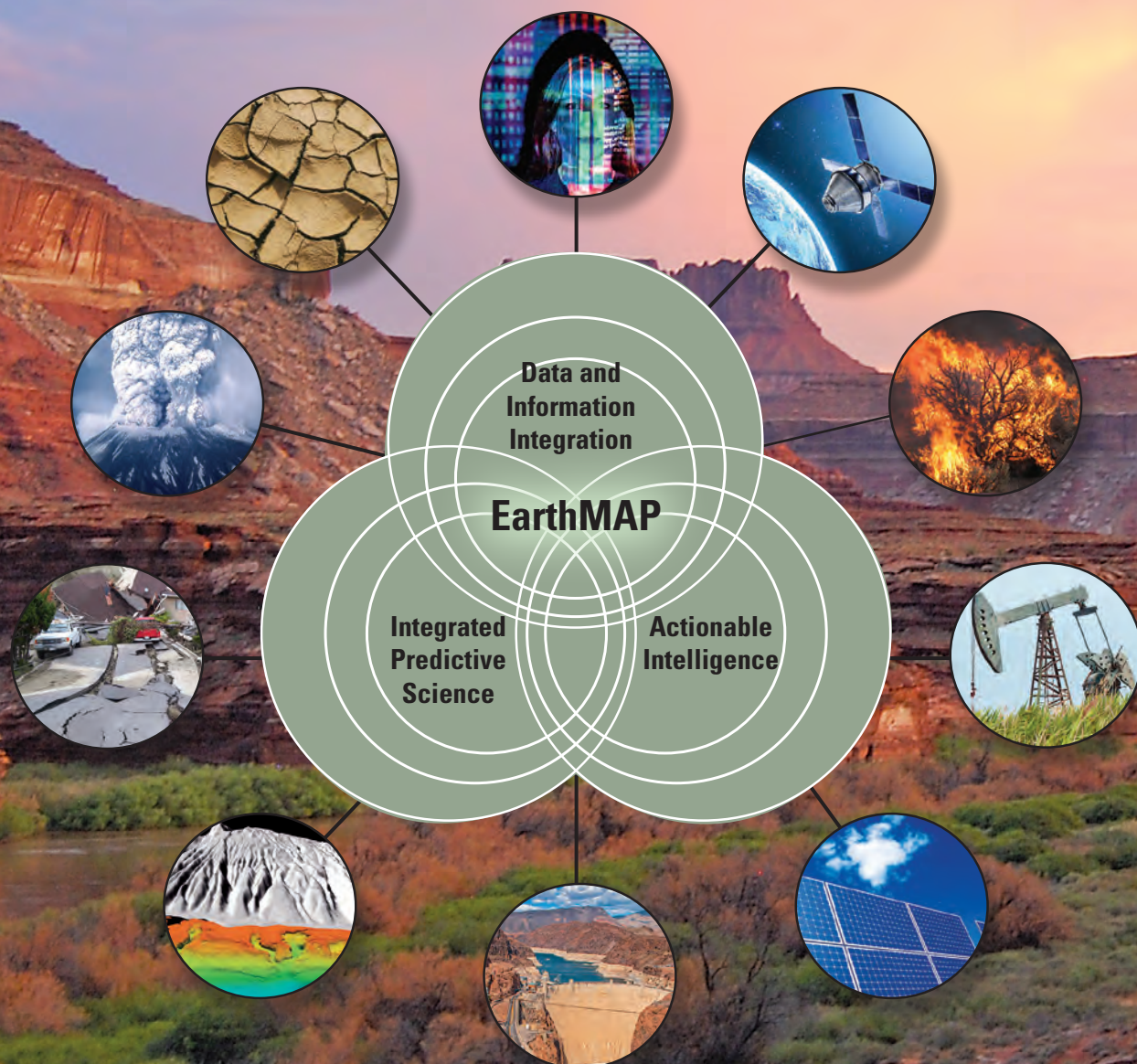


# Rocky Mountain Region Science Exchange 2020— EarthMAP and the Colorado River Basin



Circular 1483

**Cover:** Sunset view, looking west, at Turks Head campsite, Green River, mile 21, Utah. Photograph by Richard J. Moscati, USGS. Illustration includes the following photographs, clockwise from the top.

