SOME EXAMPLES OF METEOROLOGICAL CONDITIONS MEASURED WITH METEOROLOGICAL ROCKETSONDES

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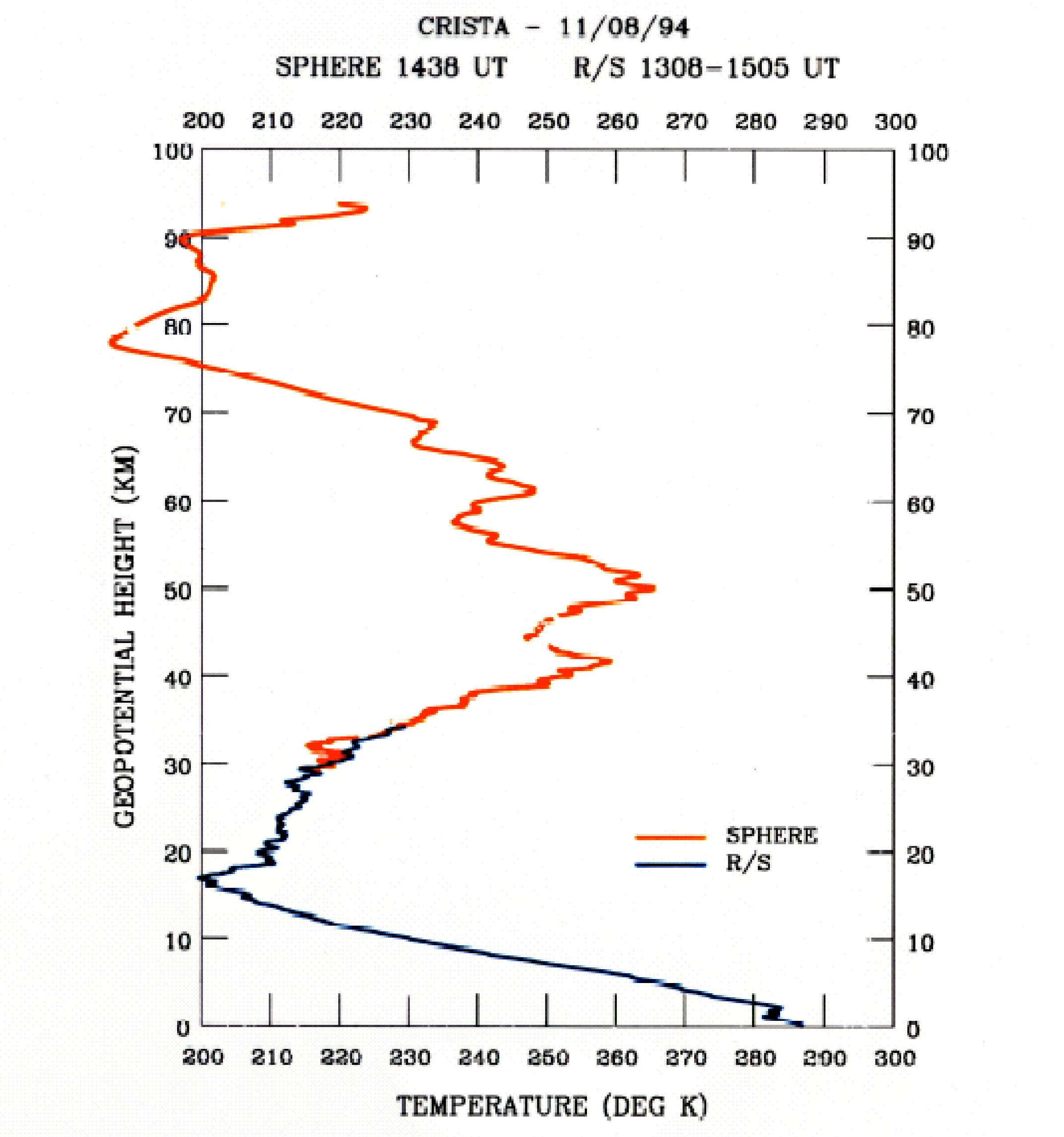
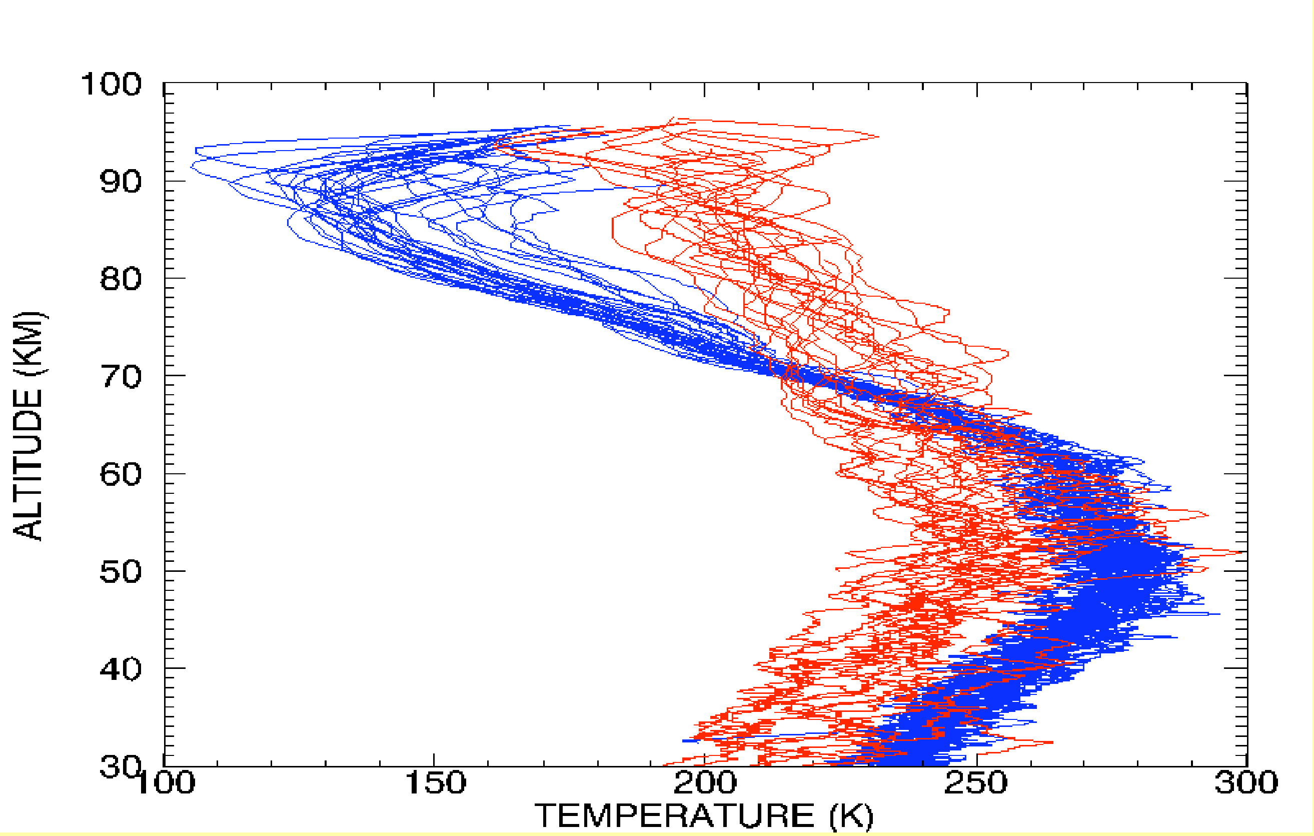
Structure of the stratosphere and mesosphere is defined mainly by measurements from a handful of rocket observations, mostly large sounding rockets and the small meteorological rocketsonde. Falling Sphere observations, in spite of many observations to 90 km, have not been able to fully describe tidal behavior from *in situ* measurements. Most high latitude observations do not extend over a full day, limiting information on the diurnal cycle; extended observations over many diurnal periods would be useful, The Mountain and Convective Waves Ascending Vertically Experimentt (MaCWAVE), designed to study gravity wave activity, provided the longest period of observations spaced nearly equally in time that could be used to look at the diurnal tides. Even so, the 12-hour series of observations from ESRANGE, Sweden in January 2003 while useful, still does not allow a full diurnal description of the tidal activity. However, these data, coupled with satellite data have added significantly to our understanding about this very important region of the atmosphere.

