

Office of Science
Notice DE-FG02-06ER06-11

Terrestrial Carbon Processes Research

U.S. Department of Energy

**Office of Science Financial Assistance Program Notice
DE-FG02-06ER06-11; Terrestrial Carbon Processes Research**

AGENCY: U.S. Department of Energy
Office of Science

ACTION: Notice inviting grant applications.

SUMMARY: The Office of Biological and Environmental Research (OBER) of the Office of Science (SC), U.S. Department of Energy (DOE), hereby announces its interest in receiving applications for carbon cycle research that will improve the understanding of terrestrial carbon processes (TCP) and aid carbon cycle predictions related to climate change. Research to improve understanding of carbon processes includes attention to mechanisms that control net CO₂ exchange between the atmosphere and terrestrial biosphere. This includes studies of carbon metabolism and transformations involving plant and soil components of ecosystems that collectively are important for quantifying terrestrial carbon sources and sinks. The scope includes CO₂ exchange measurements (e.g., AmeriFlux), experiments on the CO₂ effects on terrestrial ecosystem carbon processes (e.g., Free-Air- CO₂-Enrichment, FACE), and research on mechanisms of soil carbon transformation, and terrestrial carbon cycle modeling and integration. TCP measurements and experiments are expected to produce spatial and temporal carbon process information for mechanistic and prognostic models. Modeling research is expected to use this information for ecosystem carbon cycle modeling, and for integrated and inverse analysis of carbon cycle behavior. In addition, TCP results are used for improving and testing carbon cycle models, and the information contributes to more comprehensive modeling approaches for predicting atmospheric CO₂ change. It is also important for proposed scientific investigations of terrestrial carbon processes to point out how the research intends to address DOE/Climate Change Program performance measures.

DATES: Applicants are encouraged (but not required) to submit a brief Letter-of-Intent by February 17, 2006. The Letter-of-Intent will provide advance information on general scope of planned research, and will aid the Program Manager to plan the peer-review.

The deadline for receipt of formal applications is 8:00 p.m., Eastern Time, March 21, 2006 to be accepted for merit review and to permit timely consideration for award in Fiscal Year 2006 and Fiscal Year 2007.

ADDRESSES: Letters-of-Intent, referencing Program Notice DE-FG02-06ER06-11, should be sent by e-mail to: roger.dahlman@science.doe.gov. Use "Program Notice DE-FG02-06ER06-11 LETTER-OF-INTENT" as the subject of the email.

Formal Applications

Applications submitted to the Office of Science must be submitted electronically through Grants.gov to be considered for award. The Funding Opportunity Number is: DE-FG02-06ER06-11 and the CFDA Number for the Office of Science is: 81.049. Instructions and forms are available on the [Grants.gov](http://www.grants.gov) website. Please see the information below and also refer to the "Funding Opportunity Announcement", Part IV - Application and Submission Information; H. Other Submission and Registration Requirements for more specific guidance on "Where to Submit" and "Registration Requirements." If you experience problems when submitting your application to Grants.gov, please visit their customer support website: <http://www.grants.gov/CustomerSupport>; email: support@grants.gov; or call 1-800-518-4726.

Registration Requirements: There are several one-time actions you must complete in order to submit an application through Grants.gov (e.g., obtain a Dun and Bradstreet Data Universal Numbering System (DUNS) number, register with the Central Contract Registry (CCR), register with the credential provider and register with [Grants.gov](http://www.grants.gov)). See <http://www.grants.gov/GetStarted>. Use the Grants.gov Organization Registration Checklist to guide you through the process. Designating an E-Business Point of Contact (EBiz POC) and obtaining a special password called an MPIN are important steps in the CCR registration process. Applicants, who are not registered with CCR and Grants.gov, should allow at **least 14 days** to complete these requirements. It is suggested that the process be started as soon as possible.

VERY IMPORTANT - Download PureEdge Viewer: In order to download the application package, you will need to install PureEdge Viewer. This small, free program will allow you to access, complete, and submit applications electronically and securely. For a free version of the software, visit the following Web site: <http://www.grants.gov/DownloadViewer>.

