



# Atmospheric Research and Meteoric Dust Detection by the All-Sky Polarization Measurements of the Twilight Sky

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# Meteors and Atmosphere

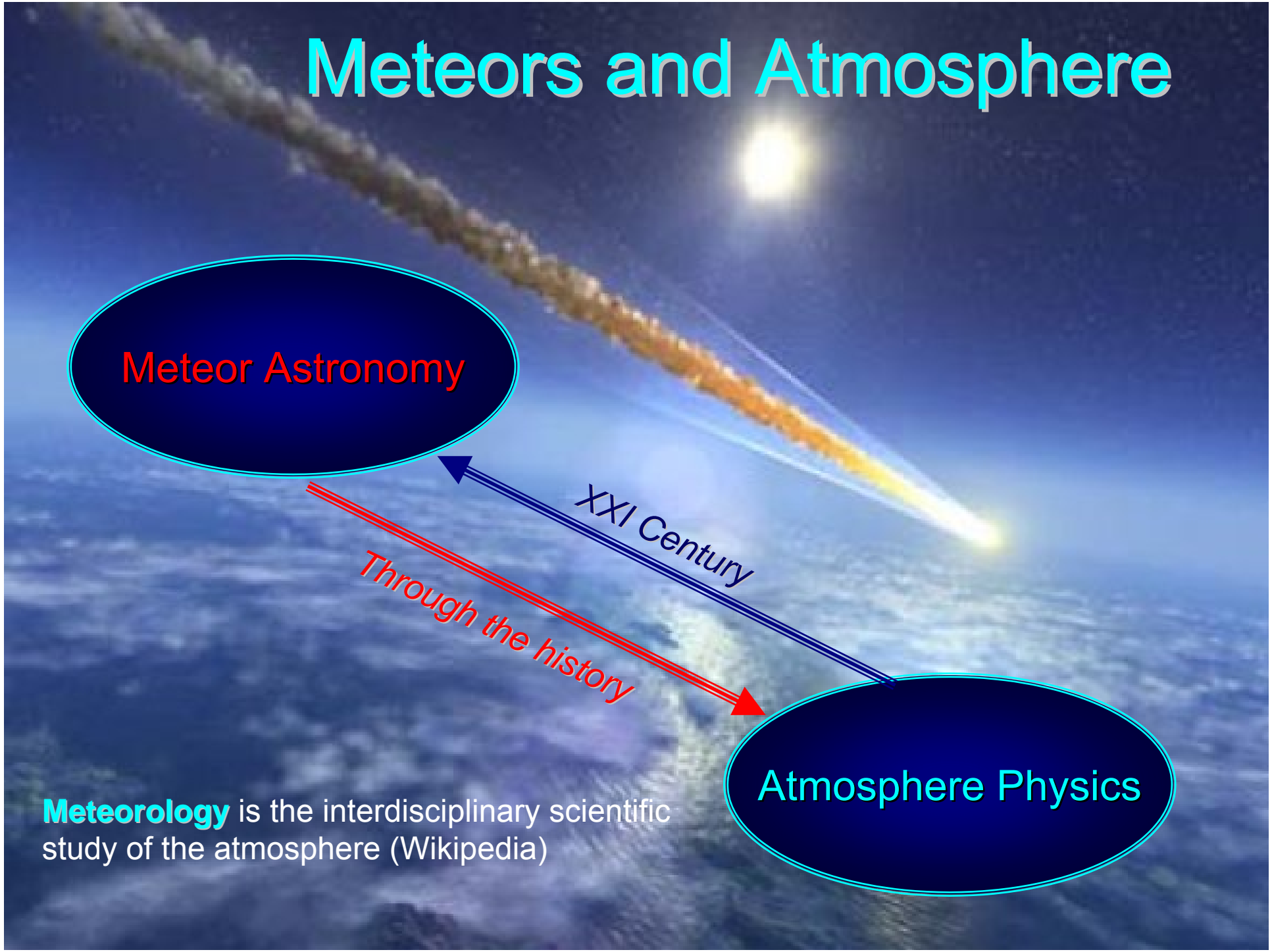
Meteor Astronomy

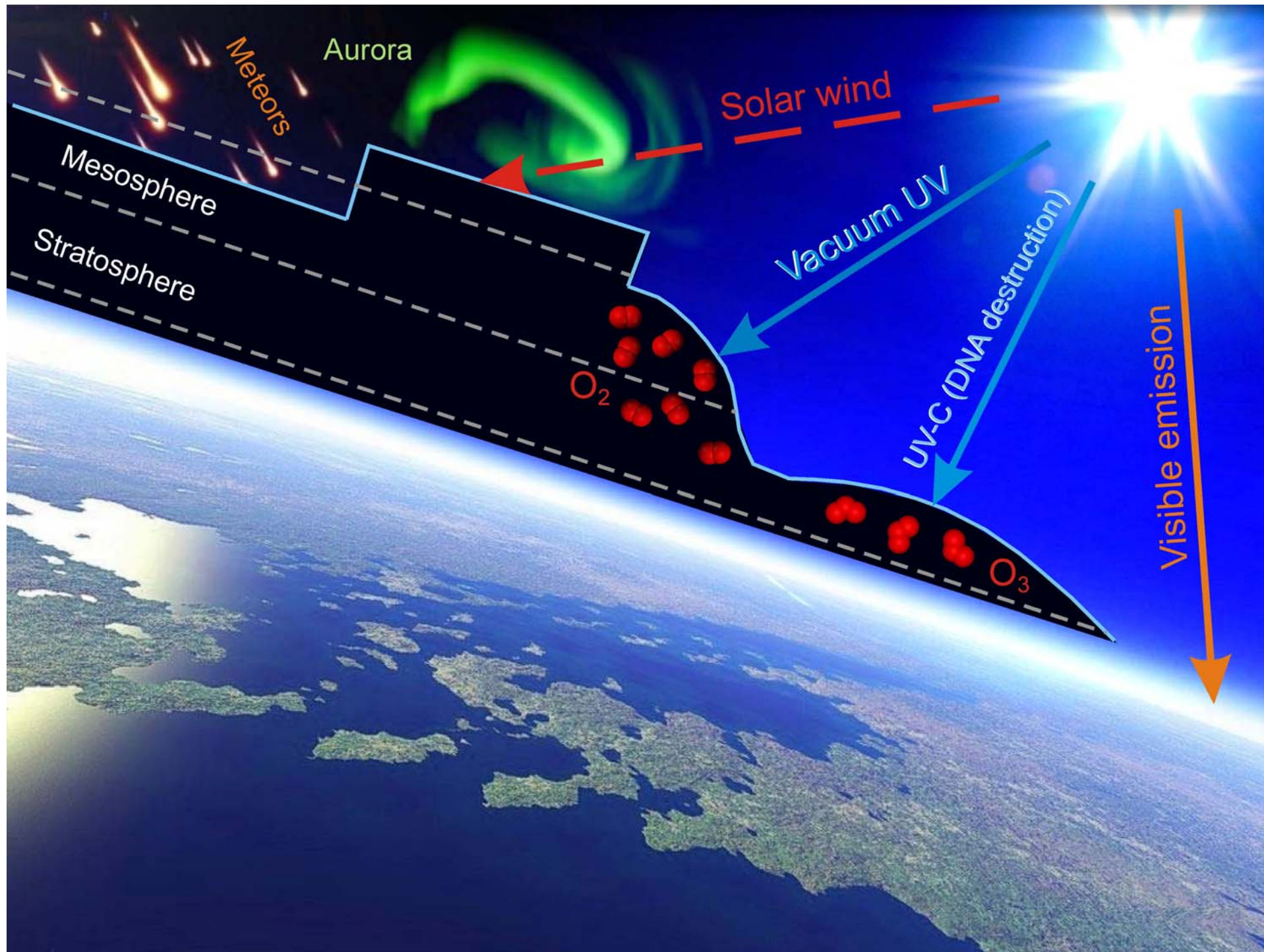
XXI Century

Through the history

Atmosphere Physics

**Meteorology** is the interdisciplinary scientific study of the atmosphere (Wikipedia)

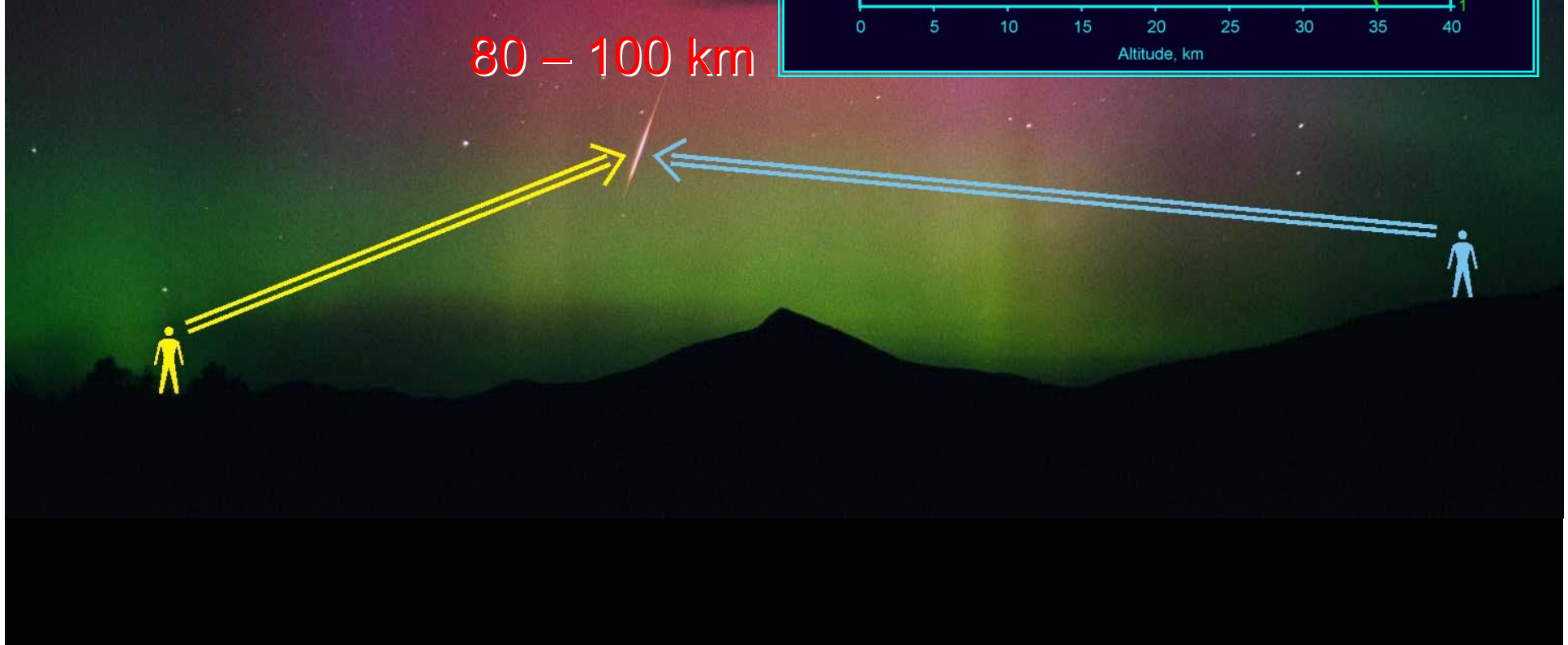
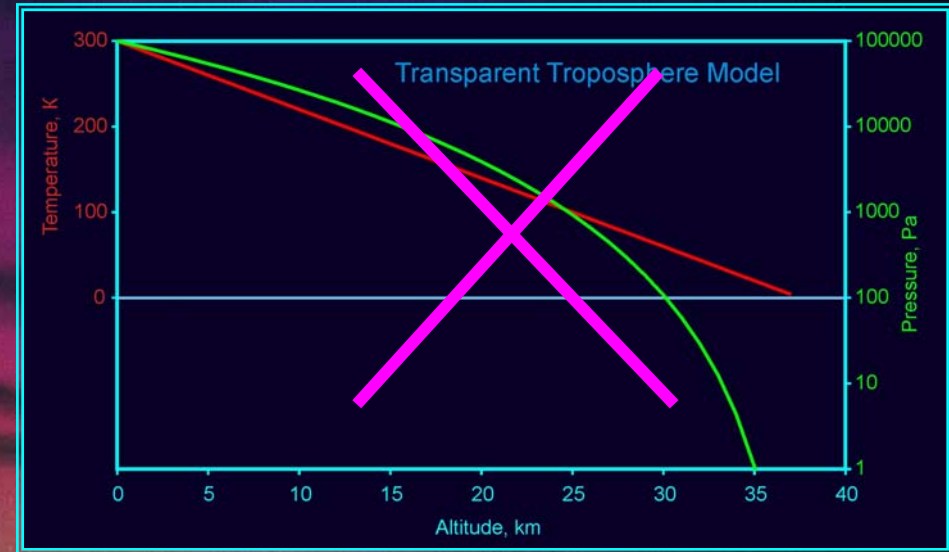




