National Aeronautics and Space Administration

The NASA POWER Global Solar Insolation and Meteorological Parameter Cloud-based Web Services

The Prediction Of Worldwide Energy Resources (POWER) Project, a NASA Applied Sciences Project

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What is POWER?

The **Prediction Of Worldwide Energy Resources (POWER)**[1] Project aims to improve the capability for integrating environmental data from NASA Earth Observations (EO), regarding surface solar irradiance and related parameters, into decision making processes regarding energy and agriculture

As a NASA Applied Sciences project, POWER creates application ready datasets and improves the accessibility and usage of EO data supporting community research in **three focus areas**

National Aeronautics and Space Administration

1 Renewable Energy Development

Assisting in Energy System Design

POWER's Renewable Energy Web Data Services provide access to parameters specifically tailored to inform the design of solar and wind powered renewable energy systems

2 Building Energy Efficiency & Sustainability

Informing Building Energy Efficiency

POWER's Sustainable Buildings Web Data Services provide industry-friendly parameters for the buildings community in customized formats for input to building decision support tools.

3 Agroclimatology Applications.

Enhancing Food Security

POWER's Agroclimatology Web Data Services are designed to provide web-based access to industry-friendly parameters formatted for input to crop models contained within agricultural decision support tools.

POWER Is 100% Driven by User Needs

EARTH SCIENCE
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Data Products | Global Surface Solar Radiation

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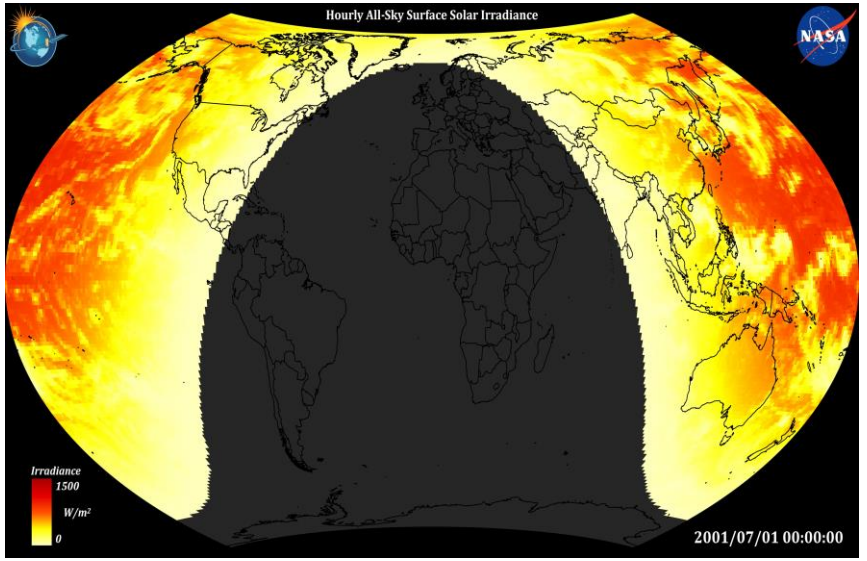
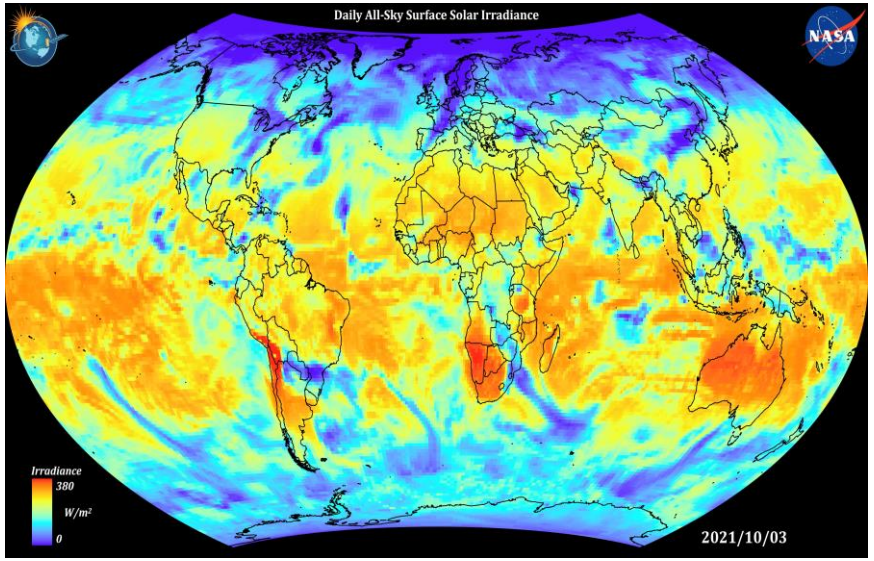
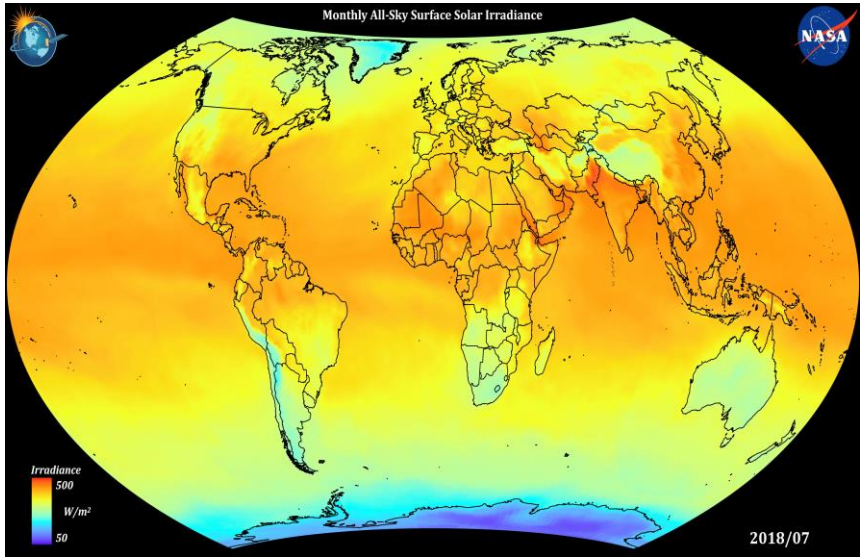
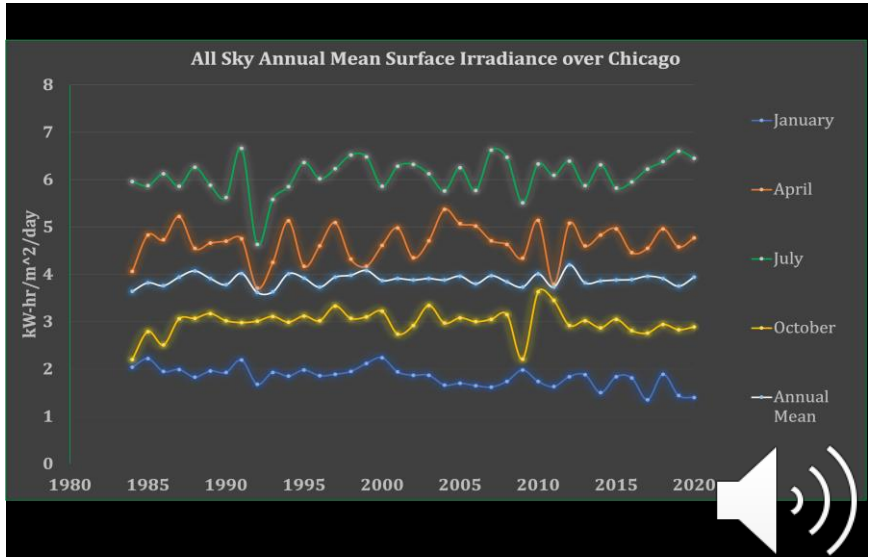
- Hourly since 2001
- Daily, monthly back to Jan 1984
- Latency within 3-4 days (solar a longer)









Data Source | Global Surface Solar Radiation

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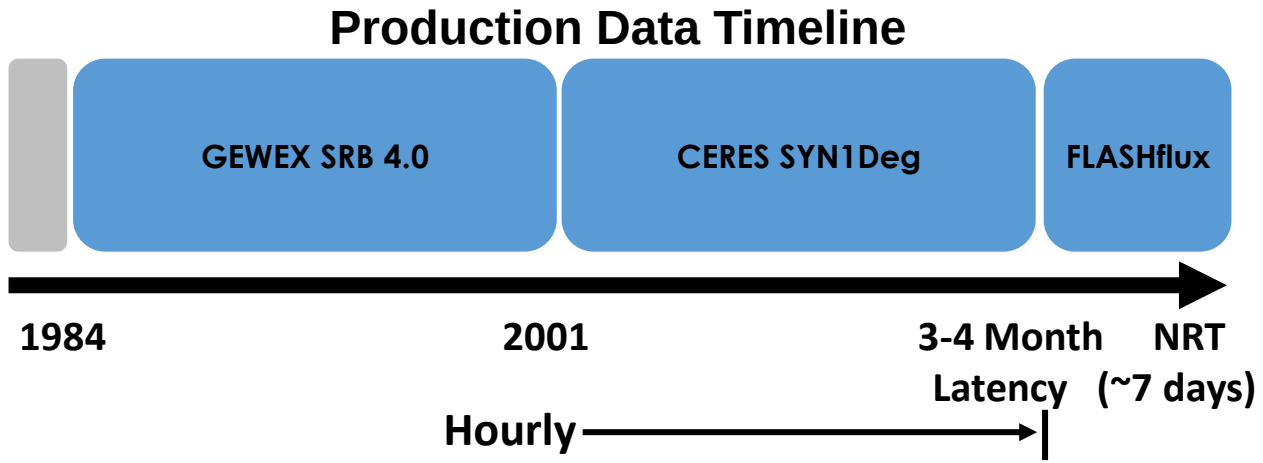
Source	Temporal Span		Temporal Average		Description
	Start	End	Input	Output	
GEWEX SRB 4.0	Jan 1, 1984	Dec. 31, 2000	Daily	Daily, Monthly, Annual, Multi-year	Satellite analysis from global cloud imagers (from geosynchronous and polar orbiters satellites) using radiative transfer lookup tables
CERES SYN1Deg (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) providing daily averaged estimates of radiative fluxes within 5-6 days of real-time.

Production System:

- Daily solar data products from 1984 provided through 7 days of real-time at 1 Deg resolution
- SRB to CERES SYN1Deg, to FLASHFlux
- Hourly from 2001 through 3-4 months of observation



