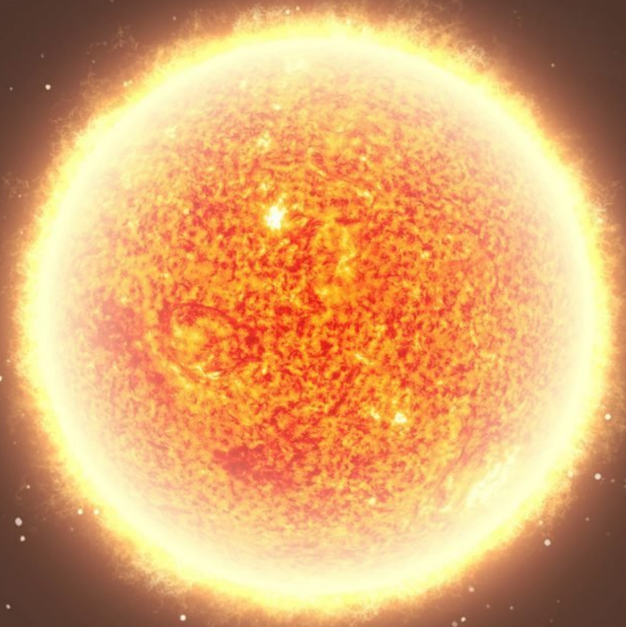
Role of the Ionosphere & SPWx in Military Communications

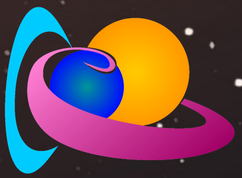
SWEC
Space Weather Education Center

Solar-Terrestrial
Centre of Excellence

LARGE SCALE PICTURE OF SPHERES
Around the Earth



Petra Vanlommel



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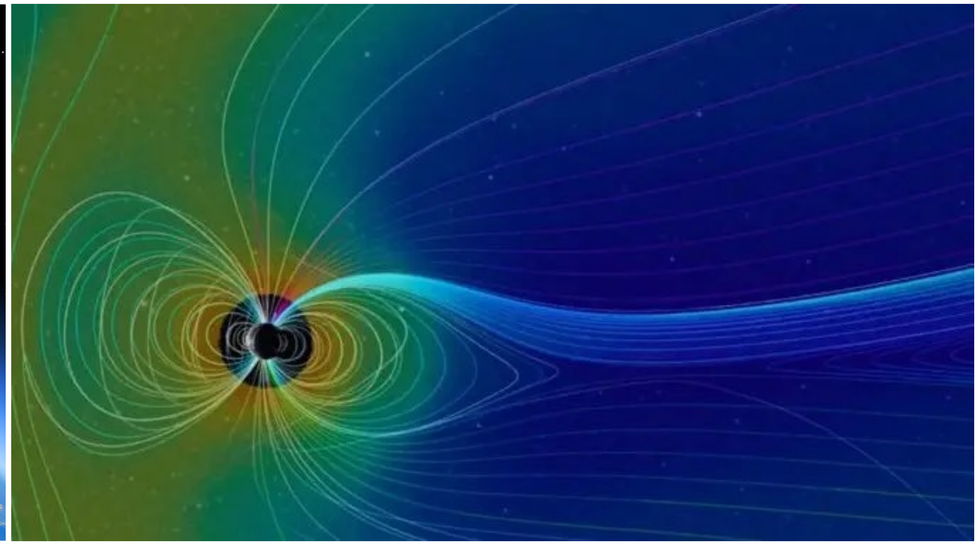
Space Weather

The Sun’s energy impacting earth’s atmosphere and magnetic shield.



Large scale picture of the spheres around Earth

1. Earth’s neutral atmosphere: troposphere, stratosphere, mesosphere and thermosphere

2. Earth’s charged atmosphere: the ionosphere and plasmasphere

3. Magnetosphere

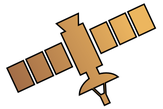
Where does the atmosphere end and where does space begin?

- **Biology / human activity:** it becomes very hard to survive for long in low oxygen and cold temperature environments on Earth's highest mountains [~5 km]

- **Density:** At what altitude does the density of particles become indistinguishable from that in interplanetary space?

