# 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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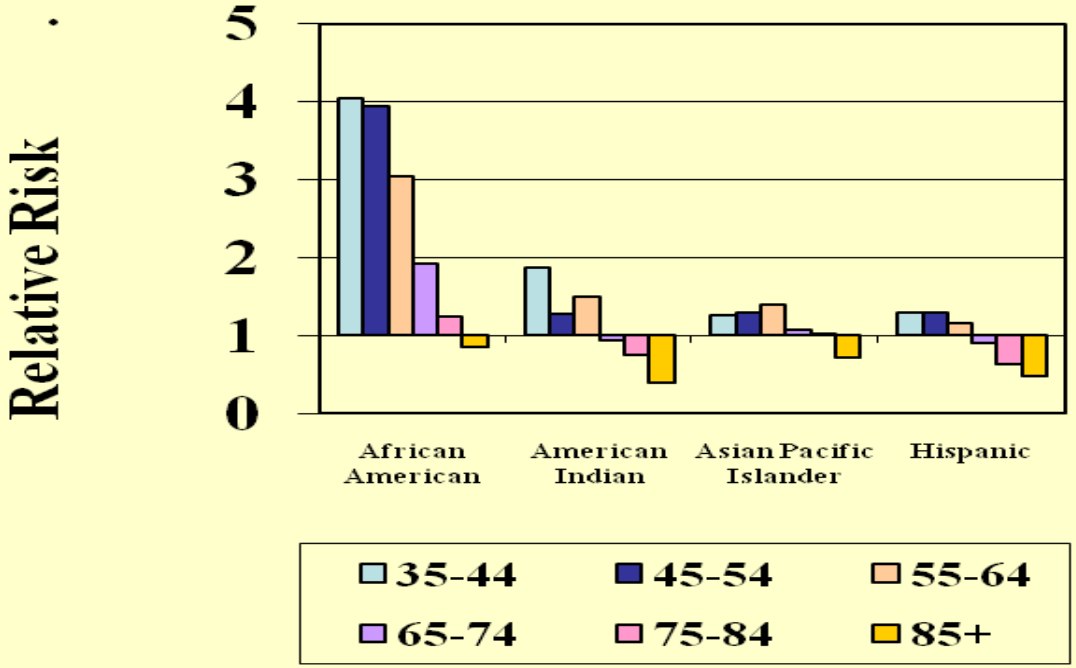
Santa Fe, New Mexico

# Outline

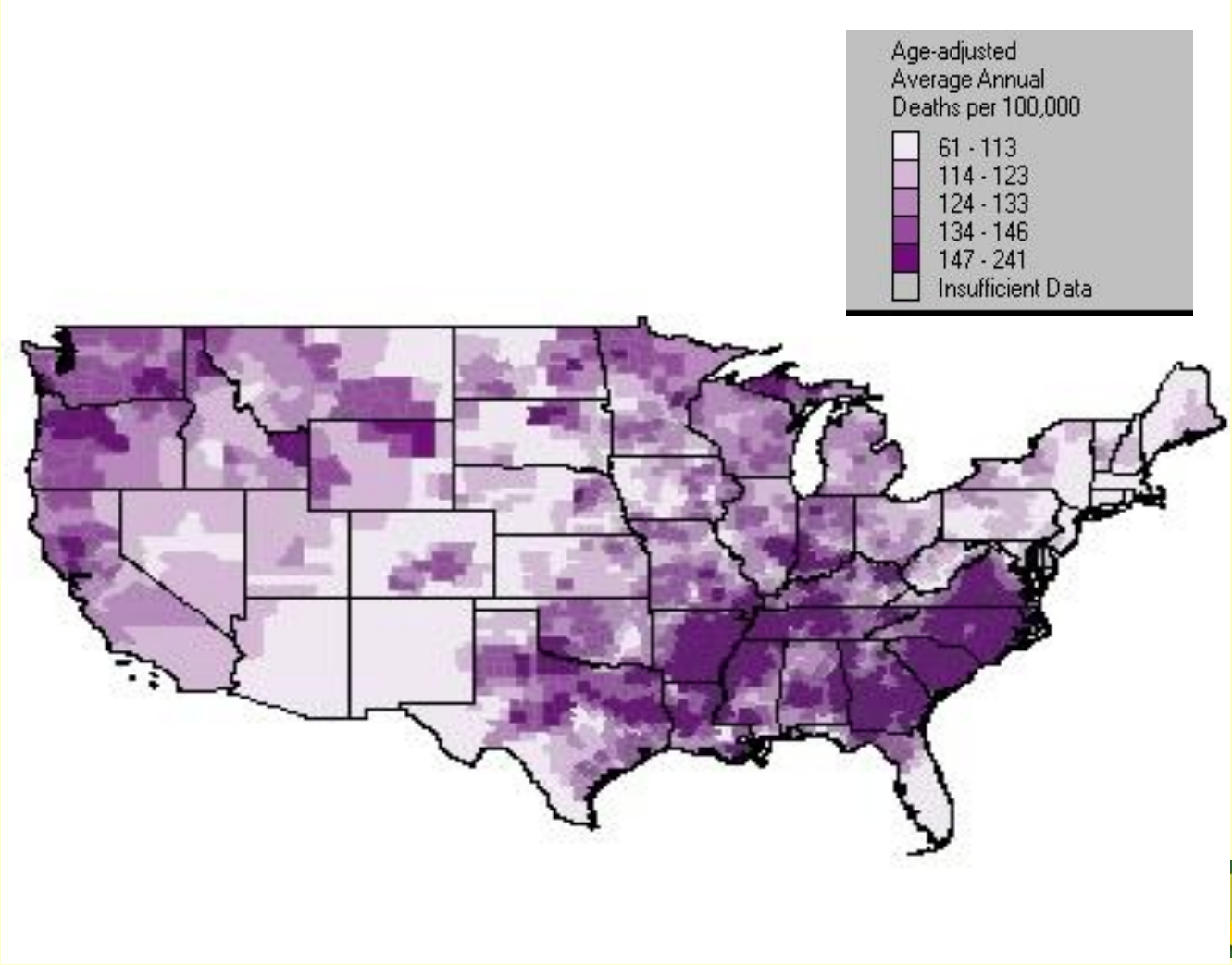
- Brief introduction to REGARDS
- Objectives of current funding
- Progress to date
- Goals for the next year

