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The 2024 Collectors Tour: A Case Study in Field-Based Geoscience Communication

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Abstract. The 2024 Collectors Tour is a field-based science communication initiative that uses narrative structure, place-based explanation, and methodological transparency to engage non-specialist viewers with Critical Zone science. The project consists of a 21-episode video series produced during an 18-day, 4500-km field campaign to service a network of mineral dust collectors deployed across alpine, desert, and urban environments in Utah, Nevada, and Idaho as part of the NSF-funded DUST^2 Critical Zone project. Each episode in the Tour is anchored to a specific site and task, such as arriving at a collector, observing the surrounding landscape, and retrieving samples, and uses that moment to introduce focused concepts related to mineral dust, soil formation, snow–hydrology interactions, climate variability, ecosystem function, and human influence. This approach foregrounds scientific process, uncertainty, and interdisciplinarity, allowing viewers to observe how geoscience knowledge is generated in real settings. The communication strategy emphasizes authenticity, continuity across episodes, and visual engagement with landscapes, transforming a routine monitoring campaign into a coherent outreach narrative. Mineral dust serves as a unifying theme through which otherwise disparate environments and disciplines are connected, illustrating the Critical Zone as a laterally linked system rather than a set of isolated sites. The Collectors Tour also reflects lessons learned from long-term communication efforts, including the value of consistency, the power of storytelling grounded in genuine field practice, and the importance of acknowledging collaboration, logistics, and uncertainty. As a case study, the Collectors Tour offers a replicable model for integrating science communication into ongoing field research and contributes to broader discussions on effective strategies for communicating Earth and space science to diverse publics.

1. Introduction

Public engagement is an essential component of contemporary geoscience, not only for disseminating research findings but for fostering Earth-system literacy and strengthening public trust in scientific practice (Stewart and Lewis, 2017). However, challenges inherent in conveying accurate science to public viewers are as real in Earth science as they are in other disciplines (Groffman et al., 2010; Liverman, 2008; Nisbet and Scheufele, 2009). Equipment and approaches for digital story-telling are providing new opportunities for geoscientists to connect with broader viewers (Brown Jarreau et al., 2019; Groshans et al., 2019; Lee et al., 2018), yet effective communication requires more than simplifying technical concepts and presenting

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compelling visuals. It benefits from narrative structure, place-based learning, and authentic demonstrations of how scientific knowledge is generated (Bowater and Yeoman, 2012; Dunn et al., 2025; Lidal et al., 2013; Seidel et al., 2023). Relatively little work has examined how media-rich, researcher-produced narratives can function as integrated outreach strategies capable of conveying the complexity, interdisciplinarity, and lived experience of Earth science fieldwork.

Here we present the 2024 Collectors Tour as a case study in geoscience outreach. The Tour consists of 21 short, on-location videos filmed during the autumn field season of the DUST^2 project, an effort funded by the U.S. National Science Foundation to study Earth's "Critical Zone," the surface environment where geology, ecology, hydrology, and society intersect. Over 18-days, the narrator for the Tour travelled nearly 4500 km miles to service 20 dust samplers located in spectacular and unique alpine, subalpine, desert, and urban environments. Videos comprising the Tour provide a sense of what is involved in getting to these remote sites, views of the diverse landscapes surrounding each collector, and a succinct elaboration of the scientific questions that are being answered through the collection and analysis of these dust samples. Viewed together, the videos form a coherent narrative that blends field practice with transdisciplinary geoecological concepts, and situate scientific ideas within specific landscapes.

Despite being filmed informally and often under challenging field conditions, the Collectors Tour was intentionally designed for pedagogical consistency. Each video uses the surrounding landscape as a visual entry point into broader scientific themes. Complex concepts such as dust-soil nutrient coupling, snow-albedo feedbacks, geochemical isotopic fingerprinting, paleoclimate reconstruction, and urban environmental exposure are introduced through concrete, place-based examples. The videos also foreground methodological transparency, including demonstrations of how the dust collectors work, how the duration of snow cover at each site is estimated, and the procedures used to extract and preserve the dust samples. This authenticity creates an unusually clear window into how geoscience is practiced in the field.

When viewed collectively, the Collectors Tour illustrates how an informal, episodic field-narrative approach can function as an integrated outreach platform. The series communicates fundamental concepts in Critical Zone science, demonstrates the spatial connectedness of landscapes across the Intermountain West, and highlights the relevance of dust deposition for soil development, water resources, ecosystem function, and environmental justice. The videos also illustrate how narrative storytelling, landscape-anchored explanation, and transparent field methods can help bridge the distance between scientific practice and public understanding.

In the sections that follow, we present the Collectors Tour as a model of geoscience communication. We examine how its narrative and spatial structure supports conceptual understanding of Earth-surface processes; how its demonstration of field methods influences audience engagement; how its framing of dust, snow, soil, and atmosphere reflects the transdisciplinary nature of the Critical Zone; and what lessons this example may offer to researchers seeking to integrate outreach into long-term field programs. By contextualizing the Tour within the broader literature on geoscience communication, we argue that it represents an effective, scalable, and replicable approach to engaging diverse viewers in the practice and significance of contemporary Earth-surface research.

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2 Mineral Dust and the DUST^2 Project

Mineral dust is an easy-to-overlook component of Earth-surface systems, yet it exerts disproportionate influence on landscape evolution, ecosystem function, hydrology, and human–environment interactions (Brahney et al., 2024; Kok et al., 2023). Through wind transport, dust connects distant regions that are rarely considered part of the same system (Kim et al., 2024), including arid lowlands and alpine summits, agricultural valleys and remote mountain soils, urban environments and headwater catchments (Munroe et al., 2024, 2025). Dust therefore provides a powerful framework for understanding the Critical Zone as a spatially connected system rather than a collection of isolated vertical profiles or watersheds (Munroe, 2026).

A primary motivation for studying mineral dust is its role in soil formation and fertility. In many mountain environments, geochemical analyses reveal that a substantial fraction of soil mass is derived from dust rather than through weathering of local bedrock (Lawrence et al., 2011; Munroe et al., 2020, 2024). In a wide variety of terrestrial settings, wind-transported dust also delivers key elements such as calcium, phosphorus, potassium, and micronutrients (Aciego et al., 2017; Arvin et al., 2017; Bristow et al., 2010; Chadwick et al., 1999; Yu et al., 2015). Dust therefore helps create and sustain productive soils and diverse vegetation in landscapes that might otherwise be nutrient-limited, thereby supporting entire ecosystems (Okin et al., 2004).

Dust also exerts strong control over hydrologic processes, particularly in snow-dominated systems. When dust accumulates on seasonal snowpack, it reduces surface albedo, increases solar absorption, and accelerates melt (Painter et al., 2007, 2010). This effect can shift the timing of snowmelt runoff by days to weeks, altering streamflow patterns, reservoir operations, and water availability for downstream communities (Lang et al., 2023, 2026; Skiles et al., 2018). Dust further influences water chemistry by interacting with snowmelt and soils, mobilizing metals and nutrients that can be transferred to streams in brief but ecologically significant pulses (Carling et al., 2012, 2015; Checketts et al., 2020). These processes underscore the importance of dust not only for water quantity, but also for water quality and timing.

