PHOENICS

EVK2-CT-2001-00098 – http://phoenics.chemistry.uoc.gr

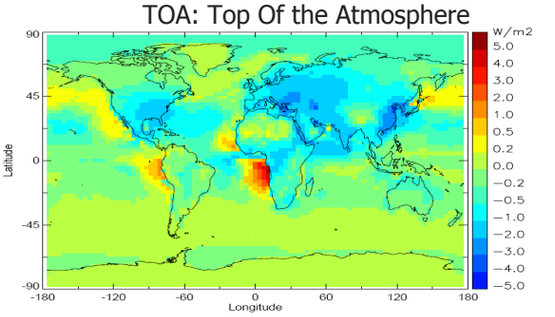
Particles of **H**uman **O**rigin **E**xtinguishing **N**atural solar radiation **I**n **C**limate **S**ystems

Aerosols are complex ensembles of particles in the atmosphere of varying composition and size. Aerosols compromise human and ecosystem health, influence visibility, ozone and the global radiation budget, modify cloud properties, and are responsible for feedbacks on the hydrological cycle and for climate perturbation.
The European Union has put forward and implemented a number of policies and legislation to improve air quality and reduce anthropogenic climate change. Fundamental questions for this are: "How and how much do aerosols affect climate? What is the contribution of European emissions to this impact?"
The European Commission's PHOENICS project, supported under the 5th Framework Programme, aimed at answering these questions, and specifically made a rigorous evaluation of our knowledge of the magnitude and uncertainties of the direct climate effect of multi-component mixed tropospheric aerosol.

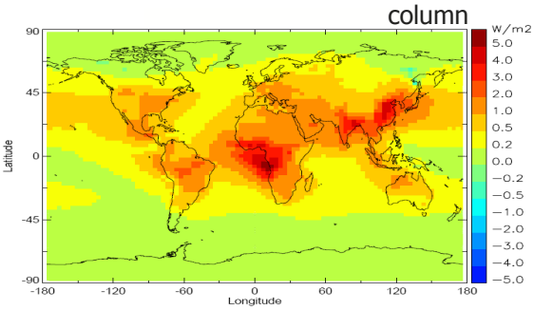
While aerosol forcing tends to cool the surface and warm the atmosphere, the overall response is a cooling of the climate system.

All-sky direct aerosol forcing from all anthropogenic sources

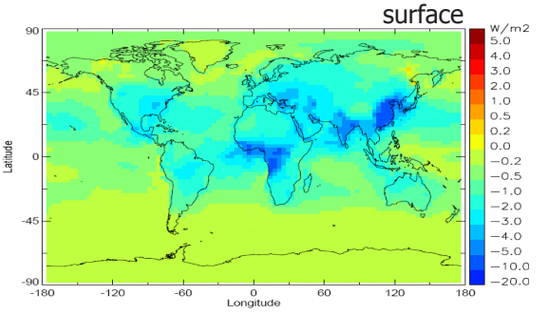
TOA: Top Of the Atmosphere

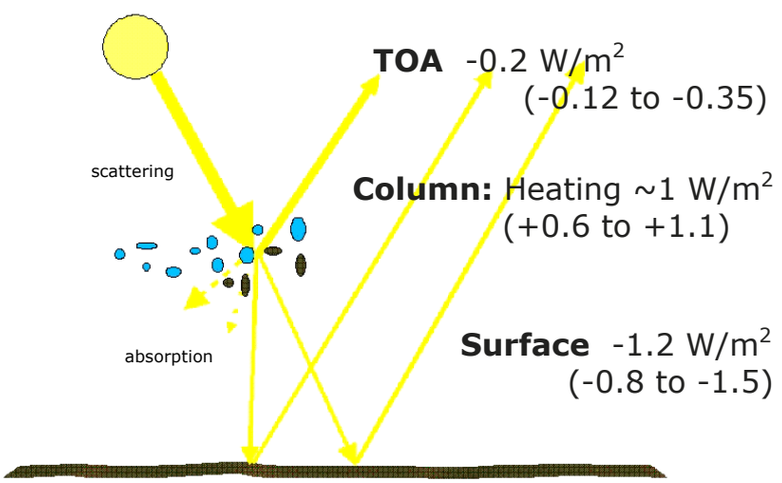


column



surface





Visible radiation from the sun is reflected and absorbed by aerosols. Some infrared radiation is additionally absorbed and reemitted by aerosols. At the top of the atmosphere there is a net imbalance of about -0.2 W/m^2.

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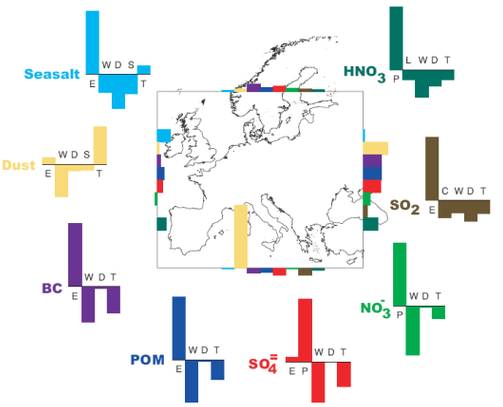
Europe and the other regions

PHOENICS

Bars directed inside the frame indicate influx of the aerosol components whereas directed outside it indicate outflux from the European continent.



