years' delay. The latter, however, had already become aware of the increasing importance of spatiotemporals of the atmosphere by the discovery of interferometric speckle by A. Labeyrie in 1970 and by the limits imposed by the twinkling of stars in precision photometry. But engineers and instrument designers had to wait almost ten years to see work written in a more accessible style by e.g.: S.F. Clifford in 1978 or F. Roddier in 1981.

It was precisely during this period, the 1980's, that projects were introduced for the construction of large telescopes to become operational before the year 2000. They were to be equipped with sophisticated techniques to compensate, at least partially, for atmospheric effects on light waves. However, these techniques are only as effective and economical as the site quality is good. It was clear that the choice of a site was not just an unavoidable, rather administrative, formality but a decision with far-reaching consequences on the future performance of the observatory.

These were the favourable conditions in which a site study campaign for the VLT was launched. First there was a pre-selection of the candidate sites based on criteria such as logistics and large-scale meteorological analysis, followed in 1983 by inspection visits that led to the establishment of a team of observers on the summit of Cerro Paranal at the end of the same year (*The Messenger* Nr. 64). The chronology of a study of this kind was predetermined: first of all, the regions with the least cloud cover, in other words offering the highest number of photometric and spectroscopic nights, had to be located before looking at atmospheric turbulence. The observers, who worked in fortnightly shifts, had the task of observing the quality of the sky both night and day. They also had conventional meteorological instruments and infrared radiometers that enabled them to measure the emissivity of the sky to deduce the precipitable water vapour content. Similar work was carried out simultaneously at the La Silla Observatory and after a few months the exceptional quality of the summits of the Atacama desert became evident, both for cloud cover and for water vapour content.

There are three mountain ranges at this latitude (23–25 degrees south): a coastal range of which Cerro Paranal is one of the highest summits, an intermediary or pre-Cordillera range 100 km more to the east and rising above 5,000 m, and then the Cordillera of the Andes with its volcanoes, some of which are higher than 6,000 m. Sporadic measurements taken on many of these summits confirmed the tendency to an increase in cloud cover near the Cordillera as well as a more marked seasonal influence. Worth mentioning is the infamous Bolivian winter that manifests itself in several weeks of wintry conditions in the middle of the southern summer.

The aridity of the Atacama desert is due to the low temperature of the Pacific Ocean, driven along the coastline by the cold Humboldt current that maintains the inversion layer, and clouds, at an altitude of less than 1,000 m in the main. This phenomenon, in addition to the steep slope of the coastal range facing the ocean, guarantees Cerro Paranal's complete isolation which means no sea spray in the ambient air even though it is situated only 12 km from the sea. At the beginning of 1987 and in view of the first encouraging results, ESO decided, following agreement with the Chilean government, to make permanent changes to the landscape and constructed a rudimentary access road up to the summit. In April of the same year the first image quality measurements were available from a differential image motion monitor (DIMM). This instrument uses intensified CCD imaging. It was still being developed and became fully operational in October 1988. However, it was only one year later that the DIMM reached the required accuracy (better than 10 % down to 0.25 arcsec seeing). So it was on the basis of statistics on cloud cover and humidity collected over 7 years and 1 year of taking image quality measurements that ESO committed itself to the construction of a new observatory on Cerro Paranal. The same DIMMs are now in routine operation both at Paranal and La Silla and permit the estimation of the stability of ESO observatories with regard to the long-term climatic trends, as described in the next article.

(Part of this text was translated from the original French by S. Milligan.)

Seeing Update: La Silla Back on the Track

M. SARAZIN, ESO

The VLT at Paranal will be equipped with a new feature hitherto unknown at observatories: an Astronomical Site Monitor (ASM) whose function it is to deliver permanently and in real-time the status of the site parameters that affect astronomical observing and/or telescope performances. The ASM comprises several dedicated instruments locally controlled by a common unit and part of the observatory network. It will feed a database accessible by users, telescope subsystems and by the science archive management system.

Meteorological data and seeing have already been routinely monitored at Paranal, with one interruption period of 15 months during levelling work. A new 5-m-high tower based on a design for Galileo at La Palma by Capodimonte Astronomical Observatory (Italy) was erected last April for the differential image motion monitor (DIMM3). This tower has the advantage of being easily dis-

Figure 1: *This fully retractable enclosure (here shown half open) was entirely designed and built solely for the La Silla DIMM by the Department of Maintenance and Construction. It was installed on the 5-m-high concrete tower in April 1993 and can be remotely controlled by the DIMM itself.*

