Sustained Coordinated Processing
of Environmental Satellite Data
for Climate Monitoring

SCOPE-CM
Sustained, Co-Ordinated Processing of Environmental Satellite Data
for Climate Monitoring

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Outline

- Background and concept
- Phase 1 – Establishing International Collaborations
- Phase 2 – Sustained Production of Climate Data Records
- Invitation to Participate
- Conclusions

Background

- The aim of the Sustained, Co-Ordinated Processing of Environmental Satellite Data for Climate Monitoring (SCOPE-CM) is to enable a network of facilities ensuring continuous and sustained provision of high-quality Climate Data Records (CDRs) from satellite observations.

- The foundation of SCOPE-CM is the network of relevant space agencies and other organisations (including GSICS) with the aim to develop, extend and preserve the capabilities and skills of generating and re-generating CDRs.
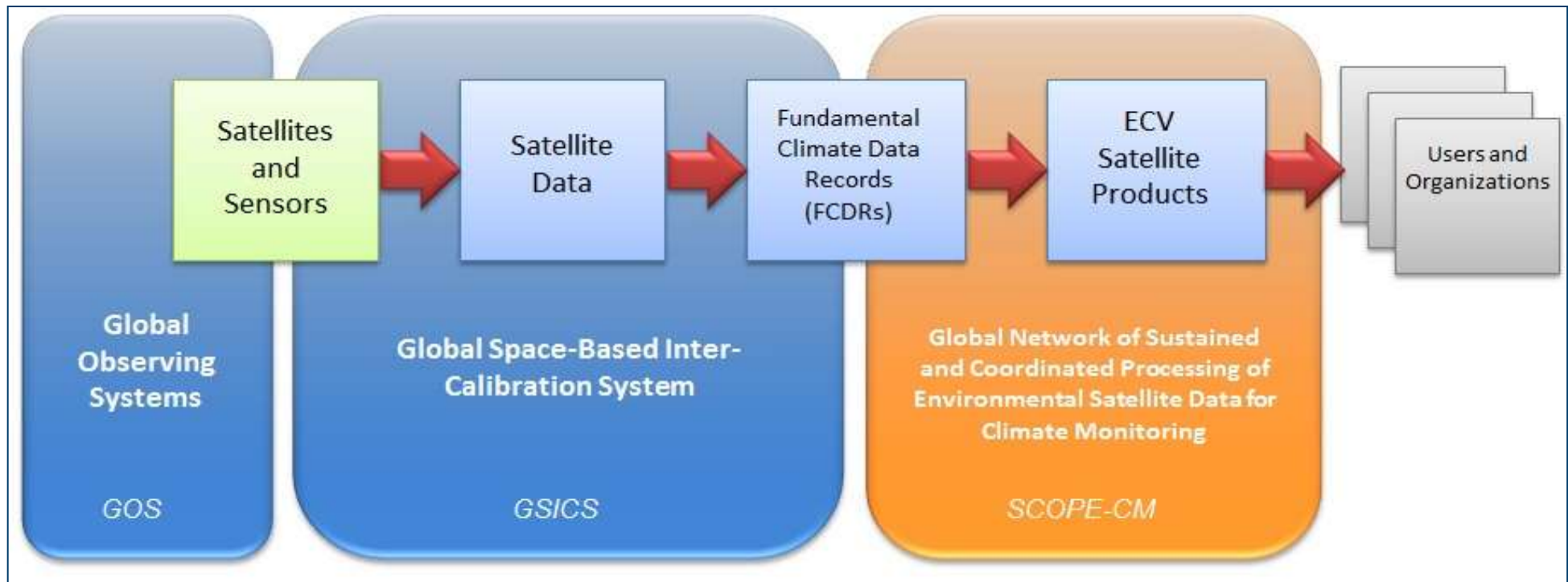
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WMO's SCOPE-CM Initiative

- Coordinated international network to produce CDRs from multi-agency mission data in operational environment addressing GCOS requirements

- Current Participants of the SCOPE-CM Network

- Operational Satellite operators:
  – NOAA, JMA, CMA, EUMETSAT

- Stakeholder:
  – WMO Space Programme, GCOS, CEOS, GEO, CGMS/GSICS, WCRP/GEWEX, ESA (observer)

Background
SCOPE-CM Conceptual Framework

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SCOPE-CM Phase 1
Establishing International Collaborations

- The primary activities accomplished in Phase 1 of SCOPE-CM include:
  - Establishing the initial network and structure
  - Agreeing on principles and standards
  - Establishing the first pilot projects on selected subjects
  - Assessing current capabilities
  - Establishing feedback mechanisms with users

	Sensors	Parameters and topics	Lead	Contributors
1	AVHRR	Clouds and Aerosols	NOAA	CM SAF
2	SSM/I	Water vapour, clouds, precipitation	CM SAF	NOAA
3	GEO	Surface albedo, clouds and aerosols	EUMETSAT	EUMETSAT, NOAA
4	GEO	Winds and clear sky radiances	EUMETSAT	EUMETSAT
5	GEO	Upper tropospheric humidity	NOAA	EUMETSAT, CM SAF