Data Products | Global Surface Meteorology

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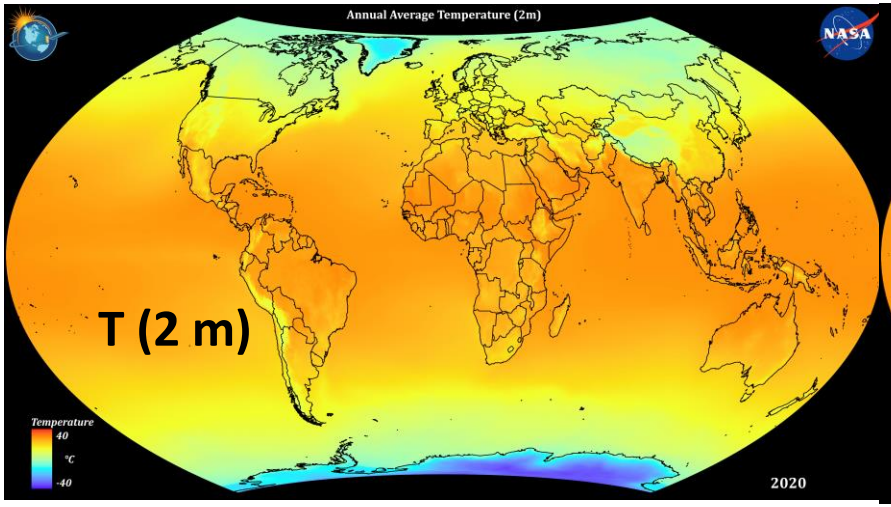
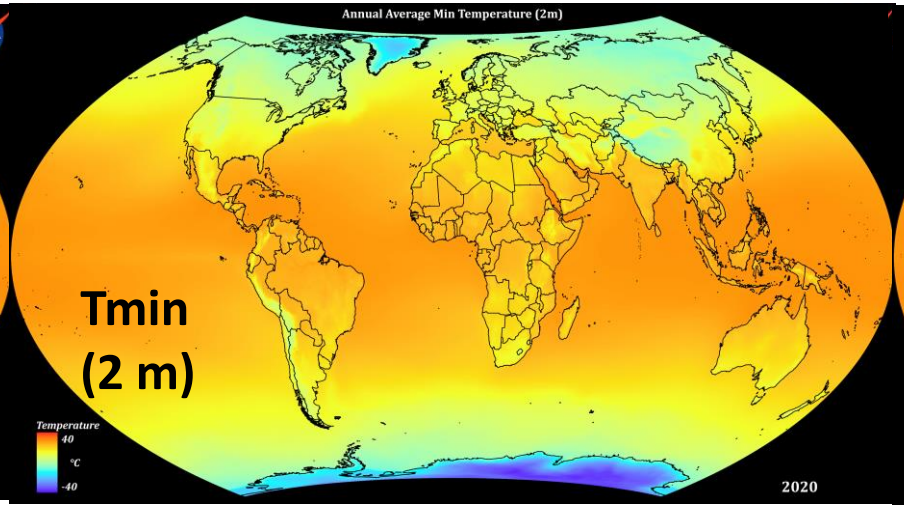
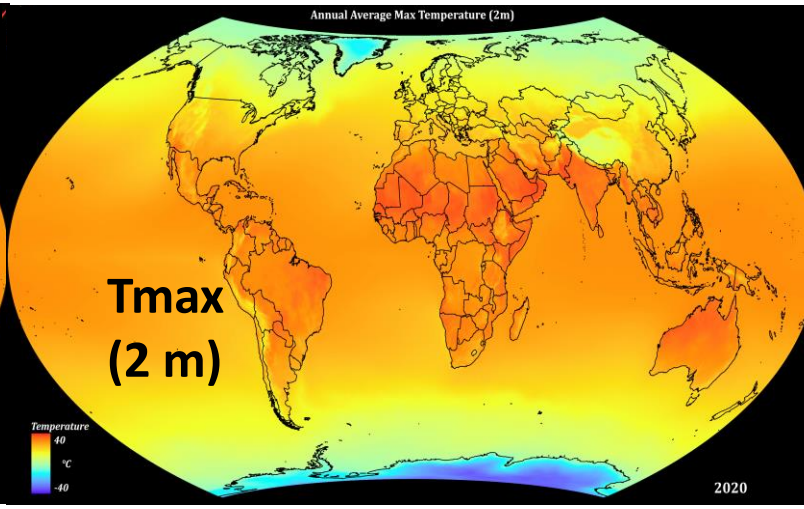
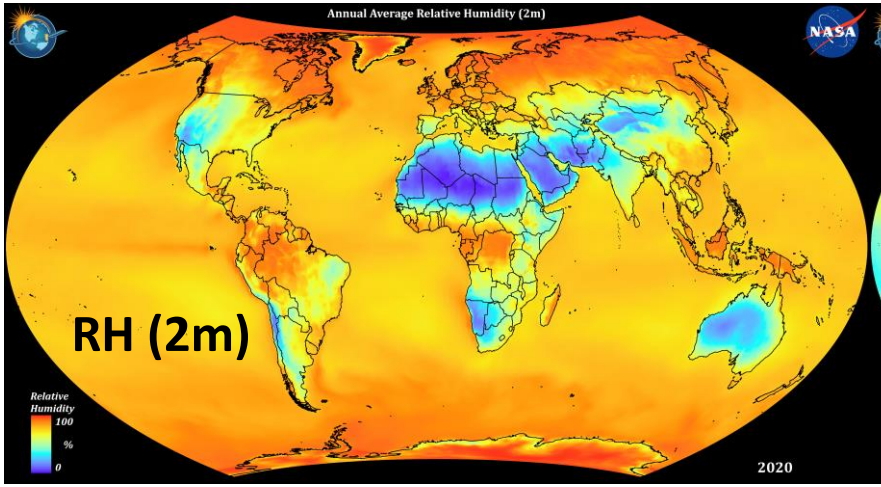
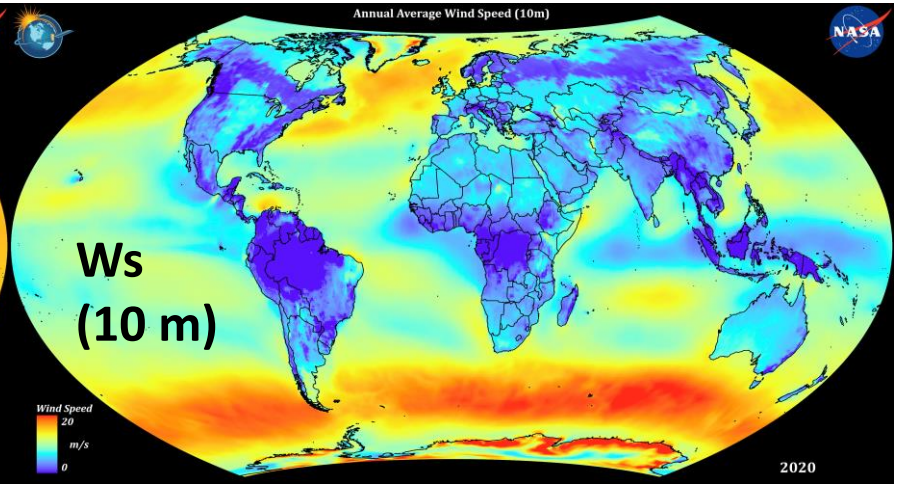
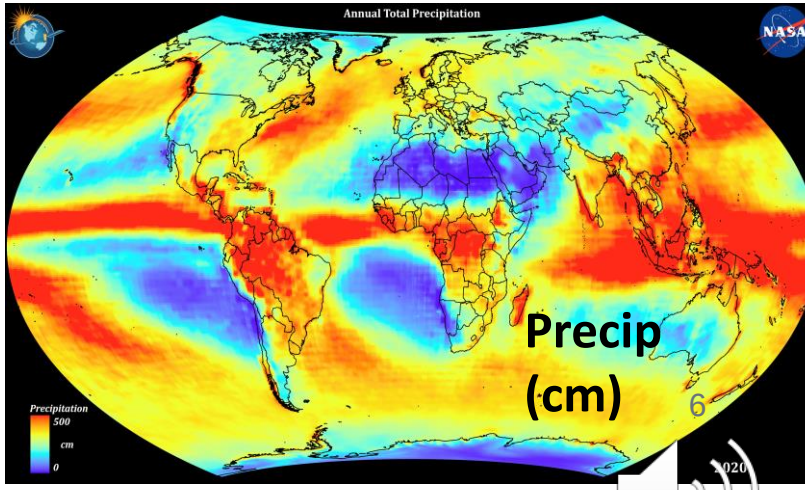












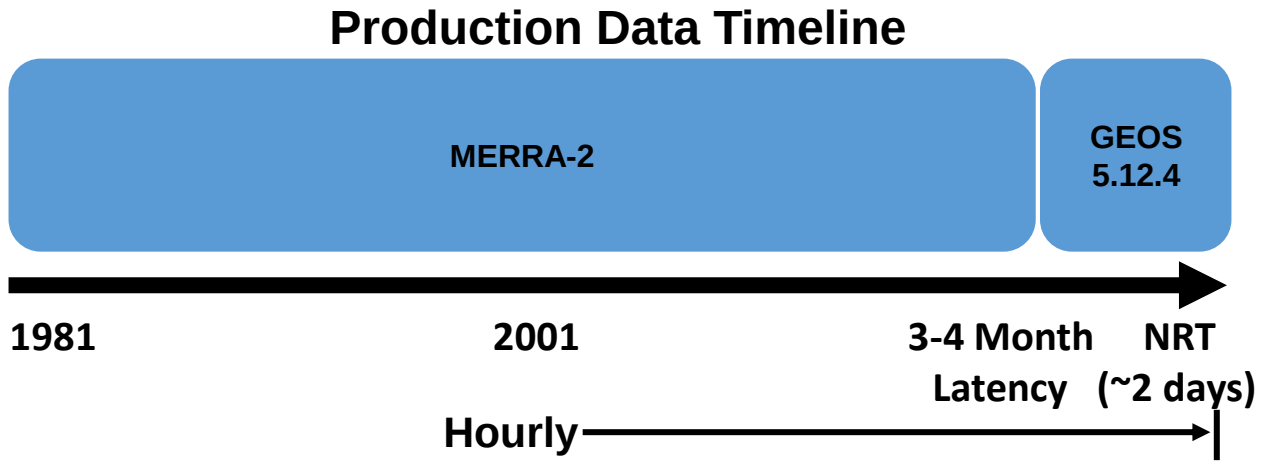
Data Source | Global Surface Meteorology

EARTH SCIENCE APPLIED SCIENCES

Source	Temporal Span		Temporal Average		Description
	Start	End	Input	Output	
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	Near Real Time	Daily	Daily	The Multi-satellite Retrievals for GPM (IMERG) algorithm provides estimates of precipitation in UTC time at 10 km resolution, available within 2 days of real-time.

Production System:

- Daily surface meteorology data products from 1981 provided through 3 days of real-time
- MERRA-2 to GEOS 5.12.4
- Data is at ~half degree spatial resolution



CERES SURFACE RADIATION BUDGET FLASHFlux MERRA-2 GMAO GET DATA GLOBAL PRECIPITATION MEASUREMENT

POWER Provides Trusted Latest Version Of Datasets

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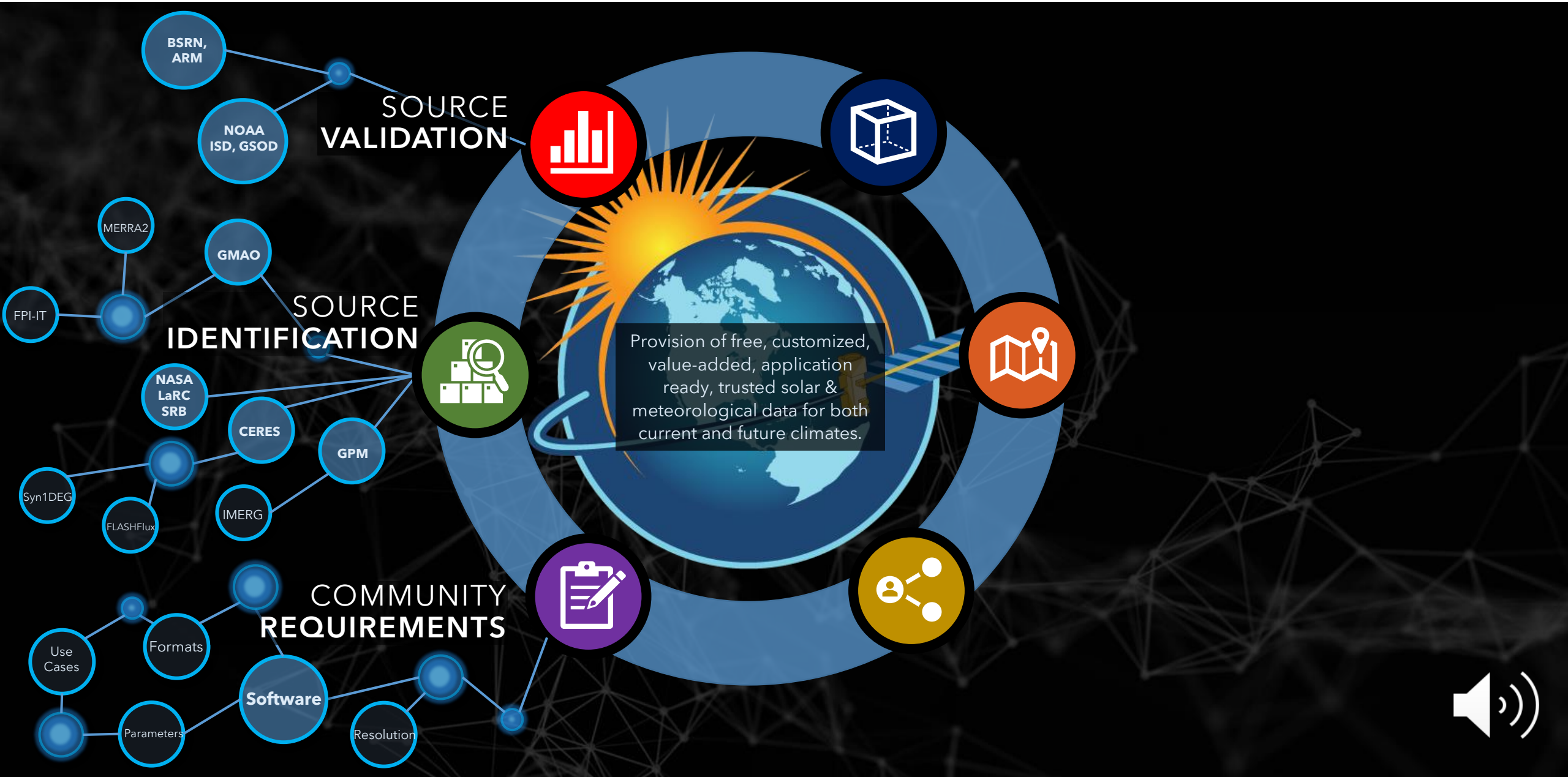

How Is Data Parameter Quality Determined ?

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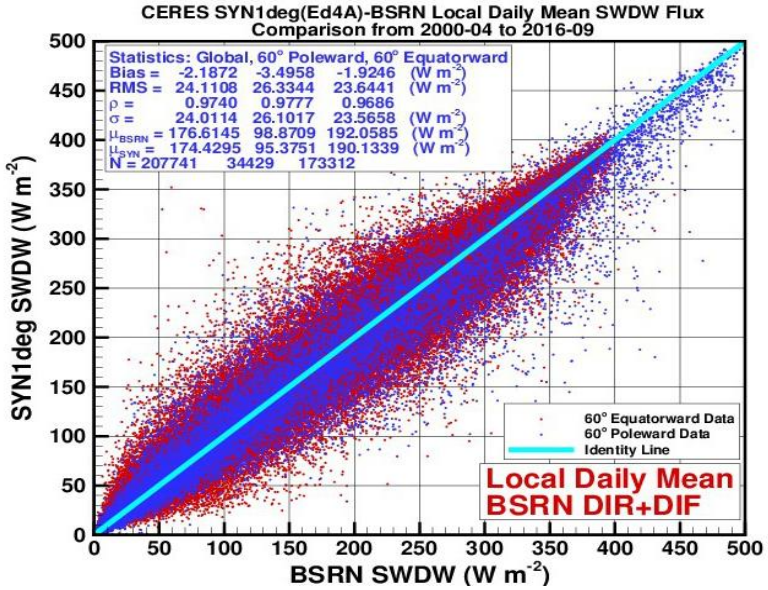
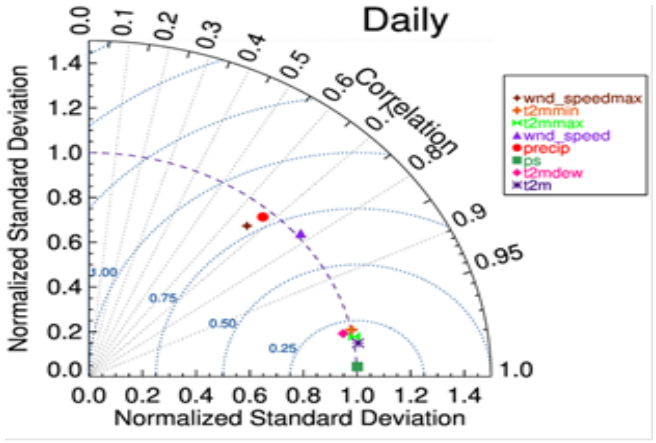
POWER uses surface measurements to characterize data product uncertainty

Validation at various temporal scales (up to hourly) and assessments for value-added products as observations available

