

MS45 Data- model interaction and initial model application workshop

ECLAIRE C3 Modelling Integration Workshop

Monday 27th January, 2014

Venue: Room "Espace Dubos", AgroParis Tech, 16 rue Claude Bernard, Paris

Minutes

Present: Patrick Büker, Per Erik Karlsson, Seraina Bassin, Gunilla Pihl-Karlsson, Helena Danielsson, Håkan Pleijel, Harry Harmens, Felicity Hayes, Katrina Sharps, Vicky Bermejo, Dan Hewitt, Giacomo Gerosa, Ricardo Marzuolli, Thomas Verbeke.

Via Skype: Gina Mills and Laurence JH Jones

(1) Modelling C allocation

Model ozone fluxes and photosynthesis (A_n) for various plant functional types (grassland and forests), using data from experimental sites in ECLAIRE. Ozone effects: 1) via stomata (functioning) or 2) direct effect on photosynthesis (Rubisco act). How can we model the latter? A_n now in DO₃SE (Farquhar approach) as function of V_{cmax} , internal CO₂ and radiation. Stomatal conduction a function of photosynthesis, dark respiration also included. Model calculates A_n and dark respiration and their impact on stomatal conductance via Leuning approach. Literature data used to parameterise V_{cmax} , J_{max} and m (relating stomatal conductance to P_n) for different plant functional types. Medlyn approach used to determine m . Question: can we derive our own parameterisation e.g. for m using the ECLAIRE data base? Parameterisations could be based on data from Bangor (silver birch), Whim bog data in the future (?) – although mainly Sphagnum moss, and Italy (holm oak and horn beam). Some grassland data from Spain available, can expect more soon (meteorological, photosynthesis, g_{sto} data); Spain also has some leafy crops data (spinach and chard). Some data from Denmark for heathland-grassland, but not response data (no crops data available). Alp Flix: no photosynthesis or g_{sto} data, but can look at trends via stable isotope data as surrogate (at leaf level for 11 species). Currently, Patrick has no crops data at all. Gina will follow up crop data from Denmark. Patrick to follow up flux-tower data from Casteloziana (Silvano Fares). Also flux tower in Bosco Fontana (Giacomo et al.).

Put all future data in ECLAIRE database, no need to fill in separate spreadsheet from SEI-York anymore.

Modelling currently based on leaf level data, need to discuss up-scaling in future.

Patrick showed initial result A_n - g_{sto} DO₃SE model, with rather site-specific parameterisations. Currently, J_{max}/V_{cmax} ratio kept constant at 2. More data needed for generic parameterisations. Currently only A/C_i data from Curno and Bangor, more data expected from Curno for 2013.

Next step: how to account for the C allocation term? There are different approaches available which differ in complexity, mostly available for trees, less for crops and grasslands. How complex do we want our model to be? Generally maintenance respiration is subtracted from available C and remaining C is allocated to 3 main sites (leaves, stem, roots). Very simple approaches have fixed portion of C allocation to leaves/stem/roots (e.g. Running and Coughlan, 1988), subtract growth respiration to calculated growth. Another very simple approach is to have a proportion that is respiration, taking temperature into account. Patrick to check with Richard Falk how this is done in JULES. But how to account for light, water and nutrients? – need a slightly more complex approach. Data mining results could contribute do that potentially: effect of ozone on C allocation. This will be available for crops and natural vegetation, data mining for trees did not get done. Bangor and Curno data could provide ‘modifying factors’ for response to ozone.

Håkan Pleijel: Include C allocation for crops; during grain filling crops loose biomass which is allocated to grain filling, many models do not account for this, assuming grain filling relies on ‘current’ fixed C. Håkan is re-analysing data. There is a lot of data on C allocation between vegetative growth and reproductive growth.

Patrick: For trees: light limiting – more allocation into leaves, water or N limiting – more allocation into roots. CO₂ enrichment – more allocation into roots.

Next steps Patrick modelling:

- 3 approaches for effect of ozone on P_n : Wittig approach (fixed effect ozone on P_n), JULES – POD_y impact on A_n ; get in touch with JULES modellers, Martin approach – fixed effect ozone on V_{cmax} .

Seraina Bassin: Semi-natural vegetation: currently not limited by A_n , so effect of ozone does not matter.

Giacomo Gerosa: Ozone impacts more via stomatal conductance than on A_n , which will affect C allocation.

Patrick: Water accounted for in models, nitrogen will hopefully soon be included.

Questions:

- How closely are g_{sto} and A_n coupled? How to incorporate uncoupling in model?
- Availability input data (e.g. VPD). Not many complete data sets received. Bits expected from Bangor, Curno, Spain, Denmark, Alp Flix
- Availability of data to parameterise the models is limited (e.g. A/C_i , A/Q , A_n , g_{sto})
- Limited response data (e.g. Denmark), but quite some response data from Alp flix, Spain. Expected response data from Bangor and Curno soon.
- C allocation: which approach to use? Simple model sufficient enough?

(2) Literature based data mining for modelling

Gina Mills via Skype: ECLAIRE C3 data mining update.

Many papers do not have info on standard deviation which is needed for meta-analysis. Bootstrapping allows determination of confidence intervals, so meta-analysis can be done. Ozone metric most present in papers: Ozone daylight mean (ppb).

Significant effects of ozone on relative photosynthesis in crops (A_{sat} , V_{cmax} , net photosynthesis: limited data for J_{max}). For cereals ca. 80% of data is for wheat. Non-cereal: soybean and oil seed rape. A_{sat} seems to have two data clouds, specific for species (?). Gina/Laurence to check this in more detail.

Per Erik: how is phenology (time factor) accounted for? Gina: Currently not accounted for. There is scope to look at time factor in A_n data if there are enough data points.

