Towards an Assessment of the European ECV CDR Capability

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EU FP7 Project: CORE-CLIMAX
COordinating Earth observation data validation for RE-analysis for CLIMAte ServiceS

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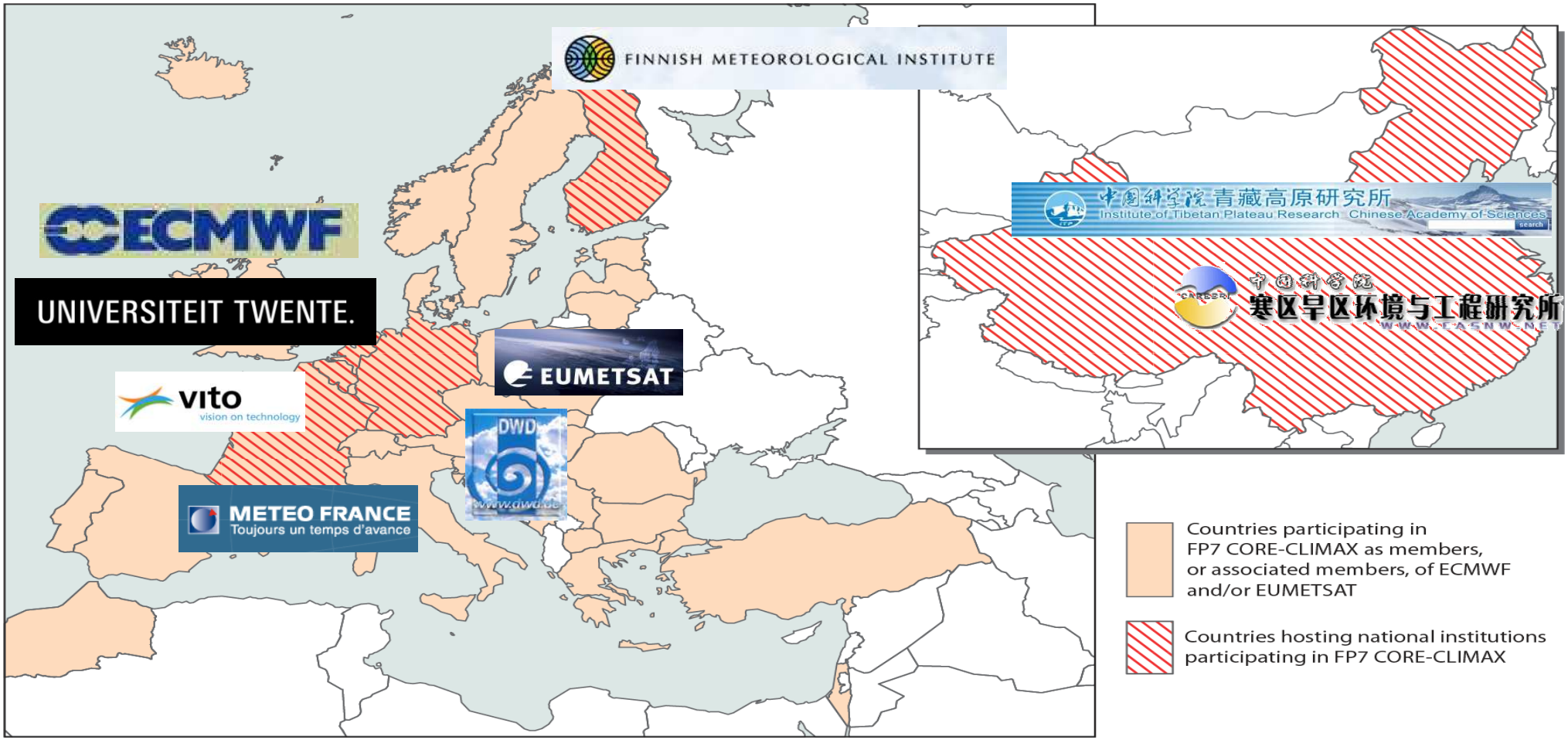

CORE-CLIMAX - Key Objectives and Deliverables

- Coordination with Copernicus ongoing activities to support the formulation of the Copernicus Climate Change Service;
- Major Objectives:
  - Analyse the European capability to generate ECV CDRs;
  - Develop a structured process for generating ECV CDRs – Best practises book on CDR generation;
  - Develop a validation process for ECV CDRs – establishes a protocol for validation and develops validation concepts for some ECVs;
  - Develop a feedback mechanism from NWP-based reanalysis – Establishes protocol for feedback from reanalysis to CDR provider and generates a CDR quality assessment procedure in reanalysis environment;
  - Develop a process for comparison of different NWP-based reanalysis - Establishes a protocol for comparison of re-analysis data.

