Fig. 1. iUTAH's Integrated Socio-Environmental Observatory, consisting of (1) data collection within an integrated observatory network made up of biophysical, social-science, and engineering components; (2) cyberinfrastructure, which supports data collection, publication, discovery, access, and archival; provides scientific expertise and innovation in the modeling of coupled systems and the visualization of scientific information; and provides high-performance computing capacity for researchers and modelers; and (3) the Office of Engaged Scholarship, which provides support and coaching for the conduct of collaborative research, training for Utah's next generation STEM workforce; and engagement with stakeholders, the general public, and underserved populations.
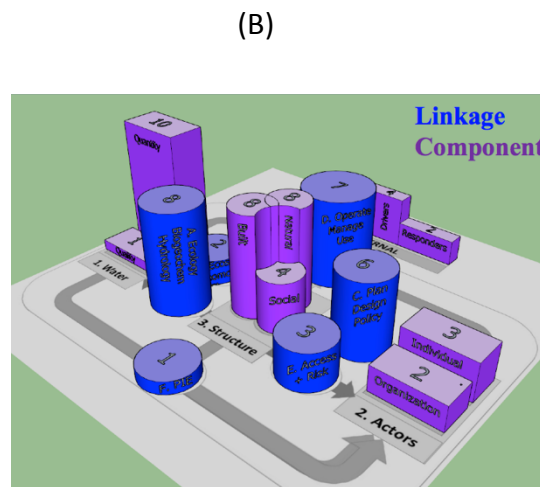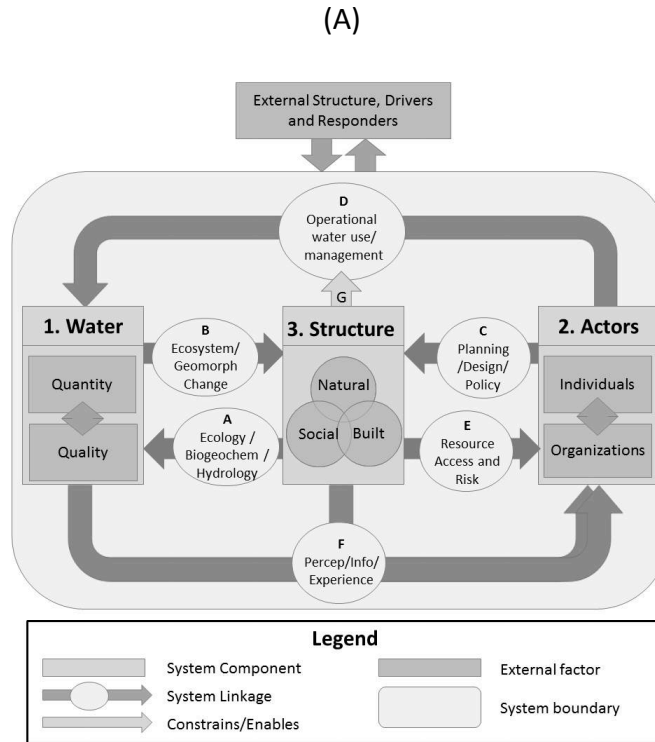
(A)

(B)

