DOWNSLOPE WINDS ON EASTERN SLOPES OF THE CENTRAL ANDES MOUNTAINS OF SOUTH AMERICA IN A 20-YR CLIMATE SIMULATION WITH THE ETA MODEL

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What is Zonda wind?

- Zonda wind is the local version of the alpine foehn.

Where does it occur?

- It may blow almost everywhere at extratropical latitudes down of the Andes, but it is more common between 32° and 33°S, near the cities of Mendoza and San Juan in Argentina (Norte 1988).

SCHEMATIC REPRESENTATION OF A ZONDA WINDSTORM AROUND 33°S

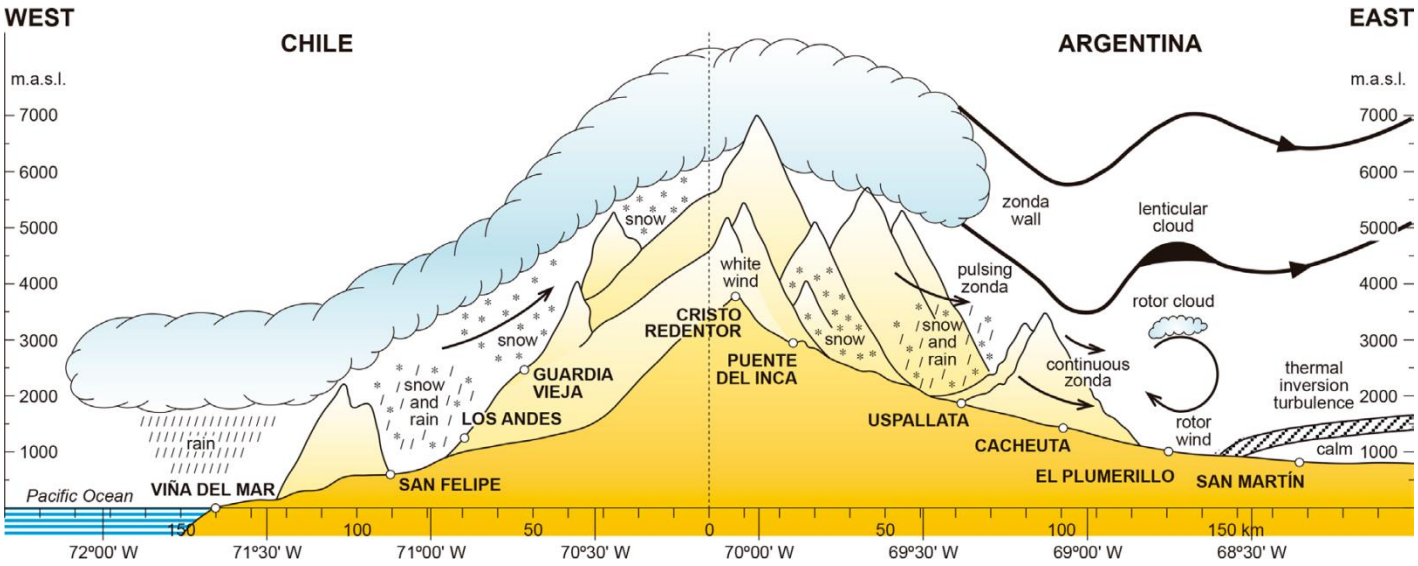
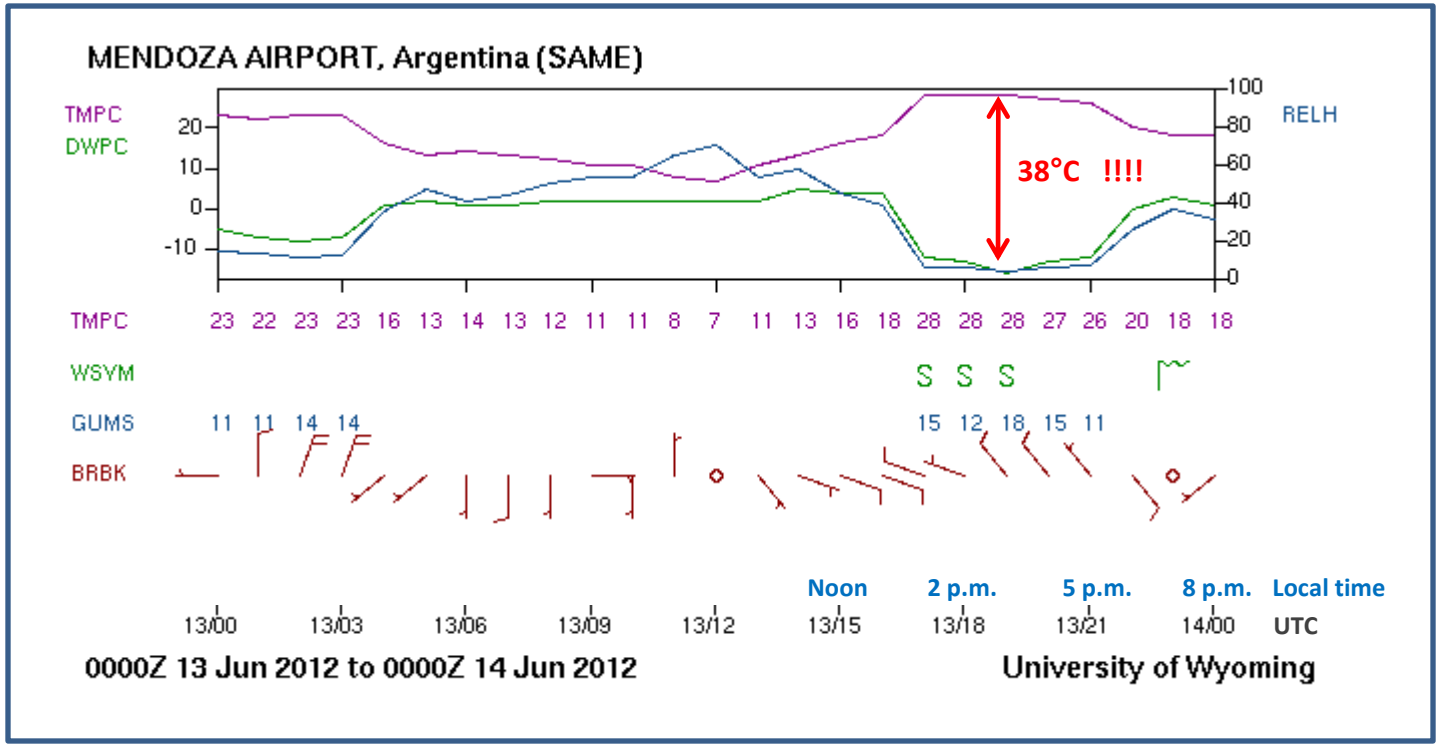