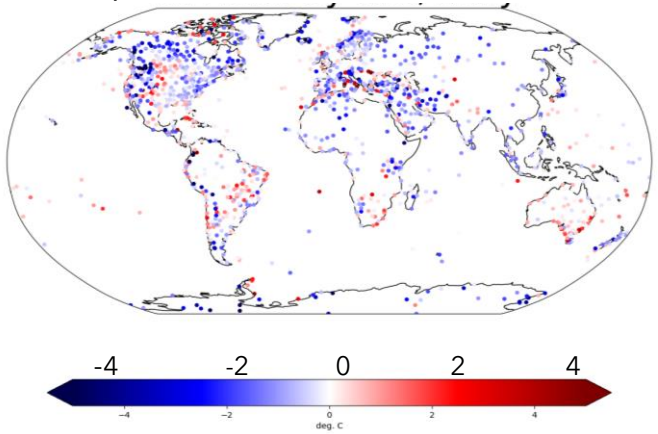
See "Methodology Documentation" pages for more information and statistics



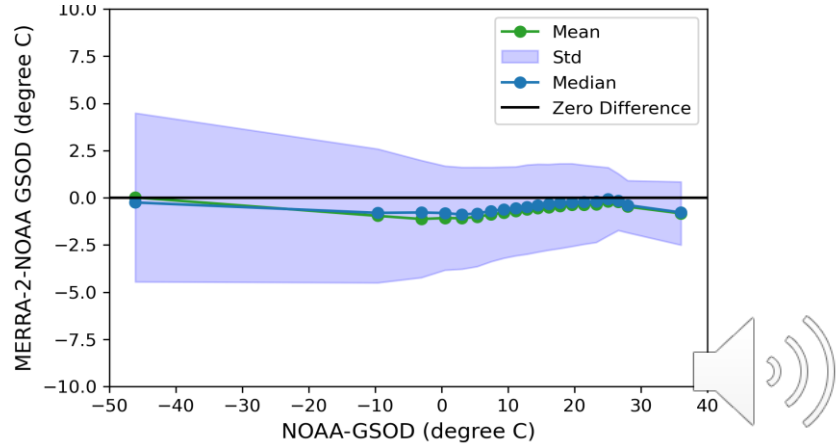
Merra-2 Daily Mean fields



2m Daily Temperature: Bias Comparison from 1981 - 2020



2m Daily Temperature Differences



Beyond Data Needs | Accessibility

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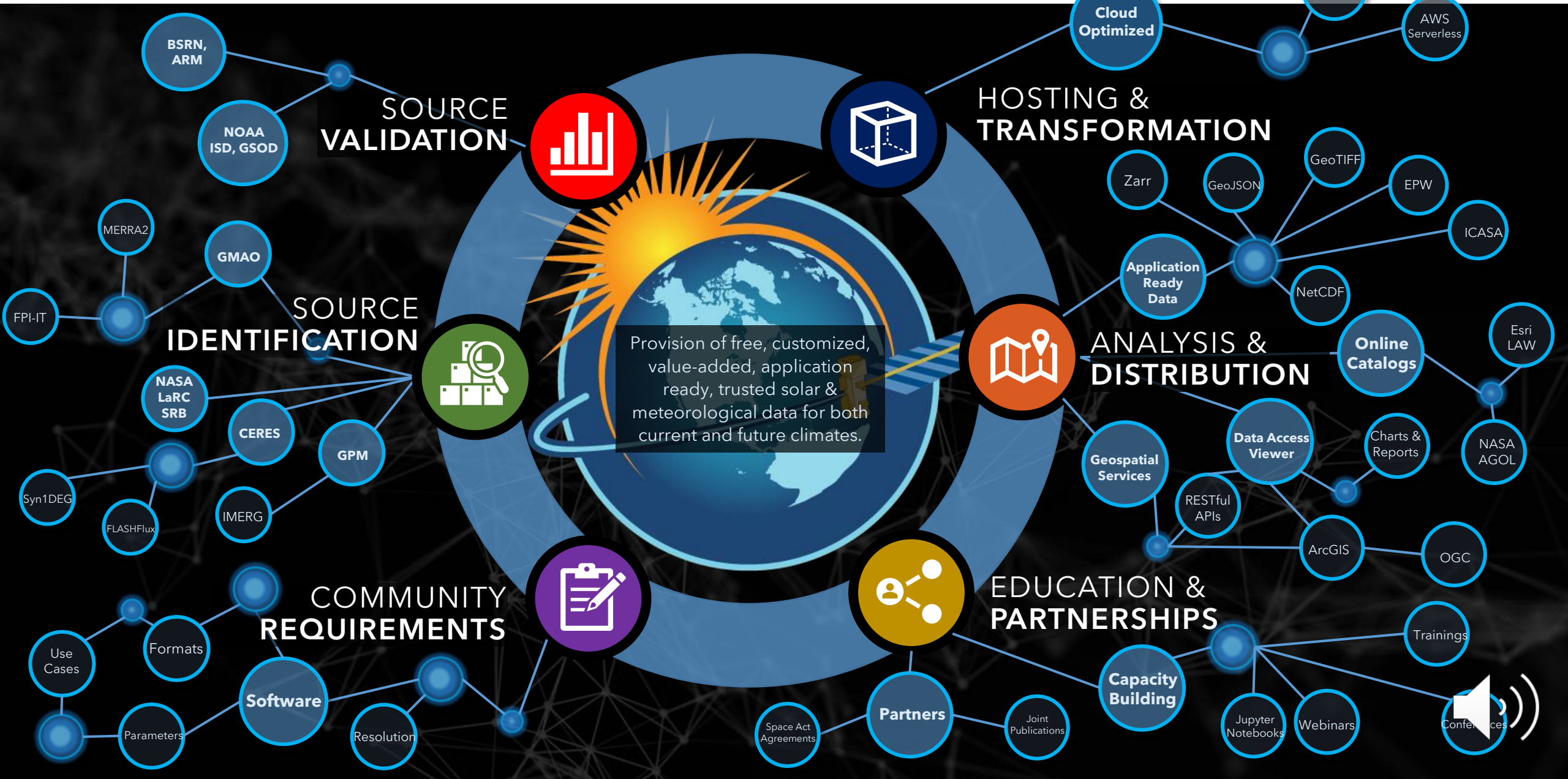

POWER Services for Data access

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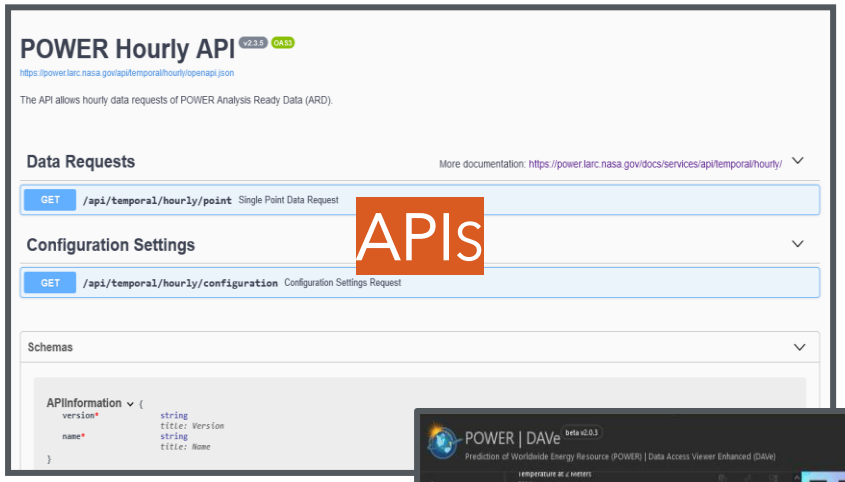
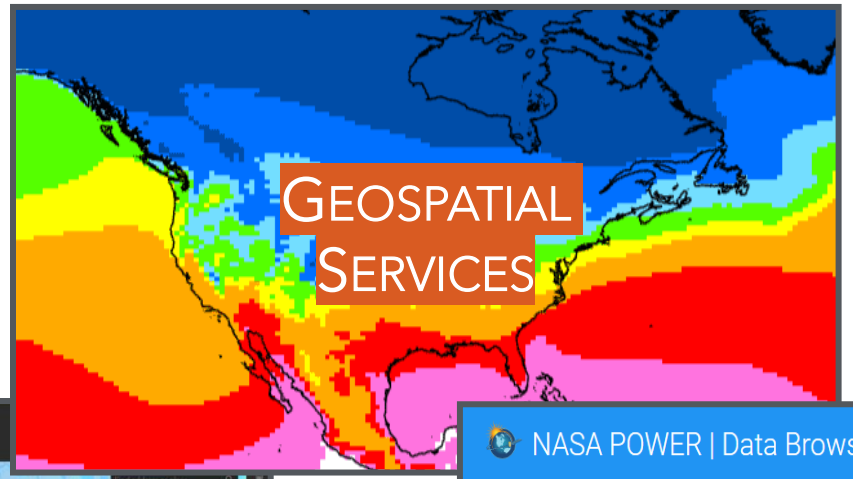
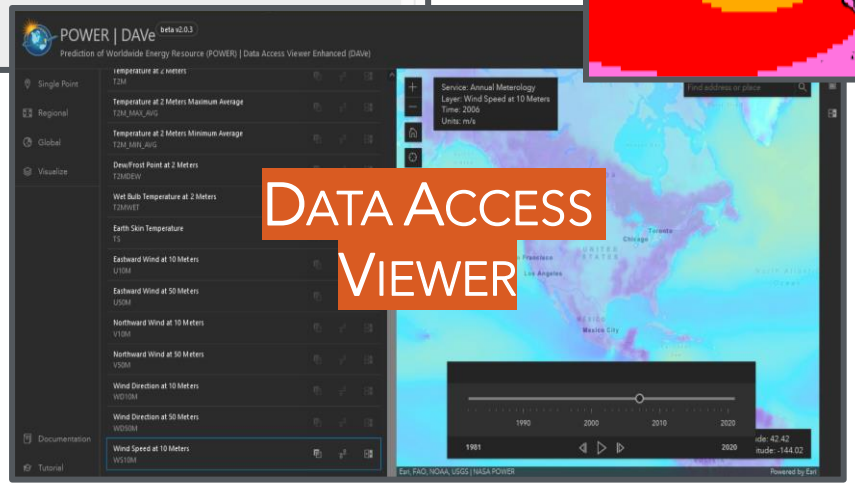
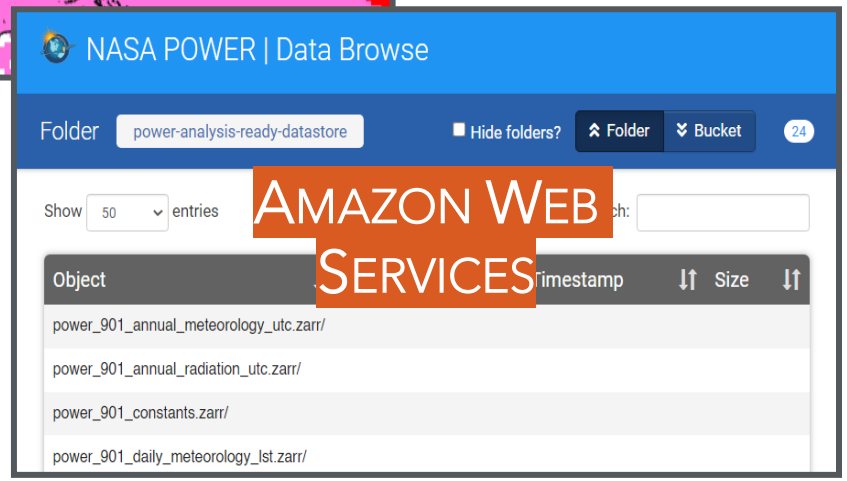
Different users require ***different ways to access*** *the* ***same data***







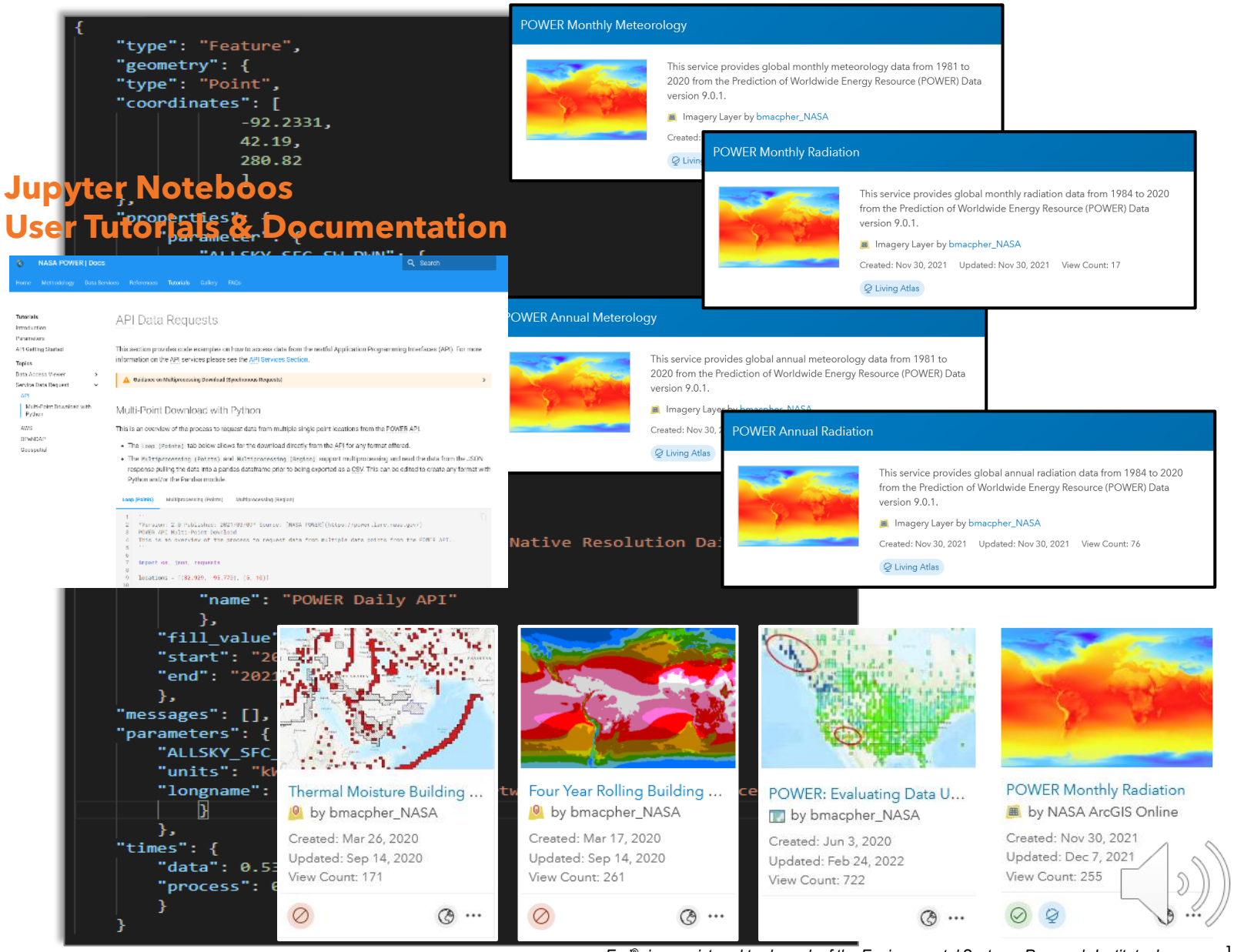


Creating **trusted, value-added, easy-to-use** Application Ready Data & **Services**

POWER Products & Services | RESTful APIs & Geospatial Services

POWER is currently providing image services for annual radiation, annual meteorology, monthly radiation, and monthly meteorology, and climatologies

The services can be accessed via the NASA eGIS Portal for ArcGIS POWER Group, NASA ArcGIS Online POWER Group, and the Esri® Living Atlas of the World (submitted on 11/30/2021).



