S-MOF

User manual

Code release V 0.0

Korbinian Breinl* and Giuliano Di Baldassarre

University of Uppsala, Department for Earth Sciences, LUVAL, Villavägen 16, 752 36 Uppsala, Sweden

27 November 2017

*korbinian.breinl@geo.uu.se

Document information

Model name	S-MOF
Document title	S-MOF User manual
Document version	0.0
Release data	27 November 2017

Executive summary

This document is the quick user manual for the open-source space-time disaggregation tool S-MOF (Spatial-Method-Of-Fragments) version 0.0. The code is a scientific tool for the disaggregation of daily into hourly values in space and time for rainfall and temperature. The tool can be seen as the spatial interpretation of the univariate method of fragments (MOF), which has been proposed for rainfall [*Mehrotra et al.*, 2012; *Sharma and Srikanthan*, 2006; *Westra et al.*, 2012].

As the related scientific article is not published yet, this user manual is a limited description with the main goal to making the model run. The scientific content will be added after the related scientific article has been published.

History of model versions

Version	Date	Information
0.0	November 2017	First version created by Korbinian Breinl in MATLAB R2016a

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1. Data requirements and input files

1.1. Data requirements

S-MOF requires for files, which are (i) daily rainfall, (ii) daily temperature, (iii) hourly rainfall and (iv) hourly temperature.

1.2. Input files

1.2.1. Daily rainfall file (Daily_rain.csv)

This file contains the daily precipitation records for disaggregation. The file is a comma separated .csv file. The first column of the file contains the dates of precipitation records in the format YYYY-MM-DD. The second and/or following columns contain the precipitation records in mm. The header is "date" for the date column and "S1", "S2", "S3" etc. for the precipitation records, depending on the number of sites modelled. The precipitation records do not have to complete, i.e. (complete) days can be missing. An example precipitation input file Daily_rain.csv is given below (for five rainfall gauges):

```
Date,S1,S2,S3,S4,S5
19/11/1991,2,0.6,1.4,0.4,1
20/11/1991,5,7.8,7,5.8,5.6
21/11/1991,1.8,13.4,0.2,1.6,1.8
22/11/1991,6.2,7.2,1.2,3,1
23/11/1991,5.2,1,1.8,1,1.8
24/11/1991,0.2,10.2,0,1,0
25/11/1991,0,0.2,0,0,0
26/11/1991,0,0.2,0,0,0
27/11/1991,0,0,0,0,0
28/11/1991,0,0,0,0,0
29/11/1991,0,0,0,0,0
(…)
```

1.2.2. Daily temperature file (Daily_temp.csv)

This file contains the temperature records for disaggregation. The file is a comma separated .csv file. The first column of the file contains the dates of temperature records in the format YYYY-MM-DD. The second and/or following columns contain the temperature records in mm. The header is "date" for the date column and "S1", "S2", "S3" etc. for the precipitation records, depending on the number of sites modelled. The temperature records do not have to complete, i.e. (complete) days can be missing. An example temperature input file Daily_temp.csv is given below (for five temperature gauges):

```
Date,S1,S2,S3,S4,S5
19/11/1991,-0.1,2.6,4.2,-1.0,-1.2
20/11/1991,0.7,3.4,4.8,0.3,0.1
21/11/1991,0.7,3.3,6.0,0.0,-0.1
22/11/1991,1.2,4.0,7.1,-0.2,0.0
23/11/1991,0.8,4.4,6.5,-0.6,0.2
24/11/1991,0.6,3.6,6.5,0.3,-0.1
25/11/1991,1.8,5.2,6.0,0.8,1.3
26/11/1991,0.7,4.3,4.1,0.6,0.2
27/11/1991,1.2,3.6,2.9,1.5,0.4
28/11/1991,1.8,3.8,2.7,2.5,1.0
29/11/1991,2.5,4.4,2.6,3.4,1.8
```

1.2.3. Hourly rainfall file (Hourly_rain.csv)

The hourly rainfall file has the same formatting as the daily rainfall file, but each day consists of 24 lines with the same date format, which is YYYY-MM-DD.

