



Scientific Quality Assessment and Report for gridded data ECVs in the CDS

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What an ECV is ?

Essential is the keyword

→ Should follow user requirements

Want to make a step ahead ...

→ In turn should be “used” by users – potentially diverse

Information on the use you can make out of it

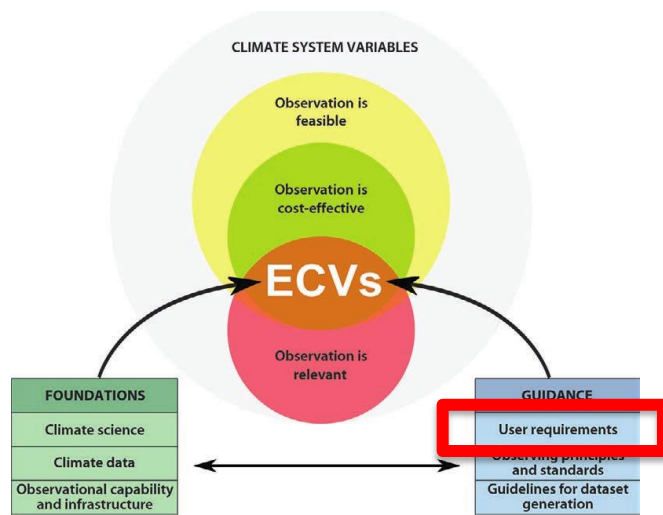


FIG. 2. Schematic of the ECV concept: knowing existing climate-relevant observing capabilities, climate datasets, and the level of scientific understanding of the climate system are the foundations (lower-left box) necessary for selecting the ECVs from a pool of climate system variables. In addition, guidance is needed to make practical use of the ECVs (lower-right box): user requirements capture the data quality needs of science, services, and policy; climate-specific principles guide the operation of observing systems and infrastructure; and guidelines facilitate the transparent generation of ECV data records. The latter address the availability of metadata, provisions for data curation and distribution, and the need for quality assessment and peer review.

SEPTEMBER 2014 | BAMS | 1433

TABLE 1. The essential climate variables (for qualifying details, see GCOS 2010a).

| | | |
|-------------|-------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Atmospheric | Surface: ^a | Air temperature, wind speed and direction, water vapor, pressure, precipitation, surface radiation budget |
| | Upper air: ^b | Temperature, wind speed and direction, water vapor, cloud properties, Earth radiation budget (including solar irradiance) |
| | Composition: | Carbon dioxide, methane, other long-lived greenhouse gases, ^c ozone and aerosol supported by their precursors ^d |
| Oceanic | Surface: ^e | Sea surface temperature, sea surface salinity, sea level, sea state, sea ice, surface current, ocean color, carbon dioxide partial pressure, ocean acidity, phytoplankton |
| | Subsurface: | Temperature, salinity, current, nutrients, carbon dioxide partial pressure, ocean acidity, oxygen, tracers |
| Terrestrial | | River discharge, water use, groundwater, lakes, snow cover, glaciers and ice caps, ice sheets, permafrost, albedo, land cover (including vegetation type), fraction of absorbed photosynthetically active radiation, leaf area index, above-ground biomass, soil carbon, fire disturbance, soil moisture |

Overall objectives and needs

Uniform assessment of all ECVs (Atmosphere – Ocean – Land)

Every dataset has its own evaluation, done in different ways

Provide synthetic and appealing reports on quality and applicability

Evaluation doesn't include "quick" information for users

Work adaptively to ensure:

- interdependence and evolving content of the CDS.

Implement scientific evaluation "User Oriented" on:

- "climate applicability" of observationally-based products and datasets
- adapted to the needs of the CDS users

