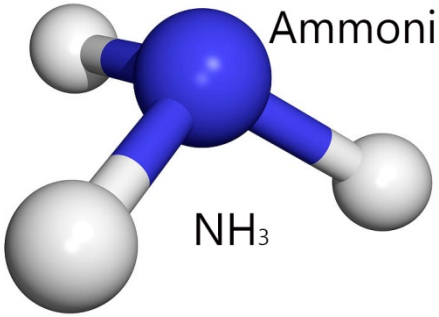
Ammonia, Particles and Health



Bert Brunekreef, PhD
Institute for Risk Assessment Sciences
Utrecht University, NL

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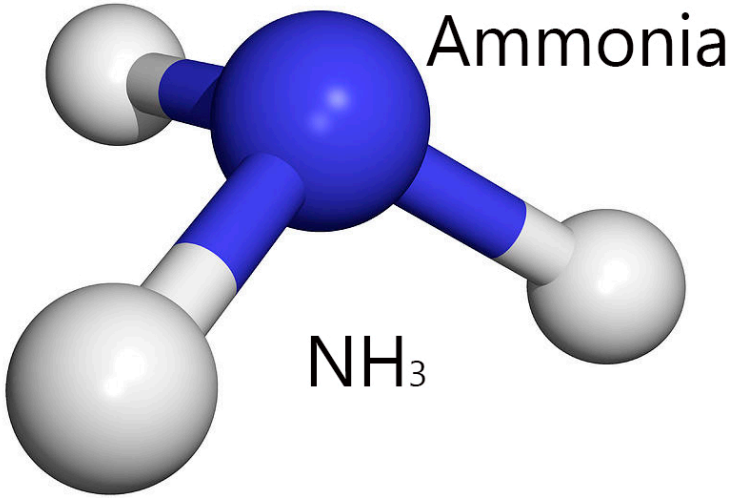
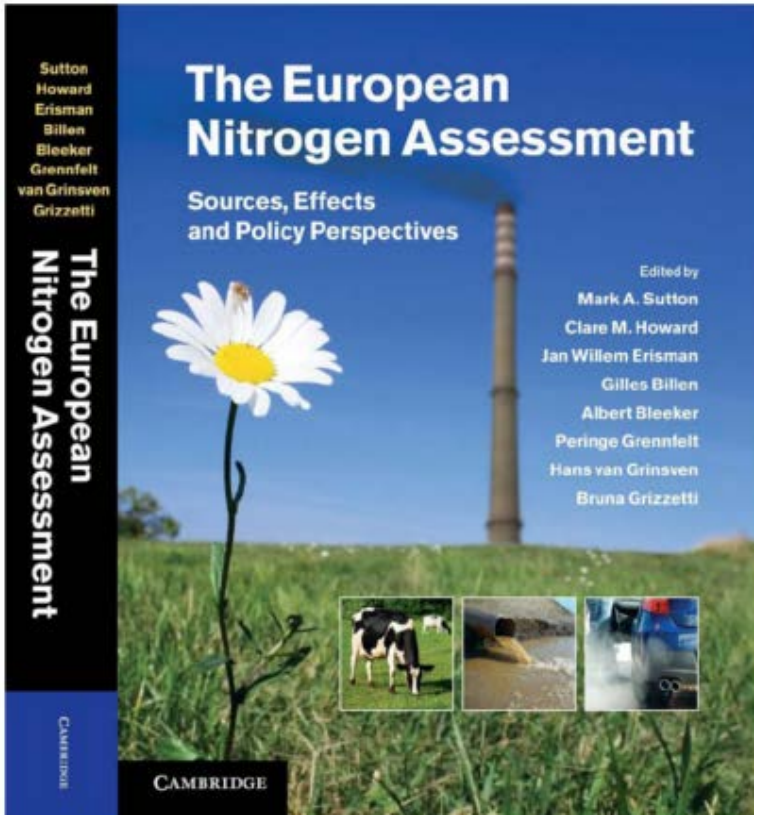
Ammonia all by itself…



- Odor threshold ~ 3 mg/m3
- Irritation at ~20 mg/m3
- Outdoor concentrations typically < 0.05 mg/m3

Ammonia contributes significantly to formation of Secondary Inorganic Aerosols (SIA ~ Ammonium Sulfates and Nitrates) which make up a large part of Fine Particles, PM2.5



