



NOAA Research • Earth System Research Laboratory • Physical Sciences Division

Climate Projections and Energy Security

Andy Hoell and Jim Wilczak

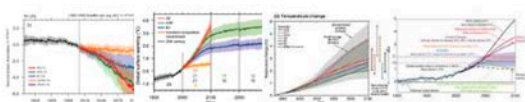
Research Meteorologists, Physical Sciences Division

Information on Climate Projections

Google search results for "climate projections".

Search results include:

- Local Climate Projections - climatewise.org
- Climate Projections | WMO
- Global Climate Projections - IPCC
- NASA releases detailed global climate change projections
- Future Climate Change | Climate Change | US EPA
- Images for climate projections



Google search results for "climate projections 2030".

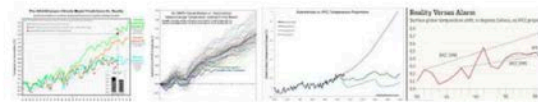
Search results include:

- Scholarly articles for climate projections 2030
- 3 Projected Climate Change by Geographic Region - Climate ...
- 3 Project climate change and its impacts - IPCC
- Mean Temperature - AR4 WGI Chapter 10: Global Climate Pro..
- Media Reports The World Will Enter A 'Mini Ice Age' In The 20...
- Degrees of change: the IPCC's projections for future temperat...
- 2030: The "Perfect Storm" Scenario

Google search results for "climate projections vs reality".

Search results include:

- IPCC overestimate temperature rise - Skeptical Science
- How reliable are climate models? - Skeptical Science
- Images for climate projections vs reality
- More images for climate projections vs reality
- IPCC predictions: Then versus now — The Daily Climate
- C3: Failed Predictions, Guesstimates, Forecasts
- Computer Models vs. Climate Reality - The New American



Information on Climate Projections

Reputable

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Information on Climate Projections

Sensational

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Local Climate Projections - climatewise.org
www.climatewise.org/local-projections
Get graphics rich climate information for your community.
Local Projections Vulnerability Assessments
Resilience Planning Educational Webinars

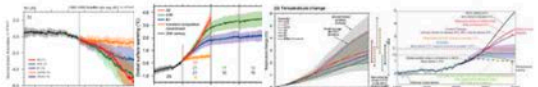
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<https://www.ipcc.ch/.../ar4-w...> Intergovernmental Panel on Climate Change
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NASA releases detailed global climate change projections
climate.nasa.gov/news/2293/ NASA
Jun 9, 2015 - The new NASA global data set combines historical measurements with data from climate simulations using the best available computer models to provide forecasts of how global temperature (shown here) and precipitation might change up to 2100 under different greenhouse gas emissions ...
NEX Global Daily Downscaled - NEX-GDDP - Fourteen years of carbon ...

Future Climate Change | Climate Change | US EPA
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Images for climate projections Report images



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Scholarly articles for climate projections 2030
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... of climate-induced crop yield changes by 2030 - Hertel - Cited by 213
Warming increases the risk of civil war in Africa - Burke - Cited by 479

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Dec 18, 2015 - 3 Projected Climate Change by Geographic Region By 2030, Houston, TX is projected under a higher emission scenario (A2) to ...

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About a third of that warming is projected to be due to climate change that is ...

Media Reports The World Will Enter A 'Mini Ice Age' In The 20...
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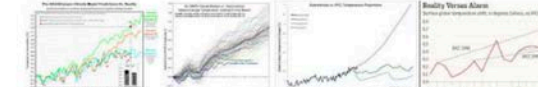
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IPCC overestimate temperature rise - Skeptical Science
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Images for climate projections vs reality Report images



More images for climate projections vs reality

IPCC predictions: Then versus now — The Daily Climate
www.dailyclimate.org/tdc-newsroom/2012/.../ipcc-prediction-fact-check
Dec 6, 2012 - Reality: Summer ice is thinning faster than every climate projection, and today scientists predict an ice-free Arctic in years, not decades.

C3: Failed Predictions, Guesstimates, Forecasts
www.c3headlines.com/predictionsforecasts/
Extreme Climate Change Prediction: The Po River Will Flood More: Not 2014:
NASA/Hansen Climate Model Output Vs. Climate Reality - Failure is Always ...

Computer Models vs. Climate Reality - The New American
www.thenewamerican.com/.../20610-computer-models-vs-climate-reality
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Obviously, the IPCC's computer models are totally at odds with reality, as the ...

Information on Climate Projections

Skeptical

Google

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About 788,000 results (0.42 seconds)

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www.climatewise.org/local-projections
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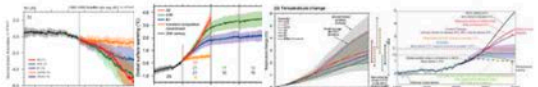
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About 11,800,000 results (0.65 seconds)

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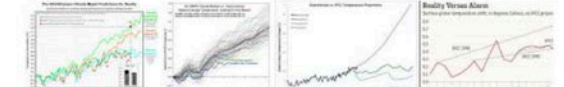
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More images for climate projections vs reality

