Geophysical Research Abstracts
Vol. 12, EGU2010-9587, 2010
EGU General Assembly 2010

Long term variability of cosmogenic and terrigenous radionuclides observed in the coastal Antarctica troposphere

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We report on quasi-continuous radionuclides records obtained at the German Antarctic Neumayer station since 1983 co-registered with ionic aerosol components and accompanied by continuous observations of various atmospheric species (including radiocarbon and radon). Emphasis will be on the cosmogenic ^{7}Be and ^{10}Be mainly produced in the lower stratosphere as contrasted to ^{210}Pb (a long lived decay product of the noble gas ^{222}Rn which is mainly emitted from continental surfaces). Different to the various chemical aerosol components, the spatio-temporal source distributions are relatively well known for these radionuclides (carried by the sub-micron aerosol fraction). Thus, particularly in combination, they may constitute unique tracers for studying the meridional long range transport to Antarctica as well as the stratosphere/troposphere air mass exchange. Time series analysis aimed at establishing the climatology of these Antarctic records (as potentially deployed for respective atmospheric transport model validation and retrospective ice core studies) revealed:

- regular seasonal cycles of the cosmogenic and terrigenous radionuclides, both, broadly peaking in the austral summer half year. Particularly based on the ^{10}Be/^{7}Be ratio this finding allowed for simple quantification of the respective seasonal change in the relative influence of stratospheric or high tropospheric air masses seen at ground level.
- decadal variation of the Be isotopes clearly related to their 11-years production signal and, for ^{210}Pb a periodicity of around 4 years potentially associated with the Antarctic Oscillation index.
- relatively weak long term trends of both radionuclide categories which are barely significant over the observational period.

Implications of these formal findings are mainly discussed in view of the transport properties of (short lived) atmospheric constituents to Antarctica, either from northward continents or from the lower stratosphere. In backing up this attempt decadal scale runs of a global 28-box model are presented as well as related Neumayer records (including among others ^{222}Rn and major chemical aerosol components).