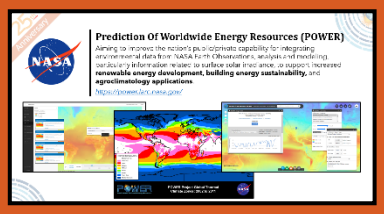
2022 POWER Global Community (GloCo) Summit Summary Report



Executive Summary

The Prediction Of Worldwide Energy Resources (POWER) Project hosted its first annual Global Community Summit on September 21-22, marking the 25th year of providing global solar and meteorology data products to the world. The goals of this event were to inform users of new, enhanced features, gather feedback on services, identify new requests and requirements, and capture more thorough user stories while identifying new user communities and partnership opportunities. The event was "virtual" and had over 580 registrants. Over the two-day event, the Summit was attended by 162 unique attendees representing 24 countries.

Dr. Emily Sylak-Glassman, who serves as the Program Manager of NASA's Applied Science Program made the opening remarks, followed by keynote addresses from each of POWER's three unique user communities: Dr. Drury B. Crawley, representing the sustainable infrastructure community, Gregory J. Leng with renewable energy, and Dr. Gerrit Hoogenboom with agroclimatology.

Highlights of the POWER project and future plans were provided by NASA POWER Chief Scientist, Dr. Paul Stackhouse (LaRC). Bradley Macpherson, Chequel McNeil, and Christopher Higham of the POWER team presented a technical showcase. Users presented their use-cases in 18 lightning talk presentations. Interactive breakout sessions allowed for direct community engagement and feedback.

Finally, three selected individuals received Recognition of Excellence Awards from NASA for their exceptional achievement in utilizing solar and meteorological data sets from the NASA POWER project in conjunction with the RETScreen® Clean Energy Management Software platform. The awards were given in three categories: Facility Owners & Operators, Service Providers & Facilitators, and Educators & Researchers.

The Recordings from the event are available here: https://power.larc.nasa.gov/global-community-summit-2022/

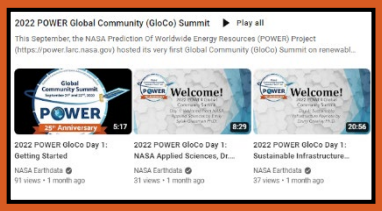


Table of Contents

Executive Summary....2
Acronyms....4
1. Event Description....5
2. Keynote Addresses....6
2.1 Keynote Speaker Biographies....7
3. User Lightning Talks....8
4. NASA RETScreen® Recognition of Excellence Showcase Award Winners....9
4.1 NASA RETScreen® Award Winners Biographies....11
5. Breakout Sessions....12
6. Event Participation Statistics....13
7. Post-Event Feedback....14
8. Key Takeaways....15
9. Acknowledgements....15
10. References....15
Appendix A: POWER GloCo Agenda....16
Appendix B: Lightning Talks, Speaker List....17
Appendix C: Breakout Session Report-out....18
Renewable Energy....18
Sustainable Infrastructure....19
Agroclimatology....20
Appendix D: Post-Summit Feedback from POWER's Community of Users....23
GloCo Registrants, Did Attend....23
GloCo Registrants, Did Not Attend....24

Table of Figures

Figure 1: Event Highlights....5
Figure 2: Keynote Speaker Talks....6
Figure 3: Keynote Speaker Biographies....7
Figure 4: Select User Lightning Talk Summaries....8
Figure 5: The NASA RETScreen® Award, Facility Owners & Operators Category....9
Figure 6: The NASA RETScreen® Award, Service Providers & Facilitators Category....10
Figure 7: The NASA RETScreen® Award, Educators & Researchers Category....10
Figure 8: Communities Selected by Users in the Registration Form....13
Figure 9: Map of the Locations of Users who Registered for the Event....13
Figure 10: Example of Questions Asked to Users 1....14
Figure 11: Example of Questions Asked to Users 2....14

Acronyms

ADC	ArcGIS DAAC Collaboration
AI	Artificial Intelligence
AIA	American Institute of Architects
API	Application Programming Interface
ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers
AWS	Amazon Web Service
BEMP	Building Energy Modeling Professional Certification
DAAC	Distributed Active Archive Center
DAV	Data Access Viewer
DSSAT	Decision Support System for Agrotechnology Transfer
EOSDA	Earth Observing Satellite Data Analytics
EOSDIS	Earth Observing System Data and Information System
GHG	Green House Gas
GIS	Geographic Information System
GloCo	Global Community
GMAO	Global Modeling and Assimilation Office
IFREE	International Fund for Renewable Energy and Energy Efficiency
LaRC	Langley Research Center
LEED	Leadership in Energy and Environmental Design
NASA	National Aeronautics and Space Administration
NRCan	Natural Resources Canada
POWER	Prediction Of Worldwide Energy Resources
RETScreen®	Renewable Energy Technology Screen
SILT	Solar Insolation Lookup Tool
USGBC	U.S. Green Building Council

1. Event Description

In September 2022, the NASA Prediction Of Worldwide Energy Resources (POWER) Project hosted its very first Global Community (GloCo) Summit on renewable energy, sustainable buildings, and agroclimatology while celebrating the project's 25th anniversary.

The POWER GloCo Summit was a **free two-(half) day virtual event** held on September 21st and 22nd, 2022, hosted by the NASA POWER Project Team.

At this event, attendees:

- Learned about POWER's latest enhancements to data product offerings and customized applications from the project's scientists and developers.
- Helped to derive future enhancements from POWER's community during interactive feedback sessions.
- Engaged with keynote speakers from the POWER community, specifically in the fields of renewable energy, sustainable infrastructure, and agroclimatology.
- Heard stories and use cases from POWER's user community, showcasing how they are applying POWER's Data Access Viewer (DAV), Application Programming Interface (API), Amazon Web Service (AWS) Open Data Registry, and/or ArcGIS Image Services in their missions across the globe.

The official Global Summit web site containing videos of the various talks is located at: https://power.larc.nasa.gov/global-community-summit-2022/ .

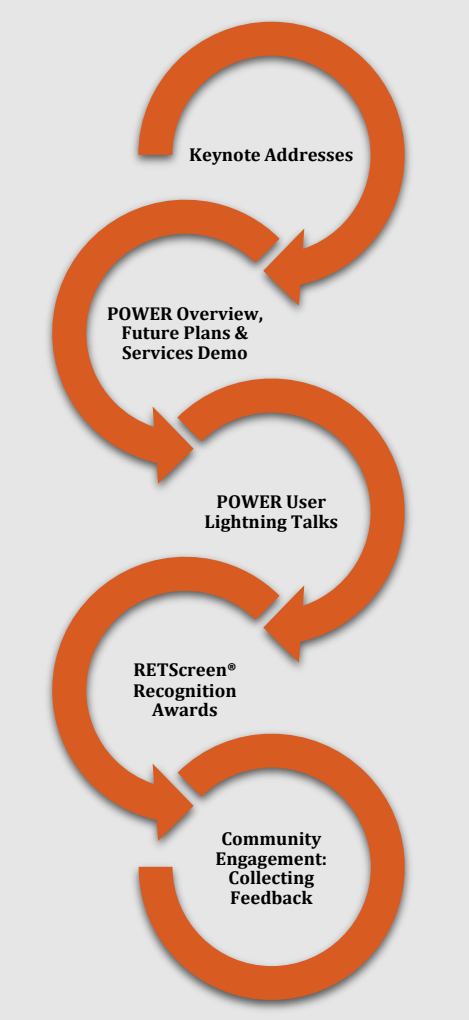


Figure 1: Event Highlights

In addition to keynote speakers and POWER user lightning talks, the POWER Team provided an overview presentation of the history of POWER, its current capabilities, and a glimpse into the future plans. The presentation on POWER's current capabilities featured a demonstration of obtaining data through POWER's Data Access Viewer, the AWS Open Data Registry, and the POWER's API, invoked using Jupyter notebook samples.

