



Supplement of

Performance-based sub-selection of CMIP6 models for impact assessments in Europe

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Table S1. Model realisations from CMIP6 ensemble that were assessed. Information regarding the available scenario experiments for the CMIP6 models is available at:

https://pcmdi.llnl.gov/CMIP6/ArchiveStatistics/esgf_data_holdings/ScenarioMIP/index.html

Model and Realisation	Institution
ACCESS-CM2 r1i1p1f1	Commonwealth Scientific and Industrial Research Organization (Australia)
ACCESS-ESM1-5 r1i1p1f1	Commonwealth Scientific and Industrial Research Organization (Australia)
BCC-CSM2-MR r1i1p1f1	Beijing Climate Center (China)
CAMS-CSM1-0 r1i1p1f1	Chinese Academy of Meteorological Sciences (China)
CESM2 r1i1p1f1	National Center for Atmospheric Research (USA)
CESM2-WACCM r1i1p1f1	National Center for Atmospheric Research (USA)
CNRM-CM6-1 r1i1p1f2	Centre National de Recherches Meteorologiques, Centre Europeen de Recherche et de Formation Avancee en Calcul Scientifique (France)
CNRM-CM6-1-HR r1i1p1f2	Centre National de Recherches Meteorologiques, Centre Europeen de Recherche et de Formation Avancee en Calcul Scientifique (France)
CNRM-ESM2-1 r1i1p1f2	Centre National de Recherches Meteorologiques, Centre Europeen de Recherche et de Formation Avancee en Calcul Scientifique (France)
CanESM5 r1i1p1f1	Canadian Centre for Climate Modelling and Analysis (Canada)
EC-Earth3 r1i1p1f1	European Center Earth Consortium (Europe)
EC-Earth3-Veg r1i1p1f1	European Center Earth Consortium (Europe)
FGOALS-f3-L r1i1p1f1	Chinese Academy of Sciences (China)
FGOALS-g3 r1i1p1f1	Chinese Academy of Sciences (China)
GFDL-CM4 r1i1p1f1	Geophysical Fluid Dynamics Laboratory, National Oceanic and Atmospheric Administration (USA)
GFDL-ESM4 r1i1p1f1	Geophysical Fluid Dynamics Laboratory, National Oceanic and Atmospheric Administration (USA)
GISS-E2-1-G r1i1p3f1	Goddard Institute for Space Studies, National Aeronautics and Space Administration (USA)
HadGEM3-GC31-LL r1i1p1f3	Met Office Hadley Centre
HadGEM3-GC31-MM r1i1p1f3	Met Office Hadley Centre
INM-CM4-8 r1i1p1f1	Institute for Numerical Mathematics, Russia Academy of Science (Russia)
INM-CM5-0 r1i1p1f1	Institute for Numerical Mathematics, Russia Academy of Science (Russia)
IPSL-CM6A-LR r1i1p1f1	Institut Pierre Simon Laplace, Paris 75252, France
KACE-1-0-G r1i1p1f1	National Institute of Meteorological Sciences/Korea Meteorological Administration (Korea)
MIROC-ES2L r1i1p1f2	Japan Agency for Marine-Earth Science and Technology (Japan)
MIROC6 r1i1p1f1	Japan Agency for Marine-Earth Science and Technology (Japan)
MPI-ESM1-2-HR r1i1p1f1	Max Planck Institute for Meteorology (Germany)
MRI-ESM2-0 r1i1p1f1	Meteorological Research Institute, Japan Meteorological Agency (Japan)
NESM3 r1i1p1f1	Nanjing University of Information Science and Technology (China)
NorESM2-LM r1i1p1f1	Norwegian Climate Center (Norway)
TaiESM1 r1i1p1f1	Research Center for Environmental Changes (Taiwan)
UKESM1-0-LL r1i1p1f2	Met Office Hadley Centre

