

USGS-FAU Collaborative Research
Meet & Greet
February 6, 2015
Florida Atlantic University Davie Campus



Hosted & Sponsored by:



Table of Contents

Table of Contents.....	2
Executive Summary.....	3
Meeting Objectives.....	3
Institutional Mission Statements.....	4
Background on CES/USGS Relationship.....	4
The Florida Center for Environmental Studies (CES):	5
Collaboration Event Description	6
Individual Presentations	6
Facilitated Networking Sessions.....	7
Institutional Linkages.....	7
USGS Perspectives	9
FAU Perspectives	9
Afternoon Reconvening	11
Methods for Evaluation	15
Survey Results.....	15
Next steps	21
References:.....	22
Appendix A Meeting Agenda	24
Appendix B - Evaluation Form.....	25
Appendix C - Evaluation Participant List.....	26

USGS-FAU Collaborative Research Meet & Greet

February, 6, 2015 ▪ FAU Davie Campus
www.ces.fau.edu/climate_change/meet-and-greet

Executive Summary

Thirty-five scientists gathered at the Florida Center for Environmental Studies (CES) in Davie with the goal of sharing research and strengthening partnerships between local researchers from Florida Atlantic University (FAU) and the US Geological Survey (USGS). Both the preparation leading up to the event and the structure of the day were designed toward meeting inter-disciplinary research goals, exploring potential funding opportunities, and identifying other mutually beneficial activities. We mapped research expertise as a mechanism for collaboration and the foundation for an institutional collaboration framework. Key themes of the day revolved around heightened collaboration via increased communication, student involvement, and pursuit of funding. Widespread agreement emerged on the need for more structured programs to stimulate joint interactions between USGS and FAU faculty and students. Participants unanimously agreed that it would help to have an administrative person who could manage these interactions. The group expressed a desire to participate in more interdisciplinary work and felt motivated to pursue the strengthening of partnerships to find relevant, solution-oriented questions to ask and to bring in new ideas and expertise.

We draw on the foundational literature to present and test a first-generation scorecard for assessing the event's scientist-stakeholder interactions in a sustainability science context. Five broad categories of evaluation criteria linked to stakeholder engagement are proposed: salience, legitimacy, credibility, solution-orientation, and human-environment interaction. Here, we investigate these characteristics through the lens of the event, as we apply the new scoring criteria which deliberately, transparently, and intentionally evaluates how fundamental sustainability science was applied within the various event components.

This report describes the ongoing relationship between FAU and USGS, the event, summary of the evaluation, and recommendations for future directions.

Meeting Objectives

- **To develop new, and to strengthen existing, linkages among participants, fostered through sharing of research interests and facilitated conversations**
- **To create a website with a topical mapping of local USGS and FAU expertise**
- **Parallelism Increased communication and awareness to promote synergistic collaborations**

Institutional Mission Statements

US Geological Survey:

- Providing reliable scientific information to describe and understand the Earth; minimize loss of life and property from natural disasters; manage water, biological, energy, and mineral resources; and enhance and protect our quality of life.

Florida Center for Environmental Studies:

- Advancing trans-disciplinary research, education and outreach on ecology, climate and society.

Florida Atlantic University’s Charles E. Schmidt College of Science:

- To provide excellence in both disciplinary and interdisciplinary science education for our students
- To apply the power of inquiry and discovery to fundamental problems of scientific importance
- To find solutions to societal challenges in a culture of research, partnership and scholarship
- To develop internationally recognized research and instructional programs to meet the needs of the region, the nation and the global community

Background on CES/USGS Relationship

CES has collaborated with USGS to organize a series of technical meetings and research projects in which existing knowledge on Everglades restoration was shared. The output of these meetings was intended to generate new transformational information in the form of recommendations. Figure 1 illustrates this progression, and the events are also described on the CES website. The following three meetings were focused on generating recommendations, which are described in their final reports:

- Hydrology of the Everglades in the Context of Climate Change 2012
- Predicting Ecological Changes in the Florida Everglades in a Future Climate Scenario 2013
- Recommendations for Everglades Restoration under a Future Climate Scenario 2014



Figure 1: Technical Meeting series presented by the USGS, CES at FAU & Florida Sea Grant

While these meetings served to introduce participating USGS and FAU staff, the key goals were translating data to determine unified recommendations, thus meeting the needs of decision-makers. The challenge remained in moving forward and making these recommendations actionable. The intention of the February 2015 collaboration meeting shifted from making recommendations to building partnerships and creating new avenues for research and implementation.

- **What is a University Research Center?**
 - A unit to catalyze university research
- **What is CES?**
 - A unit to catalyze university research on Ecology & Climate Change in S. Fl.
 - A boundary object designed to navigate the science-policy boundary
- **How will we know we are successful?**
 - Increases in funded research, peer-reviewed publications and degrees granted
 - Observed status as a “go-to” place for *convening* difficult conversations

The Florida Center for Environmental Studies (CES):

Boundary organizations are institutions or agencies, such as interdisciplinary research centers, which are designed to bridge different professional and social domains. CES is a boundary organization for environmental and sustainability questions, facilitating the productive exchange of knowledge and information needs across the science-policy-society interface. Since 1994, CES has been functioning as a boundary organization by cultivating partnerships with numerous departments and agencies and focusing on outreach and engagement. A broad goal of CES is to build upon previous work and frame future endeavors around sustainability science. Sustainability science examines the interactions between natural and social systems, and how those interactions affect the challenge of sustainability (<http://sustainability.pnas.org>). The emerging field of sustainability science has significant potential for addressing current issues because it responds to a growing urgency – the need to support multiple stresses from rapid simultaneous changes in both social and environmental systems (Kates et al., 2001). Recent literature describes how distinctions such as boundary objects should operate in the sustainability science domain yet there is less research on how these principles function in practice (Star and Griesemer, 1989; Cash 2001; Parris and Kates, 2003; Cash et al., 2003; White et al., 2010).

“Tradeoffs between salience, credibility and legitimacy pose serious challenges for those wishing to develop boundary organizations and objects that assist in mediating knowledge among the multiple social worlds involved in environmental decision-making.”

-White et al. (2010)

Collaboration Event Description

Participants were invited from the populations of Florida USGS scientists working on Everglades and wetlands questions and from the FAU Environmental Science faculty. Leading up to the event, CES issued a series of correspondence and requests for materials from participants.

Created for the event, the website www.ces.fau.edu/climate_change/meet-and-greet served as a living document, reflecting the updates to participants and their research interests.

Meeting Process

- **Event preparation**
- **Opening remarks & meeting goals**
- **Individual presentations on research projects and interests**
- **Three parallel breakout networking sessions**
- **Reconvening discussion**

Individual Presentations

The meeting began with opening remarks, mainly from the meeting facilitators. Colin Polsky, Director of the Florida Center for Environmental Studies and FAU Professor of Geosciences, welcomed the participants and described the meeting goals, immediate outcomes, and the agenda for the day (See Appendix A). Anthony Abbate, Associate Provost for FAU Broward Campuses and Professor of Architecture, highlighted CES as an uncovered jewel at FAU. Dale Gawlik, Director of the Environmental Science Program and Professor of Biological Sciences, described a similar National Parks Service event a few years ago, which generated significant outcomes, such as internships and funding opportunities. Dr. Nick Aumen, Regional Science Advisor for USGS, explained that as one of five Priority Ecosystem Sciences (PES) programs in the country, the Everglades draws significant focus and funding. With a wide variety of linked restoration-related topics, Nick explained some of the current management-relevant research at USGS. Next, John "Jay" Baldwin, Professor of Biological Sciences and Associate Director for the Florida Center for Environmental Studies welcomed participants and introduced his research.



Nick Aumen - USGS

The remaining 31 participants were each given two minutes to present their previously prepared slides on research interests. The intention of this exercise was to give the group a taste of what each participant was involved in. While it was challenging to concentrate a career of research into two minutes, participants succeeded in conveying overarching themes, specific methodologies, and synergistic efforts. This strategy allowed a foundation to be set with a group understanding of each participant's background and research interests. Mainly composed of biologists and geologists, a few engineers and social scientists rounded out the group. Clearly, research interests exceeded the bounds of traditional "departmental" delineations, and many correlations among interests emerged. Some recurring themes included population

ecology, nutrient cycling, hydrogeology, and climate change.

Facilitated Networking Sessions

After lunch, participants divided into three groups, each comprised of a mix of FAU and USGS scientists. As described below, 30-minute rotating sessions focused on A) *Institutional Linkages*, led by Colin Polsky; B) *USGS Perspectives*, led by Nick Aumen; and C) *FAU Perspectives*, led by Dale Gawlik.

