Commission G Report

July 11, 2018

1. Meeting announcement/report

- **The 19th Symposium on Planetary Science 2018** was held at Tohoku University (Sendai) on February 27 – March 1, 2018. The symposium concerned the following topics: (1) Session by young researchers, (2) Planetary Meteorology, (3) Giant Planets & Exoplanets, (4) Aqua Planets, (5) Moon and Earth, and (6) Future Visions, with 47 oral talks and 31 posters. This workshop was designed for the enhancement of the inter-disciplinary discussions with optimized keynotes and invited talks. The results were valuable for all attendants. The next workshop will be held in Feb 2019, with the concept based on this successful event.
- **The 42th COSPAR Scientific Assembly** will be held in Pasadena, California, U.S.A. on 14-22 July, 2018. COSPAR stands for Committee on Space Research is "to promote at an international level scientific research in space, with emphasis on the exchange of results, information and opinions, and to provide a forum, open to all scientists, for the discussion of problems that may affect scientific space research". The COSPAR scientific assembly is held every two years.

  http://cospar2018.org/
- **MU radar /Equatorial Atmosphere Radar Symposium** will be held at RISH, Kyoto University on September 5-6, 2018. This is the annual meeting for the cooperative use of the facilities. Commission G of Japanese URSI co-sponsors this symposium.

2. Research Report

2.1. Report from National Institute for Polar Research (NIPR)
(Yasunobu Ogawa, NIPR)

=== Recent papers related to PANSY ===

Thurairajah, B., K. Sato, J. Yue, T. Nakamura, M. Kohma, S. M. Bailey, and J. M. Russell III, Simultaneous observation of gravity waves at PMC altitude from AIM/CIPS experiment and PANSY radar over Syowa (69°S, 39°E), J. Atmos. Solar-Terr. Phys., 164, 324-331, doi:10.1016/j.jastp.2017.10.006, 2017

Nishiyama, T., K. Sato, T. Nakamura, M. Tsutsumi, T. Sato, Y.-M. Tanaka, K. Nishimura, Y. Tomikawa, and M. Kohma, Simultaneous observations of polar mesosphere winter echoes and cosmic noise absorptions in a common volume by the PANSY radar (69.0°S, 39.6°E), J. Geophys. Res., 123, doi:10.1029/2017JA024717, 2018.

=== Recent papers related to EISCAT ===

Ivchenko, N., N. Schlatter, H. Dahlgren, Y. Ogawa, Y. Sato, and I. Haggstrom, Plasma line observations from the EISCAT Svalbard Radar during the International Polar Year, Ann. Geophys., 35, 1143-1149, October, 2017.

V. Sergeeva, N. Stepanova, Y. Ogawa, S. Kakic, and K. Kauristie, Solar wind dependence of electric conductances and currents in the auroral zone, Journal of Atmospheric and Solar-Terrestrial Physics, dx.doi.org/10.1016/j.jastp.2017.07.006, 2017.

T. T. Tsuda, M. T. Rietveld, M. J. Kosch, S. Oyama, Y. Ogawa, K. Hosokawa, S. Nozawa, T. Kawabata and A. Mizuno, Survey of conditions for artificial aurora experiments by the second electron gyro-harmonic at EISCAT Tromsø using dynasonde data, Earth, Planets and Space, 70:94, 2018.

T. T. Tsuda, M. T. Rietveld, M. J. Kosch, S. Oyama, K. Hosokawa, S. Nozawa, T. Kawabata, A. Mizuno and Y. Ogawa, Survey of conditions for artificial aurora experiments at EISCAT Tromsø using dynasonde data, Earth, Planets and Space, 70:40, 2018.

2.2. Report from Institute for Space-Earth Environmental Research (ISEE), Nagoya University
(Satonori Nozawa, Nagoya University)

=== Research topics ===

Shiokawa et al. (2018) reports the detailed instrumentations of the PWING longitudinal network project to investigate dynamics of the inner magnetosphere at subauroral latitudes as a part of the ERG-ground coordinated observation network. Ozaki et al. (2018) reports discovery of 1-Hz range modulation of isolated proton aurora at subauroral latitudes associated with the electromagetic ion cyclotron waves. Ohya et al. (2018) reports the first observation of earthquake-related periodic oscillation in the D-region ionosphere through the LF standard radio waves. The observation was made just after the 2011 Tohoku Earthquake.