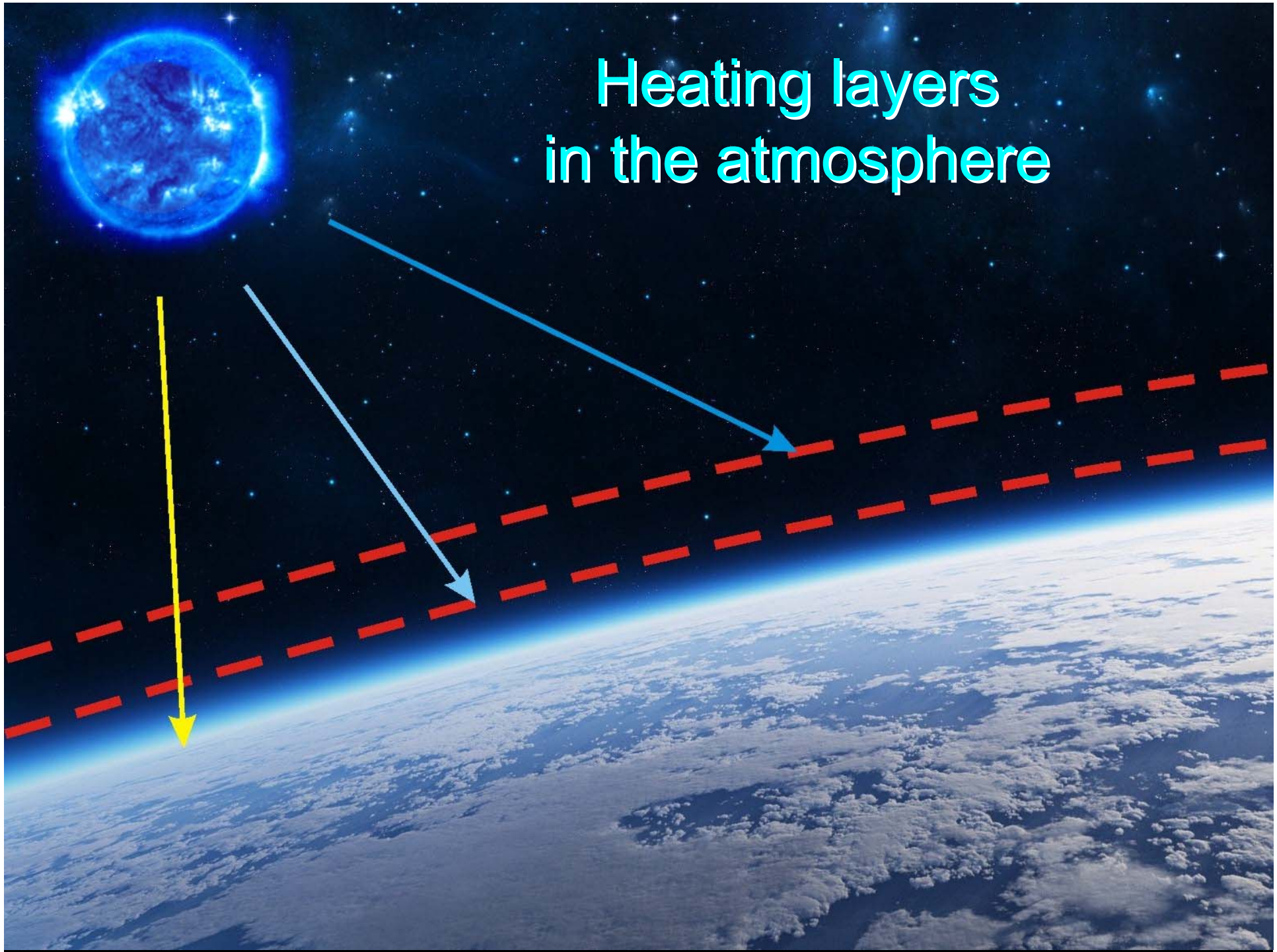
# Meteors altitude measurements

Astronomers amaze physicians:  
How **HIGH** atmosphere is!

