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Research Topics

- ◇ Dynamics of atmospheric gravity waves in terms of generation, propagation and dissipation
- ◇ Dynamics of trapped waves on the equator, mid-latitude tropopause and polar vortex edge
- ◇ Interaction of global-scale circulation/oscillation and waves in the stratosphere and mesosphere
- ◇ Interhemispheric and intra-hemispheric couplings in the middle atmosphere
- ◇ Three-dimensional transformed-Eulerian mean theory
- ◇ Mesosphere-Stratosphere-Troposphere radar observations in the Antarctic (PANSY)
- ◇ Data assimilation system development and production of reanalysis of the whole neutral atmosphere (JAWARA)
- ◇ Polar atmospheric sciences such as the katabatic winds, Antarctic ozone hole, and polar stratospheric/mesospheric clouds
- ◇ Dynamics of global-scale Martian atmospheric circulation

Research Summary

Through observational research using mesosphere-stratosphere-troposphere (MST) radars, radiosondes, and other instruments, she has highlighted the crucial roles of atmospheric gravity waves in the dynamics of the global circulation and the equatorial quasi-biennial oscillation (QBO). To address the insufficient observation capabilities in the Antarctic, she initiated and led the construction of the world's first Antarctic MST radar, the PANSY radar, which now successfully conducts long-term continuous observations.

She has also led the international collaborative project ICSOM (Observation and Model-based Coupled Research in the Northern and Southern Hemispheres), aimed at unraveling the mechanism linking the Arctic and Antarctic atmospheres. In this project, she directed seven successful campaigns capturing mesospheric gravity waves by globally networking atmospheric radars. Her team developed an advanced data assimilation system, resulting in a comprehensive reanalysis dataset covering the entire middle atmosphere. They also performed high-resolution simulations of gravity waves using a high-top general circulation model.

Building on these research resources and developing three-dimensional wave-mean flow interaction theory, she continues her research so as to comprehensively elucidate the role of atmospheric gravity waves and Rossby waves in the dynamics of the middle atmosphere in terms of heat and momentum transport.

Research methods and theories developed for studying the dynamics of the middle atmosphere dynamics are applied to Martian atmospheric reanalysis data to examine the dynamical differences in the dynamics of the two planets.

Professional Experience

- ◇ JSPS Research Fellow, Graduate School of Science, Kyoto University, 1991-1993

- ◇ Research Associate, Center for Climate System Research, The University of Tokyo, 1993-1995
- ◇ Research Associate, Graduate School of Science, Kyoto University, 1995-1999
- ◇ Associate Professor, National Institute of Polar Research, 1999-2005
- ◇ Professor, Graduate School of Science, The University of Tokyo, 2005-present
- ◇ Vice Dean, Graduate School of Science, The University of Tokyo, 2023-2026
- ◇ Director, Center for Coproduction of Inclusion, Diversity and Equity, The University of Tokyo, 2026-present
- ◇ Vice President, The University of Tokyo, 2026-present

Education

- ◇ B.S. (Geophysics), The University of Tokyo, 1984
- ◇ M.S. (Geophysics), The University of Tokyo, 1986
- ◇ PhD (Geophysics), Kyoto University, 1991

Awards

- ◇ Yamamoto-Syono Award for Outstanding Papers, the Meteorological Society of Japan, 1991
- ◇ The Award of the Meteorological Society of Japan, 1998
- ◇ The JMSJ Award, the Meteorological Society of Japan, 2010
- ◇ Commendation for Science and Technology by the Minister of Education, Culture, Sports, Science and Technology, Japan, 2014
- ◇ Commendation of the Contributor of the Promotion of Building the Maritime Nation of Japan by the Prime Minister, Japan, 2015
- ◇ Fujiwhara Award, the Meteorological Society of Japan, 2018.
- ◇ AOGS Atmospheric Sciences Section Distinguished Lecturer, 2018.
- ◇ Medal with Purple Ribbon, awarded by the Emperor of Japan, 2021
- ◇ JpGU Fellow, 2022
- ◇ AOGS Fellow, 2025

