SCOPE-CM Phase 2 Implementation Plan

Final (Version 1.0)
22 November 2012

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Document Change Record

Issue / Revision	*Date*	*Changed Pages / Paragraphs*
0.1	18 July 2012	Initial draft version distributed to SEP members
1.0	21 November 2012	Final version, approved by SEP members

1 PURPOSE OF THIS DOCUMENT

This document represents an update to the Implementation Plan for the Sustained and Coordinated Processing of Environmental Satellite Data for Climate Monitoring (SCOPE-CM) Version 1.3 of 20 March 2009 [RD-01]. Phase 2 of SCOPE-CM incorporates accomplishments and lessons learned from Phase 1, updated requirements and guidelines from the Global Climate Observing System (GCOS), and the evolving needs for climate information by a variety of users. A key component of Phase 2 is the establishment of sustained production of fundamental climate data records (FCDRs) as well as Essential Climate Variables (ECVs) satellite products (also referred to as thematic climate data records or TCDRs).

Section 2 provides an introduction and background information for SCOPE-CM, Section 3 describes the approach and the governance for second phase. Specific tasks for the implementation of the network structure and the early operations are defined in Section 4. In Annexes, this document provides the updated ToR of the Executive Panel and recalls the GCOS Climate Monitoring Principles as well as the GCOS guideline for CDR generation.

2 INTRODUCTION AND BACKGROUND

Climate is a global phenomenon and the observation of the global climate should therefore be a common responsibility among global partners. Global climate monitoring nowadays depends increasingly on continuous and sustained observation of the Earth from space and products that are derived from satellite data records. The WMO is the natural body to coordinate such activities because of its history in worldwide coordination of climate-related activities and observing systems for weather and climate in general, as evidenced by the preamble to the WMO convention as revised by the XV WMO Congress to include Climate Monitoring.

The mission of the Global Climate Observing System (GCOS), sponsored by WMO, UNESCO/IOC, UNEP and ICSU is to ensure availability of global observations for monitoring the climate system, detecting and attributing climate change, assessing impacts of and supporting adaptation to climate variability and change, application to sustainable development, and supporting climate research. GCOS has already established the GCOS Climate Monitoring Principles (GCMP), towards the delivery of global, long-term, high-quality, sustainable and reliable climate products including guidelines how those products shall be generated (GCOS-143, [RD-02]). These GCMPs are included as Annex. The SCOPE-CM addresses in particular GCMP number 16:

> *Operational production of priority climate products should be sustained and peer-reviewed new products should be introduced as appropriate.*

The GCOS Second Adequacy Report [RD-03] identified gaps in the systematic observation of climate, established a priority list of 44 Essential Climate Variables (ECV) and called for integrated global analysis products.

In August 2010, the "Implementation Plan for the Global Climate Observing System in Support of the UNFCCC" (hereafter called "GCOS Implementation Plan 2010" or "GIP 2010") [RD-04] was updated, defining priorities and identifying 138 actions necessary to fulfil the GCOS requirements for climate monitoring. This was an update to the original 2004 plan that "takes account of the latest status of observing systems, recent progress in science and technology, the increased focus on adaptation, enhanced efforts to optimize mitigation measures, and the need for improved predictions of climate change". In addition, GIP2010 identified 'key needs' of the UNFCCC. SCOPE-CM is responsive to many of the Actions identified in GIP 2010 and a complete listing of the relevant actions can be found in Appendix E. SCOPE-CM is most highly responsive to GIP2010 action C8 which states:

> *Ensure continuity and over-lap of key satellite sensors; recording and archiving of all satellite metadata; maintaining appropriate data formats for all archived data; providing data service systems that ensure accessibility; undertaking reprocessing of all data relevant to climate for inclusion in integrated climate analyses and re-analyses, undertaking sustained generation of satellite-based ECV products.*

In 2011, the GCOS document "Systematic Observation Requirements For Satellite-Based Data Products For Climate 2011 Update, GCOS-153 [RD-05] (hereafter referred to as GIP 2010 Satellite Supplement) was issued providing updated requirements for accuracy and coverage for many ECVs. The GIP 2010 Satellite supplement provides details on the ECVs, global products requiring satellite observations (also known as thematic climate data records or TCDRs), and the Fundamental Climate Data Records (FCDRs) required for product, or TCDR, generation.

Within the portfolio of WMO, SCOPE-CM is envisioned as one component of a framework that links the global observing system (GOS) with the required inter-calibration efforts (the Global Space-based Inter-Calibration System GSICS) needed for computing seamless climate records (SCOPE-CM) to provide users and organizations with needed climate data records addressing the ECVs (see Figure 1). SCOPE-CM should clearly indicate its needs (e.g., error characterization of FCDRs) vis-à-vis GSICS.

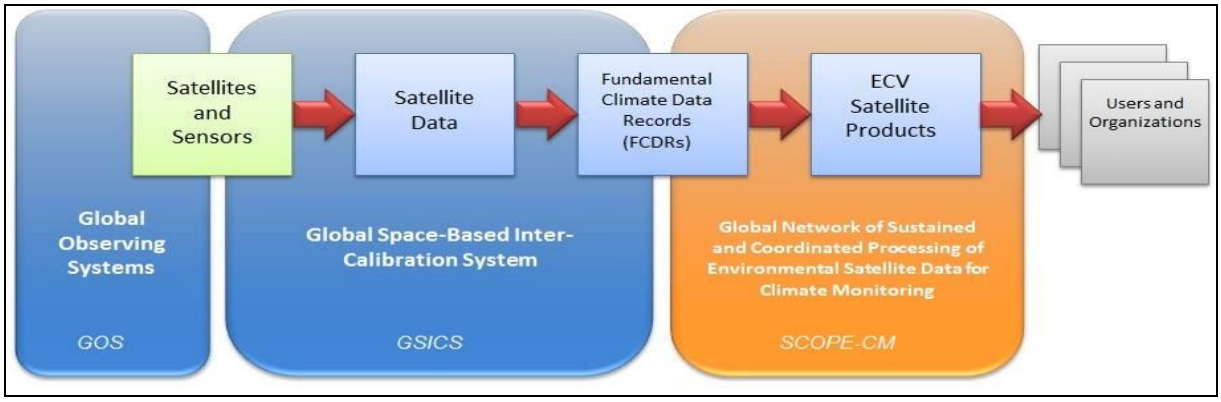

Figure 1 – Interaction between satellite observation, inter-calibration and Climate Data Records generation

The Committee on Earth Observation Satellites (CEOS), at their 24th Plenary (October 2010) in Rio de Janeiro, agreed to create a new Working Group on Climate. The mandate of this new Working Group is to facilitate the implementation and exploitation of Essential Climate Variable time-series through coordination of the existing and substantial activities undertaken by CEOS member agencies. It will accomplish this goal by coordinating and encouraging collaborative activities between the world's major space agencies in the area of climate monitoring.

