JPSS Satellite Products Applications at The Climate Prediction Center

Pingping Xie

For David DeWitt, the director of

NOAA Climate Prediction Center

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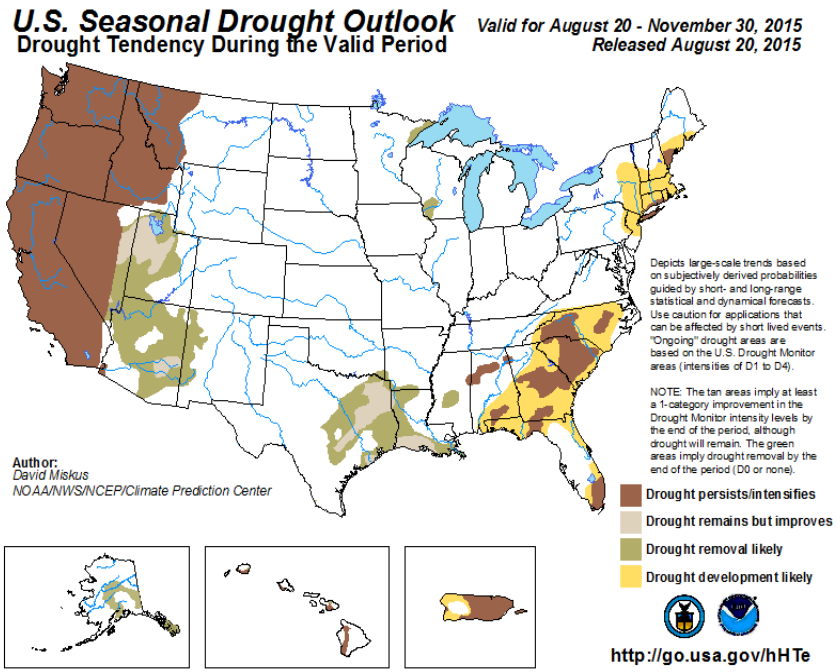
Acknowledgments: C. Long, M. Rosencrans, S.-K. Yang

CPC Mission

We deliver climate prediction, monitoring, and diagnostic products for timescales from weeks to years to the Nation and the global community for the protection of life and property and the enhancement of the economy.

Operational Requirements:

- **Deliver national outlook products: temperature, precipitation, drought, hurricanes,..**
- **Span weeks, months, seasons, years**
- **Embrace collaborative forecasting with other NCEP Service Centers, NOAA line offices, other agencies and labs**
- **Ensure real-time, on-time, all the time (since '79)**
- **Real-time monitoring (satellite applications)**



CPC is a Pioneer in Climate Applications of Satellite Data

- Areas of Satellite Data Applications at CPC
  - *Climate monitoring (atmospheric, oceanic, extreme events)*
  - *Forecasts / model verifications*
  - *Climate diagnostics*

- Two basic types of satellite data applications
  - *Direct use of satellite data from NESDIS and other satellite agencies*
  - *Integrating individual satellite data into climate analyses*

  - *Over the past three decades, CPC developed several satellite-based global analyses for climate applications, including its widely used SST, OLR, and precipitation analyses*

JPSS Applications at CPC

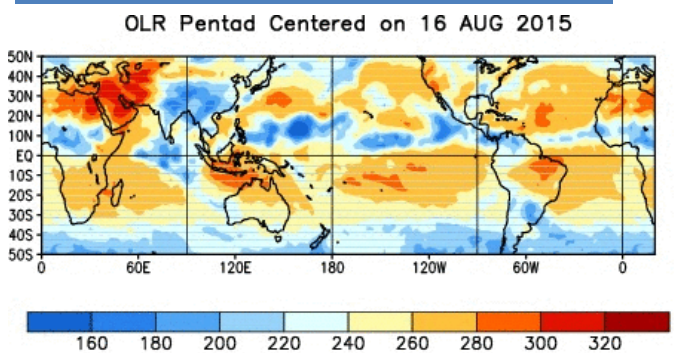
- Currently CPC is already using or plans to use the following JPSS products
    - *Hyperspectral OLR*
    - *Precipitation and snowfall rate*
    - *Ozone*
    - *Atmospheric temperature profiles*
    - *VHI*
- Applications of these JPSS products are expected to enhance CPC's capacity in:
    - *Monitoring ENSO, MJO and tropical convection and verifications of associated forecasts*
    - *Monitoring drought*
    - *Monitoring ozone*
    - *Monitoring climate change*

