MONITORING COMPLETENESS/PROGRESS OF CLIMATE DATA RECORD GENERATION

(ESTABLISHING COMMON PROCEDURES FOR CLIMATE OBSERVATION IN THE EU FP7 CORE-CLIMAX PROJECT)

EUMETSAT

User Perspective

I need good new data … and quickly. A new data product could be very good, but if it is not being conveniently served and described, it is not good for me…
So I am going to use whatever I have and know already.

User

10/21/2011 Leptoukh QA4EO'11

QA4ECV Approach to E and QC

Users need clear info on validity of EO/climate data records

Climate Data Records available, but need info on strength/weakness and fitness for purpose

Need objective system

Need guidance

Quality Assurance System

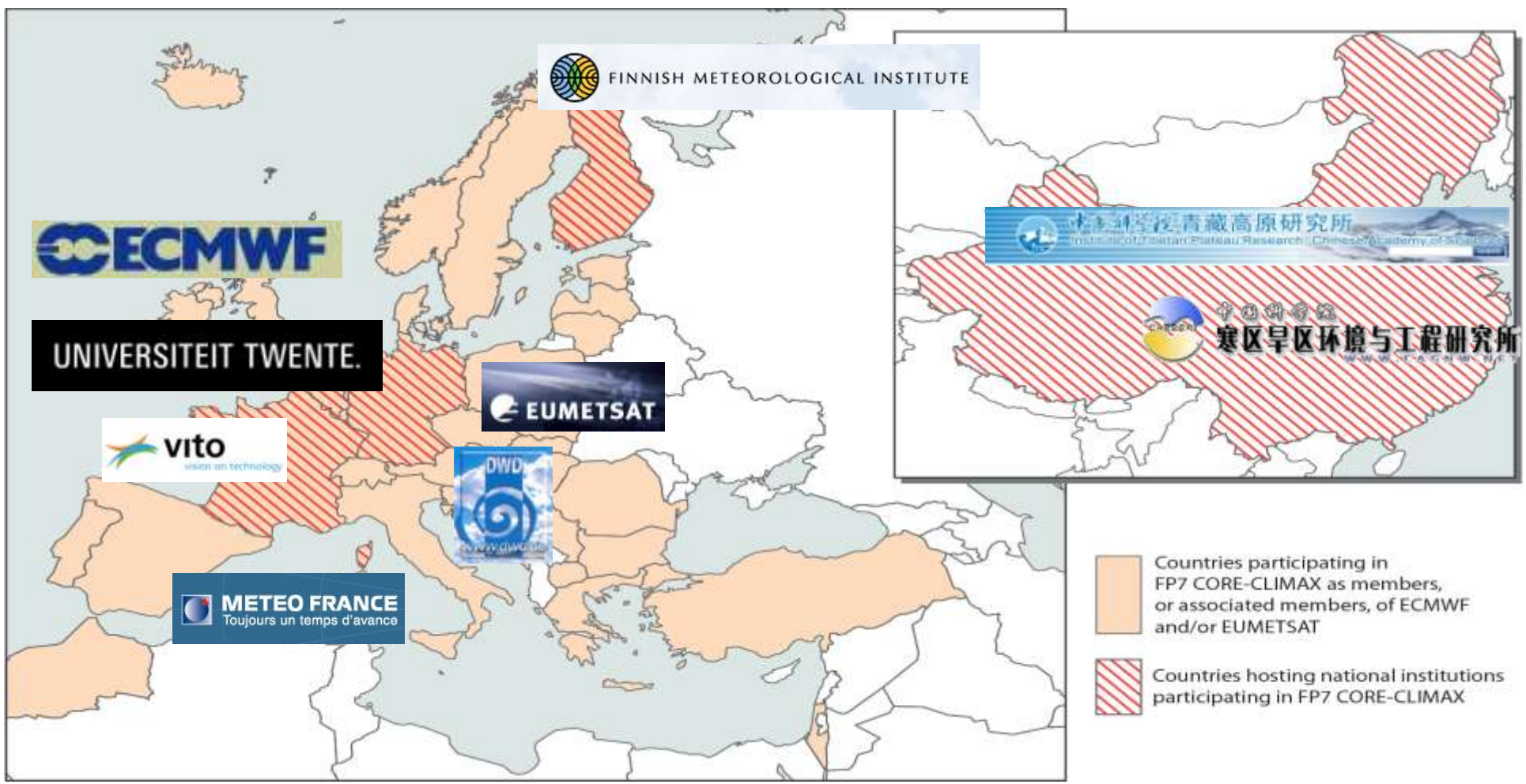
- Provides traceable quality info on EO/climate data;
- Tied to international standards;
- QA processes and tools to support user community in tracing quality;

Quality assured multi-decadal Climate Data Records of GCOS ECVs (includes all inputs, such as FCDRs into it).

