Use of the NEI 1999 Inventory for Regional and Continental Scale Chemical Transport Modeling of Regional Haze.

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Introduction - Base D Inventory

The base D inventory was created by LADCO/ The Midwest RPO using EMS-2003 Beta release. Each successive inventory created by LADCO is given a new letter base D is the fourth PM/Haze inventory created by this organization. It is using the most up to date inventory available to the LADCO. It is largely based on EPA's 1999 national emission inventory(NEI) version 2.0 with some exceptions and a few significant modifications. The base D inventory is the fourth inventory created by LADCO for its preliminary modeling of PM2.5 and haze. The modeling domain(Map A.) includes the continental United States, Southern Canada. While Mexico was part of the domain no Mexican inventory was available for this project. A summary of the emissions estimates can be found in Figure B. This inventory is being used to test the emissions, photochemical, and meteorological processors. The preliminary modeling has been a success. It has also helped us understand how far we will need to improve our efforts to build a SIP quality modeling system. We feel that to properly assess the requirements of a quality 2002 inventory for SIP planning, organizations need to have experience using the inventories in modeling and running the inventories through emissions models. Without this experience there is too much room for oversight of issues like those raised below.

EMS-2003 has been significantly modified to handle the NIF2.0 file formats. It was clear from an comprehensive examination of the NIF 2.0 file format that simply writing a converter from the NIF files to the older EMS-95 or IDA formats would result in the loss of important data. Additionally, NIF allows for much more complex temporal representation of sources including hour specific point sources. This is especially important in the case of continuous emissions monitoring data(CEM) for electric utilities.

Point Sources

The point source inventory is based on EPA's 1999 NEI inventory in the NET Input Format (NIF) version 2.0 with the following modifications

1. Several erroneous ROG sources removed from Illinois and Michigan

2. Several significant (15,000 Ton/Day ROG Sources) from Colorado because of problems with average summer weekday numbers and annual numbers. It was finally concluded that EPA did quality assure the annual numbers but no effort was made to check the reasonability of average summer day numbers. User Beware!

3. Two Erroneous NOX source removed from Florida inventory. (Same Issue as #2)

3. Removal of all Utah records where Emissions type 27 (Average Weekday) records were used. There seems to be an interpretation issue with their inventory. Utah's Average Weekday(for a single average weekday) appears to really be the sum of all weekdays for the year. the EMS-2003 interpretation of this differs from the Utah interpretation.(Simi liar to issue #2)

4. PM10-FIL and PM25-FIL and all secondary PM pollutants removed from inventory. They are all a subset of PM25-PRI and PM10-PRI and are handled by EMS-2003's speciation processor. The filterable fractions are a subset of the PM25-PRI emissions.

5. Inclusion of the 1995 Canadian Point source inventory base on the IDA files delivered by US EPA and converted into NIF format by Gwen Judson from the Wisconsin DNR.

A map showing the location and relative mass of NOX emissions can be found in Map E.

CEM and Electric Utilities.

LADCO Contracted to have the 1999 and 2000 CEM data from the Acid Rain Division (ARD) of US EPA converted into NIF 2.0 records where the Date and hour fields were filled in to reflect a specific hour. While it is possible to put hour specific Records into the NIF format, the reality is that it is a very inefficient format for this type of data. It takes 14 Gigabytes to store one year's worth of national CEM data. A significant issue with using CEM data was the successful matching of facility ID's from the ARD data and the 1999 NEI. While there were efforts made by EPA and it's contractor to include state facility ID's and boiler id's in the NEI data the CEM id's are often based on ORIS ids. A crosswalk was applied to change the ORIS ID's to state Facility ids. Special programs were written to assure that the cross references were applied correctly and special cases could be handled where sources not in the cross references were removed from the CEM data sets so that double counting of the same source with different ID's would be avoided. Another difficult decision was how to handle blank or missing hourly emissions values in the CEM data. Originally we assumed that a missing value meant there was no data. In fact, it later turned out that ARD removed all zero emissions values when the plant was shut down from the CEM records. The correct assumption is that when there is a blank record for any given hour that a zero emissions record should be included. This had a significant effect on overall emissions but the resulting seasonal and annual values became much more in line with those in the NEI. An example of the CEM data for a single CEM source can be found in Figure C.

