A Preliminary Look at IMPROVE Trends

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Introduction

- We examined temporal trends in IMPROVE data over the time periods:
  - 1989-2008 (20 year)
  - 2000-2008 (9 year)

- A 50% completeness criteria was applied to data from any given site.

- Species included:
  - Sulfate ion
  - Nitrate ion
  - Organic carbon (OC)
  - Light absorbing carbon (LAC)
  - Total carbon (OC+LAC)
  - Soil
  - Gravimetric fine mass
  - PM10 and Coarse Mass (PM10-PM2.5)

Trend Analysis

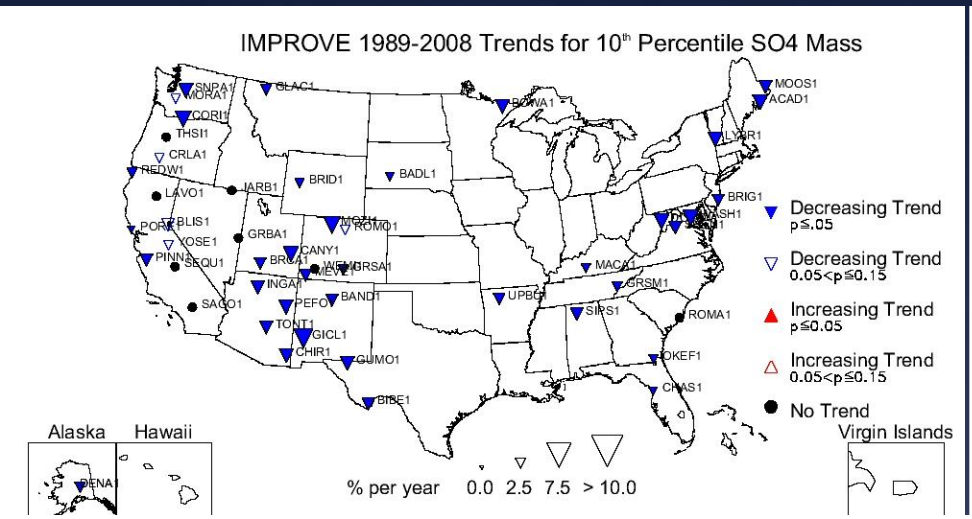
- Trends were computed for 10th, 50th, 90th, Mean, Winter (DJF), Spring (MAM), Summer (JJA) and Fall (SON).

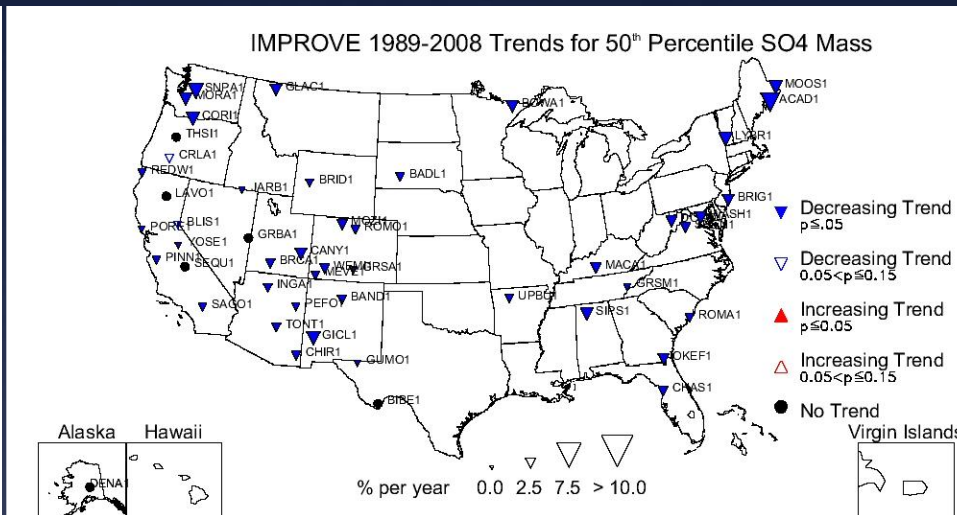
- 70% of the years were required for a given site to be included in the analysis (ranged ~150 sites for 9 yr depending on species, and ~50 sites for 20 yr)

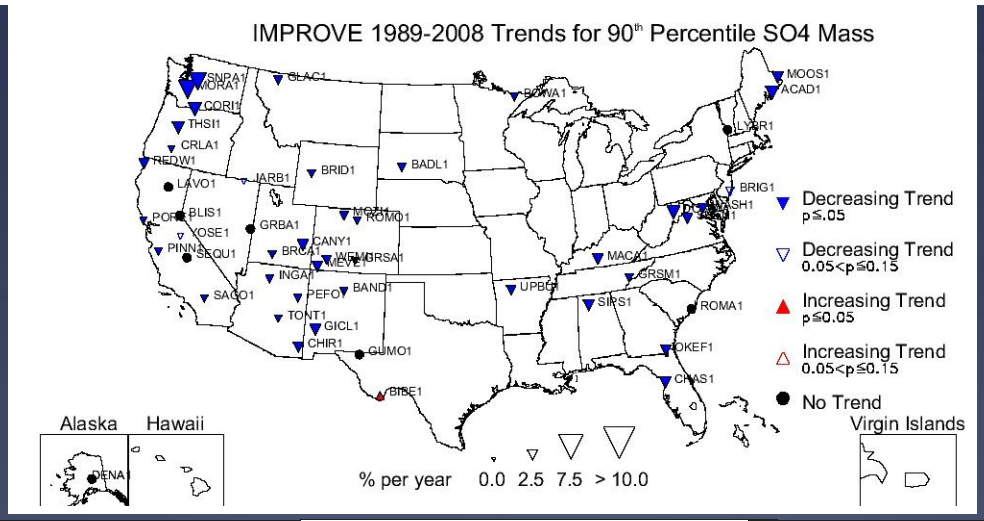
- Theil regression and Kendall's tau statistics were used to compute the slope and the significance, respectively. Theil slope is found by assuming that the true slope is zero and calculating the probability that the estimated slope occurred by chance.

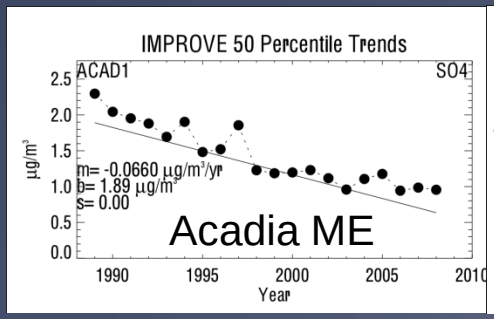
- Significance levels of 0.05 (statistically significant) and 0.15 were used. (A 5 and 15% probability that the differences occurred by chance due to random fluctuations in the time series).

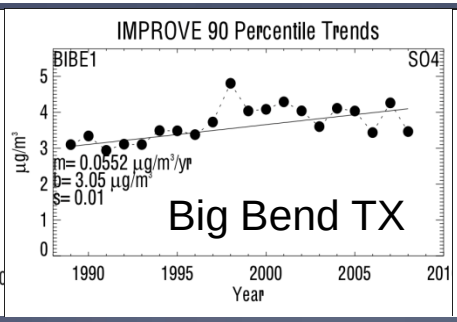
20 Year Sulfate Trends

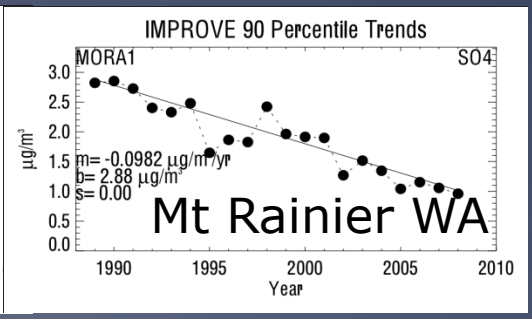












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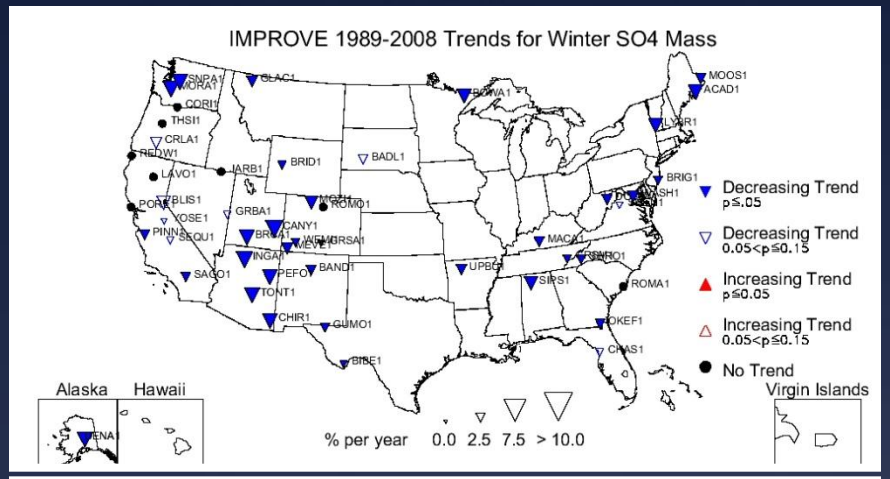
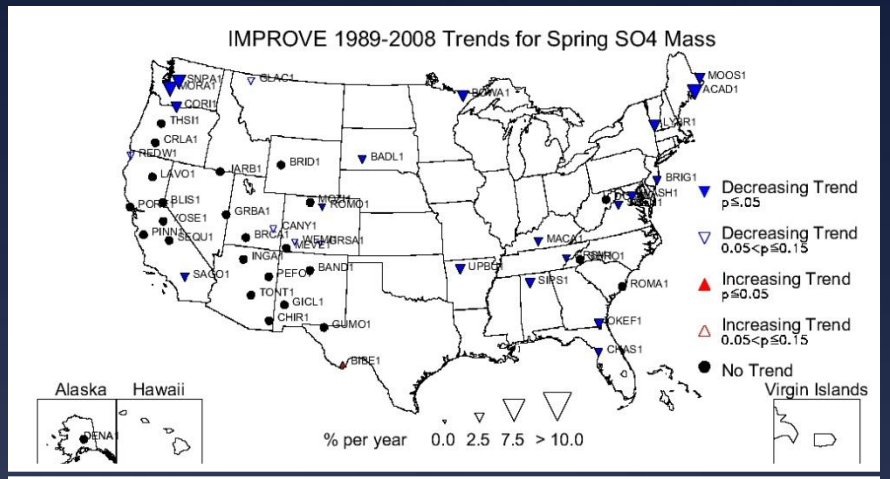
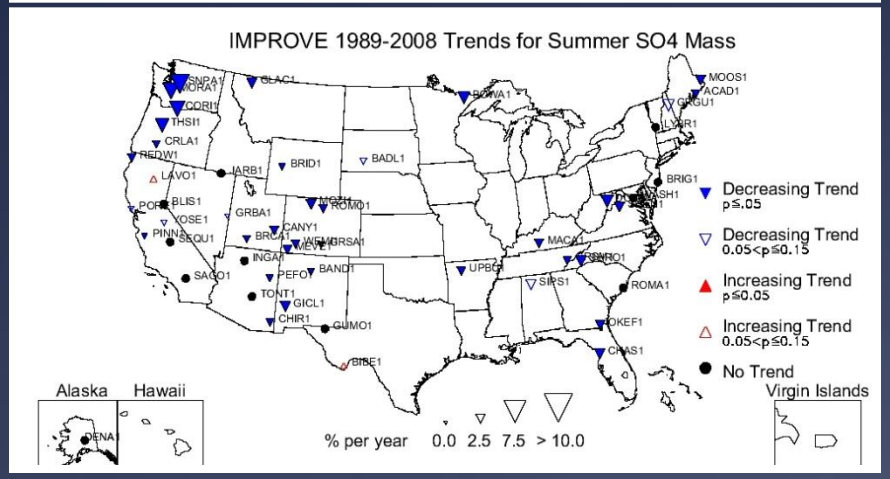
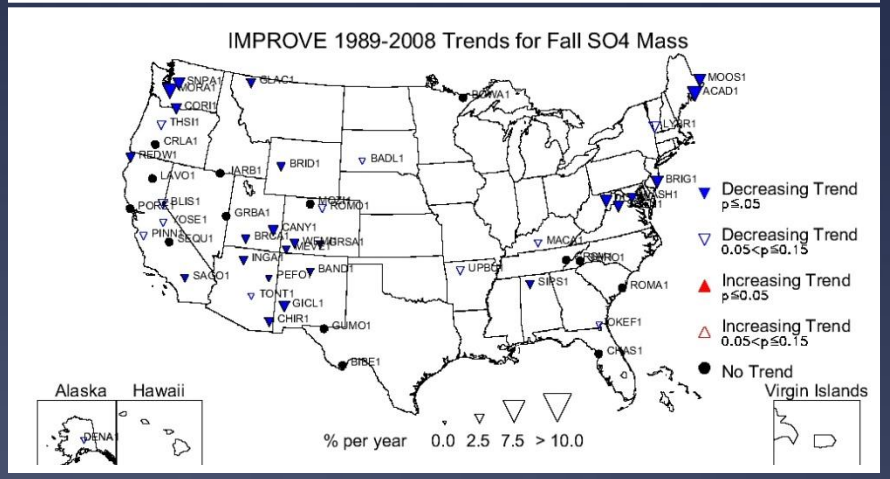
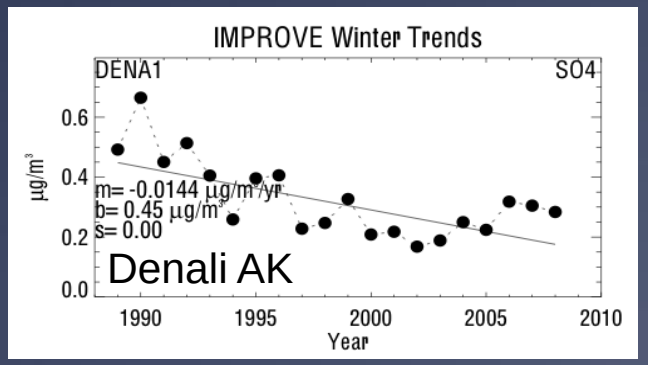
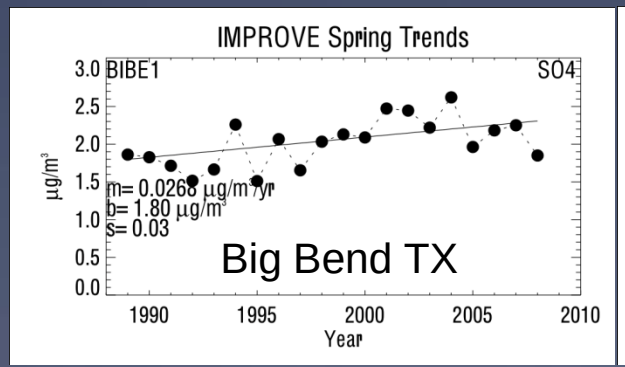


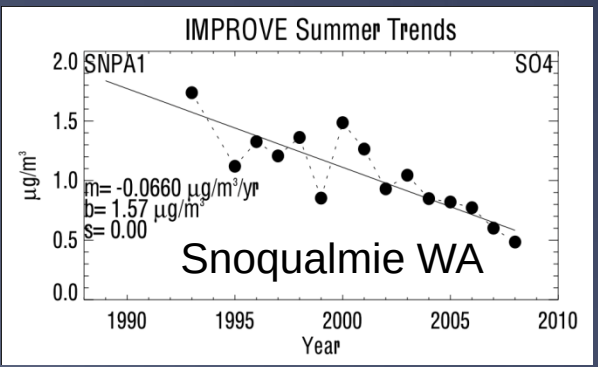




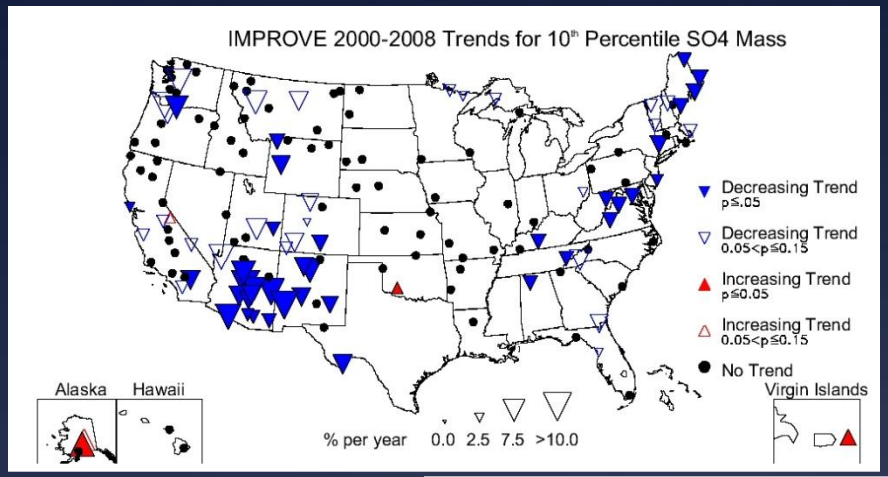


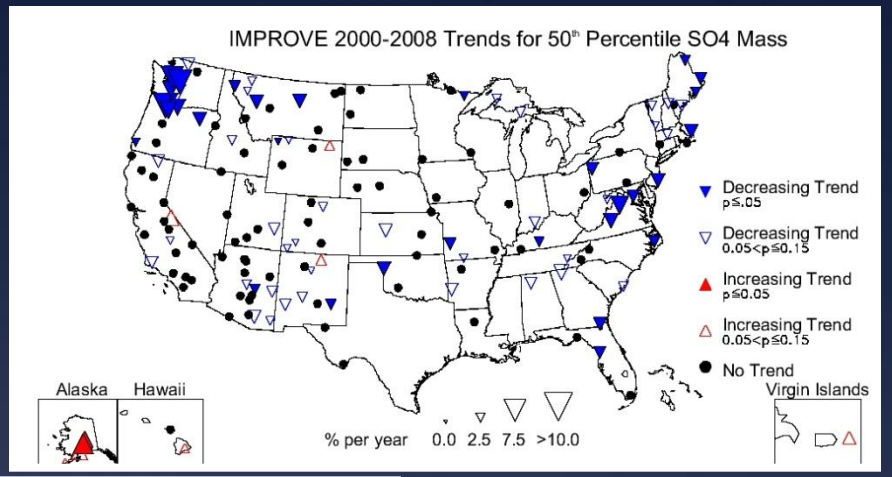


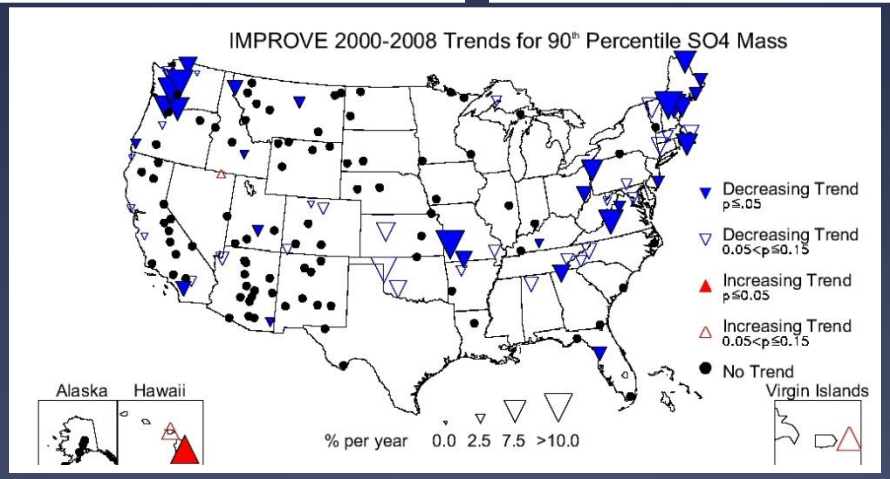


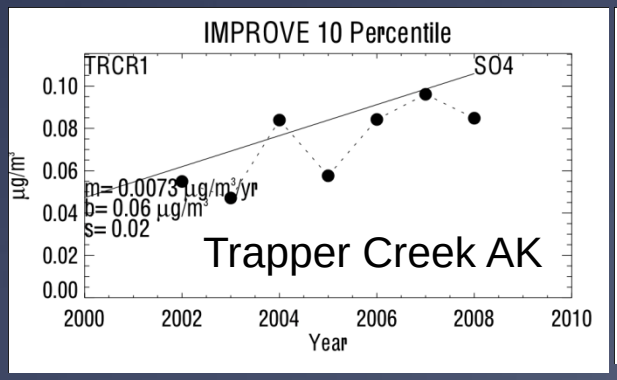


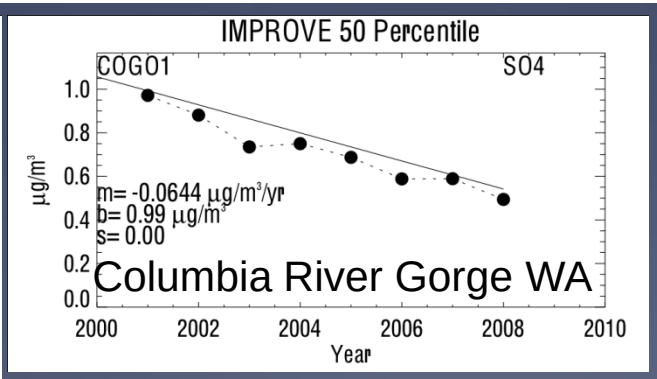
9 Year Sulfate Trends

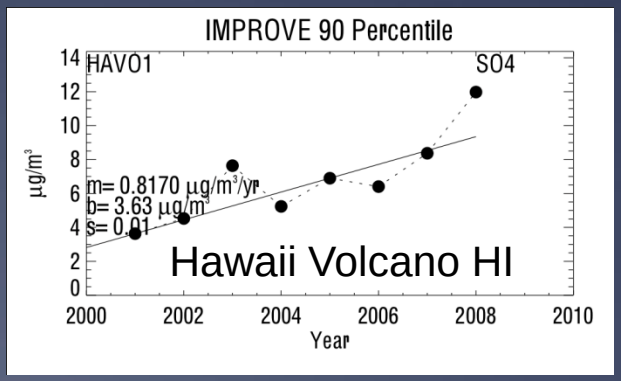












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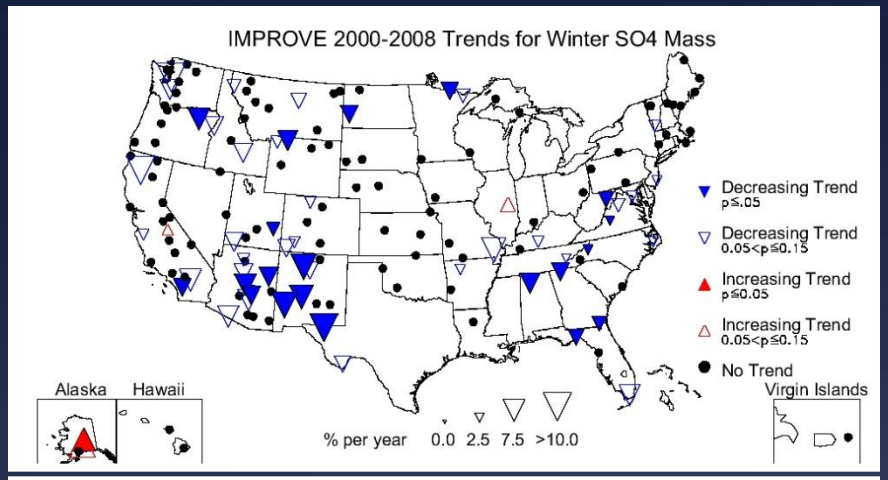
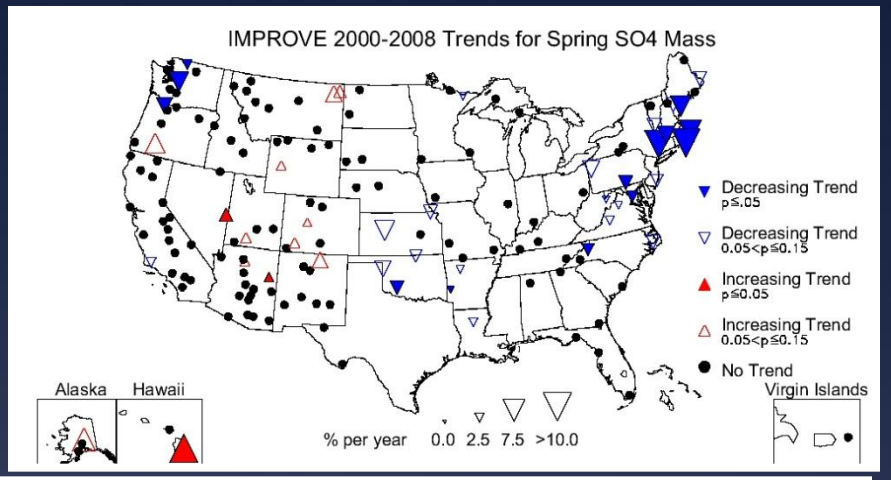
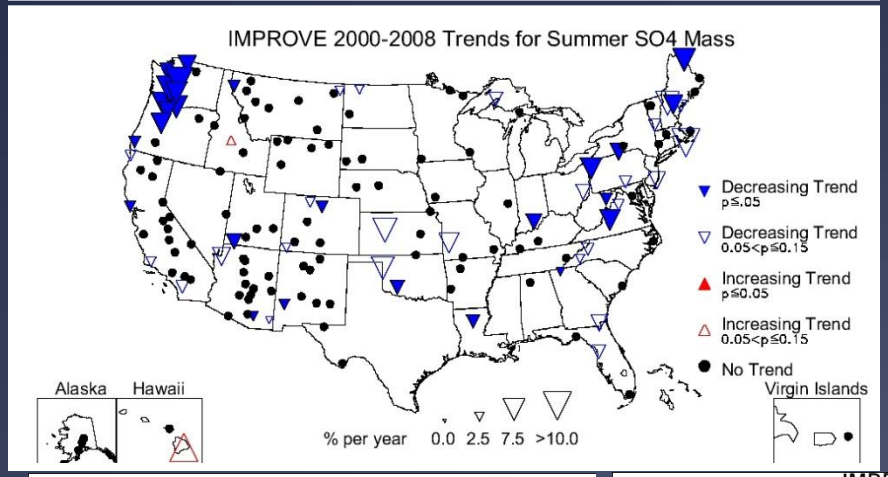
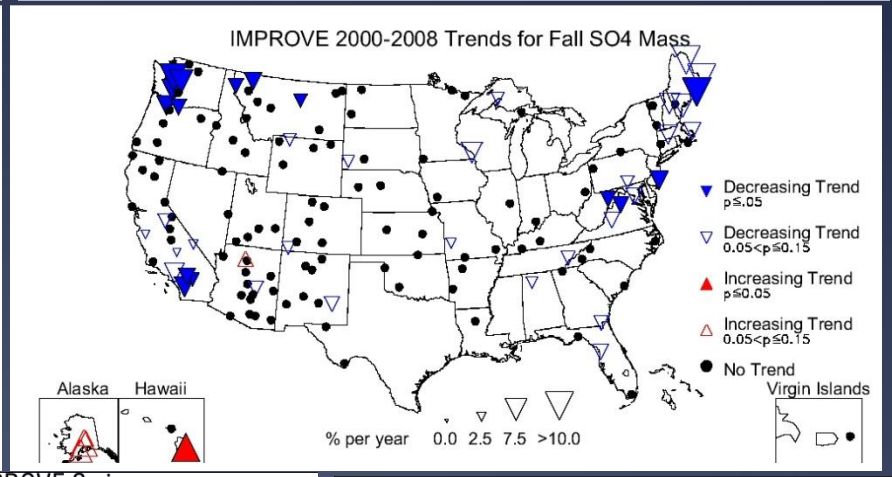
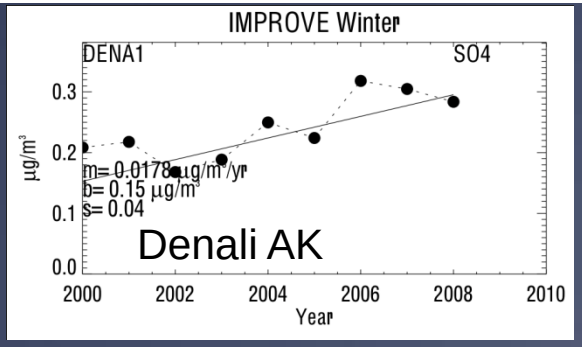
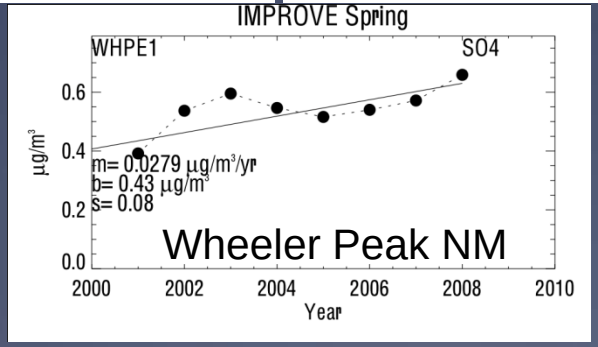


