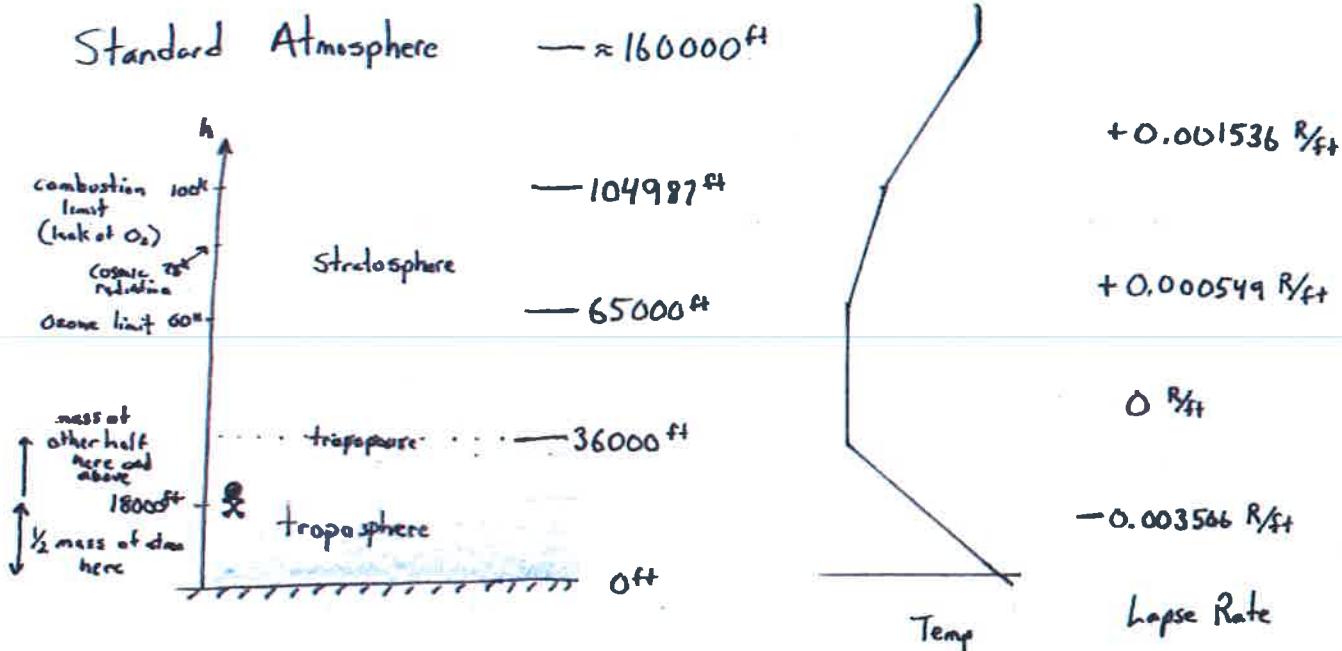


# Standard Atmosphere



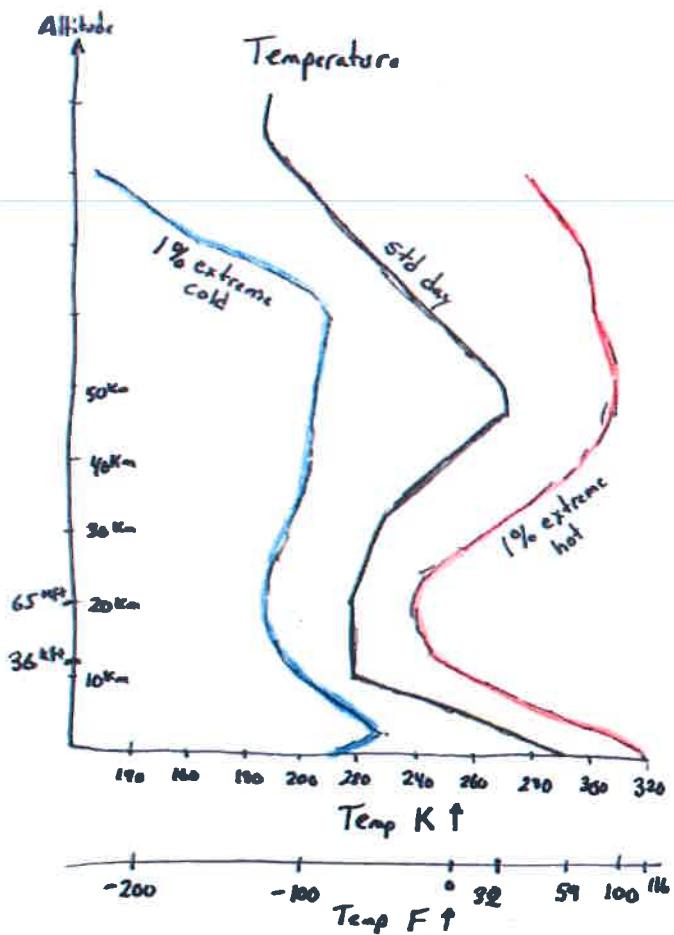
We are lucky to live at the bottom of an ocean of protective air.

- Death zone for humans begins around  $20 \text{ kft}$  or so...
- Half the mass of air is below  $18 \text{ kft}$
- Ozone above  $60 \text{ kft}$  prevents use of outside air for humans.
- Cosmic radiation becomes significant around  $75 \text{ kft}$ .
- Normal jet combustion fails around  $100 \text{ kft}$ . (Not enough O<sub>2</sub>)
- The positive lapse rate around  $65 \text{ kft}$  makes the atmosphere stable. Convection is minimal.

Non-dimensional P, T,  $\rho$  ratios

$$\delta = \frac{P}{P_{\text{sea}}} \quad \theta = \frac{T}{T_{\text{sea}}} \quad \sigma = \frac{\rho}{\rho_{\text{sea}}} = \frac{\delta}{\theta}$$

The atmosphere is not, has not, and never will be standard.



See:

U.S. Standard Atmosphere 1976  
(NASA-TM-X-74335)  
for details (241 pages!)

# Non Std Atmosphere Models. (MIL-STD-210A)

<u>Std</u>	<u>h [ft]</u>	$\lambda [R_A]$
0	-0.003566	
36089	0	
65617	+0.000549	
104987	+0.001536	
154199	0	
		$T_0 = 59^{\circ}\text{F}$
		$T_0 = 59^{\circ}\text{F}$

<u>Hot</u>	<u>h [ft]</u>	$\lambda [R_A]$
0	-0.003840	
39370	+0.000439	
67257	+0.000768	

<u>Tropic</u>	<u>h [ft]</u>	$\lambda [R_A]$
0	-0.003840	
52493	+0.002085	
68898	+0.001361	

$$T_0 = 103.28^{\circ}\text{F}$$

$$T_0 = 90.086^{\circ}\text{F}$$

## Cold

0	+0.013716
3281	0
9843	-0.003292
31168	0
42651	+0.004872
50853	0
60696	+0.002524
73819	-0.000425

