

Cooperative Institute for Climate and Satellites–North Carolina Inspire. Advance. Engage.

Research applications with NOAA's Climate Data Record Program

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NOAA's CDR Program

Mission: To develop and implement a robust, sustainable, and scientifically defensible approach to producing and preserving climate records from satellite data.

NOAA's Climate Data Record Program

AUTHORITATIVE CLIMATE RECORDS AND INFORMATION PRODUCTS



https://www.ncdc.noaa.gov/cdr



What are CDRs?

- The National Research Council (NRC) defines a CDR as a time series of measurements of sufficient length, consistency, and continuity to determine climate variability and change.
- NOAA is applying modern data analysis methods to historical global satellite data to return new economic and scientific value from the records.



Why are CDRs important?

- Provide trustworthy information on how, where, and to what extent the land, oceans, atmosphere and ice sheets are changing.
- This information will be used by energy, water resources, agriculture, human health, national security, coastal community and other interest groups.



ncei.noaa.gov

Fundamental and thematic CDRs

- CDRs are grouped by Fundamental CDRs and Thematic (Atmospheric, Oceanic, and Terrestrial) CDRs.
- Fundamental CDRs are sensor data (e.g. calibrated radiances, brightness temperatures) that have been improved and quality controlled over time, together with the ancillary data used to calibrate them.
- Thematic CDRs are geophysical variables derived from the FCDRs.



CDR examples

- Fundamental:
 - Brightness temperatures, Reflectances, Mean layer temperatures
- Atmospheric:
 - Aerosol optical thickness, Cloud properties, Ozone, Precipitation
- Oceanic:
 - Sea ice concentration, Sea surface temperature
- Terrestrial:
 - Snow cover extent, LAI, NDVI, FAPAR



NOAA CDR Operational Spiral Development





Research to Operations

•Goal - To move from the Research and Development of a CDR to Initial Operational Capability (IOC).



- IOC A CDR development state achieved when a CDR (including the <u>data</u> <u>set</u>, <u>source code</u> and <u>documentation</u>) is scientifically defensible and is archived, maintained, and made <u>publicly available</u> by NOAA. Its data may or may not have been independently reproduced. It is not regularly maintained nor is it necessarily extended as new data become available.
- FOC A CDR development state when a CDR will be <u>systematically and</u> <u>operationally maintained</u> in a cycle of continuous improvement. Source code and documentation meet high standards and results are reproducible. The record will be routinely extended as new data become available or to reprocess the record if recalibrated data become available.



CDR R20 Process Diagram



Integrated Product Team

- R2O Transition
 - Not a task the PI does alone, partnership with the IPT
- IPT consists of:
 - PI and any Assistants
 - R2O Project Manager
 - Internal NCEI Scientist
 - Archive Branch representative
 - Operations Branch representative
 - Access Branch representative
 - Additional support from IT, User Engagement, and other CDRP members
- NCEI personnel spend 400-600 hours transitioning each CDR to IOC
- Typical R2O transition takes the team 8-12 months to complete



cicsnc.org

ncsu.edu

ncei.noaa.gov

CICS-NC support of CDRs

Science



Stewardship

Scientific programming

cicsnc.org

ncsu.edu

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Tropical monitoring and prediction

- The Madden–Julian Oscillation (MJO), equatorial Rossby waves, and Kelvin waves are dominant sources of synoptic-to-subseasonal variability in the tropics
- Divergent circulations from their convection can influence tropical cyclones and other weather patterns around the globe
- Forecasters in the energy industry harness these long time scales and global impacts to anticipate energy demand in the US



Tropical monitoring and prediction

https://ncics.org/portfolio/monitor/mjo/

- Tropical monitoring derived in part from Outgoing Longwave Radiation CDR data
- 18 hr lag
- Forecasts from NCEP Climate Forecast System
- Tropical cyclogenesis tracking
- Diagnostics used operationally by NOAA CPC and Air Force 14th Weather Squadron





High-Resolution NEXRAD Reanalysis

- Provides rainfall amounts at 1-km resolution every five min
- Available from 2000 to present
- Processing stats:
 - 130 million radar files
 - 500k jobs
 - 3 million hrs CPU-time
 - ~ 1 yr real-time





High-Resolution NEXRAD Reanalysis

- Is rainfall associated with an increase/decrease in fatal accidents?
- How does this vary...
 - by region?
 - by season?
 - by time of day?
- Compare frequency of crashes which take place during the rain to the frequency of rain itself
- In the absence of a correlation, these frequencies should be roughly equal



High-Resolution NEXRAD Reanalysis

- Blue = climatological frequency of rainfall
- Red = frequency of crashes during rain
- All regions show a higher percentage of rain-associated crashes than would be expected based on climatology





Sea Ice Concentration CDR

 The Passive Microwave sea ice concentrations are an estimate of the fraction of ocean area covered by sea ice





Sea Ice Concentration CDR

• Verification and validation





Sea Ice Concentration CDR

Spatial and Temporal Variability of Sea Ice Coverage



Whole Arctic

















Monthly Sea Ice Extent (10⁶ km²): nh GSFC HudsonBay



Hudson Bay (dark brown)



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Obs4MIPS

- The Observations for Model Inter-Comparison Project (obs4MIPs) is an effort to make observational data available to the climate modeling community in the same format that they use to share climate model outputs.
- To support CDR data access, CICS-NC created a tool to convert CDR data to obs4MIPs compliant format and specifications.



Obs4MIPS

https://ncics.org/data/obs4mips/



Optimal Interpolation Sea Surface Temperature (OISST)

cicsnc.org

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HIRS Outgoing Longwave Radiation (OLR)



Passive Microwave Sea Ice Area Fraction





Other research highlighted here

- "Scientific Stewardship What Is It and What Does It Mean to Us?" – Ge Peng
- "Diurnal Cycle of Land Surface Temperatures under All-sky Conditions" – Anand Inamdar
- "Long-term HIRS-Based Temperature and Humidity Profiles" – Jessica Matthews
- "An Evaluation of Satellite Quantitative Precipitation Estimates (QPEs) Products" – Olivier Prat
- "Linking netCDF Data with the Semantic Web -Enhancing Data Discovery Across Domains" – Jim Biard



Summary

- NOAA's CDRs are robust, sustainable, and scientifically defensible.
- CICS-NC supports the effort with science, scientific programming, and stewardship expertise.
- To learn more:

https://www.ncdc.noaa.gov/cdr

