Synthesis, Integration & Analysis of Meteorological & Air Quality Data

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Presentation Outline

- Background & Objectives
- Project Overview
- Database Preparation
- Data Analysis

Background

- MMS, together with the oil and gas industry, has collected a variety of meteorological, air quality, and emission inventory data for the Gulf of Mexico region
- The data span the years 1988 to present, and have been used to support various air quality related data analysis and modeling activities
- The amount and type of data varies throughout the period and a fully integrated assessment of the data has not been conducted

Key Objectives of the Data Synthesis and Integration Study

- Assemble meteorological, emissions, and air quality data for the Gulf of Mexico region into a coherent dataset, so that the data can be more fully “mined” to
  - provide an improved understanding of the relationships between meteorology, emissions, and air quality in the region
  - support future regulatory data and modeling analyses related to ozone, fine particulate matter (PM2.5), and regional haze

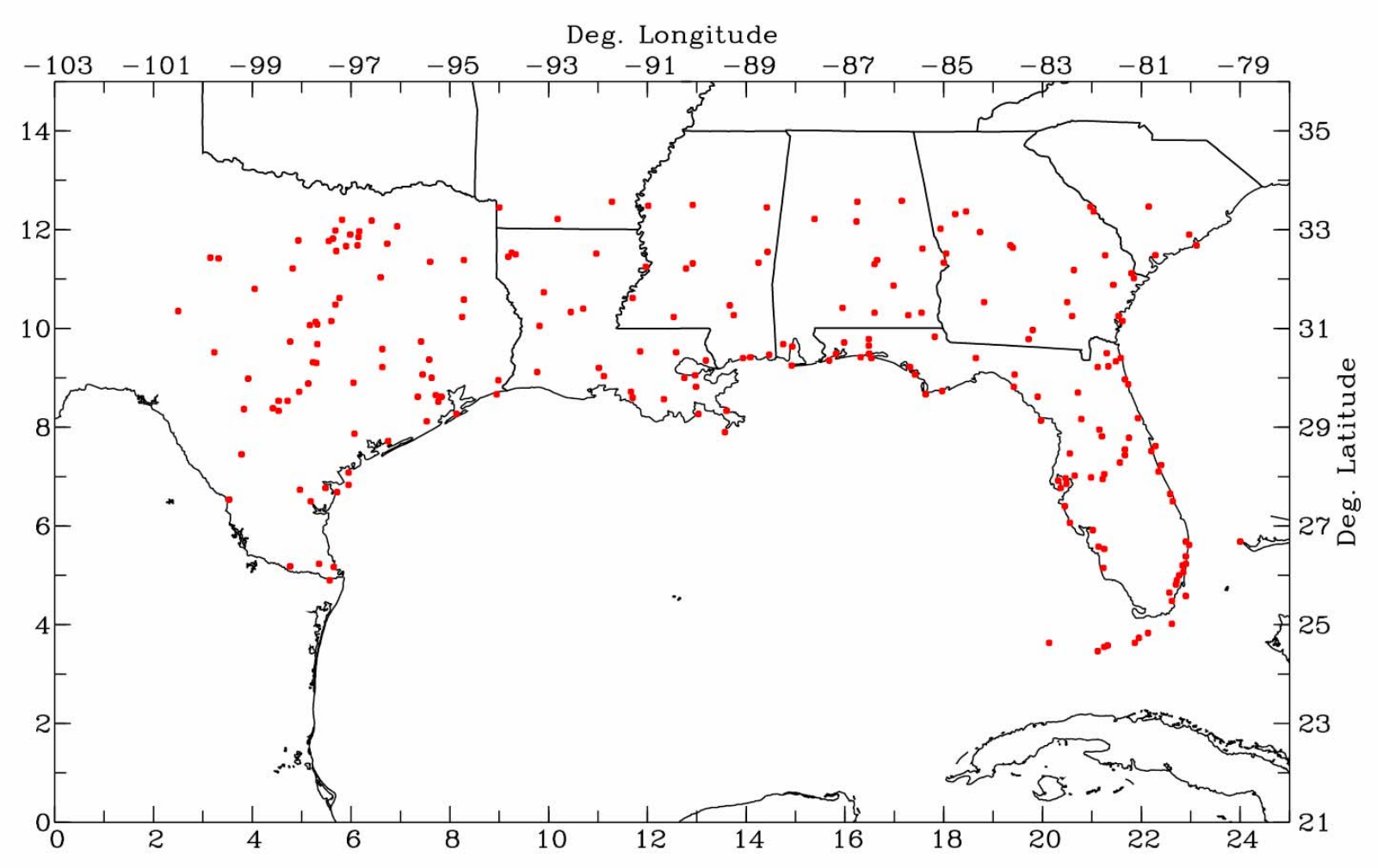
Key Objectives (continued)

