
APPENDIX



FRASER PANGLOSS



APPENDIX

ILRS INFORMATION

ILRS Contributing Organizations

Agency	Country
National University of San Juan of Argentina	Argentina
Geoscience Australia	Australia
EOS Space Systems Pty. Ltd.	Australia
Austrian Academy of Sciences	Austria
Central Laboratory for Geodesy, Bulgarian Academy	Bulgaria
Observatorio Geodetico TIGO, Universidad de Concepción	Chile
Academia Sinica	China
Chinese Academy of Sciences (CAS)	China
Chinese Academy of Surveying and Mapping (CASM)	China
Institute of Seismology, China Seismological Bureau	China
National Astronomical Observatories of China (NAOC)	China
Shanghai Astronomical Observatory (SAO)	China
State Seismological Bureau	China
Yunnan Observatory	China
Technical University of Prague	Czech Republic
National Research Institute of Astronomy and Geophysics (NRIAG)	Egypt
Finnish Geodetic Institute	Finland
Centre National d'Etudes Spatiales (CNES)	France
Groupe de Recherches de Geodesie Speciale (GRGS)	France
Institut Géographique National (IGN)	France
Observatoire de la Côte d'Azur/Center d'Etudes et de Recherches Géodynamiques et Astrométrie (OCA/CERGA)	France
Observatoire de Paris	France
Tahiti Geodetic Observatory, University of French Polynesia (UFP)	French Polynesia
Bundesamt für Kartographie und Geodäsie (BKG)	Germany
Deutsches Geodätisches ForschungsInstitut (DGFI)	Germany
European Space Agency (ESA)	Germany
Forschungseinrichtung SatellitenGeodasie/Institut fuer Erdmessung (FESG/IFE)	Germany
Helmholtz Centre Potsdam GeoForschungsZentrum German Research Centre for Geosciences (GFZ)	Germany
University of Hannover/Institut fuer Erdmessung	Germany

ILRS Contributing Organizations continued

Agency	Country
Agenzia Spaziale Italiana (ASI)	Italy
Hitotsubashi University	Japan
Hydrographic Department/Japan Coast Guard	Japan
Japan Aerospace Exploration Agency (JAXA)	Japan
National Institute of Information and Communications Technology (NICT)	Japan
Astronomical Institute, University of Latvia	Latvia
Delft University of Technology (DUT)	The Netherlands
Division for Electronics, Forsvarets ForskningsInstitutt (FFI)	Norway
Universidad Nacional de San Augustin (UNSA)	Peru
Space Research Center of the Polish Academy of Sciences (PAS)	Poland
Institute of Applied Astronomy (IAA)	Russia
Institute of Astronomy of the Russian Academy of Sciences (INASAN)	Russia
Institute of Metrology for Time and Space (IMVP)	Russia
Information-Analytical Center (IAC)/Mission Control Center (MCC)	Russia
Russian Space Agency (RSA)	Russia
Space Research Institute (SRI) for Precision Instrument Engineering	Russia
King Abdulaziz City for Science and Technology (KACST)	Saudi Arabia
Hartebeesthoek Radio Astronomy Observatory (HartRAO)	South Africa
Real Instituto y Observatorio de la Armada	Spain
Astronomical Institute, University of Berne (AIUB)	Switzerland
Astronomical Observatory of the Ivan Franko National University of Lviv	Ukraine
Scientific Research Institute (SRI) Crimean Astronomical Observatory	Ukraine
Lebedev Physical Institute in the Crimea	Ukraine
Main Astronomical Observatory (MAO) of the National Academy of Sciences of Ukraine (GAOUA)	Ukraine
Natural Environment Research Council (NERC)	United Kingdom
Newcastle University	United Kingdom
Harvard-Smithsonian Center for Astrophysics	USA
Jet Propulsion Laboratory (JPL)	USA
Joint Center for Earth System Technology (JCET), University of Maryland, Baltimore County (UMBC)	USA
National Aeronautics and Space Administration Goddard Space Flight Center (NASA GSFC)	USA
Naval Research Laboratory (NRL)	USA
University of Hawaii Institute for Astrometry	USA
University of Texas at Austin	USA
University of Texas, Center for Space Research (CSR)	USA

