



# IGS

Workshop 2014  
23-27 June  
Pasadena, California, USA

Celebrating 20 Years of Service  
1994 ☆ 2014

In honor of the 20th Anniversary of the IGS,  
on the campus of the California Institute of Technology  
in Pasadena, California, USA  
23-27 June 2014

[www.igs.org/workshop](http://www.igs.org/workshop)

## Poster Sessions

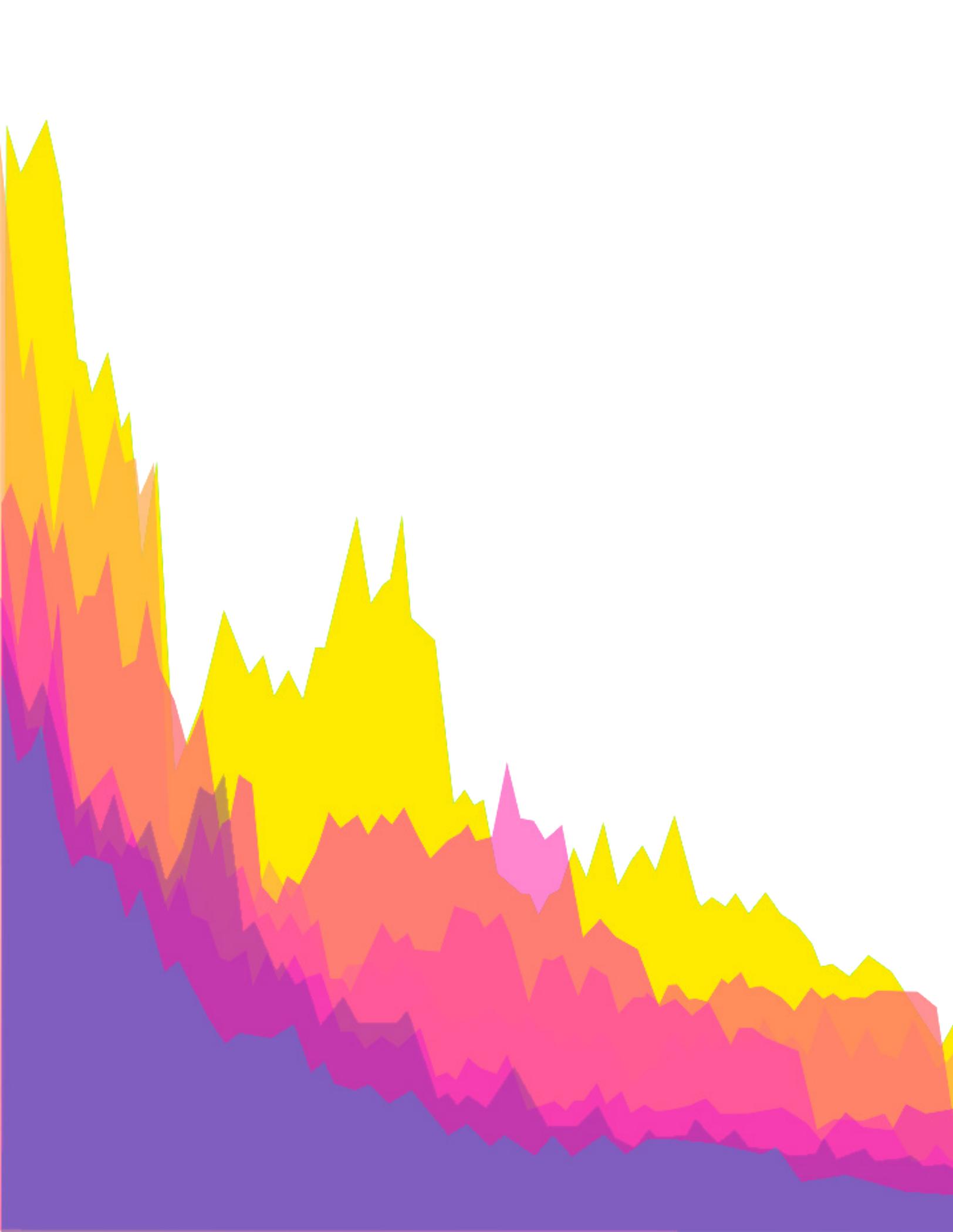
Analysis Center	Clocks	MGEX	Research
Antenna Calibrations	Data Center	Orbit Modeling	RINEX
Applications	Infrastructure	Real-Time Service	TIGA
Bias and Calibration	Ionosphere	Reference Frame	Troposphere

