Daisy Newsletter no. 31

1 The Daisy code, v. 6.32

New version official release on all platforms.

For a list of changes, go to the gidhub-link here.

Some of the more interesting changes are:

The new 'DensityDSFac' root parameter, which allows you to modify the effective root density based on development stage. Daisy assumes a homogeneous distribution of roots in the horizontal direction (for 1D-simulations). Right after emergence, this is a poor assumption as the distance between individual plants is likely larger than the diameter of the root zone This parameter allows you to compensate for this by adjusting the effective root density, user for water and solute uptake.

(Root (DensityDSFac (0.0 [DS] 0.01 []) (1.0 [DS] 1.0 []))))

The parameter is analogous to the root_homogeneity horizon parameter, and the two factors are multiplied together when finding the effective root density.

The FAO_PM pet model for daily data now requires vapour pressure. It used to wrongly use RelHum if VapPres was not available.

The "seed release" module describing release of carbon from seeds is now affected by temperature. By default, the same function as is used for maintenance respiration is used:

$0.4281 \cdot (\exp(0.57 - 0.024 \cdot T + 0.0020 \cdot T^2) - \exp(0.57 - 0.042 \cdot T - 0.0051 \cdot T^2))$ where T is the soil temperature at 1/3 of the root depth.

This is 1 at 20 °C, and less than 0.5 at 10 °C. For Danish conditions this means that release rate for spring crops is much lower and will affect your simulations if you do not adjust the rate accordingly.

You can overwrite it with the T_factor parameter under "Seed release". To get the old behaviour, specify

(T_factor (0.0 [dg C] 100 [%]) (100.0 [dg C] 100 [%]))

New condition for more detailed time-description (minute, second and microsecond): Use like:

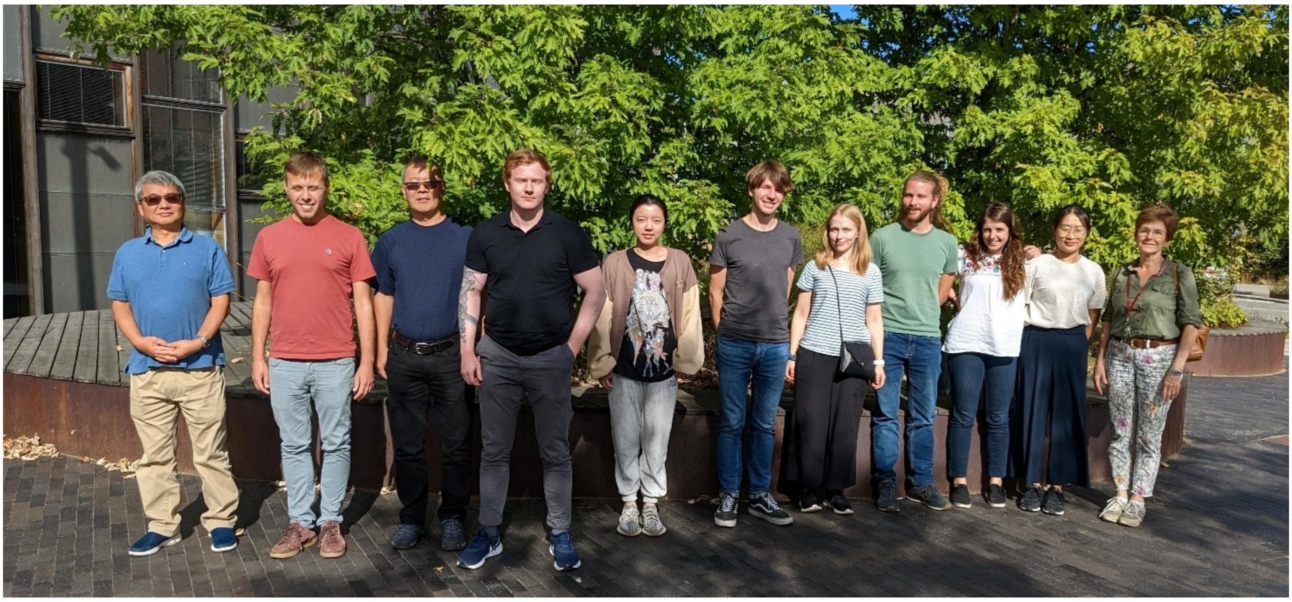
(defcondition every_10_minute

(and (or (minute 0) (minute 10) (minute 20) (minute 30) (minute 40) (minute 50)) (second 0) (microsecond 0)))

In addition, you can now limit allocation of assimilate to roots after the total root mass exceeds some threshold, which may depend on development stage. Also, there are various changes related to the surface module due to the implementation of a new mulch module.