Figure 4 of Norte, F.A. (2015) Understanding and forecasting Zonda Wind (Andean Foehn) in argentina: A Review. Atmospheric and Climate Sciences, 5, 163-193. http://dx.doi.org/10.4236/acs.2015.53012

IMPACTS OF A SEVERE ZONDA WINDSTORMS EAST OF THE ANDES MOUNTAINS

Figure 39 of Norte, F.A. (2015) Understanding and forecasting Zonda Wind (Andean Foehn) in argentina: A Review. Atmospheric and Climate Sciences, 5, 163-193. http://dx.doi.org/10.4236/acs.2015.53012

EXAMPLE OF SEVERE ZONDA AT *MENDOZA* ON 13 JUN 2012



OBJECTIVE

To evaluate the simulation of Zonda wind events on the lee side of the Andes in a 20-year simulation of the regional Eta model, by comparing the results to previous observational studies of Zonda wind events (Norte 1988, 2015; Seluchi et al. 2003).

ETA-MODEL CLIMATE SIMULATION OVER SOUTH AMERICA

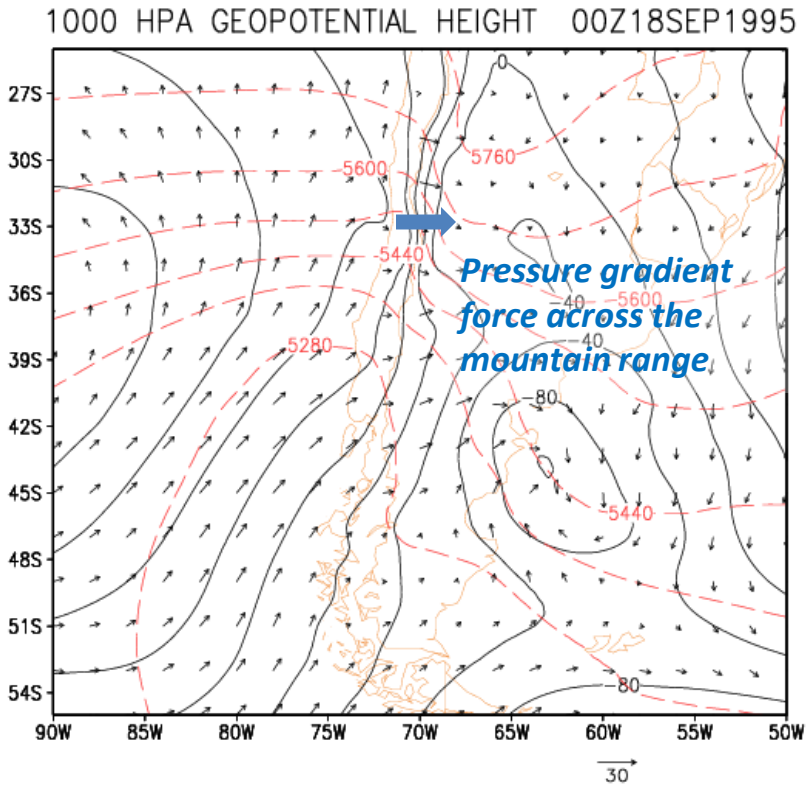
- Upgraded version of the seasonal Eta model at CPTEC (Mesinger et al., 2012), with sloping eta coordinate and the piecewise linear advection scheme.
- Climatology was constructed from 6 hourly outputs during the period 1989-2008 (20-yr long integration).
- Horizontal resolution of about 50 km and 38 vertical levels.
- First year of model integration corresponded to model spinup and was discarded.
- Hydrostatic equilibrium was assumed.
- LBC updated every 6 hours provided by ERA-Interim global analyses at 150 km of horizontal resolution.
- Sea surface temperature was updated on a daily basis.

- Lower boundary was defined by a 4 layer soil model (NOAH) (Chen et al., 1997; Ek et al., 2003) with climatol. soil moisture.
- For cumulus parameterization the model adopted the Betts–Miller scheme modified by Janjic (1994),
- For stable precipitation the model adopted the cloud microphysics scheme of Zhao et al. (1997).