- **Weather/climate:** "hardly anything interesting that affects our living environment happens above the stratosphere" [12 km?] (or does it?)

- **Flight:** It gets harder to generate enough lift on a wing in very thin air at higher altitudes. When does an aircraft turn into a rocket or a satellite? [~80 km]

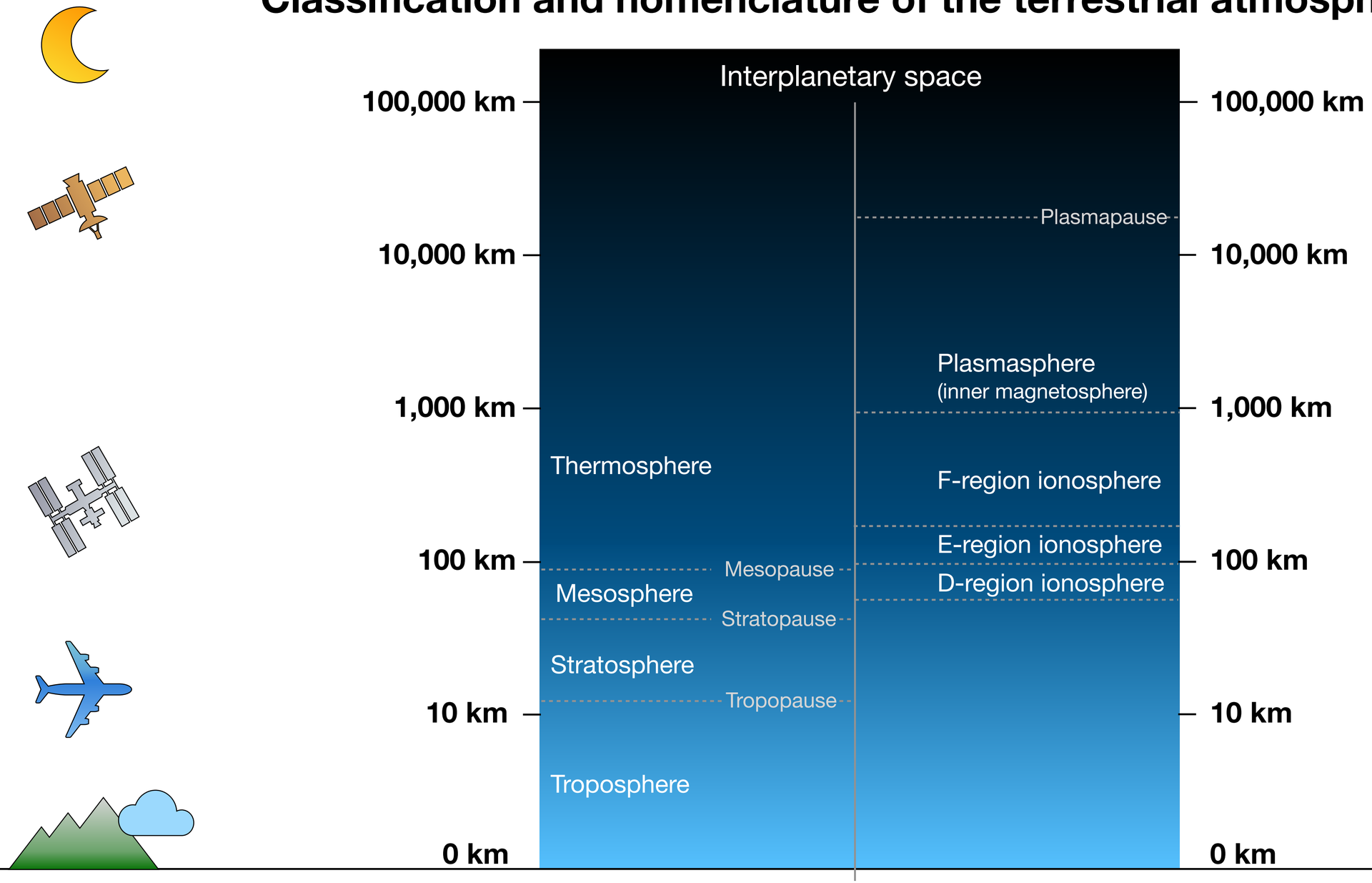


- **Spaceflight 1:** when an orbiting object gets low enough, it experiences so much drag that it cannot complete another orbit [~100 km] and/or it generates so much frictional heating that it breaks up if unprotected [~80 km].
- **Spaceflight 2:** to what altitude can spacecraft measure/make use of aerodynamic forces? [at least 1500 km]