- Conduct basic air quality data analyses for ozone, NOx, SO2, PM2.5 & regional haze that examine
  - relationships between emissions, meteorology and air quality for Breton & selected onshore coastal areas
  - potential for offshore emissions to influence onshore air quality
  - specific events represented in the special studies datasets

Project Overview

- The key technical elements of the study include
  - establish & maintain a Science Review Group (SRG)
  - design and develop a technically accurate, useable, and user-friendly integrated database
  - design and conduct basic data analyses that make use of the integrated dataset to examine air quality issues for the Gulf of Mexico region
  - document the study

Data Synthesis Study Area



Data Synthesis & Integration: Data Collection Task

- Identify relevant data collection studies and datasets*
- Obtain data
- Review & summarize each individual dataset
- Design the integrated database

*Include routine & “special studies” data for the period 1990–2004

Datasets Included to Date

- Special Studies Data:
  - MMS 1993 Gulf of Mexico Air Quality Study (GMAQS) data
  - MMS monitoring data collected by LSU (1995–2000)
  - MMS/OOC Atmospheric Boundary Layer (ABL) data (1998–2001)
  - Breton Area Monitoring Program (BAMP) (2000–2001)
  - Activities and emissions data for the Breton area and entire Gulf of Mexico (2000 and 2005 Gulfwide Emission Inventories)

Datasets Included to Date (continued)

- Routine Data:
  - AIRS/AQS ozone, PM10, PM2.5, speciated particulates, SO2, and CO for coastal TX, LA, MS, AL, and FL
  - IMPROVE data for Breton & other coastal sites
  - SouthEastern Aerosol Research and CHaracterization (SEARCH) data for MS and FL
  - NWS surface and upper-air (including radar wind profiler) meteorological data for coastal TX, LA, MS, AL, and FL
  - Meteorological buoy data for the Gulf of Mexico

Database Management

- Oracle Relational Database Management System (RDBMS), supported by an MS-Access based user interface
- User-friendly (MS-Access based) interface designed to support the type/range of queries that are important to air quality data analysis & modeling
- Format and content of the reports (outputs) designed to support the interactive review and QA of the data

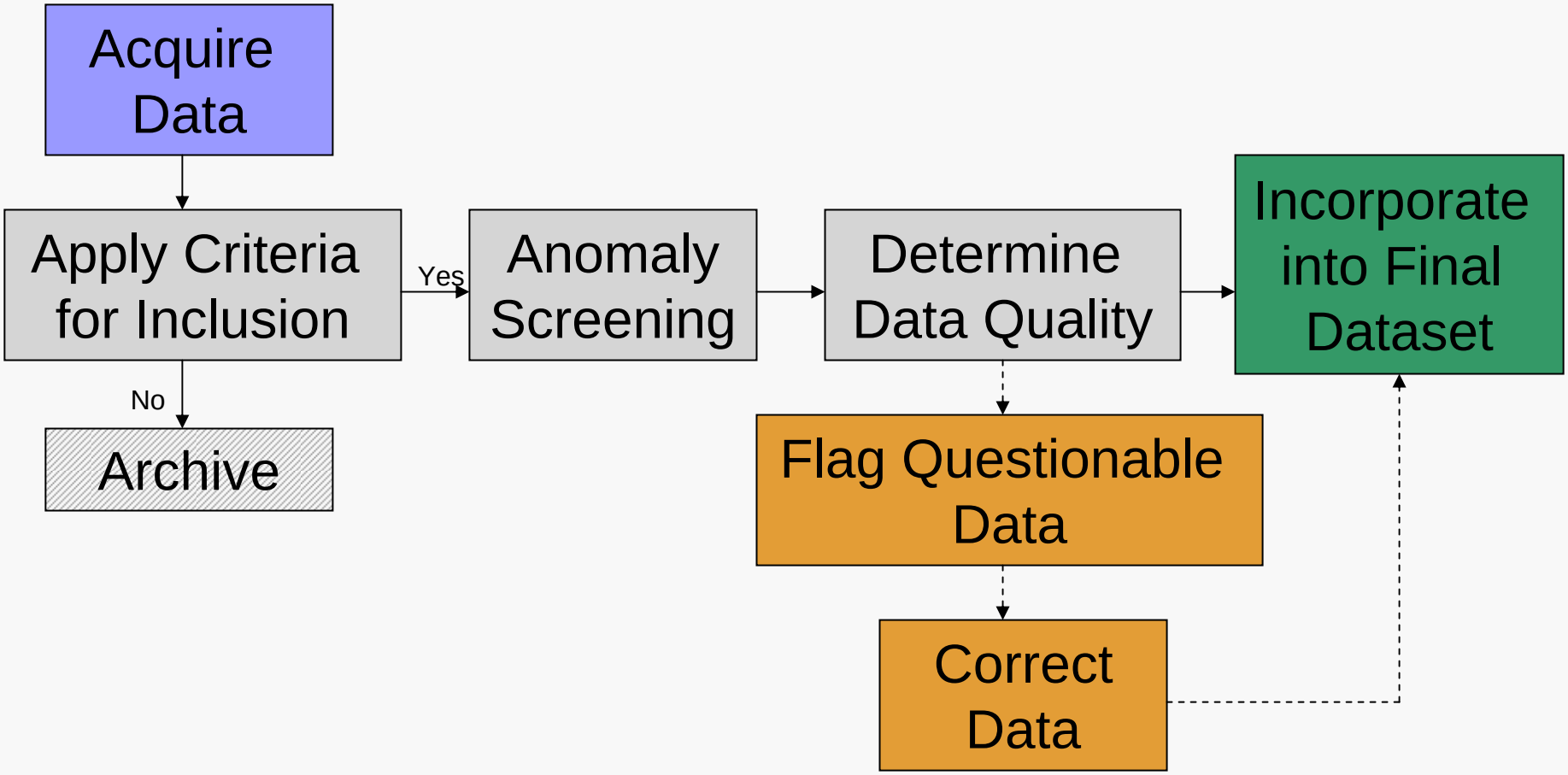
Data Evaluation: Meteorological & Air Quality Data

