MONITORING COMPLETENESS/PROGRESS OF CLIMATE DATA RECORD GENERATION

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



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.





Leptoukh QA4EO'11

age 2



Adapted form Folkert Boersma, KNMI

Harmonised ECV retrievals & records – QA4ECV Kick-off meeting, 6-7 February 2014, De Bilt



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



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Quality Assurance	System
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- 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).

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CORE-CLIMAX

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

Bob Su on behalf of CORE-CLIMAX TEAM



EUM/OPS/VWG/14/748988, v1, 27 February 2014







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.





- 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



	Is the software robust and maintainable?	Are the data and methods well documented?	Has the trueness of the data bee systematical assessed?	Are data used and feedba taken ca	well user icks re of?
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?



- 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





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3	Score 2 + Standard uncertainty nomenclature is applied	Valida reference and tem loca	tion using external data done for global poral representative tions and times	Comprehensive information on uncertainty arising from systematic and random effects in the measurement		Methods f mor	or automated quality itoring defined
4	Score 3 + Procedures to establis SI traceability are defined	h Score 3 against (other m	+ (Inter)comparison corresponding CDRs ethods, models, etc)	Score 3 + quantitative uncertainty provided product characterising uncertain data p	estimates of within the more or less points	Score 3 + a partia	automated monitoring Ily implemented
5	Score 4 + SI traceability partly established	Score partici nationa	4 + data provider pated in one inter- al data assessment	Score 4 + temporal and spatial error covariance quantified		Score 3 impleme	+ monitoring fully nted (all production levels)
6	Score 5 + SI traceability established	Score participa national incorpor the produ	4 + data provider ted in multiple inter- data assessment and ating feedbacks into ict development cycle	Score 5 + comprehensiv of the quantitative un estimates and error of	ve validation ncertainty covariance	Score 5 + a in place wi other acces meta dat	automated monitoring th results fed back to sible information, e.g. a or documentation



Maturity Matrix (OPE-FCDR)

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Maturity Matrix (Science-TCDR)



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TCDR CM-SAF Clouds (~12 years)

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TCDR ESA-CCI SST (~5 years)

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Is the Core-Climax SMM concept generally applicable? (In-situ, Satellite, and Reanalysis CDRs)

Baseline Surface Radiation Network (BSRN)

	Baseline Surface Radiation Network construction CORE-CLIMAX System Materity Matrix								
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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:





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





	SOFTWARE READINESS	METADATA	USER DOCUMENTATION	UNCEI CHARAT	RTAINTY ERISATION	PUBLIC ACCESS, FEEDBACK, UPDATE	USAGE	
	Coding standard	ls	Software Documen	tation	Numerio	cal Reproducibility d Portability	Security	
0	No coding standard or gu identified or defined	uidance d	No documentation	n	٦	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 secu problems	ırity
8	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 da provider's securi review	ita ity
4	Score 3 + compliance is syst checked in all code, but r compliant to the stand;	tematically not yet ards.	Score 3 + a draft Software Installation/User Manual		3rd party affirms reproducibility and portability		Passes data provider's securi review	ity
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 data provider's review	the ;
6	Score 5 + code is fully comp standards.	pliant with	As in score 5		Score 5	5 + Turnkey system	As in score 5	





	SOFTWARE READINESS	METADATA	USER UNCERTAINTY DOCUMENTATION CHARATERISATION		PUBLIC ACCESS, FEEDBACK, UPDATE	USAGE	
Í	Stand	lards	Collect	ion level	File level		
0	No standard	considered	N	one	None		
Ž	No standard	considered	Lin	nited	Limited		
3	Metadata standard defined but not sys	s identified and/or tematically applied	Sufficient to use a data independ assistance; Sufficion to extract discov meta data	and understand the dent of external ent for data provider ery metadata from repositories	Sufficient to use and understand 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		I Score 3 + Enh met	anced discovery adata	Score 3 + Limited location (pixel, station, grid-point, etc.) level metadata		
6	Score 4 + meta data standard compliance systematically checked by the data provider		Score 4 + Cor metadata mee star	nplete discovery ets international ndards	Score 4 + Complete locati station, grid-point, etc. metadata	on (pixel, .) level	
6	Scor	re 5	Score 5 + Re	gularly updated	Score 5		





