

Health Effects of PM from Fires in Equatorial Asia

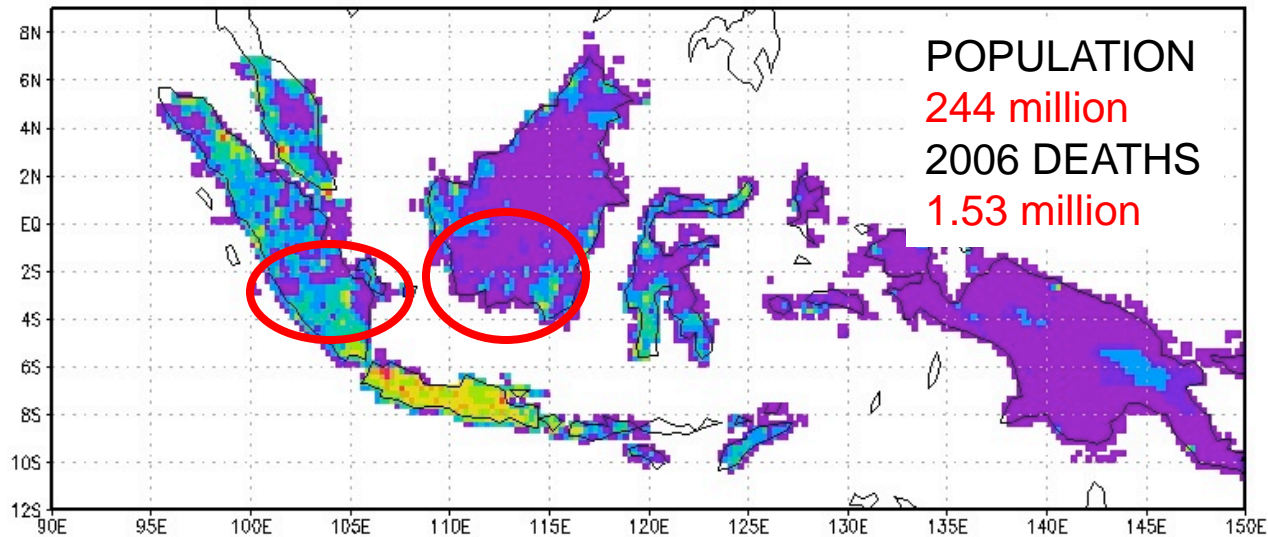
Prasad Kasibhatla
Duke University

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with help from
A. Donkelaar, S. Philip, R. Yantosca, M. Payer
and
the GFED Team

FOCUS ON EQUATORIAL ASIA

EQAS POPULATION DISTRIBUTION



LFS Mortality Estimates in SE Asia

Johnson et al.(2012) vs Marlier et al. (2013)

El Nino: 296,000 vs 13,000

La Nina: 43,000 vs 1,800

-> all-cause vs CPD+LC

→ region definition

→ counterfactual

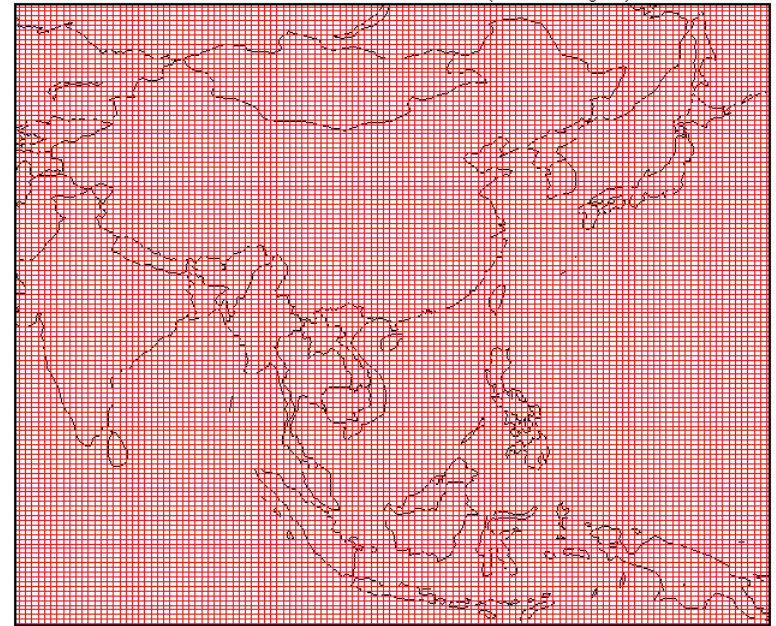
Both studies used 2x2.5 GC → Does model resolution matter?

