Supporting material to EGU21-15102

Karlsruher Institut für Technologie

Non-orographic gravity wave between jet streams above South-Atlantic: synergy of airborne observations and performance of ECMWF IFS

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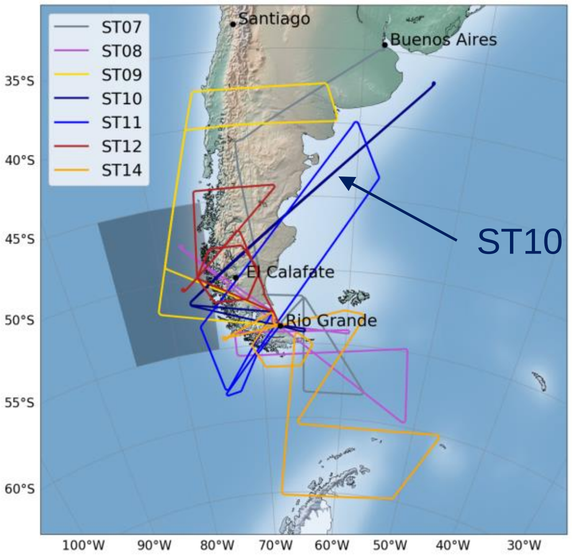
SOUTHTRAC Mission

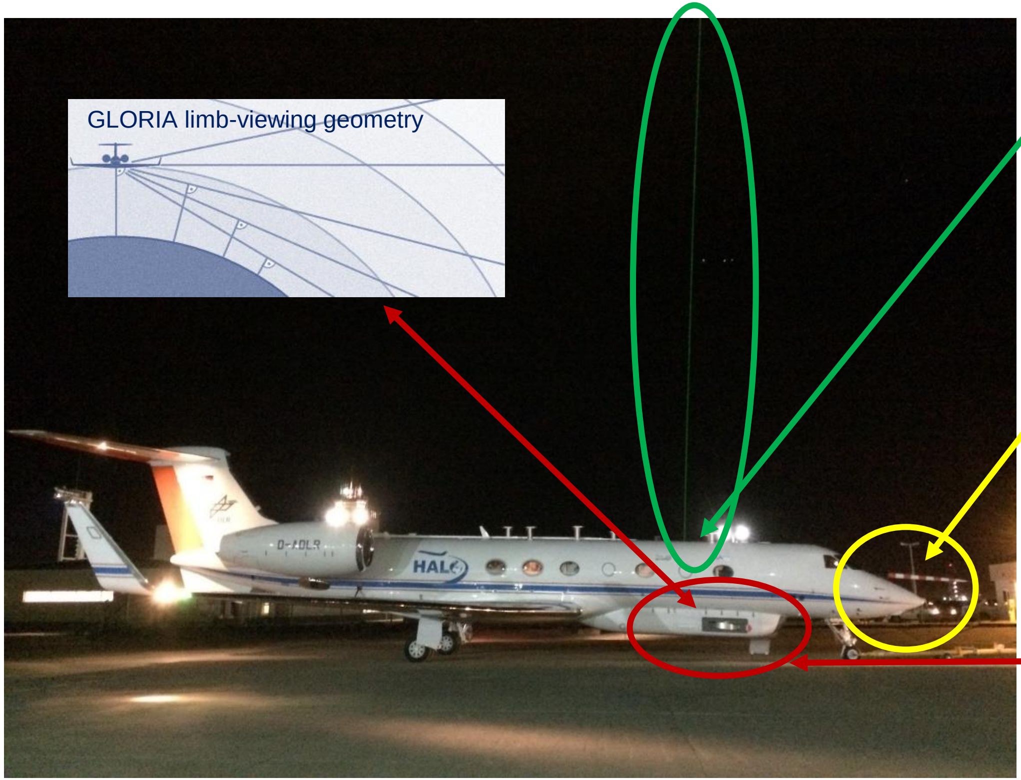
- Joint research project by research centres and universities (Germany) together with international partners
- Investigation of transport, dynamics and chemical composition in the Southern Hemisphere UTLS
- SOUTHTRAC-GW: Exploration of gravity waves in the hotspot region around South America and the Antarctic peninsula
- Airborne observations by research aircraft HALO in September and November 2019
- Ground-based observations and radiosoundings

https://www.pa.op.dlr.de/southtrac/
https://www.imk-asf.kit.edu/Projekte_3737.php
https://www.pa.op.dlr.de/wasclim/



Overview on SOUTHTRAC GW flights (from Rapp et al., BAMS, 2020, https://doi.org/10.1175/BAMS-D-20-0034.1).

