

Renewal Proposal for the Penn State Earth System Science Center

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

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

3. Participants: There are currently 25 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)

Affiliates:

Richard Alley (Dept. of Geosciences)

Sridhar Anandakrishnan (Dept. of Geosciences)

Michael Arthur (Dept. of Geosciences)

Timothy Bralower (Dept. of Geosciences)

Robert Crane (Dept. of Geography/AESED)

Ken Davis (Dept. of Meteorology)

Jenni Evans (Dept. of Meteorology)

Steve Feldstein (EESI)

Chris Forest (Dept. of Meteorology)

Kate Freeman (Dept. of Geosciences)

José Fuentes (Dept. of Meteorology)

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)

David Pollard (EESI)

David Reusch (Dept. of Geosciences)

Yvette Richardson (Dept. of Meteorology)

Ryan Sriver (EESI; Dept. of Meteorology; Dept. of Geosciences)

Tim White (EESI)

4. Rationale for Center:

The Penn State Earth System Science Center (ESSC) serves to nurture and develop Penn State's historic strength in the area of Earth System Science. ESSC interests emphasize climate dynamics, paleoclimate, climate change research, and public outreach and education. The ESSC mission serves the larger priorities of both the Earth and Environmental Systems Institute (EESI) and Penn State Institutes of Energy and the Environment (PSIEE) to support Penn State's position as a leading institution both nationally and internationally in the areas of energy and environmental sciences.

The ESSC seeks to foster interdisciplinary Earth system research through (a) maintaining the high-performance ESSC computing cluster for climate modeling (a 64 core Xeon cluster maintained by the High Performance Computing Group of the Graduate Education and Research Services unit of Information Technology Services at Penn State), (b) supporting a seminar series (the ESSC brown bag climate dynamics seminar) that highlights topics at the forefront of climate research and brings together Penn State students, faculty, and researchers engaged in climate research, and (c) leveraging visits from leading scientists in the field. The modest ESSC financial resources have supported several high profile joint speakers in the ESSC and departmental colloquium series; for example, over the past three years, the ESSC has provided support for talks by Kerry Emanuel (MIT), Jeffrey Park (Yale), Alan Robock (Rutgers), Tony Broccoli (Rutgers), and Michael Oppenheimer (Princeton).

While the research agenda of the ESSC is adapted over time to address current needs and priorities of the scientific community and funding agencies, areas of specific focus over the past few years have been:

- Value-added use of existing state-of-the-art simulations: With expertise in fundamental atmospheric, oceanic, and climate processes underlying climate dynamics and climate change, ESSC researchers (e.g. S. Lee, J. Evans, S. Feldstein, C. Forest, M. Mann) have sought to add value to existing state-of-the-art simulations (e.g. the IPCC model simulations and projections), focusing on both insights and uncertainties related to the representations of key processes such as e.g. the El Nino/Southern Oscillation and North Atlantic Oscillation in the models (M. Mann, R. Crane), the atmospheric mechanisms underlying the polar amplification of warming (S. Lee), and the factors governing changes in the Asian summer monsoon (M. Mann, S. Lee, J. Evans), and projections of future tropical cyclone behavior (J. Evans, M. Mann) and global sea level (M. Mann, K. Keller).
- 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 is able to maintain niche in the highly competitive field of global climate modeling through the strategic use of large ensemble simulations of less computationally intensive 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, R. Sriver) 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, and global sea level rise.

- 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 such as D. Pollard have used the ESSC computing cluster for 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 to Pliocene) and deep time (e.g. Cenozoic and Cretaceous) paleoclimate. The ice sheet model is currently also being coupled with the RegCM3 regional atmospheric climate model (with Rob DeConto at U. Massachusetts) and with a self-gravitational model of glaciostatic Earth and sea level (with Jerry Mitrovica at Harvard).

- Downscaling of climate change scenarios

The expertise of several ESSC collaborators (including R. Crane and M. Mann) on downscaling of existing climate model simulations is already providing a new framework for analyzing potential changes on a local or regional scale. In developing more realistic regional 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), climate change impacts on tropical cyclone behavior (M. Mann in collaboration with Kerry Emanuel of MIT, as well as the collaboration of J. Evans and C. Forest), 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. PSIEE recently identified this area of research as a priority and is committed to providing additional resources, including potential funding to help leverage hiring of researchers with expertise in *dynamical* downscaling of climate predictions, complementary to existing strengths at Penn State primarily in the area of *statistical* downscaling.

