

# 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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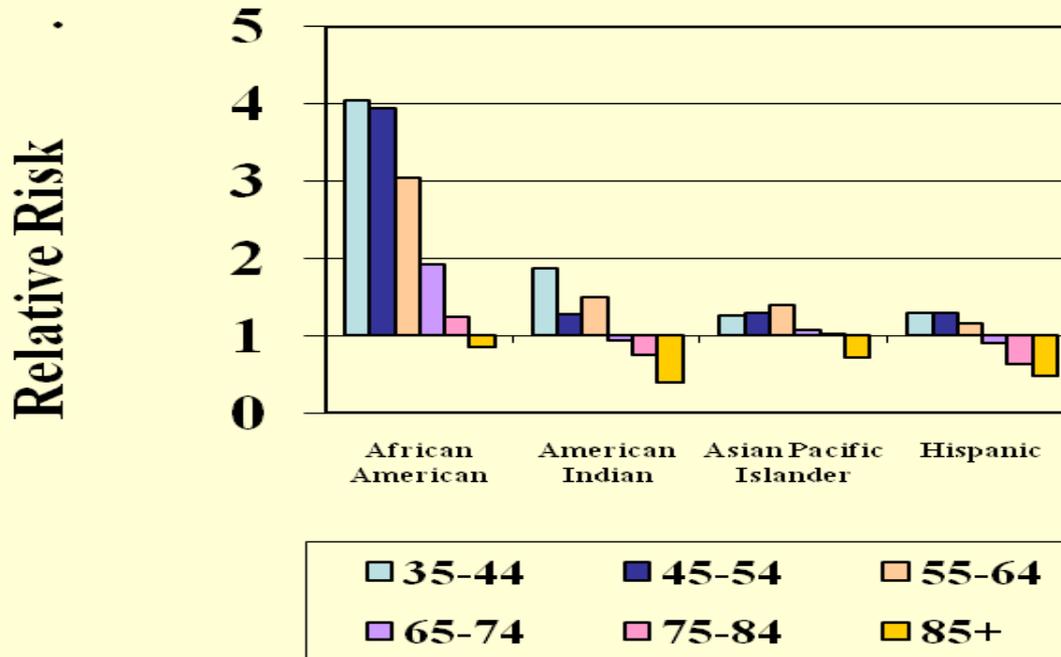
September 19, 2012  
Newport, Rhode Island

# Outline

- VERY Brief introduction to REGARDS
- Objectives of current funding
- Progress to date
- Remaining goals