- Collected monitoring data (special studies and routine data) are undergoing review and quality assurance for consistency, completeness, and quality
- Data handling procedures will include:
  - Automatic anomaly screening
  - Automatic identification of missing data
  - Manual review of data parameters
  - Data corrections, where possible

Data Evaluation: Emissions Data

- Emission inventory information (MMS, oil and gas industry, and NEI) are also being reviewed and quality assured
- For example, for offshore sources, this includes
  - review of facility information for completeness and reasonableness
  - review of emission totals for all species
  - rank-ordering of platform sources for all species
  - plotting offshore emissions to check location & magnitude

Overview of MMS Synthesis Database Preparation



Data Analyses

- Data summaries
  - Statistical and graphical overview of the meteorological, air quality, and emissions data
  - Information to guide the remaining data analysis tasks
- CART analysis for the Breton National Wilderness Area (NWA)
  - Classification and Regression Tree (CART) analysis to probe the relationships between meteorology and SO2, PM2.5, and visibility (regional haze) at the Breton NWA

Data Analyses (continued)

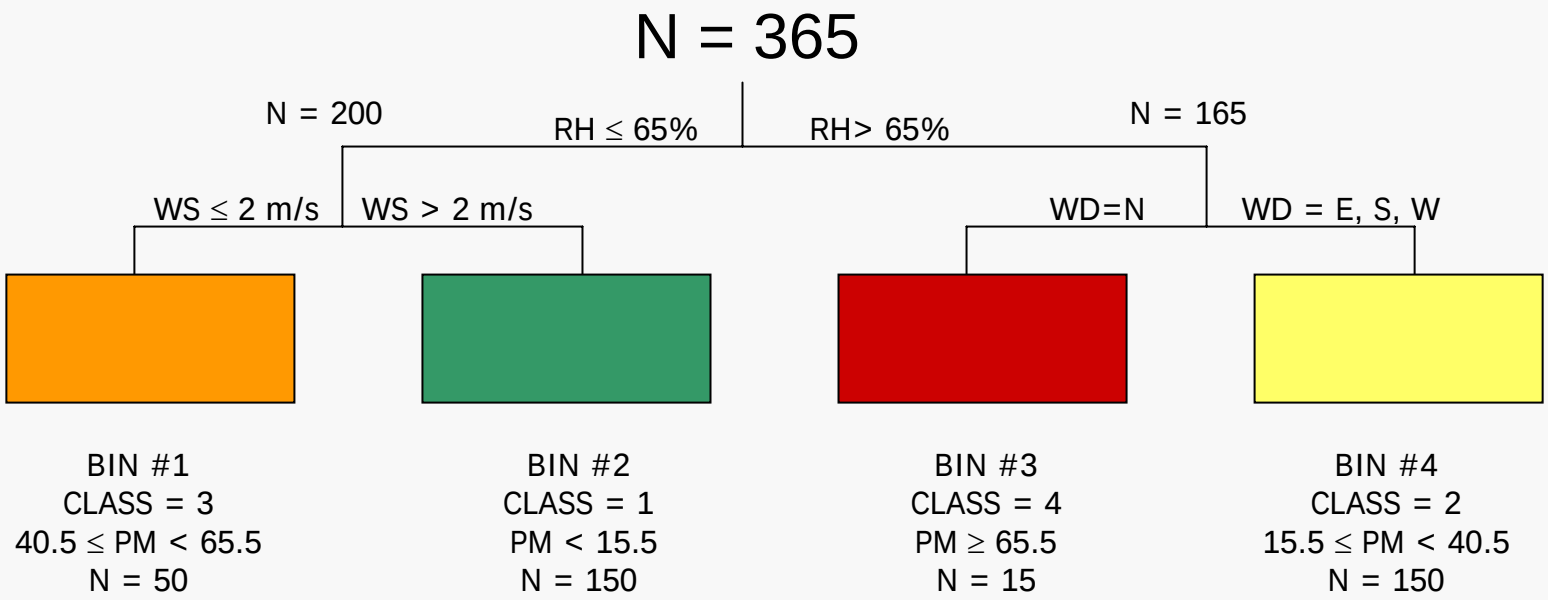
- CART analysis for coastal ozone non-attainment areas
  - Examination of the relationships between onshore and offshore meteorological conditions and ozone air quality in coastal non-attainment areas
- Air quality trends analysis
  - Information on the effects of meteorology & emissions changes on onshore 8-hour ozone and PM2.5 air quality