Histograms illustrate aerosol component European budget terms: E=emission, W=wet deposition, D=dry deposition, S=sedimentation, T=transport in/out Europe, P=chemical production, L=chemical loss.

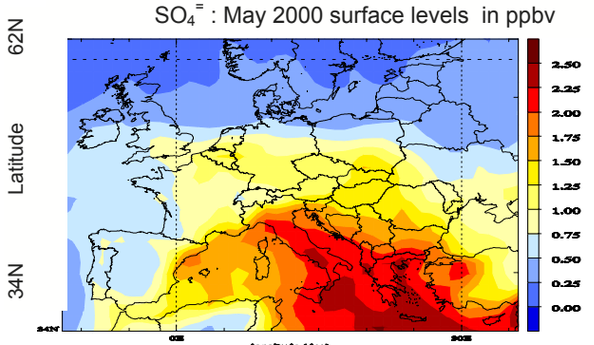
Europe is mainly importing dust and sea-salt.

The European anthropogenic contributions to the AOD over Europe are:

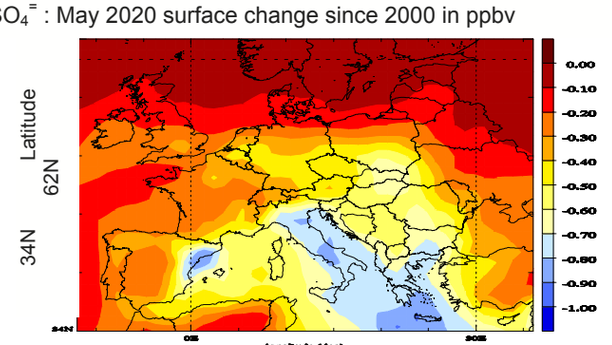
61% for sulphate ($SO_4^=$) and nitrate (NO_3^-), 79% for black carbon (BC), 44% for primary organic matter (POM), 18% for secondary organic aerosol (SOA) from natural precursors and 79% for SOA from anthropogenic sources. SOA from biogenic precursors over Europe is 10 times higher than SOA from anthropogenic sources.

In 2000, 40-50% of the European AOD is caused by anthropogenic emissions over Europe.

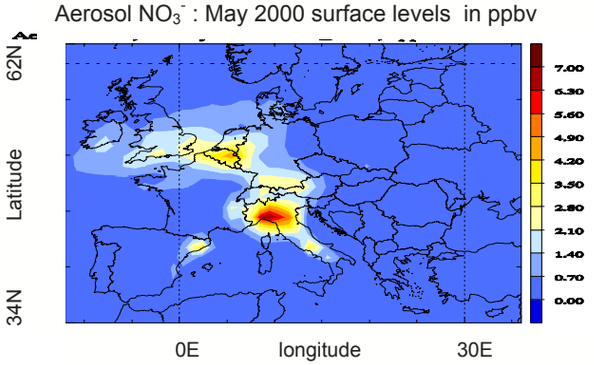
$SO_4^=$: May 2000 surface levels in ppbv



$SO_4^=$: May 2020 surface change since 2000 in ppbv



Aerosol NO_3^- : May 2000 surface levels in ppbv



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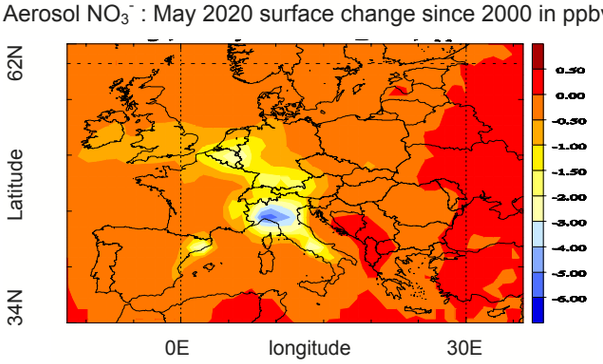

Present: (May 2000) Simulated surface aerosol concentrations (ppbv) of $SO_4^=$, and NO_3^-.

Future: (May 2020) Simulated change in surface concentrations (ppbv) using current legislation emission reductions for the year 2020 (IIASA).

The role of NO_3^- and $SO_4^=$ may change in the future. By 2020 aerosol nitrate is expected to increase, locally despite anticipated NO_x emission reductions.

All-sky aerosol direct TOA effect from European anthropogenic sources is about 28% of the direct aerosol TOA forcing from global anthropogenic sources.

Read more in PHOENICS Synthesis and Integration Report
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http://phoenics.chemistry.uoc.gr/synthesis
e-mail: mariak@chemistry.uoc.gr

Aerosol is not a single compound but a multi-component mixture with variable characteristics and behaves differently from its individual components.
Our work clearly indicates the very important climatic role of aerosols on regional basis.
Thus, for abatement strategies and future climatic scenario simulations aerosols should receive the same attention as greenhouse gases.