# Why REGARDS?
## *Racial Disparities*

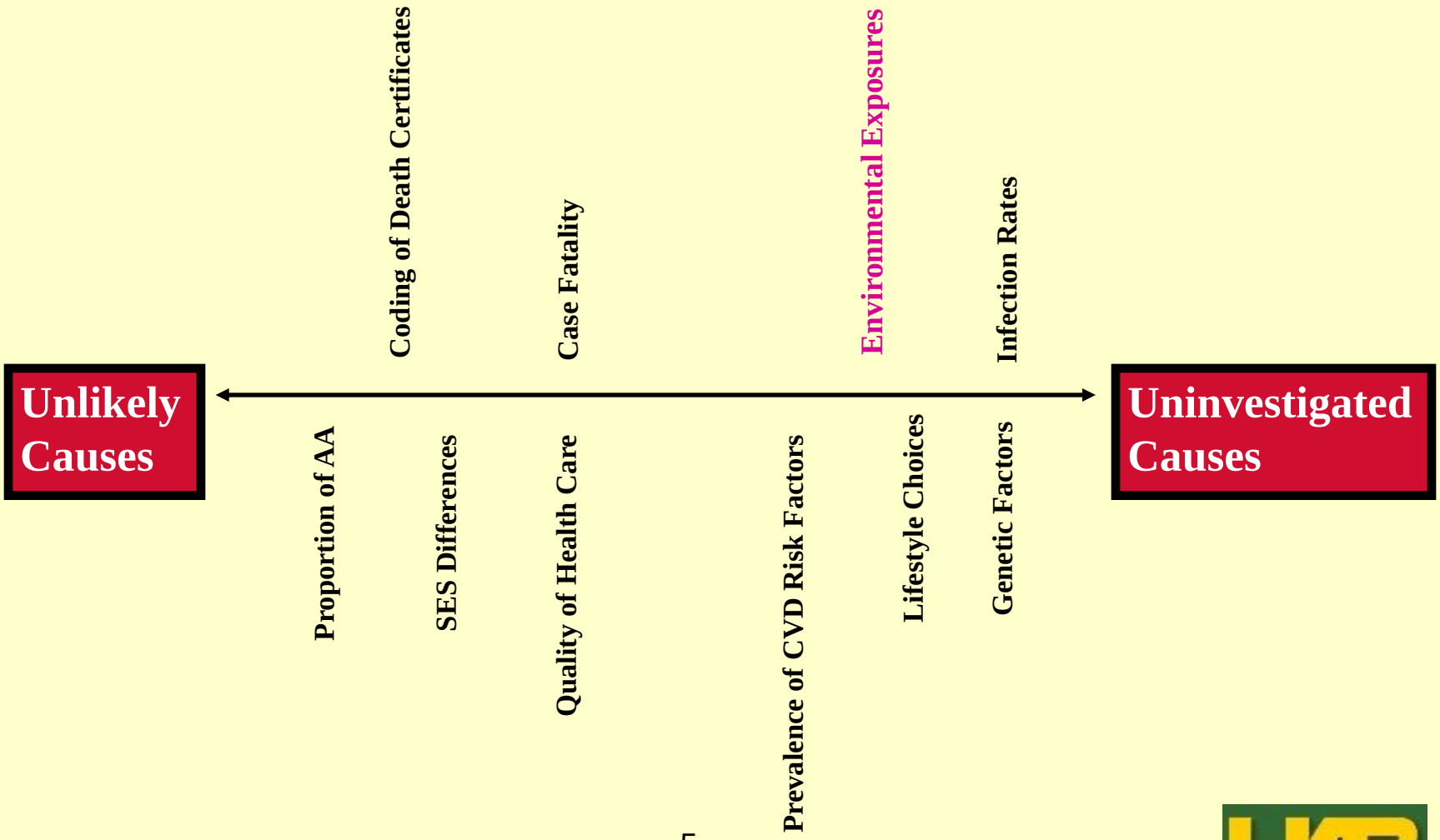
**Race/Ethnic Relative Risk**
White Reference (1997)



# Why REGARDS?
## *Regional Disparities*



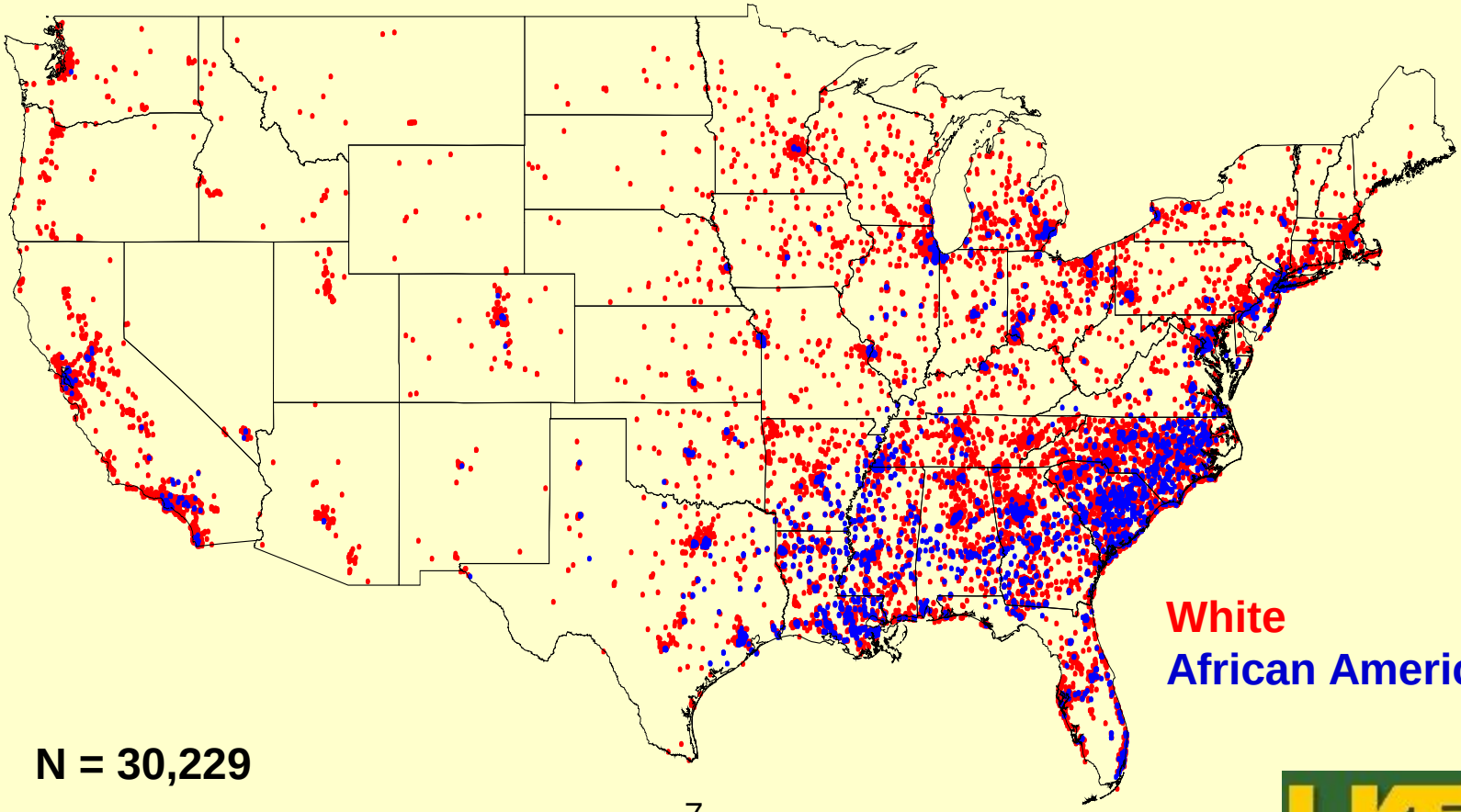
# Why REGARDS?
## *Regional Disparity*



# 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 $PM_{2.5}$, 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
- Disseminate the dataset to end-users for decision making through CDC WONDER

