Web page: http://geophysics.tau.ac.il/personal/nili/MAD/MAD-course.htm

References:

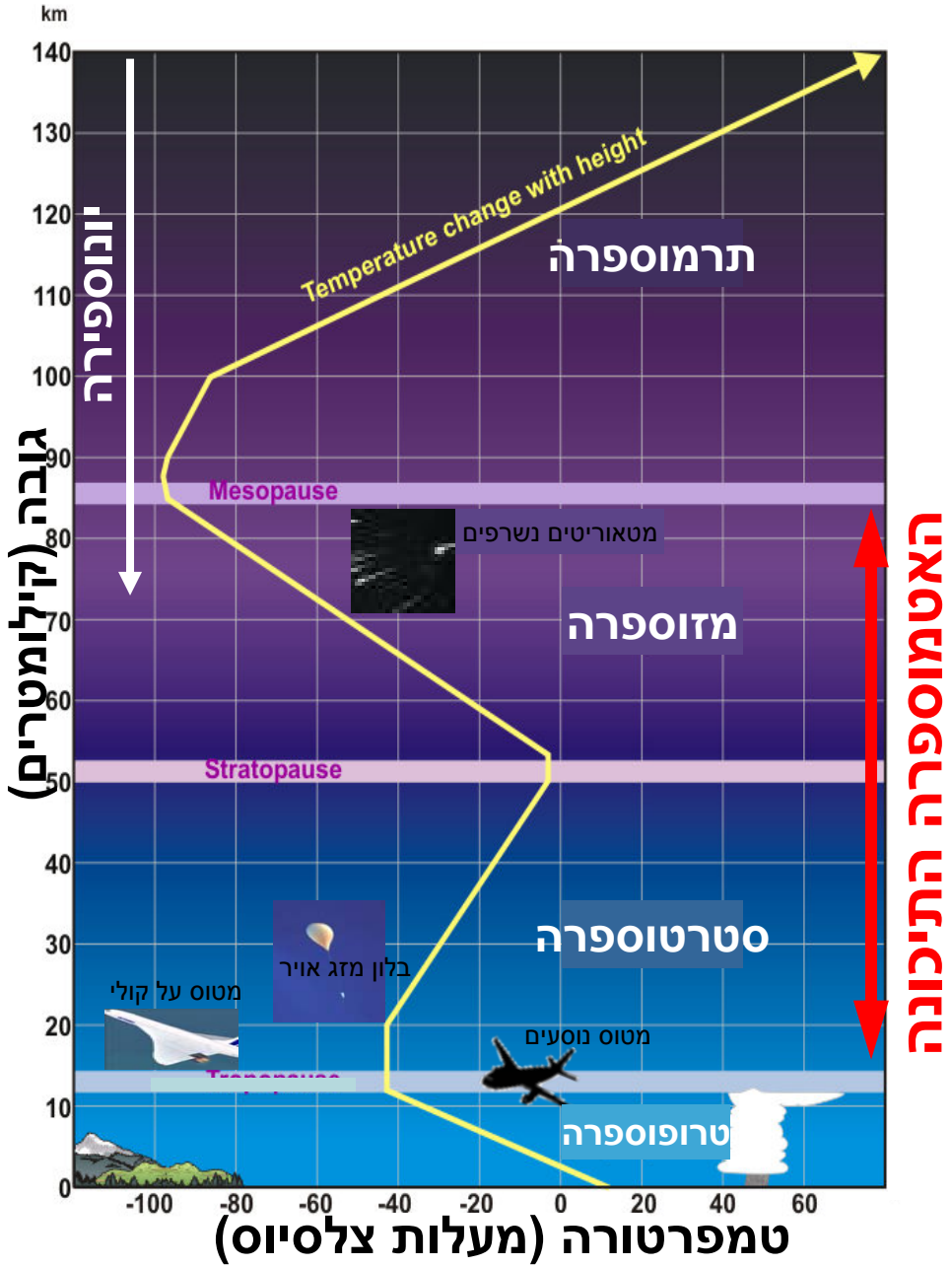
- Andrews, Holton, Leovy (1987) “Middle atmosphere dynamics”, Academic Press.

- Holton, (1992, 2004) “An introduction to dynamic meteorology.” Elsevier, Academic Press. Chapter on the middle atmosphere (12).

- Geoffrey Vallis (2006) “Atmospheric and Oceanic Fluid Dynamics.” Cambridge press. Chapter 13 on planetary waves and the stratosphere. The chapter relies on theory developed in earlier parts of the book (I, II).

מבנה האטמוספרה

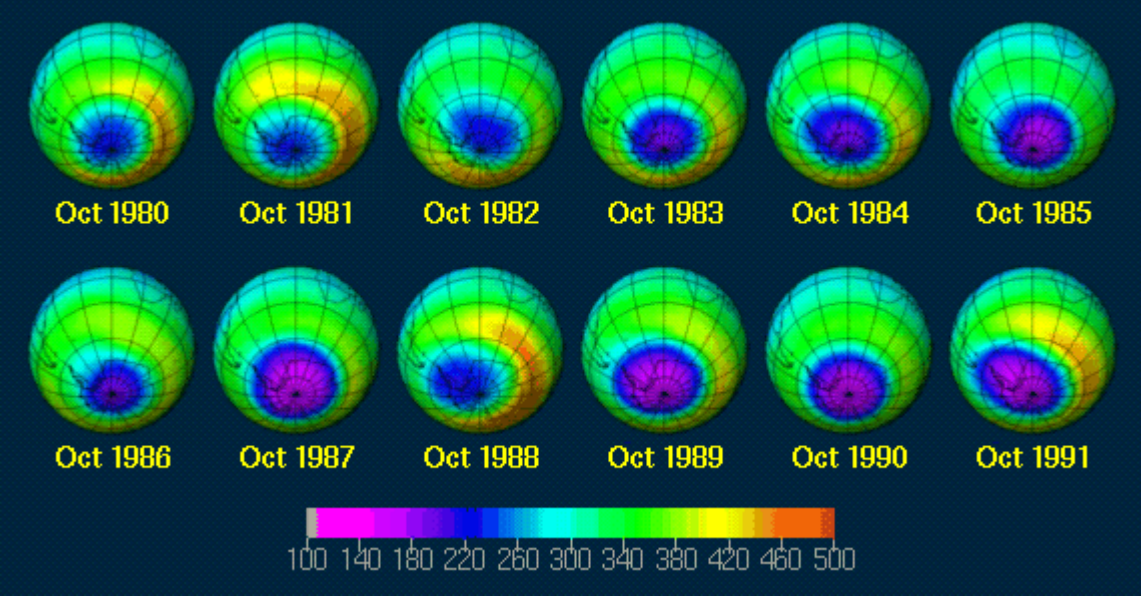
השכבות באטמוספרה מוגדרות לפי מבנה הטמפרטורה עם הגובה