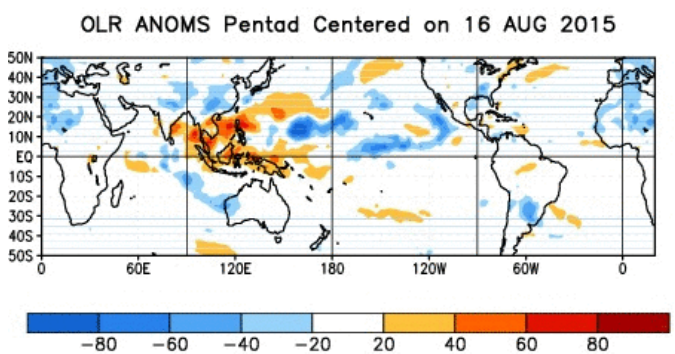
Monitoring the Atmosphere

Outgoing Longwave Radiation

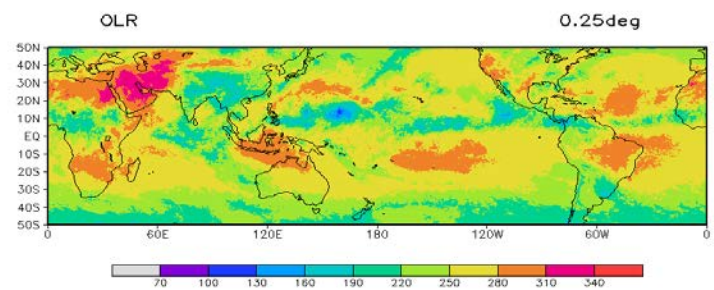
- OLR is widely used to monitor global climate and its variations such as ENSO and MJO
- Currently operational OLR data set is derived from the AVHRR using an old technique
- Hyspectral OLR from IASI aboard MetOp and CrIS from SNPP provide much improved quality
- Hyspectral OLR from all satellites need to be reprocessed and integrated for climate applications