List of Acronyms

3D-ART	Three-Dimensional Ray Tracing
	◆ ◆ ◆
AAC	Associate Analysis Center
AC	Analysis Center
ACES	Atomic Clock Ensemble in Space
ACT	Australian Capital Territory
ADEOS	Advanced Earth Observing Satellite
AG	Absolute Gravimeter
AGU	American Geophysical Union
AIRS	Atmospheric Infrared Sounder (USA)
AIUB	Astronomical Institute of Berne (Switzerland)
ALOS	Advanced Land Observing Satellite
Alt/Az	Altitude/Azimuth
ALTIDEMON	Altimetry and Transponder Ground Simulation Demonstration (Germany)
ANDE	Atmospheric Neutral Density Experiment (USA)
ANDE-RR	Atmospheric Neutral Density Experiment Risk Reduction (USA)
ANSI	American National Standards Institute
ANU	Australian National University
AOM	Acousto-Optic Modulator
APD	Avalanche Photodiodes
APOLLO	Apache Point Observatory Lunar Laser-ranging Operation (USA)
AQ-SPAD	Actively-Quenched Single Photoelectron Avalanche Detector
ARB	Average Per Year Range Bias
ARTEMIS	Advanced Relay And Technology Mission
ASI	Agenzia Spaziale Italiana (Italian Space Agency)
ASTRO-G	Astronomy Satellite-G (Japan)
AVNIR	Advanced Visible Near-Infrared Radiometer (Japan)
AWG	Analysis Working Group
Az-El	Azimuth-Elevation
	◆ ◆ ◆
BAS	Bulgarian Academy of Sciences
BE-C	Beacon Explorer C
BELA	BepiColombo Laser Altimeter
BIPM	International Bureau of Weights and Measures
BIU	Beijing Industrial University
BKG	Bundesamt für Kartographie und Geodäsie (Germany)
BLITS	Ball Lens In The Space (Russia)
BNSC	British National Space Center
BSW	Bernese Software
	◆ ◆ ◆
Cal/Val	Calibration/Validation
CAMAC	Computer Automated Measurement And Control
CAS	Chinese Academy of Sciences
CASM	Chinese Academy of Surveying and Mapping
CB	Central Bureau
CC	Combination Center
CCD	Charge-Coupled Device
CCR	Corner Cube Reflector

CDDIS	Crustal Dynamics Data Information System (USA)
CEG	School of Engineering and Geosciences, Newcastle University (UK)
CERGA	Centre d'Etudes et de Recherches Géodynamiques et Astrométrie (France)
CfA	Center for Astrophysics (USA)
CFD	Constant-Fraction Discriminator
CGS	Centro di Geodesia Spaziale (Italy)
CHAMP	CHALLENGING Mini-Satellite Payload
CLG	Central Laboratory for Geodesy (Bulgaria)
CLS	Collecte, Localisation, Satellites (France)
CMD	Constant Mid-signal Detection
CMONOC	Crustal Movement Observation Network of China
CNES	Centre National d'Etudes Spatiales (France)
CNS	Communication, Navigation and Surveillance
CODE	Center for Orbit Determination in Europe
CoM	Center of Mass
COPs	Control Operation Planning Subsystem (Japan)
COPS	Control and Operation Planning Subsystem
COSPAR	Committee on Space Research
CPF	Consolidated Prediction Format
CPP	Combination Pilot Project
CRD	Consolidated Laser Ranging Data format
CRDF	Civilian Research and Development Foundation (USA)
CRF	Celestial Reference Frame
CRL	Communications Research Laboratory (Japan)
CSPAD	Compensated Single Photoelectron Avalanche Detector
C-SPAD	Compensated Single Photoelectron Avalanche Detector
CSR	Center for Space Research (USA)
CSRIFS	Combined Square Root Information Filter and Smoother (Finland)
CSTG	International Coordination of Space Techniques for Geodesy and Geodynamics
CTC	Cross Track Channel
CTU	Czech Technical University (Czech Republic)

