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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EUMETSAT and SCOPE-CM Secretariat

Big jumps with empty pockets

Outline

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

Background

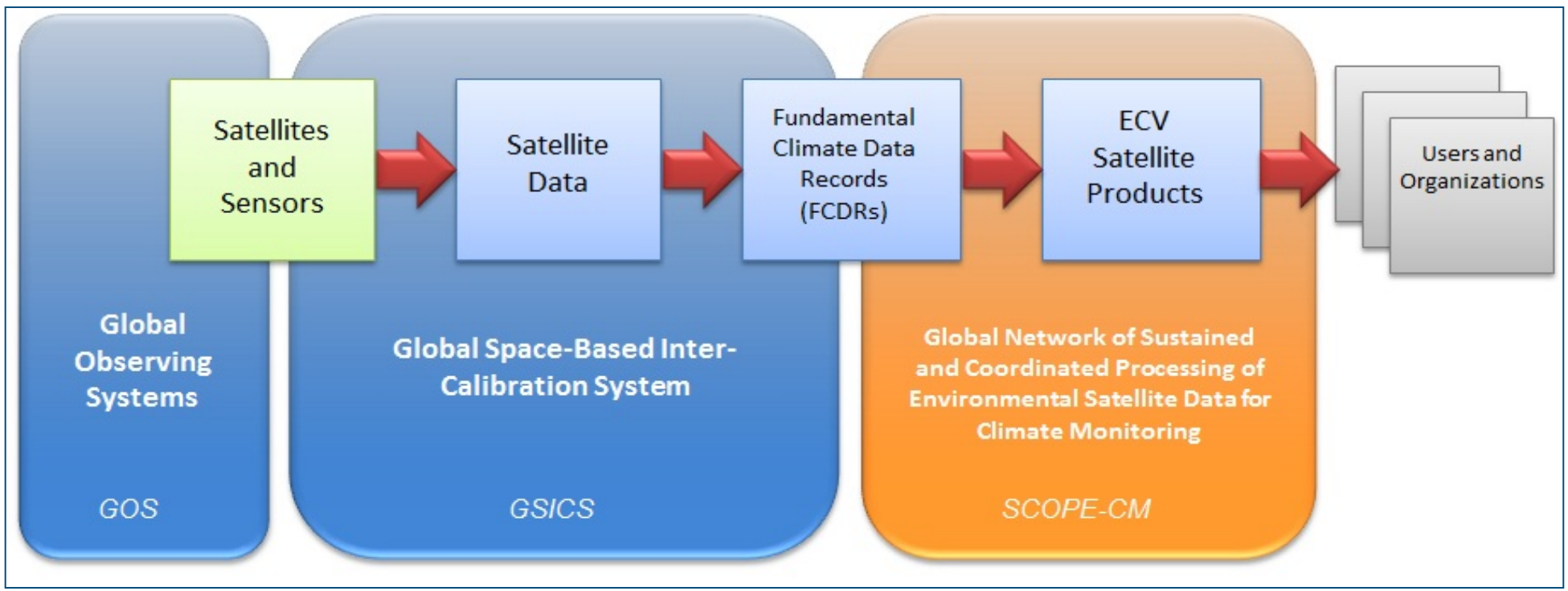
- The aim of the Sustained, Co-Ordinated Processing of Environmental Satellite Data for Climate Monitoring (SCOPE-CM) is to enable a network of facilities ensuring continuous and sustained provision of high-quality Climate Data Records (CDRs) from satellite observations.

- The foundation of SCOPE-CM is the network of relevant space agencies and other organisations with the aim to develop, extend and preserve the capabilities and skills of generating and re-generating CDRs.

