Water vapor measurements in the tropical upper troposphere and lower stratosphere : applications in UT-LS and deep convection

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Credits : NASA

STRATEOLE-2

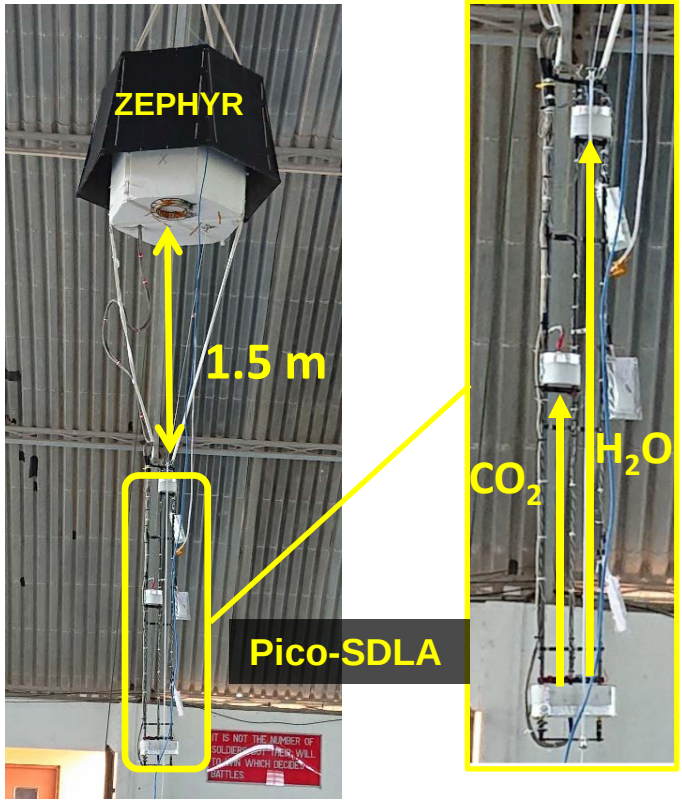
14 laboratories/institutes

Supports

Long duration balloon campaign in the TTL/lower equatorial stratosphere :

- Dynamics and thermal structure of the TTL
- Chemical and aerosol transport near the TTL
- Multiscale equatorial waves and large scale circulations such as the Quasi Biennial Oscillation (QBO).
- Dehydration of air entering the stratosphere

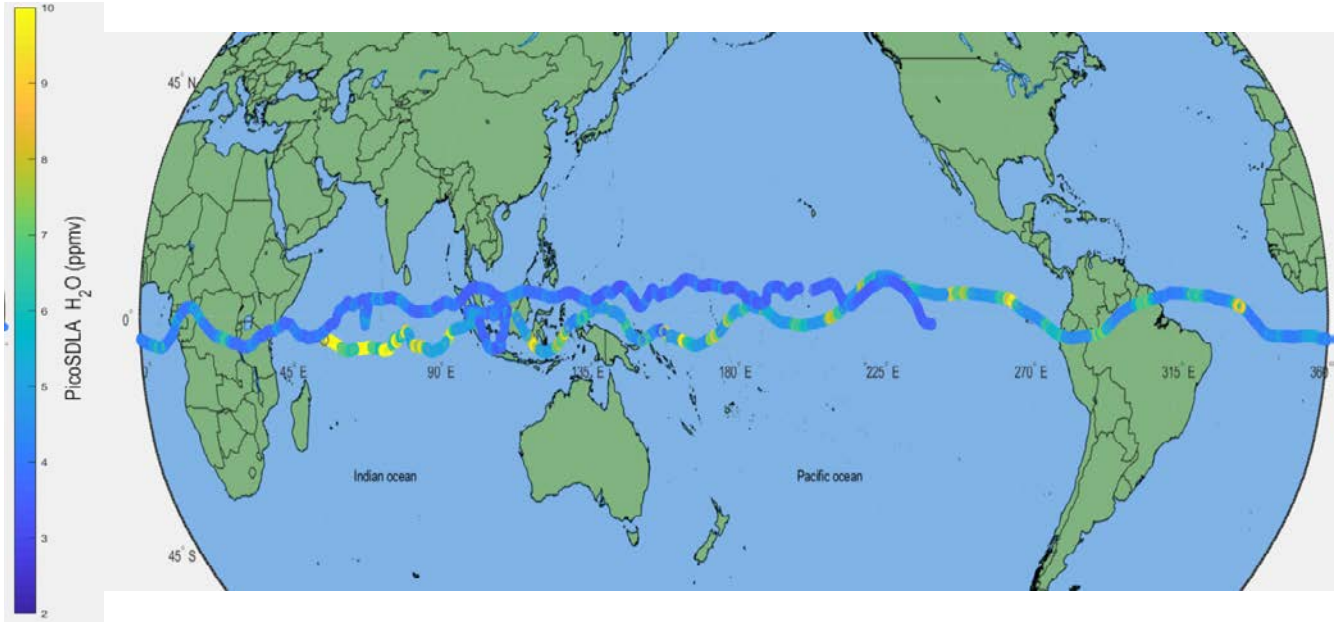
Pico-STRAT H_2O/CO_2 : infrared laser spectrometer (Pico-SDLA for Stratéole-2)



- ✓ Energy budget < 6Wh
- ✓ Intermittent meas. : 4’ to12’
- ✓ Thermal management improved
- ✓ Reduced weight (<5kg)
- ✓ Autonomy