## Special Anniversary Colloquium - "IGS: the First 20 Years"

## Plenary Sessions

Welcome Plenary  
Celebrating 20 Years of Operational IGS Service  
IGS Real-Time Service on the way to FOC  
Reprocessing and Reference Frame  
Orbit and Modeling Effects in IGS Products  
Infrastructure and Calibration  
Progress and Development of MGEX  
Ionosphere Modeling and Related GNSS-Biases  
Troposphere Modeling and Other Applications  
Theory and Applications of GNSS Processing





Dear Workshop Attendee,

Welcome to the IGS Workshop 2014, held on the campus of the California Institute of Technology (Caltech) in Pasadena, California, USA. This special twentieth anniversary workshop is hosted by the IGS Central Bureau, with support from the NASA Jet Propulsion Laboratory (JPL) and Caltech.

This week-long workshop will feature plenary presentations and posters presented by our colleagues from around the world – illustrating how the IGS is truly an international organization serving science, engineering, and society in general.

The local organizing committee has been led by Ruth Neilan (JPL) and Steve Fisher (JPL), with support from members of the IGS Central Bureau. The scientific program committee has been led by Rolf Dach (AIUB), Shailen Desai (JPL), and Andrzej Krankowski (UWM).

We welcome you to attend the Icebreaker Reception on Monday evening, as well as the Anniversary Colloquium Reception on Thursday evening. We also encourage you to register for the special Workshop Dinner, to take place on Wednesday evening. Please let a member of the local organizing committee know if you have any questions or dietary restrictions.

Coffee breaks will be served at 10:30 and 15:30 each day on the Ramo Auditorium Patio, and will include a selection of baked goods and other snacks.

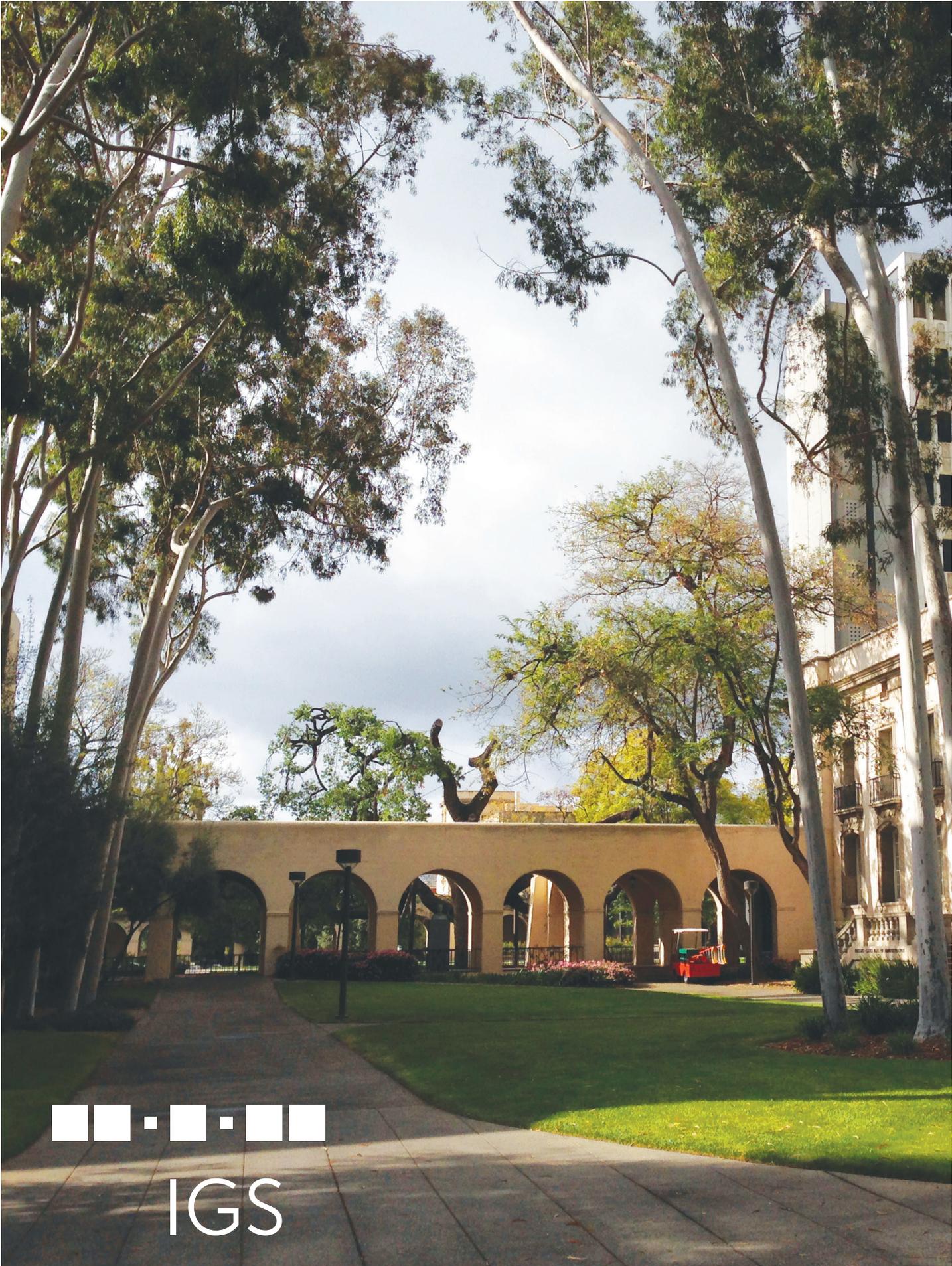
Lunch is on your own; we recommend the Chandler Cafeteria here on the Caltech campus, and can suggest many other nearby restaurants, if you wish to have lunch off campus.