The Table gives a capsule digest of the campaigns and meteorological rocket observations available. Payloads were Datasonde and Falling Sphere. The Datasonde employs a bead thermistor to measure temperature and radar track for position; the falling sphere tracking requires a high-precision radar.

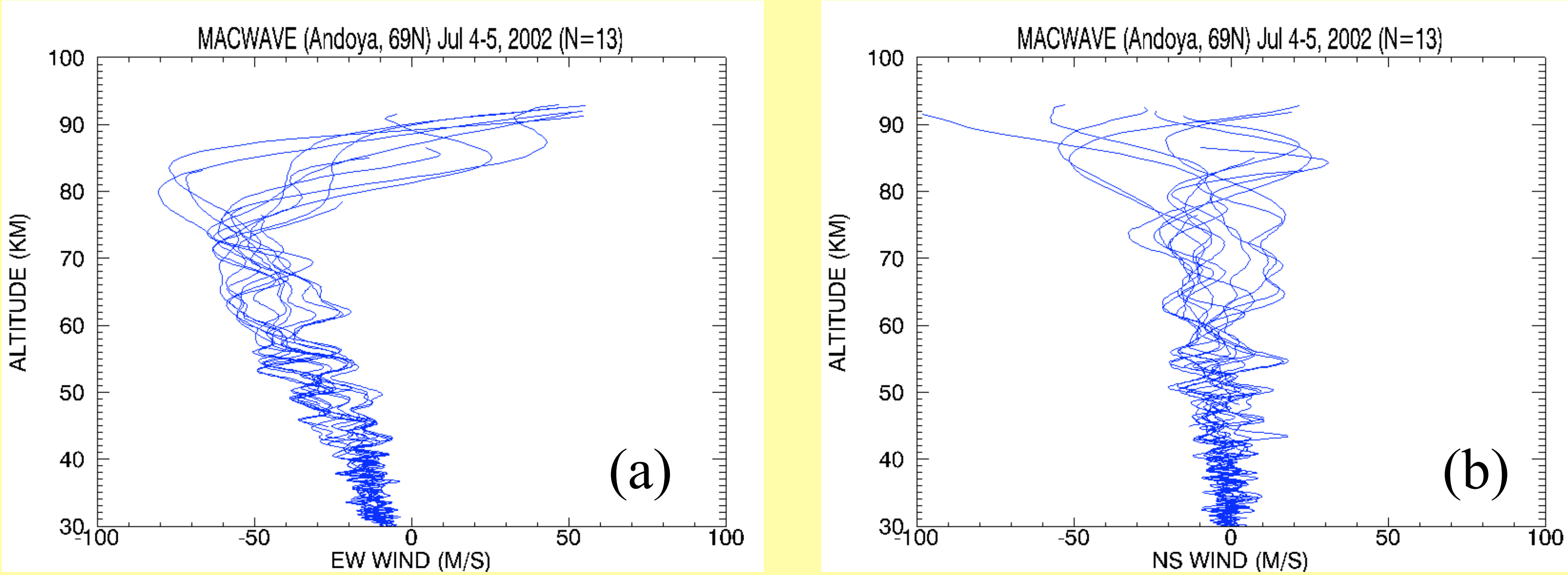
1980 October	MAE-1	Norway	Datasondes
1980 December	EBC	Sweden	Datasondes + Falling Spheres
1982 May	UARS	Norway	Falling Spheres
1984 Nov 1985 Feb	MAPWINE	Norway	Falling Spheres
1987 June	MACSINE	Norway	Falling Spheres
1987 October	EPSILON	Norway	Falling Spheres
1990 Oct 1991 Feb	DYANA	Norway	Datasondes + Falling Spheres
1991 July/August	NLC-91	Sweden	Falling Spheres
1993 July	NLC-93	Sweden	Falling Spheres
1999 July	DROPPS	Norway	Falling Spheres
2002 July	MaCWAVE	Norway	Falling Spheres
2003 January	MaCWAVE	Sweden	Falling Spheres



