Agenda: Fall 2022 Joint Committee Meeting

(Times are Mountain Standard Time)

Monday, November 14, 2022

09:00-09:15 Welcome/Introduction (Mohan Ramamurthy/Chair)
09:15-09:45 Thank you to parting/transitioning members and welcome to new committee members

1. Introductions (abbreviated round table) – highlight what doing and excited about
2. Committee Chairs Update

09:45-10:15 Agency Update (NOAA Data – Anne Myckow)
10:15-10:45 Agency Update (USGS – David Blodgett)
10:45-11:00 Break
11:00-11:30 Agency Update (NASA – Justin Rice)
11:30-12:00 NSF Update (Bernard Grant)
12:00-01:00 Lunch
01:00-01:30 Agency Update (NOAA – Scott Jacobs)
01:30-02:30 Lightning Staff Presentations and Open Questions to Staff (Staff)
Topics:

1. ML / AI
2. NSF Sovereign Network Project and MSI Engagement
3. THREDDS Microservices
4. Unidata Science Gateway Revisioning
5. NetCDF Zarr - Move Unidata to More Cloud-friendly
6. Q&A

02:30-03:15 Director's Report (Mohan Ramamurthy)
03:15-03:30 Wrap Up Day 1

06:30 Dinner and Collaborative discussion on the day's proceedings at BJ's Restaurant and Brewhouse, 1690 28th Street (map)

Tuesday, November 15, 2022

09:00-09:10 Welcome and Administrative Items (Chair/Tanya)
09:10-09:30 Strategy Overview - Up to Now (SWOT, Themes, Draft Key Elements for Vision, Goals, and Strategies)

09:30-10:15 Scope of Service

1. Issue and Context
    - Support Load on Unidata & DEI SMART Goal
2. Thoughts on Initial Approach to Problem
3. Feedback and Impact
    - What it Means for Folks in the Community

10:15-10:30 Break

10:30-11:00 Budget (New hires, etc.)

11:00-12:00 Status Reports Discussion (Committee/Staff)

12:00-01:00 Lunch

01:00-01:45 Strategic Planning Continued: Break-out: Draft Vision, Goals, Strategies

- Break-out Session with Questions (25 min)
- Reconvene to Collate and Discuss (20 min)

01:45-02:10 Strategy - Capture Main Points for Vision, Goals, Strategies

02:10-02:30 Wrap Up, Admin (Spring Meeting Dates, Actions)

02:30-03:30 DeSouza Presentation (Ryan Abernathey, remote)

Status Report: Users Committee Actions

June 2022- October 2022

Unidata Program Center Staff

Actions from the Previous Meeting (June 2-3 2022)

Action 1

Fall Users Committee meeting topic to address what types of "equipment" are fundable under the Community Equipment Awards program. UPC staff to gather input from the committee between meetings and draft a proposal for discussion/decision at the Fall meeting. Also for consideration: do we need a formal policy about delaying the 1-year reporting requirement in the face of supply chain issues? [UPC Staff; Committee]

Result

The committee met November 1, 2022 to discuss refinements to the Call for Proposals specifying types of equipment that are fundable. Revised language is being drafted, to be reviewed asynchronously and used for the 2023 solicitation.

Action 2

Decide on 2023 Users Workshop planning schedule and next steps. [UPC Staff; Kim Wood, Alex Haberlie, Kevin Goebbert?]

Result

Users Workshop planning is under way. Dates (5-8 June 2023) and location (CU Boulder) have been selected, and broad themes outlined.

Action 3

Report/inform the Committee and community on any hardware adjustments needed (e.g. re-aiming of satellite dishes) as a result of changing SBN satellite from Galaxy 28 to ??? [Anne Myckow]

Result

Note from Tom Yoksas:
We have been aware of the upcoming move from Galaxy 28 to Galaxy 31 for quite a long time, and we know that we will be responsible for re-pointing the dish. We do not anticipate any problems resulting from the re-pointing since we have setup input into the IDD to be from a number of different machines at various places around the continental U.S., so ingest disruption at one site should have no effect on the continued flow of data.

Action 4

Enlist someone from NCEI to address the Committee about future archive data possibilities (e.g. NOMADS) [UPC Staff, consulting with Anne Myckow]

Result

Under investigation

Action 5

Fall Users Committee meeting topic to discuss possible approaches to keeping Unidata's technical support archives open to the community, especially in the face of GDPR and similar regulations. How does the community want to receive support in the future? [UPC Staff]

Result

This discussion is delayed until the Spring 2023 Users Committee meeting, due to the tight schedule for the Fall meeting.

Action 6

Create a tutorial on how to tune an LDM system [UPC: Steve Emmerson]

Result

In progress

Action 7

Provide documentation or methods to reproject CIRA products coming over the IDD [UPC: TomY]

Result

Under investigation

Action 8

Fall Users Committee meeting topic to revise the language around DeSouza nominations, specifically as relates to joint nominees?

Result

The Users Committee met September 21, 2022. Jon and Doug to draft paragraphs for website (in progress).

Action 9

Get e-mail list of faculty from Casey [UPC: Tanya Vance; Casey Davenport]

Result

Complete

Action 10

Set up/configure Slack channel(s) for Usercom [UPC: Doug Dirks]

Result

Complete

Action 11

Set up recurring standing (short: 45 minute?) remote committee meetings with well-defined topics. Decide on schedule for Fall academic term during June/July 2022 [UPC: Tanya Vance, Doug Dirks; Kevin Goebbert]

Result

Complete

Action 12

Bring a draft of a Users Committee charter to the next meeting [UPC Staff; Kevin Goebbert]

Result

Draft document: Unidata Governing Committees: Historical and Proposed Areas of Activity was created to help spur discussion among committee members about the scope and functioning of Unidata's committees.

Action 13

Fall Users Committee meeting topic to discuss how the Committee can help the community support all/some of the Unidata software/data projects [UPC Staff; Committee]

Result

A discussion of Unidata's "Scope of Service" statement is scheduled for the Fall 2022 meeting. Additional discussions are delayed until the Spring 2023 Users Committee meeting, due to the tight schedule for the Fall meeting.

Action 14

Gather information from community members about specific products to add to CONDUIT [Mike Zuranski]

Result

In progress

Action 15

Discuss process for adding WMO products to the IDD, how best to manage requests from community members [UPC: Tom Yoksas; Anne Myckow, Mike Zuranski]

Result

Under investigation

Action 16

Explore alternatives for effective surveying such as targeted focus groups, links on affiliated web sites (e.g. the COD page), piloting survey to targeted audiences, have community user members provide survey to their respective classes [UPC Staff]

Result

In Progress

Action 17

Explore augmenting data resource decision tree on Unidata web site (pending both web site transition and hiring of Data Engineer) [UPC Staff]

Result

In Progress

Status Report: Strategic Advisory Committee Actions

June 2022- October 2022

Unidata Program Center Staff

Actions from the Previous Meeting (July 7-8 2022)

Action 1

Work with Scott Jacobs to create a Unidata-centric track in the EIPT conference at AMS 2023 [UPC]

Result

The Unidata track is scheduled for the AMS 2023 Annual Meeting.

Action 2

Send a request to all current committee members for short "what's good about Unidata" and "what's good about being on the committee" statements to be used in recruiting new members. [UPC, all committee members]

Result

Delayed to focus on Strategic Planning initiatives.

Action 3

Create a list of roles and responsibilities for the SAC, and define what's needed from the committee, creating an “elevator pitch” for recruiting. [UPC]

Result

Delayed to focus on Strategic Planning initiatives.

Action 4

Strategic Plan discussion notes from July 7-8 meeting in the collaborative space [Doug]

Result

Complete (Google Drive folder)

Action 5

Plan a joint committee meeting for the fall (November 14-15), with both committees to have virtual meetings prior to joint meeting for committee-specific business [UPC, chairs]

Result

Complete

Action 6

Set up Strategic Planning workshops/activities for “focus groups,” staff, committee members with the goal of having an outline of the new plan by early fall. [UPC]

Result

Complete

Action 7

Replace the gavel [UPC]

Result

Complete

Prepared *October 2022*

Status Report: AI/ML

June 2022- October 2022

Unidata Program Center Staff

Areas for Committee Feedback

We are requesting your feedback on the following topics:

1. To you and your own community, what tutorials or resources for machine learning are the highest priority?

Thank you to everyone who responded to the pre-workshop survey!

Activities Since the Last Status Report

- Thomas Martin was hired in July to resume the role of AI/ML Software Engineer
- Added support-ml@unidata.edu as a direct support channel
- Python resources have been shared on Project Pythia and other openly available github repositories
- Started testing GPU (graphics processing units) resources on Jetstream2 for wider adoption.

Machine learning is actively being used for earth systems science and research. Most online training and examples do not use earth system science examples due to specific dataset I/O and pre-processing requirements. We plan on developing training resources to help bridge this gap, while using applicable earth system science examples. Besides tutorial development for scientists who are new to machine learning, python workflow development of tighter integration of xarray datasets to machine learning packages is a high priority. We are also actively exploring where current and future unidata tools (e.g. netCDF, THREDDS, etc.), can be leveraged for machine learning research, training, and deployment.

New Activities

We are looking for more ways to support our community at large. This might include in-person or remote workshops, 1 on 1 mentoring and tutoring, and online aschynorious resources. Expect these activities to increase in 2023. Thomas will also be at AGU (December 2022) and AMS (January 2023) available to discuss potential workshops or collaborations.

Prepared *October 2022*

Status Report: AWIPS

June 2022 - October 2022

Tiffany Meyer, Shay Carter

Areas for Committee Feedback

Are you aware of AWIPS Tips? Have you ever read any, and have you found any editions particularly helpful?

Would a beta version of AWIPS v20 be useful? Ie. A NWS version of AWIPS with operational functionality removed, but not necessarily having all Unidata-specific functionality incorporated back into it?

Activities Since the Last Status Report

AWIPS

Over this past summer, Unidata's Jetstream production EDEX server transitioned from its existence in the original, Jetstream1, cloud, to the newly available Jetstream2 cloud platform. This effort required the work of several teams at Unidata, and for our users, was a seamless transition with continuous data flow. With the upgrade from Jetstream 1 to 2, the new machines have increased CPU and RAM. Our new Jetstream2 servers now continue to serve real-time weather and geographic data to CAVE clients and the python-awips data access framework API.

Through the use of ancillary EDEX machines we have been able to decouple certain datasets from the main EDEX instance. The virtual machine (VM) instances on Jetstream2 are more powerful than their Jetstream1 predecessors. At this time, we have successfully overcome a few hiccups (outages) with the help of Jetstream personnel, and not noticed or been made aware of any performance declines (which had happened occasionally in the past). We still take advantage of distributing EDEX workload over three machines: a main EDEX, an ancillary radar EDEX, and an ancillary satellite EDEX. These distributed architectural concepts of AWIPS allow us to scale EDEX in the cloud to account for the size of incoming data feeds.

Texas A&M has also been using a similar distributed architecture since Summer of 2021. We have worked closely with them throughout the past year as we've released new versions of AWIPS, to help them transition between versions and identify weaknesses in their EDEX server.

During the summer, the AWIPS team was excited to host and mentor our first (ever) Unidata Intern – Rhoen Fiutak. Rhoen worked closely with the AWIPS team and with our educational designer, Nicole Corbin. Rhoen contributed to our python-awips examples, participated in CAVE development, wrote an AWIPS Tips blog entry, and designed and produced a new eLearning module! These projects will be discussed in more detail to follow.

Since the last status report, we've put out a major release (18.2.1-6) of AWIPS – which includes updates to both CAVE and EDEX. A link to all of our AWIPS release notes can be found here.

The release included several upgrades to both EDEX and CAVE; some feedback and suggestions came from our users. On the EDEX side of things we have:

- LDM pqact updates for NAM12
- Updates to obs stations and locations
- Update to the maps database
- GOES vertical temp profiles
- GLM data source change (to NOAA AWS data)
- Added GFS LAMP Visibility product

For CAVE we have:

- Updated radar displays to load best resolution Z/V
- Additional display functionality and menu items/bundles for Watches, Warnings, and Advisories (WWA) resources
- Updated Warngen button (to match NWS version)
- New PIREP menu option
- Current and total frame display

For our Virtual Machine build:

- Reduced default memory from 16GB to 8GB (for better performance and smaller memory machines)
- Installed Anaconda3 and created a python-awips environment (*python3-awips*)
- Installed python-awips git repo with source code and Jupyter Notebook examples

The WWA resource updates came out of significant testing and evaluation from Rhoen. Several of the other CAVE and EDEX updates came as a direct result of user feedback and suggestions.

Additionally, since our last status report, the AWIPS team has made another update and release for the python-awips package with version 18.1.11, which was released in August 2022. This release enabled python-awips compatibility with Python 3.10, which is more current than the NWS AWIPS python software (ufpy).

Over the summer, we also successfully transitioned our public EDEX server away from distributing Eric Bruning's gridded GLM products (which are no longer available), and are running a NOAA developed tool (ISatSS) to access and redistribute NOAA-created GLM products. This transition has been publicly recognized by Eric as well on Twitter. We would like to specifically mention Brian Rapp (from NOAA), and acknowledge the role he played in

getting us set up with ISatSS and access to their AWS bucket. We have updated that process once since its original implementation, and that update was seamless to our users as well.

A significant portion of our documentation both for CAVE, EDEX, and python-awips has been modified for easier understanding and comprehension. We are continuing to update our python-awips example notebooks to follow our new template that contains a helpful table of contents, with consistent subsections across the various example topics.

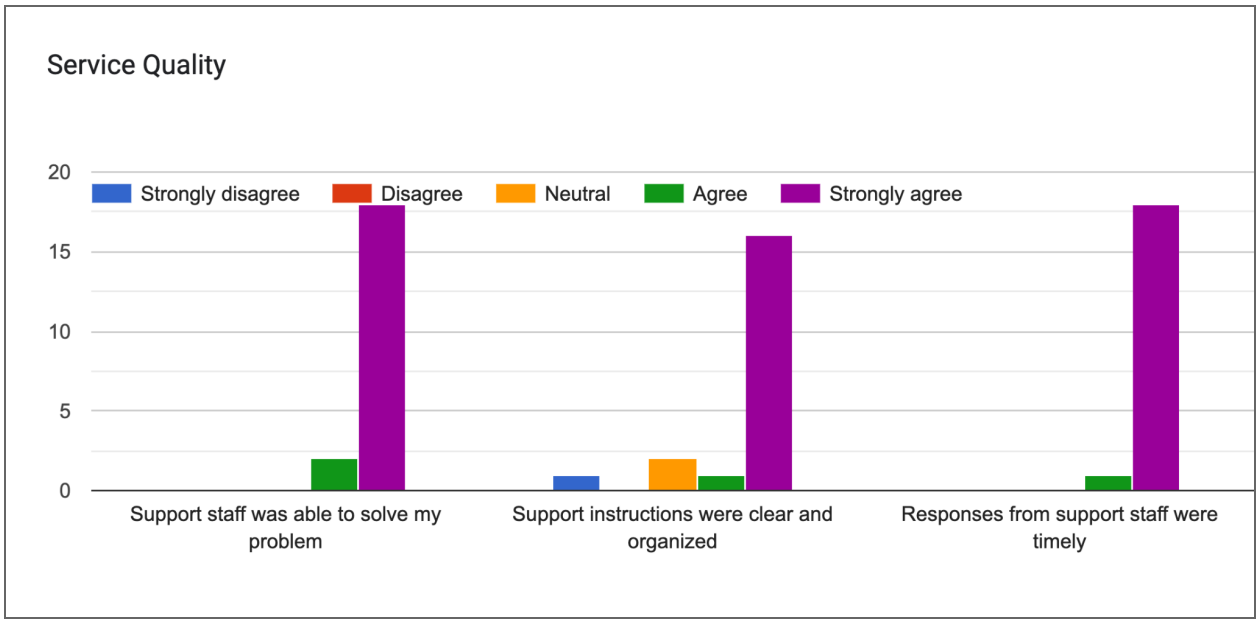
Our blog series, AWIPS Tips, has successfully been running every other week for over a year now. As of October 24th, 2022, we will have released 41 blog entries. Rhoen also created a short walkthrough video for our AWIPS Tips entry *Using Drawing Properties for WWA Display in CAVE*. A current list and breakdown of all the entries is provided on our documentation website in the Educational Resources page. We plan to continue the blog series for the foreseeable future and have several more ideas already planned out for upcoming entries. Announcements for new blog posts are shared through our mailing list (awips2-users@unidata.ucar.edu), and our social media accounts (Facebook, Twitter, LinkedIn, and YouTube when applicable).

Our asynchronous CAVE training course has been live since October 2021. We have had over 100 users sign up and take our course. We encourage those who have never used CAVE and those who have but still might be fairly new to the software to sign up and try out the course for themselves.

Along the same lines, we were excited to release our second eLearning module, *Learn Python-AWIPS*. This course was primarily designed, developed, and created by Rhoen, with support from Nicole, Tiffany, and Shay. The course was released on September 21, 2022. *Learn Python-AWIPS* is tailored for users with entry level Python knowledge, and zero python-awips knowledge. The course walks learners through the process of using python-awips to connect to an EDEX, interrogating the server to find what data is available, constructing and tailoring a refined data query, and displaying the results of the data in a user-friendly plot. After completing the course, the learner will have a fully functioning Jupyter Notebook example from their work following along in the course. The skills and knowledge gained from the course will hopefully allow the learners to then easily understand and alter our example notebooks to be able to produce customized, useful data plots. We are actively encouraging our University members to take the learning course themselves, and recommend it to their students as well. We know Python is growing in popularity in the meteorologic field and would like to offer this learning experience as a tool for professors and students to take advantage of.

The AWIPS team still has an active support evaluation survey that is advertised in our support email signatures. Since the last status report we have had two new evaluation entries, which is slightly under our average of one per month. The majority of our feedback has been

overwhelmingly positive, and the graphic below is a summary from all responses we've received regarding the quality of service we provide:



Some of the latest open-ended feedback from the support evaluations includes the following:
"The excellent support is appreciated!"
"Fast great assistance during a historic storm"
"Your team responded to my inquiry exceptionally fast. Frankly I was surprised and pleased!"
"Your AWIPS Team is awesome. I'm getting responses back usually in less than two to three hours. More responsive than the NWS AWIPS Program Office!!"

Since our last status report the AWIPS team at Unidata was invited to present at a few UCAR related events. We gave a presentation to the President's Council for UCAR over the summer. The presentation was well received, and from that, President Busalacchi recommended we be featured on the UCAR Commons message board. We wrote a blog about AWIPS which was published on UCAR Commons on August 16, 2022. From there we were invited to present a lightning presentation during the Annual UCAR Members Meeting. Our lightning talk was to an in-person crowd of at least 80 people, with additional audience members joining virtually.

For AMS 2023, we have been accepted to present in a new, Unidata session titled "Community Driven: Unidata Projects Enhancing Geoscience Teaching and Research". We will present an overview of AWIPS capabilities, the differences between our version and the NWS version, our use of the Jetstream2 cloud platform, and our current development milestones and outlooks.

Software Releases

Since our last status report we have put out one major AWIPS (CAVE and EDEX) release, version 18.2.1-6. This update was made available for all three platforms (Linux, Windows, and MacOS). All of these releases were fully signed (and notarized, in the case of the Mac)

packages to allow for easy download and installation.

In addition to pushing out new releases of CAVE and EDEX, we also have made a minor release (18.1.11) of our Python package, python-awips. The release notes for this update can be found on the GitHub page. We now have a partially automated and fully documented process for making python-awips changes and packaging and publishing the releases to both PyPI and Conda.

We have currently been actively developing a new Unidata AWIPS release of NWS's version 20 of AWIPS. This release includes major upgrades in the form of Java (from 1.8 to 1.11), Python (2 to 3) and Eclipse. This version will be incompatible with AWIPS v18, meaning both CAVE and EDEX will need to be on version 20 to be compatible. We anticipate this process to take quite a while until we are able to release a fully branded and supported Unidata version. However, we are optimistic we will release a Beta version available to the public, around the end of this calendar year. Our plan is to release a few versions of the Beta as we get closer to a production release later next year.

Activities Ongoing/In-Progress

AWIPS development activities are constantly ongoing. Currently the following activities are in progress:

- The AWIPS team has been testing our new Jetstream2 platform with our production and development EDEX servers.
- The AWIPS team is experimenting with a special, large virtual machine in Jetstream2 as a potentially more efficient machine for our main EDEX servers.
- The AWIPS team is responding to all AWIPS support questions from the community and striving to provide realistic solutions in a timely manner.
- The AWIPS team is actively updating and refining our online documentation to be as accurate and useful as possible.
- The AWIPS team has maintained a bi-weekly blog series called AWIPS Tips that began on April 7th, 2021 and has been used to highlight useful functionality and fundamentals for CAVE, EDEX, python-awips, and general AWIPS announcements.
- The AWIPS team has begun our first transition between major Raytheon AWIPS releases (from v18 up to v20).
- The AWIPS team is actively developing a new release of AWIPS that includes upgrades to Python3 and Java11.