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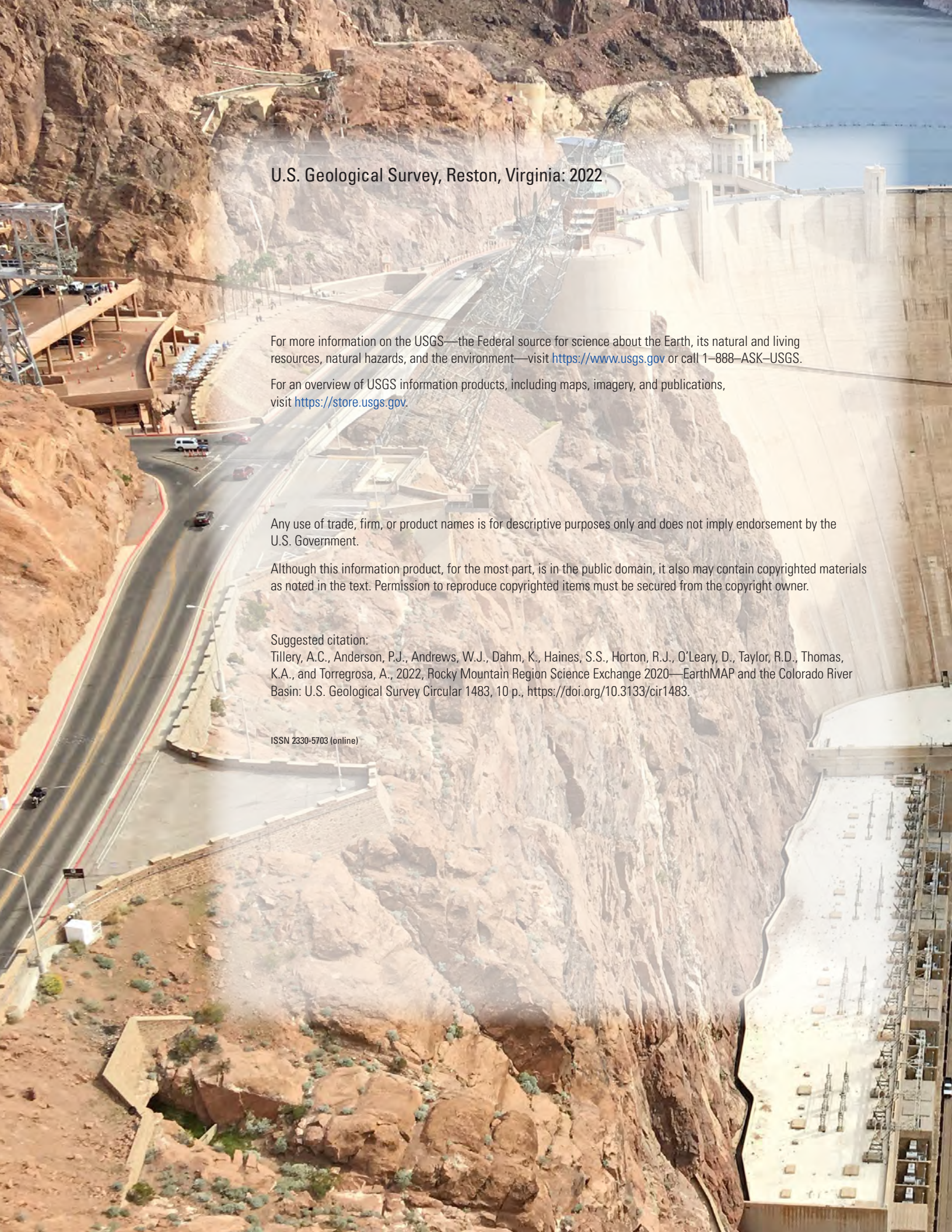
# **Rocky Mountain Region Science Exchange 2020—EarthMAP and the Colorado River Basin**

By Anne C. Tillery, Patrick J. Anderson, William J. Andrews, Katharine Dahm,  
Seth S. Haines, Robert J. Horton, David O'Leary, Ryan D. Taylor, Kathryn A. Thomas,  
and Alicia Torregrosa

Circular 1483

**U.S. Department of the Interior  
U.S. Geological Survey**



An aerial photograph of the Hoover Dam in Nevada, showing the massive concrete structure, the winding road along the canyon rim, and the surrounding desert landscape with red rock formations and sparse vegetation.

## U.S. Geological Survey, Reston, Virginia: 2022

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[The U.S. Geological Survey Rocky Mountain Region is also known as the Department of the Interior Unified Region 7: Upper Colorado Basin]

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## Acknowledgments

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## Abbreviations

CDI	Community for Data Integration (USGS)
EarthMAP	Earth Monitoring, Analyses, and Prediction
FSP	Fundamental Science Practices
OSQI	Office of Science Quality and Integrity (USGS)
RMR	Rocky Mountain Region
USGS	U.S. Geological Survey

Pages iv and v: Dust samplers used to determine dust flux (dust particles carried on the wind, three samplers on the pole, left side of image) and dust deposition (collection pan in the center of the image) in a oil and gas field in Lincoln County, Wyoming, June 2017. Photograph by Patrick Anderson, USGS.



The background of the page is a photograph of a waterfall. The water is white and turbulent as it falls over a series of rocks and large, fallen tree trunks. The surrounding forest is dense with green trees, and the scene is brightly lit by sunlight.

## Abstract

The U.S. Geological Survey (USGS) Rocky Mountain Region (RMR) hosted USGS scientists, managers, program coordinators, and leadership team members for a virtual Science Exchange during September 15–17, 2020. The Science Exchange had 216 registered participants and included 48 talks over the 3-day period. Invited speakers presented information about the novel USGS Earth Monitoring, Analysis, and Prediction (EarthMAP) concept. Scientists in the RMR and other regions showcased their research and participated in discussions related to the EarthMAP concept and EarthMAP applications. In addition, the Colorado River Basin Pilot Project, the first formal EarthMAP pilot project, was unveiled during the Science Exchange. Many of the products designed during the RMR Science Exchange were done so with the EarthMAP – Colorado River Basin Pilot Project in mind. This report summarizes the organization and objectives of the Science Exchange, highlights key points from session presentations, panel discussions, and breakout sessions, and, most importantly, discusses momentum generated for the EarthMAP – Colorado River Basin Pilot Project.



