Commission G Report

August 6, 2021

1. Meeting report

- **MU radar /Equatorial Atmosphere Radar Symposium** This is the annual symposium for the cooperative use of MU radar and Equatorial Atmosphere Radar. Commission G of Japanese URSI co-sponsors this symposium. Next meeting will be held on September 9-10, 2021. The event will be onsite at RISH, Kyoto Univ. or online.

2. Awards

There were awards given to the researchers related to the URSI Japan Commission G research activies.

- Kaoru Sato (Univ. Tokyo), Medal with Purple Ribbon (Shiju Housho) by Cabinet Office, Atmospheric Science Research, April 29, 2021.
- Takanori Nishiyama (NIPR), ZELDOVICH Medal for COSPAR Scientific Commission C from COSPAR and the Russian Academy of Sciences, January 2021.
- Tatsuhiro Yokoyama (Kyoto Univ.), Nishida Prize by Japan Geoscience Union, Study on ionospheric disturbances by various observations and numerical simulations, June 3, 2021.
- Nozomu Nishitani (Nagoya Univ.), PEPS Most Cited Paper Award by Japan Geosciene Union, June 3, 2021.
- Yuichi Minamihara (Univ. Tokyo), Matsuno Award by the Meteorological Society of Japan, The Kelvin-Helmholtz billows in the Antarctic troposphere and lower stratosphere captured by the PANSY radar at Syowa Station, November 13, 2020.

3. Masterplan 2023

Science Council of Japan (SCJ) is planning the Masterplan 2023. The selection process is starting. On June 26, 2021, the SCJ Geocience committee hold a meeting to review potential projects for the SCJ Masterplan 2023.

Research Institute for Sustainable Humanosphere (RISH), Kyoto University, National Institute of Polar Research (NIPR), Institute for Space-Earth Environmental Research (ISEE), Nagoya University, and International Center for Space Weather Science and Education (ICSWSE), Kyushu University proposed the research project “Coupling process in the solar-terrestrial system” to the meeting. We study the solar energy inputs into the Earth and the response of Geospace (magnetosphere, ionosphere, and atmosphere) to the energy input by installing large atmospheric radars with an active phased array antenna at the equator and the Arctic regions. One is Equatorial MU (EMU) radar by RISH in Sumatera Island, Indonesia, and the other is EISCAT_3D by NIPR in northern Scandinavia under international collaborations. We also develop the global observation network that is jointly conducted by ISEE and ICSWSE. This project has been successfully selected as one of highest-priority projects in Masterplan 2014/2017/2020. We hope for continuous spport from the Japanese URSI meeting.

4. Research Report

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

=== Recent papers related to PANSY ===

Kohma, M., Sato, K., Nishimura, K., Tsutsumi, M., Weakening of polar mesosphere winter echo and turbulent energy dissipation rates after a stratospheric sudden warming in the Southern Hemisphere in

2019. Geophysical Research Letters, 48, e2021GL092705, 2020. https://doi.org/10.1029/2021GL092705, 2021.

=== Recent papers related to EISCAT ===

Miyoshi, Y., K. Hosokawa, S. Kurita, S.-I. Oyama, Y. Ogawa, S. Saito, I. Shinohara, A. Kero, E. Turunen, P. T. Verronen, S. Kasahara, S. Yokota, T. Mitani, T. Takashima, N. Higashio, Y. Kasahara, S. Matsuda, F. Tsuchiya, A. Kumamoto, A. Matsuoka, T. Hori, K. Keika, M. Shoji, M. Teramoto, S. Imajo, C. Jun, S. Nakamura, Penetration of MeV electrons into the mesosphere accompanying pulsating aurorae, doi.org/10.1038/s41598-021-92611-3, Scientific Reports 11(1), 2021.

