



Horizon 2020 Societal challenge  
5: Climate action, environment,  
resource efficiency and raw materials

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

<b>Deliverable number (relative in WP)</b>	<b>D4.10</b>
<b>Deliverable name:</b>	Online GitHub code of the emulators with improvements made regarding their use of climate patterns for climate impact (FAIR) and feedbacks (OSCAR) studies
<b>WP / WP number: 4</b>	
<b>Delivery due date:</b>	Project month 42 (31/12/2022)
<b>Actual date of submission:</b>	31/12/2022
<b>Dissemination level:</b>	Confidential
<b>Lead beneficiary:</b>	CNRS, UNIVLEEDS
<b>Responsible scientist/administrator:</b> Lawrence Jackson (UNIVLEEDS)	
<b>Contributor(s):</b>	Thomas Gasser (IIASA) Lawrence Jackson (UNIVLEEDS) ...
<b>Internal reviewer:</b>	Piers Forster

**1.Changes with respect to the DoA**

Deferred the delivery date from M30 (31 December 2021) this was to allow more time to allow 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)

Our results show that spatial patterns of SST in climate model projections are weaker than in observational datasets of historical SSTs. 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 D4.11:

- A technical note summarising our results emulating the pattern effect.
- A paper published in Geophysical Research Letters on the limitations of emulator projections.
- A paper in review on pattern scaling errors in regional climate model emulations.

#### OSCAR

The contribution of OSCAR to the IPCC 6<sup>th</sup> 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 (for D4.11).

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 (for D4.11).

#### 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.

Jackson, L. S., Maycock, A. C., Andrews, T., Fredriksen, H.-B., Smith, C. J., & Forster, P. M. (2022). Errors in simple climate model emulations of past and future global temperature change. *Geophysical Research Letters*, 49, e2022GL098808. <https://doi.org/10.1029/2022GL098808>

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

Wells, C. D., Jackson, L. S., Maycock, A. C., and Forster, P. M.: Understanding pattern scaling errors across a range of emissions pathways, *EGUsphere* [preprint], <https://doi.org/10.5194/egusphere-2022-914>, 2022.

- The latest published version of OSCAR is v3.1.2. Its source code is available on GitHub and on Zenodo:

<https://github.com/tgasser/OSCAR/>

<https://zenodo.org/record/4282112>

- The code to run the CMIP5, CMIP6 and RCMIP experiments used to evaluate OSCAR v3.1 was also published online:

[https://github.com/yquilcaille/scripts\\_OSCAR\\_CMIP6](https://github.com/yquilcaille/scripts_OSCAR_CMIP6)

- The new Pathfinder model's source code is also available on GitHub and Zenodo:

<https://github.com/tgasser/Pathfinder/>

<https://zenodo.org/record/7003848>