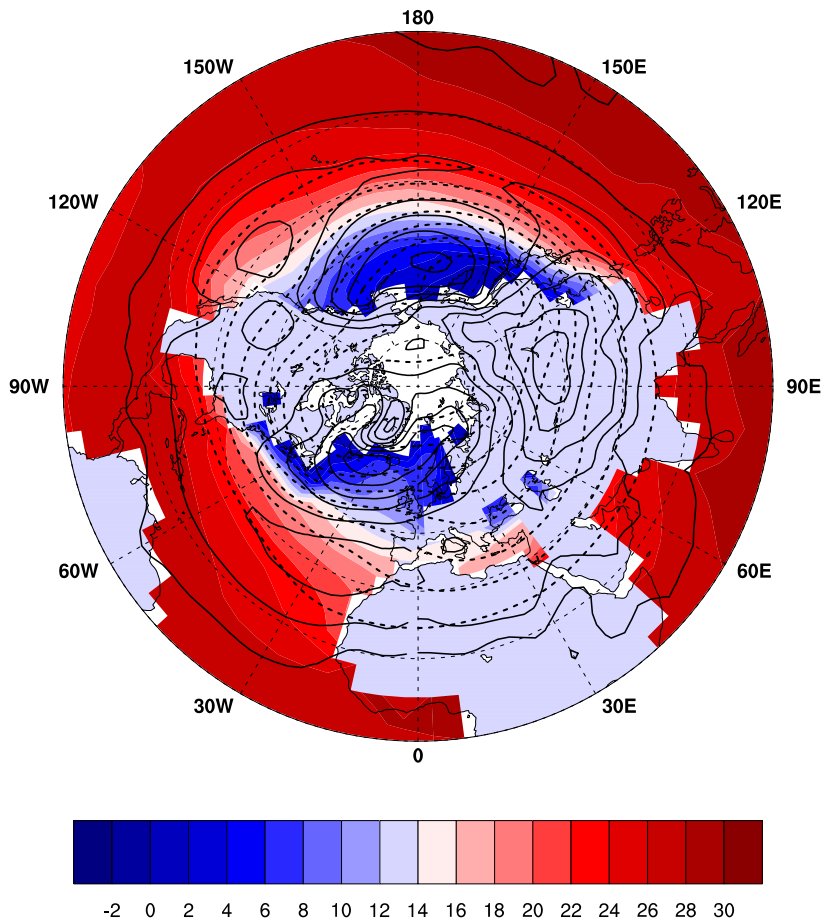


SIO 209 (Spring 2001)

Interannual to interdecadal extratropical coupled atmosphere–ocean variability

Background notes:

Winds are nearly geostrophic (balance between Coriolis and pressure gradient force) at large scales, especially above the surface where friction is weak. They travel nearly parallel to contours of pressure or geopotential height with lows to the left in the Northern Hemisphere. Winds are stronger when pressure/height contours are closer together. Counterclockwise flow is *cyclonic* and clockwise flow is *anticyclonic* in the Northern Hemisphere.



Shading: climatological DJF sea surface temperature (SST)

Solid: climatological DJF sea level pressure (SLP) every 4 mb

Dashed: climatological DJF 500-mb geopotential height (Z500) every 100 m

Climatological DJF SST pattern

Western boundary currents (Gulf Stream and Kuroshio) bring warm water to midlatitudes. These separate from eastern continental margins and create a region of strong SST gradient in western ocean basins. Interannual SST variability is greatest at the location of the climatological SST gradient.

Climatological DJF SLP pattern

Midlatitude oceans are dominated by the Aleutian and Icelandic Lows, and subtropical Highs are weak and located in eastern subtropical ocean basins. High pressure dominates midlatitude continents.

Climatological DJF Z500 pattern

The 500-mb level occurs at about the middle of the troposphere and is the *steering level* for *extratropical cyclones* (storms). Z500 decreases poleward and has the strongest gradient at midlatitudes, which is co-located with the SST gradient and the *storm track*. At midlatitudes, *troughs* in Z500 occur over western ocean basins and *ridges* occur over eastern ocean basins. Extratropical cyclones tend to be generated in western ocean basins due to the strong surface *baroclinicity* and land-ocean temperature contrast, travel eastward along the storm track, and decay in eastern ocean basins.

PNA pattern

The *Pacific/North America (PNA) pattern* is the dominant pattern of large-scale atmospheric variability over the Pacific basin and North America, occurring on time scales of several weeks to decades. It is an internal mode of the atmosphere but is responsive to tropical heating associated with ENSO. In the positive phase of the PNA, an anomalous low occurs over the central North Pacific, an anomalous high over western Canada, and an anomalous low over the southeastern U.S. The negative phase of the PNA is the opposite patterns of anomalous lows and highs. The climatological Z500 troughs and ridges are strengthened by positive phase PNA, whereas flow is more zonal (west-east) with negative phase PNA.

NAO pattern

The *North Atlantic Oscillation* is the dominant pattern of large-scale variability over the Atlantic basin and Europe, occurring on times scales of weeks to decades. It is an internal mode of the atmosphere, and it is currently an open question as to how responsive the NAO is to external forcing. The Icelandic Low and Azores High are stronger in the positive phase and weaker in the negative phase of the NAO.