Data Access Viewer for Obtaining Data

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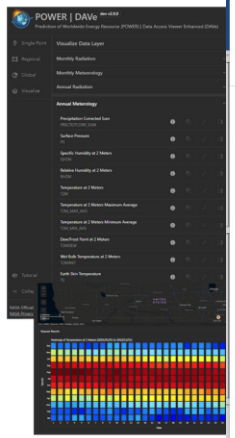

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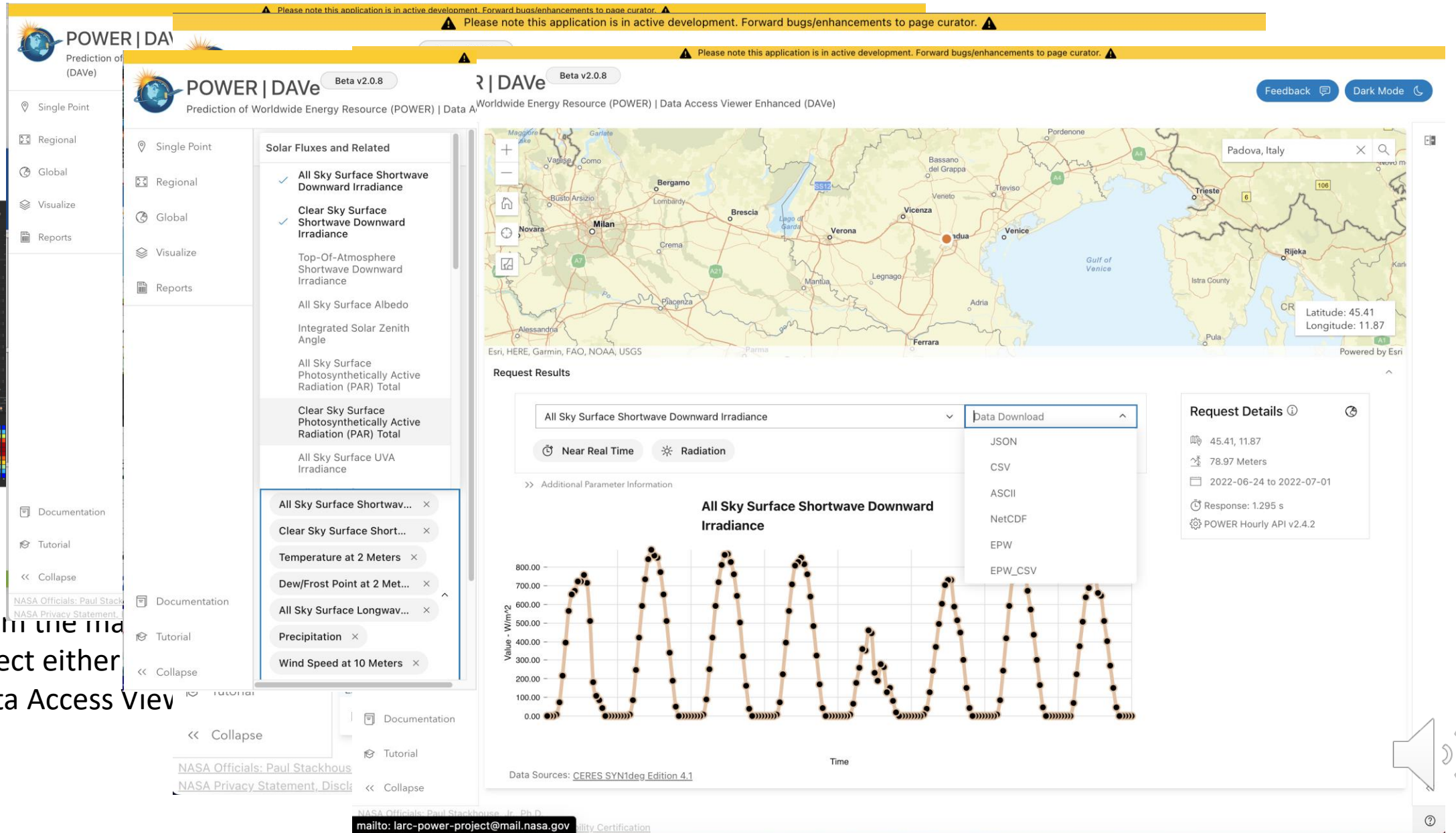


Analytic Data Services | Reports

EARTH SCIENCE APPLIED SCIENCES

Building Climatic Design Conditions

POWER Climatic Design Conditions (MERRA-2 and SRB/CERES)

Latitude: 29.6106 | Longitude: -82.2603 | Elevation: 28.3 | StdPres: 14.68 | Time Period: 2014 - 2019 | Note: 0.5 x 0.5 Degree Gridded Data

Annual Heating and Humidification Design Conditions

Coldest Month	Heating DB 99.6%	Heating DB 99%	Humidification DP/MCDB and HR 99.6% DP	HR	MCDB	Humidification DP/MCDB and HR 99% DP	HR	MCDB	Coldest month WS/MCDB 0.4% WS	MCDB	1% WS	MCDB	MCWS/PCWD to 99.6% DB MCWS	PCWD
1	-0.2	1.8	-5.6	0.0		-3.2	0.0		2.7		2.7			

Annual Cooling, Dehumidification, and Enthalpy Design Conditions

Hottest Month	Hottest Month DB Range	Cooling DB/MCWB 0.4% DB	MCWB	1% DB	MCWB	2% DB	MCWB	Evaporation WB/MCDB 0.4% WB	MCDB	1% WB	MCDB	2% WB	MCDB	MCWS/PCWD to 0.4% DB MCWS	PCWD
7	12.5	35.8		34.7		33.6		28.4		28.1		27.8			

Dehumidification DP/MCDB and HR 0.4% DP	HR	MCDB	1% DP	HR	MCDB	2% DP	HR	MCDB	Enthalpy/MCDB 0.4% Enth	MCDB	1% Enth	MCDB	2% Enth	MCDB	Extreme Max WB
35.8	20.0		25.3	20.0		25.0	20.0								29.6

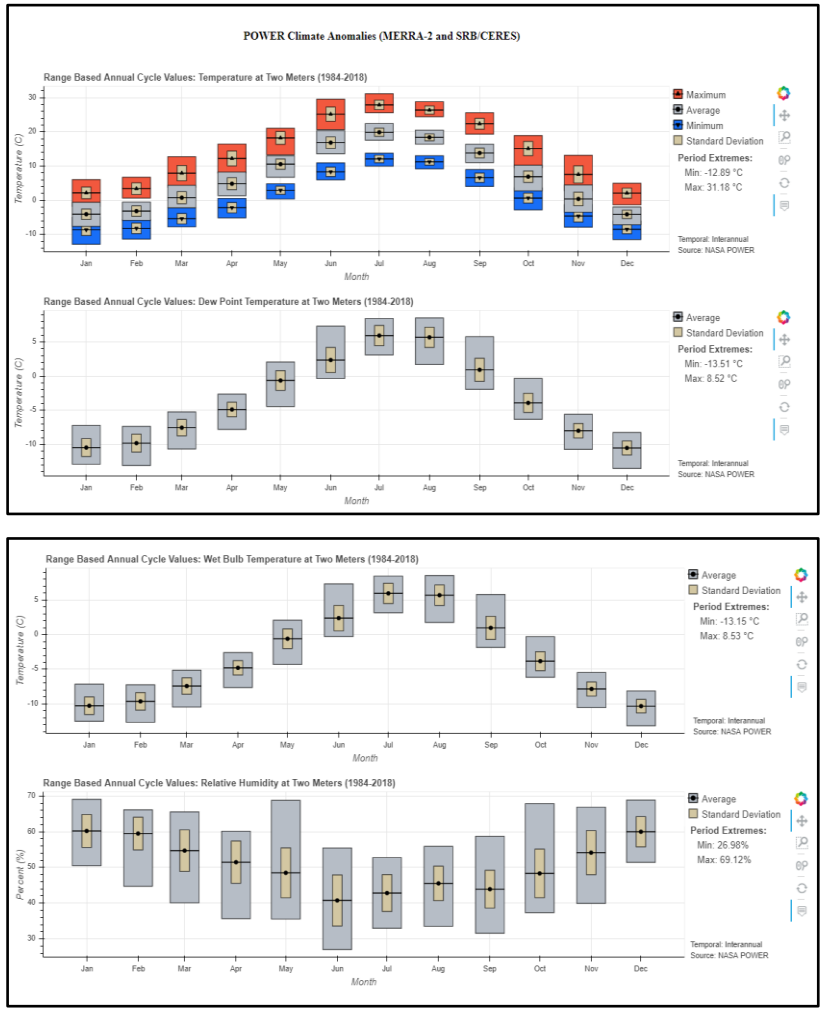
Extreme Annual Design Conditions

Extreme Annual WS 1%	2.5%	5%	Extreme Annual Temperature	Mean Min	Mean Max	Standard deviation Min	Standard deviation Max	n-Year Return Period Values of Extreme Temperature n=5 years Min	n=5 years Max	n=10 years Min	n=10 years Max	n=20 years Min	n=20 years Max	n=50 years Min	n=50 years Max
6.0	5.2	4.5	DB	-3.6	37.4	1.8	1.6	-4.9	38.6	-6.0	39.6	-7.0	40.5	-8.3	41.7
			WB	-5.4	29.2	2.9	0.4	-7.5	29.5	-9.2	29.7	-10.8	29.9	-12.9	30.1

Monthly Climatic Design Conditions

		Annual	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Temperatures, Degree-Days and Degree-Hours	DBAvg	21.2	11.5	15.3	17.3	21.3	25.1	27.1	27.9	27.5	26.0	22.3	17.2	15.6
	DBStd	0.7	2.2	3.0	1.8	1.3	1.1	0.9	0.8	0.4	0.8	1.4	2.1	2.1
	HDD10.0	59	40	8	2	0	0	0	0	0	0	0	3	6
	HDD18.3	535	204	95	63	8	0	0	0	0	0	8	61	95
	CDD10.0	4302	100	168	240	350	475	524	563	555	495	397	235	199
	CDD18.3	1747	7	20	45	109	218	275	306	298	246	148	44	31
	CDH23.3													
	CDH26.7													
Wind	WSAvg	2.3	2.7	2.6	2.6	2.6	2.3	2.0	1.7	1.9	2.1	2.6	2.4	2.5
Precipitation	PrecAvg	811	53	44	45	41	45	86	77	145	173	38	44	31
	PrecMax	1383	125	94	146	99	108	202	156	268	394	92	101	80
	PrecMin	3	3	2	1	2	1	3	5	3	1	2	2	5
	PrecStd	637	48	39	53	41	40	76	68	123	155	37	46	27
Monthly Design Dry Bulb and Mean Coincident Wet Bulb Temperatures	0.4% DB	15.2	18.2	19.3	22.9	26.8	28.1	29.4	28.1	27.1	24.3	20.2	19.1	
	0.4% MCWB	11.2	16.0	15.2	18.4	19.4	23.0	23.8	24.2	23.4	20.1	17.7	16.3	
	2% DB	15.0	18.1	19.2	22.9	26.7	28.1	29.3	28.1	27.1	24.3	20.1	18.9	
	2% MCWB	11.0	15.9	15.2	18.4	19.4	23.0	23.8	24.2	23.4	20.0	17.5	16.0	
	5% DB	14.4	18.1	19.2	22.9	26.5	28.1	29.1	28.0	27.0	24.2	19.7	18.5	
	5% MCWB	10.7	15.8	15.1	18.3	19.4	23.0	23.8	24.2	23.3	19.8	17.1	15.5	
	10% DB	13.6	17.9	19.2	22.8	26.2	28.1	28.7	27.9	26.9	24.0	19.1	17.9	
	10% MCWB	10.1	15.7	15.0	18.1	19.4	23.0	23.8	24.2	23.1	19.5	16.5	14.6	
Monthly Design Wet Bulb and Mean Coincident Dry Bulb Temperatures	0.4% WB	11.2	16.0	15.2	18.4	19.4	23.0	23.8	24.2	23.4	20.1	17.7	16.3	
	0.4% MCDB	15.2	18.2	19.3	22.9	24.1	26.5	27.9	27.7	27.1	24.3	20.2	19.1	
	2% WB	11.0	15.9	15.2	18.3	19.3	23.0	23.8	24.2	23.4	20.0	17.4	16.0	
	2% MCDB	15.0	18.1	19.3	22.8	24.1	26.5	27.9	27.7	27.1	24.1	20.1	18.9	
	5% WB	10.7	15.8	15.1	18.0	19.2	23.0	23.8	24.2	23.3	19.8	17.0	15.5	
	5% MCDB	14.4	18.1	19.2	22.6	24.1	26.5	27.9	27.7	27.0	23.8	19.7	18.5	
	10% WB	10.1	15.6	14.9	17.5	19.0	22.9	23.8	24.2	23.1	19.4	16.2	14.6	
	10% MCDB	13.6	18.0	19.2	22.4	24.1	26.5	27.8	27.6	26.9	23.3	19.1	17.9	
Mean Daily Temperature Range	5% DB MDBR	11.5	11.8	12.5	12.3	12.1	9.5	9.0	8.4	8.4	10.2	11.6	10.7	
	5% DB MCDBR													
	5% WB MCWBR													
	5% WB MCDBR													
Clear Sky Solar Irradiance	taub													
	taud													
	Ebn,noon													
	Edn,noon													
All-Sky Solar Radiation	RadAvg	3.2	3.94	5.02	5.97	6.45	5.84	5.43	5.38	4.79	4.48	3.53	2.95	
	RadStd	1.12	1.42	1.53	1.64	1.6	1.72	1.65	1.44	1.44	0.99	1.05	0.94	