Data Analyses (concluded)

- Case study analyses (MM5)
  - Comparison of existing MM5 results with the special studies meteorological data
  - Recommendations for specific areas for improvement for future applications of MM5 or other meteorological models to the Gulf Coast region

Classification and Regression Tree (CART) Analysis

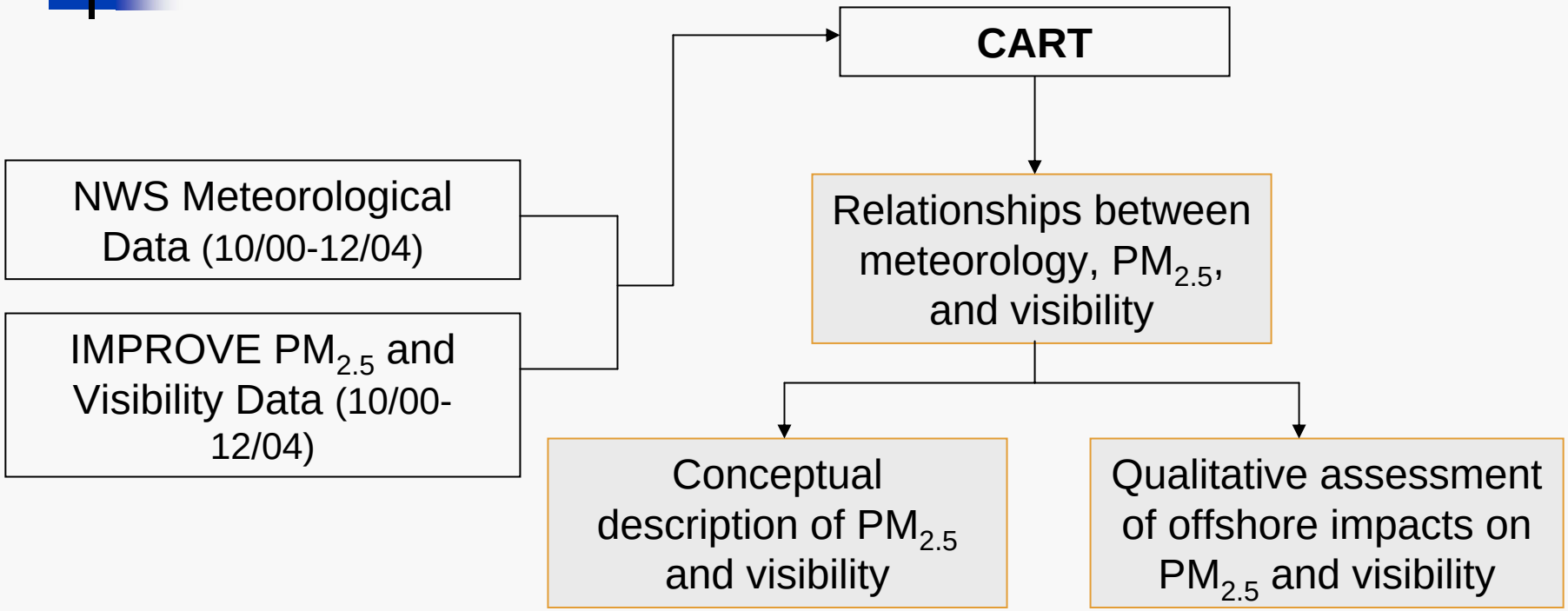
- CART will be used to probe the relationships between meteorology and various air quality metrics
- Simple example of a CART classification tree for PM2.5



