ILRS Central Bureau Report

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Michael Pearlman
ILRS Central Bureau

2019 ILRS Technical Workshop
October 21, 2019
Stuttgart, Germany

Outline

- GB overview
- Recent developments
  - Network
  - Missions
  - Infrastructure
  - Operations

ILRS Governing Board: 2019-2020

- Elected positions:
  - EUROLAS Network Representatives:
    Pippo Bianco, Georg Kirchner*
  - NASA Network Representatives:
    Jan McGarry, Stephen Merkowitz*
  - WPLTN Representatives:
    James Bennett, Zhang Zhongping
  - Data Center Representative:
    Christian Schwatke*
  - LLR Representative:
    Jean-Marie Torre*
  - Analysis Representatives:
    Cinzia Luceri*, Erricos Pavlis*
  - At-Large Representatives:
    Toshi Otsubo* (Chair), Matt Wilkinson*
- Ex-officio/appointed positions:
  - Director of the Central Bureau:
    Mike Pearlman
  - Secretary of the Central Bureau:
    Carey Noll
  - Representative of IAG Commission I:
    Urs Hugentobler
  - IERS Representative:
    Daniela Thaller
- Appointed by the Governing Board:
  - **Ulli Schreiber***
  - **Krzysztof Sośnica**

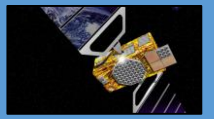
*Note: * SC/SG chair/co-chair*

Standing committees/study groups

- Analysis SC
  - Erricos Pavlis
  - Cinzia Luceri
- Data Formats and Procedures SC
  - Christian Schwatke
  - Randy Ricklefs
- Missions SC
  - Stephen Merkowitz
  - Toshi Otsubo
- Networks and Engineering SC
  - Matt Wilkinson
  - Georg Kirchner
- Transponder SC
  - Ulli Schreiber
  - Jean-Marie Torre
- Space Debris SG
  - Georg Kirchner
  - Daniel Kucharski

Recent developments: general

- Posted all material (presentations, posters, some papers, summary information) from Canberra workshop
- Held first "SLR School" before this workshop
- Established ILRS tracking strategy for GNSS
- Published new mission support request guidelines
- Developed draft Memorandum of Understanding between ILRS/GGOS and ROSCOSMOS
- Installed new SLR QC process at ILRS OCs
- Published ILRS workshop planning guidelines
- Finalizing Journal of Geodesy Special Issue on Laser Ranging
- Compiling 2016-2018 ILRS report

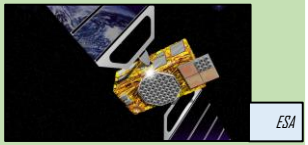


Recent developments: network

- Station closings:
  - MLRS, McDonald, TX: lightening strike; to be replaced by SGSLR
- Upgraded stations:
  - Simosato (Japan): kHz operations late 2018
  - Wuhan (China): submitting data (in quarantine)
  - BKG AGGO (Argentina): continuing setup La Plata Observatory; TIGO relocation
  - San Juan (Argentina): kHz, operations planned for 2020
- Quarantined stations:
  - Wuhan, China (new station; under evaluation)
  - San Fernando, Spain (irregular data submission)
  - Tanegashima, Japan (irregular data submission)
  - Geochang, Korea (new station; no data)
- New station installations underway/planned

GNSS tracking strategy

- Large number of GNSS satellites
  - GNSS agencies have different requirements for ILRS tracking support
  - More satellites coming with GPS-III
  - GNSS tracking strategy put in place after consultation with missions, IGS, and the ICG
- Strategy:
  - Each constellation selects 4 satellites for higher priority tracking (3 segments of tracking requested per pass)
  - All of the remaining GNSS satellites are tracked at lower priority on a non-interference basis with all of the other ILRS requirements (sampling approach)
- Concentrated tracking in special campaigns (e.g., eclipsing)



