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ACRONYMS:

APM – Application Performance Matrix
BISE – Biodiversity Informations System for Europe
C3S – Copernicus Climate Change Service
CAL/VAL – CALibration/VALidation
CCI – Climate Change Initiative
CDOP – Continuous Development and Operations Phase
CDR – Climate Data Record
CDS – Climate Data Store
CEOS – Committee on Earth Observation Satellites
CHARMe - CHARacterisation of Metadata to enable high-quality climate applications and services
Climate-ADAPT - European Climate ADAptation PlaTform
CLIPC – CLimate Information Platform for Copernicus
CM-SAF – Climate Monitoring Satellite Application Facility
CMUG – Climate Modelling User Group
CORECLIMAX – Coordinating Earth Observation data validation for RE-analysis for CLImate ServiceS
COSMOS – Consortium for Small Scale Modelling
DG CLIMA - Directorate General CLIMate Action
ECMWF – European Centre for Medium-range Weather Forecasts
ECV – Essential Climate Variable
EEA – European Environmental Agency
EIONET – European Environment Information and Observation Network
EQC – Evaluation and Quality Control
ERA-CLIM - European Reanalysis of Global Climate Observations
ESA – European Space Agency
ETC – European Topic Centre
EUCLEIA – EUropean CLimate and weather Events: Interpretation and Attribution
EUMETSAT – EUropean organisation for the exploitation of METeorological SATellites
F4P – Fitness for purpose
FIDUCEO – FIDelity and Uncertainty in Climate data records from Earth Observation
FP7 – 7th Framework Programme
GAIA-CLIM – Gap Analysis for Integrated Atmospheric ECV CLImate Monitoring
GCOS – Global Climate Observing System
GEOSS – Global Earth Observation System of Systems
GFCS – Global Framework for Climate Services
GSICS – Global Space-based Inter-Calibration System
H2020- Horizon 2020
INSPIRE – Infrastructure for Spatial Information in the European Community
LSA-SAF - Land Surface Analysis Satellite Applications Facility
LTDP – Long Term Data Preservation
OFA – Observation Feedback Archive
OPeNDAP – Open-Source Project for a Network Data Access Protocol
OSI-SAF - Ocean and Sea Ice Satellite Application Facility
QA – Quality Assurance
QA4ECV – Quality Assurance for Essential Climate Variables
ROM-SAF - Radio Occultation Meteorology Satellite Application Facility
SAF – Satellite Application Facility
SCOPE-CM - Sustained and COordinated Processing of Environmental satellite data for Climate Monitoring
SIS – Sectoral Information System
SMM – System Maturity Matrix
UERRA – Uncertainty in Ensembles of Regional Re-Analyses
WIS – WMO Information System
WISE – World Information Service on Energy
WMO – World Meteorological Organization

MINUTES

1. Welcome and Overview

On 15th – 16th January, 2015, the collocation meeting was held in the Research Executive Agency, Unit S2 – Space Research, COV2 19-SDR2, B-1049 Brussels, Belgium. This collocation meeting is the 2nd collocation meeting organized by CORE-CLIMAX.

The aim of this collocation is to coordinate with the different FP7, ESA & EUMETSAT ECV projects the processes of generating, validating and updating (including reanalysis) ECVs and to understand the gaps between the ECVs and user needs in Copernicus Climate Change Services (C3S).

Stijn Vermoote gave an overview of FP7 funded C3S precursor projects, and Horizon2020 funded projects supporting C3S and indicated the important role of co-players (DG GROW, DG CLIMA, ESA, EEA and EUMETSAT) in supporting C3S. The time frame in terms of the implementation plan for C3S was introduced. ECMWF will be managing the C3S, which is currently in the stage of "proof of concept, testing and capacity building" (stage 0). By the last quarter of 2016, the pre-operational phase (stage 1) of C3S will start. In the stage 0, the current on-going C3S precursor projects should pay attention to communicate with C3S for transferring their project results for the climate services to benefit. In Horizon2020, the future research needs will be defined for supporting C3S for its operational phase.

Bob Su gave an overview of the CORE-CLIMAX project results from the different work packages, and presented the expectations toward the co-location meeting, which are:

- To solicit comments to the CORE-CLIMAX approaches and results,
- to get updated with other relevant European projects,
- to seek opportunities to take up achievements of CORE-CLIMAX,
- to coordinate further developments in the generation of CDRs, and
- to contribute to the C3S development.