DETECTION OF ZONDA WIND IN THE 20-YR MODEL RUN

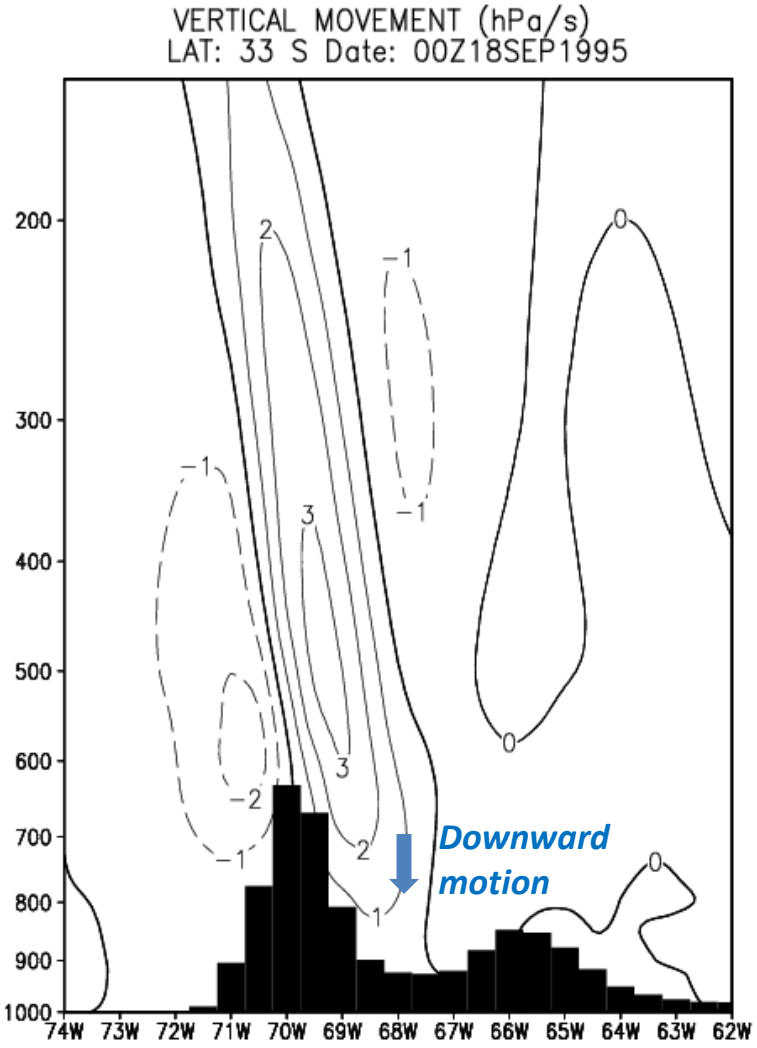
PARAMETER #1

Zonal Pressure gradient Index (*ZPI*): mean sea level pressure (mslp) at 33°S 71°W (West of the mountain) minus mslp at 33°S 68°W (East of the mountain).



