Office of Science
Notice 99-03

Environmental Meteorology Program - Vertical Transport and Mixing

Department of Energy
Office of Science

Office of Science Financial Assistance Program Notice 99-03; Environmental Meteorology Program - Vertical Transport and Mixing

Agency: U.S. Department of Energy

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 the Environmental Meteorology Program (EMP), Vertical Transport and Mixing (VTMX) Science Team. The research program supports the Department's Global Change Research Program, the U.S. Global Change Research Program, and the Administration's goals to understand the meteorological processes associated with air quality and climate change.

DATES: Formal applications in response to this notice must be received by 4:30 p.m., E.S.T., March 30, 1999 [due date has been extended from March 12, 1999 to March 30, 1999 (1/26/99] , to be accepted for merit review and to permit timely consideration for award in fiscal year 1999. Applicants are urged to review abstracts of proposals from DOE laboratory scientists that have been tentatively selected for funding as well as the draft EMP-VTMX Science Plan at ***http://www.pnl.gov/VTMX***. The draft science plan is already posted on the web site. The abstracts should be posted there by February 26, 1999 [changed from February 12, 1999 to February 26, 1999 (1/26/99)]. Applications that are collaborative with or complementary to DOE laboratory proposals are strongly encouraged.
NOTE: The above changes were published in the Federal Register February 1, 1999, Vol. 64, No. 20, page 4850.

ADDRESSES: Formal applications referencing Program Notice 99-03 should be sent to: U.S. Department of Energy, Office of Science, Grants and Contracts Division, SC-64, 19901 Germantown Road, Germantown, MD 20874-1290, ATTN: Program Notice 99-03. This address must also be used when submitting applications by U.S.

Postal Service Express Mail or any other commercial overnight delivery service, or when hand-carried by the applicant. An original and seven copies of the application must be submitted; however, applicants are requested not to submit multiple application copies using more than one delivery or mail service.

FOR FURTHER INFORMATION CONTACT: Peter Lunn, Environmental Sciences Division, SC-74, Office of Biological and Environmental Research, Office of Science, U.S. Department of Energy, 19901 Germantown Road, Germantown, MD 20874-1290, telephone: (301) 903-4819, E-mail: peter.lunn@oer.doe.gov, fax: (301) 903-8519. The full text of Program Notice 99-03 is available via the Internet using the following web site address: ***http://www.er.doe.gov/production/grants/fr99_03.html***.

SUPPLEMENTARY INFORMATION: The scope of the research to be supported under this notice is the investigation of atmospheric vertical transport and mixing processes. The geographic focus for this research will be on urban areas affected by nearby elevated terrain, with an emphasis on studies of stably stratified conditions, periods with weak or intermittent turbulence, and morning and evening transition periods.

Background

The measurement and modeling of vertical transport and mixing processes in the lowest few kilometers of the atmosphere are problems of fundamental importance for which a fully satisfactory treatment has yet to be achieved. Important aspects of air quality modeling and weather forecasting are adversely affected by our inability to describe these processes adequately. Although a general theoretical understanding of many of the physical phenomena relevant to vertical transport and mixing processes exists, that understanding is incomplete, the representation of various phenomena in models is often poor, and the data needed to test those models are lacking. The upward and downward movements of air parcels in stable and residual layers of the atmosphere and the interactions between adjacent layers are particularly difficult processes to characterize, and significant difficulties also exist in describing the behavior of the atmosphere during morning and evening transition periods. Complications due to heterogeneous land surfaces and complex terrain further compromise our ability to treat vertical transport and mixing processes properly.

The goals of the program are to increase our understanding of the mechanisms responsible for vertical transport and mixing; to improve our ability to measure quantities required for this understanding; and to develop improved treatments of vertical transport and mixing for use in conceptual and numerical models.

Although progress in these areas would be useful in a wide variety of circumstances, there is particular interest in realizing these objectives for urban regions affected by adjacent elevated terrain (e.g., urban basins or valleys). Moreover, although a complete characterization of the diurnal cycle of vertical transport and mixing may require consideration of fully developed mid-afternoon convective conditions, the emphasis in this program will be on vertical transport and mixing processes in stably stratified conditions, in conditions of weak or intermittent turbulence, and during morning and evening transition periods.