◆ ◆ ◆

DEM	Digital Elevation Model
DEOS	Department of Earth Observation (The Netherlands)
DESDynI	Deformation, Ecosystem Structure and Dynamics of Ice (USA)
DFG	German Research Foundation
DGFI	Deutsches Geodätisches Forschungsinstitut (Germany)
DIMM	Differential Image Motion Monitor
DLR	German Aerospace Center
DoD	Department of Defense (USA)
DOE	Diffraction Optical Element
DOGS	DGFI Orbit and Geodetic Parameter Estimation Software
DOP	Dilution of Precision
DORIS	Doppler Orbitography and Radiopositioning Integrated by Satellite
DPSSL	Diode Pumped Solid State Laser
DREAM	Dual-channel Radiometer for Earth and Atmosphere Monitoring (Korea)
DTOF	Differential Time of Flight
DUT	Delft University of Technology (The Netherlands)

◆ ◆ ◆

ECMWF	European Centre for Medium-Range Weather Forecasts (UK)
EDC	EUROLAS Data Center (Germany)
EGU	European Geophysical Union
EMCCD	Electron Multiplying Charge Coupled Device
EO	Earth Observation
EOP	Earth Orientation Parameter
EOS	Earth Observing System (USA)
EOS	Electro Optical Systems (USA)
EOST	EOS Technologies, Inc. (Australia)
ERP	Earth Rotation Parameter
ERP	Effective Reflecting Plane
ERS	European Remote Sensing Satellite
Er:YAG	Erbium Yttrium Aluminum Garnet
ESA	European Space Agency
ESOC	ESA Space Operations Center
ET	Event Timer
ETH	Eidgenössische Technische Hochschule/Swiss Federal Institute of Technology (Switzerland)
ETS	Engineering Test Satellite
EU	European Union
EUMETSAT	European Organization for the Exploitation of Meteorological Satellites
EUREFIAG	Reference Frame Sub-Commission for Europe
EUROLAS	European Laser Consortium
	◆ ◆ ◆
FAA	Federal Aviation Administration (USA)
FESG	Forschungseinrichtung Satellitengeodäsie (Research Facility for Space Geodesy, Germany)
FFI	Forsvarets Forskningsinstitutt (Norwegian Defense Research Establishment)
FNSPE	Faculty of Nuclear Sciences and Physical Engineering (Czech Republic)
FOV	Field Of View
FPGA	Field Programmable Gate Array
FTLRS	French Transportable Laser Ranging System
FTP	File Transfer Protocol
FWHM	Full Width at Half Maximum
	◆ ◆ ◆
GA	Geoscience Australia
GaAsP	Gallium Arsenide Photo Diode
GAOUA	Main Astronomical Observatory of the National Academy of Sciences of Ukraine
GB	Gigabyte
GeoDAF	Geodetic Data Archive Facility (Italy)
GEO	Group on Earth Observations
GEOS	Geodetic and Earth Orbiting Satellite
GEOSS	Global Earth Observation System of Systems
GFO	GEOSAT Follow-On (USA)
GFZ	GeoForschungsZentrum (Germany)
GGAO	Goddard Geophysical and Astronomical Observatory (USA)
GGM	Global Gravitational Model
GGOS	Global Geodetic Observing System
GGOS-D	Global Geodetic Observing System German Component
GIA	Glacial Isostatic Adjustment
GIOVE	Galileo in Orbit Validation Experiment
GIUB	Geographische Institut der Universität Bonn (Germany)

GLAS	Geoscience Laser Altimeter System (USA)
GLONASS	Global Navigation Satellite System
GLONASS	Global'naya Navigatsionnay Sputnikovaya Sistema
GM	Gravitational Constant
GNSS	Global Navigation Satellite System
GOCE	Gravity Field and Steady-state Ocean Circulation Explorer
GP-B	Gravity Probe B
GPS	Global Positioning System
GPSR	GPS Receiver
GRACE	Gravity Recovery And Climate Experiment
GRGS	Groupe de Recherches de Geodesie Speciale (France)
GSFC	Goddard Space Flight Center (USA)
GSTB	Galileo System Test Bed
GUTS	Global and High Accuracy Trajectory Determination System

◆ ◆ ◆

H2A/LRE	Laser Ranging Experiment
HAC	High Accuracy Clock
HartRAO	Hartebeesthoek Radio Astronomy Observatory (South Africa)
HEO	High Earth Orbiter
HIT-U	Hitotsubashi University (Japan)
HOLLAS	Haleakala Laser Station (USA)
HP	Hewlett-Packard
HTSI	Honeywell Technology Solutions, Inc. (USA)
HV	High Voltage
HVAC	Heating, Ventilation, and Air Conditioning
HxET	Herstmonceux Event Timer
Hz	Hertz