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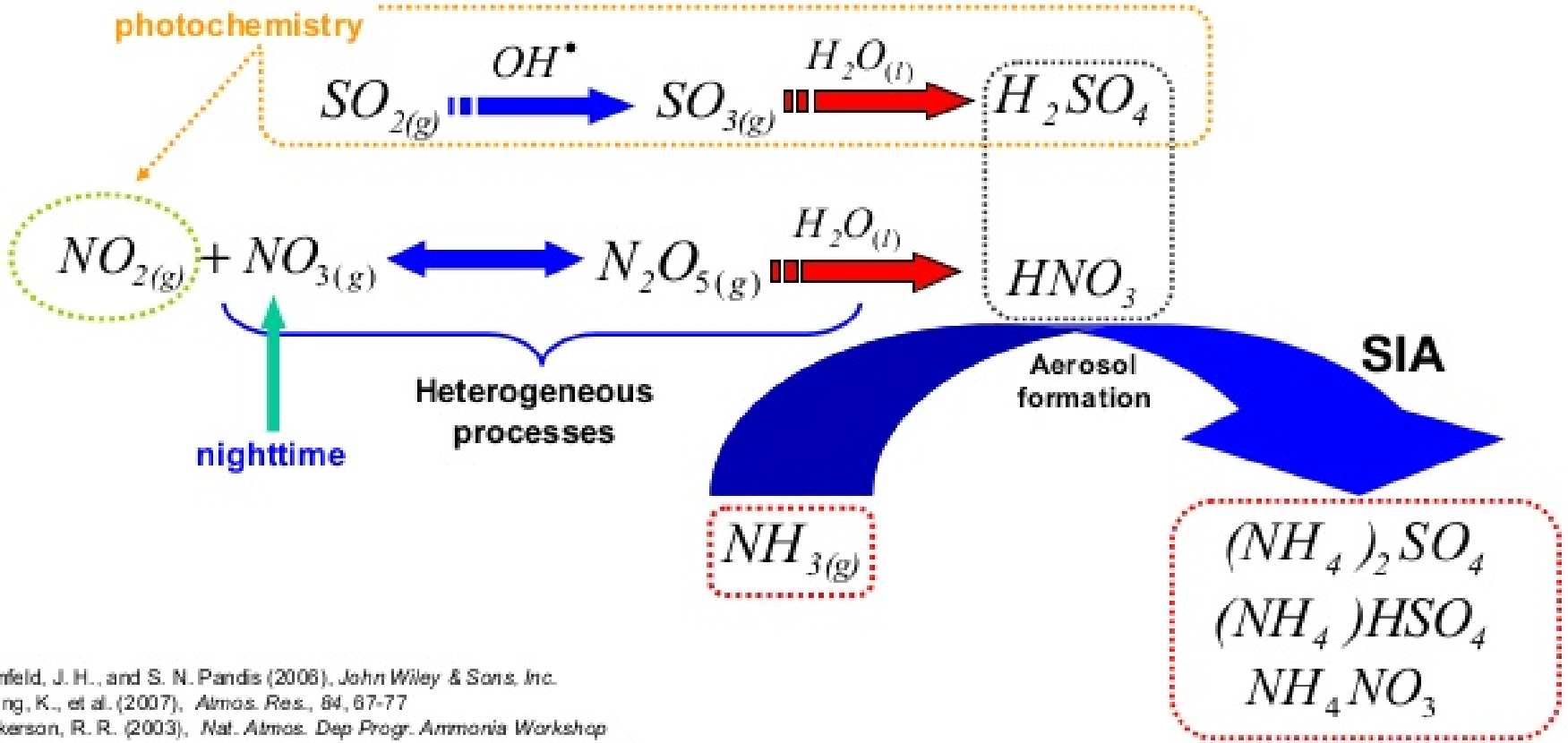
Aqueous phase photochemistry of SO_2 and NO_2