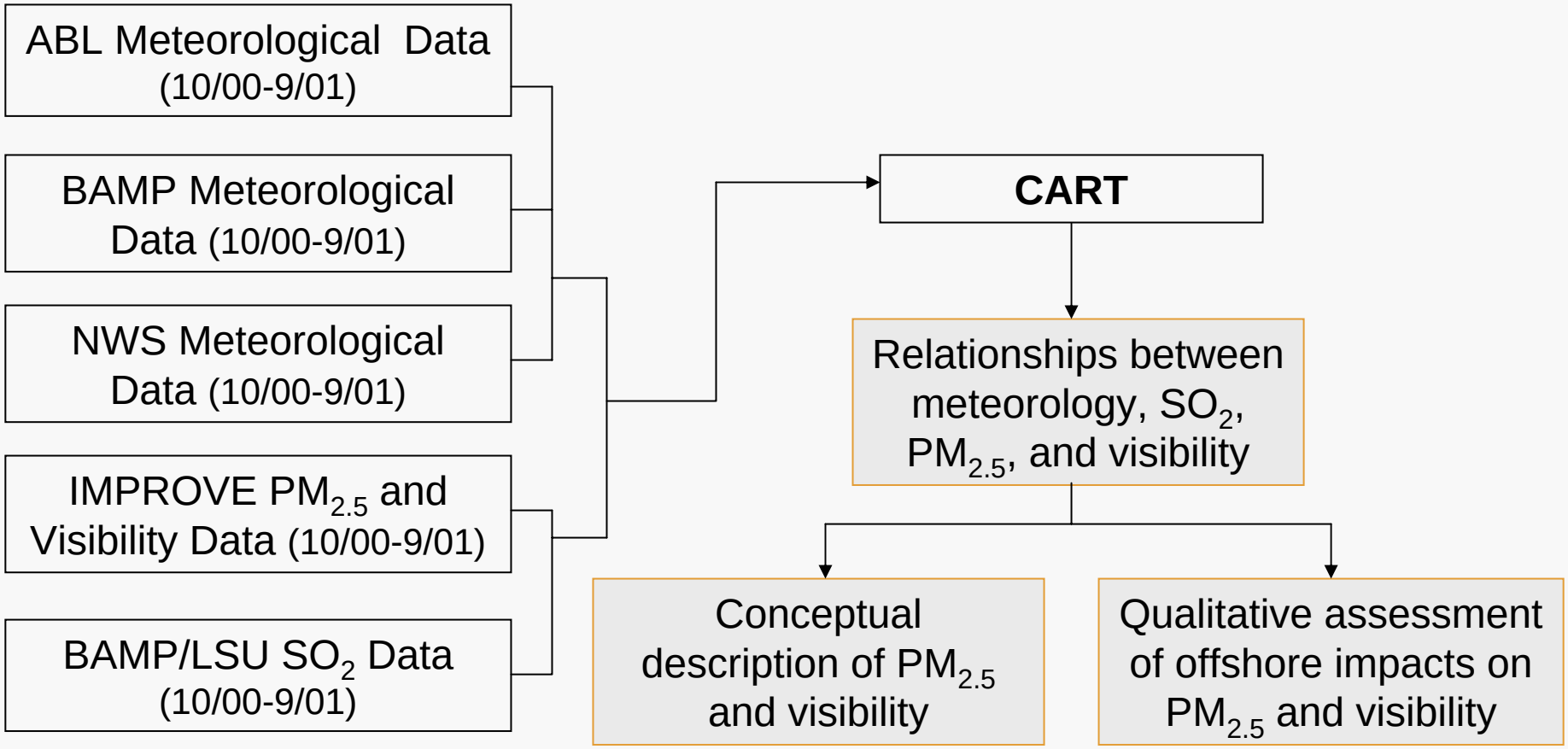
CART Analysis for the Breton National Wilderness Area

- Two CART applications using routine and special studies data
  - For 2000-2004 using routine NWS, IMPROVE, and other longer term measurements, and focusing on PM2.5 and regional haze
  - For October 2000 through September 2001 using ABL and BAMP data, in addition to the routine data and focusing on PM2.5, visibility, and (if data allow) SO2