Beyond its local effects, mineral dust serves as both a driver and an archive of environmental change. Dust emission and transport respond sensitively to climate variability, drought, vegetation cover, land-use change, and surface disturbance (Aarons et al., 2019; Munroe, 2022). Long-term dust records preserved in lake sediments, soils, and ice provide insight into past aridity, wind regimes, and landscape stability (Aarons et al., 2016; Munroe et al., 2021). At the same time, modern increases in dust emissions associated with land management and climate change raise concerns about future feedbacks among dust, ecosystems, hydrology, and human health (Boroughani et al., 2025; Zucca et al., 2022). In urban environments, dust becomes further entangled with issues of air quality, exposure, and environmental justice, highlighting its relevance to society as well as to Earth-system science (Grineski et al., 2024; Putman et al., 2022).

The DUST^2 project, which started in 2020, is designed to investigate these diverse roles of mineral dust within a unified Critical Zone framework. Funded as part of the Critical Zone Collaborative Network of the U.S. National Science Foundation, DUST^2 focuses on dust as a source-to-sink system across a broad swath of the Intermountain West, with the goal of better understanding how dust links arid source regions, mountain environments, and human-dominated landscapes. A key

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infrastructure component of DUST^2 is a network of 20 passive dust collectors deployed on mountain summits and urban rooftops in Utah, Nevada, and Idaho (Fig. 1). These collectors operate continuously year-round, capturing both dry deposition and dust scavenged by rain and snow. The samples collected in the field support construction of multi-year records of dust flux (Munroe, 2022) and geochemistry (Munroe, 2014), allowing the role of dust in soil formation to be quantified (Munroe et al., 2020, 2024), and possible dust sources to be identified (Munroe et al., 2019).

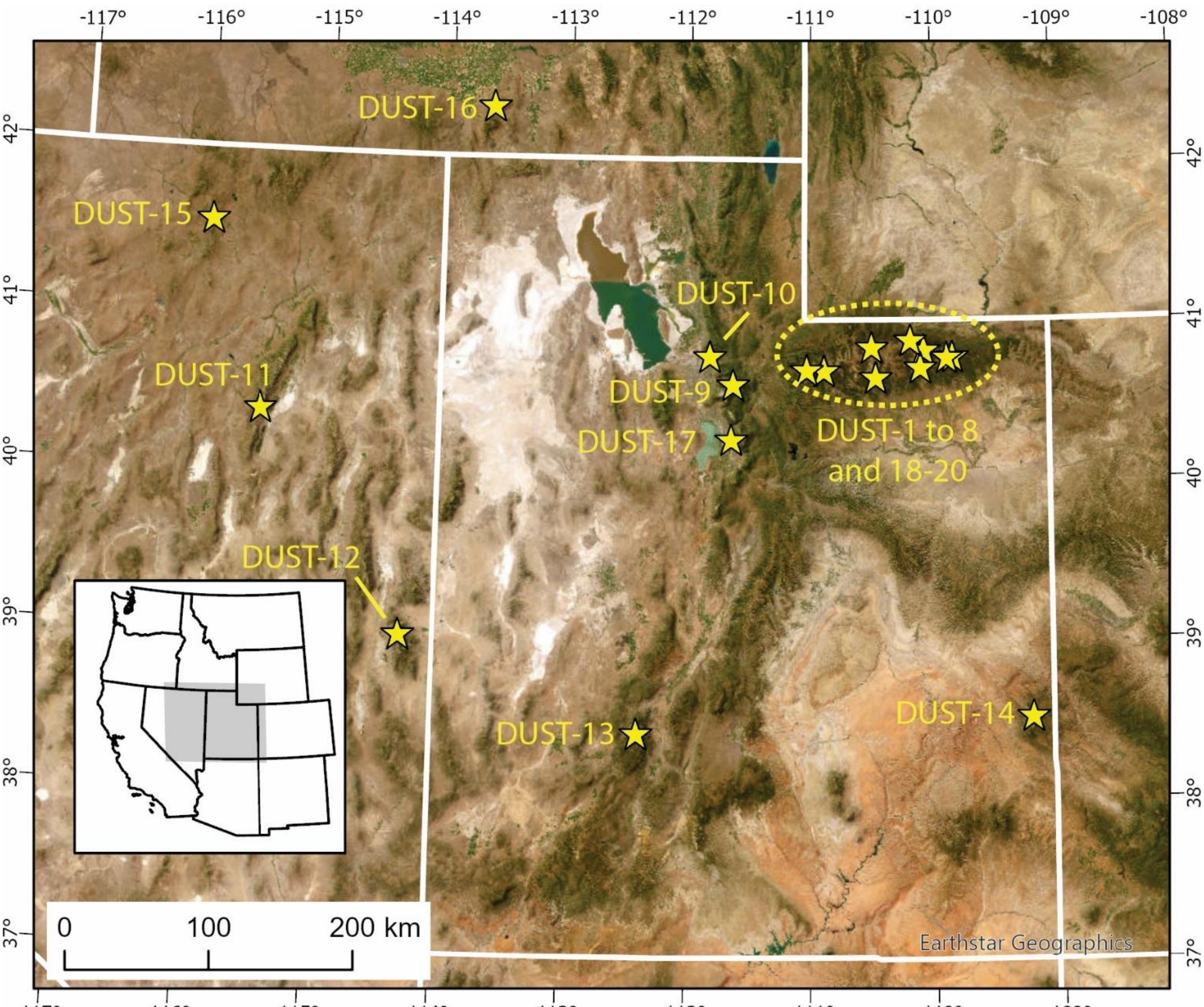

Figure 1. Locations of the 20 passive dust collectors (yellow stars). The oval surrounds DUST-1 through DUST-8, and DUST-18 through DUST-20 in the Uinta Mountains of northeastern Utah. Background is a true-colour satellite image from Earthstar Geographics (World Imagery – Overview, 2023). Inset shows the location of the larger map (grey box) within the western United States.

Although it was not always possible, throughout the DUST^2 project, the goal was to visit and empty each of the passive collectors twice per year. A visit in July after the high-elevation collectors melted out of the winter snowpack yields a sample of winter dust. Similarly, a visit a few months later in October yields a sample of summer dust. Whether alone or with a crew of field assistants, the fieldwork involved in visiting each of the dust collectors is a significant endeavour, requiring roughly 3 weeks of non-stop travel. The collectors are located in spectacular landscapes though, and each of them provides a window into different aspect of the larger DUST^2 project (Fig. 2). Accordingly, a plan was developed to document the fieldwork involved in emptying the collectors with a series of videos that would use mineral dust as an entry point for understanding soils, water, climate, ecosystems, and human influence as components of a dynamically coupled Earth-surface system.