== Recent papers ===

Shiokawa, K., Y. Kato, Y. Hamaguchi, Y. Yamamoto, T. Adachi, M. Ozaki, S.-I. Oyama, M. Nose, T. Nagatsuma, Y. Tanaka, Y. Otsuka, Y. Miyoshi, R. Kataoka, Y. Takagi, Y. Takeshita, A. Shinbori, S. Kurita, T. Hori, N. Nishitani, I. Shinohara, F. Tuchiya, Y. Obana, S. Suzuki, N. Takahashi, K. Seki, A. Kadokura, K. Hosokawa, Y. Ogawa, M. Connors, J. M. Ruohoniemi, M. Engebretson, E. Turunen, T. Ulich, J. Manninen, T. Raita, A. Kero, A. Oksanen, M. Back, K. Kauristie, J. Mattanen, D. Baishev, V. Kurkin, A. Oinats, A. Pashinin, R. Vasilyev, R. Rakhmatulin, W. Bristow, and M. Karjala, Ground-based instruments of the PWING project to investigate dynamics of the inner magnetosphere at subauroral latitudes as a part of the ERG-ground coordinated observation network, Earth, Planets and Space, 69:160, doi: 10.1186/s40623-017-0745-9, 2017.

Ozaki, M., K. Shiokawa, Y. Miyoshi, R. Kataoka, M. Connors, T. Inoue, S. Yagitani, Y. Ebihara, C.-W Jun, R. Nomura, K. Sakaguchi, Y. Otsuka, H.A. Uchida, I. Schofield, and D.W. Danskin, Discovery of 1-Hz range modulation of isolated proton aurora at subauroral latitudes, Geophys. Res. Lett., 45, doi:10.0002/2017GL076486, 2018.

Ohya, H., F. Tsuchiya, Y. Takishita, H. Shinagawa, K. Nozaki, and K. Shiokawa, Periodic Oscillations in the D-region Ionosphere after the 2011 Tohoku Earthquake using LF Standard Radio Waves, J. Geophys. Res., 123, doi: 10.0002/2018JA025289, 2018.

2.3. Report from National Institute for Information and Communications Technology (NICT)
(Hidekatsu Jin, NICT)

=== Research topics ===

Konyanat Hozumi was awarded Young Scientist Award by USRI AT-RASC 2018. The research title of the award was “Low cost development of HF receiver prototype for HF-START field campaign”.

=== Recent papers===

E. Astafyeva, I. Zakharenkova, K. Hozumi, P. Alken, P. Coïsson, M. R. Hairston, and W. Coley, "Study of the Equatorial and Low-latitude Electrodynamic and Ionospheric Disturbances During the 22-23 June 2015 Geomagnetic Storm Using Ground-based and Space-borne Techniques", J. Geophys. Res. Space Physics,123, 2424–2440. https://doi.org/10.1002/2017JA024981., 2018.

Carter, B. A., S. Tulasi Ram, E. Yizengaw, R. Pradipta, J. Retterer, R. Norman, J. Currie, K. Groves, R. Caton, M. Terkildsen, T. Yokoyama, and K. Zhang, Unseasonal development of post-sunset F-region irregularities over Southeast Asia on 28 July 2014: 1. Forcing from above? Prog. Earth Planet. Sci., 5, 10, doi:10.1186/s40645-018-0164-y, 2018.

Kato, T, Y. Terada, K. Tadokoro, N. Kinugasa, A. Futamura, M. Toyoshima, S. Yamamoto, M. Ishii, T. Tsugawa, M. Nishioka, K. Takizawa, Y. Shoji, and H. Seko (2018), Development of GNSS Buoy for a Synthetic Geohazard Monitoring System, J. Disaster Res., Vol.13, No.3, pp. 460-471, 2018, doi: 10.20965/jdr.2018.p0460.

Fujita, S., Y. Murata, I. Fujii, Y. Miyoshi, H. Shinagawa, H. Jin, and H. Fujiwara (2018), Evaluation of the Sq magnetic field variation calculated by GAIA, Space Weather, https://doi.org/10.1002/2017SW001745.

Li, Guozhu, Baiqi Ning, M.A. Abdu, Chi Wang, Yuichi Otsuka, Weixing Wan, Jiuhou Lei, Michi Nishioka, Takuya Tsugawa, Lianhuan Hu, Guotao Yang, Chungxiao Yan (2018), Daytime F-region irregularity triggered by rocket induced ionospheric hole over low latitude, Progress in Earth and Planetary Science, 5:11 doi:10.1186/s40645-018-0172-y.

