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Wet and dry spells in the Rio Santa Basin, Tropical Andes of Peru

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Context

The **Rio Santa** basin in Peru (Ancash region):

- Strong west – east contrasts (dry → wet)
- Rainy season: ≈ October to March, mostly (deep) convection
- Subsidence agriculture (**rainfed**)
- → Vulnerable to climate *variability* and *change*

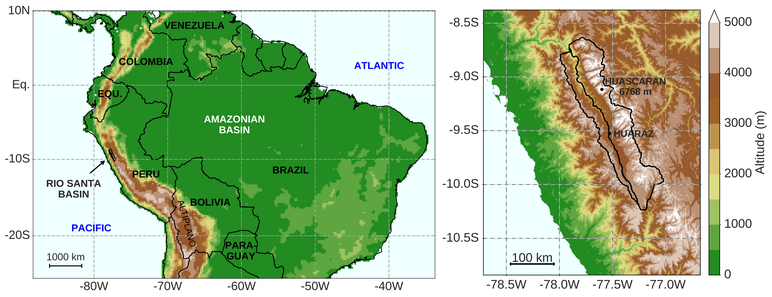

Figure 1: Overview of the study area with a close up of the Rio Santa basin

Motivation

- Precipitation variability strongly correlated to 200hPa zonal wind (Bolivian high)
- Conceptual framework formulated by Garreaud et al. (2003) for the Altiplano but never tested at such low latitudes
- Does the framework apply to the Rio Santa region as well?
- Is moisture availability really the only driver for wet & dry spells?

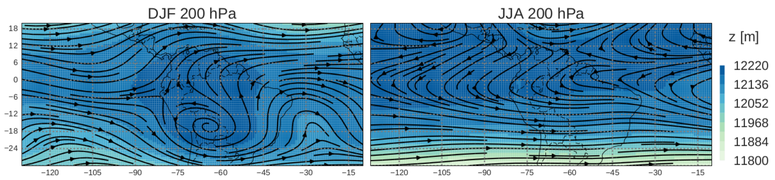

Figure 2: Seasonally averaged (1979–2016) horizontal wind streamlines and geopotential height at 200hPa from ERA-Interim data

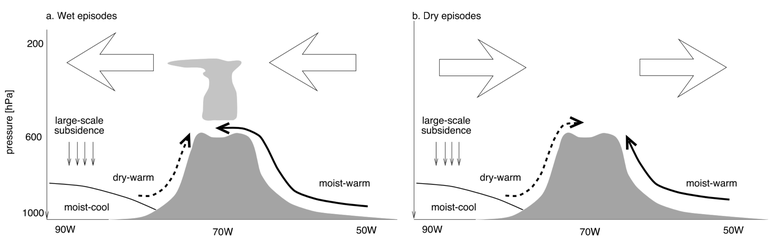

Figure 3: Conceptual framework for rainy and dry episodes over the Altiplano (Garreaud et al., 2003)

Definition of Wet and Dry spells

- Daily precipitation from 16 stations (1979–2016, variable quality)
- **Wet spell**: 50% of stations exceed the 70th percentile of daily rainfall amount for at least three consecutive days
- **Dry spell**: 50% of stations inferior to the 30th percentile of daily rainfall amount for at least five consecutive days
- Average of 3.3 wet spells per rainy season (duration 8 days)
- Average of 2.3 dry spells per rainy season (duration 10.8 days)

Teleconnections: synoptic composite analysis (ERA-Interim)

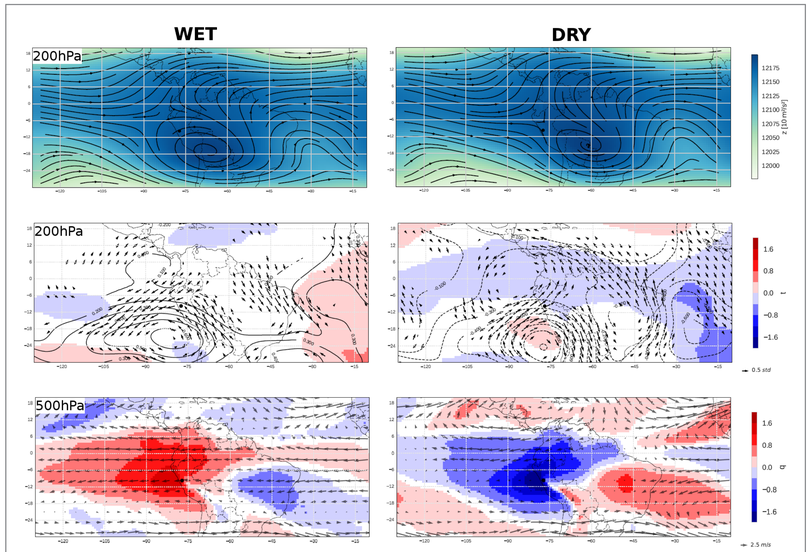

Figure 4: Composite analysis during wet and dry spells. Top: 200hPa winds and geopotential. Middle: 200hPa wind and temperature anomalies (95% confidence). Bottom: 500hPa wind composite and specific humidity anomalies.