◆ ◆ ◆

IAA	Institute of Applied Astronomy (Russia)
IAC	Information-Analytical Center (Russia)
IAG	International Association of Geodesy
IAPG/TUM	Institute of Astronomical and Physical Geodesy of the Technische Universität München (Germany)
IAPSO	International Association for the Physical Sciences of the Oceans
IA/RAS	Institute of Astronomy/Russian Academy of Sciences
IAU	International Astronomical Union
ICCD	Intensified Charged Coupled Device
ICESat	Ice Cloud and Land Elevation Satellite
ICET	International Center for Earth Tides
ICRF	International Celestial Reference Frame
ICRS	International Celestial Reference System
IDS	International DORIS Service
IEEE	Institute of Electrical and Electronics Engineers
IERS	International Earth Rotation and Reference Systems Service
IFE	Institut für Erdmessung (Germany)
IGeS	International Geoid Service
IGFS	International Gravity Field Service
IGGOS	Integrated Global Geodetic Observing System
IGLOS	International GLONASS Service
IGN	Institut Geographique National (France)

IGOS	Integrated Global Observing Strategy
IGS	International GNSS Service
ILRS	International Laser Ranging Service
ILRSA	ILRS A solution
ILRSB	ILRS B solution
IMVP	Institute of Metrology for Time and Space (Russia)
INASAN	Institute of Astronomy of the Russian Academy of Sciences
InGaAs	Indium-Gallium-Arsenide
INGV	Istituto Nazionale di Geofisica (Italy)
InSAR	Interferometric Synthetic Aperture Radar
IOV	In Orbit Validation
IPIE	Science Research Institute for Precision Instrument Engineering (Russia)
IR	Infrared
IRS	Indian Research Satellite
IRV	Inter-Range Vector
ISRO	Indian Space Research Organization
ISTRAC	ISRO Telemetry Tracking and Command Network (India)
ITRF	International Terrestrial Reference Frame
ITRS	International Terrestrial Reference System
IUGG	International Union of Geodesy and Geophysics
IVS	International VLBI Service for Geodesy and Astrometry
	◆ ◆ ◆
JAXA	Japan Aerospace Exploration Agency
JCET	Joint Center for Earth Systems Technology (USA)
JGM	Joint Gravity Model
JGR	Journal of Geophysical Research
JIVE	Joint Institute for VLBI for Europe
JPL	Jet Propulsion Laboratory (USA)
	◆ ◆ ◆
KAIST	Korea Advanced Institute of Science and Technology
KASI	Korean Astronomy and Space Science Institute
KACST	King Abdulaziz City for Science and Technology (Saudi Arabia)
kHz	Kilohertz
Km	Kilometer
KOMPSAT	Korean Multi-Purpose Satellite
KSLV	Korea Space Launch Vehicle
	◆ ◆ ◆
LAGEOS	LAser GEOdynamics Satellite
LAREG	Laboratoire de Recherches en Géodésie (France)
LARES	Laser Relativity Satellite
LE	Leading Edge
LEO	Low Earth Orbit
LLR	Lunar Laser Ranging
LNU	Lviv National University (Ukraine)
LOD	Length Of Day
LOLA	Lunar Orbiter Laser Altimeter
LOS	Loss Of Signal
LOSSAM	LAGEOS Spin Axis Model
LOSTHERM	LageOS THERmal Model

LR	Laser Ranging
LRA	Laser Retroreflector Array
LRE	Laser Retroreflector Experiment
LRO	Lunar Reconnaissance Orbiter
LRO-LR	Lunar Reconnaissance Orbiter Laser Ranging
LRR	Laser Retro Reflector
LRRA	Laser Retro Reflector Array
LTT	Laser Time Transfer
LURE	LUnar Ranging Experiment