Figure 2. Photograph of the DUST-4 collector on the north side of the Uinta Mountains near the Utah-Wyoming border on October 9, 2024.

3 Design Principles Behind the 2024 Collectors Tour

The Collectors Tour embedded scientific explanation directly within the act of fieldwork to address nine complementary objectives:

- Realism
- Continuity

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- Deconstructing complex scientific concepts
- Demonstrating transparency in methods
- Linking science to environmental impact and management
- Rapid production and release
- Open-source sharing
- Connecting fieldwork to final scientific products
- Fostering collaboration and community

Realism

A central objective of the Tour was to convey scientific practice as it actually occurs, rather than presenting a polished or retrospective account. Accordingly, each episode was filmed outdoors in real field conditions, including adverse weather, difficult terrain, and logistical constraints, and comments of the narrator were unscripted and extemporaneous. Furthermore, the videos show routine but essential aspects of field science, such as travel to each of the field sites, the process of emptying the collectors, troubleshooting, and reflecting on uncertainties. By documenting both the intellectual and physical dimensions of fieldwork, the Tour presents science as a lived process shaped by environmental conditions and practical constraints. This realism helps demystify scientific work and fosters trust by allowing viewers to observe how knowledge is generated rather than only encountering its final products.

Continuity

The Tour is structured as a sequential journey through the dust collector network, creating narrative continuity across episodes. Each video follows a consistent format, typically including arrival at a site, description of the landscape and history of the collector, and explanation of a relevant scientific concept. This repeated structure allows viewers to recognize recurring elements while encountering new environments and ideas. This repetition also reinforces key themes, such as the role of dust in soil formation and hydrology, while the progression across diverse landscapes in different mountain ranges and states emphasizes regional connectivity. Overall, the continuity of both narrative and method helps viewers build conceptual understanding over time and situates individual study sites within a larger scientific framework.

Deconstructing Complex Scientific Concepts

Each episode in the Tour was designed to explain complex geologic concepts through direct reference to observable landscape features and field equipment. Topics such as isotopic fingerprinting, snow–albedo feedbacks, soil nutrient cycling, and paleoclimate reconstruction are introduced incrementally and in context, rather than through abstract exposition. By anchoring explanations in physical settings and observable processes, the series of videos helps viewers develop intuitive understanding

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of otherwise abstract concepts. This place-based approach makes interdisciplinary Critical Zone science more accessible without sacrificing scientific accuracy.

Demonstrating Transparency in Methods

Videos in the Tour explicitly document how dust samples are collected, processed, and interpreted, providing visibility into field scientific procedures. Topics such as the operation of the passive dust samplers, the use of temperature dataloggers to track snow cover, and techniques for retrieving dust samples from the collectors are elaborated in the field, illustrating the steps required to collect dust samples and related data. This methodological transparency helps viewers understand the basis for scientific conclusions and reinforces the rigor underlying long-term environmental monitoring. By showing the simple field techniques setting the stage for sophisticated laboratory analyses, the Tour bridges the gap between fieldwork and there interpretation of scientific data.

Linking Science to Environmental Impact and Management

Because mineral dust is not a topic that many regularly consider, it was important for the Tour to emphasize the practical significance of mineral dust for environmental systems and human societies. Accordingly, videos connect dust deposition to soil fertility, snowmelt timing, water resources, ecosystem productivity, and urban environmental exposure, among other topics. These links demonstrate how fundamental geoscience research informs understanding of environmental change and resource management. By situating scientific measurements within broader ecological and societal contexts, the Tour helps viewers appreciate the relevance of Earth science to real-world challenges.

Rapid Production and Release

Visiting all the dust collectors sequentially is an all-consuming experience; each day there is another collector, followed by the journey to the next one. It was hoped that some of this feeling could be passed on to the viewer by preparing and presenting new videos in rapid succession, producing and rolling them out almost in real time. Therefore, Tour videos were recorded and released in close temporal proximity to the field campaign itself, with most appearing while the narrator was still in the field traveling through the collector network. This schedule created a sense of immediacy and shared experience for the viewers, allowing them to follow the progression of the expedition as it unfolded. This real-time communication reinforces the authenticity of the material and allows viewers to engage with scientific work as an ongoing process.

Open-Source Sharing

The Tour videos were posted to YouTube and shared primarily through the open-access platform Mastodon, ensuring that content was freely available without institutional or subscription barriers. Open-source distribution aligns with broader principles of open science by extending accessibility beyond academic viewers and enabling broader participation. Mastodon,

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in particular, facilitated engagement within decentralized scientific and public communities, encouraging dialogue, resharing, and discovery. This approach reflects a commitment to transparency and inclusivity in science communication.

Connecting fieldwork to final scientific products

Another objective of the Tour was to explicitly link field observations and sampling activities to the scientific products that emerging from the DUST^2 project. Numerous episodes were filmed at (or near) the locations where samples were collected that later informed the conclusions presented in peer-reviewed publications. These connections were noted in the videos filmed in the field. Then, as each video was released online, links were provided to the open-source publications mentioned by the narrator. This approach emphasizes that published results are not detached conclusions, but rather the culmination of sustained field effort, careful methodological design, and long-term monitoring. Making this connection visible reinforces the credibility of scientific findings and enables viewers to see fieldwork as the essential first step in producing the environmental insights that inform research, management, and policy decisions.

Fostering Collaboration and Community

Finally, the Tour highlights the collaborative nature of scientific research by acknowledging contributions from students, technicians, collaborators, land management agencies, and funding organizations, without which the DUST^2 project would have been impossible. In addition, several episodes feature shared infrastructure, such as co-located weather stations and complementary monitoring programs, illustrating how scientific understanding emerges from collective effort. The open sharing of the Tour through public platforms further extends this collaborative ethos, inviting viewers to engage with and reflect on the scientific process. One video in particular spotlights a direct invitation for researchers and citizens scientists interested in Critical Zone science to become involved in a new initiative to build a global community of Critical Zone scientists. Overall, these design elements contribute to the goal of building a broader community connected through shared curiosity about Earth systems.

4 The Videos: Structure, Production, and Distribution

The videos comprising the Collectors Tour were created with a consistent workflow from field recording, through editing, to publication and viewer engagement (Fig. 3). Each episode follows a repeatable structure designed to combine narrative coherence, scientific clarity, and authenticity. Although filmed in diverse environments and under variable conditions, the videos share a common architecture that reinforces continuity while allowing each site to foreground a distinct scientific theme. This consistency enables viewers to recognize a familiar format while progressively building conceptual understanding across episodes.

