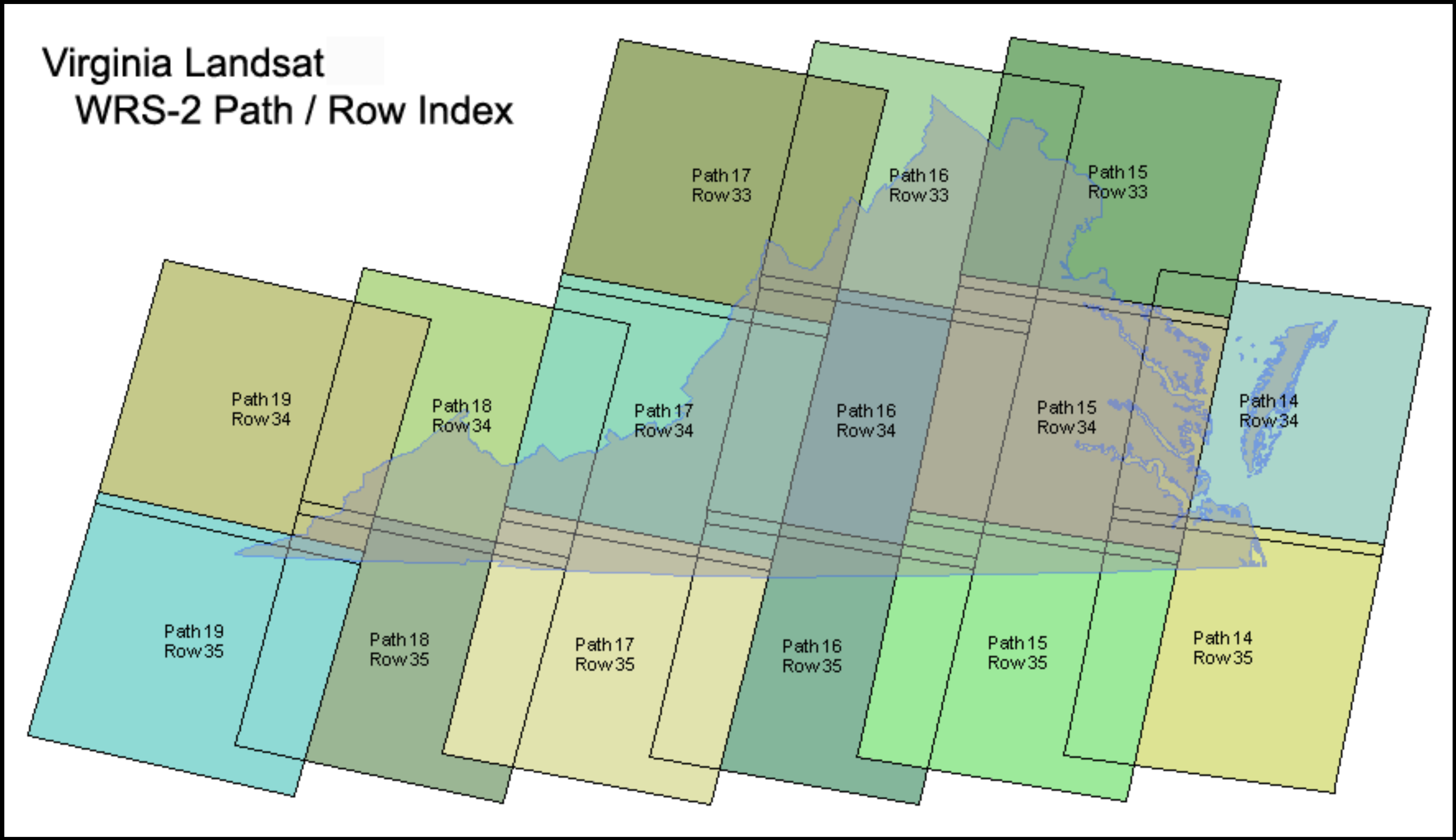
How to get data from Landsat?

Google Earth Engine
https://earthengine.google.com/

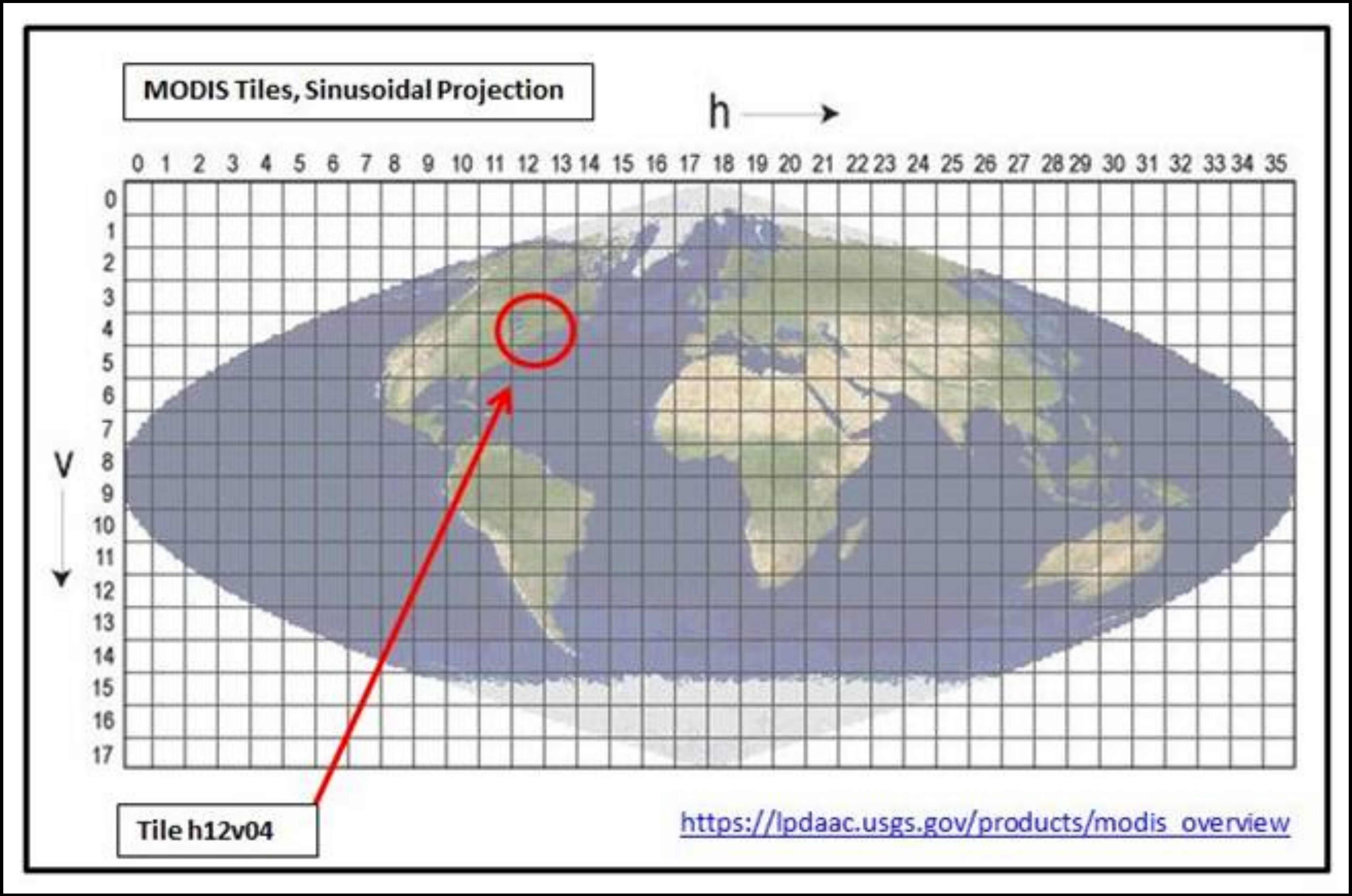
Download data from USGS
https://landsatlook.usgs.gov/

https://earthexplorer.usgs.gov/

https://glovis.usgs.gov/


Virginia Landsat
WRS-2 Path / Row Index
Path 17
Row 33
Path 16
Row 33
Path 15
Row 33
Path 19
Row 34
Path 18
Row 34
Path 17
Row 34
Path 16
Row 34
Path 15
Row 34
Path 14
Row 34
Path 19
Row 35
Path 18
Row 35
Path 17
Row 35
Path 16
Row 35
Path 15
Row 35
Path 14
Row 35

How to get data from MODIS?



How to get data from MODIS?

Ocean datasets: Temperature, Chlorophyll, and Reflectance etc.

https://oceancolor.gsfc.nasa.gov/

Atmospheric datasets: Aerosol, water vapor, and cloud etc.

