

Atmospheric and Oceanic Sciences 3/3L

Introduction to the Atmospheric Environment

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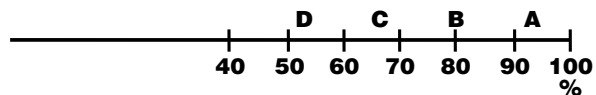
Instructor Dr. Jeffrey Lew

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lew@atmos.ucla.edu
AIM: jklew888
Twitter: atmosproflew**

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Grades

- **2 closed-book exams, 650 points total**
- **3 take-home quizzes, 150 points total**
- **5 of 7 in-lecture quizzes, 100 points total**
- **4 in-discussion quizzes, 100 points total**



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Laboratory Section (3L)

GE requirement: Foundations of Scientific Inquiry—2 courses from Physical Sciences, one of which is a 5-unit course with lab/demo or Writing II credit.

Lecture/discussion counts as a 4-unit course

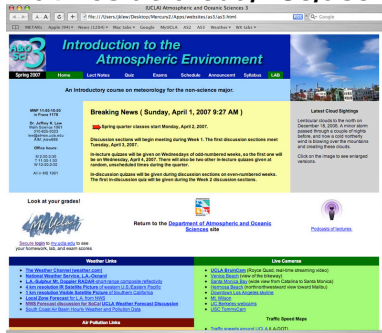
Take 1-unit lab at same time to fulfill 5-unit requirement, if needed

In any case, lab can only be taken concurrently with lecture/discussion

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Web Site

www.atmos.ucla.edu/AS3/as3.html

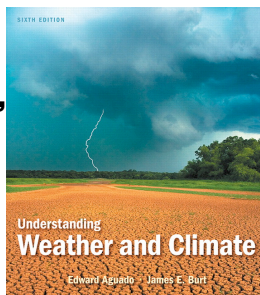


my.ucla.edu

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Textbook

E. Aguado and J.E. Burt, *Understanding Weather and Climate*, 6th ed.



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Podcasts

Audio recordings of lectures,
enhanced with slide builds



Go to class web site to get instructions on
how to subscribe using iTunes

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Ch. 1: Overview of the Atmosphere and Weather

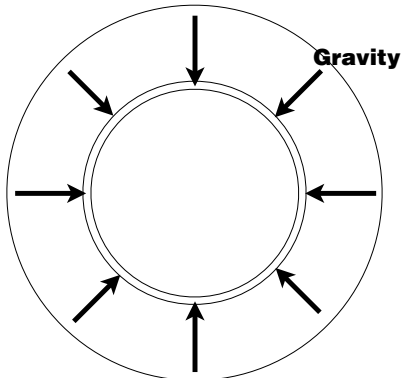
The Atmosphere

- Gaseous Composition
- Vertical Density, Temperature, and Pressure Profiles
- Atmospheric Layers
- Evolution of Earth's Atmosphere

Weather

- Definitions and Disciplines of Study
- Weather Elements
- Historical Highlights

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Atmospheric Dimensions

100–500 km

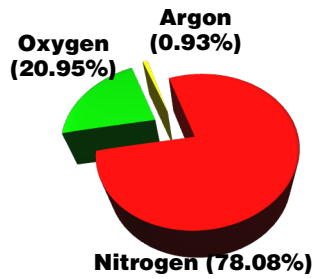


Total mass: 5×10^{18} kg

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Atmospheric Composition

Permanent/Non-variable/Fixed Gases



Permanent Trace Gases

Neon
Helium
Hydrogen
Xenon
Krypton

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TABLE 1–2 Permanent Gases of the Atmosphere

Constituent	Formula	Percent by Volume	Molecular Weight
Nitrogen	N ₂	78.08	28.01
Oxygen	O ₂	20.95	32.00
Argon	Ar	0.93	39.95
Neon	Ne	0.002	20.18
Helium	He	0.0005	4.00
Krypton	Kr	0.0001	83.8
Xenon	Xe	0.00009	131.3
Hydrogen	H ₂	0.00005	2.02

