AMAZALERT

A research project on impacts of climate change and land use change in Amazonia

Factsheet

Issue 2

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Baseline model runs performed with 4 Dynamic Global Vegetation Models (DGVMs)

Within the context of the AMAZALERT project, we are reducing the inherent uncertainty of land surface, land-use change and hydrology models by weighting ensemble model results from a suite of models according to their agreement with data. This fact sheet provides a brief overview of the establishment of the historical model runs for the four DGVMs used in AMAZALERT. Some outputs are given for visual support of the realization of the model runs.

AT A GLANCE

- All planned historical model runs for the four DGVMs are successfully completed and fully available for all AMAZALERT co-workers for further in depth analysis.
- Fine-tuning of the hydro-logical basis of the model, using river routing, is on-going or completed.
- In the coming months the database will be extended with future scenario runs.

Goal of the model runs

To achieve future run predictions, models firstly have to be tested with reference to the historical data (in the period 1970-2008) by using multiple models and data comparisons. This way of working would help increasing our knowledge on the system functioning and give insight in how to improve the models.

Protocol

For model set-up and spin-up for the historical runs the protocol of the Moore Foundation Andes-Amazon Initiative (AAI) project was used with supplementation of some extra outputs (mainly hydrology related outputs) required for AMAZALERT. The document contains not only all structural details for the model set-up and spin-up, but also information about the conventions for historical and future runs. Format of the output files and variable units are described to ensure standardization with the objective of ease of data exchange and analysis.

Forcing data

All DGVMs were run using the Sheffield forcing data, which have been analyzed to ensure correctness for use. Pattern analysis was performed for all variables, including rainfall, temperature, specific humidity and radiation (Fig.4).

Runs

Within Work Package 2 of the project, 4 models were put forward for the study.

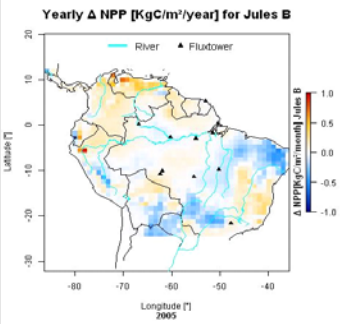

Fig.1. Average Monthly net primary production [KgC/ m²/month] anomalies for 2005 for Jules B historical runs.

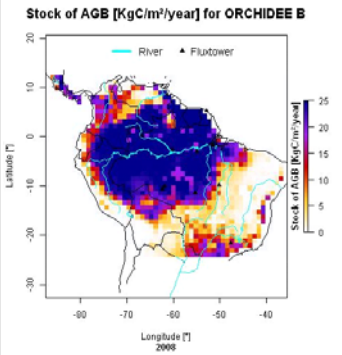

Fig. 2. The stock of above ground biomass [KgC/m²] at the end of 2008 for Orchidee B historical runs.

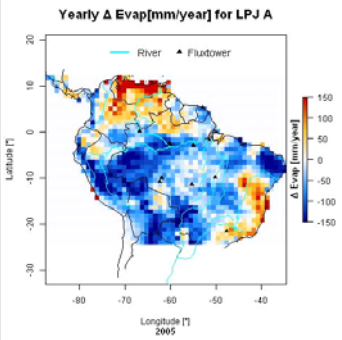

Fig. 3. Evapotranspiration [mm/y^{-1}] anomalies for 2005 for LPJ A historical runs.

First there is the ORCHIDEE Model, which is the land-surface scheme of The Institut Pierre Simon Laplace (IPSL) earth system model (Krinner et al. 2005, Verbeeck et al. 2011). The second model is LPJmL, which is a dynamic global simulation model of vegetation biogeography and vegetation/ soil biogeochemistry (Sitch et al., 2003). Third used model is the Joint UK Land Environment Simulator (JULES). It is developed from the Met Office Surface Exchange Scheme (MOSES) (Best et al. 2011, Clark et al. 2011, and Powell et al., 2013). The Integrated Model of Land Surface Processes (INLAND), the fourth model, is the land surface package for the Brazilian Earth System Model and based on the Integrated Biosphere Simulator (IBIS) (Powell et al., 2013).

Each model has performed 2 historical runs, one with no land-use change with or without fire as natural disturbances (A or B) and the other also including land-use change (D) (Table 1.). A detailed analysis has been performed to ensure correctness and usability of the outputs. The ranges of the variables were compared between the different model run outputs as well as with literature. Pattern analysis on plotted maps of the DGVMs outputs were contrasted with each other (Fig 1-3).

