The Net Effects of Vegetation on Air Quality

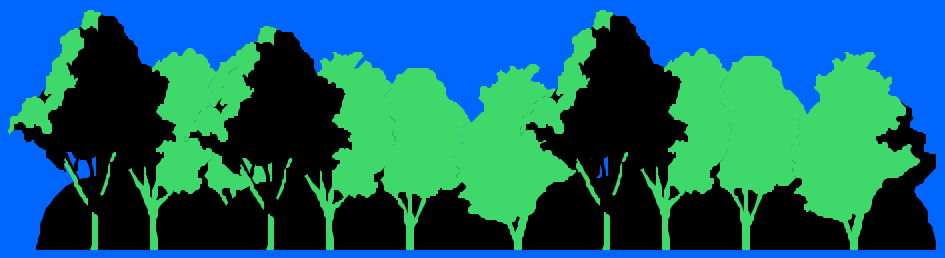
June 28, 2001

California Environmental Protection Agency

Air Resources Board

Vegetation and Air Quality

- How do plants affect air quality?
- What are we doing?
- What information do we need?
- What can individuals do?



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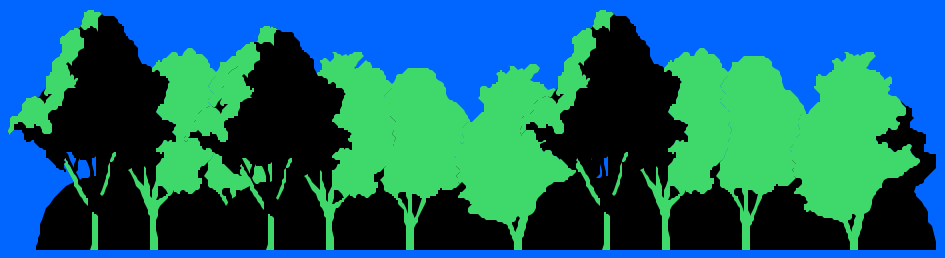
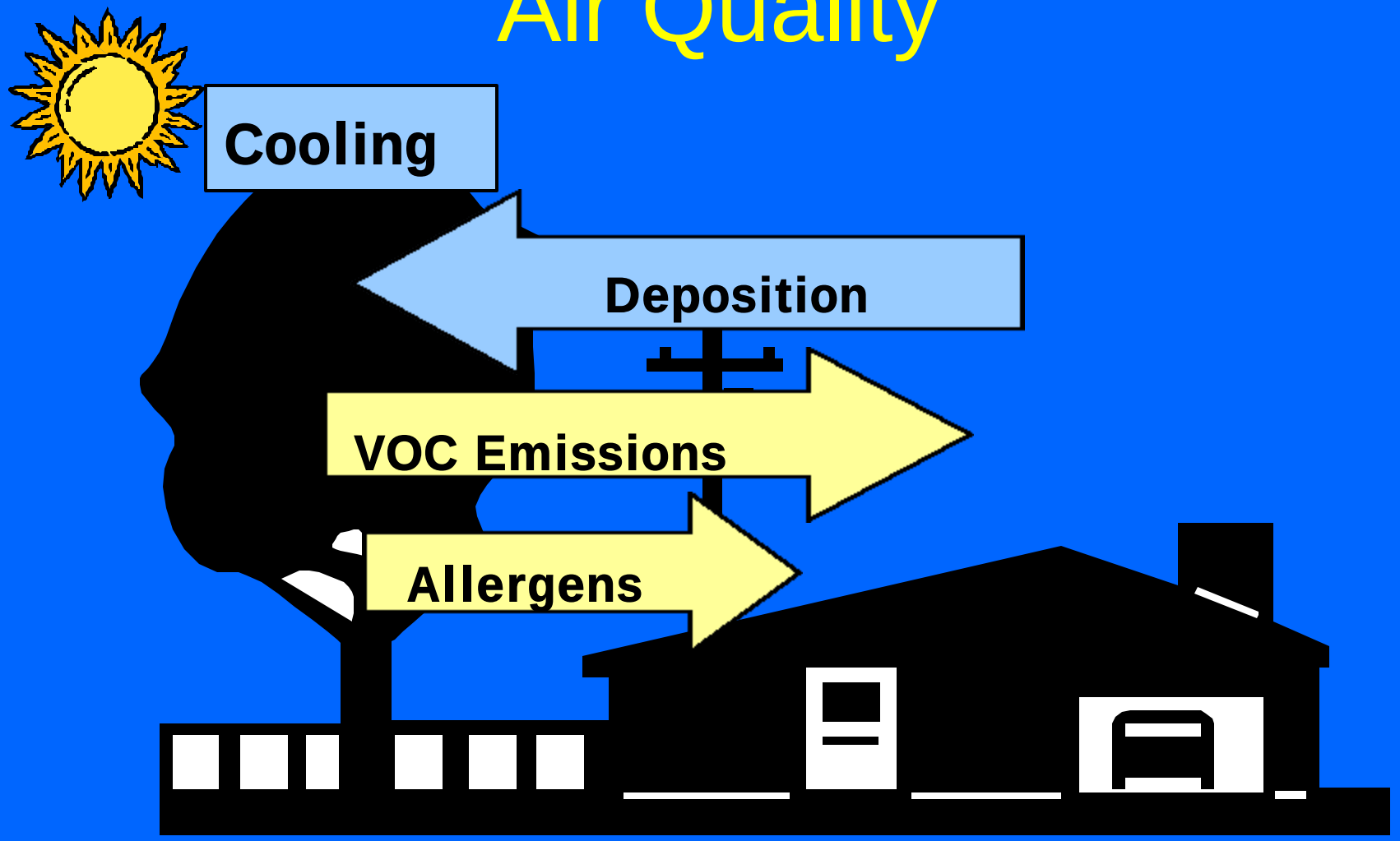
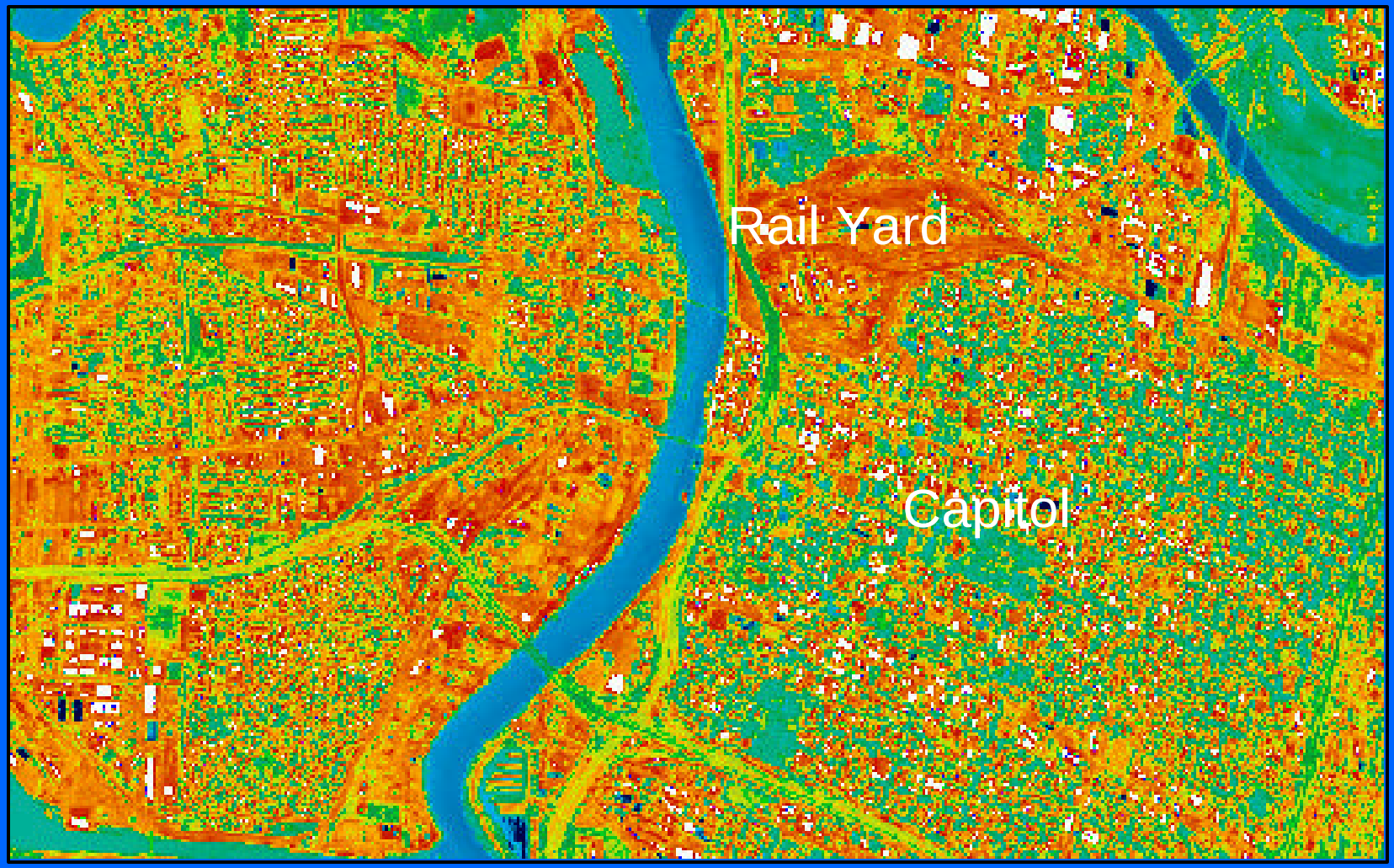