# Objectives of the Current Project

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

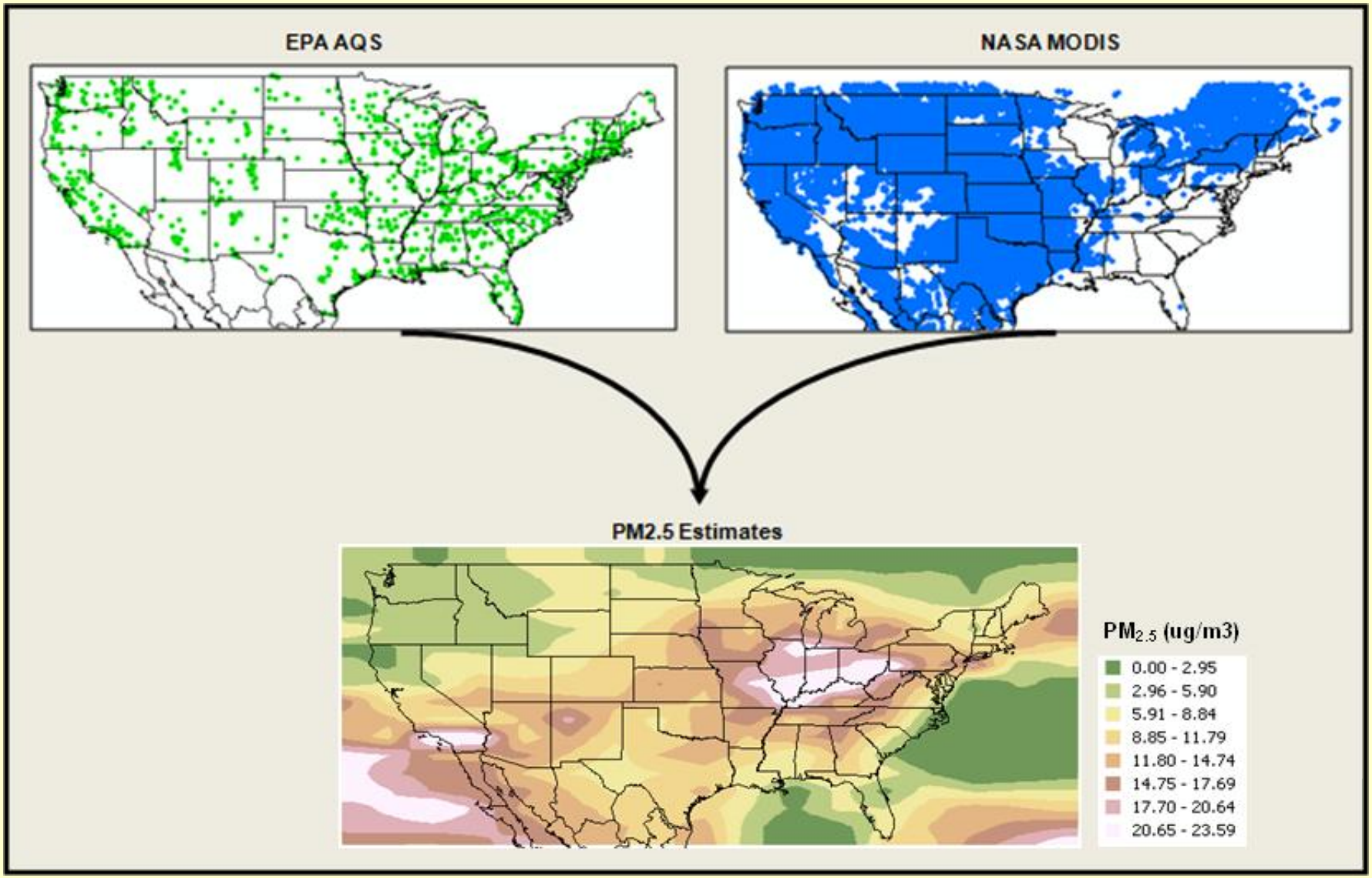
# Objectives (continued)

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

# Year 2 Status

1. Produce daily gridded estimates of $PM_{2.5}$ for the conterminous US for the years 2003-2008 from MODIS Aqua data
   - All of the daily AQUA MODIS AOD data for the US have been acquired, downloaded, and processed for 2003-2008, as have the EPA AQS $PM_{2.5}$ data
     - Processing algorithm has been updated since the HELIX ATLANTA project, based on recently published regression equations by EPA region and season
     - MSFC surfacing algorithm has been modified to generate continuous spatial surfaces of $PM_{2.5}$ (10 km resolution)
     - QC procedures and bias adjustment have been performed
   - $PM_{2.5}$ data will be delivered for linkage on September 23

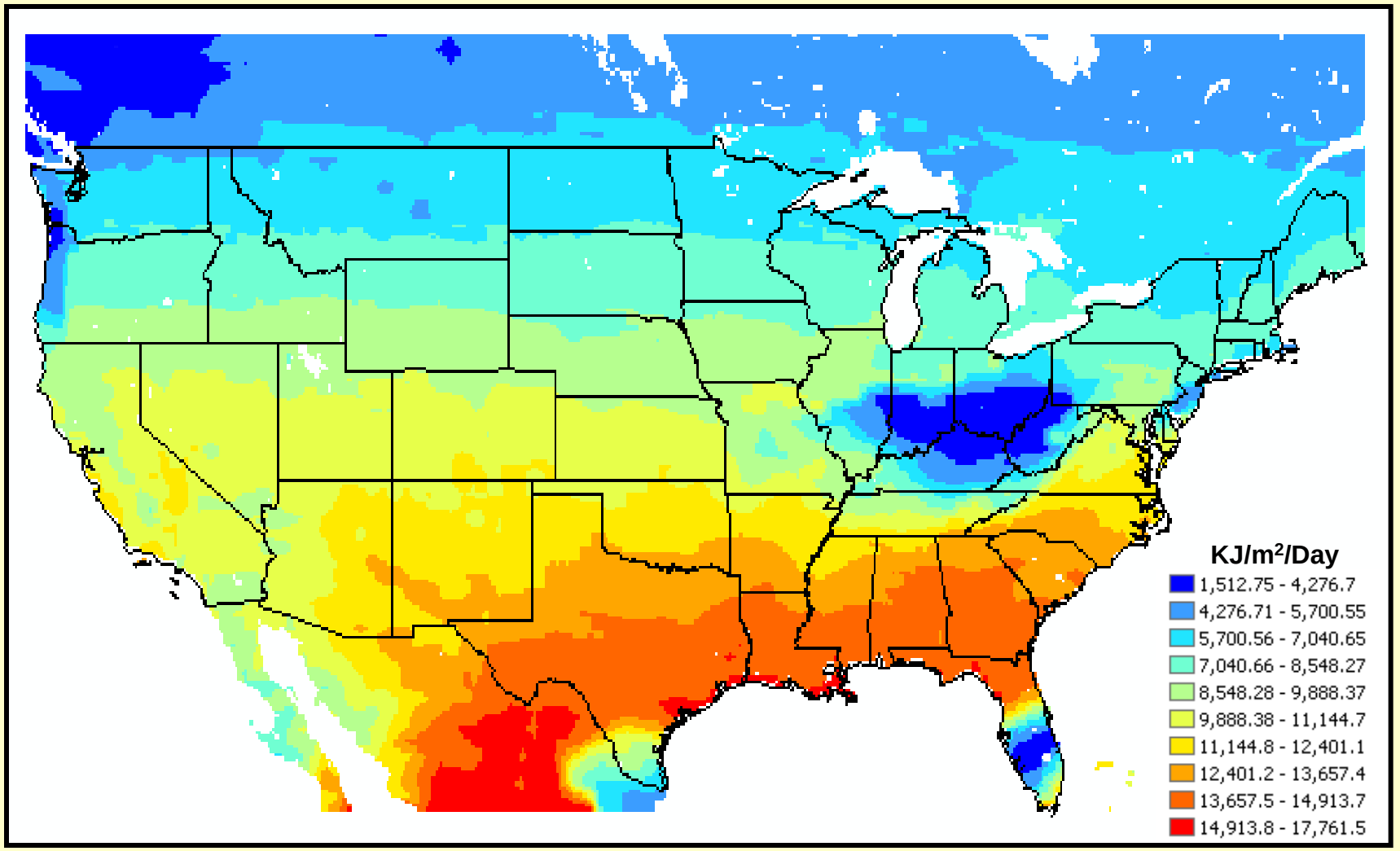
# $PM_{2.5}$ Data Algorithm



# Year 2 Status

2. Produce daily gridded solar insolation (SI) maps for the conterminous US during the same period using data from the NARR
   - As reported last year, these data were linked with REGARDS participants during year 1(using NLDAS, 12 km resolution)