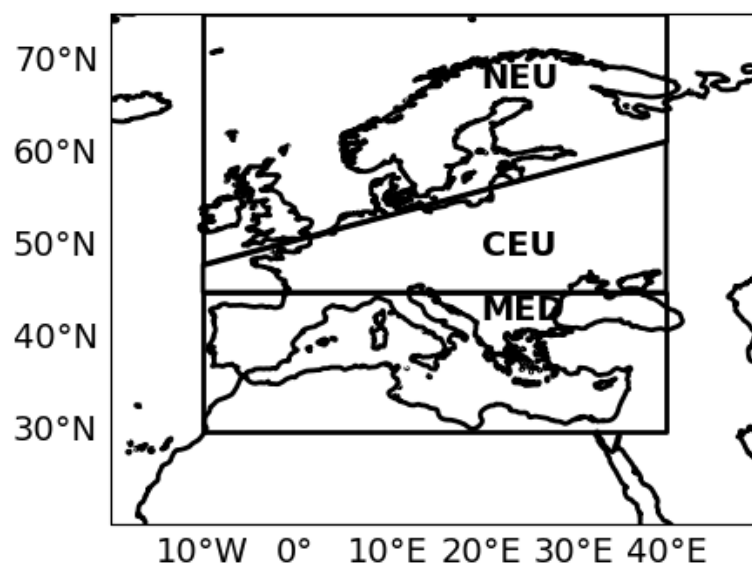


Figure S1. European regions used for regional assessment. NEU: Northern Europe, CEU: Central and Western Europe, MED: Mediterranean

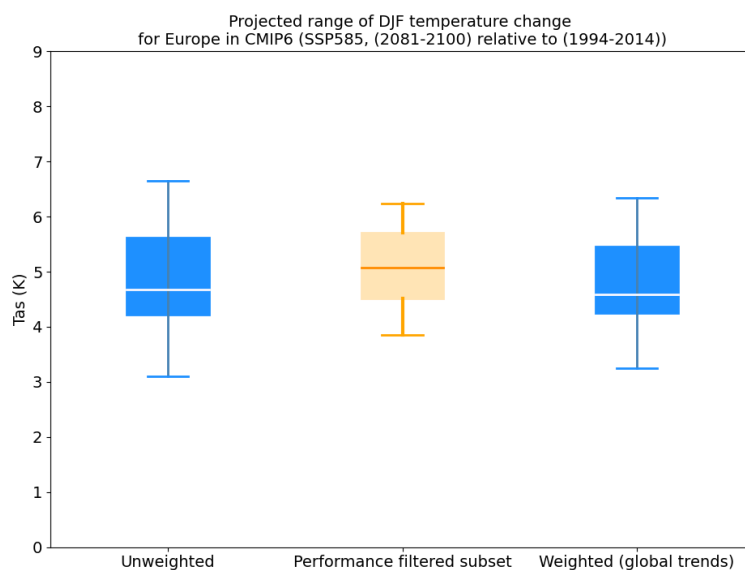


Figure S2. Projected range of JJA temperature change for Europe in CMIP6 (SSP585, (2081-2100) relative to (1994-2014)) for the raw unweighted multi-model ensemble, the performance filtered subset and the raw ensemble weighted for performance against global trends using the climWIP method . Boxes show 25th to 75th percentile. Whiskers show the 5th and 95th percentile

