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IMPACT OF ZONAL WIND CHANGES ON THE INSTABILITY RATES OF PLANETARY AND BAROCLINIC WAVES

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Arctic amplification and sea ice decline affect the meridional temperature gradient between the Equator and North Pole. Currently it is widely discussed whether this modification is enhancing or reducing planetary wave patterns and baroclinic extremes. Since the temperature gradient is the main driver of atmospheric circulation, its variation coincides with modified wind patterns in the northern hemisphere, especially in the mid-latitudes.

The impact of zonal wind changes on the instability and amplitude of planetary and baroclinic waves has been analysed using a spectral primitive equation model derived by a orthonormal basis of vertical structure functions and Hough functions.

Generally, the most unstable modes exist in the synoptic domain at wave numbers 6-8. These modes appear in the middle troposphere with a wave amplitude maximum at 40-50°N and are related to synoptic scale cyclones.

In this study, the focus is on the winter (DJF) zonal wind changes between 1979 and 2014. We sampled out periods with high and low wind phases all over the northern hemisphere and specific regions and computed the differences in the instability rates. One area includes 15-45°N, the subtropical jet stream, a second one 40-60°N, the area of the polar jet stream and a third and fourth one the Atlantic and Pacific sectors.

In periods with enhanced zonal wind, higher growth rates in the planetary scale have been observed. Increased growth rates also exist in the synoptic scale when the zonal wind between 0-45°N is strong, otherwise the synoptic scale is less sensible according to those selected regions. Further, the amplitude maxima in the synoptic and planetary scales increase and their meridional extension becomes smaller.