



# **2023-2027 Strategic Plan for the Space Science and Engineering Center**

**An Interdisciplinary  
Research Center of  
the Office of the Vice  
Chancellor for  
Research and  
Graduate Education  
(OVCRGE)  
University of Wisconsin–Madison**

**November 2023**

# Strategic Plan for the Space Science and Engineering Center

## 1. SSEC Mission

**To conduct atmospheric, oceanic, and environmental research of the Earth and other planets using foundational and innovative scientific and technological approaches to discover and apply the physical properties of our world for the benefit of humanity.**

More specifically, we consider it our mission to:

- Lead development of space-based, airborne, and ground based instrumentation for observing the earth's atmosphere, oceans and land surface, other planetary atmospheres, and astrophysical phenomena,
- Lead and conduct research programs that advance our understanding of earth system and astronomical sciences,
- Facilitate the transfer of research capabilities to operational observing and forecast systems,
- Support campus research initiatives with observational, computational, technical and management expertise, and
- Support the UW educational mission by involving undergraduate and graduate students in the research process.

## 2. Vision of SSEC

**SSEC will strive to advance our technical excellence in the observational, analytical, data, and computational sciences to further basic and applied research at the University of Wisconsin-Madison, the state of Wisconsin, the nation, and the international scientific community. SSEC is committed to the free dissemination of knowledge and creating a welcoming, diverse, and inclusive workplace.**

## 3. SSEC Structure and Roles in Strategic Planning

- Principal Investigators (PI)s lead programs, organized either as collections of programs within its NOAA Cooperative Institute [Cooperative Institute for Meteorological Satellite Studies (CIMSS)], or individually. Each program conducts its own project-level planning and management.
- The SSEC Director promotes the cooperation of independent programs and helps define unifying scientific themes and the general direction for future endeavors. The Director is responsible for the overall success of the SSEC Strategic Plan.
- The Executive Director is responsible for the administration of Center resources to implement Center-level science policy, including administrative program support and oversight. The Executive Director is responsible for helping to formulate and implement the Center-level Strategic Plan.
- The Administrative Director makes overall administrative decisions and is responsible for Accounting Services, Grants and Contracts, Human Resources, Purchasing, and Inventory. Strategic planning in this area involves projecting future financial health,

- personnel needs, and facility requirements.
- The Associate Director for Science is responsible for providing support to SSEC science activities to ensure a high-quality research environment. This includes support staff planning, coordination with technical computing on scientific computing issues, oversight of the SSEC Satellite Data Services and the McIDAS team, and supervision and proposal development support for PIs. Strategic planning activities include identifying opportunities and evaluating successful strategies.
- The Associate Director for Engineering is responsible for providing the necessary technical infrastructure, resources, and coordination in support of SSEC research activities. Technical infrastructure includes technical computing resources, receiving antenna systems, and systems required for the definition, development, and testing of scientific instrumentation. It also includes oversight of the systems and procedures necessary for assuring quality and safety. Strategic planning activities include identifying opportunities and evaluation of successful strategies.
- The SSEC Advisory Council (SAC) provides advice and information to the SSEC Director. The SAC consists of SSEC staff and affiliates, a combination of individuals who are nominated and elected by their peers in SSEC along with SSEC Director appointees. The SAC also serves as a conduit between SSEC staff and the SSEC Director. Strategic planning activities include providing feedback and evaluating strategic priorities.
- The SSEC Inclusion, Community, Equity and Diversity (ICED) Committee is responsible for increasing the awareness and priority for equity and diversity among all employees, actively fostering a sense of inclusion and community for all staff, serving as a forum for discussing issues or concerns of SSEC staff, and working collaboratively with the SSEC Directors to discuss and advise on equity and diversity issues. Strategic planning activities include providing feedback and evaluating successful strategies to support a welcoming, diverse, and inclusive workplace.

#### **4. SSEC Strategic Priorities related to UW–Madison Strategic Framework**

The UW–Madison Strategic Framework (2020-2025) identifies several priorities to “be a model public university in the 21st century, serving as a resource to the public, and working to enhance the quality of life in the state, the nation, and the world.” This section addresses SSEC contributions to the pursuit of these priorities. Detailed descriptions of specific activities are the subject of Section 5.

