Climate Change and Air Quality in California

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Important Climate Change and Air Quality Questions

- **What is the direct effect of climate change on air quality?**
- How will changing emissions affect climate impacts on air quality?
- Do climate mitigation strategies have air pollution co-benefits?
- What is the uncertainty?

How Will Climate Change Affect Ozone and Airborne Particle Concentrations?

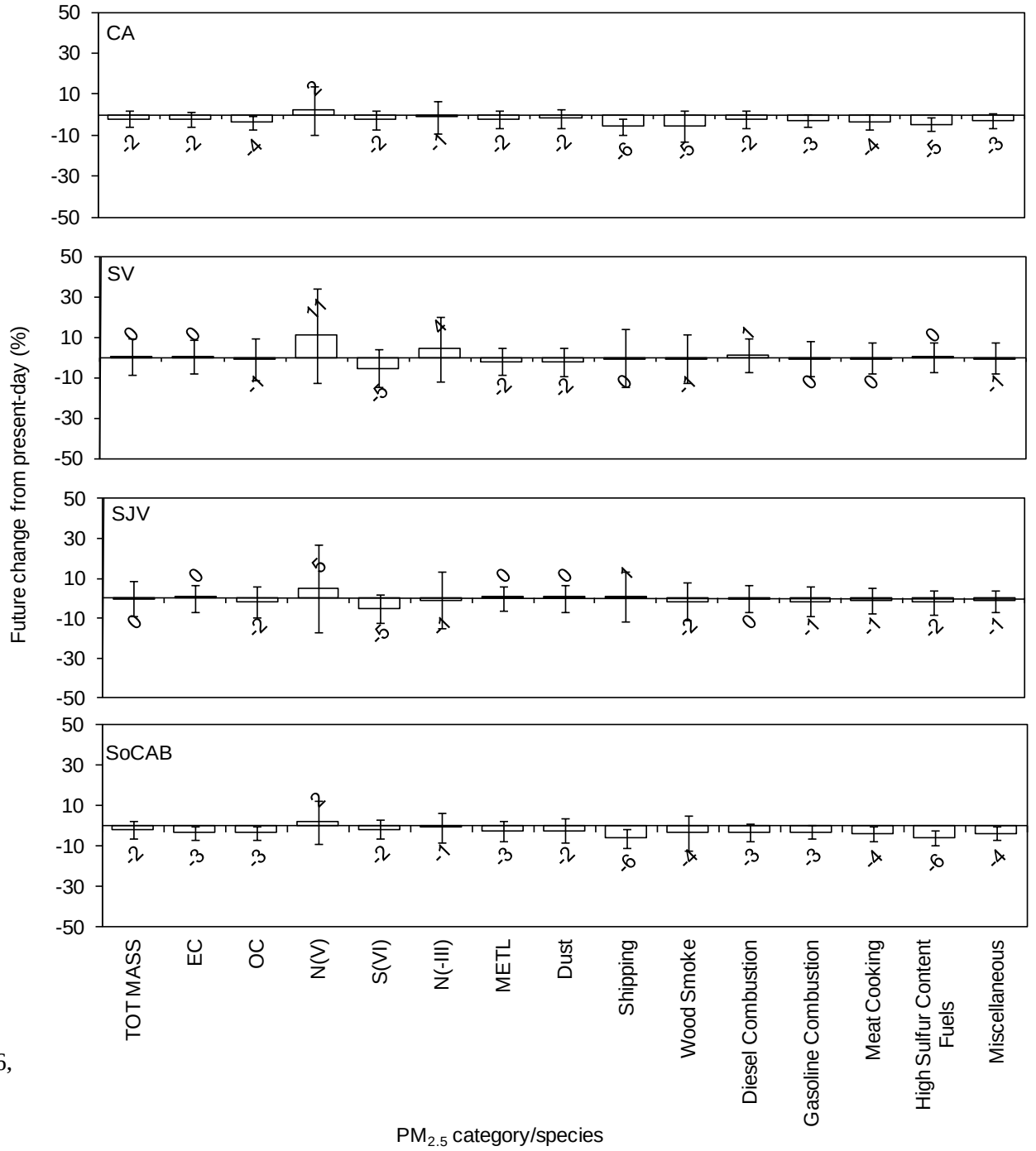
- Air pollution events occur when meteorology traps emissions close to the surface
- Climate change will affect multiple variables simultaneously
  - Temperature, relative humidity, wind speed, mixing depth, cloud cover, precipitation, etc.

