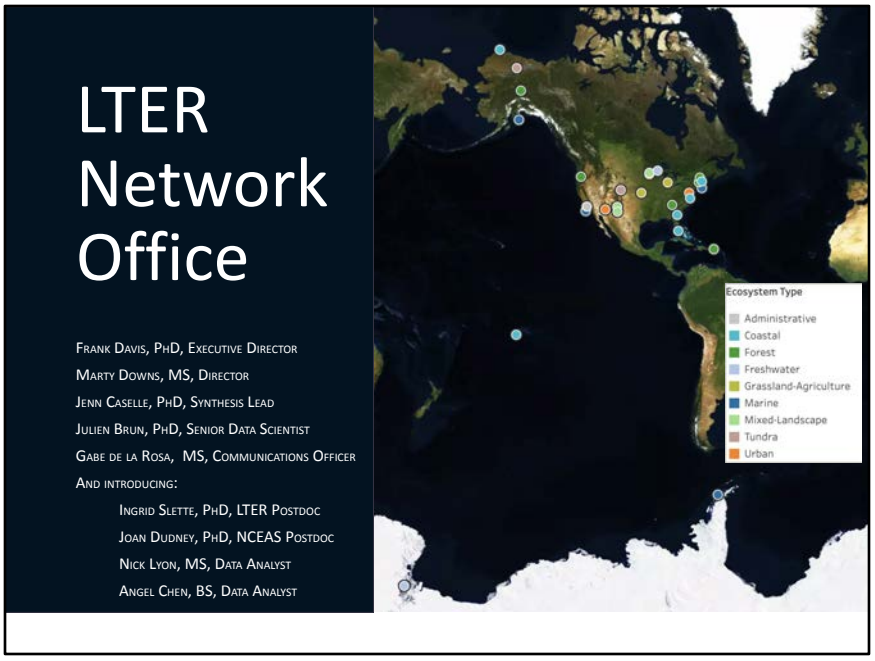
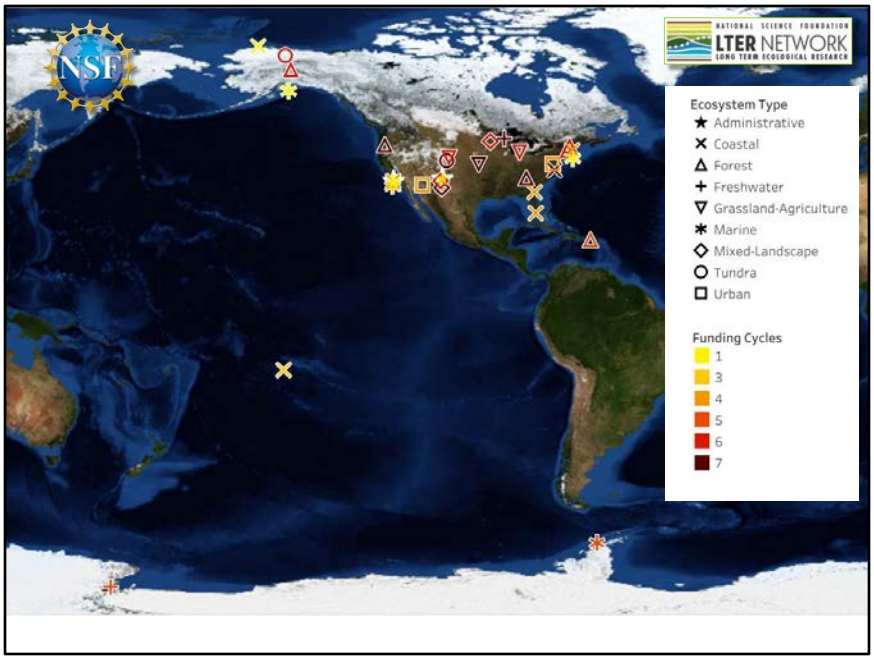


Thanks to the LTER working group and senior NSF managers for this opportunity to fill you in on progress at the LTER Network Office. We appreciate the attention to consistent communication and genuine partnership that has marked the last year.

Agenda			
Time (EST)	**Time (PST)**	**Topic**	**Presenter**
Noon	9:00 a.m.	Welcome and introductions *15 minutes*	Kendra McLauchlan
12:15 p.m.	9:15 a.m.	Overview/vision and general questions *20 min presentation/10 min Q&A*	Frank Davis/ Marty Downs
12:45 p.m.	9:45 a.m.	Synthesis *20 min presentation/10 min Q&A*	Jenn Caselle/ Julien Brun
1:15 p.m.	10:15 a.m.	30-minute break	
1:45 p.m.	10:45 a.m.	Network Coordination and LNO Project Management *15 min presentation / 5 min Q&A*	Marty Downs
2:05 p.m.	11:05 a.m.	Education/Outreach/Engagement *15 min presentation / 5 min Q&A*	Marty Downs/ Gabe de la Rosa
2:25 pm	11:25 a.m.	Conclusion *5 minutes*	Marty Downs
2:30 pm	11:30-Noon	Open Q&A *30 minutes*	

First a quick overview of our agenda for the day.

- Kendra will lead us through a few introductions
- We'll start with a broad overview of key LNO accomplishments
- Followed by a deeper dive into three key areas:
    - Synthesis, Network Coordination, and Education and Engagement
    - At the end of each section is a short period for questions pertaining to that segment.
    - At the end of the morning, we've reserved about 30 minutes for open discussion



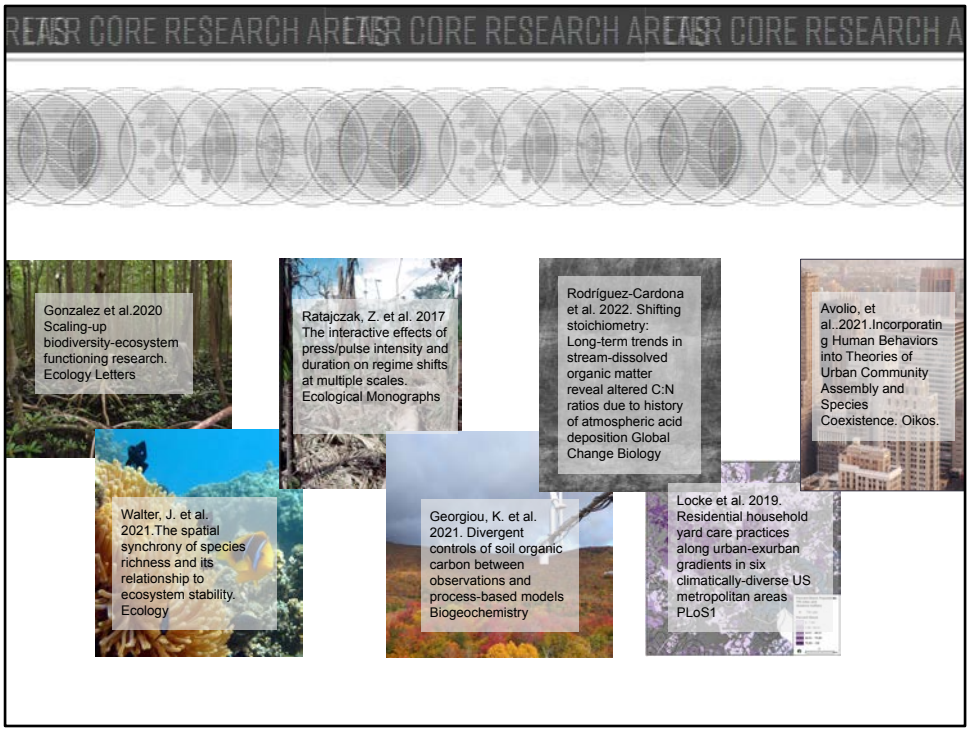
The LTER network is a diverse and dynamic organization, with 28 sites spanning many different types of ecosystems, institutional contexts and experience as an LTER site.

LTER Sites Are….

	Assets	Challenges
Place-based	Deep knowledge of site history, ecological and social context; strong relationships	Questions and methods may not be easily compatible across sites
Hypothesis-driven	Results are often novel and immediately applicable to theory	Cross-site standardization takes a back seat
Inter- and transdisciplinary	Highly networked, convergent research	Shallow bench in some areas; May lack departmental leverage for recruitment and hiring
Collaborative	Multiple perspectives can improve the quality and applicability of research	Building a collaborative team takes time, skill, and commitment
Independently funded and reviewed	Generally results in high-quality research that is responsive to current priorities	Requires careful stewardship to balance novelty and stability
Highly leveraged with non-NSF partners	Research and education dollar go far	Need to accommodate divergent priorities, limiting the ability to brand and standardize

And LTER sites themselves are not quite like other research projects. Like standard research projects, their activities are driven by a set of hypotheses. But unlike 3 or 5 year projects, they need to account for more history, context, and sustained relationships. Their funding is highly leveraged with other partners whose priorities are not always the same as NSF's.

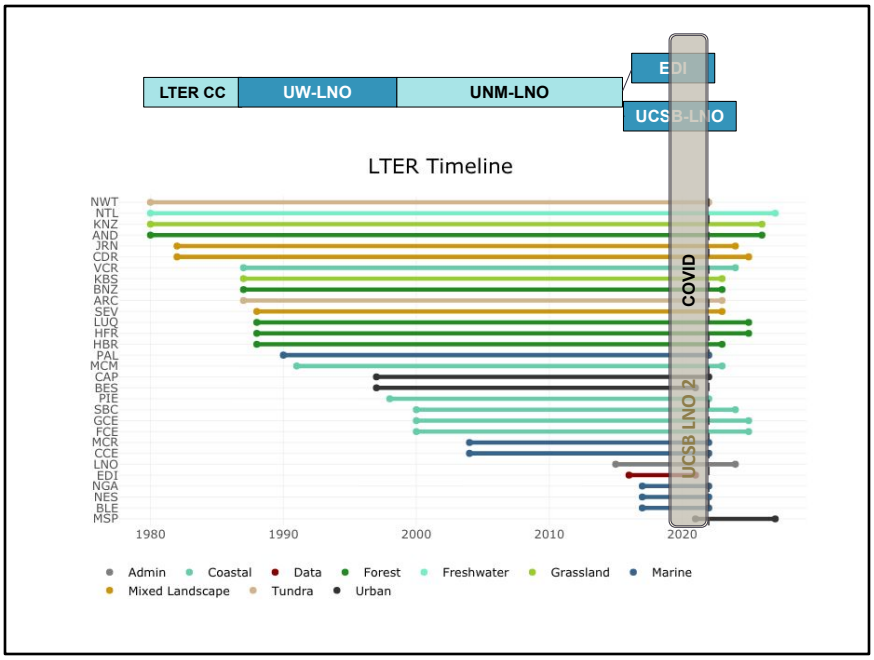
While they see great value in being and acting as a network, most incentives drive them toward acting as individual projects. So the role of the LTER Network Office is to make it as easy as possible for them to act as a network. In short, we reduce friction.



And when they DO act as a network, the results are impressive, as the papers highlighted here demonstrate.

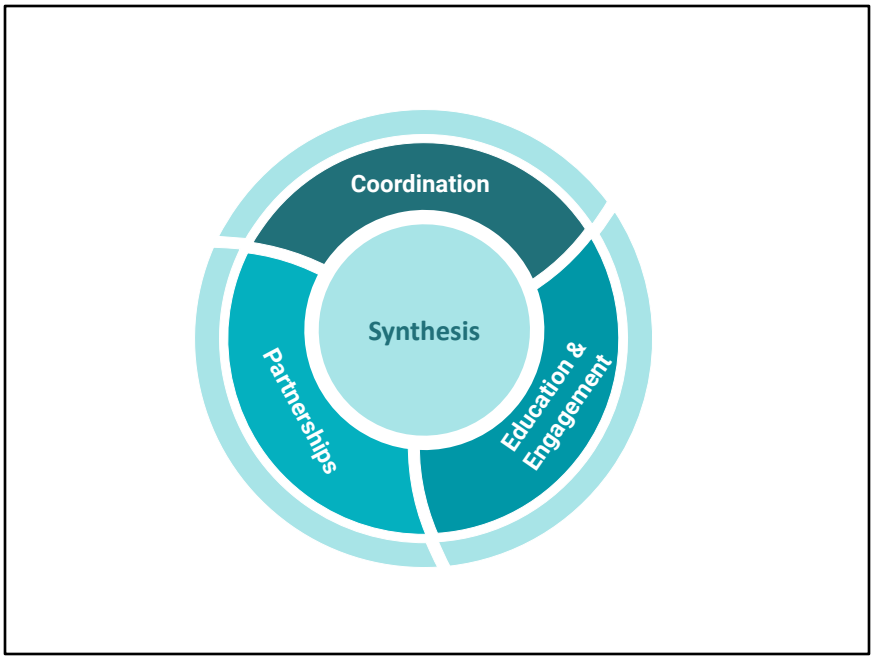
The core research areas, identified in 1980, have provided just enough structure to focus cross-site synthesis, especially when combined with synthesis funding and regular meetings. these synthetic papers produce both new theory and and new applications to resource management and human impacts.
They draw on experiments and observations in core areas, and emerge from formal synthesis groups, informal gatherings, and annual science council meetings.

This is what the Network can do, when it acts like a Network.



At the start of the current LNO award, we felt like we had navigated the transition from New Mexico to Santa Barbara, developed a strong partnership with EDI, launched three new marine LTER sites and were looking forward to a little clear sailing. And then there was COVID and our primary NSF Program Officer fell gravely ill.

In the first 2 and half years of our current cooperative agreement, we've risen to the challenge, re-imagining how we conduct synthesis, strengthening bonds with other networks and societies, and clarifying the role of the LNO in the network. We've also built a robust relationship with a new trio of NSF program officers representing each of the divisions that contributes to the LTER Program.



LTER Network Office activities fall into 4 major categories that all operate in support of synthesis. We'll delve deeper into each of these throughout the day, but I want to take a moment now to highlight progress in each of these areas in the last 2 and a half years.

