Southern Smoke Simulation System

Modeling smoke impacts from prescribed burning in the South

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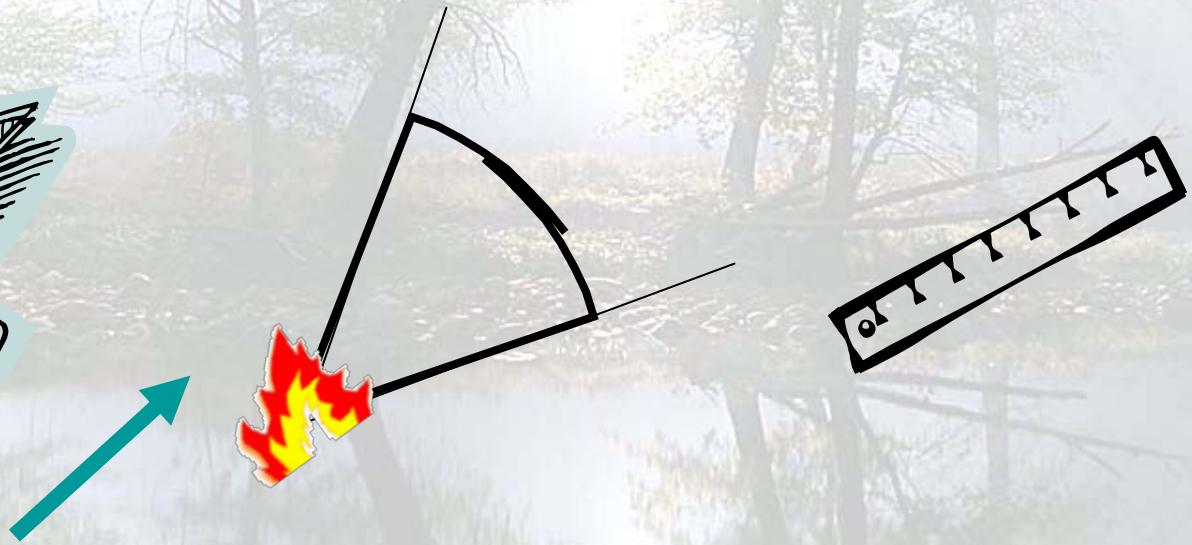
Motivation

- The South is a leader in using prescribed fire to accomplish land management objectives
- Air quality community taking an increased interest in prescribed fire

and incomplete

Brief History of Smoke Management

- None –"*Its just part of living in the country*"
- 1976 - Southern Forestry Smoke Management Guidebook



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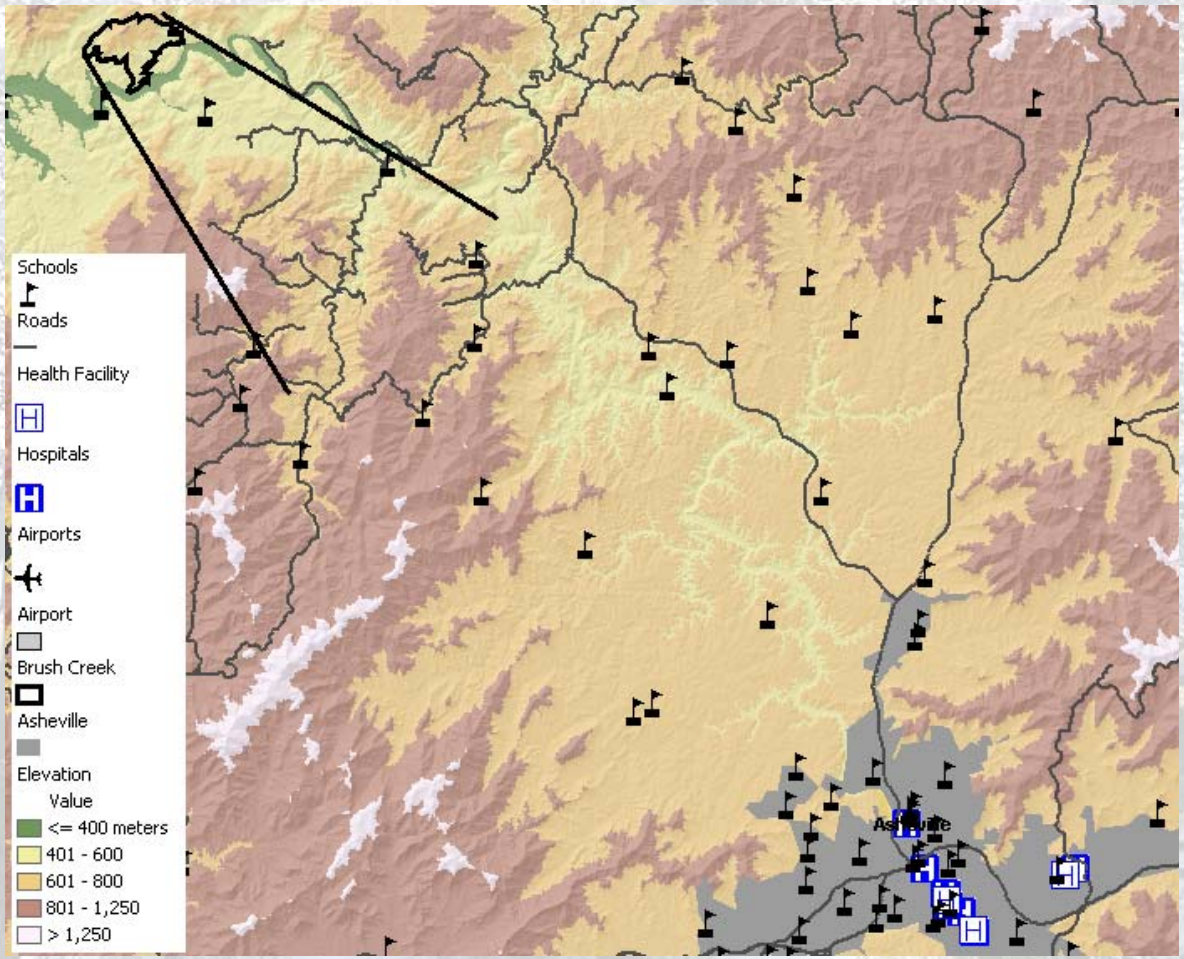
Brief History of Smoke Management



