Research Review Team Data Request

Cooperative Institute for Research in Environmental Sciences (CIRES)

17 February 2004

1) Please provide the Mission, and a brief history of your Joint Institute (JI).

Mission: The Cooperative Institute for Research in Environmental Sciences (CIRES) is a leader in innovative earth systems science research providing an integrated understanding and improving public awareness. CIRES acts as a resource for interdisciplinary research and education by providing scientific leadership in basic and applied research relevant to environmental and earth science issues, by contributing scientific expertise and resources to environmental educational programs, and by providing support to facilitate collaborations among scientists at the University of Colorado, NOAA and other research institutions.

Brief History: Circumstances were especially favorable during the mid-1960's in Boulder, Colorado for the establishment of an institute dedicated to interdisciplinary earth science research. Strong but independent programs in applicable physics, geology, and the space and atmospheric sciences existed within University of Colorado departments. Boulder was also home to the Institutes for Environmental Research (IER) of the Environmental Sciences Service Administration (ESSA), both soon to be reorganized as the Environmental Research Laboratories (ERL) of the National Oceanic and Atmospheric Administration (NOAA). The potential merger of a major research university with co-located federal laboratories provided the opportunity for a synergistic research organization building upon the strengths of both. CIRES was thus established in 1967 as NOAA's first cooperative institute to provide a setting for earth systems research and teaching in the wide-ranging environmental sciences. The challenge was to develop interdisciplinary approaches for addressing environmental questions and complex issues in the context of Earth as a physical-biological system composed of many interacting parts. Since those early beginnings, CIRES has grown from less than 50 to more than 500 researchers and students working together toward common goals. CIRES has fostered growth in the biological sciences, oceanography, and climate studies. It has further created new interdisciplinary bridges between the physical and social sciences including economics, demographics and policy institutions. The creation of interdisciplinary centers has most recently included the Colorado Center for Chaos and Complexity plus a new Center for Science and Technology Policy Research.

2) What is the total amount of NOAA funding in the last full year of the Joint Institute's (JI's) academic period?

The total amount of NOAA funding during CIRES' last fiscal year, July 2002-June 2003, was $20,819,854.

2a) Please break out funding provided by Lab/Center.

These are being provided by John Cortinas.

2b) Please provide the Research themes supported by the funding.

CIRES' Cooperative Agreement #NA17RJ1229 between NOAA and the University of Colorado identifies six research themes. These themes were identified during a scientific retreat as those which most effectively unified ongoing and anticipated research efforts during the subsequent five years. They are dynamic and expected to evolve over time, but currently include:

Advanced Modeling and Observing Systems: Characterizing and predicting the state of the Earth system on all scales using direct observations and modeling for projecting outcomes.

Climate System Variability: Climate changes that occur both in the short term – seasons to decades – and those that occur across millennia.

Geodynamics: Gaining a better understanding of convection within the Earth's mantle and of how convection affects the surface of our planet.

Integrating Activities: Boundary-crossing research and educational pursuits that convey CIRES' science mission to decision-makers and society in general.

Planetary Metabolism: Exploring the complex web of biochemical and ecological processes and the interaction of these biospheric processes with the lithosphere, atmosphere and hydrosphere.

Regional Processes: Understanding the role of climate information used in regional decisions concerning natural resources.

Further information can be found at http://cires.colorado.edu/themes/index.html.

2c) What percent of your research is short term (0-2 years), medium term (2-5 years), and long term (greater than 5 years)?

The CIRES partnership between NOAA and the University of Colorado provides a bridge between shorter term federal operational and longer term academic research objectives. CIRES research thus complements federal objectives and contributes a wider perspective to their mission-directed goals.

Short term research encompasses projects that are nearing completion and awaiting transition to NOAA's operational mission. These would include projects like the development of improved radars, wind profilers, and automated air chemistry instrumentation. ENSO forecasting improvements are being tested in operational models. CDC prototype week-two forecasting techniques are quasi-operational and may reach minimum accuracy thresholds within a few years. The SEC space weather group is now in the process of transitioning from OAR research to NWS operations.

Most of CIRES' research objectives fall within the medium to long term category due to their exploratory nature. Some projects like monitoring of the global climate must by definition be long term in nature. In this example, the precise measurements required and their interpretations also dictate that they remain within the research environment. In such cases, CIRES is increasingly defining intermediate goals to insure momentum, accountability and adaptability within a dynamic research environment. CIRES recently implemented an annual research workplan that explicitly defines these milestones and provides the basis for subsequent annual reports.

In summary, it is estimated that CIRES' short-term research constitutes less than 5% of its total research. Approximately 20% of its research falls within the medium-term category leaving more than 75% of its total research of a long term nature.

2d) What is the geographic scope of your research – regional, national, or global?

This question could be interpreted to mean the scope of our science (regional, national, international) or the geographic areas where it is conducted (regional, continental, global), so we will address both at the same time.

