Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)
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ACG09-10 Room:301B Time:May 27 11:45-12:00

Conceptual idea for future space-borne Doppler wind lidar

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Weather affects on our daily life and provides us keys for understanding daily and/or seasonal variations, spatial variations, and climate change. Climate change has many impacts on atmosphere, biosphere, hydrosphere and so on. Climate change causes severe weather disasters such as heavy rain, strong and large typhoon, strong wind, and so on. Recently, the weather disasters are becoming more serious in many parts of the world. We live in the world dangerer than before due to weather disasters or climate change. In order to understand the global climate and to reduce the weather disasters, global numerical simulation plays a very important role. Wind is one of key meteorological elements to physical describe the global numerical simulation. Three-dimensional global wind is important to significantly improve the initial conditions for the numerical weather prediction and essential for operational weather forecast at both synoptic and regional scale. GPS-radiosonde and wind profiler radar can provide vertical wind profile. The GPS-radiosonde network is the main source of global three-dimensional wind. However, the GPS-radiosonde network is mainly on land. Weather stations on oceans and remote land areas are very sparsely distributed. Single-layer wind measurement is made by aircraft and by tracking atmosphere (water vapor or cloud) or detecting microwave backscattered from near sea-surface from space (e.g. Quickscat, MTEOSAT, MTSAT). A global observation system is urgently needed to obtain three-dimensional distribution of wind. In Japan, National Institute of Information and Communications Technology (NICT) has been studying 2-μm laser technologies and optical heterodyne detection techniques for the space-borne coherent Doppler wind lidar. NICT developed a ground-based 2-μm coherent lidar for wind and CO_2 measurements. NICT made experimental wind measurements with Tohoku University, Meteorological Research Institute, and other universities and research institute. In 2011, NICT, Tohoku University, the University of Tokyo, Meteorological Research Institute, and Japan Aerospace Exploration Agency organized a working group on future space-borne Doppler wind lidar. The working group summarized the current status of lidar technologies and scientific purposes for future space-borne Doppler wind lidar in March, 2012. The working group conducts studies on feasibility based on the summary: space-borne lidar technology, impact assessment of future space-borne lidar, and innovative space technology. In this paper, we describe the future space-borne Doppler wind lidar for the global wind measurement.

Keywords: Lidar, Space-bonre, Global three-dimensional wind, Wind measurement, Numerical Weather Prediction, Climate model