FOR FURTHER INFORMATION CONTACT: Dr. Roger Dahlman, Climate Change Research Division, SC-23.3/Germantown Building, Office of Biological and Environmental Research, Office of Science, U.S. Department of Energy, 1000 Independence Ave., SW, Washington, D.C. 20585-1290, telephone: (301) 903-4951, E-mail: roger.dahlman@science.doe.gov, fax: (301) 903-8519. Communications related to the formal application should use "Program Notice DE-FG02-06ER06-11 FORMAL" in the subject line.

The full text of Program Notice DE-FG02-06ER06-11 is available via the Internet using the following web site address: <http://www.science.doe.gov/grants>.

SUPPLEMENTARY INFORMATION and REQUEST FOR APPLICATIONS:

The goal of the TCP research is to provide scientific knowledge of terrestrial components of the global carbon cycle for (i) providing accurate predictions of atmospheric CO₂ change; (ii)

quantifying terrestrial carbon sources and sinks and how they are changing in relation to other atmospheric, climatologic and hydrologic influences; and (iii) assessing terrestrial feedbacks on carbon cycle and climate. Ecosystems are the fundamental unit of TCP research. Using modeling and other extrapolation methods, TCP results are expected to extend to bioregion scales, and also contribute to continental scale analysis of carbon cycle problems that are analyzed by the North American Carbon Program (NACP), for example. The TCP component of DOE's Climate Change Research Program will consider applications on measurements, experiments and modeling that provide improved quantitative and predictive understanding of the terrestrial carbon cycle processes that can affect atmospheric CO₂ changes and thereby affect the CO₂ forcing of climate.

The TCP Program has been formally reviewed by a Biological and Environmental Research Advisory Committee (BERAC) Panel (<http://www.sc.doe.gov/ober/berac/TCCRPRReport.pdf>). In general, the BERAC Panel found the TCP carbon cycle research elements to be highly relevant and scientifically sound. Accordingly, the TCP Program will continue the current Program scope, with the objectives to (i) develop scientific understanding of terrestrial carbon processes and quantify mechanisms that regulate carbon balance of ecosystems and exchanges of CO₂ with the atmosphere; (ii) quantify current, forecast future, and assess uncertainty of carbon changes or CO₂ exchange between the atmosphere and ecosystems and in terrestrial carbon sources and sinks; (iii) elucidate responses of ecosystem carbon cycle processes to rising atmospheric CO₂ and other environmental factors; and (iv) model terrestrial carbon processes at many scales, and use terrestrial models coupled with atmosphere-ocean carbon models to estimate rate and timing of atmospheric CO₂ changes. BERAC Panel recommendations will be considered as projects are selected in this competition, and through coordination and management of Program research as appropriate.

Relevance of proposed research to DOE's mission will be gauged by the extent that proposed carbon cycle research products contribute to the long-term performance measure (LTM) of DOE's climate change research, which is -- To deliver improved data and models for policy makers to determine safe levels of greenhouse gases for the earth's system. In general terms, this LTM expects carbon cycle research to determine the fate of excess CO₂ from human activities, to understand carbon cycle mechanisms and controls that affect CO₂ as a forcing agent, and to quantify interactions between the carbon cycle and climate. In addition to the merit review criteria mentioned below, it will be important for the proposed research to identify how anticipated research products (i.e., from observations, experiments, modeling, integration) will contribute to the LTM.

Proposed measurements should contribute to the AmeriFlux Network with special attention to the acquisition of flux and biological data from high-quality, strategically placed and productive research sites. Applicants should visit the web site (<http://public.ornl.gov/ameriflux/>) for further information on AmeriFlux science and strategic plans and for guidance on operational requirements of research sites. Taken from the web site, scientific questions that guide AmeriFlux over the next decade are: (i) What are the magnitudes of carbon storage and the exchanges of energy, CO₂ and water vapor in terrestrial ecosystems? and what are their spatial and temporal variability? (ii) How is this variability influenced by vegetation type, phenology, changes in land use, management and disturbance history? and what is the relative effect of these