GLORIA, ALIMA & BAHAMAS on board HALO



ALIMA: Airborne LIdar for Middle Atmosphere research

- Compact upward pointing Rayleigh lidar (532 nm)
- Atmospheric T-profiles from >15 to 90 km
- Developed and operated by DLR-IPA

Rapp et al., BAMS, 2020, https://doi.org/10.1175/BAMS-D-20-0034.1

BAHAMAS: Basic Halo Measurement and Sensor System of HALO research aircraft

- Fast in situ T and meteorological data (10/100 Hz)
- Developed and operated by DLR-FX

Krautstrunk, M. and Giez, A., in: Research Topics in Aerospace, Springer Verlag, 2012, https://doi.org/10.1007/978-3-642-30183-4_37

GLORIA: Gimballed Limb Observer for Radiance Imaging of the Atmosphere

- *Limb-imaging* FTIR spectrometer
- Temperature, trace gases and cloud information
- Developed and operated by KIT and JÜLICH

Riese, M., AMT, 2014, https://doi.org/10.5194/amt-7-1915-2014
Friedl-Vallon et al., AMT, 2014, https://doi.org/10.5194/amt-7-3565-2014

Flight ST10 on 16-17 September 2019

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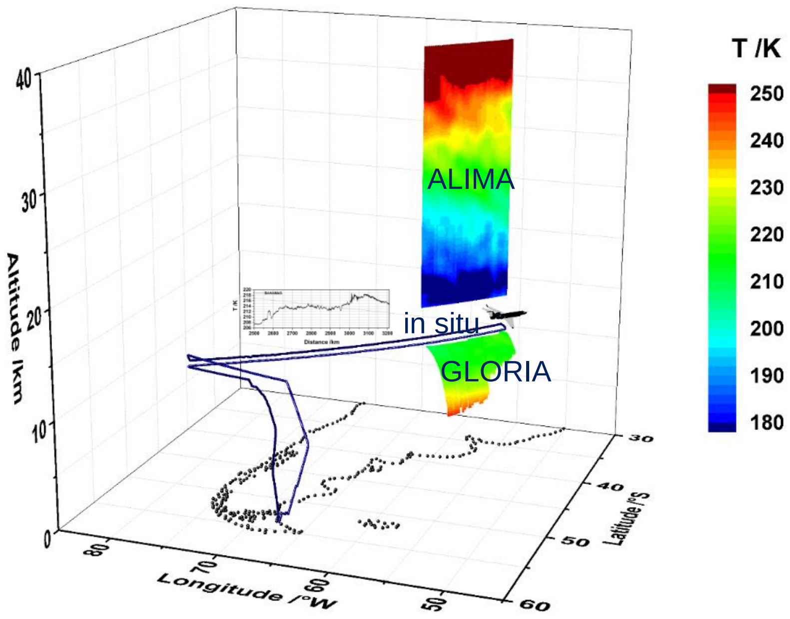
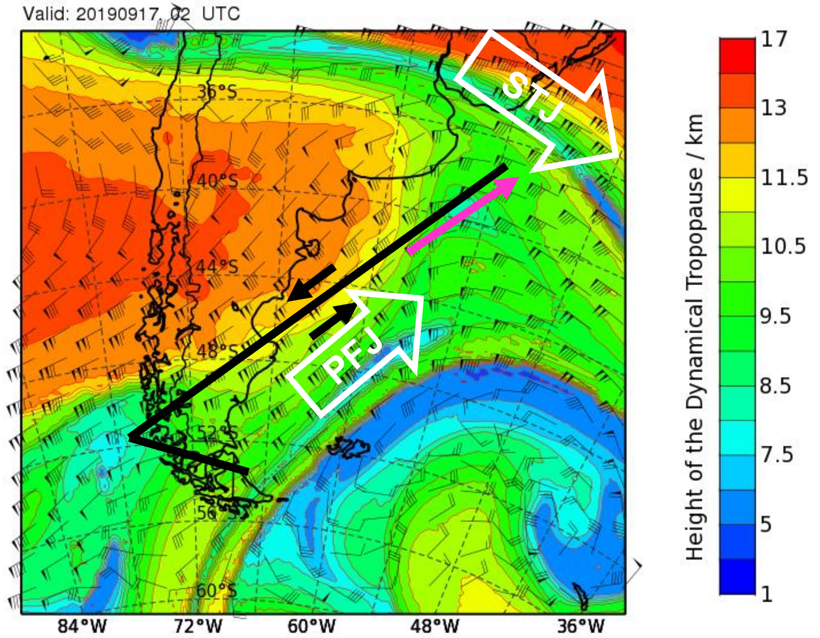
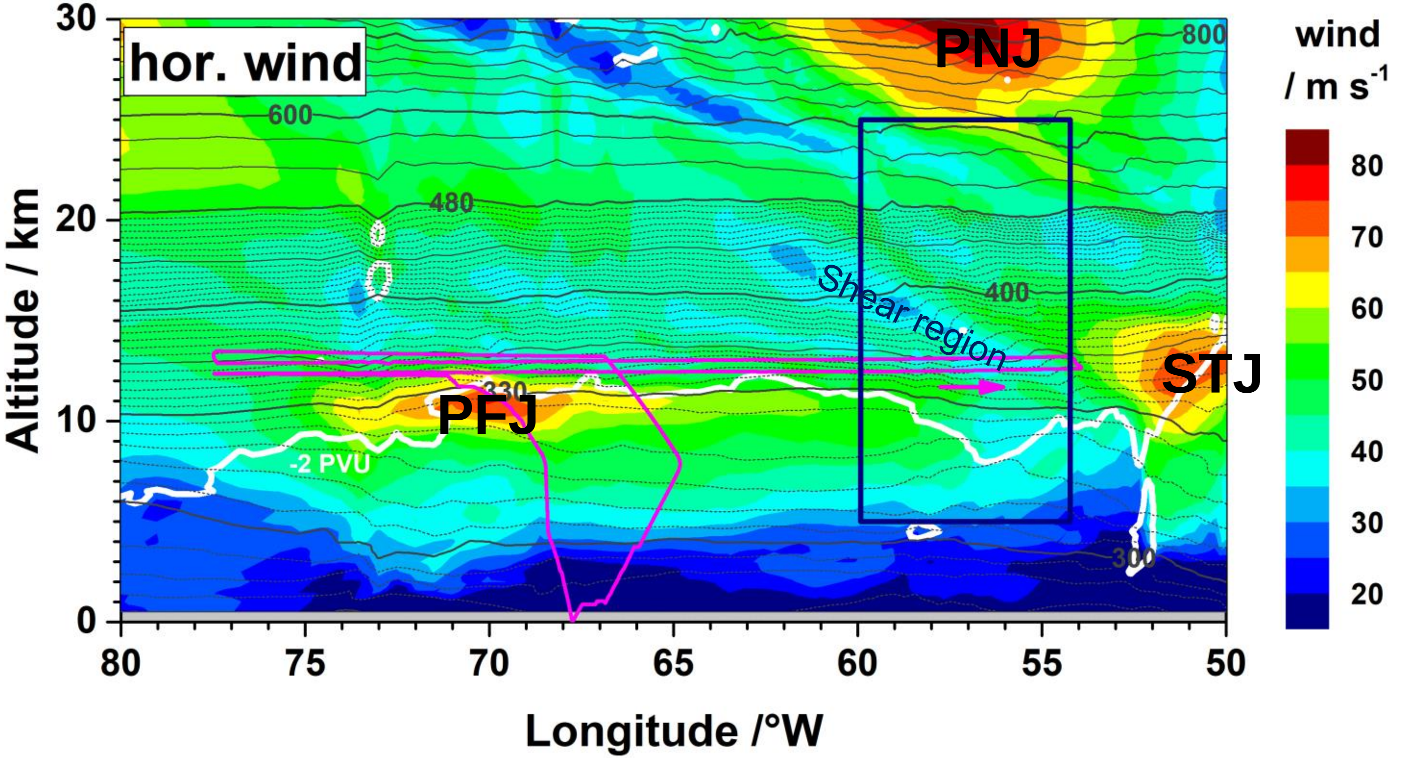


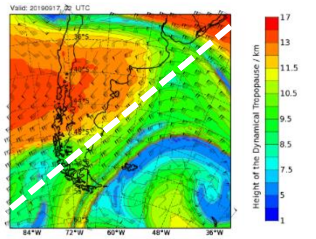
Synergy of T-observations by ALIMA lidar, BAHAMAS in situ sensor and GLORIA IR limb-imager onboard HALO aircraft during a subsection of ST10



ECMWF ERA5 tropopause height and horizontal wind together with flight path of ST10. PFJ=polar front jet, STJ=subtropical jet

