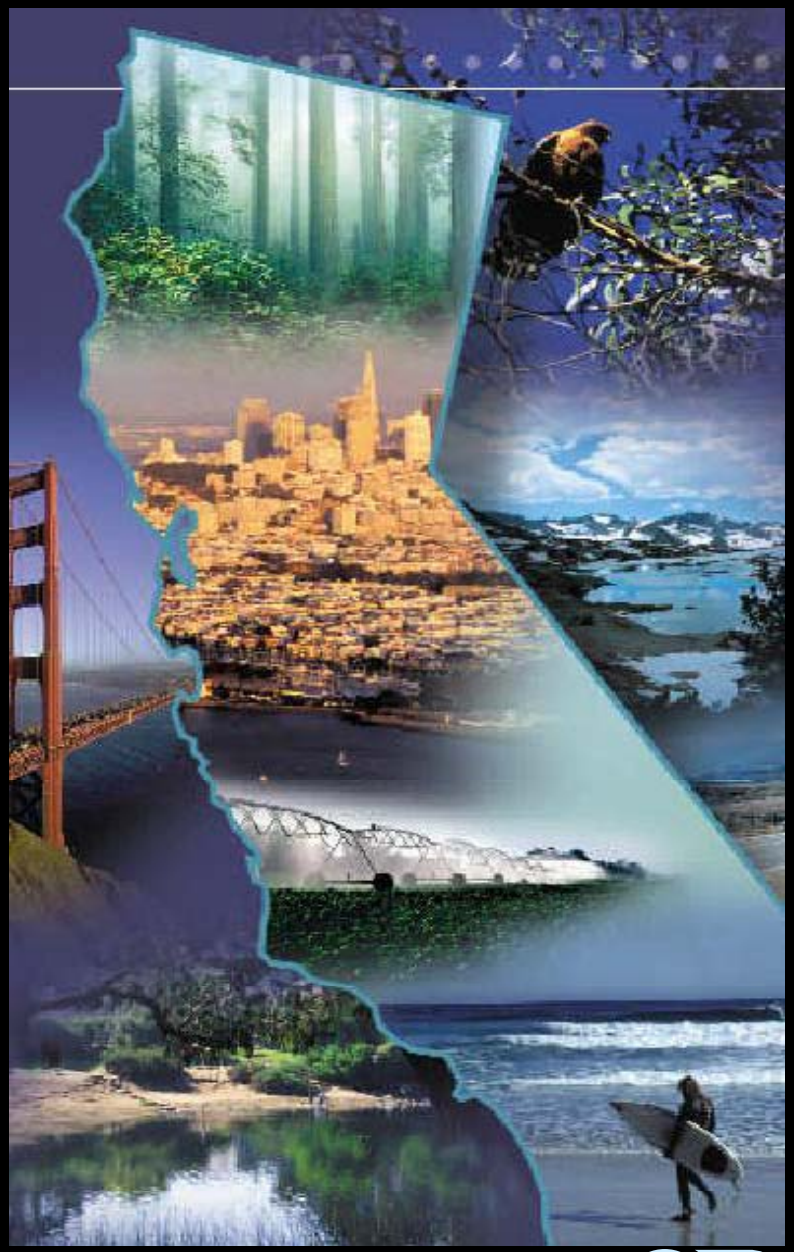


Climate Change Impacts on Air Quality in California

Nehzat Motallebi, Ph.D.
Research Division
October 12, 2010

California Air Resources Board

California Environmental Protection Agency

California Climate Impacts
over the past 100 years

1.3ºF (0.7°C) higher temperatures

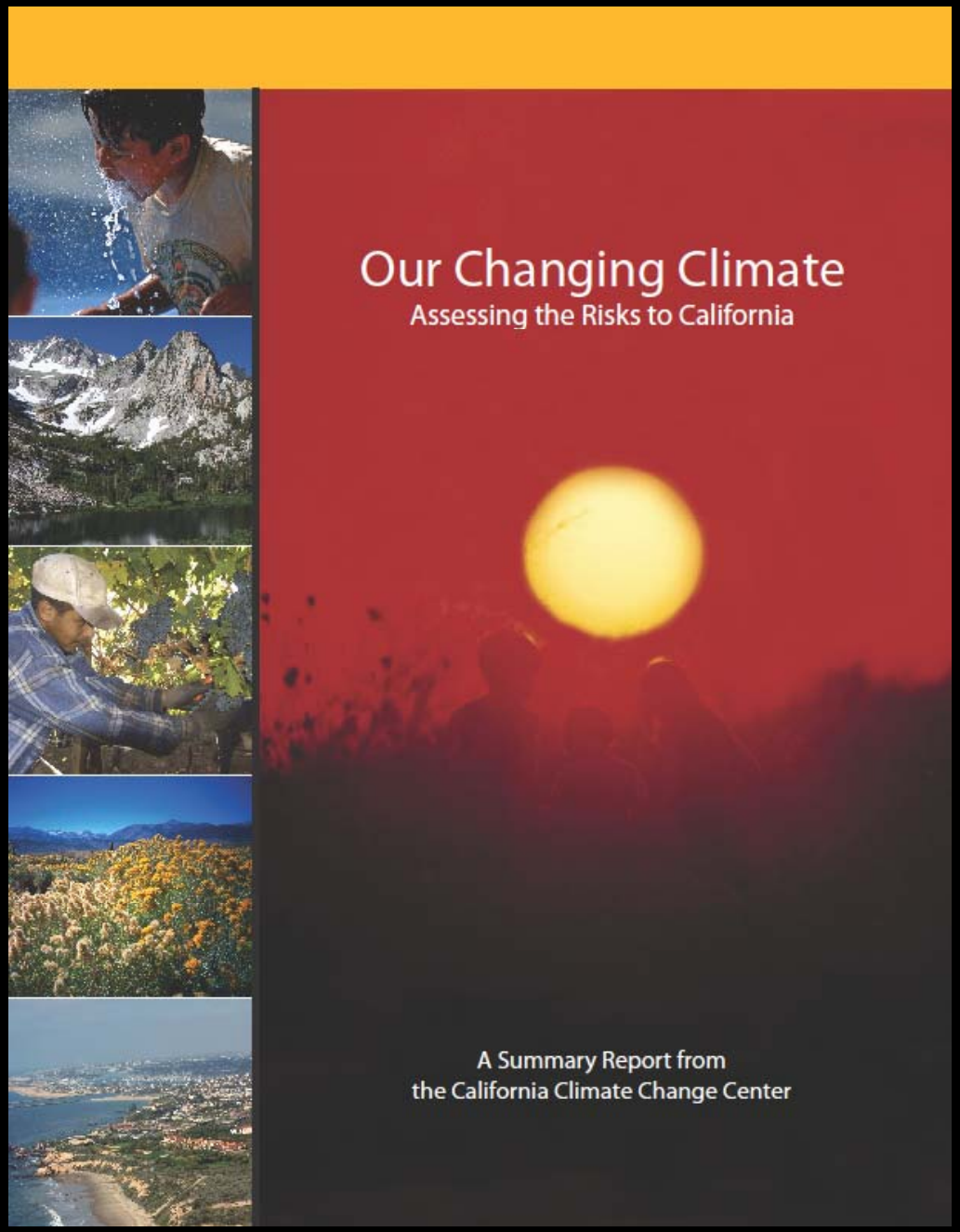
7 inch sea level rise

12% decrease in fraction of runoff between April and July

snowmelt and spring blooms advanced 2 days/decade since 1955

4-fold increase in wildfire frequency (over 34 years)

