

Meteorological Data Archive Feasibility Assessment

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Prepared by Northeast States for Coordinated Air Use Management (NESCAUM) for the Mid-Atlantic/Northeast Visibility Union (MANE-VU)

As part of MANE-VU's Year 2 planning efforts for regional haze, NESCAUM agreed to undertake a feasibility assessment of developing a meteorological data archive. This document contains a brief description of the concept that had originally been envisioned and is followed by the details of the assessment. It concludes with recommendations based upon the assessment and suggested future steps for developing the necessary meteorological data products required for regional haze planning purposes.

Concept

The initial concept for developing an archive of meteorological data products was built around the notion that a single, high-resolution, meteorological data set could be used for multiple applications, thus leveraging the costs needed to develop such a system. The system would require several components, the primary one being semi-continuous (1-6 hour temporal resolution), high spatial resolution (12 km horizontal spatial resolution with 4 km nesting around urban and coastal locations) archived meteorological output from a recognized meteorological model. This data would need to be developed over a broad geographical domain large enough to accommodate regional air quality modeling applications (e.g. Continental Divide to East Coast).

In addition to the underlying data, several post-processing computer programs would be developed to allow the data to be extracted, formatted, and repackaged for use in different applications. For example, data for a relatively small geographic domain extracted at a high spatial resolution and formatted for use with the CALPUFF modeling system would be useful for source permitting applications. Trajectory modelers and regional air quality modelers would need larger spatial domains, but may not need the highest spatial resolution available. Post-processing software compatible with CALPUFF, REMSAD, HYSPLIT, Models-3/CMAQ and other analytical tools could be developed to extend the usefulness of the meteorological data for all of these applications.

The data and post-processing routines would be housed in a central repository (probably at the same modeling center where data is generated) and accessible via ftp. This would allow multiple state and regional air quality organizations to access and use the archive without specific data requests and special arrangements for data shipments.

Feasibility Assessment

In reviewing the feasibility of such an archive, several areas of concern were raised. Data storage and human resource allocation are the chief obstacles to developing such a system. Data storage requirements were not identified explicitly, however it was noted by researchers at the University of Maryland, that archiving meteorological forecast fields generated by MM5 over a domain comparable to that which MANE-VU is likely to adopt on a 36 km horizontal resolution takes approximately 0.35 Gb of storage for every day of data. Scaling these numbers up to accommodate 12 km (with some 4 km nesting) wind fields every hour would require over 1.5 Gb of storage every day! Thus, this project would require investment in a new data storage system capable of storing and maintaining almost a Terabyte of data every year.

In addition to storing the data, substantial human resources would need to be dedicated to generating the data and the post-processing routines. While development of the post-processing software tools would be a one-time expense and could potentially be developed with contractor assistance, modeling and archiving the meteorological data would require ongoing effort. A dedicated full time employee (with a fast computer) is needed to develop and maintain the database at a minimum.

While these challenges are not insurmountable, they do require a substantial investment of resources. In addition to determining the feasibility of this project, we have considered the anticipated benefits of such an archive. It is not clear that the substantial investment of time and resources that would be required to successfully develop such a system would be realized in terms of added value to other program areas. Given that benefits outside of the regional haze modeling effort may be limited, it may make sense to focus current resources on developing meteorological data products that serve haze-planning needs most directly.

Recommendations and Future Steps

A national domain is very close to being approved by all 5 RPOs for use in national modeling simulations. MANE-VU anticipates working with VISTAS and the Midwest RPO to select an appropriate subdomain on which more detailed modeling analyses will be performed to fulfill SIP requirements. This modeling effort will require meteorological data at the same resolution used by the selected air quality models. The development of 1 year of MM5 meteorological data on a 12 km horizontal resolution with 4km nesting in urban areas and along coastal regions is all that is required for SIP modeling. A meteorological pre-processor for Models-3/CMAQ that directly incorporates MM5 output already exists. Similarly, routines for converting MM5 output to a REMSAD-ready format are also available.

While generating a year of data represents a substantial challenge, from a time and resource perspective, it is a lesser challenge than developing the additional software and functionality associated with a continuous archive. The recommendation at this time, therefore, is to approach regional haze planning in the same manner as past

regulatory programs by selecting a specific period for analysis and generating only the inputs needed for a complete and thorough analysis of that period. The major distinction will be that haze-planning efforts currently dictate that an analysis period of up to one year may be required, substantially longer than previously studied episodes.

While the recommendation at this time is not to pursue the development of a multi-purpose meteorological archive, the information gained over the course of this assessment will be useful in developing a modeling workplan for regional haze since many of the same issues are applicable. MANE-VU has plans to begin mapping out a regional haze modeling workplan during Year 3.