Institutional Linkages

Colin Polsky explained CES's new goals in promoting disciplinary/interdisciplinary science and research, as well as his aim to convey these goals clearly to USGS and FAU scientists. He asked the first group, "What kinds of institutional links or relationships might be helpful for amplifying your research?" Answers among USGS scientists focused on communication and enhanced connection with students. One participant noted how FAU and USGS have such a wide range of projects and the strong need for synthesis and communicating with the public. Another participant mentioned that USGS scientists have projects that undergraduate and graduate students are currently helping with. However, resources are needed (e.g. web portals) that make it easier for USGS staff to match these students with relevant and potential advisors at FAU. An FAU participant responded that FAU's many programs, such as Geosciences, Environmental Sciences, and Biology, could support further advising to students working on potential USGS projects.

- *"The morning presentations and participant list provided an important resource for reviewing background interests and to see who would be a potential to work with." ~ USGS Scientist*

Colin Polsky asked the second group, "What types of institutional links or resources may be helpful to launch research in ways they maybe haven't been?" The conversation addressing this question revolved

around a generation of new opportunities for research and USGS scientist affiliation at FAU. First, the group acknowledged that there have already been great strides in terms of collaborating and publishing together. USGS scientists expressed a desire to be on graduate student committees and to be adjunct professors. USGS has big data (data mining) waiting for grad students to take on as their research. The incentive here is the resulting publications for all involved. This motivation must be carefully cultivated, as barriers may dampen success on both ends. For USGS, the research evaluation panel is intense, and concern existed for push-back if USGS scientists served on too many committees unrelated to their research area. On the FAU end, concern was expressed that issues might arise if the USGS scientists do not know the departmental and graduate college rules. This led to later conversations about consolidating efforts and possibly having a unified mechanism and coordinator for each kind of collaboration (discussed further in the reconvening section).

- *“There is a need to formalize something to ensure USGS, FAU, and students are getting the same level of information.” ~ USGS Scientist*

Colin Polsky asked the third group, “How can the Center help to cement activities in peer-reviewed activities?” The ensuing discussion focused further on challenges to FAU students’ involvement with USGS. USGS has had a lack of funding the last couple of years, causing them to let students go. The situation could be improved by USGS if they can begin funding programs again for students. USGS has different funding models that not everyone is familiar with, and the scientists felt unsure about the role FAU plays to help get students involved with USGS. Support for students exists but USGS is going through a process of change right now, making it difficult. Some USGS funding-resources suggestions included the New Student Program and the National Lab.

- *“Just getting people together in person is hugely valuable. Once or twice a year could go a long way towards more conversation and building relationships and collaborations. I did meet new people and have concrete ideas for future collaboration. I also feel more knowledgeable about how to engage with FAU.” ~ USGS Scientist*

One participant suggested that CES should look beyond Florida to other “Everglades” for peer-reviewed activities. The center should have a more global impact. Another postulated that CES could start a program this summer to financially support a student or two where USGS could provide the training. The motivation on both sides to increase USGS scientists serving on students’ committees was revisited. The group discussed upcoming workshops and events and invited each other to join. The group also wanted to see USGS scientists more frequently in FAU classrooms, colloquiums, etc. to exchange information.

USGS Perspectives

Nick Aumen focused largely on guiding USGS scientists to introduce all of the possibilities for funding within the agency. The ecosystems and focus areas within the USGS mission are broad and include many exciting research areas: water, land use, hazards, and the Everglades. Specific funding opportunities include a Post-doctoral program called Mendenhall, the Southeast Climate Science Center, the Powell Grant, EPA and NOAA grants, and the Cooperative Ecosystems Studies Unit (CESU). CESU constraints were discussed, such as the issue with the 17% overhead limit. Collaborating with State and local agencies and local government was also discussed.



**Stephanie Romanach - USGS (right) &
Rindy Anderson - FAU**

Some ideas for low-hanging fruit included:

- FAU can help by bringing their expertise into areas which USGS doesn't address
- FAU can help USGS find funding sources and supply graduate student work
- USGS (or FAU) can mentoring young scientists and young PI's
- USGS can create a list of potential projects for students
- USGS scientists can serve on FAU grad committees
- USGS may hire FAU for contracted help
- USGS can participate in Graduate Research Days at FAU in Boca in March
- A website could be created where people can seek collaboration

As students are involved in USGS field work and data processing, earning valuable real-world experience for scientific work.

- *"...great facilitation between groups to generate communication of ideas and needs for collaborations on research and education projects" ~ USGS Scientist*

FAU Perspectives

Dale Gawlik asked for views on the optimal arrangement of the USGS partnership. What would it look like and what are some limits to FAU/USGS interaction? Comments for the ideal partnership included improved collaboration, complementary expertise, and increases in opportunities for funding and data synthesis/analysis. Enhanced collaboration could be achieved through physical meetings which break down barriers to physical actions. Since external and internal funding opportunities are limited, one idea surfaced to collect seed data to pool for a bigger proposal. The ability to mine data creates low cost,

achievable opportunities for synthesis of USGS data with new FAU capabilities, such as access to additional resources and instrumentation. Huge opportunity can be leveraged from the physical proximity of CES and USGS offices within the FAU Davie campus. One idea was to create an ongoing, living exchange of information and status updates where USGS and FAU staff can look for potential collaborations and browse existing projects.

- *“These face-to-face meetings with the USGS folks met an important need to foster new research connections and collaborations. I got so much out of this event and learned of many funding opportunities and projects. I am extremely happy that I came!!” ~ FAU Scientist*

Challenges listed included limited funding and administrative hurdles, for example, the cumbersome process to fund a student from USGS. For example, USGS does allow *ride-alongs* on data gathering trips. Issues also arise with computer use and getting non-governmental persons into the network. If there were an umbrella standing policy, greater potential might be realized. A discussion ensued on the lack of knowledge about individual people and what they are working on. A personal connection is important. A point person for FAU and USGS, specializing in how to navigate bureaucratic issues, would avoid reinventing the wheel for structuring the logistics of collaborations, such as paperwork.

- *“We all want funding--we need to look to merge our efforts and increase likelihood of getting funding with joint efforts and also leveraging of existing funding.” ~USGS Scientist*

Other ideas for readily achievable actions included:

- Accessing FAU’s microbiology technology and services, currently underutilized for restoration work
- Utilizing FAU undergraduate research journal
- Accessing the USGS modeling programs and abilities that can be introduced to FAU
- Integrating climate modelling
- Providing an understanding of how to make use of USGS databases and datasets
- Increasing institutional creativity
- Finding ways to swap in-kind work

- *“I’m excited. We need more face-to-face to keep the momentum going!” ~USGS Scientist*

Afternoon Reconvening

In the closing remarks, Colin Polsky revisited the question of the roles of CES as a university research Center. The effectiveness of CES in reaching goals may be evaluated by the level of involvement in research papers, students, degrees, and grants. CES could fill the role of bringing USGS and FAU together in an academic sense. The group explored the idea of having USGS review the course catalog to promote course involvement. The idea of having USGS scientists as guest lecturers was very popular.

A conversation followed which allowed the group to discuss the linkages among their research and disciplines. This “mapping of expertise” exercise was translated onto an interactive web visualization. Figure 2 depicts the resulting website layout which maps the disciplines and links to participants.