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Variable Gases

- **Thousands of gases, whose concentrations vary over short time scales:**

- **Water Vapor (H_2O)**

- 1–4%, depending on temperature
- Mostly located below 10 km altitude

- **Carbon Dioxide (CO_2)**

- 0.038% \pm 0.0006%, depending on season

- **Ozone (O_3)**

- Concentration varies with location (urban smog, stratospheric ozone layer)

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Important Features of Variable Gases

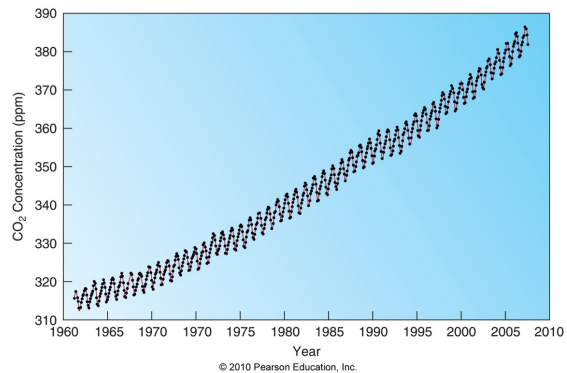
- **Water Vapor**

- **Heat transport**
- **Hydrologic Cycle**

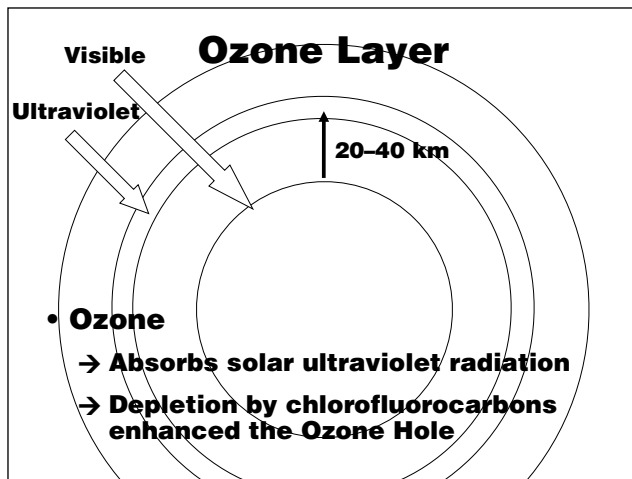
- **Carbon Dioxide**

- **Greenhouse Effect**
- **Respiration/Green Plant Photosynthesis**
- **Increasing due to human activities**

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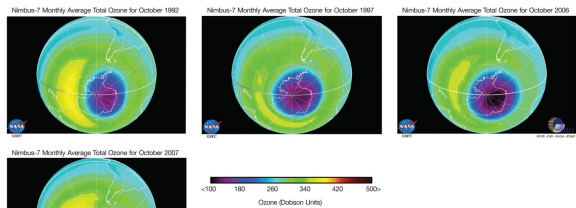


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Focus 1-2 (pp. 12–13)



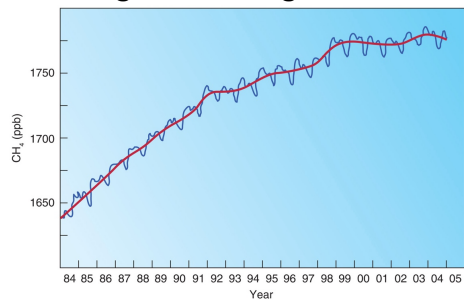
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• Methane

→ From organic decay, fossil fuel leaks

→ Also a greenhouse gas

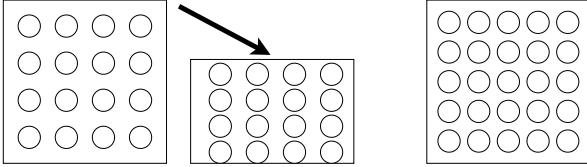


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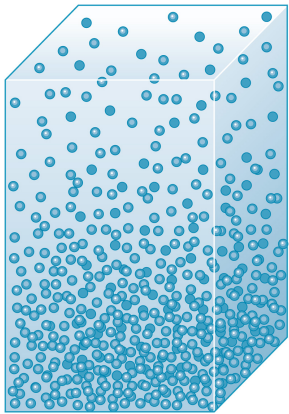
Physical Structure of the Atmosphere