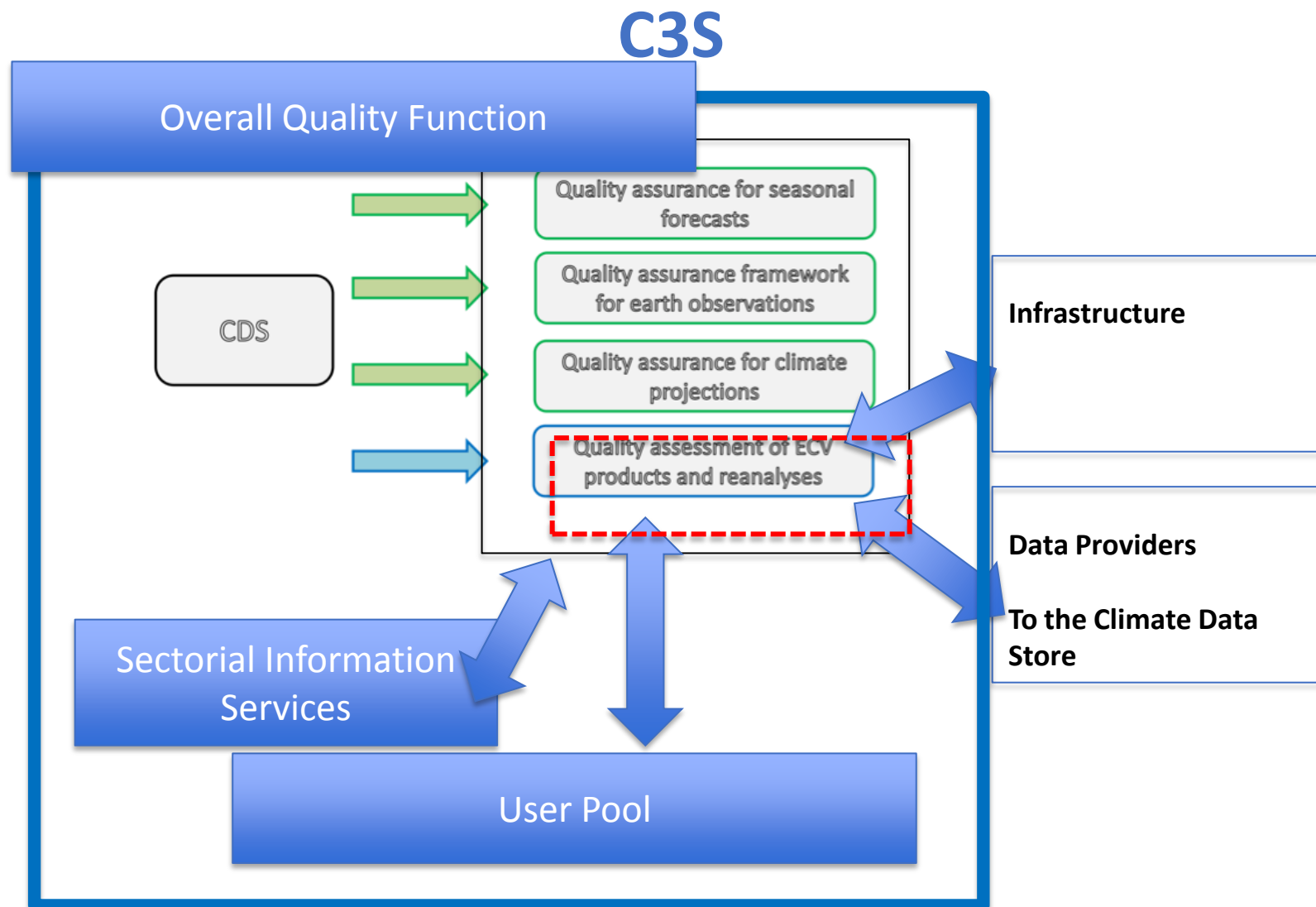
Efficient and replicable procedure based on the ESMValTool software :

- high scientific quality assessment standard
- solid framework with automated system

Provide scientific evaluation of a multi-thematic data store based on:

- wide know-how and experience with data evaluation and analysis.

