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A numerical study of effect of cloud properties on climate

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It has been pointed out that the colder climate during the Mounder Minimum was associated with lower solar activity and the smaller number of sunspots. The intensity of galactic cosmic ray into the terrestrial atmosphere increases when the solar activity is low. While it is not understood clearly yet, the cosmic ray intensity may change cloud properties such as liquid water content, droplets' mode radii, amount and height. The changes in these may have impact on climate. In order to investigate the effect of cloud properties on climate, we have conducted numerical simulations of a vertically one-dimensional radiative-convective balance model (RCBM) and a three-dimensional atmosphere-ocean coupled general circulation model (CGCM). Various cloud properties were changed in RCBM experiments. Macroscopic cloud properties, such as amount and height, have larger effect on climate than microscopic properties, such as liquid water content and droplets' mode radii. The cloud droplets' mode radii were changed in CGCM experiments. In the control run, the radii were 1.0 μm and 1.5 μm for liquid and solid water droplets, respectively. The radii were halved and doubled for the half run and double run. Even though the RCBM results showed smaller effect of microscopic properties than macroscopic ones, the change in radii resulted in decrease and increase of global averaged surface air temperatures by about three degrees for the half and double runs, respectively, within about eight years. Recent argument of near past and future climate changes due to fluctuations in the intensity of galactic cosmic ray will be discussed in the presentation.