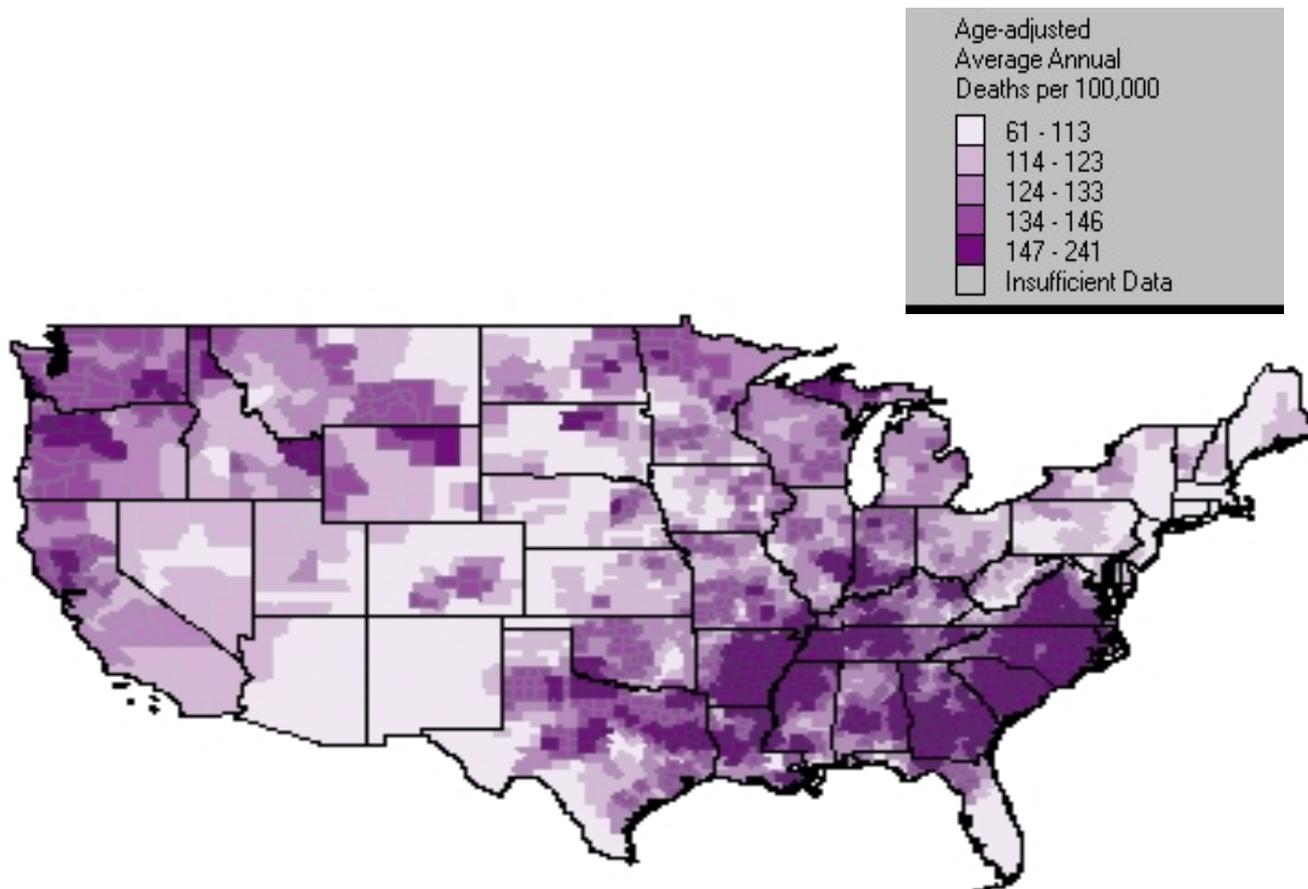
# Why REGARDS? *Racial Disparities*

**Race/Ethnic