ClimateBench v1.0: A benchmark for data-driven climate projections

*D. Watson-Parris[1], **Y. Rao[2]**, D. Olivié[3], Ø. Seland[3], P. Nowack[4], G. Camps-Valls[5], P. Stier[1], S. Bouabid[1], M. Dewey[6], E. Fons[7], J. Gonzalez[8], P. Harder[1,9], K. Jeggle[7], J. Lenhardt[8], P. Manshausen[1], M. Novitasari[10], L. Ricard[11], C. Roesch[12]*

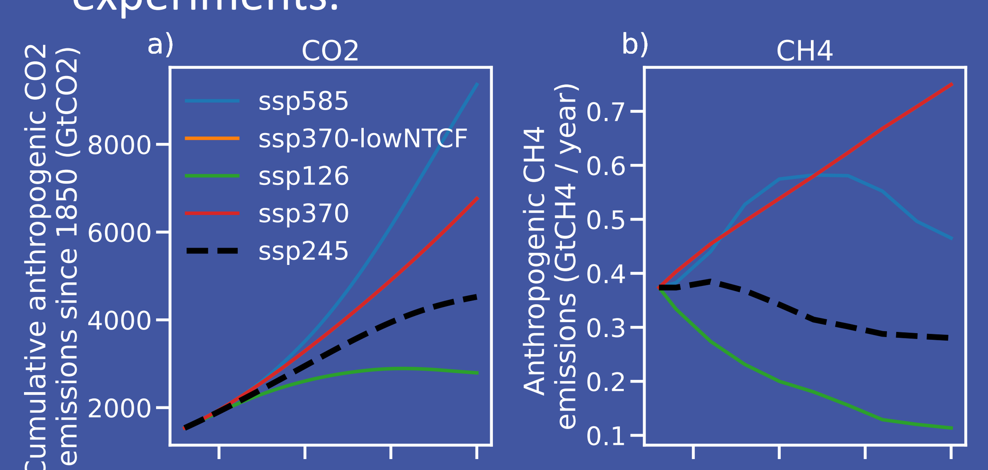
[1]University of Oxford; [2]North Carolina State University; [3]Norwegian Meteorological Institute; [4]Climatic Research Unit; [5] Universitat de València; [6]Stockholm University; [7]ETH Zurich; [8]Universität Leipzig; [9]Fraunhofer ITWM; [10]University College London; [11]Ecole Polytechnique Fédérale de Lausanne; [12]University of Edinburgh

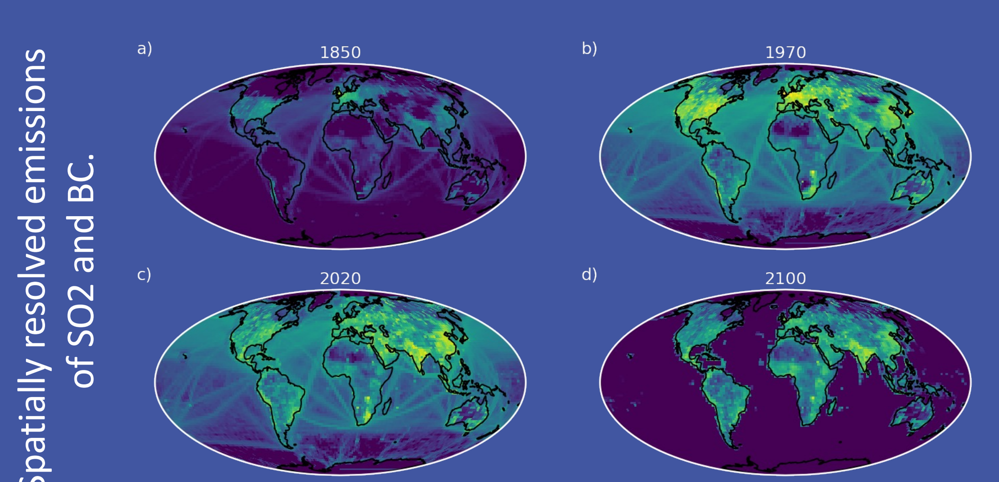
INTRODUCTION

- It is impractical to use fully-coupled Earth system models to fully explore all possible future emission pathways.
- ClimateBench - the first benchmarking framework based on a suite of state-of-the-art simulations performed by a full complexity Earth System Model (ESM),
- Including a set of baseline machine learning models that emulate temperature and precipitation (including extreme precipitation) to a variety of forcers (carbon dioxide, methane and aerosols).