- Public Outreach & Education:

ESSC scientists continue to be featured prominently in public discussions of climate change, especially ESSC director Dr. Michael Mann and Dr. Richard Alley. Dr. Mann has been interviewed by a wide variety of media outfits from *NPR's All Things Considered* to *CBC's* George Stroumboulopoulos (the “David Letterman of Canada”). Dr. Alley is featured in a PBS series on climate change that will be airing in spring 2011. Both individuals are involve in a number of government-funded and private-sector campaigns aimed at educating the public on climate change. ESSC scientists Mann, Alley, Crane, Kasting, and Kump have all authored recent books on climate and Earth System science for both popular audiences and use as college text books.

ESSC scientists also serve as members of the scientific advisory board for EESI's NASA-funded “Science on a Sphere” educational outreach project (R. Alley, M. Mann) and as co-PIs on NSF-funded climate change education efforts such as the climate change zoo education network (M. Mann in collaboration with Chicago Zoological Society an a network of 9 Zoos in the U.S. including our own Pittsburgh and Philadelphia zoos).

The ESSC web page (<http://www.essc.psu.edu>) has received over 51,000 unique visits in the past 3 years, many of whom come from relevant search engine queries. It is currently the 6th ranked google hit for searches on “Earth System Science”.

5. Funding Opportunities:

The ESSC leverages research efforts within EESI, the individual EMS departments (Meteorology, Geosciences, and Geography), and larger inter-college collaborations, in a number of ways. Primary among these is extramural grant funding raised by ESSC principals and affiliates whose research has been leveraged both by ESSC computational support (i.e. research done using the ESSC high-performing computing cluster), and the interdisciplinary collaborative atmosphere fostered by ESSC activities such as the brown bag seminar series and support for special joint ESSC/departmental colloquium outside speakers.

Quantifying the precise funding raised by the ESSC is challenging, since the accumulated grant funding raised by all two dozen ESSC affiliates likely overstates the funds solely attributable to ESSC activities. It is nonetheless reasonable to argue that ESSC activities and support have leveraged in the neighborhood of tens of millions of extramural funding within EESI and EMS over the past 3 years, including a number of multi-million dollar grants (e.g. the NSF award supporting the study of climate change impacts on infectious disease dynamics joint between Mann, Crane, and individuals within the Huck Institutes).

ESSC research activities remain within core areas of high priority for funding by the major granting agencies including NSF, NOAA, NASA, and DOE. We therefore have every reason to believe that ESSC research activities will achieve similarly successful levels of extramural funding over the next 3 years.

As part of its recent strategic planning process, PSIEE Director Tom Richard and assistant director Denice Wardrop solicited and reviewed several dozen theme areas briefs for consideration with respect to prioritization for future PSIEE funding and support. A theme brief on “Climate Science: From Basic Processes to Impacts” was led by M. Mann and co-signed by a large group of ESSC affiliates and researchers from other units and colleges [*Richard Alley (EMS: Geosciences); Rob Crane (EMS: Geography); Ken Davis (EMS: Meteorology); Jenni Evans (EMS: Meteorology); Steven Feldstein (EMS: EESI); Chris Forest (EMS: Meteorology); Jose Fuentes (EMS: Meteorology); James Kasting (EMS: Geosciences); Klaus Keller (EMS: Geosciences); Lee Kump (EMS: Geosciences); Sukyoung Lee (EMS: Meteorology); Ray Najjar (EMS: Meteorology); David Pollard (EMS: EESI); Patrick Reed (College of Engineering: Civil Engineering); Matthew Thomas (College of Agricultural Sciences: Etymology); Anne Thompson (EMS: Meteorology); Petra Tschakert (EMS: Geography); Thorsten Wagener (College of Engineering: Civil Engineering); Fuqing Zhang (EMS: Meteorology)*]. We were delighted to learn that this submission ranked at the highest level for priority for future support by PSIEE. PSIEE has pledged to do what it can to leverage both funding and hiring opportunities in this area in the future, which we are confident will advance the strategic mission of ESSC and EESI.

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 the current proposal, we seek continued EESI funding for the ESSC 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 10K per year. This budget will provide for:

- Roughly 7K to support partial salary of ESSC associate director Sonya Miller
- Roughly 3K to support ESSC brown bag refreshment budget and modest travel support for visiting scientists and speakers.

