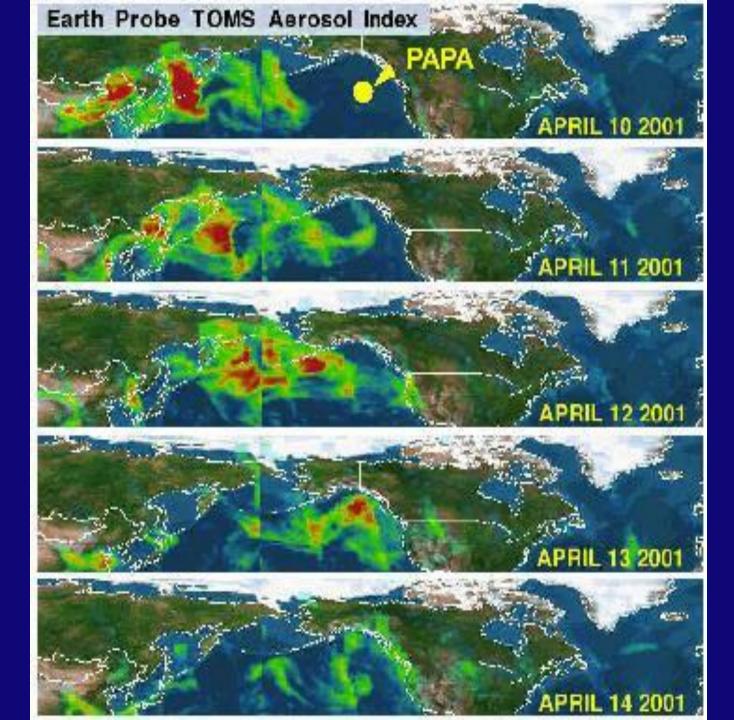


# AIR POLLUTION AND HEALTH

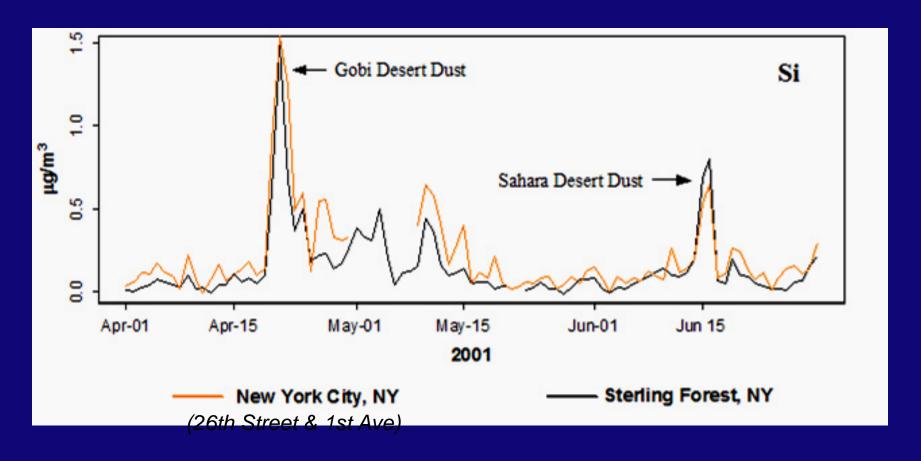
George D. Thurston, ScD.
Professor
NYU School of Medicine

Pollution
Travels Long
Distances:

NASA Satellite
Images of the Gobi
Desert Dust Plume
being Transported
Across the North
Pacific and into the
U.S.



# Trans-Ocean Transport: Chinese Desert Dust Particles Travelled All the Way to NYC



### GBD Study Updated with Improved PM2.5 Effect Estimates

## THE LANCET

#### The Global Burden of Disease Study 2010



The Laws AND WINE THE SANDAY MADE SHAPE THE THE DESCRIPTION OF A STATE OF THE SANDAY MADE IN THE SANDAY MADE REPORTE INCIDENCING A TO SEE THE METERS CONTROL FOR SECURITIES AND ADDRESS OF SECURITIES AND ADD

Provided SRES- Published would



A comparative risk assessment of burden of disease and injury attributable to 67 risk factors and risk factor clusters in 21 regions, 1990-2010: a systematic analysis for the Global Burden of Disease Study 2010

