Successfully Integrating NASA Data Into an On-going Public Health Study and Linking NASA Environmental Data with a National Public Health Cohort Study to Enhance Public Health Decision Making

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OR:
An on-going partnership between NASA and UAB

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Outline

- The past
  - The initial cooperative agreement
  - Major milestones
- The present
  - Current work in progress
- The future
  - The ROSES 2008 proposal
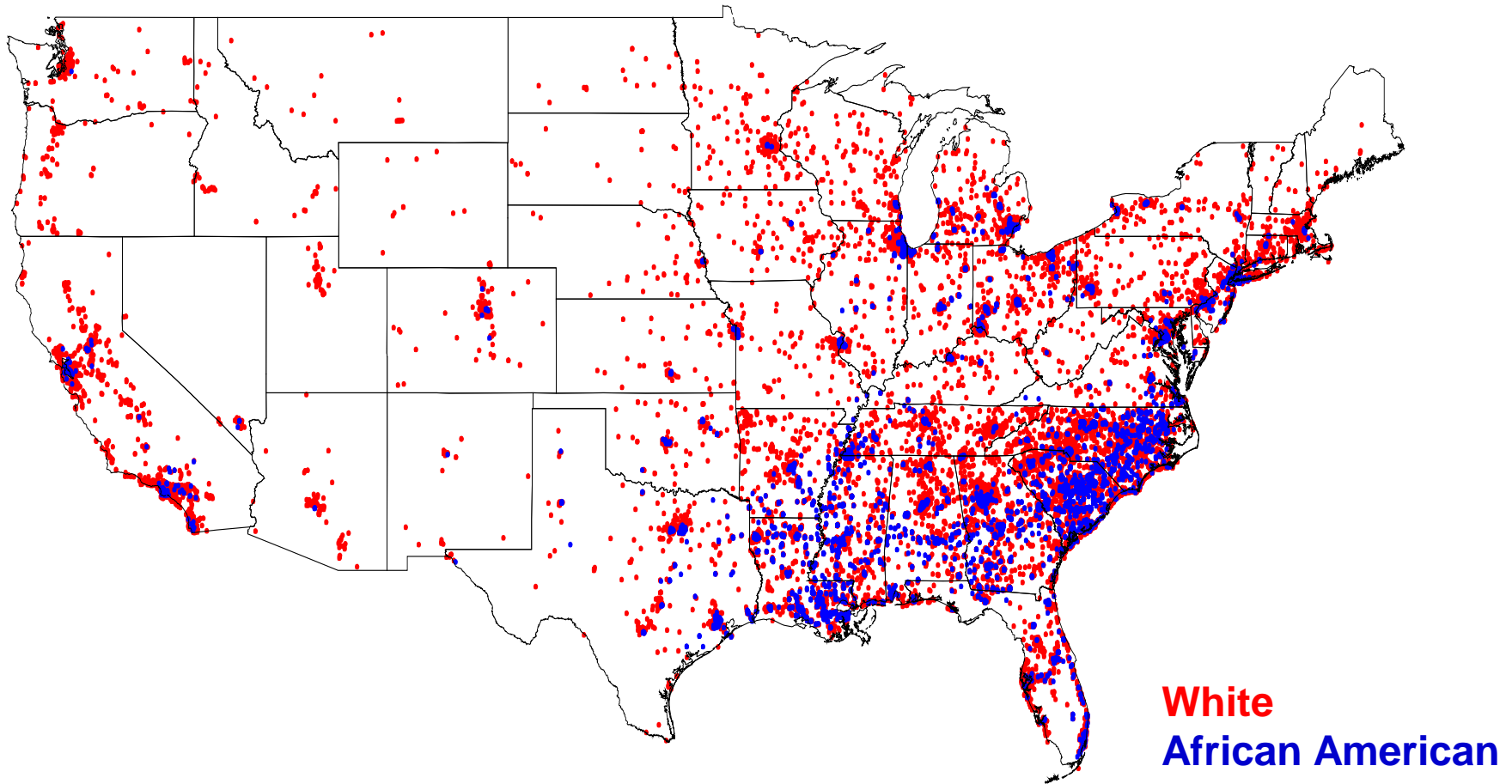 - Major deliverables
  - Timeline for the next year

The Past

- The main goal of the cooperative agreement was to build a relationship between researchers at NASA and the University of Alabama at Birmingham

- However, there were several initial aims that were proposed to aid in achieving that goal

The Past

- REGARDS (McClure)
  - Assess relationships between environmental risk factors collected via NASA satellites and data from the REasons for Geographic And Racial Differences in Stroke Study
    - Cross-sectional: hypertension/SBP, diabetes, cognitive function
    - Incident events: all-cause mortality, stroke, cognitive decline

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REGARDS Participants

White
African American

N = 30,201

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The Past

- ## Lung Health Center (Gerald/McClure)
  - Examine the effect of environmental risk factors on the effectiveness of supervised therapy for asthma, in an urban population of school children

