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**10 years of characterization
of the troposphere in the
East Antarctic plateau
region using a ground-based
Fourier transform
spectroradiometer**

**Giovanni Bianchini, Marco De
Pas, Gianluca Di Natale, Luca
Palchetti, and Marco Prevedelli**

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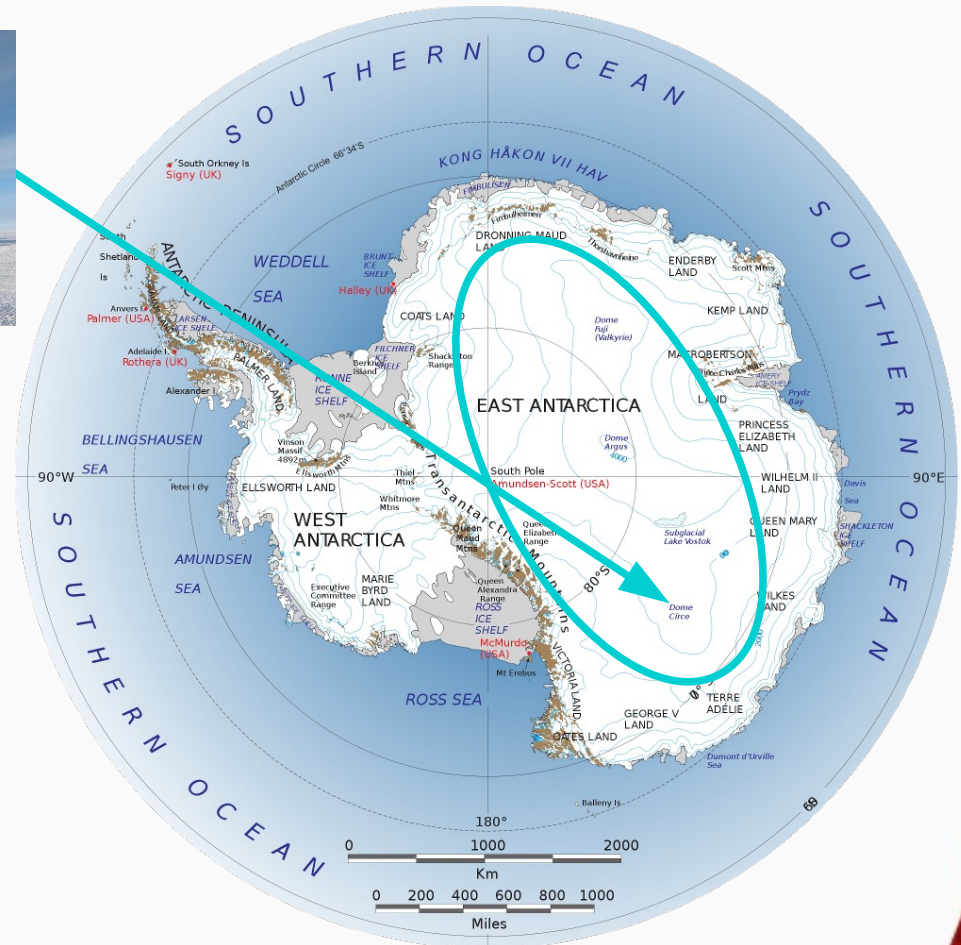
Climate on the Antarctic plateau



Concordia Station (IT/FR), Dome C region, **East Antarctic plateau**:

