Daisy Newsletter no. 13

The Daisy code, v. 5.59

Daisy 5.59 is now released on all platforms.

Improvements to pesticide modelling:

1. Daisy will now use small timesteps for short irrigation events. This is useful for simulating water dissolved pesticide application as very short irrigation events. Without this, the water in the pesticide application may evaporate before it hits the soil.
2. New **'molar_mass'** chemical parameter has been introduced in order to be able to handle metabolites.
3. New implementation of **'canopy_washoff_coefficient'**. The new code it no longer timestep dependent.
4. New **'decompose_soil_factor**' parameter. When set to 'FOCUS', it will replace the default depth, heat, and water factors with functions consistent with FOCUS recommendations for regulatory pesticide modeling, see http://daisy.ku.dk/news/alignment-of-daisy-with-focus-recommendations/. FOCUS: (https://esdac.jrc.ec.europa.eu/projects/focus-dg-sante).
5. New **'remove_solute**' management action. The function removes a specified chemical from the soil column. In long simulations, this allows individual simulations of individual pesticide applications.

Other changes:

6. New **FAO_PM_hourly** evapotranspiration model. This model is similar to FAO_PM, but adjusted for use with hourly weather data according to *Allen at al.:A recommendation on standardized surface resistance for hourly calculation of reference ETo by the FAO56 Penman-Monteith method. Agricultural Water Management 81 (2006) 1–22.* If you use hourly weather data, this function provides a more correct estimate of reference evaporation due to different surface resistance during day and night.
7. New '**quartz**' horizon parameter. The quartz content overrides the quarts content calculated from texture and affects the heat transport in the soil.
8. New '**log_suffix**' parameter.The parameter is analogue to 'log_prefix', and the specified text is appended to all output file names.

A mass balance error related to the use of Freundlich sorption together with a secondary domain was removed. In addition, a number of bugs were corrected and improvements added to the SSOC-SVAT model. These will be documented in a paper presently in prep.

Activities about to start

Lars Stoumann Jensen and Sander Bruun (the Soil Fertility group) have recently acquired funding for several research and development projects, where Daisy will applied: i) *StyrN (Nutrient balance accounting with soil pool changes and losses to provide farmer decision support), ii) CarbonFarm (Sustainable cultivation concepts in agriculture) and iii) Nutri2Cycle (Transition towards a more carbon and nutrient efficient agriculture in Europe).* These projects are funded by either the Danish GUDP program (i, ii) or the EU Horizon 2020 program (*iii*).

The aim of the *StyrN* project is to improve the utilization of nitrogen (N) and phosphorus (P) in plant production and reduce N loss to the aquatic environment. Project outputs will be nutrient accounting tools that agricultural farms can use to control N and P surplus, nutrient use efficiency and N loss in their plant production.

The *CarbonFarm* project aims to develop and demonstrate organic and conventional cultivation concepts based on Conservation Agriculture principles, adapted to Danish conditions, which i) increase soil carbon (C) contents, ii) increase biodiversity and ecosystem services, iii) retain N in the root zone, and iv) minimize N2O emissions.

The *Nutri2cycle* project aims to enable the transition from the current suboptimal nutrient household in European agriculture to the next-generation of agro-nomic practices, characterized by improved recycling of nutrients and organic C. The project will develop an assessment framework which can be used to evaluate potential impacts of different technologies to achieve improved recycling of societal waste streams.

For all three projects, one joint postdoc position is currently open (http://jobportal.ku.dk/videnskabelige-stillinger/?show=146771, deadline 11th March); the person recruited will be working with Daisy applica-tion, calibration and validation in all three projects.

Additional staff, including student and research assistants may be associated with the project.