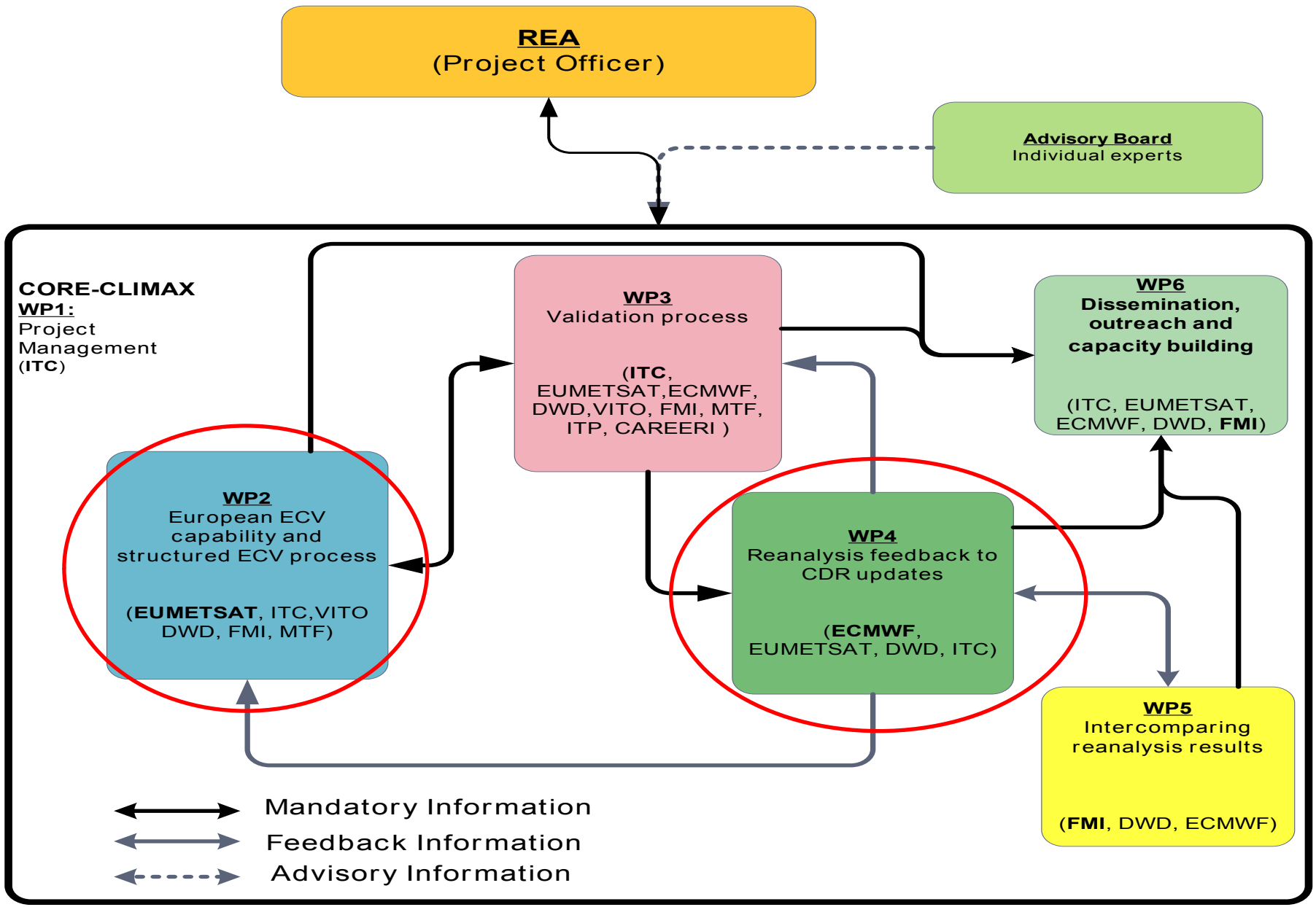
CORE-CLIMAX

Coordinating Earth observation data validation for RE-analysis for CLIMAte ServiceS

Bob Su on behalf of CORE-CLIMAX TEAM



CORE-CLIMAX work packages



EU FP7 CORE-CLIMAX WP2
Assessment of European Capacity for CDRs

- Assessment of European capacity producing Climate Data Records (CDR):
  - Provides consistent view on strengths and weaknesses of the process to generate, preserve and improve CDRs to each individual CDR producer, agencies and EC;
  - Provides information to the user community on:
    - Status of individual records;
    - Collective state of all records;
  - Provides this information for the first time across different observing and production systems (satellite, in situ and reanalysis);
  - Increases transparency and openness towards the user;
  - Potentially supports selection of CDRs for Copernicus Climate Change Service;
  - Supports Europe's contribution to the next Obs4Mips activity in the framework of the Climate Model Inter-comparison (CMIP-6) by providing consistent information on CDRs produced in Europe.
- Workshop held at EUMETSAT 21-23 January 2014 endorsed assessment concept and tools and performed self assessment of 30 CDRs (23 satellite, 6 in situ and one reanalysis);

EU FP7 CORE-CLIMAX
Assessment of European Capacity for CDRs

The capacity is assessed using three support tools developed by the project:

- **Data Record Descriptions (DRD)**
  - Contain technical specifications and links to documented information on quality;
  - Provides consistent and coherent information about CDRs produced in Europe (serves as input to CMIP-6 obs4mips activities).
- **System Maturity Matrix (SMM)**
  - Evaluates if the production of a CDR follows best practices for science and engineering and is assessing if data records are used and feedback mechanisms are implemented;
  - The SMM can be used in self assessment mode or in an audit type assessment.
- **Application Performance Metric (APM)**
  - Evaluates the performance of a CDR with respect to a specific application;
  - Might be implemented as an interactive App that convolves user requirements with product specification information in a database.

