

## ISEE Award in 2025

**Award Winner:**

**Hiroyuki Yamada (Professor, Former Faculty of Science, University of the Ryukyus)**

**Title: Establishment of high-altitude penetration flight observation techniques for the inner core region of typhoons and contributions to the pioneering of typhoon research based on these techniques**

Professor Hiroyuki Yamada has produced many research achievements on mesoscale meteorology, focusing on clouds and precipitation, through observational studies and numerical simulations. Among these, a remarkable achievement related to the ISEE's Joint Usage/Research Program is his work on typhoon research based on aircraft observations. In this research, Professor Yamada has made significant contributions to pioneering a new research field: observational studies of the inner core region of typhoons, including the eye, using aircraft. According to his great efforts, it became possible to conduct high-altitude penetration observations of the typhoon eye, focusing on the inner core region, and direct observations of typhoon intensity during the T-PARCII (Tropical cyclones-Pacific Asian Research Campaign for Improvement of Intensity estimations/forecasts) project, which is currently led by ISEE. Such observations had rarely been conducted before, and even now, are almost exclusively carried out by T-PARCII worldwide. In this sense, the high-altitude penetration flight observations of the typhoon inner core region pioneered by Professor Yamada are extremely original and internationally significant. Furthermore, these observations have developed into the aircraft joint usage (dropsonde) category, one of the categories of ISEE's Joint Usage/Research Program.

T-PARCII's first aircraft observation of a typhoon was with Super Typhoon Lan in 2017. Initially, the plan was to observe only the peripheral regions of the typhoon, but Professor Yamada discovered the possibility of penetrating the eyewall by the aircraft and challenged the penetration observation of the eye. This observation greatly changed the direction of subsequent aircraft observations of typhoons and opened a new path for research on the intensity of super typhoons. By observing all vertical layers of the eye and inner core region from high-altitude aircraft using dropsondes, new discoveries such as the double warm-core structure were made (Yamada et al. 2021 [6]), and these results contributed to elucidating the formation mechanisms through studies using numerical models (Tsujino et al. 2021 [8]). These observation data were used for data assimilation in numerical weather prediction models, demonstrating improvements in typhoon forecasts (Ito et al. 2018 [10]).

In the following year, 2018, continuous observations over four days of Super Typhoon Trami were conducted, capturing rapid changes in the typhoon and characteristic clouds that formed within it, and clarifying their formation mechanisms (Hirano et al. 2022 [3]). The dropsonde data from this time were also used to validate satellite observations of the double eyewall structure of Typhoon Trami (Tsujino et al. 2021 [7]).

Professor Yamada continued aircraft observations of typhoons, proposing flight patterns suitable for observing the inner core region, such as the Alpha pattern and Butterfly pattern, and succeeded for the first time in observations using the Butterfly pattern with Super Typhoon Mindulle in 2021. In the 2022 observation of Super Typhoon Nanmadol, observations of the double eyewall structure were also successful. Furthermore, Professor Yamada actively participated in ISEE's Joint Usage/Research Program, contributing to the promotion of collaborative research on ISEE's Aircraft Joint Research (Dropsonde) through the employment of researchers. He also served as the chair of the Aircraft Utilization Committee of ISEE,

contributing to the development of the institute from a broad perspective.

In the western North Pacific, aircraft observations of typhoons are conducted by the Taiwan Central Weather Administration, but only peripheral observations are performed, and penetration observations into the typhoon eye have not been conducted. For hurricanes, the US Hurricane Hunters conduct penetration observations of the eye, but at a low altitude of about 3 km, and high-altitude penetration observations like those conducted by T-PARCII at about 14 km are not performed. By conducting dropsonde observations from high altitudes through the entire layer from the inside of the eye to the sea surface, it becomes possible for the first time to observe the structure of the warm core inside the eye, which controls the intensity of the typhoon. In this respect, the penetration observation of the eye pioneered by Professor Yamada is groundbreaking. Japan's aircraft observations of typhoons are currently attracting attention from various countries, such as the United States, Taiwan, Korea, and China.

As described above, Professor Hiroyuki Yamada is a leading scientist in typhoon research centered on aircraft observations, promoting typhoon research from both observational and numerical simulation perspectives, and achieving many excellent results. In particular, he made possible the world's first dropsonde observations of the typhoon eye from high altitudes, and these achievements have developed into ISEE's Aircraft Joint Research (Dropsonde). For these significant achievements, it has been decided to award him the 2025 ISEE Award (Institute for Space-Earth Environmental Research Award).

Professor Yamada collapsed due to illness in autumn 2023 and passed away suddenly in autumn 2024.