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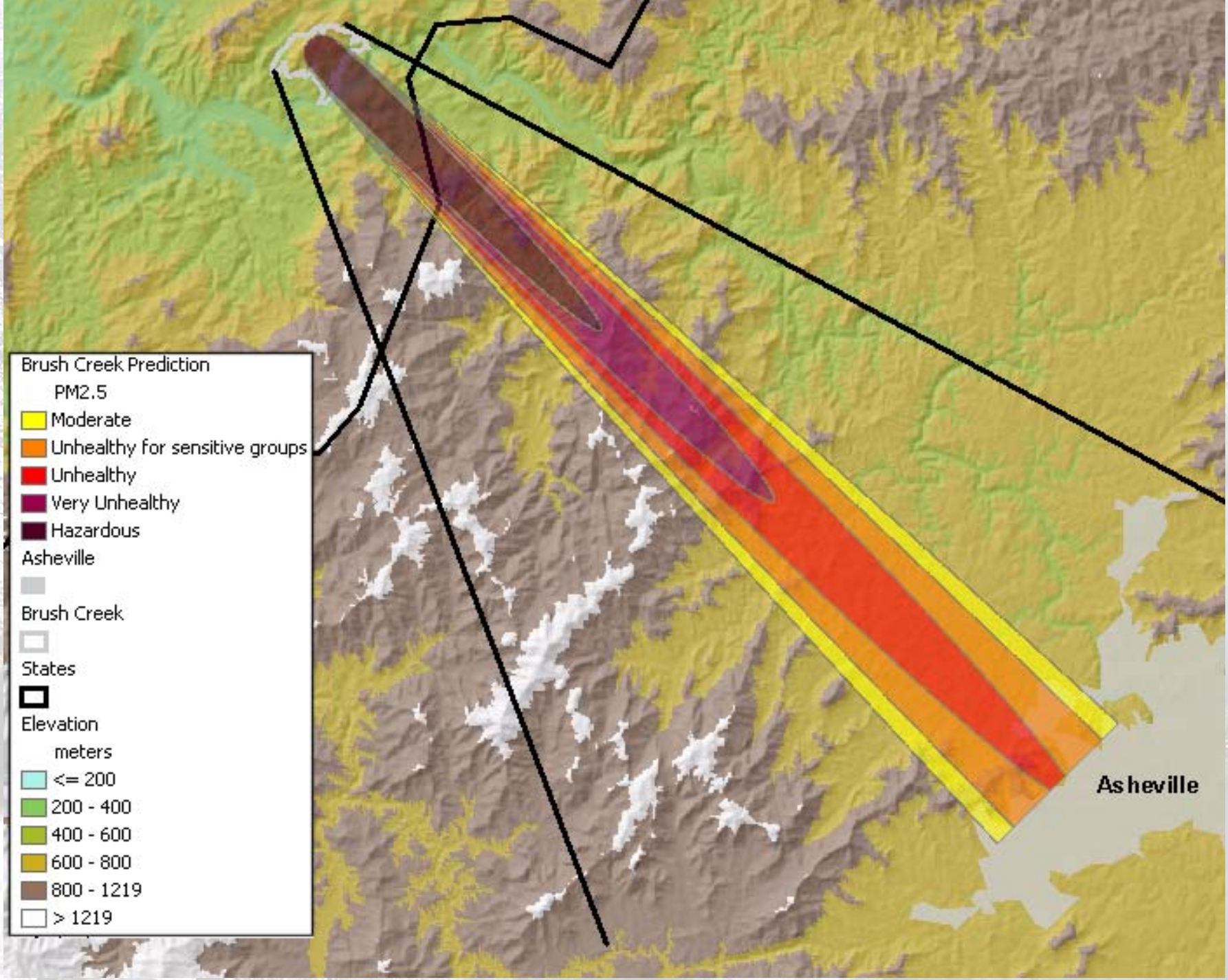
Brief History of Smoke Management

- Early 1990's – VSmoke, a gaussian plume model is integrated into the smoke screening process


Brush Creek Prediction
PM2.5
Moderate
Unhealthy for sensitive groups
Unhealthy
Very Unhealthy
Hazardous
Asheville
Brush Creek
States
Elevation
meters
<= 200
200 - 400
400 - 600
600 - 800
800 - 1219
> 1219
Asheville

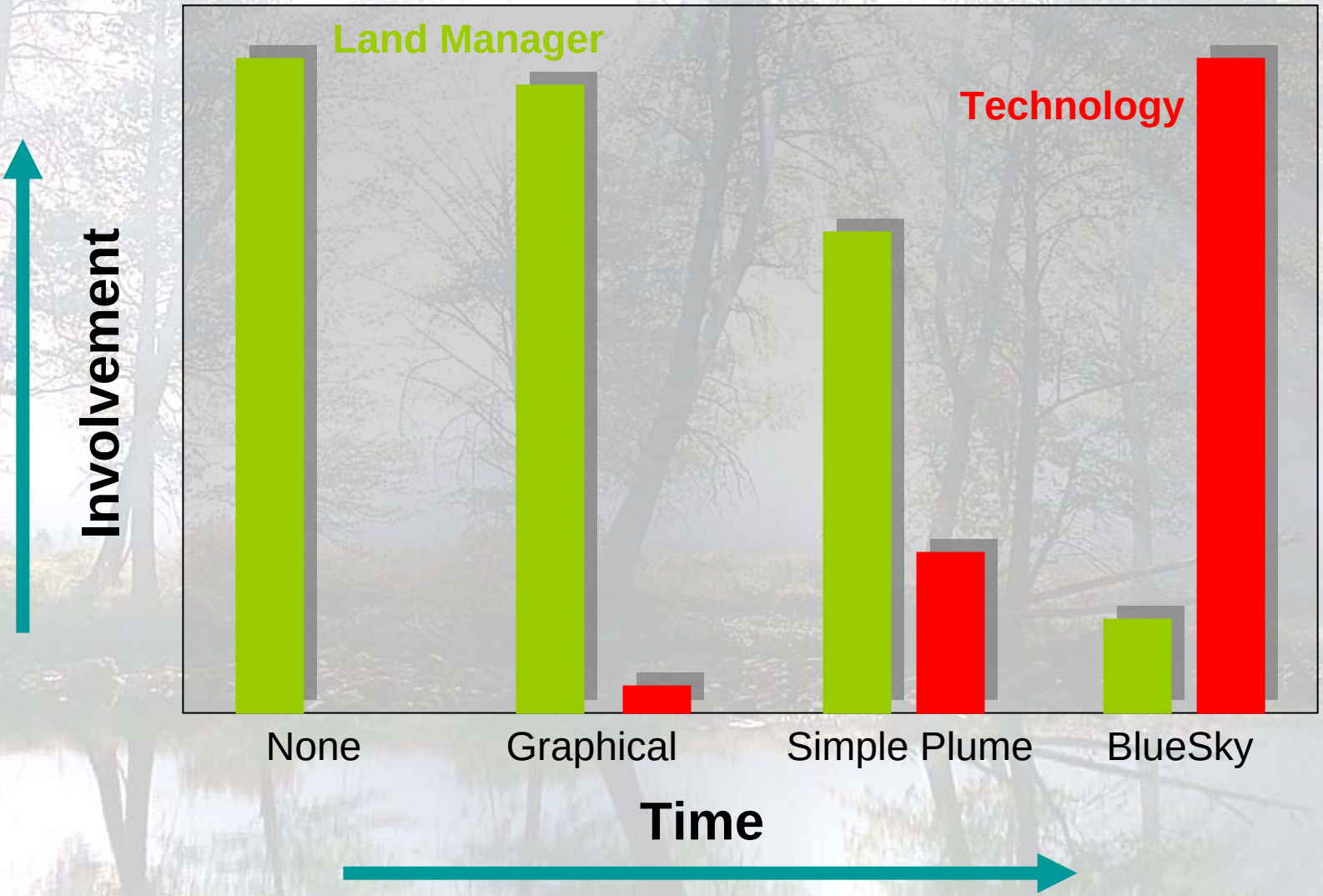
and incomplete

Brief History of Smoke Management

- 2000 – BlueSky links together models for fuel consumption, emissions source strength and dispersion to provide real-time forecasts of smoke from wildland fires.

and incomplete

Brief History of Smoke Management



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Brief History of Smoke Management

- Technology common in the air quality arena has slowly been diffusing into the land management realm

Motivation

- Distinctly different groups interested in wildland fire emissions
  - Different levels of technical knowledge
  - Different purposes for the data
  - Different spatial and temporal scales of interest

Southern Smoke Simulation System

- 4S
- Originally designed as a system similar to BlueSky, but using CMAQ and DaySmoke rather than Calpuff
- Has since evolved to encompass a broader range of space/time scales to better address the needs of a diverse user group