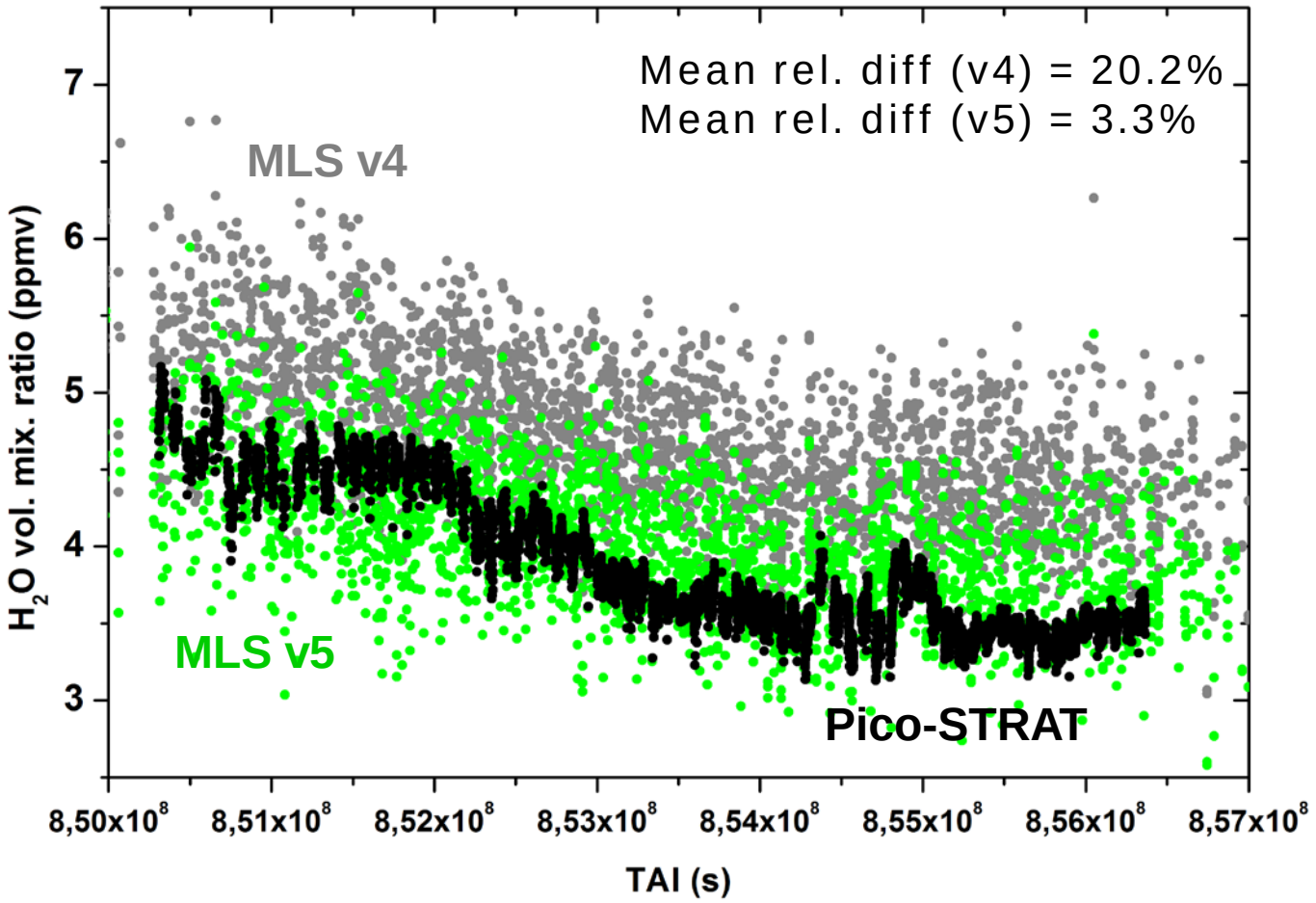
Test campaign (Dec 2019 – Feb 2020) :1 Pico-SDLA
~ 130 000 H_2O spectra over 80 days

Scientific campaigns 2021 & 2024 : 4 Pico-SDLA
Expected over 500 000 meas/species.

