TIME SERIES TRENDS OF REGIONAL AIR POLLUTANTS FOR ASSOCIATION WITH AIRBORNE DISEASES OVER MISSISSIPPI REGION USING METEOROLOGICAL PARAMETERS AND MODELING

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Abstract

The industrial, commercial, and transportation activity surrounding off-shore and on-shore of Gulf of Mexico has apparent impact on the urban air quality of southern regions of US such as Mississippi, Louisiana, and Alabama. Some of the air pollutants of concern are particulate matter, nitrogen oxides, sulfur dioxide, and Ozone caused by the emissions from sources such as cars, power plants, chemical plants, industrial boilers, power plants, oil refineries. In particular, the population in the urban areas over the US southern regions is likely to be exposed to higher levels of air pollutants under certain weather conditions and meteorological conditions. Air Quality levels are strongly affected by weather, while air borne diseases are also aggravated by meteorological conditions. In human beings, health related diseases like asthma are of much concern in addition to climate sensitive diseases such as malaria and smog. It is important to investigate and understand the interplay between air pollutants, meteorological parameters, and health. In the present study, we present a detailed study of the long term and spatial variations of air pollutants such as particulate matter and Ozone in selected regions of Mississippi – Northern, Central, and Southern. The health data will be collected from CDC and will be examined for any association with the observed air pollutant data and meteorological data in these regions.

Key words: Criteria Air Pollutants, Wind Speed, Wind Directions, Statistical Modeling, Environmental modeling, Health Impacts

MOTIVATION AND ORGANIZATION

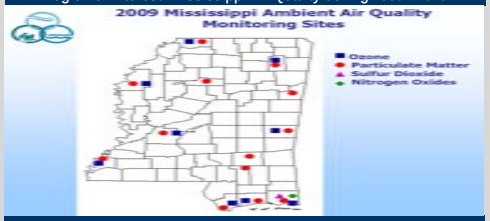
•Impact of Air Quality on Health (e.g., increases in daily mortality, illness, hospital admissions and emergency room visits).
•Associations between the levels of particulate matter/ozone in the air and adverse respiratory and cardiovascular effects in people
•Present work
- •Location: Selective regions of Mississippi
- •PM and Ozone time series during 2000 - 2010
- •Relationships
  - Weather and Climate variables
  - Health effects

Results and Discussion
Future Work

Factors Influencing Health and Symptoms

- Particular Matter (PM) is a complex mixture of solid and liquid particles that are suspended in air typically consist of a mixture of inorganic and organic chemicals, including carbon, sulfates, nitrates, metals, acids, and semi-volatile compounds.
- Why PM is important
  - Particles of different sizes in air: coarse (10 to 2.5 µm), fine (2.5 µm or smaller), and ultrafine (0.1 µm or smaller).
  - Particles deposit in the respiratory tract and affect human health. Coarse particles are deposited almost exclusively in the nose and throat;
- Environmental Effects
  - better understand the nature of the relationship between the pollutant and disease - especially how PM affects human health
  - Dependence on weather, human interference, other pollutants
  - cold and dry condition, as characterized by low and temperature and humidity
  - Provides the most effective condition for influenza virus survival and transmission
  - high influenza incidences occur in the winter for temperate regions.

Region of Interest: Mississippi Air Quality during 2000 - 2010

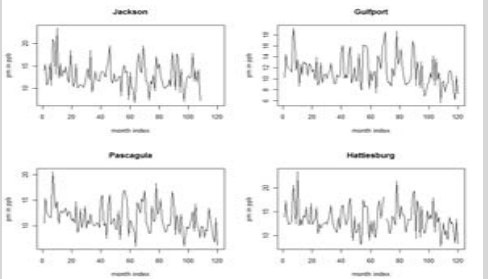


EPA Standards

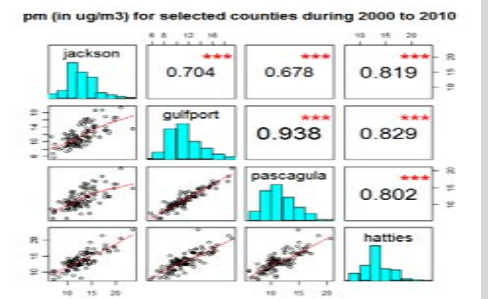
- Ozone
  - The 8-hour standard in 2008 of 75 ppb.
- PM2.5
  - annual averages does not exceed 15.0 micrograms per cubic meter (µg/m3); the 24-hour average standard: does not exceed 35 micrograms per cubic meter (µg/m3).
- *coarse* particles (PM_{10})
  - EPA also retained the existing national 24-hour PM_{10} standard of 150 $\mu g/m^3$; however, it revoked the annual PM_{10} standard.

