Project #: G-35-X07  
Cost share #:  
Rev #: 3  
OCA file #:  
Work type: RES  
Document: GRANT  
Contract entity: GTRC  

Active

Contract#: ATM-9213643  
Mod #: AMENDMENT 003  

Subprojects?: N  
Main project #:  

Project unit: E & A SCI  
Unit code: 02.010.140  

Project director(s): CHAMEIDES W L  
E & A SCI  
(404)894-3883

Sponsor/division names: NATL SCIENCE FOUNDATION / GENERAL  
Sponsor/division codes: 107 / 000

Award period: 930501 to 961031 (performance) 970131 (reports)

Sponsor amount
Contract value New this change 0.00
Funded 168,700.00

Total to date
503,500.00
503,500.00
0.00

Cost sharing amount

Does subcontracting plan apply?: N

Title: THEORETICAL & DIAGNOSTIC STUDIES OF TROPOSPHERIC CHEMISTRY & THE ATMOSPHERE..

PROJECT ADMINISTRATION DATA

OCA contact: Jacquelyn L. Bendall  894-4820
Sponsor technical contact  

JARVIS L. MOYERS  
(202)357-9657  

Sponsor issuing office

JOHN S. CRUICKSHANK  
(202)357-9621  

NATIONAL SCIENCE FOUNDATION  
1800 G STREET, NW  
WASHINGTON, DC 20550

ONR resident rep. is ACO (Y/N): N

Defense priority rating : N/A  
NSF supplemental sheet

Equipment title vests with: Sponsor GIT X

NONE PROPOSED

Administrative comments -

AMENDMENT NO. 3 ADDS $168,700 TO PROJECT.
GEORGIA INSTITUTE OF TECHNOLOGY
OFFICE OF CONTRACT ADMINISTRATION
NOTICE OF PROJECT CLOSEOUT

Closeout Notice Date 10/31/96

Project No. 6-35-X07
Center No. 10/24-6-R7790-OA0

Project Director CHAMEIDES W L
School/Lab E & A SCI

Sponsor NATL SCIENCE FOUNDATION/GENERAL

Contract/Grant No. ATM-9213643
Contract Entity GTRC

Prime Contract No.

Title THEORETICAL & DIAGNOSTIC STUDIES OF TROPOSPHERIC CHEMISTRY & THE ATMOSPHERE

Effective Completion Date 961031 (Performance) 970131 (Reports)

Closeout Actions Required:  

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Comments  
LETTER OF CREDIT APPLIES. 98A SATISFIES PATENT REPORT.

Subproject Under Main Project No. 

Continues Project No. 

Distribution Required:  

- Project Director: Y  
- Administrative Network Representative: Y  
- GTRI Accounting/Grants and Contracts: Y  
- Procurement/Supply Services: Y  
- Research Property Management: Y  
- Research Security Services: N  
- Reports Coordinator (OCA): Y  
- GTRC: Y  
- Project File: Y  
- Other: N
ANNUAL NSF GRANT PROGRESS REPORT

NSF Program: Atmospheric Sciences
Division/Global Tropospheric Chemistry Program
PI Name: W.L. Chameides

NSF Award Number: ATM-9213643
Period Covered By This Report: 5/1/93 - 4/31/94

PI Institution: Georgia Tech Research Corporation
PI Address: School of Earth and Atmospheric Sciences
Georgia Institute of Technology
Atlanta, Georgia 30332-0340

☐ Check if Continued Funding is Requested

Please include the following information:

1. Brief summary of progress to date and work to be performed during the succeeding period;
2. Statement of funds estimated to remain unobligated—if more than 20%—at the end of the period for which NSF currently is providing support (not required for participants in the Federal Demonstration Project);
3. Proposed budget for the ensuing year in the NSF format, only if the original award letter did not indicate specific incremental amounts or if adjustments to a planned increment exceeding the greater of 10% or $10,000 are being requested;
4. Current information about other research support of senior personnel, if changed from the previous submission;
5. Any other significant information pertinent to the type of project supported by NSF or as specified by the terms and conditions of the grant;
6. A statement describing any contribution of the project to the area of education and human-resource development, if changed from any previous submission; and
7. Updated information on animal care and use, Institutional Biohazard Committee and Human Subject Certification, if changed substantially from those originally proposed and approved.