Effects of Vegetation on Air Quality



Sacramento Temperatures

June 29, 1998, 1 p.m.



Source: NASA/Marshall Space Flight Center and Global Hydrology and Climate Center

Cooling Improves Air Quality

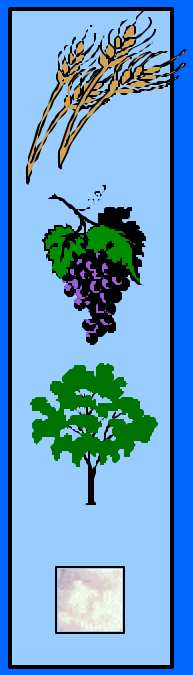
- Reduces evaporative emissions
- Reduces power generation emissions
- Slows photochemical reactions

Plants Remove Some Pollutants

- Atmospheric mixing controls removal of highly reactive gases
- PM size, meteorological variables, shapes of surfaces
- Plants increase removal of O_3 and NO_2
  - Leaf area, open stomata

Ozone Deposition

(approximate pounds per acre per day in July)



Dry rangeland	~0.01 - 0.04
Vineyard	~0.1 - 0.4
Orchard	~0.1 - 0.6
Cotton	~0.2 - 0.6

BVOC Emissions

(approximate pounds (isoprene + monoterpenes) per acre per day in July)

