Growing Season Change and Variability in the Northeastern U.S.

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Introduction

Growing season changes directly affect ecosystems and reflect change and variation in the climate. The primary influence to growing season relates to air temperatures and the timing of intra-annual/seasonal temperature changes and variations.

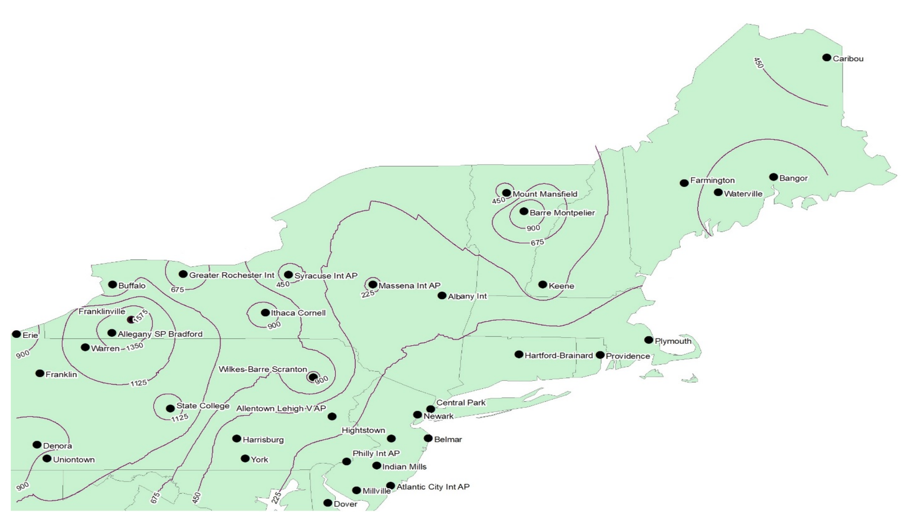
Study Goal

To identify patterns of growing season changes including length and variability across the Northeastern U.S.

Data

- Mean monthly air temperatures (Ta) and growing season duration at 37 surface stations throughout the ten-state NE U.S. region were analyzed (Fig 1)
- All data were obtained from the Applied Climate Information System (SC-ACIS, 2018).
- Surface stations were selected to ensure adequate temporal and spatial regional coverage
  - Records = 1880 -2017
- Growing season is the number of days between the Last Spring Freeze (LSF) and the First Autumn Freeze (FAF)

Fig 1. Stations With Elevation Contours



Methods

- Data were statistically analyzed for the entire period of record as well as pre- and post-1980 segments
- 1980 was the first year global air temperatures exceeded and stayed above the century mean
- Means and variances were analyzed for significant trend and change using difference of means *t*-tests and variance F-tests

Results

Average Monthly Temperatures

- 20 Stations recorded significant annual temperature increases
- Seasonally, 52 station-months recorded significant temperature increases in summer, 36 in spring, 33 in winter and 32 in autumn
- Alleghany, Denora, and Unionville PA stations showed decreasing temperature in January and October relative to the "warming hole" of the SE US, documented in climatological literature

Growing Season

- 20 stations recorded significant increases growing season length
- 9 stations showed significant variance change from pre- to post 1980
- Elevation, latitude, urban heat islands, and geographic proximity to water influences are discernable in spatial patterns (Fig 2)
- Temporal differences between higher elevations and urban areas had strongest differences between pre- and post- 1980

Julian Day

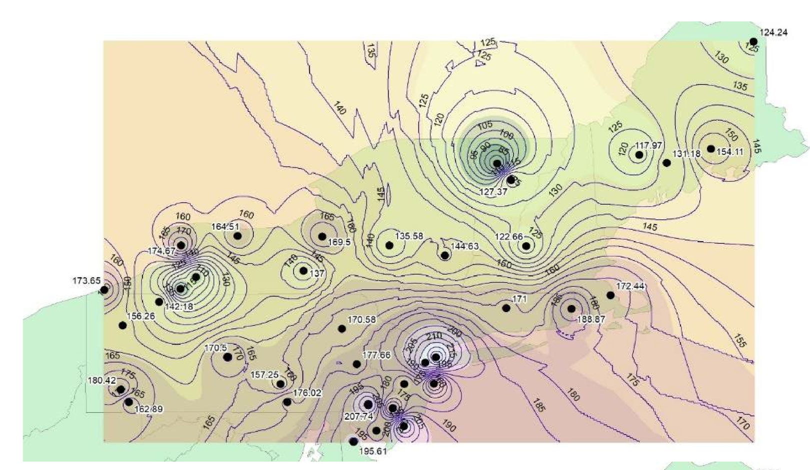
- 18 stations recorded significant change in the FAF, 13 for LSF, indicating a lengthened warm period (Fig 3)