Density: mass
per unit volume

$$\rho = \frac{M}{V}$$



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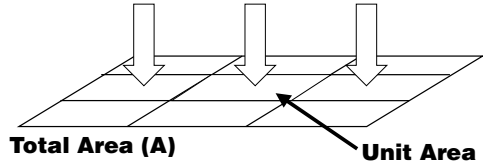


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Pressure = Force per Unit Area

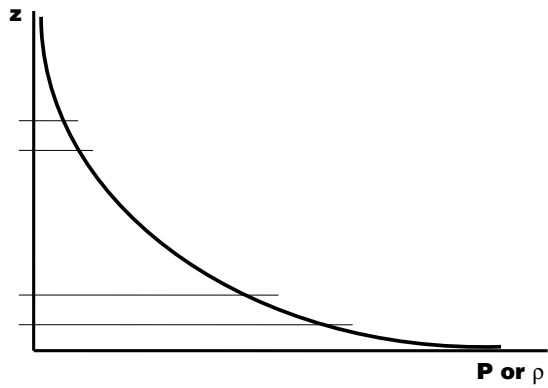
$$P = \frac{F}{A}$$

Force (F)



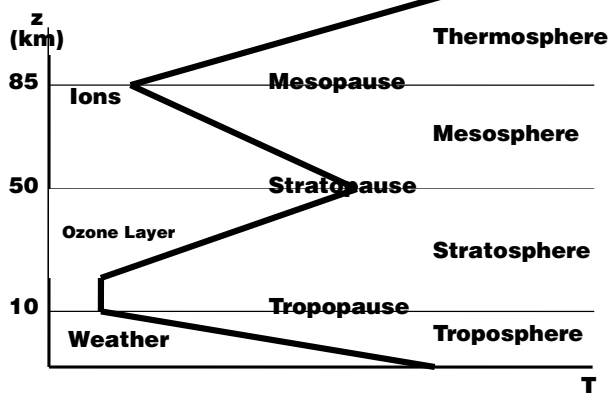
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P vs. z



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Vertical Temperature Profile

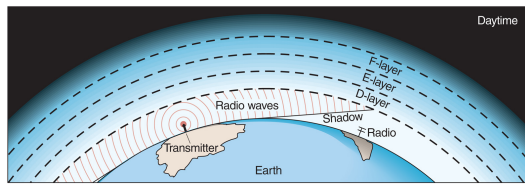


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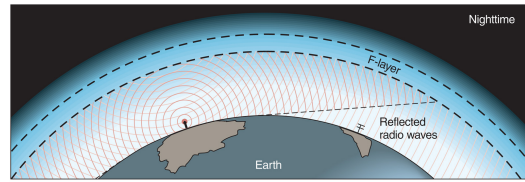
Ionosphere

- **Outer layers of atmosphere exposed to strong sunlight**
 - **Produces electrically charged ions**

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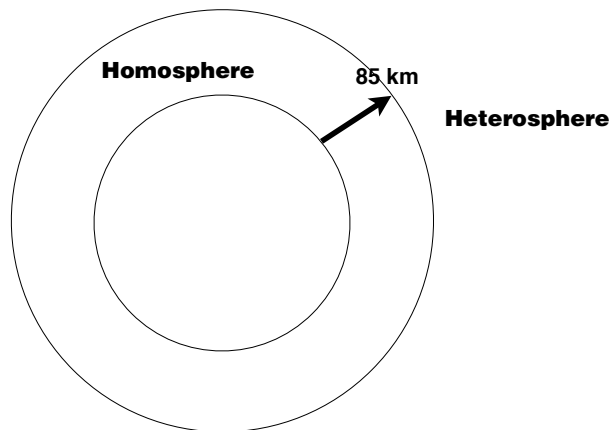


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Atmospheric Evolution

- **Primordial Atmosphere: 4.5 BYA**
 - Condensation of Interstellar Matter (mostly Hydrogen and Helium)

- **Secondary Atmosphere: 4 BYA**
 - Formed by planetary outgassing (mostly Water Vapor and Carbon Dioxide)
 - Later, water vapor condensed out to form oceans, and carbon dioxide dissolved into the ocean water