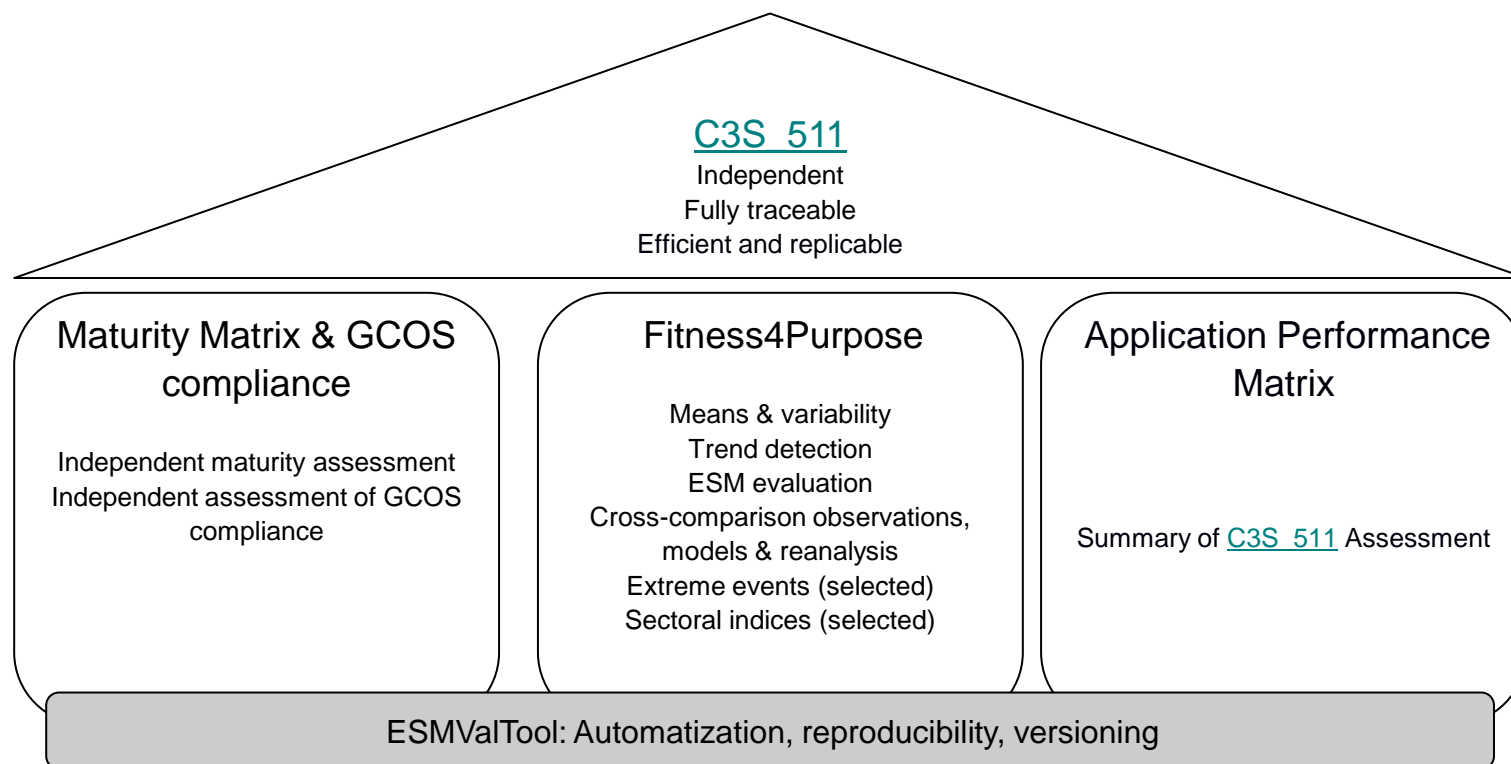
Context of C3S_511 within the Copernicus



Consortium Roles

- **CNR:** lead contractor, coordinates **Atmosphere and Ocean** ECV assessments
- **DLR, ETH, LMU, UCL, CNR** implementation of the **quality assessment functions and tools**
- **NUIM:** lead the **Surface Atmospheric** ECV assessments
- **ETHZ:** lead the **Land** ECV assessments
- **ENEA:** lead the **thematic assessment** and contribute to **ocean** and **atmosphere** assessment
- **CICS:** **ocean** ECV assessments for **sea level** and **current**
- **IO-PAN:** **Ocean** ECV assessments for **carbon**
- **VUB:** **land ice** variables and **lakes** together with
- **UCL :** **Sea Ice**

EQC Functions



Based on EU framework (QA4ECVs, Core-Climax, GAIA-CLIM ...)

Single Product Assessment

2-STEPS

Qualitative Assessment gathering from C3S_51

- Available metadata and product quality
- Maturity Matrix compared to C3S_51
- Compliance with reference to GCOS target requirements
- Recommendation with eventual indications for further improvements.