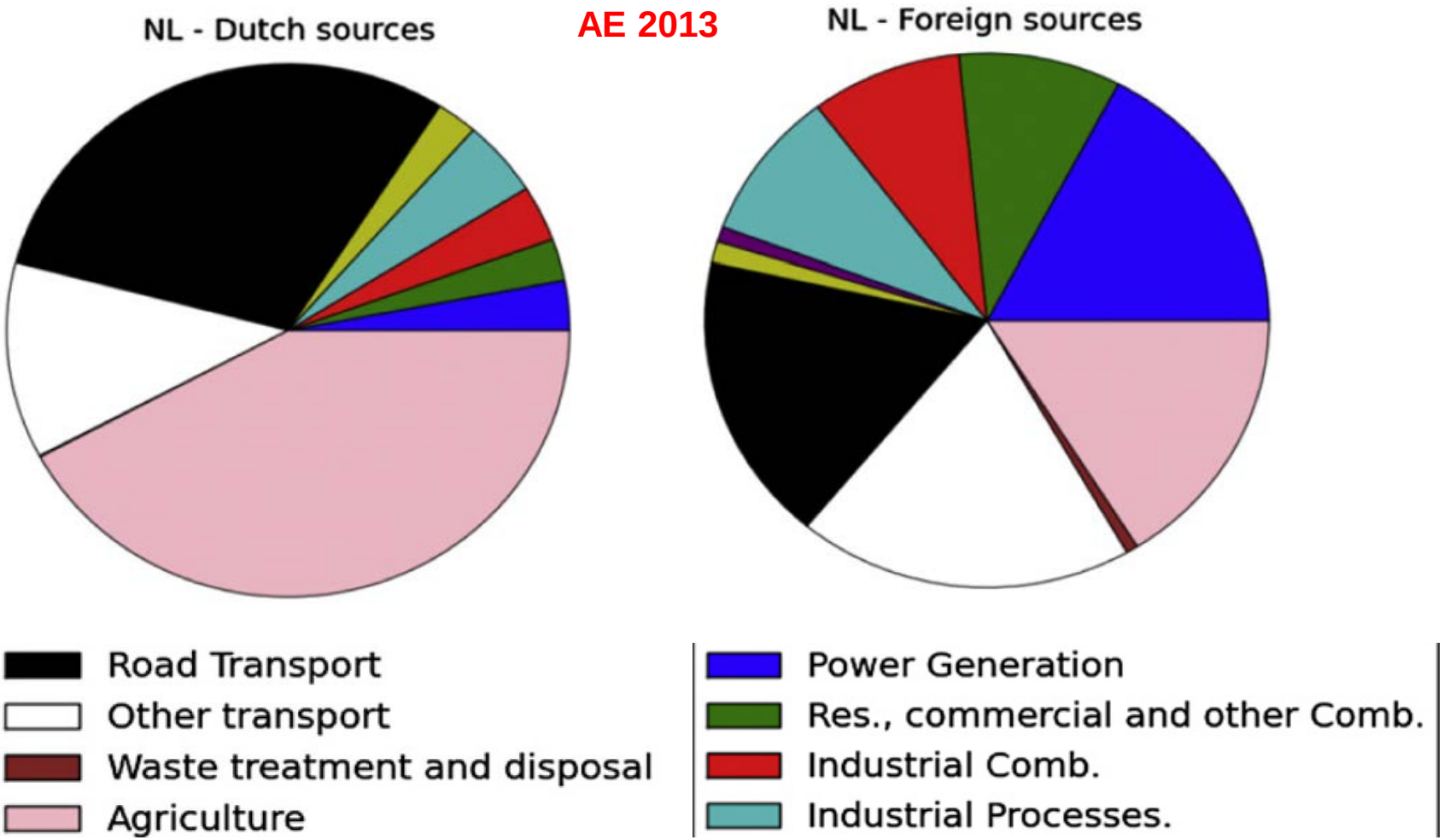


Seinfeld, J. H., and S. N. Pandis (2006), *John Wiley & Sons, Inc.*
Zhang, K., et al. (2007), *Atmos. Res.*, *84*, 67-77
Dickerson, R. R. (2003), *Nat. Atmos. Dep Progr. Ammonia Workshop*
Finlayson-Pitts, B. J., and J. N. Pitts, (2000), *Academic Press: San Diego*
Karagulian, F., and M. J. Rossi, (2005), *7(17)*, *Phys. Chem. Chem. Phys.* 3150-3162

The origin of ambient particulate matter concentrations in the Netherlands

Carlijn Hendriks*, Richard Kranenburg, Jeroen Kuenen, René van Gijlswijk, Roy Wichink Kruit, Arjo Segers, Hugo Denier van der Gon, Martijn Schaap

AE 2013



The Economist

Car ban in the French capital

Paris in the smog

Mar 17th 2014, 12:33 by S.P. | PARIS

Timekeeper Like 193 Tweet 33

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Feedback on and analysis of the PM pollution episode in March 2014

Bertrand BESSAGNET & Laurence ROUÏL

19th EIONET Workshop on
Air Quality Assessment and Management
Berne, Switzerland, 30 September and 1 October 2014