The physical traverse of the entire collector network in the fall of 2024 provides the narrative backbone for the series. There is no particular order in which the 20 collectors need to be accessed; any of them could serve as a starting point for the

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circuit. The tour in 2024 started with the DUST-12 collector in eastern Nevada, and proceeded in a counter-clockwise loop (Fig. 1, Table 1). In preparing the videos, the hope was that viewers would watch them in sequence, so they were intended to build on one another. But at the same time, each video needed to stand alone, so that a viewer would learn something about mineral dust and the DUST^2 project even if they only watched just a single one.

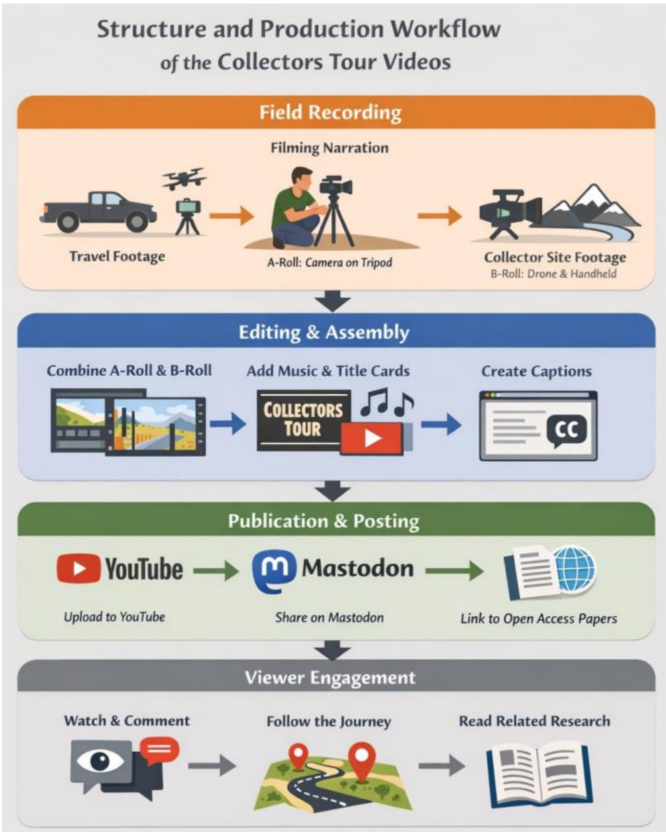

Figure 3. Structure and production workflow of the Collectors Tour video series, illustrating how field-based recording, editing, and online dissemination combine to connect real-time fieldwork with public engagement and the scientific literature. YouTube logo used for illustrative purposes only. YouTube™ is a trademark of Google LLC. Mastodon logo © Mastodon gGmbH. Used under the Mastodon Trademark Policy.

Videos typically begin with a montage of footage documenting travel to the collector site. In many cases, this includes video from a drone following the truck or researcher on the trail, often augmented by footage collected by a handheld camera during the final approach to the collector location. These opening moments documenting the journey are intentional, allowing the environment surrounding each collector to serve as both a visual anchor and conceptual entry point. These opening

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Table 1. Summary of Episodes in the 2024 Collectors Tour

Collector	Location	Date	Themes	Synopsis	Link
DUST-12	Snake Range, NV	9/28/2024	Introduction to Tour; long-term dust monitoring	Opens the Tour in Great Basin National Park. Introduces the DUST^2 project, long-term passive collector deployment, and the 4500-km sampling loop.	
DUST-13	Tushar Mountains, UT	9/30/2024	Collector design & function; dust deposition	Explains why passive collectors use glass marbles to mimic rough gravel surfaces. Describes collector design and function.	
DUST-14	La Sal Mountains, UT	10/1/2024	Dust as soil parent material; nutrient delivery	Shows how dust contributes essential nutrients to mountain soils. Notes ecological implications under shifting climate regimes.	
DUST-2	Uinta Mountains, UT	10/2/2024	Long-term climate–dust relationships	One of the original collector sites. Demonstrates how multi-year records reveal dust increases during regional drought periods.	
DUST-5	Uinta Mountains, UT	10/3/2024	Patterned ground; dust-derived soil formation	Uses periglacial patterned ground to illustrate how thick soils can develop in rocky terrain, heavily supplemented by dust inputs.	

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DUST-1	Uinta Mountains, UT	10/4/2024	Longest running site; soil thickness	Reflects on 13 years of operation and the use of geophysical techniques to estimate thickness of dust-augmented soil.	
DUST-1 Bonus	Uinta Mountains, UT	10/4/2024	Active dust sampler	Bonus content introducing the active sampler for capturing dust from north vs south directions.	
DUST-19	Uinta Mountains, UT	10/5/2024	Snow cover duration; dust accumulation mechanisms	Explains use of temperature dataloggers to show that longer snow cover can actually increase dust accumulation.	
DUST-20	Uinta Mountains, UT	10/5/2024	Extreme snow-burial experiment	Collector buried ~22 months under a persistent snowbank. Tests upper bound of snow-enhanced dust accumulation.	
DUST-8	Uinta Mountains, UT	10/6/2024	Collector emptying procedure	Demonstrates the process of emptying a dust collector, complete with time-lapse video.	
DUST-7	Uinta Mountains, UT	10/7/2024	Dust contributions to soil mass and fertility	Geochemical mixing models show 50–80% of soil mass is dust-derived. Dust -delivered nutrients support alpine vegetation in quartzite landscapes.	

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DUST-3	Uinta Mountains, UT	10/8/2024	Paleo-dust records from lakes	Explains geochemical methods for reconstructing past dust flux from lake sediment records.	
DUST-18	Western Uintas, UT	10/8/2024	Co-monitoring	Co-located with weather stations and wet–dry sampler. Highlights value of combining dust data with rich climate instrumentation.	
DUST-6	Western Uintas, UT	10/8/2024	Dust–hydrology interactions	Shows how metal-rich dust in soils produces transient pulses of dissolved metals during spring snowmelt.	
DUST-4	Uinta Mountains, UT	10/9/2024	Isotopic fingerprinting to identify source regions	Describes how radiogenic isotopes can be used to identify dust sources in western Utah, central Nevada, and the Mojave Desert.	
DUST-16	Albion Range, ID	10/11/2024	The Critical Zone	Provides explanation of the Critical Zone as the Earth's "living skin."	
DUST-15	Independence Mountains, NV	10/12/2024	Local vs regional dust contributions	Shows that dust properties vary significantly across sites, indicating a dominance of local sources rather than a uniform regional material.	

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DUST-11	Ruby Mountains, NV	10/13/2024	CZ-NoN and global CZ networking	Uses a dramatic mountain setting to discuss past CZ analogs and introduces the new Critical Zone-Network of Networks initiative.	
DUST-9	Wasatch Mountains, UT	10/14/2024	Dust-on-snow albedo impacts	Explains how dust darkens snow, accelerates melt, and advances meltout timing by up to three weeks.	
DUST-10	University of Utah (Urban)	10/14/2024	Urban dust; environmental justice	Highlights dust sources in cities, effects of the shrinking Great Salt Lake, and demographic differences in dust exposure.	
DUST-17	Brigham Young University	10/15/2024	Tour conclusion; collaboration	Final rooftop site overlapping with BYU samplers. Reflects on the 4500-km circuit, thanks collaborators, and closes the series.	