##### **4.1 Excellence in Research and Scholarship:** *Provide leadership for discovery, through support of the fearless sifting and winnowing of our world-class research enterprise and the dissemination of knowledge in its many forms.*

- Conduct basic and applied research with a commitment to excellence, developing knowledge and expertise to foster effective use of theory, observations, models, and technology to learn about the Earth and planets, their response to change, and to learn about astrophysical phenomena outside our solar system.
- Promote research by attracting talented people from a wide range of disciplines (scientists, engineers, technical and administrative staff), by providing opportunities for continuous professional development, and campus wide collaboration to stimulate new areas of investigation.

- Improve laboratory and computational infrastructure needed for instrument development, data analysis, modeling, data acquisition, and collaborative science.
- Provide the environment necessary to nurture innovative and enthusiastic research through teamwork and individual excellence.
- Facilitate the dissemination of research results to an interested public and those communities that might directly benefit from specific results, through web pages, open houses, cooperation with news outlets, and targeted mailings of publications (journal articles, newsletters, brochures, etc.).

**4.2 Excellence in Teaching and Educational Achievement:** *Provide access to a world-class, affordable educational experience.*

- Continue a strong campus affiliation with the Department of Atmospheric and Oceanic Sciences (AOS), the College of Engineering, and the Departments of Astronomy and Physics for student involvement and research synergism.
- Offer undergraduate and graduate students direct involvement in scientific discovery through participation on research teams.
- Provide hands-on experience with NASA, NOAA, DOE, and other agency instrument development and research programs, not often available in the university environment.

**4.3 Living the Wisconsin Idea:** *Partner with the community and the state to extend and apply our research, education, and practice-based knowledge to foster learning and support innovation and prosperity throughout Wisconsin.*

- Participate in collaborative research with federal agencies, including NASA, NOAA, NSF, and DOE.
- Support the education and outreach activities within CIMSS.
- Support the involvement of SSEC staff in public service activities.
- Expand remote learning and training of students and professionals through innovative education concepts and applications.
- Foster international cooperation by conducting training in the use of satellite data, developing global observing systems and analysis techniques for weather and climate applications.
- Accommodate and encourage exchange programs with international scientists and students.

**4.4 A Vibrant Campus Community:** *Build an organizational culture and climate that fosters engagement, inclusion, diversity, and equity.*

- Promote the recognition of contributions in all areas to Center programs.
- Maintain an atmosphere of group and individual achievement through openly sharing ideas and effective teamwork.
- Create opportunities to continue building a diversified research-oriented staff.
- Encourage cordial and respectful interactions at all times.
- Encourage personal development and growth by offering new opportunities and training.
- Promote student involvement in programs.

#### **4.5 A High-Performing Organization:** *Practice continuous improvement in all we do, for those we serve.*

- Maintain a well-staffed and experienced administrative team to manage pre- and post-award financial and reporting requirements, complete complex purchasing transactions, book regional, national and international travel, maintain records for capital inventory, and hire, onboard and support all employees with human resources needs.
- Provide a strong communications and library team to disseminate research results, publicize the SSEC story, and build a strong community.
- Leverage outcomes from SSEC2022 internal funding competition to strengthen SSEC's competitiveness.
- Continuously monitor the work environment for potential roadblocks to success and engage workforce to develop effective strategies for improvement.

### **5. Strategic Research Activities for 2023-2027**

In this section we have defined the SSEC activities expected to contribute to accomplishing our mission over the next five years, again using major headings corresponding to the priorities of the UW–Madison Strategic Framework. While the activity descriptions are reasonably general and brief, they include references to specific program names to make clear connections with research we are currently conducting. In addition to ongoing efforts, we have included new activities that are expected to be important during the next five years to present our vision of the foreseeable future. We plan to update this section annually with input from the SAC, ICED, SSEC scientists and our collaborators.

#### **5.1 Advance Research: 2023-2027**

##### **5.1.1 Observing Science**

- Actively participate in the development of operational satellite observing systems, including new high spectral resolution infrared (IR) instruments, and high spatial resolution visible and infrared imagers (Next-Generation Polar Orbit Constellation and Geostationary Extended Orbit (GeoXO) programs).
- Continue to play a leading role in satellite and aircraft-based instrument radiometric calibration and pre-launch spectral and radiometric performance characterization.
- Continue evaluation of climate change signals from spaceborne assets like hyperspectral infrared sounders from NOAA (CrIS), EUMETSAT (IASI and IASI-NG), and China (HIRAS).
- Continue seeking opportunities to participate in NASA Earth Venture (EV) proposals such as TEMPO, PREFIRE, and TROPICS and actively pursue university and industry partnerships for future EV solicitations.
- Conduct research and development activities that align with NOAA's mission to benefit the public through the next-generation LEO and GEO programs.
- Continue SSEC's pioneering development of machine learning-based algorithms for severe weather, lightning, and tropical cyclone applications and extend these capabilities to short-term fire behavior predictions and other geophysical phenomena.
- Explore ground-based high spectral resolution IR applications and development of new low-cost high spectral resolution IR capabilities.

