

# A Data Fusion Approach for Daily Humidity at Public Health Relevant Scales Using AI methods

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# Motivation

The influence of humidity on human heat stress is an understudied mechanism. This is due, in part, to the lack of a homogenized humidity dataset at the spatial (US County) and temporal (daily maximum, minimum, average) resolutions necessary for coordinated analysis with public health data.



*Rising temperatures coupled with high humidity creates dangerous conditions for outdoor workers.  
Source: Cyrus McCrimmon/Denver Post/Getty Images*

# Objective

The objectives of this work are to:

(1) develop a homogenized humidity dataset at the spatial (US County and census tract) and temporal (daily) resolutions, and

(2) conduct a pilot health study examining the independent and joint effects of ambient temperature and humidity on emergency cardiac admissions in North Carolina, 2009-2020.

# AI fusion approach

We propose to develop a homogenized humidity dataset by blending remotely-sensed and in-situ data using AI methods.

Pilot project domain: Southeast CONUS, 2000-2020



# Humidity variables

Of the >100 metrics available to assess thermal health hazards, we have selected 5 candidate indices for further evaluation: Heat index, Humidex, Universal Thermal Climate Index, WBGT, sWBGT

All of these metrics may be calculated from the following 3 key environmental variables:

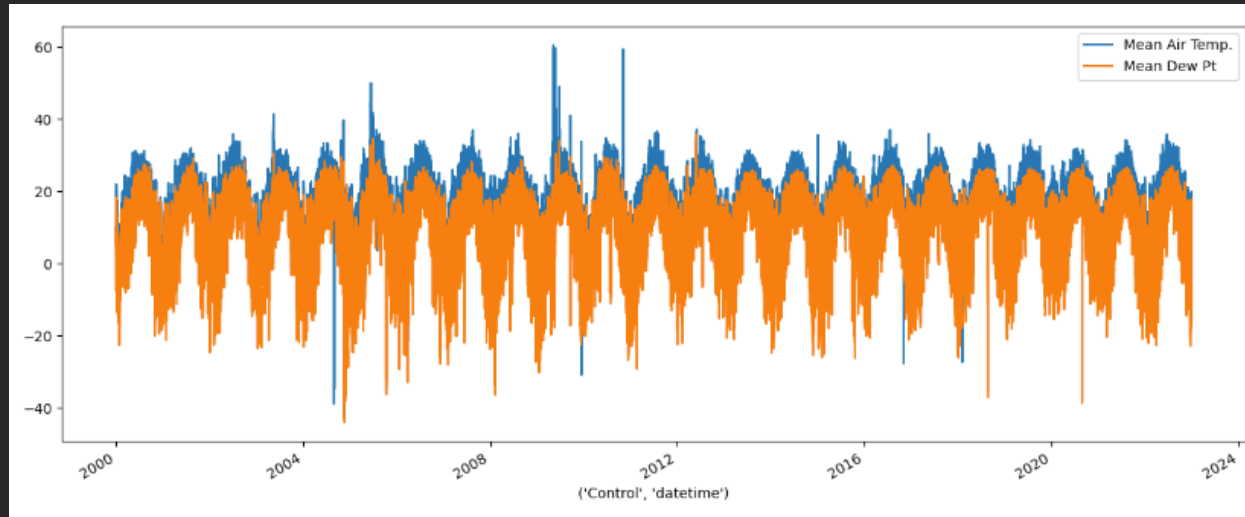
- Ambient temperature
- Dew point temperature
- Relative humidity

