PRESENT AND PAST INTER-HEMISPHERIC CLIMATE LINKAGES IN THE AMERICAS

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The Americas offer a unique possibility for inter-hemispheric comparison of present climate and paleoclimate data, because of the geographic comparability of both land areas. North and South America form one landmass extending continuously from pole to pole; a continuous series of longitudinal mountain ranges runs along the western continental margin, and the climate is largely affected by the Pacific ocean-atmosphere dynamics. The major climate features show a comparable pattern of seasonal latitudinal shifts. The Inter Tropical Convergence Zone (ITCZ) and its convection maximum moves with the respective summer hemisphere and the westerly stormtrack belts shift towards the poles in summer and equatorwards during the winter. Also the El Niño-Southern Oscillation (ENSO) interannual climate anomaly affects both North and South America in a comparable way, with El Niño enhancing precipitation at lower latitudes than normal and decreasing precipitation at the higher latitudes. Did this climate symmetry exist also in the past, when boundary conditions, such as solar insolation, continental ice cover, sea surface temperatures, and sea level were markedly different from today?

In analyzing records from regions sensitive to ENSO variability it becomes evident that prior to 5000 BP ENSO did not exist as we see it today. Neither do the records show the high variability that is characteristic for the present pattern, nor are the climate patterns the same. The question then remains: has ENSO different major modes of expression in terms of its teleconnection patterns or are there times when the trans-Pacific ocean-atmosphere interaction that produces the ENSO variability is suppressed? Explanation for the different behavior of ENSO during the early Holocene may relate to differences in insolation, with the northern hemisphere characterized by extreme seasonality contrast, while the southern hemisphere has a reduced contrast.

The westerly storm tracks also show different behaviors in the past compared to the present, at times shifting in parallel (both polewards in summer), at times in opposite direction (one polewards, the other equatorwards). During the early Holocene e.g. northwestern North America, today characterized by year round precipitation, experienced dry conditions with high fire frequencies. This implies that the westerly storm tracks were located equatorwards of the present-day position. An explanation for this location is the continuing presence of remains of the Laurentide ice sheet in northeastern North America, which diverged the jet stream southwards. In southwestern South America on the other hand, the zone of maximum precipitation was focused in the higher mid-latitudes during the early Holocene. The interpretation is that because of the reduced circum-Antarctic sea ice the steepest portion of the pole-equator temperature gradient was located at the intermediate high latitude, which would be where the storm tracks would be located. During full-glacial times, on the other hand, westerly storm tracks were located farther equatorwards from today in both North and South America. In both cases due to the far steeper temperature gradient between the heavily glaciated poles and the equator.

The most enigmatic paleoclimate feature is the ITCZ and its behavior during full-glacial times. Records from the tropics all show greatly reduced precipitation during that time, suggesting that the ITCZ was not simply shifted to some other latitude, but that it perhaps even did not operate as today. Perhaps the combination of lower ocean temperatures and enhanced trade winds prevented a convective pattern to develop as it does today.

In conclusion, inter-hemispheric comparisons of climate patterns do reveal very interesting aspects insights into global linkages of climate and their possible mechanisms.