80 – 100 km

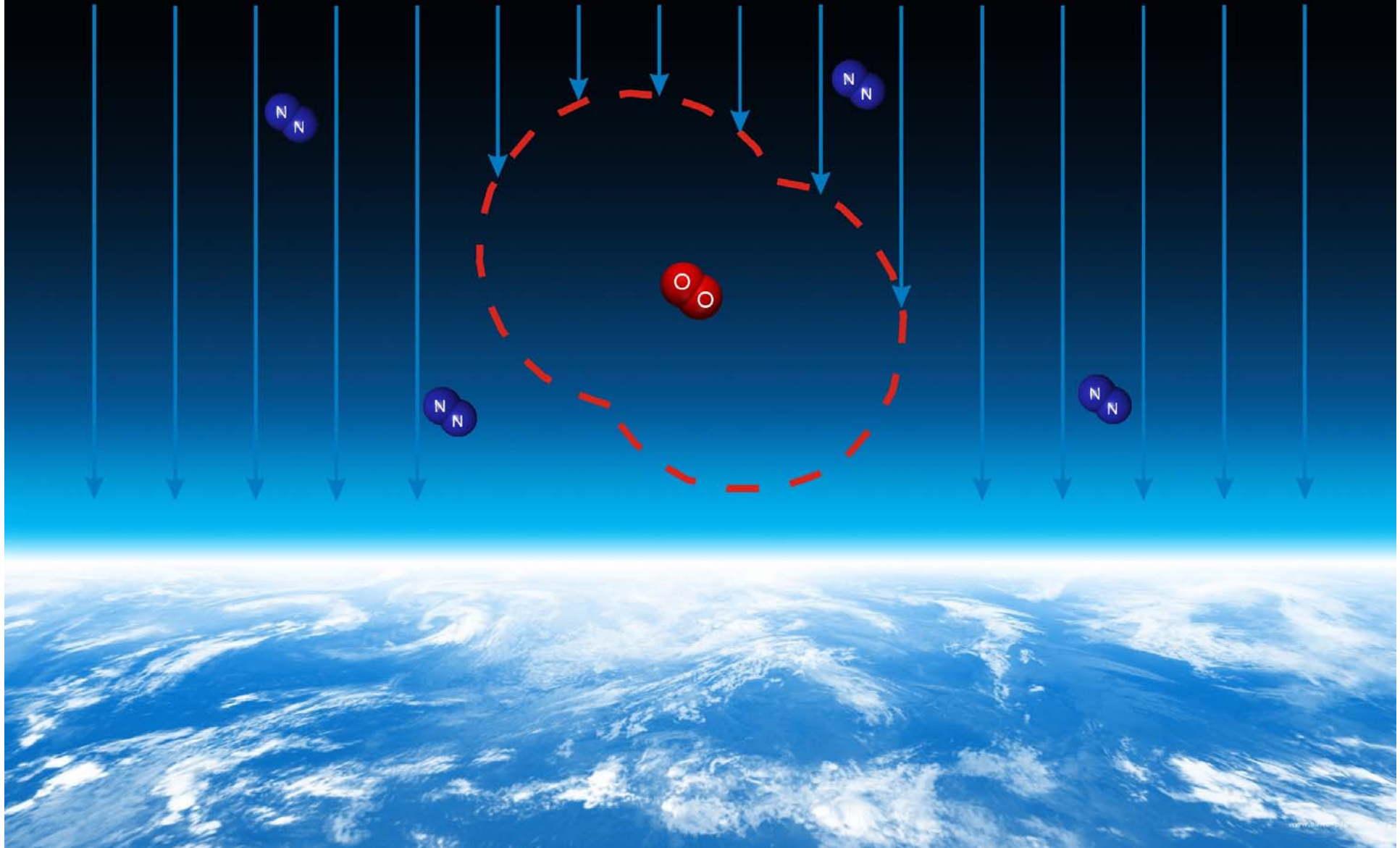


# Heating layers in the atmosphere

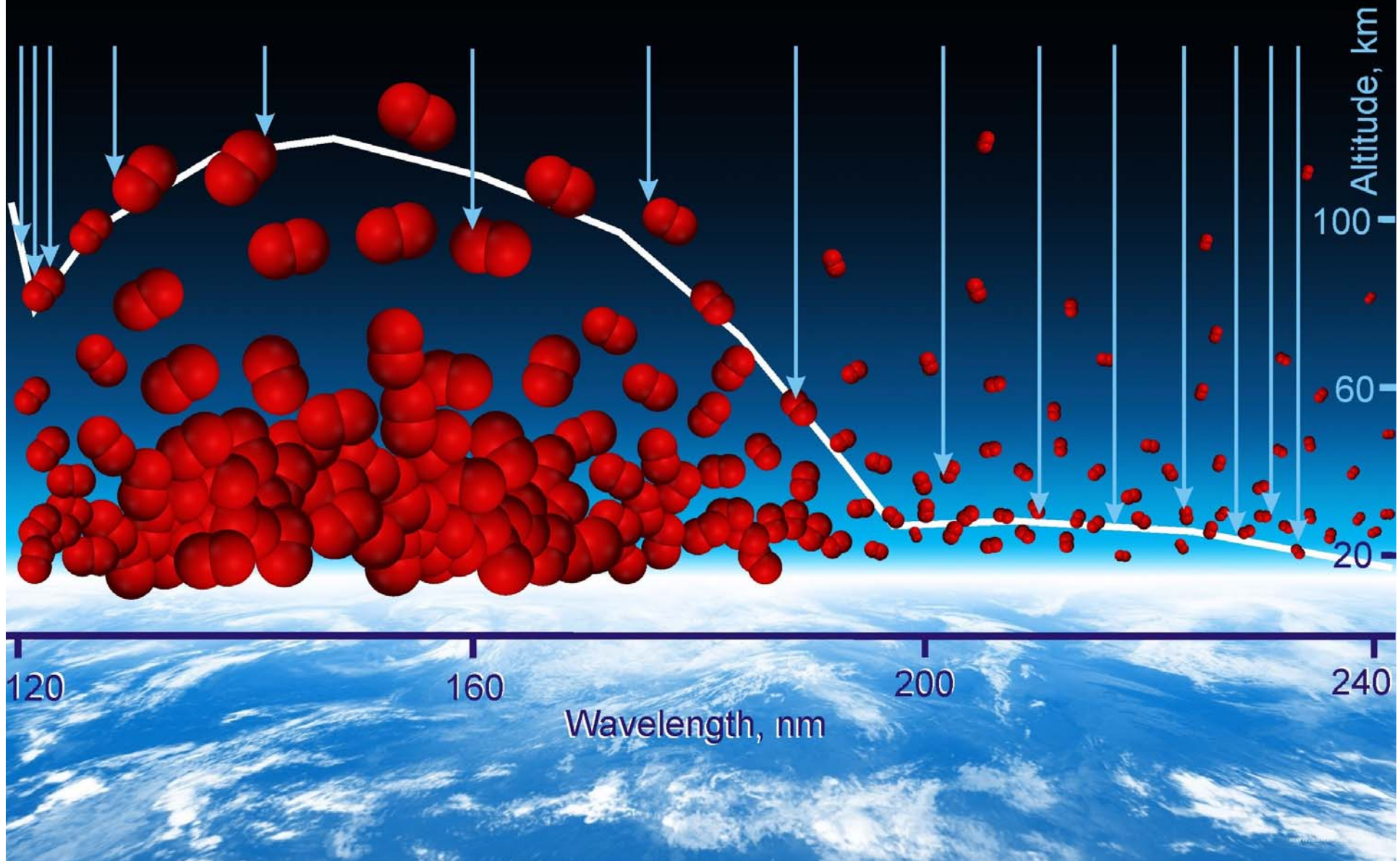


# Oxygen

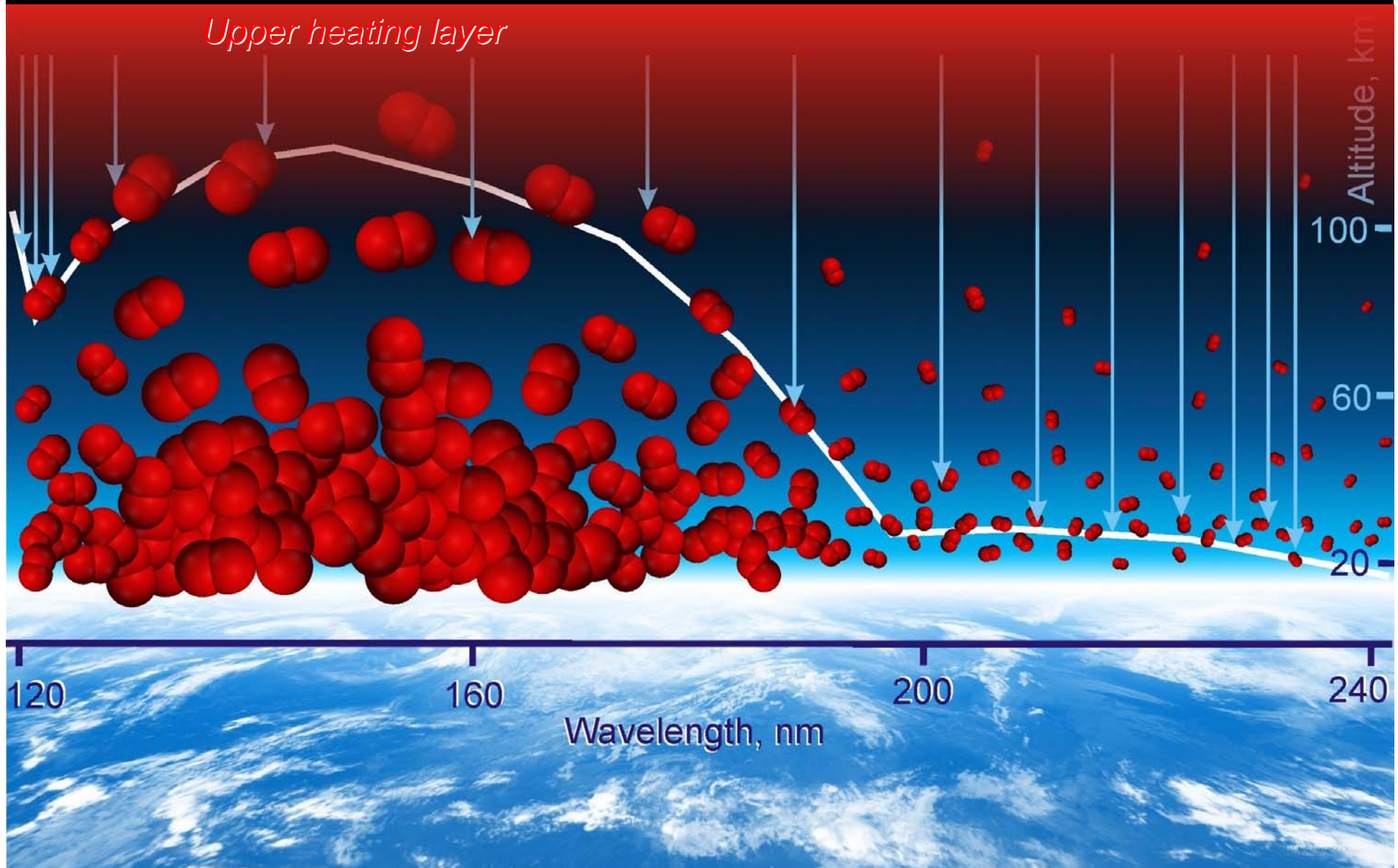
«Vacuum ultraviolet» rays



# Oxygen and solar UV

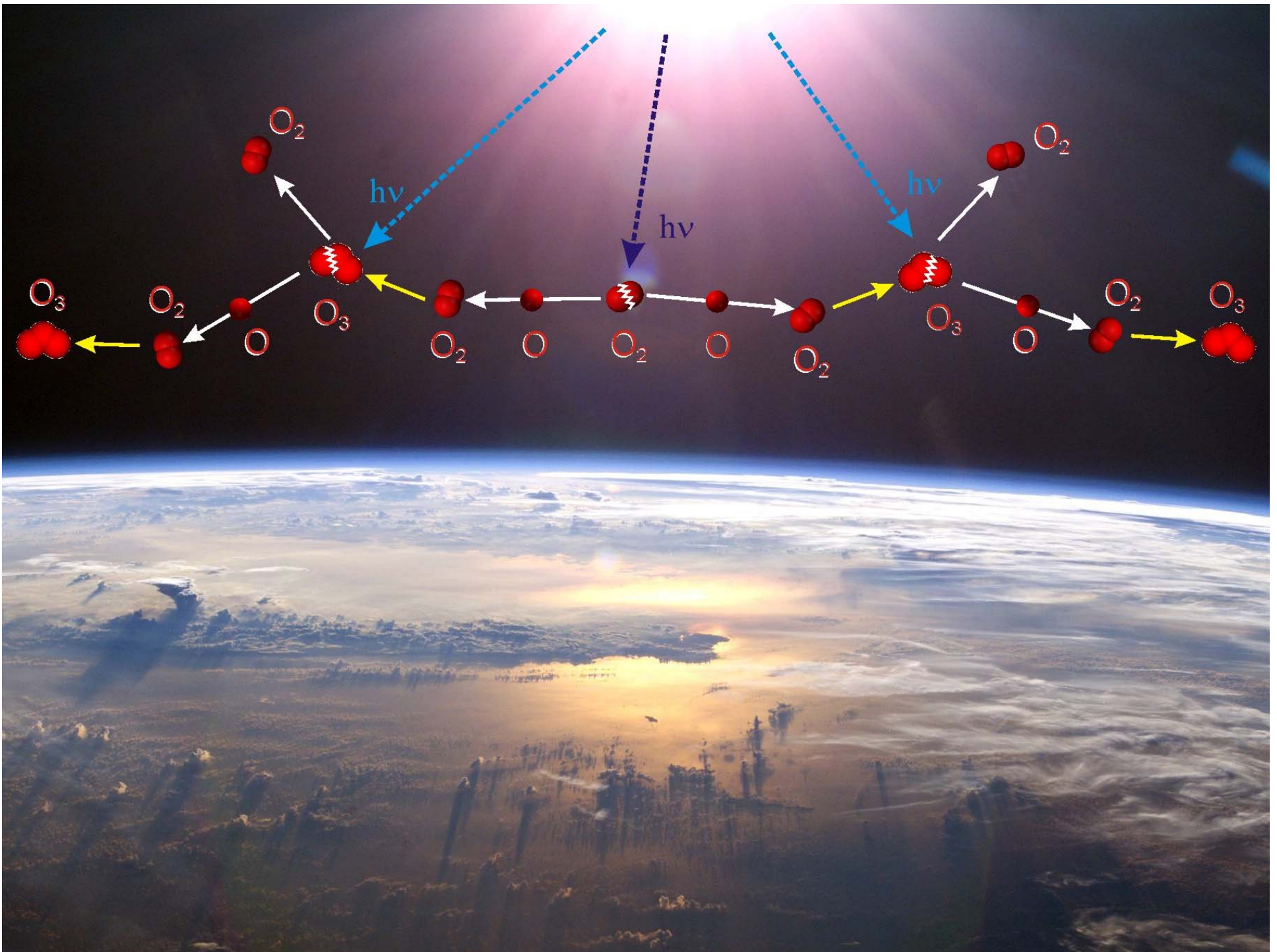


# Oxygen and solar UV

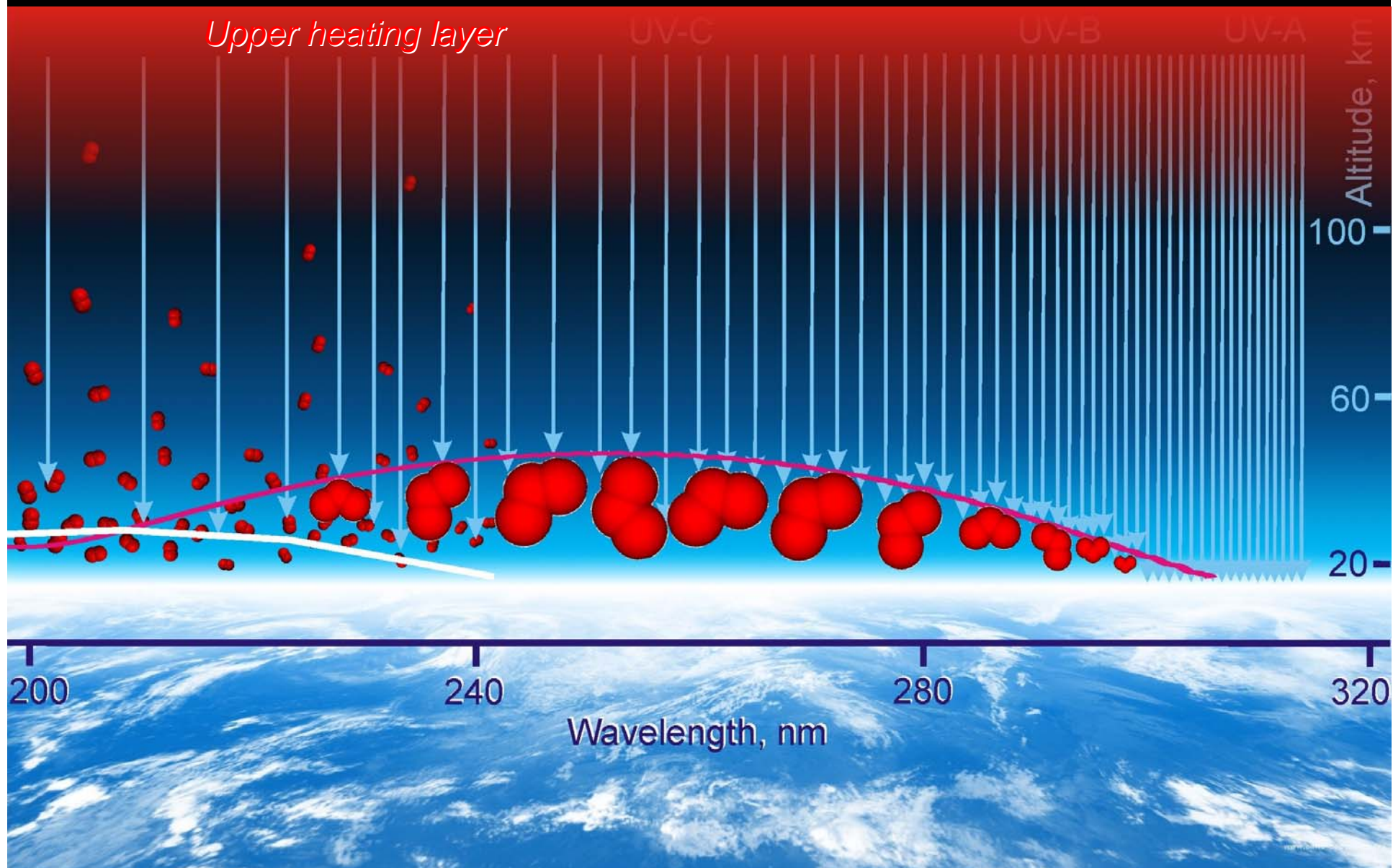




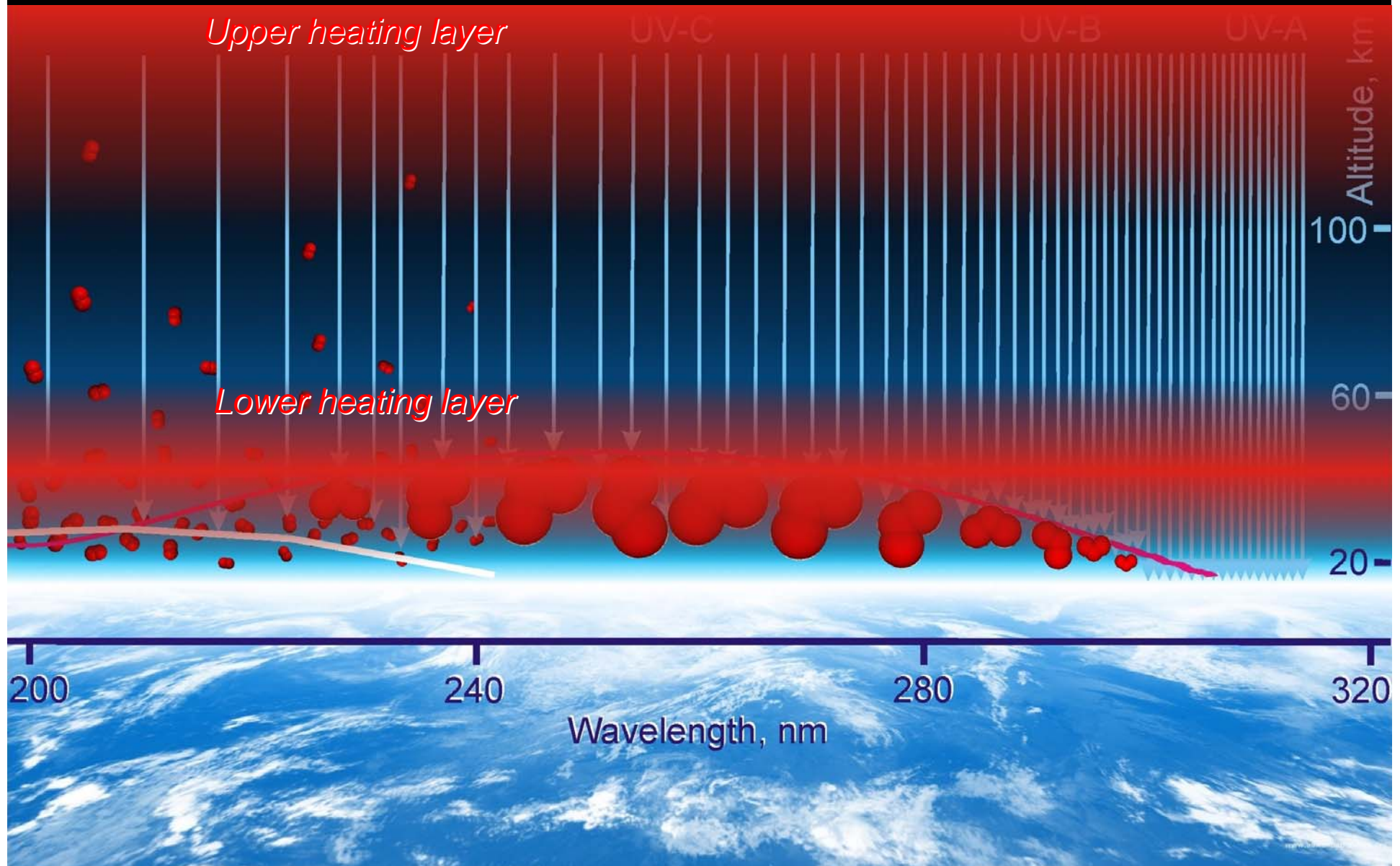




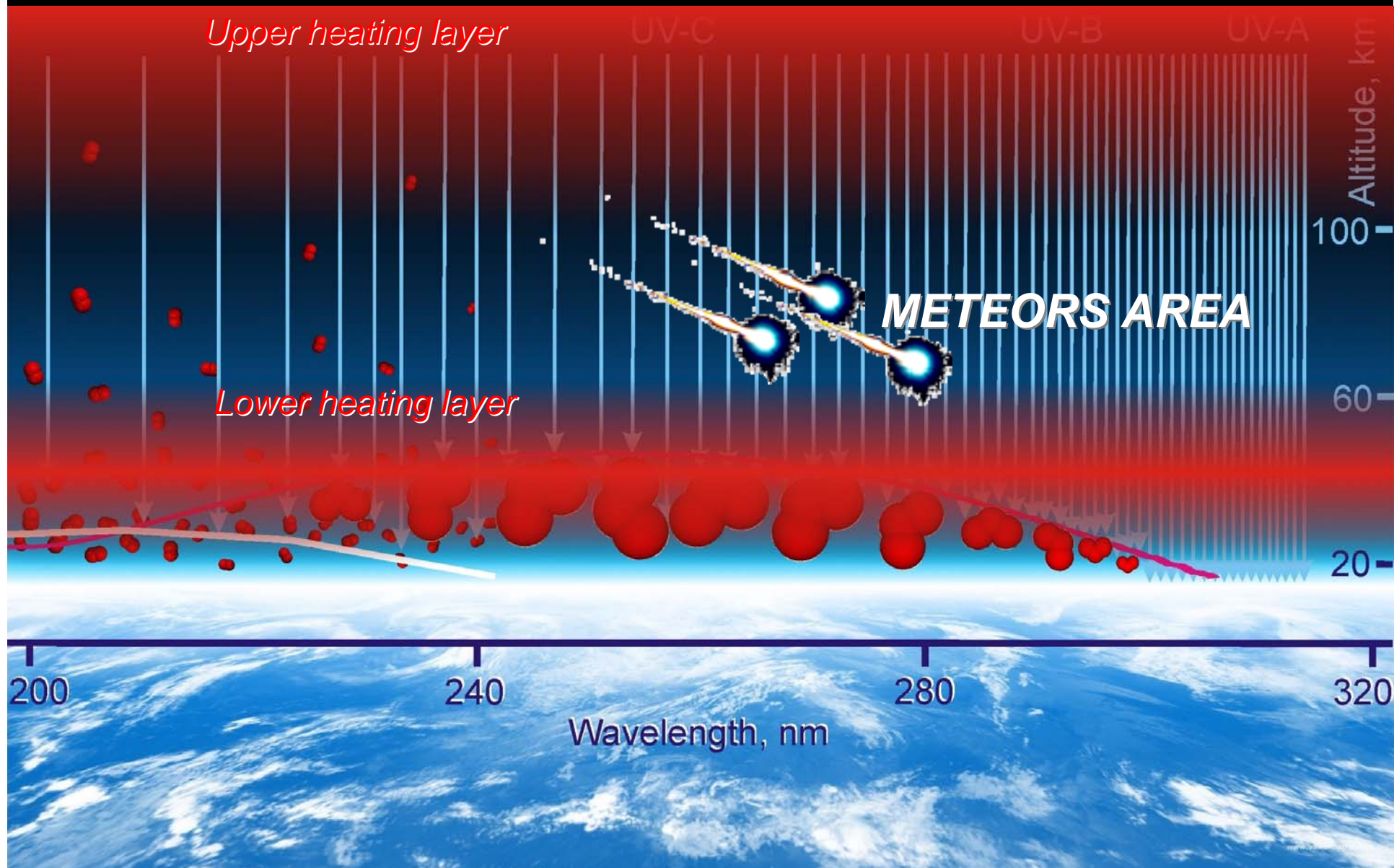
# Oxygen, ozone and solar UV



# Oxygen, ozone and solar UV



# Oxygen, ozone and solar UV



# Noctilucent clouds

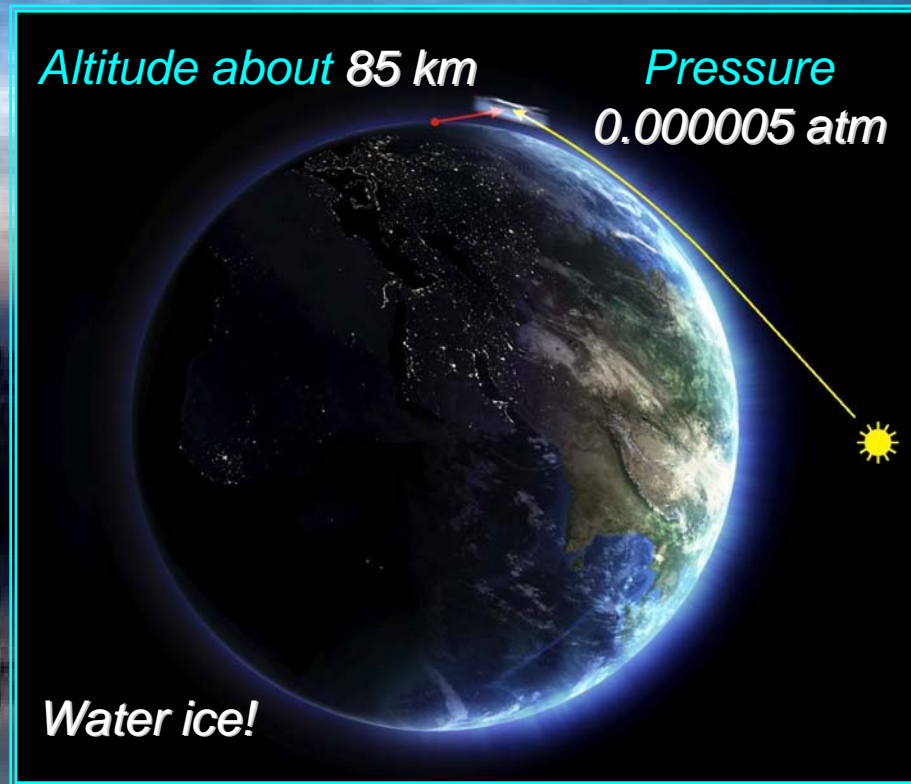
*Astronomers amaze physicians once more:  
How **COLD** atmosphere can be!*