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sequences are accompanied in nearly all videos by a consistent soundtrack, again emphasizing continuity that helps the viewer grasp that what they are seeing in a single episode is part of something larger (the entire Tour) embedded in something larger still (the entire DUST^2 project).

The central portion of each video is a monolog focused on a single scientific concept associated with that site. These concepts vary across episodes and include topics such as the influence of dust on soil formation, effects of dust deposition on snowpack, isotopic fingerprints as a technique for identifying dust source, hydrologic impacts of metal mobilization during spring snowmelt, paleoclimate reconstruction from lake sediments, and urban dust exposure (Table 1). These topics are presented by the narrator in an informal manner, typically sitting on the ground next to the collector. Each narrated segment, usually about 5 minutes long, was recorded in a single extemporaneous take, filmed with an iPhone on a tripod and a wireless microphone (Fig. 3). These monologs are intentionally casual and unscripted; both because of time constraints and out of a desire to keep things approachable, retakes were avoided and the resulting footage was unedited. This decision explicitly distances these monologs from lecturing, with the result that viewers are drawn to the narrator because of authenticity rather than demonstrated authority.

By limiting each episode to one primary idea like dust in soils, or urban dust exposure, the Tour avoids cognitive overload and allows the complex, interdisciplinary concepts inherent in Critical Zone science to be introduced incrementally. Furthermore, whenever possible, explanations offered by the narrator are anchored in features observable at the collector site, for instance periglacial patterned ground, snowfields, weather station infrastructure, or the collector itself. These connections capitalize on the visual component of video-based storytelling, allowing explanations of abstract processes to be tied to visible evidence in the landscape.

Towards the end of each video the narrator typically offers brief reflections that situate a particular dust collector site within broader environmental or societal contexts. These closing remarks connect dust to processes like soil fertility, water-resource timing, climate variability, ecosystem function, or land-management decisions. Acknowledgements of collaborators, students, and land management agencies that permitted the work of the DUST^2 project are also included, underscoring the collaborative nature of scientific research. These consistent sign-offs reinforce both scientific integrity and community engagement.

Episodes typically close with the narrator remarking that it is time to empty the collector and move on to the next site. This repeated refrain reinforces that the primary purpose of the 18-day journey is not filming, but rather the sustained effort of traveling between remote field sites, servicing instruments, and maintaining a long-term monitoring network across vast and often sparsely inhabited landscapes. Returning to this motif subtly reminds viewers that the scientific task continues regardless of the camera. The brief pause in each episode, during which the narrator offers a focused monolog, therefore appears as an intentional interruption of an otherwise demanding routine. These interruptions were not required for the success of the research campaign, rather they were voluntary additions layered onto an already full field schedule. Framed in this way, each educational interlude becomes a deliberate investment of time and energy motivated by a desire to make Critical Zone science

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visible and accessible. The structure underscores that communication is not incidental to the work, but a conscious extension of it, and invites viewers to recognize the effort involved in opening this window into the scientific process.

The production process for each video began after field recording was complete (Fig. 3). Editing required approximately two hours per episode and involved assembling two primary categories of footage: the A-roll and the B-roll. The A-roll consisted of the narrator's unedited monologue, which served as the narrative core of the video. B-roll footage, which included aerial imagery from the drone, GoPro footage recorded while driving or hiking, and handheld shots of the collector and surrounding landscape, was used to establish setting and provide visual context for the scientific explanations. The length of each episode was largely determined by the duration of the A-roll, with B-roll sequences used primarily to frame the narrative and provide visual transitions.

Audio also played an important role in establishing authenticity. Natural ambient sound recorded by cameras, for instance vehicle noise, wind, and footsteps on the trail, was retained whenever possible to reinforce the sense of place. A consistent musical theme, selected from Creative Commons–licensed sources, was used at the beginning and end of each episode to reinforce continuity across the series. The music was edited to fade as narration began and then swell again during the closing remarks as the narrator indicated it was time to return to work.

Once video and audio editing were complete, title cards and end credits were added. The Horizon font was selected for the title sequence to evoke the visual identity of the western landscapes where the fieldwork took place (Fig. 4). End-credit cards acknowledged the DUST^2 project, the Critical Zone Collaborative Network, and the National Science Foundation. Open captions were then generated for each video using automated transcription software (Descript) and manually edited to ensure accuracy. Captioning was considered essential to improve accessibility and comprehension for viewers engaging with the videos (Gernsbacher, 2015).

Completed videos were uploaded to YouTube, which provided a stable hosting platform, data analytics, and integration with existing channels associated with DUST^2 and the Critical Zone Collaborative Network. Each new video was then shared through Mastodon, typically shortly after editing was complete, allowing episodes to appear sequentially on back-to-back days. Posts announcing each episode included links to open-access peer-reviewed publications associated with the featured site, authored either by the narrator, collaborators in the DUST^2 project, or other researchers studying the dust system of the southwestern United States. This strategy intentionally linked episodic field narratives with the scientific literature, making the process traceable from landscape to publication.

Overall, by prioritizing authenticity, methodological transparency, and visual connection to place, the Collectors Tour transformed a routine monitoring campaign into a structured outreach framework that communicates both how field science is done and why it matters.

5 Assessment

The overarching question driving the Collectors Tour was simple: Is it possible to collect video from the field, send it remotely to an editor, and produce and upload content in near real time? Our experience indicates that this experiment was successful.

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Figure 4. The opening title card for the Dust 13 episode. This same font and style were used for each episode to maintain a consistent visual identity for the series, and to communicate to viewers the name of the series and the episode title.

A total of 21 videos were shared: one from each collector, plus one bonus video. YouTube describes a view as a "Legitimate View," which is counted after the platform's internal analysis tools filter out bots or other spam views. With this definition, Collectors Tour videos were viewed 2721 times between October 1, 2024 and March 6, 2026 (Table 2). Time-series data indicate that all Collectors Tour videos were seen by platform audiences (Fig. 5). Typically, view numbers exhibit a spike when each video was first released and smaller spikes when the videos were shared again as part of ongoing content distribution on the DUST^2 Mastodon account. The creation of this "evergreen content" extends the lifespan of the videos and makes them valuable for use and reuse as part of future communication strategies (Arregui Olivera, 2025). As a result, the videos continue to accumulate total numbers of views months after they were first released.