# Humidity observational data: Overview

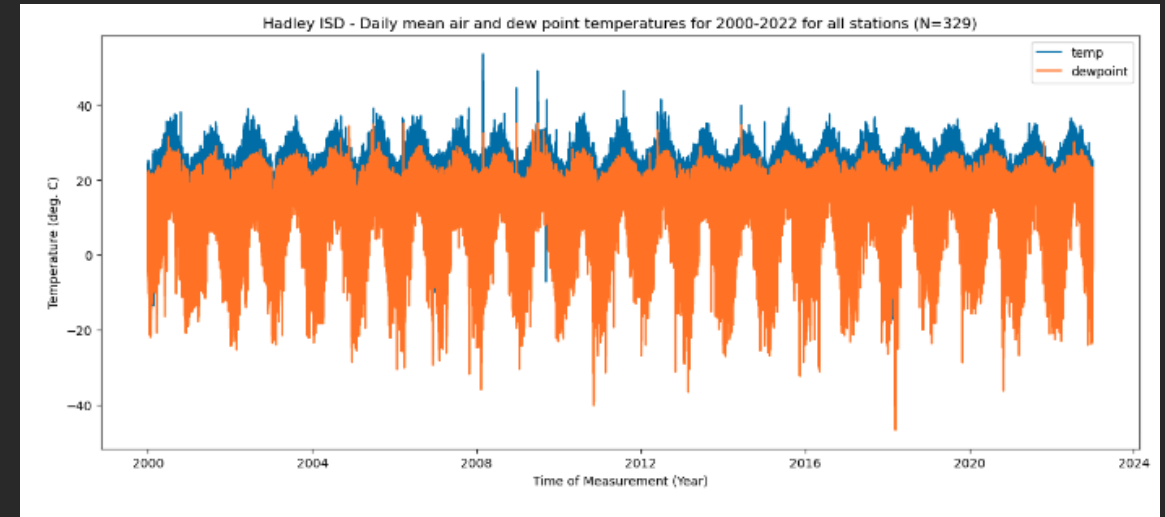
Hadley ISD	HIRS	MODIS
329 stations across the Southeast US	MetOp-A, NOAA-14, NOAA-15, NOAA-16, NOAA-17 satellites	TERRA and AQUA satellites
Hourly data From Hadley group at UK Met Office Has gone through additional layers of QA/QC	Twice daily Polar-orbiting satellites	Morning observations from TERRA Afternoon observations from AQUA
Data was subset for 2000-2020	Data was subset for 2000 - 2020	2000 - 2020

# Humidity observational data: In Situ Data

ISD



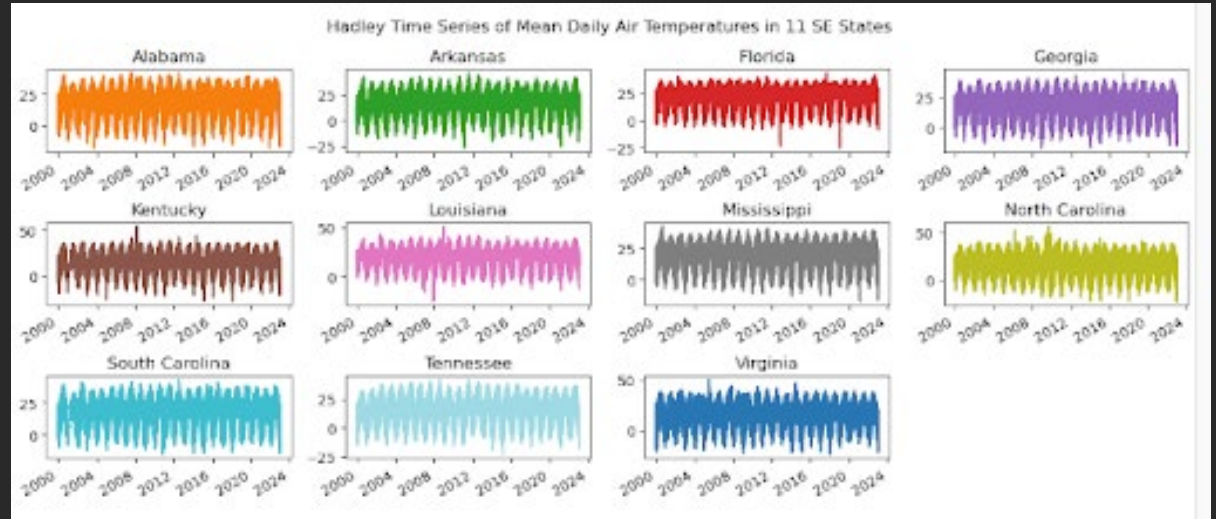
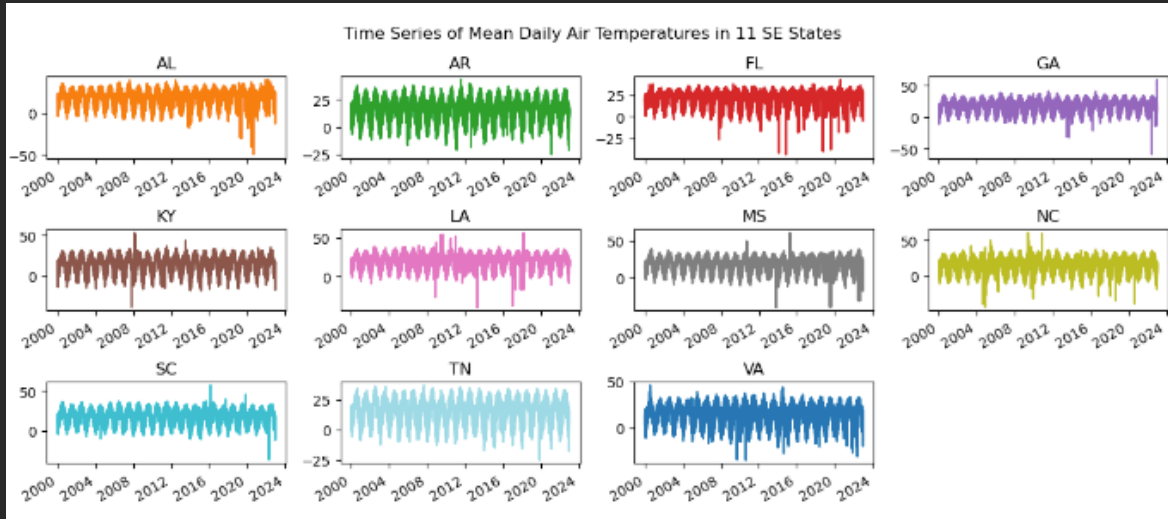
HadISD