WMO's SCOPE-CM Initiative

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

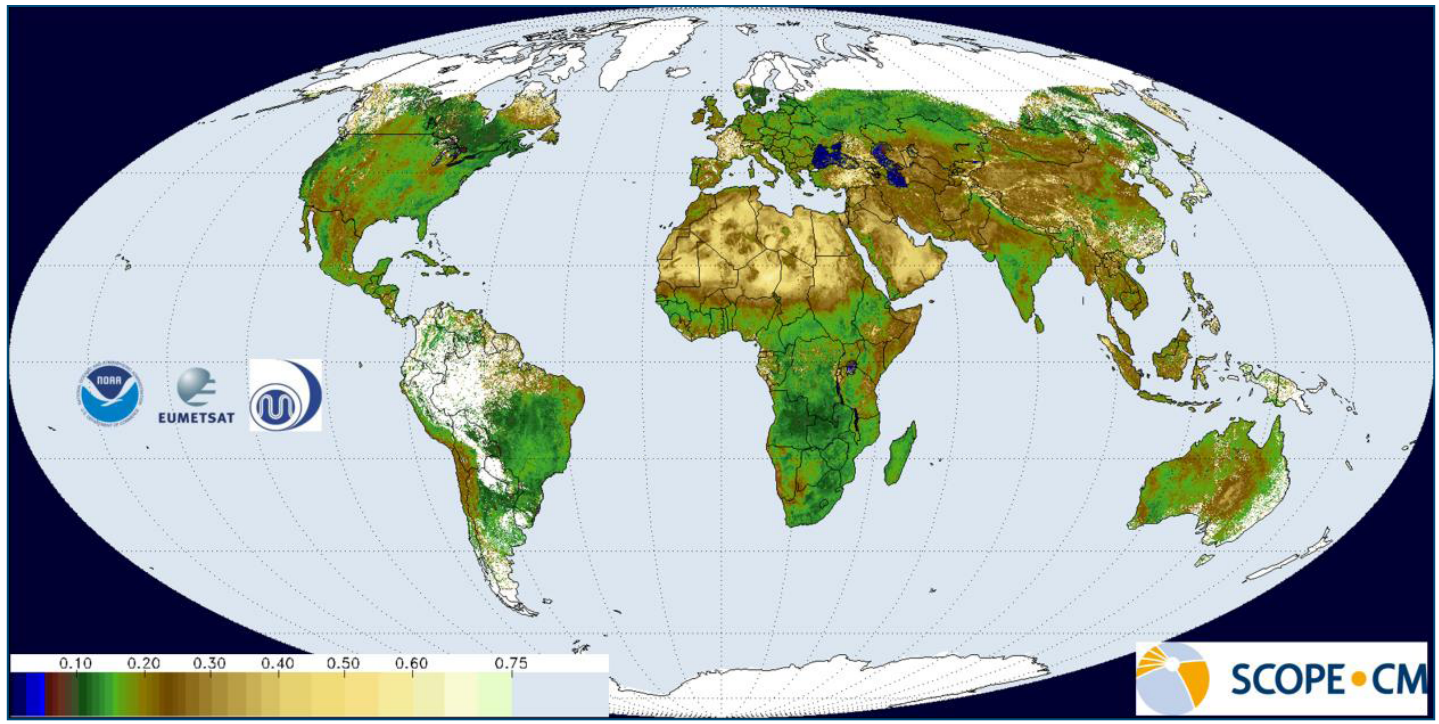


SCOPE-CM Phase 1
Establishing International Collaborations

- 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

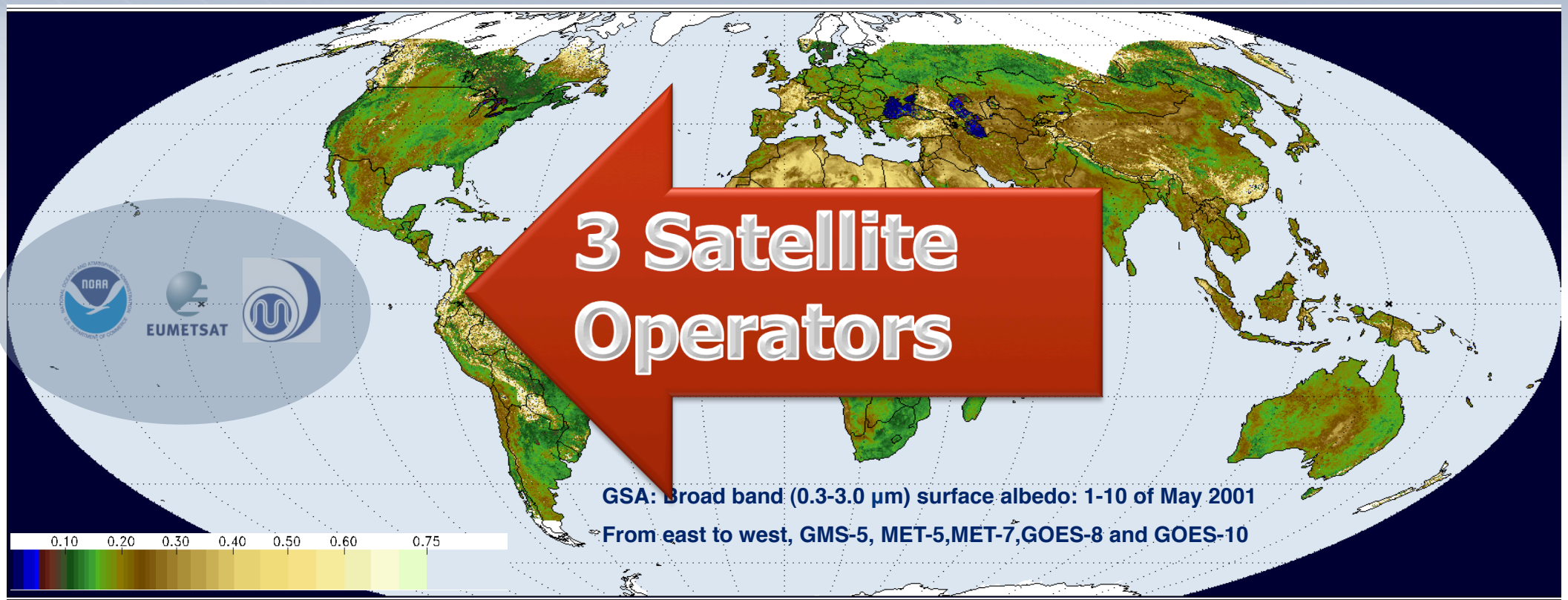
	Sensors	*Parameters and topics*	*Lead*	*Contributors*
1	AVHRR	Clouds and Aerosols	NOAA	CM SAF
2	SSM/I	Water vapour, clouds, precipitation	CM SAF	NOAA
3	GEO	Surface albedo, clouds and aerosols	EUMETSAT	EUMETSAT, NOAA
4	GEO	Winds and clear sky radiances	EUMETSAT	EUMETSAT
5	GEO	Upper tropospheric humidity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

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

Project Objective



SMS Series (GOES 1-3)

GOES First Generation (4-7)

GOES Second Generation (8-12)

GOES Third Generation (13-15)

GOES Fourth Generation (R-U)

