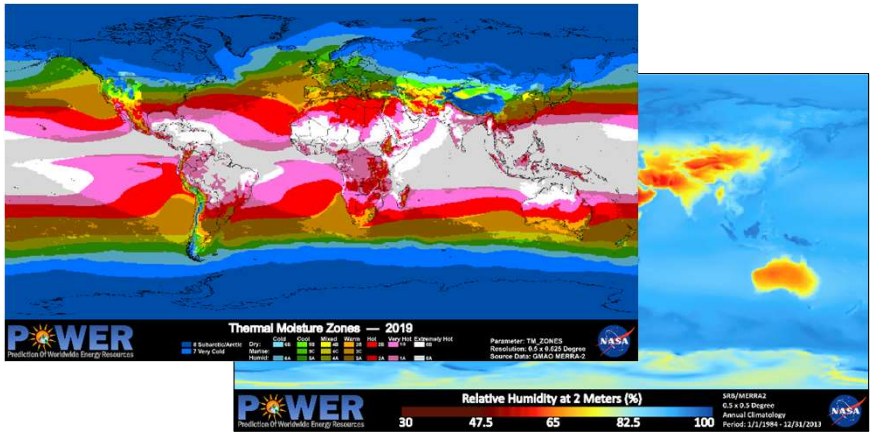
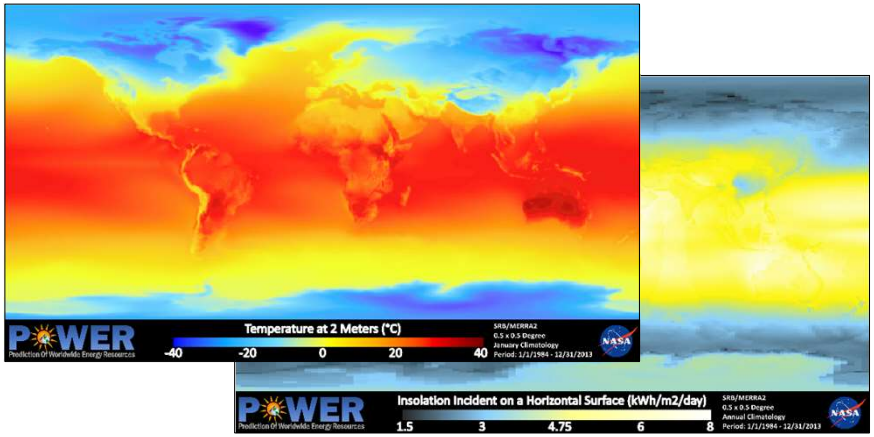
Updates from the POWER Project
(Prediction Of Worldwide Energy Resource)

Aiming to improve the nation's public/private capability for integrating environmental data from NASA Earth observations, analysis and modeling, particularly information related to surface solar irradiance, to support increased **renewable energy development, building energy efficiency,** and **agroclimatology applications**.

https://power.larc.nasa.gov/

Principal Investigator: Dr. Paul W. Stackhouse, Jr. – National Aeronautics and Space Administration (NASA)
Co-Investigators:
- Bradley Macpherson, Madison Broddle, Chequel McNeil, & A. Jason Barnett – Booz Allen Hamilton (BAH)
- Colleen Mikovitz & Taiping Zhang – Science Systems and Applications, Inc. (SSAI)





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POWER Analysis Ready Data: Hourly Operational

The POWER Data Archive uses NASA research and modeling data products plus value added data processing and services to customize parameters for community use (currently hosted at NASA LaRC ASDC)

