EarthCARE - Science Application Studies on Radiative Heating in North African Aerosol Plumes

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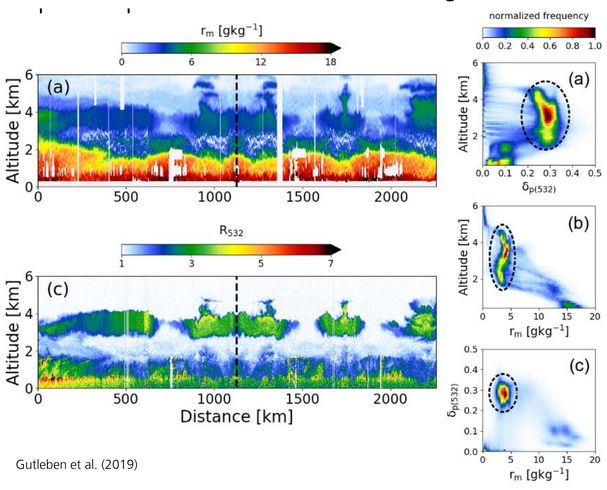
Enhanced Saharan air layer water vapor concentrations

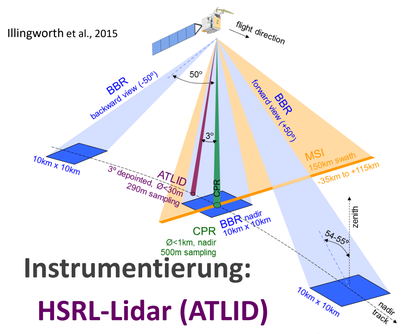


Gutleben et al. (2019)

- Enanced water vapour mass mixing ratios in SAL-altitudes compared to dry freetroposphere,
- Typical Saharan dust depolarization ratios (δ_{p532}) corresponds to increased r_m

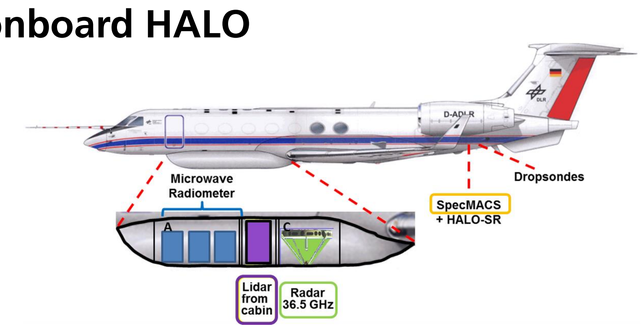
How does SAL-water vapour affects clouds and radiative transfer?

EarthCARE-like payload onboard HALO



Instrumentierung:

HSRL-Lidar (ATLID)
Cloud-Profiling Radar (CPR)
Multi-Spektral Imager (MSI)
Broadband Radiometer (BBR)



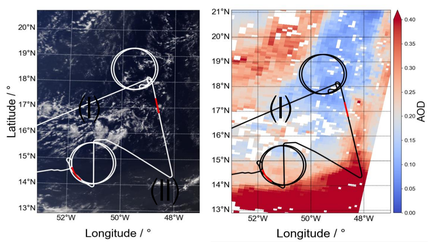
Instrumentierung:

HSRL-Lidar + DIAL (WALES)
Cloud-Profiling Radar (MIRA35)
Hyper-Spectral Imager (specMACS)
Microwave Radiometer (HAMP)