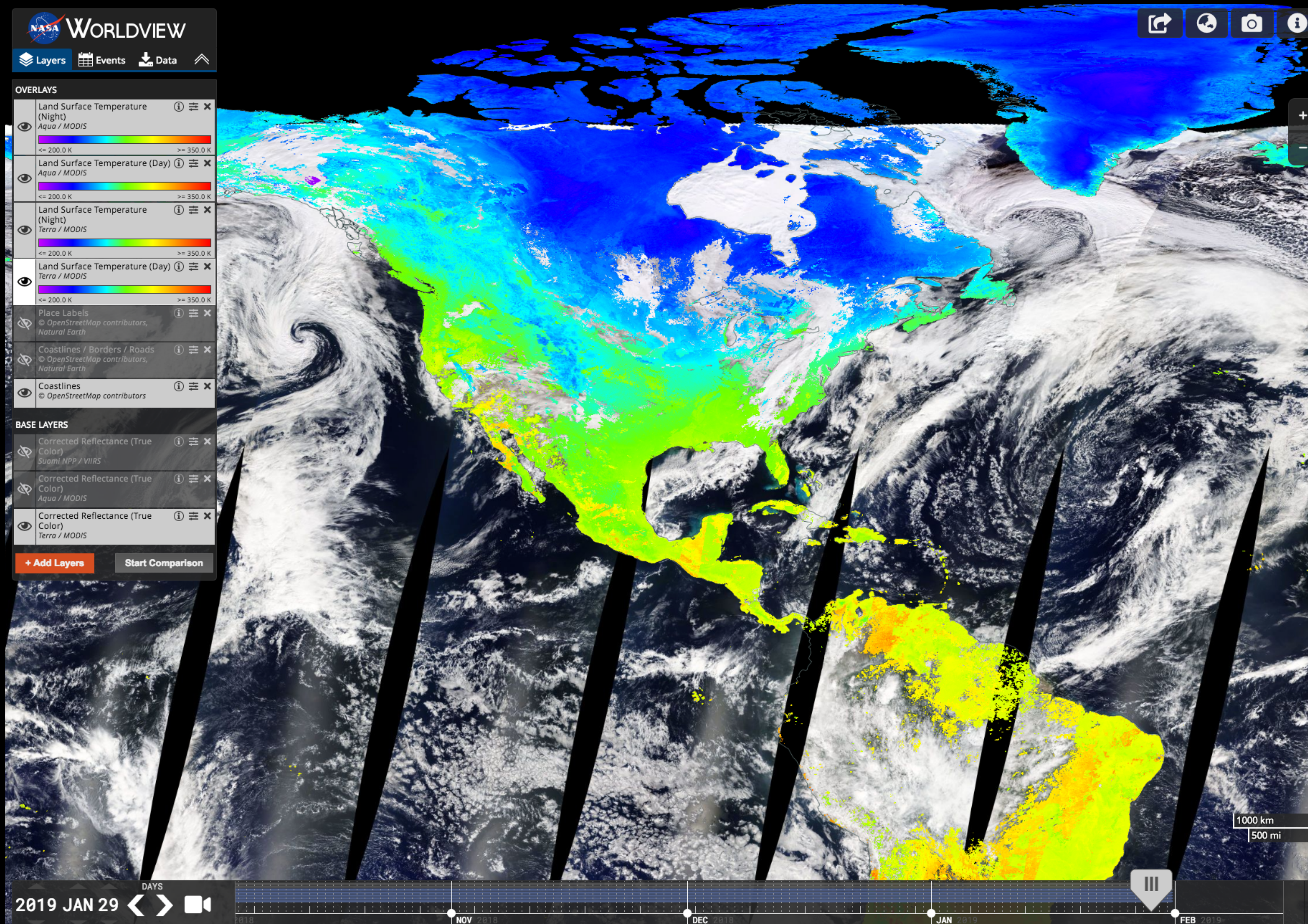
https://modis-atmos.gsfc.nasa.gov/

NASA EarthData

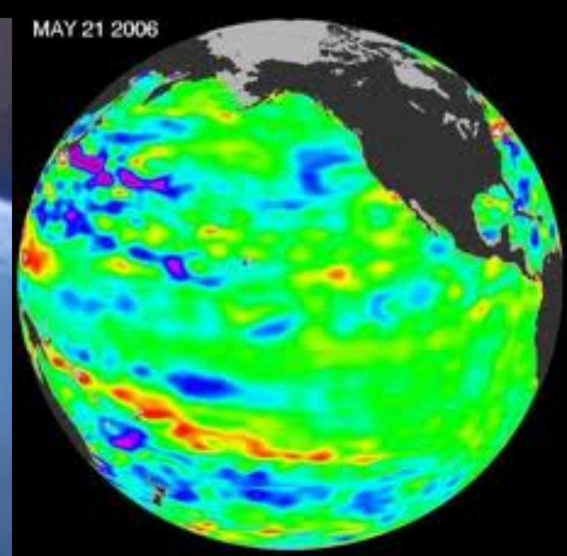
https://search.earthdata.nasa.gov/search

NASA appears

https://lpdaacsvc.cr.usgs.gov/appeears/



https://worldview.earthdata.nasa.gov


Radiative Transfer Theory

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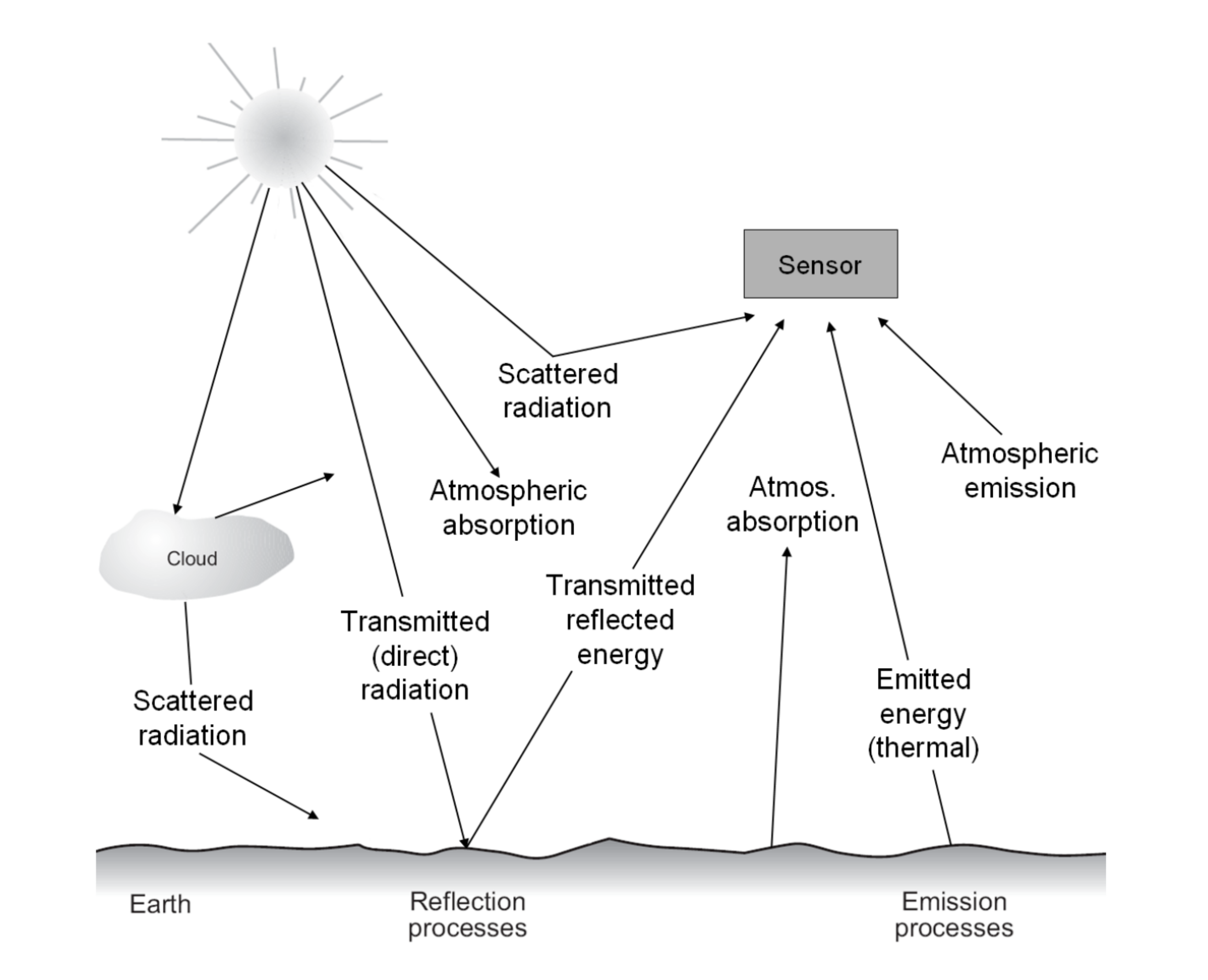
EVSC 4010/7010 Week 4

Paths of solar radiation



Week 4 Outline

- Scattering and absorption and trans in the atmosphere
- Beer’s law
- Atmospheric correction


Dr
SR 1821
Ln
SR 1820
1821
STOP

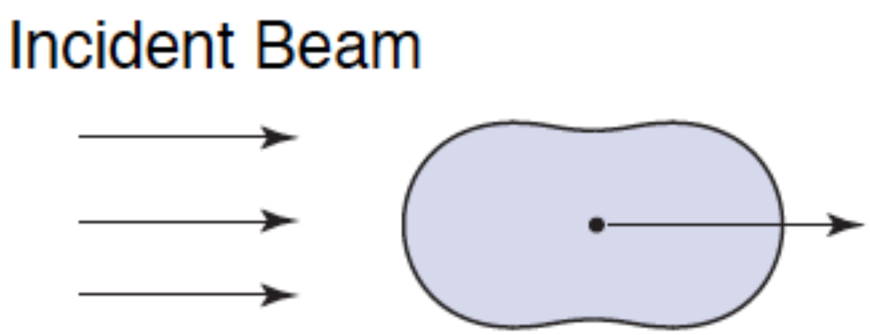
Three types of scattering in the atmosphere

