

**Title:** GEO satellite based climate data records (CDR): Production and Service

**Short title:** GEO CDR

**Proposed category:** Community activities

**Overview:** Climate Data Record (CDR) is defined as “a time series of measurements of sufficient length, consistency, and continuity to determine climate variability and change”. Many agencies and institutions are producing the CDRs from satellite observations, however, the same CDR may come from different satellite data, with different qualities, temporal ranges, and spatial and temporal resolutions. The main objective of this project is to enhance the international community’s capability to produce long-term, highly consistent and accurate CDRs from satellite observations by coordinating the production methodology development, validation, access and applications.

**Planned activities:** To achieve the above objectives, GEOCDR activities will be organized into six major components: 1) current status of satellite CDR development and future needs; 2) Satellite CDR production framework for multiple satellite data; 3) CDR intercomparisons; 4) data services, 5) cooperation building and advocacy, 6) scientific applications and social outputs.

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## Purpose

Although a huge amount of satellite observations have been acquired by various space agencies, private companies and other institutes, their values cannot be fully realized unless they can be converted to different physical quantities (e.g., temperature, surface albedo) that can be integrated into the numerical models and decision support systems. One important task in satellite Earth observation (EO) is to generate the high-level satellite products of these physical quantities from the raw observations. At present, most high-level products are mainly generated from a single satellite data, so the time span is limited. There are also significant inconsistencies among the products generated from different satellite data due to the inherent uncertainties.

The U.S. National Research Council (NRC) in 2004 defined the Climate Data Records (CDR) of the Essential Climate Variables (ECVs) to be "a time series of measurements of sufficient length, consistency, and continuity to determine climate variability and change." An ECV is defined as a geophysical variable that can provide information describing the state of the global climate system and can be used for long-term climate monitoring related to climate change and its global impact. Obviously satellite data are the only sources for producing global and regional CDRs. Since then different agencies have started to produce the CDRs from satellite observations. For example, the US National Oceanic and Atmospheric Administration (NOAA) created the CDR program and generated a series of CDRs. European Space Agency (ESA) funded the Climate Change Initiatives (CCI) in 2010 to produce 10 CDRs and additional CDRs in 2017 as part of the CCI+. China has funded the research project entitled "Generation of the global climate data records and their use for monitoring the key variables and processes of climate change" by the Chinese Ministry of Science and Technology for generating 7 atmospheric CDRs, 17 ocean CDRs, and 15 land CDRs. Many other institutes are also generating the long-term highly consistent and accurate satellite products although they are not called the CDRs.

There is an urgent need under the GEO framework to facilitate, coordinate and advocate for the satellite CDR generation, service and applications. The main objective of this project is to enhance the international community's capability to produce long-term, highly consistent and accurate climate data records (CDRs) from satellite observations. This will be achieved by

- Characterizing different CDRs based on an inventory of national satellite CDR production capabilities
- Developing a robust framework for utilizing multiple data sources from the GEO member countries and the most appropriate estimation algorithms
- Establishing a persistent consortium of organization to oversee the production of various satellite CDRs
- Assessing the uncertainties of various CDRs using in situ measurements under different environmental conditions at the global scale
- Advancing a system to facilitate access to the satellite CDRs
- Fostering wider use of the satellite CDRs by the potential users of different EO societal benefits areas besides climate change
- Ensuring sustainability of the satellite CDR production

### **Key activities**

To achieve the above objectives, GEOCDR activities will be organized into six major components: 1) current status of satellite CDR development and future needs; 2) Satellite CDR production framework for multiple satellite data; 3) CDR intercomparisons; 4) data services, 5) cooperation building and advocacy, 6) scientific applications and social outputs. Specifically,

- 1) Creating an inventory of existing satellite CDRs and assess other long-term satellite products that have not been called CDRs.
- 2) Coordinating with other agencies and identify any new CDRs that are highly required and can be generated from satellite observations
- 3) Developing new methodologies for generating satellite CDRs from multiple satellite observations
- 4) Conducting extensive validation of satellite CDRs using in situ observations and intercomparisons for characterizing their accuracies and quality
- 5) Organizing the effective links in the GEOSS portal and various relevant web pages and provide better data service through the actual data centers
- 6) Communicating through various agencies and institutes for efficient operation
- 7) Collaborating closely with model developers and users for integrating satellite CDRs for various applications.

### **Governance**

Our key leader will organize and coordinate activities for national and international satellite data inventory, investigation of CDRs requirements and accuracy thresholds, satellite CDRs development, and user community outreach. The progress of key activities will be managed and advanced by engaging members in this proposal and stakeholders from climate, weather, natural resources, and disaster mitigation agencies.

### **Data Policy**

The satellite CDRs will be made available to the public following the GEOSS Data Sharing Principles and GEOSS Data Management Principles. The approaches to generate the CDRs will also be made available to the public in the forms of Algorithm Theoretical Basis Documents (ATBDs) and academic journal publications.