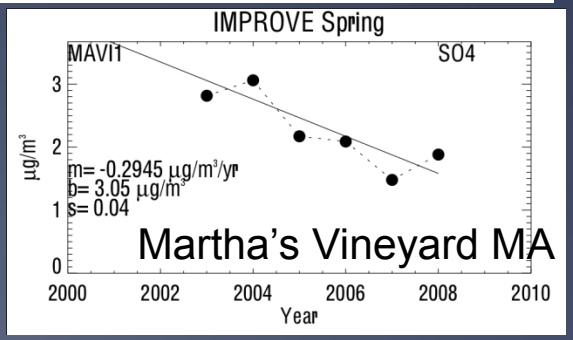




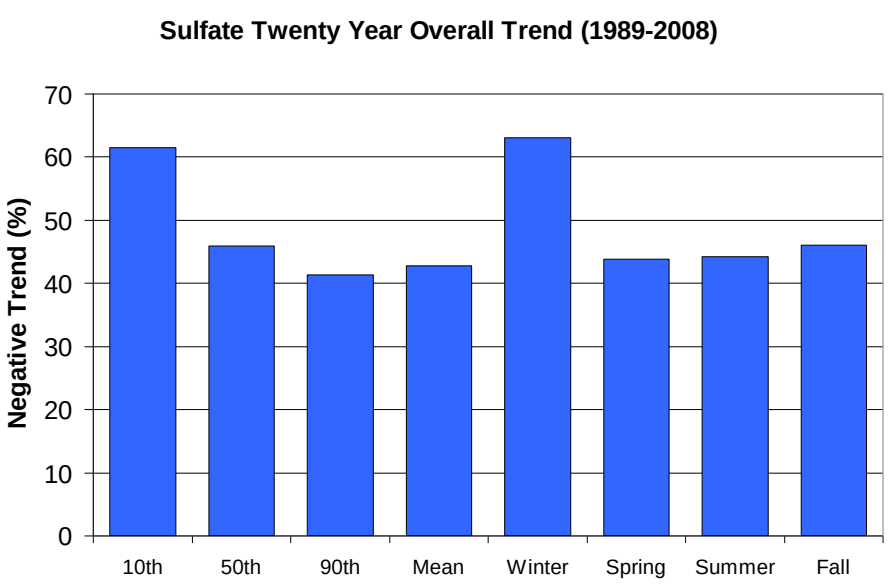


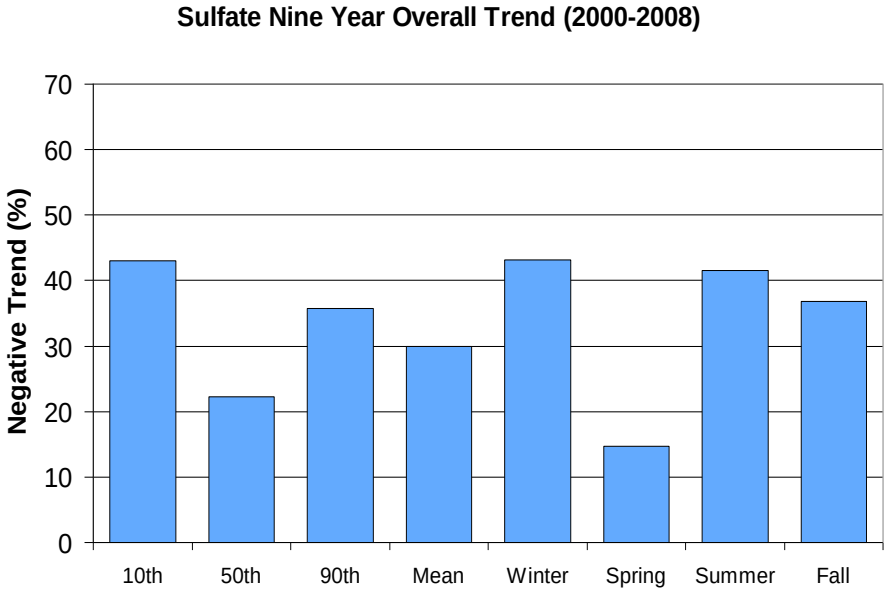






9 Year vs 20 Year Sulfate Trends





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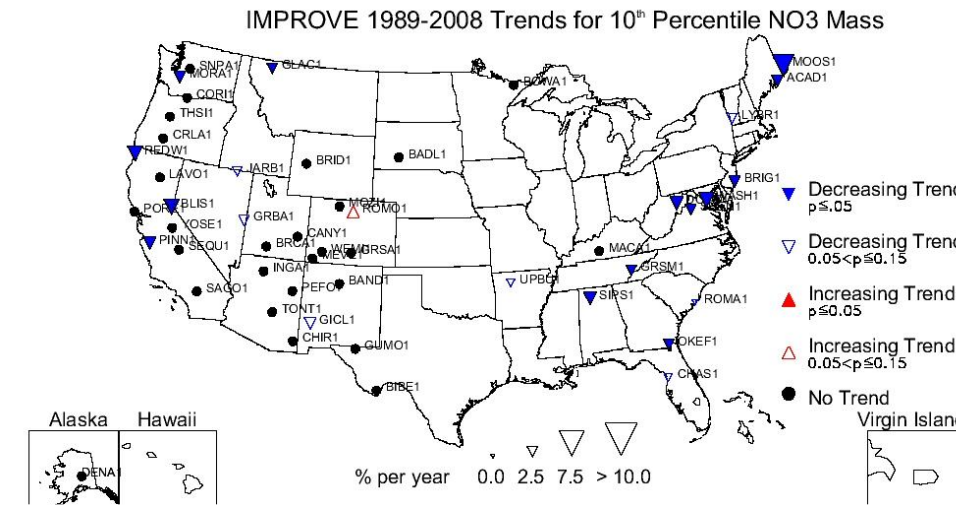

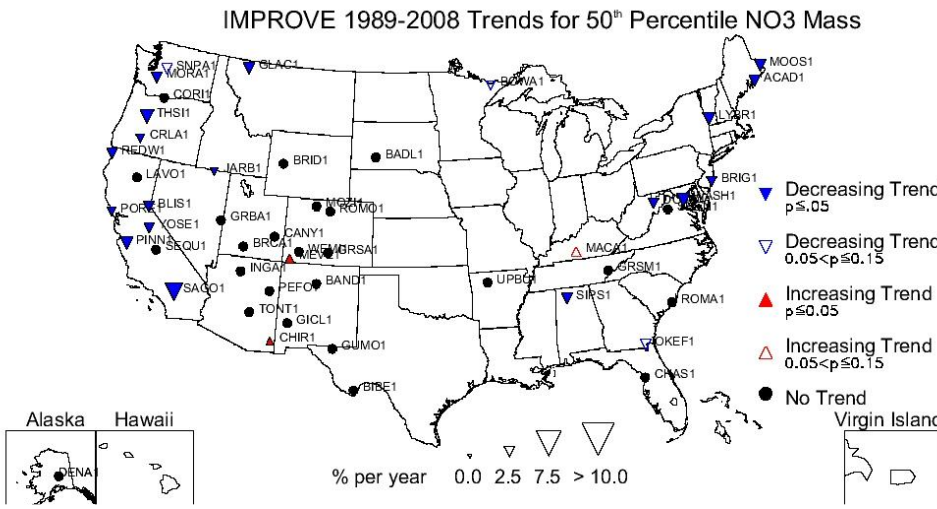

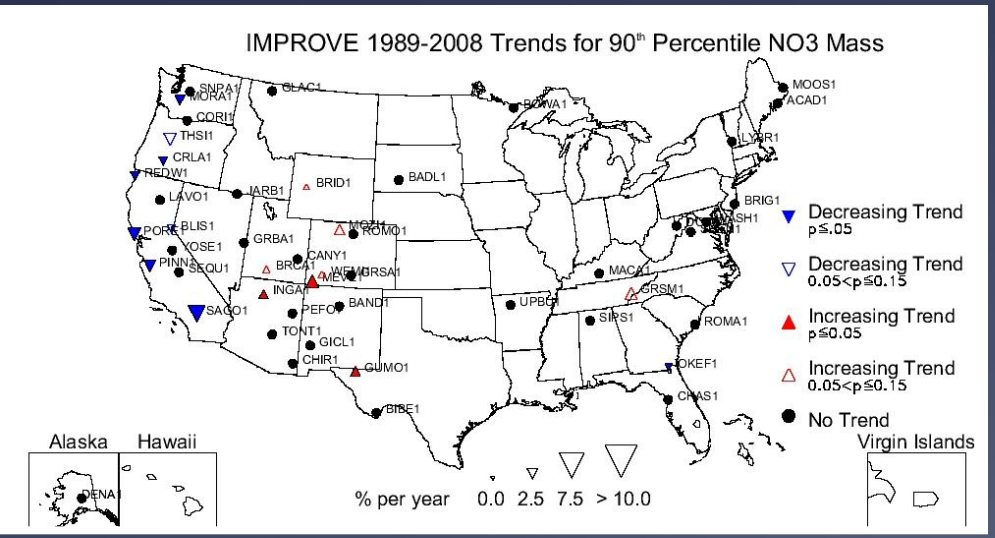

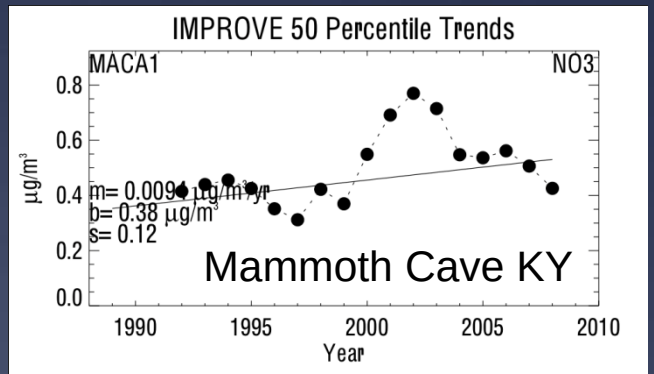

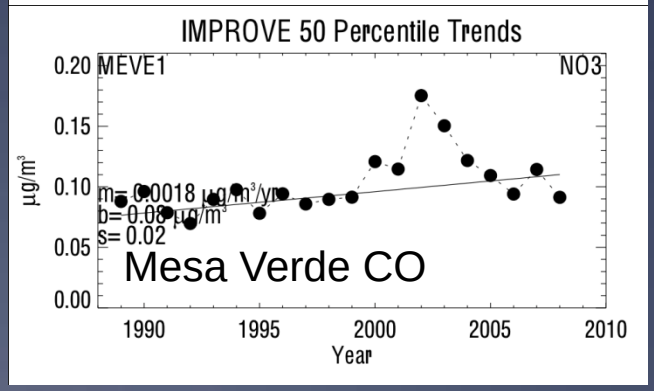

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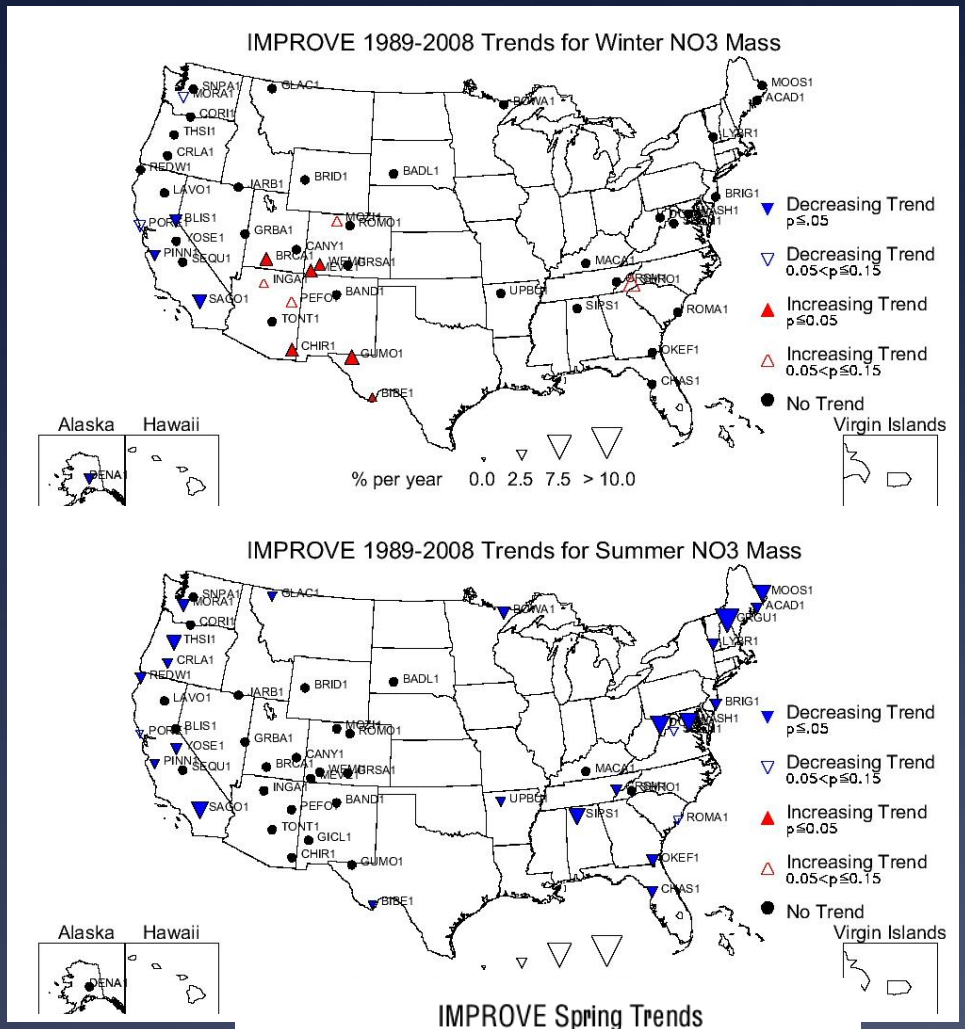

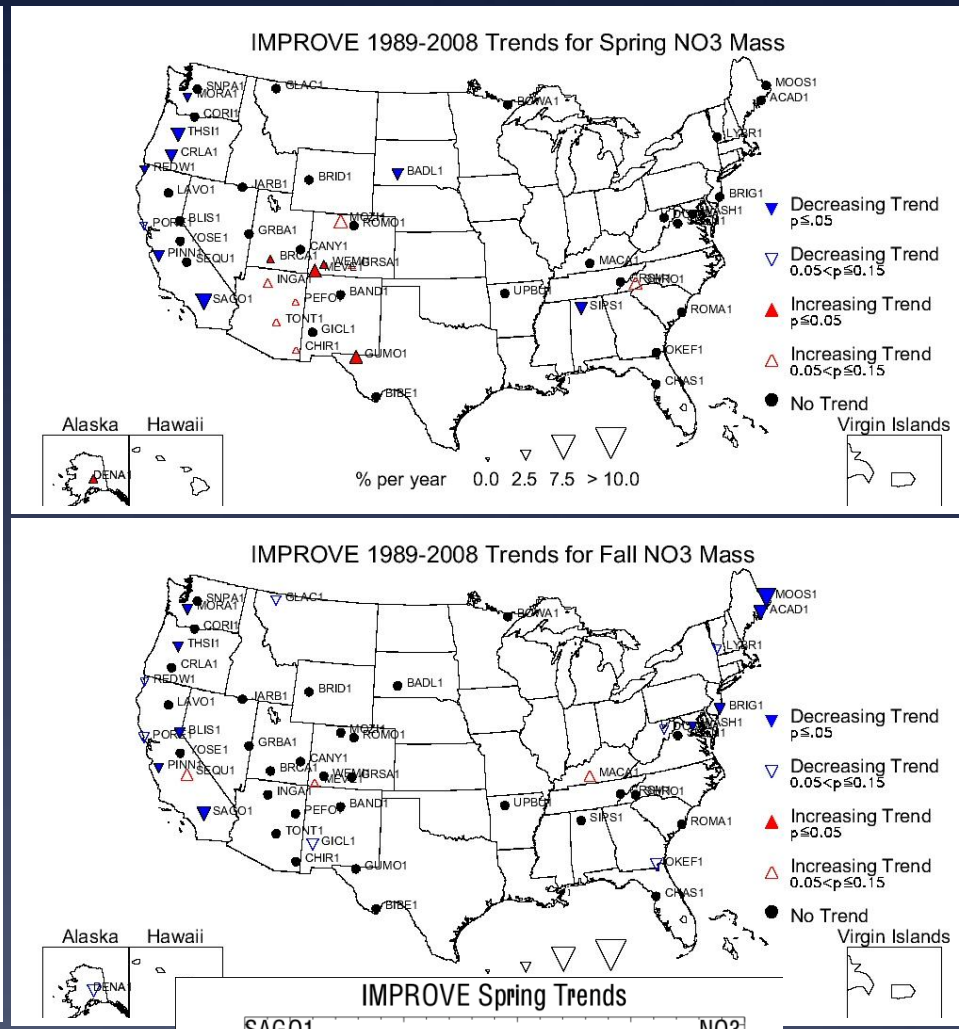

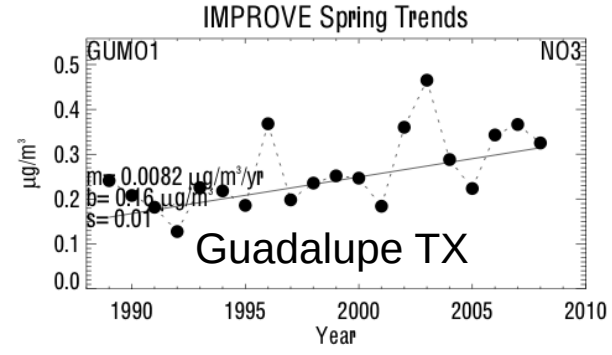

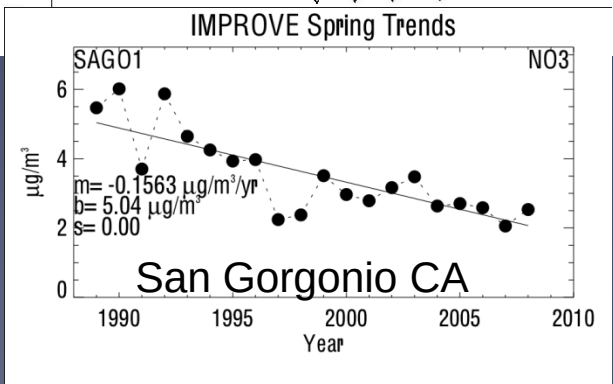

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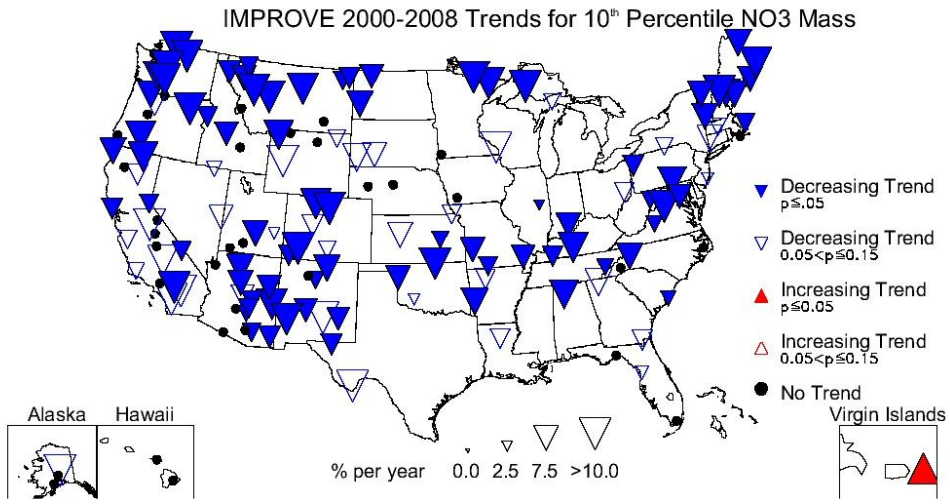

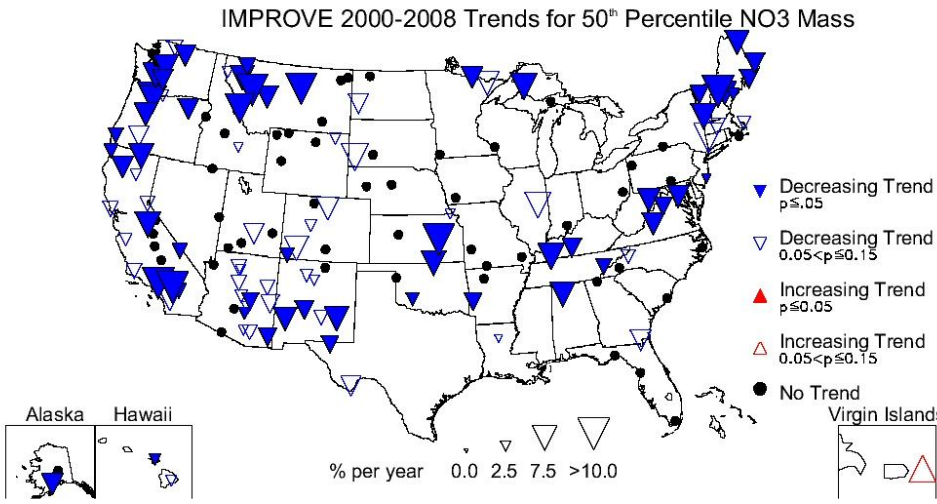

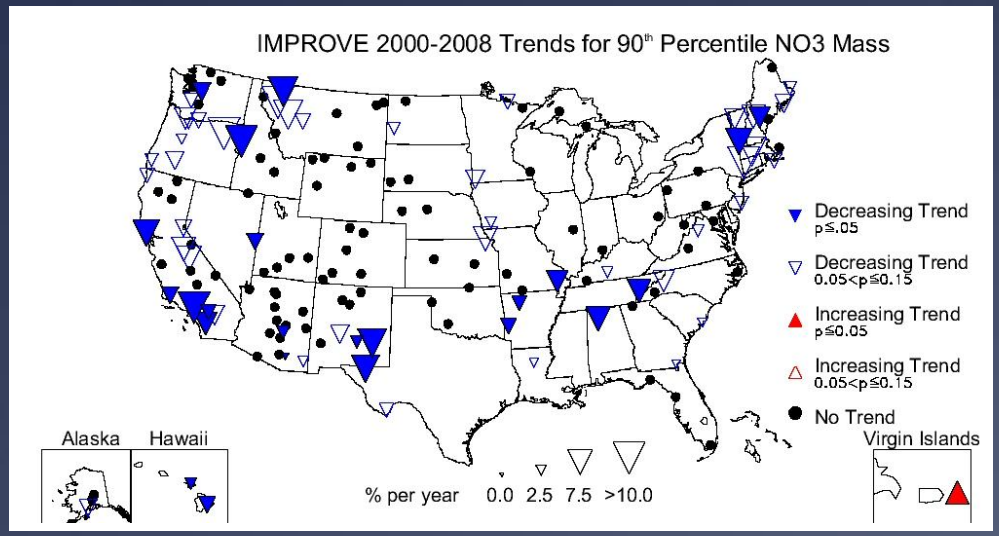

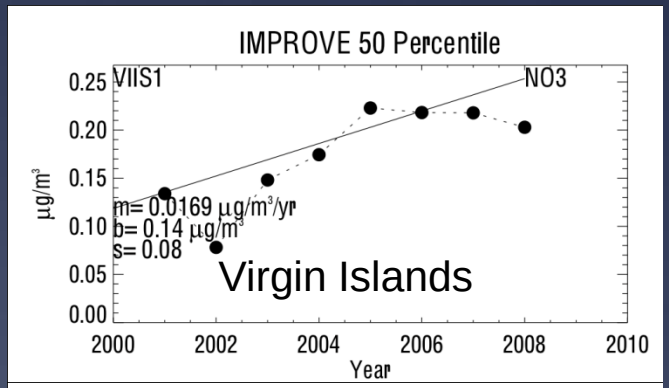

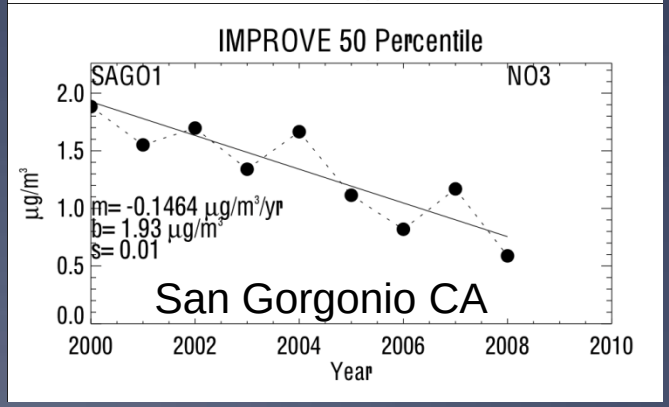

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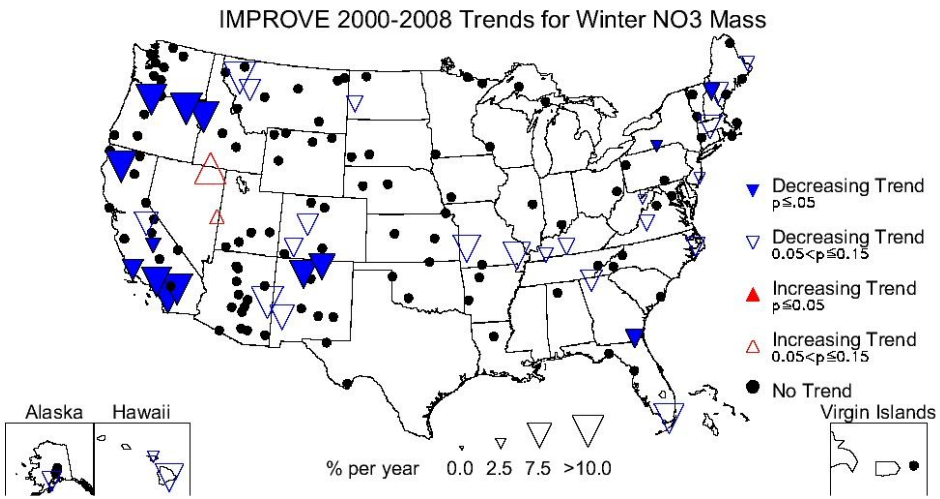
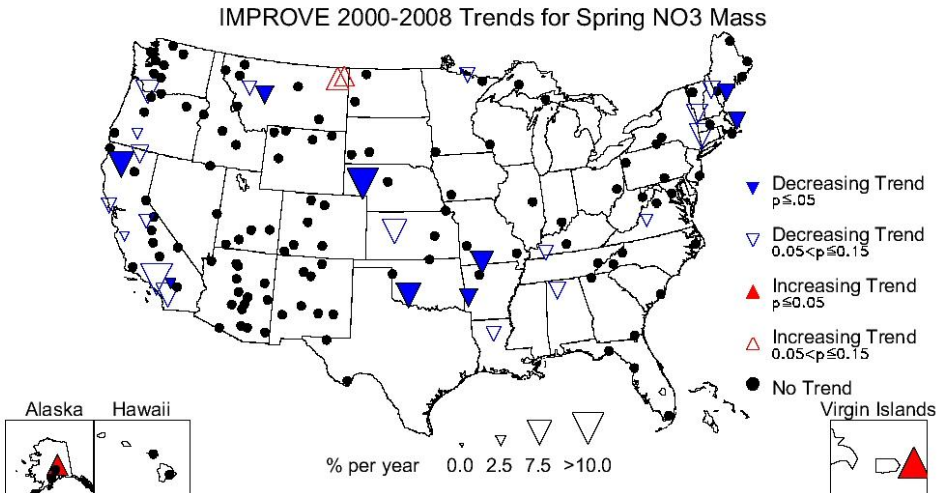
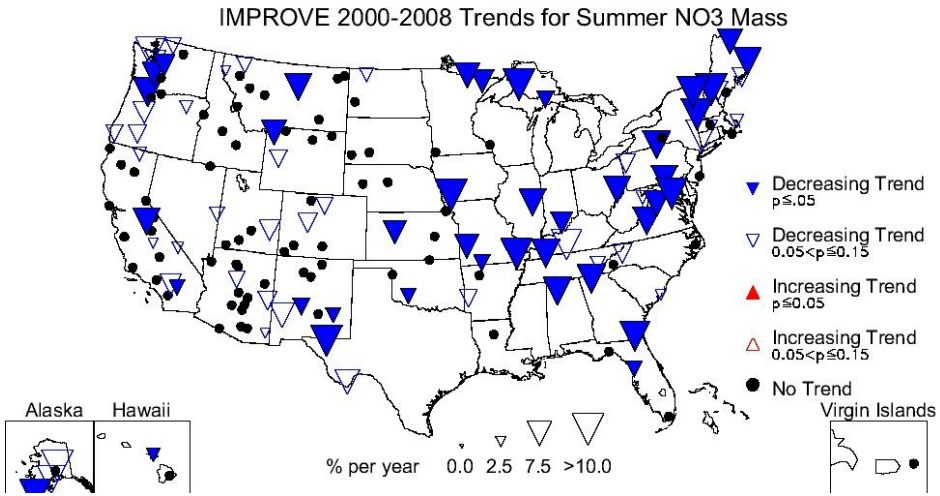
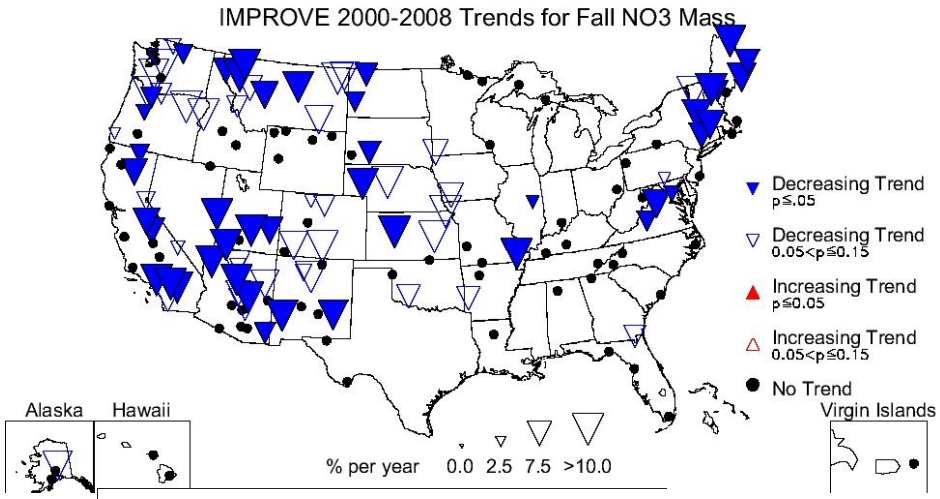
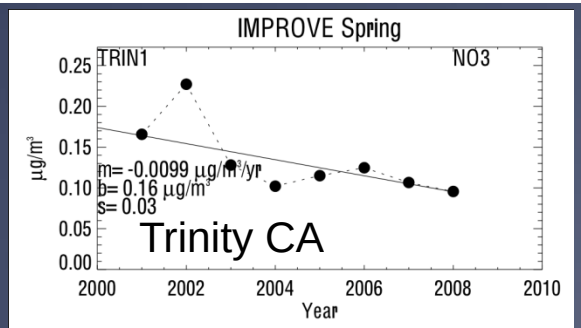
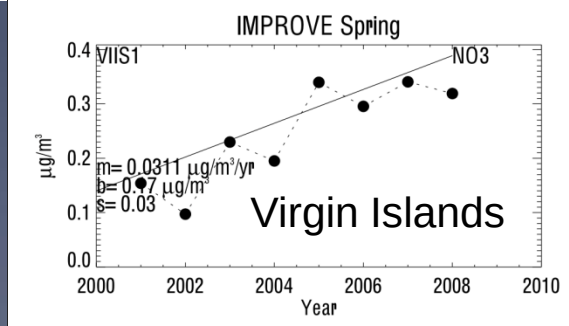




