Middle and high latitude mesosphere and lower thermosphere mean winds and tides in response to Polar-night Jet Oscillations

J. Federico Conte[1], Jorge L. Chau[1], Dieter H. W. Peters[1]

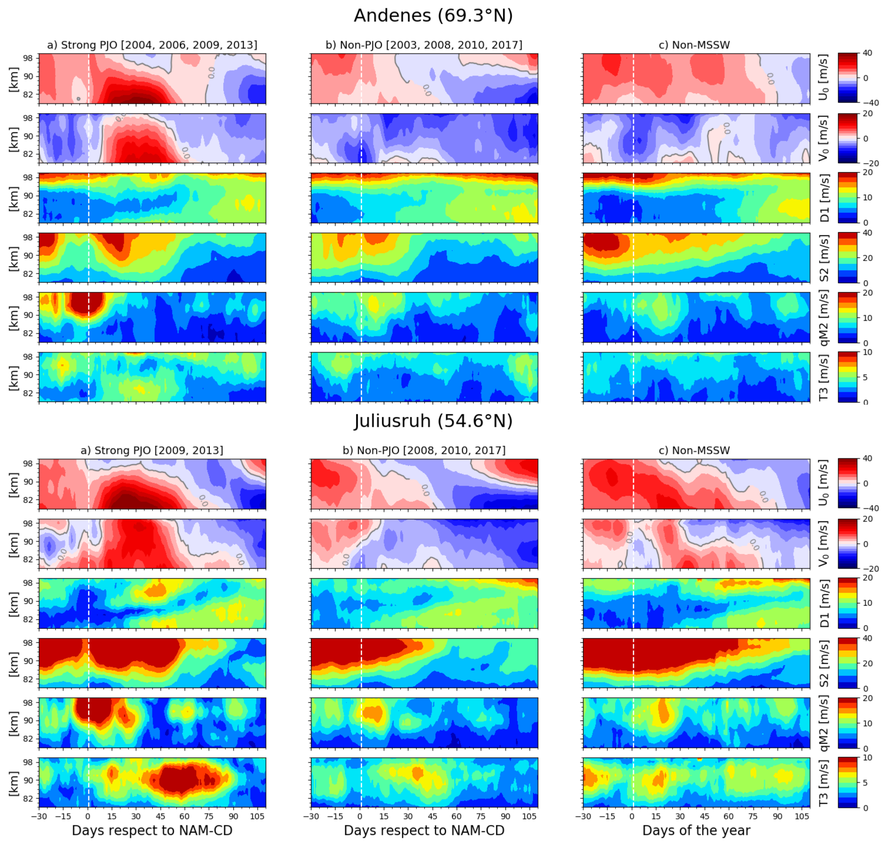
LEIBNIZ-INSTITUT FÜR ATMOSPHÄREN PHYSIK IAP

Leibniz-Gemeinschaft

DynamicEarth

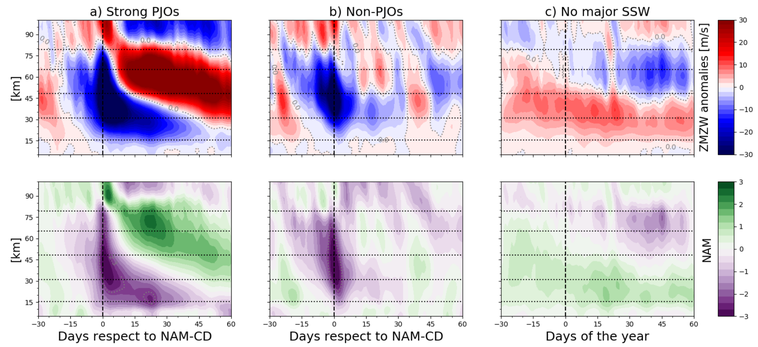
The mesosphere and lower thermosphere as seen by meteor radars

A great amount of studies have focused on the response of the mesosphere and lower thermosphere (MLT) to dynamically disturbed conditions, particularly to sudden stratospheric warming events. However, to the best of our recollection, the boreal MLT mean winds and tides obtained from meteor radar measurements have not been analyzed with respect to PJO events. We hypothesize that the mean winds and tides in the MLT region should exhibit clear and distinctive responses depending on the development or not of a strong PJO.



