

# **Atmospheric and Oceanic Sciences 3/3L**

## **Introduction to the Atmospheric Environment**

# **Instructor**

## **Dr. Jeffrey Lew**

**Math Science 1961**

**310-825-3023**

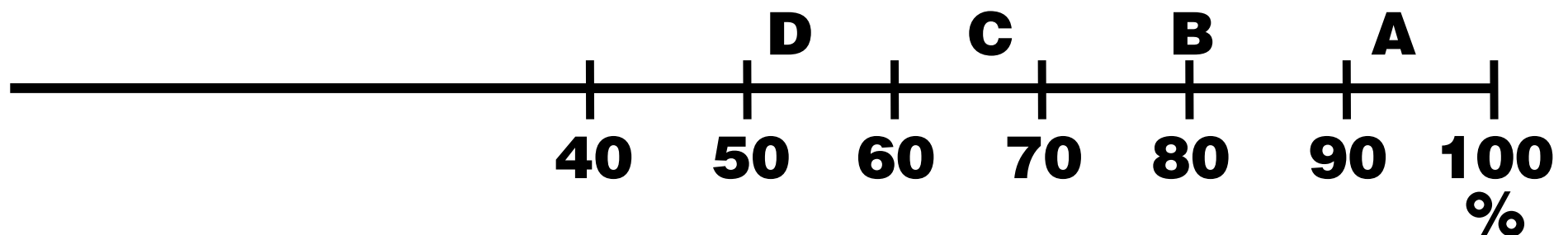
**lew@atmos.ucla.edu**

**AIM: jklew888**

**Twitter: atmosprowlew**

# 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**



# **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**

# Web Site

[www.atmos.ucla.edu/AS3/as3.html](http://www.atmos.ucla.edu/AS3/as3.html)

(UCLA) Atmospheric and Oceanic Sciences 3

file:///Users/jklew/Desktop/Mercury2/Apps/websites/as3/as3.html

ABO Sci 3 Introduction to the Atmospheric Environment

Spring 2007 Home Lect Notes Quiz Exams Schedule Announcemnt Syllabus LAB

An Introductory course on meteorology for the non-science major.

MWF 11:00-10:50  
in Franz 1178

Dr. Jeffrey K. Lew  
Math Science 1981  
310-825-3023  
lew@atmos.ucla.edu  
AIM: jklew888

Office hours:  
M 2:00-3:30  
T 11:30-1:30  
W 12:00-2:00  
All in MS 1981

**Breaking News ( Sunday, April 1, 2007 9:27 AM )**

➔ Spring quarter classes start Monday, April 2, 2007.

Discussion sections will begin meeting during Week 1. The first discussion sections meet Tuesday, April 3, 2007.

In-lecture quizzes will be given on Wednesdays of odd-numbered weeks, so the first one will be on Wednesday, April 4, 2007. There will also be two other in-lecture quizzes given at random, unscheduled times during the quarter.

In-discussion quizzes will be given during discussion sections on even-numbered weeks. The first in-discussion quiz will be given during the Week 2 discussion sections.

Latest Cloud Sightings

Lenticular clouds to the north on December 18, 2006. A minor storm passed through a couple of nights before, and now a cold northerly wind is blowing over the mountains and creating these clouds.

Click on the image to see enlarged versions.

Look at your grades!

Return to the [Department of Atmospheric and Oceanic Sciences](#) site

[Podcasts of lectures](#)

[Secure login to my.ucla.edu](#) to see your homework, lab, and exam scores

**Weather Links**

- [The Weather Channel \(weather.com\)](#)
- [National Weather Service, L.A.-Oxnard](#)
- [L.A.-Sulphur Mt. Doppler RADAR-short-range composite reflectivity](#)
- [4 km resolution IR Satellite Picture of western U.S./Eastern Pacific](#)
- [1 km resolution Visible Satellite Picture of Southern California](#)
- [Local Zone Forecast for L.A. from NWS](#)
- [NWS Forecast discussion for SoCal](#) [UCLA Weather Forecast Discussion](#)
- [South Coast Air Basin Hourly Weather and Pollution Data](#)

**Live Cameras**

- [UCLA BruinCam](#) (Royce Quad, real-time streaming video)
- [Venice Beach](#) (view of the bikeway)
- [Santa Monica Bay](#) (wide view from Catalina to Santa Monica)
- [Hermosa Beach](#) (northnorthwestward view toward Malibu)
- [Downtown Los Angeles skyline](#)
- [Mt. Wilson](#)
- [UC Berkeley webcams](#)
- [USC TommyCam](#)

**Air Pollution Links**

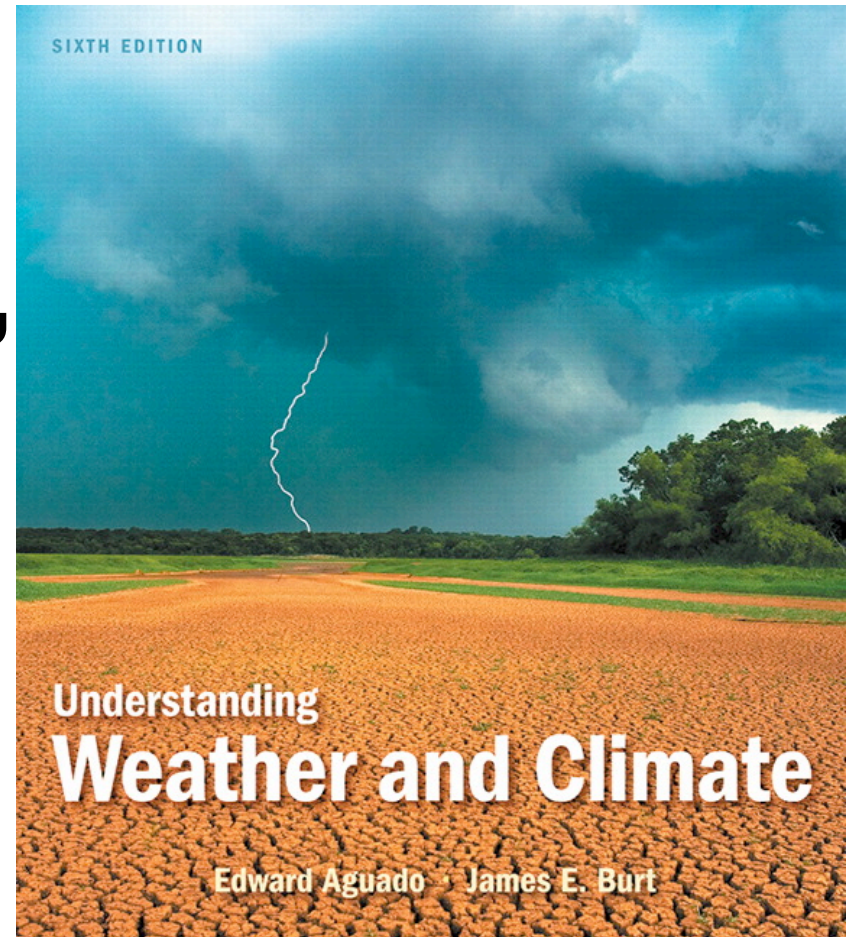
**Traffic Speed Maps**

- [Traffic speeds around UCLA \(LA-DOT\)](#)

[my.ucla.edu](http://my.ucla.edu)