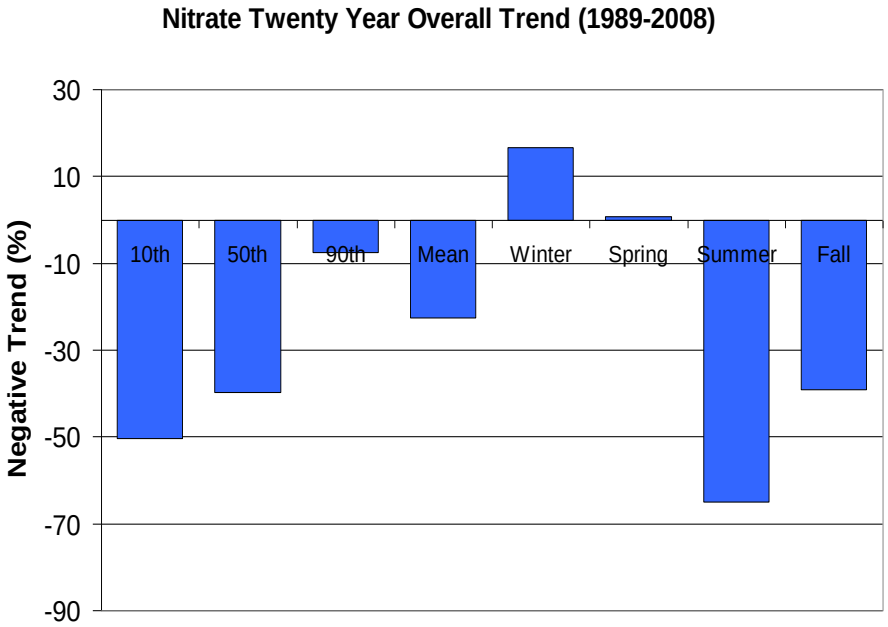


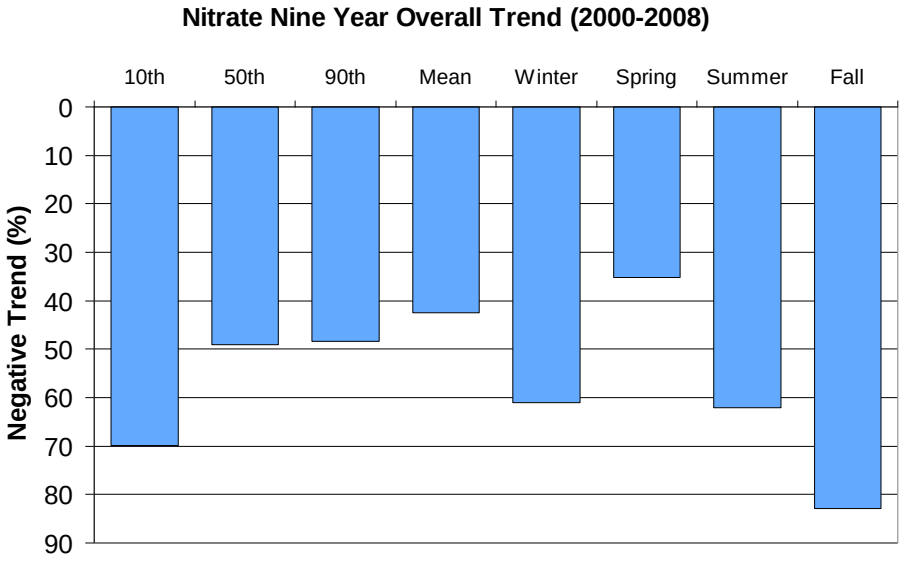




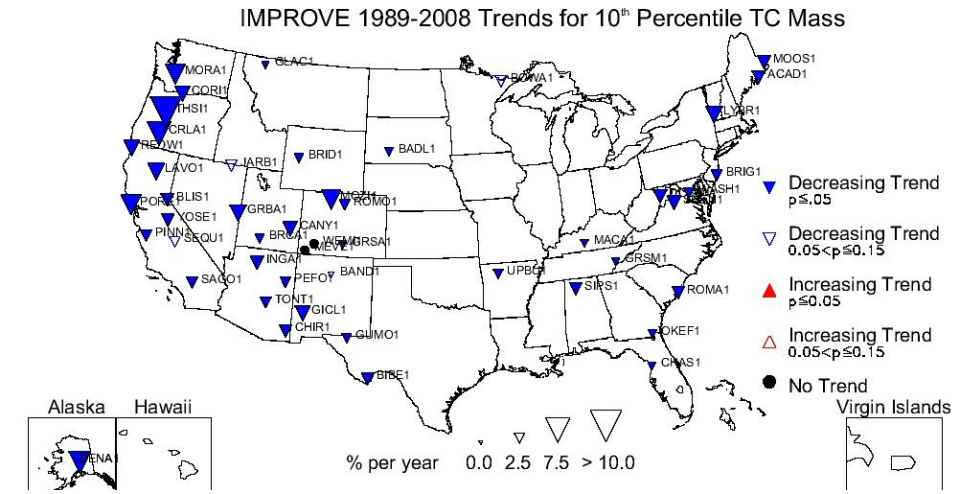


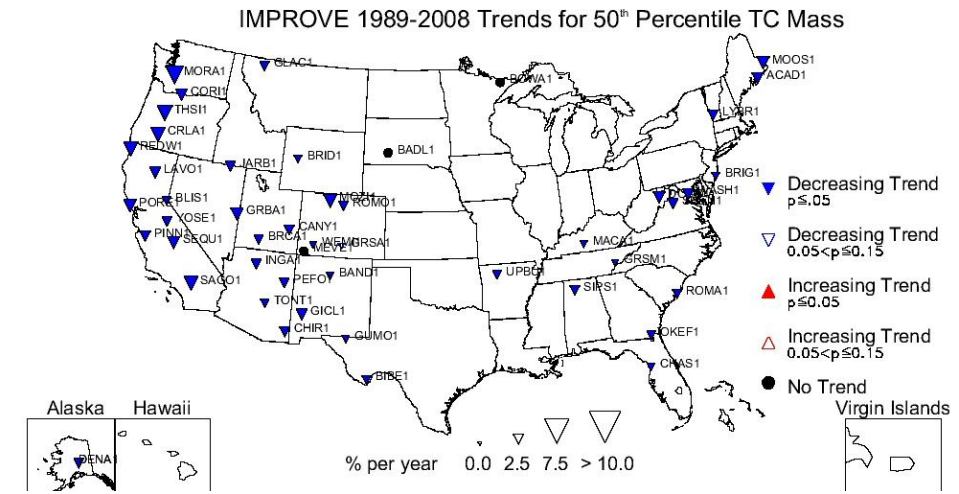
9 Year vs 20 Year Nitrate Trends

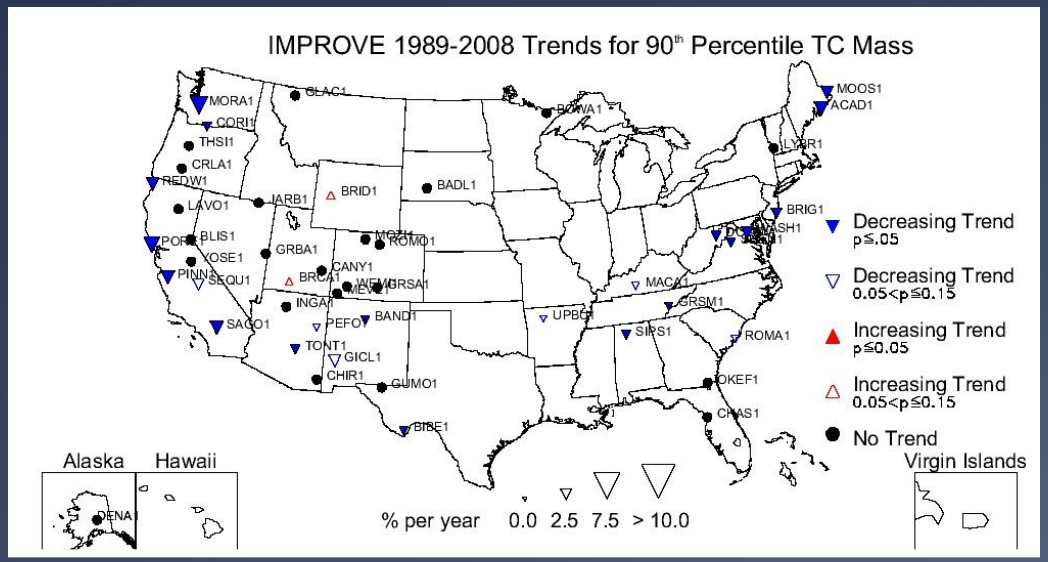


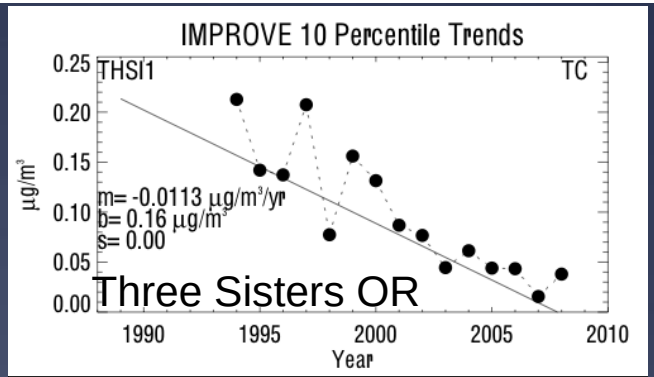


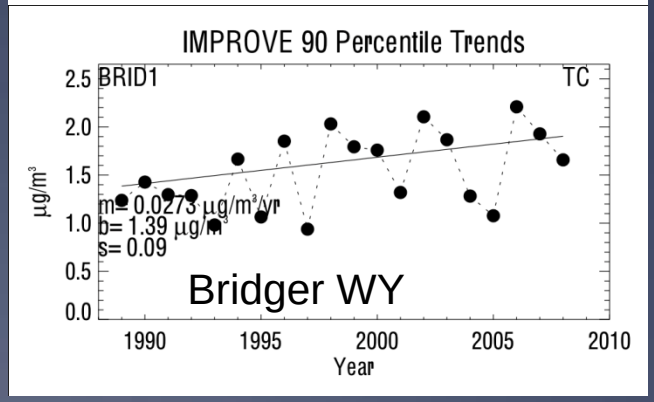
20 Year Total Carbon Trends











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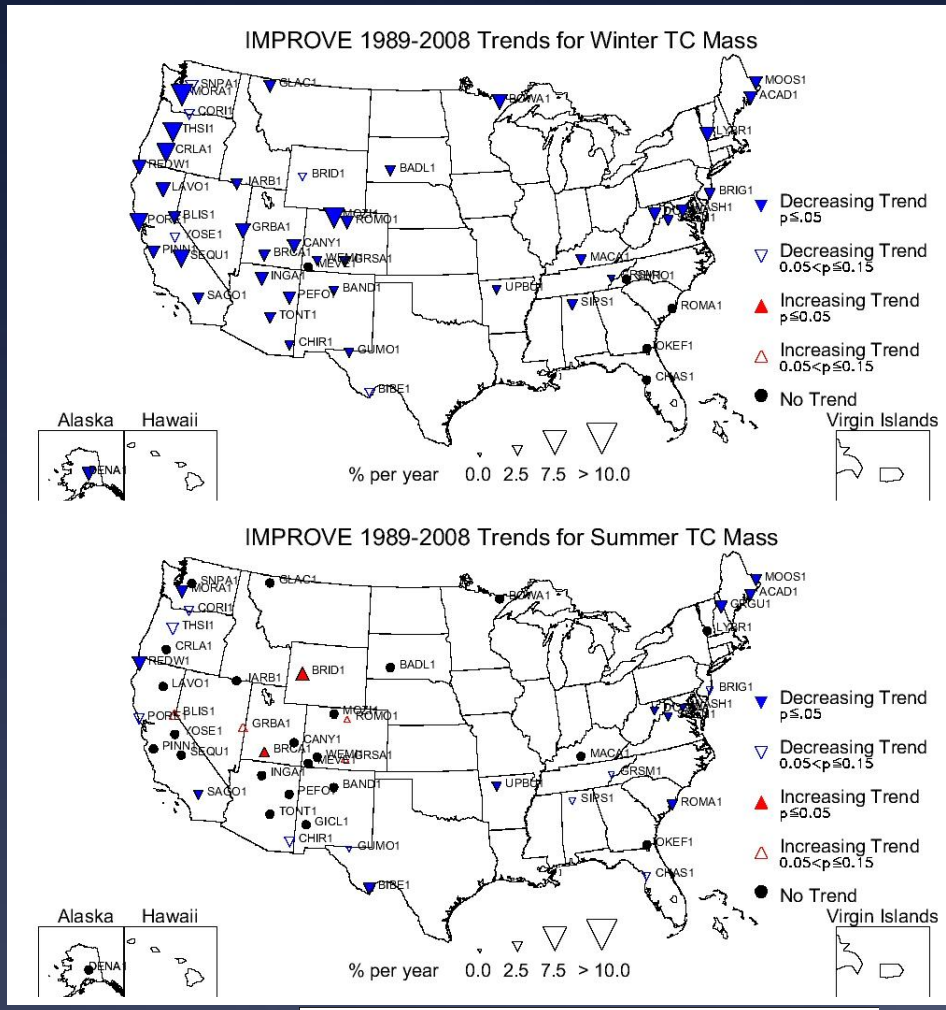
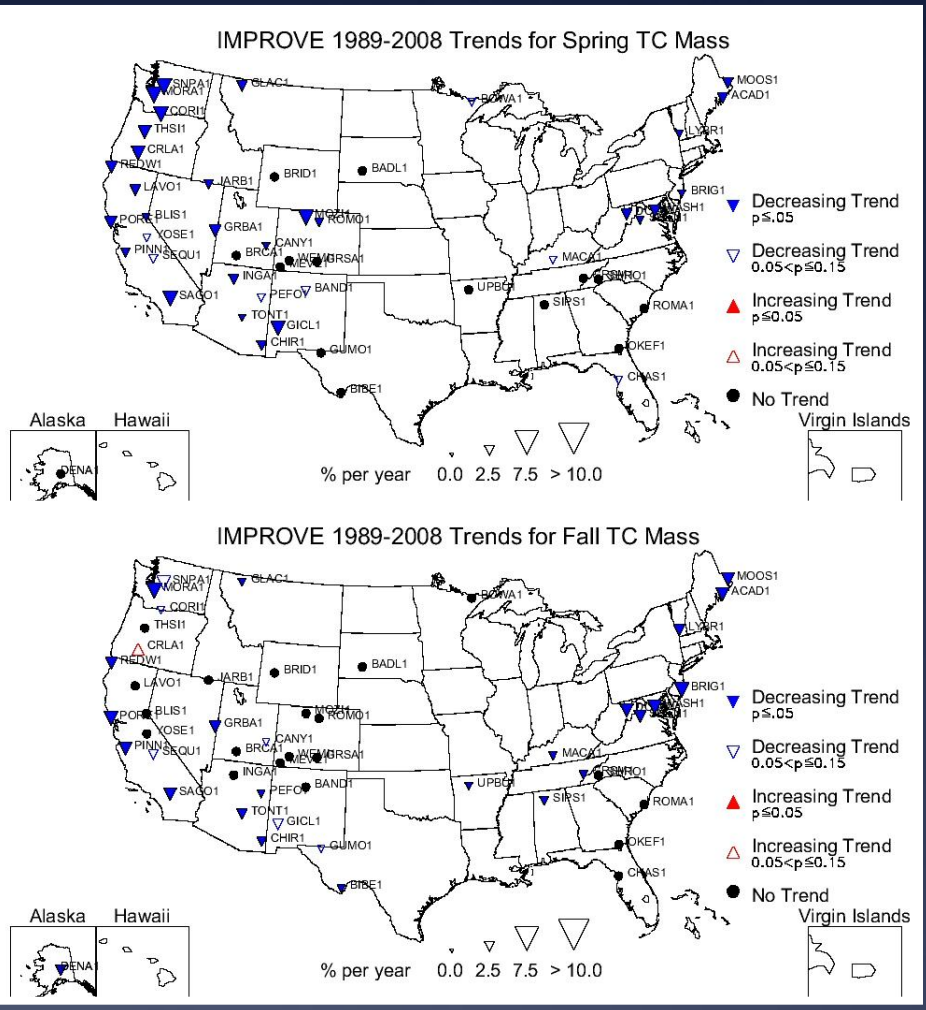
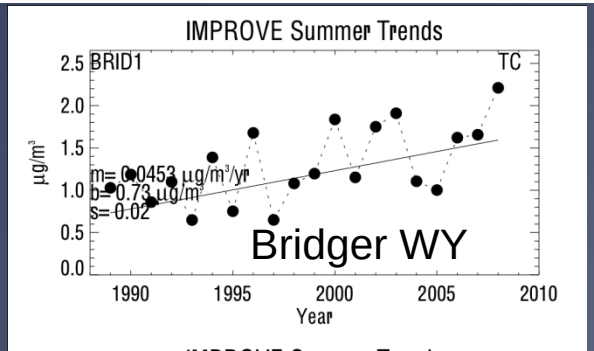
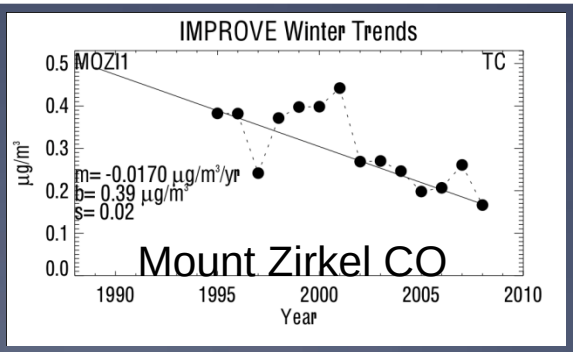
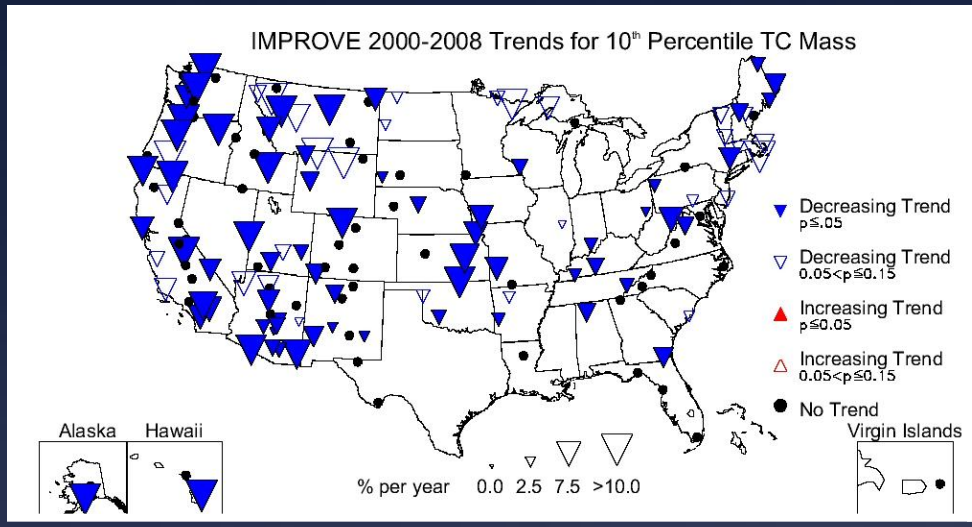