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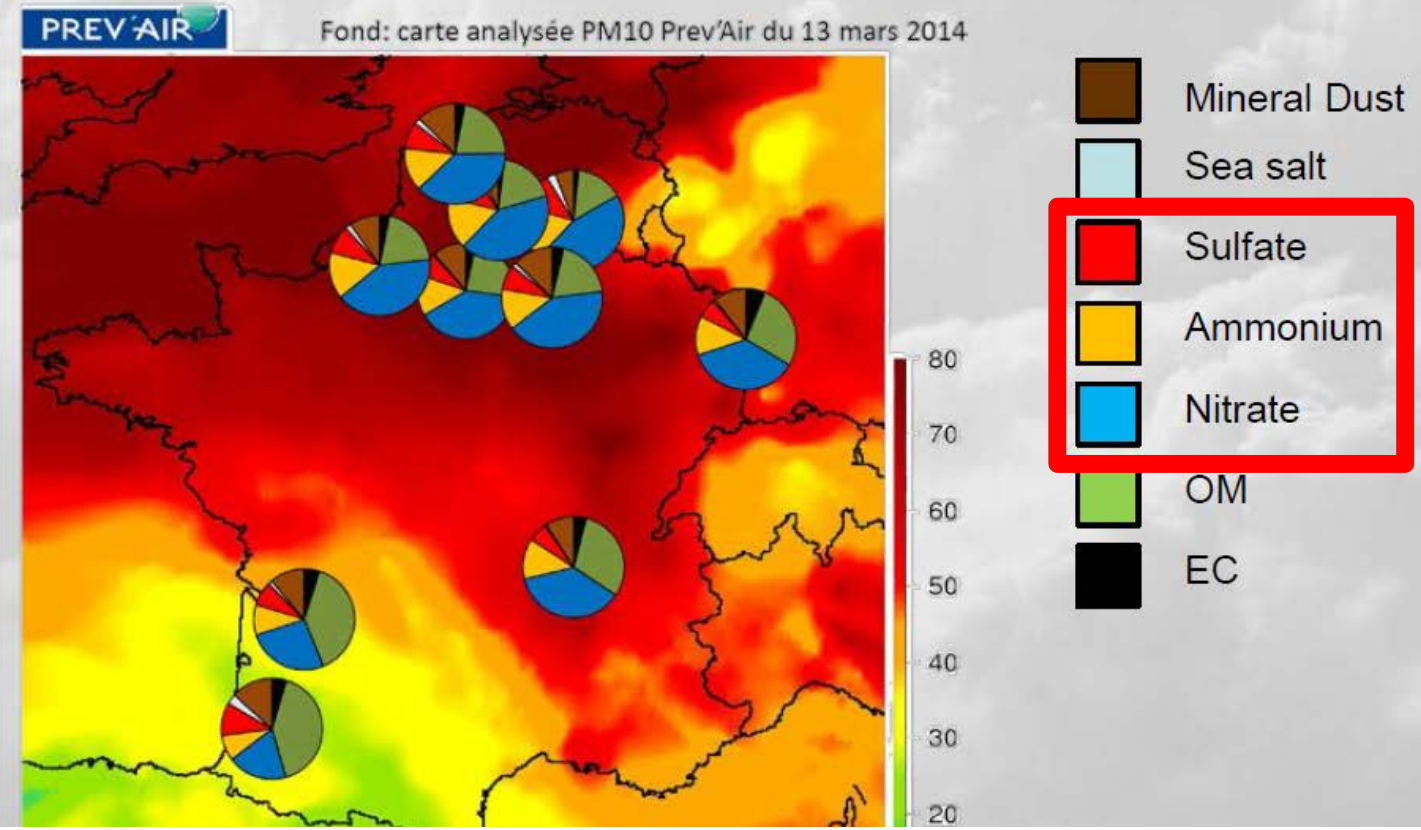
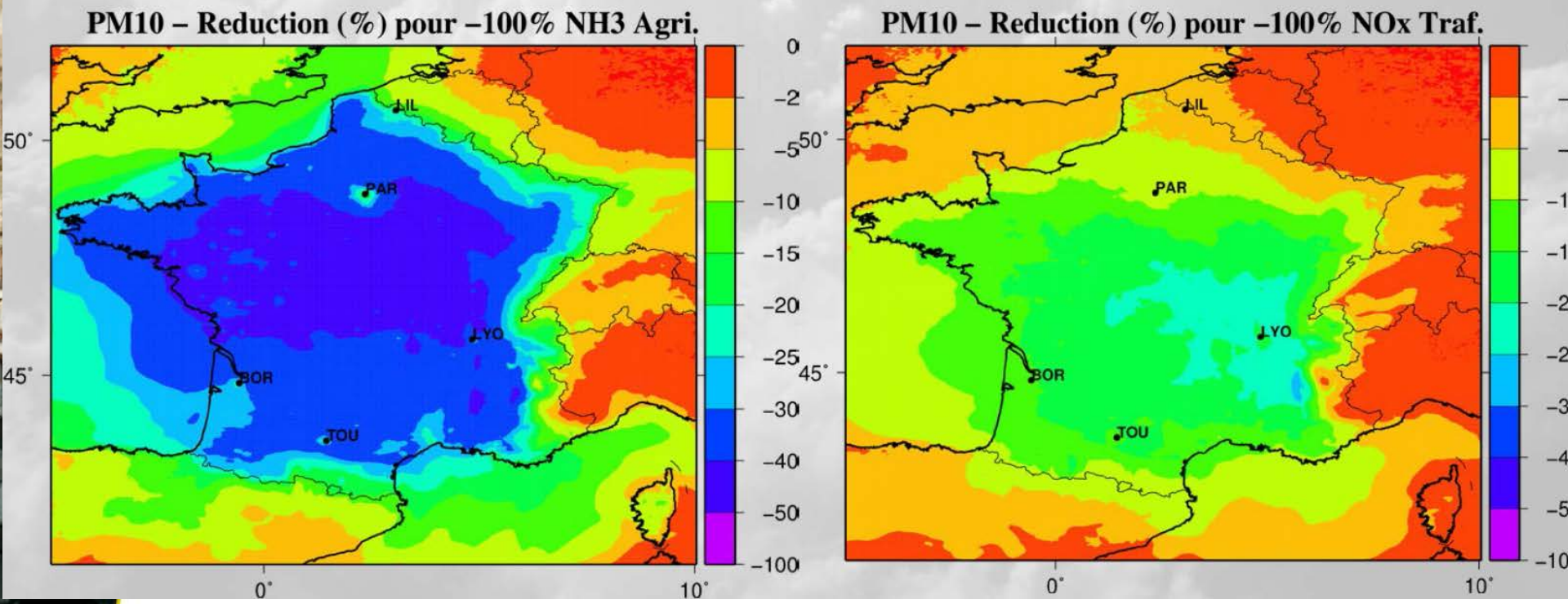
Mean composition observed during the episode with PM10 analized map from PREV'AIR