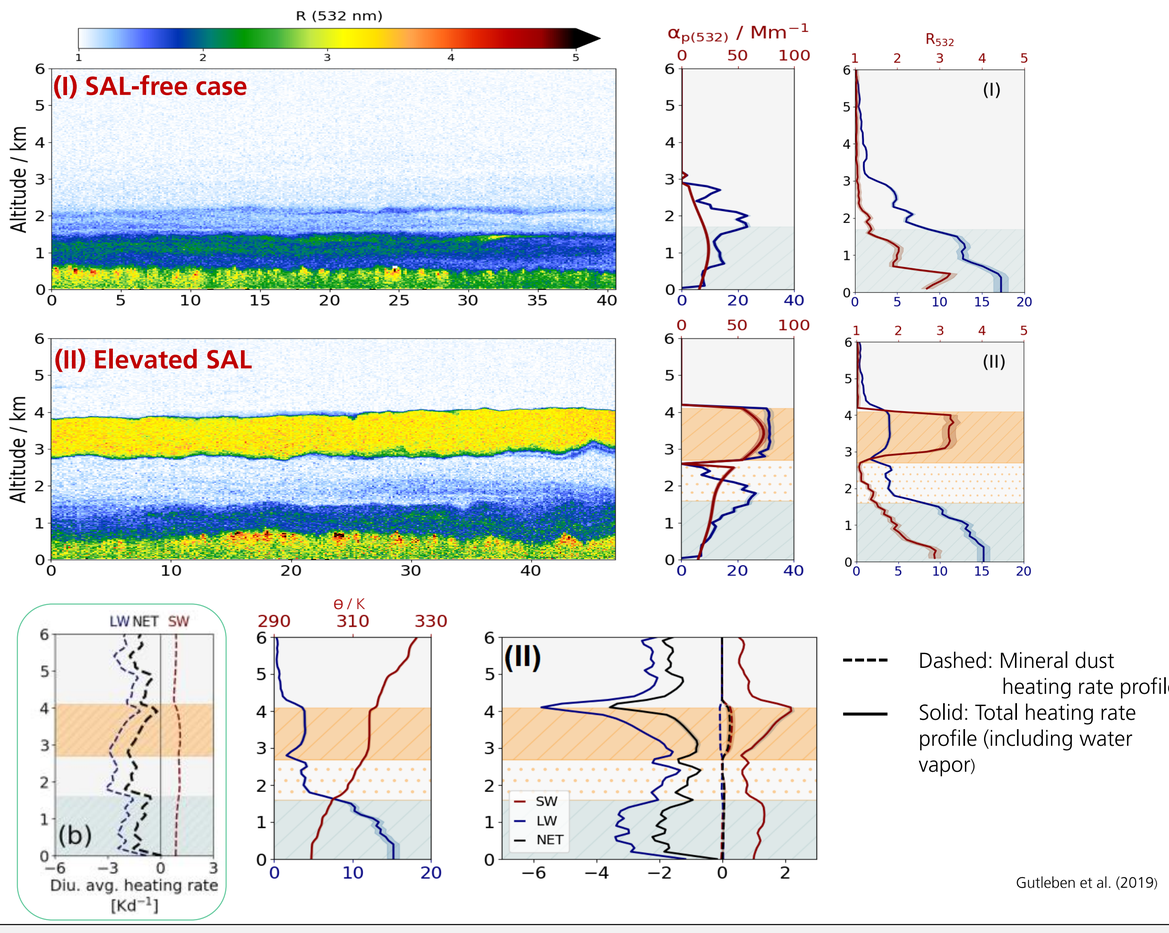
Summer time Saharan Air Layer (SAL)

- Case study during NARVAL-II Champagne at Barbados in 2020
- Enhanced water vapor concentrations associated with SAL

