**Model Calibration**

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# **Summary**

The model is calibrated by modifying any or all of the twelve parameters including six cultivar parameters in cultivar file (‘MZCER046.CUL') located in ‘C:\DSSAT46\Genotype\ ' and six standard parameters in the standard file (‘SOMFX046.SDA’) that is located in ‘C:\DSSAT46\StandardData\’. The purpose of the program is to allow flexibility of any combination of parameters for model calibration. The program automates the process of changing parameters in the corresponding files, running simulations, and comparing simulated versus observed data plots for calibration purposes. The experimental data is available for six experimental sites that were treated with different crop management practices. Table 1 summarizes important information about the experimental sites.

**Table 1. Description of the nitrogen track experiments in Illinois.**

|  |  |  |  |
| --- | --- | --- | --- |
| Experiment | Latitude | Longitude | Crop Management |
| Planting | N-treatments |
| Urbana | 40.11 | –88.21 | 04/23/2015 | 0, 220F, 200S, 100F+50+50, 50S+150 |
| Monmouth | 40.91 | –90.65 | 04/21/2015 | 0, 220F, 200S, 100F+50+50, 50S+150 |
| Dekalb | 41.93 | –88.75 | 05/01/2015 | 0, 220F, 200S, 100F+50+50, 50S+150 |
| Perry | 39.78 | –90.75 | 04/22/2015 | 0, 220F, 200S, 100F+50+50, 50S+150 |
| Dixon Spring | 37.46 | –88.72 | 05/07/2015 | 0, 150S, 50S+150V5, 50S+150V9 |
| Brownstown | 39.00 | –88.95 | 05/03/2015 | 0, 150S, 50S+150V5, 50S+150V9 |

F: Fertilizer applied in Fall, 2014 (November 15); S: Fertilizer applied in Spring, 2015 (May, 15).

# **Prerequisites:**

1. DSSAT 4.6 installed on default directory, i.e. ‘C:\DSSAT46\’
2. Weather files (\*.WTH) already available for each station in ‘C:\DSSAT46\Weather’. The weather file format and explanation of variable are provided in the link:

<http://rsetserver.sws.uiuc.edu/docs/N%20Tracking%20Project/Weather%20Data/WEATHER%20DATA%20file%20format.docx>

Weather files for the six sites are currently available on [\\SWSATMOSSCI](file:///%5C%5Cswsatmossci) in ‘C:\DSSAT46\Weather\’ with names *XXXX1501.WTH*, where XXXX is a four-letter code for each station. Notice that these files only have weather data for 2014 and 2015, so will only work for simulations within these two years. The code for each station is as follows:

* + - Brownstown 🡪 BRWN
		- Champaign/Urbana 🡪 CHMP
		- DeKalb 🡪 DEKL
		- Dixon Spring 🡪 DXSP
		- Monmouth 🡪 MONM
		- Perry 🡪 PERY
1. Soil files (\*.SOL) corresponding to each station are available in ‘C:\DSSAT46\Soil\’. They are currently available on [\\SWSATMOSSCI](file:///%5C%5CSWSATMOSSCI) with names XX.SOL, where XX is a two-letter code for each station. The two-lettered code for each stations are as follows:
	* + Brownstown 🡪 BR
		+ Champaign/Urbana 🡪 CH
		+ DeKalb 🡪 DE
		+ Dixon Spring 🡪 DX
		+ Monmouth 🡪 MO
		+ Perry 🡪 PE

Soil file format and the variables are explained in the link below:

<http://rsetserver.sws.uiuc.edu/docs/N%20Tracking%20Project/Soil%20Data/Champaign%20soil%20data%20sample.xlsx>

Note: The calibration program does not use the map unit keys for each

1. DSSAT input file templates (\*.MZX) are already available for each station in ‘C:\DSSAT46\Maize. These are the input files for DSSAT that are updated with new information every time the simulations are run for each site. The format and help about FileX file and variables are provided in the following link:

<http://rsetserver.sws.uiuc.edu/docs/N%20Tracking%20Project/FileX%20format.docx>

The files for all six sites are available on [\\SWSATMOSSCI](file:///%5C%5Cswsatmossci) in ‘C:\DSSAT46\maize\Calibration FileX\’ with names *UIXX1501.MZX*, and *UIXX1500.MZX* where UI is the institute code and XX is a two-letter code for each station as described below:

* + - Brownstown 🡪 BR
		- Champaign/Urbana 🡪 UB
		- DeKalb 🡪 DK
		- Dixon Spring 🡪 DX
		- Monmouth 🡪 MO
		- Perry 🡪 PE

*UIXX1500.MZX* files correspond to 0N applications while *UIXX1501*.MZX correspond to non-zero N applications. Copy the files from ‘Calibration FileX’ folder to the ‘C:\DSSAT46\Maize\’ before using the program.

# **Hierarchy of the program**

The following is the hierarchy of the program. Indentation indicates the levels, meaning that the function is being called by another function with one less level.

