Geophysical Research Abstracts
Vol. 12, EGU2010-11645, 2010
EGU General Assembly 2010

Intermittent multidecadal-to-centennial fluctuations dominated global temperature evolution during the Last Millennium

Davide Zanchettin (1), Angelo Rubino (2), and Johann H. Jungclaus (1)

(1) Max Planck Institute for Meteorology, Bundesstrasse 53, 20146 Hamburg, Germany (davide.zanchettin@zmaw.de), (2) University of Venice, Dorsoduro 2137, 30123 Venice, Italy

Observed long climatic time series are often characterized by periodic fluctuations on multidecadal-to-centennial timescales. These fluctuations, however, are not homogeneously distributed in time: Instead, they appear on irregularly intermittent temporal intervals, whose begin and duration vary with their typical fluctuation frequency. A similar irregularly intermittent and frequency-dependent appearance of energetic fluctuations is found in long-term Earth system model integrations. Specifically, we analyze the results of one unperturbed 3100-year simulation (i.e., the control run) and an ensemble of five 1200-year realistically forced simulations carried out with the comprehensive Earth System Model ECHAM5/MPIOM ("Community Simulation for the Last Millennium" project). We focus on the low-frequency variability of the global mean surface temperature (GST) and its relation to variability patterns, such as the Pacific Decadal Oscillation (PDO) and the Atlantic Multidecadal Oscillation (AMO).

In the unperturbed simulation, large fluctuations at O(50-90 years) dominate GST variability as well as PDO and AMO variability: purely internal GST variability thus essentially reflects surface temperature variations in the multidecadal band that are preferably excited by ocean-atmosphere coupling. However, O(50-90 years) fluctuations are more intermittent in the AMO than in the PDO.

In the forced simulations, we observe that O(50-90 years) fluctuations in the GST are generally overruled as external forcings apparently shift the spectral peaks to the very low-frequency part of the spectrum [O(100) and beyond] of climate variability: As a consequence, correlations of PDO and AMO with GST are generally weaker than in the unperturbed simulation. Moreover, the ensemble standard deviations of PDO, AMO and GST vary strongly over time in the forced simulations, both for the individual time series and their cross-correlations. Thus, different time intervals exhibit different degrees of coherency in the behavior of the simulated climate. An apparent feature of the time series is that ensemble standard deviations are small when the simulated climatic evolution is predominantly determined by the imposed external forcing. Nonetheless, major transients in the correlations among PDO, AMO and GST do not occur, generally, at the same time, which highlights how possible interferences among externally and internally driven variability add complexity to climate dynamics at multidecadal to centennial time scales.