The files delivered to OAQPS and eventually used by LADCO from ARD did not contain any hour specific stack parameter data. Additionally NIF does not allow hour specific stack parameter data. A decision was made not to include any hour specific adjustments to stack parameters. Additionally neither atmospheric chemistry model handles plume chemistry for particulates.

The second part of the CEM work was to define temporal profiles for each boiler at each plant. The three temporal profiles that LADCO was most concerned with were by Season, Day of week and Hour of the day. This data set includes hour of the day, Day of the week, and month of the year adjustment factors for all CEM units in the States of IL, IN, WI, MI, OH as well as states outside LADCO MN, IA, MO, KY, TN, WV, PA. This was done with four season specific NIF "EP" files because the day of the week and hour of the day values were season specific and NIF does not support season specific temporal factors. The default values for temporalization that were part of the NIF are in-adequate for regional scale modeling.

Other Area sources

Other Area sources is a catch all group that includes all categories not included in the Point, Nonroad, Ammonia, or Biogenics inventory. Significant portions of this group include non-point fuel combustion, Solvent utilization, Commercial/Consumer Products, Wind blown and Road Dust, and fires. This inventory is primarily based on EPA's 1999 NEI inventory. For this modeling exercise LADCO also included the entire Canadian non-point inventory in this group which will include Canadian Nonroad, Onroad, and Ammonia estimates. Significant attributes and modifications in this inventory from the 1999 NEI Include:

1. Removal of all Ammonia(NH3) Pollutant Records(They will be base on CMU ammonia model discussed later)

2. Inclusion of the Canadian Inventory converted to NIF by Gwen Judson from Wisconsin DNR

3. Removal of all emissions using the pollutant PM25-FIL or PM10-FIL.

4. Application of a 90% reduction factor to all dust categories to account for the transportable fraction of emissions. Given the amount of depositable surfaces in the upper Midwest and other research we believe that at this time it is a reasonable assumption for a large 36km regional scale grid.

Nonroad/Offroad Mobile Sources

EPA delivered the 1999 version 2 NEI with emissions run through the NONROAD2002 emissions model and outputted to NIF format. Nonroad Mobile sources include Agricultural, Construction, and Recreational Equipment as well as Locomotive and

Aircraft emissions. There were no significant modifications to the NIF records for our modeling. We would like to comment that it would greatly improve the usability of the NIF files created by the NONROAD model if they included not only emissions but also the equipment populations, fuel used, and temporal factors used to generate the estimates.

Ammonia /Carnegie Melon University Ammonia Model

LADCO and Carnegie Melon University put significant effort into the CMU model to improve usability, transparency, and improved emissions factors. This included an enhanced user interface and NIF output format as a native format of the CMU Ammonia Model. Additionally LADCO contracted with outside consultants to update the emissions factors used in the CMU model to reflect the state of the science of emissions factors for the various components of the model. LADCO used the NIF output files directly from the CMU model with no modification. LADCO did not include soil based emissions in this round of modeling although fertilizer based ammonia estimates were used. The CMU model does not currently generate nonroad/offroad NH3 estimates and EPA's NONROAD 2003 does not include them yet research does show that they exist. Future enhancements to nonroad 2002 or CMU should include them. A spatial plot of the Ammonia inventory from the CMU model can be found in Map D.

Biogenic Sources

Biogenic emissions are emissions generated from natural sources like trees, Water surface, and Fertilized Soils. LADCO uses BIOME3 a derivative version of the BEIS3 model written in the computer language SAS. The model current generates emissions for Isoprene(ISOP), Terpenes(TERP), Other VOCs(OVOC), and Nitrogen Oxides(NOX). The model was run with day specific meteorological parameters derived from MM5

On Road Mobile Sources

On road mobile source were generated using the Alpha release of a new MOBILE6 based emissions model for EMS-2003. This release generates MOBILE6 based emissions estimates for Criteria and PM emissions sources for specific grid cells based on the local temperature parameters. The raw data used to run the model was the same as the data used to generate Version 2 of the 1999 NEI. Modifications were made to the default temporal tables to include more complex hourly distribution of VMT for weekends. While this is an improvement over past methods, Significant additional work is necessary before these inventories are SIP quality.