Halforn's Kaleur's Martin Asset, Charles Alleman's Jonaine What har "Adi'th Adaptive Digitary Baltiminhous", principalment Number Other, Americk Report, District Hill, 2007 Blood, From BigDY, Carina Borner, California Bager Finger Financia Make Browning, "District Brown", New Brook: "Algo's Brown", Brick Browning", (New Brown), Charles Brown, Charle Finantial", dishord Citizens C, Fan I Barra", Birana Calabert', Josephan Company C, Fordy Commban', Son Dially', Francis Darbon', Honglei Clear' Supplieding ", Adrigo Doub", Louis Department", Force Commert, Don't Too India'r, Sonn Sonia'r, 66 April Difensil', Fish Libral Ettiy Chingy", Tile Chicali", Karle Edmond", Suid-Effetir Ali' Associad Grydl", Patrica Elman", Samuel Astoni", Sail Fabler', Associad for Also Farrage T. Minut M. Francisco T. Arth. Floridate T. Happer S. Francisco T. May Printer S. M South Chief Chief Compression, Address South States and an Indian States Chief Court, Should Second, Holy Printeres Wayne Half Store William Street Stores Hager' & Darry Respond W. Sansten Hart Hassan Hart Boson (Hobbill Safe) Safe (Hospital) Subject Floring Commercial States (Subject States States Floring States Young He Blang", Shehab Chatthoodh", Inn Paul Blook, Chidy Kolf", Preceive Lader, Aprilla Lallair, Jong Lan', Tim Lat New Y, Janet Li Jan New Y. pimat Lagh", Yong 1", Jakonton Lim, Stiverni Lighteto", Stephonis Limbor, Aldad Lournet, Yose Lim, Jedh Meil "AvenMelekoete colo Mallouri - Manuel Manuel - Lin Month India Month Tourist Manuel - Pro-1805-bir - John McColo V. Sond Mohry - Const Mohry Step Willemonto", Hierata Micha", Cacherine Michaele", Noochthalvel", Chapeypali World Hongleit", Alt A. Atabidal", Lafe Monyolat', Out-of-Manufacture", Nacha Morphy", Adoleses Maghani", Hani P. Neid P. Neiders II, Joan Hilliam Market, France Market, Corry (Street Sport Oner", pusion Section F. School Delement, Burt Devel. Andrew Page", Flore I Francis: ", Daylor Delement, Distriction of Section Page 1 Residences, Parieta M Philipper, Alba Patriotal, Alla hair Philippe, Don Paper, Challes Paper III, John Frenker, Mayures (1921, Herrien Respect that A Markers' Joges P Bales's Team RDS' Fragenck P Rooms' Thomas Roberts' Caroles Malescon', Jose P Madelgoo's Fortake's Nadelli Norman Balandinan'', Lieu' Banneliki'', Imanyalikiy'', Lesliy Bulklav', Jalikua A Salaman'' (I) bulkulun langana'', Lilia Sarahay Basa'' Alki'isa matr And Septem? Some Septem Paths Str., Rose World Street World Street Street Mingle? Despite Street, Francis Stre Blacks I Chapelbook", Epit Systelinet", Head StateP, Lett James ", Burt Straff", Lake Strange", George O'Photosom", James H. Free " Big No. Biggrent, Austra op Sockstudt, A. const Normant, Latcher Nazulainner, Betart Weistrach M. Marc Bi Weissen, Til Nort A. White' Haras Mitchell', Janes Fillerster', James Fillerster', April City Millerster, Warrell Millions', McKelly Millerst, Access (1994) Paul Fy'.

SHART STATE OF THE PARKS in Comment pages 2003, 2004. SEAS, MARK, BARK, SHEEK m67066

