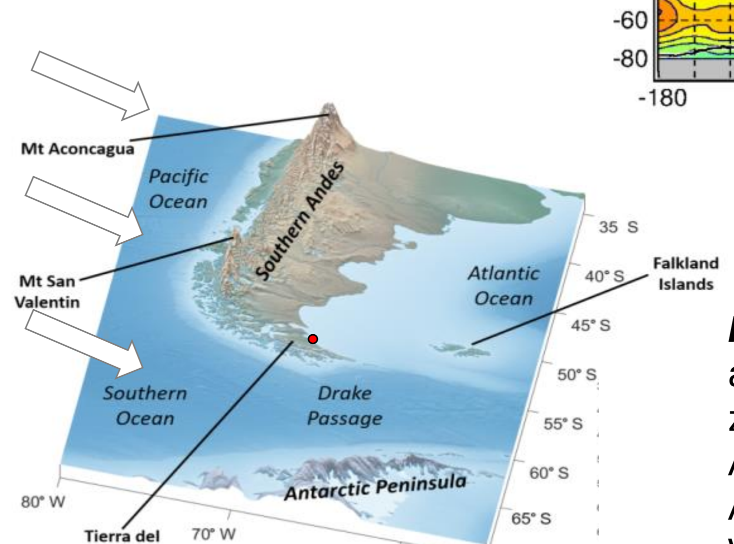
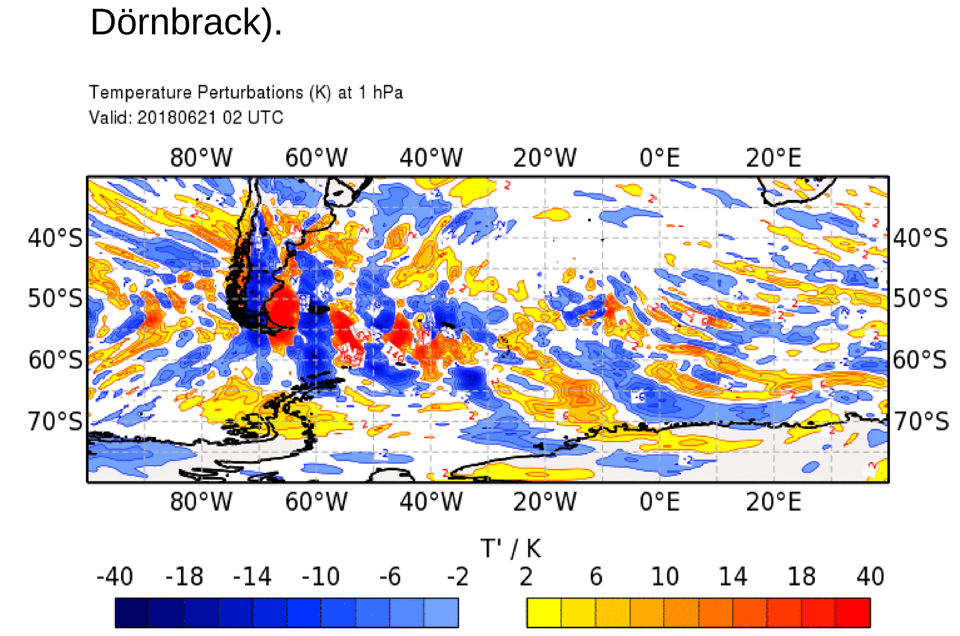