Galileo

GLONASS

BeiDou

GPS-III

New mission support guidelines

- ILRS carefully reviews new mission support requests based on need and likelihood of success in meeting their tracking requirements
- Recent MSRs showed need for more information earlier in request process
- New guidelines for missions to address prior to submitting MSR:
  1. Does SLR provide a unique capability that other tracking systems cannot? Is SLR the primary or secondary tracking technique? Can the tracking requirement be met by another technique?
  2. What added value will SLR data provide to the data products?
  3. Has the mission sufficiently quantified its tracking requirement (accuracy, data volume, coverage, etc.)? Does the mission have a vulnerable payload aboard that will require special tracking procedures?
  4. What is the procurement source of the retroreflector array(s)? Does the design include accommodation for the velocity aberration?
  5. Has the signal link budget been estimated either through comparison with spacecraft already tracked by SLR or through the link equation?
  6. Have provisions been made to provide reliable predictions in CPF format? Has this source tested their CPF files or are there plans to do such testing?
- Distributed and posted on ILRS website Feb-2019

Workshop planning guidelines

- International Workshops on Laser Ranging (IWLR)
  - Held every 2 years
  - ILRS CB requests proposals 3 months before next workshop
  - Host for next workshop selected at current workshop
  - Request proceeding papers
- Technical/Specialized ILRS Workshop
  - Held every 2 years between IWLR
  - Focus on topic of current importance
  - ILRS CB requests proposals 1.5-2 years prior; reviewed by GB
- All material made available to CB for posting on workshop websites
- Schedule for upcoming workshops:
  - 2020: 22nd IWLR in Kunming, China
    - October 2019: LOC presentation
  - 2021: Technical/Specialized Workshop
    - October 2019: begin search
    - January 2020: close search, GB review
    - March 2020: Notify host, community
    - October 2020: LOC presentation
  - 2022: 23rd IWLR
    - July 2020: begin search
    - October 2020: LOC presentations at 22nd IWLR and vote from attendees

OC data screening: updates

- ILRS OCs (NASA and EDC) updated incoming data screening process and criteria
  - Implemented more thorough QC procedures to improve ILRS data product for the user community
  - Harmonized process between EDC and NASA Ocs
  - Data screened and characterized as:
    - Valid: passed screening; data released
    - Errors: adversely impact quality of data and products (e.g., invalid date, invalid satellite, erroneous calibration, etc.); data not released
    - Warnings: minor impact on data quality; data released
- Process operational 15-Aug-2019
- Criteria posted on ILRS website:
  https://ilrs.gsfc.nasa.gov/network/site_procedures/data_screening_procedure.html

