# 7.4 INTEGRATING NATIONAL CLIMATIC DATA CENTER (NCDC) ARCHIVED DATASETS FOR AIR QUALITY INVESTIGATIONS

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## 1. INTRODUCTION

The integration of datasets archived at the National Climatic Data Center (NCDC) useful for air quality investigations is described. Land-Surface Observations and Upper Air observations including visibility, temperature, wind direction and speed data from airports, rawinsond and cooperative observing stations are used in urban climatologies, and have applications in transport models and public health. Many data sets archived at the NCDC useful for air quality issues such as modeling haze have been described (Knapp, 2004). Examples are presented here of seasonal trend analysis in visibility, air stagnation studies, and the National Air Quality Forecast Model output, all of which are accessible from the NCDC. Much remains to be done, however, in integrating observations for applications in air quality for societal benefits.

The NOAA Operational Model Archive and Distribution System (NOMADS) improves access to observational and model data assimilation products. NOMADS is a tool to that promotes product development and collaborations within the between the research and operational modeling communities and help the climate and weather modeling communities use collections of distributed data (Rutledge, 2002). Initial steps have been taken to utilize NOMADS as a tool for integrating archived datasets for use in air quality investigations.

## 2. SAMPLE ANALYSIS

### 2.1 *Air Stagnation Index*

The Climate Monitoring Branch of NCDC produces an Air Stagnation Index map for each calendar month of the year. The stagnation index is intended as an indication of temporal build up through stagnation of atmospheric pollution either gaseous (e.g. ozone, sulfur dioxide, nitrogen oxides) or particulate (e.g. soot, dust). Stagnation is considered to consist of light winds so that horizontal dispersion is at a minimum, a stable lower atmosphere that effectively prevents vertical escape, and no precipitation to wash any pollution away. Persistence in air stagnation has been positively associated with increased numbers of visits to emergency departments for asthma treatments (Norris, 2000).

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The methodology for producing the maps is based on the work of Wang and Angell (1999), with modifications. Here the stagnation index is the percentage of days in the month that meet the requirements for stagnation conditions. A stagnation day is defined as one with sea level geostrophic wind less than 8m/sec, 500mb wind less than 13m/sec, and no precipitation. If there is a temperature inversion below 850mb the 8m/sec is relaxed by 10% (to 8.8m/sec).

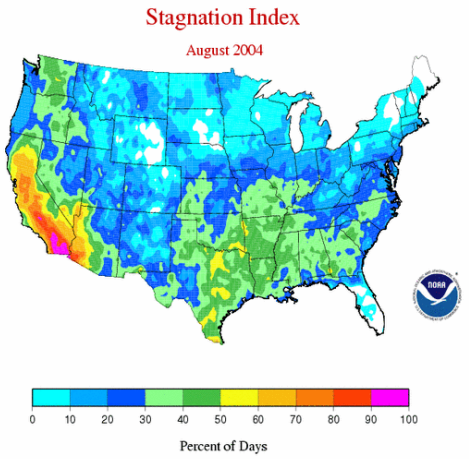



**Figure 1. Air Stagnation Index map for August 2004.**

The calculations are performed over a 0.25 x 0.25 degree grid. The methodology integrates gridded mean sea level pressure, 500mb wind components, and surface and 850mb temperature data, and gridded daily precipitation data obtained from rawinsonds and surface stations recording precipitation.

At present, this Air Stagnation Index has not been analyzed for trends by month over a number of years, so the probability of stagnation for an area of the United States for a period of days is unknown. An analysis for ventilation probability, in effect the opposite of stagnation, has been performed (Ferguson, 2004).

Without an adequate tool, the Air Stagnation Index would remain a stand-alone product, one that is more difficult to apply to societal needs in health related air quality issues.

