“Terra-Astronomy”: multi-disciplinary studies with Antarctic Ice cores and Numerical Simulations

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In the proposals of large-scale science plans by research communites for submission to the Master Plan 2020 of the Science Council of Japan, the support of neighboring scientific fields may play a key role in obtaining a high rank in the selection process among the many other large-scale plans proposed. “Terra-Astronomy” is a new multi-disciplinary and even trans-disciplinary area, including astronomy, astrophysics, cosmic-ray sciences, as well as climatic science: it is the study of the relationships between the Universe and Earth from an anthropological viewpoint. We use terrestrial archives (historical written and oral records, as well as radioisotopes observed in ice cores, deep-sea sediments and tree rings) to study the effects on Earth of variable solar activity and nearby stellar explosions. These variations in long-term high-energy solar irradiance and high-energy space events all deposit energy into the atmosphere; they affect the chemical composition of the atmosphere, and can therefore change the climate and even the biological environment on our Earth: the point is to consider “Terra (planet Earth)” as an integral part of the Universe.

In research communities in Japan, studies related to such a new area using Antarctic ice cores have been developed over the past 10 years. In particular, snow and ice cores recovered from the area around the Dome Fuji station, located in an inland site in East Antarctica, have a great advantage in the promotion of these kinds of studies. This is because of the environmental location: samples taken from the Dome Fuji area preserve information from the stratosphere, where high-energy emissions from the Universe have most effect.

In this presentation, we will briefly introduce the international trends in Terra-Astronomy, and present our results using Antarctic ice cores and numerical simulations to demonstrate relationships between the Universe and Earth. Promoting future ice core studies in Japan can lead the way in this new area internationally, reflecting the significant advantages of Dome Fuji snow and ice cores. We might also mention our developing ice-core laser-melting method that meets the demands for high temporal resolution in the investigation of astronomical events using ice cores.