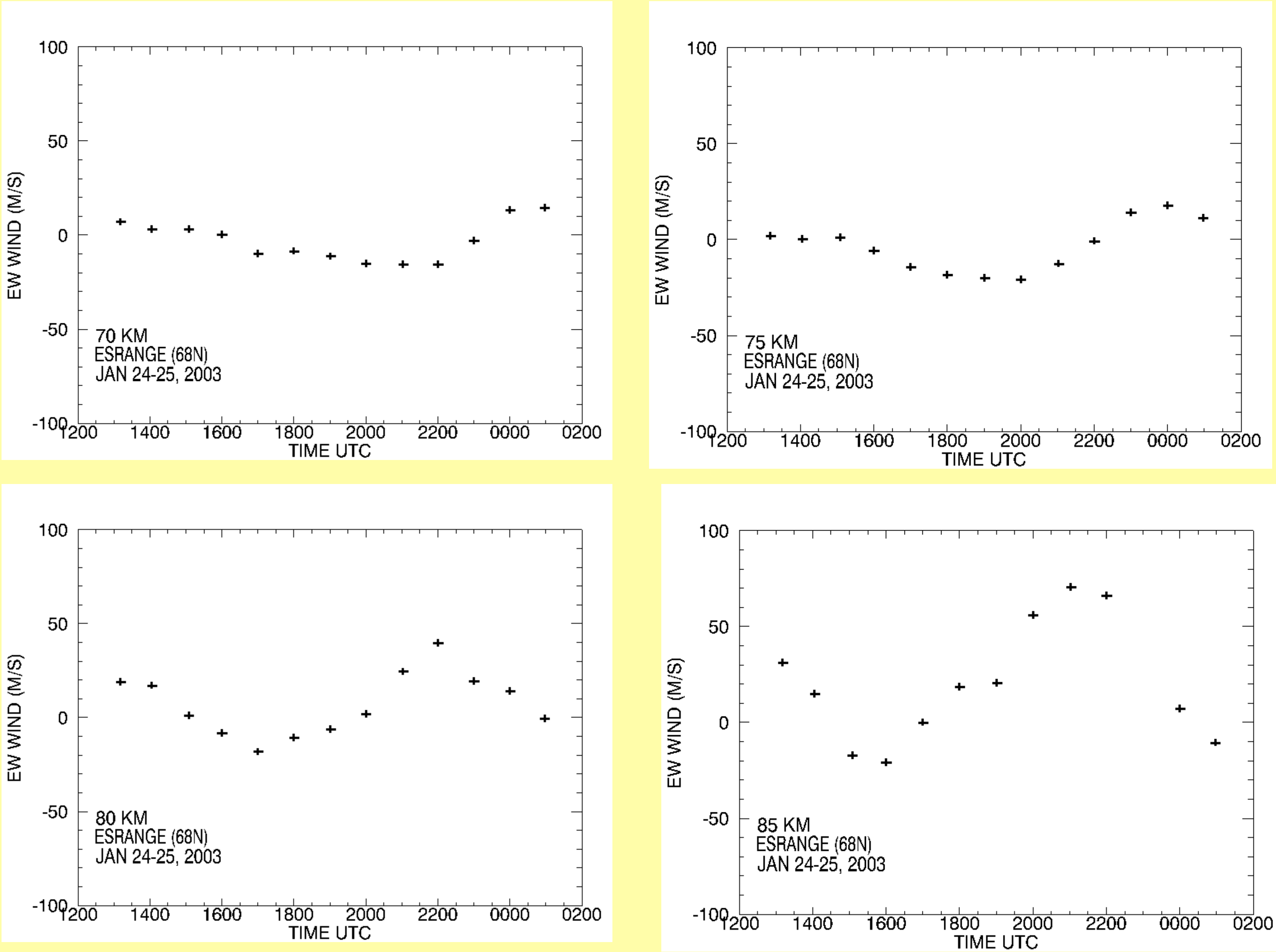
CRISTA - 11/08/94
SPHERE 1438 UT R/S 1308-1505 UT
200 210 220 230 240 250 260 270 280 290 300
100 90 80 70 60 50 40 30 20 10 0
GEOPOTENTIAL HEIGHT (KM)
TEMPERATURE (DEG K)
SPHERE
R/S