GEOS-CHEM MODEL

- v9-01-03
- GEOS-5 meteorology
- Resolution
 - Global 4° lat x 5° lon
 - Global 2° lat x 2.5° lon
 - Nested SE Asia grid at 1/2° lat x 2/3° lon
- Standard model gas-phase NO_x-VOC-O₃ chemistry and aerosols, no SOA
- 3-hourly GFED3 fire emissions

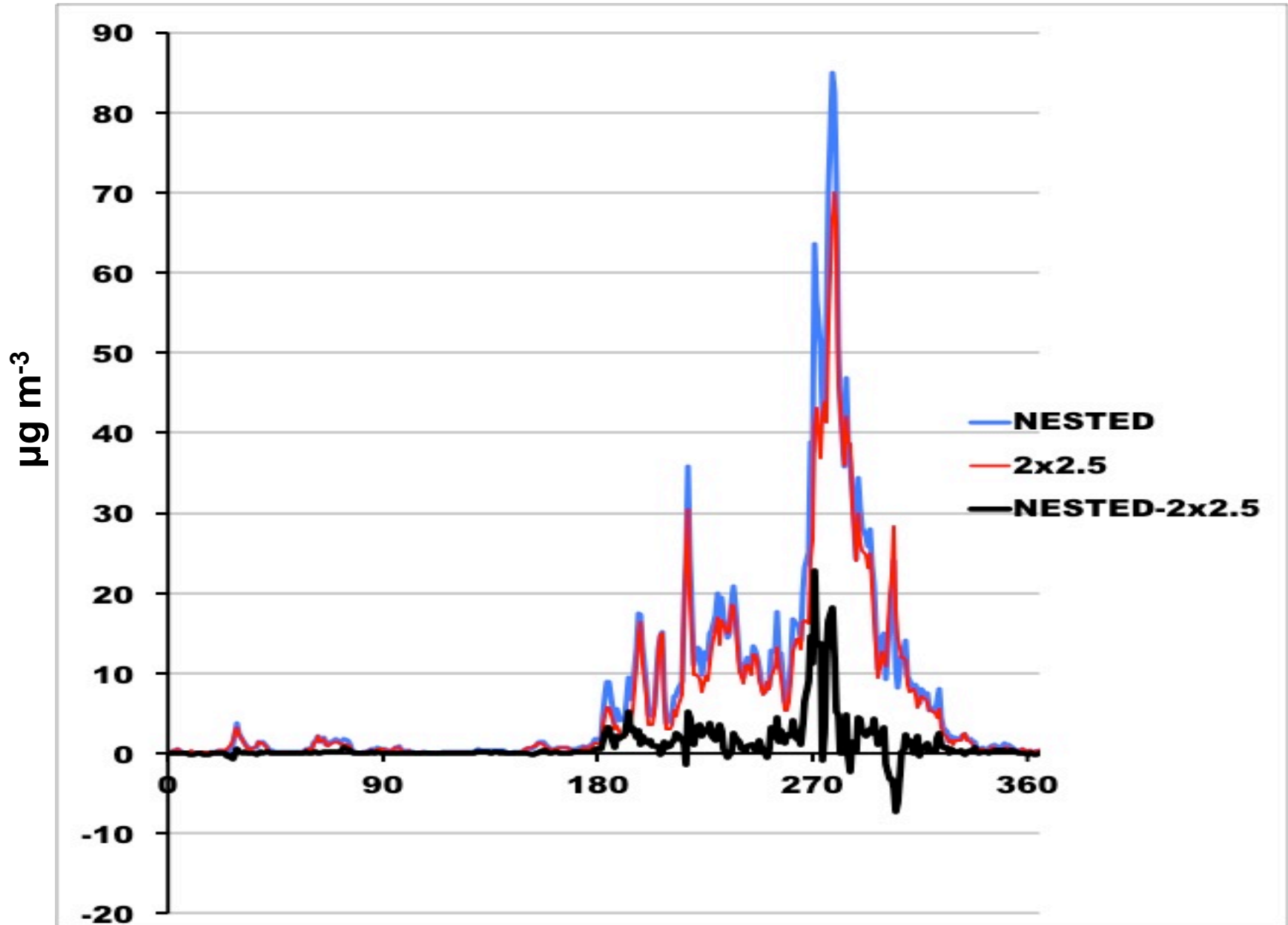
NESTED GRID DOMAIN

GEOS-Chem 0.5 x 0.667 resolution (SE Asia region)



