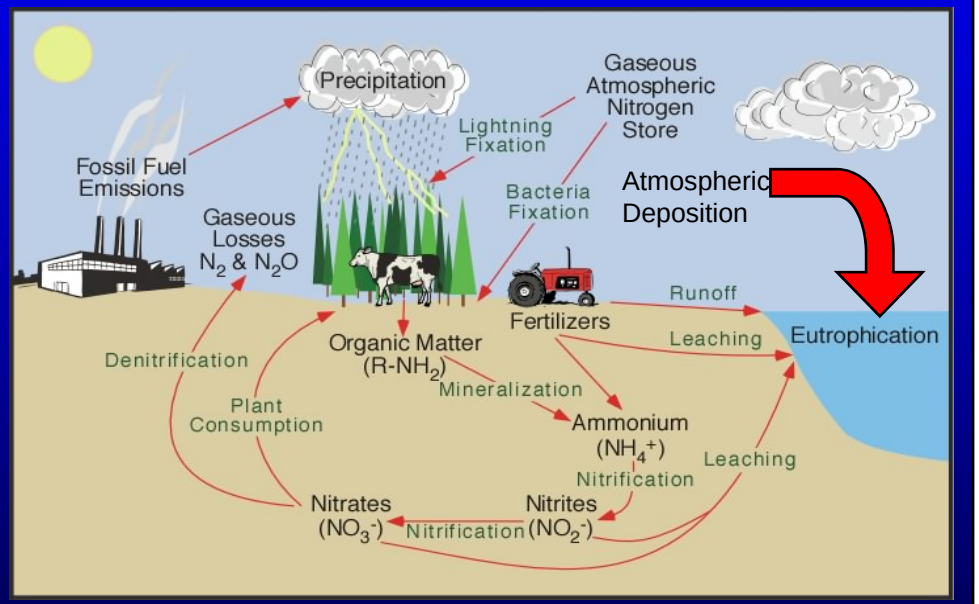
DEMAND: DSS Environment for Modeling of Atmospheric Nutrient Deposition

Udaysankar S. Nair [1], Sundar A. Christopher[2], Ken Keiser[3], Danny Hardin[3]

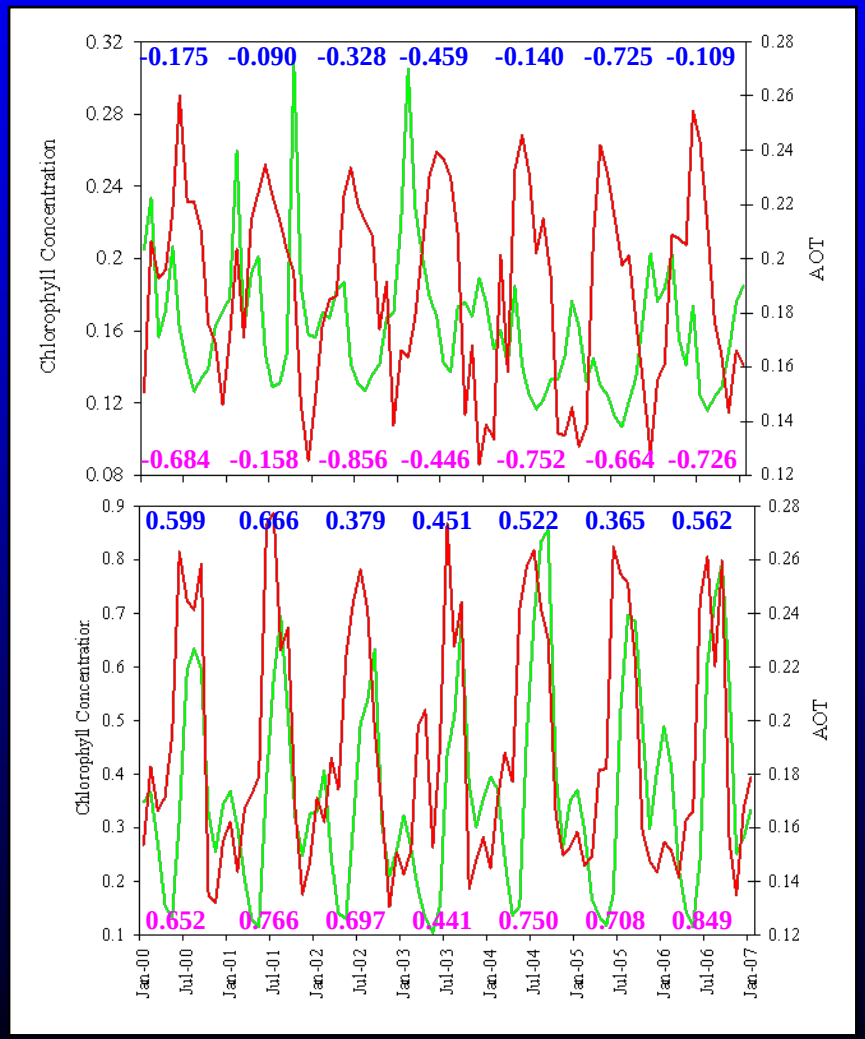
[1]Earth System Science Center
[2]Department of Atmospheric Science
[3]Information Technology System Center
University of Alabama in Huntsville