Cal/EPA-OEHHA, "Environmental Protection Indicators for California" (2002), *www.oehha.ca.gov/multimedia/epic/Epicreport.html*
Westerling et al., "Warming and Earlier Spring Increase Western U.S. Forest Wildfire Activity", *Science* (2006)



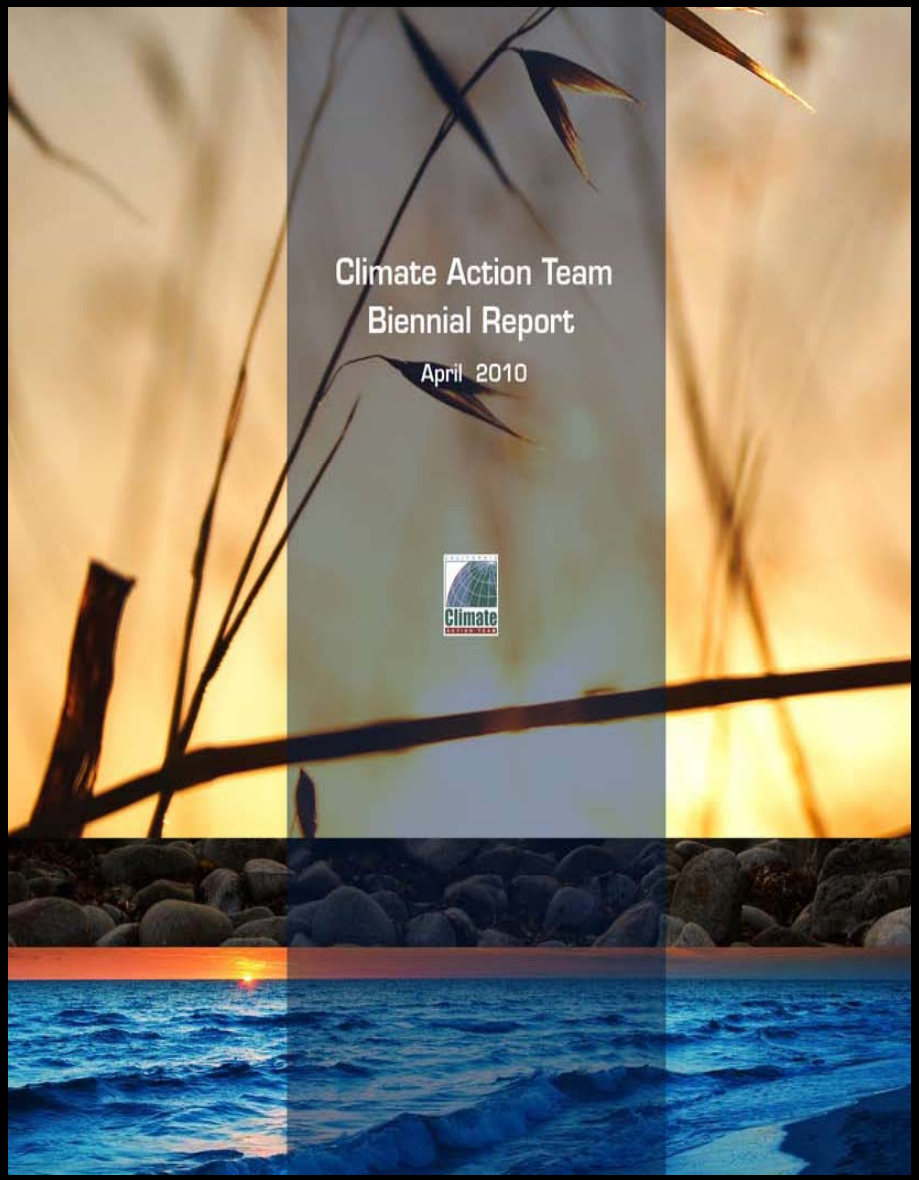
California Climate Change Scenarios Assessment

By Governor Executive Order (2005)

Commissioned this peer-reviewed study (released in March 2006) of potential climate change impacts, and

Provided key scientific input to California's landmark greenhouse gas reduction legislation, AB 32

www.climatechange.ca.gov



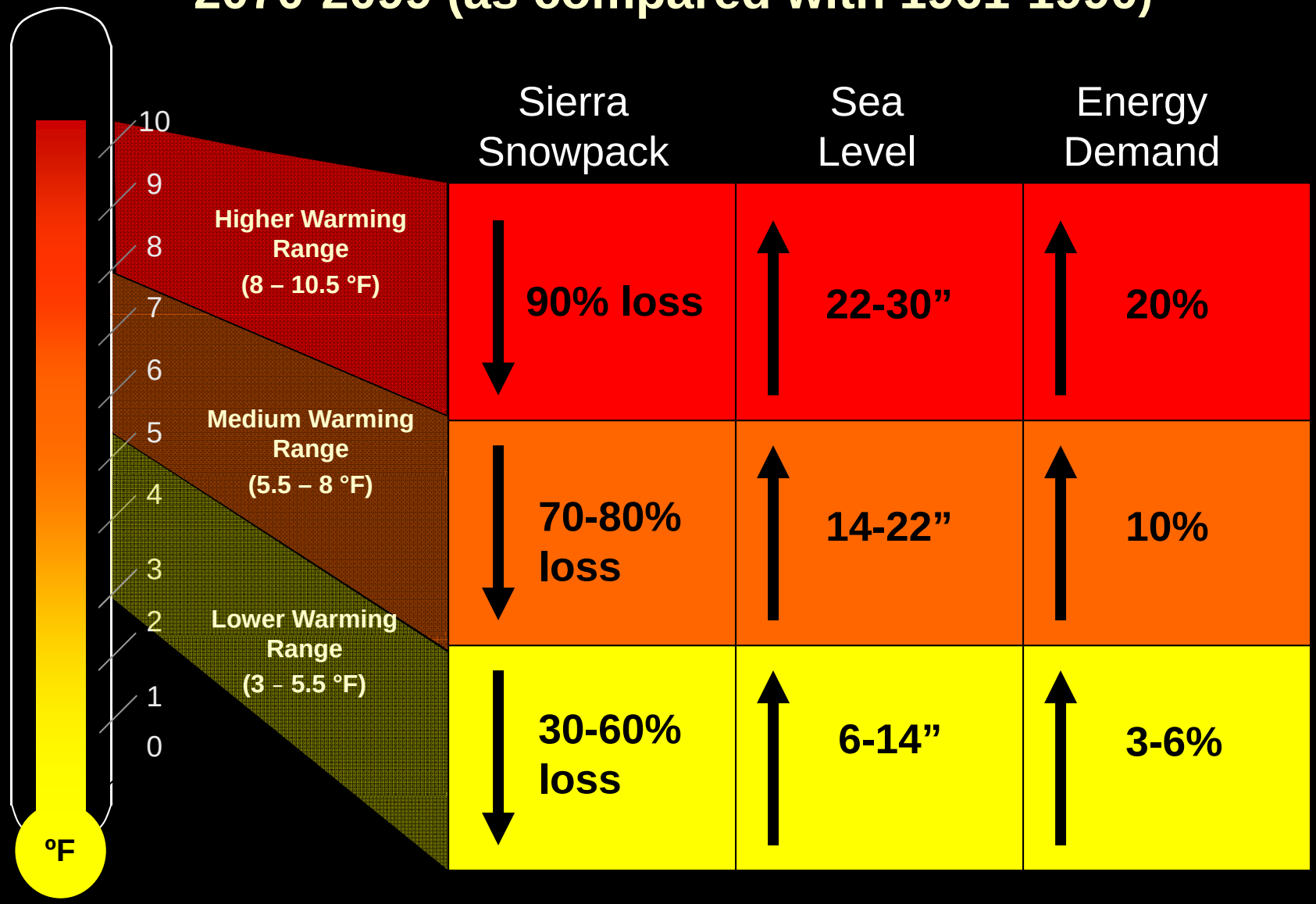
2009 Climate Action Team Scenarios Assessment