Sensitivity of emission reductions on PM conc. by removing NH3 from agriculture versus NOx from trafic



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Air Pollution Modeling and its Application XXII

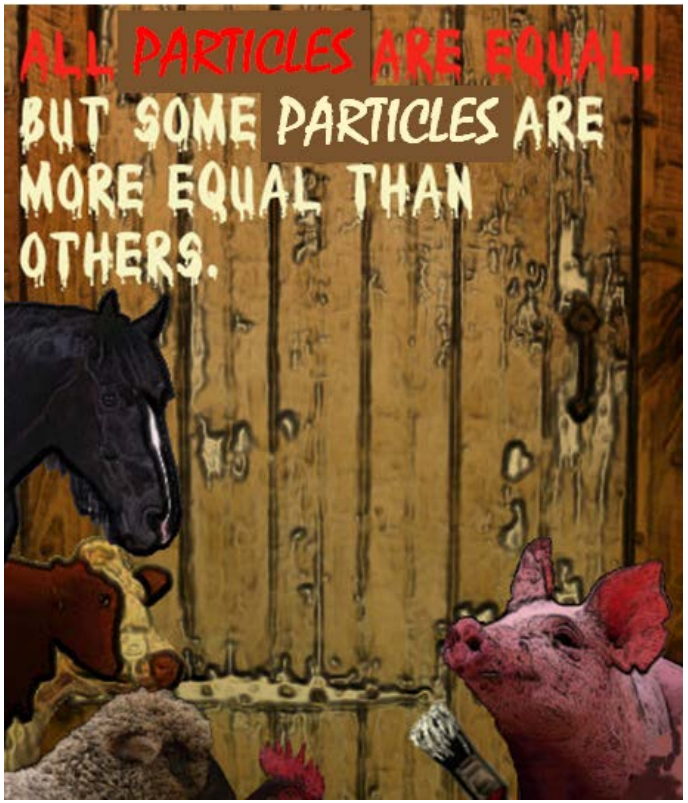
Sensitivity of Fine PM Levels in Europe to Emissions Changes

A.G. Megaritis, C. Fountoukis, and S.N. Pandis

periods to quantify also the seasonal variation. Reduction of NH_3 emissions seems to be the most effective control strategy for reducing $PM_{2.5}$ over Europe, in both seasons, mainly due to reduction of NH_4NO_3. A reduction of SO_2 emissions

2014

Current scientific evidence considers the major PM2.5 components ~ equally hazardous; so, the contribution of NH_3 emissions to adverse health effects of PM2.5 is likely to be large



Review of evidence on health aspects of air pollution – REVIHAAP Project

World Health Organization
REGIONAL OFFICE FOR Europe

2013

Three important components or metrics – black carbon, secondary organic aerosols, and secondary inorganic aerosols – have substantial exposure and health research finding associations and effects. They each may provide valuable metrics for the effects of mixtures of pollutants from a variety of sources.