A discussion was initiated on the missing link (e.g. the Essential Water Variables) from the current defined ECVs to achieve C3S, in particular for the sectorial information system (8 sectors & 18 indices).

Benard Pinty commented that in stage 3 of the C3S implementation plan, more ECVs will be included and some of it may help to bridge this link. Furthermore, C3S is currently undergoing the "proof of concept" stage, during which "water" and "energy" have been identified as the pilot sectors and the "prior information notice" for these two sectors has been announced. Folkert Boersma asked how the System Maturity Matrix (SMM) was taken up by other projects. Joerg Schulz explained that during the CDR assessment workshop at Darmstadt (January 2014) participants, which came from a wide range of CDR producers and users, assessed ECVs by using the SMM. It is emphasized that such a CDR assessment should be re-implemented periodically (e.g. 3~5yrs).

Mark Dowell commented that if possible the interlink between SMM and CHARMe shall be built. In addition, if there is a document for explaining the current discrepancy in defining the essential water variables, it is the right time to present this to GCOS in the next 18 months, as GCOS is organizing the next issue of the implementation plan for the global observing system for climate.

Section 1: European ECV capability and structured ECV process

Jon Blower presented CHARMe results, which used linked data techniques to help users of climate data to connect with all the experience in the community (not specific to climate data). The key software is completed and released as open source based upon open standards and can be injected into existing websites. Geert Jan van Oldenborgh asked if CHARMe would be interested to link to the KNMI Climate Explorer website. It was pointed out that the identifier of the data set should be created to enable the link which can then be used by the CHARMe.

Rhona Phipps presented the FIDelity and Uncertainty in Climate data records from Earth Observation (FIDUCEO) project. The core concept of FIDUCEO is to develop and apply a rigorous metrology of Earth observation from climate data records. The project is focused on investigating uncertainty in a comprehensive and realistic way, which will be communicated using internationally agreed standards, will be traceable from detector to gridded geophysical product and be propagated rigorously across product levels.

Martin Juckes presented the CLIPC (Climate Information Platform for Copernicus) project, which will provide access to climate information of direct relevance to a wide variety of users, from scientists to policy makers and private sector decision makers. The "one-stop-shop" platform will provide data and information on climate and climate impacts, and ensure that the providence of science and policy relevant data products is thoroughly documented, and engage with user communities to inform about development. A user consultation was implemented to review past and ongoing projects with four identified different user categories. The CLIPC architecture includes a single 'sign-on' through the Earth System Grid Federation OpenID system, controlled vocabularies to support structured navigation between and within datasets, and direct access to data via OPeNDAP and distributed services. CLIPC will address the demand for harmonized data through bias adjustment and reduced ensembles. Scenario-based exploration tools and indicator comparison tools will be developed.

Section 2: Validation processes in ECVs

Folkert Boersma presented an overview and highlights from the first year of the QA4ECV project, which objective is to design and develop a generic quality assurance system and to generate long-term (30-year) data records of atmosphere and land parameters relevant to air pollution and climate change (6 ECVs). The project has surveyed user and provider needs and designed the specifications for a quality assurance system and provided traceability chains for 6 ECVs. From the user survey, it is learned that:

- both data providers and users need QA information,
- QA information is often missing, but considered necessary/useful,
- uncertainty and traceability information is missing,
- very different requirements are needed with respect to the "level" of QA.

Based on lessons learnt, the QA system is designed towards a maturity-based QA endorsement on ECV/CDRs leading to user confidence, and for those who produce, validate and use ECVs, providing a mechanism for evaluation of QA procedures, and for complying with ISO-standards. The relevant achievements from other projects will be used to design the QA system, from example, from CHARMe (cataloguing and versioning process) and CORE CLIMAX (SMM, Application Performance Matrix, i.e. APM)

Peter Thorne presented the GAIA-CLIM (Gap Analysis for Integrated Atmospheric ECV CLImate Monitoring) project, which aims at characterizing satellite measurements using in-situ, ground-based and sub-orbital capabilities. It will define data quality attributes and map capabilities of the current observing system, improve metrological quantification of in-situ ground-based and sub-orbital measurements, quantify robustly the impacts of inevitable measurement mismatches, use data assimilation to improve the usefulness of high quality measurements, and provide useable information to end users to improve the value of both satellite and non-satellite data.

