Renewal Proposal for the Penn State Earth System Science Center

***1. Name of Center*:** Earth System Science Center (ESSC)

2. Director: Michael E. Mann,
Associate Professor in Dept. of Meteorology w/ joint appointments in EESI and Dept. of Geosciences (2 page CV attached)

3. Participants: There are currently 24 faculty and research staff affiliates of the ESSC as listed below:

Director:
Michael Mann (Dept. of Meteorology; joint appointments in Dept. of Geosciences and EESI)
Assistant Director:
Sonya K. Miller (Dept. of Meteorology)

Additional Affiliates:
Richard Alley (Dept. of Geosciences)
Sridhar Anandakrishnan (Dept. of Geosciences)
Michael Arthur (Dept. of Geosciences)
Timothy Bralower (Dept. of Geosciences)
Ken Davis (Dept. of Meteorology)
Jenni Evans (Dept. of Meteorology)
Steve Feldstein (EESI)
Kate Freeman (Dept. of Geosciences)
Bernd Haupt (EESI)
Jim Kasting (Dept. of Geosciences)
Klaus Keller (Dept. of Geosciences)
Lee Kump (Dept. of Geosciences)
Sukyoung Lee (Dept. of Meteorology)
Paul Markowski (Dept. of Meteorology)
Ray Najjar (Dept. of Meteorology)
Byron Parizek (Dept. of Geosciences)
David Pollard (EESI)
David Reusch (Dept. of Geosciences)
Yvette Richardson (Dept. of Meteorology)
Arthur A. Small III (Dept. of Meteorology)
Tim White (EESI)
Zhihua Zhang (EESI)

4. Rationale for Center:

As Director of the Penn State Earth System Science Center (ESSC), I am seeking to maintain and further build a thriving environment for interdisciplinary climate-related research at Penn State University.

The original ESSC rose to prominence in the late 1980s under the directorship of Eric Barron as a center for excellence in large-scale climate and paleoclimate modeling. In the time since it was founded, the scientific environment that the center finds itself has changed significantly. It is unclear that academic institutions can maintain a leadership role in running computationally-intensive, state-of-the-art global coupled climate models. This role has instead been taken over by major government research institutes such as NCAR, GFDL, Lawrence Livermore, and NASA/GISS in the U.S., and about a dozen other institutions internationally. On the other hand, with the advent of public archiving protocols used by major modeling groups, it is no longer essential that an institution run state-of-the-art global coupled models in house. For example, with the most recent report of the IPCC having adopted just such a protocol, researchers now have access to the results of the 20+ state-of-the-art simulations of 20th century climate and 21st century climate projections that comprise the IPCC "multi-model" (also now know as "CMIP 3") ensemble.

In this new environment, it has become important to rethink the mission of a center such as the ESSC devoted to the study of climate, i.e. the behavior of Earth's coupled atmosphere-ocean-biosphere-cryosphere system. Given the personnel and resources within the ESSC, it is been appropriate for the ESSC to focus on a specific multi-pronged research agenda for the years ahead. The research agenda involves the following key focus areas:

• Value-added use of existing state-of-the-art simulations: Given the expertise that faculty within the ESSC have in the area of climate dynamics (e.g. S. Lee, J. Evans, S. Feldstein, D. Pollard, M. Mann) we can add value to IPCC model results and projections through analyzing the model results in an informed dynamical context, recognizing the limitations and relative strengths and weaknesses of different models, e.g. caveats associated with current representations of key processes underlying e.g. the behavior of the El Nino/Southern Oscillation in the models. Furthermore, we have key personnel in place within the college of EMS (e.g. R. Crane) who can facilitate the establishment of Penn State as a leader in the development of meaningful regional future climate change projections via the application of downscaling methods to existing model simulation results. In developing such climate projections, the ESSC, EESI, and college of EMS can play a crucial role in broader university-wide initiatives underway to apply regional climate change projections to an array of impact studies. Such initiatives include applications to infectious disease dynamics (in collaboration with P. Hudson and others within the Huck Institute) and issues involving future energy and water resources (in collaboration with researchers such as T. Wilder within the water resources in the College of Engineering). Applications to water resources issues are, in turn, highly synergistic with the PSU Water Initiative currently being lead by Geosciences faculty member K. Freeman.

