CREST NESDIS Partnership
Current and Future Directions

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CREST – NESDIS/STAR Technical Meeting
December 7-8, 2009
SSMC3, NOAA Office
Silver Spring, MD
Presentation Overview

- **CREST At-a-glance**
- **SCIENCE**
  - Research Thrusts
  - Science Accomplishments
- **STUDENTS**
  - Students at CREST
  - Success Stories and Accomplishments
- **EDUCATION; RECRUITMENT & OUTREACH**
  - Academic Programs & Courses
  - Recruitment
  - Seminars
  - Conferences & Workshops
- **FUTURE DIRECTIONS**
  - In line with NOAA’s NGSP (Next Generation Strategic Plans)
  - National Enterprise/partner of NOAA/NESDIS/STAR
  - International Collaborative Vision (Research and Education)
**Science**
Conduct cutting-edge research in Remote Sensing Science and Technology in line with NOAA’s Mission Goals, and in support of NOAA line offices.

**Education**
Educate and train students in science, engineering, and technology relevance to NOAA to provide diverse future workforce for NOAA, NOAA contractors and other related federal, state, and industrial stakeholders.

**Recruitment & Outreach**
Recruit, retain students by developing a pipeline from high school through college level to train them in NOAA sciences.
CREST Performance Prism: Interlinked Perspective

**Sciences**
- CREST Research Thrusts:
  - Climate Applications and Remote Sensing (CARS)
  - Coastal Remote Sensing
  - Remote Sensing Applications in Water Resources and Hydrology

**In line with NOAA's Goals and Mission**

**CREST and its Partners**
- CREST research in line with NOAA's goals of Environmental Assessment, Prediction and Stewardship

**Capacity Building**
- Facilities/Infrastructure
- Faculty/Scientists/Personnel
- Partnerships/Collaborations

**Strategic Direction**

**Education**
- Recruit; mentor; retain and train students in NOAA related Sciences

**Performance Metrics**
- Students training in NOAA-related sciences
- Perform research in view with NOAA's Goals and Mission
- Scientific Publications (peer reviewed and refereed conferences)
- Generate Leverage/Extramural Funding

**Remote Sensing Observatory Enterprise**

**Outreach**
- conferences, seminars, workshops, summer activities; REU; Weather Bug at HS/MS and Weather Camps...

**EPP Deliverables**
CUNY
City College
CUNY Lehman College
Bronx Community College
NY City Tech College, CUNY
Hunter College, CUNY
LaGuardia Community College

Columbia University

• University of Maryland, College Park (CICS- NESDIS/CI)
• Colorado State University, Fort Collins (CIRA – NESDIS/CI)
• University of Wisconsin, MI (CIMSS- NESDIS/CI)

CREST Partners & Alliances

• University of Maryland – Baltimore County
• Bowie State University-Maryland
• Hampton University-Virginia
• University of Puerto Rico, Mayaguez
  UPR, Rio Pedras

• NOAA-Environmental Science CSC FAMU
• NOAA-Interdisciplinary Science & Technology Cooperative Science Center, ISETCSC, NC A&T
• NOAA-Center for Atmospheric Sciences (NCAS), Howard University
CREST Industrial Partners

- Raytheon
- Northrop Grumman
- Earth Resources Technology (ERT)
CREST RESEARCH THRUSTS

Climate & Air
Coastal Waters
Land & Hydrology

Weather & Water
Ecosystem
Climate

Recruitment; Education & Outreach

Provide Critical Support to NOAA’s Missions Support

NOAA’s Current Goals and Missions

NOAA’s Support Mission
### CREST RESEARCH THRUSTS

#### Global Climate and Atmosphere

<table>
<thead>
<tr>
<th>Tropospheric Air Quality (TRAQ)</th>
<th>Climate Applications and Remote Sensing</th>
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</thead>
<tbody>
<tr>
<td>Satellite Algorithm Development and Validation</td>
<td>Middle Atmospheric Remote Sensing</td>
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<tr>
<td>Ground-based Remote Sensing Network</td>
<td>Integrated Analysis of Global Observations</td>
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<tr>
<td>Ground-based In-Situ Measurements Sampling, Sample Analysis and Speciation</td>
<td>Hyper-Spectral Remote Sensing</td>
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<tr>
<td>Modeling and Validation</td>
<td>Data Compression Algorithms</td>
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<td>Health Impacts</td>
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#### Coastal Remote Sensing