Section 3: Reanalysis feedback mechanisms to ECV/CDR updates

Dick Dee presented the ERA-CLIM and ERA-CLIM2 projects and their connections to C3S. The importance of data rescue (in-situ upper air and satellite observations) was highlighted. It is recognized that the preparation of input observations, model data, and data assimilation systems for a global atmospheric reanalysis of the 20th century needs a long-term effort. Some examples were shown to demonstrate the incremental development of new reanalysis products, and the impact of using the rescued data in reanalysis on trends.

ERA-CLIM2 aims to produce a consistent 20th century Earth system reanalysis: atmosphere, land surface, ocean, sea-ice, and the carbon cycle. It will enable the production of an ensemble of 20th-century reanalyses using a coupled atmosphere-ocean model, the production of a coupled reanalysis of the satellite era with near-real time data updates, the improvement of earth-system reanalysis capability in a coupled data assimilation manner, the improvement of observation data sets (both in-situ and satellite-based), and the uncertainty assessment in reanalysis products (e.g. through the Observation Feedback Archive).

The short- and long- term impacts on C3S from ERA-CLIM and ERA-CLIM2 were discussed. The short term impact includes better input data sets for a new generation reanalysis products (ERA5), better data services including NetCDF support, Observation Feedback Archive and associated tools, coordination of in-situ data rescue, simulation and coordination of activities in satellite data rescue. The long term impact on C3S may be reflected by the improved extended climate reanalysis, meaningful information about uncertainties in reanalysis products and a coupled reanalysis for the satellite era.

Section 4: Intercomparing reanalysis results

Andrea Kaiser-Weiss (on behalf of Per Unden) presented the UERRA project, in terms of comparisons of European regional reanalysis and uncertainty estimates. Significant user interest (renewable energy, hydrological applications, agriculture and forestry) in high resolution reanalysis was highlighted. To meet such user needs, UERRA will provide data sets and uncertainty estimates, building upon EURO4M and extension in several dimensions (longer time period, higher resolution, more data rescue, quality and uncertainty measures, comprehensive web based data and visualization service and user guidance on user oriented products). The uncertainty estimation will be implemented through the comparison between UERRA and reference data and observations (independent ECV datasets that were derived independently), between UERRA re-analyses and ECMWF ERA (using a common evaluation procedure), and between

UERRA re-analyses. It is expected that UERRA ensembles and independent data comparison can provide guidance and enhance confidence for certain products.

Joerg Schulz asked what is the difference between the 24km regional reanalysis produced by UERRA and the to-be-developed 31km global reanalysis by ERA5; "Are there <10km regional reanalysis products?". Frank Kaspar commented that the COSMO deterministic reanalysis is produced at 6km. Dick Dee commented that usually the ratio of spatial scale of the global reanalysis to the regional reanalysis is constantly at a factor of 3. A question was raised on whether global reanalysis could use a higher resolution, instead of using local reanalysis. Dick Dee commented that the current global reanalysis system can be pushed with higher resolution, however the real value of doing so comes only if the high resolution reanalysis system can utilize the observations. Jean-Christophe Calvet commented that the value of finer resolution reanalysis can contribute to improve precipitation simulations over unobserved areas. Dick Dee commented that an intelligent downscaling method may achieve that purpose as well. Andrea mentioned that for some areas downscaling may work while for other areas regional climate modelling is required. It therefore requires the comparison to see which method is more applicable for certain areas.

Geert Jan van Oldenborgh (on behalf of Peter Stott) presented the Eucleia (European Climate and weather Events: Interpretation and Attribution) project, which aims to provide well verified assessments of the extent to which recent extreme weather has changed due to human influences, and to identify those types of weather events where science is still too uncertain to make a robust assessment of attributable risk. The methods applied to achieve this aim include SST-forced models, coupled climate models and trend analysis of observations (detection only, attribution in a two-step process). There is a high demand/requirement on data for such kind of research. For example, fast-track attribution needs data at daily scale, from >50yr series, while the seasonal time scale attribution may relax timing requirements but the quality of the data need is more stringent. In addition, many events are small-scale in time and space. Robust event attribution needs reliable data (make inventory of data that is available for event attribution on various time scalds with a quality assessment), diagnostics and model evaluation (understand the development of the events, compare observed and modelled events, trace impact of climate change on extreme events), and reliability assessment methods (use seasonal forecasting skill assessment, especially reliability, for event attribution). An example was shown to check how in-situ, satellite and reanalysis data can be used to detect attribution of a flood event in the north east of Malaysia (Kota Bahru). It turns out that with the current lack of in-situ data, coarse satellite and reanalysis data cannot help to do such an attribution at small-scale yet.