- Rayleigh Scattering
- Mie Scattering
- Geometric Optical

Rayleigh and Mie scattering

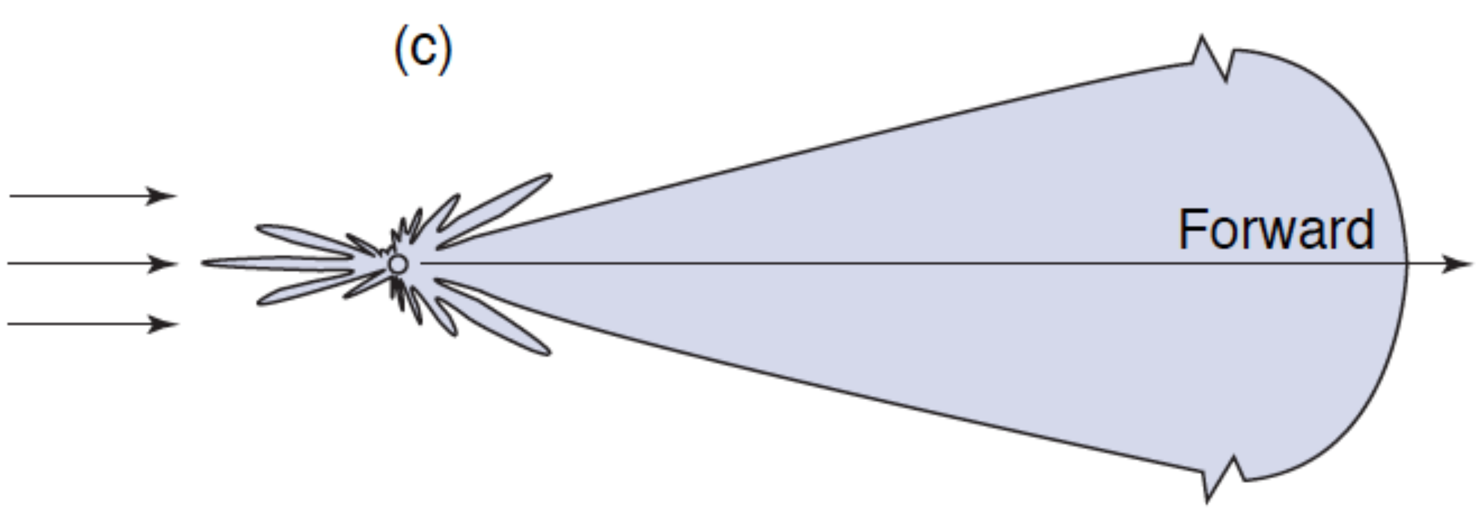
$$x = \frac{2\pi r}{\lambda}$$

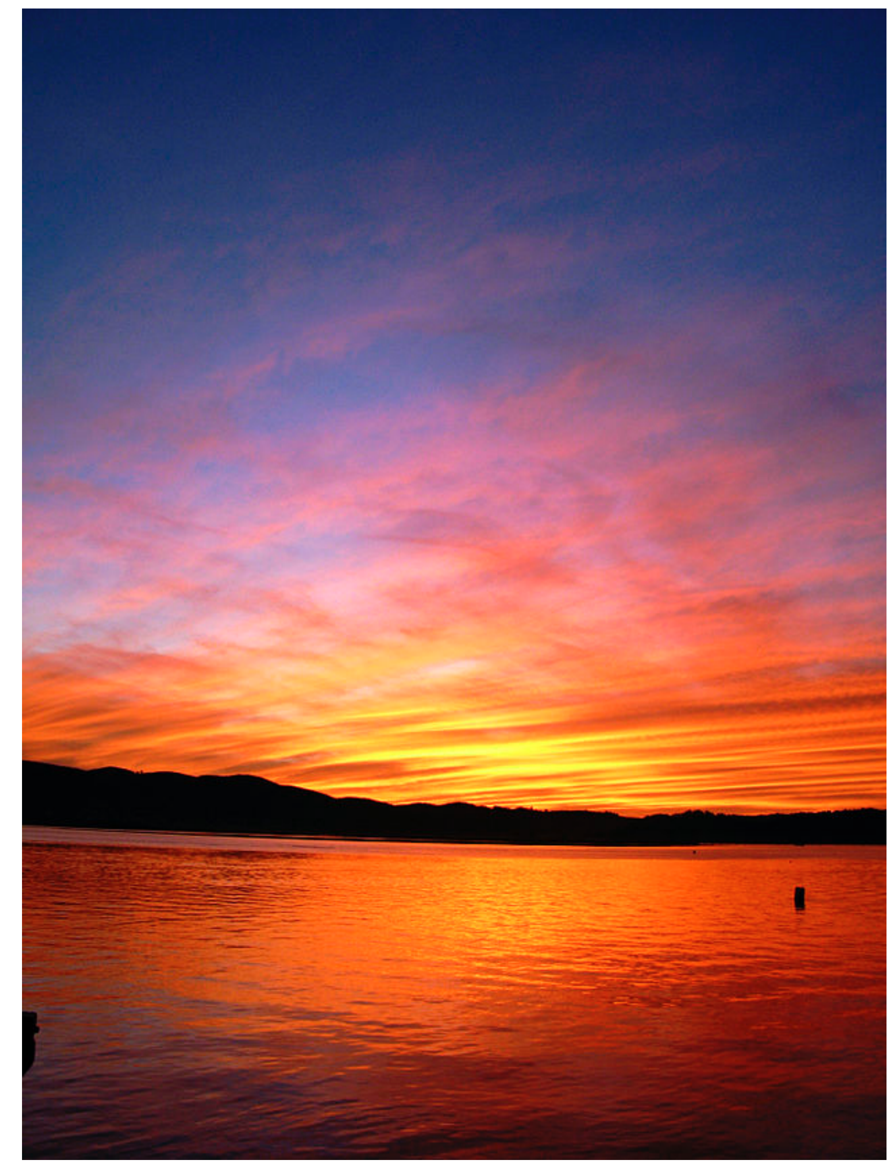
Rayleigh scattering



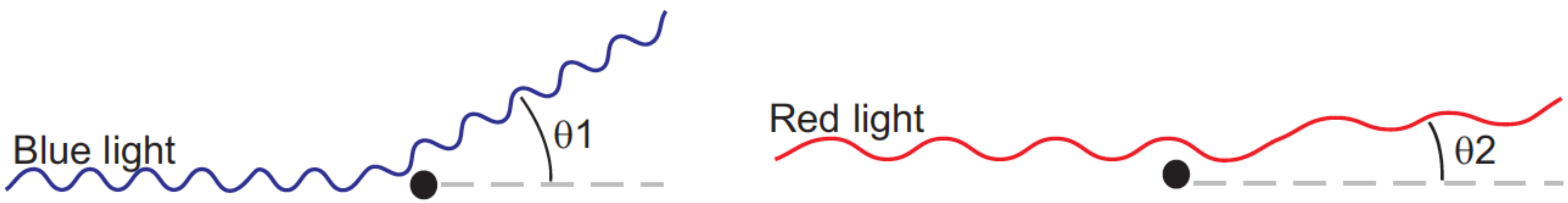
$$K_\lambda \propto \lambda^{-4}$$

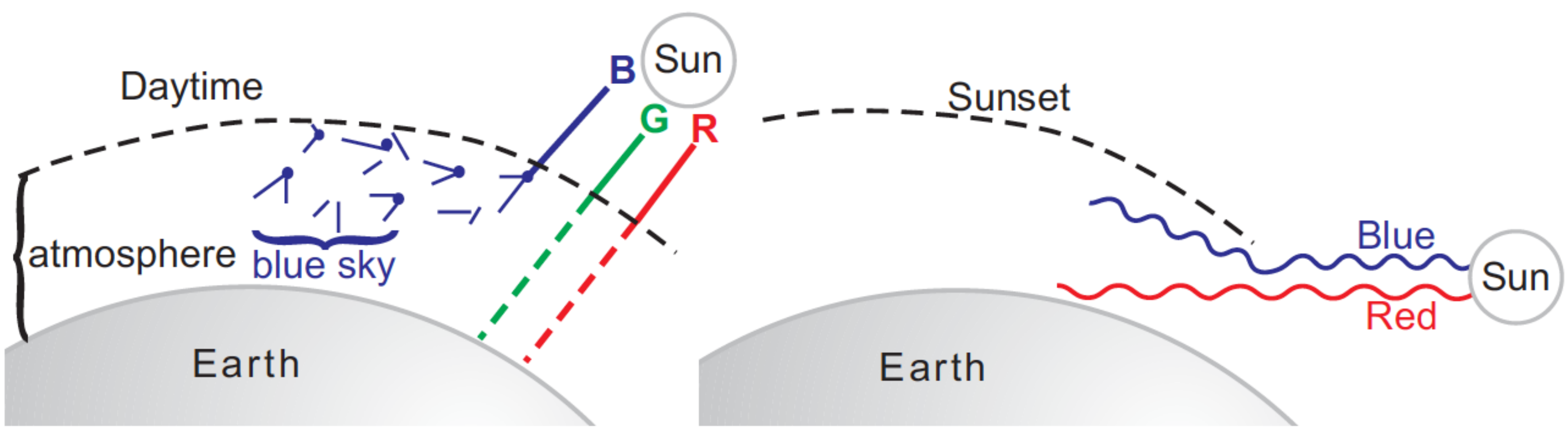
Mie scattering

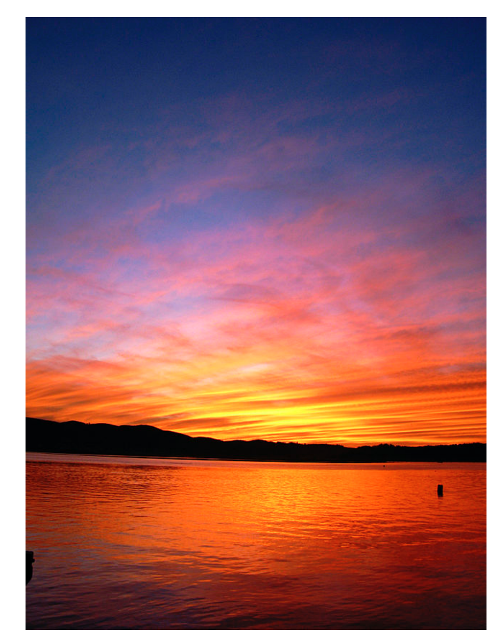




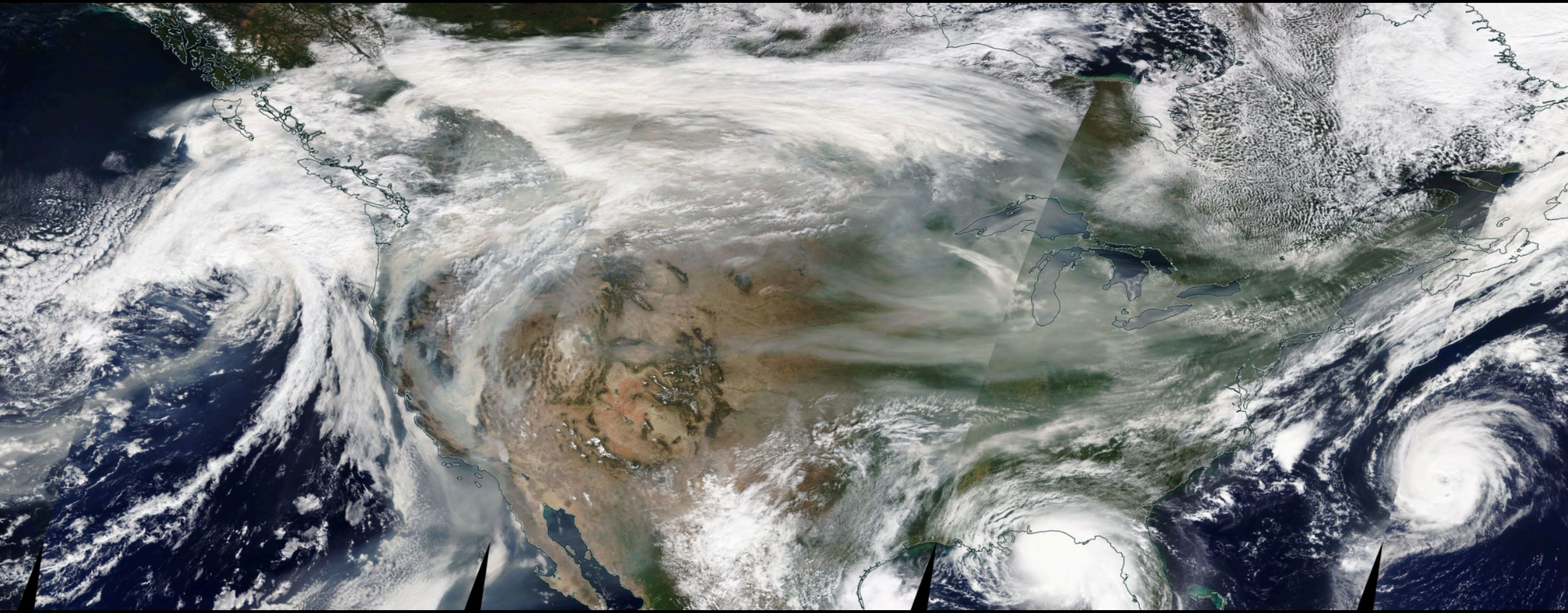
Rayleigh Scattering: why blue/red skies?