Builds on 2006 study to:

- Improve assessment of climate change impacts
- Translate impacts into costs
- Develop adaptation strategies

Source: http://www.climatechange.ca.gov/publications/cat/index.html

Projected Climate Impacts on California, 2070-2099 (as compared with 1961-1990)



Our Changing Climate: Assessing the Risks to California (2006), *www.climatechange.ca.gov*

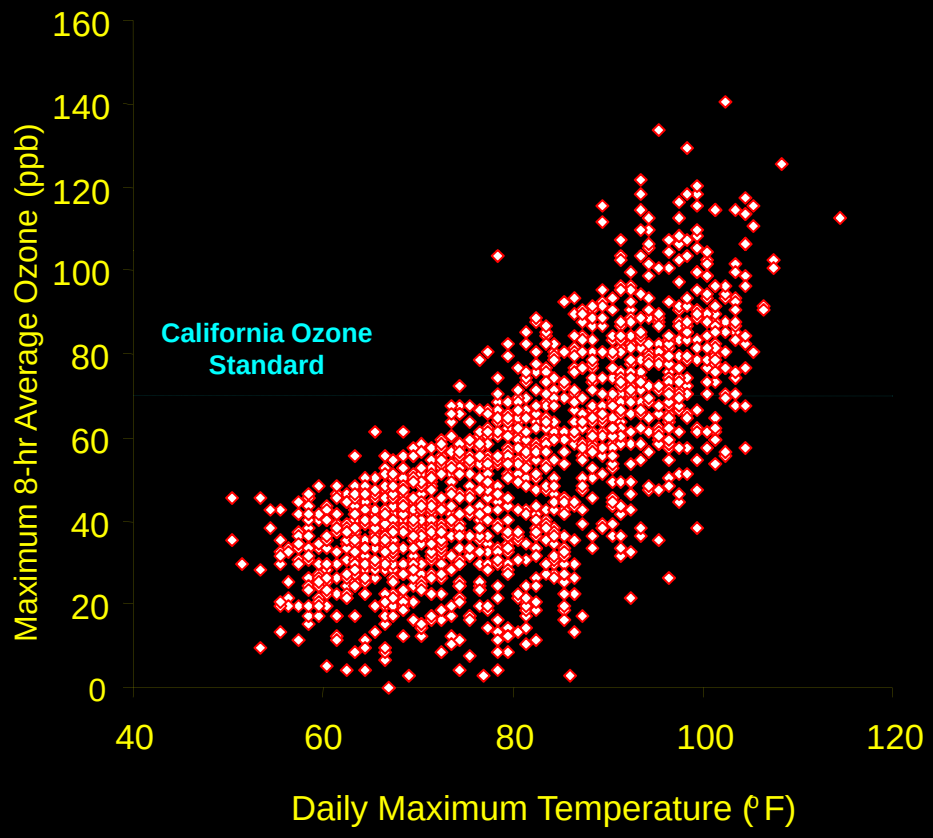
