RESEARCH FOUNDATION OF CUNY
555 WEST 57TH STREET, 11th FLR, NY, NY 10019

SUBCONTRACT NUMBER- 49866-00-03 A (Year 3)

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1. CONTRACTOR- RESEARCH FOUNDATION OF CUNY ON BEHALF OF CITY COLLEGE (FOUNDATION):
COLLEGE: CITY COLLEGE OF CITY UNIVERSITY OF NEW YORK
ADDRESS FOR INVOICES: 138TH STREET AT CONVENT AVENUE, NEW YORK, NY 10031

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2. SUBCONTRACTOR-
NAME: UNIVERSITY OF PUERTO RICO
ADDRESS: MAYAGUEZ CAMPUS, PO BOX 9001, MAYAGUEZ, PR 00681-9001

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3. PROJECT DESCRIPTION-
SPONSOR: NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION (NOAA)
TITLE: NOAA COOPERATIVE CENTER FOR REMOTE SENSING SCIENCE AND TECHNOLOGY (CREST)
SPONSOR ID: NA17AE1625   CFDA #: 11.481

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4. KEY PERSONNEL/PROJECT DIRECTOR-
RFCUNY: DR. REZA M. KHANBILVARDI
SUBCONTRACTOR: DR. RAMON VASQUEZ

4a. KEY PERSONNEL/PROJECT DIRECTOR TELEPHONE #-
RFCUNY: 212-650-8009
SUBCONTRACTOR: 787-832-4040 EXT. 3822

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5. BUDGET- YEAR 3

PERSONNEL-
　　SALARY-
　　　FRINGE BENEFITS-
TOTAL PERSONNEL-

TRAVEL
EQUIPMENT
MATERIALS AND SUPPLIES

TOTAL DIRECT-

INDIRECT COSTS   @25%

　　TOTAL BUDGET-

[SEE APPENDIX B FOR DETAILED BUDGET.]

6. ATTACHMENTS:
APPENDIX A- SCOPE OF WORK
APPENDIX B- BUDGET
APPENDIX C- SPECIAL TERMS & CONDITIONS
APPENDIX C-1: NOAA's SPECIAL TERMS & CONDITIONS
APPENDIX C-2: NOAA'S REVISED STANDARD AWARD
　　　　CONDITIONS
APPENDIX D- GENERAL TERMS & CONDITIONS
APPENDIX E- INVOICE

6a. CONDITION PRECEDENT- Payment to the Foundation from the NOAA for performance of this subcontract is a condition precedent to Subcontractor's right to payment, hereunder. The Subcontractor relies on the credit of the NOAA, not the Foundation, for payment of its work. The Subcontractor agrees that its right to payment extends to only those funds made available by the NOAA pursuant to this subcontract cover sheet.

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7. SUBCONTRACT TERM- OCTOBER 1, 2003 TO SEPTEMBER 30, 2004

ADDITIONAL TERMS- Prospective funding is contingent upon availability of funds and satisfactory performance on the current and/or previous award and is at the sole discretion of NOAA. The Award Agreement No. NA17AE1625 between NOAA and City College of CUNY is hereby incorporated by reference into this Subcontract. This Subcontract is governed by the Administrative Principles of A-110 and the Cost Principles of A-21.

IN WITNESS WHEREOF, the parties agree to be bound by the terms and conditions of this agreement.

RESEARCH FOUNDATION OF CUNY
BY: _(Signature)_
NAME: RICHARD F. ROTHBARD _(Printed Name)_
　　PRESIDENT
TITLE: _(Printed Title)_
DATE: 1/22/04

CITY COLLEGE OF CUNY
BY: _(Signature)_
NAME: REGINA MASTERSON _(Printed Name)_
TITLE: DIRECTOR, OFFICE OF RESEARCH ADMINISTRATION THE CITY COLLEGE OF CUNY _(Printed Title)_
DATE: 1/21/04

SUBCONTRACTOR
BY: _(Signature)_
NAME: Jorge Ivan Velez Arocho _(Printed Name)_
TITLE: Chancellor _(Printed Title)_
DATE: March 2, 2004

3/marzo/04
Recogio' este doc.
Vanessa del ICIS
787-833-3323

Appendix A - NOAA CREST
Description of Research Work for Year 2

Participating Institution: University of Puerto Rico, Mayagüez Campus

Title: Modeling of atmospheric, water and land processes using remote sensing

Institutional PI
Dr. Ramon Vasquez
Dean of Engineering
Office of the Dean of Engineering
University of Puerto Rico
Mayagüez, PR 00681
Ph: (787) 832 4040 x 3822
Email: reve@ece.uprm.edu

