Aerosols: Climate & Air Quality

Introduction - Christoph Senff

Aerosol Sources, Sinks, Distributions, and Processes - Chuck Brock

ESRL Research on Aerosol Direct Radiative Forcing of Climate - John Ogren

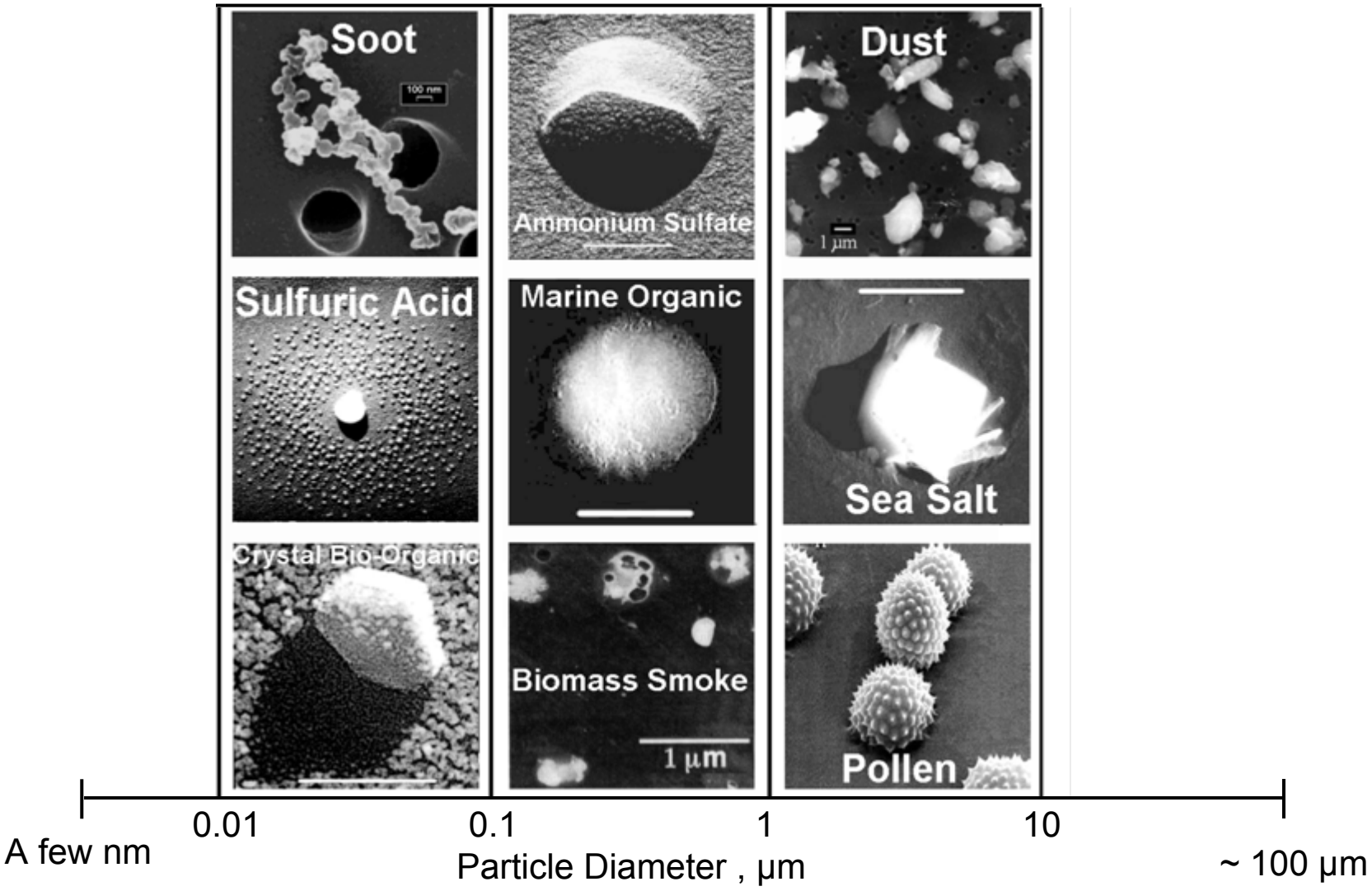
Aerosol - Cloud Interactions - Graham Feingold

Coupled Modeling Systems that allow for Aerosol/AirQuality/Weather/Climate interactions - Georg Grell

