Observation of clouds and precipitation with the remote sensing suite on the research aircraft HALO during the NARVAL II and NAWDEX campaigns

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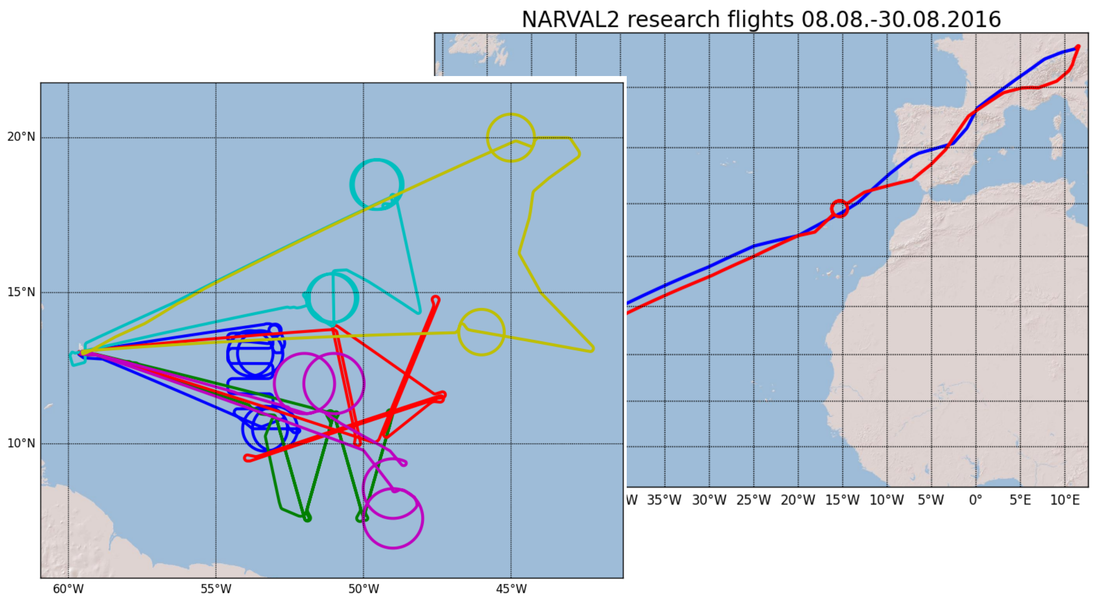
NARVAL II

The **Next-generation Aircraft Remote sensing for VALidation studies II (NARVAL II)** flight campaign is the summer-time (August) follow up of NARVAL I – South (December 2013). Both campaigns were based on Barbados and focused on the tropical Atlantic eastward with the goals:

- Characterize the cloud macrophysics and microphysics of trade wind convection and its evolution by airborne remote sensing observations
- Characterize the thermodynamic structure (temperature and humidity) and the dynamics (horizontal wind field) in vicinity of evolving convective systems in the trade wind region



NAWDEX

The **North Atlantic Waveguide and Downstream Impact Experiment (NAWDEX)** is an international field experiment with the overarching scientific hypothesis:

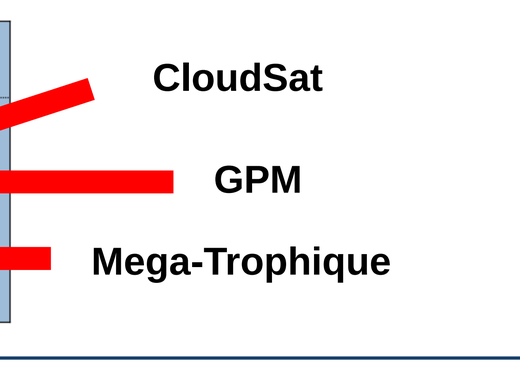
Diabatic processes over North America and the North Atlantic have a major influence on jet stream meanders, the downstream development of Rossby waves on the tropopause, and high impact weather phenomena over Europe.