In 2011, the WMO Congress welcomed the setting-up of the Sustained Coordinated Processing for Environmental Satellite Data for Climate Monitoring (SCOPE-CM) and expected that this initiative would soon reach an operational stage and be expanded. It invited the Space Programme to consider similar initiatives to coordinate the delivery of satellite derived products responding to the requirements of other application areas including severe weather forecasting, precipitation estimation, or volcanic ash detection. Congress welcomed the orientation taken by the Commission for Climatology (CCl) to further incorporate satellite products in climate monitoring and its plan for enhancing linkages with the Space Programme and the SCOPE-CM initiative. It expected that this collaboration would bring substantial benefits to WMO global and regional climate monitoring activities. It recommended using existing mechanisms such as workshops, seminars or expert meetings coordinated by the CCl or within SCOPE-CM to address gaps in satellite-derived products for use in the WMO Climate System Monitoring (WMO-CSM).

The participants and agencies involved with Phase 1 of SCOPE-CM have come to realize that the developing and sustaining production of ECVs often involves complex interactions within and across agencies. These interactions span a range of time scales, latency requirements, and user requirements. A notional diagram of the pathways from observations to applications illustrates that a robust framework is required to sustain production of CDRs and ECVs.

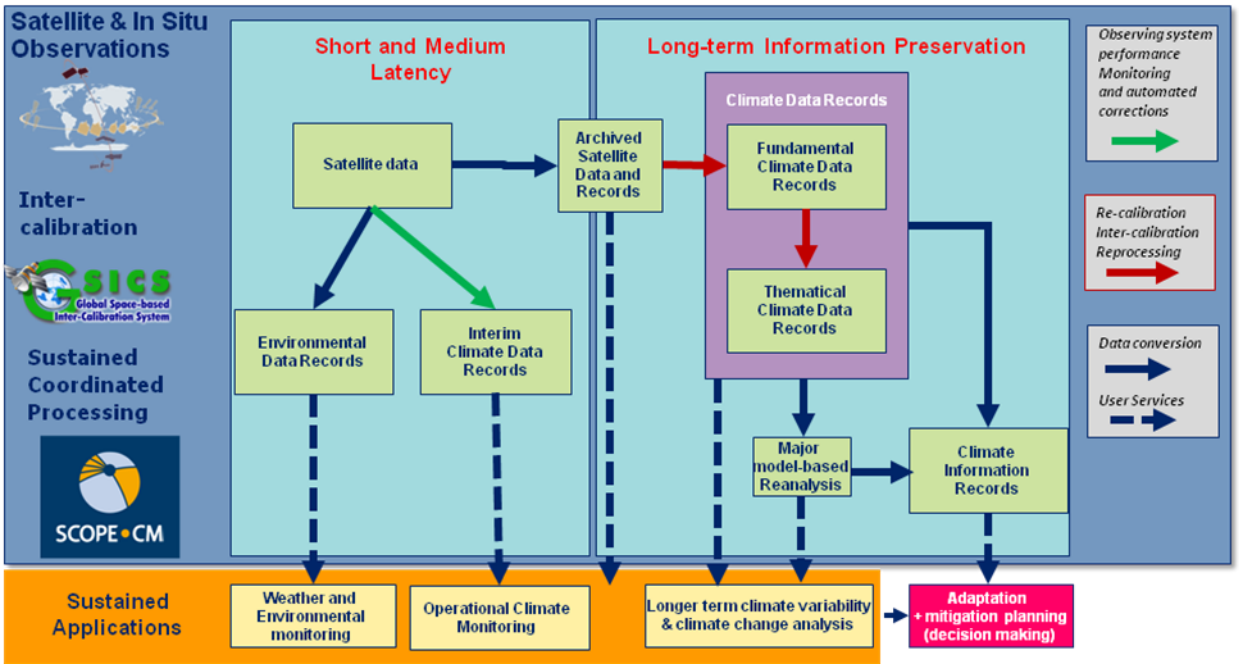

Figure 2 – Sustained Climate Information Flow

Relationships between Space agencies, operational meteorological and climate services, and academia and industry need to be continuously developed and evolved in order to best utilize all systems and talents. Recognizing this is a complex challenge, WMO, CGMS and CEOS have collaborated recently on a document that outlines how to facilitate the collaborations needed for the successful generation of climate records. This has been captured in a document called, 'Strategy Towards an Architecture for Climate Monitoring from Space' [RD-06].

In 2009 the third World Climate Conference (WCC-3) unanimously agreed to develop the GFCS. A high-level task force completed its report [RD-07] on the proposed scope, implementation modalities and governance arrangements for the GFCS in 2011. The next steps in the development of the GFCS include the generation of an implementation plan. The architecture is linked to the Global Framework of Climate Services (GFCS) as it describes the value adding process from the observations to information contained in climate records that can be used by decision makers.

3 APPROACH AND GOVERNANCE FOR SCOPE-CM PHASE 2

This section provides a description of the approach taken for SCOPE-CM Phase 2, taking into account the discussions and developments during the first SCOPE-CM phase as well as the lessons learnt from its Pilot Project activities.

3.1 Overall Goals and objectives of SCOPE-CM

The overall aim of SCOPE-CM is the advancement of the sustained generation of Climate Data Records from satellite data. This shall be achieved through advancing projects (or project series) within SCOPE-CM by identifying CDR-generating activities that are in principle sustainable, by providing guidance and advice, and by fostering partnerships. "Advancing" projects means that the CDRs targeted should be elevated in their level of scientific and operational "maturity". The established Maturity Matrix Model (MMM) [RD-08, RD-09], which is described in section 3.2, provides a description of different levels of maturity with respect to sustained CDR generation. It includes six broad criteria for maturity assessment, such as scientific utility, documentation, accessibility, validation and sustainable hosting. As this MMM was accepted by the SEP as a reference for SCOPE-CM, the overall aim of SCOPE-CM can technically be expressed as to increase the number of CDR generation capabilities of higher maturity. The MMM should be made universally useable (in terms of terminology, etc.) by a broad range of potential participating institutions in SCOPE-CM, such as satellite operators, research institutions and universities.

The structure of SCOPE-CM (SCM) projects and the related processes are described in section 3.3.1. The maturity of individual CDR capabilities may increase gradually through a series of SCM Projects.

SCOPE-CM provides the framework to coordinate the international cooperation to set up additional and more efficient CDR generation capabilities and to bring them to higher maturity levels. Within SCOPE-CM, the maturity of CDR generation capabilities will be assessed and quantified applying the Maturity Matrix Model by means of dedicated reviews.

Collaboration with other international groups, such as international scientific expert groups and the CEOS WG Climate will be sought, as required.

3.2 The Maturity Matrix Model as a reference SCOPE-CM

The aim of the Maturity Matrix Model is to provide a framework for assessing the completeness and maturity of CDRs to support the broad range of potential users both now and in the future.

The CDR maturity matrix model (Figure 3) combines best practices from the scientific community, preservation description information from the archive community, and software best practices from the engineering community.

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

Figure 3 – The CDR Maturity Matrix Model Version 4.0 (RD-10)

There are six proposed thematic areas for assessment, based on discussion and feedback from many scientists (including SCOPE-CM) over the past several years. These include: software readiness, metadata, documentation, product validation, public access, and utility. Each of these thematic assessment areas then is expanded into six levels of completeness, or maturity. These maturity levels capture the business practices that have arisen over the past two decades in fielding climate observing systems, particularly satellite observing systems. Maturity levels 1 and 2 are associated with the analysis of data records from new instruments or a new analysis of historic observations or proxy observations which is designated research. Products at this stage of development may show interesting results and be useful mostly for scientific research. However there is insufficient maturity of the product for it to be used in building climate services for decision making. Medium maturity is achieved in maturity levels 3 and 4. At these levels, the product has achieved sufficient maturity in both the science and applications that it may tentatively be used in sustained applications. Finally,

high maturity is achieved only after the product has demonstrated all aspects of maturity are complete. These levels correspond to CDR generation capability with operational, service-level standards.