Data and Observations

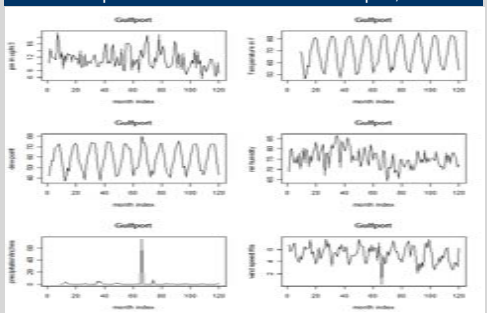
PM and O3 monthly trends: Selective Regions in Mississippi



Correlation Coefficient Table



Example of Weather Pattern Trends : Gulfport, MS

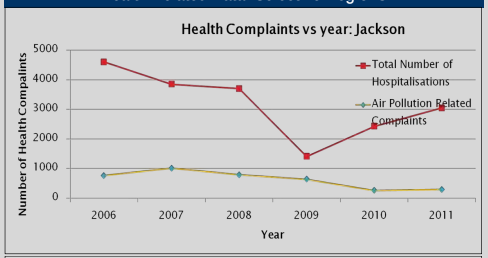


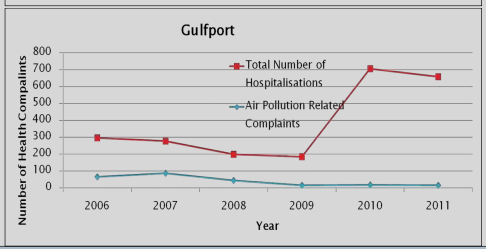
Correlation Table: PM and Environmental Variables at Gulfport

	pm25	ta	dewpt	rh	pc	wspd
pm25	1.00	0.40	0.36	-0.20	0.03	-0.21
ta	0.40	1.00	0.98	0.13	0.01	-0.58
dewpt	0.36	0.98	1.00	0.25	0.09	-0.58
rh	-0.20	0.13	0.25	1.00	-0.09	-0.05
pc	0.03	0.01	0.09	-0.09	1.00	-0.28
wspd	-0.21	-0.58	-0.58	-0.06	-0.29	1.00

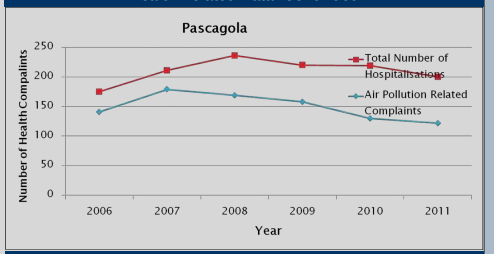
Ta: ambient temperature; dewpt: dew point; rh: relative humidity; pc: precipitation; wspd: wind speed

Health Related Data: Selective Regions





Health Related Data: Continued



Results and Discussion

- PM and Ozone pollutant trends:
  - Semi annual oscillations, peaking during early spring and summer Trend changes due to weather disturbances)
  - Prime sources:
    - photochemical reactions, secondary pollutants or precursors
- Dispersion Effects by Wind patterns
  - Low wind – ground level
  - High wind – stack emissions
  - Wind-blown sources e.g. particle suspension
  - Source at farther distance, affecting the site at larger speeds
  - Dominance of Southernly, and South Easterly winds controlling the overall mean of PM2.5
- Ozone sources
  - Mostly ground level; Evidence of a source in S and SW
  - Low winds
    - Contributed by the PM2.5 emissions
    - Sources of pollution
      - Mostly by Refineries to the South and SE of the location
      - Industries – Southern of LA, Alabama; Northern of Memphis
- Health Effects in selective regions of MS
- Dependence on pollutant levels, weather patterns observed
  - Hinds region:
    - Period 1998 to 2007
    - Higher number of cases related to air borne diseases

Summary

•In spite of decreasing national and regional trends by Increased regulation standards, there appears to be significant number of hospital admissions related to the air borne diseases
•A good understanding of the association between air pollutants and health is required for controlling and mitigation
•Future Studies: Linear Path Model to find association between pollutants and Health Effects

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