The Daisy Model Newsletter
Department of Plant and Environmental Sciences
University of Copenhagen

Daisy Newsletter no. 33

1 The Daisy code, v. 6.32

The last official release on all platforms is 6.32.

2 Courses

The PhD-summer course "Short course on Daisy" will run from 28th August to 1st September 2023. See our homepage for more information and enrolment. This year, special arrangements have been made to be able also to enrol MSc's.

3 Events

Daisy lunch meetings were arranged in January and February, but we do not yet have a volunteer for March. Please write to styczen@plen.ku.dk if you would like to do a presentation or want to discuss your project with other modelers. Talks are normally held last Wednesday in the month.

4 Progress on AgroEco-HPM

In the last newsletter, we announced that we have received funding from the Novo Nordic Foundation for "A high-performance data-driven agroecosystem modelling platform for developing agricultural systems with minimum environmental impact (AgroEco-HPM)" under the "Data Science Research Infrastructure 2022"-program. This has so far resulted in two new TAP-employments: Sarah M. Niebe Abel (from 1.2) and Maja Holbak (1.3), with backgrounds in data science and geography/Daisy modelling, respectively. Associate Professor Sune Darkner (DIKU) is heading the project and Per Abrahamsen is coordinating the TAP-team. The first meeting for core collaborators is planned for 8th of May 2023. We intend to update the Daisy homepage with information about the project as soon as possible, and announce new developments and events there too, over the course of the project.

5 Daisy N model to be updated to predict N_2O emissions in new project

The Danish Agricultural Agency last year opened a call for research under 'Bedriftsudlednings-programmet' (BUP, Farm Emissions Program), with a total funding of 130 mio, with an aim to achieve a more robust knowledge on significant emissions of GHG and N at farm-level. Nine projects were funded, one of which is led by University of Copenhagen (prof. Lars Stoumann Jensen, PLEN) called 'KlimaGødning' (ClimateFertilisation - Model for climate impact of fertiliser use in Danish agriculture).

The background for KlimaGødning is that there is a lack of good models for emission of the potent greenhouse gas N_2O (nitrous oxide) that include the most important risk factors, and which can calculate the effect of policy measures on N_2O emissions with reasonable accuracy.

It is therefore an aim of the KlimaGødning project to develop a new N modelling approach in Daisy that can calculate more reliable estimates of N_2O emissions at the field level from soil biogeo-physical conditions and farm activity data, especially N fertilisation. This entails revising and expanding the current Daisy N sub-model, which currently only includes N_2O production from a simple nitrification process, and a denitrification process producing only N_2, no N_2O.

To develop a better N_2O model, we therefore need to improve our knowledge of how key controlling factors, such as climate, soil, crop and crop residues, fertiliser type and their management, affect the risk of N_2O emissions from the application of inorganic and organic fertilizers under current agricultural conditions.

Project activities will include both field and lab experiments to produce new datasets on N_2O emissions and key factors, as well as utilisation of

existing datasets on N_2O emission from earlier and concurrent projects. These will feed into the development and calibration of a new N_2O sub-model component of Daisy for more valid N_2O estimates. Also, simpler empirical approaches for estimation of N_2O emission risk will be applied to the datasets included. Finally, the developed model will be applied to selected field areas, using farm activity data, satellite data, soil map data and hydrological modelling, to identify situations or areas with high N_2O emission risk, and effective measures to mitigate these risks.

Partners involved are from KU-PLEN-Soil (Lars Stoumann Jensen, Sander Bruun), KU-PLEN-Agrohydrology (Simon Fiil Svane, Per Abrahamsen), AU-Agroecology (Søren O. Petersen, Leanne Peixoto, Diego Abalos & Diego Grados) and SEGES Innovation (Cecilie Skov Nielsen, Leif Knudsen). A postdoc position at AU has just been appointed and a PhD position at KU will be announced shortly. The project duration is 2023-2026.

6 Recent articles where Daisy has been used

Pouryazdankhah et al. (2022) have parameterised a Daisy crop model for sunflower and tried to use it under partial root-zone drying conditions. This is, to the best of my knowledge, the first time the model has been used to simulate sunflower. An extended abstract is available in English, but the original article seems to be in Persian.

van't Veen et al. (2023) tried to combine NLES-4-estimated N-leaching from 3 Danish catchments (divided into several subcatchments) with stream measurements to establish sub-catchment retention of nitrate/total N. Daisy was only used for calculation of percolation. Retention of nitrate was very high in the coarse sandy catchment near Viborg, while it was lower in the two moraine catchments – and very variable from sub-catchment to sub-catchment. Particularly the Odder catchment in eastern Jutland showed values that were very different from the national retention map.

Wolf et al. (2023) analysed data from suction cups to determine the optimal number of suction cups in experiments considering cost and accuracy. Daisy was used to generate water flow in the experiments for calculation of N-flux.

7 Other articles

Cammarano et al. (2020) have edited a new book on modelling for precision agriculture. From the chapter headings, they cover water, nitrogen, crop protection, use of remote sensing data and data fusion in general. It may be a good place to find inspiration.

8 References

8.1 Daisy

Pouryazdankhah, H., Shahnazari, A., Ziatabar Ahmadi, M., Khaledian, M.R and Andersen, M.N. (2022). 'Calibration and Validation of Daisy Model for Sunflower under Partial Root-Zone Drying', Irrigation Sciences and Engineering, 45(3), pp. 15-30. DOI: 10.22055/JISE.2021.37452.1973.

van't Veen, S.G.M., Rolighed, J., Laugesen, J.R., Blicher-Mathiesen, G. and Kronvang, B. (2023). High Spatial Resolution Nitrogen Emission and Retention Maps of Three Danish Catchments Using Synchronous Measurements in Streams. Water, 15, 498. https://doi.org/10.3390/w15030498.

Wolf, K.A., Pullens, J.W.M. and Børgesen, C.D. (2023). Optimized number of suction cups required to predict annual nitrate leaching under varying conditions in Denmark. Journal of Environmental management 328, 116964. https://doi.org/10.1016/j.jenvman.2022.116964.

8.2 Other publications of general interest

Cammarano, D., van Everts, F.K. and Kempenaar, C. (Eds) (2023): Precision Agriculture: Modelling. Part of the book series: Progress in Precision Agriculture (PRPRA). ISBN: 978-3-031-15258-0. https://link.springer.com/book/10.1007/978-3-031-15258-0.