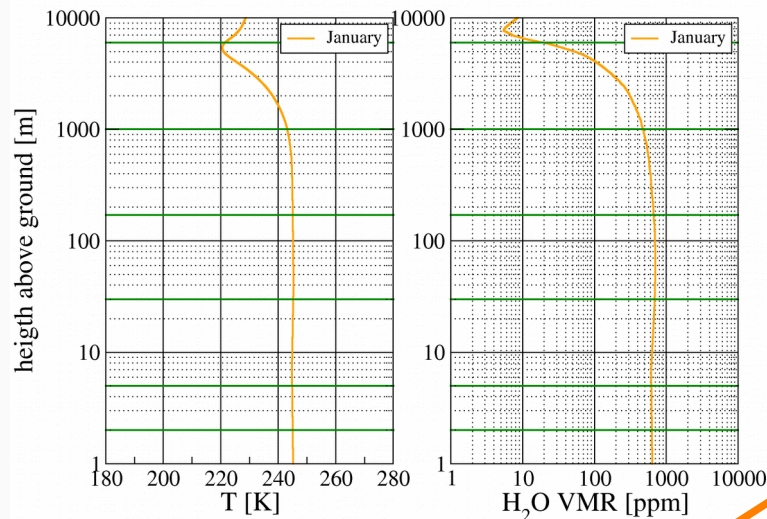
High altitude, low temperatures, high UV-Vis albedo and IR emissivity, very low water vapor content

- Main radiative sink of the Planet
- Low sensitivity to polar amplification of climate forcings
- Very small temperature trends





Lower troposphere on the Antarctic plateau



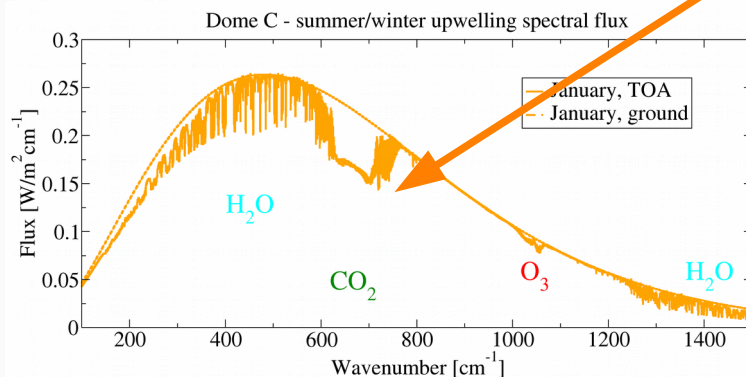
Outgoing radiative flux calculated using average seasonal vertical profiles of T and water vapor from radiosoundings

Summer:

Top of atmosphere flux is **lower** than flux at the surface



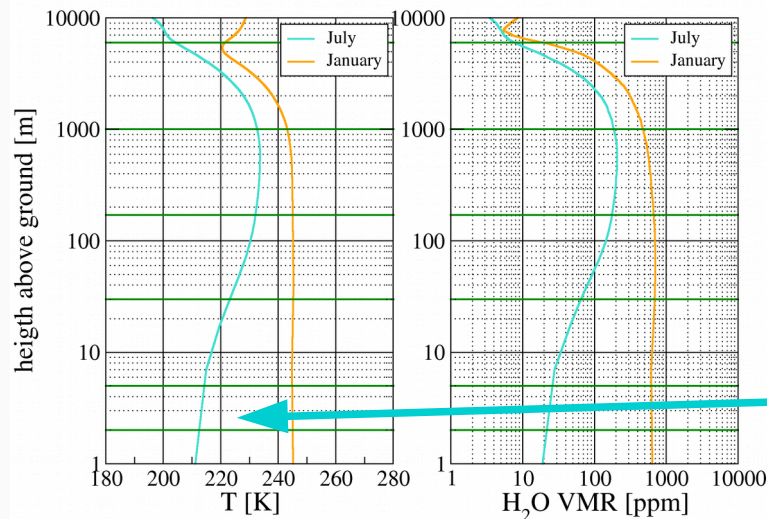
Greenhouse effect due to water vapor, carbon dioxide, ozone



radiosoundings courtesy of Osservatorio Meteo-Climatologico Antartico <https://www.climantartide.it>