## 2.2 *Visibility Trend Analysis*

Visibility measurements had been consistently made from staffed airport weather observation sites through manual recording of landmark sitings. This method of observing visibility ceased dramatically with the installation of Automatic Surface Observing Stations (ASOS) technology in the early 1980's. A select group of voluntary cooperative observers continue to record maximum daily visibility. An analysis of the visibility measurement by one such observer reveals the annual average visibility has decreased about seven miles in the last 20 years (Figure 2). Combining these observations with surface wind and upper air data reveals that the reduction in visibility is affected by regional subsidence inversions as well as drainage inversions in local valleys. Integrating the manually-observed visibility measurements with the calculated stagnation index and surface wind data could indicate if the visibility reduction is due to increased source air pollutants or a decline in surface air ventilation

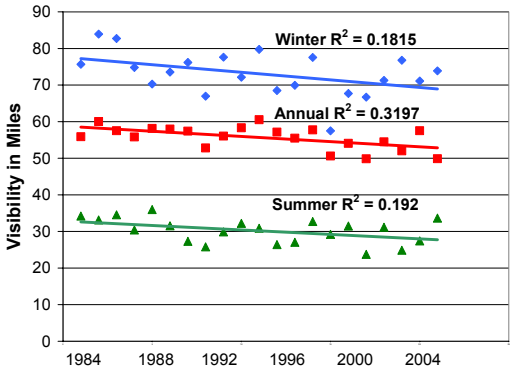
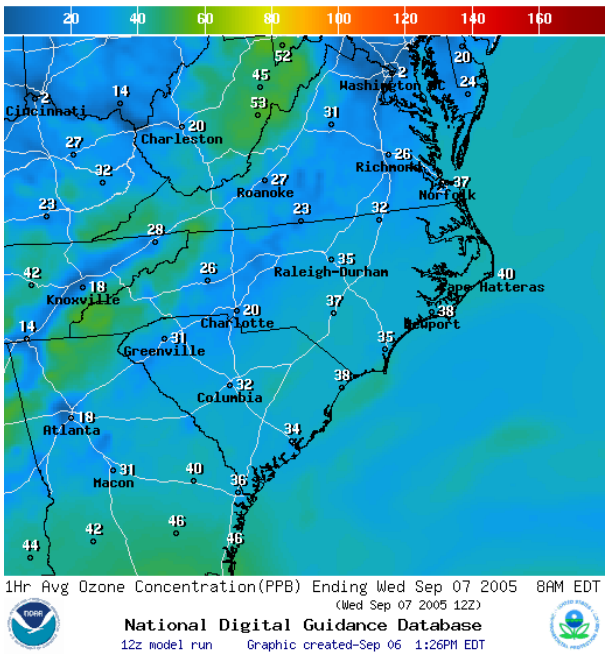



**Figure 2. Annual and Seasonal Trends in Visibility measured from 1984-2004 at a Coop Site on Flat Top Mountain in Western North Carolina. (Goodge 2004).**

A tool that allows the integration of point data, even manually observed data, would facilitate the understanding of the seasonal decline in visibility.

## 2.3 *National Air Quality Forecasts*

National Air Quality Forecast generated by the National Weather Service provides the US with ozone, particulate matter and other pollutant forecasts with enough accuracy and advance notice to take action to prevent or reduce adverse effects. Since the forecasts became operational, the forecast model fields have been archived at the NCDC.




Planned future utilization of NOMADS would allow for the retrospective and near real-time access of the grids from the Air Quality Forecast.

## 3. NOMADS RETRIEVALS

The NOMADS systems involve grand cooperative efforts among the atmospheric modeling and analysis community. With the inception of real time Air Quality Forecasts, NOMADS will be offer utility to the Air Quality community as well. The NCEP Real-time NOMADS (RT-NOMADS) prototype project serves real time operational data and sends NCDC data for archival. NCDC is the operational archive and thus holds data sets older than real time. The NCDC NOMADS goal is to save model (run history) data but budget realities provide that the archives can save initial conditions and observations sufficient to restart NCEP models to reconstruct model run history. Other NOMADS participants (such as NASA and UCAR) serve their own data sets. NOMADS uses common data and observation distribution software, uses a format independent and description methodology, and provides a unified documentation and organizational framework for data distribution.