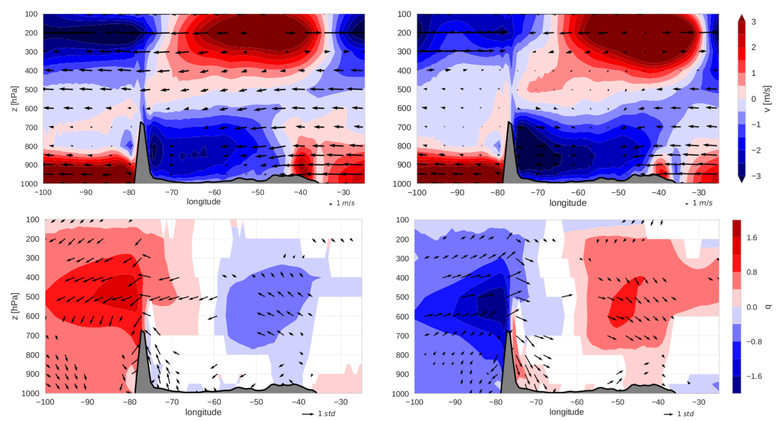

Figure 5: Cross section at 9.75°S. Top: wind. Bottom: wind and specific humidity anomalies.

Case study: WRF simulations

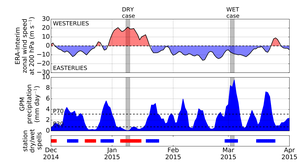

Figure 6: Selection of the simulation periods.

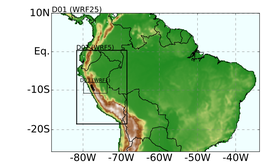

Figure 7: WRF model domains.

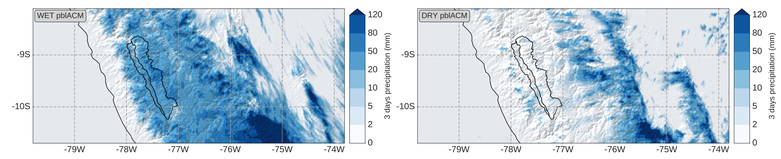

Figure 8: Simulated 3-day accumulated precipitation in the wet and dry cases (WRF 1km).

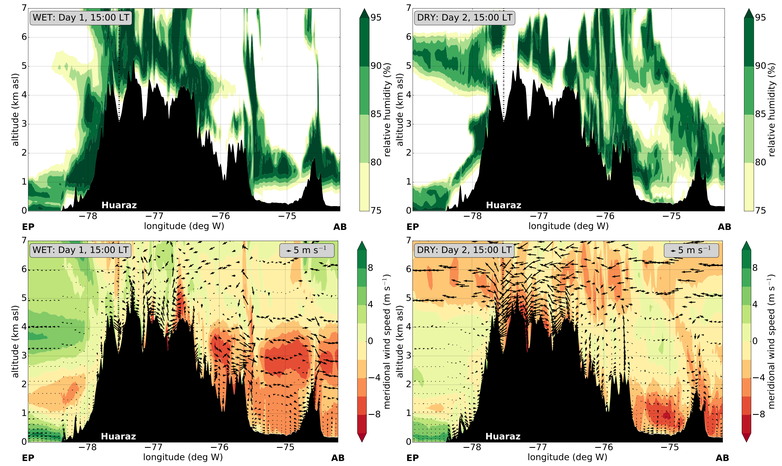

Figure 9: Cross section at 9.75°S. Top: relative humidity. Bottom: zonal and meridional wind.

Conclusions

- synoptic composite analysis roughly confirms previous conceptual framework – albeit coarse and qualitative
- detailed WRF modelling provides a much more nuanced picture
- ingredients for convection need to be studied in more detail!

References:

Garreaud, R. D., Vuille, M., and Clement, A. C. (2003). The climate of the Altiplano: observed current conditions and mechanisms of past changes. *Palaeogeography, Palaeoclimatology, Palaeoecology*

Schlumpberger (2017) & Siller (2017), Master Theses:
`http://diglib.uibk.ac.at/urn:nbn:at:at-ubi:1-6985`
`http://diglib.uibk.ac.at/urn:nbn:at:at-ubi:1-7816`

Acknowledgements:

This study relies heavily on the two Master Theses listed above.
The WRF simulations were run on the HPC infrastructure of the U. of Innsbruck.