The Past

- International Applications (Sathiakumar)
  - Incorporate satellite-estimated environmental exposures into a study aiming to characterize mercury exposure among a cross-section of pregnant women residing in the coastal areas of India
  - Incorporate NASA environmental exposures into a proposal in southern Sri Lanka studying the consequences of low-level occupational and environmental organophosphate exposures on pregnancy outcomes and fertility, and on neurodevelopment in children

The Past

- Educational Opportunities (McClure/Parcak)
  - Provide opportunities for students to work with NASA data, in order to assess relationships between environmental exposures and health outcomes
  - Provide guidance to students involved in the DEVELOP program
  - Develop courses that utilize NASA remote sensing data

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The Past – Milestones Reached

- Several of the milestones that we have reached through the cooperative agreement have crossed the lines between the various sub-projects

- In addition, we have been successful in building bridges between Birmingham and Huntsville
  - Our collaborations have begun to also involve researchers from UAH

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The Past – Milestones Reached

- Effect of sunlight exposure on cognitive function among depressed and non-depressed participants: a REGARDS cross-sectional study (Kent, McClure, Crosson, Arnett, Wadley and Sathiakumar)
  - Initially proposed: 2/2007
  - Data received by NASA/USRA: 3/2007
  - Datasets complete for analysis: 8/2007
  - Master's thesis successfully defended: 8/2008
  - Manuscript published in *Environmental Health*: 7/2009

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The Past – Milestones Reached

- Effect of sunlight exposure on cognitive function among depressed and non-depressed participants: a REGARDS cross-sectional study (Kent, McClure, Crosson, Arnett, Wadley and Sathiakumar)

  – Briefly, found an association between decreased exposure to sunlight and increased likelihood of cognitive impairment

    • Used NARR product to estimate solar radiation

The Past – Milestones Reached

- Use of remotely-sensed data to evaluate the relationship between living environment and blood pressure (M. Estes, Al-Hamdan, Crosson, S. Estes, Quattrochi, Kent and McClure)
  - Initially proposed: 2/2007
  - Data received from NASA/USRA: 1/2008
  - Data complete for analysis: 2/2008
  - Preliminary results presented: 6/2009
  - Manuscript submitted to *Environmental Health Perspectives*: 4/2009
  - Manuscript accepted for publication: 8/2009

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The Past – Milestones Reached

- Use of remotely-sensed data to evaluate the relationship between living environment and blood pressure (M. Estes, Al-Hamdan, Crosson, S. Estes, Quattrochi, Kent and McClure)
  - Presented at GIS in Public Health Conference (Al-Hamdan): 6/2009
  - To be presented at National Environmental Public Health Conference (Crosson): 10/2009
  - To be presented at APHA (McClure): 11/2009

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The Past – Milestones Reached

- Use of remotely-sensed data to evaluate the relationship between living environment and blood pressure (M. Estes, Al-Hamdan, Crosson, S. Estes, Quattrochi, Kent and McClure)
  - Briefly, we showed that you could utilize Landsat data describing land cover/land use to characterize living environment as urban, rural or suburban
  - Further, we found that after adjustment for race, there was no association between living environment and blood pressure

The Past – Milestones Reached

- The relationship between meteorological factors and blood pressure (Kent, McClure, Howard, …)
  - Initially proposed: 1/2007
  - Data received from NASA/USRA: 10/2007
  - Dataset complete for analysis: 1/2008
  - Analyses complete: 1/2009
  - Manuscript circulating at UAB: currently

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The Past – Milestones Reached

- The relationship between meteorological factors and blood pressure (Kent, McClure, Howard, …)
  - Briefly, utilized data from NARR to examine the relationship between temperature and blood pressure, and found that as temperature decreased, blood pressure increased

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The Past – Milestones Reached

- Lung Health Center (Gerald, McClure)
  - Presentation of UAB/NASA collaboration at American Thoracic Society Meeting: 5/2008
  - Dr. Lynn Gerald departs UAB: 12/2008
  - Stimulus "white paper" submitted: "Linking NASA Environmental Data with Elementary School Children's Asthma Data" (PI: Al-Hamdan): 2/2009
  - Analysis of the impact of PM and O_3 on the effectiveness of supervised asthma therapy: on-going

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The Past – Milestones Reached

- International Applications (Sathiakumar)
  - Grants submitted:
    - A feasibility study to use remote sensing data to monitor acute pesticide poisoning in Sri Lanka (ROSES 2008)
  - Student projects
    - Use of GIS and remote sensing in the development of a surveillance system for dengue in Karnataka, India (data collection on-going)
    - Heat waves and climate change (data collection on-going)
    - GIS-Based disease surveillance system for dengue fever in Karachi, Pakistan (data collection on-going)
    - Spatial analysis of environmental factors associated with lead exposure in children, using remote sensing and GISH technology in Karachi, Pakistan (class project, completed)
    - Assessing spatial and temporal environmental factors associated with emerging leptospirosis in Sri Lanka (class project, completed)
    - Relation between land use/land cover change between 1989-2001 and dengue fever in Karachi, Pakistan (class project, completed)