Future Activities

Future plans are constantly evolving to meet the needs of our users. The AWIPS team is focused on developing and releasing a Beta of the next major version of AWIPS (version 20). We are also looking forward to the opportunity of potentially hosting in-person or virtual AWIPS workshops. The team is actively participating in conferences, workshops, and virtual message boards (blogs) to expand our user base. We are going to put out an AWIPS Tips entry documenting Texas A&M's use of our eLearning material and AWIPS in the classroom.

Metrics

Downloads May 1, 2022 - October 31, 2022

AWIPS downloads: 2,947

Strategic Focus Areas

We support the following goals described in Unidata Strategic Plan:

1. **Managing Geoscience Data**
   The cloud-based EDEX data server continues to see widespread use and growing adoption. More and more datasets continue to be added to the server as Unidata deploys more decode/ingest nodes.

2. **Providing Useful Tools**
   All AWIPS tools (EDEX, CAVE, and python-awips) are freely available, and also incorporate LDM/IDD technology for accessing geoscience data.

3. **Supporting People**
   At this juncture, we are providing full technical support with regards to AWIPS for the community.

Prepared *October 2022*

Status Report: Science Gateway and Cloud Computing Activities

June 2022 - October 2022

Shay Carter, Julien Chastang, Bobby Espinoza, Ward Fisher, Ryan May, Tiffany Meyer, Jen Oxelson, Mohan Ramamurthy, Jeff Weber, Tom Yoksas

Areas for Committee Feedback

We are requesting your feedback on the following topics:

1. In the post-pandemic era what changes have you noticed in the instructional landscape? Have students adapted to online instruction and prefer it? What about in class instruction and “flipped classrooms”?
2. A science gateway is a place that can provide tools or resources to researchers, educators, and students to facilitate their work. What kinds of tools would you like to see that can solve problems or alleviate tedium in your scientific and computational workflows?

Activities Since the Last Status Report

Successful Migration of Unidata Operations from NSF Jetstream1 to Jetstream2

Jetstream1 was officially end-of-lifed at the end of July 2022. In the months leading up to this date, Unidata staff has successfully migrated all resources onto the new cloud platform including: AWIPS operations, multiple IDD nodes, multiple THREDDS data servers, a RAMADDA server, and JupyterHub operations. This was facilitated by our previous and on-going efforts to provide our community with containerized and readily deployable versions of many Unidata technologies, in addition to well documented workflows. As a result of this transition, we are also updating our documentation (e.g., READMEs).

GPU Exploration on Jetstream2

With the arrival of Jetstream2, Unidata now has the potential to provide science gateway users access to GPU computing. GPUs can be an important component of AI/ML workflows employing software such as TensorFlow, an open-source AI/ML API . We have been experimenting with Jetstream2 GPU VMs with the aim of correctly installing NVIDIA CUDA and Tensorflow in a manner that harnesses the GPU. After a number of false starts, we were able to make a GPU-enabled Tensorflow API available via a JupyterHub employing a vetted Tensorflow Docker container. We then proceeded to install JupyterHub software on top of that Tensorflow container. The end result is we now have a GPU enabled JupyterHub that Thomas Martin and Unidata staff can experiment with. Future work in this area will focus on

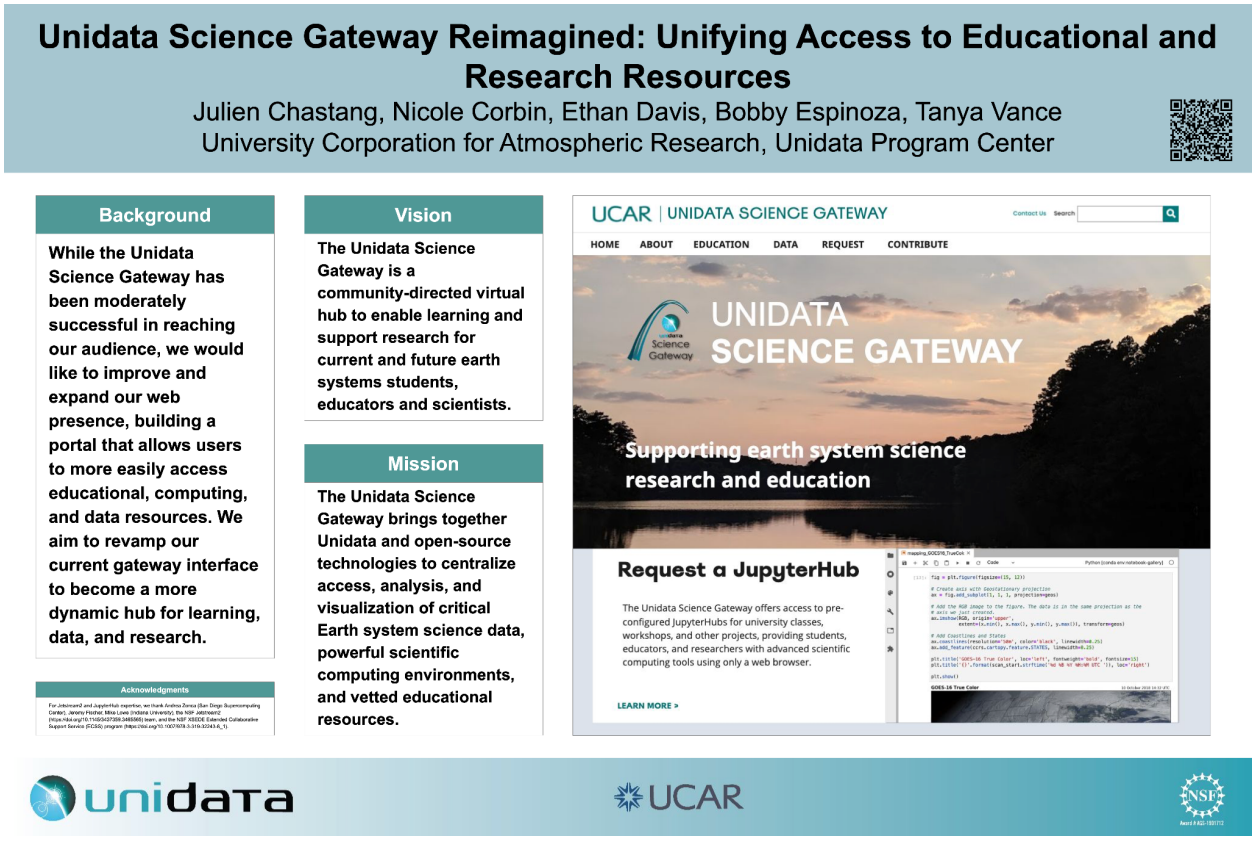
how to best provide this capability to community members.

Gateways 2022 Conference

Science gateway staff attended this year's Science Gateways Community Institute (SGCI) conference in San Diego this October where we presented posters on two new projects (see the next two sections below). In addition to meeting new contacts and reconnecting with old ones, we were able to gain valuable knowledge through developer lead tutorials on technologies such as Tapis and Open OnDemand. These open up potential avenues of exploration regarding methods on how to provide researchers, educators, and students with a secure web or API based interface to Jetstream2 resources.

Unidata Science Gateway Re-Imagined

Unidata staff have been meeting regularly to begin the process of revamping the Unidata Science Gateway (USG) website. Our aims are described in the poster below. As a first milestone, we presented this poster at the Gateways 2022 conference summarizing our efforts thus far; a vision, and mission statement as well as a USG mock-up landing web page.



We will continue to evolve and mature what we have so far as well as create mockups for additional portions of the Unidata Science Gateway website. We hope to eventually have a

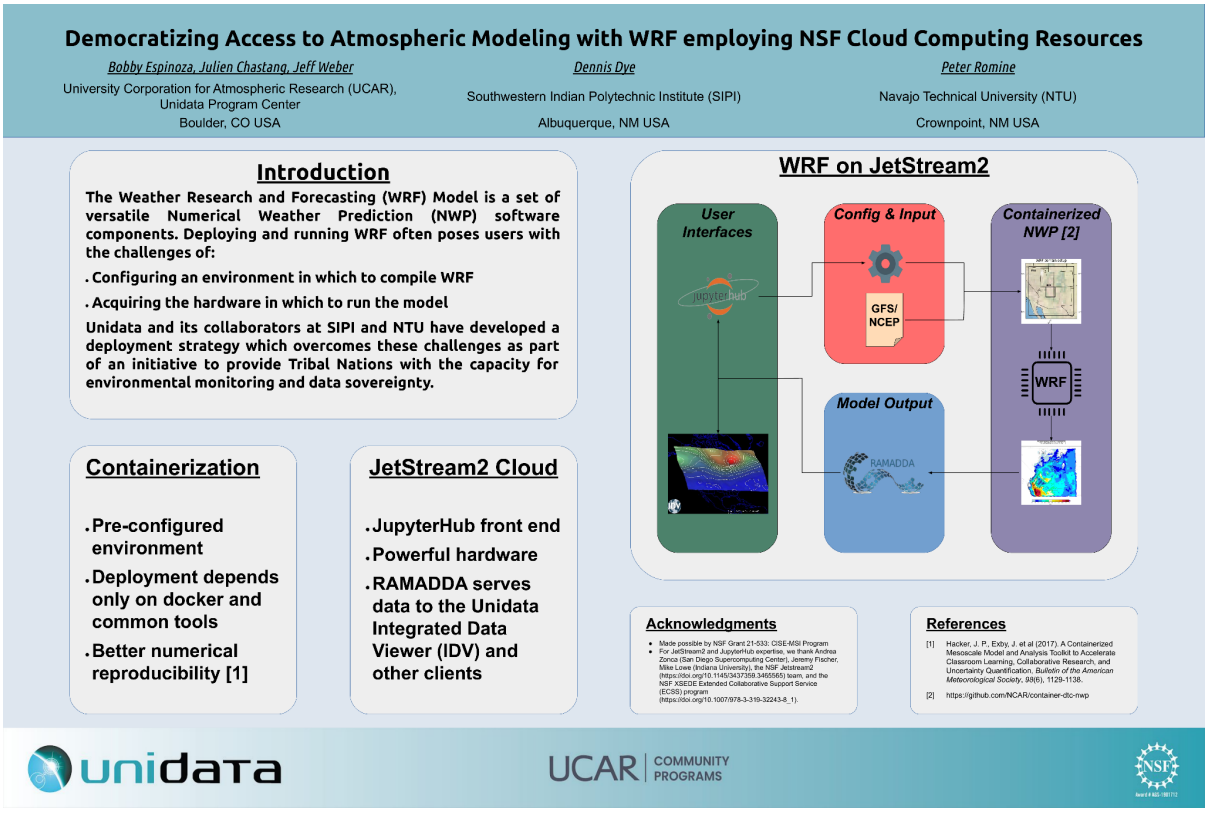
plan to create a Unidata Science Gateway portal that better meets the needs of our current and future users.

WRF Collaboration with Navajo Tech University and The Southwestern Indian Polytechnic Institute

Unidata is involved with NTU and SIPI under NSF grant #21-533 in order to develop a data sovereign network and provide the capacity for environmental modeling for Tribal Nations. In collaboration with Jeff Weber, science gateway staff have made progress on providing the Tribal Nations with the capability to run the WRF model on the NSF Jetstream2 cloud through the use of a containerized version of WRF developed by the Developmental Testbed Center at NCAR RAL.

In addition to running WRF, Jetstream2 will be used to fetch model input data via an IDD node and store/serve output through a co-located RAMADDA server. This server can ultimately interface with locally installed RAMADDA servers, the Unidata IDV, and other clients to serve and visualize data. Lastly, the team has future plans to provide a JupyterHub front-end interface to allow researchers, educators, and students to dynamically run WRF jobs and perform pre/post-processing of input/output.

While these efforts have primarily been focused on deploying this workflow on Jetstream2, care has been taken to ensure this same workflow can run on any system with only Docker and other common tools (`git`, `curl`, `tar`, etc.) installed.



JupyterHub Servers for Online Instruction Summer and Fall 2022

Unidata JupyterHub activities continue to advance since the last status report. These JupyterHubs are deployed in collaboration with Andrea Zonca at SDSC and the Jetstream2 group at Indiana University (IU).

We have supported a number of semester-long classes, and workshops with JupyterHub servers hosted on the Unidata Science Gateway. The JupyterHub servers are tailored to the instructor's objectives with pre-configured PyAOS (Python for the Atmospheric and Oceanic Sciences) environments, classroom material and data. Notwithstanding the fact that academic institutions have now returned to in-person instruction, the on-going demand for JupyterHubs demonstrates that they are a valuable learning and instructional tool. We are more than happy to assist instructors in this area, and would like to help in whatever way we can with these resources. See the metrics section below for more detailed numbers on this topic.

University of Oklahoma REU Students

Unidata continues to collaborate with Ben Schenkel (OU) to provide data sets via the science gateway RAMADDA server. We also deployed a JupyterHub server so that NSF REU students at OU could access those data for their projects.

Unidata Docker Container Improvements

- We implemented a Github Actions workflow to ensure images (e.g., thredds-docker) remain up-to-date and secure with respect to upstream changes and improvements
- We automated push of updated images to DockerHub
    - Collaborated with the TDS group to allow them to build and push the TDS Docker images as part of their workflow.
- For the thredds-docker container, we made major/minor version updates, as well as security patches and bug fixes, to base images (Tomcat, Rocky Linux, etc.) that automatically propagate to child containers.
- Made some `Dockerfile` improvements leading to smaller image sizes
- As CentOS 7 is nearing end-of-life, we are transitioning to Rocky Linux based containers wherever possible. Rocky Linux is another RHEL-flavored OS that is meant to be the successor to CentOS.
- We have been collaborating with Axiom software to make minor improvements to the tomcat-docker container.

Custos OAuth

Science gateway staff worked together with Suresh Marru and his team at Indiana university to experiment with Custos OAuth. Custos could eventually serve as a replacement for GitHub OAuth presently in use throughout all of our JupyterHub servers. It could potentially provide some advantages such as allowing users to employ institutional logins instead of relying on GitHub accounts.

Ongoing Activities

NOAA Big Data Program

- Unidata continues to manage the NEXRAD archive in Amazon S3, ensuring that realtime data are successfully delivered to the noaa-nexrad-level2 bucket. LDM is employed to deliver these data.
- Unidata also continues to deliver NEXRAD level 3 products to the unidata-nexrad-level3 bucket, part of the AWS public datasets program.
- TDS on Jetstream2 for level II NEXRAD: http://thredds-aws.unidata.ucar.edu/thredds/catalog.html
- AWS Explorer (Public access): https://s3.amazonaws.com/noaa-nexrad-level2/index.html
- Public Bucket for level II NEXRAD: https://noaa-nexrad-level2.s3.amazonaws.com
- Continue to populate the NEXRAD level II archive with real time data.
- Continue to populate new GFS 0.25 degree output and NCEP HRRR output to an S3 bucket for access. We did not place a TDS on this collection as this output is available from our standard sources.

JupyterHub Demonstration Server

Unidata continues to enhance the Unidata JupyterHub demonstration server. This server needs to be regularly updated as the Jupyter, JupyterHub, and JupyterLab ecosystems rapidly evolve.

Docker Containerization of Unidata Technology

Beyond what we mentioned earlier about improvements in this area, we continue to employ Docker container technology to streamline building, deploying, and running Unidata technology offerings in cloud-based environments. Specifically, we are refining and improving Docker images for the LDM, ADDE, RAMADDA, THREDDS, and AWIPS. In addition, we also maintain a security-hardened Unidata Tomcat container inherited by the RAMADDA and THREDDS containers. Independently, this Tomcat container has gained use in the geoscience community.

Progress has been made on the following

- See earlier section on “Unidata Docker Container Improvements”

AWIPS EDEX in Jetstream2 Cloud

Unidata continues to host our publicly accessible EDEX server on the Jetstream2 cloud platform where we serve real-time AWIPS data to CAVE clients and the python-awips data access framework (DAF) API. The distributed architectural concepts of AWIPS allow us to scale EDEX in the cloud to account for the desired data feed (and size). We continue using

Jetstream2 to develop cloud-deployable AWIPS instances as imaged virtual machines (VMI) available to users of OpenStack CLI. This summer the AWIPS team worked closely with other Unidata staff members (namely Julien Chastang, Bobby Espinoza, and Mike Schmidt) to successfully transition all our EDEX machines from Jetstream1 to Jetstream2.

EDEX is designed with a distributed architecture, so different components can be run across separate virtual machines (VMs) to improve efficiency and reduce latency. Our current design makes use of three VMs: one large instance to process most of the data and run all of the EDEX services including all requests, and two other ancillary machines which are smaller instances used to ingest and decode radar and satellite data individually.

We have successfully maintained a duplicate set of VMs to mirror our production EDEX environment. These backup VMs have served as a testing ground for implementing new changes, as well as a backup for when our production server is unavailable. This has also allowed us to perform regular patches and software updates on the machines, since we can quickly "fall back" on the other set whenever we need the downtime. Our systems are more secure and protected because of this ability.

All of our EDEX servers on Jetstream1 were decommissioned on July 31st, 2022. Our Jetstream2 instances were set up in the beginning of June and after a month of testing our production URL was transitioned to the new machines on July 13th.

In our new allocation for Jetstream2, we have secured access to an even more powerful machine (a "large instance" virtual machine) that we have just recently begun using as a test platform for our v20 EDEX server.

Nexrad AWS THREDDS Server on Jetstream2 Cloud

As part of the NOAA Big Data Project, Unidata maintains a THREDDS data server on the Jetstream2 cloud serving Nexrad data from Amazon S3. This TDS server leverages Internet 2 high bandwidth capability for serving the radar data from Amazon S3 data holdings.

Jetstream2 and Science Gateway Security

We continually work with Unidata system administrator staff to ensure that our web-facing technologies and virtual machines on Jetstream2 adhere to the latest security standards. This effort involves such tasks as ensuring we are employing HTTPS , keeping cipher lists current, ensuring docker containers are up-to-date, limiting ssh access to systems, etc. It is a constantly evolving area that must be addressed frequently.

Unidata Science Gateway Website and GitHub Repository

Website

The Unidata Science Gateway web site is regularly updated to reflect the progress of what is available on the gateway. The news section is refreshed from time-to-time for

announcements concerning the gateway. The conference section and bibliography is also maintained with new information. We are in the process of redesigning this web site. See “Unidata Science Gateway Re-Imagined” section above.

Repository

All technical information on deploying and running Unidata Science Gateway technologies is documented in the repository README. This document is constantly updated to reflect the current state of the gateway.

Presentations/Publications/Posters

- J. Chastang, N. Corbin, E. Davis, B. Espinoza, and T. Vance. Unidata Science Gateway Reimagined: Unifying Access to Educational and Research Resources. In Gateways 2022, San Diego, California, USA, Oct. 18-20 2022.
- B. Espinoza, J. Chastang, J. Weber, D. Dye, and P. Romine. Democratizing Access to Atmospheric Modeling with WRF employing NSF Cloud Computing Resources. In Gateways 2022, San Diego, California, USA, Oct. 18-20 2022.
- M. Ramamurthy and J. Chastang. The use of the Unidata Science Gateway as a cyberinfrastructure resource to facilitate education and research during COVID-19. In EGU General Assembly 2022, Vienna, Austria, May 23-27 2022.

New Activities

Over the next three months, we plan to organize or take part in the following:

Forthcoming Conference Attendance

- American Geophysical Union Fall Meeting 2022
- American Meteorological Society Winter Meeting 2023

Experiment with Jetstream2 Large Memory VMs

In addition to new GPU capabilities, Jetstream2 has a new class of “Large Memory VMs”, e.g., 128 vCPU 1000 RAM (GB). Science gateway, AWIPS and system administration staff are working together to see if such a system can benefit AWIPS EDEX operations. Also see the “AWIPS EDEX in Jetstream2 Cloud” section above.

Over the next twelve months, we plan to organize or take part in the following:

JupyterHub Collaboration Andrea Zonca

We plan to continue our collaboration with Andrea Zonca (San Diego Supercomputing Center) for deploying JupyterHub clusters on Jetstream2 and exploring new technologies in this area such as Dask. We continue to provide Andrea with feedback as he releases new versions of the software. Unfortunately, XSEDE, ECSS project has sunsetted and Andrea is looking for a new source of funding to continue this vital collaboration.

Unidata Science Gateway Re-Imagined

See sections on this topic above.