# NLDAS Solar Insolation on January 1, 2008

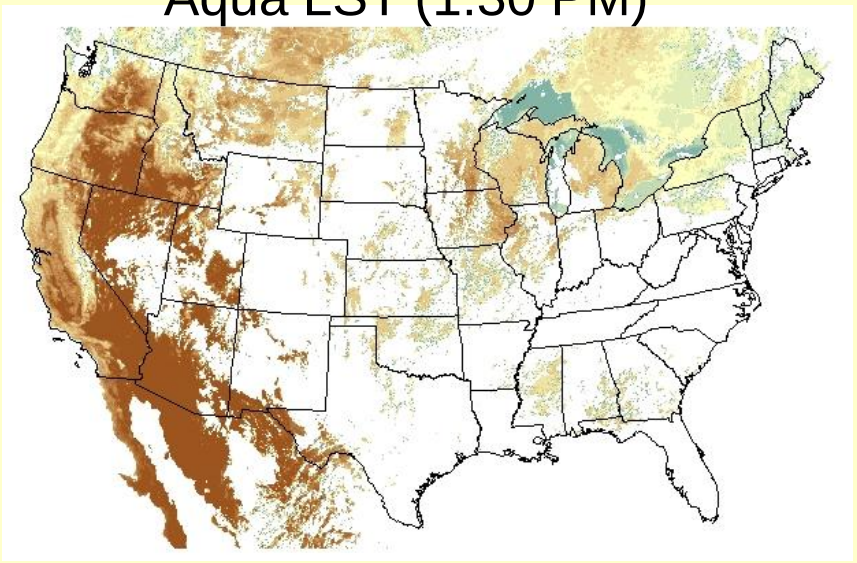


# Year 2 Status

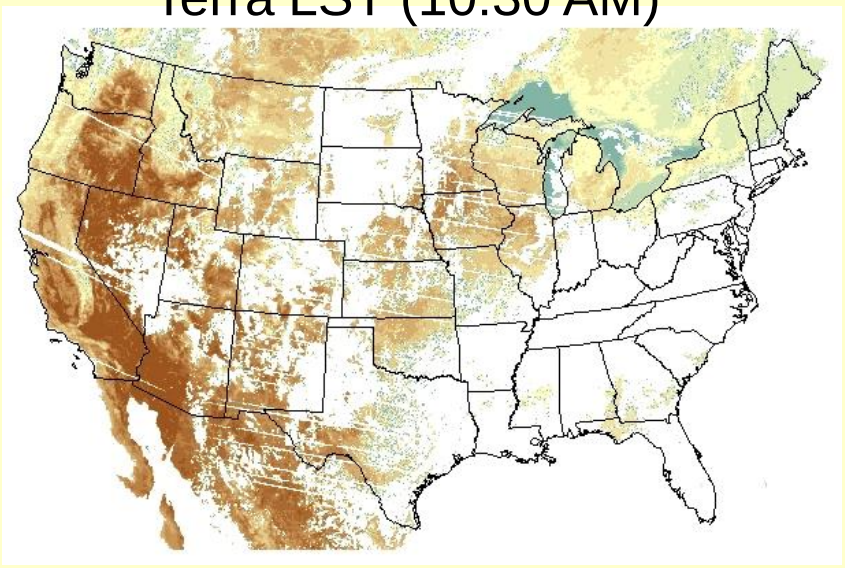
3. Produce daily gridded and surface temperature (LST) maps over the conterminous US during the same period using data from MODIS
   - At the time of last year's report, these data were processed
     - Gaps in coverage prompted us to use NLDAS (12 km resolution)
   - Since then, these data have been linked with REGARDS participants

# Land Surface Temperature (LST) on June 16, 2003

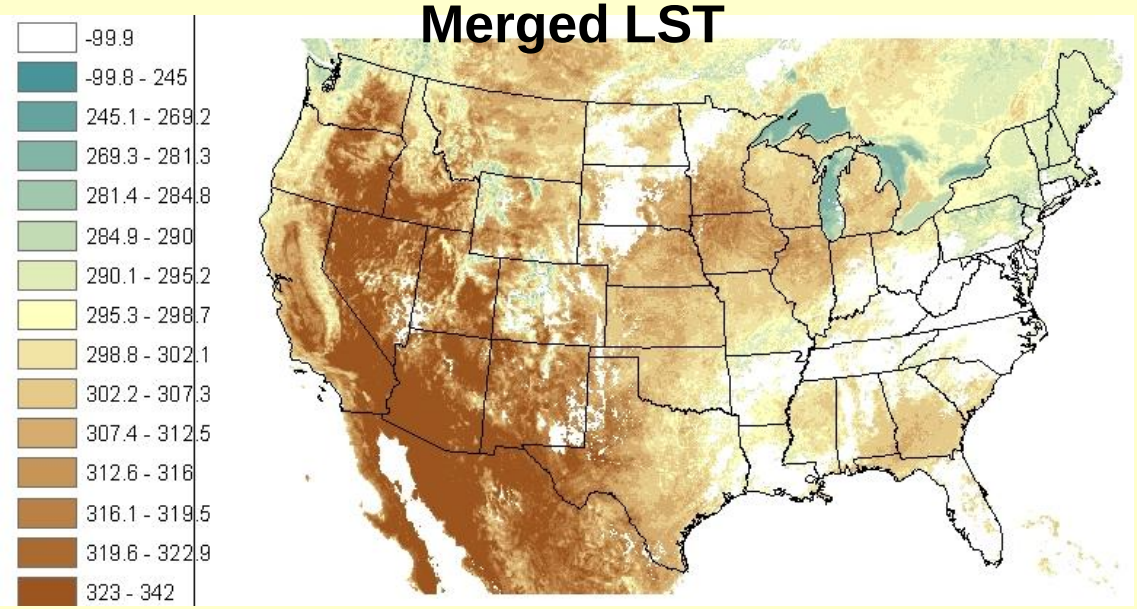
Aqua LST (1:30 PM)



Terra LST (10:30 AM)