- Airborne particles account for the majority of the air pollution public health burden

Past Results: Parallel Climate Model (PCM) Business as Usual (BAU-B06.44) Global Emissions Scenario

- Downscaled meteorology using WRF
- Year 2000 emissions estimates from CARB and South Coast Air Quality Management District
- 8km spatial resolution over all of California
- Evenly spaced episodes over the entire year
- 1008 effective days each of 2000-2006, 2047-2053

Seven Year Average Population Weighted ΔPM2.5

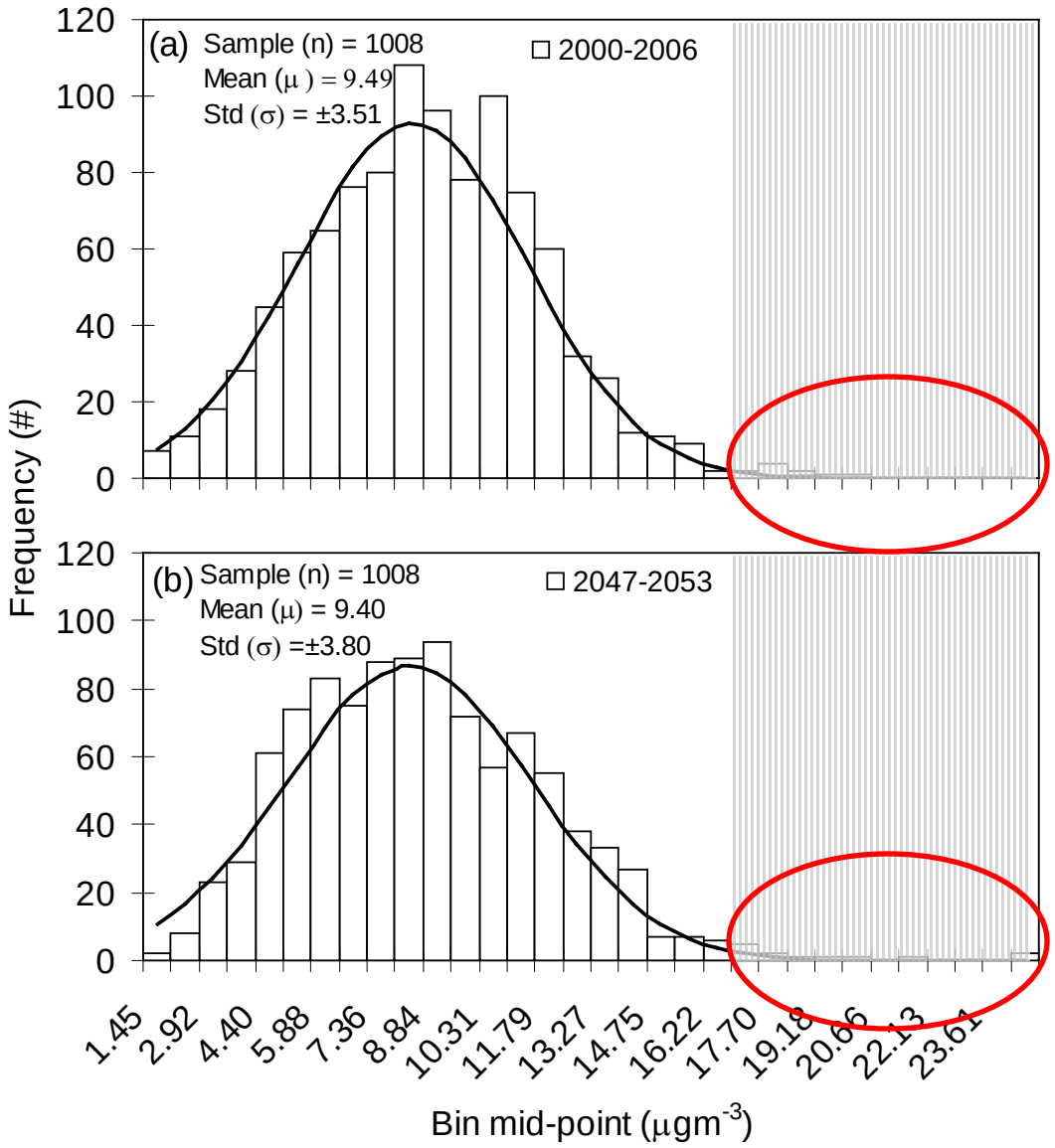


Source: A. Mahmud, M. Hixson, and M. Kleeman. Climate Change Increases Population Exposure to Airborne Particulate Matter During Extreme Events in California. Atmospheric Chemistry and Physics, 12:16, pp7453-7463.