Climate Variability and Anomalies Report



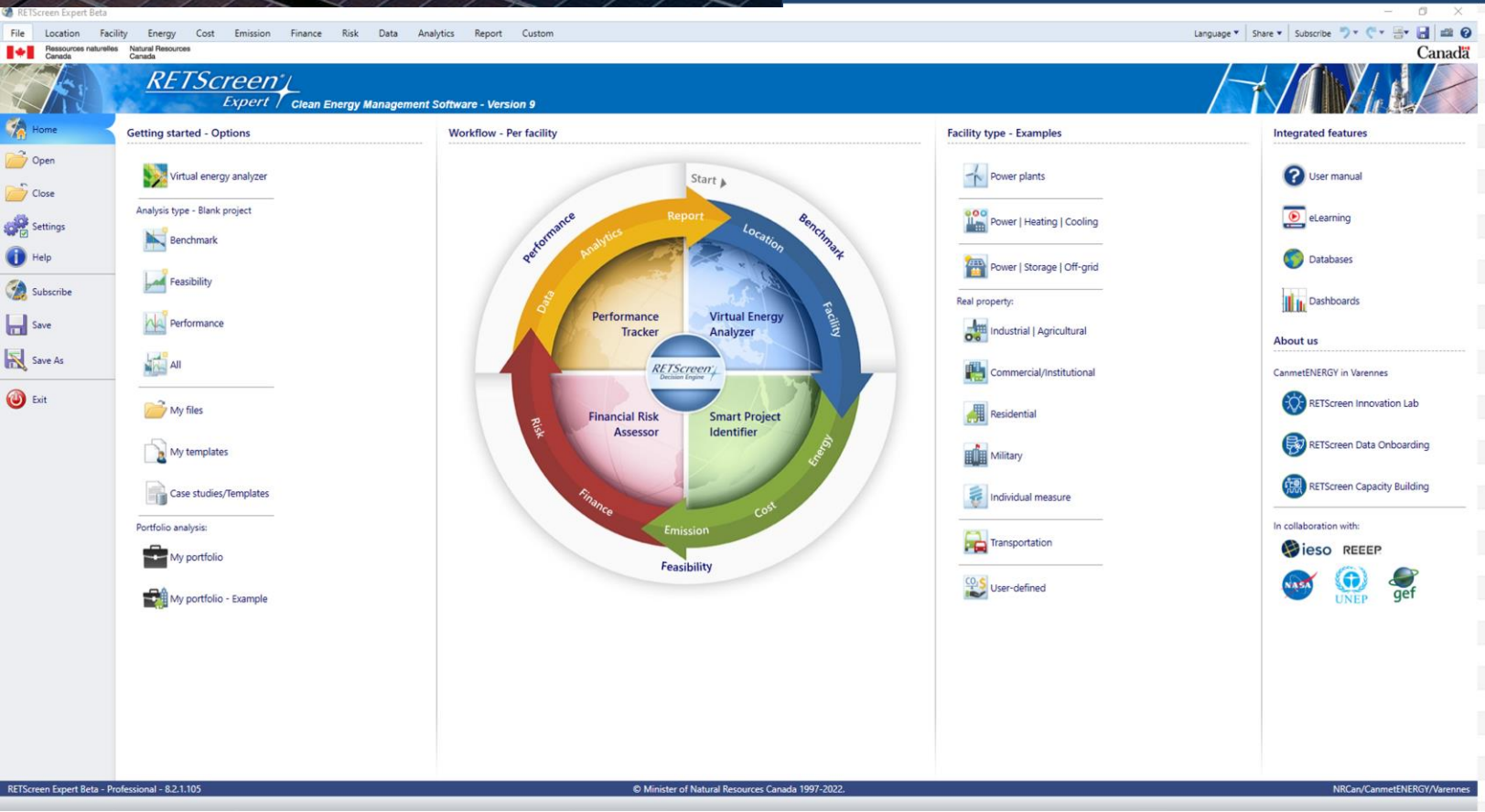
Windrose Report Table by NREL Classes

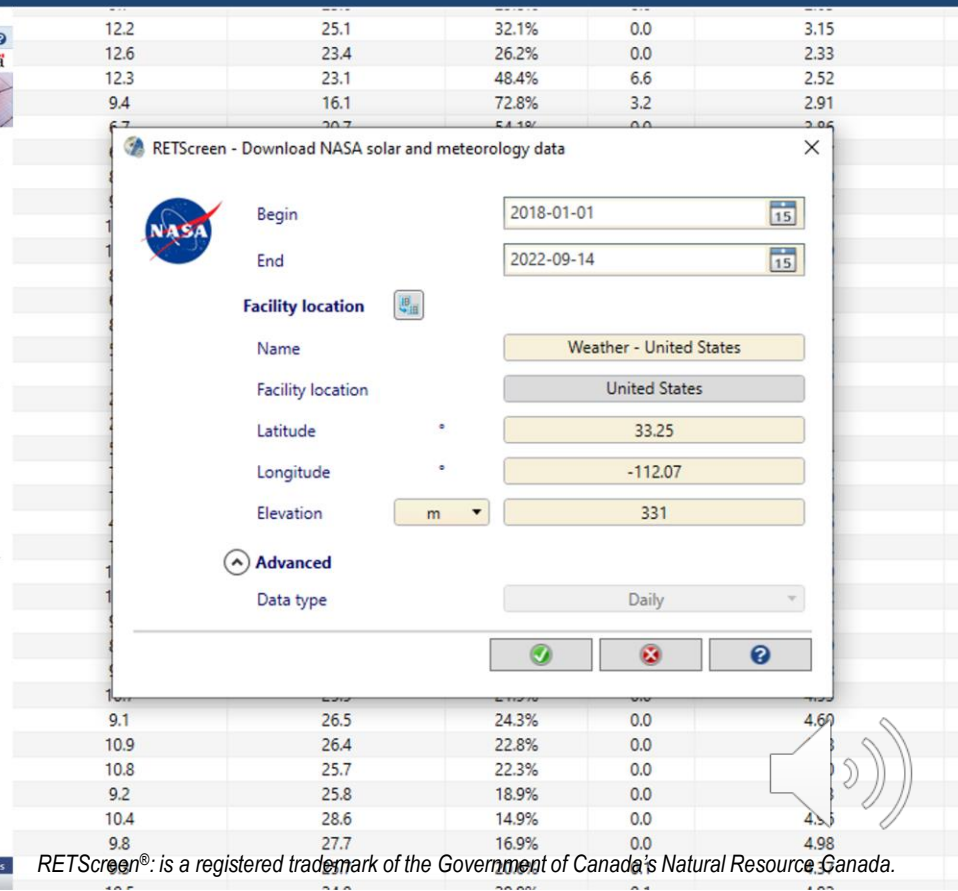
```
-BEGIN HEADER-
NASA/POWER Wind Rose MERRA2/GEOS 5.12.4 (FP-IT) 0.5 x 0.5 Degree Daily Averaged Data
Dates (month/day/year): 01/01/1984 through 12/31/2018
Single Point Total
Location: Latitude  38.9531   Longitude -77.028
Elevation from MERRA-2: Average for 1/2x1/2 degree lat/lon region = 83.32 meters   Site = na
Value for missing model data; cannot be computed or out of model availability range: -999
Parameter(s):
    WR10M      Wind Rose at 10 meters (percent)
                    CLASS_1: 0-1.5 m/s
                    CLASS_2: 1.5-3.0 m/s
                    CLASS_3: 3.0-4.4 m/s
                    CLASS_4: 4.4-5.1 m/s
                    CLASS_5: 5.1-5.6 m/s
                    CLASS_6: 5.6-6.0 m/s
                    CLASS_7: 6.0-6.4 m/s
                    CLASS_8: 6.4-7.0 m/s
                    CLASS_9: 7.0-9.4 m/s
                    CLASS_10: 9.4+ m/s
    WR50M      Wind Rose at 50 meters (percent)
                    CLASS_1: 0-1.5 m/s
                    CLASS_2: 1.5-3.0 m/s
                    CLASS_3: 3.0-5.6 m/s
                    CLASS_4: 5.6-6.4 m/s
                    CLASS_5: 6.4-7.0 m/s
                    CLASS_6: 7.0-7.5 m/s
                    CLASS_7: 7.5-8.0 m/s
                    CLASS_8: 8.0-8.8 m/s
                    CLASS_9: 8.8-11.9 m/s
                    CLASS_10: 11.9+ m/s
    WD_PCT      Wind Direction Percent (percent)
    WD_AVG      Wind Direction Average Wind Speed (m/s)
DIRECTION       This consists of 16 22.5 degree swaths; the center point being defined. (degrees)
CLASS           The NREL Wind Classifications with enhanced low-end wind levels that have different cutoffs for 10m and 50m Heights.
PARAMETER DIRECTION  CLASS_1  CLASS_2  CLASS_3  CLASS_4  CLASS_5  CLASS_6  CLASS_7  CLASS_8  CLASS_9  CLASS_10  WD_PCT  WD_AVG
-END HEADER-
    WR10M     000.0     1.59     4.03     1.60     0.33     0.16     0.03     0.05     0.02     0.03     0.00    7.83    2.50
    WR10M     022.5     1.73     3.86     0.94     0.10     0.00     0.02     0.00     0.01     0.00     0.00    6.66    2.15
    WR10M     045.0     1.42     4.07     1.27     0.09     0.02     0.01     0.00     0.00     0.00     0.00    6.87    2.28
    WR10M     067.5     1.53     4.69     2.89     0.41     0.10     0.04     0.02     0.01     0.00     0.00    9.68    2.64
    WR10M     090.0     1.44     3.77     1.69     0.16     0.06     0.02     0.01     0.01     0.00     0.00    7.15    2.42
    WR10M     112.5     1.33     2.56     0.77     0.09     0.03     0.01     0.01     0.00     0.00     0.00    4.80    2.15
    WR10M     135.0     1.01     1.71     0.41     0.11     0.00     0.01     0.00     0.00     0.00     0.00    3.25    2.06
    WR10M     157.5     1.15     1.76     0.39     0.03     0.00     0.00     0.01     0.01     0.01     0.00    3.36    1.95
    WR10M     180.0     1.00     1.64     0.51     0.09     0.02     0.02     0.02     0.00     0.00     0.00    3.29    2.14
    WR10M     202.5     1.06     2.07     0.63     0.09     0.02     0.02     0.01     0.00     0.01     0.00    3.91    2.18
    WR10M     225.0     1.17     1.99     0.79     0.09     0.08     0.02     0.02     0.02     0.04     0.00    4.22    2.31
    WR10M     247.5     1.19     1.94     0.80     0.13     0.03     0.02     0.02     0.02     0.03     0.00    4.18    2.33
    WR10M     270.0     1.13     2.64     1.34     0.13     0.08     0.04     0.03     0.02     0.02     0.00    5.42    2.48
    WR10M     292.5     1.23     3.30     2.03     0.41     0.23     0.09     0.08     0.03     0.09     0.00    7.49    2.82
    WR10M     315.0     1.60     3.56     3.49     0.95     0.48     0.24     0.26     0.21     0.25     0.02   11.05    3.28
    WR10M     337.5     1.51     4.01     3.13     1.02     0.45     0.27     0.17     0.10     0.20     0.01   10.86    3.14
    WR10M       ALL    21.09    47.60    22.68     4.23     1.76     0.86     0.71     0.46     0.68     0.03  100.02
    WR50M     000.0     0.63     1.85     3.79     0.59     0.41     0.16     0.23     0.15     0.13     0.01    7.95    4.12
    WR50M     022.5     0.46     1.73     3.75     0.53     0.16     0.11     0.03     0.02     0.01     0.00    6.80    3.77
    WR50M     045.0     0.54     1.63     4.06     0.65     0.21     0.09     0.07     0.02     0.01     0.00    7.27    3.87
    WR50M     067.5     0.41     1.66     5.24     1.18     0.61     0.34     0.23     0.13     0.13     0.00    9.93    4.51
    WR50M     090.0     0.52     1.48     3.81     0.56     0.20     0.15     0.09     0.06     0.04     0.00    6.90    4.00
    WR50M     112.5     0.37     1.45     2.44     0.24     0.06     0.05     0.04     0.05     0.02     0.00    4.72    3.57
    WR50M     135.0     0.39     1.08     1.45     0.13     0.07     0.06     0.02     0.00     0.00     0.00    3.21    3.33
    WR50M     157.5     0.47     1.18     1.44     0.06     0.04     0.01     0.00     0.01     0.03     0.00    3.24    3.10
    WR50M     180.0     0.46     1.09     1.49     0.15     0.07     0.02     0.02     0.01     0.02     0.00    3.32    3.24
    WR50M     202.5     0.43     1.18     1.81     0.17     0.10     0.04     0.02     0.01     0.03     0.01    3.80    3.49
    WR50M     225.0     0.47     1.31     2.01     0.17     0.12     0.07     0.02     0.05     0.05     0.01    4.28    3.57
    WR50M     247.5     0.42     1.20     1.83     0.27     0.12     0.05     0.02     0.02     0.07     0.00    4.01    3.64
    WR50M     270.0     0.55     1.31     2.63     0.45     0.16     0.07     0.05     0.10     0.04     0.01    5.37    3.87
    WR50M     292.5     0.58     1.35     3.39     0.74     0.35     0.31     0.22     0.18     0.24     0.02    7.38    4.52
    WR50M     315.0     0.62     1.53     4.21     1.30     0.86     0.62     0.56     0.58     0.70     0.07   11.04    5.23
    WR50M     337.5     0.54     1.71     4.32     1.06     0.81     0.58     0.53     0.61     0.59     0.05   10.80    5.07
    WR50M       ALL     7.86    22.74    47.67     8.25     4.35     2.73     2.15     2.00     2.11     0.18  100.02
```

Natural Resources Canada's RETScreen® Clean Energy Management Software Platform

World's leading clean energy decision making software for benchmark, feasibility, performance, and portfolio analysis related to nergy efficiency, heating and cooling, power generation and cogeneration,with 732,000+ registered users.