Meteosat First Generation

Meteosat Second Generation

Meteosat Third Generation

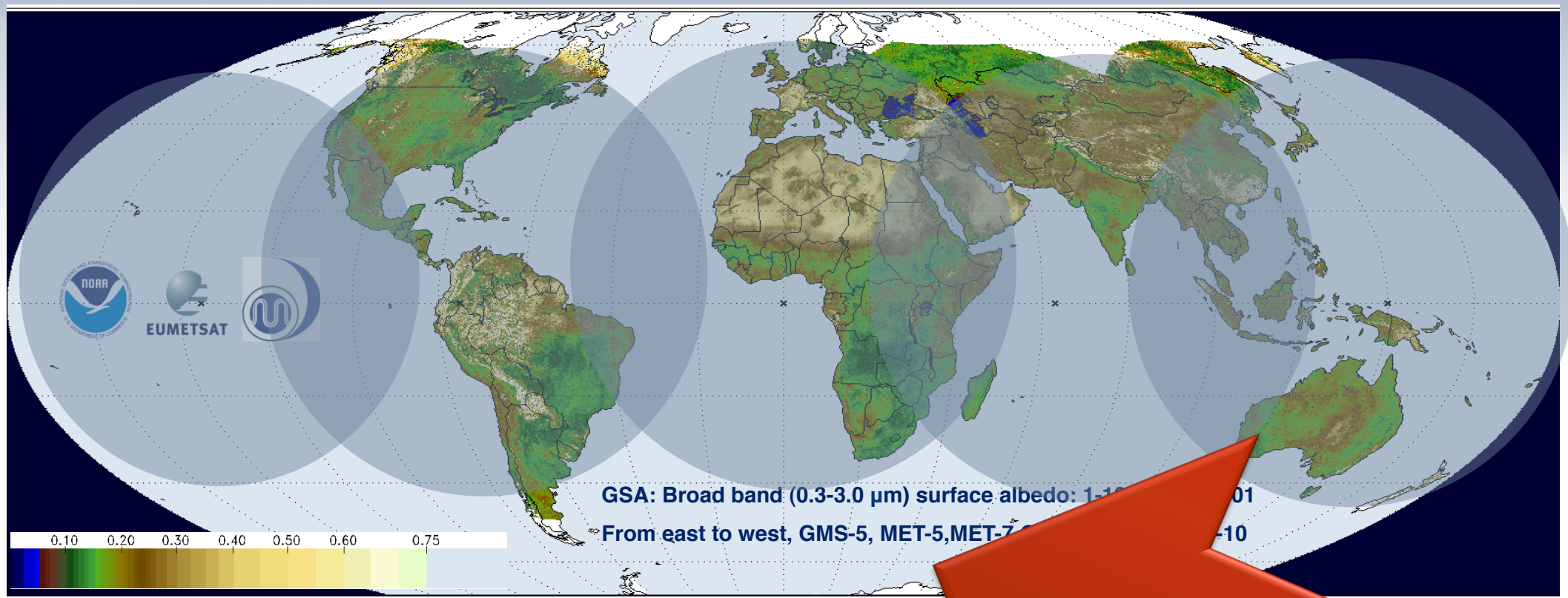
GMS 1-5

MTSAT 1R, 2

1975 2003 2040

SCOPE•CM

Project Objective



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GMS 1-5

MTSAT 1R, 2

5 Orbits

1975 2003 2040

Project Objective

>50 years continuity

SMS Series (GOES 1-3)

GOES First Generation (4-7)

SCOPE•CM

-15)

OES Fourth Generation (R-U)

Meteosat First Generation

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Meteosat Third Generation

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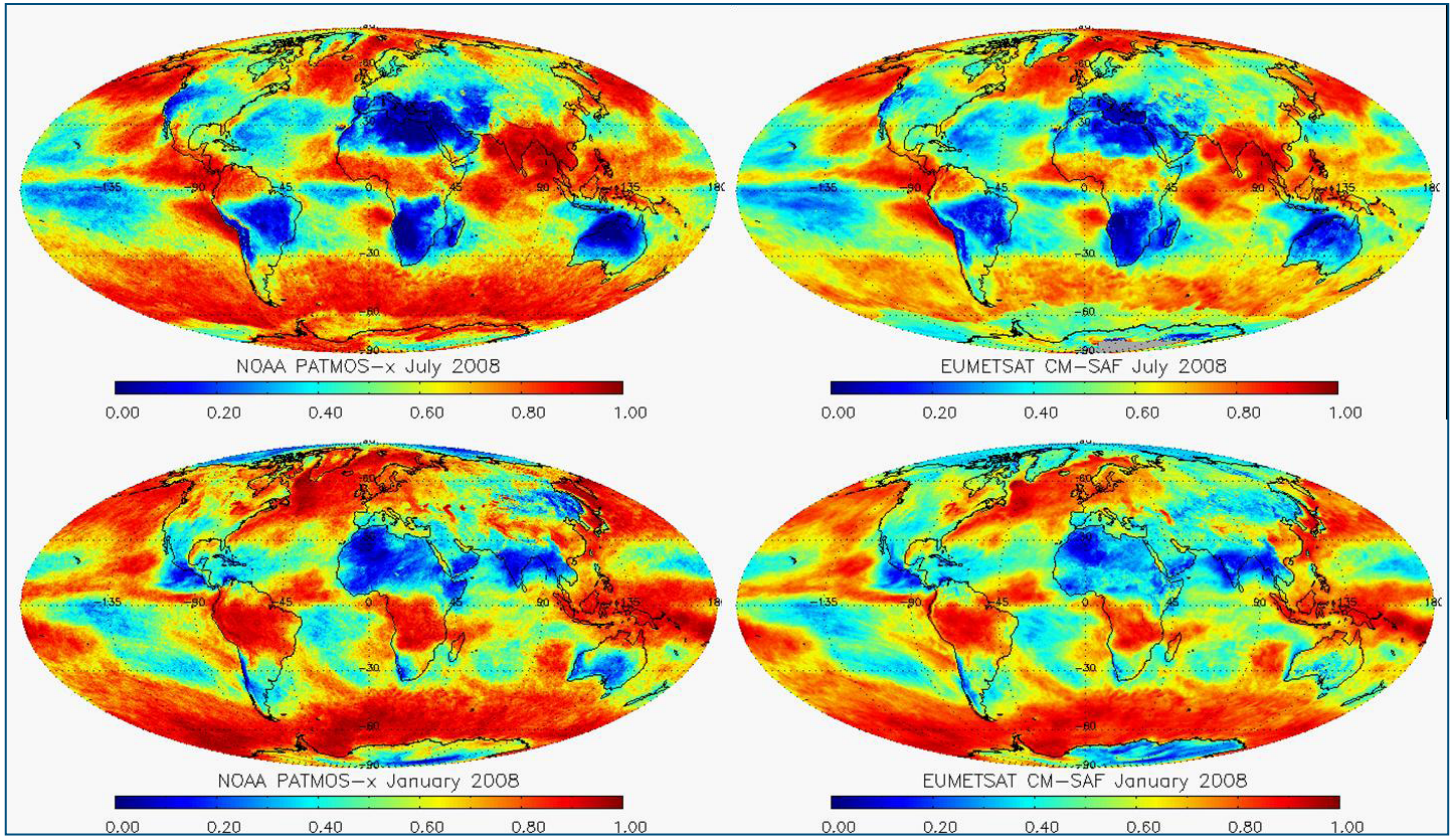
MTSAT 1R, 2

