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Dynamics of gaseous elemental mercury during polar spring and winter

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Since June 2001 the long-term monitoring of the gaseous elemental mercury (thereafter, mercury) in the surface layer of the atmospheric has been conducted near the Amderma settlement (69,72Ð¾N; 61,62°E; Yugor Peninsula, Russia).

During this monitoring, variations of the lowered mercury concentrations (<1.0 ng m^{-3}) were observed for spring (March–May) period in 2005 and 2011. For spring 2005, the intensity of the solar radiation did not affect the number of low values of mercury concentrations. With an increase of solar activity during the day there was a reverse effect: i.e. from 9 until 15 h the number of lowered values of concentration decreased. For the evening hours, the highest number of lowered concentrations and atmospheric mercury depletion events, AMDEs (12 events) were observed. For 2005, upon reaching a daily high solar activity the processes of mercury depletion were not observed. It could be because lacking of a large number of marine aerosols in the atmospheric surface layer, although the processes of photochemical reactions did not stop. For spring 2011, during increased solar activity the number of AMDEs increased to 62 events. However, there was no ice cover observed in the coastal area, and consequently, large amounts of sea aerosol could be presented in the surface layer of the atmosphere.

For the winter (December-January) period, the maximum number (in total, 495) of lowered values of mercury concentration and AMDEs (32 events) were recorded in 2010–2011. Such situation was previously observed only in winter of 2006–2007 (13 events). As there is no direct sunlight in mentioned period, the removal of mercury from the atmosphere may be caused by combination of physical and chemical processes that are not related to photochemistry. Starting mid-January, although duration of the day increases, but solar energy is not enough to activate photochemical reactions and predominant type of solar radiation is diffuse rather than direct one. However, AMDEs were still reported at that time (18 events were registered in January 2011).

After mid-March, the angle of sun's declination increases and the incoming solar energy is sufficient to activate photochemistry. However, during March–May there was no linear relationship identified for AMDEs. The maximum number (300) of lowered values of mercury concentration and AMDEs (21 events, with duration up to 66 hours) were registered in April. Such

AMDEs are connected with presence of elevated concentrations of aerosols in the absence of ice cover in the marine coastal zone. Not excluded a possibility of contribution of anthropogenic aerosols (from burning of fossil fuels) in the process of mercury deposition from the atmosphere on the underlying surface.