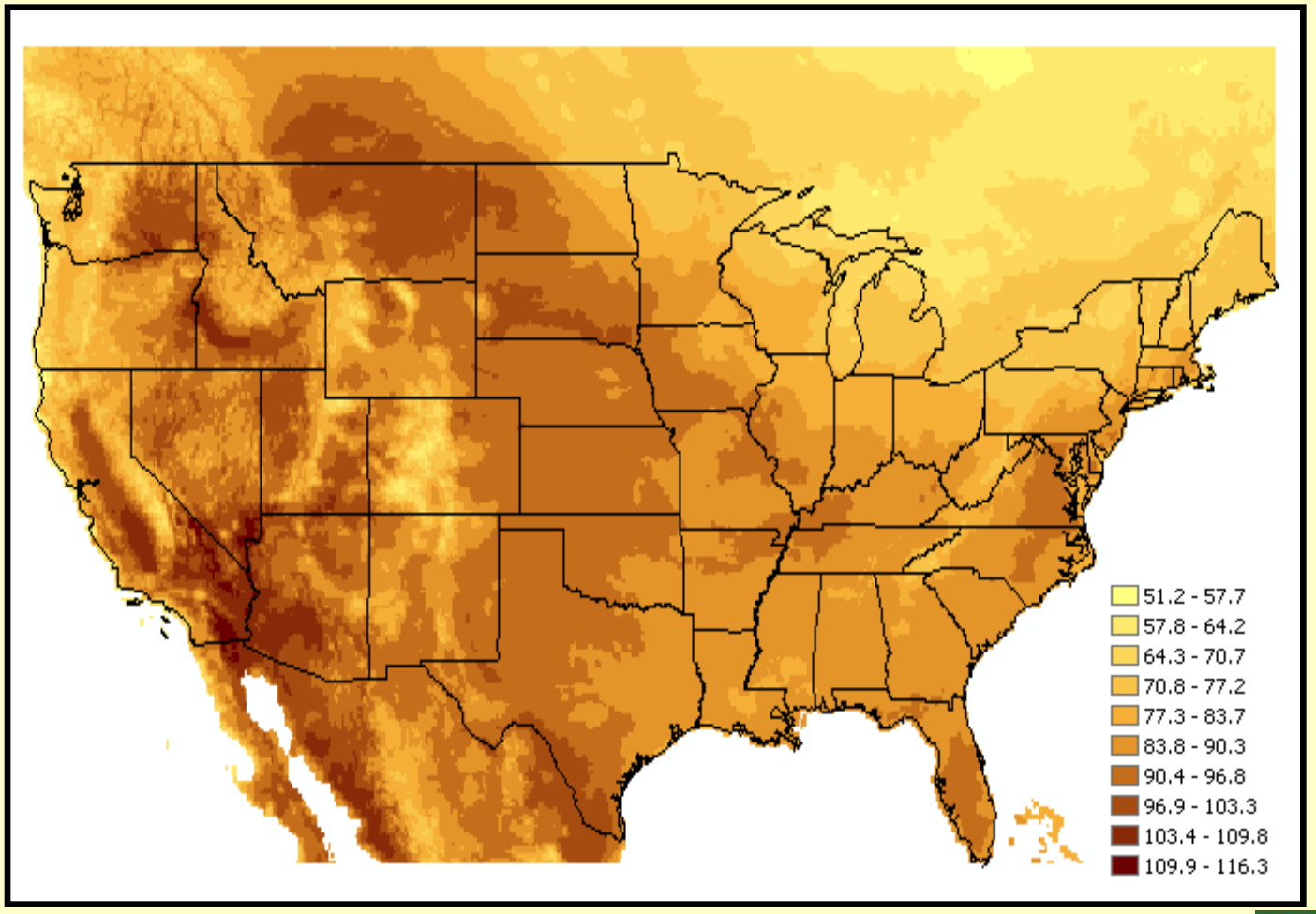


## Merged LST




**Slide prepared by W. Crosson, G. Wade & S. Hemmings**

# NLDAS Max Air Temperature, July 15, 2008



# Year 2 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 but PM have been linked; PM to be linked later this month
   - Linkage done based on a random grid-cell assigned to each participant's longitude and latitude

# Year 2 Status

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
   - First analysis of SI, LST and cognitive decline has been completed and manuscript drafted (Shia Kent's dissertation: Paper 1)
   - Additionally, analysis of SI, LST and stroke has been completed and manuscript drafted (Shia Kent's dissertation: Paper 2)
   - $PM_{2.5}$ and cognition analyses to commence shortly after data are transferred and linked

# Cognitive Data

- Analyses first assessed the most appropriate exposure for both SI and LST period: 15 yr, 10 yr, 5 yr, 2 yr or 1 yr
  - Found 1-year period prior to baseline to have the strongest association with cognitive decline
  - However, no clear temporal trends emerged
    - Second strongest association was observed with the 15-year period; weakest association was observed with the 5-year period

# Cognitive Data

- Next, assessed whether the association between each of SI and LST and cognitive decline was significant after inclusion of known risk factors for cognitive decline
  - Additionally, considered whether the impact of SI varied as a function of LST (that is, was there an interaction)
  - Used logistic regression models to determine whether the odds of incident impairment varied by each exposure

# Cognitive Data

- Found that even after multivariable adjustment, there is an association between SI and cognitive decline, but that this relationship differs depending on the temperature (p for interaction=0.0011)

Association between SI (below median vs. above median) and decline, by temperature tertile

| | OR (95% CI) |
|---|---|
| 1st Tertile of Temp | 1.26 (0.94, 1.68) |
| 2nd Tertile of Temp | 1.30 (1.06, 1.58) |
| 3rd Tertile of Temp | 1.95 (1.29, 2.96) |

# Stroke Data

- Analyses followed the same methods as the cognitive decline data
  - Assessed the appropriate exposure measure for solar insolation and daily maximum temperature
    - Again, used average exposure during the year prior to baseline interview

# Stroke Data

- Next, assessed whether the association between each of SI and LST and stroke was significant after inclusion of known risk factors for stroke
  - Accounted for known stroke risk factors, other possible confounders that may be “in the pathway”

# Stroke Data

- Found that those above the median SI exposure were less likely to have stroke than those below the median, independent of known stroke risk factors and LST
- Those exposed to SI below the median were 1.61 times more likely to have a stroke than those exposed to SI levels above the median (95% CI: 1.15, 2.26)
- Found that there was a J-shaped association between maximum temperature and stroke, again after multivariable adjustment

| | OR (95% CI) |
|---|---|
| 1st Quartile of Temp | 1.41 (0.99, 2.03) |
| 2nd Quartile of Temp | REF |
| 3rd Quartile of Temp | 1.69 (1.17, 2.46) |
| 4th Quartile of Temp | 1.91 (1.27, 2.91) |

# Year 2 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)
   - We are beginning to draft manuscript proposals to examine associations between secondary outcomes and SI
     - Are hoping to use split sample methodology to take advantage of the large sample size in REGARDS for these largely hypothesis-generating analyses

# Year 2 Status

7. Deliver daily gridded environmental data sets ($PM_{2.5}$, SI and LST) to CDC-WONDER for the 2003-08 period
   - We have had many discussions with our CDC-WONDER collaborators during the last year**, and now** have a prototype page up and running
     - We are currently making edits/changes to this site, but are excited about having it go live soon