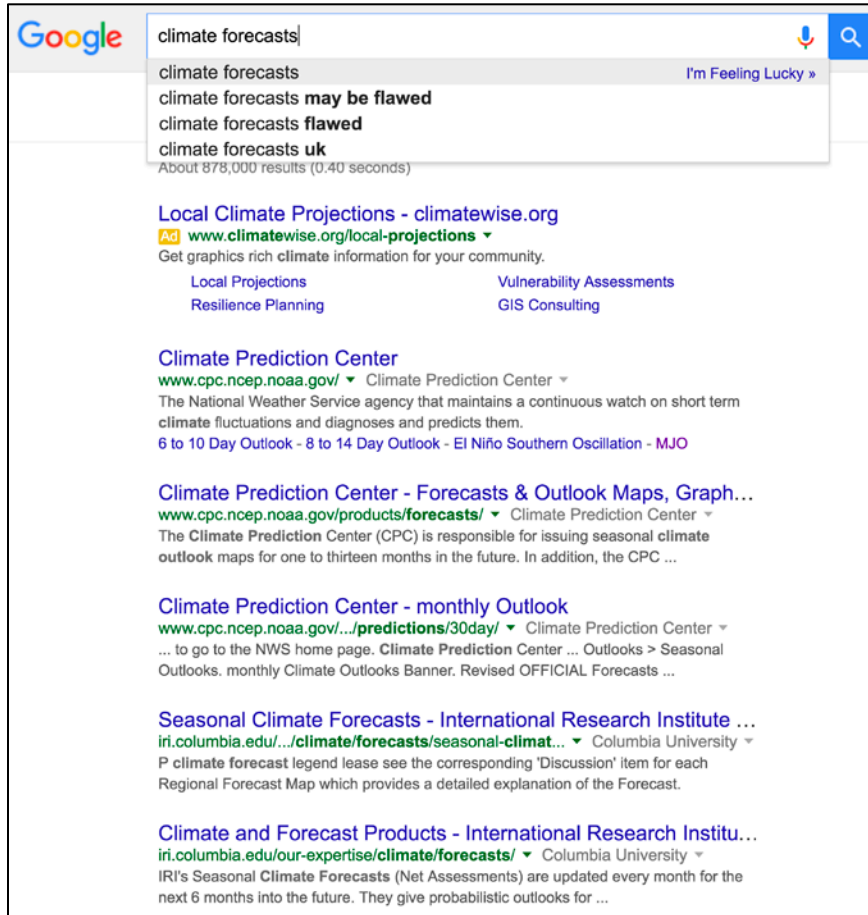
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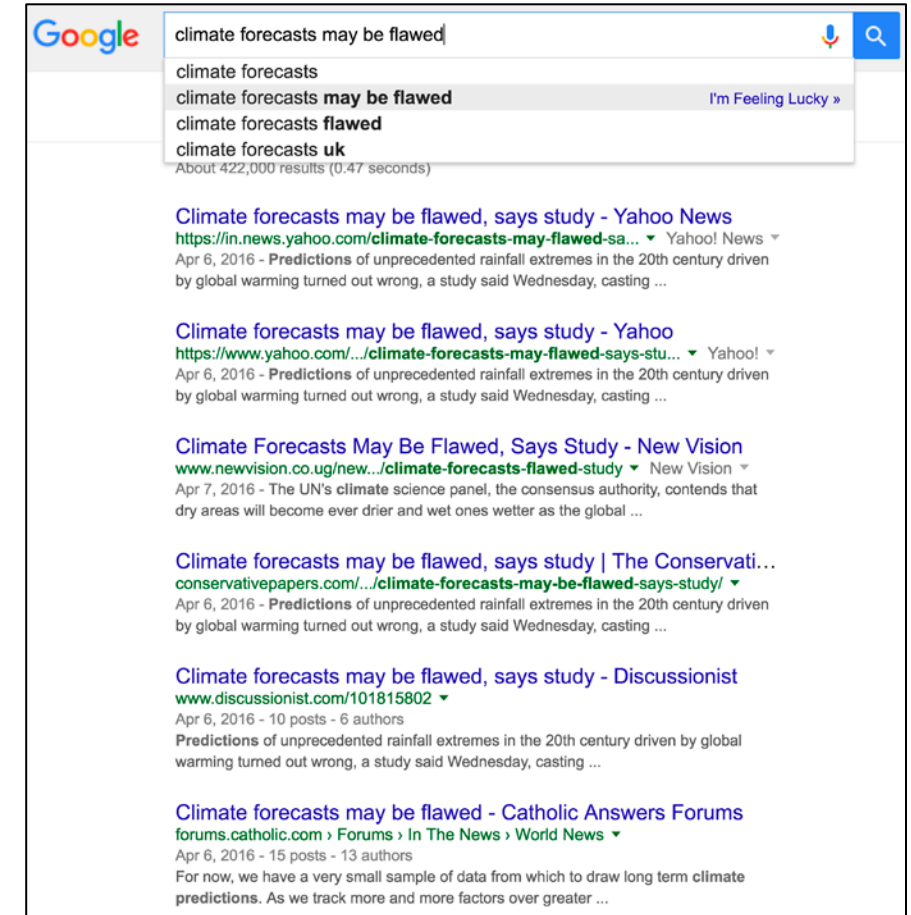
Everyone Has an Opinion

Evidence Based



Google search results for "climate forecasts". The search bar shows "climate forecasts" and the dropdown menu lists "climate forecasts", "climate forecasts may be flawed", "climate forecasts flawed", and "climate forecasts uk". The search results show "About 878,000 results (0.40 seconds)". The first result is "Local Climate Projections - climatewise.org" with a link to "www.climatewise.org/local-projections". Below this is the "Climate Prediction Center" link to "www.cpc.ncep.noaa.gov/". The second result is "Climate Prediction Center - Forecasts & Outlook Maps, Graph..." with a link to "www.cpc.ncep.noaa.gov/products/forecasts/". The third result is "Climate Prediction Center - monthly Outlook" with a link to "www.cpc.ncep.noaa.gov/.../predictions/30day/". The fourth result is "Seasonal Climate Forecasts - International Research Institute ..." with a link to "iri.columbia.edu/.../climate/forecasts/seasonal-climat...". The fifth result is "Climate and Forecast Products - International Research Institu..." with a link to "iri.columbia.edu/our-expertise/climate/forecasts/".

