Protocol for Urban-PLUMBER

A multi-model, multi-site benchmarking evaluation project for urban areas

Mathew Lipson[1,2], Sue Grimmond[2] and Martin Best[3], with
Gab Abramowitz[1], Martin De Kauwe[1], Aristofanis Tsiringakis[4], Matthias Demuzere[5],
Helen Ward[6], Andrew Coutts[7], Andrew Pitman[1]

[1]UNSW Sydney, [2]University of Reading, [3]Met Office, [4]Wageningen University, [5]Ruhr-University,
[6]Innsbruck University, [7]Monash University

1. Background

The first international urban land surface model comparison project (PILPS-Urban; Grimmond et al., 2010, 2011) brought together many groups to consider model performance at two urban sites. Urban-PLUMBER will extend this to evaluate models at many sites, from highly urbanised to highly vegetated.

The project is open to models able to simulate local-scale (neighbourhood) radiant and turbulent energy fluxes representative of above canopy (roof) exchange, i.e. land surface models (LSMs) predicting energy partitioning at the Earth's surface from meteorological inputs. Both specialised urban LSM and those without an explicit urban representation (e.g. vegetation focussed LSM) are invited. Models will be evaluated by comparing predicted radiant and turbulent heat fluxes with local-scale observations.

2. Scope

Urban-PLUMBER project has two phases (Fig. 1):

Phase 1: (May 2020 – Nov 2020) a single site evaluation to ensure participants are comfortable with the configuration, submission and evaluation process.

Phase 2: (Nov 2020 – Mar 2021) a multi-site evaluation across a range of increasingly urbanised sites.

In both phases models are run offline (i.e. without coupling to an atmospheric model), forced by locally observed meteorology measured within the inertial sub- (or constant flux) layer. Simulations will include a 10-year spinup, with analysis period varying with observational data availability, from months to years.

In Phase 1 the Preston (Melbourne, Australia) site is re-used (from PILPS-Urban). Phase 2 will involve approximately 20 additional urban sites from across a range of urban densities and climates. Resources to help participants automate model configuration in the second phase are provided.

Submissions for Phase 1 will be accepted between **May and August 2020**, with an opportunity to update submission to November (if required). Phase 2 will run from November 2020 to March 2021.