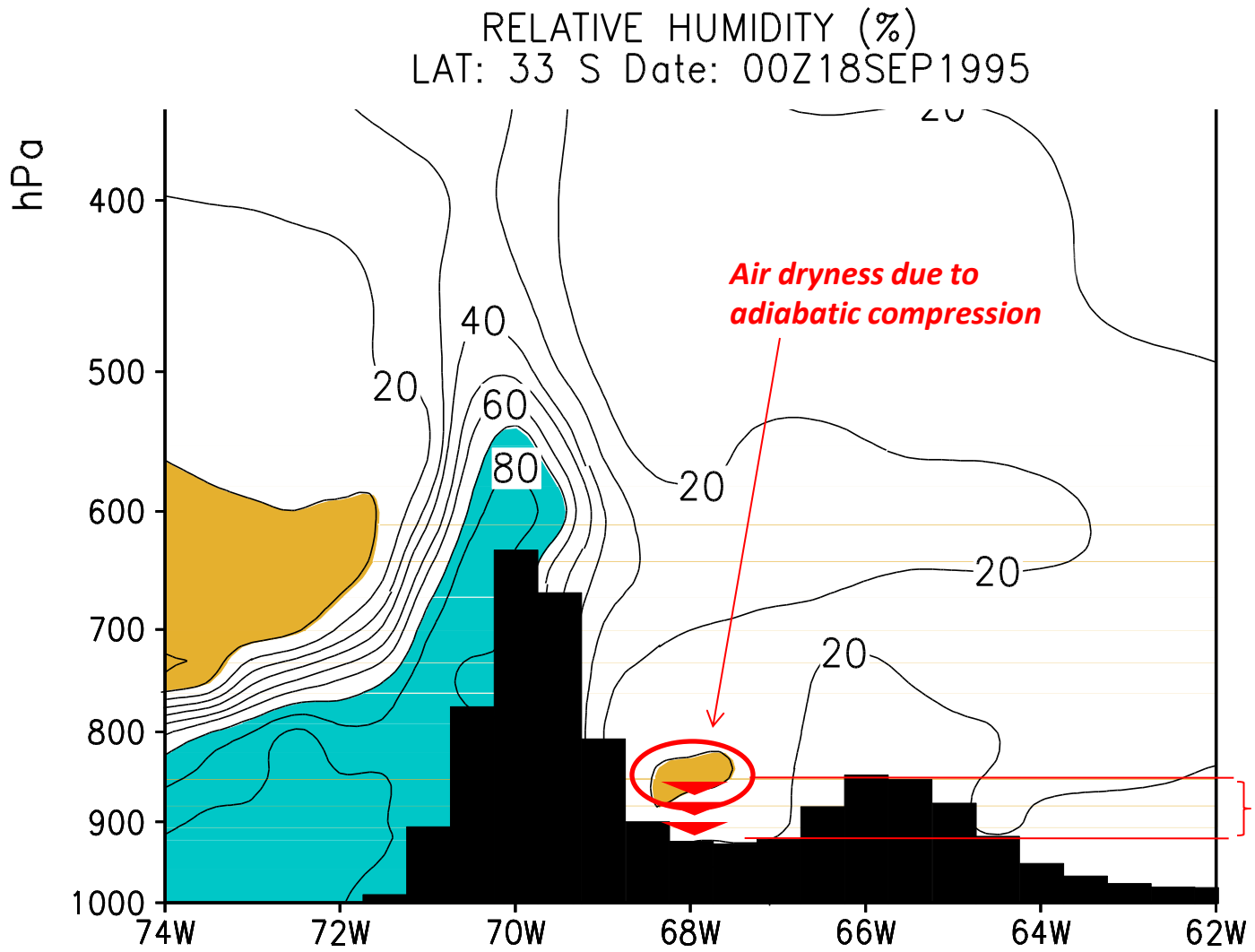
PARAMETER #2

ω_{700} Index: 700-hPa vertical movement at 33°S 68°W.



PARAMETER #3:

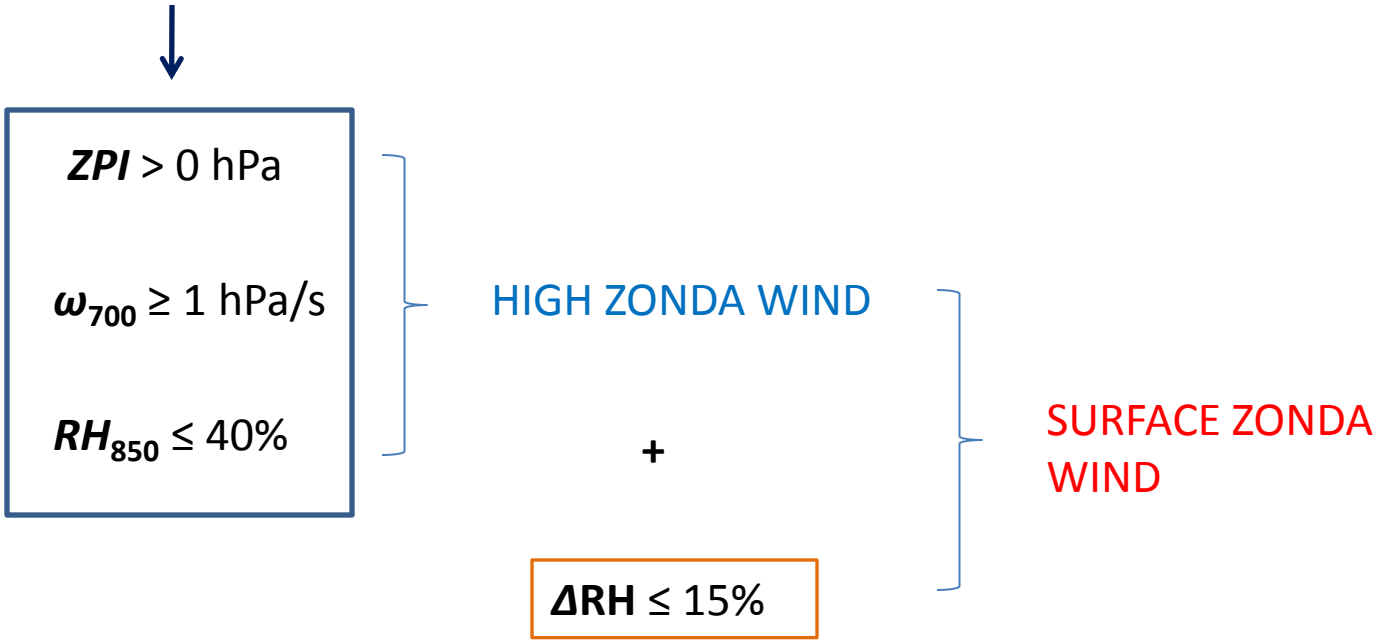
***RH*$_{850}$ Index**: 850-hPa relative humidity at 33°S 68°W.



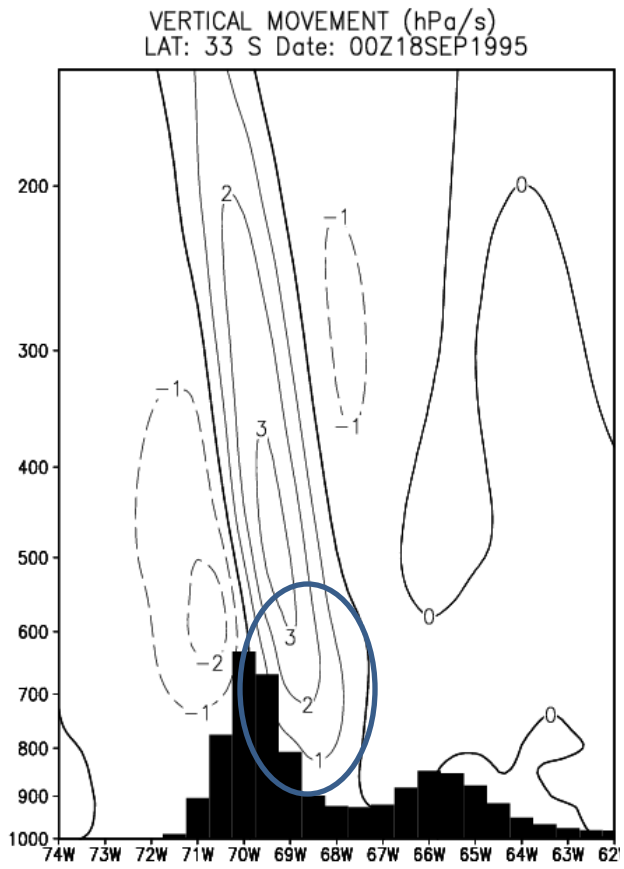
PARAMETER #4:

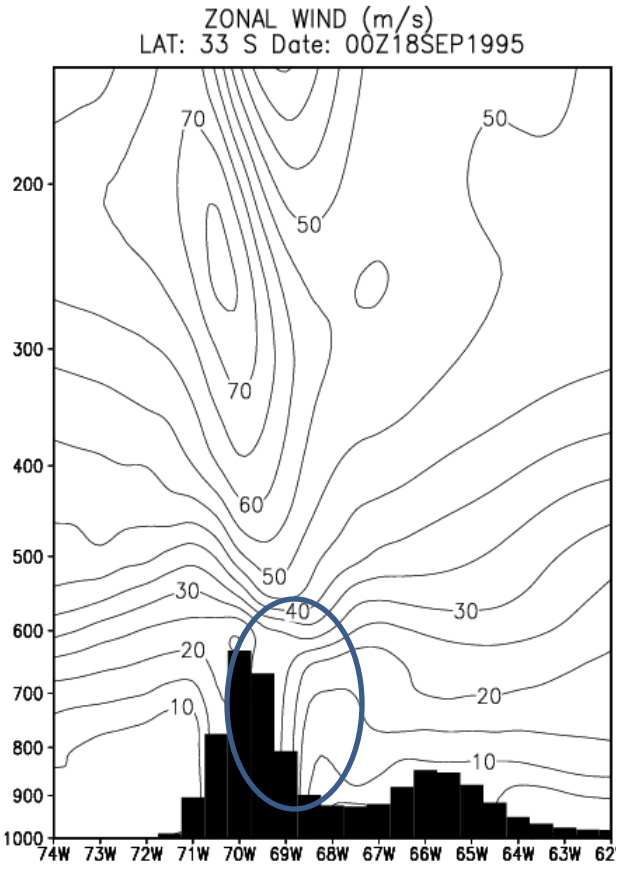
ΔRH Index: *RH*$_{850}$ index minus relative humidity at surface level (2-m above ground) at 33°S 58°W.

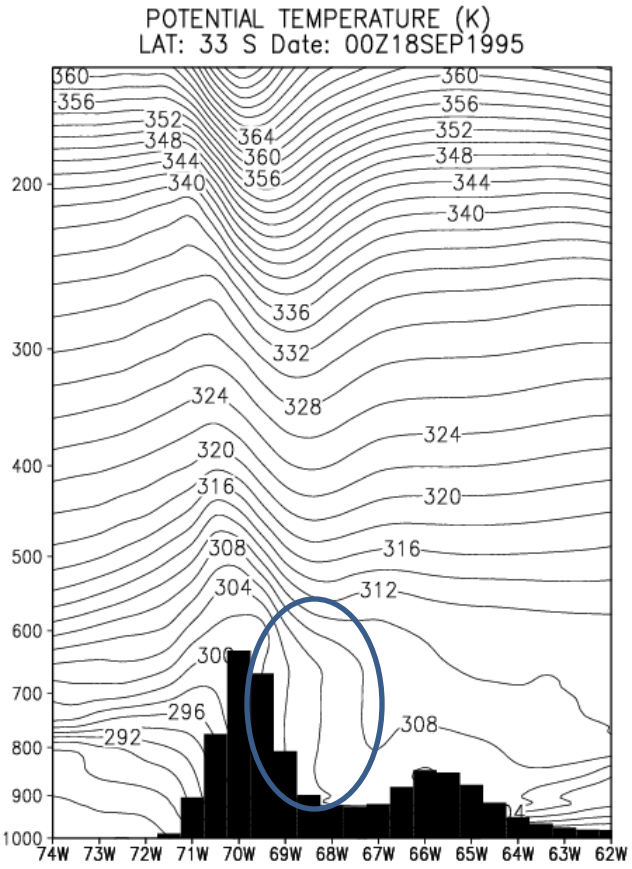
Parameter thresholds to detect Zonda wind events in the 20-yr model run



EXAMPLE OF ZONDA DETECTION: Surface Zonda episode in the 20-yr Eta model run: 00UTC 18SEP1995