factors? (iii) What is the causal link between climate and exchanges of energy, CO₂ and water vapor for major vegetation types? (iv) What is the spatial and temporal variation of boundary layer CO₂ concentrations? how does this change with topography, climatic zone and vegetation? The web site also lists information on the distribution of existing locations, vegetation type and other characteristics of the current AmeriFlux Network. To minimize redundancy of locations in the Network, applicants should examine the current distribution and characteristics of AmeriFlux sites before proposing new locations; they should also refer to the Hargrove et. al., (2003) analysis of "representativeness" when assessing whether proposed new locations may add value to the Network. It is also important to explain how proposed new AmeriFlux locations will enhance or add value with respect to unique net ecosystem exchange (NEE)/net ecosystem production (NEP) data products; to providing carbon flux and process information for unique climate zones; and for the potential that a new site would offer for integrating its data products with other carbon cycle research, e.g., with NACP. In relation to AmeriFlux science questions listed above, proposed AmeriFlux-related research must demonstrate the capability for producing systematic high-quality flux and biological measurements useful for estimating NEE of CO₂, NEP, and gross primary production (GPP). Proposed investigations at AmeriFlux sites also should identify terrestrial carbon process research that will provide the scientific basis for interpreting uncertainties; evaluate climate- or CO₂-induced feedbacks; and explain how the research results are relevant to the DOE Climate Change performance measure. With applications that seek to sustain existing parts of the AmeriFlux network, priority will be placed on research that has a strong record of measurement performance and prompt delivery of data products to the AmeriFlux archive in form and content for use by the broader scientific community. Applicants are referred to the "AmeriFlux self- evaluation" report on the web site for information on expected operational and performance requirements. There is an established archive for reporting AmeriFlux data (see AmeriFlux web site for protocols), and supported projects will be expected to comply rigorously with reporting guidelines and standards. TCP is also interested in possible creation of an AmeriFlux "supersite" for experimentally evaluating site-specific questions on flux footprints; advection processes; methodology development and evaluation of biological vs NEE estimations of NEP and GPP; comparative studies of photosynthesis, respiration and other flux components; and for in-depth study of other scientific questions related to goals of AmeriFlux. Proposed non-AmeriFlux CO₂ measurements must be coordinated with science goals of AmeriFlux, and should explain how the observations relate to or enhance terrestrial carbon results produced by Network or other TCP research. (Ref, Hargrove, W. W., Forrest M. Hofman, and B.E. Law. December 2003. "New Analysis Reveals Representativeness of the AmeriFlux Network." *Eos Trans. AGU*, 84(48), 2003).

Applications are solicited for continuation or modification of existing FACE experiments, or for creating new FACE-type experiments. General objectives of FACE research are to (i) understand the processes by which elevated CO₂ (e CO₂) influences carbon cycle dynamics; (ii) measure ecosystem level carbon cycle responses to e CO₂; (iii) understand feedbacks among carbon nutrient and water cycles in the context of e CO₂; (iv) provide validation data and understanding of mechanisms for models; and (v) provide facilities to investigators exploring secondary e CO₂ effects (e.g., biodiversity, community change, pest responses). Applications will initially be reviewed for intrinsic scientific merit, and for the potential of experimental results to provide prognostic information for predictive modeling. Also, as recommended by the BERAC review panel (<http://www.sc.doe.gov/ober/berac/TCCRPreport.pdf>, see pp 3-4), and before

continuation or implementation of FACE experiment components, a separate panel of experts will be convened to provide guidance to DOE on scope, continuity and future scientific direction of FACE research. Technical applications submitted to this solicitation will be a major item considered by the FACE panel. The BERAC Panel also recommended establishment of a data base for archiving results from all FACE experiments, and applicants should refer to a CDIAC website (http://cdiac.esd.ornl.gov/programs/FACE/data_needs_for_synthesis.html) for information on data delivery, including data management protocols and standards, that will enhance the use of FACE data by broader segments of the carbon cycle modeling and synthesis communities.

As a potential long-term terrestrial sink for carbon, the goals of soil carbon research are to quantify rates and magnitudes of soil carbon accretion, and to understand processes and properties that control transformation of biomass into soil organic matter, including studies of stabilization mechanisms of the long residence time components. Research is also needed on these processes for different climate and vegetation conditions (i.e., as represented by AmeriFlux research sites) where results can be spatially scaled to estimate carbon changes across climate zones and bioregions. Products of research that focus on soil carbon processes (e.g., organic matter stabilization and dynamics, carbon turnover rates, root and microbial respiration, carbon/nitrogen/other relationships) should provide new insights on residence time and other carbon source or sink properties of ecosystem soil components. Priority will be placed on soil carbon research that is conducted at or closely linked to either AmeriFlux sites or FACE experiments. By associating soil carbon studies with coordinated carbon measurements at these sites and experiments, and in concert with the respective resident carbon cycle expertise, results are expected to add value to overall TCP research products. The intent of associating this research with existing sites and experiments is to enhance value of the research to TCP Program objectives, and the research products are expected to also aid model scaling and testing of terrestrial carbon processes, thereby improving quantitative prediction of regional scale carbon sources and sinks. Applicants must certify that resident coordinators have agreed to plans for soil carbon research by offsite scientists at their sites or experiments.