Motivation

- Nutrient inputs into inland water bodies and ocean are an important modulator of aquatic ecosystem functions and services

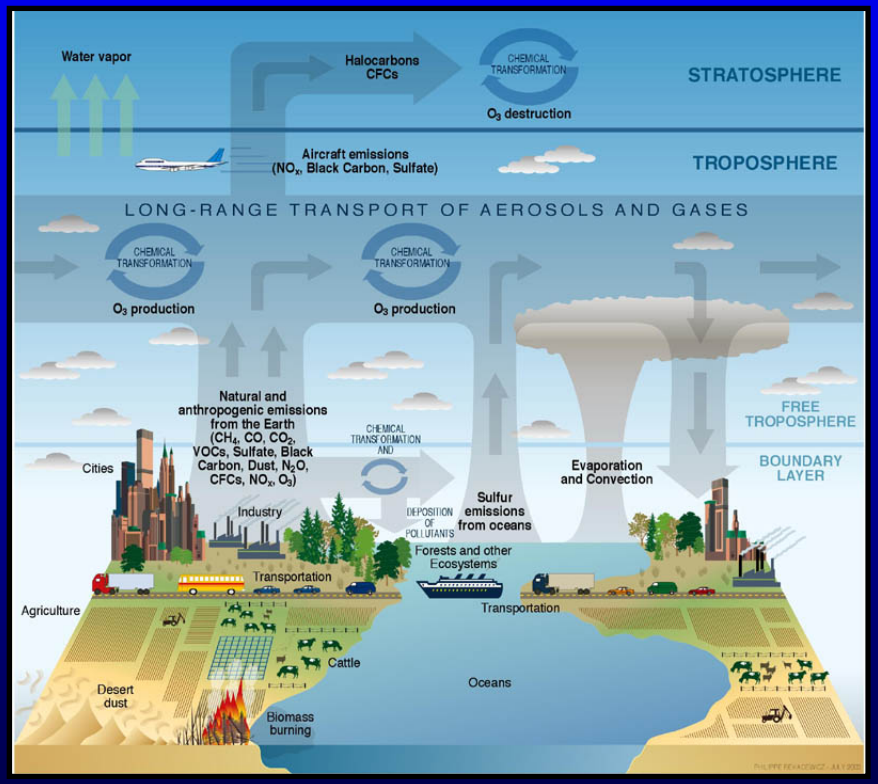


Source: Pidwirny, M. (2006)
http://www.physicalgeography.net



Motivation

- Significant input from atmospheric pathway, atmospheric aerosols



Source: CCSP Strategic Plan Report
www.climatescience.gov/Library/stratplan2003

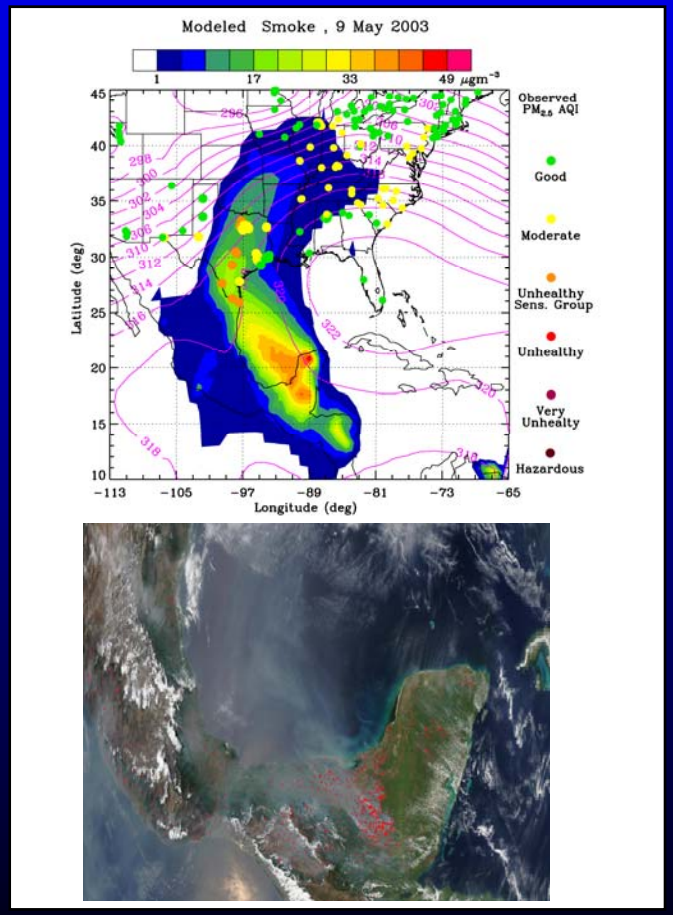
	Pre-industrial	Human derived	Total
Inputs			
Biological nitrogen fixation	120	20†	140