# Textbook

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





# Podcasts

**Audio recordings of lectures,  
enhanced with slide builds**



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

# **Ch. 1: Overview of the Atmosphere and Weather**

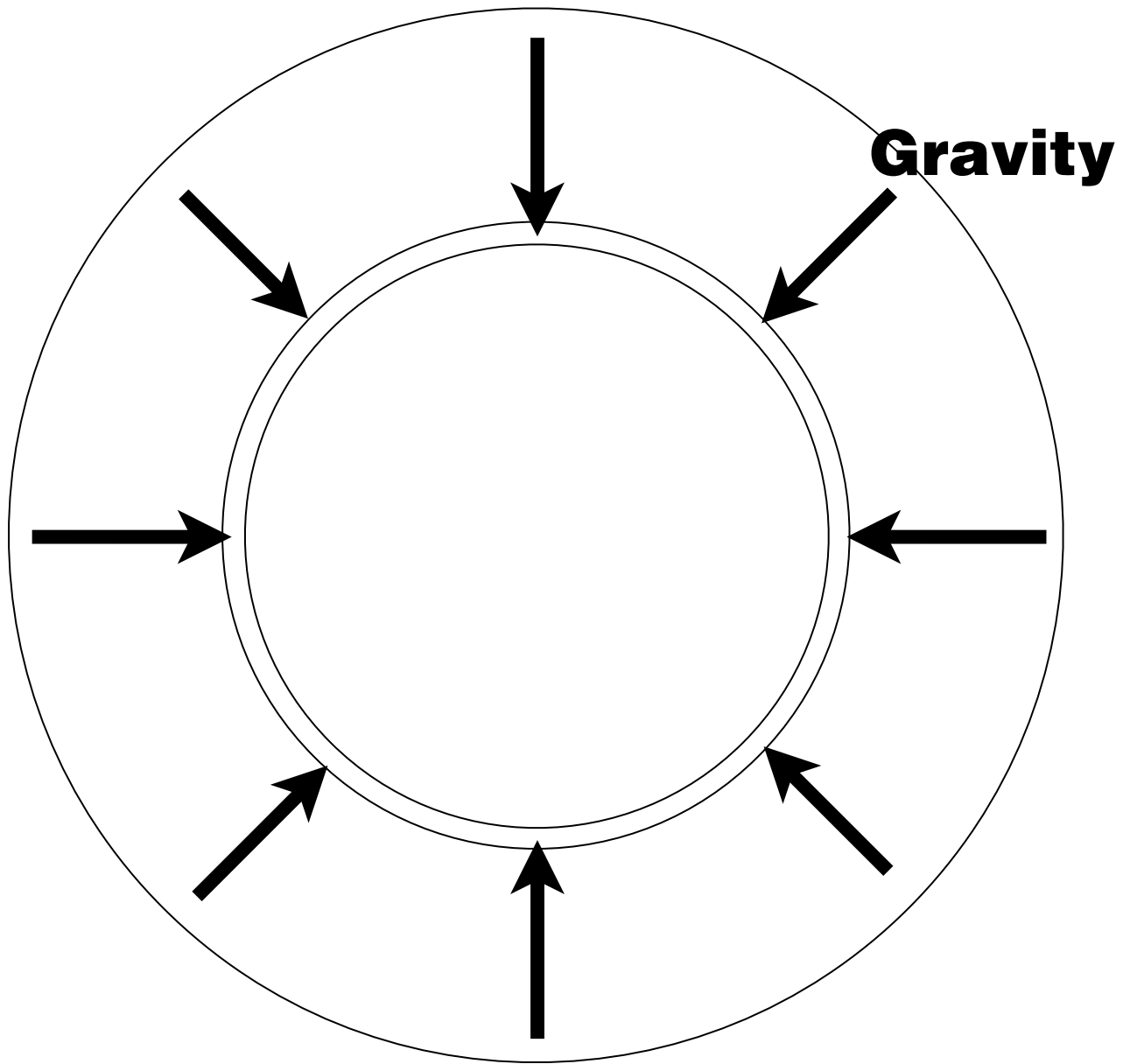
## **The Atmosphere**

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

## **Weather**

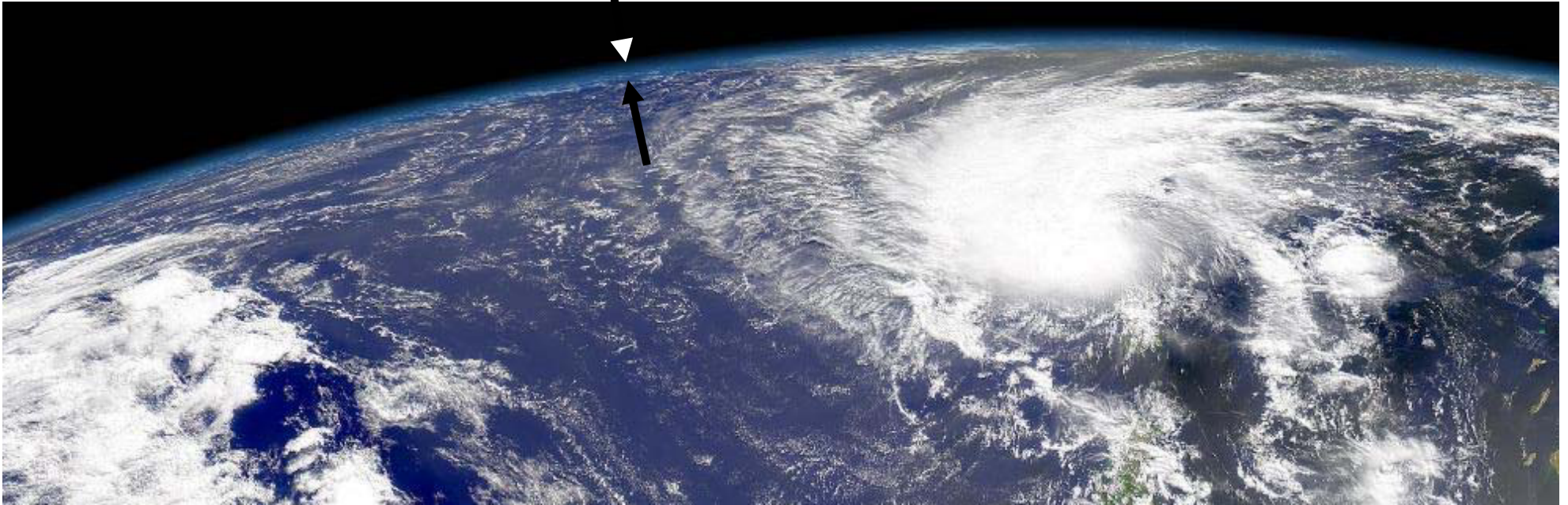
- Definitions and Disciplines of Study**
- Weather Elements**
- Historical Highlights**





# Atmospheric Dimensions

**100–500 km**

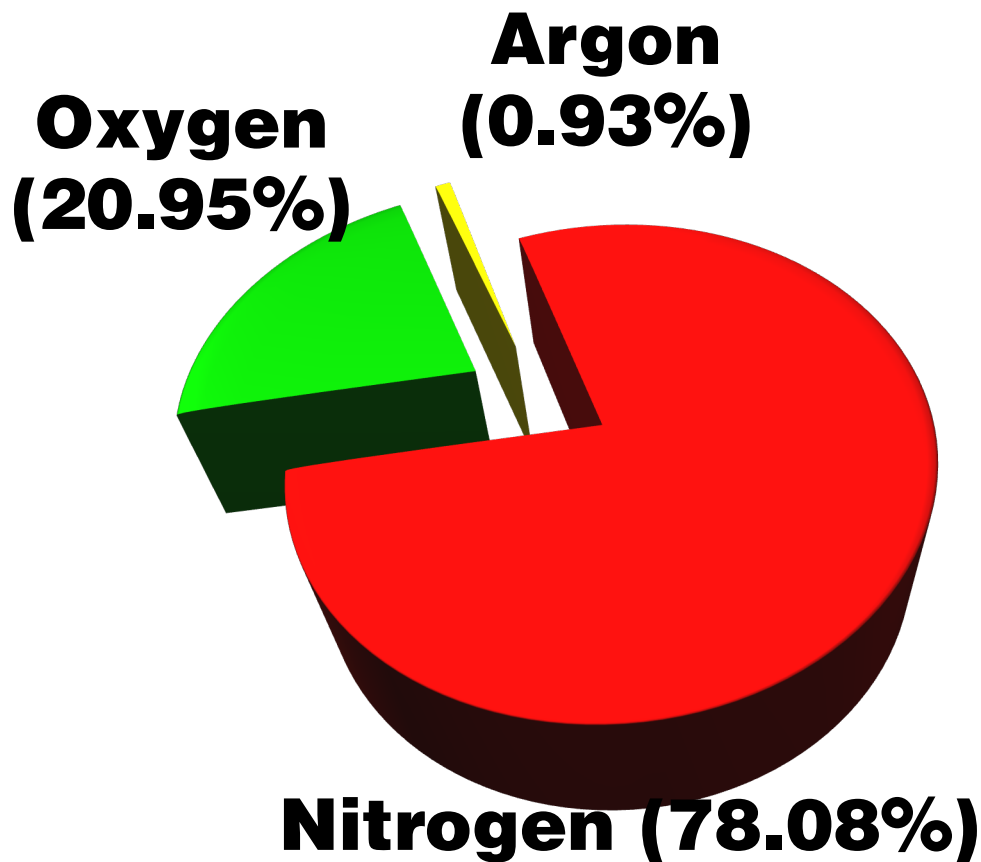


**Total mass:  $5 \times 10^{18}$  kg**

# Atmospheric Composition

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## Permanent/Non-variable/Fixed Gases



### Permanent Trace Gases

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Neon  
Helium  
Hydrogen  
Xenon  
Krypton