Patra, A. K., P. Pavan Chaitanya, J.-P. St.-Maurice, Y. Otsuka, T. Yokoyama, and M. Yamamoto, The solar flux dependence of ionospheric 150-km radar echoes and implications, Geophys. Res. Lett., 44, 11,257-11,264, doi:10.1002/2017GL074678, 2017.

Pavan Chaitanya, P., A. K. Patra, Y. Otsuka, T. Yokoyama, M. Yamamoto, R. A. Stoneback, and R. A. Heelis, Daytime zonal drifts in the ionospheric 150 km and E regions estimated using EAR observations, J. Geophys. Res. Space Physics, 122, 9045-9055, doi:10.1002/2017JA024589, 2017.

Shinagawa, H., Y. Miyoshi, H. Jin, H. Fujiwara, T. Yokoyama, and Y. Otsuka (2018), Daily and seasonal variations in the linear growth rate of the Rayleigh-Taylor instability in the ionosphere obtained with GAIA, Progress in Earth and Planetary Science, 5:16 https://doi.org/10.1186/s40645-018-0175-8.

Tsugawa, T., M. Nishioka, M. Ishii, K. Hozumi, S. Saito, A. Shinbori, Y., Otsuka, A. Saito, S. M. Buhari, M. Abdullah, and P. Supnithi (2018),Total electron content observations by dense regional and worldwide international networks of GNSS, Journal of Disaster Research, Vol.13, No.3, pp. 535-545, 2018, doi: 10.20965/jdr.2018.p0535.

Yamazaki, Y., C. Stolle, J. Matzka, H. Liu, and C. Tao (2018), Interannual Variability of the Daytime Equatorial Ionospheric Electric Field, J. Geophys. Res.: Space Physics, 123, https://doi.org/10.1029/2017JA025165.

Yokoyama, T., and C. Stolle, Low and midlatitude ionospheric plasma density irregularities and their effects on geomagnetic field, Earth's Magnetic Field, Space Science Series of ISSI vol. 60 edited by C. Stolle, N. Olsen et al., 503-527, 2017.

Yokoyama, T., A review on the numerical simulation of equatorial plasma bubbles toward scintillation evaluation and forecasting, Prog. Earth Planet. Sci., 4, 37, doi:10.1186/s40645-017-0153-6, 2017.

2.4. Report from Electronic Navigation Research Institute (ENRI)
(Susumu Saito, ENRI)

=== Research activities ===

Equatorial scintillation in GPS signals was studied by Abadi et al. (2017). Post-sunset raise of the F-layer and plasma bubble occurrence was studied by Tsunoda et al. (2017). Impacts of ionospheric scintillation on integrity monitors of the ground-based GNSS augmentation system (GBAS) was studied by Saito et al. (2018). Ionospheric TEC gradient analysis over Japan was studied by Nakamura et al. (2018).

Following paper (reported in September 2017) was recently selected as a journal highlite, and shown in AGU Publication Quarterly Update.

Saito, S., and T. Yoshihara, Evaluation of extreme ionospheric total electron content gradient associated with plasma bubbles for GNSS Ground-Based Augmentation System, Radio Science, 52, doi:10.1002/2017RS006291, 2017.

=== Recent papers===

Abadi, P., Y. Otsuka, K. Shiokawa, A. Husin, H. Liu, and S. Saito, Equatorial scintillation in GPS signals: Equatorial asymmetry in the zonal distribution of scintillation as observed by GPS

receivers in Indonesia, J. Geophys. Res. Space Physics, 122, doi:10.1002/2017/2017JA024146, 2017.

R. T. Tsunoda, S. Saito, and T. T. Nguyen, Post-sunset raise of the F-layer and plasma bubble occurrence: Post-sunset rise of equatorial F layer – or upwelling growth?, Progress in Earth and Planetary Science, 5:22, doi:10.1186/s40645-018-0179-4, 2018.