Source	Temporal Span		Temporal Average		Description
	Start	End	Input	Output	
GEWEX SRB 4.0	Jan 1, 1984	Dec. 31, 2000	Daily	Daily, Monthly, Annual, Multi-year	Satellite analysis from global cloud imagers (from geosynchronous and polar orbiters satellites) using radiative transfer lookup tables
CERES SYN1Deg (Ed 4A)	Jan 1, 2001	End of SYN1Deg (current)	Hourly	Hourly, Daily, Monthly, Annual, Multi-year	Satellite analysis from CERES convolved with MODIS for scene and TOA fluxes, then uses radiative transfer with additional input from geosynchronous satellites and other inputs to produce surface fluxes
CERES FLASHFlux	End of SYN1deg (current)	Near Real Time	Daily	Daily, Monthly, Annual, Multi-year	Satellite analysis of CERES (reflected solar) and MODIS (cloud imager) measurements (on Terra and Aqua satellites)
MERRA-2	Jan. 1, 1981	End of MERRA-2 (current)	Hourly	Hourly, Daily, Monthly, Annual, Multi-year	Atmospheric reanalysis with assimilated observations (1-2 months behind real time)
GMAO FP-IT (GEOS 5.12.4)	End of MERRA-2	Near Real Time	Hourly	Hourly, Daily, Monthly, Annual, Multi-year	Atmospheric reanalysis with assimilated observations with less assimilated observations, available within 2 days of real-time
IMERG	Jan 1, 2001	End of "Bias corrected" product	Daily	Daily	Atmospheric reanalysis with assimilated observations of precipitation, available in UTC time at 10km resolution, available within 2 days of real-time

Data Updates

- We have integrated higher resolution precipitation data derived from NASA's Global Precipitation Measurement (GPM) mission's Integrated Multi-satellitE Retrievals for GPM (IMERG). The IMERG precipitation data is available from January 1, 2001, at the **daily temporal level** at the Coordinated Universal Time (UTC) time standard. Latency products:
  - Low latency: 1-2 days of Near Real Time
  - Latest look: rain gauge “bias” corrected

- The MERRA-2 Science Team reported a discrepancy in the values around the Caribbean and Gulf of Mexico during late summer 2021 for near-surface temperature. The POWER Project has reverted to the FP-IT data until the corrected MERRA-2 data becomes available.

- **We’ve updated the EPW format related to the Hourly Time Index to go from 1-24 (rather than 0-23; Other formats unchanged)**

Methods to Obtain POWER's Analysis Ready Data

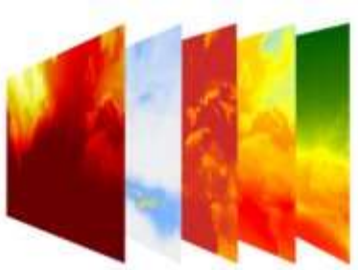
With POWER Version 2 now in production, POWER provides:

- hourly data access
- including the EnergyPlus Weather (EPW) format
- analytic reports for sustainable building design

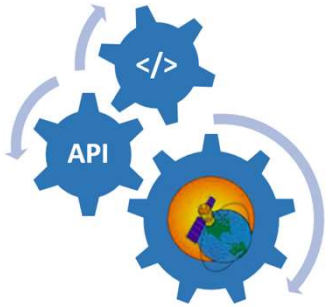
POWER enhances data discovery, access, and distribution as Analysis Ready Data (ARD) for direct application of inputs to decision to support tools, modeling and forecasting packages, and as inputs to scientific research is provided via three basic services:

- Application Programming Interface (API)
- Data Access Viewer (DAV)
- Geospatial Services