- Explore opportunities for collaboration with College of Agriculture and Life Sciences (CAL S) faculty and staff through the Wisconsin Mesonet (WiscoNet).
- Explore ground-based high spectral resolution lidar (HSRL) applications, and development of new low-cost HSRL capabilities.
- Continue aircraft instrument development and field deployments, including development of the next generation of the Scanning High-resolution Interferometer Sounder (S-HIS NG).
- Pursue new opportunities for deploying the Space Science and Engineering Center Portable Atmospheric Research Center (SPARC) and SPARCLET through the NSF Community Instruments and Facilities (CIF) program.
- Design and develop automated surface-based weather stations in extreme climates (e.g., Antarctica) and serve as the national data repository for Antarctic observations through the Antarctic Meteorological Research Center (AMRC).
- Design and develop new ice core drills and drilling technology required to enable the science supported by the U.S. Ice Drilling Program (IDP).
- Promote planetary science, including ground-based and space telescope observing and analysis, and instrument/mission development.
- Develop university and external collaborations in astrobiology, atmospheric science, and circulation modeling to pursue planetary research, including exoplanets, using the James Webb Space Telescope (JWST) and the Nancy Roman Space Telescope.

#### 5.1.2 Analytical Science

- Ensure that SSEC is a key part of the next generation of U.S. geostationary satellites (GeoXO) including participation in science teams, training, education and outreach, instrument trade studies, and proxy data and waiver analysis for GXI and GXS.
- Create and improve applications and products from remote sensing observations to improve weather analysis, nowcasts and forecasts focusing on end-user needs and display systems and mechanisms.
- Expand research in data assimilation, emphasizing the use of satellite data in numerical models and testing their impact through collaboration with the Joint Center for Satellite Data Assimilation (JCSDA), Joint Effort for Data assimilation Integration (JEDI) and the National Center for Environmental Prediction (NCEP).
- Lead efforts in all-sky data assimilation, coupled data assimilation, land surface models, and model verification.
- Continue innovative research in NWP modeling and prediction, including partnering with the NOAA Earth Science Research Laboratory (ESRL) to implement stratospheric and tropospheric chemistry into the Unified Forecast System.
- Conduct observing system simulation experiments to evaluate the utility of proposed instrument systems.
- Participate in the DOE ARM climate program through instrument development and applications studies.
- Build on the climate related aspects of our cloud research, and bridge the gap between the climate modelling and climate observing communities. Increase SSEC's observed cloud climate record role in international efforts like the IPCC reports.
- Conduct cloud properties research for better understanding the role clouds play in

weather and climate.

- Continue biomass-burning research to improve detection of fires from space, provide low latency detection to the fire management community, and assess wildfire impacts on air quality.
- Expand satellite-based trace gas studies for regional air quality and climate applications.
- Apply remote sensing science to multi-disciplinary issues (e.g., flash drought, energy analysis and policy, environmental justice, air quality).
- Expand model verification expertise to include assessments of the land surface, land-atmosphere coupling, and the use of multi-variate verification methods.
- Improve the determination of land surface temperature and emissivity.
- Expand research relating the closely coupled remotely sensed land surface fluxes and soil moisture to agricultural applications, short- to medium-term weather prediction, and monitoring of the land-surface climatology.
- Strengthen ties to WiscoNet.
- Conduct polar weather and climate studies using *in situ* and satellite observations.
- Continue climate studies using the expanding archive of satellite observations.
- Engage in planetary research in radiation transfer modeling of solar reflected spectra of outer planet discrete features.

#### 5.1.3 Data Science

- Use machine learning and satellite, radar, lightning, NWP, and surface observations to help the operational and aviation community predict and mitigate different risks (convection, fire, icing, volcanic ash, etc.).
- Develop techniques for assimilating satellite data into consistent and accurate descriptions of the environment.
- Engage in innovative software development to support new instruments and their scientific applications.
- Develop new ways of distributing software and data through the cloud and containers.
- Promote collaborative software developments with other leading scientific institutions.
- Promote the free international exchange of scientific data and software.
- Promote close collaboration between programmers and scientists.