Personal Preference



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Outline

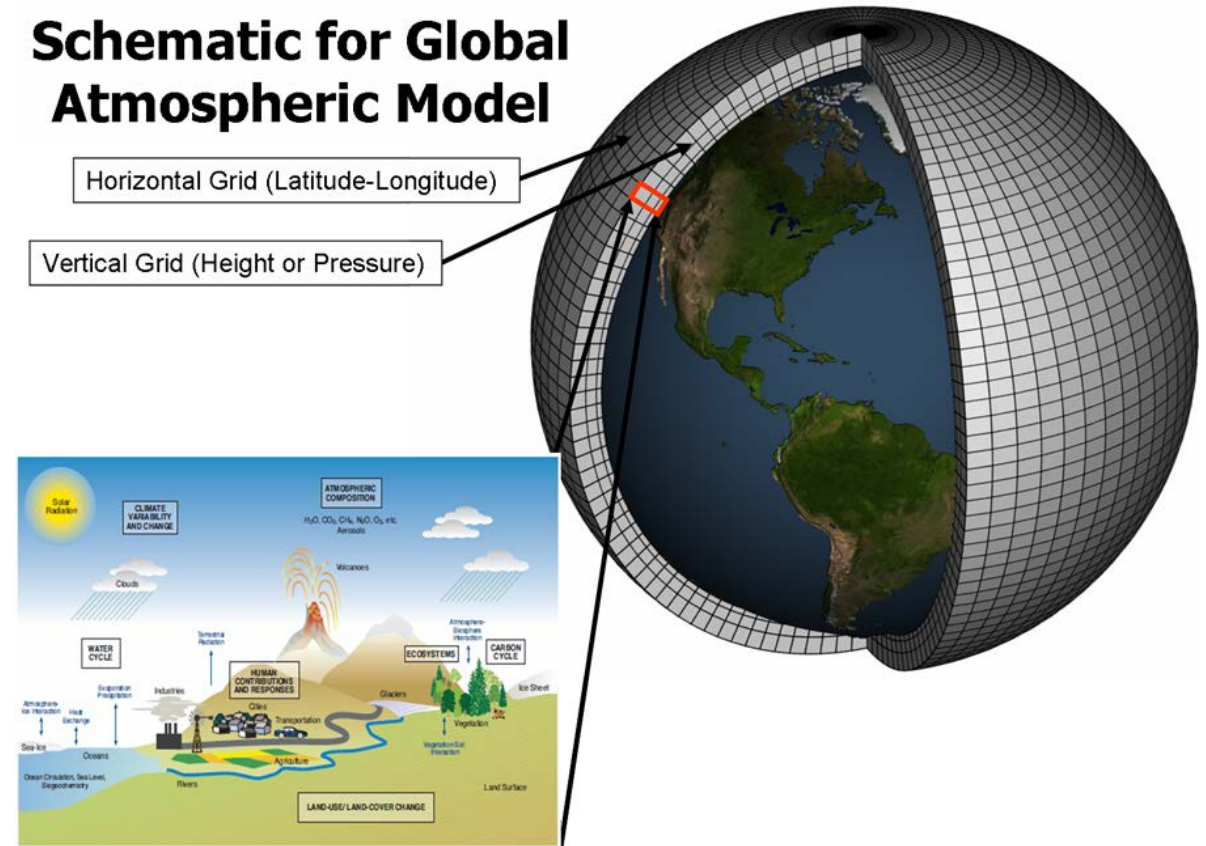
- Overview of Climate Models
- Seasonal Forecasts
- Climate Projections
- Application to Energy Security

Climate Models

How Climate Models Work

- Climate models replicate the physics of the climate system using equations that account for mass, momentum, energy
- Climate models separate the Earth and its atmosphere into finite areas and solve the equations in those finite areas
- Climate models can be used for seasonal forecasts and long-term projections

Schematic for Global Atmospheric Model

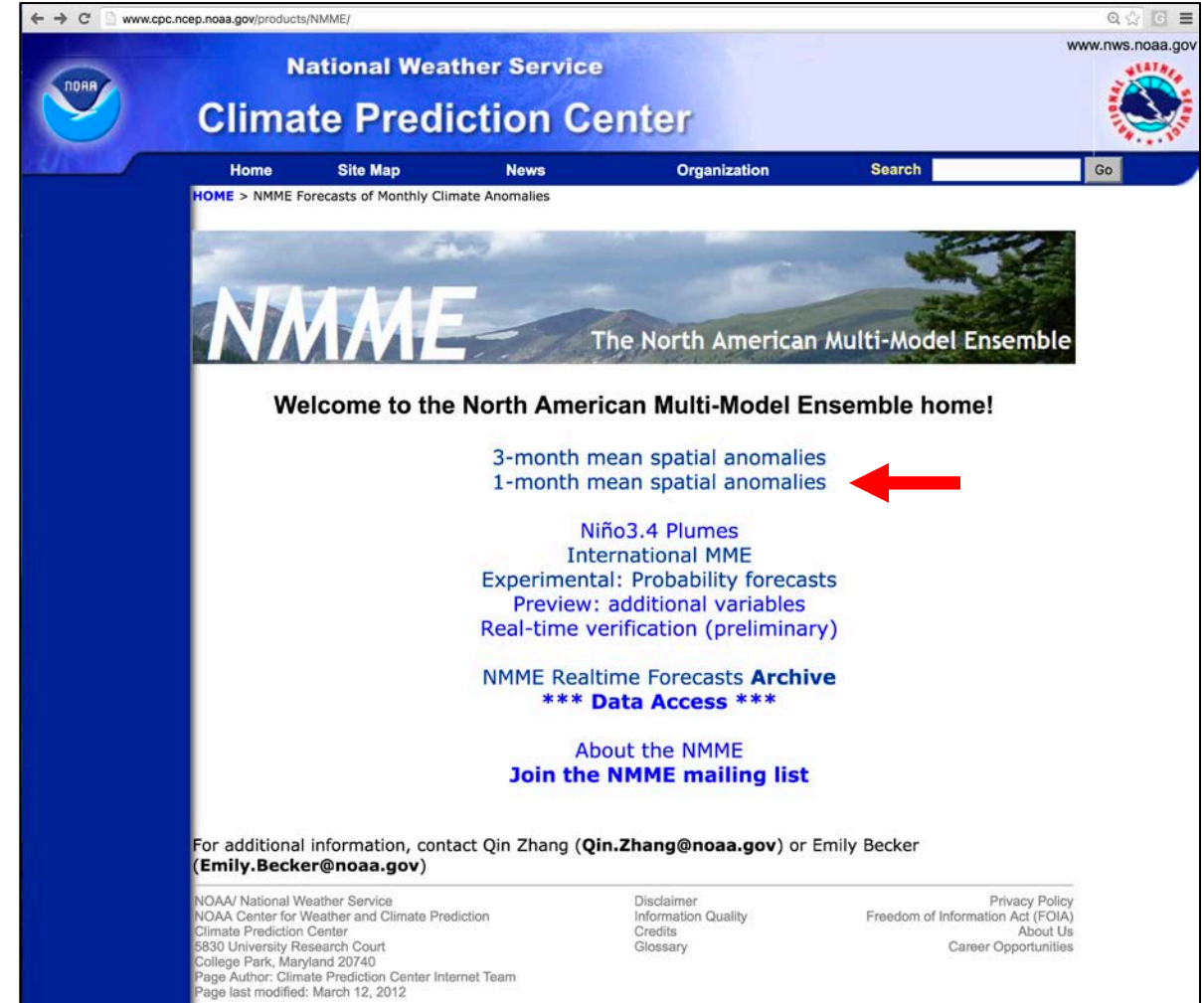


Seasonal Forecasts

North American Multi-Model Ensemble

cpc.ncep.noaa.gov/products/NMME

- Forecast system made up of 7 models
- Forecasts of monthly and seasonal surface temperature and precipitation



