Motivation

- Why is there a marked decrease in the blocking frequency over the midlatitude North Atlantic from the periods 1960-1970 to 1980-1990? (Fig.1).
- Is there a relationship between the NAO and the blocking frequency?

Data and Methodology

- NCEP re-analysis 500 hPa height and 1000 hPa temperature data from January 1958 to December 1996 are used to define winter season DJFM.
- The NAO index is based on the first rotated (varimax) EOF of the 500 hPa heights.
- The objective blocking index as defined by Tibaldi and Molteni (1990) is used in this study.

Statistical Relationship

- The NAO index and the Atlantic blocking index are negatively correlated (cross correlation = -0.54, significant at 5% level).
- When the NAO is in the positive phase, the duration of blocking is mainly in the 5 to 6 day range. In the negative phase of the NAO, the mean duration is about 11 days.

Causal Relationship

- We adopt the Charney and DeVore's (1979) model to show the existence of two stable equilibrium states, a low-index flow and a high-index flow (Fig. 2), depending on the zonally asymmetric thermal forcing.
- The negative phase of the NAO (Fig. 3a) provides the thermal forcing (warm ocean/cold land) which acts in concert with topographic forcing to create an environment conducive for block formation. The positive phase of the NAO (Fig. 3b) provides thermal forcing (cold ocean/warm land) that reduces the resonance forcing of the topography, making block formation difficult.

Conceptual Model

- Based on our results, we propose a conceptual model in which these three components (the NAO, blocking and the thermal contrast between the land and the seas) are interrelated (Fig. 4).
- The phase of the NAO determines the land-sea temperature distribution over the North Atlantic and the adjacent landmass. This distribution in turn controls the nature of the atmospheric flow, which is either an amplified meridional wave-like flow (favourable for block formation), or a more zonally orientated, i.e. unfavourable for block formation.