#### 5.1.4 Computational Science

- Continue to support scientific research at SSEC by providing direct access to data through our Satellite Data Services.
- Leverage success of the SSEC NASA Atmosphere Science Investigator-led Processing System (A-SIPS) VIIRS processing, reprocessing, and production system to support future Advanced Baseline Imager (ABI), and Advanced Himawari Imager (AHI) processing.
- Develop techniques to enable scientists to share data and knowledge, as exemplified by SSEC's RealEarth and GeoSphere software systems.
- Continue to enhance the value to scientists of SSEC-developed software systems, including CSPP, CSPP-Geo, and McIDAS.
- Develop techniques to exploit GPU clusters and cloud computing to simulate, analyze and visualize ever-increasing amounts of data.
- Preserve, and provide to scientists, large archives of data such as SSEC's GOES

- archive and archives for polar orbiting satellites.
- Provide ground system support for smaller satellite missions including cube sats.

#### 5.1.5 Campus Science Support

- Contribute management, engineering, science, administrative and technical writing support to large science proposal initiatives.
- Extend the center’s research computing expertise and infrastructure to foster more collaboration on campus. SSEC must be visible in general to campus as a valuable resource for research computing expertise and operations to both help encourage these campus collaborations and to make them successful.

### 5.2 **Advance Learning: 2023-2027**

- Enhance our strong affiliation with the Department of Atmospheric and Oceanic Sciences (AOS), the College of Engineering, and the Astronomy and Physics Departments for supporting graduate education and providing research opportunities for undergraduate and graduate students.
- Create new collaborations through the American Family Insurance Data Science Institute, Wisconsin Energy Institute, Aquatic Sciences Center, and other OVCRGE interdisciplinary research centers.
- Create new collaborations with Life Science Communications to engage in training a new generation of researchers with the necessary skills to communicate weather and climate science to stakeholders and the public.
- Explore development opportunities with private sector sponsors to support undergraduate summer internships and graduate student RA support.
- Continue collaborations with the UW–Madison Pre-College program to enhance our K-12 outreach and education activities.

### 5.3 **Amplify the Wisconsin Idea: 2023-2027**

- Communicating the science of SSEC is central to the Wisconsin Idea. This involves translating and creating awareness of our research for our audiences including funders, the public, collaborators and partners, educators, students, donors, and others.
- Continue cooperative work with federal agencies, including NASA, NOAA, NSF, and DOE.
- Seek opportunities to enhance and broaden research within the Great Lakes region through collaboration with NOAA, NASA, Wisconsin DNR, and LADCO.
- Seek to build partnerships across the state and the nation through our outreach offices to expand the impact of our outreach and education programs.

### 5.4 **Nurture a Vibrant Campus Community: 2023-2027**

- Strengthen the ties between the SSEC Inclusion, Community, Equity, and Diversity (ICED) and AOS Diversity Equity and Inclusion (DEI) committees to assure that we are sustaining a healthy workplace.
- SSEC Director will continue to serve as member of the AOS DEI committee to promote development of AOSS wide community.
- Continue to implement practices identified during 2020/2021 Unlearning Racism in Geoscience (URGE) learning/planning sessions in collaboration with AOS DEI committee.
- Offer opportunities for staff education and professional development.



- Diversify the SSEC workforce, including leadership, and develop communications to reflect that diversity.
- Incorporate multi-lingual speakers in satellite training activities and translate selected webpages to make them more accessible to Spanish-speaking populations.
- Foster a welcoming and inclusive learning environment by using the newly remodeled AOSS Library as a gathering space for collaboration, meetings, and study.

### **5.5 Continue to be a High-Performing Organization: 2023-2027**

- Support transition to upcoming changes to the campus administrative systems to support pre- and post-award activities, human resources, and purchasing.
- Maintain a strong Quality Assurance and Safety program to insure SSEC is eligible for NASA contracts and other projects that require a QAS program or support.
- Develop a training platform for supervisors that provides information to further enhance their abilities to properly supervise their staff.
- Ensure SSEC has the technical and computing infrastructure to conduct and support our research.
- Maintain close partnership between SSEC TC, programmers, and researchers.
- Increase staff expertise in AI and ML through collaboration with the Data Science Institute.
- Lead and assist in adoption of modern programming practices such as Continuous Integration/ Continuous Deployment (CI/CD) that are well suited to cloud infrastructure providers.
- Develop capabilities for cloud-based data distribution.