**TABLE 1-2 Permanent Gases of the Atmosphere**

<b>Constituent</b>	<b>Formula</b>	<b>Percent by Volume</b>	<b>Molecular Weight</b>
Nitrogen	N <sub>2</sub>	78.08	28.01
Oxygen	O <sub>2</sub>	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 <sub>2</sub>	0.00005	2.02

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# Variable Gases

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

- **Water Vapor ( $\text{H}_2\text{O}$ )**

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

- **Carbon Dioxide ( $\text{CO}_2$ )**

- 0.038%  $\pm$ 0.0006%, depending on season

- **Ozone ( $\text{O}_3$ )**

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

# **Important Features of Variable Gases**

- **Water Vapor**

- **Heat transport**

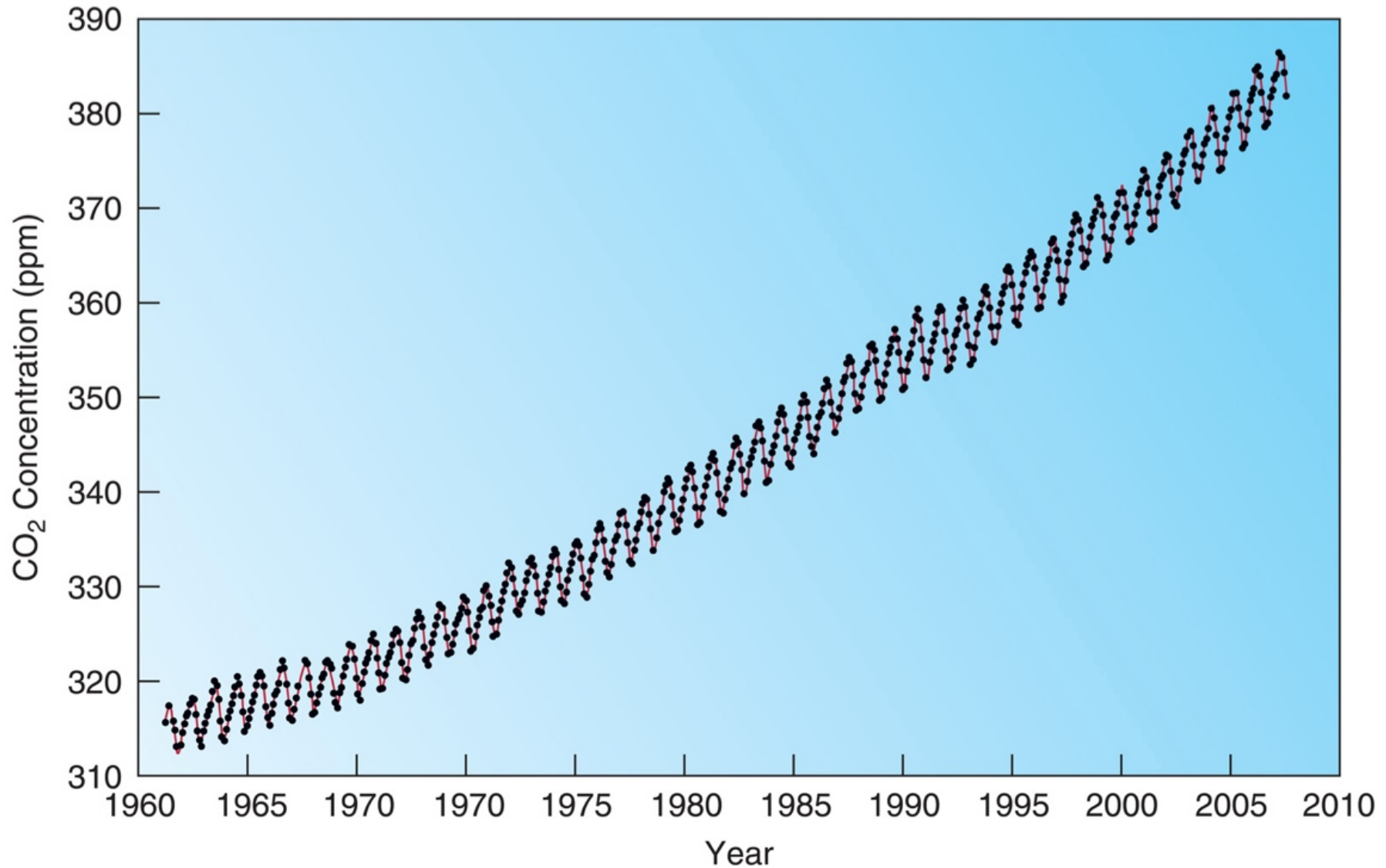
- **Hydrologic Cycle**

- **Carbon Dioxide**

- **Greenhouse Effect**

- **Respiration/Green Plant Photosynthesis**

- **Increasing due to human activities**



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# Ozone Layer

Visible

Ultraviolet

20-40 km

- **Ozone**

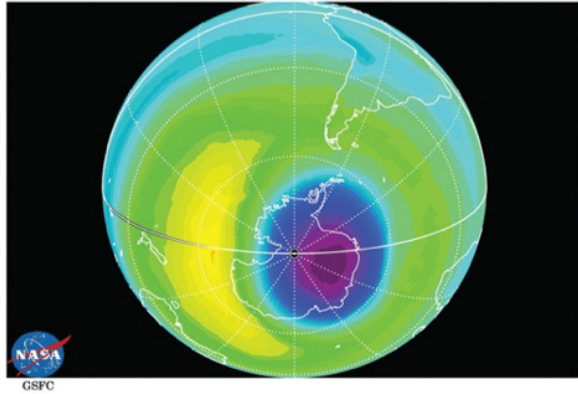
- **Absorbs solar ultraviolet radiation**

- **Depletion by chlorofluorocarbons enhanced the Ozone Hole**

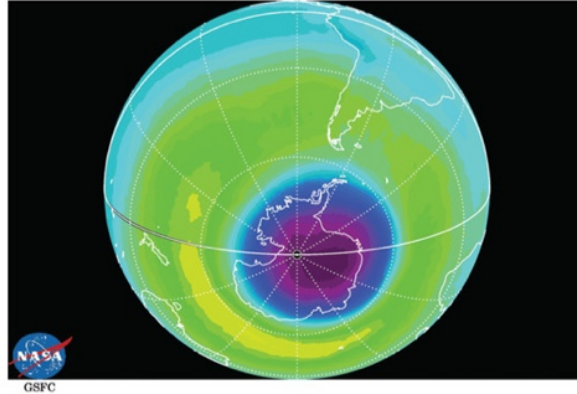


# Focus 1-2 (pp. 12–13)

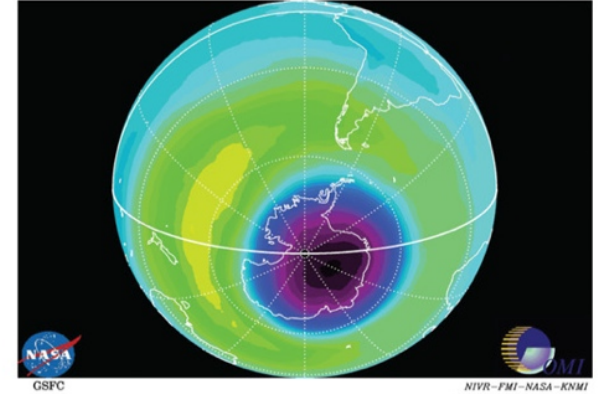
Nimbus-7 Monthly Average Total Ozone for October 1992



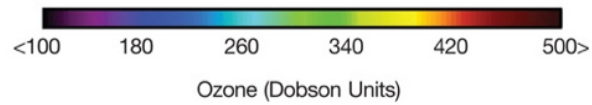
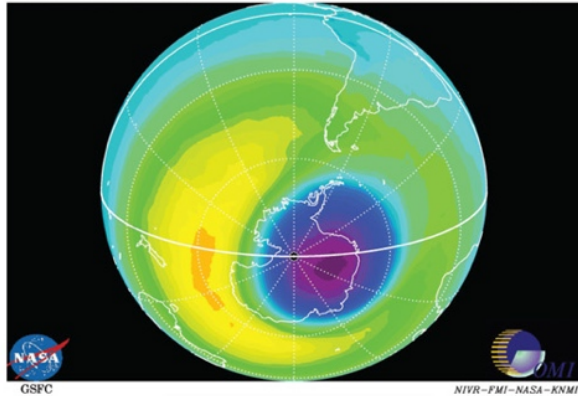
Nimbus-7 Monthly Average Total Ozone for October 1997



