

**EXTERNAL REVIEW  
OF THE  
COOPERATIVE INSTITUTE FOR RESEARCH IN THE ATMOSPHERE  
(CIRA)  
COLORADO STATE UNIVERSITY**

**REVIEW PANEL MEMBERS**

**RAYMOND J. BAN, CHAIR  
BAN AND ASSOCIATES, LLC**

**WILLIAM LAPENTA, Ph.D.  
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION**

**ROBERT J. MOORHEAD II, Ph.D.  
MISSISSIPPI STATE UNIVERSITY**

**JOSEPH TRIBBIA, Ph.D.  
NATIONAL CENTER FOR ATMOSPHERIC RESEARCH**

**KAREN YUEN  
JET PROPULSION LABORATORY  
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION**

**SUBMITTED TO THE  
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION  
SCIENCE ADVISORY BOARD**

**ON  
19 NOVEMBER 2013**

## Summary

An external review of the Strategic Plan, Science, Education/Outreach and Science Management of the Cooperative Institute for Research in the Atmosphere (CIRA), at Colorado State University (CSU) was conducted on May 21 and 22, 2013 in Fort Collins, CO. Guidelines for conducting the review were provided by the Cooperative Institute Program Office within the National Oceanic and Atmospheric Administration's (NOAA) Office of Oceanic and Atmospheric Research (OAR). The review was conducted under the auspices of the NOAA Science Advisory Board (SAB) and, therefore, is subject to the requirements of the Federal Advisory Committee Act (FACA). A list of review panel members is provided in Appendix I. The review panel's on-site agenda is provided in Appendix II.

CIRA was founded in 1980 to foster collaborative projects between what is today the Earth System Research Lab (ESRL); the National Environmental Satellite, Data, and Information Service (NESDIS); and the Department of Atmospheric Science at Colorado State University. The collaboration includes NESDIS' Regional and Mesoscale Meteorology (RAMM) Branch that was imbedded within CIRA from its inception in 1980. The vision of this collaboration has remained constant over the years. Work on CIRA's themes related to satellite algorithm development, modeling, process studies, and data distribution are all traceable back to the origins of CIRA.

The review panel found that CIRA has, under the capable direction of its leadership, created extremely productive partnerships between academia and government and through these partnerships, CIRA has leveraged an impressive array of research support that has added value, not only to NOAA, but to other agencies and society at large. CIRA, and therefore NOAA, has become a leader in understanding satellite observations and atmospheric modeling and the effective transfer of research in these areas to operations. CIRA research is vital to meeting the NOAA strategic objective of a Weather Ready Nation and supports Climate Adaptation and Mitigation. However, the ability of CIRA to fully realize its potential is limited by short term funding challenges which inhibit longer term planning.

### I. Overview of CIRA

CIRA was founded in 1980 to foster collaborative projects between what is today the Earth System Research Lab (ESRL); the National Environmental Satellite, Data, and Information Service (NESDIS); and the Department of Atmospheric Science at Colorado State University. The collaboration includes NESDIS' Regional and Mesoscale Meteorology (RAMM) Branch that was imbedded within CIRA from its inception in 1980. The vision of this collaboration has remained constant over the years. Work on CIRA's themes related to satellite algorithm development, modeling, process studies, and data distribution are all traceable back to the origins of CIRA.

CIRA is a cooperative institute that is also a research department within CSU's College of Engineering, in partnership with the Department of Atmospheric Science. Its vision is to conduct interdisciplinary research in the atmospheric sciences by entraining skills beyond the meteorological disciplines, exploiting advances in engineering and computer science, facilitating transitional activity between pure and applied research, leveraging both national and international resources and partnerships, and assisting NOAA, Colorado State University, the State of Colorado, and the Nation through the application of its research to areas of societal benefit. The CIRA Mission is to serve as a nexus for multi-disciplinary cooperation among Cooperative Institute (CI) and NOAA research scientists and University faculty, staff, and students in the context of NOAA-specified research theme areas in satellite applications for weather and climate

forecasting. Important bridging elements of the CI include the communication of research findings to the international scientific community, transition of applications and capabilities to NOAA operational users, education and training programs for operational user proficiency, outreach programs to K-12 students and educators and the general public on environmental literacy, and understanding and quantifying the societal impacts of NOAA research.

