3D imaging observations of atmospheric turbulence layers with the MU radar imaging observation system

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Atmospheric turbulences have been studied by the MU radar standard observation mode, which shows time-height variations of turbulences with resolutions of about 1 minute and 150 m altitude. In 2004, the MU Radar Imaging Observations System has been installed to the MU radar, which allows to us make simultaneous observations of SDI (Spatial Domain Interferometry) and FII (Frequency Interferometry Imaging) techniques with much better range-angular resolutions [1].

We conducted the SDI/FII simultaneous observations on 13th November 2005. The data were first analyzed with each of SDI and FII with the Capon method. FII analyses showed that there are many thin turbulence layers within 1 range (150 m), which can not be detected by the normal standard observation mode. SDI analyses showed that several thin turbulences have some tilts, and these tilts varied in time in a few minutes like a wave, which indicated that these turbulences was not a flat plane but had wave-like structures. We then expanded the data analysis to use the three-dimensional imaging technique. Example of the analysis is shown in Figure 1. We found a scattering layer that has thickness of less than the range resolution (Figure 1, left panel). Scattering positions revealed from the three-dimensional analysis showed that, in time, center positions of the echoes moved from west-northwest to east southeast within the range of 150 m thick. That indicates that there are some angular distributions of turbulences within 1 range, in addition, we found some turbulences motion along background wind. The features were not well detected by conventional SDI and FII techniques.

These results show that simultaneous observation of SDI and FII techniques with the MU radar new system can detect detail information of three-dimensional strictures of atmospheric turbulences including their time variations with much better height-angular resolutions than normal standard observation mode.

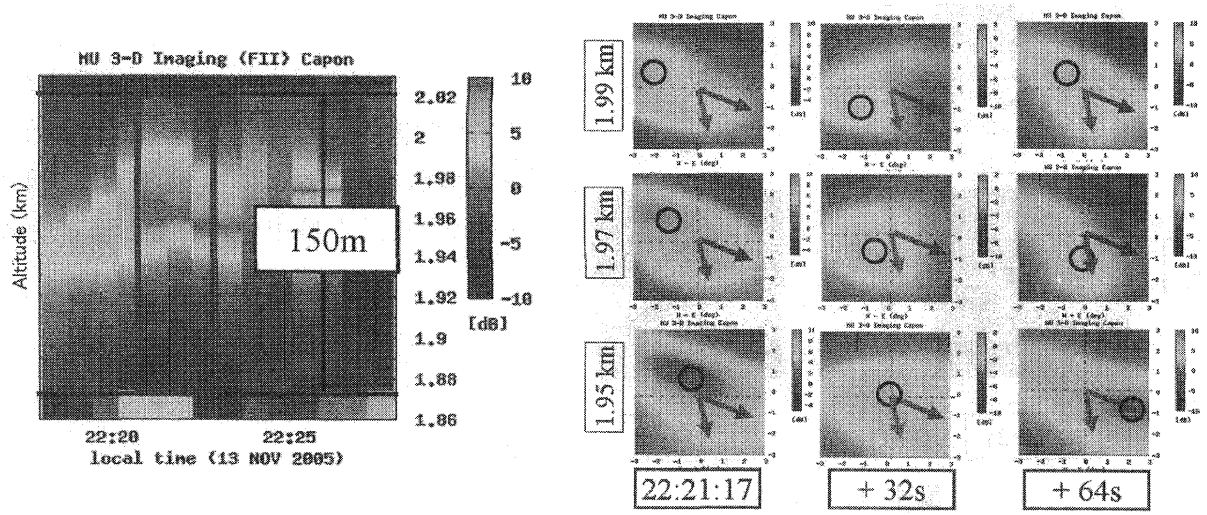

Figure 1: Result form three-dimensional radar imaging. Time-height distribution of echo power within one range gate of 150 m thick (left panel). Angler distribution of echo power at 22:21:17 LT and after at 1.95 km, 1.97 km, and 1.99 km (right panel). In each panel circles denote center position of the echoes, and two angles show directions of wind velocity (east-southeastward) and wind shear (south-southeastward), respectively.

REFERENCES

[1] Luce, H., G. Hassenpfulug, M. Yamamoto and Fukao, S., High-resolution vertical imaging of the troposphere and lower stratosphere using the new MU radar system, *Ann. Geophys.*, 24, 791—805, 2006.