CENTRE NATIONAL
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MULTI-COMPONENT AEROSOL TRANSPORT AND RADIATIVE EFFECTS IN LMDZ-GCM

Part I

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MODEL DESCRIPTION

Resolution: grid-point model with 96x72x19 (3.75º in longitude, 2.5º in latitude, 19 vertical layers with a hybrid pressure co-ordinate system)

Transport: Large-scale advection - *Van Leer* [1977]; turbulent mixing in the boundary layer; mass flux convection – Tiedtke [1996]

Time steps: Dynamical part – 3 minutes
Large scale advection - 15 minutes
Physical and chemical parameterizations – 30 minutes
Radiation – 2 hours

Possibility for nudged simulations (ECMWF, 6 hourly analyses)

Zoom capability on a specific domain

➔ Validation with ^{222}Rn and ETEX experiment

AEROSOL TRACERS

Sulfate : DMS, SO_2, sulfate, H_2S, DMSO, MSA

Black Carbon (BC) : Hydrophobic BC, Hydrophilic BC

Organic Matter (OM): Hydrophobic BC, Hydrophilic OM

Mineral Dust : Sub-micron, Super-micron (on-line parameterization, M. Schulz/Y. Balkanski)

Sea-Salt : up to 20 µm in radius at 80% RH, 5 size bins in sub-micronic range; 5 size bins in 1-20 µm range (*Monahan* [1986]).

Fly-Ash : < 2.5 µm fraction, at present over India

AEROSOL EMISSIONS

SO_2: EDGAR-3.2, baseline year 1995,
except for - ship emissions from Corbett et al. (1999)
- biomass burning from Pham et al. (1995)
High and low sources, no seasonality,
5% of SO_2 emitted directly as sulfate.

H_2S: scaled to EDGAR 3.2 industrial sources of SO_2

DMS: on-line using the latest oceanic DMS climatology of A. Kettle and the Nightingale et al. (2000) air-sea transfer function.

Emissions are ~70, ~27, ~3, and ~3 TgS/yr for SO_2, DMS, H_2S, and sulfate, respectively.

AEROSOL EMISSIONS

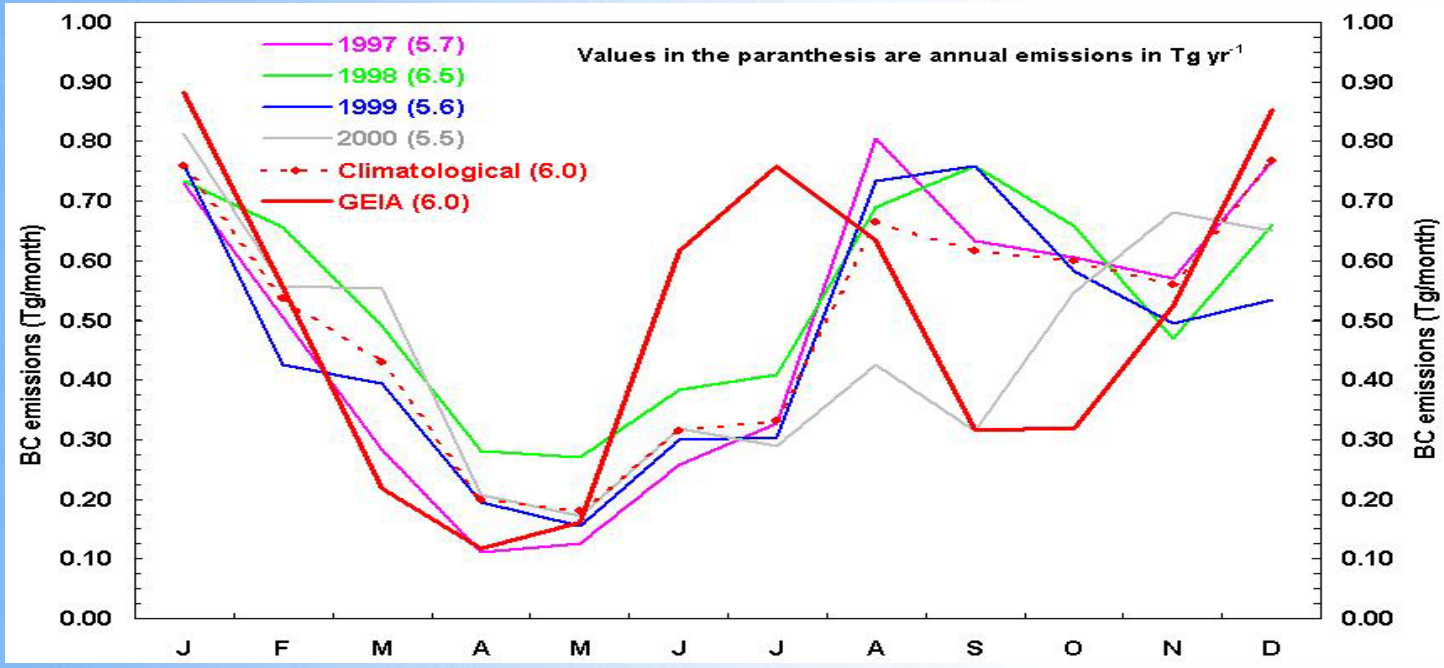
BC and OM: **Fossil fuels: Cooke et al. (1999)**
Biomass: Cooke and Wilson (1996) modified with ATSR fires