Fig. 2. The iSAW (integrating Structure, Actors and Water) conceptual framework (A) is organized around three main structure, actor, and water components (gray boxes); seven key linkages (arrows); and a system boundary (light grey shaded box) that separates internal and external (box with dark shading) components (Hale et al. 2015). An illustration of the current suite of iUTAH models mapped onto iSAW (B) shows coverage of ALL iSAW linkages and components, with comparatively weak coverage in the *Water Quality* and *Organizational Actor* components as well as the *PIE* (perceptions, information, and experience) and *Ecosystem/Geomorphic Change* linkages.
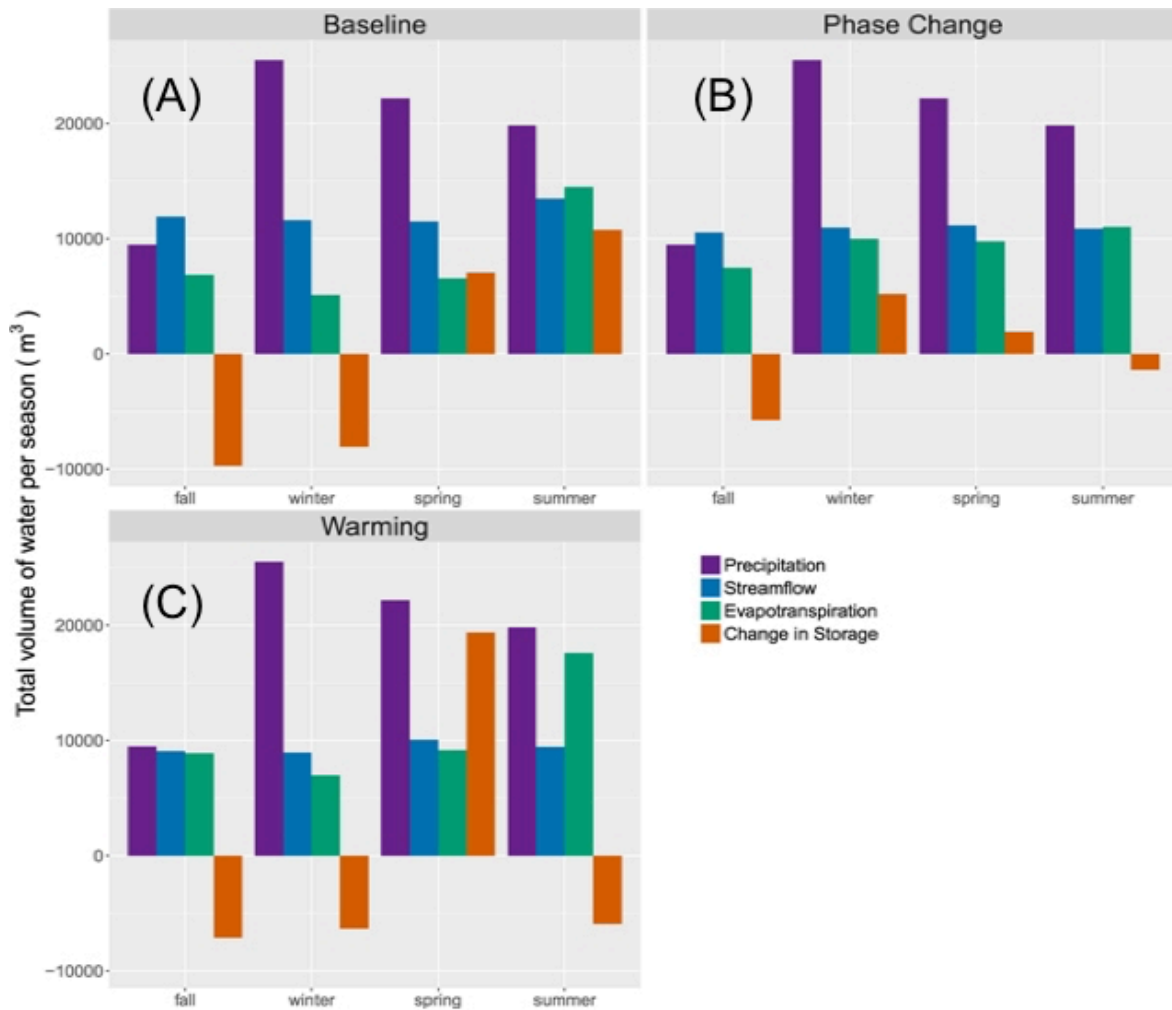
Fig. 3.   Net water balance components (precipitation, streamflow [Q], evapotranspiration [ET], and change in storage [ΔS] are plotted seasonally for three scenarios: compared to *Baseline* (A), the *Phase Change* (B) alters the pattern of storage fluctuations. The *Warming Scenario* (C) exhibits an extreme peak of recharge during a short snowmelt, but the summer demonstrates increased drought risk with lower Q, very high ET, and significant storage losses (Foster et al. 2016).
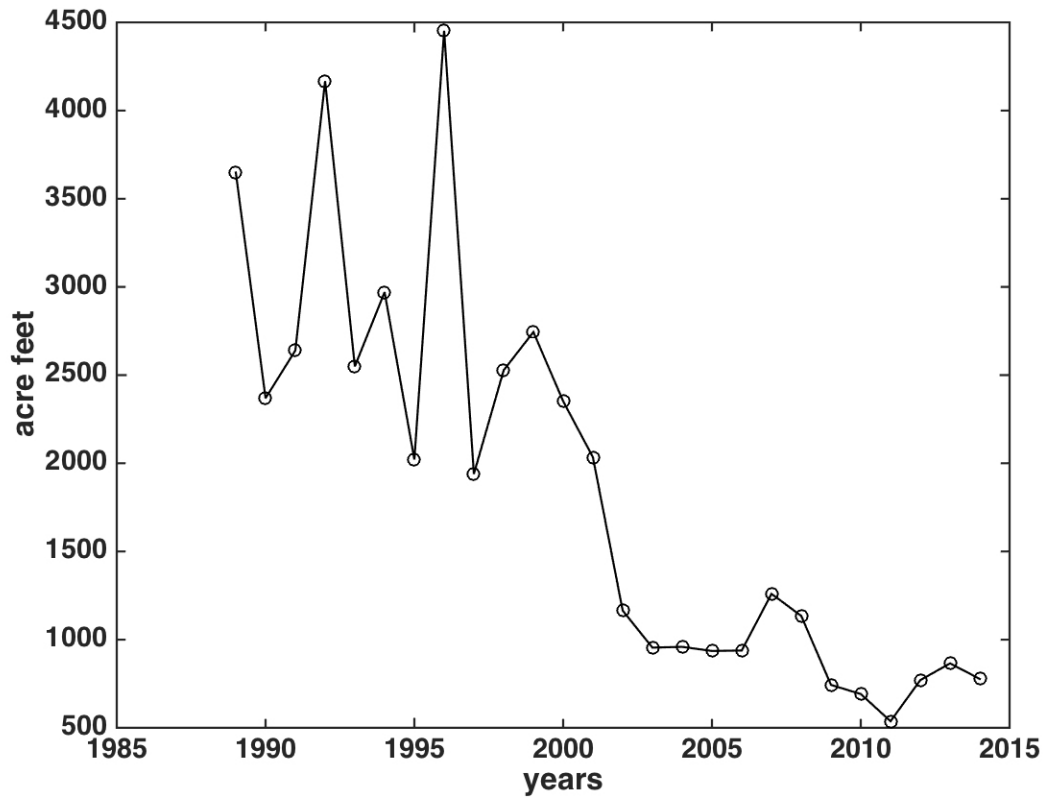
Fig. 4. Annual total groundwater diversion for agriculture in acre-feet for Jordan River basin, Utah. These data, which were obtained by iUTAH RFA1/RFA3 in collaboration with the Utah Division of Water Resources, form an essential component of large-scale water balance modeling, and will supplement precipitation and evapotranspiration data from RFA3 regional climate modeling work, along with agriculture surface water use and population growth-adjusted demand (Khatri and Strong, *in prep*.).
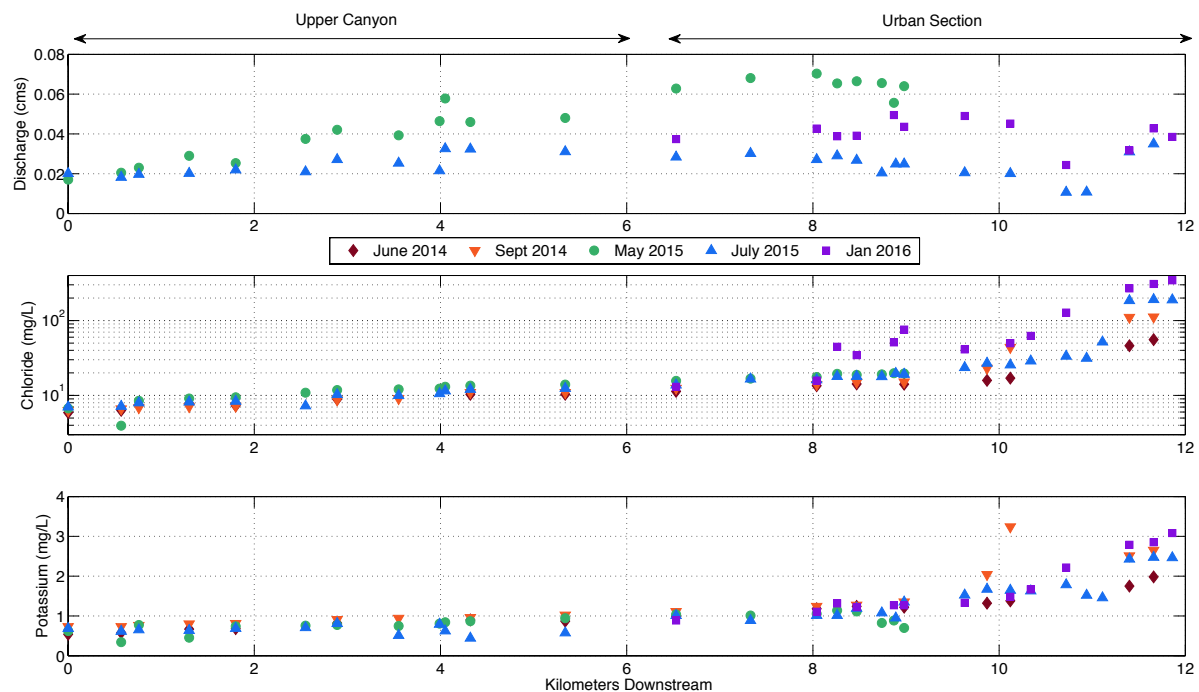
Fig. 5. Results from synoptic surveys of Red Butte Creek baseflow hydrochemistry in 2014 and 2015. In the canyon, the stream is a low nutrient gaining system heavily dominated by groundwater inputs, with minimal downstream changes in water chemistry. After Red Butte leaves the canyon at 6.3 km, the flow patterns are variable, with both losing and gaining sections. Chemical indicators of human impact, including chloride and potassium, as well as nitrate, phosphate, and other analytes all increase in this section, partially entering from the surface but predominately entering the stream as impacted groundwater. At 11.3 km, where there is substantial groundwater input to the stream, there is a large increase in chloride, nitrate, and other urban inputs that appear to be partially from leaky sewer pipes. The fact that urban influence to the stream can be seen during baseflow, and not only during storms, indicates that groundwater places a substantial role in how the urban environments impact rivers, and thus must be considered in urban plans to manage water quality.
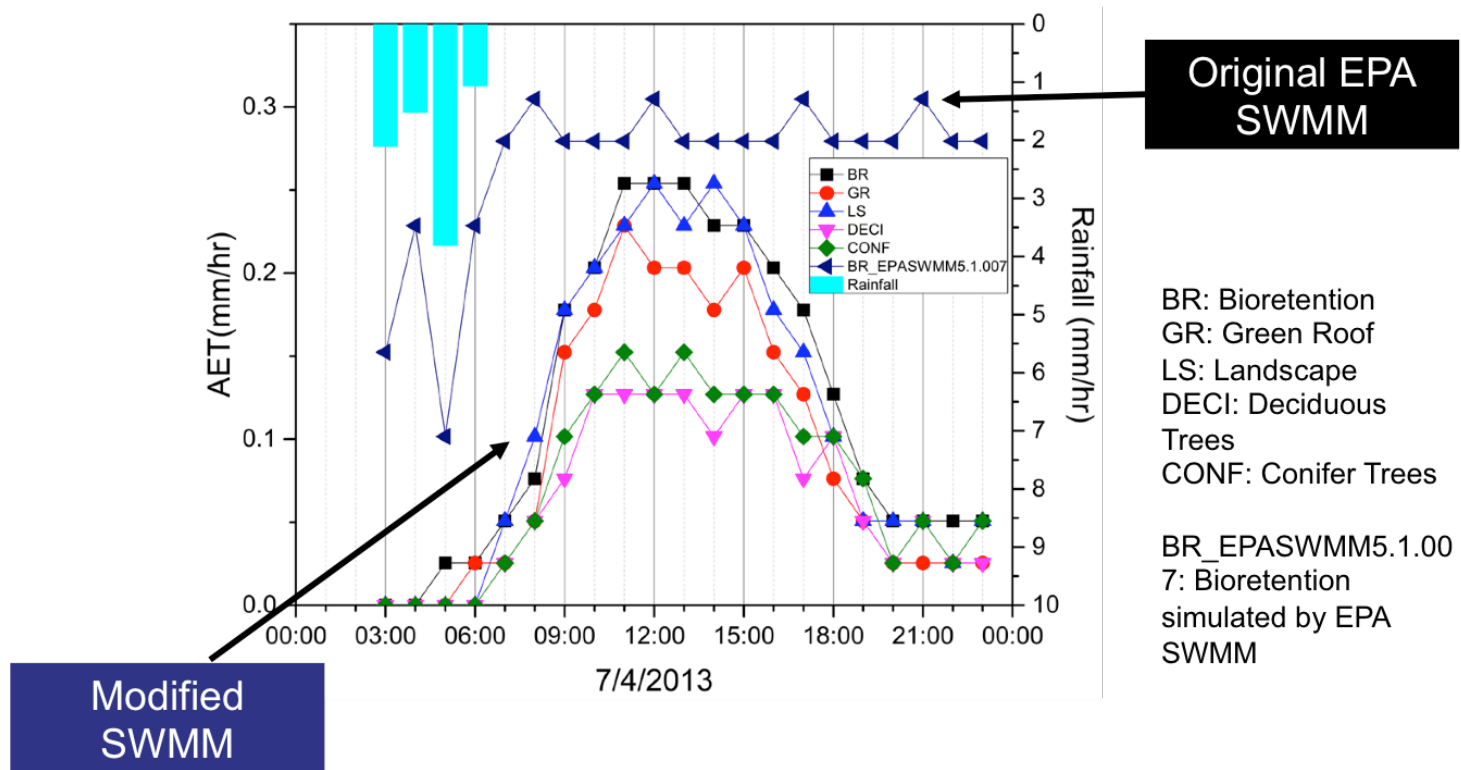
Fig. 6. Updated urban landscape Stormwater Management Model (SWMM) for Red Butte Creek using data from the iUTAH RFA2 engineering group green roof research. Model simulations for generalized green infrastructure (black triangles) are improved by specifying green infrastructure types, resulting in more realistic estimates of actual evapotranspiration following a rainfall event (Feng et al., *in review*).