Lightning	5	0	5
Industrial N-fixation	0	125‡	125
Fossil fuel combustion	0	25	25
Totals	125	170	295
Fates			
Biospheric increment	0	9	9
Riverflow	27	35	62
Groundwater	0	15	15
Denitrification	92*	17	109
Atmospheric transport to the ocean	6	48	54
Totals	125	124	249

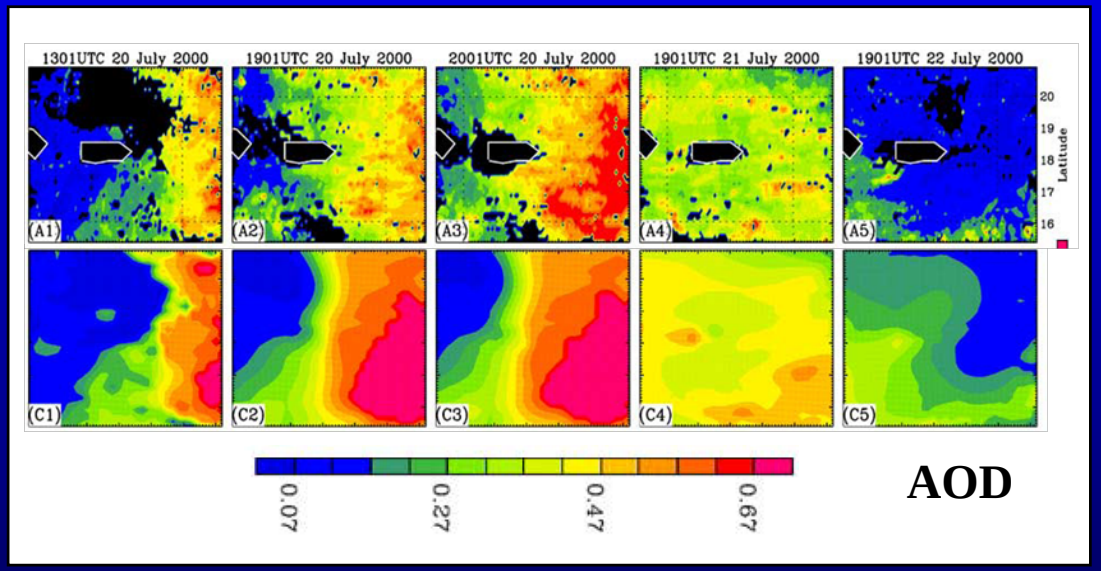
All values are TgN/yr. Unless otherwise indicated, preindustrial values and human-derived inputs are for the mid-1990s from Galloway *et al.* (43) and Duce *et al.* (22). Fates of anthropogenic nitrogen are derived in this paper.