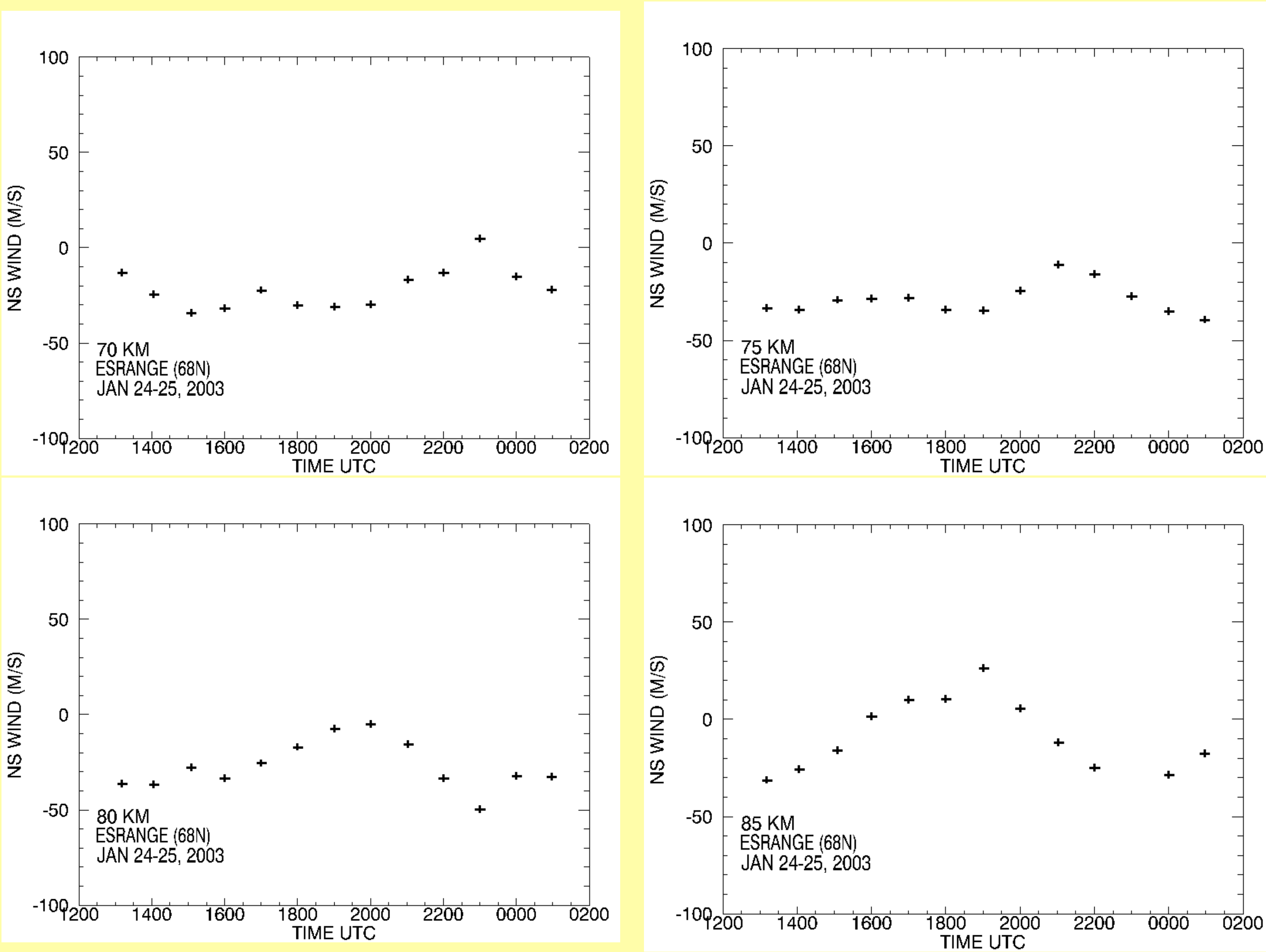
Falling Sphere temperatures obtained in different years for the summer [May, June, July, and August (**blue**)] reveal a definitive mesopause structure with lowest temperatures varying in height between 85-92 km. Below the mesopause, temperatures from 60 to 80 km decrease monotonically with a small variance. Below about 50 km the sphere temperatures are more ragged due to the sphere's response to vertical winds and also possibly the onset of sphere collapse. Wintertime temperatures (**red**) have larger variance and do not display a definitive mesopause (located at a higher altitude). Also, winter has lower temperatures in the stratosphere and higher temperatures in the mesosphere compared with summer. Of note, in the summer, the lapse rates often exceed adiabatic.