Quantifiable standards can, or will, exist for each thematic area and each maturity level. For example, peer reviewed publications are required in three separate areas to address product documentation, validation, and utility. When assessing the validation status of CDRs and their uncertainty, reference should be made, where appropriate, to the use of information provided by GSICS, and of data from the GCOS Reference Upper-Air Network (GRUAN) and other ground-based reference networks.

Particular attention is also paid to software maturity and access. This includes requiring the code to be managed and reproducible, metadata with provenance tracking and meeting ISO standards, and all code publicly accessible. Uncertainty of the product must be documented, assessed by multiple teams and positive value demonstrated. Each of these steps must be independently verifiable.

The MMM does not describe the CDR quality per se, but the quality of the CDR generation capabilities with respect to its sustainability. The quality of the CDR itself depends strongly on the intended applications, for which different requirements exists. SCOPE-CM is explicitly not defining such requirements, neither is setting up the processes to assess the scientific quality of CDRs. Instead, SCOPE-CM relies on the high-level GCOS requirements for ECV satellite products and encourages scientific assessment of the quality through engagement with international scientific expert groups. It is expected that in particular for the high maturity levels the consortium members of SCM projects have implemented suitable review processes to assess the scientific quality as part of the CDR generation process.

It is expected that the MMM will in its evolution become more and more and agreed standard among institutions involved in CDR generation.

SCOPE-CM will provide feedback on the applicability and adequacy of the MMM to support its evolution.

3.3 SCOPE-CM Structure for Phase 2

The Structure of SCOPE-CM in its Phase 2 consists of the following elements:

- **SCOPE-CM Projects**, dedicated to specific CDR generation capabilities, activities by consortia aiming at maturity increase.
- **SCOPE-CM Executive Panel** (SEP), decision and advisory body, consisting of representatives of participating organisations as well as related initiatives and institutions. The SCOPE-CM Executive Panel and participating organization provide guidance, advice, international visibility and, where possible, resources to advance SCM Projects
- **SCOPE-CM Working Groups**, consisting of experts supporting the activities of the SEP e.g. for scientific and engineering aspects. No specific Working Groups are prescribed; the groups should be implemented by the SEP and can be standing or limited time Working Groups.

- **SCOPE-CM Secretariat**, monitoring the SCOPE-CM planning and progress, reporting to SEP, coordinates and monitors the SCM Projects, acting as SEP Secretariat.

The following sections provide a description of characteristics and functions of these elements.

3.3.1 SCOPE-CM Projects

The overall aim of SCOPE-CM is to enable sustained generation of CDRs and to ensure the necessary support by (one or more) host institutions. This shall be achieved through advancing projects (or project series) within SCOPE-CM.

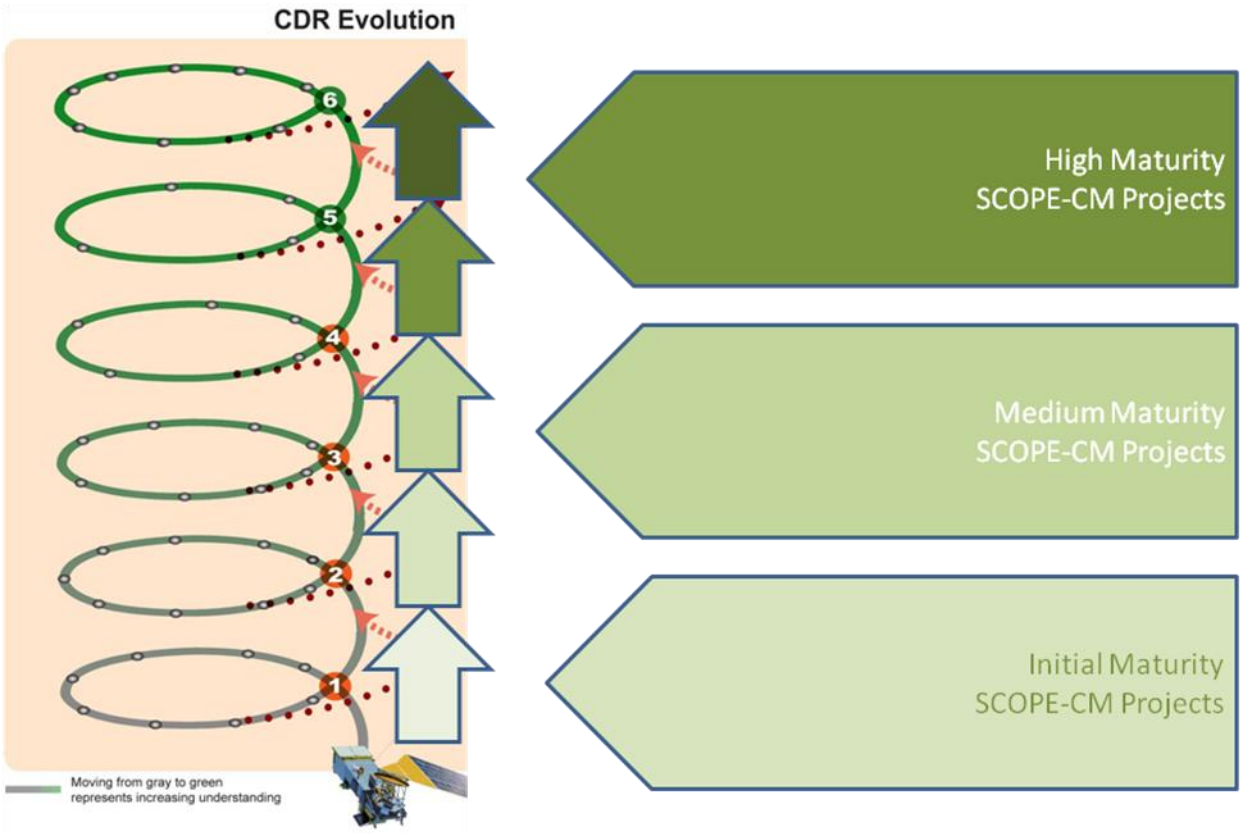

Figure 4 – Classification of SCOPE-CM Projects targeting different maturity levels for CDR capabilities.

The goal of a specific SCOPE-CM Project (SCM Project) is to advance a specific CDR generation capability to a higher maturity. Depending on the targeted Maturity Level, three types of SCOPE-CM Projects can be distinguished:

- Initial maturity SCM Projects,
- Medium Maturity SCM Projects, and
- High Maturity SCM Projects.

This generic concept is illustrated in Figure 4.

3.3.1.1 SCM Project Calls

SCM projects are initialised by a call issued by the SCOPE-CM Secretariat approximately once a year. The call will refer to the overall status of climate activities of the international community and suggest some priority topics. In particular, it may ask for specific ECVs if future gap analysis, e.g., as performed by the CEOS WG Climate, clearly reveal the need of specific actions by the international community.

3.3.1.2 SCM Project structure

A SCM project shall be proposed and eventually executed by a multi institutional consortium, which coordinates their activities.

