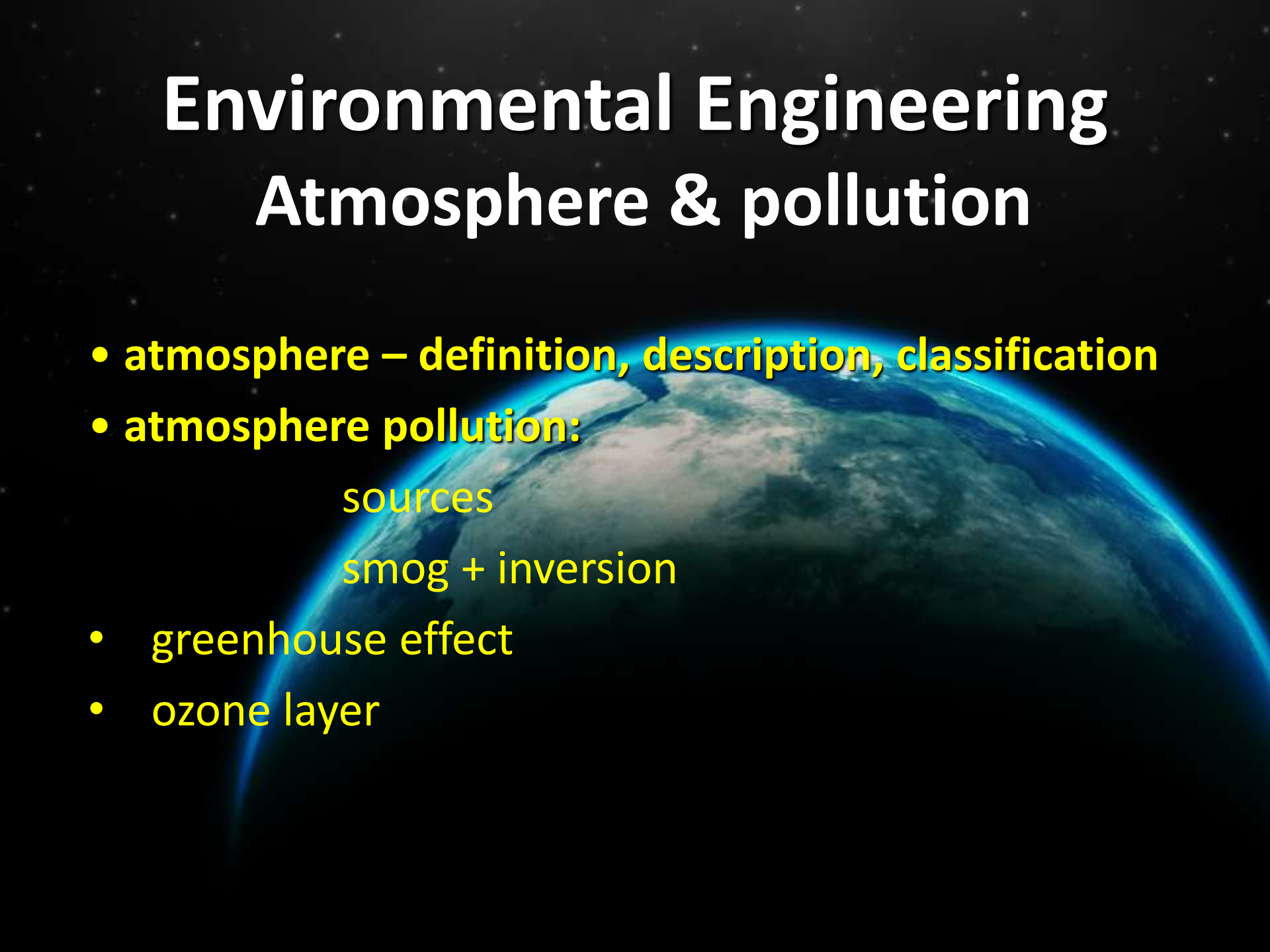


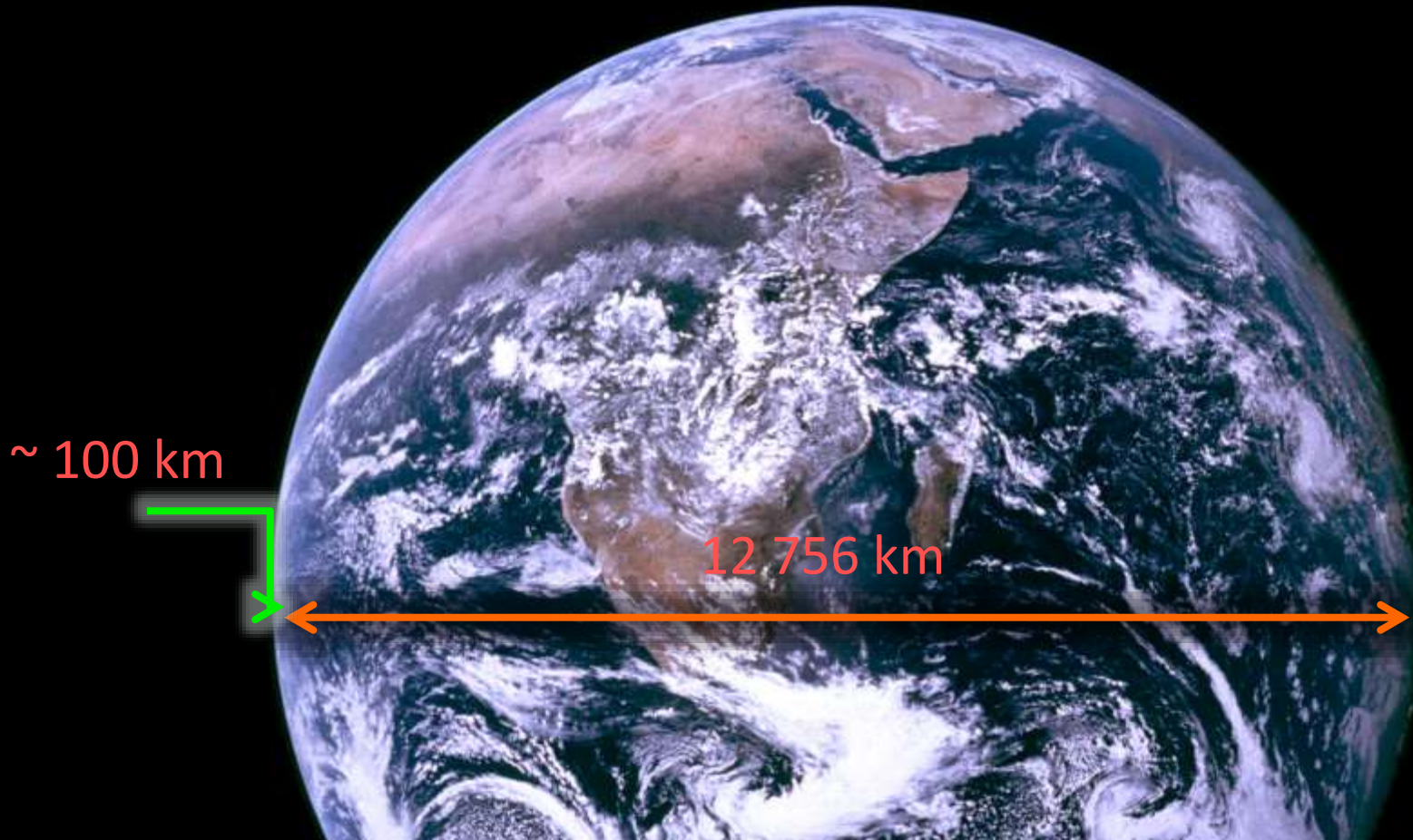
Environmental Engineering

Atmosphere & pollution

- atmosphere – definition, description, classification
 - atmosphere pollution:
 - sources
 - smog + inversion
 - greenhouse effect
 - ozone layer
- 

What does ,atmosphere‘ mean ?