Analysis of Extreme Events

2000-06

2047-53



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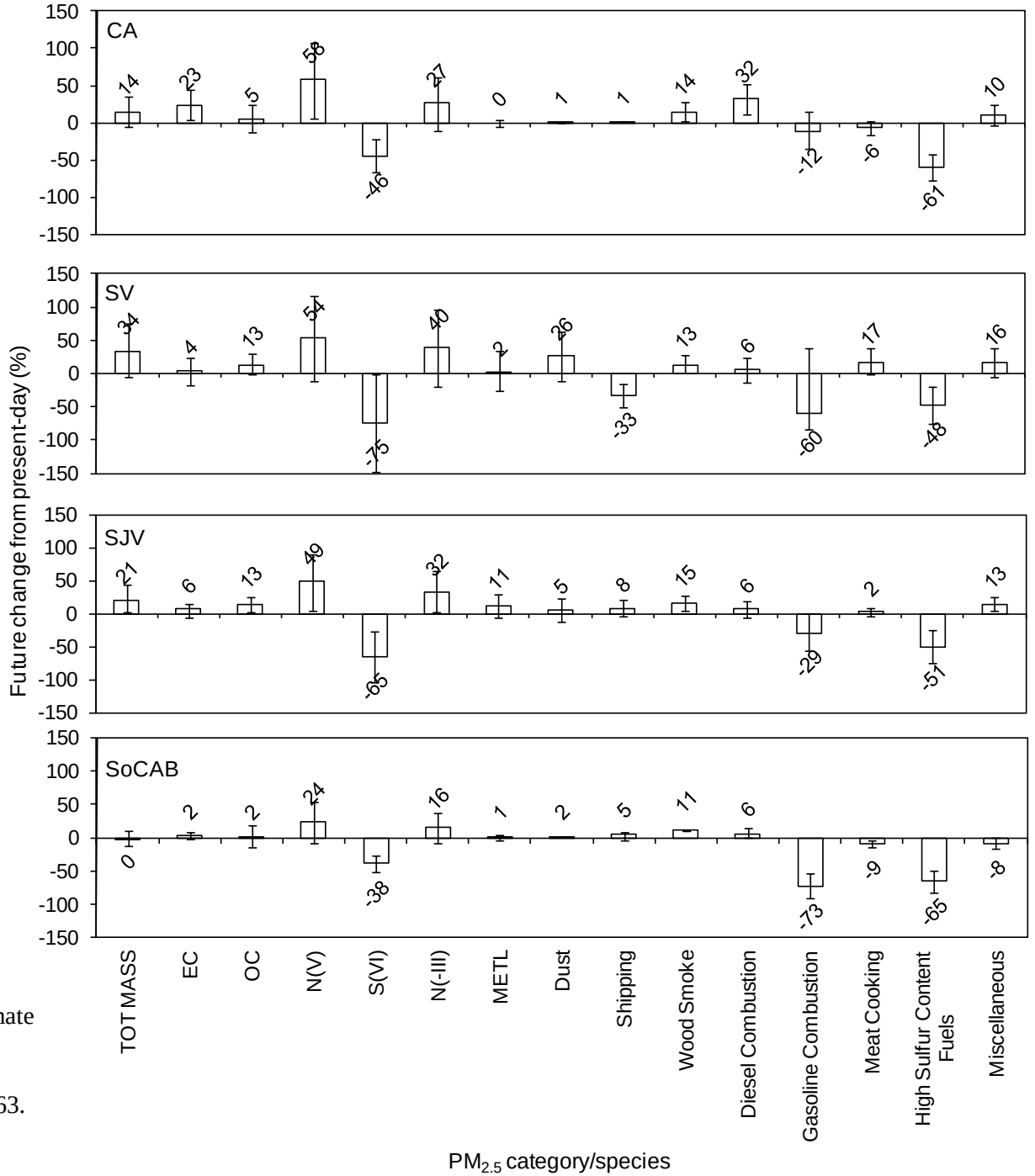
Extreme Event Population Weighted ΔPM2.5