One Month Forecasts

www.cpc.ncep.noaa.gov/products/NMME/monanom.shtml

National Weather Service
Climate Prediction Center

Home Site Map News Organization Search Go

HOME > NMME Forecasts of Monthly Climate Anomalies > 3-Month Mean Spatial Anomalies

NMME Forecasts of Monthly Climate Anomalies for
May 2016 - November 2016

[NMME Forecasts of Monthly Climate Anomalies Home](#)
[View Forecasts by Model](#)

One-month mean spatial anomalies

	Lead 1	Lead 2	Lead 3	Lead 4	Lead 5	Lead 6	Lead 7
Global SST	●	●	●	●	●	●	●
Global prate	●	●	●	●	●	●	●
Global tmp2m	●	●	●	●	●	●	●
US prate	●	●	●	●	●	●	●
US tmp2m	●	●	●	●	●	●	●

Skill maps for one-month means

	Lead 1	Lead 2	Lead 3	Lead 4	Lead 5	Lead 6	Lead 7
Global SST	●	●	●	●	●	●	●
Global prate	●	●	●	●	●	●	●
Global tmp2m	●	●	●	●	●	●	●
US prate	●	●	●	●	●	●	●
US tmp2m	●	●	●	●	●	●	●

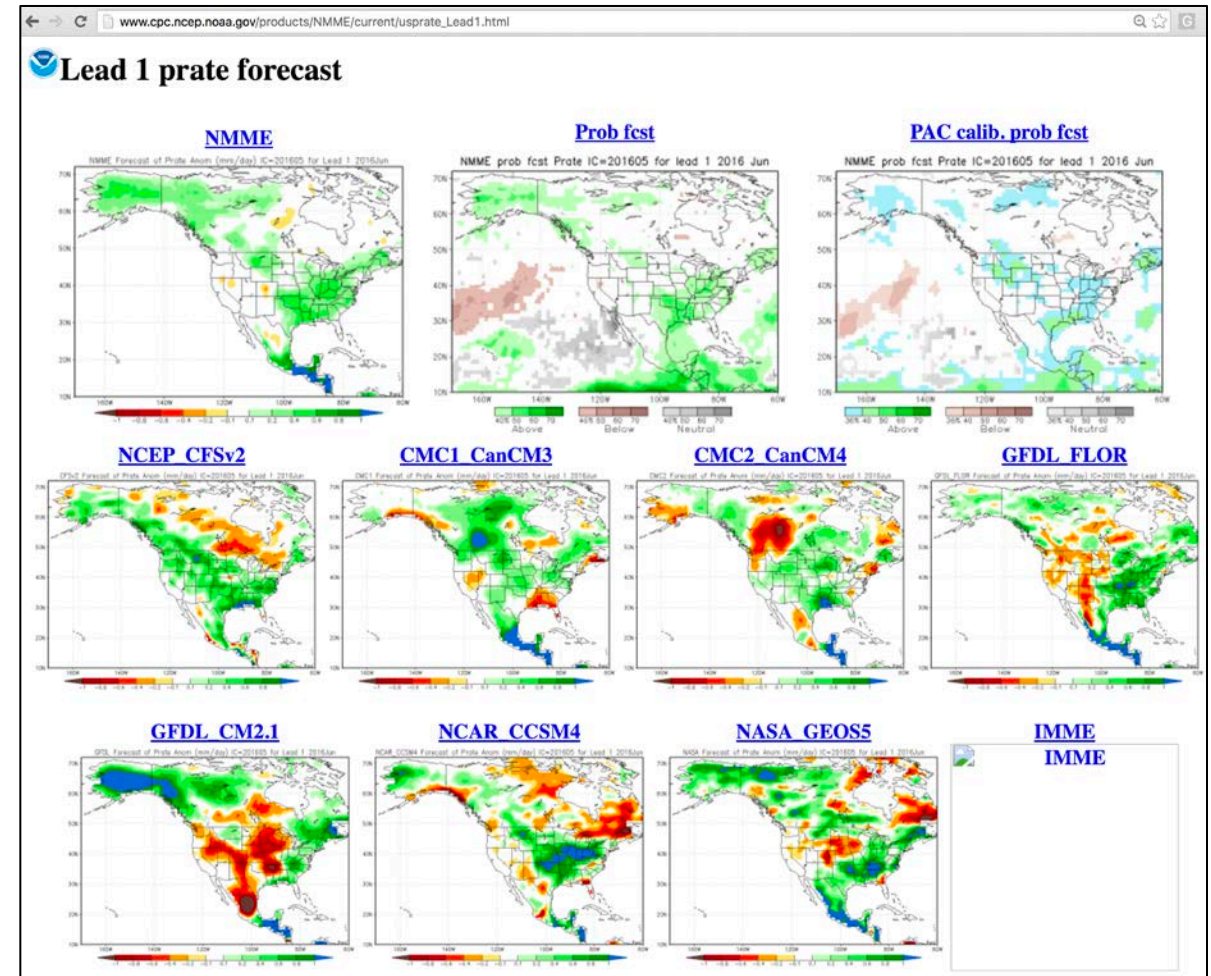
Anomalies with Skill Masks Applied

NOAA/ National Weather Service
NOAA Center for Weather and Climate Prediction
Climate Prediction Center
5830 University Research Court
College Park, Maryland 20740
Page Author: Climate Prediction Center Internet Team
Page last modified: March 15, 2012