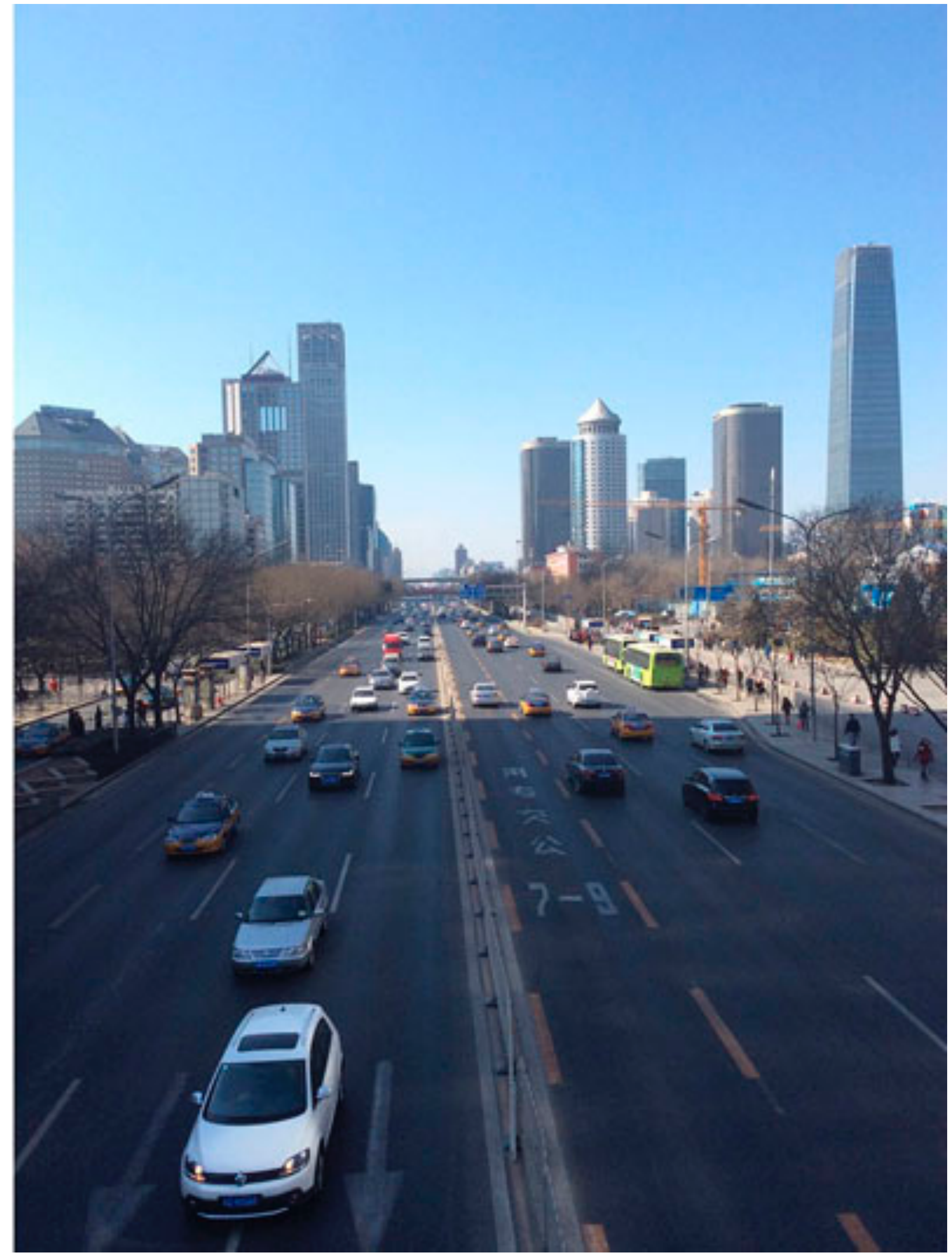


Blue ridge Parkway



https://worldview.earthdata.nasa.gov

Mie Scattering



Rayleigh Scattering

163.com

Blood moon

Estimate the relative efficiency with which blue light (470 nm) comparing with red light (640 nm) are scattered by **air molecules** (0.1 nm)?

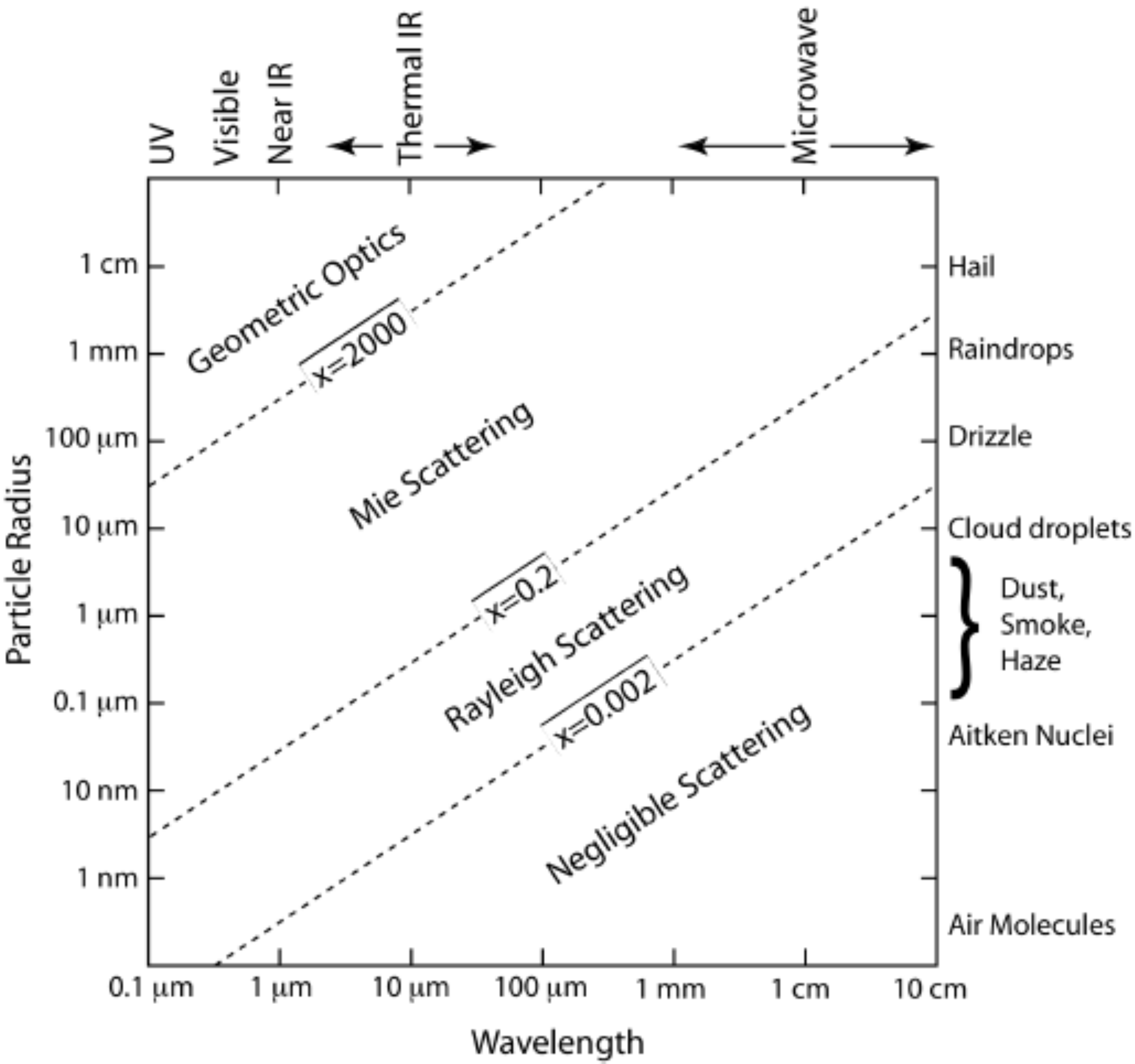
$$K_\lambda \propto \lambda^{-4}$$

$$\frac{K(blue)}{K(red)} = (\frac{\lambda_{red}}{\lambda_{blue}})^4 = (\frac{640}{470})^4 = 3.44$$

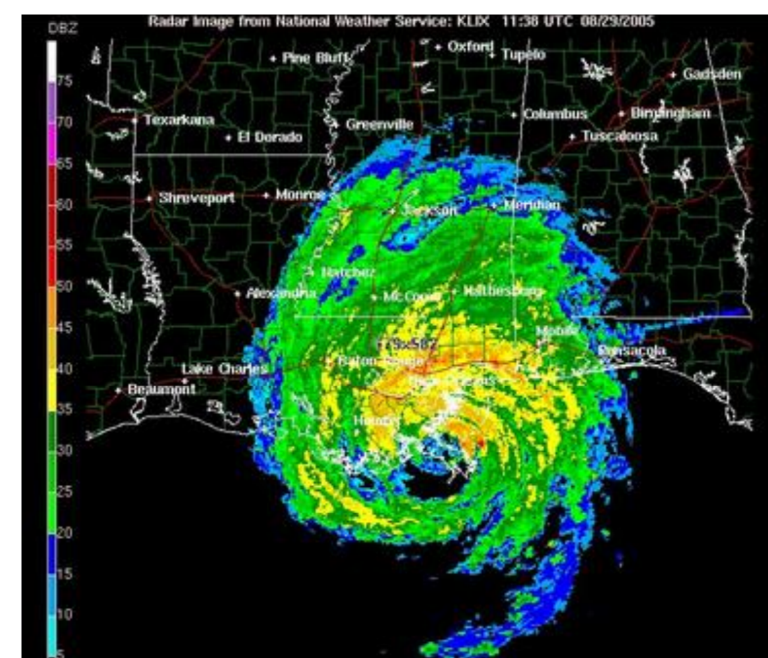
Estimate the relative efficiency with which red light (640 nm) comparing with green light (500 nm) are scattered by **smoke** (1-10 um)?