The local organizing committee is delighted to be hosting you during this week-long meeting. Please do not hesitate to ask us if you have any questions.

We wish you a good workshop here in sunny southern California!



Ruth Neilan  
IGS Central Bureau Director  
Head of the Local Organizing Committee



IGS

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### Campus Directory Map

- + EMERGENCY TELEPHONE
- S SECURITY STATION
- ◆ FIRST AID STATION
- ★ SHELTER SITE
- ▲ EMERGENCY OPERATIONS CENTER
- CAMPUS BOUNDRY

## Venue and Registration



Registration and plenary sessions take place at Ramo Auditorium, located in Baxter Hall (building number 77 on the map)

Coffee breaks will be held on the patio outside of Ramo, 10:30-11:00 and 15:30-16:00 each day.



Poster presentations will take place in the Dabney Lounge, Wednesday and Thursday (building number 40 on the map)



The Anniversary Colloquium will take place in the Dabney Gardens on Thursday evening, 17:30-19:30. (building number 40 on the map)

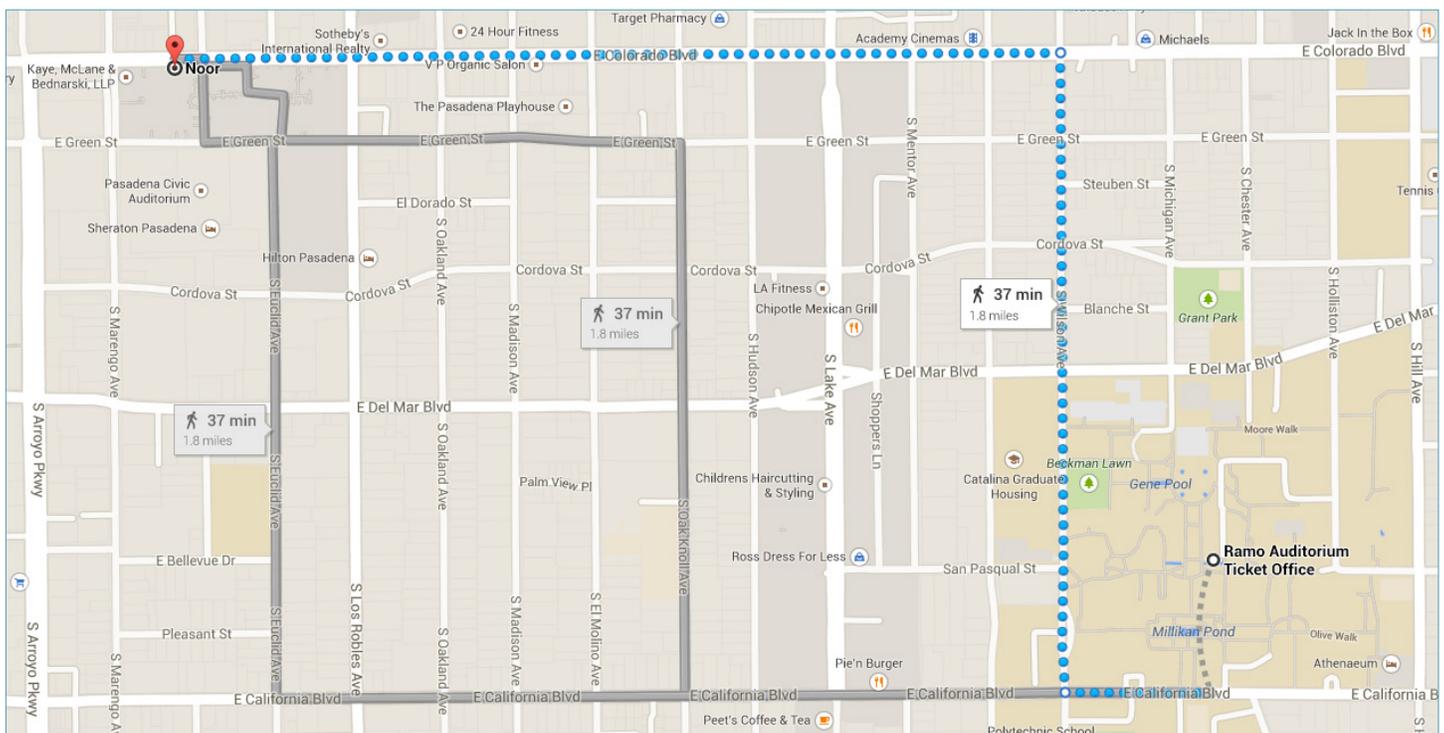
# Off-Campus Events

The Monday evening Icebreaker Reception will be held at Noor Banquet Hall from 19:00-21:00.

Noor is located on the second floor of the Paseo Colorado shopping complex. This event is included in your registration.

The Wednesday evening Workshop Dinner will also take place at Noor Banquet Hall at 19:00. This event is a separate registration fee of \$75.00.

If you have not yet registered for the Workshop Dinner and would like to attend, please talk to a member of the Local Organizing Committee at the registration desk. Guests are welcome to register for this event.



Lunch breaks will take place from 12:30 to 14:00, every day.

Lunch is not provided with registration. We recommend the Chandler Cafe on the Caltech campus (see map below) for those wishing to eat lunch close to the workshop venue.

Chandler Cafe provides a wide variety of food served in a cafeteria-style setting. Cash only, no credit cards accepted.

