Geophysical Research Abstracts, Vol. 8, 06128, 2006
SRef-ID: 1607-7962/gra/EGU06-A-06128

Serial clustering of extra-tropical cyclones

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The clustering in time (seriality) of extratropical cyclones is responsible for large cumulative insured losses in western Europe, though surprisingly little scientific attention has been given to this important property. This study has investigated and quantified the seriality of extratropical cyclones in the Northern Hemisphere using a point-process approach. A possible mechanism for serial clustering is the time-varying effect of the large-scale flow on individual cyclone tracks. Another mechanism is the generation by one ’parent’ cyclone" of one or more ’offspring’ through secondary cyclogenesis. A long cyclone-track database was constructed for extended October to March winters from 1950 until 2003 using 6-hourly analyses of 850-mb relative vorticity derived from the NCEP/NCAR reanalysis. A dispersion statistic based on the variance-to-mean ratio of monthly cyclone counts was used as a measure of clustering. It reveals extensive regions of statistically significant clustering in the European exit region of the North-Atlantic storm track and over the central North Pacific. Monthly cyclone counts were regressed on time-varying teleconnection indices with a log-linear Poisson model. Five independent teleconnection patterns were found to be significant factors over Europe: the North-Atlantic Oscillation (NAO), the East-Atlantic pattern, the Scandinavian pattern, the East-Atlantic/Western Russian pattern, and the Polar/Eurasian pattern. The NAO alone is not sufficient for explaining the variability of cyclone counts in the North-Atlantic region and Western Europe. A seriality analysis of various climate forecast runs for the 21st Century reveals remarkable features that reflect predicted changes of atmospheric variability and storm-track activity.