GLOBAL AND SYNOPTIC-SCALE WEATHER PATTERNS CONTROLLING WET DEPOSITION OVER CENTRAL EUROPE

URI DAYAN(1), and DENNIS LAMB(2)
(1) Geography Department, The Hebrew University of Jerusalem,
(2) Meteorology Department, The Pennsylvania State University, PA

HARMO-10 Crete 2005

The EMEP precipitation chemistry network was used in combination with the Reanalysis NCEP/NCAR archive to analyze the influence of climatic-scale variations in atmospheric circulation on summertime wet sulfate deposition over central Europe from 1984 through 1999. Correlation of deposition with hemispheric and global circulation patterns indicates a significant role (49% of the variance) for the North Hemispheric Pacific Transition teleconnection in the wet deposition of sulfate over central Europe in August.

The seasonal correlation of air temperature at shallow tropospheric layers reveals significantly cooler air masses over central Europe, Alaska and the southwestern U.S. coast and warmer air over Greenland, the Barents and Kara Sea and the South Atlantic and Indian Ocean.

The geopotential height anomalies for sulfate-rich deposition years exhibit a pattern consistent with the seasonal correlation. A weakening of both belts of Sub-polar lows and Antarctic Polar Highs is also observed. In the Northern Hemisphere, a distinct dipole in geopotential height is observed, with a positive anomaly over Iceland and the Norwegian Sea and a negative anomaly over Russia and Scandinavia.

Composite plots of the most loaded/unloaded days of sulfate deposition yielded a prominent signal of the associated mean atmospheric field patterns. The composite sea-level pressure for the twenty highest deposition days shows an average intensification of 1 hPa and a northeastward migration of the Azores Subtropical High, leading to a significant anomaly in the negative meridional wind component at the 925-hPa level. This flow presumably enables the transport and oxidation of SO_2 emitted from major upwind pollution sources toward central Europe.

The observed downward trend in sulfate deposition suggests that the study period was characterized by predominantly warm zonal circulation.

More frequent zonal flows in the future, together with further reductions in sulfur dioxide emissions are likely to lead to lower sulfate deposition.