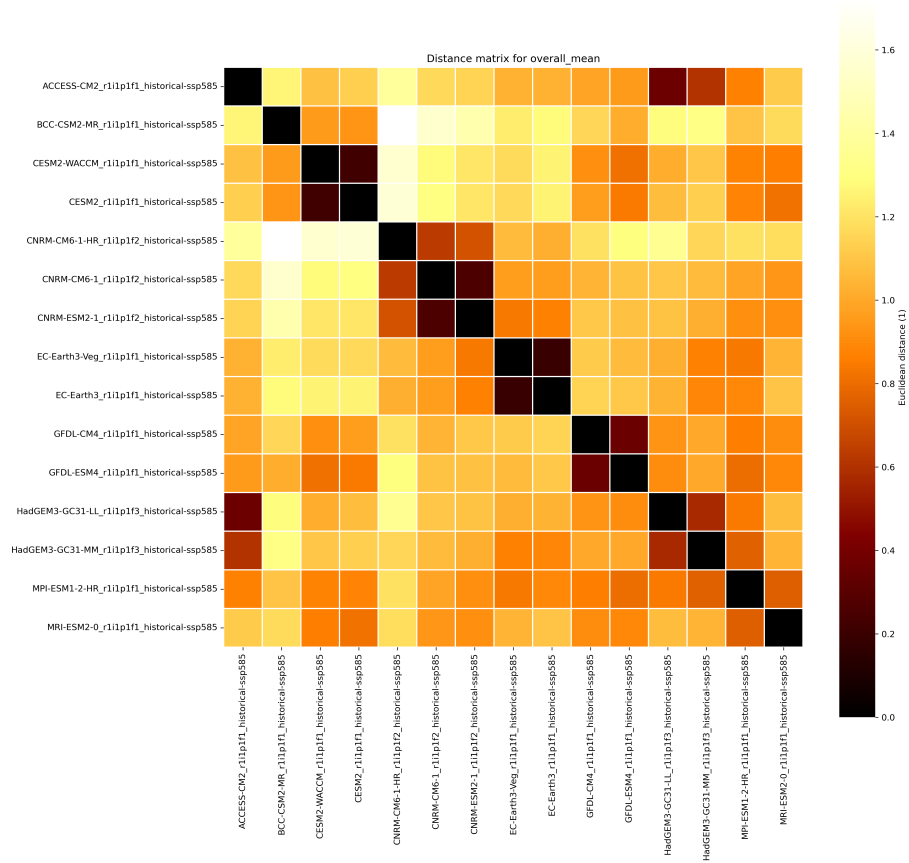


Figure S3. Euclidean distance for CMIP6 models using the ClimWIP method (Brunner et al., 2020)

The Euclidean distances for the filtered sub-set was used to determined group the models into cluster. The TaiESM1 model has been added to the filtered sub-set and is not included in figure S3. This model has clear dependencies in terms of shared components with the CESM2 family of models, so it was added to the same cluster.

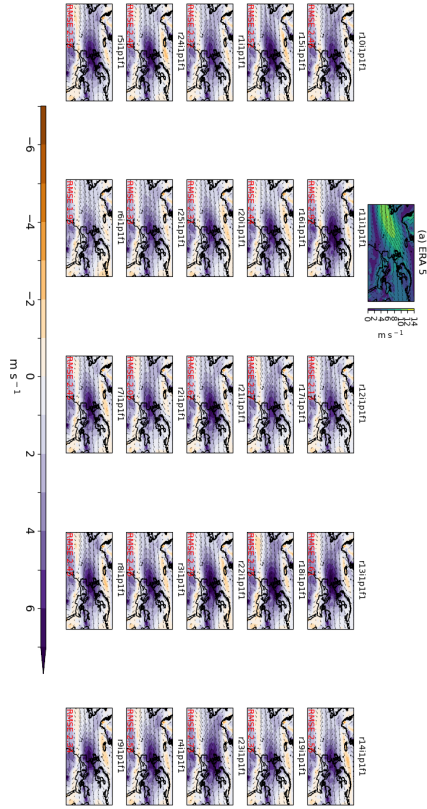


Figure S5. DJF circulation (850hPa) classifications for the CanESM5 realisations. Top panel shows ERA5 climatology. Windspeed and direction are shown as a 20 year mean 1995 – 2014. Arrows show wind direction (absolute, scaled by windspeed) for climatology across all panels. The shading for the 3 panels shows the difference in windspeed between the realisation and ERA climatology

