Astroclimatological ***Rep.108/****J.Navarrete/VLT.TRE.ESO.17400.11.01.1999/*

ENVIRONMENTAL conditions on ESO Observatories[1]

Cerro La Silla 2400m
70° 42' W 29° 16' S
Distance from coast: 40km

Cerro Paranal: 2636 m
70° 24' W 24° 37' S
Distance from coast: 12km

for the months of **October,November,December 1998**

Automatic meteorological stations, microthermal sensors, and Differential Image Motion Monitors (DIMM) are beeing used to monitor environmental conditions at La Silla and in the area of the VLT observatory.

The Vaisala meteorological station at the **La Silla Observatory** was installed in February 1985 on a 30 m high mast. The seeing monitor (DIMM2) was installed in March 1991, close to the Schmidt telescope as part of the permanent Astronomical Site Monitor (ASM). Connected to the ESO computer network and protected by a retractable enclosure, DIMM2 operates in fully automated mode since Dec. 93.

30 m level: Wind dir, vel (D3, S3), temp (T3)
20 m level: Wind dir, vel (D2, S2)
10 m level: Wind dir, vel (D1, S1)
5 m level: Seeing (DIMM)
2 m level: Temp., Humid., Pres. (T1, RH, P)
-0.1 m level: Ground temperature (T2)

The Vaisala meteorological station was installed at **Cerro Paranal** in October 1984 on a 10 m high mast. Seeing measurements started at Paranal summit in April 1987 (DIMM1). All measurements were disrupted in July 1991 when levelling work started on the VLT site and moved to the nearby summit Cerro NTT. They were restarted in December 1992 on Paranal, with the seeing monitor (DIMM3) tentatively on a 1 m high platform. A 5 m high dismountable tower was completed in April 1994.DIMM3 was removed for upgrade in January 1997.

10 m level: Wind dir, vel (D1, S1)
5 m level: Seeing (DIMM)
5 m level: Wind dir, vel (D2, S2)
2 m level: Temp., Humid., Pres. (T1, RH, P)
-0.1 m level: Ground temperature (T2).

REMARKS:
In the frame of the development of the VLT Astronomical Site Monitor(VLT-ASM) the following changes occurred in May 98: the Vaisala station was upgraded to a newer Milos500 system on a 30m high mast. At the same time started the tests of the seeing monitor (DIMM3) automated operation after an extensive upgrade to the VLT standards

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The meteorological data are stored as average, root mean square and extrema of each parameter during a preset averaging period (20 mn). Wind direction and speed are digital measurements (Fig. 1 to 5) sampled every 2 seconds. Relative humidity (Fig.6),ground and air temperature (Fig. 7 to 8), and pressure (Fig. 9) statistics are computed out of digitally converted analog levels sampled every minute.
The seeing is measured at 5 m above ground (1 m at Paranal from Dec. 92 to Apr. 94) and defined as the Full Width Half Maximum of a stellar image observed with a perfect large telescope, at 0.5µm wavelength and at zenith. It is measured over periods of a few minutes all night long. Maximum wind speed for operation is about 15 m/s (18 m/s for the La Silla automated version) and sky must be clear in the zenith area. Seeing averages every 20 mn are plotted on Fig. 10.

The resolution of the various sensors is the following:
-Wind direction: 5.63° (threshold: 0.3m/s)
-Wind speed: accuracy ±2% over 10m/s (threshold: 0.4m/s)
-Temperature: accuracy ±0.1°
-Humidity: linearity about 1%
-Seeing: better than 10% above 0.25 arcsec
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[1]This document is available on the ESO Web (http://www.eso.org/gen-fac/pubs/reports/environ/)

La Silla: *Astroclimat Rep.108/J.Navarrete/VLT.TRE.ESO.17400/11.01.1999*

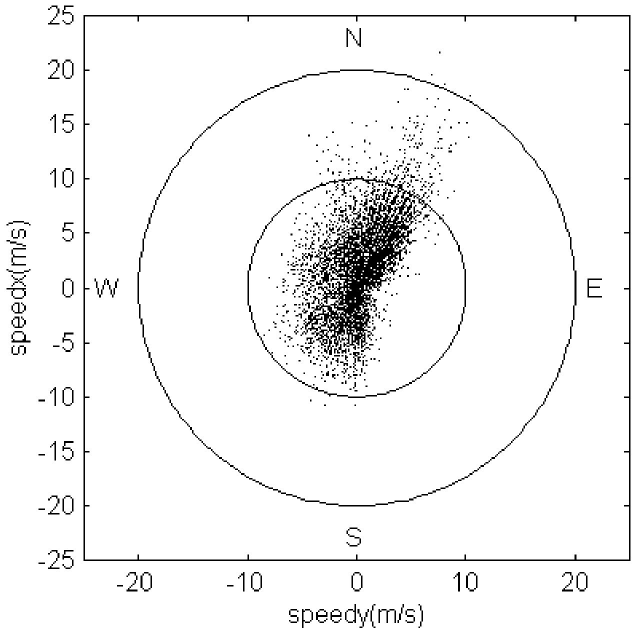

Figure 1: Windrose **La Silla**: the extremity of the average wind vector is plotted for each calculation interval of the period considered, with a geographic orientation.