http://wonder.cdc.gov/nasa-v2010-2.html

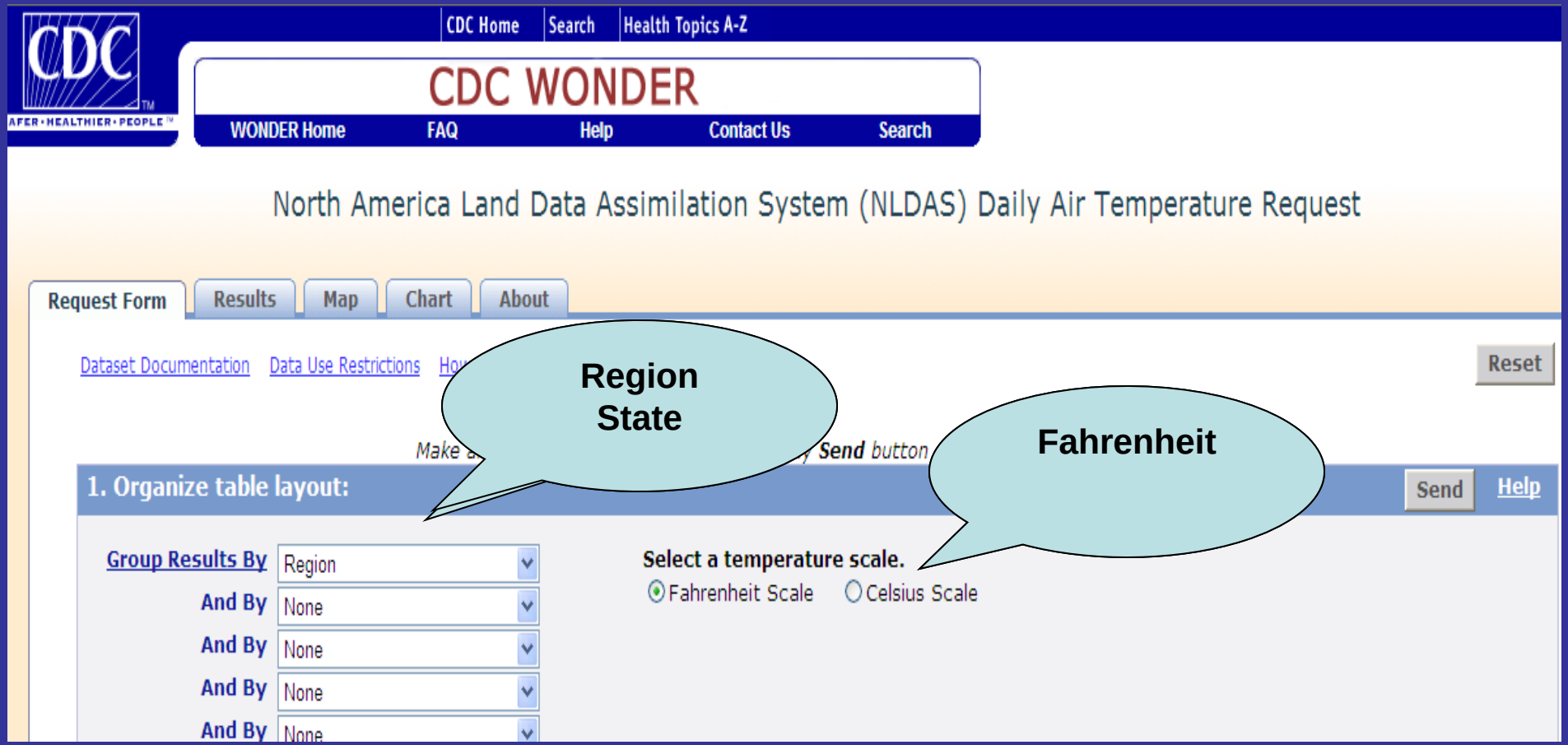
# Planned Year 3 Activities

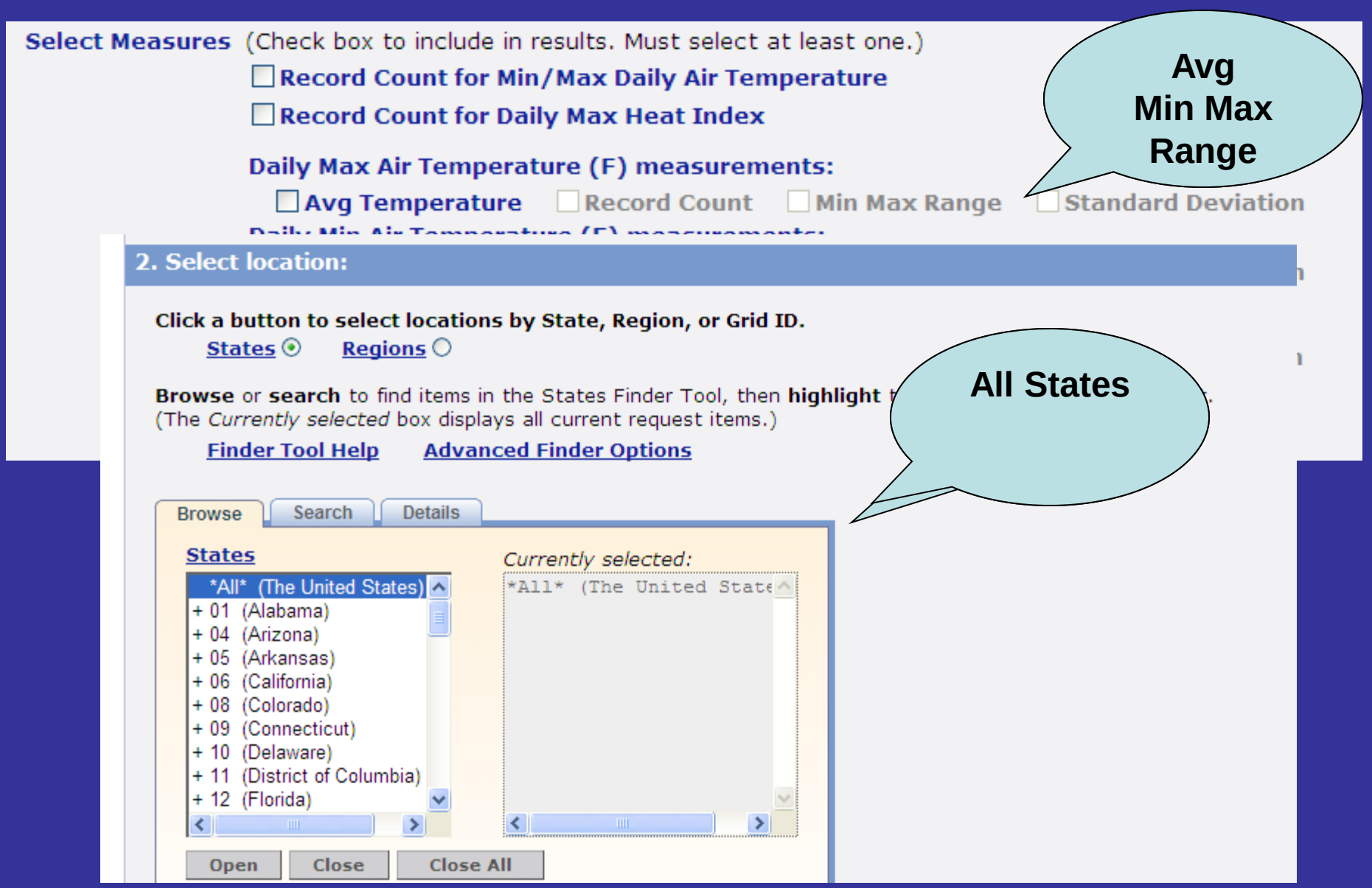
- Link the $PM_{2.5}$ data; analyze the linked dataset
- Complete the secondary analyses of both the SI and $PM_{2.5}$ data
- Complete data transfer between MSFC and CDC-WONDER
- Develop ideas for and submit additional grants that continue and further our current work

