AQMEII4 Activity 2 Call Notes, 6/6/2023

Attendance: Olivia Clifton, Kenjiro Toyota, Christian Hogrefe, Jesse Bash, Jon Pleim, Olivia Clifton, Nichole Ruiz, Limei Ran, Anam Khan, Chris Holmes, Roberto San Jose, Laurens Ganzeveld

Olivia introduced Nicole Ruiz, an undergraduate in computational biology at Barnard College, who will be working with Olivia on a summer project focused on the non-stomatal uptake component of ozone dry deposition. Her initial analysis may focus on Bugacpuszta. She also plans to work on the question whether/how ozone dry deposition and its different components fit within the "ecosystem services" framework.

Olivia shared that the open discussion phase of her Activity 2 overview paper has been closed and that both reviewers provided comments that were generally positive. Olivia plans to start drafting a response soon and highlighted the following three reviewer comments to the call participants to ask for feedback and potential help in drafting some parts of the response.

> 1) Model documentation "obstructs the flow" of the paper. Potential response: move to appendix (preferred) or supplemental (not desirable). The second reviewer did not think that having the model documentation as part of the main text is distracting and in fact stated that the paper was well organized. The call participants felt that these different takes on the paper's organization give us more leeway on how to respond to the reviewer who was critical of having the documentation inline. After some discussion, the group agreed with Olivia to definitely not move the documentation to the supplemental material, and suggested to keep it as part of the main manuscript and, if the editor were to disagree with that choice, move it to the appendix which is still part of the same PDF file as the main manuscript.
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> 2) Could we address how to alleviate overreliance of different schemes on LAI for seasonal variations? Planned response: Reference Anam's ongoing work. Jesse also offered to contribute to the response to this question (leaf nitrogen mass).
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> 3) The overarching comments provided by reviewer #2 was to have more discussion on what additional analyses could be done with the existing data sets or sensitivity simulations rather than highlighting measurement gaps since new measurements will not become available for some time. Planned response: elaborate on planned work with existing datasets (Anam, Kenjiro, Colin). Laurens: in response to this question, are we asked to comment on possible specific changes to measurement approaches (e.g. chamber measurements, measurements at multiple canopy layers)? Olivia's review paper has some relevant sections that could be used here. Jesse: also discuss the need for better characterization of soil and vegetation characteristics.

Anam updated the group that she has started to extend the calculation of stomatal uptake estimates to additional sites and is currently working on Ramat Hanadiv. She also noted that she has been comparing two different implementations of the Penman–Monteith (PM) water vapor flux inversion approach, and compared both of them to the gross primary productivity (GPP)-based / CO2-flux-based estimate. The two PM-based inversions are based on Knauer et al. and Gerosa et al., respectively. Initial findings indicate that the Medlyn slope is similar between both inversions and going forward Anam likely will use the Gerosa et al. for a couple of reasons. One, Gerosa et al. PM implementation does not require

measured ground heat flux which is not available at all sites [Gerosa et al. approach doesn't explicitly require energy balance closure (latent / sensible heat flux); however, in using methods that close the energy balance by altering latent flux there will be an indirect influence]. Second, there seems to be a stronger correlation between Gerosa and Medlyn gs estimates. One question this work hopes to address is whether differences in how the different stomatal parameterizations respond to environmental stresses (e.g. vapor pressure deficit) are significant causes of model spread. This could be investigated by plotting stomatal conductance estimates vs. different environmental variables. Since it is hard to isolate dry periods at the different sites, this would be an alternate approach to get to the question of how water stress affects stomatal conductance. Laurens mentioned a previous related paper (Visser et al.) looking at Ispra and Hyytiala and asked how this work could be integrated with ozone fluxes. Anam responded that this could potentially done with the higher-frequency data available at Borden and that for her PhD she is also performing some new high-frequency measurements at a site in Illinois. There was a discussion that for lower frequency data one could maybe use O3 deposition velocity to constrain water/GPP fluxes. Olivia pointed out that Anam is already working with the effective stomatal conductances, not "actual" stomatal conductances, so there is some constraint, and Anam will be looking at stomatal fraction of ozone dep velocities, in addition to effective stomatal conductances.

References mentioned in the discussion:

Visser, A. J., Ganzeveld, L. N., Goded, I., Krol, M. C., Mammarella, I., Manca, G., and Boersma, K. F.: Ozone deposition impact assessments for forest canopies require accurate ozone flux partitioning on diurnal timescales, Atmos. Chem. Phys., 21, 18393–18411, https://doi.org/10.5194/acp-21-18393-2021, 2021.

Knauer, J., Zaehle, S., Medlyn, B. E., Reichstein, M., Williams, C. A., Migliavacca, M., Kauwe, M. G. D., Werner, C., Keitel, C., Kolari, P., Limousin, J.-M., & Linderson, M.-L. (2018). Towards physiologically meaningful water-use efficiency estimates from eddy covariance data. Global Change Biology, 24(2), 694–710. https://doi.org/10.1111/gcb.13893

G. Gerosa, S. Cieslik, A. Ballarin-Denti, Micrometeorological determination of time-integrated stomatal ozone fluxes over wheat: a case study in Northern Italy, Atmospheric Environment, 37, 6, 2003, 777-788, https://doi.org/10.1016/S1352-2310(02)00927-5

Kenjiro provided an update on Colin's machine learning work. Colin is currently using a 2-layer dense neural network to estimate Vd from input variables and comparing that estimate to both the measured Vd and the Vd calculated with one of the GEM-MACH schemes. When this is done on a site-by-site basis, the neural network shows much better agreement with observations than a comparison of GEM-MACH to observations. There is less agreement with observations when applying the neural network to all sites simultaneously. The next steps are to design and apply a physics-informed machine learning technique. Olivia pointed out the following reference for consideration in Colin's work: Silva, S. J., Heald, C. L., Ravela, S., Mammarella, I., and Munger, J.W. (2019). A Deep Learning Parameterization for Ozone Dry Deposition Velocities. Geophys. Res. Lett., 46. https://doi.org/ 10.1029/2018GL081049

Christian reported that following discussions with Olivia, Paul and Iannis at the recent ITM in Chapel Hill, he has started to extract some diagnostic ozone dry deposition output (starting with deposition velocities) from Activity 1 at the location of all point intercomparison sites except Ramat Hanadiv. The

hope is that these extractions will be helpful when future work tries to link results from Activity 1 and Activity 2.

Next call: Wednesday July 5, then every first Tuesday of the month thereafter. Christian will send out new calendar invites for these calls.