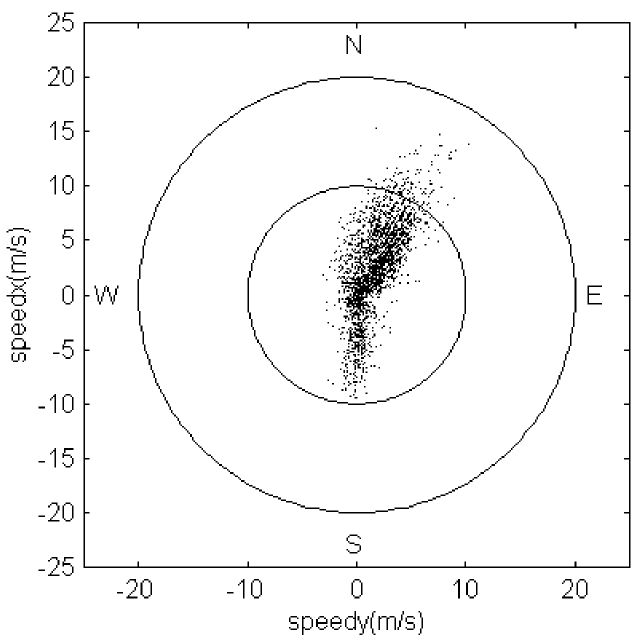

Figure 2: Night windrose **La Silla**: same as Fig. 1, but for samples taken between 0h and 10h, universal time.

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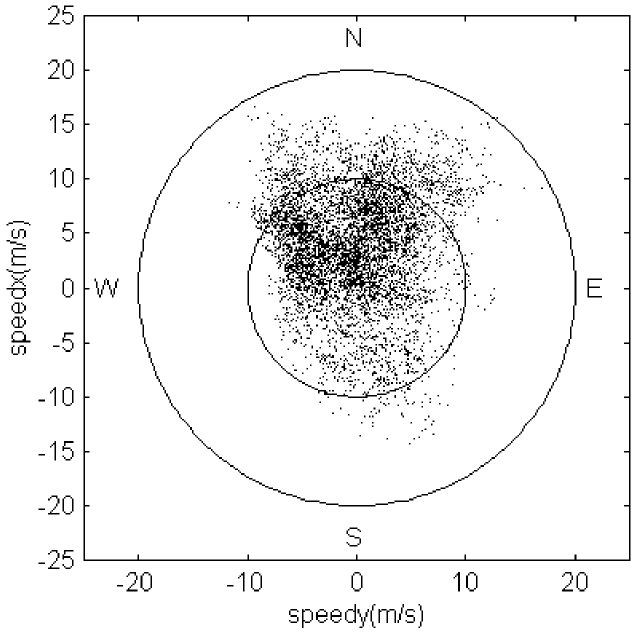

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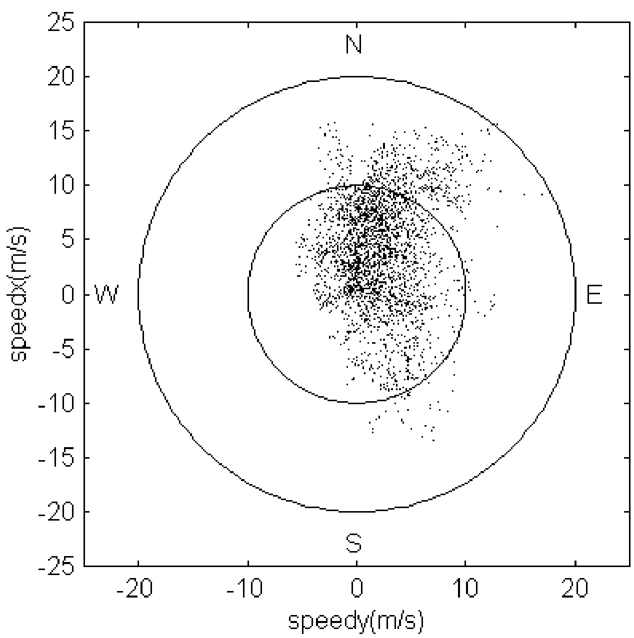

