

Geophysical Fluid Dynamics Laboratory Review

June 30 - July 2, 2009



Climate and Air Quality

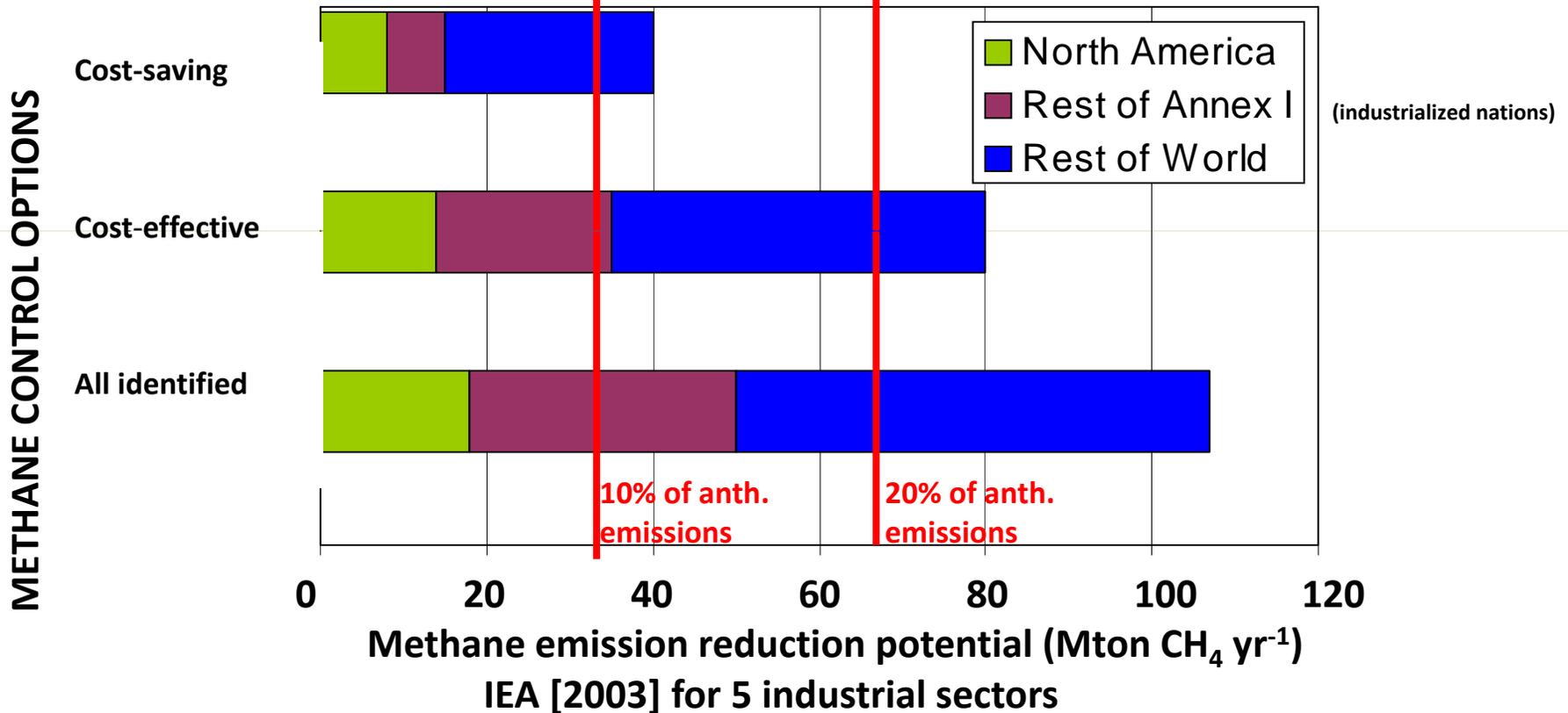
Presented by
Arlene Fiore

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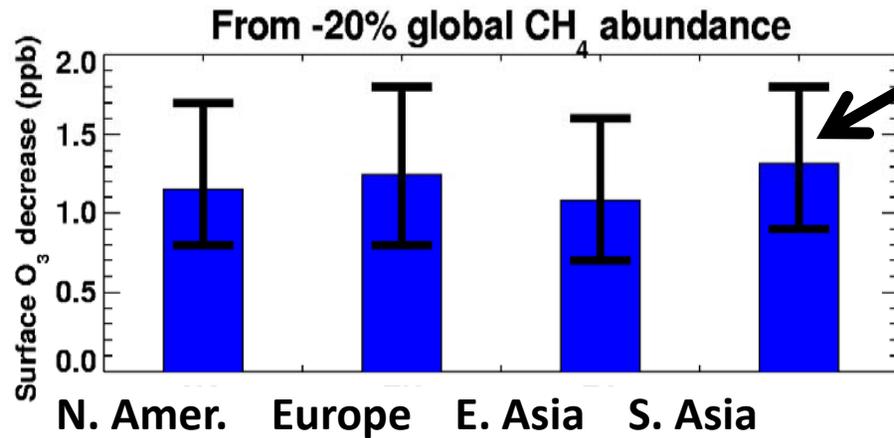