Descending motions on the lee side

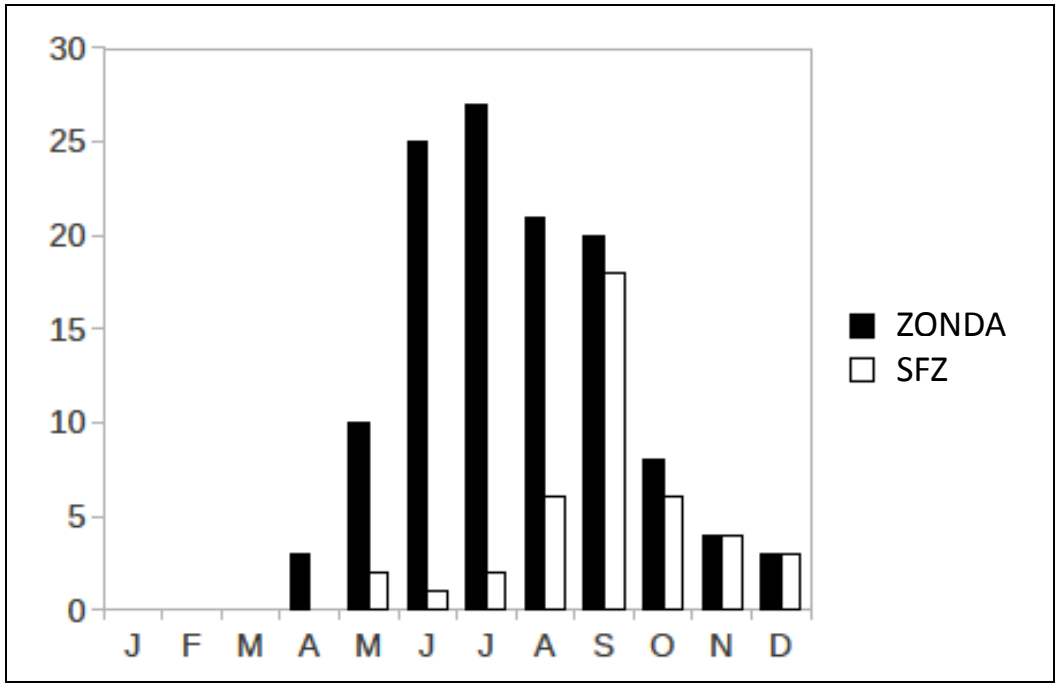
Downslope winds

ZPI = 20.7 hPa RH_{850} = 10%

ω_{700} > 2 *hPa/s* ***ΔRH*** = 5%

Neutral or negative static stability

20-YR SIMULATED CLIMATOLOGY FOR ZONDA WIND OCCURENCE NEAR MENDOZA CITY

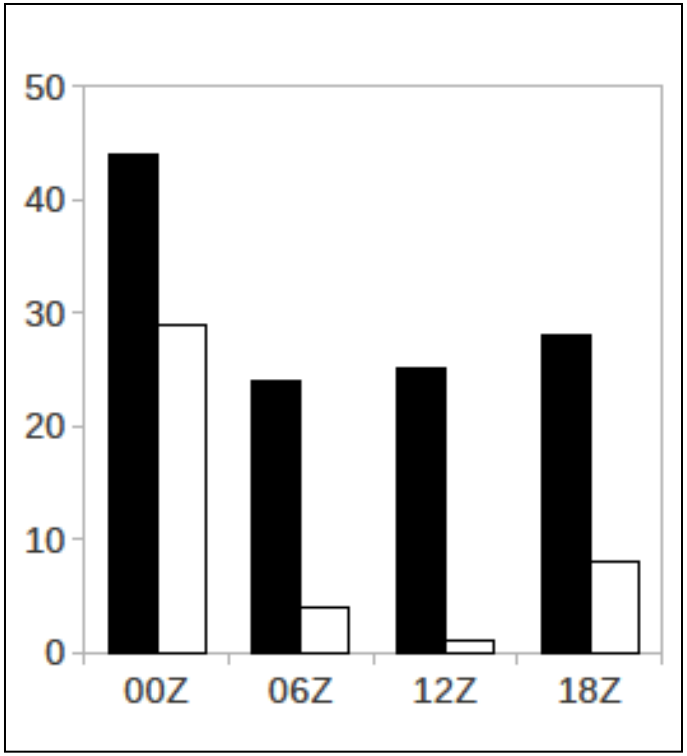


Annual frequency of Zonda wind and Surface Zonda wind in the 20-yr climate simulation with the Eta model considering ω_{700} = 1.0 hPa s^{-1} and RH_{850} = 40 %. For SFZ the adopted criteria is ΔRH = 15%.

Adapted from Antico et al. (2015) Zonda downslope winds in the central Andes of South America in a 20-year climate simulation with the Eta model *Theor Appl Climatol* DOI 10.1007/S00704-015-1709-2

OF DATES/HOURS MATCHING HIGH ZONDA DEFINITION : 209
ZONDA WIND EVENTS (BOTH HIGH AND SURFACE) : 121

DATES/HOURS MATCHING SURFACE ZONDA DEFINITION : 64
SURFACE ZONDA WIND EVENTS : 42



Diurnal frequency of the starting time of Zonda wind.

CONCLUDING REMARKS

- Eta model at a hor. res. of 50 km and assuming hydrostatic equilibrium properly simulates the foehn-like effect on the eastern slopes of the highest Andes mountains in a 20-yr long run.

- Both the annual distribution and the preferred stating time for Zonda wind are mostly in agreement with previous results exclusively based on observational data (Norte, 2015).