For the locations of many more off-campus restaurants, cafes, and supermarkets, please visit the interactive workshop map:

[www.igs.org/workshop/map](http://www.igs.org/workshop/map)



# Restaurants

## Less than 0.75 km from Caltech

*Intersection of South Lake Avenue and California Boulevard*

Southwest Corner

- Peet's Coffee and Tea – good quality hot and cold beverages
- Einstein Brothers Bagels – breakfast and lunch fare, wide variety of sandwiches, salads, and soups
- Fresh and Easy Market – small supermarket with a selection of to-go salads and sandwiches.

Northwest Corner

- Starbucks Coffee
- Winchell's Donuts – donuts, fritters, and other pastries
- Pavilions Supermarket – deli has a wide variety of sandwiches available to order.
- Burger Continental – sit-down restaurant with middle-eastern style food

Northeast Corner

- Noda Sushi – sit-down restaurant featuring Japanese food
- Subway Sandwiches – made-to-order deli style sandwiches
- Pie 'n Burger – 1960s style diner featuring hamburgers and pies

## Less than 1.5 km from Caltech

*Intersection of South Lake Avenue and Cordova Steet*

- Cham Bistro (Korean)
- Abricott Café (Vietnamese-French fusion)
- Oregano Café (Greek)

*Intersection of SouthLake Avenue and Del Mar Boulevard*

- Wahoo's Fish Tacos (Mexican)
- Real Food Daily (California Vegan)
- Corner Bakery Café (Sandwiches)
- Neapolis (Italian)
- San Sai (Japanese)

*Intersection of South Catalina Avenue and East Green Street*

- Malbec (Argentinean)
- Café Verde (Californian, Latin American)

*Intersection of South Wilson Avenue and East Green Street*

- Matsuri (Japanese)

**For more restaurants, supermarkets, pharmacies, and other places of interest, see the interactive workshop map:**

**[www.igs.org/workshop/map](http://www.igs.org/workshop/map)**

# Wireless Internet Access

Network name: IGSworkshop

User name: IGSworkshop2014

Password: 6232014



# Workshop Agenda: Monday, 23 June

## Plenary PY01: Welcome

Ramo Auditorium

Shailen Desai, Chair  
IGS Governing Board Member and  
Analysis Center Representative  
NASA Jet Propulsion Laboratory  
United States