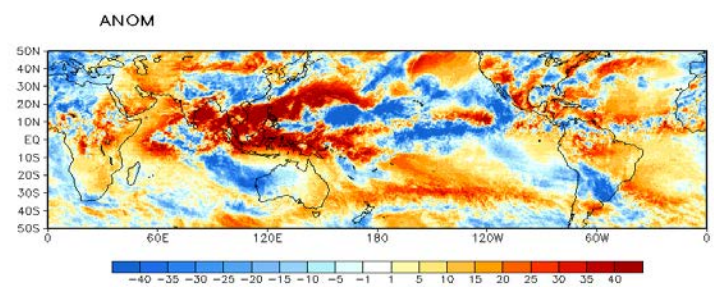
Operational OLR





Hyperspectral (IASI) OLR

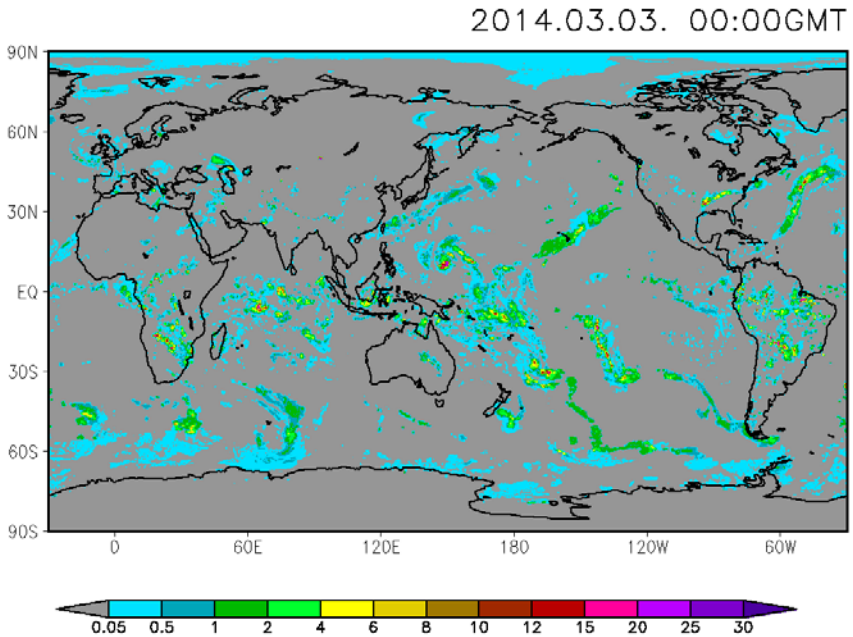




Monitoring the Atmosphere

Precipitation

Pole-to-pole Global CMORPH



- At CPC, we integrate information from all satellite data into a global product (CMORPH)
- CMORPH is improved through infusing rainfall and snowfall rate retrievals from SNPP/ATMS
- CMORPH data domain is expanded to cover the entire globe