Summer: **T < 150 K!**

*Altitude about 85 km*

*Pressure  
0.000005 atm*

*Water ice!*

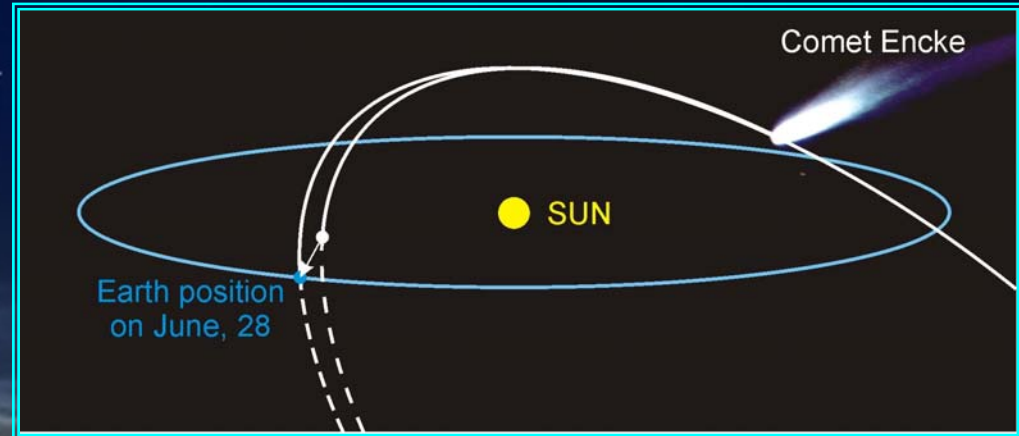


# Noctilucent clouds

*Were NOT observed until 1885!*



*Krakatoa eruption, 1883*



*Comet Encke's orbit evolution*

# Tunguska – June, 30, 1908



**EARTH**



*Bristol, England,  
night of July, 1-2, 1908*



# $\beta$ -Taurids (comet Encke, late June)



# The reason of clouds appearance:

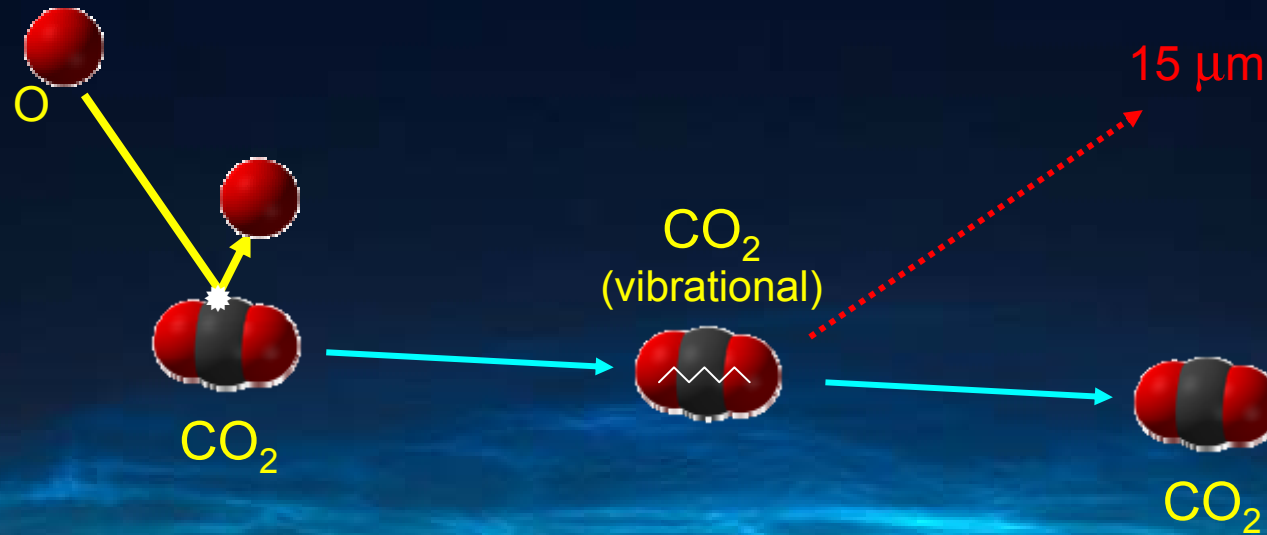
~~Volcanoes~~

~~Comet Encke orbit evolution~~

**WE ARE**



# The reason of clouds appearance:



Mesosphere is not just cold.  
It is **GETTING COLDER!**

# Mesosphere

(or Ignorosphere)