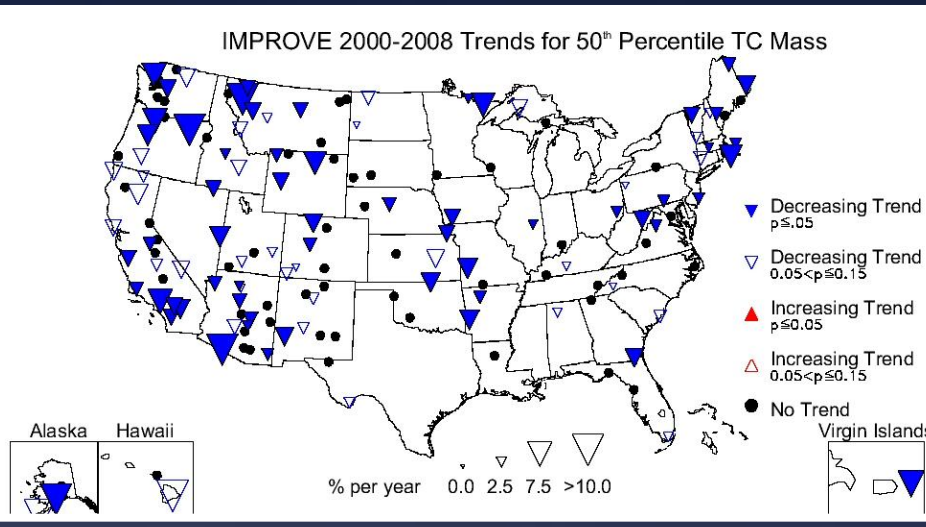


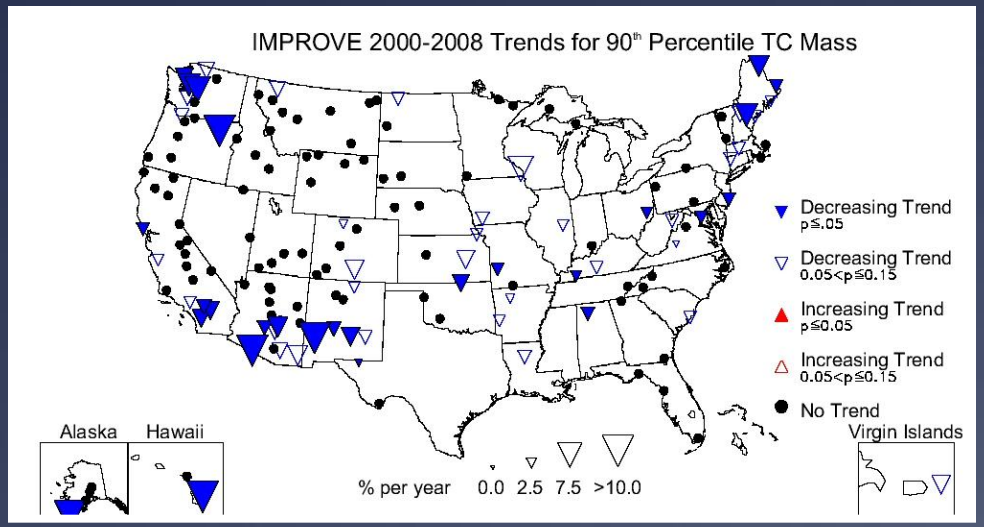


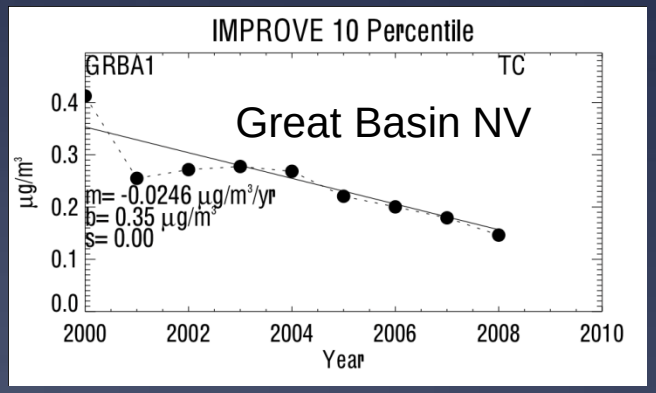


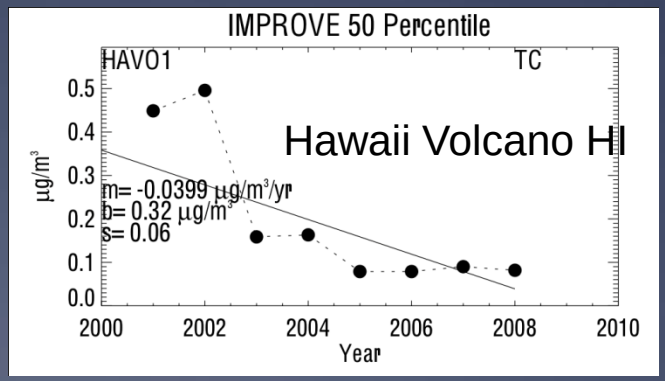
9 Year Total Carbon Trends



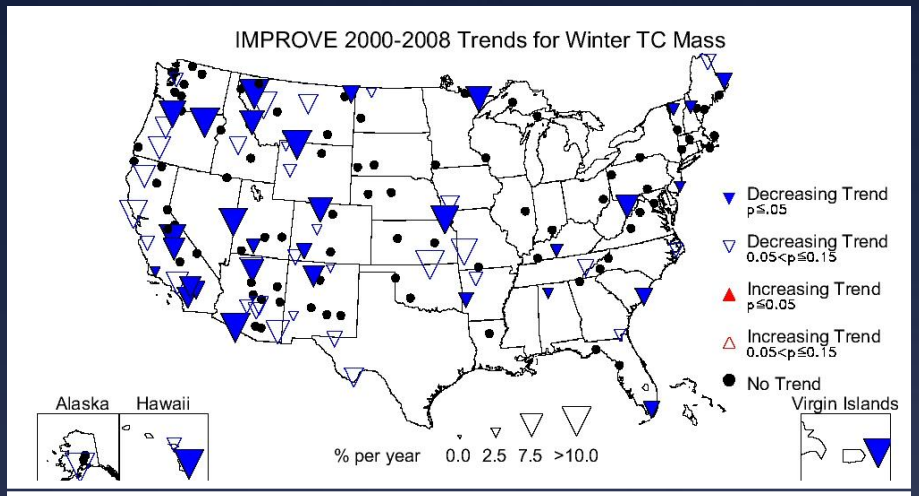


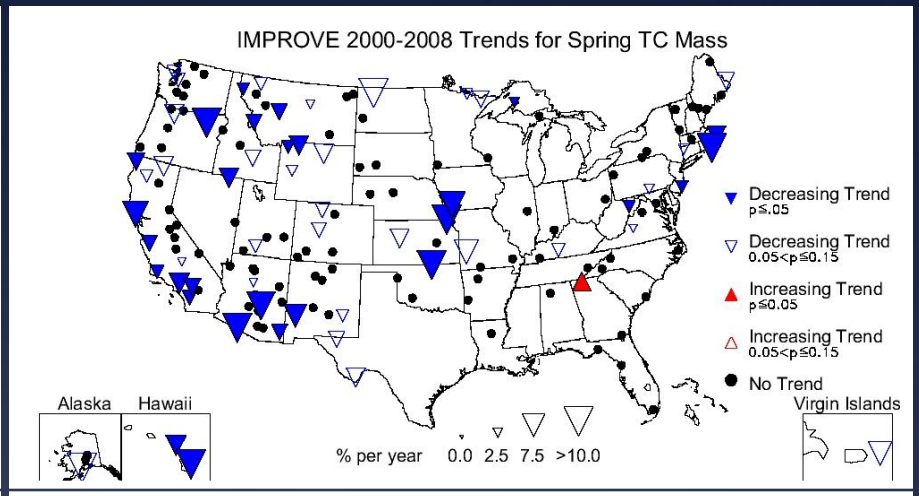


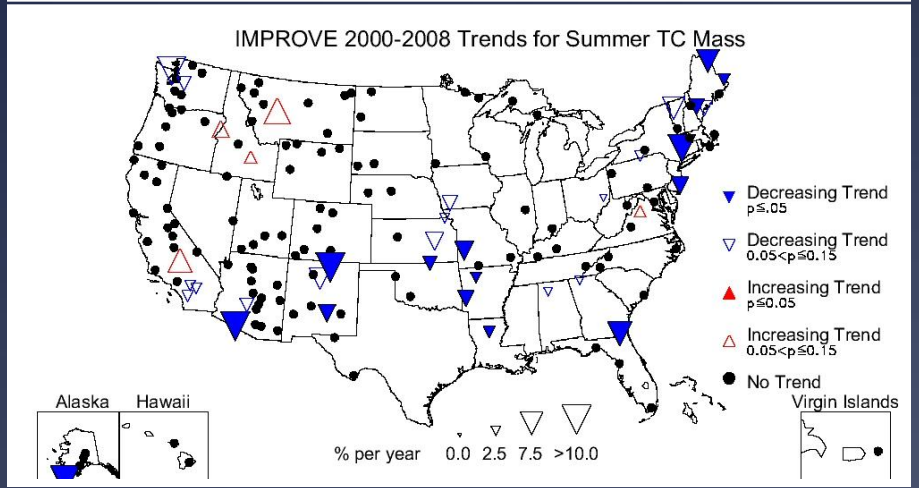


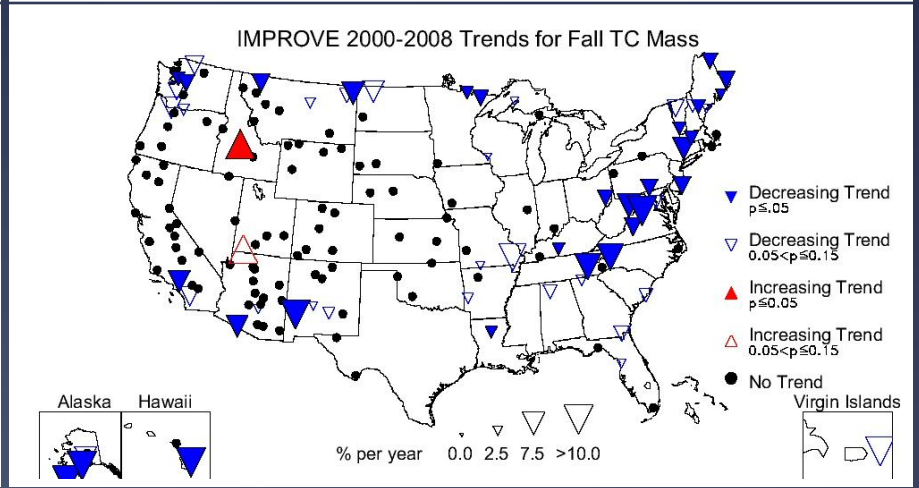


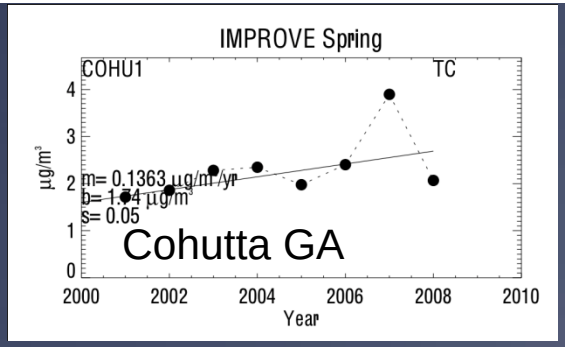
9 Year Total Carbon Trends

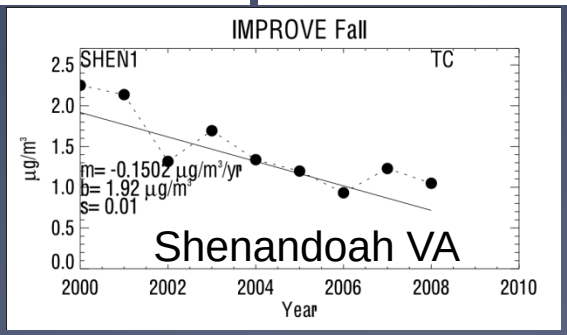


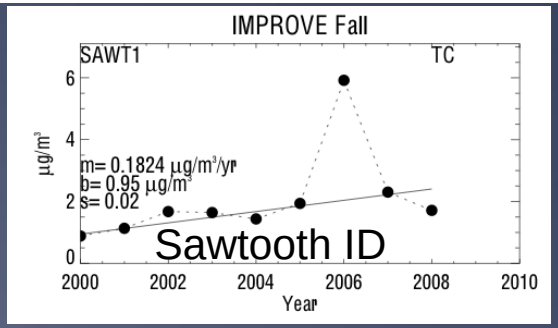




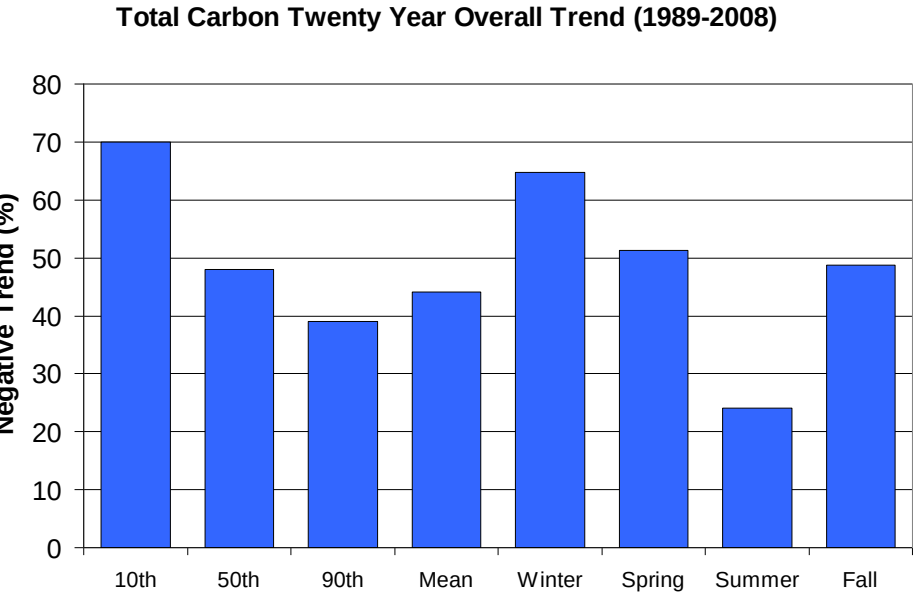


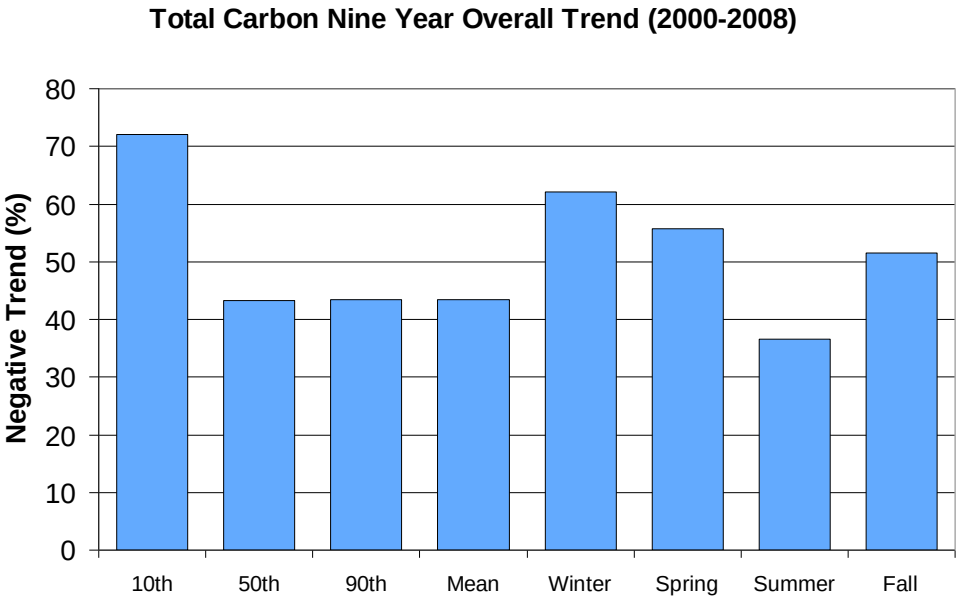




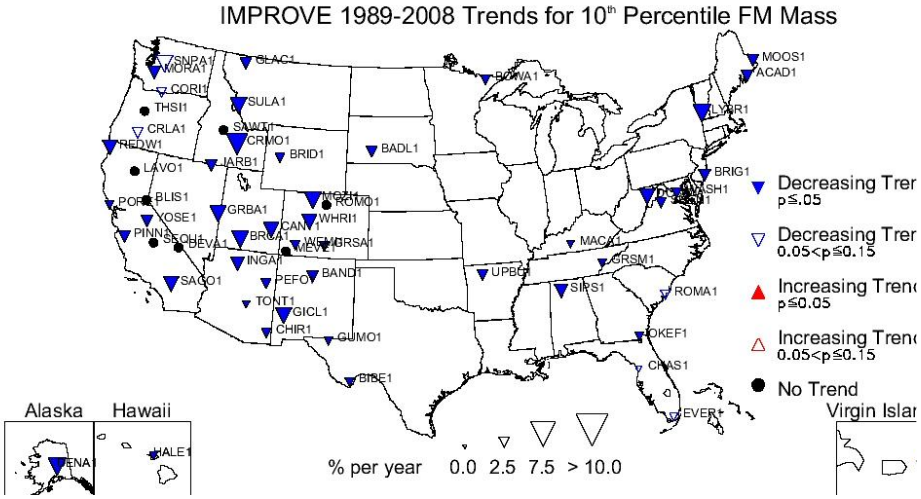


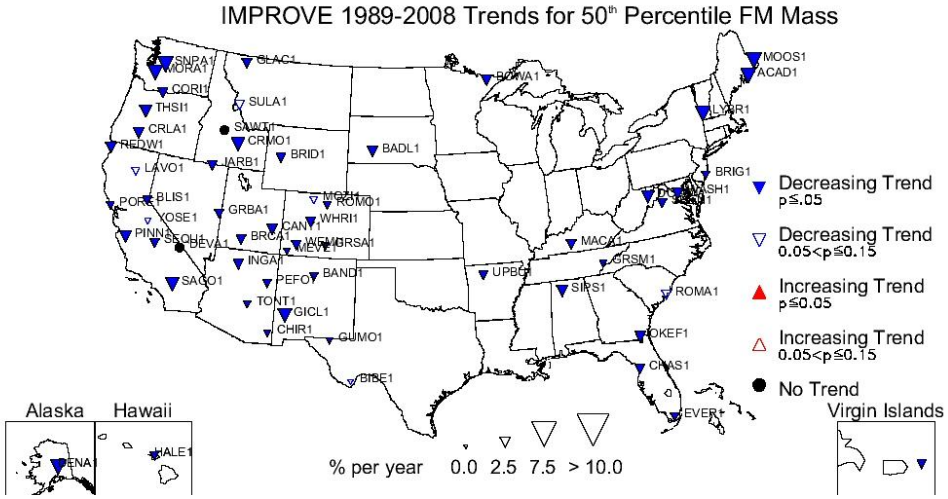
20 Year versus 9 Year TC Trends

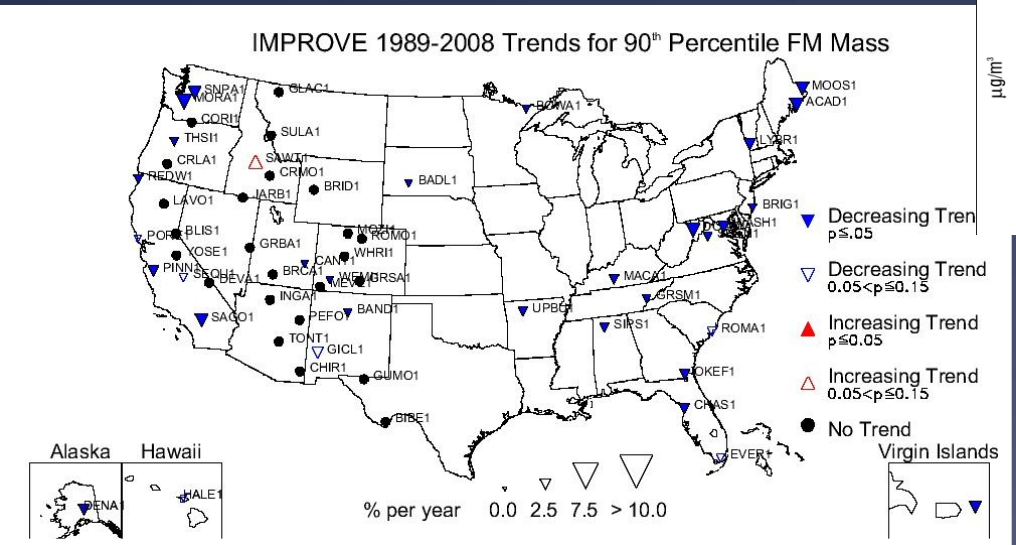


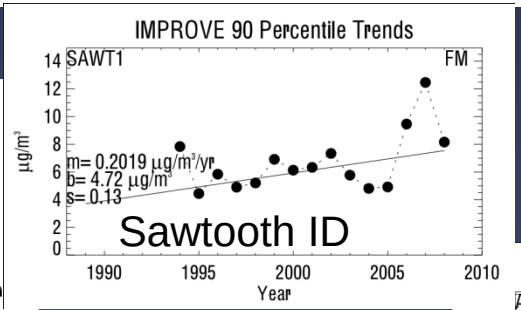


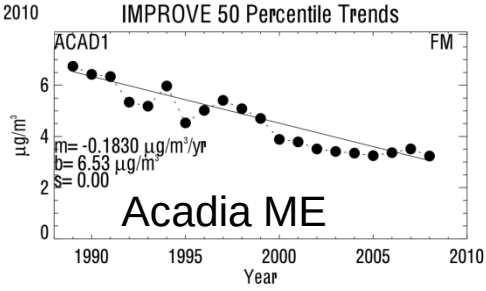
20 Year Fine Mass Trends

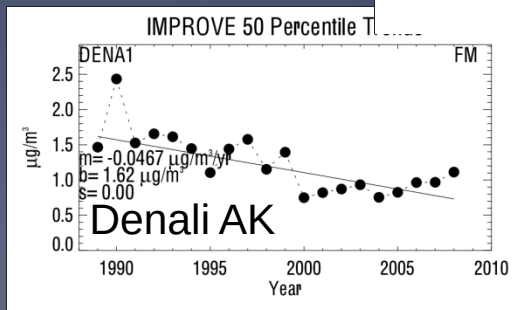




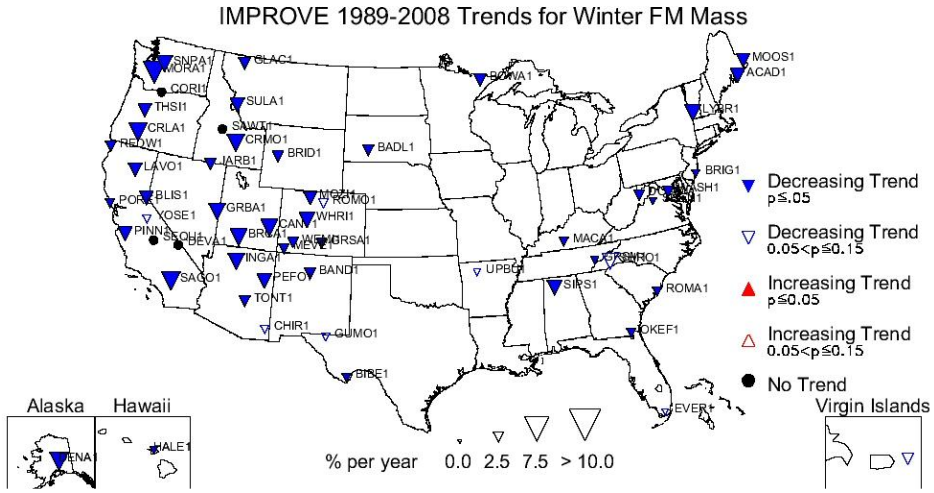


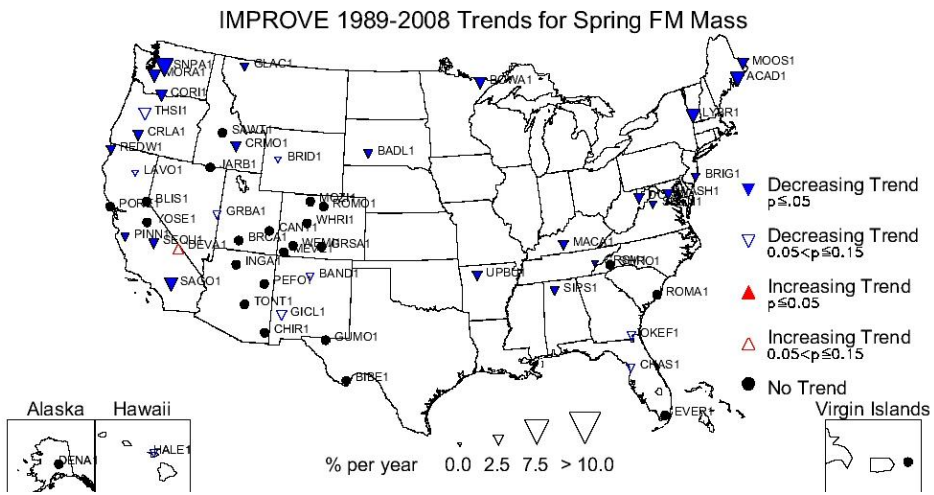


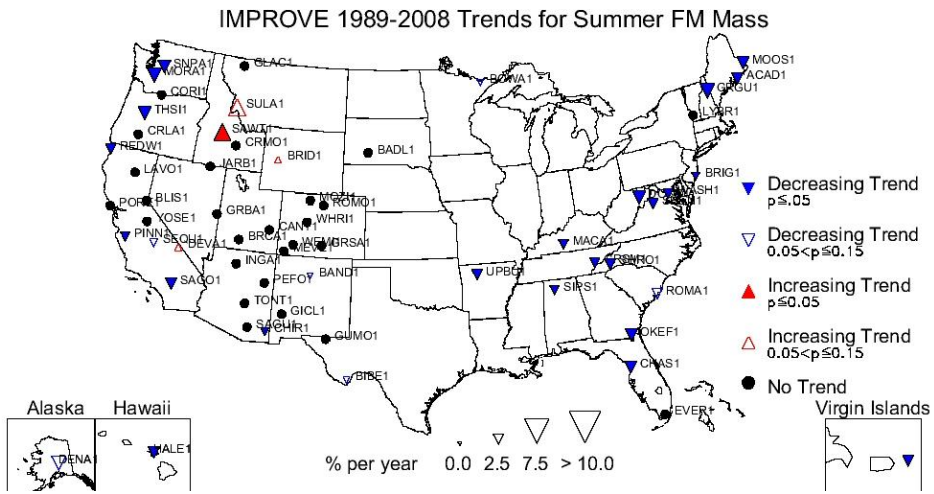


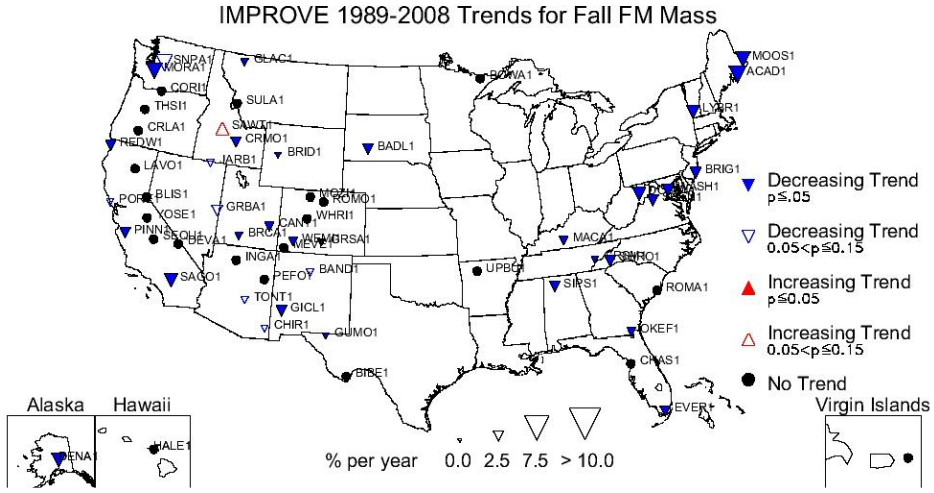


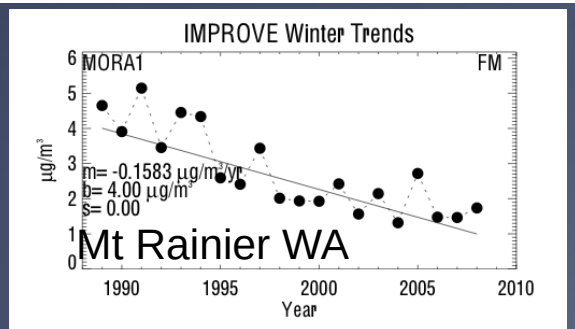
20 Year Fine Mass Trends

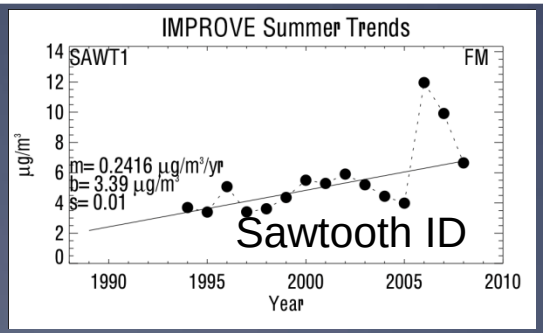




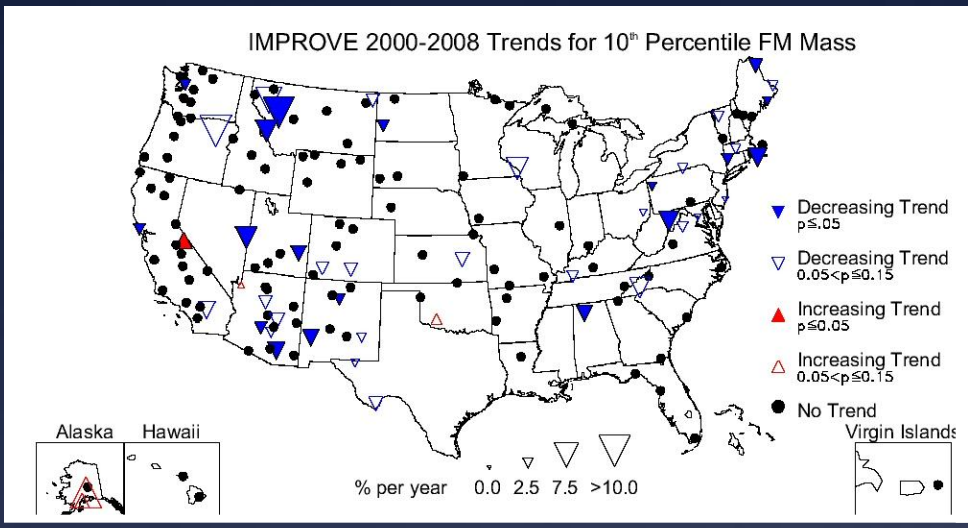


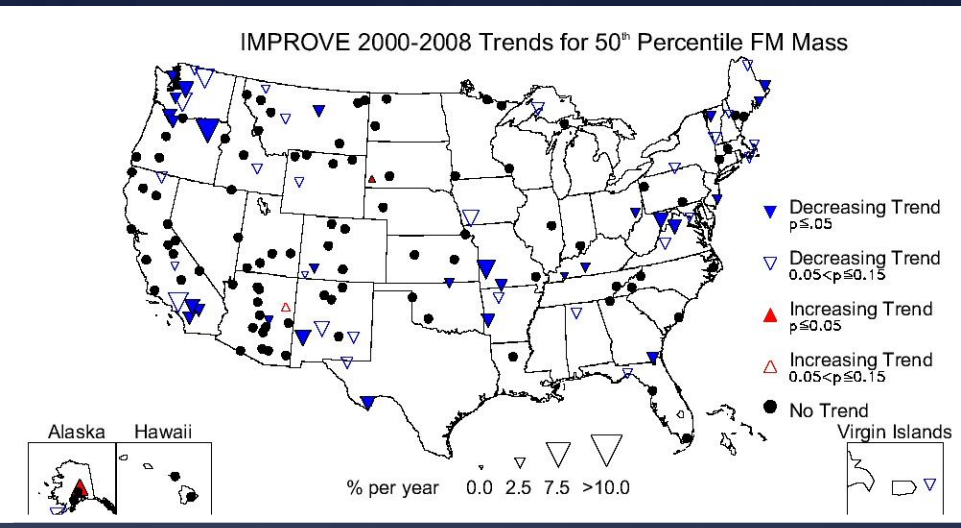