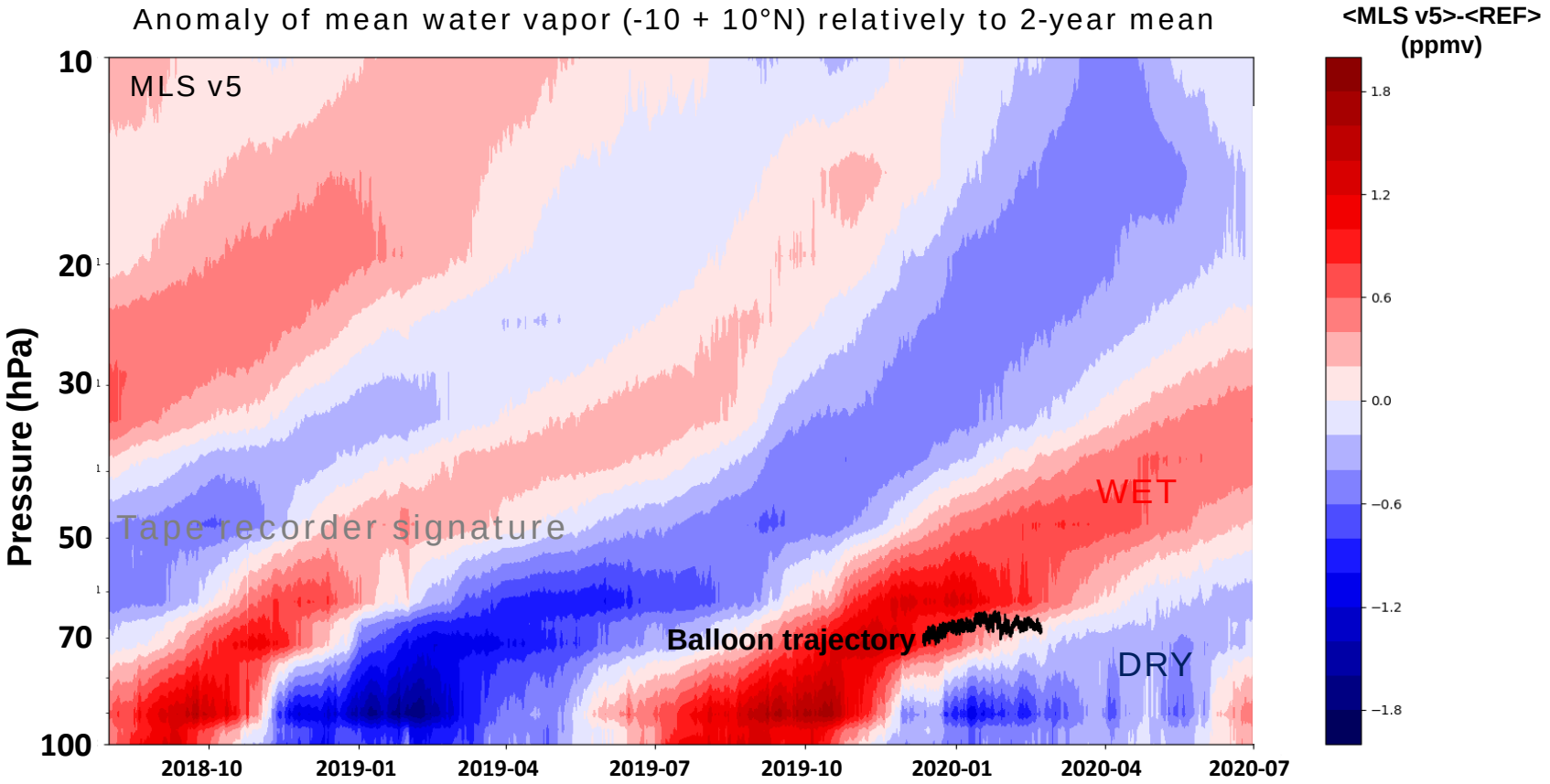


PRELIMINARY RESULTS FROM TEST CAMPAIGN (DEC 2019-FEB 2020)

66-71 hPa


Mean rel. diff (v4) = 20.2%
Mean rel. diff (v5) = 3.3%
MLS v4
MLS v5
Pico-STRAT
H2O vol. mix. ratio (ppmv)
7
6
5
4
3
8,50x10^8
8,51x10^8
8,52x10^8
8,53x10^8
8,54x10^8
8,55x10^8
8,56x10^8
8,57x10^8
TAI (s)