Synthesis

Approach

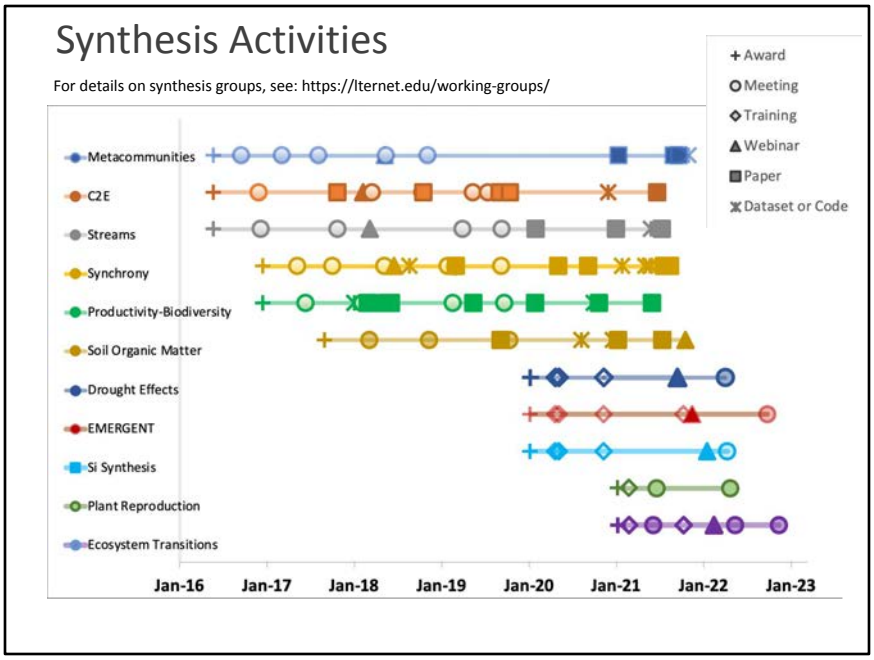
Open calls for synthesis proposals are widely disseminated to encourage participation from inside and outside the Network. During COVID, analytical and facilitation support were increased to improve between-meeting progress and accessibility of synthesis products.

Key Accomplishments

- Completed 2 requests for proposals, yielding 5 strong synthesis groups
- Added whole-team kickoff meetings and trainings in remote facilitation and reproducible research practices
- Anticipating a crunch of synthesis group activity post-COVID, hired LTER Postdoc and 2 analysts to expand concrete support of analysis and curation of derived data

Our primary approach to synthesis is through formal, funded synthesis groups – though we recognize that many other kinds of interaction help generate ideas that turn into synthesis proposals.

- Since the start of the current cooperative agreement, we've completed 2 proposal processes and have 5 active synthesis groups. both launched during COVID.
- We've added new trainings and improved our group launch process to help groups make progress while working remotely.
- We've continued to promote synthesis activities through webinars and assist in improving access to papers, derived data, and relevant code
- Anticipating a crunch of activity as COVID recedes, we've hired 2 analysts to directly support synthesis activities.



Until recently, “funding” a synthesis group meant funding travel for gatherings. With new funding for a postdoc and analysts, we’re excited to change that.

The top 6 groups, funded on our prior National Communications Office grant, have been quite productive (papers are squares), but most also had other funding for postdocs. The groups at the lower right were funded just as COVID came on the scene – and have been unable to travel until this spring.

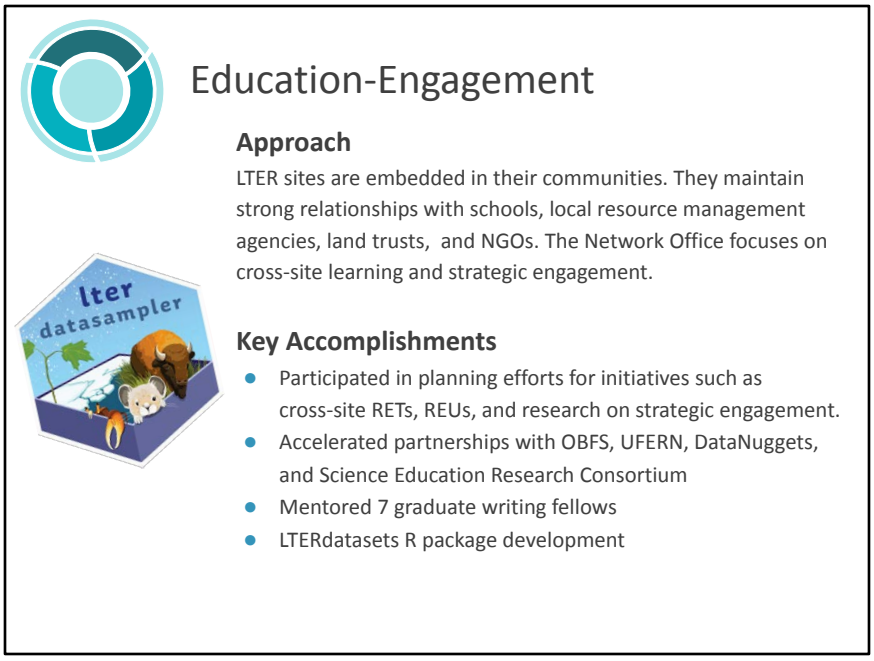
To help maintain cohesion and improve remote interaction, we’ve provided a series of trainings in remote facilitation and remote analysis. Most groups are also meeting online at somewhat regular intervals, but their meetings are shorter and less immersive. They have found it difficult to make the kind of rapid progress that comes from a solid 4-day in-person meeting.

Jenn’s going to come back to this timeline in the upcoming synthesis section.

Network **coordination** aims to engage LTER participants in research and education across the Network. Focusing mainly on committees and meetings helps to support *key* roles such as information managers, PIs and education coordinators – but it tends to leave others behind – such as graduate students and loosely affiliated investigators.

In the last two years, we've made a few changes to address that issue.

- We've added twice-annual online orientations for new students and investigators
- The network has added a bunch of new PIs in the last few years, so we've added quarterly PI Meetings for PIs to share skills and institutional knowledge
- We launched a representative DEI Committee, composed of individuals who hold a mix of roles at their sites - from graduate students to lead PIs
- We've launched the new LTERHub - with a directory that allows searching and connecting by research interest as well as site and committee membership.



There is so much great stuff happening in education and community engagement at LTER sites! Local connections are one of the network's great strengths. So the question becomes – where – and how can the Network Office add value to existing efforts, especially without dedicated education staff?

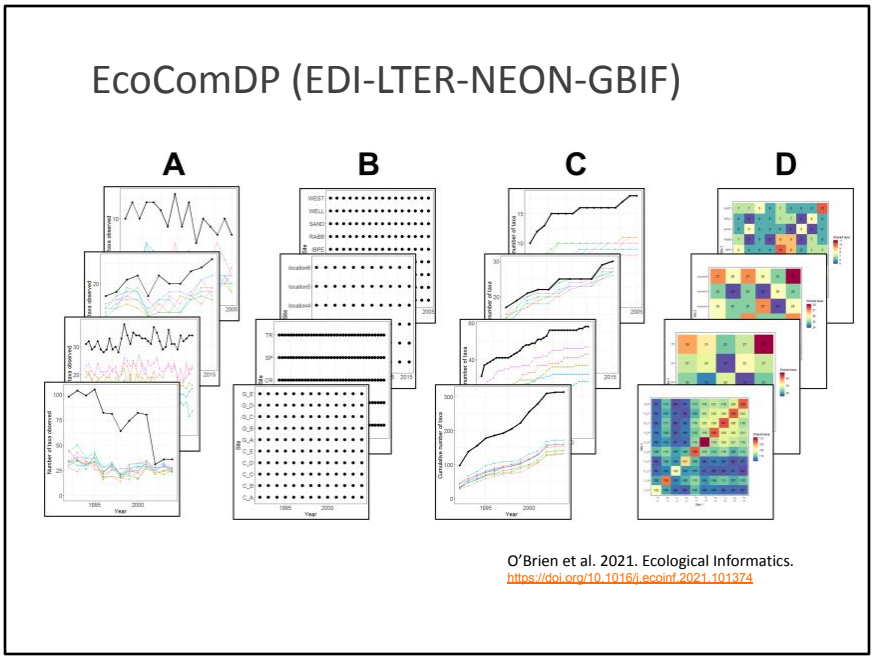
Our answer has been to focus in a few specific areas:

- helping to plan cross-site education initiatives, such as REUs and the recently funded RET program connecting the Arctic LTER, Andrews Forest LTER, and santa Barbara Coastal LTER.
- working on national partnerships – which can offer greater reach for the resources developed at sites.
- Mentoring graduate writing fellows - a win-win. The fellows, mostly PhD students at LTER sites, get exposure to a range of research, improved writing skills, and writing samples. We get great contributions to the newsletter.
- Focus on data science education – such as the lterdatasampler R package that you'll hear more about later.

One very important role for the Network Office is to be a first point of contact for other organizations to enable information-sharing and potential partnerships. This activity runs the gamut from simply posting an occasional newsletter announcement or connecting committee chairs with relevant organizations – to negotiating letters of support and Memoranda of Understanding.

The past few years have seen a lot of activity in this area, with two major solicitations – the Open Environmental Data Synthesis Center and the NEON Operations and Maintenance Agreement – with potential intersections with the LTER Network.

Working with the LTER Executive Board, we provided two letters of support for each competition and also helped connect committees with a variety of relevant organizations.



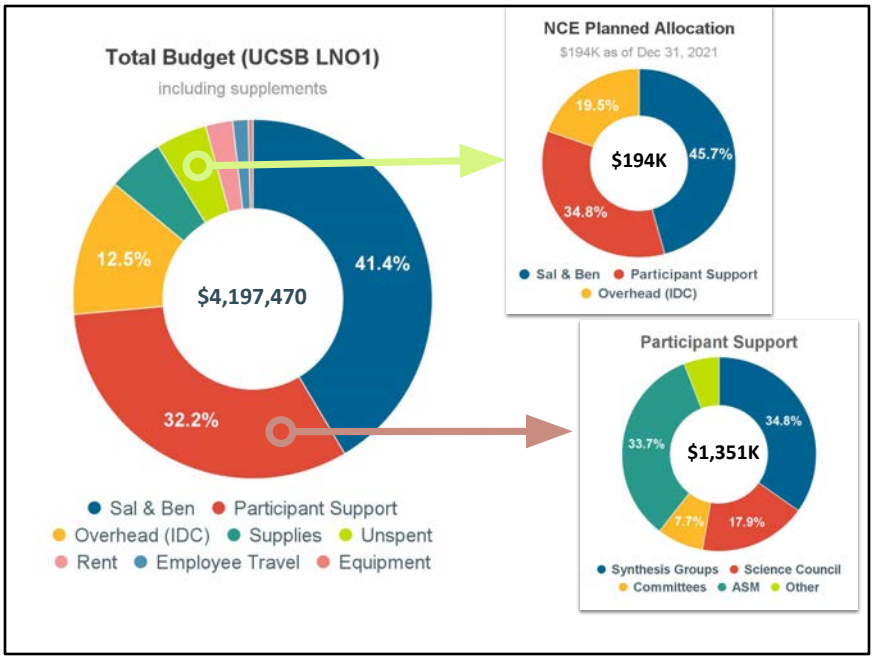
To dig a bit deeper into how those partnerships work, I'll share a couple of examples:

The Ecological Community Data Design Pattern (EcoCommDP) is an intermediate format between idiosyncratic individual investigator data sets and fully harmonized derived datasets. It facilitates harmonization and reuse of datasets originally collected for investigator-specific purposes.
EDI and GBIF did the bulk of the work in developing the data pattern, but LTER synthesis projects identified the need and served as focus groups to workshop and refine the approach. A similar tactic was used for LTER soils data combined by the Soil Organic Matter Synthesis Group and is under consideration for LTER stream data.

Another example is the Demystifying field experiences workshop developed and offered across UFERN, OBFS and LTER.
The field experience is often formative for undergraduates considering further study in ecology – but a first field experience can be a serious obstacle. Conversations among UFERN, OBFS and LTER educators and coordinators led to the development of a workshop on making “site trailer videos” – short accessible introductions to a site and what new students (and their families) might expect as they embark on a first field experience. Ultimately, trailers turned out to be useful even for more senior personnel arriving at a new location.

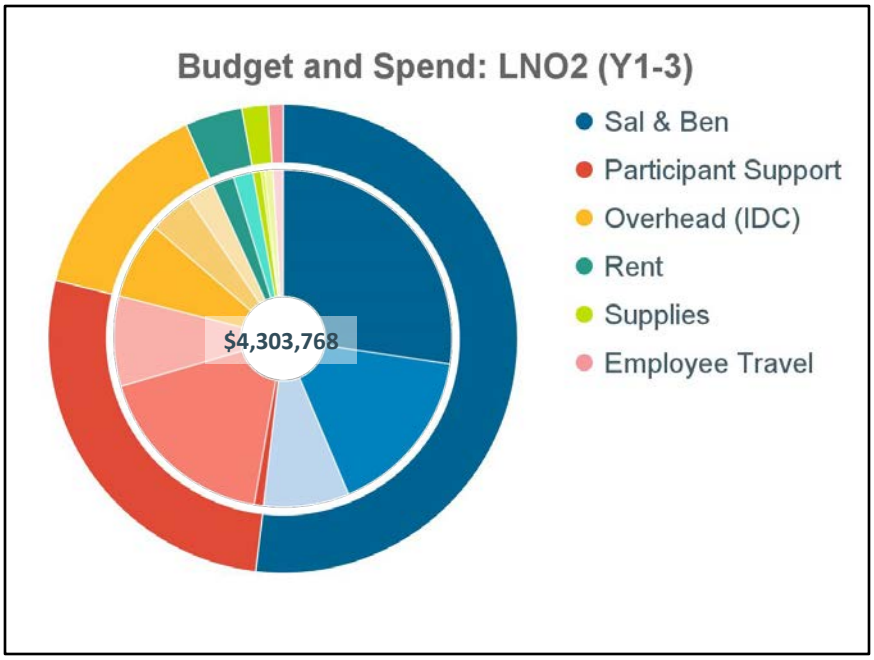
For the LNO, there are several advantages to our location at NCEAS. NCEAS' new location and the launch of UCSB's first-in-the nation Master's in Environmental Data Science Program make NCEAS an even more attractive home for the LNO.

By sharing key personnel with NCEAS,the LNO is able to get highly skilled individuals – in IT, logistics, and data science – for just a portion of an FTE. Co-location with DataONE, the Arctic Data Center and the NCEAS Learning Hub also creates superior access to training opportunities and reproducible research expertise without requiring full-time staffing commitments in these areas.



Turning to the budget, I want to start with the National Communications Office grant, which is still in No-cost extension.
At the end of December 2021, about $194 thousand dollars remained unspent. We expect to finish that out by June, with salary and benefits going to the new analysts and participant support going to the May science council meeting.

The overall breakdown remains consistent with what you've seen in previous years, with salary and benefits accounting for less than half the budget and participant support at about one third.



Moving on to the current budget, The outer wheel represents the planned budget allocation.
In the inner wheel the darkest slice of each color is the amount already spent, the medium tone is allocated and the lightest is unspent and not yet allocated.

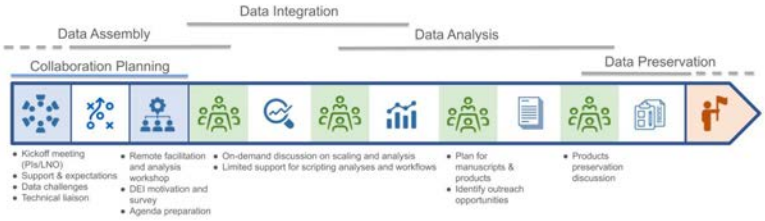
We are a bit over-budgeted in year three for 2 reasons.
COVID, of course, has slowed spending on participant support
But also, we were asked to distribute our budget evenly across the years of the cooperative agreement, even though we know there were substantial funds remaining in the previous grant,


Questions

As we have noted, synthesis is at the core of the LNO and LTER network. LTER is in a very unique situation to have so many long-term datasets and the experience and the mechanisms that the LNO can provide to ensure collaboration can happen.