Avocado ~0.0

Vineyard ~0.0001

Cotton or Orange ~0.02

Valley Oak ~0.09

Pine or Lemon ~0.2

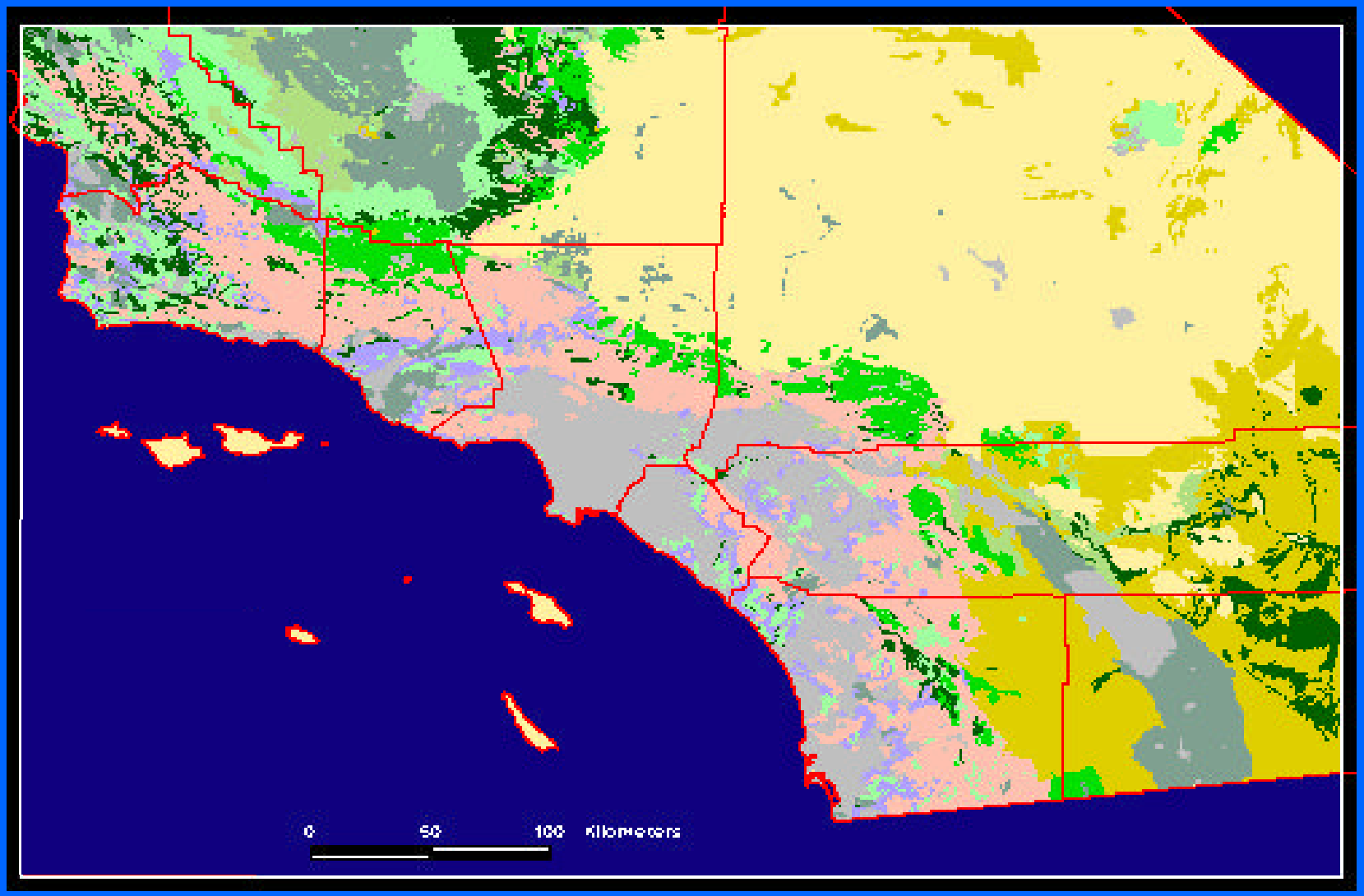
Tomato ~0.7

Coast Live Oak ~1.3

Challenges to Estimating BVOC Emissions