Position of the observations relatively to global atmospheric context



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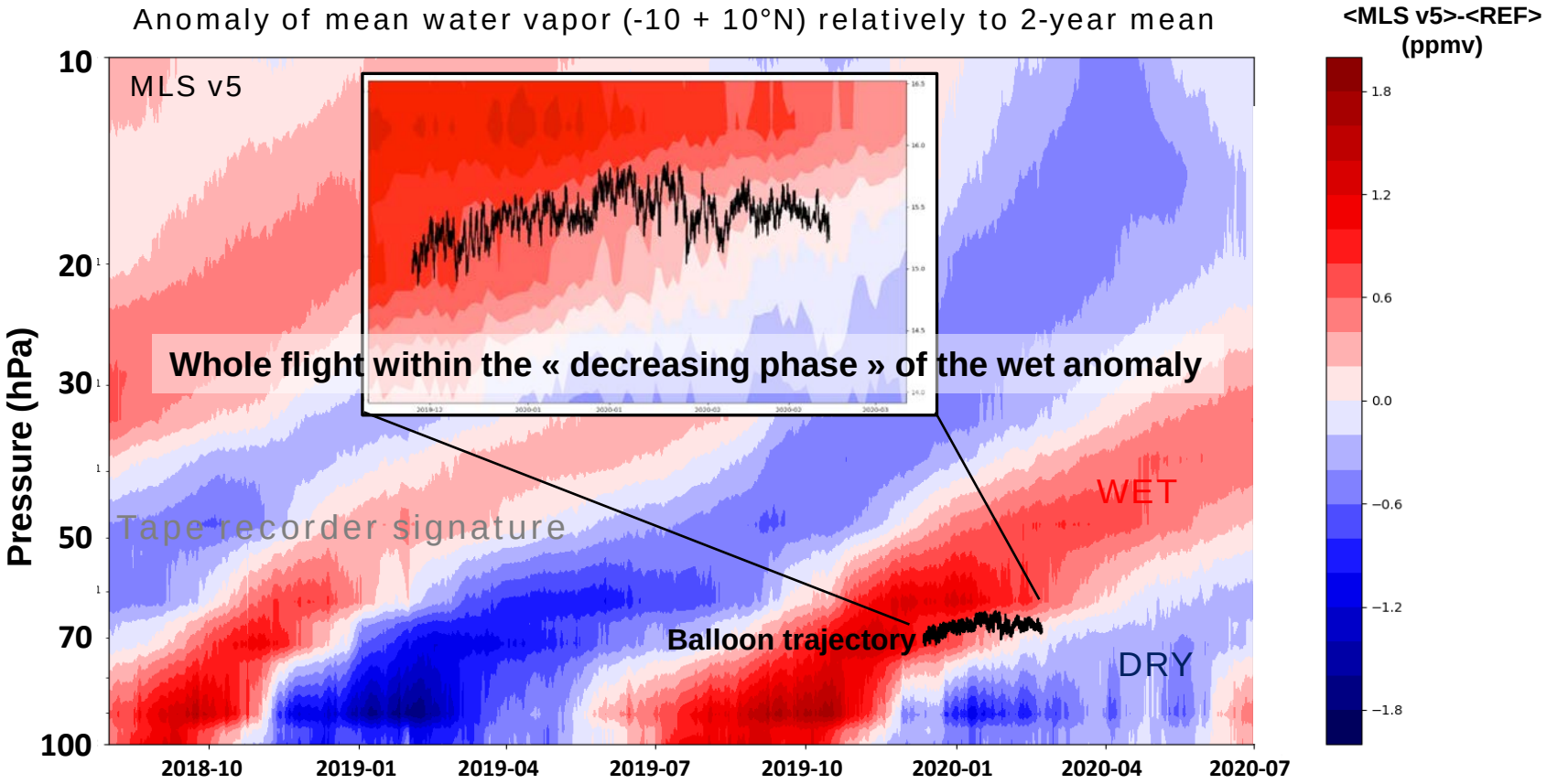
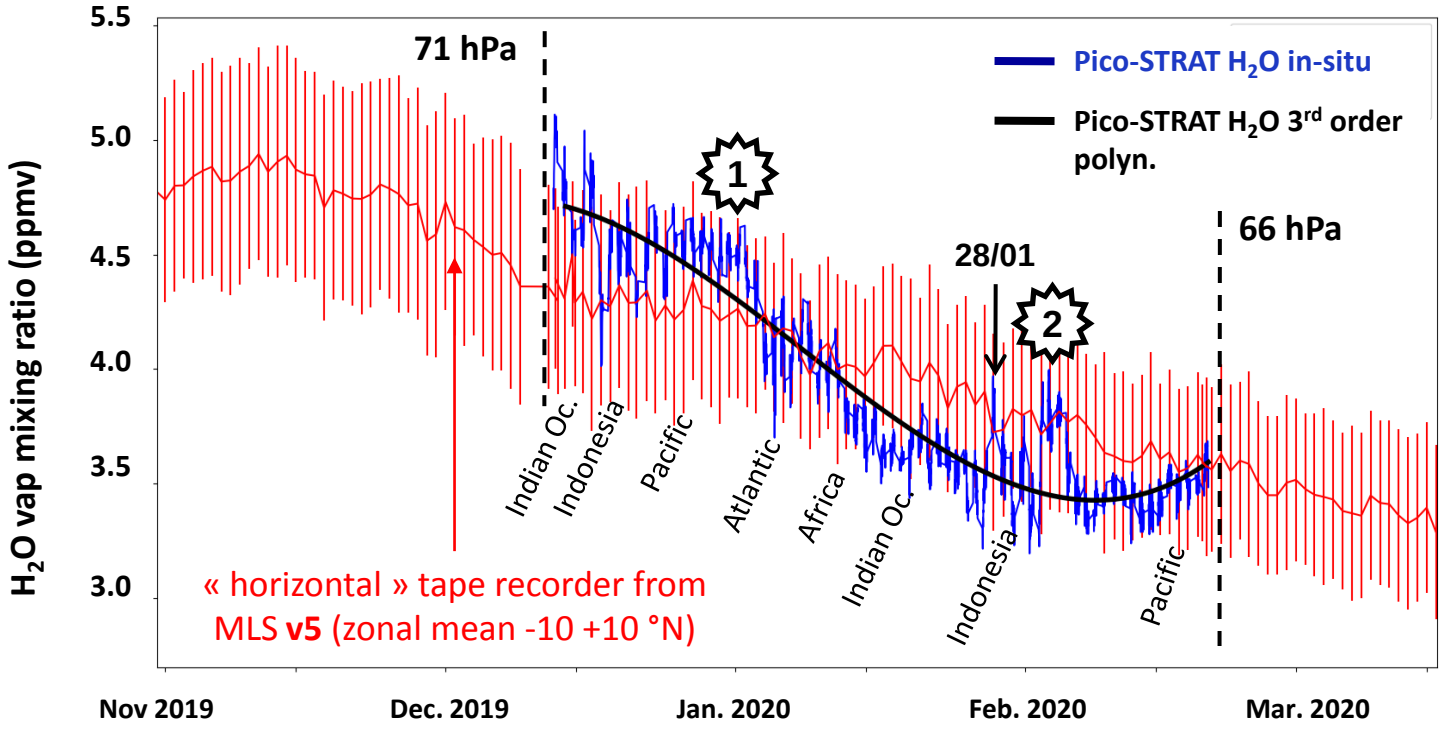


