Quality Assessment of SLR Observations

Peter Dunn (Raytheon Inc., Greenbelt, Maryland, USA)
Mark Torrence (SGT Inc., Greenbelt, Maryland, USA)

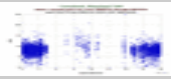
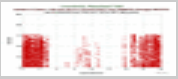
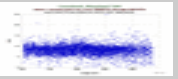
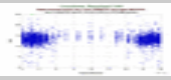
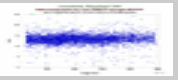
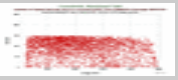
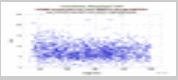
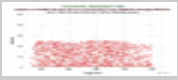
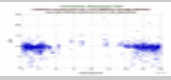
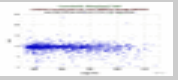
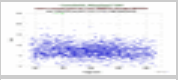
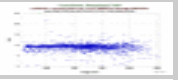
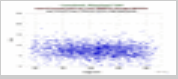
The ILRS web-site includes summaries of satellite characteristics in the menu for each station. The quantity of the range measurements is denoted by the average number of full rate returns included in a normal point, and the quality is given by the average RMS of the full rate measurements contributing to the normal point. This information is contained within the data records and the summaries can be used to monitor the performance of a station, as well as to show characteristics of the station's instrumentation. The quality and quantity assessment summaries for all stations in the network are now also available on the web-site menus for each satellite. Inspection of this new perspective shows characteristics which are common to all stations, indicating the satellite signature, but some differences between stations tracking the same satellite are also noticeable. We will show examples of quality assessment plots given as functions of local time and range, and discuss the implications of these results on the accuracy of the satellite orbits determined by a network of different SLR tracking instruments.

SLR Data Characteristics

- Quantity : number of returns in a normal point
- Quality: RMS of the normal point contribution
- Station performance: day/night tracking from local time dependence
- Satellite and station behavior: range dependence includes array effects

Greenbelt, Maryland satellite information as a function of local time and satellite range

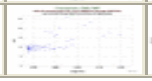
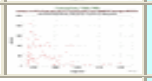
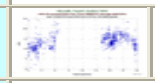
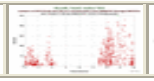
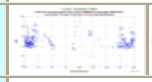
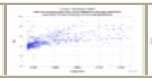
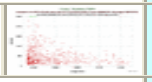
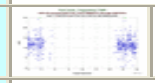
timespan is May 1, 2006 through May 30, 2007

satellite	local time		range		satellite	local time		range	
	npt rms	num FR /npt	npt rms	num FR /npt		npt rms	num FR /npt	npt rms	num FR /npt
ANDE-Act 5 sec					Jason-1 15 sec				
ANDE-Pas 5 sec					Ajisai 30 sec				
CHAMP 5 sec					LAGEOS-2 120 sec				
Grace-A 5 sec					LAGEOS-1 120 sec				
Grace-B 5 sec					Etalon-1 300 sec				
ICESat 5 sec					Etalon-2 300 sec				
OICETS 30 sec	n/a				GLONASS-78 300 sec	n/a			
GP-B 15 sec	n/a				GLONASS-86 300 sec	n/a			
Larets 30 sec					GLONASS-87 300 sec				
ALOS 15 sec					GLONASS-89 300 sec				
ERS-2 15 sec					GLONASS-95 300 sec				
Envisat 15 sec					GLONASS-99 300 sec				
GFO-1 15 sec					GPS-35 300 sec	n/a			
Starlette 30 sec					GPS-36 300 sec	n/a			
Stella 30 sec					GIOVE-A 300 sec				
Beacon-C 15 sec					ETS-8 300 sec	n/a			