Quantitative assessment for the Fitness4Purpose

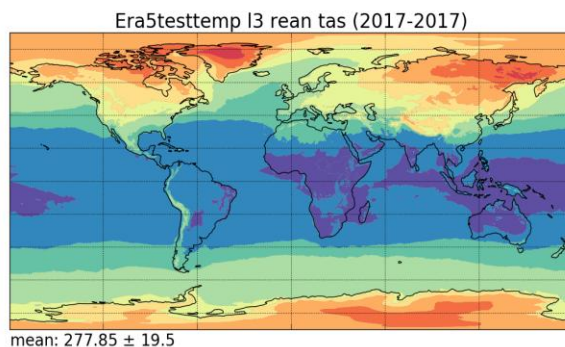
- Use diagnostics to calculate means and variability, trends and plots
- Assess the suitability of the ECV data records for all fitness for purpose use cases,

Summary assessment based on the application performance matrix resuming results

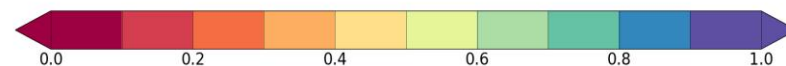
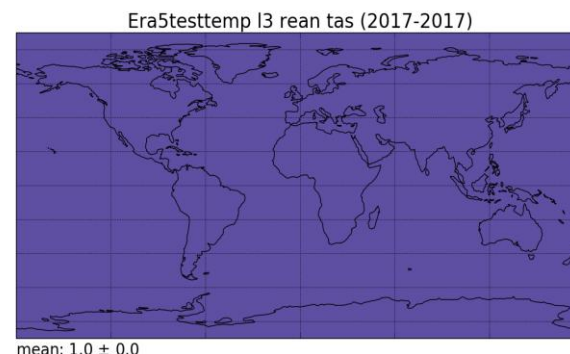
Example of Single Product Report 1: ESMVal Tool

Graphical Sample (ERA5 tas monthly – 2017)

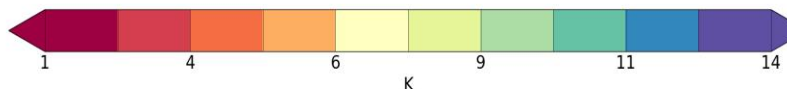
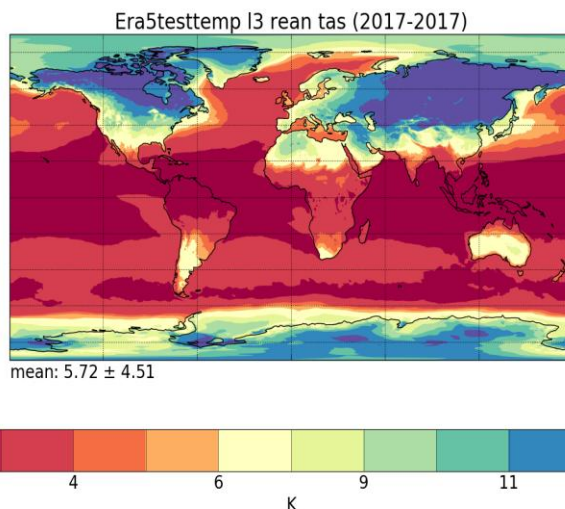
Mean



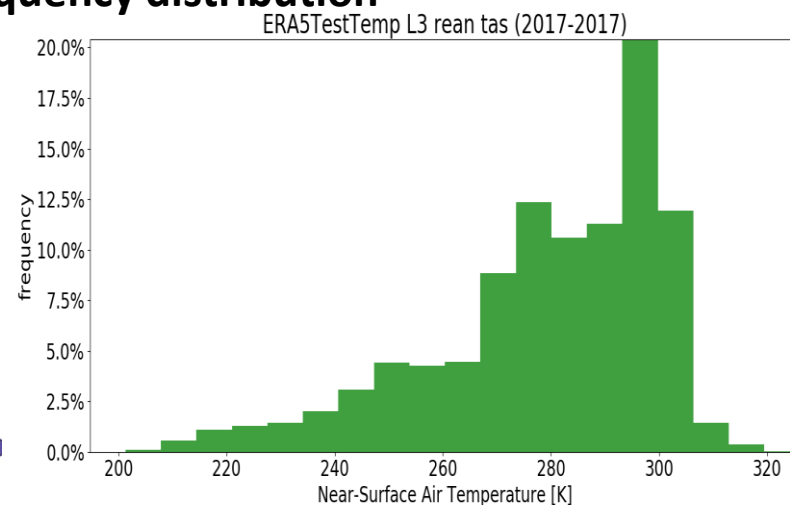
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SD