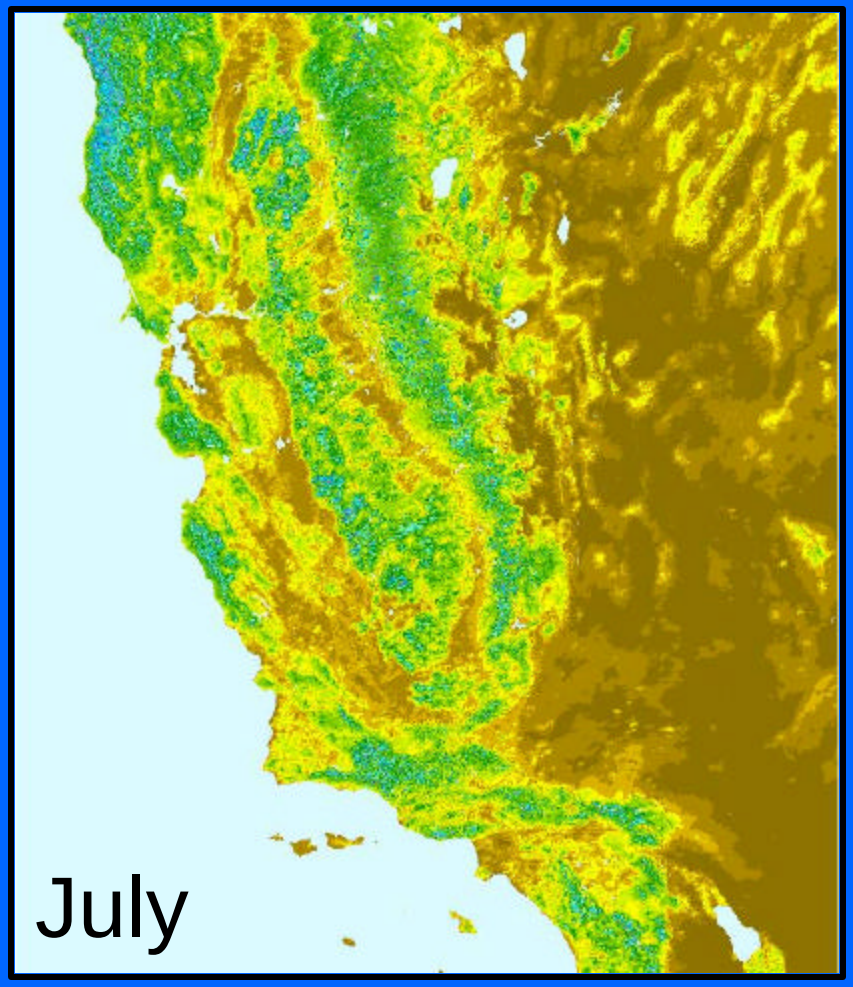
- Emission rates vary by 10,000 times
- Estimating emissions for 6,000 species
- Leafy biomass
- Species maps to locate high emitters

