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Improvement of the method for estimating thermospheric temperature using small FPIs and evaluation of their temperatures

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Fabry-Perot interferometer (FPI) is an instrument that can measure the temperature and wind velocity of the thermosphere from the ground through observation of airglow emission at a wavelength of 630.0nm. The Solar-Terrestrial Environment Laboratory (STEL), Nagoya University, has five FPIs as parts of the Optical Mesosphere Thermosphere Imagers. Two of those FPIs, possessing a large aperture etalon (diameter: 116mm), were installed at Shigaraki, Japan in 2000 and in Tromso, Norway, in 2009. The other three small FPIs, using 70-mm diameter etalons, were installed in Thailand, Indonesia, and Australia in 2010-2011. They use highly-sensitive cooled-CCD cameras with 1024-1024 pixels to obtain interference fringes. However, appropriate temperature has not been obtained from the interference fringes using these new small-aperture FPIs. In the present study we aimed to improve the procedure of temperature derivation using these small etalon FPIs, to evaluate the accuracy for obtained temperatures and to perform statistical analysis of the temperature data obtained for 2-3 years.

The FPIs scan the sky in north, south, east, and west directions repeatedly by rotating a light receiving mirror. We determined each center of the laser fringe and sky fringes for north, south, east, and west directions. Then we found that they are slightly a few pixels different depending on the mirror directions. This difference of fringe centers seems to be due to distortion of the optics body, which is caused by the motion of the heavy scanning mirror on top of the optics. Thus, we decided to determine the fringe center for each direction. After this revision, we could make a reliable temperature determination. In this presentation, we show these procedures of temperature derivation and relation between airglow intensity and standard deviations of obtained temperatures as accuracy of temperature derivation. We also discuss effects of the etalon gap drift due to changes in etalon temperature for accuracy of measured thermospheric temperatures and winds.

Keywords: Fabry Perot Interferometers, thermospheric temperature