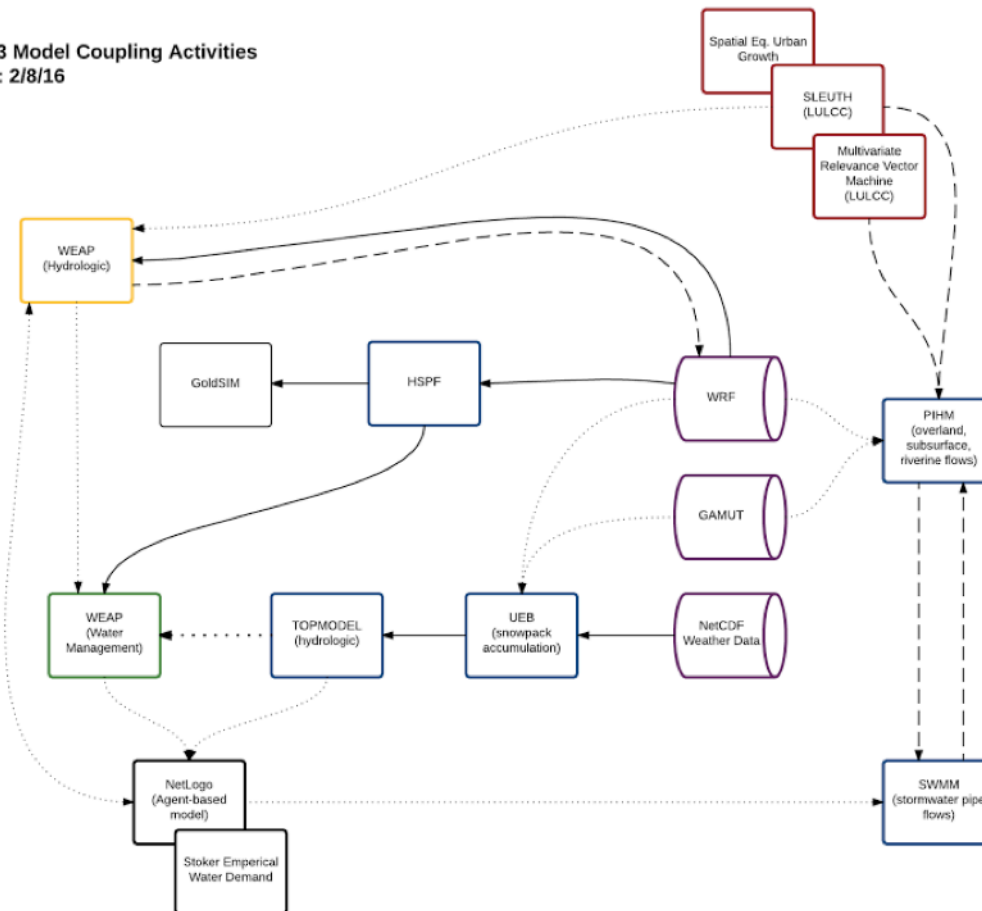**Modified RFA3 Model Coupling Activities**
Last Modified: 2/8/16

Fig. 7. Vision for models coupling developed by RFA3 researchers through a series of workshops held in Years 3 and 4. Solid lines represent couplings that have been implemented (complete), dashed lines are couplings that are under development, and dotted lines are couplings that are feasible and being envisioned for implementation in Year 5.
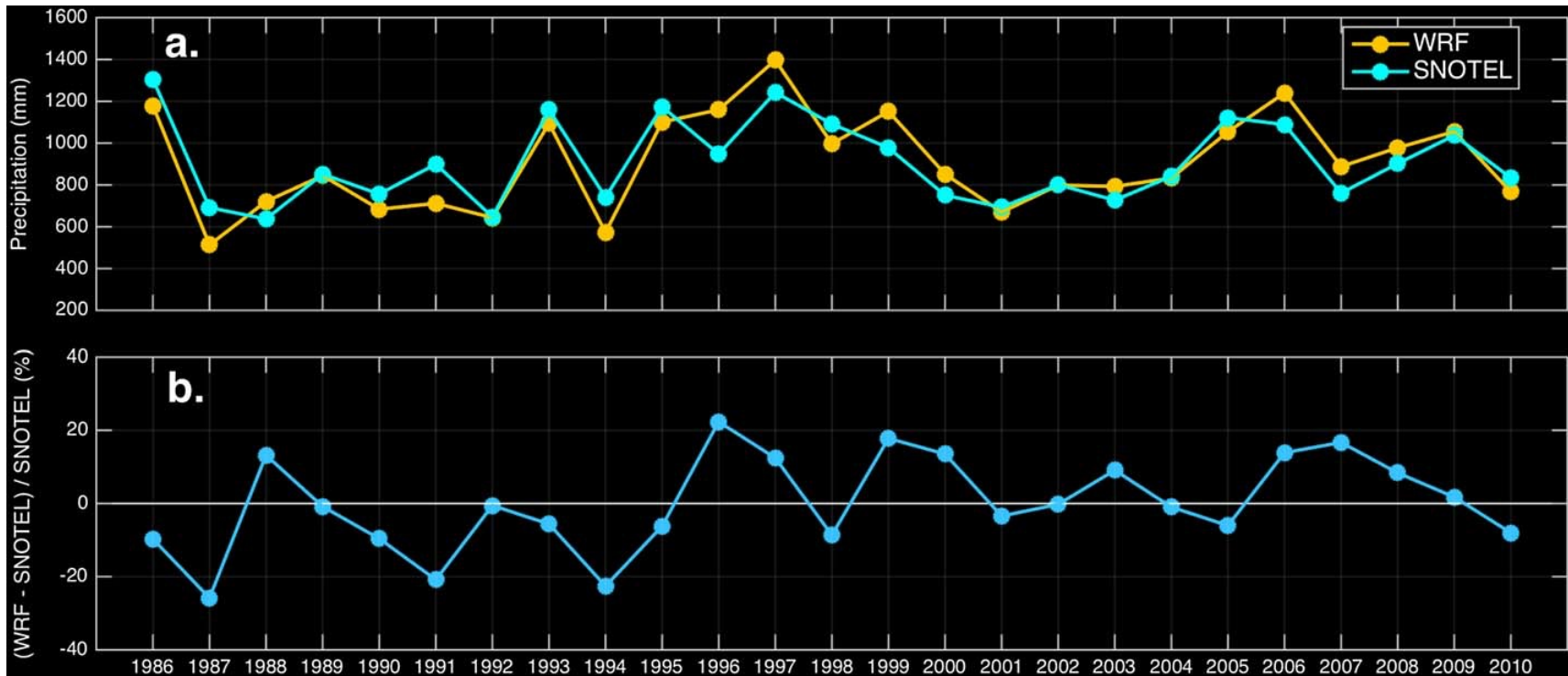
Fig. 8. Annual water year precipitation for SNOTEL (blue) and Weather Research and Forecasting (WRF) model (yellow) (A) and percent difference (100 x (WRF-SNOTEL)/SNOTEL) (B). There is high correlation (r = 0.87, p < 0.01) between the WRF and SNOTEL annual values but no clear evidence of a systematic sign to an overall bias in the model. Percent difference between WRF and SNOTEL for each year in the simulation is bounded by approximately ±20%. The percent difference time series exhibits periodicity, and examination of its autocorrelation sequence reveals maximum lagged correlation over a period of 4 years, significant at p = 0.05 level. This temporal pattern suggests a projection of oceanic modes of variability onto the bias via storm track shifts.
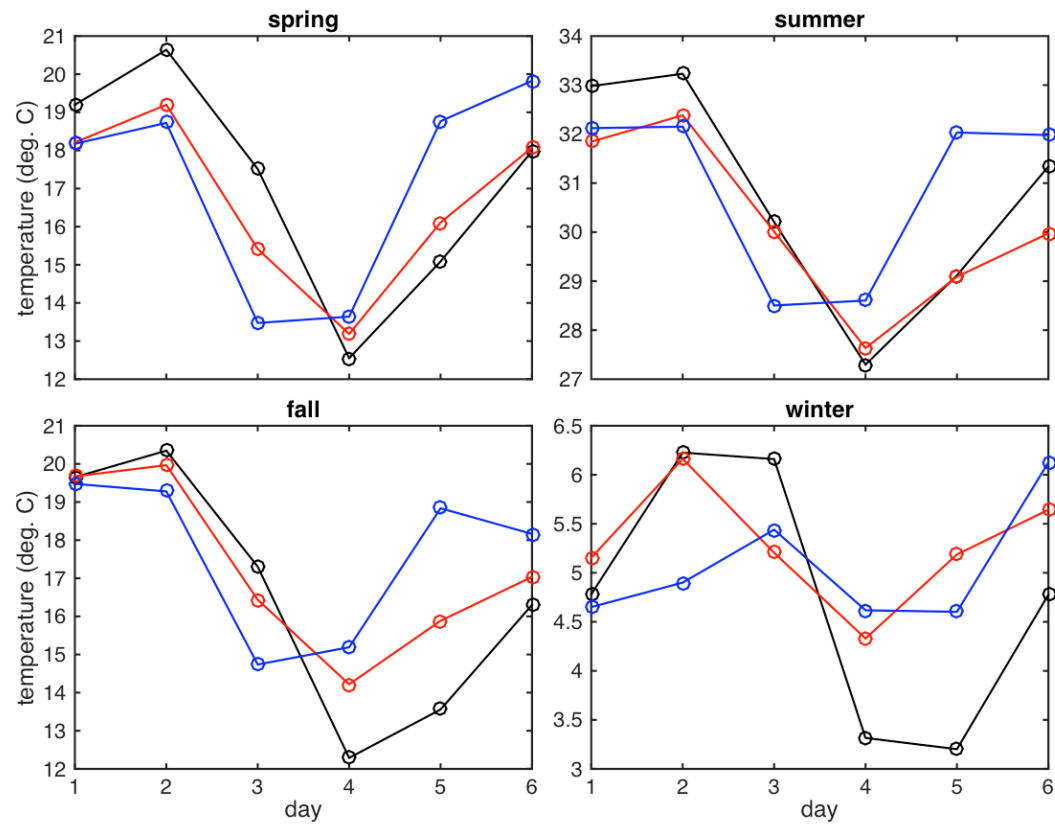
Fig. 9. Mean observational maximum temperature (black lines) and synthetic temperature for days that follow the precipitation occurrence sequence dry-dry-wet-wet-dry-dry in each season (winter does not include December), with red lines indicating Smith and Strong model and blue lines indicating Richardson model. The new Smith and Strong method better models what actually happens with the system compared to the existing Richardson method.