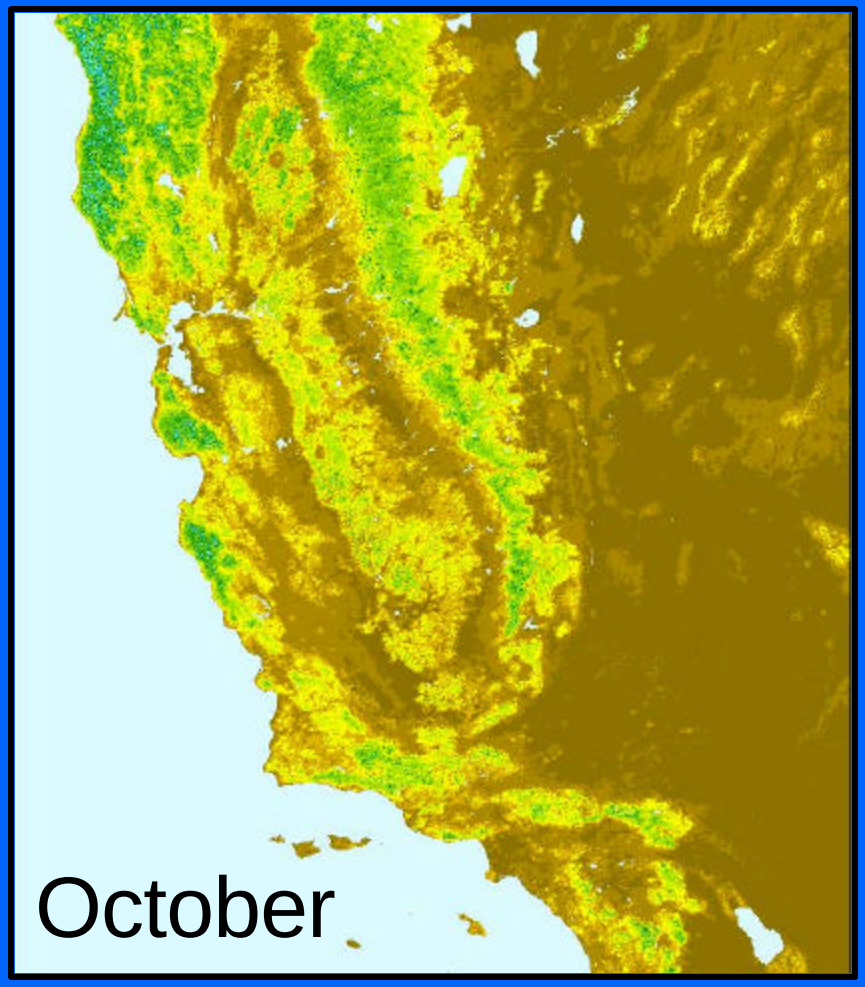
Vegetation Classes



Source: GAP Database

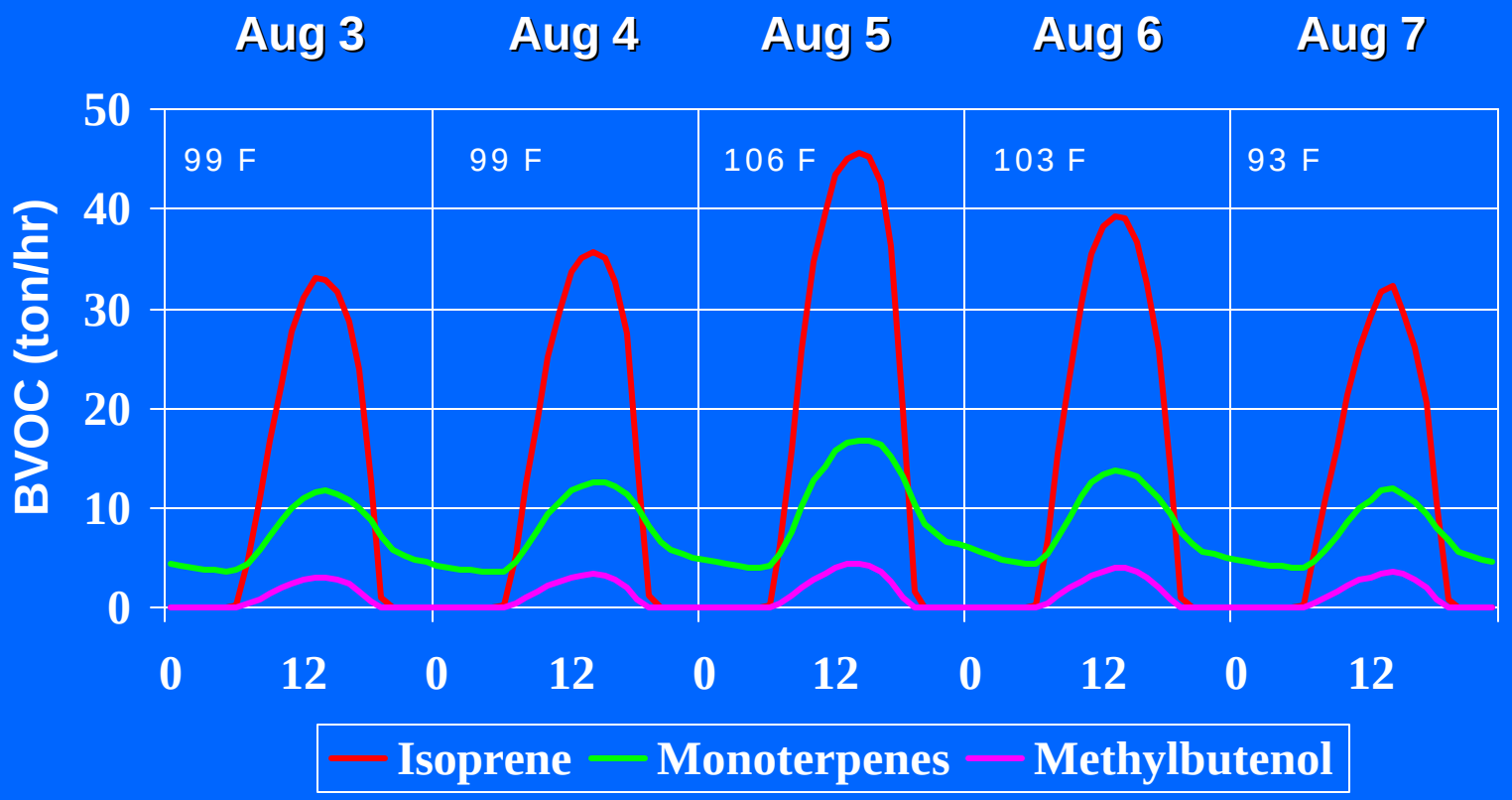
Leaf Area in California





Hourly Emissions

August 3-7, 1997

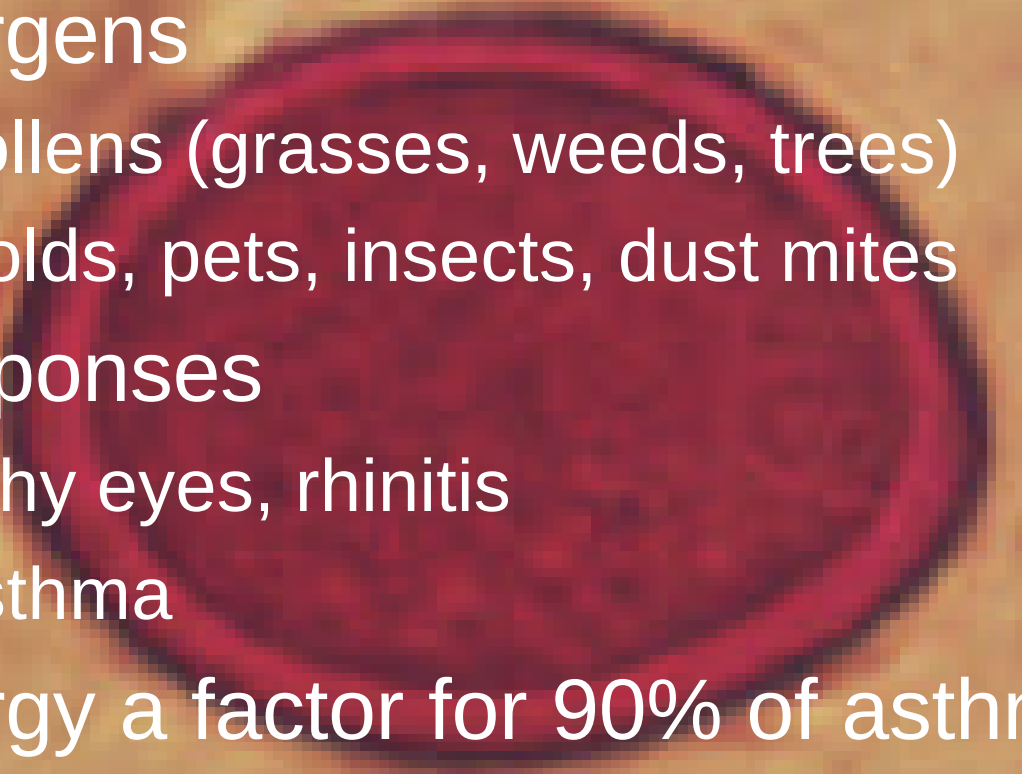


Emissions: Greater Southern California (SCOS97 - NARSTO Domain)

Maximum daily temperature: Azusa

Allergens and Their Effects

- Allergens
  - Pollens (grasses, weeds, trees)
  - Molds, pets, insects, dust mites
- Responses
  - Itchy eyes, rhinitis
  - Asthma
- Allergy a factor for 90% of asthmatics



Elm Pollen