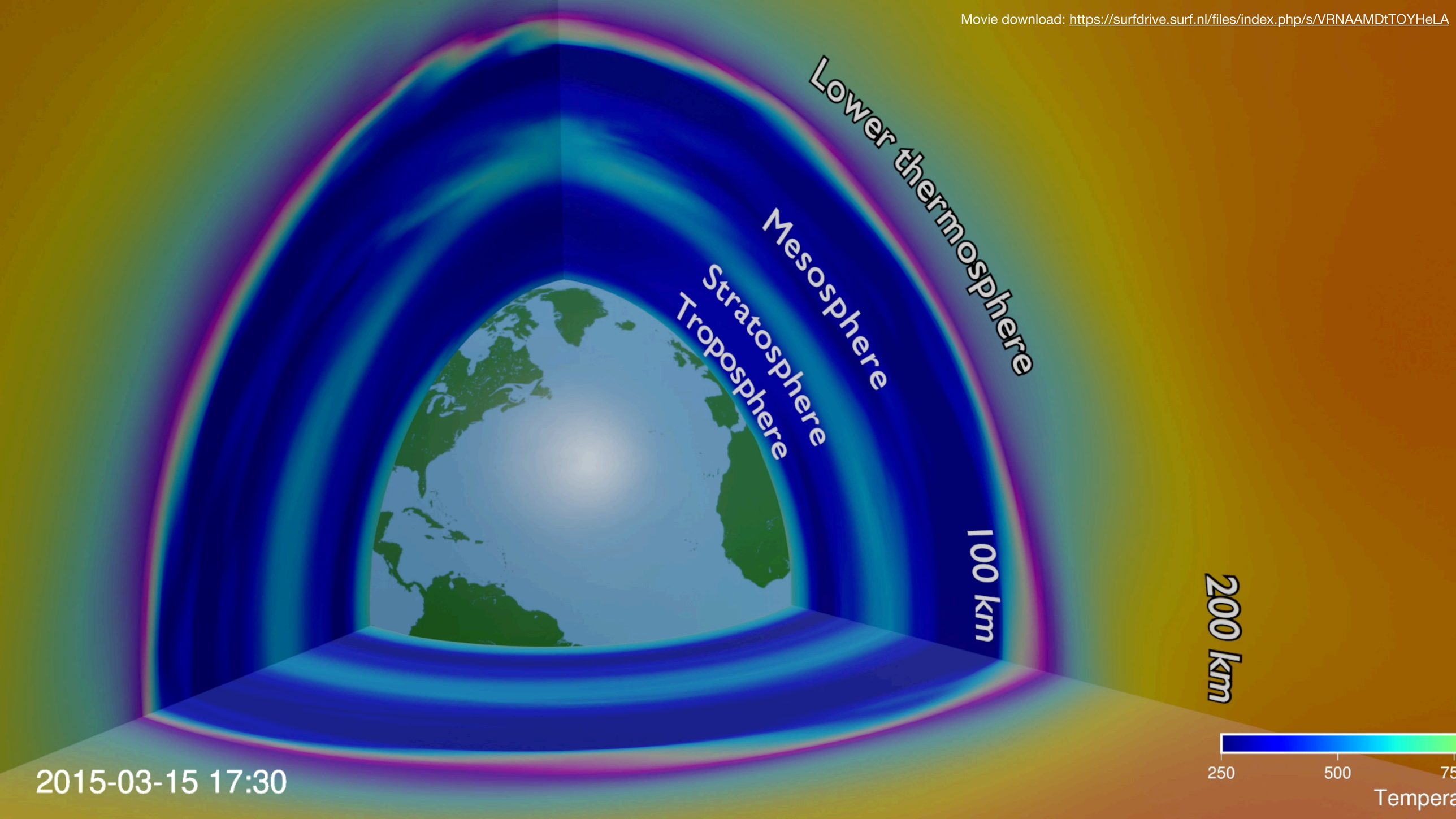
- **Connections between atmospheric layers:** to what altitudes can atmospheric waves, which originate at the Earth's surface, propagate? [at least 300 km]