Lower troposphere on the Antarctic plateau



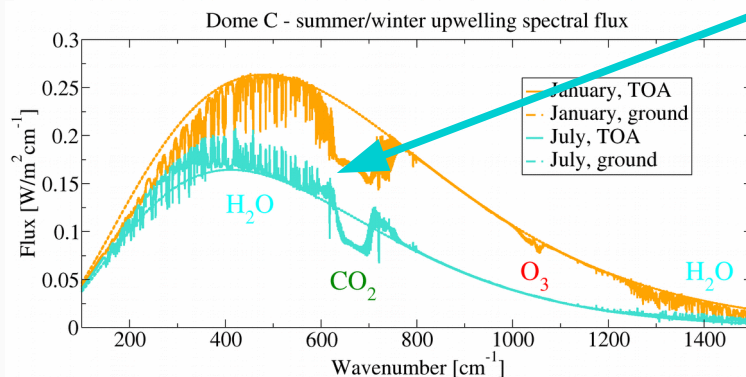
Outgoing radiative flux calculated using average seasonal vertical profiles of T and water vapor from radiosoundings

Winter:

strong temperature inversion



negative greenhouse effect

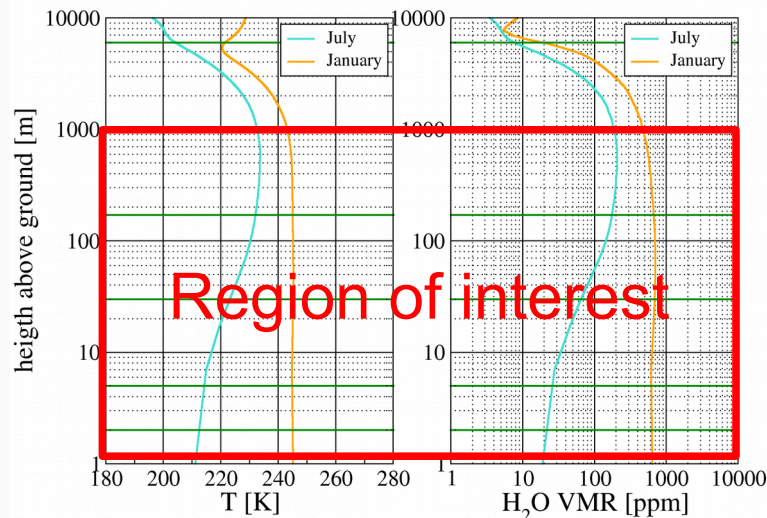


- Stronger when inversion appears together with higher water vapor content (autumn)
- Disappears when inversion layer is disrupted (sudden warming events)

radiosoundings courtesy of Osservatorio Meteo-Climatologico Antartico <https://www.climantartide.it>



Lower troposphere on the Antarctic plateau



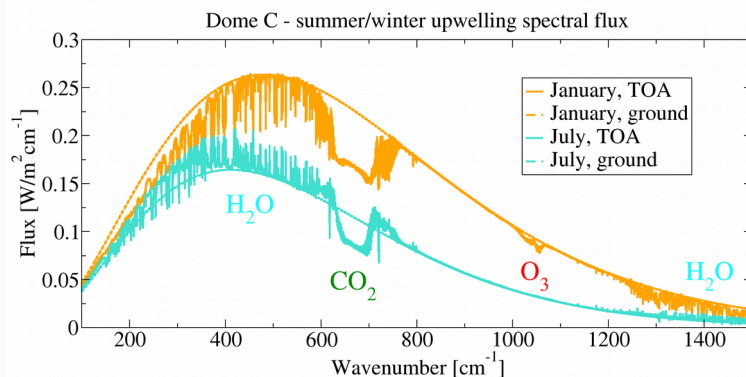
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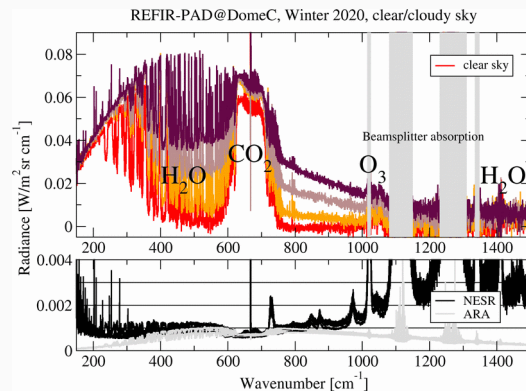
radiosoundings courtesy of Osservatorio Meteo-Climatologico Antartico <https://www.climantartide.it>