Relative Risk**  
White Reference (1997)



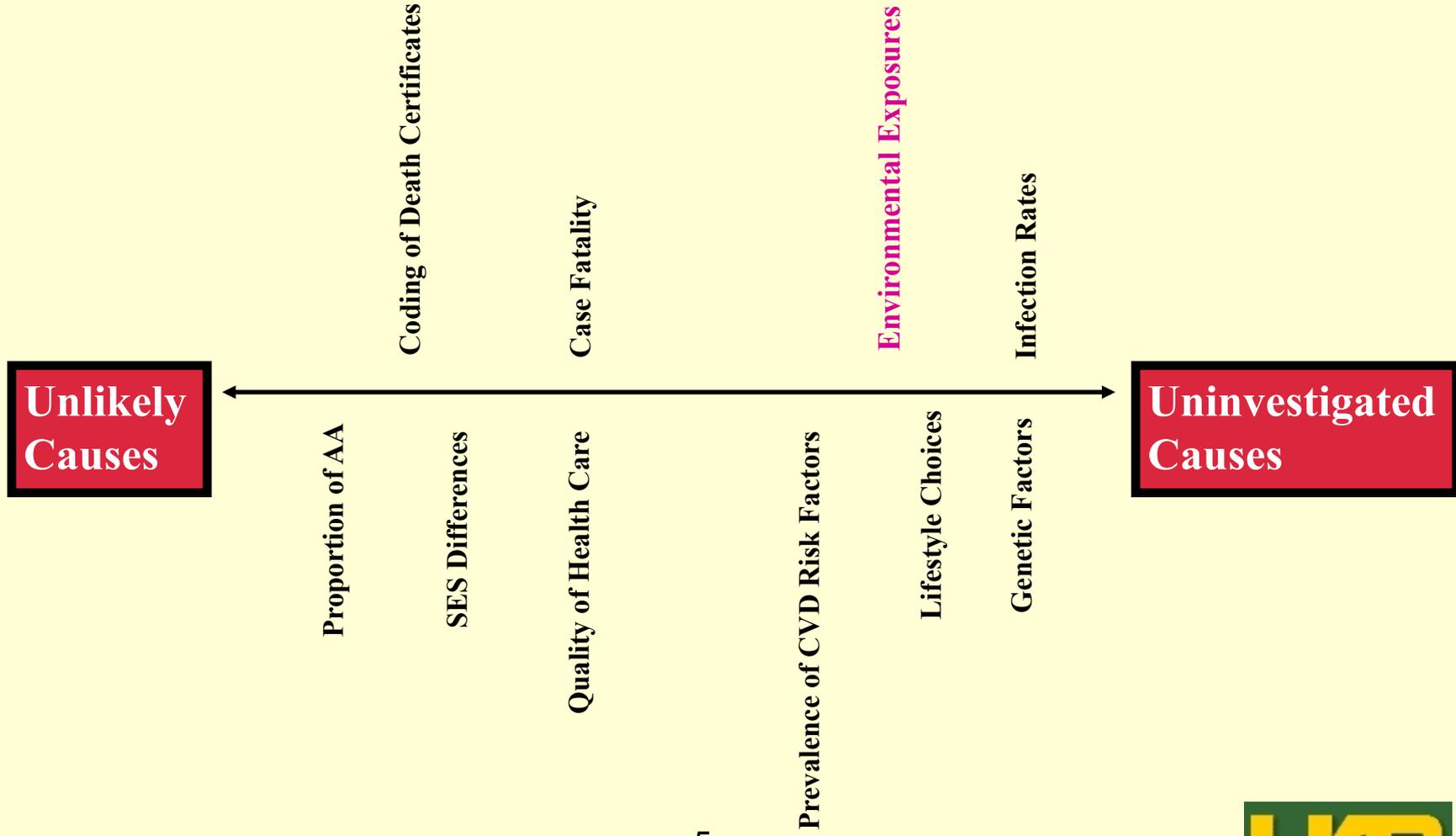
# Why REGARDS?