- **Corotation:** To what altitude do particles rotate along with the Earth's rotation around its axis? [up to several 1000 km]

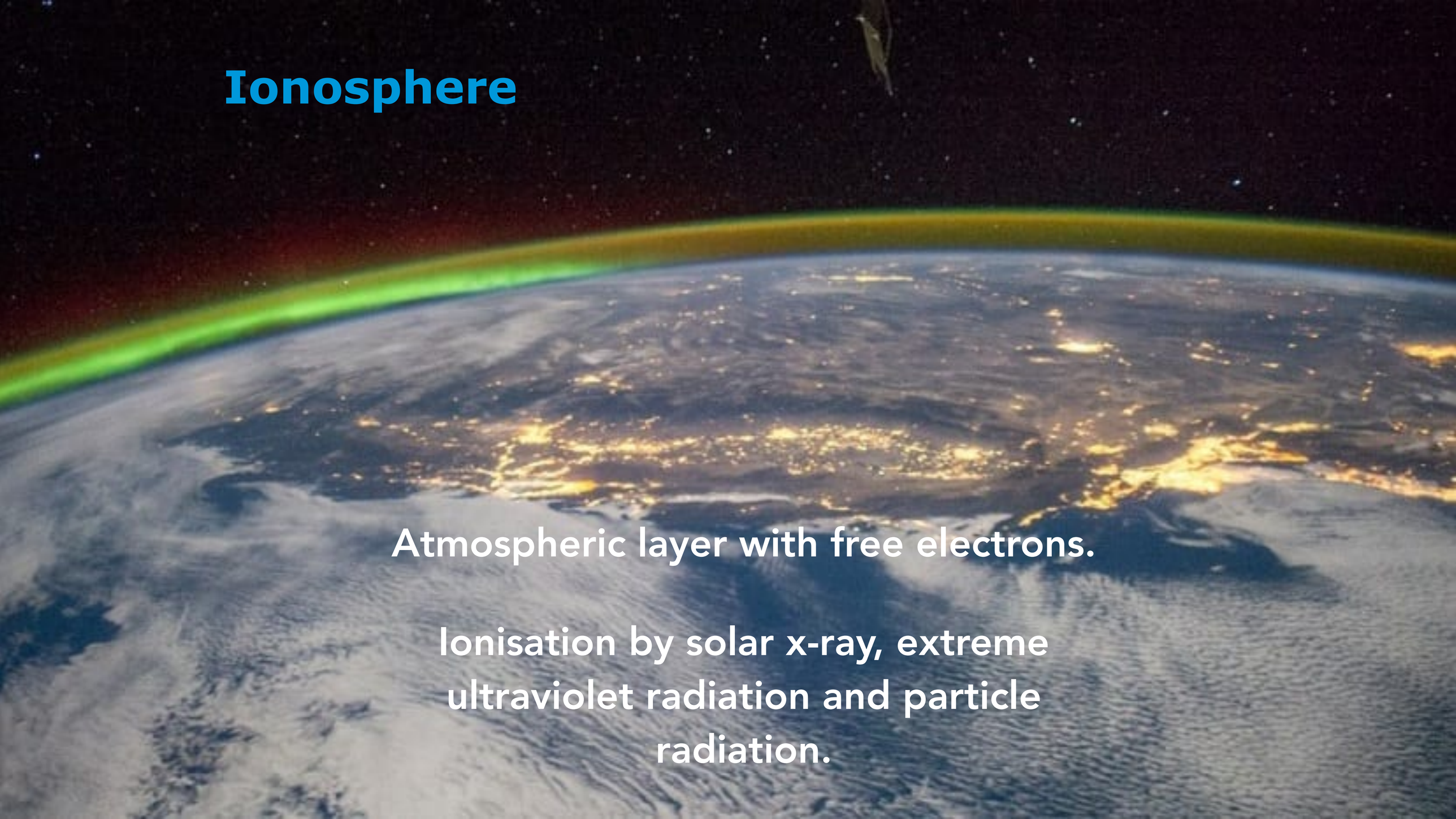
Classification and nomenclature of the terrestrial atmosphere



