Plumes associated with circular heat sources in the presence of a cross-flow exhibit several interesting features, but are dominated by an embedded counter-rotating vortex pair (Fig. 1). This vortex pair results in the splitting of the plume into two distinct cores above the heat source (Fig. 2), and can often dominate the nature of smoke and pollutant transport in large or intense fires. In this regard, observations of split and/or rotating plumes arising from such fires are relatively common. Nevertheless, the details of the generation and evolution of this feature are somewhat complex and still under debate.

Ongoing and future work is directed toward describing the dynamical mechanisms responsible for the behavior seen in the simulations, and the dependence of this behavior on the intensity of the heat source, the magnitude of the shear of the cross-flow, and other parameters such as the vertical temperature profile of the surrounding atmosphere. Of particular interest are the implications for smoke and pollutant transport arising from prescribed fires and wildfires.—PHILIP CUNNINGHAM (THE FLORIDA STATE UNIVERSITY), M. YOUSEFF HUSSAINI, SCOTT L. GOODRICK, AND RODMAN R. LINN. *"Numerical Simulations of Buoyant Plumes in a Vertically Sheared Cross-flow," presented at the 10th Conference on Mesoscale Processes, 23–27 June 2003, Portland, Oregon.*

## RAINFALL TRENDS IN BRAZIL

The monthly rainfall data (1951–90) for two extreme regions of Brazil—northwestern Amazonia (NWA) and southern Brazil (SB)—show two interesting features. First, they exhibit opposite climatic trends—a decline in rainfall in NWA and an increase in SB. Second, the climate shift observed in the mid-1970s appears to have modified the amplitude of the rainfall annual cycle in both regions.

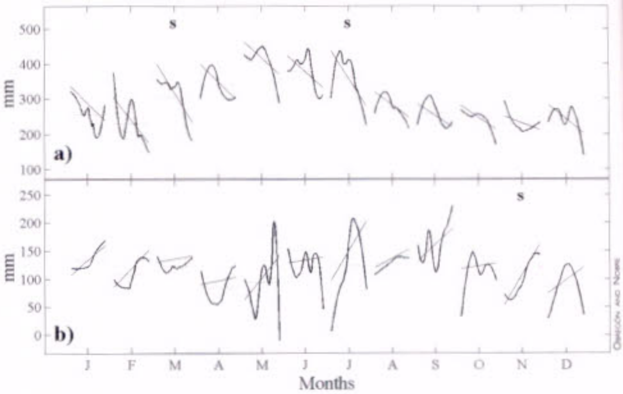



FIG. 1. Rainfall annual cycle variability (1951–90; shown here for a representative station for each region), as based on the monthly time series in (a) northwestern Amazonia (0.6°S–69.2°W) and (b) southern Brazil (31.4°S–52.7°W). Smoothed time series (thick line), linear trend (thin line), and mean (dashed line) are shown. Linear trend significance at the 95% confidence level are indicated by "S."

As shown in Fig. 1, the negative trend in NWA and positive trend in SB is consistent throughout the four-decade period for both regions. These linear trends seem to be related to the climate shift that occurred around the mid-1970s in the Pacific Ocean associated with the interdecadal Pacific oscillation (IPO).

The time series characterizing the austral summer for NWA and spring for SB (Fig. 2) clarify the character of climate shift. Both time series show strong interannual variability, with a positive linear trend in SB and negative trend in NWA, statistically significant at 95%. The trend in both regions seems to be caused by the interdecadal variability. The Mann–Kendall sequential test indicates 1976 as the year when abrupt change in the rainfall occurred in NWA in March and 1973 as the shift for SB in September.

To explore the possibility that a teleconnection is a probable explanation for the rainfall trend, a multivariate statistical analysis was carried out between rainfall observations for South America, global NCEP–NCAR reanalysis of sea level pressure, 500-hPa geopotential heights and 200-hPa winds, and SST

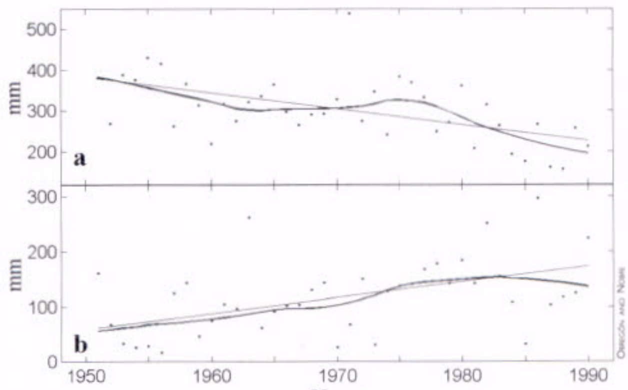



FIG. 2. Dots indicate values of (a) Mar rainfall totals for Northwestern Amazonia and (b) Nov rainfall totals for Southern Brazil. The smoothed times series (thick line) and the linear trend (thin line) are shown.

for the global oceans. This analysis shows that the rainfall shifts that occurred in the mid-1970s over both regions are strongly associated with SST changes in the Pacific Ocean, mainly the North Pacific, during the austral summer months. There is also evidence that the rainfall shift found in southern Brazil may be related to the Antarctic Oscillation.