Public Health Concerns

Air Quality

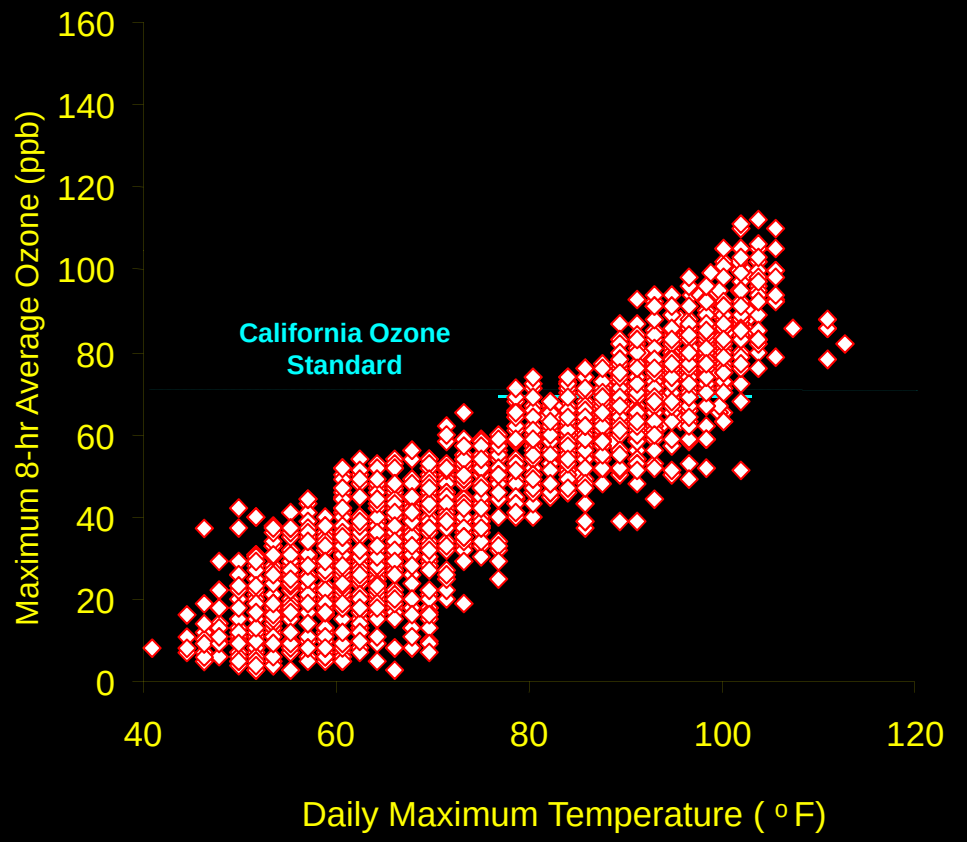
Heat Extremes

Wild Fire Smoke

Hotter Days Lead to Higher Emissions and More Smog



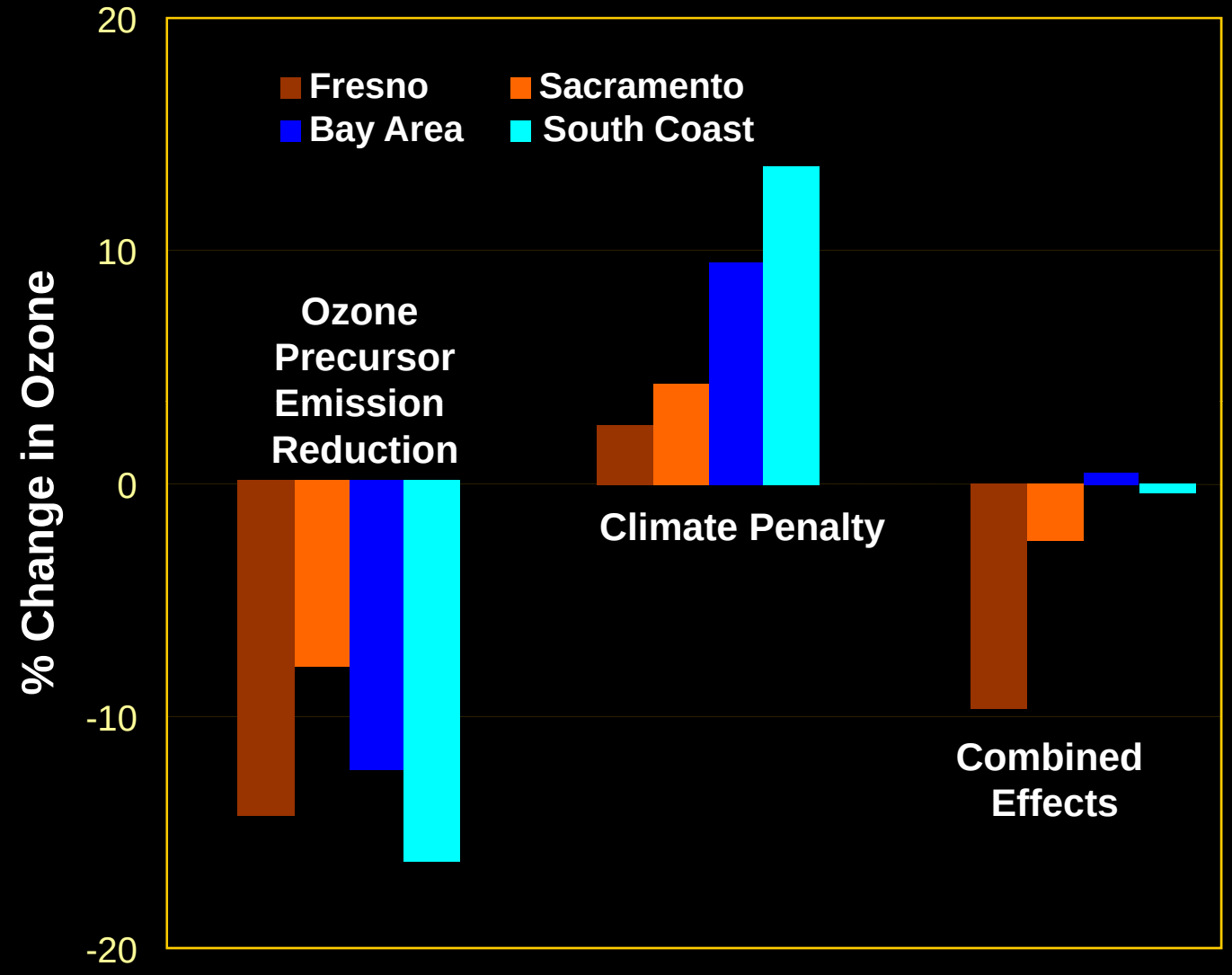
Riverside, 2003-2006



Fresno, 2003-2006

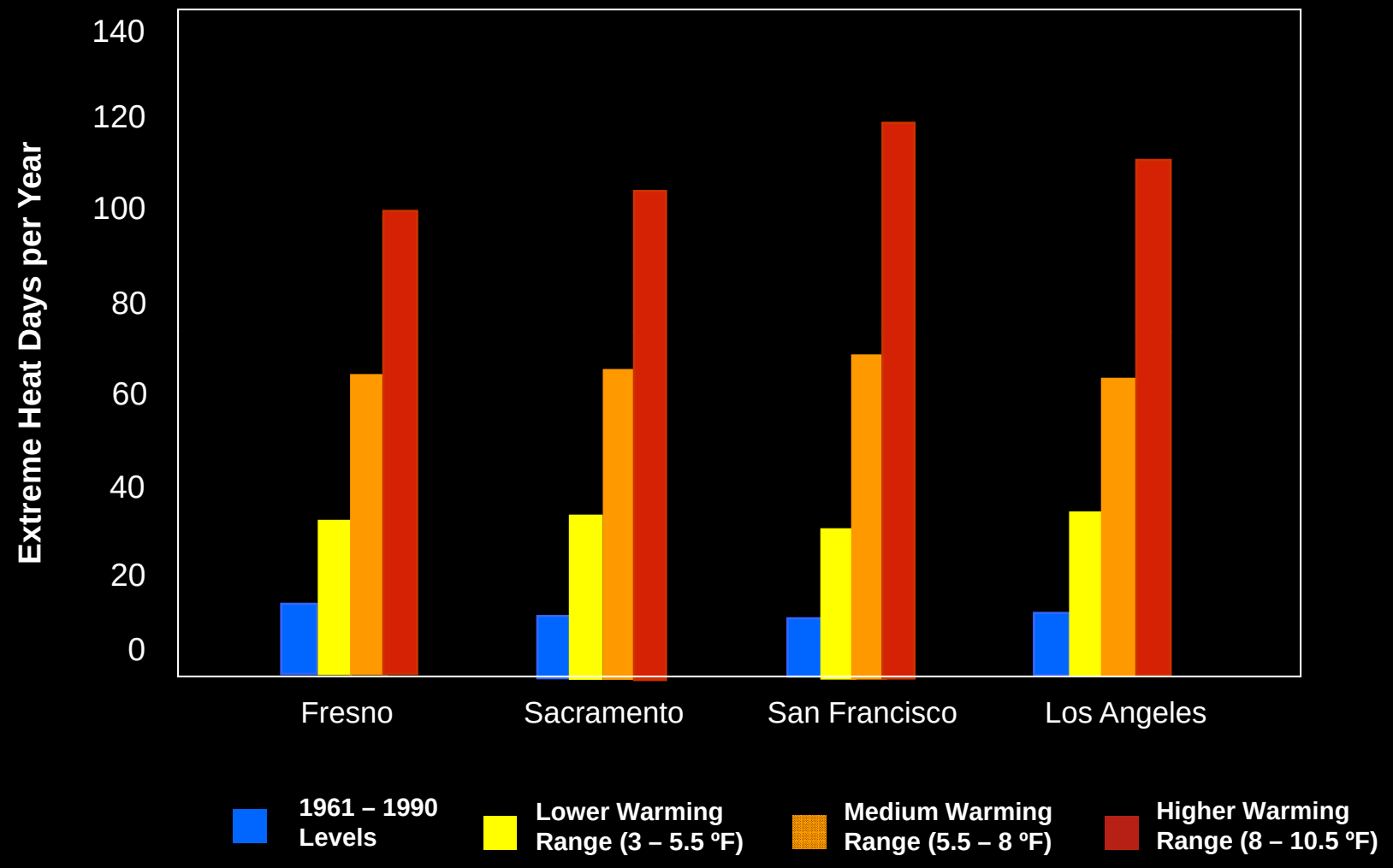
N. Motallebi (2008) Cal/EPA

Projected Ozone Response to Climate - 2050



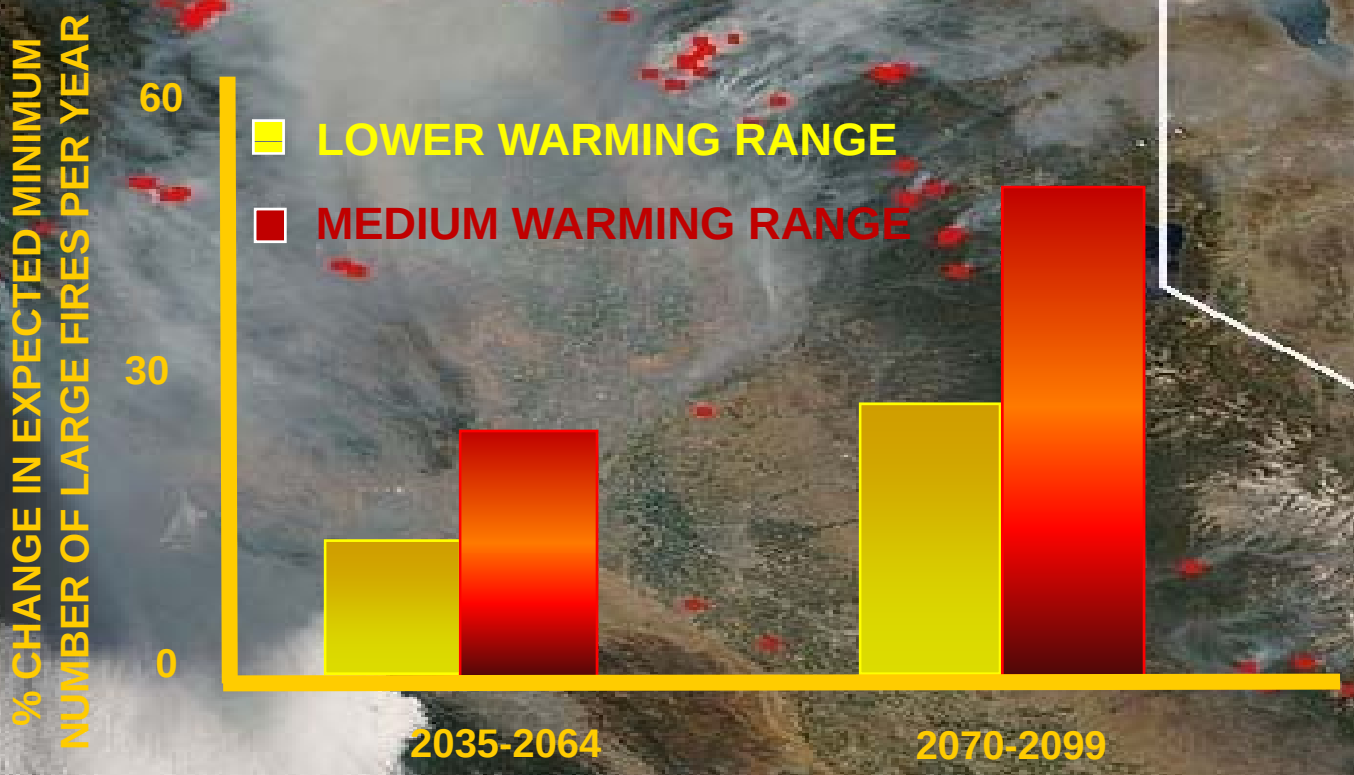
