30 YEARS 1986-2016

EUMETSAT

How to Establish Confidence into Usage of Climate Data Products?

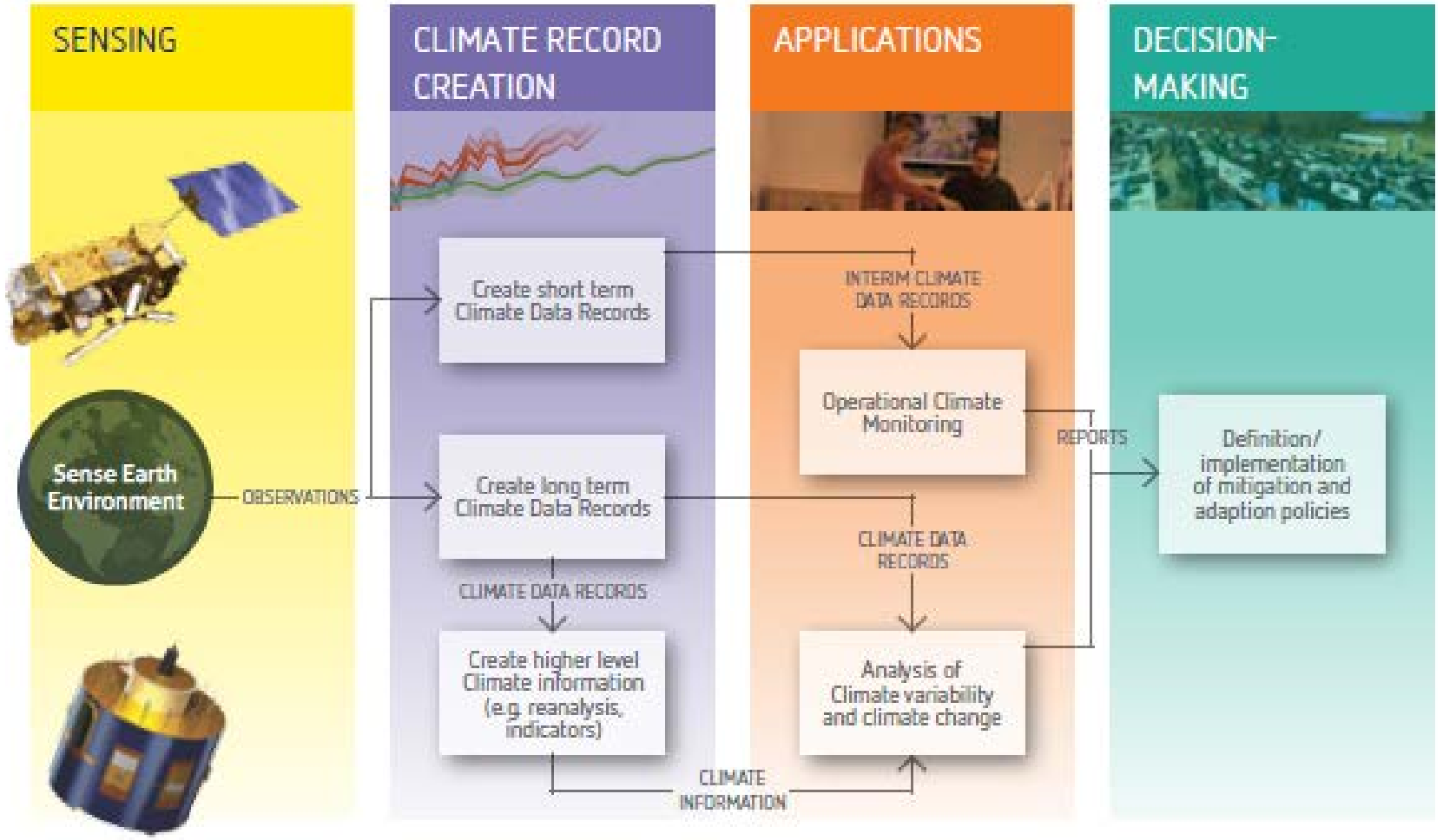
Jörg Schulz

Relevant Outcome of COP-21

Adaptation (Article 7(c)):

