Session 5B: Climate Change and Water Quality
February 11, 2009

The Rise and Fall of the Great Lakes

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Great Lakes water levels have varied for thousands of years. However, recent water level declines have been particularly worrisome, in part because they are consistent with many global climate change scenarios. Nearby inland seepage lakes in the Long Term Ecological Research site in northern Wisconsin exhibit similar declines, supporting the idea that regional climatic factors are the principle cause of the current low levels. We examined water level changes over time with Dynamic Linear Models (DLMs) and Seasonal Trend Decomposition using Loess (STL). STL results highlight periodicities at several frequencies, including a relationship with sunspot activity. Interestingly, the sign of this relationship changed from positive to negative in about 1940. DLMs show a relationship with precipitation at three annual time lags, with a pseudo-r-squared of 0.89, and reveal an underlying water level decline that began in the 1970s. The DLM results provide a basis to forecast annual average water levels, given previous year precipitation, with accompanying uncertainty estimates. They may also be a useful tool to help delineate the causes of the long-term underlying water level decline.

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