# Rocky Mountain Region Science Exchange 2020— EarthMAP and the Colorado River Basin

By Anne C. Tillery, Patrick J. Anderson, William J. Andrews, Katharine Dahm, Seth S. Haines, Robert J. Horton, David O'Leary, Ryan D. Taylor, Kathryn A. Thomas, and Alicia Torregrosa

## Introduction

In 2017, the U.S. Geological Survey (USGS) Southwest Region began an effort to facilitate a knowledge exchange of programs and capabilities across regional Science Centers and to foster regional scientific collaboration across disciplines and Science Centers. Region-wide Science Exchange workshops were part of this effort. After USGS regional restructuring in which the majority of the Southwest Region became the Rocky Mountain Region (also known as the Department of the Interior Unified Region 7: Upper Colorado Basin), the Science Exchange workshops continued, making the 2020 Science Exchange its third regional science exchange.

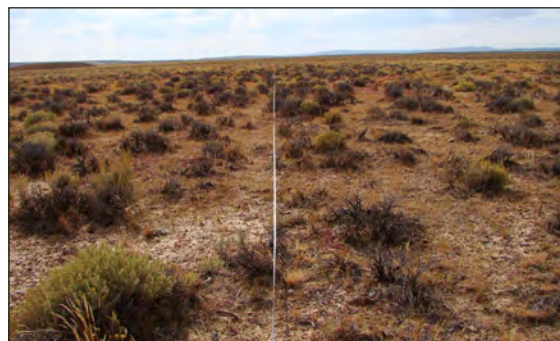
EarthMAP (Earth Monitoring, Analyses, and Prediction) is an effort initiated by the USGS in 2019 to deliver actionable information at the scales and timeframes needed to inform decisions through application of integrated science, advanced technologies, and predictive models built upon USGS and stakeholder datasets. The term EarthMAP is used throughout this document to refer to this aspirational USGS approach for delivering science. The EarthMAP theme for the Rocky Mountain Region (RMR) 2020 Science Exchange was suggested by the RMR Director's Office and the EarthMAP Program Management Team. The EarthMAP theme was suggested, in part, to build on existing EarthMAP momentum by familiarizing scientists with the EarthMAP concept and soliciting input from those scientists that could be useful or enlightening for national EarthMAP teams. The Science Exchange was the ideal setting in which to announce the EarthMAP – Colorado River Basin Pilot Project. The RMR leadership convened the Science Exchange Planning Committee (see inside cover) to plan for a virtual meeting. The committee's roles included defining the workshop objectives and session themes, identifying and inviting presenters, and organizing panel discussions. Six major objectives, identified in the sidebar on this page, were established for the Science Exchange by the planning committee.

## Purpose and Scope

This report summarizes the organization and objectives of the 2020 Science Exchange, and highlights key points from session presentations, panel discussions, and breakout sessions. Additionally, the report introduces the products and resources generated during the Science Exchange for future USGS EarthMAP activities and reference.

## Objectives of the Science Exchange

- To share vision, purpose, and need for EarthMAP and to help Science Centers explore possibilities of incorporating EarthMAP into their project planning where appropriate.
- To bring together USGS scientists working in the Colorado River Basin to share work that they are doing and see how different projects could relate to EarthMAP.
- To identify data gaps and stakeholder needs at this meeting that can be communicated to the National EarthMAP Use Case Development and Capacity Assessment Teams.
- To define major themes in support of an EarthMAP – Colorado River Basin Pilot Project.
- To promote scientific collaboration among Science Centers.
- To create a virtual location to continue the conversations on EarthMAP, USGS studies in the Colorado River Basin, and USGS studies in the RMR begun during this meeting.



Belt transect (4 meters by 100 meters) used to count sage-grouse (*Centrocercus urophasianus*) pellets to track their use in treated and untreated sagebrush habitats near the Green River, Lincoln County, Wyoming, September 2009. Photograph by Patrick Anderson, USGS.



## Science Exchange Planning

### Developing the Agenda

After drafting the six meeting objectives identified in the side bar, the planning committee announced the Science Exchange to the RMR and selected Center Directors from the Southwest Region and requested nominations for presentations from their programs. Guidance was provided to the Center Directors to consider those studies that best addressed the Science Exchange meeting objectives and reflected EarthMAP characteristics, existing capacities, or potential use cases. In this context, an EarthMAP Use Case is a description of a stakeholder need with associated identification and description of existing and (or) future USGS (and partner) science capacity and technological innovations that will meet that need. The planning committee used the nominations to plan the Science Exchange agenda, develop session themes, and organize panel discussions and breakout sessions.

