PRIMAVERA

Grant Agreement 641727

PRocess-based climate sIMulation: AdVances in high resolution modelling and European climate Risk Assessment

Deliverable D9.4

Publication of the PRIMAVERA Stream 1 Data Set

Deliverable Title	Publication of the PRIMAVERA Stream 1 data set
Brief Description	Publication of the PRIMAVERA data set for Stream 1 through data DOIs and data description publication.
WP number	9
Lead Beneficiary	Met Office
Contributors	Jon Seddon, Met Office
Creation Date Version Number Version Date	3rd July 2019 1.0 10th July 2019
Deliverable Due Date Actual Delivery Date	30th June 2019 10th July 2019

Nature of the Deliverable	R	*R - Report*
		P - Prototype
		D - Demonstrator
		O - Other
Dissemination Level/ Audience	PU	*PU - Public*
		PP - Restricted to other programme participants, including the Commission services
		RE - Restricted to a group specified by the consortium, including the Commission services
		CO - Confidential, only for members of the consortium, including the Commission services

Version	Date	Modified by	Comments
1.0	10th July 2019	Jon Seddon	First version

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Acknowledgements

Deliverable 9.4 was achieved through the work of many PRIMAVERA project members across work packages 9, 6 and others. There are too many people involved to credit each individually but this deliverable wouldn't have been achieved without their hard work.

1. Executive Summary

The PRIMAVERA Stream 1 simulations have now been published. The data has been uploaded to JASMIN and the metadata for each file is published on the PRIMAVERA data management tool. DOIs have been reserved for all of the datasets and have been released for a subset of them. PRIMAVERA users have been accessing the published data since 2017 and increasing numbers of invited collaborators are accessing the data at JASMIN. The data has begun to be made freely available through the Earth System Grid Federation to the global community.

2. Project Objectives

With this deliverable, the project has contributed to the achievement of the objectives shown in Table 1 (DOA, Part B Section 1.1), WP numbers are in brackets:

No.	Objective	Yes	No
A	To develop a new generation of global high-resolution climate models. *(3, 4, 6)*	Yes	
B	To develop new strategies and tools for evaluating global high-resolution climate models at a process level, and for quantifying the uncertainties in the predictions of regional climate. *(1, 2, 5, 9, 10)*	Yes	
C	To provide new high-resolution protocols and flagship simulations for the World Climate Research Programme (WCRP)'s Coupled Model Intercomparison Project (CMIP6) project, to inform the Intergovernmental Panel on Climate Change (IPCC) assessments and in support of emerging Climate Services. *(4, 6, 9)*	Yes	
D	To explore the scientific and technological frontiers of capability in global climate modelling to provide guidance for the development of future generations of prediction systems, global climate and Earth System models (informing post-CMIP6 and beyond). *(3, 4)*	Yes	
E	To advance understanding of past and future, natural and anthropogenic, drivers of variability and changes in European climate, including high impact events, by exploiting new capabilities in high-resolution global climate modelling. *(1, 2, 5)*	Yes	
F	To produce new, more robust and trustworthy projections of European climate for the next few decades based on improved global models and advances in process understanding. *(2, 3, 5, 6, 10)*	Yes	
G	To engage with targeted end-user groups in key European economic sectors to strengthen their competitiveness, growth, resilience and ability by exploiting new scientific progress. *(10, 11)*	Yes	
H	To establish cooperation between science and policy actions at European and international level, to support the development of effective climate change policies, optimize public decision making and increase capability to manage climate risks. *(5, 8, 10)*	Yes	

Table 1 – The objectives that this deliverable has contributed to.

3. Detailed Report

Stream 1 data from all seven of the PRIMAVERA modelling centres has been published at JASMIN. The Stream 1 simulations consist of 1.7 million netCDF files containing 692 terabytes of data. The data complies with the HighResMIP protocol (Haarsma et al. 2016) and all data files strictly comply with the CMIP6 project (Eyring et al. 2016) model output requirements and metadata standards. The HighResMIP data request was extended to include additional variables required for planned PRIMAVERA science.

The HighResMIP protocol includes the following experiments at standard and high resolution:

- *highresSST-present*   atmosphere-only simulation from 1950 to 2014
- *highresSST-future*   an extension of the atmosphere-only simulation to 2050
- *spinup-1950*   at least 30 years for the spin-up of the coupled model
- *hist-1950*   coupled simulation from 1950 to 2014 with historic forcings
- *control-1950*   100 years of coupled simulation with a constant 1950s forcing
- *highres-future*   an extension of hist-1950 to 2050

The models and experiments run by each of the modelling groups are shown in Table 2 in Appendix A. AWI did not run the atmosphere-only simulations as they use the same atmosphere model as MPI. ECMWF did not run any future simulations as their organisational policy prevents them from making projections. Descriptions of each of these models are available on the PRIMAVERA external website at https://www.primavera-h2020.eu/modelling/our-models/ including links to the model description journal papers as these are being published.