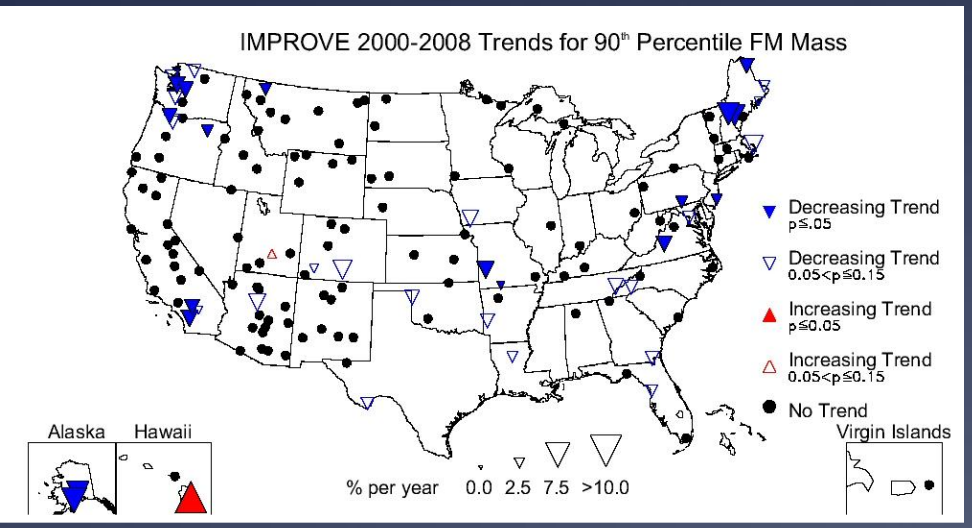


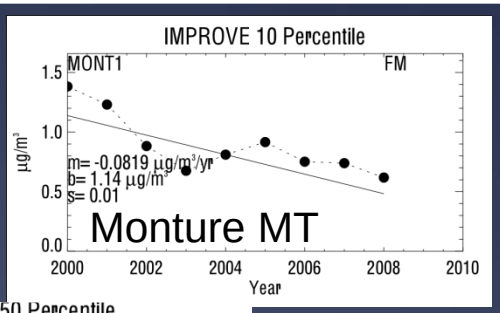


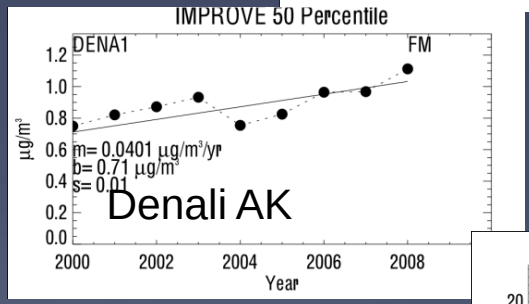
9 Year Fine Mass Trends

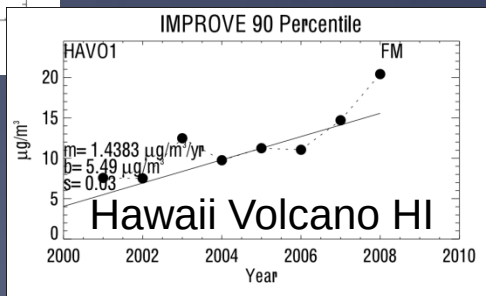




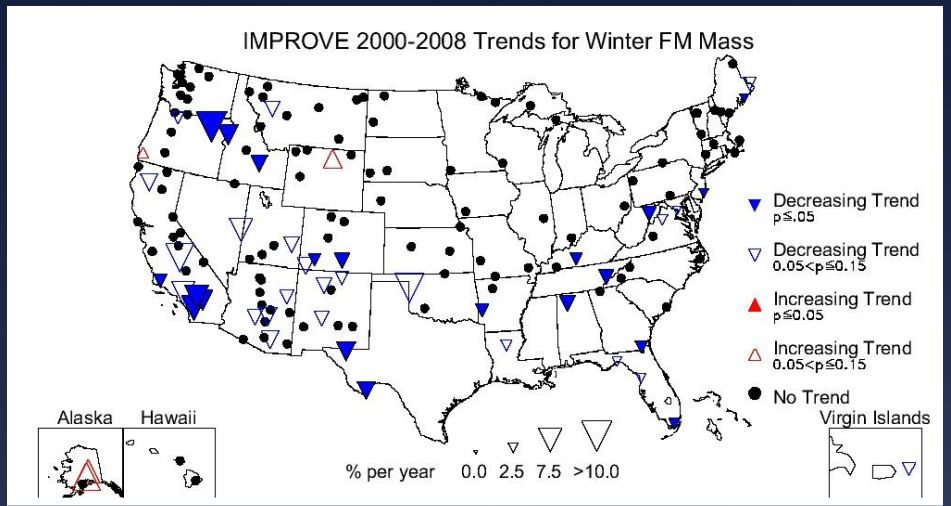


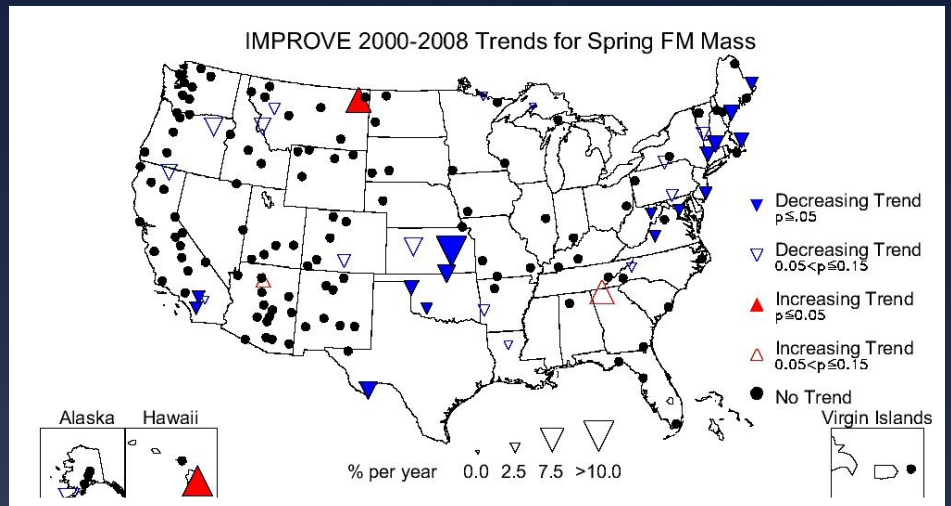


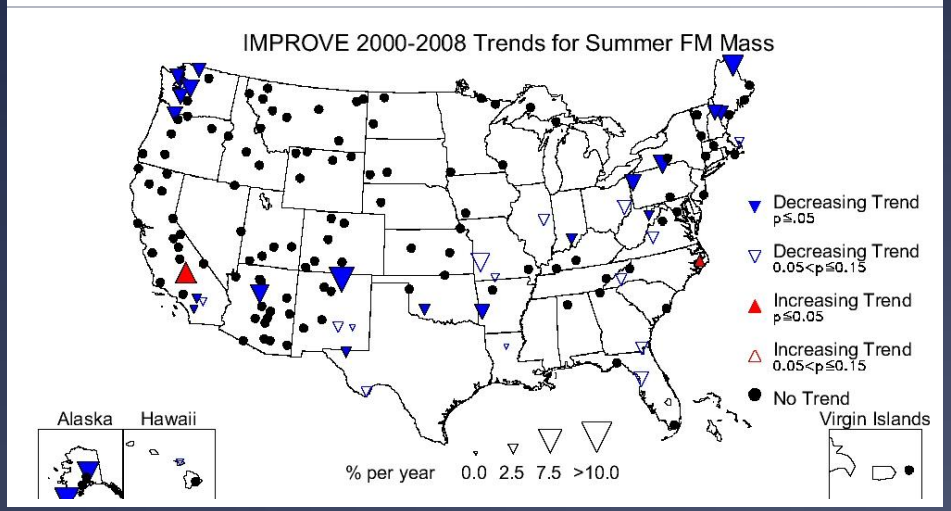


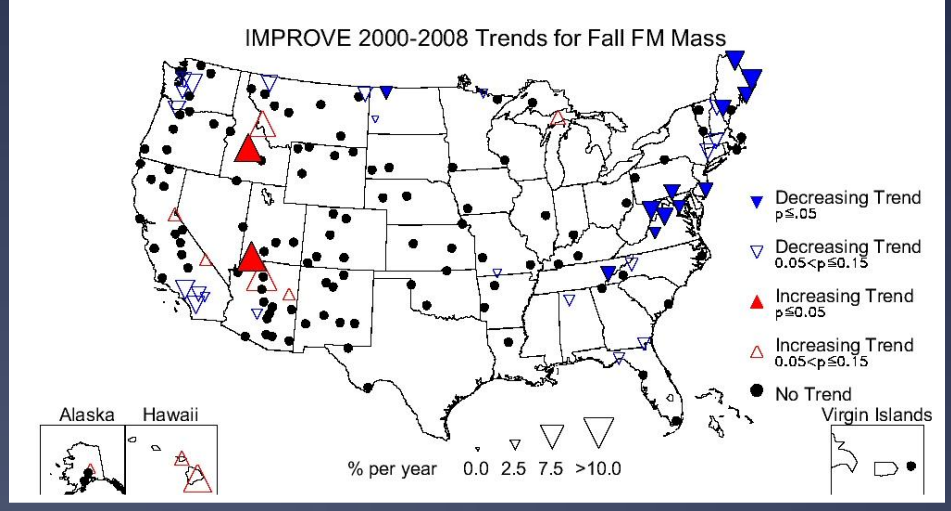


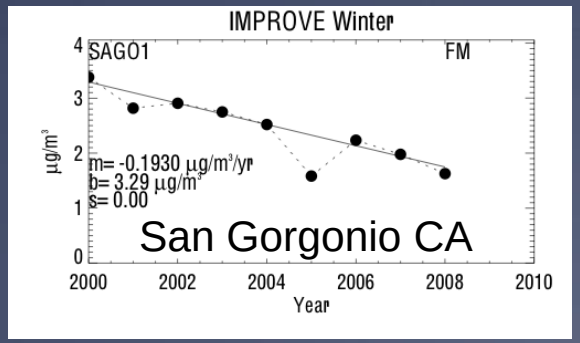
9 Year Fine Mass Trends

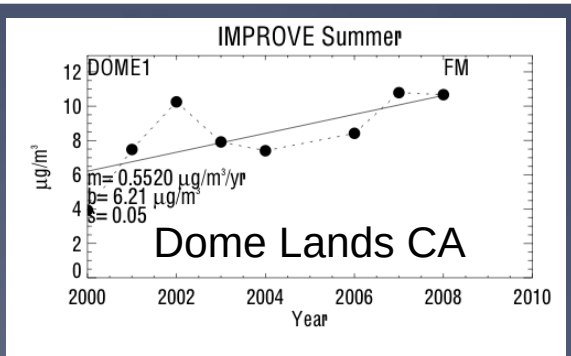




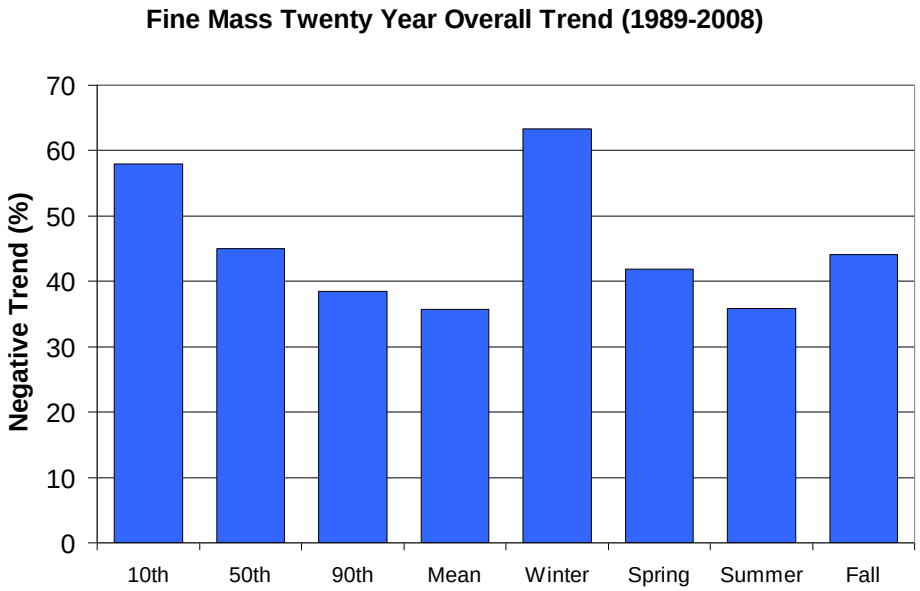


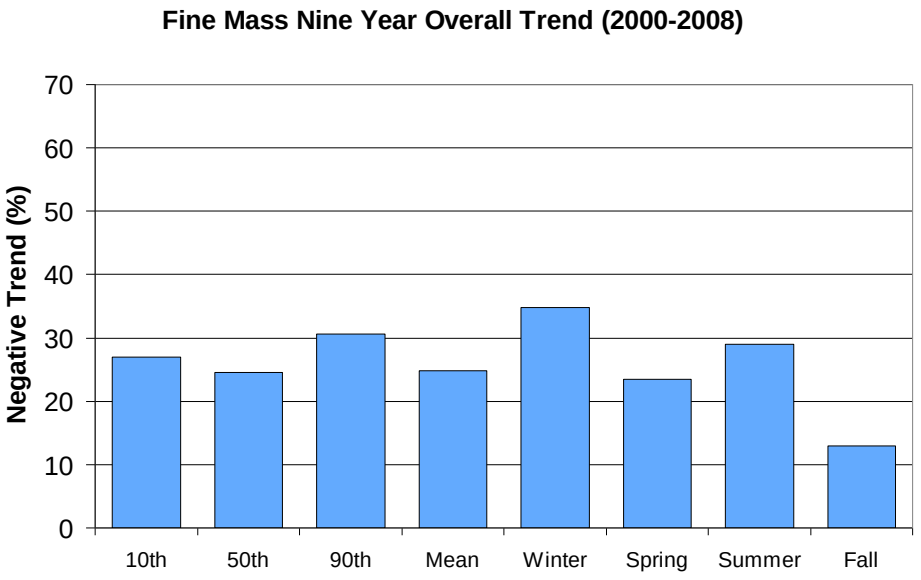




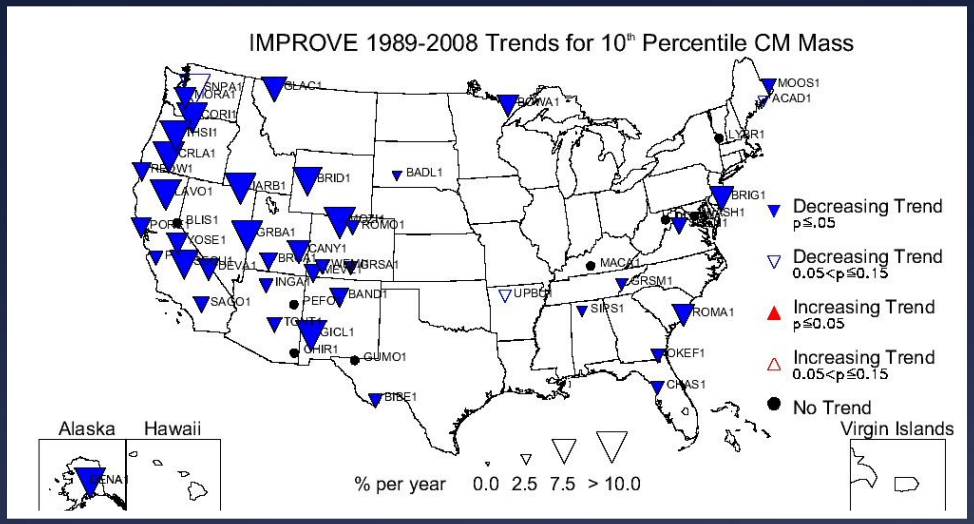


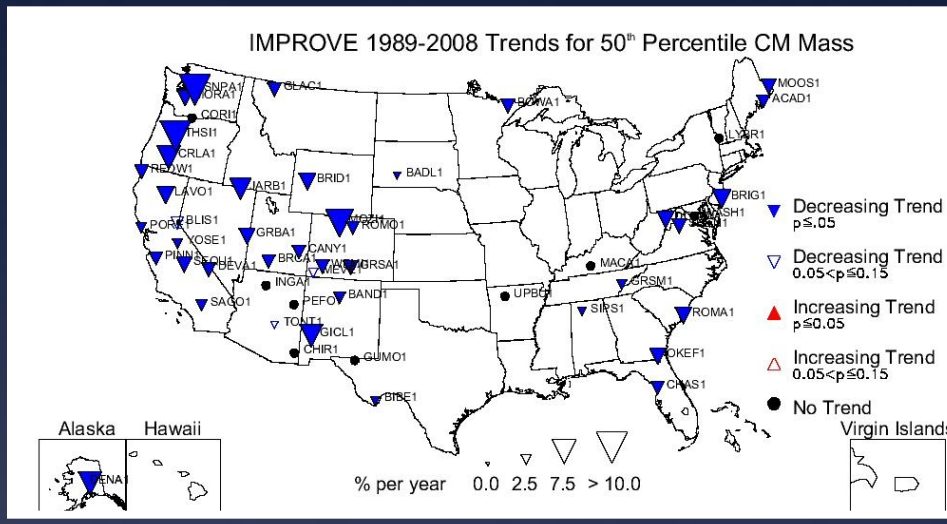
20 versus 9 Year Fine Mass Trends

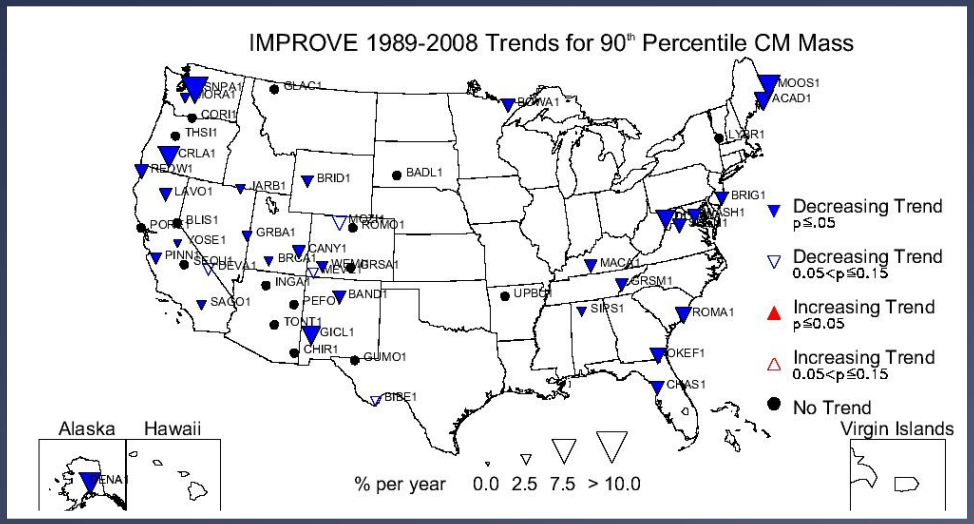


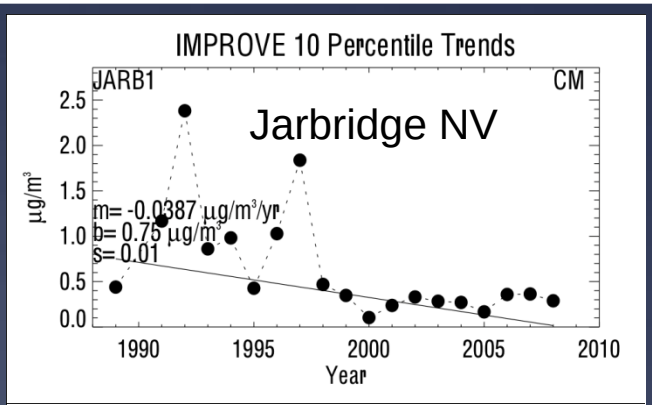


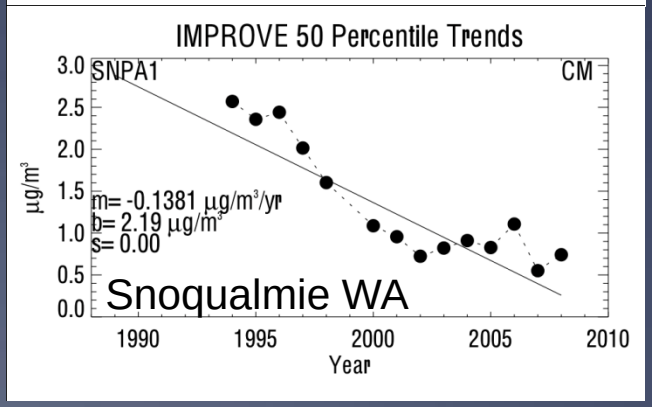
20 Year Coarse Mass Trends



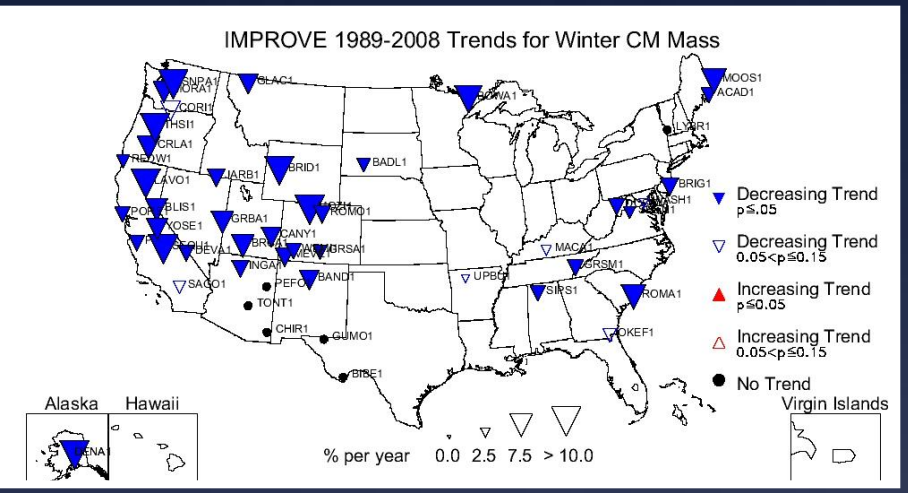


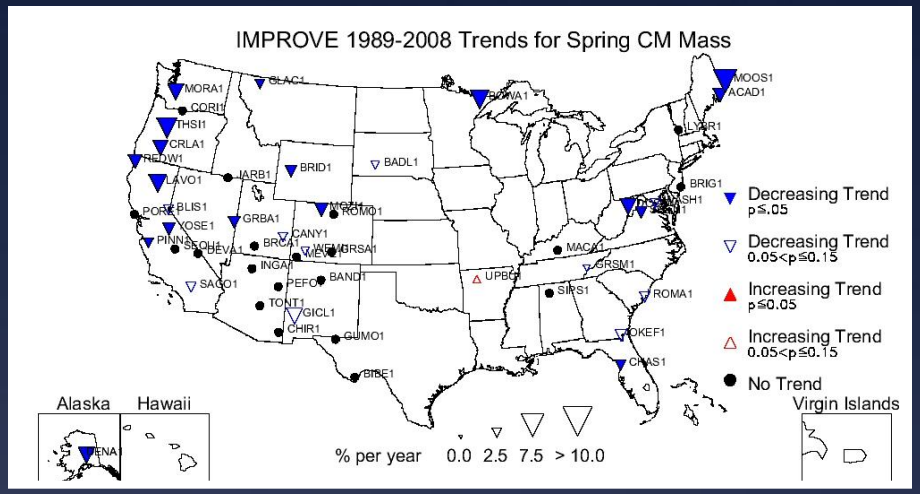


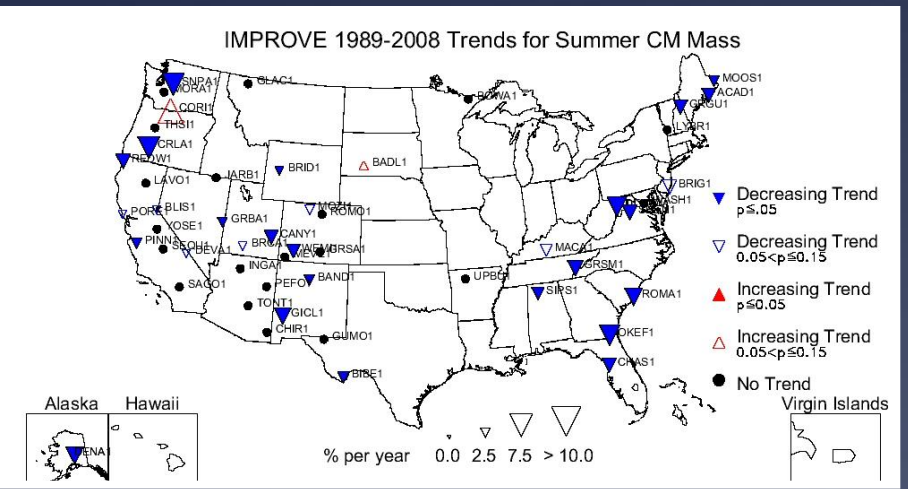


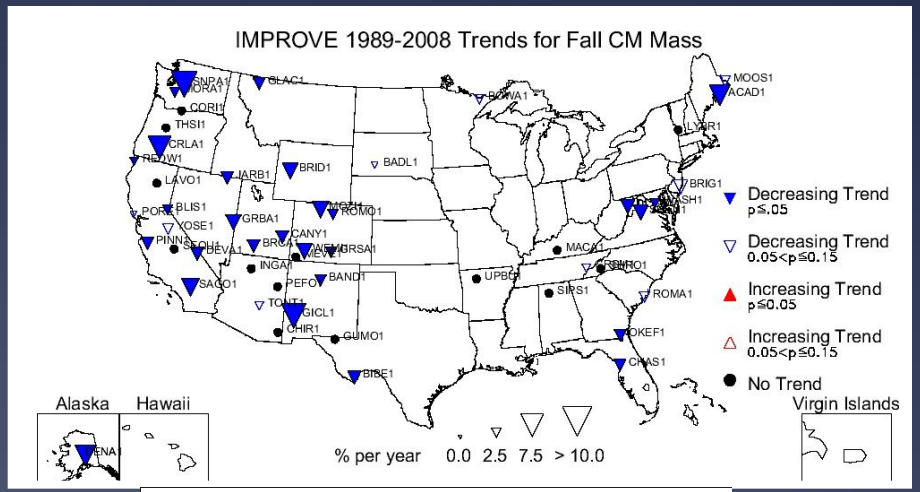


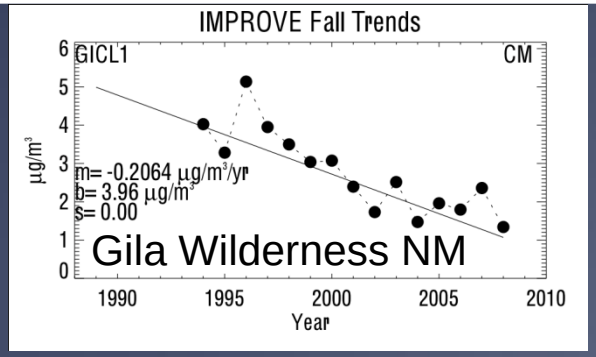
20 Year Coarse Mass Trends

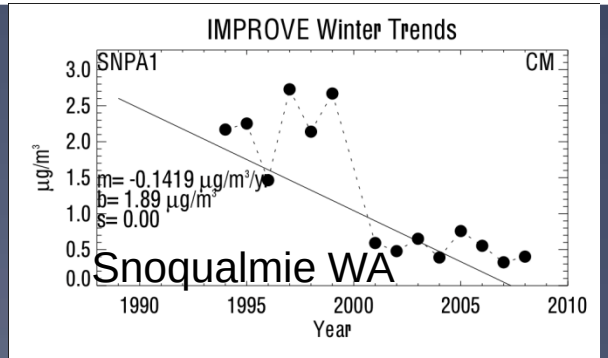




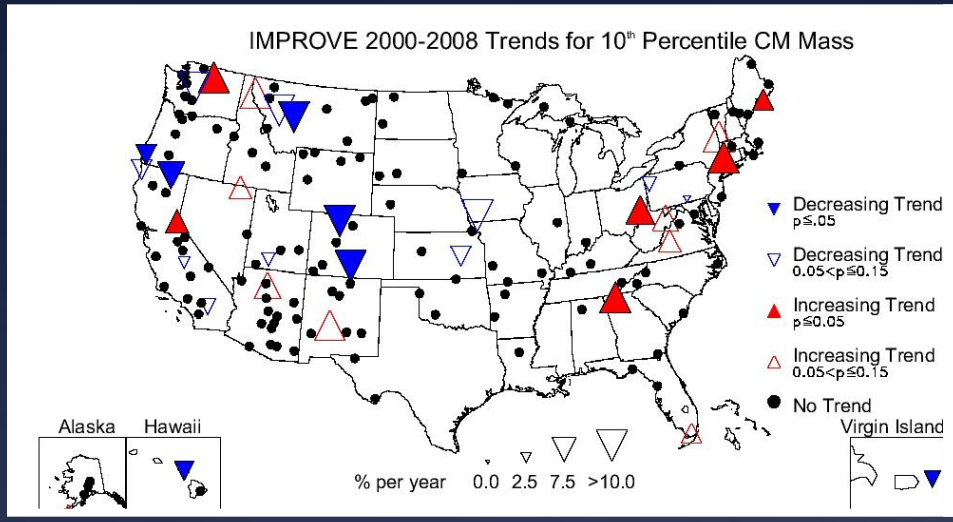


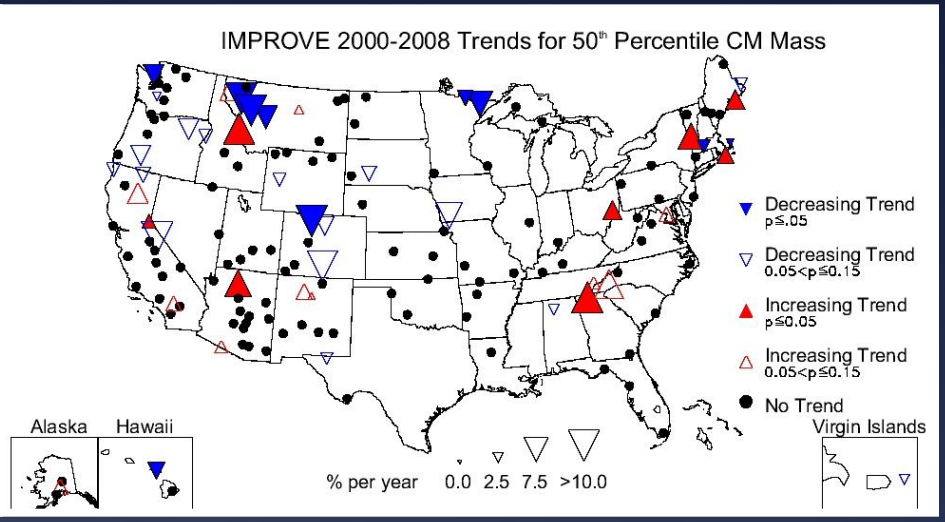


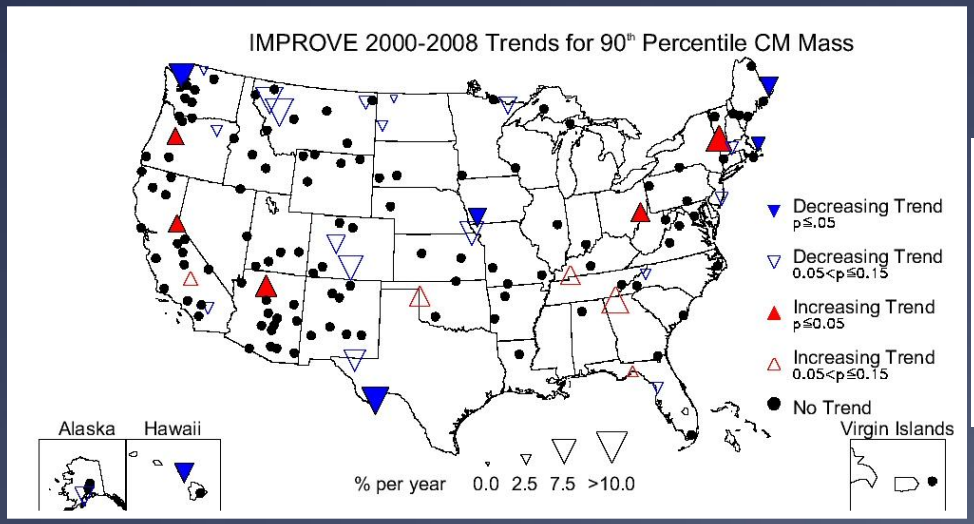


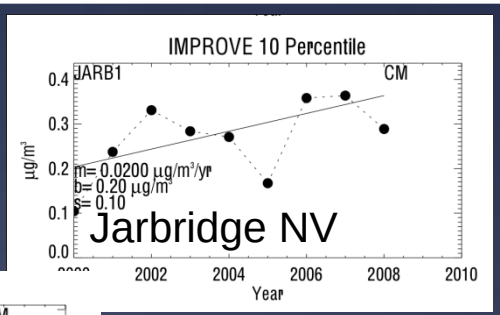