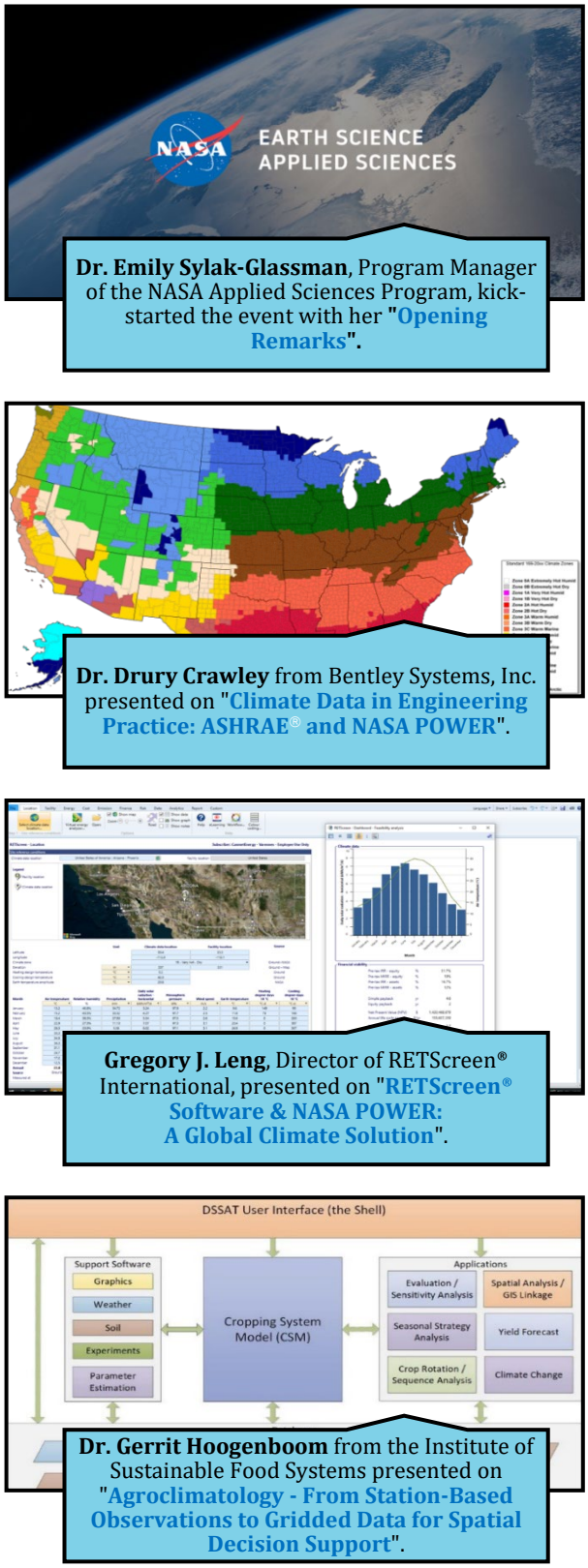
Each of the various sections of the meeting are summarized in this report and the complete agenda for this event can be found in Appendix A.

2. Keynote Addresses

Established partners and advanced users from POWER's community were invited to present keynotes to the community. Keynote addresses were designed to benefit the broader community of users, from hearing more about how POWER has been a key resource for the speaker's organization and the project's impact on their work.

On the first day of the GloCo Summit, Dr. Emily Sylak-Glassman, Program Manager of NASA Applied Sciences program, gave opening remarks to kick off the event. She detailed the purpose and mission of the NASA Applied Sciences Program, while noting how POWER fits into the program's broader initiatives. Dr. Drury Crawley, a Bentley Fellow and Director of Building Performance Research with Bentley Systems Inc., representing ASHRAE® (formerly known as the American Society of Heating, Refrigerating, and Air-Conditioning Engineers), presented an overview of the climatic data that ASHRAE® uses as well as comparisons of reanalysis data with ground station data and its impact on building energy performance. ASHRAE® committees and NASA POWER have been working together for more than 20 years,

On the second day of the event, Gregory J. Leng, Director of the RETScreen® Clean Energy Management Software platform at Natural Resources Canada's (NRCan) presented. The RETScreen® platform enables low-carbon planning, implementation, monitoring and reporting and utilizes POWER-provided data in its analysis. Dr. Gerrit Hoogenboom, Preeminent Scholar from the Global Food Systems Institute and Professor at University of Florida, presented on the institute's vision: to become a globally preeminent and transformative community for advancing the frontier of knowledge and practice for food and fiber systems. POWER data is used as input into the program's decision support system for agrotechnology transfer (DSSAT), a crop modeling system that is used globally in systems analysis and decision support (Hoogenboom *et al.*, 2021).



Dr. Emily Sylak-Glassman, Program Manager of the NASA Applied Sciences Program, kick-started the event with her "**Opening Remarks**".

Dr. Drury Crawley from Bentley Systems, Inc. presented on "**Climate Data in Engineering Practice: ASHRAE® and NASA POWER**".

Gregory J. Leng, Director of RETScreen® International, presented on "**RETScreen® Software & NASA POWER: A Global Climate Solution**".

Dr. Gerrit Hoogenboom from the Institute of Sustainable Food Systems presented on "**Agroclimatology - From Station-Based Observations to Gridded Data for Spatial Decision Support**".

Figure 2: Keynote Speaker Talks

2.1 Keynote Speaker Biographies

Welcome from Applied Sceinces by Emily Sylak-Glassman, Ph. D.

Program Manager of the NASA Applied Sciences Program

Dr. Emily Sylak-Glassman serves as the program manager/deputy director of the Applied Sciences Program in NASA's Earth Science Division, where she leads a broad portfolio of efforts to apply knowledge of Earth science to benefit people and the planet. She has also served as senior policy analyst for the Office of Technology, Policy, and Strategy, in which she provided data- and evidence-driven advice to NASA leadership. Before joining NASA, Emily worked at the Science and Technology Policy Institute, in which she supported the White House Office of Science and Technology Policy. Emily holds a PhD in chemistry from UC Berkeley and B.S. degrees in chemistry and biological chemistry from the University of Chicago.

Sustainable Infrastructure Keynote by Drury Crawley, Ph. D.

Bentley Fellow/Director, Building Performance Research, Bentley Systems, Inc.™

Dr. Drury B. Crawley, Ph.D., AIA, Fellow ASHRAE, BEMP, is a Bentley Fellow and Director of Building Performance Research with Bentley Systems Inc., focusing on building performance, BIM, zero-energy buildings, resilience, sustainability, and smart cities. With more than 40 years of experience in energy efficiency, renewable energy, and sustainability, Dr. Crawley has worked in engineering software development, government research, and standards development organizations, as well as building design and energy consulting companies.

Renewable Energy Keynote by Gregory J. Leng

Director, RETScreen® International

Gregory J. Leng is the creator and Director of the RETScreen® Clean Energy Management Software platform at Natural Resources Canada's (NRCan) CanmetENERGY research centre in Varennes, Quebec. The platform enables low-carbon planning, implementation, monitoring and reporting. Greg is also a Fellow at the Payne Institute, Colorado School of Mines, in Golden, Colorado.

His career is focused on the clean energy market, technology and policy interface and he has been working in the renewable energy and energy efficiency fields since 1987. Prior to joining NRCan, he was based in Hyderabad, India as the India Country Manager (dLA Consultant) for the International Fund for Renewable Energy and Energy Efficiency (IFREE).

Greg obtained a Master of Science degree from the University of Massachusetts Lowell in Energy Engineering (Solar Energy Engineering) and a Bachelor of Commerce degree (Marketing and International Business) from McGill University.

Agroclimatology Keynote by Gerrit Hoogenboom, Ph.D.

Professor and Preeminent Scholar, Institute for Sustainable Food Systems

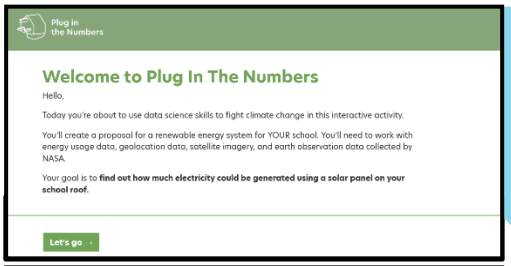
Dr. Gerrit Hoogenboom is a Preeminent Scholar in the Food Systems Institute and Professor of Agricultural and Biological Engineering at the University of Florida, USA. Prior to joining the University of Florida, he was the Director of the AgWeatherNet Program and Professor of Agrometeorology at Washington State University. He has over 30 years of experience in the development of crop simulation models and decision support systems. Applications range from freeze forecasting to climate variability and climate change, water resources management, biofuels, economic and environmental sustainability, and food and nutrition security. He currently coordinates the development of the Decision Support System for Agrotechnology Transfer (DSSAT; www.DSSAT.net), one of the most popular crop modeling systems across the world. He frequently organizes and facilitates international training workshops on crop modeling and decision support systems. He has published over 450 scientific papers in refereed journals as well as numerous book chapters and proceedings (h-index 88; i10-index 452; Citations 35,906; Google Scholar). Since 2019, he is the Editor-in-Chief for The Journal of Agricultural Science (Cambridge). He received his Ph.D. from Auburn University, USA, and M.Sc. in Theoretical Production Ecology and M.Sc. and B.Sc. in Horticulture from Wageningen University, the Netherlands.