Professional Activities

- ◇ Visiting Scientist, Northwest Research Associates, 1995-2000
- ◇ Wintering Party Member, The 44th Japanese Antarctic Research Expedition, 2002-2004
- ◇ President of the Meteorological Society of Japan (2020-2024)
- ◇ President of the Atmospheric and Hydrospheric Science section, Japan Geoscience Union (2022-)
- ◇ Member of American Meteorological Society, American Geophysical Union, Society of Geomagnetism and Earth, Planetary and Space Sciences
- ◇ Member, Science Council of Japan, 2005-present
- ◇ Assistant to the President, The University of Tokyo, 2010-2011
- ◇ Special Adviser to the President, The University of Tokyo, 2020-2021
- ◇ Chief Editor, Journal of the Meteorological Society of Japan, 2008-2010
- ◇ Commission Member, ICMA/IAMAS/IUGG, 2002-2006
- ◇ Scientific Discipline Representative, SCOSTEP, 2002-2012

- ✧ Scientific Steering Group Member (2013-), Co-leader of Gravity Wave Activity (2014-), SPARC/WCRP
- ✧ 179 peer-reviewed articles (including 14 Japanese articles)
<http://www-aos.eps.s.u-tokyo.ac.jp/~sato-lab/en/publications/publications/>
- ✧ 27 invited talks in international conferences in past 10 years
- ✧ PI, The Program of the Antarctic Syowa MST/IS radar, 2000-present

Selected papers (* corresponding author)

- ✧ Asumi, A., K. Sato, & Y.-Y. Hayashi (2026), Effects of global dust storm in MY28 and roles of unresolved waves on the general circulation of Mars. *J. Geophys. Res. Planets*, **131**, e2025JE009200. <https://doi.org/10.1029/2025JE009200>
- ✧ Sato, K., D. Koshin, J. Suclupe, J. L. Chau, L. M. Lima, G. Li, S. V. B. Rao, M. V. Ratnam, R. Rodriguez, and D. Scipion (2025), Causes of the abnormally strong easterly phase of the mesopause semiannual oscillation during the March equinox of 2023 revealed by a new reanalysis data covering the entire middle atmosphere. *Geophys. Res. Lett.*, **52**, e2025GL114658. <https://doi.org/10.1029/2025GL114658>
- ✧ Asumi, A., K. Sato, M. Kohma, and Y.-Y. Hayashi (2025), Climatology of the Residual Mean Circulation of the Martian Atmosphere and Contributions of Resolved and Unresolved Waves Based on a Reanalysis Dataset. *J. Geophys. Res. Planet*, **130**, e2023JE008137. <https://doi.org/10.1029/2023JE008137>
- ✧ Koshin, D., K. Sato*, S. Watanabe, and K. Miyazaki (2025), The JAGUAR-DAS whole neutral atmosphere reanalysis: JAWARA. *Prog. Earth Planet Sci.*, **12**, 1. <https://doi.org/10.1186/s40645-024-00674-3>
- ✧ Sato, K., Y. Tomikawa, M. Kohma, R. Yasui, D. Koshin, H. Okui, et al. (2023), Interhemispheric Coupling Study by Observations and Modelling (ICSOM): Concept, Campaigns, and Initial Results. *J. Geophys. Res. Atmos.*, **128**, e2022JD038249. <https://doi.org/10.1029/2022JD038249>
- ✧ Minamihara, Y., K. Sato*, and M. Tsutsumi (2023), Kelvin-Helmholtz Billows in the Troposphere and Lower Stratosphere Detected by the PANSY Radar at Syowa station in the Antarctic. *J. Geophys. Res. Atmos.*, **128**, e2022JD036866. <https://doi.org/10.1029/2022JD036866>
- ✧ Sato, K., T. Kinoshita, Y. Matsushita, and M. Kohma (2022), A new three-dimensional residual flow theory and its application to Brewer–Dobson circulation in the middle and upper stratosphere, *J. Atmos. Sci.*, **79**(2), 429-448. <https://doi.org/10.1175/JAS-D-21-0094.1>
- ✧ Okui, H., K. Sato, D. Koshin, and S. Watanabe (2021), Formation of a mesospheric inversion layer and the subsequent elevated stratopause associated with the major stratospheric sudden warming in 2018/19, *J. Geophys. Res. Atmos.*, **126**, e2021JD034681. <https://doi.org/10.1029/2021JD034681>
- ✧ Kohma, M., K. Sato, K. Nishimura, M. Tsutsumi, and T. Sato (2020), A statistical analysis of the energy dissipation rate estimated from the PMWE spectral width in the Antarctic. *J. Geophys. Res. Atmos.*, **125**, e2020JD032745. <https://doi.org/10.1029/2020JD032745>
- ✧ Minamihara, Y., K. Sato, and M. Tsutsumi (2020), Intermittency of gravity waves in the Antarctic troposphere and lower stratosphere revealed by the PANSY radar observation. *J. Geophys. Res. Atmos.*, **125**, e2020JD032543. <https://doi.org/10.1029/2020JD032543>
- ✧ Sato, K., and S. Hirano (2019), The climatology of Brewer–Dobson circulation and the contribution of gravity waves, *Atmos. Chem. Phys.*, **19**, 4517-4539. <https://doi.org/10.5194/acp-19-4517-2019>
- ✧ Sato, K., R. Yasui, and Y. Miyoshi (2018), The momentum budget in the stratosphere, mesosphere, and lower thermosphere Part 1: Contribution of different wave types and in situ generation of Rossby waves, *J. Atmos. Sci.*, **75**, 3613-3633. <https://doi.org/10.1175/JAS-D-17-0336.1>