The planning committee identified 35 nominated science presentations and divided these presentations into 7 different sessions that included 4 panel discussions. Most presentations were formatted as 5- or 10-minute lightning talks. Presenters were asked to include at least one slide highlighting the relevance of their work to EarthMAP. The planning committee invited 12 additional speakers to provide big-picture information and to ensure a common language and knowledge base around EarthMAP objectives, aspirations, and provenance. During the morning on the first day of the exchange, these 12 invited speakers addressed the need for EarthMAP, provided an overview and current status of EarthMAP, discussed data frameworks for EarthMAP, gave examples of large-data science and integration with EarthMAP, highlighted the intersections between EarthMAP and existing communities of practice and the USGS Fundamental Science Practices, introduced the Colorado River Basin Pilot Project, and explained the next steps for use-case development and the EarthMAP capacity assessment. A detailed program for the science exchange including the agenda, author affiliations, and presentation abstracts was also developed.

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***“When we try to pick out anything by itself, we find it hitched to everything else in the universe.”***

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— John Muir

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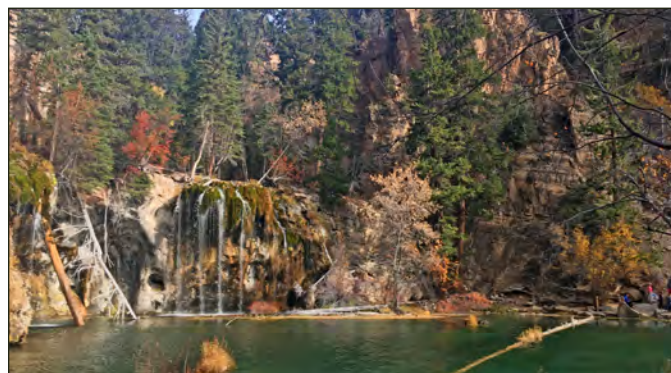
### EarthMAP 101

The first RMR Science Exchange participant activity that the planning committee produced was a live Teams (a virtual platform) event on September 4, 2020, designed to provide workshop participants with an introduction to the EarthMAP concept prior to the workshop. Gary Rowe, the EarthMAP Program Manager, gave an “EarthMAP 101” presentation, which included the basic principles, concepts, and possible applications of EarthMAP. The presentation was attended by approximately 80 people and was followed by a 45-minute question-and-answer session between the audience and members of the EarthMAP Program Management Team, Capacity Assessment Team, and Use Case Development Team. The Capacity Assessment Team is working to identify and characterize existing USGS capacities that can support EarthMAP goals and products and identifying opportunities to leverage current capacities (Keisman and others, 2021). The Use Case

Development Team is identifying and compiling use cases to highlight the benefits of EarthMAP; these use cases may also identify near-term opportunities for research and studies that would support EarthMAP development (Wilson and others, 2022).