Synthesis Working Group Process

- Team of experts working together for the first time
  - Transdisciplinary
  - Multi-institutional
- Combining data from various sources
  - Reusing data from others
  - Global and large data sets
- Developing interdisciplinary science



The LTER Network Office funds regular competitions for synthesis working groups. While there are many kinds of synthesis, we fund a particular subset that highlights one of LTER's special strengths -- long term, well-documented data across multiple biomes.

For those unfamiliar with our model: Working groups of 12-18 people. meeting regularly for 2 years, combine existing data from more than one site to develop broad ecological theory about how drivers and mechanisms vary across ecosystems. Research teams incorporate diverse expertise, perspectives, and place-based knowledge to analyze data from multiple ecosystems and we have emphasized the inclusion of both LTER data from multiple sites and non-LTER data.

- LNO funding supports travel and lodging, but no working group salary.
- WGs are funded to approx. 80k - 100k total
- In addition to funding, staff provide logistical and analytical assistance to working groups and you will hear more from Julien on this in a short time.

This graphic shows a general process for how working groups proceed and we are able to help PIs manage this process as they move along with their group- from onboarding and agenda setting, to data assembly and integration through to data

preservation and archiving.

- Working group topics range widely -- from the role of synchrony in stabilizing communities, to how soil organic matter is processed, to scaling the biodiversity-productivity relationship.
- Ideas emerge from many types of gatherings, including triennial All Scientists' Meetings, Science Council, and scientific society meetings.
- The triennial All Scientists' Meetings are particularly fertile ground so timing of RFPs is planned to allow working group development in the year following the ASM.

Selection of groups

RFP	Start Date	No. submitted	No. Funded	%	Panel size
March 2016	Sep-16	23	3	13%	9
Oct 2016	Apr-17	20	3	15%	9
	Sept-17*		1		
Oct 2019	Jan-20	13	3	23%	9
Oct 2020	Jan-21	4	2	50%	6

*reviewed in the Oct 2016 RFP

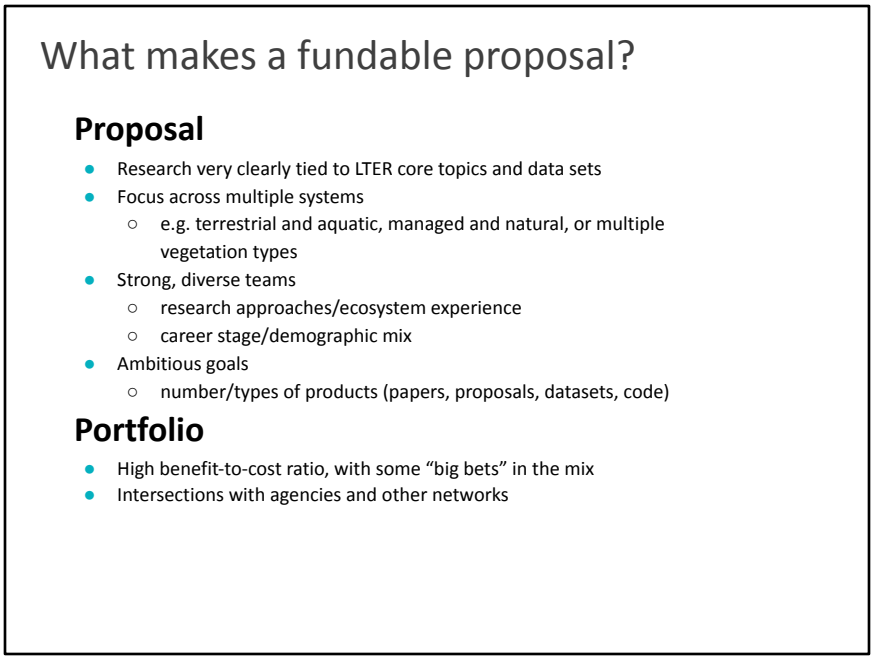
Next RFP released Spring 2022 - Proposals due Fall 2022

So how do we select groups?

We run an open and widely advertised RFP process that allows a good amount of time for proposal development. Reviews are done by a panel made up of 6-9 scientists from both inside the network and outside the network.
Each proposal gets multiple written reviews and we have a Panel meeting to discuss all proposals and make recommendations to the Exec Director of the LNO and the LTER Executive board.

These are the statistics from the four competitions we have had so far. To really jumpstart synthesis, we ran two RFPs in 2016, one in spring and another in late fall. We received very large numbers of proposals. and funded 3 from each rfp.
We were able to fund one more very highly ranked proposal in Fall 2017 that had been part of the Fall 2016 review process
Since then, and during this funding cycle, we ran two more proposal calls and have landed on Fall due dates with early winter start dates.
You can see that proposal submission was very low during Oct 2020 call and due to that and our inability to host groups in person, we held off on a Fall 2021 call as we both transitioned to more virtual training and support and prepared ourselves for the

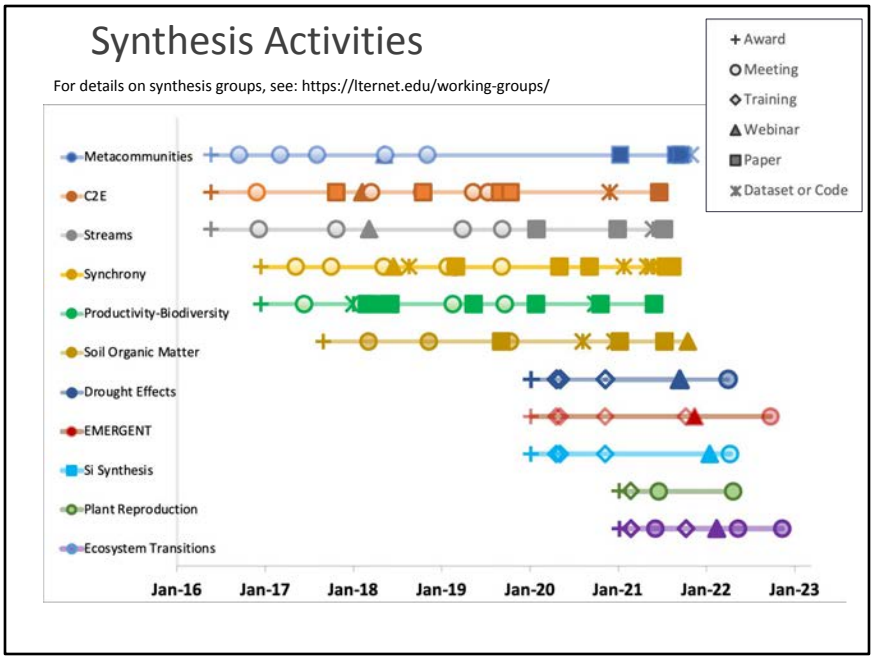
resumption of in person meetings for all five of these groups.
We will be putting out a new call in the spring of this year with a long open call, proposals will be due sometime in the Fall after the ASM



Funded Projects tend to have (beyond well written and clear proposals):

- Research very clearly tied to LTER core topics and data sets
- Focus across multiple systems
    - e.g. terrestrial and aquatic, managed and natural, or multiple vegetation types
- Strong, diverse teams
    - research approaches/ecosystem experience
    - career stage/demographic mix
- Ambitious goals
    - number/types of products (papers, proposals, datasets, code)

also Good attention to previous reviewer comments on resubmissions.
also Products that will likely go further than publications including shared datasets and code, and increased cohesion among synthesis-minded ecological researchers



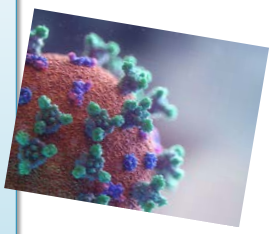
As mentioned earlier, we have a robust set of synthesis activities. You saw this earlier in the presentation but I want to point out a few of the details here.

- Names of the groups don't really matter here - examples
- Meetings (circles) : early on in the pre-covid groups
- Papers (squares) -often about midway through the funded period but note that they continue long past the grant period. We track these products for five years past the initial funding date. (and often continue to support open access charges)
- The latest groups have been doing much more training (diamonds) than previous groups. Having to meet virtually has required trainings to take best advantage of the virtual format. These groups have also been having meetings but often in smaller subsets of the full group. Each of these groups will be coming to NCEAS in the next 4-5 months.
- Webinars (triangles) have been a successful components of the WG experience and we ran a series for the first groups and are in the middle of a series for the current groups.
- We have learned that it is more difficult to track their activity when they are meeting virtually. So there are in fact some meetings in the early months of the 2020 and 2021 groups that we just don't have a record of.

Evolution of synthesis group support

COVID insights

- COVID demanded and facilitated a new approach to synthesis group support
  - support funds were devoted to analysts instead of data interns (which were difficult to hire and onboard)
- Groups launching remotely needed guidance in online collaboration
  - Piloted new trainings (online facilitation and GitHub primer) in Spring of 2020
  - Expanded opportunities in weeklong reproducible research techniques course (1-> 3)
- Increased support from NCEAS scientific programmer, postdoc, and analysts allows coaching and sprints.



We have changed how we have supported groups since COVID, some of these changes were directly COVID related and some were things that we had been wanting to do even pro-COVID

- COVID demanded and facilitated a new approach to synthesis group support
  - support funds were devoted to analysts instead of data interns (which were difficult to hire and onboard)
- Groups launching remotely needed guidance in online collaboration
  - Piloted new trainings (online facilitation and GitHub primer) in Spring of 2020
  - Expanded opportunities in weeklong reproducible research techniques course (1-> 3)
- Increased support from NCEAS Scientific Programmer, postdoc, and analysts allows coaching and sprints.

Postdoctoral Scholars

Ingrid Slette

PhD Colorado State University

- Impacts of compound precipitation extremes belowground

Research interests

- Ecosystem responses to global change
- Using synthesis to advance understanding of fundamental ecological processes

Joan Dudney

PhD UC Berkeley

- Global change impacts in terrestrial plant communities

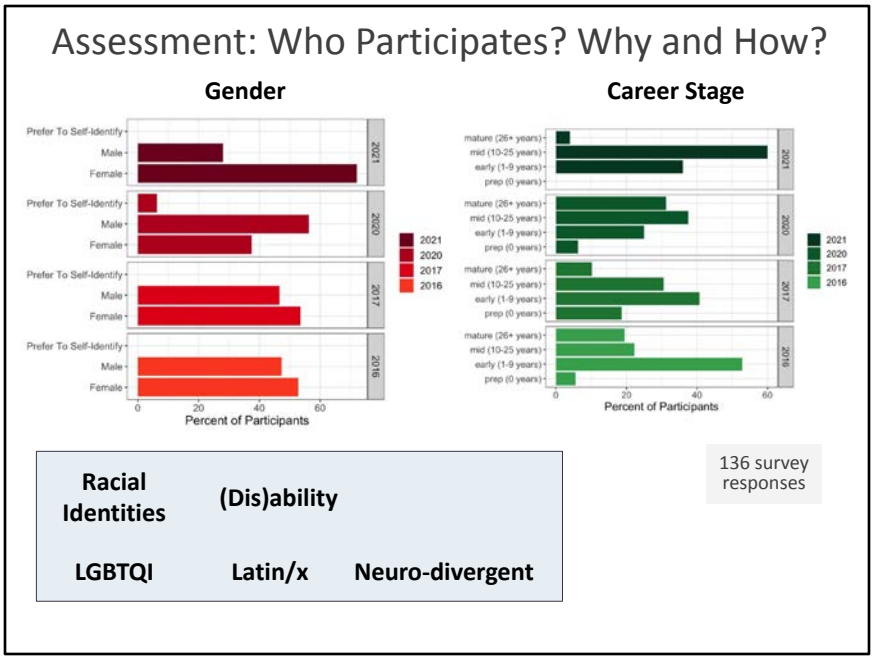
Smith Postdoctoral Fellowship at UC Davis

- Relating plant community changes with global change drivers using novel methodological approaches combined with long-term observational and experimental data

Participant in LTER Synchrony and Transitions working groups

Some working groups have funding from other sources for their own postdocs, some synthesis groups are even proposed **by** postdocs as part of their own work.

- The addition of an LTER postdoc this funding cycle offers added flexibility–allowing them to to join working groups that align with their goals and brings energy, new ideas and advanced analytical skills.
- Ingrid was selected in a competitive process.
- Joan (who couldn't be here today) is an independently funded postdoc based at NCEAS who is has previous experience as a graduate student in the Synchrony group and is already aligned with the Ecosystem Transitions Synthesis group.
- Both work closely with the rest of the LTER team and the data analysts.



As part of our ongoing assessment of synthesis groups, we are interested in understanding who participates in LTER synthesis groups. What obstacles they face and what they get out of the experience.

To understand this, we have implemented a survey that the working groups complete at the beginning, middle and end of the projects.

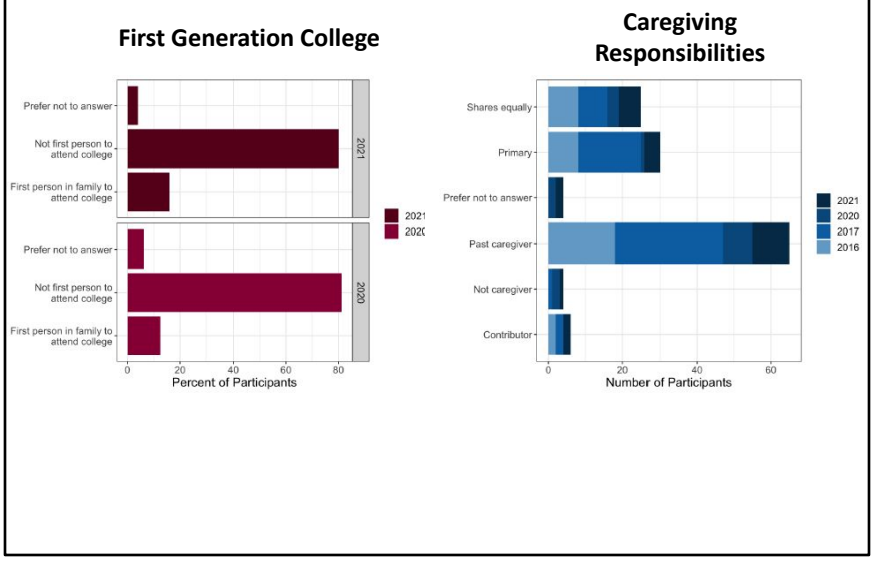
In addition to survey data, we also conduct informal exit interviews with synthesis group PIs - which has resulted in many improvements to the process and is also a way in which we create PI to PI learning. These exit interviews have also improved our WG onboarding greatly. We've added agenda setting, authorship, and collaboration resources, instituting a full team meeting with all of us at the LNO and setting up the analytical structures that are necessary for data integration.