Closing remarks



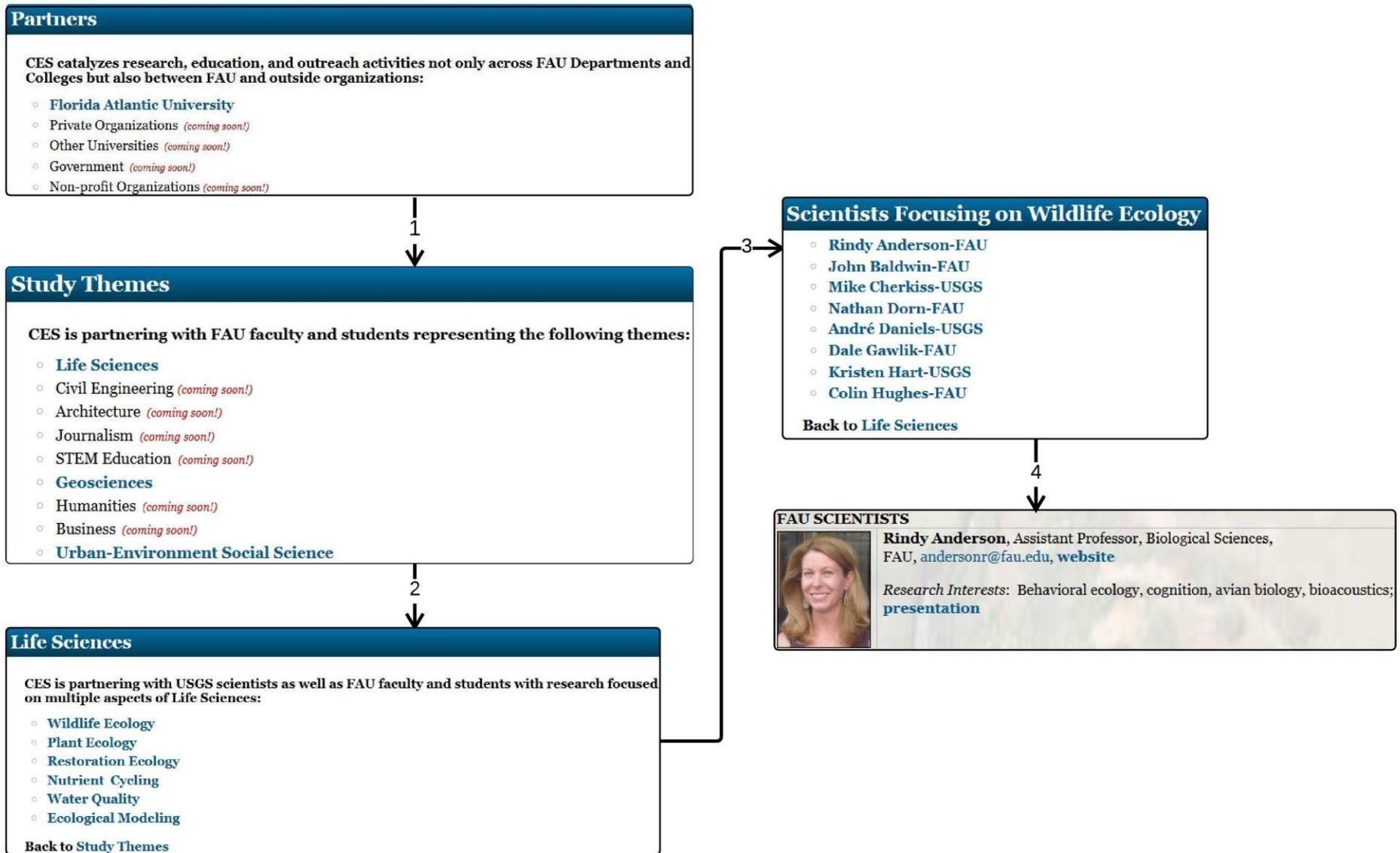


Figure 2: Illustration example of how to navigate through <http://www.ces.fau.edu/partners/> to find CES partners. Boxes denote each webpage; numbered arrows denote the process of clicking on the first blue link within a webpage that brings the visitor to the next.

Sustainability Science Literature Review

As we review recent literature characterizing the fundamental dimensions that distinguish sustainability science from more discipline-specific research, we focus on the connection to stakeholder involvement. A stakeholder is anyone with an interest in having the specific human-environment system under study towards attain a more sustainable state (Star and Griesemer 1989) Stakeholders therefore include the people in a polluted watershed demanding greater access to clean water, non-profit groups working to eradicate invasive species, or government agencies. The fundamental distinction in the literature, even if implicit, is between scientists in academic settings, and everyone else. In this sense, even scientists outside academia (e.g., in industry or government settings) may also constitute a stakeholder group for academics. In short, the argument is that without meaningful stakeholder-scientist interactions, the research results – whatever their scientific appeal – are likely to be ignored by the very people needed to translate the results into action towards sustainability. To be clear, research that does not meet the SCL criteria can still of course be considered “good science,” just not good sustainability science, given the imperative with the latter domain to have results translate into application.

Five broad characteristics are synthesized from the literature: salience, legitimacy, credibility, solutions-orientation, and human-environment interaction.

Sustainability Science Principles

- **Salience:** relevance to interests, based on an intensive assessment of the needs of stakeholders (White et al., 2010)
- **Credibility:** trust, scientific adequacy (Cash et al., 2003)
- **Legitimacy:** unbiased, fair (Quay et al., 2013)
- **Solutions-orientation:** Centered around addressing a specific problem (Clark and Dickson, 2003)
- **Human-environment interaction:** Connected to both development and sustainability (Kates, 2011)

Much of the literature on sustainability science highlights the need for the research to be salient, credible, and legitimate (“SCL”) as necessary conditions for the research to be successful (Cash 2001; Cash et al 2003). These three criteria, if satisfied, are thought to maximize the likelihood that the research findings will be both useable and used. **Salience** refers to the relevance and applicability of research in terms of meeting the needs of stakeholders. Salient scientific information is developed and tailored for specific use – essentially, information must be provided in a format (in terms of presentation, spatial extent, and timescale) that decision makers can use. Salience may be achieved by showing stakeholders that their

collective interests are shared and relevant. Explicit research interests may be connected through boundary spanning across disciplines, organizations, and between knowledge and action (Cash et al. 2003). Expanding the variety of stakeholders and departments may be balanced by adding specificity in the form of location focus. Increased salience occurs as translation and mediation serve as a boundary-bridge between different forms of knowledge. **Credibility** represents scientific adequacy of technical evidence and recognition (Quay et al., 2013). Establishing credibility requires a continuous process of stakeholder engagement to establish relationships and trust. Legitimacy requires that methods and results are unbiased, fair, and reflecting of the values and beliefs of all stakeholders (White et al. 2010). Legitimacy must be established to ensure that data is perceived as respectful of a wide variety of views and interests. Legitimate means the research process is perceived by stakeholders to be minimally influenced by politics or hidden interests. **Legitimacy**, much like salience and credibility requires extensive collaboration and stakeholder interaction.

Solutions-oriented science contrasts with curiosity-driven inquiry in that problem-driven questions lead to answers which serve a purpose (Clark and Dickson, 2003). In curiosity-driven research, the lack of direction in framing a question increases the likelihood that the answer does not contribute to stated goals (Clark, 2007). Sustainability science goes beyond basic and applied research to focus directly on utility. As solutions-oriented research is use-inspired, the results are certain to be practical, actionable and relevant. Of course, curiosity-driven science remains a valuable approach to knowledge production. One never knows what insights may be gained by asking novel questions simply because the questions are novel. Yet sustainability thinking places a higher value on addressing solutions-oriented research questions that are co-produced with stakeholders, designed to meet specific objectives. Finally, adding to the solutions-oriented criterion is the question of the type of system for which the solutions are being designed: **human-environment interaction**. If sustainability science lies at the intersection of environmental science and sustainable development, then the unit of analysis must be not an environmental system, nor a human system, but instead a complex, coupled human-environment system (NRC, 1999; Pfirman 2003; Turner et al., 2003; Kates et al. 2005). The human-environment focus functions as a characteristic of content rather than a guidance structure for sustainability science.

Sustainability science is a relatively new discipline, such that some of its fundamental principles still require testing (Wiek et al., 2012). One such principle is the proposition that scientists interested in advancing sustainability should interact with stakeholders of various kinds. Failure to engage with stakeholders means the scientists' research goals may be misaligned with what is needed outside the laboratory, rendering the results unusable and of only academic appeal. This proposition may appear uncontroversial, but it is more aspirational than operational. Practical guidance is needed because establishing and cultivating meaningful scientist-stakeholder interactions is not a simple process. Improperly managing this interface may hinder rather than enhance research. Yet the literature provides little guidance on how to produce and assess meaningful scientist-stakeholder interactions designed to align sustainability science goals.

Methods for Evaluation

There are many ways in which a sustainability science boundary organization might engage stakeholders. The evaluation form served as validation tool for measuring success of the event in creating intended results, thus it was tailored to specific event goals as well as sustainability science principles. Deep reflection of the principles during event design led to insights for event priorities and strategies. All participants were required to fill out an evaluation form, which had been designed as a first-generation scorecard to assess interdisciplinary collaborations in meeting sustainability science principles (see Appendix B). Statements on the evaluation form were correlated to each of the five criteria using similar language and applications used in previous questionnaires in the literature (Blackstock et al. 2007; White et al. 2010). The evaluation form was structured with two objectives: 1) to gauge the effectiveness of meeting six specific goals and 2) to measure the implementation principles in terms of meeting component (morning presentations, break-out, reconvening) academic/stakeholder perspective (FAU/USGS), and sustainability science principles. The evaluation form was divided into sections based on the meeting sections, each with identical questions linked to five sustainability science principles: salience, legitimacy, credibility, solutions-orientation, and human-environment interaction.