To the extent that additional funds are available, we would request additional support for the research activities of Dr. David Pollard, who is a critical member of the Penn State climate and glaciological research communities.

7. Management Structure:

M. Mann serves as director, and S. Miller serves as associate director of the ESSC.

An Advisory Board consisting of Robert Crane, Jenni Evans, James Kasting, Lee Kump, and David Pollard serves as a sounding board concerning Center and resource allocation.

There are currently 25 EMS faculty and research scientists in total that remain affiliated with the ESSC. This includes individuals from the departments of meteorology and geosciences, and from EESI. PSICE and CLIMA are separate centers that remain directly affiliated with the ESSC.

Significant decisions regarding direction, allocation of resources, etc. are generally put before the Advisory Board during annual/semi-annual meetings, or before the full membership where appropriate.

The EESI weekly 'This Week' email distribution, a separate dedicated ESSC list serv, the EESI and ESSC websites all serve as conduits to advertise ESSC talks and events, and to provide announcements to ESSC affiliates and their students and post-docs.

We also distribute an annual newsletter for interested individuals (anyone may sign up for receipt of the newsletter at the ESSC website).

8. Past Budgets and Work:

a. Past Budgets

FUNDING RECEIVED	FY 08/09	FY 09/10	FY 10/11
<i>EESI Funding</i>	\$10,000.00	\$10,000.00	\$10,000.00
<i>Pollard Funding</i>	\$15,000.00	\$15,000.00	\$15,000.00
<i>Carryover</i>	\$535.00	\$-	\$2,901.03
TOTAL	\$25,535.00	\$25,000.00	\$27,901.03

EXPENSES	FY 08/09	FY 09/10	FY 10/11 (through Feb 2011)
<i>Salary</i>	\$23,089.97	\$20,446.00	\$25,000.00*
<i>Travel (visitors)</i>	\$1,118.00	\$667.74	\$255.53
<i>Catering (seminars)</i>	\$1,067.30	\$864.20	\$173.80
<i>Group Meals (visitors)</i>	\$259.73	\$121.03	
TOTAL SPENT	\$25,535.00	\$22,098.97	\$25,419.33

**Includes salary spent and salary encumbered*

b. Past Work:

Key Areas of Research Emphasis (past 3 years):

- Ongoing research with the LOVECLIM model [Mann, Keller, Sriver, Miller]. LOVECLIM is an environmental model of intermediate complexity (EMIC). Current research involves using large ensembles and assimilation of paleoclimate proxies to improve simulations of the climate response to anthropogenic forcing
- Statistical downscaling of precipitation projections from climate change scenarios [Mann, Crane; Wagener (Civil Engineering)]. Downscaling using self-organizing maps is being used to determine potential changes in precipitation patterns and amounts over the watersheds in Pennsylvania.
- Ice sheet modeling [Pollard, Alley, Anandkrishnan]. Using an ice sheet model and various climate change scenarios, ESSC researchers have been able to model the behavior of the Antarctic ice sheet under various melting scenarios. Further work with coupling this model to ocean or general circulation models, and to Earth-sea level models, should be able to refine these results and provide useful projections.
- Projections of global sea level rise including (a) Bayesian approach to assessing uncertainty in future thermosteric sea level rise [Sriver, Keller] using a large ensemble of simulations from the UVic EMIC with data assimilation and (b) use of paleoclimate data spanning the past millennium to validate semi-empirical models of global sea level rise [M. Mann in collaboration with researchers at U. Penn and Univ. of Potsdam, Germany]
- Climate response to tropical cyclone mixing [Mann, Keller, Sriver]. By incorporating tropical cyclone diffusivity into the UVic EMIC, ESSC researchers are able to look at the potential effects of mixing from tropical cyclones on a global scale.

- Observed and modeled changes in the South Asian Summer Monsoon [Mann, Lee, Evans] Looking at observations and output from the IPCC CMIP3 historical simulations and future projections, key dynamical elements are being identified that may impact the strength, location, and extent of the South Asian Summer Monsoon.
- Analysis of paleoclimate records of the past millennium [Mann, Miller]. Climate reconstructions using paleoclimate proxies have been used to evaluate the robustness of conclusions regarding the uniqueness of modern warming, to infer dynamical mechanisms of past natural climate changes, and drive semi-empirical models of tropical cyclone behavior and sea level rise for comparison with independent archives.