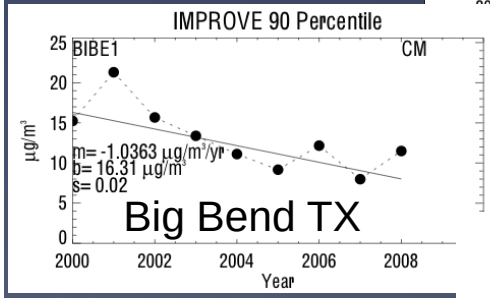
9 Year Coarse Mass Trends

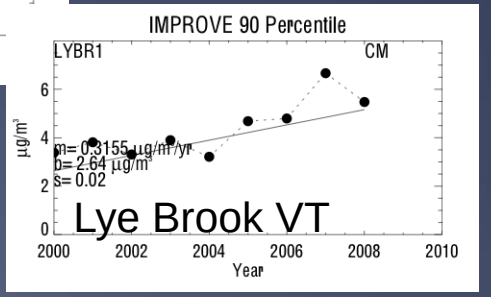




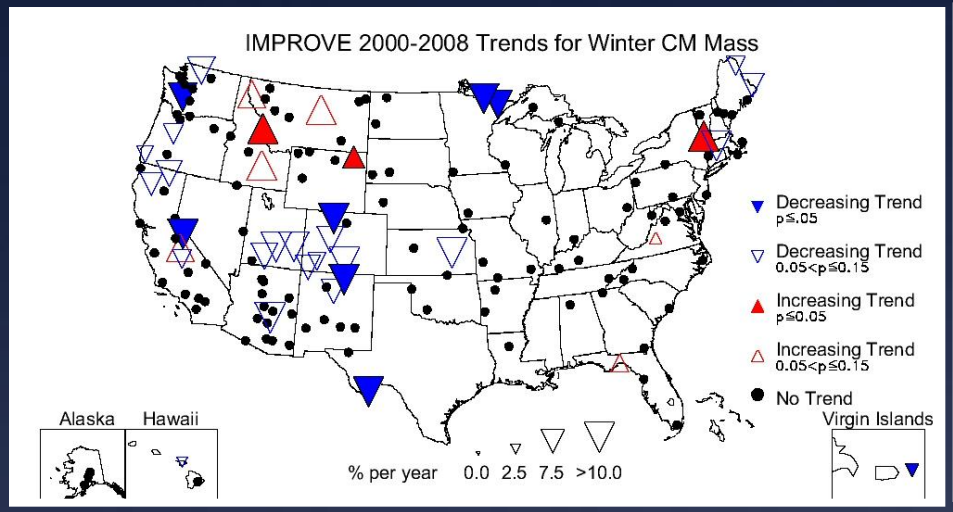


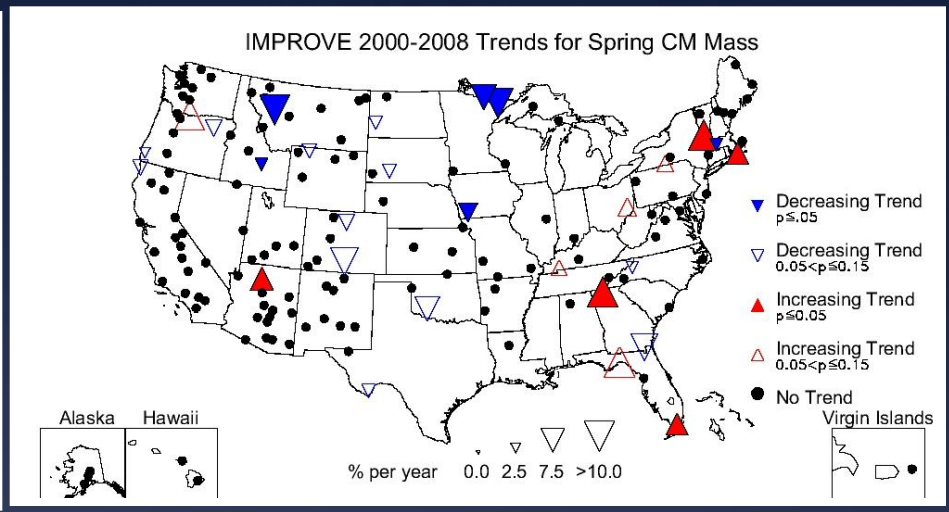


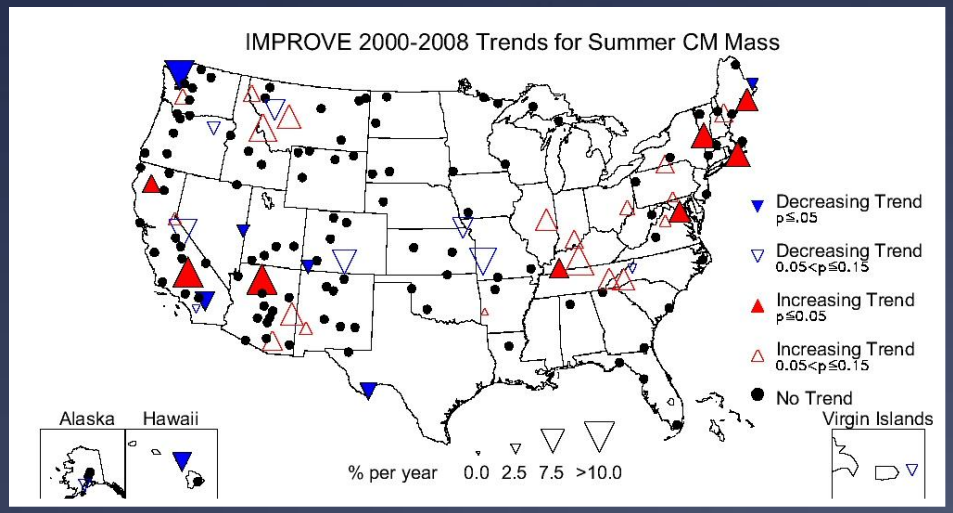


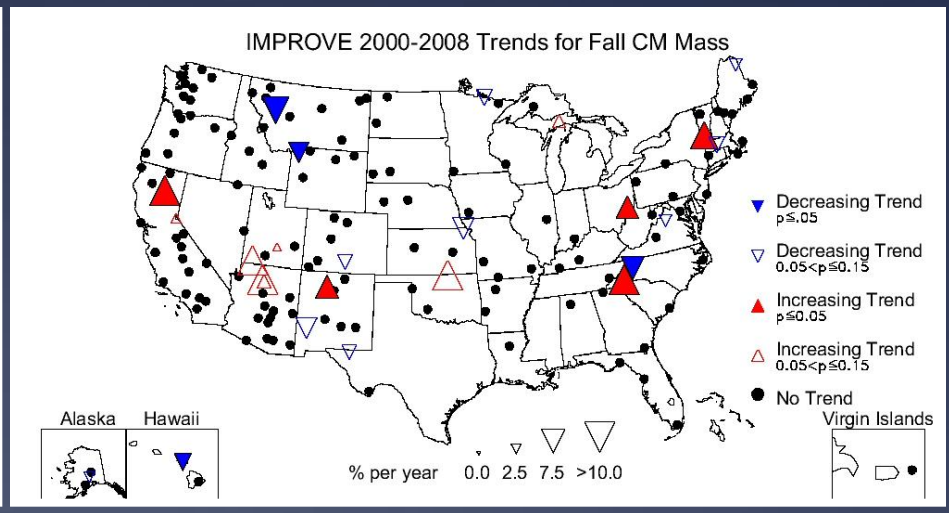


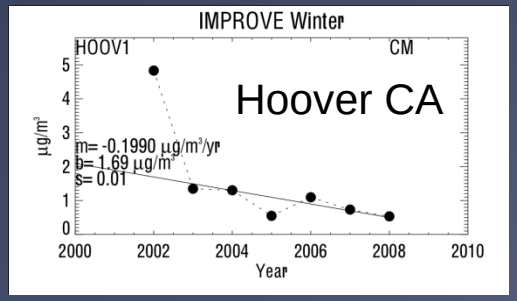
9 Year Coarse Mass Trends

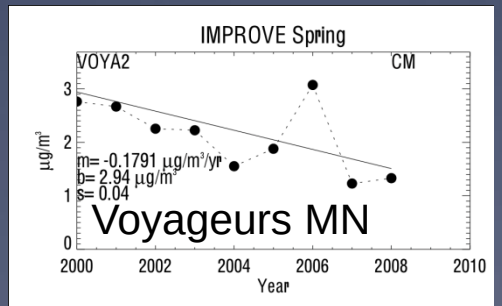


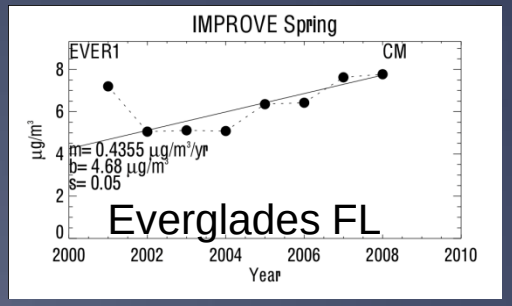




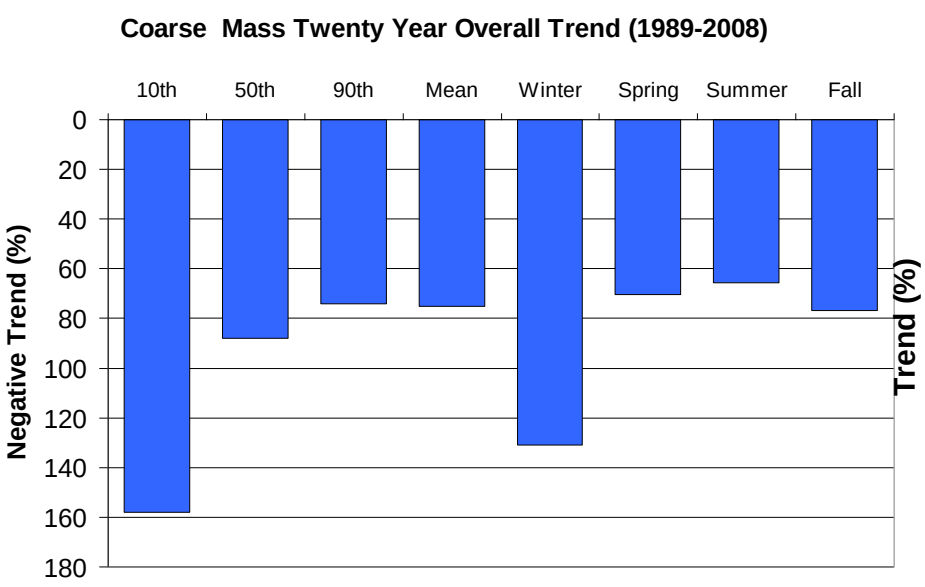


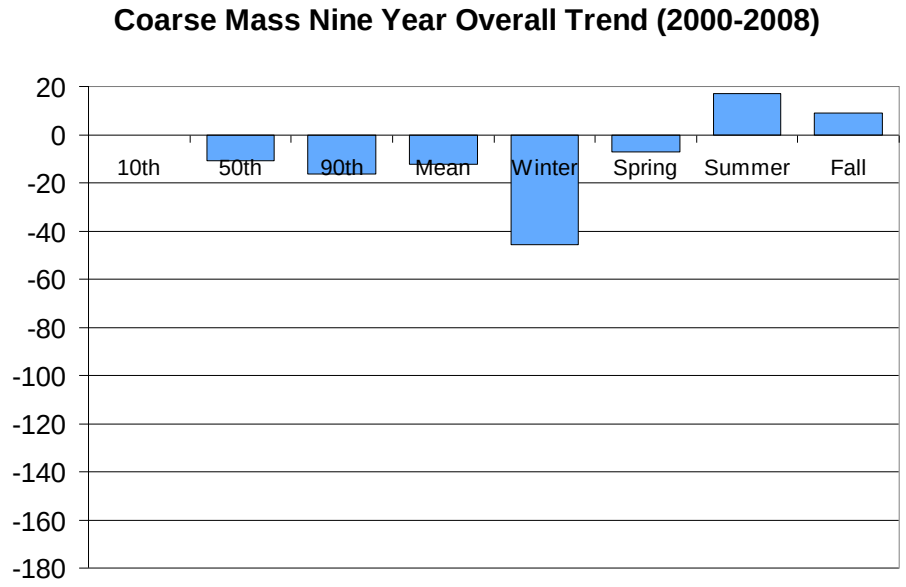




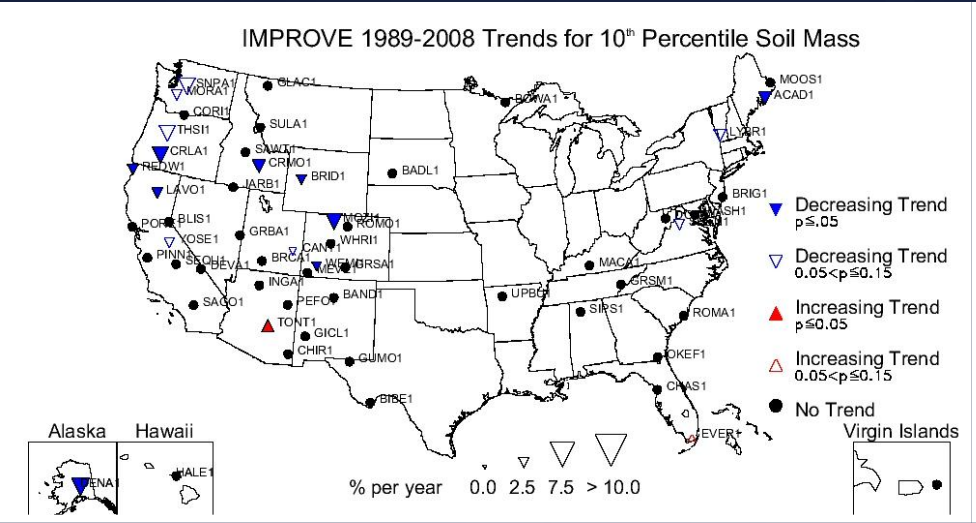


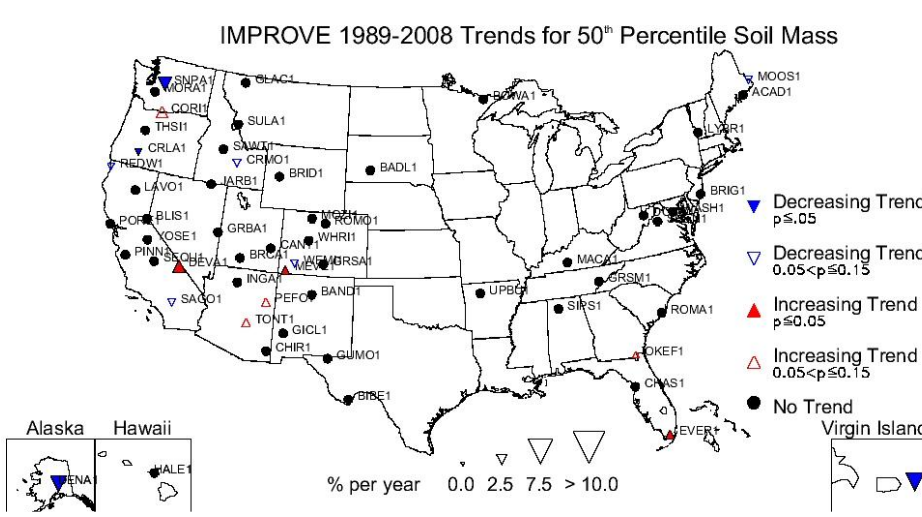
20 versus 9 Year Coarse Mass Trends

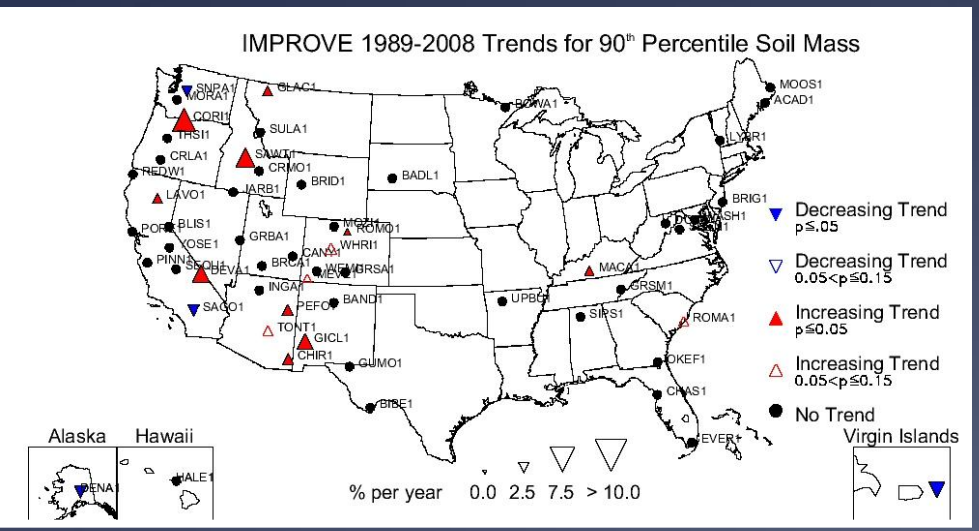


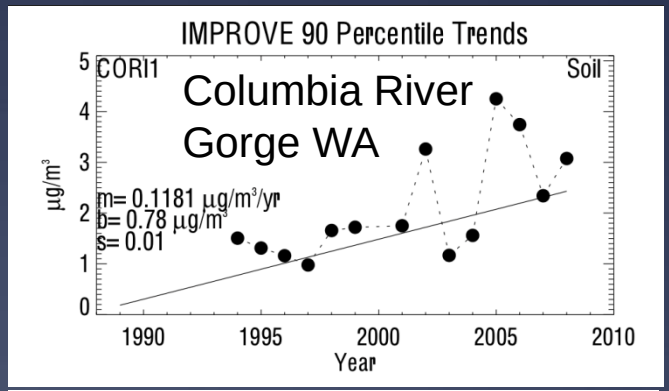


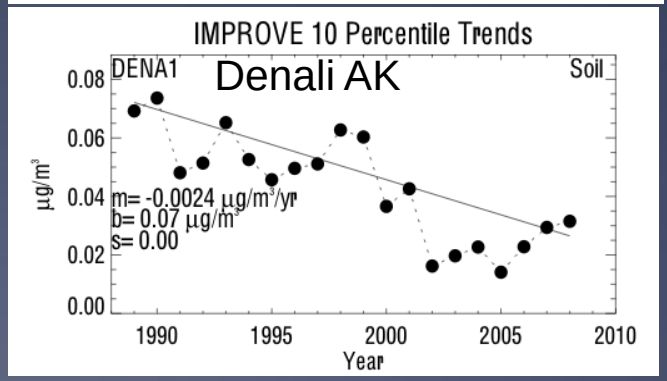
20 Year Soil Mass Trends



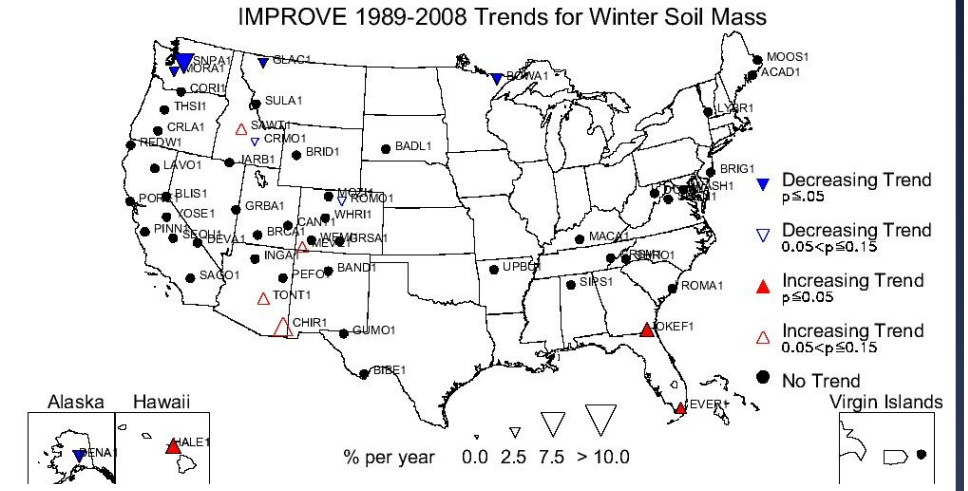


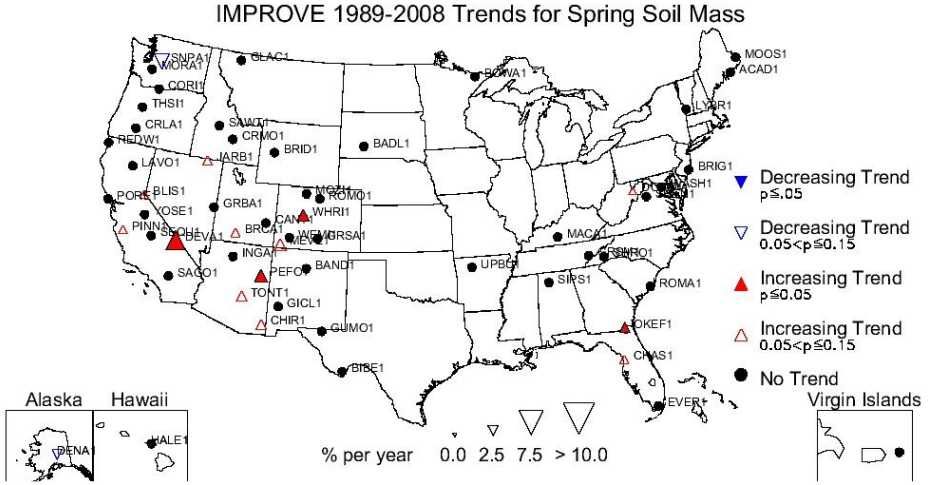


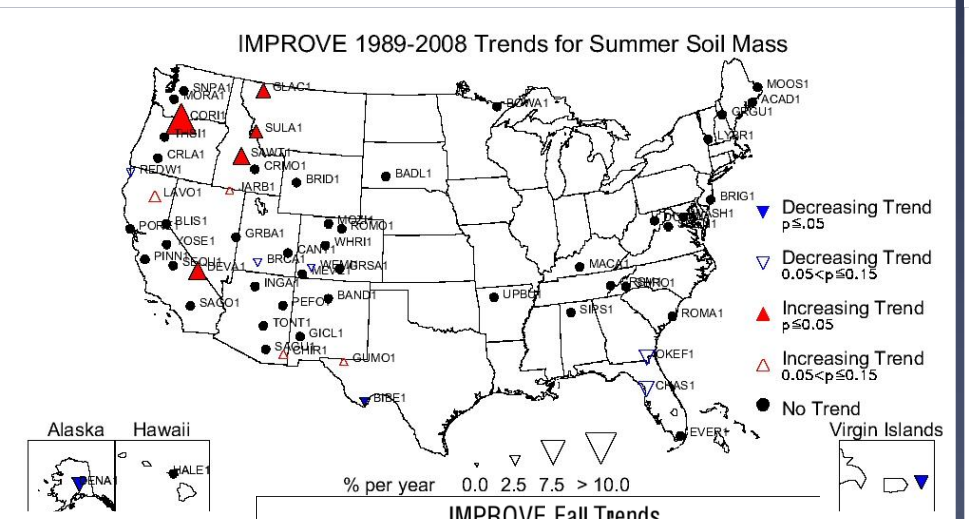


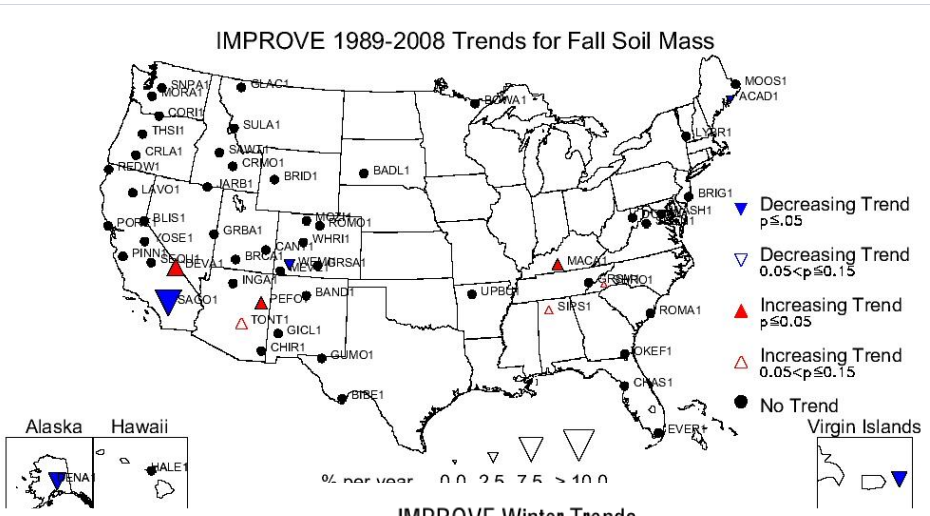


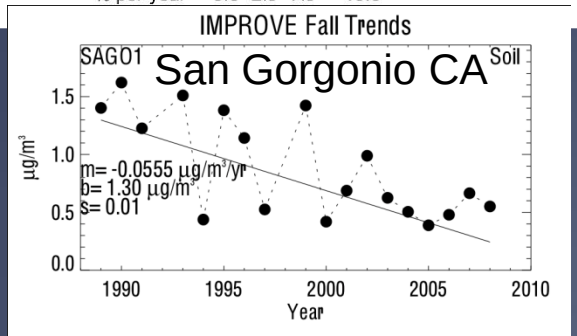
20 Year Soil Mass Trends

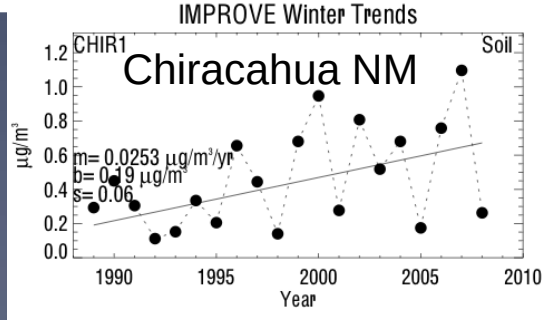




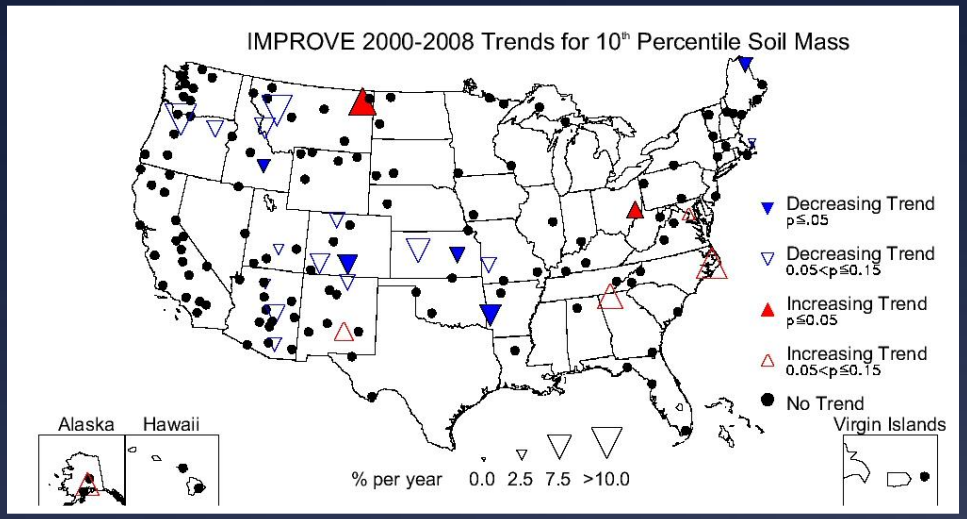


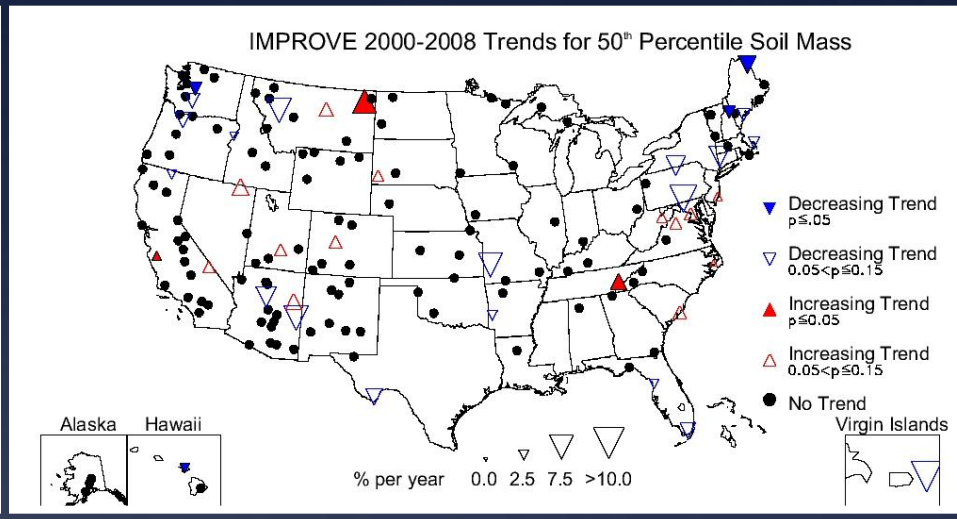


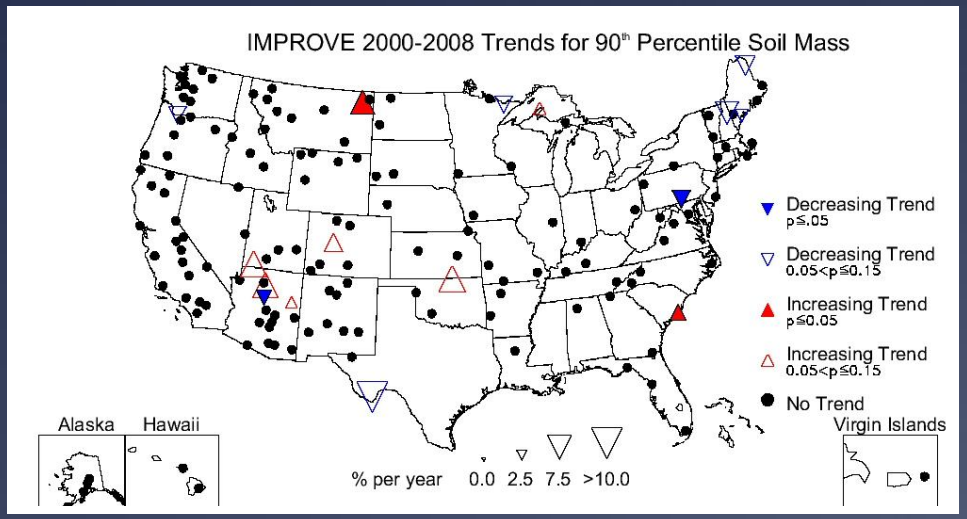


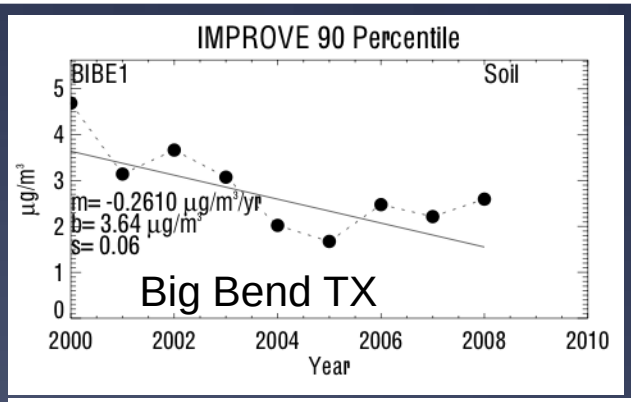


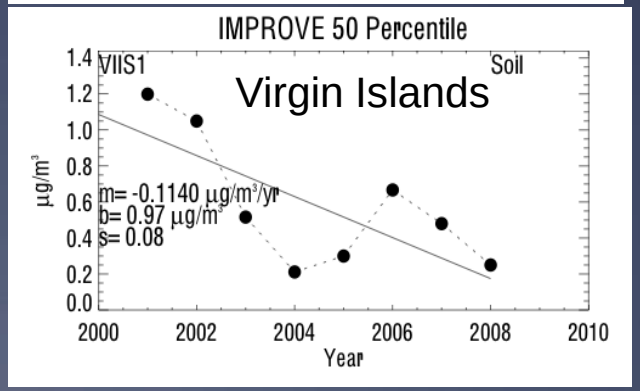