De Malabanage 2001, 1996. 23,116,754 e-0.00

Seem LA and Everyonic

maketa for beautiful debics

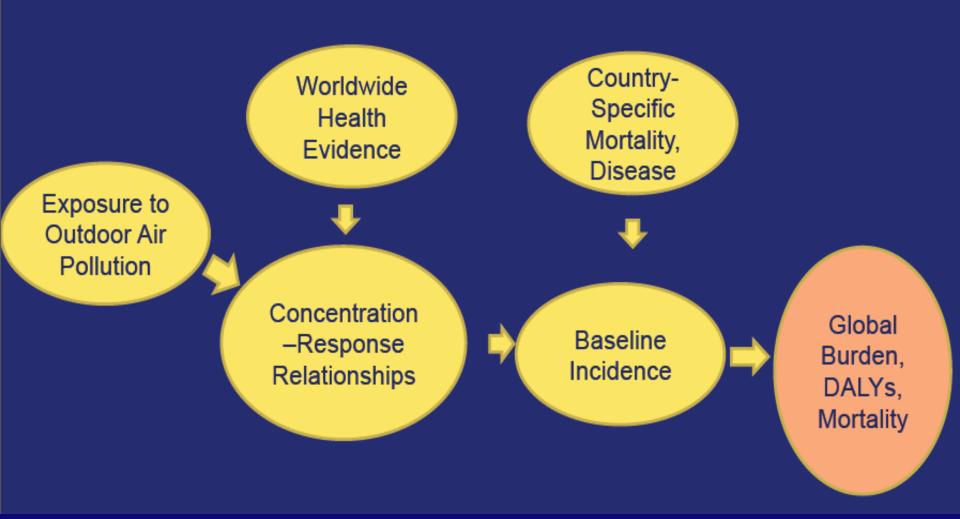
Sadgment Quantification of the disease hardes cannot be different risks inform prevention by providing an account of health loss different to that provided by a disease-by-disease analysis. No complete revision of global classes burden trassed by tisk factors has been done since a comparative risk assumment in 1900, and no previous analysis has assessed changes to burden attributable to risk factors over tirus.

tterious We estimated deaths and disability-adjusted life years (DALYs; sum of years fixed with disability [YLD] and years of life lost (YLI) attributable to the independent effects of 67 six factors and closters of risk factors for 21 regions. in 1996 and 2006. We estimated expanses distributions for each year, region, sex, and age group, and relative risks per unit of expusure by sovernatically reviewing and synthesisting published and unpublished data. We used these estimates, tagether with estimates of cause-specific drafts and DACTs from the Global Bustless of Disease Study 1990, to calculate tention to barden attributable to each risk factor exposure compared with the theoretical-minimum-risk exposure. We incorporated ancertainty in Geome burden, relative risks, and exponents into our estimates of attributable burden.

> Findings In 2010, the three leading risk factors for global disease burden were high blood pressure (2-2%) 1995, ancertainty interval 5. 2. 7. 71 of global DALW), tobacca sensiting including second hand mode of 1945-5-7-83. and alcohol use (5-5% [5-0-5-39]. In 1990, the leading risks were childhood underweight (7-5% [6-0-5-4]). bassehold six pollution from solid finds (HAP: 7-8% [5-6-5-3], and toluous amoking including second-hand wasks (5-1% (5-4-6-8)). Distary risk factors and physical inactivity collectivity accounted for 18-9% (55%) ULS 3-30-6) of global DAITs in 2018, with the most preminent distary risks being diets low in fruits and those high in sodium. Several risks that primarily affect childhood communicable diseases, tacheling uningroved water and numbries and childhood micromation deficiencies, fell in such between 1990 and 2018, with unimproved water

warministration fold the December 2015/15, 1903

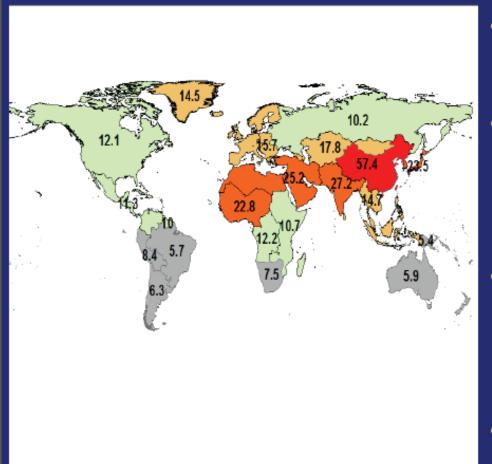
## Estimating the Global Burden of Disease due to Ambient Air Pollution



### Exposure Assessment for Estimation of the Global Burden of Disease Attributable to Outdoor Air Pollution

Michael Brauer,<sup>4,,†</sup> Markus Amann,<sup>‡</sup> Rick T. Burnett,<sup>§</sup> Aaron Cohen, <sup>∥</sup> Frank Dentener, <sup>⊥</sup> Majid Ezzati, <sup>#</sup> Sarah B. Henderson, <sup>▽</sup> Michal Krzyzanowski, <sup>○</sup> Randall V. Martin, <sup>♠,‡</sup> Rita Van Dingenen, <sup>⊥</sup> Aaron van Donkelaar, <sup>♠</sup> and George D. Thurston <sup>+</sup>