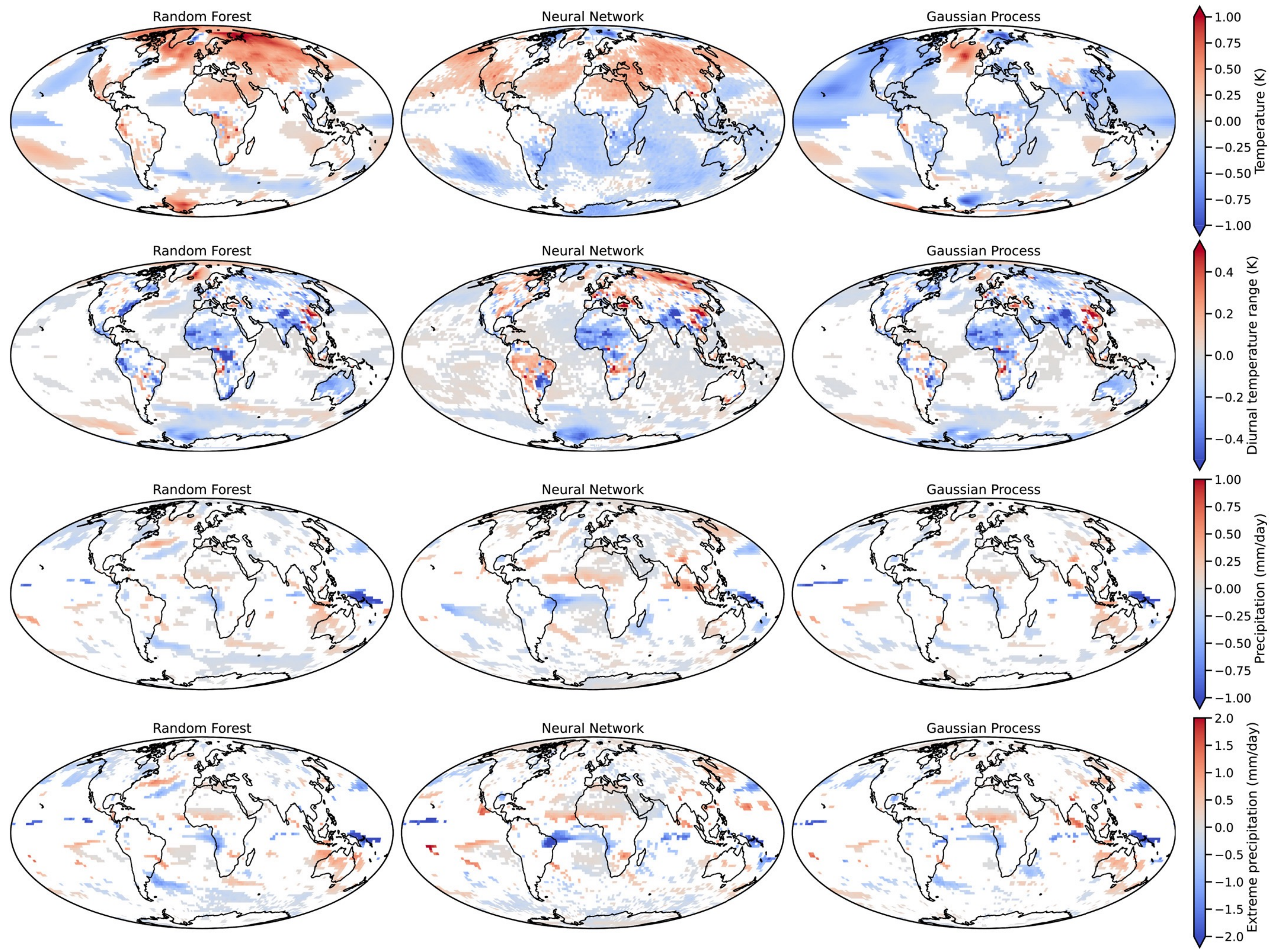
DATA & WORKFLOW

- ***Input***: Emission data from historical, ScenarioMIP, DAMIP & AerChemMIP experiments.





Data-driven climate projections could enable exploration of climate responses given a wide range of emissions scenarios using **efficient emulator of Earth system models**.

