

Interactions between anthropogenic and natural emissions & impacts on air pollution, the oceans and climate

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Experimental evidences of

some interactions between

natural and anthropogenic

emissions are highlighted

here and supported by

modeling results

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Based on 2-year

observations of NO2

radicals at Finokalia,

chemistry box model

Vrekoussis et al., (GRL 33, L05811, 2006)

estimated that, on an

from the seawater

interacts with NO3

quantification.

annual base, dimethyl sulfide naturally emitted

radicals of anthropogenic

origin and contributes up

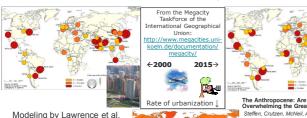
to 20% to nutrient (N)

Crete and using a



Our changing environment

The increasing population and simultaneous desire to improve the standard of living and health has resulted in an ever increasing demand for energy, water and food. Increased urbanization produces agglomerations and megacities: the majority being located at the interface between land and oceans. Thereby Human change the terrestrial and oceanic ecology and emit into the environment large amounts of chemicals that alter the natural equilibrium of the earth system.

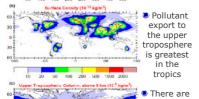


Modeling by Lawrence et al. (Atmos Chem Phys 7 3969-3987 2007) describing the transport of tracers emitted over highly populated areas shown that

The tendency for major cities to develop near coasts is reflected in the computation that over half of the long range low-level export occurs over the oceans

Longrange nearsurface pollutant export is generally strongest in the middle and high

latitudes



often substantial intraregional differences

Relevant information in the April 2008 issue of IGAC Newsletter http://www.igac.noaa.gov/newsletter/



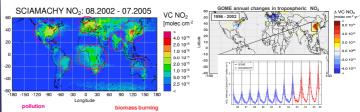
anthropocene era

large emissions of pollutants, which now can be seen from space!

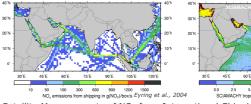
interactions between natural and anthropogenic emissions, changing atmospheric composition and impacting on the Earth's climate

Continuous efforts in observing and modeling the Earth system are needed to evaluate the impacts on ecosystems and on humans

The high concentration of humans results in:



NO2 column observations from space and trends, Richter et al., Nature, 437, 2005.



Satellite Measurements of NO_2 from International Shipping Emissions, Richter et al., Geophys. Res. Lett., 31, doi:10.1029/2004GL020822, 2004

Dust approaching Crete and

nixed with clouds April 2001

Consequences of interactions between natural & anthropogenic emissions

- Photochemical ozone formation is one striking example since significant amounts of ozone (a greenhouse gas and pollutant) are produced during biogenic organics oxidation when sufficient anthropogenically driven nitrogen oxides are available.
- These conditions also favor chemical formation of particulate organic matter.
- Particulate matter emitted from urban areas is ageing during outflow and by interactions with gases of biogenic and pollution origin.
- Natural emissions from the sea water are also shown to increase the anthropogenic component of aerosols and the atmospheric deposition of nutrients to the ocean and thus ocean net primary productivity.
- Natural dust particles, originating from desert regions, or seasalt particles are commonly mixed with and modified by reactions with **anthropogenic substances** during transport in areas affected by industrial and urban activities. They consequently impact on both air quality and ocean productivity of downwind areas and regional climate.
- Pollution enhanced atmospheric particles affect the energy balance and the water cycle.
- We do not have an adequate knowledge of the feedbacks in the system

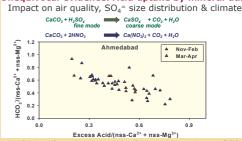
formation in this oligotrophic area. The impact of these interactions to the seawater net primary productivity and the carbon sink requires

Dust is a carrier of iron, an important micronutrient for the oceanic environment. Dust **interactions** with anthropogenic substances can **affect** iron solubility and thus bioavailability (Mahowald et al., GBC, 19, 4, GB4025.1-GB4025, 2005)

Dust mixed with air pollution leads to a brownish haze, which absorbs and scatters sunlight and leads to large reductions in sunlight at the surface resulting in so-called 'global dimming" (Ramanathan et al., JGR, 106, 2001)D900133, 2001)

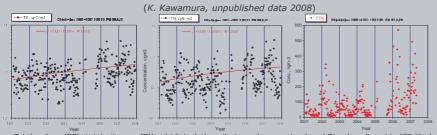
Dust mixed with clouds leads to dusty clouds causing a large reduction in cloud radiative cooling resulting in warmer air (Huang et al., GRL, 33, 2005GL024724, 2006).

Unequivocal evidence: Acid uptake by mineral dust



Neglecting these interactions leads to an overestimate of SO₄= climate impact (Rastoni & Sarin, Atmos. Environ., 39, 5541, 2005, Rengarajan et al., JGR, 112,2007).

Long-term Observation of Atmospheric Aerosols in the Western North Pacific during 2001-2007: Increase in the Organic Carbon and Water-soluble Organic Acids over Chichi-jima Island.



Total carbon (TC), total nitrogen (TN, which includes nitrate and ammonium) and Dicarboxylic acids (C2di) show increasing trend for the last years possibly resulting from enhanced pollutant emissions from Asian. Stable carbon isotopic composition of the aerosols shows an increase in d¹³C values during the last seven years suggesting enhanced

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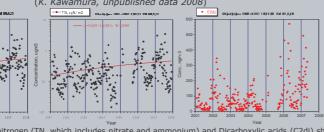
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emissions of fossil fuel-derived organic aerosols from Asian and their long-range transport over the western N. Pacific.

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