Land Managers

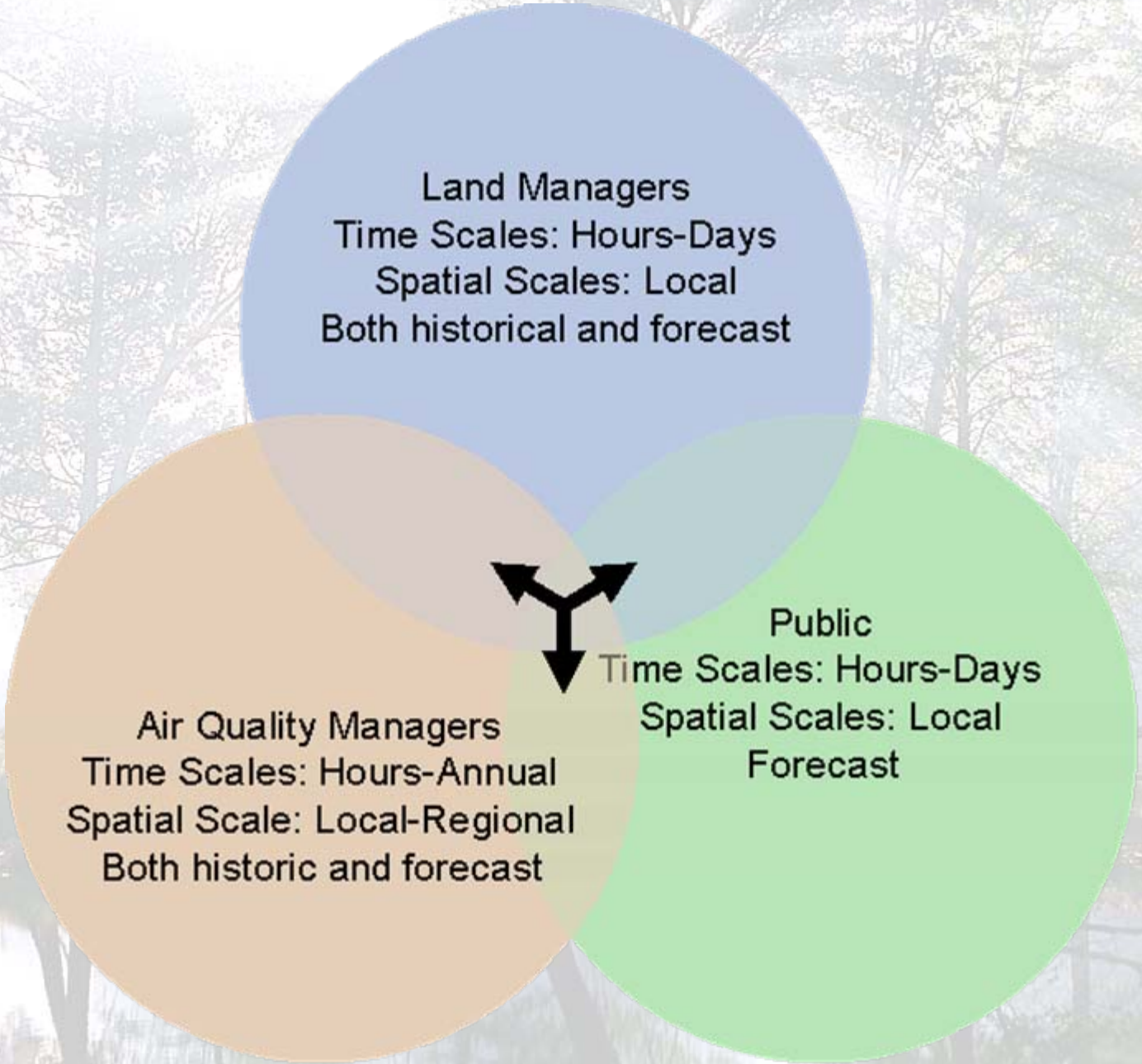
- Assist land managers in both the planning and operational phases of prescribed burning.
  - What weather conditions will help minimize the impact of burning on the local community?
  - Will my fire produce hazardous roadway conditions?
  - How many acres could I burn without causing any problems?
  - I had a smoke problem on my burn today, Why?

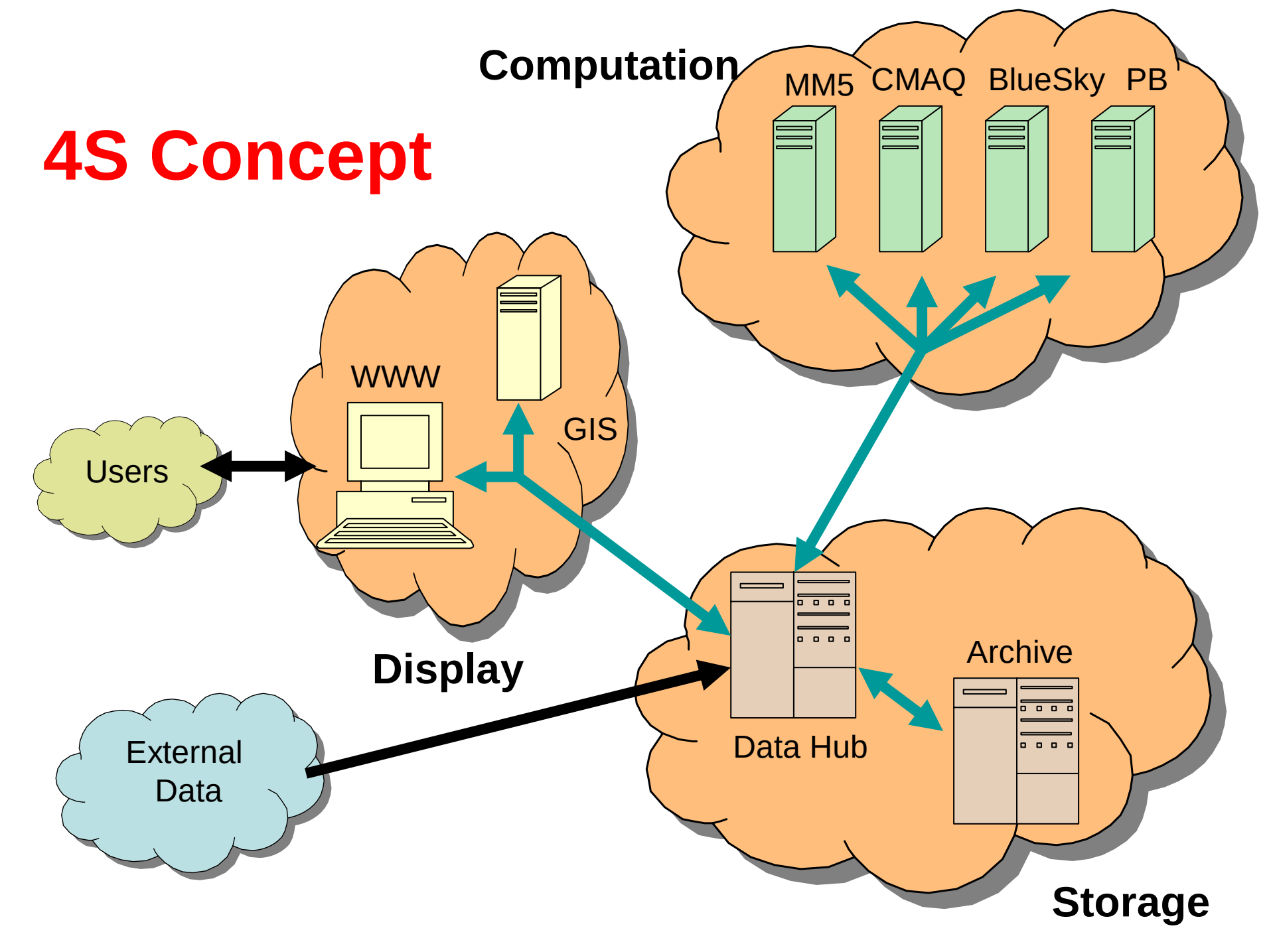
Air Quality Managers

- Assist air resource managers in assessing impact of smoke emissions and the impact of policy on prescribed fire activities.
  - What are the annual emissions from prescribed fires?
  - What would the impact of changing PM2.5 NAAQS be on prescribed burning?
  - This area had a NAAQS violation, what was the contribution of smoke?

Public

- Assist public health and safety officials in monitoring for potentially hazardous conditions due to emissions from wildland fires.
  - Are PM2.5 or ozone levels high enough to impact sensitive populations?
  - Is smoke going to be a major issue on any roadways?