Takada, M., K. Seki, Y. Ogawa, K. Keika, S. Kasahara, S. Yokota, T. Hori, K. Asamura, Y. Miyoshi, I. Shinohara, Low‐Altitude Ion Upflow Observed by EISCAT and its Effects on Supply of Molecular Ions in the Ring Current Detected by Arase (ERG) , Journal of Geophysical Research: Space Physics 126(5), 2021.

Namekawa, T., T. Mitani, K. Asamura, Y. Miyoshi, K. Hosokawa, Y. Ogawa, S. Saito, T. Hori, S. Sugo, O. Kawashima, S. Kasahara, R. Nomura, N. Yagi, M. Fukizawa, T. Sakanoi, Y. Saito, A. Matsuoka, I. Shinohara, Y. Fedorenko, A. Nikitenko, C. Koehler, Rocket observation of sub-relativistic electrons in the quiet dayside auroral ionosphere, Journal of Geophysical Research: Space Physics, doi:10.1029/2020JA028633, 2021.

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Oyama, S., A. Shinbori, Y. Ogawa, M. Kellinsalmi, T. Raita, A. Aikio, H. Vanhamäki, K. Shiokawa, I. Virtanen, L. Cai, A. B. Workayehu, M. Pedersen, K. Kauristie, T. T. Tsuda, B. Kozelov, A. Demekhov, A. Yahnin, F. Tsuchiya, A. Kumamoto, Y. Kasahara, A. Matsuoka, M. Shoji, M. Teramoto, M. Lester, An Ephemeral Red Arc Appeared at 68° MLat at a Pseudo Breakup During Geomagnetically Quiet Conditions, Journal of Geophysical Research: Space Physics 125(10), 2020.

Tsuda, T. T., Li, C., Hamada, S., Hosokawa, K., Oyama, S., Nozawa, S., et al., OI 630.0‐nm and N2 1PG emissions in pulsating aurora events observed by an optical spectrograph at Tromsø, Norway, Journal of Geophysical Research: Space Physics, 125, e2020JA028250. https://doi.org/10.1029/2020JA028250, 2020.

Bjoland, L. M., Y. Ogawa, U. P. Løvhaug, D. A. Lorentzen, S. M. Hatch, K. Oksavik, Electron Density Depletion Region Observed in the Polar Cap Ionosphere, Journal of Geophysical Research: Space Physics 126(1), 2021.

Stepanov N.A., V. A. Sergeev, M.A. Shukhtina, Y. Ogawa, X. Chu, D.Rogov, Ionospheric electron density and conductance changes in the auroral zone during substorms, Journal of Geophysical Research: Space Physics, doi:10.1029/2021JA029572, 2021.

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

== Summary ===

Many ground-satellite conjugate measurements of phenomena at subauroral latitudes have been reported in recent one year. Inaba et al. (2020; 2021) firstly reported plasma and field observations in the magnetospheric source region of four stable auroral red (SAR) arc by the Arase and RBSP satellites, and concluded that the SAR arc is most likely caused by Coulomb collision between ring current ions and plasmaspheric electrons. Takeshita et al. (2021) studied spatiotemporal development of global distribution of magnetospheric ELF/VLF waves using ground-based and satellite observations, and RAM-SCB simulations, for the March and November 2017 storms. Ozaki et al. (2021) reported magnetic conjugacy of Pc1 waves and isolated proton precipitation at subauroral latitudes withi importance of ionosphere as intensity modulation region. Martinez-Calderon et al. (2021) reported multi-event study of characteristics and propagation of naturally occurring ELF/VLF

waves using high-latitude ground observations and conjunctions with the Arase satellite. Nakamura et al. (2021) reported simultaneous observation of two isolated proton auroras at subauroral latitudes by a highly sensitive all-sky camera and Van Allen Probes. Kawai et al. (2021) reported first simultaneous observation of a nighttime medium-scale traveling ionospheric disturbance from the ground and a magnetospheric satellite. Yadav et al. (2021) reported multi-wavelength imaging observations of STEVE at Athabasca, Canada, showing STEVE consists of broad optical spectra in visible wavelengths.