~1.00

The type of scattering depends on the particle size and wavelength of the radiation



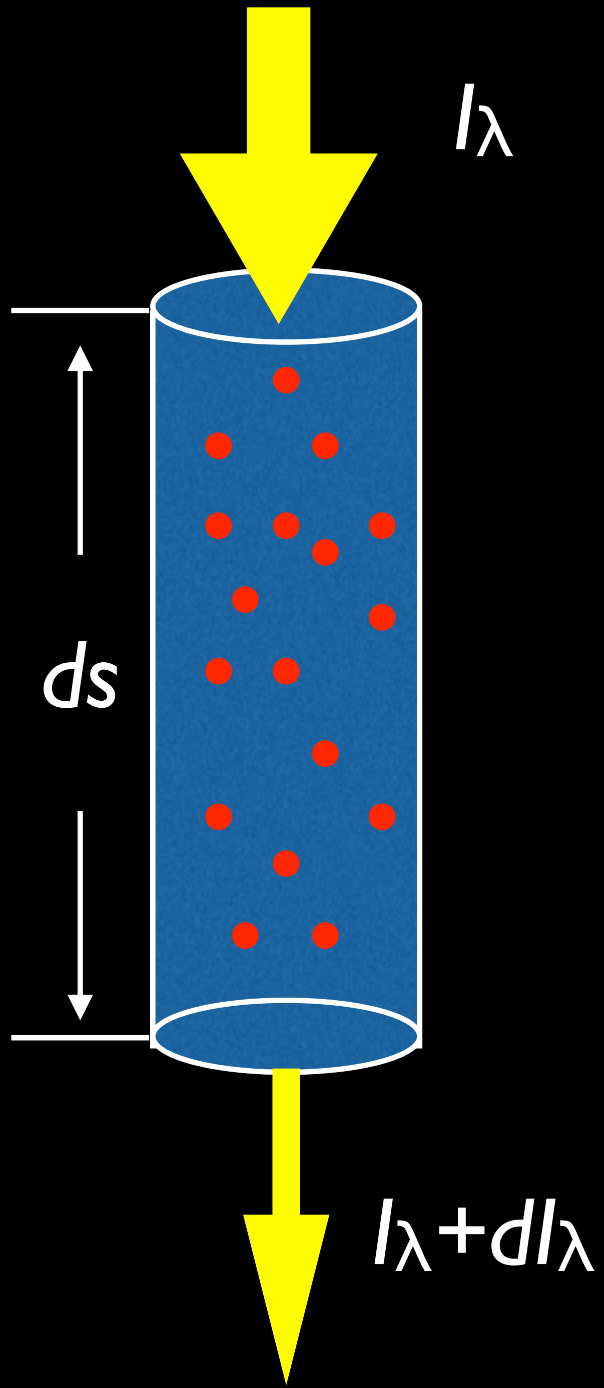
$$x = \frac{2\pi r}{\lambda}$$



Beer’s law

A simple model of scattering and absorption

$$dI_\lambda = \text{intensity} \times \text{attenuation} = -I_\lambda \rho r k_\lambda ds$$



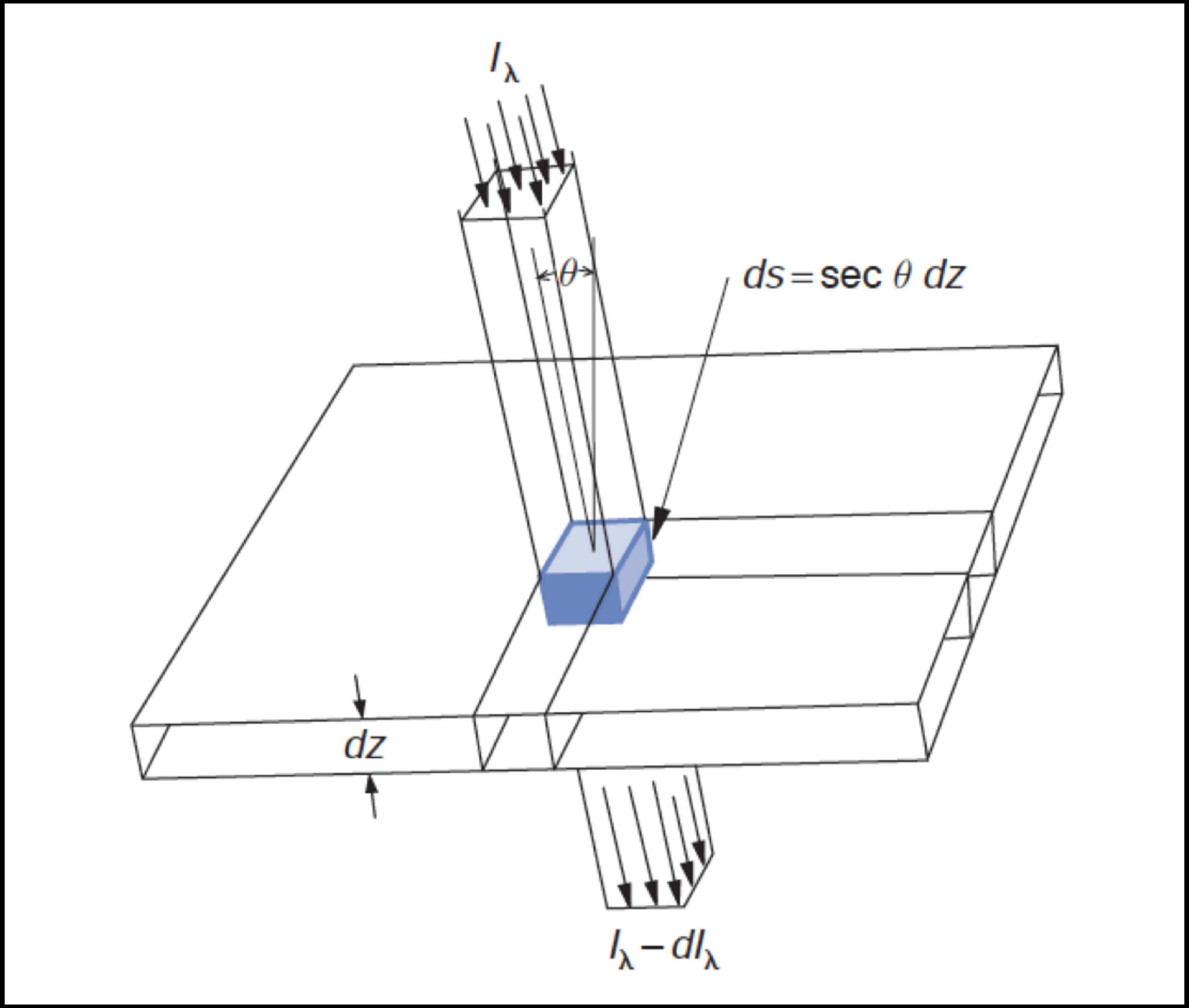
***ρ**: the density of the air;*

***r**: the mass of the absorbing gas per unit mass of air;*

***kλ**: mass absorption coefficient;*

***ds**: the path length along the ray path of the incoming radiation.*

Beer's law



$$dI_\lambda = \text{intensity} \times \text{attenuation} = -I_\lambda \rho r k_\lambda ds$$

The derivation of Beer's law

$$I_{\lambda z_0} = I_{\lambda\infty} e^{-\sec\theta \int_{z_0}^{\infty} k_\lambda \rho r \, dz} = I_{\lambda\infty} e^{-\tau_A \sec\theta}$$

$$\tau_\lambda = \int_{z_0}^{\infty} k_\lambda \rho r \, dz$$

Radiative Transfer in the Atmosphere

Case 1: No atmosphere

$$L_{sat} = \frac{\rho E_o \cos\theta_s}{\pi}$$

L_{sat}: radiance at sensor
E_o: TOA solar irradiance
ρ: surface reflectance
θ: solar zenith angle

Case 2: Atmosphere attenuation

$$L_{sat} = \frac{\rho T_\phi [T_\theta E_o \cos\theta_s + E_D]}{\pi} + L_{path}$$

T_θ: Transmission of the atmosphere from TOA to the surface
T_φ: Transmission of the atmosphere from the surface to TOA
E_D: Downwelling scattered irradiance (diffuse radiance)
L_{path}: Path irradiance

Why do we need atmospheric correction?

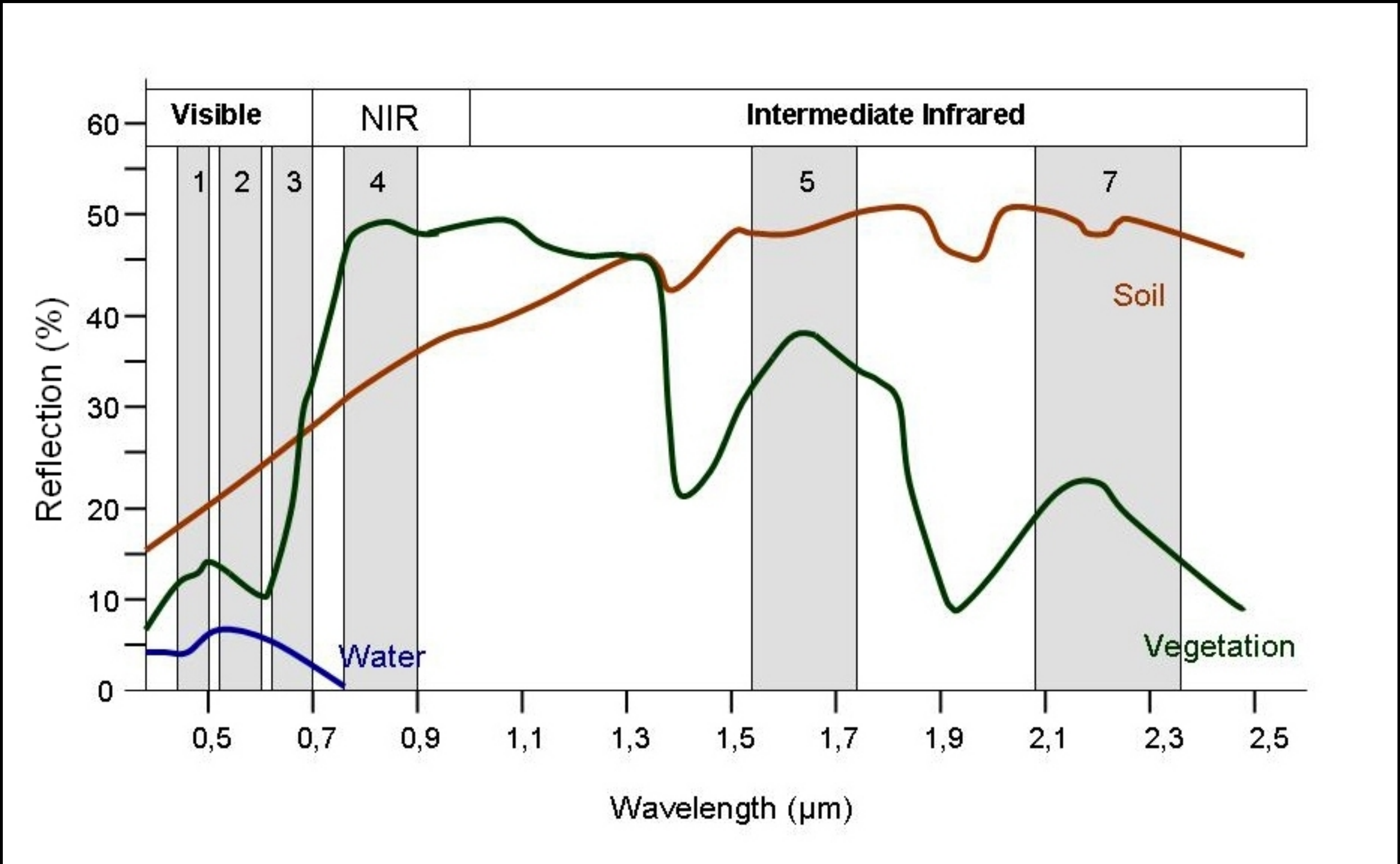
a. Before atmospheric correction.