Nimbus-7 Monthly Average Total Ozone for October 2006



Nimbus-7 Monthly Average Total Ozone for October 2007

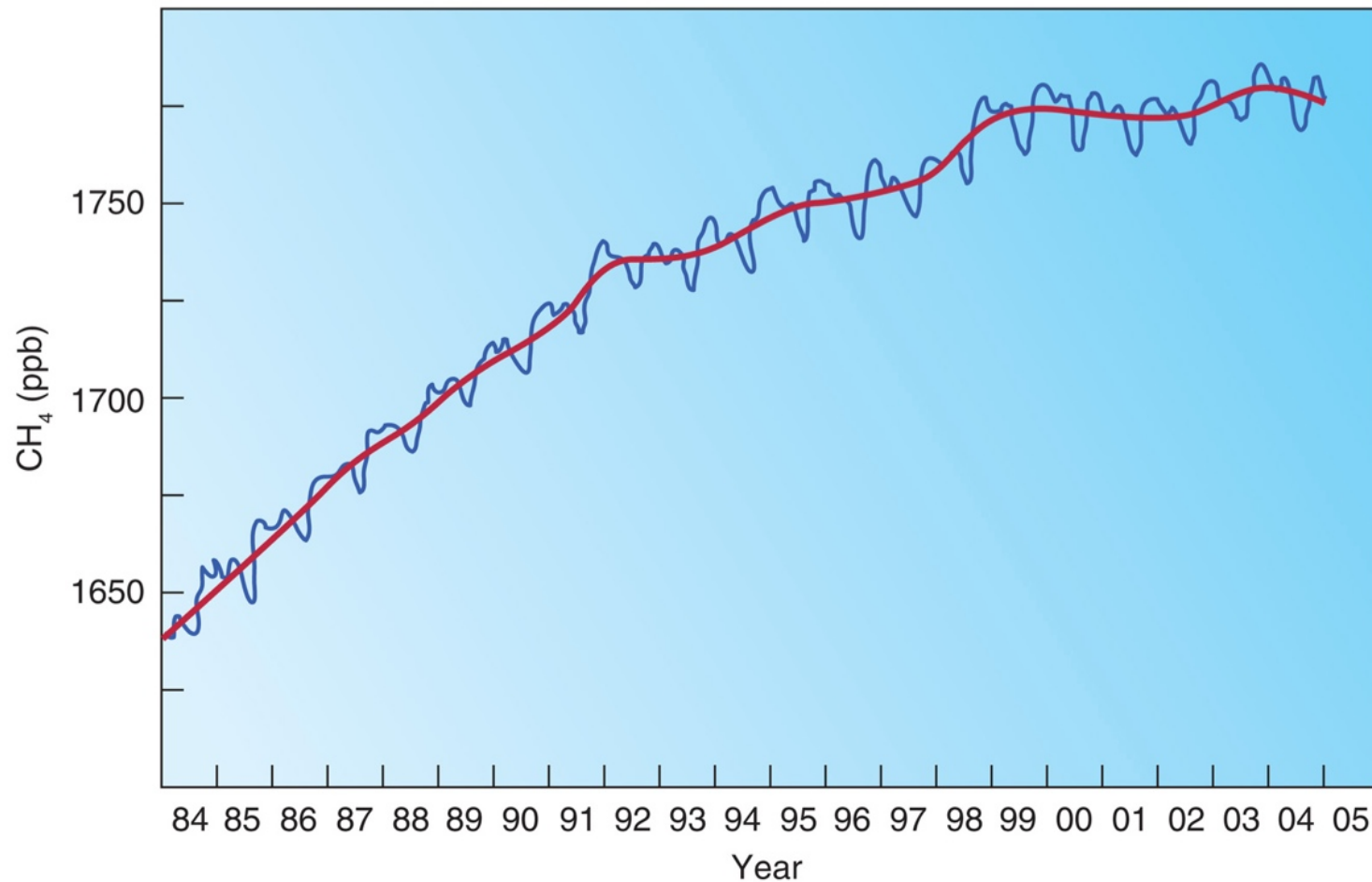


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- **Methane**

- **From organic decay, fossil fuel leaks**

- **Also a greenhouse gas**

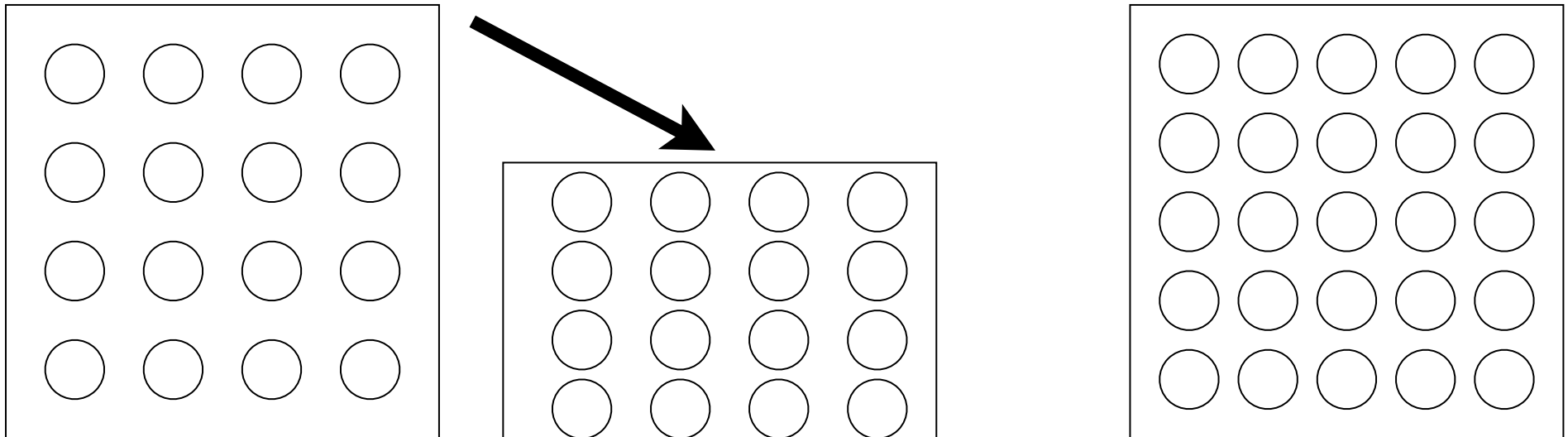


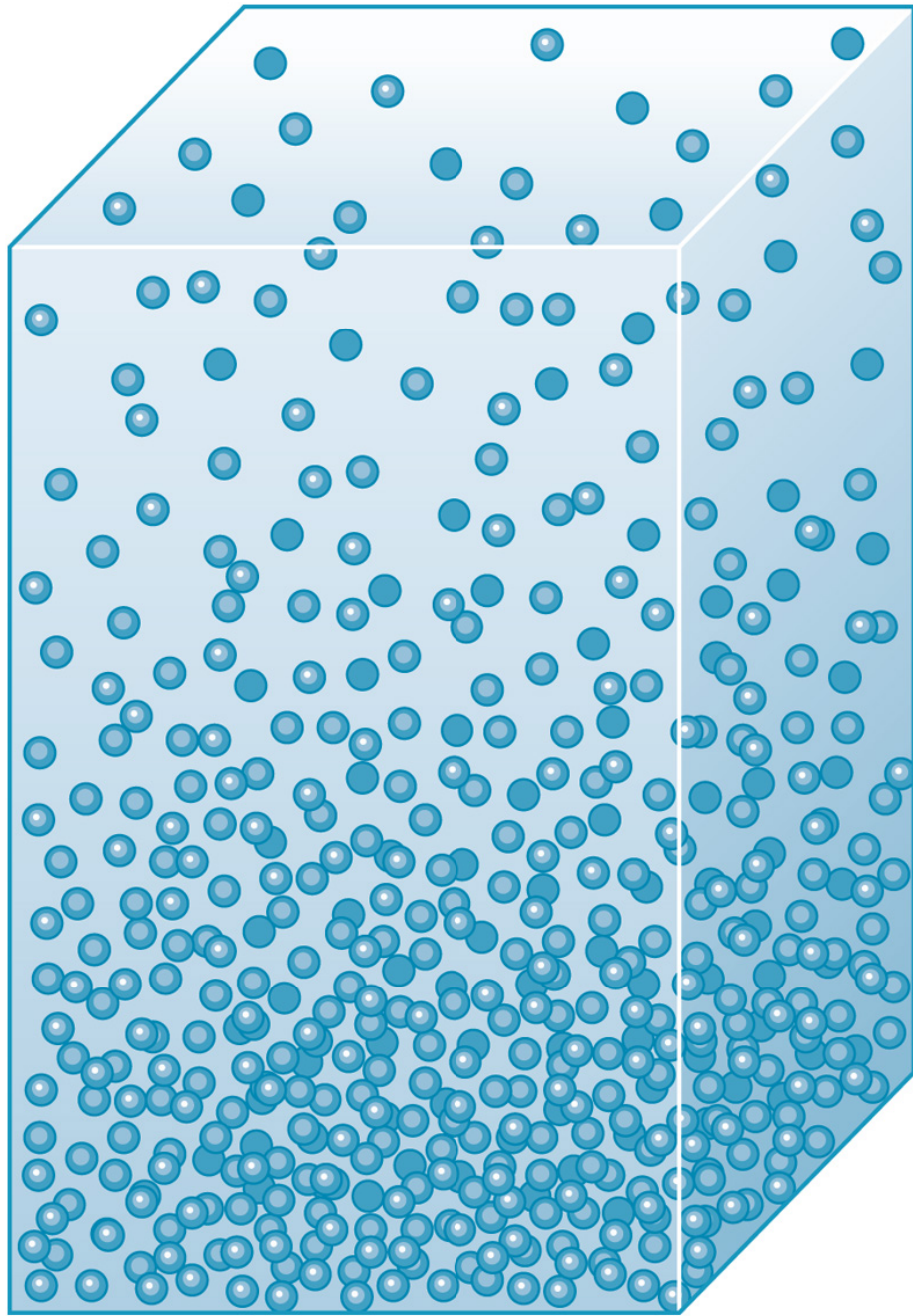
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# Physical Structure of the Atmosphere