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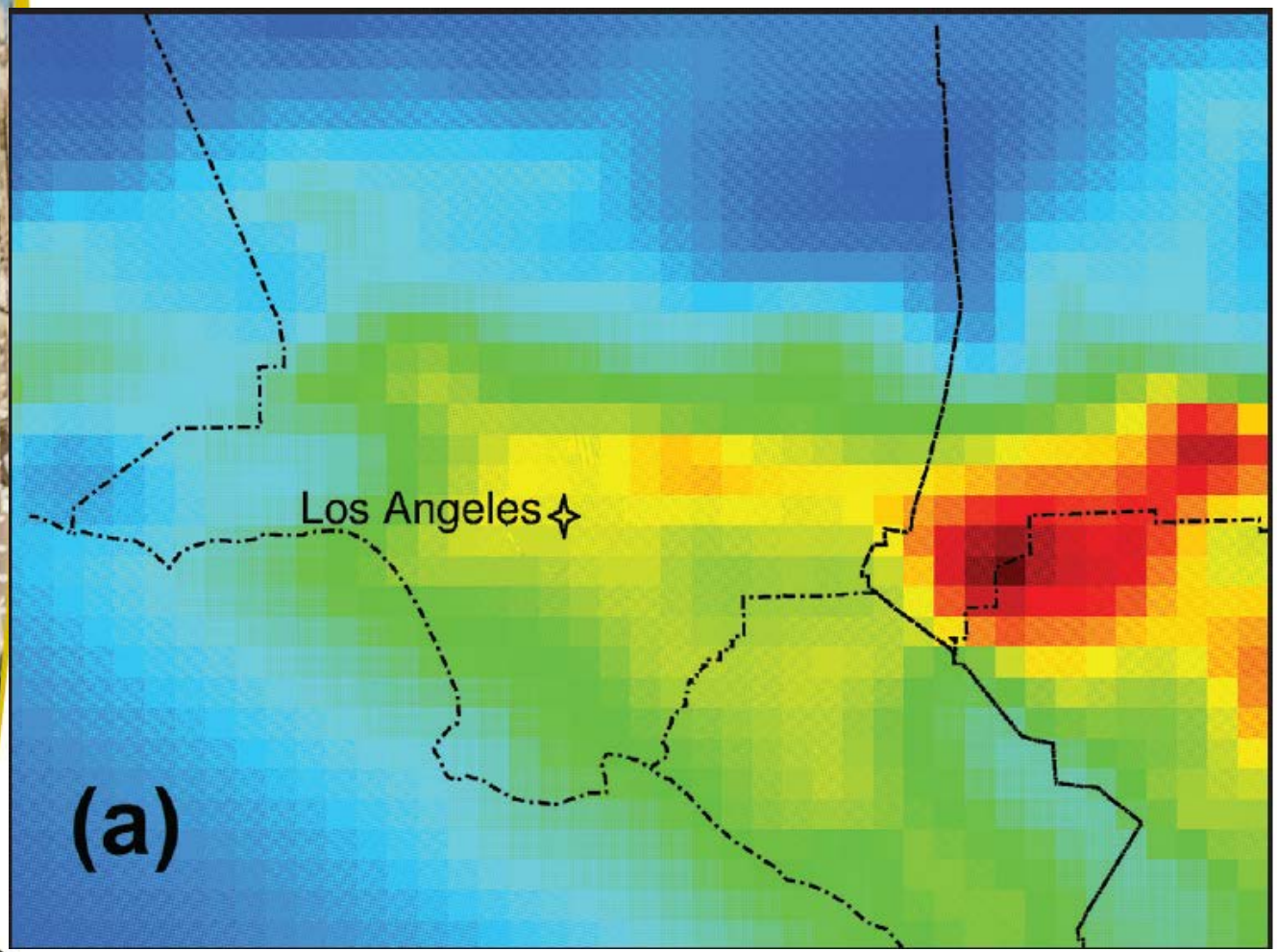
Associations of Mortality with Long-Term Exposures to Fine and Ultrafine Particles, Species and Sources: Results from the California Teachers Study Cohort

Bart Ostro,[1] Jianlin Hu,[2] Debbie Goldberg,[3] Peggy Reynolds,[3] Andrew Hertz,[3] Leslie Bernstein,[4] and Michael J. Kleeman[2]



PM2.5

Nitrate

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ehp ENVIRONMENTAL HEALTH PERSPECTIVES

2015

Table 4. Hazard ratios (HR) and 95% CIs for ischemic heart disease mortality for two-pollutant models of $PM_{2.5}$ nitrate with each of the other constituents.

	$PM_{2.5}$ constituent ($\mu g/m^3$)			$PM_{2.5}$ nitrate ($\mu g/m^3$)		
Pollutant	IQR	HR[a] (95% CI)	*p*-Value	IQR	HR[a] (95% CI)	*p*-Value
Mass	9.6	1.03 (0.91, 1.18)	0.61	3.9	1.25 (1.07, 1.45)	< 0.05
Cu	0.4[b]	1.02 (0.94, 1.10)	0.67	3.9	1.26 (1.11, 1.44)	< 0.001
Fe	0.2	0.92 (0.82, 1.03)	0.14	3.9	1.35 (1.19, 1.54)	< 0.0001
Mn	4.0[b]	0.94 (0.85, 1.04)	0.23	3.9	1.34 (1.18, 1.53)	< 0.0001
Nitrate	—	—	—	3.9	1.28 (1.16, 1.42)	< 0.0001
EC	0.8	1.04 (0.94, 1.14)	0.49	3.9	1.25 (1.11, 1.42)	< 0.001
OC	2.8	1.00 (0.91, 1.09)	0.94	3.9	1.29 (1.15, 1.44)	< 0.0001
Other compounds	1.4	0.96 (0.87, 1.05)	0.34	3.9	1.33 (1.17, 1.51)	< 0.0001
Other metals[c]	0.5	0.93 (0.83, 1.04)	0.21	3.9	1.35 (1.18, 1.53)	< 0.0001
SOA_bio	0.1	0.95 (0.86, 1.05)	0.31	3.9	1.34 (1.17, 1.53)	< 0.0001
SOA_ant	0.1	0.97 (0.78, 1.21)	0.78	3.9	1.32 (1.05, 1.66)	0.02

Hidden Cost of U.S. Agricultural Exports: Particulate Matter from Ammonia Emissions