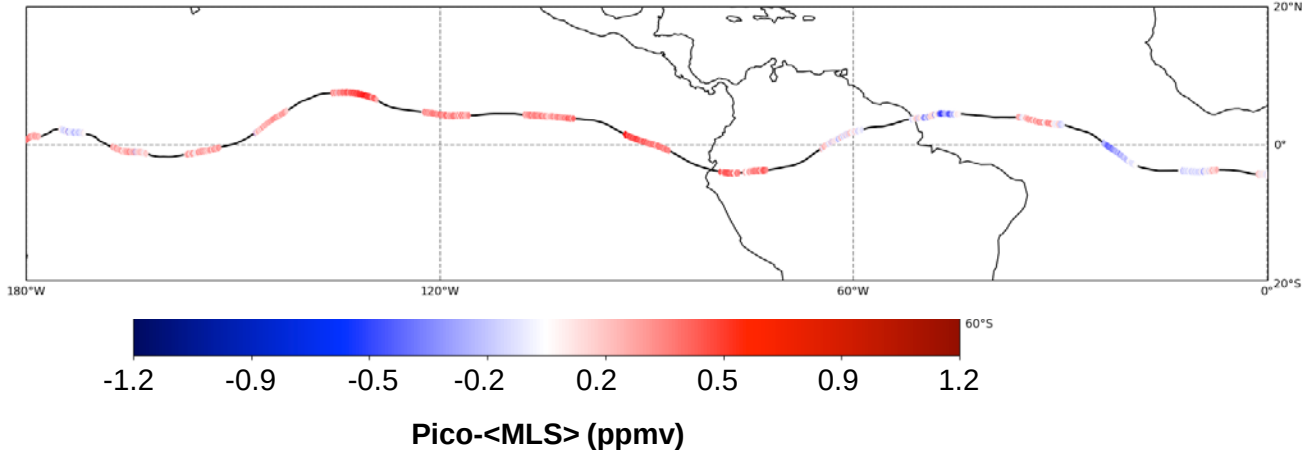
Position of the observations relatively to global atmospheric context

Balloon local tape recorder signal vs. horizontal zonal mean tape recorder signal

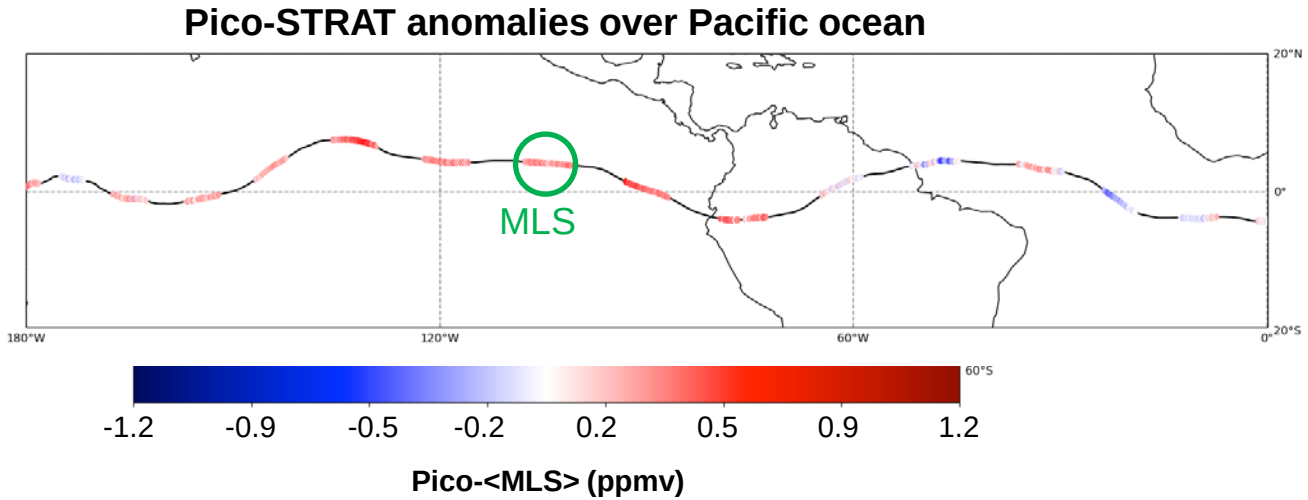


Anomalies linked with atmospheric waves #1

Pico-STRAT anomalies over Pacific ocean (Dec 21, 2019- Jan 04, 2020)

