Strategic Plan for the Space Science and Engineering Center

a Research Center of
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1. SSEC Mission

To conduct atmospheric, oceanic, environmental and astronomical research using space or space-age techniques to discover and apply the physical properties of our universe for the benefit of humanity.

As further explanation of this general mission statement, we consider it our mission to:

- Lead development of space-based and space-age 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 atmospheric, oceanic, environmental and astronomical sciences,
- Facilitate the transfer of knowledge to operational observing and forecast systems,
- Support campus research initiatives with technical and management expertise, and
- Support the UW educational mission by involving undergraduate and graduate students in the research process.

These more specific roles are conducted with a commitment to education and public outreach, and free dissemination of knowledge.

2. Vision of SSEC

SSEC will strive to advance our technical excellence in the areas of:

- **Observational Science** (instrumentation, spacecraft system/mission design, field programs, and space flight instrument fabrication),
- **Analytical Science** (satellite and conventional data analysis, technique development and modeling),
- **Computational and Visualization Science** (hardware and software systems for information generation, data management and communication),
- **Campus Science Support** (Physics, Astronomy, Botany, Geology), and
- **Education and Public Outreach** (UW undergraduate and graduate programs, K-12 collaborations, science education of the general public).

Areas of special expertise include:

- Innovative observing techniques and applications development,
- Instrument design, development, and applications for ground, aircraft, and space flight systems,
- Data reduction techniques to extract geophysical information from instrument observations,

- Computer systems and software for data manipulation, visualization, and archive,
- Ice drill technology development in support of science initiatives,
- Transition of research results to operational users to maximize public benefit.

3. SSEC Structure and Roles in Strategic Planning

- Principal Investigator (PI) -led programs are the heart of SSEC, organized either as collections of programs within its two Institutes [Cooperative Institute for Meteorological Satellite Studies (CIMSS) and Antarctic Astronomy and Astrophysics Research Institute (A^3RI)], 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 presents annual State of the Center reports to the Center staff and is responsible for the success of the overall SSEC Strategic Plan.
- The Executive Director team is responsible for effective administration of Center resources to implement Center-level science policy, including administrative program support and oversight. The team is responsible for helping to formulate and implement the Center-level Strategic Plan. The team consists of Executive Directors for Administration, Science, and Technology.
  - The Executive Director for Administration makes overall administrative decisions and is responsible for Accounting Services, Grants and Contracts, Personnel, Payroll and Fringe Benefits, Purchasing, Inventory, and the Library. Strategic planning in this area involves projecting future financial health, personnel needs, and facility requirements.
  - The Executive Director for Science is responsible for providing support to the SSEC science activities to ensure a high quality research environment. This broad-based program management includes support staff planning, coordination with technical computing on scientific computing issues, oversight of the SSEC Data Center, and supervision and proposal development support for PIs. Strategic planning activities include identifying proposal opportunities and evaluation of successful proposal strategies.
  - The Executive Director for Technology 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 the various tools and systems required for the definition, development and testing of scientific instrumentation. It also includes the development and maintenance of the systems and procedures necessary for conducting instrument and system developments and assuring their quality. Strategic planning activities for technology also include identifying proposal opportunities and evaluation of successful proposal strategies.

- The SSEC Science Council advises the Director on matters of science policy, identifying issues that need attention, and helping to formulate approaches and reach decisions. The Council provides advice on overhead spending, including reviews of in-house funding requests and plans. The Council has approximately 10 members, with strong representation from SSEC/CIMSS scientists, selected to represent the full range of Center science and the close association with our NOAA, NASA and NSF partners. The Director of SSEC is a member and chairs Council meetings. The Director of CIMSS and the Chair of the Department of Atmospheric and Oceanic Sciences are also members, along with representatives from other departments that foster key scientific links and broaden perspective. The Council will help update the SSEC Strategic Plan annually as well as review progress.

4. SSEC Strategic Priorities related to UW-Madison Priorities

The UW-Madison Strategic Plan (October 2001) identifies several strategic priorities "to sustain and strengthen our position of preeminence in research and higher education." This section addresses SSEC contributions to the pursuit of these priorities. Detailed descriptions of specific activities are the subject of Section 5.