Representative Publications (past 3 years):

- Alder, J.R., S.W. Hostetler, **D. Pollard** and A. Schmittner. 2011. Evaluation of a present-day climate simulation with a new coupled atmosphere-ocean model GENMOM. *Geosci. Model Dev.*, 3, 4, 69-83, 2011.
- Alley, R.B.**, Fahnestock, M., Joughin, I., CLIMATE CHANGE: Understanding Glacier Flow in Changing Times, *Science*, 322, 1061-1062, 2008.
- Alley, R.B.**, Horgan, H.J., Joughin, I., Cuffey, K.M., **Dupont, T.K.**, **Parizek, B.R.**, **Anadkrishnan, S.**, Basses, J., A Simple Law for Ice-Shelf Calving, *Science*, 322, 1344, 2008.
- Bowman, T.E., Maibach, E., **Mann, M.E.**, Moser, S.C., Somerville, R.C.J., Creating a common climate language, *Science* 324, 37, 2009.
- Crespin, E., Goosse, H., Fichefet, T., **Mann, M.E.**, The 15th century Arctic warming in coupled model simulations with data assimilation, *Climate of the Past*, 5, 389-405, 2009.
- DeConto, R.M., **Pollard, D.**, Wilson, P., Palike, H., Lear, C., and Pagani, M., Thresholds for Cenozoic bipolar glaciation. *Nature*, 455, 653-656, 2008.
- Edson, A., **S. Lee**, P. Bannon, **J.F. Kasting** and **D. Pollard**. Atmospheric circulations of terrestrial planets orbiting low-mass stars. *Icarus*, 212, 1-13, 2011.
- Fan, F.**, **Mann, M.E.**, **Lee, S.**, **Evans, J.L.**, Observed and Modeled Changes in the South Asian Summer Monsoon over the Historical Period, *J. Climate*, 23, 5193-5205, 2010.
- Fan, F.**, **Mann, M.E.**, Ammann, C.M., Understanding Changes in the Asian Summer Monsoon over the Past Millennium: Insights From a Long-Term Coupled Model Simulation, *J. Climate* 22, 1736-1748, 2009.
- Goosse, H., Crespin, E., de Montety, A., **Mann, M.E.**, Renssen, H., Timmermann, A., Reconstructing surface temperature changes over the past 600 years using climate model simulations with data assimilation, *J. Geophys. Res.*, 115, D09108, doi:10.1029/2009JD012737, 2010.
- Haupt, B.J.**, "Ocean Circulation: An Overview and Current Trends in Research", in *Ocean Circulation and El Nino: New Research*, John A. Long and David S. Wells (Eds.), ISBN: 978-1-60692-084-8, 2009.
- Horton, D.E., C.J. Poulsen and **D. Pollard**. Influence of high-latitude vegetation feedbacks on late Paleozoic glacial cycles. *Nature Geosci.*, 3, 572-577, 2010.
- Jones, P.D., Briffa, K.R., Osborn, T.J., Lough, J.M., van Ommen, T.D., Vinther, B.M., Luterbacher, J., Wahl, E.R., Zwiwers, F.W., **Mann, M.E.**, Schmidt, G.A., Ammann, C.M., Buckley, B.M., Cobb, K.M., Esper, J., Goosse, H., Graham, N., Jansen, E., Kiefer, T, Kull, C., Kuttel, M., Mosely-Thompson, E., Overpeck, J.T., Riedwyl, N., Schulz, M., Tudhope, A.W., Villalba, R., Wanner, H., Wolff, E., Xoplaki, E., High-resolution paleoclimatology of the last millennium: a review of current status and future prospects, *Holocene* 19, 3-49, 2009.
- Kump, L.R.**, **Kasting, J.F.**, and **Crane, R. G.**, *The Earth System*, 3rd edition. Pearson Publishing, 2009.
- Kump, L.R.**, Tipping pointedly colder. *Science (Perspectives)*, 323, 1175-1176, 2009.
- Kump, L.R. and Pollard, D.** Amplification of Cretaceous warmth by biological cloud feedbacks. *Science*, 320, 195, 2008.
- Mackintosh, A., N. Golledge, E. Domack, R. Dunbar, A. Leventer, D. White, **D. Pollard**, R. DeConto, D. Fink, D. Zwartz, D. Gore and C. Lavoie. Retreat of the East Antarctic ice sheet during the last glacial termination. *Nature Geosci.*, 4, 195-202. 2011.