- 1: a particular environment or surrounding influence
- 2: a unit of pressure
- 3: the mass of air surrounding the Earth
- 4: the weather or climate at some place
- 5: the envelope of gases surrounding any celestial body
- 6: a distinctive but intangible quality surrounding a person or thing



NASA: man above 80 km = astronaut

Karman's boundary in 100 km – above we do not use m asl, but the distance from a space object

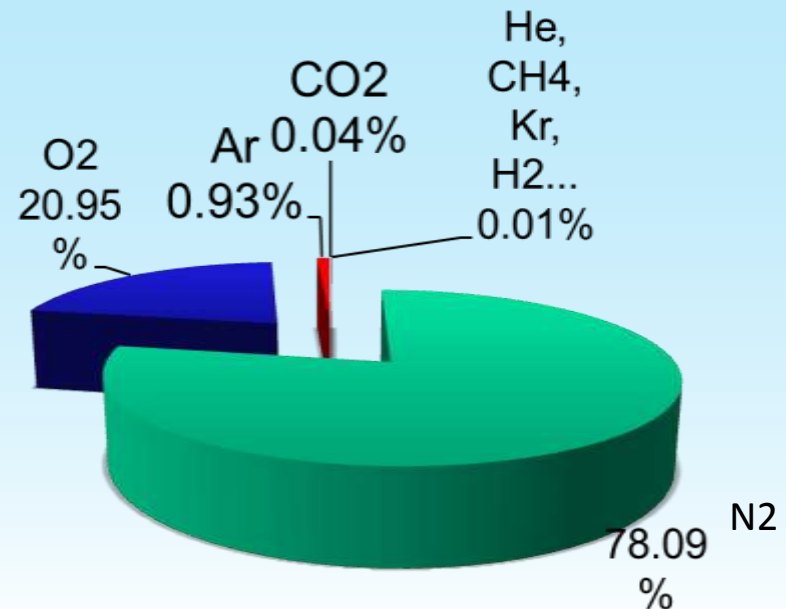
Anacoustic zone: above 160 km. Low molecules density does not permit sound transmission

Atmosphere description

how thick is the mass of air ?

up to 16km 90% of particles, 30km 99%, 48km 99,9%, totally over 700km

Chemical content:



Atmosphere description - troposphere

Chemical content:

Variable components

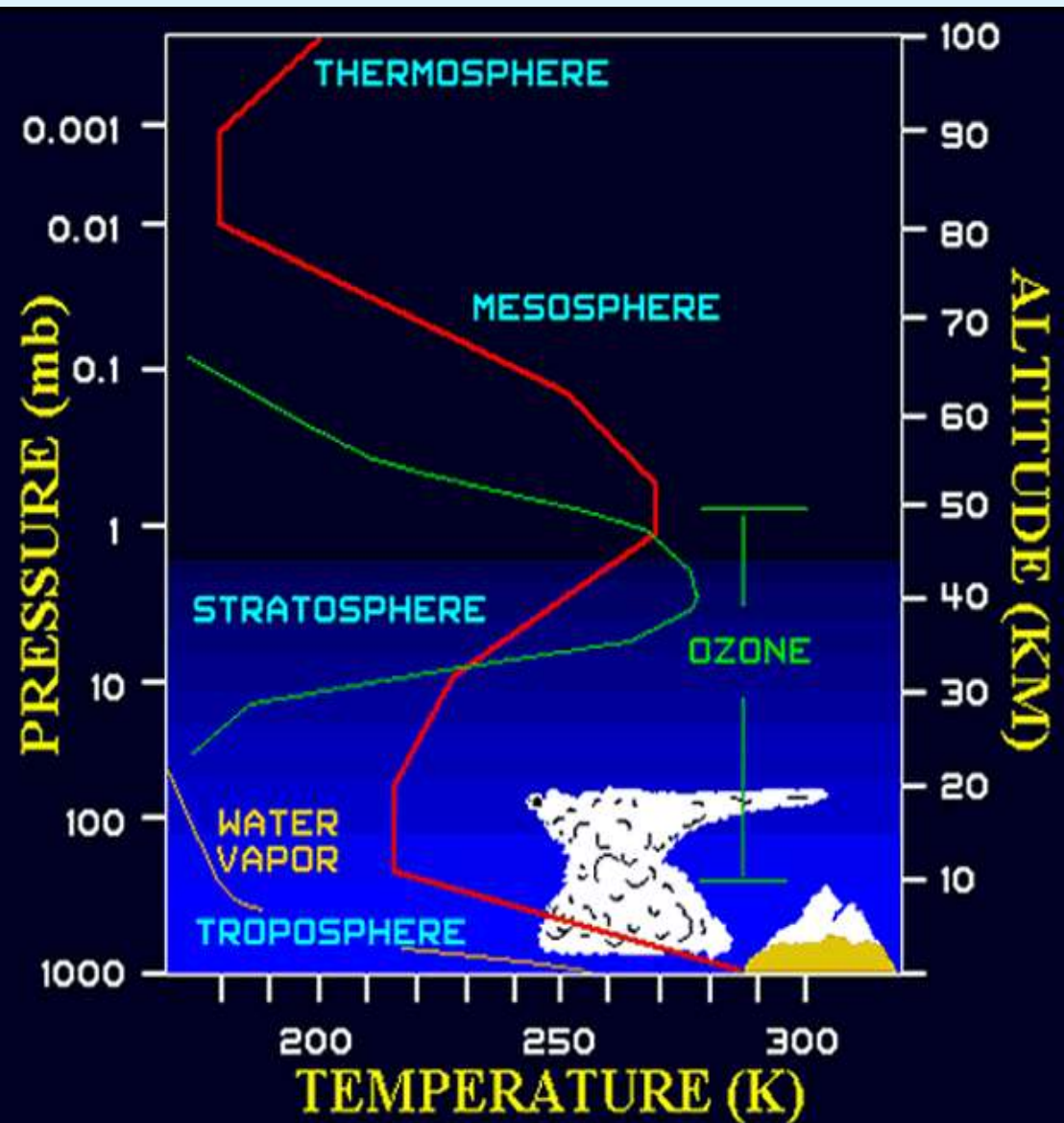
(amounts vary over time and location)