Figure 3: Keynote Speaker Biographies

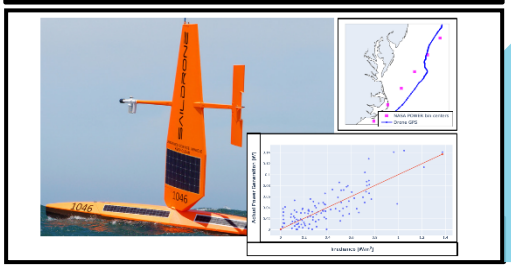
3. User Lightning Talks

The POWER Project invited its user community to present three-to-five-minute lightning talks at the GloCo Summit. The goal of session was to feature stories and use cases from POWER community, showcasing how POWER's Data Access Viewer (DAV), Application Programming Interface (API), AWS Open Data Registry, and/or Esri ArcGIS Image Services were being used across the globe. **14 users of POWER data gave talks during the event, representing the renewable energy, and agroclimatology communities**.

This session presented a unique opportunity to connect with our community outside of the Project's established partnerships. The users who presented were a great representation of POWER's global user community, with projects taking place from Scotland to Brazil and Bangladesh to West Africa. Topics of the lightning talks ranged from the monitoring of crop yield and crop loss due to adverse meteorological conditions, to a solar insolation lookup tool, to a solar power site suitability study, to powering instrumented drones making measurements over oceans. Below are highlights of select talks. Recordings of all talks are available:

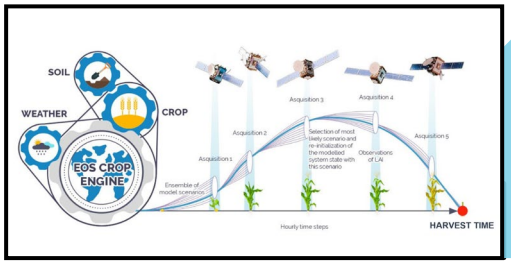


- Students in Iverness, Scotland worked with POWER to develop "Plug in the Numbers" interactive game. Plug in the Numbers uses energy usage data, geolocation data, satellite imagery, and Earth Observation data from NASA POWER database.
- Users are able to zoom in on local schools to determine potential energy savings using renewable energy.The intent is to teach learners basic data science skills to better understand climate change through an interactive activity.



- Saildrone is a platform for real time ocean data collection using a global fleet of wind and solar-powered ocean drones. Saildrone uses location specific hourly irradiance data from POWER, to predict the solar power generated by a drone.
- Clarity on power generation has been useful for Saildrone in several contexts e.g in Mission planning, execution and engineering aspects, such as, predicting viable operating season with drone support, prioritizing load shedding vs enhancing solar decisions, as well as in its business development

- The Davis & Shirtliff Group©, with an office in Kenya, is a leading supplier of water-related equipment in the East African region. They provide Solar Pumping specification and sizing for their solar water pumping products.
- Using NASA POWER solar data in their "SolarCalc" application, the Davis & Shirtliff Group calculates the most appropriate configuration of solar water pumps for their customers, i.e. how many panels (including the arrangement) are needed to power the Solar Water Pumps.



- The Earth Observing Satellite Data Analytics (EOSDA) is global provider of AI-powered satellite data analytics. The company is provides information such as crop development, crop disease, and yield forecast to their the global agricultural sector clients. These outcomes are heavily dependent on accurate estimation of past and current weather.
- EOSDA's operational crop growth monitoring and yield forecasting system uses meteorological data from NASA POWER database and services.

Figure 4: Select User Lightning Talk Summaries

See Appendix B for the complete list of speakers and topics.

4. NASA RETScreen® Recognition of Excellence Showcase Award Winners

The summit featured inaugural NASA POWER/RETScreen® Recognition of Excellence Awards in three categories: "Facility Owners & Operators", "Service Providers & Facilitators", and "Educators & Researchers". Three individuals were selected to receive the award from NASA due to their exceptional achievement in utilizing solar and meteorological data sets from NASA's POWER project in conjunction with the RETScreen® Clean Energy Management Software platform, a longtime POWER partner.

Candidates from RETScreen®'s 750,000+ global user base were nominated by the RETScreen® Team based upon the impact of the work that they have for facilities and on the community. The nominees were then reviewed by the NASA POWER team for final selection. Each awardee showcased their work in a brief presentation, highlighting the impact of using POWER data. Shown below are details of the award category, the award certificates, respective award winners their presentations.

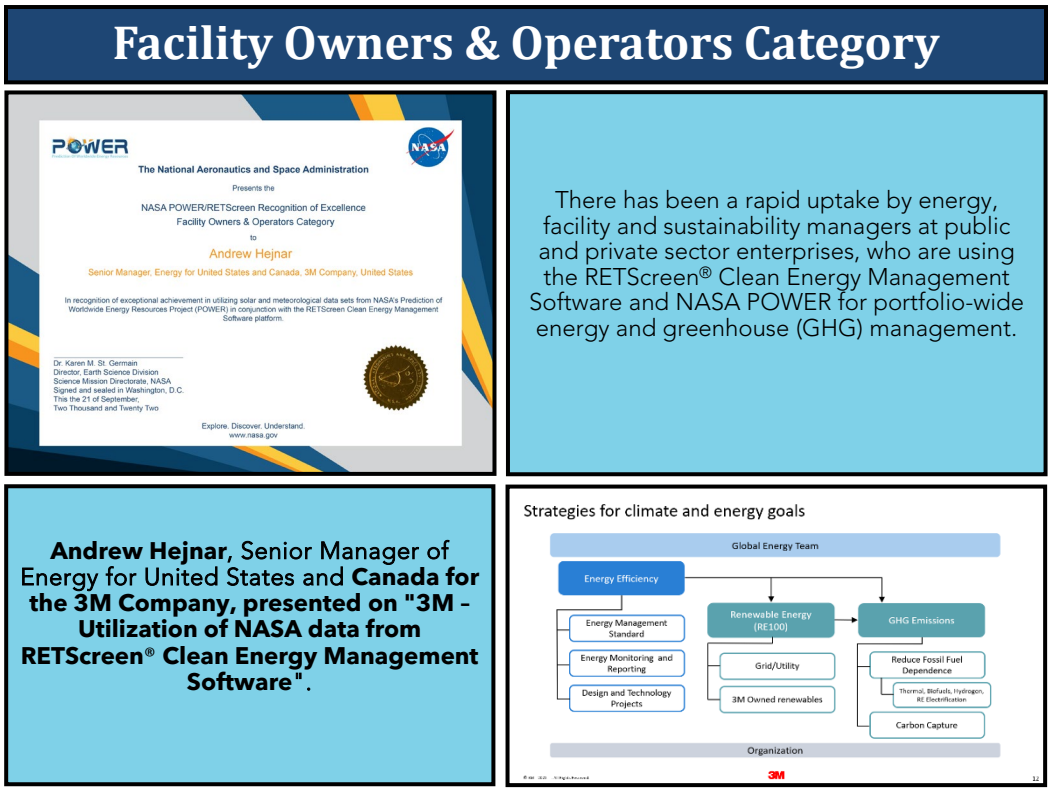


Figure 5: The NASA RETScreen® Award, Facility Owners & Operators Category

Service Providers & Facilitators Category

Service providers, including engineering, architecture & consulting firms, as well as Energy Service Companies, have increasingly embraced the RETScreen® Clean Energy Management Software and NASA POWER.

Government, multi-lateral organizations, and regulated electricity and natural gas utilities, also use RETScreen® software and POWER extensively to help facilitate clean energy project deployment by their stakeholders and customers, and to help verify the ongoing performance of their investment portfolios.

Stephen Dixon, president of the TdS Dixon Inc., Canada, presented on "**Application of NASA Power Data to RETScreen® Expert Energy Analysis**".