## II. Strategic Planning

CIRA's Strategic Plan focuses on the execution of its vision and mission by acquiring and improving the intelligence, infrastructure, and support, which allows CIRA to respond to opportunities as they arise. The major research theme areas and the personnel, equipment, and data needed to perform these scientific endeavors are all underpinnings to the success of the CIRA Strategic Plan.

*Finding-* CIRA is strategically effective in leveraging the assets of CSU and ESRL to accomplish its mission, especially the CSU Department of Atmospheric Science.

*Finding-* CIRA has diversified its funding mechanisms so as to reduce dependency on any one funding source.

*Finding-* CIRA's strategic plan is well aligned with NOAA's Strategic Plan.

*Finding-* CIRA has created partnerships that significantly amplify return on investment to NOAA.

*Finding-* CIRA has focused on training early and mid-career scientists which is in line with NOAA's interest in the development of a scientific workforce.

*Recommendation-* The partnerships that CIRA has created have significantly enhanced its value. CIRA should seek to maintain these partnerships, while working with NOAA to assure adequate support for NOAA's objectives.

*Recommendation-* CIRA must continue to strengthen the collaboration between personnel in Fort Collins and Boulder in order to bring to bear the most robust satellite observation and atmospheric modeling expertise upon NOAA's research portfolio.

*Recommendation-* CIRA must insure communication and processes are in place to fully enfranchise and leverage personnel in College Park and Kansas City into CIRA.

## III. Science

The science review detailed a number of scientific accomplishments and highlights derived from base funding. The review encompassed CIRA's five research themes: 1) Satellite Algorithm Development, Training, and Education; 2) Regional- to Global-Scale Modeling; 3) Data Assimilation (D/A); 4) Climate and Weather Processes; and 5) Data Distribution. This agenda complements many activities in NOAA operations and positions CIRA ideally to make significant research to operations (R2O) contributions. Below are the findings and recommendations of the panel:

*Finding* - Within the Satellite Algorithm Development, Training, and Education theme there is a record of excellent science in the development of new algorithms and satellite derived products with demonstrated R2O successes of transferring research developments to NESDIS and NOAA's National Hurricane Center (e.g. solar energy forecasting, hurricane re-curvedure, and applications of Suomi-NPP data).

*Finding* - Within the Regional to Global-Scale Modeling theme there is a very strong activity in Boulder that has resulted in the operational use at NOAA's National Centers for Environmental Prediction (NCEP) of the Rapid Refresh (RAP) and High-Resolution Rapid Refresh (HRRR) forecast systems in the multi-model ensemble forecast suite. There is also the possibility for the R2O transition of the Flow-following Finite-volume Icosahedral Model (FIM) and Non-hydrostatic Icosahedral Model (NIM) to NCEP.

*Finding* - The Data Assimilation theme represents a very strong activity with multiple areas of application. Among these areas are the carbon and water cycles, aerosols, and air quality analyses. These are in addition to the more traditional applications in Numerical Weather Prediction (NWP) of model initialization and model verification.

*Finding* - The Climate and Weather Processes theme represents one of the most innovative and unique aspects of the activities at CIRA in Fort Collins with research in process modeling and use of satellite products. Examples include the use of Orbiting Carbon Observatory-2 (OCO-2) for the carbon budget analysis and Visible and Infrared Scanner (VIIRS) and Advanced Technology Microwave Sounder (ATMS) data to improve hurricane intensity prediction.

*Finding* - The Data Distribution research theme contains an excellent body of work being done on a number of distinct projects. Among these are real-time fire weather modeling, the CloudSat data distribution center, and Science on a Sphere.

*Recommendation* – The review panel suggest that the Satellite Algorithm Development, Training, and Education research theme should consider having an on-site presence at College Park to guide and mentor CIRA personnel.

*Recommendation* – The review panel recommends that Regional to Global-Scale Modeling theme re-invigorate and strengthen the collaborative research bonds between the Boulder FIM and NIM modeling efforts and the Fort Collins observations/processes research themes.

*Recommendation* – The review panel suggests that the Data Assimilation (DA) theme could enhance its R2O impact with NCEP by collaborating more closely with NCEP and either use operational DA methods or mutually agree on future development. This is particularly the case with respect to NWP assimilation.