Relevant Metrics

Summer/Fall 2022 JupyterHub Servers

Since spring of 2020, Unidata has provided access to JupyterHub scientific computing resources to approximately 960 researchers, educators, and students (including a few NSF REU students) at 14 universities, workshops (regional, AMS, online), and the UCAR SOARS program. Below are the latest metrics since the last status report.

Institution	# of users	Point of contact
Summer 2022		
UCAR SOARS Internship	22	Keith Maull, UCAR/UCP
Fall 2022		
St. Cloud State	15	Matthew Vaughan
University of Colorado	24	Mark Seefeldt
Regis University	6	Mark Seefeldt
Southern Arkansas University	50	Keith Maull
University of Oklahoma	4	Ben Schenkel
Indian Institute of Technology Bombay	3	Saswata Nandi
Metpy CSU Workshop Fall 2022	15	Drew, Ryan

Total	139	

Github Statistics

Repository	Watches	Stars	Forks	Open Issues	Closed Issues	Open PRs	Closed PRs
science-gateway	4	15	11	12	156	0	550
tomcat-docker	9	54	64	2	38	0	71
thredds-docker	13	25	24	5	109	0	158
ramadda-docker	2	0	2	1	10	0	24
ldm-docker	6	13	13	3	36	0	59
tdm-docker	3	3	7	1	9	0	18

Strategic Focus Areas

We support the following goals described in Unidata Strategic Plan:

1. **Managing Geoscience Data**
   Unidata supplies a good portion of the data available on the IDD network to the Jetstream2 cloud via the LDM and the high bandwidth Internet 2 network. Those data are distributed to the TDS, ADDE, RAMADDA and AWIPS EDEX installations running on Jetstream2 for the benefit of the Unidata community. Unidata also makes the AWS Nexrad archive data accessible through the TDS Nexrad server running on Jetstream2 at no cost to the community. These data can be accessed in a data-proximate manner with a JupyterHub running on Jetstream2 for analysis and visualization. Containerization technology complements and enhances Unidata data server offerings such as the TDS and ADDE. Unidata experts install, configure and in some cases, security harden Unidata software in containers defined by Dockerfiles. In turn, these containers can be easily deployed on cloud computing VMs by Unidata staff or community members that may have access to cloud-computing resources.

2. **Providing Useful Tools**
   Jupyter notebooks excel at interactive, exploratory scientific programming for

researchers and their students. With their mixture of prose, equations, diagrams and interactive code examples, Jupyter notebooks are particularly effective in educational settings and for expository objectives. Their use is prevalent in many scientific disciplines including atmospheric science. JupyterHub enables specialists to deploy pre-configured Jupyter notebook servers typically in cloud computing environments. With JupyterHub, users login to arrive at their own notebook workspace where they can experiment and explore preloaded scientific notebooks or create new notebooks. The advantages of deploying a JupyterHub for the Unidata community are numerous. Users can develop and run their analysis and visualization codes proximate to large data holdings which may be difficult and expensive to download. Moreover, JupyterHub prevents users from having to download and install complex software environments that can be onerous to configure properly. They can be pre-populated with notebook projects and the environments required to run them. These notebooks can be used for teaching or as templates for research and experimentation. In addition, a JupyterHub can be provisioned with computational resources not found in a desktop computing setting and leverage high speed networks for processing large datasets. JupyterHub servers can be accessed from any web browser-enabled device like laptops and tablets. In sum, they improve "time to science" by removing the complexity and tedium required to access and run a scientific programming environment.

3. **Supporting People**
   A Unidata science gateway running in a cloud computing setting aims to assist the Unidata community arrive at scientific and teaching objectives quickly by supplying users with pre-configured computing environments and helping users avoid the complexities and tedium of managing scientific software. Science gateway offerings such as web -based Jupyter notebooks connected with co-located large data collections are particularly effective in workshop and classroom settings where students have sophisticated scientific computing environments available for immediate use. In the containerization arena, Unidata staff can quickly deploy Unidata technologies such as the THREDDS data server to support specific research projects for community members.

Prepared *October 2022*

Status Report: Community Services

June 2022 - October 2022

Nicole Corbin, Doug Dirks, Tanya Vance, Jeff Weber

Areas for Committee Feedback

We are requesting your feedback on the following topics:

Have your needs from the Unidata Program Center changed during this unique time?

Activities Since the Last Status Report

News@Unidata blog

Posts to the News@Unidata blog appear regularly, but not on a specific schedule. Some highlights:

- Unidata Committee Nomination Period Extended
- Welcome Summer Intern Nathaniel Martinez
- Welcome Summer Intern Rhoen Fiutak
- Welcome Summer Intern Hassanpreet Kaur Dhaliwal
- Unidata Program Center Welcomes Tanya Vance
- Offer: Unidata Science Gateway JupyterHub Resources Available for Fall 2022 Courses
- Unidata Program Center Welcomes Thomas Martin
- Summer 2022 Unidata Interns Wrap Up Their Projects
- Unidata-hosted TDS Servers Upgrading to Version 5
- Unidata Program Center Welcomes Mike Zuranski
- Unidata Program Center Welcomes Megan Lerman
- Announcing a New eLearning Course: Learn Python-AWIPS
- Software release information
- Many AWIPSTips and MetPy Mondays episodes
- Community job postings
- Community meetings and other announcements

Dependencies, challenges, problems, and risks include:

- Finding community members willing to contribute stories (or story ideas) for the blog is an ongoing challenge. We're starting to make progress working with committee members, but there is more to do.

Community Outreach and Services

The community services group continues to actively reach out to and engage with Unidata community members.

Progress has been made on the following:

- Continue to engage with underserved populations and institutions as part of Unidata's outreach efforts to groups such as Rising Voices, SACNAS and AISES
- Continue to serve on the CUAHSI HIS standing committee.
- Continue to serve on the CUAHSI DEI standing Committee.
- Participating on new one year grant NSF#2220614 "The Indigenous Data Governance in Open Data Working Group"
- Engage with the Arctic Research Consortium of the US on multidisciplinary projects
- We continue to update Unidata's social media channels (Facebook, Twitter, Google+).
- We continue to publish short videos/screencasts on the Unidata YouTube channel.
- Represent Unidata at the National Weather Service Partners events
- We continue to actively support the NCAR/SOARS program.
- Actively participate in Super Science Saturday.
- Engage and support the Undergraduate Leadership Workshop (ULW) at UCAR.
- Support the development and operation of the UCAR:NCAR Equity and InclusiON (UNEION) community of practice.
- Support UCAR/NCAR media services by responding to requests from media outlets
- Met towers installed at SIPI and NTU, instrumentation is underway
- Preparations for a Unidata "track" in the EIPT conference of the 2023 AMS Annual Meeting are underway

Dependencies, challenges, problems, and risks include:

- Facilitating community adoption of new technological services (cloud, etc)
- Engagement with Unidata social media streams among community members is not particularly high.
- Engaging with new communities that have different resources, capacities, and expectations

Learning and Outreach

The community services group has expanded efforts to promote learning Unidata products and workflows.

Progress has been made on the following:

- Added Learn Python-AWIPS to Unidata eLearning catalog. This course was authored by Unidata student intern Rhoen Fiutak.
- Documented and shared the available Unidata Learning Experience Types at the UCAR members meeting

- Currently scoping the educational resources section of the Unidata Science Gateway re-envisioning
- Currently delivering a new multi-phase "fit-to-purpose" learning event focusing on Python.
    - Students first complete a self-assessment and are then given personalized list of recommendations for asynchronous lessons and resources.
    - A TA at the university then delivers a knowledge-check session to confirm prerequisite knowledge and skills.
    - Then Unidata staff deliver a two-part workshop focusing on exploratory data analysis techniques and troubleshooting with an emphasis on inquiry-based learning methods.
    - After the workshop, Unidata will facilitate Train-The-Trainer sessions to empower the university to continue delivering the materials without requiring Unidata intervention.
    - The first pilot is at Colorado State University, and will also be delivered (in part) at the 2023 AMS Student Conference, the 2023 Unidata Triennial Users Workshop, and others in the works.

Dependencies, challenges, problems, and risks include:

- With limited instructional design resources in-house, it is easier for us to create small, microlearning experiences. How can we better promote the concept of modular microlearning for use in classrooms or labs as opposed to generating new workshops?
- To evaluate the success of our learning opportunities, it is important to have a connection to learners after completion of the opportunity. Finding the time to meet with advisors/supervisors is limited.
- With the increase in scalable/reusable training materials, we are interested in increasing participation and learning more about potential barriers to use.

Ongoing Activities

We plan to continue the following activities:

- Engagement with science or cyber communities at large
- Support for governing committee activities (convening and coordinating discussions, planning for the upcoming Users Workshop, etc.)
- NAWIPS migration to AWIPS, including the overall AWIPS project
- Ongoing development of news articles for publication through News@Unidata
- Continue to support and contribute to governing committees
- Seminars
- Outreach
- Inclusion and equity
- Engagement with professional societies
- Support for cloud-related projects
- Further development of the Data Management Resource Center
- Support the pursuit of funding

- Site visits as the budget and pandemic allow
- Engage other UCAR/NCAR divisions regarding Unidata software use i.e. CESM/IDV
- Active participation in the Hydroshare Advisory Committee (CUAHSI)
- Ongoing work to transition Unidata's web site to UCAR-mandated system

New Activities

Over the next three months, we plan to organize or take part in the following:

- Expanded emphasis on engagement with MSIs
- Expanded effort organizing and supporting community seminars/working sessions
- Provide additional support for instructors/supervisors using or planning to use Learn AWIPS CAVE or Learn Python-AWIPS, especially in the form of content that can be embedded into university LMSs.
- Delivery of the Python EDA workshop

Over the next twelve months, we plan to organize or take part in the following:

- Design and develop a learning experience for machine learning in the atmospheric sciences without requiring prior knowledge in advanced math or programming.
- Design and develop the mechanism for serving learning experiences to the broader geoscience community via the Unidata Science Gateway.
- Make structural changes to broaden participation in Unidata community engagement
- Continue to engage the hydrologic community regarding WRF-Hydro/IDV interactions and the National Water Center's efforts
- Continue to engage the arctic community to find opportunities for collaboration
- Seek additional opportunities to engage and listen to the community
- Continue collaboration with UCAR's SOARS program to expand internship opportunities that meet the needs of underrepresented communities

Beyond a one-year timeframe, we plan to organize or take part in the following:

- Support the providing additional cloud-related training

Relevant Metrics

Statistics from the Community pages on the Unidata web site. Comparisons are made with statistics from the previous six-month period.

All community pages

Most recent six months:

- 35,619 unique pageviews (43,711 in previous period)
- 9.3% of total unique pageviews (9.5% in previous period)

Top community pages

1. All blog pages
   25784 unique pageviews (28664 in previous period)
   61% of total community pageviews (68% in previous period)
2. www.unidata.ucar.edu/community
   4543 unique pageviews (10415 in previous period)
   11% of total community pageviews (25% in previous period)
3. www.unidata.ucar.edu/about
   3196 unique pageviews (2917 in previous period)
   7% of total community pageviews (7% in previous period)
4. www.unidata.ucar.edu/events
   1601 unique pageviews (1188 in previous period)
   4% of total community pageviews (3% in previous period)

Social media statistics, May 23, 2022

1. # of Twitter followers: 1901 (up from 1672)
2. # of Facebook followers: 889 (up from 879)
3. # of YouTube subscribers: 2853 (up from 2126)
4. # of LinkedIn followers: 70 (up from 50)

Strategic Focus Areas

We support the following goals described in Unidata Strategic Plan:

1. **Managing Geoscience Data**
   We monitor and collaborate with data sources to stay apprised of impending changes and to advocate for the needs of our user community.

2. **Supporting People**
   We provide user workshops, tutorials, and community workshops to help build supportive relationships between community members.

   We coordinate with our governing committees to find ways to expand Unidata's community participation. We use our web site, electronic newsletters, and social media to keep community members informed about enhanced data services, software tools, and cyberinfrastructure.

   We participate in UCAR/NCAR and NSF projects for underrepresented populations and minority communities (SOARS, AIHEC, outreach to HBCUs). We provide services and

tools to facilitate education and research in diverse communities. We work to broaden the Unidata community by participating in student and professional conferences.

Prepared *October 2022*

Status Report: Data Standards and Technical Outreach

June 2022 - October 2022

Ethan Davis, Ward Fisher, Hailey Johnson, Dennis Heimbigner, and Ryan May

Areas for Committee Feedback

We are requesting your feedback on the following topics:

No requests currently.

Activities Since the Last Status Report

NCZarr/Zarr Specification Efforts

As part of implementing Zarr support in both the netCDF-C and -Java libraries, the NCZarr convention/extension has been developed to provide a clean and complete mapping between the netCDF and Zarr data models. During this work, the netCDF developers have been participating in discussions around clarification and evolution of the Zarr (version 2 and 3) specifications.

Progress has been made on the following:

- The Zarr community has added an Implementation Council to the Zarr governance structure. Dennis will represent the netCDF-C library and Hailey will represent the netCDF-Java library on the Zarr Implementation Council.

CF Conventions for netCDF activities

Unidata has a long history of involvement in the development of the Climate and Forecast (CF) Conventions for netCDF. These efforts continue with ongoing participation in development conversations on the CF GitHub repositories, participation in and help in organizing the annual CF Workshops, and participation in the governance of CF.

Progress has been made on the following:

- The 2022 CF Workshop was held 13-15 Sept 2020 in Santander, Spain.
- Ethan Davis continues serving as chair of the CF Governance Panel.

WMO Task Team for CF-netCDF

The WMO Expert Team on Data Standards (ET-Data) was formed in late 2020 and tasked with maintaining and developing the various WMO data standards. The newly formed Task Team

for CF-netCDF (TT-CFNetCDF) is one of several ET-Data Task Teams and is tasked with developing WMO profiles detailing how WMO will store data in CF-netCDF. So far the TT-CFNetCDF has developed WMO Profiles for radar data (based on CF-Radial) and oceanographic glider data and is working on a WMO Profile for aircraft data. The radar and glider profiles have been approved for experimental distribution on the WMO Information System (WIS) 2.0. The WIS 2.0 provides similar functionality to the GTS as well as more interactive access to data and is intended to eventually replace the GTS.

Progress has been made on the following:

- Ethan Davis continues as a member of the TT-CFNetCDF (and ET-Data).
- Taking part in discussions of how WMO CF-netCDF profiles and the WIS 2.0 transition will impact and benefit the University community.

Dependencies, challenges, problems, and risks include:

- Possible direct connection between LDM/IDD and WIS 2.0 would likely require development work.
- WMO moves very slowly, WIS 2.0 transition likely years away.

Updating and Reorganizing NetCDF User's Guide (NUG)

The NetCDF User's Guide (NUG) was initially developed when the netCDF-C library was the only netCDF implementation. While many sections of the NUG apply to all netCDF implementations (e.g., the data models and the file format descriptions), these more abstract parts of the current NUG are often still intertwined with netCDF-C implementation details. Similarly, support, development, and advancement of the NUG have also been intertwined with the netCDF-C library.

The goals of this work are to

1. Separate the aspect of netCDF that are useful to any user/developer, independent of which library or tool they use (i.e., data model, file formats, CDL definition, conventions, and best practices) from those that are library or language specific and
2. Clarify where and how the netCDF community can ask questions about the NUG as well as discuss and contribute to the development and advancement of the NUG.

Progress has been made on the following:

- Work on this effort has been slow but we plan to have a draft version of a library independent NUG document (GH repo) available in the next six months.

Registering netCDF Media Type (application/netcdf) with IANA

The idea of registering a netCDF media type has been discussed a number of times over the years but never gained the momentum needed to undertake the effort. A request from the group developing the OGC Linked Data in NetCDF standard (and their offer of assistance) initiated the current effort to officially register the netCDF media type with IANA.

Progress has been made on the following:

- The netCDF media type ("application/netcdf") has been added to IANA's provisional registry list with Unidata listed as the standards-related body supporting the effort.
- Documents in support of this effort are being developed in the new Unidata/netcdf GitHub repo (see PR #45).

Ongoing Activities

We plan to continue the following activities:

- Represent Unidata in Earth System Information Partners
    - Unidata has been a Type II ESIP Partner Organization since 1999
    - Ethan Davis is currently the Unidata voting representative to ESIP.
- Represent UCAR and Unidata in OGC and various OGC working groups
    - Ethan Davis is the UCAR voting representative to the OGC Technical Committee, Jeff de la Beaujardiere (NCAR/CISL) is alternate voting representative.
    - Participate in OGC MetOcean Domain Working Group (DWG) meetings.
    - Ethan Davis is co-chair of the OGC netCDF Standards Working Group (SWG)
    - Track and participate in the OGC Environmental Data Retrieval (EDR) SWG meetings.
    - Track and participate in OGC Community Standard process for CoverageJSON.

New Activities

Over the next three months, we plan to organize or take part in the following:

- Deploy a draft version of the new, library independent, NetCDF User's Guide (NUG).

Over the next twelve months, we plan to organize or take part in the following:

- Submit request for full registration of the netCDF media type with IANA

Strategic Focus Areas

We support the following goals described in Unidata Strategic Plan:

1. **Managing Geoscience Data**
   Unidata's various data standards efforts contribute to important tools for data producers, especially those that design and develop new data products, and for those that develop software tools for data management, analysis, and visualization.

Status Report: Unidata Community Equipment Awards

Sponsored by the National Science Foundation

June 2022 - October 2022

Areas for Committee Feedback

We are requesting your feedback on the following topics:

1. Suggestions from previous panel members on how to improve the program

Community Equipment Awards

The NSF provides the Unidata Program Center up to $100k in equipment grant funds each year. In alignment with the Unidata 2024 proposal, the Equipment Awards Program is designed to broaden participation and promote the use of Unidata tools and systems (e.g., THREDDS, NetCDF, IDV, GIS connections) to support education and research on various aspects of climate studies (e.g., diagnostics, change and impacts), by providing grants to be used in the procurement of new computers and equipment including upgrades to existing classroom and laboratory equipment.

The Users Committee met in early November 2022 to discuss possible adjustments to the wording of the Equipment Awards Call for Proposals to clarify what types of equipment are fundable through the program.

Relevant Metrics

Since taking over the management and administration of the Equipment Awards program in 2003 on behalf of the NSF, Unidata has made 104 awards totaling over $1,300,000.

Prepared *October 2022*

Status Report: GOES-East/West, NOAAPort and Other Satellite Imagery

June 2022 - October 2022

Mike Schmidt, Tom Yoksas, Mike Zuranski, Stonie Cooper

Questions for Committee Members

- What image coverages, spatial and temporal resolutions and possibly projections should be considered for addition to the **UNIWISC** IDD feed?

- What kind(s) of data access methods are most desired/usable for the community?

  We currently provide access via the IDD (push), AWIPS EDEX (pull), McIDAS ADDE (pull), and THREDDS Data Server (pull).

- Other questions?

Activities Since the Last Status Report

- We are still working towards establishing an additional GOES-R downlin in a locations that has a good view of the southern sky

  Comment(s):

  An effort to establish a new GOES-R downlink facility at the NCAR Marshall field site (just south of Boulder) was stymied by an NSF moratorium on any ground penetrations until an environmental impact assessment has been done for the entire site. We will be repointing the 4.5m dish at the Mesa Lab from GOES-17/18 back to GOES-16 to see if the Terrestrial Interference (TI) that we encountered about three years ago has been mitigated by replacement of power lines on the southern flank of the Mesa Lab. If ingest quality is now acceptable, we will install a GOES-West downlink on the western pad. This configuration was what was envisioned when we embarked on establishing GRB downlink capabilities.

  By any measure, GOES-16/17/18 imagery continues to be very popular in the community!

Ongoing Activities

We plan to continue the following activities:

- Participate in UW/SSEC's "fanout server" sharing of GOES-R/S data (redistribution of

the GRB-200 UDP unicast stream over TCP) for GOES-16/17/18 GRB products.

We are feeding from SSEC's GOES-16/17/18 fanout servers, and they are feeding from the ingest machine that we operate. Sharing of the feed streams has allowed SSEC and Unidata to minimize effects of solar and terrestrial interference.

- Ingest GOES ReBroadcast (GRB) streams from GOES-16 and GOES-17/18 in real-time

  Replacement of the power lines at the base of the hill on the south side of the Mesa lab facility may allow the dish currently ingesting GOES-17/18 to be repointed to GOES-16 as it was originally intended. If this test is successful, a new dish that will be installed on the western pad at the Mesa Lab will be pointed at GOES-West (which will likely be GOES-18 when the work is done).