# In Situ Data: Temporal Coverage

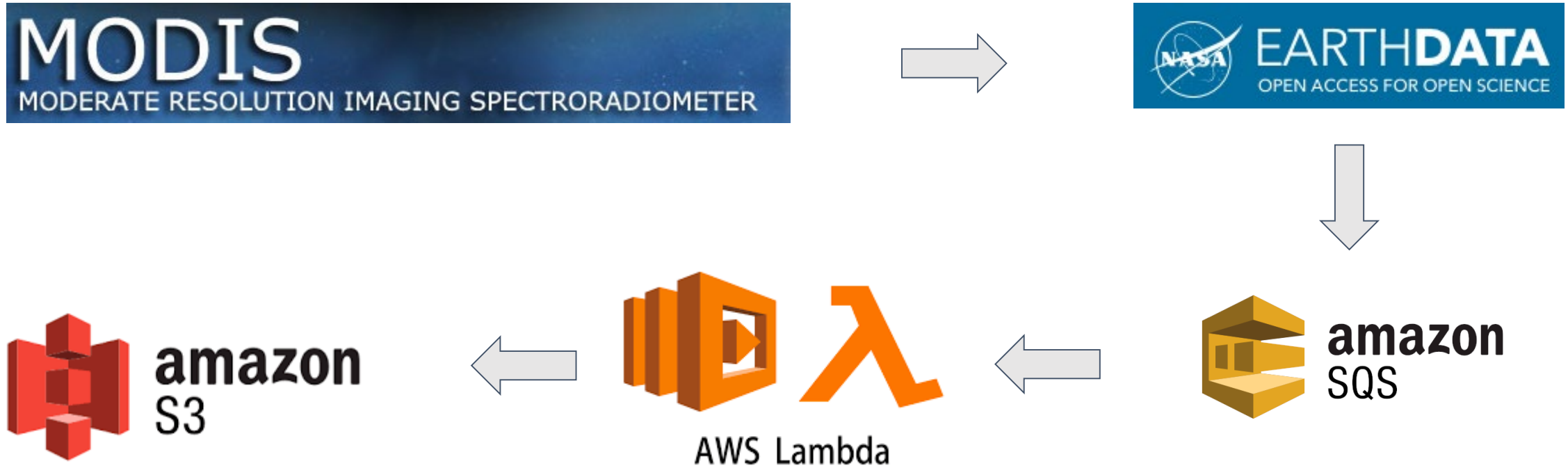
ISD

HadISD



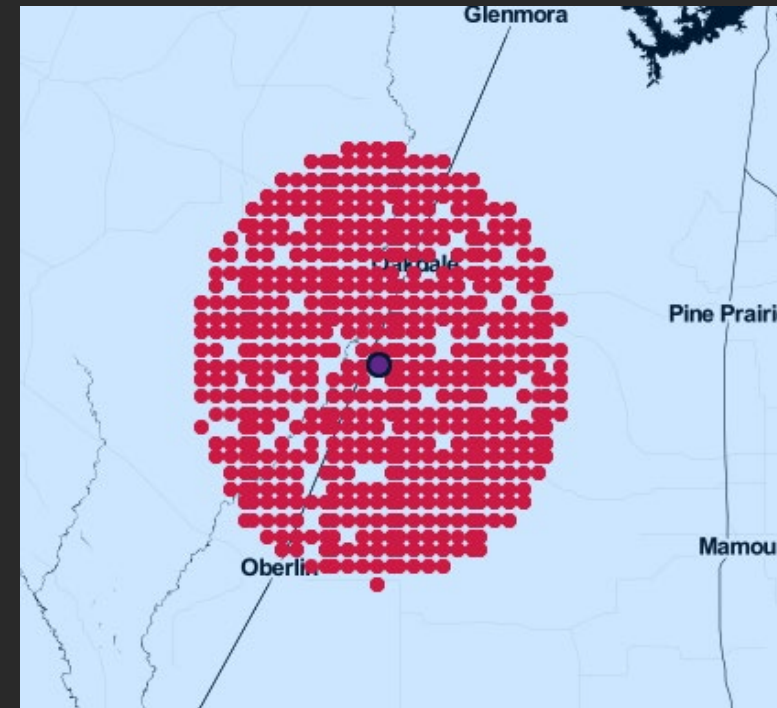


# Humidity observational data: Remote Sensing Data



# Colocating In Situ and Remote Sensing Data

In preparation for AI algorithm training, data pairs were identified for remote-sensing pixels containing a HadISD station with observations  $< 1$  hour apart.



# How were remote-sensing pixels that contained a HadISD station identified?

The HIRS/2 and HIRS/3 sensors have a resolution of 18km, and are on the N-14, N-15, N-16, and N-17 satellites.

The HIRS/4 sensor has a resolution of 10km, and is on the N-19 and M-02 satellites.

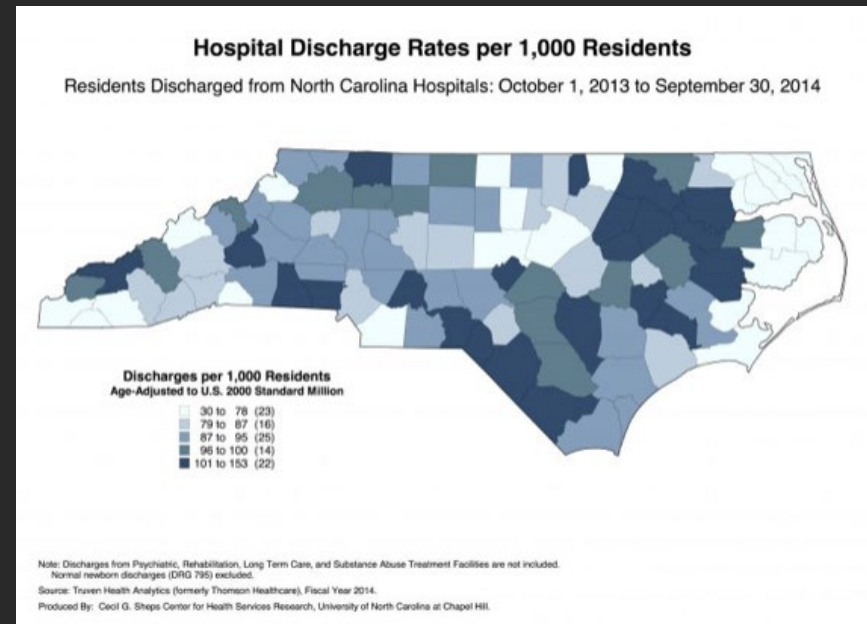
Based on these resolutions, all HIRS/4 pixels that were within 0.1414 degrees, and all HIRS/2 and HIRS/3 pixels that were within 0.2546 degrees, of a HadISD station were captured.

# Health targets



Inpatient emergency department visit data for a large sample of the US from the Healthcare Cost and Utilization Project (HCUP)

North Carolina individual level inpatient and ED visit data from the Sheps Center (2008-21)



# Next steps

- AI algorithm training
- Creation of beta-level version of a homogenized humidity dataset for SouthEast CONUS, 2000-2020.
- Evaluation of relationships between heat health hazard metrics and excess risk for cardiovascular disease-associated emergency department admissions.

# Acknowledgements

We thank the NOAA Center for Artificial Intelligence (NCAI) for supporting this pilot project.



Questions?

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