Geospatial Services



APIs



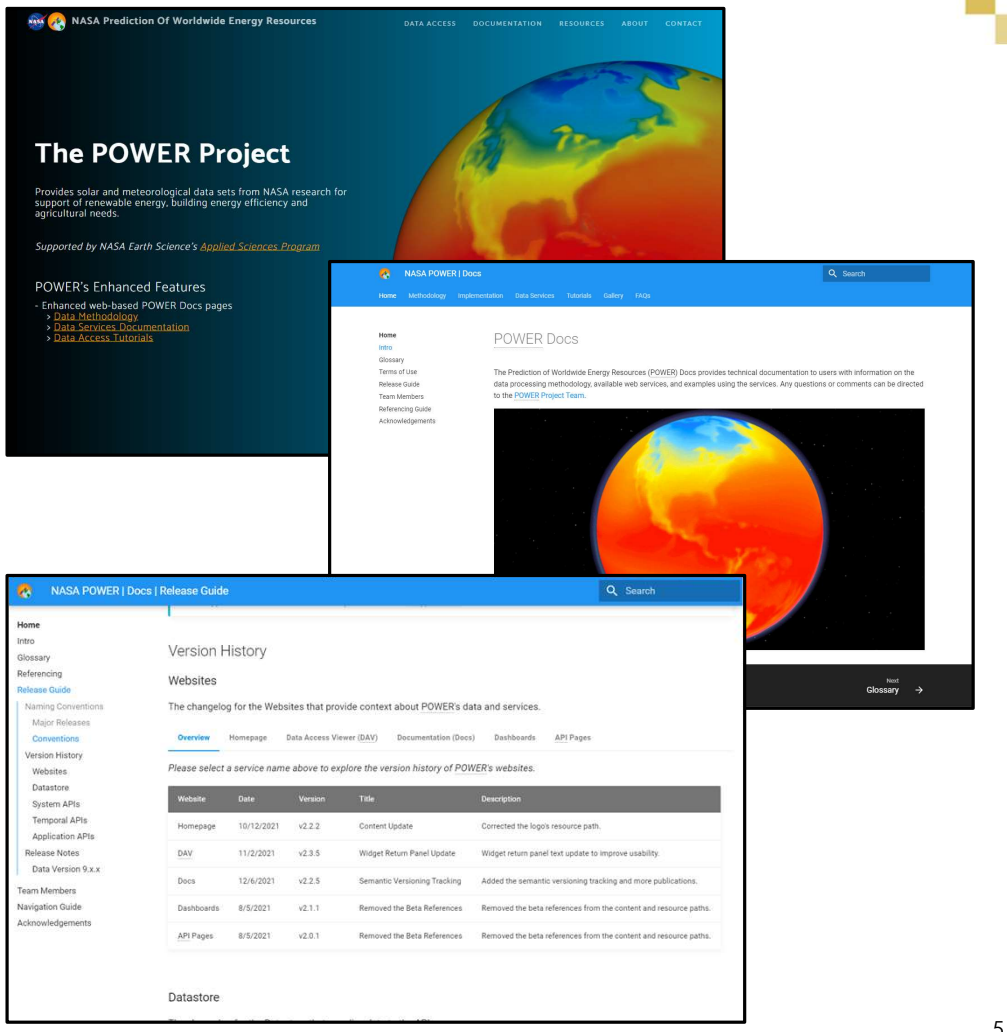
Data Access Viewer

Documentation Enhancements & Validation

The POWER Project Team has updated the below pages to improve usability of the POWER system:

- Frequently Asked Questions (FAQs)
- Data Access Viewer (DAV) User Guide & Quick Start pages
- Application Programming Interface (API) Getting Started Tutorial

POWER has also documented and shared semantic version-based change tracking for all websites and service endpoints, as well as Data methodology and enhanced validation information.



Added POWER StoryMap for Improved Introduction

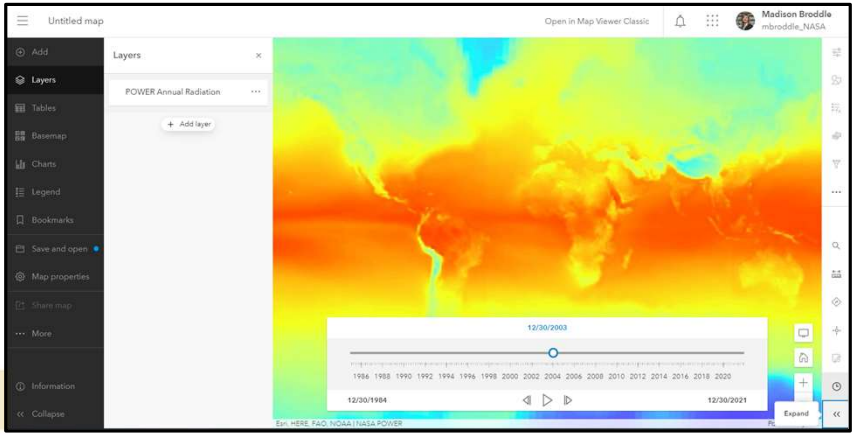
The POWER Team has recently put together an Esri ArcGIS StoryMap.