CORE CLIMAX Assessment Workshop

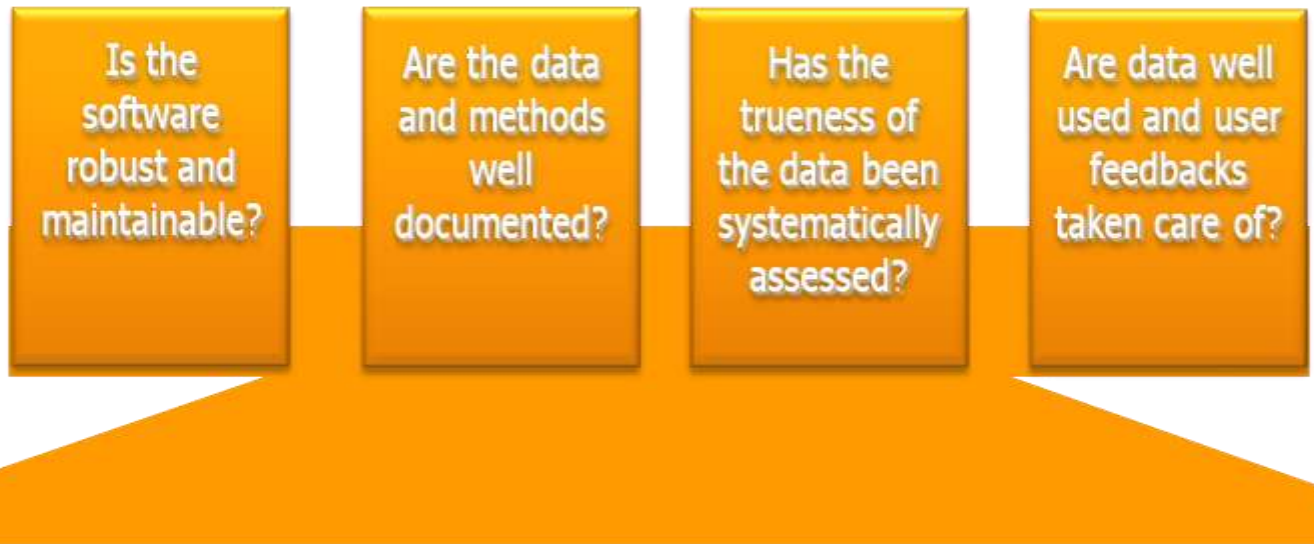
- Workshop held at EUMETSAT 21-23 January 2014;
- Performed self assessment of 30 CDRs (23 satellite, 6 in situ and one reanalysis) prior to the workshop;
- Develop common understanding on the developed System Maturity Matrix (SMM);
- Recommend to CORE-CLIMAX needed improvements to the SMM and instruction manual;
- Discuss results of self assessment;
- Discuss and agree on way forward for external/independent assessment;
- Discuss value and potential of the Application Performance Matrix concept and its implementation.

Data Set Description

Each CDR provider is asked to provide a Data Set Description

1. INTENT OF THE DOCUMENT
   Brief description of CDR presented
2. POINT OF CONTACT
   Information on CDR provider
3. DATA FIELD DESCRIPTION
   Information on the technical product specifications (format, fields etc)
4. DATA ORIGIN
   Description of the input data used (stations, satellites, etc)
5. VALIDATION AND UNCERTAINTY ESTIMATE
   Description of the validation procedure adopted
6. CONSIDERATIONS FOR CLIMATE APPLICATIONS
   Description of limitations to be considered
7. INSTRUMENTS OVERVIEW
   Detailed description of the measurement system
8. REFERENCES

Maturity Matrix Concept



Software readiness	Metadata	User documentation	Uncertainty Characterisation	Public Access, Feedback and Update	Usage
Are the codes compliant with standards, stable, portable and reproducible?	Do the metadata meet international standards, and allow provenance tracking?	Are the formal documents and peer-reviewed papers up-to-date and public?	Are the uncertainties assessed systematically in a standard manner?	Are the data, source code, and documents publicly available and regularly updated?	Are the data widely used in the scientific, and decision and policy making communities?

What the CORE-CLIMAX Project did for the SMM

- Made it applicable for in situ data records and other data sources such as reanalysis (we took out a lot of satellite specific language);
- Made it more easy applicable for agencies worldwide (we took out agency specific language);
- Concentrated it on the question of completeness in a sense of following best practices in science and engineering that developed over several decades;
- Tried to make the Maturity Matrix independent of individual applications;
- Accommodated many comments made by the CEOS Working Group Climate, the ESA CCI and the EUMETSAT SAFs in recent discussions of the maturity approach.