9 Year Soil Mass Trends



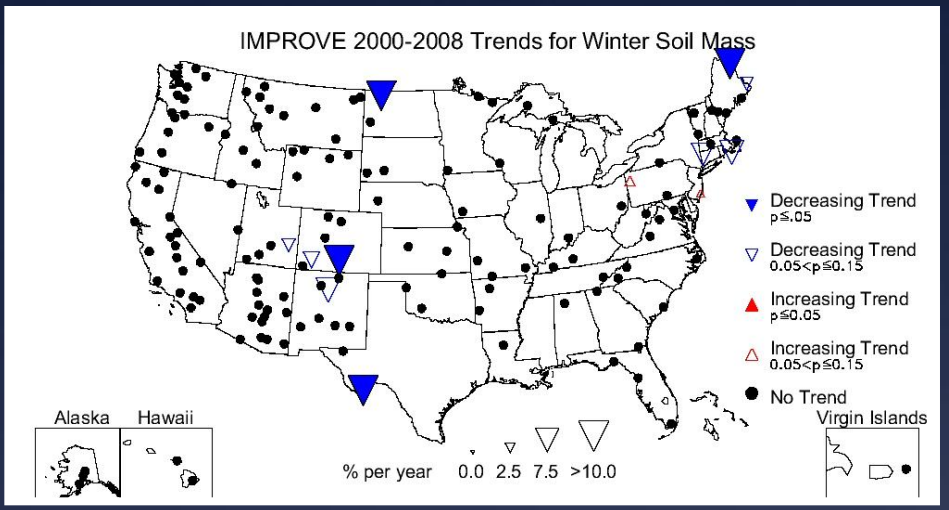


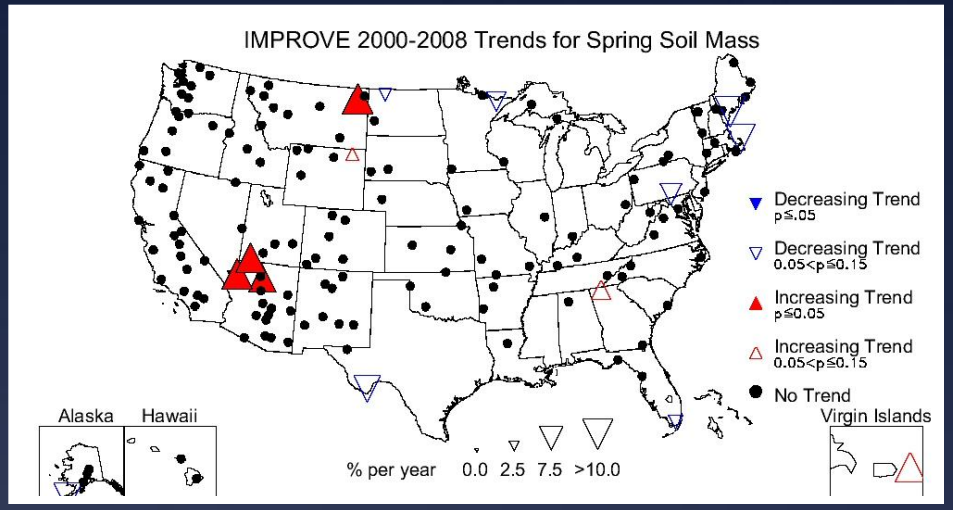


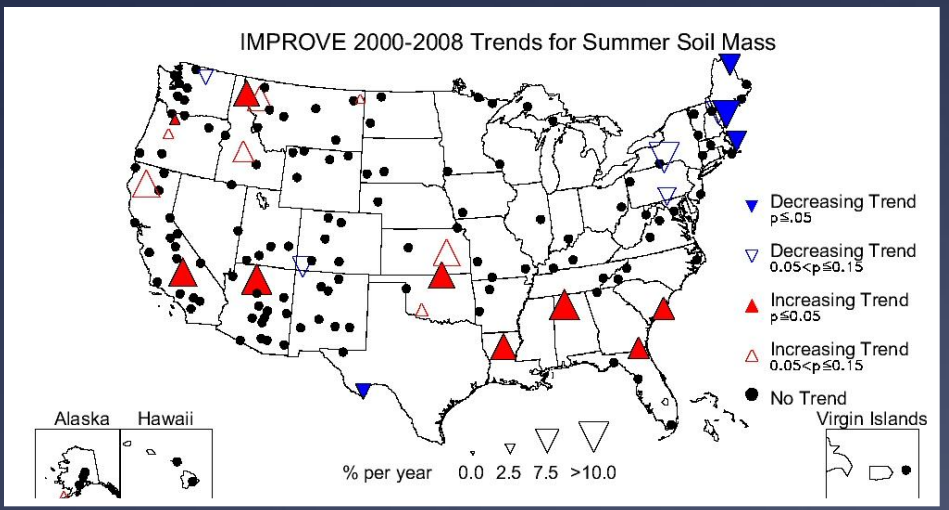


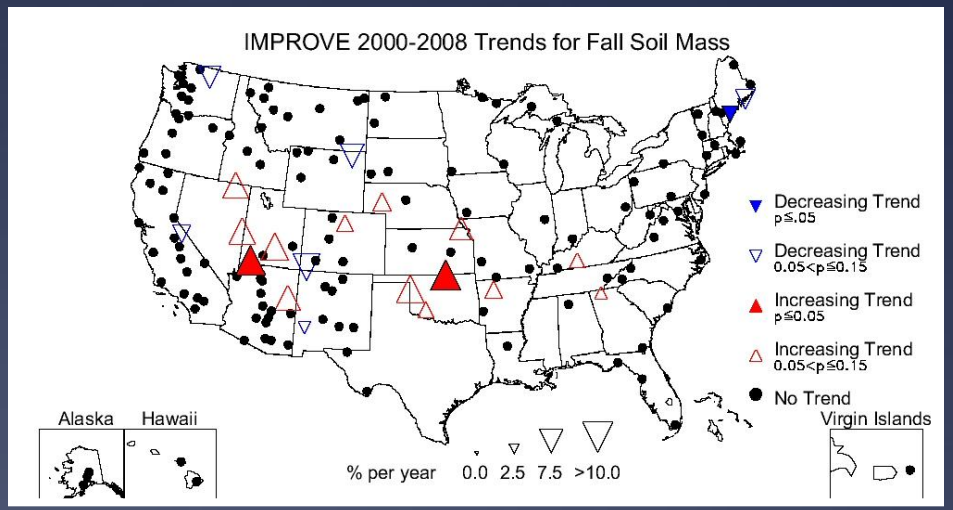


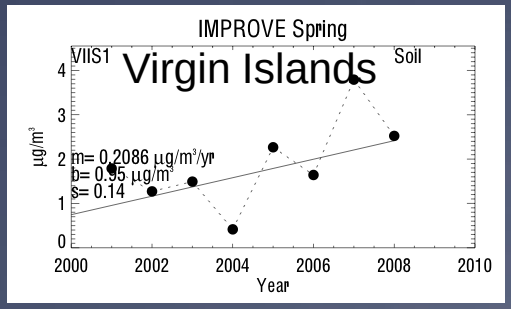
9 Year Soil Mass Trends

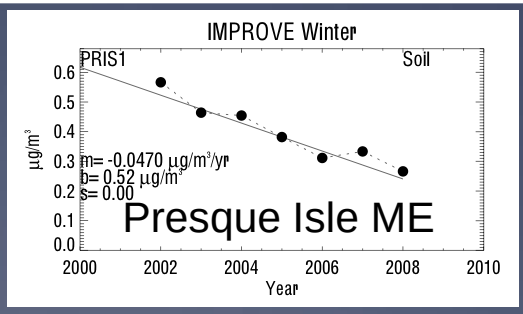




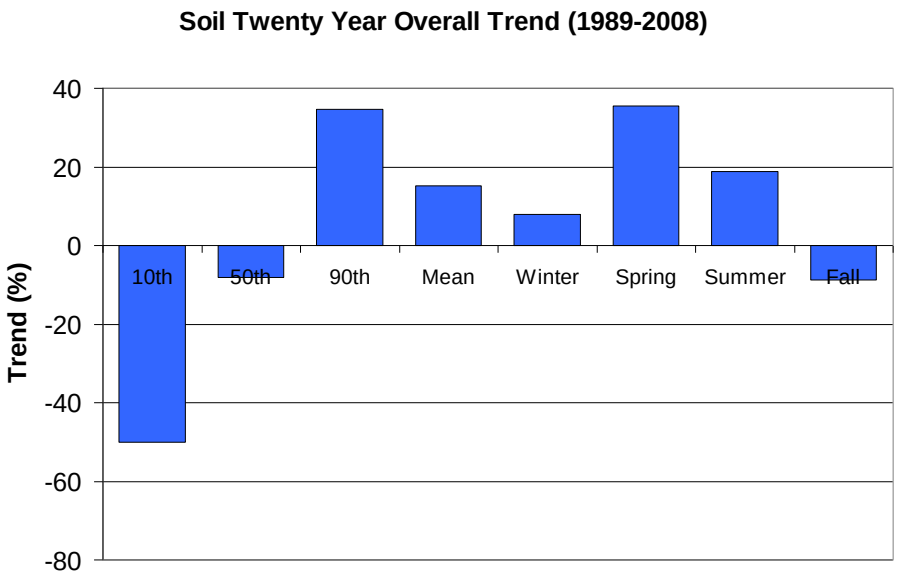


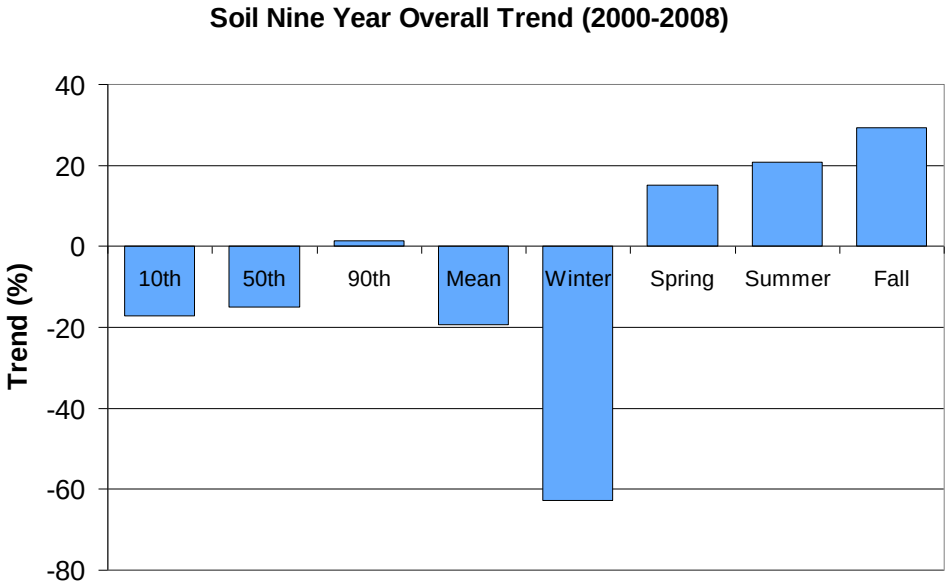




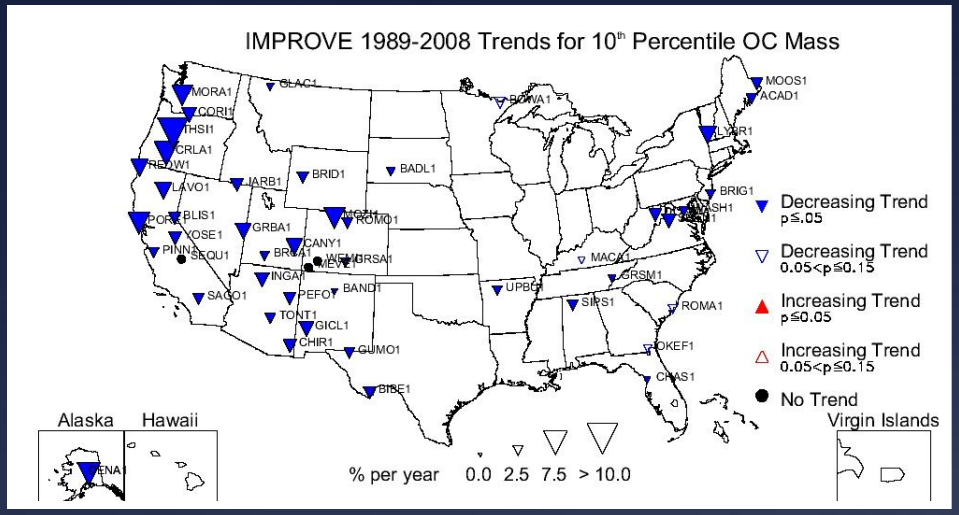


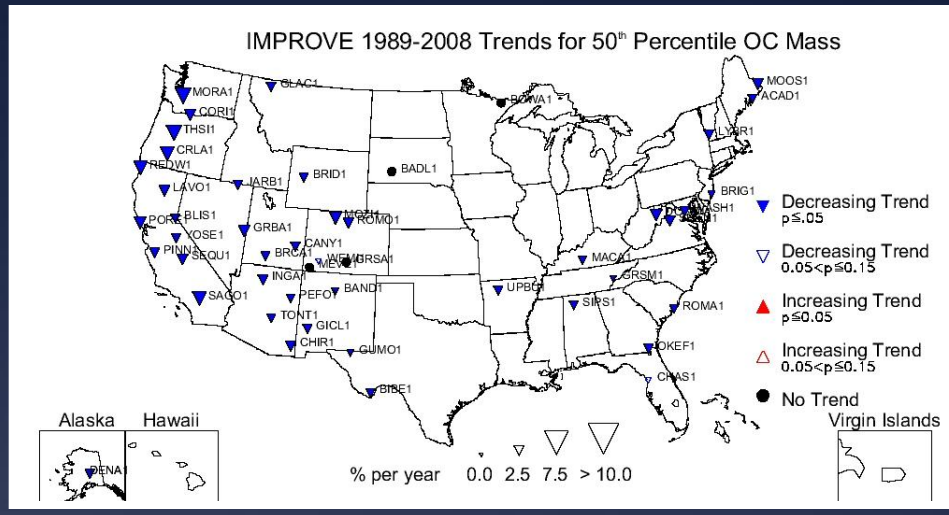
9 versus 20 Year Soil Mass Trends

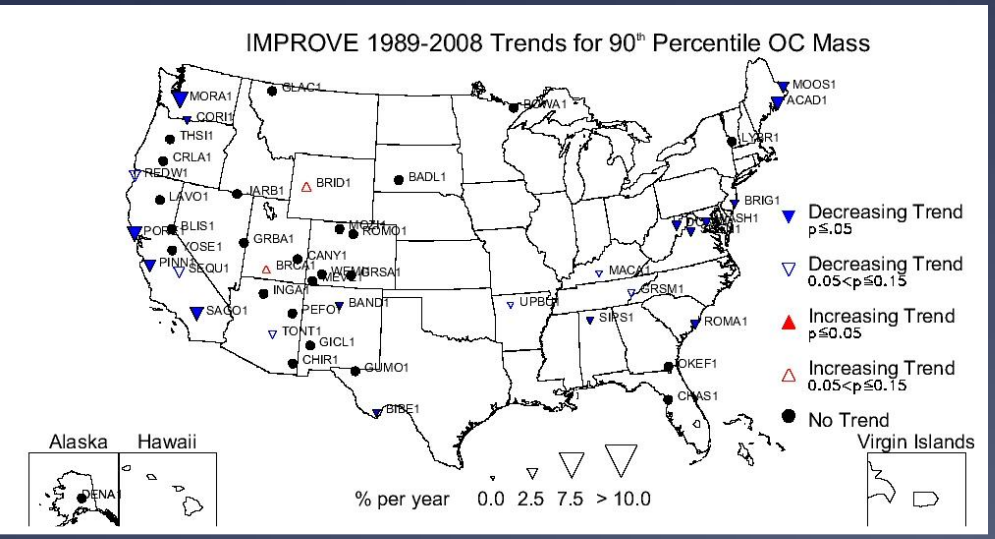




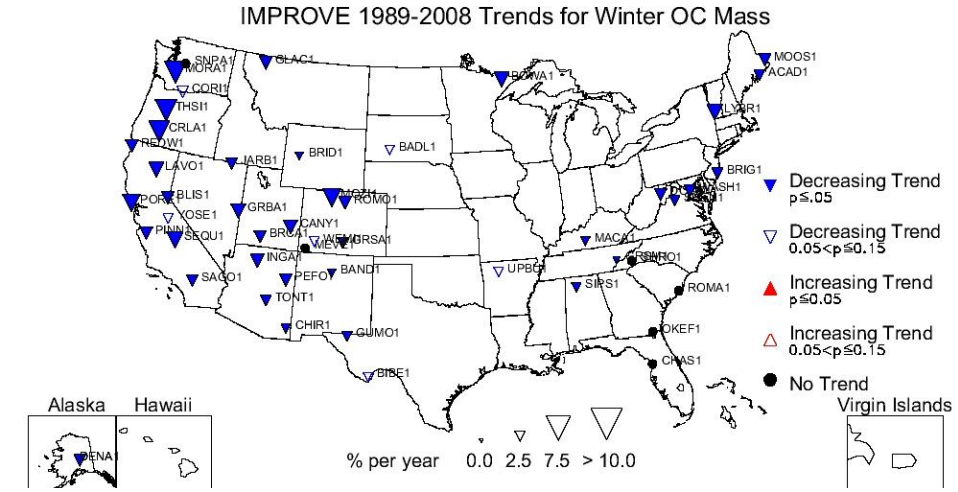
20 Year Organic Carbon Trends

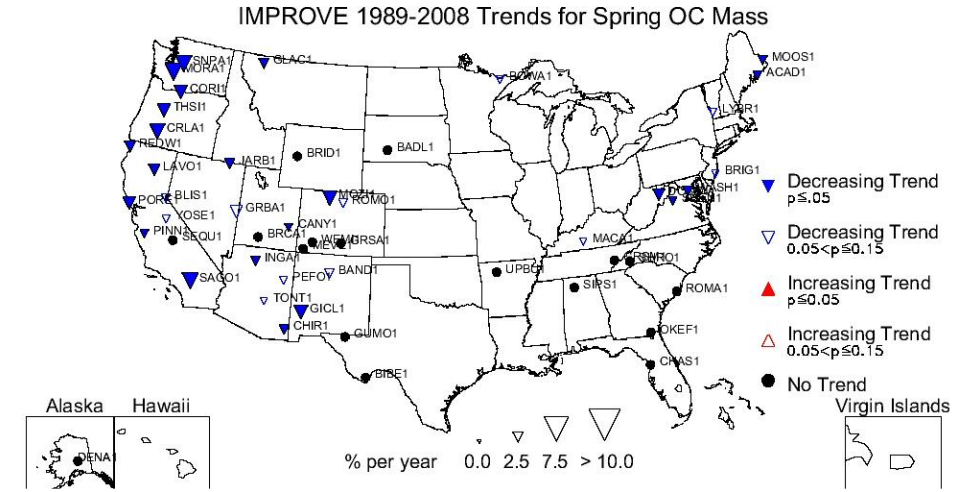


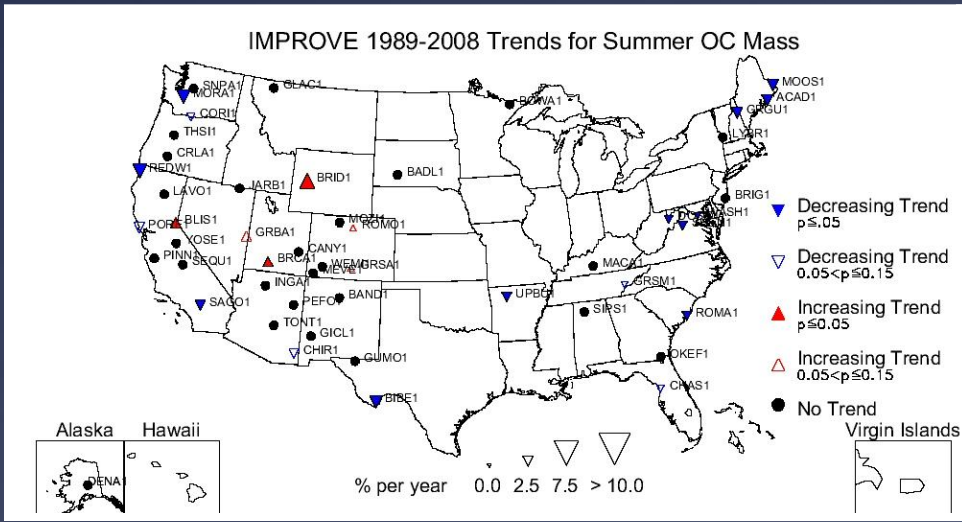


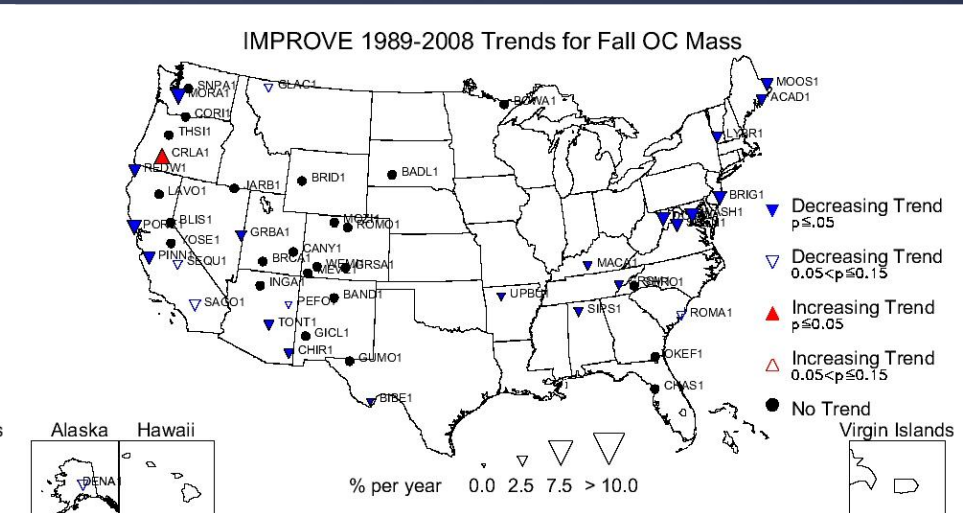


20 Year Organic Carbon Trends

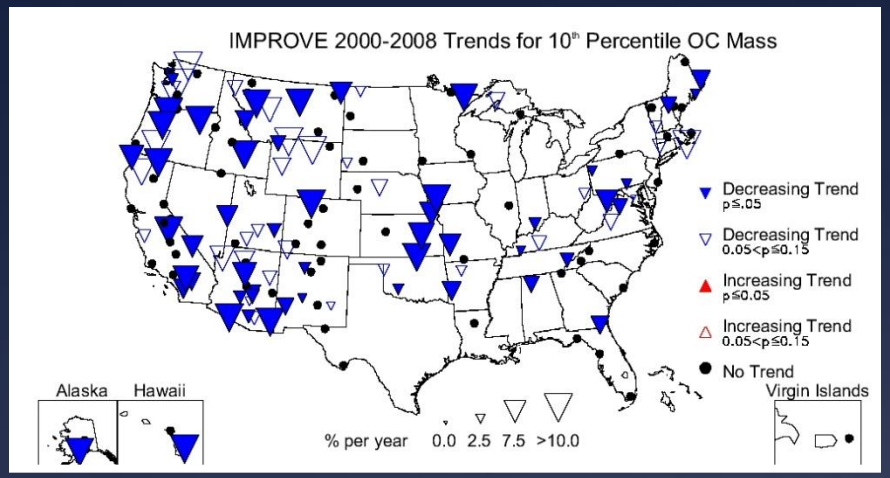


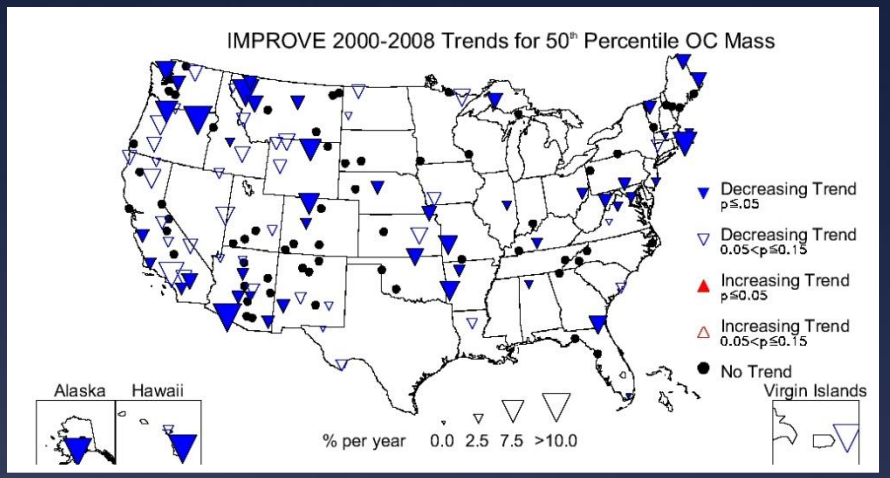


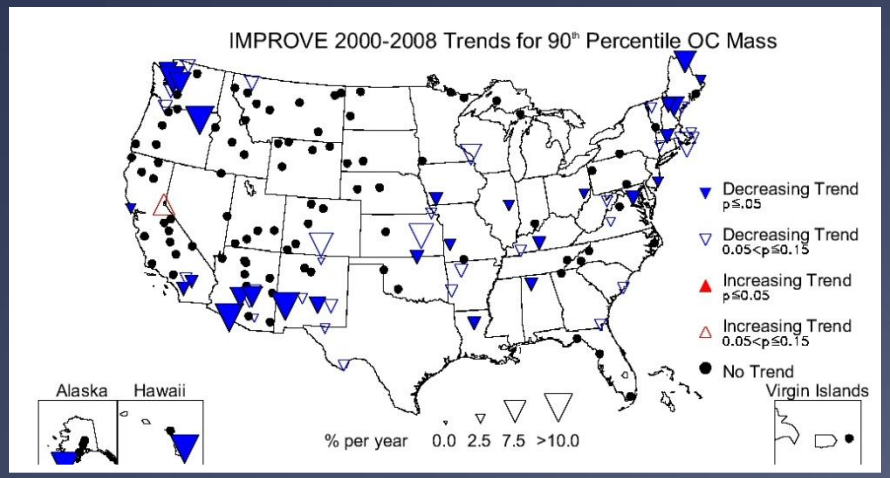




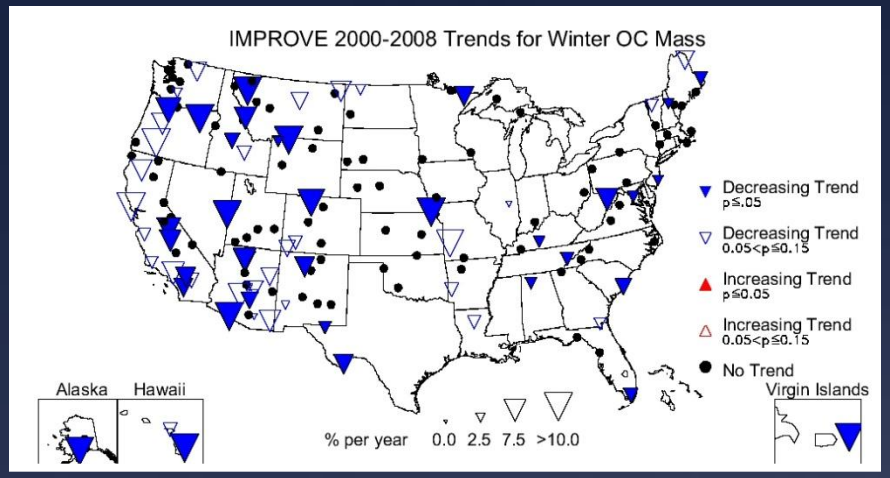
9 Year Organic Carbon Trends

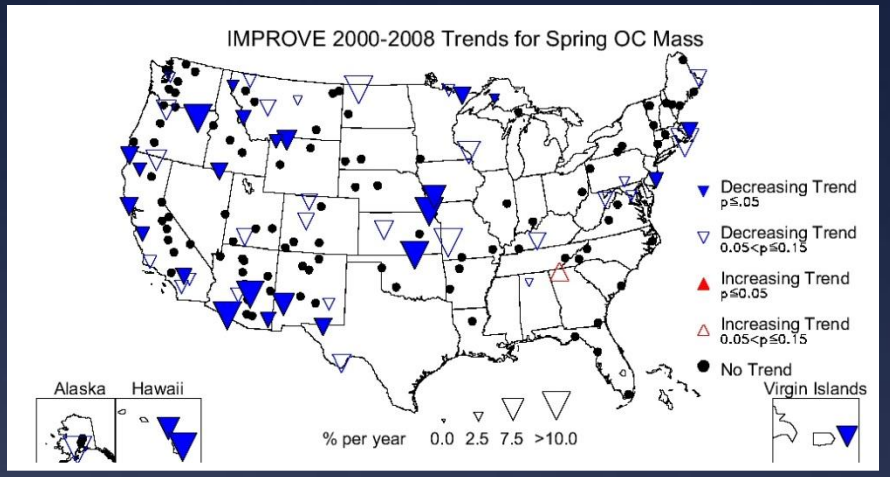


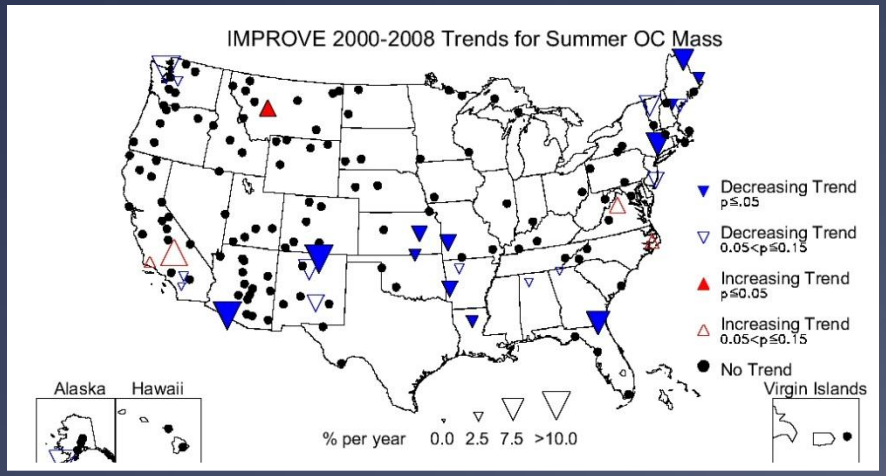


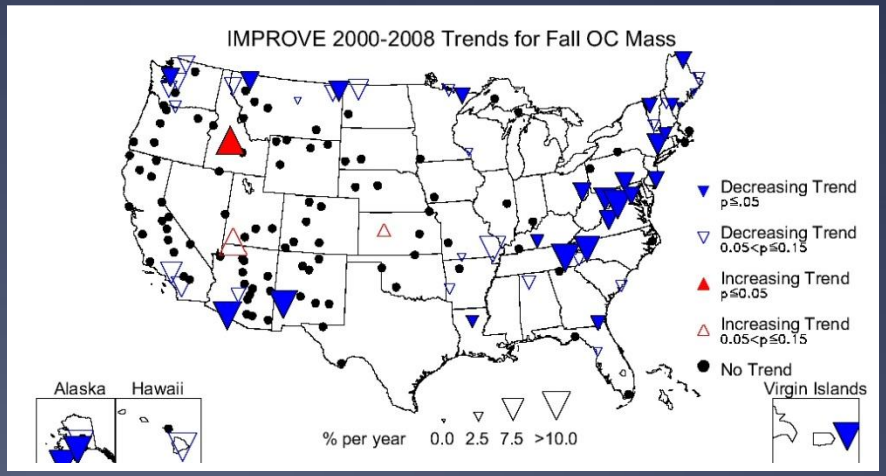


9 Year Organic Carbon Trends

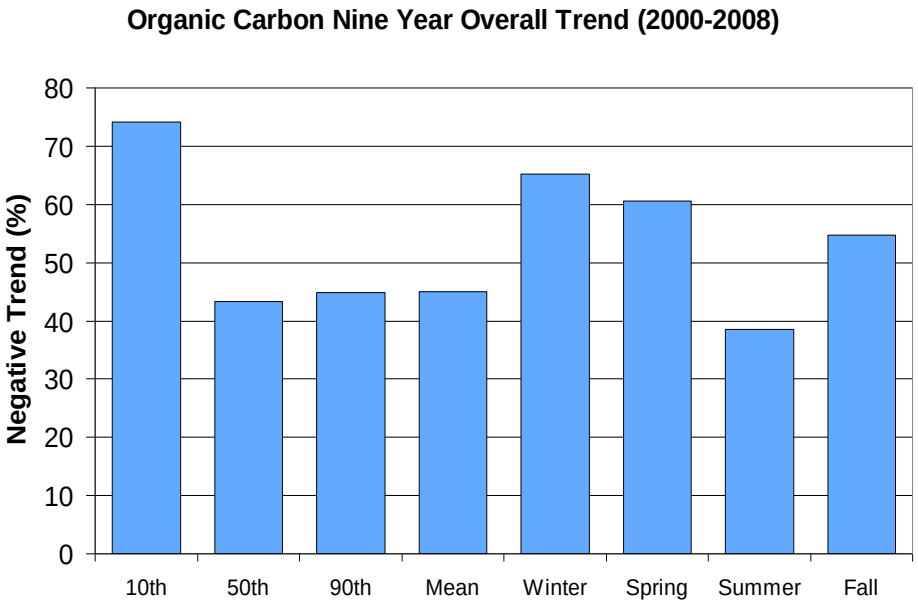


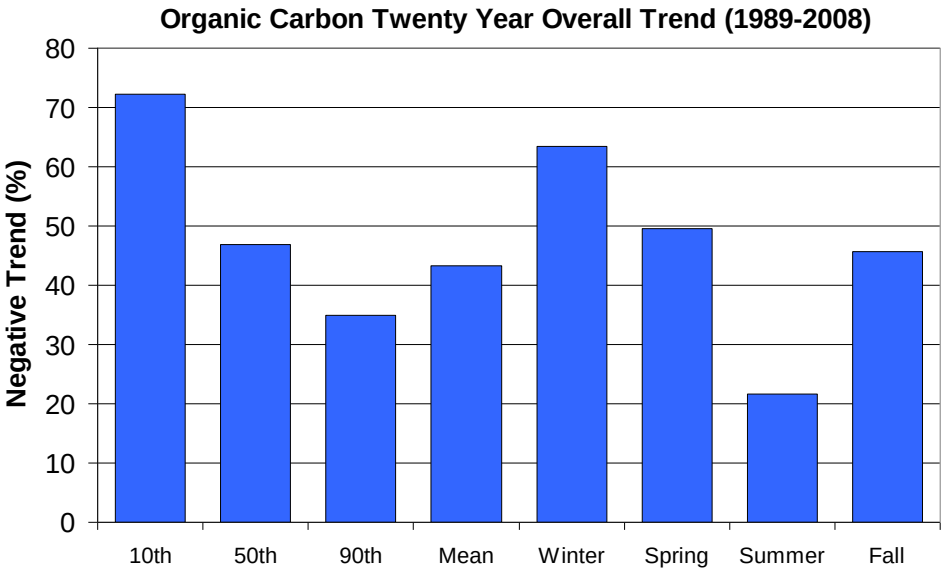




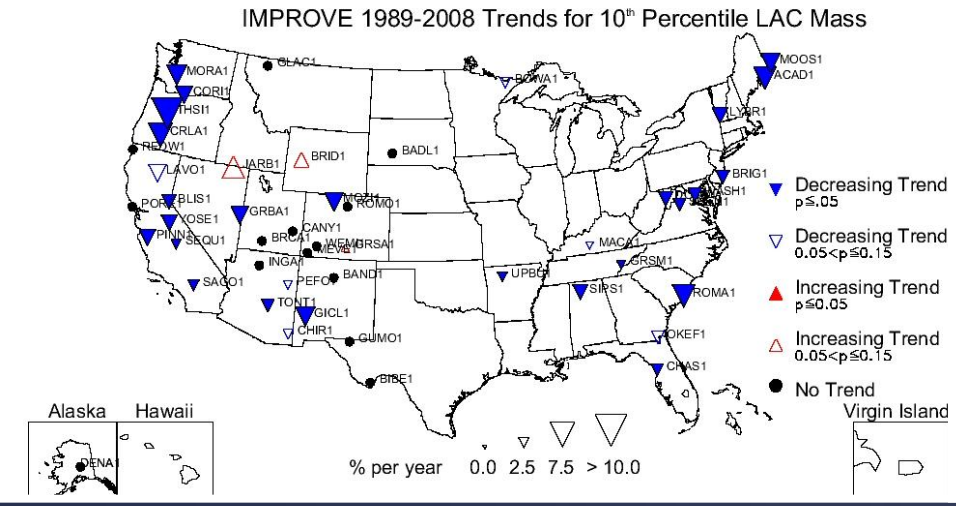