Over Asia: Streets et al. (2002)

Over India: Reddy and Venkataraman (2002)

BC – 80% hydrophobic; 20% hydrophilic.

OM – 50% hydrophobic; 50% hydrophilic.



DEPOSITON PARAMETERS

Dry deposition through prescribed dry deposition velocities.
Constant values for all surfaces except for sulphur species.

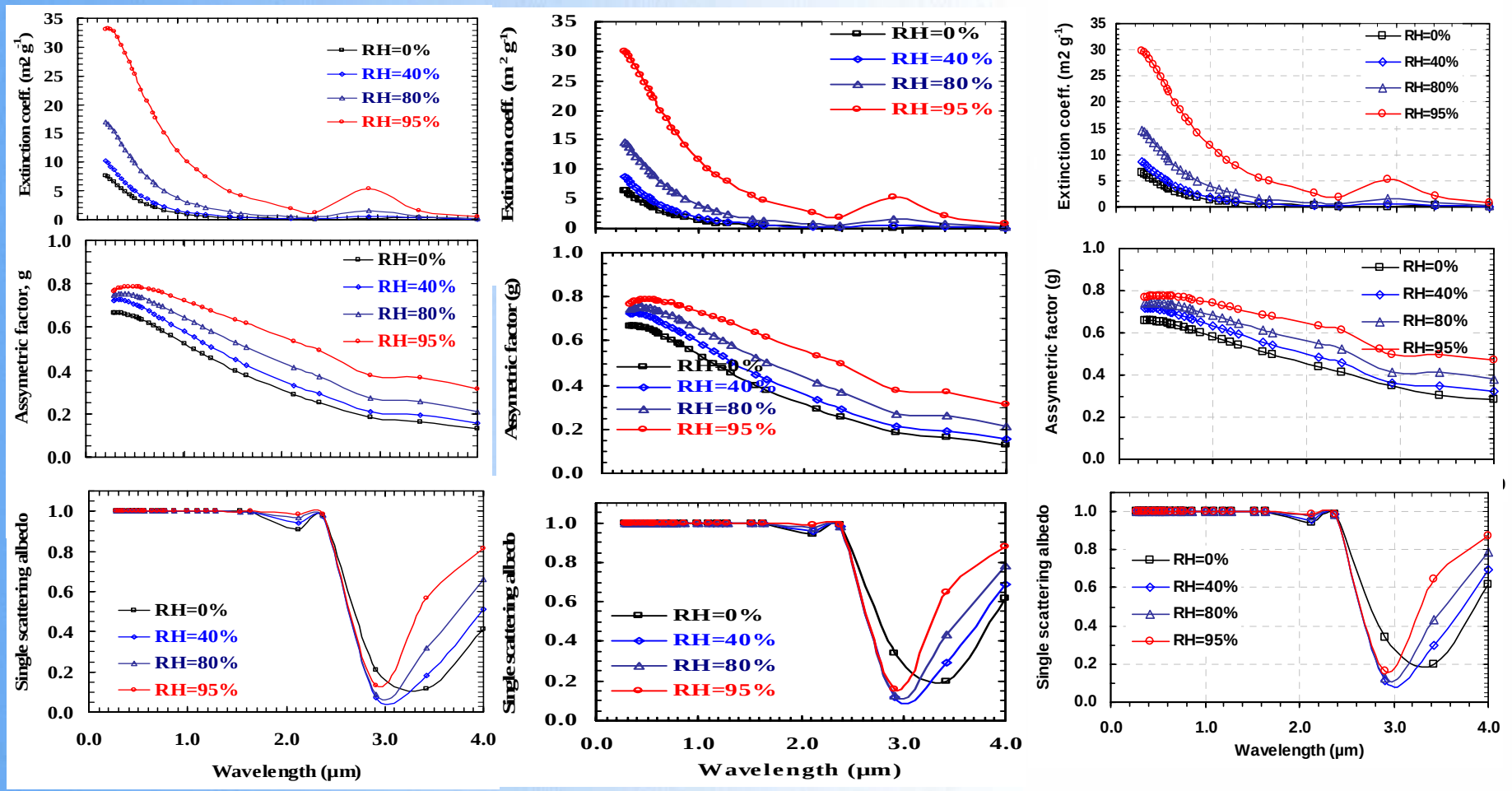
Sedimentation for super-micronic sea-salt and dust only.