$$T_0 = -59^{\circ}\text{F}$$

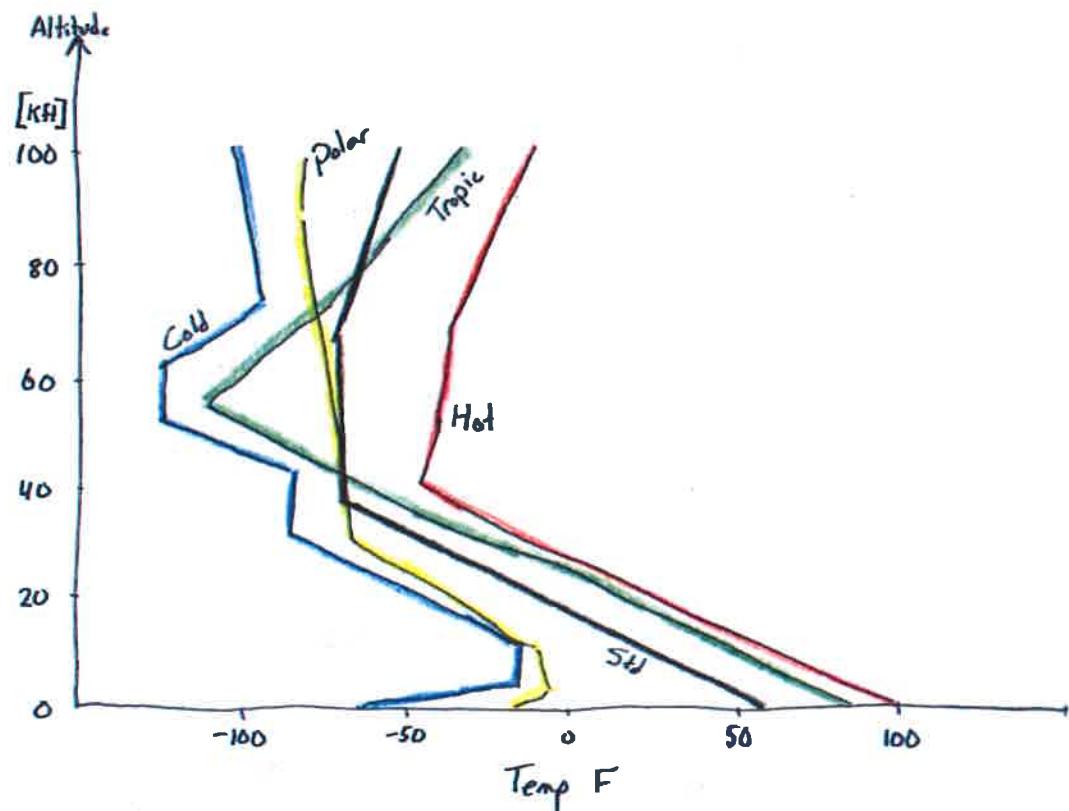
## Polar (Warning: reverse engineered from data!)