Based on G.W. Prölss, Physics of the Earth's Space Environment, Figure 2.13


Movie download: https://surfdrive.surf.nl/files/index.php/s/VRNAAMDtTOYHeLA
Lower thermosphere
Mesosphere
Stratosphere
Troposphere
100 km
200 km
2015-03-15 17:30
250
500
Tempera

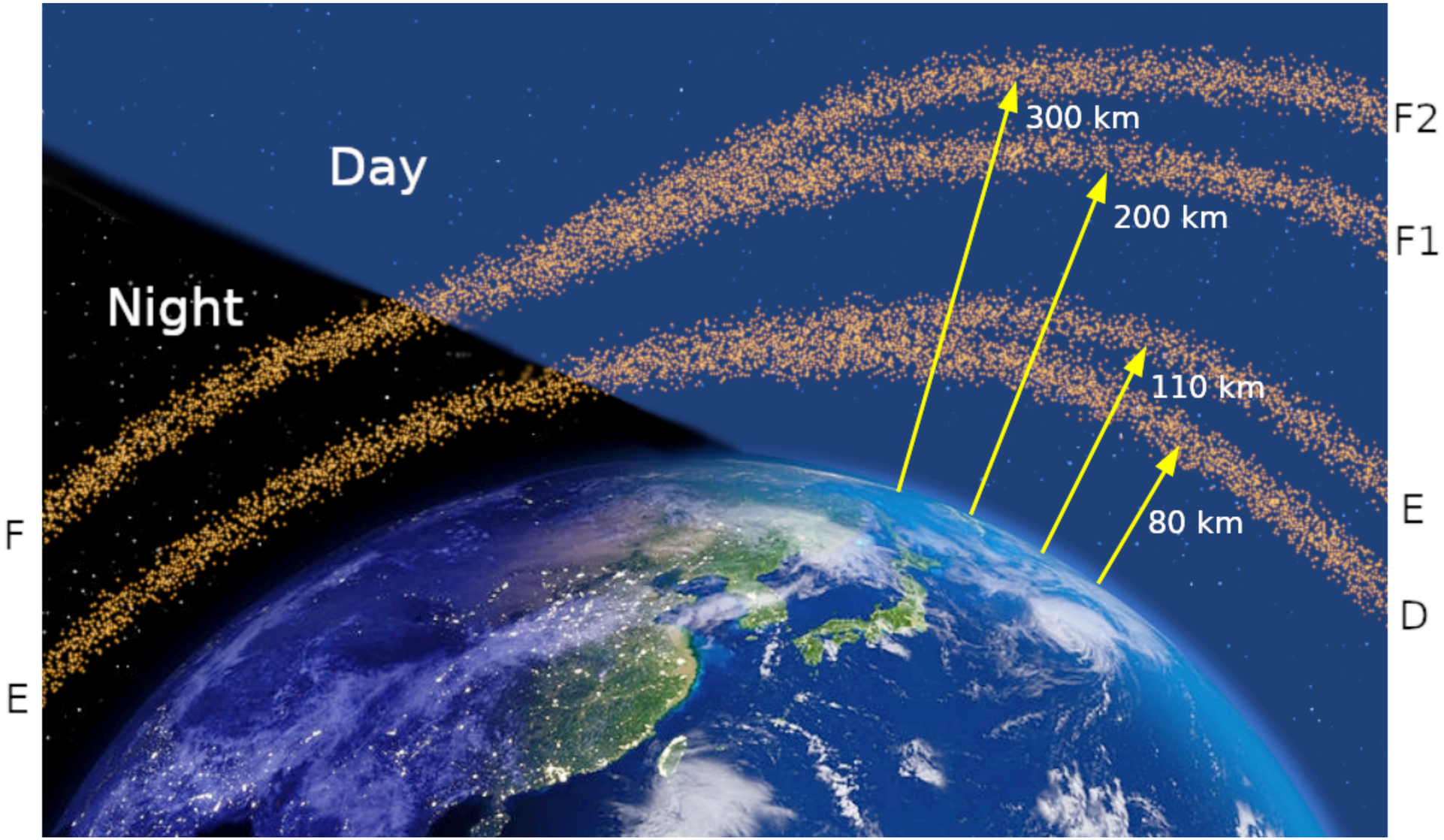
Ionosphere

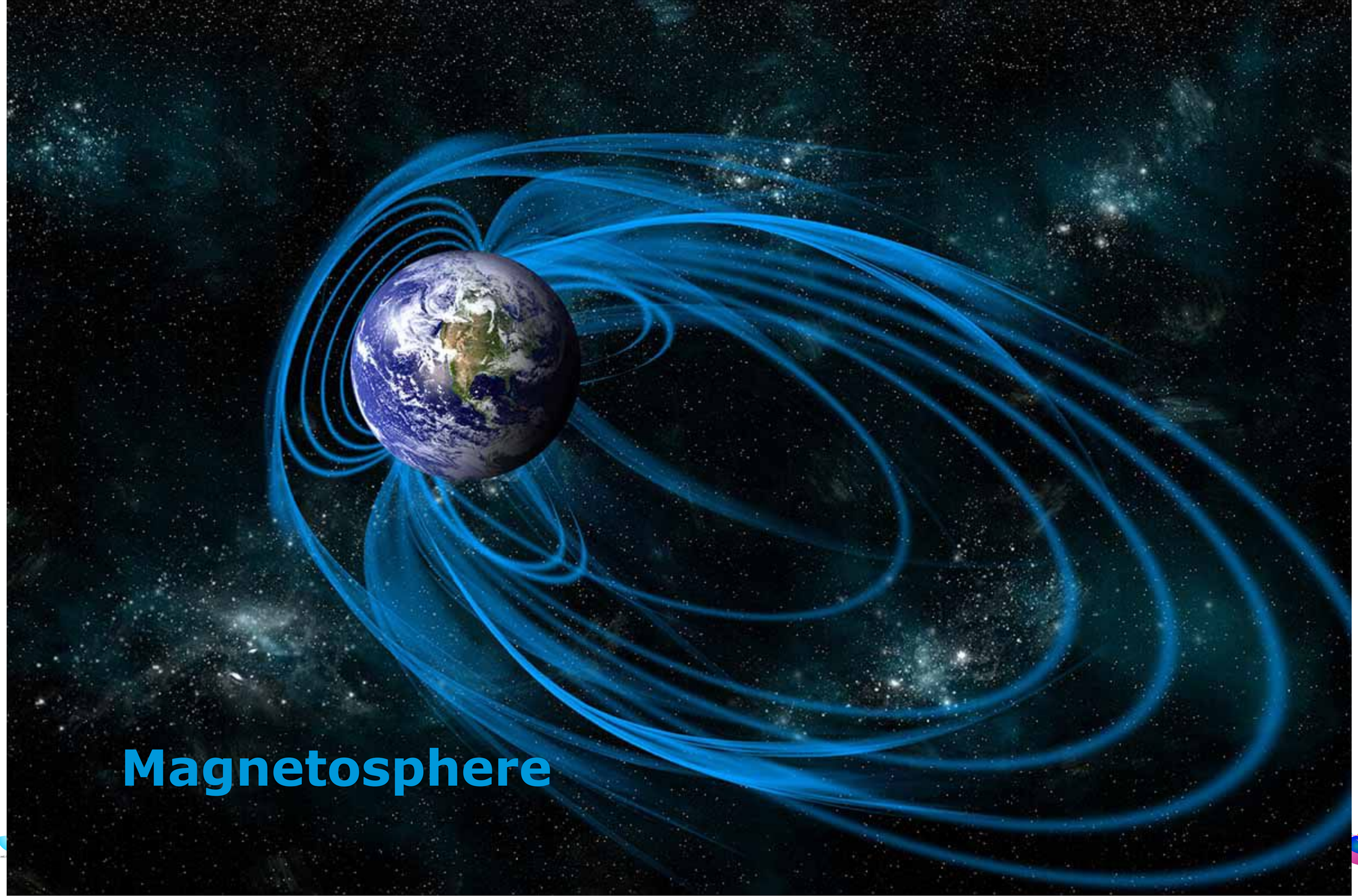