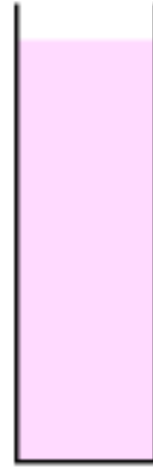
**Density: mass per unit volume**

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





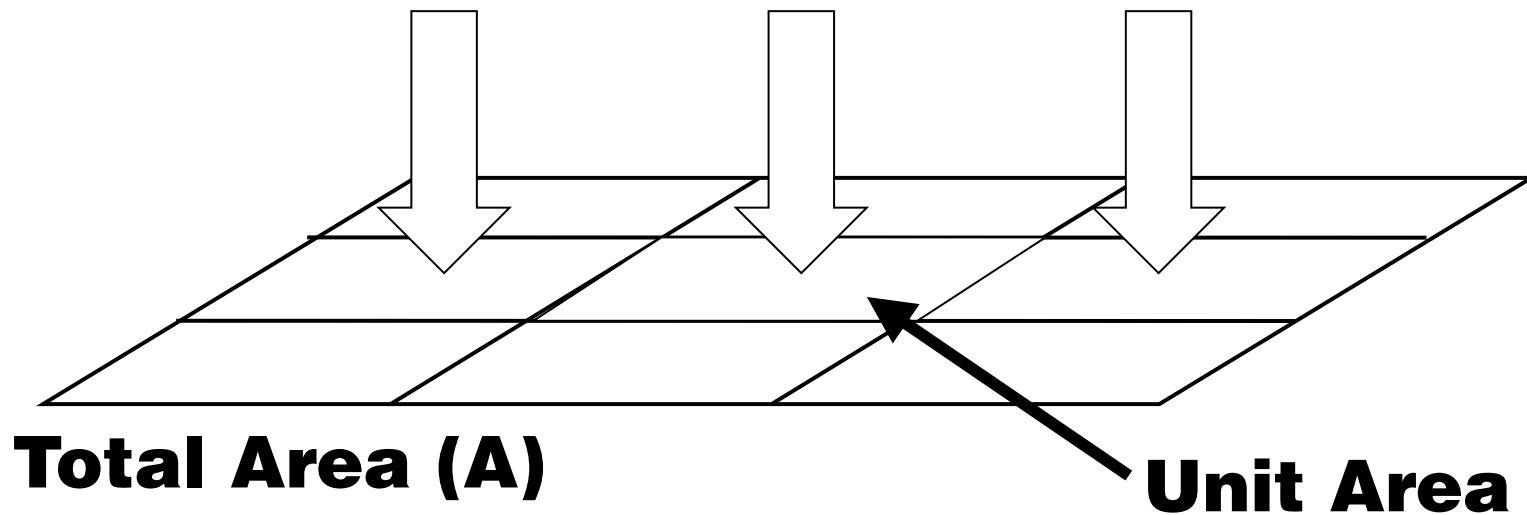
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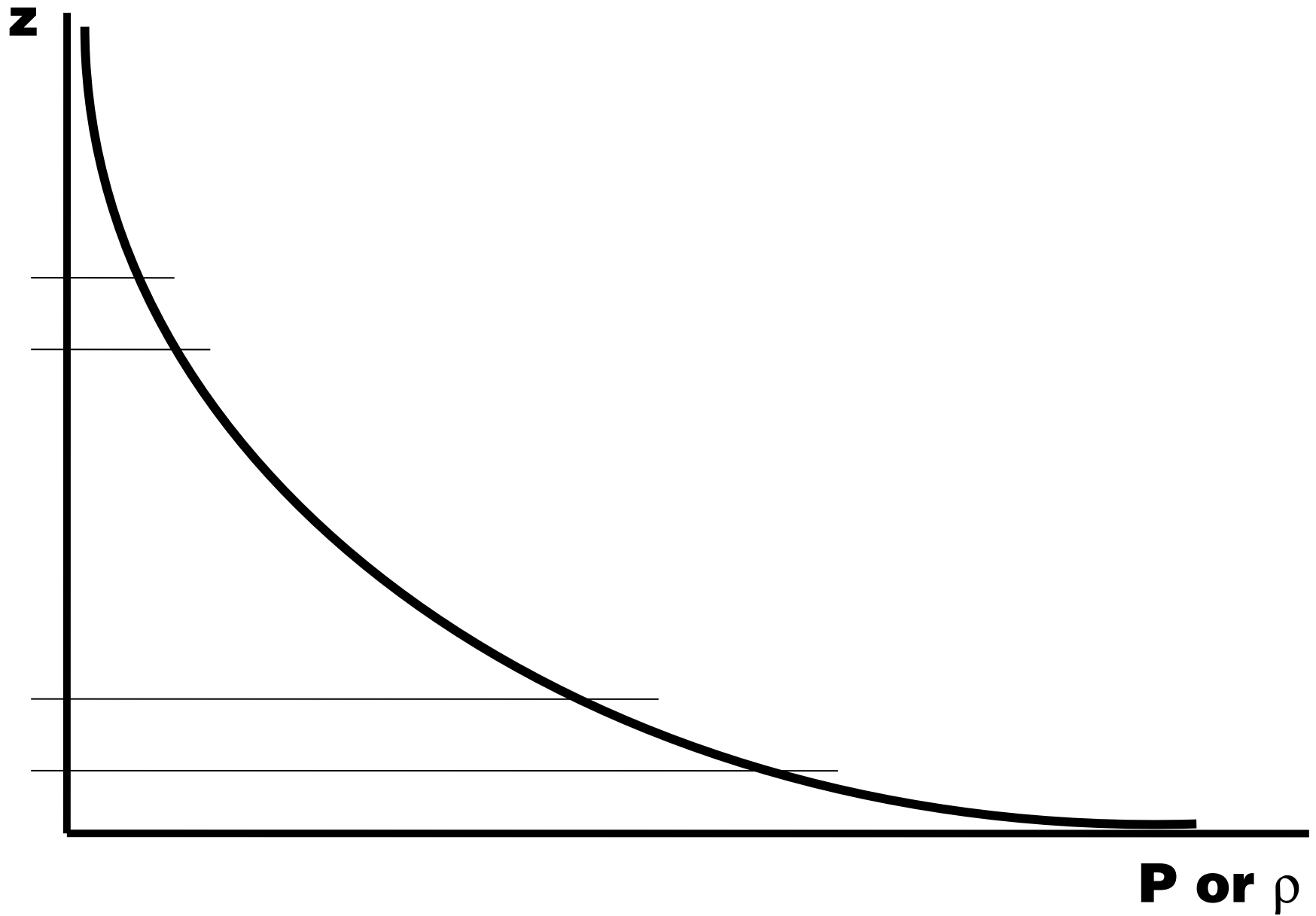
# Pressure = Force per Unit Area