Design of the Breton NWA CART Analysis: 2000–2004

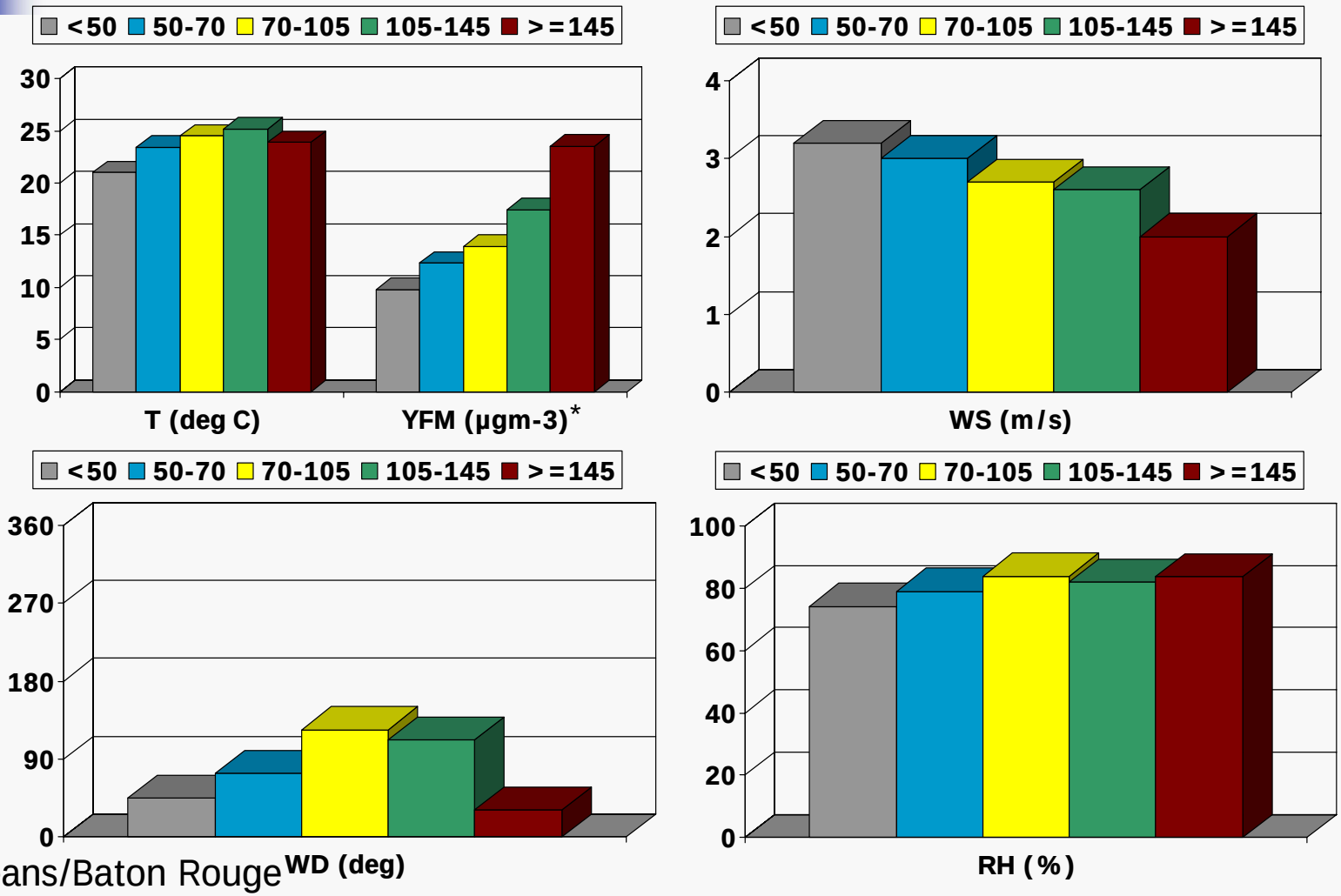


Design of the Breton NWA CART Analysis: 2000-2001 (ABL/BAMP)



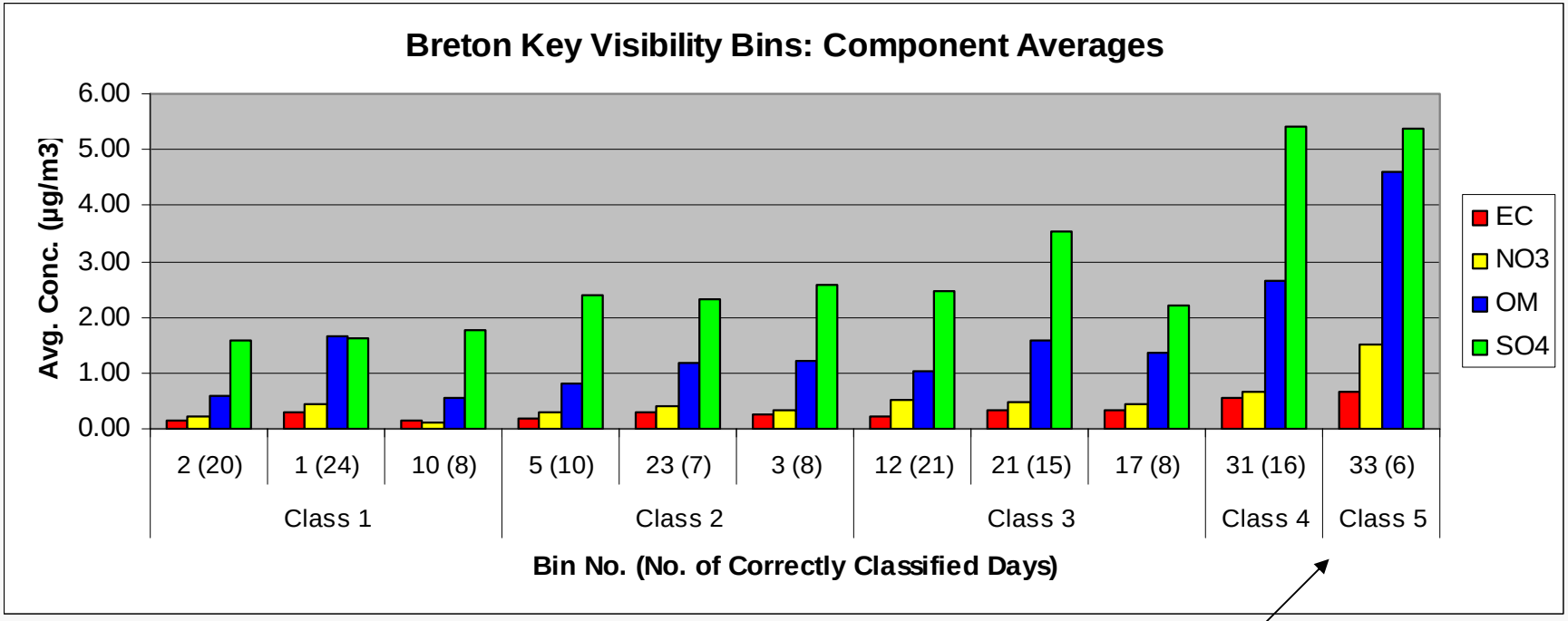
Variation in Meteorology for CART-Based Visibility Classes for Breton