Frequency distribution

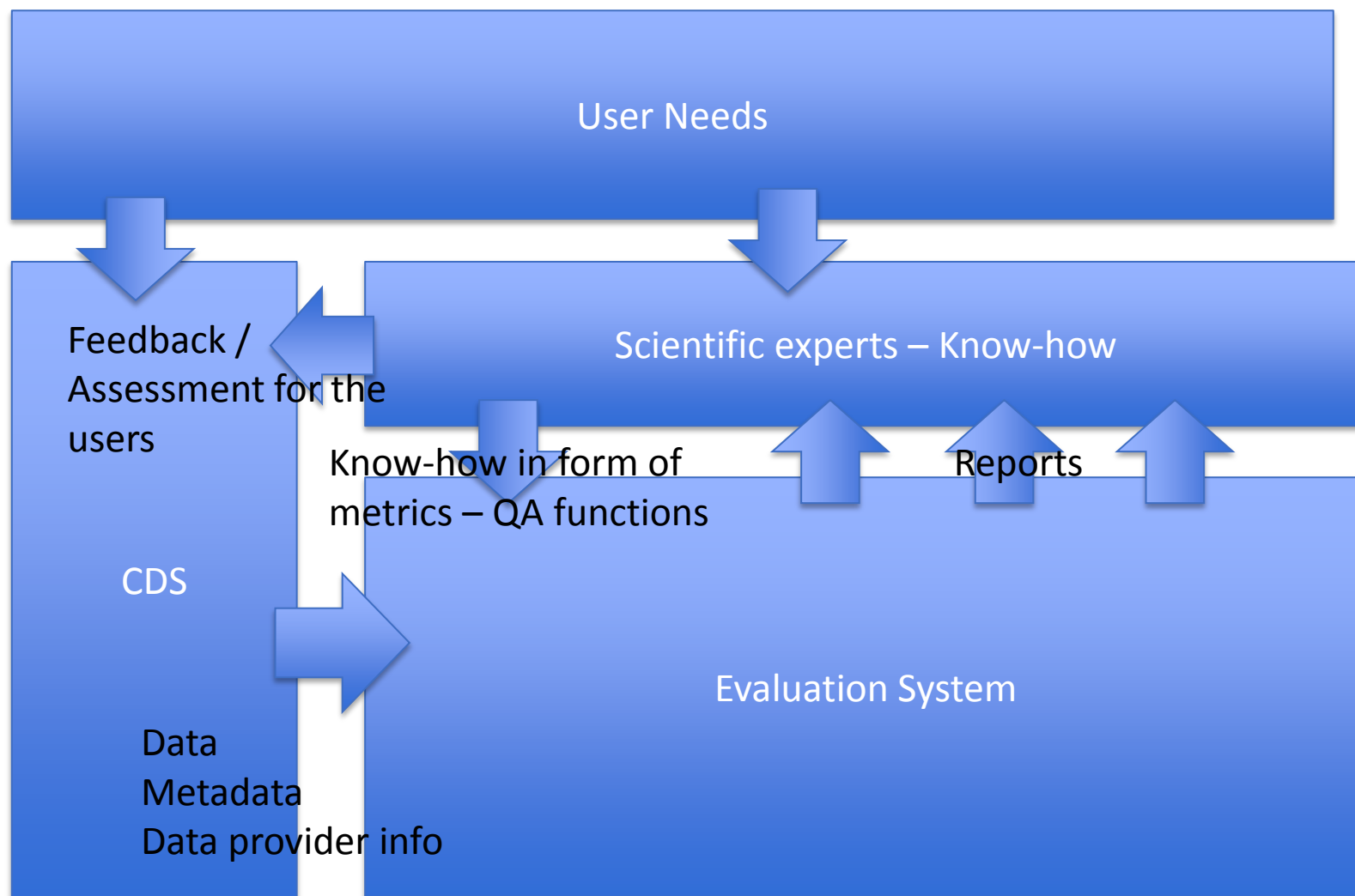




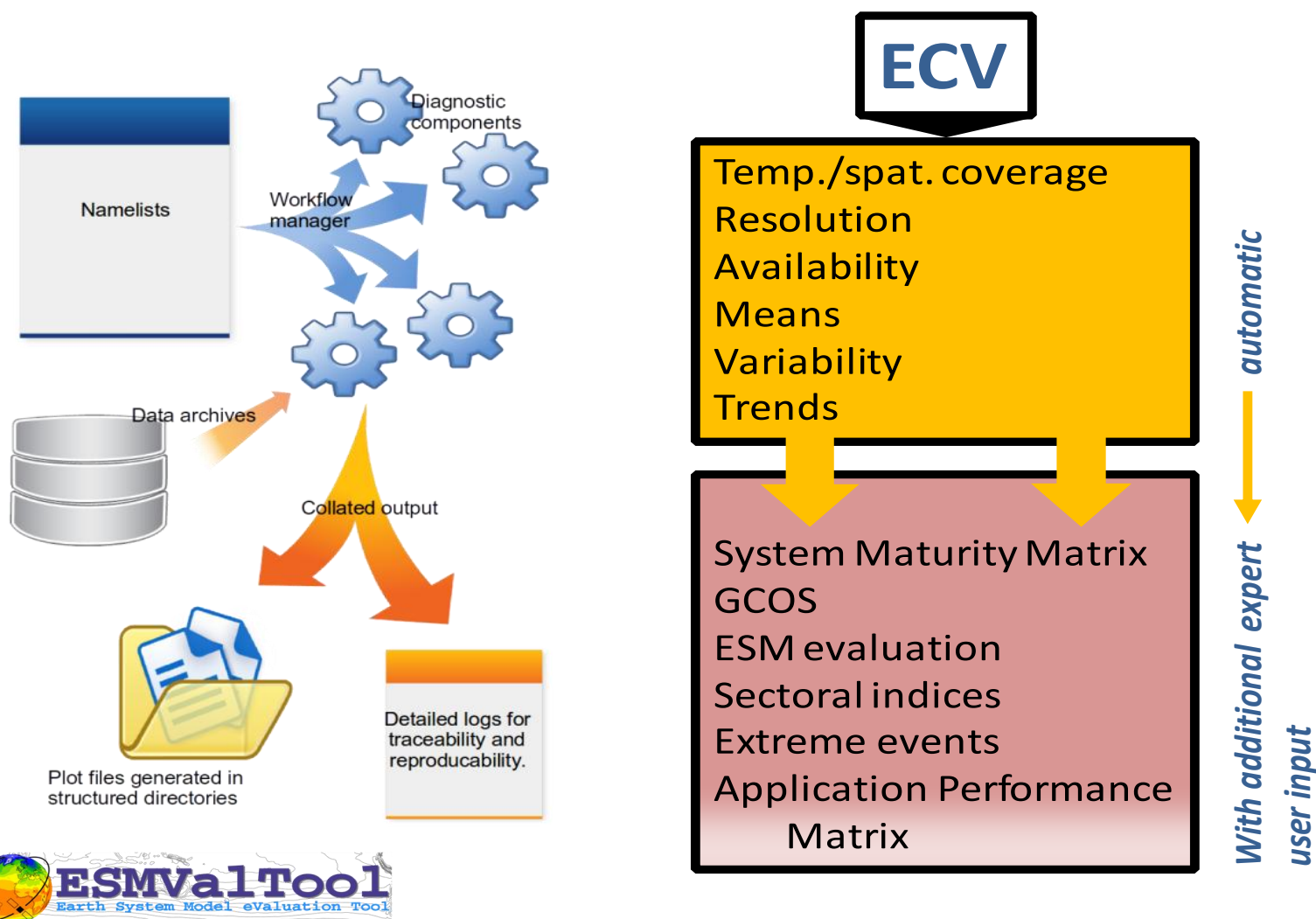
Example of Single Product Report 2: Report Structure Overview

1. **Product Description: Data format, resolution, coverage etc**
2. **Overview on dataset: Completeness & coverage – latitude, longitude, time**
3. **Fitness for Purpose: Product-specific SMM evaluation (modified CORE-CLIMAX template)**
4. **Overall evaluation: APM evaluation –GCOS requirements met?**
5. **References: White (grey) Literature support for evaluation?**

How the reports are built: Blending of automated and top-level scientific know-how



How the reports are built: ESMValTool



Multi Product Assessment

Multi-product is intended as:

- The same variable from different providers (e.g., surface temperature from ERA-5, HadCRUT ... or Ozone from CAMS, C3S_312a).
- Different variables composing the same ECV (e.g., aerosol optical depth, aerosol profile).