MAO	Main Astronomical Observatory (Ukraine)
MCC	Mission Control Center (Russia)
MCP	Micro Channel Plate
MeO	Meteorology and Optics (France)
MEO	Medium Earth Orbit
MESSENGER	MERCURY Surface, Space ENVIRONMENT, GEOchemistry, and Ranging
MF	Mapping Function
MFC	Microsoft Foundation Class
MGS	Mars Global Surveyor
MHz	Megahertz
MIT	Massachusetts Institute of Technology (USA)
MLA	Mars Laser Altimeter
MLRO	Matera Laser Ranging Observatory (Italy)
MLRS	McDonald Laser Ranging System (USA)
MRR	Modulated Retro-Reflectors
MO	Master Oscillator
MOBLAS	MOBILE LASER Ranging System
MOE	Medium Orbit Ephemerides
MOLA	Mars Orbiter Laser Altimeter
MOPA	Master Oscillator Power Amplifier
MSTA	Ministry of Science and Technology of Argentina
MSTC	Ministry of Science and Technology of China
MTLRS	Modular Transportable Laser Ranging System



NAO	National Astronomical Observatories (China)
NAOC	National Astronomical Observatories of Chinese Academy of Sciences
NASA	National Aeronautics and Space Administration (USA)
NASDA	National Space Development Agency (Japan)
NAS	National Academy of Sciences (Ukraine)
NASU	National Academy of Sciences of Ukraine
NCEP	National Centers for Environmental Prediction (USA)
NCL	Newcastle University (UK)
NCRIEO	North China Research Institute of Electro-Optics
NCST	Naval Center for Space Technology (USA)
Nd:VAN	Neodymium Vanadate
Nd:YAG	Neodymium Yttrium Aluminum Garnet
Nd:YLF	Neodymium: Yttrium Lithium Fluoride
NEAR	Near Earth Asteroid Rendezvous
NEOS	National Earth Orientation Service (USA)
NERC	Natural Environment Research Council (UK)

NGA	National Geospatial-Intelligence Agency (USA)
NGSLR	Next Generation Satellite Laser Ranging System (USA)
NICT	National Institute of Information and Communications Technology (Japan)
NOAA	National Oceanic and Atmospheric Administration (USA)
NP	Normal Point
N-PET	New Precision Event Timer
NPET	New Pico Event Timer
NPOESS	National Polar-orbiting Operational Environmental Satellite System
NRIAG	National Research Institute of Astronomy and Geophysics (Egypt)
NRL	Naval Research Laboratory (USA)
NSF	National Science Foundation (USA)
NSGF	NERC Space Geodesy Facility (UK)
NTUA	National Technical University of Athens (Greece)
NUSJA	National University of San Juan of Argentina

◆ ◆ ◆

OCA	Observatoire de la Côte d'Azur (France)
OGT	Observatoire Géodésique de Tahiti (French Polynesia)
OICETS	Optical Inter-orbit Communications Engineering Test Satellite (Japan)
OSTM	Ocean Surface Topography Mission

◆ ◆ ◆

PALSAR	Phased Array L-band Synthetic Aperture Radar (Japan)
Pan-STARRS	Panoramic Survey Telescope and Rapid Response System (USA)
PAS	Polish Academy of Sciences
PCA	Point of Closest Approach
PCI	Peripheral Component Interface
PDF	Portable Document Format
PI	Principal Investigator
PM	Passive Modelocker
PMSL	Permanent Service for Mean Sea Level
PMT	Photo Multiplier Tube
POD	Precision Orbit Determination
POE	Precise Orbit Ephemerides
POL	Proudman Oceanographic Laboratory (UK)
POLAC	Paris Observatory Lunar Analysis Center (France)
PPET	Portable Pico-Second Event Timer
PPN	Parameterized Post Newtonian
PQ-SPAD	Passively Quenched Single Photoelectron Avalanche Detector
PRARE	Precise Range and Range-rate Equipment
PRISM	Panchromatic Remote-sensing Instrument for Stereo Mapping (Japan)
PROBA	Project for On-Board Autonomy
PTM	Pulse Transmission Mode

◆ ◆ ◆

QC	Quality Control
Q/C	Quality Control
QE	Quantum Efficiency
QZS	Quasi-Zenith Satellite
QZSS	Quasi-Zenith Satellite System