Research flight paths over Saharan dust-laden regions

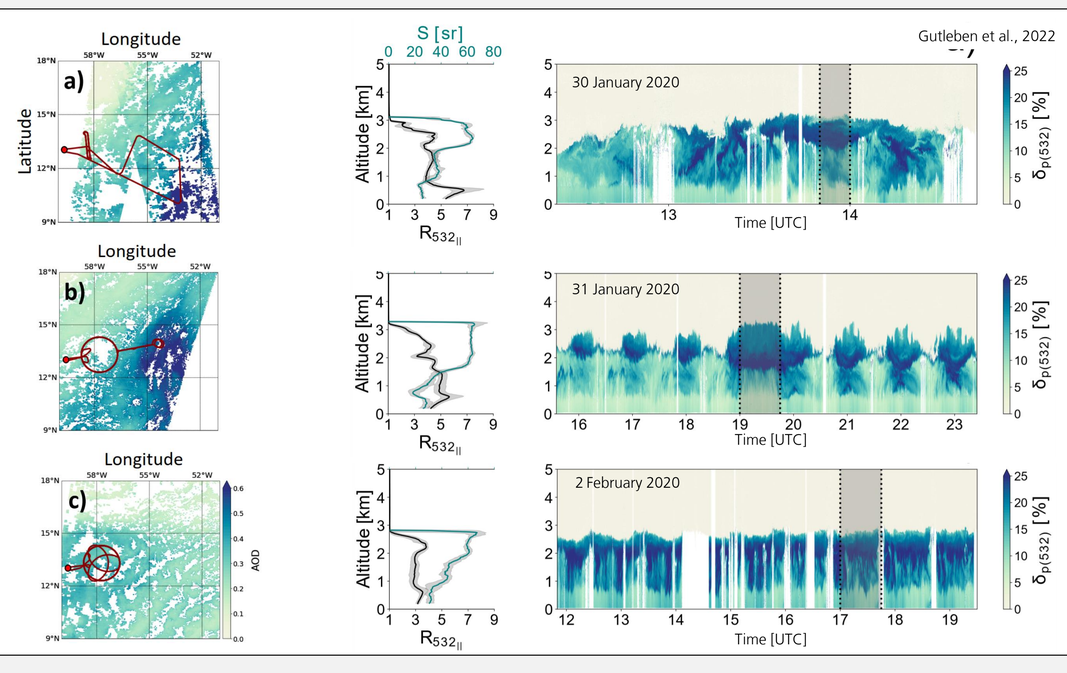


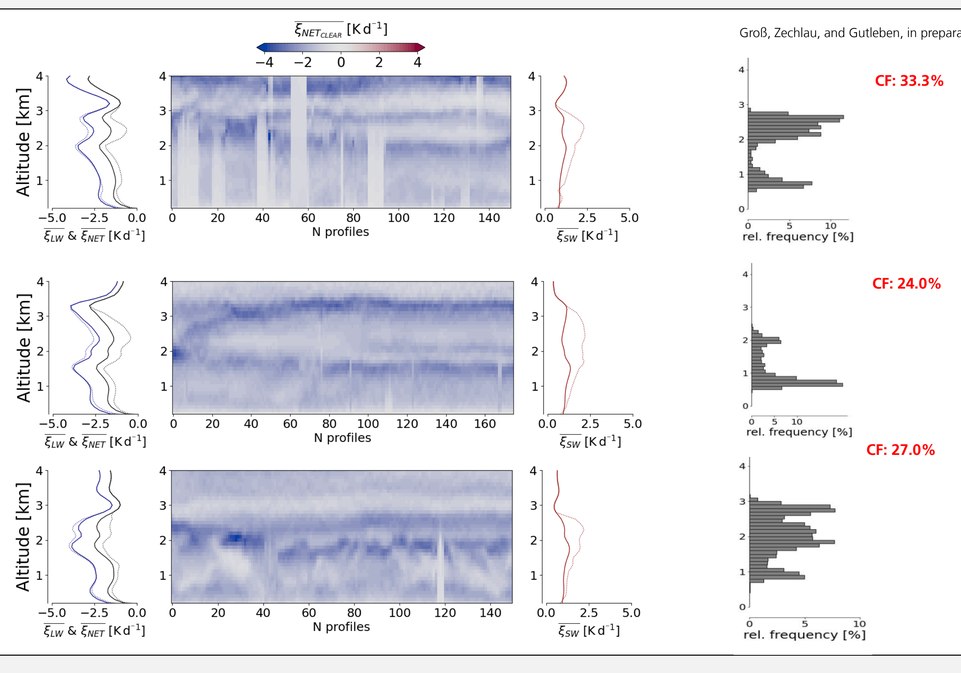
- (i) No SAL signature in lidar measurements, only some residual dust in marine boundary layer – enhanced values of δ_{p532}
- (II) Pronaunced backscatter signals at 3-4 km altitude
  - Increased water Vapor mass mixing ratio (r_m : 3-5 g/kg) in SAL-altitude and increased backscatter ratio (R_{532})
  - This correlation is also presend in radiosonde profiles at the African coast indecating an importand roul of SAL in water vapour transport
  - Measurements with the DIAL show, that water vapour uis the main driver for heating in the SAL layer



Dashed: Mineral dust heating rate profile
Solid: Total heating rate profile (including water vapor)

Gutleben et al. (2019)





Winter time Saharan Air Layer (SAL)

- Case study during EUREC^{4}A Campaigne at Barbados in 2020
- Characterization of long-range transported aerosol layers
- Main dust season in June/July/August
- 3 days of significant dust transport during dry season to Caribbean
- Dust impact on heating rate profiles and cloud top height distribution
- Different vertical structure of heating rate profile compared to summertime
- Strong gradient on top of mixed layer (transition layer)
- Different impact on cloud structure depending on vertical mixing

Summary and Conclusions

- EarthCARE – like payload over the Northern west Atlantic including also a water vapour DIAL
- Enhanced water vapour mixing ratios were detected together with dust laden regions → predominantly in SAL regions
- Detailed analysis of the vertical structure shows that water vapour is the main for atmospheric heating rates
- Modification of heating rate profile with maximum SW-heating and LW-cooling at the top of the SAL
- Net heating rate decreases with height: indicator for vertical mixing and instability
- Development of convection underneath SAL is suppressed

References

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