First Super-Pressure Balloon-Borne Fine-Vertical-Scale Profiles in the Upper TTL: Impacts of Atmospheric Waves on Cirrus Clouds and the QBO

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Strateole 2

Strateole 2 – in a nutshell:

- 25 super-pressure balloons from Mahe, Seychelles Islands (4.7S, 55.5E)
- Flight altitude: 18 – 20km
- Data from:
  - November 2019 until late February 2020
  - October 2021 until January 2022
- Mean flight duration: ~3 months
- Insitu instrument: TSEN (temperature, pressure, wind)
- Other scientific instruments: Ozone, CO_2, water vapor and particles

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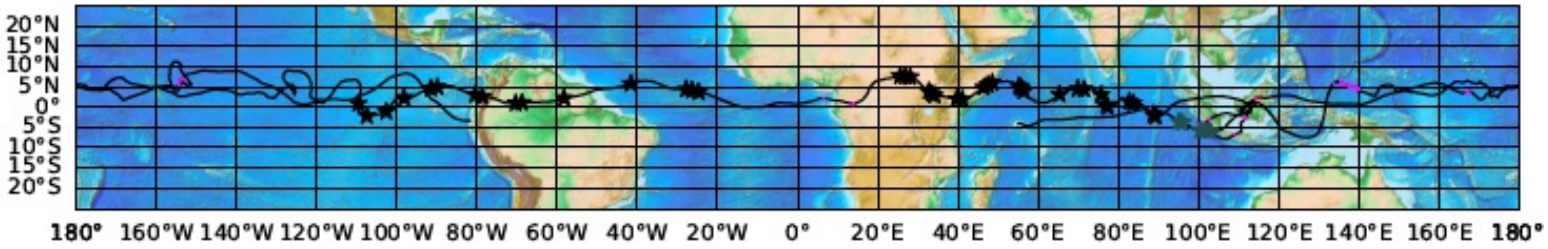
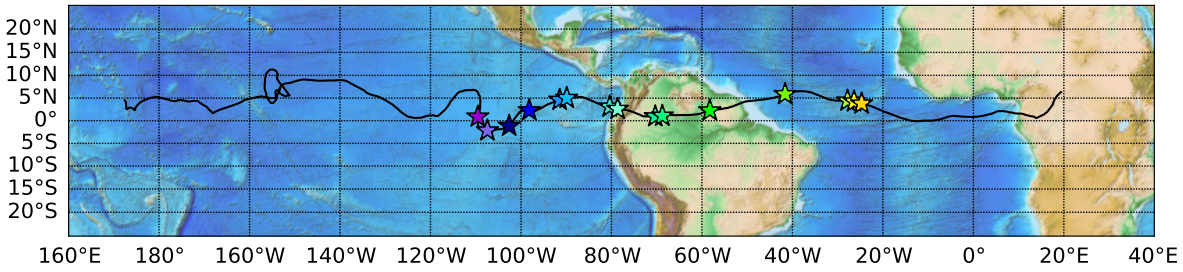
Strateole 2 - Case Study

- STR0 TTL3 flight (test campaign)



- Focus on area from Pacific, over South America to Antlantic



- Data from TSEN, COSMIC-2, ERA5 and RACHuTS

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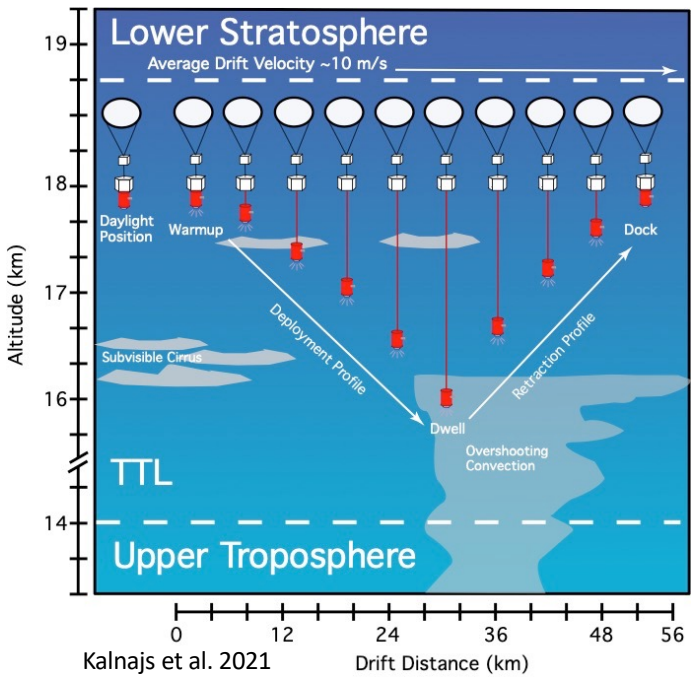
Strateole 2 - RACHuTS

