

**Application for
2010-2011 FACULTY GRANTS FOR INTERNATIONAL CONNECTIONS
Lehigh University**

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Title: Peatlands and the Global Carbon Cycle: International Modeling Collaborations

Rationale

Building on our recent data synthesis on global peatlands and the peat-accumulation process understanding (Yu et al. 2010; Yu 2011), I'm expanding my research expertise and activities from empirical data studies to modeling peatland carbon dynamics in the present (Holocene) and past warm interglacials. Our recent discovery that seasonality in solar radiation and in climate has been a dominant control of peatland carbon dynamics (Jones and Yu 2010; Yu et al. 2010) would greatly facilitate the design of model simulation experiments for testing some important ideas, such as peatlands' role in glacial-interglacial C cycle, and the difference between different previous interglacials.

For this reason, I'm applying for this faculty international connection grant to support my visit and collaboration with Dr. Victor Brovkin and his research group in Max Planck Institute for Meteorology in Hamburg, Germany during my scheduled sabbatical leave in AY 2011-2012. Dr. Brovkin is a world leader in modeling biosphere-climate interaction, and MPI-M is a work leading research institution on climate and Earth system modeling. See the links below for more information about the institute and host:

<http://www.mpimet.mpg.de/en/home.html>

<http://www.mpimet.mpg.de/en/staff/victor-brovkin.html#c7881>

Also, see the attached letter of support from Dr. Brovkin and Dr. Kleinen as part of NSF proposal.

- **Professional and personal goals for the visit**

The visit will initiate formal collaborations with a world leader on biosphere-climate modeling. The proposed global peatland modeling as part of visit and continuing collaboration is a logic extension of my research program. The new research and international collaboration will further strengthen the reputation of Lehigh and my group as a center of peatland carbon cycle research in the world.

- **Expected outcomes: short-term and long-term**

Short-term. This collaboration will be one component of a pending proposal that I submitted to NSF's Arctic Research programs on November 10, 2010, and in the proposal both Dr. Brovkin and his research associate, Dr. Thomas Kleinen, are collaborators on modeling circum-Arctic peatlands. So the short-term goal is to carry out the proposed research activities, if funded.

Long-term. Even though the pending proposal is not funded this round, the proposed visit will still move forward as this nicely fits with my long-term goal as described above. If the pending NSF Arctic proposal is funded, the formal collaboration will continue for the next few years. From the disciplinary point of view, the CLIMBER2-Peat model (validated with our global synthesis data and the model simulations will provide a first assessment of the role of global peatlands in the global carbon cycle.

- **Nature of interaction: provide a narrative outlining substance of the interaction at the host institution and the arrangements. Name(s) of the foreign academic institution(s) or the research center/institute, and the name(s) of one or two faculty members (or equivalent) in these institutions**

For the modeling research, I plan to use an Earth system model of intermediate complexity (EMIC), CLIMBER2, coupled to a dynamic global vegetation model and a new peat accumulation model (under development by Dr. Kleinen), to simulate long-term carbon histories of peatlands as well as other ecosystems, as been used by my German collaborators (Kleinen et al. 2010). The proposed activities include model validation with the global peatland database that we have compiled (Yu et al. 2010), sensitivity analysis of peat carbon accumulation to temperature and precipitation, and global assessment of peatlands' role in the global carbon cycle.

- **What pre-trip planning and preparation will be done prior to leaving campus to ensure that the stated goals will be achieved? Attach a letter or e-mail message from the proposed counterpart extending an invitation outlining in concrete terms the proposed joint activities during the faculty member visit to the host institution and host's own expectations.**

I have met Dr. Kleinen at international conferences in September 2009 in Prague and again in December 2009 in San Francisco. I met with Dr. Brovkin in December 2010 in San Francisco – after I talked with him briefly in Amsterdam in 2000. We have had in-depth discussion about collaborative activities by emails related to the preparation of the pending NSF proposal as mentioned above. I have never been to their institute, and this is a new collaboration. See the attached letter of support for more detail.

