CONSTRAIN
Constraining uncertainty of multi-decadal climate projections
GA number 820829
H2020-LC-CLA-2018-2

<table>
<thead>
<tr>
<th>Deliverable number (relative in WP)</th>
<th>D4.11</th>
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<tr>
<td>Deliverable name:</td>
<td>Full documentation of the improved emulators in the form of a technical report or a model presentation publication for FAIR and OSCAR</td>
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<td>WP / WP number: 4</td>
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<tr>
<td>Delivery due date:</td>
<td>Project month 42 (31/12/2022)</td>
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<td>Actual date of submission:</td>
<td>31/12/2022</td>
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<td>Dissemination level:</td>
<td>Confidential</td>
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<td>Lead beneficiary:</td>
<td>CNRS, UNIVLEEDS</td>
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<tr>
<td>Responsible scientist/administrator:</td>
<td>Lawrence Jackson (UNIVLEEDS)</td>
</tr>
<tr>
<td>Contributor(s):</td>
<td>Thomas Gasser (IIASA) Lawrence Jackson (UNIVLEEDS) ...</td>
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<td>Internal reviewer:</td>
<td>Piers Forster</td>
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1. Changes with respect to the DoA
Deferred the delivery date from M36 (30 June 2022) this was to allow more time for development work and recruitment, ensuring scientific quality

2. Dissemination and uptake
Published academic papers and code for use by the wider academic community and decision makers. Results shared within the project.
3. Short Summary of results (< 250 words)

Climate patterns for impact (FaIR)

As described for deliverable D4.10, our results show that spatial patterns of SST in climate model projections are weaker than in observational datasets for the historical period. The methods tested for characterising SST patterns and modelling their impact on radiation fluxes at the top of atmosphere had weak predictive skill in out-of-sample tests. We have produced the following outputs for this deliverable and deliverable D4.10:

- A technical note summarising our results emulating the pattern effect.
- A paper in review on pattern scaling errors in regional climate model emulations.

OSCAR

The contribution of OSCAR to the IPCC 6th assessment report and to the reduced complexity model intercomparison project (RCMIP) allowed a thorough diagnosis of the model, which culminated in an evaluation paper that compares the behaviour of OSCAR against that of complex models for close to 100 experiments from CMIP5 and CMIP6.

As a number of shortcomings and development leads were identified, a reduced-form version of OSCAR was further created (dubbed Pathfinder). Its main role was to explore advanced Bayesian calibration techniques using AR6 and CMIP6 data, with the goal of applying the same technique to the fully fledged model. This led to a comprehensive model description paper.
4. Evidence of accomplishment

- Technical note summarising the predictive skill achieved emulating the impact of SST patterns on out-of-sample projections for future global mean temperatures.

- Publication highlighting limitations in out-of-sample projections produced by climate model emulators such as FaIR:

- Manuscript in review highlighting pattern scaling errors in regional climate model emulation:

- Manuscript in review with the journal GMD providing validation and showcasing the performance and behaviour of OSCAR v3.1:
  Quilcaile et al. CMIP6 simulations with the compact Earth system model OSCAR v3.1. https://gmd.copernicus.org/preprints/gmd-2021-412/

- Model description paper (accepted) for the Pathfinder model:

- In addition, both OSCAR and Pathfinder come with an evolving manual:
  https://github.com/tgasser/OSCAR/blob/master/MANUAL.md
  https://github.com/tgasser/Pathfinder/blob/master/MANUAL.md