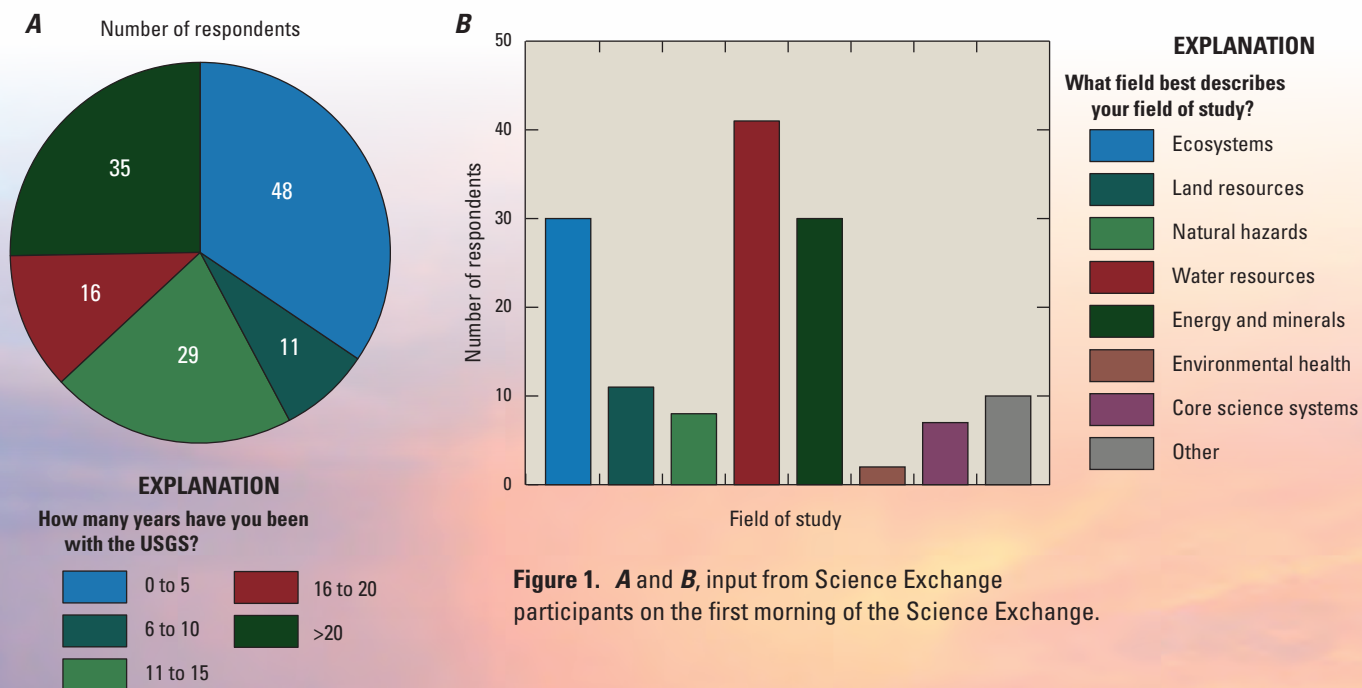
### Polling

Prior to and throughout the Science Exchange, the planning committee directed polling questions to workshop participants (fig. 1). Polling was used to gather information from attendees, to augment panel discussions, and to provide attendees opportunities to actively participate in the Science Exchange. Information gathered from attendees was used to introduce attendees to each other and to evaluate the effectiveness of the Science Exchange in improving understanding of the EarthMAP concept among attendees.



Hanging Lake, a National Natural Landmark formed by travertine deposition, Glenwood Canyon, Colorado. Photograph by Katharine Dahm, USGS.





**Figure 1. A and B,** input from Science Exchange participants on the first morning of the Science Exchange.



## Summary and Outcomes

### Session I: Setting the Stage

The first session of the exchange was designed to set the stage for the remainder of the conference. The objective of this session was to provide background into the history, vision, and need for EarthMAP and to introduce examples of EarthMAP-relevant datasets already in use and current USGS projects that closely fit the scope and scale of EarthMAP. The anticipated outcome of this session was to construct a solid foundation on which the rest of the workshop could stand, such that participants were thinking about and ready to discuss EarthMAP applications of their own or other USGS science.

The science exchange began with an address from the USGS Director, Jim Reilly, who welcomed attendees, shared his vision for the future of the USGS and EarthMAP, and challenged attendees to push the boundaries of how they think about the delivery of USGS science. Next, in his keynote address, USGS Scientist Emeritus Marty Goldhaber described some of the grand challenges facing our generation and motivation for the development of the EarthMAP concept. The plenary session featured Gary Rowe (EarthMAP Program Manager), who updated participants on the progress and direction of the national USGS EarthMAP teams and then opened the session for questions from the attendees.

### Session Ia: Examples of Large-Data Science and Their Role in EarthMAP

The purpose of this session was to provide examples of relevant science being produced on a grand scale within the USGS. Each of the four speakers in this session were associated with leading large-scale studies in a different earth science domain: water, land imaging, ecosystem dynamics, and fire. All four presenters also had extensive experience with the use of their products across domains, including the challenge of delivering products relevant to users at multiple

scales, from local to continental. The objective of this session was to use these existing examples to explore the challenges associated with delivery of large data streams and building of robust models that provide timely projections for decision makers. This session helped begin the conversation regarding (1) requirements needed for EarthMAP to integrate existing enterprise-level monitoring and data delivery systems with models that synthesize data across domains and (2) requirements for taking these and other existing USGS capacities to the next functional level.

### Session Ib: The Future of Data Delivery

One of the goals of EarthMAP is to provide near-real-time earth science data products for use by decision makers managing resources and responding to immediate and long-term hazards such as fire, floods, drought, and sea-level rise. The USGS has a long history of providing useful data products and of meeting the challenge of improving both the science and the delivery of data products. Two USGS organizational units that have helped meet this challenge are

the Office of Science Quality and Integrity (OSQI) and the Community for Data Integration (CDI). The Fundamental Science Practices (FSP) administered through OSQI are the foundation that ensures the excellence of USGS science products (Fundamental Science Practices Advisory Committee, 2011). The technological

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***“Fundamental Science Practices will be an important factor in promoting integration that combines data from different sources into a single, unified view that facilitates unrestricted sharing and use of data between disparate systems.”***

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– Harry Jenter, RMR 2020 Science Exchange

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innovations, edge-of-the-envelope thinking, and inclusivity that characterize the CDI provide for increased communication infrastructure and integration capacity among disparate researchers and groups. This session was designed to initiate a conversation among the different the EarthMAP teams (pilot, regional, and national use case, and capacity teams) with representatives from OSQI and CDI. Presenters in this session highlighted how the USGS FSP and EarthMAP are coevolving to deliver the high-quality science that stakeholders can trust at the accelerated product delivery speeds they need. Presenters also described the elements of a community of practice and the types of collaboration and co-creation that happen when a community of practice is effective and how that may apply to EarthMAP.





White River National Forest near Hanging Lake in Glenwood Canyon, Colorado, October 2016. Photograph by Katharine Dahm, USGS.

## Session II: RMR Science Related to EarthMAP Themes

This session was designed to be a transition from the EarthMAP concept and introductory presentations to the RMR science presentations and to show how current project science is relevant to EarthMAP. The science products and information that USGS Science Centers produce are the fundamental building blocks needed to support EarthMAP. The objective of this session was to demonstrate to the Science Exchange attendees how diverse USGS projects each have a potential role in supporting EarthMAP. The desired outcome of this session was to encourage attendees to start thinking about how their own science projects can meet their program and stakeholder needs as well as support the EarthMAP concept, and to show examples of how that might look.

