NASA Experimental Program to Stimulate Competitive Research
(EPSCoR)
Administered by Office of Education, NASA
Congressionally Directed Appropriation
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321-867-6988
3/6/12

PROJECT DESCRIPTION

Public Law 102-588, passed in 1992, authorized NASA to initiate NASA EPSCoR to strengthen the research capability of jurisdictions that have not in the past participated equably in competitive aerospace research activities.

The twenty-eight jurisdictions eligible to participate in FY 2011 are Alabama, Alaska, Arkansas, Delaware, Hawaii, Idaho, Iowa, Kansas, Kentucky, Louisiana, Maine, Mississippi, Montana, Nebraska, Nevada, New Hampshire, New Mexico, North Dakota, Oklahoma, the Commonwealth of Puerto Rico, Rhode Island, South Carolina, South Dakota, Tennessee, Utah, Vermont, West Virginia, and Wyoming. An additional jurisdiction, Missouri, was added with eligibility beginning in 2012.

The goal of NASA EPSCoR is to provide seed funding that will enable jurisdictions to develop an academic research enterprise directed toward long-term, self-sustaining, nationally-competitive capabilities in aerospace and aerospace-related research. This capability will, in turn, contribute to the jurisdiction's economic viability and expand the nation's base for aerospace research and development. Since its inception, NASA EPSCoR has been closely linked to the National Space Grant College and Fellowship Program (Space Grant).

PROJECT GOALS

The specific objectives of NASA EPSCoR are to:

- Contribute to and promote development of a research capability in NASA EPSCoR jurisdictions in areas of strategic importance to the NASA mission;
- Improve the capabilities of the NASA EPSCoR jurisdictions to gain support from sources outside the NASA EPSCoR program;
- Develop partnerships between NASA research assets, academic institutions, and industry;
- Contribute to the overall research infrastructure, science and technology capabilities, higher education, and economic development of the jurisdiction; and
- Work in close coordination with the Space Grant consortium in the jurisdiction to improve the environment for science, technology, engineering and mathematics (STEM) education.

PROJECT BENEFIT TO OUTCOME (1, 2, OR 3)

NASA EPSCoR directly supports Outcome 1, which comprises five Objectives. EPSCoR directly contributes to Objectives 1.1 and 1.5 and may also contribute to Objectives 1.2, 1.3, and 1.4.

- **Objective 1.1 – Faculty and Research Support:** Provide NASA competency-building education and research opportunities for faculty, researchers, and post-doctoral fellows.
- **Objective 1.5 -- Targeted Institution Research and Academic Infrastructure:** Improve the ability of targeted institutions to compete for NASA research and development work.

The two main components of NASA EPSCoR are:

--NASA EPSCoR Research Infrastructure Development
The Research Infrastructure Development (RID) Cooperative Agreements enable jurisdictions to build and strengthen relationships with NASA researchers. The RID has a three-year base period of performance with a potential single, two-year renewable period of performance. Awards are up to $125,000 per year. A one-to-one cost-sharing (cash or in-kind) is required for every NASA dollar awarded. There is also an additional $25,000 for jurisdictions in their first year of the RID program. The most recent RID was awarded in 2007. NASA intends to announce the RID opportunity every 3-5 years, pending funding availability.

--NASA EPSCoR Research
Research Cooperative Agreements address topic-specific, high-priority NASA research and technology development needs. Awards are up to $750,000 for a three-year performance period. Awards are required to provide cost-sharing, the percentage of which may vary from year to year. NASA intends to announce the EPSCoR CAN for Research Awards yearly, pending funding availability.

