Announcing the Final Examination of Lee Mullon for the degree of Master of Science

Time & Location: October 20, 2014 at 8:00 AM in ENG2 211
Title: INTEGRATED REMOTE SENSING AND FORECASTING OF REGIONAL TERRESTRIAL PRECIPITATION WITH GLOBAL NONLINEAR AND NONSTATIONARY TELECONNECTION SIGNALS USING WAVELET ANALYSIS

Global sea surface temperature (SST) anomalies have a demonstrable effect on terrestrial climate dynamics throughout the continental U.S. SST variations have been correlated with greenness (vegetation densities) and precipitation via ocean-atmospheric interactions known as climate teleconnections. Prior research has demonstrated that teleconnections can be used for climate prediction across a wide region at sub-continental scales. Yet these studies tend to have large uncertainties in estimates by utilizing simple linear analyses to examine chaotic teleconnection relationships. Yet non-stationary signals exist, making teleconnection identification difficult at the local scale. Part 1 of this research establishes short-term (10-year), linear and non-stationary teleconnection signals between SST at the North Atlantic and North Pacific oceans and terrestrial responses of greenness and precipitation along multiple pristine sites in the northeastern U.S., including (1) White Mountain National Forest - Pemigewasset Wilderness, (2) Green Mountain National Forest - Lye Brook Wilderness and (3) Adirondack State Park - Siamese Ponds Wilderness. Each site was selected to avoid anthropogenic influences that may otherwise mask climate teleconnection signals. Lagged pixel-wise linear teleconnection patterns across anomalous datasets found significant correlation regions between SST and the terrestrial sites. Non-stationary signals also exhibit salient co-variations at biennial and triennial frequencies between terrestrial responses and SST anomalies across oceanic regions in agreement with the El Nino Southern Oscillation (ENSO) and North Atlantic Oscillation (NAO) signals. Multiple regression analysis of the combined ocean indices explained up to 50% of the greenness and 42% of the precipitation in the study sites. The identified short-term teleconnection signals improve the understanding and projection of climate change impacts at local scales, and harness the interannual periodicity information for future climate projections.

Part 2 of this research paper builds upon the earlier short-term study, by exploring a long-term (30-year), teleconnection signal investigation between SST at the North Atlantic and Pacific oceans and the precipitation within Adirondack State Park in upstate New York. Non-traditional teleconnection signals are identified using wavelet decomposition and teleconnection mapping specific to the Adirondack region. Unique SST indices are extracted and used as input variables in an artificial neural network (ANN) prediction model. The results show the importance of considering non-leading teleconnection patterns as well as the known teleconnection patterns. Additionally, the effects of the Pacific Ocean SST or the Atlantic Ocean SST on terrestrial precipitation in the study region was compared with each other to deepen the insight of sea-land interactions. Results demonstrate reasonable prediction skill at forecasting precipitation trends with a lead time of one month, with r values of 0.55. The results are compared against a statistical downscaling approach using the HadCM3 global circulation model output data and the SDSM statistical downscaling software, which demonstrate less predictive skill at forecasting precipitation within the Adirondacks.

Major: Civil Engineering

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Approved for distribution by Ni-Bin Chang, Committee Chair, on September 27, 2014.

The public is welcome to attend.