We don't have a lot of time today to delve into the nuances of the survey response data, but I want to give you a flavor of what we collect.

In terms of Who participates, you can see the gender mix on the left panel and the

Career stage mix on the right. These are really just examples of the kind of results we can provide and these are some of the other types of demographic information here on the bottom.

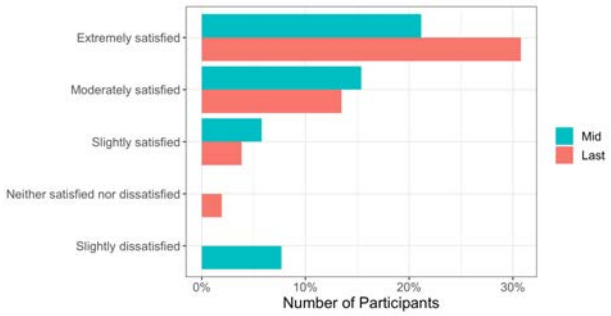
What obstacles do they face?



We also are interested in obstacles that participants might have faced - either early in their careers (such as whether they are first gen colleges students) and ongoing, such as past, recent or current caregiving responsibilities.

Not shown here but we ask about what benefits they expect to receive (and whether they are ultimately realized), as well as how they approach problem solving and conflict.

Satisfaction and rewards?

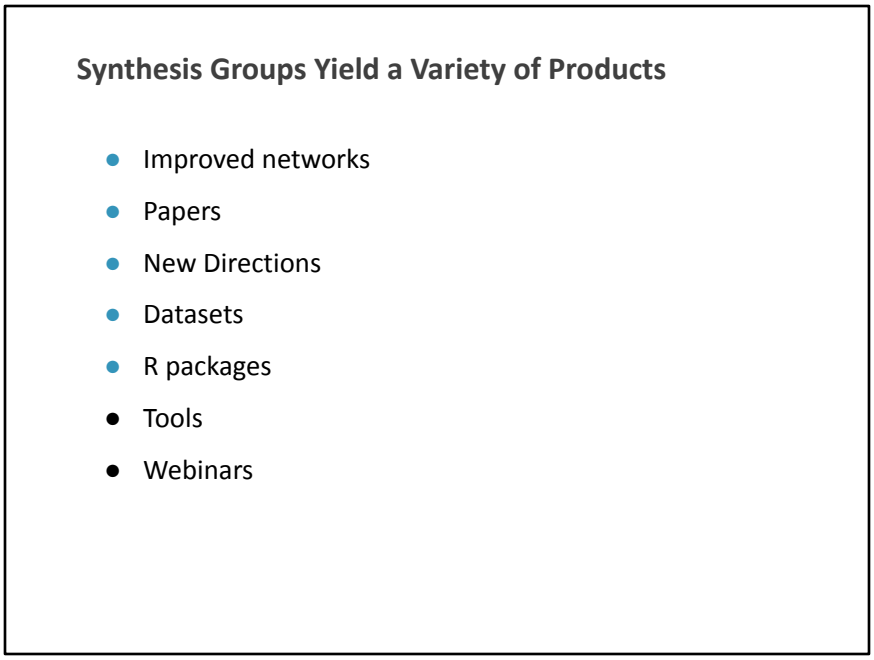


"[the working group] lead to a spinoff working group on more theoretical dimensions of the problem. These were funded by other synthesis and research centres in Canada and France."

"The LTER NCO encouraged us to give a webinar, to make a video summarizing our activities, and to offer a workshop at the LTER ASM. All these activities helped our working group connect with others in the LTER network and beyond in very useful ways."

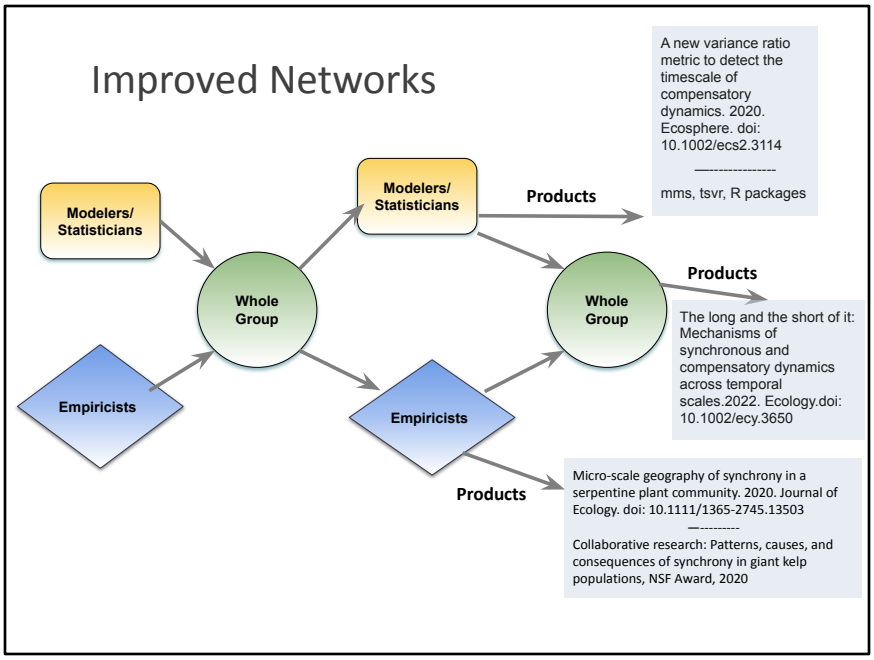
These results are from the completed Working groups, where we have the beginning, middle and end surveys.
Overall, synthesis group participants are extremely satisfied with the process – more so as they approach the "end" of the working group. Some of the most cited benefits of working group participation are networking, group problem solving and the chance to enhance their own thinking by encountering diverse perspectives.

This combination of early-career networking and skill building really highlights the value of synthesis groups for capacity building as well as scientific discovery.



In addition to concrete products, synthesis groups often reuse and expand data products from prior synthesis groups and are among the first investigators to attempt comparisons across the marine and terrestrial realms. They also provide feedback to information managers and other data synthesizers on what formats for data harmonization might be effective.

- WEBINARS



- The Synchrony team set an ambitious goal of applying wavelet analyses to understand the dynamics of community synchrony in terrestrial and aquatic ecosystems.
- Assembled a team of statisticians, modelers, aquatic and terrestrial empirical ecologists, which included a few individuals with a foot in both worlds
- They also found that it was occasionally helpful to break into their separate specialties.
- Ultimately, modelers and the empiricists produced papers and packages relevant to their own communities **and t**he team as a whole developed several papers, one of which is highlights here.
- WG has expanded the community of this group in ways that they might not have done without the WG

Some groups – especially those that align with the work of a funded postdoctoral scholar – are exceptionally productive in terms of papers. The Biodiversity/Productivity group was one such group. It also followed on an earlier synthesis group funded by the New Mexico Network Office.

In spite of major career transitions among the groups most committed members, it yielded 10 papers addressing new theory, practical applications and pointing the way to the next set of exciting questions.

New Directions

- Biodiversity/Productivity
  - **NSF-funded proposal**
- EMERGENT
  - **DOE-funded analytical award**
- Soil Organic Matter
  - **Complementary Powell Center synthesis with isotope focus**
- C2E
  - **SDiv funding**
- Synchrony
  - **SDiv funding and NSF funding**

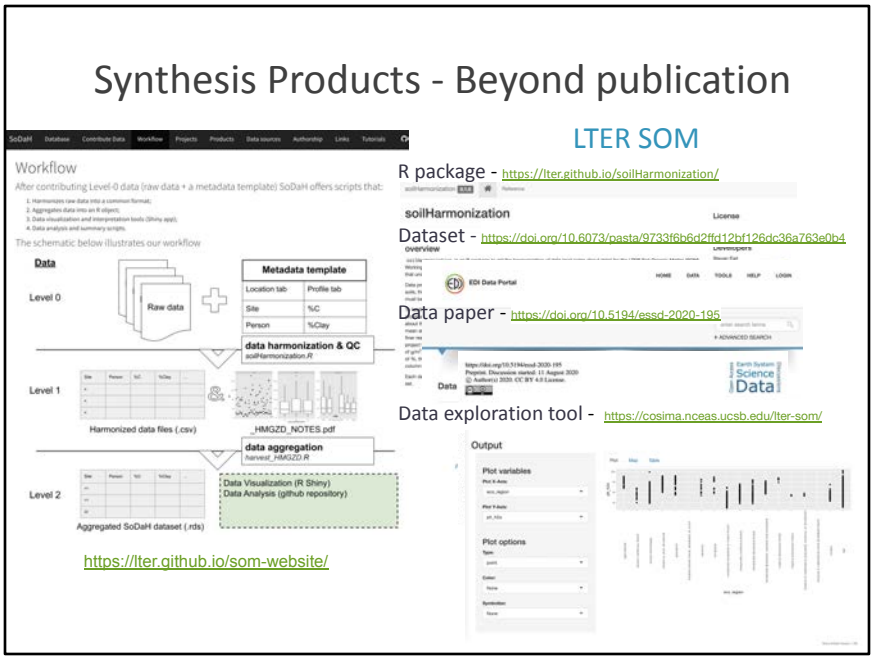
The work of C2E and Metacommunities synthesis groups were also grounded in the CoRRE database, built with LTER Network Office funding to Meghan Avolio and Kim Komatsu starting in 2012.

Several synthesis groups have sparked new ideas that resulted in proposals for further work (both with agencies and with synthesis centers).

In addition, the datasets developed for one LTER synthesis activity often lay the foundation for additional analyses. These include - **READ SLIDE**

The CoRRE database gathered data on the outcomes of LTER experiments that manipulate global change drivers. One idea for increased LNO support of synthesis is for the LNO to develop and maintain an LTER-wide experiment database.

(**Co**mmunity **r**esponses to **r**esource **e**xperiments)



Julien:

Synthesis products generated by our LNO working groups go beyond the traditional research publication workflow. As an example, the LTER Soil Organic Matter team with our help developed:

- A website to explain their project (here on the left a description of their data processing workflow) and centralize all the information and products they have been producing so far. They use this website as an outreach tool for future collaborations

–Click –

- An R package with a series of tools to process soil data into a standardized format

–Click –

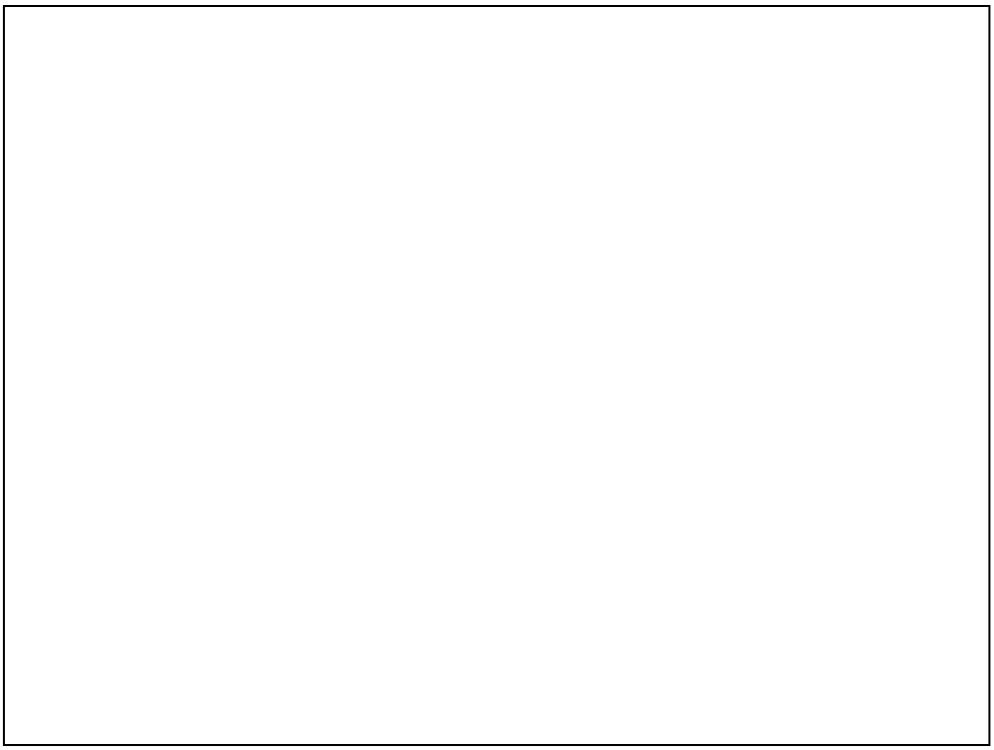
- They used that tool to create a new database for soil organic matter and soil characteristics integrating data from several networks such as LTER, NEON, CZO, NutNet and other international data sets. This database has been archived on EDI.

–Click –

- As a companion to this database, they also published a data paper to explain this new tool in greater details

–Click –

- Our support team also helped them to develop an interactive data exploration tool to let users subset and visualize this new soil database according to their own interest. This web application is currently hosted on NCEAS server.



Julien:

Our goal at the LNO is to enable working group participants to do synthesis science differently in a more collaborative and reproducible manner.

This is motivated by the fact that Synthesis science has many specific characteristics: 1. in terms of team science: It is highly collaborative involving participants from various institutions who often have not previously worked together - 2. it is also highly interdisciplinary by nature involving people with various backgrounds and thus using various tools and analytical techniques. On the data science side it also requires to re-use data from others, which also comes with specific challenges such as semantic interpretation of metadata or experimental design interpretation.

We keeping improving on how we support these teams by providing a suite of services to help participants to produce a more open and reproducible science during their project and hopefully beyond it.