Monitoring the Atmosphere

Precipitation

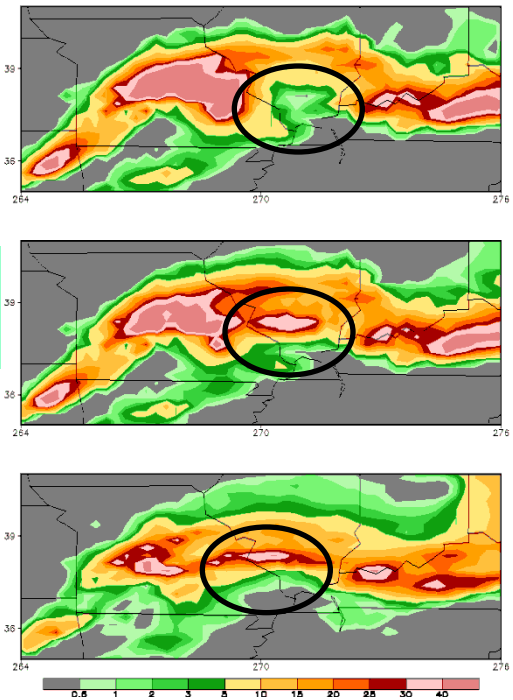
CMORPH Improved with Infusion from JPSS

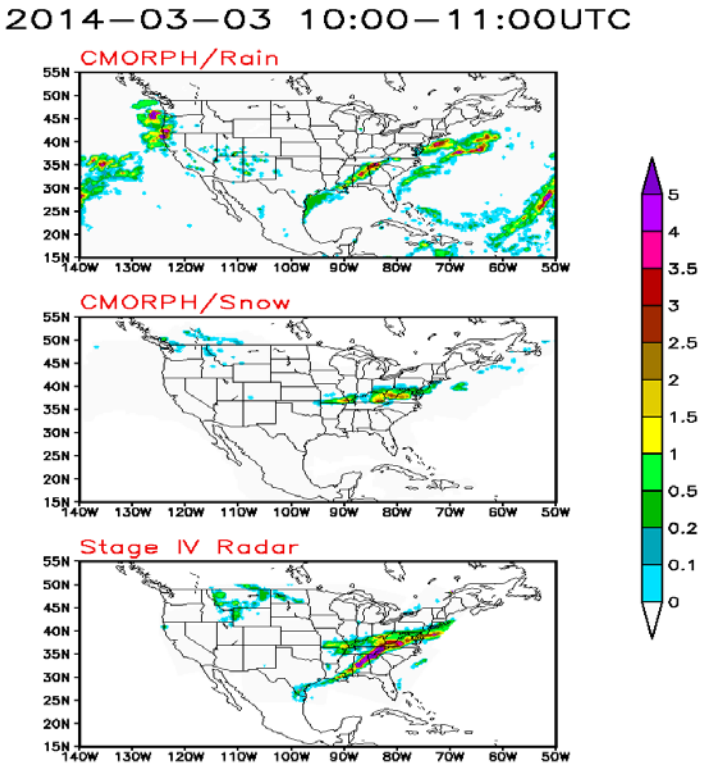
18-24 UTC, 3 April 2014

CMORPH w/o SNPP

CMORPH with SNPP

Stage IV Radar Est





CMORPH w/o snow

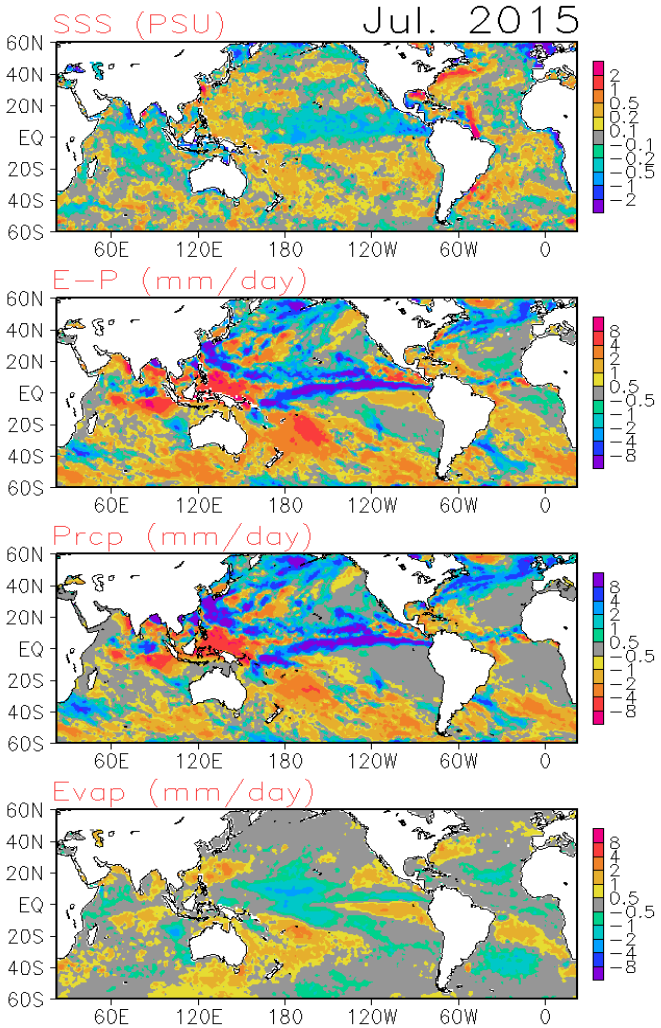
CMORPH with snow

Stage IV Radar Est

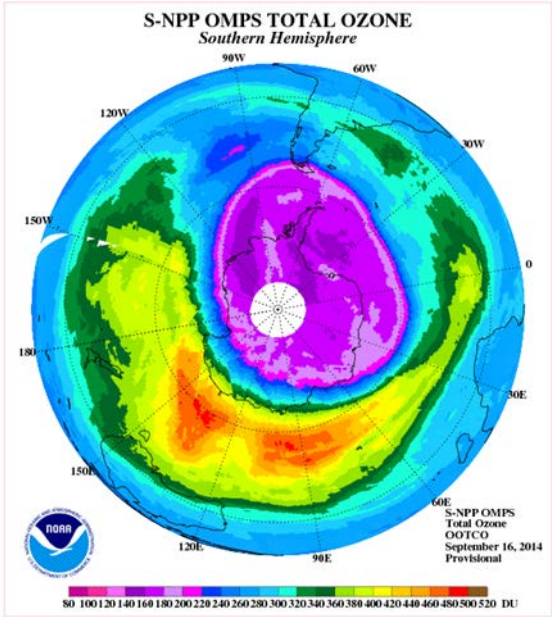
Monitoring the Ocean

Salinity and Oceanic Fresh Water Flux

- **Anomaly for July 2015**
- The oceanic salinity and fresh water flux package is updated monthly and used by CPC in its Monthly Ocean Briefing
- JPSS infused CMORPH is used to define the oceanic fresh water flux