	SOFTWARE READINESS	METAD	ATA	USER DOCUMENTATION	UNCE CHARAT	RTAINTY ERISATION	PUBLIC ACC	ESS, PDATE	USAGE	
	Formal description scientific methodolo	of gy	Fo	ormal Validation Re	eport	Formal P G	roduct User uide	Forma oper	al descriptio ations conce	n of ept
D	Limited scientific descripti methodology available fro	on of m PI		None		٦	lone		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		Comprehens availat	sive User Guide ble from PI	Limit operatio	ed description	of ailable	
1	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 + data	available from provider	Compreh operatio	ensive descrip ns concept ava	ition of ailable	
5	Score 4 + Comprehensive scientific description maintained by data provider		Score 4 + Report on data assessment results exists		t Score 4 + regularly updated by data provider with product updates and/or new validation results		Opera descr implen	tions concept iption of practi nentation avail	and ical lable	
3	Score 5 + Journal papers on updates published	product	Sc comp cova unc	core 5+ Journal papers rehensive validation, e riance, validation of qu certainty estimates pul	more .g., error alitative olished	So	core 5	Score 5 - rec	+ Operations c gularly updated	:oncept J



Sub Matrix – Public Access, Feedback and Update



	SOFTWARE READINESS	METADATA	US	ER	UNCERTAINTY CHARATERISATION	PUBL FEEDBA	IC ACCESS, CK, UPDATE	USAGE	
	Public Access/Archive	Versio	on	Use	r Feedback Mechani	sm	Updat	es to Record	
O	Data may be available through request to PI	None	<u>;</u>		None			None	
2	Data available through PI	Preliminary ve by PI	ersioning [PI collect	ts and evaluates feedbac scientific community	ck from	Irregularly by exchang	PI following scie ge and progress	entific
8	Data and documentation archived and available to the public from PI	Versioning	by PI	PI and Da feedback	ita provider collect and e and from scientific corr	evaluate Imunity	Irregularly by exchan	PI following scie ge and progress	entific
4	Data and documentation archived and available to the public from Data Provider	Version cc institution	ontrol alised	Data p mechani advisory ر utili	provider establishes feed sm such as regular work groups, user help desk, ses feedback jointly with	lback kshops, etc. and i PI	Regularly by established f	PI utilising input feedback mechar	from nism
6	Score 4 + source code archived by Data Provider	Fully establishe control consic aspect	ed version dering all ts	Establis internat results २	hed feedback mechanisi ional data quality asses are considered in period record updates	m and sment ic data	Regularly op provider as dic new input dat followin	perationally by d tated by availab a or new methoo g user feedback	lata vility of dology
6	Score 5 + source code available to the public from Data Provider	Not us	ed	Score 5 + and interr results ar provisions	Established feedback me national data quality ass re considered in continuc s (Interim Climate Data I	echanism essment ous data Records)	Score 5 + improvement provisions & Climate	capability for fa ts in continuous established (Inte e Data Records)	st data rim





SOFTV READI	SOFTWARE READINESS METADATA		USER DOCUMENTATION	UNCERTAINTY CHARATERISATION	PUBLIC ACCESS, FEEDBACK, UPDATE	USAGE		
		Resear	ch	Decision S	Support System			
0		None						
2	Benefit	s for research app	plications identified	Potential b				
6	Benefits f	or research applic by publica	cations demonstrated	Use occurring and benefits emerging				
4	Score 3 -	 Citations on pro 	duct usage occurring	Score 3 + societal di				
6	Score 4 +	product becomes application	s reference for certain	Score 4 + societal dem				
6	Score 5 + refe	Product and its a Product and its a Product and its a Product and Its a Product of the Product o	applications becomes e research field	Score 5 + influence o making	n decision (including policy demonstrated	()		

