2019 ISEE Award

Award Winner: UCSD IPS group
 （Dr. B. V. Jackson, Dr. H.S. Yu, Dr. P. P. Hick, Dr. A. Buffington, Dr. D. Odstrcil）

Title: Contribution to Space-Earth Environmental Research through Studies on the Improvement of Space Weather Forecasting by the Computer-Assisted Tomography of Interplanetary Scintillation Data.

Citation:
Hot plasma flows from the sun at a speed of 300-800 km/s, and the earth is constantly engulfed by this outflow, which is known as the solar wind. The solar wind observed at the Earth varies drastically over time. This variation imposes significant influences on both the space environment and the Earth's upper atmosphere. When violent fluctuations of the solar wind occur due to excitation by a coronal mass ejection, which is a solar eruptive phenomenon, and these solar winds arrive at the Earth, the space environment and upper atmosphere are greatly disturbed. These disturbances in the space weather are known to cause serious problems in spacecraft systems, radio communications, and electric power grids. Therefore, studies that forecast the space weather have been actively conducted at many institutes worldwide.

The prediction of solar wind conditions at the Earth is a key issue in space weather forecasting. However, it is quite difficult to accurately predict this from solar observations since the formation mechanisms of the solar wind are not yet understood. Dr. Jackson of the University of California San Diego (UCSD) intended to improve space weather forecasting by utilizing observations of interplanetary scintillation (IPS), which serves as an effective method for remote sensing of the solar wind. IPS observations provide information on the solar wind flowing between the Sun and the Earth, and real-time analysis of IPS data enables accurate predictions of the solar wind. Dr. Jackson and his colleagues (the UCSD group) have developed a time-dependent tomography that enables reliable determination of the solar wind speed and density from IPS observations, with collaboration from the Institute for Space-Earth Environmental Research (ISEE) in Nagoya University. Through these ISEE joint research programs, they have developed advanced systems to predict various solar wind parameters including the magnetic field through the combination of a solar magnetic field model and a solar wind numerical model, known as ENLIL. The studies have revealed new aspects of the relationship

between the coronal and interplanetary magnetic fields. The results of these studies have been used at the Community Coordinated Modeling Center of NASA and the Korean Space Weather Center.

The UCSD IPS group has developed a new method for utilizing IPS observations, greatly contributing to the improvement of space weather forecasting. The UCSD IPS group has also contributed to nurturing young researchers via scientific research using IPS data. For these reasons, the ISEE award for 2019 is awarded to the UCSD IPS group.

List of ISEE Joint Research Program activities and the related publications by the award winner:
- ISEE Joint Usage and Joint Research Program Activities:
  ➢ 2015 Joint Research (International)
    PI: B.V. Jackson (UCSD), Title: A determination of Bz from closed photospheric magnetic field, Period: Jan. 12-22, 2016.
  ➢ 2016 International Joint Research Program
    PI: H.-S. Yu (UCSD), Title: Three-dimensional tomographic analysis using integrated global IPS data sets from MEXART and ISEE observations, Period: Jan. 13-20, 2017.
- Related publications
  ➢ Jackson, B.V., H.-S., Yu, A. Buffington, P.P. Hick, N. Nishimura, N. Nozaki, M. Tokumartu, K. Fujiki, and K. Hayashi (2016), Exploration of solar photospheric magnetic field data sets using the UCSD tomography, Space Weather, 14, 1107-1124.
  ➢ Jackson, B.V., H.-S. Yu, A. Buffington, P.P. Hick, M. Tokumaru, K. Fujiki, J. Kim, and J. Yun (2019), A Daily determination of Bz using Russell-McPheron effect forecast geomagnetic activity, Space Weather, 17, 639-652.
- Other Joint Research Activities
  ➢ Hsiu-Shan Yu conducted the joint research at ISEE from 12 to 20 Jan. 2016.
  ➢ Hsiu-Shan Yu conducted the joint research at ISEE on 1 Nov 2016.
  ➢ Hsiu-Shan Yu conducted the joint research at ISEE from 2 to 3 July 2018.
  ➢ B. V. Jackson and Hsiu-Shan Yu convened the Space Weather Radio Science (ST09) session in AOGS2018 at Honolulu, Hawaii with Munetoshi Tokumaru.
  ➢ B. V. Jackson conducted the joint research at ISEE on 8 July 2018.

Career summaries of the award winners:

Dr. Bernard V. Jackson (Research Scientist, CASS/UCSD) received his PhD in Astrophysics at Indiana University (USA) in 1970. He began his career in Solar Physics when he joined the Skylab coronagraph project at HAO in 1975. In 1979, he moved to UCSD, and helped develop the 74 MHz multi-station IPS system. He has been working on heliospheric studies using IPS and coronagraph observations since 1983 at the Center for Astrophysics and Space Sciences (CASS) at UCSD. He was a principal investigator of the Solar Mass Ejection Imager (SMEI), which was launched in 2003.

Dr. Hsiu-Shan Yu (Post-Doctoral Scholar, CASS/UCSD) received her PhD in Solar/Space Science at the National Central University (Taiwan) in 2011. She then worked at CASS/UCSD as a post-doctoral researcher/scholar in Dr. Jackson's lab. She performed combined analyses using IPS, SMEI, LASCO, STEREO, and Hinode observations to elucidate the propagation mechanisms of polar solar jets in interplanetary space. She has been actively involved in the integrated analysis of IPS observations collected at many stations worldwide.
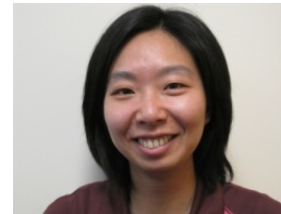
Dr. Paul P. Hick (Data Administrator, San Diego Supercomputer Center/UCSD) received his PhD in Astronomy at the Netherlands Institute for Space Research (SRON, Netherlands) in 1988. He worked at the Goddard Space Flight Center (GFSC, USA) on data analysis of solar X-ray observations made by Solar Maximum Mission (SMM) spacecraft. He also has several years of experience working with the observations of zodiacal light made by the Helios spacecrafts, and this led him to join the UCSD IPS group in 1994. He is an expert in computer programing and has made significant contributions to the development of the computer-assisted tomography method for IPS data.

Dr. Andrew Buffington (Research Scientist, CASS/UCSD) received his PhD in Physics at the Massachusetts Institute of Technology (USA). He has worked on physical experimental projects on cosmic ray measurements and superconducting magnets, among others. In 1984, he began to work on optical astronomy using high-precision photometry at CASS/UCSD. He played an important role in designing and developing SMEI in Dr. Jackson's lab. He has excellent knowledge and skills related to telescope optics, especially stray light reduction, which is important for high-precision photometry.

Dr. Dusan Odstrcil (Research Professor, George Mason University) received his PhD at the Comenius University (Czechoslovakia) in 1984. After gaining experience working as a researcher at several institutes in Czechoslovakia, he began to work on a 3D numerical model of the solar wind at the Space Environment Center in Boulder, CO, USA. The ENLIL model, which he developed on his own, has excellent reliability, and it has been widely used for space weather forecasting. In 2012, he moved to George Mason University (GMU). Since then, he has been collaborating with the UCSD IPS group on combined analysis using the ENLIL model and IPS tomography.