Core-Climax: System Maturity Matrix

Maturity	SOFTWARE READINESS	METADATA	USER DOCUMENTATION	UNCERTAINTY CHARACTERISATION	PUBLIC ACCESS, FEEDBACK, UPDATE	USAGE
1	Conceptual development	None	Limited scientific description of the methodology available from PI	None	Restricted availability from PI	None
2	Research grade code	Research grade	Comprehensive scientific description of the methodology, report on limited validation, and limited product user guide available from PI; paper on methodology is sumitted for peer-review	Standard uncertainty nomenclature is idenitified or defined; limited validation done; limited information on uncertainty available	Data avaliable from PI, feedback through scientific exchange, irregular updates by PI	Research: Benefits for applications identified DSS: Potential benefits identified
3	Research code with partially applied standards; code contains header and comments, and a README file; PI affirms portability, numerical reproducibility and no security problems	Standards defined or identified; sufficient to use and understand the data and extract discovery metadata	**Score 2 +** paper on methodology published; comprehensive validation report available from PI and a paper on validation is submitted; comprehensive user guide is available from PI; Limited description of operations concept available from PI	**Score 2 +** standard nomenclature applied; validation extended to full product data coverage, comprehensive information on uncertainty available; methods for automated monitoring defined	Data and documentation publically available from PI, feedback through scientifc exchange, irregular updates by PI	Research: Benefits for applications demonstrated. DSS: Use occuring and benefits emerging
4	**Score 3 +** draft software installation/user manual available; 3rd party affirms portability and numerical reproducibility; passes data providers security review	**Score 3 +** standards systematically applied; meets international standards for the data set; enhanced discovery metadata; limited location level metadata	**Score 3 +** comprehensive scientific description available from data provider; report on inter comparison available from PI; paper on validation published; user guide available from data provider; comprehensive description of operations concept available from PI	**Score 3 +** procedures to establish SI traceability are defined; (inter)comparison against corresponding CDRs (other methods, models, etc); quantitative estimates of uncertainty provided within the product characterising more or less uncertain data points; automated monitoring partially implemented	Data record and documentation available from data provider and under data provider's version control; Data provider establishes feedback mechanism; regular updates by PI	**Score 3 +** Research: Citations on product usage in occurring DSS: societal and economical benefits discussed
5	**Score 4 +** operational code following standards, actions to achieve full compliance are defined; software installation/user manual complete; 3rd party installs the code operationally	**Score 4+** fully compliant with standards; complete discovery metadata; complete location level metadata	**Score 4 +** comprehensive scientific description maintained by data provider; report on data assessment results exists; user guide is regularly updated with updates on product and validation; description on practical implementation is available from data provider	**Score 4 +** SI traceability partly established; data provider participated in one inter-national data assessment; comprehensive validation of the quantitative uncertainty estimates; automated quality monitoring fully implemented (all production levels)	**Score 4 +** source code archived by Data Provider; feedback mechanism and international data quality assessment are considered in periodic data record updates by Data Provider	**Score 4+** Research: product becomes reference for certain applications DSS: Societal and economic benefits are demonstrated
6	**Score 5 +** fully compliant with standards; Turnkey System	**Score 5 +** regularly updated	**Score 5 +** journal papers on product updates are and more comprehensive validation and validation of quantitative uncertainty estimates are published; operations concept regularly updated	**Score 5 +** SI traceability established; data provider participated in multiple inter-national data assessment and incorporating feedbacks into the product development cycle; temporal and spatial error covariance quantified; Automated monitoring in place with results fed back to other accessible information, e.g. meta data or documentation	**Score 5 +** source code available to the public and capability for continuous data provisions established (ICDR)	**Score 5 +** Research: Product and its applications becomes references in multiple research field DSS: Influence on decision and policy making demonstrated

Sub-Matrix - Uncertainty

SOFTWARE READINESS	METADATA	USER DOCUMENTATION	**UNCERTAINTY CHARATERISATION**	PUBLIC ACCESS, FEEDBACK, UPDATE	USAGE

	Standards	**Validation**	**Uncertainty quantification**	**Automated Quality Monitoring**
1	None	None	None	None
2	Standard uncertainty nomenclature is identified or defined	Validation using external reference data done for limited locations and times	Limited information on uncertainty arising from systematic and random effects in the measurement	None
3	Score 2 + Standard uncertainty nomenclature is applied	Validation using external reference data done for global and temporal representative locations and times	Comprehensive information on uncertainty arising from systematic and random effects in the measurement	Methods for automated quality monitoring defined
4	Score 3 + Procedures to establish SI traceability are defined	Score 3 + (Inter)comparison against corresponding CDRs (other methods, models, etc)	Score 3 + quantitative estimates of uncertainty provided within the product characterising more or less uncertain data points	Score 3 + automated monitoring partially implemented
5	Score 4 + SI traceability partly established	Score 4 + data provider participated in one inter-national data assessment	Score 4 + temporal and spatial error covariance quantified	Score 3 + monitoring fully implemented (all production levels)
6	Score 5 + SI traceability established	Score 4 + data provider participated in multiple inter-national data assessment and incorporating feedbacks into the product development cycle	Score 5 + comprehensive validation of the quantitative uncertainty estimates and error covariance	Score 5 + automated monitoring in place with results fed back to other accessible information, e.g. meta data or documentation

Maturity Matrix (OPE-FCDR)

MATURITY	SOFTWARE READINESS	METADATA	USER DOCUMENTATION	UNCERTAINTY CHARATERISATION	PUBLIC ACCESS, FEEDBACK, UPDATE	USAGE
1						
2						
3						
4						
5						
6						

FCDR AVHRR rad.

FCDR HIRS clear sky rad.

Maturity Matrix (Science-TCDR)

MATURITY	SOFTWARE READINESS	METADATA	USER DOCUMENTATION	UNCERTAINTY CHARATERISATION	PUBLIC ACCESS, FEEDBACK, UPDATE	USAGE
1						
2						
3						
4						
5						
6						