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

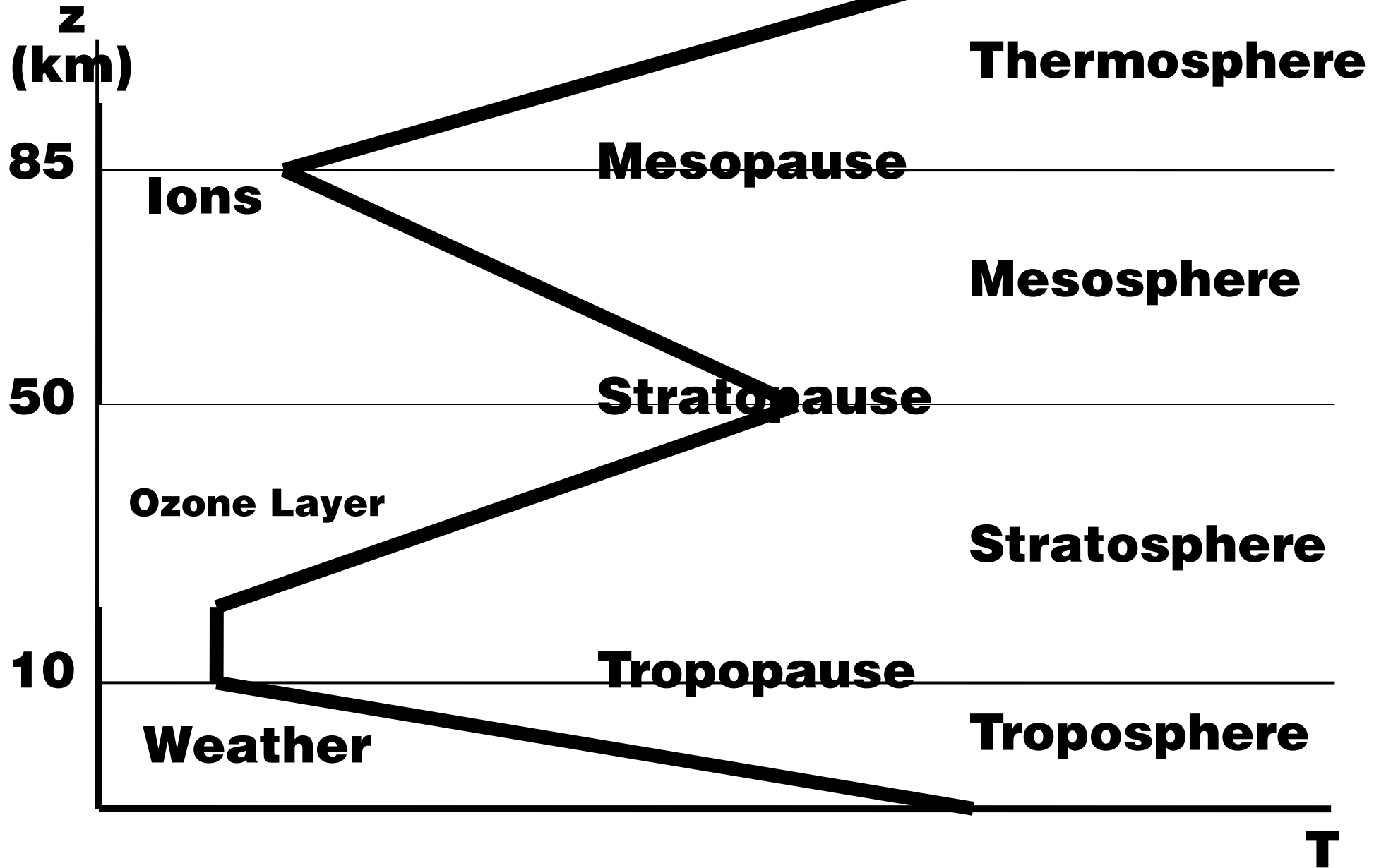
**Force (F)**



# P vs. z



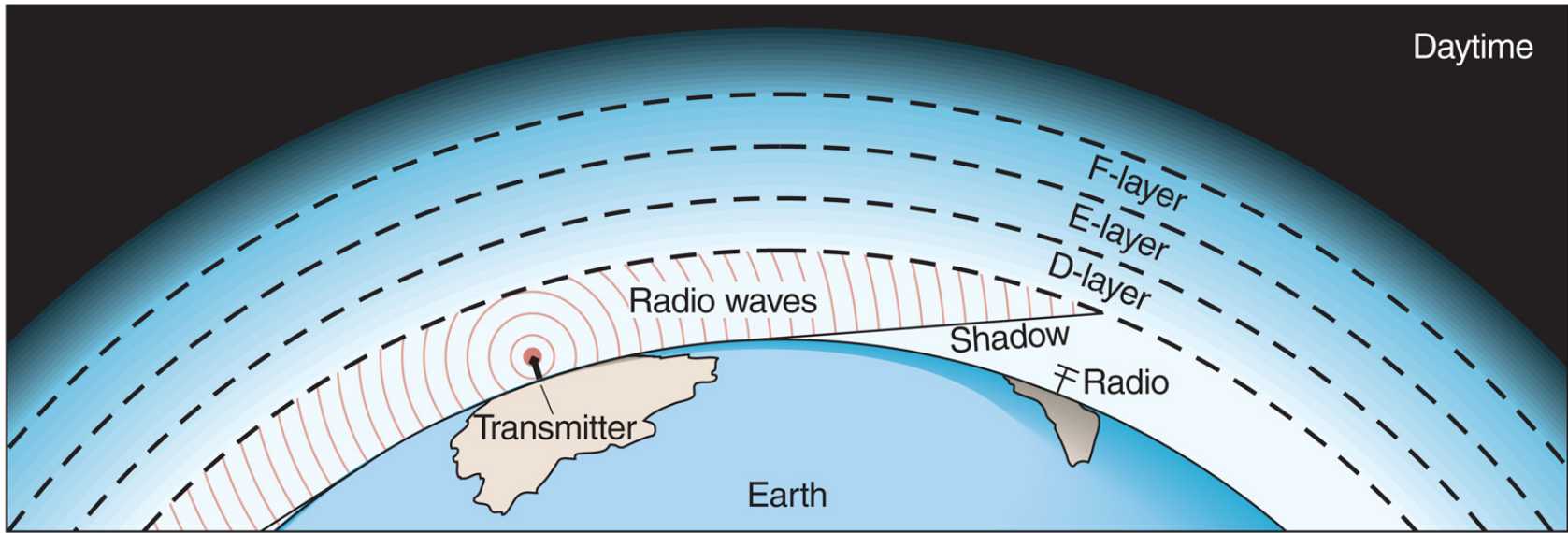
# Vertical Temperature Profile



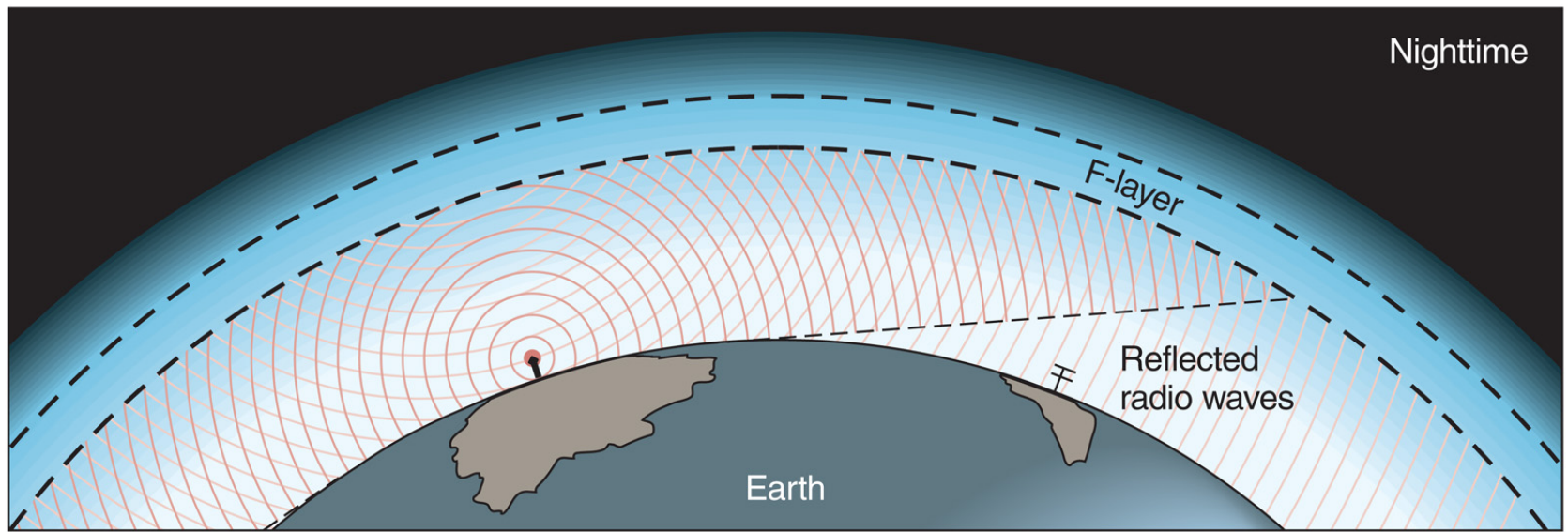


# **Ionosphere**

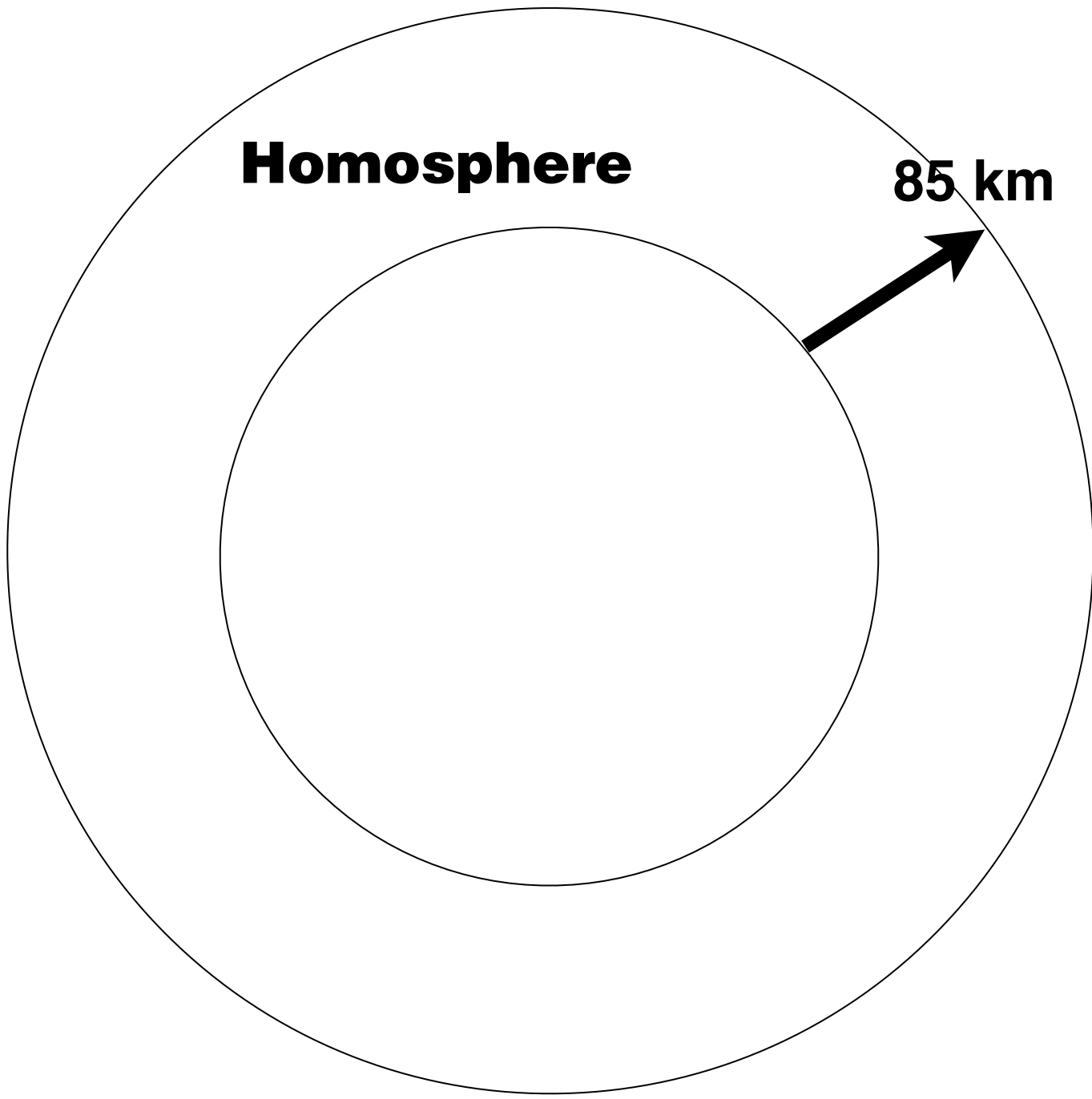
- **Outer layers of atmosphere exposed to strong sunlight**
  - **Produces electrically charged ions**