Wrap-up & Outlook - John Ogren

Discussion

Aerosols come in all shapes and sizes



Aerosol Size Distribution

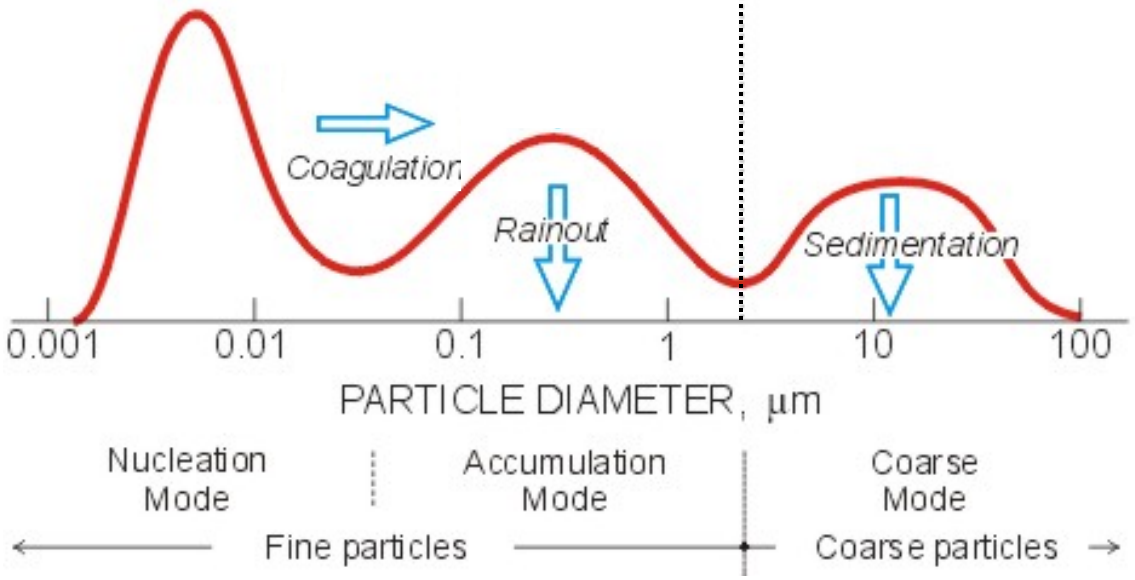
Chemical Processes

Combustion & conversion from gases:

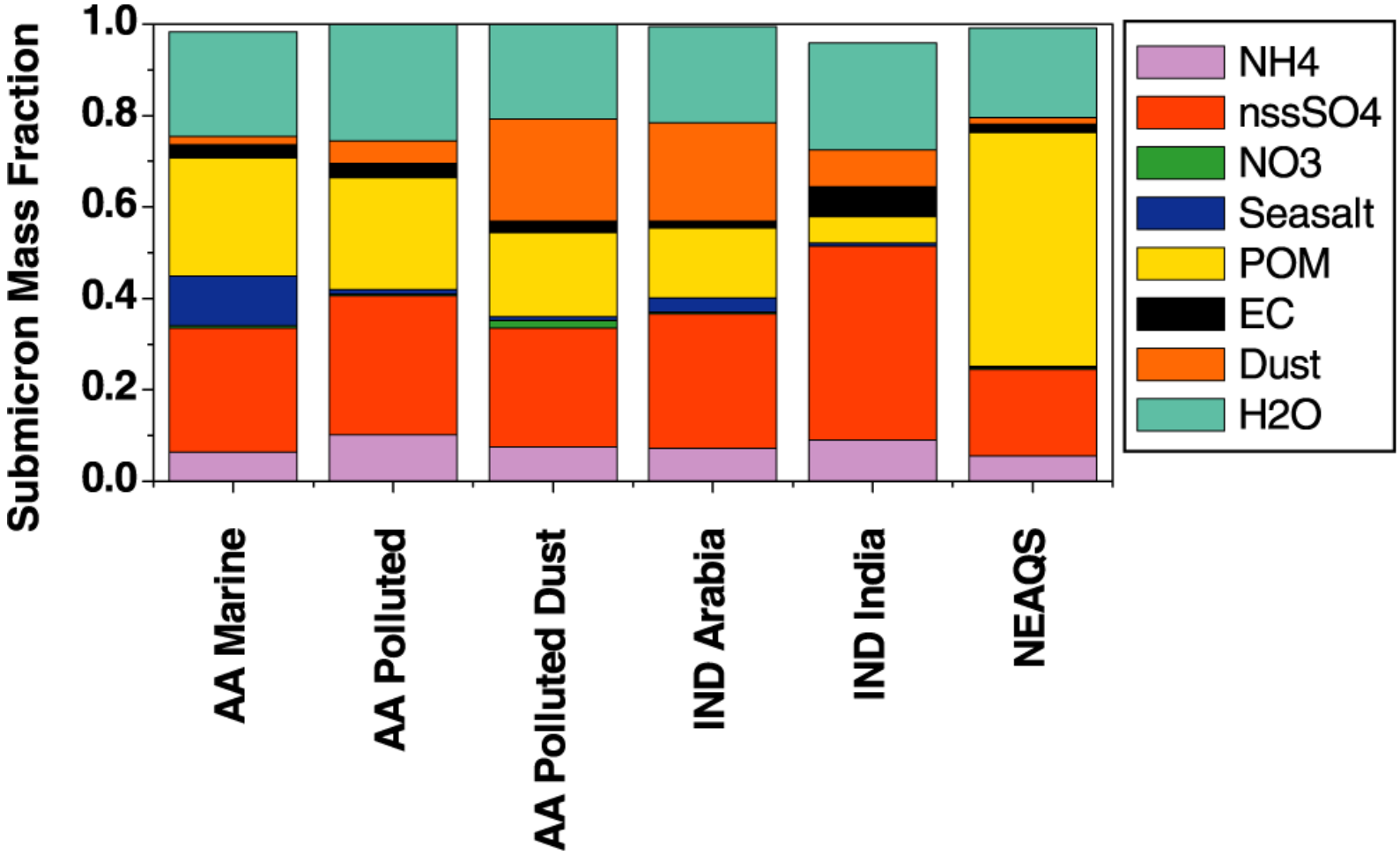
- Sulfate
- Nitrate
- Ammonium
- Organics
- Black carbon