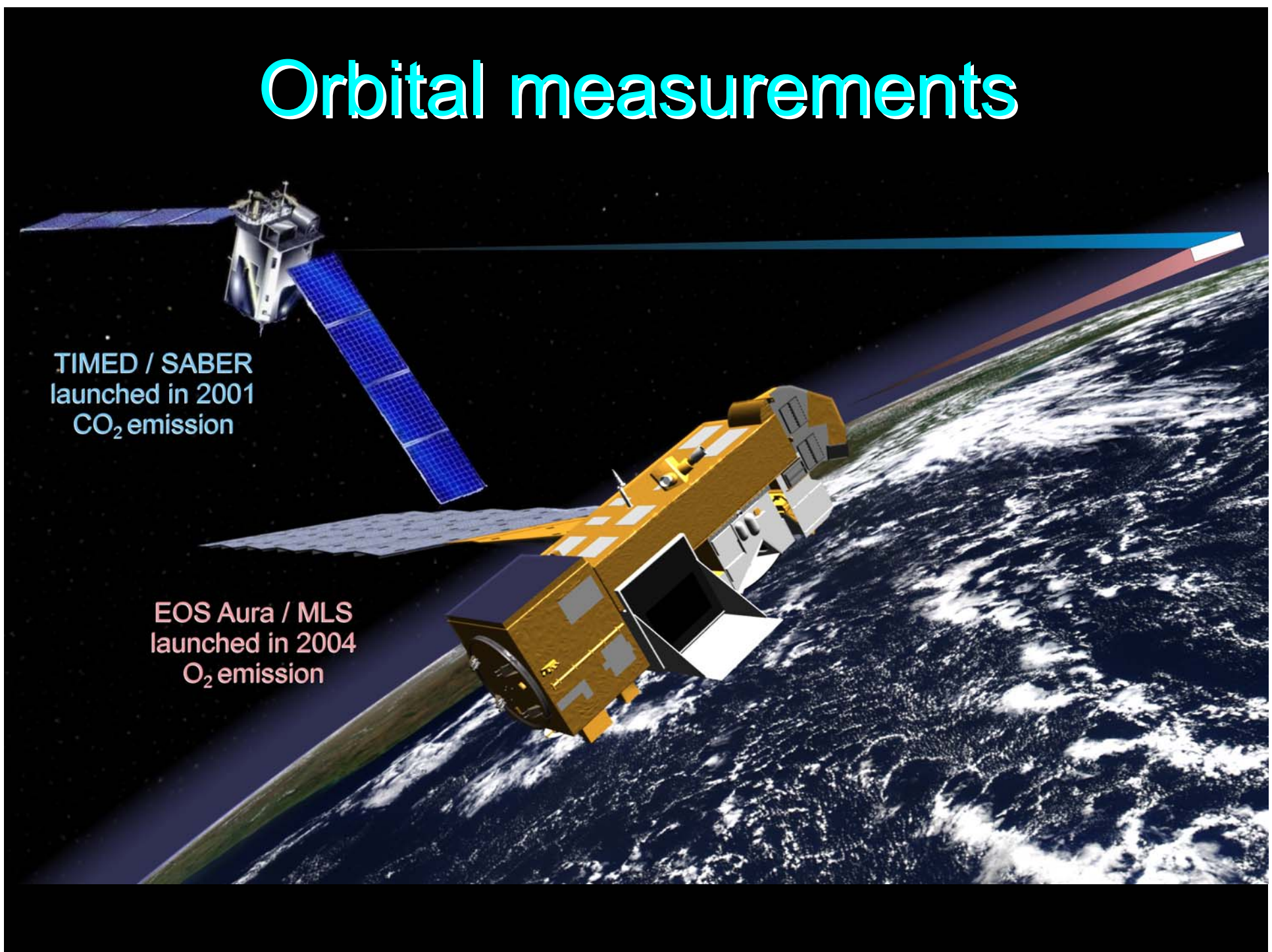
*Too high*



*Too low*



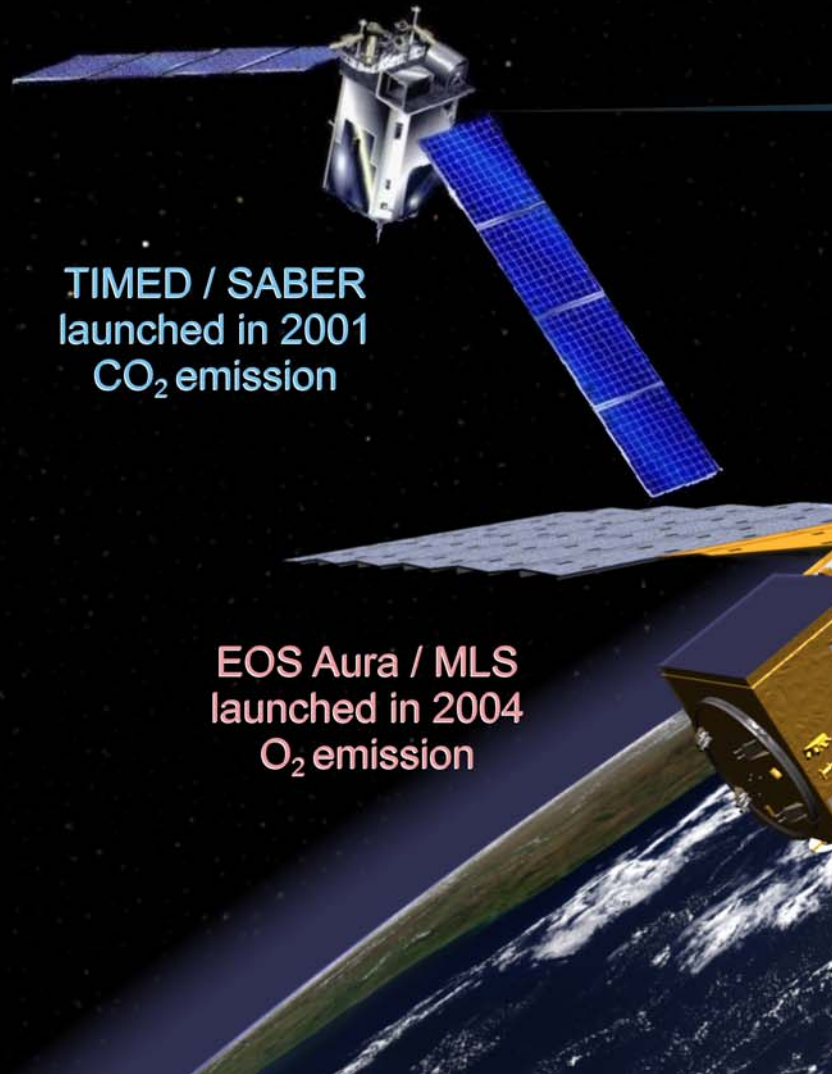
# Orbital measurements



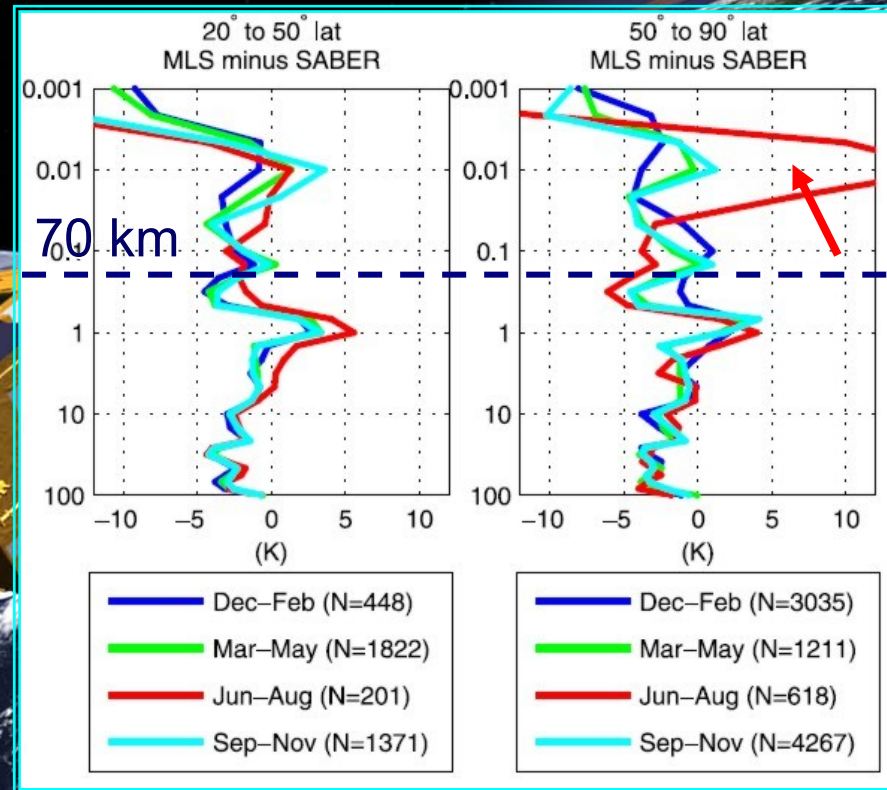
TIMED / SABER  
launched in 2001  
CO<sub>2</sub> emission