S. Saito, S. Zureikat, and T. Yoshihara, Impacts of ionospheric scintillation on integrity monitors of the ground-based GNSS augmentation system (GBAS): Preliminary results of impacts of ionospheric scintillations on GAST-D ground integrity monitors, Proc. Institute of Navigation International Technical Meeting, 177-187, 2018. (Peer-reviewed)

M. Nakamura, S. Saito, and T. Yoshihara, Study of the spatial scale of plasma bubbles for ionospheric threat model for GBAS, Proc. Institute of Navigation International Technical Meeting, 763-770, 2018. (Peer-reviewed)

2.5. Report from Research Institute for Sustainable Humanosphere (RISH), Kyoto University
(Mamoru Yamamoto, RISH)

=== Research activities ===

The Institute of Electronics, Information, and Communication Engineering (IEICE) awarded its Milestone, “A program commemorating the 100th anniversary of IEICE” to the MU radar in 2017. The MU radar was also awarded “Denki no ishizue (Cornerstone of electricity)” by the Institute of Electrical Engineering of Japan (IEEJ). They both awarded the MU radar as the world first atmospheric radar with active phased-array technique.

=== Recent papers===

Hubert Luce, Lakshmi Kantha, Hiroyuki Hashiguchi, Dale Lawrence, Masanori Yabuki, Toshitaka Tsuda, and Tyler Mixa, Comparisons between high-resolution profiles of squared refractive index gradient M2 measured by the Middle and Upper Atmosphere Radar and unmanned aerial vehicles (UAVs) during the Shigaraki UAV-Radar Experiment 2015 campaign, Ann. Geophys., 35, 423-441, doi:10.5194/angeo-35-423-2017, 2017.

Noersomadi and T.Tsuda, Comparison of three retrievals of COSMIC GPS radio occultation results in the tropical upper troposphere and lower stratosphere, Earth, Planets and Space (2017) 69:125, doi:10.1186/s40623-017-0710-7

Shoji,Y., K. Sato, M. Yabuki and T. Tsuda, Comparison of shipborne GNSS-derived precipitable water vapor with radiosonde in the western North Pacific and in the seas adjacent to Japan, Earth, Planets and Space (2017)69:153, https://doi.org/10.1186/s40623-017-0740-1, 3 November 2017

Juaeni,J., H.Tabata, Noersomadi, H.Hashiguchi and T. Tsuda, Retrieval of temperature profiles using radio acoustic sounding system (RASS) with the equatorial atmosphere radar (EAR) in West Sumatra, Indonesia, Earth, Planets and Space (2018) 70:22, https://doi.org/10.1186/s40623-018-0784-x

Hubert Luce, Hiroyuki Hashiguchi, Lakshmi Kantha, Dale A.Lawrence, Toshitaka Tsuda, Tyler Mixa and Masanori Yabuki, On the Performance of the Range Imaging Technique Estimated Using Unmanned Aerial Vehicles During the ShUREX 2015 Campaign, IEEE Transactions on Geoscience and Remote Sensing, Volume 56, Issue 4, 2033-2042, April 2018, ISNN:0196-2892

L. Kantha, D. Lawrence, H. Luce, H. Hashiguchi, T. Tsuda, R. Wilson, T. Mixa, and M. Yabuki, Shigaraki UAV-Radar Experiment (ShUREX2015): Overview of some preliminary results, Progress in Earth and Planetary Science, 4, doi:10.1186/s40645-017-0133-x, 2017.

Oigawa,M., T.Tsuda, H.Seko, Y.Shoji and E.Realini, Data assimilation experiment of precipitable water vapor observed by a hyper-dense GNSS receiver network using a nested NHM-LETKF

system, Earth, Planets and Space, 2018 70:74, https://doi.org/10.1186/s40623-018-0851-3, Published: 4 May 2018

Tulasi Ram, S., K. K. Ajith, T. Yokoyama, M. Yamamoto, and K. Niranjan, Vertical rise velocity of equatorial plasma bubbles estimated from Equatorial Atmosphere Radar (EAR) observations and HIRB model simulations, J. Geophys. Res. Space Physics, 122, 6584-6594, doi:10.1002/2017JA024260, 2017.

Dao, T., Y. Otsuka, K. Shiokawa, M. Nishioka, M. Yamamoto, S. M. Buhari, M. Abdullah, and A. Husin (2017), Coordinated observations of postmidnight irregularities and thermospheric neutral winds and temperatures at low latitudes, J. Geophys. Res. Space Physics, 122, 7504?7518, doi:10.1002/2017JA024048.

Pavan Chaitanya, P., A. K. Patra, Y. Otsuka, T. Yokoyama, M. Yamamoto, R. A. Stoneback, and R. A. Heelis (2017), Daytime zonal drifts in the ionospheric 150 km and E regions estimated using EAR observations, J. Geophys. Res. Space Physics, 122, doi:10.1002/2017JA024589.