## *Regional Disparities*



# Why REGARDS?

## *Regional Disparity*



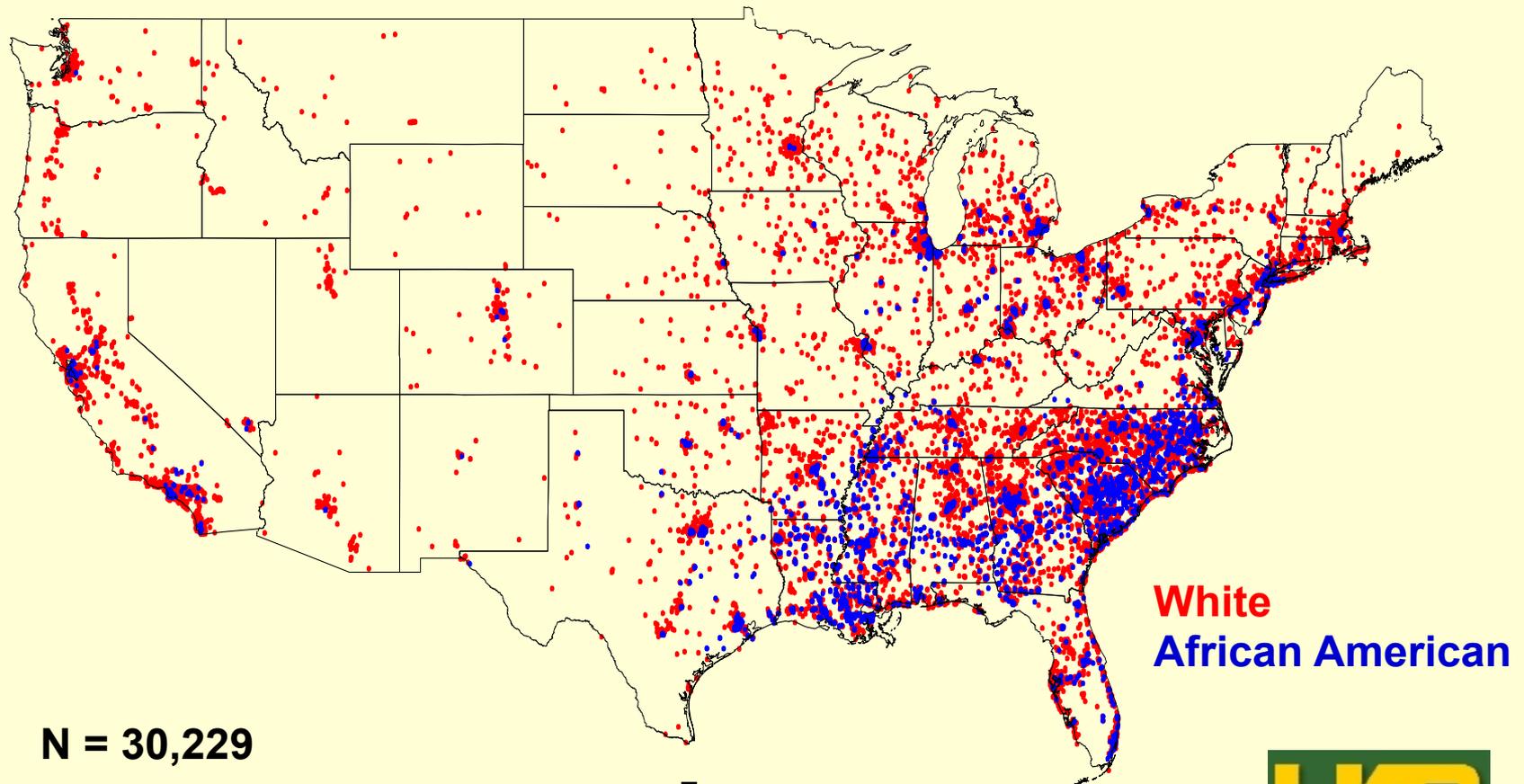
# REGARDS

## *Study Population*

- Longitudinal population-based cohort of 30,229 volunteers aged 45 and older, **with a goal of determining why there are racial and region differences in stroke mortality rates**
- Simple random sampling with geographic representation
  - 21% from the buckle of the stroke belt (goal was 20%)
  - 35% from the stroke belt (goal was 30%)
  - 44% from the rest of the contiguous US (goal 50%)
- Racial representation: 42% African American / 58% white (goal was 50/50%)
- Sex representation: 45% male / 55% female (goal was 50/50%)

# REGARDS

## *Study Population*



**N = 30,229**

# Overarching Goals of this Research

- Characterize PM<sub>2.5</sub>, solar insolation, and land surface temperature using NASA satellite observations, EPA ground level data, and other national datasets
- Link these data with data from REGARDS, in order to assess whether these factors impact cognitive decline and secondary outcomes
- Disseminate the dataset to end-users for decision making through CDC WONDER

# Objectives of the Current Project

- We have 7 objectives through which we hope to accomplish our overarching goals
  1. Produce daily gridded estimates of PM<sub>2.5</sub> for the conterminous US for the years 2003-2008 from MODIS Aqua data
  2. Produce daily gridded solar insolation (SI) maps for the conterminous US during the same period using data from the NARR
  3. Produce daily gridded and surface temperature (LST) maps over the conterminous US during the same period using data from MODIS

# Objectives of the Current Project

- We have 7 objectives through which we hope to accomplish our overarching goals
  4. Link the estimates of PM<sub>2.5</sub>, SI and LST with data from the more than 30,000 participants from the REGARDS study.
  5. Determine whether exposure to PM<sub>2.5</sub> 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<sub>2.5</sub> and SI and other health-related conditions among REGARDS participants, including diminished kidney function, hypercholesterolemia, hypertension, and inflammation (CRP)

