



## Questions & Answers Session Part 4

Please type your questions in the Question Box. We will try our best to answer all your questions. If we don't, feel free to email The POWER Project ([larc-power-project@mail.nasa.gov](mailto:larc-power-project@mail.nasa.gov)), Paul Stackhouse ([paul.w.stackhouse@nasa.gov](mailto:paul.w.stackhouse@nasa.gov)), or Bradley Macpherson ([bradley.macpherson@nasa.gov](mailto:bradley.macpherson@nasa.gov)).

Question 1: In the Develop Satellite Beach project, can you explain what caused the variations in the heatmap shown in the upper right of the slide?

Answer 1: The heat map is the high resolution Land Surface Temperature (LST) which is showing variations of temperature due to areas of buildings, parking lots and vegetation. The higher home density areas and parking lots show darker red colors, while areas with more vegetation or less densely built areas are in yellow and green.

Question 2: What is the spatial resolution available in POWER/RETScreen for solar radiation data?

Answer 2: All the solar data products have a native resolution of  $1^{\circ} \times 1^{\circ}$  lat/lon (approximately 110 km at the Equator). However, for the current version we replicated the data to  $0.5^{\circ} \times 0.5^{\circ}$  in order to be on the same grid as the MERRA-2 atmospheric reanalysis. The new POWER beta will provide the native resolution of all the input data products. Future plans are to provide higher spatial resolution.

Question 3: What would be the cost benefit ratio? How much cost per sq ft of solar panel and maintenance cost? What level of technical knowledge and training is required to maintain solar panels? Is the public capable of maintaining solar panels in a technical aspect?

Answer 3: These questions are out of our expertise, but a solar engineer could provide this information. Another great resource is the RETScreen Expert tool (<https://www.nrcan.gc.ca/maps-tools-and-publications/tools/modelling-tools/retscreen/7465>) which provides a complete feasibility analysis for a wide variety of projects using user specifications for the system and/or building.

Question 4: What is NASA LaRC solar panel?

Answer 4: The NASA Langley Research Center (LaRC) facility, located in Hampton, Virginia, has installed solar panels at two locations to reduce the amount of energy from the local electrical utility. Several other buildings are being conformed to industry



standards for energy efficiency (see information about the LEED program - <https://www.usgbc.org/leed>).

Question 5: What site is to download climate data?

Answer 5: Navigate to our homepage <https://power.larc.nasa.gov/> and scroll down or navigate directly to our <https://power.larc.nasa.gov/data-access-viewer/>. Choose the single point app in blue then select climatological data in the second set of options. Please see our tutorial on how to use the Data Access Viewer at <https://power.larc.nasa.gov/beta/docs/tutorials/data-access-viewer/user-guide/> or <https://power.larc.nasa.gov/docs/tutorials/data-access-viewer/quick-start/>.

Question 6: How about daily precipitation parameter usage from POWER? I obtained it last year for my study area, that was something distributed per day. For every day showing less precipitation like 0.2mm, 0.03mm... I think this is not usable because 0.2mm precipitation evaporates immediately.

Answer 6: Precipitation comes from the atmospheric reanalysis, MERRA-2 which has a spatial resolution of  $0.5^{\circ} \times 0.5^{\circ}$ . We provide the output in mm/day. If you review our methodology document, you can learn about the validation of this product. Within this, we produced contingency tables for classes of agreement for different cases, like MERRA-2 reports rain, but the surface site did not. Those documents are found here: <https://power.larc.nasa.gov/beta/docs/methodology/meteorology/precipitation/>.

Unfortunately, there was a bug in the code for the current version that gave incorrect values for "interannual" (i.e., monthly and annual averaged time series) starting in January 2018. The incorrect value is actually the monthly average (i.e., add up the months and divide by the number of days) rather than the monthly precipitation sum. So, the monthly (and annual) averaged data can be corrected if multiplied by number of days. This issue does not impact the daily averaged or long-term climatological averages. This has been addressed in the beta version. If using the beta and the values still don't seem plausible, please contact the POWER team so we can discuss the specific location of interest.

Question 7: Are you planning to add performance 'optimal performance calculations' for hydro power plants as an addition to your existing solar and wind models? Thanks in advance for your answer and a big thank you for the wonderful series of workshops!