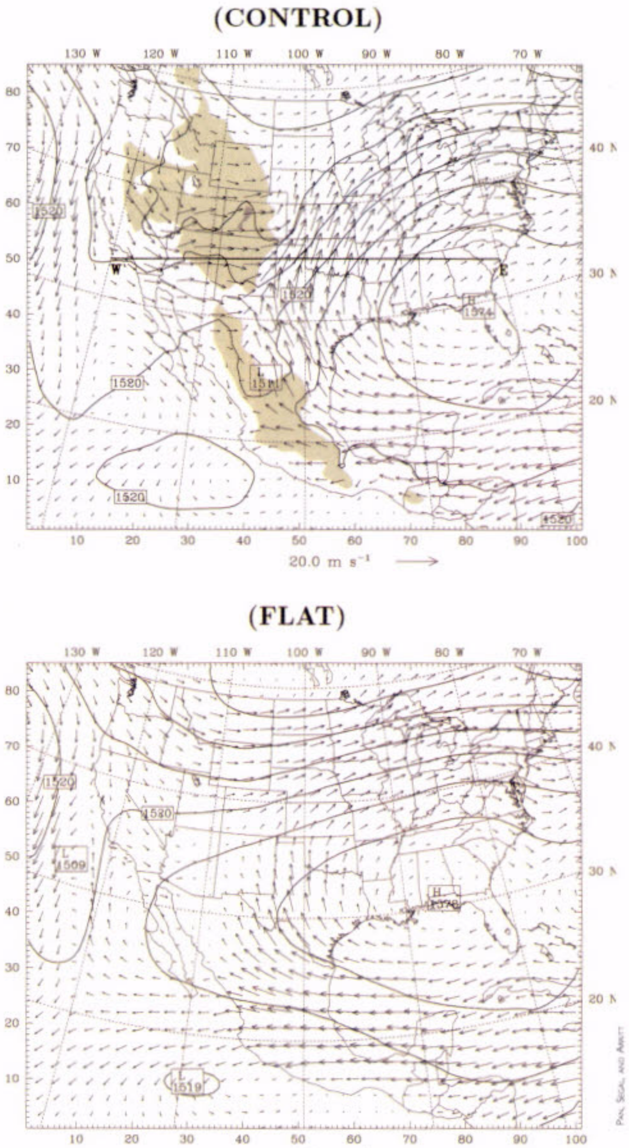
It is well known that interannual ENSO variability affects rainfall over South America. In particular, during the El Niño phase, negative rainfall anomalies are observed over Amazonia and positive anomalies are observed over southeastern South America. Apparently, stronger and more frequent El Niño episodes occur during the warm phase of the IPO, such as one from 1976 to 2000. If that is the main mechanism responsible for the observed trend, one would expect to see a reversal of these trends during the next decades, since the IPO recently changed its phase.

The relevance of this work lies mainly in establishing a probable linkage between observed climate shifts over South America and interdecadal climate variability in the North Pacific. The mechanisms explaining how the climate variability over the Pacific Ocean, mainly the North Pacific, affect the climate over Brazil are still lacking. However, ongoing and future studies to unravel such mechanisms hold promise for useful decadal climate predictions for parts of South America. —GUILLERMO O. OBREGÓN (CENTER FOR WEATHER FORECASTING AND CLIMATE STUDIES/INPE) AND CARLOS A. NOBRE. *"A Climate Shift in Mid-1970s in Northwestern Amazonia and Southern Brazil," presented at the Seventh Conference on Southern Hemisphere Meteorology and Oceanography, 24–28 March, Wellington, New Zealand.*

## THE ROLE OF THE ROCKIES IN LOW-LEVEL JETS

Because of their linkage to warm-season precipitation over the Great Plains, nocturnal low-level jets (LLJs) have been the focus of numerous theoretical, observational, and modeling studies. We introduced hypothetical modifications of the topography in model simulations over the continental United States in order to evaluate how topography affects the characteristics of LLJs. These simulations illustrate the influences of topographical blocking, leeside cyclogenesis, and slope thermal effects exerted by the Rocky Mountains on LLJ formation.

We simulated a 45-day period during the 1993 summer flood in the central United States, when strong LLJs were frequent, using a regional climate model forced continuously in time by observed meteorological lateral boundary conditions. The control (real terrain) simulation (see figure) agrees with the observed pattern: a well-defined ridging from the Bermuda high east of the Rocky Mountains is accompanied




**Simulated 45-day averaged geopotential height at 850 hPa (m) and wind velocity at ~700 m above surface (reflecting typical height of LLJ maximum) at 0600 UTC; with topography (CONTROL) and without topography (FLAT). Shading indicates that terrain height is above 1500 m.**