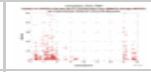
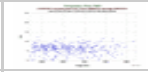
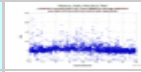
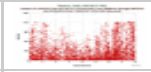
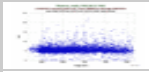
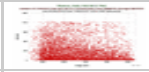
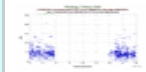
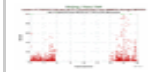
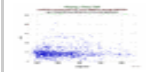
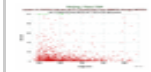
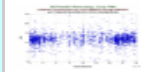
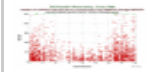
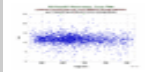
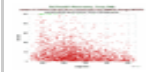
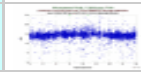
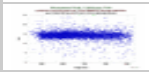
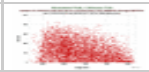
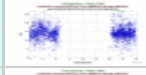
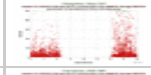
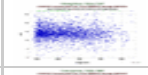
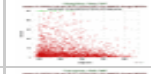
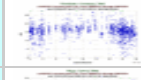
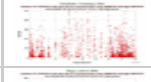
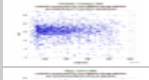
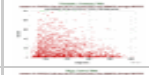
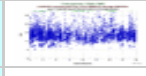
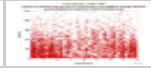
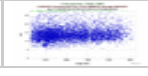
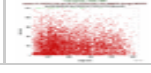
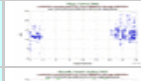
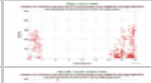
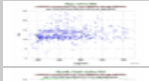
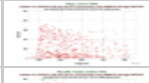
Satellite Properties

- Now consider the breakdown by satellite for all stations
- Satellite dependent properties can be isolated

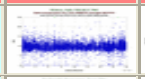
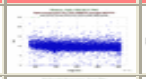
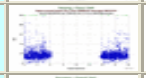
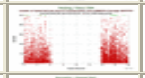
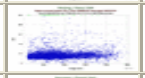
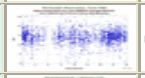
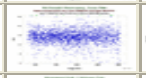
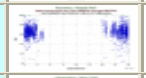
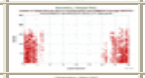
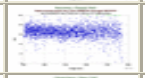
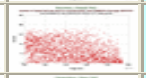
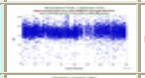
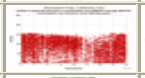
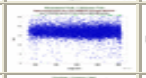
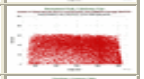
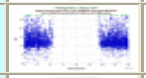
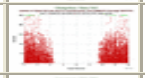
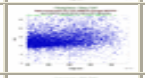
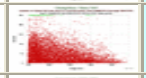
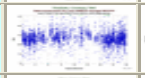
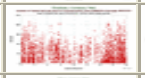
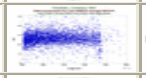
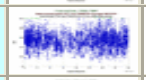
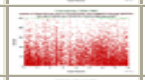
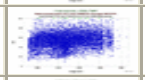
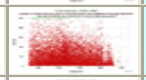
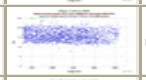
GPS-35 information
as a function of local time and satellite range
timespan is May 1, 2006 through May 30, 2007

site	local time		range		site	local time		range	
	npt rms	numFR/npt	npt rms	numFR/npt		npt rms	numFR/npt	npt rms	numFR/npt
Arequipa, Peru AREL, 7403	n/a				Matera, Italy (MLRO) MATM, 7941				
Beijing, China BEIL, 7249	n/a				McDonald Observatory, Texas MDOL, 7080				
Borowiec, Poland BORL, 7811					Monument Peak, California MONL, 7110				
Changchun, China CHAL, 7237					Potsdam, Germany POT3, 7841	n/a			
Concepcion, Chile CONL, 7405					Riga, Latvia RIGL, 1884	n/a			
Golosiiv, Ukraine GLSL, 1824	n/a				Riyadh, Saudi Arabia RIYL, 7832				
Tanegashima, Japan GMSL, 7358					San Fernando, Spain SFEL, 7824	n/a			
Greenbelt, Maryland GODL, 7105	n/a				Shanghai, China SHA2, 7821	n/a			
Graz, Austria GRZL, 7839					Simeiz, Ukraine SIML, 1873	n/a			
Haleakala, Hawaii HA4T, 7119	n/a				Simosato, Japan SISL, 7838	n/a			
Hartebeesthoek, South Africa HARL, 7501	n/a				San Juan, Argentina SJUL, 7406				
Herstmonceux, United Kingdom HERL, 7840					Stafford, Virginia STAL, 7865	n/a			
Helwan, Egypt HLWL, 7831	n/a				Mt Stromlo, Australia STL3, 7825				
Koganei, Japan(CRL) KOGC, 7308					Tahiti, French Polynesia THTL, 7124	n/a			
Katzively, Ukraine KTZL, 1893	n/a				Wettzell, Germany (WLRS) WETL, 8834				
Lviv, Ukraine LVIL, 1831	n/a				Yarragadee, Australia YARL, 7090				
Maidanak 1, Uzbekistan MAIL, 1864					Zimmerwald, Switzerland ZIML, 7810				