Source: Schlesinger (2009)

Decision Support Overview

- Improved estimates of atmospheric deposition from numerical models utilizing satellite emission fluxes and AOD. End users: Alabama Department of Environmental Management (ADEM) and Mobile Bay National Estuary Program (MBNEP)





Wang et al., 2004

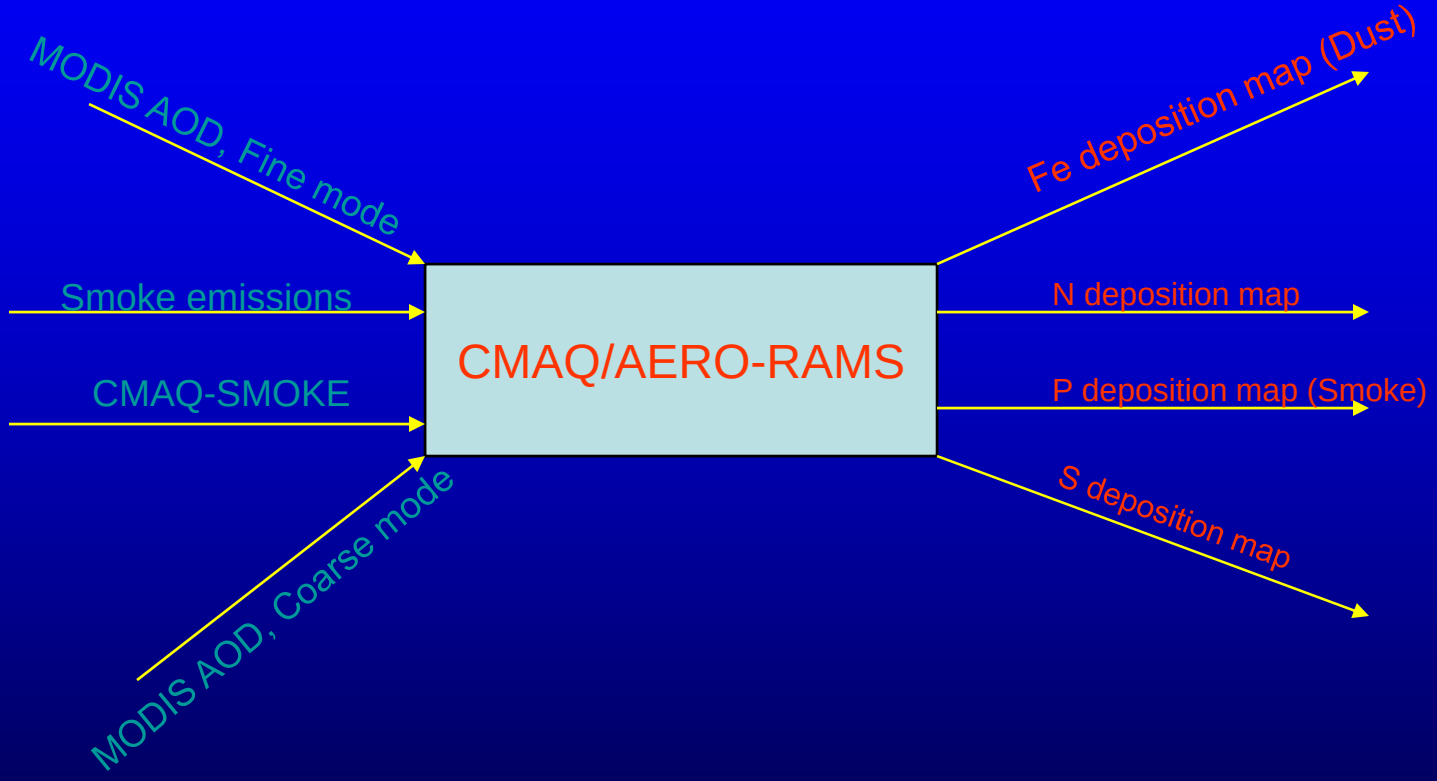
Wang et al., 2006

Summary of Methodology

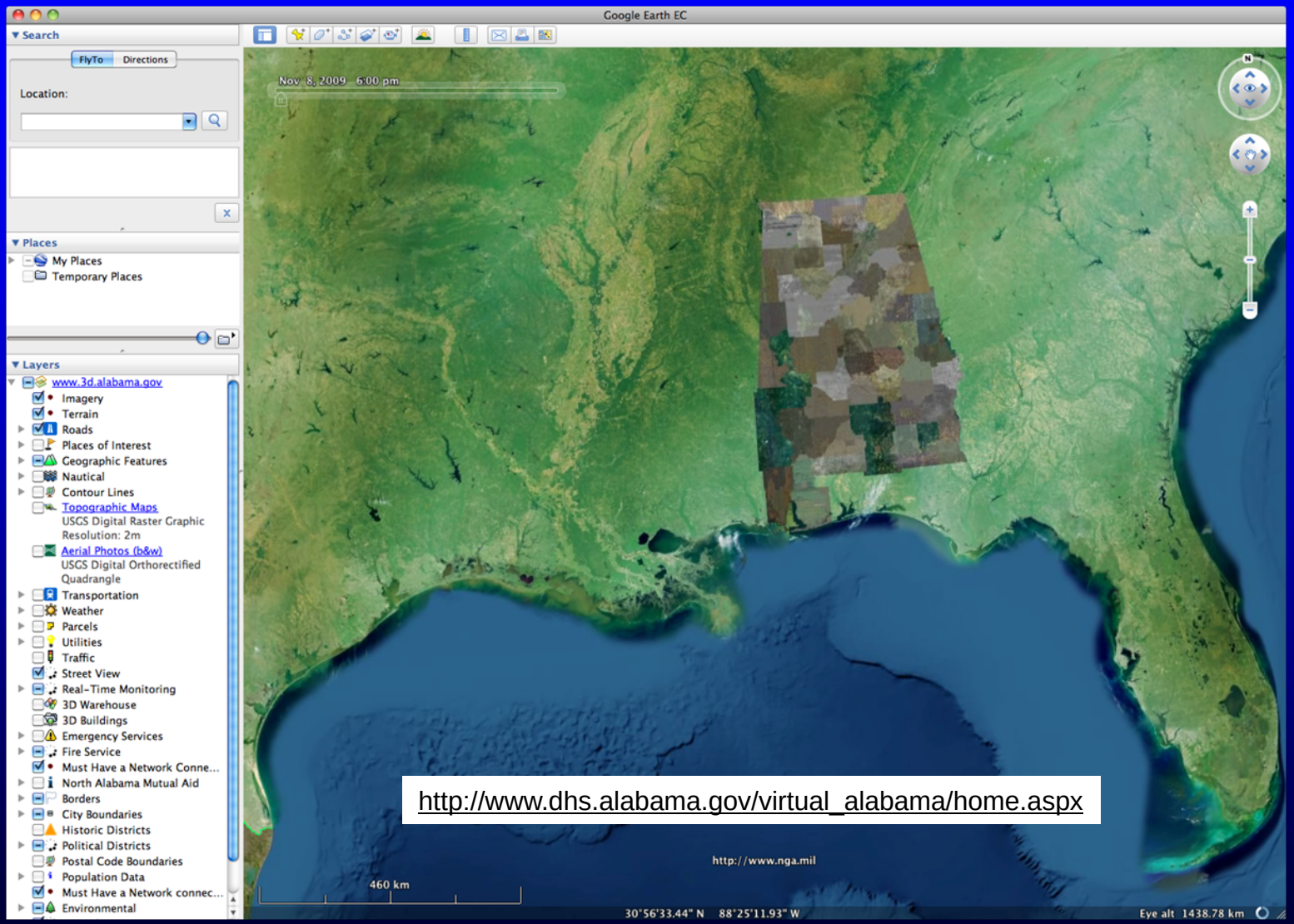
- Use CMAQ/AERO-RAMS to simulate sulfate, nitrate, dust and biomass burning aerosol transport. Utilize satellite derived smoke emission, MODIS AOD and fine mode fraction to constrain simulated aerosol fields.