**Sub-themes**

- Evolution of measurements approaches for Coastal Water Parameters
- Field Measurement in Coastal Waters for Algorithms development/testing & Satellite Validation
- Improvement/development for Remote Sensing of Coastal Waters

#### Precipitation and Water Resources

**Sub-Themes**

<table>
<thead>
<tr>
<th>Hydro-Climate</th>
<th>Land Hydrology</th>
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<tbody>
<tr>
<td>Develop and improve satellite-based precipitation retrieval algorithms</td>
<td>Develop advance technique for snow-cover and depth monitoring using microwave satellite observations</td>
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<tr>
<td>Validation of existing Precipitation Retrieval Algorithms</td>
<td>Estimate vegetation characteristics from Geo-stationary Satellite Data</td>
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<tr>
<td>Flood Forecasting using Rainfall Estimates</td>
<td>Reducing the negative effect of Vegetation Cover on Soil Moisture Retrieval from Microwave Satellite Data</td>
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Data Management/Quantitative Image Restoration
<table>
<thead>
<tr>
<th>NOAA Missions</th>
<th>CREST Thrust Areas</th>
<th>NOAA Strategic Missions</th>
<th>Missions &amp; Goals</th>
<th>Support Mission</th>
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<tbody>
<tr>
<td></td>
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<td>Ecosystem</td>
<td>Climate</td>
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<tr>
<td>Remote Sensing Applications in Climate &amp; Air Quality Stratosphere (NESDIS/NWS/OAR)</td>
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<tr>
<td>Troposphere (NESDIS)</td>
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<tr>
<td>Precipitation &amp; Water Resources (NESDIS &amp; NWS/OAR)</td>
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<tr>
<td>Remote Sensing of Coastal Waters (NESDIS &amp; NOS)</td>
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</table>
## CREST

### Remote Sensing Application in Climate and Air Quality

#### a) Stratosphere

1. Satellite Services Program
2. Climate Observation Analysis
3. Integrated Observing and Data Management System

#### b) Troposphere

1. Weather & Water Science Technology
2. Infusion Program through Algorithm Refinement for Current Satellite Instruments & Algorithm Development for future Instruments
3. Climate Missions

## NOAA Line Offices Missions

<table>
<thead>
<tr>
<th></th>
<th>NESDIS</th>
<th>NWS</th>
<th>NOS</th>
<th>OAR</th>
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<tbody>
<tr>
<td><strong>NESDIS</strong></td>
<td><strong>1. Satellite Services Program</strong></td>
<td><strong>1. To understand Climate Variability and Change to Enhance Society’s Ability to Plan and Respond</strong></td>
<td></td>
<td><strong>1. Decision Support Climate Information and Assessments</strong></td>
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<tr>
<td><strong>Climate Missions</strong></td>
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<tr>
<td><strong>NWS</strong></td>
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<tr>
<td><strong>OAR</strong></td>
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</table>

**1.** Decision Support Climate Information and Assessments
<table>
<thead>
<tr>
<th>CREST</th>
<th>NOAA Line Offices Missions</th>
</tr>
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<tbody>
<tr>
<td></td>
<td><strong>NESDIS</strong></td>
</tr>
</tbody>
</table>
| Precipitation and Water Resources | 1. Weather & Water Science Technology  
2. Infusion Program through Algorithm Refinement for Current Satellite Instruments  
3. Climate Missions | 1. Serve Society’s needs for Weather and Water Information | | 1. Scenarios for future climate mitigation and adaptation studies – including land use changes  
2. Water resource & drought forecasting  
3. Weather related disease forecasts (e.g. Malaria, SARS, West Nile Virus) |
Air Quality Monitoring Program to Assess Impact on Regional and Global Climate Change

Precipitation and Rainfall Estimation

Stratospheric Ozone Analysis

Data Compression/Quantitative Image Restoration

Remote Sensing of Coastal Waters

**CREST Science Goals**

- Air Quality Monitoring Program to Assess Impact on Regional and Global Climate Change
- Precipitation and Rainfall Estimation