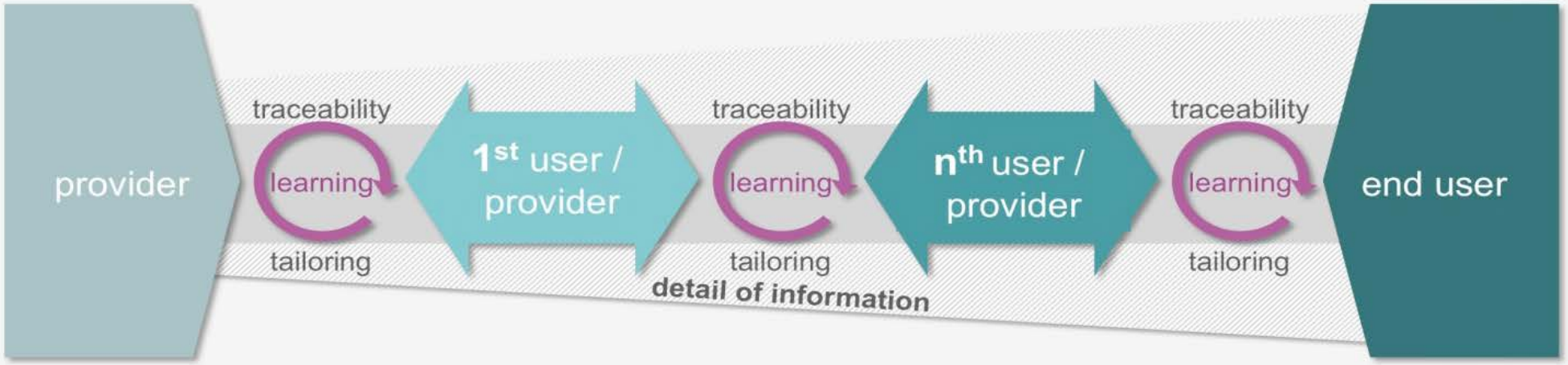
Strengthening scientific knowledge on climate, including research, *systematic observation of the climate system* and early warning systems, in a manner that *informs climate services and supports decision-making*

The Architecture for Climate Monitoring from Space



Implementation coordinated by
Joint CEOS – CGMS Working Group on Climate (JWG Climate)

Information Transfer



MEASUREMENTS / SIMULATIONS

- satellite, airborne and ground-based observations
- climate simulations
- data assimilation (re-analyses)

CLIMATE DATA PROCESSING

- climate data records (observational and re-analyses)
- ensemble simulations/ post-processing/ analyses
- impact modeling

CLIMATE INFORMATION

- confidence analysis
- extracting decision relevant knowledge
- co-development of prototypes

PRODUCTS

- application of user-tailored products by decision makers, public, media

© Otto, J., C. Brown, C. Buontempo, F. Doblas-Reyes, D. Jacob, M. Juckes, E. Keup-Thiel, B. Kurnik, J. Schulz, A. Taylor, T. Verhoelst, P. Walton, 2016: Uncertainty: Lessons learned for climate services. Bulletin of American Meteorological Society, submitted.

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

Adapted from Folkert Boersma, KNMI

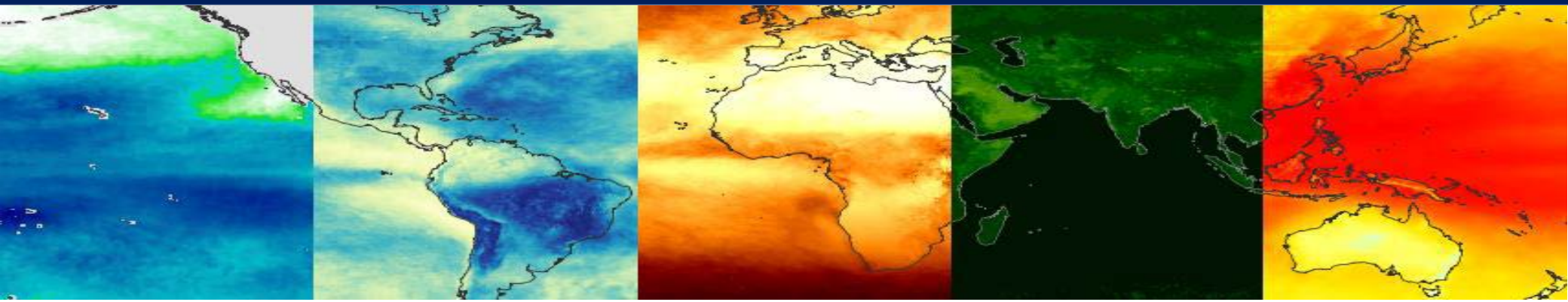
5. WP4 Harmonised ECV retrievals & records – QA4ECV Kick-off meeting, 6-7 February 2014, De Bilt

How to Build Confidence?