EOS Aura / MLS  
launched in 2004  
O<sub>2</sub> emission

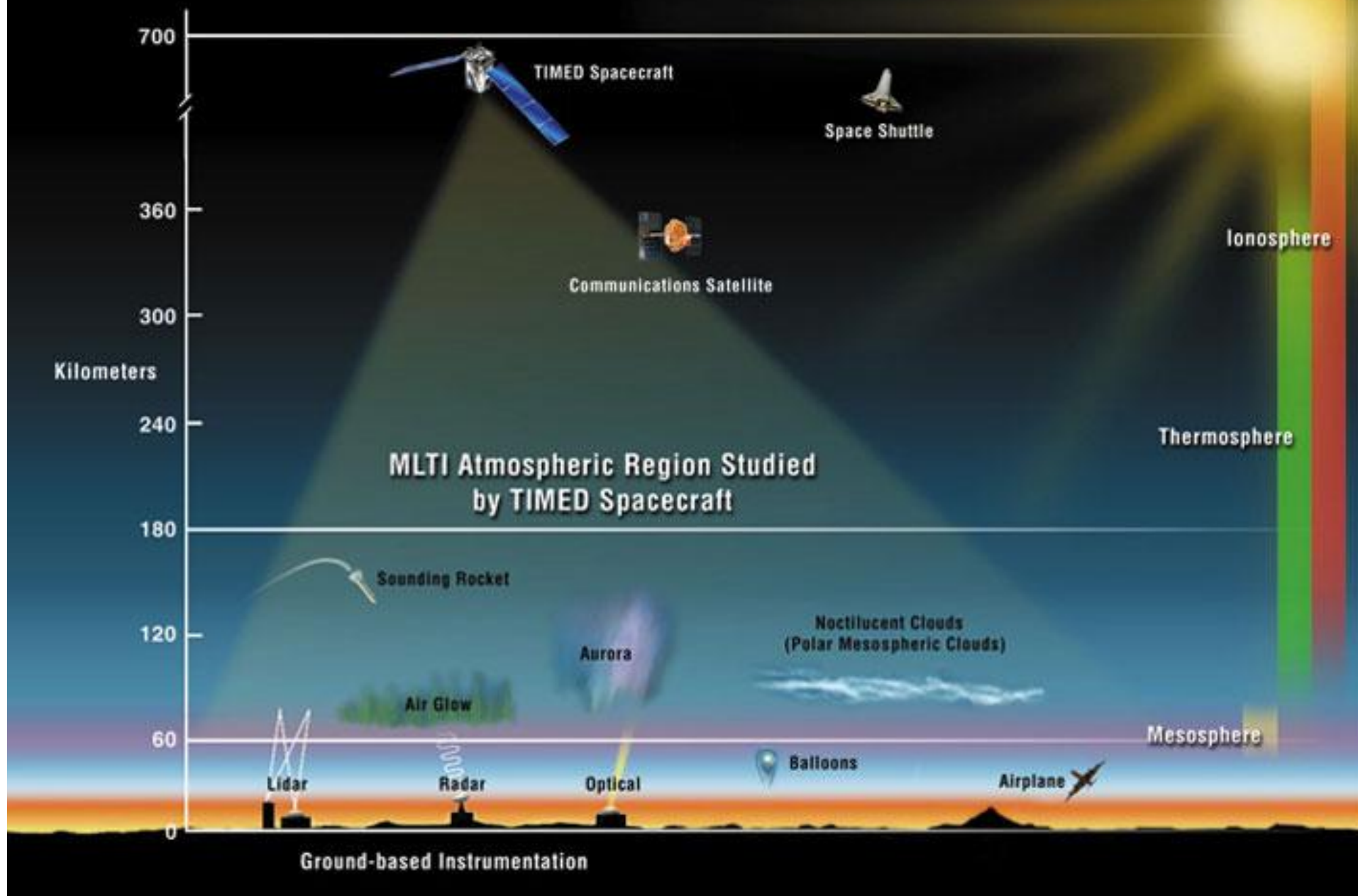
# Orbital measurements



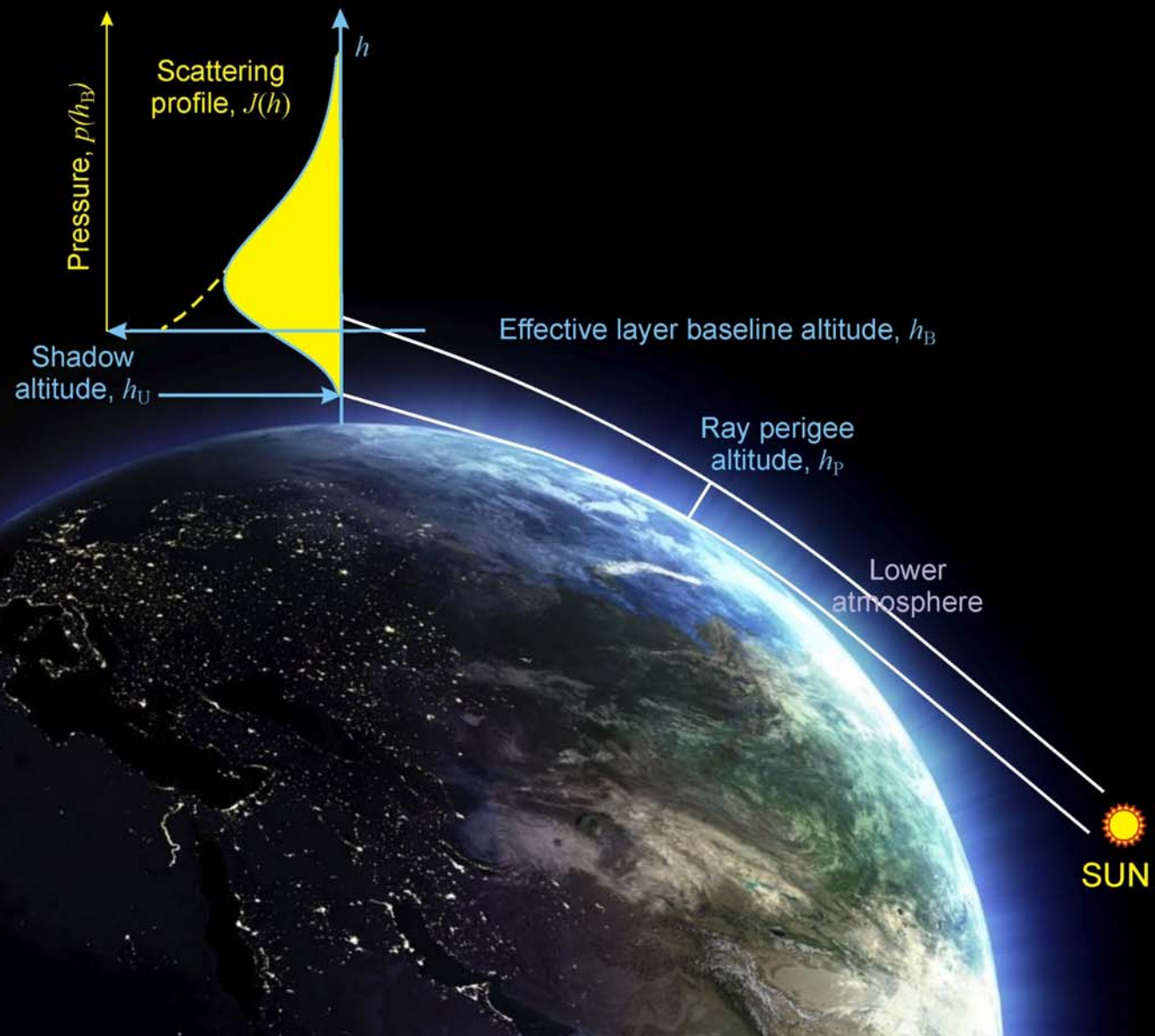
## Temperature difference



# Methods of sounding



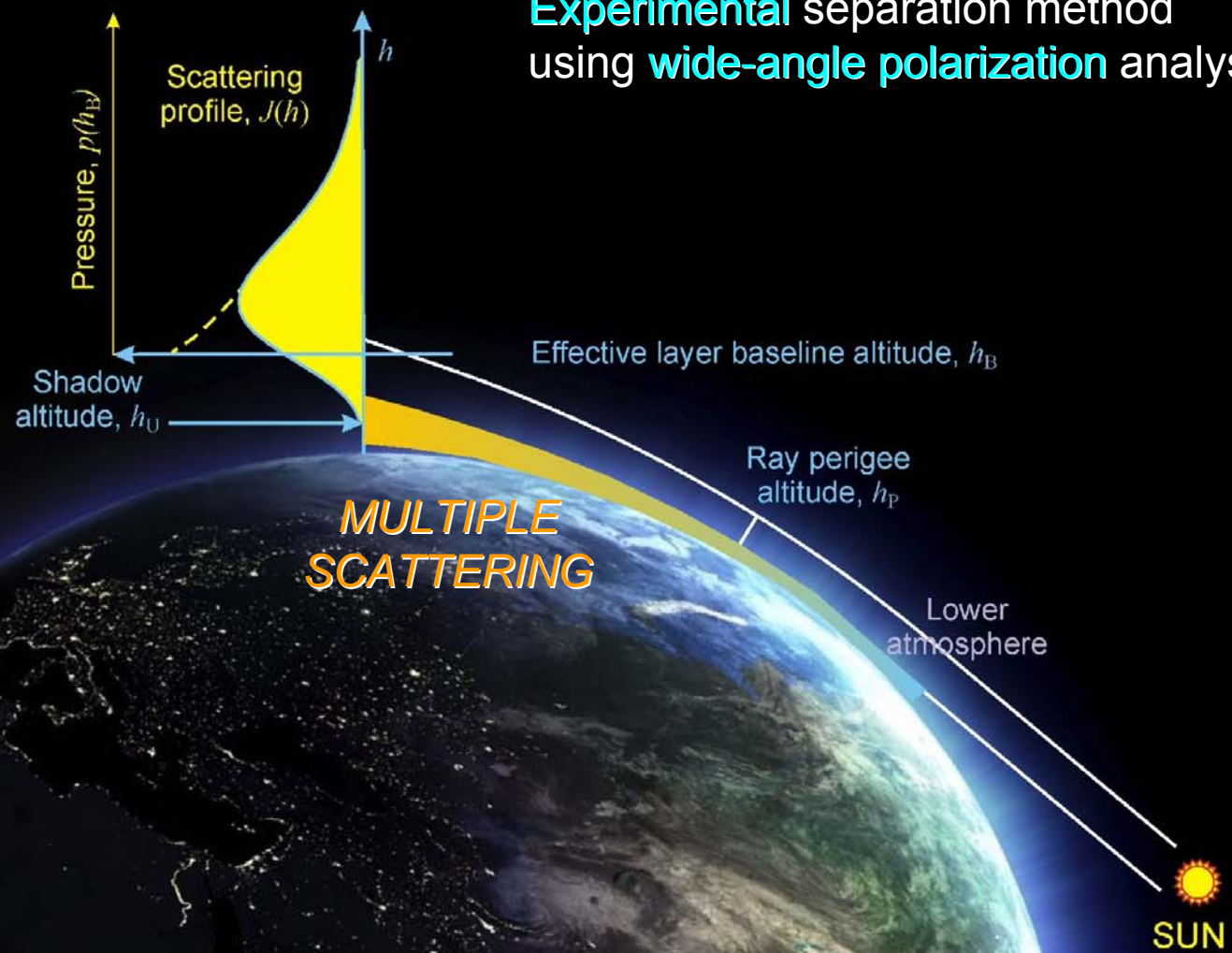
# Twilight sounding





# Twilight sounding

Experimental separation method  
using wide-angle polarization analysis

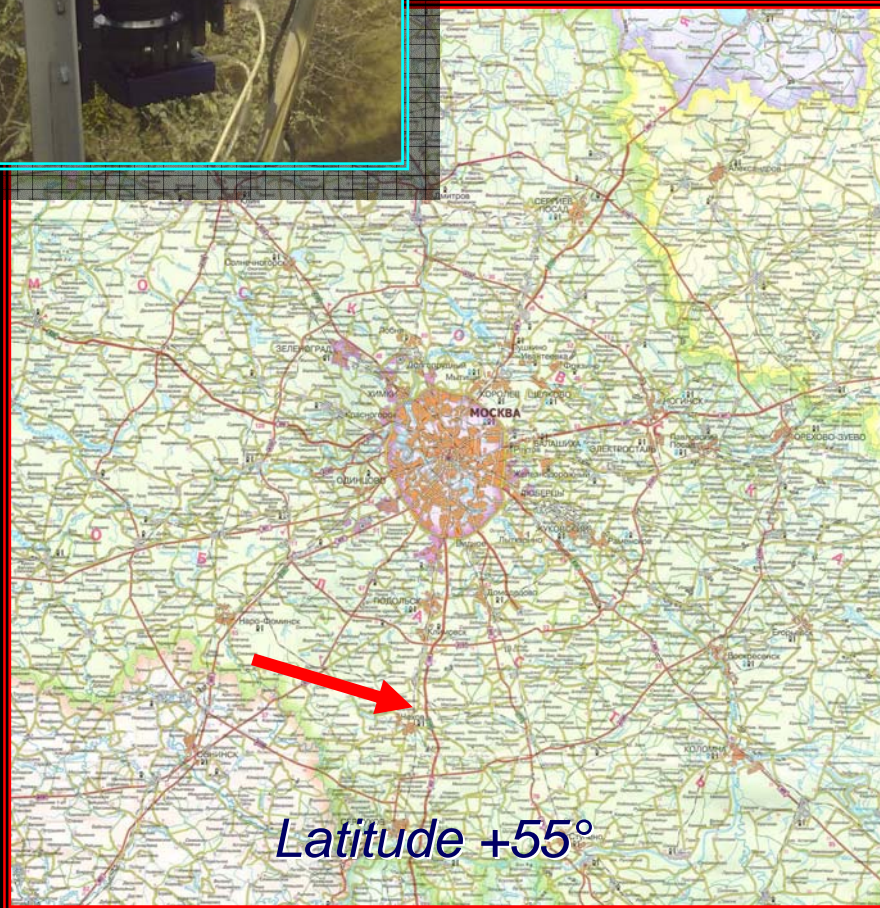


# Observations

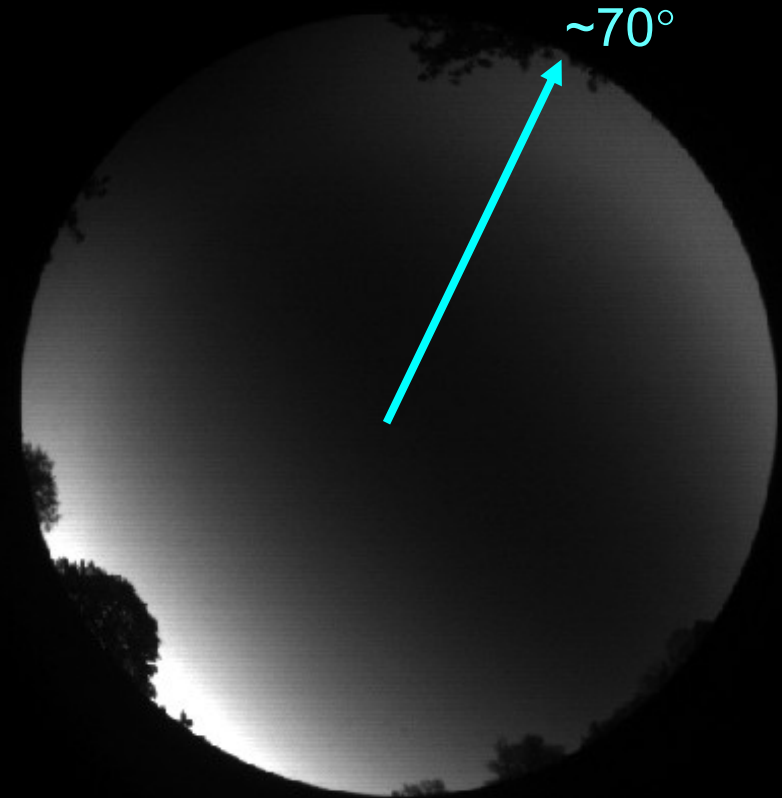
All-sky camera, designed for polarization measurements



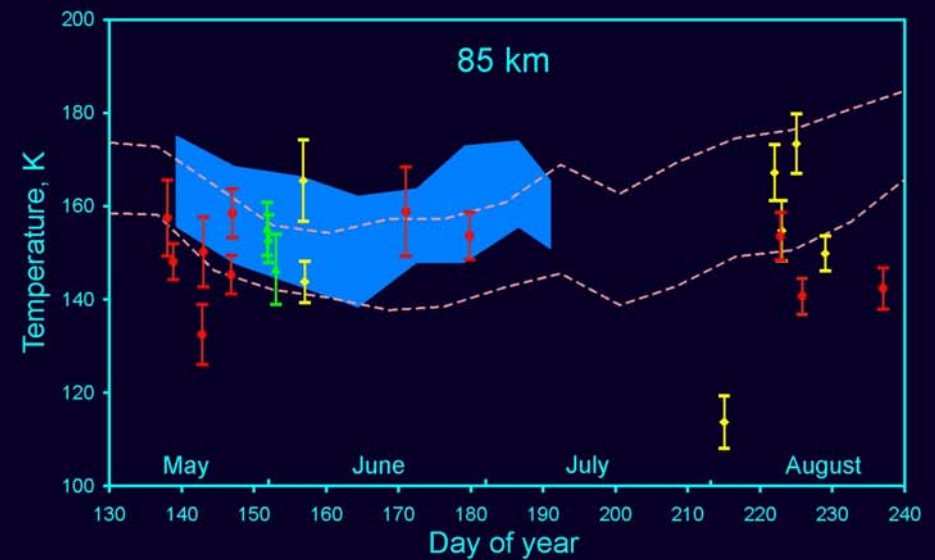
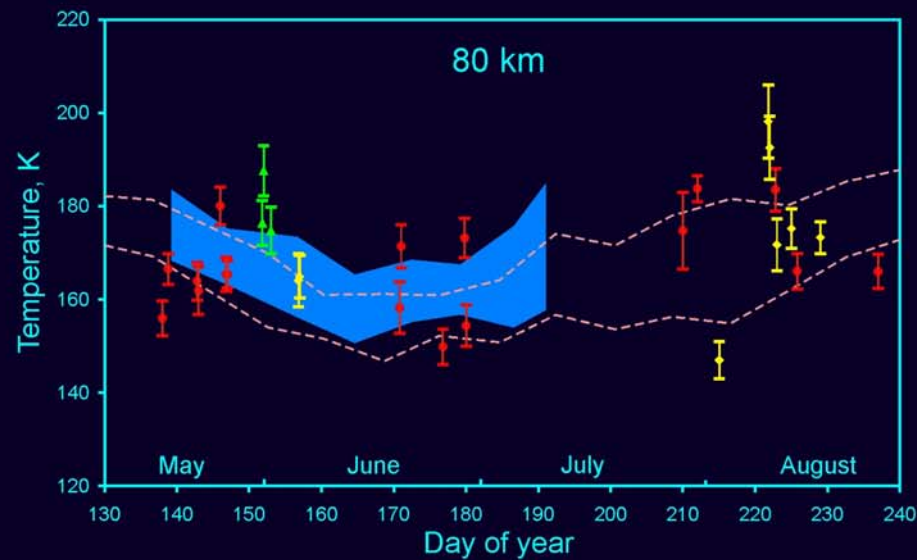
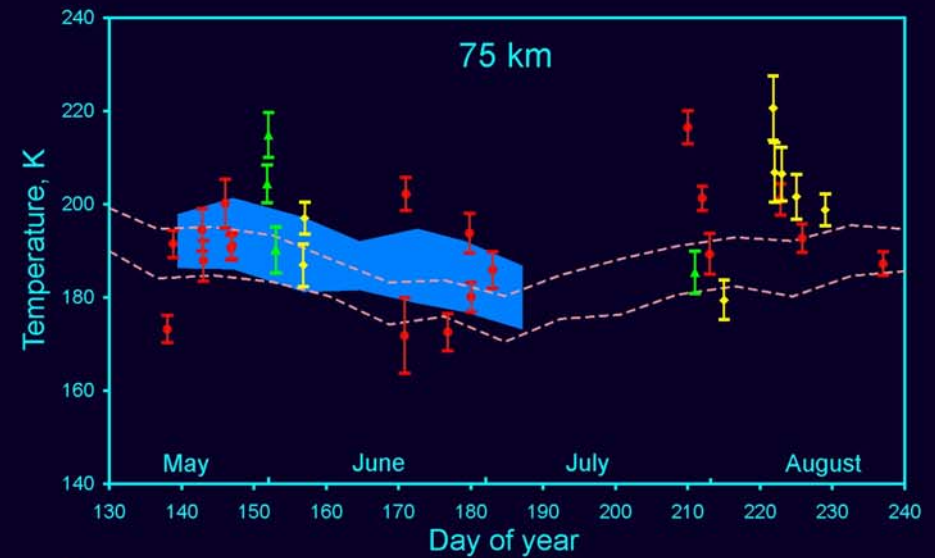
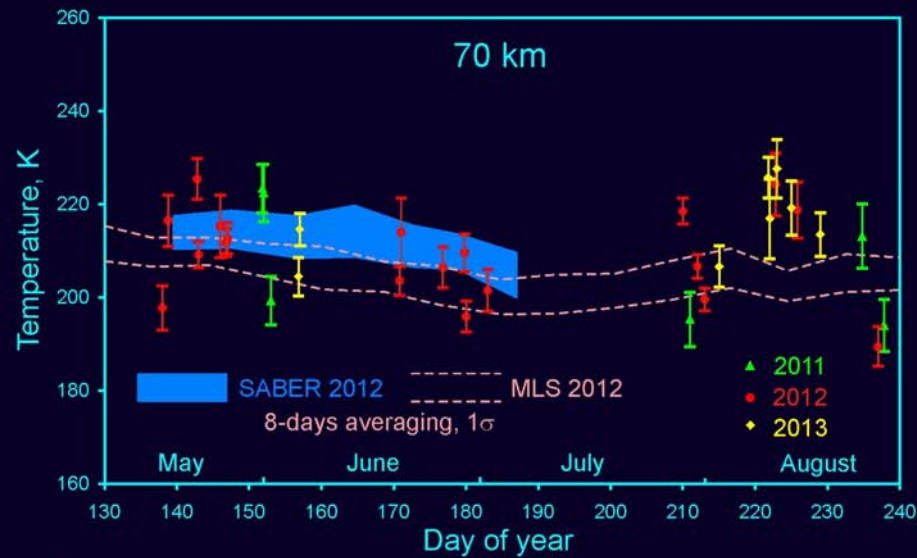
540 nm,  
*Polarization filter*



