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Interhemispheric temperature difference as a predictor of boreal winter ENSO

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We use statistical analysis to show statistically significant relationship between the boreal winter MEI index of ENSO and HadCRUT3 temperature difference between Northern and Southern hemispheres (NH – SH) during the preceding summer. Correlation values increase (in absolute terms) if the correlated time periods are increased from month to seasonal length. For example December and January (DJ) MEI values anticorrelate stronger with the preceding MJJA period than with any of the four months taken separately. We believe this is further evidence that the correlation is caused by a real physical process as increase of the averaging period tends to reduce statistical noise.

The motivation for looking for such a relationship comes from review of literature on paleoclimatic ENSO behavior. We have noticed that in many cases relatively cold NH coincided with "strong ENSO" (frequent El Niños), for example the Ice Age periods and Little Ice Age. On the other hand periods of relatively warm NH (the Holocene climate optimum or Medieval Climate Anomaly) are coincident with frequent or even "permanent" La Niñas. This relationship suggest the influence of the position of Intertropical Convergence Zone (ITCZ) on the frequency of El Niños. The simplest physical mechanism of the relationship is that the positive (negative) NH-SH temperature difference causes a north (south) shift of ITCZ with a parallel shift of trade wind zones. The North-South orographic difference between the Panama Isthmus and the South America may cause stronger (weaker) trade winds in Eastern Tropical Pacific increasing (decreasing) the thermochemical tilt which, in turn, causes a more negative (positive) ENSO values. Of course this may be only a first approximation of the real mechanism of this "teleconnection".

The correlations we have found are not strong even if statistically significant. For example, the MJJA NH-SH temperature vs. DJ MEI correlation has r = -0.28 implying it explains only 8% of boreal winter ENSO variability. In, fact, we did not expect a high value for a phenomenon which is a self-regulated ocean-atmosphere oscillation with timing partly triggered by stochastic atmospheric forcing, especially as we predict ENSO with (semi)global parameters. It is possible that further research may identify smaller regions of both hemispheres which temperature differences explain a larger part of ENSO variability. However in our opinion, the importance of this result is that it may not only improve ENSO prediction but also help in better understanding of ENSO variability in different time scales.