*Recommendation* – The review panel recommends that in addition to strengthening collaborations in Climate and Weather Processes between CIRA/CSU and CIRA/ESRL an additional collaboration with NCEP could be possible and desirable in the area of improving feedback between modeling and satellite observations at the process level.

#### **IV. Education, Training, and Outreach**

CIRA showed excellent progress in meeting their strategic objectives for Education, Training, and Outreach. The review panel had a good overview of the type of activities and products as

presented by the Education & Outreach (E&O) coordinator and researchers, and a sense of enthusiasm and overall support for E&O from the CI. CIRA demonstrated a clear direction for how they wanted to do E&O. The findings and recommendations from the review team are as follows:

*Finding* - CIRA met Education & Outreach (E&O) criteria by working with an Institute defined set of objectives for E&O that is in line with the agency and nation's needs.

*Finding* - CIRA has a dedicated staff member to support E&O activities and ensure deliverables.

*Finding* - CIRA has a strong affiliated program and partners to host and support graduate students of atmospheric research.

*Finding* - CIRA has collaborated on or created programs to address community and end users' needs [VLab training and Earth Science Standards Professional Development Workshops, offering training to new end users such as meteorologists, and a strong university affiliation (CSU) for capacity building].

*Finding* - CIRA showed preparedness in seeking additional funding revenues to support E&O and flexibility in addressing E&O scope changes.

*Finding* - The initial effort to establish a societal impacts capacity is recognized and encouraged.

*Finding* - Most of the efforts noted are funded by university (CSU) support to CIRA. It is paradoxical to expect a review on E&O activities of a CI, with **minimal funding** from the parent agency.

*Recommendation* - Set aside or enable the delivery of set funding to support E&O in capacity building (multi-year student research funding will ensure a continual pipeline of qualified researchers for the future) and the staffing and development of E&O activities on behalf of the agency.

*Recommendation* - Increased attention and resources should be considered for the societal impacts objective in order to establish a competitive program. Although the majority of the E&O programs and activities are structured to be supported locally and aimed at a K-12 audience, some of the activities, such as the Earth Science Standards Professional Development Pilot Program is scalable in topic and grade level, and have the potential for long term and broader reach.

## V. Science Management

CIRA has established and implemented a management plan that enables collaboration, promotes quality science, and engages students. The following are findings noted by the review team:

*Finding* - CIRA management of science is exceptional. Members of the leadership team are well known and respected by the research community and federal program managers. Roles and responsibilities within the CI are well defined and clearly communicated across the organization.

*Finding* – CIRA effectively engages the Executive Board and Council of CIRA Fellows to determine and implement scientific priorities for the CI. New funding opportunities well aligned with CIRA scientific priorities are strategically identified and responded to.

*Finding* – CIRA has been responsive to past review team recommendations and has effectively formed partnerships with the international community.

*Finding* – Employee satisfaction and productivity levels are high. Management has an established employee recognition and reward system that effectively acknowledges the scientific contribution of CIRA staff to NOAA projects. CIRA has a productive work environment fostering intellectual exchange between CIRA and federal scientists. CIRA scientists are empowered by CI and NOAA managers to play significant and critical roles in projects. The CI has a reasonable and healthy employee turn-over rate. Mid-career employees are trained and found to obtain leadership positions in the field.

*Finding* – CIRA has demonstrated the ability to adapt to budget trends. The total annual budget has increased each year since FY02-03 with the largest contribution associated with the NOAA off campus component. The National Aeronautics and Space Administration/National Science Foundation/Other component has become the third largest contribution to the total budget starting in FY09-10. However, uncertainty in FY13-14 federal funding places CIRA in a yet to be determined level of risk requiring a mitigation plan based on priorities.

*Finding* – CIRA has developed successful strategies to support multi-year graduate student projects despite the single year nature of the NOAA funding model.

*Recommendation:* CIRA management needs to ensure staff located in College Park and Kansas City has an adequate level of access to the CIRA collaborative/scientific culture and management. Employees should be rewarded for designing and executing projects that result in the transition of CIRA research into NOAA operations.

*Recommendation* – CIRA management needs to make the University contributions more visible. Specific examples include articulating how the Computer Science Department and College of Engineering bring value to the CI as required to satisfy NOAA needs.

*Recommendation* – CIRA management should consider including a NOAA National Weather Service representative to serve on the CIRA Executive Board to increase operational perspective.