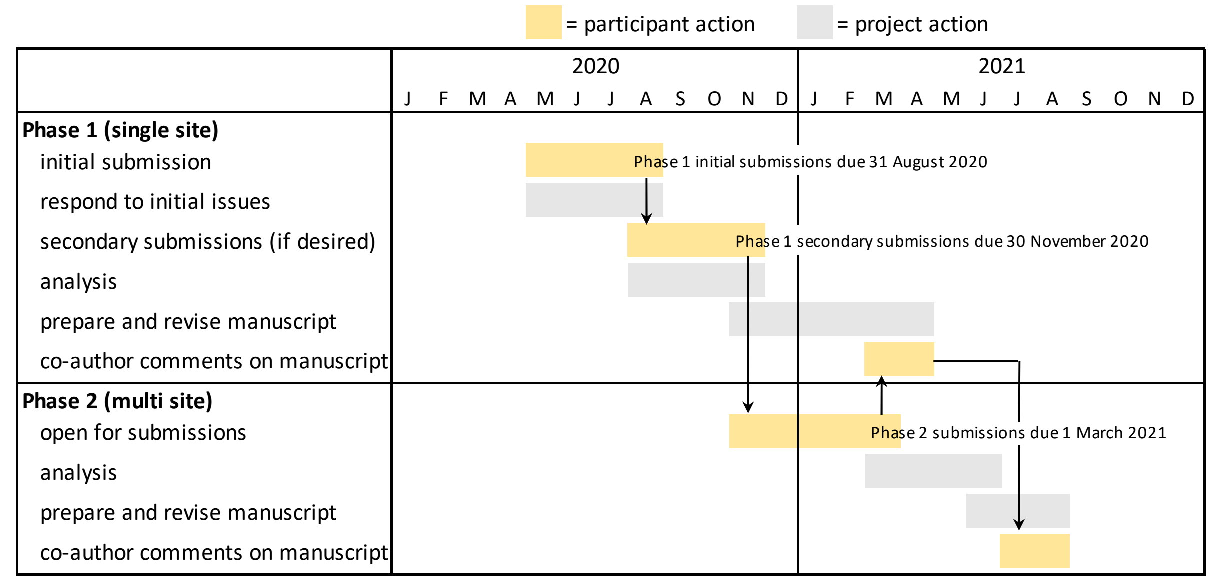

Figure 1: Project timeline.

3. Project outputs

Those who provide model outputs or observational data will be invited as authors on relevant papers.

Paper 1: Comparison of urban and non-urban LSM performance at a suburban site including process-based analysis. This will also assess how developments have affected urban model performance since the last major comparison at the same site (Grimmond et al., 2011).

Paper 2: Model performance at multiple sites. This will assess how different modelling approaches perform at different points along the urban/vegetation fraction continuum. Analysis will draw on the benchmarking evaluation methods of the PLUMBER[1] project (Best et al., 2015).

4. Experiments at each site

Two simulations per site are to be undertaken to assess how site-specific information affects performance:

a) Baseline

- Basic site information (parameters 1-9 Table 2) may be used in the baseline simulation.
- All other values should be default model parameters and settings, as defined in the model version being used by the participant.
- *Models without default parameters*: choose appropriate parameters for an average city; these values will be used for all baseline simulations in the multi-site phase.
- *Models without an explicit urban scheme:* select the method you will use to represent urban areas (e.g. bare soil).
- *Modelling systems with spatially varying default information* (e.g. soil type by location): these can be used but do not manually configure information.

b) Detailed

- All site information (parameters 1-24 Table 2) may be used in the detailed simulation, along with any other information participants think relevant, with the aim of improving model performance.
- Care should be taken to ensure your simulated bulk albedo is close to observed values as this is important for performance in modelling urban energy fluxes (Best and Grimmond, 2015).

[1] Protocol for the Analysis of Land Surface Models (PALS) Land Surface Model Benchmarking Evaluation Project

5. How to participate

1. Register interest in participating by emailing: **met-urban-plumber@reading.ac.uk**.
2. Read details of model forcing, configuration and output requirements in **Section 6 and 7**.
3. Download site data files (forcing and site information) following instructions in **Appendix A**.
4. Downloading example scripts to help automate the process of configuring models, amending forcing files, and creating complying submission files following instructions in **Appendix B**.
5. Amend the provided scripts (or write your own) to create your model configuration and model forcing for both baseline and detailed experiments at the first site: AU-Preston.
6. Run your simulations and use scripts to get model output into complying form.
7. Upload per instructions in **Appendix A**. You should see some basic analysis of your submission. If you note major issues, make corrections and resubmit.
8. Once additional site data are available (in Phase 2), download and run automation scripts to configure models, prepare forcing and create complying submission files at multiple sites.

6. Model forcing and configuration

Files (in **bold**) can be accessed by following instructions in Appendix A and B.

6.1 Forcing data

Forcing data is provided to drive models (Table 1) using ALMA[2] conventions in Coordinated Universal Time (UTC). Two equivalent files are provided:

1) text: **[site]_metforcing_[years]_UTC_v1.txt**
2) netCDF: **[site]_metforcing_[years]_UTC_v1.nc**

The text file format follows the PILPS-Urban project (Grimmond et al., 2011). The netCDF follows the PLUMBER project (Best et al., 2015). Either can be used directly, or the provided python script (**create_forcing_EXAMPLE_v1.py**) can be modified by participants to convert units and write a new forcing file if models require it (Appendix B).

