

東南極の気候変動の検出と解明に向けた長期観測

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Long-term field experiment for detection and study of climate change in East Antarctica

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This presentation will make a brief review on the climatic change in Antarctica during the last decades and discuss important observation to understand the mechanism of the present situation of Antarctica and the future trajectory.

The observational results have clearly indicated that West Antarctica has been warmed up since the middle of the last century, which is one of the areas with the highest warming rate in the warming world (e.g. Steig et al., 2009; Bromwich et al., 2013). On the other hand, it is the scientific consensus that clear temporal tendency in surface temperature of East Antarctica is not detected. The mechanism of suppression of surface warming of East Antarctica has not been understood yet.

If we see the tropospheric temperature for the last several decades, the scientific discussion on the temporal change has not been done sufficiently mainly due to limitation in observation. Thompson and Solomon (2002, Science) showed stratospheric cooling tendency mainly responding to ozone hole growth for 1969 to 1998. It has been reflected in deepening of the polar vortex in the stratosphere. They also indicated the possibility in the reflection in the tropospheric polar vortex as well. Consequently, it has suppressed surface warming in the Antarctic region, which is a candidate of the mechanism.

However, if we see their figure 1 carefully, tropospheric warming tendency is rather dominant through year for the same decades, the situation of which is inconsistent with the strengthening tendency of the tropospheric polar vortex. Turner et al. (2006, Science) also showed the tropospheric warming tendency. These discussion is based upon very limited data, in particular, radiosonde observation has been operated at the coast of Antarctica, except for the South Pole station. So, at first, we should make effort to operate radiosonde with surface meteorological observation at interior station of Antarctica to confirm that the tropospheric warming tendency is robust feature above whole the Antarctic ice sheet or not.

In the last decade, some remarkable topics were observed in Droning Maud Land. One of the top issues is the extreme accumulation on the lower slope of the ice sheet at 2009 (Boening et al., 2006). The Japanese snow stakes data along the traverse route from Syowa station to Dome Fuji station also captured the same feature. Another issue is a warming event in 2012/13 summer, which would induce surface melting at higher elevated slope of the ice sheet than in normal summer. This warming event was intense one since 1970s for Syowa station, namely, which is a kind of extreme phenomenon (Hirasawa et al., 2014). Increment in precipitation and extreme phenomena are the typical features emerged in the global warming, and thus, we should pay attention to the data from East Antarctica in climatological sense.

From the view point mentioned above, the purpose of this project are 1) detecting ongoing climatic changes in East Antarctica, 2) specifying the mechanisms together with the relevant processes, and 3) indicating possible trajectories of the detected changes from past to future, focusing on 1) transportation of heat, moisture and aerosols in atmosphere and exchange of those at the surface, paying attention to diurnal variation of boundary layer and katabatic wind circulation in summer and 2) contribution of radiative process forced by clouds, aerosols, moisture, and snow property to change in the surface heating and moisture budget.

In order to achieve the purposes, in-situ observation will be carried out with 1) radiosonde, tethered balloon, UAV (unmanned aerial vehicle) and ground-based remote sensing at key stations for obtaining atmospheric circulation and the property such as water vapor, aerosols and clouds and 2) traverse around Droning Maud Land and installing AWS (Automatic Weather Station) for obtaining accumulation, snow samples, snow property data (grain size, impurity), surface-air property data (aerosols, water vapor and its stable isotopes) etc. Satellite data and numerical models are important for this project.