b. After atmospheric correction.

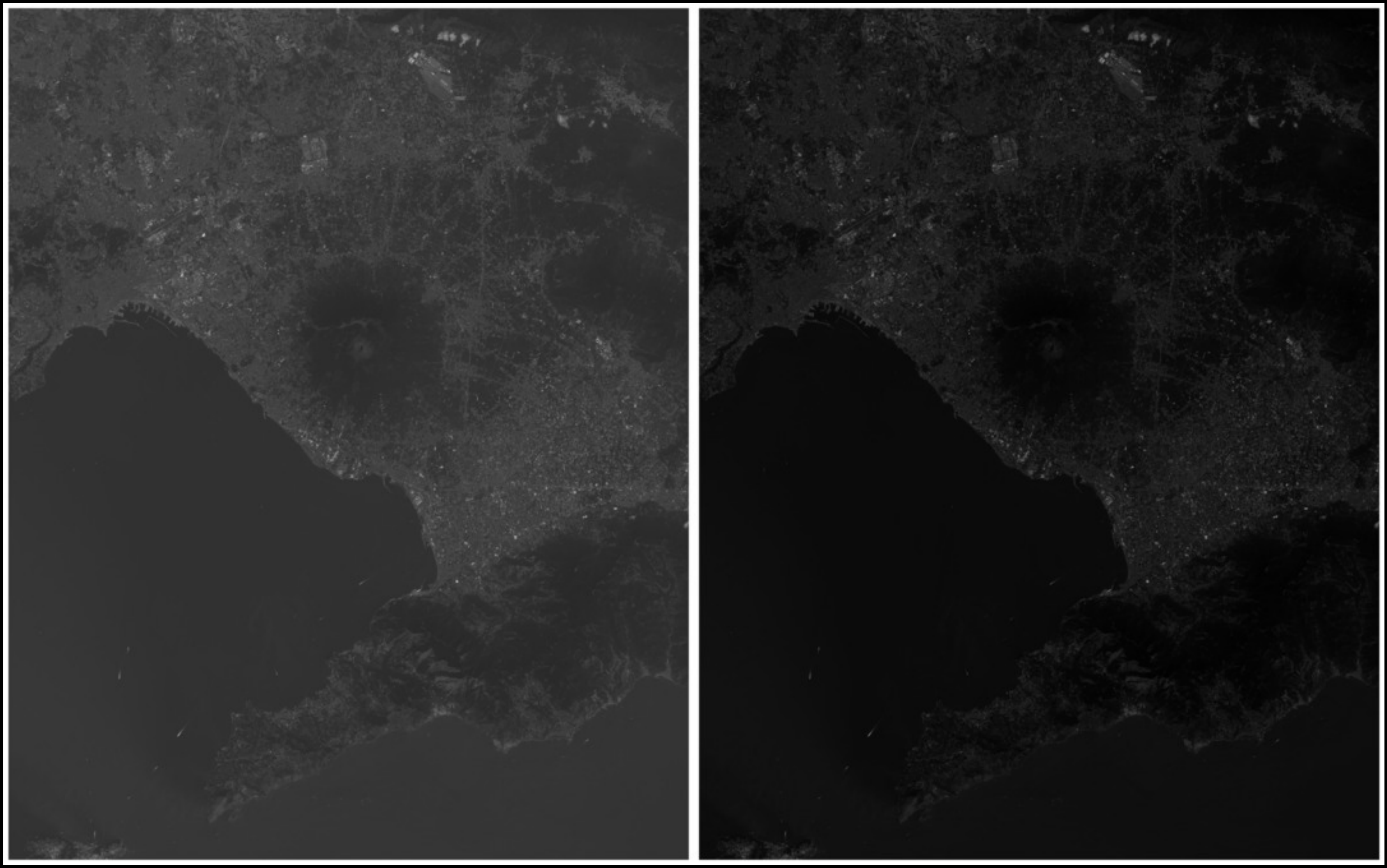
Dark target atmospheric correction

Take the path radiance out

Dark target atmospheric correction

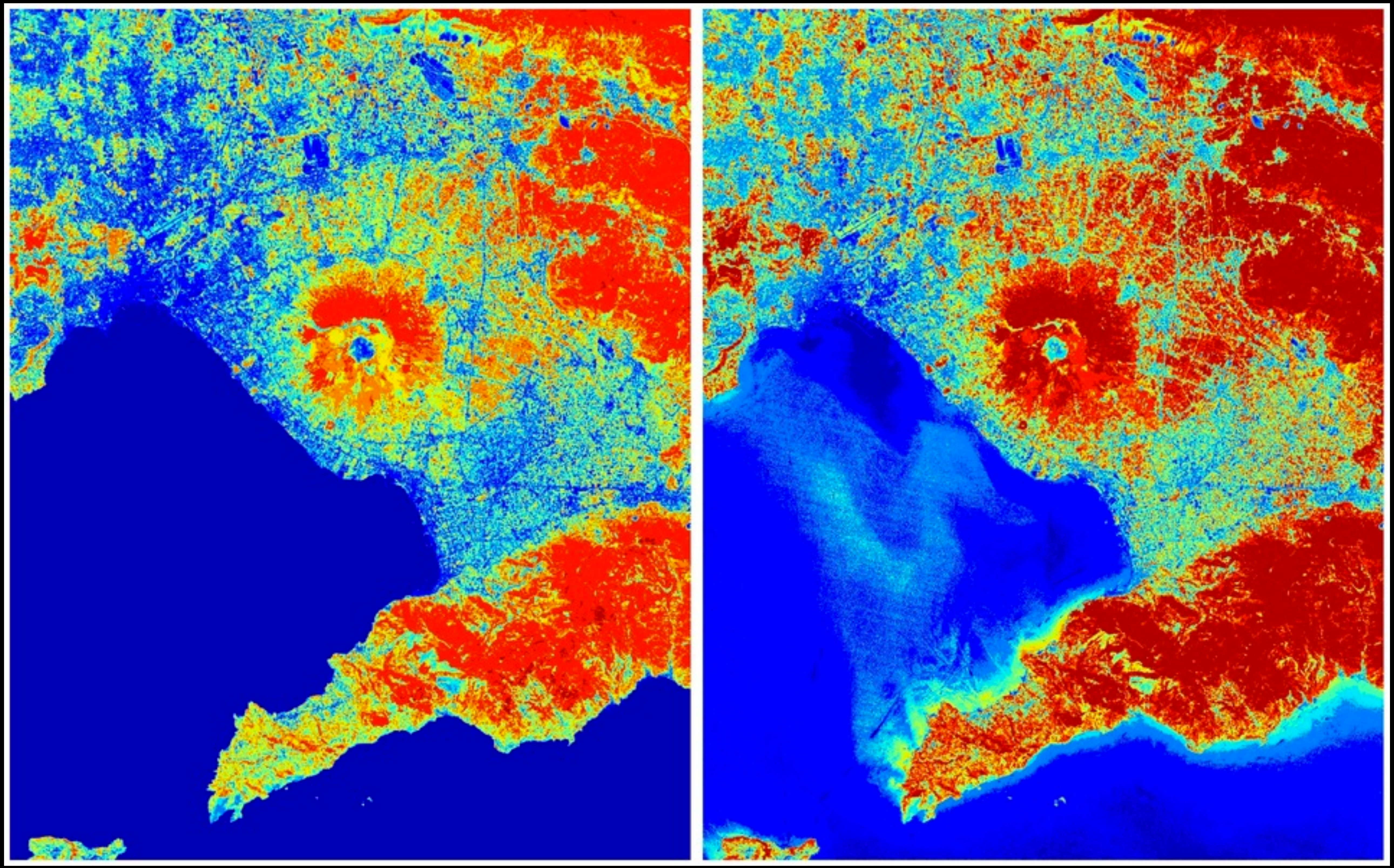


Dark target atmospheric correction (cont.)



Dark target atmospheric correction (cont.)

