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# Atmospheric emissions of N2O deduced from long-term observations at the Mediterranean Island of Lampedusa

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Nitrous oxide (N2O) is the third principal long-lived greenhouse gas (GHG) emitted by human activities, as it has been assessed by the last Intergovernmental Panel on Climate Change (IPCC) report. It is produced both naturally and anthropogenically. Natural sources include microbial processes of nitrification and denitrification in soils and water. Use of nitrate and ammonium fertilizers increased noteworthy the emission of N2O from soils. Other anthropogenic sources of N2O are fuel combustion and waste management activities. Its mixing ratio in the atmosphere has considerably risen during the past two centuries as demonstrated by analyses of polar ice cores.
Long-term observations of GHG atmospheric concentration are crucial in the investigation of global climate changes and are essential for the prediction of their future trends. For this reason a number of global monitoring studies aimed at determining trends and distribution in the tropospheric abundance of N2O and other GHGs have been carried out during the last years. Scarce information on the magnitude and distribution of N2O emissions is available in the Mediterranean area.
In this work we present and analyse long-term N2O records measured at the remote site of Lampedusa Island, located in the middle of the Mediterranean basin. Lampedusa is part of the majors GHG global monitoring programs such as the Global Atmosphere Watch (GAW), established by the World Meteorological Organization, and the National Oceanic and Atmospheric Administration (NOAA) networks.
Monitoring of the atmospheric mixing ratio of N2O has been started in Lampedusa in 1996 on a weekly basis but also continuous measurements have been carried out since October 2005. Weekly records are analyzed and the linear trend line has been used to evaluate the annual growth rate.
In agreement with data reported by the IPCC 4th Assessment Report, the mean N2O value recorded at Lampedusa in this period is 319.6$\pm$0.6 ppb. This finding remarks the representativeness of Lampedusa on global and regional scale. Atmospheric N2O levels have linearly risen at a growth rate of about 0.8 ppb yr-1 and reached in 2008 a mean mixing ratio of 322.5 ppb. Our data mirror the N2O pattern recorded at other global stations located in the Northern Hemisphere.
Constraining of source and sink distribution of N2O has been carried out through transport studies and backward trajectory analysis. Records of N2O have been combined with an airmass back-trajectory analysis with the aim to identify possible source regions that lead to elevated N2O mixing ratio at Lampedusa. Results have been compared with the European Environment Agency (EEA) emission database. Preliminary trajectory analysis results show high emissions from Western Europe that are confirmed by the EEA database and can be attributed to fossil fuel combustion and the enhanced microbial production caused by the expansion of the fertilized agricultural lands in this area. The contribution from Northern Africa and Eastern Europe seems to be very low. However N2O emissions from the marine geographical area (Atlantic Ocean and Mediterranean Sea) are elevated confirming the results of recent studies demonstrating that the North Atlantic Ocean is a considerable N2O source.