SPECIAL PROJECT FINAL REPORT

All the following mandatory information needs to be provided.

Project Title:	Pollution in world regions: analysis of past-trends with sensitivity simulations
Computer Project Account:	sp…
Start Year - End Year :	2013- 2015
Principal Investigator(s)	F. Dentener
Affiliation/Address:	Via E. Fermi 1, 21020 Ispra, Italy
Other Researchers (Name/Affiliation):	Rita Van Dingenen

The following should cover the entire project duration.

Summary of project objectives

(10 lines max)

This SP is the follow up of SP JRCSRC. Within SP JRCSRC the focus was on creating as set of worldwide Source Receptor emissions sensitivity Relationships, which were used in various assessments, such as the Global Energy Assessment, and the UNEP assessment on Black Carbon. Within the proposed project the TM5 model will be run in a hind-cast mode (contributing to projects such as PEGASOS and IGAC ACC), using the newest EDGAR4.2 emissions and era-interim re-analysis, and be further analyzed to account for a range of uncertainties in emission inventories and their impact on global air pollutions. Sensitivity simulation are foreseen as well, as well as contribution to the Phase 2 of the Task Force Hemispheric Transport Air pollution.

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Summary of problems encountered

(If you encountered any problems of a more technical nature, please describe them here.)

There were no problems of technical nature- however

Experience with the Special Project framework

(Please let us know about your experience with administrative aspects like the application procedure, progress reporting etc.)

The SP framework is clear, and the support professional. The amount of reporting requested seems reasonable and adequate with respect to the service provided.

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Summary of results

(This section should comprise up to 10 pages and can be replaced by a short summary plus an existing scientific report on the project.)

Unfortunately, due to re-organisation in the JRC, the work foreseen in the project description has been only partially performed. The project results were obtained using existing computations that were earlier performed the ECMWF computing facilities, and did not require running new scenarios. Nevertheless the ECMWF support has been central to obtaining these new analysis, and for this reasons we show some results below.

Analysis of the role hemispheric transport in pollution in India.

Chakraborty et al. (2015) describe the effect of pollution transport between East Asia and South Asia on tropospheric ozone (O_3) using model results from the Task Force on Hemispheric Transport of Air Pollution (TF HTAP). Ensemble mean O_3 concentrations are evaluated against satellite-data and ground observations of surface O_3 at four sta- tions in India. Although modeled surface O_3 concentrations are 1020 ppb higher than those observed, the relative magnitude of the seasonal cycle of O_3 is reproduced well. Using 20% reductions in regional anthropogenic emissions, we quantify the seasonal variations in pollution transport between East Asia and South Asia. While there is only a difference of 0.05 to 0.1 ppb in the magnitudes of the regional contributions from one region to the other, O_3 from East Asian sources affects the most densely populated parts of South Asia while Southern Asian sources only partly affect the populated parts of East Asia. We show that emission changes over East Asia between 2000 and 2010 had a larger impact on populated parts of South Asia than vice versa. This study will help inform future decisions on emission control policy over these regions. Figures describe the transport between East Asia and South Asia.