Carbon dioxide (CO ₂)	0.0003%
Water vapour (H ₂ O)	0-4%
Methane (CH ₄)	<i>trace</i>
Sulphur dioxide (SO ₂)	<i>trace</i>
Ozone (O ₃)	<i>trace</i>
Nitrogen oxides (NO, NO ₂)	<i>trace</i>

Atmosphere description

Term ,clean air' – exists only in labs !

- cannot be found in nature (there are always particles and pollution (even trace amounts) – cause of fires, volcanic activities....etc.)



Exosphere: only H and He, no boundary with space

Thermosphere: few molecules, temp up to 1000°C

Mesosphere: temp decreases (down to -90°C)

Stratosphere: ozone layer – absorbs UV => heated

Troposphere: most of air mass, weather, temp decreases with alt

Atmosphere pollution

Sources:

- **natural** (volcanic activity, fires, natural wind erosion, pollen dispersion, natural radioactivity...)
- **anthropogenic** (industry, transportation, power plants, agriculture, mining, sprays...)

Extent:

- **local** (chimneys, local fires...)
- **regional** (power plant)
- **global** (no boundaries exist – sand from the Sahara in the Alps, acidification of the Scandinavian lakes...)

More hazardous pollution is discharged into air than into landfills, waters and groundwater combined