- Profiles down to 2 km below the balloon of:
  - Temperature,
  - Water vapor and
  - Aerosol
- Part of the TTL3 configuration
- Unprecedented vert. resolution with one data point per meter
- 110 vertical profiles available from the test campaign



Kalnajs et al. 2021

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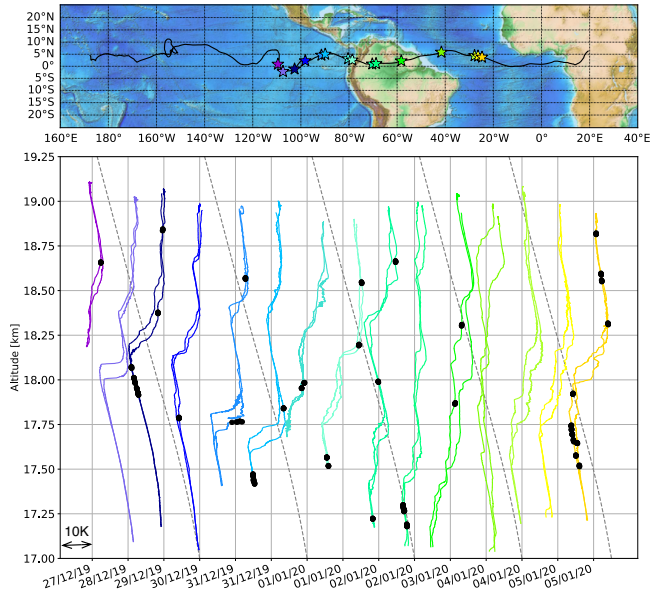
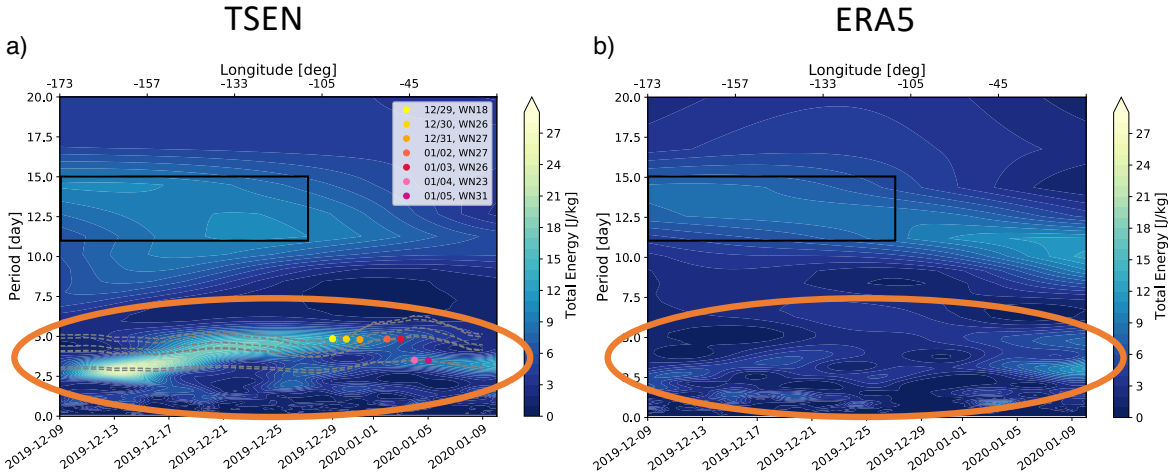
Strateole 2 - First Results (Bramberger et al. 2022)





- Analysis of fine-vertical scale waves that previously eluded observation and simulation in climate models and modern reanalyses
- In the observed period these waves:
  - Provided majority of forcing of QBO in lowermost stratosphere
  - Controlled relative humidity and subvisible cirrus clouds occurrence through their temperature variations

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Conclusions

Cirrus Clouds

- Detection of sub-visible cirrus clouds
- Most of cloud occurrence associated with large-scale waves (EIGW)

Large-scale waves

- EIGWS with short vertical wavelengths not resolved in modern GCMs or re-analyses as e.g. ERA-I, ERA5
- Provide considerable forcing for the QBO in the lowermost stratosphere
- Modulate the life cycle of cirrus clouds in lowermost stratosphere

Bramberger, M., Alexander, M. J., Davis, S., Podglajen, A., Hertzog, A., Kalnajs, L., et al. (2022). First super-pressure balloon-borne fine-vertical-scale profiles in the upper TTL: Impacts of atmospheric waves on cirrus clouds and the QBO. Geophysical Research Letters, 49, e2021GL097596. https://doi.org/10.1029/2021GL097596


Thank you!
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