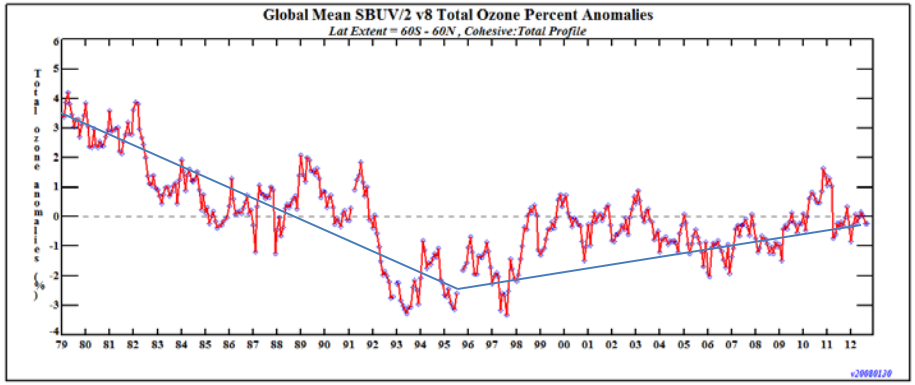


Stratospheric Ozone Monitoring



2014 Antarctic Ozone Hole

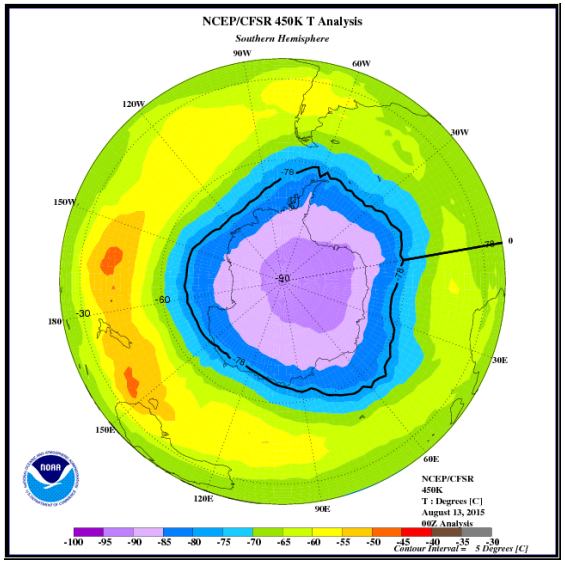
CPC monitors the ozone layer daily and historically. Ozone observations in the vertical and total column from the SBUV/2 instrument on NOAA satellites are analyzed daily to **monitor short term** depletion events such as the "ozone hole" over Antarctica.