- Mann, M.E., Zhang, Z.**, Rutherford, S., Bradley, R.S., Hughes, M.K., Shindell, D., Ammann, C., Faluvegi, G., Ni, F., Global Signatures and Dynamical Origins of the Little Ice Age and Medieval Climate Anomaly, *Science*, 326, 1256-1260, 2009.
- Mann, M.E.**, Woodruff, J.D., Donnelly, J.P., **Zhang, Z.**, Atlantic hurricanes and climate over the past 1,500 years, *Nature*, 460, 880-883, 2009.
- Mann, M.E.**, Schmidt, G.A., **Miller, S.K.**, LeGrande, A.N., Potential biases in inferring Holocene temperature trends from long-term borehole information, *Geophys. Res. Lett.* 36, L05708, doi:10.1029/2008GL036354, 2009.
- Mann, M.E.**, Defining Dangerous Anthropogenic Interference, *Proc. Natl. Acad. Sci.* 106, 4065-4066, 2009.
- Mann, M.E.**, Do Global Warming and Climate Change Represent a Serious Threat to our Welfare and Environment, *Social Philosophy and Policy*, 26, 389-405, 2009.
- Mann, M.E., Kump, L.** *Dire Predictions: Understanding Global Warming*, Pearson/DK, 208 pp, 2008.
- Mann, M.E., Zhang, Z.**, Hughes, M.K., Bradley, R.S., **Miller, S.K.**, Rutherford, S., Proxy-Based Reconstructions of Hemispheric and Global Surface Temperature Variations over the Past Two Millennia, *Proc. Natl. Acad. Sci.*, 105, 13252-13257, 2008.
- Pollard, D.**, A retrospective look at coupled ice sheet-climate modeling. *Clim. Change*, 100, 173-194, 2010.
- Pollard, D.** and DeConto, R.M., Modeling West Antarctic ice sheet growth and collapse through the past five million years, *Nature*, 458, 329-332, 2009.
- Srивer, R. L.** Climate Change: Tropical cyclones in the mix, *Nature*, 463, 1032-1033, doi:10.1038/461032a, 2010.
- Srивer, R.L.**, Goes, M., **Mann, M.E., Keller, K.**, Climate response to tropical cyclone-induced ocean mixing in an Earth system model of intermediate complexity, *J. Geophys. Res.*, 115, C10042, doi:10.1029/2010JC006106, 2010.
- Srивer, R. L.**, and Huber, M., Modeled sensitivity of upper thermocline properties to tropical cyclone winds and possible feedbacks on the Hadley circulation, *Geophysical Research Letters*, 37 L08704, doi:10.1029/2010GL042836, 2010.
- Steig, E.J., Schneider, D.P. Rutherford, S.D., **Mann, M.E.**, Comiso, J.C., Shindell, D.T., Warming of the Antarctic ice sheet surface since the 1957 International Geophysical Year, *Nature* 457, 459-463, 2009.
- Urban, M. N. and **Keller, K.**, Complementary observational constraints on climate sensitivity, *Geophys. Res. Lett.*, L04708, doi:10.1029/2008GL036457, 2009.
- Vacco, D.A., **Alley, R.B.** and **Pollard, D.**, Glacial advance and stagnation caused by rock avalanches, *Earth Plan. Sci. Lett.*, 294, 123-130, 2010.
- Vacco, D.A., **Alley, R.B., Pollard, D.**, and Reusch, D.B., Numerical modeling of valley glacier stagnation as a new paleoclimatic indicator, *Quat. Res.*, 73, 403-409, 2010.
- Vacco, D.A., **Alley, R.B.**, and **Pollard, D.**, Modeling dependence of moraine deposition on climate history: the effect of seasonality, *Quat. Sci. Rev.*, 28, 639-646, 2009.
- Wei, F., Xie, Y., **Mann, M.E.** Probabilistic trend of anomalous summer rainfall in Beijing: Role of interdecadal variability, *J. Geophys. Res.* 113, D20106, doi:10.1029/2008JD010111, 2008.
- Williams, J.Z., J.Z. Bandstra, **D. Pollard** and S.L. Brantley. The temperature dependence of feldspar dissolution determined using a coupled weathering-climate model for Holocene-aged loess. *Geoderma*, 156, 11-19, 2010.
- Winberry, J. P., **S. Anandakrishnan**, and **R. B. Alley**, Seismic observations of transient subglacial water-flow beneath MacAyeal Ice Stream, West Antarctica, *Geophys. Res. Lett.*, 36, L11502, doi:10.1029/2009GL037730, 2009.
- Winberry, J. P., **S. Anandakrishnan**, **R. B. Alley**, R. A. Bindschadler, and M. A. King, Basal mechanics of ice streams: Insights from the stick-slip motion of Whillans Ice Stream, West Antarctica, *J. Geophys. Res.*, 114, F01016, 2009.
- Zhou, J., C.J. Poulsen, **D. Pollard** and **T.S. White**, Simulation of modern and middle Cretaceous marine $\delta^{18}\text{O}$ with an ocean-atmosphere general circulation model, *Paleoceanography*, 23, PA3223, doi:10.1029/2008PA001596, 2008.