  Background:

  In the fall of 2017 we began experiencing significant TI in the GOES-16 signal being received by our 4.5m satellite dish at the NCAR Mesa Lab. An outcome of the collaborations we had with Quorum Communications (the manufacturer of the electronics we use in our GOES-R/S ingest installations) was our moving of the GOES-16 ingest to a 3.8 m satellite dish located at the UCAR FL-2 location. The relocation of GOES-16 ingest required that an additional signal cable be pulled from the satellite dish that was repurposed from GOES GVAR ingest into the 2nd floor FL-2 NCAR/RAL computer room where our ingest electronics are located. The cost of this work was contributed by the UCAR/NCAR networking group.

  While the actual source of the TI being experienced at the Mesa Lab could not be pinpointed, the best guess at the time was that the noise being experienced was coming from power lines that lie south and downhill from the Mesa Lab. All of those power lines have since been replaced (by Xcel Energy), so there is a possibility that the TI is now gone. We will be conducting an experiment of re-pointing the dish from GOES-West back to GOES-East to see if the power lines were, in fact, the source of the TI. If the results of the test are positive, meaning the TI is gone or has decreased to an acceptable level, we will leave the dish pointing at GOES-East and resurrect the original plan of installing a GOES-West downlink on the western satellite pad at the Mesa Lab. This experiment will be conducted in conjunction with UWisc/SSEC to minimize potential data loss to the Unidata community.

  In the spring, we were given a 3.7m satellite dish that was being excessed by a private company that was relocating their operations. We will use this dish to establish either a GOES-R or NOAAPort downlink at the NCAR Marshall field site. Even more recently, we were given an additional 3.8m satellite dish that was being replaced by another company in Centennial, CO (on the southern side of Denver). Pending the testing described above, this dish may be installed on the western satellite pad at the Mesa Lab and used for GOES-West data ingestion.

- Continue to distribute GOES-16 and GOES-17/18 data via the LDM/IDD and serve the data via the TDS, ADDE and EDEX

The volume of data available in the SATELLITE datastream can be seen in:

http://rtstats.unidata.ucar.edu/cgi-bin/rtstats/iddstats_vol_nc?SATELLITE+oliver.unidata.ucar.edu

Future Activities

CSPP GEO Gridded Geostationary Lightning Mapper (Gridded GLM)

On March 21, 2021 Graeme Martin (UWisconsin/CIMSS) announced the initial release of **Gridded Geostationary Lightning Mapper (Gridded GLM)** software package:

The software is capable of processing GOES-16 and GOES-17 GLM Level 2+ products in mission standard format, generating a new set of products which have been gridded to the Advanced Baseline Imager (ABI) 2-km resolution, and are aggregated at one-minute intervals. Spatial extent information that is not readily available in the GLM L2+ data is recovered and used to create the gridded products.

The following products can be produced:

- *Minimum Flash Area*
- *Flash Extent Density*
- *Total Optical Energy*

AWIPS-compatible tiles can optionally be generated, using functionality that was developed within the open source Python SatPy library.

Input GLM L2+ files can be obtained from the CSPP Geo GRB software running at a direct broadcast site, or from NOAA CLASS. Output is in NetCDF4 format.

We intend to implement this software, evaluate the products, and distribute them in the IDD when appropriate.

Gridded Geostationary Lightning Mapper (Gridded GLM) products from Amazon AWS S3

We obtained access (effort spearheaded by `Tiffany Meyer`) to Gridded GLM products being created by the NWS for use in forecast offices. Redistribution of these products in the IDD as replacements for the Gridded GLM products currently being created by Eric Bruning of Texas Tech University was implemented in early summer 2022.

Himawari Imagery and Level 2 Products

We have also obtained access to Himiwari imagery and Level 2 products from Amazon AWS S3. We are asking the User Committee to weigh in on the importance/need of adding some of these products to the IDD. One thing that must be kept in mind is the volume of Himiwari

data is ***large***, so the ability of end user sites to handle real-time feeds of the full set of data is in question.

NOAAPort SBN

We are keeping abreast of the evolving schedule for moving NOAAPort SBN activities from Galaxy 28 to a new satellite. Exactly which satellite the SBN will be moved to is currently uncertain, but it will be west of where Galaxy 28 is. If the new satellite is as far west as some speculation from NOAA has suggested, our current NOAAPort ingest will suffer since there are trees that could be in the line-of-sight from the dish at FL-2. Or contingency for this possibility is to be ready to setup NOAAPort ingest at the Marshall Field site.

IDD NIMAGE and UNIWISC Datastreams

As noted earlier, both the **NIMAGE** and **UNIWISC** datastreams were revamped to include GOES-East/West imagery and products, and we will add more products if asked to do so by the governing committees. The **FNEXRAD** datastream was enhanced by the addition of MRMS products we receive in an LDM feed from NOAA/NCEP. More recently, the N0Q U.S. national radar composite was replaced by a composite of the so-called "super res" N0B product that was, along with several others, added to NOAAPort by the NWS.

The volume of data available in the **NIMAGE**, **UNIWISC,** and **FNEXRAD** datastreams can be seen in:

http://rtstats.unidata.ucar.edu/cgi-bin/rtstats/iddstats_vol_nc?NIMAGE+oliver.unidata.ucar.edu

http://rtstats.unidata.ucar.edu/cgi-bin/rtstats/iddstats_vol_nc?UNIWISC+oliver.unidata.ucar.edu

http://rtstats.unidata.ucar.edu/cgi-bin/rtstats/iddstats_vol_nc?FNEXRAD+oliver.unidata.ucar.edu

VALUE-ADDED Products

Texas Tech University (Eric Bruning) had been creating value-added Level 2 products created from Geostationary Lightning Mapper (GLM) data as a precursor for similar products potentially being added to NOAAPort, and we had been distributing these Level 2 products in the **NIMAGE** IDD datastream. Creation of these GLM Level 2 products stopped when the Unidata equipment grant that funded the effort expired in July. These GLM products were replaced by full disk products that are being created as tiles by the Vlab group in NOAA. The Vlab products have fewer parameters (3 versus 8 for the TTU products), but they are available for both GOES-East and GOES-West, and they also include a Level 3 product of 5 minute accumulations of Flash Extent Density, Total Optical Energy, and Minimum Flash Area.

We welcome contributions of additional value-added Level 2 satellite products community members.

SSEC Collaboration

Continue working with SSEC on their *fanout* approach that insulates GRB ingestion from expected (e.g., NCAR twice per year power downs; twice per year solar interference periods; etc.) and unexpected (e.g., TI caused) service interruptions

L2 Product Creation Testbed

We still want to establish a test bed for the creation of Level 2 (L2) products from GOES-16/17/18 imagery, model output and observational data.

The objective would be to provide the capability of running user site submitted algorithms to create L2 products and make them available for testing for a short period of time via the IDD, the TDS, McIDAS ADDE and AWIPS EDEX. This initiative has been slowed by the inability by most staff to work on-site.

Relevant Metrics

- Lots O Data!

  That the volume of GOES-16 and GOES-17/18 GRB products, 13 GB/hour average and 20 GB/hour maximum, is the second most voluminous IDD feed can be seen in the real-time statistics listings from any of the accumulators for our toplevel IDD relay clusters. For instance :

  https://rtstats.unidata.ucar.edu/cgi-bin/rtstats/rtstats_summary_volume?oliver.unidata.ucar.edu

- Feeding data to a slowly growing list of sites via the IDD:

  We are distributing all or part of the GOES-East/West GRB products to:

  - Groups within UCAR/NCAR (3: all products Unidata, EOL, RAL))
  - U.S. Universities (25: variety of feeds; GLM very popular)
  - U.S. Government (3: all products to 2 NOAA sites and one Military site)
  - International (3: Full Disk imagery and GLM L2 products)

Strategic Focus Areas

We support the following goals described in Unidata Strategic Plan:

1. **Managing Geoscience Data**
   Providing TDS, ADDE and EDEX servers for GOES-16/17 imagery and products benefits the greater community by providing access to real-time observations from the U.S. operational satellite constellation.

2. **Supporting People**
   Providing access to data in real-time has been a fundamental Unidata activity since its inception. Continuing to provide data enables Unidata sites to focus on their educational and research activities.

Prepared *October, 2022*

Status Report: Internet Data Distribution

June 2022 - October 2022

Stonie Cooper, Steve Emmerson, Mike Schmidt, Jeff Weber, Tom Yoksas, Mike Zuranski

Questions for Committee Members

- Do you have suggestions regarding content of data streams like CONDUIT, FNEXRAD, NIMAGE, UNIWISC, NLDN Lightning, SATELLITE, etc.?

  We (UPC, the Unidata community and UAlbany for the NLDN component of LIGHTNING) have control of the content of these data streams, so their contents are open for suggestions.

  NB: We now have access to Himiwari imagery and Level 2 products on AWS S3, so we could add some of these products to the IDD (probably in the SATELLITE feed), IF the committee thinks that this would be useful AND manageable by sites. Also, we are working with the UCP JCSDA group to get access to METEOSAT imagery from Eumetsat. If this access can be established, select METEOSAT imagery could be added to the IDD feed (probably in the SATELLITE feed).

Activities Since the Last Status Report

Internet Data Distribution (IDD)

IDD data volumes have not increased since the last meeting.

The following output is from a Linux-based data server that the UPC operates on behalf of the community, lead.unidata.ucar.edu:

```
20221021

Data Volume Summary for lead.unidata.ucar.edu

Maximum hourly volume 112914.668 M bytes/hour
Average hourly volume  69763.108 M bytes/hour

Average products per hour     447186 prods/hour

Feed                            Average             Maximum     Products
                       (M byte/hour)            (M byte/hour)   number/hour
CONDUIT                 15420.449    [ 22.104%]    47767.699    90072.067
SATELLITE               14846.467    [ 21.281%]    20088.552     6539.567
NIMAGE                   8883.970    [ 12.734%]    13060.520     7417.133
NGRID                    6836.012    [  9.799%]    12007.907    63311.200
```

```
NEXRAD2                6358.898    [  9.115%]     8394.424    83171.667
HDS                    5021.970    [  7.199%]    13175.723    30845.200
FNEXRAD                4770.820    [  6.839%]     8182.483    10180.267
EXP                    3098.346    [  4.441%]     6147.620    23195.733
NEXRAD3                2384.968    [  3.419%]     3148.587    73918.967
UNIWISC                 978.767    [  1.403%]     1136.777     1003.067
FSL2                    714.219    [  1.024%]     3040.840     1763.900
NOTHER                  267.764    [  0.384%]      722.806       57.733
LIGHTNING               100.276    [  0.144%]      525.843      682.133
IDS|DDPLUS               80.181    [  0.115%]       93.242    55027.100
```

Data Distribution:

IDD CONDUIT feed:

Data delivery has been reasonably good since NCEP upgraded the memory available and LDM queue sizes on the top level (virtual) machines that they operate as the source of CONDUIT data. Responsiveness to alerts raised by CONDUIT recipients has been very good since the last IDD status report in the spring of 2022.

IDD FNEXRAD, NIMAGE and UNIWISC feeds:

We continue to create the content for the FNEXRAD (NEXRAD Level III national composites), NIMAGE (GOES-East and -West Level 2 images and products, fully reconstituted images from NOAAPort tiles and with broadcast headers and footers stripped off to leave “bare” netCDF4 files), and UNIWISC (select GOES-East and -West images converted to McIDAS AREA format for use in legacy systems like GEMPAK) feeds.

We are still waiting for access to the full suite of NEXRAD Level III products to be opened. When this access is established, we will, upon guidance from the Users Committee, resume redistribution of some products that were removed from the NOAAPort SBN.

IDD NIMAGE feed:

The NIMAGE feed, which was originally populated solely with GINI imagery distributed in NOAAPort, continues to provide imagery reconstituted from tiles distributed in NOAAPort. Value-added GLM Level 2 products from NOAA’s Vlab group were added to the NIMAGE feed to replace similar products created by TTU in the summer of 2022. The Vlab products have fewer parameters, but they have full disk coverages from both GOES-East and GOES-West.

Experimental HRRR feed to eventually be replaced by RRRS:

Unidata used to receive experimental High Resolution Rapid Refresh (**HRRR**) grids (both 2D

and 3D fields) in an LDM/IDD feed from NOAA/GSL and feed these products to a small number of university sites on **hrrr.unidata.ucar.edu** (which is also known as **lead.unidata.ucar.edu**). Once the HRRR data went operational, NOAA/GSL stopped creating experimental **HRRR** output. The experimental **HRRR** is, however, being replaced by the **RRFS** (Rapid Refresh Forecast System) in NOAA/GSL. We have requested a feed of these data, but we have been told that the **RRFS** is still a few months away from being available.

Existing Data Distribution:

The primary top level IDD relay cluster, idd.unidata.ucar.edu, has been operating well since its move to the NCAR Wyoming SuperComputer (NWSC) facility in Cheyenne, WY.

The data volume seen in the **SATELLITE** (which is known as **DIFAX** in LDM distributions prior to v6.13.6) listing above represents all products received in the GOES ReBroadcast (GRB) downlinks that we installed in UCAR (currently GOES-17 at the NCAR Mesa Lab and GOES-16 at UCAR Foothills Lab 2). The data volume seen in the **NIMAGE** entry represents GOES-East/West ABI Level 2 imagery that has been reconstituted by stitching together tiles that are distributed in NOAAPort and all other Level 2 products. In both cases, binary headers and footers that are added to products before distribution in NOAAPort have been stripped off leaving "raw" netCDF4 files. The **UNIWISC** feed represents the volume of 3 select channels (0.64um VIS, 6.2um WV and 10.3um IR) for all coverages (CONUS, FullDisk, Mesoscale-1 and Mesoscale-2) of GOES-East/West image products that are in PNG compressed McIDAS AREA format that is suitable for use in GEMPAK, the IDV and McIDAS-V, McIDAS-X, and AWIPS.

Challenges, problems, and risks:

More sites, including UCAR, are installing intrusion detection/prevention systems (e.g., Palo Alto), which can adversely affect LDM throughput if not configured correctly.

Ongoing Activities

We plan to continue the following activities:

- Unidata has long distributed GPS radio occultation solutions from COSMIC. The LDM feed from COSMIC to Unidata was interrupted by UCAR security perimeter changes (as was/is the SUOMINET products).

- Many, but not all, of the products in NCEP operational HRRR are being distributed in the NOAAPort SBN and relayed in the IDD NGRID feed. Fire weather products (HRRR Smoke) that are being made available by NOAA/GSL in an EXP feed were added to the set of HRRR products that are available from hrrr.unidata.ucar.edu. All of these products along with with other model output are available via the TDS and Unidata AWIPS EDEX:

- Other data sets we continue to explore with NOAA/GSD/ESRL are:
    - FIM
    - HIWPP
    - RRFS

- NCEP (operational) HRRR fields and forecasts times were added to the IDD CONDUIT datastream.

NOAAPort Data Ingest

- Ingest of the DVBS-2 NOAAPort Satellite Broadcast Network (SBN) products and their relay to end-users via the IDD has been "operational" at the UPC since August 2014.

  Unidata continues to assist LSU/Climate (formerly LSU/SRCC) with the maintenance of their NOAAPort ingest capability. Activities have included providing a spare LNB to bring their NOVRA S300N receiver to Boulder for testing, configuration, power supply replacement, routine monitoring of their data and distribution, and consultation on satellite dish maintenance and pointing.

  Considerable effort has been expended in streamlining our NOAAPort ingest systems and assisting sites (UW/SSEC, NOAA/GSL, NOAA/SPC, Fox13 TV) in troubleshooting problems being experienced in their systems. More on the most recent of these activities can be found in the LDM status report.

- The NOAAPort-derived data streams (**HDS**, **IDS|DDPLUS**, **NGRID**, **NIMAGE**, **NEXRAD3** and **NOTHER**) are redundantly injected into the IDD at five geographically separate locations: UCAR/Unidata, UW/SSEC, LSU/Climate, Allisonhouse.com and Fox13 TV in Tampa, FL. Even though GOES-15 will periodically be taken out of storage for use in western Pacific hurricane monitoring, the GINI image products that are created from its scans are only available during the short periods when the satellite is taken out of storage.

- Unidata's NOAAPort ingest package is bundled with current versions of the LDM. The current LDM release is v6.13.16. A new LDM distribution is being tested on Unidata ingest machines, and should be ready for release in early summer.

Relevant Metrics

- Approximately **555** machines at **193** sites are running LDM-6 **and** reporting real-time statistics to the UPC.

  We routinely observe that the number of sites reporting real-time statistics fluctuates. We are not certain why this may be the case, but our best guess is that some sites do not keep their LDMs running all of the time; campus firewall adjustments block the sending of the statistics; and/or sites decide to stop sending statistics. The latter

possibility seems to be happening more frequently.

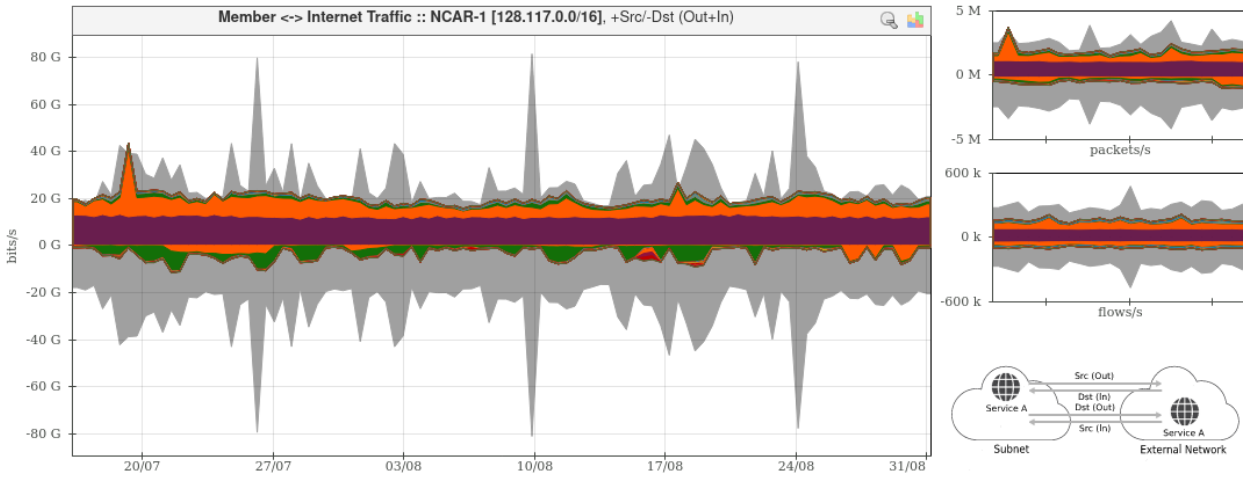
We know that there are a number of sites that are participating in the IDD, but are not reporting real-time statistics back to us. Reporting of real-time statistics is not and never has been mandatory.

Unidata staff routinely assist in the installation and tuning of LDM-6 at user sites as a community service. We have learned about sites not sending real-time statistics during these kinds of support activities, and a number of times the impediment to sending in stats is firewall configurations at the user sites.

- A number of organizations/projects continue to use the LDM to move substantial amounts of data that do not report statistics to Unidata: NOAA, NASA, USGS, USACE, Governments of Spain, South Korea, private companies, etc.).

- UCAR IDD toplevel relays, **idd.unidata.ucar.edu and iddb.unidata.ucar.edu**

  The IDD relay clusters, described in the June 2005 CommunitE-letter article Unidata's IDD Cluster, routinely relays data to more than 1205 downstream connections. The primary IDD relay cluster, **idd.unidata.ucar.edu**, was moved to the NCAR/Wyoming Super Computing facility in Cheyenne, WY in late August 2019.



Services	Src (Out+In)		Dst (Out+In)		Total (Out+In)	
	Avg	Max	Avg	Max	Avg	Max
Port [388]	7.3 Gbps (43.7	13.3 Gbps	46.3 Mbps (0.3	84.1 Mbps	7.3 Gbps (22.0	13.4 Gbps
HTTPS [443]	3.7 Gbps (22.3	29.4 Gbps	492.2 Mbps (3.(	7.0 Gbps	4.2 Gbps (12.6	29.5 Gbps
SSH [22]	541.9 Mbps (3.:	2.2 Gbps	840.0 Mbps (5.(	8.2 Gbps	1.4 Gbps (4.1 %	9.1 Gbps
Port [5201]	644.5 kbps (<0.	3.1 Mbps	161.4 Mbps (1.(	530.4 Mbps	162.0 Mbps (0.!	532.3 Mbps
HTTP [80, 8081]	150.9 Mbps (0.!	1.6 Gbps	1.5 Mbps (<0.1	12.2 Mbps	152.4 Mbps (0.!	1.6 Gbps
Port [4501]	79.7 Mbps (0.5	530.5 Mbps	36.3 Mbps (0.2	295.4 Mbps	116.0 Mbps (0.:	701.4 Mbps
Port [112]	58.2 Mbps (0.3	113.9 Mbps	498.2 kbps (<0.	938.8 kbps	58.7 Mbps (0.2	114.8 Mbps
Port [50040]	45.6 Mbps (0.3	248.1 Mbps	2.3 Mbps (<0.1	846.2 Mbps	47.8 Mbps (0.1	900.9 Mbps

Over the period from July 17 through August 31, 2022 (IDD volume snapshots are taken during periods that do not have monitoring dropouts in NetVizura plots) the

average volume of LDM/IDD data flowing from the UCAR/NCAR network averaged around 7.3 Gbps (~78.84 TB/day), and peak rates reached 13.3 Gbps (which would be ~144TB/day if the rate was sustained (which it is definitely **not**)).