Multiple-choice answers were coded and open-ended answers were reviewed. The responses were analyzed on many levels; we differentiated between USGS and FAU participants, and we looked at the five selected criteria as they were applied to each component of the event.

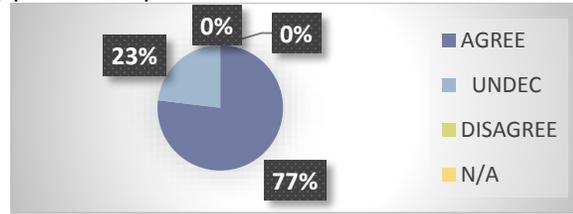
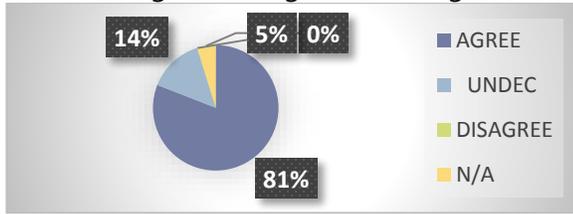
Survey Results

The evaluation forms were analyzed on many levels; we distinguished USGS scientists from academic participants, we looked at the five principles as they were applied to each component of the event. First, the overall meeting goals were assessed (Figure 3) to show that the most successful goals reached were the sharing of research interests and strengthening of partnerships. The least successful goals were the learning of new funding opportunities and new knowledge of human-environment systems interactions. USGS participants had more agreement with most goals. When comparing the participants for the criteria based statements, Figures 4, 5, and 6 reflect the results based on the component of the day. USGS also had more positive responses collectively. The statements that were agreed upon most frequently were "Participants were engaged and enthusiastic," and "A variety of perspectives and backgrounds were explored." This reflects that the events key strengths include interdisciplinary, transformational and unbiased characteristics. The key weaknesses for the event were reflected in the strongest disagreement with the statements about research. The solution-oriented nature of research was disagreed with most for the morning presentation among FAU scientists, while 0% of USGS scientists disagreed. In fact, USGS scientists did not disagree with any of the statements which described the components of the day. If they did not agree, they selected "undecided" or "n/a".

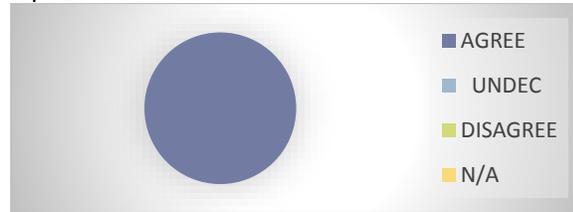
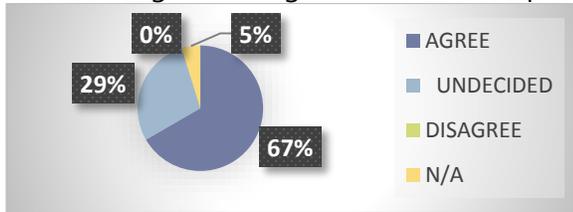
FAU

USGS

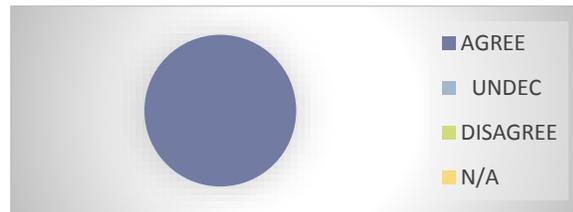
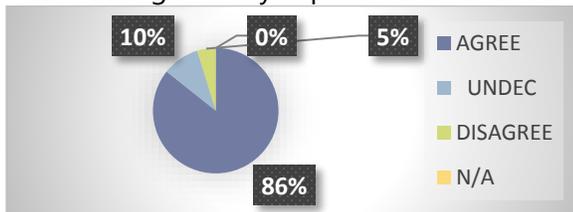
The meeting met the goal to strengthen existing partnerships



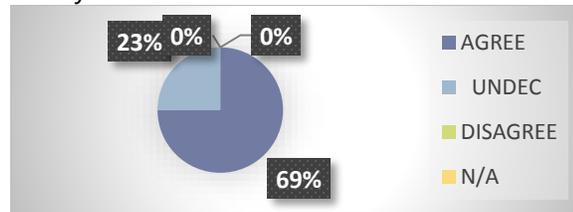
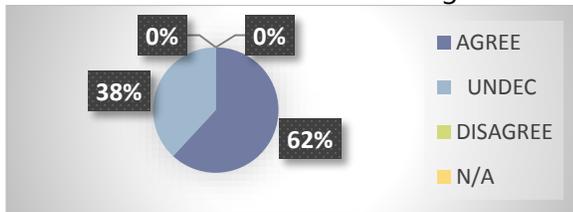
The meeting met the goal to foster new partnerships



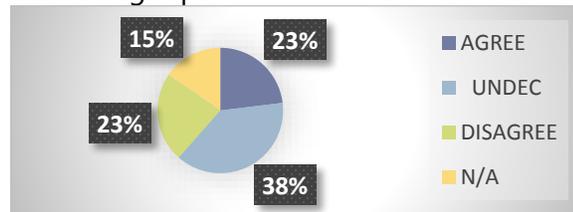
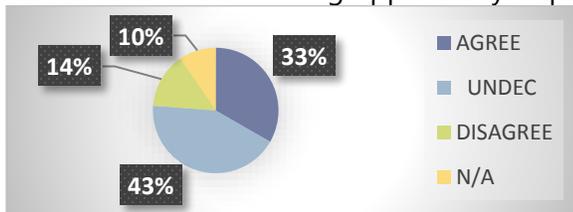
The meeting met my expectations for sharing of research interests



Information learned at the meeting will be useful in my work



I learned of a new funding opportunity or project that I might pursue



I have significant new knowledge of human-environment systems interactions

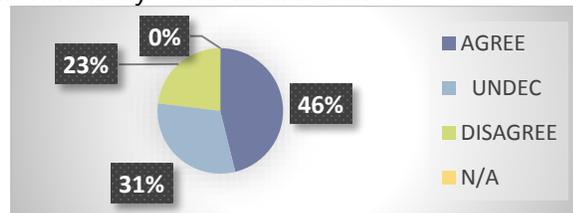
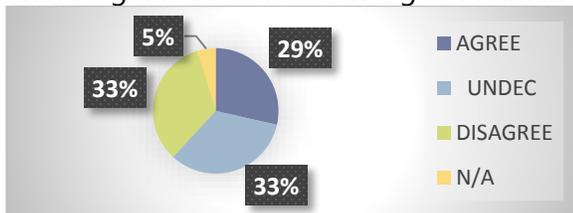