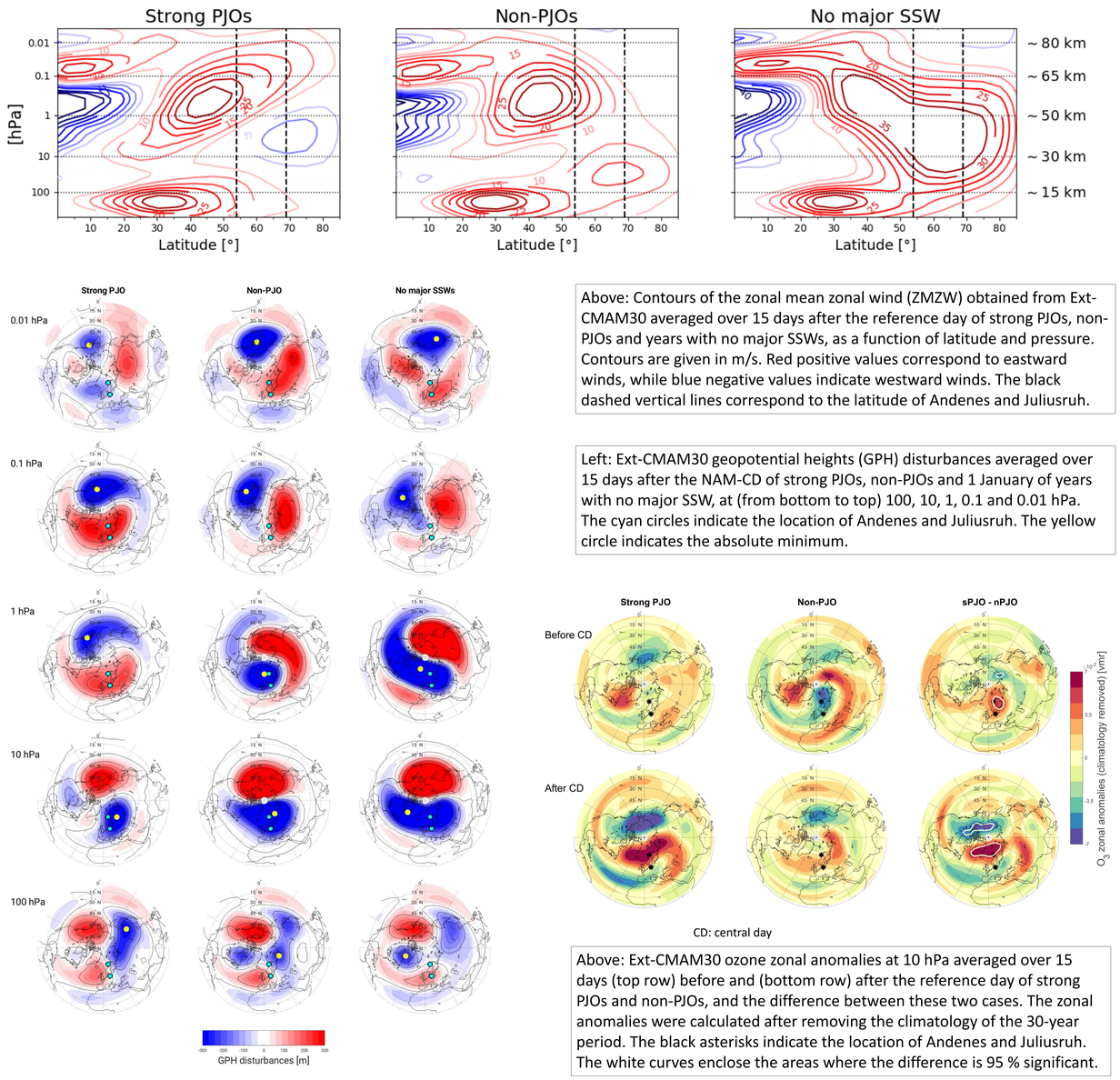
Composites of mean zonal (U_0) and meridional (V_0) winds, diurnal (D1) and semidiurnal solar (S2) tides, the semidiurnal quasi-lunar (qM2) tide and the terdiurnal solar tide (T3) over Northern Norway and Northern Germany, for (a) strong PJOs, (b) non-PJOs and (c) no major SSW (non-MSSW). The white dashed lines indicate the day of reference: northern annular mode central day (NAM-CD) in a) and b), and 1 January in c).

Stratosphere and mesosphere dynamics in the Ext-CMAM30 simulations



Zonal mean zonal wind (ZMZW) anomalies and northern annular mode (NAM) index obtained from the 30-year nudged simulation by the Extended CMAM. The black vertical dashed line indicates the NAM-CD in a) and b), and 1 January in c). The black dotted horizontal lines correspond approximately to 100, 10, 1, 0.1 and 0.01 hPa.

[1] Leibniz Institute of Atmospheric Physics at the University of Rostock, Kühlungsborn, Germany.



Above: Contours of the zonal mean zonal wind (ZMZW) obtained from Ext-CMAM30 averaged over 15 days after the reference day of strong PJOs, non-PJOs and years with no major SSWs, as a function of latitude and pressure. Contours are given in m/s. Red positive values correspond to eastward winds, while blue negative values indicate westward winds. The black dashed vertical lines correspond to the latitude of Andenes and Juliusruh.

Left: Ext-CMAM30 geopotential heights (GPH) disturbances averaged over 15 days after the NAM-CD of strong PJOs, non-PJOs and 1 January of years with no major SSW, at (from bottom to top) 100, 10, 1, 0.1 and 0.01 hPa. The cyan circles indicate the location of Andenes and Juliusruh. The yellow circle indicates the absolute minimum.

Above: Ext-CMAM30 ozone zonal anomalies at 10 hPa averaged over 15 days (top row) before and (bottom row) after the reference day of strong PJOs and non-PJOs, and the difference between these two cases. The zonal anomalies were calculated after removing the climatology of the 30-year period. The black asterisks indicate the location of Andenes and Juliusruh. The white curves enclose the areas where the difference is 95 % significant.

- **Categorization into strong PJO, non-PJO and non-MSSW is better suited to explain the wintertime variability of the MLT region.**
- **The strong eastward (northward) jet observed in the mean zonal (meridional) wind during strong PJO events depends on the location of the polar vortex at mesospheric heights.**
- **The S2 tide decrease/increase pattern around the NAM-CD of strong PJOs is a result of changes in the global distribution of ozone, and of changes in the mean zonal winds at mesospheric heights.**

References

- Conte, J. F., J. L. Chau, D. H. W. Peters (2019), Middle and high latitude mesosphere and lower thermosphere mean winds and tides in response to Polar-night Jet Oscillations, submitted to JGR Atmospheres.
- Peters, D. H. W., A. Schneidereit, A. Y. Karpechko (2018), Enhanced stratosphere/troposphere coupling during extreme warm stratospheric events with strong Polar-night jet Oscillation, Atmosphere, 9, 467, doi: 10.3390/atmos9120467.