POWER provides global data as climatological averages that are embedded in the software and near-real time data obtained via a direct connection to POWER.





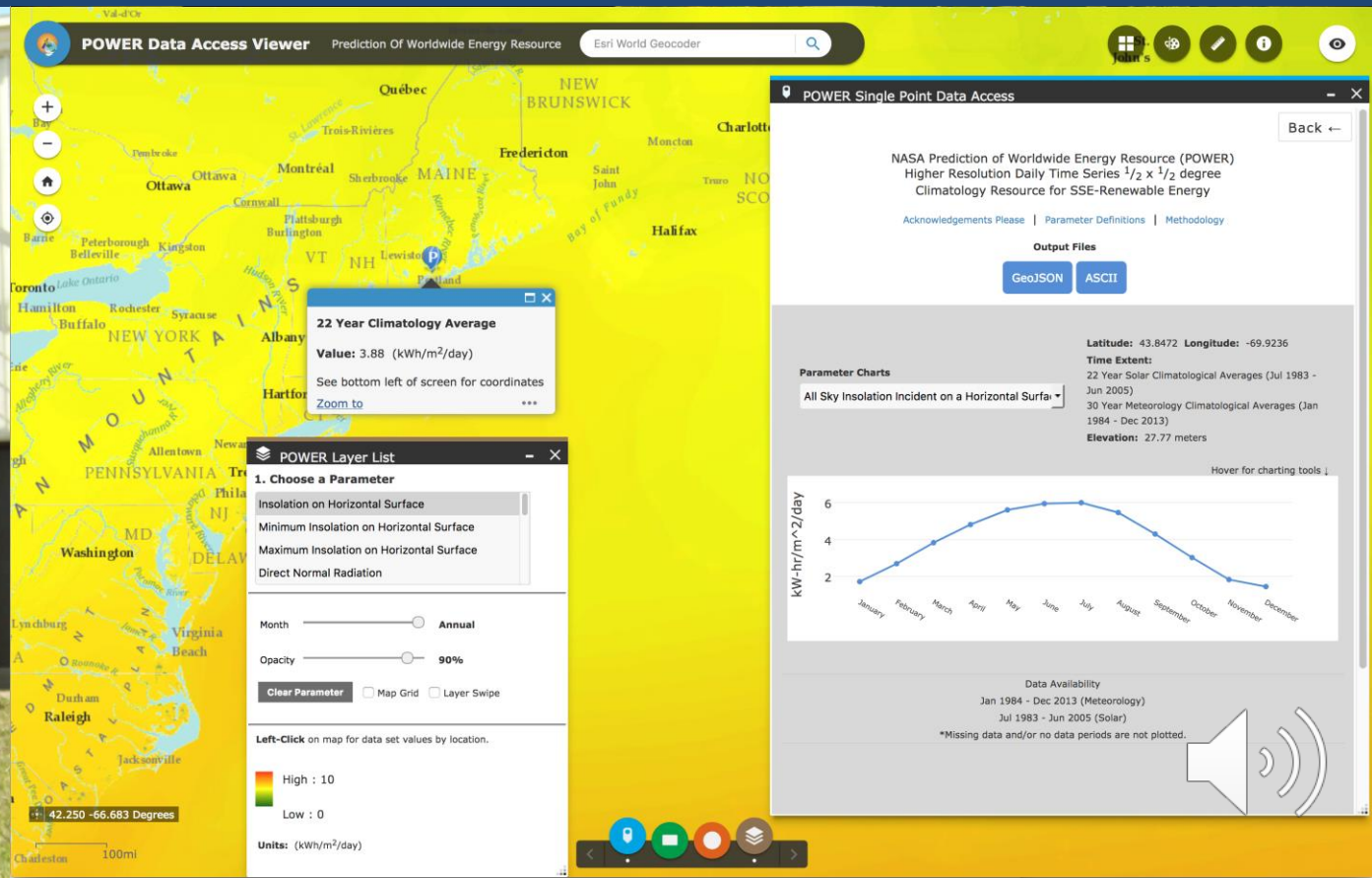
Renewable Energy Development

Wicked Joe Organic Coffees

"The benefits of solar, in our view, go far beyond the financial considerations or return on investment. While some regions may have 'more optimal' conditions for solar, we believe that any place where the sun shines is a good place for solar."

–Bob Garver, Wicked Joe Founder

Wicked Joe Coffee utilized RETScreen™ and POWER data to determine that a glazed solar wall would result in 40% more heat savings of approximately $10,000 per year.

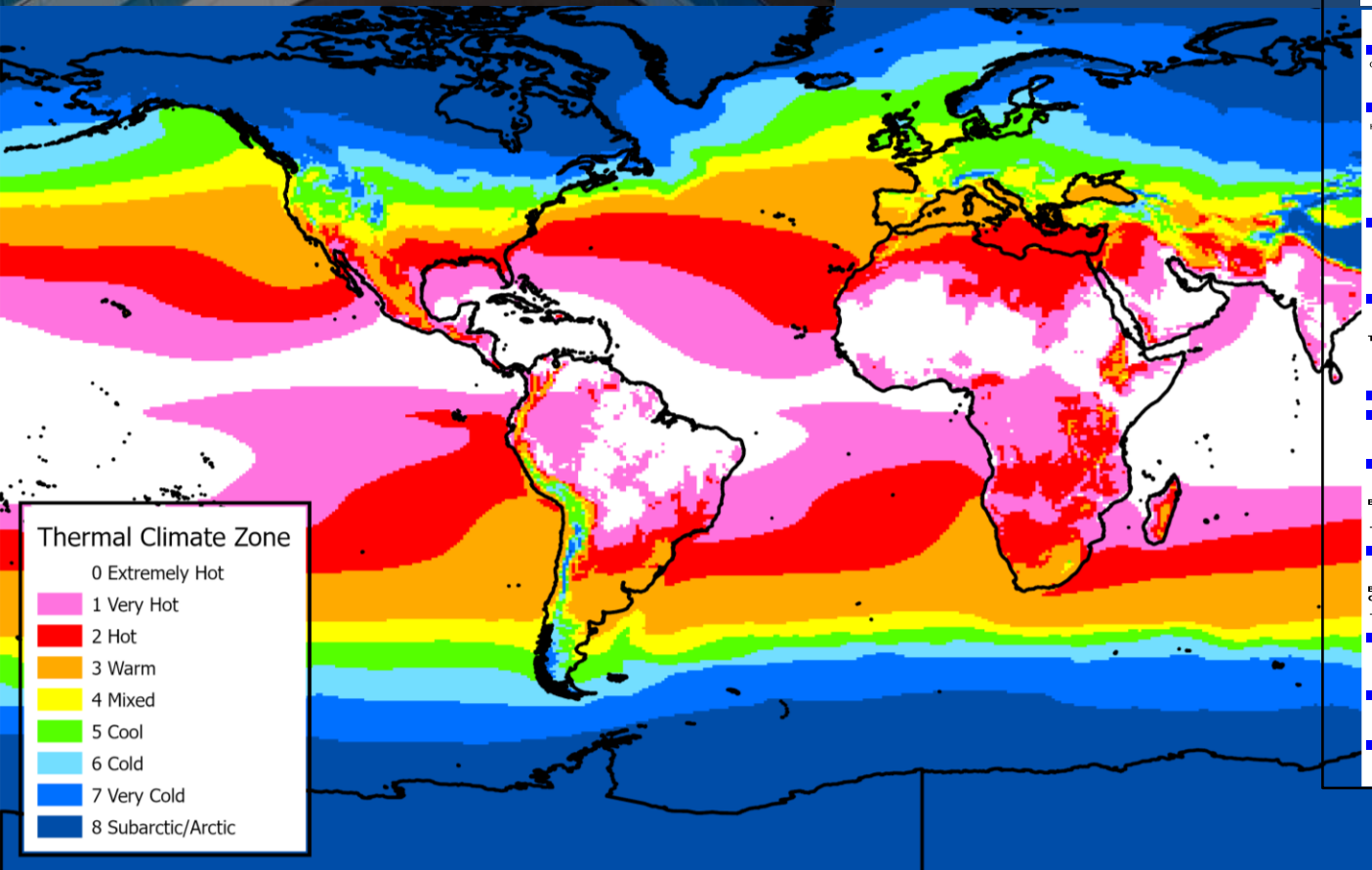


Building Energy Efficiency & Sustainability

American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)

The POWER project is working with ASHRAE professional association to make their Climatic Design Conditions report available to the public with POWER data globally.

Using MERRA-2, POWER creates Global ASHRAE Building Climate Zone maps, as well as"rolling" climate zones from 4-year means to illustrate the changes in time from 1984 through 2021.



Building Climatic Design Conditions

POWER Climatic Design Conditions (MERRA-2 and SRB/CERES)

Latitude: 29.6106 | Longitude: -82.2603 | Elevation: 28.3 | StdPres: 14.68 | Time Period: 2014 - 2019 | Note: 0.5 x 0.5 Degree Gridded Data

Annual Heating and Humidification Design Conditions

Coldest Month	Heating DB 99.6%	Heating DB 99%	Humidification DP/MCDB and HR 99.6% DP	99.6% HR	99.6% MCDB	Humidification DP/MCDB and HR 99% DP	99% HR	99% MCDB	Coldest month WS/MCDB 0.4% WS	0.4% MCDB	Coldest month WS/MCDB 1% WS	1% MCDB	MCWS/PCWD to 99.6% DB MCWS	MCWS/PCWD to 99.6% DB PCWD
1	-0.2	1.8	-5.6	0.0		-3.2	0.0		2.7		2.7			

Annual Cooling, Dehumidification, and Enthalpy Design Conditions

Hottest Month	Hottest Month DB Range	Cooling DB/MCWB 0.4% DB	0.4% MCWB	Cooling DB/MCWB 1% DB	1% MCWB	Cooling DB/MCWB 2% DB	2% MCWB	Evaporation WB/MCDB 0.4% WB	0.4% MCDB	Evaporation WB/MCDB 1% WB	1% MCDB	Evaporation WB/MCDB 2% WB	2% MCDB	MCWS/PCWD to 0.4% DB MCWS	MCWS/PCWD to 0.4% DB PCWD
7	12.5	35.8		34.7		33.6		28.4		28.1		27.8			

Dehumidification DP/MCDB and HR 0.4% DP	0.4% HR	0.4% MCDB	1% DP	1% HR	1% MCDB	2% DP	2% HR	Enthalpy/MCDB 0.4% MCDB	0.4% Enth	1% MCDB	1% Enth	2% MCDB	2% Enth	Extreme Max WB
35.8	20.0		25.3	20.0		25.0	20.0							29.6

Extreme Annual Design Conditions

Extreme Annual WS 1%	2.5%	5%		Extreme Annual Temperature Mean		Standard deviation		n-Year Return Period Values of Extreme Temperature n=5 years		n=10 years		n=20 years		n=50 years	
				Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
6.0	5.2	4.5	DB	-3.6	37.4	1.8	1.6	-4.9	38.6	-6.0	39.6	-7.0	40.5	-8.3	41.7
			WB	-5.4	29.2	2.9	0.4	-7.5	29.5	-9.2	29.7	-10.8	29.9	-12.9	30.1

Monthly Climatic Design Conditions

		Annual	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Temperatures, Degree-Days and Degree-Hours	DBAvg	21.2	11.5	15.3	17.3	21.3	25.1	27.1	27.9	27.5	26.0	22.3	17.2	15.6
	DBStd	0.7	2.2	3.0	1.8	1.3	1.1	0.9	0.8	0.4	0.8	1.4	2.1	2.1
	HDD10.0	59	40	8	2	0	0	0	0	0	0	0	3	6
	HDD18.3	535	204	95	63	8	0	0	0	0	0	8	61	95
	CDD10.0	4302	100	168	240	350	475	524	563	555	495	397	235	199
	CDD18.3	1747	7	20	45	109	218	275	306	298	246	148	44	31
	CDH23.3													
	CDH26.7													
Wind	WSAvg	2.3	2.7	2.6	2.6	2.6	2.3	2.0	1.7	1.9	2.1	2.6	2.4	2.5
Precipitation	PrecAvg	811	53	44	45	41	45	86	77	145	173	38	44	31
	PrecMax	1383	125	94	146	99	108	202	156	268	394	92	101	80
	PrecMin	3	3	2	1	2	1	3	5	3	1	2	2	5
	PrecStd	637	48	39	53	41	40	76	68	123	155	37	46	27
Monthly Design Dry Bulb and Mean Coincident Wet Bulb Temperatures	0.4% DB	15.2	18.2	19.3	22.9	26.8	28.1	29.4	28.1	27.1	24.3	20.2	19.1	
	0.4% MCWB	11.2	16.0	15.2	18.4	19.4	23.0	23.8	24.2	23.4	20.1	17.7	16.3	
	2% DB	15.0	18.1	19.2	22.9	26.7	28.1	29.3	28.1	27.1	24.3	20.1	18.9	
	2% MCWB	11.0	15.9	15.2	18.4	19.4	23.0	23.8	24.2	23.4	20.0	17.5	16.0	
	5% DB	14.4	18.1	19.2	22.9	26.5	28.1	29.1	28.0	27.0	24.2	19.7	18.5	
	5% MCWB	10.7	15.8	15.1	18.3	19.4	23.0	23.8	24.2	23.3	19.8	17.1	15.5	
	10% DB	13.6	17.9	19.2	22.8	26.2	28.1	28.7	27.9	26.9	24.0	19.1	17.9	
	10% MCWB	10.1	15.7	15.0	18.1	19.4	23.0	23.8	24.2	23.1	19.5	16.5	14.6	
Monthly Design Wet Bulb and Mean Coincident Dry Bulb Temperatures	0.4% WB	11.2	16.0	15.2	18.4	19.4	23.0	23.8	24.2	23.4	20.1	17.7	16.3	
	0.4% MCDB	15.2	18.2	19.3	22.9	24.1	26.5	27.9	27.7	27.1	24.3	20.2	19.1	
	2% WB	11.0	15.9	15.2	18.3	19.3	23.0	23.8	24.2	23.4	20.0	17.4	16.0	
	2% MCDB	15.0	18.1	19.3	22.8	24.1	26.5	27.9	27.7	27.1	24.1	20.1	18.9	
	5% WB	10.7	15.8	15.1	18.0	19.2	23.0	23.8	24.2	23.3	19.8	17.0	15.5	
	5% MCDB	14.4	18.1	19.2	22.6	24.1	26.5	27.9	27.7	27.0	23.8	19.7	18.5	
	10% WB	10.1	15.6	14.9	17.5	19.0	22.9	23.8	24.2	23.1	19.4	16.2	14.6	
	10% MCDB	13.6	18.0	19.2	22.4	24.1	26.5	27.8	27.6	26.9	23.3	19.1	17.9	
Mean Daily Temperature Range	5% DB MDBR	11.5	11.8	12.5	12.3	12.1	9.5	9.0	8.4	8.4	10.2	11.6	10.7	
	5% DB MCDBR													
	5% WB MCWBR													
	5% WB MCDBR													
Clear Sky Solar Irradiance	taub													
	taud													
	Ebn,noon													
	Edn,noon													
All-Sky Solar Radiation	RadAvg	3.2	3.94	5.02	5.97	6.45	5.84	5.43	5.38	4.79	4.48	3.53	2.95	
	RadStd	1.12	1.42	1.53	1.64	1.6	1.72	1.65	1.44	1.44	0.99	1.05	0.94	

