Dynamics of wintertime cold air intrusions at the East of the Andes:

A perspective from subtropical Argentina to Bolivian and Peruvian Amazon




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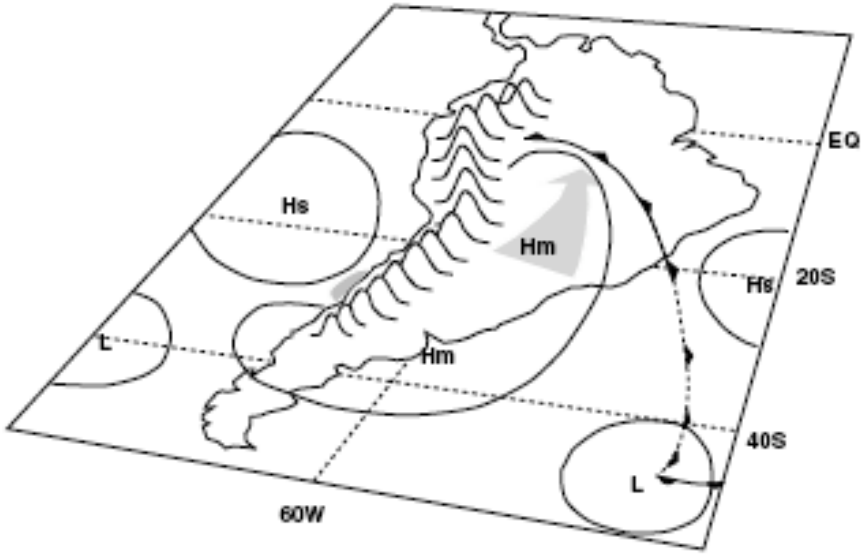
Cold air intrusions

Southern winds incursions from high latitudes, can penetrate until tropical South America, in the Amazon basin, producing severe drops in temperature (e.g. Marengo et al., 1997, Garreaud and Wallace, 1998; Lupo et al., 2001; Poveda et al., 2006).

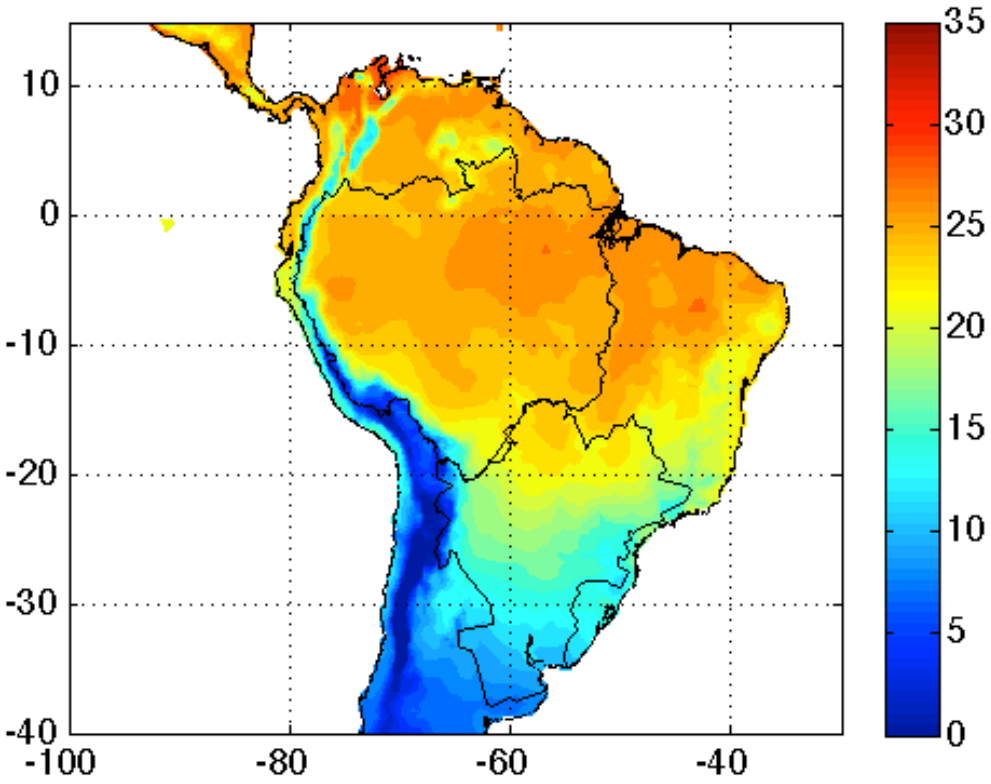


Cold air intrusions modulate the day-to-day variability of deep convection, rainfall and temperature in the southern tropics (e.g. Oliveira and Nobre 1986; Montes de Oca 1995, Garreaud and Wallace, 1998).

