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A study on development of statistical analysis system for variations of atmospheric environment

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Integrated data analysis of various observations is important to understand the atmospheric environment, which requires cross-reference of data-base archived at different institutes. The Inter-university Upper atmosphere Global Observation NETwork (IUGONET) project has been conducted in FY 2009-2014 in order to enhance data exchange among the Japanese universities and research institutes. This project aims at establishing a meta-database system for ground-based observations as well as the data analysis software (UDAS). This thesis is concerned with development of the statistical analysis system as a part of UDAS, consisting of five functions as follows:
(1) A test for the difference in the mean values between the two data distributions.
(2) Cross-correlation coefficient and a test for non-correlation.
(3) Analysis of coherence and phase for each frequency component.
(4) S(Stockwell) transform analysis : Temporal variations of spectral density and dominant frequency for transient phenomena.
(5) Trend test for the slope of a linear regression.
Because the sampling interval of observations is not always constant and missing data are sometimes included, a linear interpolation is adopted on the data before applying the statistical analysis system.
We applied this analysis system for the two meteor radars in Indonesia. The same radar systems are operated on the equator in west Sumatra and west Papua, Indonesia in 2003-2013. These data-sets are unique and useful to study longitude variations of the wind fields.First, we tested the altitude distribution of meteor echoes, and found no difference in the mean altitude, but a slight long-term trend. Frequency spectrum indicated that the quasi-two day wave is dominant at 90 km altitude for the meridional wind component, where the long-term envelope of the wave amplitudes correlated well between the two radars. This statistical analysis system can clarify trends and variations of atmospheric conditions. Therefore, it is expected to advance our understanding on the global changes as well as the effects of solar activities on the lining environment.

Keywords: IUGONET, analysis software, statistical test, frequency analysis, trend test, meteor radar