Otsuka (2021) has reviewed recent works of medium-scale traveling ionospheric disturbances (MSTIDs). Otsuka et al. (2021) have reported statistical results of the MSTID activity and propagation direction of MSTIDs by analyzing 22-years data of GPS-TEC over Japan. Cheng et al. (2021) have investigated MSTIDs statistically over Taiwan by applying the automatic detection algorithm including the three-dimensional fast Fourier transform TEC observations.

Sori et al. (2021) have reported the occurrence features and causes of storm-time plasma bubbles in the equatorial to mid-latitude ionosphere by performing a superposed epoch analysis of TEC during 652 geomagnetic storm events. Shinbori et al. (2021) have statistically investigated relationship between the locations of the midlatitude trough minimum in the ionosphere and plasmapause in the inner magnetosphere using GNSS-TEC and electron density data obtained from the Arase satellite from March 23, 2017 to May 31, 2020.

Watanabe et al. (2021) have attempted to calculate TEC variations by inputting the temporal variation of the solar flare spectrum for the X9.3 flare into the GAIA model and compared it with the observed TEC. Currie et al. (2021) have reported an unseasonal equatorial plasma bubble (EPB) event over South-East Asia was observed on July 22, 2014, and suggested that this unseasonal event was caused by large seed perturbations in TEC. Sivakandan et al. (2021) have statistically investigated TEC variations for the whole year 2011 in the world, and shown that the seasonal and longitudinal variation of the daytime MSTID activity is well reproduced by the GAIA model. Li et al. (2021) have presented a general review of equatorial plasma bubbles and scintillation features including their physical mechanisms and controlling factors responsible for their occurrence, and unresolved issues related to their day-to-day and short-term variability. Dao et al. (2020) have reported TEC day-to-day variations of TEC and scintillation at Ho Chi Minh City, Vietnam based on the data obtained by a Trimble NetR9 GNSS receiver. Huang et al. (2020) have reported MSTID over China based on TEC observations from Beidou geostationary satellites.

J.-P. St-Maurice and Nishitani (2020) proposed a new generation mechanism of the near range echoes observed by the SuperDARN radars. Nishitani et al. (2021) reported on the initial results of the remote HF wave receiver system in Nagoya, which monitors the SuperDARN Hokkaido East radar wave and obtain information of the HF wave propagation in the ionosphere.

== Recent papers ===

Inaba Y., K. Shiokawa, S. Oyama, Y. Otsuka, A. Oksanen, A. Shinbori, A. Yu. Gololobov, Y. Miyoshi, Y. Kazama, S.-Y. Wang, S. W. Y. Tam, T.-F. Chang, B.-J. Wang, S. Yokota, S. Kasahara, K. Keika, T. Hori, A. Matsuoka, Y. Kasahara, A. Kumamoto, Y. Kasaba, M. Shoji, I. Shinohara, and C. Stolle, Plasma and field observations in the magnetospheric source region of a stable auroral red (SAR) arc by the Arase satellite on 28 March 2017, J. Geophys. Res., 125, https://doi.org/10.1029/2020JA028068, 2020.

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Hosokawa K., M. Nagata, K. Shiokawa, and Y. Otsuka, What controls the luminosity of polar cap airglow patches?: implication from airglow measurements in Eureka, Canada in comparison with SuperDARN convection pattern, Polar Science, https://doi.org/10.1016/j.polar.2020.100608, 2020.

Yadav S., K. Shiokawa, Y. Otsuka, M. Connors, and J.-P. St. Maurice, Multi-wavelength imaging observations of STEVE at Athabasca, Canada, J. Geophys. Res., 126, https://doi.org/10.1029/2020JA028622, 2021.

Takeshita Y., K. Shiokawa, Y. Miyoshi, M. Ozaki, Y. Kasahara, S. Oyama, M. Connors, J. Manninen, V. K. Jordanova, D. Baishev, A. Oinats, and V. Kurkin, Study of spatiotemporal development of global distribution of magnetospheric ELF/VLF waves using ground-based and satellite observations, and RAM-SCB simulations, for the March and November 2017 storms, J. Geophys. Res., 126, https://doi.org/10.1029/2020JA028216, 2021.