A potential strategy to build reputation and confidence could comprise of:

- Active and systematic management of data/information needs;
- Peer review process for the application oriented quality of products;
- Quality assurance for the processes applied to generate data/information.

Example: Application Oriented User Workshop



APPLICATIONS OF SATELLITE CLIMATE DATA RECORDS IN NUMERICAL MODELING

Organized by CM SAF and EUMETSAT
ECMWF | Shinfield Park, Reading | 15 – 17 November 2016

OBJECTIVES

- Establish feedback on and promote usage of EUMETSAT/CM SAF climate data in modelling applications

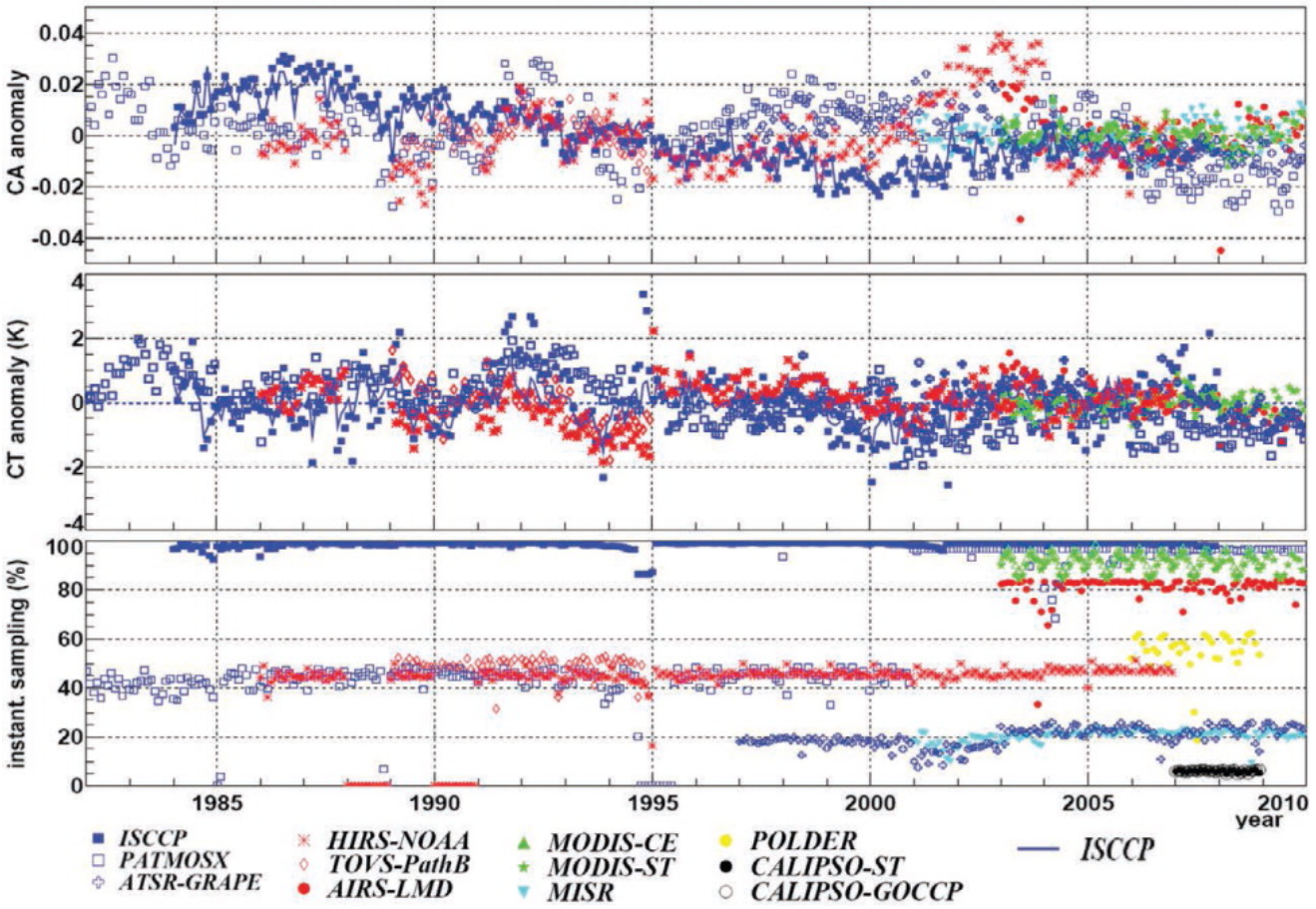
Topics

- Data assimilation and model initialization (using satellite data as 'input') ;
- Process-oriented model evaluation and improvement using satellite data;
- Operational validation and model performance using satellite data, e.g., Obs4Mips;
- Capture and discuss evolving user needs for future evolution of products.

WCRP
Structured Data Set Quality Assessments

GEWEX

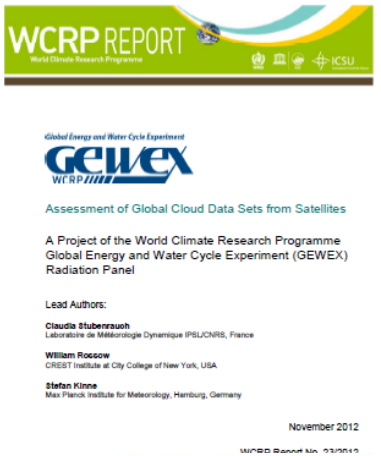
GEWEX Assessment of Cloud Data Records



Stubenrauch et al., BAMS, 2013

"An assessment of long-term variations in global-mean cloud amount from nine different satellite datasets by Stubenrauch et al. (2013) found differences between datasets were comparable in magnitude to the inter-annual variability. Such inconsistencies result from differences in sampling as well as changes in instrument calibration and inhibit an accurate assessment of global-scale cloud cover trends."

IPCC, Chapter 2, AR5, 2013


WCRP REPORT

Global Energy and Water Cycle Experiment
GEWEX
WCRP

Assessment of Global Cloud Data Sets from Satellites

A Project of the World Climate Research Programme
Global Energy and Water Cycle Experiment (GEWEX)
Radiation Panel

Lead Authors:

Claudia Stubenrauch
Laboratoire de Météorologie Dynamique IPSL/CNRS, France

William Rossow
CREST Institute at City College of New York, USA

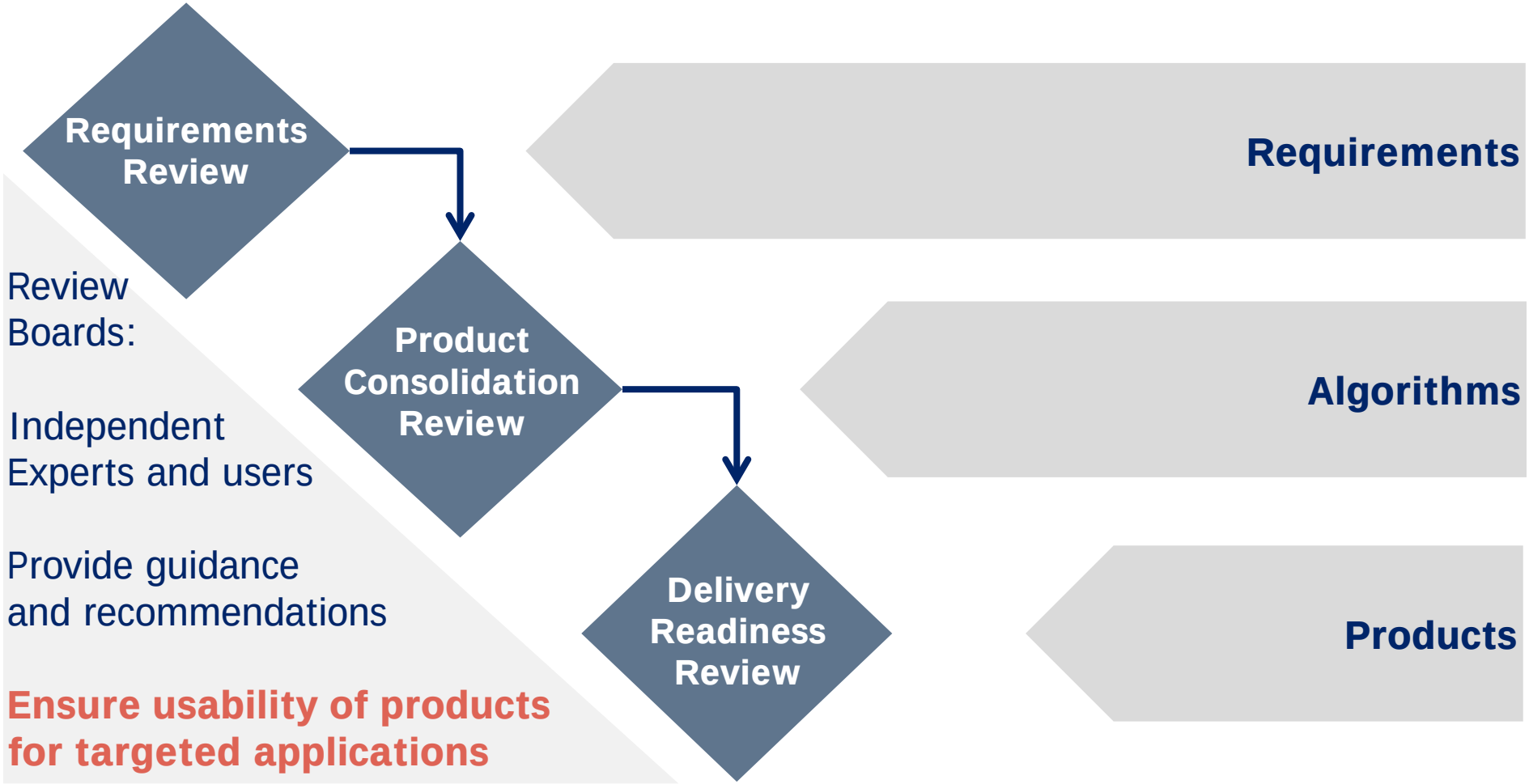
Stefan Kinne
Max Planck Institute for Meteorology, Hamburg, Germany