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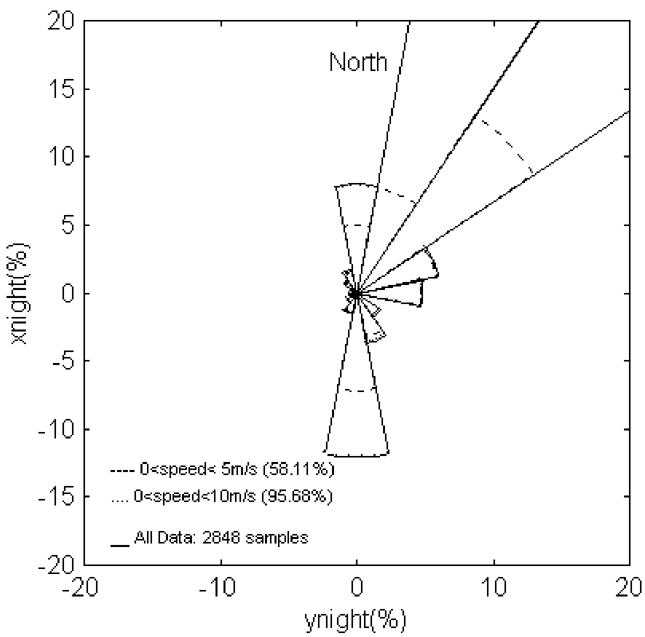

Figure 3: Night (0-10h, U.T.) wind direction **La Silla:** 2-D histogram with a geographic orientation, as function of wind velocity. Units is % of nightime per sector of 22.5° .

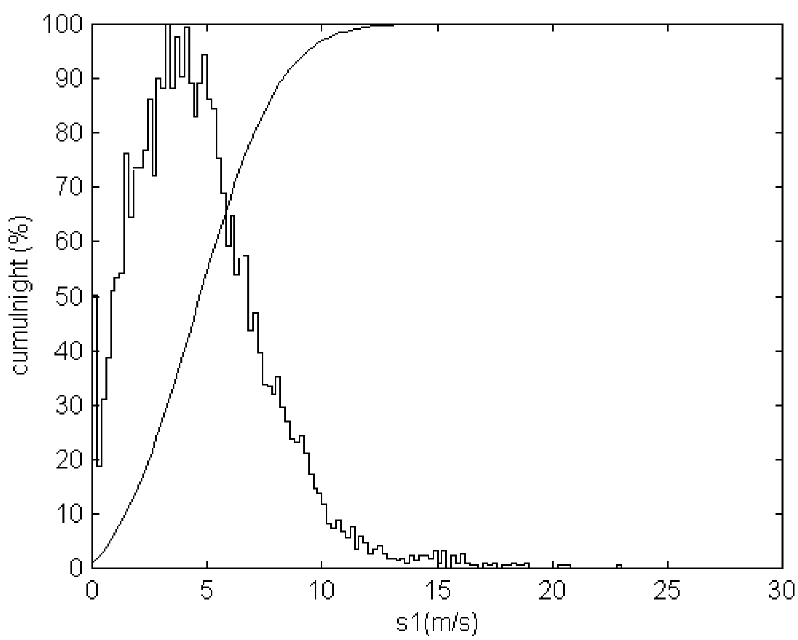

Figure 4: Night (0-10h, U.T.) wind speed **La Silla:**histogram and cumulative probability of average wind velocity distribution, in m/s, at 10m height.

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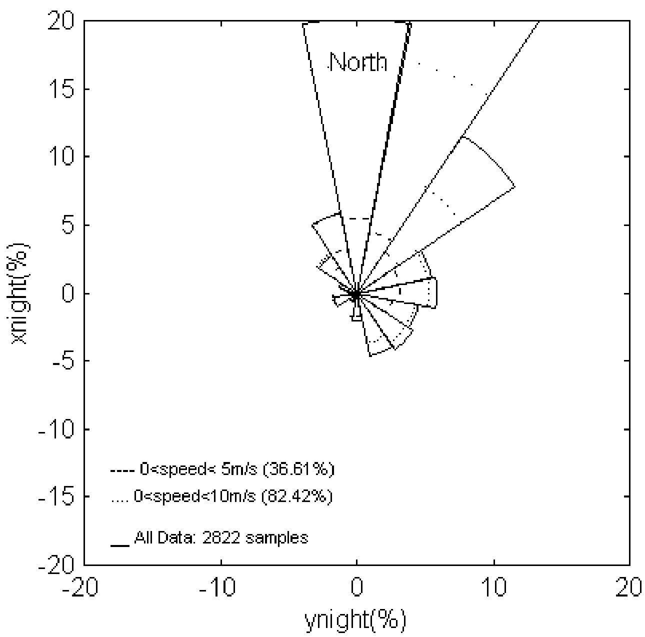