Conclusions:

Overall the NEI 1999 is a good starting point for regional and local agencies to begin development of regional modeling infrastructure. Additional improvements seem necessary to use the NEI effectively for regional or local scale modeling. These include

enhanced temporal profiles. This seems especially true for EGU point, and on-road mobile sources.

Map A: 36 KM Base D emissions modeling Domain

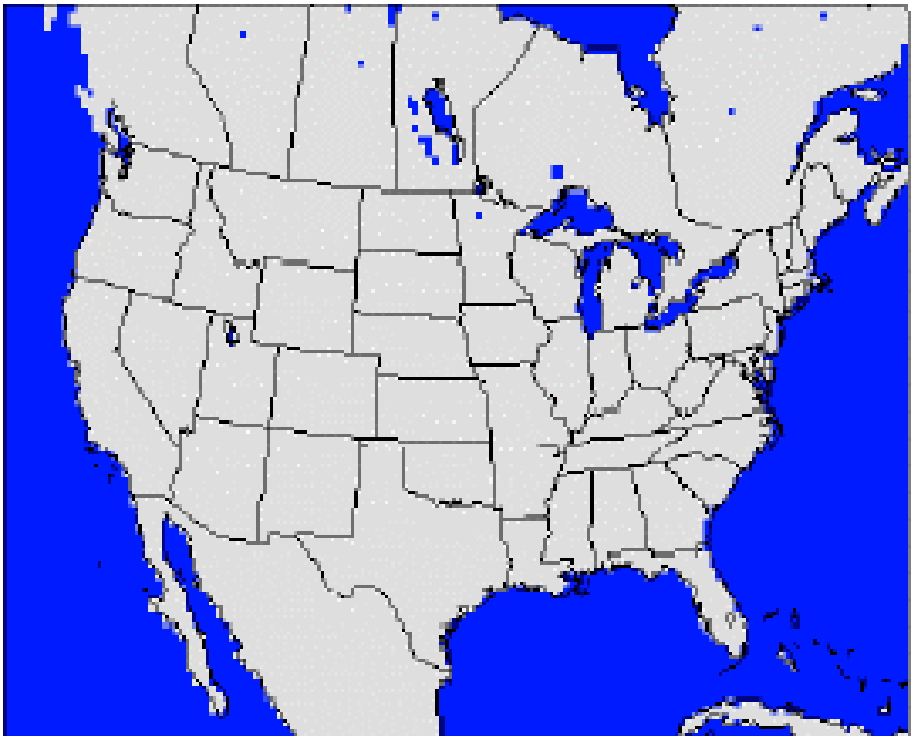
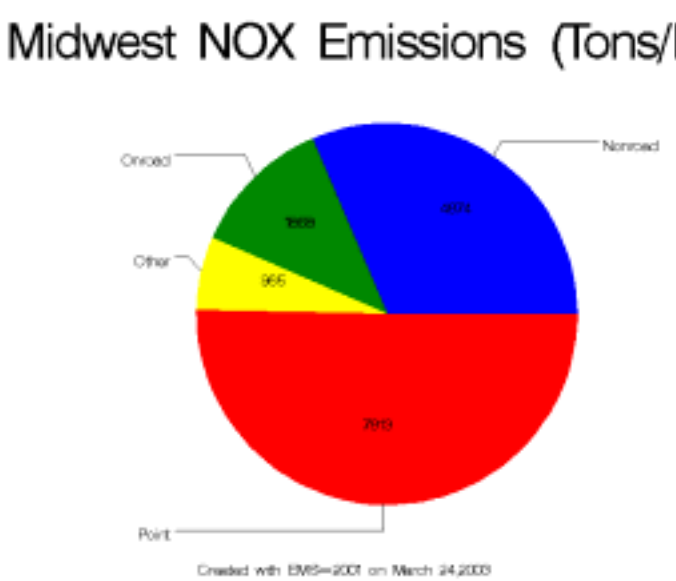
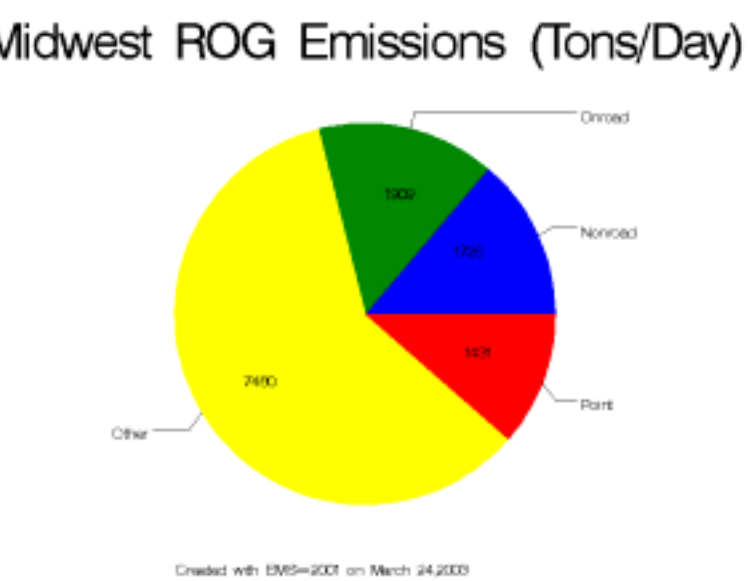
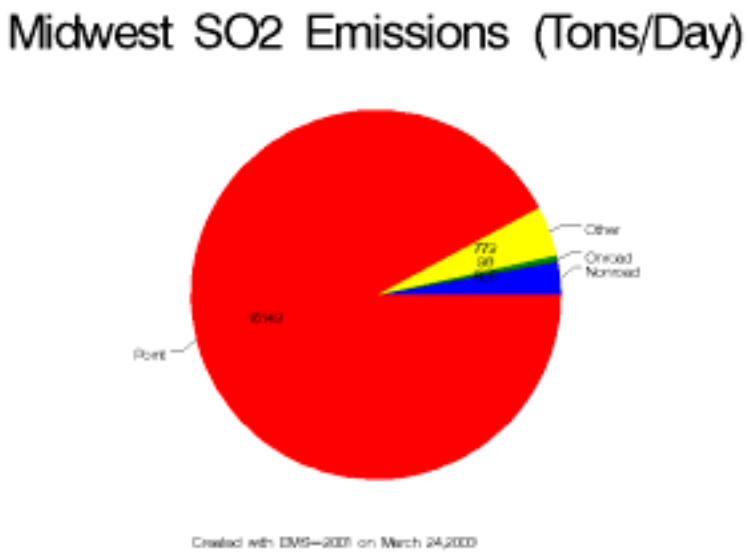