Table 1. This table explains the design of the historical simulations.

Scenario	Description
A	natural disturbances + no land-use change + changing climate (recycling the SHEF driver) + changing CO_2 .
B	natural disturbances by excluding fire + no land-use change + changing climate (recycling the SHEF driver) + changing CO_2
D	natural disturbances + land-use change + changing climate + changing CO2.

GLOSSARY OF TERMS

- **Dynamic Global Vegetation Models**

Computer program simulating shifts in potential vegetation and its associated biogeochemical and hydrological cycles as a response to shifts in climate

- **Spin-up**

Climate and vegetation models usually need to reach an equilibrium state with no significant shifts in carbon pools and other parameters, before running the models with the newly defined parameter conditions over the desired period in time. The process of running the model with initial condition to create an equilibrium state, is termed spin-up.

- **Forcing data**

Data used by the model, after spin-up, defining the new environmental conditions for the model.

- **Net Primary Production**

The rate at which all the plants in an ecosystem produce biomass.

- **Evapotranspiration**

The sum of evaporation (the movement of water to atmosphere from sources such as the soil, canopy interception and waterbodies) and plant transpiration (loss of water as vapour trough the stomata at the leaves)

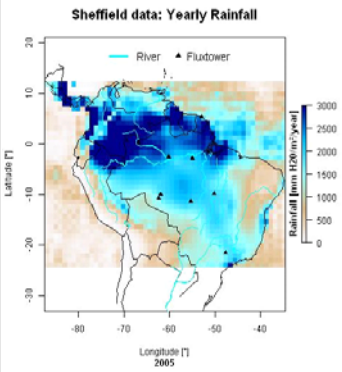

Figure 4. Total rainfall [mm $H_2O/m^2/year$] during the drought year 2005 covering the northern part of Latin - America.

DGVM	A	B	D	River-Routing
ORCHIDEE		x	x	x
JULES		x	x	ongoing
LPJmL	x		x	x
INLAND	ongoing		ongoing	

Table 2. This table indicates which historical runs have been completed and for which models the additional runs with river-routing have been finished.

Conclusions

Historical DGVM runs are now available in a database for all AMAZALERT partners. These runs are currently being analyzed and improved model runs will be added by the end of the project. In the coming months the database will be extended with future scenario runs.

References

Best M.J., Pryor M., Clark D.B., Rooney G.G., Essery R.L.H., Menard C.B., Edwards J.M., Hendry M.A., Porson A., Gedney N., Mercado L.M., Sitch S., Blyth E., Boucher O., Cox P.M., Grimmond C.S.B. & Harding R.J. (2011) The Joint UK Land Environment Simulator (JULES), model description - Part 1: Energy and water fluxes. Geoscientific Model Development, 4, 677-699.

Clark D.B., Mercado L.M., Sitch S., Jones C.D., Gedney N., Best M.J., Pryor M., Rooney G.G., Essery R.L.H., Blyth E., Boucher O., Harding R.J., Huntingford C. & Cox P.M. (2011) The Joint UK Land Environment Simulator (JULES), model description - Part 2: Carbon fluxes and vegetation dynamics. Geoscientific Model Development, 4, 701-722.

Krinner, G., Viovy, N., de Noblet-Ducoudré, N., Ogée, J., Polcher, J., Friedlingstein, P., Ciais, P., Sitch, S. & Prentice, I.C. (2005) A dynamic global vegetation model for studies of the coupled atmosphere-biosphere system. Global Biogeochemical Cycles, 19, GB1015.

Powell T.L., Galbraith D.R., Christoffersen B.O., Harper A., Imbuzeiro H.M.A., Rowland L., Almeida S., Brando P.M., da Costa A.C.L., Costa M.H., Levine N.M., Malhi Y., Saleska S.R., Sotta E., Williams M., Meir P. & Moorcroft P.R. (2013) Confronting model predictions of carbon fluxes with measurements of Amazon forests subjected to experimental drought. New Phytologist, in press.

Sitch S, Smith B, Prentice IC et al. (2003) Evaluation of ecosystem dynamics, plant geography and terrestrial carbon cycling in the LPJ dynamic global vegetation model. Global Change Biology, 9, 161–185

Verbeeck, H., Peylin, P., Bacour, C., Bonal, D., Steppe, K. & Ciais, P. (2011) Seasonal patterns of CO2 fluxes in Amazon forests: Fusion of eddy covariance data and the ORCHIDEE model. J. Geophys. Res., 116, G02018.

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