Figure 3: Survey Results for Overall Meeting goals

Percent Agreement with Statements: Morning Presentations

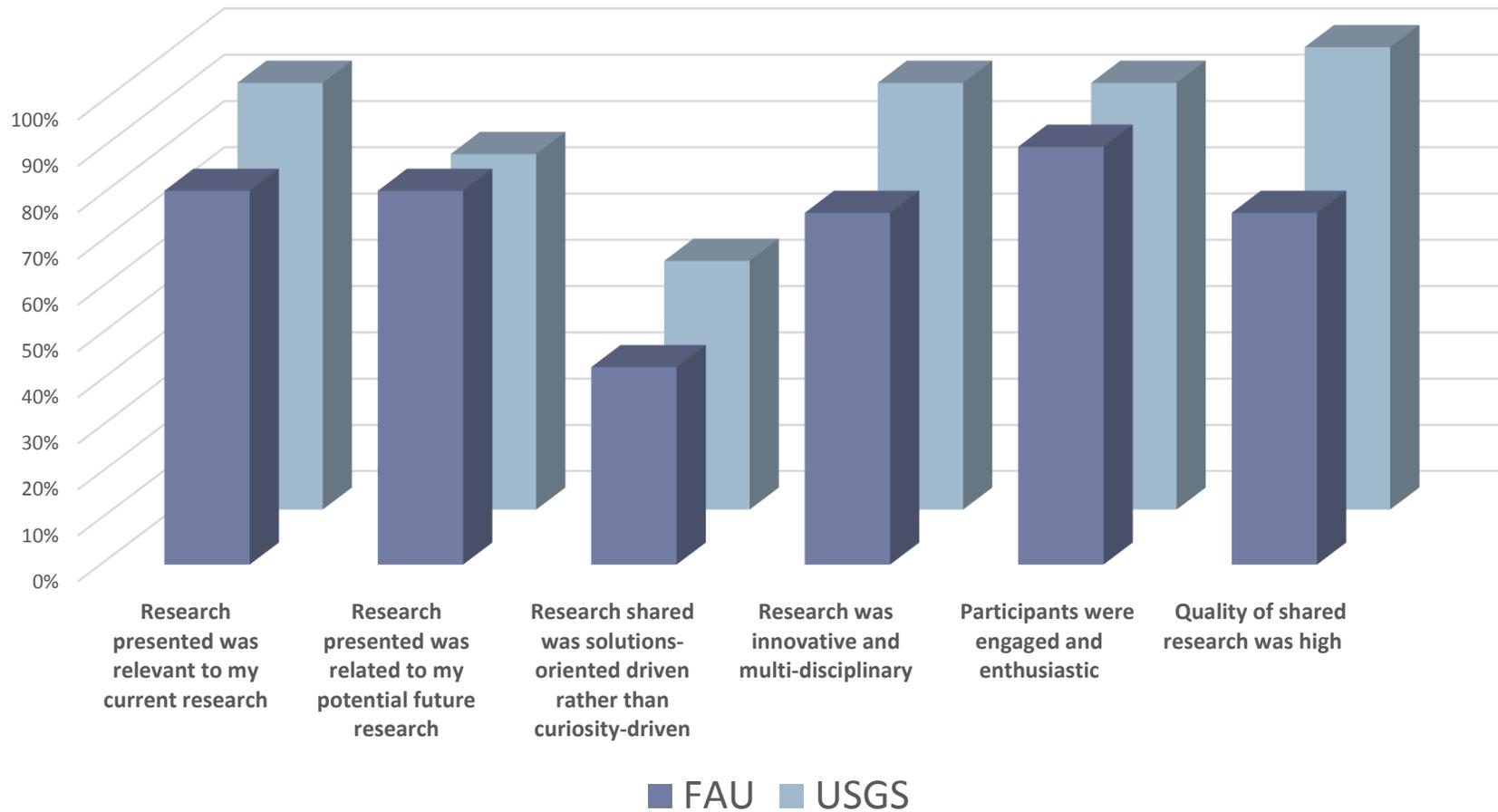


Figure 4: Survey Results for Agreement with Statements about Morning Individual Presentations

Percent Agreement with Statements: Afternoon Breakout Sessions

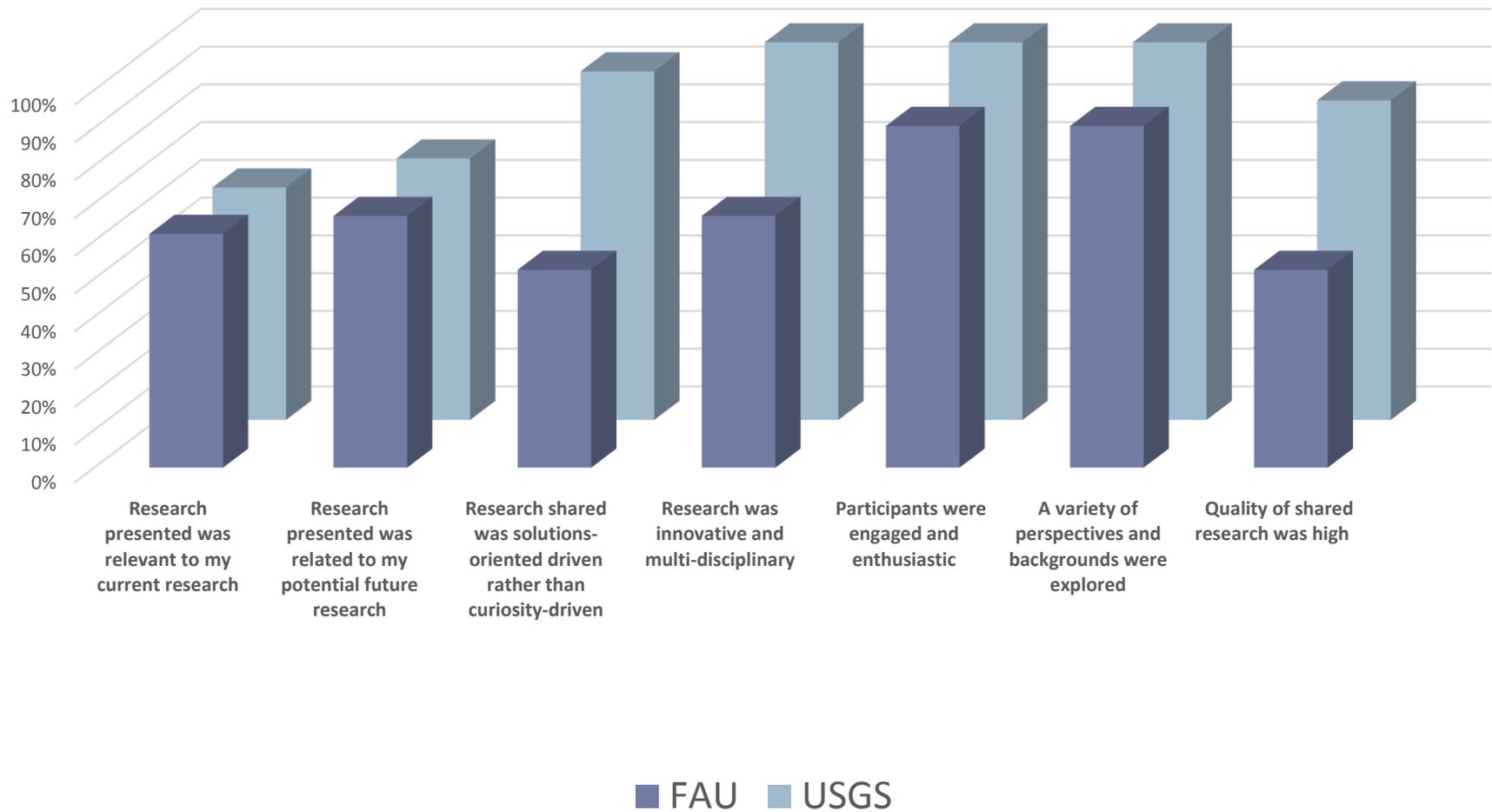


Figure 5: Survey Results for Agreement with Statements about Parallel Breakout Sessions