Objective

In winter, cold fronts can generate very cold episodes leading to frost in Argentina and southern Brazil that may severely impact agriculture (e.g. Marengo et al., 1997; Rusticucci and Vargas 1995; Vera and Vigliarolo, 2000; Bettolli et al., 2010).

Mean temperature at 2m for JJA season (CRU)

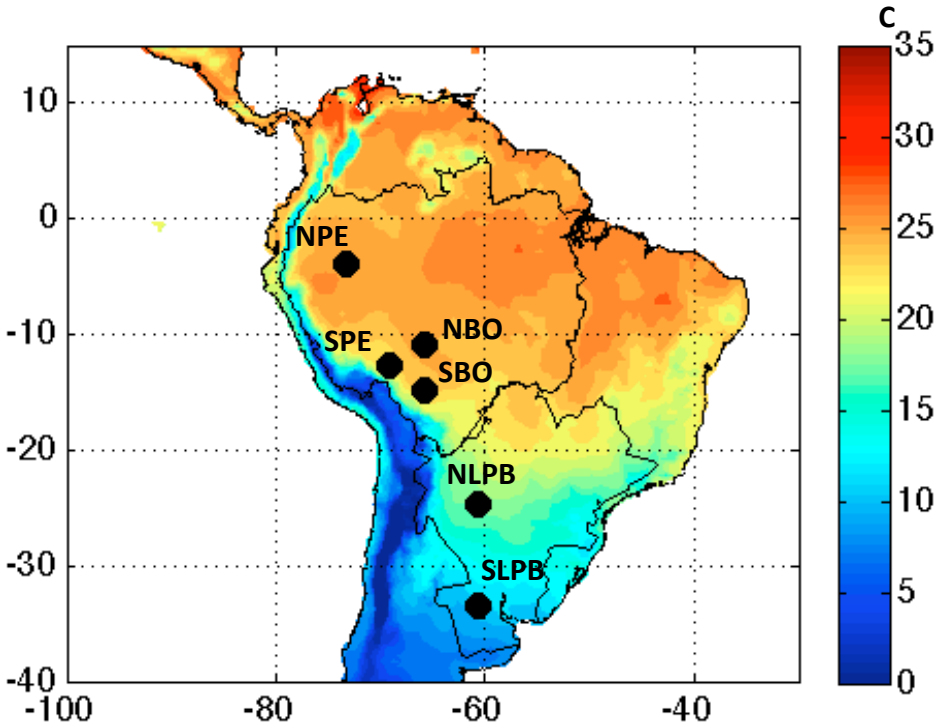


*In Amazon region, few particular cases have been documented in the scientific literature (e.g. Ronchail, 1989; Marengo et al., 1997)

*Dynamics of cold surges at the East of the Andes has not be analysed systematically using in-situ information at a regional scale

Observed minimal temperature

Mean temperature at 2m for JJA season (CRU)



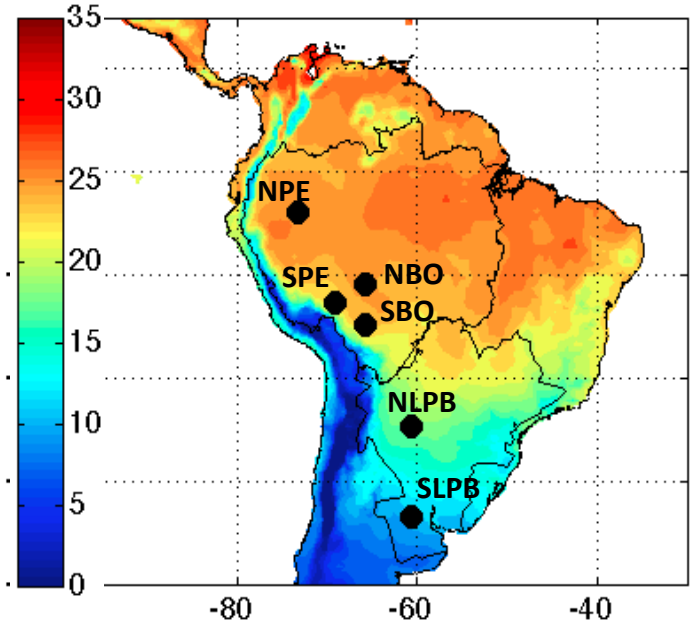
Station	Lat.	Lon.	Virtual station
Pergamino	-33.56	-60.55	SLPB
Rosario	-32.92	-60.78	
Presidencia Sanez Peña	-26.82	-60.45	NLPB
Las Lomitas	-24.70	-60.58	
San Borja	-14.85	-66.73	SBO
Trinidad	-14.82	-64.90	
Riberalta	-11.00	-66.10	NBO
Guayaramerín	-10.82	-65.34	
Puerto Maldonado	-12.40	-69.10	SPE
Tamshiyacu	-4.00	-73.16	NPE
Iquitos	-3.75	-73.25	

