

# ESTIMATING NITROGEN DEPOSITION INTO THE CONNECTICUT RIVER BASIN USING CMAQ

Patricia A. Bresnahan, David R. Miller and Jesse O. Bash  
 University of Connecticut, Atmospheric Resources Lab,  
 Department of Natural Resource Management and Engineering, Storrs, CT

## INTRODUCTION

Nitrogen from the Connecticut River Basin is a significant component of nitrogen loading into Long Island Sound and contributes to the problems of hypoxia in this water body (Mullaney et al. 2002). Deposition also impacts terrestrial and freshwater ecosystems through the acidification of soil and surface waters, reducing the diversity of aquatic organisms and stressing native vegetation (Driscoll et al. 2003). The atmospheric modeling group associated with the Connecticut River Airshed Watershed project (<http://www.ctriver.org>) is focusing on the factors affecting air quality and atmospheric deposition in the Connecticut River Basin. The study reported here is describes some preliminary estimates of nitrogen deposition into the Connecticut River Basin using CMAQ.

## MODELING ENVIRONMENT

- CMAQ (version 4.2.2) and other Models3 tools were compiled and used for this test.
- Domain: 36K Unified Grid for Eastern US, 5226 grid cells in the surface layer
- Emissions: Net96 Inventory
- MMS: three days in July 1997, provided to us courtesy of NYDEC/UMaryland

## METHODS SUMMARY

The spatial domain (Figure 1) was based on a July 1997 MMS run provided to us through NYDEC, that was generated at the University of Maryland. This dataset is based on the 36km Unified Grid and covers the eastern portion of the United States (67x78x21, 84Hrs). Emissions were generated using SMOKE with the Net96 inventory. The hardware and software configuration used in this work was described in a benchmark study reported on in Bresnahan (Bresnahan et al. 2003). The May 2003 release of CMAQ (version 4.2.2) and other Models3 tools were compiled and used for this test.

In order to extract deposition within the basin boundary only, in ArcInfo, the modeling domain was overlaid onto a data layer containing the shape of the Connecticut River Basin.

The contribution of each model nitrogen species to total nitrogen mass deposition was made by weighting the species deposition mass by the relative amount of nitrogen mass in that species.

The annual deposition estimate was made by multiplying daily average deposition for the modeling period (excluding the 12 hour "spin up") by 365. The hourly deposition rates were converted to kilograms per hectare for comparison with published deposition estimates for the region.

## RESULTS AND CONCLUSIONS

As shown in Figure 2, HNO3 contributed by far the most dry deposition nitrogen mass during the 3-day simulation period, with peak deposition occurring during the afternoons of the second and third simulation days.

Wet deposition of nitrogen mass for this period was dominated by nitrogen contributed by the particulate species of NO3 and NH4 (indicated as ANO3J and ANH4J in Figure 3 below), with a peak on the second day occurring slightly later than the dry deposition peak. Wet deposition was associated with a precipitation event in the lower basin.

Total nitrogen mass deposition (Figure 4) was dominated by dry deposition for most hours in the simulation period, but during the precipitation event, wet deposition exceeded dry in the basin.

A very crude estimate of annual nitrogen mass deposition into the Connecticut River Basin can be made using the results of the July 5-7, 1997 data. When the July estimates are extrapolated to an annual time period, the estimate comes out to approximately 10.4 kilograms of nitrogen per hectare per year (Table 1 below). This is well within the range of annual estimates reported by other researchers for the region.