2 Courses

We just finished our Daisy PhD-course with 9 participants from institutions in Canada, Finland, Sweden and Denmark and an even wider range of nationalities.



Figures 1 and 2. Hard working students and later enjoying the autumn sunshine in Copenhagen.

Our MSc-course on modelling has just started and will run till November.

3 Events

Tentative: We expect that Maja Holbak will defend her PhD-thesis with the title “Modelling Pesticide Leaching from Drained Agricultural Fields: Implementation, Calibration, and Application of the Biopore Model in Daisy" on Friday30th September from 13:00-16:00 in “Festauditoriet” A1-01.01 at Bülowsvej 17, Frederiksberg.

4 Recent articles where Daisy has been used

Børgesen et al. (2022) describe the NLES5-model, where Daisy is used on the underlying observed datasets to generate percolation. This is required to change the N-concentrations measured in suction cups into leached amounts. Daisy is also used to simulate the percolation used when predicting N-loss using NLES5.

Holbak et al. (2022) did a very interesting study of pathways for pesticide leaching from the surface to drains. They were allowed to use a very good experimental data from Andest in The Netherlands with data on Bentazone and Imidacloprid, and parameterized two conceptual models in 2D-Daisy: with drain-connected biopores and with both drain- and matrix-macropores. Both models were able to describe the observed transport of pesticide to drains, but when it came to the distribution of pesticide within the matrix, the setup with both drain-connected and matrix-macropores was better. Both types of transport may thus play a role.

Rashid et al. (2022) has investigated a series of nitrogen-based indicators for farm productivity proposed by the EU nitrogen expert panel for a range of crop rotations using Daisy-simulations over 24 years. The indicators are “N-output”, efficiency (NUE) and N-surplus as indicator of environmental emissions. Firstly, the effects of soil type, soil organic matter (SOM), cropping pre-histories varying in C input, 3-to-4 manure-to-mineral N proportions and ten crop rotations on the N-based indicators was investigated, and secondly the adequacy of these indicators were evaluated by establishing quantitative relationships between N surplus, N loss and soil organic N (SON) stock change.

The results, averaged over 24-year simulation period, indicated that grass-clover dominant rotations had highest N output and showed a tendency to increase SON stocks when compared with spring-cereal monocultures. For most rotations, the NUE ranged between 70 and 75%. The SON stocks were mainly influenced by initial SOM and cropping prehistory, and stocks increased only under low initial SOM and low C input cropping pre-history (spring barley).

The relations between N surplus, N loss and SON stock change were strongly affected by crop rotations, emphasizing that using N surplus as an indicator for N leaching/losses while ignoring changes in SON stocks may result in biased conclusions. The results also imply that the environmental assessment of cropping systems must be improved by combining above indicators with estimation of N loss and SON stock changes.

5 Other articles

Polido-Moncada et al. (2020) provides a thorough and interesting review of nitrous oxide emissions in managed agro-ecosystems, particularly in relation to soil compaction. They refer to the model study of Petersen and Abrahamsen (2021) (mentioned in an earlier Newsletter), but generally, they rely on field experiments and measurements. There is obviously more to learn before we fully understand the dynamic of N_2O-formation.

6 References

6.1 Daisy

Børgesen, C.D., Pullens, J. W.M., Zhao, J., Blicher-Mathiesen, G., Sørensen, P. and Olesen, J.E. (2022) NLES5 – An empirical model for estimating nitrate leaching from the root zone of agricultural land. European Journal of Agronomy 134, 126465. https://doi.org/10.1016/j.eja.2022.126465.

Holbak, M., Abrahamsen, P., and Diamantopoulos, E. (2022). Modeling preferential water flow and pesticide leaching to drainpipes: The effect of Drain-connecting and Matrix-terminating biopores. Water Resources Research 58 (7) e2021WR031608. https://doi.org/10.1029/2021WR031608.

Rashid, M.A., Bruun, S., Styczen, M.E., Borgen, S.K., Hvid, S.K., and Jensen, L.S. (2022). Adequacy of nitrogen-based indicators for assessment of cropping system performance: A modelling study of Danish scenarios. Science of the Total Environment 842, 156927. http://dx.doi.org/10.1016/j.scitotenv.2022.156927.

6.2 Other articles of general interest

Pulido-Moncada, M., Petersen, S.O. and Munkholm, L.J. (2022). Soil compaction raises nitrous oxide emissions in managed agroecosystems. A review. Agronomy for Sustainable Development (2022) 42: 38. https://doi.org/10.1007/s13593-022-00773-9 .