

ZATasks for Work Package 2: Scope includes both research aspects and delivery

Status of Research: Currently we have explored downscaling most VCSN variables (e.g. Wind, TMax, Tmin, Tmean, precip, wind, PET, SMD). All variables are fairly skilful. However, our research efforts have been tailored towards precipitation (because it is most challenging).

Variables to be downscaled: Tmax/Tmin/Tmean/precip/wind on the VCSN grid (5km), and potential to use 500m VCSN.

Project	Task	Sub-task	Notes	Start date	End date	POC	Scientific Risk
Downscaling GCMs with ML	Download CMIP6 Data	1. Downloading a single GCM (NorESM -MM) 2. Download Other models	Test ML method on a single GCM	Now	April 2022	Neelesh Rampal, Nicolas Fauchereau & Peter Gibson	Low
	Downscale a single GCM	1. Downscale two SSPs + historical	Can ML methods reproduce trends observed in GCMs / RCMs	May 2022	August 2022	Neelesh Rampal & Nicolas Fauchereau	Low-Medium
	Evaluation of the ML Model	1. Establish metrics to evaluate the ML model 2. Compare with a dynamically downscaled model (e.g. 12 km)		September 2022	January 2023	Neelesh Rampal, Nicolas Fauchereau, Peter Gibson	Low
	Creating a pipeline to downscale GCMs with ML	Creating a seamless pipeline that enables downscaling of GCMs, so that we can apply our		January 2023	July 2023	Maxime Rio, Neelesh Rampal, Nicolas Fauchereau	Low-Medium

		models to a wide variety of GCMs.					
Designing new Deep Learning Methods	Investigate the possibility of leveraging high-resolution datasets.	<ol style="list-style-type: none"> 1. Training a model to predict 500m VCSN rainfall / temperature. 2. Evaluation of ML model performance relative to 5km rainfall / temperature. 	Christian Zammit has been contacted.	August 2022	January 2023	Neelesh Rampal, Nicolas Fauchereau	Low
	Emulation of an RCM	<ol style="list-style-type: none"> 1. Training a deep learning model on RCM output, so that a deep learning model could potentially replace RCMs at a fraction of the computational cost 	This would be “cutting edge” research and very few communities are looking into this.	January 2023	January 2024	Neelesh Rampal, Nicolas Fauchereau	High
	Continue to develop innovative deep learning models for downscaling	<ol style="list-style-type: none"> 1. Leverage recent research such as GANs and graph neural networks for downscaling. 2. Evaluation of the performance of these models 	Other more advanced methods such as model hyperparameter tuning	January 2023	January 2024	Neelesh Rampal, Nicolas Fauchereau	Medium - High

Statistical downscaling of 12km to 5km VCSN	This is covered in WP1, however here we will develop the ML component of the work.	<ol style="list-style-type: none"> 1. Develop a ML based approach 2. Develop a BCSD and statistical approach from more traditional methods 	-Code development and testing for statistical downscaling to 5km VCSN for select variables -Development of this can begin after NorESM2 historical run complete -Completion of this requires all CCAM output available in 2023	July 2022	December 2023	Neelesh Rampal, Nicolas Fauchereau	Medium
--	---	--	--	-----------	---------------	------------------------------------	--------

Notes:

The workflow plan has been constructed to ensure that deliverables (e.g. downscaled outputs), can be delivered in the required time.

The research component (**Designing new Deep Learning Methods**), has been assigned a lower priority, however it is important that we are adding some weighting to investigate new methods.

Workflows will be organized as **SPRINTs** (used in software development), in-person sprints could also be desirable (e.g. inter-regional travel).

Reanalysis forced runs from CCAM / and other the UM, could be extremely valuable training data, for both BCSD and ML.

Have emailed Christian Zammit regarding the 500m VCSN products – this could be a very valuable resource to use here.