Table 1: Forcing data available as text or netCDF with naming based on ALMA conventions.

short_name	long_name	units	direction positive
SWdown	Downward shortwave radiation	W/m2	Downward
LWdown	Downward longwave radiation	W/m2	Downward
Tair	Air temperature	K	-
Qair	Specific humidity	kg/kg	-
PSurf	Air pressure	Pa	-
Rainf	Rainfall rate	kg/m2/s	Downward
Snowf	Snowfall rate	kg/m2/s	Downward
Wind_N	Northward wind component	m/s	Northward
Wind_E	Eastward wind component	m/s	Eastward

Forcing files include the following time metadata, with values for the first site (Preston) shown:

- time_coverage_start: first date and time of forcing in UTC: (1993-01-01 00:00:00)
- time_coverage_end: last date and time of forcing in UTC: (2004-11-28 13:00:00)
- time_analysis_start: first date and time of analysis period in UTC: (2003-08-12 03:30:00)
- local_utc_offset_hours: local standard time offset from UTC: (10.0)
- timestep_interval_seconds: timestep interval in seconds: (1800)
- timestep_number_spinup: timestep number during spinup: (186007)
- timestep_interval_seconds: timestep number during analysis: (22772)

[2] Assistance for Land-surface Modelling Activities

6.2 Spinup

- Model simulations are sensitive to initial soil moisture conditions, so 10-years spinup data are included as part of the forcing data, following Best and Grimmond (2014, 2016).
- Spin-up data are ERA5 (C3S, 2017) for the closest grid point with corrections for elevational differences between site and ERA5 surface height following Weedon et al. (2011).
- Spinup and analysis periods should be run together (not repeated).
- Submit the full simulation including spinup. Only the observed periods will be evaluated.
- We recommend the soil column be saturated at the beginning if the spin-up period.

6.3 Model configuration

Table 2 lists site data provided for each site, with example values for Preston shown.

- Basic site information (parameters 1-9) are for use in the baseline experiment, while all parameters may be used for the detailed experiment.
- Data tables are standard for each site, provided as a comma-separated file: **[site]_sitedata_v1.csv**
- We encourage participants to automate model configuration through scripts which convert the site data tables into model configuration files. An example Python script for automation is provided: **create_config_EXAMPLE_v1.py** (Appendix B).

Table 2: Standard *site data table* with values for Preston. Parameters are further described in the csv file.

id	parameter	value	units	source
	Parameters 1-9 should be used in the baseline experiment only			
1	latitude	-37.73	degrees_north	Coutts et al. 2007a
2	longitude	145.01	degrees_east	Coutts et al. 2007a
3	ground_height	93.0	m	Coutts et al. 2007a
4	measurement_height_above_ground	40.0	m	Coutts et al. 2007b
5	impervious_area_fraction	0.62	1	Grimmond et al. 2011
6	tree_area_fraction	0.225	1	Grimmond et al. 2011
7	grass_area_fraction	0.15	1	Grimmond et al. 2011
8	bare_soil_area_fraction	0.005	1	Grimmond et al. 2011
9	water_area_fraction	0.0	1	Grimmond et al. 2011
	Any or all parameters 10-24 can be used in the detailed experiment (optional)			
10	roof_area_fraction	0.445	1	Grimmond et al. 2011
11	road_area_fraction	0.13	1	Grimmond et al. 2011
12	footpath_area_fraction	0.045	1	Grimmond et al. 2011
13	building_mean_height	6.4	m	Grimmond et al. 2011
14	tree_mean_height	5.7	m	Nice et al. 2018
15	roughness_length_momentum	0.4	m	Grimmond et al. 2011
16	displacement_height	4.57	m	Macdonald et al. 1998
17	canyon_height_width_ratio	0.42	1	Grimmond et al. 2011
18	wall_to_plan_area_ratio	0.4	1	Grimmond et al. 2011
19	average_albedo_at_midday	0.15	1	Grimmond et al. 2011
20	resident_population_density	415.78	person/km2	Grimmond et al. 2011
21	anthropogenic_heat_flux_mean	11.0	W/m2	Best and Grimmond 2016
22	topsoil_clay_fraction	0.18	1	openlandmap.org
23	topsoil_sand_fraction	0.72	1	openlandmap.org
24	topsoil_bulk_density	1230	kg/m3	openlandmap.org

7. Model output

To allow evaluation outputs are required in a standard format.