Research Institutions as well as satellite operators and space agencies (operational and research) can be involved in SCM Projects. The role of the satellite operators and operational agencies is expected to be more pronounced for the higher maturity CDR projects, targeting the implementation of generation capabilities in the most controlled and sustained way.

The project is led by a Principle Investigator, responsible for coordinating the activities inside the project consortium and representing the SCM Project at SCOPE-CM level (Secretariat and Executive Panel).

3.3.1.3 SCM Project Funding

An individual SCM project addresses an individual CDR generation capability, with the goal to bring it to the next step of maturity (see section 3.1). It is expected, that the funding of project activities will be allocated by the participating organisation or by means of external funding. SCOPE-CM does not provide funding for its projects but it facilitates direct collaboration with and among satellite agencies including access to data, information on data, operational infrastructure and a perspective for a long-term sustainability of activities. SCM projects proposals may be positively evaluated by the SEP before the funding for the activities could be found and in that way alleviates the search for funding.

3.3.1.4 SCM Project proposals

Each proposal shall contain the following minimum elements supporting the assessment by the SEP:

- Identification of a Principle Investigator (as project managers and major contact point to SCOPE-CM Secretariat and Executive Panel);
- Definition of targeted CDRs;
- Current (maturity) status of the CDR;
- Identification of the targeted Maturity Level (or Maturity level category) at the end of the project (which defines the high level deliverables and processes);
- In particular for projects targeting CDRs with low maturity, a planning perspective shall be given for reaching higher maturity;
- Description of the proposed activities (how to achieve the targeted maturity level), including how the users will be involved);

- Description of the validation method and of the utility assessment approach (for moderate and high maturity level projects);
- High-level data flow diagram;
- Linkages and requirements of the Project vis-à-vis GSICS and, where applicable, vis-à-vis the GCOS Reference Upper-Air Network (GRUAN) and other ground-based reference networks;
- Description of the Consortium and engaged users as well as potential user base;
- List and short description of Deliverables;
- Project Schedule and milestones;
- Funding situation (which activities are funded, which not);
- Dependencies (programmatic, data availability, etc.).

3.3.1.5 SCM Project procedures

The technical and acceptance/release procedures for the CDR generation strongly depend on the structures and standards of the institutions at which the CDR will be generated as well as on the conditions of the funding agencies. SCOPE-CM relies on these procedures and will not interfere with them. Discussions in SCOPE-CM may lead to recommendations targeting e.g. useful and feasible homogenisation of standards and procedures, as foreseen in the Implementation Procedures. SCOPE-CM as well does not claim any authority with respect to the release of the CDRs and documents describing them. SCOPE-CM will also rely on the assessment of scientific quality of the algorithms and products by the science community (e.g. results of peer-reviewed journal articles, assessments).

The main procedure under the responsibility of SCOPE-CM is the assessment of the CDR generation maturity at the end of each SCM Project against the categories and criteria as defined in the Maturity Matrix Model. Such "Maturity Assessment Reviews (MAR)" are organised by the Secretariat, and the assessment is performed either by SEP members directly or by an independent review board composed by experts specific to the CDR under review. The objective is to review the results of the self assessed maturity level. The MAR will result in a recommendation to the SEP to assign a maturity index. The decision will be taken by the SEP and communicated to the SCM Project.

A further objective of the MAR is to assess the conditions and feasibility for a follow-on SC project targeting higher maturity levels. This might be input to decision processes at funding/operations agencies.

Input to the MAR are the data sets and documents as relevant for the MMM criteria, as well as latest version of the Maturity Matrix Model. The MAR will recognise that the MMM might have developed during the life time of a SCM project which may affect the validity of the targeted maturity at the beginning of a project.

Figure 5 illustrates the generic process for all SCOPE-CM projects, including the review and decision processes.

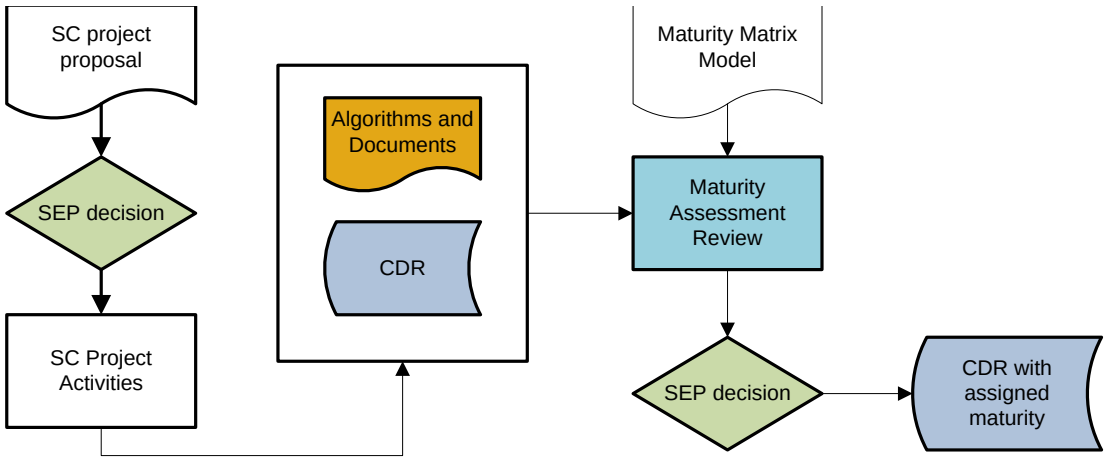

Figure 5 – SCOPE-CM Projects generic procedure

Although the generic process is the same for all types of projects (see Figure 5), the expected project outcome in terms of documents, data and conditions differ, according to the conditions defined in the Maturity Matrix Model. The following subsections elaborate on the differences.

The SCM Project team is also expected to provide a self assessment of their CDR generation capability with respect to the Maturity Matrix Model, providing the report on the compliance in each category.

3.3.1.6 Initial Maturity SCM Projects

In case a SCM Project targets low maturity levels (M1-M2), the SC projects may be referred to as "Initial Maturity SCM Projects". The execution of projects of that type in the SCOPE-CM framework might be useful and adequate, in case there is at least a technical/scientific perspective (e.g. in terms of usefulness, feasibility, satellite data availability) to increase the maturity to higher levels at a later stage

Typically, the Initial Maturity SCM Projects would include activities that address CDR generation related issues, assess the quality of existing and new retrievals and methodologies, assessment of the conditions for implementing algorithms/CDR capabilities within SCOPE-CM. The project's activities may include selection/improvements of algorithms, generation of prototype CDRs (test data), preliminary algorithm validation/assessment, concept definitions etc.

Figure 6 below illustrates the procedure of an Initial Maturity SCM Project. Apart from the CDR itself (even as a prototype) the mandatory elements for the MAR are a (draft) scientific description of the retrieval algorithm(s) (manuscripts of) peer reviewed journal articles. Initial validation activities (uncertainty assessment) – if available – might be presented in a draft Validation report.

