# Performance of Southern Hemisphere Stations

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## Abstract

*The opening of the San Juan station in Argentina, and upgrades to other stations, has lifted the productivity of Southern Hemisphere stations to perhaps 40% of the global total, with a nice distribution in longitude. Various operational statistics will illustrate the improvements achieved up to the start of October 2006.*

## Introduction

The new San Juan station came on-line in March 2006, in collaboration with NAOC, Beijing. Its performance is highly impressive, and is significantly helping to satisfy the eternal cry for more SLR observations from the Southern Hemisphere.

At the same time, the BKG station TIGO at Concepcion, Chile has been upgraded to hectoHertz ranging with reliability enhancements, and has improved its output considerably in recent months. MOBLAS 8 at Papeete, Tahiti and MOBLAS 6 at Hartebeesthoek, South Africa are also making significant contributions. Of the Australian stations, MOBLAS 5 at Yarragadee continues to be the benchmark and workhorse station for the entire global SLR network, while the re-built EOS/GA station on Mount Stromlo is again one of the top performers.

Statistics for three 28-week time periods in Fig.1 and Table 1 show that data quantities from Southern Hemisphere stations have sustainably improved this year (2006). Other performance metrics are also displayed in this paper.

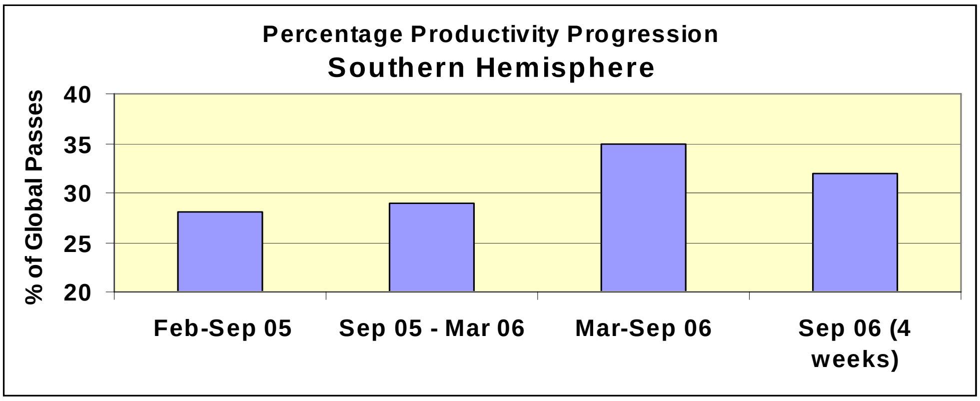



***Figure 1**: Percentages of passes from Southern Hemisphere stations. Data extracted from CDDIS weekly SLRQL reports*

***Table 1**: Pass percentages from S. Hemisphere stations, and also by ILRS Network*

| **Period** | **Southern Hemisphere** | **By Network** (see (Luck, 2006)) | | |
|---|---|---|---|---|
| | | **WPLTN** | **NASA** | **EUROLAS** |
| 2005 Feb-Sept | 28 | 38 | 15 | 46 |
| 2005 Sept – 2006 Mar | 29 | 44 | 15 | 41 |
| 2006 Mar-Sept | 35 | 42 | 16 | 41 |
| 2006 Sept 03-30 | 32 | 45 | 12 | 43 |

### Numbers of passes by station

In Fig.2, station totals are grouped by hemisphere. Some of the least productive Northern Hemisphere stations are not shown. Each point is a 28-week total.