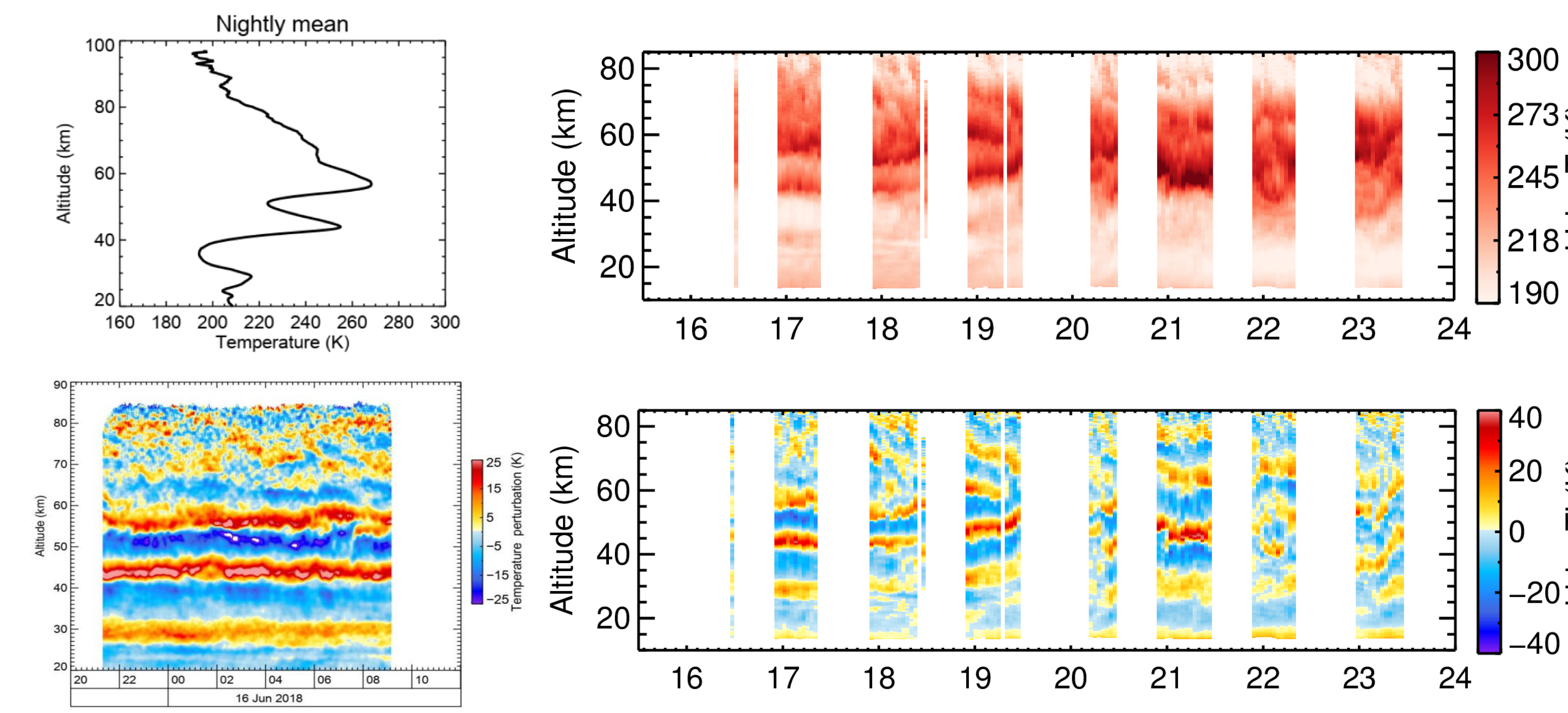
Fig. 4: Mountain waves are excited by strong zonal winds crossing the Andes mountains and Antarctic Peninsula (from Wright et al., ACP, 2017).

Fig. 5: Strong mountain waves extending leewards from Tierra del Fuego in the ECMWF IFS model data on 21 June 2018 (Fig. by A. Dörnbrack).



Mountain wave event of 16-24 June 2018

Fig. 6: Large-amplitude mountain waves with constant phase lines perturb the stratospheric temperature and break in the lower mesosphere. The event lasted for eight days and impacted the southern stratospheric circulation several thousand kilometers leeward (see Fig. 5).