PROJECT ACCOMPLISHMENTS in 2010-2011

Research Infrastructure Development Annual Reporting

Cooperative Agreements Reporting	27
Faculty/Post-docs	374
Students	542
Peer Reviewed Publications Accepted / Published	140
Other Publications Accepted / Published	77
Number of Talks/Presentations at Professional Meetings	338
Number of Patents Applied For (or pending)	11
Patents Awarded	3
Collaborations (NASA)	130
Collaborations (Other)	294
Number of New Grants Awarded	103
Value of New Grants Awarded	$26,601,917

Research Infrastructure Development Final Reporting (Cumulative Data)

Cooperative Agreements Reporting	1
Faculty/Post-docs	110
Students	75
Peer Reviewed Publications Accepted / Published	39
Other Publications Accepted / Published	50
Number of Patents Applied For (or pending)	18
Patents Awarded	4
Number of Talks/Presentations at Professional Meetings	95
Collaborations (NASA)	18
Collaborations (Other)	42
Number of New Grants Awarded	25
Value of New Grants Awarded	$20,713,770

2007 – 2010 Research Awards Annual Reports

Cooperative Agreements Reporting	70
Faculty/Post-docs	440
Students	581
Peer Reviewed Publications Accepted / Published	227
Other Publications Accepted / Published	157
Number of Talks/Presentations at Professional Meetings	454
Number of Patents Applied For (or pending)	18
Patents Awarded	2
Collaborations (NASA)	95
Collaborations (Other)	286
Number of New Grants Awarded	140
Value of New Grants Awarded	$42,001,259

2007/2008 Research Awards Final Reports (Cumulative Data)

Cooperative Agreements Reporting	18
Faculty/Post-docs	143
Students	313
Peer Reviewed Publications Accepted / Published	350
Other Publications Accepted / Published	213
Number of Talks/Presentations at Professional Meetings	558
Number of Patents Applied For (or pending)	11
Patents Awarded	4
Collaborations (NASA)	42
Collaborations (Other)	142
Number of New Grants Awarded	155
Value of New Grants Awarded	$56,758,763

PROJECT CONTRIBUTIONS TO PART MEASURES

The data below are a list of the number of different institutions that participate in NASA Office of Education projects, including Space Grant, MUREP, and GSRP, in those states served by EPSCoR.

State	Institutions	State	Institutions
Alabama	4	Nevada	5
Alaska	5	New Hampshire	5
Arkansas	17	New Mexico	8
Delaware	6	North Dakota	11
Hawaii	12	Oklahoma	10
Idaho	9	Puerto Rico	5
Iowa	5	Rhode Island	7
Kansas	10	South Carolina	11
Kentucky	6	South Dakota	10
Louisiana	8	Tennessee	10
Maine	6	Utah	3
Mississippi	8	Vermont	6
Montana	16	West Virginia	12
Nebraska	13	Wyoming	6
		Total	**234**

The below table shows the amount of the awards and the match provided by the jurisdictions in the two EPSCoR Programs in FY2011. There were 28 Research awards and one RID awarded.

EPSCoR 2011 Awards and Cost-Share

	Award	**Cost-Share**	**Total**
RID FY11	$148,714	$158,475	$307,189
Research FY 11	$19,981,323	$10,705,382	$30,686,705
Totals	**$20,130,037**	**$10,863,857**	**$30,993,894**

PROJECT PARTNERS AND ROLE OF PARTNERS IN PROJECT EXECUTION

NASA science and engineering personnel are associated with all NASA EPSCoR Research Cooperative Agreements. Each task has a Technical Monitor (TM) who provides guidance and technical advice, reviews annual reports, and provides feedback to the EPSCoR staff. These TM's, most of who are located at NASA Centers, are nominated by the Education Liaison in the appropriate Mission Directorate.

Examples of benefits in addition to the accomplishment of the research objectives -

Idaho

Mars is considered a likely place to look for extraterrestrial life given its proximity to Earth, the presence of carbon and other essential major and trace elements, and the presence of water. This research looks at whether microorganisms from Earth, traveling on spacecraft, pose a risk to planetary protection goals and future life detection missions. One of the primary focuses of planetary protection efforts at Jet Propulsion Laboratory (JPL) is the biological sampling of spacecraft to ensure cleanliness of spacecraft and to meet international planetary protection requirements. JPL has archived approximately 3500 isolates from spacecraft ranging from the Mars Viking Landers (1970's) to the Mars Science Laboratory which have been collected by post bioreduction procedure. For this effort, JPL and the University of Idaho will work with the Department of Homeland Security/ National Biodefense Analysis and Countermeasures Center (NBACC) to provide sequencing services and physiological characterization of isolates. Data from the research will also be used by the DHS for homeland biodefense purposes.