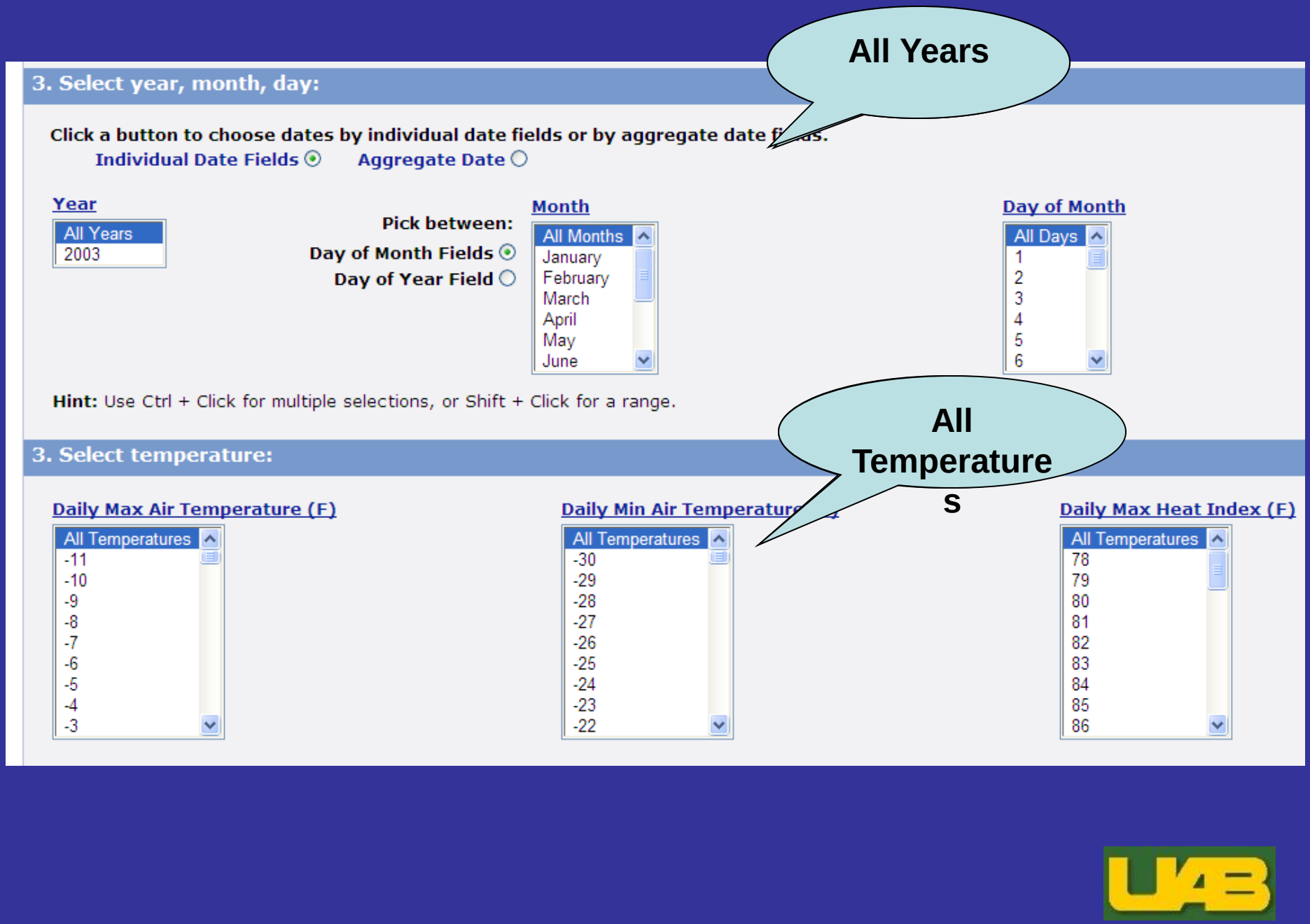
# Major Deliverables & Time Schedule

- We are ahead of our timeline with almost all of our deliverables, with the exception of the $PM_{2.5}$ data
  - For the PM data, we are right on schedule

| Task | | Year 1 | | | | Year 2 | | | | Year 3 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 |
| 1a | Production of LST data set | | | | | | | | | | | | |
| 1b | Production of solar insolation data set | | | | | | | | | | | | |
| 1c | Production of $PM_{2.5}$ data set | | | | | | | | | | | | |
| 2a | Linkage of LST and cognitive decline data sets | | | | | | | | | | | | |
| 2b | Linkage of insolation and cognitive decline data sets | | | | | | | | | | | | |
| 2c | Linkage of $PM_{2.5}$ and cognitive decline data sets | | | | | | | | | | | | |
| 3a | Analysis of insolation and cognitive decline | | | | | | | | | | | | |
| 3b | Analysis of $PM_{2.5}$ and cognitive decline | | | | | | | | | | | | |
| 4a | Analysis of insolation and secondary outcomes | | | | | | | | | | | | |
| 4b | Analysis of $PM_{2.5}$ and secondary outcomes | | | | | | | | | | | | |
| 5 | Transition to end-users through CDC WONDER | | | | | | | | | | | | |
| 6 | Final research report | | | | | | | | | | | | |


CDC Home
Search
Health Topics A-Z
CDC WONDER
WONDER Home
FAQ
Help
Contact Us
Search
North America Land Data Assimilation System (NLDAS) Daily Air Temperature Request
Request Form
Results
Map
Chart
About
Dataset Documentation
Data Use Restrictions
Reset
Region
State
Fahrenheit
1. Organize table layout:
Send
Help
Group Results By
Region
And By
None
And By
None
And By
None
And By
None
Select a temperature scale.
Fahrenheit Scale
Celsius Scale


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
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 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 Temperatures
3. Select temperature:
Daily Max Air Temperature (F)
All Temperatures
-11
-10
-9
-8
-7
-6
-5
-4
-3
Daily Min Air Temperature
All Temperatures
-30
-29
-28
-27
-26
-25
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-23
-22
Daily Max Heat Index (F)
All Temperatures
78
79
80
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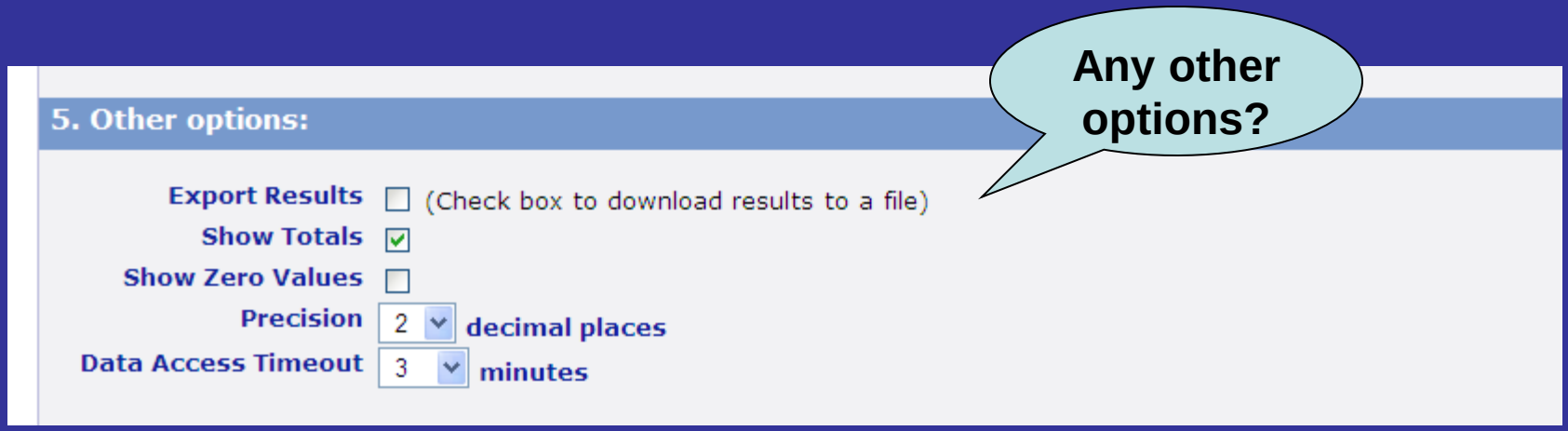
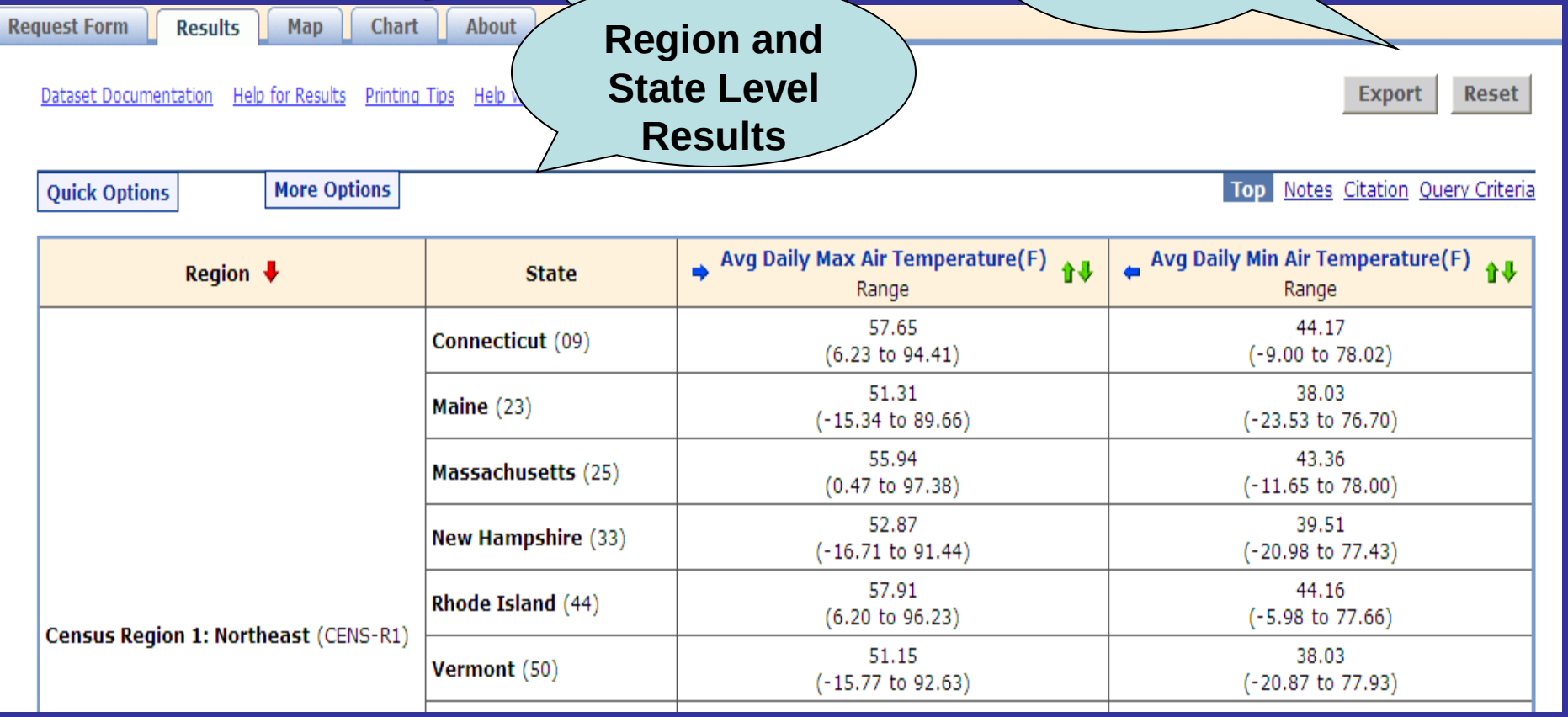
84
85
86