- Simulation metadata (Section 7.1) and variable outputs (Section 7.2) should be included within a single netCDF file for each simulation (i.e. two files for each site).

- An example script is provided to create a complying netCDF with all requested data for a 7-day test period: **create_netcdf_EXAMPLE_v1.py** (Appendix B).

7.1 Simulation metadata

Table 3 lists requested simulation metadata, to be included as global attributes in the netCDF file.

Table 3: Requested metadata as global attributes in output files.

attribute	contents
title	"[Model name] model output for the Urban-PLUMBER project"
site	Site name (e.g. AU-Preston)
experiment	Baseline or detailed experiment.
institution	Name of group submitting
primary_contact	Name and email of primary contact person
secondary_contact	Name and email of secondary contact person
model	Short name of model (9 or less characters)
source	Full name of model and version
references	Publication reference(s) for the model
repository	A link to model code repository (e.g. github) if available
site_experience	Has the group had previous experience modelling the site?
additional_data	List any additional site-specific data used by the group to configure the simulation
comment	Any additional comments participants wish to record

7.2 Variable outputs

Table 4 lists requested variables based on the ALMA protocol for standard model outputs.

- "Critical" energy balance components (noted in Table 4 with #) are **required**.
- Include as many of the other variables as you are able.
- Unless noted in the subgrid column with a particular type (e.g. "roof"), variables are grid-averaged (i.e. area-weighted average of all subgrid types, including urban and vegetation areas together).
- Some variables do not appear in the ALMA standard (noted in Table 4 with *), e.g.:
    - Qanth: net anthropogenic heat flux (sensible, latent and radiant) from all sources (energy emitted in buildings, by vehicles, industry and metabolism). If Qanth is not modelled, set Qanth=0 at all timesteps.
    - Qstor is the net storage heat flux in the near-surface system including air, buildings, vegetation, roads and soil. If not modelled and advection fluxes are negligible, it can be determined as the residual of the surface energy balance (Grimmond et al., 2011):
        - Qstor = SWnet + LWnet + Qanth – Qle – Qh
- Enter time dimension units as a string: "seconds since YYYY-MM-DD HH:MM:SS" using the first timestep in UTC as noted in the *time_coverage_start* variable of the forcing metadata (Appendix C). For example, the Preston site will be: "seconds since 1993-01-01 00:00:00".

Table 4: Output variables with ALMA standards must use the variable name and units indicated. Critical variables (#) and those not in the ALMA standard (*) are indicated. Further information on ALMA variable definitions are available at: http://www.lmd.jussieu.fr/~polcher/ALMA/convention_output_3.html

	short_name	long_name (positive direction)	units/{dims}	subgrids
		Dimensions		
#	time	Time	seconds since <time_coverage_start>	-
	soil_layer	Soil layer number (from surface)	-	-
		Critical energy balance components	{time}	
#	SWnet	Net shortwave radiation (downward)	W/m2	all
#	LWnet	Net longwave radiation (downward)	W/m2	all
#	Qle	Latent heat flux (upward)	W/m2	all
#	Qh	Sensible heat flux (upward)	W/m2	all
#*	Qanth	Anthropogenic heat flux (upward)	W/m2	all
#*	Qstor	Net storage heat flux in all materials (increase)	W/m2	all