Addressing air quality and climate via methane emission controls: A viable option?



~25% of global anthropogenic emissions at cost-savings / low-cost

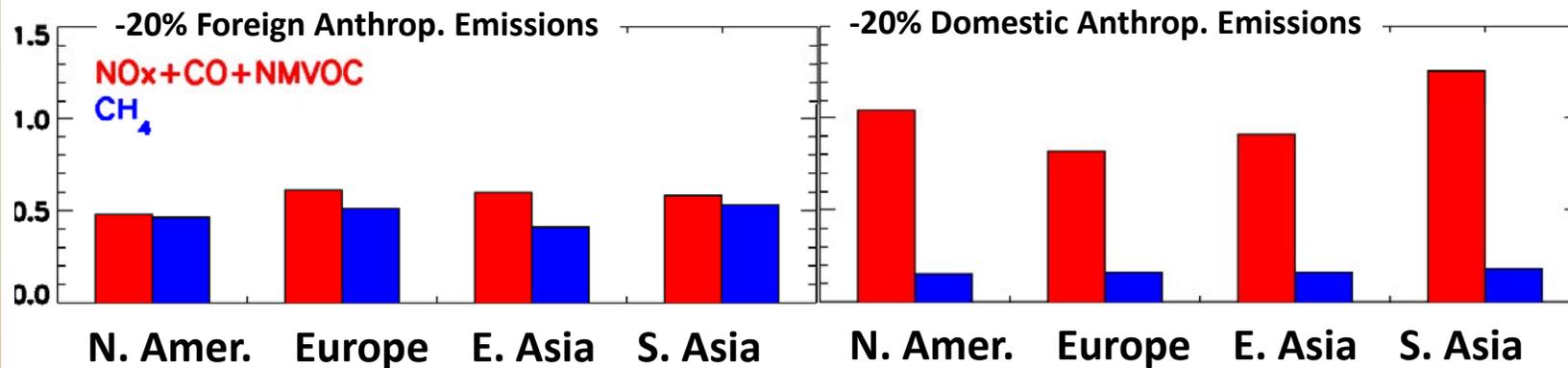
(West and Fiore, 2005)