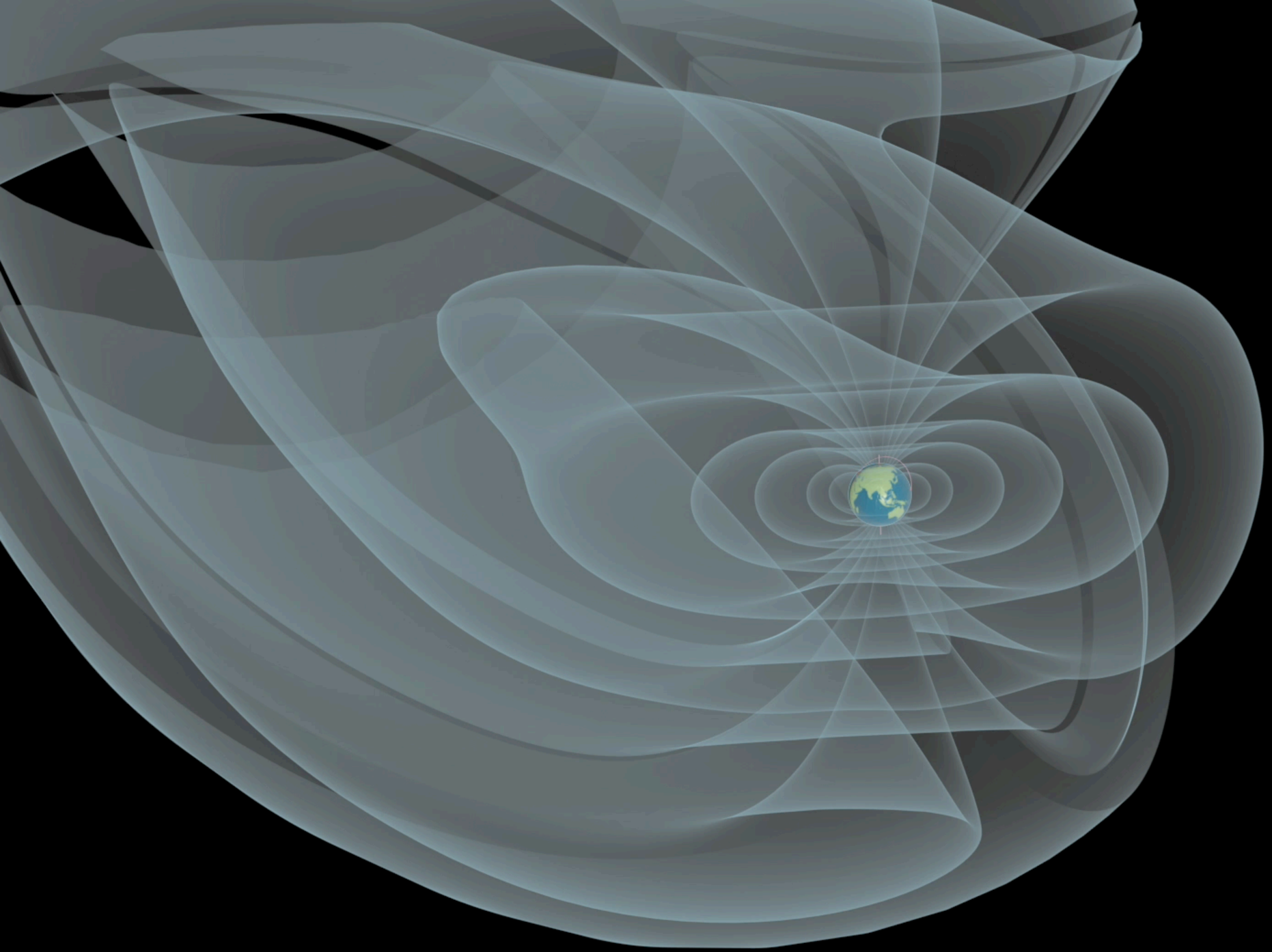
Atmospheric layer with free electrons.

Ionisation by solar x-ray, extreme ultraviolet radiation and particle radiation.