	short_name	long_name (positive direction)	units/{dims}	subgrids
		Additional energy balance components {time}	{time}	
	Qg	Ground heat flux (downward)	W/m2	all
*	Qanth_Qh	Anthropogenic sensible heat flux (upward)	W/m2	all
*	Qanth_Qle	Anthropogenic latent heat flux (upward)	W/m2	all
	Qtau	Momentum flux (downward)	N/m2	all
		General water balance components {time}	{time}	
	Snowf	Snowfall rate (downward)	kg/m2/s	all
	Rainf	Rainfall rate (downward)	kg/m2/s	all
	Evap	Total evapotranspiration (upward)	kg/m2/s	all
	Qs	Surface runoff (out of gridcell)	kg/m2/s	all
	Qsb	Subsurface runoff (out of gridcell)	kg/m2/s	all
	Qsm	Snowmelt (solid to liquid)	kg/m2/s	all
	Qfz	Re-freezing of water in the snow (liquid to solid)	kg/m2/s	all
	DelSoilMoist	Change in soil moisture (increase)	kg/m2	all
	DelSWE	Change in snow water equivalent (increase)	kg/m2	all
	DelIntercept	Change in interception storage (increase)	kg/m2	all
*	Qirrig	Anthropogenic water flux from irrigation (increase)	kg/m2/s	all
		Surface state variables	{time}	
	SnowT	Snow surface temperature	K	snow
	VegT	Vegetation canopy temperature	K	all vegetation
	BaresoilT	Temperature of bare soil (skin)	K	bare soil
	AvgSurfT	Average surface temperature (skin)	K	all
	RadT	Surface radiative temperature	K	all
	Albedo	Surface albedo	1	all
	SWE	Snow water equivalent	kg/m2	all
	SurfStor	Surface water storage	kg/m2	all
	SnowFrac	Snow covered fraction	1	all
	SAlbedo	Snow albedo	1	snow
*	CAlbedo	Vegetation canopy albedo	1	all vegetation
*	UAlbedo	Urban canopy albedo	1	all urban
*	LAI	Leaf area index	m2/m2	all vegetation
*	RoofSurfT	Roof surface temperature (skin)	K	roof
*	WallSurfT	Wall surface temperature (skin)	K	wall
*	RoadSurfT	Road surface temperature (skin)	K	road
*	TairSurf	Near surface air temperature (2m)	K	all
*	TairCanyon	Air temperature in street canyon (bulk)	K	canyon
*	TairBuilding	Air temperature in buildings (bulk)	K	building
		Sub-surface state variables (two dimensional)	{time, soil_layer}	
	SoilMoist	Average layer soil moisture	kg/m2	all
	SoilTemp	Average layer soil temperature	K	all
		Evaporation components	{time}	
	TVeg	Vegetation transpiration	kg/m2/s	all vegetation
	ESoil	Bare soil evaporation	kg/m2/s	bare soil
	RootMoist	Root zone soil moisture	kg/m2	all
	SoilWet	Total soil wetness	1	all
	ACond	Aerodynamic conductance	m/s	all
		Forcing data (at forcing height)	{time}	
	SWdown	Downward shortwave radiation	W/m2	all
	LWdown	Downward longwave radiation	W/m2	all
	Tair	Air temperature	K	all
	Qair	Specific humidity	kg/kg	all
	PSurf	Air pressure	Pa	all
	Wind	Wind speed	m/s	all

7.3 Subgrid parameters

Models have different numbers of subgrid surfaces (e.g roof, wall, street, bare soil, water) and vegetation types (e.g. tree, shrub, grass). Some models combine surfaces into bulk subgrid types (e.g. canyon, urban, vegetation). Please submit your subgrid types, surface area fractions and albedos used in each simulation as a spreadsheet/text document ancillary file. An example is provided, see Appendix B.

For other parameters, submit the namelist or configuration files used in each simulation, or expand the spreadsheet/text document to include all soil, facet material and vegetation parameter information.

7.4 Output filenames

The netCDF output and subgrid parameter filenames should be:

[model_shortname]_[sitename]_[experiment]_v[submissionNumber].[extension]

e.g. the netCDF of the NOAH-LSM 2007 model at the first site and baseline experiment would be:

  - **NOAH07_AU-Preston_baseline_v1.nc**
- If you need to resubmit a particular experiment, increment submission number **v2** etc.