Percent Agreement with Statements: Reconvening Discussion

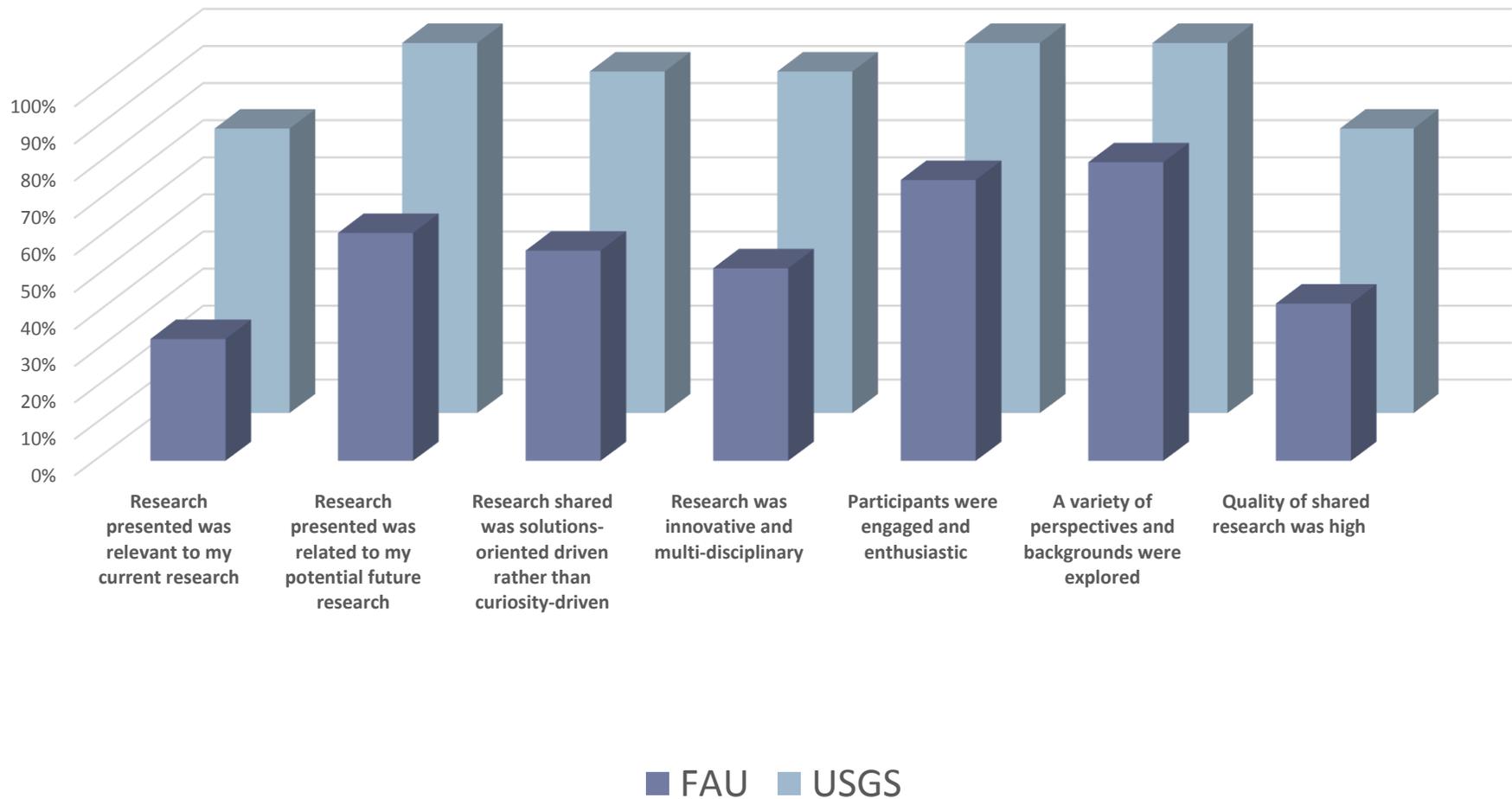


Figure 6: Survey Results for Agreement with Statements about Full Group Reconvening

Figure 7 illustrates the scorecard results for each principle with the measurement statements below.

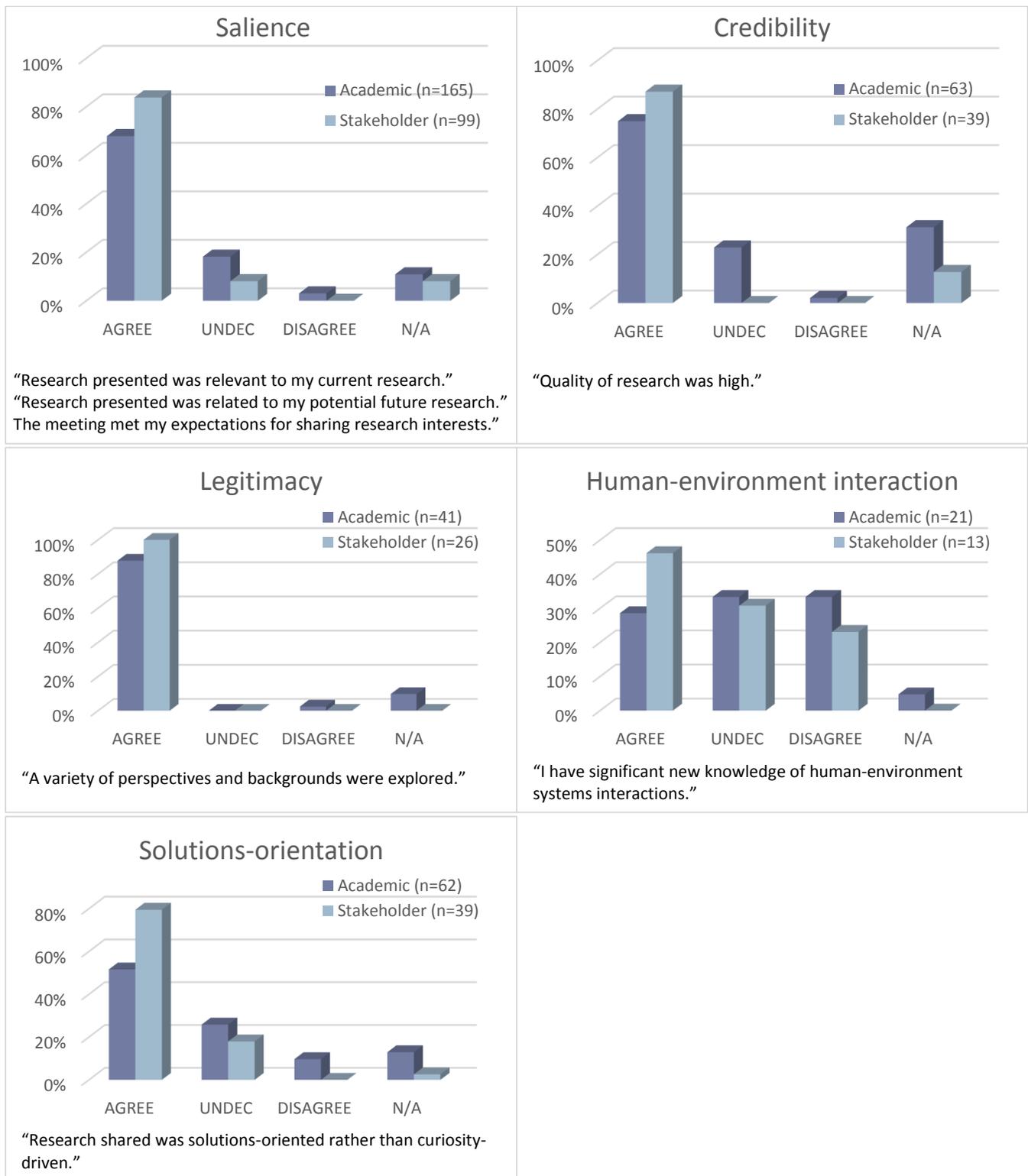


Figure 7: Pooled evaluation results from 21 academics (FAU) and 13 stakeholders (USGS).

Open-ended responses indicated that stakeholder engagement was enhanced via focus on specific shared goals and a broad scope, but in some ways was limited by the correlating lack of specificity.

Conclusion

One USGS scientist commented, "Promoting themes rather than departments opens up trust and willingness to collaborate. This will more easily allow for people with different interests to come together." This overall positive attitude was shared unanimously among participants. After the event, there was correspondence between several participants to follow up on ideas and one USGS scientist went to visit an FAU lab to see some new instrumentation. There was a Geosciences departmental email which circulated relevant job and scholarship opportunities shared by a USGS scientist as a result of the event. These and similar indications of increased communication will likely be tracked in a follow-up evaluation at a later date to determine long term impacts.

When a participatory approach is structured around diverse stakeholders, new information is created at the boundary of multiple disciplines. Numerous sustainability science principles in the literature require evaluation in practice. As a boundary organization CES tested these principles and used them to generate the design and evaluation of this event. We build upon previous assessments, highlighting the great potential which stakeholder engagement holds in enriching an event when integrating specific criteria. As our collaborative event was assessed using the criteria scorecard, results reflect a successful event in terms of salience, credibility, and legitimacy (SCL), but slightly lacking on the solutions-orientation and human-environment interaction dimensions. The new scoring criteria assemblage presented here serves as a validation tool for measuring success of events in creating intended results.

Next steps

Moving forward, a series of additional collaborative stakeholder meetings are in the planning phase, centered on topics such as invasive species and downscaling of global climate models specifically to South Florida. The results of the evaluation have also be submitted for peer-reviewed publication in a special leadership issue of the Journal of Environmental Studies and Sciences. The evaluation "scorecard" presented here may be tailored to fit specific event goals and to quantitatively gauge the level of effectiveness in terms of each sustainability science principle. We envision future generations of similar measurement tools developed to design and evaluate interdisciplinary events with additional sustainability science criteria. Guidance is particularly needed to meet the goal of scientists engaging with stakeholders (Bäckstrand 2003). Failing to engage with stakeholders means the scientists' research goals may be unaligned with what is needed outside the laboratory. As a result, the research results may be unusable and of only academic appeal.

References:

Bäckstrand K (2003) Civic science for sustainability: reframing the role of experts, policy-makers and citizens in environmental governance. *Global Environmental Politics* 3(4):24–41.

Cash DW (2001) “In order to aid in diffusing useful and practical information”: Agricultural extension and boundary organizations. *Science, Technology & Human Values*, 26(4): 431-453.

