**Model Validation**

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# **Introduction:**

The N-tracking model was calibrated using the ISWS WARM weather data while the online tool is using NWS weather data. The purpose of this document is to validate WARM weather data based online N-tracking model’s predictive accuracy against the field observations with NWS weather data. The validation was performed for three stations (Urbana, Monmouth, and Perry) only, but may be expanded as more field data becomes available. The field plots were treated with different N amounts at different times, i.e. 0 N, 200 lbs/acre in Fall, and 200 lbs/acre in Spring.

# **Field Data File:**

Field data source file (‘All REC N Tracking Results 2016.xlsx’) is available on [\\SWSATMOSCI](file:///\\SWSATMOSCI) in the MATLAB root directory (C:\Users\Administrator\Documents\MATLAB\Validation). The file contains field observation data such that each excel sheet corresponds to all the N treatment results from one site. Each site has multiple plots that were treated with different amounts of N at different times of the year, e.g. Fall or Spring. Different treatments are coded with numerical numbers. Table 1 provides all the treatment codes and their explanation.

**Table 1**: Treatment numbers and corresponding N application practices.

|  |  |
| --- | --- |
| Treatment # | N Application |
| 1 | 200 Fall + NS (N-Serve) |
| 2 | 200 Fall no NS |
| 3 | 100 Fa/NS+50P+50SD |
| 4 | 200 Spring no NS |
| 5 | 200 Spring + NS |
| 6 | 50P + 150 SD |
| 7 | no N |

For ease of use, the data for each site and each type has been copied to individual files because main file’s format has a certain randomness in how the data was recorded and is not readily available to be used in any program. The new files are also available in the same folder as that of the main source file and the files are named as xxxx\_Ntype\_trt#.csv. Here xxxx is a four-letter code for the sites (Urbana – uiub, Monmouth – monm, and Perry – pery), Ntype is the N application type, e.g. 200f for 200 lbs/acre N applied in Fall or 200s for 200 lbs/acre N applied in Spring, and trt# is the treatment code as found in table 1. Each file contains the date of the observation, treatment code, and NO3 and NH4 concentrations in first (0-1 ft) and second depths (1 – 2 ft) (table 2). This data is used to compare with the data obtained by DSSAT simulations at the same site with same N treatment to test model’s predictive accuracies.

**Table 2**: Structure of the table for each site and each treatment. The data in the table belongs to DeKalb site with 0 N.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Date | Trt | NO3\_1 | NO3\_2 | NH4\_1 | NH4\_2 |
| 11/12/2015 | 7 | 5.4 | 3.5 | 1.8 | 3.3 |
| 04/14/2016 | 7 | 3.6 | 3.2 | 5.7 | 3.3 |
| 05/07/2016 | 7 | 5.3 | 5.4 | 2.9 | 2.7 |
| 05/20/2016 | 7 | 6.8 | 4.9 | 5.2 | 2 |
| 06/03/2016 | 7 | 10.8 | 7 | 5.9 | 1.8 |
| 06/17/2016 | 7 | 7.7 | 4.8 | 4.8 | 3.1 |

# **Steps for validation:**

The process of model validation involves few manual steps before running the MATLAB program. These steps include the following:

1. Submission of a simulation request to the online tool. The user will have to submit a separate request for each site and for each N application type. The input to the online tools should be according to the data provided in the main excel file. N application dates and planting dates for each site are provided on ‘Sites and dates’ sheet of the ‘All REC N Tracking Results 2016.xlsx’.
   1. Note down the observation period from the observed data. Simulation should start just before the fall NH3 application date and should end at the harvest stage or after the last date of data collection. For example, for the case of table 2 at DeKalb, the fertilizer was applied on 11/11/15 (from ‘Sites and dates’ sheet) so the simulation start date can be 3-5 days before 11/11/15 and the end date can be 3-5 days after 06/17/16 (last data collection date). This is important to be able to compare all observed date’s data with the simulation data.
   2. Use the planting date at each site as provided on ‘Sites and dates’ sheet.
   3. Enter the location (Latitude/Longitude) of each field site according to the data below.
      1. Urbana: 40.084, -88.2404
      2. Monmouth: 40.9334, -90.7236
      3. Perry: 39.8058, -90.8238
   4. Submit a request to process the data.
2. After the simulations are successfully completed (an email has been received with an output link), go to the DSSAT’s directory (C:\DSSAT46\Maize) on [\\SWSATMOSSCI](file:///\\SWSATMOSSCI) and rename the file SoilNi.Out to SoilNi\_xxxx\_Ntype\_trt#.Out. For example, for Urbana (uiub) with 200 lbs/acre in fall (200f) and treatment number 2 (no NS), the name would be ***SoilNi\_uiub\_200f\_2.OUT***.
3. Repeat step 1-2 for each site and for each N application, every time changing the name of output file (SoilNi.Out) according to the above described naming convention.
4. The MATLAB program is set to run for all three sites (uiub, monm, and pery) with same N application type together. To run the program and compare simulated versus observed data at all the three sites, change the variable name ‘filename’ on line 3 of model\_testing.m’ to whatever N application is desired to run. For example, for no nitrogen application (0N), the treatment number code is 7 (table 1), therefore change the line to as follows:

filename = [stations{k}, '\_0f\_7.csv'];

Similarly, for 200 lbs/acre in spring with no N-Serve,

filename = [stations{k}, '\_200s\_4.csv'];

**Note**: If the program fails, it is most probably due to non-existence of the corresponding SoilNi\_\*.OUT file. Repeat steps 1-2 for the missing case and run the program again.

# **MATLAB Program:**

The MATLAB program that automates the process of reading simulation outputs and plotting the simulated versus observed data for comparison is located on [\\SWSATMOSSCI](file:///\\SWSATMOSSCI) in the directory C:\Users\Administrator\Documents\MATLAB\ Validation. The program has the following files and structure:

* Model\_testing.m
  + plot\_sim\_data.m
    - measured\_nwatch\_data.m

## **Model\_testing.m**

This is the main module where user can change the variable ‘filename’ to run the simulations for the three stations.

## **plot\_sim\_data.m**

This function takes in the provided DSSAT output file (SoilNi\_\*.OUT), corresponding field data csv file, and output file name for the output plot, and produces comparison plots for the three stations.

## **measured\_nwatch\_data.m**

This function takes in csv data and calculates total NO3 and NH4 at the two depths.