**CREST Accomplishments**

- Established the CREST lidar network across NE corridor (NY, NJ, MD & Puerto Rico) PR went operational in 2009.
- Developed an algorithm for Radar gap area by merging satellite-rainfall data and Next Generation Radar (NEXRAD) Stage-IV rainfall data. Developed operational nowcasting for server storms in NY metro region.
- Validation, calibration, and trend analysis of SBUV/2 and Brewer-Umkehr algorithm development.
- Reached data reductions of 3.7-to-1 overturning widely held perceptions that Lossless compression was limited to a 2-to-1 reduction.
- Developed & Validated polarization discrimination technique (patent pending) to separate fluorescence from overlapping elastic scattering.

**NOAA Strategic Goals & Missions**

- **Weather and Water**
  - Serve Society’s needs for Weather & Water Information
  - RS, Weather & Water, Improvement of rainfall estimation (QPE) for precipitation and flood forecasting (QPF & QFF)

- **Climate**
  - To Understand Climate Variability and Change to Enhance Society’s Ability to Plan and Respond

- **Ecosystem Weather and Water**
  - Integrated Earth Observing System & Data Management
  - Manage Coastal Resources to Optimize benefits to the Environment, the Economy, and Public Safety

- **Integrated Earth Observing System & Data Management**

- **Manage Coastal Resources to Optimize benefits to the Environment, the Economy, and Public Safety**
### CREST-NOAA Interactions and Collaborations

<table>
<thead>
<tr>
<th><strong>NOAA Collaborators</strong></th>
<th><strong>Project Description</strong></th>
<th><em><em>Students</em> Supported</em>*</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>NESDIS</strong> (S. Kondragunta, M. Goldberg, R. Heymann, I. Laszlo, A. Prados) &amp; <strong>ESRL</strong> (M. Hardey)</td>
<td>Ground Based Remote Sensors &amp; Sensing Networks (3 Tasks)</td>
<td>9 (PhD); 3 (MS) &amp; 2 (UG)</td>
</tr>
<tr>
<td><strong>NESDIS</strong> (S. Kondragunta, M. Goldberg) &amp; <strong>AOML/HRD</strong> (J. Gamache)</td>
<td>Air Quality Remote Sensing Applications (10 Tasks)</td>
<td>5 (PhD); 2 (UG)</td>
</tr>
<tr>
<td>Paul Menzel (<strong>CIMSS- NESDIS/C1</strong>)</td>
<td>Approaches to Aerosols Studies (5 Tasks)</td>
<td>2 (PhD); 3 (MS); 5 (UG)</td>
</tr>
<tr>
<td><strong>NESDIS</strong> (B. Ramsay; R. Ferraro; G. Dittberner), <strong>NWS</strong> (J. McQueen &amp; M. Cohen), <strong>NOS</strong> (M. Monaco)</td>
<td>Environmental Health Impacts (3 Tasks)</td>
<td>2 (PhD)</td>
</tr>
<tr>
<td><strong>NESDIS</strong> (L. Flynn), <strong>ESRL</strong> (J. Elkins &amp; I. Petropavlovskikh)</td>
<td>Stratospheric Ozone Analysis (10 Tasks)</td>
<td>3 (PhD)</td>
</tr>
<tr>
<td><strong>NWS</strong> (D. Kitzmiller, C. Kondragunta), <strong>NESDIS</strong> (R. Ferraro &amp; B. Kuligowski') &amp; <strong>NWS/MDL</strong> (Ama Ba; Stephan Smith) ; <strong>OAR</strong> – Bob Rabin</td>
<td>Precipitation &amp; Rainfall Estimation (9 Tasks)</td>
<td>4 (PhD); 3 (MS); 1 (UG)</td>
</tr>
<tr>
<td><strong>NESDIS</strong> (P. Romanov), <strong>NOHRSC/NWS</strong> (Carrol), <strong>NWS</strong> (I. Matos); <strong>NESDIS</strong> (Fuzhong Weng; Cesar Konguli;</td>
<td>Soil Moisture &amp; SWE (4 Tasks)</td>
<td>2 (PhD); 2 (MS); 10 (UG)</td>
</tr>
<tr>
<td><strong>NOS</strong> (M. Wang; D. Clark; M. Ondrusek; R. Stumpf)</td>
<td>Remote Sensing of Coastal Waters (4 tasks)</td>
<td>5 (PhD); 3 (MS); 3 (UG)</td>
</tr>
<tr>
<td><strong>NESDIS</strong> (R. Heymann, M. Goldberg, N. Nalli; Walter Wolf; Lihang Zhou, Ingrid Guch)</td>
<td>Data Compression; Quantitative Image Restoration (QIR)</td>
<td>1 (PhD); 1 (MS); 2 (UG)</td>
</tr>
</tbody>
</table>

