The yearly and seasonal variations from 7year data set of daily cosmogenic nuclide Be-7 concentrations in the atmosphere

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Motivation

We have been studying the relationship between the cosmogenic nuclides and solar activities.

Topics

- Daily profile of Be-7 concentrations in the atmosphere for 7 years from 2000 at Yamagata(38.3° N), Japan.
- Comparison among the yearly profiles of which are the Be-7 concentrations, the Sunspot Number (SSN) and the neutrons
- A relationship between the seasonal variation of Be-7 and the yearly profile of SSN
- A response of the daily Be-7 concentrations to the 27days periodic variation of SSN

Solar modulation of cosmic rays



The energy spectrum of primary protons

modulated by solar activities, really?

Cosmogenic nuclide Be-7

Production

¹⁴N(n,x)⁷Be
¹⁴N(p,x)⁷Be
¹⁶O(n,x)⁷Be
¹⁶O(p,x)⁷Be
⁴⁰Ar(n,x)⁷Be
⁴⁰Ar(p,x)⁷Be



Aerosols with Be-7 fall down to the ground.

We collect the aerosols and measure the radioactivity of Be-7.

Vector
7Be

0.4776
10.3%(EC)

Gamma ray: 477 keV

7Li

Collection and Measurement of Be-7 in the air





Collected filter •Glass fiber filter collection efficiency : 99.99% (\$\overline 0.3 \mum particle)

High Volume Air Sampler (HV-100F)

Collection: Daily from 2000
Location: Yamagata(38.3° N), Japan
Intake rate: 1000 L/min
Collection time: 23 hours/day

Measurement time : 6 hours

detection efficiency	2.68%
resolution @1.33MeV	1.69keV



HPGe detector

Daily profile of Be-7 concentration for 7 years



- 1. The daily Be-7 is very variable and complex.
- 2. The seasonal variation
- 3. gradually increasing



Rate of variability between Max and Min Be-7: 60 % SSN: -87% neutron: 6.7%



Periodic analysis by Wavelet for 7-year daily data sets

- The SSN indicates a periodic variation of 27 days corresponding to the rotation period of the sun.
- 2) The spectrum Be-7 at 2006 is different from the others.
- The spectrum of Be-7 at the several portions correspond to that of the 27days periodic variation of the SSN except at 2006.



Summary

- We have been continuously observing the daily Be-7 concentration at Yamagata, Japan for 7 years since 2000.
- The rate of variability of Be-7 concentrations and sunspot number in yearly data are 60% and -87%, respectively.
- The seasonal variation of Be-7 concentration in the fall is strongly anti-correlated to the variation of the sunspot number.