The Dome C Tropospheric Observer project

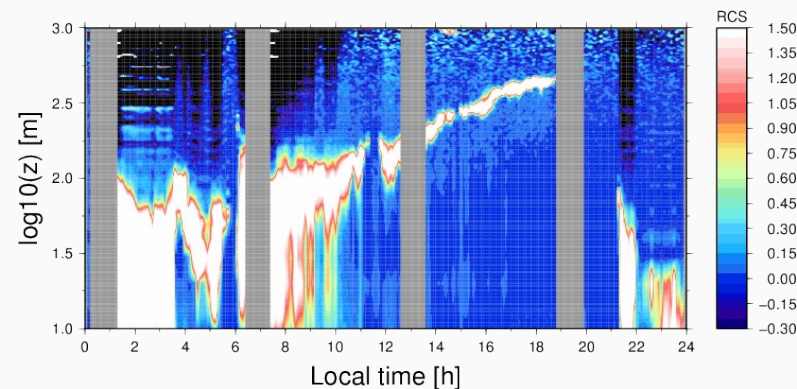
The Dome C Tropospheric Observer (DoCTOr) project: an **integrated system** for monitoring the East Antarctic plateau troposphere → two main components:

- An **observing system** based on field instrumentation at Concordia Station (FT spectroradiometer, cloud profiler, auxiliary sensors)
- A **data analysis** infrastructure in Italy for the inversion of measured spectra to retrieve vertical profiles of T and VMR



REFIR (Radiation Explorer in the Far-Infrared): spectrally resolved downwelling radiance in the 100-1500 cm^{-1} (6.7-100 μm) range, 5 per hour.

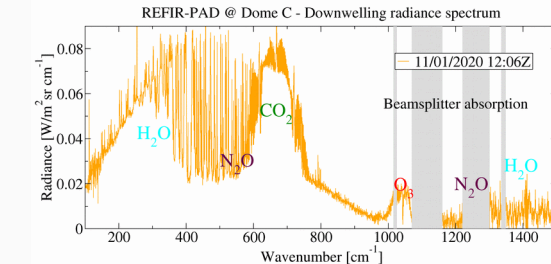
CW-lidar map



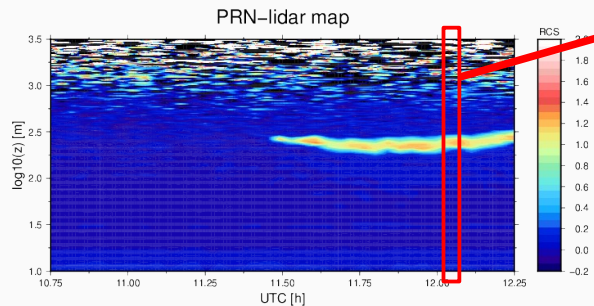
PRN-lidar: vertical profiles of cloud backscatter in the 0-2 km range with 10 m resolution, 20 per hour.



