Deciphering different aerosol effects on climate from a global perspective

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More than three decades ago, Twomey [1] stated the first hypothesis on how anthropogenic aerosols may influence climate through their impact on clouds. According to this hypothesis, often termed the first aerosol indirect effect or cloud albedo effect, an increase in atmospheric pollution will lead to an increase in cloud albedo, all else being equal. Since then, this and other mechanisms as to how aerosols interact with cloud droplets and ice crystals are being understood and tested in GCMs. This led to an increased level of understanding of the cloud albedo effect in IPCC AR4 as compared to the previous IPCC assessment reports and allowed the cloud albedo effect to be estimated as -0.7 W m^{-2} with a range of -0.3 to -1.8 W m^{-2} [2]. While some of the hypotheses have been studied extensively using models, satellite data or laboratory experiments, other hypotheses are new and controversial and have not yet been sufficiently tested. Therefore the range of the global mean total anthropogenic aerosol effect (sum of direct and indirect effects) is larger than for the cloud albedo effect as is estimated between -0.2 and -2.3 Wm^{-2} with an average of -1.2 Wm^{-2} [3]. The smallest estimates stem from simulations in which satellite data of the fine mode aerosol optical depth versus the cloud droplet number concentration were used to constrain the indirect aerosol effect.

Deciphering the different indirect aerosol effects remains a challenge. In this talk, I will address different aerosol indirect effects. I will also address how observations can be used to constrain or validate certain processes and how different processes can be disentangled.

[1] Twomey (1977) *J. Atmos. Sci.* **34**, 1149-1152. [2] Forster *et al*. (2007). *Changes in Atmospheric Constituents and in Radiative Forcing, in Climate Change 2007, The Physical Science Basis*. Contribution of WGI to IPCC AR4, Cambridge Univ. Press, Cambridge. [3] Denman *et al*. (2007) *Couplings between changes in the climate system and biogeochemistry, in Climate Change 2007, The Physical Science* Basis. Contribution of WGI to IPCC AR4, Cambridge Univ. Press, Cambridge.

Hydrocarbon oxidizing microorganisms and their ability to degrade oil and its derivatives at natural oil seepage sites (Central Baikal)

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Natural oil seepage sites in Lake Baikal have been known since the 18th century. At present, a lot of data on its composition, age and origin have been collected. In 2005, a new oil seepage was observed in Central Baikal. Annually about 4 tons of oil is discharged to the water column from bottom sediments [Kontorovich et al., 2007]. Studies carried out in 2005-2008 showed that the size of oil patch where hydrocarbons are fixed has not been enlarged. According to the data on 16S rRNA gene analysis, phylogenetic structure of the total microbial community consists of representatives of α-, β-, γ-proteobacteria, Actinobacteria, Bacteroidetes (*Porphyromonadaceae*) and *Firmicutes (Bacillales)*. Its cultivated part, hydrocarbon oxidizing microorganisms (HCOM) able to utilize oil and its derivatives as the only source of carbon, has the highest percentage of homology with representatives of α-, β-, γ-proteobacteria, Actinobacteria, and Firmicutes (Bacillales). AlkB genes of group III responsible for utilization of a wide range of n-alkanes have been detected in 74% of HCOM strains.

In laboratory experiments with natural microbial community, 70-90% of oil is degraded in 35-60. At the background station, n-alkane conversion does not exceed 35% depending on the amount of oil added. In the experiment with pure cultures of genera Pseudomonas, Mycobacterium, and Bosea (5 strains), there is a diverse dynamics of n-alkane utilization. On the fifth day of the experiment, strain *Pseudomonas sp.* (#5) degrades 26% of n-alkanes. For 36 days of the experiment this strain degrades 35% of oil n-alkanes. The concentration of n-alkanes in the medium decreases from 10 to 20% at the presence of other strains. Natural microbial community degrades oil more actively than pure cultures of hydrocarbon oxidizing microorganisms.

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[1] Kontorovich *et al.* (2007). *Russian Geology and Geophysics* **48**, 1346–1356.