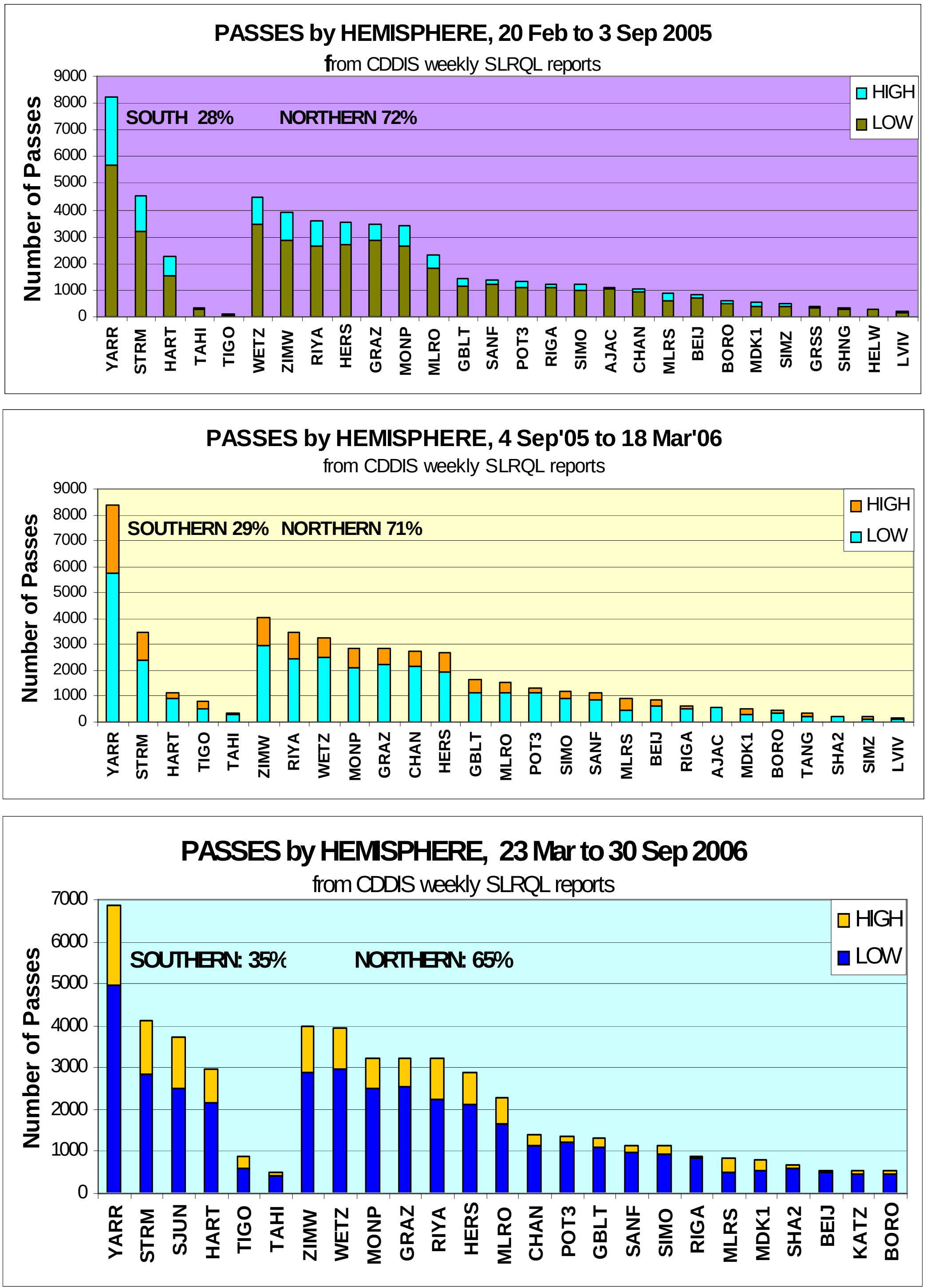



*Figure 2: Station totals for three 28-week periods, grouped by hemisphere.*

### Range bias stability

Fig.3 compares Southern and Northern Hemisphere stations for the RMSs since 19 March this year. They are the RMSs of range biases for LAGEOS I and II combined taken from NICT daily analysis reports, after some outlier editing.