The BERAC Panel emphasized the need for integrated modeling and analysis of the carbon cycle and for an approach to build a "National Terrestrial Carbon Model (NTCM)" (<http://www.sc.doe.gov/ober/berac/TCCRPreport.pdf>, see pp 15-16). Although such an undertaking logically would require a broad base of Federal support, ideas are solicited here to begin building this capability. Candidate elements of this "design" that would be of interest to DOE are overall architecture of a NTCM, ecosystem carbon process model (including soil aspects), using models to extrapolate results from TCP investigations to the bioregion scales and the modeling of carbon and climate feedbacks that would possibly affect climate (research not of interest in this solicitation would be formally coupled carbon-climate modeling). Modeling and integration employing the NTCM approach must also take full advantage of available AmeriFlux and FACE data products. Applications should identify large computational requirements, if any.

Investigations using carbon isotopes are solicited as an approach for tracing carbon transformations, for quantifying rate and mass parameters of the terrestrial carbon cycle, and for improved understanding of controlling mechanisms. Priority will be placed on isotopic tracer research that is carried out in an ecosystem context in conjunction with research at AmeriFlux

and FACE sites to realize mutual benefit from related measurements, and to coordinate with other flux measurements, ecosystem soil carbon research and other in-residence carbon cycle expertise and modeling research at these locations. Applicants must certify that resident coordinators have agreed to plans for isotopic research by offsite scientists at their respective sites or experiments.

DOE's TCP research is an integral component of the U.S. Climate Change Science Program (CCSP) (<http://www.climatechange.gov/>), which is closely coordinated with other Federal research of the Interagency Carbon Cycle Research Program (<http://www.asd.ssc.nasa.gov/ccsp/>). TCP is specifically addressing questions 7.1, 7.4 and 7.5 of the Carbon Cycle element of the CCSP Strategic Plan (<http://www.climatechange.gov/Library/stratplan2003/final/default.htm>). Accordingly, TCP is placing increased attention on understanding the fate of CO₂ from emissions, on the role of the terrestrial biosphere as source or sink for carbon, and on understanding terrestrial carbon processes across North America, specifically as a part of the North American Carbon Program (NACP). DOE's carbon measurements (e.g., AmeriFlux), process experiments (e.g., FACE) and modeling and synthesis as solicited here are expected to contribute to the NACP Science Implementation Strategy (<http://www.nacarbon.org/nacp/documents/NACP-SIS-final-july05.pdf>), and applicants are strongly encouraged to identify how their proposed research will likely contribute to regional or continental scale NACP research. In general it is expected that TCP research contributes to understanding the underlying carbon cycle processes, and ecosystem scale modeling and prediction elements of NACP.

Program Funding

It is anticipated that up to \$5,000,000 will be available for multiple awards to be made in Fiscal Years 2006 and 2007, contingent on the availability of appropriated funds. Applications may request project support for up to three years, with out-year support contingent on the availability of funds, progress of the research, and programmatic needs. Annual budgets are expected to range from \$100,000 to \$400,000 total cost for non-FACE science investigations. Further guidance based on funding experiences to date, it is estimated that maintenance-level data collection and reporting at established AmeriFlux sites might be of the order of \$125,000; the add-on for collection and reporting of biological data may double this estimate. Costs of research at cluster or "super" sites might range from \$300,000 to \$400,000. Costs for resident scientific studies at FACE sites would range from \$400,000 to \$500,000, which would not include facility operating costs. Upper limits of the cited ranges would include very nominal administrative support for off-site investigations conducted at AmeriFlux and FACE locations. Cost of modeling projects is estimated from \$200,000 to \$300,000. If supercomputer time is required for large calculations and if justified, it may be possible for carbon cycle modeling projects to compete for CPU time at no additional cost. DOE is under no obligation to pay for any costs associated with the preparation or submission of applications if an award is not made.