Saito, S., Suzuki, S., Yamamoto, M., Chen, C.-H., and Saito, A. (2017),

Real-time Ionosphere Monitoring by Three-Dimensional Tomography over Japan,

J. Inst. Navig, 64, 495-504, doi:10.1002/navi.213.

Patra, A. K., P. Pavan Chaitanya, J.-P. St-Maurice, Y. Otsuka, T. Yokoyama, M. Yamamoto (2017), The Solar Flux Dependence of Ionospheric 150 km Radar Echoes and Implications, Geophys. Res. Lett., 44, 11257-11264, doi:10.1002/2017GL074678.

Takeo, D., K. Shiokawa, H. Fujinami, Y. Otsuka, T. S. Matsuda, M. K. Ejiri, T. Nakamura, M. Yamamoto (2017), Sixteen year variation of horizontal phase velocity and propagation direction of mesospheric and thermospheric waves in airglow images at Shigaraki, Japan, J. Geophys. Res. Space Phys., 122, 8770-8780, doi:10.1002/2017JA023919.

Kato, S., H. Hashiguchi, T. Tsuda, and M. Yamamoto (2017), Middle and Upper Atmosphere (MU) Radar -IEEE Milestone Dedicated-, IEICE Communications Society GLOBAL NEWSLETTER, Vol. 41, No. 4, pp. 4-9, December 2017.

H. Hashiguchi T. Manjo M. Yamamoto (2018), Development of Middle and Upper Atmosphere Radar Real‐Time Processing System With Adaptive Clutter Rejection, Radio Sci., 53, 83-92, doi:10.1002/2017RS006417.

Yamamoto, M., Y. Otsuka, H. Jin, Y. Miyoshi, (2018), Relationship between day-to-day variability of equatorial plasma bubble activity from GPS scintillation and atmospheric properties from GAIA assimilation, Progress in Earth and Planetary Science, Vol. 5, page 26, doi: 10.1186/s40645-018-0184-7

Ajith, K. K., S. Tulasi Ram, B. A. Carter, S. Sathish Kumar, M. Yamamoto, T. Yokoyama, S. Gurubaran, S. Sripathi, K. Hozumi, K. Groves, R. G. Caton, Unseasonal development of post-sunset F-region irregularities over Southeast Asia on 28 July 2014: 2. Forcing from below?, Progress in Earth and Planetary Science, Vol. 5, in press, 2018.

2.6. Report from Research Institute for Sustainable Humanosphere (RISH), Kyoto University
(Takeshi Sakanoi, Tohoku University)

=== Research activities ===

<Earth: Radiation belt and pulsating aurora>

Katoh et al. (2018a) describes principles of the Wave–Particle Interaction Analyzer and the implementation of the Software-type WPIA on the Arase satellite. The dedicated system has been developed in the Arase satellite to realize the time resolution required for inter-instrument communication. By a series of self-consistent electron hybrid code simulations, Katoh et al. (2018b) revealed the dependence of chorus generation process on the temperature anisotropy and

density of energetic electrons in the Earth's inner magnetosphere. The simulation results clarified that the spectra of chorus are essentially different from those predicted by the linear theory and are determined fully by nonlinear processes of wave-particle interactions in the chorus generation region.

The Rocksat-XN/G-CHASER rocket is planned to be launched in January 2019 from the Andoya rocket range. Groups in ISAS/JAXA, Tohoku Univ., Univ. of Tokyo are developing PARM which consists of auroral imager (AIC), medium energy particle detector (MED) and high energy telescope (HEP) to clarify high-energy electron precipitation associated with pulsating aurora. Collaboration with ground-based instruments will also be carried out during the rocket campaign period.

<Earth: D region ionosphere>

Tohoku University has constructed a low frequency (LF) and very low frequency (VLF) subionospheric radio propagation network (http://pparc.gp.tohoku.ac.jp/lf/). The subionospheric VLF/LF propagation is a useful probe to sense modification in the lower ionosphere. Using the radio network, Ohya et al. (2018) reported the first observations of ~100-s periodic oscillations of intensity in LF radio waves over Japan at 4 min and 42 s after mainshock onset of “the 2011 off the Pacific coast of Tohoku Earthquake” on 11 March 2011. Based on a numerical simulation of the neutral atmosphere and the subionospheric radio propagation, the occurrence time of the ~100-s periodic oscillations were in good agreement with the total propagation time of the Rayleigh wave that spread concentrically from the epicenter to the radio propagation paths.