Mechanical Processes

- Mineral dust
- Sea salt
- Volcanic emissions
- Plant particles

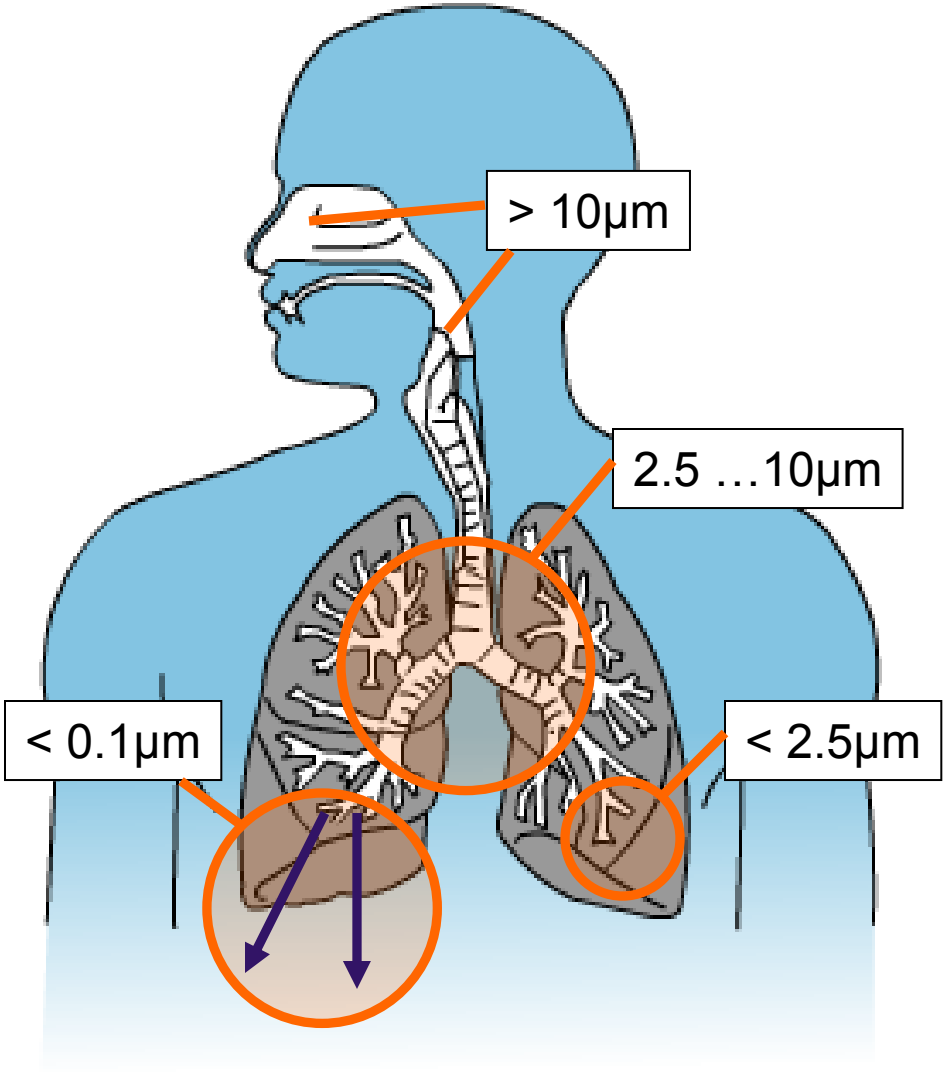


Aerosol Composition



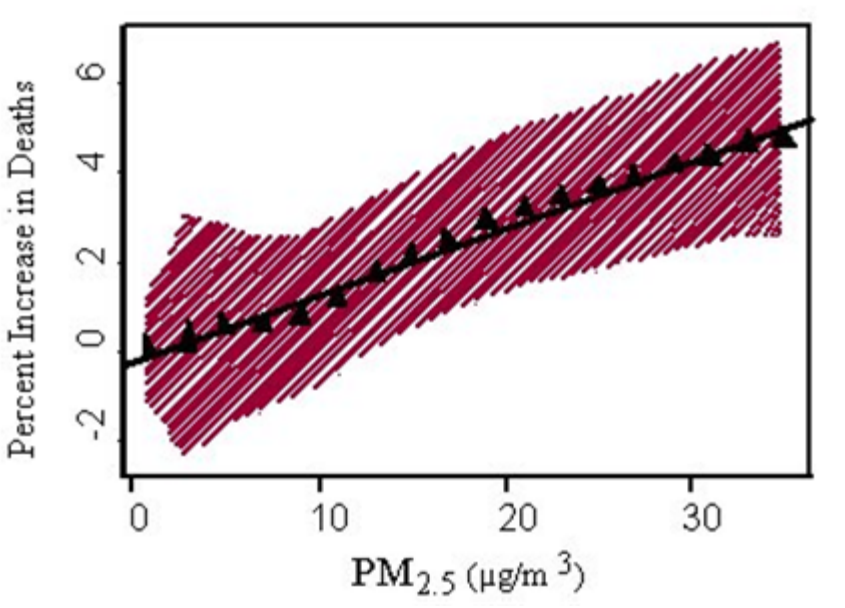
P. K. Quinn and T. S. Bates: American, Asian, and Indian haze: Similar regional impacts on climate? *Geophys. Res. Lett., 30*(11), 1555, doi:10.1029/2003GL016934, 2003.

Aerosols & Air Quality → Health Effects



After: C.-Y. Wu, Y.-M. Hsu, University of Florida

Exposure response between PM2.5 and daily deaths



From: THE EPA'S PARTICULATE MATTER (PM) HEALTH EFFECTS RESEARCH CENTERS PROGRAM, 2002.