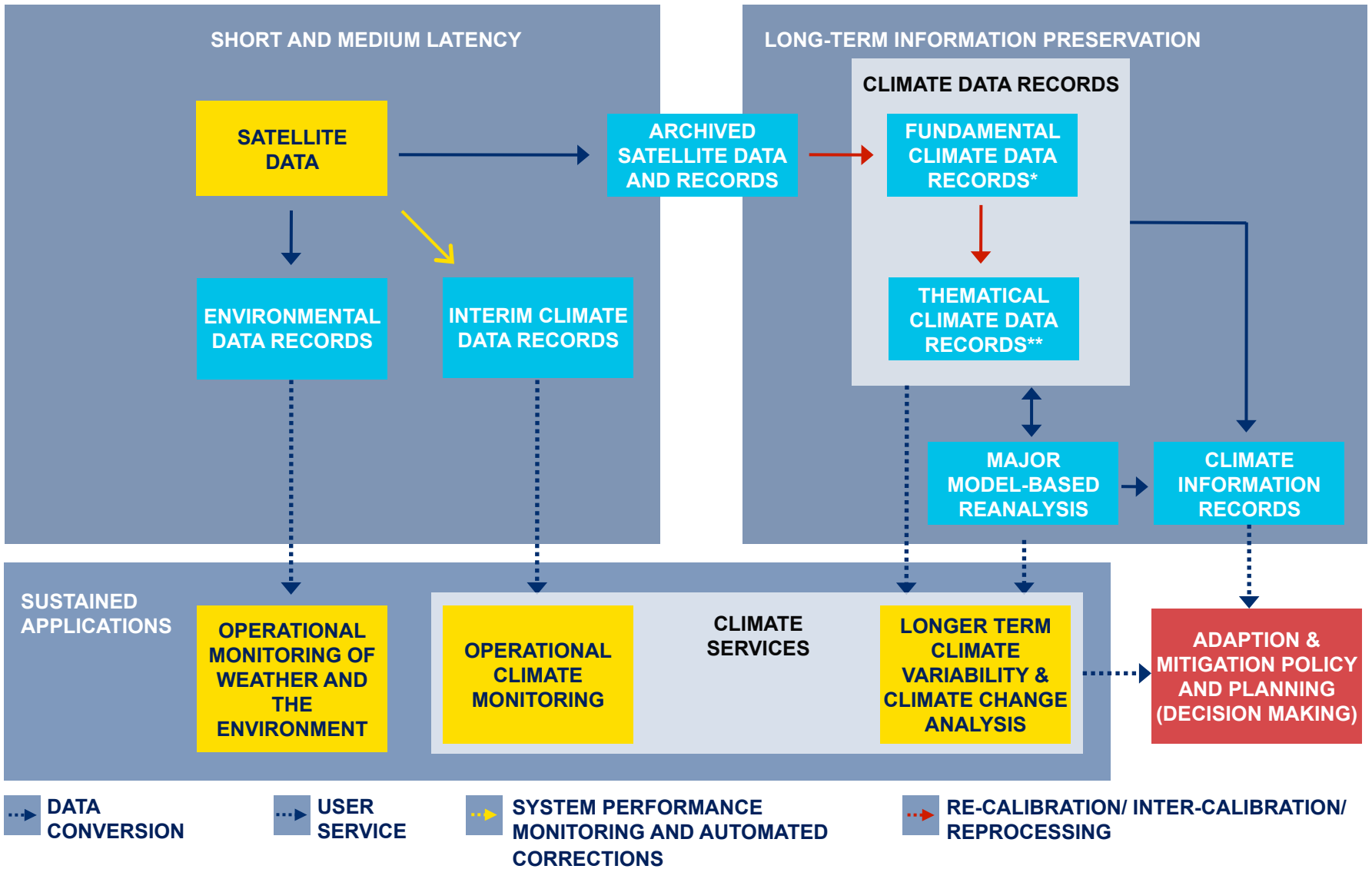
1975 **2011** **2040**

SCOPE-CM Global Cloudiness Coordinated Processing of AVHRR data



- Phase 1 concentrated on processing of polar orbiter satellites (20 years AVHRR record) applying different approaches and performing systematic comparisons;
- Phase 2: collaboration in providing the Fundamental Climate Data Records (Radiances).

