Recent developments of the Earth System Model Evaluation Tool (ESMValTool)

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INTRODUCTION AND AIM (WP4)

Earth system models (ESMs) are important tools to improve our understanding of present-day climate and to project climate change under different future scenarios. For robust assessments of future climate change, it is important to evaluate how well the historical climate is reproduced and to systematically analyze, understand and document possible shortcomings using Earth observations with satellite data playing a key role. Progress in climate science and an increase in available computing resources over the last decades has led to a massive increase in the complexity of ESMs and the amount of data they provide. For this reason, innovative tools for a frequent and comprehensive model evaluation such as the Earth System Model Evaluation Tool (ESMValTool) have been developed.

→ Exploit ESA CCI and CCI+ data in the context of Earth system model evaluation with ESMValTool

ESMValTool

Earth System Model Evaluation Tool

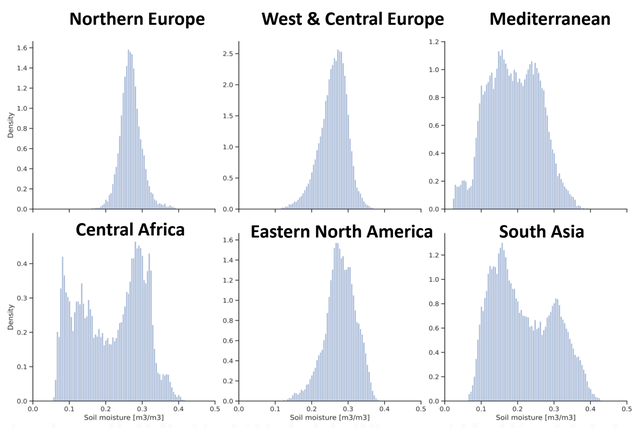
- Community diagnostic and performance metrics tool for evaluation and analysis of ESMs
- Open source community development on GitHub (> 200 developers, > 60 international institutes)
- Used in several chapters of the Assessment Report 6 of the IPCC's WG1
- Release of v2.0.0 in August 2020, currently at v2.11.0

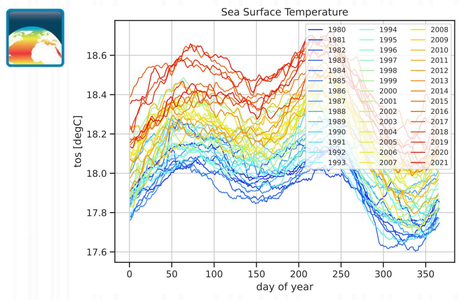
PROGRESS IMPLEMENTATION AND UPDATES

✓ aerosol cci	**update** to Swansea ATSR (v4.33) and SLSTR / 3A (v1.12) OR ensemble (ATSR v3.0 and SLSTR / 3A v2.2) v6.1	
For optional WP: biomass cci	**implement** L4-AGB-MERGED-100m-2018-fv3.0	
WORK IN PROGRESS: cloud cci	v3.0 AVHRR AM+PM **add** L3U data (daily)	
✓ land cover cci	**update** to v2.0.8	
(✓) land surface temperature cci	v3.00, MODIS EOS Aqua **add** daily values sensible for selected time periods only	
permafrost cci	**implement** MODISLST_CRYOGRID-AREA4_PP-fv03.0	✓
snow cci	**implement** multi-sensor.multi-platform.MERGED.2-0.r1	✓
soil moisture cci	**update** to version v8.1	✓
sst cci	**add** daily values **update** to v3.0	✓
water vapour cci	v3.1 TCWV-global (COMBI) **add** daily values	✓

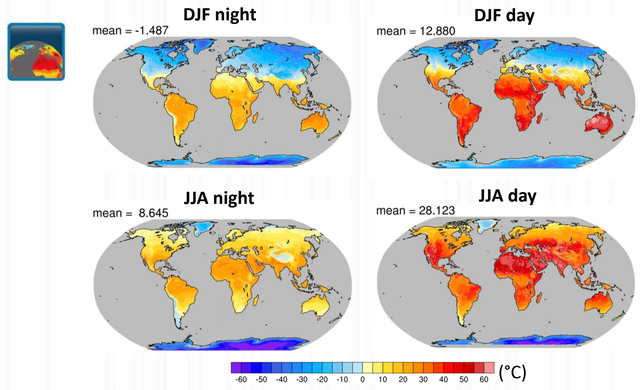
WP4.1 IMPLEMENTATION/UPDATE OF CCI DATASETS

Spatiotemporal distribution of monthly mean soil moisture from ESA CCI SOILMOISTURE in the period 1979-2022 for six IPCC AR6 regions. Each month in each grid cell in the corresponding regions is considered with equal weight.