Seasonal evolution of temperature and gravity wave activity

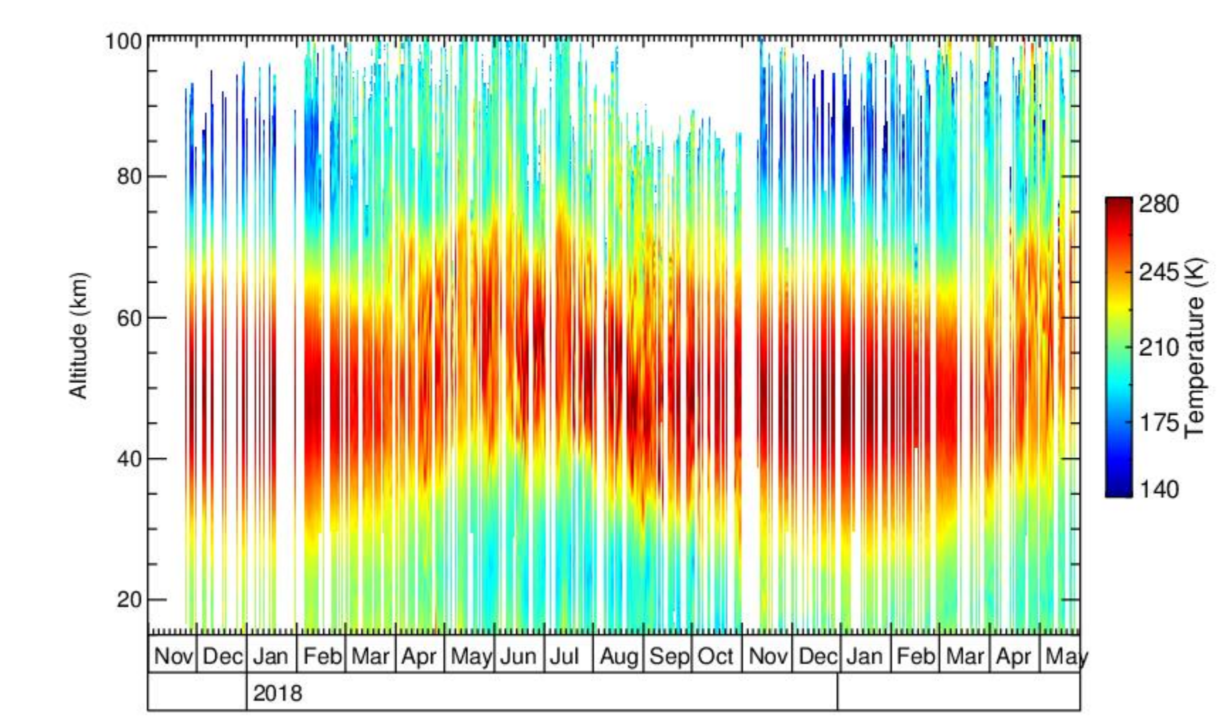


Fig. 7: Temperature derived from atmospheric density between 10 and 100 km above Rio Grande with stable conditions during austral summer and wave-perturbed conditions in winter.

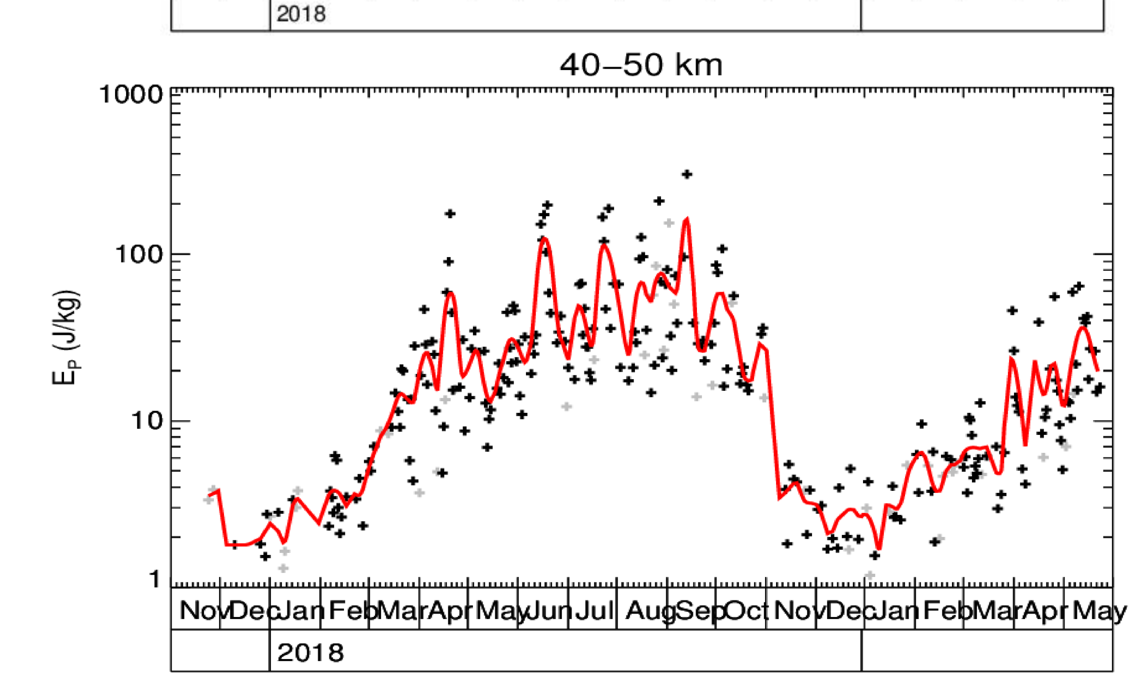


Fig. 8: Potential energy densities of upper stratospheric atmospheric gravity waves. High and strongly intermittent wave activity is observed during austral winter.

Outlook: Wind lidar

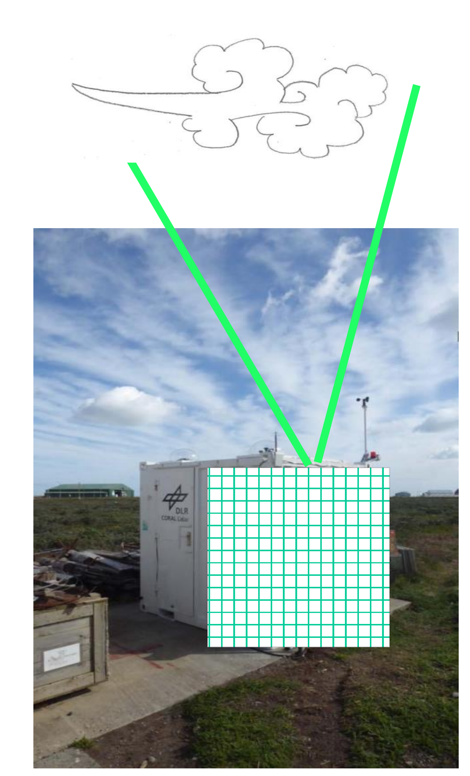


Fig. 9: Proposal of an extended version of CORAL adding a wind measurement capability between 15 and 65 km also during daylight, using two telescopes and beams in a slightly larger container.