Geophysical Research Abstracts,
Vol. 11, EGU2009-4443, 2009
EGU General Assembly 2009

Application of SCIAMACHY satellite methane measurements to regional studies: the case of the Greater Area of Eastern Mediterranean

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The Greater Area of Eastern Mediterranean-GAEM [25^{o}N-50^{o}N, 5^{o}E-55^{o}E] is considered as a methane background area of the northern hemisphere with limited sources. Many studies have focused on geological formations such as mud volcanoes or geothermal systems which abound in the area constituting a more and more established methane source on a global scale. However, these and other studies in the region focus on specific spots rather than extended regions which has led to a "gap" in our knowledge about methane abundances and their spatial and temporal variability. In this work we present characteristics of methane loading over land in GAEM using dry air columnar data (XCH_4) retrieved from SCIAMACHY satellite instrument aboard ENVISAT with WFM-DOAS version 1.0 algorithm. The data used here have been produced using modelled CO_2 fields from the CarbonTracker assimilation system instead of a constant assumed CO_2 dry air column used for the standard WFM-DOAS version 1.0 product. The CarbonTracker corrected data are scaled by 0.01 in order to account for a 1% systematic low bias appearing on the corrected data. We defined the annual, seasonal and monthly patterns of methane by applying a combined spatiotemporal analysis for two separate years, 2003 and 2004. The annual mean XCH_4 levels over the study area were estimated to $\sim$1761$\pm$27 ppb for 2003 and $\sim$1758$\pm$26 ppb for 2004. A seasonal variability with a summer-autumn peak was observed for both 2003 and 2004, August being the month with the highest concentrations. The northeastern part of the area exhibits the highest XCH_4 values while the high elevation regions defined from the Triangle of eastern Turkey, the Persian Gulf and the Caspian Sea and the region of the eastern coast of Red Sea exhibit the lowest levels. Our analysis revealed that a latitudinal gradient was observed for the area during 2003 and 2004. The latitudinal analysis is used to examine the sensitivity of different areas in GAEM to seasonal changes. GAEM bristles with geological formations such as mud volcanoes being the same time highly seismogenic. The possibility of a strong earthquake triggering a series of mud volcanic eruptions and consequently inserting huge amounts of methane in the atmosphere cannot be excluded. The comparison of XCH_4 levels above the region around Lokbatan in eastern Azerbaijan (world's biggest mud volcanoes and densest mud volcano population) and the area around the southern part of the eastern Carpathians foredeep in Romania (Europe's largest mud volcanoes) with modeled methane columnar concentrations for different mud volcano eruption scenarios revealed that not any significant eruption was captured from SCIAMACHY within 2003 or 2004.