–Click –

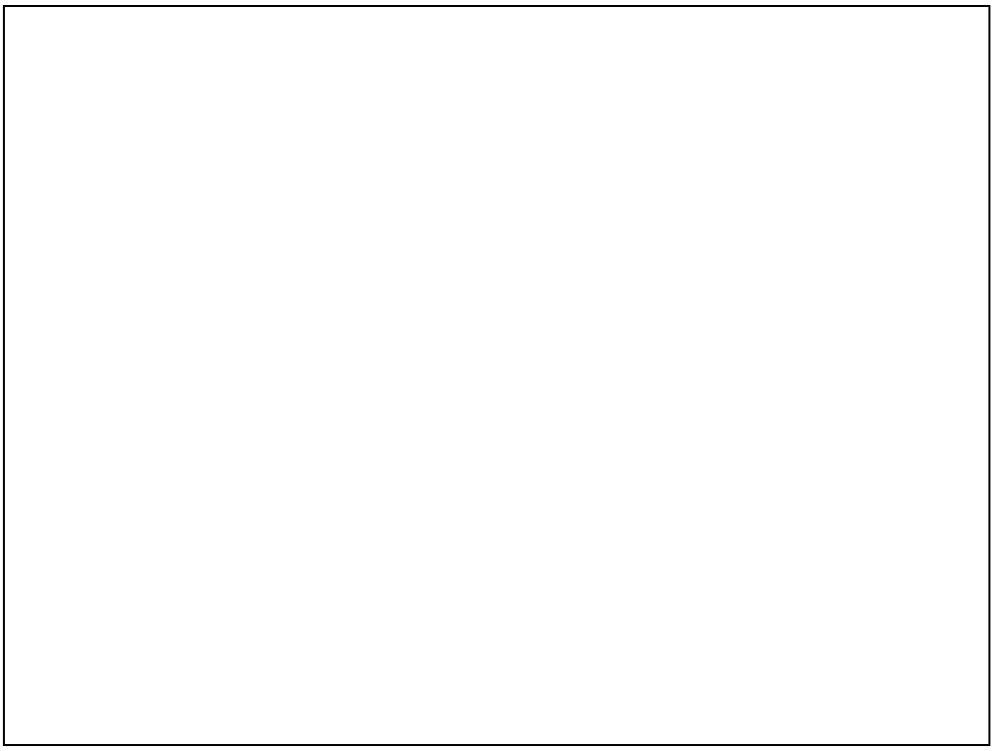
We have always relied on NCEAS staff and facilities to organize and provide space for those groups to meet and foster novel ideas

More recently we started to leverage NCEAS learning Hub to provide training in collaborative and reproducible data science.

The LNO Data Analysts can follow up on this training with ad hoc workshops in small groups and 1:1 coaching to help working group members to combine the various sources of data they are using in their research and develop reproducible analytical workflows. We look forward to our newly increased capacity in that regards that will help us to accelerate those groups even more.

With the addition of LNO postdoctoral fellows, we are now going to be able to also foster and support novel research questions for and also among groups, as well as enable better collaboration between the network science and the synthesis working groups.

The LNO communication team is also here to help and support the working groups to communicate their science findings in an efficient way



Julien:

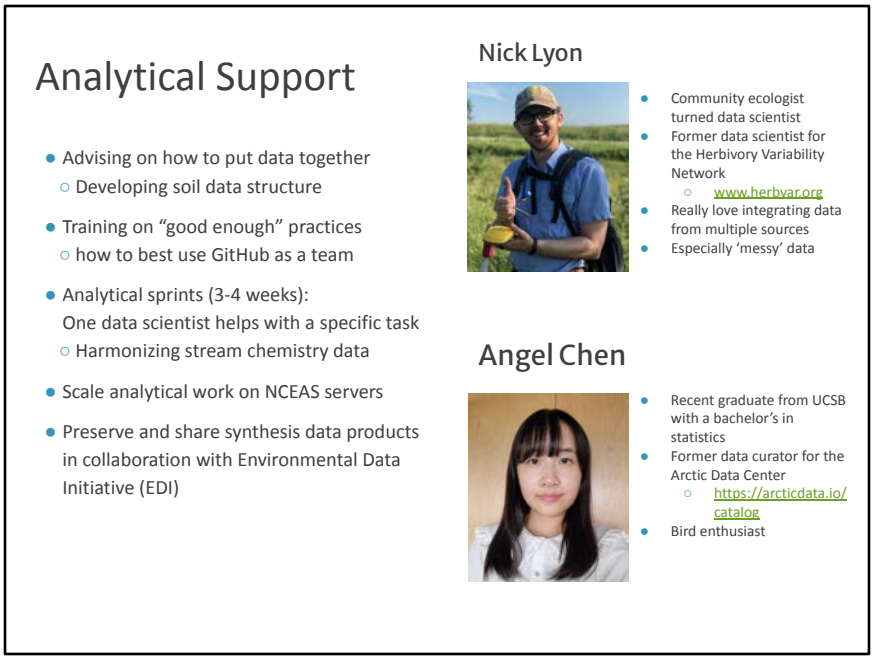
Elaborating a little bit more on the data science support we provide, we really see it at the Intersection of Collaboration, Analysis and Computing, as coding as a team of several analysts is actually quite different from doing so on your own.

– Click –

Our goal is to develop reproducible analytical workflows to accelerate those teams by enabling them to iterate quickly. We encourage them to use scripting language for the various analytical parts of their project as it is rare that they find all the data they need from the beginning of the project. As they discover new datasets, this scripted approach will empower them to integrate this new information more rapidly.

– Click –

It is first for themselves, their collaborators, but also for their future selves



Julien:

We are very excited to have Angel and Nick joining our team to help support the synthesis working groups.

Nick is a community ecologist who became a data scientist over the years. He was previously a data scientist for the Herbivory Variability Network where he further developed is interest in integrating messy data.

Angel recently graduated from UC Santa Barbara with a bachelor in statistics and until recently was a data curator for the Arctic Data Center helping scientists to preserve their data.

Our team aims at helping LNO synthesis working group participants to solve data and analytical challenges. As part of our support portfolio we offer different services:

- Advising them on best approached to combine the various sources of data necessary to answer their scientific questions
  For example, We help design the workflow to harmonize solid data for the soil

- organic working group

- Provide 1:1 and small group coaching sessions on “good enough” practices to code together
  We provided several short training to get started on collaborating with GitHub and for example this helped a lab PI to share their code online with the synchrony working group members

- Have one of the LNO analysts to work full time with a group for a period of 3-4 weeks to tackle an data or analytical challenge that the working group is struggling with (either due to skills or humanpower)
  For example. we developed a reproducible workflow to harmonize stream chemistry data across several networks. This collaboration inspired Adam Wymore to come to NCEAS for a 6-month residency under a EPSCoR Research Fellowship

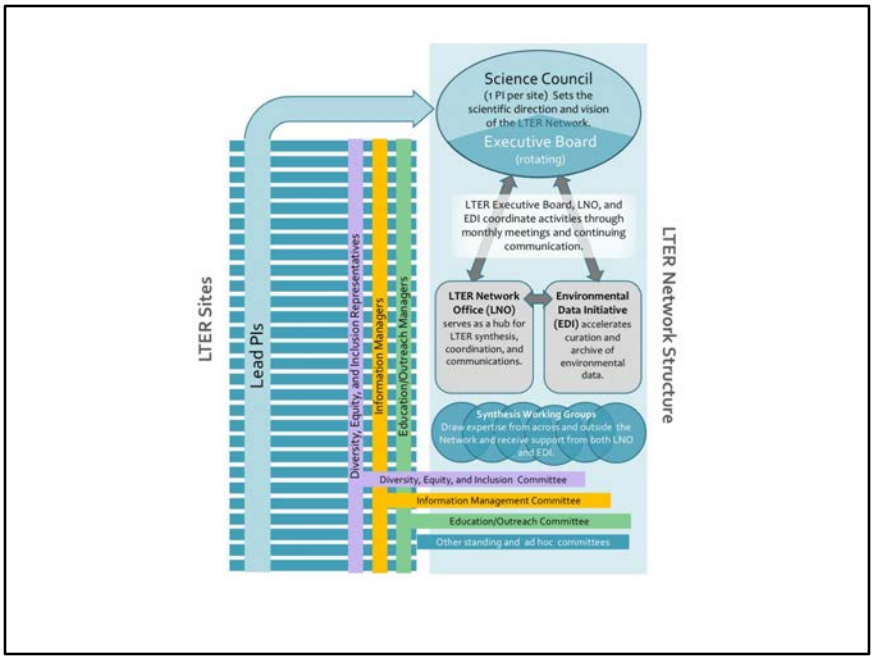
- Advise on how to best scale their analyses on NCEAS analytical servers so they can go beyond what a personal computer can do. This helped the productivity - biodiversity working group to run their models and test parameters in a more efficient way

- Work with EDI to preserve and share their synthesis data products as well when possible to archive the raw data used in their project.

Julien:

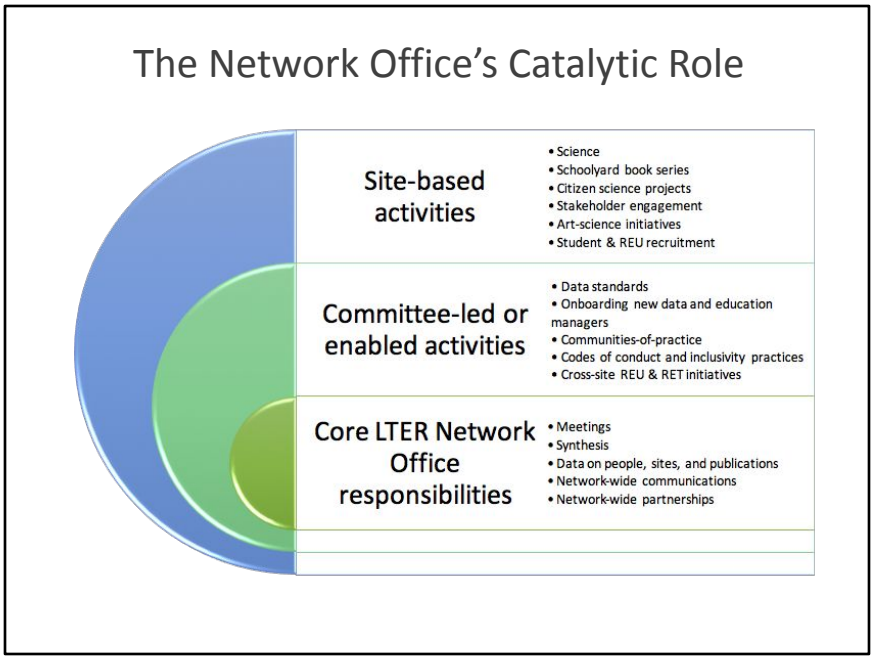
We hope this overview of the LNO synthesis activities has sparked your interest and we look forward to answer any questions you might have at this point


Coordination



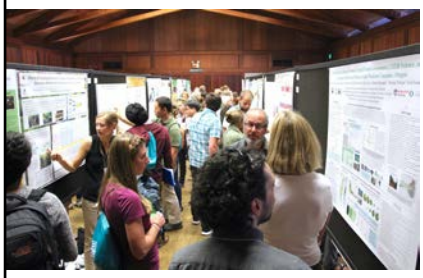
To set things up, let's do a quick review of LTER's organizational structure.

- The **Science Council** -- composed of the lead PI from each site -- sets the scientific direction for the Network, via a rotating Executive Board and annual science council meetings.
- The LNO works closely with the Executive Board, the Environmental Data Initiative, and the LTER committees to maintain an inclusive, collaborative, and engaged community – focused on long term ecological research, synthesis, education, and training.
- Synthesis groups compete for funding through the LNO but receive data and analytical support from both the LNO and EDI.
- Currently, the Network has 4 representative committees, with members from each site (Information Management, Education and Outreach, and Diversity Equity and Inclusion, and Graduate Students) plus a handful of smaller ad hoc committees.



The ambitions -- and the potential -- of the LTER Network far outstrip the resources of the Network Office for direct support.

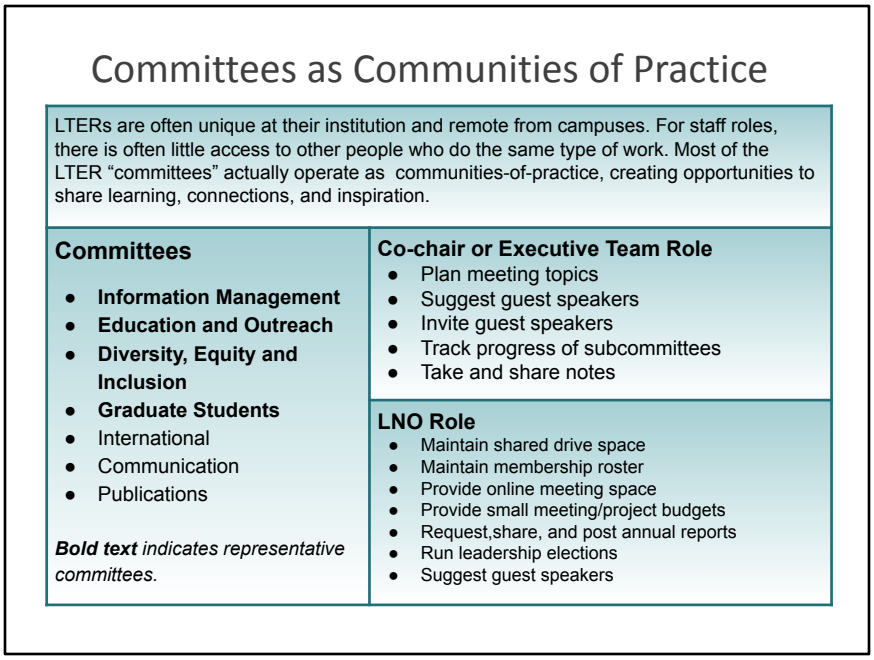
- We see our role as catalytic -- focusing our resources first on the activities that require long-term record keeping and direct financial and logistical support - the inner green circle.
- In the outer green circle is a second tier of activities -- primarily committee-driven, that requires communications and logistical support, but not direct financial assistance
- The third tier could probably happen without any intervention from the Network Office, but is improved and expanded when the network office is able to coordinate, contribute, and amplify site efforts.



- LTER All Scientists' Meeting (September 19-22, 2022)
- Science Council Annual Meeting (May '22)
- Lead Principal Investigators Quarterly Meetings (virtual)
- Monthly Executive Board Meeting (virtual)
- Monthly Committee Meetings (virtual)
- Synthesis Working Groups (mixed)

Regular in-person and online meetings are critical to the network culture. They maintain camaraderie, help seed and fertilize new ideas, and develop a shared sense of purpose.