* Run\_model\_for\_all.m
* Run\_model.m
* User\_params.m
* Update\_std\_params.m
* Get\_index.m
* Update\_cultivar.m
* Get\_index.m
* Generate\_fileX.m
* Get\_index.m
* Station\_info.m
* Calibration\_plot.m
* Measured\_data.m

# **File Descriptions**

## **Run\_model\_for\_all.m**

This file is the main entry point to the program. The program can be run for 0 lbs/acre (No N) application, for all the six N-track sites (Brownstown, Urbana, DeKalb, Dixon Spring, Monmouth, and Perry) by setting ‘n = 0;’ on the first line of the script. The input arguments on line 12 (for n= 0 case), are site names, type of Nitrogen application (e.g. 0N, 150N, 200N, or 200 NS), and parameters that needs to be changed provided as key-value pairs. Currently, all twelve parameters are listed and may be used as is by just modifying the ones that needs to be updated while keeping the rest unchanged. However, the command can be simplified by using only the ones that needs to be changed. For example;

osn = run\_model(station, napp, 'p1', 270.0, 'p2', 0.600, 'p5', 800.0, 'g2', 840.0, 'g3', 9.50, 'phint', 50.00, 'decmet0', 0.3055, 'decmet1', 0.3068, 'decs10', 0.01904, 'decs11', .009, 'decs21', 0.00188, 'decs31', 0.00011);

is the full form of the command, if the user wants to change all the parameters at once. If only a few needs to be changed, the value can be updated here after the name of the parameter. The same can be achieved by running the command but with reduced number of arguments

osn = run\_model(station, napp, 'phint', 50.00, 'decmet0', 0.3055, 'decmet1', 0.3068, 'decs10', 0.01904);

where only the key-value pairs of the four parameters are provided that needs updated. The other parameters in this case will remain at default values, provided in user\_params() function.

 For non-zero N application cases (150N, 200N, or 200NS), change the value of *n* on line 1 to any value other than 0. Moreover, additional changes in the file needs to be done. This is because four of the sites (Urbana, DeKalb, Monmouth, and Perry) were treated with 200N and 200NS while the rest of the two (Dixon Spring and Brownstown) were treated with 150N only. The program is currently set to run for the four sites with 200N and 200NS applications. In order to run for other two sites, comment out line 18 and 19, uncomment 22 and 23, and run the program.

Currently, the program is set to use ‘DEKALB 485’ cultivar as default (on line 15) because this was the type used when the data was collected in the fields.

## **Run\_model.m**

This function takes in site name, nitrogen treatment type, and key-value pairs of parameter values as input arguments and call other functions to modify corresponding files, generate FileX, run DSSAT simulations, and plot measures vs simulated graphs. The process starts with selecting a corresponding FileX, XXXX1500.MZX for 0N case, and XXXX1501.MZX for non-zero N application case from ‘C:\DSSAT46\Maize\’. It then calls user\_params.m to process the key-value pairs arguments by the user.

## **User\_params.m**

This function takes in variable number of input arguments as key-value pairs and updates the default values for the specific keys provided in the arguments.

## **get\_index.m**

Given a pattern and a text, the function return te index where the pattern is match

## **update\_std\_params.m**

Last six parameters out of the total twelve, are part of the standard parameters of DSSAT and include decmet0, decmet1, decs10, decs11, decs21, and decs31. This function updates the Standard Data file ‘SOMFX046.SDA’ located in ‘C:\DSSAT46\StandardData\’ with the user provided values to be used for the simulations.

## **update\_cultivar.m**

First six parameters of the input arguments P1, p2, p5, g2, g3, and phint are cultivar parameters that are updated for the current used cultivar.

## **Generate\_fileX.m**

The role of this function is to update the tempelate FileX files with the new information before running the simulations. The function updates cultivar name and ID, weather stations name, weather station ID, soil IDs, and latitude and longitude of the weather station.

## **Station\_info.m**

Returns weather file name, soil file ID, and latitude and longitude for the provided site name.

## **Calibration\_plot.m**

This function uses the measured data stored in the function measured\_data() and plots it with the simulated data at two depths, 0-1 and 1-2 feet for easy comparison between the two. The user can then change the parameter values and re-run the program to compare the results for quick calibration.

## **Measure\_data.m**

All the observed field data has been stored in this function so that the other function can retrieve this information whenever needed.

# **Current Calibration Parameters with ISWS WARM data**

The table below provides values of calibrated parameters for the six experimental sites. However, notice that these parameters are for ISWS WARM weather data and may need to be recalibrated for NWS data.

**Table 2: Calibrated parameters of the DSSAT model.**

|  |  |
| --- | --- |
| Calibrated parameters | Value |
| Cultivar parameters |
| P1: Thermal time from seedling emergence to the end of the juvenile phase (expressed in degree days above a base temperature of 8 deg.C) during which the plant is not responsive to changes in photoperiod. | 260 |
| P2: Extent to which development (expressed as days) is delayed for each hour increase in photoperiod above the longest photoperiod at which development proceeds at a maximum rate (which is considered to be 12.5 hours) | 0.75 |
| P5: Thermal time from silking to physiological maturity (expressed in degree days above a base temperature of 8 deg.C). | 850 |
| G2: Maximum possible number of kernels per plant | 800 |
| G3: Kernel filling rate during the linear grain filling stage and under optimum conditions (mg/day) | 8.5 |
| PHINT: Phylochron interval; the interval in thermal time (degree days) between successive leaf tip appearances. | 50 |
| Species parameters |
| FSLFN: Fraction of leaf area senesced under 100% nitrogen stress, 1/day | 0.150 |
| Decomposition parameters |
| DECMET(0)DECMET(1)DECS1(0) | 0.040550.050680.01644 |
| DECS1(1) | 0.0200 |
| DECS2(1) | 0.000548 |
| DECS3(1) | 0.000012 |
|  |  |