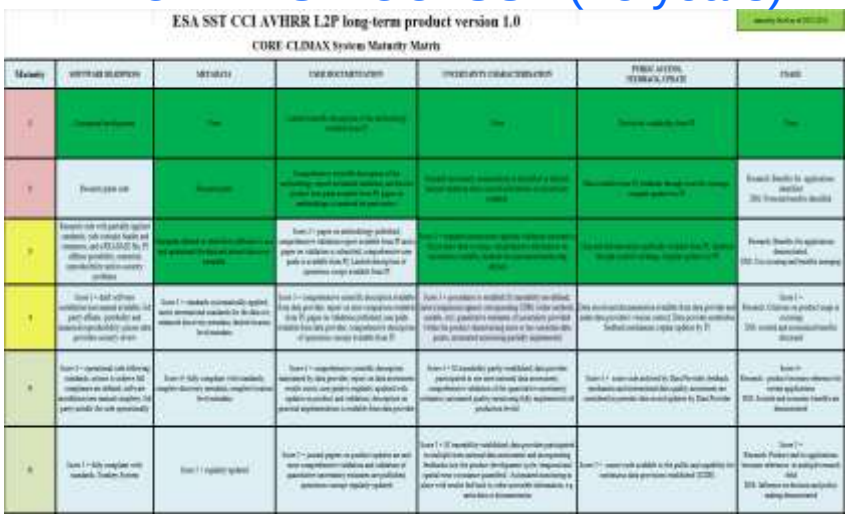
TCDR ESA-CCI Soil Moisture

TCDR ROM-SAF Radio Occult.

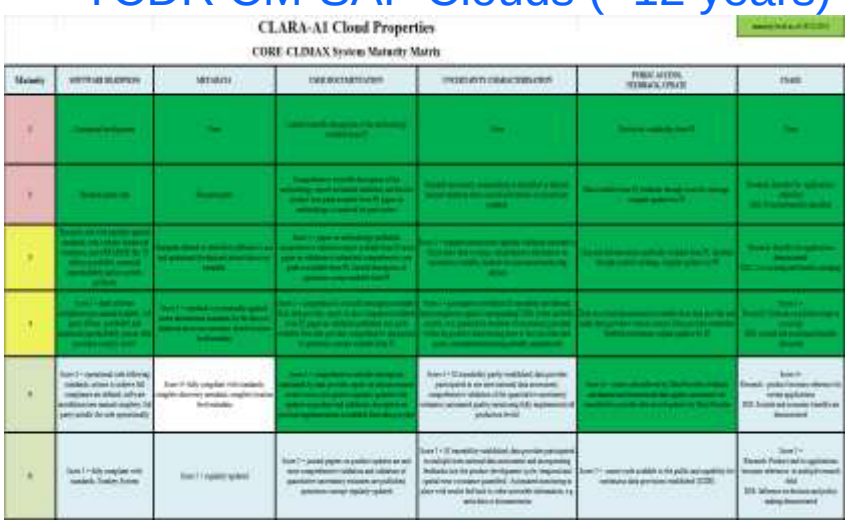
Maturing Takes Time
The SMMs need to be updated regularly

MATURITY	SOFTWARE READINESS	METADATA	USER DOCUMENTATION	UNCERTAINTY CHARATERISATION	PUBLIC ACCESS, FEEDBACK, UPDATE	USAGE
1						
2						
3						
4						
5						
6						

TCDR ESA-CCI SST (~5 years)



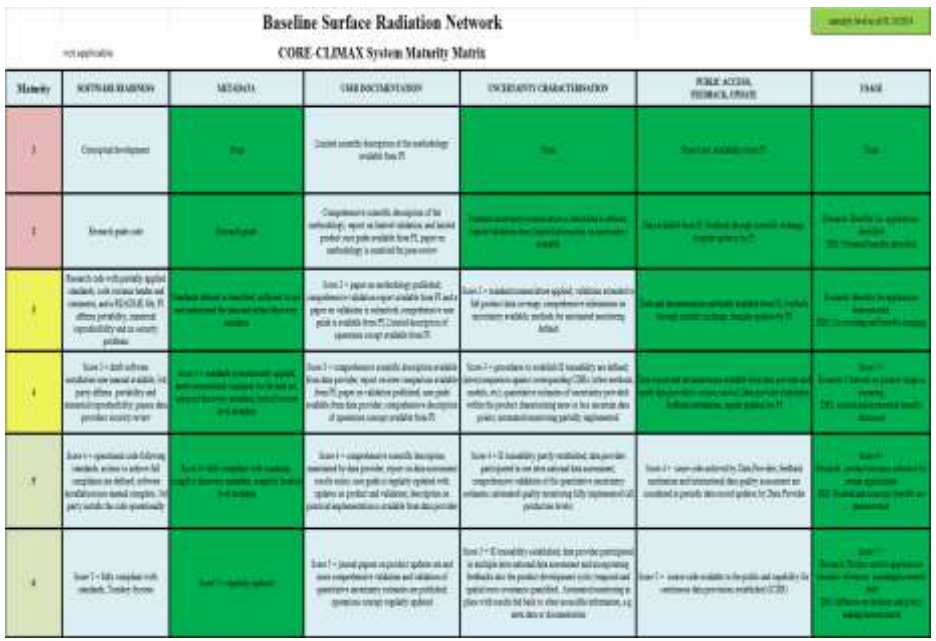
TCDR CM-SAF Clouds (~12 years)



Is the Core-Climax SMM concept generally applicable?