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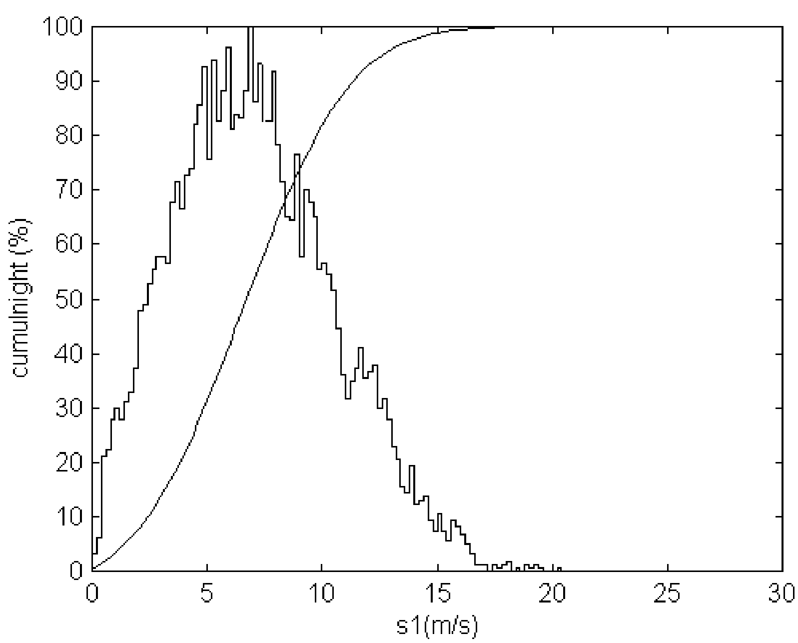

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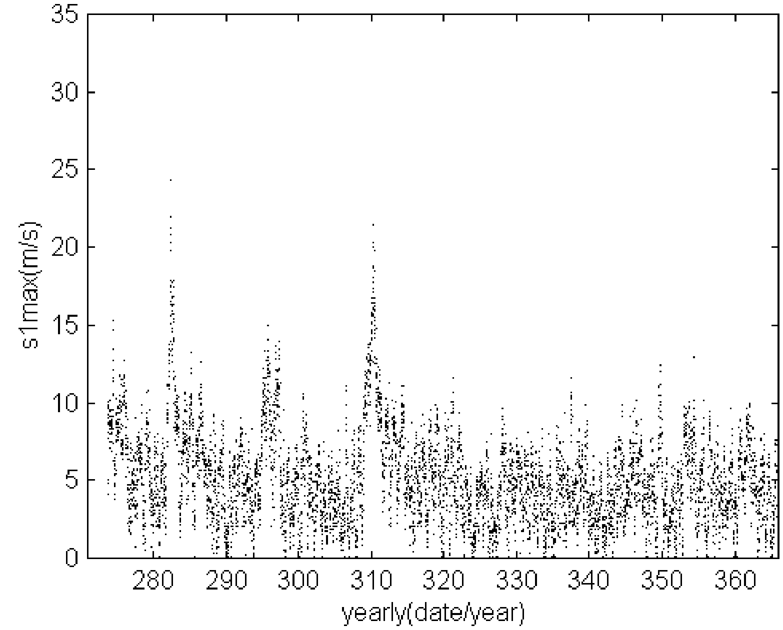

Figure 5: Maximum wind speed **La Silla:** in m/s, at 10m height, in a chronological order (day of year).

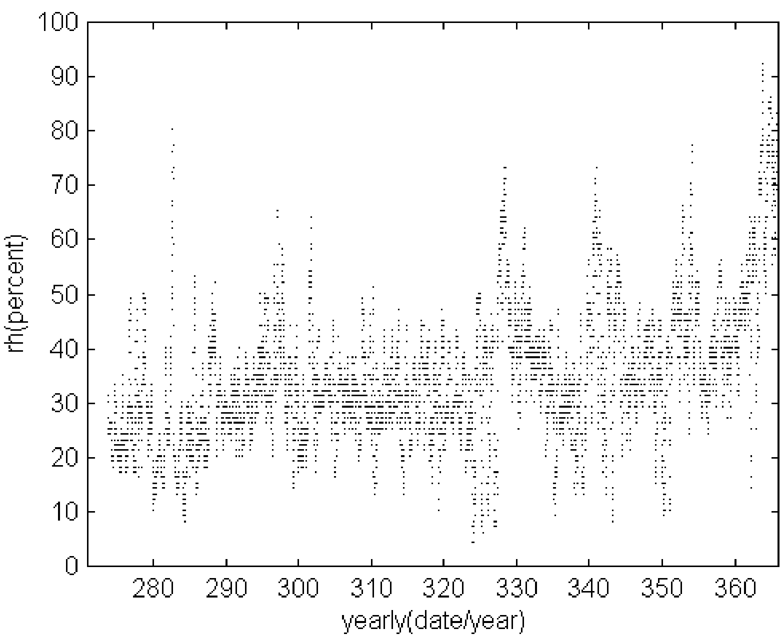

Figure 6: Average relative humidity **La Silla:** in % at 2.5m height, in a chronological order (day of year).