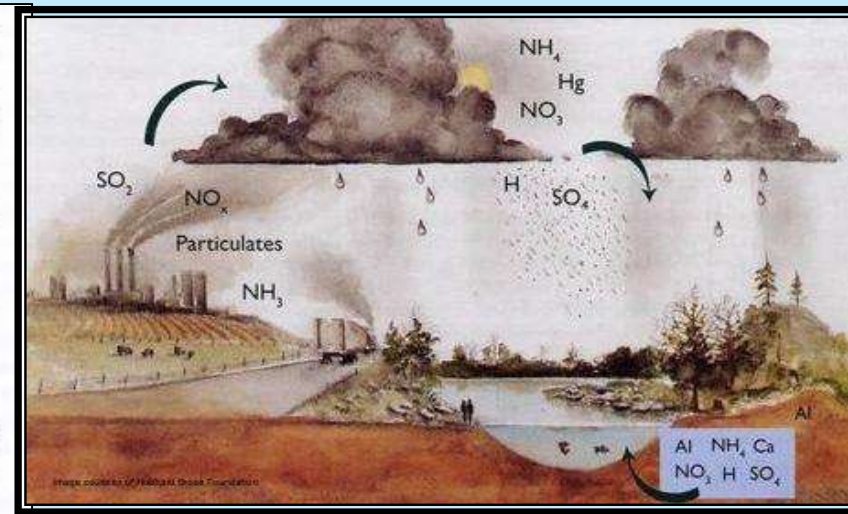
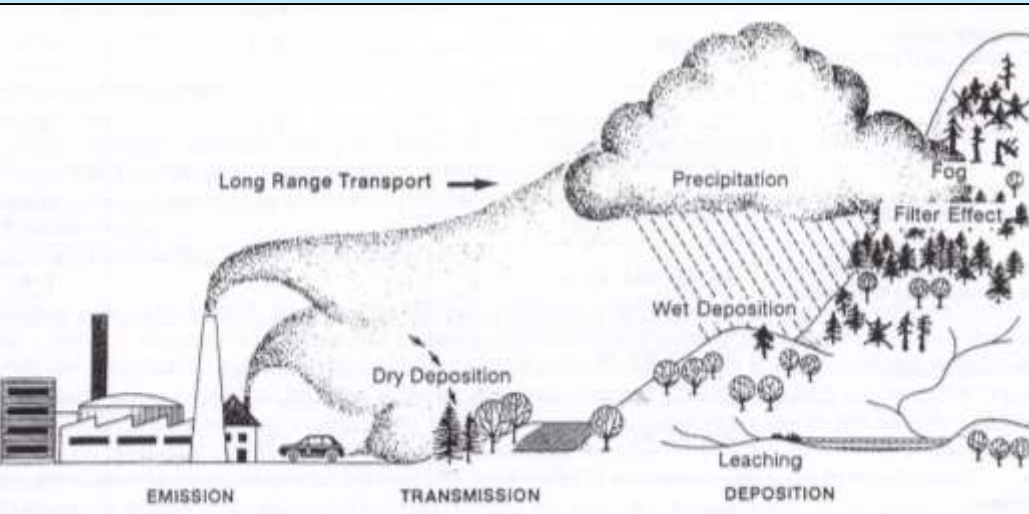
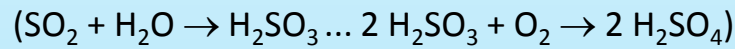


26. aug 2007. Fire in a southern Greece vs sandstorm in Sahara

We have to distinguish between:

Emission – pollutants **emitted** from the sources of pollution, they **characterize the sources**
(SO₂) [kg.h⁻¹]

Immission – the emissions which have reacted with the atmosphere, they characterize the **state of the atmosphere** (H₂SO₄) [kg.m⁻³]



Polluting the air – the process of entering pollutants in the atmosphere

Polluted air – the air containing pollutants

Consequences of the pollution:

- ✓ risks and damages for people (respiration, skin diseases), animals, plants...
 - ✓ More dangerous for kids
- ✓ risks and damage for constructions, forestry, agriculture...
- ✓ adverse affects in the ambient areas – smell, visibility...
- ✓ Ozone layer depletion, greenhouse effect acceleration

the Sumava mountains 2004



Sights damage is caused by sulphur deposition...





- Acid rain: weathering effect on marble
- Air pollution: colour changes due to dust and carbon particles deposition
- Dusty winds: abrasion

Sky glow – light scattering of particles



Burning oil wells Kuwait, 1991 – were burning for almost a year



METEOROLOGICAL INVERSION

- ,negative‘ meteorological situation – cold air under warm
- inverse progress of the temperature gradient
- low horizontal and vertical convection
- emissions and clouds in the ground layer
- depends also on morphology
- may cause smog
- it is a natural process



SMOG

→ „*smoke & fog*“ (known since 1911) – specific state of the atmosphere

→ **mix of particulates and gases**

PM_{2.5} – aerosol particles smaller than 2.5 microns, burning of fossil fuels, lodge deep in lungs