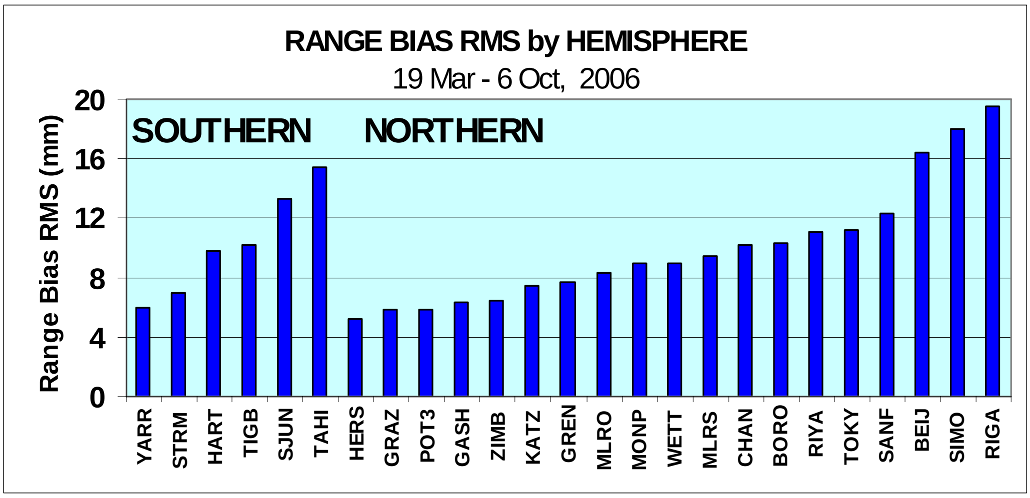



***Figure 3**: RMS of Range Bias per station per hemisphere, L1 & L2*

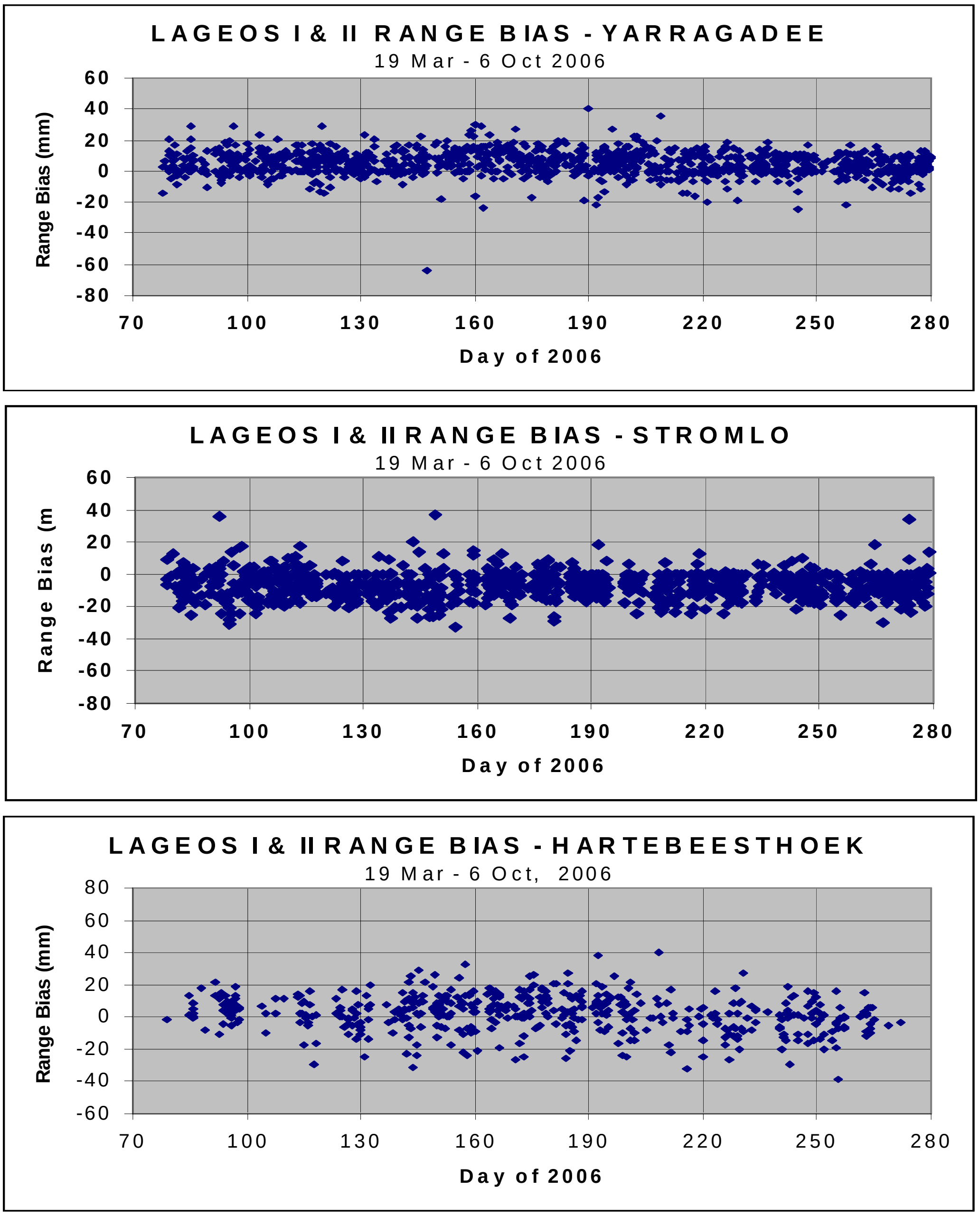



***Figure 4a**: Range Biases for LAGEOS I & II for Yarragadee, Stromlo and Hartebeesthoek .*

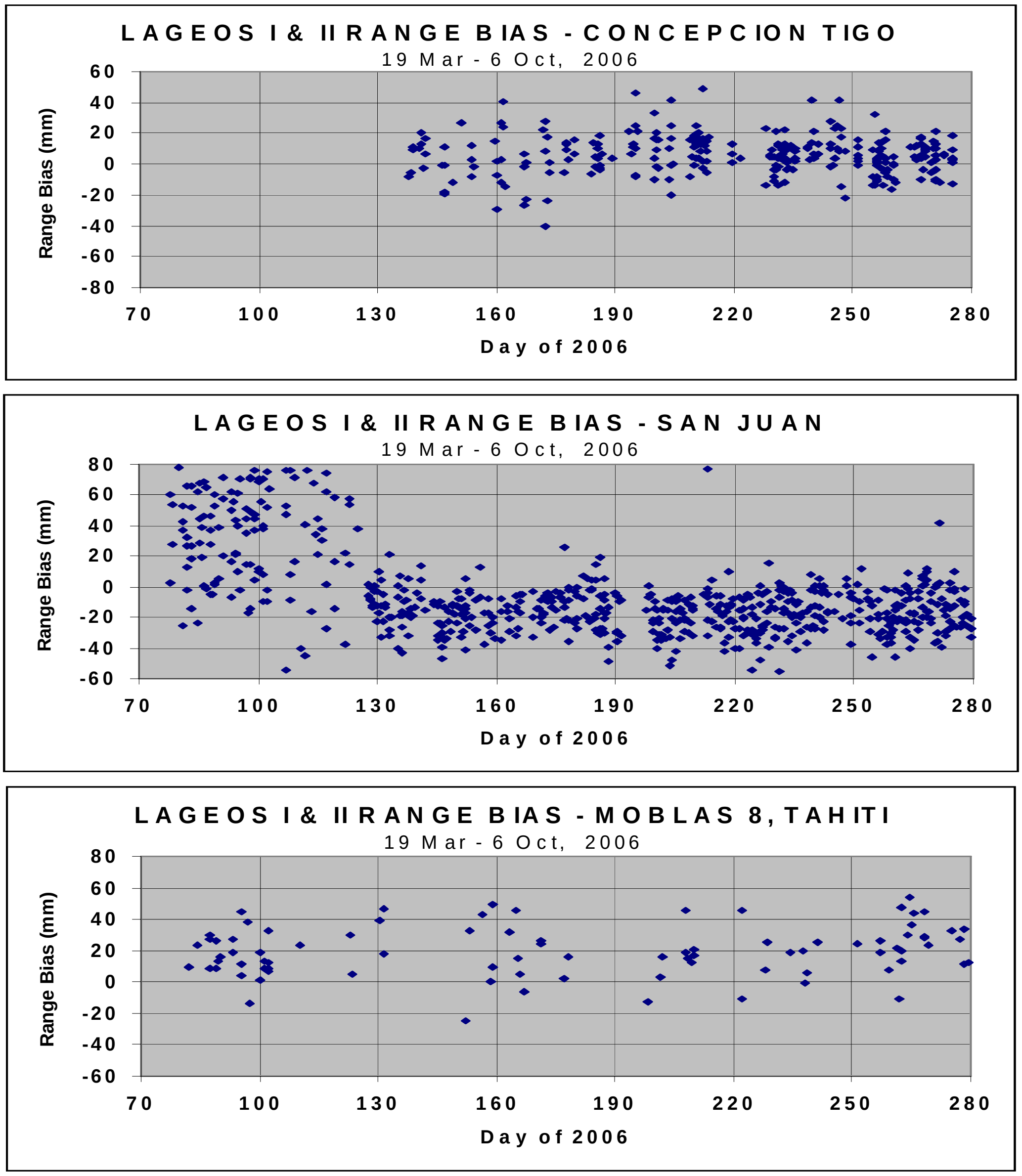



***Figure 4b***: *Range Biases for LAGEOS I & II for Conception, San Juan and Tahiti.*

The time series for the 6 stations are shown in Figures 4a and 4b.

## Normal points per pass

This category reflects the observing efficiency of the stations, and is affected by skill in acquiring satellites