Need to Assess European Capability

- The 2010 European capacity analysis (JRC report by Wilson et al.) concentrated on the space segment and was analysing data records only with a helicopter view;
- Europe has very capable institutions and project consortia to provide climate data records from in situ and satellite data as well as reanalysis (as shown by the FP7 EUGENE project) but what do we know about their maintainability and comparative quality?
- Many European activities (EC projects, ESA CCI, EUM SAFs) work in parallel and there is potential for duplications which we cannot afford;
- Long term investment into a space-based architecture for climate monitoring serving the Copernicus Climate Change Service and the Global Framework of Climate Services needs clear knowledge about the joint capability of Europe.

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Need for Tools to Assess the Capability

- We need to consider different aspects of our capability:
  - Scientific and engineering practises,
  - Utilisation of products,
  - Quality of products with respect to applications;
- Assessing if data record generation follows best practises provides an internal view on strengths and weaknesses of the processes to generate data record for agencies (including funding) and data record providers themselves;
- The assessment of quality of products is facilitating an external view on the data record trying to answer the most important user question: Is the quality good enough for my application.

Tools Used by CORE-CLIMAX Project

- We defined three elements for a capability assessment:
  - Data Record Inventories that contain technical specifications and also links to documented information on quality;
  - A System Maturity Matrix (SMM) that evaluates if the production of the ECV CDR follows best practices for science, engineering and utilisation;
  - An Application Performance Matrix (APM) that evaluates the performance of an ECV CDR with respect to a specific application.

The System Maturity Matrix

Maturity	SOFTWARE READINESS	METADATA	USER DOCUMENTATION	UNCERTAINTY CHARACTERISATION	PUBLIC ACCESS, FEEDBACK, UPDATE	UTILITY
1	Conceptual development	Little or none	Draft description on the theoretical basis of the methodology. Peer reviewed paper on methodology in preparation	Little or None	Restricted availability from PI	Little or none
2	Research grade code	Research grade	Description on the theoretical basis of the methodology. Peer reviewed paper on methodology published; draft validation report and user guide	Standards defined, limited information on uncertainty and quality, preliminary validation	Data avaliable from PI, feedback through scientific exchange, irregular updates by PI	Science application demontstrated by publication
3	Research code following producers standards with some portability, reproducibility	Research grade. Meets international standards for metadata, file naming conventions and file format for the dataset	Public description on the theoretical basis of the methodology. Peer reviewed paper on methodology published. Peer reviewed Paper on the product in preparation; reviewed validation report and user guide	Standards partially applied, information on uncertainty and quality identified, validation for selected locations	Data, source code, and user documentation archived and publically available, feedback through scientifc exchange, irregular updates by PI	Product is used by scientific community. Potential benefits for climate services identified
4	Code with systematically applied standards, portability and reproducability tested	Exists at file and collection level. Stable. Allows provenance tracking and reproducibility of dataset; Meets international standards for the dataset	Public description on the theoretical basis of the methodology; Draft description on the operational concept of the methodology; Peer review papers on methodology and product published; public validation report and user guide	Standards systematically applied, information on uncertainty and quality quantified and documented, validation for widely distributed locations and times; representativity and redundancy of information characterised	Data, source code and documentation archived and under version control and publically available; Operational quality monitoring under development; Known issues are public; Data provider establishes feedback mechanism; regular updates by PI	Used by scientific community. Started to use in climate service.Societal and economical benefits discussed
5	Operational code following standards with known quality, documented, portable and reproducible	Complete at file and collection level. Stable. Allows provenance tracking and reproducibility of dataset. Meets international standards for dataset	All formal documents public and maintained by data provider; Several peer reviewed papers on methodology and product published.	Standards systematically applied, errors quantified, participation in an international assessment; representativity and redundancy of information optimised	Data, source code and documentation archived and under version control and publically available. Operational quality monitoring established; Known issues are public; Feedback mechanism and international data quality assessment are considered in periodical data record updates	Widely used by scientific community. Societal and economic benefits are demonstrated.
6	Operational code fully compliant with standards; 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	All formal documents public and maintained by data provider; Multiple peer reviewed papers on methodology and product published.	Standards systematically applied, errors minimized, participation in multiple international assessments; representativity and redundancy of information optimised	As Level 5; capability for fast improvements in continuous data provisions established	Widely used by multiple scientific communities. Influencing decision and policy making.