*Latitude +55°*



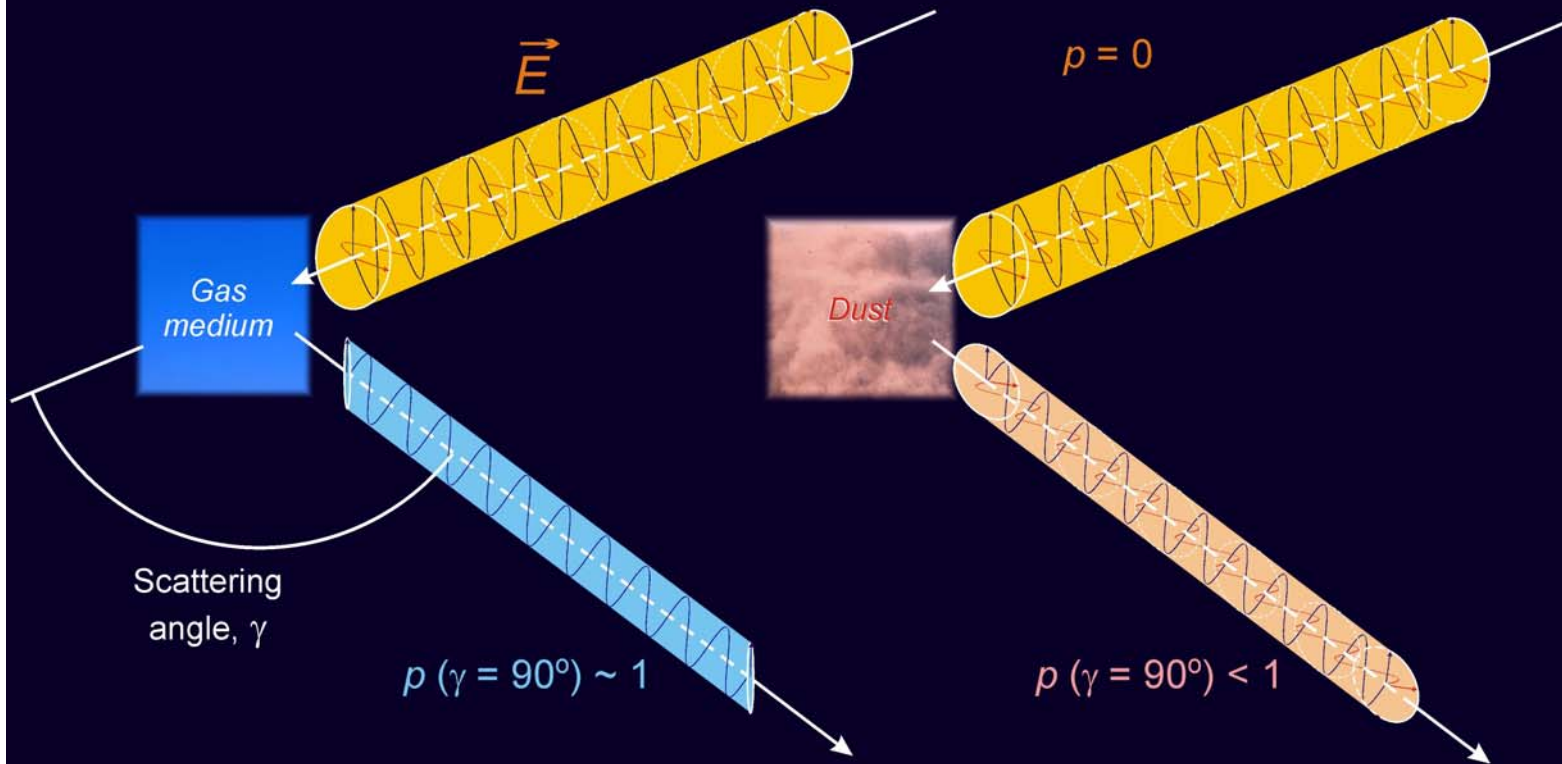
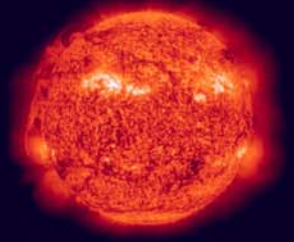
# Temperature measurements