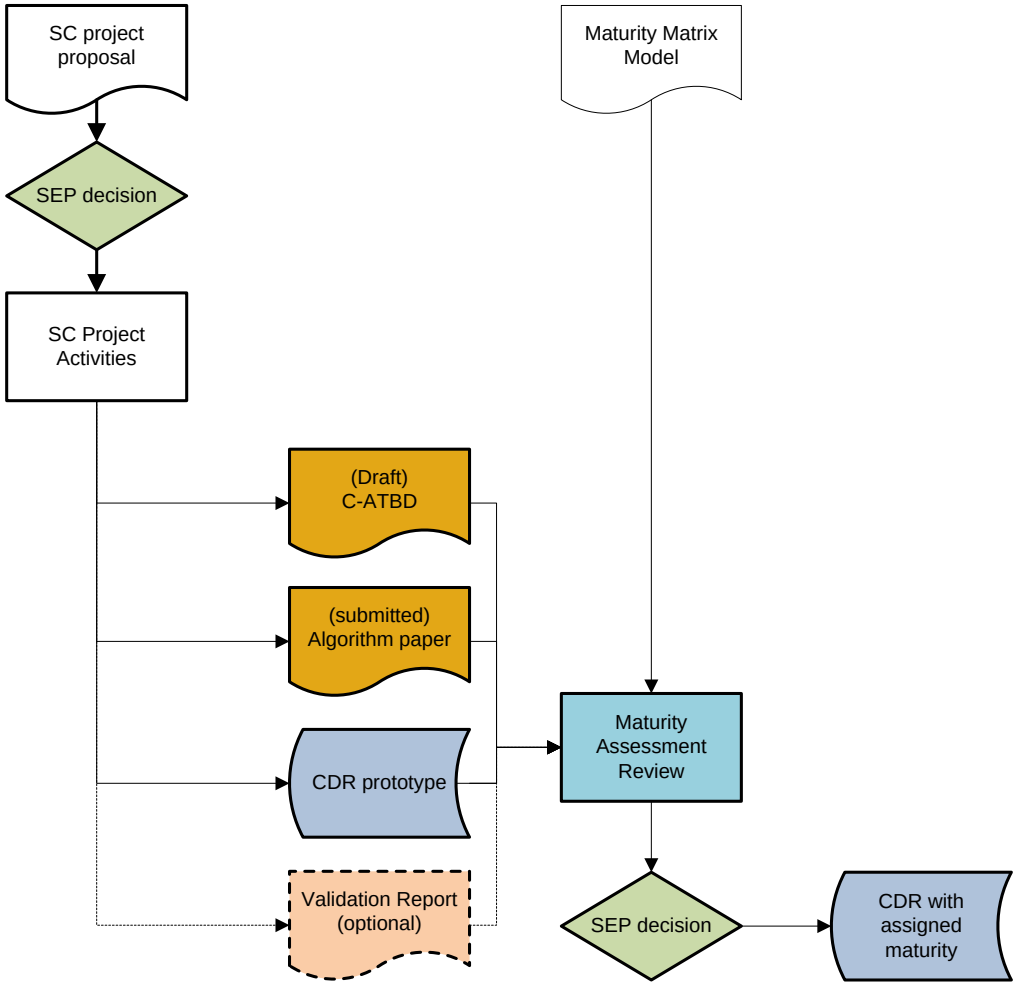

Figure 6 – Initial Maturity SCM Projects generic procedure

3.3.1.7 Medium Maturity SCM Projects

SC Projects that target Maturity Levels of 3-4 are referred to as "Medium Maturity SC Projects". As outcome of such projects (Figure 7), a consolidated version of the retrieval algorithms and its scientific description (e.g. "Public ATBD") is expected as well as documentation on the validation results and on utility.

The reproducibility is an important aspect to be considered in this kind of SCM Projects. This implies the cooperation between research institutions (CDR developers) and organisation with operational/sustained processing capabilities (CDR implementers) with the aim to jointly prepare for a sustained CDR generation.

Medium Maturity SCM Projects might be based on the achievements and results of previous Initial Maturity SCM projects.

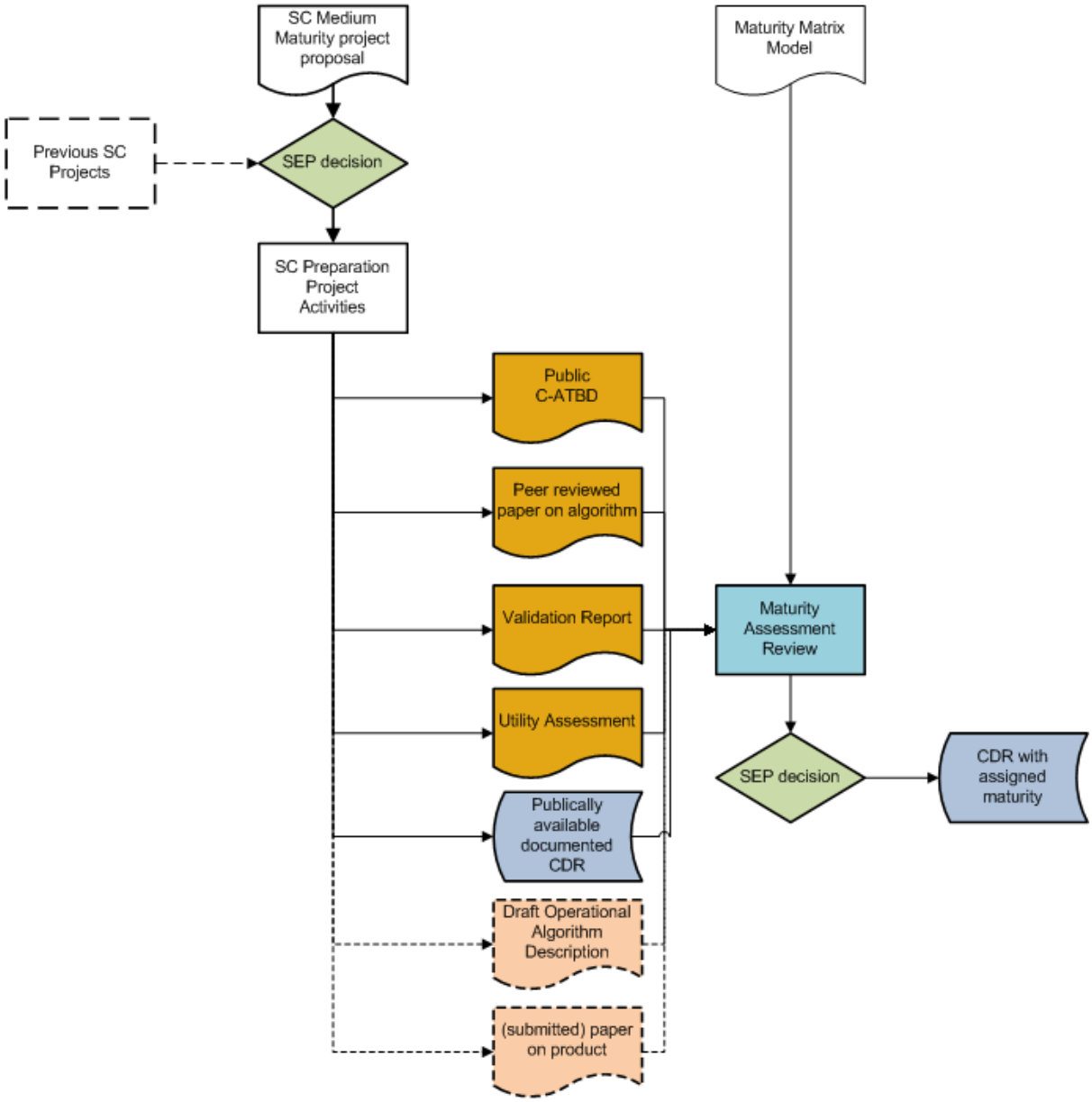

Figure 7 – Medium Maturity SCM Projects generic procedure

3.3.1.8 High Maturity SCM Projects

To target high Maturity Levels 5 or 6 (corresponding to sustained/operational CDR generation capabilities) SCM Projects need to provide (or to ensure) a robust and complete system, that includes long-term archive, traceable and reproducible data sets, full documentation, and an extensive uncertainty characterisation together with continuous checks and error quantifications. The output in terms of project deliverables of these High Maturity SCM projects (which probably will be based on previous SC projects) are illustrated in Figure 8. Most likely, the implementation of these CDR generation capabilities will be conducted under the major involvement of institutions (e.g. satellite operators) suited for sustained production and dissemination (as "CDR implementer") in an operational environment.