1 & 2	Research Capability (RC)
3 & 4	Initial Operations Capability (IOC)
5 & 6	Full Operations Capability (FOC)

The Application Performance Matrix (Draft)

Performance Level	Length of Record	Spatial Coverage	Temporal Sampling	Spatial Sampling	Systematic Uncertainty (Bias)	Random Uncertainty (Precision)	Temporal Stability (Degree of Homogeneity)
1	very short	Too sparse/very limited coverage	Very infrequent with respect to user requirement	Very limited, only few locations	Large and not very well quantified	Much larger than UR and not very well quantified	Inhomogeneous
2	short	Sparse/limited coverage	Infrequent compared to user requirement	Limited, more locations but badly distributed	Large, but known	Larger tan UR, but known	Inhomogeneous
3	Not short, but not sufficient; may be used with care for some ECVs	Sparse	Frequent compared to user requirement, but not sufficient	Minimal, maybe suffucient to sample spatial representativeness in some areas	Above threshold UR, moderate and quantifiable	Above threshold UR, moderate and quantifiable	Homogenized, but there are still break-points
4	Close to be sufficient but use with care	Just sufficient	Close to user requirement, but parts of temporal variability not observed, e.g. day or night only;	Just suffieient to sample the spatial representativeness in certain areas	Close to UR, moderate and quantifiable	Close to UR, moderate and quantifiable	Homogenized, but there are still break-points
5	Sufficient, use with confidence	Sufficient	Matching user requirment e.g., but diurnal cycle is not fully sampled;	Just enough to sample the spatial representativeness	Matching UR	Matching UR	Sufficiently homogeneous
6	More than sufficient	More than sufficient	Much higher than user requirement, e.g., Diurnal cycle is fully sampled; no durnal cycle aliasing	Enough and more to capture the spatial representativeness	Better than UR	Better than UR	Homogeneous

shall not be used
usable with care
perfectly suited for application

Prerequisites and Needs for the Application Performance Matrix

- Needs useful User Requirements for an application that ideally provide 3 levels (breakthrough, target and optimum);
- Needs useful technical specification and published validation results (ideally from data set quality assessments) for products assessed;
- Need a weighting scheme for the columns as importance is different for different applications;
- Need to define a function that maps distance to User Requirement into index 1-6;
- Should jointly be populated by expert on data product and expert for application;
- Result shall be an understandable message on the usability of a data record for a specific application.

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Example: Mid-Tropospheric Temperature Trend

Product Technical Specification

Data Name	Length of Record	Spatial Coverage	Temporal Sampling	Spatial Sampling	Systematic Uncertainty	Random Uncertainty	Temporal Stability
RSS MSU-AMSU	1978 - present	70S – 82.5N	Monthly means	2.5x2.5 deg	0.0 K[1]	0.2 K	Good?
GPS-RO	2001 - present	Global	Monthly means	5x5 deg	0.0 K[1]	0.06 K	Very Good?

[1] anomalies are considered

User Requirements Table – Trend Analysis – Mid Tropospheric Temperature

Length of record	Spatial coverage	Temporal sampling	Spatial Sampling	Systematic Uncertainty	Random Uncertainty	Temporal Stability
46 years	global	Monthly	1x1deg	0.0 K	0.2 K	<0.01 K/dec