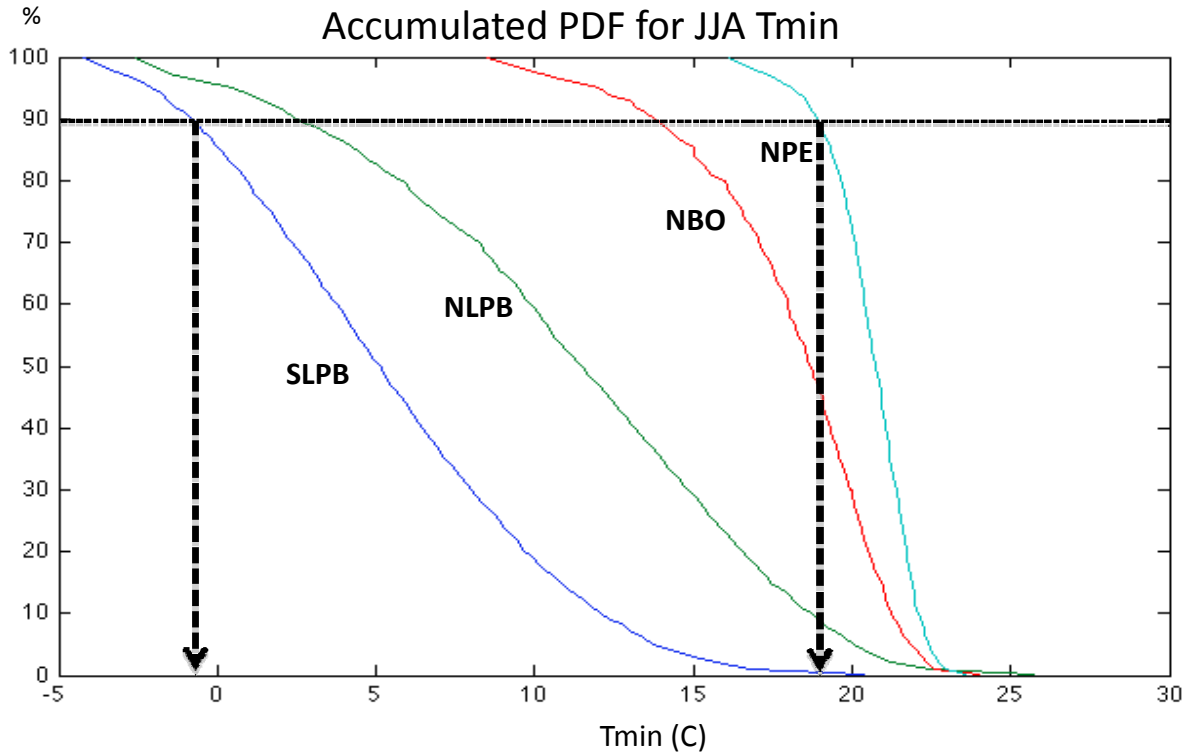
Tmin observations have been collected along the East side of the Andes in the extra-tropics (Argentina), tropical regions (Bolivia and South of Peru) and near the Equator (north of Peru), during a common period, 1975-2001

Observed minimal temperature

*Larger amplitude in the South, where Tmin values vary from -5.˚C to 20˚C.

*Tmin distribution is more uniform in Bolivia and especially in northern Peru.