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**Homosphere**

**85 km**

**Heterosphere**

# **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**

- **Green “Plants”**: 2.5 BYA

- **Green Plant Photosynthesis released molecular oxygen into the environment**

- **Present Atmosphere**

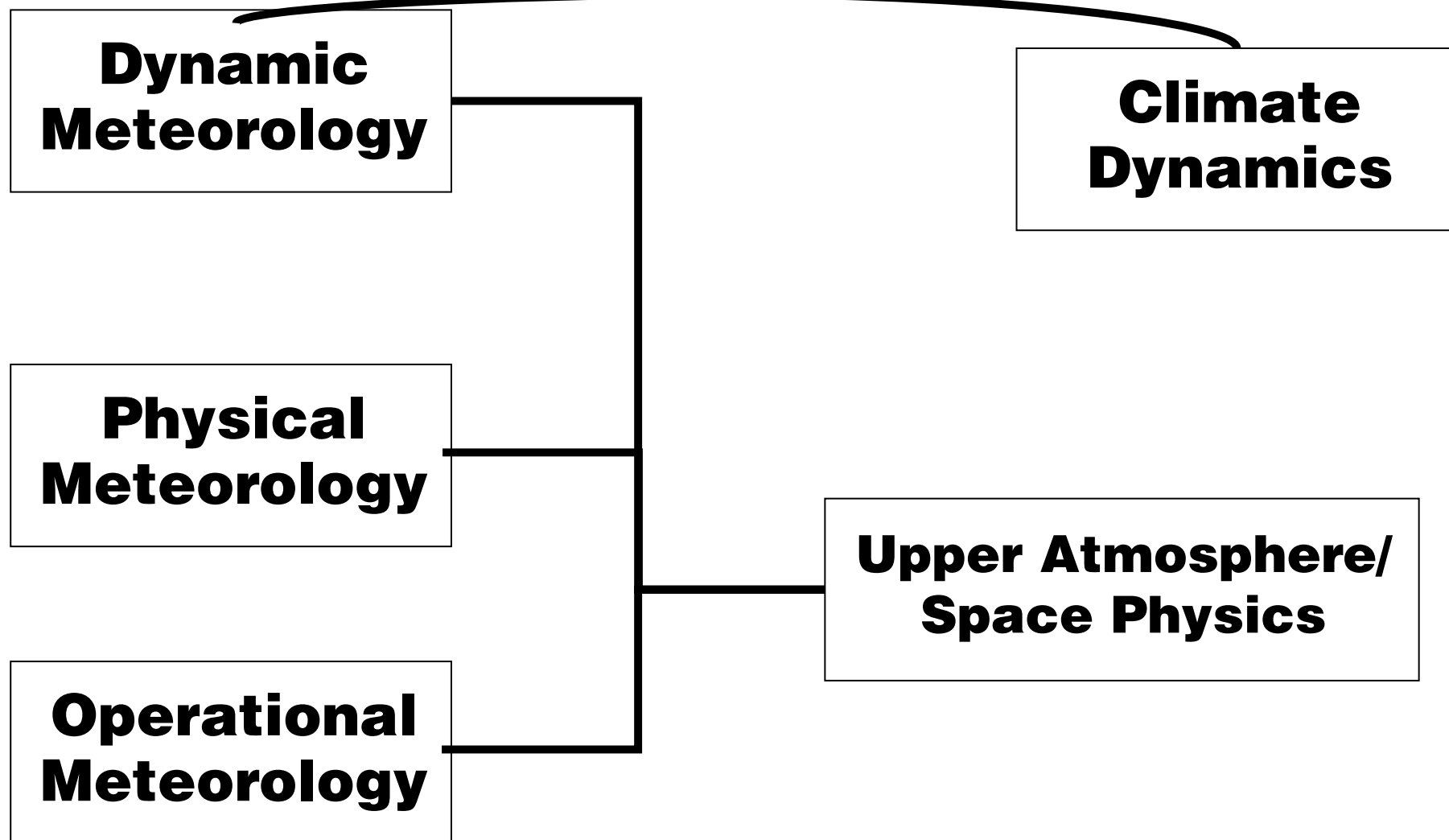
- **Lifeforms and atmosphere co-evolved to form “Class-M” environment: nitrogen/oxygen**