The following table of volume snapshots shows that the volume of data flowing to downstreams out of UCAR has been reasonably consistent:

Date range	Src Ave Max	Dst Ave Max	Total Ave Max
20200508 - 20200630	5.4 7.5	42.1 52.9	5.5 7.5
20200701 - 20200930	5.4 7.9	41.9 60.3	5.4 7.9
20201001 - 20201231	5.2 6.9	39.9 55.9	5.3 7.0
20210101 - 20210331	5.5 8.0	42.3 59.9	5.5 8.1
20210401 - 20210415	6.1 15.5	46.4 112.7	6.1 15.7
20210601 - 20210719	6.6 9.2	50.5 73.0	6.6 9.2
20210908 - 20211005	7.6 14.9	59.3 121.7	7.7 15.0
20211101 - 20211231	6.7 9.1	52.4 71.4	6.8 9.2
20220208 - 20220311	6.6 15.2	53.5 114.8	6.6 15.3
20220412 - 20220521	7.2 14.5	52.6 103.7	7.3 14.6
20220717 - 20220831	7.3 13.3	46.3 86.1	7.3 13.4

NB: The units for Src and Total Ave and Max are Gbps (gigabits per second), and the units for Dst are Mbps (megabits per second).

Strategic Focus Areas

We support the following goals described in Unidata Strategic Plan:

1. **Managing Geoscience Data**
   The IDD project demonstrates how sites can employ the LDM to move and process data in their own environments.

2. **Providing Useful Tools**
   The freely available LDM software and the IDD project that is built on top of the LDM have served as a demonstration for distribution of real-time data for a variety of organizations including the U.S. National Weather service.

The cluster approach for LDM/IDD data relay that Unidata pioneered has been been adopted by several Unidata university sites, and is currently being implemented at U.S. government sites.

Unidata's NOAAPort ingest package, which is bundled with LDM-6, is being used by a variety of university, U.S. government, and private sector entities.

Both the LDM and NOAAPort ingest packages are bundled with AWIPS.

3. **Supporting People**
   The IDD is the primary method that core Unidata sites use to get the meteorological data that they need. Providing access to data in near real-time is a fundamental Unidata activity. The IDD-Brasil, the South American peer of the North American IDD, and IDD-Caribe, the Central American peer of the North American IDD, are helping to extend real-time data delivery throughout the Americas

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Prepared *October, 2022*

Status Report: IDV with RAMADDA

June 2022 - October 2022

Yuan Ho, Julien Chastang

Activities Since the Last Status Report

IDV Releases

The IDV 6.1 was released on August 1 of 2022.

The IDV 6.1u2 was released on August 20 of 2022.

The IDV 6.1u2 was released on September 8 of 2022.

IDV System Changes

__Latest netCDF-Java Version__

The version of the netCDF-Java library currently distributed with the stable release version (6.0u1) is the 5.5.3-SNAPSHOT . There have been many new features and bug fixes in that range. The complete release notes for these versions can be found here.

__IDV Certificates__

Java Webstart, Windows app and MacOS certificates have been renewed and will be valid until at least May 30, 2021 (MacOS certificate is valid until 2024). Moreover, as properly signing the IDV under these different environments can be an involved process, this information has been thoroughly documented here.

__IDV Webmod2 Migration__

Webmod2 project: Working with other developers to migrate all the IDV related resources, release engineering process, and documents to the new UCAR web infrastructure.

__Changes to nightly release that will eventually be incorporated into into stable version__

- IDV uses the latest Java 8 AdoptOpenJDK
- IDV employes latest Java3D (1.6.2)
- Updated the IDV code signing certificates on all platforms (i.e., MacOS, Windows, Webstart)
- IDV now “notartized” on MacOS

- Updated Unidata's Install4J license from version 5 to 8.
- Updated the IDV Install4J configuration.

IDV Display Changes

__Dark Mode Appearance__

In macOS and Linux users can choose to adopt a light, dark, or IDV regular appearance. The dark appearance, known as Dark Mode, implements an interface style that many apps already adopt. Users can edit the preference and can choose their interface appearance based on ambient lighting conditions.

__New PROBSEVERE Data Display__

The IDV has developed a new data source type to create a time series display of the PROBSEVERE Statistical models output that provide probabilistic guidance to forecasters on the likelihood of severe weather occurrence for convection in the near term. Algorithms of PROBSEVERE incorporate multiple datasets from satellite, radar, total lightning, and NWP into easy-to interpret products. With a direct connection to the NCEP PROBSEVERE web page to retrieve data of the last 24 hours and the time matching feature of the IDV, it is very easy to integrate PROBSEVERE model data with other data source types and to assist forecasters in severe weather situations.

__New ADT Integration__

The ADT integration and development: The Advanced Dvorak Technique (ADT) utilizes longwave-infrared, temperature measurements from geostationary satellites to estimate tropical cyclone (TC) intensity. The Dvorak Technique continues to be the standard method for estimating TC intensity.The IDV ADT integration is still experimental and has not been found through testing. More information about the ADT and various run-time options, algorithms, and program outputs can be found in the McIDAS-X ADT-Version 8.2.1 Users' Guide at http://tropic.ssec.wisc.edu/misc/adt/info.html. We are going to further integrate the ADT feature with the IDV ACTF hurricane track analysis interface to provide a more powerful tool for the community.

__MP4 Movie Capture__

Other than Quicktime and animated GIF and other movie formats, the support of MP4 format has been added to the output format list in this release.

__WRF Grid Diagnostics Formulas__

The original WRF netCDF output is in sigma coordinate. The current grid diagnostic formula is mostly designed for the isobaric surface parameters. The newly added WRF derived formulas provide the capability to directly create the derived parameters such as: Equivalent potential temperature, relative humidity, Saturated Equivalent potential temperature, dewpoint, and others.

__Latest Version of VisAD__

The SSEC team at UW, Madison has made a number of improvements to support 3D trajectories.

IDV Community Support

In the hybrid environment of in person and remote-learning system as a result of the COVID-19 pandemic, we keep helping universities and research institutes to run Unidata's Integrated Data Viewer (IDV) at home.

__Yuan provided a remote IDV training class to students of the satellite meteorology course from the University of Millersville.

__Yuan collaborated with the research project team including UPC, MMM, Univ. of Hawaii, and CMB (Central **Weather Bureau of Taiwan)**.

__Yuan collaborated with the research project team including UPC and Univ. of Hawaii.

__Yuan provided a remote IDV training class to Univ., Ethiopia.

__Yuan worked with Jeff Weber to provide support to the NSF funded project "The Indigenous Data Governance in Open Data Working Group".

__Yuan mentored this year summer intern Hassan and developed a few functions of calculating the boundary layer depth.

As international collaborations, I provided several online training classes for university students of Turkey, Spain, and Italy. Students from Turkey ran the regional WRF models and do the analysis and visualizations of outputs with the IDV, students from Spain using the GFS datasets from our TDS server and the IDV new grid coverage feature to do analysis across the data boundary, and students from Italy run the IDV to visualize 3D oceanographic observations in the Mediterranean sea for climate research.

KIOSK IDV Project

In collaboration with UCAR Center for Science Education and Computational Information Systems Laboratory, the project developed an extended IDV package for a Real-Time Weather Museum Touchscreen. This new real-time weather museum touchscreen display will undergo further usability testing to eventually join other weather and climate exhibits at NCAR's Mesa Lab in Boulder, CO, and at the NCAR-Wyoming Supercomputing Center Visitor Center in Cheyenne, WY.

IDV Publication Highlights

Synoptic–Dynamic Meteorology in 3D: Introducing an IDV-Based Lab Manual by Gary Lackmann, B. Mapes and K. Tyle

A Google Scholar Search reveals a number of publications that cite use of the IDV (doi:10.5065/D6RN35XM).

IDV and RAMADDA Training, Conference Attendance and Presence

__2021 AGU Fall Meeting__

- Impact of GNSS radio occultation data on the prediction of convective systems associated with a Mei-Yu front
- Machine Learning Predictive Model of Ice Supersaturated Regions (ISSRs) with Advanced 3D Visualization and Analysis

__2022 AMS Annual Meeting__

- Cross boundary subset of 2D/3D Grid coverage dataset and visualization

Ongoing Activities

We plan to continue the following activities:

__Investigation of Java 3D Alternative__

Because of concerns about the long-term viability of the open-source Java 3D project, the IDV team has begun discussions with our University of Wisconsin, SSEC collaborators to replace Java 3D with a more viable alternative within the VisAD API. We have started investigating whether the Ardor 3D can meet that objective. Looking into alternatives to Java 3D was also a goal described in the Unidata 2018 Five-year plan.

New Activities

Over the past few months, we plan to organize or take part in the following:

We plan to upgrade the version of OPenJDK Java. This change will necessitate in depth testings and the IDV building and distribution workflow.

Relevant Metrics

__E-Support__

The IDV team continues to provide the geoscience community with high-quality support through e-support software and idv-users mail list. In the last half year the IDV team has closed ~40 e-support tickets. Each individual ticket may and often does involve many back-and-forth messages. There is an especially large number of support requests coming from international users.

Top ten universities running IDV are: Millersville, Oklahoma, University of Utah, St Cloud state, Plymouth, NC State, West Kentucky, Lyndon State, University of Illinois, and San Francisco State.

__GitHub Pull Requests__

In the area of greater collaborative development, since the migration of the IDV project to github, we have closed a total of 125 “pull requests” or code contributions from internal and external collaborators.

__Youtube IDV Instructional Videos__

In the area of online IDV training, the Youtube IDV instructional videos have been viewed thousands of times.

Strategic Focus Areas

We support the following goals described in Unidata Strategic Plan:

1. **Managing Geoscience Data**
   The IDV is a state of the art geoscience visualization application. It gives users the ability to view and analyze a rich set of geoscience data, including real time data, in a seamless and integrated fashion. This analysis is captured in IDV bundles. RAMADDA is a content management system and service specifically tailored towards the sharing and distribution of IDV bundles facilitating distribution of scientific data and analysis.

2. **Providing Useful Tools**
   The IDV has been an open-source project for several years. The IDV is available on the github version control platform for greater open-source collaboration. The IDV provides users the unparalleled ability to analyze, integrate, and visualize heterogeneous geoscience data in two, three, and four dimensions. The IDV coupled with RAMADDA enables geoscience specialists the capability to share and collaborate their IDV analysis via social scientific networks.

3. **Supporting People**
   Unidata offers yearly multi-day training and occasionally regional workshops for IDV and RAMADDA. The IDV coupled with RAMADDA enables our earth science community partners to distribute geoscience data and metadata through web-based technologies thereby fostering scientific collaborations. Moreover, the IDV's ability to share bundles through RAMADDA creates a scientific social and collaborative network for the geoscience community.

Prepared May, 2022

Status Report: Information Technology

June 2022 - October 2022

Mike Schmidt, Matt Perna, & Jennifer Oxelson

Major Activities

****Remote working**** -- with most of the Unidata staff continuing with remote working over the long term, we have and will continue to experience some level of ongoing challenges managing remote systems, especially hardware problems for users out-of-state who are never expected to come to the office. Overall, it's been a successful test of the infrastructure and software supporting remote working staff

****Data center upgrades**** -- UCAR is nearing completion of their Mesa Lab Data Center (MLDC) co-location facility upgrade. We have been putting pieces in place to facilitate the relocation of our MLDC based servers when the time comes. There may be the need to roll some of our Internet based services to the NWSC in Cheyenne for extended outages.

****Security**** -- we continue efforts to keep services and systems secure which takes consistent attention and occasional herculean efforts (to patch everything all at once). UCAR has embarked on a number of new initiatives to segment the network into smaller and smaller zones, centralize DNS, and gain a more dynamic inventory of assets on the network. Unidata continues to play a role in these efforts.

****LDM 7 node**** -- we maintain a LDM7 test node at the Front Range GigaPOP (FRGP) just off downtown Denver in co-location with the major backbone networks supporting FRPG participants (UCAR, ..). We expect to support intensive data movement and LDM testing for the next few years on this effort.

Ongoing Activities

We plan to continue the following activities:

- Day-to-day system and network support to the community as needed
- Resolve daily staff help desk issues
- Maintain security profile and exceed UCAR security standards
- Following UCAR directives regarding DNS and Palo Alto zones centralization

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Prepared October, *2022*

Status Report: LDM

June 2022 - October 2022

Steve Emmerson, Tom Yoksas, Mike Schmidt, Stonie Cooper

Activities Since the Last Status Report

LDM

The LDM is the primary software package by which research and education institutions obtain near real-time meteorological and related data.

Progress has been made on the following:

- Installation:
  - Added support for use of chronyd(8) instead of ntpdate(8)
- NOAAPort:
  - Major refactoring and improvements to blender(1) regarding the parsing of NOAAPort feeds (despite a complete lack of documentation from NOAA).
- Logging:
  - Corrected initialization of logging module when it's configured to use the system logging daemon.
- scour(1):
  - Improved documentation on the specification of the hours and minutes in how long to keep a file before deleting it.
- ldmadmin(1):
  - Added "-o <template>" option to "plotmetrics" command to write metrics plots to files instead of to the X-server.
  - Sped-up "ldmadmin start" and "ldmadmin stop"
- Miscellaneous: Removed lint identified by clang(1), Coverity Scan, and the US Air Force (in unexecuted code).
- Released version 6.13.17.
- Support:
  - Answered many questions from Universities, NOAA, US Military, and corporations
  - Gave a virtual workshop on the LDM to the NWS Southern Region HQ
  - Gave a presentation on the LDM to Google.

Dependencies, challenges, problems, and risks include:

The LDM is sometimes held responsible for decisions made by the NWS when they don't follow their own policy on how to categorize and name data products (not a new challenge).

More sites are installing intrusion detection/prevention systems (e.g., Palo Alto), which can adversely affect LDM throughput if not configured correctly (again, not new).

The documentation from NOAA on the semantics and syntax of NOAAPort frames is sub-optimal; consequently, ensuring correct behavior of the blender(1) program took longer than expected. Stonie Cooper, our latest hire, has copies of the original specifications. This might prove very useful.

Ongoing Activities

We plan to continue the following activities:

- Support and maintain the LDM
- Convert the LDM build process from the current one based on GNU automake(1) to one based on CMake. Beside being cleaner, this will enable the automatic creation of binary distributions (e.g., RPM and DEB files).
- Stonie Cooper will gradually assume responsibility for the LDM

Relevant Metrics

- Data on LDM downloads
- The LDM system at the Unidata Program Center powers the Unidata IDD (Internet Data Distribution) system. Metrics on that program can be found in the IDD status report.

Strategic Focus Areas

We support the following goals described in Unidata Strategic Plan:

1. **Managing Geoscience Data**
   By enabling researchers, teachers, and students to process a wide variety of meteorological and related data in near real time.

2. **Providing Useful Tools**
   By enabling researchers, teachers, and students to obtain a wide variety of meteorological and related data in near real time and at no cost via the Internet.

   By using the LDM to move data into the cloud and developing multicast technologies.

3. **Supporting People**
   By answering support questions, writing documentation, and conducting workshops.

Status Report: McIDAS

June 2022 - October 2022

Tom Yoksas

Areas for Committee Feedback

We are requesting your feedback on the following topics:

1. Are there any features that users would like to be added to Unidata McIDAS-X and/or ldm-mcidas?

Activities Since the Last Status Report

Aside from routine updates/bugfixes to existing code and tables, the main area of activity recently has been the release of Unidata McIDAS v2021. The main development area that we have been involved in is enhancing the HimawariCast ADDE serving to handle the Himawari HRIT images that are being distributed in EUMETCAST, images that are different from the ones being distributed in HimawariCast by the JMA.

Current Activities

- Support use of McIDAS-X/XCD in-house and in the community

- Ensure that the Unidata instances of McIDAS ADDE continue to function efficiently (ADDE serves on the order of 1.7 TB/day from three servers that Unidata operates on behalf of the community)

- McIDAS-X is used to convert GOES-East/West ABI imagery that is in netCDF4 format to McIDAS AREA format that is usable by all supported display and analysis packages (except Python/MetPy) for the Unidata-Wisconsin (**UNIWISC** aka **MCIDAS**) IDD feed.

The Unidata v2021 release includes these SSEC v2021.1 release features:

- Added support for McIDAS-X on **macOS 11** systems.
- Updated **GOES-R Series ABI and GLM** servers with additional bug fixes and enhancements, including preparations for future GOES-18 and GOES-19 satellites, adding support of database search capabilities for improved performance in the SDS ABI archive, and access to ABI L2 Cloud and Moisture Imagery (CMIP) data.
- Updated the **VIIRS and MSG** servers and calibration modules to allow **IMGPROBE** to return VIIR REF and NREF values and MSGS/MSGT RAD values with more precision.
- Updated the ADDE servers to honor both the client's and the server's **ADDETIMEOUT** environment variable. ADDETIMEOUT now overrides the 600 second timeout of the default ADDE server.

- The **GVAR** servers were updated for **EWS-G1** satellite data. GOES-13 became EWS-G1 on 8 September 2020. McIDAS-X checks for that date to appropriately set the SS number correctly for each satellite.
- The **GRIB servers and GRD* commands** were updated to list and display GRIB data with decimal pressure levels between 0 and 1 hPa, levels in potential vorticity units (PVU), and soil temperature levels in units of meters below ground (MBG).
- The **mcinet.sh** script was updated to allow the McIDAS-X system service to be controlled by **systemd** or **xinetd**.
- Improvements were made to the **IMGPROBE** command. The new NORM option enhances the displayed image with a histogram normalization by taking the min/max of the specified unit in the defined region and having the displayed BRIT values stretched from 0 to 255. IMGPROBE was updated so the BOX region has a limit of 30,000,000 points, and the BOX CONT (contouring) option has a limit of 10,000,000.
- The **GAMMA=** keyword was added to the **IMGOPER** command to apply gamma values to output AREA files, and **RGB.MCB** was added to -XRD, along with many **RGB recipes for current real-time satellites**. The **RGB** recipes use **IMGOPER** with GAMMA= to calculate the red, green, and blue channels, and then **RGBDISP** to display the products.
- Changes were made to the McIDAS-XRD Python Package to better handle single quotes in McIDAS-X commands. Each user must redo the **mcxpyinstall** installation step to utilize this new feature.

Ongoing Activities

We plan to continue the following activities:

- SSEC McIDAS Advisory Committee (MAC)

  The UPC (Yoksas, Ho) continues to participate as the Unidata representative to the McIDAS Advisory Committee (MAC) that is operated by SSEC, but meetings of this group have been rare for quite some time.

  The MAC was assembled by UW/SSEC to advise SSEC on McIDAS-X users' needs/concerns/desires for development in the next generation McIDAS, McIDAS-V. The MAC was modeled after the Unidata IDV Steering Committee.

- Interest in McIDAS by non-core users

  The UPC occasionally receives requests for McIDAS-X and help using McIDAS-X from international university users, U.S. government agencies and other non-traditional Unidata users (e.g., private businesses, etc.). Government agencies and non-traditional Unidata users are referred to UW/SSEC for access to McIDAS; international educational community user requests are granted on a case-by-case basis after they provide a clear statement of their acceptance of the terms of use provided by SSEC.

- Continued support of existing and new community members

New Activities

- Add support for new types of data when they become available, otherwise McIDAS-X support is in maintenance mode.

Relevant Metrics

- Data delivered by the Unidata McIDAS ADDE servers exceeds 1.7 TB/day. The great majority of the data being served is imagery from GOES-16/17/18.

- McIDAS-X/-XCD Inquiry Metrics

ldm-mcidas Decoders Activities

Development

ldm-mcidas releases are made when needed to support changes in software development and operating system environments. **ldm-mcidas** v2012 was released at the end of September, 2012. Recently, the ldm-mcidas code was moved to GitHub.

Geostationary Satellite Data Ingest and Data Serving

Unidata continues to ingest GOES-East and GOES-West imager data at the UCAR Foothills Lab and NCAR Mesa lab campuses in Boulder.

- Direct, programmatic access to real-time GOES-East (GOES-16) and GOES-West (currently GOES-17 but soon to be GOES-18) data via McIDAS ADDE services on three publicly accessible servers (lead.unidata.ucar.edu, atm.ucar.edu and adde.ssec.wisc.edu) has been averaging on the order of 1.7 TB/day for the past two years.

