

What is TERRABITES about?

Evidently, the terrestrial biosphere is altered by climate change. It is less recognized that these changes also feed back to climate through modified hydrological conditions, alterations in biogeophysical properties (albedo, roughness), and via the exchange of greenhouse gases (CO₂, N₂O, CH₄) between plants, soils and the atmosphere.

Consequently, the climate modeling community is currently integrating the terrestrial biosphere into their models to simulate the future co-evolution of climate and biosphere. Such projections could give a much more coherent picture of the consequences of human activities for climate and ecosystems.

The TERRABITES COST Action supports this development. It is an attempt of the European research community to integrate existing knowledge on global biosphere functioning and the expertise in Earth system simulation and observation. Such an integrative view is currently missing, since the relevant knowledge is scattered about at least three different, largely separated communities, namely the Earth observation community, the ecological research community, and the climate modeling community.

During the last years each of these communities made large advancements that so far have not made their way into Earth system models. The remote sensing community developed new sensors and methods to map with unprecedented detail the current state of the terrestrial biosphere. Ecologists, in a collective effort, began to revise classical theories by analyzing recently assembled global databases on plant properties. Finally, climate modelers started to replace their land surface parameterizations by more sophisticated descriptions including vegetation as an autonomous component of the Earth system.

TERRABITES aims at fostering the integration between these different research communities. In four working groups (see overleaf) major modeling challenges are addressed. TERRABITES organizes cross-community workshops, open conferences, and training schools.

www.terrabitest.net



TERRABITES

The Terrestrial Biosphere
in the Earth System

COST Action ES0805

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For further information

please contact Dr. C. Reick
Christian.Reick@zmaw.de

Responsible

for the contents: Dr. C. Reick
for the design: B.Diallo
MPI for Meteorology, Hamburg
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"The main objective of the TERRABITES research network is a cross-disciplinary assessment of our current understanding of the terrestrial biosphere from an Earth system perspective to improve the reliability of future Earth system projections in coupled climate-biosphere simulations."

Working Group 1: Modeling plant function

In recent years a disconnect has become apparent between the vegetation modeling community and experimental ecologists. The former are using rather coarse and mostly static plant classifications ("Plant Functional Types") based on only a small number of plant traits (e.g. life form, phenology, photosynthetic pathway). Instead, ecologists focus on a larger range of ecophysiological plant traits, emphasizing their dynamic character.

This leads to the question on the appropriate level of detail needed for the representation of plants in Earth system models. Because of the close linkage between carbon cycle and climate, there is an urgent need to include climate relevant biological processes into today's models. But for a proper modeling and subsequent inclusion into Earth system models these processes must be understood sufficiently well.

Moreover, for parameter estimation and model validation observation data must be easily accessible now or in near future to assess the quality of simulation results. Accordingly, the goal of WG 1 is to assess the existing knowledge on these issues and to develop a cross-community perspective for improved plant representations in Earth system models.

Working Group 2: Modeling carbon and nutrient cycling

The cycling of carbon and nutrients in terrestrial ecosystems is highly sensitive to changes in climate, land use and land management, and other disturbances. Although Earth system models have started to incorporate established ecological concepts (e.g. soil carbon cycling with multiple soil pools), new ecological insight suggests that several of the adopted approaches may not be suited for extrapolations to future conditions.

Important improvements may be achieved by separately addressing the controls of soil organic matter stabilization/destabilization mechanisms, which determine how much soil organic matter is available for decomposition, and the controls of the decomposition process itself.

For incorporation into Earth system models, realistic generalizations of the understanding of in situ processes to the global scale are necessary. But proven in situ responses to climate change need not be expressed at landscape scales, because disturbance and management often override all local biological or ecological responses. Examples of such overriding processes include top soil erosion, harvesting by man (and by herbivores), fire, and salination. The aim of WG 2 is to discuss perspectives for incorporation of such processes into Earth system models.



Working Group 3: Modeling plant ecology

The response of plant communities to disturbance, which is a major structuring element of vegetation at global scale, is to a large extent determined by the so-called life history traits of plants. Fire, as one such disturbance, is usually accounted for in existing global vegetation models, but other disturbances may be regionally very important, too. E.g. herbivory by mammals structures savannah vegetation and grasslands in temperate regions.

Likewise, birds (especially geese) play that role in tundra systems. Herbivory by insects is critically important in boreal forests and some semi-humid regions. In addition, life history traits also strongly

determine the dispersal ability of plant species. Life history traits so far received much less attention in vegetation models than functional traits, which are related to resource acquisition. However, in order to account properly for the responses of vegetation to disturbance, appropriate modeling concepts need further development. This is complicated by the wide range of relevant phenomena and mechanisms. Bringing life history traits into the conceptual framework of Earth system models is the main task of WG 3.

Working Group 4: Modeling human land use

Human land use greatly modifies fluxes of heat, water, and gas exchange between land and atmosphere. Land surface models coupled to climate models currently either do not represent human land use at all, or only in a very coarse manner. To develop a long-term perspective for the modeling of human land use within the Earth system WG 4 brings together expertise on the functioning of agroecosystems, spatial detail and heterogeneity of land cover changes, and human land use practices on a global scale. Main challenges are the proper representation of agricultural plants, agro-hydrological cycles including irrigation, and land management of pastures and forests.

A more general theme is to link human extraction of biomaterials from the environment to the spatial patterns of socioeconomic processes. A comprehensive Earth system model would take into account not only emissions from the human energy production system, but also the material flows generated by industrialized and industrializing regions, which influence climate and biodiversity through land use changes even remotely. Models of this type could more directly contribute to discussions of the sustainability and economic feasibility of global use of biospheric resources.