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SCOPE-CM Global Surface Albedo
High Volume, Distributed Processing
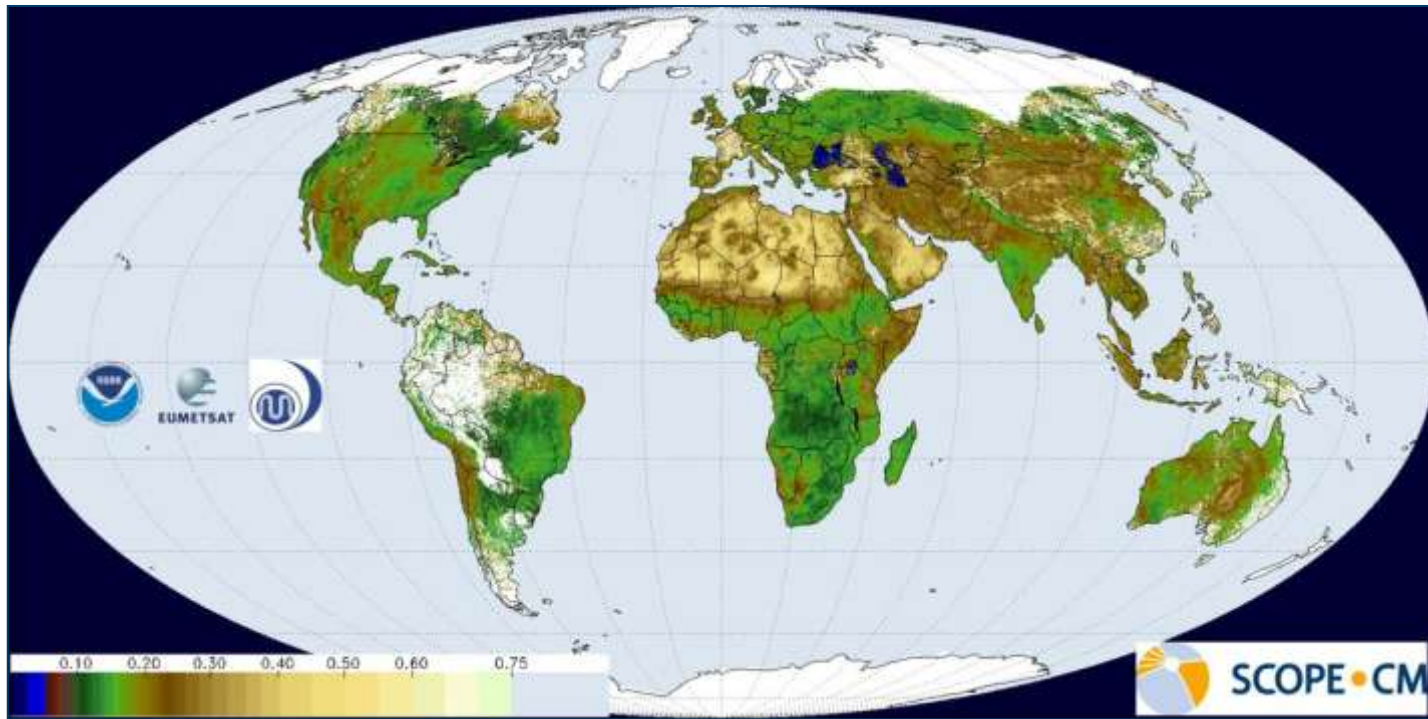
- Global Surface Albedo software from EUMETSAT (JRC) successfully ported and implemented at JMA and NOAA NCDC

- Collaborative, distributed processing of high volume Geostationary data at operational centers