4.1 Advance Research*

- 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, and 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 by using internal funding to stimulate new areas of investigation.
- Improve continuously the laboratory and computational infrastructure needed for instrument development, data analysis, modeling, data acquisition, and collaborative communications.
- 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 Advance Learning

- Continue a strong campus affiliation with the Department of Atmospheric & Oceanic Sciences (AOS), the College of Engineering, and the Departments of Astronomy and Physics for student involvement and research synergism.
- Offer students direct involvement through participation on research teams.

* Generalized from UW Priority, Promote Research, to include conducting research

- Provide hands-on experience with NASA and other agency instrument programs, not often available in the university environment.

4.3 Accelerate Internationalization

- Foster international cooperation by developing global observing systems and analysis techniques for weather and climate applications.
- Accommodate and encourage exchange programs with international scientists and students.

4.4 Amplify the Wisconsin Idea

- Participate in collaborative research with Federal Agencies, including NASA, NOAA, NSF, and DOE.
- Support the Office of Space Science Education (OSSE) within SSEC to conduct education and public outreach.
- Support the involvement of SSEC staff in public service activities.
- Expand distance collaboration and training of students and professionals through innovative education concepts and applications.

4.5 Nurture Human Resources

- 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.

5. Strategic Activities for 2002-2006

The SSEC activities expected to contribute to accomplishing our mission over the next five years are defined in this section, again using major headings corresponding to the priorities of the UW-Madison Strategic Plan. 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, new activities that are expected to be important during the next 5 years are also included to present our vision of the foreseeable future. This section is expected to be updated annually with input from SSEC scientists and our collaborators.

5.1 Advance Research: 2002-2006

5.1.1 Observing Science

- Actively participate in the development of new research satellite observing systems, including new high spectral resolution IR instruments (AIRS and CrIS for polar EOS and NPOESS satellites, and GIFTS for geostationary orbit).
- Conduct research and development, and transition to the operational environment, to support the NPOESS and NOAA next-generation GOES programs.
- Design and deploy the IceCube Neutrino telescope within the South Pole ice cap.
- Explore ground-based high spectral resolution IR applications, including many potential uses of the AERI instrument for marine and land surface applications and polar science.
- Continue aircraft instrument development and field deployments, including S-HIS and the next generation NAST.
- Promote planetary science, including ground-based and space telescope observing and analysis, and instrument/mission development. Involvement with a Mars mission to sample the polar ice cap is a growing possibility.
- Design and build new lidar systems, with data analysis capability.
- Design and develop automated surface based weather stations in extreme climates (e.g., Antarctica).
- Participate in future space missions that promote strong student involvement (e.g., a future reincarnation of NASA's UnESS program).

5.1.2 Analytical Science

- Create/improve applications and products from remote sensing observations to improve weather analysis, nowcasts and forecasts, including partnerships with NOAA/NESDIS to develop and deliver techniques and products for NESDIS and NWS operations.
- Expand research in data assimilation, emphasizing the use of satellite data in numerical models and testing their impact, plus collaboration with the Joint Center for Satellite Data Assimilation (JCSDA), and forward model development.
- Continue innovative research in NWP modeling, including Hybrid Isentropic Models, CRAS, UWNMS, and MM5.
- Create expert systems using observational data for short term forecast applications.
- Support aviation safety technique and product development, emphasizing the use of satellite data.
- 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.
- Conduct cloud properties research for better understanding of the role of clouds in weather and climate.
- Continue biomass burning research to detect fires from space and assess their impact on the biosphere.
- Expand trace gas studies for regional and climate applications.
- Apply remote sensing science to multi-disciplinary issues (e.g. RESAC).
- Improve the determination of land surface temperature and emissivity.

- Relate the closely coupled remotely sensed land surface fluxes to agricultural applications, and short- to medium-term weather prediction, as well as general monitoring of the land-surface climatology.
- 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.
- Build new models of Jupiter's cloud structure that provide results consistent with measurements.
- Advance neutrino detection science to isolate high energy astrophysical sources.

5.1.3 Computational and Visualization Science

- Continue to support scientific research at SSEC by providing direct access to data through the SSEC Data Center.
- Develop techniques to enable scientists to share data and knowledge over networks, as exemplified by SSEC's VisAD and VisitView software systems.
- Preserve and continue to enhance the value to scientists of SSEC-developed software systems, including McIDAS and Vis5D.
- Develop techniques to exploit processor clusters for simulation, analysis and visualization of ever-increasing amounts of data.
- Preserve, and provide to scientists, large archives of data such as SSEC's 200 terabyte GOES archive and archives for forthcoming instruments such as GIFTS and IceCube.
- Develop techniques for assimilating data into consistent and accurate descriptions of the environment.
- Engage in innovative software development to support new instruments and their scientific applications.
- Promote collaborative software developments with other leading scientific institutions.
- Promote the free international exchange of scientific data and software.
- Preserve the wisdom from SSEC's long history of software leadership, and promote close collaboration between programmers and scientists.