ASHRAE

ANSI/ASHRAE Standard 169-2021
(Supersedes ANSI/ASHRAE Standard 169-2020)
Includes ANSI/ASHRAE addenda listed in Appendix C

Climatic Data for Building Design Standards

tenance by a Standing Standard Project Committee (SSPC) for which the Standards ed program for regular publication of addenda or revisions, including procedures for on requests for change to any part of the Standard. Instructions for how to submit a website (https://www.ashrae.org/continuous-maintenance).

ndard may be purchased from the ASHRAE website (www.ashrae.org) or from ology Parkway NW, Peachtree Corners, GA 30092. E-mail: orders@ashrae.org. Fax: 400 (worldwide), or toll free 1-800-527-4723 (for orders in US and Canada). For org/permissions.

-2336

Includes Web-based access to climatic data, design conditions, figures, and tables. (Requires Adobe Acrobat® and Microsoft Excel®)

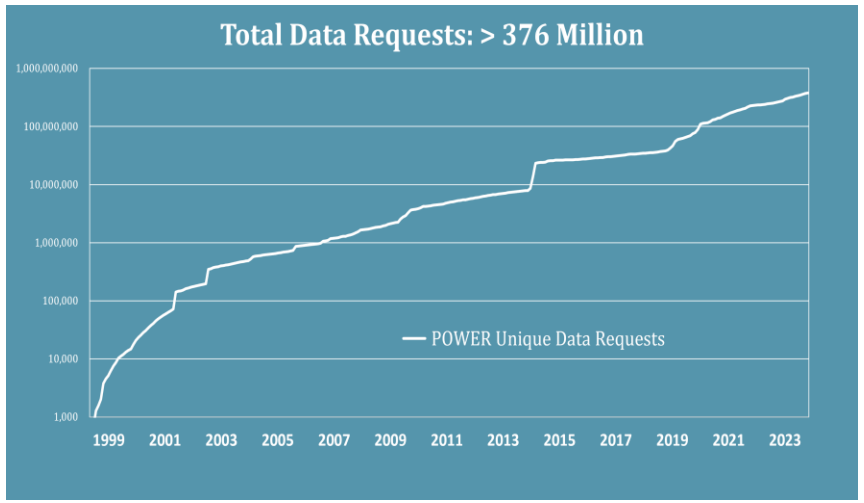
POWER Users | Impact of Modern Technology Adoption

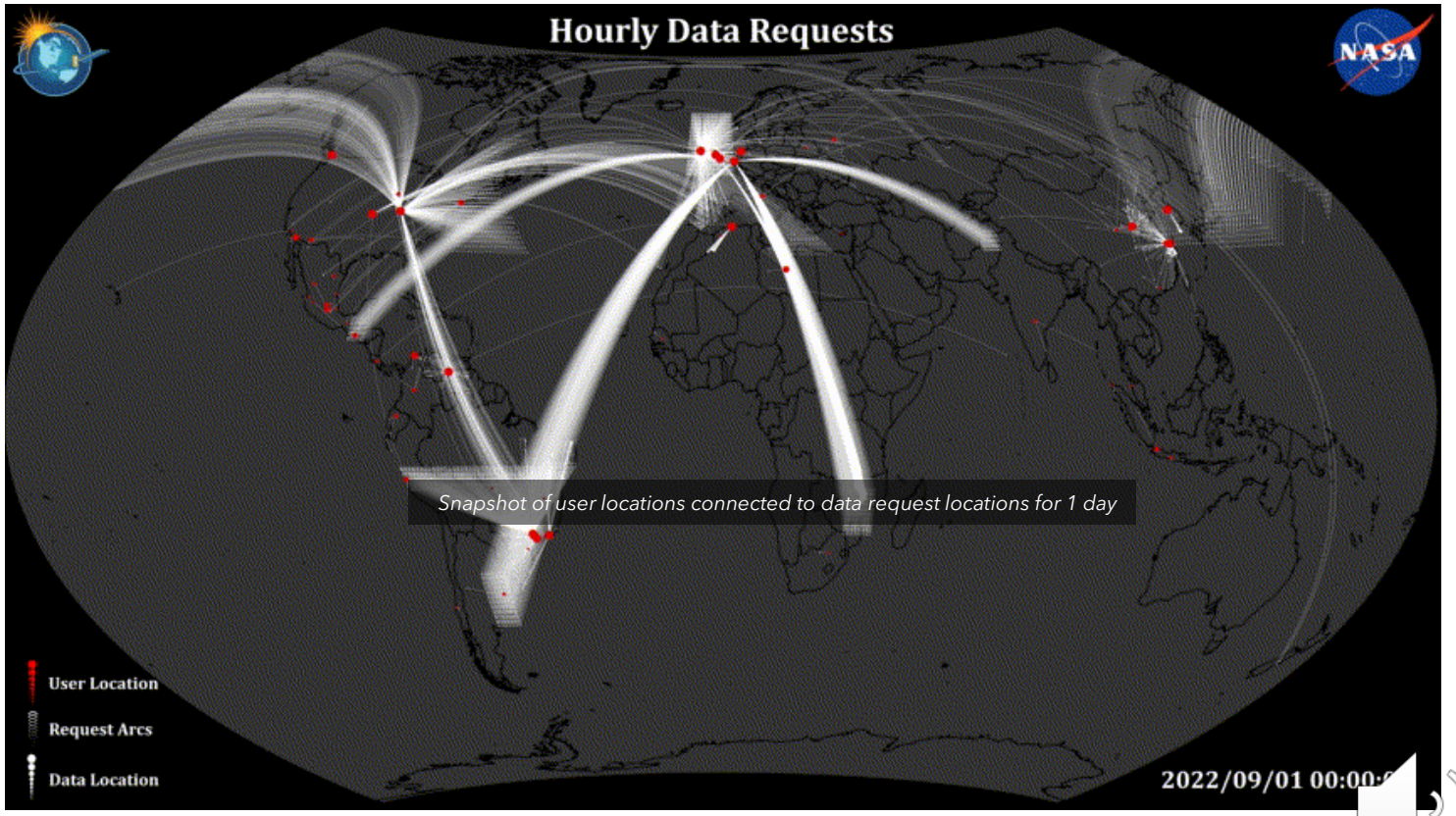
EARTH SCIENCE
APPLIED SCIENCES

POWER fulfills
7+ million data requests
for over
30,000 unique users
per month

Before Geospatial Services	
1999/06/01 to 2018/05/01	
Requests	35,988,533
Data Volume	3,612 GB
The data volume is available from 6/01/2019	

After Geospatial Services	
2018/05/01 to Present	
Requests	340,264,728
Data Volume	110.46 TB
Unique Users	734,389

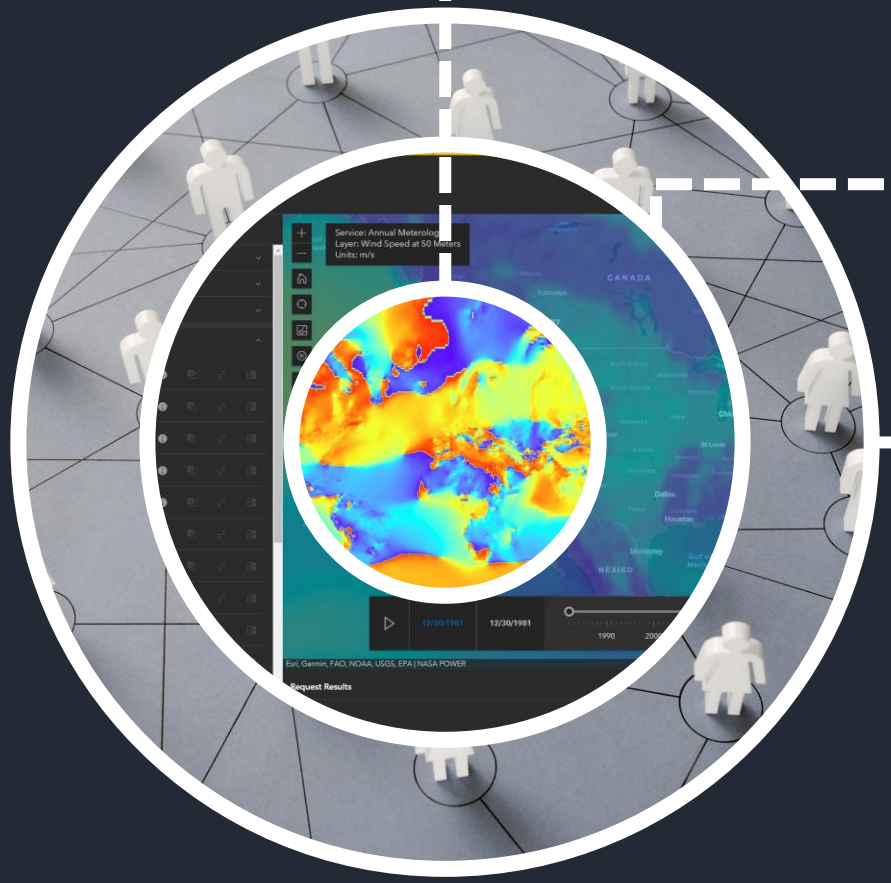




https://power.larc.nasa.gov

Roadmap | POWER's Future Plans

EARTH SCIENCE
APPLIED SCIENCES



New & Improved Datasets from Providers (including predictive data!)

Enhanced Data Production Technologies

Increased User Community Engagement & Communication
(e.g Validation Tool PRUVE)

Roadmap | Climate Data Services

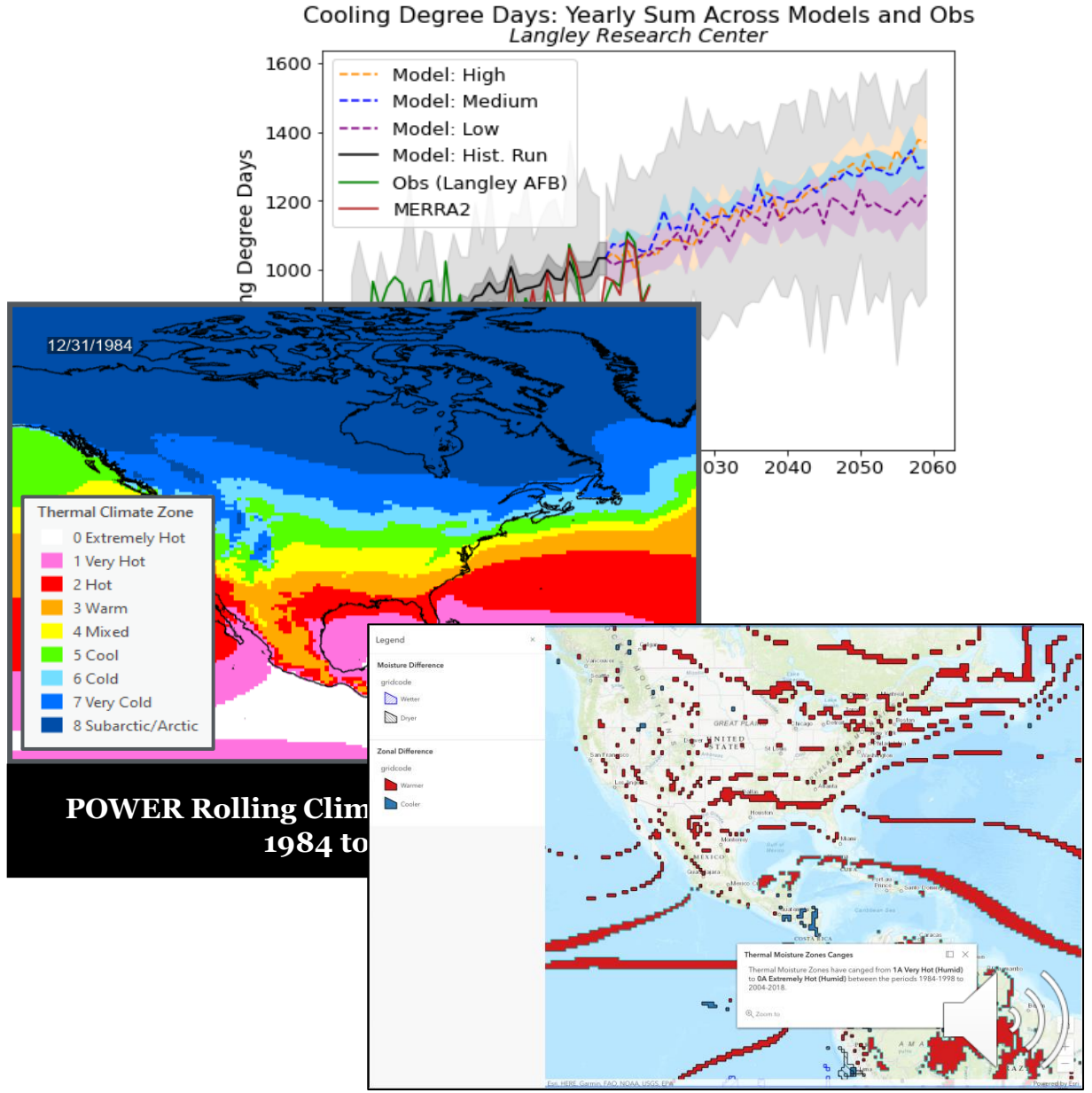
EARTH SCIENCE APPLIED SCIENCES

NASA-wide project to assess building system sustainability for operations, maintenance and planning according to Federal regulations