Scavenging: *In-cloud* – treated separately for stratiform and convective precipitation [*Giorgi and Chameides*, 1986], for all species except hydrophobic BC and OM.
***Below-cloud* – treated separately for stratiform and convective precipitation, for all species.**

Convective transport: *Tiedtke* [1989] but a fraction of gases and aerosols released outside the updrafts is scavenged.

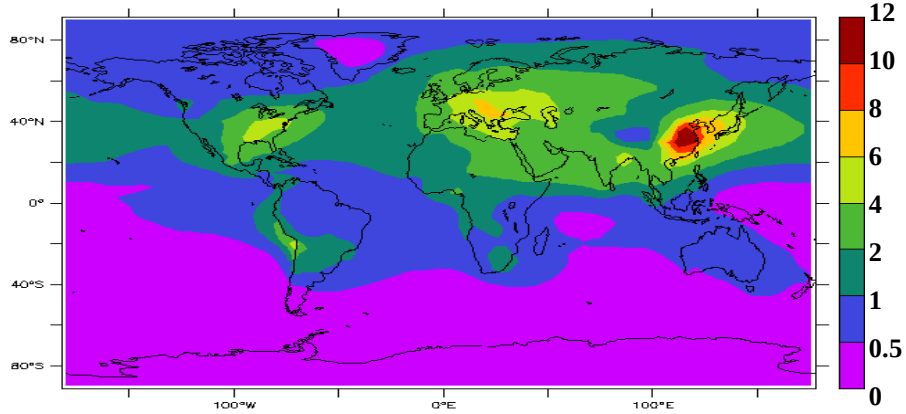
AEROSOL OPTICS

Mie-theory computed optics in the shortwave range: 0.25-4.0 μm; RH-dependent optical properties for sulfate, hydrophilic BC and OM, and sea salt.

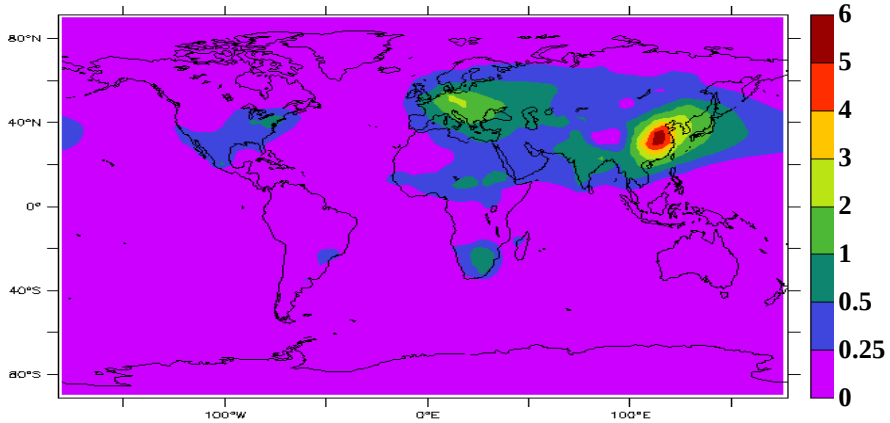


AEROSOL BURDENS (mg m^{-2})