# Objectives of the Current Project

- We have 7 objectives through which we hope to accomplish our overarching goals
7. Deliver daily gridded environmental data sets (PM<sub>2.5</sub>, SI and LST) to CDC-WONDER for the 2003-08 period

# Year 3 Status

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 (SI) maps for the conterminous US during the same period using data from the NARR
3. Produce daily gridded and surface temperature (LST) maps over the conterminous US during the same period using data from MODIS

**All datasets have been produced,  
and transferred to UAB!**

# Year 3 Status

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

**All datasets have been linked  
to the REGARDS participants!**

# Year 3 Status

5. Determine whether exposure to PM<sub>2.5</sub> 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
  - SI analyses completed for cognitive decline, results reported last year (using six-item screener)
    - Paper under review at *International Journal of Biometeorology*
    - Secondary analyses of more sensitive cognitive measures planned

# PM<sub>2.5</sub> Analyses (ICD)

- Assessed association between PM<sub>2.5</sub> and incident cognitive decline (ICD)
  - Primary exposure: average PM<sub>2.5</sub> exposure during the two-week period prior to baseline interview
  - Primary outcome: ICD based on impairment on the six-item screener at the most recent follow-up visit

# PM<sub>2.5</sub> Analyses (ICD)

- Fit incremental logistic regression models to assess association
  - Model 1: PM<sub>2.5</sub>, temperature, season, incident stroke
  - Model 2: M1+age, race, sex, education, income
  - Model 3: M2+smoking, exercise, alcohol use, obesity
  - Model 4: M3+depression, dyslipidemia, diabetes, hypertension
- Also, examined the impact of urban/rural residence on relationship between PM<sub>2.5</sub> and ICD

# PM<sub>2.5</sub> Analyses (ICD)

- Results:

Model 1: 1.15 (1.01, 1.31)

Model 2: 1.12 (0.98, 1.28)

Model 3: 1.12 (0.97, 1.28)

Model 4: 1.13 (0.97, 1.30)

- Thus, there is an association between PM<sub>2.5</sub> and ICD, but after adjustment for a variety of factors, it is no longer statistically significant
  - For each increase of 10 µg/m<sup>3</sup> in PM<sub>2.5</sub>, the odds of ICD increase by approximately 15%
  - The association does not differ depending on whether participants are rural or urban residents

# PM<sub>2.5</sub> Analyses (ICD)

- Manuscript currently under review at *Environmental Health Perspectives*
- Plans to assess the relationship between PM<sub>2.5</sub> and more sensitive measures of cognitive function are in the works

# Year 3 Status

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)
  - Analyses of SI and secondary outcomes completed, manuscript in progress
  - Analyses of  $PM_{2.5}$  and stroke completed
  - Analyses of  $PM_{2.5}$  and MI proposed
  - Analyses of  $PM_{2.5}$  and CRP under development

# SI and Secondary Outcomes

- Analysis of SI and secondary outcomes (CRP, cholesterol, systolic blood pressure (SBP) and chronic kidney disease) largely hypothesis generating
  - Use a split sample methodology, in which we randomly divided the sample in two
    - First half used as “exploratory sample” in which all analyses conducted
    - Second half used as “confirmatory sample” in which significant associations from the exploratory sample were confirmed

# SI and Secondary Outcomes

- Primary exposure: average insolation for the year prior to the baseline assessment, categorized into above or below the median exposure (i.e. high and low levels of exposure)
- Primary outcomes:
  - C-reactive protein (CRP)
  - High density lipoprotein (HDL)
  - Low density lipoprotein (LDL)
  - Total cholesterol
  - SBP
  - Estimated glomular filtration rate (eGFR)