Assess and utilize NASA Earth Exchange (NEX) Global Downscaled Data Product from CMIP6 model data products:

- 22 of 26 models utilized; runs out to 2100
- 3 SSPs processed
- 60°S-90°N, all longitudes; downscaled to 20 km; daily temporal resolution
- 9 parameters including: T, Tmin, Tmax, RH (q), Wind Speed, Precip, SWdown, Lwdown

22 Member Ensemble for each SSP processed to assess CCD/HDD at each center

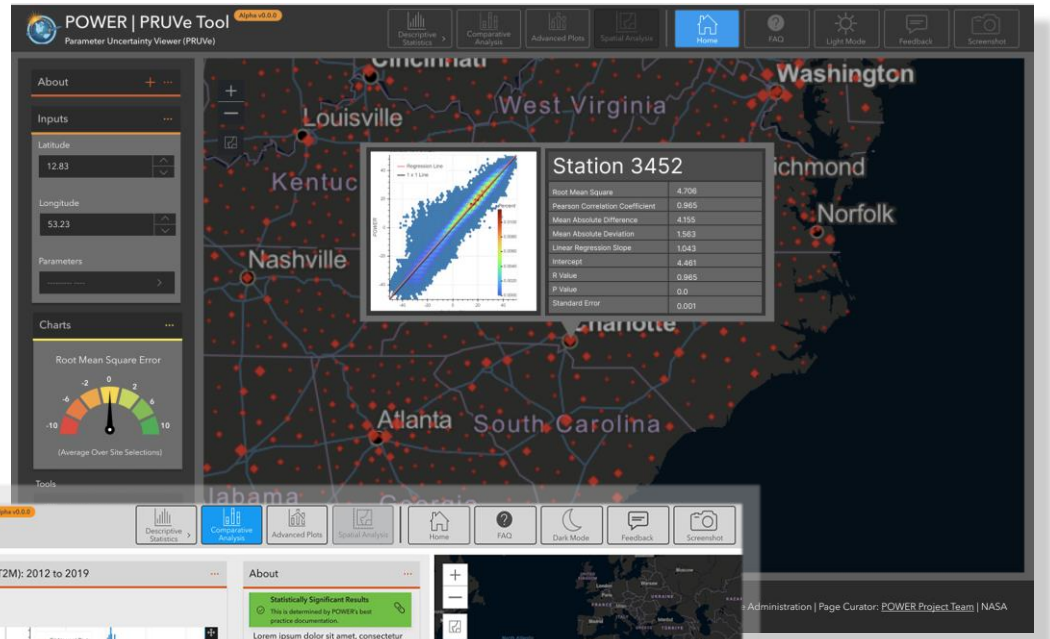


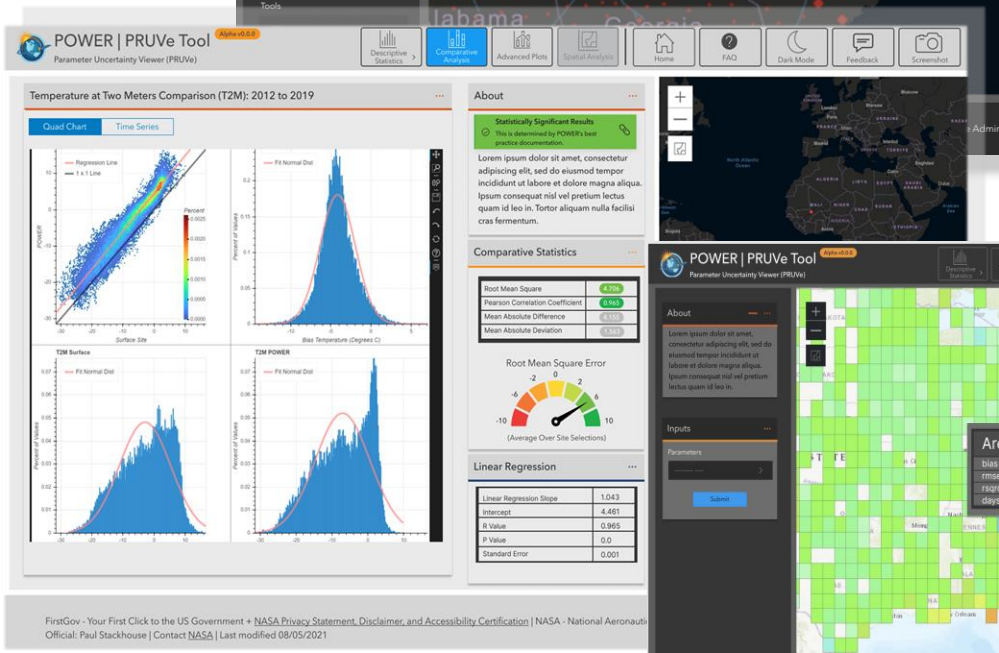
Roadmap | Online Data Validation Tool (PRUVE)

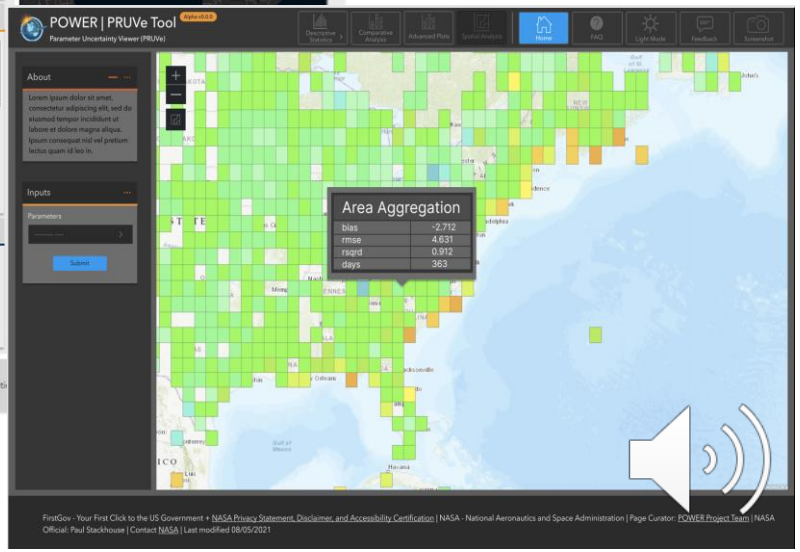
EARTH SCIENCE APPLIED SCIENCES

Currently working on a new web-application called PaRameter Uncertainty ViEwer (PRUVE)

Provides Ability to assess the uncertainties of the data products for a region and time period of interest







Key Features:

- Single feature service provides the underlying uncertainty statistics
- No-coding access
- Prototype to include ~3,000 surface sites
- Dynamic data visualization available for each site
- Creates maps, plots, and conducts spatial analysis on the fly
- Automatically displays referenced statistical content
- Integrated image service as a backdrop

Connect with POWER & Learn More

Explore POWER's docs & learning resources!

➥ Esri® ArcGIS StoryMap
➥ POWER Services Dashboard
➥ API Landing Pages
➥ Methodology Docs

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

Submit your user stories & POWER-featured publications!

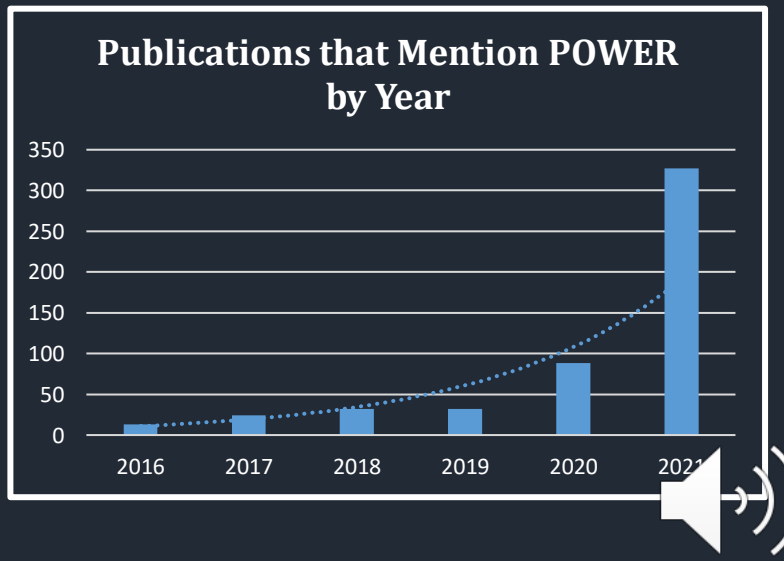
➥ The team keeps a list of presentations, papers, & projects that have used POWER Data.

Energy Webinars

Reach out to POWER directly!

larc-power-project@mail.nasa.gov

falguni.patadia@nasa.gov



Thank you!

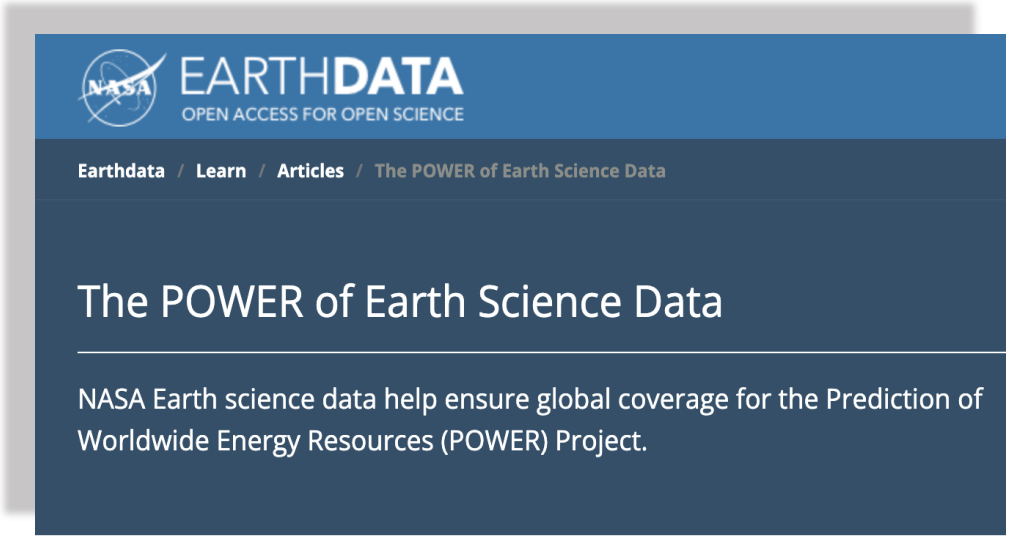
Email: larc-power-project@mail.nasa.gov
Website: https://power.larc.nasa.gov

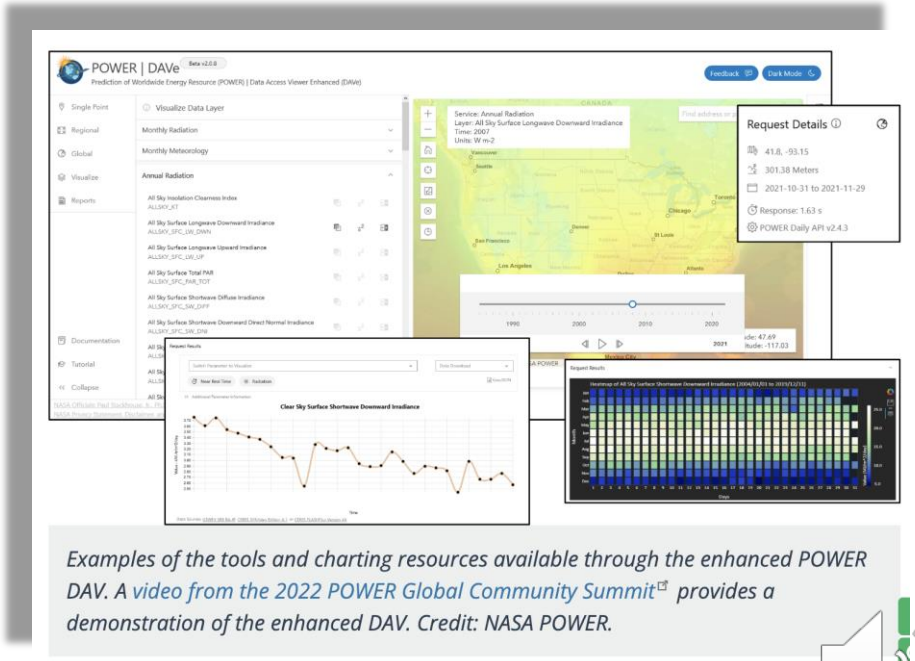
Principal Investigators: Dr. Paul W. Stackhouse, Jr. & Dr. Falguni Patadia – National Aeronautics and Space Administration (NASA)

Co-Investigators:

- Bradley Macpherson, Madison Broddle, Christopher Higham, Claire Baldacci, & A. Jason Barnett – Booz Allen Hamilton (BAH)
- Taiping Zhang, Colleen Mikovitz, Bradley Hegyi, & Neha Khadka – Science Systems and Applications, Inc. (SSAI)

https://www.earthdata.nasa.gov/learn/articles/power-overview





Examples of the tools and charting resources available through the enhanced POWER DAV. A video from the 2022 POWER Global Community Summit provides a demonstration of the enhanced DAV. Credit: NASA POWER.