(A)
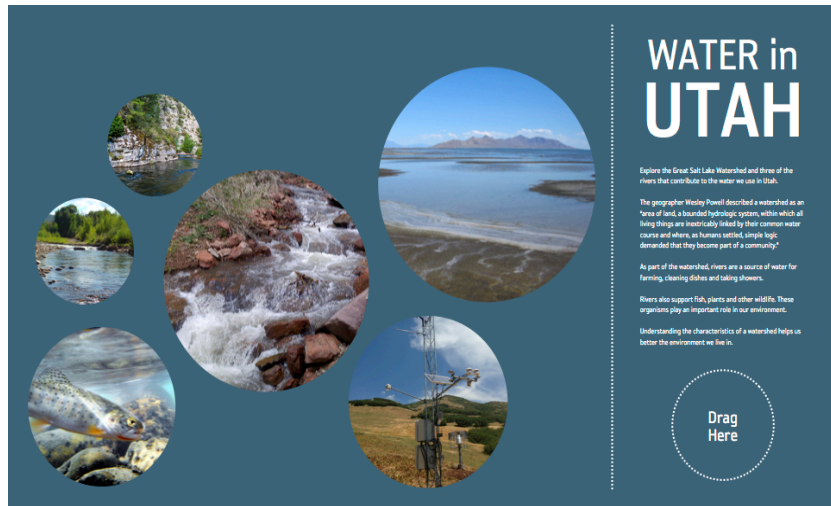
(B)

Fig. 10. The iUTAH-sponsored digital interactive exhibit "The Whole GAMUT" (A) at the Natural History Museum of Utah (B) in Salt Lake City, Utah

Table 1. Goals, strategies, and timelines for the iUTAH project.

Goal	Strategy	Year
Create common research platform required to enhance interdisciplinary excellence in water and urban science	• Create integrated, instrumented watershed observatories across urbanization gradient	1-2
	• Create integrated, multi-institutional research teams	1-3
	• Engage existing, and target new, expertise in social sciences with an emphasis on maximizing interdisciplinary collaboration	2-4
	• Create an urban green infrastructure facility to test engineering solutions to water quality and quantity issues	3-5
Promote excellence and innovation in integrated modeling of coupled human-natural systems	• Create a highly integrated cyberinfrastructure data storage and modeling network in Utah, and in collaboration with Wyoming and New Mexico, that will provide state-of-the-art data storage and high throughput modeling capabilities	1-5
Enhance Utah economy and workforce	• Partner with private industry through sensor system design, development, and deployment	1-4
	• Partner with private industry and government agencies through student internship and exchange programs	1-5
Grow a STEM-informed citizenry	• Engage women and underrepresented groups in STEM	2-5
	• Partner with statewide experts on recruitment and retention of diverse communities	2-5
Integrate research, education, and decision-making	• Create "Environmental Situation Rooms" for data visualization that will bring researchers, educators, and decision-makers together in a participatory modeling environment	3-5
	• Enhance STEM pipeline with an emphasis on female, Hispanic, Native American, and rural students	1-5

Table 2. Year 4 target metrics and outputs/outcomes for iUTAH RFA1.

Metric	Year 4 Target	Year 4 Output/Outcome	% of Target Midpoint
Hydrology datasets available	3-5	5+	120%+
Nutrient chemistry datasets available	3-5	5+	120%+
Presentations	10-15	10+	80%+
Peer-reviewed publications	3-6	11	244%
Popular press publications	2-5	3	86%
Collaborative proposals	3-5	5	150%
Datasets published	5-10	58	773%

Table 3. Year 4 target metrics and outputs/outcomes for iUTAH RFA2.

Metric	Year 4 Target	Year 4 Output/Outcome	% of Target Midpoint
RFA2 subgroup or planning meetings	3-10	13	200%
Stakeholder meetings	2-5	13	371%
Urban form neighborhood typology	1	1	100%
Social science data collection protocols and instruments	2-3	3	120%
Datasets that document social and engineered aspects of the study area	3-5	8	200%
GIRF completed	Operational	Operational	100%
Synoptic sampling campaign of urban influence on water outcomes	1	2	200%
Presentations	5-8	37	569%
Peer-reviewed publications	3-5	6	150%
Popular press publications	2-3	12	480%
Collaborative proposals with input from RFA2	1-2	4	266%
Team members working with RFA3 on coupled modeling and participatory engagement	3-5	2	50%

Table 4. Year 4 target metrics and outputs/outcomes for iUTAH RFA3.

Metric	Year 4 Target	Year 4 Output/Outcome	% of Target Midpoint
Collaborative team meetings/workshops	5-8	7	108%
Model inventory meetings	2-3	4	160%
Interdisciplinary model development workshops	1-2	2	133%
Stakeholder engagement meetings	1-3	8	400%
Stakeholder products	1-3	4	200%
Scenarios modeling workshops	2-3	2	80%
Visualization outreach activities	3-5	1	25%
Presentations	1-5	9+	300%+
Peer-reviewed publications	2-3	5	200%
Popular press publications	1-2	2	133%
Collaborative proposals	1-2	5	333%

Table 5. Year 4 target metrics and outputs/outcomes for iUTAH CI.

Metric	Year 4 Target	Year 4 Output/Outcome	% of Target Midpoint
CI staff supported	3	4	133%
Student programmers trained	1-2	7	467%
Data storage supporting visualization infrastructure by Year 5	250 TB	60TB[a]	24%
Disk capacity of large storage infrastructure in collaboration with CI-WATER	1 TB	Operational	100%
Datasets from external partners accessible through iUTAH MDF	5-8	6	92%
New registered users of the modeling and data federation	5-10	N/A[b]	N/A
Downloads of iUTAH datasets	5-10	N/A[c]	N/A
Presentations	3-5	5	125%
Peer-reviewed publications	2-3	5	200%
Hydroinformatics course offerings	1	1	100%
Grad students trained in hydroinformatics course	15-20	28	160%
CI-related proposals	2-5	4	114%
iUTAH proposals that cite iUTAH MDF in their data management plans	2-3	10+	400%+

[a] Current data storage level is more than sufficient to meet project needs.
[b] Registered users are not tracked by date of registration. There are currently 49 registered MDF users.
[c] Current MDF tracking does not provide information on downloads.

Table 6. Traffic Light Analysis (TLA) of Year 4 (1 August 2015 – 31 July 2016) iUTAH milestones as indicated in strategic plan or revised in Years 1-4.

Project Component	Milestone	TLA[a]	Explanation
Project Management			
	Weekly EPSCoR staff meetings	🟡	25 out of 47 scheduled weekly meetings held (53%).
	Biweekly Leadership Team meetings	🟢	21 meetings held over 24 two-week periods (88%).
	Biannual All-hands meetings	🟢	Fall All-hands meeting: 13 November 2014, NHMU, Salt Lake City, Utah; Spring All-hands meeting: 6 April 2016, Utah State University, Logan, Utah.
	Annual EAB & EAT meeting	🟢	14 July 2016, University of Utah, Salt Lake City, Utah.
	Annual Symposium held	🟢	15 July 2016, University of Utah, Salt Lake City, Utah.
	NSF Reverse Site Visit	🟢	iUTAH attended Year 4 NSF Reverse Site Visit on 10 September 2015; received report 23 October 2015; submitted response December 2015; and submitted addendum January 2016.