8. Acknowledgments

We gratefully acknowledge those who have provided feedback to the protocol and offered observational datasets including Gert-Jan Steeneveld, Denise Hertwig, Natalie Theeuwes, Mengyuan Mu, Zutao Yang, David Reed, Yurong Shi, David Reed and Andreas Christen.

9. References

Best, M. J. and Grimmond, C. S. B.: Importance of initial state and atmospheric conditions for urban land surface models' performance, Urban Climate, 10, 387–406, doi:10.1016/j.uclim.2013.10.006, 2014.

Best, M. J. and Grimmond, C. S. B.: Key conclusions of the first international urban land surface model comparison project, Bull. Amer. Meteor. Soc., doi:10.1175/BAMS-D-14-00122.1, 2015.

Best, M. J. and Grimmond, C. S. B.: Modeling the Partitioning of Turbulent Fluxes at Urban Sites with Varying Vegetation Cover, J. Hydrometeor., 17(10), 2537–2553, doi:10.1175/JHM-D-15-0126.1, 2016.

Best, M. J., Abramowitz, G., Johnson, H. R., Pitman, A. J., Balsamo, G., Boone, A., Cuntz, M., Decharme, B., Dirmeyer, P. A., Dong, J., Ek, M., Guo, Z., Haverd, V., van den Hurk, B. J. J., Nearing, G. S., Pak, B., Peters-Lidard, C., Santanello, J. A., Stevens, L. and Vuichard, N.: The Plumbing of Land Surface Models: Benchmarking Model Performance, J. Hydrometeor, 16(3), 1425–1442, doi:10.1175/JHM-D-14-0158.1, 2015.

C3S: ERA5: Fifth generation of ECMWF atmospheric reanalyses of the global climate, Copernicus Climate Change Service (C3S) Climate Data Store (CDS), 2017.

Grimmond, C. S. B., Blackett, M., Best, M. J., Barlow, J., Baik, J.-J., Belcher, S. E., Bohnenstengel, S. I., Calmet, I., Chen, F., Dandou, A., Fortuniak, K., Gouvea, M. L., Hamdi, R., Hendry, M., Kawai, T., Kawamoto, Y., Kondo, H., Krayenhoff, E. S., Lee, S.-H. and Loridan, T.: The International Urban Energy Balance Models Comparison Project: First Results from Phase 1, Journal of Applied Meteorology & Climatology, 49(6), 1268–1292, doi:10.1175/2010JAMC2354.1, 2010.

Grimmond, C. S. B., Blackett, M., Best, M. J., Baik, J.-J., Belcher, S. E., Beringer, J., Bohnenstengel, S. I., Calmet, I., Chen, F., Coutts, A., Dandou, A., Fortuniak, K., Gouvea, M. L., Hamdi, R., Hendry, M., Kanda, M., Kawai, T., Kawamoto, Y., Kondo, H., Krayenhoff, E. S., Lee, S.-H., Loridan, T., Martilli, A., Masson, V., Miao, S., Oleson, K., Ooka, R., Pigeon, G., Porson, A., Ryu, Y.-H., Salamanca, F., Steeneveld, G. j., Tombrou, M., Voogt, J. A., Young, D. T. and Zhang, N.: Initial results from Phase 2 of the international urban energy balance model comparison, International Journal of Climatology, 31(2), 244–272, doi:10.1002/joc.2227, 2011.

Nice, K. A., Coutts, A. M. and Tapper, N. J.: Development of the VTUF-3D v1.0 urban micro-climate model to support assessment of urban vegetation influences on human thermal comfort, Urban Climate, 24, 1052–1076, doi:10.1016/j.uclim.2017.12.008, 2018.

Weedon, G. P., Gomes, S., Viterbo, P., Shuttleworth, W. J., Blyth, E., Österle, H., Adam, J. C., Bellouin, N., Boucher, O. and Best, M.: Creation of the WATCH Forcing Data and Its Use to Assess Global and Regional Reference Crop Evaporation over Land during the Twentieth Century, J. Hydrometeor., 12(5), 823–848, doi:10.1175/2011JHM1369.1, 2011.