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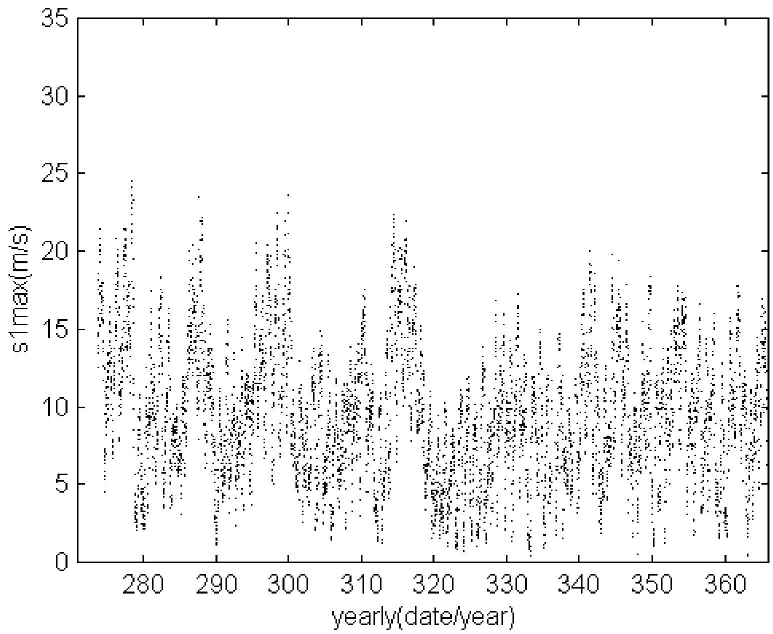

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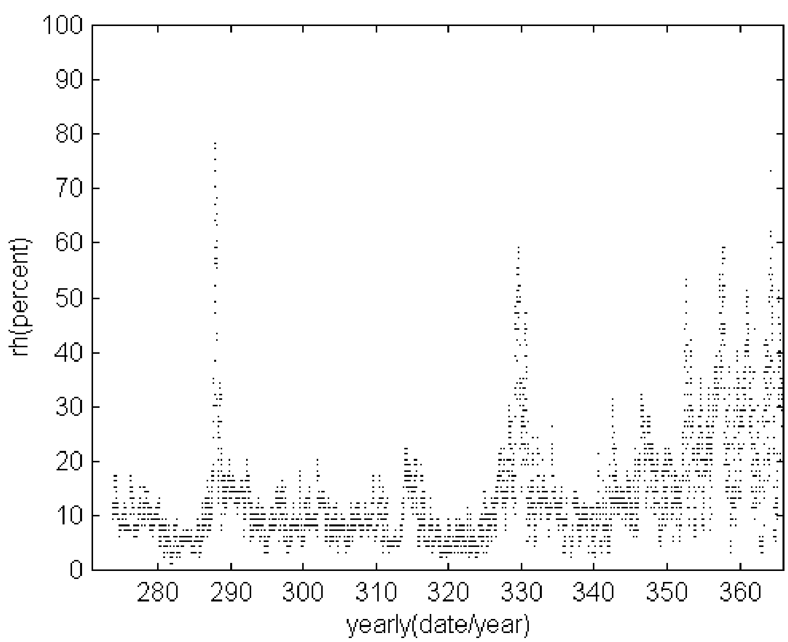

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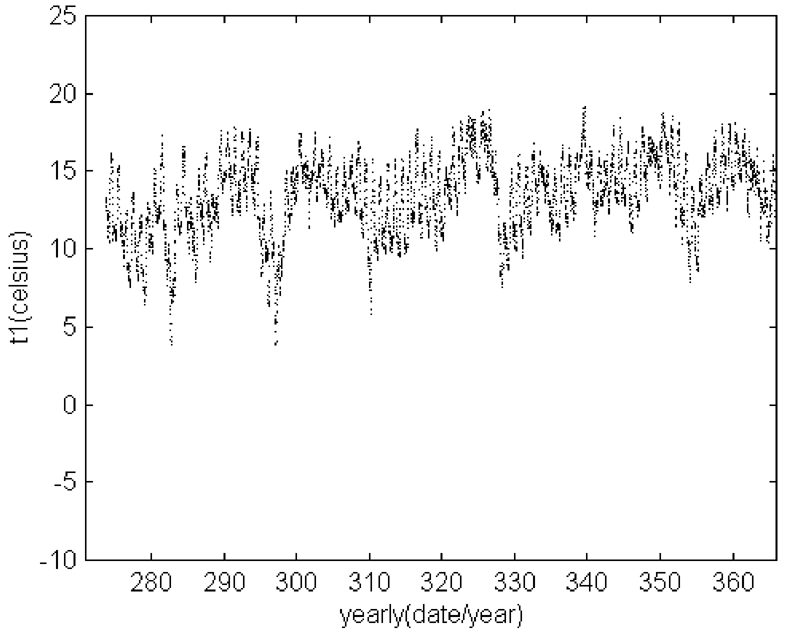