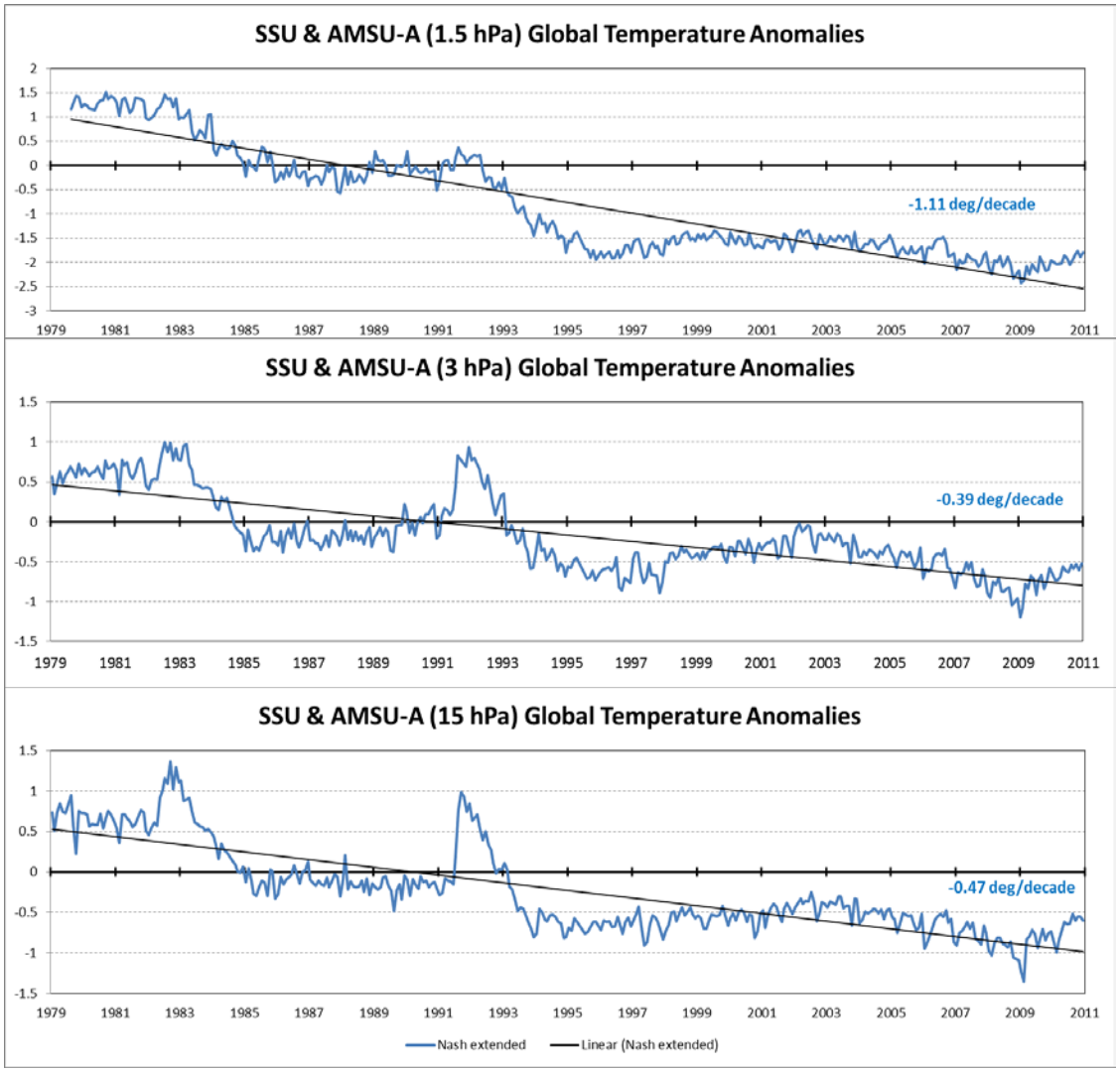


Long term monitoring using successive SBUV datasets allow CPC to monitor the global ozone depletion that occurred in the 1980s and early 1990's and the status of ozone recovery since the mid 1990's. Increased UV radiation at the surface results from ozone depletion. Environment, food supply, and human health communities are concerned about the impacts of increased UV radiation. The Montreal Protocol in 1987 lead the way towards eliminating ozone depleting substances and the recovery of the ozone layer.

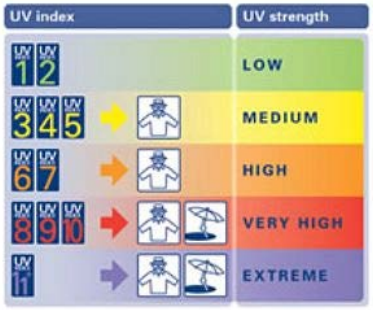
Stratospheric Temperature Monitoring

CPC monitors the **short term events** and **long term trends** of satellite derived temperatures in the stratosphere. There was strong cooling in the upper stratosphere in the 80's and 90's. Satellite temperature trends are validated using rocketsondes, Lidars, and microwave instruments.