- **18 major Research Projects with 104 tasks in collaboration with NOAA Scientists**
- **87 Students involved in the research projects (mostly MS and PhD)**
- **37+ NOAA-Collaborators**
- **66 CREST Faculty**
## Publications & Patents (2006-09)

<table>
<thead>
<tr>
<th></th>
<th>THRUST I</th>
<th>THRUST II</th>
<th>THRUST III</th>
<th>TOTAL</th>
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<tbody>
<tr>
<td>Peer Reviewed</td>
<td>85</td>
<td>7</td>
<td>40</td>
<td>132</td>
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<tr>
<td>Refereed Proc.</td>
<td>105</td>
<td>20</td>
<td>47</td>
<td>172</td>
</tr>
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</table>

*Leveraged Publications
Three Patents filed one by Coastal RS group and two (Serial Number: 11/774,704) by Data Compression group
Educational & Outreach Goals

- Academic Programs
- Recruitment Retention
- Training Mentoring
- Professional Development Seminars Conferences
New and Modified Courses/Program

- **EESE (Earth Environmental Science & Engineering)** 4-year BS/BE degree program at CUNY

- **SEAS (Space Earth & Atmospheric Sciences)** minor undergraduate program at Hampton University, which led to formation of a New Department (Atmospheric and Planetary Sciences)

- A one-year certificate course in GIS at Lehman College.

- Overall 6 Undergraduate and 10 Graduate (existing and new) courses have been impacted since the inception of CREST in 2001.
New Programs in Pipeline

- MS degree in Geographic Information Sciences (MGISc) – Lehman College of CUNY
- MS degree in Earth System Sciences and Environmental Engineering (ESSEE) by CCNY, CUNY
- Submitted a proposal on Science Masters’ Program (SMP) for funding through NSF
CUNY/UPRM Joint Ph.D. in Engineering Signing Ceremony, October 15, 2007

A joint PhD program between CUNY and UPRM since October 2007
## CREST Students Statistics (2001-2009)

<table>
<thead>
<tr>
<th>Students</th>
<th>African American</th>
<th>Hispanics</th>
<th>Other Minority</th>
<th>Others</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A*</td>
<td>P</td>
<td>A</td>
<td>P</td>
<td>A</td>
</tr>
<tr>
<td>PhD</td>
<td>3</td>
<td>7</td>
<td>7</td>
<td>10</td>
<td>6</td>
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<tr>
<td>Masters</td>
<td>9</td>
<td>11</td>
<td>21</td>
<td>9</td>
<td>6</td>
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<tr>
<td>BS</td>
<td>51</td>
<td>5</td>
<td>32</td>
<td>17</td>
<td>8</td>
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<tr>
<td>GISc. Cert.</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>0</td>
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<tr>
<td>Total</td>
<td>63</td>
<td>23</td>
<td>62</td>
<td>36</td>
<td>20</td>
</tr>
</tbody>
</table>
Ethnicity-wise breakdown of Students Graduated in NOAA Sciences

- **Total**: 172
  - GiSc Cert
  - BS
  - MS
  - PhD

- **Others**: 27
  - GiSc Cert
  - BS
  - MS
  - PhD

- **Other Minority**: 20
  - GiSc Cert
  - BS
  - MS
  - PhD

- **Hispanics**: 62
  - GiSc Cert
  - BS
  - MS
  - PhD

- **African American**: 63
  - GiSc Cert
  - BS
  - MS
  - PhD
Ethnicity-wise breakdown of Students in Pipeline being trained in NOAA Sciences