Decreasing methane lowers global surface O₃ background



Range across 18 models

→ Robust result across models



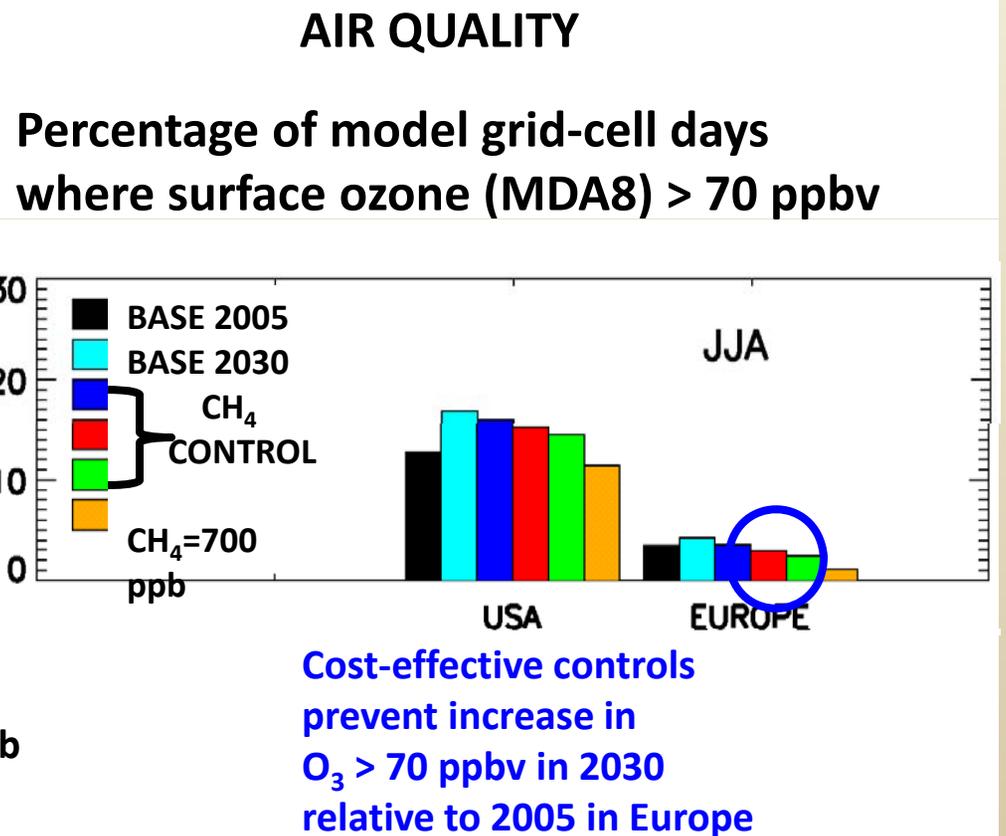
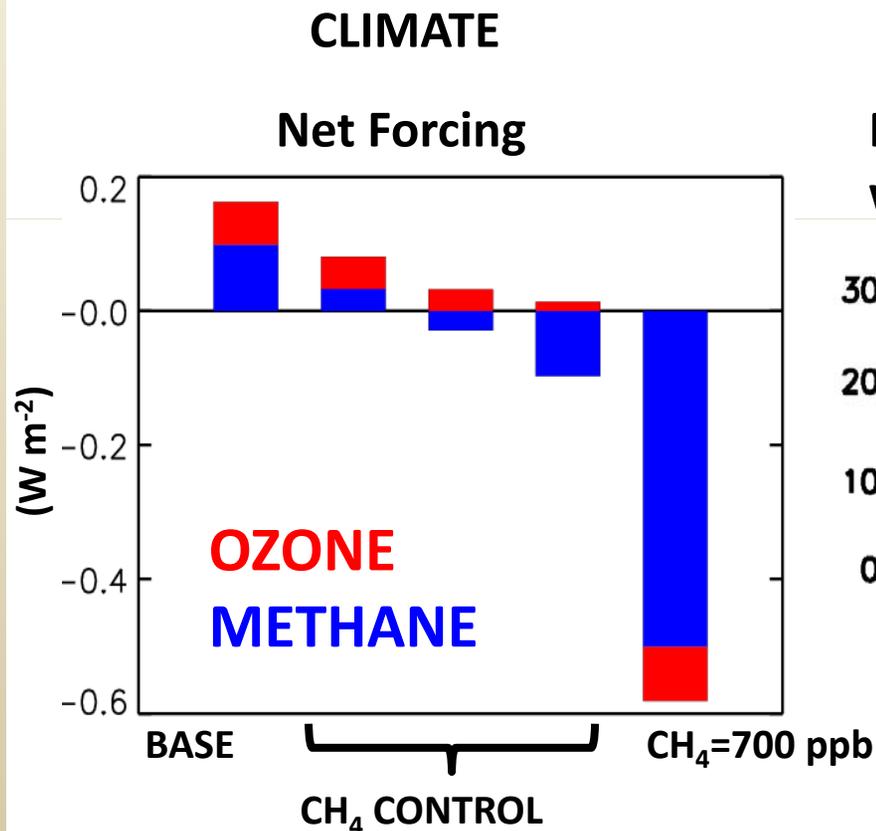
→ Intercontinental emission controls: CH₄ ≈ NO_x+NMVOC+CO