◆ ◆ ◆

R&D	Research and Development
RAS	Russian Academy of Sciences
RGG	Range Gate Generator
RGO	Royal Greenwich Observatory (UK)
RINEX	Receiver Independent Exchange format
RIS	Reflector In Space
RLEP	Robotic Lunar Exploration Program (USA)
RMS	Root Mean Square
ROA	Real Instituto y Observatorio de la Armada (Spain)
RRA	Retro Reflector Array
RSA	Russian Space Agency
RSG	Refraction Study Group
◆ ◆ ◆	
SAGE	Strategic Aerosol and Gas Experiment
SALRO	Saudi Arabian Laser Ranging Observatory
SAM	Saturable Absorber Mirror
SAO	Shanghai Astronomical Observatory (China)
SAO	Smithsonian Astrophysical Observatory (USA)
SAR	Synthetic Aperture Radar
SAW	Surface Acoustic Wave
SCEG	School of Civil Engineering and Geosciences (UK)
SESAM	SEmiconductor Saturable Absorber Mirror
SGF	Space Geodesy Facility (UK)
SGT	Stinger Ghaffarian Technologies, Inc. (USA)
SINEX	Software Independent Exchange Format
SIRAL	SAR/Inteferometric Radar Altimeter
SLR	Satellite Laser Ranging
SLRP	Satellite Laser Ranging Processor
SNR	Signal-to-Noise Ratio
SOD	Site Occupation Designator
SOHLA	Space Oriented Higashiosaka Leading Association (Japan)
SOS-W	Satellite Observing System-Wettzell (Germany)
SOVT	System Operational Verification Test
SP3	Standard Product 3 (satellite orbit format)
SPAD	Single Photoelectron Avalanche Detector
SPIE	International Society for Optical Engineering
SPWG	Signal Processing Working Group
SRI	Scientific Research Institute (Russia)
SRIF	Square Root Information Filter
SSC	Set of Station Coordinates
SSV	Set of Station Velocities
SSN	Space Surveillance Network (USA)
SST	Satellite-to-Satellite Tracking
SSTL	Surrey Satellite Technology Ltd. (UK)
STSAT	Science and Technology Satellite (Korea)
◆ ◆ ◆	

T2L2	Time Transfer by Laser Link
TC	Timer and Counter
TCE	Time Compare Equipment
TDC	Time-to-Digital Converter
TIGO	Transportable Integrated Geodetic Observatory
TIRV	Tuned Inter-Range Vector
Ti:Sap	Titanium Sapphire
Ti:Sapphire	Titanium Sapphire
TIU	Time Interval Unit
TKSC	Tskuba Space Center (Japan)
TLRS	Transportable Laser Ranging System
TOF	Time-Of-Flight
TOPEX	Ocean TOPography Experiment
ToR	Terms of Reference
TOR	Tracking, Occultation and Ranging
T/P	TOPEX/Poseidon
T/R	Transmit/Receive
TRF	Terrestrial Reference Frame
TROS	TRansportable Observation Station
TROS	Transportable Range Observation System
TTS	Transit Time Spread
TTS	Triple Threshold Screening
TM	Technische Universität München (Germany)
TUP	Technical University of Prague (Czech Republic)
	◆ ◆ ◆
UAW	Unified Analysis Workshop
UB	Ukraine Branch
UCSD	University of California San Diego (USA)
UFP	Université de la Polynésie Française (French Polynesia)
UK	United Kingdom
UMBC	University of Maryland Baltimore County (USA)
UNAVCO	University NAVSTAR Consortium
UNESCO	United Nations Education, Scientific and Cultural Organization
UNSA	Universidad Nacional de San Augustin (Peru)
UPF	University of French Polynesia
UPS	Uninterruptible Power Supply
URL	Uniform Resource Locator
USA	United States of America
UT	University of Texas
UTC	Universal Coordinated Time
UV	Ultraviolet
	◆ ◆ ◆
VLBI	Very Long Baseline Interferometry
	◆ ◆ ◆

WDC World Data Center
WDGPS Wide-area Differential Global Positioning System
WESTPAC Western Pacific Laser Tracking Network Satellite
WG Working Group
WLRS Wettzell Laser Ranging System (Germany)
WPLTN Western Pacific Laser Tracking Network
WRMS Weighted Root Mean Squared



XML Extensible Markup Language



YAG Yttrium Aluminum Garnet
Yt:YAG Ytterbium Yttrium Aluminum Garnet



ZD Zenith Delay