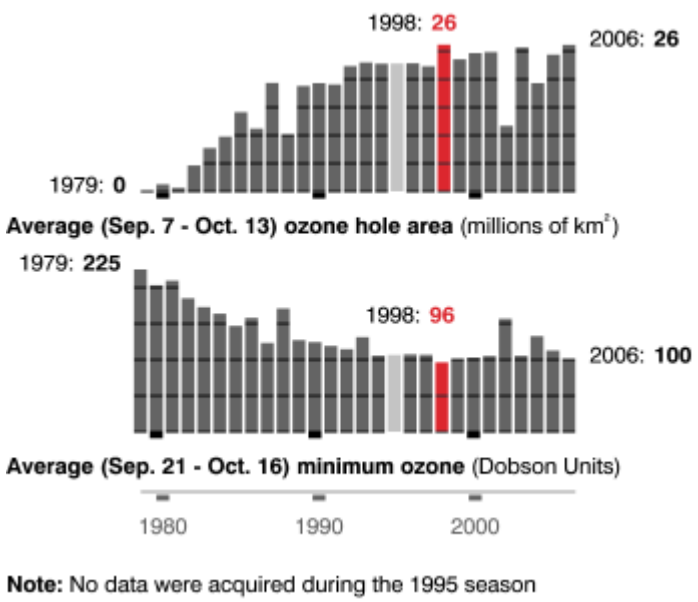


מזוספרה- השכבה בין 50-85 ק"מ בה הטמפרטורה שוב קטנה עם הגובה.
מטאוריטים נשרפים כאן

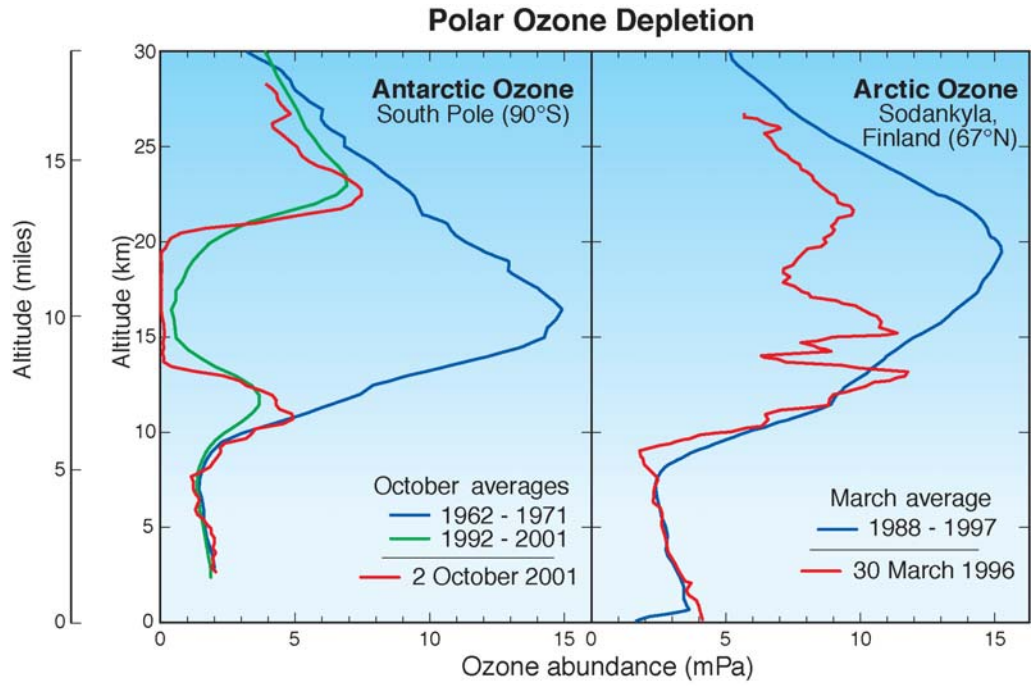
סטרטוספרה- השכבה עד כ- 50 ק"מ
בה הטמפרטורה גדלה עם הגובה.
מטוסי סילון ובלוני מזג אויר טסים כאן

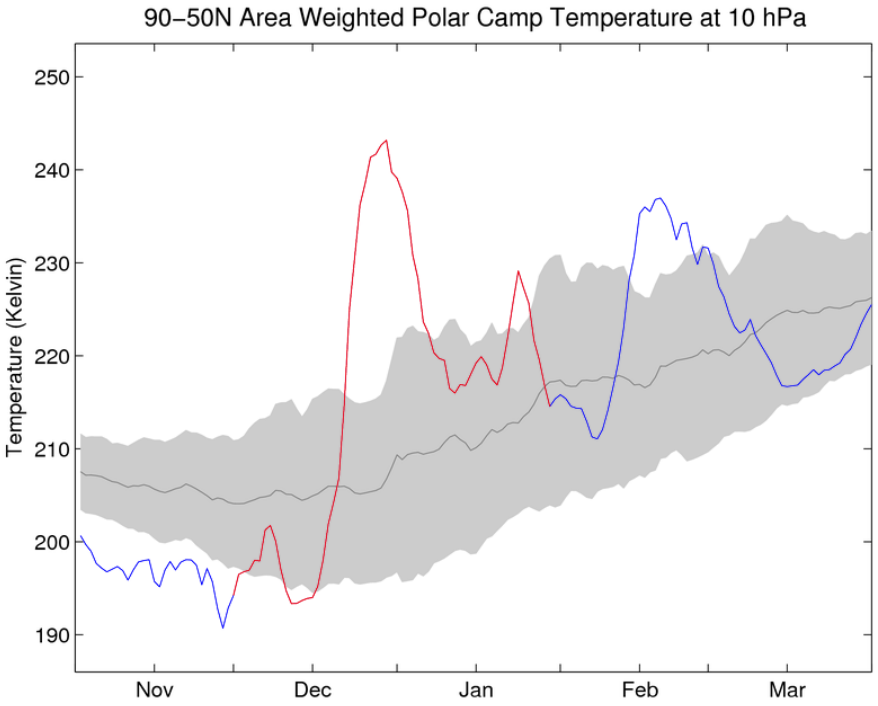
טרופוספרה- עד כ-12 ק"מ. השכבה בה אנו חיים, בה קורות תופעות מזג האויר.
מטוסי נוסעים טסים בגבול העליון שלה.
הטמפרטורה יורדת עם הגובה.