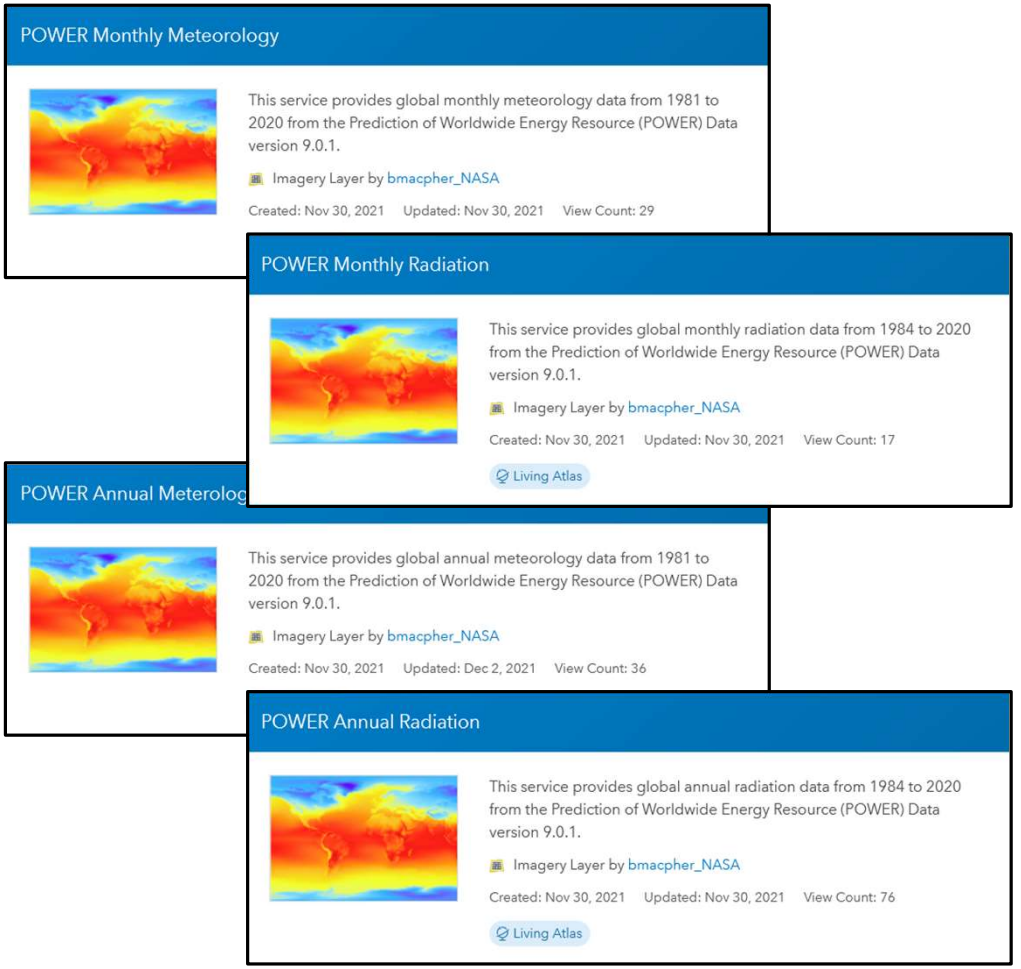
- Through text, GIFs, videos, and interactive map content, viewers can become more familiar with the project.
- By scrolling through the StoryMap, users learn more about the POWER Project, its data sources, how to access POWER data, POWER's communities and users, and how to discover more POWER-related information.
- Link: https://arcg.is/0Xe851

POWER's Image Services

Recently, POWER has released new image services.

- POWER is currently providing image services for annual radiation, annual meteorology, monthly radiation, and monthly meteorology.
- The services can be accessed via the NASA LaRC ASDC's Portal for ArcGIS POWER Group, NASA ArcGIS Online POWER Group, and the Esri Living Atlas of the World (submitted on 11/30/2021).