*Recommendation* – NOAA should implement new formula for Task 1 funding and strategies to reduce the burden of reporting and proposal writing.

*Recommendation* – NOAA should improve the coordination and communication between federal Program Managers and Program Officers with CIRA management. Each NOAA Line Office should provide CI's with longer term scientific priorities (strategic plans often too high level).

*Recommendation* – NOAA should develop and execute an aggressive schedule to establish renewal agreements in a timely manner to minimize disruption in work and funding. They should also consider funding multi-year CI research projects that are high risk/reward.

*Recommendation* – CSU should consider increasing level of support within Sponsored Programs and develop workforce succession strategies in the areas of numerical modeling, remote sensing, and tropical meteorology.

## **Final Rating**

Following a thorough review of the strategic planning, science, education and outreach, and science management performed by CIRA, the Review Panel unanimously agreed to a performance rating of Outstanding. The Review Panel's Findings/Recommendations are items presented to strengthen CIRA.

## Appendix 1.

Review Panel  
Cooperative Institute for Research in the Atmosphere (CIRA)

### **Raymond J. Ban, Chair [Member of NOAA's Science Advisory Board (Chair)]**

Ban and Associates Consulting LLC  
3525 Billingsley Drive  
Marietta, GA 30062  
Telephone:  
E-mail: raymondjban@gmail.com

Raymond J. Ban is retired Executive Vice President of Programming, Operations and Meteorology at The Weather Channel, Inc. (TWC). Most recently, he served as Consultant for Weather Industry and Government Partnerships, responsible for growing TWC relationships with the atmospheric science community across the entire weather and climate enterprise. He is currently President of Ban & Associates, providing consultative services to the weather media industry and also a guest lecturer in the Meteorology Department at Penn State University where he teaches one month each semester in the Weather Communications Program. Ban has been associated with The Weather Channel for 30 years and is considered one of the founding members of the TWC team. Ban was a member of the senior leadership team that grew The Weather Channel from a modest cable television network into a top, multi-platform media brand. In the community, Ban has been an active member of the AMS for almost 40 years and is a Fellow of the Society. Ban is an Alumni Fellow of Penn State University and a Centennial Fellow of its College of Earth and Mineral Sciences. He has served on the Board of Atmospheric Science and Climate of the National Academy of Sciences, and was Chair of the Academy Committee on Effective Communication of Uncertainty in Weather and Climate Forecasts. Currently, he is active on several Boards and Committees including Chair of the NOAA Science Advisory Board, Co-Chair of the Weather Coalition, a member of the Board of Directors of the National Environmental Education Foundation and a member of the Advisory Council to The National Center for Atmospheric Research. He graduated from Penn State University in 1973 with a degree in meteorology.

### **William (Bill) Lapenta, Ph.D.**

Acting Director  
Environmental Modeling Center  
National Centers for Environmental Prediction  
National Weather Service  
NOAA  
5830 University Research Court  
College Park, MD 20740  
Telephone: 301-683-3700  
E-mail: bill.lapenta@noaa.gov

Dr. William M. Lapenta has served as the Acting Director of the Environmental Modeling Center at the National Centers for Environmental Prediction/NOAA/NWS since January 2011. From October 2008 to December 2010 he served as the EMC Deputy Director. The Environmental Modeling Center (EMC) is responsible for the development, enhancement, maintenance and transition to



operations of the modeling systems within the National Centers for Environmental Prediction Production Suite. Before arriving at NOAA in 2008, Dr. Lapenta worked for NASA for 20 years at the Marshall Space Flight Center where he held several positions. While at NASA, his work included orchestrating a project to apply NASA's advanced satellite remote sensing technologies and Earth system modeling capabilities to improve our understanding of tropical cyclones that develop within and move across the Atlantic basin; transitioning NASA earth science assets into the NWS forecasts offices; and numerical modeling of the earth/atmosphere system with specific interest in land/atmosphere interactions, land surface data assimilation and energy/water budgets associated with regional climate simulations. He taught graduate level courses at the University of Alabama in Huntsville Atmospheric Science Department where he was an Adjunct Professor from 1992 through 2008. Dr. Lapenta holds a B.S. in Meteorology from Pennsylvania State University (1983) and a Ph.D. from SUNY at Oneonta in Meteorology/Mathematics (1990).