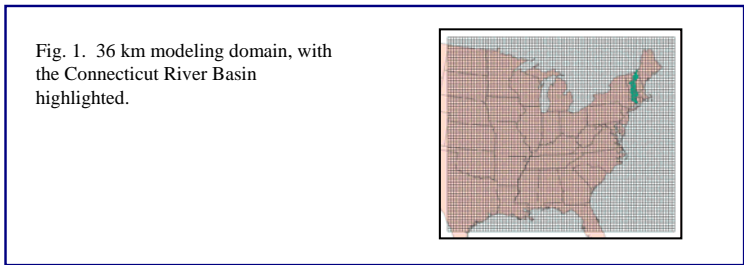
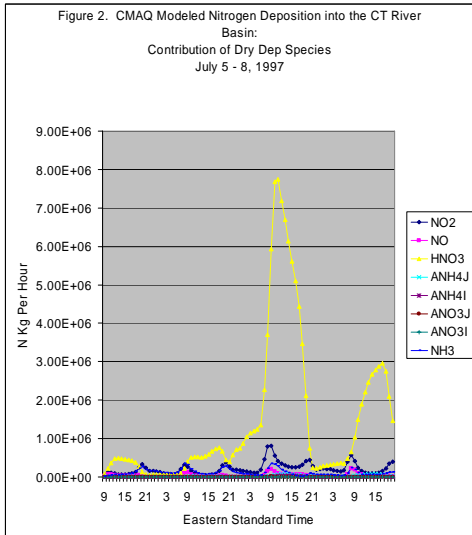
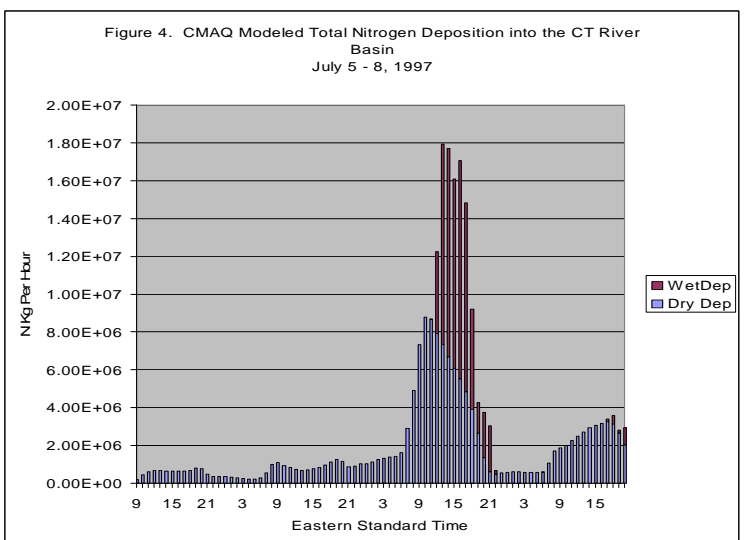
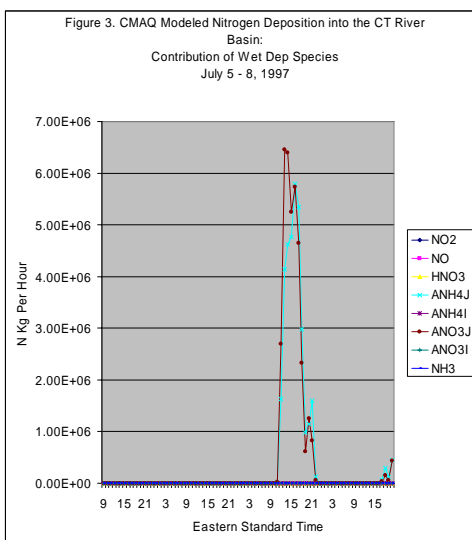


Table 1. Estimating annual nitrogen deposition in the Connecticut River basin by extrapolating CMAQ output for July 5-7, 1997.

Time Period	Dry	Wet	Total
84 HR Total Basin N Kg	1.54E+08	7.11E+07	2.25E+08
72 HR Total Basin N Kg:	1.47E+08	7.11E+07	2.18E+08
Ave Total Basin N Kg/Day:	4.90E+07	2.37E+07	7.27E+07
N Kg/Hectare/Day	1.92E-02	9.30E-03	2.85E-02
<b>N Kg/Hectare/Yr</b>	<b>7.01E+00</b>	<b>3.39E+00</b>	<b>1.04E+01</b>



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