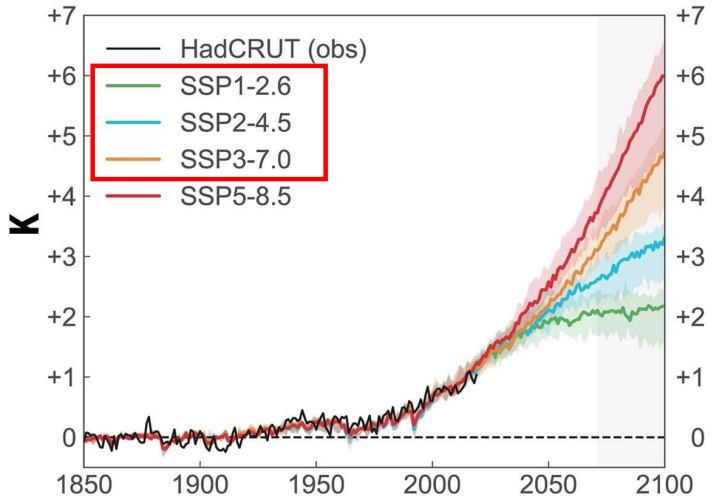
POWER Plans and Improvements

- NASA HQ Approved Upgrade to Current Capabilities
  - Moving to NASA managed AWS Cloud => improved performance (still maintaining partnership with ASDC; plans to move data to Cloud)
  - Reinventing Data Access Viewer to improve ease of use; simple analytics
  - Improvements to current products: Direct/Diffuse, Tilted solar fluxes
  - Improvements to current format and “reports”:
    - Climate Design Reports => global availability with NASA data
    - EPW format and parameter improvements
  - Building out Image services of parameters for visualization (w/ ASDC)
- NASA HQ Approved New Scope
  - Adding “Climate Services” from CMIP6
  - Developing improved higher resolution solar data products => working with remote sensing team for global cloud fusion product
  - Adding new partnerships

POWER Climate Services Strawman

- Collaborating with NASA-wide project to assess infrastructure risk including sustainable buildings
  - Develop algorithms/QC at NASA center locations
  - Expand to entire NASA Earth Exchange (NEX) domain
    - 60°S-90°N, all longitudes
- Using NEX downscaled projections from a large number of CMIP6 climate models
  - Runs out to 2100
  - 9 parameters including: T, Tmin, Tmax, RH (q), Wind Speed, Precip, SWdown, LWdown
  - 25 km resolution
- Beginning "Bias correction analysis" utilizing MERRA2/ERA5/etc.

CMIP6 Scenarios via NEX



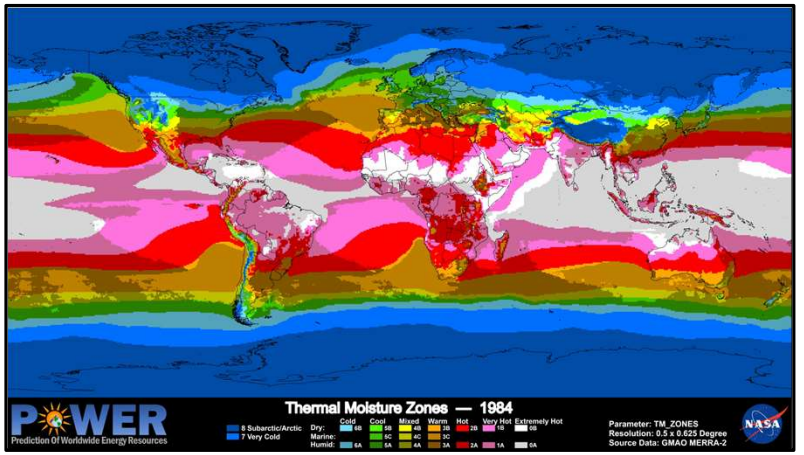
NASA focus on SSP1, SSP2 and SSP3

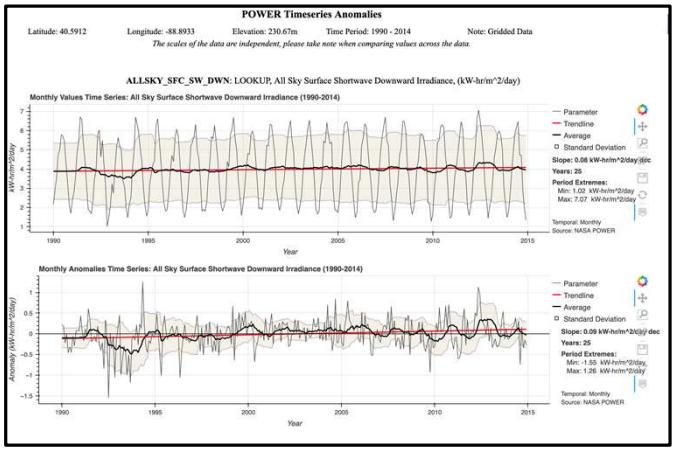
What's ASHRAE's thoughts?