New formats: data and site logs

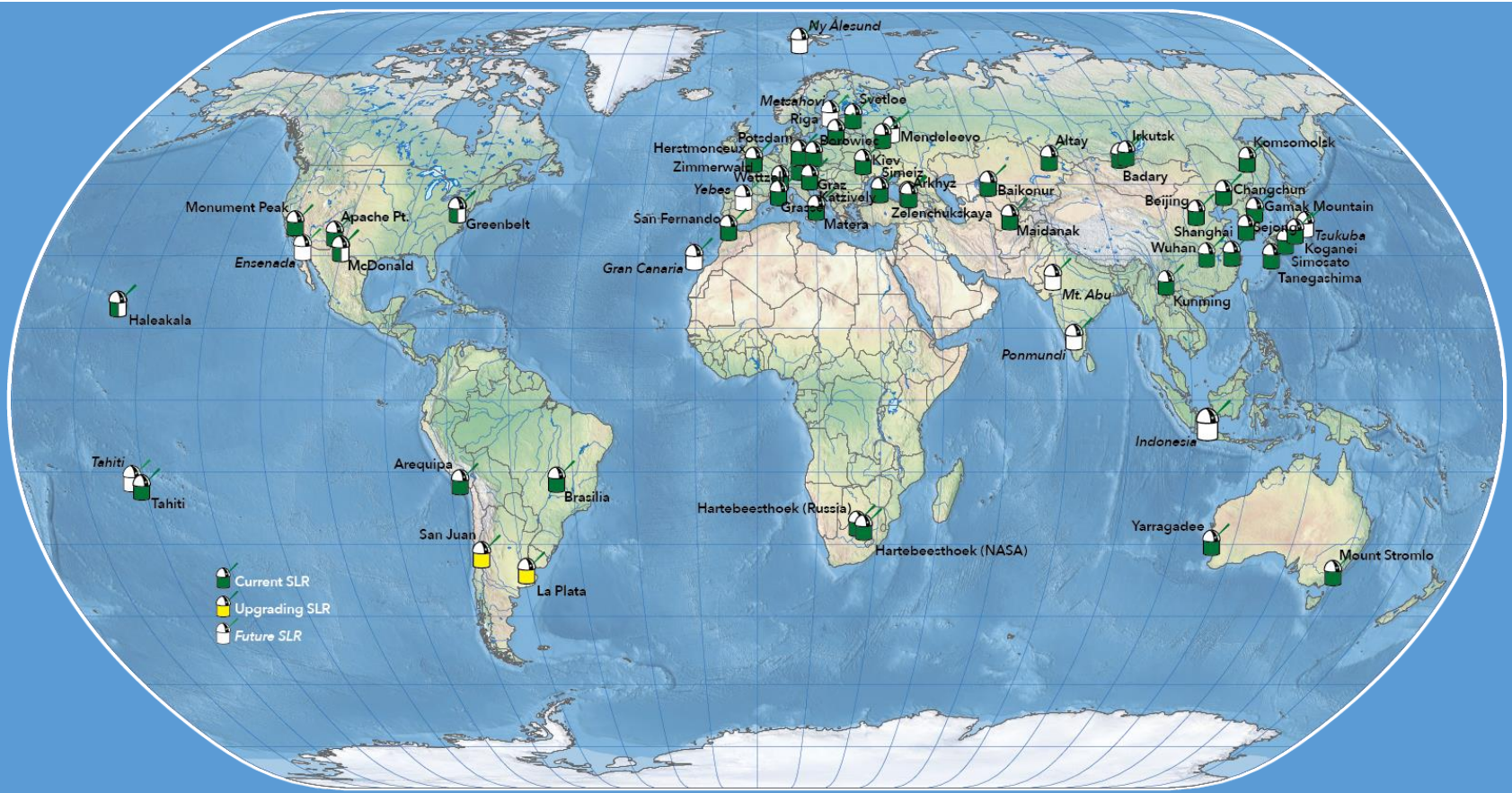
- Site logs
  - Updated format to add more information about station configuration and operations
  - Implemented improved web-based procedures at EDC for submitting/updating station site logs
  - Tool supports station personnel in keeping site logs current
  - ILRS CB reviewed many logs to push new version to operational status
  - New procedure operational: 15-Sep-2019
- CRD and CPF formats
  - Issued version 2 of both formats; final input on any modifications due
  - Facilitate support of future missions and applications (e.g., ELT, space debris)
  - Transmitting test data and predictions
  - Implementation date goal: end of 2020

Station/data evaluation/reporting

- Station assessment tool
  - Allows station personnel, analysts, CB to view network capabilities (e.g., #passes, #normal points, adherence to ILRS guidelines, etc.)
  - Emphasizes value of station performance to the user community and to the creation of science products
  - Shows areas of improvement to support ILRS goals
  - Generated monthly, reflects data assessed over the previous 12 months
- ILRS report cards
  - Generated since 2012
  - Required update of legacy software
  - Developed new software; under evaluation to compare results to legacy reports
  - Affects station and satellite-specific plots

Backup

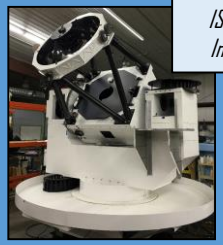
ILRS network



Future developments: network

Site	Type	Agency	Timeframe
La Plata, Argentina	Upgraded core site	BKG, Germany	2019 – 2020
San Juan, Argentina	Upgraded SLR system	NAOC, China	2019 – 2020
Metsahovi, Finland	New SLR system	FGRI, Finland	2019 – 2020
Greenbelt, MD, USA	Replacement core site	NASA, USA	2020 – 2022
Haleakala, HI, USA	Replacement core site	NASA, USA	2020 – 2022
McDonald, TX, USA	Replacement core site	NASA, USA	2020 – 2022
Ny Ålesund, Norway	New core site	NMA, Norway/NASA, USA	2020 – 2022
Ensenada, Mexico	New SLR site	IPIE, Russian Federation	2022 – 2026
Java, Indonesia	New SLR site	IPIE, Russian Federation	2022 – 2026
Gran Canaria, Spain	New SLR in core site	IPIE, Russian Federation	2022 – 2026
Tahiti, French Polynesia	New SLR system	IPIE, Russian Federation	2022 – 2026
Mt Abu, India	New SLR site	ISRO, India	2020 – 2022
Ponmundi, India	New SLR site	ISRO, India	2020 – 2022
Tsukuba, Japan	New SLR site	JAXA, Japan	2021
Yebes, Spain	New SLR site	IGS, Spain	2022