• Large ensemble simulations using intermediate complexity models: Given our available computational resources (e.g. the high-performance 64 node ESSC Linux computing cluster), the ESSC can maintain a niche in the use of large ensemble simulations of so-called intermediate complexity or 'EMIC' coupled ocean-atmosphere climate models to explore key outstanding questions involving past and potential future climate change. Currently, efforts are underway among ESSC researchers (M. Mann, K. Keller, and D. Pollard) that involve the use of large ensemble simulations to optimize key climate parameters of simple coupled ocean-atmosphere

EMICS (both the U.Vic. and 'LOVECLIM' EMICs) based on assimilation of modern observational and paleoclimate constraints. The aim of these analyses is to improve current probabilistic projections of future climate change, including the potential risk of abrupt climate changes impacting, for example, ocean circulation pattern and continental drought patterns.

• Targeted use of state-of-the-art coupled models: Given the historical strengths of the ESSC and the expertise of its personnel in the area of paleoclimate modeling and coupled ocean-atmosphere-cryospheric dynamics, it is important for the ESSC to continue to maintain activities in this area. Where appropriate, ESSC computational resources continue to be used for a targeted set of experiments employing more elaborate coupled models and aimed at addressing specific problems. ESSC personnel (D. Pollard, in collaboration with R. Alley and student P. Applegate) are currently, for example, using the ESSC computing cluster for a small set of experiments employing a conventional coupled ocean-atmosphere model ("GENESIS") in conjunction with the Penn State dynamical ice sheet model, to explore various questions related to climate and ice sheet dynamics in both recent (e.g. Holocene and Pleistocene) and deep time (e.g. Cenozoic and Cretaceous) paleoclimate.

As discussed below (section 5), there continue to be numerous funding opportunities to support the various research activities described above. As also discussed below (section 8), there is a foundation of numerous past successes for the ESSC to build upon as it continues to support and facilitate interdisciplinary climate-related and climate-relevant research in the years ahead.

5. Funding Opportunities:

A significant factor in the revitalization of the ESSC during my tenure over the past few years as ESSC director was the successful securing of computational resources to support climate modeling efforts and related research activities, through a grant from the NSF Infrastructure and Facilities program (P.I. Mann; ESSC co-PIs: Alley, Pollard, Evans, and Arthur) to support a high-performance computing cluster. These funds were supplemented by a generous contribution from EESI to support the purchase of a 64 node high performance linux computing cluster housed within the GEARS division at Penn State. As discussed above, this computing cluster has supported a diverse array of research activities within the ESSC, and has in turn leveraged a number of successful additional grant proposals (see below).

There are a number of current or future funding opportunities that have been seized upon by ESSC personnel. These opportunities take the form of a number of funded and pending grant proposals that have or will potentially provide support for ESSC personnel and research activities. These can be broken down in terms of the various research foci discussed above (please refer to section 4 for detailed descriptions):

- Value-added use of existing state-of-the-art simulations:

These efforts are pending base funding from a number of internal PSU sources who have indicated their interest in supporting climate change projection activities at Penn State. These include the Huck Institute (directed by Peter Hudson) and AESEDA (directed by Robert Crane).

These efforts are also pending funding from the DOE in the form of an invited full grant proposal (in response to DOE Funding Opportunity Announcement DE-PS02-08ER08-18) to be submitted April 2008 by P.I.s T. Wilder (Dept. of Civil Engineering, College of Engineering),M. Mann (Dept. of Meteorology, R. Crane, and K. Freeman).

- Large ensemble simulations using intermediate complexity models:

This effort is currently partly funded through EPA and NSF, with additional pending funding from NSF and NOAA in the form of two grant proposals submitted by M. Mann, K. Keller, and their collaborators at other institutions. These activities have also been leveraged by access to and use of the ESSC high performance computing cluster.

- Targeted use of state-of-the-art coupled models:

These activities are supported by various grants from the NSF. These activities have also been leveraged by access to and use of the ESSC high performance computing cluster.

- ***6. Center Needs:***

ESSC has a long history as a vital unit within EESI and EMS at Penn State. We hope to maintain its status as such for the foreseeable future.

With regard to the proposal at hand, wee seek continued EESI funding for the ESSC at past levels for an additional 3 year term, with the hope of continuing this in future cycles.

Because ESSC has met its near-term computational needs through an NSF-funded high performance computing cluster (with supplementary funds by EESI), our financial needs remain modest.