Figure B. Base D emissions Summaries(No Biogenics)







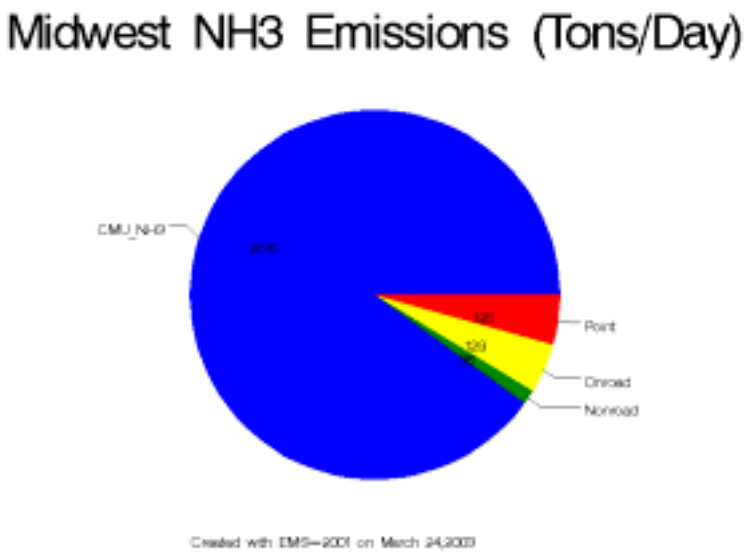
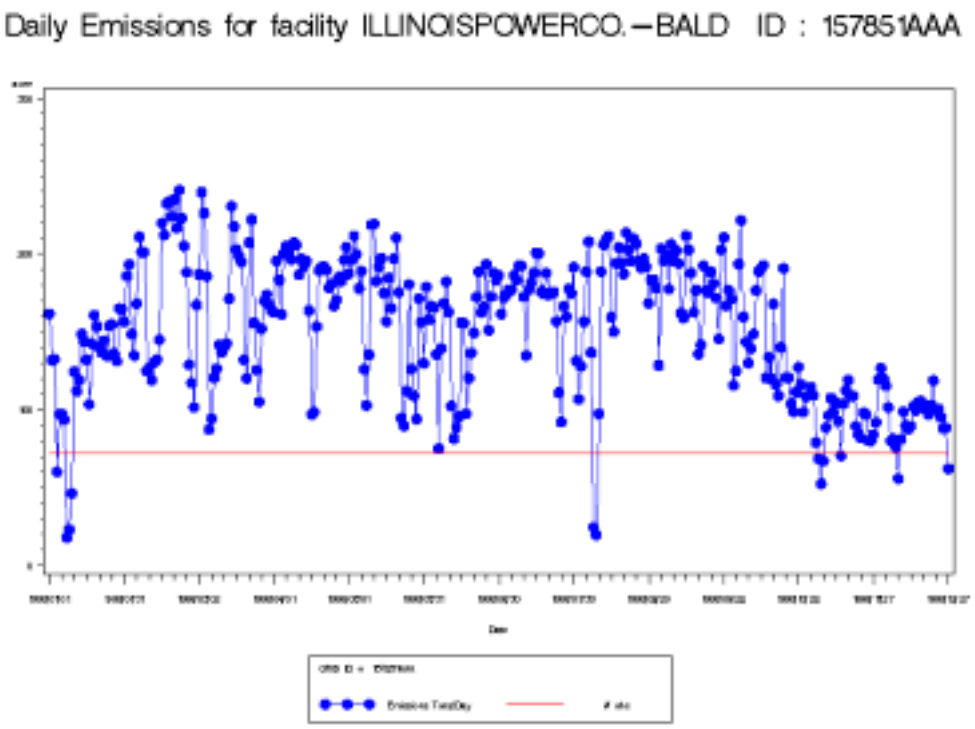
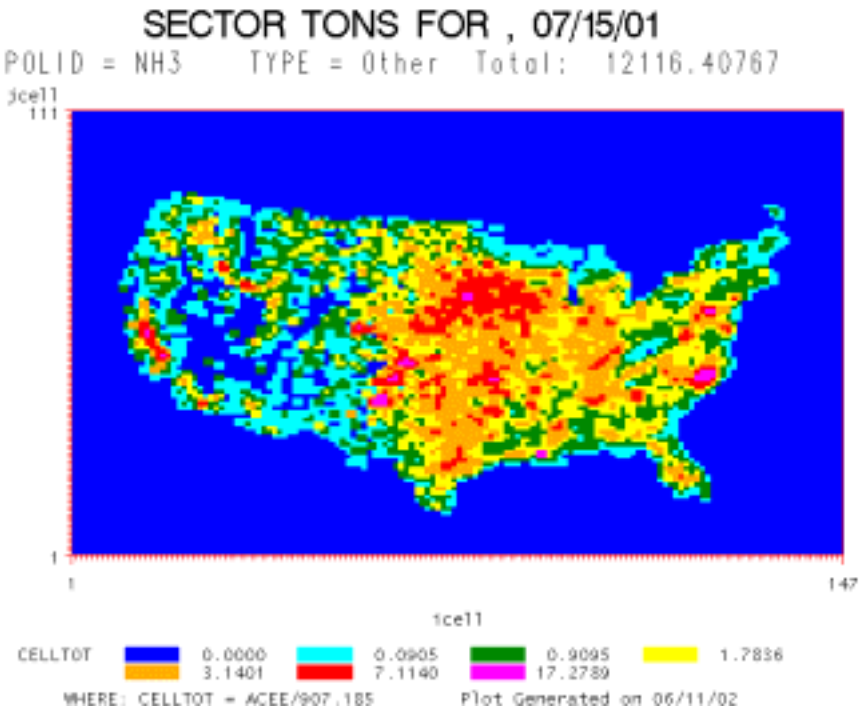