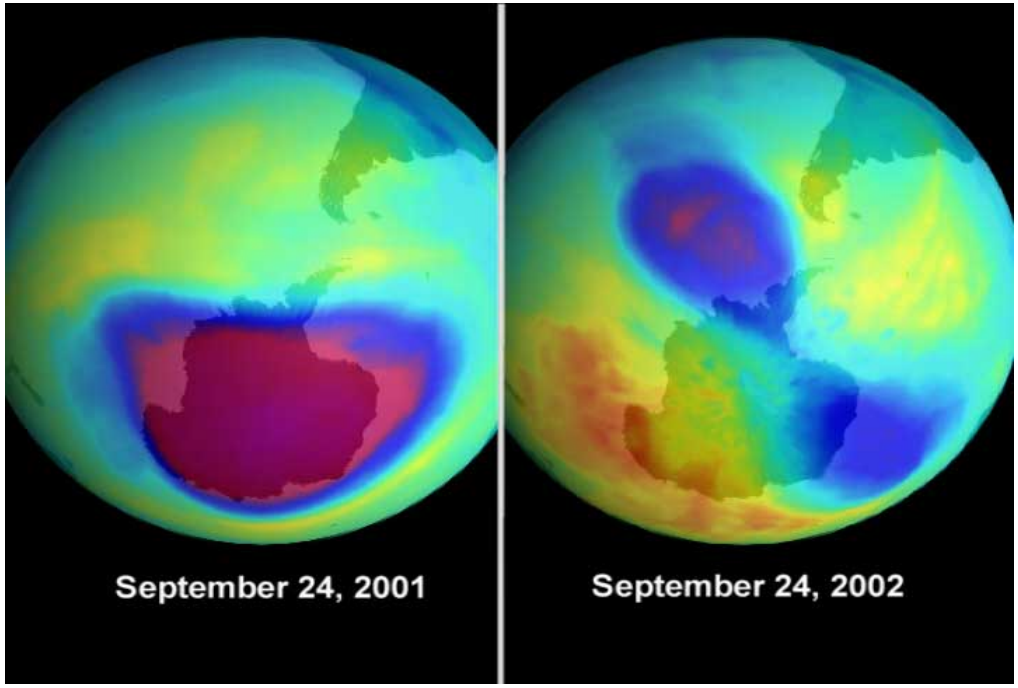


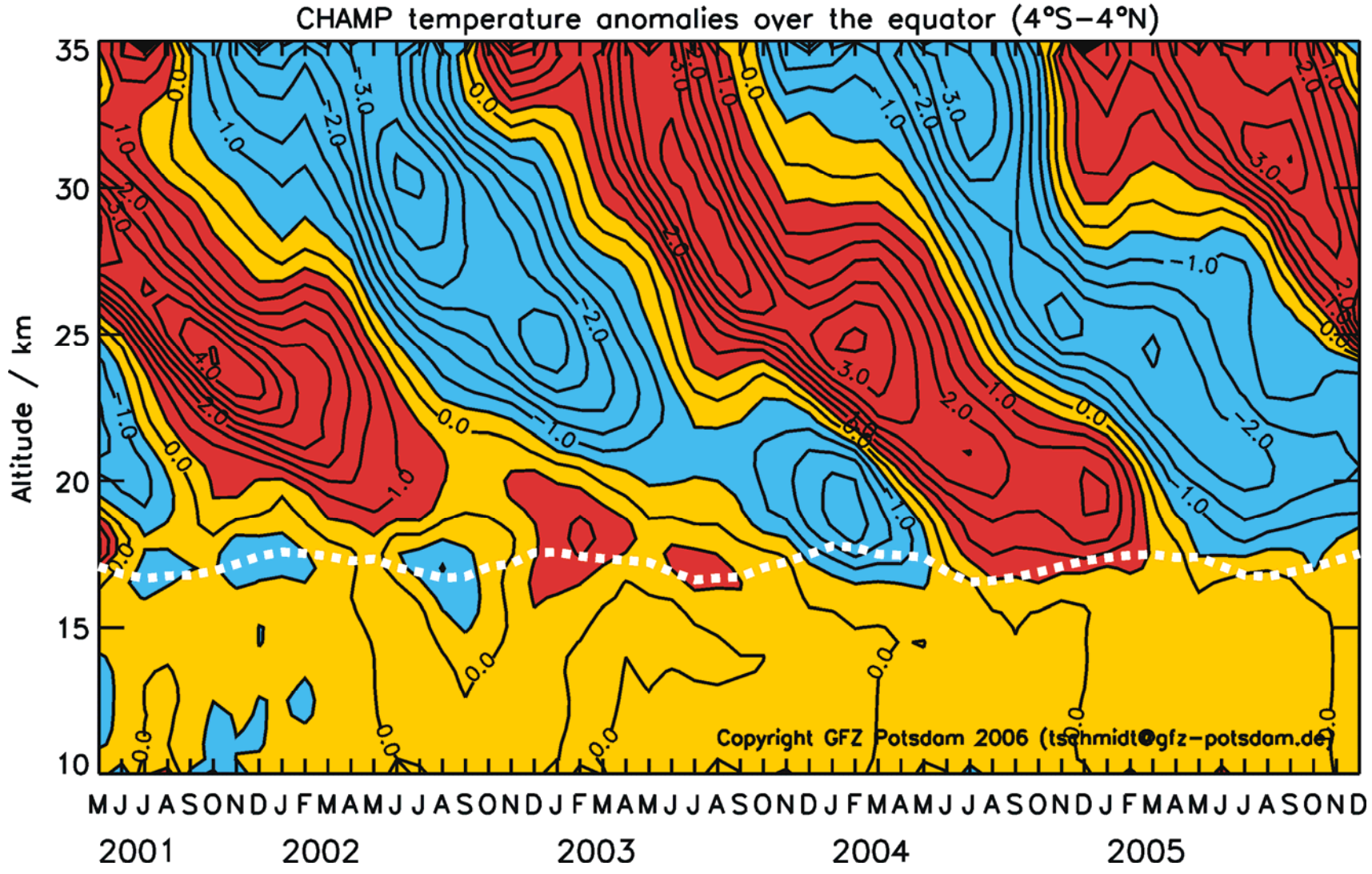
Note: No data were acquired during the 1995 season