Figure 7: Average air temperature **La Silla:** in degrees Celsius, at 2.5m height, in a chronological order (day of year)

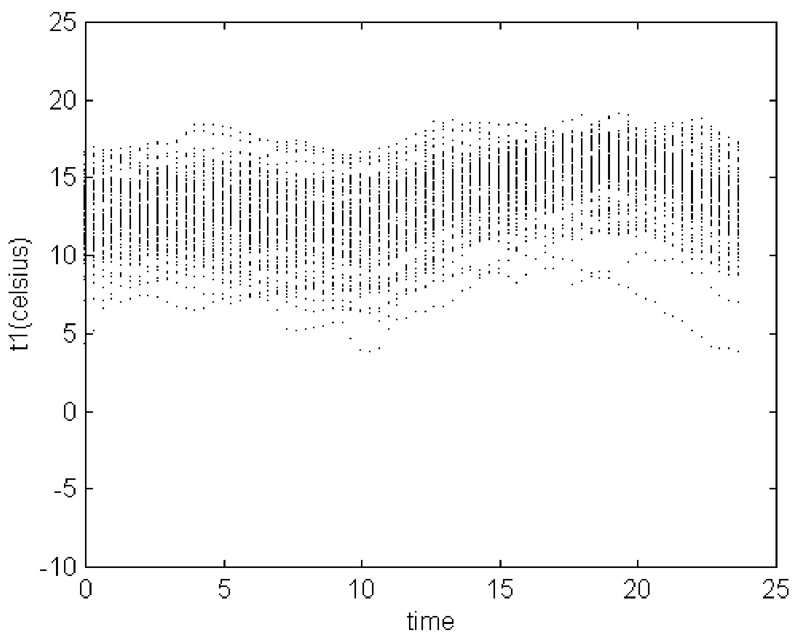

Figure 8: Diurnal air temperature variation **La Silla:** cumulative plots of average air temperature for the whole period on a 24 hours basis.

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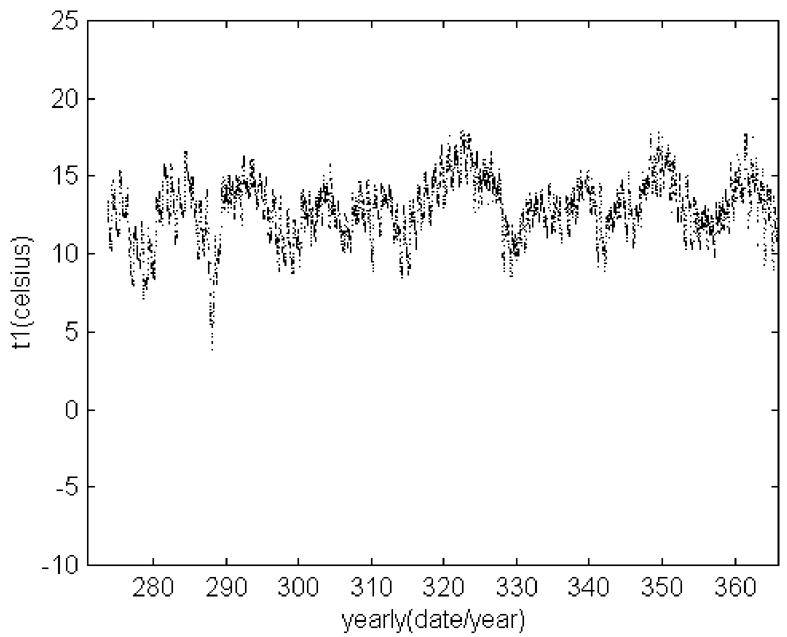