Two sample retrievals from the NCDC NOMADS systems (Figures 3 and 4) show two products with applicability to air quality issues.

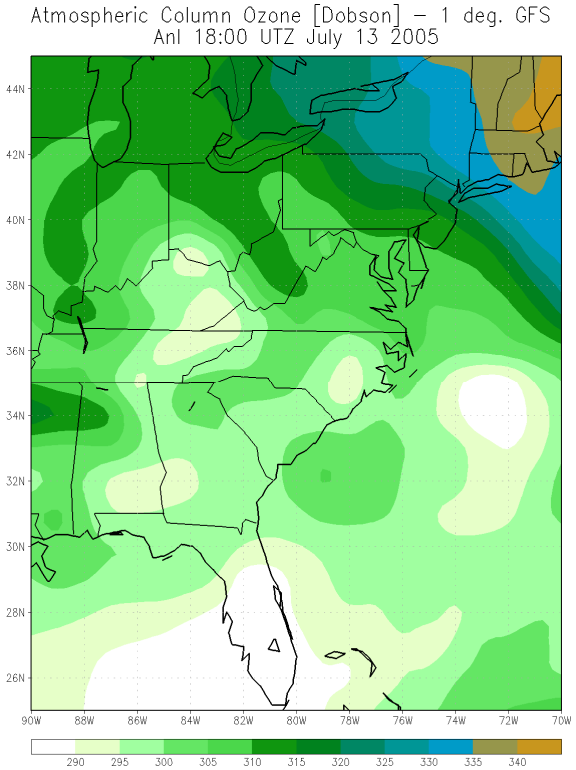



**Figure 3. NOMADS retrieval of a total atmospheric column ozone data.**

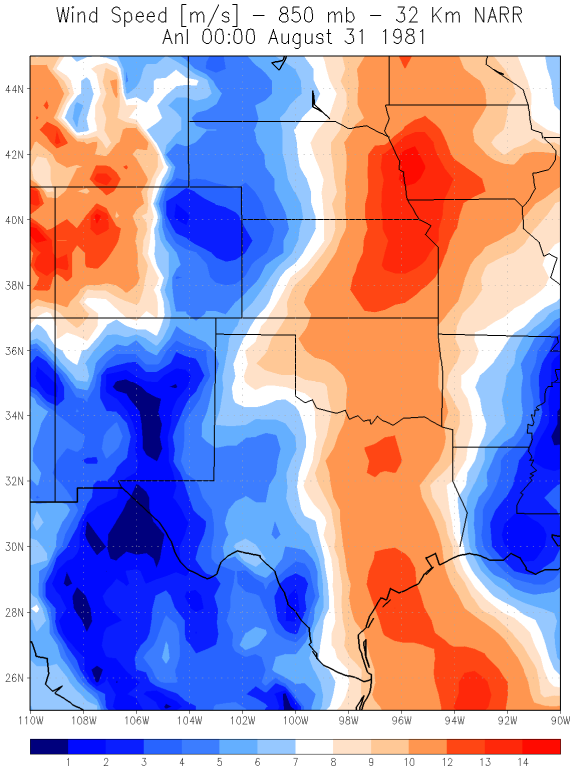



**Figure 4. NOMADS retrieval of 850 mb wind vector data.**

## 4. SUMMARY

NCDC maintains many sorts of data and produces analysis useful for the understanding of and application to of air quality issues. Future development of the NOMADS tool will allow better integration of disparate data sets such as visibility, air stagnation, and air quality forecast with other data sets such as gridded analysis fields. By better integrating data and information, better products and services can be provided for the benefit of society.

## 5. REFERENCES

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