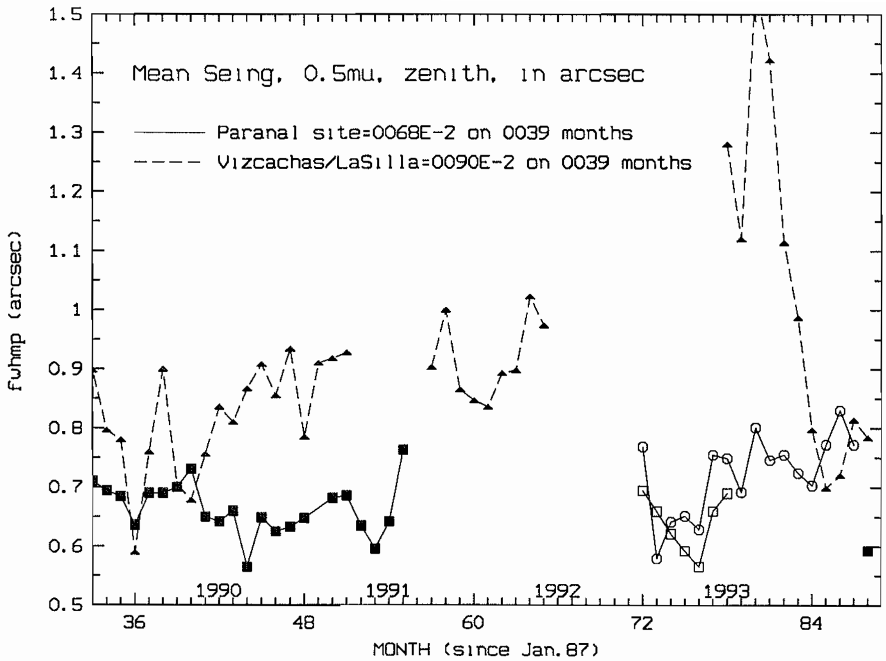

Figure 2: *The statistics of monthly averages of seeing measured at ESO sites. The dotted line corresponds to measurements taken on 5-m-high towers (filled triangles) at Vizcachas (Sept. 1989 to March 1991) and La Silla afterwards. The full line corresponds to measurements made at Paranal on a 5-m-high tower (filled squares) before levelling (Sept. 1989 to Aug. 1991) and at the new VLT Telescope Area on a 1-m-high platform (Dec. 1992 to March 1994) where southern (open circles) and northern (open squares) edges have been monitored. Since April 1994 measurements resumed on a 5-m-high tower at the northern edge (filled square on the right end).*

mantled if it disturbs VLT construction work during the years to come.

In the same way, although with less regularity, an identical monitor (DIMM2) was operated at La Silla after the Vizcachas candidate site was closed in March 1991. The instrument suffered serious damage from a thunderstorm in 1992 and was back in operation only in April 1993, with the addition of a remotely-controllable retractable enclosure (Fig. 1), and with an upgrade to the Unix operating system. In the meantime, the real-time dispatch of meteorological data to all La Silla telescopes was implemented (it is now also available with xmosaic). Since December 1993, DIMM2 has been fully automatized and the integration of seeing data in the starcat database has made it available to the community at large.

A comparative analysis of the trends in seeing quality at Paranal and La Silla was made regularly from September 1989 onwards on the basis of monthly averages (Fig. 2). It confirmed the steady degradation of observing conditions at La Silla in 1992 until the middle of 1993 which gave rise to increasing discontent on the part of users and was often misinterpreted as a general deterioration of telescope efficiency. But the most striking phenomenon has been the recent return of La Silla to the average level of 1989, in the three months from August to November 1993. Several recent reports from astronomers visiting La Silla confirm that this positive trend is also noticeable in the final quality of astronomical work. As an illustration of this remarkable improvement, Figure 3 shows the seeing record of the night before New Year's Eve where sub-half arcsec imaging was possible at La Silla for four consecutive hours.

Such a relatively rapid change teaches us something new about the dynamics of seeing and, although the climatic causes of low-frequency seeing variations are not yet understood, it should help us to improve our analysis of the results obtained during short-term surveys of potential observatory sites. A comparison with the evolution of Paranal, in spite of a slight increase of the average seeing at ground level in the past 8 months, also confirms the validity of the initial assumption that a site further north within the Atacama desert would be more stable than one located at its edge.

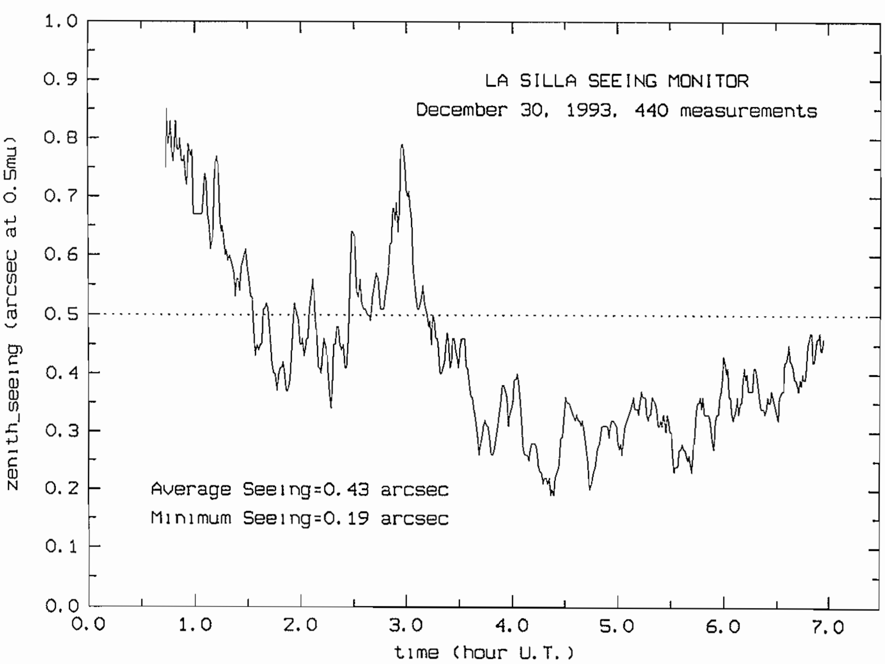

Figure 3: *The DIMM2 seeing record at La Silla with a 120s temporal resolution during a particularly good night.*