We request a continuing budget at the level of roughly 20K per year (this represents a reduction of 2K per year from previous budgets). This budget will provide for:

- Roughly 16 K to support 1/3 time salary of ESSC associate director Sonya Miller
- Roughly 2K to support ESSC brown bag refreshment budget and modest travel support for visiting scientists and speakers.
- Roughly 2K to support research activities of Dr. David Pollard, who is a critical member of the Penn State climate and glaciological research community

7. Management Structure:

M. Mann serves as director, and S. Miller serves as associate director of the ESSC. There are currently 24 EMS faculty and research scientists in total that remain affiliated with the ESSC. This includes individuals from the departments of meteorology, geosciences, and from EESI. PSICE (focus on the cryosphere) and ACRE (focus on the biosphere) are separate centers that remain directly affiliated with the ESSC.

Significant decisions regarding direction, allocation of resources, etc. are generally put before entire group for a vote (typically via email) where appropriate.

8. Past Budgets and Work:

a. Past Budgets

Past ESSC Budgets	FY 2005-06	FY 2006-07	FY 2007-08	3 Yr Total
Salaries:				
Seidov	8120			8120
Haupt	10564			10564
Fan	2965			2965
Pollard		14212	7500	21712
S. Miller			16885	16885
Zhang		3235		3235
ESSC Seminars/speakers	851	1366	1010	3227
Totals	22500	18813	25395	66708
Funding	22500	22500	22500	67500
Balance				**792**

b. Past Work:

As a result of an NSF grant we secured last year (with invaluable matching funds provided by EESI Director Sue Brantley), ESSC researchers have had access for more than a year now to a high-performance Linux computing cluster. This accomplishment is now clearly bearing fruit. ESSC scientists have used these computational resources to perform leading edge climate and paleoclimate research analyses in several key research focus areas (see section 4) including (i) large ensemble "EMIC" simulations aimed at constraining key parameters of the climate and coupled climate/carbon cycle system (K. Keller, M. Mann, and colleagues), and (ii) experiments employing a conventional coupled ocean-atmosphere model in conjunction with the Penn State dynamical ice sheet model, to explore various questions related to climate and ice sheet dynamics in both recent (e.g. Holocene and Pleistocene) and deep time (e.g. Cenozoic and Cretaceous) paleoclimates (D. Pollard, R. Alley, and colleagues).

Scientists working in the Penn State Earth System Science Center (ESSC) have used the ESSC 'lionxc' cluster acquired through NSF funding of this project (NSF award #0548962) for the following climate and paleoclimate-related analyses (P.I.s, affiliated investigators, or associated students involved in the analyses are indicated in brackets):

- "Snapshots" of climate over the last 12,000 years have been performed using the GENESIS global climate model. The results of the simulations will be used to determine how small alpine glaciers have fluctuated in response to changes in the earth's orbit over that time period. This work is timely because there have been suggestions in the literature recently that glaciers in the northern hemisphere have become progressively larger over the last 12,000 years, whereas glaciers in the southern hemisphere have become progressively smaller. The model results will help to test this hypothesis [*Penn State Geosciences graduate student Patrick Applegate co-advised by R. Alley, M. Mann, D Pollard*].

- Ongoing development of version 3 of the GENESIS Global Climate Model, mainly interactive coupling to the MOM2 OGCM, and incorporating CCM3 solar and thermal infrared radiation modules into the GENESIS code. Subsequent multi-decadal simulations (multi-millennial with asynchronous

coupling) to calibrate and test the new results for present-day climate and deep-sea conditions. One benefit of the radiative change is more accurate greenhouse effects of atmospheric CO2 on thermal infrared fluxes at high CO2 levels. This has supported NSF grants ATM 0513421 and ATM 0310032, where the GENESIS GCM is used in paleoclimate (Cenozoic and Cretaceous) simulations [*D. Pollard*]

- Three multi-decadal simulations with GENESIS v2.3 GCM of the Holocene at 10 ka BP, 6 ka BP and modern, in collaboration with J. Williams (PSU), S. Brantley (PSU) and Y. Godderis (LMTG, Toulouse). GCM fields of soil temperatures and moisture fluxes over a Mississippi Valley transect are provided to a soil geochemistry model, which is then run through the Holocene and results compared with observed weathered soil chemistry profiles in Peoria loess. This work is ongoing as part of J. Williams' master's thesis, and has resulted in two meeting posters to date (Williams et al., 2006, 2007), and ongoing collaboration with Y. Godderis [*D. Pollard*]

