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Atmospheric electrical conductivity measured at the summit of Mt. Fuji and in Tokyo

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It has been proposed that climate could be affected by changes in cloudiness caused by variations in the intensity of galactic cosmic rays in the atmosphere. The cause of it is considered as a new particle formation with ion induced nucleation. The ion induced nucleation is occurred under the low concentration of particles and high concentration of ions, but there are a few reports. Then we observed small ions, aerosol size distributions, radon concentrations, and intensity of cosmic rays at the summit of Mt. Fui simultaneously. We also observed the similar elements at Kagurazaka in Tokyo. We compared these results with the passed values.

Observation periods were from 29th July to 25th August 2100 at the summit and from 30th October to 31st December 2010 at Kagurazaka, respectively. Small ions were measured with the Gerdien type meter (COM-3400). The critical mobility was set 0.7 $cm^2/V/s$ and we measured positive and negative ions alternately. Size distributions from 4.4 nm to 5000 nm in diameter were measured with a scanning mobility particle sizer (SMPS, TSI 3936N25 or 3936L22) and an optical particle counter (OPC, RION KR12 or KC01C). Radon concentration was obtained radioactive aerosols collected on a filter.

Small ions are generated with ionization of air by cosmic rays or radiation from radon. Small ions are lost by various mechanisms such as ion-ion recombination and ion-aerosol attachment.

$$dn/dt = q - an^2 - bnN$$

where n : small ion concentration, N : aerosol concentration, q : ion pair production (ionization rate), a : recombination coefficient, b : attachment coefficient. As the second term can be neglected because of small n compared with N in large city, dn/dt goes to q - bnN. Under the equilibrium conditions, the left-hand side is zero, q = bnN. If q is constant, n is inversely proportional to N. However, aerosol concentration is low and the ionization rate by cosmic ray is high in mountain atmosphere. Conductivity L is obtained by the equation:

$L = enk$ with $k = 1.3\ cm^2/V/s$.

The average value of conductivity at the summit was a third of the value measured by Sekikawa (1960), on the other hand, the average value at Kagurazaka showed nearly same value as the value measured by Tuge (1996). Hourly averaged values showed often the diurnal pattern, high in the early morning and low in the evening. There was inversely good correlation between conductivity and particle concentration at Kagurazaka and also weak correlation at the summit. There was no correlation between conductivity and radon concentration. The possibility of ion induced nucleation was observed once.

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References

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