


Atmospheric Structure and Composition



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http://www.gsfc.nasa.gov/gsc/earth/bin/atm_bomages.htm

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Atmospheric Composition

- Permanent Gases
 - Major Constituents
 - Nitrogen
 - Oxygen
 - Argon
 - Minor/Trace Constituents
- Gases of Variable Concentration
- Particulates
- See Handout




Image courtesy of AP/WIDEWORLD, Image Creator: Wikimedia, Source: January 20, 2008 13:52:00

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Vertical Structure

- See handout (0–100 km)
- The troposphere...
 - contains 75–80% of total mass of atmosphere
 - is synonymous with the **turbosphere**: the region where turbulence frequently exists
- Exosphere
 - Above thermosphere (~500/1000 km to ~10,000 km)
 - Negligible atomic collisions between particles
 - Gases can escape into outer space

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A two-part division of the atmosphere

- Homosphere
 - Region of uniform atmospheric composition from the surface to roughly 80–100 km
- Heterosphere
 - Variation in composition and mean molecular weight of constituent gases
 - Begins at roughly 80–100 km above the surface
 - Closely coincides with the ionosphere and thermosphere

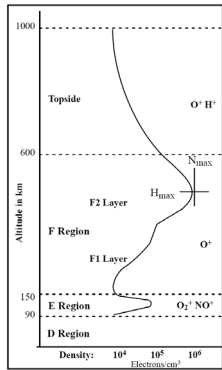
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Ionosphere

- D region: 50–90 km
- E region: 90–150 km
- F region: 150 km and beyond

Layers of the ionosphere and their predominant ion populations
(Source: NOAA SEC)

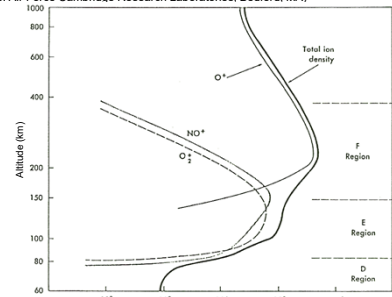


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Another look at the ionosphere

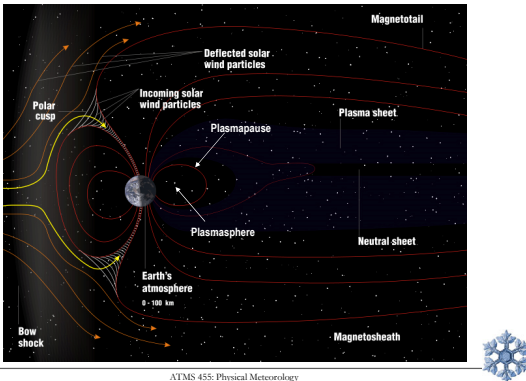
Average mid-latitude vertical distributions of the principal, positively charged and molecular ions at midday. Both scales are logarithmic.
(Source: Air Force Cambridge Research Laboratories, Bedford, MA)



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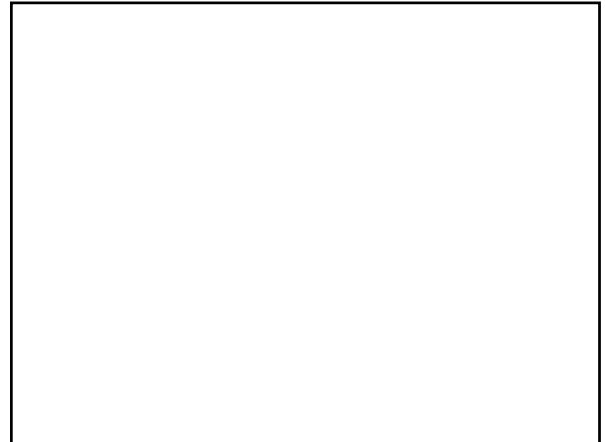
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Magnetosphere: Area of space controlled by Earth's magnetic field



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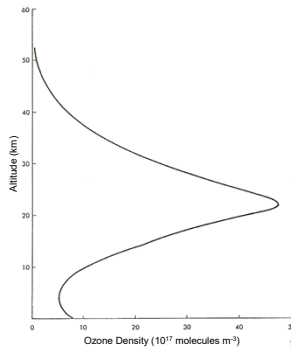
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Average vertical distribution of mid-latitude ozone

- Dobson unit: Measures column abundance of ozone (often determined via satellite)
- 1 DU = 2.69×10^{16} molecules of O_3 per cm^2
- 300 DU of ozone would be _____ thick if brought down to the surface at STP



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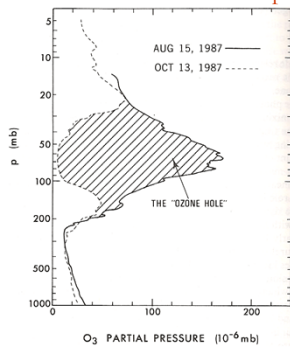
Ozone concentrations

- At 25 km, O_3 density is $\sim 4-5 \times 10^{18}$ molecules m^{-3}
- ρ_{air} at 25 km is $\sim 10^{24}$ molecules m^{-3}
- So $O_3 \approx 4-5$ ppm = 4000-5000 ppb
- Near the surface, O_3 density is $\sim 10^{18}$ molecules m^{-3}
- ρ_{air} at MSL is $\sim 10^{25}$ molecules m^{-3}
- So $O_3 \approx 100$ ppb

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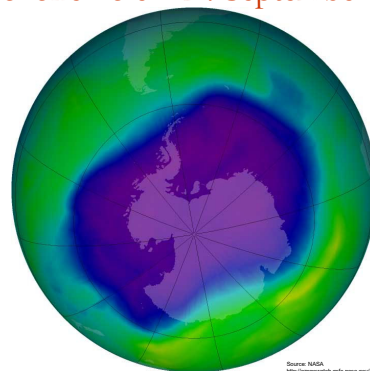
Ozone concentration before and after the development of the ozone hole in the spring of 1987



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The ozone hole – 24 September 2006



Source: NASA
http://www.nasa.gov

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