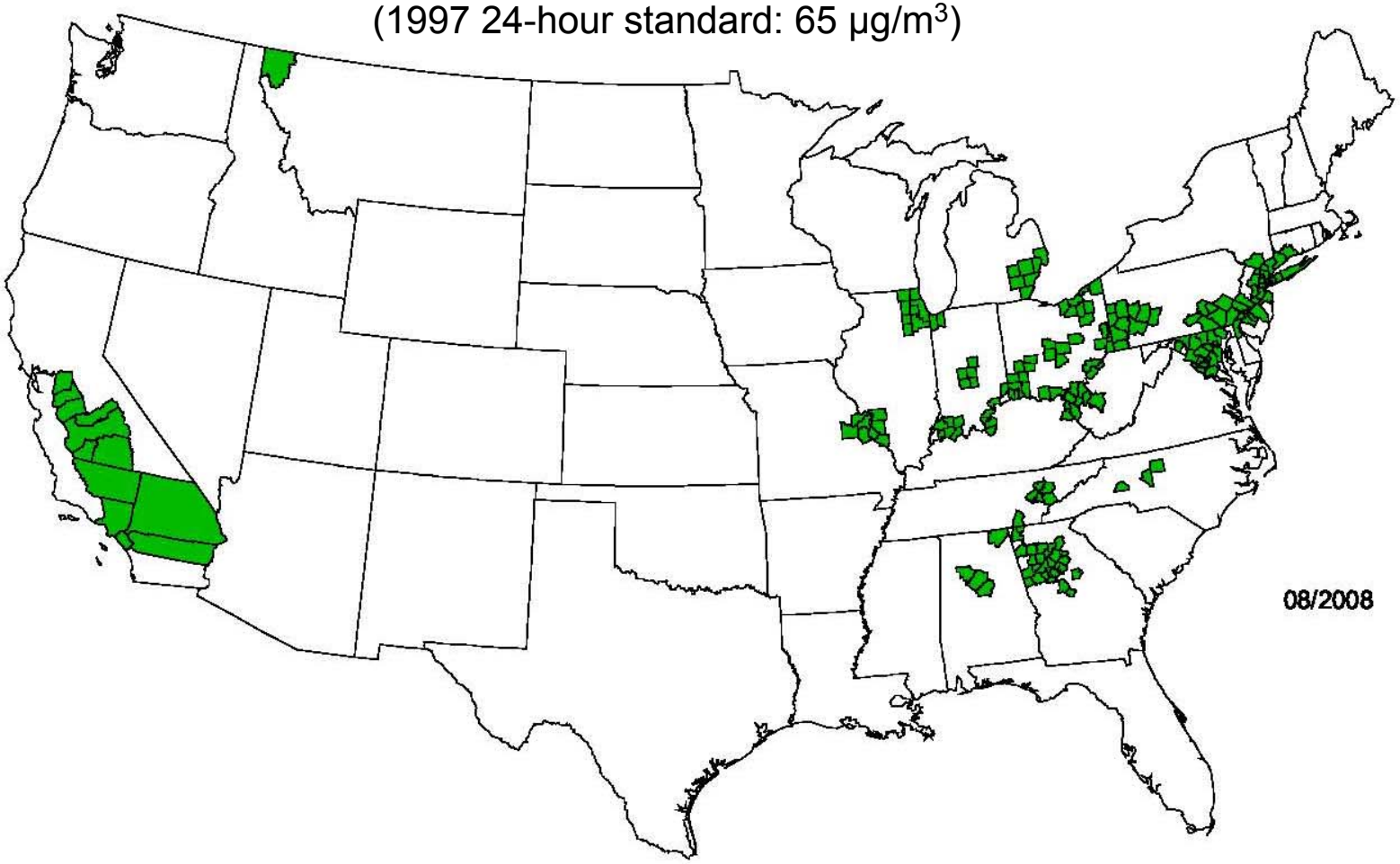
Aerosols & Air Quality

EPA National Ambient Air Quality Standard (NAAQS) for Particulate Matter (PM):

	Standard	Averaging Time
PM10	150 μg/m^3	24-hour
PM2.5	15 μg/m^3 35 μg/m^3	Annual 24-hour

Counties Designated Nonattainment for PM-2.5

(1997 24-hour standard: 65 μg/m^3)



Areas attaining or not attaining the 2006 24-hour PM2.5 standard (35 μg/m^3) will be designated in December 2008.

Most Polluted World Cities by PM

PM10 annual average, μg/m^3 (2004)	City, Country