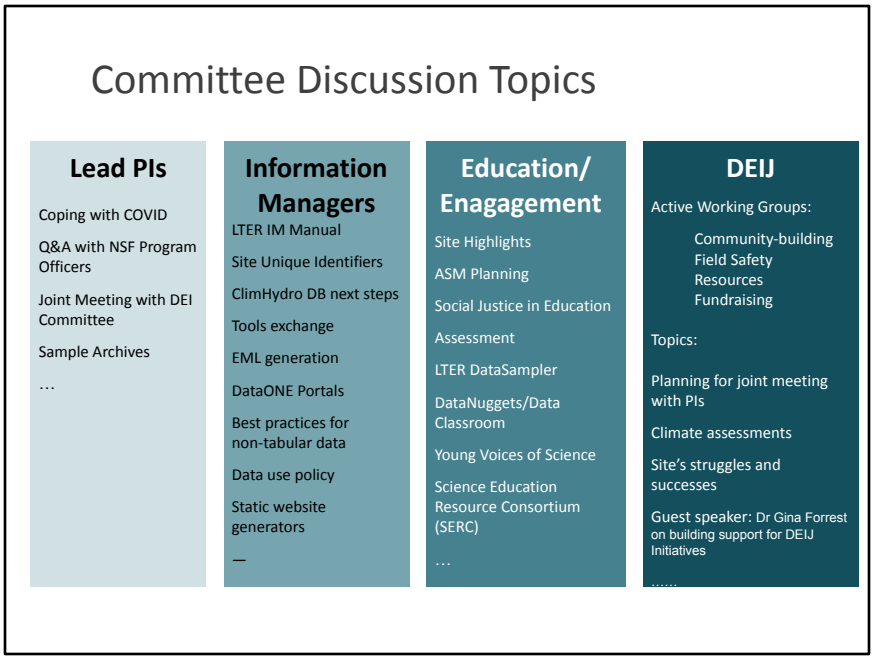
- All Scientists' Meeting happens every 3 years and is scheduled for September 19-23, 2022
- The LTER Science Council Meets Annually
    - Since the start of COVID, LTER PIs have been meeting quarterly
- Executive Board meets every month and is staffed by the LNO
- Representative Committees meet monthly, online



Committee Meetings mainly serve as communities of practice, where key roles such as IM, education coordinators, and diversity leads learn from one another's experience and LNO gives and receives regular feedback about needs and plans.

Committee chairs or an executive team generally keep the ball rolling meeting-to-meeting, but the LNO ensures that there ARE chairs, that members have access to a shared drive and rosters, know when meeting are scheduled and have links.

Even when they are not carrying out major projects, the committees serve an important role in onboarding new staff members and maintaining a shared culture across the network.



Committees are also one of the major avenues for peer-to-peer learning and information-sharing. Here are some of the topics that committee meetings have focused on over the past 2 years. Suggestions for topics most often come from the committee membership. Then committee chairs or the LNO identify speakers and arrange schedules and programs.

Decadal Review Activities

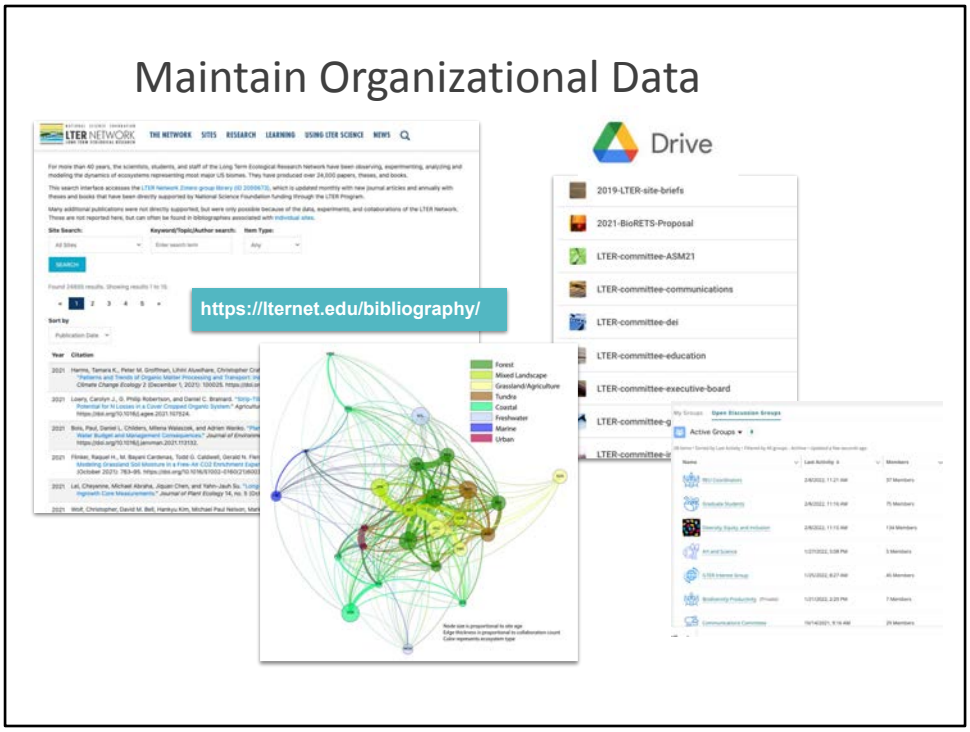
- 2019 Science Council Meeting - focused on self-assessment
- Data gathering, cleaning and analysis for review
- Site brief development and design
- Committee updates and follow-up questions

Anticipating:

- Coordination of Network response to review report

Over the past few years, the decadal review has also formed a portion of the coordination activities. The 2019 Science Council meeting focused entirely on the self assessment. Data cleaning and analysis and development and design of site briefs took us into the fall of 2019. While follow up questions continued to flow through the fall of 2021.

At this point, we are truly looking forward to seeing the committee's recommendations and beginning to put them into action.



Collating organizational data for the decadal review inspired some major updates to data processes. Tracking and making available basic organizational data isn't sexy, but it is a necessary to allow network participants to find one another - and for committees to preserve continuity.

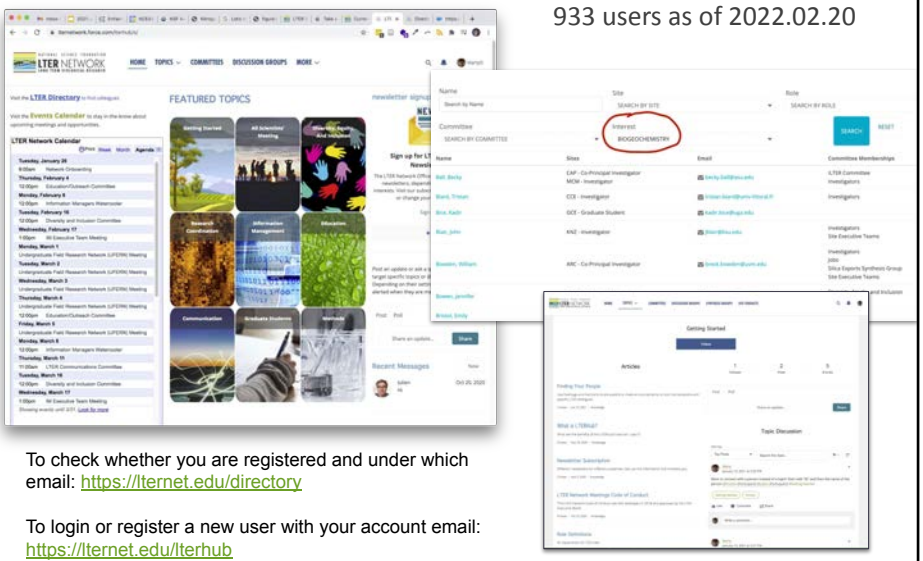
We track scholarly products to maintain an continuously-updated network bibliography, which serves as a source of story ideas for the network newsletter and a way to find colleagues with specific interests, as well raw material for analyses such as the 2019 BioScience paper on network collaboration.

Personnel updates have been a particular challenge. Sites report current personnel to NSF, but don't often keep track of participants as they move on. We would love to be to access program "alumni" to both better understand their experience and outcomes. We have also drawn on their connections with agencies, NGO's, and industry for career webinars and other presentations. It's also common for individuals to move among sites -- doing an REU at one site, a graduate degree at another and a postdoc at a third. We'd love to better understand how that process affects career trajectories and outcomes.

The new LTERHub and the directory that draw on it are a step in the right direction, but are still not as easy-to-use and robust as we had envisioned..

LTERHub: Find and connect with people, discussions, events

933 users as of 2022.02.20



To check whether you are registered and under which email: https://lternet.edu/directory

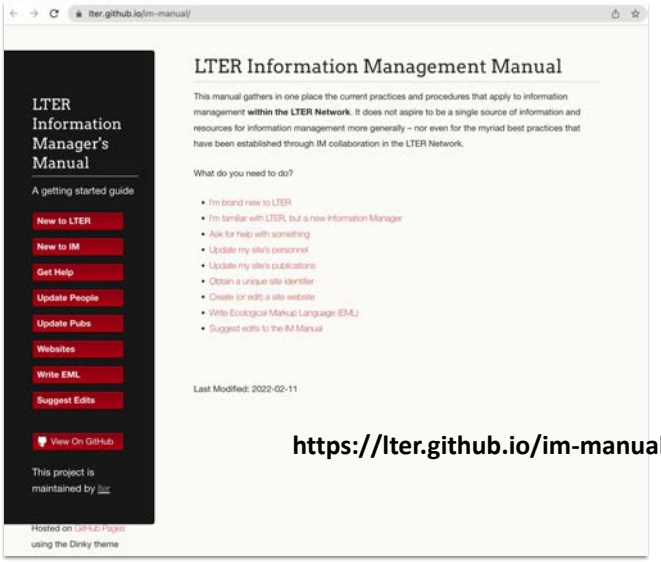
To login or register a new user with your account email: https://lternet.edu/lterhub

The vision for LTERHub was that participants would be motivated to login (and update their data) because the platform would provide a pathway to connect with others in the Network – a peer-to-peer source of information, job leads, collaborators, methods, etc.

The directory has moved to the LTERHub this year and is now searchable by research interest as well as site and committee membership.

The technology behind the Hub (SalesForce) has been more challenging to manage on a part-time basis than I anticipated, leaving little capacity for the active community management that would be required to realize this vision.

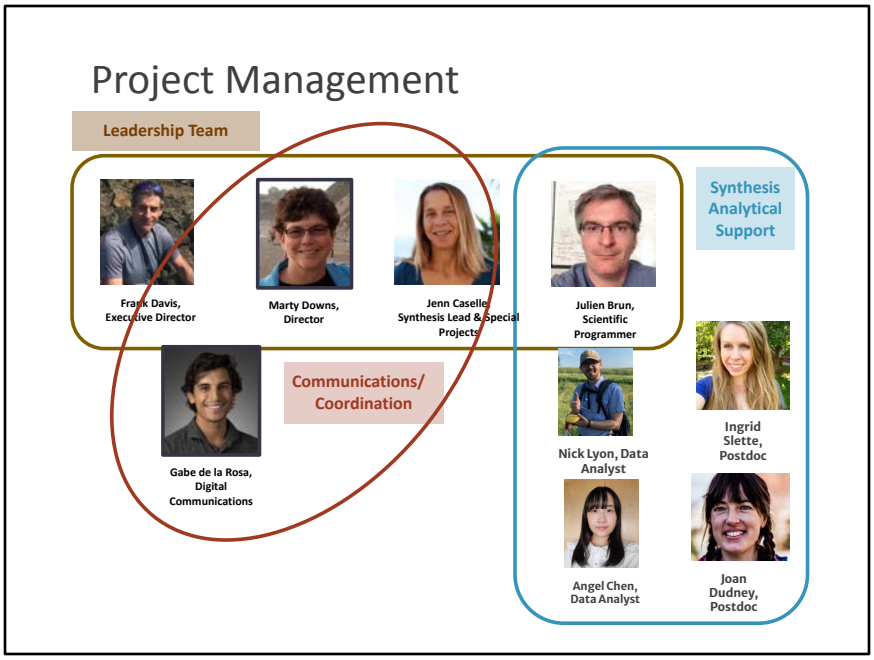
The Hub is,however, beginning to yield valid demographic data and a small additional investment in upgraded memberships will allow site PIs and DEI Committee reps to access summary data by site.



Changes in procedures for updating personnel and publications – prompted by the decadal review and the LTERHub – have frustrated information managers over the past few years. In addition – new sites – and the retirement of several long-serving information managers – have created an influx of new, or new-to-LTER information managers.

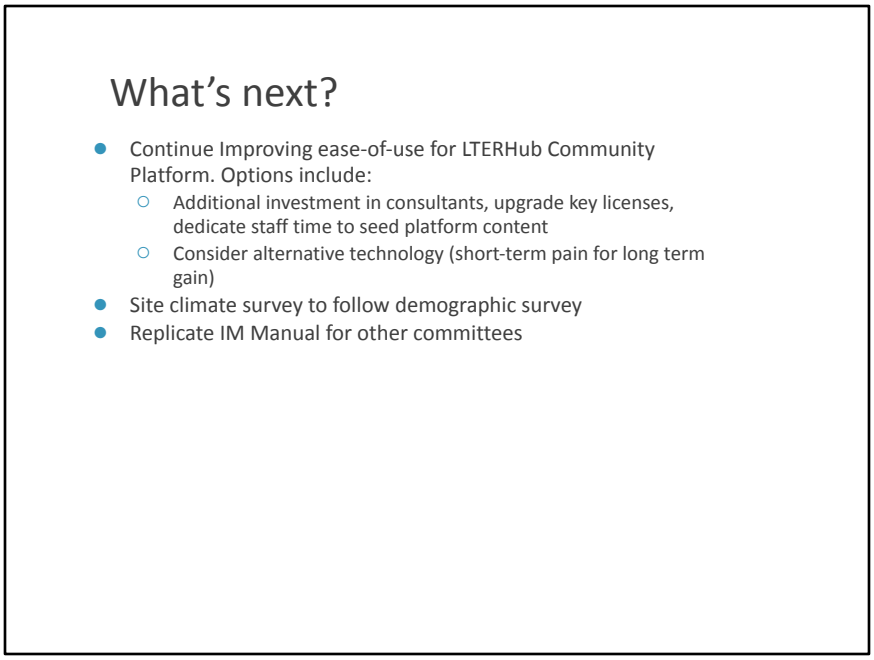
These two factors led to the development of the LTER Information manager's manual this year. The manual is not intended to be a broad information management resource – that's EDI's role – rather, it's a single place to go for LTER policies and practices and saves a lot of hunting through old emails!

It's maintained in the LTER GitHub Instance and any IM can easily use the issues tracker to make suggestions for new topics or contribute to improvements.



Until 2022, the Network Office consisted of just 5 individuals and a total of 2.5 FTEs and internal coordination was pretty straightforward – we kept a weekly meeting on the calendar and –with travel and event schedules – ended up meeting biweekly. So pretty much – everyone knew everything and had a chance to weigh in on decisions.

Moving into 2022, we've been able to significantly increase analytical support for synthesis. We still expect to hold all-team meetings at least monthly, with the leadership group continuing a biweekly meeting schedule and the analytical support team meeting about weekly to parse out support requests and discuss priorities and approaches.



Focusing on the coordination part of our role, the LNO's priorities for the coming year include:
Continue working to make the LTERHub more user-friendly and add more onboarding resources.