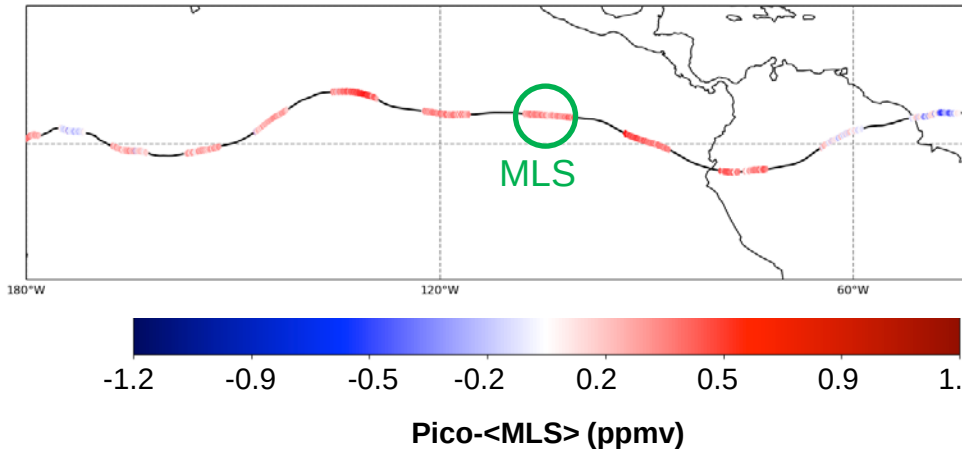


Anomalies linked with atmospheric waves #1



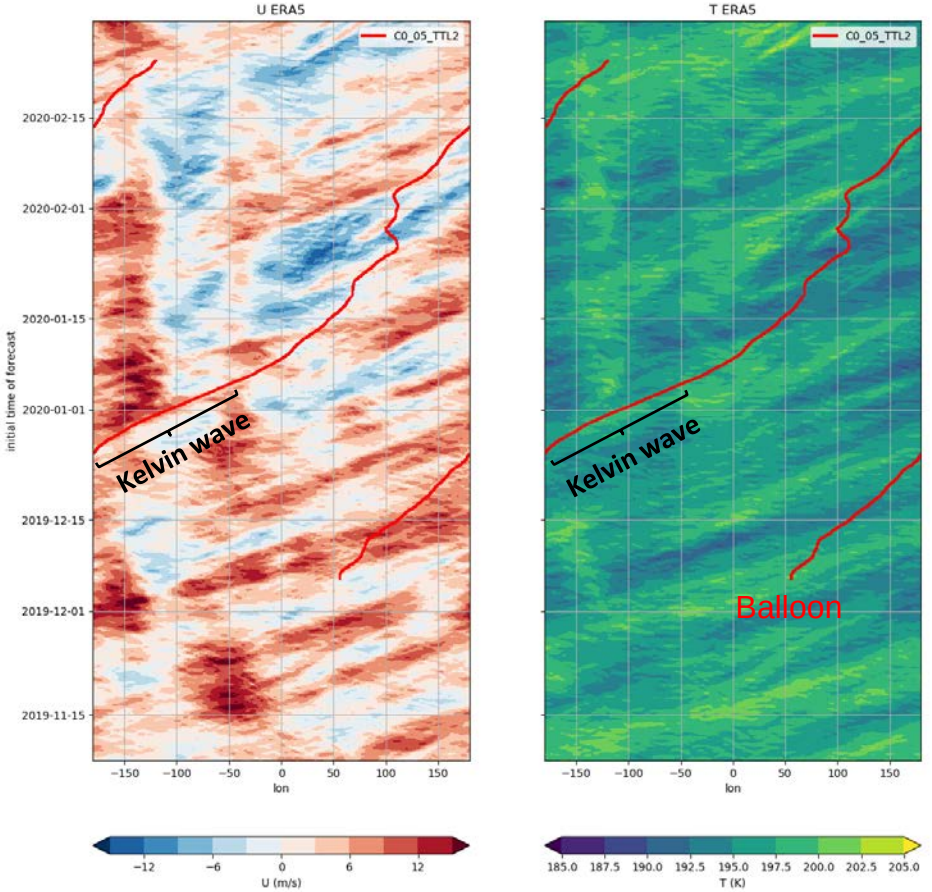
Anomalies linked with atmospheric waves #1

Pico-STRAT anomalies over Pacific ocean



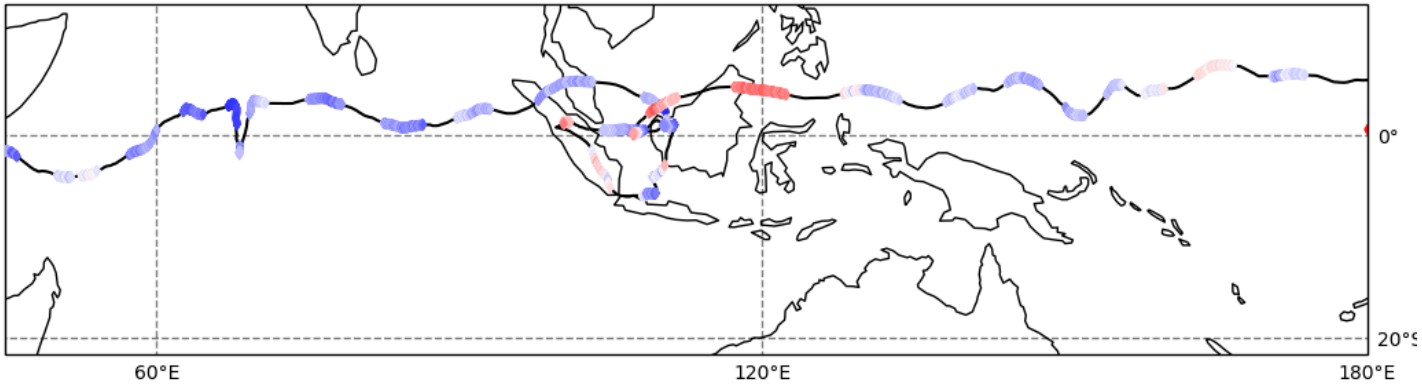
H_2O modulation : 0.5/0.8 ppmv

ERA 5 on 65 – 75 hPa (10°N, 10°S)



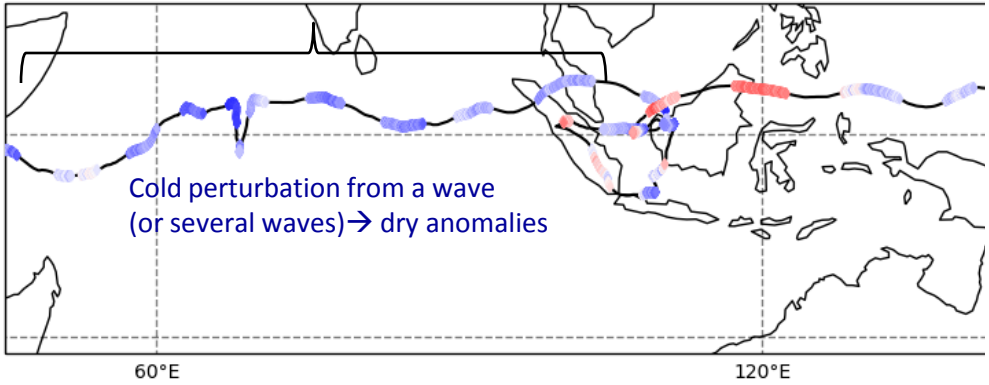
Anomalies linked with atmospheric waves #2