Sustained Applications Drive the Climate Architecture Required



* **Fundamental Climate Data Record (FCDR):** a long-term data record of calibrated and quality-controlled sensor data designed to allow the generation of homogeneous products that are accurate and stable enough for climate monitoring

** **Thematic Climate Data Record (TCDR):** a long-term data record of validated and quality-controlled geophysical variables derived from FCDRs.

SCOPE-CM Phase 2 -Sustained Production of Climate Data Records (CDRs)

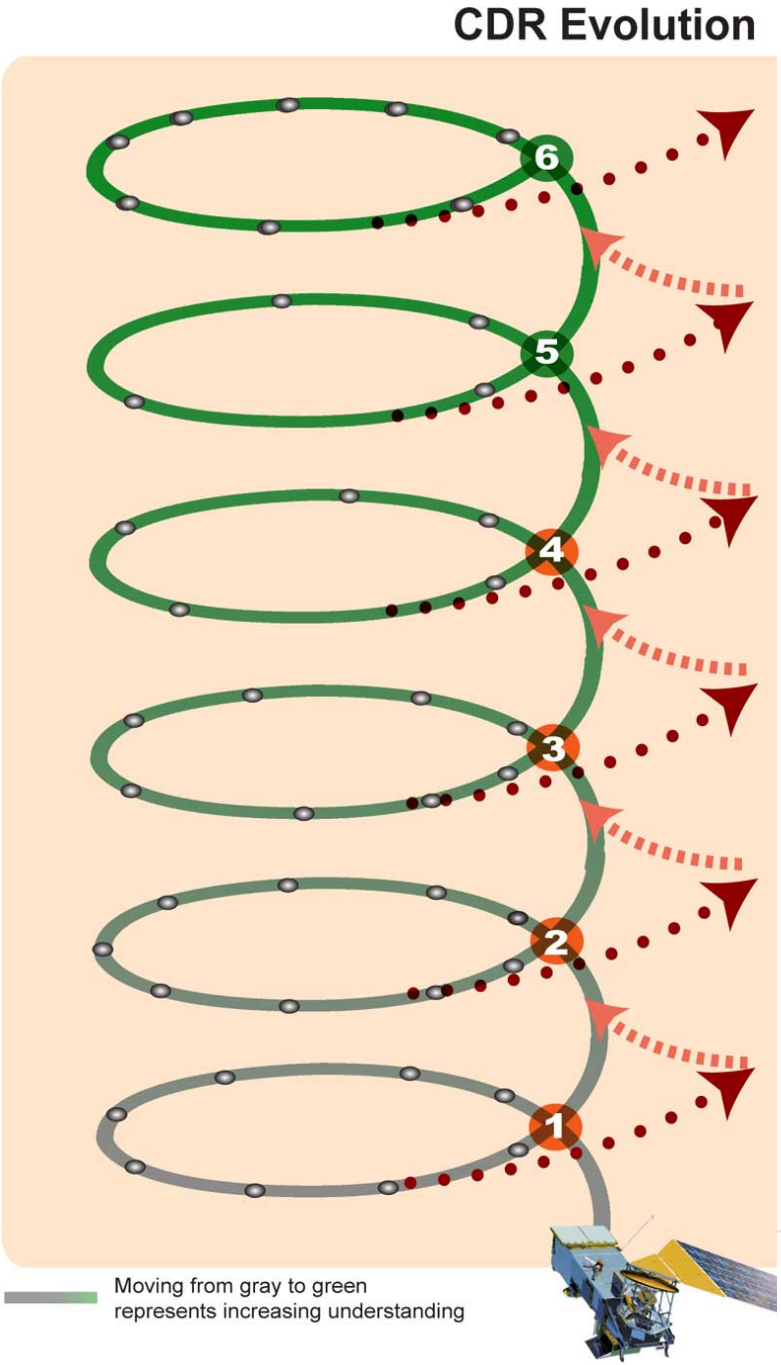
- Establish a systematic approach to increase the sustainability (maturity) of CDR generation capabilities
- Establishment of structures for sustainable generation of Fundamental CDRs, Thematic CDRs and Interim CDRs
  - Generation of first SCOPE-CM CDR products
  - Increased coverage of products in terms of ECVs, time and spatial dimension
  - Fostering extension of the network to additional partners
- The Maturity Matrix assessment will help organize elements of the CDR life cycle
- Dedicated projects (SCM-Projects) with the objective to elevate a specific CDR capability to higher maturity.