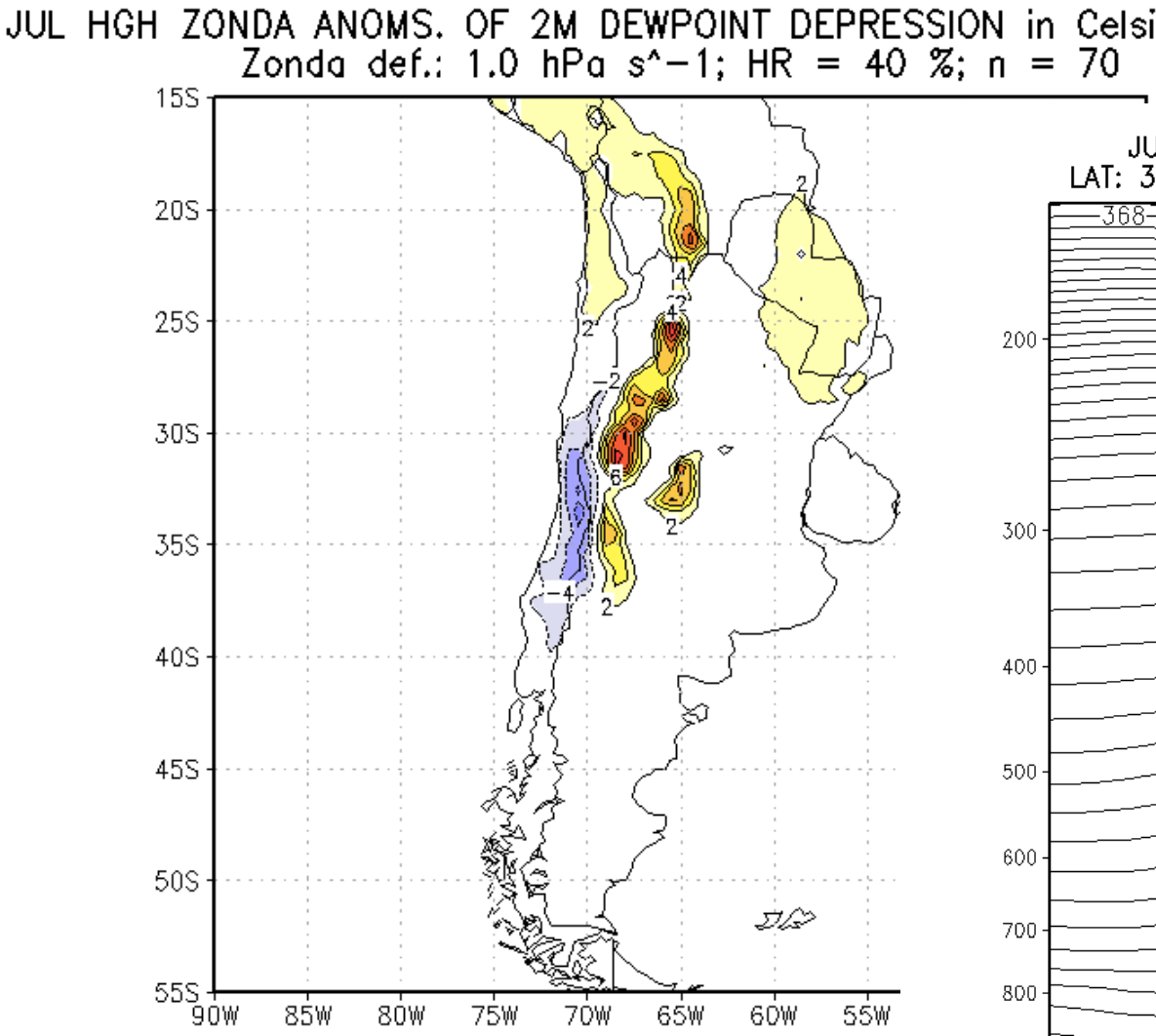
Suggested reference:

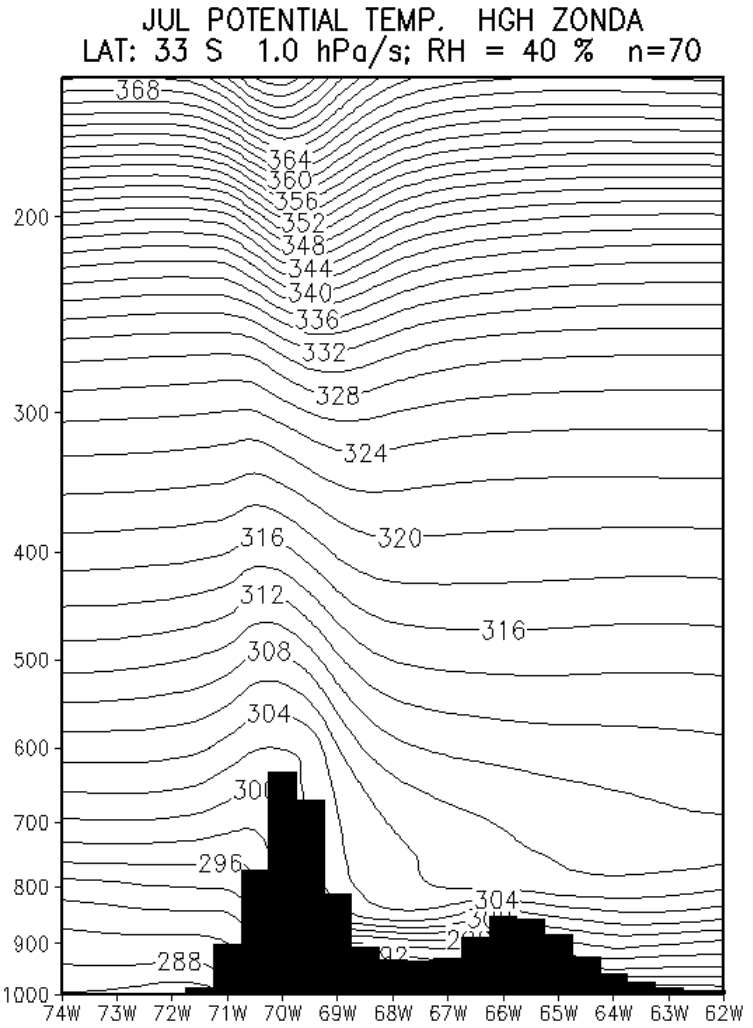
Antico, PL, Chou, SC and Mourao, C 2015. Zonda downslope winds in the central Andes of South America in a 20-year climate simulation with the Eta model *Theor Appl Climatol* DOI 10.1007/S00704-015-1709-2

ONGOING RESEARCH:

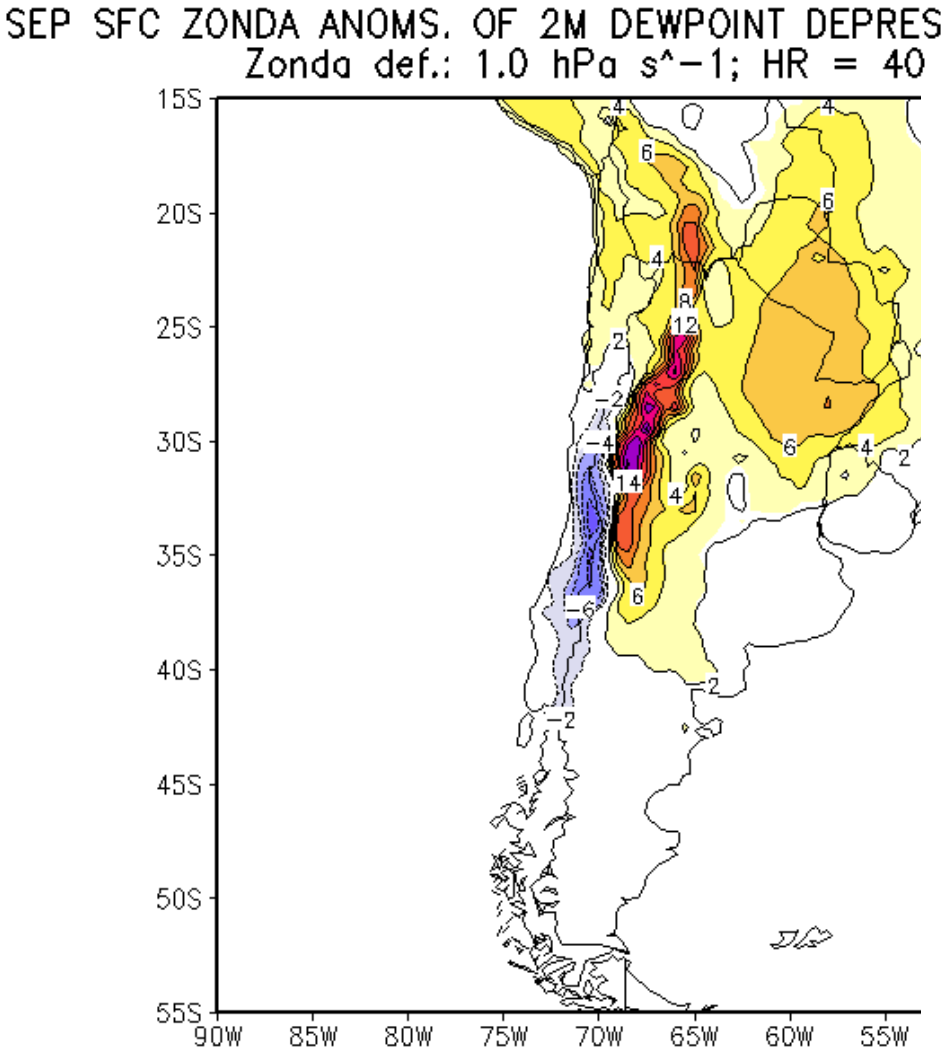
Regional Extent of Zonda Wind Impacts

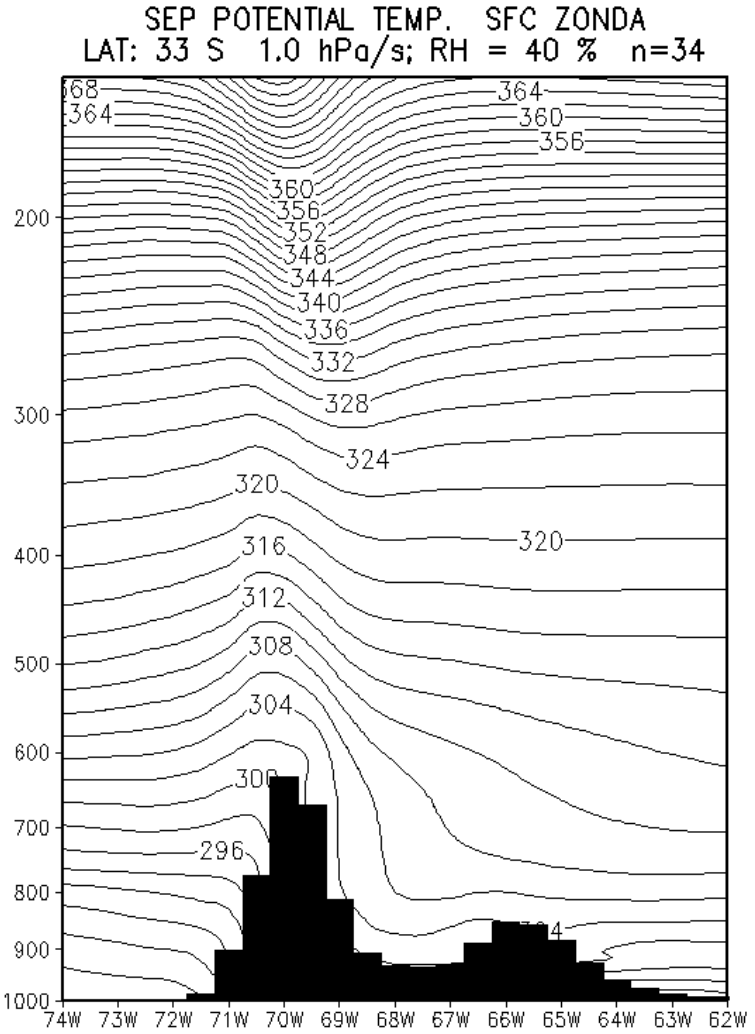
REGIONAL IMPACT S OF HIGH ZONDA WIND IN A 20-YR CLIMATE SIMULATION





REGIONAL IMPACT S OF SURFACE ZONDA WIND IN A 20-YR CLIMATE SIMULATION





Muito obrigado

Thank you very much

Muchas Gracias