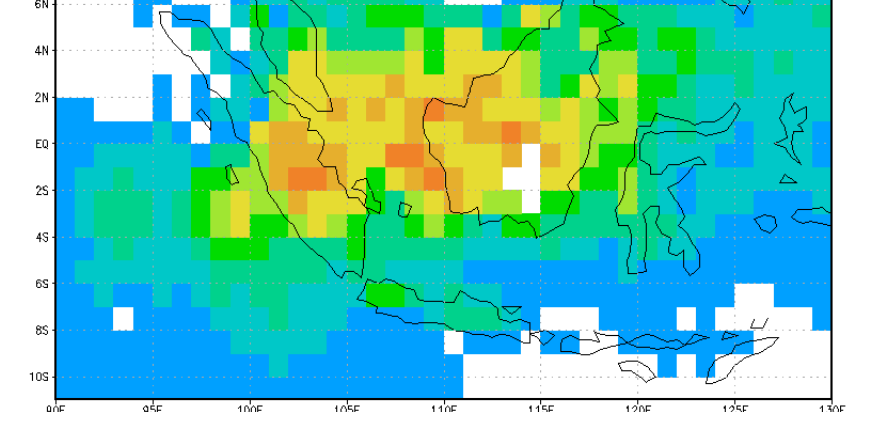
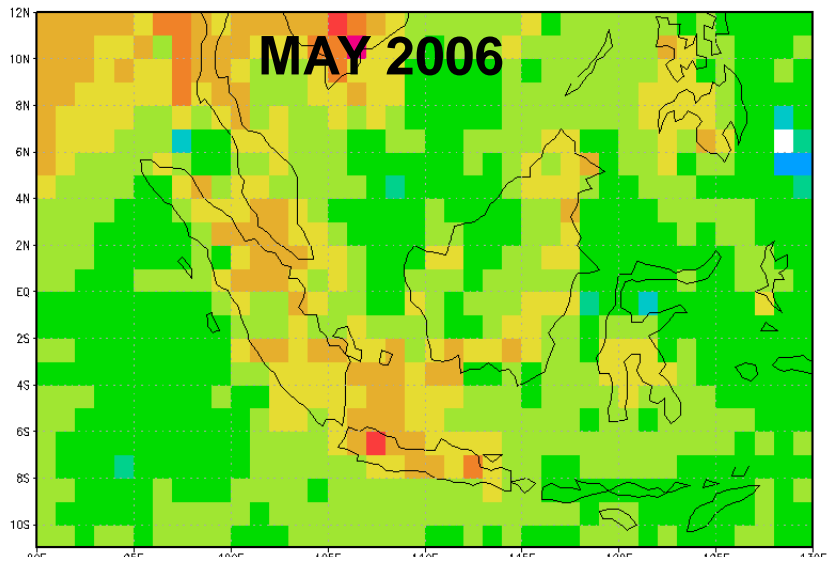
Simulations with and without fires for 2006