1.2.4. Hourly temperature file (Hourly_temp.csv)

The hourly rainfall file has the same formatting as the daily rainfall file, but each day consists of 24 lines with the same date format, which is YYYY-MM-DD.

1.2.5. Link file for rain gauges (links_rain.csv)

This file defines the links between the daily and hourly sites, i.e. it assigns an hourly gauge to a daily gauge. The assignment has to be conducted outside the tool, for example via the site distance in a GIS or other criteria of similarity. This is particularly important when the number between daily and hourly gauges differs. The first entry in a row is the ID (i.e. the column) of the daily site, the second is the assigned ID (i.e. column) of the hourly site. An exemplary file entry is shown below:

1,1
2,2
3,2
4,3
5,3

In this example, the daily network consists of five gauges, and the hourly network consists of three gauges. The first hourly gauge is assigned to the first daily gauge, the second hourly gauge is assigned to the second and third daily gauge, and so on. If the number of hourly and daily gauges is the same, the first and second entries are all the same.

1.2.6. Link file for temperature gauges (links_temp.csv)

This file has to be created in the same way as for the file links_rain.csv (see above).

1.2.7. Model parameters (param.yml)

This file defines all model parameters required for the simulations. The required values have to be written between the colon and the hashtack of each line. The file can be altered in any text editor. An example model parameter file param.yml is given below (**Error! Reference s ource not found.**):

```
# ----------------------
# Copyright (c) 2017, Korbinian Breinl
# All rights reserved.
#
# Model parameter file S-MOF
# ----------------------

wind      :    30
nn        :     7
historical  : off
```

In the following, all parameters are explained in detail.

wind

This is an integer value defining the window of all days around the day t of disaggregation. For example, if *t* represents the 1st of January and *wind*=14, all days between the 18th of December and the 15th of January are considered for disaggregation

nn

This is an integer value that defines the number of nearest neighbors used for the disaggregation, i.e. if *nn*=7, the seven closest vectors are used for the disaggregation and one of them is sampled. The nearest neighbour algorithm introduces noise to the simulations.

historical

If the observations (i.e. aggregated historical hourly values as daily input) are disaggregated, S-MOF will recreate the actual observations. For this reason, if disaggregating the (aggregated) hourly observations, the value must set to "on" to avoid the recreation of the actual observations. The parameter can be set to "off" if the daily variables come from another source than the observations, for example from a daily stochastic weather generator.

2. Preparing and running a simulation

The following files are required for a simulation. The file param.yml and the four files with the daily and hourly weather observations have to be prepared by the user (see above).

File	Description	Comment
Daily_rain.csv	.csv file with daily rainfall	To be prepared by user
Daily_temp.csv	.csv file with daily temperature	To be prepared by user
Hourly_rain.csv	.csv file with hourly rainfall	To be prepared by user
Hourly_temp.csv	.csv file with hourly temperature	To be prepared by user
links_rain.csv	.csv with links between daily and hourly rain gauges	To be prepared by user
links_temp.csv	.csv with links between daily and hourly temperature gauges	To be prepared by user
read_file.m	Routine to read the weather observations (four .csv files)	
read_param.m	Routine to read parameter values from the file param.yml	
S_MOF.m	Main application	

All files as described in section 2 have to be copied into a common folder. The simulation is run by executing the file S_MOF.m. The simulated (disaggregated) rainfall and temperature time series are written out into new .csv files.

3. References

Mehrotra, R., S. Westra, A. Sharma, and R. Srikanthan (2012), Continuous rainfall simulation: 2. A regionalized daily rainfall generation approach, *Water Resour Res*, *48*.

Sharma, A., and S. Srikanthan (2006), Continuous rainfall simulation: A nonparametric alternative, paper presented at 30th Hydrology & Water Resources Symposium: Past, Present & Future, Conference Design.

Westra, S., R. Mehrotra, A. Sharma, and R. Srikanthan (2012), Continuous rainfall simulation: 1. A regionalized subdaily disaggregation approach, *Water Resour Res*, *48*.