#### **Related Collaborative Research Projects at ISEE (Selected)**

- 2023, General Collaborative Research: Development of cylindrical coordinate datasets using typhoon dropsonde data
- 2022, General Collaborative Research: Same as above
- 2021–2020, General Collaborative Research: Safety studies of typhoon flights using high-resolution numerical models
- 2018, General Collaborative Research: Optimal estimation of typhoon intensity using ground radar and aircraft in the Ryukyu Islands

#### **Selected Publications (Main Typhoon-Related Papers Since 2018)**

- [1] Maru, E., K. Ito, and **H. Yamada**, 2025: Analysis of Tropical Cyclone Rapid Intensification in the Southwest Pacific Region, *J. Meteor. Soc. Japan*, 103(2), 201-218, doi:10.2151/jmsj.2025-010.
- [2] Hirano, S., K. Ito, and **H. Yamada**, 2023: Tropical cyclone track modified by a front located to the northeast, *SOLA*, 19, 109-115, doi:10.2151/sola.2023-015.
- [3] Hirano, S., K. Ito, **H. Yamada**, S. Tsujino, K. Tsuboki, and C.-C. Wu, 2022: Deep eye clouds observed in Tropical Cyclone Trami (2018) during T-PARCII dropsonde observations. *J. Atmos. Sci.*, **79**, 683-703.
- [4] Ohigashi, T., K. Tsuboki, T. Shinoda, H. Minda, M. Kyushima, **H. Yamada**, and H. Iwai, 2021: Mammatus-like echo structures along the base of upper-tropospheric outflow-layer clouds of typhoons observed by cloud radar. *Geophysical Research Letter*, **48**, e2021GL094973.
- [5] Higa, M., S. Tanahara, Y. Adachi, N. Ishiki, S. Nakama, **H. Yamada**, K. Ito, A. Kitamoto, and R. Miyata, 2021: Domain knowledge integration into deep learning for typhoon intensity classification. *Scientific Reports*, **11**, 12972.
- [6] **Yamada, H.**, K. Ito, K. Tsuboki, T. Shinoda, T. Ohigashi, M. Yamaguchi, T. Nakazawa, N. Nagahama, and K. Shimizu, 2021: The double warm-core structure of Typhoon Lan (2017) as observed through the first Japanese eyewall-penetrating aircraft reconnaissance. *J. Meteor. Soc. Japan*, **99**, 1297-1327.

- [7] Tsujino, S., T. Horinouchi, T. Tsukada, H.-C. Kuo, **H. Yamada**, and K. Tsuboki, 2021: Inner-core wind field in a concentric eyewall replacement of Typhoon Trami (2018): A quantitative analysis based on the Himawari-8 satellite, *J. Geophys. Res. (Atmospheres)*, **126**, e2020JD034434. <https://doi.org/10.1029/2020JD034434>.
- [8] Tsujino, S., K. Tsuboki, **H. Yamada**, T. Ohigashi, K. Ito, and N. Nagahama, 2021: Intensification and Maintenance of a Double Warm-Core Structure in Typhoon Lan (2017) Simulated by a Cloud-Resolving Model, *J. of Atmos. Sci.*, **78**, 595-617. DOI:<https://doi.org/10.1175/JAS-D-20-0049.1>
- [9] Ohigashi, T., K. Tsuboki, Y. Suzuki, **H. Yamada**, and K. Nakagawa, 2020: Characteristics of upper-tropospheric outflow-layer clouds of Typhoon Francisco (2013) observed by hydrometeor videonde. *Atmos. Res.*, **235**, DOI:<https://doi.org/10.1016/j.atmosres.2019.104736>
- [10] Ito, K., **H. Yamada**, M. Yamaguchi, T. Nakazawa, N. Nagahama, K. Shimizu, T. Ohigashi, T. Shinoda, and K. Tsuboki, 2018: Analysis and forecast using dropsonde data from the inner-core region of Tropical Cyclone Lan (2017) obtained during the first aircraft missions of T-PARCII. *SOLA*, **14**, 105-110.

## Career summary of the award winners:

Hiroyuki Yamada

Professor, Former Faculty of Science, University of the Ryukyus

He earned his Ph.D. in Science from Hokkaido University in 2000. That same year, he began his research career at the Frontier Research System for Global Change, followed by roles at JAMSTEC as researcher and senior researcher. In 2012, he joined the University of the Ryukyus as associate professor and became full professor in 2022. Since 2023, he has served as assistant to the university president. He has also been a visiting faculty member at Yokohama National University since 2021 and has contributed to ISEE since 2015 as a specialist committee member.