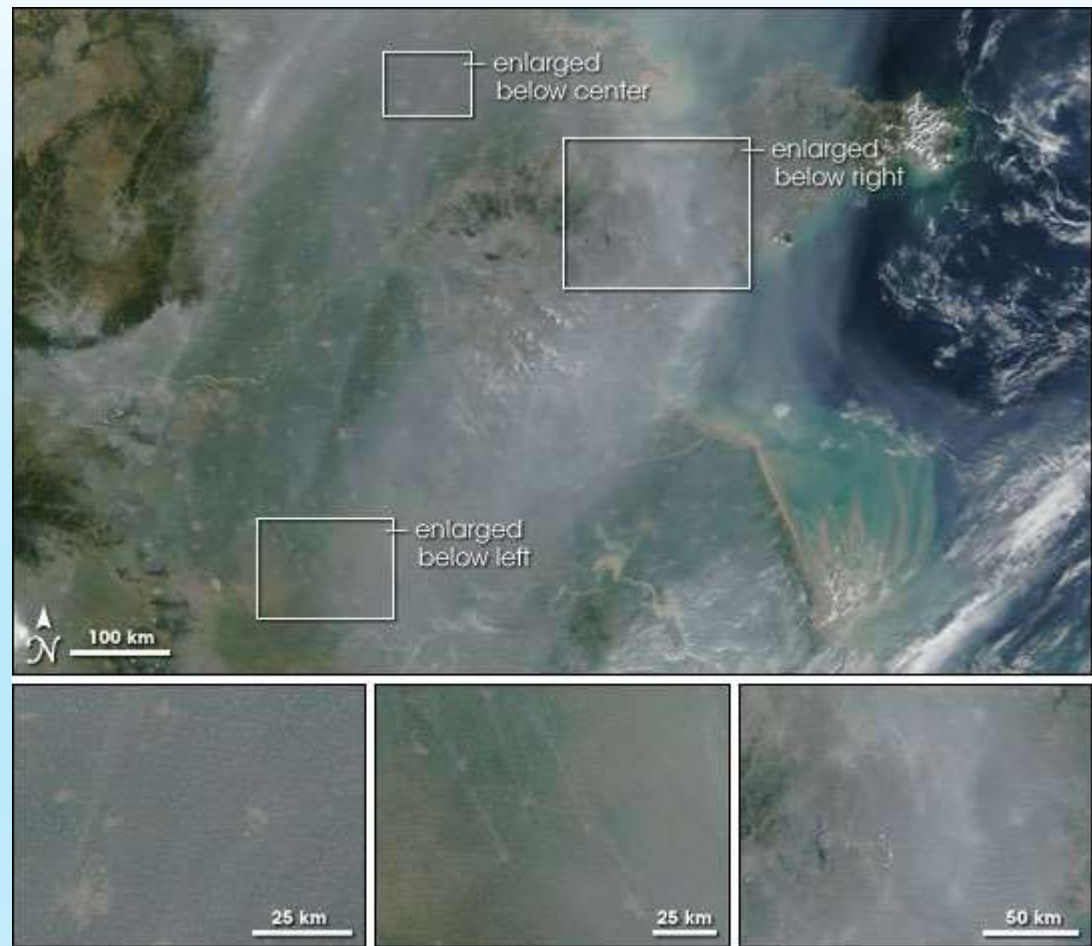
<http://www.earthobservatory.nasa.gov/IOTD/view.php?id=77495>



• Type **London** – **reductive**; high moisture, inversion, temperatures around 0°C, SO₂ → emission from the industry

• Type **Los Angeles** – **photo-chemical**; sun, NO_x, ground ozone, emission from the traffic -> brown haze

„Reducing light“



http://www.earthobservatory.nasa.gov/IOTD/view.php?id=5865&eocon=image&eoci=related_image