New Hampshire

The proposed project is a collaborative effort between the University of New Hampshire (UNH) and the U.S. Army Cold Regions Research and Engineering Laboratory (CRREL) which brings together an important Federal agency partner as well as a significant workplace with the University of New Hampshire. CRREL PIs will serve on Ph.D. committees and CRREL PIs working with the UNH EPSCoR Science PIs will jointly design and teach a course in snow hydrology. CRREL will obtain SWE datasets from the National Snow and Ice Data Center (NSIDC) in an EASE-grid projection as 25 km grids. SSM/I and AMSR-E global SWE products are available twice daily. Snow instrumentation will be developed and deployed as a network. The approach is to design and build low-cost ultrasonic snow depth, temperature and wetness sensors. The rational is that local observational data provide needed measurements of conditions as well as advancing STEM training and institutional capacity of environmental sensor construction. Students will work with CRREL scientists to calibrate and to deploy twenty-four sensors at two snow courses in Hubbard Brook, NH. Sensors will also be deployed in the Red River basin near Fargo, North Dakota (collaborator Dr. Xinhua Jia, North Dakota State University - NDSU). In addition to NASA, results of this research will also benefit both the UNH and CRREL through development of new snow depth sensing capabilities for the state of New Hampshire and the U.S. Army.

Kentucky

With air traffic expected to double by 2025, rising oil prices and increasing public awareness of the environmental impact, there is a growing demand for novel aeronautical technologies that result in more fuel efficient, lower emission, and quieter air vehicles. A cross-agency initiative, called Next Generation Air Transportation System (NextGen), is charged with transforming the air traffic management infrastructure and the industries comprising the commercial

aviation sector. NextGen is a partnership of the FAA, industry, NASA and the Departments of Defense, Commerce and Homeland Security collaborating to develop and implement advanced technologies for commercial aircraft and aviation management. An interdisciplinary team of University of Kentucky faculty, industry partners and NASA researchers are developing advanced high-temperature shape memory alloys (SMAs) that will enable better, "greener," and more versatile air vehicles in support of the NextGen initiative. SMAs are a unique class of functional materials with the ability to change shape depending on applied temperature, stress or magnetic field. Due to their unique properties, such as very high actuation strain, stress, and work output through reversible phase transformation, SMAs are one of the key technologies for significant reductions in drag and considerable versatility compared to today's aircraft with fixed aerodynamic surfaces/structures. The primary goal of this research is to bridge the gap between the astonishing properties of this intrinsically intelligent class of materials and the challenging requirements of the aerospace industry.

Alaska

Wildfires are one of the most significant agents of ecosystem disturbance in the boreal forests of Alaska and the neighboring Canada, with tremendous climate implications. The effects of these fires are not limited to the immediate areas where they occur. The massive amounts of smoke that they generate have been shown to contribute to the radiative forcing of the Arctic region, where they are transported through the processes of injection high into the upper atmosphere, and through deposition on Arctic snow and ice. Accurate assessment of such climate-scale fire impacts requires sustained long-term monitoring of fire activity and emissions. However, because of the erratic nature of large open-air vegetation fires, such as those found in Alaska, the only feasible way to consistently monitor them over long time periods is through satellite remote sensing.

Although satellite remote sensing of biomass burning has practically become routine since the early 1990s, most of the observations simply focus on detecting the fire locations or estimating the area burned, with limited information on other parameters needed for modeling, thereby failing to provide the essential quantitative constraints needed to advance our understanding of fire/smoke effects and impacts in a coherent and timely fashion. To analyze and understand the full impact of biomass burning on the environment and climate from remote sensing data, it is essential to measure a wide array of fire and smoke parameters when the fire is still burning, at its different stages of activity (flaming, smoldering, glowing, area burned), as well as the unburned background. Through combining measurements from unmanned aircraft with satellite data, it will be attempted to extrapolate local measurements to regional scales for the analysis of larger scale burns. These objectives are in direct support of specific NASA Science Focus Areas within the Earth Science Division of the Science Mission Directorate and possess significant impact for Alaska, including local wildfire prediction and fighting interest. An advisory board, staffed with NASA remote sensing experts involved in wildfire research, will regularly

monitor this program and provide guidance to maximize the technical benefit. The advisory panel will include individuals with intimate knowledge of the technology and scientific needs and vested interest in seeing these efforts succeed.