Answer 7: We don't currently have information on hydroelectric power because we don't have the information on reservoir levels and/or streamflows. We do have information that can be used to perform a hydrological watershed analysis (although some watersheds may require higher spatial resolution data than currently provided



with POWER data). However, supporting hydro power applications may be something we could consider in the future either directly or indirectly through a partner.

Question 8: When calculating the optimum tilting angle for solar panels, does the model take other parameters than the position of the sun into consideration? For example, topology and clouds. The best angle on the field may differ from the best angle calculated using the sun position.

Answer 8: These optimal tilt calculations utilize “all-sky” solar radiative fluxes which include clouds and aerosols. However, topology (i.e., shadowing in mountainous regions) is not considered in the product. If there is a known shadowing issue at a specific location, the user will need to adjust the values that POWER provides. The new version (currently in beta) will compute the fluxes from our hourly estimates of the diffuse and direct horizontal fluxes rather than invoking the current parameterizations. Our methodology provides information on how the tilted irradiance estimates are estimated at: <https://power.larc.nasa.gov/beta/docs/methodology/solar/irradiance/>.

Question 9: The Satellite Beach Energy project sounds really interesting. Is there a link to a full report (with detailed methodology)?

Answer 9: There is more information at:

<https://develop.larc.nasa.gov/2020/summer/SatelliteBeachEnergy.html>

Presentation slides are available at: <https://ntrs.nasa.gov/citations/20205005207>

Question 10: You talked about partnership with different organizations? Are you partnering with SIDS (Small Island Developing States), developing countries' governments for technical assistance in areas of such EO applications? Could you elaborate on it?

Answer 10: That is not a partnership we have yet, but are open to one. We will be continuing to reach out to form more partnerships in the future and we'll add SIDS to the list. The US Department of the Interior used an older version of the POWER website to conduct a solar resource assessment for US territorial islands, but we don't know if they have since updated those assessments. We have also spoken with US AID officials in the past.

Question 11: How can I compare satellite and station data?

Answer 11: Currently we do not have an integrated tool to complete the comparisons but you can use the POWER API to download the data via the API or DAV and compare it with surface sites that you have access to. For comparison to radiative fluxes, Baseline Surface Radiation Network (<https://bsrn.awi.de/>) and US NOAA maintains



several sites (SurfRAD: <https://gml.noaa.gov/grad/surfrad/index.html> ). Our own validation can be found in the methodology section of the POWER website: (<https://power.larc.nasa.gov/docs/methodology/>) Part 3 of this course also identified how POWER performs comparisons with ground measurements.

Question 12: Is there any data available from NASA related to migratory birds mapping (from ARGOS or ISS, etc.)?

Answer 12: We do not have personal knowledge in this topic area. I am aware of projects like AMASS project and here's a link [https://www.nasa.gov/mission\\_pages/station/research/news/amass-ceo](https://www.nasa.gov/mission_pages/station/research/news/amass-ceo). Perhaps you already know of this link, but if not then this might be a good place to start.

Question 13: Are you generally open to "student projects" (e.g., at the level of a master's thesis) for focused use cases like adding hydrological models in cooperation with power plant owners?

Answer 13: We welcome student involvement and try to support their work by answering questions as we can. There is a US based NASA internship program but it is very competitive, so in general we can support by providing information on the available products and answering questions. Questions can be submitted to our email list [larc-power-project@mail.nasa.gov](mailto:larc-power-project@mail.nasa.gov) or to NASA Langley's Atmospheric Science Data User Forum <https://forum.earthdata.nasa.gov/> and selecting "POWER - SSE" under the projects. Please reach out if we can provide more information.

Question 14: A local electrical power company told me that they can "track" the movement of a rainstorm across their service area, as the demand for power drops, with rooftop evaporation. Is it possible to "calibrate" the reduction in energy consumption from anticipated rainfall?

Answer 14: If there's a reliable relationship that the company has found, then it is reasonable to make an attempt at this. However, POWER data parameters would not be best at making such a forecast at the spatial and time scales needed, nor do we provide short term forecasts.

Question 15: Is it possible to access meteorological data from a different height of the atmosphere?