# SI and Secondary Outcomes

- Results
  - From the exploratory sample, we found that SI was associated with SBP and HDL after multivariable adjustment
    - The association between SBP and SI differed by race ( $p=0.02$ )
      - For blacks, exposure to SI below the median was associated with an increase in SBP of 1.6 mmHg (95% CI: 0.4, 2.8)
    - Exposure to SI below the median was associated with HDL levels 1.6 mg/dL lower than those exposed above the median (95% CI: 0.5, 2.4)

# SI and Secondary Outcomes

- Results
  - Only the association between HDL and SI was confirmed in the confirmatory sample
    - In the multivariable model, SI exposure below the median was associated with HDL levels 2.1 mg/dL lower than for those exposed above the median (95% CI: 1.2, 3.1)

# Year 3 Status

7. Deliver daily gridded environmental data sets (PM<sub>2.5</sub>, SI and LST) to CDC-WONDER for the 2003-08 period
  - All data have been transferred to CDC WONDER
    - MODIS LST, NLDAS Daily Sunlight Data to go live **ANY DAY NOW!**
    - Daily PM<sub>2.5</sub> data are live
    - Daily temperature data are live
  - <http://wonder.cdc.gov/>
  - We're very excited about the feedback we've received
    - User feedback to improve the portal
    - Interest from Google Public Data Explorer
    - Interest from Temboo Library (App developer)

# Planned Activities – No Cost Extension

- Complete the secondary analyses of both the SI and PM<sub>2.5</sub> data
  - SI manuscript in progress
  - PM<sub>2.5</sub> manuscripts in development
    - Stroke analyses completed
    - MI, CRP in discussion
- Complete additional analyses of ICD and each of: SI and PM<sub>2.5</sub> using more sensitive measures of cognition
- Continue to work with CDC to refine the NASA data available on the WONDER portal
  - Performance measures, describing user access needed
- Develop ideas for and submit additional grants that continue and further our current work