and interleaving passes as well as factors like aperture, laser power, sun avoidance, priorities and bad weather. In general, a low ratio means more uncertainty in determining time bias, unless the few normal points are very well distributed throughout the pass. Fig 5 contrasts northern and southern hemispheres.

## Normal point precision

NP precision is calculated as the RMS of normal points about a trend-line fitted through the orbit residuals of the Analysis Centre's global solution. It is thus a measure of a station's internal consistency, and is affected by short-term variations in the station's observations, method of forming normal points, and errors in weather data as well as the Analysis Centre's methods of filtering and fitting. Fig.6 shows the results for the 28-week period Mar-Sep 2006 taken from the NICT daily analysis reports, but only for passes containing at least four NPs, and Fig.7 shows the time-series for each station over the same period.

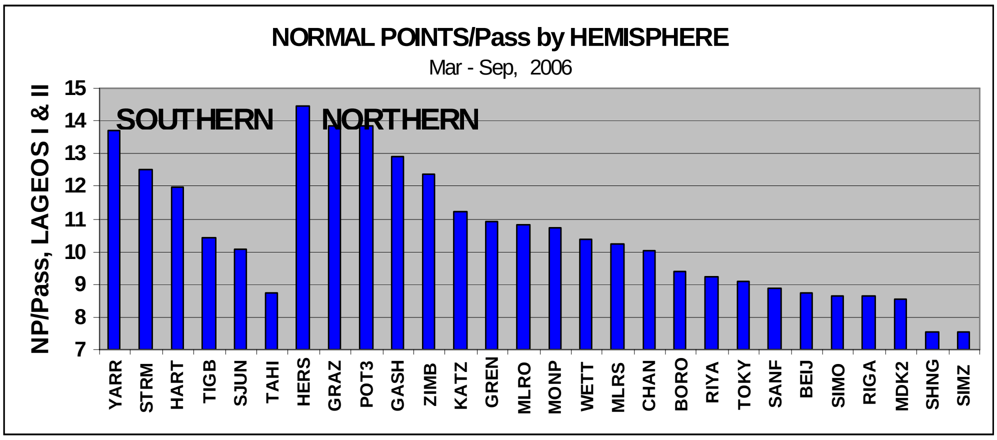



***Figure 5**: Normal points per Pass, LAGEOS I & II combined, extracted from NICT daily Analysis Reports. (Note truncated vertical scale - it looks worse than it is!)*