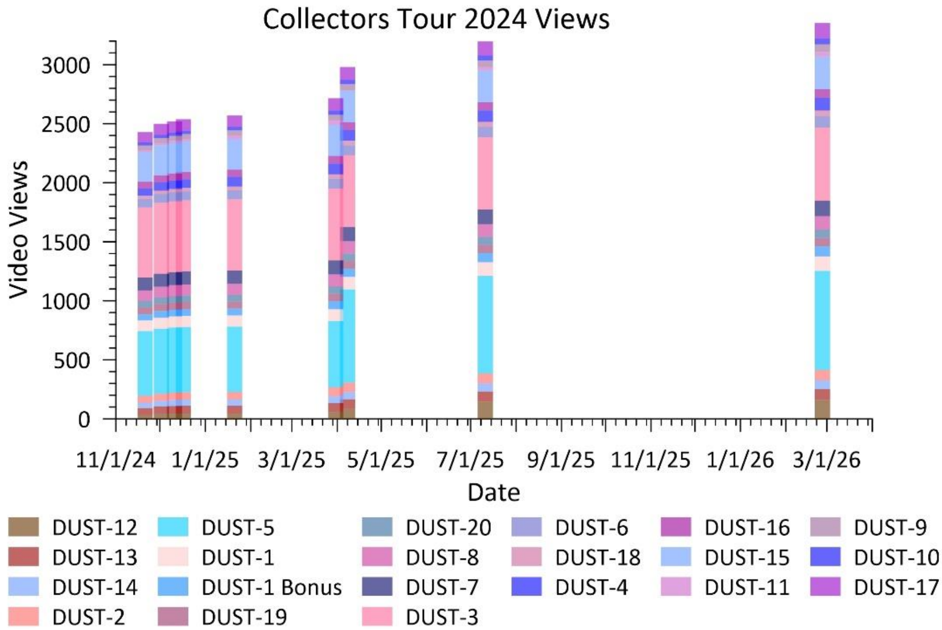

Figure 5. Timeline of accumulating views of Collectors Tour videos between late November 2024, and February 2026. Note that the videos had been viewed a total of nearly 2500 times less than two months after the full series was first released.

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The "watch time" metric from YouTube is a useful parallel to counting views (Table 2). YouTube tracks how long a person watches a video and reports the percentage of the audience remaining as viewers drop off. Each of the 21 Collectors Tour videos was watched in its full duration by some viewers, although all videos also showed viewer drop-off. The videos had an average view duration of 1:25, while the average video length in the playlist (n = 21) was 4:40. However, as watch time was not a primary goal of the project, this result is not considered discouraging (Park et al., 2016).

In total, data show that between October 1, 2024 and March 6, 2026, Collectors Tour video content has been watched for 65.9 hours (Table 2). The video with the highest number of views (Dust 3) contributed 11 hours of watch time to that total, while the least-viewed video (Dust 11) contributed 0.9 hours. Dust 11 is an outlier video, where a correction to the original version required it to be re-uploaded. Because YouTube does not allow videos to be replaced with updated versions, any metrics from the original upload were lost in this summary. However, before being replaced and hidden from view, the original Dust 11 video had 1.1 hours of watch time, which is statistically similar to the 0.9 hours recorded by the corrected version. Dust 5 was also re-uploaded to improve video quality. This had a more dramatic effect on the metrics; the original upload added 22 hours of watch time, but that number is not reflected in the totals for the publicly available version of the Collectors Tour series. Either way, it is important to reiterate that getting audiences to watch an entire Collectors Tour video was not the goal of this project. Increasing watch time is something that future science communication research could explore.

Quantitative metrics alone are not sufficient to explain why some videos had higher views or longer watch times than others. There is no clear correlation between these two data sets (Table 2). For example, the video with the most views (Dust 3) had the lowest percentage of watch time (19%). This makes it simultaneously both the most successful and the least successful video, depending on the strategic goal. However, because it was viewed the most, its total watch hours are the highest, at just over 11 hours. In contrast, Dust 12, had the highest watch-time percentage at 68% (Table 2). It is also the shortest video, with a runtime of 1:30, well below the average length of 4:40. These data could suggest that shorter videos are watched for longer, but the pattern is inconsistent. For example, Dust 10, with a runtime of 3:31, was watched 51% of the way through on average, while Dust 19, at 3:41, had a mean watch percentage of 39%.

Additional complexity arises when considering engagement on the social networking site Mastodon. For example, after the conclusion of the Collectors Tour, videos were reshared as part of the evergreen content strategy. On April 1, 2025, a revised version of the Dust 5 video was posted to YouTube and subsequently shared on Mastodon (Fig. 6). On that day, YouTube reports that the video was viewed 15 times. On April 2, it was viewed 19 times, followed by 18 additional views on April 3. On April 4, however, Dust 5 was viewed 156 times. The following day, April 5, the video received 15 views, and views gradually declined over the next few days.

Examining the corresponding Mastodon post might suggest a correlation between social media engagement and this spike in views. However, the available data do not support that conclusion. On April 1, the Mastodon post received one favourite. A week later, on April 8, 2025, the post saw a small increase in engagement, receiving two additional favourites and three boosts (Fig. 7). Because this engagement occurred several days after the April 4 spike in YouTube views, it does

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Table 2. The Collectors Tour Watch Data

Video title	Date Published	Views	Video length	Average view duration	Average portion viewed	Total watch time
	dd-mm-yr	*--*	*mm:ss*	*mm:ss*	*%*	*hr*
Dust 3 | The Collectors Tour 2024	30-Oct-24	621	5:36	1:04	19.2	11.0
Dust 5 | The Collectors Tour 2024	1-Apr-25	278	6:00	1:15	20.8	5.8
Dust 15 | The Collectors Tour 2024	3-Nov-24	274	5:04	1:12	23.8	5.5
Dust 1 | The Collectors Tour 2024	8-Oct-24	123	5:35	2:01	36.4	4.2
Dust 7 | The Collectors Tour 2024	9-Oct-24	112	4:48	1:48	37.6	4.0
Dust 4 | The Collectors Tour 2024	2-Nov-24	107	7:00	2:04	29.5	3.7
Dust 17 | The Collectors Tour 2024	6-Nov-24	103	4:31	1:24	31.1	3.2

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Dust 8 | The Collectors Tour 2024	8-Oct-24	113	5:32	1:40	30.3	3.2
Dust 1 Bonus Content | The Collectors Tour 2024	8-Oct-24	85	5:21	2:08	39.9	3.0
Dust 12 | The Collectors Tour 2024	30-Sep-24	157	1:30	1:01	68.2	2.7
Dust 2 | The Collectors Tour 2024	3-Oct-24	89	4:05	1:43	42.1	2.5
Dust 14 | The Collectors Tour 2024	2-Oct-24	74	4:12	1:48	43.2	2.2
Dust 6 | The Collectors Tour 2024	31-Oct-24	94	4:13	1:24	33.3	2.2
Dust 13 | The Collectors Tour 2024	1-Oct-24	71	3:41	1:41	46.1	2.0
Dust 16 | The	2-Nov-24	74	4:40	1:37	34.9	2.0