Appendix A: Instructions for accessing modelevaluation.org

For each site the following files are available from modelevaluation.org:

- **[site]_sitedata_v1.csv**: comma-separated text file with site characteristic information (Table 1)
- **[site]_metforcing_v1.nc:** meteorological forcing data in netCDF format (Table 2)
- **[site]_metforcing_v1.txt:** equivalent forcing data in space-separated text format

Getting site data and running simulations:

1. Register an account for your group at modelevaluation.org
2. Enter your model information by clicking on “Model Profiles -> Create Model Profile”
3. Join the “Urban-PLUMBER1” workspace using the button in the top banner
4. Click on “Data Sets->In Current Workspace” in the banner,
   a. select the AU-Preston: Urban-PLUMBER tab to see a site summary and download the forcing data (in netCDF and text formats) and ancillary information files (the XX-Test site can also be used to test the process with a shorter 7-day dataset).
5. After configuring your model using site information (Section 6):
   a. run the baseline simulation in your local environment
   b. run the detailed simulation in your local environment
6. Adjust your model output to conform with reporting standards (section 7), preferably using the provided **create_netcdf_EXAMPLE.py** script to ensure file and variable compliance.

Submitting simulations:

7. Upload model output by clicking “Model Outputs -> Upload Model Output”, then:
   a. Name the simulation as **[modelname]_[sitename]_[experiment][submissionversion]**.
      i. The experiment (baseline or detailed) may be shortened here to “b” and “d”. For example: **NOAH07_AU-Preston_ b1**
   b. Select the experiment “Urban-PLUMBER Phase 1” in the dropdown menu.
   c. Select your model from the list (as entered in step 2).
   d. Click the “Upload files” button to upload model netcdf output file. Do not select “downloadable by others” or make the submission public.
   e. Upload your model subgrid and configuration (namelist) files(s) in “Ancillary Files”.
   f. You may choose a benchmark model to compare your submission with, for example one of your previous submissions, or a simple empirical benchmark (e.g. REG1-SW).
   g. Click on “Save” at the bottom of screen.
   h. Click “Run Analysis” at bottom of screen. Your upload will be tested for compliance. If output cannot be read the error messages should indicate what is not complying.
8. With a complying submission you can view some indicative analysis plots under the “Analyses” tab.