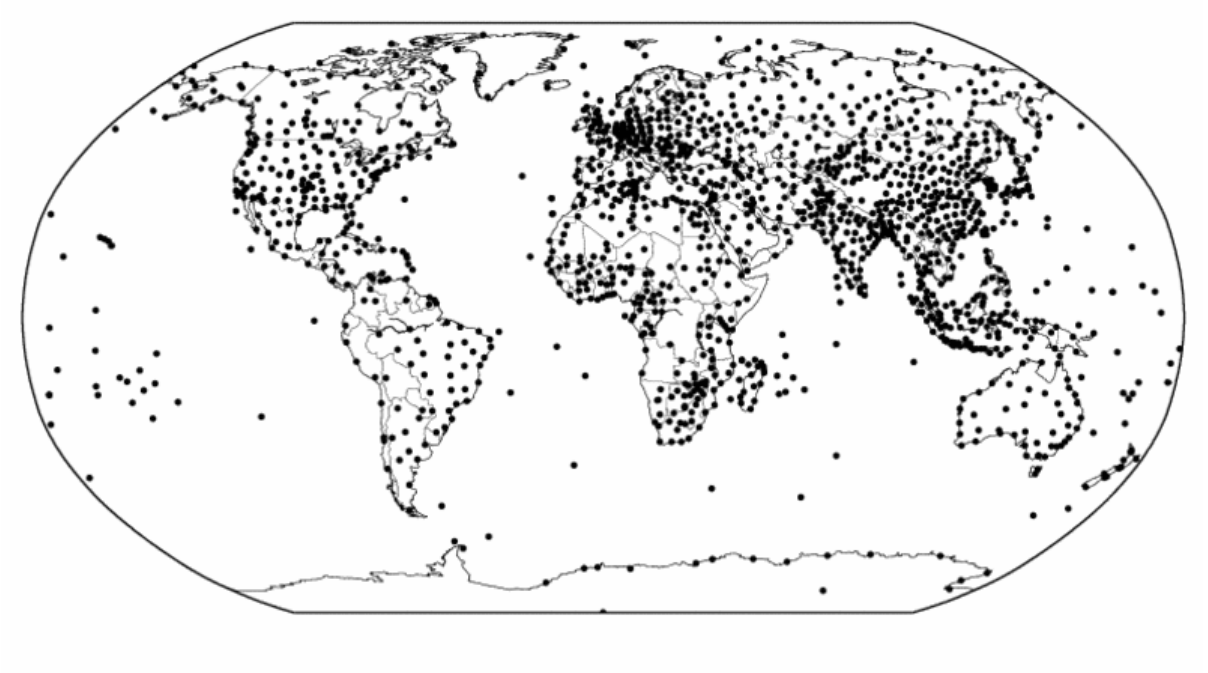
90-50N Area Weighted Polar Cap Temperature for the 17-Feb-2002 event. Shading shows the mean polar cap temperature and the span of plus and minus one standard deviation from this mean obtained by taking the mean and standard deviation of the set of area weighted polar cap temperatures for each of the years from 1958 to 2002. ERA40 data.



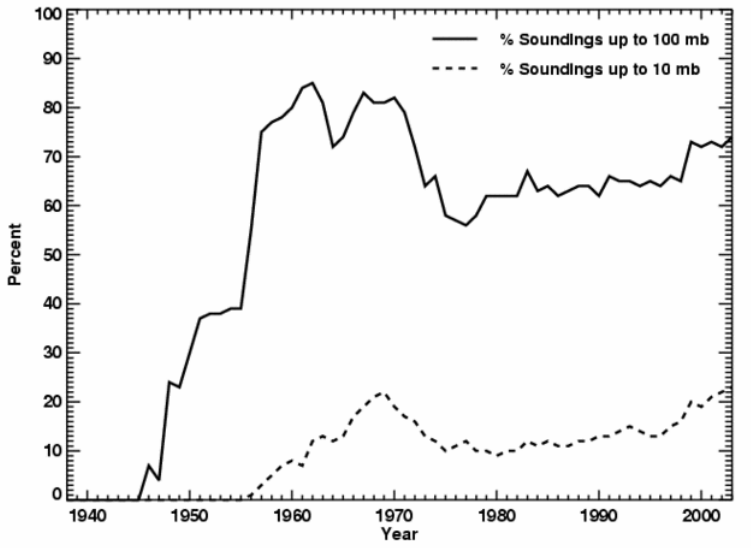

CHAMP temperature anomalies over the equator (4°S–4°N)
Altitude / km
35
30
25
20
15
10
M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
2001
2002
2003
2004
2005
Copyright GFZ Potsdam 2006 (tschmidt@gfz-potsdam.de)

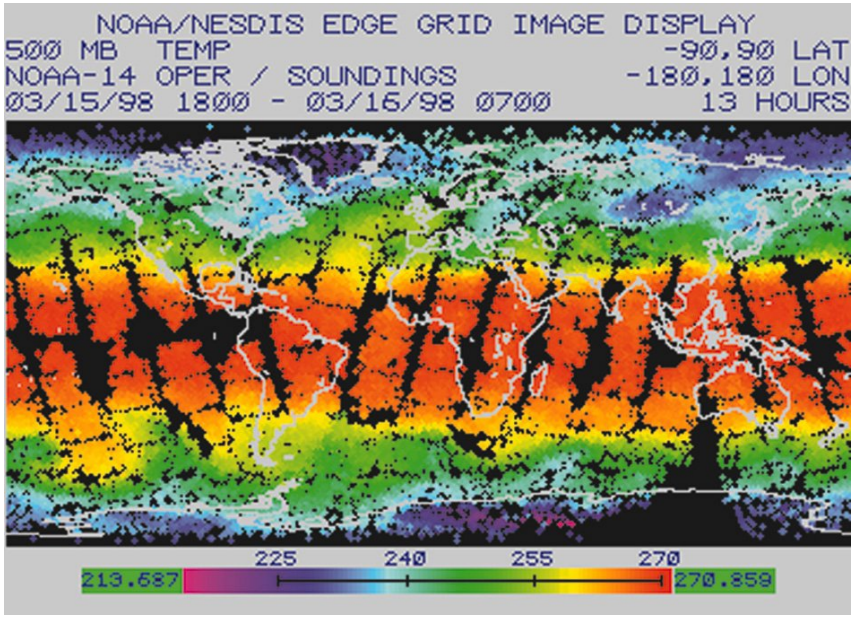
Mesospheric gravity waves seen in airglow

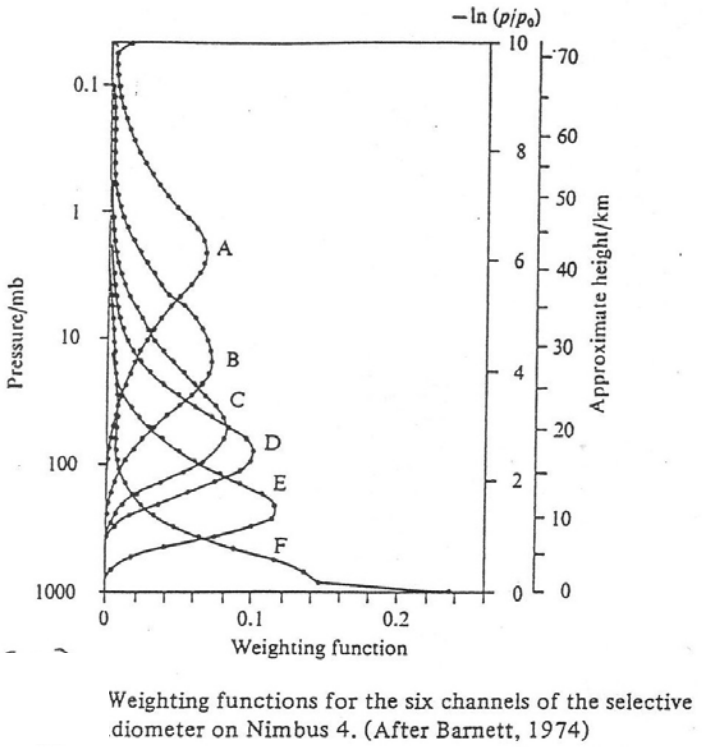
Global radisonde coverage



Middle atmosphere coverage:



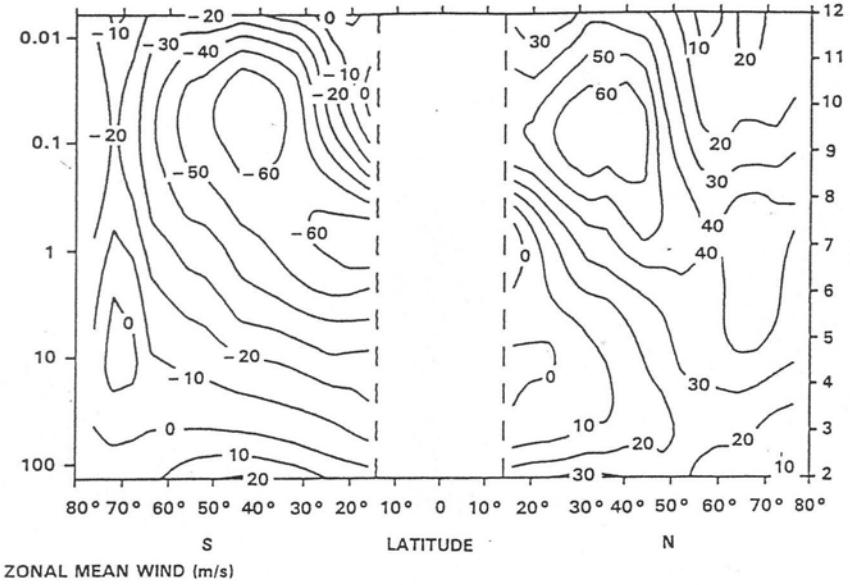


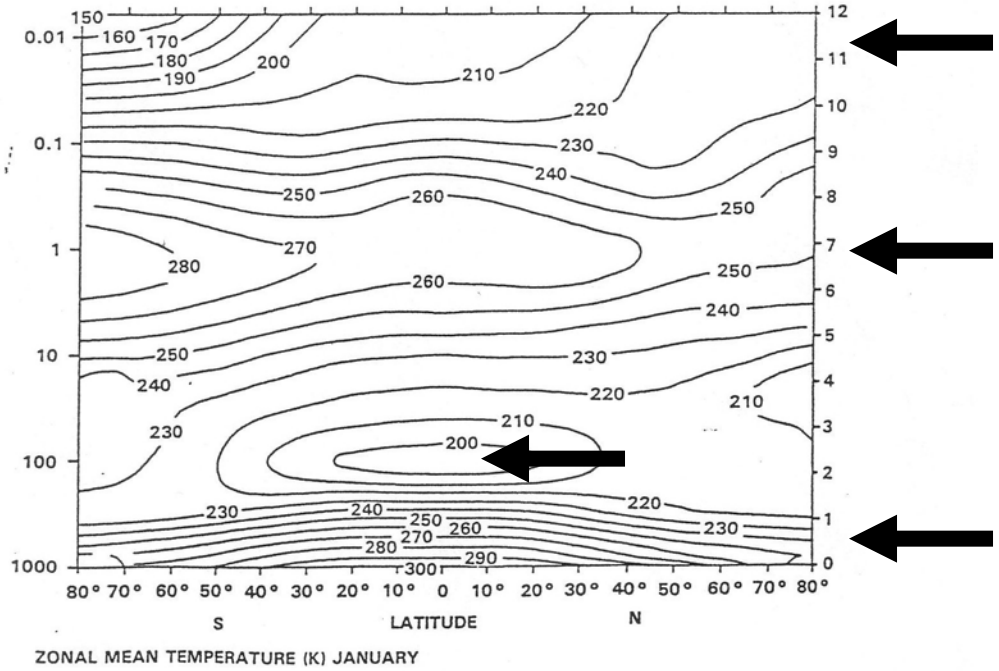


Weighting functions for the six channels of the selective diometer on Nimbus 4. (After Barnett, 1974)

Satellite vertical resolution.
(Houghton, QJRMS 104, 1,1978)