Spatial

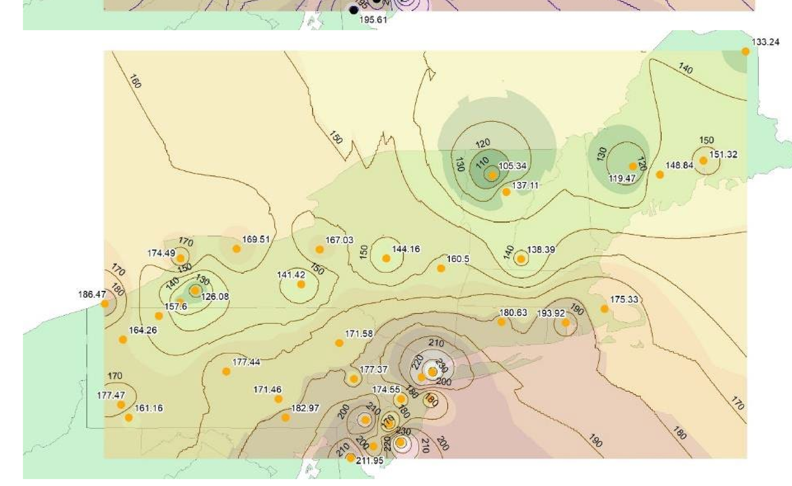
- Spatial distributions pre- and post-1980 are related to elevations, latitude, proximity to water bodies, and urban heat islands.
- Strongest GSL differences were in the Megalopolis area from urban heat island influence and increasing North Atlantic sea surface temps, and near the Great Lakes (indicating increase in lake water and lower winter albedo

Figures 2a-c. Average GSL, in Days per Year, for the pre-1980 Period (a), the post-1980 Period (b), and the Difference pre- and post-1980 (2)

a.



b.



c.