Contact Information (for contract and payment processing):
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Director, R&D Center
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Email: fbird@uprm.edu

For Sub-Contract Signature:
Dr. Jorge I. Velez Arocho
P.O. Box 9000
Mayagüez, PR, 00681-9000
Voice: 787-265-3878
Fax: 787-834-3031
Email: rector@rectoria.uprm.edu
        brenda@rectoria.uprm.edu

Brief Statement of Research Work:

Research efforts include modeling for air and water quality. This includes modeling of air mixtures based on both equilibrium and non-equilibrium conditions. The work will also examine and model aeration processes in coastal waters. The work will implement algorithms that make use of remote sensing data to extract and estimate parameters for atmospheric models and texture algorithms for cloud cover detection. A study of bio-optical properties of the Mayagüez Bay will be conducted to develop new algorithms for water quality. Algorithms will be developed for removing noise from GPR (Ground Penetrating Radar) and for using this data in land cover and soil moisture studies. Land

cover and land use classification using images obtained from multispectral and radar sensors will be performed.

Description of Research work

1. The proposed work involves the modeling of the aeration process using the non-equilibrium model and the comparison of the prediction with the experimental data. The coastal waters will be specifically studied. We plan to compare the experimental data with the numerical predictions of the non-equilibrium model that involve mass transfer calculations. This will enable us to be able to determine the rate of oxygen flow required for the aeration. Dr. Sridhar has published several articles on work involving this model and has developed a lot of software for performing calculations. Also, remote sensing image data will be used to estimate parameters for the models.

2. This research work will concentrate on developing algorithms and applying them to remote sensing images to extract parameters to be used in the models of step 1. The research will make use of images from different types of sensors. Image analysis and pixel processing algorithms will be developed to estimate parameters from Landsat, SAR and multispectral sensors. Dr. Ramon Vasquez's research group has developed existing and new methods for image texture analysis and has published several papers applying them to remote sensing images. Existing and new texture algorithms will be implemented for performing land cover and land use classifications.

3. The research work of Dr. Parsiani will be done in collaboration with Dr. Eric Harmsen of the UPRM Agricultural & Biosystem Engineering. Dr. Parsiani will be developing image processing algorithms which will denoise, enhance, and analyze images (data) obtained by the Ground Penetrating Radar. 2-D, and 3-D images of the subsurface will be developed. The data will be used to extract soil moisture content, which is needed for developing, calibrating, and validating subsurface flow models. The spatially continuous GPR data will have to be converted accurately into moisture content distribution with the aid of the Agricultural Department's Time Domain Reflectometer (TDR) point soil moisture measurement device. The subsurface data from our test-bed in Puerto Rico will be shared with other NOAA collaborators for further model improvements.

4. Dr. Fernando Gilbes will conduct the coastal marine research of the Mayaguez Bay. New approaches, new methods and new instruments will be used to allow consideration of all sources responsible for the optical variability in the interpretation of the remote sensing signal. Inverse modeling of the reflectance curve is an alternative approach that has been suggested for coastal remote sensing (Gould and Arnone, 1997). In this procedure, the different spectral contributors of the light field are separated and their effects in the remote sensing reflectance are evaluated (Lee et al., 1994). The available data demonstrate that improved algorithms and different remote sensing techniques are necessary for this coastal region. The results of these efforts will be shared with other NOAA collaborators in the coastal waters of Long Island, New York.

List Specific Issues to be addressed in year 2:

1. The development of models for aeration processes for air and water quality will continue.
2. Remote sensing image data will continue to be analyzed to extract parameters that will be input to the models. Image data will be used to acquire potential information about water and land constituents. SAR, AVHRR and Landsat image data will be used for the above tasks.
3. Texture analysis algorithms will continue to be developed for extraction useful parameters such as temperature and composition from images for use in aeration models.
4. Soil moisture studies using GPR (Ground Penetrating Radar) will continue. This involves removing the noise from the GPR data and developing algorithms to interpret the data from GPR.
5. Bio-optical instruments will be used to measure profiles of different water properties. New methods and instruments will be used to study the bio-optical properties of the Mayagüez Bay. The results will be compared with similar efforts in coastal waters of the Long Island area.

Expected results from FY2 work (should conform to proposed work)

1. Development and refinement of algorithms for remote sensing image analysis for parameter extraction.
2. Implementation of texture based algorithms for coastal classification.
3. Models for atmospheric aeration processes.
4. Obtain continuous spatial GPR data of subsurface test-bed, develop methods to denoise, and enhance the GPR data for its use in soil, and water characterizations.
5. Profiles of different water properties.