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SCOPE-CM Global Cloudiness Coordinated Processing of AVHRR data
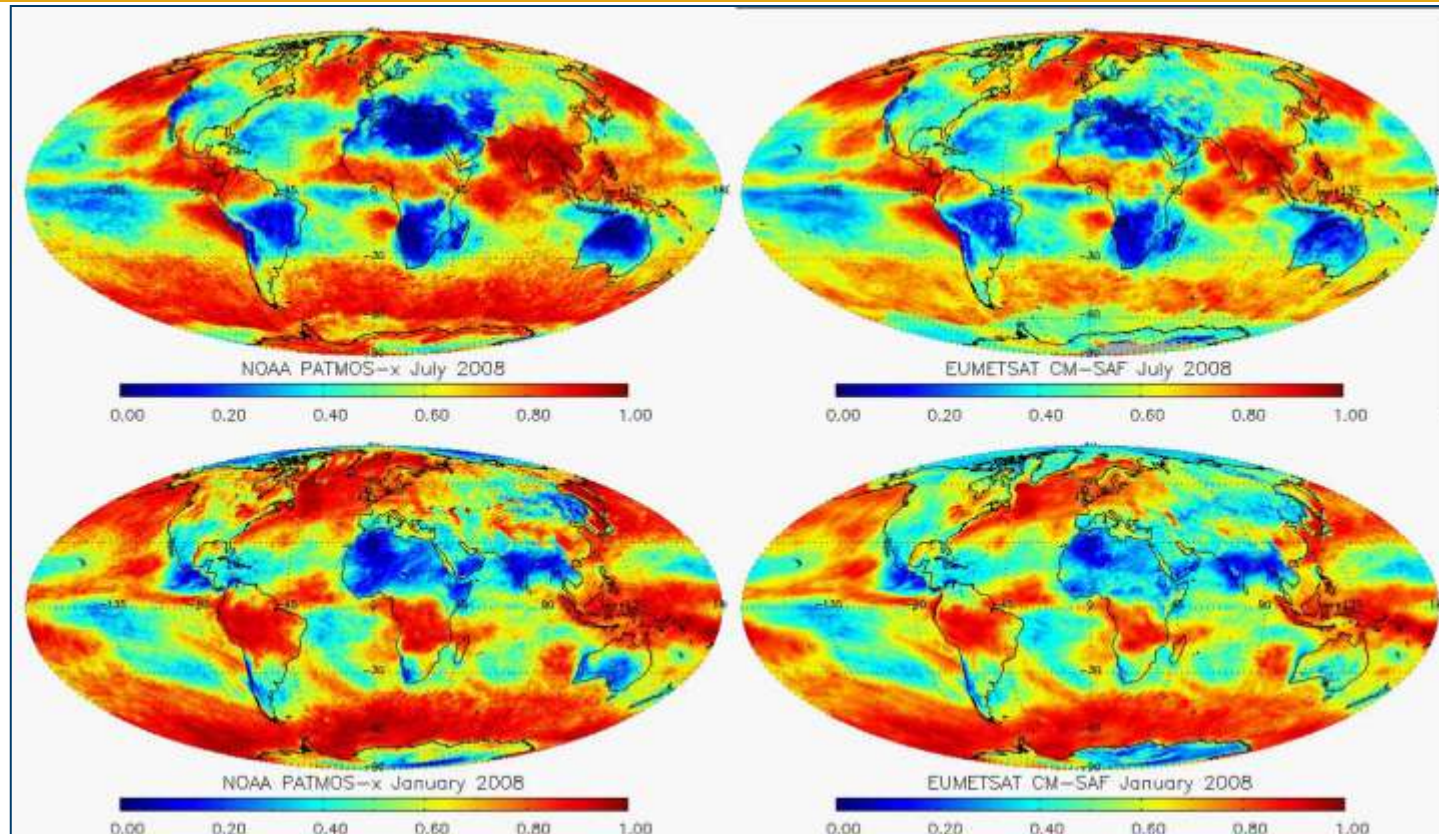
- Phase 1 concentrated on processing of polar orbiter satellites (20 years AVHRR record)
- Phase 2: collaboration in providing the Fundamental Climate Data Records (Radiances)

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Sustained Applications Drive the Climate Architecture Required
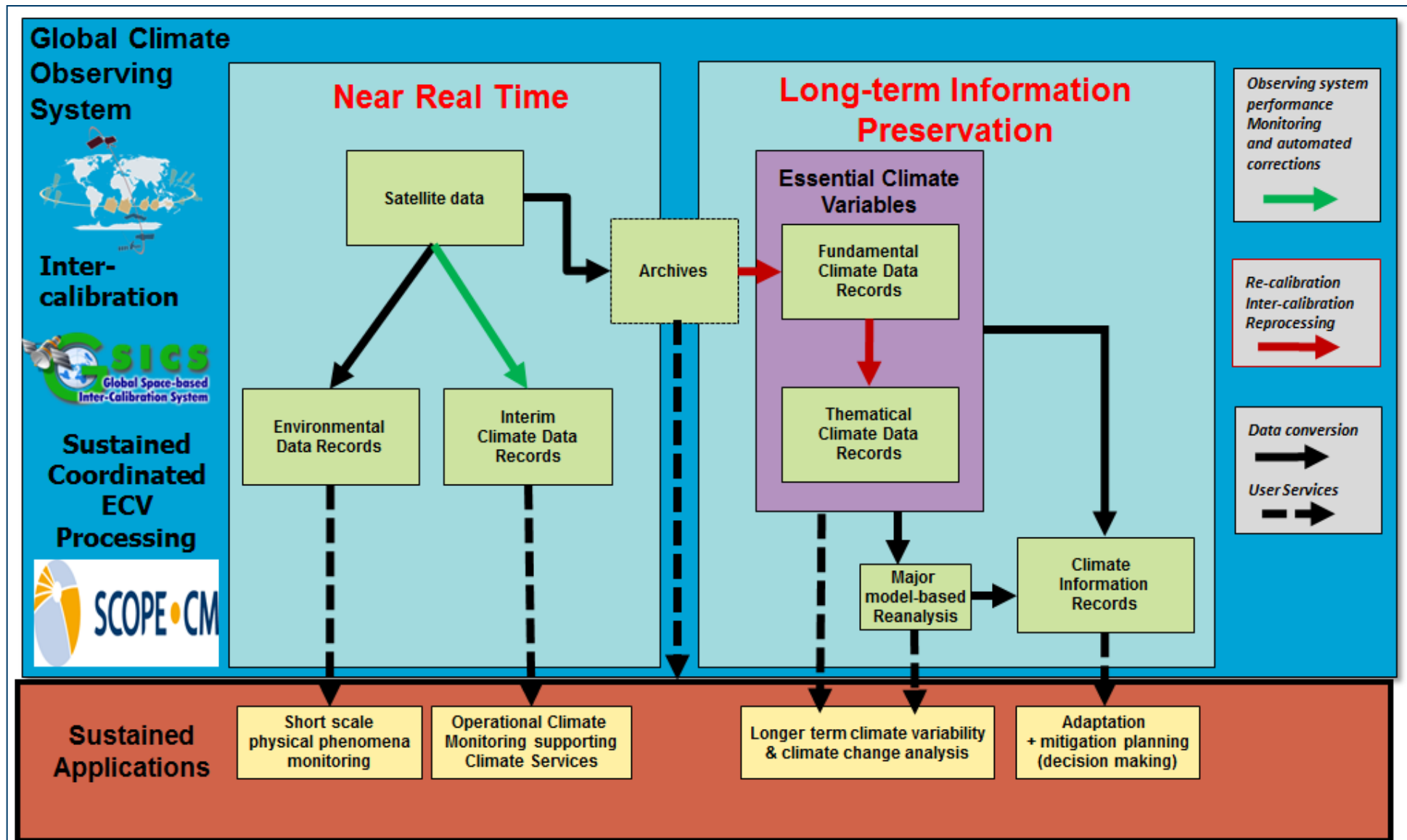
SCOPE-CM Phase 2 -Sustained Production of Climate Data Records (CDRs)