Section 5: How to transfer existing results into the Copernicus Climate Change Services (C3S) and which can be uses thereof?

Blaz Kurnik presented climate information for European assessments, climate change impacts and adaptations in EEA. The main tasks of EEA are to maintain regular flow of environmental data and data collection through the EIONET, to regularly update environmental indicators, to publish environmental (including climate change) assessments, to maintain environmental information platforms (BISE, WISE, Climate-ADAPT), and to coordinate implementation of two components of C3S (Copernicus land monitoring service and Copernicus In-situ component).

The climate change impact indicators are updated every 1 to 4 years, and the climate change impact reports will be updated every 4 years. The underpinning datasets for the impact factor include climate variables and climate indices, which come from research projects and programmes, Met offices and climate services, global and European organizations, scientific literature, EIONET and ETC. The criteria for the selection of datasets include thematic and policy relevance, scientific soundness, geographical coverage, appropriate geographical characterization, long time series, reliable data supply and clear methodology.

The climate change impact report is an indicator-based report, which investigates the changes in the climate system, climate impacts on environmental systems, climate impacts on socio-economic systems and health and vulnerability indices. Climate-ADAPT is a partnership between the EC and the EEA, which collects and disseminates information on adaptation. A global view of C3S and Climate-ADAPT was given on research projects, climate services, adaptation services and end users.

The potential future links between C3S and EEA through Climate-ADAPT were discussed:

- The selected climate variables (from the CDS) or indicators from the SIS could be used as data sources for a subset of the EEA climate and impact indicators.
- C3S could be a key contributor to EEA assessment reports (annual joint updates of climate change reports)
- Climate-ADAPT can include the C3S pre-operational project reports as a new section, the presentation of C3S outputs to the section on (climate change) observations and scenarios. In addition, the map viewer (for climate change impacts, vulnerability and risks) could be extended or replaced by outputs from C3S, including pre-operational projects.

Lothar Schüller presented the climate monitoring at EUMETSAT and the role of the Satellite Application Facilities (SAFs). The EUMETSAT climate monitoring is one of the prioritized EUMETSAT Secretariat’s activities, and is contributed by through the SAF network. There is a working group on coordination of CDR generation. The activities are embedded in/articulated with cooperative projects (e.g. WMO GSICS and SCOPE-CM, FP-7/H2020, ESA CCI). The goal of SAFs is to provide “operation” products, the characterization of which can be described as the continuity of product provision, improvements and quality monitoring, committed user services, validation and review before official release, and complete documentation of products, algorithms and validation results. In addition to CM-SAF, the OSI-SAF, ROM-SAF and LSA-SAF are also producing CDRs.

EUMETSAT committed to the sustained production and delivery of CDRs. C3S can be a user of EUMETSAT CDR activities to identify possible usage of the currently committed EUMETSAT CDRs, to identify requirements on additional CDR generation by EUMETSAT fitting in the mandate and concept of EUMETSAT secretariat and SAFs. Therefore, the specific, documented requirements from C3S would be extremely instrumental for the definition of CDR commitments in the 2017-2022 timeframe (CDOP-3), the proposals of which are to be submitted until October 2015.

Mark Dowell asked how the EUMETSAT climate monitoring activities (CDR generation) can meet the frequent reprocessing requirement for redundant climate services. Lothar Schüller commented that there is a certain priority weighting for different CDRs, which will be influenced by user requirements. Joerg Schulz commented that it always takes time (e.g. to have a secretariat and establish relevant workflows) to tackle the ad hoc repeated processing of CDR generation. On the other hand, in EUMETSAT one can find the concept of climate information flow which includes three streams of data products: the classical climate data record generation, the near-real-time weather monitoring and an interim record. The concept of an interim record is to provide support to maintain the prioritized long-term data records (if needed) with corresponding infrastructures.

Pascal Le Comte and Pierre-Philippe Mathieu presented the ESA-CCI context, objectives and achievements. It was introduced how ESA CCI was developed. The CCI initiative will ensure that ESA can play a full role in retrieving relevant ECVs specified by GCOS, based on ESAs current and archived EO data. ESA will work with CEOS agencies to ensure an as complete coverage of the entire suite of ECVs as possible. The specific objectives of the CCI are to realize the full potential of the long-term global EO archives that ESA, together with its Member States, has established over the last 30yrs, and that it can be a significant and timely contribution to the ECV databases required by the United Nations Framework Convention on Climate Change. The achievement of the particular CCI objectives will help to put European scientist at the forefront of generating satellite based climate data records and strengthen the European Research Communities presence in IPCC assessments.