Disclaimer
Information Quality
Credits
Glossary

Privacy Policy
Freedom of Information Act (FOIA)
About Us
Career Opportunities

Example: One Month Precipitation Forecasts



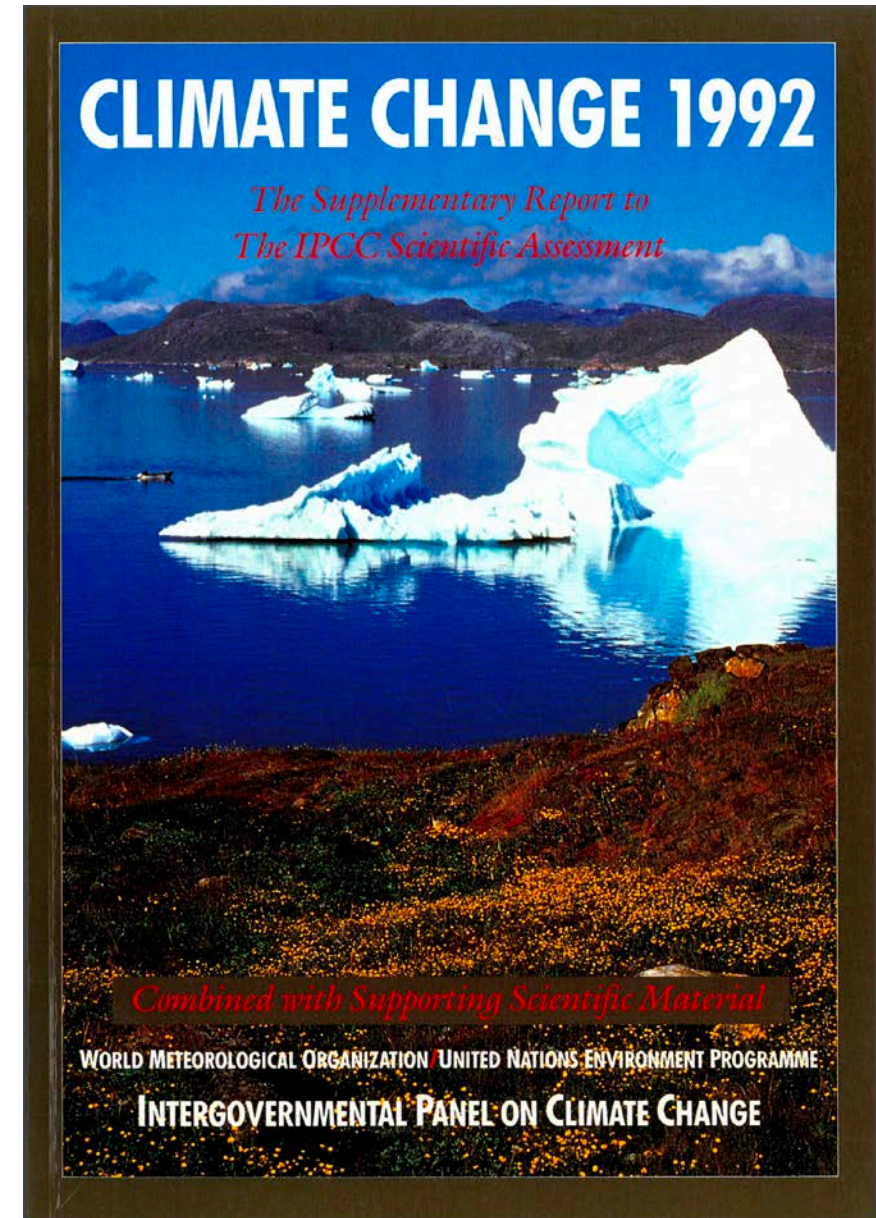
Climate Projections

IPCC First Assessment

2. Our Major Conclusions

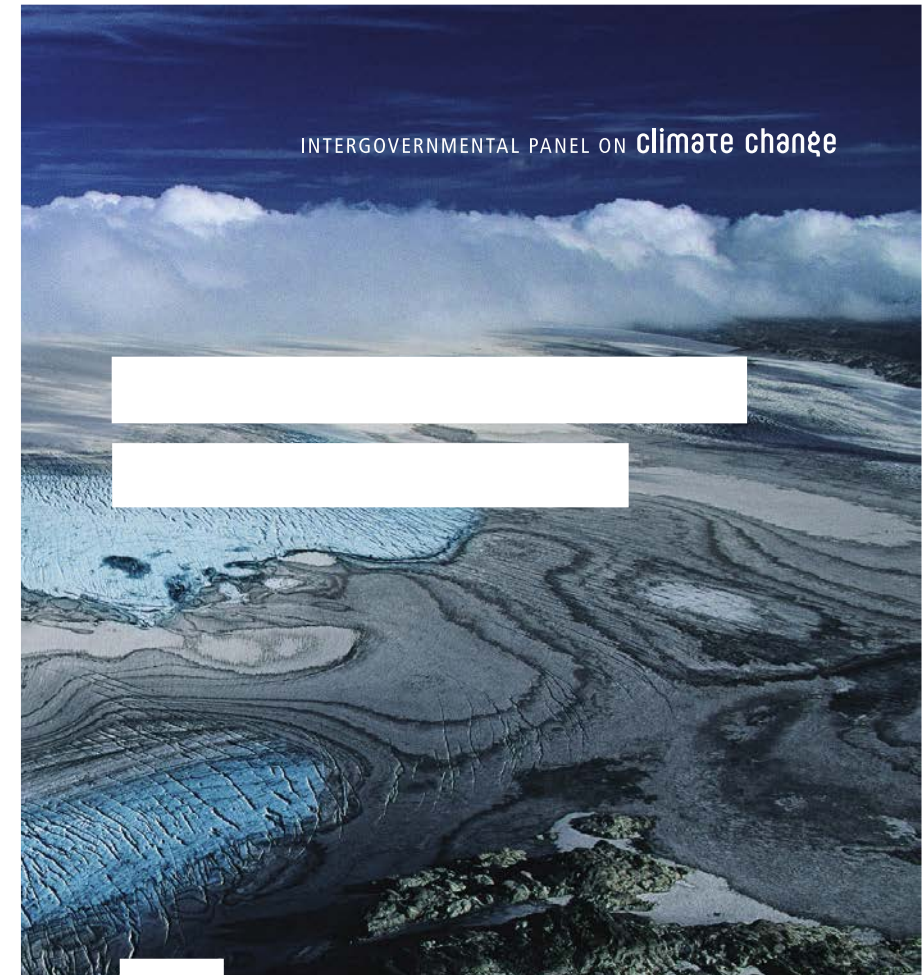
Findings of scientific research since 1990 do not affect our fundamental understanding of the science of the greenhouse effect and either confirm or do not justify alteration of the major conclusions of the first IPCC Scientific Assessment, in particular the following:

- emissions resulting from human activities are substantially increasing the atmospheric concentrations of the greenhouse gases: carbon dioxide, methane, chlorofluorocarbons, and nitrous oxide;
- the evidence from the modelling studies, from observations and the sensitivity analyses indicate that the sensitivity of global mean surface temperature to doubling CO₂ is unlikely to lie outside the range 1.5 to 4.5°C;
- there are many uncertainties in our predictions particularly with regard to the timing, magnitude and regional patterns of climate change;