Data analysis process: vertical profiles

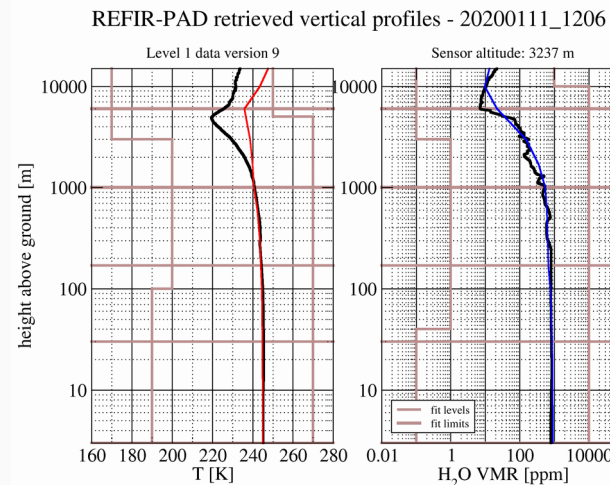
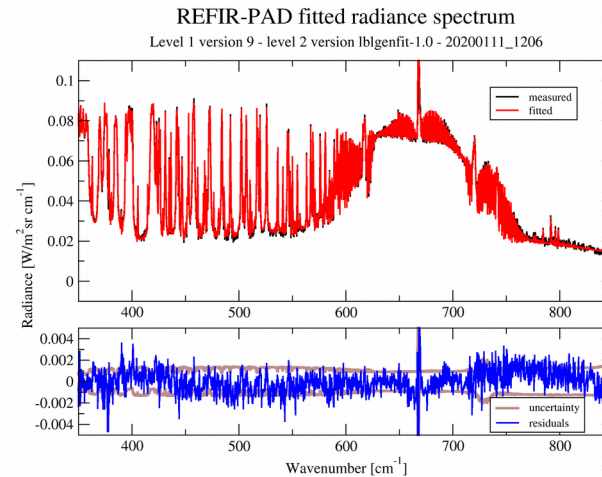


Spectral
radiance



Cloud
profile

Spectral radiance and cloud profile data are processed through an inversion code based on the LBLRTM atmospheric forward model to retrieve the vertical profiles of T, H_2O

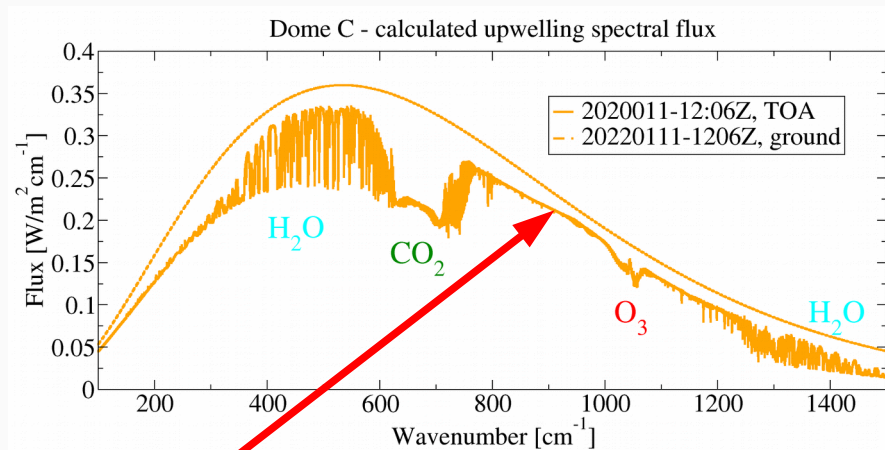


LBLRTM
+
inversion
code



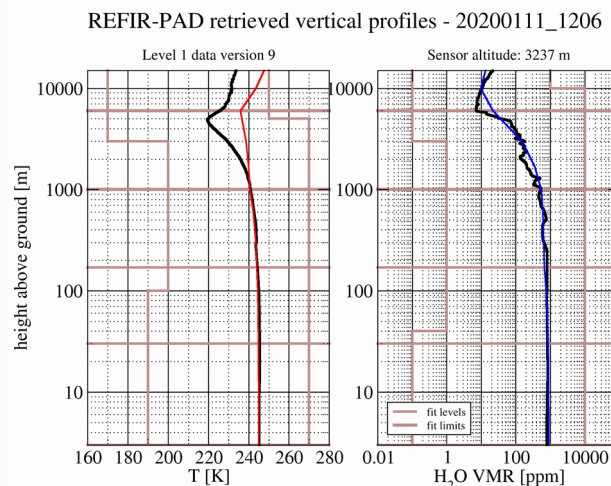
Data analysis process: atmospheric radiation

Profiles of T, H₂O and clouds are used as inputs for the LBLRTM forward model to calculate upwelling radiances, fluxes and cooling rates