Table 6. Continued.

Project Component	Milestone	TLA[a]	Explanation
	Broaden private partnerships	🟢	Several ongoing efforts to engage with industry: Kennecott Utah Copper/Rio Tinto hydrologist participating in RFA1; established relationships with irrigation companies in Cache County. Several ongoing efforts to engage with NGOs: sponsorship of Annual Friends of Great Salt Lake Issues Forum; participation in Provo River Watershed Festival; renewed engagement with Western Water Assessment.
	Revise activities based on previous assessment; formative assessment of PM activities	🟢	(1) Policy Compliance—instituted regular tracking of student participation, outcomes, and ethical conduct of research compliance; instituted process for monitoring and enforcement of data policy compliance; increased frequency of monitoring of expenditures with monthly traffic-lighting of main budget and subawards; iUTAH Project Management now involved in administration of RCG program; instituted iUTAH-wide laboratory safety policy; working on iUTAH-wide field safety policy. (2) Communication—partnered with Utah State University Office of Research and Graduate Studies to offer workshops by the Alan Alda Center for Communicating Science to iUTAH participants and the campus community at large. (3) Diversity—elevated discussion on diversity and best practices for recruitment and retention of URMs to Management/Leadership Team level. (4) Broadening/Expansion of PUI/R1 Engagement—increased engagement with PUIs and academic partnerships in general statewide.

Table 6. Continued.

Project Component	Milestone	TLA[a]	Explanation
Research			
RFA1			
Water Balance	Finalize water balance models	🟢	Ongoing work by Brooks indicating that WRMA sits at transition between precipitation-dominated and temperature-dominated streamflow fills important gaps for Strong's large-scale water balance work; Carling and Neilson's work adds an equally important canyon-scale perspective.
	Validate rating curves	🟢	High-quality rating curves completed for all GAMUT sites across all 3 watersheds; data points, particularly during high-flow events, will continue to be added.
	Continue data collection	🟢	Multiple cross-institutional and interdisciplinary synoptic surveys in each catchment have provided high-resolution spatial data to complement GAMUT's high-resolution temporal data.
	Publish long-term datasets	🟢	58 RFA1 datasets generated to date, published, and accessible in their entirety or in part to the public; these include 40 datasets from our core facilities, as well as 18 additional records: e.g., snow-water equivalence in beetle-killed forest in Wolf Creek; Provo River discharge, temperature, and conductivity; iUTAH GAMUT Synoptic Sampling site sub-watershed delineations.
Water Quality	Continue data collection	🟢	Multiple cross-institutional and interdisciplinary synoptic surveys in each catchment have provided high-resolution spatial data to complement GAMUT's high-resolution temporal data.

Table 6. Continued.

Project Component	Milestone	TLA[a]	Explanation
	Finalize water quality transport models	🟡	Work is ongoing, e.g., Khatri's work on historical and future Jordan River water quality modeling.
	Publish datasets	🟢	Multiple datasets submitted to iUTAH MDF and either published or cleared for publication once the underlying research has been published: e.g., N content and isotopic composition of lichens in northern Utah; nutrient uptake by stream biofilms: an incubation experiment; riparian plant, algae, and moss N and C isotopes across iUTAH watersheds.
Climate and Land Use Change	Collaborate with RFA3 modelers to inform land-use scenarios models	🟢	New data collected by RFA1 fills critical gaps in RFA3's land-use scenarios modeling with Salt Lake City Department of Public Utilities: Brooks, Burian, Strong.
	Develop climate change scenarios models	🟢	New data collected by RFA1 fills critical gaps in RFA3's climate change scenarios modeling: comparison of Jones, S. GAMUT-wide ET estimates with Strong land surface model work to inform regional climate simulations. Supercomputing allocation request to NCAR will make these model runs feasible.
	Publish datasets	🟡	iUTAH Data Policy Committee in the process of devising protocol to inform treatment of model inputs/outputs and simulation runs for the purpose of data publication and archival.

Table 6. Continued.

Project Component	Milestone	TLA[a]	Explanation
RFA2			
Water and Land Use	Work with partners to identify ways to incorporate RFA2 research results into ongoing water system planning efforts	🟢	Extensive engagement with governmental and private partners: Governor's Water Task Force, UDWQ, UDWR, municipalities, regional water organizations.
Urban Form	Work with RFA3 team to simulate impacts of alternative urban growth scenarios on water and ecological outcomes	🟢	Work by Li and Buahin is ongoing.
Built Systems	Develop improved models to simulate GI at neighborhood or landscape scale	🟢	Updated urban landscape SWMM model for Red Butte Creek by Feng incorporates insights and improvements from Green Roof monitoring.
	Establish 1 new GI research site in extended network	🟢	Several new GI sites being monitored: 300 East curb cut in Logan, SLCDPU parking lot bioswale, dry wells for on-campus stormwater drainage at USU.

Table 6. Continued.

Project Component	Milestone	TLA[a]	Explanation
	Integrate considerations of GI options into RFA3 coupled models	🟢	Emerging models for simulating alternative urban infrastructure developed by Feng and Buahin will be incorporated into coupled systems modeling framework.
RFA3			
Interdisciplinary Modeling	Populate models with GAMUT and other iUTAH-collected data	🟢	Strong and Scalzitti using Wasatch Front observational data (SNOTEL) to validate iUTAH regional climate modeling data sets; Castronova configured GAMUT network to function as a data model in the iUTAH Model Coupling System (MCS); Strong has initiated new collaboration focusing on development and validation of statewide potential ET data; Null and Beach are using thermal infrared imagery to collect stream temperature data.
	Continue model coupling	🟢	Khatri meta-model links climate change, land use/urban form, population change, and hydrology for Salt Lake County; Null and Rosenberg are coupling hydrologic/ ecosystems model of Bear River with water management model of Bear River.
	Update model inventory	🟢	Rosenberg and Buchert canvassed iUTAH modelers for run-ready models; results were mapped onto iSAW conceptual framework, queried by Castronova and Buchert for immediately feasible model couplings, and will set coupled-modeling research agenda in Year 5.

Table 6. Continued.

Project Component	Milestone	TLA[a]	Explanation
Coupling Research	Continue integration of RFAs 1 and 2	🟢	Integration is occurring organically without RFA3 facilitation, including both pairwise (RA1-RFA2, RFA2-RFA3, RFA1-RFA3) and higher-order interactions.
	Publication and dissemination of results	🟢	2 manuscripts published, 1 manuscript in press, 1 manuscript conditionally accepted, 1 manuscript in preparation; 5 invited oral presentations related to coupled modeling activities.
	Participatory data collection and modeling to test adaptation and mitigation strategies	🟢	UDWR and UDWQ actively engaged via use of modeling frameworks; both agencies are providing data required for simulations and model validation; resiliency analysis framework developed by Khatri enables stakeholders to develop adaptation and mitigation strategies.
Scenarios Modeling and Simulation	Disseminate products and tools	🟢	Khatri meta-model has been presented to UDWR and UDWQ; business-as-usual urban growth scenario developed by Tian and Ewing made available for use to the region's Metropolitan Planning Organization (Wasatch Front Regional Council) for continuing development of advanced UrbanSim-based model of land-use change.
	Hold a new round of stakeholder workshops	🟢	3 stakeholder engagement meetings: (1) UDWR (17 February 2016); (2) Salt Lake City Department of Public Safety (3 February 2016); (3) Salt Lake City Department of Public Utilities (18 September 2015).

Table 6. Continued.

Project Component	Milestone	TLA[a]	Explanation
	Continue development of apps, web applications, and interactive tools based on user feedback	🟢	NHMU digital interactive is operational and continues to be improved and advanced based on user feedback; interactive web-app highlighting drainage network topology and historic flows for the Great Salt Lake watershed in development; interactive visualizations of RFA2 urban typology and state-wide water use data in development.
Cyberinfrastructure			
	New proposals for CI-related research developed	🟢	2 proposals submitted and funded for $750,000 in new research funding; 10+ proposals make use of CI data and/or capabilities (e.g. data management plan).
	Data from iUTAH facilities (GAMUT, GIRF) made discoverable, accessible, and citable in iUTAH MDF	🟢	Data repository provides custom landing page, unique URL, and full citation for each published dataset; website provides faceted browsing and discovery of all datasets.

Table 6. Continued.

Project Component	Milestone	TLA[a]	Explanation
	Software tools for streaming sensor data management are refined and revised based on user input	🟢	Multiple releases in Year 4 of ODM Tools Python software for managing streaming sensor data; related manuscript has been published; continued refinement based on user input (e.g., watershed technicians) is ongoing.
	Initial release of iUTAH MDF client web serve interfaces	🟢	CUAHSI HIS WaterOneFlow web services published for each watershed and registered with CUAHSI Water Data Center, allowing for searching and programmatical retrieval of GAMUT data by any user using any programming language capable of consuming SOAP or REST web services; data repository web service interface also allows for programmatical retrieval of any file from any public dataset.
	Support for model coupling and execution on HPC is made available	🟡	Development of software to enable model coupling is ongoing, with substantive progress over Year 3; ways to enable interaction with HPC and other systems that allow for remote execution of models are being actively explored.
	Additional servers and storage added to virtualization infrastructure	🟢	3 additional virtualization hosts and additional storage resources brought online; increased efficiency through separation of virtualization hosts into production and research clusters.