Cash DW, Clark, WC, Alcock, F, Dickson, NM, Eckley N, Guston DH, Jäger DH, Mitchell RB (2003) Knowledge systems for sustainable development. *Proceedings of the National Academy of Sciences*, 100(14): 8086-8091.

Clark WC (2007) Sustainability science: A room of its own. *Proceedings of the National Academy of Sciences of the United States of America*, 104(6): 1737-1738.

Kates RW, Clark WC, Corell R, Hall JM, Jaeger CC, Lowe I, McCarthy JJ, Schellnhuber HJ, Bolin B, Dickson NM, Faucheux S, Gallopin GC, Grubler A, Huntley B, Jager J, Jodha NS, Kasperson RE, Mabogunje A, Matson P, Mooney H, Moore B, O'Riordan T, Svedin U (2001) Sustainability science. *Science* 292(5517):641–642.

Robert KW, Parris TM, Leiserowitz AA (2005). What is sustainable development? Goals, indicators, values, and practice. *Environment: Science and Policy for Sustainable Development*, 47(3): 8-21.

Kates RW (2011) What kind of a science is sustainability science? *Proceedings of the National Academy of Sciences*, 108(49): 19449-19450.

NRC National Research Council (US). Policy Division. Board on Sustainable Development. Our common journey: a transition toward sustainability. National Academies Press, 1999.

Parris TM Kates RW (2003) Characterizing a sustainability transition: Goals, targets, trends, and driving forces. *Proceedings of the National Academy of Sciences of the United States of America*, 100(14): 8068-8073. doi:10.1073/pnas.1231336100

Pfirman S (2003) Complex environmental systems: synthesis for earth, life, and society in the 21st century: a 10-year outlook for the National Science Foundation. National Science Foundation.

Quay R Larson KL White DD (2013) Enhancing water sustainability through university–policy collaborations: Experiences and lessons from researchers and decision-makers. *Water Resources IMPACT*, 15(2): 17-19.

Star SL Griesemer JR (1989) Institutional ecology, translations' and boundary objects: Amateurs and professionals in Berkeley's Museum of Vertebrate Zoology, 1907-39. *Social Studies of Science*, 19(3): 387-420. doi:10.1177/030631289019003001

Turner BL Kasperson RE Matson PA McCarthy JJ Corell RW Christensen L Eckley N Kasperson JX Luers A Martello M Polsky C Pulsipher A Schiller (2003) A framework for vulnerability analysis in sustainability science. *Proceedings of the National Academy of Sciences of the United States of America*, 100(14): 8074-8079. doi:10.1073/pnas.1231335100

White DD Wutich A Larson KL Gober P Lant T Senneville C (2010) Credibility, salience, and legitimacy of boundary objects: Water managers' assessment of a simulation model in an immersive decision theater. *Science and Public Policy*, 37(3): 219-232. doi:10.3152/030234210X497726

Wiek A Farioli F Fukushi K Yarime M (2012) Sustainability science: Bridging the gap between science and society. *Sustainability Science*, 7(1):1-4. doi:10.1007/s11625-011-0154-0

Appendix A Meeting Agenda

USGS-FAU Collaborative Research Meet & Greet February 6, 2015 Florida Atlantic University Davie Campus Davie West

Goal

The goal of this cross-disciplinary meeting is to strengthen partnerships and projects between FAU and USGS scientists. The objective is to develop new and strengthen existing linkages among participants fostered through sharing of research interests and facilitated conversations.

Agenda

10:00 – 10:15 **Opening Remarks & Meeting Goals – DW-108**

- Colin Polsky, Director, Center for Environmental Studies; Professor, Geosciences, FAU
- Tony Abbate, Associate Provost for the Broward Campuses, FAU (invited)
- Dale Gawlik, Professor and Director, Environmental Sciences Program, FAU
- Nick Aumen, Regional Science Advisor, USGS
- Jay Baldwin, Assoc. Director, Center for Environmental Studies; Professor, Biological Sciences, FAU

10:15 – 12:00 **USGS & FAU Scientists Sharing of Individual Research Interests**

12:00 – 12:30 **Lunch**

12:30 – 2:00 **Brief Parallel Break-out Groups – DW-107, 109, 110**

*Identifying Needs, Making Connections

2:00 – 3:00 **Reflections and Moving Forward – DW-103**

3:00 – 4:00 **Networking Reception**

*Opportunities for further discussion

*Beer/Wine & Hors d'oeuvres in DW Lobby

Appendix B - Evaluation Form

USGS-FAU Collaborative Research Meet & Greet

USGS, FAU Center for Environmental Studies

Name (optional) _____

What is your affiliation? FAU USGS

Please rate the following areas by checking the appropriate box or responding to the question:

Overall Meeting Goals

	AGREE	UNDECIDED	DISAGREE	N/A
The meeting met the goal to strengthen existing partnerships	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
The meeting met the goal to foster new partnerships	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
The meeting met my expectations for sharing of research interests	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Information learned at the meeting will be useful in my work.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I learned of a new funding opportunity or project that I might pursue.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I have significant new knowledge of human-environment systems interactions.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Morning Presentations:

	AGREE	UNDECIDED	DISAGREE	N/A
Research presented was relevant to my current research.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Research presented was related to my potential future research	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Research shared was solutions-oriented driven rather than curiosity-driven	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Research was innovative and multi-disciplinary.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Participants were engaged and enthusiastic	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Quality of shared research was high	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Parallel Breakout Sessions:

	AGREE	UNDECIDED	DISAGREE	N/A
Discussions were relevant to my current research.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Discussions were related to my potential future research	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Discussions were solutions-oriented rather than curiosity-driven	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Discussions were innovative and multi-disciplinary.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Participants were engaged and enthusiastic	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
A variety of perspectives and backgrounds were explored	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Quality of shared research was high	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Full group reconvening discussion:

	AGREE	UNDECIDED	DISAGREE	N/A
Discussions were relevant to my research.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Discussions were related to my interests.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Discussions were solution-oriented	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Discussions were innovative and cross-disciplinary.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Participants were engaged and enthusiastic	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
A variety of perspectives and backgrounds were explored	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Quality of shared research was high, and methods were validated	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Please share any additional comments (continue on back if necessary).

Appendix C - Evaluation Participant List

Facilitators

1. **Colin Polsky**, Director, Florida Center for Environmental Studies; Professor, Geosciences, FAU, cpolsky@fau.edu, website: www.ces.fau.edu/staff/colin-polsky.php Research Interests: Human dimensions of global environmental change
2. **Dale Gawlik**, Director, Environmental Science Program; Professor, Biological Sciences, FAU, dgawlik@fau.edu, website: www.science.fau.edu/biology/gawliklab/ Research Interests: Avian and wetland ecology, wetland ecosystem restoration
3. **Nick Aumen**, Regional Science Advisor, SE Region, USGS, naumen@usgs.gov, website: <http://sofia.usgs.gov/personnel.php?per=466> Research Interests: Nutrient biogeochemistry, microbial ecology, wetland restoration, linking sciences and policy
4. **John "Jay" Baldwin**, Professor, Biological Sciences; Associate Director, Florida Center for Environmental Studies, FAU; Science Coordination Group, South Florida Ecosystem Restoration Task Force, jbaldwin@fau.edu, website: www.science.fau.edu/biology/faculty/baldwin.html Research Interests: Population and conservation genetics; Marine biology, ichthyology and fisheries; Wildlife avian ecology; Everglades restoration

Participants

5. **Rindy Anderson**, Assistant Professor, Biological Sciences, FAU, andersonr@fau.edu, website: <http://www.science.fau.edu/biology/faculty/anderson.html> Research Interests: Behavioral ecology, cognition, avian biology, bioacoustics
6. **James Beerens**, Ecologist, USGS, jbeerens@usgs.gov, website: <http://profile.usgs.gov/jbeerens> Research Interests: Defining wildlife habitat – modeling habitat selection, occurrence, reproduction; Evaluating and assessing Everglades restoration; Developing conservation strategies for species sensitive to anthropogenically disturbed landscapes
7. **Brian Benschoter**, Assistant Professor, Biological Sciences, FAU; Chair, Society of Wetland Scientists Peatland & Biogeochemistry Sections; Chair, Ecological Society of America 2016 Conference Local Host Committee, bbenschot@fau.edu, website: www.science.fau.edu/biology/faculty/benschoter.html Research Interests: Peatland (wetland) ecology; fire ecology; community and ecosystem ecology
8. **Frederick Bloetscher**, Associate Professor, Civil, Environmental and Geomatics Engineering, FAU, h2o_man@bellsouth.net, www.h2o-pe.com, Research Interests: Water resources, infrastructure vulnerability and management
9. **Keren Bolter**, Research Coordinator, Florida Center for Environmental Studies, FAU, kbolter@fau.edu, Research Interests: Spatial analysis of physical, socioeconomic, and health impacts of sea-level rise