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Martinez-Calderon, C., Y. Katoh, J. Manninen, O. Santolik, Y. Kasahara, S. Matsuda, A. Kumamoto, F. Tsuchiya, A. Matsuoka, M. Shoji, M. Teramoto, I. Shinohara, K. Shiokawa, and Y. Miyoshi, Multi-event study of characteristics and propagation of naturally occurring ELF/VLF waves using high-latitude ground observations and conjunctions with the Arase satellite, J. Geophys. Res., 126, https://doi.org/10.1029/2020JA028682, 2021.

Ozaki, M., K. Shiokawa, R. B. Horne, M. J. Engebretson, M. Lessard, Y. Ogawa, K. Hosokawa, M. Nose, Y. Ebihara, A. Kadokura, S. Yagitani, Y. Miyoshi, S. Hashimoto, S. Sinha, A. K. Sinha, G. K. Seemala, and C.-W. Jun, Magnetic conjugacy of Pc1 waves and isolated proton precipitation at subauroral latitudes: Importance of ionosphere as intensity modulation region, Geophys. Res. Lett., 48, https://doi.org/10.1029/2020GL091384, 2021.

Kim, H., K. Shiokawa, J. Park, Y. Miyoshi, C. Stolle and S. Buchert, Statistical analysis of Pc1 wave ducting deduced from Swarm satellites, J. Geophys. Res., 125, https://doi.org/10.1029/2020JA029016, 2021.

Thomas, N., K. Shiokawa, Y. Miyoshi, Y. Kasahara, I. Shinohara, A. Kumamoto, F. Tsuchiya, A. Matsuoka, S. Kasahara, S. Yokota, K. Keika, T. Hori, K. Asamura, S.-Y. Wang, Y. Kazama, S. W. Y. Tam, T. F. Chang, B. J. Wang, J. Wygant, A. Breneman, and G. Reeves, Investigation of small-scale electron density irregularities observed by the Arase and Van Allen Probes satellites inside and outside the plasmasphere. Journal of Geophysical Research: Space Physics, 126, e2020JA027917. https://doi.org/10.1029/2020JA027917, 2021."

Wang, Y., Z. Cao, Z.-Y. Xing, Q.-H. Zhang, P. T. Jayachandran, K. Oksavik, N. Balan, and K. Shiokawa, The GPS scintillations and TEC variations in association with a polar cap arc, J. Geophys. Res., 126, https://doi.org/10.1029/2020JA028968, 2021.

Inaba, Y., K. Shiokawa, S. Oyama, Y. Otsuka, M. Connors, I. Schofield, Y. Miyoshi, S. Imajo, A. Shinbori, A. Y. Gololobov, Y. Kazama, S.-Y. Wang, S. W. Y. Tam, T. F. Chang, B.-J. Wang, K. Asamura, S. Yokota, S. Kasahara, K. Keika, T. Hori, A. Matsuoka, Y. Kasahara, A. Kumamoto, S. Matsuda, Y. Kasaba, F. Tsuchiya, M. Shoji, M. Kitahara, S. Nakamura, I. Shinohara, H. E. Spence, G. D. Reeves, R. J. Macdowall, C. W. Smith, J. R. Wygant, J. W. Bonnell, Multi-event Analysis of Plasma and Field Variations in Source of Stable Auroral Red (SAR) Arcs in Inner Magnetosphere during Non-storm-time Substorms, J. Geophys. Res., 126, https://doi.org/10.1029/2020JA029081, 2021.