<Earth: Ion outflow and electric field in the cusp region>

SS-520-3 sounding rocket is planned to be launched at Svalbard, Norway, in order to clarify the heating and acceleration mechanisms of ions in the dayside cusp region where ionospheric ion outflow was often found. Measurements of thermal ions, low-energy ions and electrons, plasma waves, electron density, and magnetic field are performed in the altitude range up to 800 km. The launch of SS-520-3 was scheduled in the winter of 2017. So, the developments of the onboard instruments were finished at the spring of 2017. However, since some failures of the avionics were found in the ground test in the summer of 2017, the launch date was delayed after 2019.

Takahashi et al. (2017) treated the propagation and evolution of electric fields associated with solar wind pressure pulses associated with sudden commencements (SCs) using multipoint equatorial magnetospheric (THEMIS, RBSP, and GOES) and ionospheric (C/NOFS) satellites with radars (SuperDARN). The ionospheric electric field responds ~41 s after the onset of dayside magnetospheric electric field, which can be explained by the propagation of the Alfvén wave along magnetic field lines. Poynting fluxes toward the ionosphere support these propagations. The path from the dayside to the nightside magnetosphere through the ionosphere could be qualitatively and quantitatively compared with the propagation in the magnetosphere.

< Planetary atmosphere: Mars>

Terada et al. (2017) revealed gravity wave-like perturbations in the Martian upper thermosphere observed by the Neutral Gas Ion Mass Spectrometer (NGIMS) onboard the Mars Atmosphere and Volatile EvolutioN (MAVEN) spacecraft. The amplitudes of small-scale perturbations with apparent wavelengths between ~100 and ~500 km in the Ar density around the exobase show a clear dependence on temperature (T0) of the upper thermosphere. The average amplitude of the perturbations is ~10% on the dayside and ~20% on the nightside, which is about 2 and 10 times larger than those observed in the Venusian upper thermosphere and in the low-latitude region of Earth's upper thermosphere, respectively.

Aoki et al. (2017a) performed sensitive measurements of Martina CH4, which could be a signature of biological and/or geological activities on Mars, by using the echelon-Cross-Echelle Spectrograph (EXES) onboard the Stratospheric Observatory for Infrared Astronomy (SOFIA). Thanks to the high altitude of SOFIA ~ 13.7 km, this result got the strong restriction of the upper limit from 1 to 9 ppb across the Martian atmosphere. This result emphasizes that release of CH4 on Mar is sporadic and/or localized if the process is present. Aoki et al. (2017b) investigated

mesospheric CO2 ice clouds on Mars through analysis of NIR spectra acquired by PFS onboard MEX from MY27 to MY32. A total of 111 occurrences of CO2 ice cloud features have been detected over the period. The spatial and seasonal distributions of the CO2 ice clouds are consistent with previous observations. The higher spectral resolution achieved detailed spectral features of the ice cloud, and we found that these spectral features cannot be reproduced using available CO2 ice refractive indices.

<Planetary atmosphere: Venus>

Masunaga et al. (2017) examined Venusian EUV dayglow observed by the JAXA Hisaki space telescope data. They showed that ~4-day periodic variations are detected and are dominant on the dawnside of Venus. The ~4 day periodic dayglow variations may reflect atmospheric dynamics of Venus.

<Planetary atmosphere: Mercury>

Aizawa et al. (2018) investigated the transport and non-adiabatic energization of planetary ions in the magnetospheric flanks. They showed that the scattering and energization are controlled by the characteristics of the electric field burst encountered along the particle path across large-scale rolled up Kelvin-Helmholtz vortices, the net energy change realized corresponding to the maximum drift energy.

<Planetary ionosphere: Jupiter>

For Jupiter aurora, Kita et al. (2016) reported the statistical relationship between the total power of the Jovian ultraviolet aurora and the solar wind properties found from long-term monitoring by the spectrometer EXCEED on board the Hisaki satellite. Superposed epoch analysis indicates that auroral total power increases when an enhanced solar wind dynamic pressure hits the magnetosphere.