10. **Tiffany Roberts Briggs**, Assistant Professor, Geosciences, FAU, briggst@fau.edu, website: www.geosciences.fau.edu/people/briggst.php Research Interests: Coastal morphology, geology, and sedimentology
11. **Mike Cherkiss**, Wildlife Biologist, USGS, mcherkiss@usgs.gov, website: <https://profile.usgs.gov/mcherkiss> Research Interests: Population ecology and biology of endangered and invasive reptile species (American crocodile, alligator, pythons, tegus, etc.); Everglades restoration
12. **Xavier Comas**, Associate Professor, Geosciences, FAU; Research affiliate, Carbonate Aquifer Characterization Laboratory (CACL), USGS, xcomas@fau.edu, website: www.geosciences.fau.edu/people/comas.php Research Interests: Application of near-surface geophysical methods to: 1) peat soils, 2) karst environments, 3) critical zone studies, 4) other (archeological applications and biological studies)
13. **Andre Daniels**, Marine Ecologist, USGS, andre_daniels@usgs.gov, website: <http://sofia.usgs.gov/personnel.php?per=169> Research Interests: Estuary and marine environments, seagrass communities and coral reef communities
14. **Don DeAngelis**, Ecologist, Senior Scientist, USGS; Adjunct Professor, University of Miami, don_deangelis@usgs.gov, website: www.as.miami.edu/biology/people/faculty/don-deangelis/ Research Interests: Development of individual-based population models; Theoretical and computational ecology; Ecosystem ecology
15. **Donna Devlin**, Assistant Research Professor, Biological Sciences, FAU, ddevlin@fau.edu, website: www.science.fau.edu/biology/faculty/devlin.html Research Interests: Plant-invertebrate interactions
16. **Mark Dickman**, Hydrologic Data Section Chief, USGS, mdickman@usgs.gov, website: <http://sofia.usgs.gov/personnel.php?per=410> Research Interests: Hydrologic monitoring and monitoring projects
17. **Nathan Dorn**, Associate Professor, Biological Sciences, FAU, ndorn1@fau.edu, website: www.science.fau.edu/biology/faculty/dorn.html Research Interests: Freshwater ecology, Community ecology
18. **Alana Edwards**, Education and Training Coordinator, Florida Center for Environmental Studies, FAU, aedwards@fau.edu, Research Interests: Ecosystem management for imperiled butterflies
19. **Nwadiuto Esiobu**, Professor, Biological Sciences, FAU, nesiobu@fau.edu, website: www.science.fau.edu/biology/faculty/esioibu.html Research Interests: Applied and environmental microbiology; Plant-Microbe interactions; Ecology of pathogens and climate change; Beach quality; Sustainable development
20. **Kristen Hart**, Research Ecologist, USGS, kristen_hart@usgs.gov, website: <http://sofia.usgs.gov/personnel.php?per=253> Research Interests: Large reptile research and ecosystem restoration (sea turtles, diamondback terrapins, American crocodile, American alligator, Burmese pythons)

21. **Colin Hughes**, Associate Professor, Biological Sciences, FAU, chughe@fau.edu, website: <http://www.science.fau.edu/biology/faculty/hughes.html> Research Interests: Evolutionary genetics and its relationship to conservation
22. **Ken Krauss**, Research Ecologist, National Wetlands Research Center, USGS; Adjunct Professor, LSU, UL-Lafayette, Clemson Univ., kraussk@usgs.gov, website: <https://profile.usgs.gov/kraussk> Research Interests: Scaling ecophysiological processes associated with water use in wetland forests; Ecology of greenhouse gas emissions; Coastal wetland vulnerability to sea-level rise; Ecology of tidal freshwater forested wetlands
23. **Bill Louda**, Research Professor, Chemistry and Biochemistry and Environmental Sciences Program, FAU, blouda@fau.edu, website: www.science.fau.edu/chemistry/2008faculty/2009loudw.htm Research Interests: Environmental biogeochemistry, water quality, global climate change, environmental restoration, organic geochemistry (petroleum, coal)
24. **Scott Markwith**, Associate Professor and Assistant Chair, Geosciences, FAU; Director, Doctoral Program, Geosciences, FAU smarkwit@fau.edu, website: www.geosciences.fau.edu/people/markwith.php Research Interests: Ecological biogeography; Environmental restoration; Dispersal/migration processes; Exotic species invasion and mitigation
25. **Daniel Meeroff**, Associate Chair and Professor, Civil, Environmental & Geomatics Engineering, FAU; Director, Laboratories for Engineered Environmental Solutions (Lab.EES), dmeeroff@fau.edu, website: <http://labees.civil.fau.edu/staff.html> Research Interests: Environmental engineering; Development of innovative treatment technologies that mimic natural systems; Aquatic water quality; Water use efficiency and pollution prevention strategies; Water/wastewater treatment process; Solid/Hazardous waste management
26. **Diana Mitsova**, Associate Professor, School of Urban and Regional Planning, FAU; Southeast Florida Regional Climate Change Compact Shoreline Resilience Working Group, dmitsova@fau.edu, website: www.fau.edu/surp/people/mitsova.php Research Interests: Sea-level rise; Planning approaches to shoreline stabilization; Coastal resilience
27. **Erik Noonburg**, Associate Professor, Biological Sciences, FAU, enoonbur@fau.edu, website: www.science.fau.edu/biology/faculty/noonburg.html Research Interests: Ecological modeling; Population dynamics; Foraging behavior
28. **Ed Patino**, Hydrologist, USGS Caribbean-Florida Water Science Center, epatino@usgs.gov, website: <http://sofia.usgs.gov/personnel.php?per=79> Research Interests: Wetland and coastal ecosystems monitoring – flow and water quality; Use of sensor data as proxies for continuous monitoring of selected water quality parameters (i.e. carbon, mercury, suspended sediment – concentration & load)
29. **Stephanie Romanach**, Research Ecologist, USGS, sromanach@usgs.gov, website: <https://profile.usgs.gov/sromanach> Research Interests: Large-scale issues in conservation; Ecosystem restoration and climate change
30. **Tara Root**, Associate Professor, Geosciences, FAU, troot@fau.edu, website: www.geosciences.fau.edu/people/root.php Research Interests: Groundwater chemistry: water chemistry

as a tracer of the movement of water through the hydrologic cycle; Water resources sustainability: water use in science

31. **Dorothy Sifuentes**, Supervisory Hydrologist, USGS, dsifuentes@usgs.gov, website: <http://sofia.usgs.gov/personnel.php?per=454> Research Interests: Groundwater flow and solute transport; Coastal aquifers and saltwater intrusion
32. **David Sumner**, Associate Director for Studies, USGS Caribbean-Florida Water Science Center, dmsumner@usgs.gov, website: <http://sofia.usgs.gov/personnel.php?per=405> Research Interests: Water and carbon cycling
33. **Eric Swain**, Research Hydrologist, USGS, edswain@usgs.gov, website: <https://profile.usgs.gov/edswain> Research Interests: Effects of sea-level rise on coastal hydrology and ecology; Modeling surface-water/groundwater interactions; Statistical analysis of hydrologic parameters and methodology for determining field parameters
34. **Xing-Hai Zhang**, Associate Professor, Biological Sciences, FAU, xhzhang@fau.edu, website: www.science.fau.edu/biology/faculty/zhang.html Research Interests: Plant physiology and biochemistry; Molecular biology and biotechnology; Molecular ecology for Everglades; Genetics of invasive plants
35. **Mark Zucker**, Supervisory Physical Scientist, USGS, mzucker@usgs.gov, website: <http://sofia.usgs.gov/personnel.php?per=126> Research Interests: Coastal monitoring networks; Continuous water quality monitoring; Everglades restoration (Florida Bay)

For More Information Please Contact:

Mary Beth Hartman, Conference & Outreach Coordinator, Center for Environmental Studies, FAU
3200 College Ave. DW-313, Davie, FL 33314 • mhartman@fau.edu • 954-236-1203

Center for Environmental Studies Research Assistants:

Hannah Cooper, hcooper2013@fau.edu Research Interests: GIS, Remote Sensing and Statistical Modelling of Sea-Level Rise and Carbon Flux

Andrew Kamosky, akamosky2013@fau.edu Research Interests: Ecological Resiliency, Ecological-Societal Systems, Climate Change Impact Management