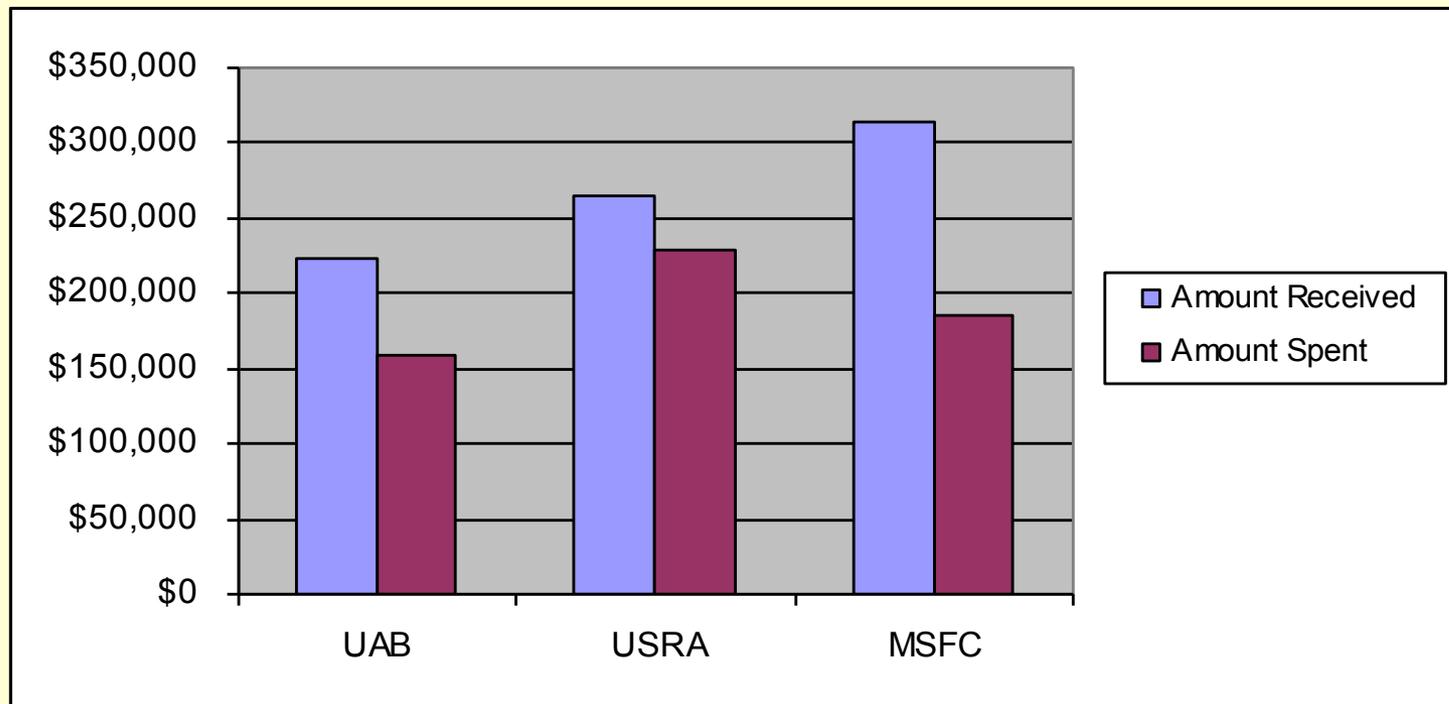
# Major Deliverables & Time Schedule

- We experienced some delay in meeting our time schedule this year, with a backlog of analyses that are on-going
  - We hope to complete these during our no-cost extension period



# Financial Status

Figure describing the financial status of our project – money received vs. money spent



Total dollars received: \$801,3996

Total dollars spent: \$573,298

# Collaborators

## UAB

Shia Kent

George Howard

Matthew Loop

## NASA

Dale Quattrochi

Douglas Rickman

## CDC

Sigrid Economou

Mark Puckett

## USRA

Mohammad Al-Hamdan (co-PI)

William Crosson

Maury Estes

Sue Estes

Gina Wade

Sarah Hemmings



# CDC WONDER

## North America Land Data Assimilation System (NLDAS) Daily Air Temperature Request

Request Form Results Map Chart About

[Dataset Documentation](#) [Data Use Restrictions](#) [How to Use](#)

Reset

Make a selection

### 1. Organize table layout:

[Help](#)

<b>Group Results By</b>	Region	▼
<b>And By</b>	None	▼

Select a temperature scale.

Fahrenheit Scale  Celsius Scale

Region State

Fahrenheit



**Select Measures** (Check box to include in results. Must select at least one.)

- Record Count for Min/Max Daily Air Temperature
- Record Count for Daily Max Heat Index

**Daily Max Air Temperature (F) measurements:**

- Avg Temperature
- Record Count
- Min Max Range
- Standard Deviation

**Daily Min Air Temperature (F) measurements:**

Avg  
Min Max  
Range

## 2. Select location:

Click a button to select locations by State, Region, or Grid ID.

[States](#)  [Regions](#)

**Browse** or **search** to find items in the States Finder Tool, then **highlight** the item.  
(The *Currently selected* box displays all current request items.)

[Finder Tool Help](#) [Advanced Finder Options](#)

All States

Browse Search Details

**States**

- \*All\* (The United States) ^
- + 01 (Alabama)
- + 04 (Arizona)
- + 05 (Arkansas)
- + 06 (California)
- + 08 (Colorado)
- + 09 (Connecticut)
- + 10 (Delaware)
- + 11 (District of Columbia)
- + 12 (Florida)

**Currently selected:**

- \*All\* (The United State ^

Open Close Close All

All Years

### 3. Select year, month, day:

Click a button to choose dates by individual date fields or by aggregate date fields.

Individual Date Fields  Aggregate Date

#### Year

All Years
2003

Pick between:

Day of Month Fields   
Day of Year Field

#### Month

All Months
January
February
March
April
May
June

#### Day of Month

All Days
1
2
3
4
5
6

**Hint:** Use Ctrl + Click for multiple selections, or Shift + Click for a range.

All Temperature

### 3. Select temperature:

#### Daily Max Air Temperature (F)

All Temperatures
-11
-10
-9
-8
-7
-6
-5
-4
-3

#### Daily Min Air Temperature (F)

All Temperatures
-30
-29
-28
-27
-26
-25
-24
-23
-22

S

#### Daily Max Heat Index (F)

All Temperatures
78
79
80
81
82
83
84
85
86

Any other options?

