North Atlantic Oscillations in total ozone detected by chemistry- climate model and reanalysis

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The North Atlantic Oscillation (NAO) is one of the most prominent relative pressure pattern changes in the North Atlantic Oceanic region over Azores Island, the west of Portugal (sub- tropical or Azores high) and over Iceland (sub-polar or Icelandic low) for all seasons. The positive and negative NAO phases represent stronger and weaker pressure differences between two regions respectively. These large-scale see-saw pressure changes have a massive impact on winter weather and climate patterns in Europe and North America and can extended further into northern Asia if NAO phases are prolonged. Local weather parameters such as temperature, rainfall, wind strength/direction and atmospheric trace compositions such as ozone (distributions and transport) are strongly influenced by the NAO phases.

To study the NAO modulated variability of total ozone (TOZ), we used the chemistry-climate model CHASER (MIROC-ESM) simulation and reanalysis (ECMWF ERA- Interim) TOZ for the period 1981-2010. We performed the EOF analysis of detrended pressure (to detect the NAO mode) and TOZ over the NAO region (80^{o} W- 40^{o} E & 20^{o} N - 80^{o} N) to examine the NAO modulated variability in TOZ. We found that the first and second dominant modes of EOF patterns (EOF-1, 57.9 % & EOF-2, 24.7 %) shows NAO modulated variability in TOZ and the second mode (EOF-2) clearly depicts the north-south dipole pattern of NAO in TOZ. We also performed some case studies to look into the NAO related TOZ variability using NAO Index from NOAA - CPC website (to identify the NAO phases) and TOZ anomalies from the model and reanalysis during the winter seasons (1981-2010). It is observed that the dipole pattern of TOZ anomalies (negative and positive) between sub-tropical and sub-polar regions are modulated by the strength of NAO phases. The correlation between TOZ and pressure over the NAO regions also shows the NAO dipole pattern with negative correlations over the subtropical region and positive correlations over the subpolar region during winter seasons. Thus, prior knowledge of forthcoming changes in the NAO can provide information about the northern hemispheric TOZ variability (including high latitude ozone depletion) in seasonal timescales and beyond.