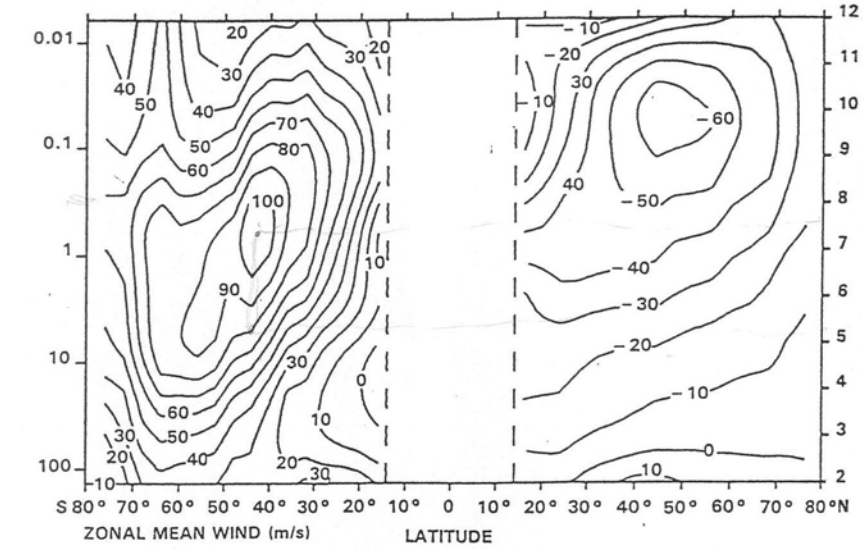
January

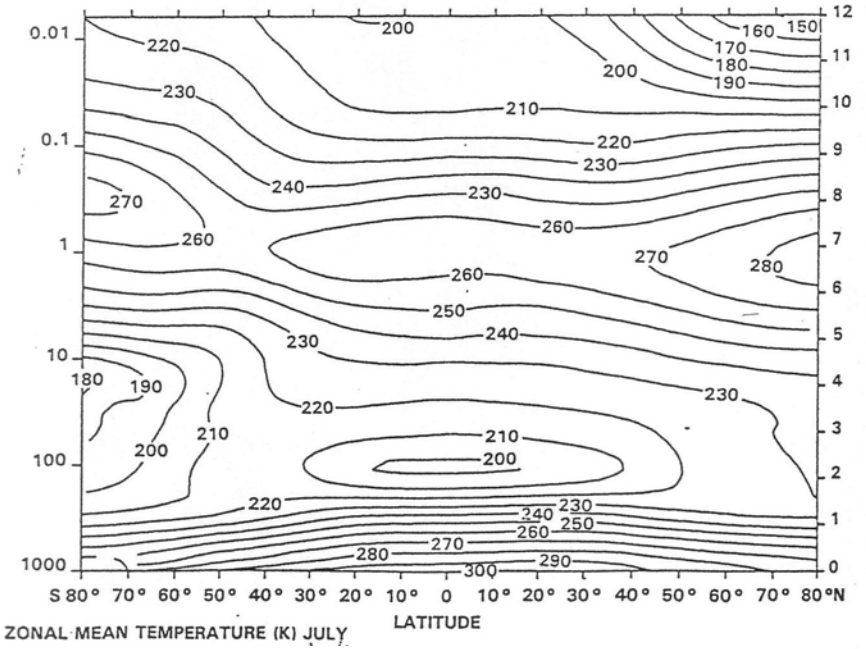


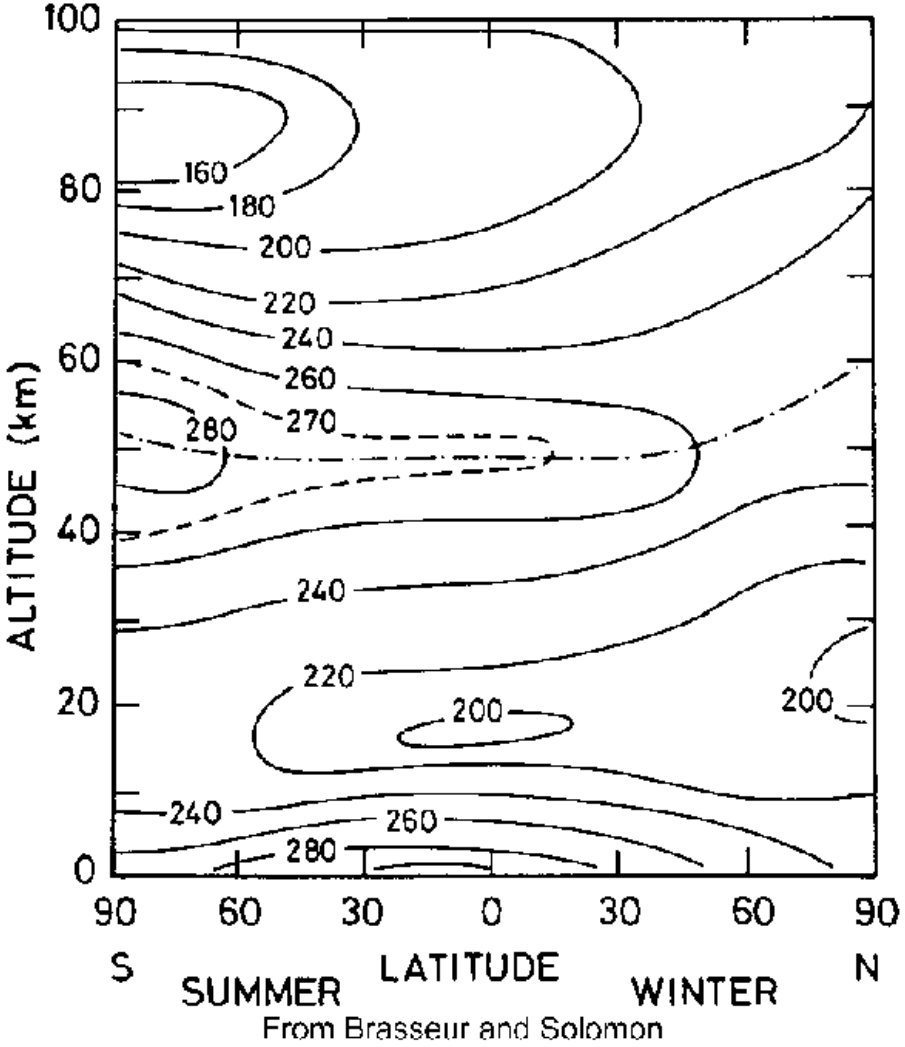


Cross sections [pressure (mbar)-latitude] of zonal mean geostrophic wind (ms^{-1}) and zonal mean temperature (K) for the average over 5 years of the monthly means for January. The data are from the combined SCR/PMR retrieval made at the University of Oxford for the period January 1973 to December 1974 and July 1975 to June 1978. (Supplied by J.J. Barnett and M. Corney).

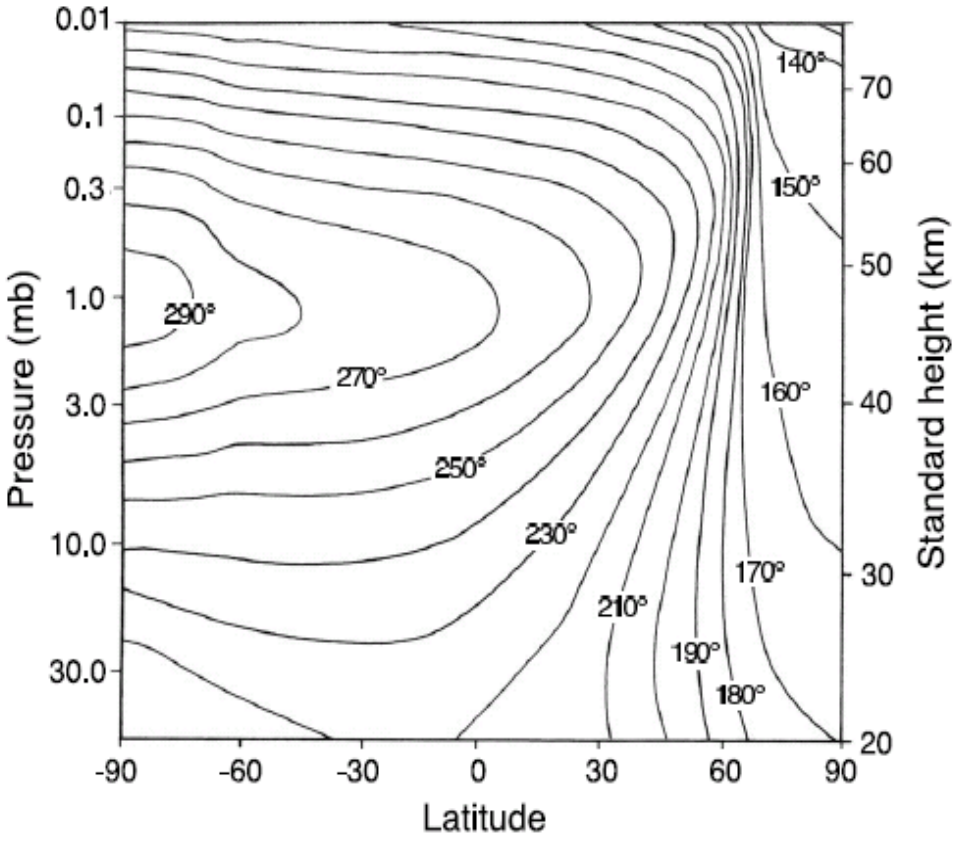
July


0.01
0.1
1
10
100
S 80° 70° 60° 50° 40° 30° 20° 10° 0 10° 20° 30° 40° 50° 60° 70° 80°N
ZONAL MEAN WIND (m/s)
LATITUDE


0.01
0.1
1
10
100
1000
S 80° 70° 60° 50° 40° 30° 20° 10° 0 10° 20° 30° 40° 50° 60° 70° 80°N
ZONAL MEAN TEMPERATURE (K) JULY
LATITUDE