## Session III: Assessing Drivers of Change and Integrating Science: Model Approaches for EarthMAP

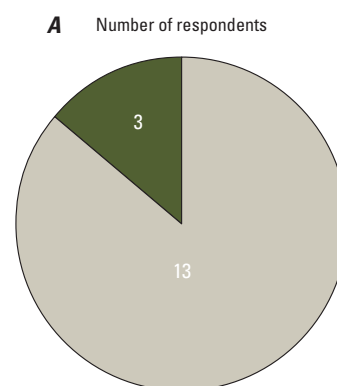
Drought, invasive plants, energy development, mining, recreation, and other competing land uses are major drivers of change being studied by USGS scientists in the Rocky Mountain and Southwest Regions. USGS scientists are using modeling and a broad range of analytical procedures and tools to understand drivers of change and predict outcomes of these changes (fig. 2). The purposes of this session were (1) to learn about projects in the Rocky Mountain and Southwest Regions involving environmental drivers and landscape change, including the approaches that are used and the spatial and temporal scales being addressed; and (2) to learn how project science is helping stakeholders with decision making.

The panelists focused on how these projects could serve as EarthMAP use cases. Although many USGS programs already demonstrate how the integration of scientific data provides vital information for those making land-management decisions and policies, collaboration across USGS science disciplines can still be improved. Panelists also demonstrated that the USGS has well-established expertise in compiling, synthesizing, and integrating data and incorporating retrospective and predictive modeling required for EarthMAP to understand past conditions and predict future conditions. Many of these models can be expanded, scaled up, or further integrated with other explanatory and predictive models, spatial locations, and temporal domains.

## Drivers of change

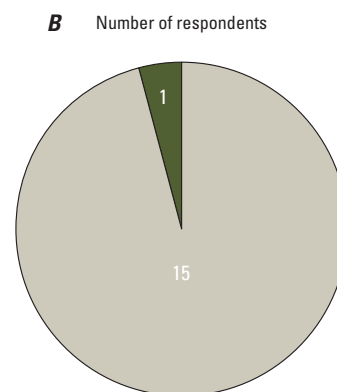
**Audience poll:**  
Does your science address the “MAP” in EarthMAP?

Yes (81 percent)  
No (19 percent)



Do you get requests from your USGS colleagues for data and models you developed after your manuscripts are published?

Yes (94 percent)  
No (6 percent)



**Figure 2.** A and B, input about data and models from Science Exchange participants.



EarthMAP can be used to expand locally driven and mission-driven science efforts. EarthMAP could also catalyze an increase in collaboration among USGS scientists, and existing capabilities could be springboards for further development. The panelists suggested supporting the continuation and improvement of empirical and process-based models, including support for field efforts to collect data and support for continued work with stakeholders to coproduce future data-collection efforts. The panelists suggested being cautious when scaling up study results (because of “fiendish complexities” and many uncertainties), keeping models robust, and focusing on providing actionable information. The panelists also discussed how they make determined efforts to share models, data, and approaches among USGS colleagues and across mission areas. Finally, the panelists suggested that the EarthMAP pilot project should follow the “keep it simple” approach to demonstrate utility and to get buy in from internal programs and cooperators.

## Session IV: EarthMAP Components in the Colorado River Basin and Beyond: Minerals, Metals, Climate, and Water

Presentations in this session demonstrated the diverse disciplines and science topics in which USGS scientists are currently engaged that are relevant to EarthMAP. The projects were summarized in seven 5-minute lightning talks showcasing data collection, data synthesis, data delivery, and predictive capabilities. The topics covered a wide range of spatial and temporal scales as well as disciplines, including geologic/mineral assessments, paleoclimate, geophysics, hydrology, and modeling. Presenters discussed the motivations, methods, and lessons learned regarding their projects and highlighted their ability to deliver relevant and timely products to cooperators, stakeholders, and decision makers. The variety of topics and the interdisciplinary aspects of the science involved are a reminder that collaboration and integrative science will play a key role in the future of the USGS and EarthMAP.

## Session V: EarthMAP – Colorado River Basin Pilot Project

The Science Exchange served to introduce the drought-focused EarthMAP – Colorado River Basin Pilot Project, hereinafter referred to as the EarthMAP CRB pilot project (USGS, 2021). Drought was identified as the focus of the project because of the threat it poses to human communities and ecosystems in the Colorado River Basin region (fig. 3) and also because of the USGS efforts towards integrated drought science (Ostroff and others, 2017). This session included panel discussions and breakout sessions for smaller groups to

develop potential use cases, identify existing regional capacities, and capture drought-related use-case concepts for the EarthMAP CRB pilot project. The EarthMAP CRB pilot project is planned to demonstrate the EarthMAP concept by addressing requirements from major partners for integrating models and tools to build an Earth system predictive capability. As a part of demonstrating the EarthMAP concept, the EarthMAP CRB pilot project will also deliver actionable information to reduce risks from ongoing drought. The EarthMAP CRB pilot project is planned to provide the initial demonstration of the EarthMAP components and contribute to the development of a national framework for EarthMAP. Data and tools developed are planned to be scalable and extensible to ensure an enterprise approach that is applicable to other pilot projects, regions, and the national framework of EarthMAP.