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Collectors Tour 2024						
Dust 20 | The Collectors Tour 2024	8-Oct-24	71	4:49	1:40	34.7	2.0
Dust 19 | The Collectors Tour 2024	8-Oct-24	71	3:41	1:25	38.8	1.7
Dust 10 | The Collectors Tour 2024	4-Nov-24	49	3:31	1:48	51.4	1.5
Dust 9 | The Collectors Tour 2024	4-Nov-24	65	3:49	1:15	33.2	1.4
Dust 18 | The Collectors Tour 2024	1-Nov-24	49	4:11	1:35	38.2	1.3
Dust 11 | The Collectors Tour 2024	7-Apr-25	41	6:12	1:20	21.7	0.9
Average	**--**	***130***	***4:40***	***1:33***	***35.9***	***3.1***

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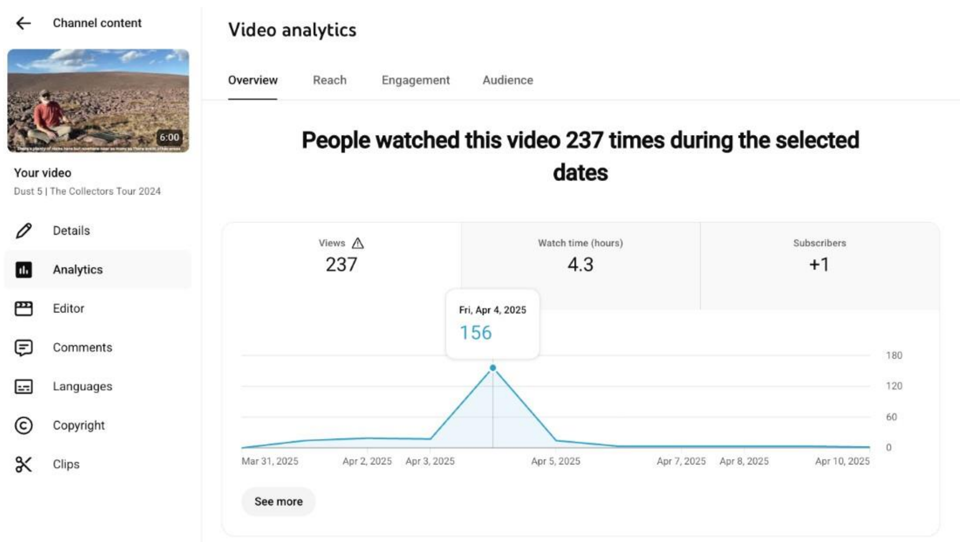

Figure 6. YouTube data showing the DUST-5 video viewing spike on April 4, 2025. Source: YouTube analytics for CZNet Cluster Outreach: Dust 5 | The Collectors Tour 2024, available at: https://youtu.be/m3v3G7jLeUo.

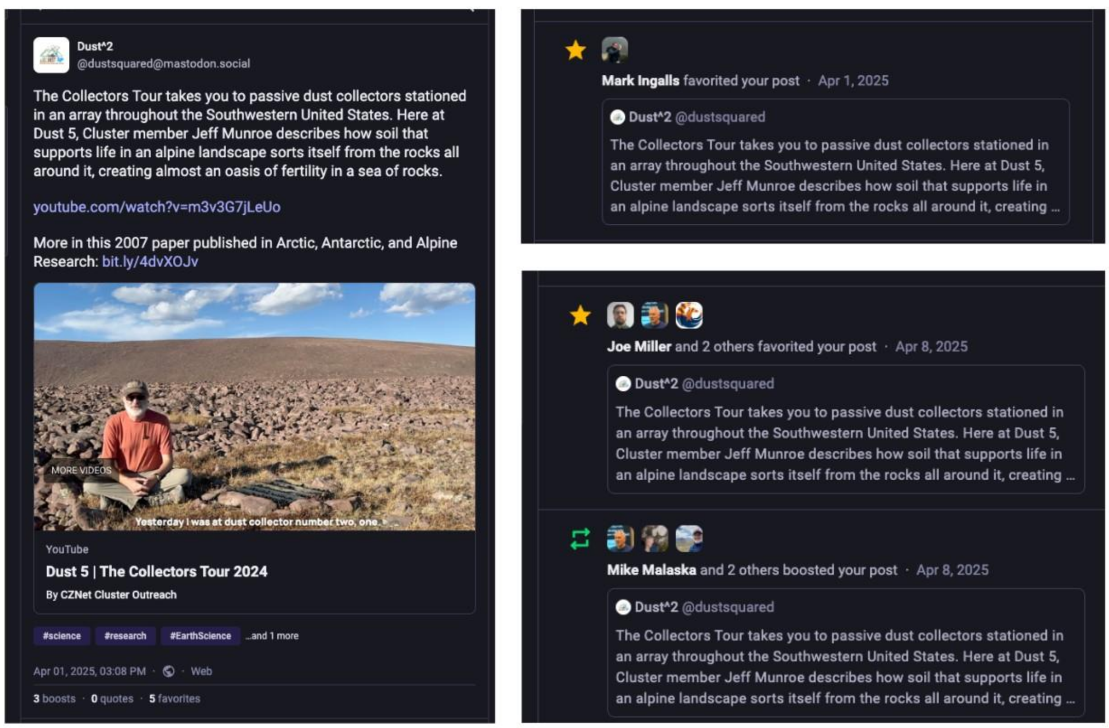

Figure 7. Screenshots from Mastodon in April 2025 showing the original Dust 5 post on April 1 and subsequent engagement with the content (DUST^2, 2025).

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not explain the sudden increase in viewership. What the data clearly do show, however, is that when content was posted, people saw it. That was the goal of the Collectors Tours project. Further qualitative research in future science communication projects may be able to shed light on why some videos go 'viral' with unexpectedly high viewership numbers seemingly disconnected from any sharing strategy.

6 Lessons Learned

Creating the Collectors Tour offered a several valuable lessons, coupled with an array of successes that provide encouragement for attempting something similar again in the future. One of the clearest and most self-evident lessons is that meaningful science communication in the field requires a substantial investment of time beyond the scientific work itself. Filming while underway from one site in the collector to the next added additional tasks to an already demanding field schedule, including launching the drone to follow the narrator on the trail, and capturing multiple video and still image perspectives of the landscape surrounding each collector. Similarly, setting up the tripod to record each monolog, even in just a single take, required time to do carefully, considering lighting, background, and wind conditions. Together, these activities extended the time required for the already significant endeavour of visiting all of the collector sites sequentially. Integrating filming into fieldwork therefore required balancing communication goals with scientific priorities, highlighting that outreach of this type must be recognized as a significant component of the research process rather than an incidental activity.

The physical realities of field-based communication also became apparent through the logistical burden of carrying filming equipment into remote environments (Fig. 8). Cameras, the tripod, microphones, a drone, and spare batteries added weight to a backpack already containing sampling supplies, food, water, and equipment for servicing the dust collector. This constraint reinforced the importance of selecting equipment that balances durability, portability, and video quality, particularly given the difficult off-trail access to most of the collector locations.