The data has been published at JASMIN. All of the data is held in the MASS and Elastic Tape tape-archives that are connected to JASMIN. Data that is currently being analysed is also available on disk on the PRIMAVERA group workspaces. When data files are uploaded to JASMIN they are validated to ensure that the files comply with the CMIP6 standards and their metadata is published to the PRIMAVERA Data Management Tool's (DMT) database before they are moved to tape. The DMT is freely available for PRIMAVERA and external users to query the data available at https://prima-dm.ceda.ac.uk/.

PRIMAVERA users have been accessing the Stream 1 data at JASMIN since the first data was published in May 2017. External users working with PRIMAVERA users have also been granted access to the data at JASMIN using the instructions available on the external website at https://www.primavera-h2020.eu/modelling/data-code/.

Digital Object Identifiers (DOIs) to provide a persistent link to the data have been generated by the CMIP6 data citation team. DOIs for models are not normally released until its Diagnostic, Evaluation and Characterization of Klima (DECK) experiments have been published to the Earth System Grid Federation (ESGF). The PRIMAVERA project worked with the CMIP6 data citation team to supply test data for the data challenges that were used to test the CMIP6 ESGF processes. In return for this assistance we were given early access

to the DOIs for some of the PRIMAVERA models. The DOIs that were released are summarised on the PRIMAVERA external website at https://www.primavera-h2020.eu/modelling/. The remaining models will have their DOIs released when their DECK experiments have been published by their modelling centres. Alternatively, data can be cited using the CMIP6 recommended reference form, for example:

MPI-M MPIESM1.2-HR model output prepared for CMIP6 HighResMIP. Earth System Grid Federation.   http://cera-www.dkrz.de/WDCC/meta/CMIP6/CMIP6.HighResMIP.MPI-M.MPI-ESM1-2-HR

Summary plots of the highresSST-present and hist-1950 experiments have been published at:

highresSST-present   http://cerfacs.fr/giec6/CVDP/CMIP6_PRIMAVERA_HighResMIP-highresSST-present_JASMIN/

hist-1950   http://exporter.nsc.liu.se/444a57ad27ea429a9abb04a9fecb4bff/

An example of the sea surface temperature means from the highreSST-present atmosphere-only simulations is shown in Figure 1 in Appendix B.

The PRIMAVERA Stream 1 simulations are currently being made freely available to the global community through the Science and Technology Facilities Council's (STFC) Centre for Environmental Data Analysis (CEDA) ESGF node at https://esgf-index1.ceda.ac.uk/projects/esgf-ceda/ with data being replicated across the federation.

4. Lessons Learnt

The Stream 1 data has been published according to the Data Management Plan published in Deliverable 9.1. The DMT has been developed iteratively from this plan. The evolution of the DMT can be seen in its repository at https://github.com/PRIMAVERA-H2020/primavera-dmt.

All members of the project will contribute to a full lessons learnt report for Deliverable 9.6 towards the end of the project.

5. Links Built

Work Package 9 (WP9) has worked with all of the other work packages to make the Stream 1 data available in a useful format. WP9 has worked closely with the global CMIP6 project to identify and fix bugs in the CMIP6 data request and to test the ESGF.

References

Eyring, Veronika, Sandrine Bony, Gerald A. Meehl, Catherine A. Senior, Bjorn Stevens, Ronald J. Stouffer, and Karl E. Taylor. 2016. "Overview of the Coupled Model Intercomparison Project Phase 6 (CMIP6) Experimental Design and Organization." *Geoscientific Model Development* 9 (5): 1937–58. https://doi.org/10.5194/gmd-9-1937-2016.

Haarsma, Reindert J., Malcolm J. Roberts, Pier Luigi Vidale, Catherine A. Senior, Alessio Bellucci, Qing Bao, Ping Chang, et al. 2016. "High Resolution Model Intercomparison Project (HighResMIP v1.0) for CMIP6." *Geoscientific Model Development* 9 (11): 4185–4208. https://doi.org/10.5194/gmd-9-4185-2016.

Appendix A

Institute	Model	highresSST-present	highresSST-future	spinup-1950	hist-1950	control-1950	highres-futre
AWI	AWI-CM-1-1-LR			x	x	x	x
	AWI-CM-1-1-HR			x	x	x	x
CERFACS	CNRM-CM6-1	x	x	x	x	x	x
	CNRM-CM6-1-HR	x	x	x	x	x	x
CMCC	CMCC-CM2-HR4	x	x	x	x	x	x
	CMCC-CM2-VHR4	x	x	x	x	x	x
EC-Earth[1]	EC-Earth3P	x	x	x	x	x	x
	EC-Earth3P-HR	x	x	x	x	x	x
ECMWF	ECMWF-IFS-LR	x		x	x	x	
	ECMWF-IFS-HR	x		x	x	x	
Met Office	HadGEM3-GC31-LM	x	x				
	HadGEM3-GC31-LL			x	x	x	x
	HadGEM3-GC31-MM	x	x	x	x	x	x
	HadGEM3-GC31-HM	x	x	x	x	x	x
	HadGEM3-GC31-HH			x	x	x	x
MPI	MPI-ESM1-2-HR	x	x	x	x	x	x
	MPI-ESM1-2-XR	x	x	x	x	x	x

Table 2 – The Stream 1 models and experiments run.