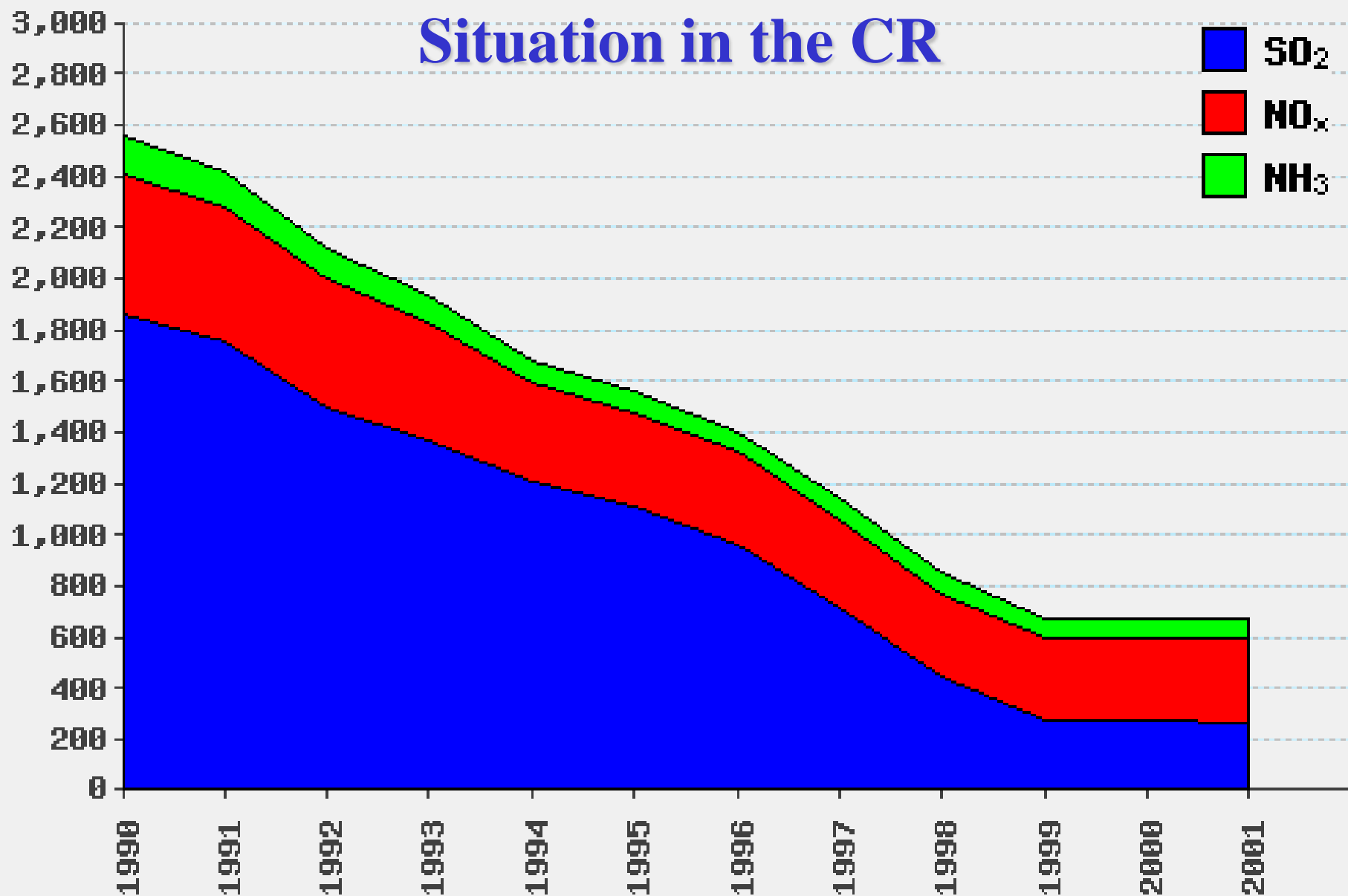
Smog reduces the amount of light entering the Earth's surface (reduction during the 2.½ 20. cent of 10%)

- it influences the plant growth, evaporation...