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. Chris Forest, Associate Professor, Department of Meteorology
6. James Kasting; Distinguished Professor, Department of Geosciences
7. Klaus Keller; Associate Professor, Department of Geosciences



Department of Geosciences, and PSICE
(Penn State Ice & Climate Exploration Center)
517 Deike Building
The Pennsylvania State University
University Park, PA 16802, USA
Ph. (814) 863-1700; Fax (814) 863-7823
Email rba6@psu.edu

March 22, 2011

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, continues to serve an important role in generating collaboration among Institute-affiliated faculty and others interested in climate change.

The speaker series brings in fascinating people, and promotes interactions. The enhanced modeling effort is welcome. We “ice” types in the ESSC-affiliated PSICE are especially interested in the advances in coupling being made with Dave Pollard’s models, but clearly there is a much broader range of exciting modeling going on. We also are grateful for access to computational resources for other “icers”—we have a broad and ambitious modeling program involving several glaciological researchers, and the ESSC resources really help.

Climate change is a long-standing strength of Penn State in general, and of EESI in particular. ESSC strengthens our position, our recruiting, and our interactions.

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,

A handwritten signature in black ink that reads "Richard B. Alley".

Richard B. Alley
Evan Pugh Professor of Geosciences



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

31st March, 2011

Dear Sue,

This letter is in support of Dr. Michael Mann's proposal to continue the Earth System Science Center under EESI. ESSC serves a critical purpose in the College, assembling and integrating research and education of a multitude of topics, concerning both modern and ancient climate that takes place in the Meteorology, Geoscience and Geography Departments.

I have not been an active participant in the center activities over the last six years due to my administrative position. However, I keep up with seminars and events and it is clear that ESSC has been doing its job, bringing folks together to collaborate and stimulating scientific discussion and discovery with a vibrant agenda.

There is no more critical time for research and education in the climate field than the present. Public concern about climate change is decreasing and political willpower to reduce emissions is dwindling. The stakes have never been higher for the academic community to maintain strong programs related to climate change.

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

Sincerely,

Timothy Bralower
Professor and Head
Department of Geosciences



April 14, 2011

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

Dear Sue,

I would like to offer my strong support and the support of AESEDA for the continuation of the Earth System Science Center within EESI. Over the last few years, Mike has done an excellent job of revitalizing the Center, maintaining an emphasis on multi-disciplinary Earth System Science within the College, and helping to focus efforts in climate change research at Penn State.

The University is currently engaged in developing a strong strategic partnership with the University of Cape Town. An important element of that partnership will revolve around climate change research and education. The College and EESI are well positioned to take a major role in this initiative and the Earth System Science Center is a logical locus for organizing these type of collaborative activities and helping to define research objectives that would benefit from a multi-institutional effort.

Mike and the ESSC have already become involved in research projects involving climate change and Africa and there is considerable potential for much larger efforts in the future. AESEDA strongly supports this proposal and we will be happy to assist in any way we can in supporting the ESSC's continued success.

Yours sincerely,



Robert Crane
Director



Prof. Jenni L. Evans
Department of Meteorology

503 Walker Building
The Pennsylvania State University

College of Earth and Mineral Sciences
Email: jle7@psu.edu

University Park, PA 16802
Office: (814) 865 3240

24 March 2011

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

Dear Sue,

Over the last three years, Michael Mann has been an effective director of the Earth System Science Center, regularly bringing students and faculty together to nurture a diverse community of scholars with broad interests in climate science.