Steiner et al., "Influence of future climate and emissions on regional air quality in California", *JGR* (2006)
Millstein D.E. and R. A. Harley (2008) Impact of Climate Change on Photochemical Air Pollution in Southern California. To be submitted to Journal of Geophysical Research.

Increase in Extreme Heat Days

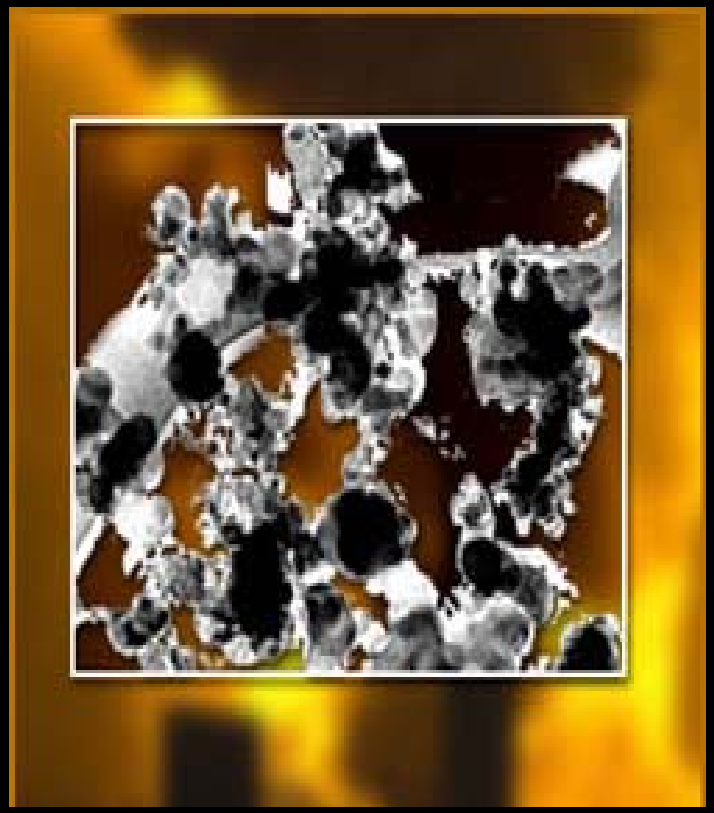


Our Changing Climate: Assessing the Risks to California (2006), *www.climatechange.ca.gov*