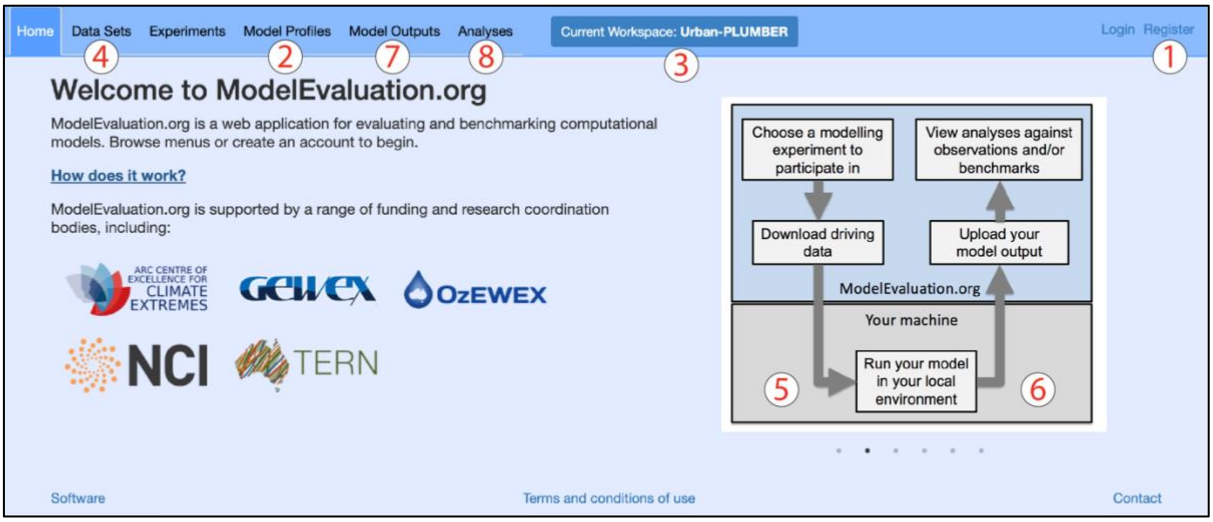

Figure 2: Screenshot of **modelevaluation.org** with numbers per instructions above. If you do not see menu bar items, widen the window, or use the dropdown bar at the top right. For help email m.lipson@unsw.edu.au.

Appendix B: Model configuration, forcing and output scripts

Python scripts are provided to help participants. Files can be cloned or downloaded from https://bitbucket.org/matlipson/urban-plumber/src/master/. Files include:

- **create_config_EXAMPLE_v1.py**: automates model configuration by reading the provided sitedata file, making necessary conversions and outputting a namelists for an example model (in this case NOAH-LSM). Automated configuration reduces work for the multi-site phase and ensures provided information is used consistently at all sites.
- **create_forcing_EXAMPLE_v1.py**: takes the netCDF forcing file, makes variable conversions and creates a padded text forcing file in the format required for an example model. Includes a function to convert UTC to standard local time if required.
- **create_netcdf_EXAMPLE_v1.py:** takes dummy model output and constructs a single netCDF with all requested metadata (Table 3) and variables (Table 4).

The repository includes site and forcing data from an example test site with 7 days of data:

- **XX-Test/XX-Test_sitedata_v1.csv:** A site data table for the test site (Table 2).
- **XX-Test/XX-Test_metforcing_v1.nc:** A forcing file in netCDF format (7 days).
- **XX-Test/XX-Test_metforcing_v1.nc:** A forcing file in text format (7 days).
- **XX-Test/output/modeloutput_EXAMPLE.txt:** dummy model output (7 days).
- **XX-Test/output/EXAMPLE_XX-Test_baseline_v1.txt:** an example of the subgrid model parameter spreadsheet/text submission (Section 7.4).

Appendix C: Example of metadata in forcing file

The following metadata is included in both netCDF and text site forcing files, with Preston shown below:

```
// global attributes:
		:title = "Model forcing data for Urban-PLUMBER at site AU-Preston" ;
		:summary = "Combined observational and ERA5-derived surface meteorological data for Preston, Melbourne, Australia. To be used for forcing of land surface models participating in Urban-PLUMBER. Data is for use by registered participants of the Urban-PLUMBER project only. Do not distribute. All times in UTC." ;
		:sitename = "AU-Preston" ;
		:siteid = "Mb03m" ;
		:version = "v1" ;
		:conventions = "ALMA+CF.rev13" ;
		:featureType = "timeSeries" ;
		:time_coverage_start = "1993-01-01 00:00:00" ;
		:time_coverage_end = "2004-11-28 13:00:00" ;
		:time_analysis_start = "2003-08-12 03:30:00" ;
		:time_shown_in = "UTC" ;
		:local_utc_offset_hours = 10. ;
		:timestep_interval_seconds = 1800 ;
		:timestep_number_spinup = 186007 ;
		:timestep_number_analysis = 22772 ;
		:date_created = "2020-05-22 18:03:07" ;
		:primary_contact = "Mathew Lipson: m.lipson@unsw.edu.au" ;
		:secondary_contact = "Martin Best: martin.best@metoffice.gov.uk" ;
		:observations_reference = "Coutts, A. M., Beringer, J. and Tapper, N. J.: doi:10.1175/JAM2462.1" ;
		:other_references = "ERA5: Copernicus Climate Change Service (C3S) (2017): https://cds.climate.copernicus.eu/cdsapp#!/home" ;
		:acknowledgements = "Contains modified Copernicus Climate Change Service Information (ERA5 hourly data on single levels). With thanks to all involved in collecting, processing and sharing observational data" ;
```