169	Cairo, Egypt
150	Delhi, India
128	Kolkata, India
125	Tianjin, China
123	Chongqing, China
109	Kanpur, India
109	Lucknow, India
104	Jakarta, Indonesia
101	Shenyang, China
19	Boulder, CO
20	WHO guideline

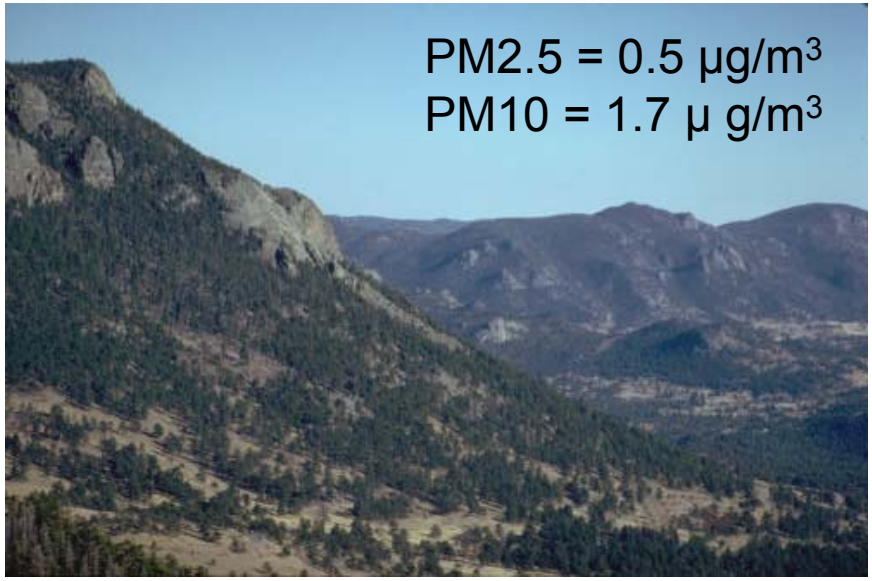
from: World Bank study by K. D. Pandey et al., 2006: “Ambient Particulate Matter Concentration in Residential and Pollution Hotspot Areas of World Cities: New Estimates Based on the Global Model of Ambient Particulates (GMAPS)”