Land Managers
Time Scales: Hours-Days
Spatial Scales: Local
Both historical and forecast
Air Quality Managers
Time Scales: Hours-Annual
Spatial Scale: Local-Regional
Both historic and forecast
Public
Time Scales: Hours-Days
Spatial Scales: Local
Forecast


4S Concept
Computation
MM5
CMAQ
BlueSky
PB
WWW
GIS
Users
Display
External Data
Data Hub
Archive
Storage

4S - Computation

- Computation component is composed of a suite of models
- Model independent output is supplied through OPeNDAP or XML
- Models range from local to regional scale in scope
- Most models run in both real-time forecast mode and historical analysis mode

4S - Display

- Products are data
- User Interface will rely on a collection of web services that can be chained together to produce user customized products
- Standard Services for mapping and graphing will be provided along with geostatistical and time series analysis tools

User questions can be viewed as queries for data subject to user defined constraints

Short Digression

- Google
  - All documents on the Internet comprise a dataset
  - How do we find what we need
    - Stumble blindly
    - Exhaustive search
    - Indexed search

Short Digression

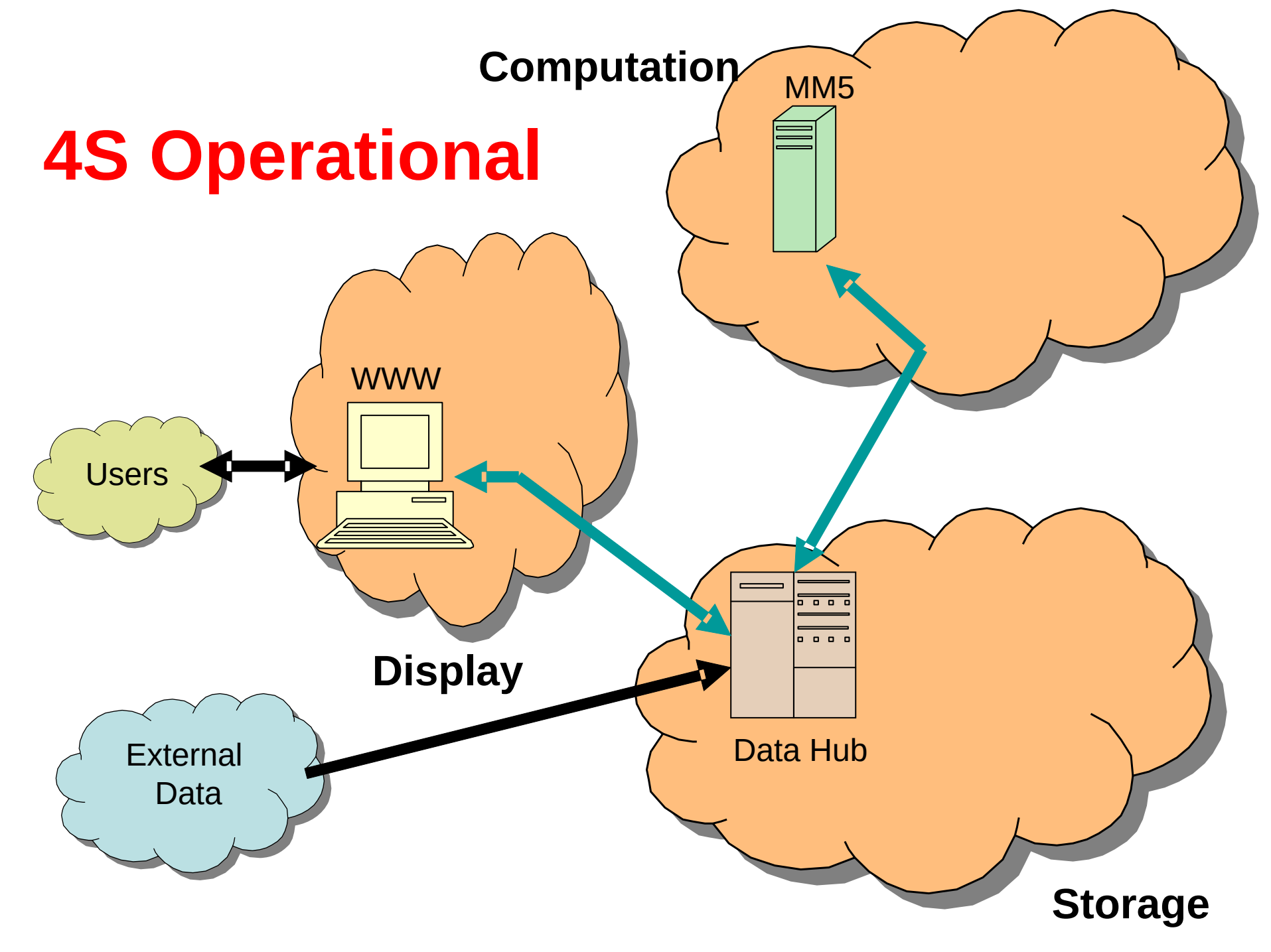
- NEXRAD radar network produces copious amounts of data
- Kruger et al (2006) employed a relational database containing metadata for each NEXRAD image to facilitate finding data that met user needs

4S Structure

- What if metrics were developed for weather, fire activity and emissions data?
- users defined their space and time scale of interest

4S - Storage

- Archive server (OPeNDAP enabled)
- Metadata database – allow indexing of model output and input data to facilitate future queries


Computation
MM5
4S Operational
WWW
Users
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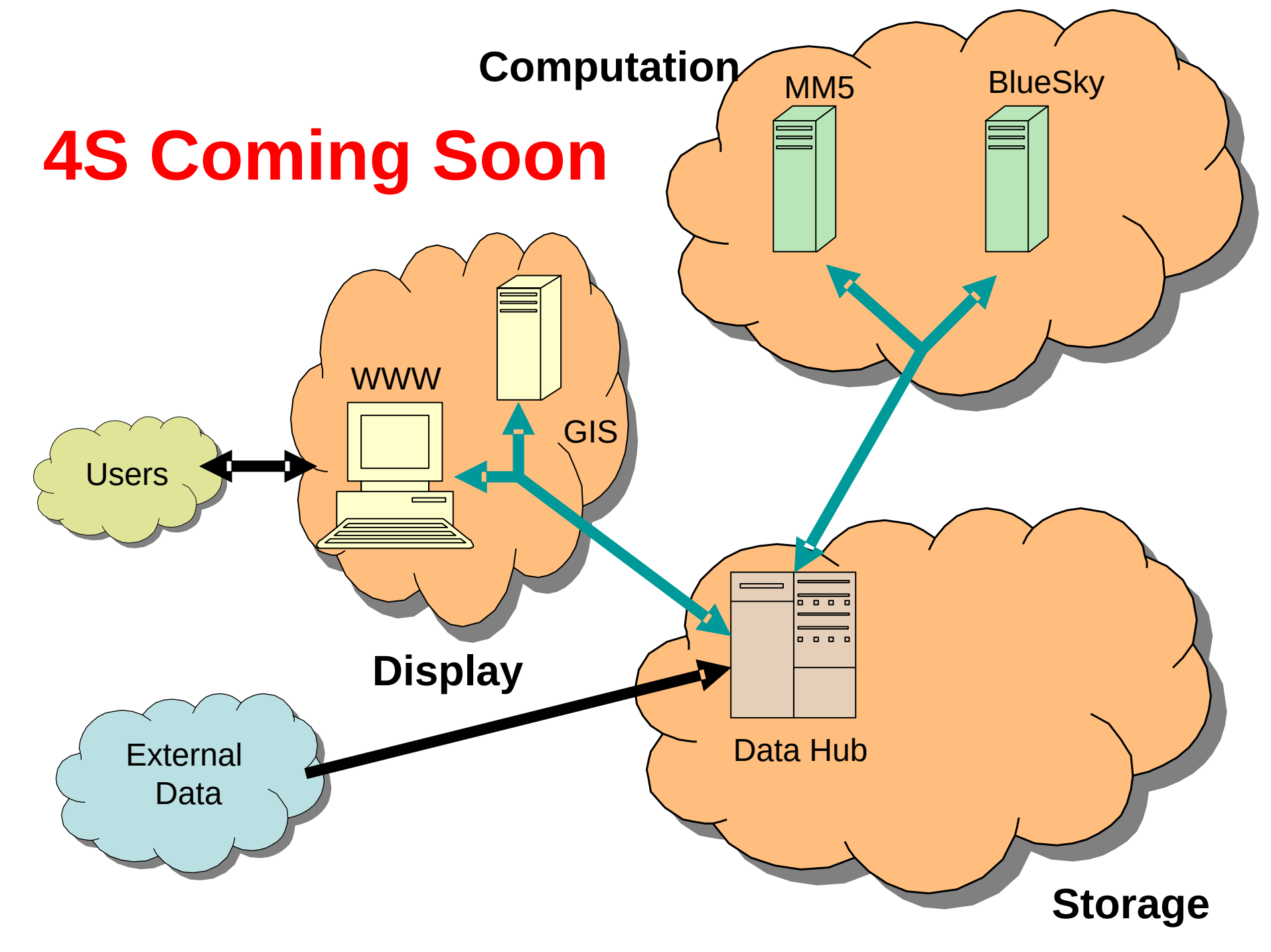
External
Data
Data Hub
Storage