Student Recruitment and Training Plans, including existing students (must conform to NOAA requirements)

Graduate and undergraduate students have been recruited for performing research. Preparation of modules in existing courses that creates awareness in NOAA's objectives, is on schedule..

Relevance to NOAA interests and Collaboration with NOAA entities (within the overall context of the proposal)

Collaborations with NOAA entities will be initiated. A call for abstracts for papers has been issued. A NOAA-CREST Symposium is being organized and will be held on Jan. 9-10 2003 at the University of Puerto Rico at Mayagüez. All NOAA-CREST Partners will participate.

Collaborations with Industry

Collaboration exists and will continue in the form of a proposed Joint Institute with NASA, PR-EPSCoR and other entities.

Equipment Acquisitions

1. Purchase of GPR has been completed. The Ground Penetrating Radar (GPR) is being used to collect continuous spatial subsurface soil moisture data from our test-bed area in P.R.
2. Additional Computing workstation and PCs have been acquired

We will need 2 workstations and 2 personal computers for each investigator. These will be used by 2 graduate students (1 MS and 1 PhD) and 2 undergraduate research students. The undergraduate students will test the software developed by the graduate students.

Expected Deliverables FY2

Number of students – 8 graduate (4 MS and 4 PhD) ; undergraduate students supported by other climate related projects are covered as an in-kind contribution to the NOAA-CREST program.

Graduate students will play an active role in data analysis, modeling, and algorithm development activities. Undergraduate students will be involved in performing experiments which involve data collection and calibration. The students will acquire the skill to program in Matlab, C-language, and Fortran (as needed), for performing above tasks. The research results will be presented and published in international conferences. Regular reports will be submitted to the technical committee.

Goals and Expected results from FY2 Efforts

The models developed will be tested with the data obtained from remote sensing images. Collection of data that will be useful for our modeling from other satellites such as MODIS and Hyperspectral sensors will be undertaken. Image processing and data classification will be done. Data from GPR and other devices such as magnetometer, and conductivity sensors will be used for calibrating remote sensing data from satellite for soil moisture estimation. Infrastructure will be evaluated and improved as needed by the researchers. Collaboration with CREST program partners will be continued. Student training and recruitment will be continued. Courses and modules of courses that train students in NOAA sciences will be developed and offered. Research work will be presented in reputed international conferences and published. An annual CREST meeting/conference will be organized and held in Puerto Rico. The NOAA-CREST Congressional visit and associated activities planned for January 8, 9 and 10, 2003 will result in additional expenses not covered in the original budget. **The total additional amount requested is $25,000 + 25%.**

Future Plans

Integration, testing and validation of all the individual research components will be performed. Collaboration with CREST program partners will be continued. Infrastructure will be evaluated and improved as needed by the researchers. Student training and recruitment will be continued. Research work will be presented in reputed international conferences and published. A NOAA-Crest Symposium is being organized. Six months Progress reports will be submitted.

Personnel Efforts

1. Dr. Ramon Vasquez will be performing remote sensing image analysis and development of algorithms for extracting suitable parameters for the models.
2. Dr. Hamed Parsiani will be involved in analyzing Ground Penetrating Subsurface radar data for continuous soil characterization and in extracting useful land and water parameters for the models.
3. Dr. Lakshmi Sridhar will be involved in developing and implementing the models
4. Dr. Eric Harmsen, an associate from Agricultural Engineering, has begun research work on soil moisture analysis and is assisting Dr. Hamed Parsiani in developing, calibrating, and validating subsurface flow models.
5. Dr. Robin Williams, a visiting faculty member, is supporting the Atmospheric Sciences Research and Remote Sensing Applications programs at the College of Engineering. His duties will include teaching graduate and undergraduate courses in atmospheric sciences, conducting research in collaboration with the investigators of NOAA-CREST projects and assisting in the supervision of undergraduate and graduate students.
6. A new recruitment director, Dr. J.D. Chinea Rivera has been appointed for the academic year 2002-2003.
7. Dr. Fernando Gilbes will be conducting studies to improve the remote sensing techniques for a better estimation of water quality parameters in coastal waters. Cross-validation of the results with similar efforts in coastal waters of the Long Island area will be carried out.
8. Dr. Jorge Gonzalez will be in charge of organizing the NOAA-CREST Symposium, Climate Modeling and the conceptualization of a Joint Institute for Caribbean Climate Studies.