- **Expected follow-up steps upon return to campus. Note: Each faculty member who is awarded this grant will be asked to submit a brief written trip report upon their return to campus to the vice president for international affairs, the department chairperson and the dean as well as agree to join the rest of the recipients to give a short oral presentation about their experiences to faculty interested in applying for this program as well as newly hired faculty.**

I expect long-term and continued collaborations with this group, as for one thing we are so complementary in reaching the overall science goals (simulating and understanding the role of peatlands in the global carbon cycle) by combining our synthesis empirical data and their expertise and reputation in Earth system modeling.

Also, I will prepare a brief report to summarize the collaboration activities and concrete scholarly outcomes as well as talk with other faculty about my international experiences.

- **A proposed budget for travel and in-country costs and proposed date of trip.**

Round-trip airfare: \$1400; in country-cost of \$5712 for 2 week at per diem rate of \$408 per day. A grand total of request: \$7112. The proposed dates are in September to November 2011.

References Cited:

- Jones, M.C. and Yu, Z.C. 2010. Rapid deglacial and early Holocene expansion of peatlands in Alaska. *Proceedings of National Academy of Sciences USA* **107**: 7347-7352.
- Kleinen, T. V. Brovkin, W. von Bloh, D. Archer, and G. Munhoven. 2010. Holocene carbon cycle dynamics. *Geophysical Research Letters* **37**, L02705, doi:10.1029/2009GL041391.
- Yu, Z.C., Loisel*, J., Brosseau*, D.P., Beilman, D.W. and Hunt,* S.J. 2010. Global peatland dynamics since the Last Glacial Maximum. *Geophysical Research Letters* **37**: L13402 doi:10.1029/2010GL043584.
- Yu, Z.C. 2011 (in press). Holocene carbon flux histories of the world's peatlands: Global carbon-cycle implications. *The Holocene*. doi:10.1177/0959683610386982



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National Science Foundation
Arctic Research Opportunities

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Hamburg, den 11. November 2010

Letter of support for the proposal "Sensitivity of Circum-Arctic Peatland Carbon to Holocene Warm Climates and Climate Seasonality"

Dear Sir or Madam,

first, to say a little about ourselves: Victor Brovkin is the leader of the group "Climate-Biogeosphere Interactions" at the Max Planck Institute for Meteorology in Hamburg, Germany, while Thomas Kleinen is a member of the group, specialised in modelling wetlands and peat formation.

In our group, we are focused on modelling interactions of climate and vegetation in the present climate, as well as past climate states.

Peat-accumulating wetlands play an important role in the global carbon cycle. Due to their importance, we are currently developing modules that allow the consideration of wetland carbon cycle dynamics in climate models, both in our model of intermediate complexity CLIMBER-LPJ, which we use for model studies over time scales of interglacials, and in our general circulation model ECHAM6, which we use for studies on shorter timescales as well as projections of future climate change.

One essential prerequisite for the development of credible models is the availability of high quality measurement data to be used for model calibration and validation. Since climate models are global in scope, data that is available for selected points only is of limited use. Instead, large scale syntheses of homogenized measurement data are very much preferable.

We therefore express strong support for the proposal "Sensitivity of Circum-Arctic Peatland Carbon to Holocene Warm Climates and Climate Seasonality" by Drs Z. Yu, D. Beilman, and P. Camill. In their project, they propose to fill some vital gaps in the spatial coverage of available measurement data, and to generate a synthesis of peatland data on a circum-Arctic scale. We are very keen on collaborating in the proposed project, on the one hand to test our models against the circum-Arctic data synthesis, and on the other hand to test hypotheses on the climate dependence of peatland growth.

We are glad that Dr. Z. Yu will visit us during his sabbatical in 2011. This visit will allow intense discussion and a depth of cooperation that would be difficult to achieve otherwise. Similarly, we will be glad to attend the proposed synthesis workshop, and we also expect an additional visit by Drs Yu, Beilman and Camill at a later date to be quite fruitful.

Of course we expect to be co-authors of any products or publications that result from our collaboration.

Dr. Victor Brovkin and Dr. Thomas Kleinen