→ Domestic emission controls: NO_x+NMVOC+CO more effective

(Results from TF HTAP model intercomparison; Fiore et al., 2009)

Benefits from CH₄ controls to climate and air quality: Decreased radiative forcing and high-O₃ events

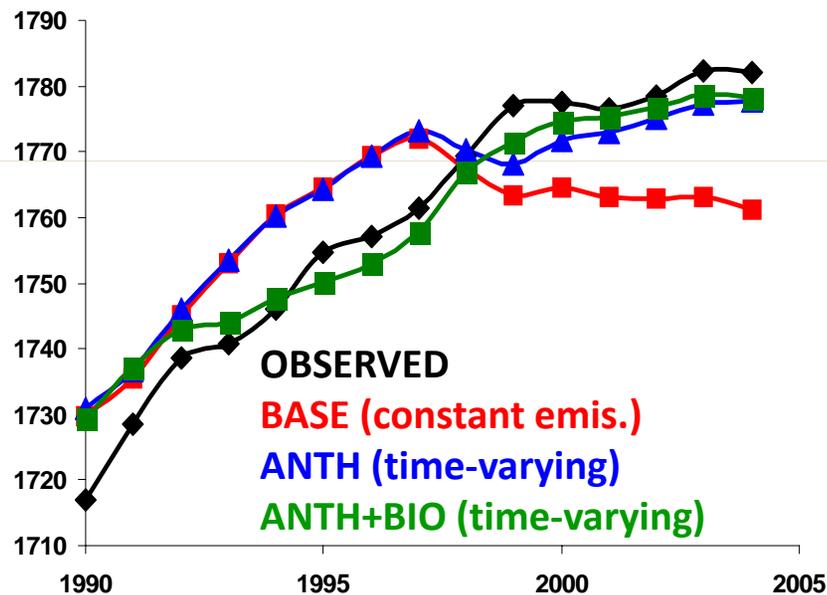
Methane emission reductions are applied to BASE emission scenario
(2005 to 2030 full-chemistry transient simulations in MOZART-2)



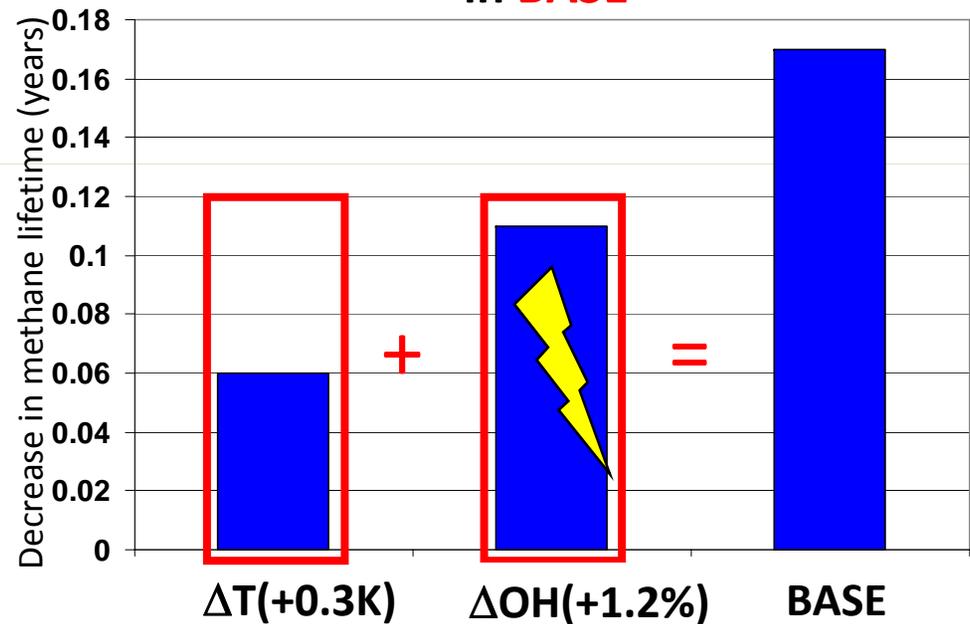
(Fiore et al., 2008)

Climate sensitivity: Small increases in temp. and OH shorten the methane lifetime

Global mean surface methane (ppb)



Contributions to change in methane lifetime from 1991-1995 to 2000-2004 in **BASE**



(Fiore et al., 2006)

Summary: Connecting climate and air quality via O₃ & CH₄

CLIMATE AND AIR QUALITY BENEFITS FROM CH₄ CONTROL

- Decreased hemispheric background O₃ (robust across models)
- Complementary to NO_x, NMVOC controls
- Independent of reduction location (but depends on NO_x)

IMPACT OF CHANGING CLIMATE ON METHANE TRENDS ?