The field campaign is currently ongoing (Sept./Oct. 2016) and based at Keflavik (Iceland) with the key observational targets:

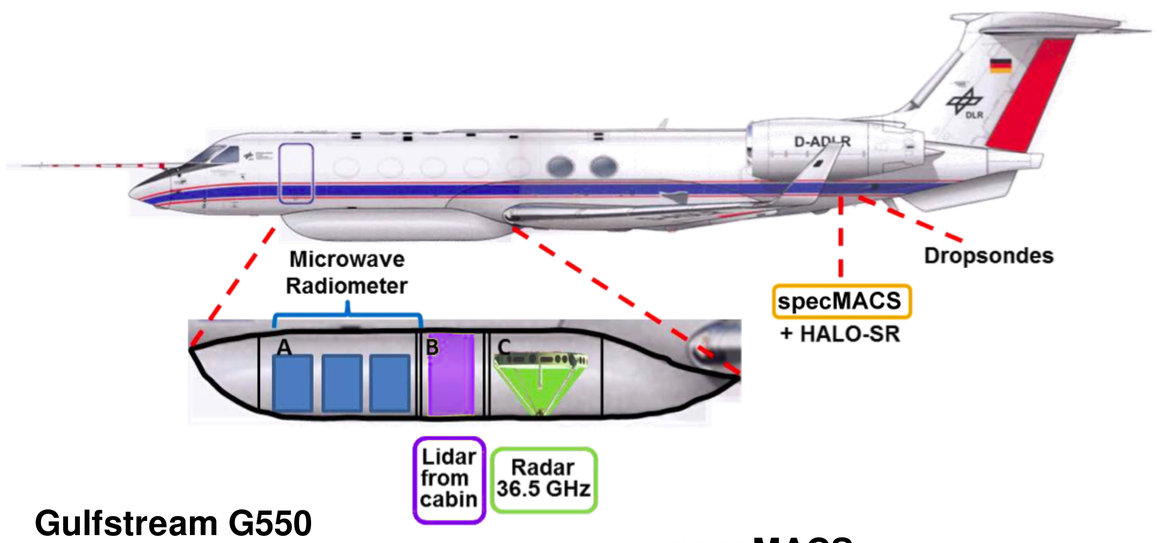
- Impact of tropopause wave guide uncertainty on HIW events
- Moisture and cloud structure in tropopause region
- Mositure structure in the boundary layer
- Mixed phase clouds
- Upper level PV
- Cyclonic systems
- Quantification of analysis error

Coordinated flights with:

- DLR Falcon (2 wind lidars)
- French Falcon (94 GHz radar)
- BAe 146 (in-situ, ISMAR submm)
- Global Hawk within SHOUT



Aircraft & Instrumentation



Gulfstream G550

- Range of 10h / 10000 km
- Altitude max. 15.5 km

Microwave Radiometers

- 26 channels (22 to 183 GHz)
- FOV @ 12 km (1.3 – 0.8 km)
- temperature and humidity profiles
- integrated water vapour and hydrometeor contents

WALES lidar

- Water vapor absorption lidar with four wavelengths
- humidity profiles and aerosol contents

Cloud Radar

- Pulsed radiometric Doppler radar at 36 Ghz (-38 dBZ sensitivity @ 5km range)
- Reflectivity, LDR, Doppler velocity spectra

specMACS

- VNIR (417-1016 nm) and SWIR (1015-2496 nm) hyperspectra camera, push-broom priniciple
- cloud phase and mask, effective particle size,, optical thickness, distance

SMART

- up- and downward spectral irradiance (350 - 2200 nm)
- upward nadir spectral radiance (350 - 2200 nm)
- cloud phase, optical thickness, particle effective radius

Dropsondes

- four sondes at one time
- profiles of temperature, humidity and wind speed and direction

Satellite underpasses

In both capaigns, underflying satellites with comparable instruementation is an essential part of the flight planing. Target satellites are A-Train and GPM observations.

Summary

HALO successfully accomplished the NARVAL II campaign and is currently in operation for the NAWDEX campaign with the remote sensing suite on board

- 16 (+5-6) flights all in all 200 flight hours (10 NARVAL II, 10-11 NAWDEX) with high data coverage: > 400 dropsondes
- Collocation with the GPM, A-Train, and Mega-Trophique, and super-site overpasses, and coordinated flights with DLR Falcon, French Falcon, BAe 146, Gobal Hawk
- Preliminary results are very promising and reveal great detail of water vapour, shallow cumulus clouds, deep convection over tropical Atlantic, trade winds, ITCZ
- Several stages of North Atlantic weather system with high impact on Central European weather, the Warm converyor Belt in- and outflow region, tropopause folds, and regions of high jet winds have been studied

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