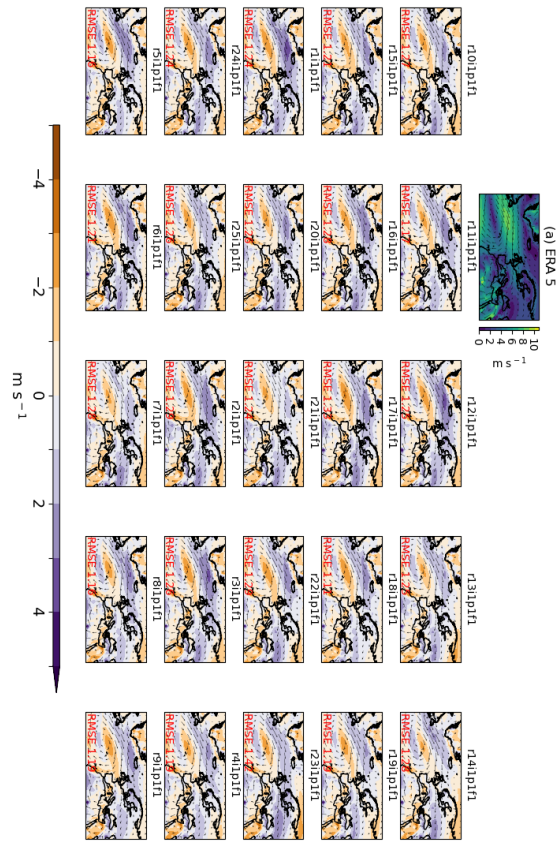


Figure S6. JJA circulation (850hPa) classifications for the CanESM5 realisations. Top panel shows ERA5 climatology. Windspeed and direction are shown as a 20 year mean 1995 – 2014. Arrows show wind direction (absolute, scaled by windspeed) for climatology across all panels. The shading for the 3 panels shows the difference in windspeed between the realisation and ERA climatology

From Fig S5 and S6 it can be seen that the pattern of errors remains strikingly similar across the ensemble realisations of CanESM5 for both DJF and JJA. There is however variability in the magnitude of the errors. For example, for DJF the large-scale circulation for CanESM5 was found to be 'Inadequate', based on the first ensemble member. While many of the ensemble members have larger errors than the first member (e.g. r18i1p1f1, r22i1p1f1), there is one realisation (r61p1f1) that would likely to qualify as 'Unsatisfactory'. The pattern of errors for JJA is again very similar across the realisations, but there is some variation in the magnitude of the errors. From this we conclude that there may be instances where the variability across realisations means that a model that has been classified as 'Inadequate' may have some realisations where the performance of the model might be acceptable. It is also likely to be the case that where a model has been classified as 'Unsatisfactory', some individual realisations could be considered 'Inadequate'

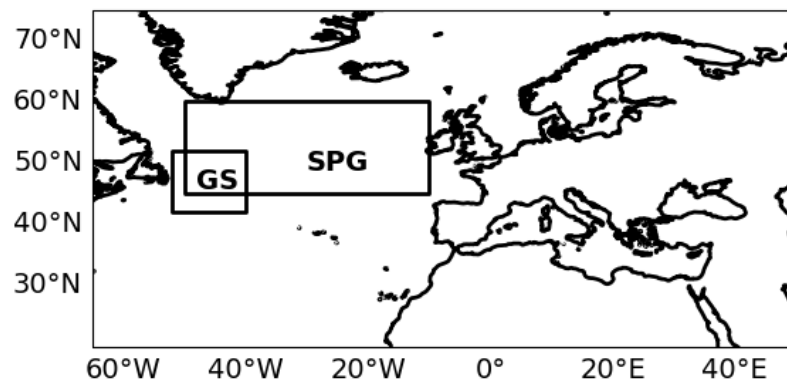


Figure S7. SST regions used for the assessment. GS: Gulf Stream region, SPG: Subpolar gyre