Extreme cold events in each virtual station are identified considering days where Tmin below the tenth percentile

Atmospheric circulation patterns and cold surges

Identifying the large-scale meteorological situations associated to extreme cold events

Circulation patterns for JJA (1975-2001)

(Espinoza et al., 2011a *Clim Dyn*)

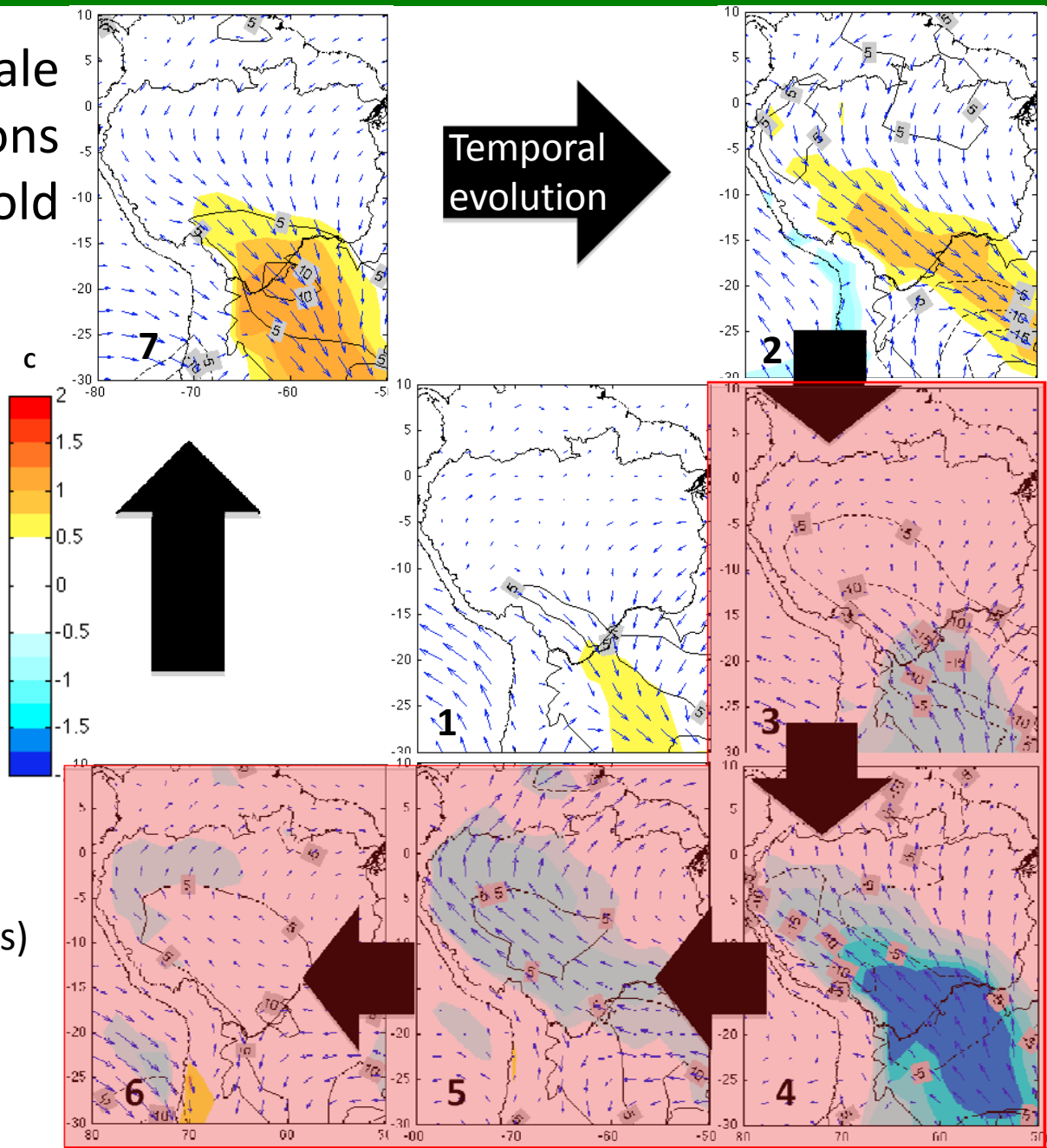
ERA-40 Reanalysis

*Winds at 850hPa (vectors)

*Temperature anomalies (colours)