Increase in Wildfires



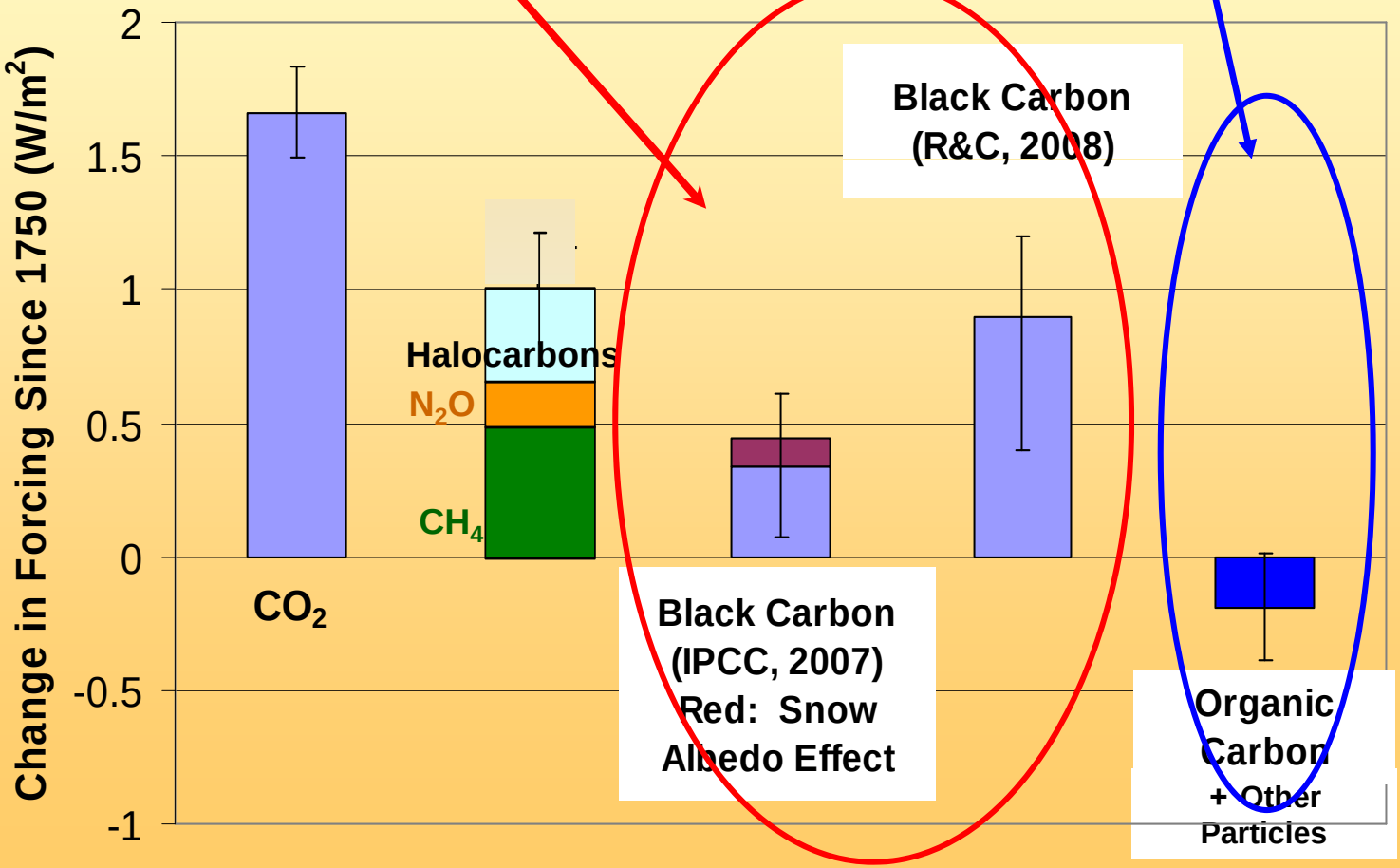
Westerling and Bryant, "Climate change and wildfire in and around California: Fire modeling and loss modeling" (2006), *www.climatechange.ca.gov*



Relevance of Black Carbon Particle Pollution for California's Climate Protection Efforts

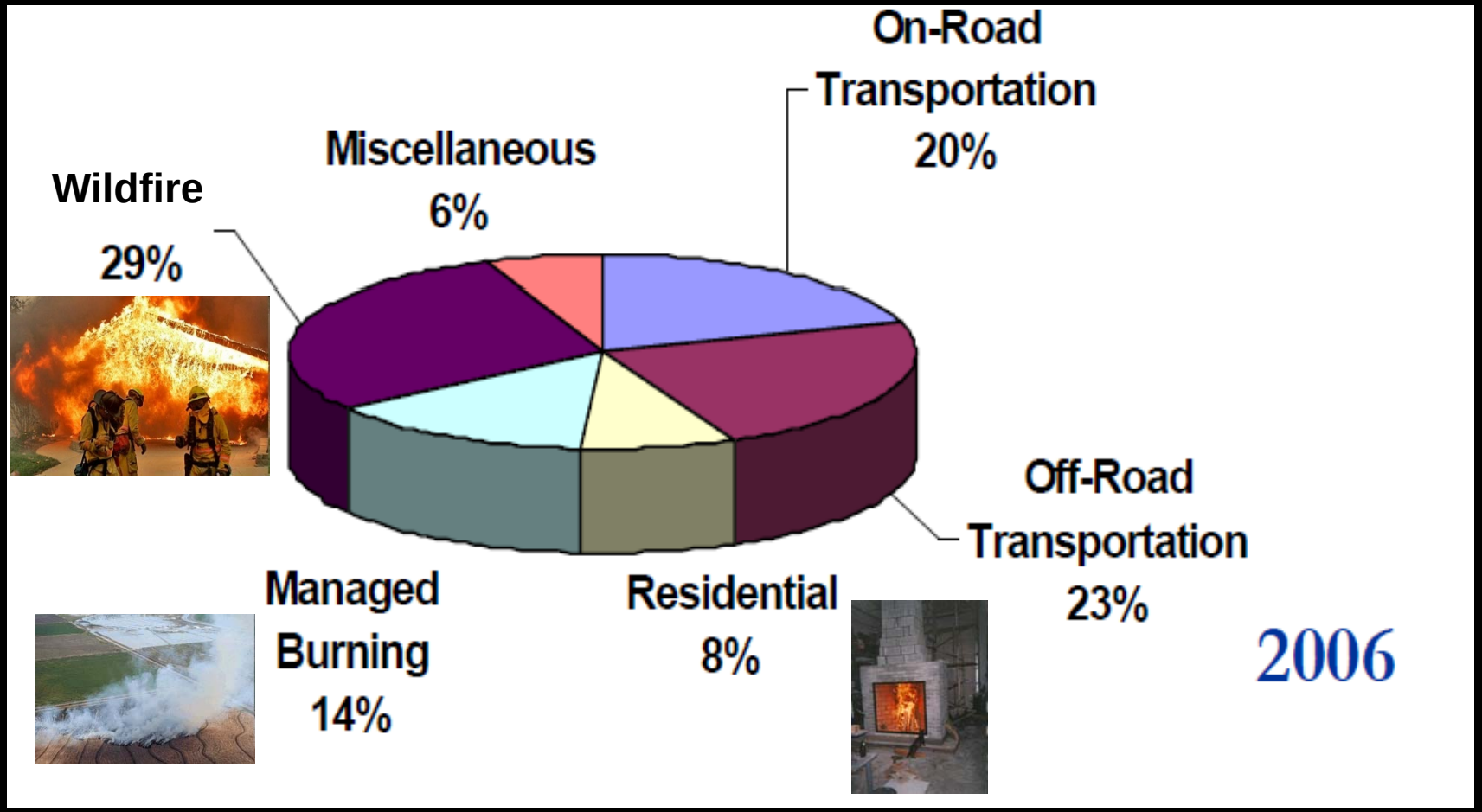
Black Carbon Causes Significant Warming Impact