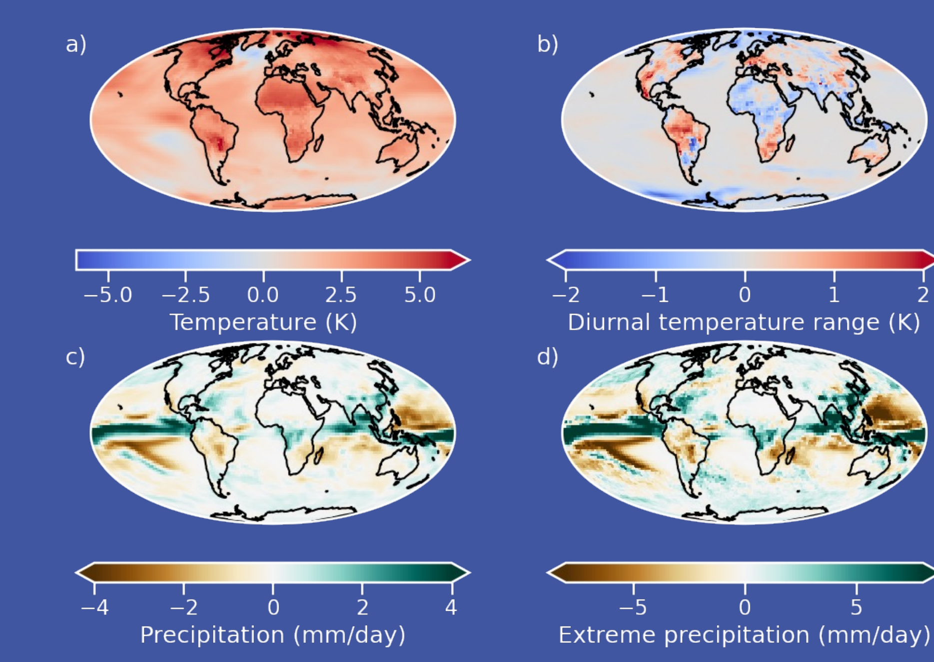


**This work is a result from the jointed virtual hackathon between 3rd NOAA AI Workshop and Climate Informatics.*

Get our paper!

DATA & WORKFLOW

- ***Output***: NorESM2 temperature and precipitation simulations.



EVALUATION METRICS

- The target evaluation metric is a combination of the RMSE over the spatial and global mean scales, $NRMSE_t$:

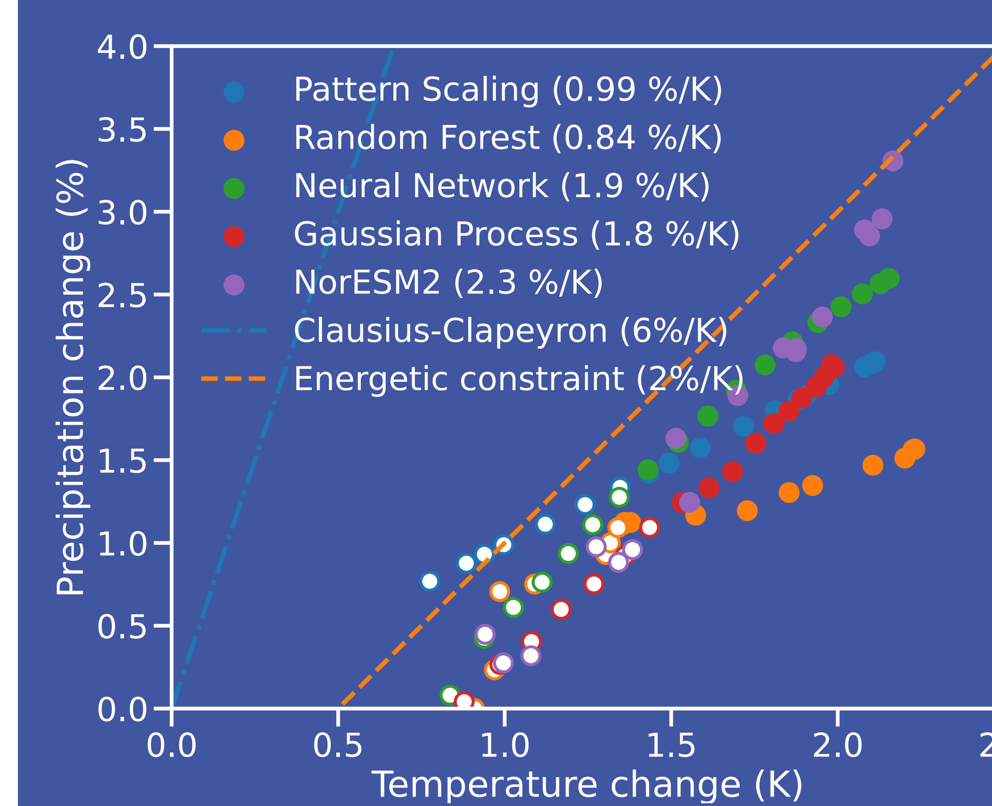
$$NRMSE_s = \sqrt{\left\langle \left(|x_{i,j,t}|_t - |y_{i,j,t,n}|_{n,t} \right)^2 \right\rangle} \Big/ |\langle y_{i,j} \rangle|_{t,n}$$

$$NRMSE_g = \sqrt{\left| \left(\langle x_{i,j,t} \rangle - \langle |y_{i,j,t,n}|_n \rangle \right)^2 \right|_t} \Big/ |\langle y_{i,j} \rangle|_{t,n}$$

$$NRMSE_t = NRMSE_s + \alpha * NRMSE_g,$$

DISCUSSION

- All emulators broadly respect global conservation of energy in global mean precipitation change, but that the RF and Pattern scaling baseline significantly under-predict the hydrological sensitivity.



- Future work is embedding physical constraints into hybrid models to allow improved accuracy, robustness and generalisability, and ultimately trust.