Variation characteristics of Jupiter's radio emissions during the HISAKI Jupiter observation campaign in 2015

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ABSTRACT

Around Jupiter's oppositions to the earth in 2014 and 2015, remote observations for Jupiter had been made continuously by the HISAKI satellite. In particular in the 2015 campaign period, sudden enhancement of Iogenic gas and plasma emissions occurred in the middle of Jan. and the enhancement had lasted for more than two months (Yoneda et al., Icarus, 2015 etc.). Kronberg et al. (JGR, 2007) proposed a conceptual model for periodic magnetospheric variations by assuming that magnetospheric reconfigurations are caused by ion mass loading from the internal plasma sources. This proposal implies that enhancement of Iogenic plasma enhances internal magnetic variations. On the other hand, Shay and Swisdak (PRL, 2004) indicated that magnetotail reconnection rate is reduced when heavy ions (O^+) are contained larger. The observed long term Iogenic plasma enhancement phenomena therefore would give an important opportunity to investigate how magnetospheric activities respond to the Iogenic plasma enhancement.

We have analyzed Jupiter's hectometric radiations (HOM) by using the WIND/WAVES data for the period. HOM is known to be one of indicators reflecting Jupiter's global magnetospheric activities (Louarn et al., JGR, 2014 etc.), and to consist of two components having some correlation and no correlation with solar wind variations (Nakagawa et al., ASR, 2000 etc.). Thus, variations of the non solar wind correlative component is considered to be suitable to investigate magnetospheric activities for the Iogenic plasma enhancement. As the results of the the preliminary analysis, we found the followings; 1)activity of HOM increased after the Iogenic plasma enhancement, 2)the enhancement is generally intermittent and quasi-periodic like, and 3)variations of Aurora & HOM are somewhat similar, but not same.

Acknowledgements: We would greatly appreciate M. Kaiser, J.-L. Bougeret and the WIND/WAVES team for providing the radio wave data.

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ABSTRACT: Around Jupiter's oppositions to the earth in 2014 and 2015, remote observations for Jupiter had been made continuously by the HISAKI satellite. In particular in the 2015 campaign period, sudden enhancement of Iogenic plasma emissions occurred in the middle of Jan. and the enhancement had lasted for more than two months. This phenomena would give important clues to investigate what parameters and/or processes control magnetosphere's variations. We have analyzed Jupiter's hectometric radiations (HOM) by using the WIND/WAVES data for the period. HOM is known to be one of indicators reflecting Jupiter's global magnetospheric activities (Louarn et al., JGR, 2014 etc.), and to have some correlation with solar wind variations (Nakagawa et al., ASR, 2000 etc.). In this presentation, we introduce the following results from the preliminary analysis; 1)activity of HOM increased after the Iogenic plasma enhancement, 2)the enhancement is generally intermittent and quasi-periodic like, and 3)variations of Aurora & HOM are somewhat similar, but not same.

Purpose of This Study

Investigation of global activity of Jupiter's magnetosphere and its driver from coordinated observations of radio wave & HISAKI (aurora/torus)

Around the middle of Jan. 2015 in the HISAKI Jupiter observation campaign, sudden enhancement of Iogenic gas and plasma emissions was detected. We have analyzed Jupiter's HOM data and compared them with the HISASKI data for investigating following subjects;

- **How HOM varied during the Iogenic plasma enhancement?**
- **How does Iogenic plasma affect to Jupiter's magnetosphere?**
  — So far, HOM is known to show weak solar wind control and more intense non-solar wind control, and show good relation with some inner process. HISAKI data offer information on relation among HOM activity, global magnetospheric activity suggested by aurora & heavy ions from torus, and solar wind variations.

Known variation characteristics of HOM

- **Relation with solar wind variations**

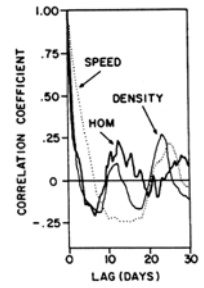


Fig. Autocorrelation coefficients vs. time-lag for HOM energy, solar wind density and velocity, observed by Voyager-2. (Desch & Barrow, 1984)

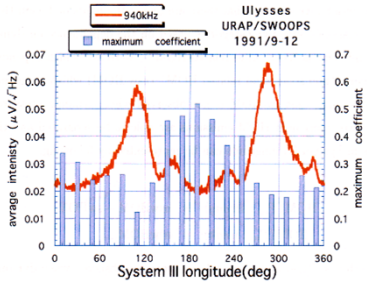
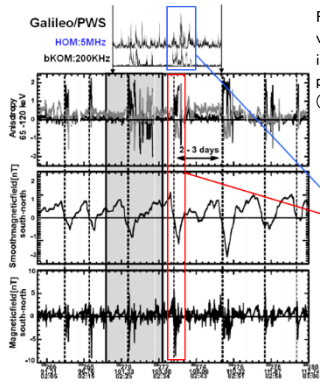


Fig. HOM occurrence dependence on CML and correlation coefficients for solar wind pressure. (Nakagawa et al., 2000)

- **Non solar wind control event (substorm like event)**



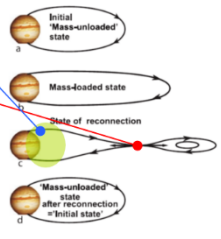
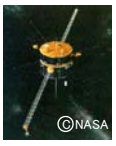