Key Question:

Can we accurately predict the effects of trees and vegetation on air quality?

Net Effects on Air Quality

- Effects depend on species, placement
- BVOCs important part of inventory
- Low emitters can reduce ozone
- High emitters can increase ozone

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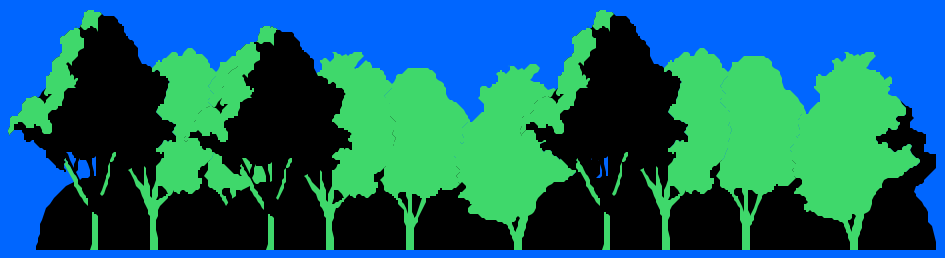

Current Efforts

- Cooling and air quality - LBNL
- Deposition study collaboration
- Active biogenic research program
- Biogenic Working Group
- Allergen/pollutant interactions
- Outreach