November 2012

GEWEX EUMETSAT

Decision Process for EUMETSAT Climate Data

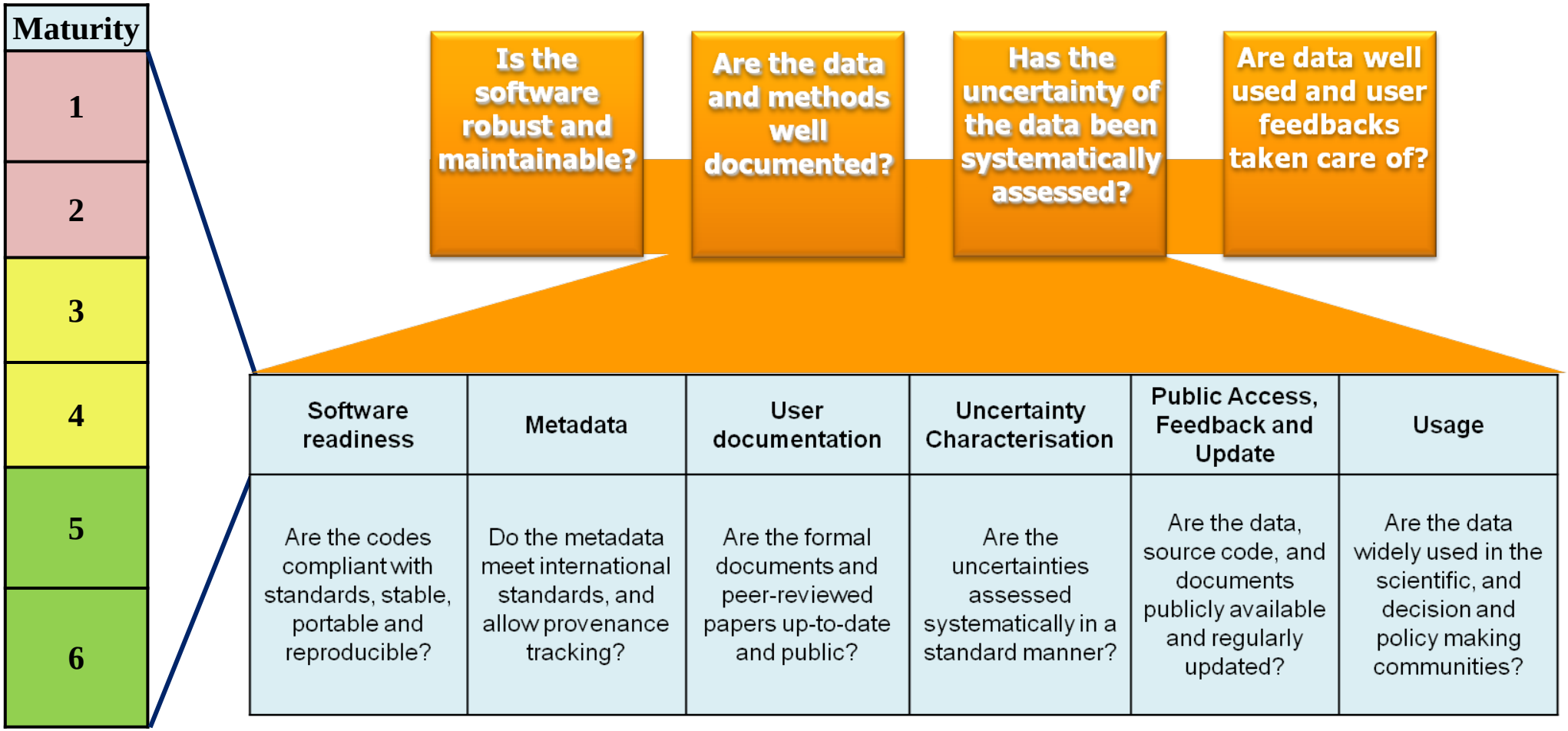
- Product lifecycle decisions by Steering Groups based on Review Board recommendations:



QA and Best Practices

- Climate Data Record developments in the last 20-30 years have led to common elements emerging as best practices;
- How do we capture and make available these best practices and ensure their application?
- Increasingly complex observing systems and resulting data records require more process control to ensure quality, access, and preservation;
- Software Engineering is also increasingly complex and process management is required to optimise cost, schedule, productivity and quality;
- Users deserve very good documentation, openness and transparency;
- It is imperative that Climate Services respond with quantifiable metrics that inform about both the scientific quality and process maturity of CDRs.

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?

Sub-Matrix – Uncertainty Characterisation

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

Example 1 – SSU L1b Radiances (FCDR)

Origin	NCDC/CLASS; Cheng-Zhi Zou cheng-zhi.zou@noaa.gov
Spatial Characteristics	Global
Temporal Characteristics	Dec 1978 – Jan 2006; Instantaneous

Status 2014

Software Readiness	Metadata	User Documentation	Uncertainty Characterisation	Public access, feedback, and update	Usage
Coding Standards	Standards	Formal description of scientific methodology	Standards	Public Access/Archive	Research
Software Documentation	Collection level	Formal validation report	Validation	Version	Decision support system
Numerical Reproducibility and portability	File level	Formal product user guide	Uncertainty quantification	User feedback mechanism	
Security		Formal description of operations concept	Automated quality monitoring	Updates to record	
Legend					
1	**2**	**3**	**4**	**5**	**6**

Example 2 – SSM/I Brightness Temperature (FCDR)

Origin	CM SAF; contact.cmsaf@dwd.de
Spatial Characteristics	Pixel resolutions varying with channels.
Temporal Characteristics	Jul 1987 – Dec 2008

Software Readiness	Metadata	User Documentation	Uncertainty Characterisation	Public access, feedback, and update	Usage
Coding Standards	Standards	Formal description of scientific methodology	Standards	Public Access/Archive	Research
Software Documentation	Collection level	Formal validation report	Validation	Version	Decision support system
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Legend					
1	**2**	**3**	**4**	**5**	**6**

Summary

- The process of formulating understandable user needs that reach the provider is important;
- Provider need to more systematically survey and understand user needs and develop application tailored products;
- Tailored products need to maintain traceability, e.g., for uncertainty estimates;
- Quality evaluation and control needs to consider both scientific and process dimensions;
- QA systems should include an evaluation of how far the provider follows best practises established over decades.

➢ Footnote: Process maturity estimates always need interpretation, they must not be used for a beauty contest by adding up or averaging scores or doing ranking.