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

Several Levels of Region and State Level Results

Export the Data




| 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<br>(15.64 to 104.77) | 47.76<br>(-2.29 to 81.74) |
| | **Utah** (49) | 57.89<br>(5.84 to 102.55) | 40.67<br>(-11.63 to 83.52) |
| | **Wyoming** (56) | 55.54<br>(-5.9 | 37.60<br>(-19.39 to 80.66) |
| | **California** (06) | | 49.05<br>(-4.65 to 95.52) |
| | **Oregon** (41) | | 42.52<br>(-7.86 to 84.11) |
| | **Washington** (53) | (1.15 to 110.33) | 42.58<br>(-15.18 to 84.27) |
| | **Total** | **60.36**<br>**(-17.86 to 120.07)** | **42.05**<br>**(-30.31 to 95.52)** |
| **Total** | | **66.05**<br>**(-18.42 to 120.07)** | **48.15**<br>**(-36.61 to 95.52)** |

**Regional Total and Overall Total**

**Notes**



## Notes:

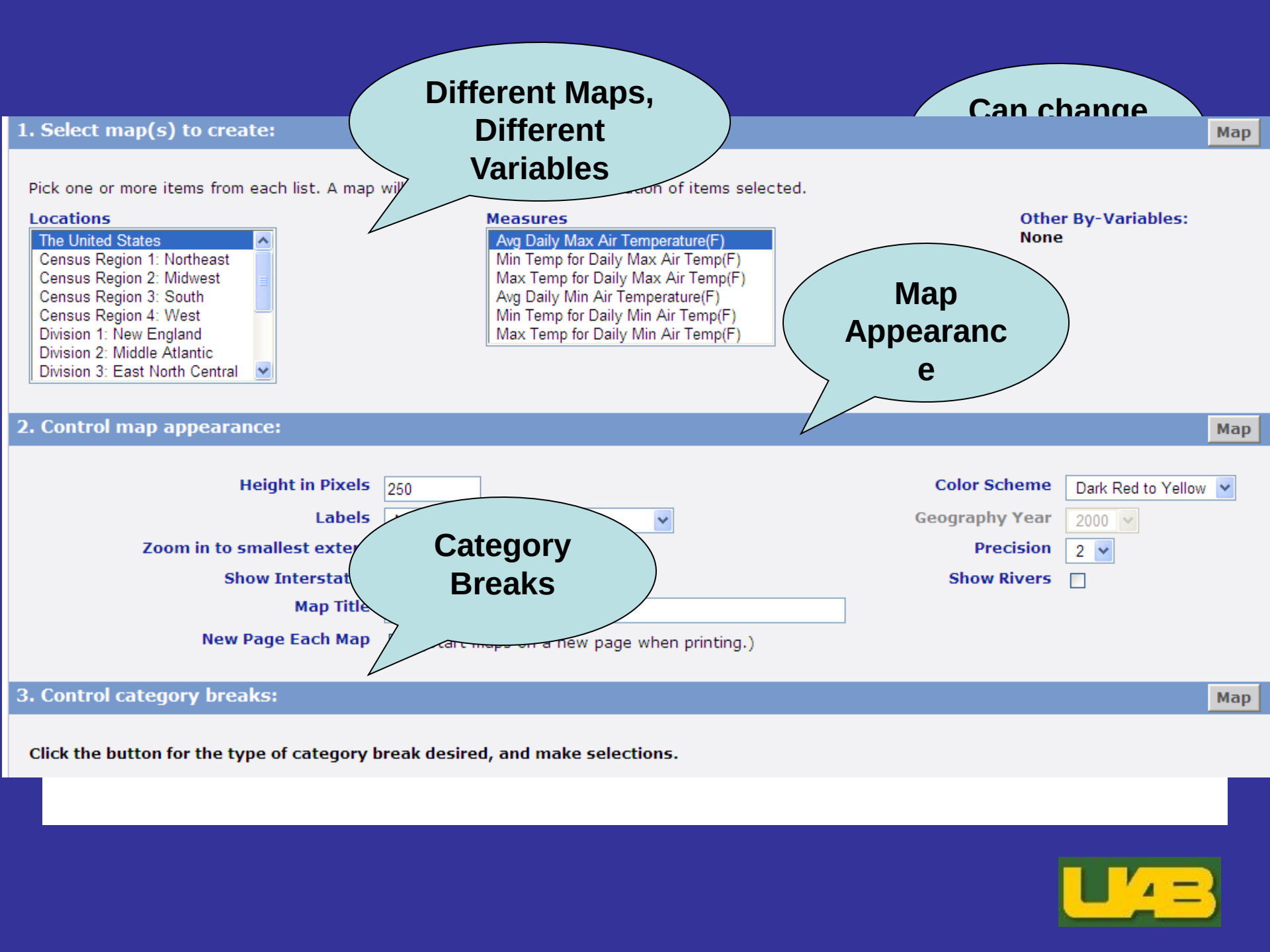
**Help:** See North America Land Data Assimilation System (NLDAS) Daily Air Temperatures and Heat Index (2003-2008) Documentation for more information.

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

**Citation**



## Suggested Citation:


Different Maps, Different Variables
Can change
1. Select map(s) to create:
Map
Pick one or more items from each list. A map wil
ation 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:
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Map Appearanc e
2. Control map appearance:
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Labels
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tart maps on a new page when printing.)
Color Scheme
Dark Red to Yellow
Geography Year
2000
Precision
2
Show Rivers
Category Breaks
3. Control category breaks:
Map
Click the button for the type of category break desired, and make selections.

# Collaborators

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