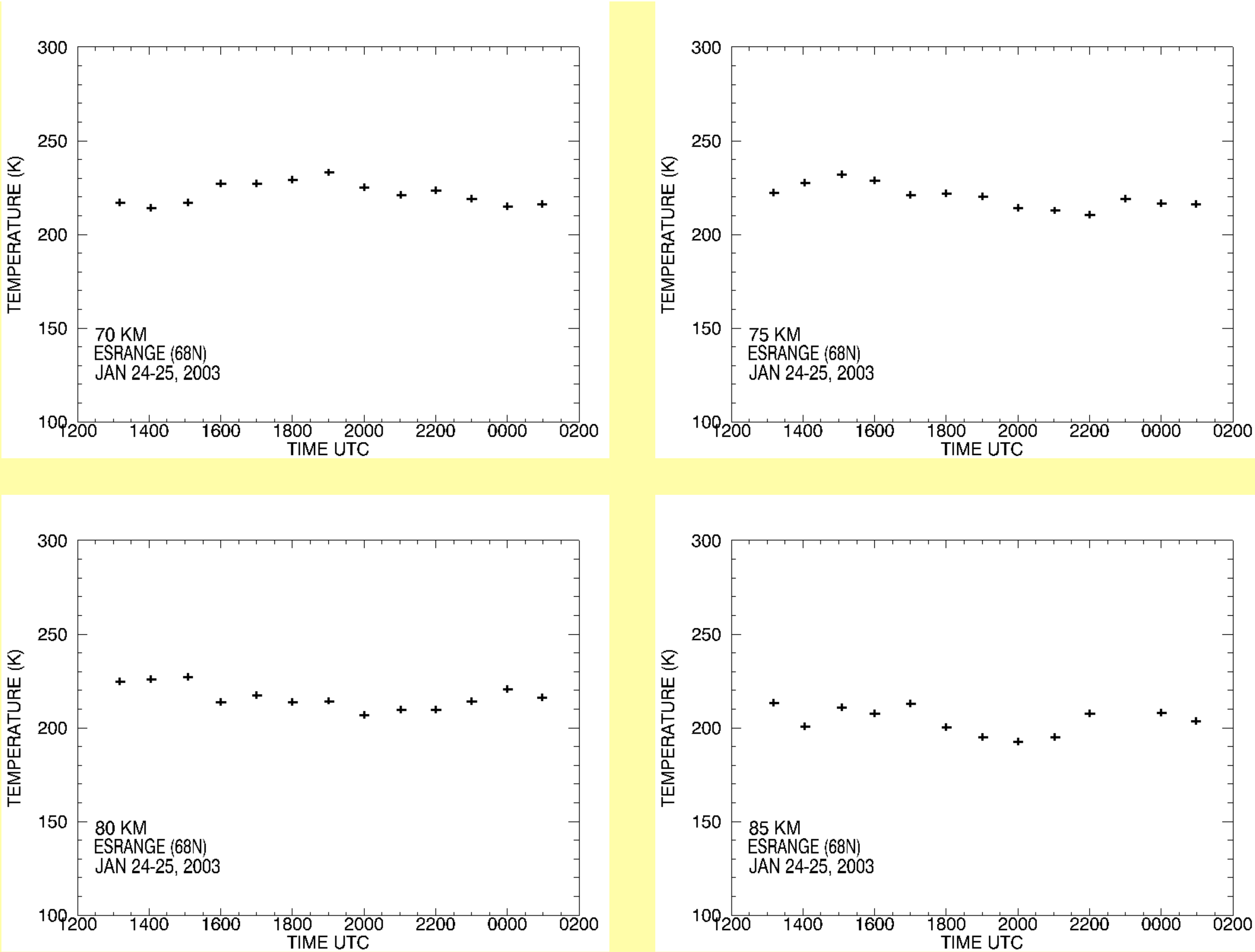
Two sequences of Falling Sphere measurements (1-2 July and 4-5 July 2002) were carried out from the Andoya Rocket Range in Norway. Wind data from the series on 4-5 July are illustrated. Panel (a) shows details of the zonal component clearly indicating easterly (westward) winds between 30 km and about 80-85 km. Westerly (eastward) winds appear at 85 km and higher, indicative of cyclic activity. Indeed, analyses of the time-series indicate large zonal wind amplitudes with westerly components present between 1900 UTC and 2230 UTC. In fact, the zonal component can be clearly tracked to lower altitudes showing the time of maximum wind increasing. This is not seen in the meridional component in panel (b) where no clear definition of cyclic signature is noted; nor is there cyclic signature in the temperature data. As concluded by Williams et al (2004) vertical wave may be breaking at different altitudes and may be a contributing factor for the suppression of horizontal wave activity.



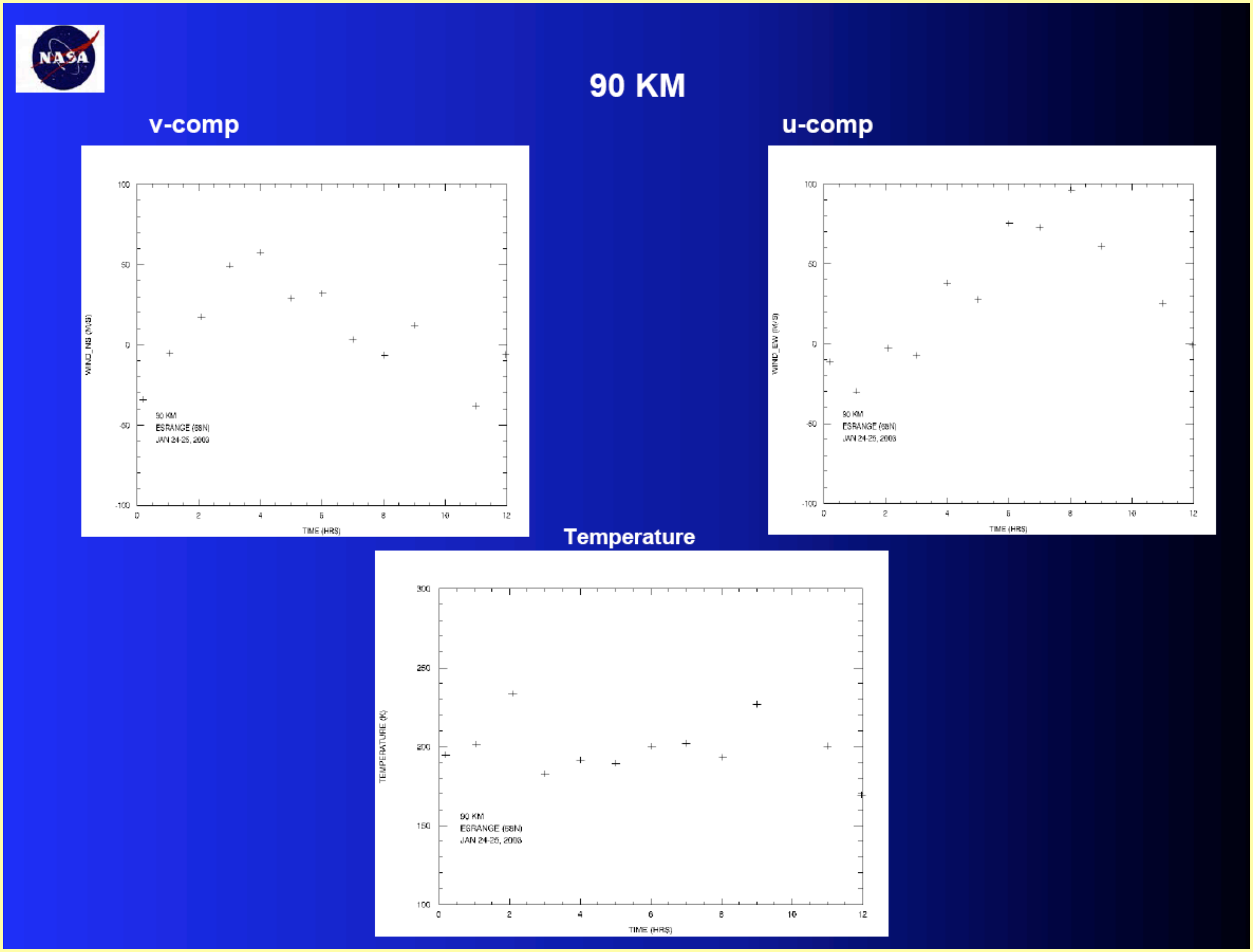
Cyclic behavior of the zonal wind component for period 1300-0100 UTC.