- Extensive suites of simulations with 1-D and 2-D versions using the Penn State dynamical ice-sheet/shelf model, participating in the international Ice Sheet Model Intercomparison Project (ISMIP, http://homepages.vub.ac.be/~phuybrec/ismip.html). The model has participated both in the ISMIP/HEINO (Heinrich Events) and in the ISMIP/HOM (Higher Order Models) intercomparisons. This has resulted in a collaborative poster at EGU (Calov et al., 2007) and has contributed to NSF grants ATM 051342 and OPP/ANDRILL subaward 25-0500-0001-007. [*D. Pollard*]

- Many experiments with our dynamical ice-sheet/shelf model, investigating new methods of representing grounding-line migration. Grounding-line behavior has recently been recognized as a serious problem in large-scale ice-sheet modeling (C. Schoof, J. Fluid Mech., 2007, and J. Geophys. Res., in press). Model grids usually do not adequately resolve the narrow boundary layer at the grounding line where there is a sharp transition from sheet-like to shelf-like flow. However, accurate grounding-line migration is likely to be essential for the next generation of ice models in order to predict future acceleration and destabilization of Greenland and Antarctic marginal outlet streams. As a result of this work, we have successfully incorporated theoretical advances by C. Schoof into our 3-D ice model, so grounding-line movement is treated accurately with horizontal resolutions coarse enough to still allow continental-scale simulations. This work has resulted in one solicited talk to date (Pollard and DeConto, 2007), and has contributed to NSF grants ATM 051342 and OPP/ANDRILL subaward 25-0500-0001-007. [*D. Pollard*]

- Monte Carlo simulations are being run for a project (see Dorin et al, 2007) examining evidence for potential anthropogenic modulation of ENSO properties in the paleo-record? [*Penn State Geosciences graduate student J. Dorin advised K. Keller w/ additional input from M. Mann*]

- Ensemble runs of an intermediate complexity model ('EMIC') simulations are being used to examine (see Militch et al , 2007ab) the utility of atmospheric, oceanic, and ice-core carbon dioxide observations to constrain estimates of historic land-use emissions and projections of future carbon sinks? [*K. Keller*]

Relevant publications/meeting presentations resulting from this research include:

- Calov, R., R. Greve, P. Huybrechts, E. Bueler, D. Pollard, F. Pattyn and L. Tarasov, 2007. First results of the ISMIP-HEINO model intercomparison project, European Geosciences Union, Vienna, Austria, abstract CR140-1TH5P-0021.
- Dorin, J.N., B.C. Tuttle, and K. Keller, 2007: Testing for anthropogenic ENSO modulation using millennial-scale paleo-observations. Talk at the European Geophysical Union spring meeting, April 15, Vienna (Austria) (2007).
- Miltich, L.I., D. M. Ricciuto, and K. Keller, 2007a: Which estimate of historic land use CO_2 emissions makes most sense given atmospheric and oceanic CO_2 observations?, *Journal of Geophysical Research - Biogeosciences*, in review, available at: http://www.geosc.psu.edu/~kkeller/publications.html
- Miltich, L.I., D. Ricciuto, and K. Keller, 2007b: A probabilistic assessment of historic carbon dioxide emissions due to land use changes. Poster at the European Geophysical Union spring meeting, April 18, Vienna (Austria).
- Pollard, D. and R.M. DeConto, 2007. Grounding line behavior in a heuristically coupled ice sheet-shelf model. European Geosciences Union, Vienna, Austria, solicited talk CR150-1FR2O-001.

- Williams, J.Z., D. Pollard and S.L. Brantley, 2006. Weathering reactions in soils on Peoria loess document mineral weathering kinetics as a function of climate, Eos Trans. AGU, 87(52), Fall Meet. Suppl., Abstract H53B-0609.
- Williams, J., D. Pollard, Y. Godderis, J. Bandstra, J. Schott and S. Brantley, 2007. Interpreting soil profiles developed on loess using a GCM and a watershed weathering model. Abstract submitted to 2007 Goldschmidt Conference, Cologne, Germany.

Through the bi-weekly "Climate Dynamics" brown bag seminar series, the ESSC continues to bring together faculty, researchers and students interested in earth and climate system research. ESSC funds also continue to be used effectively to leverage visits to Penn State by leading climate and paleoclimate researchers, to provide modest salary support for key Penn State research personnel, such as climate modeler David Pollard and ESSC associate director and Meteorology Dept. researcher Sonya Miller, and to support synergistic efforts such as the 2007-2008 "Quantitative Environmental Decision Analysis Seminar Series" hosted by ESSC scientists K. Keller and A. Small. List of sponsored visitors and seminar speakers is provided as an appendix to this document.