Answer 15: Yes, we provide MERRA-2 outputs (temp, winds, etc) at 2, 10, 50 and meters for meteorology. For the upper atmosphere, the user would need to access the original MERRA-2 data products.



Question 16: How can we track cyclone paths? Is there any model or process?

Answer 16: For forecasts of cyclones, it is best to use the various tropical forecasting offices around the world, such as NOAA's [National Hurricane Center](#). To view historical meteorology, the original MERRA-2 products might provide some information.

Question 17: Can ASHRAE© and the POWER application provide free download for any country aside from custom formats?

Answer 17: You can download at no cost to you anywhere in the world. While there are not currently shapefile or polygon definitions for downloads, you can define the latitude and longitude ranges that cover your region of interest.

Question 18: Any system or prediction for earthquakes?

Answer 18: There is no known prediction of earthquakes but NASA can support recovery efforts after one has occurred. See <https://appliedsciences.nasa.gov/what-we-do/disasters/earthquakes> for more information.

Question 19: In the solar installation monitoring slides, since the sensor was noted to be bad in the comparison between real-time data and satellite data, what will be the conclusion or the correlation between them?

Answer 19: Based on working with the sensor operator, we were able to determine that it was the sensor that was diverging, not the satellite data provided by POWER. The conclusion was the operator replaced the sensor in this case. The helps prove the point that the day-to-day variability from the solar irradiance data products is reliable enough to detect issues with surface based sensors.

Question 20: How can one assess NASA data set?

Answer 20: Please see the answer provided for Question 11 for comparisons of POWER data to on-ground sites. For access to the POWER data set, one option is to use the [NASA POWER Data Access Viewer](#).

Question 21: For the HDD and CDD, how were the thresholds calculated and how were the base temperatures determined?

Answer 21: For the HDD and CDD  $0^{\circ}$ ,  $10^{\circ}$ , and  $18.3^{\circ}$  Celsius  $T_{\text{base}}$  are calculated following the methodology in the ASHRAE 2013 handbook. For more information see the [POWER Degree Day methodology](#). Those standards are the ones most frequently used by ASHRAE, but other engineers/companies do define and use their own.



Currently, we don't support arbitrary standards, but this is potential future enhancement depending upon the demand from users like yourself.

Question 22: Could we use POWER data with QGIS as WMS or WFS? Or in the future?  
Answer 22: Currently, POWER has Climatological image services that can be added to QGIS via OGC's WMS or WFS standards. We do provide Esri feature services for select data products. The time series data can be added to QGIS by using the GeoJSON format via the API.

<https://nasa.maps.arcgis.com/home/group.html?id=4b75def515df430980faebca6a007465#overview>

A tutorial for ArcGIS data requests is available at [POWER ArcGIS Tutorials](#).

Question 23: Does POWER GIS get feedback from users?

Answer 23: We do and we value it. There are a number of ways to provide feedback. You can go to the homepage and go to the bottom and email us at our project email address. There is also an [EarthData forum](#) that's available from the Atmospheric Science Data Center but you will need an EarthData account to post a question or comment to POWER. You can also use our NASA email addresses:

The POWER Project ([larc-power-project@mail.nasa.gov](mailto:larc-power-project@mail.nasa.gov))

Paul Stackhouse ([paul.w.stackhouse@nasa.gov](mailto:paul.w.stackhouse@nasa.gov))

Bradley Macpherson ([bradley.macpherson@nasa.gov](mailto:bradley.macpherson@nasa.gov))

Question 24: Does NASA work directly with development of solar panels or something related?

Answer 24: For calculations of solar panel requirements at a location, there are existing decision support tools available, like the one mentioned in Question 3. NREL has other tools as well. You can use our products to provide the key inputs for those tools to do an assessment. The POWER team does not currently work directly with solar panel manufacturers to improve panel design.

Question 25: Since you mentioned applications in Peru, I would like to know if this data is also available?

Answer 25: Yes, POWER data is available for the entire globe. But there are many complex and high mountains in Peru such that there may be some shadowing and other topographical effects not accounted for at our spatial resolution, but people have used it before successfully.



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Question 26: Is it possible to easily access detailed case studies on the added value of the POWER project?

Answer 26: We are working on adding this to the website. We have some use cases on [Space For US](#), such as the [Wicked Joe](#) case study.