Extreme Climatic Events in South America: Tropical-Extratropical Links

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Meridional air mass exchanges have a strong impact on climate variability in tropical and temperate regions of South America. Polar air advection is of special interest since it is related today to freezing events in southern and southeastern Brazil with serious economic consequences. Polar advection also influenced past climates, with Antarctic air reaching as far as central Amazonia circa 13,000 years ago. To further our understanding of the present-day characteristics of polar outbreaks in South America and their effects on present and past climates, a meeting was convened at the Instituto Nacional de Pesquisas Espaciais (INPE) near São Paulo to bring together climatologists, climate modelers and paleoclimatologists. The questions adressed were: What are the primary circulation features that produce cold air outbreaks in the Americas? How do Antarctic cold air masses interact with seasonal climates of South America? What are the specific climate signals related to polar outbreaks in low and high latitudes? What are the paleoclimatic responses to polar outbreaks in paleoenvironmental records?

The opening presentation by José Marengo (CPTEC-INPE, Brazil) presented a record of extreme climatic events that occurred at tropical latitudes during recent decades and their relation to Antarctic cold air outbreaks.

Climatological analysis of the Antarctic cold air masses reported by Pedro Silva Dias (IAG-USP, Brazil) showed different frequencies and intensities according to the season, which implies a complete reorganization of the atmospheric circulation.

Bruno Turcq (IRD, France) presented lake-lavel records from Brazil and compared his results with Pedro Silva Dias' model reconstructions for the mid Holocene, when the change in insolation resulted in warmer winters and colder sum-
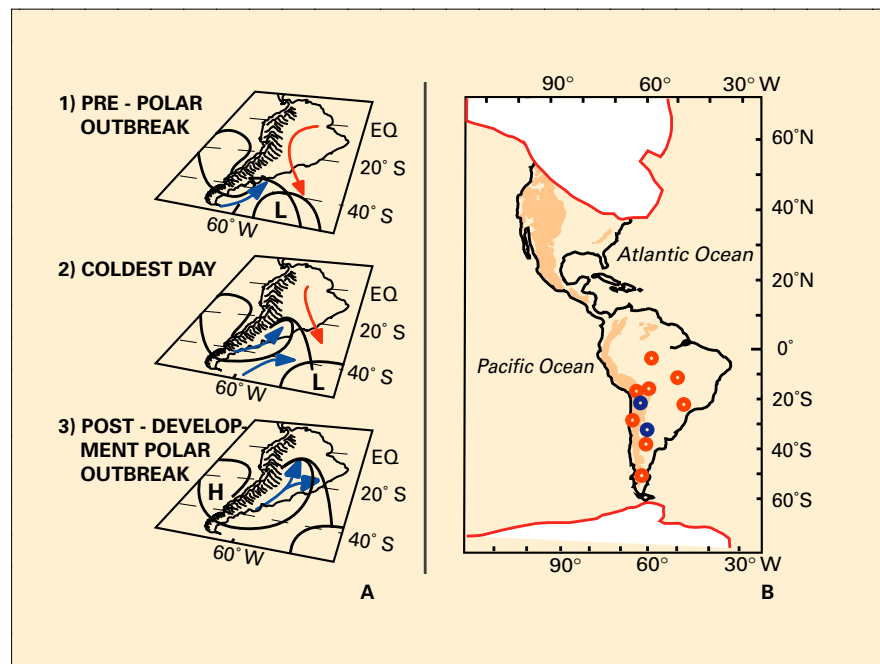

Fig. *A*: Schematic trajectories of cold and dry air masses over South America (blue arrows) and warm and moist tropical air masses (red arrows). *B*: Full glacial conditions in South America interpreted from pollen and lake level records. Red circles are conditions drier than today, blue circles are wetter than today.

mers, weakened the Inter Tropical Convergence Zone and shifted the South Atlantic Convergence Zone northwards. This might have resulted in stronger cold air outbreaks at ca 6,000 yr BP.

A climate reconstruction for the last 2,000 years was presented by Ricardo Villalba (CRICYT, Mendoza, Argentina). Southern hemisphere tree ring records allowed reconstruction of pressure gradients between New Zealand and Chile and/or Australia and Chile, related to the Transpolar Index. Vera Markgraf (INSTAAR, Boulder, USA) presented records of lake-level and vegetation changes in Patagonia for the last 18,000 years. Finally Marie-Pierre Ledru (IRD-USP, Brazil) presented vegetation and lake-level records for three extreme paleoclimatic events, at 18,000, 13-12,000, and 11-10,000 ^{14}C yr BP. These events were interpreted as documenting a reorganization of air masses due to changes in the pole equator temperature gradient.

The primary outcomes of this workshop are: 1) the need to im-

prove our understanding of the synoptic conditions that produce polar outbreaks at present; 2) the need to improve our understanding of how polar outbreaks affect seasonal climate patterns in South America; 3) the importance of comparing modern and paleoclimate data in order to better understand past climates and their hemispheric and interhemispheric climatic teleconnections; and 4) the relevance of teleconnections with the pacific warm pool area as a possible trigger for major readjustments in Southern Hemisphere atmospheric circulation. To continue the discussion, a second meeting will be held in São Paulo, Brazil, in 2003.

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