Planned Activities

Ongoing Activities

Continued ingest, distribution via the IDD and ADDE serving of GOES-East and GOES-West imagery from the GRB downlinks we installed in UCAR

Continued ingest and ADDE serving of GOES-15 and GOES-14 imagery when available. GOES-15 and GOES-14 were put into standby mode on March 2, 2020. GOES-14 remains in its standby location (104W) and is turned on for periodic testing as needed. GOES-15 supplemental operations began on Sunday, August 9, 2020 and continues to provide surveillance during Pacific hurricane seasons. It is most likely that GOES-15 operations will end when GOES-18 assumes the role of GOES-West from GOES-17. It is our understanding that GOES-17 will be drifted towards the GOES-14 standby orbit and function as an in-orbit standby for GOES-16 and GOES-18.

These efforts require maintenance of the satellite ingest and data serving equipment.

New Activities

Establish a testbed for generating Level 2 products from GOES-East/West imagery and select model output. The intention is to be able to test vetted algorithms submitted by community members for a long enough period for the algorithms to be fully tested.

Strategic Focus Areas

We support the following goals described in Unidata Strategic Plan:

1. **Managing Geoscience Data**
   Remote, programmatic access to data provided by the Abstract Data Distribution Environment (ADDE) environment of McIDAS has been a model for the development of remote access methodologies since 1994. Concepts articulated in ADDE inspired the development of THREDDS (to address the lack of rich metadata available in ADDE) and RAMADDA. ADDE remains one of the most used data services in the Unidata suite. ADDE servers operated by Unidata are currently serving in excess of 1.6 TB/day.

2. **Providing Useful Tools**
   McIDAS remains the application of choice for the satellite meteorology community. The Abstract Data Distribution Environment (ADDE) component of McIDAS was the first application offered by Unidata to provide remote, programmatic access to a wide variety of data that is important to the atmospheric science community.

   The fifth generation of McIDAS, McIDAS--V, unlike its predecessors, is a fully open source application that is in wide scale and growing use in the worldwide satellite meteorological community

   McIDAS ADDE continues to evolve and provide access to a rapidly increasing volume of imagery and non-image data.

3. **Supporting People**
   McIDAS is still in active use by those interested in satellite meteorology worldwide.

Prepared *October, 2022*

Status Report: netCDF

June 2022 - October 2022

Ward Fisher, Dennis Heimbigner

Areas for Committee Feedback

We are requesting your feedback on the following topics:

1. In what specific ways can netCDF be modified to help with the modern cloud-based, scientific workflow?
2. What aspects of the modern AI/ML workflow might be improved by changes to the netCDF technical infrastructures.
3. What messaging and communication would you like to see improved from the netCDF team, moving forward?

Activities Since the Last Status Report

We are using GitHub tools for C, Fortran and C++ interfaces to provide transparent feature development, handle performance issues, fix bugs, deploy new releases and to collaborate with other developers. Additionally, we are using docker technology to run netCDF-C, Fortran and C++ regression and continuous integration tests. We currently have **216** open issues for netCDF-C, **89** open issues for netCDF-Fortran, and **49** open issues for netCDF-C++. The netCDF Java interface is maintained by the Unidata CDM/TDS group and we collaborate with external developers to maintain the netCDF Python interface.

In the netCDF group, progress has been made in the following areas since the last status report:

- The netCDF and netCDF-Java teams have joined with the Zarr Implementation Committee, in order to help guide the development of the Zarr v3 and future specifications in a way that promotes broad compatibility across Zarr implementations.
- The netCDF and netCDF-Java teams have also joined with the Zarr Enhancement Protocol (ZEP) committee, in an effort to help codify the process by which features are added to the Zarr v3 specification.
- The release of ncZarr (netCDF with native Zarr support) has been improved as of netCDF-C version 4.9.0.
- Continuing improvement for the NUG: We previously migrated the NetCDF User's Guide to a new, separate repository. This repository will contain the concise, language-agnostic summary of the netCDF data model. Language-specific documentation (primarily used by developers) will remain associated with the individual code repositories.
- Further enhancements to the netCDF-C documentation, modernization of the netCDF-Fortran and netCDF-C++ documentation.

- We continue to see a high volume of contributions to the netCDF code base(s) from our community. While these contributions require careful review and consideration, it is encouraging to see this model of development (enabled by our move to GitHub) being more fully embraced by our community.
- Introduction of additional filter and plugin support for dynamic, selective compression, based on work contributed by Charlie Zender and Ed Hartnett.

Dependencies, challenges, problems and risks include:

- The small group of netcdf developers is under a lot of pressure to provide project management as well as implement new features, fix bugs, provide esupport, etc. With 1.5 FTE assigned to the project, the workload is significant.
- Rapid evolution of the Zarr standard is very useful, but also provides a bit of a moving target.
- Increase in external contributions has greatly increased the project management overhead for netCDF-C/C++/Fortran.
- Advances in compilers (GCC 10.x) and newer architectures (such as Apple's ARM M1 architecture) are requiring additional overhead to ensure compatibility.

Ongoing Activities

We plan to continue the following activities:

- Continue work towards adoption of additional storage options, separating out the data model from the data storage format (as much as possible).
- Provide support to a large worldwide community of netCDF developers and users.
- Continue development, maintenance, and testing of source code for multiple language libraries and generic netCDF utility programs.
- Continue modernizing the documentation for netCDF-C, Fortran and C++ libraries.
- Extend collaboration as opportunities arise, for increasing the efficiency of parallel netcdf-3 and netcdf-4.

New Activities

Improved NetCDF/Zarr Integration

The netCDF team has released the first public version of netCDF-C which provides Zarr I/O compatibility, dubbed 'ncZarr'. This work has been highly anticipated, and well received, by the broader netCDF and Zarr communities. Work continues in collaboration with the Zarr community group and the Zarr Enhancement Protocol group

Over the next three months, we plan to organize or take part in the following:

- Release iterative versions of netCDF-C, netCDF-Fortran, netCDF-C++.
- Continue modernizing/editing the netCDF documentation to provide easy access to documentation for older versions of netCDF.

Over the next twelve months, we plan to organize or take part in the following:

- Release an official Windows port of the netCDF-Fortran and netCDF-C++ interfaces.
- Continue to encourage and support the use of netCDF-4's enhanced data model by third-party developers.
- Expand support for native object storage in the netCDF C library.
- Continue to represent the Unidata community in the HDF Technical Advisory Board process.
- Continue to represent the Unidata community in the Zarr/n5 collaboration conference calls.

Beyond a one-year timeframe, we plan to organize or take part in the following:

- Improve scalability to handle huge datasets and collections.
- Improve the efficiency of parallel netcdf3 and parallel netcdf4.
- Continue to add support for both file-storage and object-storage options.

Relevant Metrics

Google Metrics

Google hits reported when searching for a term such as netCDF-4 don't seem very useful over the long term, as the algorithms for quickly estimating the number of web pages containing a specified term or phrase are proprietary and seem to change frequently. However, this metric may be useful at any particular time for comparing popularity among a set of related terms.

Currently, Google hits, for comparison, are:

- **963,000** for netCDF-3
- **996,000** for netCDF-4
- **3,750** for ncZarr
- **2,000,000**for HDF5
- **83,900** for GRIB2
- **1,370,000** for ZARR

Google Scholar hits, which supposedly count appearances in peer-reviewed scholarly publications, are:

- **433** for netCDF-3
- **1,230** for netCDF-4
- **39** for ncZarr
- **37,800** for netCDF
- **21,900** for HDF5
- **1,620** for GRIB2

Strategic Focus Areas

We support the following goals described in Unidata Strategic Plan:

1. **Managing Geoscience Data**
   by supporting the use of netCDF and related technologies for analyzing, integrating, and visualizing multidimensional geoscience data; enabling effective use of very large data sets; and accessing, managing, and sharing collections of heterogeneous data from diverse sources.

2. **Providing Useful Tools**
   by developing netCDF and related software, and creating regular software releases of the C, C++ and Fortran interfaces; providing long-term support for these tools through the various avenues available to the Unidata staff (Github, eSupport, Stackoverflow, etc).

3. **Supporting People**
   by providing expertise in implementing effective data management, conducting training workshops, responding to support questions, maintaining comprehensive documentation, maintaining example programs and files, and keeping online FAQs, best practices, and web site up to date; fostering interactions between community members; and advocating community perspectives at scientific meetings, conferences, and other venues.

Prepared *October, 2022*

Status Report: Outreach to Underserved Communities

June 2022 - October 2022

Tanya Vance, Jeff Weber

Areas for Committee Feedback

We continue to request your feedback on the following topics:

Are you currently collaborating with an MSI?

Are there MSI's geographically close to you that you have not engaged with?

Are there other underrepresented communities you would like to engage with?

New Activities

Over the next three months, we plan to organize or take part in the following:

- Continue to develop outreach stakeholder list for broadening distribution of opportunities (equipment awards, internships, etc) and engage remotely
- SIPI and NTU site visits
- Jeff Weber is actively involved in the "Sensing the Earth" conference with planning, hosting, and presenting. This conference involves TCU's and partners. Planning committee members are from UCAR, NEON, and AIHEC. This conference is in person at UCAR June 15-17.
    - Follow up conference at Haskell Unniversity Nov 17-18
- Jeff Weber is working with AIHEC, NEON, UCAR/NCAR staff on an NSF proposal for an MSI engagement and data sovereignty project.
- Jeff Weber is serving on the one year **NSF#2220614** "The Indigenous Data Governance in Open Data Working Group"
- SIPI faculty and students participated in a Campbell data logger workshop
- Present at AGU and AMS on the sovereign network effort

Over the next twelve months, we plan to organize or take part in the following:

- Implement changes to the process of how Unidata opportunities are announced and awarded
- Plan exhibition or other activities at subsequent appropriate conferences
- Identify relevant metrics (contacts, partners identified, meetings attended)

- Identify sustaining partnerships for the next five years
- Engage other underrepresented communities
- Expand sovereign network to other TCU's and AIHEC members
- Prepare for follow up proposal w NTU, SIPI, TOCC, and others

Beyond a one-year timeframe, we plan to organize or take part in the following:

- This effort is an ongoing commitment for the next award period (5 years); however, during this first year we are piloting efforts and then will apply lessons learned for the next 4 years.

Engaged with Rising Voices

- Jeff Weber is actively involved with Indigenous Peoples Climate Change Working Group **(IPCC-WG)**
- Jeff Weber is actively involved with **Indigenous-FEWSS**. Indigenous Food, Energy & Water Security and Sovereignty

Internships

- Active engagement in the SOARS program
    - Jeff Weber participated on Selection Committee for 2022
    - Jeff Weber served on the SOARS Advisory Committee for 2022

Jeff Weber is working with DOE/SAIL and NOAA/SPLASH this summer with students and faculty from NTU and SIPI

Progress has been made on the following:

- Designing structural changes (e.g. modifications to how equipment awards, internships, workshops, and committee placements are announced and selected)
    - This work is on hold currently awaiting new Community Services Manager

Dependencies, challenges, problems, and risks include:

- The only known dependency is regarding funding and time both of which have been dedicated to this effort. Since this is a new project, other dependencies or risks have

not been identified at this time. This activity continues to need the **full support** of the program and the Unidata Community

Ongoing Activities

We plan to continue the following activities:

- SACNAS and Rising Voices engagement

Relevant Metrics

Relevant metrics should be discussed and decided for reports going forwarded

Strategic Focus Areas

We support the following goals described in Unidata Strategic Plan:

1. **Providing Useful Tools**
   Better understanding these communities and characterizing their needs will allow us to develop more fit for purpose tools that can and will be adopted

2. **Supporting People**
   Unidata has always served the broad geoscience community; however we are making a concerted effort to expand our reach to underrepresented individuals and organizations as an emphasis of our new award

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Prepared *October, 2022*

Status Report: Python

June 2022 - October 2022

Ryan May, Drew Camron, Julien Chastang, Nicole Corbin, Thomas Martin

Areas for Committee Feedback

We are requesting your feedback on the following topics:

1. Given the current set of offerings from Unidata and what else is available, what format or style needs the most growth, especially for students? Notebooks? Videos? Synchronous Training? Asynchronous training modules?
2. Anything lacking in MetPy that keeps you or your colleagues and students from using it more?

Activities Since the Last Status Report

Python Training Efforts

Supported by engineers,Unidata's instructional designer, and our Science Gateway, Python education remains a focus for workforce development, community engagement, and user feedback. Throughout Summer and Fall 2022, we focused these resources internally on rapidly preparing (once again!) for in-person, synchronous training offerings in the Fall and Winter. For these offerings we prioritized effective learning design, packaging for rapid re-use, and equitable access. Designing in this way emphasizes two-way partnership with our educators and their institutions, and we look to use this process to support and grow our community in new ways.

We do this without neglecting virtual and asynchronous offerings, as we continue to support Project Pythia's *Cookbook* ecosystem, and the infrastructure and educational content it provides to the community. This includes transitioning our "Unidata Python Training" resource to its own Pythia Cookbook, a project in-progress.

Progress has been made on the following:

- Unidata led a two-day in-person workshop designed around "leveling the Python playing field" for an incoming graduate student class at CSU
- AMS Student Conference 2023 has accepted an introductory Python course, which will focus similarly on "Exploratory Data Analysis" and Python troubleshooting
- AMS has accepted a MetPy short course on data discovery and processing. This will be offered synchronously, in-person at the AMS 2023 annual meeting
- Unidata continues to be a primary collaborator on *Project Pythia*, particularly through support of the new *Cookbook* ecosystem. Unidata's own Python Training will be available as one of these Pythia Cookbooks later this year
- John Leeman continues to lead the "MetPy Mondays" effort.

MetPy

Development continues to be driven by requirements for our dedicated awards (in addition to bug reports and pull requests from community members). MetPy 1.3.1 was also released in July 2022 with a variety of fixes for 1.3.0. MetPy 1.4 was released in early November 2022 with a variety of fixes and enhancements including:

- Added SWEAT, CCL, and convective temperature sounding calculations (community contributions)
- Support for improved spatial derivative calculations on projected and lat/lon (spherical) grids
- Added ArrowPlot and RasterPlot, as well as other various enhancements, to the simplified plotting interface
- Added many more examples to MetPy's gallery and in the documentation itself
- GINI support works as an xarray backend
- Better support for working with other libraries using Pint for unit-handling

The MetPy team continues to work to increase the release cadence for the project, nominally trying to make a release every other month. This is aimed to avoid having releases slide to get "one more thing" in the release, and instead more readily get developments in the hands of the user–whenever they choose to upgrade. Success in doing so has been mixed, with the most recent push to get improved derivative calculations (aka "spherical support") into the 1.4 release.

Moving forward, 1.5 is planned for release in December 2022 in advance of AMS. This is planned to include the long-promised support for plotting fronts and analysis from the WPC. For the AMS short course, this should include improved, xarray-based handling for MetPy's NEXRAD data support. More broadly, we will also be continuing the performance improvement work that is the focus of the CSSI award, as well as incorporate the "automated solver" from the previous award.

The MetPy article should be appearing in the print version of the Bulletin of the American Meteorological Society in November (or December) of 2022. MetPy has also been installed on NOAA's WCOSS2 system, as "MetPy is needed to derive various meteorological parameters from NBM, NDFD, and GEFS model data to support MDL's Whole Story Uncertainty & Probabilities (WSUP) Viewer".

Progress has been made on the following:

- MetPy 1.3.1 released July 2022
- MetPy 1.4.0 released early November 2022
- Work towards requirements of MetPy-related NSF awards
- Community awareness continues to grow, with the volume of engagement (especially support requests) and mentions on social media growing; the MetPy twitter account has reached 2357 followers.
- 47 theses or peer-reviewed publications have cited or mentioned MetPy in 2022; this is in comparison to 58 in all of 2021, and 43 in all of 2020.

Siphon and Data Processing

Siphon continues to exist in a steady state–continued maintenance and use, but minimal feature advancement. Some of this is due to limited development resources being focused on MetPy's needs; it is also due to limited pressing needs on the data access side. Largely, Siphon meets the needs we have identified for Python data access (that aren't also already met by zarr, xarray, etc.). With that said, Siphon does remain an important part of the stack used by our training work, and by Unidata's community of Python users in general. The most pressing developments we anticipate for Siphon are improvements to working with Siphon in interactive sessions, like the Jupyter notebook environment: improved catalog crawling interface, better string representations, and tab completion.The decision has been made to separate **non-TDS functionality** (e.g. Wyoming Upper Air archive access) out into a new remote-access toolset contained within MetPy, and we hope to begin this transition work soon.

We also continue to maintain the LDM Alchemy repository as a collection of LDM processing scripts in Python. Currently this includes the code powering the AWS NEXRAD archive as well as the program that reconstitutes NOAAPORT GOES-16/17 imagery. As we transition more of our internal data processing to Python, this repository will hold those scripts. We have seen several community questions regarding both the GOES and NEXRAD processing software.

External Participation

The Python team attends conferences as well as participates in other projects within the scientific Python ecosystem. This allows us to stay informed and to be able to advocate for our community, as well as keep our community updated on developments. As participants in a broader Open Source software ecosystem, the Python team regularly encounters issues in other projects relevant to our community's needs. As such, we routinely engage these projects to address challenges and submit fixes. We also continue to host Jeff Whittaker's netCDF4-python project repository; Jeff continues to be the active maintainer of the project. The overall involvement helps ensure that important portions of our community's Python stack remain well-supported. Ryan May continues to serve as a core developer for CartoPy as well as a member of Matplotlib's Steering Council and conda-forge's core team.

Progress has been made on the following:

- We continue to engage with the Pangeo project, a grass-roots effort to develop a community stack of tools serving the atmospheric, oceanic, land, and climate science. This engagement is enhanced by work on the Pangeo EarthCube award, which will likely drive some contributions to the XArray project.
- Ryan May continues to work as a developer on the matplotlib and CartoPy projects, and as a member of conda-forge core team.
- We also continue to actively engage with the xarray and pint projects.

