



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

Kanakidou, M.*, Kawamura, K., Burrows, J.P. and the CACGP Commission (<http://www.icacgp.org>)

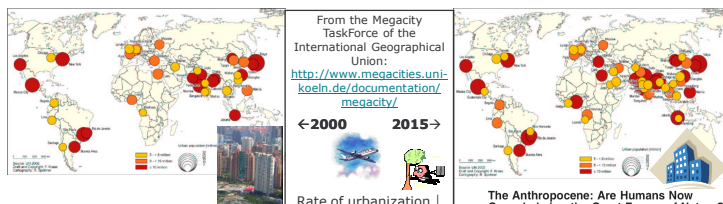
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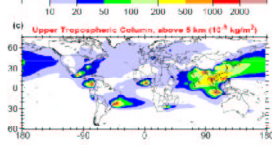
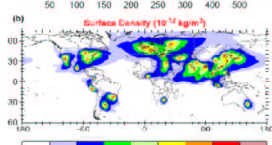
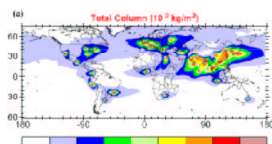
Our changing environment

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 **Humans** change the terrestrial and oceanic ecology and emit into the environment large amounts of **chemicals** that alter the natural **equilibrium** of the earth system.

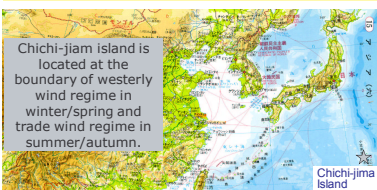


Modeling by Lawrence et al. (*Atmos. Chem. Phys.*, 7, 3969-3987, 2007) describing the transport of tracers emitted over highly populated areas shown that

- 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**

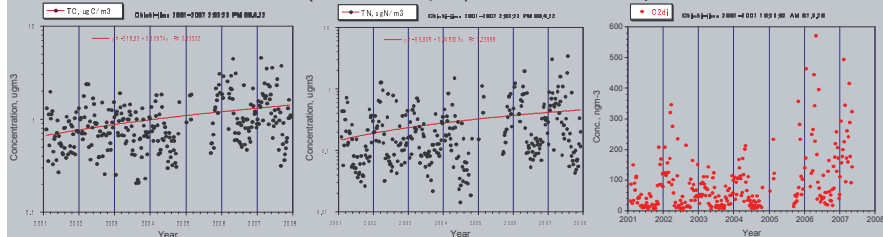


Relevant information in the April 2008 issue of IGAC Newsletter <http://www.igac.noaa.gov/newsletter/>



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.

(K. Kawamura, unpublished data 2008)



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 $\delta^{13}\text{C}$ values during the last seven years suggesting enhanced emissions of fossil fuel-derived organic aerosols from Asian and their **long-range transport** over the western N. Pacific.

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Next IGAC International Conference, Annecy, France, Sept. 2008 Next Joint IGAC/CACGP International Symposium, Halifax Canada, 2010

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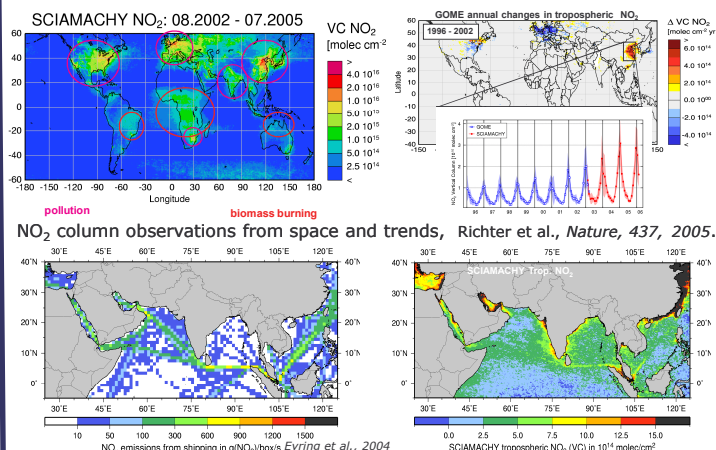
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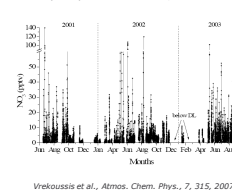
The high concentration of humans results in:

- 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 and the oceans.

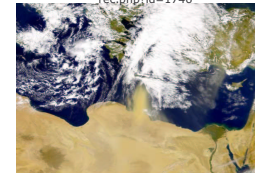
Continuous efforts in observing and modeling the Earth system are needed to evaluate the impacts on ecosystems and on humans



Satellite Measurements of NO₂ from International Shipping Emissions, Richter et al., *Geophys. Res. Lett.*, 31, doi:10.1029/2004GL020822, 2004



Dust approaching Crete and being mixed with clouds in April 2001
http://visibleearth.nasa.gov/view_rec.php?id=1746

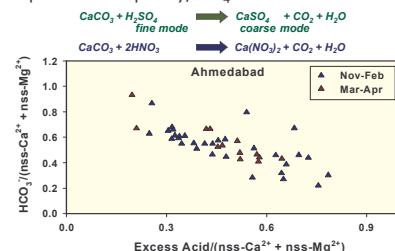


Dust is a carrier of iron, an important micronutrient for the oceanic environment. **Dust interactions** with anthropogenic substances can **affect iron solubility** and thus **bioavailability** (Mahowald et al., *GBC*, 19, 4, GB4025.1-GB4025, 2005).

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, 2001D900133, 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 Impact on air quality, SO₄²⁻ size distribution & climate



Neglecting these interactions leads to an overestimate of SO₄²⁻ climate impact (Rastoni & Sarin, *Atmos. Environ.*, 39, 5541, 2005, Rengarajan et al., *JGR*, 112, 2007).