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- **Green “Plants”: 2.5 BYA**

- Green Plant Photosynthesis released molecular oxygen into the environment



Cyanobacteria

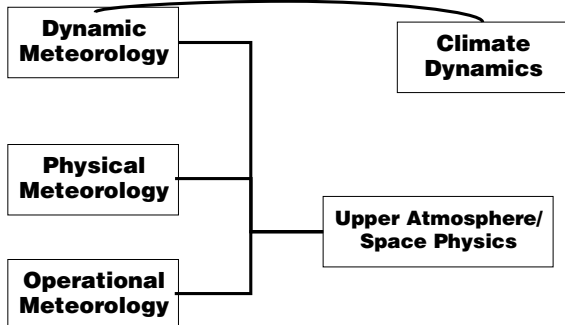
- **Present Atmosphere**

- Lifeforms and atmosphere co-evolved to form “Class-M” environment: nitrogen/oxygen

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Meteorology

Things in air



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Definitions

- **Weather**

→ An observation of the weather elements at one point in time

- **Climate**

→ A summary of a set of weather observations taken over a period of time

Weather Elements

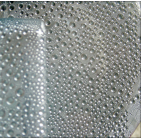
Temperature



Pressure



Humidity



Wind



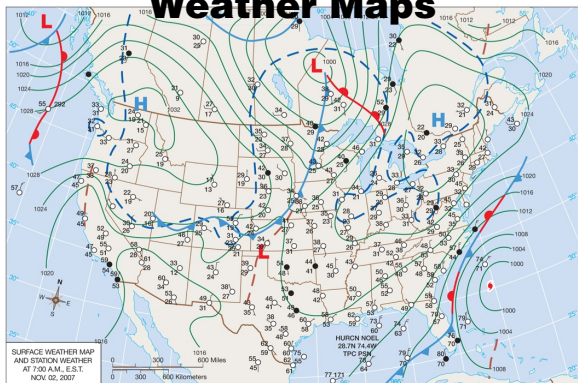
Clouds



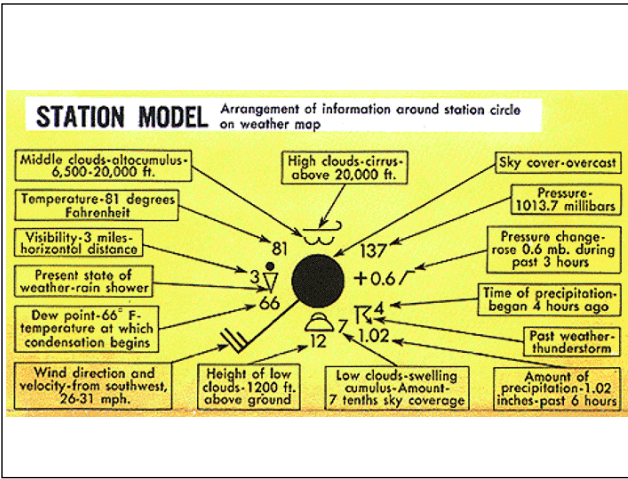
Precipitation



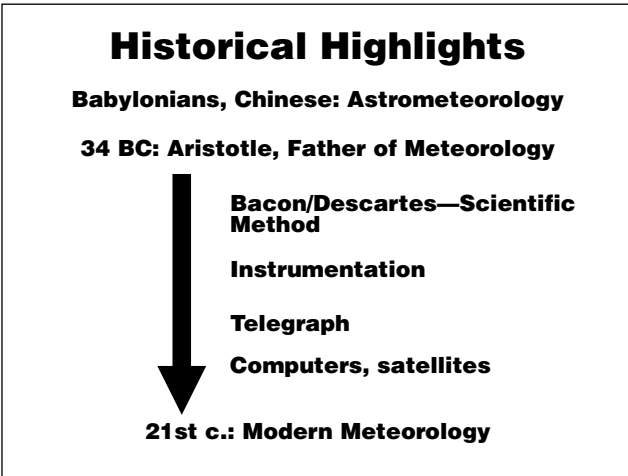
Weather Maps



(a)



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