I certify that to the best of my knowledge (1) the statements herein (excluding scientific hypotheses and scientific opinions) are true and complete, and (2) the text and graphics in this report as well as any accompanying publications or other documents, unless otherwise indicated, are the original work of the signatories or individuals working under their supervision. I understand that the willful provision of false information or concealing a material fact in this report or any other communication submitted to NSF is a criminal offense (U.S. Code, Title 18, Section 1001.)

P.I. Signature: ____________________________

NSF Form 1328 (1/94)

31
ANNUAL PROGRESS REPORT

On NSF Grant ATM-9213643
Theoretical and Diagnostic Studies of Tropospheric Chemistry and Atmospheric Cycles of Ozone, N, and S

Principal Investigator: W.L. Chameides

This report summarizes the progress made during the first year of the three-year subject grant. During this period, work has focused on the development of a global Chemical Transport Model (CTM) to simulate the cycles of nitrogen oxides, ozone, and sulfur, an initial assessment of the impact of regional ozone pollution on world food production, the analysis of field data gathered during NASA's GTE CITE 3 and PEM-West experiments, the analysis and simulation of data documenting ozone pollution episodes in rural Georgia, and the development of a research plan for Mid-Latitude Ecosystems and Tropospheric Oxidants (MILOX), a research activity of the International Global Atmospheric Chemistry (IGAC) Program. During the first year of the grant, the following papers have been published and/or submitted for publication:


In addition, the P.I. participated in the preparation of material for the upcoming IPCC report and has served as Chairman of the National Research Council's Committee on Atmospheric Chemistry. Funds from the grant were used to support research for a number of graduate students including Ms. Jiangfen Zheng, who received her Ph.D. in December, 1993 and is now working at NOAA's Aeronomy Laboratory.
Plans for the coming year include: 1) Continued collaboration with the Geophysical Fluid Dynamics Laboratory in the development of CTM's; 2) Initiation of a collaboration with personnel at NASA Goddard Space Flight Center to develop a CTM using their analyzed wind system; 3) Development of a model system to study in a dynamically coupled manner the interactions between climate, the atmospheric S cycle, and aerosols; 4) Continuation of our work on the effects of regional air pollution on food production with emphasis on China and India; and 5) Analysis of field data from a variety of remote field experiments.
NSF Program: Atmospheric Sciences
Division/Global Tropospheric Chemistry Program
NSF Award Number: ATM-9213643
PI Name: W.L. Chameides
Period Covered By This Report: 5/1/94 - 4/30/95
PI Institution: Georgia Tech Research Corporation
PI Address: School of Earth and Atmospheric Sciences
Georgia Institute of Technology
Atlanta, Georgia 30332-0340

☐ Check if Continued Funding is Requested

Please include the following Information:

1. Brief summary of progress to date and work to be performed during the succeeding period;
2. Statement of funds estimated to remain unobligated—if more than 20%—at the end of the period for which NSF currently is providing support (not required for participants in the Federal Demonstration Project);
3. Proposed budget for the ensuing year in the NSF format, only if the original award letter did not indicate specific incremental amounts or if adjustments to a planned increment exceeding the greater of 10% or $10,000 are being requested;
4. Current information about other research support of senior personnel, if changed from the previous submission;
5. Any other significant information pertinent to the type of project supported by NSF or as specified by the terms and conditions of the grant;
6. A statement describing any contribution of the project to the area of education and human-resource development, if changed from any previous submission; and
7. Updated information on animal care and use, Institutional Biohazard Committee and Human Subject Certification, if changed substantially from those originally proposed and approved.

I certify that to the best of my knowledge (1) the statements herein (excluding scientific hypotheses and scientific opinions) are true and complete, and (2) the text and graphics in this report as well as any accompanying publications or other documents, unless otherwise indicated, are the original work of the signatories or individuals working under their supervision. I understand that the willful provision of false information or concealing a material fact in this report or any other communication submitted to NSF is a criminal offense (U.S. Code, Title 18, Section 1001.)