- Establish a systematic approach to increase the sustainability (maturity) of CDR generation capabilities

- Establishment of structures for sustainable generation of Fundamental CDRs and Thematic CDRs
    - Generation of first SCOPE-CM CDR products
    - Increased coverage of products in terms of ECVs, time and spatial dimension
    - Fostering extension of the network to additional partners

- A Maturity Matrix assessment will help organize elements of the CDR life cycle

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A Maturity Matrix for Assessing the Completeness of Climate Data Records

Where can products easily be found?	What original observations were used in the product?	What methods were used to create the product?	How do we ensure authenticity of the product?

SCOPE-CM Portal

Digital Signature
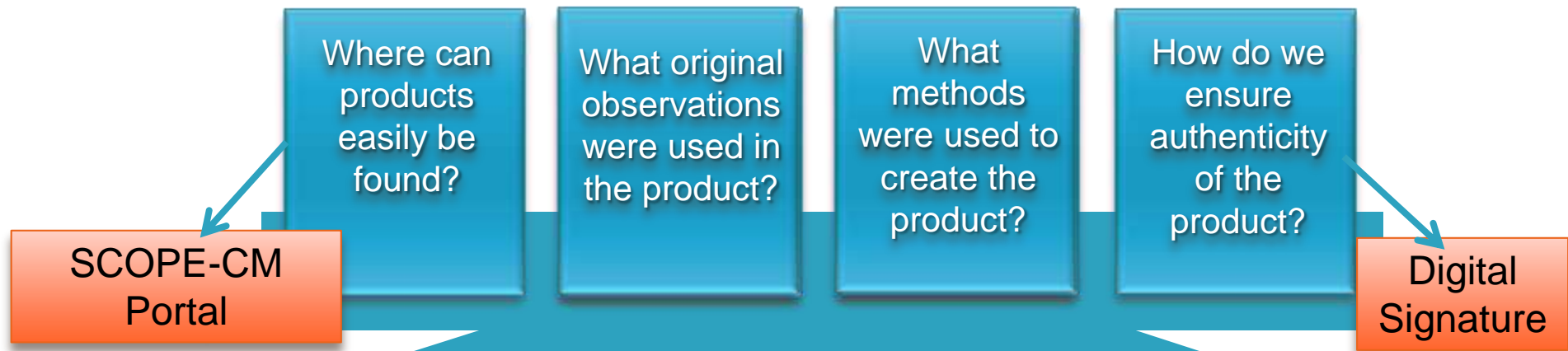
Let's define a Maturity Matrix (1=low; 6=high) that sets expectations and assesses progress

| Software Readiness	Metadata	Documentation	Product Validation	Public Access	Utility
Are algorithms under configuration management and how mature?	How full and complete are the metadata and quality assessment?	Is the Operational Algorithm Description full, complete, and peer reviewed?	How complete is the validation?	Are the data, algorithms and software open and available to the Public?	How extensive is the peer reviewed literature and how varied are the applications?