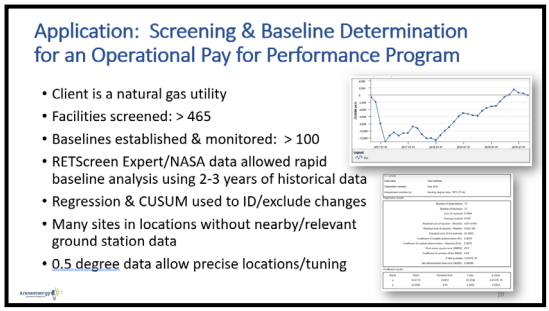


Figure 6: The NASA RETScreen® Award, Service Providers & Facilitators Category

Educators & Researchers Category

More than 1,400 universities and colleges around the world use the RETScreen® Clean Energy Management Software and NASA POWER for teaching and research.

Thousands of students learn and subsequently use the RETScreen® software and NASA POWER data every year. The RETScreen® software and NASA POWER data have been utilized in over 5,000 scholarly publications to-date.

Luis Ramón Rojas-Solórzano, a professor at several universities, presented on "**Integrating Teaching and Research in the Classroom with RETScreen® and NASA POWER**".

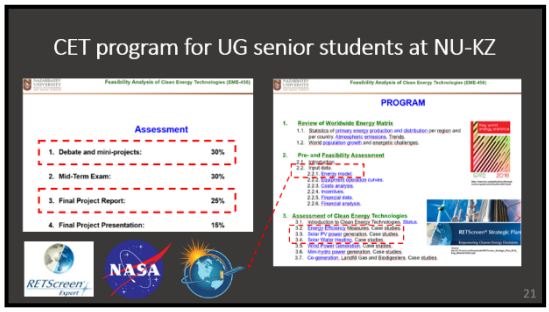


Figure 7: The NASA RETScreen® Award, Educators & Researchers Category

4.1 NASA RETScreen® Award Winners Biographies

Facility Owners & Operators Award: Andrew Hejnar

Senior Manager, Energy for United States and Canada, 3M Company, United States

Andrew Hejnar leads the effort at 3M Corporation to deploy the software, including use of NASA POWER, for 3M's numerous facilities located in the United States, Canada and around the world. A large part of what makes energy efficiency at 3M's facilities possible are international standards like ISO 50001 and the Superior Energy Performance System, which provide a consistent best practice for designing, implementing, measuring and optimizing an energy management process. The RETScreen® software and NASA POWER have been an integral part of this process for Andrew and his colleagues at 3M Company.

Service Providers & Facilitators Award: Stephen Dixon

President, TdS Dixon Inc., Canada

Stephen Dixon is an independent energy consultant and trainer, including extensive work with the RETScreen® software and NASA POWER, supporting a broad range of institutional, commercial, and industrial organizations. His activities include extensive energy training, performing energy audits, monitoring and verification studies with such customers as municipalities, large commercial property owners, government agencies, industrial facilities and local utilities. Through his consulting and training work, Stephen has helped to build the capacity of a large group of energy professionals from across the globe in the use of the RETScreen® software and NASA POWER.

Educators & Researchers Award: Luis Ramón Rojas-Solórzano

Associate Professor, Nazarbayev University, Kazakhstan; Invited Professor, IMT-Atlantique, France; Professor, Simon Bolivar University, Venezuela

Professor Luis Ramón Rojas-Solórzano is a RETScreen® software and NASA POWER academic trailblazer. For example, since 2010 he has taught "Clean Energy Project Analysis - Using RETScreen" which is an intensive 4-day course offered in France each year for about 20-30 Master's students from all around the world and has been teaching consistently the full-semester course every year since 2013 for senior students of Mechanical Engineering at Nazarbayev University and in the past between 2007-2012 at Simon Bolivar University, with RETScreen® and NASA POWER at the center of this course. In addition to leading this course, he is also Associate Provost for Graduate Studies at Nazarbayev University in Kazakhstan, where he uses RETScreen® and NASA POWER extensively for both teaching and research, including numerous peer-reviewed publications with his students and collaborators.

5. Breakout Sessions

Three Interactive breakout sessions were convened on Day 2 of the summit, for each of the POWER's primary user communities. A virtual whiteboard platform, Mural, was utilized to allow smaller groups to split off from the main webinar into the breakouts. These sessions occurred simultaneously, and participants could choose what sessions to attend or switch between rooms based on their work/interests. These sessions allowed users to collaborate and share ideas over chat with a moderator leading the discussion. Each breakout room had a preconfigured space with prompts, comment boxes, and open text areas. Each room had a subject matter expert as the Moderator of the session to lead the discussion, collect feedback and facilitate dialogue. Other POWER Project team members were in each room to provide technical assistance as well as help spur conversation, and capture notes, questions, and feedback. A summary report was completed after input from each session was consolidated and presented to the participants at the summit.

- Within the **Renewable Energy** breakout session, users reported to utilize a wide variety of POWER parameters, such as total solar irradiance, wind speed, air temperature, and surface air density. Related to future needs, users were interested in being able to access forecast data, pollution-related parameters, and illumination parameters. Additionally, user requested additional GIS-formats available for data requests, as well as expanded GIS image services.
- During the **Sustainable Infrastructure** session, users noted that they utilize solar radiation data and climate zone information in their current workflows. For future needs, users would like to see higher resolution data, future projections/forecasts, and multi-year typical/extremes at an hourly scale. On the question of future tools and technologies from POWER services, users responded that they would like POWER to be able to plug into Leadership in Energy and Environmental Design (LEED), U.S. Green Building Council (USGBC), and WELL building standards, among others.
- Users who participated in the **Agroclimatology** session wrote that solar, temperature, windspeed, and precipitation data were the top parameters utilized in their current workflows. When brainstorming possible future needs, users commented that they were interested in POWER providing evapotranspiration data, as well as a variety of soil parameters, such as soil humidity, temperature, type, and moisture. This community was also interested in higher resolution data and forecasted parameters, in addition to trend analysis and increased documentation on how to access POWER's API via Python and R packages.

See Appendix D for the full report.

6. Event Participation Statistics

The Global Community Summit event webpage was hosted on POWER website. Starting in August of 2022, the POWER team publicized this event through various NASA communication channels including POWER's email lists, Atmospheric Science Data Center's website, Langley Research Center's (LaRC) website, LaRC Science Directorate's website, Applied Sciences' website, Earthdata Twitter, Earth Observing System Data and Information System's (EOSDIS) Slack instant messaging platform, NASA GIS Community of Practice's email list, ArcGIS DAAC Collaboration's (ADC) email list, DEVELOP Program email list, and My NASA Data's email list. The team also worked with collaborators to publicize the event on World-Wide Human Geography Data email list, Decision Support System for Agrotechnology Transfer's (DSSAT) email list, Esri's social media, and various Booz Allen Hamilton, Inc. platforms.

Below is a summary of the statistics gathered, related to event registrants and participants.

- Users Registered: 587
  - The representation of registrants from different user communities is shown in Figure 8. Roughly 21% of registrants were from the Agroclimatology and Renewable Energy Communities; about 10% of the Sustainable Infrastructure Community and about 5% of Agroclimatology Community also identified with Renewable Energy. The community overlap (registrants who selected all 3 sectors (~22%)) shows the cross-cutting nature of work done across these communities. Besides the main user communities, there were 95 registrants who selected "Other" as their community.
- Total Unique Event Attendees: 162
  - 149 plus the POWER Team and keynote speakers
  - ~25 countries represented: Armenia, Brazil, Canada, Chad, Colombia, Egypt, Ethiopia, French Guiana, India, Kazakhstan, Kenya, Libya, Malaysia, Mexico, Pakistan, Peru, Russia, Scotland, Spain, Sri Lanka, Thailand, Ukraine, United Kingdom, United States of America
- Day 1: 149 Unique attendees/individuals
  - Average Attendance Duration = 136 minutes
- Day 2: 100 Unique attendees/individuals
  - Average Attendance Duration = 137 minutes