EQAS POP-WEIGHTED SURFACE PM2.5 FROM FIRES

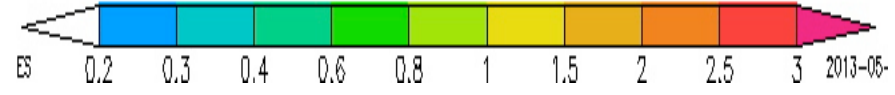
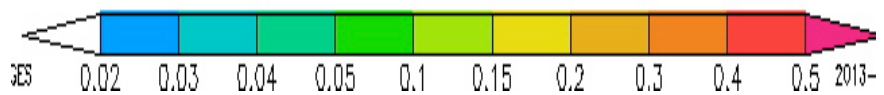
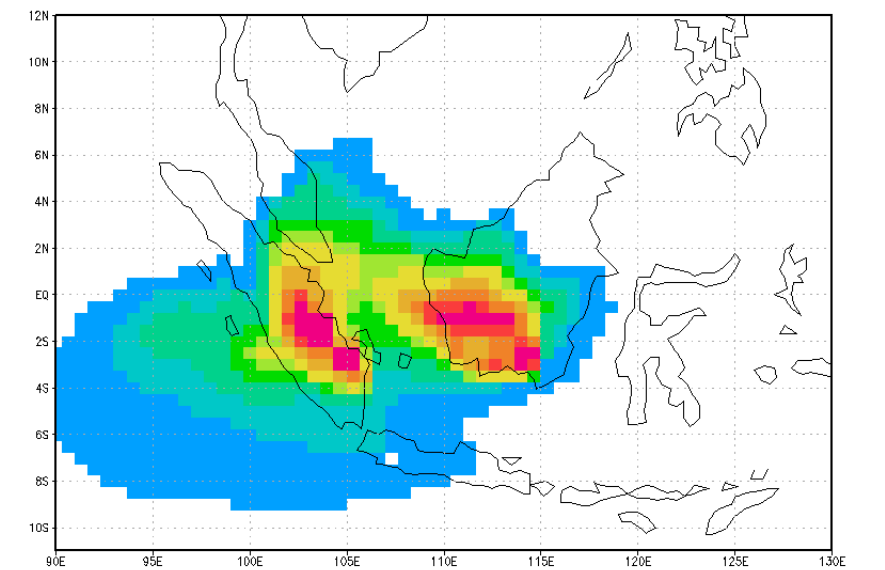
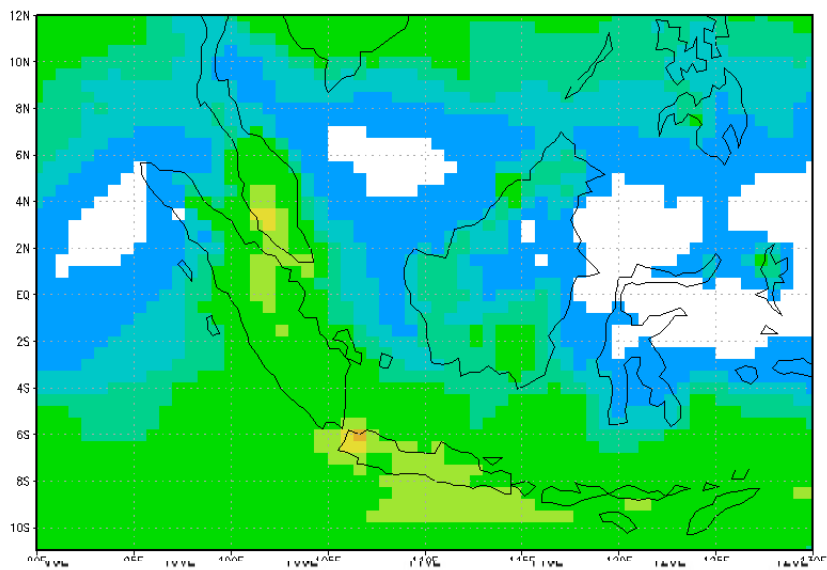