The success of the ESSC over the past few years can also be measured in terms of the widespread public exposure the center, it researchers, and their research have received. The ESSC has received favorable public exposure in popular media coverage at the international, national, and state-wide level during 2007, including mention of the ESSC in a special "Green" issue of the widely read magazine *Vanity Fair*, in May 2007. The ESSC website continues to rank prominently in the major web search engines (it is the first hit for "Earth System Science Center", the 2nd hit for "Earth System Science", and the 7th hit for "Earth System" in google searches).

9. Letters of Support:

Letters of Support have been provided (attached) from the following individuals:

1. Richard Alley; Evan Pugh Professor, Department of Geosciences

2. Timothy Bralower; Professor (and Chair), Department of Geosciences

3. Robert Crane; Professor, Department of Geography; Director of AESEDA

4. Jenni Evans; Professor, Department of Meteorology

5. James Kasting; Distinguished Professor, Department of Geosciences

6. Klaus Keller; Assistant Professor, Department of Geosciences

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March 31, 2008

Dr. Susan Brantley, Professor
Director, Earth and Environmental Systems Institute
The Pennsylvania State University
University Park, PA 16802

Dear Director Brantley:

The Earth System Science Center, under the direction of Prof. Michael Mann, serves an important role in generating collaboration among Institute-affiliated faculty and others interested in climate change. The speakers and discussion sessions have been well-attended and stimulating, and the interactions contribute to additional activities. And, as an "umbrella" for our Penn State Ice and Climate Exploration Center, we have special appreciation for ESSC.

Climate change is a long-standing strength of Penn State in general, and of EESI in particular. Many of us were hired by the forerunner of EESI, which was ESSC, and ESSC has been visible at Penn State for a long time; maintaining this link to the recognized strengths of the institution should be helpful in recruitment and general recognition externally.

For these and additional reasons, I am happy to support the application from Director Mann for continuation of the ESSC. Should you require further information, please contact me.

Yours truly,

Richard B Alley

Richard B. Alley
Evan Pugh Professor of Geosciences

PENNSTATE

Timothy J. Bralower
Professor and Head
Department of Geosciences

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Dr. Susan Brantley, Director
Earth and Environmental Systems Institute
Penn State Campus

18 April 2008

Dear Sue,

This letter is in support of Dr. Michael Mann's proposal to continue the Earth System Science Center under EESI. I have been a somewhat irregular participant in the center activities over the last two years due to my administrative position. However, I can say without doubt that the ESSC agenda has been dynamic and the center has been doing its job: bringing folks together to collaborate and stimulating scientific discussion and discovery.

I am very much in support of continued funding for the Earth System Science Center.

Sincerely,

Timothy Bralower
Professor and Head
Department of Geosciences

PENNSTATE

Alliance for Earth Sciences, Engineering, and Development in Africa (AESEDA)

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April 20th, 2007

Susan Brantley, Director
Earth and Environmental Systems Institute
Penn State
University Park, PA 16802

Dear Sue,

I am pleased to express strong support for continuing the Earth System Science Center in the Earth and Environmental Systems Institute. Not only do I have an interest in the ESSC from a personal, research perspective, but the activities of the Center are closely aligned with research needs and opportunities that affect AESEDA's interests in African climate change and water resources.

Global Climate Model data are now readily available from multiple GCMs that have been applied to 20th Century climate as well as to several future SRES emissions scenarios. This provides incredible opportunity for value-added research that focuses on understanding climate dynamics, as well as downscaling to higher spatial resolutions for impact assessment and adaptation research. In this respect, Penn State is uniquely positioned to play a major role in the next round of IPCC assessments as we have strengths across the spectrum from understanding basic climate dynamics and model output interpretation, through downscaling, impacts and vulnerability assessment, policy and ethical implications. Much of this strength lies within EMS, and the Center is well positioned to coordinate these activities and take a leadership role in climate change across the University.

AESEDA has similar interests as Africa is emerging as the region that is considered to be most threatened by climate change, and climate change is likely to be the single most important factor affecting future social and economic development on the sub-continent. Given the Center's focus on water resources, it makes even more sense for the Center and for AESEDA to collaborate and coordinate activities in climate change and water.

The ESSC's renewed focus on climate change and the emphasis on downscaling and environmental impacts will be of considerable benefit to my own research in climate downscaling; it also offers a significant opportunity for collaboration with AESEDA. I am, therefore, very supportive of continuing support for the Center and if I can supply any further information, please let me know.