<Planetary and solar radio waves>

IPRT (Iitate Planetary Radio Telescope) is a VHF-UHF range radio telescope with the aperture of 1000 m2 developed by Tohoku University, Japan (http://pparc.gp.tohoku.ac.jp/data/iprt/). The major targets of IPRT are solar, planetary and also extra solar radio emissions to investigate dynamical features of plasmas in solar corona and planetary magnetospheres and atmospheres etc. Receiver system in HF range (15-40MHz) was continuously operated at Iitate Observatory of Tohoku University. Spectrograms of Jovian and solar radio wave with a time resolution of 0.5 sec were automatically archived and provided to the researchers through the internet. In collaboration between Paris Astronomical Observatory and Tohoku University with support of JSPS Bilateral Program (France-Japan Joint Research Project titled "Coordinated observational and theoretical researches for Jovian and Kronian auroral radio emissions" in 2016-2018), a metadata server for Jovian radio wave spectrogram in HF range, and solar radio wave spectrograms in VHF-UHF range was developed at Tohoku University. The server provide metadata using EPN-TAP protocol as a part of Virtual Observatory (VO), which enables us to share the ground based observation data with wide researchers.

=== Recent papers===

Aizawa, S., D. Delcout, and N. Terada, Sodium ion dynamics in the magnetospheric flanks of Mercury, Geophys. Res. Lett., 45, 595-601, doi:10.1002/2017GL076586, 2018.

Aoki, S., Y. Sato, M. Giuranna, P. Wolkenberg, T. Sato, H. Nakagawa, Y. Kasaba, Mesospheric CO2 ice clouds on Mars observed by the Planetary Fourier Spectrometer onboard Mars Express, Icarus, 302, 175-190, dOI:10.1016/j.icarus.2017.10.047, 2018.

Aoki, S., M. J. Richter, C. DeWitt, A. Boogert, T. Encrenaz, H. Sagawa, H. Nakagawa, A. C. Vandaele, M. Giuranna, T. K. Greathouse, T. Fouchet, A. Geminale, G. Sindoni, M. McKelvey, M. Case, Y. Kasaba, Stringent upper limit of CH4 on Mars based on SOFIA/EXES observation, Astron. Astrophys., 610, id:A78, 9, doi:10.1051/0004-6361/201730903, 2018.

Bader, W., B. Bovy, S. Conway, K. Strong, D. Smale, A. J. Turner, T. Blumenstock, C. Boone, M. C. Coen, A. Coulon, O. Garcia, D. W. T. Griffith, F. Hase, P. Hausmann, N. Jones, P. Krummel, I. Murata, I. Morino, H. Nakajima, S. O'Doherty, C. Paton-Walsh, J. Robinson, R. Sandrin, M. Schneider, C. Servais, R. Sussmann and E. Mahieu, The recent increase of atmospheric methane from 10 years of ground-based NDACC FTIR observations since 2005, Atmos. Chem. Phys., 17, 2255-2277, doi:10.5194/acp-17-2255-2017, 2017.

Katoh, Y., H. Kojima, M. Hikishima, T. Takashima, K. Asamura, Y. Miyoshi, Y. Kasahara, S. Kasahara, T. Mitani, N. Higashio, A. Matsuoka, M. Ozaki, S. Yagitani, S. Yokota, S. Matsuda, M. Kitahara, and I. Shinohara, Software-type Wave-Particle Interaction Analyzer on board the Arase satellite, Earth Planets Space, 70:4, doi:10.1186/s40623-017-0771-7, 2018.

Katoh, Y., Y. Omura, Y. Miyake, H. Usui, and H. Nakashima, Dependence of generation of whistler-mode chorus emissions on the temperature anisotropy and density of energetic electrons in the Earth's inner magnetosphere, J. Geophys. Res. Space Physics, 123, 1165-1177, doi:10.1002/2017JA024801, 2018.

Kita, H., S. Fujisawa, C. Tao, M. Kagitani, T. Sakanoi, Y. Kasaba, Horizontal and vertical structures of Jovian infrared aurora: Observation using Subaru IRCS with adaptive optics, Icarus 313, 93–106, doi:10.1016/j.icarus.2018.05.002, 2018.

Kumamoto, A., F. Tsuchiya, Y. Kasahara, Y. Kasaba, H. Kojima, S. Yagitani, K. Ishisaka, T. Imachi, M. Ozaki, S. Matsuda, M. Shoji, A. Matsuoka, Y. Katoh, Y. Miyoshi, and T. Obara, High Frequency Analyzer (HFA) of Plasma Wave Experiment (PWE) onboard the Arase spacecraft, Earth Planets Space, 70:82, doi:10.1186/s40623-018-0854-0, 2018.
(- In the initial Arase PWE/HFA operations, UHR waves, AKR, whistler-mode chorus, ESCH waves, and NTC radiation were observed.
- For the purpose of derivation of electron number density, the semiautomatic UHR frequency identification by the computer and a human operator was applied to the HFA spectrograms.)

