The Daisy Model Newsletter
Department of Plant and Environmental Sciences
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Daisy Newsletter no. 24

Merry Christmas and Happy New Year from the Daisy-group at PLEN, UCPH

1 The Daisy code, v. 5.88

The version 5.88 is still the last official release on all platforms. A new official version is postponed due to ongoing work on process descriptions that should improve simulation of conservation agriculture. This includes, among other, an improved description of the dynamics of a mulch layer on top of the soil.

However, if you are using the Windows version, there are a few improvements (5.93) you may benefit from.

A new horizon parameter (root_homogeneity) has been introduced, which can scale the effective root density in a particular horizon. It is multiplied onto the effective root density to for horizon, affecting water and nutrient uptake, while it will not affect root mass or rhizodeposition. A value below 1 will emulate the effect of soil compaction.

The winter wheat parameterisation described in Gyldengren et al. (2020) (see newsletter 22) is now available in the library. It includes a new partitioning function, where N status affects partitioning between leaves and stem. It also includes the seed model for initial growth and an advanced NO3_uptake parameter, also described earlier.

A new litter_washoff_coefficient has been introduced, that controls washoff from a litter layer. With a default of 1, the chemical is fully dissolved in water, as was assumed earlier.

If you download new versions, be aware that the parameterisations in chemistry-base.dai and chemistry.day have been updated, so if you have defined your own chemicals (pesticides), they might need updating, see details on GitHub concerning all changes since your last version.

2 Courses

Our MSc-course on modelling ran during autumn, with campus attendance of 8 participants, in spite of Covid 19.

3 Events

For quite some time, people working with Daisy at PLEN, UCPH have met informally every last Wednesday of each month. In each meeting, one participant have to present Daisy-related work, followed by discussions. Since the lock-down last spring, we do it on-line, and we have decided to invite other interested people to participate. We meet at 12.15 and stay on-line for about 30 min. Participants will be asked to contribute. Write to Merete Styczen (see below) to receive a link.

4 Recent articles where Daisy has been used

Hashemi and Kronvang (2020) used Daisy for water flow calculations in a study of how a targeted land use change in a Danish catchment (River Odense) may provide multi-functional benefits through nitrogen (N)-load reductions to obtain good ecological quality in Odense estuary, protection of N-vulnerable groundwater aquifers, protection of Natura2000 sites and carbon sequestration. The results show that obtaining

multi-functional benefits at the lowest cost requires a targeted shift of set-aside from the traditional hot-spot N-load areas to designated protected areas.

Styczen et al. (2020) calculated the extra N-leaching expected from fields with sub-optimal crop cover. As a rule of thumb, one percent of bare soil in a hectare causes around 2 kg extra leaching compared to a full plant cover, assuming fertilization according to Danish norms. The increase in leaching is almost proportional to the relative vegetation cover, defined as cover percentage at the end of tillering divided by the cover percentage of in a stand with optimal plant density at the same time. The relationship was similar across soil types (sandy loam/loamy sand) and precipitation conditions considered.

Vuaille et al. (2020) investigated the effect of loosening compacted wheel tracks influence pesticide leaching to drains and surface waters. Loosening strongly affected air permeability and steady-state infiltration. Daisy was used to simulate the effects of soil structural and hydraulic changes on pesticide leaching to subsurface drain lines over a 332-year period. Measured properties of the topsoil were combined with a representative subsoil and weather series and with realistic management scenarios. The loads of the test herbicides glyphosate, metamitron, and phenmedipham (used in sugar beet cultivation in spring) in the drains for 3 months after loosening were calculated for each year, and the risk was defined as the 90th percentile of the load.

The simulations showed that for all pesticides loosening could lower the risk by 10% on average for a 3-m working width, and the tracks contribution to the risk by 34%, for all drain spacing and working width settings. Wheeling did not affect the risk but this result was sensitive to the parameterization of the hydraulic conductivity in the compacted soil layer, showing potentially higher risk under certain conditions. Thus, wheel track loosening is an effective strategy for reducing the risk of surface water contamination from field applied pesticides.

5 Other articles

Böttcher et al. (2020) described new dynamic crop growth model based on empirically derived allometric partitioning rules developed for winter oilseed rape. The model simulates dry matter production, nitrogen uptake and distribution, leaf, stem and pod area expansion and yield formation under optimal and water- and nitrogen-limited conditions.

The model includes hibernation, senescence due to self-shading, freezing and aging, translocation of assimilates and nitrogen, light absorption and reflection by flower layer and oil synthesis. It was parameterized with two data sets from Hohenschulen, northern Germany, and validated with datasets from Germany, France, Great Britain, and the Czech Republic.

Kheir et al. (2020) discuss the potential and limitations of wheat crop models to assist breeders, researchers, agronomists and decision-makers to address the current and future challenges linked with global food security.

6 References

6.1 Daisy

Hashemi, F., Kronvang, B. (2020). Multi-functional benefits from targeted set-aside land in Danish catchment. Ambio 49: 1808-1819.

Styczen, M.E., Diamantopoulos, E., Gyldengren, J.G.G. and Toft, T. (2020). Plantedække og kvælstofudvaskning i vinterhvede. (Plant cover and nitrogen leaching in winter wheat). Vand og Jord, 27: 56-56.

Vuaille, J., Daraghmeh, O., Abrahamsen, P., Jensen, S.M., Nielsen, S.K., Munkholm, L.J., Green, O., Petersen, C.T. (2020). Wheel track loosening can reduce the risk of pesticide leaching to surface waters. Soil Use and Management. 00:1-15. https://doi.org/10.1111/sum.12641.

6.2 Other articles of general interest

Böttcher, U.k Weymann, W., Pullens, J.W.M., Olesen, J.E. and Kage, H. (2020): development and evaluation of HUME-OSR: A dynamic crop growth model for winter oilseed rape. Field Crops Research 246, 107679. https://doi.org/10.1016/j.fcr.2019.107679.

Kheir A.M.S., Ding Z., Ali M.G.M., Feike T., Abdelaal A.I.N., Elnashar A. (2020) Wheat Crop Modelling for Higher Production. In: Ahmed M. (eds) Systems Modeling. Springer, Singapore. https://doi.org/10.1007/978-981-15-4728-7_6.