Key integrated science presentations and use cases were presented by Rocky Mountain and Southwest Region project leads. Targeted breakout sessions facilitated by panelists, the EarthMAP Project Management Team, and the Science Exchange Planning Committee allowed for smaller group discussions between Science Exchange participants to identify initial use cases and technical capabilities for the EarthMAP CRB pilot project. Breakout brainstorm questions included subjects related to EarthMAP actionable intelligence, integrated predictive science, and data and information integration.



**Figure 3.** The location of the Upper and Lower Colorado River Basins.



In 16 breakout discussions about the EarthMAP CRB pilot project, about 80 participants identified more than 25 use cases with potential for short-term and long-term development under the EarthMAP CRB pilot project. Use-case topics that can be pursued as short-, mid-, and long-term actions to demonstrate EarthMAP included the following:

- Legacy mine land remediation
- Regional water availability studies
- Sagebrush recovery tools
- Socioeconomic drought impact indicators
- Wildfire alert network and post-fire alerts
- High-flow ecological experiments
- Water quality and quantity prediction in reservoirs
- Fish and wildlife tourism
- Dust effects and citizen science applications
- Colorado River Delta use cases
- Oil- and gas-produced water and fracking water availability
- Forest health interconnection use cases
- Connections between surface-water hydrology and terrestrial wildlife

Additionally, multiple groups highlighted examples of integrated science by projects underway in the Rocky Mountain and Southwest Regions that could be expanded as initial “quick wins” under the EarthMAP CRB pilot project. One such project is the work being done in southwest Wyoming to optimize the choice of regional restoration strategies to meet multispecies management objectives; another is work being done in Colorado to operationalize an early flood and debris-flow warning gage network that can provide advanced warning of hydrologic hazards.

## **Session VI: Emerging Opportunities: Data, Tools, and Technologies**

This session showcased examples of innovative approaches, tools, and technologies with which data are being collected, processed, and used to inform actionable science. Advanced capacities were summarized in five 5-minute lightning talks followed by a panel discussion of how these approaches, tools, and technologies may help advance the EarthMAP vision of actionable science. The discussion focused on the use of tools and technologies to collect and deliver data and other science products for internal use and for stakeholders.

### ***Emerging Opportunities: Data, Tools, and Technologies***

Cyber infrastructure services are vital for providing dynamic data delivery.

Aspects of cyber infrastructure services are

- Continued improvements and innovations in field-deployable sensors.
- A necessity for well-organized data workflows for efficient data actualization.
- Use of the functionality provided by cloud hosting and cloud computing services.
- Innovations in data-delivery applications and decision support tools.

USGS advanced data development and delivery are not static. USGS is a data provider but another important, often unacknowledged, role is that of a data synthesizer of USGS data and of data collected by other organizations. These roles could be expanded with EarthMAP. The panel acknowledged that many small projects across the USGS are implementing innovations in data development and delivery. Finding ways to connect scientists working at this level could be synergistic for development of new data-synthesis methods. Lastly, dynamic delivery of data and the FSP process can sometimes be in conflict regarding expedited delivery of results. This conflict necessitates development of new science integrity practices to achieve timely compilation and synthesis of data.

The USGS has many useful capacities for conducting data-intensive science, and more capacities can be built or expanded. The CDI facilitates several communities of practice and cloud hosting solutions. USGS science-support specialists will be vital to advancing data delivery processes as EarthMAP develops. Finally, data-rich science requires use of guiding principles. Digital assets should be readily accessible, interoperable, and reusable, as set forth in the Findable, Accessible, Interoperable, and Reusable (FAIR) principles (Wilkinson and others, 2016).



## Session VII: Multidisciplinary Studies Relevant to EarthMAP in the Rocky Mountain and Southwest Regions

Multidisciplinary studies can be designed to provide multiple integrated and connected lines of evidence needed for holistically describing and simulating natural systems; these studies can also provide the tools needed for helping decision makers resolve large, complex environmental problems. The purposes of this session were to describe recent and current multidisciplinary science projects that are relevant to the EarthMAP CRB pilot project and to encourage discussion about potential benefits of multidisciplinary science projects for addressing cooperator and stakeholder needs. The desired outcomes of this session were to (1) inspire inclusion of more scientific tools than have traditionally been used in USGS studies to produce more holistic and useful science products for wide ranges of cooperators and stakeholders engaged in solving complex environmental and resource-management issues and (2) establish connections that can lead to further sharing of ideas about new tools and technologies that can be used to broaden the scopes of studies, thus providing more relevant and actionable answers to stakeholders seeking to sustainably address and manage environmental issues.

## Looking Forward—Colorado River Basin Pilot Project and Science Exchange Momentum

The next steps for the EarthMAP CRB pilot project include (1) forming a pilot project team, (2) summarizing short- and long-term use cases identified during the meeting, (3) assessing the preliminary capacity for the pilot project, and (4) holding a follow-up meeting to continue discussion of relevant EarthMAP use cases. During 2021, this pilot project plans to focus on short-term prototype projects for EarthMAP and begin to work with external stakeholders to prioritize integrated science needs.