Pico-STRAT anomalies over maritime continent



Anomalies linked with atmospheric waves #2

Pico-STRAT anomalies over maritime continent



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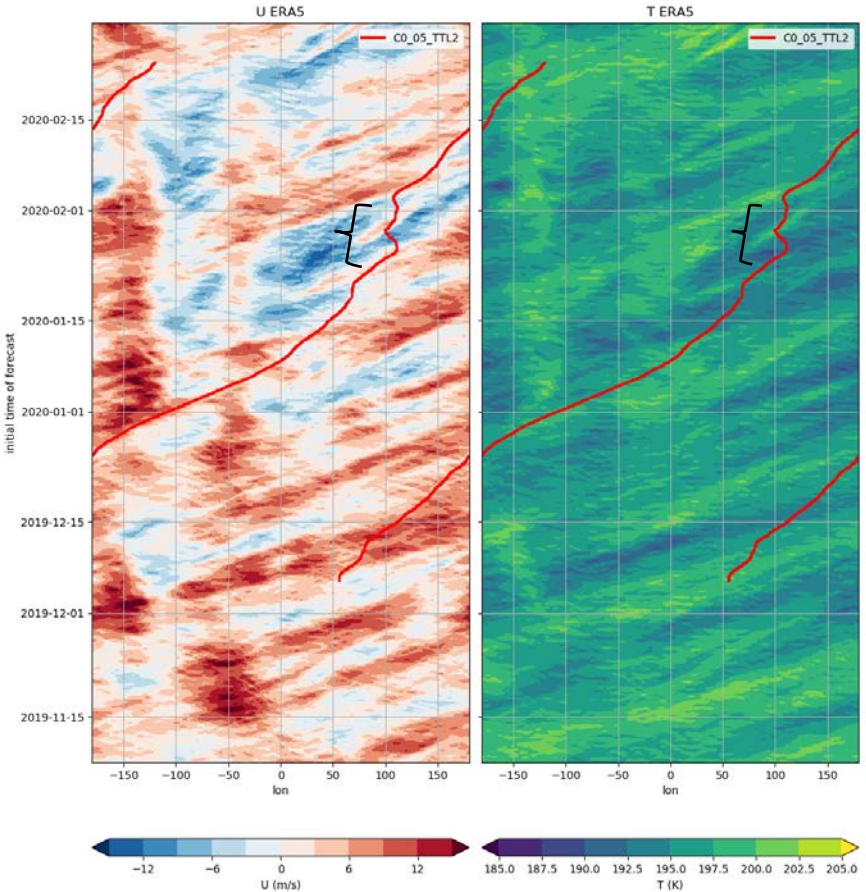

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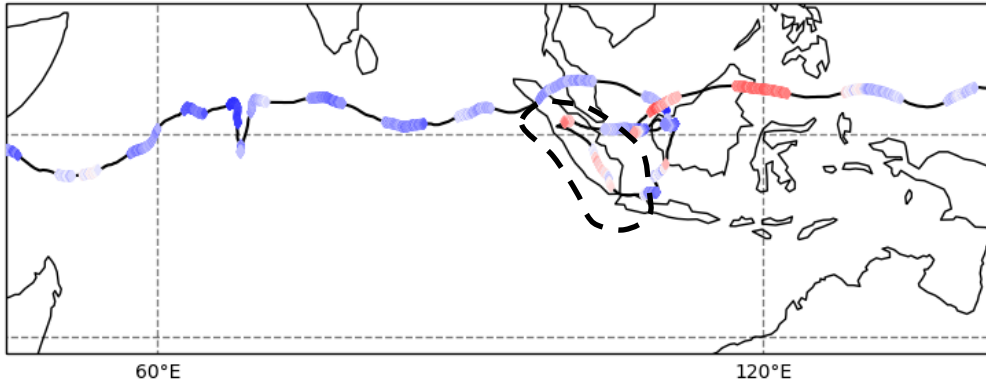

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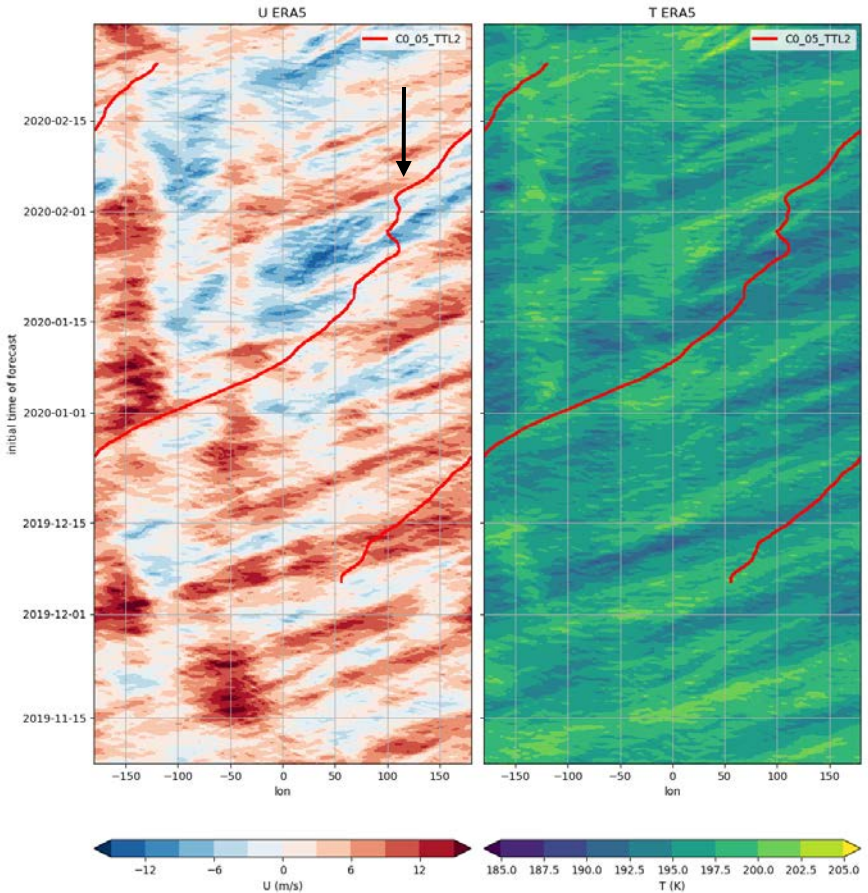