Ongoing Activities

We plan to continue the following activities:

- Supporting Unidata's collection of online Python learning materials
- Engaging in synchronous Python teaching opportunities, virtual or otherwise
- Growing Siphon as a tool for remote data access across a variety of services
- Growing and developing MetPy as a community resource for Python in meteorology
- Continued participation in the scientific Python community as advocates for the atmospheric science community
- Working with JupyterHub as a way to facilitate data-proximate analysis
- MetPy Mondays for engaging the community

New Activities

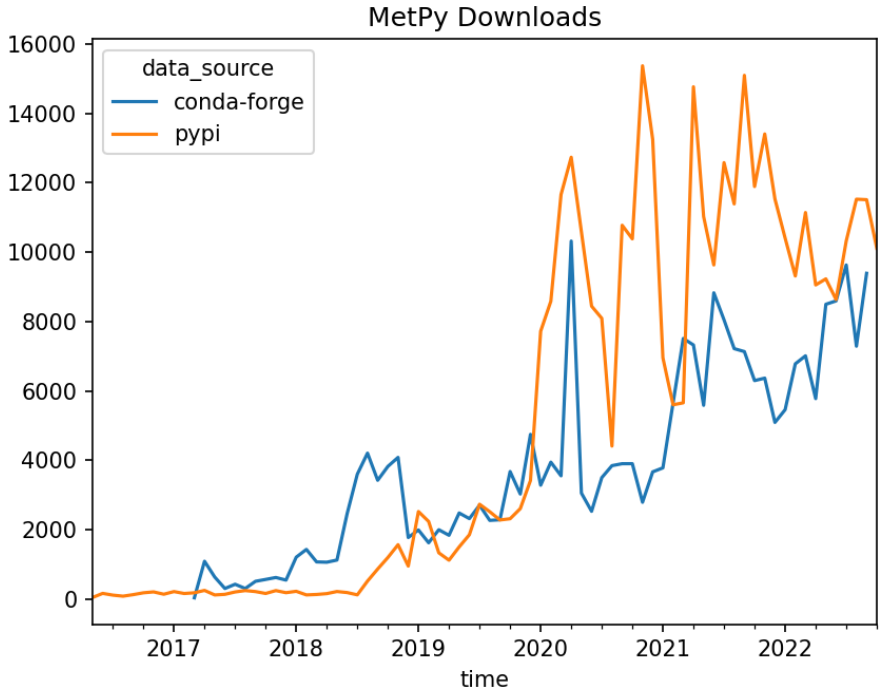
Over the next three months, we plan to organize or take part in the following:

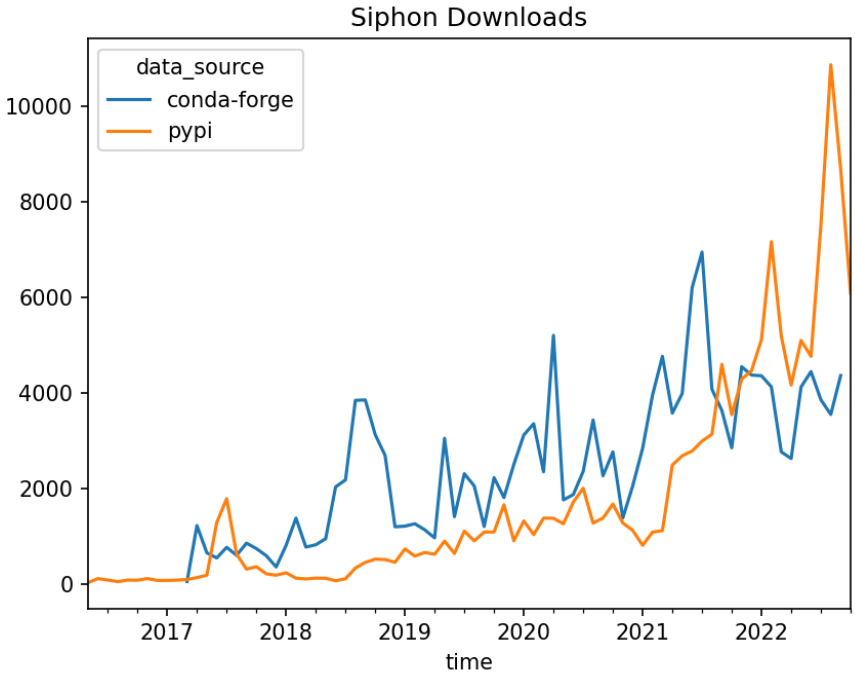
- Deploy a much of the Python Gallery and training materials as a "cookbook" within the Project Pythia materials
- Release MetPy 1.5 December 2022 with a variety of features, including frontal analysis plotting and improved radar data handling
- Engage in AMS 2023 student conference
- Teach a short course at the 2023 AMS Annual meeting
- Present on updates to MetPy at the 2023 AMS Annual Meeting
- Engage in continued support of Project Pythia and adjacent UCAR Python education efforts

Over the next twelve months, we plan to organize or take part in the following:

- Offer additional virtual or in-person MetPy workshops
- Separate non-TDS siphon capability into new MetPy remote functionality
- Develop more training ideas for a proposal in response to NSF's CyberTraining RFP
- Explore ways to leverage Web Assembly to provide MetPy as an in-the-web-browser experience for users

Relevant Metrics





MetPy

- 95% test coverage
- Watchers: 59
- According to GitHub, 290 repositories and 32 packages depend on MetPy
- Downloads for the releases made in the last year (Conda + PyPI):

    - 1.2.0: 35986
    - 1.3.0: 23460
    - 1.3.1: 25569
- Since 1 April 2022
    - Active Issues: 131 (63 created, 57 closed)
    - Active PRs: 258 (242 created, 238 closed)
    - External Issue Activity: 45 opened, 64 comments
    - External PR Activity: 36 opened, 57 comments
    - Unique external contributors: 43
    - Stars: 76 (928 total)
    - Forks: 5 (332 total)
    - Commits: 470
- Since 1 October 2021
    - Active Issues: 203 (127 created, 100 closed)
    - Active PRs: 445 (418 created, 420 closed)
    - External Issue Activity: 91 opened, 170 comments
    - External PR Activity: 62 opened, 90 comments
    - Unique external contributors: 78
    - Stars: 152 (928 total)
    - Forks: 5 (332 total)
    - Commits: 980

Siphon

- 98% test coverage
- Watchers: 14
- According to GitHub, 143 repositories and 14 packages depend on Siphon
- Since 1 April 2022
    - Active Issues: 4 (2 created, 1 closed)
    - Active PRs: 94 (85 created, 83 closed)
    - External Issue Activity: 2 opened, 7 comments
    - External PR Activity: 0 opened, 0 comments
    - Unique external contributors: 5
    - Stars: 16 (173 total)
    - Forks: 0 (61 total)
    - Commits: 93
- Since 1 October 2021
    - Active Issues: 12 (5 created, 4 closed)
    - Active PRs: 202 (183 created, 190 closed)
    - External Issue Activity: 3 opened, 14 comments
    - External PR Activity: 6 opened, 5 comments
    - Unique external contributors: 11
    - Stars: 25 (173 total)
    - Forks: 0 (61 total)
    - Commits: 254

Strategic Focus Areas

We support the following goals described in Unidata Strategic Plan:

1. **Providing Useful Tools**
   Python has become a key tool in the atmospheric sciences, and the geosciences in general. MetPy leverages the rest of the scientific Python ecosystem to provide a suite of documented and tested domain-specific functionality, supporting greater use of Python by the community. Siphon serves to provide access to the growing collection of remote data sets. Together, MetPy and Siphon give the community a platform for scripted analysis of real-time and archived weather data. These tools are also readily used in the Jupyter Lab/Notebook environment, for ease of use in cloud and HPC computing environments, facilitating data-proximate analysis. We also participate in a variety of projects in the broader scientific Python ecosystem, to help ensure the ecosystem's viability and that it continues to meet our community's needs.

2. **Supporting People**
   We provide a variety of online training resources to facilitate our community's education and use of Python. We also regularly conduct training workshops to teach attendees how to use tools and apply them to their problems and challenges in research and education.

Prepared *October 2022*

Status Report: Support

June 2022 - October 2022

Jennifer Oxelson, Tom Yoksas, UPC Staff

Areas for Committee Feedback

We are requesting your feedback on the following topics:

1. Is the support that we provide sufficient for the community's needs?

   If not, what else should we be doing?

Activities Since the Last Status Report

Training

Yuan Ho gave the following training since the last status report:

- 1-hour training to Millersville University
- 2-hour training to Bahirdar University, Ethiopia
- Will give a presentation at Big Earth Data 2022, in WuHan, China

Steve Emmerson and Tom Yoksas gave the following training workshop since the last User Committee meeting:

- 17-19 August 2022: "NOAA Southern Region HeadquartersLDM Training Workshop" (virtual)

New Support Departments

- A Support Department for Unidata's Machine Learning initiative has been created and is now in use.

New Activities

In order to fulfill our objectives articulated in the Unidata 2018 Proposal, focused efforts are needed in two major areas:

- Enhance electronic support offerings
- Create instructional materials for online virtual training

Relevant Metrics

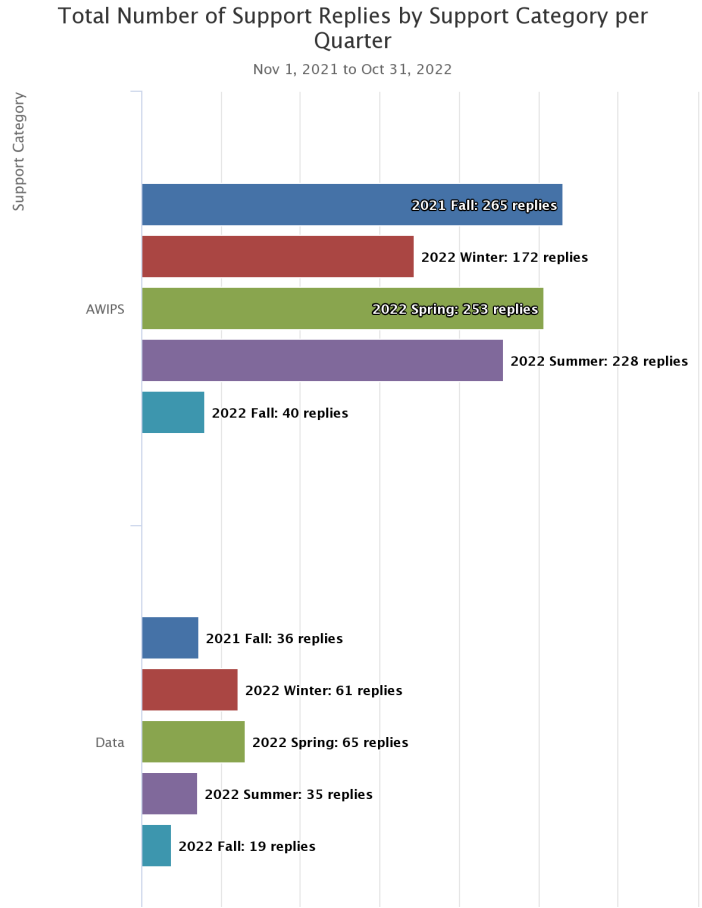
Since January 26, 2006 approximately 68475 user support "transactions" (new inquiries and follow-ups) have been processed through the Unidata inquiry tracking system. Other methods of providing answers to questions posed (e.g., Github, Stack Overflow, Jira, mailing list replies, etc.) add substantially to the support load.

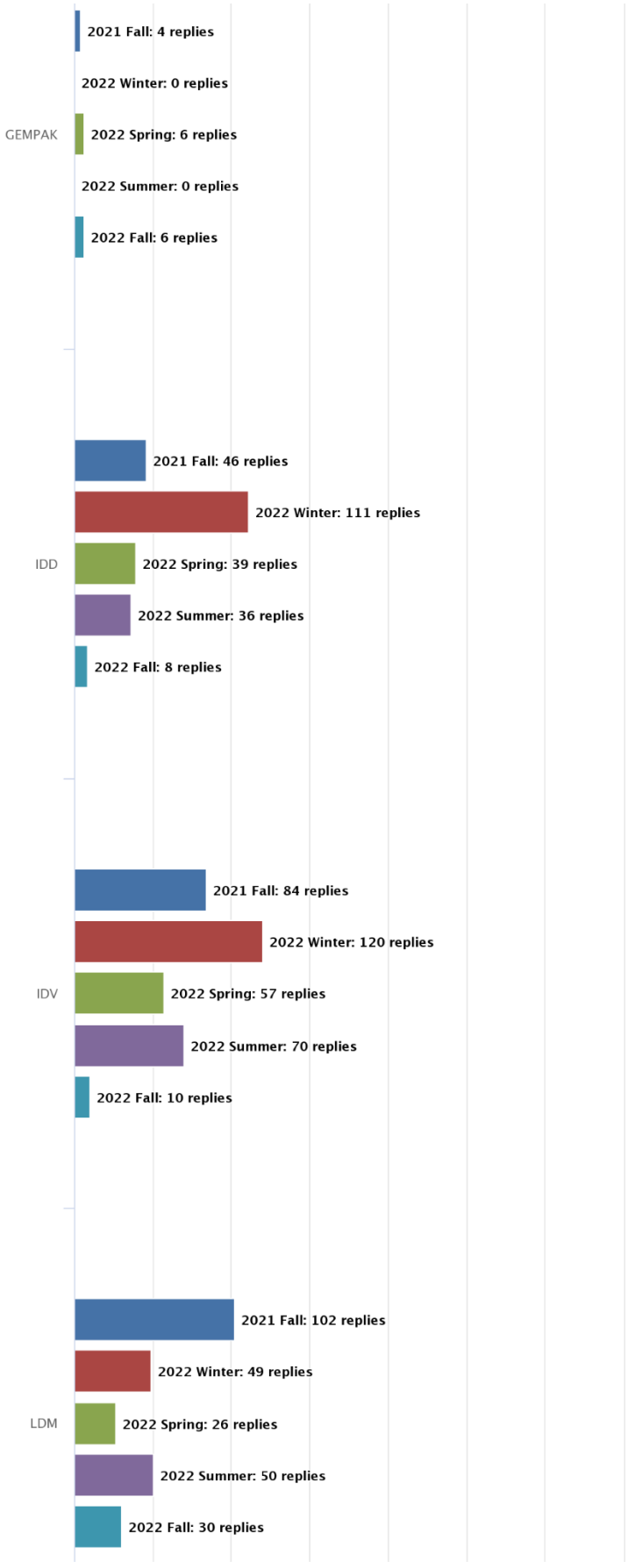
Additional metrics may be found in the Comprehensive Metrics Data portion of this meeting's agenda.

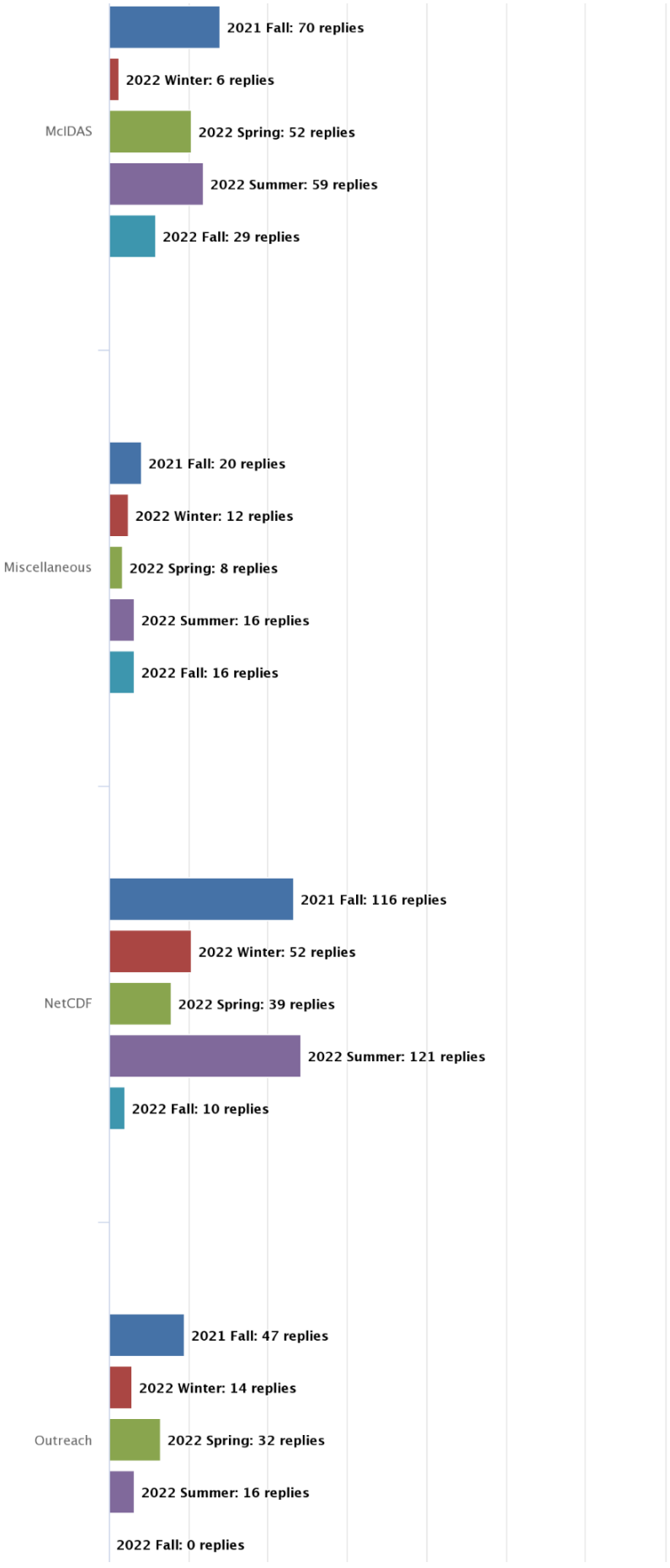
Fig. 1: Below are histograms that portray the number of Unidata email responses for categories of support logged in the Unidata Inquiry Tracking System for the 12 month period from November 1, 2021 until October 31, 2022.

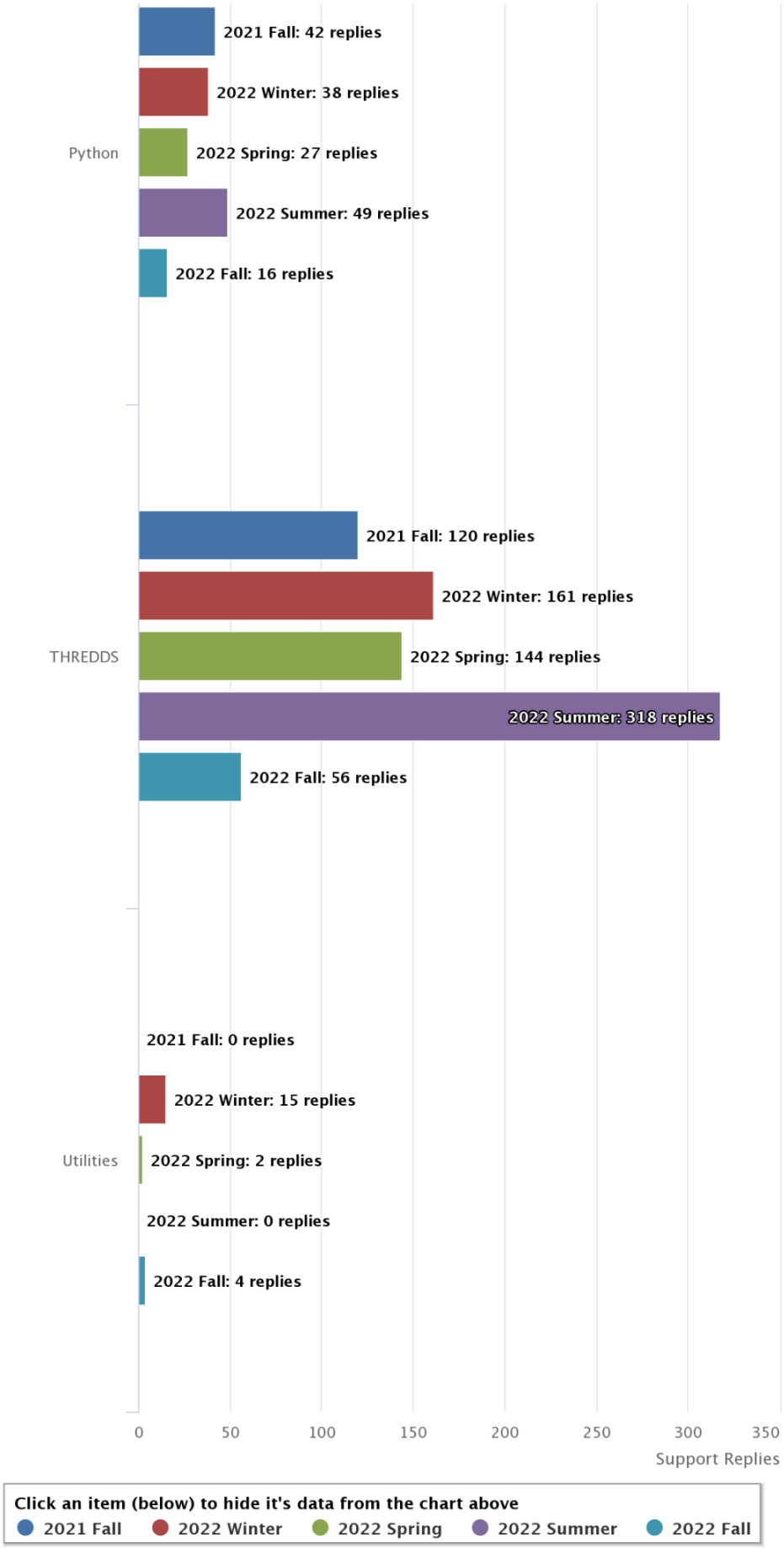
The quarters shown are defined as:

Winter:	**Spring:**	**Summer:**	**Fall:**
January, February, March	April, May, June	July, August, September	October, November, December




GEMPAK
2021 Fall: 4 replies
2022 Winter: 0 replies
2022 Spring: 6 replies
2022 Summer: 0 replies
2022 Fall: 6 replies
IDD
2021 Fall: 46 replies
2022 Winter: 111 replies
2022 Spring: 39 replies
2022 Summer: 36 replies
2022 Fall: 8 replies
IDV
2021 Fall: 84 replies
2022 Winter: 120 replies
2022 Spring: 57 replies
2022 Summer: 70 replies
2022 Fall: 10 replies
LDM
2021 Fall: 102 replies
2022 Winter: 49 replies
2022 Spring: 26 replies
2022 Summer: 50 replies
2022 Fall: 30 replies


McIDAS
2021 Fall: 70 replies
2022 Winter: 6 replies
2022 Spring: 52 replies
2022 Summer: 59 replies
2022 Fall: 29 replies
Miscellaneous
2021 Fall: 20 replies
2022 Winter: 12 replies
2022 Spring: 8 replies
2022 Summer: 16 replies
2022 Fall: 16 replies
NetCDF
2021 Fall: 116 replies
2022 Winter: 52 replies
2022 Spring: 39 replies
2022 Summer: 121 replies
2022 Fall: 10 replies
Outreach
2021 Fall: 47 replies
2022 Winter: 14 replies
2022 Spring: 32 replies
2022 Summer: 16 replies
2022 Fall: 0 replies


Python
2021 Fall: 42 replies
2022 Winter: 38 replies
2022 Spring: 27 replies
2022 Summer: 49 replies
2022 Fall: 16 replies
THREDDS
2021 Fall: 120 replies
2022 Winter: 161 replies
2022 Spring: 144 replies
2022 Summer: 318 replies
2022 Fall: 56 replies
Utilities
2021 Fall: 0 replies
2022 Winter: 15 replies
2022 Spring: 2 replies
2022 Summer: 0 replies
2022 Fall: 4 replies
0
50
100
150
200
250
300
350
Support Replies
Click an item (below) to hide it's data from the chart above
2021 Fall
2022 Winter
2022 Spring
2022 Summer
2022 Fall

Individual support activities included in the categories shown above are listed in the following table.