Surface Characteristics: All Days (2000-2004)/5 Ex. Coeff. Categories (Mm^{-1})



*New Orleans/Baton Rouge

Variation in PM2.5 Composition for Key CART Visibility Bins: Breton

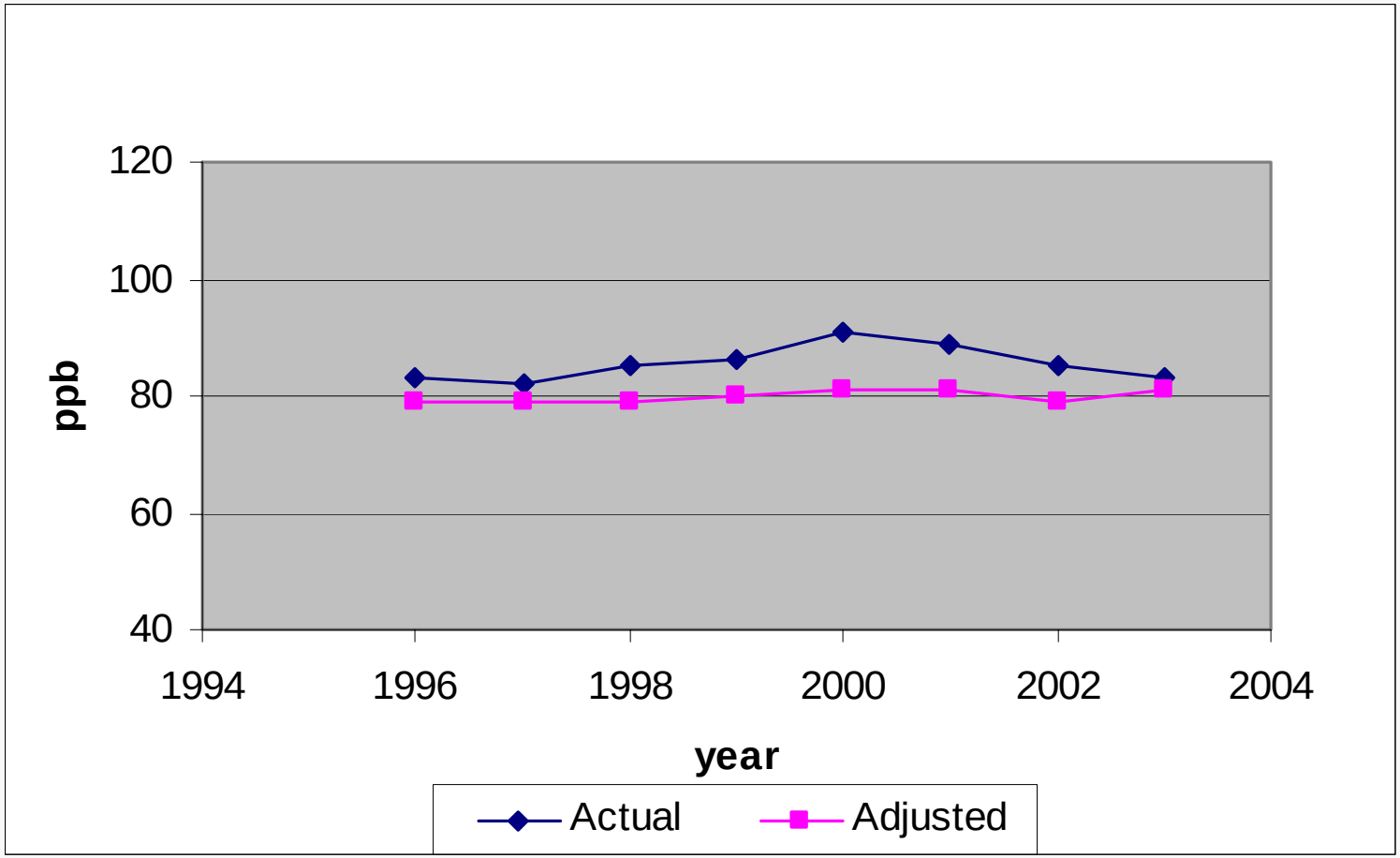


Class 4 & 5 bins contain the worst visibility days

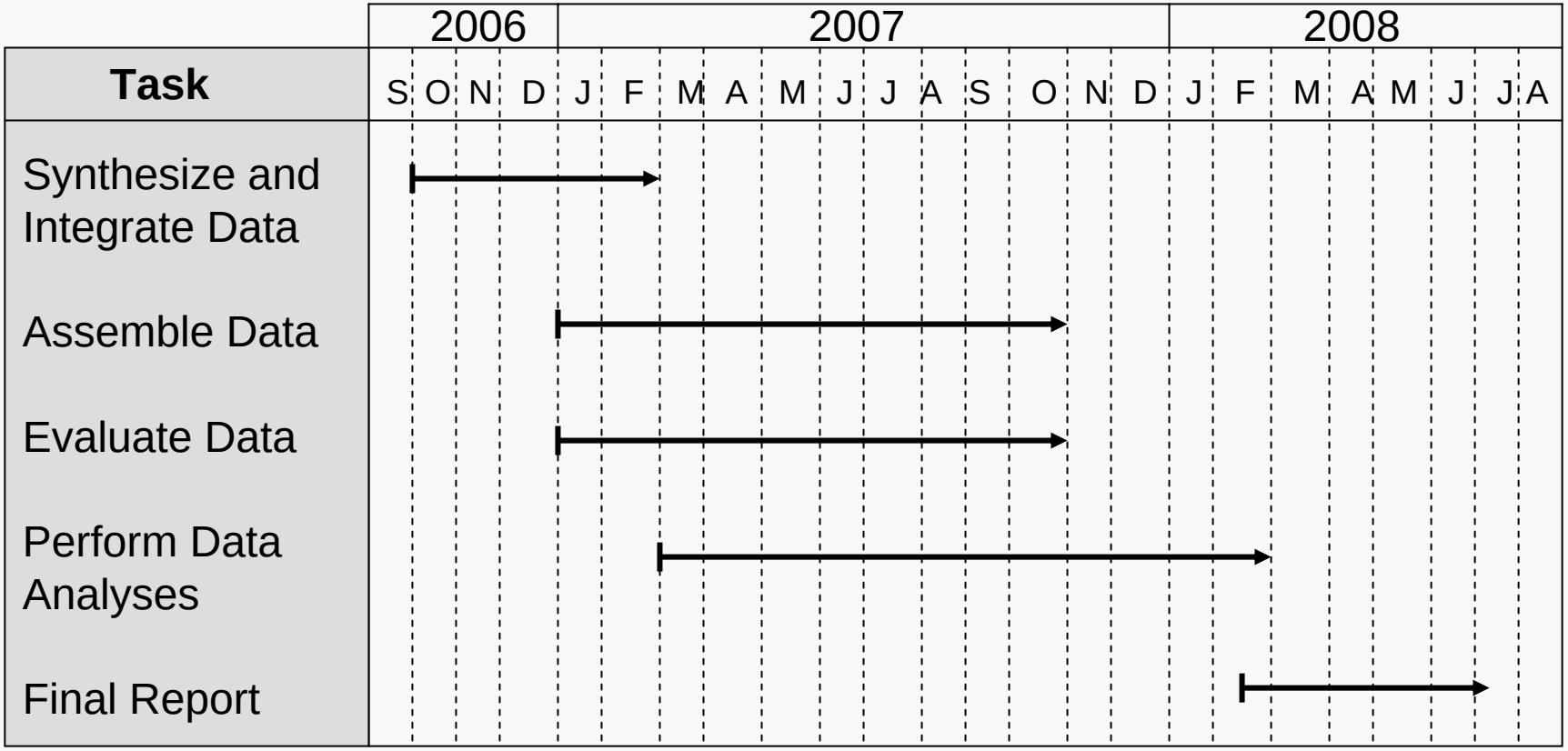
Air Quality Trends Analysis

- Trends analysis will provide
  - Information on the effects of meteorology & emissions changes on onshore 8-hour ozone and PM2.5 air quality
- Methodology
  - Propose to focus on Houston, Beaumont/Port Arthur, Lake Charles, Baton Rouge & New Orleans
  - Use CART results to calculate meteorologically adjusted trends
  - Calculate statistical significance and confidence intervals for the trend estimates
  - Relate these to known changes in emissions

Example Meteorologically Adjusted Ozone Design Values: New Orleans



Schedule


2006
2007
2008
Task
S O N D J F M A M J J A S O N D J F M A M J J A
Synthesize and Integrate Data
Assemble Data
Evaluate Data
Perform Data Analyses
Final Report