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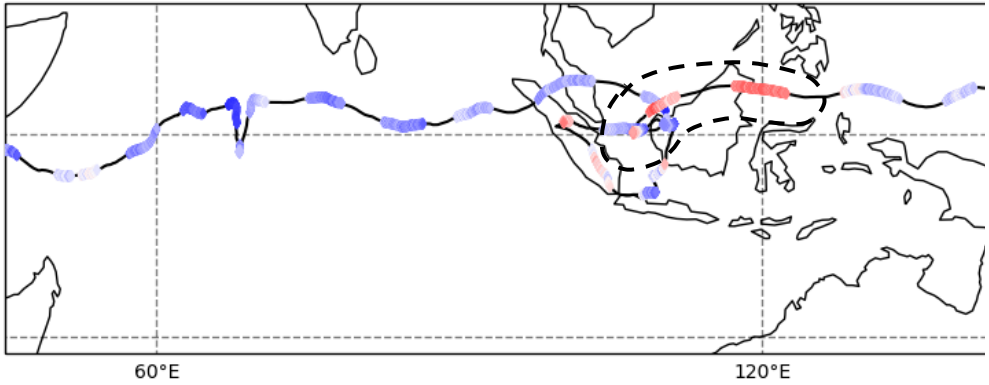

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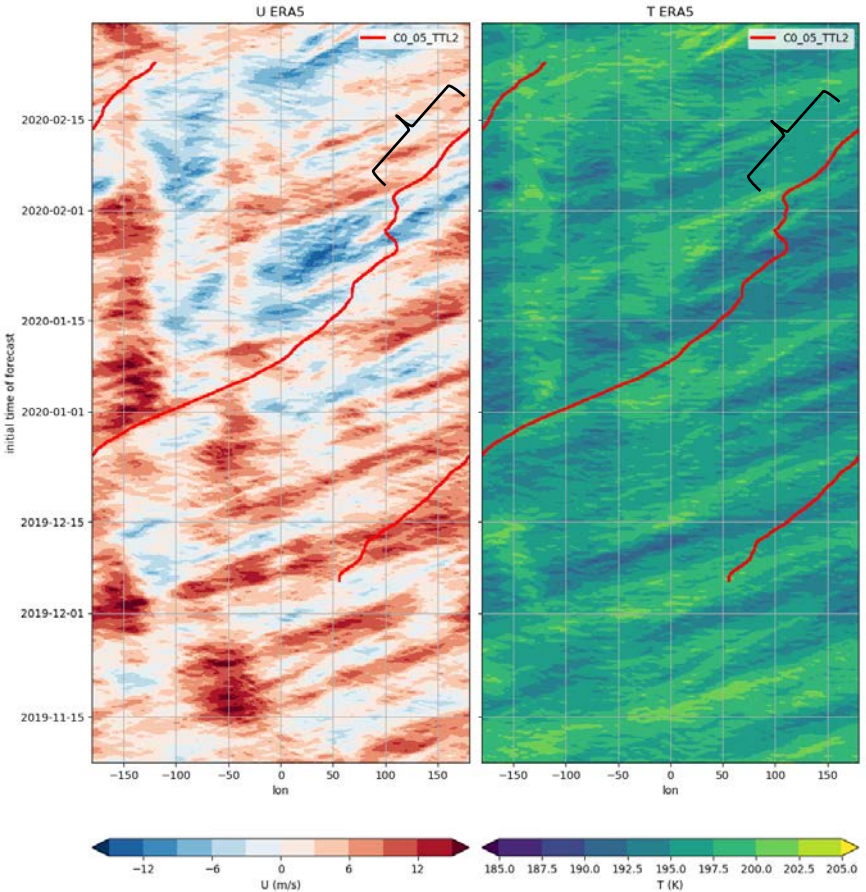

Conclusion

- Success of technological campaign beyond expectations

Challenges :

- Biases between regional climatology (MLS) and in situ
- Is anomaly calculation the best method?
- How to separate signals from different sources?

Outlook

Investigate methods to separate contributions from tape recorder, deep convection and waves

Address enhancements linked with deep convection and waves

Gather case studies to perform statistics, find correlations with ENSO, QBO…

In support :
AquaVIT-4 campaign (PI: M. Ghysels-Dubois) @ AIDA simulation chamber (Feb-March 2022, Germany)
Still time to manifest interest! – Hygrometer intercomparison campaign

THANK YOU FOR YOUR ATTENTION