Tochka, Mendeleevo, Russia

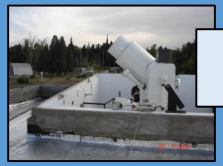


ISRO, India

Sazhen-TM, Brasilia, Brazil

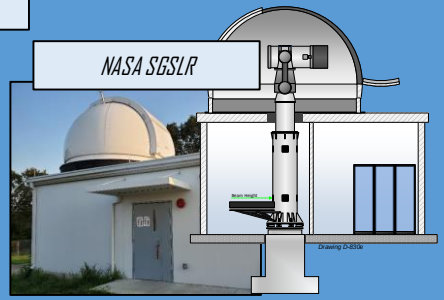
Metsähovi, Finland

Wuhan, China



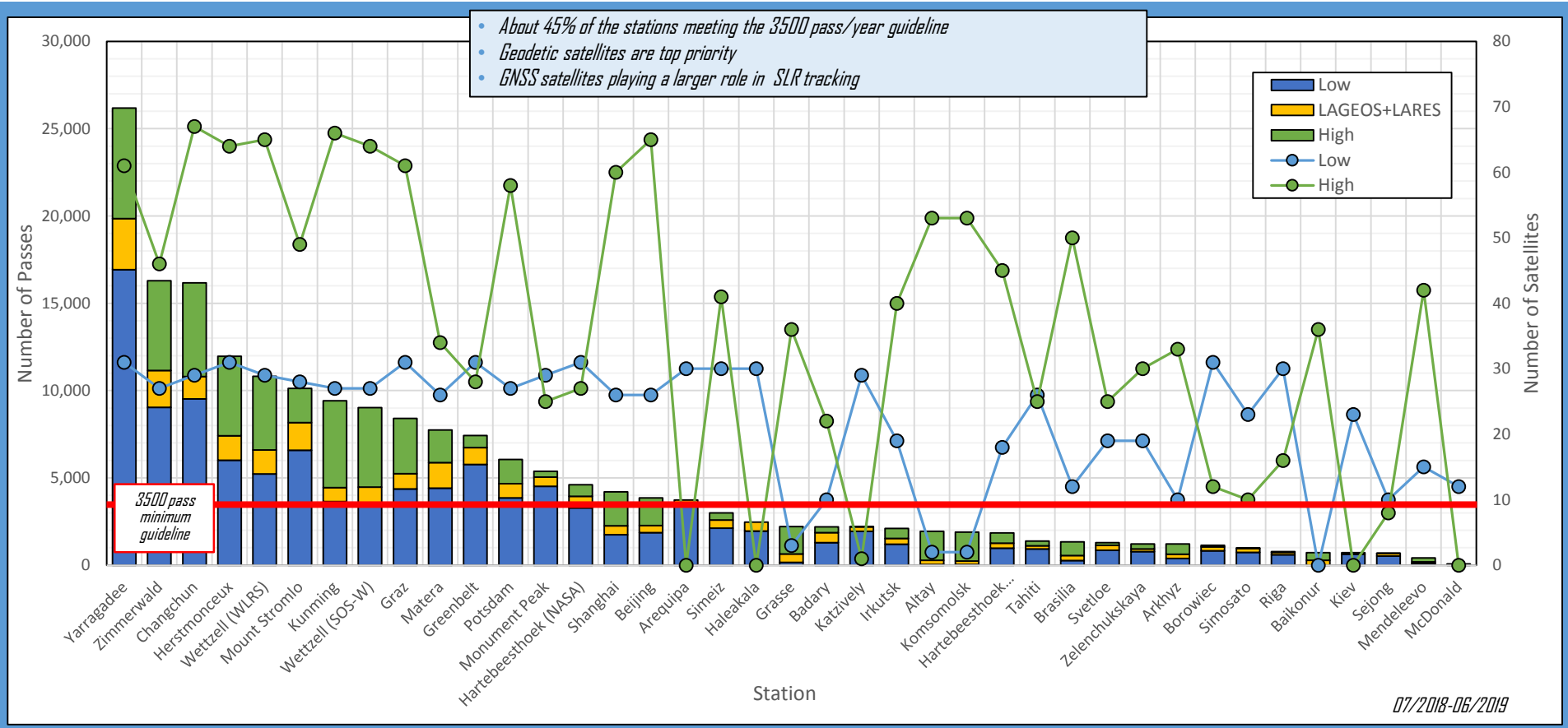
San Juan, Argentina

Ny Ålesund, Norway



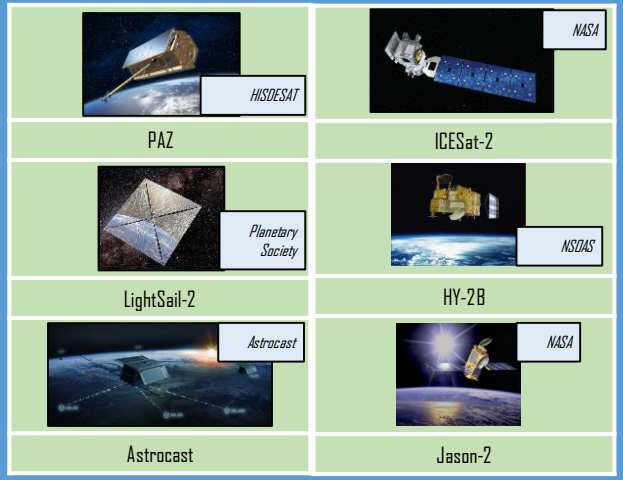
NASA SGSLR

Station performance: passes



Recent developments: missions

- Recent additions to the ILRS priority list:
  - PAZ (SAR mission)
  - ICESat-2 (laser altimetry mission/restricted tracking)
  - Beidou-3M (4 GNSS satellites)
  - Galileo (4 GNSS satellites)
  - HY-2B (altimetry mission)
  - LightSail-2 (solar sail)
- Past missions:
  - Jason-2 (ended 30-Sep-2019)
  - Select GNSS satellites
- Future approved missions requesting ILRS support:
  - Astrocast Precursor (2 cubesats/engineering testing)
  - Additional GNSS: BeiDou/Compass, Galileo, etc.
  - COSMIC-2, HY-2C, SWOT, NISAR
- Etalon tracking campaign held; results available *https://ilrs.gsfc.nasa.gov/docs/2019/Etalon_land2_2019_Campaign.pdf*



ILRS 2016-2018 Report: Status