Computation
MM5
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4S Coming Soon
WWW
GIS
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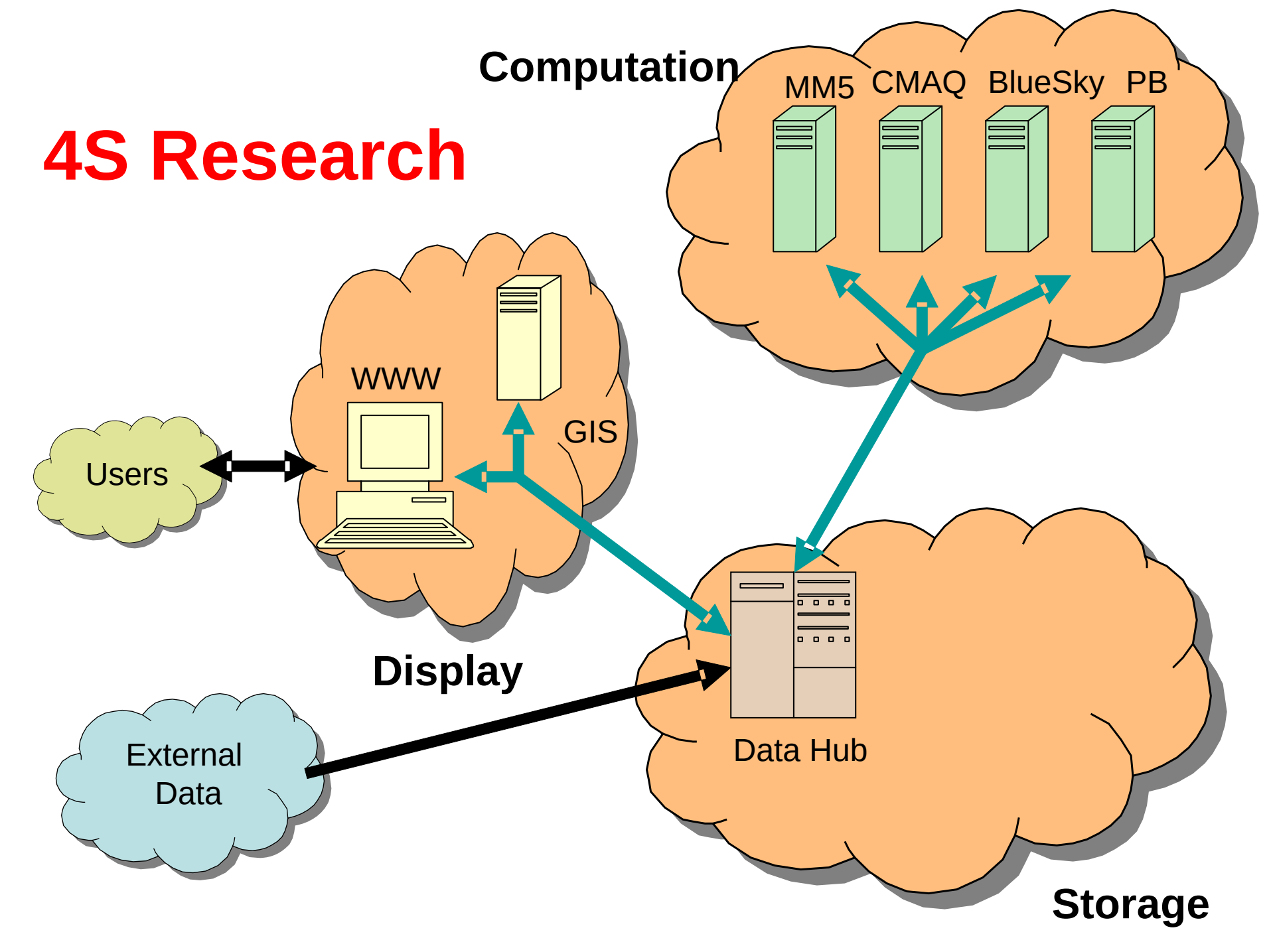
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