NDVI image before and after correction



Atmospheric correction with RTMs*

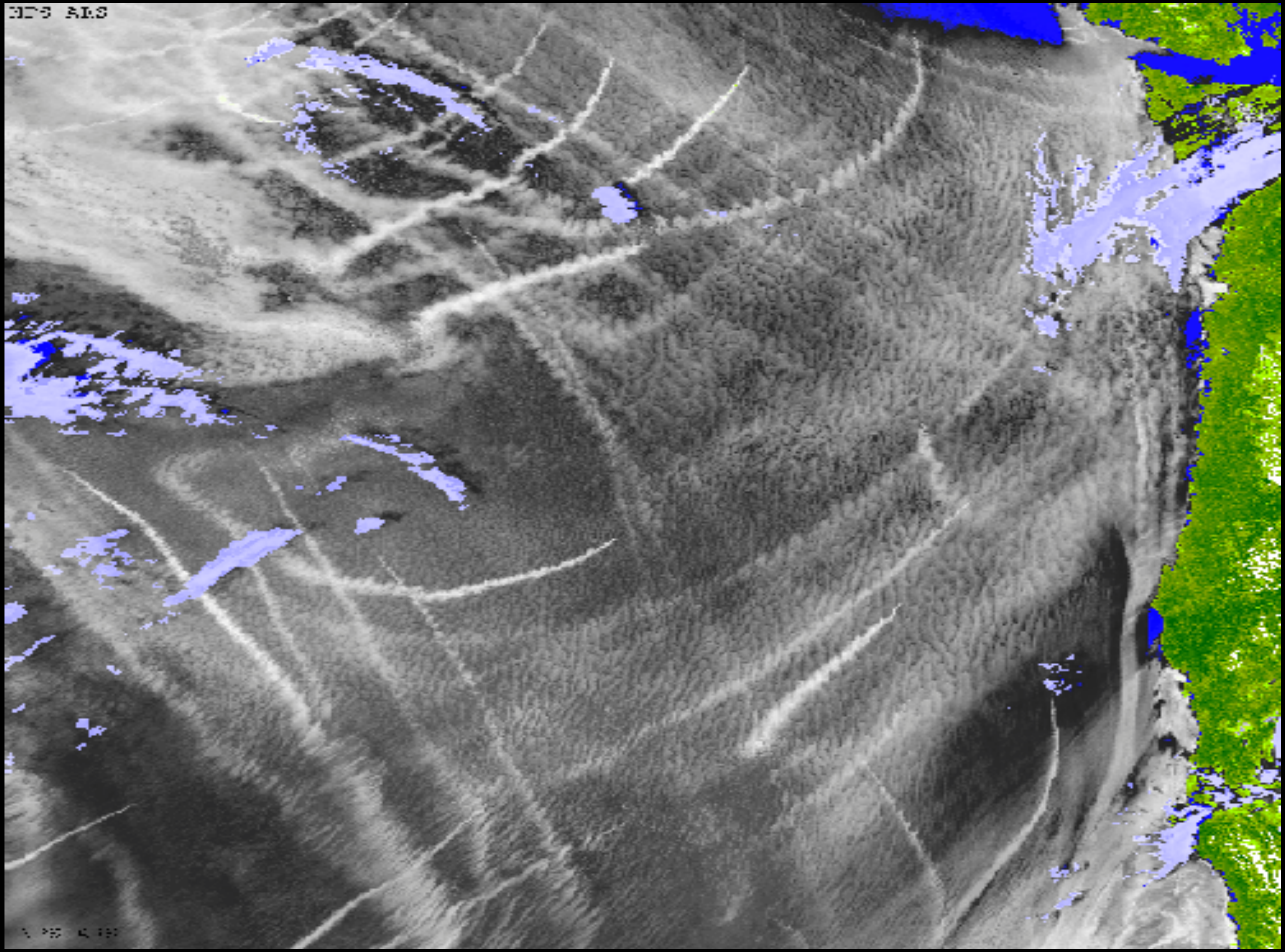
Models: MODTRAN 4+; ACORN; ATREM; FLAASH; 6S; ATCOR

Input:

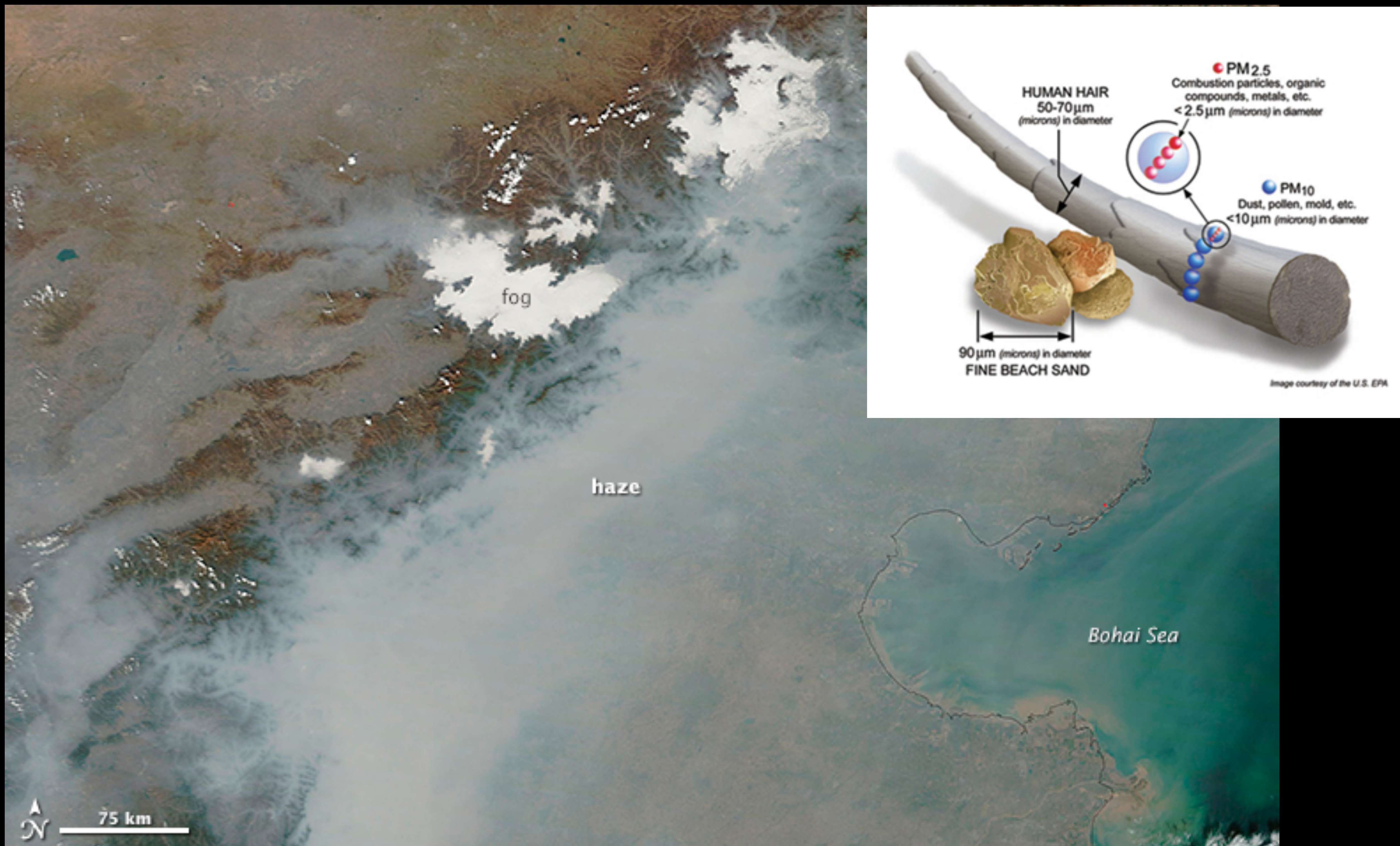
1. Latitude/Longitude of the image taken;
2. Date and time;
3. Image acquisition altitude;
4. Mean elevation ASL;
5. An atmosphere model: mid-latitude summer, mid-latitude winter, tropical;
6. Radiometrically calibrated radiance;
7. Local atmospheric condition (visibility)