One example of ongoing regional studies is our *Western Water Assessment* that is addressing the potential impact of climate variability on the availability, quality, and allocation of scarce water in the interior west. Researchers have also created a new model to assess the stresses on the South Platte basin in Colorado and the benefits and pitfalls of coping strategies and resource management decisions. In another regional study, a new method to monitor the extent and treatment of underground fluid waste was field-tested in Colorado and Arizona. A third one includes the Texas and New England Air Quality Studies and air-sea interaction processes along the California and Atlantic Coasts.

An example of CIRES research with a national or continental scope includes Arctic studies where ice dynamics and climate have been annually assessed and modeled on Greenland for more than a decade. A second one is CIRES' Center for Science and Technology Policy Research that is exploring how scientific information is linked to risk assessment, decision making and governance of scientific enterprise. A third is CIRES' Outreach group who has been identified as a leader in the emerging Digital Library for Earth Systems Education (DLESE) program and is providing tools for educational development, evaluation, and assessment nation-wide.

CIRES has always been involved in research with an international or global scope. Expeditions have in recent years been sent to the Himalayas to probe continental drift, Australia and Canada to study atmospheric and climate dynamics, and Antarctica to study the expanding ozone hole. Additional studies include field work focused on the Arctic climate system and climate variability, runoff from the Siberian Arctic drainage basin, and the Arctic Rapid Integrated Monitoring System (RIMS) to monitor key components of the Arctic terrestrial hydrologic system. Researchers have also studied the hydrologic response to permafrost thawing over the Russian Arctic drainage basin.

Further south, CIRES researchers have done work on Tropical Pacific climate, developing a theory of ENSO as a planetary scale "heat pump" and regulator of the tropical Pacific climate. Researchers in South America are examining the local and remote influences on rainfall variations and extreme events in the La Plata Basin.

CIRES researchers also specialize in extreme events including earthquakes and wildfires. Scientists recently deployed a Nepal/Tibet earthquake seismic array that yielded data necessary for a full geodynamic model of Himalayan crustal deformation, slab subduction, and the

mountain building processes that are important for hazard analysis. CIRES researchers have also investigated air quality through the impacts of distant forest fires or dust storms on intercontinental tropospheric ozone and the pollution transport along the trans-Siberian railway corridor.

3) What percent of the total Joint Institute funding comes from NOAA?

50.2% of CIRES' total funding came from NOAA during the most recent fiscal year. The remaining sources derive from NASA, NSF, EPA and others.

4) What is the unique expertise that CIRES brings to NOAA (e.g. special scientific skills)?

CIRES' unique value to NOAA and the international research community derives from its growing capacity to extend beyond traditional disciplinary science to enable integrated studies at their boundaries. CIRES is increasingly providing vision and leadership in conducting innovative research where results are presented in a context that can be utilized by decision makers. The *Western Water Assessment* is one example that is addressing the potential impact of climate variability on the availability, quality, and allocation of scarce water in the rapidly populating areas of the arid interior west. It is building mutually beneficial partnerships between public and private sector users of information to determine what tools are available, can be adapted, or should be developed to assist in the utilization of a growing body of climatic information. This is a product of active partnership with the four other Regional Integrated Sciences and Assessment (RISA) programs supported by NOAA's Office of Global Programs (OGP).

Another relatively unique capability to NOAA available through CIRES is its biological sciences program that includes national leadership in limnology, environmental sustainability, and biogeochemical cycling. Recent research thrusts in this area have included the enzymatic degradation of anthropogenic pollutants, the release of biogenic volatile organic compounds associated with agriculture, the relationship between drought and water quality in inland rivers, and the impact of natural and anthropogenic stresses on ecosystem dynamics.

CIRES also maintains a technical services capability to support the specialized requirements of its researchers. Its Integrated Instrument Development Facility includes design engineering, advanced machine shop, and glassblower in one combined facility. Staff work directly with researchers onsite to develop instrumentation necessary to continually extend their capabilities. Design capabilities include CAD, finite element analysis, charged particle trajectory calculations, and optical systems. Electronics capabilities include multi-layer PCB/CAD, circuit simulation, and metal plating. Shop capabilities include CNC machining (lathe, 2-axis and 4-axis mills), CAM, precision grinding, and TIG welding. Glassblowing includes custom designed apparatus in Pyrex or quartz plus specialized techniques such as silvering. Recent projects have included a wing-mounted stirling cooler, electrostatic lens controller, ion trap resonator, 1400˚ flash pyrolyzer, OH radical source FTIR detector, and hygrometer inlet foil port.

5) Please provide a breakdown of staff funded by NOAA. Please include staff who receive 50% or more of their funding from NOAA.

The number of CIRES employees is continually in flux, so the following numbers are a snapshot of staffing at the beginning of the current fiscal year. The following numbers are full-time-equivalents (FTE), so the actual number of CIRES employees exceeds what is listed below.

TASK I	
Staff	27
Visiting Fellows	12
Scientists	3
	42

TASK II (NSIDC)	
Staff	0
Scientists	2
	2

TASK III (NOAA labs)	
Scientists	226
Graduate Research Assistants	4
Student Assistants	10
	240

TOTALS	
Staff	**27**
Scientists	**231**
Visiting Fellows	**12**
Graduate Research Assistants	**4**
Student Assistants	**10**
	284

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