It is anticipated that a significant component of this program will revolve around observations and data analyses from field measurement programs in urban basins or valleys conducted approximately every second or third year. The initial field experiment will most likely occur during the fall of 2000 or the winter of 2001, and likely candidate sites include Salt Lake City and Phoenix; a final determination of dates and location will be made late in the summer of 1999.

Horizontal scales of interest are on the order of two hundred kilometers or less. Vertical scales will depend on the height of the daytime mixed layer and the elevation of any nearby terrain and will generally be on the order of a few kilometers or less. It is realized, or course, that processes involving larger scales may have to be taken into account for a full understanding of smaller-scale ones.

Categories

The EMP-VTMX Program consist of four categories. Prospective investigators should explicitly specify what category or categories are addressed by the proposed research. Individuals or groups intending to participate in field experiments should describe what measurements they intend to make and what instruments will be used to make them. Those intending to analyze data from one or more instruments or who will use data in numerical or conceptual modeling should specify what data are required for their purposes.

Category 1. Analysis of Existing Data Sets.

There are a large number of existing data sets collected in previous field campaigns that may be useful in the study of vertical transport and mixing processes. Analyses or other use of these data may directly contribute to the realization of the program's goals, and they may also help to identify processes to be studied in future field experiments and in the design of those experiments.

Category 2. Field Experiments.

Experiments designed explicitly to investigate selected vertical transport or exchange mechanisms will be conducted every two to three years during this program. Measurements will include observations of surface meteorological conditions; vertical profiles of wind velocity, temperature, and humidity; turbulence; tracer concentrations; and other quantities that may be relevant to the study of vertical transport or exchange. Measurements, and subsequent analysis of the data, in one or more of these areas is encouraged. Novel approaches for obtaining and interpreting remote sensing data, combining results from a variety of instrument platforms, and relating these data to quantities that can be calculated in numerical models are also areas of research encouraged in this program.

It is not anticipated that this research program will support significant efforts in instrument development per se. However, to the extent that the use of a specific instrument might provide crucial measurements for field experiments, or that these experiments might provide an opportunity to test instrument technologies developed under other programs, support for such activities will be considered.

Category 3. Improvement and Applications of Numerical and Conceptual Modeling Approaches.

Parameterizations of vertical transport or exchange are often based on assumptions about turbulence that are not applicable in all circumstances or on results of simulations that have been "tuned" to match a particular data set.

In many cases the choice of parameter values is left to the individual investigator. Numerical models are particularly prone to failure as the atmosphere becomes more stable and in areas where topographic and thermal forcing are all significant. New conceptual or numerical approaches may then be required to effect significant improvements in model performance. There is a need not only for further developments in numerical and conceptual modeling but also for more systematic testing and evaluation of the parameterizations and assumptions in these models. Whenever possible, such testing should be based on data and not simply on model vs. model comparisons.

Category 4. Development and Application of Tracer Technology.

Tracers are expected to be an important tool in the study of vertical transport and mixing in field measurement programs. Tracers can either be naturally occurring, such as ozone, aerosols, or radon, or material released in a controlled manner specifically to study transport and diffusion. Tracer releases may be required from multiple point sources in an urban area or from areas surrounding a city. If released from a city, point, line, and area sources may be necessary. Sampling in both vertical and

horizontal directions is desired, with time resolution ranging from hours down to minutes or less. It is expected that successful applicants in this area will play an active role in the design and execution of major field campaigns carried out in this program.

Programmatic Issues

Collaboration among funded investigators will be strongly encouraged in the EMP-VTMX Program. Scientists from non-DOE laboratories/universities are encouraged to explore potential areas of collaboration with scientists from one or more of the DOE laboratories by reviewing the abstracts of proposals from the DOE laboratory scientists that have been tentatively selected for funding. The abstracts will be posted on the DOE EMP-VTMX Website, ***http://www.pnl.gov/VTMX***, approximately February 12, 1999, five weeks after the closing date of the Lab announcement. It is for this reason that the submission dates for DOE and non-DOE scientists are staggered. Alternatively, non-DOE participants may identify gaps in the required research that are not covered by DOE laboratory approved proposals. Note that while independent investigations are anticipated in this program, it is important to keep the programmatic scope (vertical transport and mixing), geographic focus (urban basins or valleys), and areas of emphasis (stable conditions, conditions of weak or intermittent turbulence, and morning and evening transition periods) in mind when proposing and pursuing a course of investigation. Many of the principal research activities of this program will be associated with major field measurement campaigns and with the subsequent analysis of the data collected in them. In addition, efforts will be made to encourage scientists funded by other agencies to participate in field experiments and to share data and results with researchers in this program. An annual meeting of program participants and other interested parties is anticipated, and investigators funded under this program should plan to attend.