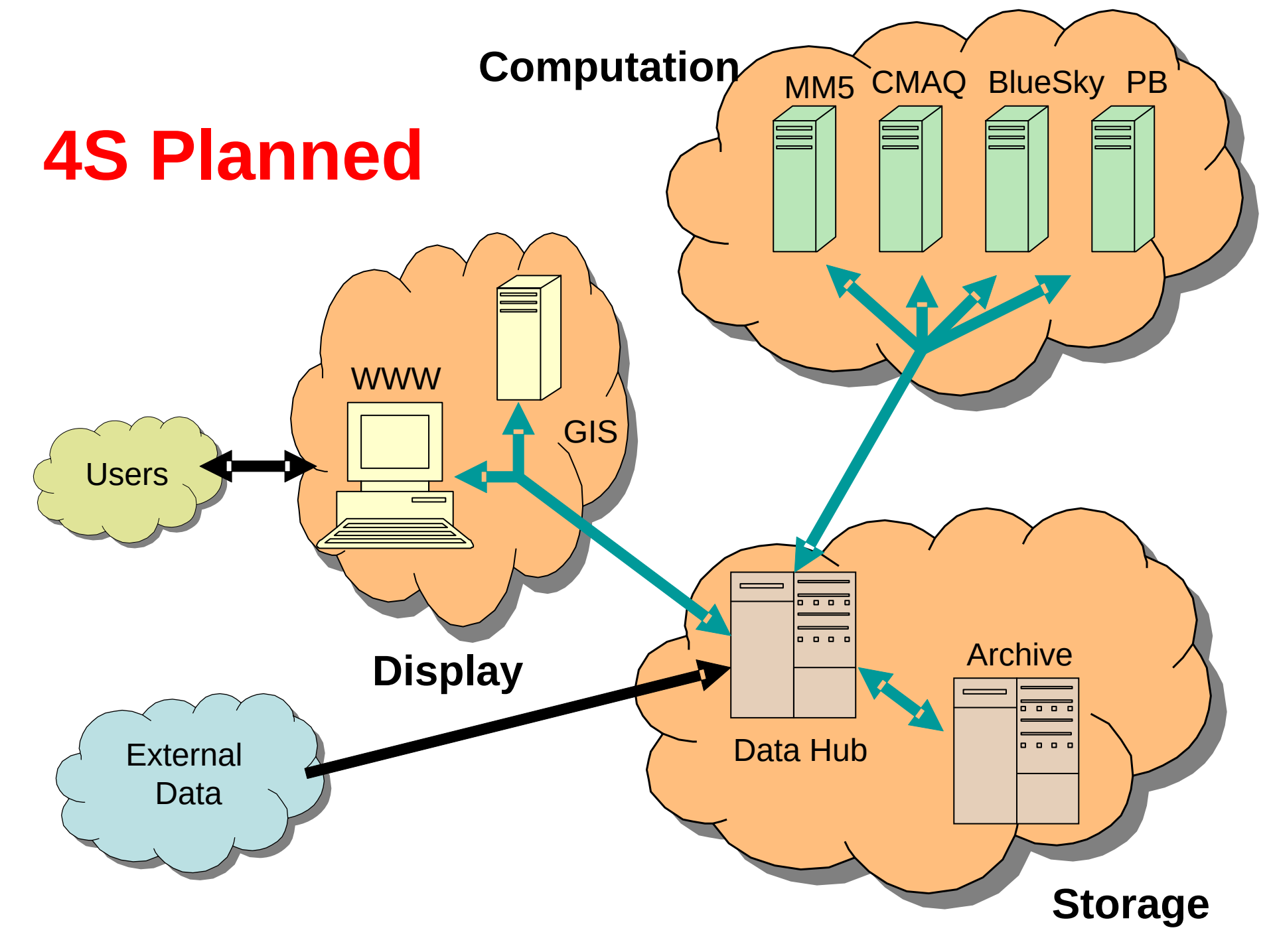
4S Planned
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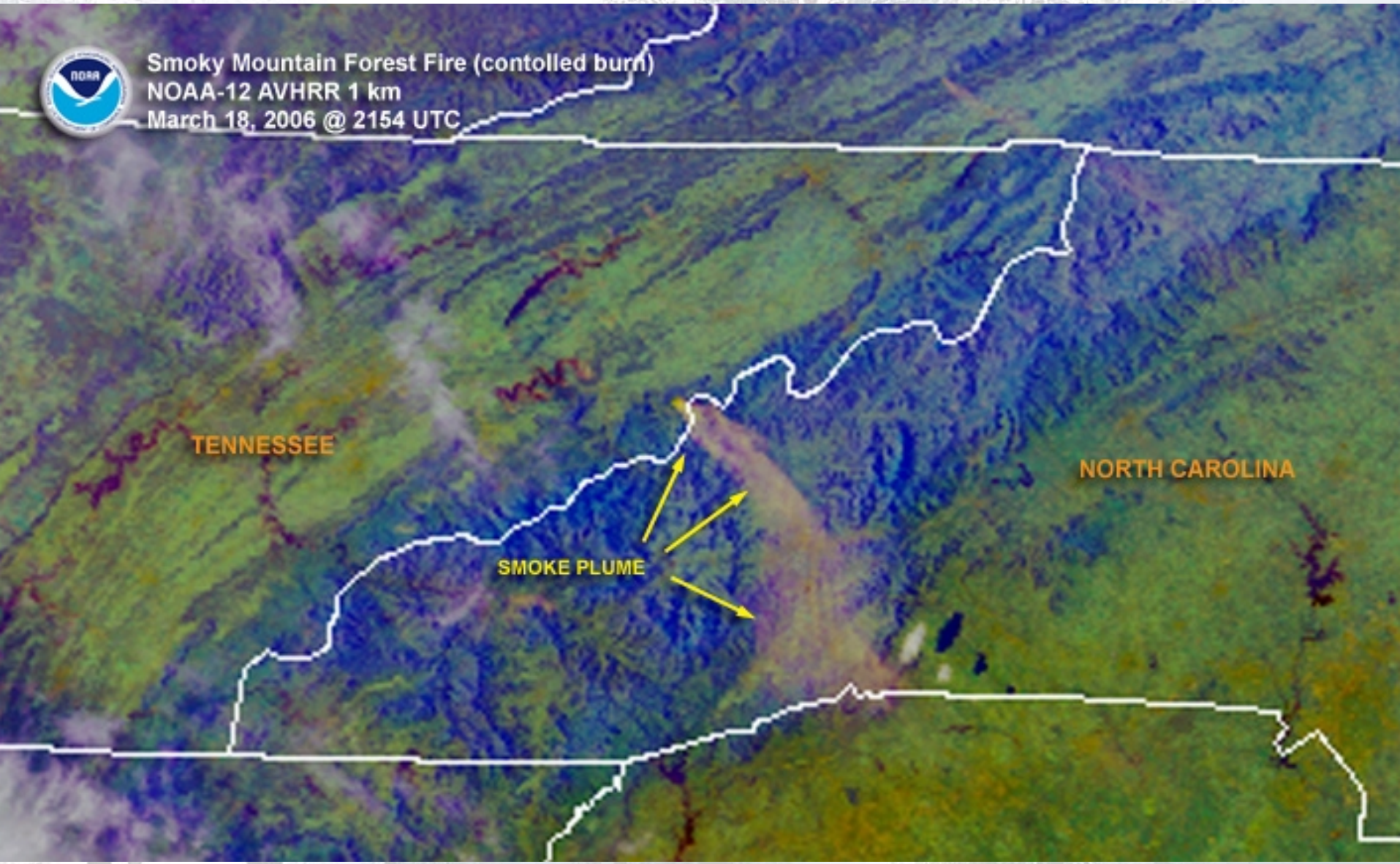
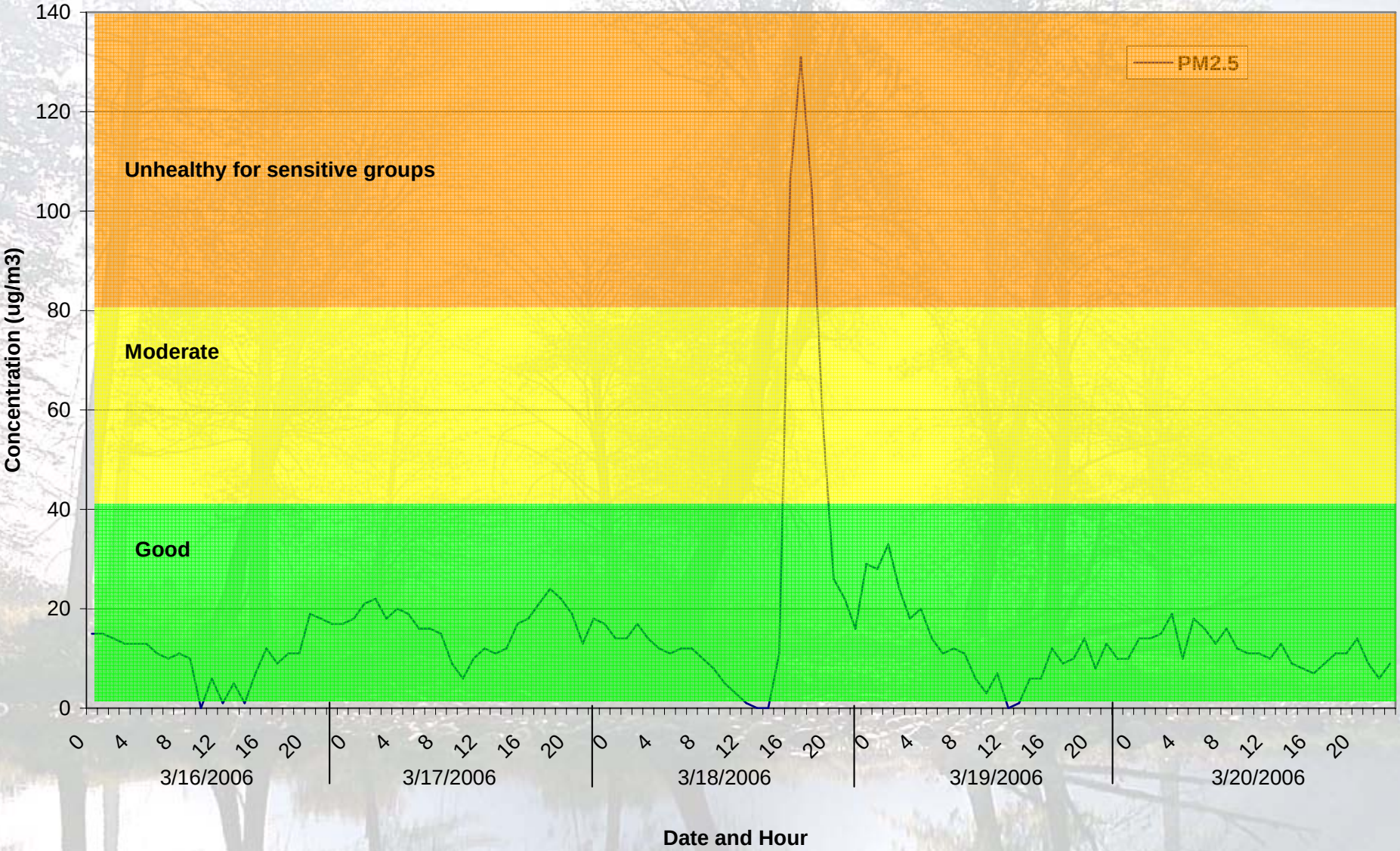
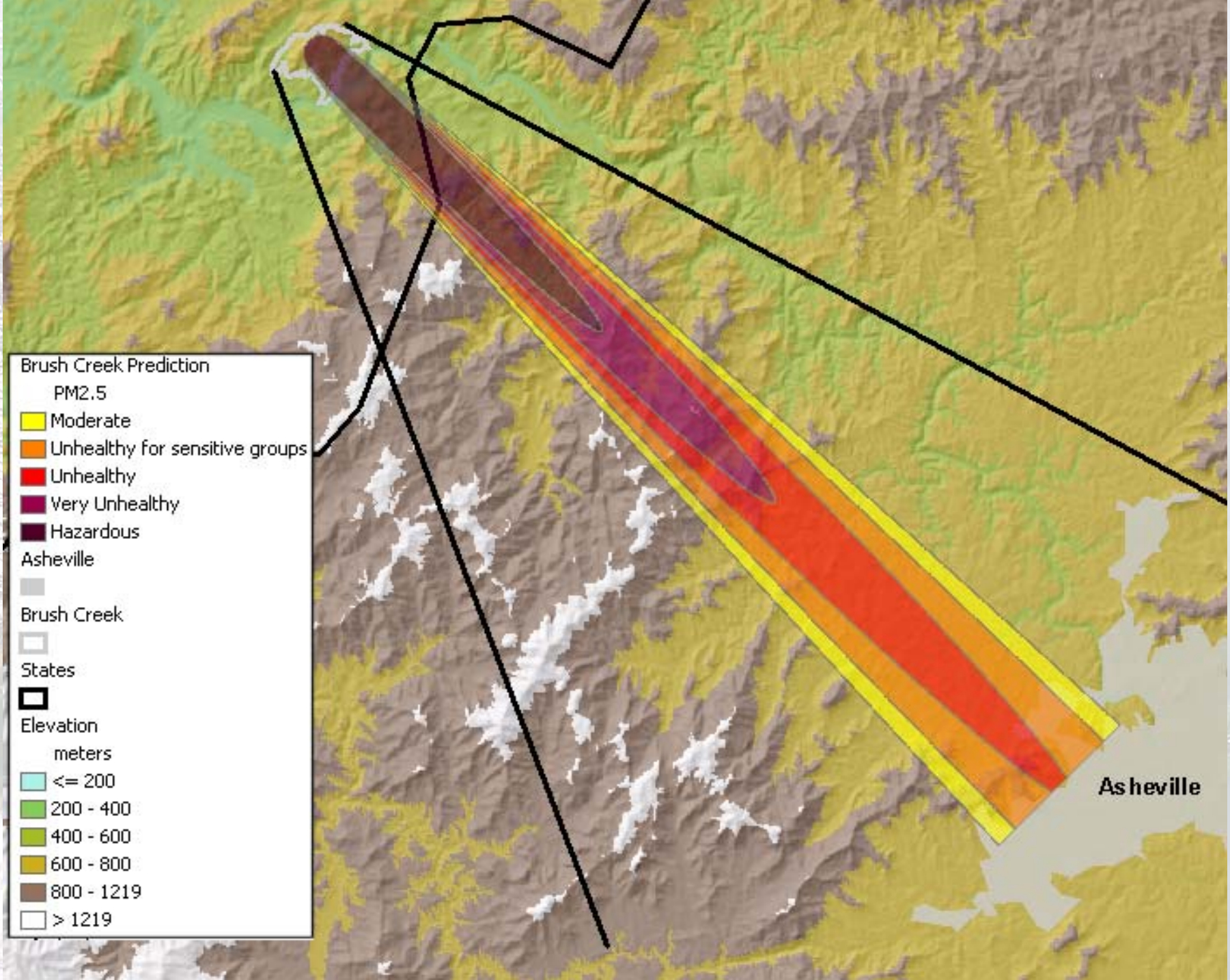
4S - Summary