From Brasseur and Solomon

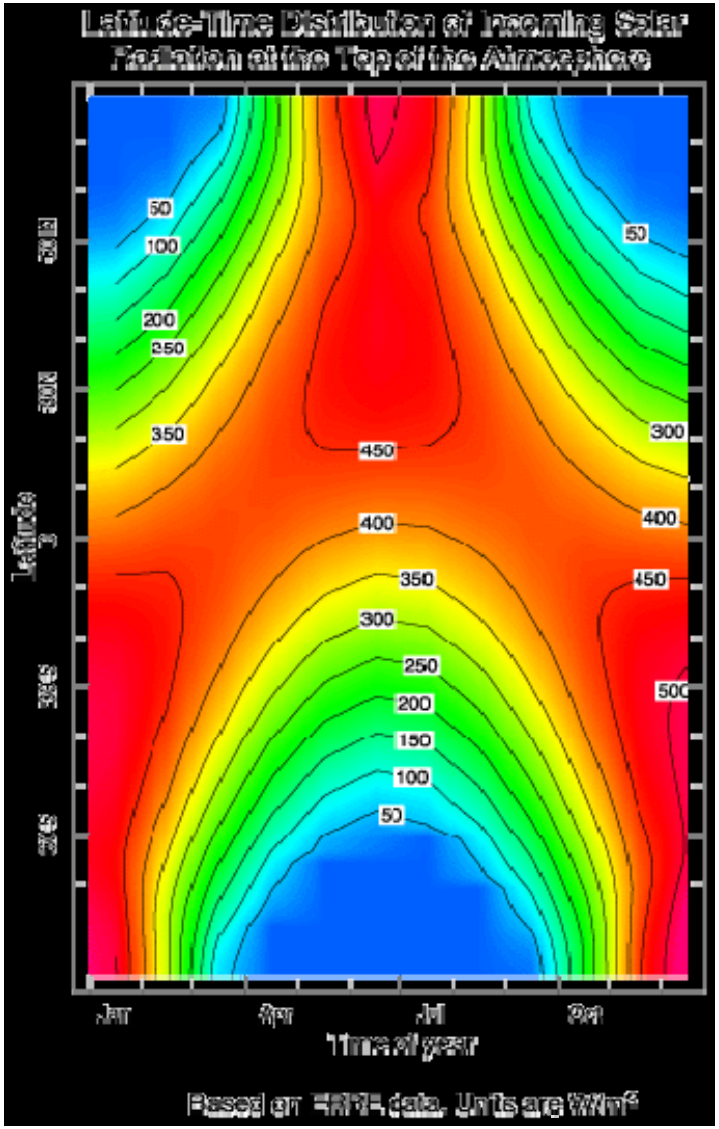


From Vallis (2006)

Adapted from Fels (1985), with the help of K. Hamilton.

Daily incoming solar radiation at the top of the atmosphere (W/m^2)

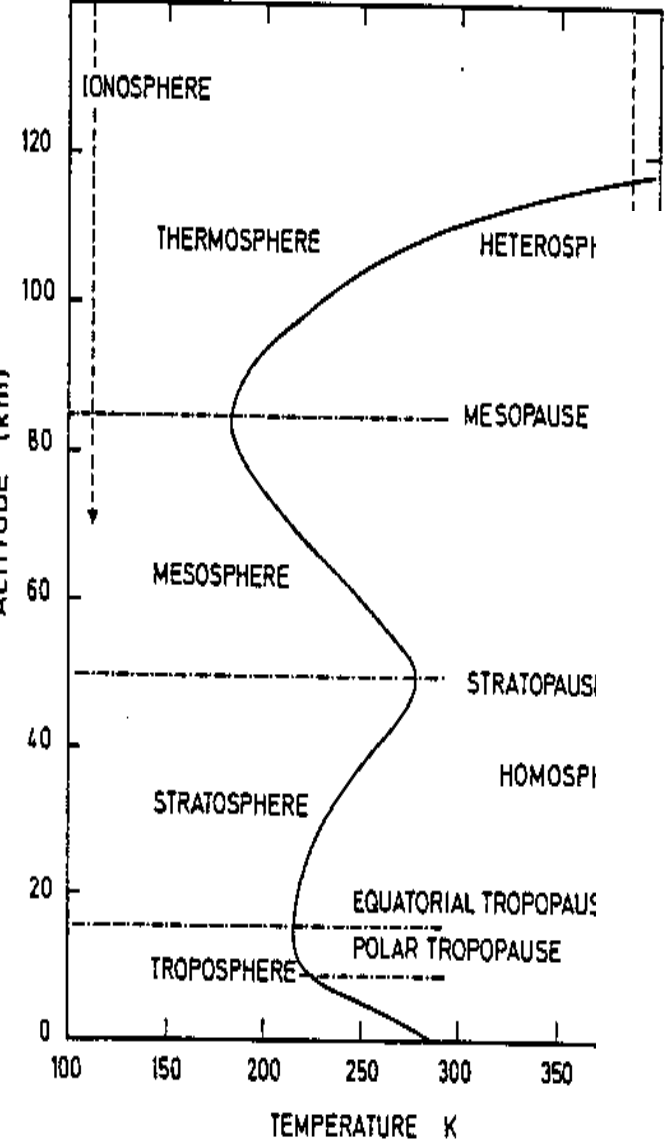
Averaged over a full 24-hour period, the amount of incoming radiation varies with latitude and season. At the poles, during solstice, the earth is either exposed to sunlight over the entire (24-hours) day or is completely hidden from the Sun throughout the entire day. This is why the poles get no incoming radiation during their respective winter or more than the maximum radiation at the equator during their respective summer.



Latitude

Based on ERBE data

Time of year



Mean Atmospheric Temperature Profile
(Adapted From Brasseur and Solomon)

consideration.