Fabien Paulot* and Daniel J. Jacob

EST 2014

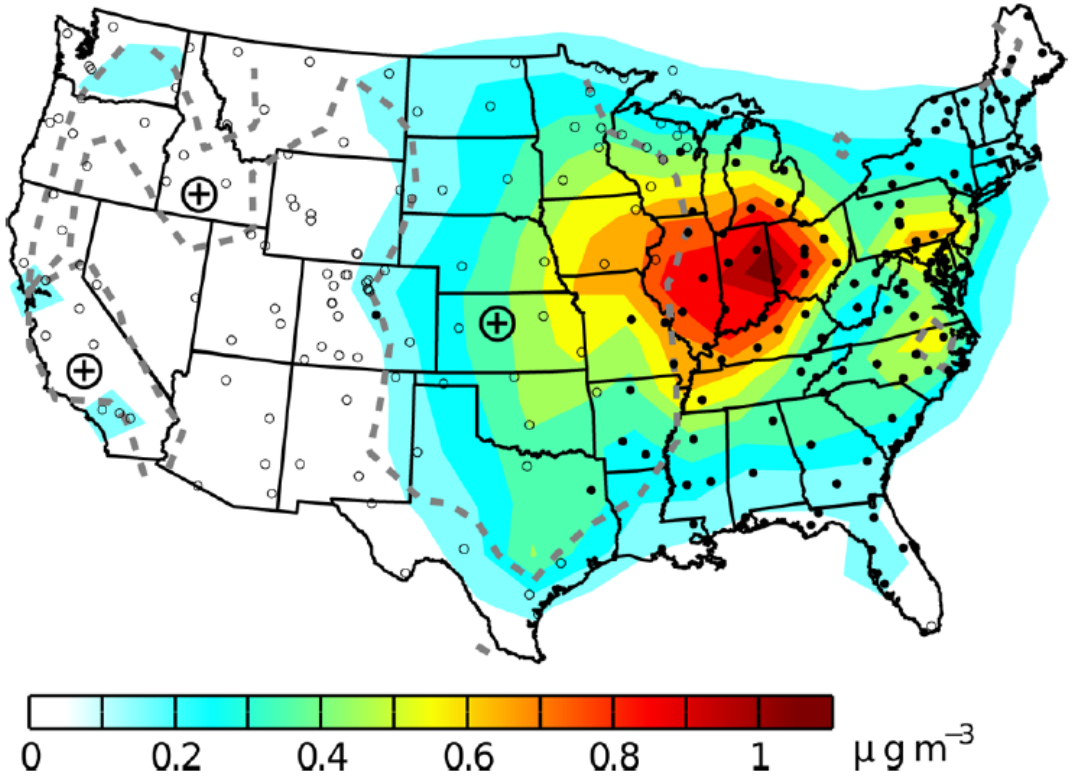


Figure 2. Impact of NH_3 emissions from food export on annual mean surface $PM_{2.5}$ concentration. The GR = 1 contour line is shown as

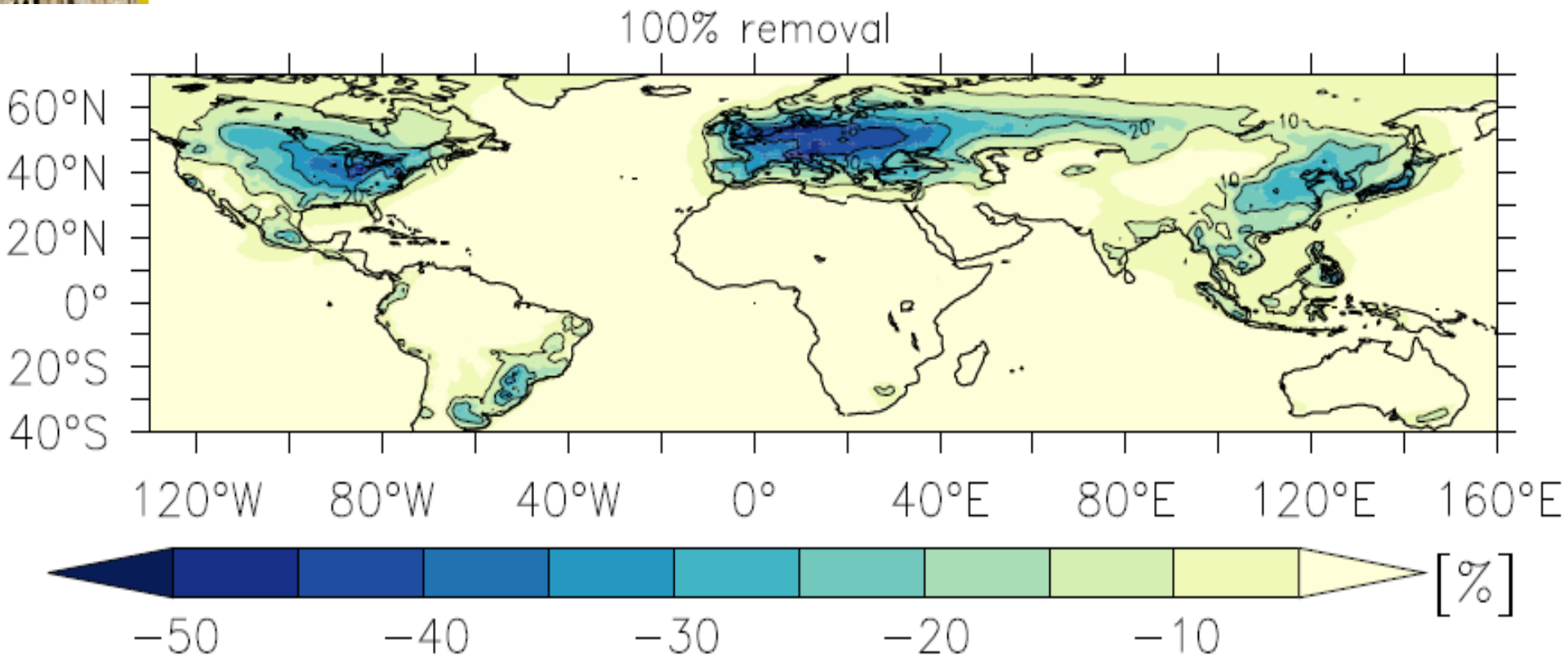
Comparison between the cost of the increased health risk (36 (4−100) billion US$ (2006) for NH_3 emissions alone) associated with agricultural exports and the gross (55 billion US $ (2006)) and net value (23.5 billion US$ (2006)) of these exports (Table 1) indicates extensive negative externalities.