South Dakota

This project will bring together a multi-institutional, multi-disciplinary research team from South Dakota State University, South Dakota School of Mines and Technology, and Oglala Lakota College to:

1. Create highly productive and industrially robust strains of cyanobacteria to produce energy dense fuels, high value chemicals, O2, and cleansed water directly from CO2, sunlight, and wastewater
2. Develop an integrated photobioreactor (PBR) and product recovery system, driven by solar power provided by light fibers
3. Strengthen collaborations with the NASA Ames Research Center (ARC) to also improve performance of the Offshore Membrane Enclosures for Growing Algae (OMEGA) system
4. Enhance multi-disciplinary undergraduate and graduate education on molecular engineering, bioprocessing systems, and applied photonics, including Native American students
5. Collaborate with industrial partners to promote economic development in South Dakota. Our initial target product is linalool, a ten-carbon alcohol with an energy density of 40 MJ/kg, heat of vaporization of 0.19 MJ/kg, and octane of 102.

This project will provide "Game Changing" technology to the Office of the Chief Technologist (OCT), and will help resolve critical issues in both the "Space Power and Energy Storage" and the "Human Health, Life Support and Habitation Systems" roadmaps. This proposal also addresses two of NASA's grand challenges (Space Colonization and Affordable Abundant Power). The Exploration Systems Mission (ESMD) and Space Operations Mission Directorates (SOMD) will benefit by development of an integrated system that can support colonization missions.

Oklahoma

This research is an in-depth investigation of applying pulse compression technology to spaceborne and airborne radars for precipitation measurement. It is in direct support of NASA's Strategic Goals, the Global Precipitation Measurement (GPM) and Tropical Rainfall Measuring (TRMM) missions, and CloudSat mission. It specifically addresses NASA's need for sensitive, high resolution radar sensing from space, and ultra-low sidelobe pulse compression technologies for cloud/precipitation applications. This project incorporates strategic partnerships with NASA's Mesoscale Atmospheric Process Research Group at the Goddard Space Flight Center (GSFC), the Oklahoma Space Grant Consortium (OSGC), the Atmospheric Radar Research Center (ARRC) at OU, the Radar research group at National Ocean and Atmosphere Administration (NOAA),

Ball Aerospace, Enterprise Electronics Corporation (EEC) and Lockheed Martin Corporation (LMCO). The project will be supported with the existing NOAA ground-based radar facilities for actual weather data collection and algorithm performance evaluations, and supported by advanced radar laboratory facilities for in-door measurements.

North Dakota

The design of low pressure turbines is particularly challenging due to their highly loaded blades, often widely varying incidence angles combined with low Reynolds number during normal operation. Moreover, the thermodynamic efficiency of gas turbines is strongly dependent on Low Pressure Turbine (LPT) efficiency. This research seeks to establish a combined experimental and computational investigation on LPT flows. This work will support NASA's Aeronautics Research Mission Directorate (ARMD) Fundamental Aeronautics Program in the area of Subsonic Fixed Wind and Subsonic Rotary Wing Projects. The initial collaboration will team the experimental capabilities of the University of North Dakota (UND) with the computational capabilities of North Dakota State University (NDSU) to pursue LPT research of direct interest to the Turbomachinery and Heat Transfer Branch of NASA Glenn Research Center as well as to Rolls Royce of North America.

This research effort will be used to further build experimental and computational methods, defined as crucial needs by NASA and the gas turbine industry for advancing understanding of complex LPT flows to improve LPT efficiencies. During the course of this work collaborations will be built with the US aviation gas turbine industry (Rolls Royce, Pratt and Whitney, GE, Honeywell, and Williams International) and the Air Force Research Laboratory. Further, the project will develop outreach activities to local Tribal Colleges and high schools to improve the demographics of underrepresented groups in engineering in order to help supply the workforce needs of the gas turbine and aerospace industries.