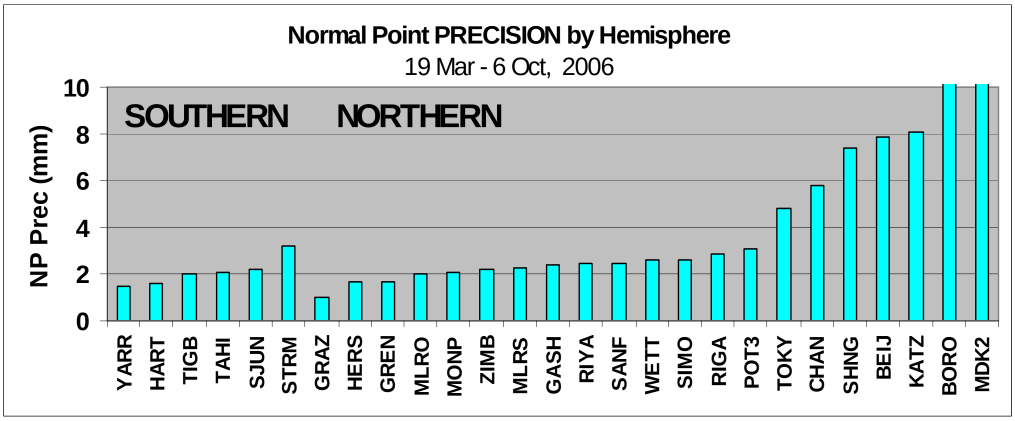



***Figure 6**: Normal Point Precisions Summary*

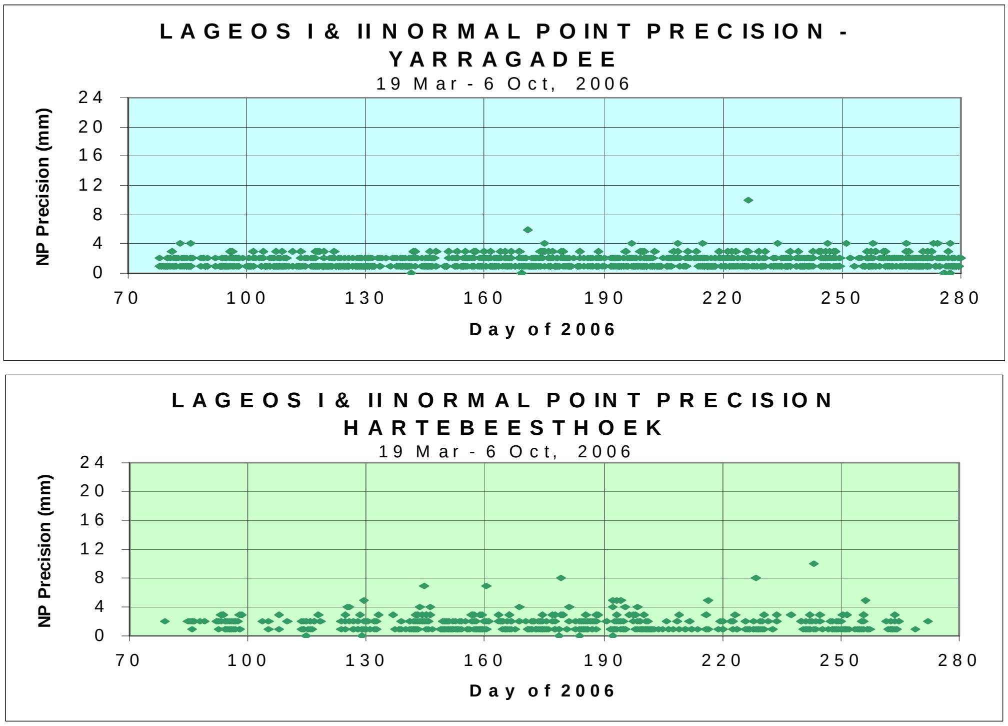