P.I. Signature: ____________________________

NSF Form 1328 (1/94)
ANNUAL PROGRESS REPORT: 5/94 - 4/95

On NSF Grant ATM-9213643
Theoretical and Diagnostic Studies of Tropospheric Chemistry
and Atmospheric Cycles of Ozone, N, and S

Principal Investigator: W.L. Chameides

This report summarizes the progress made during the second year of the three-year subject grant. During this period, work has focussed on the development and application of a global Chemical Transport Model (CTM) to simulate the cycles of nitrogen oxides, ozone, and sulfur, the analysis of field data gathered during NASA's GTE CITE 3 and PEM-West experiments, the analysis and simulation of data documenting ozone pollution episodes in rural Georgia, the development of numerical algorithms for the diagnostic analysis of data to be gathered during the ACE-1 field experiment, the simulation of the near-wake transformations and growth of soot and sulfate aerosols arising from aircraft exhaust, within the wake of and the development of a research plan for Mid-Latitude Ecosystems and Tropospheric Oxidants (MILOX), a research activity of the International Global Atmospheric Chemistry (IGAC) Program. During the two years of the grant, the following papers have been published and/or submitted for publication:


The following papers have been presented at scientific conferences and symposia:


Regional ozone pollution and world food production, (Invited Lecture), Symposium on Global Change, Great Lakes Regional American Chemical Society, Ann Arbor, May, 1994.

In addition, the P.I. participated in the preparation of material for the upcoming IPCC report, took part in the drafting the research plan for the North American Strategy for Tropospheric Ozone (NARSTO), and, in his capacity as Chairman of the National Research Council's (NRC) Committee on Atmospheric Chemistry, is leading the NRC's efforts in the preparation of a report on the "Imperatives for Atmospheric Chemistry Research Entering the 21st Century". Funds from the grant were used to support research for a number of graduate students including Dr. Jiangfen Zheng, who received her Ph.D. in December, 1993 and is now working at NOAA's Aeronomy Laboratory, and Dr. Jennifer Richardson, who received her Ph.D. in August, 1994 and is now working at the NASA Langley Research Center.

Plans for the coming year include: 1) Continued collaboration with the Geophysical Fluid Dynamics Laboratory in the development of CTM's; 2) Initiation of a collaboration with personnel at NASA Goddard Space Flight Center to develop a CTM using their analyzed wind system; 3) Development of a model system to study in a dynamically coupled manner the interactions between climate, the atmospheric S cycle, and aerosols; 4) Continuation of our work on the spread and effects of regional-scale ozone pollution; 5) Analysis of field data from a variety of remote field experiments; and preparation for the upcoming ACE-1 field experiment.
PART I - PROJECT IDENTIFICATION INFORMATION

1. Program Official/Org. Jarvis L. Moyers/ATM

2. Program Name Atmospheric Chemistry

3. Award Dates (MM/YY) From: May 1, 1993 To: October 31, 1996

4. Organization and Address
   School of Earth and Atmospheric Sciences
   Georgia Institute of Technology, Atlanta, GA 30332-0340

5. Award Number ATM-9213643

6. Project Title
   Theoretical and Diagnostic Studies of Tropospheric Chemistry and
   the Atmospheric Cycles of Ozone, N, and S.
NSF Grant Conditions (Article 17, GC-1, and Article 8, FDP-11) require submission of a Final Project Report (NSF Form 98A) to the NSF Program Officer no later than 90 days after the expiration date of the award. Final Project Reports for expired awards must be received before new awards can be made (NSF Grants Policy Manual Section 340).

Below, or on a separate page attached to this form, provide a summary of the completed projects and technical information. Be sure to include your name and award number on each separate page. See below for more instructions.

**PART II - SUMMARY OF COMPLETED PROJECT** (for public use)

The summary (about 200 words) must be self-contained and intelligible to a scientifically or technically literate reader. Without restating the project title, it should begin with a topic sentence stating the project's major thesis. The summary should include, if pertinent to the project being described, the following items:

- The primary objectives and scope of the project
- The techniques or approaches, used only to the degree necessary for comprehension
- The findings and implications stated as concisely and informatively as possible

SEE ATTACHED

---

**PART III - TECHNICAL INFORMATION** (for program management use)

List references to publications resulting from this award and briefly describe primary data, samples, physical collections, inventions, software, etc., created or gathered in the course of the research and, if appropriate, how they are being made available to the research community. Provide the NSF Invention Disclosure number for any invention.

SEE ATTACHED

I certify to the best of my knowledge (1) the statements herein (excluding scientific hypotheses and scientific opinion) are true and complete, and (2) the text and graphics in this report as well as any accompanying publications or other documents, unless otherwise indicated, are the original work of the signatories or of individuals working under their supervision. I understand that willfully making a false statement or concealing a material fact in this report or any other communication submitted to NSF is a criminal offense (U.S. Code, Title 18, Section 1001).