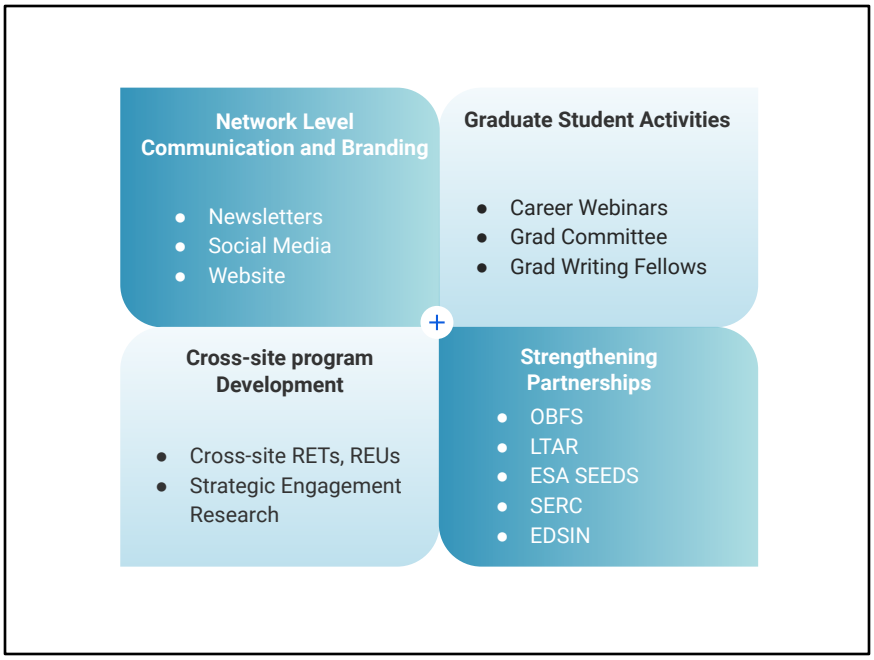
This may involve some additional investments in consulting time and upgraded licenses, as well as staff time to seed platform content and get conversations rolling. As committee mailing lists move onto the discussion platform, this will become more efficient, but right now, if involves extra effort.

We plan to follow up the demographic survey with a survey on the climate for inclusion and belonging at each site – making the results anonymously available to PIs to improve their planning.

Finally, information managers seem genuinely pleased with the new one-stop shop for onboarding and procedural information – and we plan to replicate the effort for other committees.


Questions


Education-Engagement



Marty: The LTER Network has a lot going on in the education and engagement arena. And the longevity of individual sites is a huge asset for developing deep local connections – so in many cases, the best thing the LNO can do is stand back and stay out of the way.

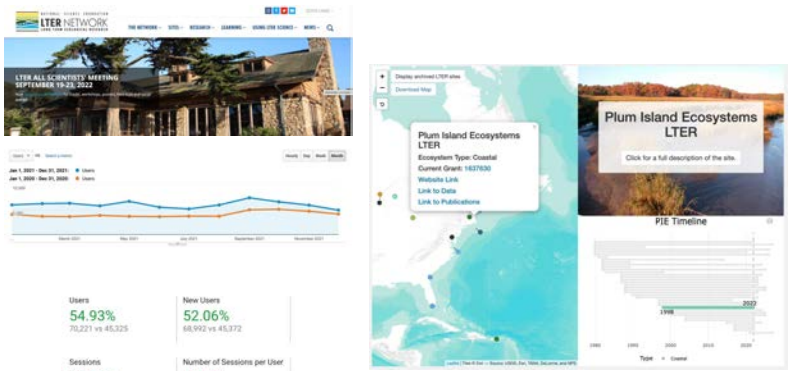
The biggest challenge for us is identifying the places where we can be uniquely helpful and limiting our involvement to those activities.

Recently, that has meant narrowing our focus to four main areas:

- Network-level communication and branding – newsletters, social media, and website
- Activities in support of LTER graduate students, including:
  - Career webinars
  - Graduate Student Committee
  - Graduate writing fellows
- Assisting in the development of cross-site programs, led by site-based researchers
- National and International Partnerships – such as with OBFS, ESA's SEEDS, and the Science Education Research Consortium

Our Digital Communications Coordinator, Gabe de la Rosa, is going to tell you about the first two categories.

Website



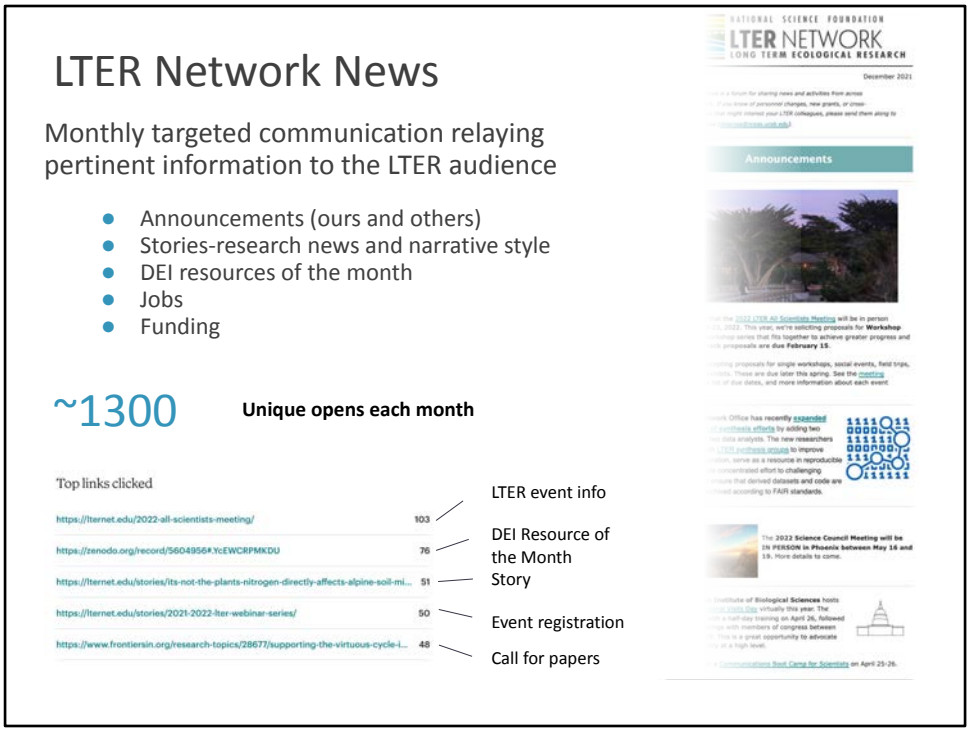
Gabe:
Our website is really a catch-all for information about the network. If there's something you want to know, this is where you come.
You can find:

- Stories
- Jobs
- Resources (like our extensive collection of LTER-relevant DEI resources)
- Events
- and more.

The website continues to be a reliable source of network information with 2-3 new research stories each month, most developed in partnership with our corps of 7 graduate student science writers. This month, we posted 8 job opportunities from REU's to faculty around the network.

The user base is up about 50% in 2021, averaging 6000 users per month.

We also added a fully interactive site map in 2021, with live links to site websites, data holdings, and bibliographies.



Gabe
We rely on newsletters to get targeted, relevant, and timely information out across the network.

I'll mainly focus on Network News, our monthly newsletter, but we also have DataBits, a biannual newsletter from the Information Managers all about data, an Opportunities newsletter with all the job openings from the past month.

Network News is a curated collection of information relevant to the network

It has announcements from ourselves and others, recently published stories both in news and narrative styles,

We include a DEI resource of the month often generated from our DEI committee

A whole slew of jobs

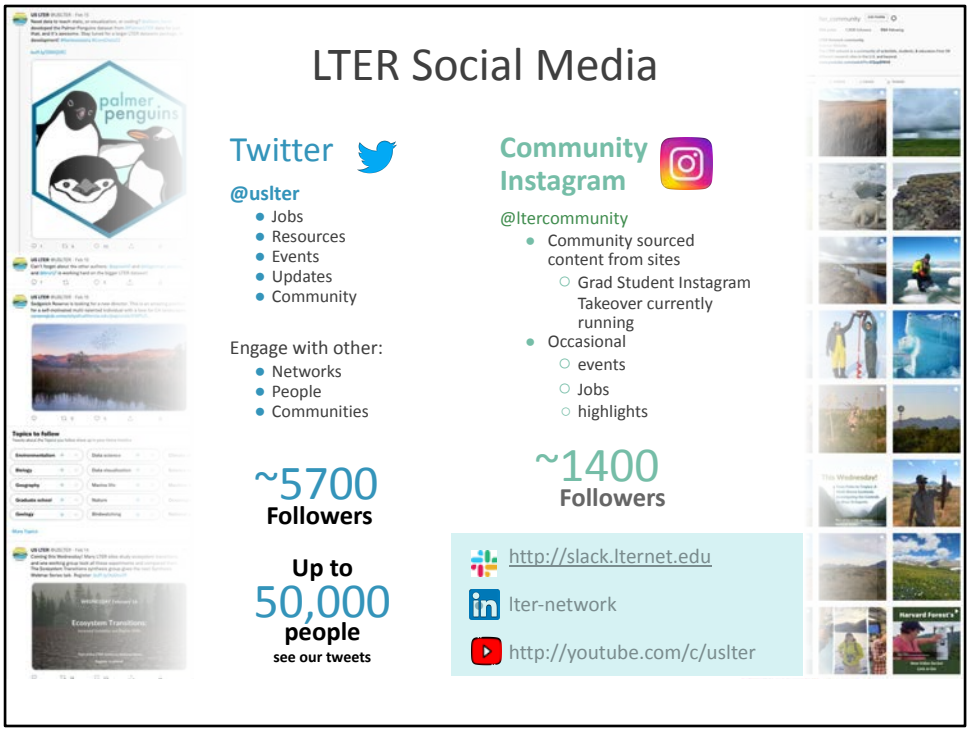
Funding opportunities

and more.

These go out to a whole bunch of subscribers, but about 1300 people actually open up the newsletter each month.

One quick metric I like is the top links clicked, because it shows what people are looking for in our newsletter. In December, the top five were the ASM information page, a DEI resource, a story about recent research, registration for our Synthesis Webinar series, and a call for papers from Frontiers.

This just goes to show that people are looking for a really wide variety of stuff in this newsletter, and we're doing well to get it out to them.



Gabe

We also use social media to engage with a broad LTER audience.

Twitter is our main platform. We tweet out job announcements, resources, event info, network updates, and amplify other posts from the LTER community.

It's also really useful for engaging with other networks, other people, and other communities.

We have ~5700 followers, and I was shocked to learn that some of our tweets go out to reach 50,000 people (MSP lter announcement & synthesis RFP webinar). This was a job announcement that was shared widely, but it just underscores the value of twitter for reaching all sorts of people.

We also help run a community instagram. This is mainly content sourced from LTER sites

There's currently a huge campaign fronted by the Grad Student Committee to have someone from each site takeover our instagram for two weeks at a time. They share great pics from the field and tidbits about the research happening. It's awesome.

Occasionally, we post events, jobs, and highlights on this-but the focus is really

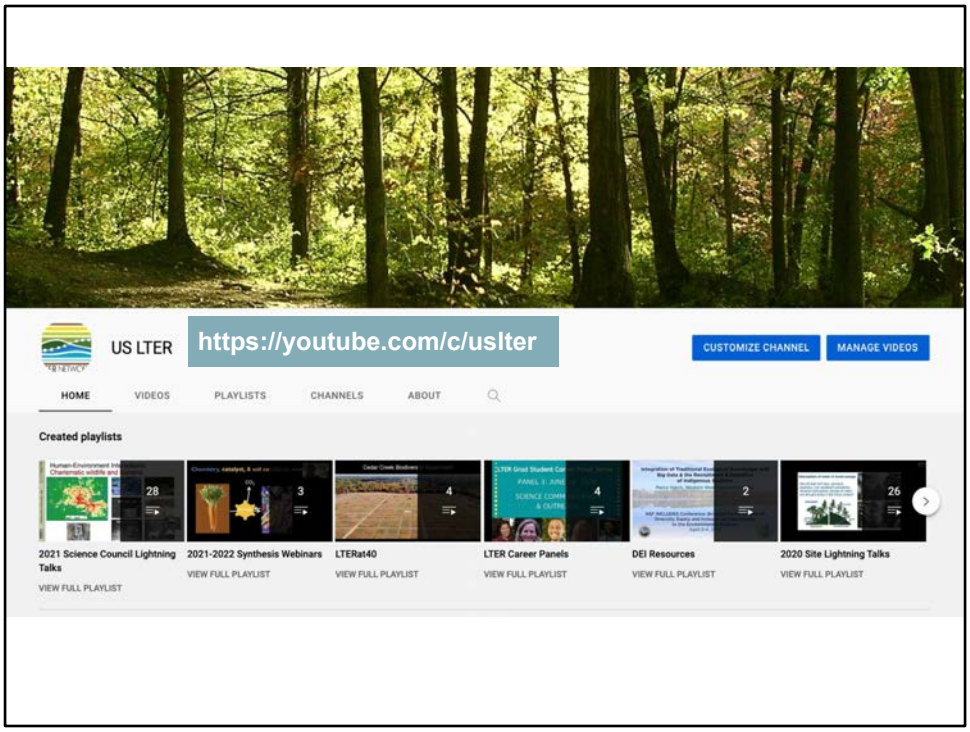
meant to be on the community.

We have ~1400 followers.

We also manage a LTER Slack account for different groups and committees across the network to communicate. Some groups are much more active than others, but it's a nice open and visible alternative to email for sharing resources, ideas, etc.

We have a LinkedIn for job postings, mainly.

And our youtube channel…



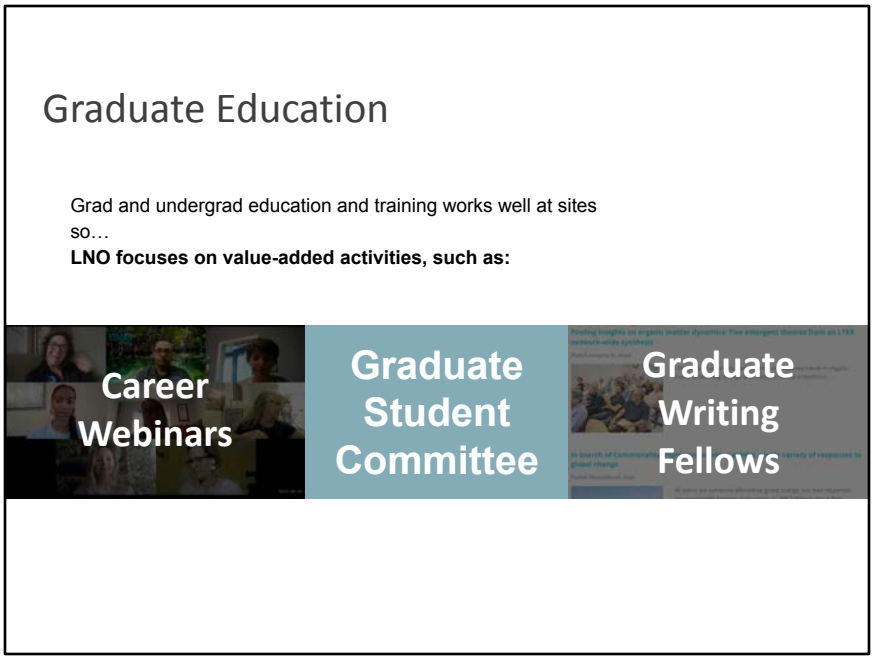
Gabe:

Our youtube channel has really grown in the last few years. One of the advantages of remote work is that it's much easier to record and share content.