Relative biomass other vegetation: wetlands/bogs less sensitive than dry and mesic grasslands. No significant effect of ozone on photosynthesis parameters of other vegetation ((semi-) natural).

Cereals: bigger effect ozone on A_n than biomass. Can this be explained again by timing effect: when were the measurements done, during vegetative growth or grain filling stage? A_n might have been measured at the end, when you expect ozone impacts on A_n due to early senescence, but less effect on biomass as biomass has already accumulated over the season. Existing analysis has used averaged A_n measurements, but time steps are available from the literature. Not enough data to compare biomass and photosynthesis effects for non-cereals and other vegetation. Biomass data includes a combination of shoot only or shoot + root if available. If different measurements were made with time in one experiment, the responses were averaged.

Giacomo Gerosa: Wetland spp. sensitivity to ozone may be linked to growth rate. Gas exchange rates might be too different between wetland and dry grass species for straightforward comparison.

Where to go next and who will do what? See other papers: Zhaozhong, Wittig and others.

(3) Håkan Pleijel, crop modelling

Data mining cereals:

- How strong coupling between A_n and g_{sto} ? Are impacts on these of the same order of magnitude?
- To what effects are ozone effects on A_n (irreversible) effects of enhanced senescence?

Mullholland et al., 1997 (UK), wheat – 2 ozone treatments and 2 CO_2 treatments: strong relationship between g_{sto} and A_n . However, this is affected by CO_2 levels (split into 2 separate relationships), with lower g_{sto} and higher A_n at high CO_2 . Measured 6-7 times during growing season, so a senescence effect can be established. If we separate A_{sat} by CO_2 concentration, there is a common relationship for both CO_2 treatments, however, the relationship might not be linear. Relationship holds as senescence occurs. Further analysis needed to see if ozone effects match the senescence effects. So for wheat there seems to

be a strong relationship between A_n and g_{sto} , but is this a general trend or just for this paper? Håkan to do some more analysis.

Gina Mills: Separate data into early, mid and late season?

Seraina Bassin: Stable C isotope analysis ($CO_2 \times O_3$ treatment) showed changes in A_n and g_{sto} , whereas ozone treatment showed changes in g_{sto} only. Some species showed effects on A_n , some on g_{sto} and some on both.

Vicky Bermejo: A_n and g_{sto} become uncoupled when plants are stressed, e.g. by drought.

(3) Harry: Impacts O_3 and N on photosynthetic capacity of silver birch.

Photosynthesis mainly driven by chlorophyll content, there seems to be an uncoupling of A_n and g_{sto} (no relationship A_{sat} and g_{sto}). Ozone effect mainly late in the season at low N. N effects only early in the season. Results at leaf level confounded by re-allocation of N within the trees during the growing season.

Patrick: Are crop data available for photosynthetic capacity? Maybe some from Giacomo Gerosa.

Vicky Bermejo: Annual grassland species, i.e. sensitive legume species: same biomass relationships between AOT40 and POD_6 as the species were growing fast during wet season (so no limitation due to soil water potential). Relationship not affected by nitrogen (as you might expect from legume species).

(3) Giacomo Gerosa: Impacts O_3 and N on Quercus robur and Hornbeam.

Quercus robur: Ozone effects on shoots almost zero after 2 years, significant decline biomass roots (16%); no N effects. Root to shoot ratio changed at highest ozone treatment.

Hornbeam: Year 1 large ozone effect, no ozone effect year 2. High N supply results in large ozone effect on roots (more than shoots). N alone increased biomass. Root biomass twice as high as stem biomass.

(4) Data needs and sources:

- Sent in data from experiments as soon as possible to ECLAIRE database, but by 1 April at the latest.
- Data mining: separate above- and belowground biomass; look at g_{sto} data vs A_n ; look at timing of experiments in relation to growth stage.
- Any other data in addition to data mining, experiments, e.g. results published in reports outside ECLAIRE work. Would be useful for Ed Rowe, but there might not be enough time to do this. Modelling needs to be finished by October this year. Maybe circulate a template in what format data is needed, some might be available in the right format which is directly usable. Ed interested in biomass data rather than photosynthesis data. Gina/Ed to e-mail ECLAIRE colleagues for additional data (how much will be in the correct format?).
- Agreement on most needed requirements:

- Patrick needs 2013 (and remaining 2012) data to do model runs
- Time schedule:
 - New experiments Whim bog contribute to modelling? Check measurements required, timing and deliverables.
 - Send data by **1 April 2014** at the latest to ECLAIRE database through the official route, inform Patrick that data has been delivered, so it goes onto the database asap for Partrick to use. Ideally all data should be included together.
 - Gina to send minutes of this meeting to Mark Sutton.

(5) How to bring C allocation into the code?

Defining parameter m based on A/C_i (V_{cmax} , J_{max}) data

Håkan to discuss with Gina more data on coupling g_{sto} and P_n .

How do we deal with data mining not being done for forests? Can we use just data from experiments (Bangor and Curno) to fill gaps?

Patrick: primary data from ECLAIRE experiments, if gap filling needed Patrick will contact Gina and Felicity with respect to data mining activities.

(6) Publications

Gina Mills: meta-analysis; how to deal with data from experiments? Separate publications or included in meta-analysis paper? The decision should be made by the data owners (experiments). Could depend on what would go in a big overview paper and what can still be published separately.

Should we try to publish in a special issue of a journal. There is a special issue (open access, over the next two years) – Gina has details, check with Mark Sutton. Issue will be open very soon for submission of papers. There might be an issue with payment for the paper (Gina to check whether there is a budget for this). Ask group how much papers can be contributed within our group (Gina to ask in e-mail) to get an idea of number of papers. Any specific topics for other papers, e.g. decoupling (or not) of A_n and g_{sto} ?