Kumamoto, A., Y. Kasaba, F. Tsuchiya, H. Misawa, H. Kita, W. Puccio, J.-E. Wahlund, J. Bergman, B. Cecconi, Y. Goto, J. Kimura, and T. Kobayashi (2017), Feasibility of the exploration of the subsurface structures of Jupiter's icy moons by interference of Jovian hectometric and decametric radiation, Planetary Radio Emissions VIII, edited by G. Fischer, G. Mann, M. Panchenko, and P. Zarka, Austrian Academy of Sciences Press, Vienna, 127-136.
(- A new passive subsurface radar technique using interference patterns in the spectrum of the Jovian HOM/DAM has been proposed, and investigated for implementation on JUICE/ RPWI.
- Based on the calculation of the attenuation rate of the radio waves in the ice from 80 K to 250 K, the intensity of the subsurface echo was estimated. The waves are expected to reach just above the ice crust/liquid ocean boundary.)

Masunaga, K., K. Seki, N. Terada, F. Tsuchiya, T. Kimura, K. Yoshioka, G. Murakami, A. Yamazaki, C. Tao, F. Leblanc, and I. Yoshikawa, Dawn-dusk difference of periodic oxygen EUV dayglow variations at Venus observed by Hisaki, Icarus, doi:10.1016/j.icarus.2016.12.027, 2017.

Ohya, H., F. Tsuchiya, Y. Takishita, H. Shinagawa, K. Nozaki, and K. Shiokawa, Periodic oscillations in the D-region ionosphere after the 2011 Tohoku Earthquake using LF standard radio waves, Journal of Geophysical Research: Space Physics, in printing.
(-This study reports the first observations of ~100-s periodic oscillations of intensity in LF standard radio waves after the 2011 Tohoku Earthquake.
-Based on a simulation of the neutral atmosphere and the wave-hop method, the oscillations were caused by the acoustic waves excited by Rayleigh waves.
- The amplitude of the D-region electron density variations during the oscillation was estimated to be about 1% compared to the background electron density.)

Sakanoi, T., M. Kagitani, H. Nakagawa, T. Obara, Y. Kasaba, S. Okano, J.R. Kuhn, S.V. Berdyugina, I.F. Scholl, and M. Yoneda, Optical and IR observations of planetary and exoplanetary atmospheres, SPIE , doi:10.1117/2.1201612.006817, 2017.

Takahashi, N., Y. Kasaba, Y. Nishimura, A. Shinbori, T. Kikuchi, T. Hori, Y. Ebihara, and N. Nishitani, Propagation and evolution of electric fields associated with solar wind pressure pulses based on spacecraft and ground-based observations, J. Geophys. Res., 122, 8446-8461, 10.1002/2017JA0233990, 2017.

Tao, C., T. Kimura, F. Tsuchiya, G. Murakami, K. Yoshioka, A. Yamazaki, S. V. Badman, H. Misawa, H. Kita, Y. Kasaba, I. Yoshikawa, and M. Fujimoto, Variation of Jupiter's aurora observed by Hisaki/EXCEED: 3. Volcanic control of Jupiter's aurora, Geophys. Res. Lett., 45, 71-79, doi:10.1002/2017GL075814, 2018.

Terada, N., F. Leblanc, H. Nakagawa, A. S. Medvedev, E. Yigit, T. Kuroda, T. Hara, S. L. England, H. Fujiwara, K. Terada, K. Seki, P. R. Mahaffy, M. Elrod, M. Benna, J. Grebowsky, and B. M. Jakosky, Global distribution and parameter dependences of gravity wave activity in the Martian upper thermosphere derived from MAVEN/NGIMS observations, J. Geophys. Res., 122, doi:10.1002/2016JA023476, 2017.

Tsuchiya, F., K. Yoshioka, T. Kimura, G. Murakami, C. Tao, H. Kita, I. Yoshikawa, A. Yamazaki, and Y. Kasaba, Three-year of observations of Jupiter's aurora and Io plasma torus variabilities by earth orbiting extreme-ultraviolet spectroscope HISAKI, IOP Conf. Series: J. Phys.: Conf. Series, 869, 012069, doi:10.1088/1742-6596/869/1/012069, 2017.