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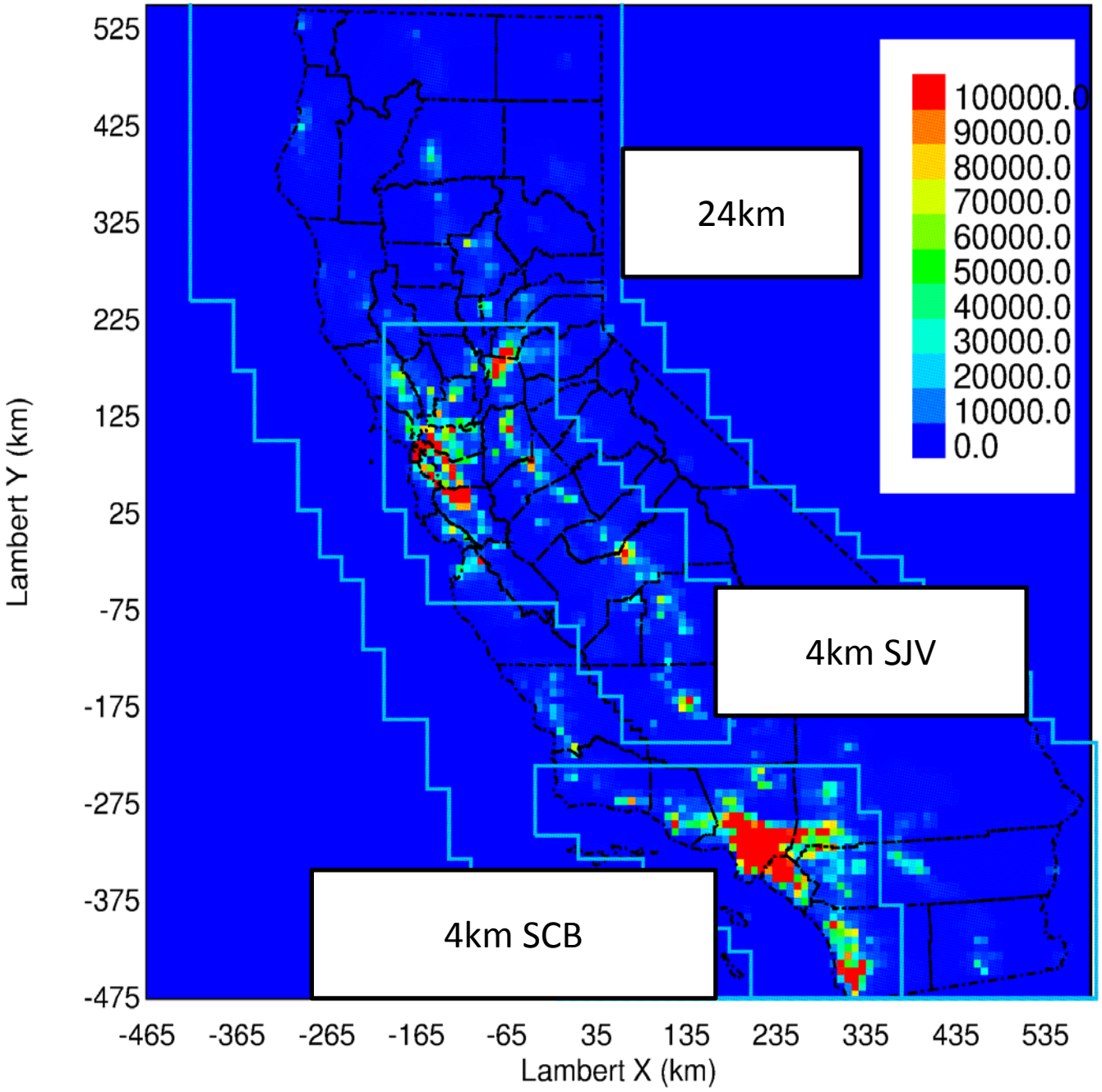
New Results: Community Earth Systems Model (CESM) Representative Concentration Pathway (RCP 8.5)

- Downscaled meteorology using WRF
- Year 2000 emissions estimates from CARB
- Nested domains with 4km resolution for 93% of California's population
- Months simulated
  - Winter: Jan, Feb, Dec
  - Summer: Jun, Jul, Aug
  - 740 effective days each of 2001-2010, 2046-2055


24km
4km SJV
4km SCB
100000.0
90000.0
80000.0
70000.0
60000.0
50000.0
40000.0
30000.0
20000.0
10000.0
0.0
525
425
325
225
125
25
-75
-175
-275
-375
-475
Lambert Y (km)
-465
-365
-265
-165
-65
35
135
235
335
435
535
Lambert X (km)

Future Research Needs

- Ensemble analysis of more GCM predictions and how they impact air quality in California
- More analysis of extreme events, especially drought
- Organized data archive for California simulations carried out with high spatial resolution over long time periods
- Continued analysis of air quality co-benefits of climate-change legislation

Acknowledgements

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