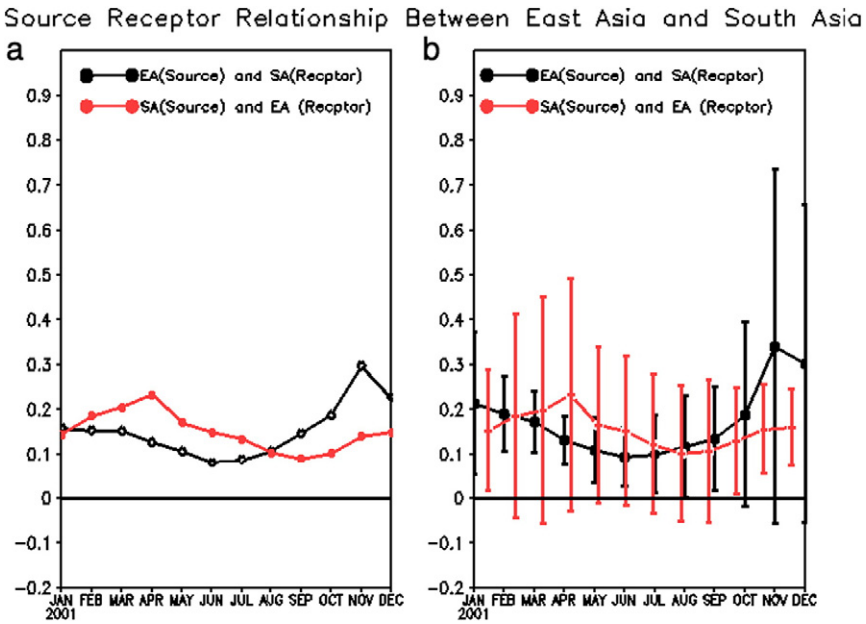

Fig. 9. Regional average change in surface O_3 over SA and EA due to a 20% emission change over the other region; (a) population weighted and (b) and area average. Error bars show the spatial standard deviation over each region.

House hold emissions and contribution to air pollution

Chafe et al (2014) evaluate the impact of household cooking with solid fuels on regional population-weighted ambient $PM_{2.5}$ pollution ($APM_{2.5}$) using the TM5-FASST calculations performed at ECMWF. The study which is building on the Global Burden of Disease study is estimated that in 2010, household cooking with solid fuels accounted for 12% of $APM_{2.5}$ globally, varying from 0% of $APM_{2.5}$ in five higher-income regions to 37% (2.8 $\mu g/m^3$ of 6.9 $\mu g/m^3$ total) in Southern sub-Saharan Africa.

Intercontinental transport of fine particulate Matter:

Fine particulate matter with diameter of 2.5 μm or less ($PM_{2.5}$) is associated with premature mortality and can travel long distances, impacting air quality and health on intercontinental scales. We estimate the mortality impacts of 20 % anthropogenic primary $PM_{2.5}$ and $PM_{2.5}$ ensemble of global chemical transport model simulations coordinated by the Task Force on Hemispheric Transport of Air Pollution and epidemiologically-derived concentration-response functions. We estimate that while 93–97 % of avoided deaths from reducing emissions in all four regions occur within the source region, 3–7 % (11,500; 95 % confidence interval, 8,800–14,200) occur outside the source region from concentrations transported between continents. Approximately 17 and 13 % of global deaths avoided by reducing North America and Europe emissions occur extraregionally, owing to large downwind populations, compared with 4 and 2 % for South and East Asia. The coarse resolution global models used here may underestimate intraregional health benefits occurring on local scales, affecting these relative contributions of extraregional versus intraregional health benefits. Compared with a previous study of 20 % ozone precursor emission reductions, we find that despite greater transport efficiency for ozone, absolute mortality impacts of intercontinental $PM_{2.5}$ transport are comparable or greater for neighboring source-receptor pairs, due to the stronger effect of $PM_{2.5}$ on mortality. However, uncertainties in modeling and concentration-response relationships are large for both estimates.