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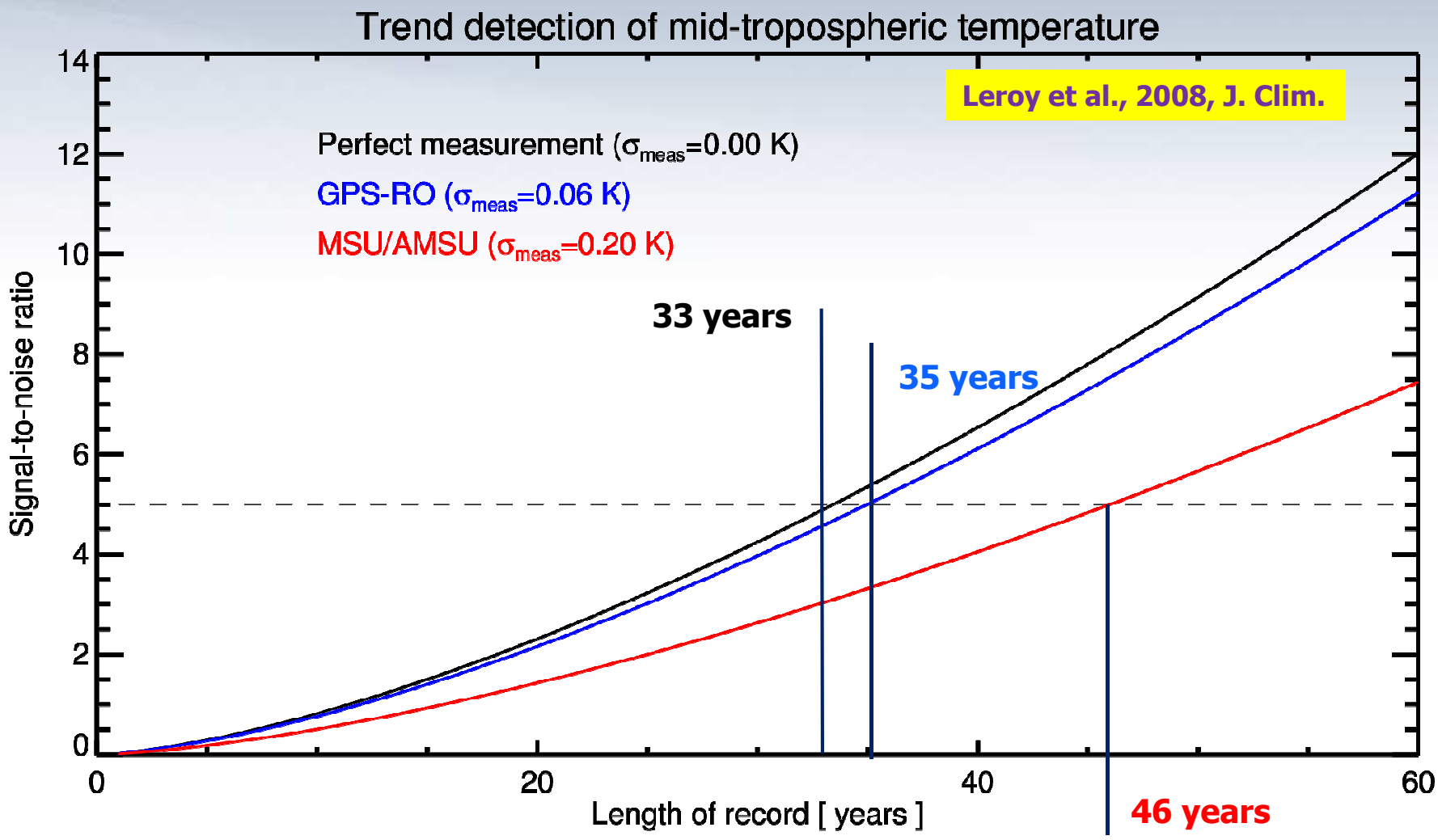
Example: Mid-Tropospheric Temperature Trend



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Potential Mapping Function

- In this case the mapping would be based on the signal to noise ratio;
- The mapping could be:

Index	Signal/Noise	Applicability
1	> 0	Shall not be used
2	> 1	Shall not be used
3	> 2	Use with care
4	> 3	Use with care
5	> 4	Suitable for application
6	> 5	Perfect for application

- This kind of advice may help people in applications, e.g. at the EEA on what data records to use for such an application.

CORE-CLIMAX Capability Assessment Workshop

- The workshop shall discuss the initial report on the European capability to create CDRs for the European Commission;
- Proposed workshop date and venue: 21-23 January 2014 @EUMETSAT
- Workshop is to:
  - Perform a self assessment using the new capability assessment tools and GCOS guidelines for each participating data record;
  - Perform independent (our SAG, the consortium members and external experts) assessment of the same data records;
  - Discuss the assessment outcome differences and find consensus on the result;
  - Integrate the results into an electronic data base for EC and Copernicus.

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Summary

- CORE-CLIMAX facilitates a capability assessment by:
  - Using and contributing to data record inventories;
  - Using an updated Maturity Matrix approach to 'measure' if data records are produced employing best practises for science, engineering and utilisation;
  - Using a novel approach of an Application Performance Matrix to break down comprehensive information on data record quality into a performance index;
- **Caveat:** Any index that is produced need to be carefully interpreted before used for decisions on program contents and/or funding;
- Until September/October 2013 we will consult with all interested parties in and outside Europe on our approach;
- We invite the CCI projects to support us in the CORE-CLIMAX capability assessment and we hope that all CCI projects will participate in the January 2014 workshop to establish a first rendition of a European capability data base.

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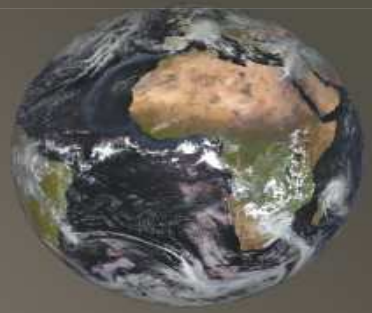

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WCRP World Climate Research Programme