Cyclic behavior of the meridional wind component for period 1300-0100 UTC



Cyclic behavior of Falling Sphere temperatures for period 1300-0100 UTC.



Cyclic behavior at 90 km. Data are more sketchy but clearly useful.

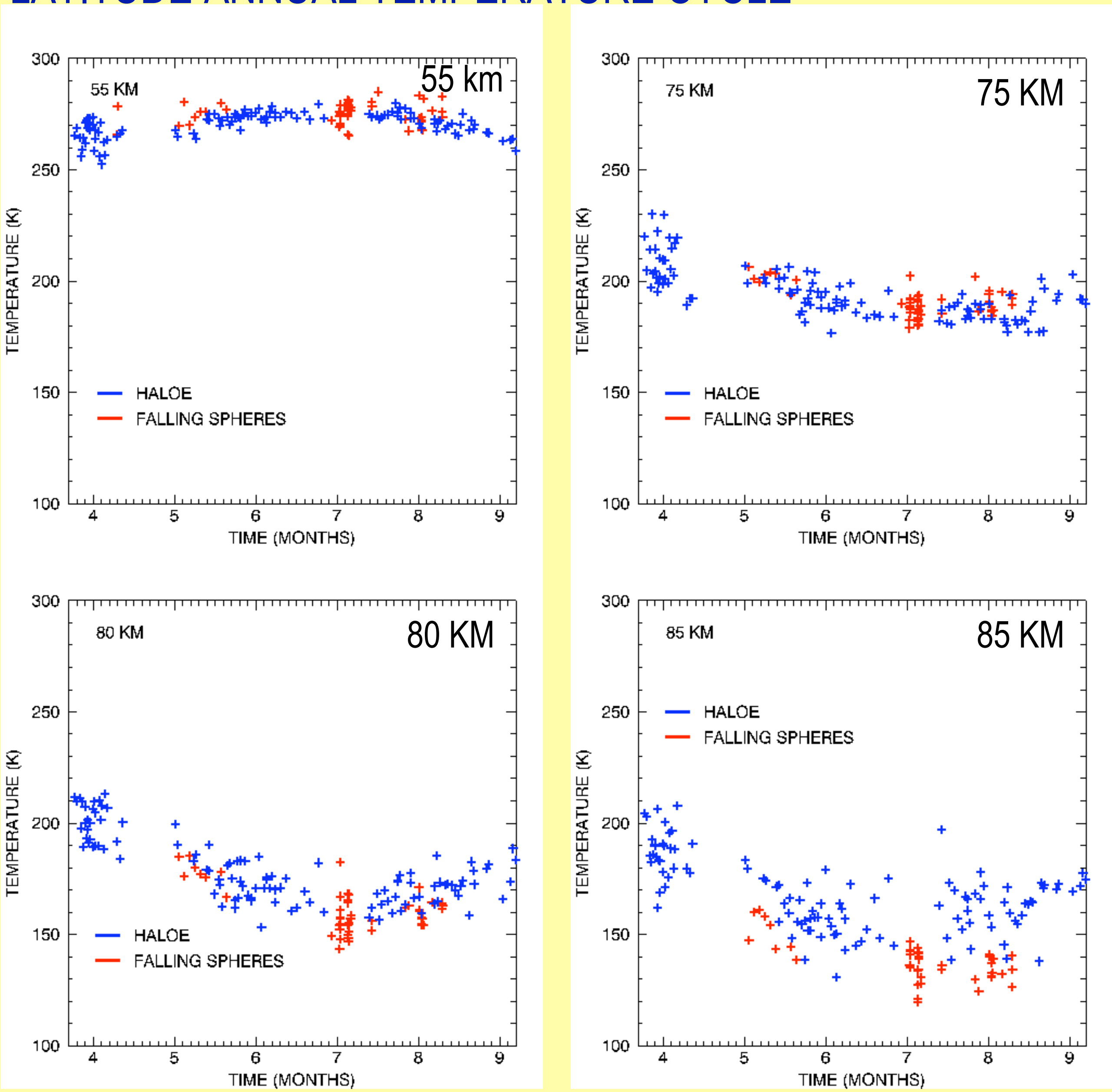
HI-LATITUDE ANNUAL TEMPERATURE CYCLE

Falling sphere temperature measurements combined with HALOE temperatures partially define the annual temperature cycle at high latitudes.