IPCC Fifth Assessment

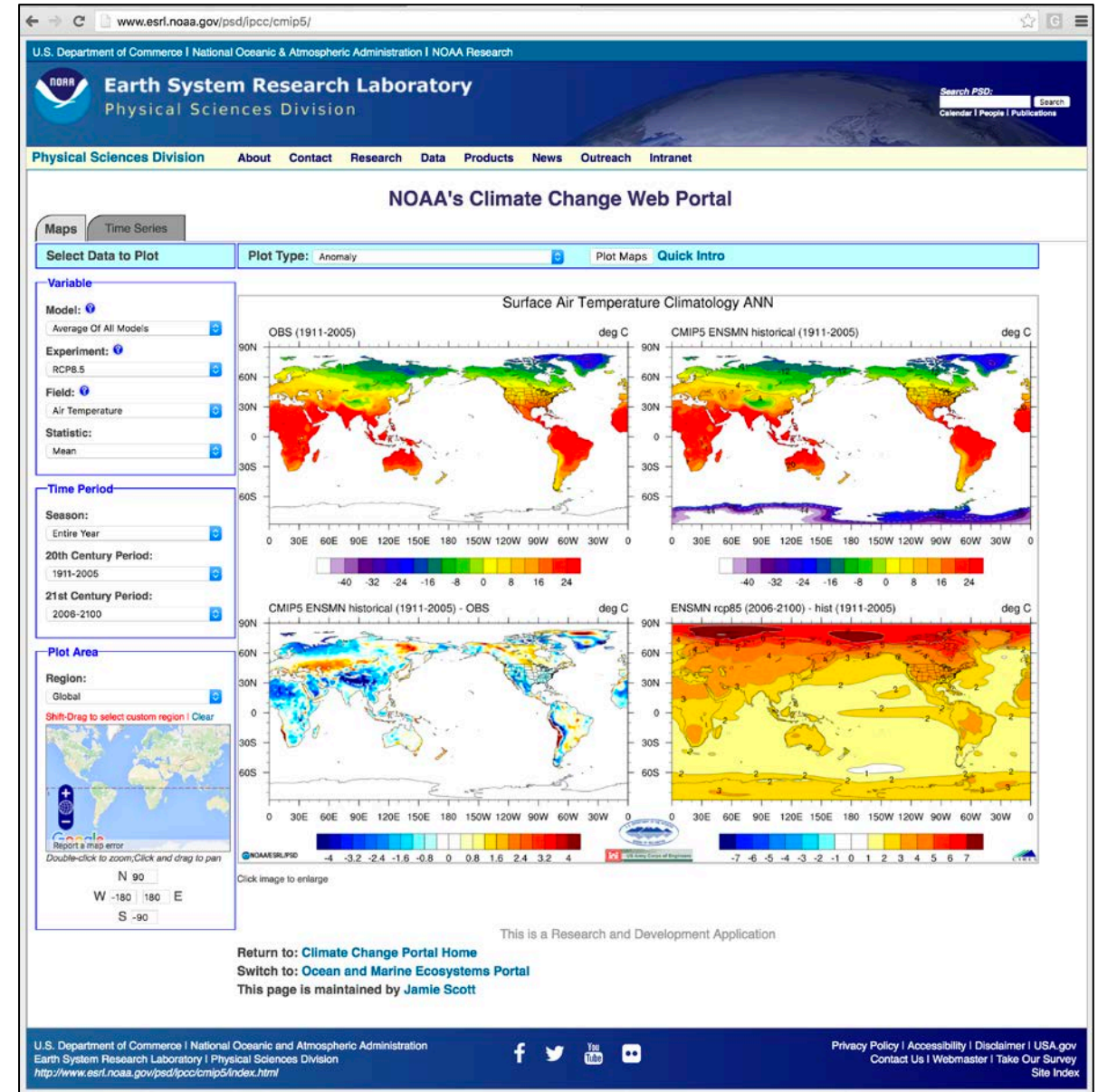
- **On regional scales, the confidence in model capability to simulate surface temperature is less than for the larger scales.** However, there is high confidence that regional-scale surface temperature is better simulated than at the time of the AR4. {9.4, 9.6}
- There has been some improvement in the simulation of continental-scale patterns of precipitation since the AR4. **At regional scales, precipitation is not simulated as well, and the assessment is hampered by observational uncertainties.** {9.4, 9.6}