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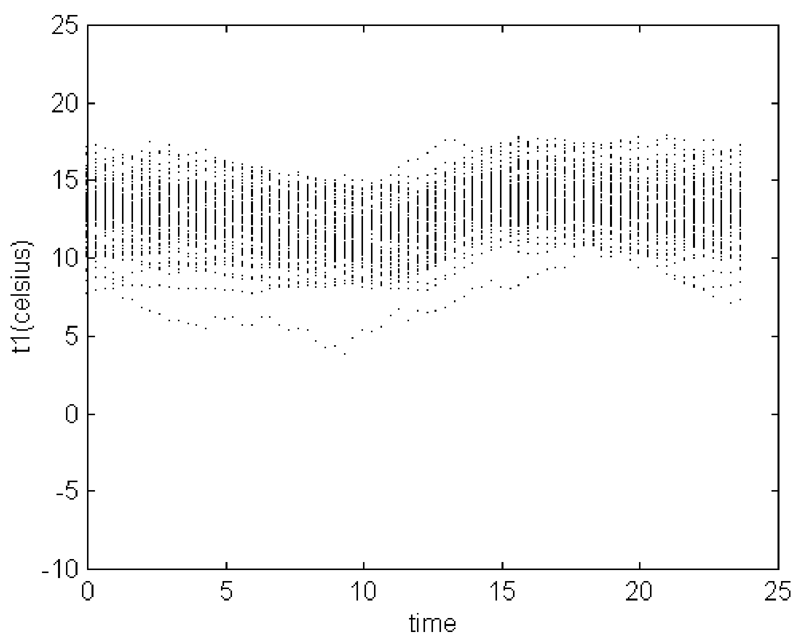

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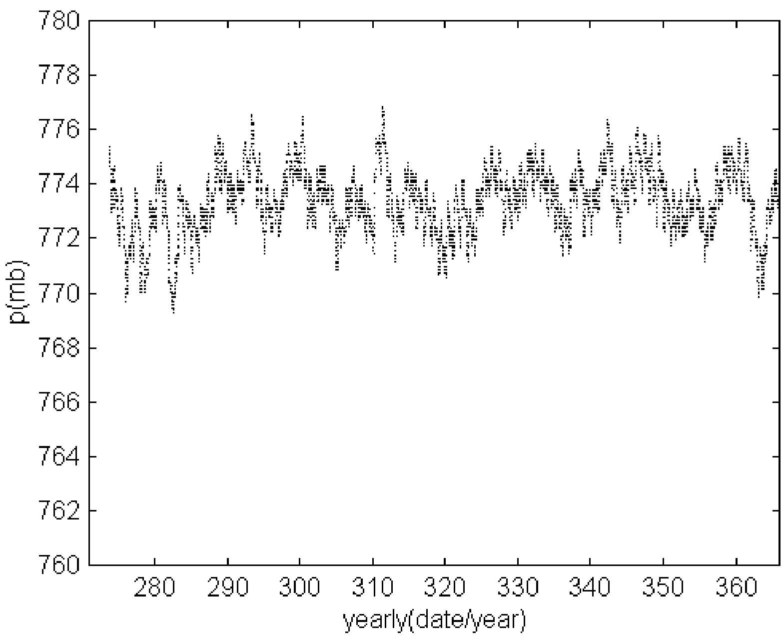

Figure 9: Average atmospheric pressure **La Silla:** im mB, at 1m height, in a chronological order (day of year).

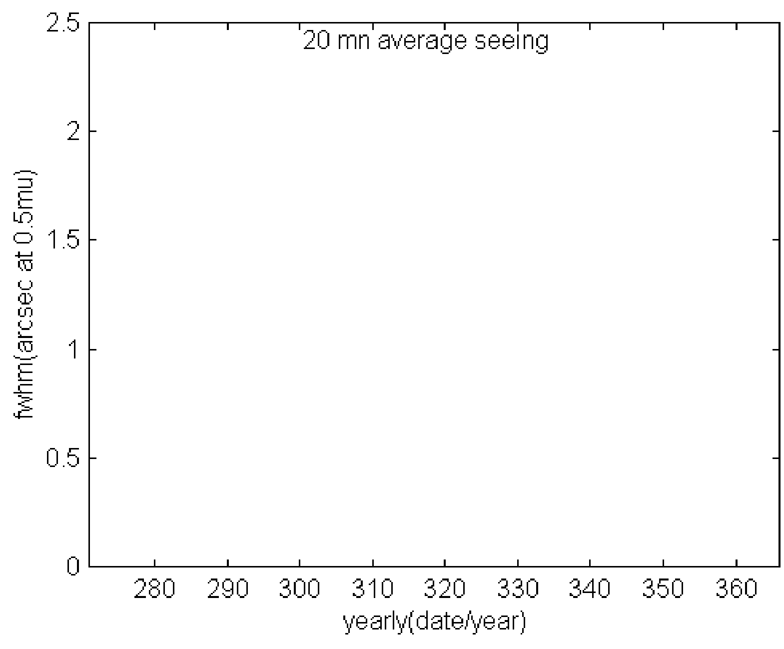

Figure 10: Average seeing **La Silla**: in arcsec, at 5 m height, at zenith and at λ=0.5µm, in a chronological order (day of year).
Note: DIMM2 de-commissioned, complete shutdown on Nov.98 due to upgrade to VLT standards.