**Cyanobacteria**

# Meteorology

Things in air



# 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

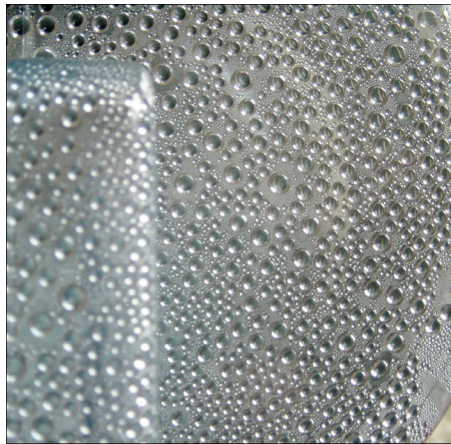
**Temperature**



**Pressure**



**Humidity**



**Wind**



**Clouds**

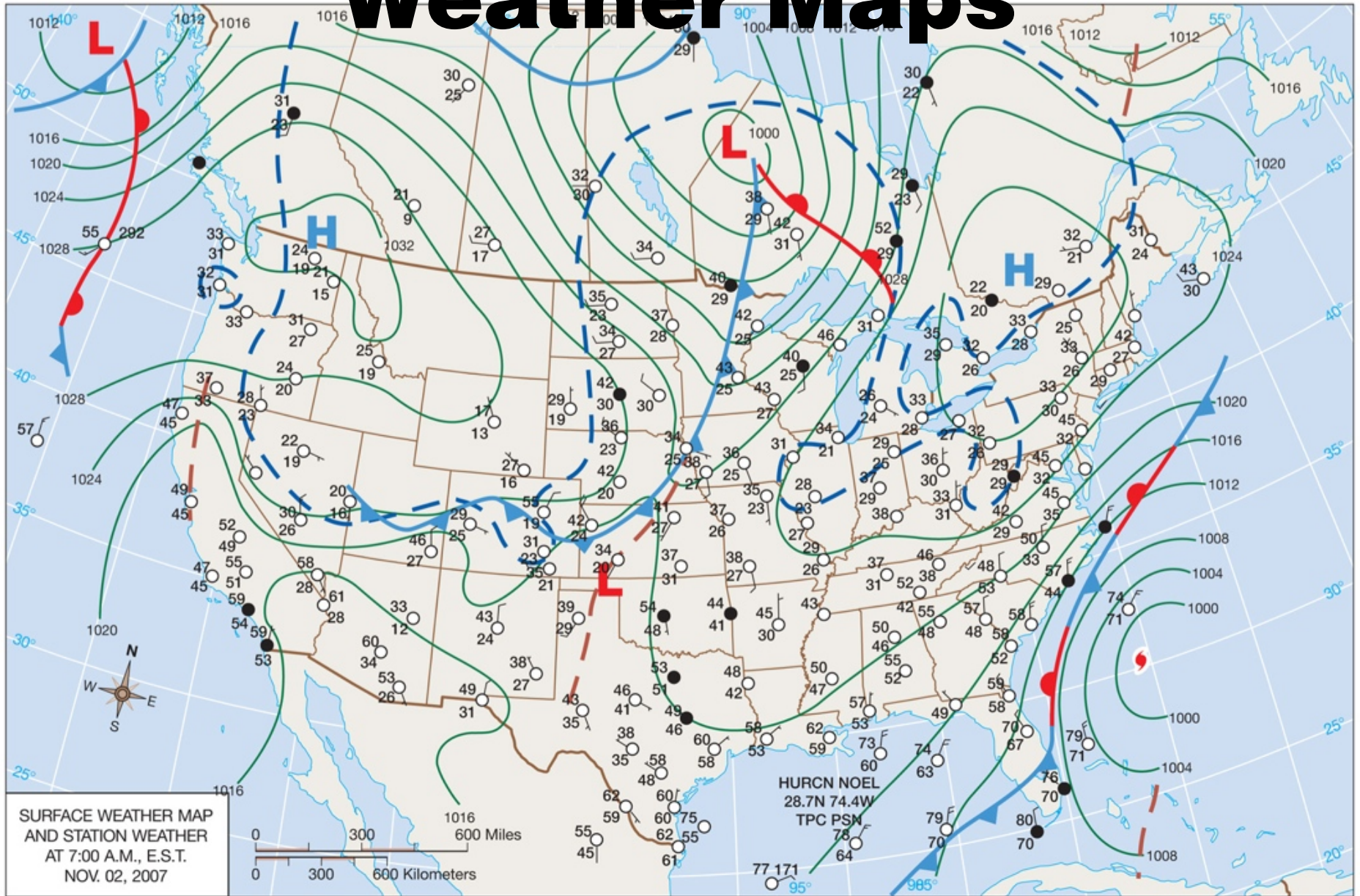


**Precipitation**





# Weather Maps

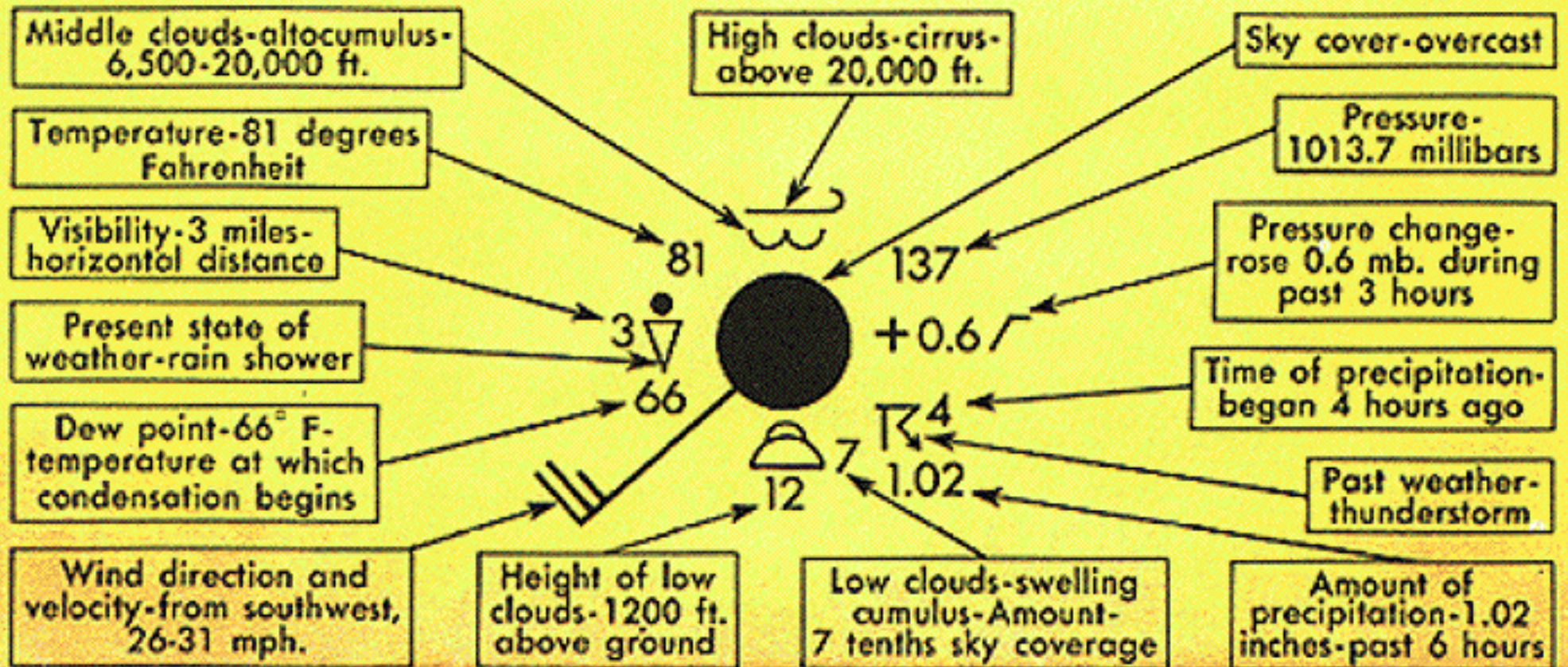


(a)

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# STATION MODEL

Arrangement of information around station circle on weather map



# Historical Highlights

**Babylonians, Chinese: Astrometeorology**

**34 BC: Aristotle, Father of Meteorology**



**Bacon/Descartes—Scientific Method**

**Instrumentation**

**Telegraph**

**Computers, satellites**

**21st c.: Modern Meteorology**