- ✧ Sato, K., M. Kohma, M. Tsutsumi, and T. Sato (2017), Frequency spectra and vertical profiles of wind fluctuations in the summer Antarctic mesosphere revealed by MST radar observations, *J. Geophys. Res. Atmos.*, **122**, 3-19. <https://doi.org/10.1002/2016JD025834>
- ✧ Shibuya R., K. Sato, M. Tsutsumi, T. Sato, Y. Tomikawa, K. Nishimura, and M. Kohma (2017), Quasi-12h inertia-gravity waves in the lower mesosphere observed by the PANSY radar at Syowa Station (39.6E, 69.0S), *Atmos. Chem. Phys.*, **17**, 6455-6476. <https://doi.org/10.5194/acp-2016-813>
- ✧ Sato, K., and M. Nomoto (2015), Gravity wave-induced anomalous potential vorticity gradient generating planetary waves in the winter mesosphere, *J. Atmos. Sci.*, **72**, 3609-3624. <https://dx.doi.org/10.1175/JAS-D-15-0046.1>
- ✧ Sato, K., M. Tsutsumi, T. Sato, T. Nakamura, A. Saito, Y. Tomikawa, K. Nishimura, M. Kohma, H. Yamagishi and T. Yamanouchi, Program of the Antarctic Syowa MST/IS Radar (PANSY) (2014), *J. Atmos. Solar-Terr. Phys.*, **118, PartA**, 2-15. <https://doi.org/10.1016/j.jastp.2013.08.022>
- ✧ Kinoshita, T., and K. Sato (2013), A formulation of three-dimensional residual mean flow applicable both to inertia-gravity waves and to Rossby waves, *J. Atmos. Sci.*, **70**, 1577-1602. <https://doi.org/10.1175/JAS-D-12-0137.1>
- ✧ Sato, K., S. Tatenno S. Watanabe, and Y. Kawatani (2012), Gravity wave characteristics in the Southern Hemisphere revealed by a high-resolution middle-atmosphere general circulation model, *J. Atmos. Sci.*, **69**, 1378–1396. <https://doi.org/10.1175/JAS-D-11-0101.1>.
- ✧ Sato, K., S. Watanabe, Y. Kawatani, Y. Tomikawa, K. Miyazaki, and M. Takahashi (2009), On the origins of mesospheric gravity waves, *Geophys. Res. Lett.*, **36**, L19801. <https://doi.org/10.1029/2009GL039908>
- ✧ Sato K., and M. Yoshiki (2008), Gravity wave generation around the polar vortex in the stratosphere revealed by 3-hourly radiosonde observations at Syowa Station, *J. Atmos. Sci.*, **65**, 3719-3735. <https://doi.org/10.1175/2008JAS2539.1>
- ✧ Sato, K., and N. Hirasawa (2007), Statistics of Antarctic surface meteorology based on hourly data in 1957-2007 at Syowa Station, *Polar Sci.*, **1**, 1-15. <https://doi.org/10.1016/j.polar.2007.05.001>.
