

# Climate Dynamics (PCC 587): Atmospheric Structure



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## Readings



- Hartmann Chapter 1
- Elliott & Frierson, “Atmospheric Structure,” from **The Encyclopedia of Weather and Climate, 2<sup>nd</sup> Edition**
  - Available on class website
- For next lecture (radiation), please read:
  - Hartmann Chapter 2
  - Hartmann Chapter 3 is optional (pretty high level stuff)

## Atmospheric Structure

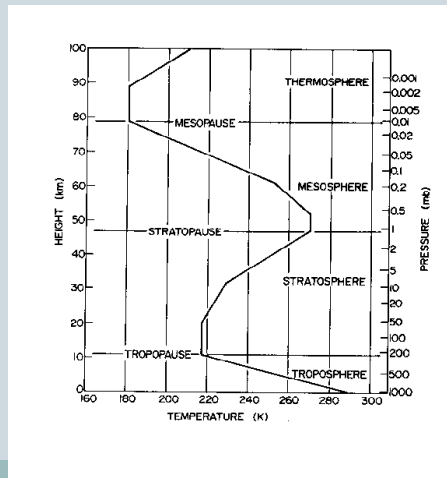
- **Atmospheric composition**
- **Vertical distribution of:**
  - Temperature
  - Pressure
  - Density

## Composition

- **Air is:**
  - 78% Nitrogen
  - 21% Oxygen
  - 1% Argon
  - These 3 are well-mixed (same ratio) in all but the very highest levels in the atmosphere
  - Make up over 99.5% of air
- **Gases important for radiation are small fraction of atmospheric mass:**
  - 0.3% Water vapor (highly variable in concentration though)
  - 0.00005% Carbon dioxide (380 parts per million by volume)
  - 0.00006% Ozone (mostly in stratosphere)

## Layers of the Atmosphere

- We'll focus on troposphere and stratosphere

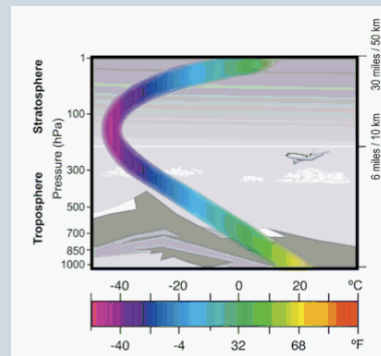


“Tropo” = turning over  
 “Strato” = stratified

Mesosphere, thermosphere, & exosphere have little connection to climate, and won't be discussed here

## Tropospheric temperatures

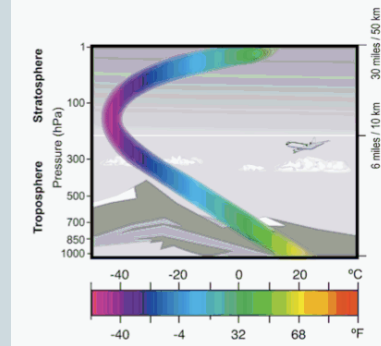
- First, why does temperature decrease in the troposphere?
- Hot air rises, right?  
Shouldn't it be warmer up there?
- Is this situation convectively unstable?



## Tropospheric temperatures

- No, because pressure is less up there
- Air has been decompressed, which causes cooling

Way to tell whether there's convective instability:  
Bring air from different levels to the same pressure, and see which is more dense

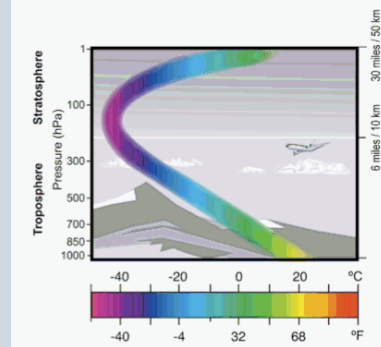


## Tropospheric temperatures

- This means stratosphere must be really stable:
  - If you pull air up, it gets colder due to decompression
  - It's then much colder than the surroundings, and will sink

*Stratosphere*: where it's strongly stratified

Vertical motion is strongly inhibited



## Stratospheric temperatures

- **Stratospheric ozone layer absorbs 93-99% of UV radiation**
  - This heating causes the high temperature at the top of the stratosphere
- **Stratosphere discovered in 1900 by Teisserenc de Bort**
- **Ozone layer discovered in 1913 by Fabry and Buisson**
- **Ironically, CFCs were first produced in the early 1890s**