Figure C. Example Graph of Daily CEM emissions



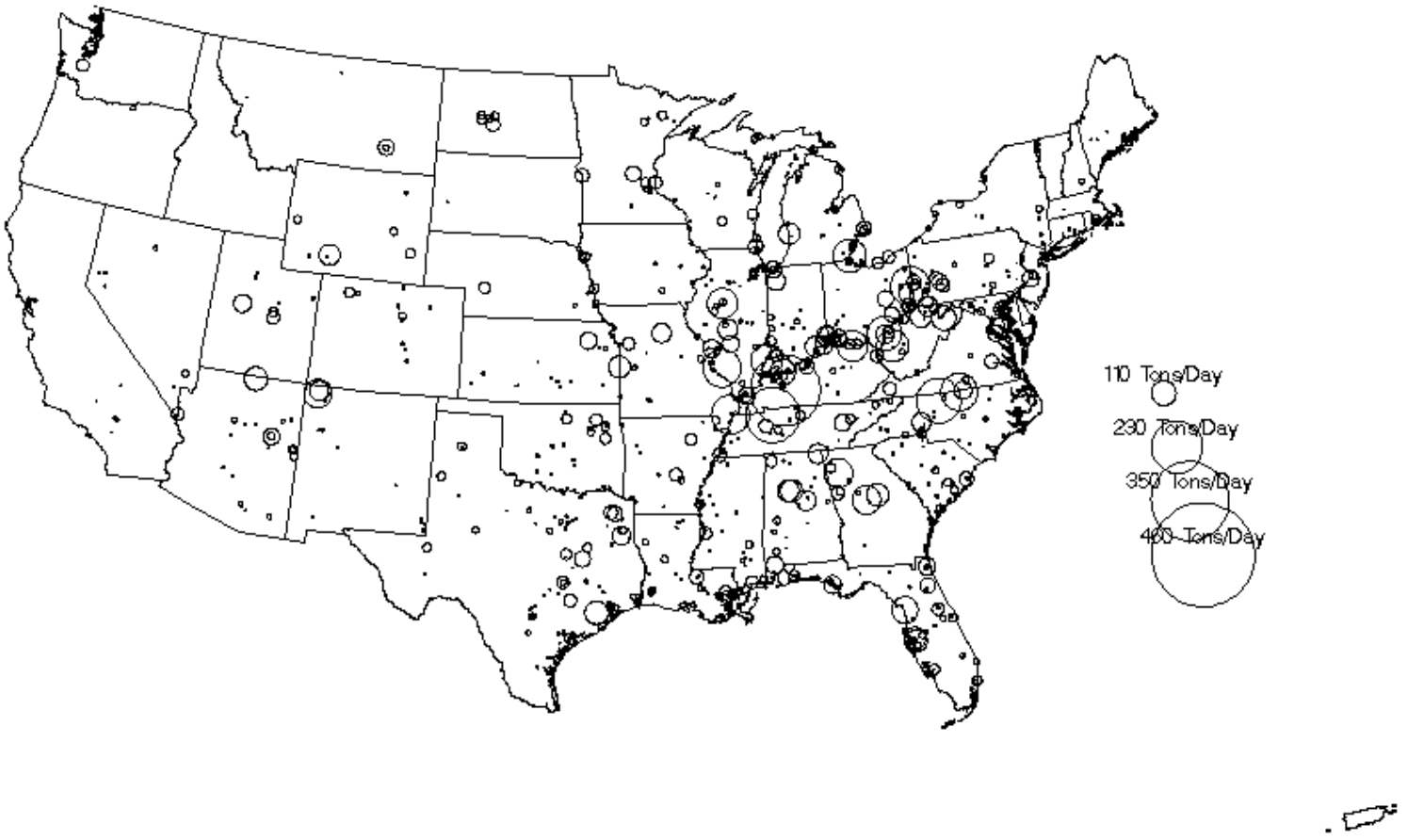
Map D. Spatial Distribution of NH3 Emissions based on the CMU Ammonia Model



Map E.

Circle Plot of NOX Sources

CASE: baseC



Created with EMS=2001 on January 8,2003