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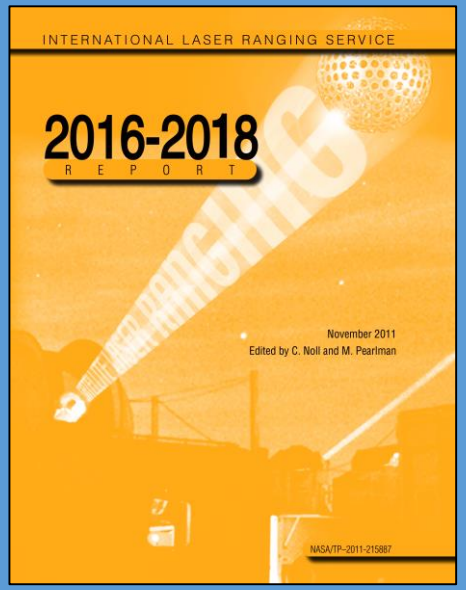

General information

- Began effort in early 2019 by identifying, then contacting, authors, contributors, etc.
- Include individual reports from stations, ACs/AACs/LAACs/CCs, SCs/SG
- Contributions have been slow to arrive
- Editing within ILRS CB
- Final publishing to be determined (NASA?)
- Limited number of printed copies (per request only)

Report outline and status

- Sections
  - Preface, etc. (50% complete)
    - Dedications?
    - Chairpersons remarks (COMPLETE)
  - Introduction (R. Gross/COMPLETE)
  - SLR Contributions to Science
  - About the ILRS (COMPLETE)
  - ILRS Operations (90% complete)
  - Emerging Technology (COMPLETE)
  - Mission Reports (90% complete)

- Sections (continued)
  - AC/AAC/LAAC/CC Reports
    - 2 of 7 AC reports received
    - 5 of 20 AAC reports received
    - 2 of 6 LAAC reports receive
  - Station Reports
    (25 of 43 reports received)
  - SC/SG/Board Reports
    (5 of 7 reports received)
  - ILRS Meetings (COMPLETE)
  - Appendices