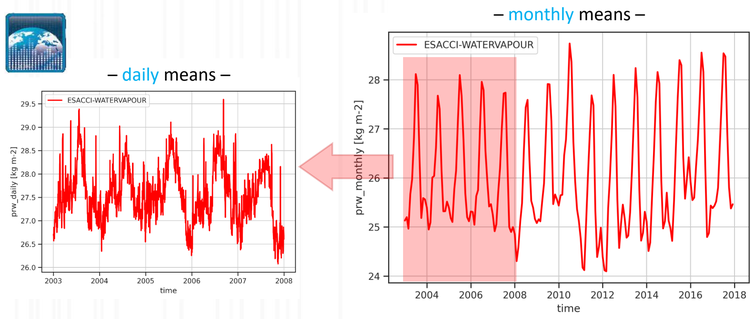




Global average daily sea surface temperature from ESA CCI SST for 1980 through 2021.



Multi-year (2003-2018) seasonal average land surface temperature from ESA CCI LST.



Time series of global average water vapor path from ESA CCI WATERVAPOUR (COMBI).

WP4.2 IMPLEMENTATION OF UNCERTAINTY ESTIMATES

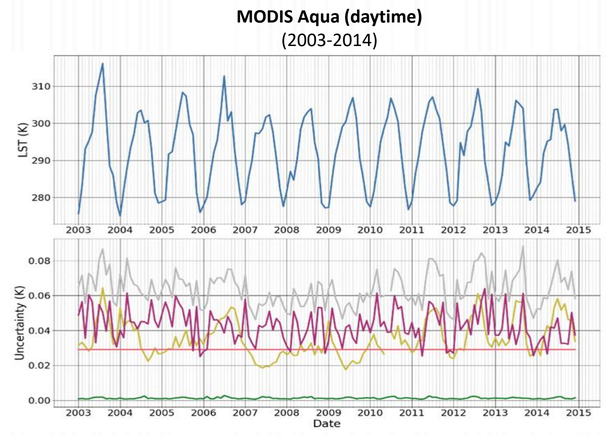
Aim: demonstrate how ESMValTool can be used to propagate uncertainty information given in satellite observation products to evaluate ESM outputs, focusing on LST.

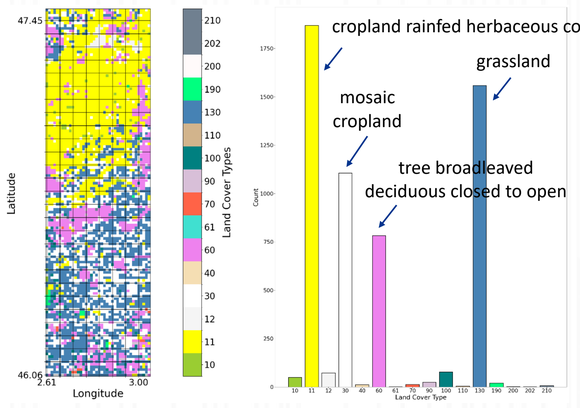
Diagnostic propagates uncertainty components across a selected region

Four components of uncertainty

1. Local correlated (atmosphere)
2. Locally correlated (surface)
3. Systematic
   - Uses the land cover class to propagate across correlated biomes
4. Random
   - Uses sampling error considering the number of available data values in the region

Example region in France
(longitude: 2.6-3.0°E, latitude: 46.1-47.5°N)





LST with Total Uncertainty range shaded
Uncertainty Components
Local Atmospheric
Local Surface
Systematic
Random
Total

Illustration of land cover classes used to perform the propagation of the surface locally correlated uncertainty component, shown for January 2003. (left) A map of each gridbox coloured by land cover class with new 0.05°×0.05° gridboxes shown. (right) A chart of the counts of each individual land cover classification.

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