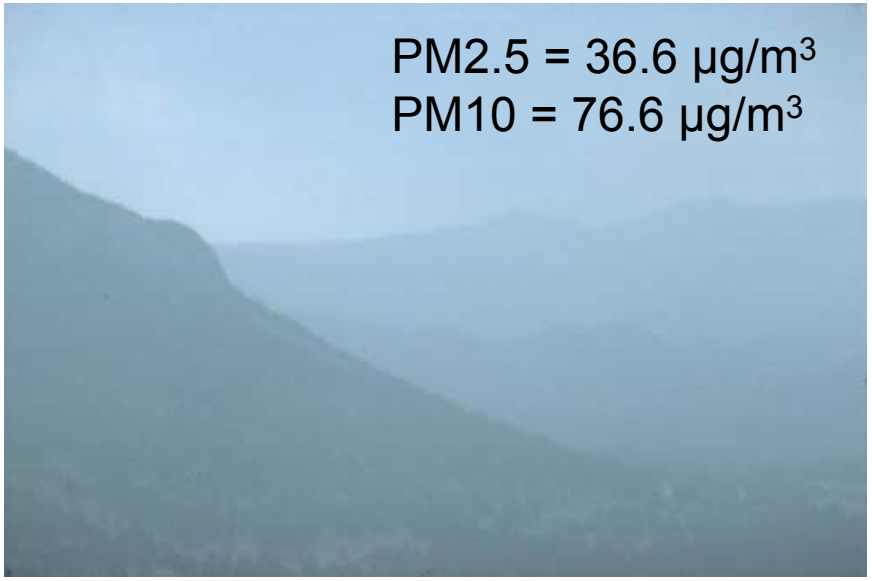
Aerosols & Air Quality → Visibility

IMPROVE (Interagency Monitoring of Protected Visual Environments) Program

- Long term monitoring program (established in 1985) to track visibility changes and determine causes of visibility impairment in National Parks and Wilderness Areas (Class I areas)

Rocky Mountain National Park

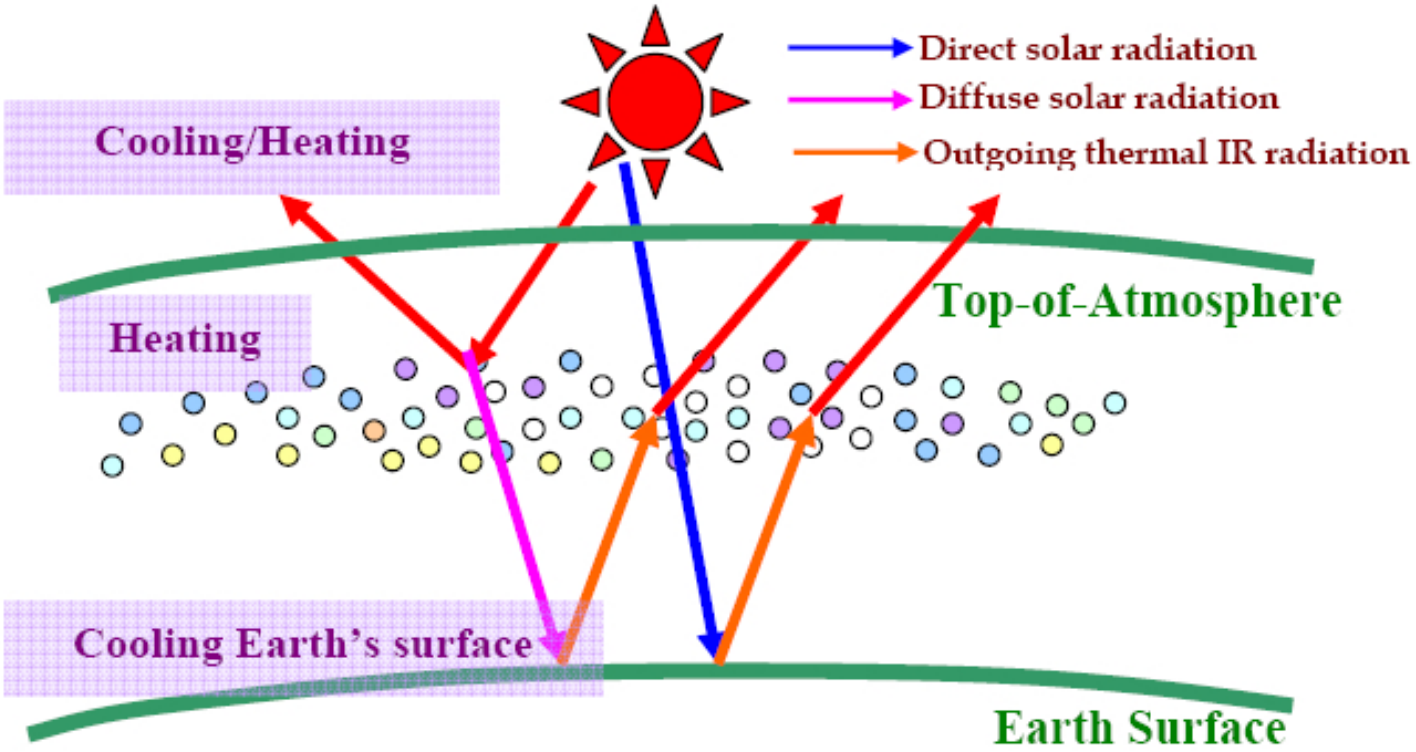




Aerosols & Climate

Direct Effect:

Perturbation of the radiation budget via scattering and absorption of incoming solar and outgoing infrared radiation

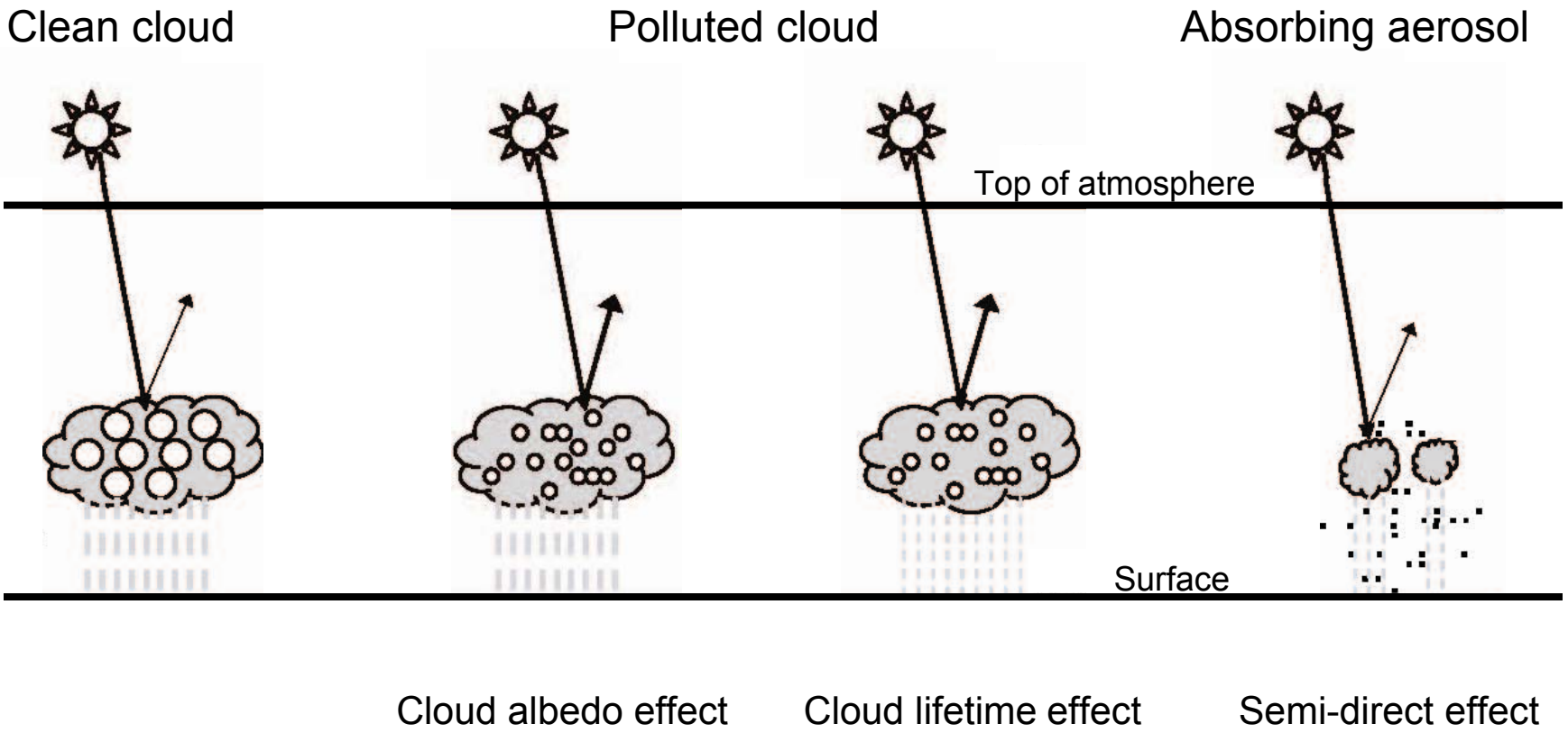


from: Dr. S. N. Tripathi, Department of Civil Engineering
Indian Institute of Technology Kanpur