- 1990 to 2004 model trend driven by increasing T, OH
- Trends in global lightning activity?
- Other potential climate feedbacks (on sources and sinks)

(Fiore et al., 2002, 2006; West and Fiore, 2005; Fiore et al., 2008, 2009)

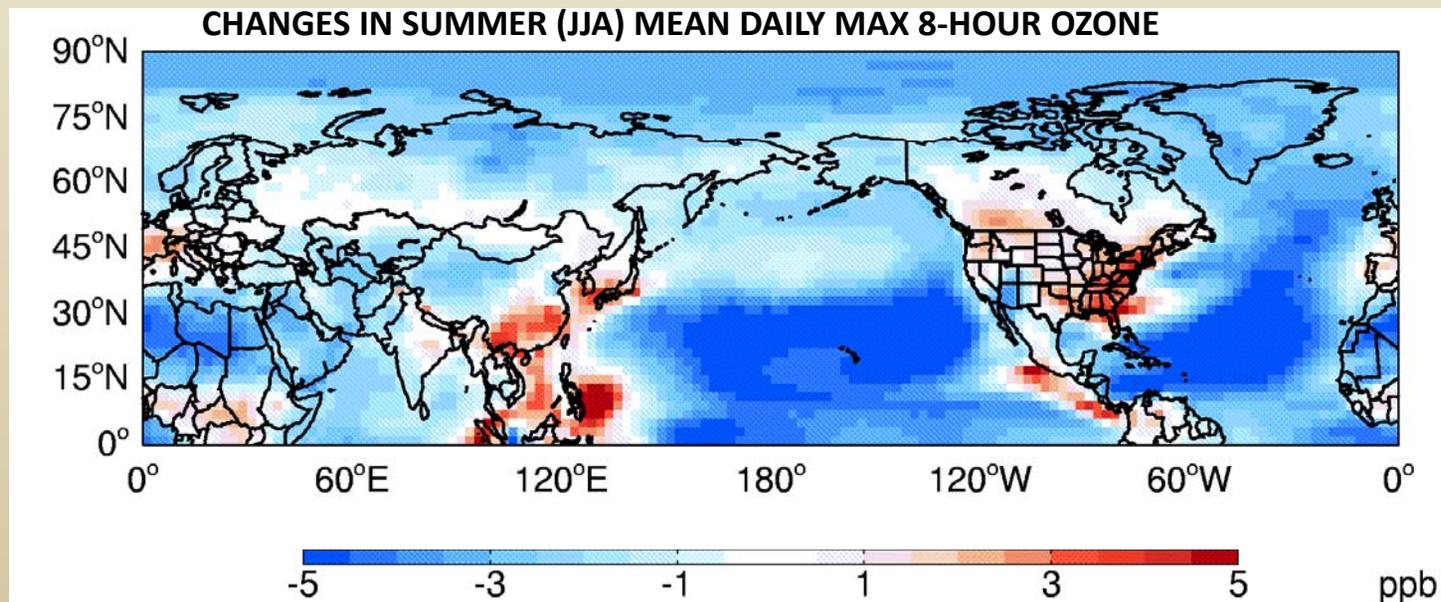


NEW DIRECTION: Impact of Future Changes in Climate on Air Quality

20-year AM3 simulations with annually-invariant emissions of ozone and aerosol precursors (except for lightning NO_x), to isolate role of climate change

1. Present Day Simulation (“1990s”): observed SSTs and sea ice (1981-2000 mean)

2. Future Simulation (“A1B 2090s”): observed SSTs and sea ice + average 2081-2100 changes from 19 IPCC AR-4 models



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