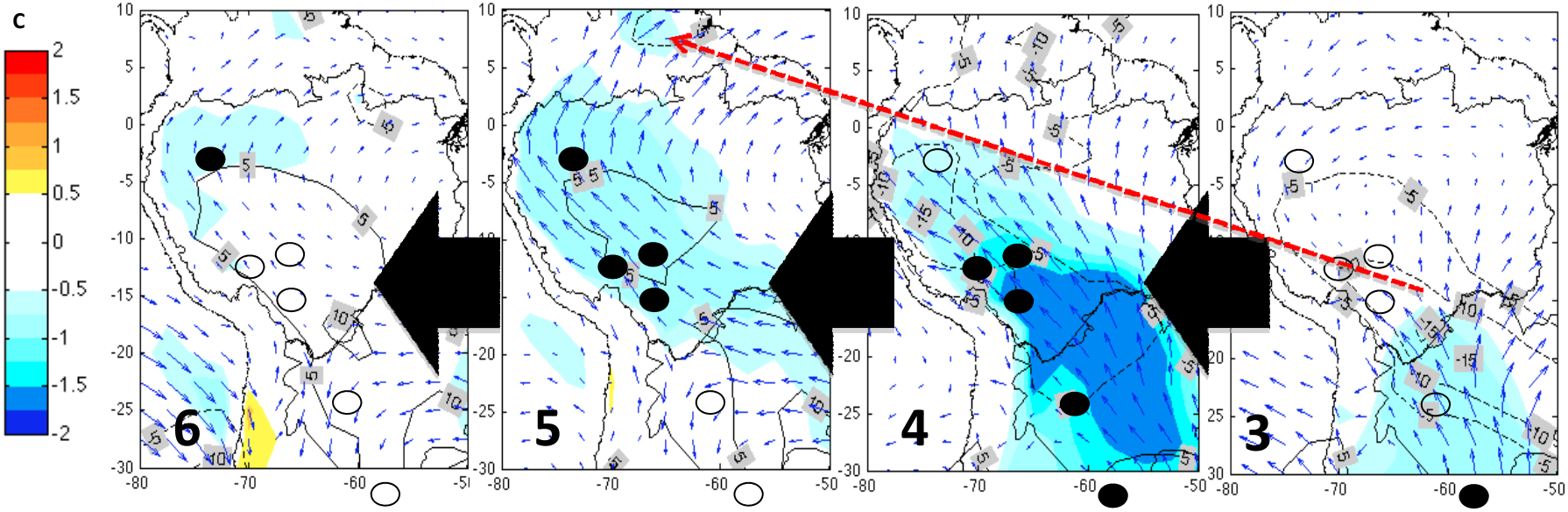
NOAA

*Observed OLR anomalies (contours)



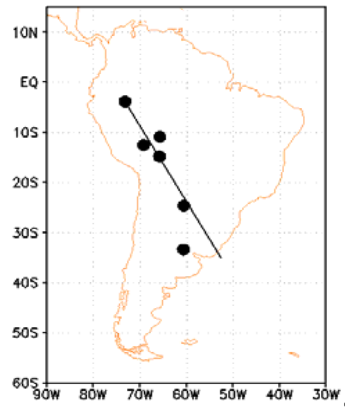
Atmospheric circulation patterns and cold surges