0	0.003
3281	-0.00055
9843	-0.0028
31168	-0.0003
88000	0

$$T_0 = -15.67^{\circ}\text{F}$$

## ISA + X

Add X to temp at std day



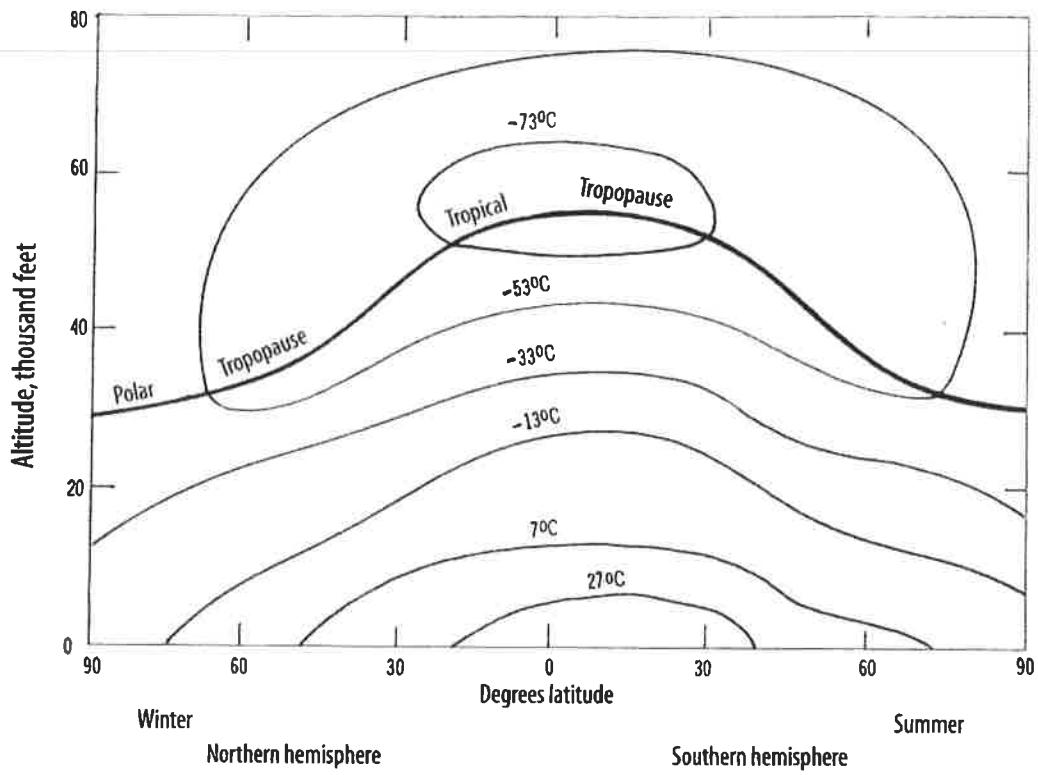


Fig. 1.1 Typical variation in atmospheric temperature along a meridian of longitude, summer in the Southern Hemisphere.

Source: TA of the Airplane, Stinton

Fact: Cold temperature testing of a/c is often done at high altitudes in the tropics!

Why? We need to know some meteorology.

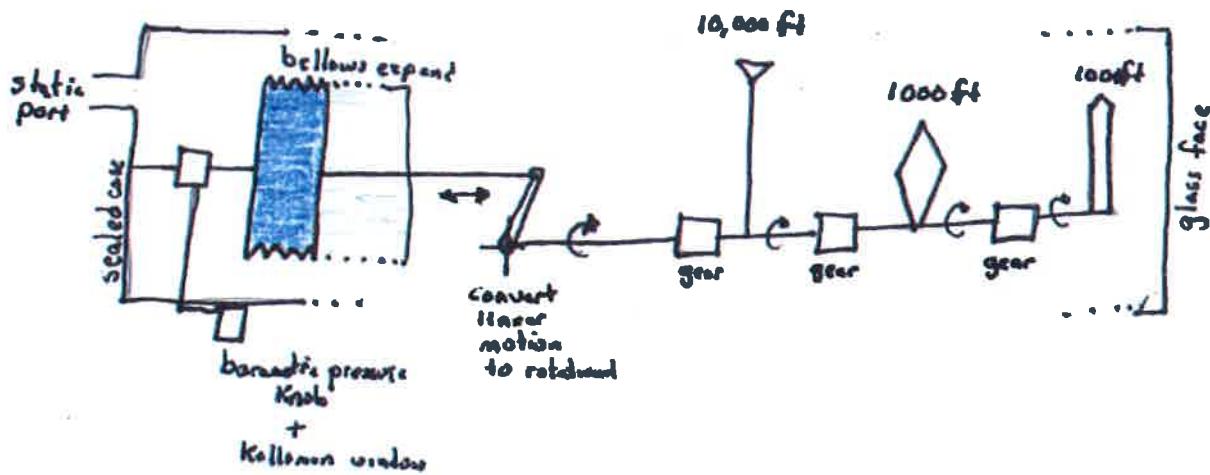
# Altimeter (pressure type)

A sensor used to measure altitude. Uses local static pressure



Reading 13700 ft

Inside (cartoon, not to scale)



Calibrated to SSL and Standard Atmosphere.

- Given a standard day, the altimeter reads a geometric altitude
- Given a non standard day, the altimeter reads pressure altitude (if 29.92 inHg)
- The knob corrects for local pressure differences such that the altimeter reads the airport's elevation. Obviously, a non standard pressure profile combined with airport approach and departures makes knowing the correct Kollsman window setting critical. "Altimeter setting, two nine eight two"

Flight Level (FL):

When set to 29.92 inHg, the altimeter's reading is a convenient reference for high altitude aircraft. Read as hundreds of feet. FL350 = 35000 ft

Q: Why not low altitude?

Q: Why is a reference needed?