Maturity Matrix Model

Climate Data Record (CDR) Maturity Matrix

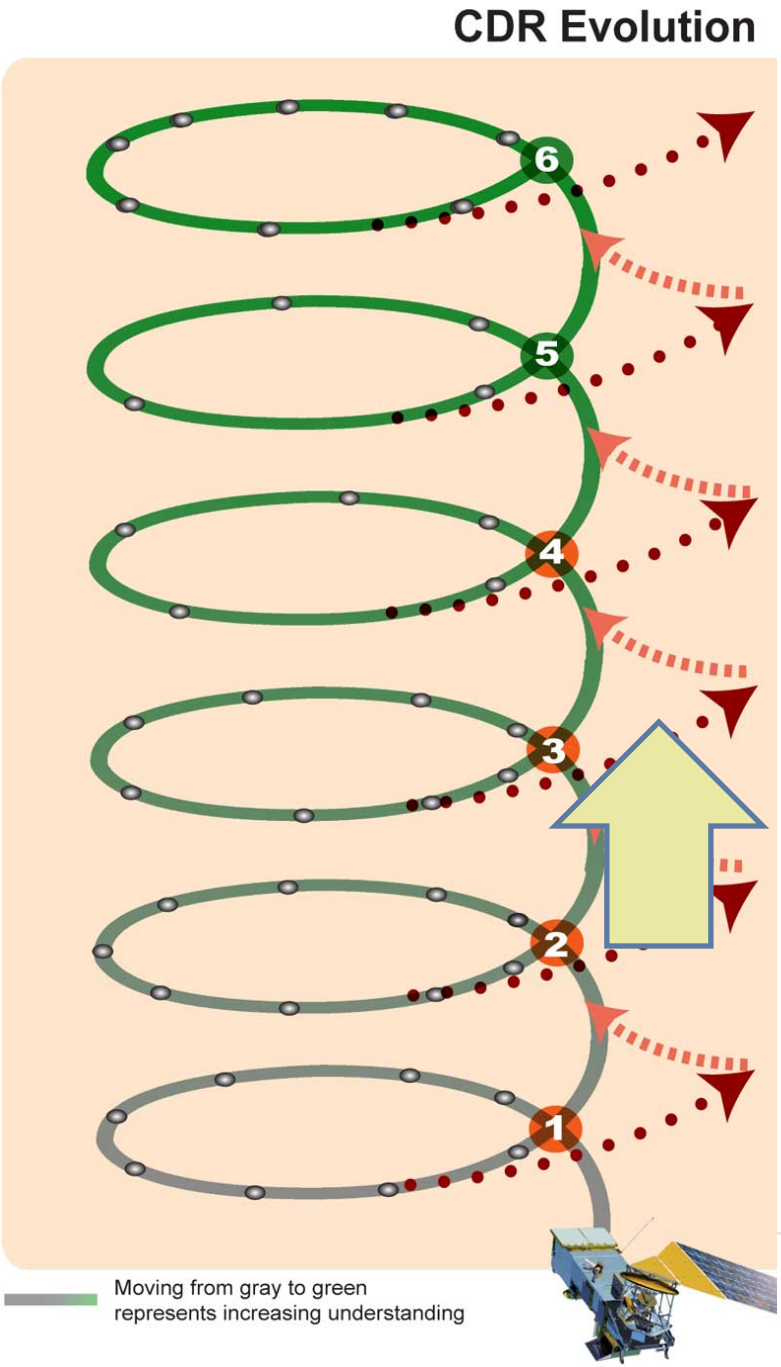
Maturity	Software Readiness	Metadata	Documentation	Product Validation	Public Access	Utility
1	Conceptual development	Little or none	Draft Climate Algorithm Theoretical Basis Document (C-ATBD); paper on algorithm submitted	Little or None	Restricted to a select few	Little or none
2	Significant code changes 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 algortihm 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

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



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

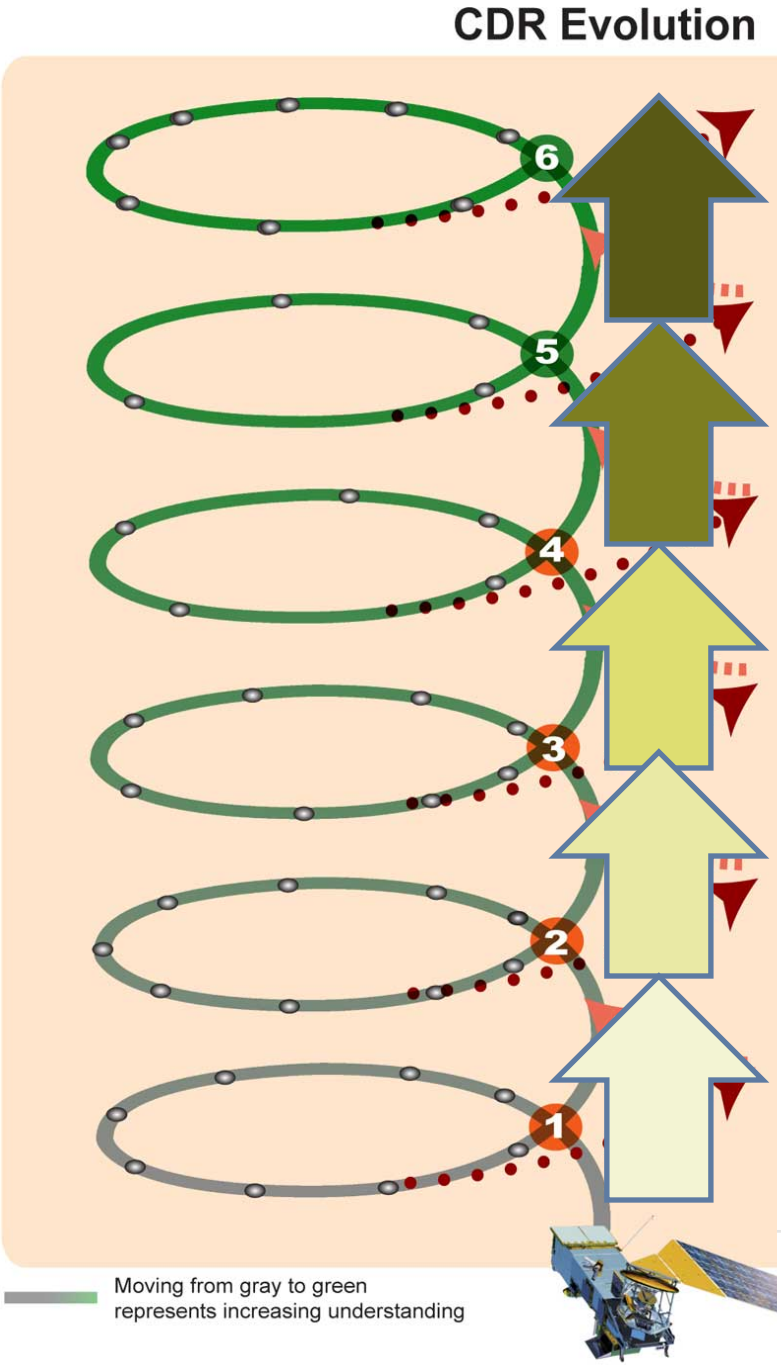
SCOPE-CM Climate Data Record Life Cycle Based on Maturity Matrix