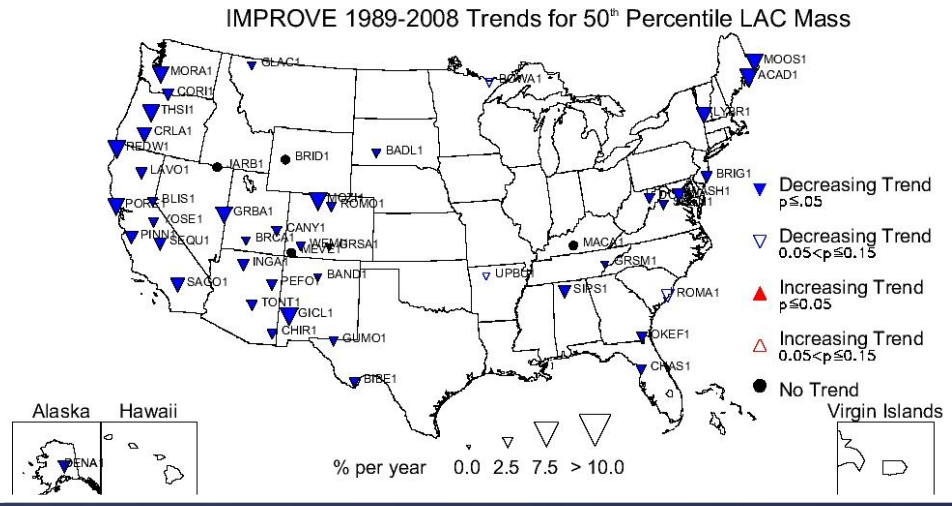
9 vs 20 Year Organic Carbon Trends

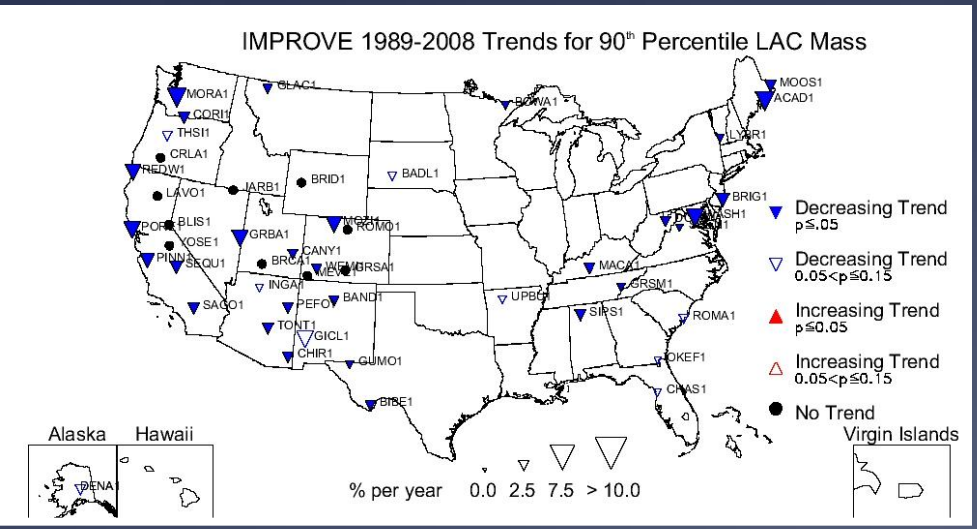




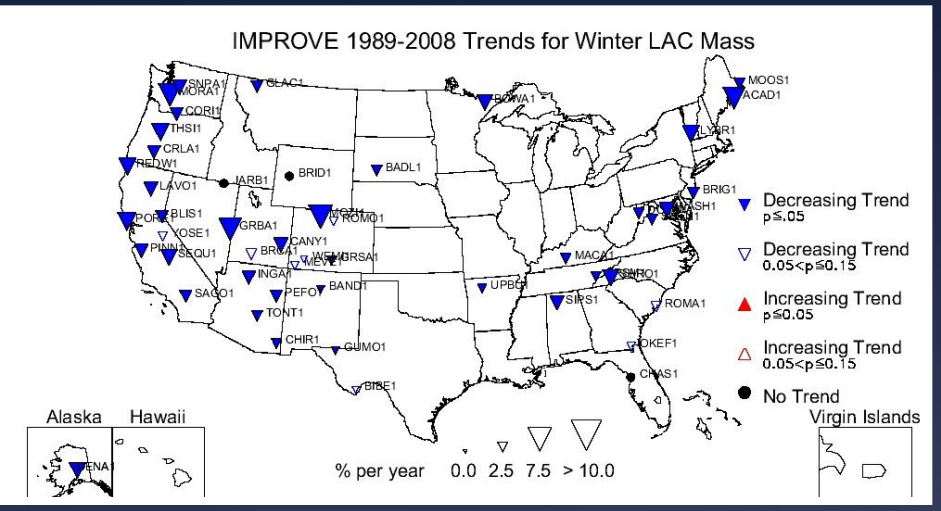
20 Year LAC Trends

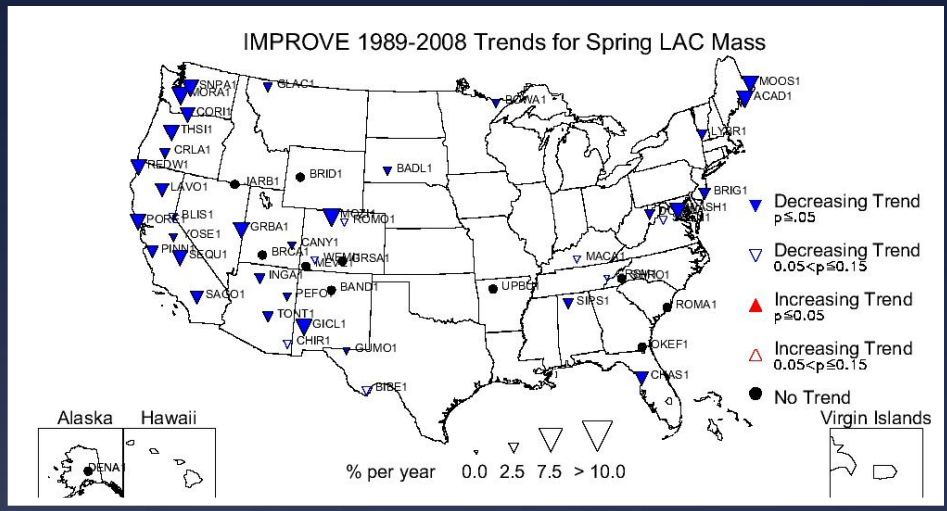


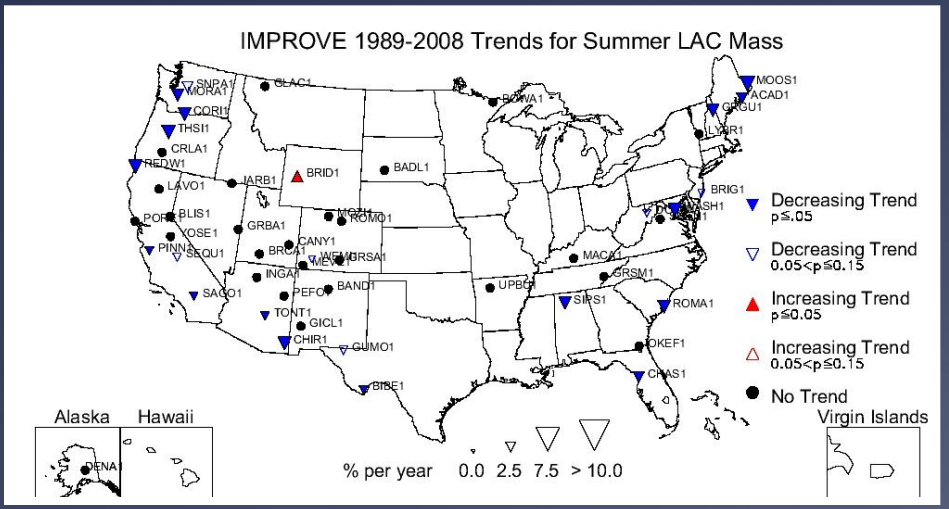


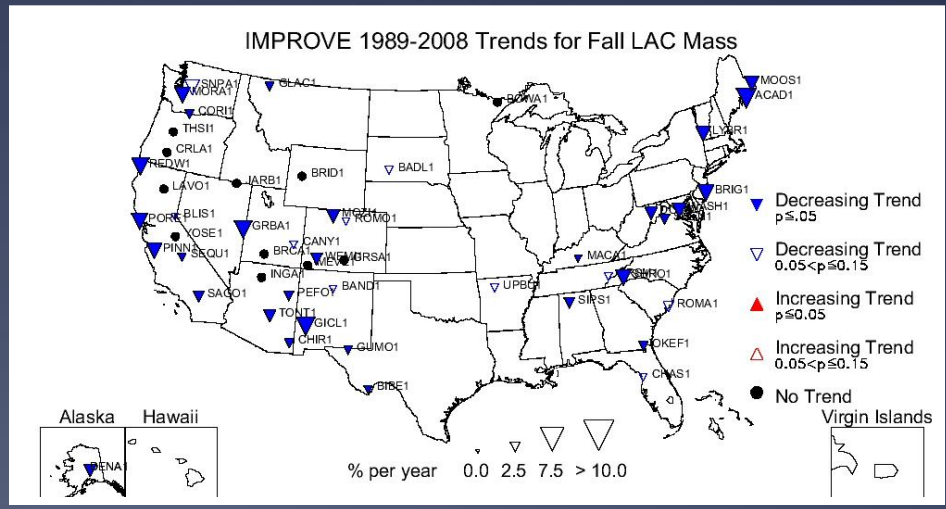


20 Year LAC Trends

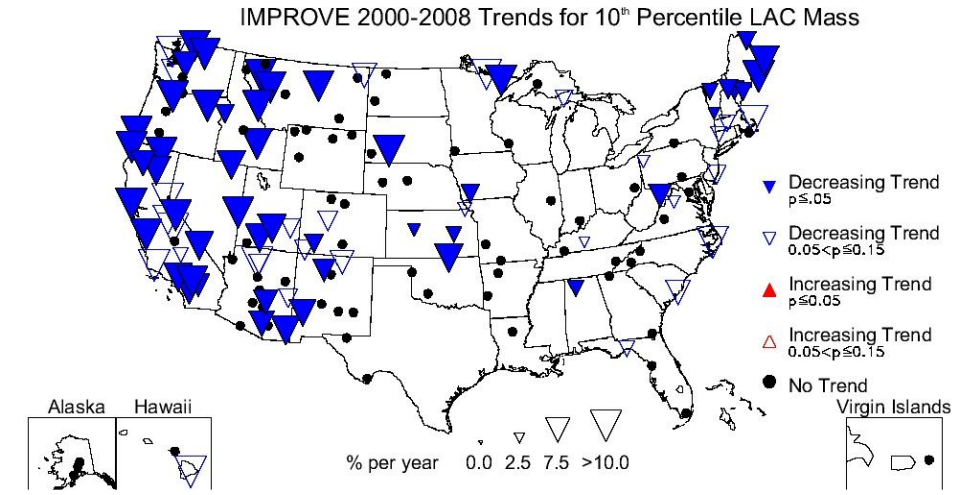


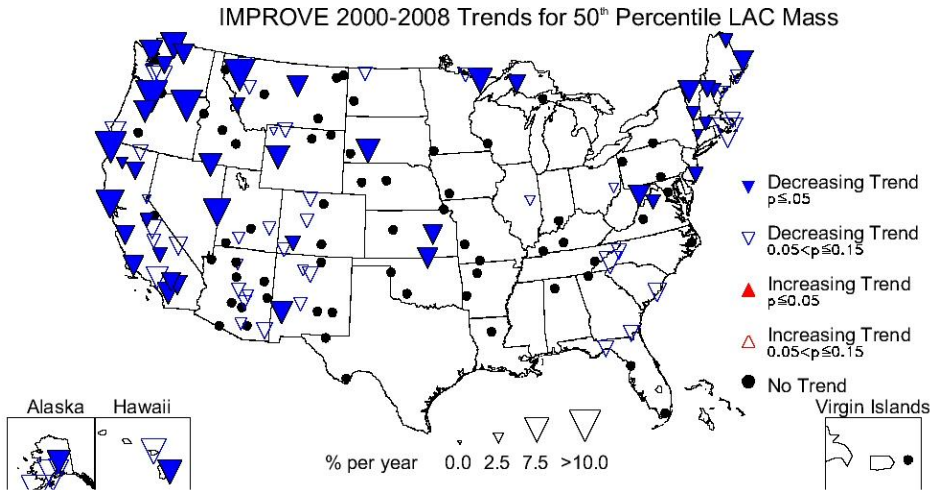


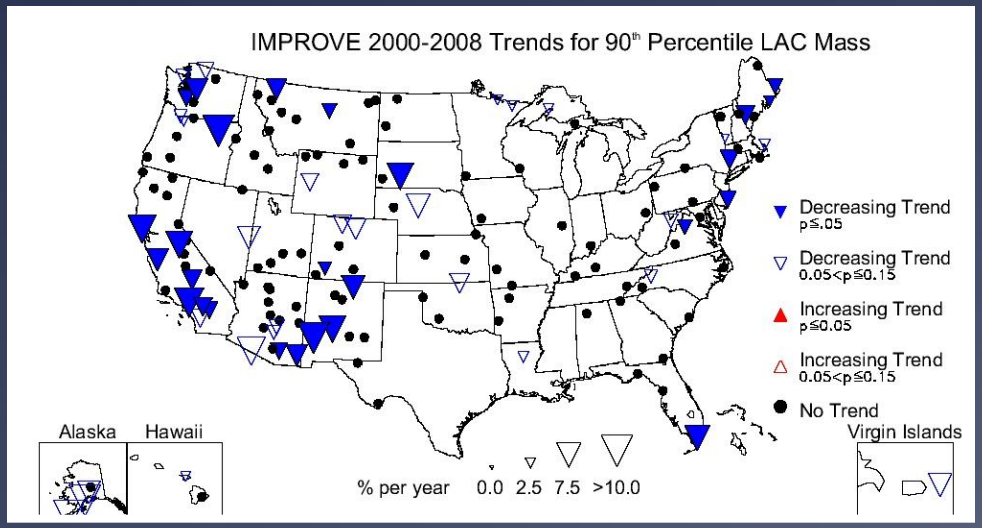




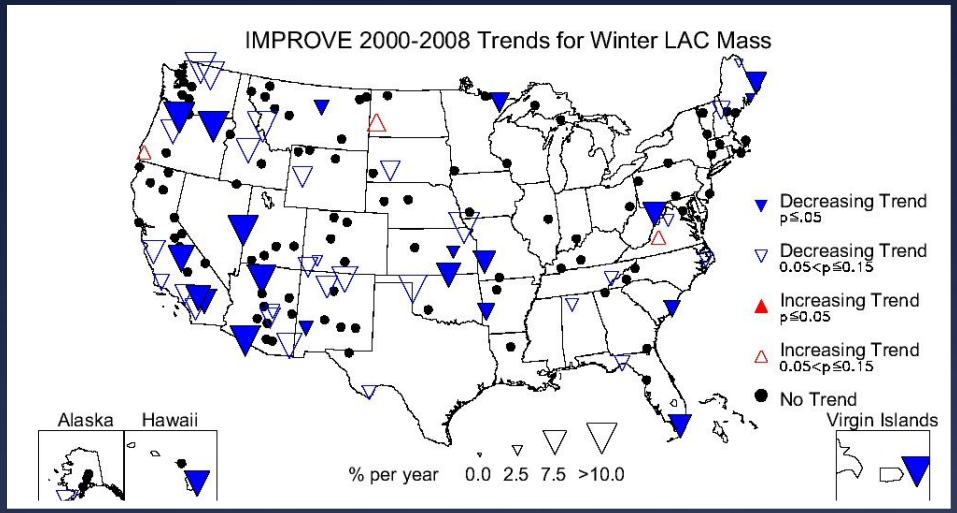
9 Year LAC Trends

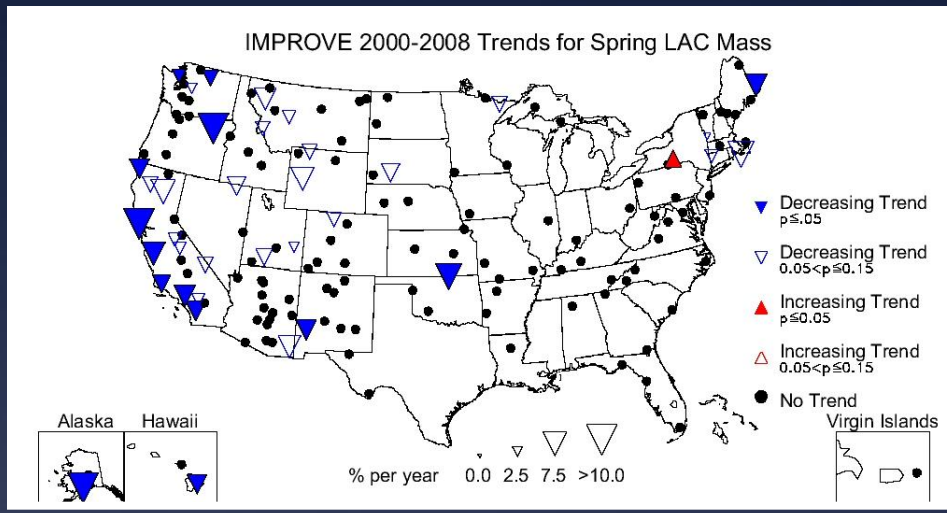


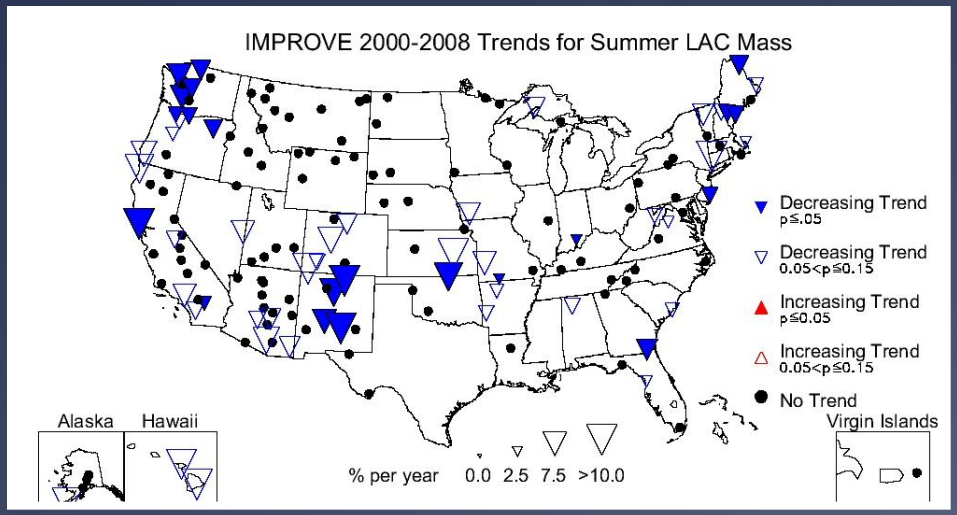


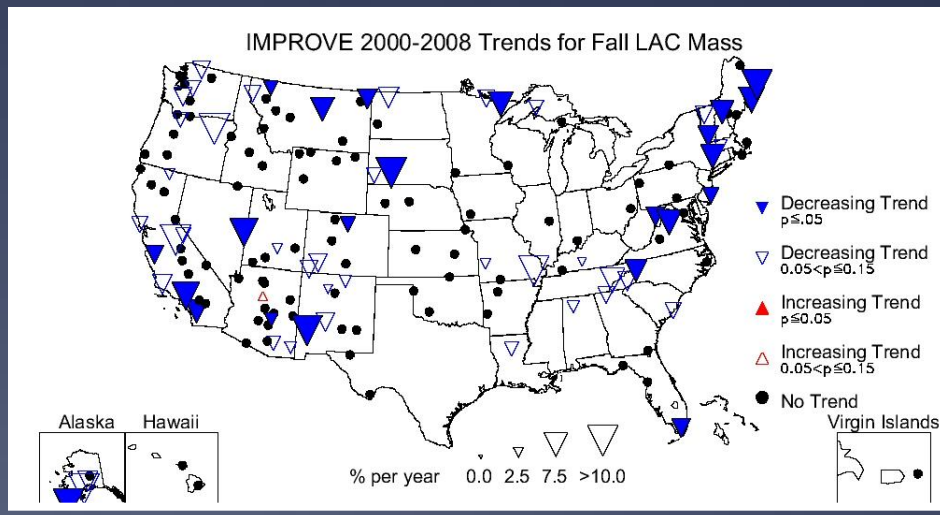


9 Year LAC Trends

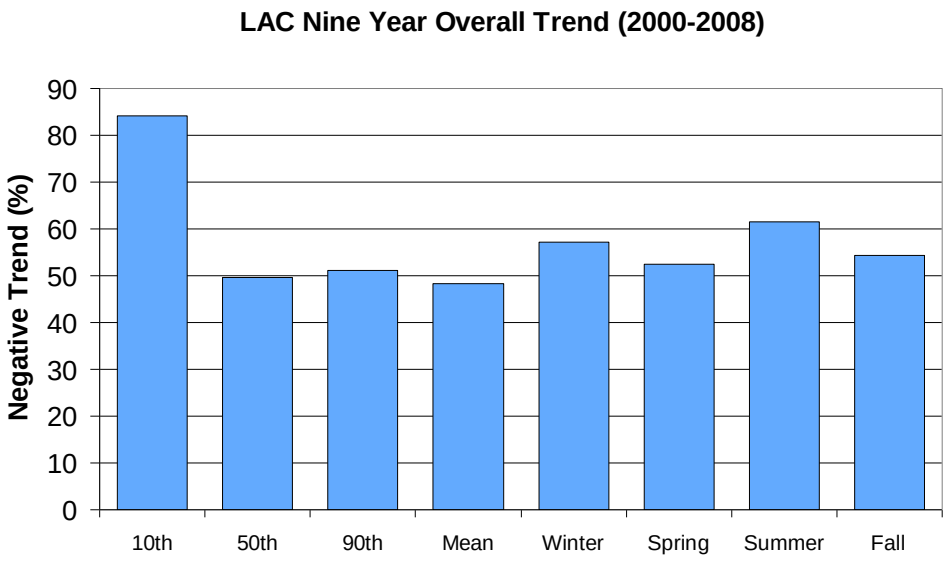


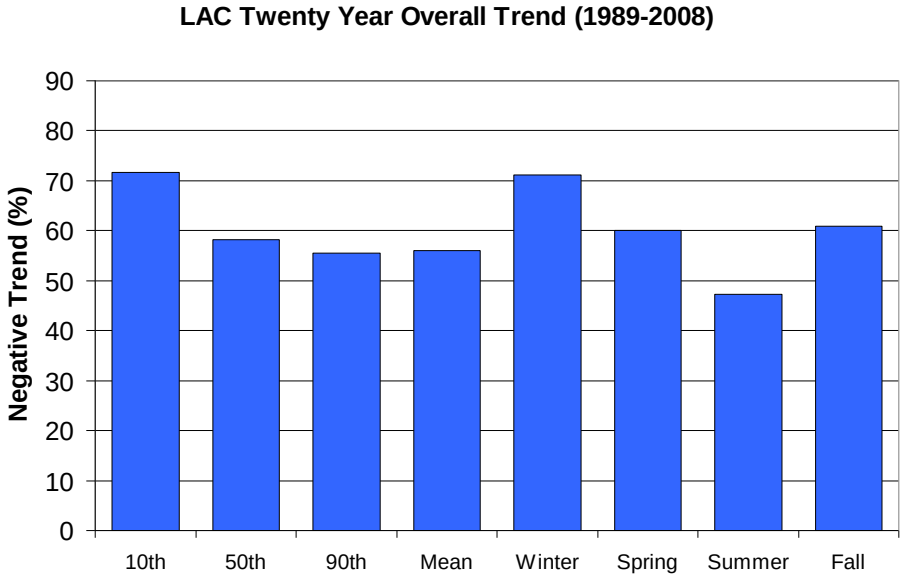




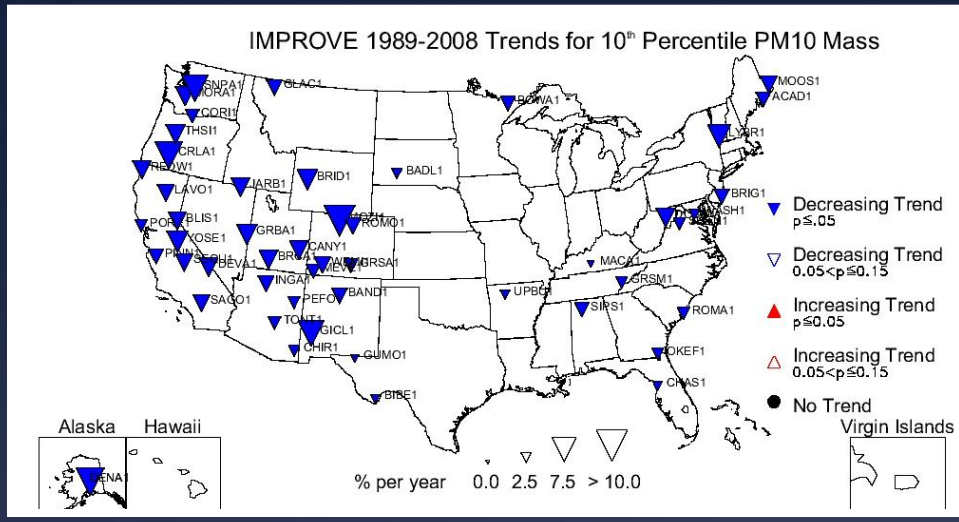


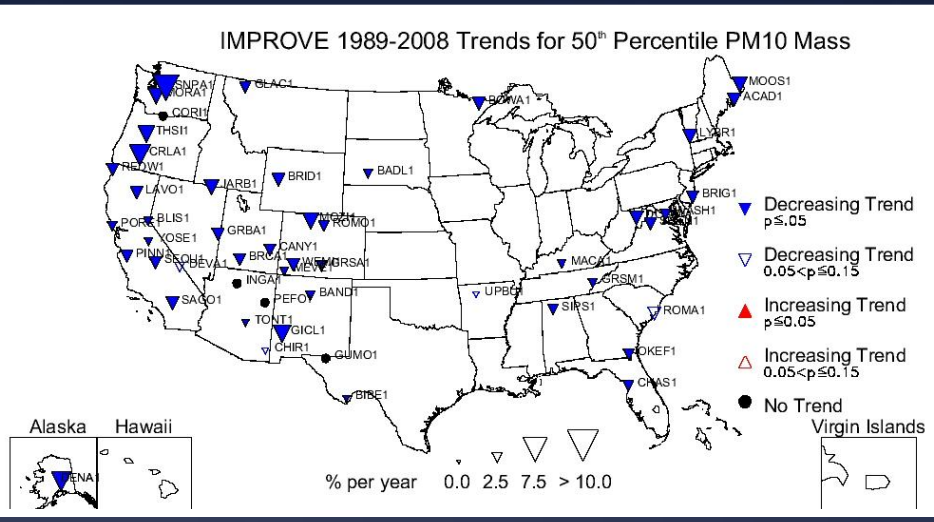
20 Year vs 9 Year LAC Trends

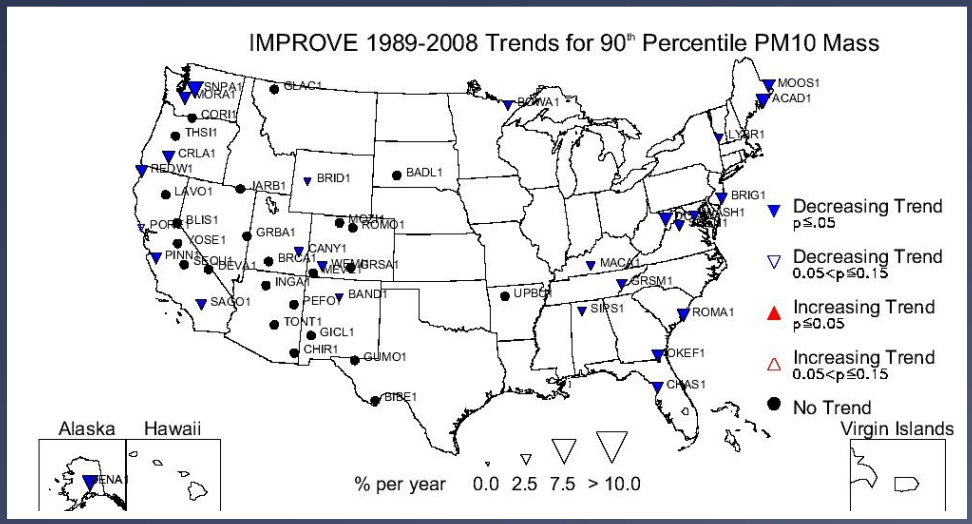




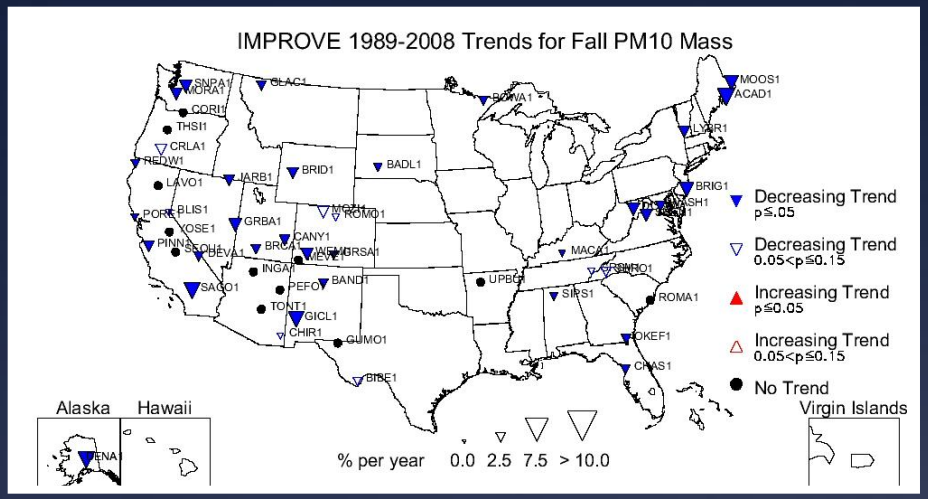
20 Year PM10 Trends

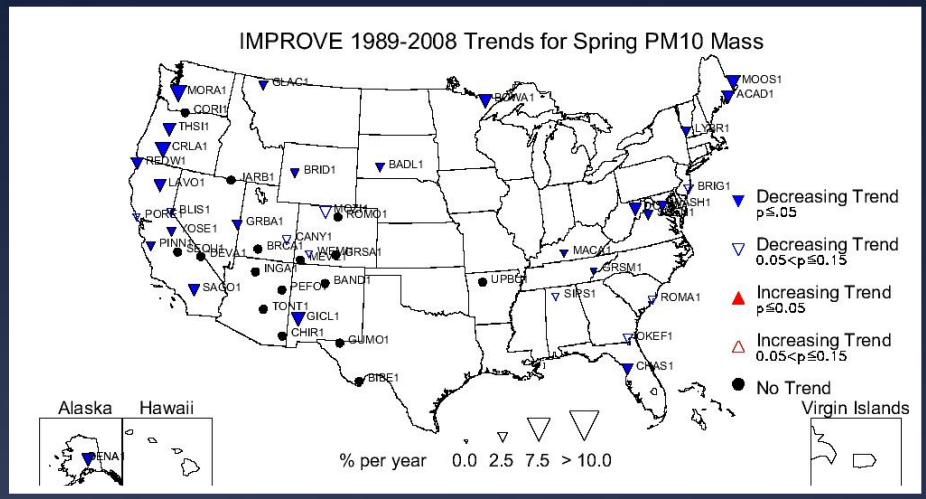


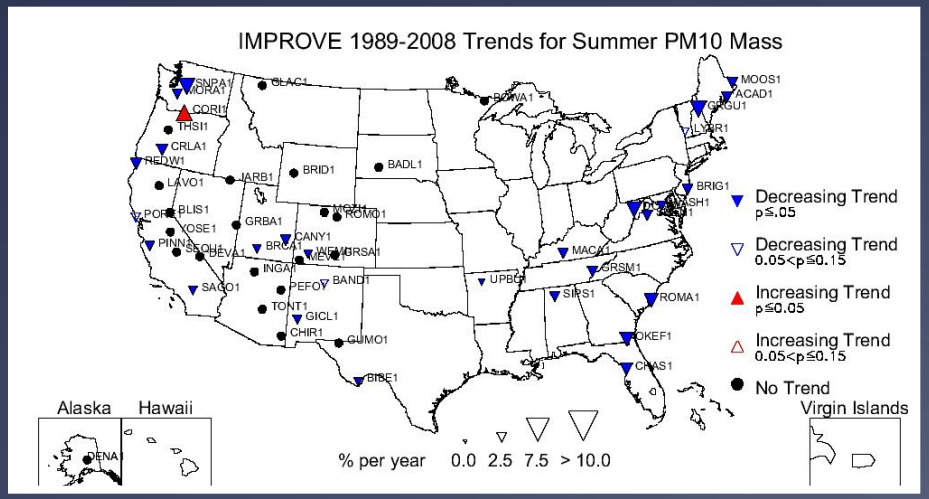


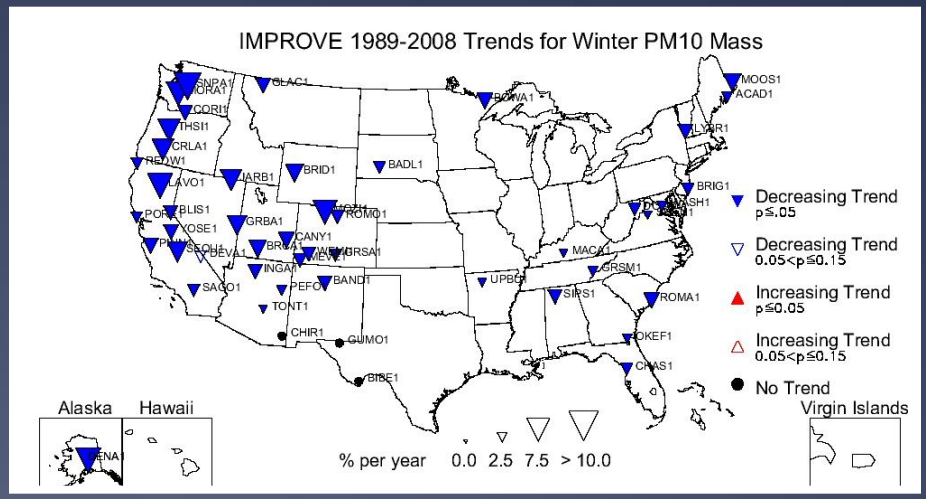


20 Year PM10 Trends

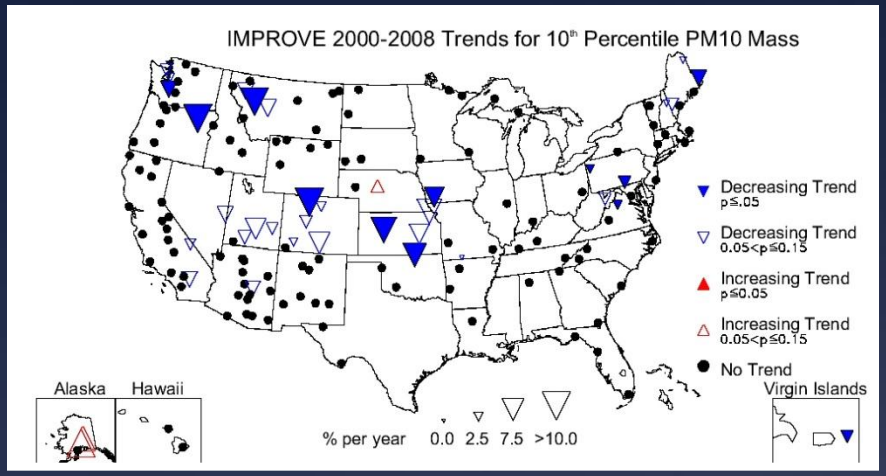


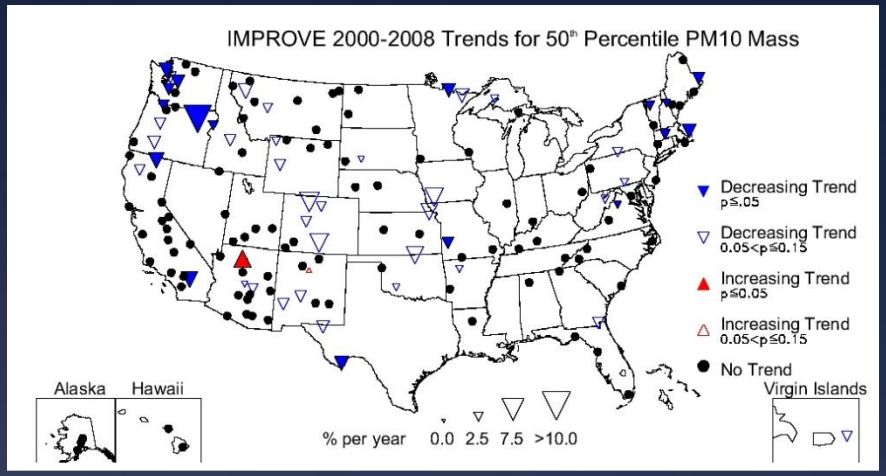


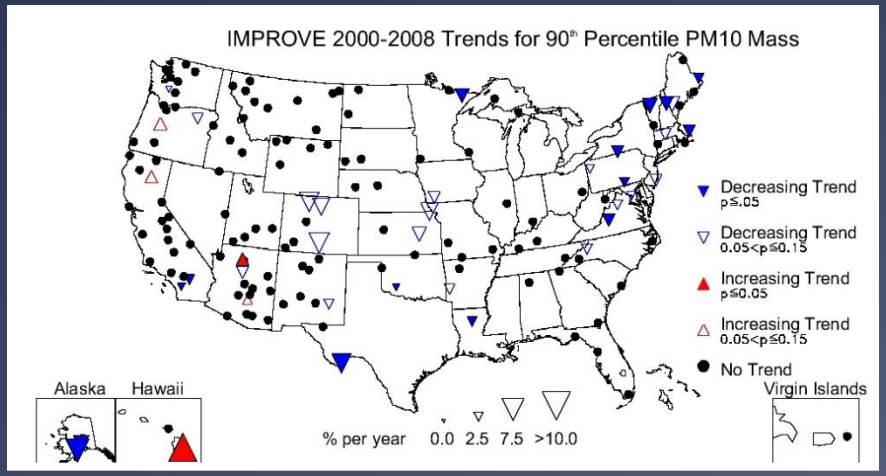




9 Year PM10 Trends







9 Year PM10 Trends