Daisy Newsletter no. 32

Snow flowers in December.

Merry Christmas and Happy New Year

from the Daisy Group

at PLEN, UCPH

1 Announcement

Many of you got the news directly but we had a wonderful Christmas gift already:

The project application: "A high-performance data-driven agroecosystem modelling platform for developing agricultural systems with minimum environmental impact (AgroEco-HPM)" was granted by the Novo Nordic Foundation under the "Data Science Research Infrastructure 2022"-program. This means that we, in cooperation with Department of Computer Science at UCPH, now has to improve the Daisy environment and the general use of the model. The project aims to improve access to a range of databases and to High-Performance Computing, but also to improve tools related to pre- and post-processing of data and provide possibilities to combine simulation and AI-methods. We aim to make the new platform, GeoDaisy, well documented, and facilitate a method of storing "best modelling practices".

The new tools will become available to all when ready. We hope the new developments will boost the use of the model and the cooperation between users across institutions.

2 The Daisy code, v. 6.32

The last official release on all platforms is 6.32.

3 Courses

Our MSc-course on modelling was conducted in cooperation between Prof. Efstathios Diamantopoulos (Bayreuth) and the Daisy group at PLEN. Seven students completed the course.

4 Events

The Daisy lunch meetings have been cancelled from January 2022, after the 1st Daisy workshop in December 2021, but was revived in October by hard-working Daisy modellers demanding feed-back on their work. So we are up and running again, already having had presentations on parameterisation on catch crops, simulation of spring barley with catch crops and generation and fate of toxins in lupin. If you would like to join and is not already on the invitation list, please write to styczen@plen.ku.dk. Talks are normally held last Wednesday in the month.

5 Recent articles where Daisy has been used

Motarjemi et al. (2023) describes measurements from a well drained and poorly drained site at Tokkerup, Denmark and results of modelling the different conditions. Leaching is higher from the poorly drained site and much of the movement in the soil seems to be through the A-horizon to drain-connected macropores. The model exercise shows that there is still considerable work to do on the description of denitrification in Daisy. Daisy overestimates denitrification severely on the poorly drained site, and underestimates leaching. Measurements indicate that the soil microbial activity in the poorly drained soil mainly is active in the A-horizon.

Takáč and Ilavská (2021) used Daisy to evaluate agro-climatic indices, water balances and crop water stress across Slovakia, comparing the periods 1961-1990 with 1991-2020. In general, water availability has decreased due to higher temperatures and increased evapotranspiration. In the area of Bratislava and Nitra, the moisture demand for spring barley and winter wheat increased by more than 50 mm, and for maize by more than 100 mm. The article describes implications across regions and soil types.

Vuaille et al. (2022) investigated whether it is possible to predict a "safest pesticide application day". They investigated whether field conditions and past and near-future weather could be predictors of the ecotoxicological risk of pesticide leaching to surface waters and help identify the safest application day. A methodological approach was developed for one climate-soil setting and two herbicides. The agro-hydrological model Daisy and a 3,000-year series of generated weather were used to simulate a total of 369,326 pesticide application days and their resulting hourly drain concentrations, used in the risk calculation. Recurrent neural networks were trained on the simulated data. The trained meta-models selected the safest application day within a 5-day period with an average accuracy of 60–80%. The effective risk reductions were only of 3–11% for the investigated climate-soil-pesticide settings. Nevertheless, they represented 46–86% of the achievable reductions according to Daisy.

Weik et al. (2022) presents a Life Cycle Assess-ent of Miscanthus-cultivation, involving an agro-economic supply model (Economic Farm Emission Model) that simulates crop and livestock production, and use Daisy to assesses effects on the nitrogen cycle. Miscantus cultivations has been proposed as a means to reduce N-leaching and as a step towards more sustainable farming. The study aimed at providing economic and environmental indicator results at regional and sub-regional levels and was applied to Baden-Württemberg in southwest Germany with eight agro-ecological regions.

While the results show the high potential of miscanthus cultivation for the reduction of greenhouse gas emissions (−16% to −724% (=from emission to sequestration)), the potential to reduce nitrate leaching (−4% to −44%) is compromised in some sub-regions and scenarios (+4% to +13%) by substantial effects on the crop rotation. Furthermore, the cultivation of miscanthus reduces gross margins in most sub-regions (−0.1% to −9.6%) and decreases domestic food production (−1% to −50%). However, in regions with low livestock density and high yields, miscanthus cultivation can maintain or increase farmers' income (0.1%–5.8%) and improve environmental protection.

6 Other articles

Jarvis et al. (2022) discuss the (poor) quality of soil description in many crop models.

Webber et al. (2022) addresses the need for and ways to address multiple stressors in crop models – an issue very important as we see increases in water stress, high temperatures, CO_2, waterlogging etc.

Hernández-Ochoa et al. (2022) reviewed modelling of crop diversification in heterogeneous landscapes to improve agricultural sustainability.

7 References

7.1 Daisy

Motarjemi, S.K., Styczen, M.E., Petersen, R.J., Jensen, K.J.S and Plauborg, F. (2023) Effects of different drainage conditions on nitrogen losses of an agricultural sandy loam soil. Journal of Environmental Management 325, 116267. https://doi.org/10.1016/j.jenvman.2022.116267.

Takáč, J. and Ilavská B. (2021). Crop water sufficiency in Slovakia. In: Pedosphere Research, vol. 1, 2021, no. 1, pp. 20 – 39. NPPC – VÚPOP 2021. ISSN 2729–8728.

Vuaille, J., Holbak, M., Perslev, M., Diamantopoulos, E., Jensen, S.M., Styczen, M.E., Petersen, C.T., Strobel, B.W. and Abrahamsen, P. (2022): Can information on past and near-future weather and field conditions predict the safest pesticide application day? Computers and Electronics in Agriculture 203, 107454. https://doi.org/10.1016/j.compag.2022.107454.

Weik, J., Lask, J., Petig, E., Seeger, S., Vidaurre, N.M., Wagner, M., Weiler, M., Bahrs, E., Lewandowski, I and Angenendt, E. (2022). Implications of large-scale miscanthus cultivation in water protection areas: A Life Cycle Assessment with model coupling for improved policy support. GCB Bioenergy, 00:1-21. DOI: 10.1111/gcbb.12994.

7.2 Other articles of general interest

Jarvis, N., Larsbo, M., Levan, E. and Garré, S. (2022): Improved descriptions of soil hydrology in crop models: The elephant in the room? Agricultural systems 202: 103477. https://doi.org/10.1016/j.agsy.2022.103477.

Webber, H., Rezaei, E.E., Ryo, M., and Ewert, F. (2022): Framework to guide modelling single and multiple abiotic stresses in arable crops. Agriculture, Ecosystems and Environment 340: 108179. https://doi.org/10.1016/j.agee.2022.108179.

Hernández-Ochoa, I.M., Gaiser, T., Kersebaum, K-C., Webber, H., Seidel, S.J., Grahmann, K. and Ewert, F. (2022): Model-based design of crop diversification through new field arrangements in spatially heterogeneous landscapes. A review. Agronomy for Sustainable Development 42: 74. https://doi.org/10.1007/s13593-022-00805-4.