Aerosols & Climate

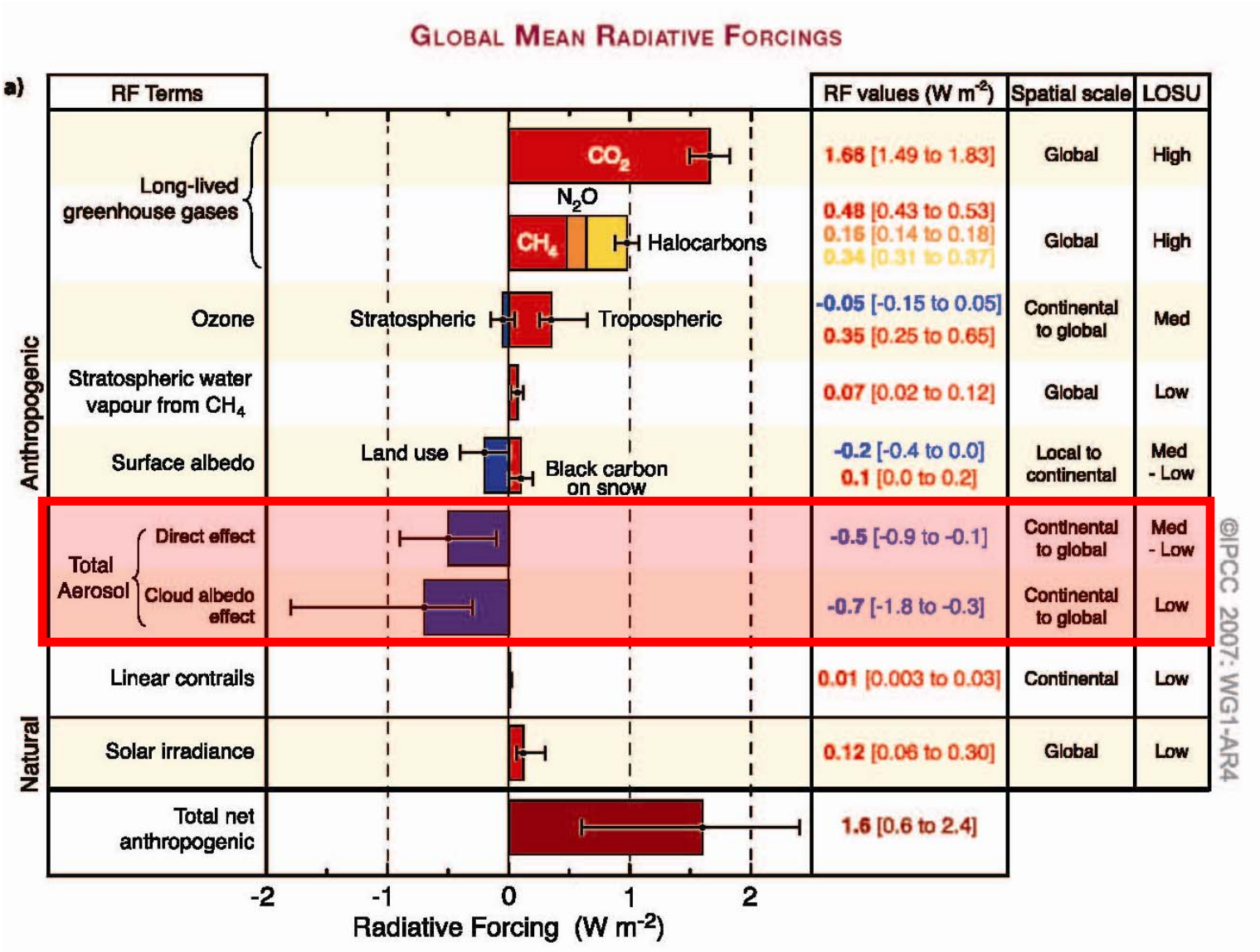
Indirect Effects:

Modification of the microphysical and hence the radiative properties, lifetime, amount, and morphology of clouds.



Radiative Forcing (RF)

Change in the radiation budget at the tropopause relative to a pre-industrial background at 1750, averaged globally and annually



From: IPCC's Fourth Assessment Report, Working Group I, Technical Summary

Aerosols: Climate & Air Quality

Introduction - Christoph Senff

Aerosol Sources, Sinks, Distributions, and Processes - Chuck Brock

ESRL Research on Aerosol Direct Radiative Forcing of Climate - John Ogren

Aerosol - Cloud Interactions - Graham Feingold

Coupled Modeling Systems that allow for Aerosol/AirQuality/Weather/Climate interactions - Georg Grell

Wrap-up & Outlook - John Ogren

Discussion