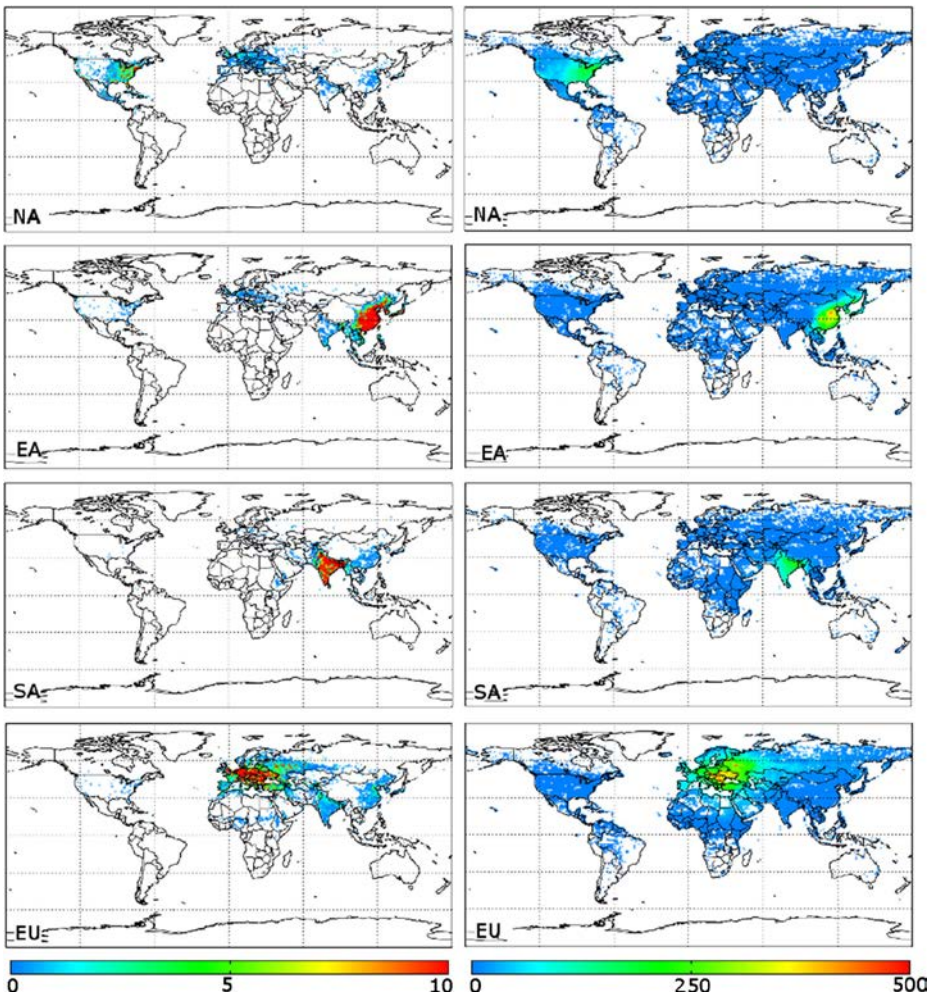

Fig. 2 Annual premature cardiopulmonary and lung cancer deaths per 1,000 km^2 (*left*) and per million people (*right*) due to 20 % primary $PM_{2.5}$ and $PM_{2.5}$ precursor emission reductions in the region shown

List of publications/reports from the project with complete references

Susan C. Anenberg, J. Jason West, Hongbin Yu, Mian Chin, Michael Schulz, Dan Bergmann, Isabelle Bey, Huisheng Bian, Thomas Diehl, Arlene Fiore, Peter Hess, Elina Marmer, Veronica Montanaro, Rokjin Park, Drew Shindell, Toshihiko Takemura, **Frank Dentener**, Impacts of intercontinental transport of anthropogenic fine particulate matter on human mortality, Air Quality, Atmosphere and Health, 1-11, 2014

Chakraborty, T. , Beig, G. , Dentener, F.J., Wild, O., Atmospheric transport of ozone between Southern and Eastern Asia Science of the Total Environment, 523, 28-39, 2015.

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Chafe, Z.A., M. Brauer, Z. Klimont, R. Van Dingenen, S. Mehta, S. Rao, K. Riahi, **F. Dentener**, K.R. Smith Contribution of Household Cooking with Solid Fuels to Ambient Particulate Air Pollution (PM2.5), http://dx.doi.org/10.1289/ehp.1206340, 122, 12, 2014.

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Future plans

(Please let us know of any imminent plans regarding a continuation of this research activity, in particular if they are linked to another/new Special Project.)

At this point in time there are no plans to continue these simulations. However, we would be very happy to collaborate with ECMWF if new opportunities arise.