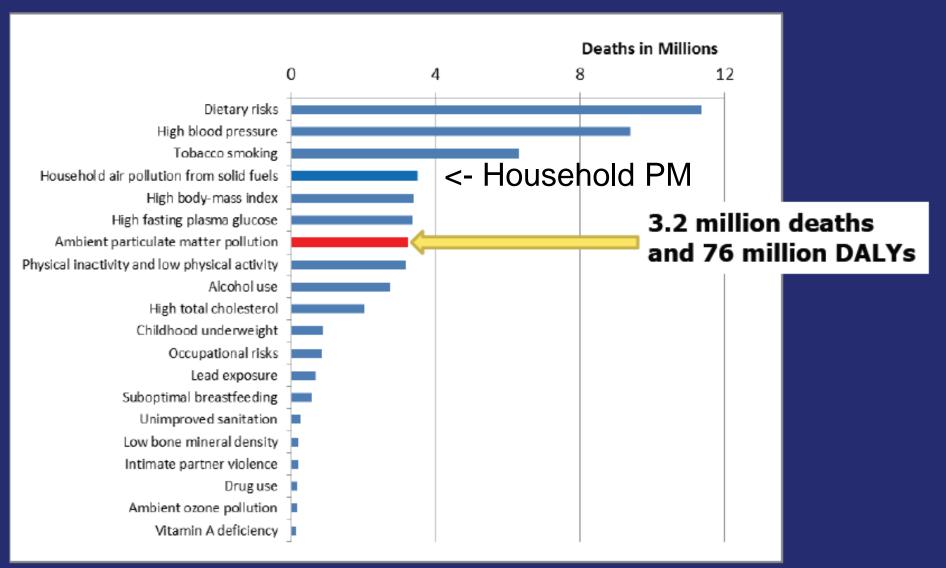
## ES&T Top Science Paper of 2012



- Global estimates of PM<sub>2.5</sub> at 10km x 10km scale
- Combined estimates from satellites (AOD), chemical transport models and groundlevel measurements
- Highest regional averages in East /South Asia - many breathe concentrations much higher than regional average
- 89% population in areas exceeding WHO Air Quality Guideline (10 μg/m<sup>3</sup> PM<sub>2.5</sub> annual average)

2005 population-weighted regional estimated average PM<sub>2.5</sub>

# Ambient PM<sub>2.5</sub> among the leading global risks for mortality and lost years of healthy life in 2010



## Health Co-Benefits of Climate Mitigation Can Be Large if Fossil Fuel Combustion Reduced

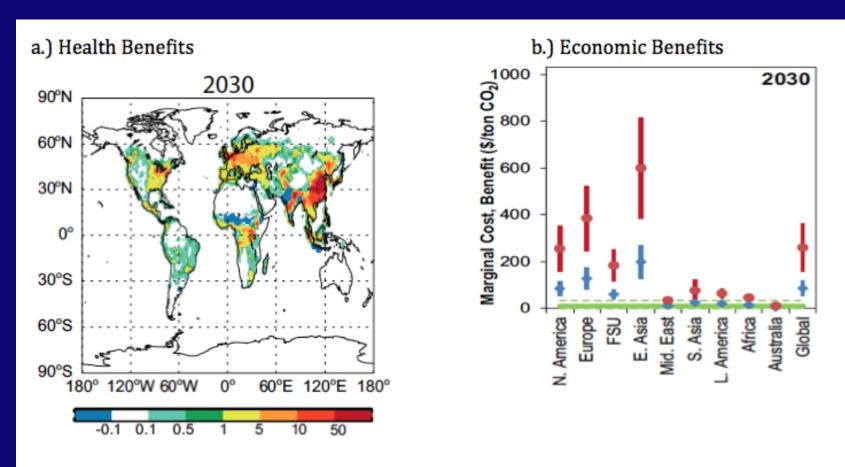


Figure 1. The Health and Associated Economic Benefits of Climate Change Mitigation<sup>4</sup> a.) the premature mortality (due to Cardio-Pulmonary Disease, CPD, plus lung cancer) from PM<sub>2.5</sub> in 2030 (deaths per year per 1000 km<sup>2</sup>) avoided by climate change mitigation measures; b.) the range of associated marginal benefits (\$/ton CO<sub>2</sub>) by region (Red: High Estimate, Blue: Low Estimate), relative to the range of expected mitigation cost (Green lines) achieved by climate change mitigation. Reproduced from West et al.