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Maturity Matrix Model

Climate Data Record (CDR) Maturity Matrix

Maturity	Software Readiness	Metadata	Documentation	Product Validation	Public Access	Utility
1	Conceptual development	Little or none	Draft Climate Algorithm Theoretical Basis Document (C-ATBD); paper on algorithm submitted	Little or None	Restricted to a select few	Little or none
2	Significant code changes expected	Research grade	C-ATBD Version 1+ ; paper on algorithm reviewed	Minimal	Limited data availability to develop familiarity	Limited or ongoing
3	Moderate code changes expected	Research grade; Meets int'l standards: ISO or FGDC for collection; netCDF for file	Public C-ATBD; Peer-reviewed publication on algorithm	Uncertainty estimated for select locations/times	Data and source code archived and available; caveats required for use.	Assessments have demonstrated positive value.
4	Some code changes expected	Exists at file and collection level. Stable. Allows provenance tracking and reproducibility of dataset. Meets international standards for dataset	Public C-ATBD; Draft Operational Algorithm Description (OAD); Peer-reviewed publication on algorithm; paper on product submitted	Uncertainty estimated over widely distributed times/location by multiple investigators; Differences understood.	Data and source code archived and publicly available; uncertainty estimates provided; Known issues public	May be used in applications; assessments demonstrating positive value.
5	Minimal code changes expected; Stable, portable and reproducible	Complete at file and collection level. Stable. Allows provenance tracking and reproducibility of dataset. Meets international standards for dataset	Public C-ATBD, Review version of OAD, Peer-reviewed publications on algorithm and product	Consistent uncertainties estimated over most environmental conditions by multiple investigators	Record is archived and publicly available with associated uncertainty estimate; Known issues public. Periodically updated	May be used in applications by other investigators; assessments demonstrating positive value
6	No code changes expected; Stable and reproducible; portable and operationally efficient	Updated and complete at file and collection level. Stable. Allows provenance tracking and reproducibility of dataset. Meets current international standards for dataset	Public C-ATBD and OAD; Multiple peer-reviewed publications on algorithm and product	Observation strategy designed to reveal systematic errors through independent cross-checks, open inspection, and continuous interrogation; quantified errors	Record is publicly available from Long-Term archive; Regularly updated	Used in published applications; may be used by industry; assessments demonstrating positive value

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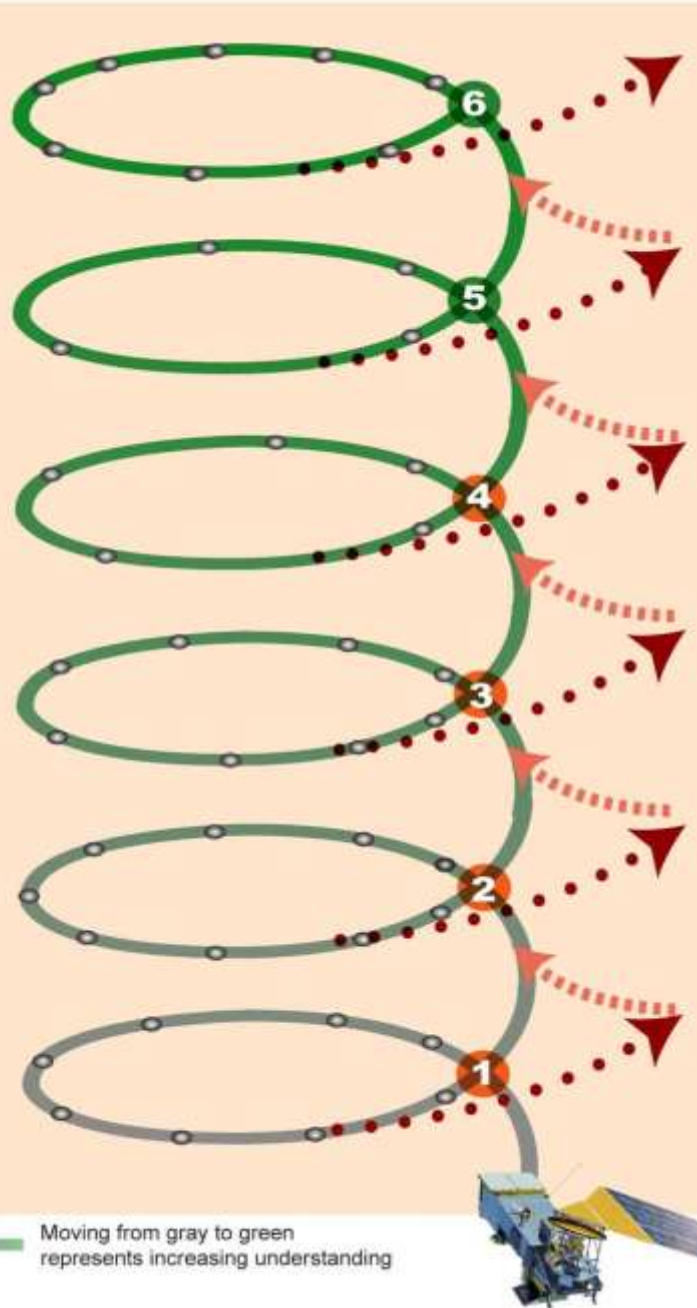
SCOPE-CM Climate Data Record Life Cycle Based on Maturity Matrix