Category	eSupport Departments
AWIPS	Support AWIPS
Data	Support CaseStudy, Support CONDUIT, Support Datastream, Support LEAD, Support Level II, Support NOAAPORT, Support SUOMINET
GEMPAK	Support GEMPAK
IDD	Support IDD, Support IDD Antarctica, Support IDD Brasil, Support IDD Cluster, Support IDD SCOOP, Support IDD TIGGE
IDV	Support IDV, Support IDV Storm, Support McV, Support VisAD
LDM	Support LDM
McIDAS	Support McDevelop, Support McIDAS
Miscellaneous	Administration, Development, Plaza, Staging Folder, Support, Support eSupport, Support Miscellaneous, Support Platforms, Support Plaza, Student Interns, Systems, Support Machine Learning
NetCDF	Support LibCF, Support netCDF
Outreach	Outreach, Polcomm, Science Gateway, Support Egrants, Support eLearning, Support News, Support Outreach, Support Workshop, Usercomm, Student Interns
Python	Support Python
RAMADDA	Support RAMADDA
THREDDS	Support netCDF Java, Support THREDDS
Utilities	Support LDM-McIDAS, Support netCDF Decoders, Support netCDF Perl, Support OPeNDAP, Support Rosetta, Support UDUNITS

Comments

- The total support provided by the UPC continues to be substantial: yearly totals have shown a slight decline over the past several years, but this is most likely attributable by the increased ways support is being provided. Overall support activities vary by somewhat by quarter. Spikes in support for individual packages is largely correlated with the releases of new distributions of the packages.
- Support for netCDF continues to be substantial, and is understandable given the very large number of users of the package worldwide.
- Support for the legacy visualization packages GEMPAK and McIDAS has decreased over the past several years, most likely due to GEMPAK users investigations of use of AWIPS and Python/MetPy.
- Support for AWIPS has steadily increased and has exceeded that for GEMPAK over the past couple of years.
- Support for Python scripting using MetPy is growing markedly.
- Support for LDM, IDD, and Data continue at a high levels and show some variability throughout the year.

Notes

These numbers and conclusions should not be taken too literally, for several reasons:

- For some packages, multiple responses in the same thread may be bundled into a single archived email. Other packages have each response in a thread counted separately.
- After a new release of software, there may be a flurry of the same or similar questions, which can be answered in separate emails or in a single mailing list posting.
- The graph primarily represents support of end users and site administrators, not developers. Support for non-Unidata developers in projects such as THREDDS, IDV, GEMPAK, and McIDAS requires significant resources, but is difficult to assess.
- Not all support records were indexable for this report. Given this, the above numbers are an **underestimate** of the actual support being provided by the UPC.

Additional User Support Metrics

Strategic Focus Areas

We support the following goals described in Unidata Strategic Plan:

1. **Managing Geoscience Data**
   Unidata User Support enables access to geoscience data by supporting the use of tools created and/or supported by the UPC.

2. **Providing Useful Tools**
   A significant part of providing useful tools is providing support for those tools. Unidata has always provided world class support for all of the tools that it makes freely available to the greater geoscience community.

3. **Supporting People**
   The user support provided by the UUPC is recognized throughout the atmospheric science community. Unidata's outreach efforts are routinely noted as being exceptional in surveys of the NCAR/UCAR community.

Prepared *October 2022*

Status Report: THREDDS

June 2022 - October 2022

Hailey Johnson, Tara Drwenski, Megan Lerman, Jennifer Oxelson, Ryan May, Ethan Davis, Dennis Heimbigner

Areas for Committee Feedback

We are requesting your feedback on the following topics:

1. How should we manage THREDDS releases, version availability, and upgrades to our own managed servers (e.g. thredds.ucar.edu)? Should we be utilizing our other domains more? Please see the “server management” section of “ongoing activities” for more details.
2. Do you have thoughts on the migration of the TDS to microservices? What do you foresee as the greatest challenges and benefits associated with the change for end users? For server administrators? Which THREDDS services are most important to you and which could you do without?
3. What has been your experience so far with the TDS v5 migration process? Do you have any concerns or suggestions for how to best support our community through the transition?

Activities Since the Last Status Report

Staffing Changes

Megan Lerman joined the THREDDS team on September 30th, 2022. Welcome, Megan! Our development team is now “fully” staffed!

The THREDDS Project

The THREDDS Project encompases four projects: **netCDF-Java, the THREDDS Data Server (TDS), Rosetta, and Siphon** (the Unidata Python client to interact with remote data services, such as those provided by the TDS). For specific information on Siphon, please see the Python Status Report. This status report contains updates on cloud compatibility within netCDF-Java and the TDS; for updates on further cloud efforts, including the popular Docker container effort, please see the Cloud Computing Activities Status Report.

NetCDF-Java

- NetCDF-Java is now on version 5.5.3.
- A stable snapshot of 5.5.4 is also available, containing a number of bug fixes.
- Since the last report, netCDF-Java has improved read support for the Zarr data model and enhanced the new filters package for use by both Zarr and HDF5 providers.

- Since the last report, we have expanded support for object storage.
- Versions 6+ of netCDF-Java, which implement a limited API relative to version 5, have been forked off into a new repository, “netcdf-java-ng”. This new project will be reversioned starting from 0 and primarily maintained by the community. The TDS will continue to use netCDF-Java version 5, and the THREDDS developers will continue to focus on supporting the current API.

TDS

- Support for TDS 4.6.x was officially ended as of August 31, 2022.
- Unidata’s main TDS instance, thredds.ucar.edu, is now running a version of TDS 5.
- We are still actively supporting organizations in upgrading their TDS instances from 4.6.x to the current release version, 5.4.
- A stable snapshot release of TDS 5.5 is also available, containing a number of bug fixes.
- Version 5.5 (official release) will be released soon and will address a number of user concerns and support tickets.
- The main development focuses for the TDS currently are stability, performance, and cloud support.

Rosetta

Rosetta remains in a temporary maintenance mode; no new development is planned for the short-term future.

Ongoing Activities

We plan to continue the following activities:

Server management

- Continue to host the latest, secure release of TDS 5.x on thredds.ucar.edu
- Determine how best to utilize our other thredds server domains to serve the following purposes:
    - Test development snapshots in a full, data-rich environment
    - Beta test new snapshot releases and provide early access to new features and bug fixes

Maintenance

- Maintain thredds.ucar.edu and keep up with the addition of new datasets to the IDD.
- Closely monitor the security status of our project dependencies, and provide updated versions of our libraries and server technologies to address as needed.
- Continue to respond to user feedback regarding TDS 5.x and transitioning servers to the latest version.

Development

- Zarr and NCZarr support

    - Continued work to implement write support for Zarr and NCZarr.
    - Continue development of the new filters module and add support for requested common filters, starting with ZStandard.
    - Add support for Zarr and NCZarr in the TDS.
- DAP4 support
    - Continued work to support the DAP4 protocol in netCDF-Java and the TDS
- Cloud Storage
    - Expand S3 support in netCDF-Java and TDS to effectively mirror that of local storage.
    - Expand testing for S3 support.
- Performance and benchmarking
    - Create automated benchmarking and regression testing tools for both netCDF-Java and the TDS.
    - Improve performance for TDS S3 access, particularly for large aggregations, to prevent potential server timeouts.
- TDS microservices
    - Continue planning a development for the next iteration of the TDS with a microservice-based architecture.

The following active proposals directly involve THREDDS work:

- We have completed the funded period of our NOAA IOOS award titled "A Unified Framework for IOOS Model Data Access", in which we partnered with Rich Signell and Axiom Data Science. The goal was to enable support of the UGRID specification within the THREDDS stack, as well as create a GRID featureType to allow for serving large collections of gridded datasets (including UGRID). Support for UGRID datasets were added to the TDS stack in August, and will be available in the next release. Individual UGRID datasets, as well as Forecast Model Run Collections (special aggregations of UGRID datasets) are now supported in the TDS for the following services: THREDDS Catalog Service, HTTPFileServer, OPeNDAP, CDMRemote, WMS and Godiva 3, ncIso and related metadata services. UGRID support for the netCDF Subset Service remains a work in progress at this time.

New Activities

Over the next three months, we plan to organize or take part in the following:

- netCDF-Java
    - Improve and expand the filters package.
    - Continue to participate in the Zarr development community,
    - Port the gCDM (gRPC for the Common Data Model) module to netCDF-Java.
    - Smooth the transition to a forked repository for netCDF-Java-NG
        - Re-evaluate deprecations in netCDF-Java 5.x
        - Improve documentation

- TDS
    - Release version 5.5 of the TDS.

    - Continue to help the user community upgrade their servers to TDS version 5.x.
    - Define the user-facing and service-facing functions of the THREDDS catalog service, in preparation for microservice development.
    - Define the user-facing and service-facing functions of the FileServer THREDDS service, in preparation for microservice development.

Over the next twelve months, we plan to organize or take part in the following:

- netCDF-Java
    - Initial support for any codecs the community deems necessary for reading Zarr and NCZarr.
    - Evaluate what other gRPC endpoints will be needed in the netCDF-Java library to support the TDS as microservices.
- TDS
    - Support Zarr and NCZarr in the TDS.
    - Develop performance and benchmarking tools for the TDS.
    - Develop a proof-of-concept version of the TDS as microservices, containing gRPC-based communication with netCDF-Java and standalone Catalog and FileServer microservices.
    - Begin development of an OPeNDAP microservice.

Beyond a one-year timeframe, we plan to organize or take part in the following:

- netCDF-Java
    - Fully support Java 11 and the Java Platform Module System (end of Java 8 support)
    - Fully support the Zarr and NCZarr data models, including new iterations of the specifications.
    - Provide broad gRPC access to netcdf objects and methods.
- TDS
    - Continue development of a new product based on microservices.
    - Continue to explore object storage as it relates to the TDS.
    - Continue to improve data access performance, exploring the possibility of asynchronous requests.

Relevant Metrics

THREDDS Startup Metrics

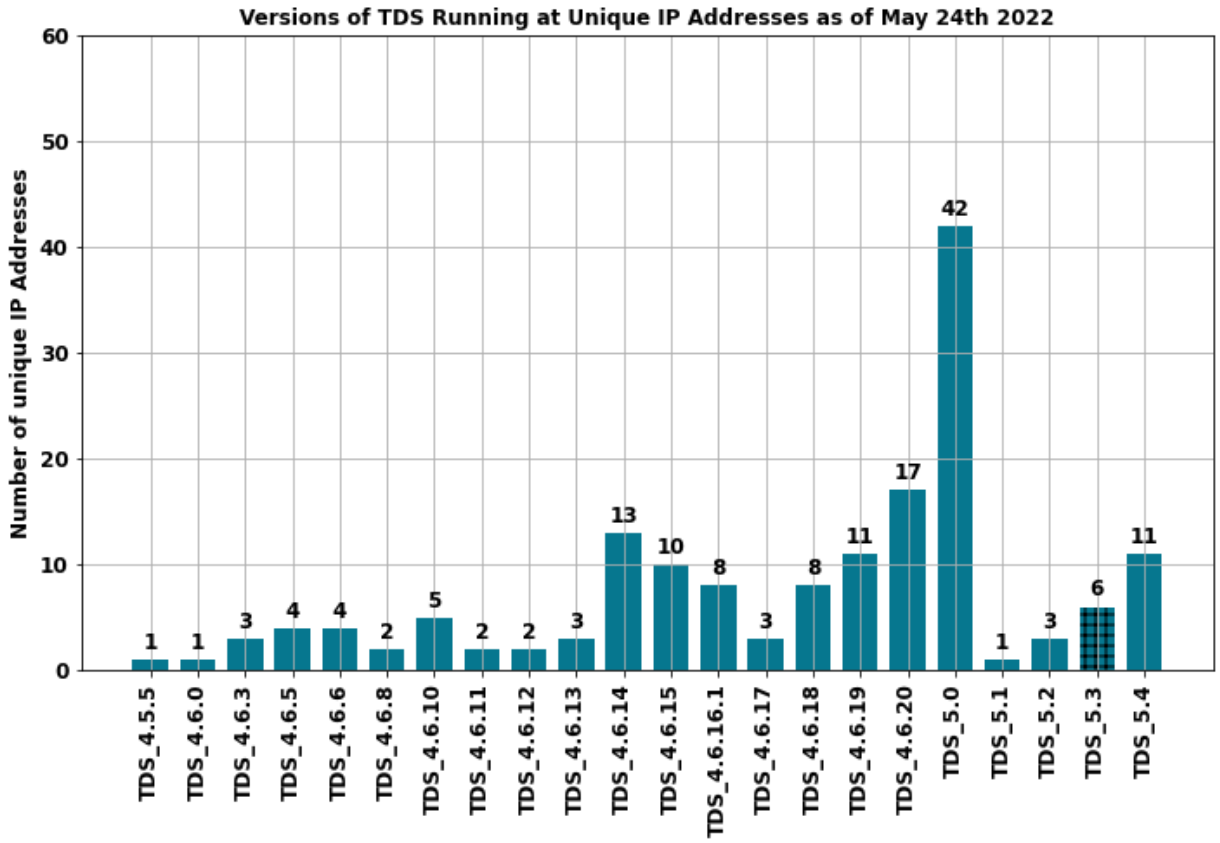
	2021-10 — 2022-05	2014-08 — 2021-04
TDS Startup (unique IP address count)	1,626	38,234

	Total Servers	Information page updated

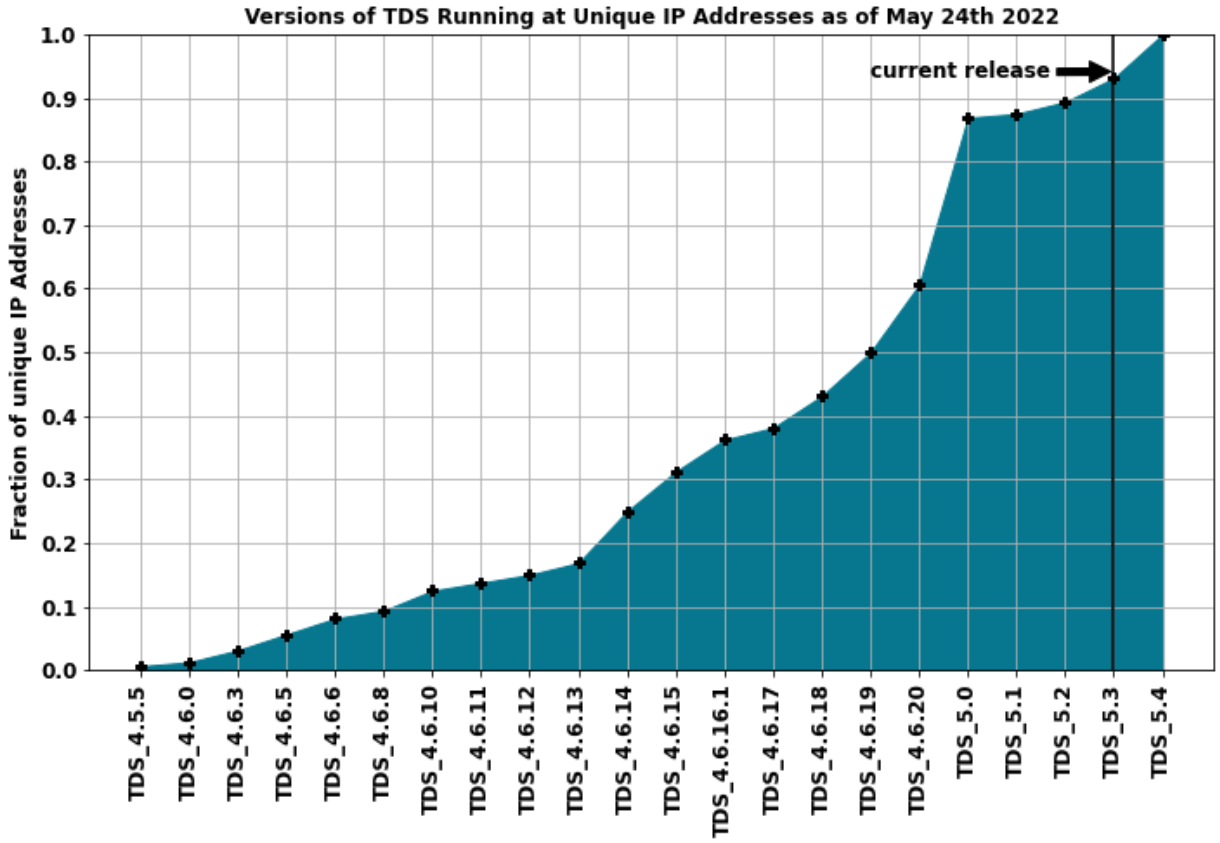
Publicly Accessible[1] TDS count	160	85

Over the past six months, **1,626** unique IPs started up the TDS (October 2021 through May 2022). Since we've started tracking these metrics (v4.5.3, August 26th, 2014), we've seen the TDS startup from **38,234** unique IP addresses. There are currently **160** publically accessible TDSs running "in the wild" (31 fewer than our last report) . Of the **160** publically accessible servers, **85** have updated the name of their server in their server configuration file (taken as a sign that they are maybe, possibly, intended to be used by others...maybe…).

The figures below show the distribution of TDS versions (top), and the fractional share of servers running version X or older (bottom). Each labeled version includes betas and snapshots, not just the official release of that version, for presentation simplicity. The majority of the publicly accessible servers are running v4.6.13 or above . TDS v5.0 is the dominant specific version running in the wild.



[1] "Publicly accessible" means we could find a top-level THREDDS Client Catalog. We checked <server>/thredds/catalog.xml (version 4), <server>/thredds/catalog/catalog.xml (version 5), including the most common ports of 80, 8080, 443, and 8443.



Strategic Focus Areas

The THREDDS projects covered in this report support the following goals described in Unidata Strategic Plan:

1. **Managing Geoscience Data**
   The component software projects of the THREDDS project work to facilitate the management of geoscience data from four points of view: __Making Geoscience Data Accessible, Making Geoscience Data Discoverable, Making Geoscience Data Usable, and Enhancing Community Access to Data__ . As a client-side library, **netCDF-Java** enables end users to read a variety of data formats both locally and across numerous remote technologies. Less user-friendly formats, such as GRIB, are augmented with metadata from community driven metadata standards (e.g. Climate and Forecast metadata standards), and viewed through the more user friendly Common Data Model (very similar to the netCDF Data Model), providing a single set of Java APIs for interacting with a multitude of formats and standards. The **THREDDS Data Server** exposes the power of the netCDF-java library outside of the Java ecosystem with the addition of remote data services, such as __OPeNDAP__ , __cdmremote__ , __OGC WCS__ and __WMS__ , __HTTP direct download__ , and other remote data access and subsetting protocols. The TDS also exposes metadata in standard ways (e.g. ISO 19115 metadata records, json-ld metadata following schema.org), which are used to drive search technologies. **Rosetta** facilitates the process of translating ascii based

observational data into standards compliant, archive ready files. These files are easily read into netCDF-Java and can be served to a broader community using the TDS.

2. **Providing Useful Tools**
   Through Rosetta, the THREDDS project seeks to intercede in the in-situ based observational data management lifecycle as soon as possible. This is done by enabling those who produce the data to create archive ready datasets as soon as data are collected from a sensor or platform without the need to write code or intimately understand metadata standards. NetCDF-java and the TDS continue to support legacy workflows by maintaining support for legacy data formats and decades old data access services, while promoting 21st century scientific workflows through the creation of new capabilities and modernization of existing services (e.g. Immutability, upgraded technical stack, microservice development).
3. **Supporting People**
   Outside of writing code, the THREDDS project seeks to support the community by __providing technical support, working to build capacity through Open Source Software development, and by building community cyber-literacy__ . The team provides expert assistance on software, data, and technical issues through numerous avenues, including participation in community mailing lists, providing developer guidance on our GitHub repositories, and leading and participating in workshops across the community. The team also actively participates in “upstream” open source projects in an effort to help sustain the efforts of which we rely and build upon. We have mentored students as part of the Unidata Summer Internship Program, and worked across organizations and disciplines in support of their internship efforts.

Prepared *October, 2022*