Table 6. Continued.

Project Component	Milestone	TLA[a]	Explanation
	Publish peer reviewed papers about iUTAH CI (2 to 3)	🟢	4 manuscripts published, 1 manuscript in revision, 1 manuscript submitted.
Education, Outreach and Diversity			
Diversity Enhancement			
	Expand and diversify DE team by 1-2	🟢	Nancy Bo Flood and Angela Enno, USU, have been added to the DE team.
	Conduct seminar and dialog program	🟢	Scheduled for 2016 iFellows program; may include undergraduates affiliated with RCG and Traineeship programs.
	Hold second diversity conference with focus on Hispanic Americans	🟢	Cross-institutional event engaging iUTAH team members and stakeholders, focusing on Utah's changing demographics and associated challenges and opportunities, was held at the University of Utah on 13 November 2015.
	Update best practices handbook	🟡	Designated a priority for Year 5.

Table 6. Continued.

Project Component	Milestone	TLA[a]	Explanation
	Implement new recruitment and retention programs for target populations	🟢	Recruitment strategies and practices have been adjusted to reflect formative assessment and informal feedback received from a statewide constituency; recruitment materials updated to reflect images of diverse participants, and to encourage higher-quality applicants to EOD programs.
	Up to 25% women and URMs in all iUTAH opportunities	🟢	iFellows: 71% women, 18% URM; iUTAH Traineeship: 23% women, 8% URM; GRAs: 41% women, 7% URM; Postdoctoral Associates: 50% women, 0% URM.
	Design up to 2 museum programs for target populations	🟢	Taking Learning Outdoors (NHMU); "Leo On Wheels" Water Carts (The Leonardo); Green Roof Agriculture Exhibit and Outreach at the Garth and Jerri Frehner Museum of Natural History (SUU).
	Train near-peer mentors	🟢	Will be conducted as part of the 2016 iFellows program; mentor trainings will address gender equity in response to 2015 evaluation.
	Attend SACNAS	🟢	Recruitment and engagement booth hosted in collaboration with 14 EPSCoR jurisdictions.

Table 6. Continued.

Project Component	Milestone	TLA[a]	Explanation
	Revise activities based on previous assessment; formative assessment of DE team activities	🟢	Recruitment of women, URMs, and PUIs will be strengthened through an assessment of 2014 iFellows and Summer Institute demographics and applicant surveys.
Workforce Development			
	Train near-peer mentors	🟢	Conducted as part of 2016 iFellows program.
	Implement Summer Institute #4 9 HS Teachers 9 HS Students 9 UG students 6 Grad students	🟢	Scheduled for 11-15 July 2016 at the University of Utah. Numbers for 2015 SI: 9 HS teachers, 10 HS students, 6 undergraduate students, 5 GRAs.
	Create K12 curriculum materials from SI#3	🟢	Ongoing and scheduled to be completed by the end of Year 4.
	Deposit curriculum materials from SIs	🟢	Updated curricula posted to Genetic Science Learning Center website as they become available.

Table 6. Continued.

Project Component	Milestone	TLA[a]	Explanation
	Recruit and hire undergraduate iFellows; up to 14 iFellows, 50% PUI, 25% URM or women	🟢	60 applicants, 37% women, 15% URM, 48% PUI; 17 hires, 71% women, 18% URM, 41% PUI.
	Recruit and hire up to 15 graduate research assistants	🟢	Few new GRAs needed; 1 GRA hired at USU; 2 GRAs hired at UU.
	Recruit and hire postdoctoral associates	🟢	All postdoctoral associates retained from Year 3.
	Recruit and fund PUI faculty RCGs	🟢	Eddy Cadet (UVU), Christopher Monson (SUU).
	Develop at least 1 cross campus graduate training course	🟢	Green Infrastructure, Hydroinformatics
	Review and fund up to 5 RCGs	🟢	2 projects funded.
	Recruit 3 postdoctoral associates	🟢	All postdoctoral associates retained from Year 3.

Table 6. Continued.

Project Component	Milestone	TLA[a]	Explanation
	Recruit additional agency and private industry partners as internship sponsors	🟢	Internship program replaced with iUTAH Traineeships, which do not depend on private partnerships.
	Recruit and hire up to 10 undergraduate iUTAH Trainees	🟢	Trainees hired in Year 3 retained in Year 4.
	Conduct year-end iUTAH Symposium	🟢	15 July 2016, University of Utah, Salt Lake City, Utah.
	Revise activities based on previous assessment; formative assessment of WFD activities	🟢	Assessment activities conducted continuously throughout the year.
External Engagement			
	Expand and diversify EE team	🟢	Laura Beck (NHMU) and Julie Koldewyn (NHMU) have been added to EE Team.

Table 6. Continued.

Project Component	Milestone	TLA[a]	Explanation
	Recruit and engage K-12 cohorts for museum programs: up to 200 students; 30 teachers	🟢	Taking Learning Outdoors (NHMU): 17 teachers, 2,500 students; "Leo On Wheels" Water Carts (The Leonardo): 6 teachers, 630 students; Green Roof Agriculture Exhibit and Outreach at the Garth and Jerri Frehner Museum of Natural History (SUU): 60 teachers, 1,740 students.
	Recruit and fund new K-12 engagement events.	🟢	Outreach with author Nancy Bo Flood in southern Utah: 7 schools (including 1 Navajo Nation school), 1 educational conference, 681 engagements (54% female, 91% URM).
	Engage K-12 students and teachers at Green Infrastructure Facility (GIRF)	🟢	2016 iUTAH Summer Institute at the University of Utah will incorporate GIRF.
	Conduct citizen science program at GIRF	🔴	GIRF not completed until third quarter of Year 4.
	Conduct UWW program at iUTAH watersheds	🟢	13 programs resulting in 4,915 contacts.
	Recruit and fund new public engagement events	🟢	Water Workshop at 2016 Plateau Conference, USU Science Unwrapped series, booth outreach (SACNAS, LIA, ISS, UCUR, SL County Watershed).

Table 6. Continued.

Project Component	Milestone	TLA[a]	Explanation
	Revise and augment iUTAH website; up to 1,000 unique visitors per month	🟢	Website completely updated and customized for diverse audiences; 1,221 visitors per month.
	Expand and diversify social media following; up to 100 new followers	🟢	Social media following growing by 1-5 per week; Facebook: 220 new page likes; Twitter: 369 new followers; LinkedIn: 112 new connections/followers.
	Refine iUTAH messages and videos	🟢	Slogan and branding revised in Years 3 and 4; new videos produced in Year 3 and 4 are available on iUTAH website.
	Produce and expand audience for bi-monthly newsletter	🟢	Monthly e-Newsletter sent to 323 total subscribers; 10-15% click rate on 1+ articles (industry standard 2.4%).
	Produce glossy highlights publication	🟢	Annual Newsletter will be published in July 2016.
	Evaluate and refine communication tools	🟢	0.75 FTE Communications Specialist hired in Year 4; Year 4 press releases greatly exceed sum total of releases for Years 1-3.

Table 6. Continued.

Project Component	Milestone[a]	TLA[b]	Explanation
	All iUTAH participants utilize Drupal for reporting activities	🟢	Participants added as they join the project; 191 active user accounts.
	Revise activities based on previous assessment; formative assessment of EE activities	🟢	Continuous assessment conducted during monthly EE calls.

[a] Green = milestone accomplished or on track to being accomplished by the end of Year 4; yellow = milestone not yet accomplished, ongoing work that may or may not be completed by the end of Year 4; red = milestone not addressed, in conceptualization or planning stage, or may need to be revised.

Table 7. Traffic Light Analysis (TLA) of Year 3 "legacy" iUTAH milestones.

Project Component	Milestone	Year 3 TLA[a]	Year 4 TLA	Explanation
Research				
RFA1				
	Validate rating curves	🟡	🟢	High-quality rating curves developed for all GAMUT sites across all 3 watersheds.
	Publish first papers	🟡	🟢	11 manuscripts published.
RFA2				
	Review Household Survey results with neighborhoods and municipal organizations	🟡	🟢	10 presentations to cities and 2 to regional water organizations; additional presentations are planned.
	First analysis linking RFA1 and RFA2 data	🟡	🟢	Work by Hale linking predicted, actual, and perceived flood risk; work by Hall on water quality changes across urban landscapes; analysis of *E. coli* by Jones, E. using urban typology framework.
	Conduct key informant interviews in WRMA communities	🟡	🟢	50 interviews with municipal leaders and staff conducted through the end of Year 4.
	Publish first papers—urban form	🟡	🟡	Several papers in review.

Table 7. Continued.