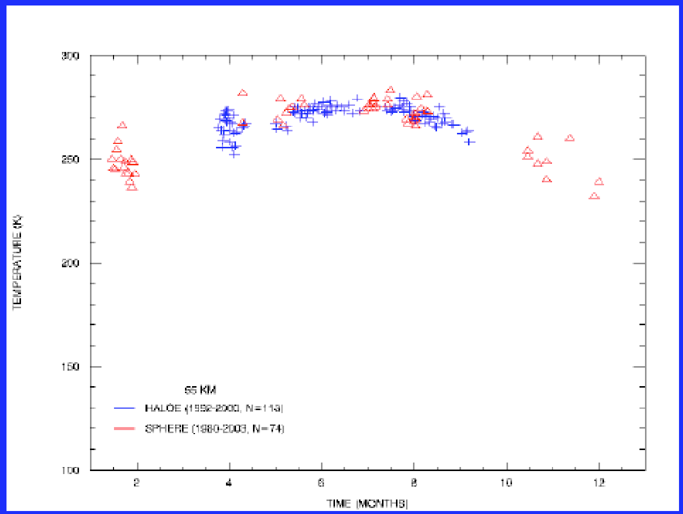
The mixture of the data sources also confirms the measurement ability of both techniques.

The temperatures become noticeably more noisy with altitude, and in some cases may not even agree. Nonetheless, the annual cycle can be detected with these data.

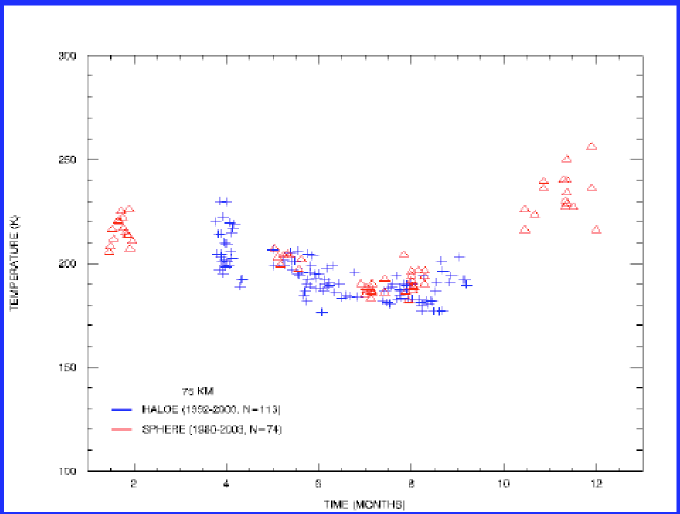
Clearly noted is the change in direction of the cycle between 55 km and 75 km.



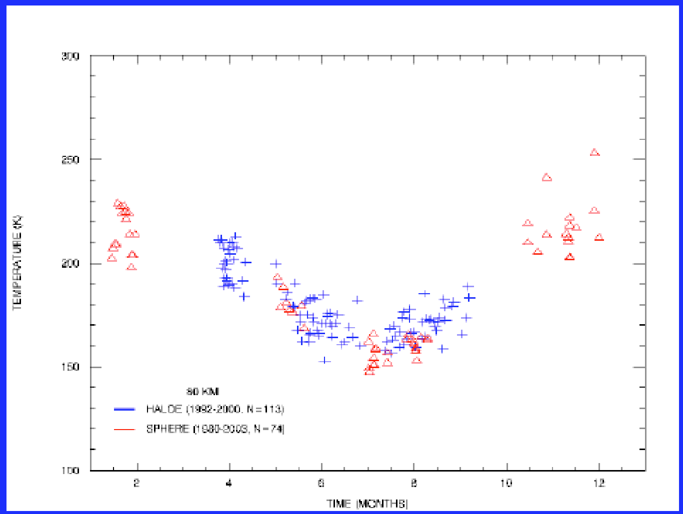
Annual Temperature Progression from Spheres and HALOE



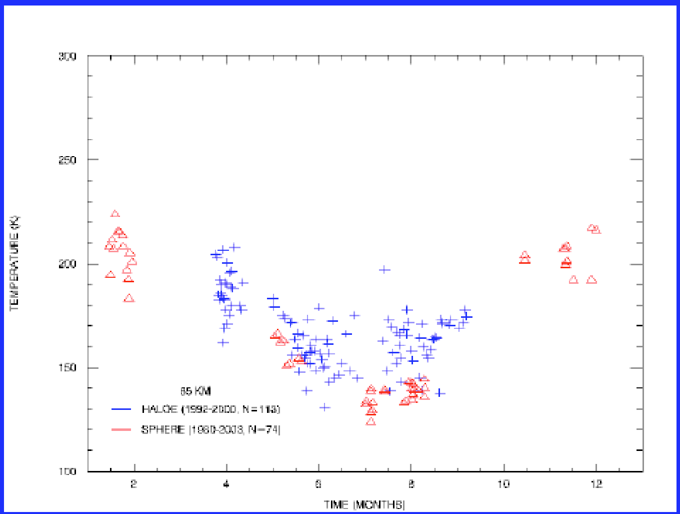
Winter/Summer Temperature Difference ~ -25°C