- Large direct BC warming at global/regional scale
- Additional warming from BC deposition on snow
- Whiter PM components may partially offset BC warming



Sources: IPCC AR4 WG1 2007 for all, except Ramanathan & Carmichael 2008 BC bar

California BC Emissions



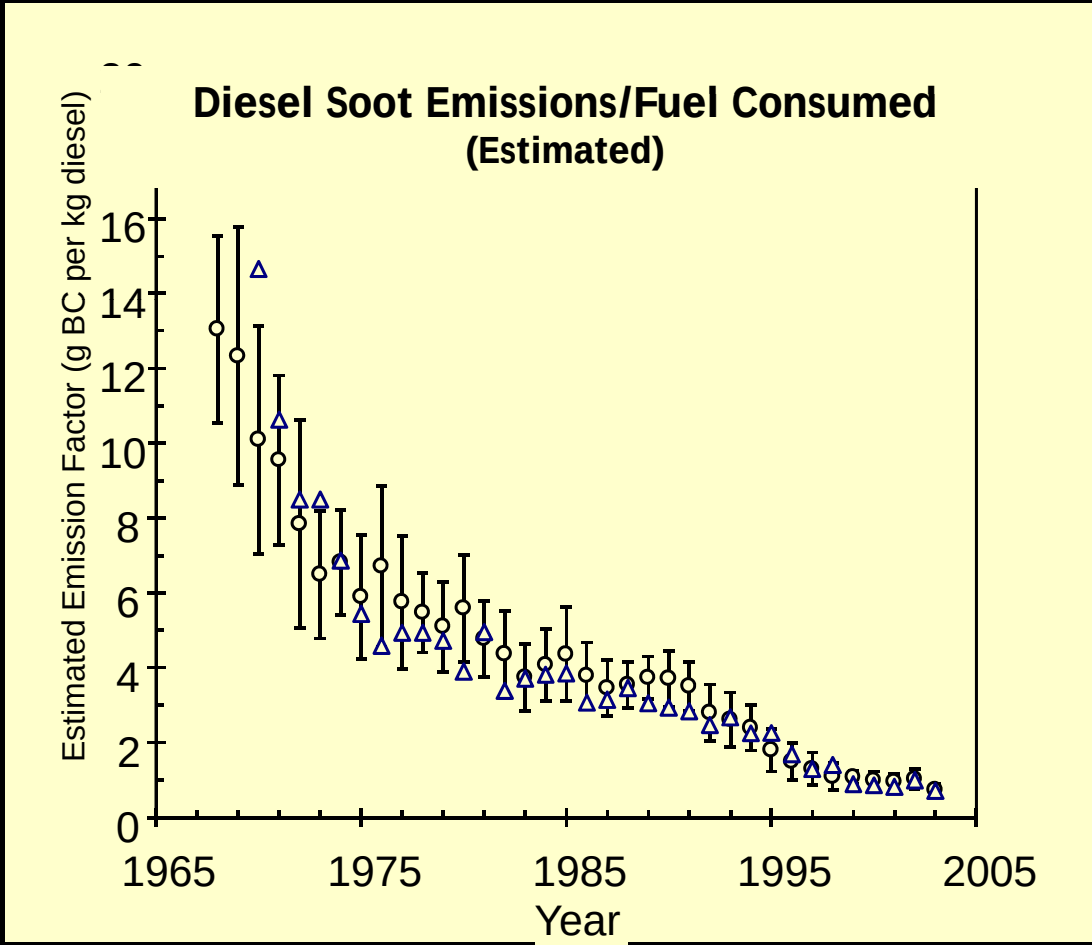
Source: Chow, J.C., Watson, J.G., Lowenthal, D.H., and Chen, L.W.A., "Climate Change – Characterization of Black Carbon and Organic Carbon Air Pollution Emissions and Evaluation of Measurement Methods," CARB study (04-307), 2009.