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The Past – Milestones Reached

- Two courses implemented that examine remote sensing in public health: Observing the Earth From Space/Remote Sensing and Health (Fall), Real World Remote Sensing/Topics in Public Health (Spring), (Parcak)
  - Students from seven UAB schools have enrolled in these courses
  - Offered 2007-08 and 2008-09
  - Incorporated lectures from NASA/USRA researchers, as well as faculty on the UAB campus

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The Past – Milestones Reached

- DEVELOP: Two very successful teams of students have completed exceptional research projects (Parcak/Luvall)
  - Spatial analysis of West Nile Virus: predictive risk modeling of a vector-borne infectious disease in central Alabama by means of NASA Earth observation systems
  - Investigation of Lyme Disease in Alabama

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The Present – Projects in Progress

- Currently, in addition to those already mentioned, other projects are on-going
  - Shia Kent, Doctoral student in Epidemiology is currently preparing to propose his dissertation research, which will first validate, then utilize, NASA satellite data, in conjunction with data from the MESA study
    - Planning to use both EPA ground-level data and personal monitors to validate satellite estimates of exposures
    - Awaiting indication from MESA executive committee which outcome data he can use

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The Present – Projects in Progress

- Currently, in addition to those already mentioned, other projects are on-going
  - Development of Statistical Methods for Environmental Epidemiology under development this fall semester
    - Course describes methodology for analyzing environmental epidemiologic studies, as well as teaching R statistical software
    - "Special topics" course, with limited enrollment

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The Present – Projects in Progress

- Currently, in addition to those already mentioned, other projects are on-going
  - Preparations for submission of an EPA Clean Air Research Center, under the leadership of Dr. Ed Postlethwait
  - A collaborative center, with focus on translational research, that includes researchers from UAB, UAH, NASA, USRA

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The Future – ROSES 2008

Objectives:

1. Produce daily gridded estimates of $PM_{2.5}$ for the conterminous US for the years 2003-2008 from MODIS Aqua data

2. Produce daily gridded solar insolation maps for the conterminous US during the same period using data from the NARR

3. Produce daily gridded LST maps over the conterminous US during the same period using data from MODIS

4. Link the estimates of $PM_{2.5}$, insolation and LST with data from the more than 30,000 participants from the REGARDS study.

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The Future – ROSES 2008

Objectives (continued):

5. Determine whether exposure to $PM_{2.5}$ or SI is related to the rate of cognitive decline among participants in the REGARDS study, independent of other known risk factors for cognitive decline

6. Examine the relationship between the estimated $PM_{2.5}$ and SI and other health-related conditions among REGARDS participants, including diminished kidney function, hypercholesterolemia, hypertension, and inflammation (CRP)

7. Deliver daily gridded environmental data sets ($PM_{2.5}$, SI and LST) to CDC-WONDER for the 2003-08 period

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The Future – ROSES 2008

- Major deliverables and time schedule:
  - LST dataset
    - Preparation and production: 10/2009-6/2010
    - Linkage with cognitive decline data: 7/2010-12/2010
  - Solar insolation dataset
    - Preparation and production: 10/2009-6/2010
    - Linkage with cognitive decline data: 7/2010-12/2010
    - Analysis: 1/2011-9/2011

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The Future – ROSES 2008

- Major deliverables and time schedule:
  - $PM_{2.5}$ dataset
    - Preparation and production: 10/2009-3/2011
    - Linkage with cognitive decline data: 4/2011-9/2011
    - Analysis: 10/2011-3/2012
  - Analysis of secondary outcomes: 10/201-6/2012
  - Transition to end-users, through CDC WONDER: 4/2012-9/2012
  - Preparation of final research report: 4/2012-9/2012

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Summary

- To date, we have made good progress towards developing fruitful collaborations between NASA researchers and folks at UAB

- With the support of additional NASA funds, and our partners at the CDC, have lofty, but reachable, goals to continue moving forward over the next three years

- Looking forward to developing ground-breaking research that makes a unique contribution to the field of Public Health

Collaborators

UAB

Dr. Nalini Sathiakumar

Dr. Lynn Gerald

Dr. Sarah Parcak

Ms. Kalyani Peri

Mr. Shia Kent

Dr. George Howard

CDC

Dr. Sigrid Economou

Dr. Judy Qualters

NASA

Dr. Dale Quattrochi

Dr. Douglas Rickman

USRA

Dr. Mohammad Al-Hamdan

Dr. William Crosson

Dr. Maury Estes

Ms. Sue Estes