- Identify products and sources for the same ECV to be included in a multi-product assessment based upon intended service provision via the CDS
- Select relevant use cases
- Include information from Single Product Assessments for those ECV products applicable
- Use the ESMValTool template from WP2 and include multi-product specific diagnostics
- Perform analysis with the ESMValTool



Gather from
Single-
Products
used for
assessment

Thematic Assessment

Multi-product assessments

Single-Product assessments

Relevance of the evaluated ECV products for climate science and climate

Focus on fundamental physical aspects of the climate system and climate change (GCOS / IPCC / WCRP / CEOS)

Due to the dependencies on outcomes of the first annual services and to the expected interactions with ECMWF and users C33S_511 provides a tentative plan

In SC 1:

Adapt the same QA framework and automated system for replicability

Update the thematic tasks

Which observational data

| Atmospheric ECVs | Products | CDS products | Timing |
|----------------------|----------------------|----------------------------|--------|
| TOA Radiation Budget | TOA SW | ERA5 | 2017 |
| | TOA LW | ERA5 | 2017 |
| Wind Air Speed | U, V | data | 2017 |
| Temperature | T | ERA5 & C3S_311a | 2017 |
| Water Vapour | Q | ERA5 & C3S_311a | 2017 |
| cloud properties | | ERA5 | 2017 |
| aerosol | AOD | C3S_312a & CAMS | 2017 |
| | SSA | C3S_312a & CAMS | |
| | ALH | C3S_312a & CAMS | |
| | Extinction profile | C3S_312a & CAMS | |
| Carbon dioxide | CO2 Total column | C3S_312a | 2017 |
| | CO2 Surface | C3S_311a | |
| Methane | CH4 Total column | C3S_312a | 2017 |
| | CH4 Vertical profile | | |
| Long-lived GHGs | CFC | C3S_312b | 2018 |
| | N2O | | |
| | ... | | |
| Ozone | Stratospheric | ERA5 & C3S_312a & C3S_311b | 2017 |
| | Tropospheric | ERA5 & C3S_312a & C3S_311b | 2017 |
| | Total Column | ERA5 & C3S_312a & C3S_311b | 2017 |

| Surface ECV | Products | CDS products | Timing |
|--------------------------|-----------|-----------------|--------|
| Wind Air Speed | U, V | ERA5 & C3S_311a | 2017 |
| Precipitation | Rain rate | ERA5 & C3S_311a | 2017 |
| Temperature | T | ERA5 & C3S_311a | 2017 |
| Water Vapour | Q | ERA5 & C3S_311a | 2017 |
| Surface Radiation Budget | Surf LW | ERA5 | 2017 |
| | Surf SW | ERA5 | 2017 |

| Ocean ECVs | Products | CDS products | Timing |
|-------------------------|----------|-----------------|--------|
| Sea Surface Temperature | | ORA5 & C3S_312a | 2017 |
| Surface Salinity | | ORA5 | 2018 |
| Surface Currents | | ORA5 | 2018 |
| Ocean Surface Stress | | ORA5 | 2018 |
| Ocean Surface Heat Flux | | ORA5 | 2018 |
| Sea Level | | ORA5 & C3S_312a | 2017 |
| Sea State | | ERA5 | 2018 |
| Subsurface Temperature | | ORA5 | 2017 |
| Subsurface Salinity | | ORA5 | 2018 |
| Subsurface Currents | | ORA5 | 2017 |
| Sea Ice | | ERA5 & C3S_312a | 2017 |
| Transient Tracers | CFCs | C3S_312b | 2018 |
| Inorganic Carbon | | C3S_312b | 2018 |
| Ocean Colour | | C3S_312b | 2018 |

| Land Variables | Products | CDS products | Timing |
|--------------------------|-----------------------|-----------------|--------|
| Soil Moisture | surface, deeper-layer | ERA5 & C3S_312a | 2017 |
| Lakes | | C3S_312b | 2018 |
| Snow | | ERA5 | 2017 |
| Glaciers | | C3S_312a | 2017 |
| Ice Sheets & Ice Shelves | | C3S_312b | 2018 |
| Permafrost | | C3S_312b | 2018 |
| Albedo | | C3S_312a | 2017 |
| Land Cover | | C3S_312b | 2018 |
| FAPAR | | C3S_312a | 2017 |
| LAI | | C3S_312a | 2017 |
| Fire | | C3S_312b | 2018 |
| Ice Caps | | C3S_312b | 2018 |