CDR Evolution

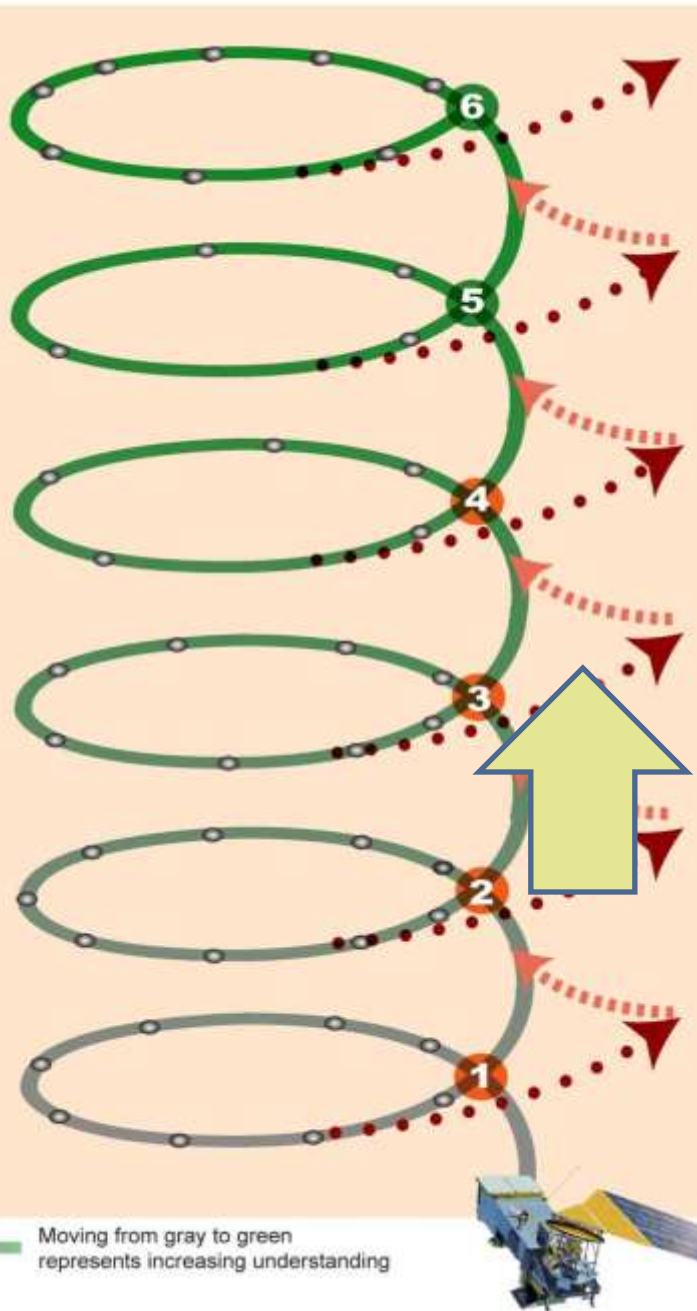Moving from gray to green represents increasing understanding

- The CDR life cycle is iterative, with improved understanding and utility as maturity increases

SCOPE-CM Climate Data Record Life Cycle Based on Maturity Matrix

CDR Evolution

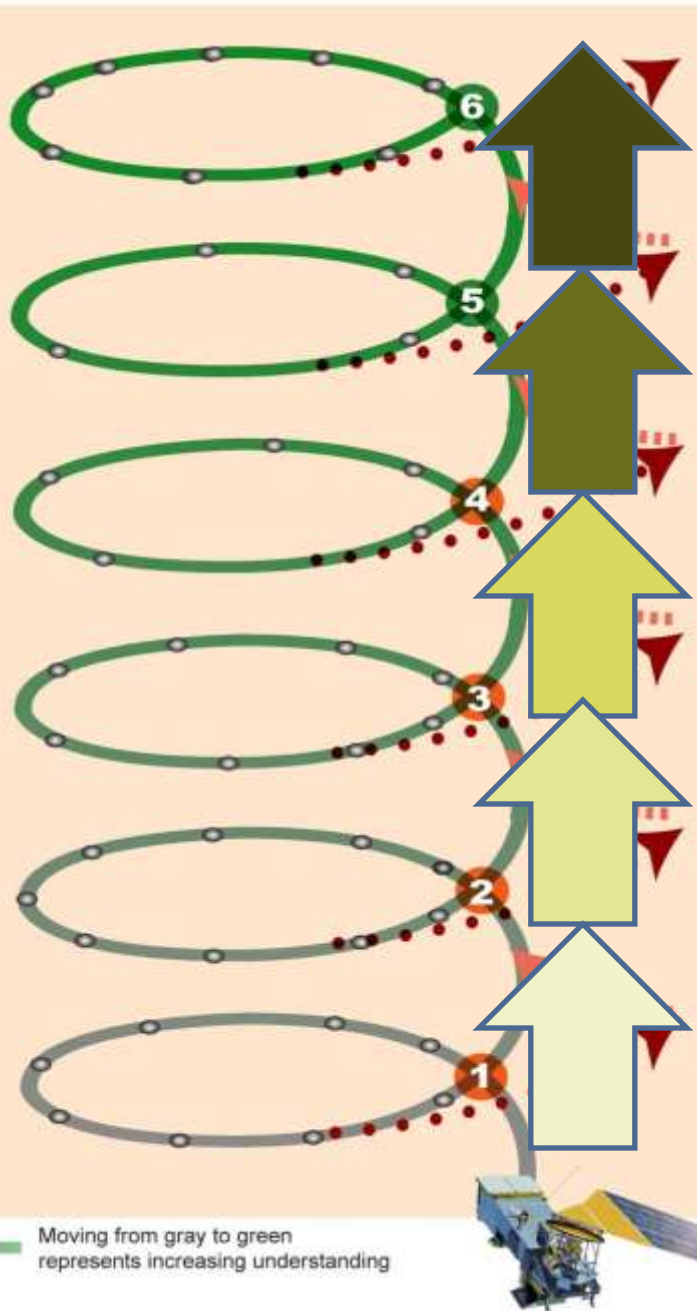Moving from gray to green represents increasing understanding