We host a bunch of LTER specific materials, like each site's flash talks from our most recent Science Council meeting, recordings of the Synthesis Webinar Series that's ongoing, the career panel the GSC put on, DEI resources, orientation materials, and more.

We also host videos from around the network, either created by sites (more common with remote reviews) or by third parties about sites or research.

Youtube is incredibly useful for linking out, but a nice centralized collection of video.

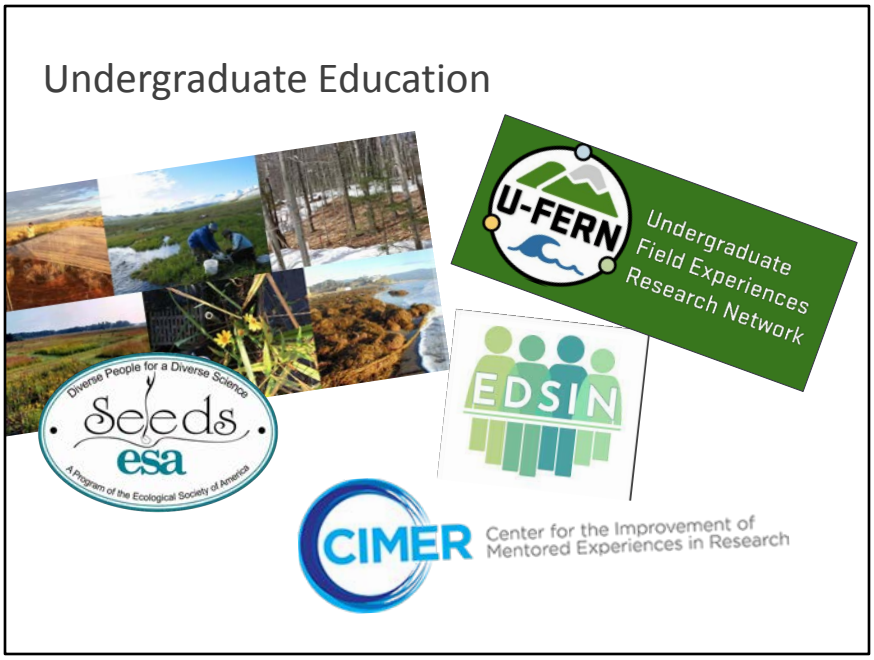


The Network Office is also engaged in education initiatives at all different levels. Starting with graduate education

Higher Education:

- Grad and undergrad education and training works well at sites
- LNO focuses on value-added activities, such as:
    - Career webinars,
        i. Run through the GSC
        ii. 3 webinars focused on different career paths (NGO, foundation, government)
        iii. ~150 attendees (plus ~150 YouTube views)
    - Grad Committee
        i. Representative committee, one student from each site
        ii. Organize webinars, social events, graduate student specific trainings (data viz module coming soon)
        iii. Instagram takeovers
    - LTER graduate science writers
        i. 7 graduate students based at LTER sites, we recruit to write about LTER science (NWT, HBR, NGA, SEV, BLE, VCR)

i. Group generates ~2 articles a month
ii. Compensated
iii. Receive editing feedback, peer edit
iv. Very successful



Marty:
LTER sites offer great opportunities to engage undergraduates students from all backgrounds in substantive research. They often have really charismatic sites, with many different kinds of work happening – meaning students get a chance to interact with a variety of potential mentors and interdisciplinary teams. They also get to see a variety of scientific jobs – such as Information managers, project managers, and education coordinators — that don't require a PhD to earn a decent paycheck.

In Undergraduate Education, the role of the Network Office is to:

1) Orient students to the breadth of work at other sites, as we have for recent cross-site REU Pilot projects
2) Work to improve the quality of mentoring in the Network by partnering with CIMER (The Center for the Improvement of Mentored Experiences in Research), AdvanceGEO, and UFERN
3) Promote opportunities for research experiences broadly with diverse audiences, reaching out through the ESA SEEDS, EDSIN and Doris Duke Conservation scholars.

LTER Datasampler

R package + website providing data samples and tutorials to teach environmental data science at the undergraduate level

- Collaboration:
  - Allison Horst, Assistant Teaching Prof. at UC Santa Barbara
  - Julien Brun, LNO
  - LTER IMs
  - LTER Education committee
  - Capstone project for a team of 5 undergraduates data science students, UC Santa Barbara
- Promotes best practices in Data preservation & reuse
- links directly to the full data set on EDI

https://lter.github.io/lterdatasampler/

=> Ultimately we aim to have one data sample per LTER site!

Every now and then, the charisma of LTER sites and organisms take on a life of their own. The LTERDataSampler project was launched when Alison Horst, a UCSB data science professor, looked to the Palmer LTER penguins for a data set to freshen up one of the hoary old staples in data science instruction.

The “Palmer Penguins” R package became an overnight sensation and Julien and Alison began working on a package of example datasets (one from each LTER site) to teach basic data science skills and link back to original, full datasets in the EDI repository.

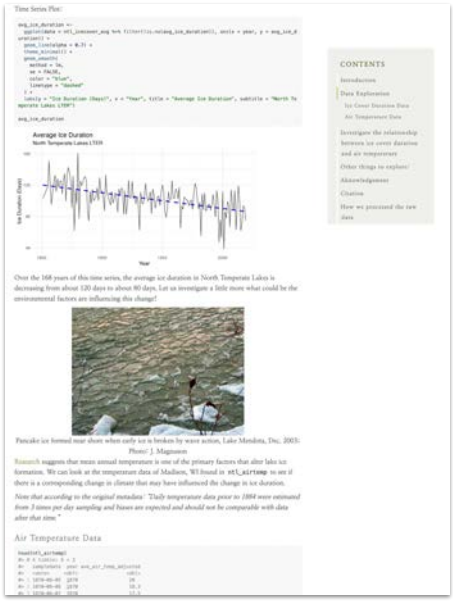
Working with LTER Information Managers, Education Coordinators and a UCSB capstone team of 5, they have curated 8 datasets and are making good progress towards complete set.

Data sample example: NTL - Ice Cover

```
Console  Terminal  Jobs
R 4.0.3 · ~/GitHub/gitLTER/lterdatasampler/
R> library(tibble)
R> library(lterdatasampler)
R> glimpse(ntl_airtemp)
Rows: 55,151
Columns: 3
$ sampledate          <date> 1870-06-05, 1870-06-06, 1870-06-07, 1870-06-09, 1870-06-10, 1…
$ year                <dbl> 1870, 1870, 1870, 1870, 1870, 1870, 1870, 1870, 1870, 1870, 18…
$ ave_air_temp_adjusted <dbl> 20.0, 18.3, 17.5, 13.3, 13.9, 15.0, 14.4, 13.9, 17.5, 18.3, 21…
R> data(package = "lterdatasampler")
R>
```

```
R data sets
Data sets in package 'lterdatasampler':

hbr_maples              Health of Sugar Maple (Acer saccharum) Seedlings in
                        Response to Calcium Addition (2003-2004), Hubbard Brook
                        LTER
ntl_airtemp             Daily Average Temperature Data in Madison, WI (1869 -
                        2019), North Temperate Lakes LTER
ntl_icecover            Ice Freeze and Thaw Dates for Madison, WI Area Lakes
                        (1853 - 2019), North Temperate Lakes LTER
pie_crab                Fiddler crab body size in salt marshes from Florida to
                        Massachusetts, USA at PIE and VCR LTER and NOAA NERR
                        sites during summer 2016.
```



https://lter.github.io/lterdatasampler/articles/ntl_icecover_vignette.html

To make the project a little more concrete, here's an example using two datasets from North Temperate lakes LTER site: lake ice cover duration and air temperature over the past 150 years

The left panel shows the analysis in the R console, combining and visualizing the datasets.
On the right, we have the accompanying website where code, data visualization, and explanations
are combined to provide both analysis and context.

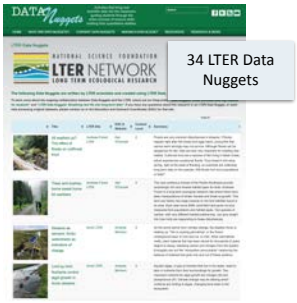
K-12 and Community Engagement

Sites

- Have a wide range of vital, diverse programs engaging local communities
- Know their audiences
- Know their assets
- Work directly with their communities

Network Role

- Partner with organizations that have an audience of educators (NAGT, SERC, QUBES, DataNuggets)
- Facilitate cross-site learning
- Scaffold opportunities to build greater interaction across sites



When it comes to K-12 Education and local community engagement, many of the same principles apply.

- Each site has a range of vital, diverse programs that engage local communities.
- They are working with Indigenous communities, contributing to after-school programs in underserved rural schools, getting Latina girls connected to STEM, and teaching ecology in urban parks.
- Those programs don't fit neatly into a network-wide initiative and trying to force it would only homogenize them.
- So, our approach is to:
    - Partner wherever possible with organizations that have a large audience of educators (NAGT, SERC, QUBES, DataNuggets)
    - Help sites learn from each other and build greater interaction across sites.

New Cross-Site RET on Biodiversity and Climate Change

Authentic Research Experiences for Teachers at LTERs (ARET@LTERs)

- 3 sites
  - Arctic LTER
  - Andrews Forest LTER
  - Santa Barbara Coastal LTER
  - Plus LNO
- Strong partnership between site educators and investigators
- Overlapping 2-year teacher cohorts
- Shared data-focused experience in second year
- Recruitment from majority-minority districts

One example to demonstrate…

Last year when the new Research Experience for Teachers opportunity came out of the Bio directorate, the LNO brought it to the attention of the education committee, which had been looking for ways to support cross-site initiatives. A handful of sites were interested, but three had the critical combination of committed researchers, strong education coordinators, robust connections with school districts serving minoritized students – links to a coherent scientific theme.

As the project came together, the idea came up that we should bring each cohort to the LNO to meet, compare experiences and plans, and learn how to access and use LTER data in the classroom.

Site education coordinators tend to focus on K-12 and informal youth education – and LTER science is great for education

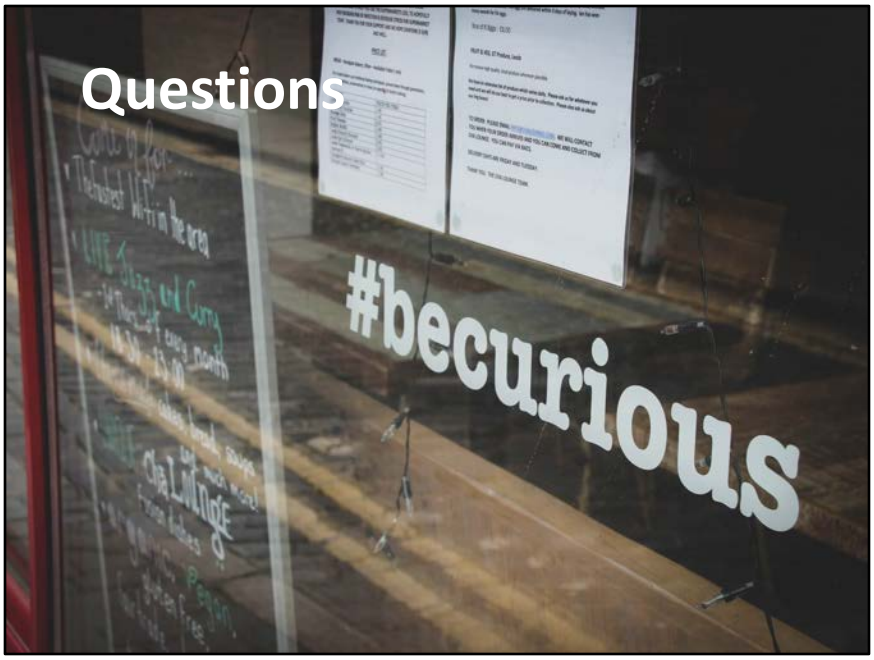
But it is also *really* relevant to the practices and decisions of resource managers, urban and marine planners, and landowners. But that kind of engagement can't be executed by outreach coordinators alone. It's got to be in partnership with site scientists, who are very busy.

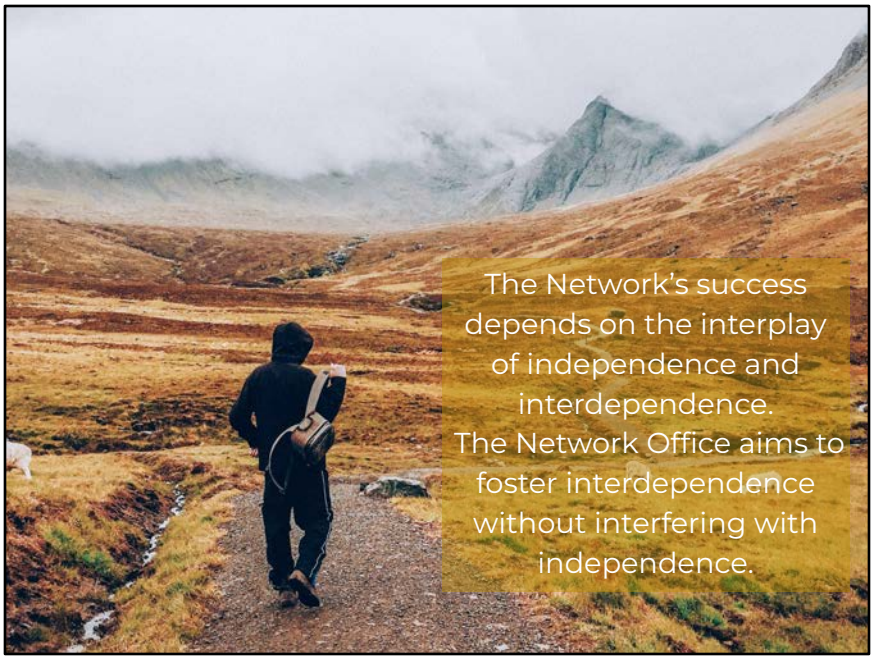
Interviewing researchers at Hubbard Brook and Harvard Forest sites, John Besley, a communications researcher at MSU and Sarah Garlic, the Director of Science Policy and Outreach at Hubbard Brook, found that researchers were willing – even excited – to participate in such work, but they wanted help to choose the strategies and tactics that were most likely to be effective.

Building on that research, Sarah, John, and a few others have put together a proposal for the Advancing Informal Science Learning Program that assesses how researchers approach engagement, develops a series of site-based case studies in strategic

engagement, and shares the learning from those back to other sites and similar networks.

If the proposal is successful, the part time program coordinator would be based at the LNO, increasing our capacity to support the USE of LTER science.


Questions
#becurious


The Network's success depends on the interplay of independence and interdependence.
The Network Office aims to foster interdependence without interfering with independence.