(In-situ, Satellite, and Reanalysis CDRs)

Baseline Surface Radiation Network (BSRN)

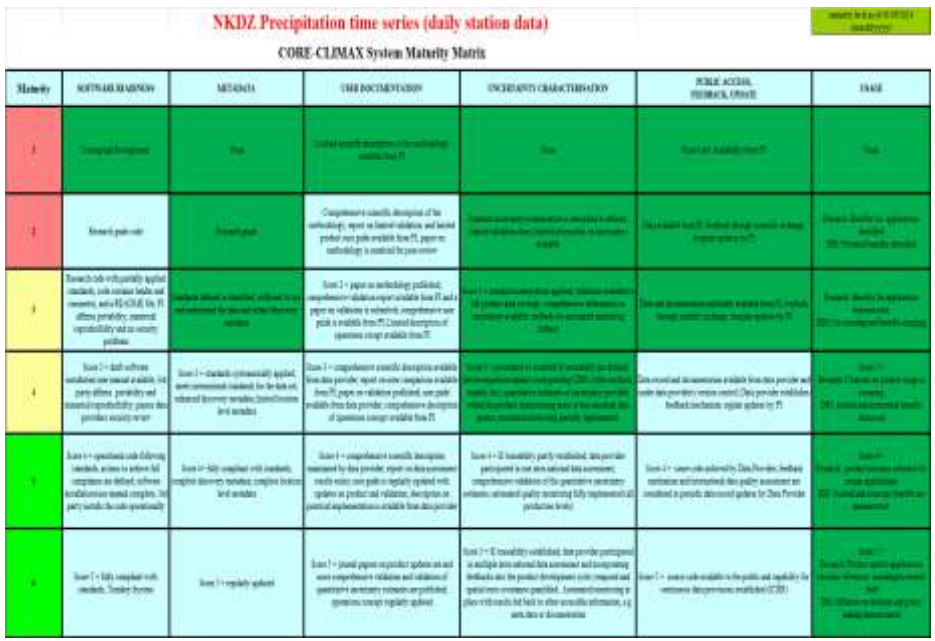


Baseline Surface Radiation Network

CORE-CLIMAX System Maturity Matrix

Maturity	SOFTWARE READINESS	METADATA	USER DOCUMENTATION	UNCERTAINTY CHARACTERISATION	PUBLIC ACCESS, FEEDBACK, UPDATE	USAGE
0	Conceptual development	None	Limited scientific description of the methodology available from PI	None	None (not available from PI)	None
1	Research grade code	Research grade	Comprehensive scientific description of the methodology, report on limited validation, and limited product user guide available from PI, papers on methodology is examined by peer-review	Limited assessment of uncertainties is described in different limited validation documents/reports or summaries available	Data is made from PI, feedback through scientific exchange, irregular updates by PI	Research describes use, applications described, CDR is used by handful of scientists
2	Research code with potentially applied standards, code contains bugs and comments, and no RELEASE file, PI defines portability, numerical reproducibility and no security problems	Standards followed as researched, sufficient to use and understand the data and to select data for a specific analysis	Score 2 = papers on methodology published, comprehensive validation report available from PI and a paper on validation is submitted, comprehensive user guide is available from PI, Limited description of operations concept available from PI	Score 2 = standard uncertainties applied, validation included in full product data coverage, comprehensive information on uncertainties available, methods for automated monitoring defined	Data and documentation publicly available from PI, feedback through scientific exchange, irregular updates by PI	Research describes the applications, CDR is in testing and benefits assessed
3	Score 2 + draft software installation now manual available, 3rd party difference, portability and numerical reproducibility, passes data provider security review	Score 2 + standards systematically applied, quasi-operational standards for the data set, enhanced discovery metadata, limited browse level metadata	Score 2 + comprehensive scientific description available from data provider, report on error comparison available from PI, paper on validation published, user guide available from data provider, comprehensive description of operations concept available from PI	Score 2 + procedures to establish CI traceability are defined, error comparisons against corresponding CDRs, (other methods, models, etc), quantitative estimates of uncertainty provided within the product characterising more or less accurate data points, automated monitoring partially implemented	Data stored and documentation available from data provider and made data providers version control, Data provider establishes feedback mechanism, regular updates by PI	Score 2 + Research CDR is in system ready to operate, CDR, assessed and documented benefits delivered
4	Score 3 + operational code following standards, access to achieve full compliance are defined, software installation now manual complete, 3rd party installs the code operationally	Score 3 = fully compliant with standards, complete discovery metadata, complete browse level metadata	Score 3 + comprehensive scientific description maintained by data provider, report on data assessment results exists, user guide is regularly updated with updates on product and validation, description on practical implementation is available from data provider	Score 3 + CI traceability partly established, data provider participated in one inter-national data assessment, comprehensive validation of the quantitative uncertainty estimates, automated quality monitoring fully implemented in all production levels	Score 3 + users code archived by Data Providers, feedback mechanism and systematized data quality assessment are established in periodic data record updates by Data Provider	Score 3 + Research, product assessed, refined to its certain application, CDR, Assessed and economic benefits are demonstrated
5	Score 4 + fully compliant with standards, Turnkey System	Score 4 = regularly updated	Score 4 = journal papers on product updates are and more comprehensive validation and validations of quantitative uncertainty estimates are published, operations concept regularly updated	Score 4 = CI traceability established, data provider participated in multiple inter-national data assessment and ensuring feedback into the product development cycle, temporal and spatial error covariances quantified, Automated monitoring in place with results fed back to other accessible information, e.g. users, data or documentation	Score 4 = source code available to the public and capability for continuous data provision established (CCDS)	Score 4 = Research, product assessed, refined to its certain application, CDR, Assessed and economic benefits are demonstrated, CDR, influence on decision and policy making demonstrated

NKDZ Precipitation time series



NKDZ Precipitation time series (daily station data)