***Figure 7a**: Normal Point Precisions for Southern Hemisphere stations*

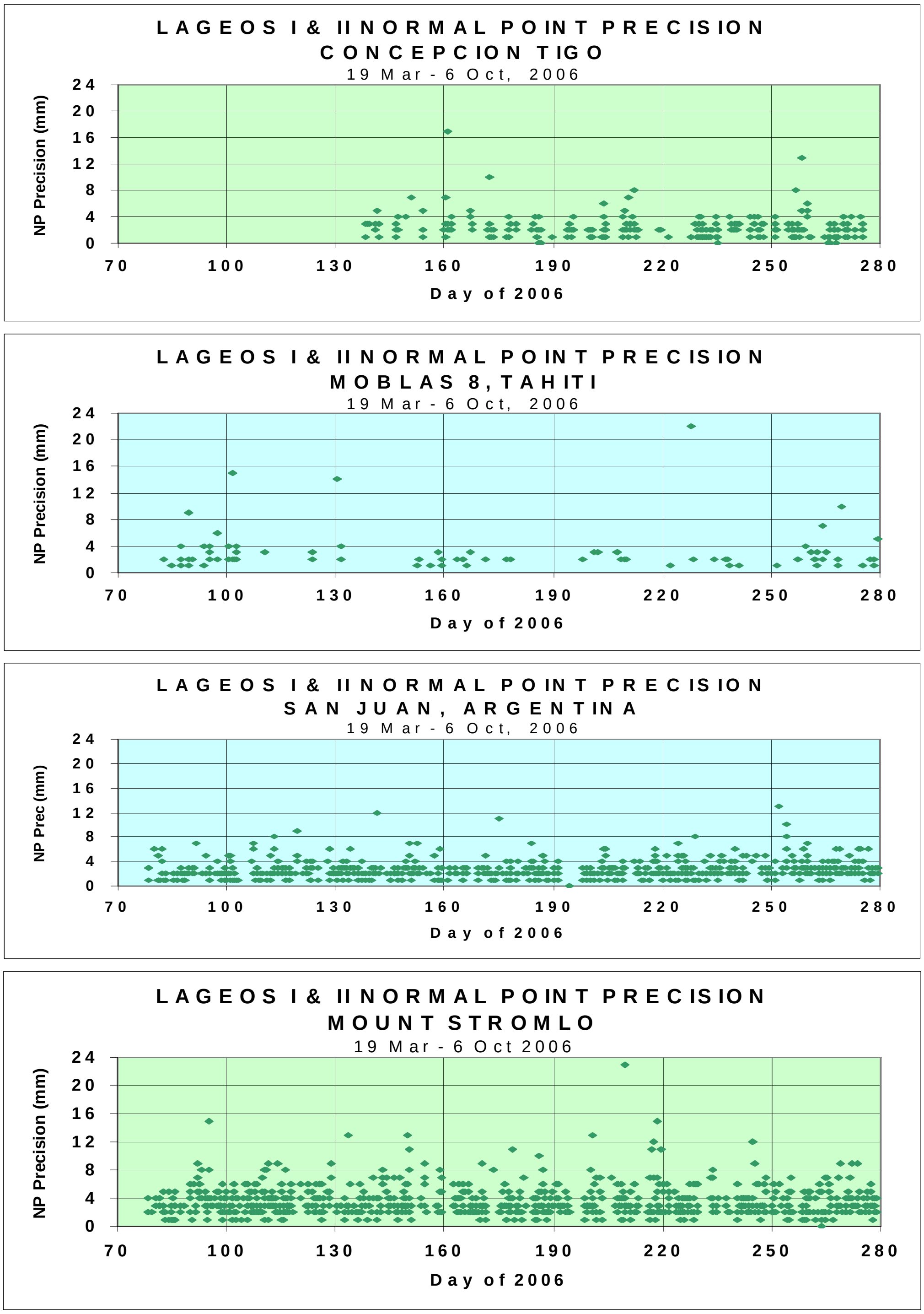
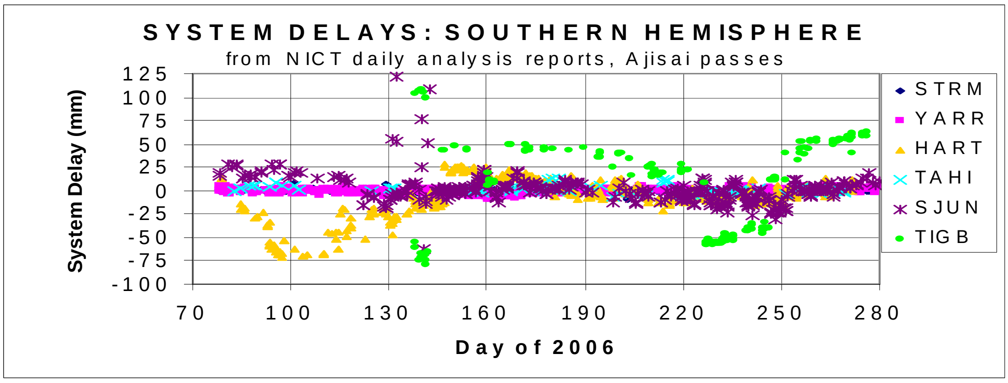