Letters-of-Intent

A brief (one-page) Letter-of-Intent is strongly encouraged (but not required) prior to submission of a full application. The Letter-of-Intent will serve notice of the intent to submit a formal

application, and the following information will aid the Program Manager in structuring the peer-review process. The Letter-of-Intent should identify the institution; the Principal Investigator's name, telephone number, and e-mail address; the title of the proposed project; and names and institutions of any proposed collaborators. The Letter-of-Intent should include a narrative describing the research project objectives and methods of accomplishment.

Merit and Relevance Review

Applications will be subjected to scientific merit review (peer review) and will be evaluated against the following evaluation criteria listed in descending order of importance as codified at 10 CFR 605.10(d):

1. Scientific and/or Technical Merit of the Project.
2. Appropriateness of the Proposed Method or Approach.
3. Competency of Applicant's Personnel and Adequacy of Proposed Resources.
4. Reasonableness and Appropriateness of the Proposed Budget.

The evaluation process will also include program policy factors such as relevance of the proposed research to the terms of the announcement and to DOE's programmatic needs, including a determination of potential contribution of the research to DOE's Climate Change Program's LTM. Note that external peer reviewers are selected with regard to both scientific expertise and absence of conflict-of-interest issues. Both federal and non-federal reviewers may be used, and submission of an application constitutes agreement that this is acceptable to the investigator(s) and the submitting institution.

Submission Information

For this Notice, applications must conform to the following two requirements: type sizes must be 10 point or larger and the margins must be at least one inch on all sides, pages should be standard 8 1/2" x 11". Figures, charts, tables, figure legends, etc., may contain smaller type as long as it is legible. Adherence to type size and line spacing requirements is necessary for several reasons. No applicants should have the advantage of providing more text in their applications by using small type. Small type may also make it difficult for reviewers to read the application. Applications must be written in English, with all budgets in U.S. dollars.

Applicants are asked to use the following ordered format and include the following in a single PDF file:

- **Face Page SF-424 (R&R)**
- **Title Page;** single page, title page of your narrative must include the following:
 - Applicant/Institution:
 - Street Address/City/State/Zip:
 - Principal Investigator:
 - Address:
 - Telephone Number:
 - Email:
 - DOE/Office of Science Program Office:

- DOE/Office of Science Program Office Technical Contact:
- DOE Grant Number (if Renewal or Supplemental Application):
- Is this a Collaboration? If yes, please list ALL Collaborating Institutions/PIs* and indicate which ones will also be submitting applications. * Note that collaborating applications must be submitted separately.
- **Project Abstract Page**; single page only, should contain:
 - Title
 - PI name
 - Abstract text should concisely describe the overall project goal in one sentence, and limit background/significance of project to one sentence. Short descriptions of each individual aim should focus on what will actually be done.
- **Relevance Statement**; single page only, should identify DOE- or NASA-relevant research that each specific aim is intended to address
- **Budget pages** for each year and a summary budget page for the entire project period
- **Budget Explanation**
- Budget pages and budget explanation for each **collaborative subproject**, if any.
- **Project Narrative, 20 pages or less**, exclusive of attachments. Applications with Project Narratives longer than 20 pages will be returned to applicants and will not be reviewed for scientific merit. (**NOTE: Project Narratives for Glue Grants should not exceed 10 pages.**) The project narrative should be a clear statement of the work to be undertaken and should include: objectives for the period of the proposed work and expected significance; relation to the longer-term goals of the principal investigator of the project; and relation to the present state of knowledge in the field, to work in progress by the investigator under other support, and work in progress elsewhere. The statement should outline the general plan of work, including the broad design of experiments to be undertaken, and an adequate description of experimental methods and procedures.
- **Literature Cited**
- **Biographical Sketches** (please limit to 2 pages per senior investigator, consistent with NIH guidelines)
- **Facilities and Resources** description
- **Current and Pending Support** for each senior investigator
- **Letters of Intent** from collaborators (if applicable)

The Catalog of Federal Domestic Assistance (CFDA) number for this program is 81.049, and the solicitation control number is ERFAP 10 CFR Part 605.

Martin Rubinstein
 Director
 Grants and Contracts Division
 Office of Science

Posted on the Office of Science Grants and Contracts Web Site
 February 3, 2006.