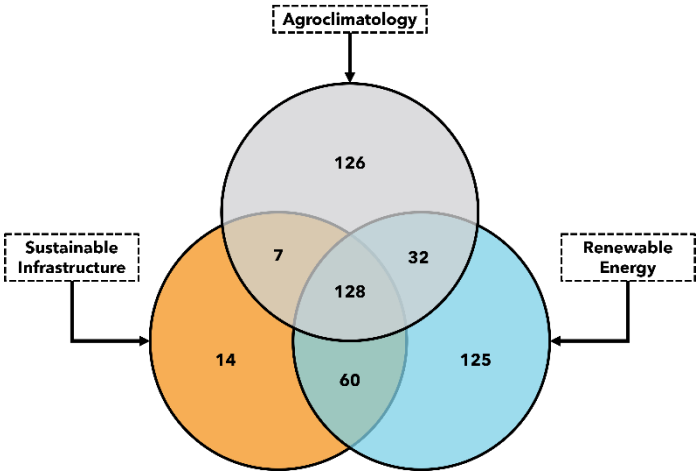


Figure 8: Communities Selected by Users in the Registration Form

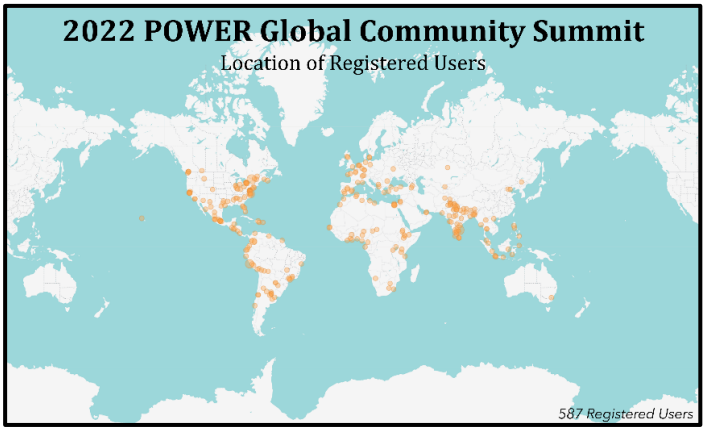


Figure 9: Map of the Locations of Users who Registered for the Event

7. Post-Event Feedback

To improve on future Global Summit, the POWER team collected feedback from the summit registrants. Details of all feedback collected can be found in Appendix E.

- Of the 25 respondents that attended the event and responded to the survey,
  - 76% rated the overall value of the content presented at the summit to be "very valuable", with 16% finding the content "somewhat valuable".
  - 96% selected that they would "absolutely" or "very likely" attend a future POWER GloCo Summit.
  - The sessions they found most valuable were the "POWER Roadmap & Technical Showcase, as well as the "POWER User Lightning Talks".
    - Most of the users (87%) noted that they would be interested in giving a POWER User Lightning Talk in the future.
  - Users thought the event was "just right" in terms of the summit duration.

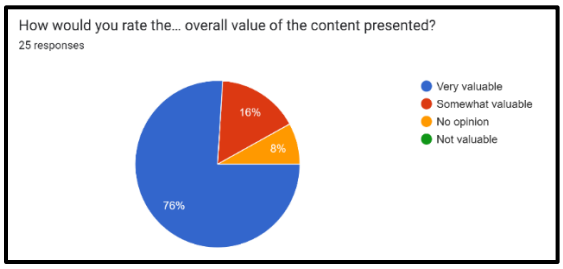


Figure 10: Example of Questions Asked to Users 1

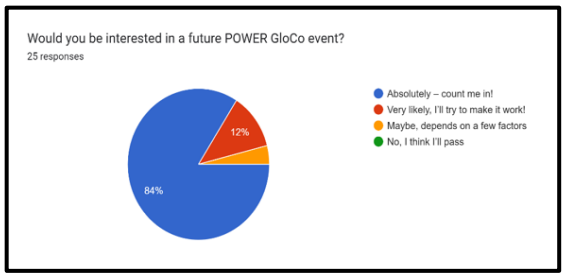


Figure 11: Example of Questions Asked to Users 2

- For those who were not able to attend the event, they noted that "inconvenient time" and "unplanned activity came up" as the top two reasons they were not able to attend.
- In the free response section, users noted that for future needs, they'd like to see higher resolution datasets, modeling/forecast parameters, and derived data, such as evaporation and vegetation indices.

See Appendix E for the full feedback report.

8. Key Takeaways

The 2022 POWER GloCo Summit was the POWER Project's first virtual event. It provided an invaluable opportunity to interact with POWER's end-users and stakeholder communities. The key takeaways from the two-day virtual event are:

- The virtual summit provided an opportunity to hear directly from several users of POWER data and services from across the globe. Future annual virtual meetings will benefit POWER's communities, that expressed keenness to participate in future.
- Participation of International community revealed the dire need and critical role of analysis ready data, tools and services in developing nations.
- In data-sparse regions of the world, there is a strong desire in the agriculture community for data and tools to meet their decision-making needs.
- The virtual event encouraged large number of registrations (500+) from POWER's worldwide users. There were 169 unique attendees. Future events can plan to better accommodate time zones of the registrants for increased participation.
- To improve the services provided by POWER to its communities, an in-person exchange with established partners and advanced users will be highly beneficial.

9. Acknowledgements

The Prediction of Worldwide Energy Resources (POWER) Project is funded through the NASA Applied Sciences Program within the Earth Science Division of the Science Mission Directorate. The POWER team could not have completed this task without both technical and scientific inputs from the following Earth Science Division teams: The World Climate Research Programme (WCRP) Global Energy and Water Cycle Experiment's (GEWEX) Surface Radiation Budget (NASA/GEWEX SRB) and the Clouds and the Earth's Radiant Energy System (CERES) projects at NASA LaRC and the Global Modeling and Assimilation Office (GMAO) at the NASA Goddard Space Flight Center. The data obtained through the POWER (Prediction of Worldwide Energy Resources) web services was made possible with collaboration from the NASA LaRC Sciences Data Center (ASDC).

10. References

Hoogenboom, G., C.H. Porter, V. Shelia, K.J. Boote, U. Singh, J.W. White, W. Pavan, F.A.A. Oliveira, L.P. Moreno-Cadena, J.I. Lizaso, S. Asseng, D.N.L. Pequeno, B.A. Kimball, P.D. Alderman, K.R. Thorp, M.R. Jones, S.V. Cuadra, M.S. Vianna, F.J. Villalobos, T.B. Ferreira, W.D. Batchelor, J. Koo, L.A. Hunt, and J.W. Jones. 2021. Decision Support System for Agrotechnology Transfer (DSSAT) Version 4.8 (DSSAT.net). DSSAT Foundation, Gainesville, Florida, USA.

Appendix A: POWER GloCo Agenda

Day 1 Agenda

Time (ET)	Item
11:00 - 11:10	**Getting Started**
11:10 - 11:25	**Welcome from NASA Applied Sciences** by Emily Sylak-Glassman, Ph.D.
11:25 - 11:55	**Sustainable Infrastructure Keynote** by Drury Crawley, Ph.D.
11:55 - 12:20	**POWER: Journey & Roadmap** by Paul Stackhouse, Jr., Ph.D.
12:20 - 12:50	**POWER: Technical Showcase**
12:50 - 1:10	*Break*
1:10 - 1:45	**Community Showcase (Lightening Talks #1)** 6 talks @ 5 minutes each
1:45 - 2:20	**Community Showcase (Lightening Talks #2)** 6 talks @ 5 minutes each
2:20 - 2:55	**Community Showcase (Lightening Talks #3)** 6 talks @ 5 minutes each
2:55 - 3:00	**Closing Remarks**

Day 2 Agenda

Time (ET)	Item
11:00 - 11:10	**Getting Started**
11:10 - 11:40	**Renewable Energy Keynote** by Gregory J. Leng
11:40 – 12:25	**NASA RETScreen® Recognition of Excellence Showcase** • Andrew Hejnar, 3M Corporation • Stephen Dixon, TdS Dixon Inc. • Luis Ramón Rojas-Solórzano, Associate Professor at Nazarbayev University, Kazakhstan
12:25 – 12:55	**Agroclimatology Keynote** by Gerrit Hoogenboom, Ph.D.
12:55 – 1:05	**Introduction to Breakout Sessions**
1:05 – 1:15	*Break*
1:15 – 2:15	**Breakout Sessions** • Renewable Energy • Sustainable Infrastructure • Agroclimatology
2:15 – 2:30	*Break*
2:30 – 2:50	**Breakout Session Report Out**
2:50 – 3:00	**Closing Remarks**

Appendix B: Lightning Talks, Speaker List

Session 1:

1. "Using NASA POWER Data to Specify Solar Water Pumping Systems" by Ken Muturi, the Davis & Shirtliff Group *(Renewable Energy)*
2. "SOLARPE PRO, a Free Android App for Photovoltaic Systems" by Pedro García, SOLARPE PRO *(Renewable Energy)*
3. "POWER in the Classroom: Plugging in the Numbers for COP26" by Daniel Devine, Digital Skills Education *(Renewable Energy)*
4. "NASA DEVELOP Energy Projects: Building Capacity to Use POWER to Determine Solar Potential" by Cecil Byles, NASA DEVELOP *(Renewable Energy)*
5. "Solar Insolation Lookup Tool (SILT)" by Davis Conley, SIL International *(Renewable Energy)*
6. *Question & Answer Session, led by Dr. Paul Stackhouse*

Session 2:

1. "Using POWER Data to Investigate the Relationship Between Climate Shocks and Women's Rights in Bangladesh" by Eleanor Horvath, Boston University *(Agroclimatology)*
2. "Monitoring Crop Loss Due to Adverse Agrometeorological Conditions" by Daniel de Castro Victoria *(Agroclimatology)*
3. "Using NASA POWER Gridded Data in Crop Monitoring and Yield Prediction by EOSDA" by Kryvobok Oleksii *(Agroclimatology)*
4. "Weather Model for Study of Mesoamerican Nephropathy" by Srinivasa Murty *(Agroclimatology)*
5. *Question & Answer Session, led by Dr. Paul Stackhouse*

Session 3:

1. "Saildrone: Ocean Data Solutions" by Erik Chubb, Saildrone, Inc.
2. "How NASA Power Data Can Be Used in Agrivoltaics Projects" by Richmond Kuleape *(Renewable Energy, Agroclimatology)*
3. "Mental Health Improves on Sunnier Days of the Year" by D Sadish
4. "Runoff Estimation Using Satellite Images in Sparsely Gauged Basins: A Case of Nzoia River Basin, Kenya" by Stephen Mureithi
5. "Comparison of Irradiation Estimates between POWER and Heliosat-2 with GOES-13" by Jessica BECHET, Energetic Transition - UMR Espace Dev *(Renewable Energy)*
6. *Question & Answer Session, led by Dr. Paul Stackhouse*

Appendix C: Breakout Session Report-out

Three Interactive breakout sessions were convened on Day 2 of the summit, for each of the POWER's primary user communities: Renewable Energy, Sustainable infrastructure and Agroclimatology. A virtual whiteboard platform, Mural, was utilized to facilitate discussion and gather feedback from the smaller groups at the breakouts. Inputs and feedback received from the participants at each breakout session are presented below. A summary of the inputs obtained in the breakout sessions, can be found in Section 5 of the report.

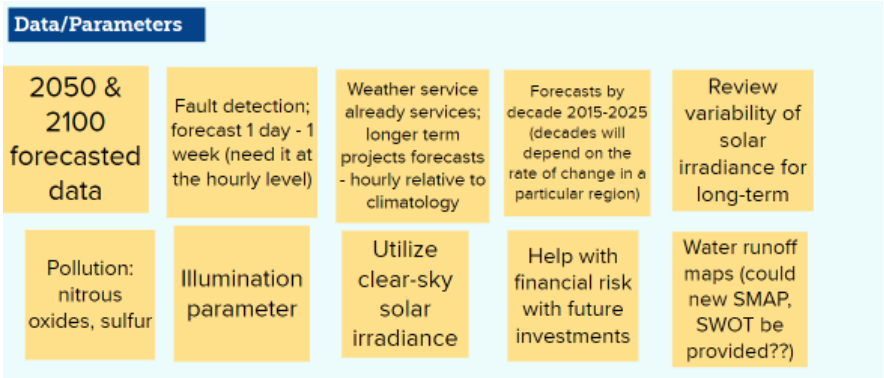
Renewable Energy

How/What POWER capabilities are used in your current workflows?

- Total Solar Irradiance
- Solar and Meteorological Data
- Wind Speed
- Air Temperatures
- Surface Air Density
- Design Temperatures (max/min, over entire year + multiple years)

What are your FUTURE NEEDS in terms of data capabilities, services, parameters?

1. *Data Parameters*



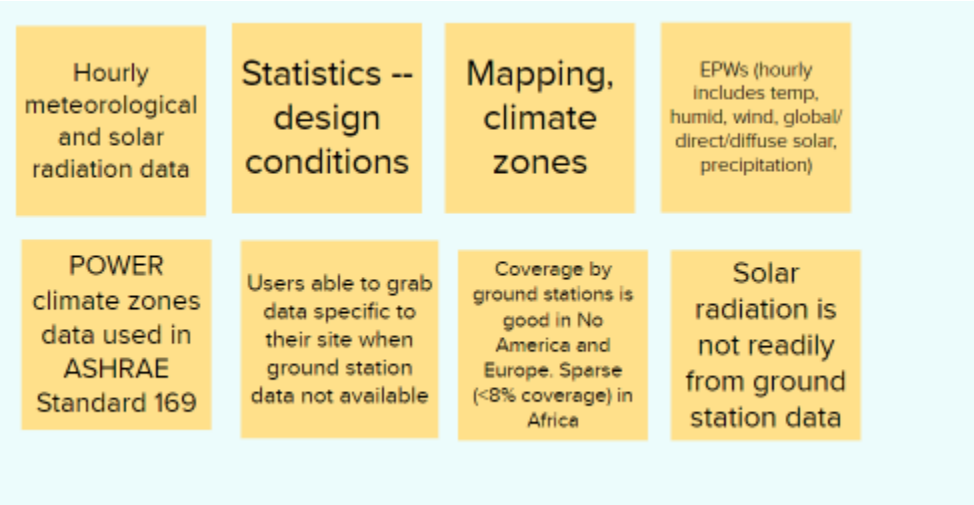
2. *Data Services & Formats*

What do you see being the next big thing in sharing science?

- Interconnectivity with other software platforms
- Enable academic research and collaboration
- Education interaction & curriculum development

Sustainable Infrastructure

How/What POWER capabilities are used in your current workflows?



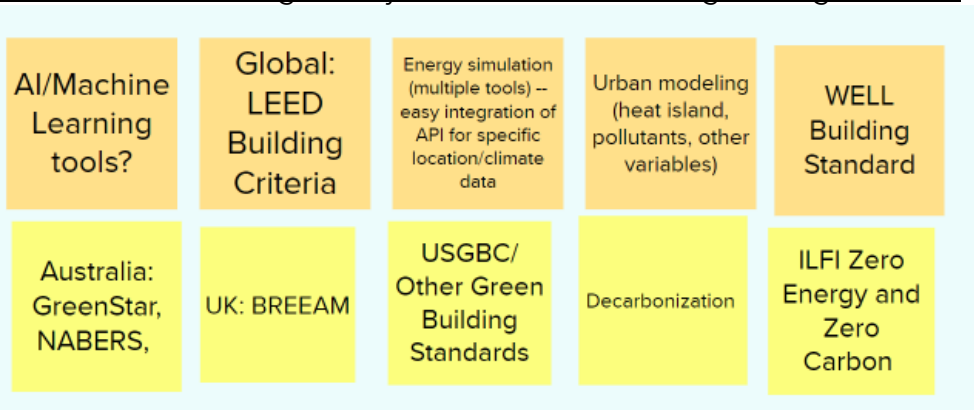
What are your FUTURE NEEDS in terms of data capabilities, services, parameters?

1. *Data Parameters*
    - Higher resolution (smaller grid size)
    - Future projections (e.g., climate change)
    - Easier integration into other software

2. *Analytic Capabilities*
    - Forecasting natural disasters (floods, drought, heat waves, etc.)
    - Building resilience
    - Multi-year typical/extremes at an hourly scale
    - Multiyear summary in custom formats

3. *Policy*
    - Increased use of POWER data in ASHRAE standards + other national/international building codes

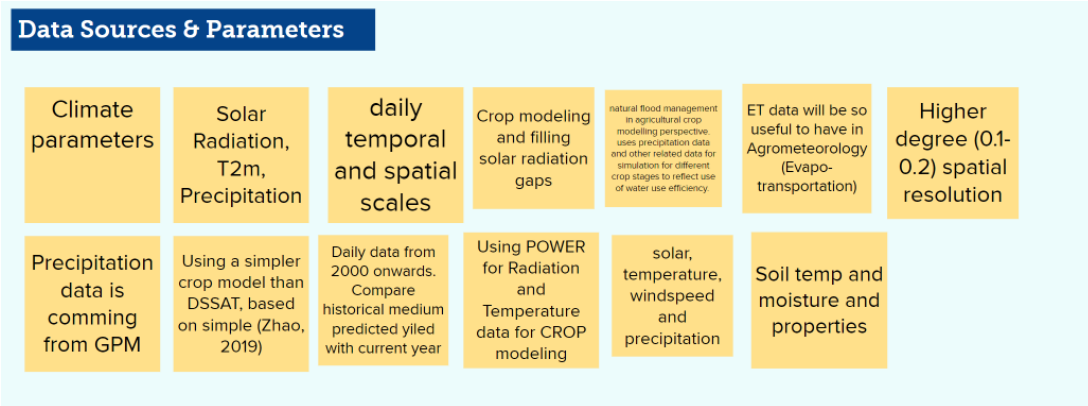
What future tools and technologies do you see POWER needing to integrate with?