Project Component	Milestone	Year 3 TLA[a]	Year 4 TLA	Explanation
	Incorporate urban form research results into RFA3 coupled modeling	🟡	🟡	Land-change modeling being informed by a simplified version of RFA2's urban typology; this work will be expanded once initial, simple coupled models are operational.
	Collaborative proposal linking urban typology to biophysical outcomes	🔴	🟢	EPA grant to Dupont, Jackson-Smith and Null et al.
	Analyze data from GIRF experiment	🔴	🟡	Data collection is ongoing at several pre-existing bioswale plots; data collection at rebuilt GIRF to commence at the end of Year 4.
	Publish first papers—built systems	🟡	🟢	Several papers published or in preparation.
	Develop improved model for simulating surface runoff in diverse built/urban contexts	🟡	🟢	Models for simulating alternative urban infrastructure are being developed (Buahin/Feng).
RFA3	Incorporate GI research into urban hydrologic models	🟡	🟢	Incorporation of updated SWMM and SWAT models into coupled systems framework is ongoing.
	Development and technical evaluation of methods for coupling models	🟡	🟢	Work by Castronova is ongoing.

Table 7. Continued.

Project Component	Milestone	Year 3 TLA[a]	Year 4 TLA	Explanation
	Integrate RFA1 and RFA2 data collection	🟡	🟢	Integration is occurring organically without need for RFA3 facilitation.
	Collaborative publication and dissemination of results	🟡	🟢	Numerous publications and presentations
	Entrain stakeholders into coupled modeling workshops	🔴	🟢	Regular stakeholder engagement via small-group meetings rather than larger, formal workshops.
	Develop stakeholder-responsive products	🟡	🟢	Khatri meta-model; Tian/Ewing business-as-usual urban growth scenario.
	Develop EOD outreach materials	🔴	🟢	NHMU digital interactive.
	Develop visualization capacity for project-wide applications, web apps, and interactive tools	🔴	🟢	iVL operational and fully staffed.
Cyberinfrastructure				
	External datasets discoverable and accessible through MDF	🟡	🟢	External data has been made accessible through MDF to the extent that there is demand.

Table 7. Continued.

Project Component	Milestone	Year 3 TLA[a]	Year 4 TLA	Explanation
	Initial release of collaborative model sharing tool	🟡	🟡	Work by Castronova is ongoing.
	Databases and software to support GIRF data deployed	🟡	🟡	GIRF data not widely available yet; thus, there is currently no need for this.
Education, Outreach, and Diversity				
Diversity Enhancement				
	Expand and diversify DE by 1-2 members	🟡	🟢	3 new members added over Years 3 and 4.
	Update best practices handbook	🟡	🟡	This has been designated a priority for Year 5.
	Implement recruitment and retention plans for target populations	🟡	🟢	Changes to recruitment practices in response to statewide feedback.

Table 7. Continued.

Project Component	Milestone	Year 3 TLA[a]	Year 4 TLA	Explanation
Workforce Development				
	Survey participants to assess iUTAH collaborations	🟡	🟢	Work is ongoing and is scheduled to culminate in a manuscript by the end of Year 4.
External Engagement				
	Develop K-12 program at GIRF	🔴	🟢	2016 iUTAH Summer Institute at the University of Utah will incorporate GIRF.
	Develop citizen science program at GIRF	🔴	🔴	GIRF not completed until third quarter of Year 4.

[a] Green = milestone accomplished or on track to being accomplished; yellow = milestone not yet accomplished, ongoing work that may or may not be completed by target date; red = milestone not addressed, in conceptualization or planning stage, or may need to be revised.

Table 8. Traffic Light Analysis (TLA) of the implementation of "legacy" planned activities from Year 3 Annual Report during Year 4.

Project Component	Planned Activity	Year 3 TLA[a]	Year 4 TLA	Explanation
Research				
General				
	Meet quarterly as a larger group to share results and feedback, identify research gaps, and build capacity between universities and stakeholders in Utah	🟡	🟢	Fall All-hands Meeting 13 November 2015; Spring All-hands Meeting 6 April 2016; Annual Symposium and Summer All-hands Meeting 15 July 2016; additional supra-team level meetings conducted around Year 4 NSF Reverse Site Visit and Year 4 AAAS Site Visit.
RFA1				
	Install scintillometer and collect data of urban ET in Salt Lake City	🟡	🟢	Instrumentation installed and operational.
	Finish downscaling snow accumulation model and parameters	🟡	🟢	Snow accumulation inferred from data being collected; no modeling efforts beyond that required.
	Outline potential water balance scenarios for use by other RFAs	🟡	🟢	Work by Brooks (RFA1) and Strong (RFA3); work by Carling (RFA1) and Neilson (RFA3).

Table 8. Continued.

Project Component	Planned Activity	Year 3 TLA[a]	Year 4 TLA	Explanation
CI				
	Identify and develop new capabilities and data services to support coupled and integrated modeling activities	🟡	🟡	Work by Castronova is ongoing; several grants submitted and manuscripts in preparation.
	Provide support for green infrastructure data	🟡	🟢	Continuous data streams from urban instrumentation directly tied into MDF; database support for sample-based GI data, as well as additional tools for access and display, are being adapted from products developed previously for RFA1 surface-sampling data.
Education, Outreach and Diversity				
WFD				
	Implement recruitment, selection, placement, and evaluation processes	🟡	🟢	New recruitment practices for iFellows program instituted in response to feedback from statewide constituencies; discussion is ongoing and will lead to further changes in Year 5.

[a] Green = milestone accomplished or on track to being accomplished; yellow = milestone not yet accomplished, ongoing work that may or may be completed by target date; red = milestone not addressed, in conceptualization or planning stage, or may need to be revised.

Table 9. Stakeholder products produced by iUTAH RFA3 in Year 4.

Product Name/Description	Responsible Party	Stakeholder	Benefit/Need
4-km downscaled historical climate data for Utah covering 1985-2010 and end-of-century conditions for moderate greenhouse gas emission scenario	Strong	Salt Lake City Department of Public Utilities, Jordan Valley Water Conservancy (JVWC)	Data being used by JVWC technicians
Calibrated version of Hydrologic Simulation Program – Fortran (HSPF)	Khatri	Utah Division of Water Resources (UDWR)	Recalibration and updating of existing UDWR model with iUTAH land use model
Modeled historical monthly unregulated Bear, Weber, and Jordan-Provo streamflow estimates for 1985-2005	Betts and Null	Wasatch Dendrochronology Group (WDG), Western Water Assessment (WWA)	WDG will use to compare reconstructed streamflow based on tree rings; WWA interested once data fully calibrated/ validated
GIS database and map-book documenting parcel-scale inventory of open space within a mile of the Jordan River	Buchert	Jordan River Commission, Tracy Aviary, Seven Canyons Trust, Utah Division of Wildlife Resources, Partners in Flight	Informs discussions on restoring Jordan River riparian habitat to expected future, rather than historic, climate and hydrologic conditions

Table 10. Use metrics for iUTAH CI websites using Google Analytics.

Website/Application	No. of Unique Sessions	No. of Unique Users	No. of Countries
iUTAH MDF Website[a]	979	853	65
iUTAH Data Repository[b]	150	72	9
iUTAH Time Series Analyst[a]	1596	535	21
iUTAH Survey Data Viewer[b]	27	15	2

[a] for the period 1 April 2015 – 31 March 2016.
[b] for March 2016 (analytics implemented on 2 March 2016).

Table 11. List of iUTAH participating and partner institutions of higher education in Utah.

Institution	Type	Relationship to iUTAH	Year 1-4 Participation
Brigham Young University	R1	Subaward	Full engagement across research/EOD spectrum
Dixie State University[a]	PUI (4-year)	Partner	iFellows, Utah Water Survey, EOD teams
Salt Lake Community College[a]	PUI (2-year)	Subaward	iFellows, EOD teams, EOD Innovation Awards
Snow College[a]	PUI (2-year)	Partner	Utah Water Survey, iFellows
Southern Utah University	PUI (4-year)	Subaward	RCGs, EOD Innovation Awards, iFellows, Management Team, EOD teams
University of Utah	R1	Subaward	Full engagement across research/EOD spectrum
Utah State University	R1	Main Award	Full engagement across research/EOD spectrum
Utah State University Eastern—Blanding[a]	PUI (2-year)	Partner	Native American Mentorship Program, iFellows
Utah Valley University[a]	PUI (4-year)	Subaward	RCGs, iFellows, Management Team, EOD teams
Weber State University[a]	PUI (4-year)	Subaward	RCGs, iFellows, EOD Innovation Awards, Management Team, EOD teams
Westminster College	PUI (4-year)	Subaward	RCGs, iFellows, Management Team, EOD teams

[a] Open enrollment school.

Table 12. Participation by women, under-represented minorities (URM), and students from primarily undergraduate institutions (PUI) in iUTAH research and Education, Outreach and Diversity (EOD) programs in Year 4.