- The CDR life cycle is iterative, with improved understanding and utility as maturity increases

SCOPE-CM Project: Elevating a CDR generation capability to a higher maturity

SCOPE-CM Climate Data Record Life Cycle Based on Maturity Matrix
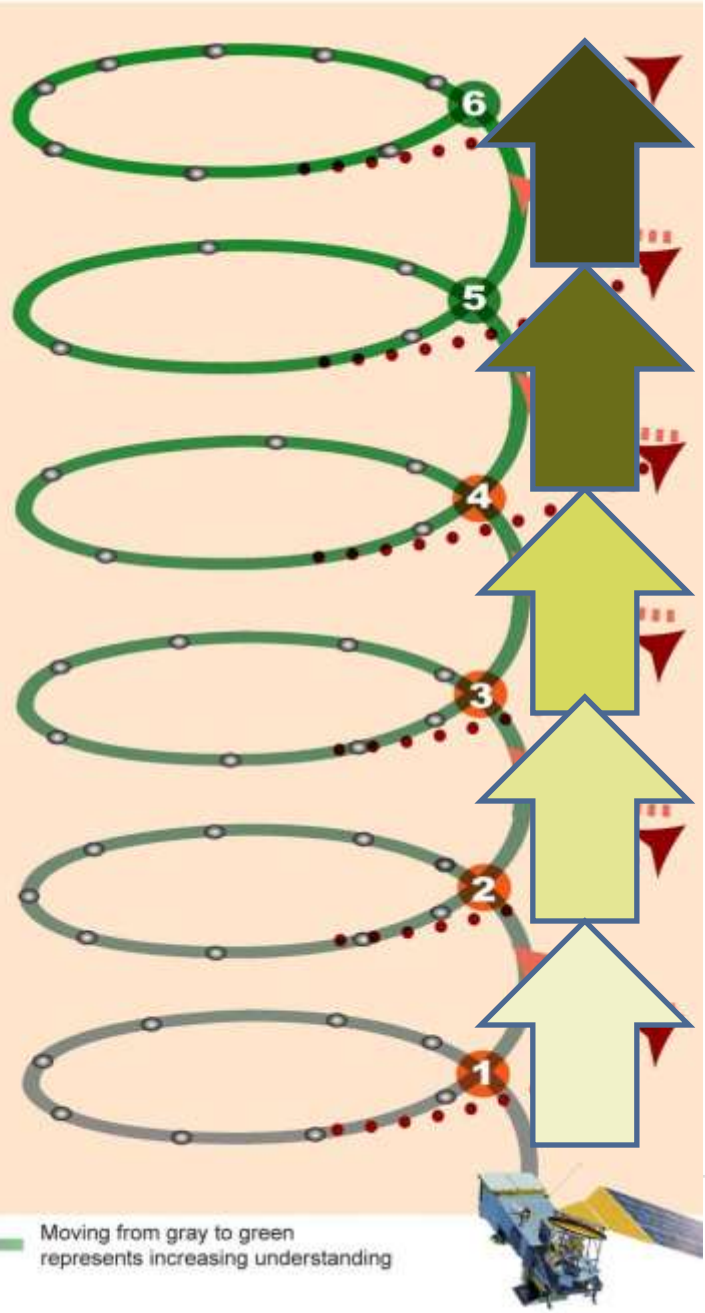

CDR Evolution

- The CDR life cycle is iterative, with improved understanding and utility as maturity increases