NESTED GC VS AQUA MODIS L3 AOD

AQUA MODIS L3

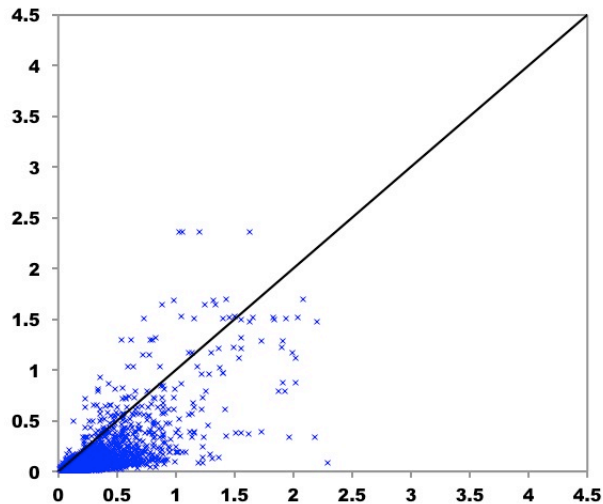


NESTED GC



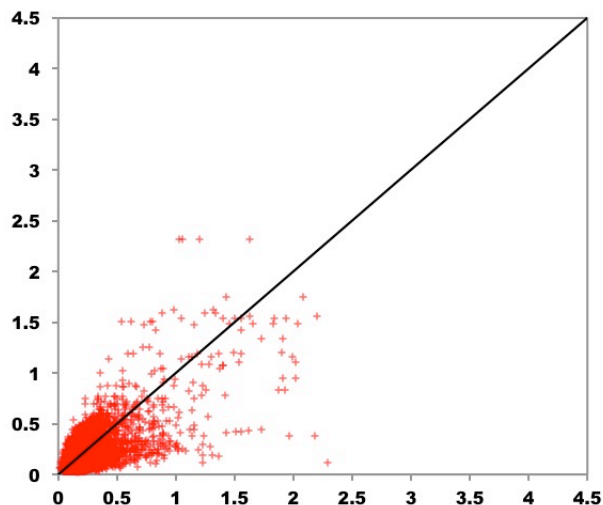
Scaling GC AOD to L3 AQUA MODIS AOD over Equatorial Asia

2x2.5



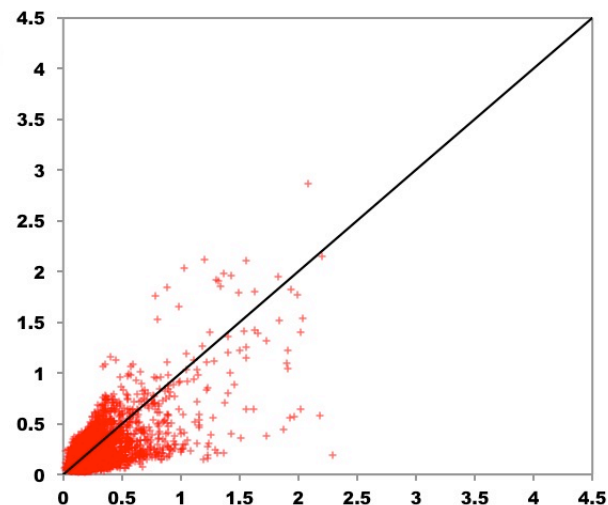
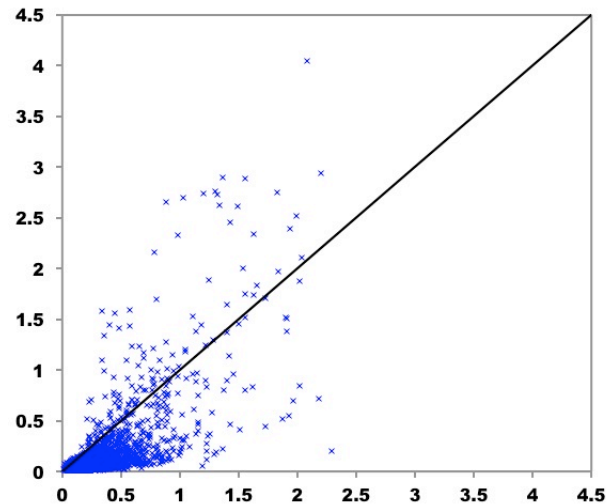
× GC

+ GC-adjusted



$$\text{AOD}_{\text{MODIS}} = 3.13 \text{AOD}_{\text{GCnofire}} + 0.84 \text{AOD}_{\text{GCfire}}$$

NESTED



$$\text{AOD}_{\text{MODIS}} = 2.99 \text{AOD}_{\text{GCnofire}} + 0.60 \text{AOD}_{\text{GCfire}}$$

ALL-CAUSE MORTALITY FROM 2006 FIRES: METHODOLOGY

Fire-related mortality $FM = \sum_i P_i \times M_i \times [1 - 1/RR(\Delta PM_{2.5} \text{scaled}_i)]$