RTMs = Radiative Transfer Models

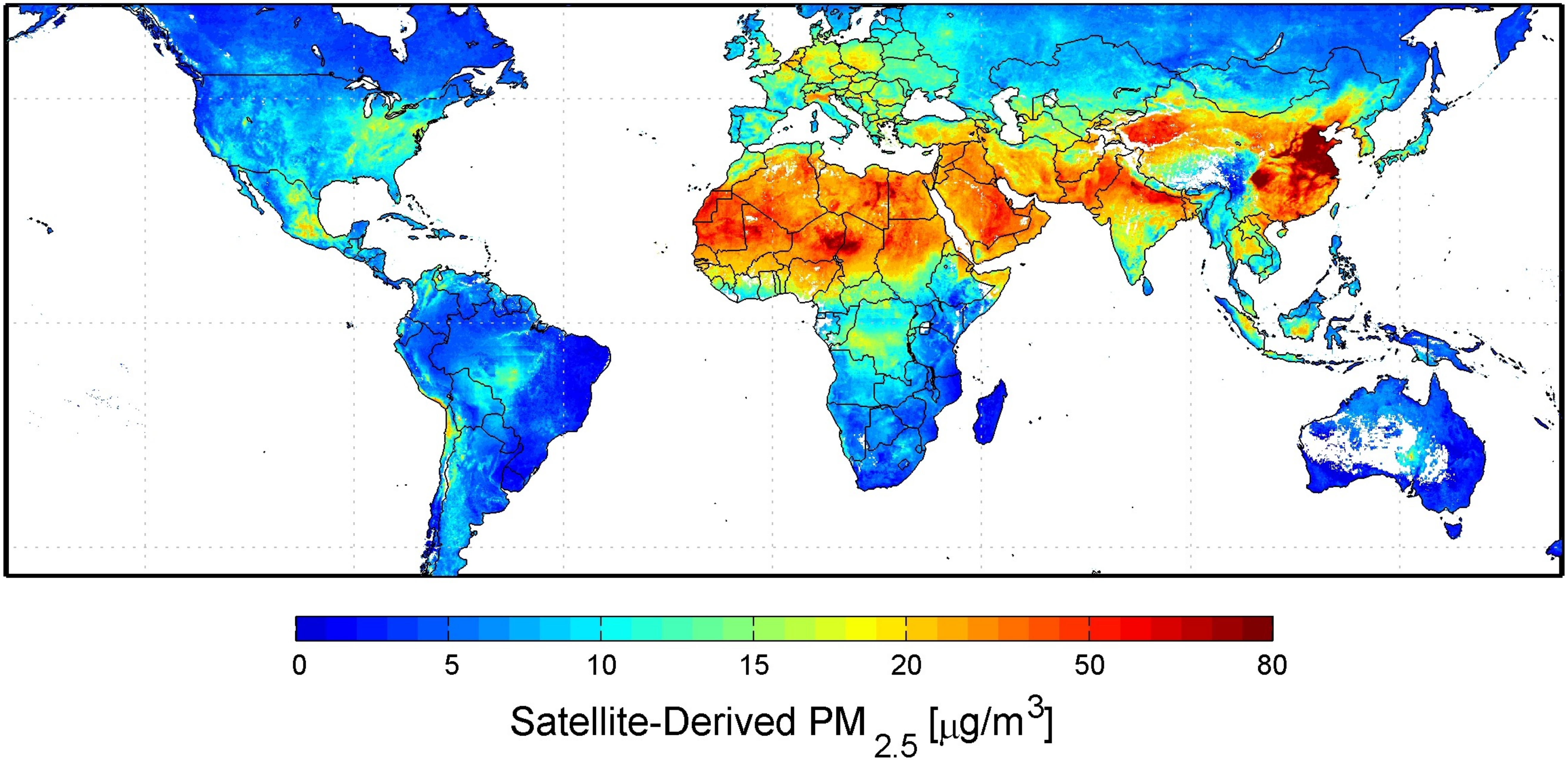
Ship tracks form clouds



Satellite observation of haze in China

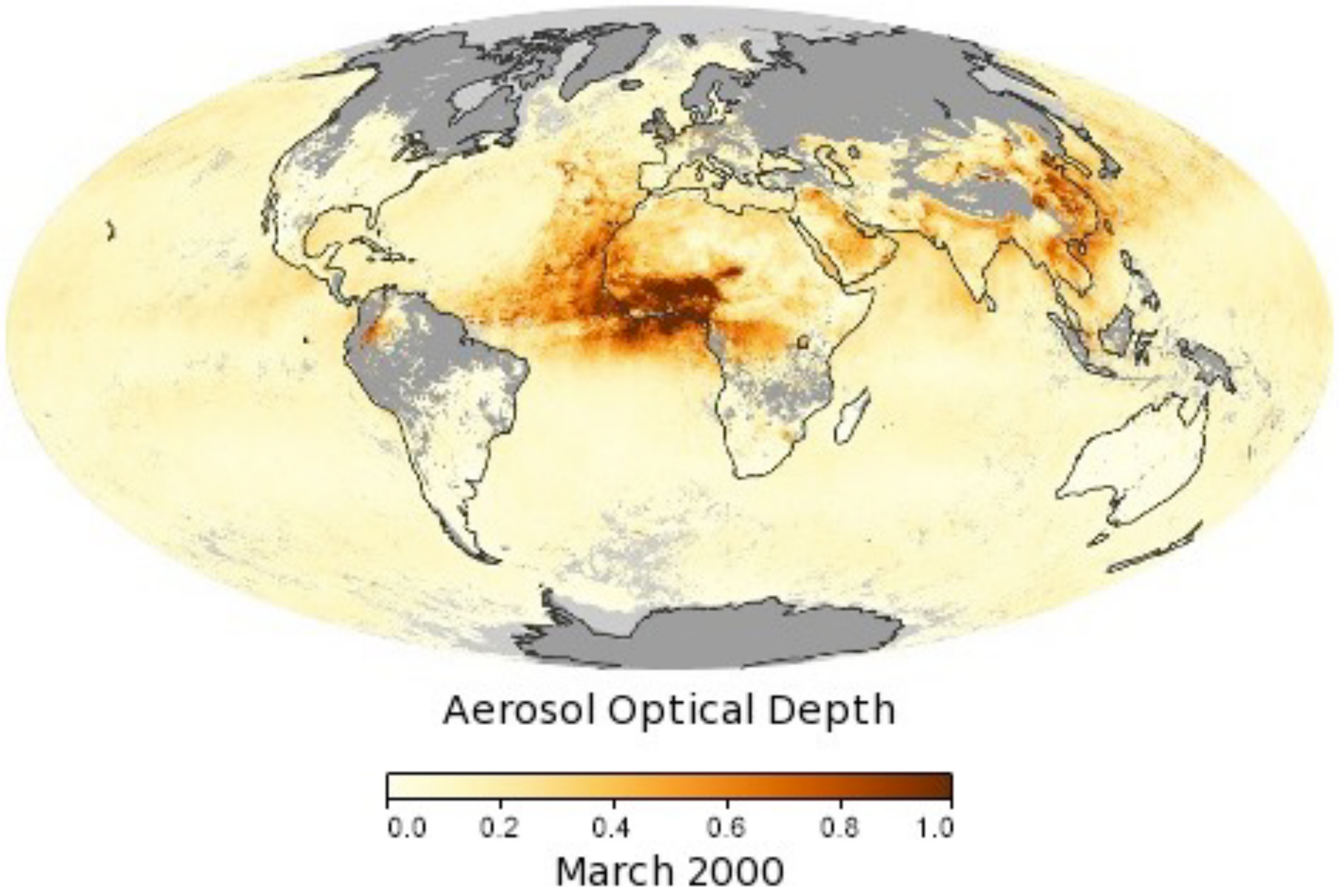


Satellite-based PM2.5 reveal the spatial distribution



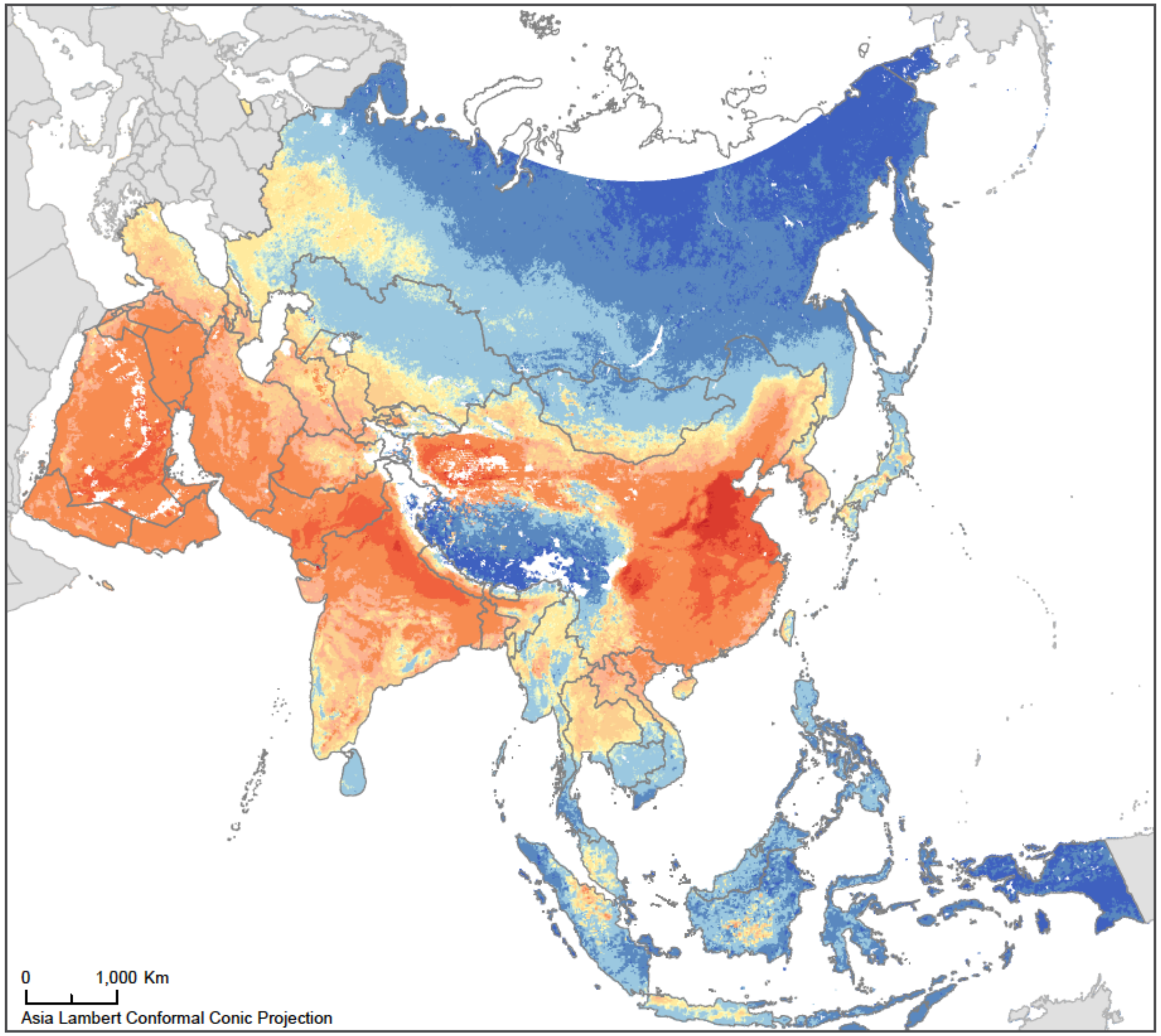
NASA

PM2.5 is estimated from aerosol optical depth (AOD)



Global Annual PM2.5 Grids from MODIS, MISR and SeaWiFS Aerosol Optical Depth (AOD), 2001–2010: Asia

Satellite-Derived Environmental Indicators



Map Credit: CIESIN Columbia University, April 2015.

The Global Annual PM2.5 Grids from MODIS, MISR and SeaWiFS Aerosol Optical Depth (AOD) data sets represent a series of three-year running mean grids (1998–2012) of fine particulate matter (solid particles and liquid droplets) that were derived from a combination of MODIS (Moderate Resolution Imaging Spectroradiometer), MISR (Multi-angle Imaging SpectroRadiometer) and SeaWIFS (Sea-Viewing Wide Field-of-View Sensor) AOD satellite retrievals. A global decadal (2001–2010) mean PM2.5 concentration grid was also produced and is mapped here. Together the grids provide a continuous surface of concentrations in micrograms per cubic meter of particulate matter 2.5 micrometers or smaller (PM2.5) for health and environmental research. The raster grid cell size is approximately 10 km at the equator, and the extent is from 70 degrees north to 55 degrees south latitude.

Decadal (2001–2010) Mean Fine Particulate Matter (PM2.5) Concentration

1 2 5 10 12 20 50 100 200

micrograms per cubic meter

Center for International Earth Science Information Network
EARTH INSTITUTE | COLUMBIA UNIVERSITY

Data Source: van Donkelaar, A., R.V. Martin, M. Brauer, and B.L. Boys. 2015. Global Annual PM2.5 Grids from MODIS, MISR and SeaWiFS Aerosol Optical Depth (AOD), 1998-2012. Palisades, NY: NASA Socioeconomic Data and Applications Center (SEDAC). http://dx.doi.org/10.7927/H4028PFS.

Searching for data: is it the right product for me?

1. Product type
2. Spatial resolution
3. Temporal resolution
4. Time span
5. Should I trust the data?
6. File format (GEOtiff, NetCDF, HDF)

NASA Panoply