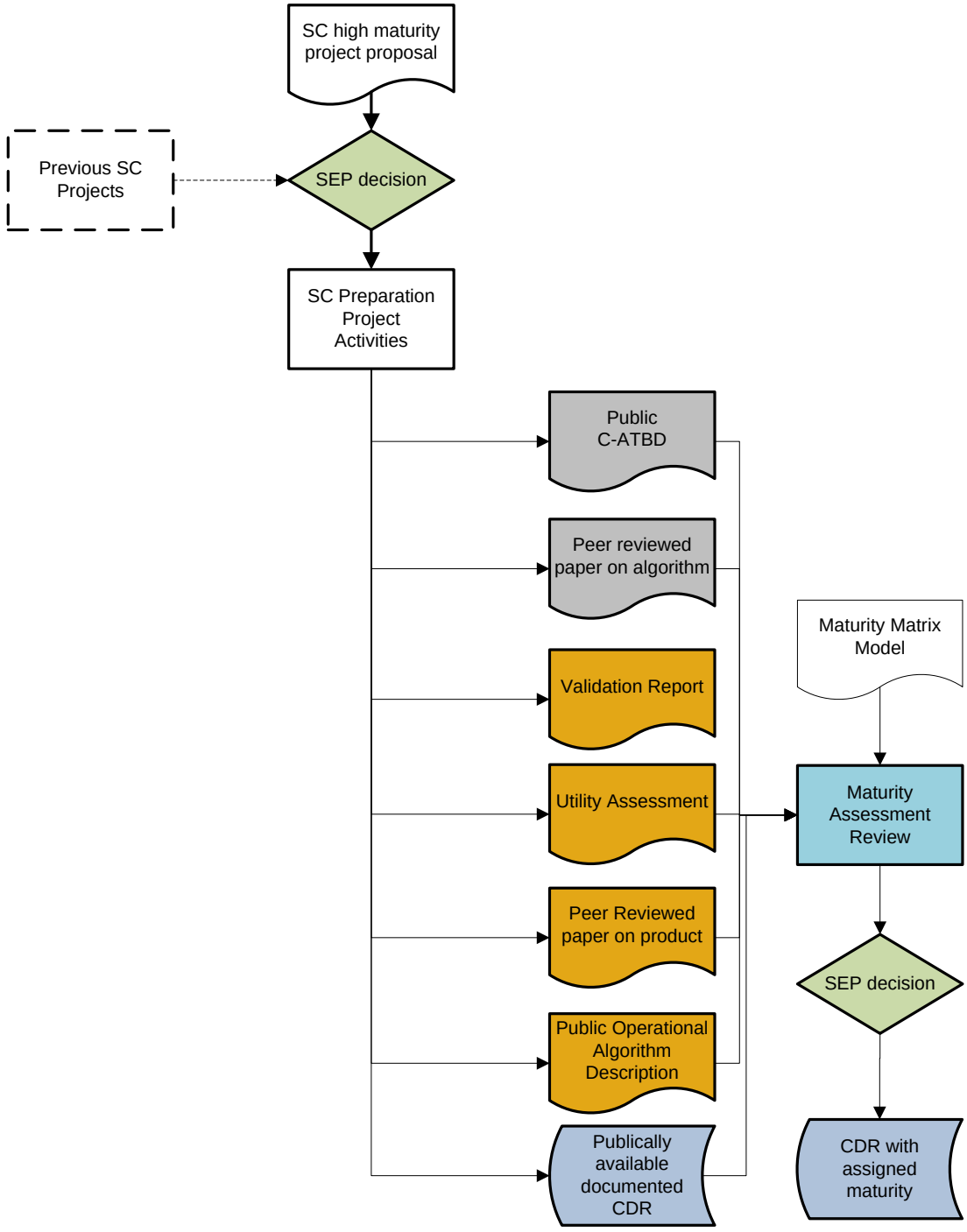

Figure 8 – High Maturity SCM Projects generic procedure

3.3.2 SCOPE-CM participating organisations

Organisations involved in sustained CDR generation (e.g. space agencies, research institutions, etc.) shall upon request and subject to decision of the SEP become new members of the SCOPE-CM network and shall nominate a representative in the Executive Panel.

3.3.3 SCOPE-CM Executive Panel

The SCOPE-CM Executive Panel (SEP) monitors, evaluate and guide the network and the SCM Projects. The Executive Panel is composed of the representatives of the SCOPE-CM

participating organisations, representatives of WMO and GCOS as full members, as well as representatives of CEOS, CGMS (GSICS), GEO and WCRP (GEWEX) as associated members. Observers from other agencies/initiatives are also welcome to participate in SEP activities.

In particular, the SEP is expected to:

- take decisions on the extension of the SCOPE-CM Network (new participating organisations),
- evaluate and approve SC proposals
  - Assess the scientific relevance of the proposed activities
  - Assess the perspective (technical, scientific, engineering) of eventually reaching higher maturity levels (suitability for sustained generation)
  - Taking into account similar activities, suggesting additional coordination/cooperation if necessary;
- take decisions on maturity assignment taking into account the results and recommendations of the Maturity Assessment Reviews at the end of each SCM Project, inclusive of assignment of a maturity index;
- take decisions on the standards and procedures within SCOPE-CM;
- supervise the activities of the SCOPE-CM Secretariat.

The Terms of Reference (ToR) of the SEP shall be adapted/specific according to the refined concept. Appendix A provides the ToR which are consistent with this approach.

3.3.4 SCOPE-CM Secretariat

The SCOPE-CM Secretariat is tasked with the overall coordination and management of SCOPE-CM network activities. The Secretariat is be hosted by one of the SCOPE-CM participating organisations.

The Secretariat coordinates and supports SCOPE-CM activities. It provides a coherent information system on available CDRs that have been generated and assessed in the SCOPE-CM framework, including related metadata and documentation. It acts for the SEP as a secretariat supporting the preparations of reports, the organisation of meetings, Maturity Assessment Reviews, workshops as well as the evaluation of SCOPE-CM project proposals.

3.3.5 Interaction with stakeholder organisations

The SCOPE-CM initiative is embedded into a framework of activities and initiatives related to Satellite data and climate monitoring. In the second phase of SCOPE-CM, formal and specific interfaces and interactions shall be intensified and developed according to the needs of the SCM Projects and in line with the SCOPE-CM objectives. Specific interactions shall include:

- Direct coordination and interactions through SEP membership of GCOS, CEOS, GEO, GSICS, CGMS, WMO, GEWEX.