LW Cooling **SW Heating**

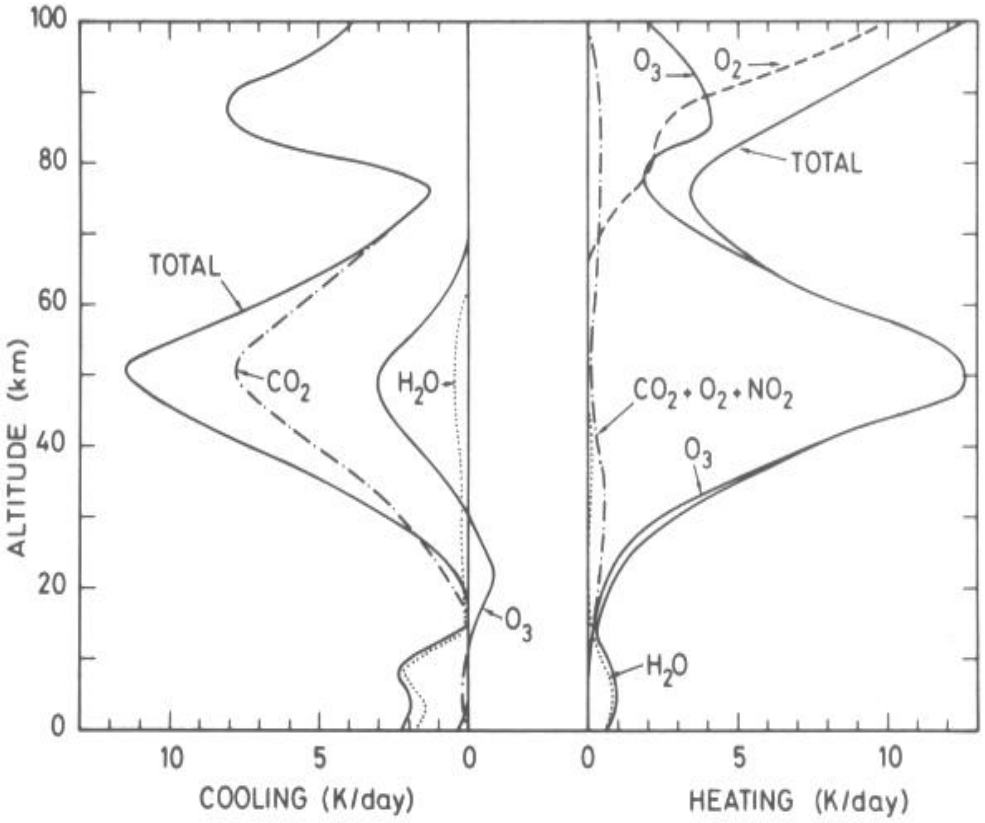
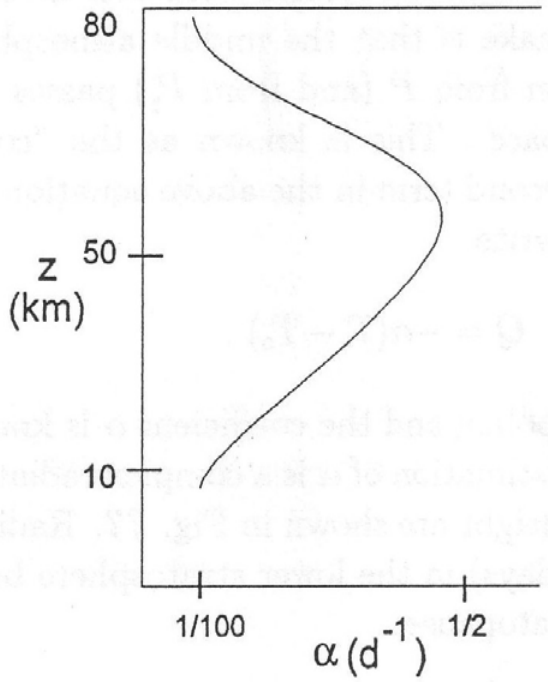
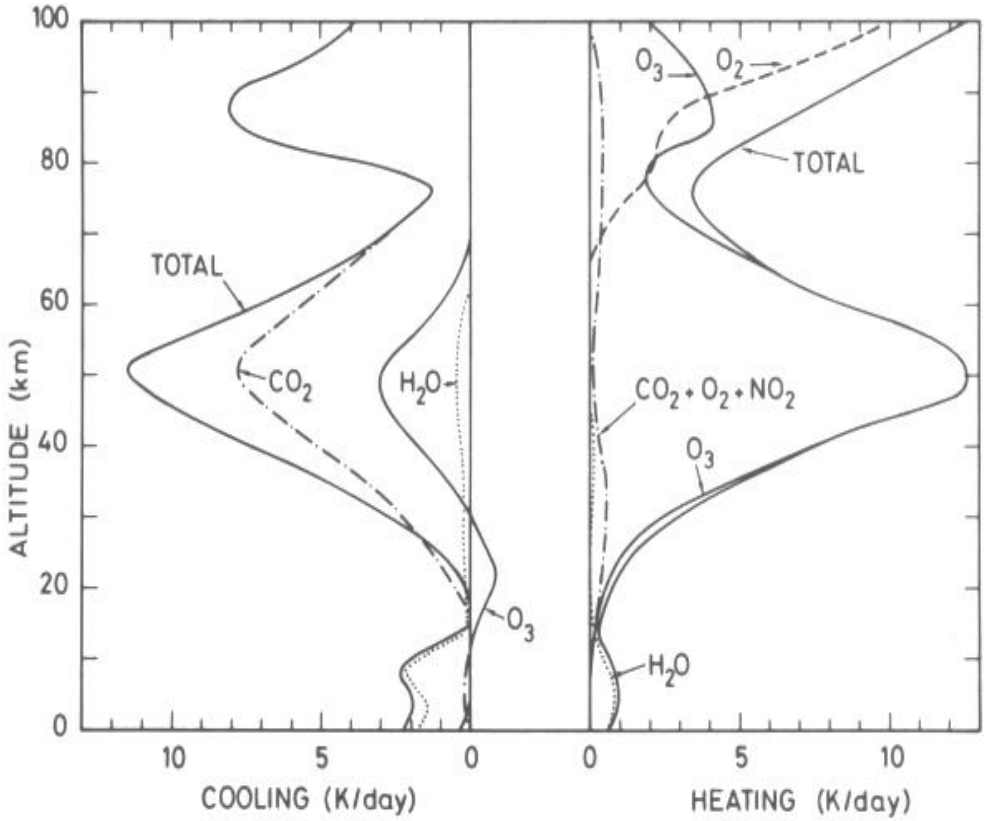


Fig. 4.19b. Vertical distribution of solar short wave heating rates by O_3, O_2, NO_2, H_2O, CO_2, and of terrestrial long wave cooling rates by CO_2, O_3, and H_2O. From London (1980).

Newtonian Cooling rate (schematic), from Plumb course notes



LW Cooling **SW Heating**



4.19b. Vertical distribution of solar short wave heating rates by O_3, O_2, $_2$, H_2O, CO_2, and of terrestrial long wave cooling rates by CO_2, O_3, and H_2O. From London (1980).

Table 1.1

The Relationship among Geometric Height z^*, Geopotential Height Z, Log-Pressure Height z, and Pressure p[a]

z^*	Z(km)	z(km)	p(mb)
0	0.00	0.09	1.01325 + 3
10	9.98	9.30	2.6499 + 2
20	19.94	20.27	5.5293 + 1
30	29.86	30.98	1.1970 + 1
40	39.75	40.98	2.8714 − 0
50	49.61	49.94	7.9779 − 1
60	59.44	58.97	2.1958 − 1
70	69.24	69.02	5.2209 − 2
80	79.01	80.25	1.0524 − 2
90	88.74	92.46	1.8359 − 3
100	98.45	104.68	3.2011 − 4

[a] From *U.S. Standard Atmosphere* (1976). Note that 1 mb = 100 Pa. The integers in the far-right column (preceded by plus or minus signs) indicate the power of ten by which the particular entry should be multiplied.

Idealized temperature profile, and corresponding log-p coordinate