The CCI project has contributed to the creation of a European EO Climate Science community, facilitated the scientific cooperation between the climate observing and modelling communities, developed a protocol for climate quality algorithms evaluation in an international context, delivered fully error characterized climate data sets and provided up to date validated scientific data sets to support international climate policy and decision making. In addition, the CCI will pave the way for the ECV component of the C3S and facilitate the sea level closure budget by strengthening the dialogue between Glaciers, ICE Sheets and Sea Level research communities.

The CMUG assessments of CCI CDRs targeted users from the climate modelling and reanalysis community, and provided an independent view of the datasets and associated uncertainties, studied consistency between ECVs and demonstrated applications for climate modelling to accelerate use by the climate/reanalysis communities.

In the ESA CCI phase 2, it is expected that the European contribution to the CEOS coordinated response to GCOS will be maintained, that the European Science Community will be involved in the development of new ECVs, that the European Research Communities presence in IPCC assessments will be further enhanced and that the new research missions to global climate records will be capitalized.

Dick Dee presented ECMWF’s role in managing the C3S. On 11 Nov. 2014, ECMWF has become the Entrusted Entity that operates both Copernicus Atmosphere Monitoring Service and C3S. The C3S shall provide information to increase the knowledge base to support adaptation and mitigation policies. It shall in particular contribute to the provision of ECVs, climate analyses, projections and indicators. The data policy for C3S aims at the commercial use of climate information. C3S is to build upon national investments and complement national climate service providers, and shall try to answer questions like: Is the climate changing? Will climate change continue, accelerate? What are the societal impacts of climate change?

The C3S infrastructure will be a market place concept (for example like Amazon), where there are various providers (e.g. ECMWF, HADLEY Center …) complying with certain protocols defined by C3S interacting with users through the web portal (broker mechanism) for delivering data products. In addition, such a broker mechanism can help to give feedback to other global systems (like WIS, GEOSS, WMO GFCS, INSPIRE …).

The climate data store will contain series of ECV datasets and climate indicators from observed, reanalyzed and simulated data that are relevant to support adaptation/mitigation polices at European level and wider, for example: reanalyses, multi-model seasonal forecast products, data reprocessing, data collection and data rescue, climate projections and other ECV datasets.

The C3S sectoral information system will provide tailored climate indicators for primary users, and data and tools to support sectoral applications and policy development. In total ~30 ECV datasets and ~8-10 sectors will be assessed by 2020.

The C3S Evaluation and Quality Control (EQC) will involve user engagement, implement continual evaluation of C3S products and services and support for expert groups and link with the EU F4P function. The EQC plays an important role in making C3S successful. The C3S outreach and dissemination will optimize the usage of existing media and tools to maximize its impact.

The C3S implementation timeline was presented and detailed. Stage 0 (2-3 years) is dedicated to infrastructure development and proof of concept. This includes the building of CDS infrastructure, testing the mechanistic of the C3S (selecting two or three pilot sectors, building and evaluating the value chain, from EO to tailored indicators, and coordinating and working with existing research projects) and engaging with users (institutional and wider) to prioritize the ECV datasets and sectors during the pre-operational phase. The implementation plans for later stages are sufficiently flexible to accommodate outcomes of FP7 precursor projects, products of ESA CCI phase 2 and new research and EQC recommendations.

In short, the C3S will be an operational service, most of the activities will be competitively procured, and a large user consultation process will be established throughout a series of workshops in 2015.

Lothar Schüller commented on the clarification of “to be an authoritative source of climate information for Europe”. Dick Dee explained that “authoritative” means “consistent”, based on the best methods and sciences. The question was raised on how the climate information can enter the “market place” through EQC (who decides, what is the timeline, procedures…). It is responded that the EQC will set requirements for the contents of CDS in terms of which variable, length of record, spatial resolution and quality. Bob Su commented that during the CORE-CLIMAX capacity building workshops there were some examples for setting the insurance premium by calculating the return period of certain extreme events, which can differ tremendously when different climate data are used. This highlights the need to have some identified authorized climate information for such a commercial practice.

Dick Dee commented that C3S will have multiple data providers. However, the type of tool, type of datasets will undergo stringent control by EQC, and comply with F4P and commission requirement. In order to engage users, the implementation of pilot sectors may help to raise more appropriate questions to ask users for understanding user requirements. Pascal commented that CCI ECVs have four categories: the one that is operational, the one that is on the edge of operational, the one that is not ready and the one that is not in the user requirements. Joerg commented that SMM developed in CORE-CLIMAX can help C3S to categorize different CDRs, from research capability to initial operational capability and to the full operational capability.