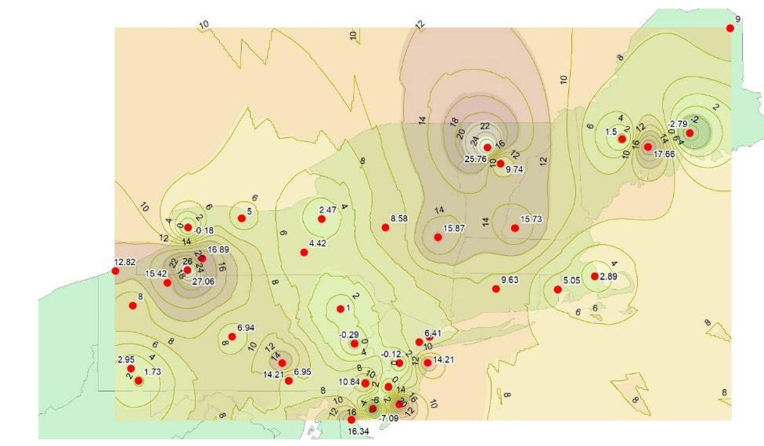
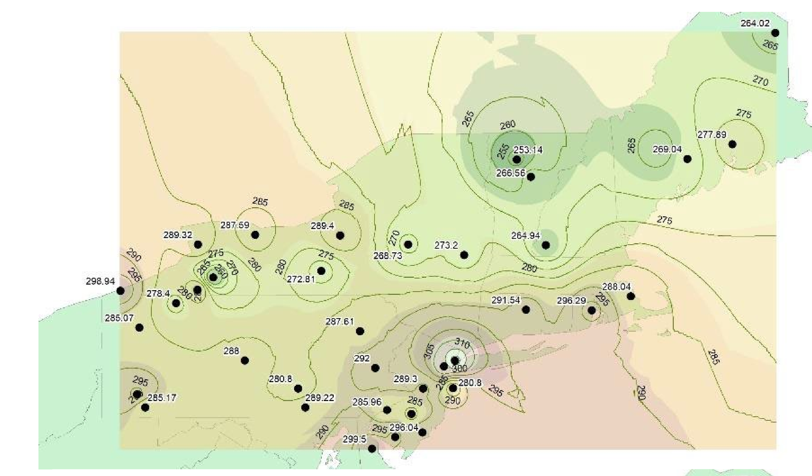
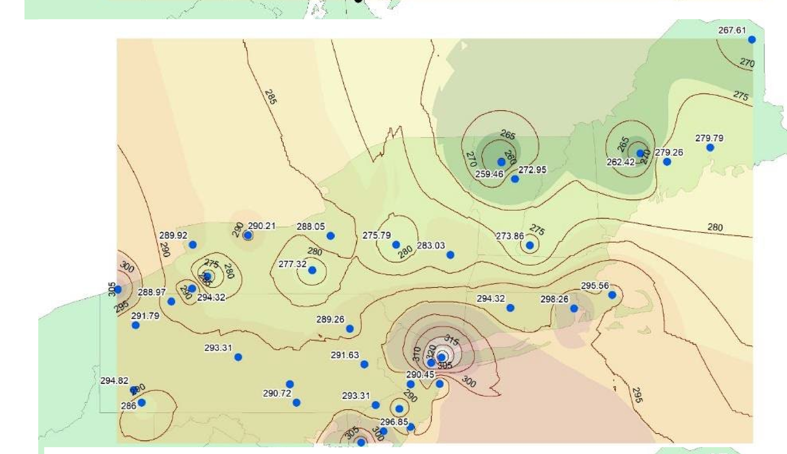


Figure 3a-c. Julian Dates of the FAF pre-1980 (a), post-1980 (b), and Difference pre- and post-1980 (c)

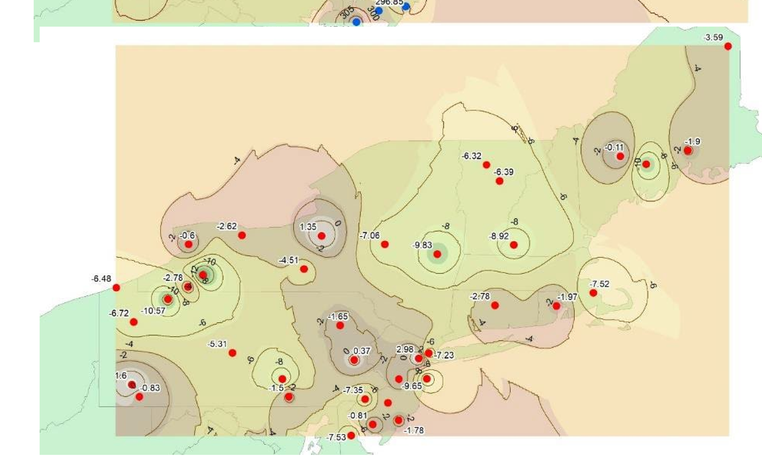
a.



b.



c.



Conclusions

- Results suggest a cohesive regional signal in the NE US regarding monthly and annual Ta change, in agreement with Bilotta et al (2015) as 62% of the stations recorded sig Ta increases
- 54% of the stations recorded a sig increase in GSL in agreement with Hu et al (2010)
- Variance changes were minimal throughout the analysis

Literature

Bilotta, R., Bell, J. E., Shepherd, E., & Arguez, A. (2015). Calculation and evaluation of an air-freezing index for the 1981–2010 climate normal period in the coterminous United States. *J. Appl. Meteorol. Climatol.*, *54*, 69–76, doi:10.1175/JAMC-D-14-0119.1.
Hu, J., Moore, D. J. P., Burns, S. P., & Monson, R. K. (2010). Longer growing seasons lead to less carbon sequestration by a subalpine forest. *Glob. Change. Biol.*, *16*, 771-783, doi:10.1111/j.1365-2486.2009.01967.x

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