Daisy Newsletter no. 29

1 The Daisy code, v. 6.22

The version 6.22 is still the latest official release on all platforms.

To work with the new root functions described at the Daisy lunch meeting in January, however, it is necessary to upgrade to version 6.23.

The new functions are called 1. PenDSFac, 2. DensityDSFac, 3. root_retardation and 4. root_homogeneity. All are relative factors. The first two are part of the root description while the last two may be added to the horizon description. One and three modifies the root growth rate compared to the specified value, while two and four are multiplied onto the root density, reducing the effective root density and therefore slowing down water and nutrient uptake.

2 Daisy Documentation.

A new page has been added to the Daisy homepage, allowing you to access the first chapters of an updated Daisy Documentation here. New chapters will be added as we work our way through earlier documentation and the present code. Chapter 3, describing the surface processes for water, heat and solutes is presently work-in-progress. For subjects, where the documentation has not been updated, other sources of information have been listed.

Also, our new icon is finally available for download from the download page.

3 Courses

The Daisy PhD-course for 2022 will take place from 29th August to 2nd September, at UCPH. More information is available here.

In addition, a course on Soil and Crop System Model – Data Fusion is planned for September 2022 in cooperation between UCPH, UHOH, SLU, BOKU and WUR. The course is scheduled to take place in Hohenheim during last week of September 2022. Further details will be published in April 2022.

4 Events

The next Daisy lunch meeting is scheduled for Wednesday 30th of March, where Maja Karolina Rydgård will talk about “Using Daisy to estimate inventory factors for LCA on sewage sludge and sewage sludge biochar”.

Tentative: Jeanne Vuaille will defend her PhD “Modelling the effect of selected agronomic practices on pesticide leaching to subsurface drain lines” on 29th of April. Date and venue to be confirmed.

5 Recent articles where Daisy has been used

Pohanková et al (2022) have produced a very comprehensive study of climate change effects on production and water use using a crop model ensemble for Czech Republic sites. The model ensemble consisted of APSIM,AQUACROP, CROPSYST, DAISY, DSSAT, HERMES, and MONICA. Two identical crop rotations (CR1 and CR2) were defined, without and with cover crops, manure and straw left behind and applied on two soil types (Chernozem, Cambisol) within three sites in the Czech Republic, which represent temperature and precipitation gradients for crops in Central Europe. Simulations were run from 1961 to 2080. For the description of future climatic conditions, seven climate scenarios were used. Six of them had increasing CO_2 concentrations according RCP 8.5, one had no CO_2 increase in the future.

The output of an ensemble expected higher productivity for yields and aboveground biomass in the future (2051–2080). However, not considering the direct effect of a CO_2 increase resulted in lower average yields for lowlands. Incorporation of organic material (CR2) resulted in higher average yields for current and climatic conditions. For the majority of climate change scenarios, the crop model ensemble agreed on the projected yield increase in C3 crops in the future for CR2 but not for CR1. Higher agreement for future yield increases was found for Chernozem, while for Cambisol, lower yields under dry climate scenarios are expected. The results indicate the potential for higher biomass production from cover crops, but CR2 is associated with almost 120 mm higher evapotranspiration compared to that of CR1 over a 5-year cycle for lowland stations in the future, which in the case of the rainfed agriculture could affect the long-term soil water balance.

Reimer et al. (2021) evaluated data from a long-term field trail, which investigates fertilization of stored human urine, compost from household waste and sewage sludge in comparison to mineral fertilization, different cattle manures (deep litter, manure and sewage sludge in comparison to mineral fertilization, different cattle manures (deep litter, manure and slurry) and unfertilized treatments, and model predictions of the soil-plant-atmosphere model Daisy. Human urine performed similar to the mineral N fertilization for yield, N efficiency, and nutrient budget, while sewage sludge and compost were more similar to the animal manures with lower yields, N efficiencies and higher nutrient imbalances, especially P and S surpluses. Daisy was used to simulate yields and N-balance over 20 years, but particularly the simulation of organic matter development in the top 25 cm is interesting. The parameterization is based on laboratory measurements of decomposition of the organic fertilizers. Turn-over rates and C/N relationships were adjusted during calibration. Organic matter content is simulated well for several of the compost types, but there seems to be a tendency to underestimation of the organic matter content for some treatments (particularly NPK, sewage sludge at the end of the 20 year period). The same is the case for total N at the end of the period, for more of the treatments. The results (suppl. Fig.1) across years and treatments show an under-prediction of Carbon content for high measured carbon contents while the prediction of soil N appears to be good apart from one treatment during 2008-10. The calibrated parameters are not given in the article.