CORE-CLIMAX System Maturity Matrix

Maturity	SOFTWARE READINESS	METADATA	USER DOCUMENTATION	UNCERTAINTY CHARACTERISATION	PUBLIC ACCESS, FEEDBACK, UPDATE	USAGE
0	Conceptual development	None	Limited scientific description of the methodology available from PI	None	None (not available from PI)	None
1	Research grade code	Research grade	Comprehensive scientific description of the methodology, report on limited validation, and limited product user guide available from PI, papers on methodology is examined by peer-review	Limited assessment of uncertainties is described in different limited validation documents/reports or summaries available	Data is made from PI, feedback through scientific exchange, irregular updates by PI	Research describes use, applications described, CDR is used by handful of scientists
2	Research code with potentially applied standards, code contains bugs and comments, and no RELEASE file, PI defines portability, numerical reproducibility and no security problems	Standards followed as researched, sufficient to use and understand the data and to select data for a specific analysis	Score 2 = papers on methodology published, comprehensive validation report available from PI and a paper on validation is submitted, comprehensive user guide is available from PI, Limited description of operations concept available from PI	Score 2 = standard uncertainties applied, validation included in full product data coverage, comprehensive information on uncertainties available, methods for automated monitoring defined	Data and documentation publicly available from PI, feedback through scientific exchange, irregular updates by PI	Research describes the applications, CDR is in testing and benefits assessed
3	Score 2 + draft software installation now manual available, 3rd party difference, portability and numerical reproducibility, passes data provider security review	Score 2 + standards systematically applied, quasi-operational standards for the data set, enhanced discovery metadata, limited browse level metadata	Score 2 + comprehensive scientific description available from data provider, report on error comparison available from PI, paper on validation published, user guide available from data provider, comprehensive description of operations concept available from PI	Score 2 + procedures to establish CI traceability are defined, error comparisons against corresponding CDRs, (other methods, models, etc), quantitative estimates of uncertainty provided within the product characterising more or less accurate data points, automated monitoring partially implemented	Data stored and documentation available from data provider and made data providers version control, Data provider establishes feedback mechanism, regular updates by PI	Score 2 + Research CDR is in system ready to operate, CDR, assessed and documented benefits delivered
4	Score 3 + operational code following standards, access to achieve full compliance are defined, software installation now manual complete, 3rd party installs the code operationally	Score 3 = fully compliant with standards, complete discovery metadata, complete browse level metadata	Score 3 + comprehensive scientific description maintained by data provider, report on data assessment results exists, user guide is regularly updated with updates on product and validation, description on practical implementation is available from data provider	Score 3 + CI traceability partly established, data provider participated in one inter-national data assessment, comprehensive validation of the quantitative uncertainty estimates, automated quality monitoring fully implemented in all production levels	Score 3 + users code archived by Data Providers, feedback mechanism and systematized data quality assessment are established in periodic data record updates by Data Provider	Score 3 + Research, product assessed, refined to its certain application, CDR, Assessed and economic benefits are demonstrated
5	Score 4 + fully compliant with standards, Turnkey System	Score 4 = regularly updated	Score 4 = journal papers on product updates are and more comprehensive validation and validations of quantitative uncertainty estimates are published, operations concept regularly updated	Score 4 = CI traceability established, data provider participated in multiple inter-national data assessment and ensuring feedback into the product development cycle, temporal and spatial error covariances quantified, Automated monitoring in place with results fed back to other accessible information, e.g. users, data or documentation	Score 4 = source code available to the public and capability for continuous data provision established (CCDS)	Score 4 = Research, product assessed, refined to its certain application, CDR, Assessed and economic benefits are demonstrated, CDR, influence on decision and policy making demonstrated

Providers of SMMs for In-Situ CDRs initially indicated that the **Software Readiness** and **User Documentation** categories
are not applicable to their data.

Support User's to Select Data

- User requirements collection exercises show a large variability in the stated requirements of users with nominally similar applications;
- But a core set of typical questions may always be isolated:

Coverage	Sampling	Uncertainty	Stability
Are the record length and spatial coverage meeting the application's requirements?	Do the spatial and temporal sampling meet the applications requirements?	Do the random and systematic uncertainties meet the requirements?	Do the temporal and spatial stability meet the requirements?

EU FP7 CORE-CLIMAX
Assessment of European Capacity for CDRs

- Events and activities after the CORE-CLIMAX workshop:
  - The workshop recommended to EUMETSAT to develop a prototype for the Application Performance Metric for a subset of TCDRs;
  - Project will continue to collect CDR self assessments from satellite and in situ data record providers until June 2014;
  - Project will evaluate the assessment results and report to the EC by December 2014;
  - ESA CCI endorsed the CORE-CLIMAX concept, may stop own development and will provide self assessments of all CCI data records (50% of the projects delivered at WS);
  - Concept was presented by us at ECMWF Copernicus Climate Change Workshop, 17-18 February 2014, recommended to be further developed during Stage 0 of CCCS and used for the assessment of system performance in the CCCS in the EQC pillar.