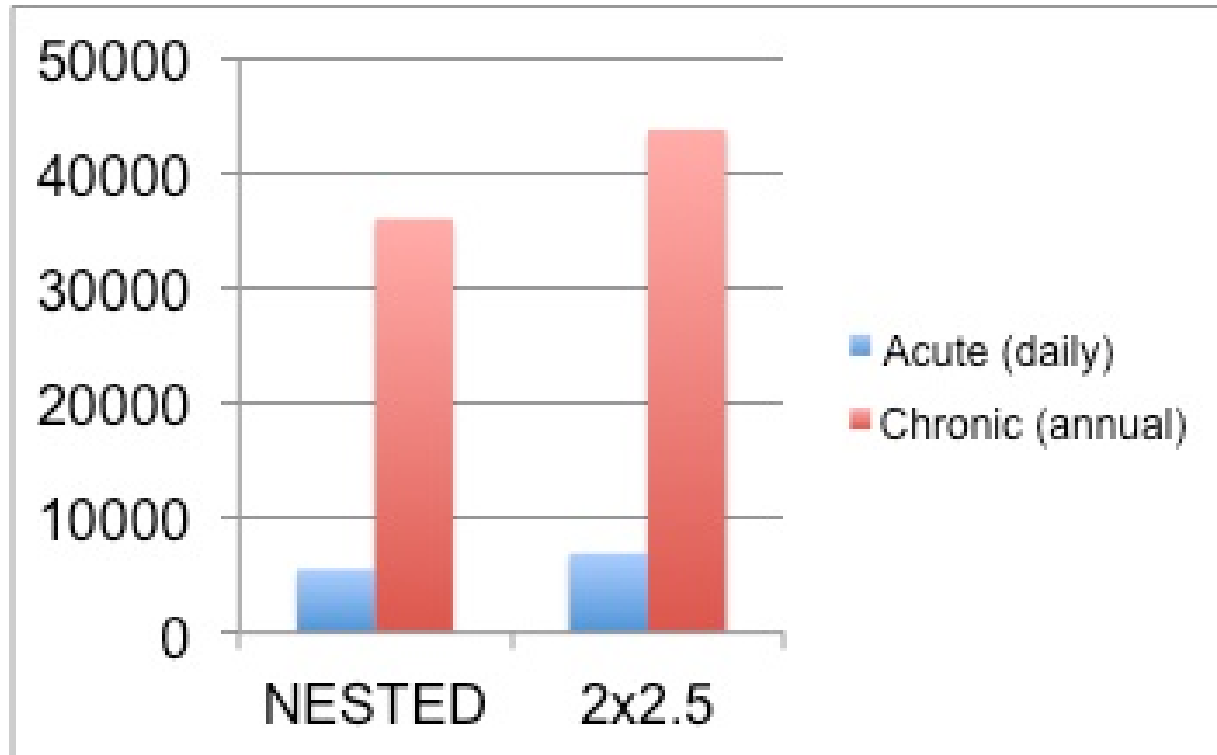
- i = grid box index
- P_i = Population in grid box i (source: CIESIN GPWv3)
- M_i = Mortality rate in grid box i (source: GBD 2010 country-specific rates)
- $\Delta PM_{2.5} \text{scaled}_i$ = Scaled GEOS-Chem 24-h $\Delta PM_{2.5}$ in grid box i
- RR = Relative risk for **all-cause mortality** due to $PM_{2.5}$

(source: Johnston et al, EHP, 2012)

$$RR(\text{daily})_i = 1 + 0.0011 * \Delta PM_{2.5} \text{scaled}(\text{daily})_i$$

$$RR(\text{annual})_i = 1 + 0.0064 * \Delta PM_{2.5} \text{scaled}(\text{annual})_i$$

ALL-CAUSE MORTALITY FROM 2006 FIRES: RESULTS



- ~40-50,000 deaths (out of a total of 1.53 million deaths) due to fires
- Mortality associated with chronic exposure more important for PM
- Similar estimates for nested and 2x2.5 GC resolution
Nested GC estimate is ~20% lower – due to AOD scaling

FUTURE WORK

- Use screened AOD satellite measurements (Quality Controlled L2)
- Estimate all-cause mortality as sum of cause-specific mortality using cause-specific mortality rates and cause-specific relative risk
- Extend to SEAS and multiple years