Climate Projections

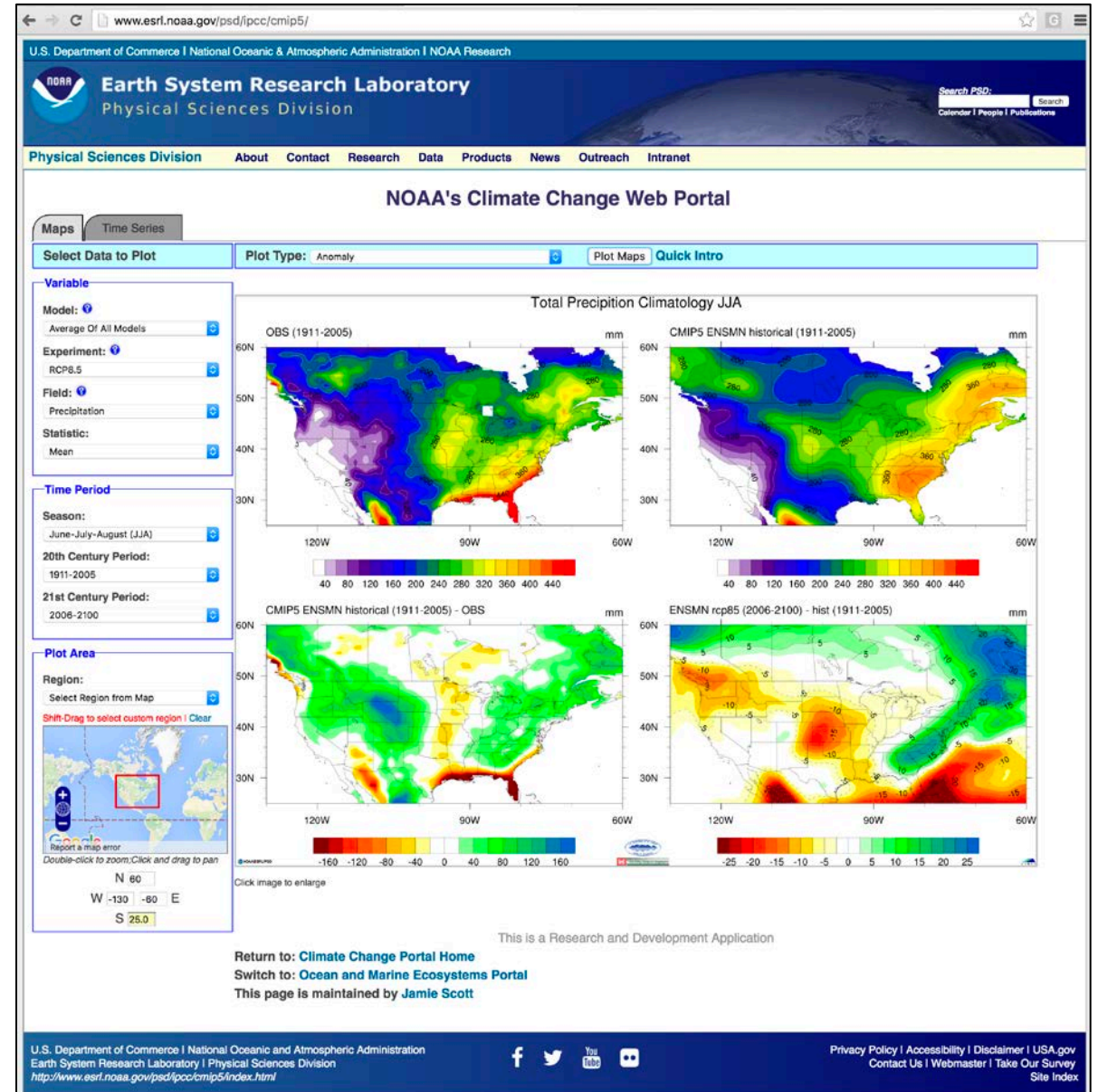
esrl.noaa.gov/psd/ipcc/cmip5

- Variables
 - Precipitation & Temperature
- 37 Models
- Scenarios
 - RCP8.5 & RCP4.5
- All 3-month Seasons
- Maps for Customizable Regions
- Regional Time Series



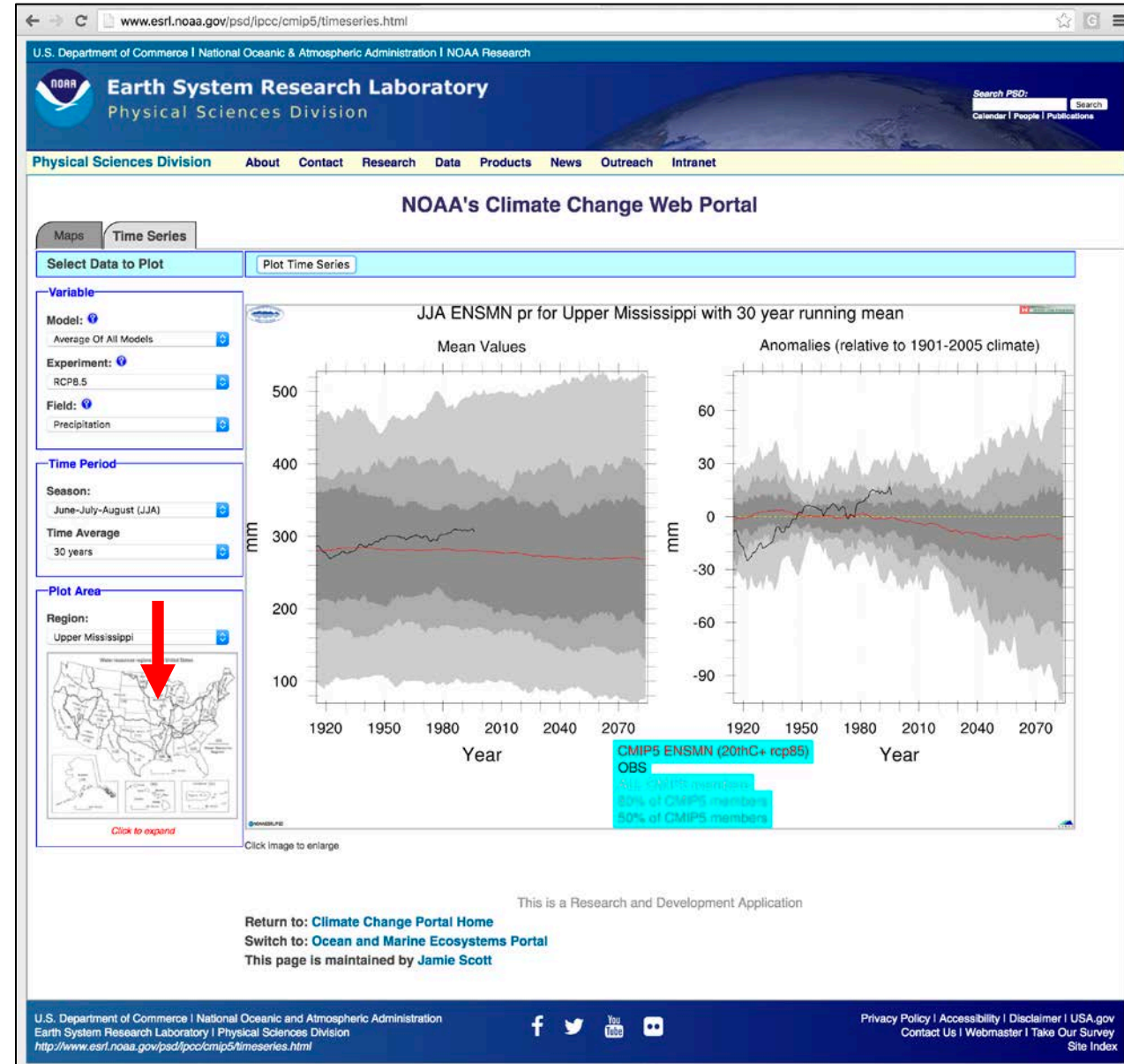
Example: North America Projections

- June-August Precipitation
- Precipitation in CMIP5 models over North America are biased
- CMIP5 models project strong regional precipitation changes over the regions in which precipitation is biased



Example: Regional Precipitation

- June-August Upper MS Basin
- The ensemble mean of CMIP5 models do not capture the observed precipitation trends
- The ensemble precipitation spread of CMIP5 models is large compared to the change in the mean
- **These precipitation projections must be used with caution**



