

PREFACE

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# Special issue “16th International Symposium on Equatorial Aeronomy (ISEA-16), 2022”

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The International Symposium on Equatorial Aeronomy (ISEA) has been held once in every 3 to 4 years since 1962. Researchers from the fields of atmospheric, ionospheric and magnetospheric sciences gather together during ISEA to share new findings, discuss the current status, and identify remaining key questions in equatorial and low-latitude aeronomy. The 16th ISEA (ISEA-16) was held from September 12 to 16, 2022 at the Research Institute for Sustainable Humanosphere, Kyoto University, Japan. Since the symposium period was close to the end of COVID-19 worldwide pandemic, it was held as a hybrid event (in-person and virtual participation). The symposium was successfully attended by 70 in-person (44 overseas) and 63 virtual (59 overseas) participants.

ISEA-16 consisted of 7 scientific sessions, a keynote lecture on the first day, and a closing lecture on the final day. The scientific sessions were: (1) Equatorial E- and F-region irregularities: cause and effects; (2) Longitudinal/hemispheric variation of equatorial electrodynamics; (3) Atmosphere-ionosphere vertical coupling at low- and mid-latitudes; (4) Space weather effects at low- and mid-latitudes; (5) Recent advances in instrumentation and observation; (6) Application of numerical techniques for aeronomy; and (7) Future trends, opportunities, and challenges in low-latitude aeronomy. Important scientific results presented in

ISEA-16 are collected within the special issue, which includes one Frontier Letter (Hosokawa et al. 2023), two Express Letters (Kumar et al. 2023; Suclupe et al. 2023), and 12 full papers. In the following, we summarize the contents of papers in the special issue briefly.

One of the oldest topics in equatorial aeronomy is Equatorial spread F (ESF), or equatorial plasma bubbles (EPB) which was observed for the first time as abnormal ionogram more than 80 years ago. Understanding the day-to-day variability of ESF has been an important and long-standing issue for HF radio communication in the pre-space era and for satellite communication/navigation systems in the modern era. Hosokawa et al. (2023) conducted EPB monitoring by using VHF radio signals for the aeronautical navigation system. This technique has been shown to have large potential to continuously monitor EPBs in wide area even over the ocean where no local ground stations are available. Abadi et al. (2023) investigated new forecast techniques for ESF occurrence based on ionosonde observations in Southeast Asia. Figueiredo et al. (2023) studied secondary instability generated on EPB walls, and Rino et al. (2023) investigate stochastic structure inside EPBs based on a high-resolution EPB simulation model. New observation instruments were installed in various regions: an UHF radar in the Jicamarca Radio Observatory (Rodrigues et al. 2023), scintillation monitors in Thailand compared with LEO observations (Seechai et al. 2023), and HF Doppler receivers in Taiwan compared with airglow observations (Sejima et al. 2023).

Strong impacts on the upper atmosphere and the ionosphere after the huge volcanic eruption in Tonga in January 2022 were timely topics during ISEA-16. Choi et al. (2023) described an ionospheric density hole observed by COSMIC-2, ICON, Swarm, and

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ground-based TEC which was suggested to result from an interplay between the EIA development and neutral wind disturbances due to the eruption. Nakata et al. (2023) investigated traveling ionospheric disturbances observed by a HF Doppler sounding system in Japan, while Pacheco et al. (2024) studied atmospheric and ionospheric impacts over Peru.

The application of machine learning technique has been a major topic in atmospheric and ionospheric sciences. Therefore, we organized Session 6 entitled “Application of numerical techniques for aeronomy” at ISEA-16 which presented several studies that used machine learning method. Two papers of this session are published in this special issue: (i) Thammavongsy et al. (2023) used artificial neural network and long short-term memory to forecast ESF occurrence by ionosonde data in Thailand, while (ii) Thanakulketsarat et al. (2023) developed models for classification of radar backscatter from EPBs using convolutional neural network and support vector machine techniques.

This special issue has also welcomed papers on recent subjects on low-latitude aeronomy which very well complement the presentations given during the conference. Kumar et al. (2023) studied the relation between the strength of the northern stratospheric polar vortex and the magnitude of solar and lunar tides detected in the equatorial electrojet. Based on a newly installed multistatic specular meteor radar, Suclupe et al. (2023) investigated the climatology of mesosphere and lower thermosphere diurnal tides in neutral winds over Jicamarca. Matamba et al. (2023) studied the response of the ionosphere over South Africa during a geomagnetic storm in November 2021.

All 15 papers in this special issue contribute to advance a variety of aspects of equatorial aeronomy. We anticipate that scientists from the aeronomy community will actively gather again in the next 17th International Symposium on Equatorial Aeronomy (ISEA-17), which will be held in Costa Rica in 2026.

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#### Author contributions

All the authors of this article served as guest editors for this special issue. TY drafted the manuscript. All the authors read and approved the final manuscript.

#### Availability of data and materials

Not applicable.

## Declarations

#### Competing interests

The authors declare that they have no competing interests.

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