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Sarudin, I., N. S. A Hamid, M. Abdullah, S. M Buhari, 4, K. Shiokawa, Y. Otsuka, K. Hozumi, and P. Jamjareegulgarn, Influence of Zonal Wind Velocity Variation on Equatorial Plasma Bubble Occurrences over Southeast Asia, J. Geophys. Res., 126, e2020JA028994, https://doi.org/10.1029/2020JA028994, 2021.

Ozaki, M. T. Inoue, Y. Tanaka, S. Yagitani, Y. Kasahara, K. Shiokawa, Y. Miyoshi, K. Imamura, K. Hosokawa, S. Oyama, R. Kataoka, Y. Ebihara, Y. Ogawa, and A. Kadokura, Spatial evolution of wave-particle interaction region deduced from flash-type auroras and chorus-ray tracing, J. Geophys. Res., 126, e2021JA029254, https://doi.org/10.1029/2021JA029254, 2021.

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Geoscience and Remote Sensing, 59:8, 6424-6430, doi: 10.1109/TGRS.2020.3032741. (Date of Publication: 05 November 2020)

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

=== Research activities ===

Characteristics of the spatial gradient in ionospheric total electron content, which are slope, width, depth, and velocity (including direction) for ionospheric threat mitigation in GBAS (GNSS ground-based augmentation system) have been studied by using data from a GNSS network. The results were utilized in implementing a GBAS at Tokyo Haneda Airport which is in a pre-operational testing phase. Similar observations and analysis have been conducted in Thailand and Vietnam. A new technique to evaluate quiet time ionospheric TEC gradient has been developed (Budtho et al., 2020). Characteristics of the sporadic E (Es) layer has been studied by a GNSS network (Saito et al., 2021). Two-dimensional distribution of the sporadic E can be monitored in a wide area. By using observations by GNSS network, a method to derive parameters of the Es layer structures such as location, propagation direction, and velocity. Operational impacts of the anomalous propagation of ILS (instrument landing system) signals on airborne receivers has been investigated. The results have been reported to the International Civil Aviation Organization for their consideration to include their manuals.

=== Recent papers===

J. Budtho, P. Supnithi, and S. Saito, Single-Frequency Time-Step Ionospheric Delay Gradient Estimation at Low-Latitude Stations, IEEE Access, 8, 2020, DOI:10.1109/ACCESS.2020.3035247

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4.4. Report from the Chiba University
(Hiroyuki Nakata, Chiba University)

=== Recent papers===

Nakata, H., Takaboshi, K., Takano, T., Tomizawa, I. (2021). Vertical propagation of coseismic ionospheric disturbances associated with the foreshock of the Tohoku Earthquake observed using HF Doppler sounding. Journal of Geophysical Research: Space Physics, 126, e2020JA028600. https://doi.org/10.1029/2020JA028600

T. Miyashita, Takuya Miyashita; Hiroyo Ohya; Fuminori Tsuchiya; Asuka Hirai; Mitsunori Ozaki; Kazuo Shiokawa; Yoshizumi Miyoshi; Nozomu Nishitani; Mariko Teramoto; Martin Connors; Simon G. Shepherd; Yoshiya Kasahara; Atsushi Kumamoto; Masafumi Shoji; Iku Shinohara; Hiroyuki Nakata; Toshiaki Takano, "ULF modulation of energetic electron precipitation observed by VLF/LF radio propagation," in URSI Radio Science Bulletin, vol. 2020, no. 372, pp. 29-40, March 2020, doi: 10.23919/URSIRSB.2020.9240099.

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

=== Recent papers===

<Atmospheric studies>

Hubert Luce, Hiroyuki Hashiguchi, On the estimation of vertical air velocity and detection of atmospheric turbulence from the ascent rate of balloon soundings, Atmospheric Measurement Techniques, 13, 4, 1989-1999, April 2020.

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M. Kohma, K. Sato, K. Nishimura, M. Tsutsumi, T. Sato, A Statistical Analysis of the Energy Dissipation Rate Estimated From the PMWE Spectral Width in the Antarctic, Journal of Geophysical Research: Atmospheres, 125, 16, August 2020.

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