40 Years of Progress on Diesel PM

Engine diesel PM emission factor
⬇~18 fold

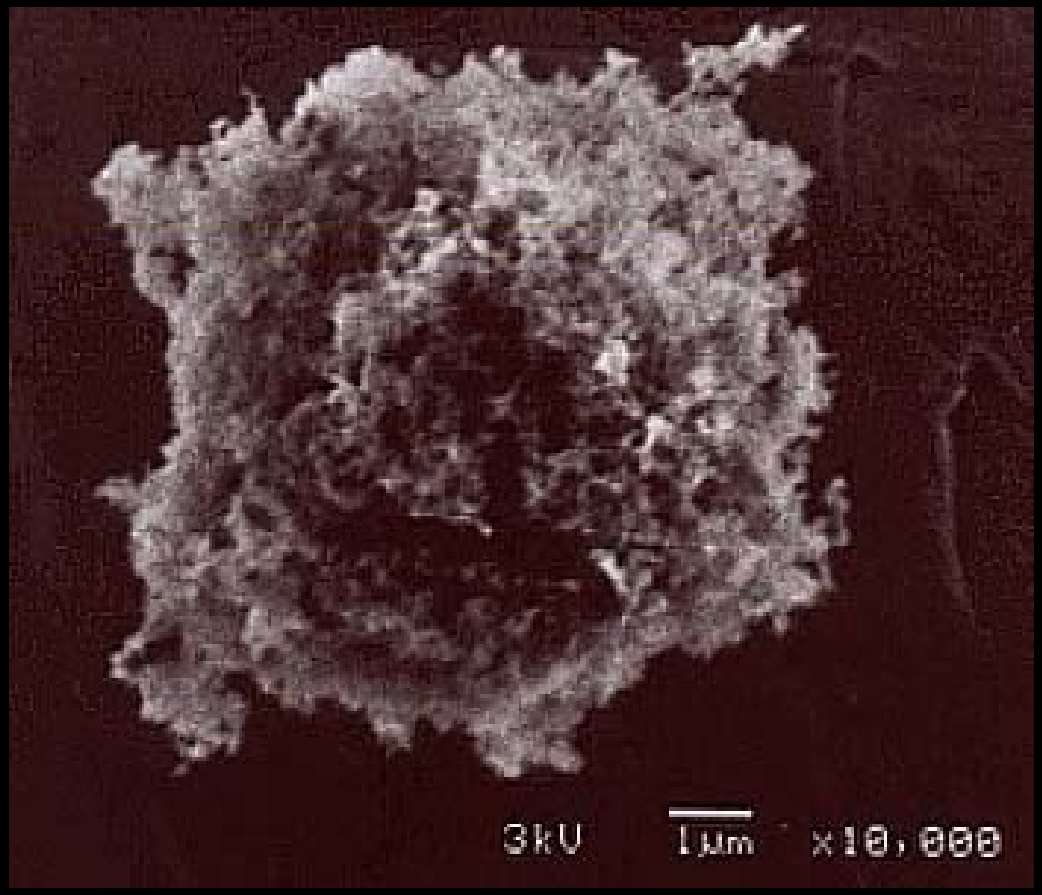
Fuel usage
⬆~6 fold

Ambient diesel PM
⬇~3 fold



Kirchstetter et al. (2008) Black carbon concentrations and diesel vehicle emission factors derived from coefficient of haze measurements in California: 1967-2003, AE, 42: 480-491.

CARB On-Going Research



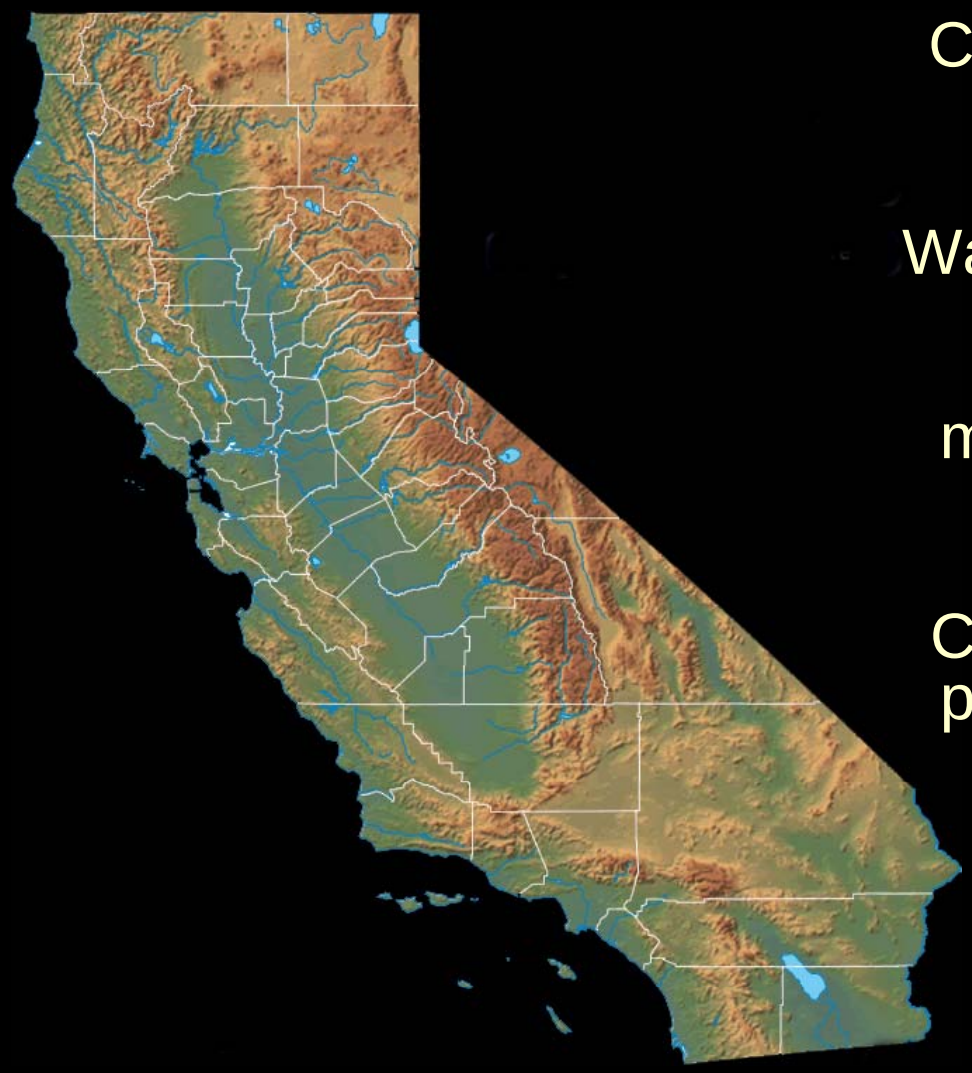
Soot Particle Under a Microscope

Image credit: D.M. Smith, University of Denver

Black Carbon and the Regional Climate of California

- Assess the impact of BC on California's climate based on observations, data analyses, and modeling studies
- How important is BC to regional climate change in California?
- Determine the radiative forcing of soot particles from different sources in California
- Understand pathways by which BC may be important in climate change

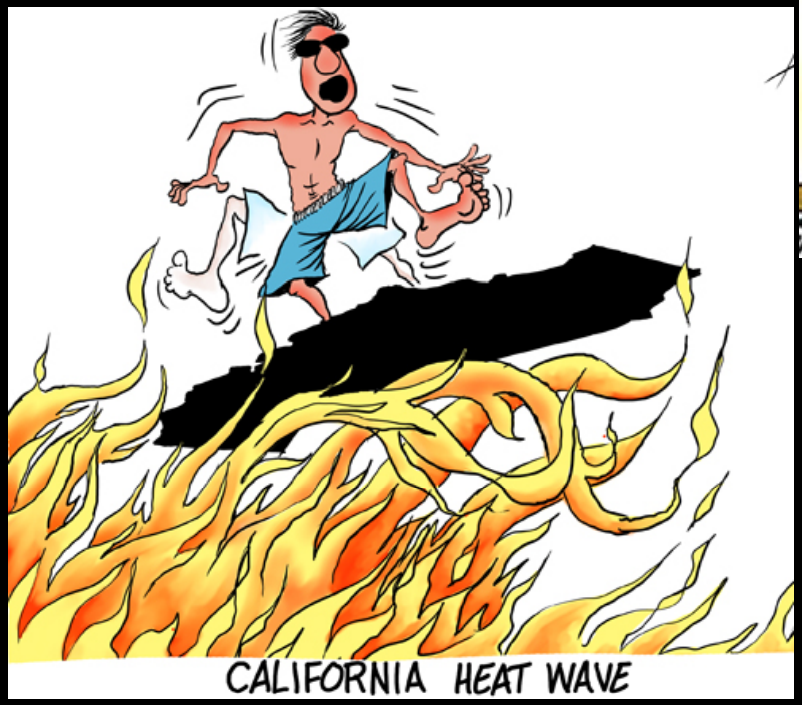
Summary



California already affected by climate change

Warmer temperatures can lead to higher emissions, faster chemistry, and more days meteorologically conducive to high ozone.

Climate change increases air pollution control requirements



Thank you