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[1] The EC-Earth Consortium's contribution comes from BSC, CNR, KNMI, SMHI, and the University of Oxford.
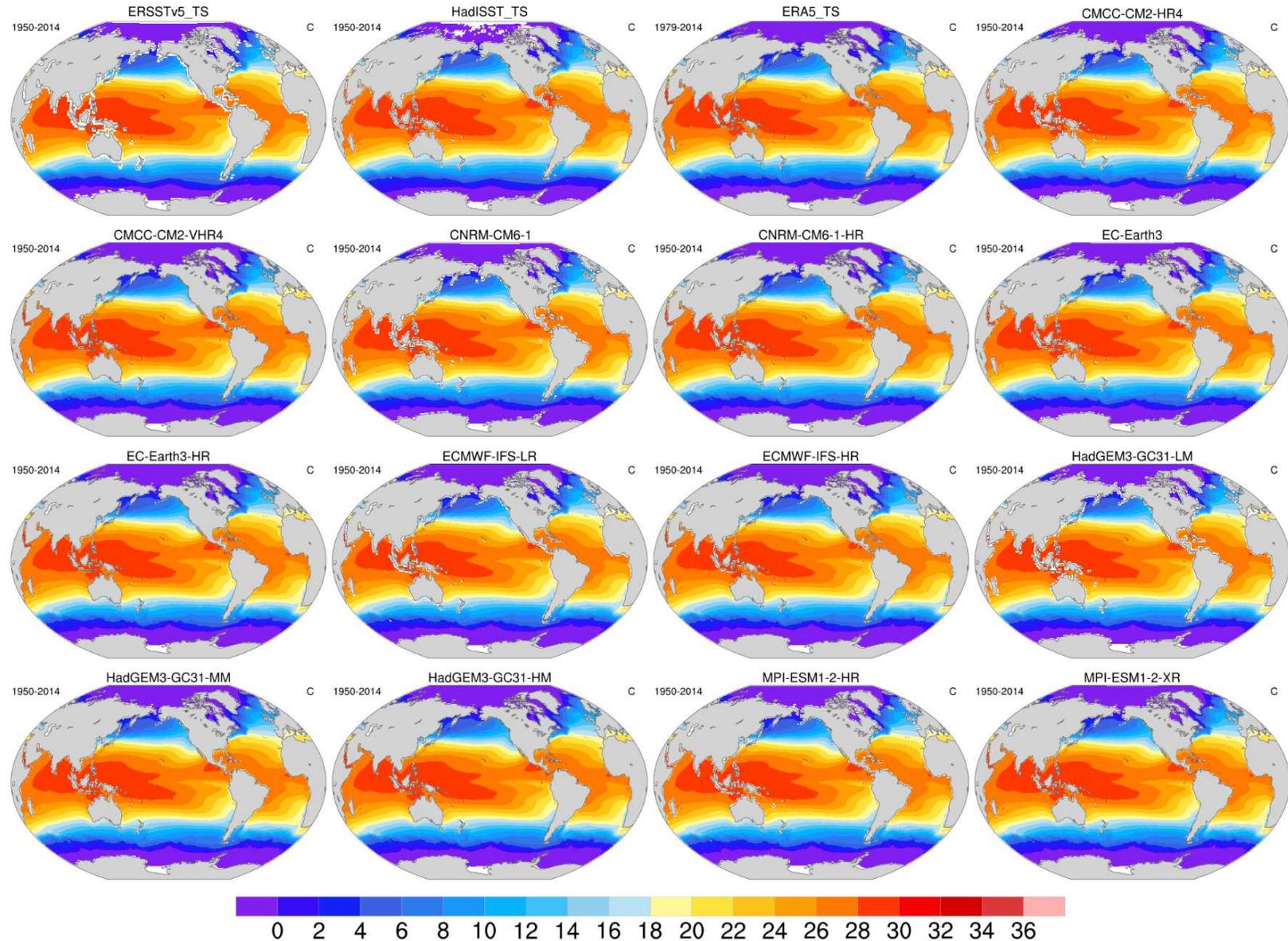
SST Means (Annual)

Figure 1 – Sea surface temperature annual means for the highresSST-present (atmosphere-only) experiments.