LAGEOS-2 information
as a function of local time and satellite range
timespan is May 1, 2006 through May 30, 2007

site	local time		range		site	local time		range	
	npt rms	num FR /npt	npt rms	num FR /npt		npt rms	num FR /npt	npt rms	num FR /npt
Arequipa, Peru AREL, 7403					Matera, Italy (MLRO) MATM, 7941				
Beijing, China BEIL, 7249					McDonald Observatory, Texas MDOL, 7080				
Borowiec, Poland BORL, 7811					Monument Peak, California MONL, 7110				
Changchun, China CHAL, 7237					Potsdam, Germany POT3, 7841				
Concepcion, Chile CONL, 7405					Riga, Latvia RIGL, 1884				
Golosiiv, Ukraine GLSL, 1824	n/a				Riyadh, Saudi Arabia RIYL, 7832				
Tanegashima, Japan GMSL, 7358					San Fernando, Spain SFEL, 7824				
Greenbelt, Maryland GODL, 7105					Shanghai, China SHA2, 7821				
Graz, Austria GRZL, 7839					Simeiz, Ukraine SIML, 1873				
Haleakala, Hawaii HA4T, 7119					Simosato, Japan SISL, 7838				
Hartebeesthoek, South Africa HARL, 7501					San Juan, Argentina SJUL, 7406				
Herstmonceux, United Kingdom HERL, 7840					Stafford, Virginia STAL, 7865	n/a			
Helwan, Egypt HLWL, 7831	n/a				Mt Stromlo, Australia STL3, 7825				
Koganei, Japan(CRL) KOGC, 7308					Tahiti, French Polynesia THTL, 7124				
Katzively, Ukraine KTZL, 1893					Wettzell, Germany (WLRS) WETL, 8834				
Lviv, Ukraine LVIL, 1831	n/a				Yarragadee, Australia YARL, 7090				
Maidanak 1, Uzbekistan MAIL, 1864					Zimmerwald, Switzerland ZIML, 7810				

