Prospectus Outline

A. Motivation for thesis topic(s)
    a. Heat as a human hazard
        i. Heat as a top threat
        ii. Future changes
            1. Population
            2. Climate change
    b. Bridging a "Public Health / Climate" community gap
        i. Urban climate studies
        ii. EHE trends
        iii. Climate datasets?

B. EHE trends analysis
    a. Study introduction / literature review
        i. Temperature trend analysis lit review
            1. Review of important Epidemiological literature
            2. Current extreme temperature trends literature
            3. EHE trends studies highlighted
        ii. Hypotheses
            1. Spatial average trends exist
            2. Spatial structure
            3. Temporal structure
            4. EHE trends as function of definition
            5. Relationships with mean temperature trends
    b. Methods to be undertaken
        i. Dataset created from USHCN
        ii. EHE Characterizations (e.g. intensity, duration, timing, etc.)
        iii. EHE type definitions
        iv. Methods overview
            1. Temporal disaggregation/station selection
            2. Relationships between EHE types
            3. Spatial structure
        v. Summer average trend mean bias, absolute accuracy and spatial structure reproducibility
    c. Current results
        i. Spatial structure relevant
        ii. Significant trends (~40% of all stations)
        iii. Mild relationships between EHE types
        iv. Good relationship with summer average trends

C. Detroit urban climate investigation
    a. UHI literature review / study introduction
        i. Urban climate theory
        ii. Urban climate studies
        iii. Intersection with health sphere
    b. Hypotheses

- i. Summertime average daily extreme temperatures vary spatially across the urban/suburban domain
- ii. The magnitude of variability diagnosable by large-scale weather
- iii. The spatial pattern diagnosable by land attributes
- iv. The spatial variability exists during heat-oppressive weather

c. Methods & results overview
- i. Network characterization
- ii. Analysis of spatial variability
  1. Magnitude of spatial variability
  2. Forecasting the magnitude of spatial variability
  3. Magnitude of spatial variability during hot weather
- iii. Statistical modeling of the spatial pattern
  1. Land-cover variables
  2. Modeling efforts

d. Main conclusions
- i. Spatial variability exists
  1. On average
  2. During hot weather
  3. Magnitude can be forecasted
- ii. Spatial pattern can be modeled

D. Validation of three high resolution observational climate datasets

a. Literature review of high resolution observational datasets / study introduction
- i. Climate community observational datasets
  1. USHCN
  2. CRU
  3. GISS
  4. UDel
  5. USCRN
- ii. Hydrological community observational datasets
  1. DAYMET
  2. Maurer
  3. Di Luzio
- iii. Utility/problem of high-res. datasets

b. Hypotheses
- i. Maurer, Di Luzio and DAYMET datasets exhibit the same trends as a reference climate dataset
- ii. The gridded datasets reproduce the spatial structured in trends across the U.S.
- iii. The error in trends are not spatially autocorrelated
- iv. The error is not a function of the physical characteristics of the stations

c. Methods to be undertaken
- i. General methods/project design
  1. Reference dataset: USHCN v1+v2 (daily) dataset

2. Interpolation to selected USHCN locations
3. Universal base period
    a. 1981-2010
    b. Reference dataset
4. Summer season: May 15th – September 15th
5. Quantification of trends/bias/accuracy
    a. Trends: OLS
        i. Trend bias: OLS of difference each year from reference data
        ii. Accuracy: OLS of absolute difference each year from reference data
    b. Significance: Mann Kendall test

ii. Comparing trends:
1. Percentile exceedence trend comparison
    a. # of summer season Tmin 90th percentile exceedances
    b. # of summer season Tmax 90th percentile exceedences
2. EHE trend comparison
    a. EHE definition:
        i. 90th percentile Exceedance
        ii. Duration required
        iii. Running mean above 90th percentile
        iv. Tmin and Tmax required
    b. Variable for comparison:
        i. # per year
        ii. mean duration

iii. Continental averages

iv. Trend bias/accuracy as a function of
    a. Elevation
    b. Distance to water

v. Spatial Structure
1. Maps of results
2. 2D correlation coefficients of gridded results

vi. Spatial autocorrelation: statistical tests (Moran's I test)

d. Hoped for figures and conclusions
    i. Table of continental averages trends, biases, absolute accuracies and percentages of stations with significant biases
    ii. Map (table) of typical difference (correlation) between datasets
    iii. Results of autocorrelation tests
    iv. Accuracy/bias as a function of elevation, distance to water and resolution

E. How these conclusions can satisfy the thesis motivation
    a. How these results will aid in the mission to protect people from heat-health hazards

        i. Knowledge of past trends in relevant HW characteristics allows better decision making for cities
        ii. Knowledge of the local scale (1-10 km) variability of temperatures in a populated region (Detroit) is important to both heat-health action plan strategies and urban planners concerned with city sustainability w.r.t. heat-health.

b. Bridging the gap as an interface to translate knowledge
    i. HW trend characterizations using definitions relevant to the public health's heat-heath discussion
    ii. Characterization (spatial, temporal aspects) of spatial variability at local scale of relevant (to the public health's heat-health discussion) exposure metrics (e.g. daily high/low)
    iii. Suitability of high-resolution climate datasets often used by the end user.

c. How our results will advance the climatology discussion
    i. Detailed knowledge of the past trends in HW characteristics and relationship with average temperature trends
    ii. Knowledge of the local scale (1-10 km) variability of temperatures in a populated region
    iii. Validation of the suitability of Hi-Res (4-12km) climate datasets to study changes in extreme temperature trends