Change in radial distribution of Io plasma torus and Jupiter's aurora activity during Io's volcanic active period in 2015

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Long term and continuous observations of Io plasma torus in the spring of 2015 with HISAKI have revealed responses of the plasma torus to volcanic activity change at the satellite Io. The HISAKI observation shows that brightness of singly ionized sulfur and oxygen due to electron impact excitation increased from DOY 20 to 40 in 2015. Doubly ionized sulfur began to increase several days after the singly ionized ion and reached a maximum around DOY 60. The intensities of these ions kept intense until DOY 70. The singly charged sulfur showed two-step decreased on DOY 70 and 90. The singly ionized oxygen and doubly ionized sulfur begins to decrease on DOY 90. The ion intensities returned to the usual level by DOY 120. These behaviors show response of the plasma torus to the change in neutral source from Io. To evaluate mass supply rate from inner to middle magnetospheres, radial gradient of emission intensity was derived from spatially resolved HISAKI data set. It is proportional to radial gradient of ion flux tube content and could be a qualitative proxy of the mass supply rate. The radial gradient at 8.5 Jovian radii from Jupiter suggested that the mass loading rate increased from DOY 40 to 80. During this period unusually strong transient enhancements of Jovian aurora were observed by HISAKI. Time interval between enhancements was a few days, which is consistent with quasi-periodic substom-like event identified by the Galileo spacecraft. Several hours after the aurora enhancement, short-live brightening was also identified in the Io plasma torus. After DOY 90 when the radial gradient almost returned to the value before the volcanic enhancement, the sporadic aurora events were still observed until DOY 110 but they did not accompany the plasma torus brightening. Transport of hot electron population to the inner magnetosphere with density depleted interchange flux tube is one of possible mechanisms to explain the HISAKI observation.