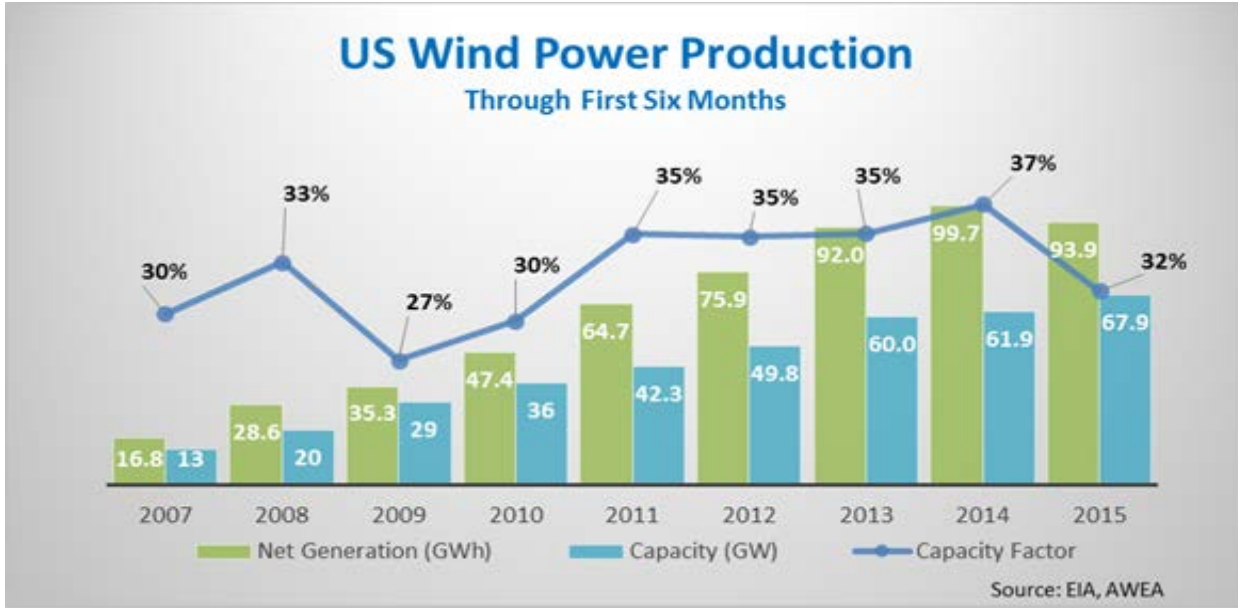
Downscaled Climate Projections

nex.nasa.gov/nex/projects/1356

To what degree should downscaled projections be used for decision making purposes?

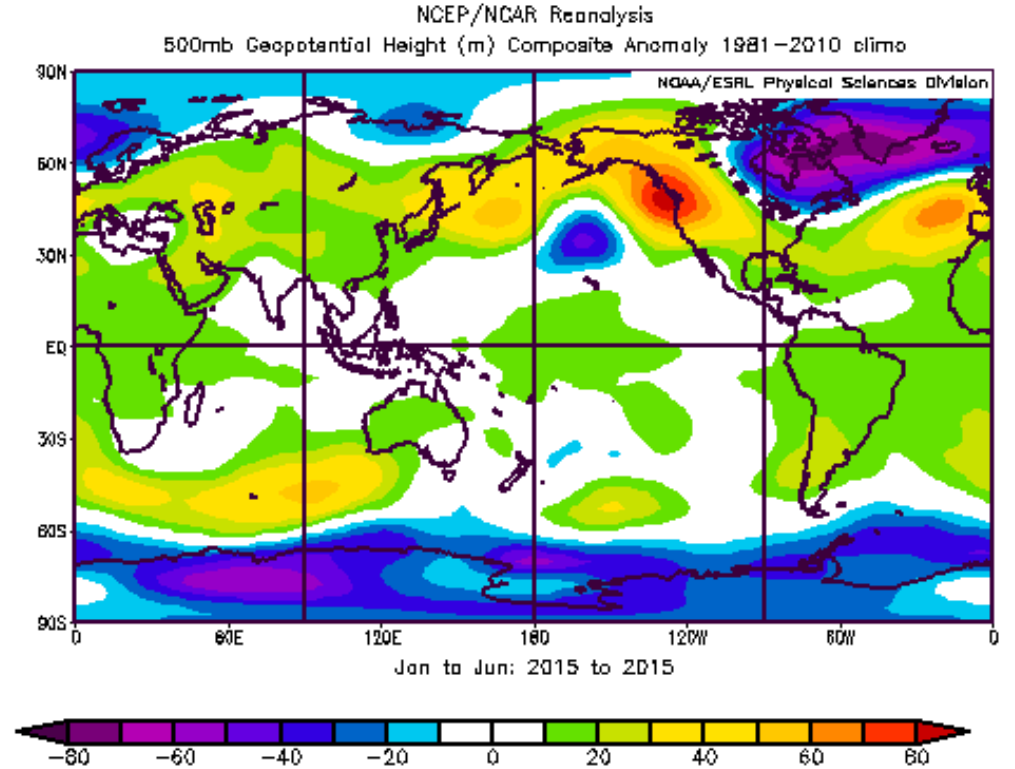
The screenshot shows the NASA NEX project page for "NEX Global Daily Downscaled Climate Projections" (ID 1356). The page features a navigation bar with links to Home, Projects, Research Areas, Resources, User Help, Members, and Login. A sidebar on the left contains links to Home, Resources, Members, and Wiki. The main content area includes a world map visualization, a "Resources" section with 2 Datasets, 2 Publications, and 1 Other, and a "Related Research Areas" section for Climate Variability & Change. The central text describes the NEX-GDDP dataset, which is derived from GCM runs under the CMIP5 project, providing downscaled projections for RCP 4.5 and RCP 8.5 scenarios from 1950 to 2100. It also mentions the dataset's spatial resolution of 0.25 degrees. Below the text is a "wiki" link and a "Tags" section. The right sidebar contains a "Project Highlight" section with 7 members and 5 resources, a "New Member" section for Cyril Caminade, and a "Related Projects" section listing "Strategies for climate change...", "Breathing Earth System Simulator", and "OpenNEX Virtual Workshop Labs". At the bottom, there is a "Popular Resources" section with links to "NEX-GDDP Data File Lists", "NEX-GDDP Technical Note", and "Global Meteorological Forcing Dataset for land surface modeling", and a "Discussions" section with a "Log In" link.

Application: Climate Information for the Future Energy System



Wind energy production in first half of 2015 was less than in first half of 2014, despite more capacity being added.

The effect was strongest in western U.S., where a persistent high pressure ridge was present for long periods of time.



As greater amounts of weather-dependent renewable energy are developed in North America, there will be an increasing need to forecast annual variations not only in precipitation and temperature, but also for wind and solar resources.