Project: 1202

Project title: Modelling the impact of global change on the terrestrial biosphere with LPJ-GUESS

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Report period: 2023-11-01 to 2024-10-31

Project 1202 previously comprised three separate but synergistic subprojects (two funded projects and LPJ-GUESS contributions to ISIMIP3). Each are reported separately below, followed by a summary and outlook.

ISIMIP

The first paper with ISIMIP3a fire sector simulations has been published (Burton et al., 2024, Nature Climate Change). The paper quantified the effects of climate change on global burnt area using an ensemble of global fire-vegetation models. Two of the seven models in the fire-vegetation climate model ensemble were simulated using resources from this DKRZ project. The output used in the analysis (burnt area and carbon mass) is available on the ISIMIP repository (with a DOI) to facilitate future analyses and publications.

Regarding the future scenario simulations in ISIMIP, the DHF (direct human forcing) for ISIMIP3b future simulation did become available this year. However, we have not yet commenced the ISIMIP3b runs due to limited person time available and because we detected an issue detected with the per month, per PFT (plant functional type) output (which is required a part of the ISIMIP protocol but not the standard LPJ-GUESS output).

We are still strategically very committed to ISIMIP and to performing ISIMIP simulations. The current code version of LPJ-GUESS used for ISIMIP has undergone development by several people over the course several model intercomparison projects and several Git servers. This has made it difficult to maintain and diagnose problems (such as the output issues mentioned above). We therefore plan to build a fresh version of LPJ-GUESS to implement the ISIMIP protocol taking advantage of the new centralised Gitlab server provided by Lund University. This will put ISIMIP simulations on to a firmer footing, but will take some time to establish.

FURNACES

The official duration of the FURNACES project is now over. A paper describing the global burnt area model (GBASS) is currently being finalised for submission to Biogeosciences. However, lacking a final published model configuration and sufficient person-power (due to personnel turnover), we did not perform the ensemble simulations that we had planned within FURNACES. Contingent on successful publication of the model, we do plan to use it for global simulations, but realistically it will require some time before this is ready. Therefore, we will not request simulations resources for such simulations at this point.

FirEUrisk

The publication describing the Burnt Area Simulator for Europe (BASE) model has been accepted and is press (Forrest et al., in press, Biogeosciences). Within the scope of FirEUrisk, the BASE model has been implemented in the LPJ-mL DGVM by colleagues from PIK. When allocating tasks within the project to meet the deliverables, it was decided that the LPJ-mL-BASE setup should be used for performing future simulations, so we did not perform any with LPJ-GUESS. Whilst simulating fire with the BASE model in LPJ-GUESS is still definitely scientifically interesting (especially the novel cropland fire component), it is not currently a high priority.

Summary and Outlook for 2025

The departure of the previous PI for both FURNACES and FirEUrisk and other staff turnover issues has stretched personnel very thin and has continued to disrupt group activities. Once again, we were over-optimistic about what could be achieved in terms of simulations in this allocation period, resulting in a large quantity of unused resources. Again, we regret this. We wish to avoid the same mistake this year and be fully realistic. We are not confident we are able to use start production simulations in Q1 2025.

However, DKRZ, and in particular Levante, remains a great asset for performing simulations with LPJ-GUESS, particularly ensemble runs for impact studies. The simulation setups and input data are in place, and as a consequence of previous work to configure the model setups, performance is excellent. We definitely want to use Levante for future production simulations, in particular for ISIMIP.

Therefore, we request only a comparatively small amount of compute time for testing at this juncture. Assuming that publications, development and bug-fixing proceed well, we hope to request compute resources for 2025 for Q3 and Q4. Additionally, we therefore request sufficient storage to keep the input data on the cluster ready for testing and eventually production.

References

Burton, C., Lampe, S., Kelley, D. I., Thiery, W., Hantson, S., Christidis, N., Gudmundsson, L., **Forrest, M**., Burke, E., Chang, J., Huang, H., Ito, A., Kou-Giesbrecht, S., Lasslop, G., Li, W., Nieradzik, L., Li, F., Chen, Y., Randerson, J., ... Mengel, M. (2024). Global burned area increasingly explained by climate change. Nature Climate Change, 1–7. https://doi.org/10.1038/s41558-024-02140-w

Forrest, M., Hetzer, J., Billing, M., Bowring, S. P. K., Kosczor, E., Oberhagemann, L., Perkins, O., Warren, D., Arrogante-Funes, F., Thonicke, K., and Hickler, T.: Understanding and simulating cropland and non-cropland burning in Europe using the BASE (Burnt Area Simulator for Europe) model, Biogeoscinces, in press, https://doi.org/10.5194/egusphere-2024-1973, 2024.