Protocol for observational data used in Urban-PLUMBER

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

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1. Background

Urban-PLUMBER is a land surface model evaluation project with simulations planned at many sites, from highly urbanised to highly vegetated. The project relies on local-scale meteorology and energy flux observations for forcing and evaluating models. We would like to invite groups with observations to contribute. Those who provide data used in the project will be invited as authors on relevant papers.

There will be additional opportunities to participate in related model evaluation sub-projects, and/or contribute to a new collection of standardised observations, if there is interest in doing so (Section 6).

To review the requirents for modelling participants, see:

https://urban-plumber.github.io/static/Urban-PLUMBER_protocol_v1.pdf

2. Observation data requirements

Observations should:

- be owned by the group submitting, and able to be used as described here
- include forcing (Table 1) and evaluation (Table 2) variables (some discrepancies are acceptable)
- be taken at the same height, within the inertial sub-layer (or constant flux layer), typically 2-5 times the height of roughness elements (i.e. well above roof height)
- be collected over urban landscapes of any type (high to low density) that is generally flat, with homogenous fetch
- be at least one month long, with datasets of one year or longer being preferred to capture seasonal variability
- be block-averaged into 30 min or 60 min periods
- have passed through standard data quality control checks

Observations can be gap-filled or include gaps (we can undertake gap-filling). If data are provided gap-filled, those intervals need to be flagged. We can accept data in most formats (e.g. ascii, csv, netCDF).

3. Data access

Observations will be split into two sets: (1) for *forcing* and (2) for *evaluating* models.

1) Forcing files

- Forcing variables (Table 1) will be accessible by all registered users of modelevaluation.org.
- Access to modelevaluation.org is password protected, and users must agree to terms of use:
    - https://modelevaluation.org/terms-of-use
- All forcing data files include a reference to your nominated publication and the following:

- o "Data are for use by registered participants of Urban-PLUMBER for this project only. Do not distribute."
- Additional statements can be included on request.

2) Evaluation files

- Evaluation variables (Table 2) will be withheld from modelling participants.
- Evaluation data will be accessible to Mathew Lipson, Sue Grimmond and Martin Best (to evaluate model output), Gab Abramowitz and Danny Eisenberg (administrators of modelevaluation.org).
- Authorisation from data owners will be obtained prior to further circulation of evaluation files (e.g. if evaluation is undertaken by other individuals).
- Data owners may refuse further circulation or retract permission to use data to evaluate models up until submission of relevant journal articles.

4. Requested variables

Variables should be block averaged into time periods ending in standard time (i.e. without daylight savings). Universal standard or local standard times are acceptable.

4.1 Forcing data

Forcing data (Table 1) will be shared with participants of Urban-PLUMBER. Some variations from requested variables are accepable, for example relative humidity rather than specific humidity, or wind direction rather than wind components or without snowfall data. We can perform the relevant conversions. Contact us if you are unsure if your data can be accepted.

Table 1: Requested forcing data which are shared with modelling participants.

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	Station 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

Observed forcing data will be combined with reanalysis-derived data (for model-spinup) and provided to participants in a single file. Some metadata (e.g. publication reference for observations) will also be included in forcing files. An example of forcing data provided in Phase 1 of the project can be viewed at:

https://bitbucket.org/matlipson/urban-plumber/src/master/XX-Test/XX-Test_metforcing_v1.txt

4.2 Evaluation data

Evaluation data (Table 2) will not be shared with modelling participants but will be used by us to evaluate models. Additional data, for example ground heat flux, surface temperatures, soil moisture or any other observed data will be gratefully accepted and could be used for additional studies (with the owner's permission). Alternatively, just let us know if additional data are available.

Table 2: Requested evaluation data which is **not** shared with participants.

short_name	long_name	unit	direction positive
SWup	Upward shortwave radiation	W/m2	Upward
LWup	Upward longwave radiation	W/m2	Upward
Qle	Latent heat flux	W/m2	Upward
Qh	Sensible heat flux	W/m2	Upward

5. Requested metadata

5.1 Site characteristics

Site characteristics will be provided to modelling participants. Table 3 gives an example with the values for the first site (Preston, Melbourne). Please fill as many fields as you are able in units noted and include in your submission, along with a description of the method for collecting site data.

Table 3: Standard *site data table* with values representative of the turbulent energy flux footprint.

id	parameter	value	units	source
1	latitude	?	degrees_north	?
2	longitude	?	degrees_east	?
3	ground_height	?	m	?
4	measurement_height_above_ground	?	m	?
5	impervious_area_fraction	?	1	?
6	tree_area_fraction	?	1	?
7	grass_area_fraction	?	1	?
8	bare_soil_area_fraction	?	1	?
9	water_area_fraction	?	1	?
area fractions above should sum to 1				
area fractions below should sum to impervious_area fraction				
10	roof_area_fraction	?	1	?
11	road_area_fraction	?	1	?
12	footpath_area_fraction	?	1	?
13	building_mean_height	?	m	?
14	tree_mean_height	?	m	?
15	roughness_length_momentum	?	m	?
16	displacement_height	?	m	?
17	canyon_height_width_ratio	?	1	?
18	wall_to_plan_area_ratio	?	1	?
19	average_albedo_at_midday	?	1	?
20	resident_population_density	?	person/km2	?
21	anthropogenic_heat_flux_mean	?	W/m2	?
22	topsoil_clay_fraction	?	1	?
23	topsoil_sand_fraction	?	1	?
24	topsoil_bulk_density	?	kg/m3	?

clarifications
- impervious_area_fraction: the total area of urban "hard surfaces" e.g. roofs, roads, paths etc.
- footpath_area_fraction: all hard surfaces that are not roads or roofs, e.g. paths, paving etc.
- roof_area_fraction: (or building area fraction) the footprint of buildings

5.2 Observations Metadata

Requested observations metadata are indicated in Table 3. Please fill this table and include with your data submission.

Table 3: Requested observations metadata.

site	Site name
references	Publication reference(s) for the observations
primary contact	Name and email of primary contact person
list of authors	Names of authors who should be included in papers
funding	Funding acknowledgement where required
sensors	Sensors used to collect observations, their height, orientation and sample rates
changes	List any changes that occurred to site or sensors
sectors	Note wind sectors where they differ significantly in land use characteristics
quality control	QC undertaken for each variable
gap filling	Explain gap-filling method (if undertaken)
model studies	List modelling groups or studies which have previously used this data set
comment	Any additional comments participants wish to record

6. Additional projects

Beyond the main Urban-PLUMBER project (i.e. evaluating models at all available timesteps), there is opportunity to participate in additional studies which use a subset of data, for example:

1. Studies focussing on particular time periods (e.g. after rain), or using additionally observed variables (e.g. surface temperatures).
2. A cross-site synthesis paper on observations.
3. The development of a "standard" data set for driving and evaluating models in the long term.

Co-authorship will be invited to those that contribute.

We are committed to ensuring observational data are appropriately handled and that the work involved in collecting and quality assuring the data is appropriately acknowledged. If you have any concerns about data use, have suggestions or requests relating to your data, please discuss with us.

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