Program	Participation		
	% Women	**% URM**	**% PUI**
Research			
GRAs	45%	3%	N/A
Postdoctoral Associates	50%	0%	N/A
Education, Outreach and Diversity			
iFellows	Applied: 37% Hired: 71%	Applied: 15% Hired: 18%	Applied: 48% Hired: 41%
Traineeship	23%	8%	N/A
Summer Institute	44%	21%	N/A
Taking Learning Outdoors	52%	19%	N/A
WaterGirls	100%	6%	6%
Student Field Trips to Red Butte Creek	53%	63%	N/A
Jordan River Water Watch	-[a]	81%	N/A
UWW Citizen Science Program	49%	9%	N/A
UWQE Outreach Events	49%	16%	N/A
The Leonardo "Water: Nature's Driving Force" Exhibit, Student Programs	55%	24%	N/A
"Leo on Wheels" Water Carts	52%	6%	N/A
SUU Green Roof Agriculture Exhibit and Outreach	52%	6%	1%
Water Runs Through This Book	54%	91%	N/A

Table 12. Continued.

Desert Water Film Screenings	44%	8%	33%
SACNAS EPSCoR Booth	63%	74%	37%
Native American Mentorship Program	48%	100%	100%
Cross-campus Hydroinformatics Course	21%	-[a]	N/A
Cross-campus Green Infrastructure Course	27%	0%	N/A

[a] Not recorded or information not available.

Table 13. Participation in iUTAH external engagement/outreach events in Year 4.

Program	Conducted by	Funded through	Participants		
			Teachers	Students	Other
Taking Learning Outdoors	Natural History Museum of Utah	EOD/EE	17	2500	10
"Leo on Wheels" Water Carts	The Leonardo	EOD Innovation Awards	6	630	10974
Green Roof Agriculture Exhibit and Outreach at SUU	Garth and Jerri Frehner Museum of Natural History	EOD Innovation Awards	60	1740	16
Citizen Science	Utah Water Watch	EOD/EE	42	1450	3423
Water Runs Through this Book	iUTAH/Nancy Bo Flood	EOD/DE	52	573	56
The Source	Utah Public Radio	EOD Innovation Awards	-[a]	-[a]	40,000/day
iUTAH WaterGirls	Salt Lake Community College	EOD Innovation Awards	2	26	1
Jordan River Water Watch	Rose Park Elementary School	EOD Innovation Awards	1	30	16
UWQE Outreach Events	USU Water Quality Extension	EOD/EE	28	1506	252
"The Whole GAMUT" Digital Interactive	Natural History Museum of Utah	EOD Innovation Awards	-[a]	-[a]	7500
"Water: Nature's Driving Force" Exhibit	The Leonardo	EOD Innovation Awards	2521	20178	107525
Student Field Trips to Red Butte Creek	UU Global Change and Sustainability Center	EOD Innovation Awards	13	317	24
Summer Institute	UU Genetic Science Learning Center	EOD/WFD	9	21	N/A
iFellows	iUTAH EOD/WFD	Participant Support	N/A	18	N/A
		Total:	**2751**	**28989**	**129797+**

[a] Not recorded or information not available.

Table 14. iUTAH participation in national, regional, and local water- and STEM-related conferences.

Event	Location	Date	Event Sponsorship	Booth	Travel Support for Student Attendees
Society for the Advancement of Chicanos and Native Americans in Science Annual Conference	Washington, DC.	29-31 October 2015	No	Yes	No
Salt Lake County Watershed Symposium	West Valley City, Utah	18-19 November 2015	No	Yes	Yes
American Indian Science and Engineering Society National Conference	Phoenix, Arizona	19-21 November 2015	No	Yes	No
Weber State University Multicultural Youth Conference	Ogden, Utah	7 January 2016	No	Yes	No
Utah Conference on Undergraduate Research	Salt Lake City, Utah	19 February 2016	No	No	Yes
2016 PLATEAU Conference	Monticello, Utah	5-6 March 2016	No	Yes	No
Intermountain Sustainability Summit	Ogden, Utah	24-25 March 2016	Yes	Yes	Yes
Latinos in Action Youth Leadership Conference	Salt Lake City, Utah	1 April 2016	No	Yes	No
Spring Runoff Conference	Logan, Utah	5-6 April 2016	Yes	Yes	Yes
Great Salt Lake Issues Forum	Salt Lake City, Utah	11-13 May 2016	Yes	Yes	Yes

Table 15. iUTAH engagement with stakeholders and the public through electronic, online, and social media resources in Year 4.

Milestone and Metric	Output/Outcome	% Increase over Year 3
Revise and augment iUTAH website	5,593 page views/month	15%
Expand and diversify social media following		
Facebook	221 new page likes	13%
Twitter	383 new followers	39%
LinkedIn	112 new connections	9%
Produce and expand bi-monthly newsletter		
Newsletters circulated	10	
Total subscribers (through 2 May 2016)	323	
Readership engagement of newsletter:		
Open rate (email opened by subscribers)	35 – 40%[a]	
Click rate (email reader opened one or more stories)	10 – 15%[b]	
Evaluate and refine communication tools		
Press releases published in popular press	35	298%

[a] Industry average is 16.5%.
[b] Industry average is 2.1%.

Table 16. Professional development activities and capacity building among iUTAH participants in Year 4.

Event	Type	Location	Date	iUTAH Participants	
				Students[a]	Faculty and Staff[b]
Ecological Society of America Annual Meeting	Conference	Baltimore, MD	9-14 August 2015	1	7
Intermountain Section of the American Water Works Association Annual Conference	Conference	Logan, UT	16-18 September 2015	1	2
Water Environment Federation Technical Exhibition and Conference	Conference	Chicago, IL	26-30 September 2015	1	1
Perth III: Mountains of Our Future Earth	Conference	Perth, Scotland[c]	4-8 October 2015	0	2
Allies on Campus	Workshop	Logan, UT	14 October 2015	0	1
8th Annual Mentoring Conference	Conference	Albuquerque, NM	21-23 October 2015	0	2
NSF EPSCoR National Conference	Workshop	Portsmouth, NH	1 November 2015	1	3
Geological Society of America Annual Meeting	Conference	Baltimore, MD	1-4 November 2015	8	6

Table 16. Continued.

NSF EPSCoR National Conference	Conference	Portsmouth, NH	2-4 November 2015	2	5
Soil Science Society of America Annual Meeting	Conference	Minneapolis, MN	6-9 November 2015	1	0
SUU College of Science and Engineering Undergraduate Research Symposium	Conference	Cedar City, UT	9 November 2015	2	1
Annual Salt Lake County Watershed Symposium	Conference	West Valley City, UT	18-19 November 2015	1	6
SRAI Basics of Research Administration	Workshop	Savannah, GA	2-4 December 2015	0	1
American Geophysical Union Fall Meeting	Conference	San Francisco, CA	12-16 December 2015	3	12
American Meteorological Society Annual Meeting	Conference	New Orleans, LA	10-14 January 2016	0	1
GCSC Environment & Sustainability Research Symposium	Conference	Salt Lake City, UT	2 February 2016	2	2
Utah Conference on Undergraduate Research	Conference	Salt Lake City, UT	19 February 2016	10	4
2016 Utah Water Users Workshop	Conference	St. George, UT	14-16 March 2016	0	1

Table 16. Continued.

Utah Chapter of the American Fisheries Society Annual Meeting	Conference	Altamont, UT	15-17 March 2016	0	1
American Geophysical Union Annual Hydrology Days	Conference	Fort Collins, CO	21-23 March 2016	13	1
Council of Educators in Landscape Architecture Conference	Conference	Logan, UT	23-26 March 2016	1	2
Association of American Geographers Annual Meeting	Conference	San Francisco, CA	29 March-2 April 2016	0	2
Scholarship of Teaching and Engagement Annual Conference	Conference	Orem, UT	31 March-1 April 2016	2	1
2016 Spring Runoff Conference	Conference	Logan, UT	5-6 April 2016	20	32
National Conference on Undergraduate Research	Conference	Asheville, NC	7-9 April 2016	2	0
National Alliance for Broader Impacts Annual Summit	Conference	Philadelphia, PA	20-22 April 2016	0	1
National Water Quality Monitoring Conference	Conference	Tampa, FL	2-6 May 2016	0	1

Table 16. Continued.

Great Salt Lake Issues Forum	Conference	Salt Lake City, UT	11-13 May 2016	1	13
Science of Team Science 2016 Conference	Conference	Phoenix, AZ	16-19 May 2016	0	2
Geological Society of America Rocky Mountain Section Annual Meeting	Conference	Moscow, ID	18-19 May 2016	2	1
Society for Freshwater Science Annual Meeting	Conference	Sacramento, CA	21-26 May 2016	4	3
National Organization of Research Development Professionals Annual Conference	Workshop	Orlando, FL	23 May 2016	0	1
National Organization of Research Development Professionals Annual Conference	Conference	Orlando, FL	24-25 May 2016	0	1
Association for Environmental Studies and Sciences Annual Conference	Conference	Washington, DC.	8-11 June 2016	0	1
International Symposium on Society and Resource Management	Conference	Houghton, MI	22-26 June 2016	4	3
International Environmental Modeling and Software Society Conference	Conference	Toulouse, France[c]	10-14 July 2016	1	1

[a] includes undergraduate and graduate students.
[b] includes postdoctoral associates and technicians.
[c] support provided via non-NSF funds.