### **Acronyms**

|          |                                                                         |
|----------|-------------------------------------------------------------------------|
| ABI      | Advanced Baseline Imager                                                |
| AHI      | Advanced Himawari Imager                                                |
| AMRC     | Antarctic Meteorological Research Center                                |
| AOS      | Atmospheric and Oceanic Sciences (UW–Madison department)                |
| AOSS     | Atmospheric, Oceanic, and Space Sciences                                |
| ARM      | Atmospheric Radiation Measurement                                       |
| A-SIPS   | Atmosphere Science Investigator-led Processing System                   |
| CALS     | College of Agriculture and Life Sciences                                |
| CI/CD    | Continuous Integration / Continuous Deployment                          |
| CIF      | Community Instruments and Facilities                                    |
| CIMSS    | Cooperative Institute for Meteorological Satellite Studies              |
| CrIS     | Cross-track Infrared Sounder                                            |
| CSPP     | Community Satellite Processing Package                                  |
| CSPP-Geo | Community Satellite Processing Package - Geostationary                  |
| DEI      | Diversity, Equity and Inclusion committee                               |
| DNR      | Department of Natural Resources                                         |
| DOE      | Department of Energy                                                    |
| ESRL     | Earth Systems Research Laboratory                                       |
| EUMETSAT | European Organization for the Exploitation of Meteorological Satellites |
| EV       | Earth Venture                                                           |
| GEO      | Geostationary Earth Orbit                                               |
| GeoXO    | Geostationary Extended Orbit                                            |

|          |                                                                                                             |
|----------|-------------------------------------------------------------------------------------------------------------|
| GOES     | Geostationary Operational Environmental Satellite                                                           |
| GPU      | Graphics Processing Unit                                                                                    |
| GXI      | GeoXO Imager                                                                                                |
| GXS      | GeoXO Sounder                                                                                               |
| HIRAS    | Hyperspectral Infrared Atmospheric Sounder                                                                  |
| HSRL     | High Spectral Resolution Lidar                                                                              |
| IASI     | Infrared Atmospheric Sounding Interferometer                                                                |
| IASI-NG  | Infrared Atmospheric Sounding Interferometer Next Generation                                                |
| ICED     | Inclusion, Community, Equity, and Diversity Committee                                                       |
| IDP      | Ice Drilling Program                                                                                        |
| IPCC     | Intergovernmental Panel on Climate Change                                                                   |
| IR       | Infrared                                                                                                    |
| JCSDA    | Joint Center for Satellite Data Assimilation                                                                |
| JEDI     | Joint Effort for Data assimilation Integration                                                              |
| JWST     | James Webb Space Telescope                                                                                  |
| LADCO    | Lake Michigan Air Directors Consortium                                                                      |
| LEO      | Low Earth Orbit                                                                                             |
| McIDAS   | Man computer Interactive Data Access System                                                                 |
| NASA     | National Aeronautics and Space Administration                                                               |
| NCEP     | National Center for Environmental Prediction                                                                |
| NESDIS   | National Environmental Satellite Data and Information Service                                               |
| NOAA     | National Oceanic and Atmospheric Administration                                                             |
| NSF      | National Science Foundation                                                                                 |
| NWP      | Numerical Weather Prediction                                                                                |
| NWS      | National Weather Service                                                                                    |
| OVCERGE  | Office of the Vice Chancellor for Research and Graduate Education                                           |
| PI       | Principal Investigator                                                                                      |
| PREFIRE  | Polar Radiant Energy in the Far-InfraRed Experiment                                                         |
| QAS      | Quality Assurance and Safety                                                                                |
| RA       | Research Assistant                                                                                          |
| S-HIS NG | Scanning High resolution Interferometer Sounder Next Generation                                             |
| SAC      | SSEC Advisory Council                                                                                       |
| SPARC    | SSEC Portable Atmospheric Research Center                                                                   |
| SPARCLET | SPARC sister enclosure option (highly customized sea container)                                             |
| SSEC     | Space Science and Engineering Center                                                                        |
| SSEC2022 | SSEC Seed Funding (2019-2021)                                                                               |
| TC       | Technical Computing                                                                                         |
| TEMPO    | Tropospheric Emissions: Monitoring of Pollution                                                             |
| TROPICS  | Time-Resolved Observations of Precipitation structure and storm Intensity with a Constellation of Smallsats |
| URGE     | Unlearning Racism in Geoscience                                                                             |
| UW       | University of Wisconsin–Madison                                                                             |
| VIIRS    | Visible Infrared Imaging Radiometer Suite                                                                   |