**Karen Yuen**

Product Delivery Manager-EPO, OCO-2 and SMAP  
NASA Applied Sciences Performance Lead  
Earth Science & Technology  
Jet Propulsion Laboratory  
4800 Oak Grove Drive  
Mailstop 321-420  
Pasadena, CA 91109-8099  
Telephone: 818-393-7716  
karen.yuen@jpl.nasa.gov

Ms. Yuen received her Bachelor's degree with majors in Chemistry/Physics and French from Saint Mary's College of Notre Dame; and she pursued a MA in Scientific Journalism at New York University, while working as an Editorial Assistant for "Neuroscience". She was the Earth Public Engagement Manager at the Jet Propulsion Laboratory, and led an EPO team in supporting the missions while following a thematic approach to aligning themselves with NASA's goals and objectives. For the past 2.5 years, Ms. Yuen has been the Product Delivery Manager-EPO for the Soil Moisture Active Passive (SMAP) and Orbiting Carbon Observatory-2 missions. She is also the NASA Applied Sciences Performance Lead.

**Joseph (Joe) Tribbia, Ph.D.**

Head, Global Dynamics Section  
Climate and Global Dynamics Division  
National Center for Atmospheric Research  
P.O. Box 3000  
Boulder, CO 80307  
Telephone: 303-497-1377  
[tribbia@ucar.edu](mailto:tribbia@ucar.edu)

Joseph J. Tribbia is a senior scientist at the National Center for Atmospheric Research (NCAR) and Head of its Atmospheric Modeling and Predictability Section in the Climate and Global Dynamics Division. He received a Bachelor of Science in Physics from the Illinois Institute of Technology in 1971, and a masters and doctoral degree in Atmospheric Science from the University of Michigan. He has been at NCAR since 1978 and his work has focused on the numerical simulation of the atmosphere and geophysically relevant flows. His research includes

works on the application of dynamical systems theory in atmospheric dynamics, the problems of atmospheric data analysis and numerical weather prediction, atmospheric predictability and the prediction of forecast reliability, and recently the simulation and prediction of El Nino/Southern Oscillation and decadal climate projections. He is a fellow of the American Meteorological Society and served as the NCAR Science Advisor in 20

**Robert J. Moorhead II, Ph.D. (Ex-Officio, cooperative institute representative)**

Mississippi State University  
Director, Geosystems Research and Northern Gulf Institutes  
Mailstop 9627  
HPC2, Room A127  
Mississippi State, MS 39762  
Telephone: 662-325-2850  
Email: [rjm@gri.msstate.edu](mailto:rjm@gri.msstate.edu)

Dr. Moorhead is currently the Director of the Geosystems Research Institute and the Northern Gulf Institute, a multi-university cooperative institute principally funded by NOAA. Before he became Director, he was funded by NOAA to develop visualization tools to assist researchers in understanding hurricane intensity and to help emergency personnel to better communicate impending severe weather to the general public. He has also been a Co-PI on a NOAA-funded project in collaboration with the Lower Mississippi River Forecast Center that addressed optimal visualization methods to understand coastal flooding. In general, his research expertise is the development of visualization techniques for scientific data. He has led visualization research and development efforts in support of Gulf of Mexico issues (physical oceanography, disposal of dredged materials, coastal/severe weather) for over 20 years. He was summer faculty at the Naval Oceanographic Office from 1991-1998. His professional activities include being the Director of the Institute of Electrical and Electronics Engineers (IEEE) Computer Society Technical Committee on Visualization and Computer Graphics. He holds a B.S. in Electrical Engineering from Geneva College (1980) and a M.S. in Electrical Engineering (1982) and a Ph.D. in Electrical and Computer Engineering (1985) from North Carolina State University.

