Global Atmospheric System Probed by Close Observations of Antarctic Atmosphere

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A major issue in climate models used to predict future climate including global warming is how to incorporate the effects of relatively small-scale atmospheric waves called atmospheric gravity waves (GWs) having horizontal wavelengths from 10 to 1000 km. In this project, the PANSY radar, a large atmospheric radar capable of observing wind velocity fluctuations associated with atmospheric gravity waves over Syowa Station in unprecedented detail, will be combined with various observation instruments that use radio waves and light to measure temperature and material distribution. The goal is to clarify the role of atmospheric gravity waves in the large-scale dynamical variablity in the atmospheric system including general circulation and interhemispheric coupling.

We are leading an international joint research project, Interhemispheric Coupling Study by Observations and Modelling (ICSOM), which targets an interesting interhemispheric coupling (IHC) discovered in the late 2020: when warming occurs in the winter polar stratosphere, the upper mesosphere in the summer hemisphere also becomes warmer with a time lag of days. This IHC phenomenon is considered to be a coupling through the processes in the middle atmosphere, i.e., the stratosphere, mesosphere, and lower thermosphere. Several plausible mechanisms have been proposed so far, but still controversial. This is mainly because of the difficulty in studying GWs having small scales which are hard to be observed and simulated, regardless of their important role in the middle atmosphere dynamics. In this project, by networking sparsely but globally distributed radars including the PANSY radar and MF radar at Syowa Station, mesospheric GWs have been simultaneously observed in seven boreal winters since 2015/16. We have succeeded in capturing five stratospheric sudden warming events and two polar vortex intensification events. This project also includes the development of a new data assimilation system to generate long-term reanalysis data for the whole middle atmosphere, and the simulations by a state-of-art GW-permitting general circulation model using the reanalysis data as initial values. By analyzing data from these observations, data assimilation, and model simulation, comprehensive studies are ongoing to elucidate the mechanism of IHC. In this talk, we will show the overview and progress of ICSOM.

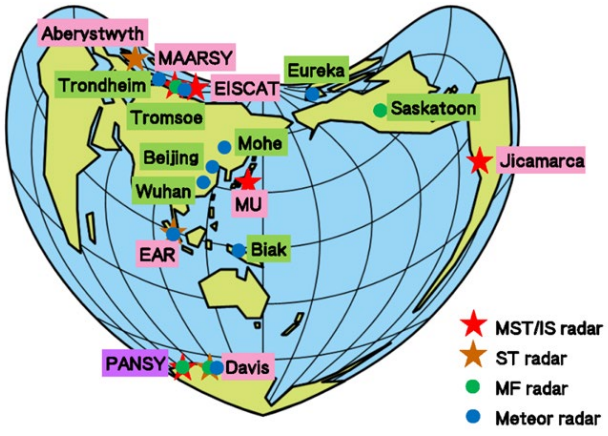

Figure 1. ICSOM radar network.

References

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