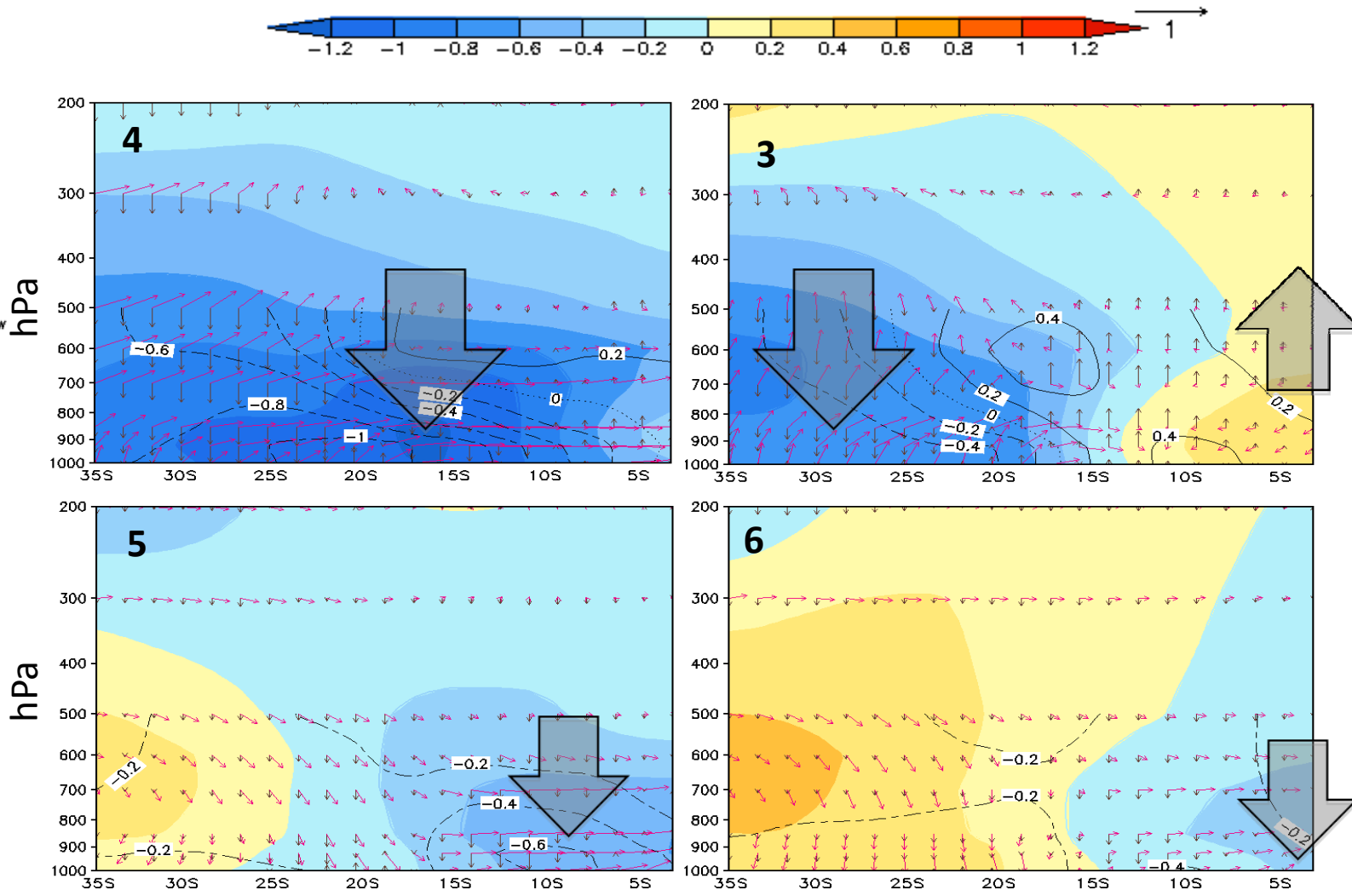
Black dots correspond to high concentration of extreme cold days in the station during the CPs



Advective + Radiative effect generate the extreme cold days

Atmospheric circulation patterns and cold surges





*Horizontal and vertical Winds (vectors)
*Temperature anomalies (colours)
*Specific humidity (contours)

Subsidence and deficit of humidity during cold surges

Conclusions and next works

*Cold surges have been characterized in terms of **dynamics of the atmosphere** and in term of their **temporal evolution** from Argentina to north of Peru.

*Cold surges have been **related to Large-Scale** circulation patterns

Some questions …

*Have cold surges become more/less frequent/intense recently ?

*Do global and regional models allow identify the dynamic of the Atmosphere and spatio-temporal features of cold surges?

*Can models be used to simulate cold surges evolution in the future, in the context of climate change?