- Interaction with newly formed WCRP WDAC (WCRP Data Advisory Council) on the provision of CDRs for climate research in all WCRP major projects (CLIVAR, GEWEX, SPARC and CliC)[1].
- Interaction with WCRP GEWEX GDAP on sustaining GEWEX CDRs.

4 IMPLEMENTATION TASK FOR SCOPE-CM PHASE 2

4.1 SCOPE-CM proposal initiation

ID	*Task*	*Implementer*	*Due*
T01	Prepare high-level close-out document on achievements of SCM Phase I projects	Secretariat	Dec 2012
T02	Preparation of a call for SCOPE-CM proposals and submit to SEP for approval	Secretariat	Jan 2013
T03	Approval of proposal call and publication/issuance	SEP	Feb 2013
T04	Reception and analysis of proposals	Secretariat	Apr 2013
T05	Proposal Evaluation and decisions	SEP	May 2013

4.2 Extension of SCOPE-CM

ID	*Task*	*Implementer*	*Due*
T06	Proactively foster the extension of the SCOPE-CM participating organisations	SEP/Secretariat	continuous
T07	Assess the need and functions of SCOPE-CM working groups in support of SEP	SEP	continuous
T08	Establish formal and/or specific interfaces/interactions with other relevant organisations and initiatives	Secretariat	May-Jul 2013, in conjunction with Phase II projects

4.3 Setup for SCOPE-CM information and procedures

ID	*Task*	*Implementer*	*Due*
T09	Update SCOPE-CM web presence	Secretariat, WMO	Oct 2012
T10	Develop and maintain SCOPE-CM Web services	Secretariat	Mar 2013
T11	Have SEP and CEOS WGC endorse the first level of the MMM, including possible amendments	Secretariat	Mar 2013
T12	Preparation of MAR generic organisation procedures	Secretariat	May 2013

[1] Names maybe subject for change.

ID	*Task*	*Implementer*	*Due*
T13	Establish and maintain a list of CDR capabilities with assigned Maturity Index, with links to the CDR producers	Secretariat	after the first Maturity Assessment Reviews
T14	Adaptation of the second level of the Maturity Matrix Model for SCOPE-CM	Secretariat	As necessary
T15	Contribute to the standardisation of Maturity Matrix Model (1st level)	Secretariat/SEP	As necessary
T16	promote progress in SCOPE-CM CDR record generation and maturity via Web page and by other means.	Secretariat	July 2013

5 REFERENCES

[RD-01] SCOPE-CM Implementation against the Implementation Plan (Version 1.3)

[RD-02] GCOS-143, 2010: Guideline for the Generation of Datasets and Products Meeting GCOS Requirements

[RD-03] GCOS-83, 2003: Second Report on the Adequacy of the Global Observing Systems for Climate in Support of the UNFCCC

[RD-04] GCOS-138, 2010: Implementation Plan for the Global Observing System for Climate in Support of the UNFCCC

[RD-05] GCOS-153, 2011: Systematic Observation Requirements For Satellite-Based Data Products For Climate 2011 Update

[RD-06] WMO, CGMS, CEOS, 2012: Strategy Towards an Architecture for Climate Monitoring from Space, Ed. Mark Dowell, in press.

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APPENDIX A TERMS OF REFERENCE SCOPE-CM EXECUTIVE PANEL

1. Provide overall guidance for the Global Network of SCOPE-CM centres.

2. Oversee and assess the performance of the SCOPE-CM, including the activities of the SCOPE-CM Secretariat, the individual SCOPE-CM Projects, the SCOPE-CM Working Groups.

3. Decide on the extension of SCOPE-CM network through new participating organisations.

4. Agree on principles and standards for SCOPE-CM products.

5. Evaluating and deciding on SCOPE-CM project proposals, taking into account existing capabilities within the network, user needs and maturity.

6. Report to WMO Space Programme, on the status and accomplishments of the SCOPE-CM.

7. Assess the results and recommendation of Maturity Assessment Reviews at the end of each SCOPE-CM Project.

8. Assess the applicability and adequacy of the Maturity Matrix Model, to decide on an applicable version for SCOPE-CM and to support its evolution.

9. Organize workshops and sessions at scientific meetings to advance the objectives of SCOPE-CM and publicize the program's achievements.

10. Develop and implement mechanisms for obtaining feedback from users of SCOPE-CM deliverables.

11. Review and oversee the utility and acceptance of FCDRs and ECV satellite products by the climate community.

12. Ensure coordination with related initiatives and programs.

13. Maintain the SCOPE-CM Implementation Plan.

14. Agree on the rules of procedure of the SEP.

APPENDIX B GCOS CLIMATE MONITORING PRINCIPLES

Effective monitoring systems for climate should adhere to the following principles:

1. The impact of new systems or changes to existing systems should be assessed prior to implementation.

2. A suitable period of overlap for new and old observing systems is required.

3. The details and history of local conditions, instruments, operating procedures, data processing algorithms and other factors pertinent to interpreting data (i.e., metadata) should be documented and treated with the same care as the data themselves.

4. The quality and homogeneity of data should be regularly assessed as a part of routine operations.

5. Consideration of the needs for environmental and climate-monitoring products and assessments, such as IPCC assessments, should be integrated into national, regional and global observing priorities.

6. Operation of historically-uninterrupted stations and observing systems should be maintained.

7. High priority for additional observations should be focused on data-poor regions, poorly-observed parameters, regions sensitive to change, and key measurements with inadequate temporal resolution.

8. Long-term requirements, including appropriate sampling frequencies, should be specified to network designers, operators and instrument engineers at the outset of system design and implementation.

9. The conversion of research observing systems to long-term operations in a carefully-planned manner should be promoted.

10. Data management systems that facilitate access, use and interpretation of data and products should be included as essential elements of climate monitoring systems.

Furthermore, operators of satellite systems for monitoring climate need to:

(a) Take steps to make radiance calibration, calibration-monitoring and satellite-to-satellite cross-calibration of the full operational constellation a part of the operational satellite system; and

(b) Take steps to sample the Earth system in such a way that climate-relevant (diurnal, seasonal, and long-term interannual) changes can be resolved.

Thus, satellite systems for climate monitoring should adhere to the following specific principles:

11. Constant sampling within the diurnal cycle (minimizing the effects of orbital decay and orbit drift) should be maintained.

12. A suitable period of overlap for new and old satellite systems should be ensured for a period adequate to determine inter-satellite biases and maintain the homogeneity and consistency of time-series observations.

13. Continuity of satellite measurements (i.e. elimination of gaps in the long-term record) through appropriate launch and orbital strategies should be ensured.

14. Rigorous pre-launch instrument characterization and calibration, including radiance confirmation against an international radiance scale provided by a national metrology institute, should be ensured.

15. On-board calibration adequate for climate system observations should be ensured and associated instrument characteristics monitored.

16. Operational production of priority climate products should be sustained and peer-reviewed new products should be introduced as appropriate.

17. Data systems needed to facilitate user access to climate products, metadata and raw data, including key data for delayed-mode analysis, should be established and maintained.

18. Use of functioning baseline instruments that meet the calibration and stability requirements stated above should be maintained for as long as possible, even when these exist on de-commissioned satellites.

19. Complementary in situ baseline observations for satellite measurements should be maintained through appropriate activities and cooperation.

