

SPARC SOLARIS & HEPPA: Direct and indirect effects of high energetic particle precipitation on middle atmospheric composition as observed by the Odin Sub-Millimetre Radiometer

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The Sub-Millimetre Radiometer (SMR) on board the Odin satellite, launched in 2001, is a limb emission sounder measuring trace gases in the stratosphere, mesosphere, and lower thermosphere. The Odin target species water vapour (H₂O) and carbon monoxide (CO) are relatively long-lived and their spatio-temporal distribution is strongly influenced by the global meridional circulation. The measurements provide information on the variability of large-scale transport during polar winter, allowing to study for example enhanced downward transport from the mesosphere into the stratosphere in the aftermath of major stratospheric warming events as well as upward transport occurring during winter in the polar lower thermosphere. Shorter lived species measured by Odin are directly affected by the precipitation of high energetic particles. Nitric oxide (NO) is formed in the thermosphere when N₂ is dissociated by solar radiation and through energy from particle precipitation (e.g. auroral activity). During polar night downward transported NO_x contributes to the NO_y budget in the mesosphere and stratosphere. Enhanced NO_x can be slowly converted to longer-lived nitric acid (HNO₃) involving heterogeneous chemistry on stratospheric aerosol or water ion cluster surfaces during polar winter in the mid-stratosphere. Besides indirect effects requiring transport, also direct effects of high energetic particle precipitation have been observed. Odin is a Swedish-led satellite project funded jointly by Sweden (SNSB), Canada (CSA), Finland (TEKES), and France (CNES), with support by the 3rd party mission programme of the European Space Agency (ESA).