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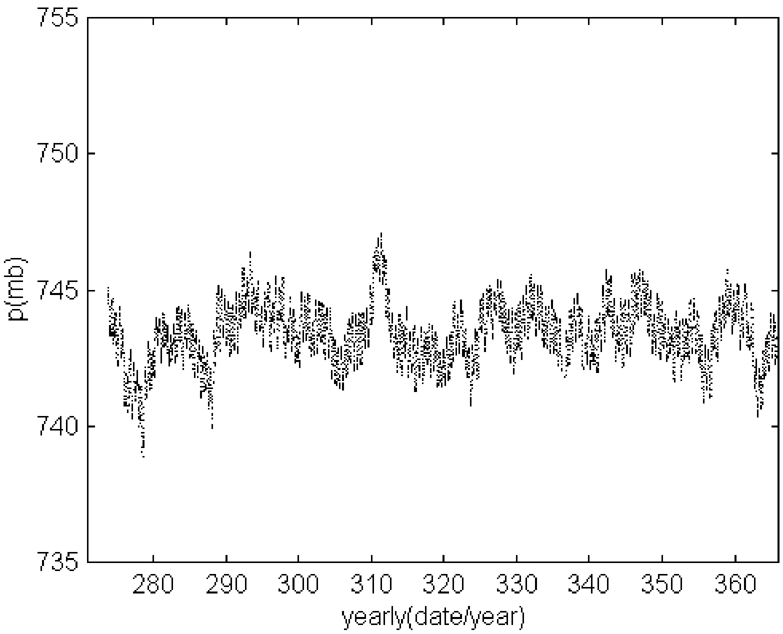

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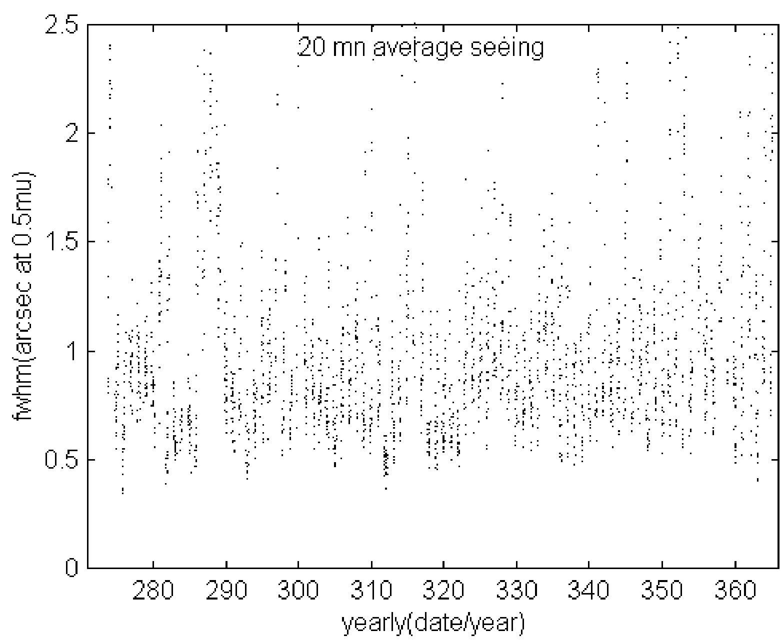

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Parameter	min	5%	Median	Average	95%	Max	nr. samples
Seeing (arcsec)							
Wind (m/s at 10m)	0	0.8	4.2	4.6	9.6	22.8	6622 (20 mn)
Wind night only (m/s)	0	0.5	4.3	4.6	9.6	17.2	2852 (20mn)
Rel. Humidity (night, %)	4	16	33	35	58	92	2850 (20mn)

Table 1: Statistical characteristics of key parameters at La Silla.

Parameter	min	5%	Median	Average	95%	Max	nr. samples
Seeing (arcsec)	0.34	0.53	0.89	1.03	2.17	4.52	2622 (20mn)
Wind (m/s at 10m)	0	1.6	6.6	6.9	13.1	20.4	6467 (20 mn)
Wind night only (m/s)	0	1.1	6.1	6.4	12.8	19.1	2822 (20mn)
Rel. Humidity (night, %)	2	4	10	13	33	92	2823 (20mn)

Table 2: Statistical characteristics of key parameters at Paranal.

Parameter	% of observed nightime bins La Silla	% of observed nightime bins Paranal
Seeing < 0.5 arcsec		3
Wind < 20 m/s	100	100
Wind < 10 m/s	96	84
Humidity < 90 %	100	100
Photometrics nights	88	79

Table 3: Summary of limits conditions at ESO sites (rounded to the closest integer)