Seidenfaden et al. (2022) have combined Daisy simulations of a catchment on Funen, Denmark, with MikeSHE-simulations with the purpose of investigating how stable the nitrate reduction maps are when subject to land use changes and changing climate. Apart from the present land use, they combined four levels of agricultural intensity with four selected realizations of future climate representing wet (+19 % increase in precipitation; ECHAM-HIRHAM5), dry (-11 % decrease in precipitation; ARPEGE-RM-5.1), warm (+3.4°C temperature increase; HadCM3-HadRM3) and a median projection with +10 % precipitation and +2.1 °C temperature increase (ECHAM5-RCA3). Nitrate reduction maps were found to be sensitive to changes in climate, leading to a reduction map change of up to 10, while land use changes were minor. They found that the reduction maps are products of a range of complex interactions between water fluxes, nitrate use, and timing and therefore depending on the assumptions made.

Takáč and Ilavská investigated water sufficiency in Slovakia using agro-climatic indices and simulations of water balance and crop water stress using Daisy for the period 1961-2020. Particularly in the west of north of Danube

Lowland, the water demand increased by more than 50 mm for spring barley and winter wheat and more than 100 mm for maize, comparing 1961-90 to 1991-2020. Increases were also seen for summer crops in Central Pohronie and East Slovakia. Within individual regions, there is spatial variability depending on soil properties and the presence of groundwater levels. They conclude that while no area in Slovakia meets the conditions for designation as dry, the coverage of crop moisture needs is insufficient in the southern regions, while the lack of soil water is the main limiting factor of agricultural production, especially in the Danube Lowland.

Wolf et al. (2022) studied nitrate and N_2O losses in a West-Danish Luvisol as function of timing of pig slurry application and addition of nitrification inhibitor. Daisy was only used to calculate soil water balance and water fluxes at the depth of suction cells. Autumn-applied pig slurry showed evidence for NO_3-removal between 50 and 100 cm depth, and N_2O concentration profiles indicated high denitrification activity around 50 cm depth. Autumn-applied slurry showed higher N_2O emissions and lower crop yields compared to spring application, indicating losses occurred during winter.

In addition to the mentioned articles, three other articles are available as pre-print and will be mentioned in our next newsletter, when published.

6 Other articles

Liau et al. (2021) presents their thoughts on how to get to a framework for multimodel ensemble prediciton of soil nitrogen losses and discuss ways and means.

7 References

7.1 Daisy

Pohanková, E., Hlavinka, P., Kersebaum, K-C., Rodríguez, A., Balek, J., Bednařík, M., Dubrovský, M., Gobin, A., Hoogenboom, G., Morindo, M., Nedel, C., Olesen, J.E., Rötter, R.P., Ruiz-Ramos, M., Sheila, V., Stella, T., Hoffmann, M.P., Takáč, J., Eitzinger, J., Dibari, C., Ferrise, R., Bláhová, M., and Trnka, M. (2022). Expected effects of climate change on the production and water use of crop rotation management reproduced by crop model ensemble for Czech Republic sites. European Journal of Agronomy 134, 126446. https://doi.org/10.1016/j.eja.2021.126446.

Reimer, M., Möller, K., Magid, J. and Bruun, S. (2021). Deliverable No. 3.2: Publication on the short-term and longer-term benefits of recycled fertilizers with respect to soil quality. (22.Dec. 2021). RELACS: replacement of Contentious Inputs in organic farming Systems. 38 p.

Seidenfaden, I.K., Sonnenborg, T.O., Refsgaard, J.C., Børgesen, C.D., Olesen, J.E., and Trolle, D. (2022). Are maps of nitrate reduction in groundwater altered by climate and land use changes? Hydrol. Earth Syst. Sci.: 955-973. https://hess.copernicus.org/articles/26/955/2022/hess-26-955-2022-relations.html.

Takáč, J. and Ilavská, B. (2021). Crop water sufficiency in Slovakia. Pedosphere Research 1 (1): 20-39.

Wolf, K.A., Børgesen, C.D., Plauborg, F. og Petersen S.O. (2022). Nitrous oxide and nitrate as indicators of subsoil removal of N in pig slurry applied to Luvisols in Western Denmark. Geoderma Regional 28, e00441. https://doi.org/10.1016/j.geodrs.2021.e00441

Pre-prints available:

García-Jorgensen, D.B., Hansen, H.C.B; Abrahamsen, P. and Diamantopoulos, E. (pre-print): Modeling the environmental fate of the natural toxin ptaquiloside: production, release and leaching to groundwater.

Kjaersgaard, N.C., Ottosen, I.M., Diamantopoulos, E. and Andersen, B. (pre-print): An investigation of economic and environmental impacts from precision fertilization.

Seidenfaden, I.K., Sonnenborg, T.O., Børgesen, C.D., Trolle, D., Olesen, J.E., and Refsgaard, J.C. (pre-print): Impacts of land use, climate change and hydrological model structure on nitrate fluxes: Magnitudes and uncertainties.

7.2 Other articles of general interest

Liao, K., Lv, L., Lai, X and Zhu, Q. (2021). Toward a framework for the multimodel ensemble prediction of soil nitrogen losses. Ecological modelling 456, 109675. https://doi.org/10.1016/j.ecolmodel.2021.109675