- 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



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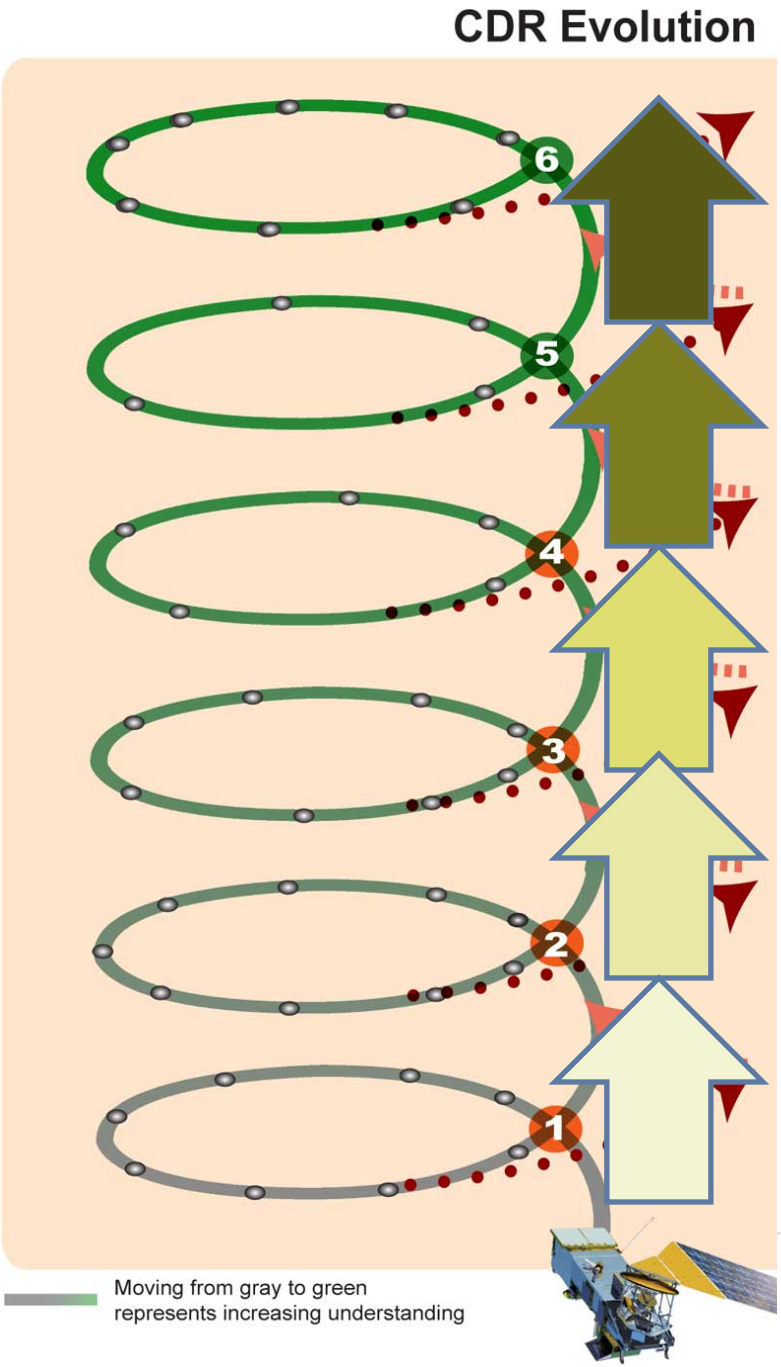
Sustaining CDR generation through a series of SCOPE-CM Projects