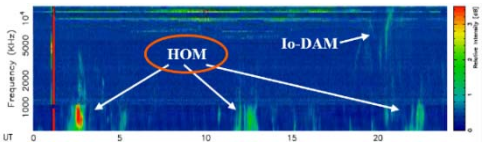
Fig. Relation between radio (HOM & bKOM) variations and "sub-storm like event" (SLE). SLE is proposed to be triggered by mass loading process of heavy plasma originated from Io. (Louarn et al., 1998 / Kronberg et al., 2005, 2007)

Radio data : WIND/WAVES

- **Data: Usage of space observation data from WIND/WAVES**

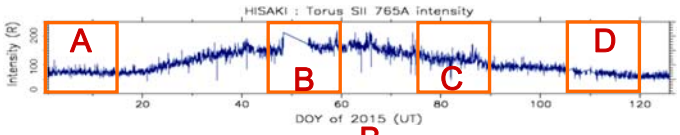
WIND: launched in Nov., 1994, orbiting around the earth or L1 point.
WAVES: Radio and Plasma Wave Investigation
- Radio Receiver Band 1 & 2 (RAD1 & 2)
  Antennas: RAD1(Ex(100m), Ez(12m)), RAD2(Ey(15m), Ez)
  Freq. range: 0.02～13.825MHz／RBW: 3 or 20kHz／Ch.: 256 each
  Sensitivity: 7 nV/Sqrt(Hz) (Bougeret et al.,1995)

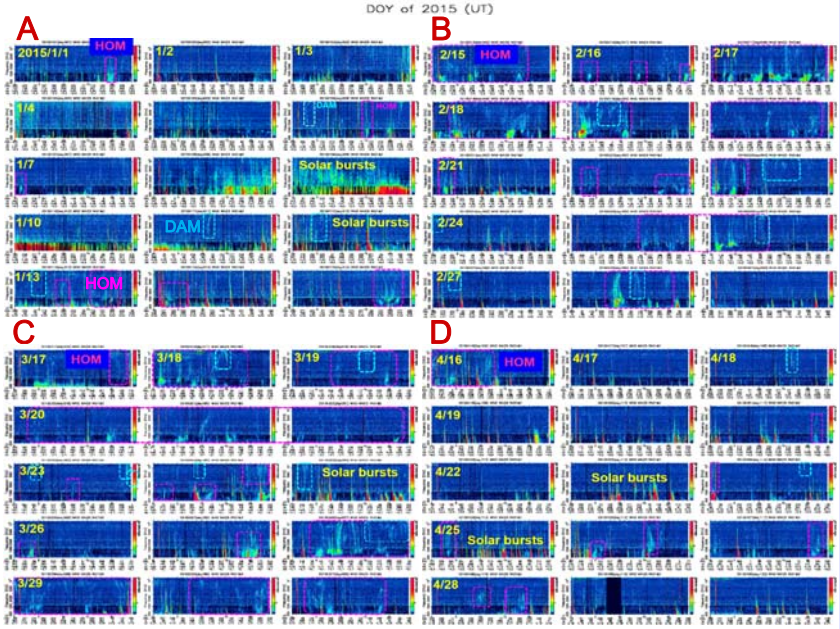


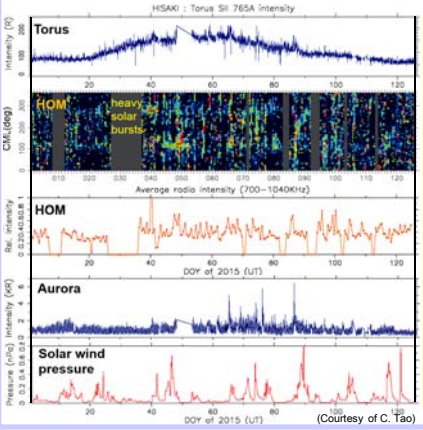


Results

- **HISAKI aurora & torus data and Radio activity around the campaign period (Jan. 1, 2015 – Apr. 30, 2015)**







(Courtesy of C. Tao)

Results of the analyses

- Activity of HOM increased after the Iogenic plasma enhancement. ➔ new !
- The enhancement is generally intermittent (short duration < half day) and QP.
- Variations of Aurora & HOM are somewhat similar, but not same(?).
  ➔ Difference of active region (or process) in the magnetosphere ?
  ➔ Next step.
- Variations of solar wind ρv^2 & HOM are seemingly different.➔Same as preceding studies but needs more precise analyses

Summary

·**Purpose: Investigate 'How does Io plasma affect to HOM (magnetospheric activities) ?'**
·**Method: Comparison between the radio data (WIND/WAVES) and HISAKI optical data.**
·**Results: 1. Activity of HOM increased after the Iogenic plasma enhancement (New!).**
2. The enhancement is generally intermittent (duration < 0.5 day) (and quasi-periodic like).
3. Variations of Aurora & HOM are similar, but not same (?).
➔ Difference of active region (or process) in the magnetosphere ?
➔ Solving contributed processes ・・・ future study
e.g. Timing analysis between HOM occurr. & the other phenomena, param, ,,,

Acknowledgements

The WIND/WAVES data were obtained from the NASA WIND/WAVES team page. We would like to thank M. L. Kaiser and the WIND/WAVES team for providing the data. The F10.7 and solar wind data were obtained from Geological Survey of Canada and NGDC, respectively.