Impact of agricultural emission reductions on fine particulate matter and public health.

ACP 2017

Andrea Pozzer[1], Alexandra P. Tsimpidi[1], Vlassis A. Karydis[1], Alexander de Meij[2,*], and Jos Lelieveld[1,3]

UP TO 50% PM2.5 REDUCTION FROM 100% NH3 REMOVAL

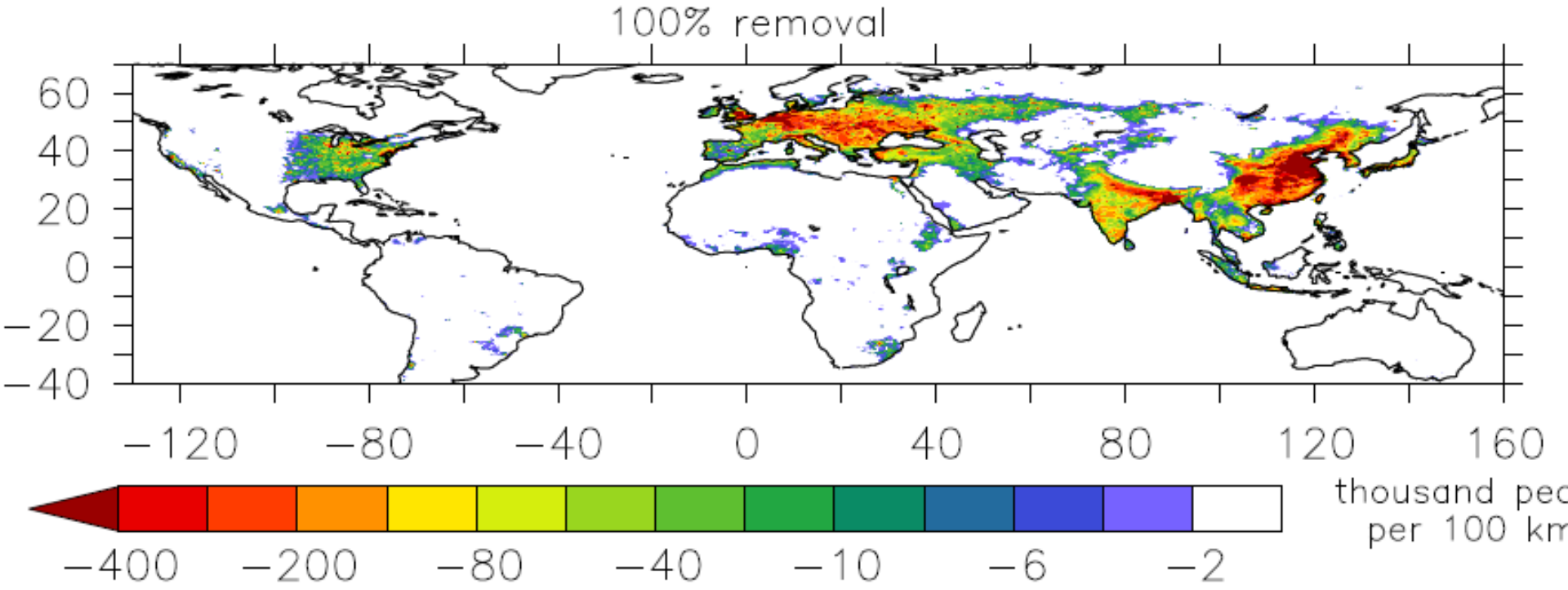


Impact of agricultural emission reductions on fine particulate matter and public health.

ACP 2017

Andrea Pozzer[1], Alexandra P. Tsimpidi[1], Vlassis A. Karydis[1], Alexander de Meij[2,*], and Jos Lelieveld[1,3]

UP TO 800,000 FEWER DEATHS FROM 100% NH3 REMOVAL



Take home messages

- Ammonia (NH3) produces airborne particles (PM) through atmospheric reactions with nitrogen oxides (NOx) and sulfur oxides (SO2)
- Ammonia (>90% agriculture) more important than NOx (~traffic) and SO2 (~shipping, energy)
- All particles ~equally harmful
- Huge health benefits expected from NH3 reduction