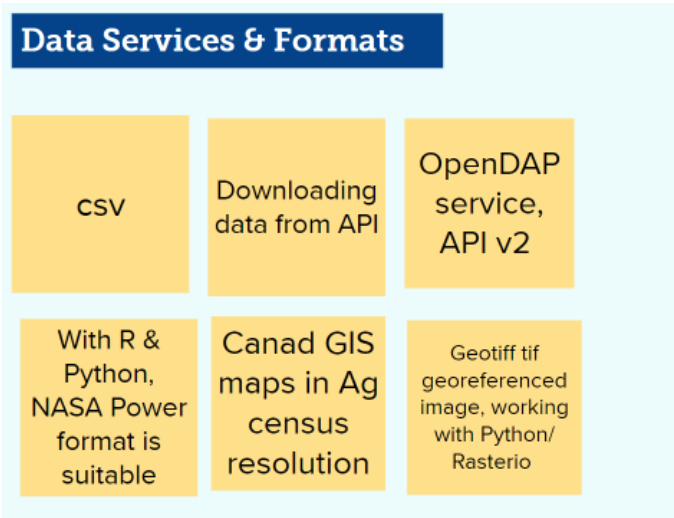
Agroclimatology

How/What POWER capabilities are used in your current workflows?

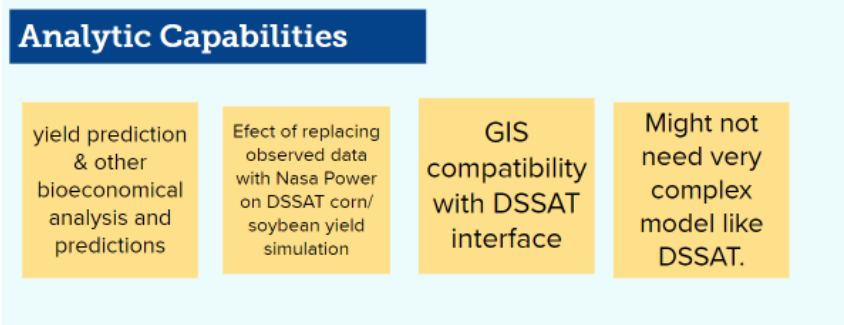
1. *Data Parameters*



2. *Data Services & Formats*



3. *Analytic Capabilities*



What are your FUTURE NEEDS in terms of data capabilities, services, parameters?

Data/Parameters

- Soil humidity
- vapor pressure - If really important
- CMIP6 scenarios (with bias correction?)
- Soil types and soil water
- Soil temperature
- Soil carbon added over time
- ET (EvapoTrasporation)
- Soil Moisture at different depths

Data Services & Formats

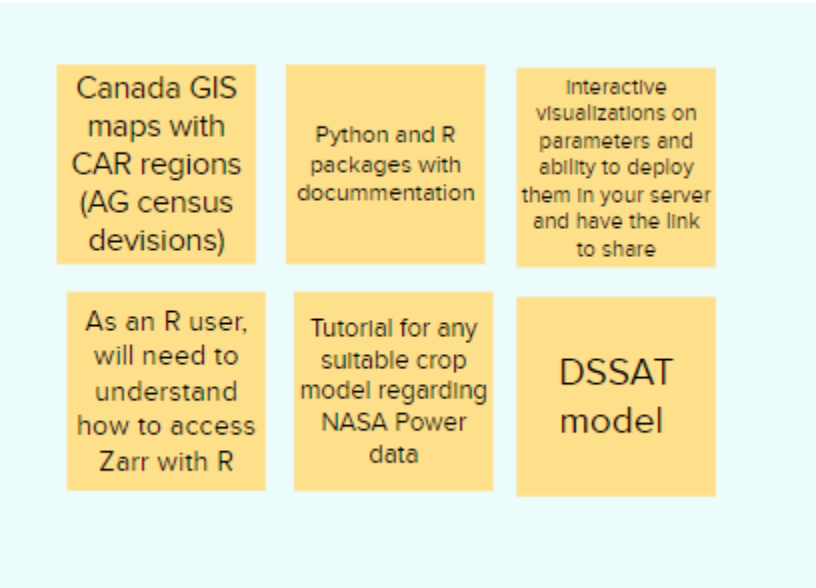
- Higher spatial resolution up to 10 km Priority solar and temperature
- Daily forecast data
- Hourly data
- Improve near real-time delivery of solar radiation and temperature data
- GPM is 10Km spatial resolution. Chirps is 5km. Would be nice if Power followed suit
- Calculate ETP (Potential Evapotranspiration)
- 0.1-0.2 degree on spatial resolution
- Must specify which formula is beeing used (FAO-56, Thornthwaite...)

Analytic Capabilities

- developing shading on ground for Agriforestory and Agrivoltiacs
- Trend analysis

  I work with climate risk. Ex.: Frequency of days with low tempearature (frost). Is the frequency increasing over time?
- parallelization of DSSAT for running with raster information

What future tools and technologies do you see POWER needing to integrate with?



What do you see being the next big thing in sharing science?

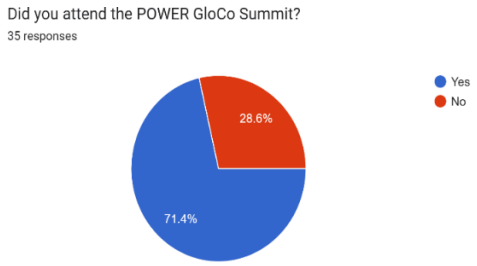
- IoT information as a data source for crop modeling
- Open Python/R codes for getting POWER data
- Open GIS software
- A free, safe, and open-source server for data visualization

Have you been able to use POWER data for informing policy and or decision making? If so, what was the impact?

- Soil erosion assessments
- Crop performance mapping + the HOLOS model of Agriculture and Food in Canada

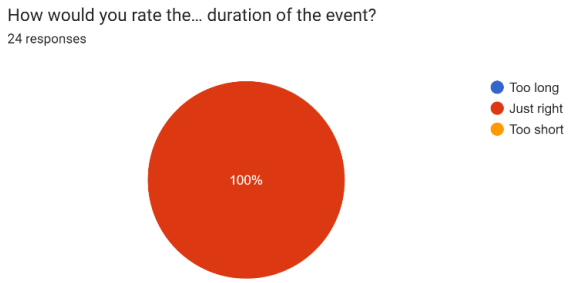
Appendix D: Post-Summit Feedback from POWER's Community of Users

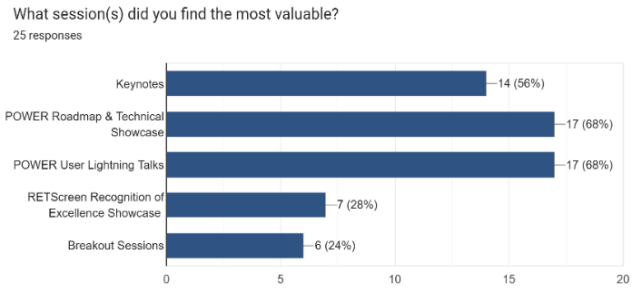
After the GloCo summit, a survey was circulated to POWER's user community to receive feedback on the attendee's experience, expectations regarding such future events and to collect feedback on data, web services and other needs from non-attendee users. We received 35 responses, that are shared below.