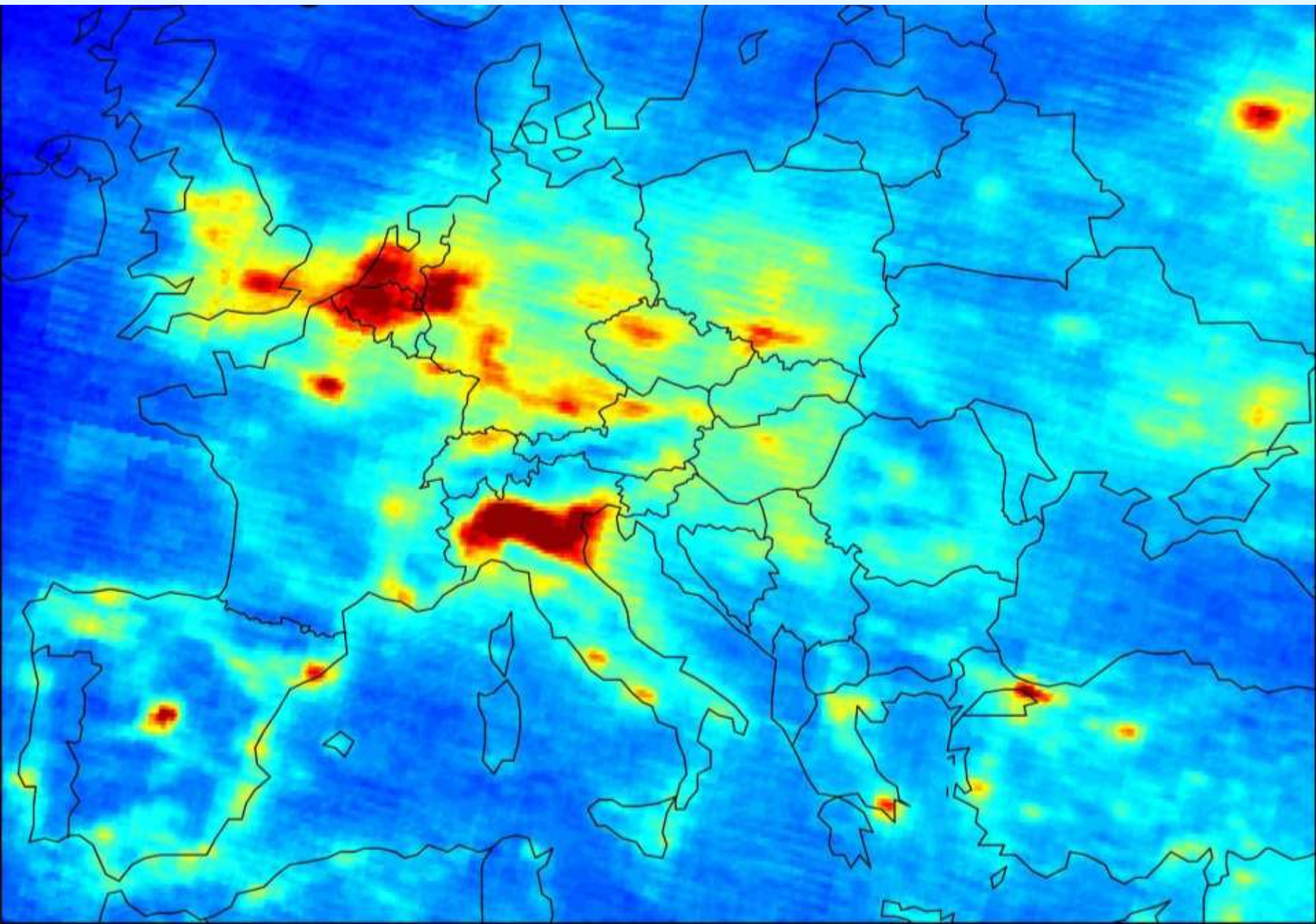
Situation in the CR

- SO₂
- NO_x
- NH₃

thousands of tons



European monitoring (NO₂) - <http://www.knmi.nl/omi>



OZONE

- ozone O_3 – very unstable, pale blue, stinks, toxic
 - Dioxygen + UV light + electrical atmospheric discharges
- ozone **in stratosphere** (approx. in 27 km, 2 – 8 ppb, protects the Earth against the UV radiation 😊)
- ozone **in troposphere** (ground) health risks, in summer (dry sunny conditions + traffic, concentration up to 100 ppb) 😞
- UV radiation is trapped in the ozone layer (UV causes skin cancer) (***10% reduction of the ozone layer = increase skin cancer risk of o 30÷40 % !***)
- O_3 concentration differs according to solar activity and Earth position

OZONE HOLE

- ozone hole = decreasing O_3 concentration above particular places due to human activities
- are created primarily at poles (less thickness due to rotation of the Earth) (1998 \rightarrow 2,5x > larger than Europe!)

Main cause:

- *Freon* – CFCs, very stable (hundreds of year)
- *Metylbromid* – fertilizers,
is 60x more effective
than Freon !

