Simulation protocol for AMEI soil temperature model intercomparison 1 (of 4) Aimes, Iowa, bare soil data set

16 May 2024

Aim

The aim of this simulation exercise is to compare nine soil temperature models exchanged between and incorporated in six modeling frameworks (platforms) to a bare soil temperature data set recorded in Ames, Iowa

Data set

The data set consist of 10 years of bare soil temperatures measured at 6.4, 10, 20, 51, and 102 cm depths between April/May and October from 1982 to 1990 and in 1995.

Available data for simulation

The following data are provided to setup the simulations:

- Field location, elevation, and slope
- Crop residue biomass and N concentration
- Initial soil layer water and N content
- Simulation start ("planting") and end date ("harvest")
- Detailed soil profile data
- Detailed soil profile layer data
- Weather station information
- Daily weather data (Tmax, Tmin, Tave, solar radiation, rain, air vapor pressure, wind speed)

Data to setup the simulations are provided in an ICASA Excel format (AMEI_fallow_Aimes_2024-02-27.xlsx) and in the AgMIP ACE JSON format (AMEI_fallow_Aimes_2024-02-23.json). You can use the AgMIP ACE JSON file to setup the simulations, but in that case you will need to complete the missing information that are provided only in the ICASA Excel file.

If some inputs are not provided, please do not estimate them but inform us so that we can provide the same estimate to all the groups (frameworks).

Simulation protocol

- Set up simulations for the 10 years
- Simulate the 10 years independently (no continuous simulation, one single treatment by year) from January 1st (except for 1995 for which the simulations start on 3rd January) to October 31st.
- Use the same initial soil layer water content for the 10 years (estimated), and crop residue (soybean roots), for the 10 years.
- Execute the simulations for each of the nine soil temperature models (**Table 3**) in your frameworks (soil-crop modeling solution, not your soil temperature model standalone/drive).

Simulation results format

- Use the template AMIE_template_Aimes_daily_layers_output.txt to save your results for the variables simulated by soil layers. Data to report in this template are:
    - Modeling framework - Framework (2-letters code, see Table 2)
    - Soil temperature model - Model (2-letters code, see Table 1)
    - Date – Date (YYYY-MM-DD)
    - Soil layer top depth – SLLT (cm)
    - Soil layer base depth – SLLB (cm)
    - Average daily soil temperature (by layer) – TSAV (°C)
    - Maximum daily soil temperature (by layer) – TSMX (°C)
    - Minimum daily soil temperature (by layer) - TSMN(°C)
    - Soil volumetric water content (by layer) – SWLD (cm^3/cm^3)

- Use the template AMIE_template_Aimes_daily_output.txt to save your results for the variables not simulated at the canopy level. Data to report in this template are:
    - Modeling framework - Framework (2-letters code, see Table 2)
    - Soil temperature model - Model (2-letters code, see Table 1)
    - Date – Date (YYYY-MM-DD)
    - Daily potential soil evaporation – EPAD (mm/d)
    - Daily actual soil evaporation – ESAD (mm/d)
    - Daily potential evapotranspiration – EOAD (mm/d)
    - Daily actual evapotranspiration – ETAD (mm/d)
    - Soil heat flux – GHFD (W/m^2)
    - Latent heat flux – LHFD (W/m^2)
    - Net radiation – RHFD (W/m^2)

- Report the soil temperature and water content for the 9 soil layers defined in Table 1.

Table 1. Soil layers at which soil temperature and water content should be reported.

Layer #	Soil layer top depth (cm)	Soil layer base depth (cm)
1	0	5
2	5	10
3	10	15
4	15	20
5	20	25
6	45	50
7	50	55
8	90	95
9	100	105

- Report daily results from 1st January (or 3rd January for 1995) to 31st October.
- Create one file for each year, soil temperature model, and framework.
- Do not leave blank lines after the last simulation day.
- File format should be txt with tab delimiters.
- If a model does not simulate an output enter "**na**" in that column (please do not use any other character string for missing values).

Naming of simulation result file

Please rename the template files using the following naming rule:

SoilTemperatureModelCodeModelingFrameworkCodeLayersAimesYear.txt

SoilTemperatureModelCodeModelingFrameworkCodeAimesYear.txt

Example: DCSILayersAimes1982.txt and DCSIAimes1982.txt for the DSSAT soil temperature model (DS) executed in the SIMPLACE framework (SI) for the year 1982 for the variable simulated by soil layers and for the variables simulated at the canopy level, respectively.

The 2-letters codes for the modeling frameworks and the soil temperature models are given in **Tables 2 and 3**, respectively.

Table 2. Name, 2-letters code, and modelers of the six modeling frameworks participating in the AMEI soil temperature model intercomparison and improvement exercise.

Modelling framework	Model 2-letter code	Team member
1. BioMA	BI	Davide Fumagalli, Davide Fanchini
2. DSSAT	DC	Fabio Oliveira, Gerrit Hoogenboom
3. MONICA	MO	Michael Berg-Mohnicke
4. Simplace	SI	Andreas Enders
5. SiriusQuality	SQ	Teiki Raihauti, Pierre Martre
6. STICS	ST	Christophe Lecharpentier, Hélène Raynal

Table 3. Name and 2-letters code of the nine soil temperature models evaluated in the AMEI soil temperature model intercomparison and exercise.

Modelling framework	Model 2-letter code
1. APSIM-Campell	AP
2. BioMA-Parton-SWAT	PS
3. BioMA-SWAT	DS
4. DSSAT-EPIC	DE
5. DSSAT-ST	DS
6. MONICA	MO
7. Simplace-APEX	SA
8. SiriusQuality	SQ
9. STICS	ST

All files can be downloaded from Google Drive at the following url:

https://drive.google.com/open?id=1Hnom4CocgRa2TBe0Pt4r16gEXgqUMMzw&usp=drive_fs

Please do not distribute this URL outside the AMEI team.

Please upload your result files (90 files) by **15 June 2024** on the AMEI NextCloud space at https://nextcloud.inrae.fr/s/RdZZqewYtWpTNeR (folder named "Aimes bare soil dataset") in the sub-folder named after your modeling framework.

Please **fill in the checklist below** (Table 4) before uploading your results on NextCloud.

Table 4. Checklist for the simulation result files.

		No	Yes
1.	Simulation results **start line 8**	☐	☐
2.	The **first simulated day** is January 1st (or January 3rd for 1995)	☐	☐
3.	The **last simulated day** is October 31st	☐	☐
4.	File has **9 (for variables simulated by layer) or 10 (for variables simulated at canopy level) columns**	☐	☐
5.	Dates ("Date") are reported as **YYYY-MM-DD**	☐	☐
6.	The name of the framework in which the soil temperature model was executed (first column, "Framework") is the **two-letter code** given in Table 2	☐	☐
7.	The soil temperature model names (second column, "Model") is the **two-letter code** given in Table 3		
8.	Missing values are reported as "**na**"	☐	☐
9.	All values are within expected **ranges** and **units** are as indicated	☐	☐
10.	All files are in txt format with tabs as column delimiters	☐	☐
11.	The names of the 90 files for the variables simulated by soil layers follow the schema SoilTemperatureModelCodeModelingFrameworkCodeLayersAimesYear.txt	☐	☐
12.	The names of the 90 files for the variables simulated at canopy level follow the schema SoilTemperatureModelCodeModelingFrameworkCodeAimesYear.txt	☐	☐