Sustaining CDR generation through a series of SCOPE-CM Projects

Moving from gray to green represents increasing understanding

SCOPE-CM Climate Data Record Life Cycle Based on Maturity Matrix

CDR Evolution

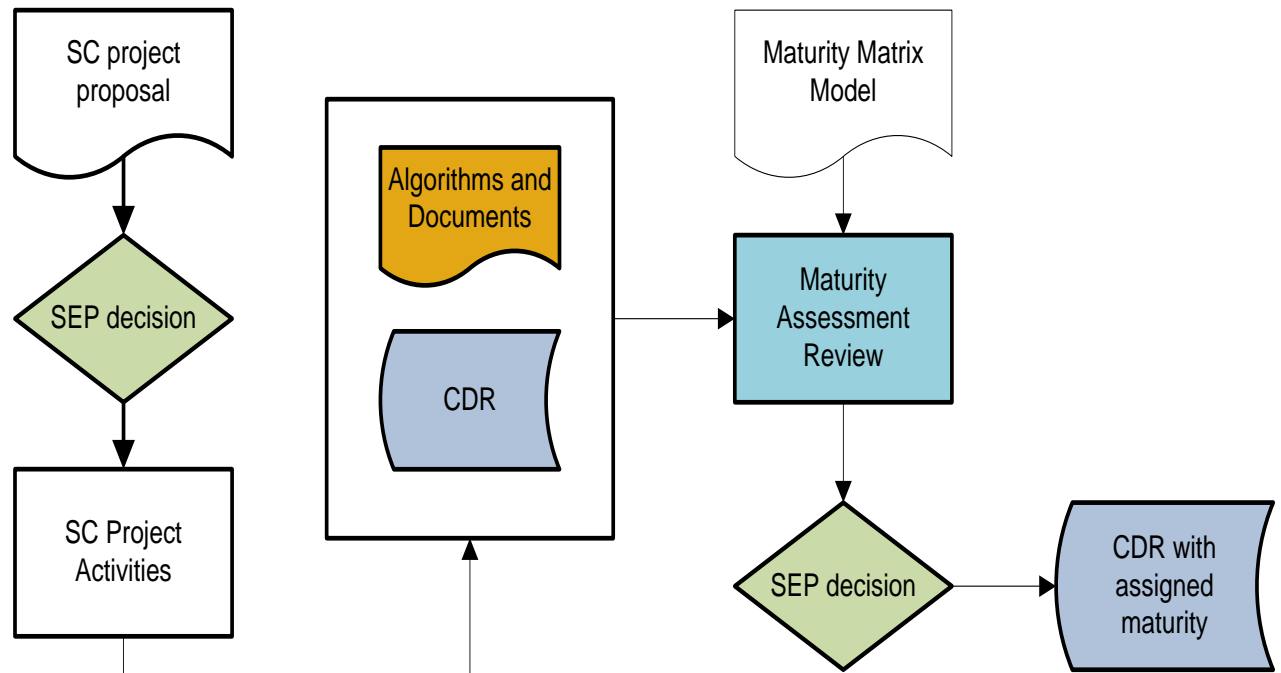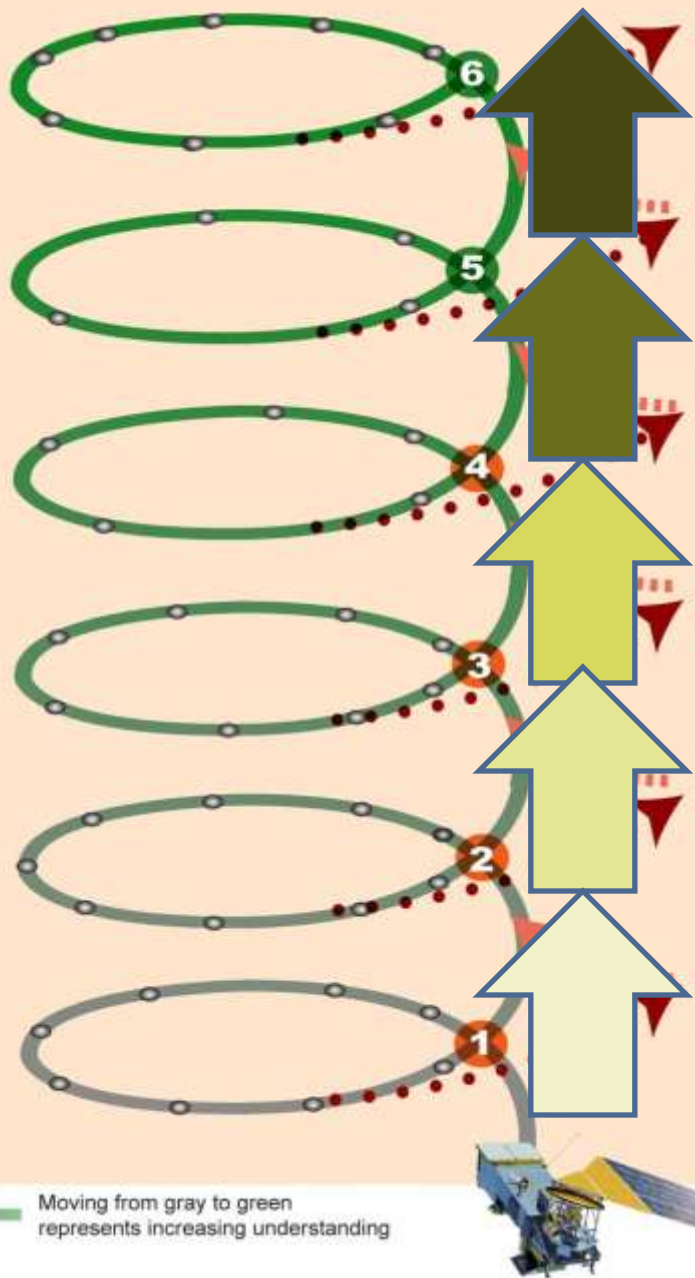Moving from gray to green represents increasing understanding

High Maturity SCOPE-CM Projects

Moderate Maturity SCOPE-CM Projects

Initial Maturity SCOPE-CM Projects

SCOPE-CM Climate Data Record Life Cycle Based on Maturity Matrix

Generic SCOPE-CM projects process

SCOPE-CM Phase 2

- Implementation Plan for Phase 2 approved by SEP in 2013

- SCOPE-CM Secretariat issued "Call for letter of intent for SCM Projects" inviting organizations to participate in the sustained development and production of CDRs.

- 10 Projects accepted, most of them started in 2014

- Further calls to be published.

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Conclusions

- SCOPE-CM has successfully completed Phase 1 with Pilot Projects and implemented algorithms at different operational processing centers for climate

- Phase 2 will use the concept of a Maturity Matrix to organize development and sustaining CDRs into initial, moderate and high maturity to better characterize CDRs for the user community

- Additional participation is welcomed for Phase 2

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