The Tour further underscored the importance of spontaneity and extemporaneous communication. Because filming occurred under real field conditions, explanations were delivered without scripts and often in response to immediate observations in the landscape. This unscripted format enhanced authenticity and allowed scientific concepts to emerge organically from place, but it also required comfort with improvisation and the ability to translate complex ideas clearly in real time. Cultivating this skill proved essential for maintaining both scientific accuracy and audience accessibility.

Technical challenges associated with file storage and transfer also emerged as a practical constraint. High-resolution video files quickly outstripped available storage capacity, at the same time that limited connectivity meant that files often could not be easily transferred or backed up immediately. This combination required opportunistic and deliberate workflows for archiving and file transfer once connectivity was restored. Even with the best contingency plans, connectivity issues were an impediment to the goal of rapidly releasing new videos in near real time. These considerations highlight the importance of planning data-management strategies alongside scientific and communication objectives.

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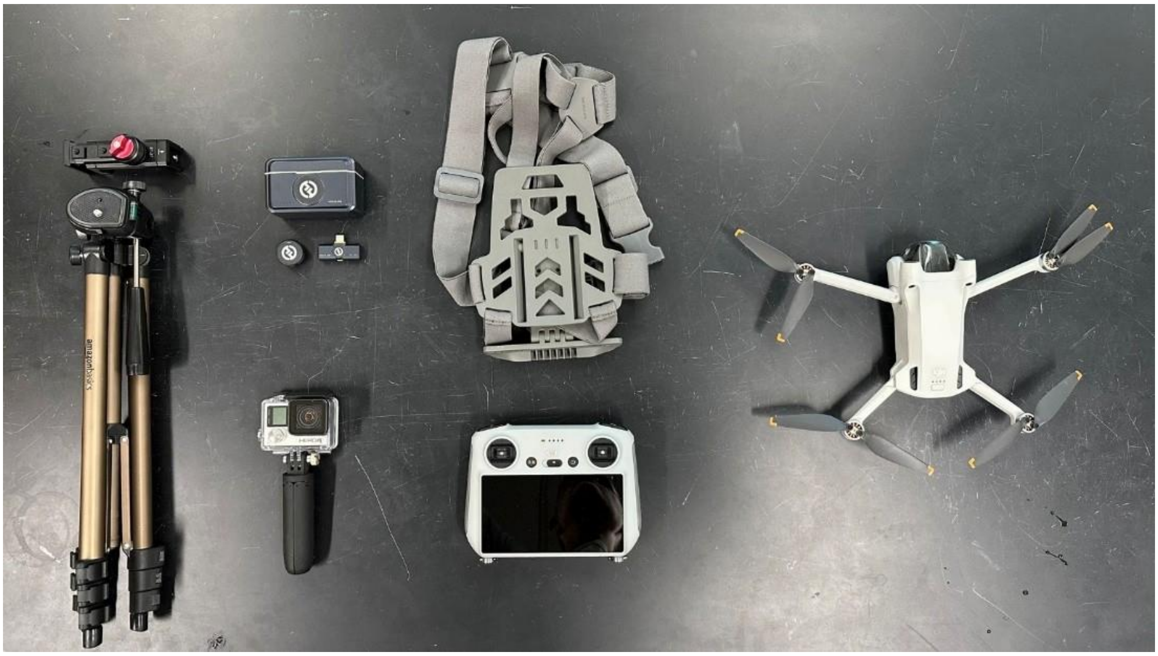

Figure 8. One lesson learned during the Collectors Tour is the reality that filming adds to the load that needs to be carried to each field site. This photo presents an overview of the additional equipment that was carried, including a camera tripod (left) a wireless microphone (upper left), GoPro camera (lower left), a chest harness for the drone controller (centre top), the drone controller (centre bottom), and a DJI Mini 3 Pro drone (right).

Because the videos were filmed in the field, environmental conditions introduced additional unpredictability. Precipitation, wind, cold temperatures, and rapidly changing mountain conditions affected both filming quality and equipment performance. Batteries drained more quickly in cold environments, wind interfered with audio clarity and sometimes precluded drone flights, and storms occasionally constrained filming opportunities. These limitations reinforced the need for flexibility and adaptability, as well as the value of embracing environmental variability as part of the narrative rather than attempting to eliminate it.

Despite these challenges, the Tour demonstrated the powerful engagement potential of field-based science communication. The narrative arc of the journey across states, mountain ranges, and environments created a sense of progression that encouraged sustained attention. Rather than functioning as isolated outreach examples, the videos operated as chapters in an unfolding story, with continuity of format, landscape, and recurring field tasks reinforcing familiarity while introducing new scientific ideas. This structure allowed viewers to build conceptual understanding over time and to develop a sense of participation in the expedition itself.

The real-time cadence of video release further strengthened engagement by aligning communication with the actual pace of the field campaign. Viewers experienced the travel, weather, and logistical constraints alongside the narrator, enhancing authenticity and interest. Importantly, the sustained engagement extended beyond the videos themselves as links to

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publications and references to collaborators created pathways from outreach to the scientific literature, reinforcing credibility and deepening interest.

Collectively, these experiences underscore both the practical demands and the substantial rewards of integrating communication directly into active field research. They demonstrate that episodic, place-based storytelling can transform routine monitoring into a sustained dialogue with broader audiences. For scientists seeking to develop similar efforts, the Collectors Tour suggests that consistency, authenticity, and intentional narrative design are key ingredients for building long-term engagement rather than one-time visibility.

7 Conclusion

The 2024 Collectors Tour demonstrates that field-based science outreach can function simultaneously as structured public engagement when communication is intentionally embedded within the research process. By integrating explanation directly into an active dust-collection campaign, the Tour transformed routine fieldwork into an episodic, place-based narrative that communicated how Critical Zone science is conducted and why it matters. The emphasis of the Tour on authenticity and continuity allowed audiences to observe the incremental, collaborative nature of scientific knowledge production rather than encountering only polished results. Using mineral dust as a unifying theme, the series of videos connected soils, snow, hydrology, climate, ecosystems, and human systems across diverse landscapes, illustrating the lateral connectivity of the Critical Zone. The release of episodes in near real-time fostered sustained engagement, while links to open-access publications reinforced continuity between fieldwork and peer-reviewed scholarship. Although completing the project required additional time, logistical effort, and adaptability in challenging field conditions, these investments were offset by the capacity of authentic field narratives to build curiosity and community. The Collectors Tour offers a replicable model for integrating communication into long-term field research and suggests that scientists can effectively expand dialogue about Earth systems by opening their field practice to broader audiences.

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Data Availability

Videos comprising the Collectors Tour can be accessed using the QR codes in Table 1.

Ethical statement

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This study involved no human subjects, therefore no ethical clearance was required. Collection of YouTube analytical data of access to online media content is always collected anonymously.

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