Ionosphere




Magnetosphere



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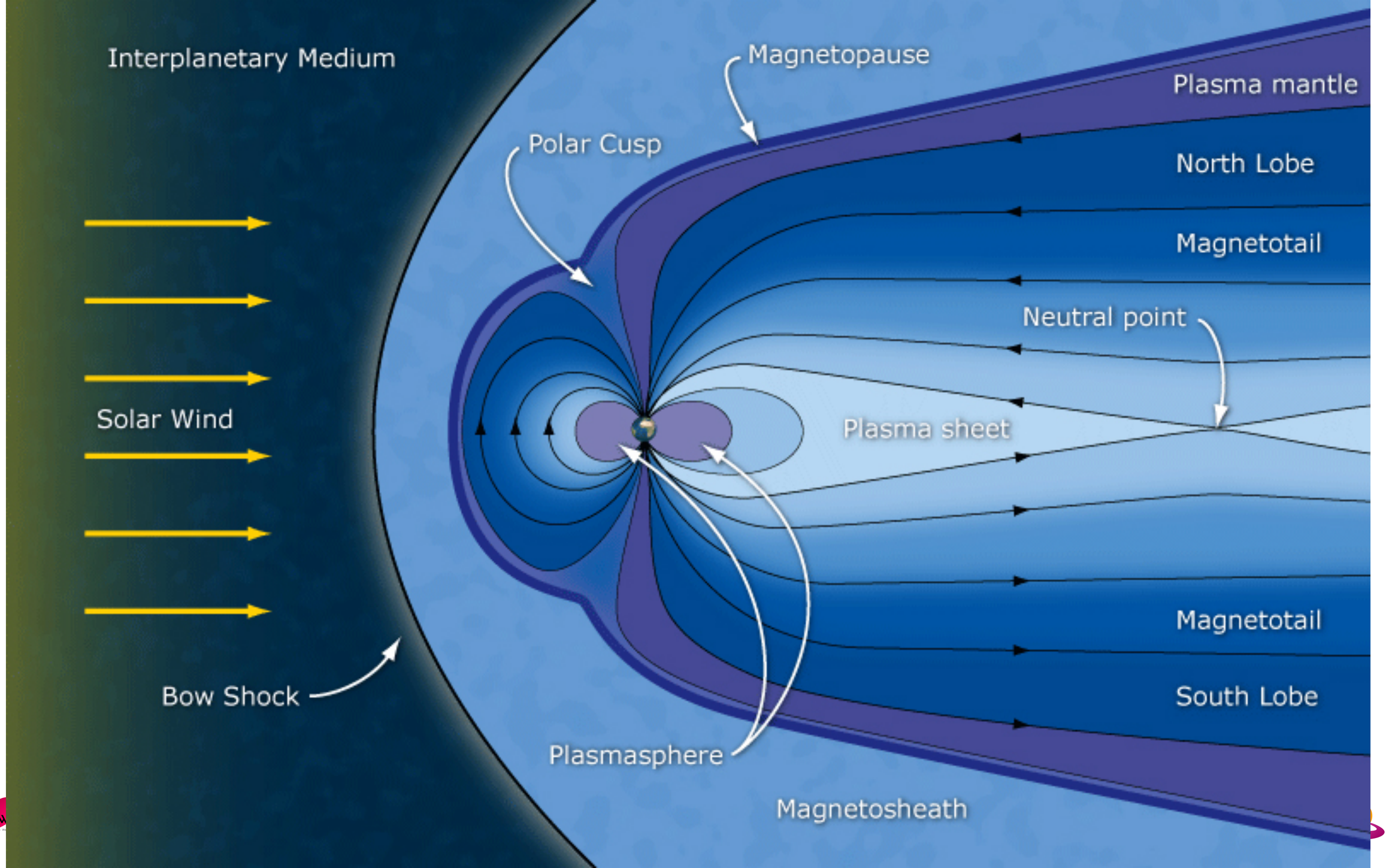
Interplanetary Medium
Magnetopause
Plasma mantle
Polar Cusp
North Lobe
Magnetotail
Neutral point
Solar Wind
Plasma sheet
Magnetotail
Bow Shock
South Lobe
Plasmasphere
Magnetosheath

Magnetospheric currents, connecting the solar wind to the thermosphere-ionosphere