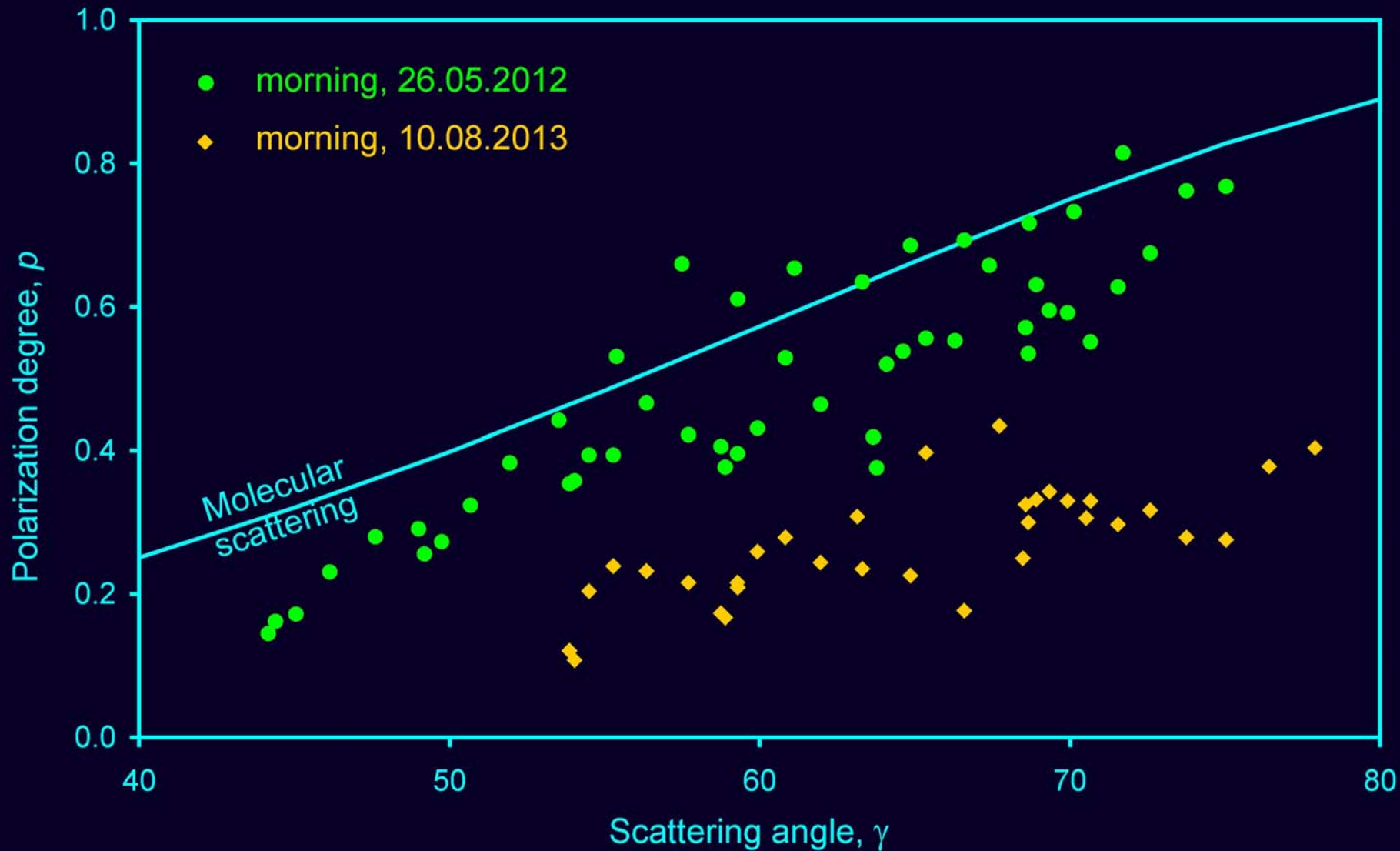
*Ugolnikov, Maslov, 2013, 2014*

# Polarization

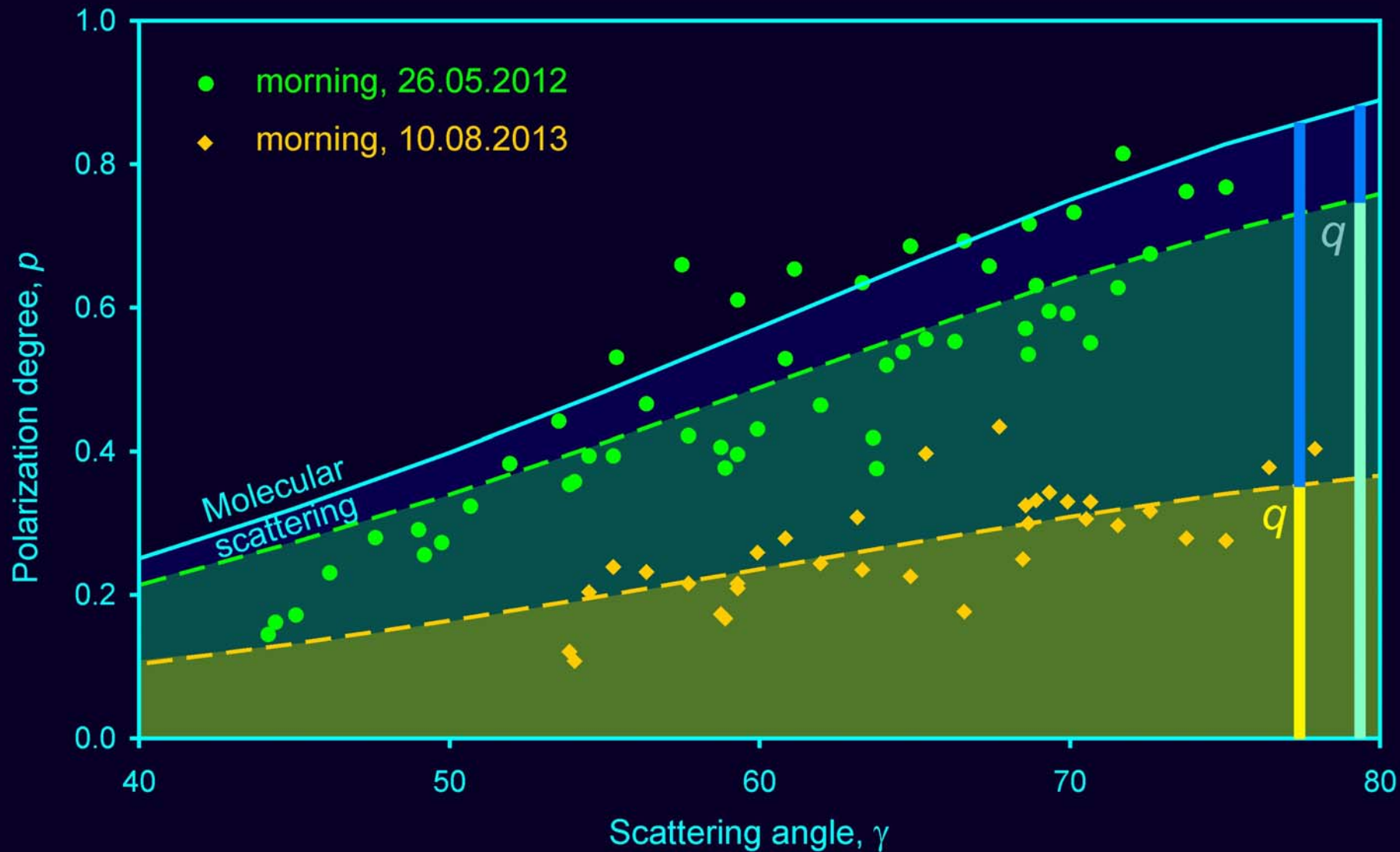
SUN



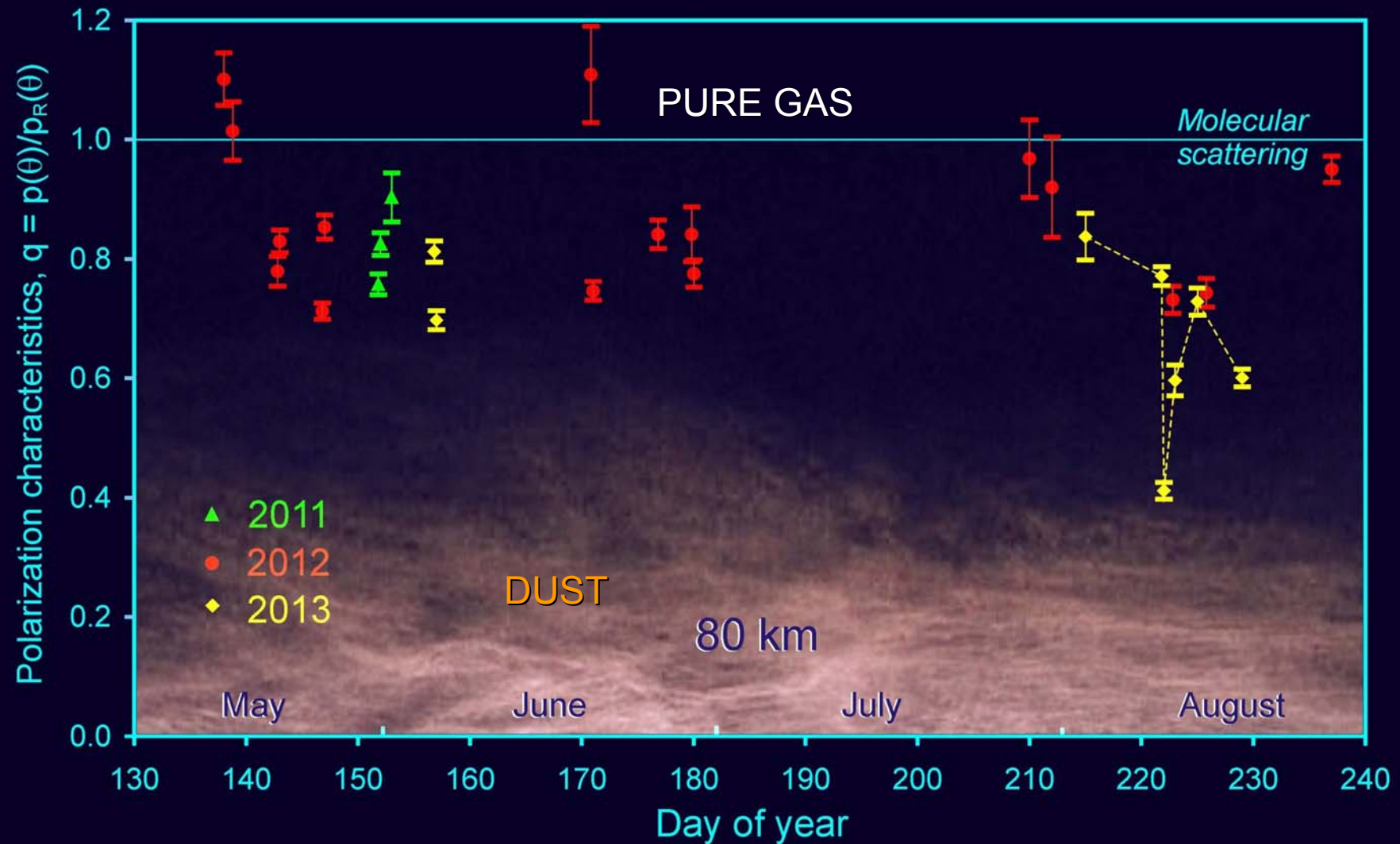
# Polarization of scattered emission (80 km)



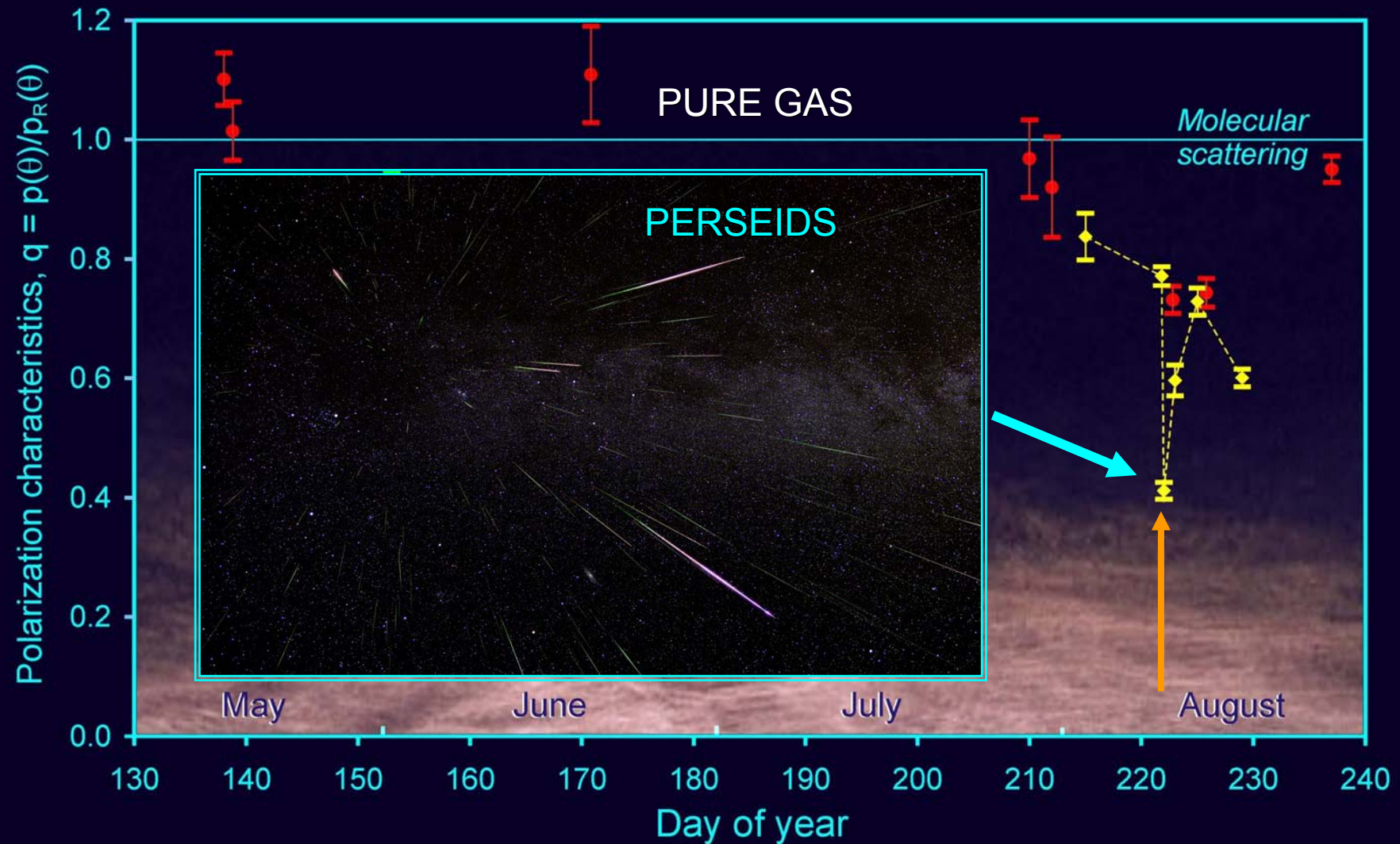
# Polarization of scattered emission (80 km)



# Temporal profile - summer

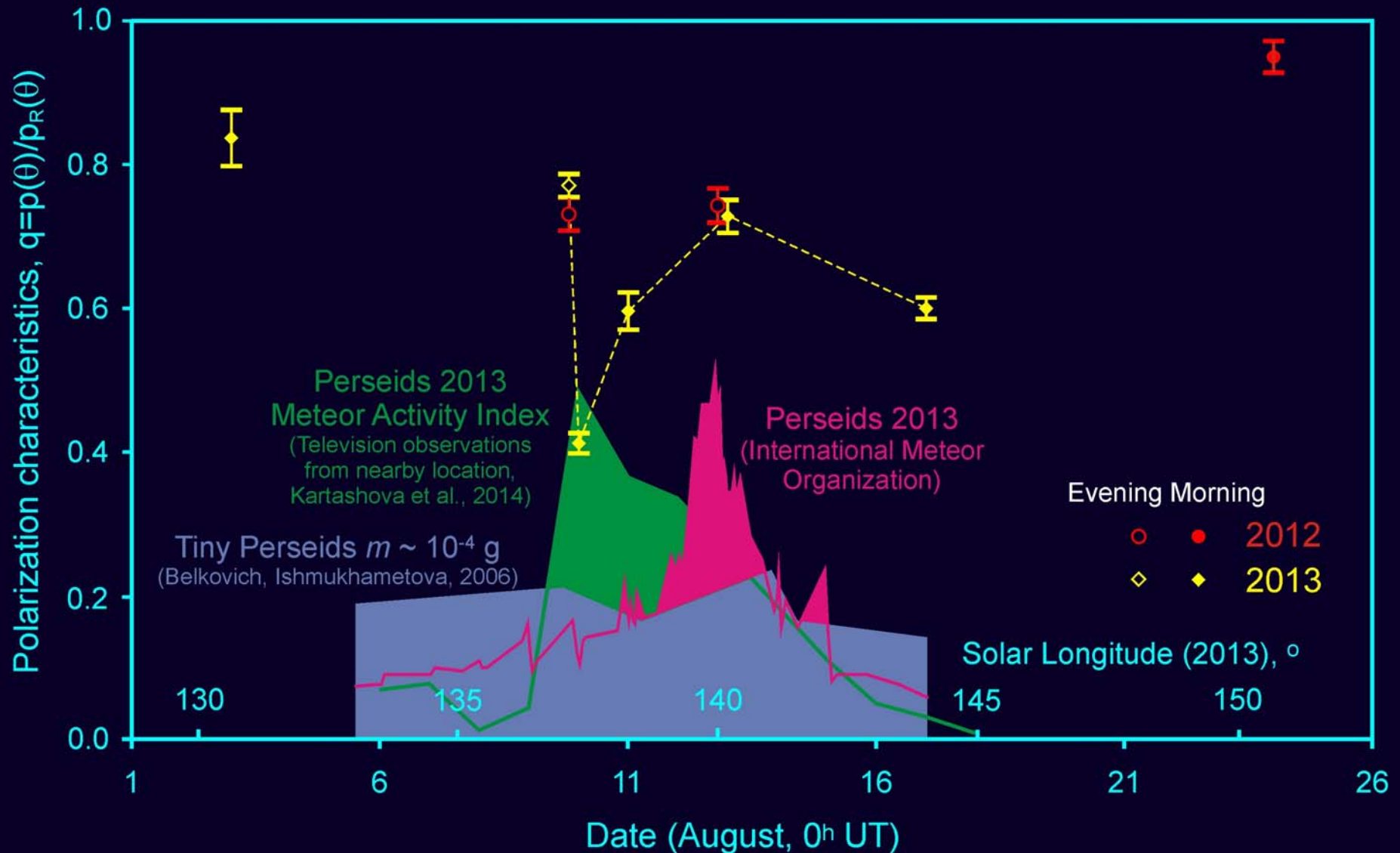


# Temporal profile - summer

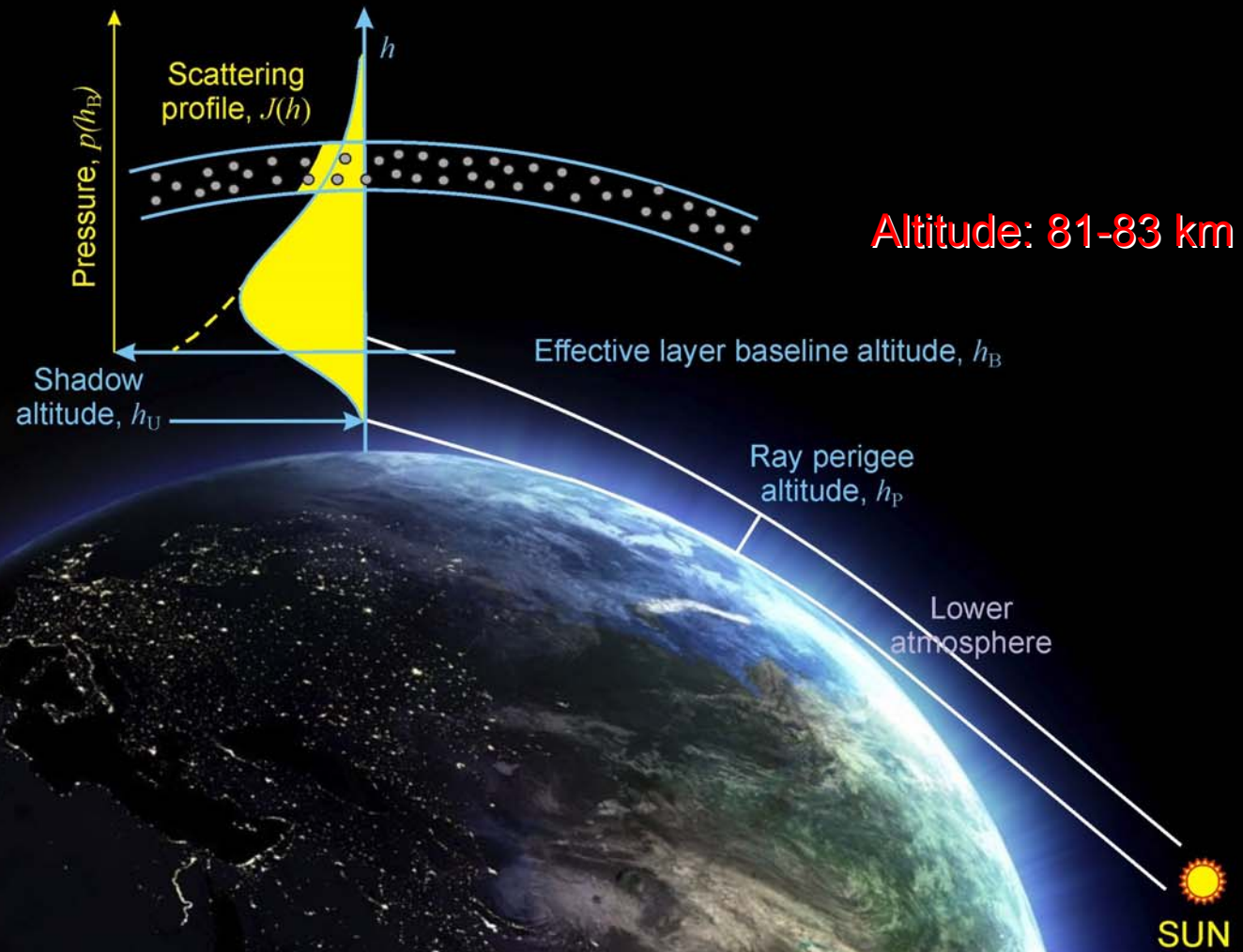




# Temporal profile - August



# Twilight sounding



# Noctilucent clouds

Altitude: 81-83 km





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