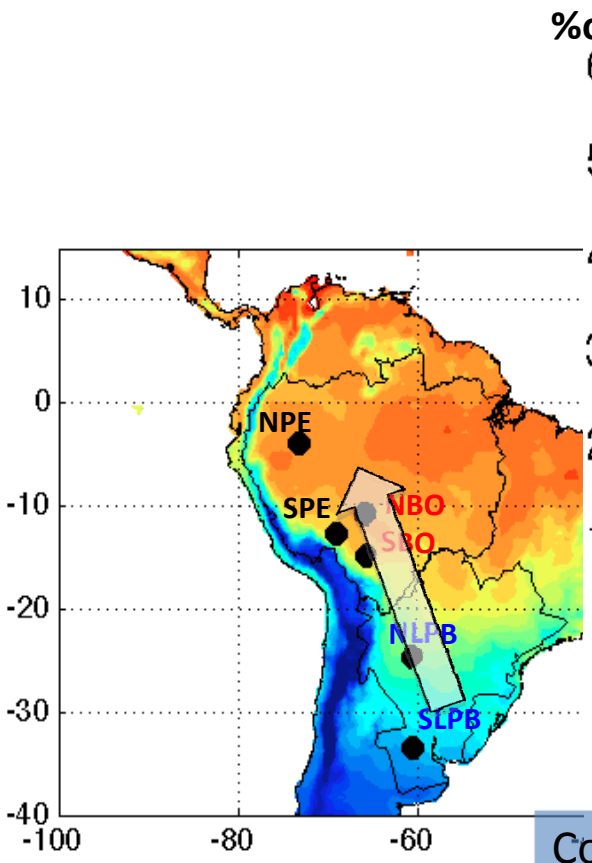


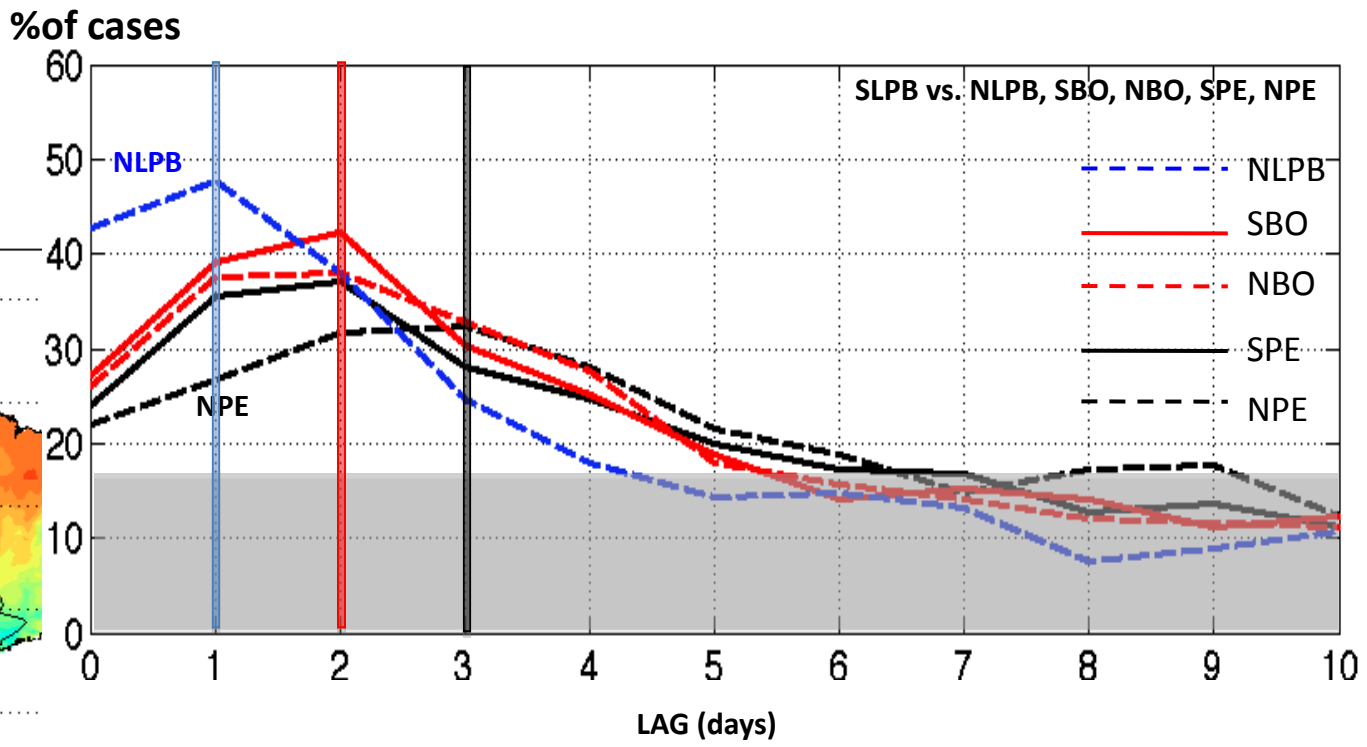
Gracias



Temporal evolution of cold surges

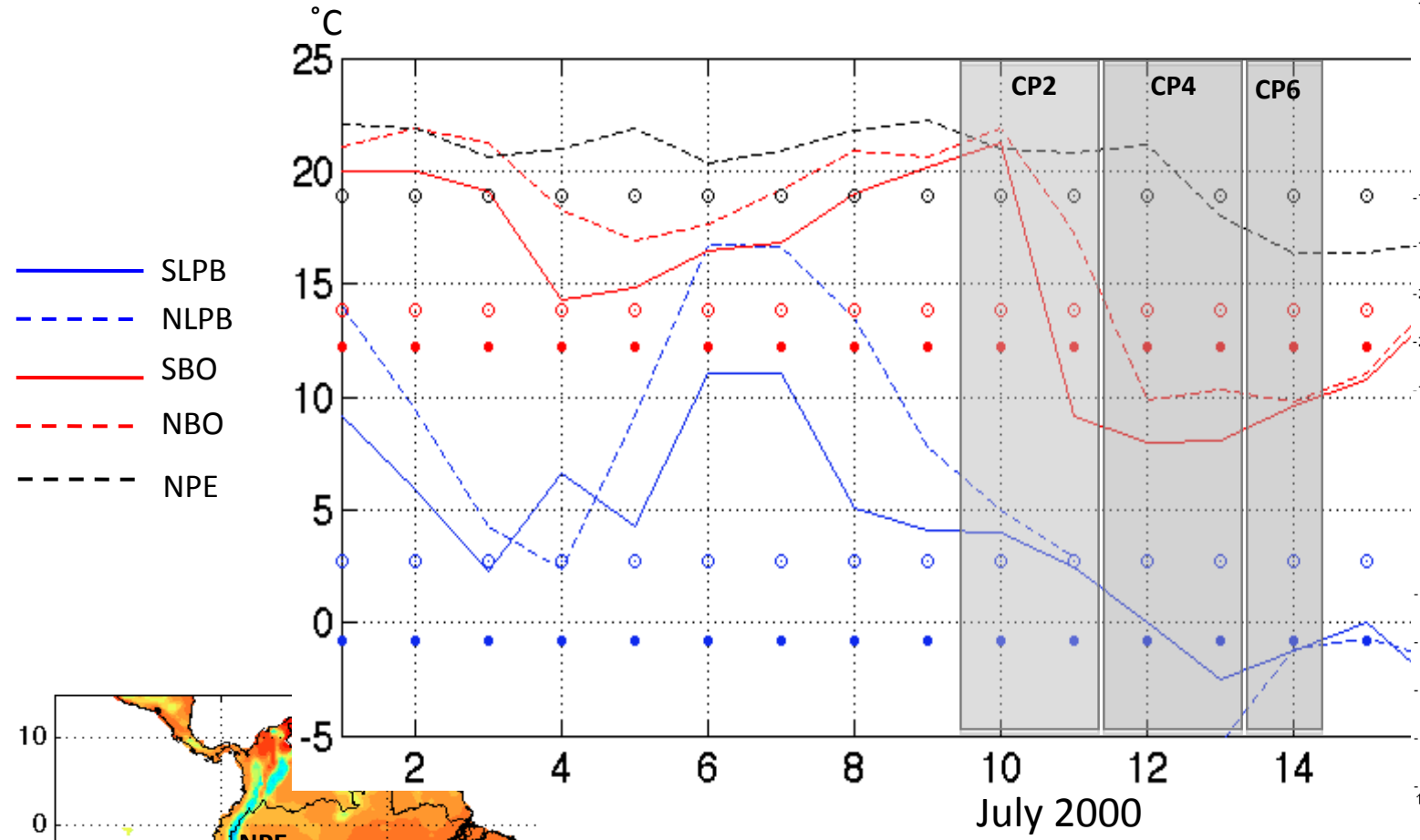
We consider the extreme cold days in SLPB and we compute the percentage of cases with extreme cold surges also