## Appendix 2.

### CIRA 5 Year Science Review Agenda

Tuesday, May 21

<u>Time</u>	<u>Agenda Item</u>	<u>Presenter</u>	<u>Location</u>
8:00	Pick up from Hotel	CIRA Staff	Hilton Lobby
8:30	Panel meets privately		CIRA Satellite Conf. Room
9:00	Introductions and Welcome to CSU	William Farland (VPR and Co-Chair of CIRA Exec. Board) & Sandy MacDonald (NOAA Co-Chair of Exec. Board)	CIRA Director's Conf. Room
9:30	CIRA Overview and Introduction of meeting participants	Chris Kummerow (CIRA Director)	CIRA Director's Conf. Room
9:50	Overview of CIRA theme areas – Satellite Algorithm Development, Training, and Education	Steve Miller (CIRA Deputy Director)	CIRA Director's Conf. Room
10:10	Overview of CIRA theme areas – Regional and Global Scale Modeling Systems	Cliff Matsumoto (CIRA Associate Director/Boulder)	CIRA Director's Conf. Room
10:30	Break		
10:50	Overview of CIRA theme areas – Data Assimilation	Milija Zupanski (CIRA Senior Research Scientist/Fellow)	CIRA Director's Conf. Room
11:05	Overview of CIRA theme areas – Climate and Weather Processes	C. Kummerow	CIRA Director's Conf. Room
11:20	Overview of CIRA theme areas – Data Distribution	Cliff Matsumoto	CIRA Director's Conf. Room
11:35	Overview of CIRA theme areas – Societal and Economic Impact Studies	John Weaver (CIRA Researcher)	CIRA Director's Conf. Room
11:50	Overview of CIRA theme areas – Education and Outreach	Matt Rogers (CIRA Education and Outreach)	CIRA Director's Conf. Room
12:05	Lunch		CIRA Director's Conf. Room
1:00	CIRA Administrative Overview	Mary McInnis-Efaw (CIRA Asst. Director)	CIRA Director's Conf. Room
1:15	CIRA's Strategic Investments	C. Kummerow	CIRA Director's Conf. Room
1:30	Review Team meets with CIRA Exec. Board Members	MacDonald, Powell, CSU VPR Farland, CoE Dean Abt	CIRA Satellite Conf. Room
2:15	Review Team meets with CIRA Stakeholders	Mark DeMaria (RAMMB), Scott Hausman (GSD), John Schneider (GSD) Ingrid Guch	CIRA Satellite Conf. Room

		(STAR),	
2:15	CIRA Executive Board provides feedback	CIRA Exec. Board	CIRA Director's Conf. Room
3:15	Partial tour of CIRA Facility – with selected poster presentations	Poster Session #1 presenters	CIRA Main Building
4:30	Review team's time & transportation back to Hilton		CIRA Satellite Conf. Room or other
7:00	CIRA sponsored dinner for review team and meeting participants.		Jay's Bistro. Oak Street

#### <sup>1</sup>Poster Session #1

Upstairs CIRA: S. Miller – Day/Night Band; Tracy Smith – RAP; Zupanski – GOES-R data assimilation.

Downstairs CIRA: H. Lin – Sat. Data Assimilation; Glen Liston – Ice Measurements; K. Musgrave – Hurricane Forecast Improvements.

#### Wednesday, May 22

<u>Time</u>	<u>Agenda Item</u>	<u>Presenter</u>	<u>Location</u>
8:00	Pick up from Hotel		Hilton Lobby
8:30	Panel meets privately		CIRA Satellite Conf. Room
9:00	Review of activities	C. Kummerow	CIRA Director's Conf. Room
9:15	Finish tour of CIRA Facility – with selected poster presentations	Poster Session #2 presenters	ACRC Building
10:15	Break		
10:30	CIRA supported Student Presentations	T. Jones and L. Grant	CIRA Director's Conf. Room
11:00	Review Team meets in private with CIRA Director and Senior Management	C. Kummerow, S. Miller, C. Matsumoto, M. McInnis-Efaw, L. Noble	CIRA Satellite Conf. Room or other
12:00	Catered Lunch		Outside if Weather Cooperates
1:30	Review Panel Writing Session		CIRA Satellite Conf. Room or other
4:00	Review Panel Feedback to CIRA	Ray Ban	CIRA Director's Conf. Room
4:30	Transportation back to Hilton	CIRA Staff	

#### Poster Session #2

Ground Floor ACRC: Partain - Guided Tour of CloudSat DPC; Jebb Stewart – NOAA Env. Info System; Matt Rogers – Outreach

1<sup>st</sup> Floor ACRC: J. Forsythe – NVAP; S. Schranz – Fire Weather

2<sup>nd</sup> Floor ACRC: D. Baker/O'Dell: OCO and Carbon Tracker