20. Random errors and time-dependent biases in satellite observations and derived products should be identified.

APPENDIX C GCOS GUIDELINE FOR THE GENERATION OF DATASETS AND PRODUCTS MEETING GCOS REQUIREMENTS

[Extract from document GCOS-143 (WMO/TD No. 1530)]:

> *Specifically, to ensure full documentation, transparency and scientific stewardship in the generation (and update) of FCDRs and ECV products, the GCOS Steering Committee* ***recommends that data producers pay particular attention to the following 12 needs:***

1. Full description of all steps taken in the generation of FCDRs and ECV products, including algorithms used, specific FCDRs used, and characteristics and outcomes of validation activities.

2. Application of appropriate calibration/validation activities.

3. Statement of expected accuracy6, stability and resolution (time, space) of the product, including, where possible, a comparison with the GCOS requirements.

4. Assessment of long-term stability and homogeneity of the product.

5. Information on the scientific review process related to FCDR/product construction (including algorithm selection), FCDR/product quality and applications.

6. Global coverage of FCDRs and products where possible.

7. Version management of FCDRs and products, particularly in connection with improved algorithms and reprocessing.

8. Arrangements for access to the FCDRs, products and all documentation.

9. Timeliness of data release to the user community to enable monitoring activities.

10. Facility for user feedback.

11. Application of a quantitative maturity index if possible.

12. Publication of a summary (a webpage or a peer-reviewed article) documenting point-by-point the extent to which this guideline has been followed.

APPENDIX D SCOPE-CM EXECUTIVE PANEL RULES OF PROCEDURES

SCOPE-CM Executive Panel
Rules of Procedures

Document change history

1. **Membership**: Members of the SCOPE-CM Executive Panel (SEP) are the nominated representatives of the participating Organisations, WMO Space Programme and GCOS as full members and representatives of CEOS, CGMS (GSICS), GEO and WCRP (GEWEX) as associated members. Observers from other agencies/initiatives are also welcome to participate in SEP activities.

Revision	*Date*	*Changes*
0.1	13 October 2009	First draft document version, submitted to SEP 03
0.2	4 October 2010	Second draft document submitted to SEP 05
0.3	24 August 2011	Third draft document submitted to SEP 06
1.0	30 September 2011	Approved by SEP

2. **Chairperson**: One SEP full member will act as chairperson upon decision of the SEP. The initial term is 3 years with one possible extension.
3. **SCOPE-CM Secretariat**: The activities of the Executive Panel are supported by the SCOPE-CM Secretariat. The secretariat liaises with the SEP chairperson and the participating organisations the as necessary.
4. **Meetings**: The SEP and the SCOPE-CM Secretariat will meet at least once a year and may hold additional meetings as agreed by the Executive Panel. The SEP will work also by correspondence and virtual meetings. Participants from other organisations and in particular experts from the SCOPE-CM projects/activities may be invited to the meetings.
5. **Decisions**: The decisions in the Executive Panel will be made by consensus.
6. **Documents**: All new documents for consideration by the SEP will be numbered and released by the SCOPE-CM Secretariat to all panel members at least 1 working week in advance of a meeting of the SEP, to allow sufficient time for the review of documents.
7. **Minutes**: The Secretariat will produce a draft minutes of SEP meetings including decisions, actions, and timelines for completing actions, no later than 2 working weeks following SEP meetings. SEP members will review the minutes and provide comments

within 2 working weeks after submission. The Secretariat will release the agreed final minutes within 2 working weeks after receiving the comments.

8. **Effective Date**: These Rules of Procedure will take effect immediately upon adoption by the SEP.
9. **Amendment**: These Rules of Procedure may be amended by the SEP at any meeting. Proposals to amend these rules of procedure should be submitted to the Secretariat prior to the SEP meeting at which the amendment will be considered.

APPENDIX E LIST OF SCOPE-CM RELEVANT ACTIONS FROM THE 2010 UPDATE OF THE GCOS IMPLEMENTATION PLAN

E.1 Action C5 *[IP-04 C7]*

Action:	**Ensure an orderly process for sustained operation of research-based networks and systems for ECVs.**
Who:	All organizations operating networks contributing to GCOS.
Time-Frame:	Continuous.
Performance Indicator:	Number of sustained networks and systems.
Annual Cost Implications:	Covered in domains.

E.2 Action C6 *[IP-04 C8]*

Action:	**Ensure all climate observing activities adhere to the GCMPs.**
Who:	Parties and agencies operating observing programmes, including calibration undertaken in collaboration with national metrology institutes.
Time-Frame:	Continuous, urgent.
Performance Indicator:	Extent to which GCMPs are applied.
Annual Cost Implications:	Covered in domains. See Action C8 for satellite component.

E.3 Action C8 *[IP-04 C10]*

Action:	**Ensure continuity and over-lap of key satellite sensors; recording and archiving of all satellite metadata; maintaining appropriate data formats for all archived data; providing data service systems that ensure accessibility; undertaking reprocessing of all data relevant to climate for inclusion in integrated climate analyses and reanalyses, undertaking sustained generation of satellite-based ECV products.**
Who:	Space agencies and satellite data reprocessing centres.
Time-Frame:	Continuing, of high priority.
Performance Indicator:	Continuity and consistency of data records.
Annual Cost Implications:	Covered in the domains.

E.4 Action C10 *[IP-04 C11]*

Action:	**Prepare the atmospheric, oceanic, terrestrial and cryospheric datasets and metadata, including historic data records, for climate analyses and reanalyses.**
Who:	Parties with Data Centres (e.g., WDCs), working together with technical commissions and the scientific community, especially the joint WOAP/AOPC Working Group on Observational Datasets for Reanalysis and the ACRE collaborative initiative.
Time-Frame:	Now and ongoing.
Performance Indicator:	New or improved datasets available for analysis or reanalysis.
Annual Cost Implications:	Covered in domains.

E.5 Action C18

Action:	**Apply standards and procedures for metadata and its storage and exchange.**
Who:	Operators of GCOS related systems, including data centres.
Time-Frame:	Initial implementation of the operational WIS and GEOSS systems is occurring in 2010, implementations will be ongoing thereafter.
Performance Indicator:	Number of ECV related datasets accessible through standard mechanisms.
Annual Cost Implications:	<1M US$ (20 k US$ per data centre) (10% in non-Annex-I Parties).

E.6 Action A23 *[IP-04 A22]*

Action:	**Continue the climate data record of visible and infrared radiances, e.g., from the International Satellite Cloud Climatology Project, and include additional data streams as they become available; pursue reprocessing as a continuous activity taking into account lessons learnt from preceding research.**
Who:	Space agencies, for processing.
Time-Frame:	Continuous.
Performance Indicator:	Long-term availability of global homogeneous data at high frequency.
Annual Cost Implications:	10-30M US$ (for generation of datasets and products) (Mainly by Annex-I Parties).

E.7 Action T25 *[IP-04 T21]*

Action:	**Implement globally coordinated and linked data processing to retrieve land surface albedo from a range of sensors on a daily and global basis using both archived and current Earth Observation systems.**
Who:	Space agencies, through the CGMS and WMO Space Programme.
Time-Frame:	Reprocess archived data by 2012, then generate continuously.
Performance Indicator:	Completeness of archive.
Annual Cost Implications:	1-10M US$ (Mainly by Annex-I Parties)