reported in the other virtual stations during the same day “D”, the day “D+1”, “D+2”…and day “D+10”

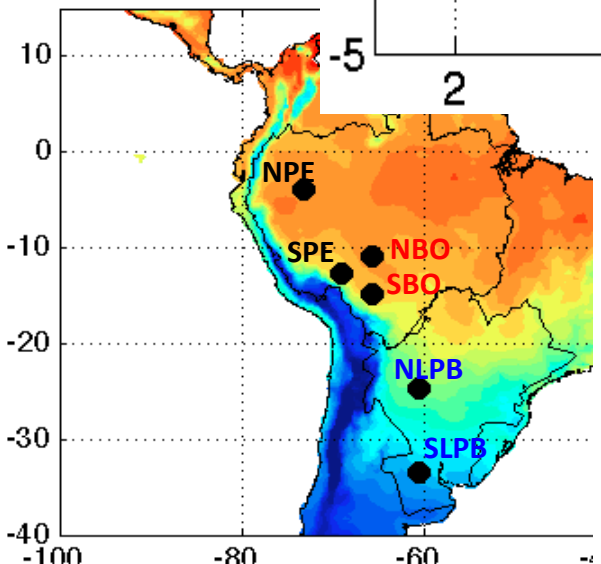




Cold surges take in average 3 days to move from SLPB to NPE

Cases of study: July 2000





Transition from CP2 to CP4 is rarely observed