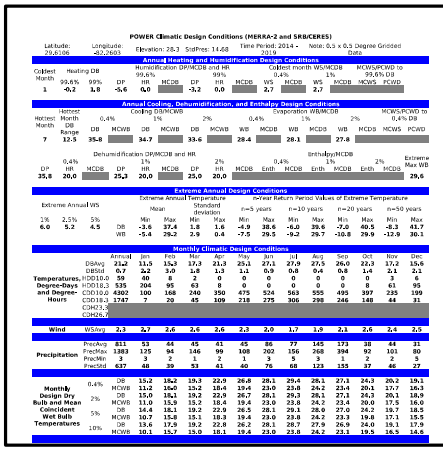
POWER Climate Services Strawman

- Proposed Services Relevant to ASHRAE
  - 10-year Running Mean Ensemble Stats for SSP1-3 scenarios
    - Stats output every 5 years for each parameter => Potential use for “Anomalies Reports” out to 2100
    - ASHRAE Building Climate Zone => show evolving changes in time
  - Future “Climates”
    - Select 2, 20(?)-year periods: 2025-2045, 2055-2075; 3 scenarios for each
    - Ensemble Stats for each period
    - Climate Design Tables?
    - Building Climate Zones
    - Time series for modeling analysis

Historical Evolution of Climate Zones: MERRA-2







Summary & Conclusions

- POWER Web Services Portal now provides:
  - Set of hourly data from beginning Jan 2001
  - Added satellite-based precipitation data called IMERG (daily UTC time standard only)
  - Trouble shooting for performance/parameter bugs => some performance issues addressed during initial months
    - Fixed EPW format error
  - Added improved documentation including Esri StoryMap
  - Made API conform to standards
  - Built out image services

- POWER Project receives approval to expand scope – future plans include:
  - Migration to Cloud computing
  - New Data Access Viewer
  - Improved horizontal resolution
  - **Proposed "Climate Services" that ASHRAE can specify "needs"**

Thank you!

Email: larc-power-project@mail.nasa.gov
Website: https://power.larc.nasa.gov

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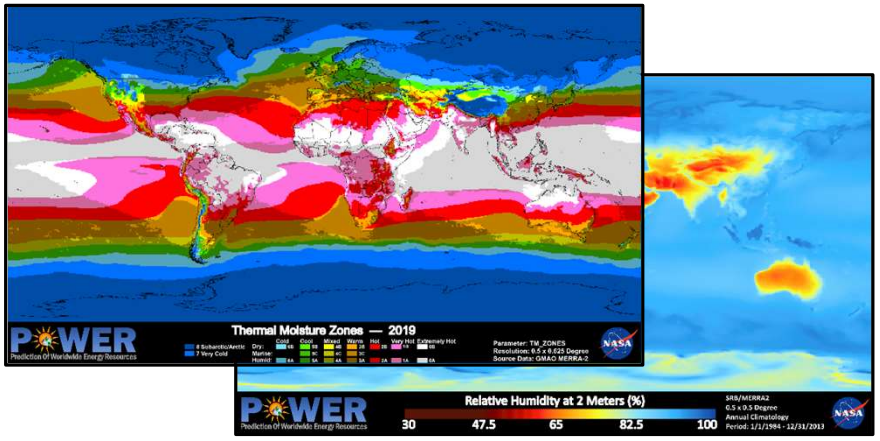

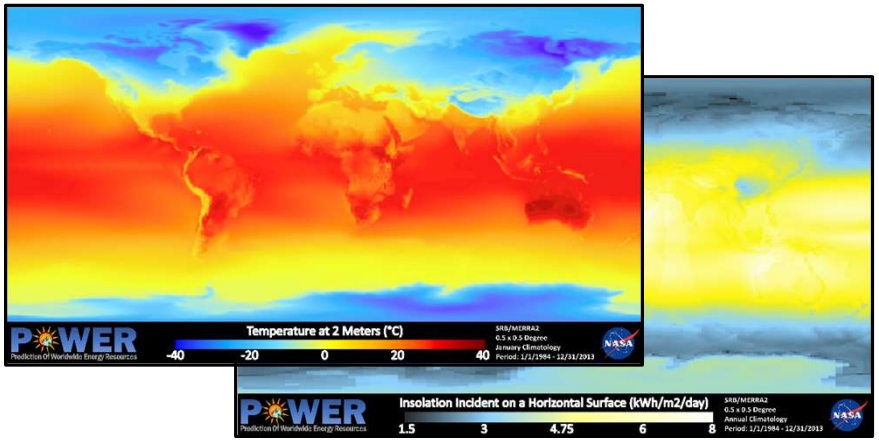

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