***Figure 7b****: Normal Point Precisions for Southern Hemisphere stations*

## System delay

The system delays are the results of system calibration by pre- and/or post-pass ground target ranging, or equivalent. They have arbitrary values and are allowed to jump when, for example, cables are changed in the paths to the timing system, components in the optical path are moved, or other repairs and maintenance are performed. Otherwise, however, they should remain constant. In particular, they should not show drifts such as TIGO has been undergoing since about day 225 in Fig.8. The results in Fig.8 are from Ajisai entries in NICT daily analysis reports, with respect to the average system delay over the 28-week period.



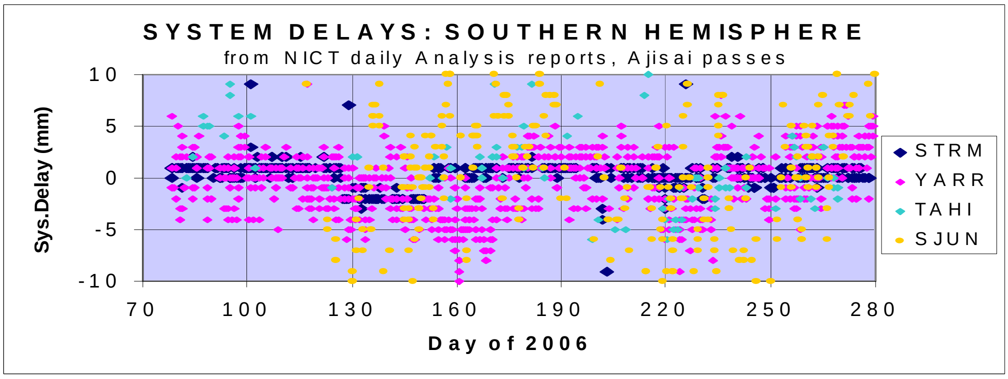




***Figure 8***: *System Delays per pass (Ajisai). The lower plot is at expanded vertical scale.*

## Conclusions

There has been a boom in Southern Hemisphere ranging in 2006, due mainly to the commissioning of the San Juan station, whose productivity is the more remarkable because it only observes at night-time. Tahiti only has limited day-time tracking.

The quality of ranging is comparable with Northern Hemisphere stations, too, although some stations show worrying trends in their system delay stabilities while Stromlo should be doing far better in its normal point precisions. The imminent resurrection of Arequipa, Peru should further enhance the Southern Hemisphere contribution to global SLR performance.

## Acknowledgements

The data used here were extracted from the CDDIS SLR Data Reports, courtesy Carey Noll, and from the NICT daily Multi-Satellite Bias Analysis Reports, courtesy Toshi Otsubo. These reports are produced on behalf of the International Laser Ranging Service (ILRS).

## Reference

[1] Luck, J.McK.: "*Performance of WPLTN Stations*", these proceedings (2006)