Additional slides describing the Maturity Matrix and its subcategories

Sub Matrix – Software Readiness

SOFTWARE READINESS	METADATA	USER DOCUMENTATION	UNCERTAINTY CHARATERISATION	PUBLIC ACCESS, FEEDBACK, UPDATE	USAGE

	Coding standards	Software Documentation	Numerical Reproducibility and Portability	Security
1	No coding standard or guidance identified or defined	No documentation	Not evaluated	Not evaluated
2	Coding standard or guidance is identified or defined, but not applied	Minimal documentation	PI affirms reproducibility under identical conditions	PI affirms no security problems
3	Score 2 + standards are partially applied and some compliance results are available	Header and process description (comments) in the code, README complete	PI affirms reproducibility and portability	Submitted for data provider's security review
4	Score 3 + compliance is systematically checked in all code, but not yet compliant to the standards.	Score 3 + a draft Software Installation/User Manual	3rd party affirms reproducibility and portability	Passes data provider's security review
5	Score 4 + standards are systematically applied in all code and compliance is systematically checked in all code. Code is not fully compliant to the standards. Improvement actions to achieve full compliance are defined.	Score 4 + enhanced process descriptions throughout the code; software installation/user manual complete	Score 4 + 3rd party can install the code operationally	Continues to pass the data provider's review
6	Score 5 + code is fully compliant with standards.	As in score 5	Score 5 + Turnkey system	As in score 5

Sub Matrix – Meta Data

SOFTWARE READINESS	METADATA	USER DOCUMENTATION	UNCERTAINTY CHARATERISATION	PUBLIC ACCESS, FEEDBACK, UPDATE	USAGE

	Standards	Collection level	File level
1	No standard considered	None	None
2	No standard considered	Limited	Limited
3	Metadata standards identified and/or defined but not systematically applied	Sufficient to use and understand the data independent of external assistance; Sufficient for data provider to extract discovery metadata from meta data repositories	Sufficient to use and understand the data independent of external assistance
4	Score 3 + standards systematically applied at file level and collection level by data provider. Meets international standards for the dataset	Score 3 + Enhanced discovery metadata	Score 3 + Limited location (pixel, station, grid-point, etc.) level metadata
5	Score 4 + meta data standard compliance systematically checked by the data provider	Score 4 + Complete discovery metadata meets international standards	Score 4 + Complete location (pixel, station, grid-point, etc.) level metadata
6	Score 5	Score 5 + Regularly updated	Score 5

Sub Matrix – User Documentation

SOFTWARE READINESS	METADATA	**USER DOCUMENTATION**	UNCERTAINTY CHARATERISATION	PUBLIC ACCESS, FEEDBACK, UPDATE	USAGE

	Formal description of scientific methodology	Formal Validation Report	Formal Product User Guide	Formal description of operations concept
1	Limited scientific description of methodology available from PI	None	None	None
2	Comprehensive scientific description available from PI and Journal paper on methodology submitted	Report on limited validation available from PI	Limited product user guide available from PI	None
3	Score 2 + Journal paper on methodology published	Report on comprehensive validation available from PI; Paper on product validation submitted	Comprehensive User Guide available from PI	Limited description of operations concept available
4	Score 3 + Comprehensive scientific description available from Data Provider	Report on inter-comparison to other CDRs, etc. Available from PI and data Provider; Journal paper on product validation published	Score 3 + available from data provider	Comprehensive description of operations concept available
5	Score 4 + Comprehensive scientific description maintained by data provider	Score 4 + Report on data assessment results exists	Score 4 + regularly updated by data provider with product updates and/or new validation results	Operations concept and description of practical implementation available
6	Score 5 + Journal papers on product updates published	Score 5+ Journal papers more comprehensive validation, e.g., error covariance, validation of qualitative uncertainty estimates published	Score 5	Score 5 + Operations concept regularly updated

Sub Matrix – Public Access, Feedback and Update

SOFTWARE READINESS	METADATA	USER DOCUMENTATION	UNCERTAINTY CHARATERISATION	**PUBLIC ACCESS, FEEDBACK, UPDATE**	USAGE

	Public Access/Archive	Version	User Feedback Mechanism	Updates to Record
1	Data may be available through request to PI	None	None	None
2	Data available through PI	Preliminary versioning by PI	PI collects and evaluates feedback from scientific community	Irregularly by PI following scientific exchange and progress
3	Data and documentation archived and available to the public from PI	Versioning by PI	PI and Data provider collect and evaluate feedback and from scientific community	Irregularly by PI following scientific exchange and progress
4	Data and documentation archived and available to the public from Data Provider	Version control institutionalised	Data provider establishes feedback mechanism such as regular workshops, advisory groups, user help desk, etc. and utilises feedback jointly with PI	Regularly by PI utilising input from established feedback mechanism
5	Score 4 + source code archived by Data Provider	Fully established version control considering all aspects	Established feedback mechanism and international data quality assessment results are considered in periodic data record updates	Regularly operationally by data provider as dictated by availability of new input data or new methodology following user feedback
6	Score 5 + source code available to the public from Data Provider	Not used	Score 5 + Established feedback mechanism and international data quality assessment results are considered in continuous data provisions (Interim Climate Data Records)	Score 5 + capability for fast improvements in continuous data provisions established (Interim Climate Data Records)

Sub Matrix - Usage

SOFTWARE READINESS	METADATA	USER DOCUMENTATION	UNCERTAINTY CHARATERISATION	PUBLIC ACCESS, FEEDBACK, UPDATE	USAGE

	Research	Decision Support System
1	None	None
2	Benefits for research applications identified	Potential benefits identified
3	Benefits for research applications demonstrated by publication	Use occurring and benefits emerging
4	Score 3 + Citations on product usage occurring	Score 3 + societal and economical benefits discussed
5	Score 4 + product becomes reference for certain applications	Score 4 + societal and economical benefits demonstrated
6	Score 5 + Product and its applications becomes references in multiple research field	Score 5 + influence on decision (including policy) making demonstrated