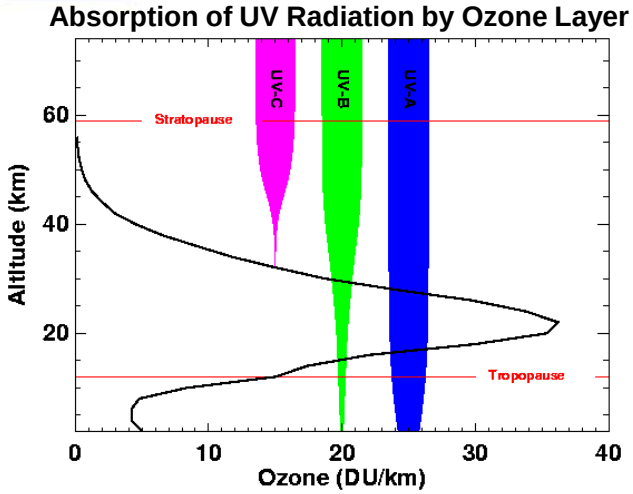


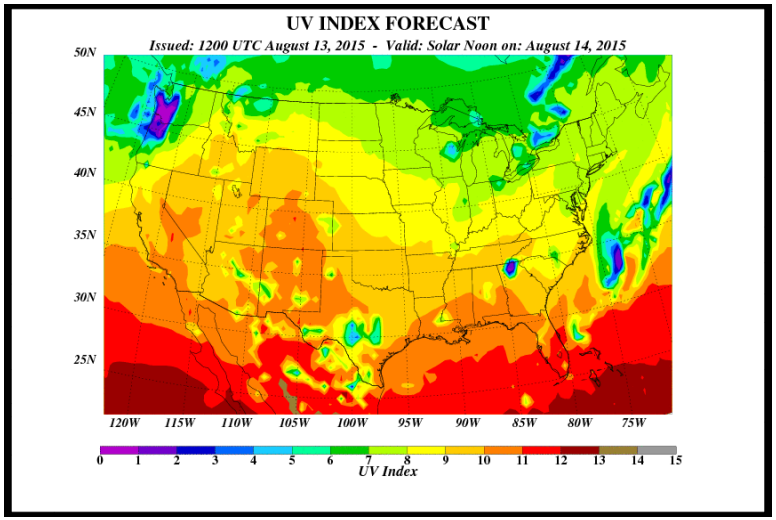


UV Index and Human Health

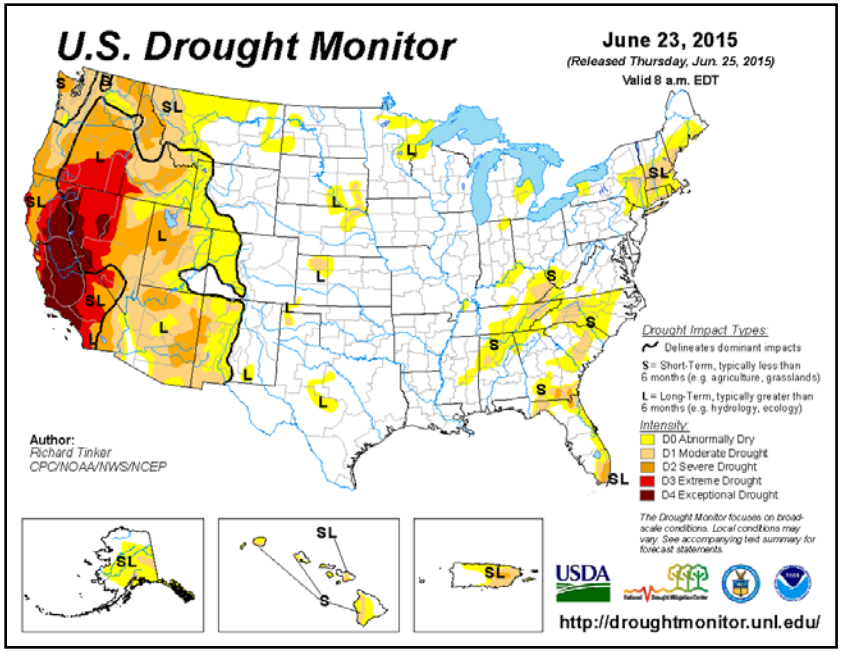


- A joint effort between the NWS and EPA to inform the public of the dangers of over exposure to the Sun's UV radiation.
- The NWS provides the UV Index forecast grids and data files.
- The EPA distributes the forecasts, UV radiation information, and precautionary steps to prevent over exposure.
- NWS UV Index forecasts are derived from forecasts of:
  - Total column ozone
  - Surface albedo (snow cover)
  - Clouds
  - Aerosols
- Satellite information feeds into each of these forecasts.





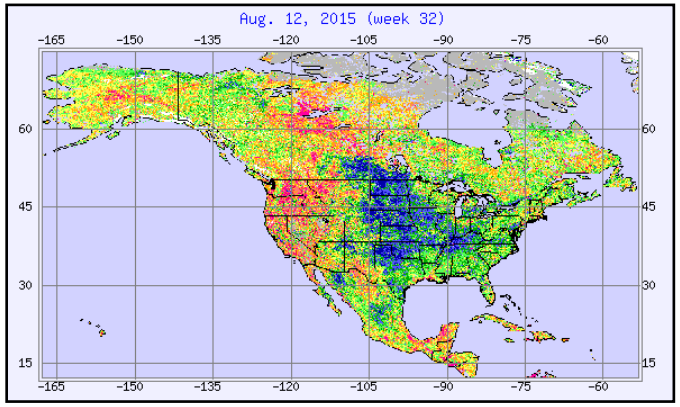
Drought Monitoring



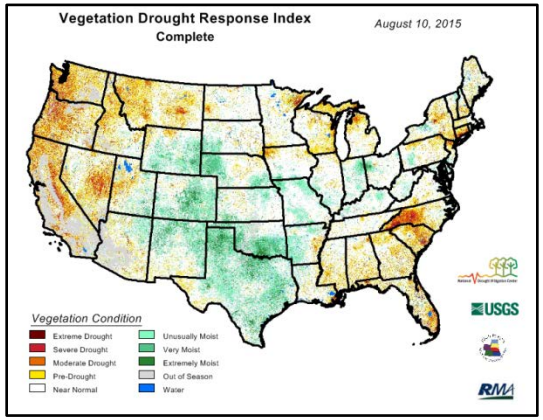
CPC monitors drought conditions across the U.S. and North America.

The U.S. Drought Monitor is created weekly, using satellite and ground based data quantitative data, as well as qualitative reports from field agents.

Core partners in this activity are NCEI, NDMC, DRI, USDA, along with many others.



VHI



VegDRI

Future Plans

- Improving the quantitative documentation and model verification for the earth radiation budget and its tempo-spatial variations taking advantage of the JPSS measurements
  - Radiation budget at TOA
  - Validate / monitor GFS / CFS radiation budget
  - Construction of new OLR data to replace the operational AVHRR OLR using hyperspectral OLR data from JPSS and other missions
- Reprocessing the pole-to-pole CMORPH for the entire JPSS era
- Inclusion of all OMPS ozone products (nadir, mapper, limb) into CPC monitoring and NCEP assimilation
- Drought monitoring with NPP/VHI
- *Explore possibility of monitoring oceanic geobiochemical state with associated JPSS retrievals*

Summary

- JPSS satellite data is indispensable for climate applications at CPC and other climate centers.
- *Climate applications of satellite data requires real-time updated long-term (30+years) data sets of temporal homogeneity.*
  - *Long-term consistency needs to be addressed in developing new satellite technology and products*
  - *Reprocessing is required when a technique / product is updated and needs to be archived at CLASS*
- JPSS should put more efforts on the development of products suitable for climate applications.
- CPC – NESDIS collaborations are important to fully capitalize JPSS achievements for climate applications.