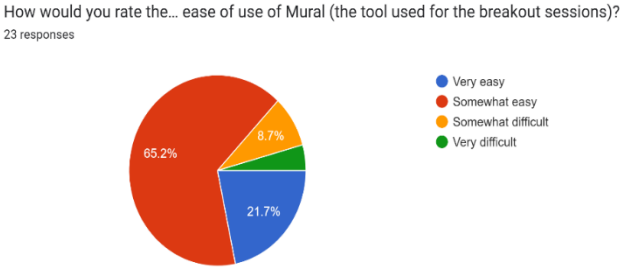


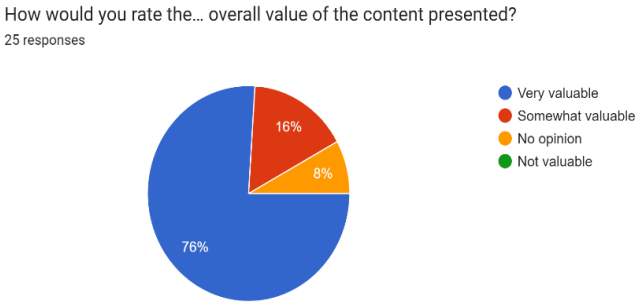
GloCo Registrants, Did Attend

Of the 25 summit attendees who responded to the post-summit survey, most found the content presented at the summit to be very valuable. POWER Roadmap presentation and technical showcase, POWER User lightning talks and Keynote presentations were most valuable. The two-half day event was rated just right by all. The Mural tool used for the breakout sessions, was rated as very easy and somewhat easy to use by most survey responders.

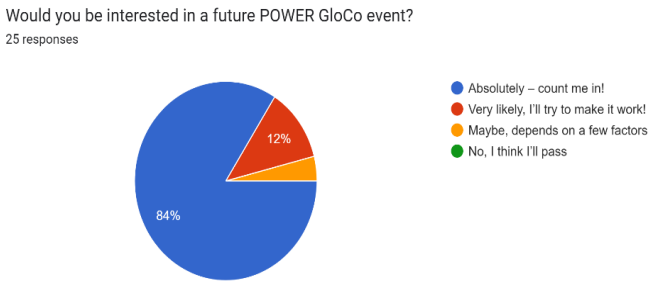


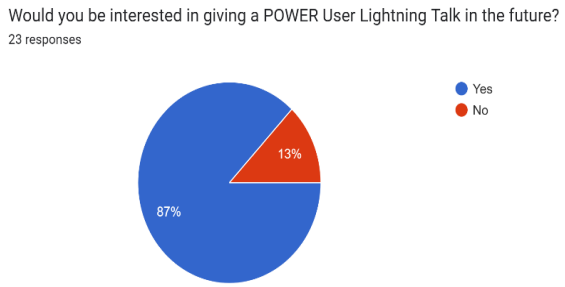


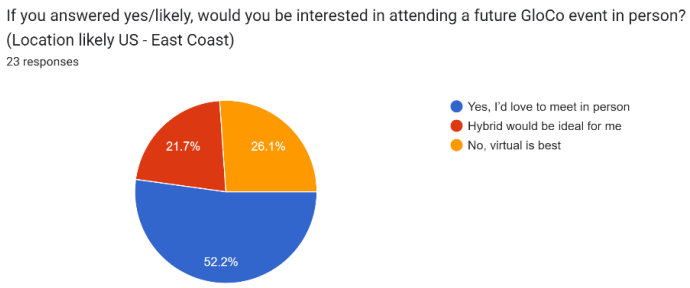




Over 95% of survey participants are absolutely or very likely to attend a future POWER GloCo event and 87% showed interest in sharing a use case story. Both virtual, hybrid and in-person meeting options were voted equally





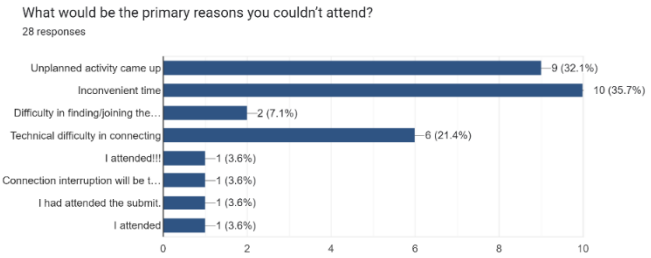


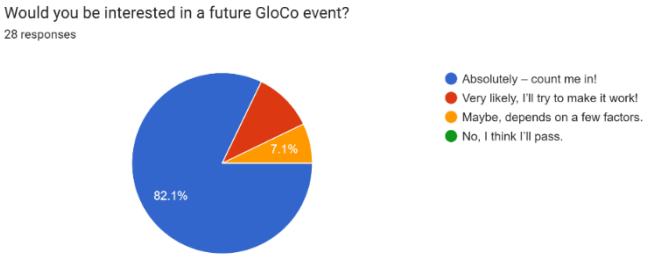
Any suggestions for future improvement?

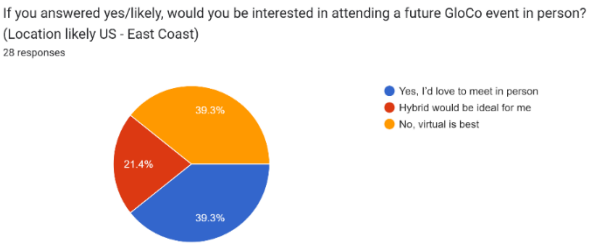
- It would be great if nexus thinking also be addressed related to power
- Please provide all recorded videos
- User tutorials and manuals for new researchers is helpful.
- Don't double book with the RE+ conference (formerly SPI; largest energy event in North America); that must've knocked out a bunch of potential attendees this year.

GloCo Registrants, Did Not Attend

The summit had received 587 registrations and 162 of them attended. For those who were not able to attend the event, we sought feedback through our post-summit survey. They noted that "inconvenient time" and "unplanned activity came up" as the top two reasons they were not able to attend. In the free response section, users noted that for future needs, they'd like to see higher resolution datasets, modeling/forecast parameters, and derived data, such as evaporation and vegetation indices. Complete set of responses are documented below.







What POWER capabilities/parameters are used in your current workflows?

- Climate data
- To use it to obtain climate data to do some research that needs diverse and long-term data
- Solar irradiance and turbine level wind speeds
- Temperature humidity sunshine rainfall
- Agroclimatology data
- Irradiation estimates
- Solar Fluxes and temperature
- Meteorological parameters for Climate assessment
- Renewable Energy data
- Solar and Agroclimatology data
- Meteorological parameters and solar related parameters
- I use meteorological data in my research work

Have you been able to use POWER data for informing policy and/or decision making? If so, how?

- Agricultural decisions
- Yes, in studying drought cases and calculating periods of return of rain Based on the results, I report from time to time and inform the competent authorities
- Climate data for crop modelling
- Not yet. I hope to use the historical solar and wind data to develop regression models.
- I had been using only CROPWAT and DESAT models.
- Yes, in analysis of past climatic event I have used
- Applications in solar thermal systems
- yes, by application of ANN
- Renewable Energy
- Teaching, referencing, incorporating in lectures.

Any suggestions for improvements?

- Would you add the solar radiation data? The resolution of the data also if possible
- Suggest increasing spatial resolution
- Ability to pull more than one year's worth of data at a time via the API.
- Training of the Modeling and remote sensing
- Accessibility for new scientists
- The app doesn't work for me on Microsoft Edge, only on FireFox
- Data in ascii format. Nomenclatures were not clear to me.
- A higher resolution less than 1-degree grid area is much desired. Thank you

What are your future needs in terms of data capabilities, services, and parameters?

- Data on solar radiation.
- Data for modeling and forecasting of crop models
- More spatially accurate climate data. It is okay from daily data if possible
- Climate data for crop modelling
- 80-100 meter AGL wind data to match most land-based turbine hub heights.
- Block level data needs.
- Agroclimatology data capabilities working in my country.
- We also need derived parameters like evaporation, vegetation indices etc.
- Instruction and research on climate change
- Radiation in inclined planes, wind speed, relative humidity, ground level temperature
- Teaching, possibly incorporation of satellite data in a college course lab.
- Weather
- Higher resolution; easier ability to determine tree/canopy height
- River flows, sediment data etc.
- Solar information
- Water resources and Air quality
- It is good, better to increase resolution
- meteorological data, solar irradiance, and wind characteristics
- Disaster Management (Hydro-met disasters), Water Resources Management, Climate Change
- I need daily average data of planetary boundary layer height & medium height cloud cover