Sincerely,

Robert G. Crane
Director

April 10, 2008

Prof. Susan Brantley
Director, Earth and Environmental Systems Institute
Penn State University
Univ. Park, PA

Dear Sue,

I am writing in support of Mike Mann's proposal to extend the operation of the Earth System Science Center (ESSC) within EESI. As one of those who were hired by the original ESSC, I have always felt an attachment both to the name and to the research goals of this center. I was delighted when this center was re-instituted a few years ago and when Mike was hired to head it up. Although I am still spending much of my own time on astrobiology, and now on extrasolar planets, the existence of ESSC has reinvigorated my own interest in environmental topics, particularly global warming. One thing that Mike has done which has gotten us going again is to run a series of Wed. 11:15 AM ESSC seminars. I try to attend these when at all possible, as they give me a chance to see and hear from other ESSC faculty and students.

One tangible outcome of the ESSC, from my perspective, was that it spurred several of us to organize last Fall's seminar series on "Policy Options to Curb Global Warming." You know about this series, as you helped fund it, along with EMS and PSIEE. Thank you again for doing so. I hope to participate in other related seminar series in the future, and I also hope that we can use ESSC as a vehicle to write some joint proposals. I strongly encourage you to continue your support for the ESSC.

Sincerely,

Jim Kasting
Distinguished Professor of Geosciences

PENNSTATE

Klaus Keller
Assistant Professor of Geosciences
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Sunday, April 20, 2008

Professor Susan Brantley
Director, Earth and Environmental System Institute

Dear Sue,

This letter is to express **my very strong support for the renewal of the ESSC** directed by Mike Mann. In my view, ESSC has been a full success and, more importantly, is heading into a very important and fruitful direction.

Looking back, the most important successes of ESSC have been twofold. First, the ESSC has succeeded in bringing together Penn State scientists working in many disciplines relevant to Earth system science. For example, the seminar series is very well designed in terms of the choices of topics, format, and frequency. My subjective measure of success is that I often come away from the ESSC seminars with new ideas for collaborative research. Many of these research ideas have resulted in quite well received publications and research proposals. Second, the ESSC has been very successful in providing access to the high performance computer cluster that enabled new research and helped to secure new funds. For example, the cluster has been used to obtain the results for ten publications from my research group alone. Three of these publications would have simply been impossible without a high priority cluster access. The availability of the cluster has also helped to secure external funding. For example, the current NSF project on "What is a 'better' prediction system? Combining statistical and economic metrics of prediction quality" with a total support of $749,992 was leveraged considerably by the ESSC cluster. I am a PI or Co-PI on more than five additional pending proposals that use the new cluster as leverage.

Looking to the future, ESSC's focus on regional climate change projections is scientifically exciting and at the forefront of the field. Equally important, this research is highly relevant to the strategic vision at Penn State (cf. the Energy initiative) and the current trajectory of the funding opportunities. ESSC provides a very important building block to further growing Penn State's recognition as a world leader in climate change research. I am very much looking forward to continuing and strengthening the enjoyable and fruitful collaborations with the scientist at the ESSC.

Please do not hesitate to contact me if I can be of any more assistance.

Sincerely,

Klaus Keller
Assistant Professor of Geosciences

Prof. Jenni L. Evans
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31 March 2008

Dr. Susan Brantley, Professor
Director, Earth and Environmental Systems Institute
The Pennsylvania State University
University Park, PA 16802

Dear Sue,

Throughout his tenure as director of the Earth System Science Center, Michael Mann has sought to build connections across the ESSC community with a view to reinvigorating research into climate change on all timescales. Since ESSC was well known for our climate change research under Eric Barron, this was a natural and fruitful research focus to develop early.

More recently, Michael has been encouraging research relating to tropical climate variability and climatic factors governing water resources. Both of these research thrusts are timely and responsive to current research agenda. Interactions between the tropics and higher latitudes have recently been recognized as major sources of uncertainty for weather and intraseasonal climate variability – and have become a central THORPEX goal. THORPEX is a decade-long, international research program under the aegis of the World Meteorological Organisation. EESI has also recognized the importance of water resource vulnerability, so this ESSC program is synergistic to the EESI goals.

In summary, Mike has succeeded in motivating active and effective dialogue among ESSC participants, providing opportunities for new collaborations to grow and develop. As a result, I am pleased to support his application for continued EESI support of the ESSC. If I can be of further help in this matter, please contact me (jle7@psu.edu).

Yours Sincerely,

Jenni L. Evans

Professor of Meteorology
The Pennsylvania State University.