Winter/Summer Temperature Difference ~35°C

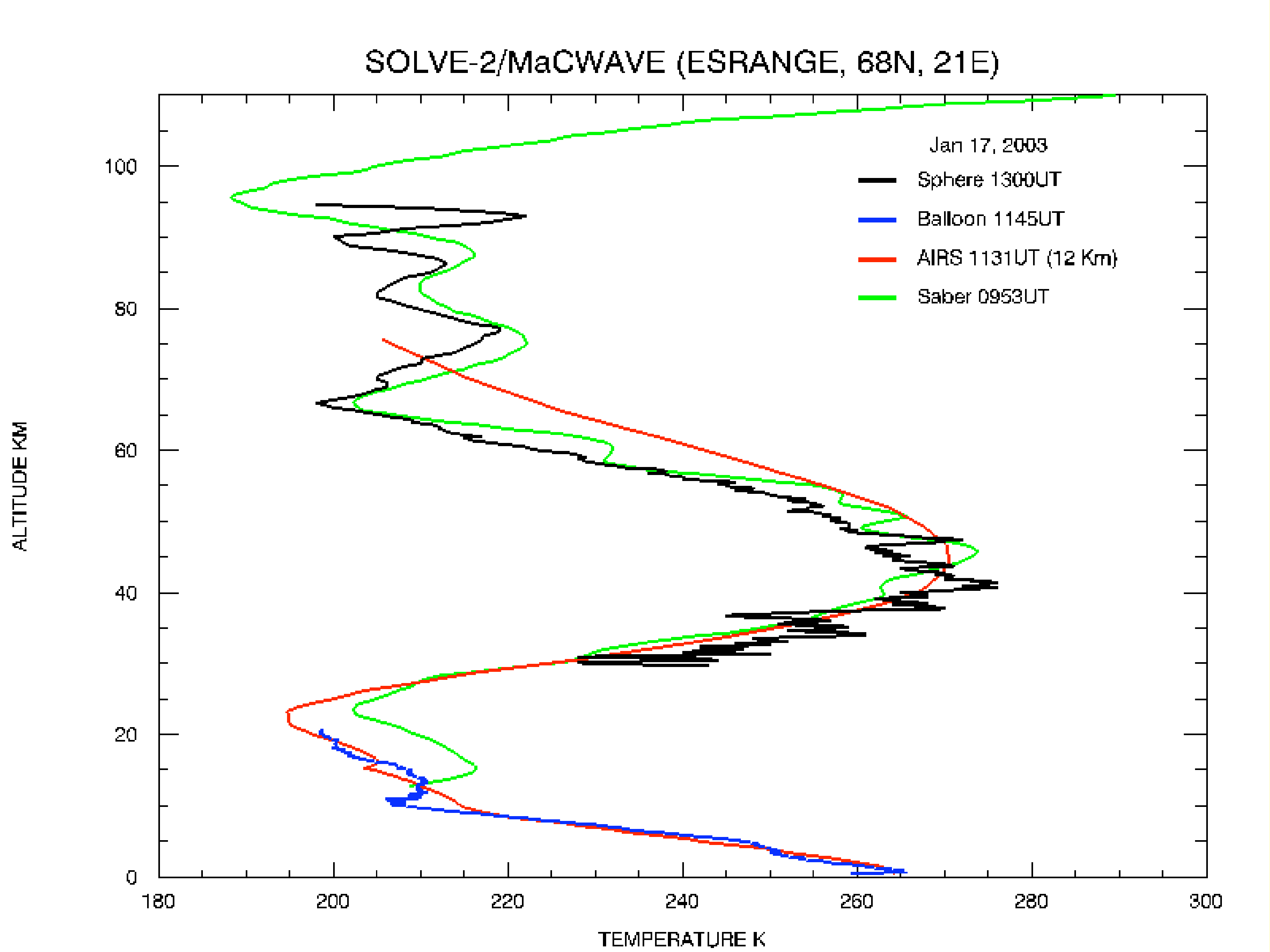


Winter/Summer Temperature Difference ~55°C



Winter/Summer Temperature Difference ~70°C

Sphere and HALOE Temperature Measurements at Andoya and ESRANGE Locations



SOLVE-2/MaCWAVE (ESRANGE, 68N, 21E)
Jan 17, 2003
Sphere 1300UT
Balloon 1145UT
AIRS 1131UT (12 Km)
Saber 0953UT
ALTITUDE KM
TEMPERATURE K
0
20
40
60
80
100
180
200
220
240
260
280
300

Parameters Measured with Small Meteorological Rockets

Temperature

Density

Wind

Ozone

Instruments measuring properties of the plasma

Dust

Small Rockets Types Possibly Having Future Application

Lunar Rocket SR500-1: ~8” diam. similar to Zuni

10 lb payload (3” dia. Dart-composite body)to 150 km

Lunar Rocket SR500-2: ~ 5” diam. similar to Zuni

10 lb payload (3” diam. Dart-composite body) to 125 km

NRE ~1 million

Production ~$25-$30K each, costs depends on lot size

- Temperature and wind variability is different between summer and winter conditions, with winter being more variable.

- Cyclic oscillations – while measurements not for a full day, they may be the only direct measurements.

- Small-scale structure reveals unique features, i.e.,lapse rate, wind shears.

- In spite of sparse upper atmosphere rocket data a snapshot of the region's vagaries is available.

- A more complete description of strato-mesospheric behavior requires considerably more data, particularly additional diurnally-oriented series of measurements during both summer and winter seasons.

- Two factors why more measurements are not available are: cost and availability.