Recent articles where Daisy has been used

Nielsen et al (2018) parameterized garden waste with and without the woody fraction as well as mature and immature garden waste compost based on laboratory studies in order to be able to perform life cycle analysis of the use of these materials. The information necessary for parameterization of the AOM-pools in Daisy is supplied in the article. The harvest factor (fraction of N harvested in response to application of an amount of compost) at low N-availability ranged between 0.1 and 0.18 for sandy loam soil and medium precipitation conditions (N.Europe), while it ranged from negative values to 0.12 under conditions of ample N-supply. In contrast, the C sequestration factor was almost unaffected by the environmental conditions but depended to a large extent on the degradability of the added material.

Ozturk et al. (2017) have produced a very interesting comparison of carbon and N-balances in model setups based on Daisy, Fasset and SWAT under present and future climates. In spite of an initial stepwise calibrat-ion of measured soil water content followed by crop phenology, crop biomass and N-content and lastly soil mineral N and N-leaching, the models produced differ-ent results and most of the variation in the prediction of soil organic carbon was due to the crop-soil models. The models also have rather different predictions of denitrification and leaching levels. In general, the choice of climate model appeared to have less influence on most of the assessed components than the crop-soil model selected.

Two articles by Zhou et al. have been published early in 2018. Both consider irrigation of potato, either with split N-fertigation or under different irrigation systems. In the first case, a Daisy setup was used to guide the fertigation. The treatment compared well with the other treatments, not least with respect to higher N recovery efficiency and agronomic and physiological N use efficiency, but the maximum yields were not obtained, implying that the critical concentrations in the plant should be adjusted upwards. In the second study, Daisy was used to estimate leaching under gun and drip irrigation. Estimates of soil water content were better under drip irrigation, as it appears to be more difficult to catch the distribution of water from gun irrigation across the ridges and furrows. The N-uptake by the tubers was underestimated in all treatments of the experiment.

Other studies of general interest

Two recent publications may be of general interest to Daisy modelers. Klumpp et al. (2017) tested different methods for initialization of organic matter pools, which is a difficult and important issue for all simulations of C and N-balances. Mirschel et al. (2018) are providing a set of coherent field data from 1993-98 for agro-ecosystem modelling. The database is freely available via the links provided in the article.

Recent articles and reports

Nielsen, M.P., Yoshida, H. Raji, S.G., Scheutz, S., Jensen, L.S., Christensen, T.H., Bruun, S. (2018). Deriving Environmental Life Cycle Inventory Factors for Land Application of Garden Waste Products Under Northern European Conditions Environmental Modeling & Assessment. https://doi.org/10.1007/s10666-018-9591-9.

Ozturk I, Sharif B, Baby S, Jabloun M, Olesen J E. (2017). Long-term simulation of temporal change of soil organic carbon in Denmark: comparison of three model performances under climate change. The Journal of Agricultural Science https://doi.org/10.1017/S0021859617000971.

Zhou, Z., Plauborg, F., Liu, F., Kristensen, K., Andersen, M.N. (2018). Yield and crop growth of table potato affected by different split-N fertigation regimes in sandy soil. European Journal of Agronomy 92: 41-50.

Zhou, Z., Plauborg, F., Parsons, D., Andersen, M.N. (2018). Potato canopy growth, yield and soil water dynamics under different irrigation systems. Agricultural Water Management 202: 9-18.

Articles of general interest:

Klumpp, N.K., Coleman, K., Dondini, M., Goulding, K., Hastings, A., Jones, M.B., Leifeld, J., Osborne, B., Saunders, M., Scott, T., Teh, Y.A., Smith, P. (2017) Soil Organic Carbon (SOC) Equilibrium andModel Initialisation Methods: an Application to the Rothamsted Carbon (RothC). Model. Environ Model Assess. 22:215–229. DOI 10.1007/s10666-016-9536-0.

Mirschel, W., Barkusky, D., Kersebaum, K.C., Laacke, L., Luzi, K., Rosner, G., Wenkel, K.-O. (2018). Field data set of different cropping systems for agro-ecosystem modelling from Müncheberg, Germany. Open Data Journal for Agricultural Research, vol. 4, pg. 1-8