$$C_{n,ADJUSTED}(z) = C_{n,CMAQ}(z)\frac{\tau_{MODIS}}{\tau_{CMAQ}}$$

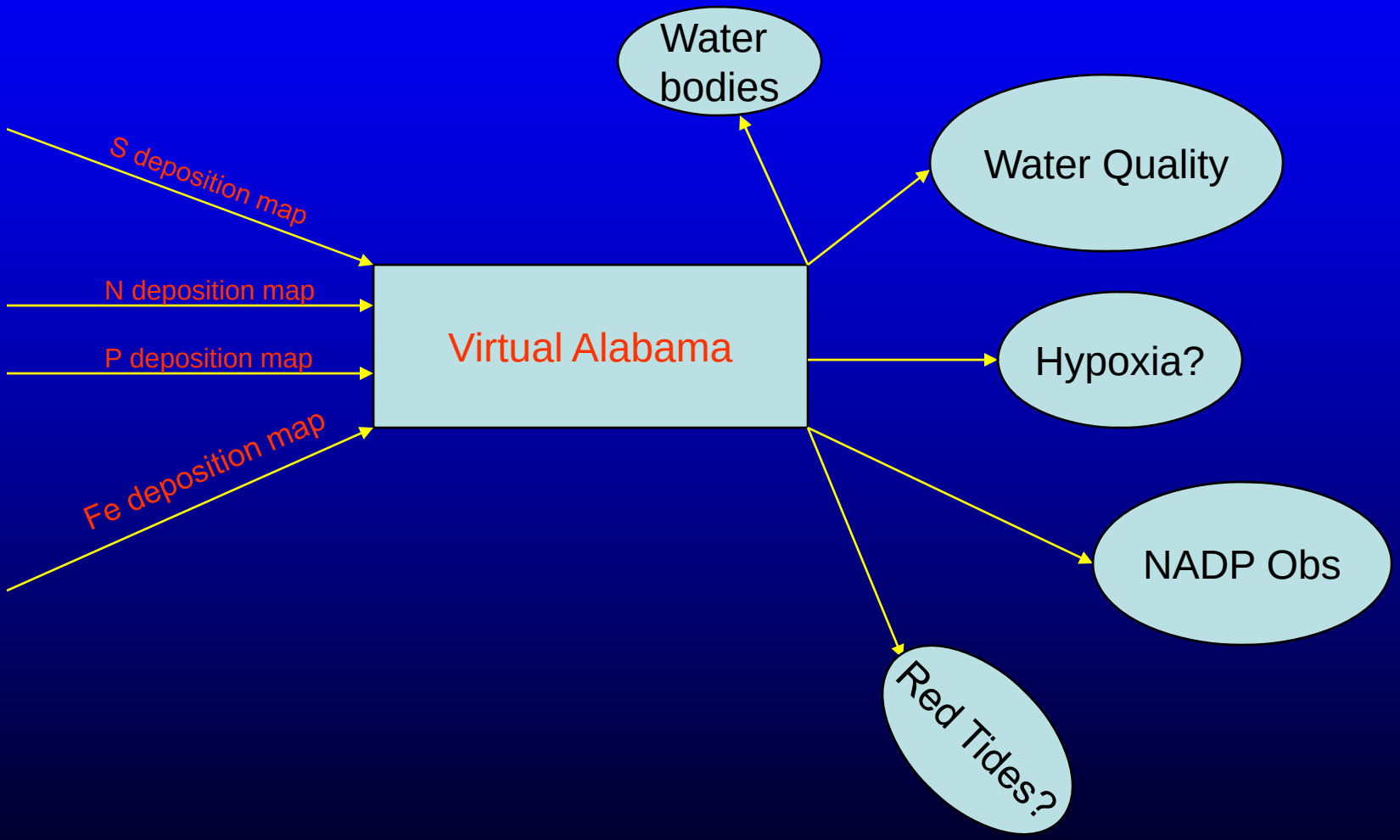
Methodology & Products



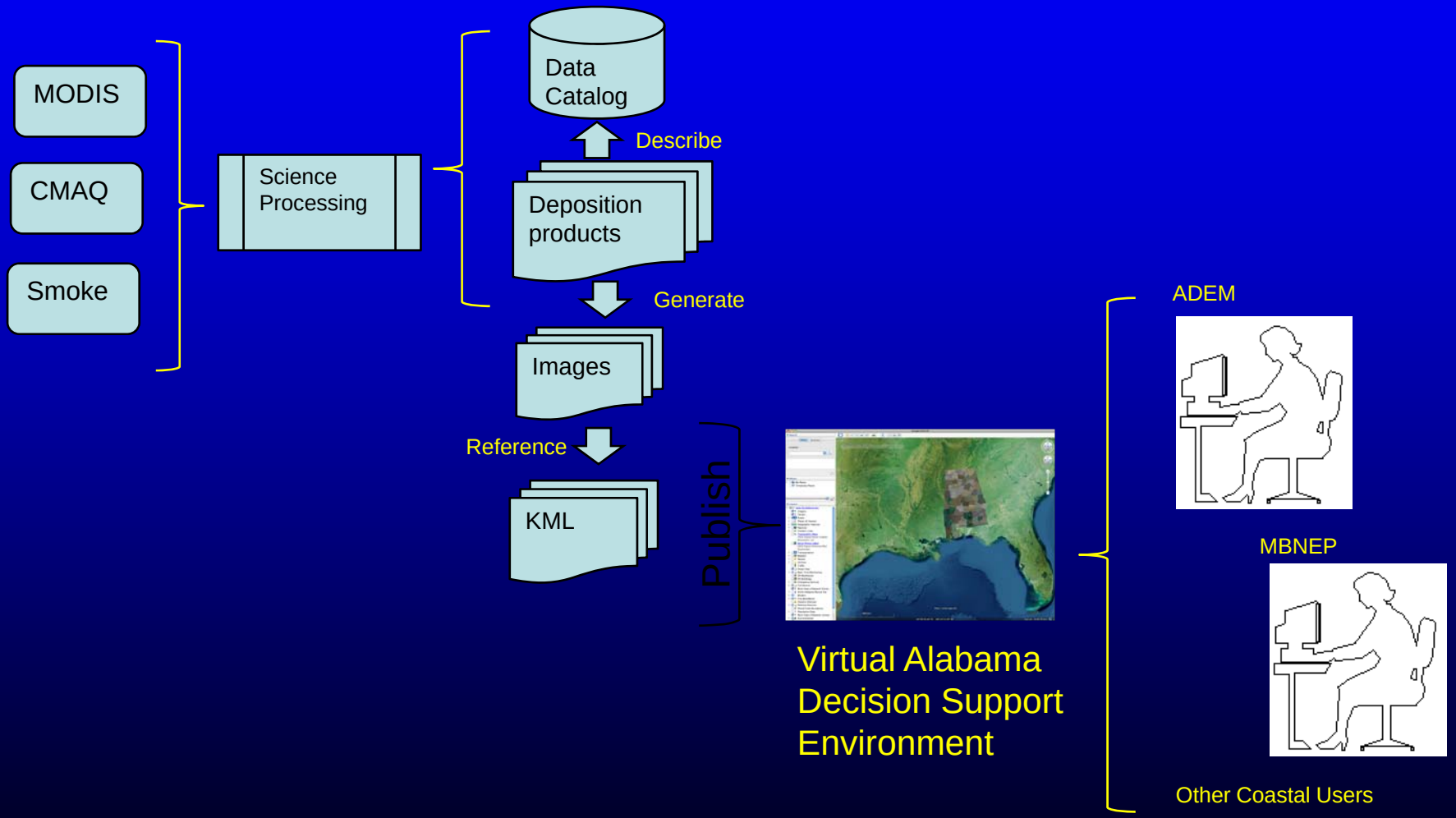
Decision Support System: Virtual Alabama



Decision Support System: Virtual Alabama



Integration of products into Virtual Alabama



Transition Approach

- Close interactions with state and regional stakeholders
- Use of a proven DSS, Virtual Alabama, with broad state and regional acceptance
- Leveraging well established computational resources at UAHuntsville, Alabama Super Computer
- Pursue minimal sustaining coverage based on documented successes

Performance Measures

- Demand portal web statistics
  - User interest
  - User interactions
- Number of satellite products and model outputs used in decision support
  - Data volumes
  - Generation of new data products
- Results of surveys with ADEM and other regional coastal users
  - Usefulness to end users
  - Perception
  - Requested improvements
- Monitor access through Virtual Alabama and other web sites
  - DSS interactions

Anticipated Results

- Deposition maps for Alabama and GOM region
- Evaluation of improvement to deposition resulting from the use of NASA ESR
- Relative importance of nutrient inputs and understanding potential ecosystem responses
- Role of episodic biomass burning aerosol transport