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Frequency of synoptic-scale winter storms over western North America: decadal variability arising from the Pacific Decadal Oscillation

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Windstorms of synoptic scale, often related to extratropical cyclones, are meteorological phenomena of great importance also from a socio-economic perspective. Due to political, economic and social plans on the time scale of decades, a growing demand for reliable climate projections on the decadal scale has emerged. A basic requirement for this kind of medium-range climate projections is a better understanding of natural processes leading to variabilities on this time scale. A crucial role for these questions is played by the ocean-atmosphere interactions.

This study addresses the natural variability of winter storm frequency (*wsf*) over western North America (*WNA*) on decadal time scales by the means of a 506-year pre-industrial control run of the ECHAM5/MPI-OM1 AOGCM. Regarding a possible oceanic influence, the most important mode of variability in the Pacific, i.e. the *Pacific Decadal Oscillation* (PDO) has to be considered.

Distinct variability of *WNA-wsf* on all time scales is evident, while spectrum analysis reveals the decadal contribution to the total variance from interannual and lower frequencies to be in the order of 10-20%. After band pass filtering to eliminate other than decadal variabilities, principal component analysis of model SSTs yields the PDO as the first EOF, explaining 28.6% of the total decadal North Pacific SST variance.
It can be shown that *WNA-wsf* is significantly influenced by the PDO on decadal time scales experiencing increased (decreased) *wsf* during positive (negative) phases of the PDO. However, it has to be considered that this influence is sensitive to changes in the oceanic current system.
There is a significant overall correlation of 0.52 between the PDO times series and the decadal variability of *WNA-wsf*. Running 35y-correlations reveal that this connection is even stronger for great sub-periods within the model simulation, except for two distinct phases of approximately 50 years with almost no correlation.
The difference between the state of strong correlation between PDO and *WNA-wsf* and the state of weak correlation is to be found within the ocean, i.e. in the appearence of the PDO itself. During the phase of weak correlation compared to the usual state, the SST-anomalies of the Kuroshio Extension proceed further north and east into the Bering Sea and towards the Gulf of Alaska, which is assumed to be related to a stronger Kuroshio-Oyashio current system.