<table>
<thead>
<tr>
<th>William L. Chameides</th>
<th>8/20/96</th>
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<tr>
<td>Principal Investigator/Project Director Signature</td>
<td>Date</td>
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**IMPORTANT: MAILING INSTRUCTIONS**

Return this *entire* packet plus all attachments in the envelope attached to the back of this form. Please copy the information from Part 1, Block I to the Attention block on the envelope.
PART II: SUMMARY OF COMPLETED PROJECT

The 3-year research project focused on key aspects of the atmospheric cycles of ozone, N, and S through the diagnostic analysis of existing atmospheric datasets and the development and application of mathematical/numerical models capable of simulating the chemical, physical, and biological processes that affect these cycles. Using a 3-dimensional global Chemical Transport Model we were able to quantify the contribution of anthropogenic sources to the global distribution of nitrogen oxides and ozone. Our simulations suggest that approximately 10-30% of the staple food production in the world are grown in regions where ground-level ozone generated from air pollutants is in excess of the concentration capable of significantly affecting crop productivity. Our calculations also suggest that, projected increases in nitrogen oxide emissions over the next 20-30 years could increase this percentage by as much as a factor of 3, with the largest affects seen in East Asia and other developing countries. In another study we combined diagnostic analysis of data from the PEM-West B airborne field campaign with global modeling to investigate the formation and fate of potentially climate-cooling sulfate aerosols. Our study suggested the existence of a potentially important, but heretofore neglected heterogenous pathway for converting SO$_2$ to sulfate, and that models that attempt to simulate homogeneous nucleation of sulfate aerosols using average or typical atmospheric conditions will significantly underestimate the actual homogeneous nucleation occurring in the atmosphere. In addition to the scientific findings, funds from NSF were used to support 5 graduate students, three post-doctoral associates, and one international visiting scientist.
The following papers were published during the period of the grant.


The data requested below are important for the development of a statistical profile on the personnel supported by Federal grants. The information on this part is solicited in response to Public Law 99-383 and 42 USC 1885C. All information provided will be treated as confidential and will be safeguarded in accordance with the provisions of the Privacy Act of 1974. You should submit a single copy of this part with each final project report. However, submission of the requested information is not mandatory and is not a precondition of future award(s). Check the "Decline to Provide Information" box below if you do not wish to provide the information.

Please enter the numbers of individuals supported under this grant.
Do not enter information for individuals working less than 40 hours in any calendar year.

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<th>Post-Doctorals</th>
<th>Graduate Students</th>
<th>Under-Graduates</th>
<th>Other Participants</th>
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A. Total, U.S. Citizens

B. Total, Permanent Residents

U.S. Citizens or Permanent Residents:
- American Indian or Alaskan Native
- Asian
- Black, Not of Hispanic Origin
- Hispanic
- Pacific Islander
- White, Not of Hispanic Origin

C. Total, Other Non-U.S. Citizens

Specify Country
1.
2.
3.

D. Total, All participants (A + B + C)

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Disabled

Decline to Provide Information: Check box if you do not wish to provide this information (you are still required to return this page along with Parts I-III).

Category includes, for example, college and precollege teachers, conference and workshop participants.

Use the category that best describes the ethnic/racial status to all U.S. Citizens and Non-citizens with Permanent Residency. (If more than one category applies, use the one category that most closely reflects the person's recognition in the community.)

A person having a physical or mental impairment that substantially limits one or more major life activities; who has a record of such impairment; or who is regarded as having such impairment. (Disabled individuals also should be counted under the appropriate ethnic/racial group unless they are classified as "Other Non-U.S. Citizens.")

AMERICAN INDIAN OR ALASKAN NATIVE: A person having origins in any of the original peoples of North America and who maintains cultural identification through tribal affiliation or community recognition.

ASIAN: A person having origins in any of the original peoples of East Asia, Southeast Asia or the Indian subcontinent. This area includes, for example, China, India, Indonesia, Japan, Korea and Vietnam.

BLACK, NOT OF HISPANIC ORIGIN: A person having origins in any of the black racial groups of Africa.

HISPANIC: A person of Mexican, Puerto Rican, Cuban, Central or South American or other Spanish culture or origin, regardless of race.

PACIFIC ISLANDER: A person having origins in any of the original peoples of Hawaii, the U.S. Pacific territories of Guam, American Samoa, and the Northern Marinas; the U.S. Trust Territory of Palau; the islands of Micronesia and Melanesia; or the Philippines.

WHITE, NOT OF HISPANIC ORIGIN: A person having origins in any of the original peoples of Europe, North Africa, or the Middle East.