Continuing the tradition in ESSC, computational resources secured by ESSC facilitate collaborative research among the ESSC affiliates. There seem to be a continuous stream of quality graduate students who are being co-advised by various combinations of faculty. A straightforward example of the center's effectiveness is provided by the seminar series. A steady stream of colleagues visits the center, speaking at the ESSC colloquium and interacting with students and affiliates. Further, graduate students are encouraged to present and given thoughtful feedback when they do. The congenial atmosphere of these meetings ensures enthusiastic participation – there is never a shortage of questions!

Through all of this, Mike has provided quiet leadership, even through the zoo that came out of “the emails.” His assistant, Sonya Miller, does an excellent job of keeping things organized.

In summary, through ESSC Mike has created opportunities for fruitful interactions among the ESSC participants, providing an environment conducive to healthy collaboration and nurturing of graduate students and junior scientists. I am pleased to support ESSC as an effective EESI center that is truly money well spent. If I can be of further help in this matter, please contact me (jle7@psu.edu).

Yours Sincerely,

Jenni L. Evans

Professor
Department of Meteorology, and Earth and Environmental Systems Institute
The Pennsylvania State University.

PENNSTATE



Department of Meteorology
College of Earth and Mineral Sciences

(814) 865-0478
FAX: (814) 865-3663
E-mail: meteodept@ems.psu.edu

The Pennsylvania State University
503 Walker Building
University Park, PA 16802-5013

April 12, 2011

Prof. Michael Mann
Director, Earth System Science Center

Dear Mike,

I am writing to offer my strong support for renewing the Earth System Science Center as one of the research centers in the Earth and Environmental Systems Institute here at Penn State University.

Throughout its long history here in the college, the ESSC has enhanced the study of the earth system as a whole and contributed directly to research on climate science. This raised the stature of interdisciplinary research here at Penn State and continues to be a strong example for other universities as they design similar programs. For my own research using both Earth systems models of intermediate complexity and with the Community Earth System Model, ESSC provides a significant community for fostering new ideas on understanding 21st century climate predictions and their implications for climate change impacts and risks.

In addition, as you have asked me to be the Interim Director while you're on sabbatical next fall, I am particularly inspired to see that ESSC continues its mission. I am very much looking forward to contributing as the interim director of the ESSC and moving forward with its agenda.

Sincerely,

Chris E. Forest

Associate Professor of Climate Dynamics
Department of Meteorology
Earth and Environmental Systems Institute Associate

March 31, 2011

Dear Mike,

I would like to take this opportunity to congratulate you on your success in running the Earth System Science Center this past year. I have not been able to participate as much as usual this year because I was on sabbatical in the Fall and because my teaching schedule this Spring conflicts with the normal ESSC seminars. Normally, however, I enjoy the seminar series greatly. It keeps me in touch with current events, as well as with my ESSC colleagues. I appreciate your work in putting this seminar series together and in coordinating other ESSC activities. I very much hope that support for ESSC is continued in the upcoming years.

Sincerely,

Jim Kasting
Distinguished Professor of Geosciences



Klaus Keller
Associate Professor of Geosciences
Department of Geosciences
436 Deike Building
The Pennsylvania State University
University Park, PA 16802
klaus@psu.edu
phone: (814) 865-6718
fax: (814) 863-7823
<http://geosc.psu.edu/~kzk10>

Friday, April 01, 2011

Michael Mann
Director of the Earth System Science Center

Via email: mann@meteo.psu.edu

Re: Letter of Support for the Earth System Science Center renewal proposal

Dear Mike:

Please accept this letter as evidence of my **very strong support** for the Earth System Science Center (ESSC) renewal proposal.

ESSC has provided important and crucial support for many interdisciplinary research and education projects. It clearly provides added value to the Earth system science community at Penn State in general and the Earth and Environmental System Institute in particular. Out of the many examples that showcase the ESSC success, three are especially worth mentioning: (i) the seminars, (ii) the access to supercomputing resources, and (iii) the web-page. The seminars bring together an amazing mix of scientists. 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. The ESSC enabled access to the supercomputer cluster supports proof-of-concept studies in support for grant proposals. Last, but not least, the web-page neatly showcases ESSC related research and has an amazing page-ranking.

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 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. Research in ESSC is synergistic and orthogonal to research in many areas, for example on climate risk management.

I am very much looking forward to continuing and strengthening the enjoyable and fruitful collaborations with the ESSC scientist.

Cheers,

A handwritten signature in black ink that reads 'Klaus Keller'.

Klaus Keller