- **Total**: 87
- **Others**: 19
- **Other Minority**: 9
- **Hispanics**: 36
- **African American**: 23

- **TOTAL**
- **GiSc Cert**
- **BS**
- **MS**
- **PhD**
Facilities & Equipments

Extramural funds Generated

Student-training/professional development

Faculty & Staff Growth
(18 in 2002
44 in 2005
66 in 2009)

Research to Operations
Patents & Publications
Facilities at CREST

- CREST Microwave Observation Unit
- Coastal Measurement Platform
- CREST Earth Observation Unit
- CREST LIDAR NETWORK (CLN)
SECOND STAGE:

NEW SATELLITE DATA ACQUISITION UNIT

NAC building roof
LIDAR @ The City College of New York
LIDAR @ Hampton
LIDAR @ University of Maryland, Baltimore County
LIDAR @ University of Puerto Rico, Mayaguez
Ground-Based Remote Sensing Instrumentation
@ The City College of New York
Ground-Based Remote Sensing Instrumentation @ The City College of New York
Advanced Computational Center @ University of Puerto Rico, Mayaguez

Tropical Center for Earth and Space Studies (TCESS)
NOW IS THE TIME … FOR NOAA TO SPUR THE CREATION OF NEW JOBS AND INDUSTRIES, REVIVE OUR FISHERIES AND THE ECONOMIES AND COMMUNITIES THEY SUPPORT, IMPROVE WEATHER FORECASTING AND DISASTER WARNINGS, PROVIDE CREDIBLE INFORMATION ABOUT CLIMATE CHANGE AND OCEAN ACIDIFICATION TO AMERICANS, AND PROTECT AND RESTORE OUR COASTAL WATERS AND ECOSYSTEMS. ……”

December 2, 2009
Stakeholder Forum, Washington DC.
Dr. Jane Lubchenco
Under Secretary of Commerce
for Oceans and Atmosphere
(NOAA Administrator)
MISSION: To understand and predict changes in Earth’s Environment and Conserve and Manage Coastal and Marine Resources to meet our Nation’s Economy, Social and Environmental needs.

VISION: Healthy and Productive Communities, Economies, and Ecosystems within a Changing World

CREST’ commitment and partnership with NOAA in its long term strategy

- Climate Adaption & Mitigation
- Weather Resilience
- Sustainable Coastal Communities and Economics
- Sustainable, Resilient Fisheries, Species & Habitats
CREST DRAFT STRATEGIC PLAN

Satellite Services
- Develop Capability to monitor variations of Eastern US Regional Water Resources.

Climate Services
- Develop Remote Sensing Capability to Study Correlation of Air-Land-Ocean Interactions in Coastal Region.
- Monitoring & retrieval capabilities for coastal water bio-optical properties & floodplain Evolution & Prediction

Promote Healthy Coastal Land-Water Zone
- Develop Operational Nowcasting capability for severe storms; precipitation and Flooding

Improve Weather Forecasts
- Develop tools for Water Resources Vulnerability
- Investigate vulnerability of coastal cities and adjacent areas to climate change

Adaptation to Climate Change
- Develop Multi-Data Analysis methods for A-train leading to NPOESS & GOES-R.
- Calibration/Validation (SMAP; GOES-R; etc)

Education; Outreach; Professional Development
Past, Present, and FUTURE…

2002

Few Handful of Students
Limited Research Areas/Expertise

2005

Cluster of more defined research themes and projects
Substantial growth in Students population
Extended collaborations with other NOAA L/O
2 Students trained by CREST joins NOAA workforce....
Increase in the research publications

2009

Significant projects/tasks in line with NOAA’s missions & goals
Substantial graduation and pipeline of the students
Extensive Collaboration with NESDIS and NWS, NOS, OAR
Major Science Accomplishments; Satellite Receiving Station
4 Students trained by CREST joins NOAA workforce....
Substantial increase in research publications and patents

2010-15

The NOAA Remote Sensing Institute/Center of Excellence in Research & Education (National & International)
GOALS:

- Improve/Expand Research Collaborations
- CREST Students Mentoring by NESDIS Scientists
- Potential Exchange Programs between CREST-NESDIS
- Help in Refining our Strategies
- Other Innovative Ideas – National and International