- Flexible system
- Based on linkable web services
- User generated products
- Query system to allow users to find desired data


Smoky Mountain Forest Fire (contolled burn)
NOAA-12 AVHRR 1 km
March 18, 2006 @ 2154 UTC
TENNESSEE
NORTH CAROLINA
SMOKE PLUME

Asheville, North Carolina PM2.5 Concentrations

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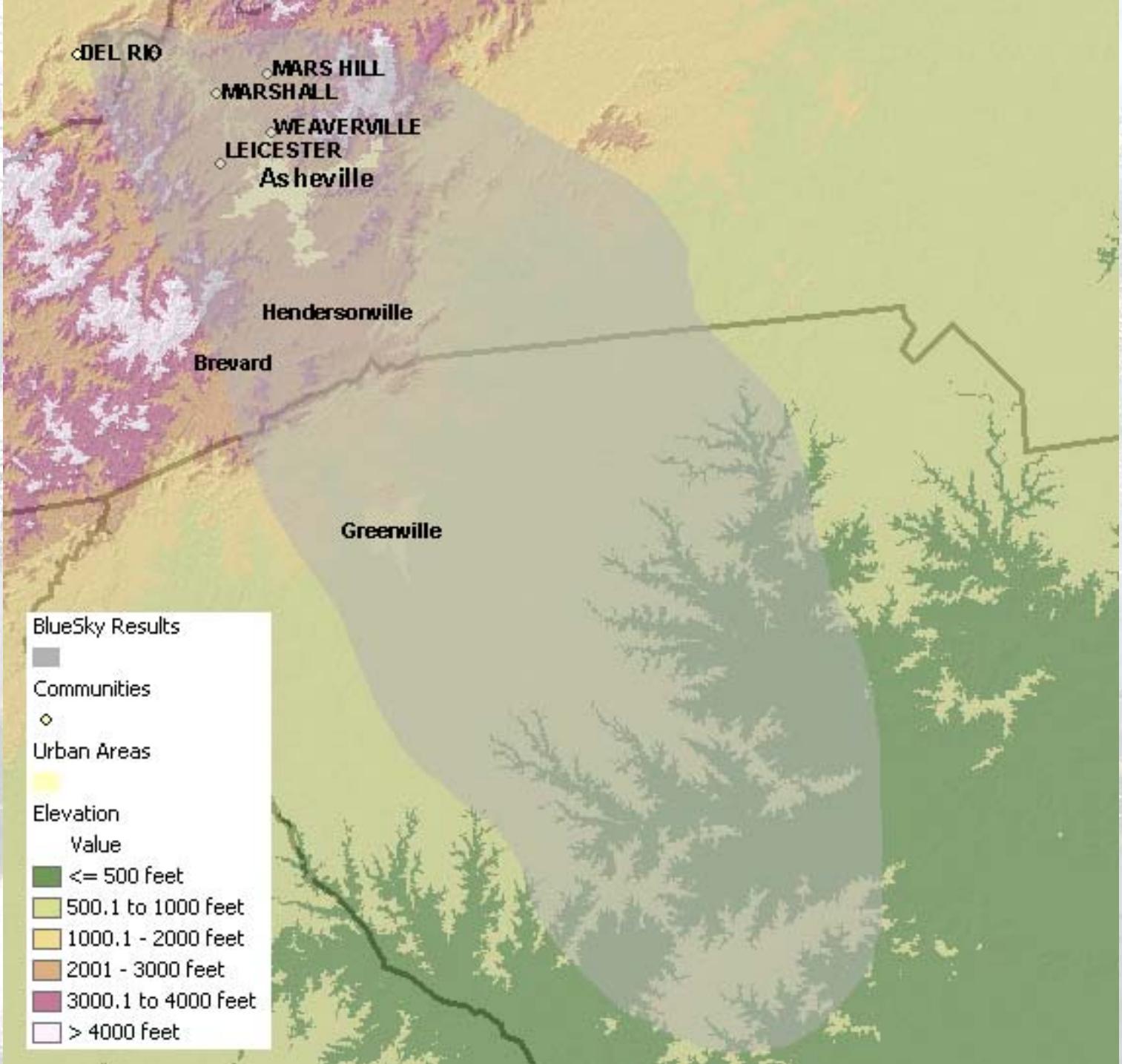
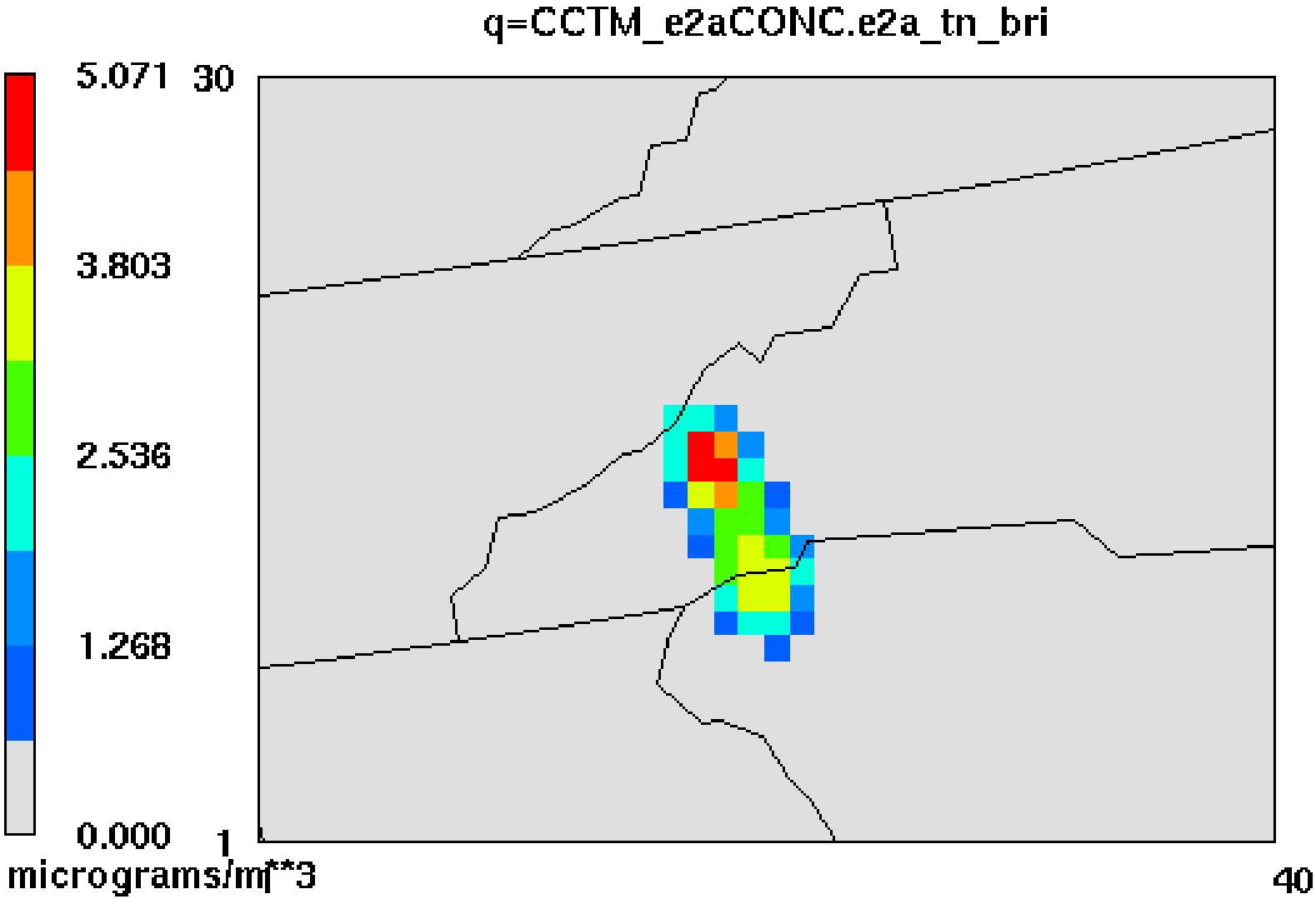
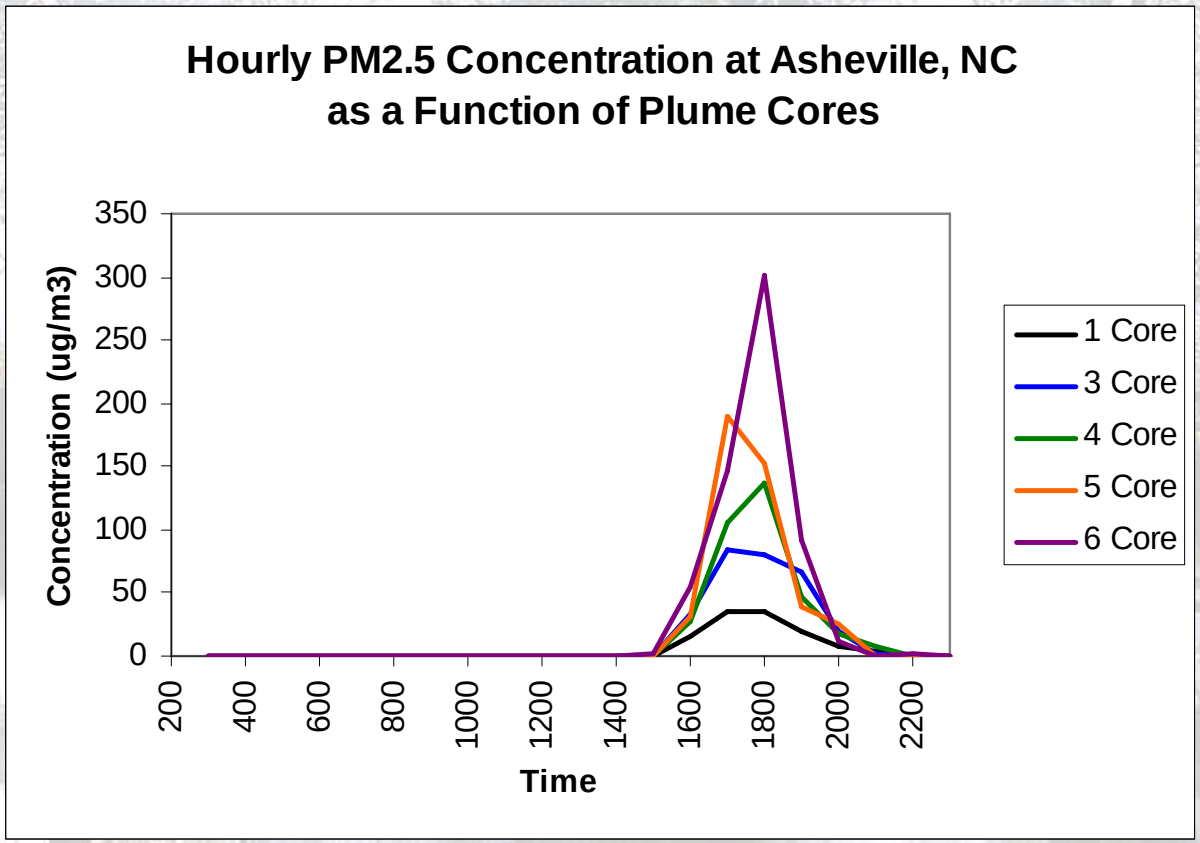

DEL RIO
MARS HILL
MARSHALL
WEAVERVILLE
LEICESTER
Asheville
Hendersonville
Brevard
Greenville
BlueSky Results
Communities
Urban Areas
Elevation
Value
<= 500 feet
500.1 to 1000 feet
1000.1 - 2000 feet
2001 - 3000 feet
3000.1 to 4000 feet
> 4000 feet

Layer 1 A25Jq




Hourly PM2.5 Concentration at Asheville, NC
as a Function of Plume Cores
Concentration (ug/m3)
350
300
250
200
150
100
50
0
200
400
600
800
1000
1200
1400
1600
1800
2000
2200
Time
1 Core
3 Core
4 Core
5 Core
6 Core