5.1.4 Campus Science Support

- Design and deploy the IceCube Neutrino telescope in the South Pole ice cap (Francis Halzen, Physics, PI), providing program management, engineering, computing, administrative and other support as necessary.
- Support Ice Coring and Drilling Services (Charles Bentley, Geology, PI), providing engineering, computing, management, administrative and other support as necessary.
- Contribute management, engineering, science, administrative and technical writing support to large science proposal initiatives. One example is X-ray astronomy (Wilt Sanders, Physics/SSEC, PI), which is expected to turn into a major program during the next 5 years.

5.1.5 Nurturing the Environment for Research

- Continuously work to enhance our internal support for research by providing effective mechanisms (e.g., seminars) for interaction, feedback on the success of work

performed, encouragement for effective teamwork, and rewards for individual excellence.
- Ensure sufficient resources to provide seed funding for new, promising projects

5.2 Advance Learning: 2002-2006

- Enhance our strong affiliation with the Department of Atmospheric and Oceanic Sciences (AOS), the College of Engineering, and the Astronomy and Physics Departments for student involvement and research synergism.
- Create new collaborations through the NASA LaRC National Institute of Aerospace.
- Provide students with hands-on involvement and training through science programs, such as GIFTS, ICDS, IceCube.

5.3 Accelerate Internationalization: 2002-2006

- Develop and support the IMAPP and ATOVS processing packages for polar orbiter data processing from Terra, Aqua, and NOAA polar platforms.
- Participate in international satellite validation activities.
- Participate in international planning activities for observing systems.
- Provide administrative leadership for the International TOVS Working Group.

5.4 Amplify the Wisconsin Idea: 2002-2006

- Continue cooperative work with Federal Agencies, including NASA, NOAA, NSF, and DOE.
- Increase the opportunities and the influence of the Office of Space Science Education (OSSE) in education and public outreach.
- Create education and outreach programs and alliances through the IceCube Education Resource Center.
- Seek to build partnerships across the State and the Nation through our outreach offices to expand the impact of our outreach and education programs.
- Explore new techniques and new opportunities in distance learning (VisitView).

5.5 Nurture Human Resources: 2002-2006

- Continue to actively monitor individual needs.
- Expand individual staff reviews with supervisors and directors to better understand human resource issues among our staff.
- Offer opportunities for staff education and professional development.

Acronyms

AERI	Atmospheric Emitted Radiance Interferometer
AIRS	Atmospheric Infrared Sounder
AOS	Atmospheric and Oceanic Sciences (UW-Madison department)
A^3RI	Antarctic Astronomy and Astrophysics Research Institute
ARM	Atmospheric Radiation Measurement
CIMSS	Cooperative Institute for Meteorological Satellite Studies
CRAS	CIMSS Regional Assimilation System
CrIS	Cross track Infrared Sounder
DOE	Department of Energy
EOS	Earth Observing System
GIFTS	Geosynchronous Imaging Fourier Transform Spectrometer
GOES	Geostationary Operational Environmental Satellite
ICDS	Ice Coring and Drilling Services
IMAPP	International MODIS/AIRS Processing Package
IR	Infrared
JCSDA	Joint Center for Satellite Data Assimilation
McIDAS	Man computer Interactive Data Access System
NASA	National Aeronautics and Space Administration
NAST	National Polar-Orbiting Operational Environmental Satellite System Airborne Sounder Testbed
NESDIS	National Environmental Satellite Data and Information Service
NOAA	National Oceanic and Atmospheric Administration
NPOESS	National Polar-orbiting Operational Environmental Satellite System
NSF	National Science Foundation
NWP	Numerical Weather Prediction
NWS	National Weather Service
OSSE	Office of Space Science Education
PI	Principal Investigator
RESAC	Regional Earth Science Applications Center
S-HIS	Scanning High resolution Interferometer Sounder
SSEC	Space Science and Engineering Center
TOVS	TIROS Operational Vertical Sounder
UnESS	University Earth System Science
VisAD	Visualization for Algorithm Development