- ✧ Sato, K., M. Yamamori, S. Ogino, N. Takahashi, Y. Tomikawa, and T. Yamanouchi (2003), A Meridional Scan of the Stratospheric Gravity Wave Field over the Ocean in 2001 (MeSSO2001), *J. Geophys. Res.*, **108(D16)**, 4491. <https://doi.org/10.1029/2002JD003219>.
- ✧ Tomikawa, Y., and K. Sato (2003), Trapped waves in the edge region of stratospheric polar vortices, *J. Geophys. Res.*, **108(D2)**, 4047. <https://doi.org/1029/2002JD002579>
- ✧ Yoshiki, M., and K. Sato (2000), A statistical study of gravity waves in the polar regions based on operational radiosonde data, *J. Geophys. Res.* **105**, 17995-18011. <https://doi.org/10.1029/2000JD900204>
- ✧ Sato, K., T. Kumakura, and M. Takahashi (1999), Gravity waves appearing in a high-resolution GCM simulation, *J. Atmos. Sci.*, **56**, No.8, 1005-1018. [https://doi.org/10.1175/1520-0469\(1999\)056<1005:GWIAH>2.0.CO;2](https://doi.org/10.1175/1520-0469(1999)056<1005:GWIAH>2.0.CO;2)
- ✧ Sato, K., and T. J. Dunkerton (1997), Estimates of momentum flux associated with equatorial Kelvin and gravity waves, *J. Geophys. Res.*, **102**, 26,247-26,261. <https://doi.org/10.1029/96JD02514>
- ✧ Sato, K. (1994), A statistical study of the structure, saturation and sources of inertio-gravity waves in the lower stratosphere observed with the MU radar, *J. Atmos. Terr. Phys.*, **56**, 755-774. [https://doi.org/10.1016/0021-9169\(94\)90131-7](https://doi.org/10.1016/0021-9169(94)90131-7)
- ✧ Sato, K., H. Eito, and I. Hirota (1993), Medium-scale traveling waves in the extratropical upper troposphere, *J. Meteor. Soc. Japan*, **71**, 427-436. https://doi.org/10.2151/jmsj1965.71.4_427
- ✧ Sato, K. (1993), Small-scale wind disturbances observed by the MU radar during the passage of Typhoon Kelly, *J. Atmos. Sci.*, **50**, 518-537. [https://doi.org/10.1175/1520-0469\(1993\)050<0518:SSWDOB>2.0.CO;2](https://doi.org/10.1175/1520-0469(1993)050<0518:SSWDOB>2.0.CO;2)
- ✧ Sato, K. (1990), Vertical wind disturbances in the troposphere and lower stratosphere observed by the MU radar, *J. Atmos. Sci.*, **47**, 2803-2817. [https://doi.org/10.1175/1520-0469\(1990\)047<2803:VWDITT>2.0.CO;2](https://doi.org/10.1175/1520-0469(1990)047<2803:VWDITT>2.0.CO;2)