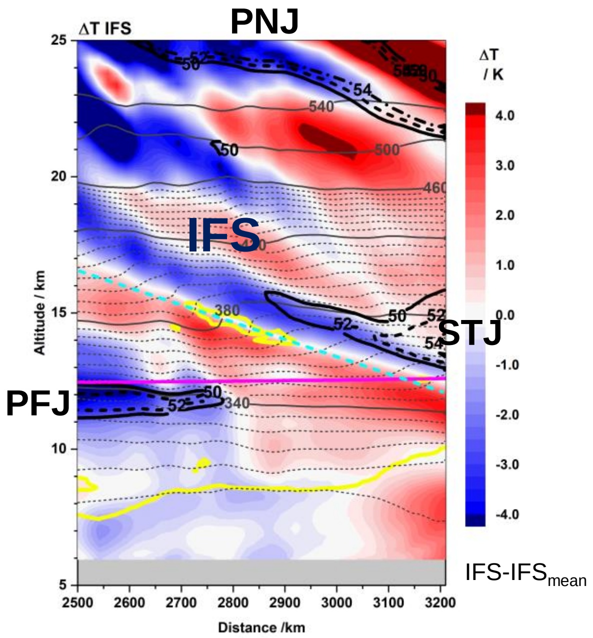
Complex situation of PFJ, STJ and PNJ

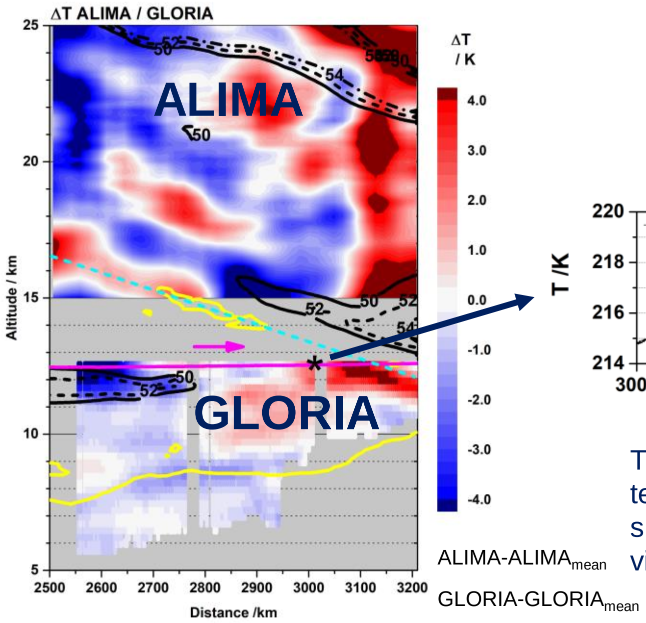


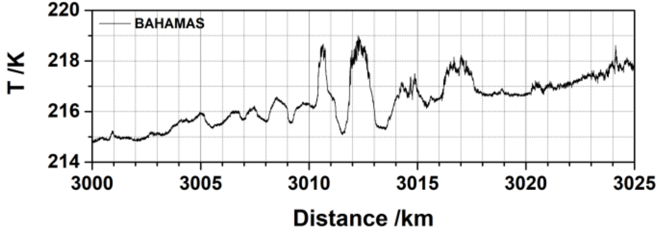


ECMWF IFS horizontal wind, potential temperature and dynamical tropopause at 02 UTC together with HALO flight path (23:00-08:58 UTC). PFJ=polar front jet, STJ=subtropical jet, PNJ=polar night jet

Temperature variations and GW signatures







Temperature variations in BAHAMAS 100 Hz temperature data (right panel) indicate a short-scale non-orographic GW event in the vicinity of the STJ

Mesoscale temperature perturbations forecasted by ECMWF IFS (left panel) and observed by GLORIA and ALIMA (middle panel). Black solid and dashed lines: horizontal wind speed (IFS); grey dashed and solid lines: potential temperature (IFS); yellow: dynamical tropopause (IFS); magenta: HALO flight altitude

Summary and Overview

- Preliminary analysis of ST10 case study shows complex temperature perturbations between PFJ, STJ and PNJ
- High degree of correspondence between mesoscale temperature perturbation observed by GLORIA/ALIMA and forecasted by IFS
- Interesting case for model validation
- Short-scale non-orographic GW event observed by BAHAMAS 100 Hz data
- Further steps: model validation, deeper analysis of synoptic situation and GW signatures

Acknowledgments

- SOUTHTRAC is supported by the German research foundation within the DFG SPP 1294
- The gravity wave observations are supported by the BMBF within the research initiative ROMIC II, project WASCLIM
- Many thanks to the GLORIA team (KIT and JÜLICH), ALIMA team (DLR-IPA) and BAMAHAS team (DLR-FX)
- We acknowledge ECMWF for providing the meteorological analyses and forecast data
- Thanks to the whole SOUTHTRAC consortium for an exciting campaign!

GEFÖRDERT VOM
Bundesministerium für Bildung und Forschung

DFG Deutsche Forschungsgemeinschaft

DLR

KIT Karlsruher Institut für Technologie

JÜLICH Forschungszentrum

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