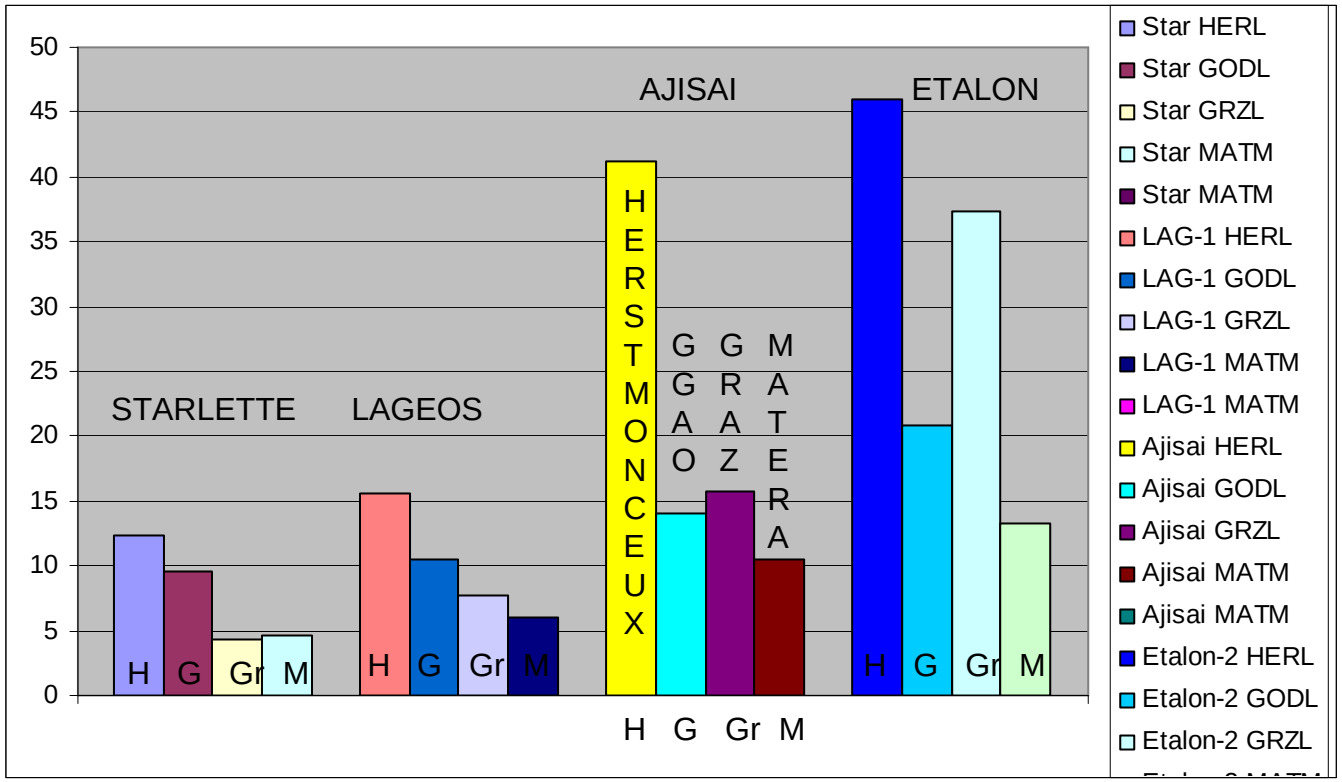
Ajisai information
as a function of local time and satellite range
timespan is May 1, 2006 through May 30, 2007

site	local time		range		site	local time		range	
	npt rms	numFR /npt	npt rms	numFR /npt		npt rms	numFR /npt	npt rms	numFR /npt
Arequipa, Peru AREL, 7403					Matera, Italy (MLRO) MATM, 7941				
Beijing, China BEIL, 7249					McDonald Observatory, Texas MDOL, 7080				
Borowiec, Poland BORL, 7811					Monument Peak, California MONL, 7110				
Changchun, China CHAL, 7237					Potsdam, Germany POT3, 7841				
Concepcion, Chile CONL, 7405					Riga, Latvia RIGL, 1884				
Golosiiv, Ukraine GLSL, 1824					Riyadh, Saudi Arabia RIYL, 7832				
Tanegashima, Japan GMSL, 7358					San Fernando, Spain SFEL, 7824				
Greenbelt, Maryland GODL, 7105					Shanghai, China SHA2, 7821				
Graz, Austria GRZL, 7839					Simeiz, Ukraine SIML, 1873				
Haleakala, Hawaii HA4T, 7119					Simosato, Japan SISL, 7838				
Hartebeesthoek, South Africa HARL, 7501					San Juan, Argentina SJUL, 7406				
Herstmonceux, United Kingdom HERL, 7840					Stafford, Virginia STAL, 7865	n/a			
Helwan, Egypt HLWL, 7831	n/a				Mt Stromlo, Australia STL3, 7825				
Koganei, Japan(CRL) KOGC, 7308					Tahiti, French Polynesia THTL, 7124				
Katzively, Ukraine KTZL, 1893					Wettzell, Germany (WLRS) WETL, 8834				
Lviv, Ukraine LVIL, 1831					Yarragadee, Australia YARL, 7090				
Maidanak 1, Uzbekistan MAIL, 1864					Zimmerwald, Switzerland ZIML, 7810				

Four Stations in the Network

- Herstmonceux: single photon
- GGAO: multiple photon, MOBLAS system
- Graz: Kiloherz
- Matera: Unique

RMS in mm for four Stations from four Satellites



Conclusions

- Much information in data charts found on the ILRS Web-site
- Performance characteristics of the stations can be quickly assessed
- They provide an extra dimension of comparison to the Global Performance Charts
- Satellite dependent effects are observed and may include systematic components