#### 5. Other options:

- Export Results**  (Check box to download results to a file)
- Show Totals**
- Show Zero Values**
- Precision**  decimal places
- Data Access Timeout**  minutes

Hit “Send” – there are “Send” buttons located throughout the page

Several Levels of

Export the Data

Region and State Level Results

Region ↓	State	→ Avg Daily Max Air Temperature(F) ↑↓ Range	← Avg Daily Min Air Temperature(F) ↑↓ Range
Census Region 1: Northeast (CENS-R1)	Connecticut (09)	57.65 (6.23 to 94.41)	44.17 (-9.00 to 78.02)
	Maine (23)	51.31 (-15.34 to 89.66)	38.03 (-23.53 to 76.70)
	Massachusetts (25)	55.94 (0.47 to 97.38)	43.36 (-11.65 to 78.00)
	New Hampshire (33)	52.87 (-16.71 to 91.44)	39.51 (-20.98 to 77.43)
	Rhode Island (44)	57.91 (6.20 to 96.23)	44.16 (-5.98 to 77.66)
	Vermont (50)	51.15 (-15.77 to 92.63)	38.03 (-20.87 to 77.93)

Census Region 4: West (CENS-R4)	New Mexico (35)	68.35 (15.64 to 104.77)	47.76 (-2.29 to 81.74)
	Utah (49)	57.89 (5.84 to 102.55)	40.67 (-11.63 to 83.52)
	Wyoming (56)	55.54 (-5.07 to 116.15)	37.60 (-19.39 to 80.66)
	California (06)		49.05 (-4.65 to 95.52)
	Oregon (41)		42.52 (-7.86 to 84.11)
	Washington (53)		42.58 (-15.18 to 84.27)
	<b>Total</b>	<b>60.36</b> <b>(-17.86 to 120.07)</b>	<b>42.05</b> <b>(-30.31 to 95.52)</b>
<b>Total</b>	<b>66.05</b> <b>(-18.42 to 120.07)</b>	<b>48.15</b> <b>(-36.61 to 95.52)</b>	

**Regional  
Total and  
Overall Total**

**Notes**

[Top](#) [Options](#) [Notes](#) [Citation](#) [Query Cr](#)

**Notes:**

**Help:** See [North America Land Data Assimilation System \(NLDAS\) Daily Air Temperatures and Heat Index \(2003-2008\) Documentation](#) for more information.

**Query Date:** Sep 12, 2011 11:11:12 PM

**Citation**

[Top](#) [Options](#) [Notes](#) [Citation](#) [Query Cr](#)

**Suggested Citation:**

Can change

Different Maps,  
Different  
Variables

Map  
Appearanc  
e

Category  
Breaks

### 1. Select map(s) to create:

Map

Pick one or more items from each list. A map will be created for each combination of items selected.

#### Locations

- The United States
- Census Region 1: Northeast
- Census Region 2: Midwest
- Census Region 3: South
- Census Region 4: West
- Division 1: New England
- Division 2: Middle Atlantic
- Division 3: East North Central

#### Measures

- Avg Daily Max Air Temperature(F)
- Min Temp for Daily Max Air Temp(F)
- Max Temp for Daily Max Air Temp(F)
- Avg Daily Min Air Temperature(F)
- Min Temp for Daily Min Air Temp(F)
- Max Temp for Daily Min Air Temp(F)

Other By-Variables:  
None

### 2. Control map appearance:

Map

Height in Pixels

Labels

Zoom in to smallest extent

Show Interstate Labels

Map Title

New Page Each Map  (Start maps on a new page when printing.)

Color Scheme

Geography Year

Precision

Show Rivers

### 3. Control category breaks:

Map

Click the button for the type of category break desired, and make selections.