GHE extending in the atmospheric transparency window due to clouds

Spectral radiance and cloud profile data are processed through an inversion code based on the LBLRTM atmospheric forward model to retrieve the vertical profiles of T, H₂O

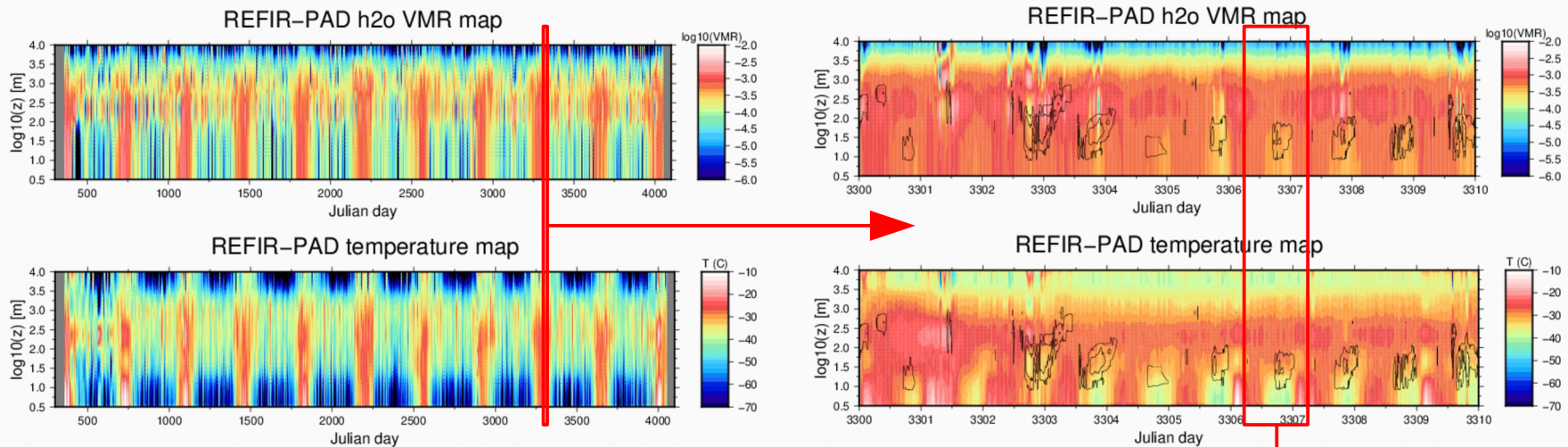


LBLRTM



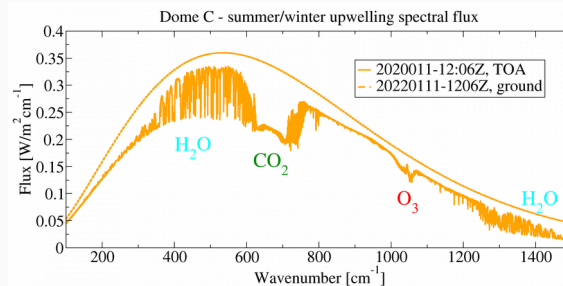
Monitoring the Antarctic troposphere

Altitude-time tomography of the lower troposphere with a <15' time resolution
Resolution of diurnal cycle and shorter time scale phenomena (cloud formation)



Radiative exchanges

- Up/down fluxes
- Cooling rates
- GHE calculation



1 day ~ 100
measurements



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Conclusions & outlook



- The monitoring system is operational, a ~10 year time series is available
- Calibration and vertical profile retrieval on the full data set is completed
- Calculation of the radiative fluxes and cooling rates are still in progress
- The time series needs to be extended further to increase trend sensitivity
- Some instrumentation issues due to ageing must be dealt with

REFIR-PAD @ Dome C: <https://doi.org/10.5194/amt-12-619-2019>
real-time data from Dome C: <https://refir.fi.ino.it/rtDomeC>

Istituto Nazionale di Ottica. Firenze – SPHERES group
Spectroscopy & PHotonics for Environmental Research and Earth Studies