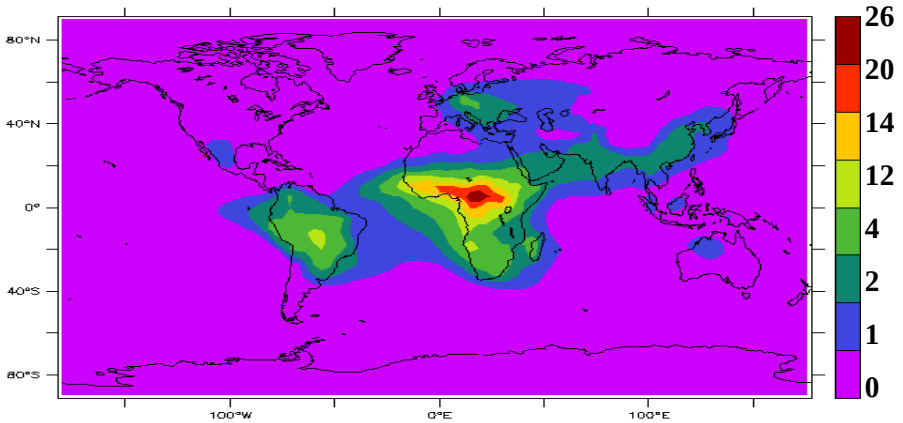
Sulfate



BC

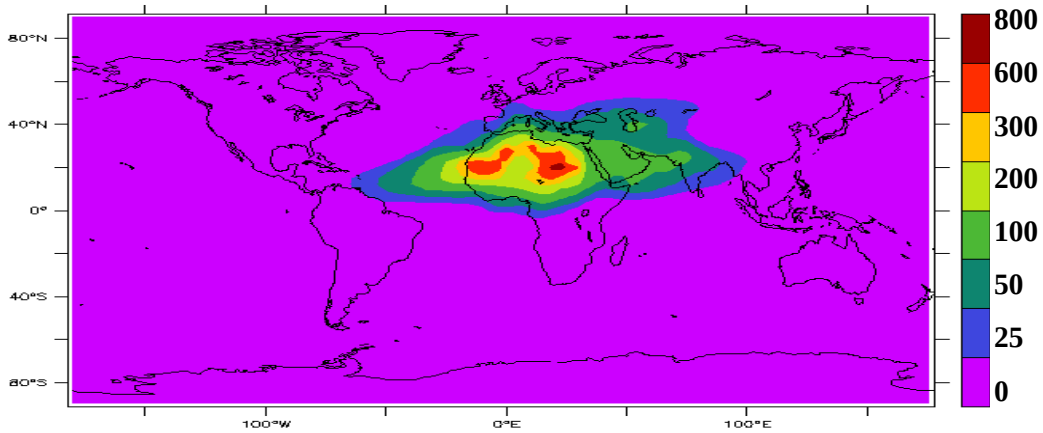


OM

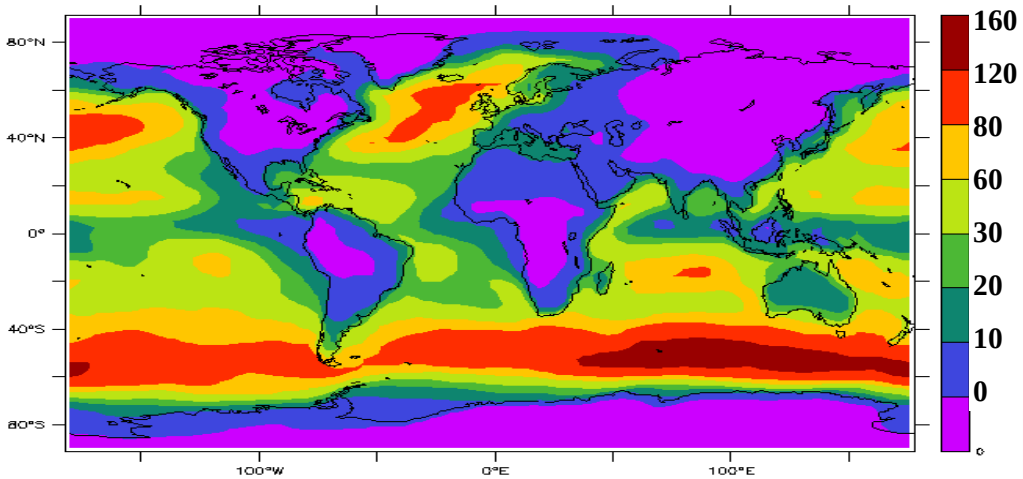


AEROSOL BURDENS

Dust



Sea Salt

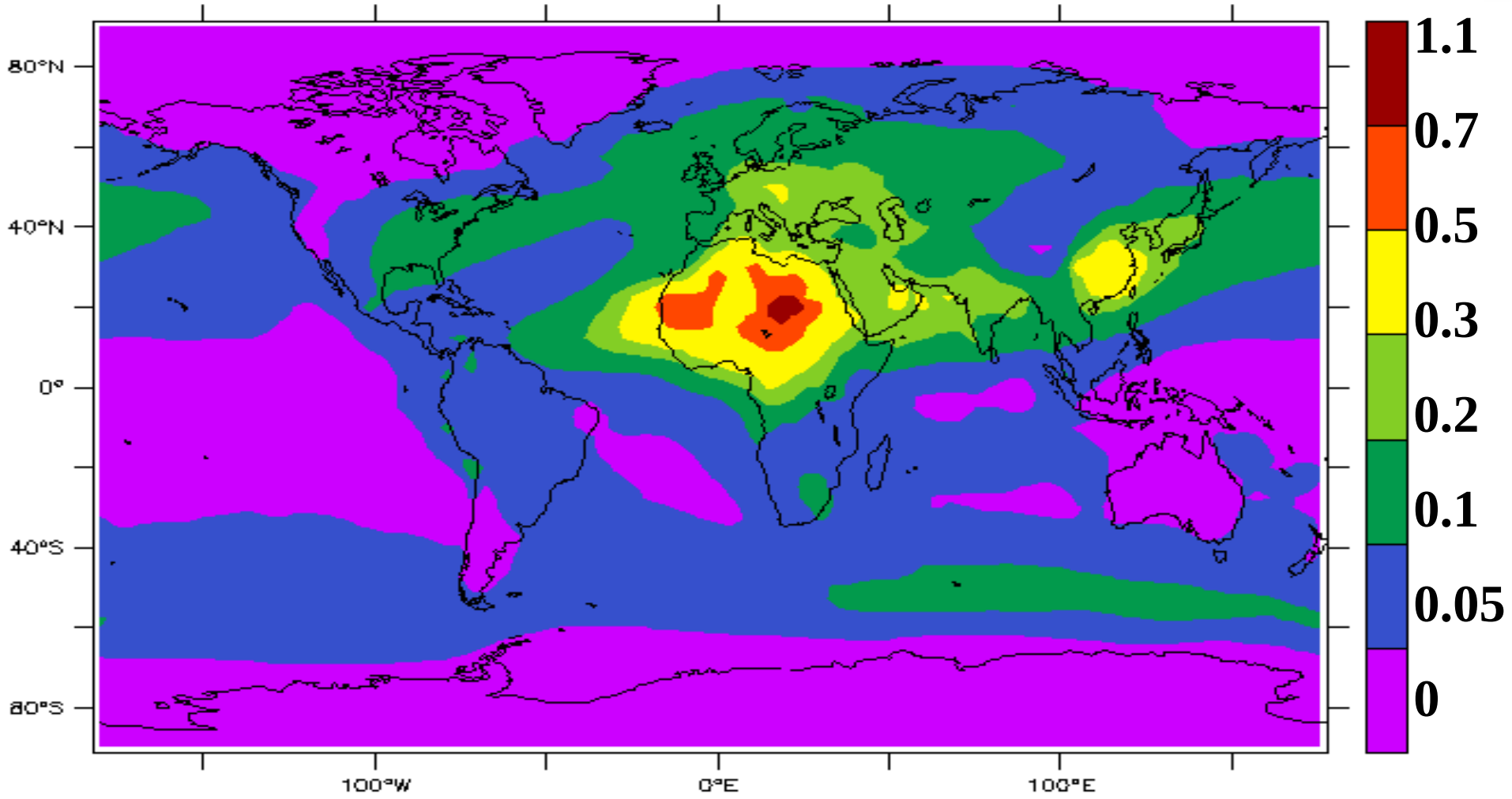


AEROSOL LIFETIMES

	Emissions (Tg yr^{-1})	Burden (Tg)	Lifetime (days)
Sulfate*	59.7	0.59	3.7
Black Carbon	11	0.23	7.4
Hydrophobic		***0.035***	***1.4***
Hydrophilic		***0.195***	***6.9***
Organic Carbon	69	1.53	7.5
Hydrophobic		***0.13***	***1.4***
Hydrophilic		***1.40***	***7.1***
Dust	762	9.75	4.7
Sea salt	6267	7.39	0.4

* *Sulfate emissions include direct emissions and production of sulfate in the atmosphere from gas and aqueous phase reactions in TgS*

AEROSOL OPTICAL DEPTH @ 550nm



PUBLICATIONS

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