Outreach Organizations

- Sacramento Tree Foundation
- TreePeople
- Municipal Utility Districts
- California ReLeaf
- California Urban Forests Council

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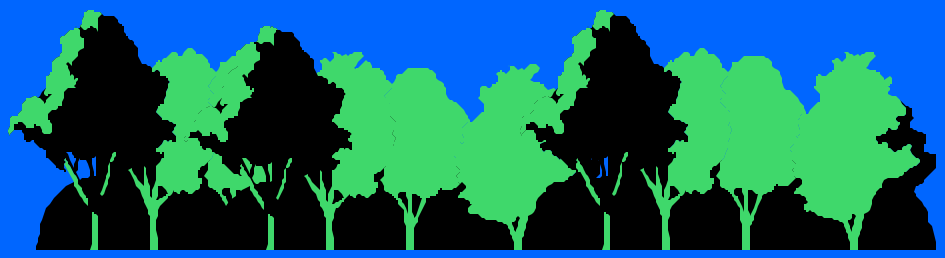

Information Gaps

- Improve plant species inventory
- Measure biogenic emissions
- Improve deposition models
- Model effects of local cooling

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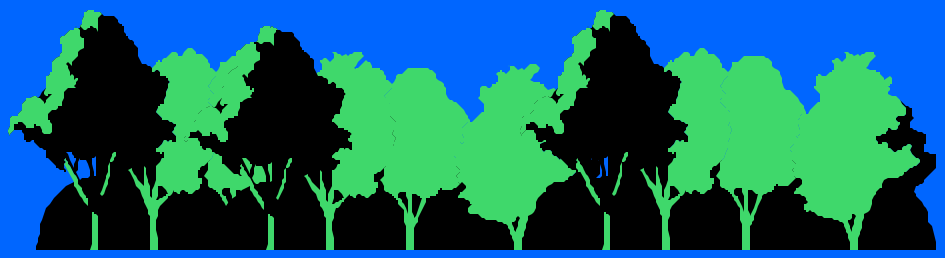
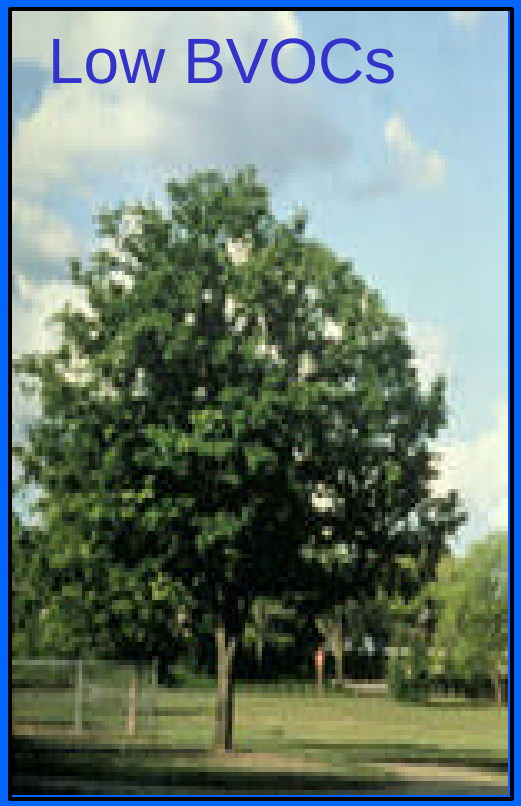


Tree Planting Guidelines

- Place trees for lower energy use
  - First plant areas with low coverage
  - Deciduous trees shade south, west sides
  - Close to buildings
  - Large trees
  - Do not block summer breezes
  - Conifers for winter wind protection
- Choose low emitters of BVOCs
- Avoid species that release allergens

Desirable and Undesirable Trees for Air Quality



Saw leaf Zelkova

Liquid amber

http://selectree.cagr.calpoly.edu/

Other Benefits of Vegetation

- Energy use
- Comfort
- Watershed health
- Neighborhood benefits

Conclusions

- Cooling lowers emissions
- Cooling slows chemical reactions
- Plants remove some pollutants
- Plants emit precursor pollutants
- Low-emitting plants have many benefits

Thank You