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

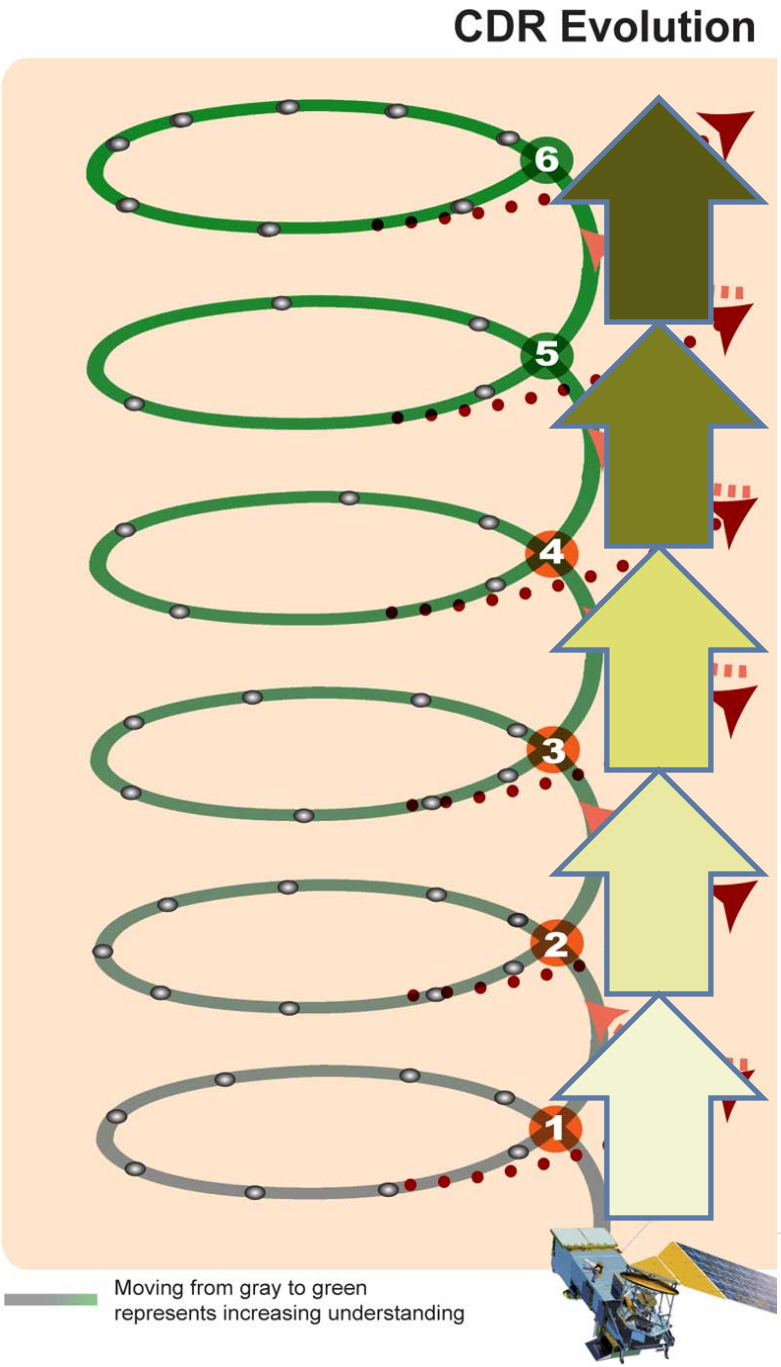


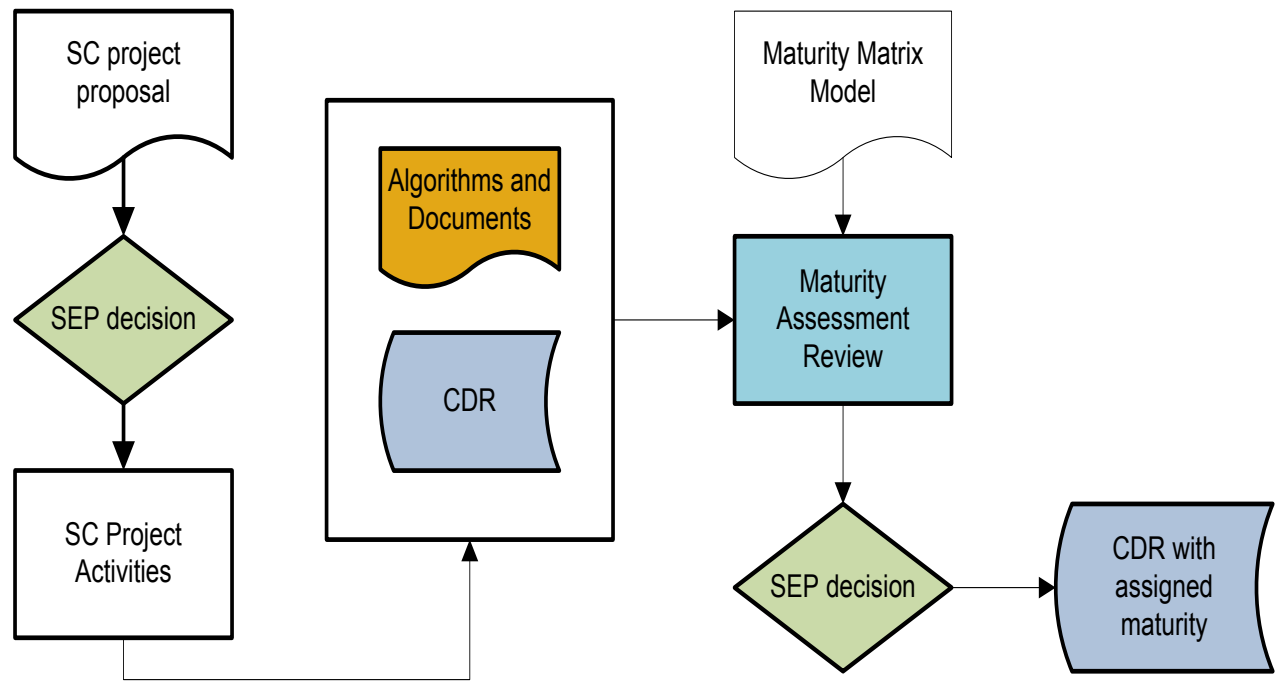
High Maturity
SCOPE-CM Projects

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

Intentions

- SCOPE-CM umbrella for CDR generation activities that will/could:
  - Directly benefit from coordination among participating space agencies/organisation;
  - Based on multi-agency sensor data;
  - Need a programmatic framework across organisations without exchange of funds.
- SCOPE-CM has no intention:
  - to coordinate every CDR activities worldwide;
  - to have the authority to indentify (certify) the best/better CDRs;
  - To duplicate coordination and steering mechanisms already established.
- SCOPE-CM focuses on the sustainability aspect of scientific/technical CDR generation.

Call for Letters of Intent : SCM-Projects

- Call for SCM-Project issued December 2012
- 10 LoI received:
  - GEO tapestry, targeting a consistent inter-calibrated geostationary data record (FCDR) employing GSICS methodology;
  - AVHRR FCDR generation;
  - Atmospheric Motion Vectors (AMV, 2 projects)
  - Continuation of ISCCP;
  - Surface Albedo (geostationary and polar platforms (2 projects);
  - Microwave cloud Liquid Water Path (LWP)
  - Free Tropospheric Humidity (GEO and LEO sensors)
  - Radio Occultation Trend analysis
- Assessment of proposals at SCOPE-CM Executive Panel, 22 Feb 2013.

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;
- 10 Phase 2 projects are envisioned following the LoIs;
- Additional participation is welcomed for Phase 2