To continue the information sharing generated during the RMR Science Exchange, the RMR Director's office initiated the virtual RMR Science Seminar Series in October 2020 to share integrated science achievements and challenges, discuss USGS capacities, and engage internal and external organizations working towards integrated science efforts. Seminar presentations are planned to cover a wide range of topics, such as EarthMAP use cases, ecosystem restoration studies, and data mining and integration.

Numerous products were initiated during the RMR Science Exchange with the prospect that they could be useful and further developed by the EarthMAP CRB pilot project team. Each speaker submitted an abstract that was included in a program created for the exchange.



Black Canyon of the Gunnison River, Colorado. Photograph by William J. Andrews, USGS.

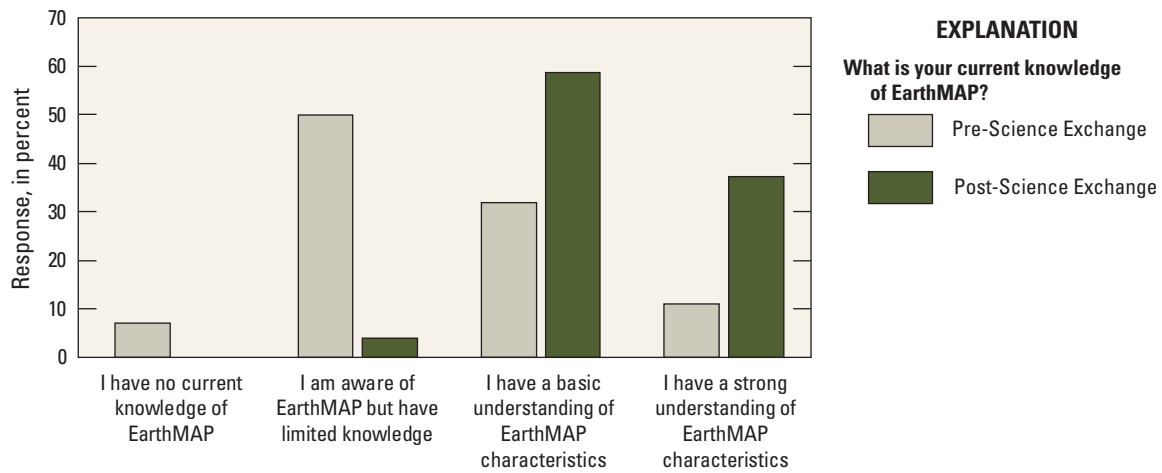
A spatial catalogue containing information related to Colorado River Basin projects was also envisioned. Presenters were encouraged to participate in beginning the compilation of geospatial data by entering data into a preliminary “spatial catalog.” All registered participants were also invited to contribute to this spatial catalog. The intent of the spatial catalog was to facilitate compilation efforts for the EarthMAP CRB pilot project.

## Measures of Success

After the Science Exchange, attendees noted a substantial improvement in their understanding of EarthMAP (fig. 4); 86 percent of the attendees surveyed indicated interest in continuing to participate in EarthMAP discussions.

The EarthMAP – Colorado River Basin Pilot Project is one of the first of multiple activities that the EarthMAP Program Management Team has identified for supporting the program-formulation phase of EarthMAP. The Science Exchange was successful in initiating the discussion on the EarthMAP CRB pilot project (fig. 5). The organization and virtual access of digital files related to the RMR Science Exchange has served as a model for the EarthMAP CRB pilot project. The experimentation with a Science Exchange ArcGIS Online Spatial Catalog, to which presenters and attendees were invited to upload existing studies and data related to EarthMAP, is expected to be built upon along with information generated during the Science Exchange breakout sessions to support the pilot project. The next steps for the EarthMAP CRB pilot project were already underway as of December 2020, including formation of the EarthMAP CRB pilot project team, preparation of a summary of short- and long-term use cases identified during the meeting, preparation of a preliminary capacity assessment for the project, and a follow-up meeting to continue discussion of relevant EarthMAP use cases.





**Figure 4.** Changes in knowledge and understanding of EarthMAP prior to and following the Rocky Mountain Region Science Exchange, 2020.



**Figure 5.** Words invoked by the term “EarthMAP” as identified by attendees at the end of the Rocky Mountain Region Science Exchange, 2020.

Upper Green River in Moffat County, Colorado, near the Browns Park National Wildlife Refuge, August 2016.  
Photograph by Patrick J. Anderson, USGS.



The RMR 2020 Science Exchange workshop laid a solid foundation for future collaborative science for the EarthMAP program and other collaborative USGS science projects. The RMR plans to continue conducting annual Science Exchange workshops and monthly science seminars to build on the progress made in the 2020 RMR Science Exchange workshop for EarthMAP. Collaboration of USGS scientists and regional staff members in the Rocky Mountain and Southwest Regions is planned to continue for the development and coordination of the EarthMAP – Colorado River Basin Pilot Project and other collaborative science efforts.



Arches National Park Windows Trail near Moab, Utah, October 2016. Photograph by Katharine Dahm, USGS.

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Lake Mead formed by the Hoover Dam in Arizona and Nevada. Reservoir levels in 2018. Photograph by Katharine Dahm, USGS.



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