Section 6: Thematic Discussion

Hilppa Gregow organized the thematic discussions to be held in 4 sub-groups. The processes of generating, validating and updating (including reanalysis) ECVs were discussed as well as the gaps between the ECVs and user needs in C3S. The specific questions that were given for the subgroups were:

1) What would you like to happen next, what is important?

2) What is needed for that to happen?

3) What could be the obstacles, what is your concern?

4) How can we solve these?

Key words that Hilppa Gregow gave as support to help to tackle some relevant issues were: C3S, operational, continuity, consistency, IPR, useful, certainty, tools, tailored, access, profit, outreach levels, resources, calls, users, MoU.

The sub-groups were divided as follows:

1) European structured ECV capability, led by Joerg Schulz

2) Validation processes in ECVs, led by Jean-Christophe Calvet

3) Reanalysis feedback mechanisms, led by David Tan

4) Inter-comparing reanalysis results, led by Andrea Kaiser-Weiss

The outcome/summary of the discussions is as follows:

Ad “European structured ECV capability”

It is important to look back on the success from the JRC workshop in 2009 to the establishment of the C3S today. For the establishment of the C3S the obstacles are the transition to operations and funding, e.g., issues with LTDP versus CCI. In addition CDRs out of scientific activities such as the CCI and the projects will need to be funded by the service or transitioned to other operational budget such as SAFs.

For the transfer of FP7/H2020 project results into C3S there is a need to establish and maintain a regular dialogue between C3S and the projects to enable best uptake as possible. Concerning the transfer of knowledge from projects to operational activities such as SAFs, best practice guides need to be brought into work, however it is uncertain if outreach activities from the project will achieve this.

Ad “Validation process in ECVs”

A better engagement of metrologists is needed in order to define best practices. It is recommended to link to the European metrology community as much as possible and to secure funding for independent pre-launch and long term post-launch CAL/VAL studies.

Innovative validation methods and infrastructures are needed in order to permit a cross-cutting quality monitoring (i.e. considering several variables at the same time and assessing the consistency between variables).

It is recommended to (1) develop the use of data assimilation for validation as the obtained analyses account for the synergies of the various upstream products and provides statistics which can be used to monitor the quality of the assimilated observations; (2) create or consolidate in situ reference data sets by measuring as many variables as possible at the same location, using several relevant sensors.

Finally, there is a need for better international collaboration. The European efforts in developing reference datasets need to be coordinated with the international community inasmuch as global products are considered.

Ad ”Reanalysis feedback mechanisms”

The group recognized that reanalysis-based CDR assessment has proved valuable and endorsed the idea of widening its use.

It is recommended to have short feedback loops in the assessment process and to facilitate 3rd-party access to the quantitative datum-level feedback information.

The main needs are for (a) sustained infrastructure to compute/archive/analyze reanalysis feedback, (b) more personnel with the skills to conduct reanalysis-based CDR assessment, and (c) systems for the CDR providers to make visible to users the assessment findings and any ensuing CDR update plans.

Lack of capacity is a potential obstacle, it could be addressed by programs to build more capacity.

Ad “Inter-comparing reanalysis results”

The main objective of inter-comparing re-analyses is to estimate the uncertainties of the various reanalysis products.

This is needed to help the users to decide whether re-analyses are generally fit for the user's purposes, to help users to decide which product to use, and last not least to build trust in the reanalysis products.

Typically, users firstly require an overview of available products. Possibly they are looking for any alternatives to familiar products. Anyway, they need help to pick the right product. Maybe they just think of the easiest to download or the highest resolution and would benefit from being pointed to other criteria. Future, especially targeted inter-comparisons could provide such criteria.

It is important to note that usually users do not have the resources to do their own inter-comparisons, or to estimate uncertainties for their particular application on their own. They might lack the know-how to do so. Thus, there is a gap to be bridged for a full use of C3S re-analyses data sets, where re-analyses inter-comparisons could help.

A concern is that various users have quite different applications and backgrounds. In other words, we need various bridges and have to cover a range of inter-comparison methods and independent reference data (see the CORE-CLIMAX WP5 deliverables D5.53 and D5.54 for details). Strengthening the community efforts could help to address a wide range of questions related to uncertainty and could also increase user involvement.

Inter-comparison of re-analyses would feed into C3S guidance and user support.