Science Issues

Given the programmatic considerations described above, examples of scientific questions that may be addressed in the EMP are:

- What are the fundamental processes that control vertical transport for stable and transition boundary layers?
- What measurements are required to identify and quantify these processes and how can they be made?
- How can momentum, heat, and moisture fluxes be modeled and predicted in a stratified atmosphere with multiple layers?
- What improvements in numerical simulations and forecasts of vertical transport and mixing during stable and transition periods are feasible and how can they be implemented?

- What formulations are most appropriate for the description of vertical diffusion in stable air? For example, how rapidly will an elevated layer of pollutants mix towards the ground in a stable pool trapped within a basin, and how can that mixing be modeled?
- How do pollutants move through residual layers above a stable or convective surface layer and to what extent can pollutants penetrate stable and residual layers aloft?
- What is the sensitivity of current local weather forecast and dispersion model predictions to variations in the treatment of vertical diffusivity and turbulence? What limits our ability to forecast vertical transport in current numerical prediction models?
- How well can remote and in situ sensors measure winds, temperature, turbulence, and pollutants in the lowest few kilometers of the atmosphere? What improvements are needed and practical?
- How do traveling weather systems remove stable stagnant air out of a basin, and under what conditions do these removal mechanisms fail?
- What are the effects of the thermal and roughness properties of urban areas on the vertical structure of the boundary layer?
- What is the nature of the interaction of terrain-induced flows (e.g., drainage winds at night, upslope winds during the day, and waves) with cold air pools in basins, and how do such flows affect the formation and erosion of those pools and the dispersion of pollutants in them?

Supplementary funding

In years in which major field campaigns are carried out, some modest supplementary funding may be available to offset the increased costs associated with field work. Prospective investigators who anticipate the need for additional support in those circumstances should request in their application the level of additional funding desired and describe the reasons for the request.

EMP field campaigns may also include the use of the DOE G-1 Research Aircraft Facility.

Educational Opportunities

Opportunities exist for the financial support of undergraduate and graduate students wishing to participate in this program through the Department of Energy's Global Change Education Program. Information can be obtained at ***http://www.atmos.anl.gov/GCEP/*** on the Internet.

Program Funding

It is anticipated that up to $1 million in first-year funding will be available for multiple awards to be made in FY 1999 in the categories described above, contingent upon availability of appropriated funds. Applicants may request project support up to four years, with out-year support contingent on availability of appropriated funds, progress of the research, and programmatic needs. The number of awards and range of funding will depend on the number of applications received and selected for award. Annual budgets are expected to range from $60,000 to $200,000 in total costs. Awards are expected to be made in the summer of 1999.

Applications

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 will include program policy factors such as the relevance of the proposed research to the terms of the announcement and an agency's programmatic needs. Note, that external peer reviewers are selected with regard to both their scientific expertise and the absence of conflict-of-interest issues. Non-federal reviewers will often be used, and submission of an application constitutes agreement that this is acceptable to the investigator(s) and the submitting institution.

Information about the development and submission of applications, eligibility, limitations, evaluation, selection process, and other policies and procedures may be found in 10 CFR Part 605, and in the Application Guide for the Office of Energy Research Financial Assistance Program. Electronic access to the Guide and required forms is made available via the World Wide Web at ***http://www.er.doe.gov/production/grants/grants.html***. The research project description must be 15 pages or less, exclusive of attachments and must contain an abstract or summary of the proposed research. On the SC grant face page, form DOE F 4650.2, in block 15, also provide the PI's phone number, fax number, and E-mail address. Attachments include curriculum vitae, a listing of all current and pending federal support, and letters of intent when collaborations are part of the proposed research.

Although the required original and seven copies of the application must be submitted, researchers are asked to submit an electronic version of their abstract of the proposed

research in ASCII format and their E-mail address to the Program Director for Atmospheric Sciences, Peter Lunn, by E-mail to peter.lunn@oer.doe.gov. Curriculum vitae should be submitted in a form similar to that of NIH or NSF (two to three pages), see for example: ***http://www.nsf.gov:80/bfa/cpo/gpg/fkit.htm#forms-9***.

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

John Rodney Clark
Associate Director of Science
for Resource Management

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