- 09:00-09:05 A. Craddock, Local Organizing Committee Member  
Local Organizing Committee Welcome and Workshop Logistics
- 09:05-09:20 L. James, Deputy Director of the NASA Jet Propulsion Laboratory (JPL)  
Official Welcome from JPL
- 09:20-09:35 J. Labrecque, Former sponsor of IGS Central Bureau and NASA Global GNSS Network  
Welcome from NASA and NASA's role with the IGS
- 09:35-09:55 U. Hugentobler, IGS Governing Board Chair  
An Exciting and Challenging Future after Twenty Years of Service
- 09:55-10:15 T. Springer, IGS Governing Board Executive Committee Member  
Status of IGS products
- 10:15-10:30 C. Rizos, President of the International Association of Geodesy (IAG)  
The IGS: A First Class IAG Service
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## Plenary PY02: Celebrating 20 Years of Operational IGS Service: A

Ramo Auditorium

*review of the past 20 years of achievements, discussion of the relation of IGS to IAG and other organizations, and a look into the future.*

Ruth Neilan, Co-Chair  
IGS Governing Board Member and  
Central Bureau Director  
NASA Jet Propulsion Laboratory  
United States

Markus Rothacher, Co-Chair  
Former IGS Governing Board Member  
GeoForschungsZentrum Potsdam  
Germany

- 11:00-11:20 I. Mueller  
Planning the IGS
- 11:20-11:40 G. Beutler  
The International GNSS Service: Development since 1991
- 11:40-12:00 M. Rothacher  
Science Applications enabled by the IGS/GGOS
- 12:00-12:20 O. Montenbruck  
Preparing for the Future - The IGS in a Multi-GNSS World
- 12:20-12:30 R. Neilan  
Day-to-day with the IGS

# Workshop Agenda: Monday, 23 June

**Plenary PY03: IGS Real-Time Service on the way to FOC:** *status of the IGS real-time service, on the way to FOC*

**Ramo Auditorium**

Mark Caissy, Co-Chair  
IGS Governing Board Member  
Natural Resources Canada  
Canada

Loukis Agrotis, Co-Chair  
IGS Associate Member  
Symban Ltd.  
United Kingdom

- 14:00-14:15 M. Caissy and L. Agrotis  
IGS-RTS Status Update
- 14:15-14:30 Gerhard Wübbena et al.  
PPP with Ambiguity Resolution (AR) using RTCM-SSR
- 14:30-14:45 M. Fritsche et al.  
GNSS real-time developments at GFZ
- 14:45-15:00 R. Pacione and W. Söhne  
Exploitation of IGS Real-Time Products for Tropospheric Monitoring
- 15:00-15:15 M. Hernandez Pajares et al.  
Real-time global electron content determination thanks to the RT-IGS global network datastreams
- 15:15-15:30 Y. Bock et al.  
Real-time GNSS for natural hazards: Early warning and monitoring systems
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## Monday Splinter Sessions

- 16:00-17:30 Real-Time Splinter Session  
(Chair: L. Agrotis) Arms 155 (Sharp Lecture Hall)
- Orbit Modeling Splinter Session  
(Chair: M. Ziebart) Guggenheim 101 (Lees Kubota Lecture Hall)
- Bias and Calibration Splinter Session  
(Chair: S. Schaer) Noyes 147
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## Icebreaker Reception

19:00-21:00

**Noor Banquet Hall**

# Workshop Agenda: Tuesday, 24 June

**Plenary PY04: Reprocessing and Reference Frame:** *Reports on IGS repro02 effort, analysis of results related to ITRF2013, and other content related to analysis center, reprocessing, and reference frame working groups.*

**Ramo Auditorium**

Paul Rebischung, Chair  
IGS Associate Member  
Institut National de l'Information  
Géographique et Forestière  
France

- 09:00-09:15 Z. Deng et al.  
IGS 2nd Reprocessing at GFZ
- 09:15-09:30 S. Loyer et al.  
Time Variable Gravity in GRGS REPRO2 solution
- 09:30-09:45 T. Springer et al.  
ESA Reprocessing: Advances in GNSS analysis
- 09:45-10:00 S. Lutz et al.  
GNSS orbits and ERPs from CODE's repro2 solutions
- 10:00-10:15 Z. Altamimi et al.  
ITRF2013: IGS contribution and early results
- 10:15-10:30 J. Weiss et al.  
Terrestrial Reference Frame from Combined Precise Orbit Determination of GPS, GRACE, and LAGEOS
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**Plenary PY05: Orbit and Modeling Effects in IGS Products:** *modeling issues in the repro02 and operational products will be discussed, in addition to other content related to the reference frame and orbit modeling working groups.*

**Ramo Auditorium**

Tim Springer, Co-Chair  
IGS Governing Board Member  
and Analysis Center Representative  
ESA/European Space Operations Centre  
Germany

Marek Ziebart, Co-Chair  
IGS Governing Board Member and Satellite  
Vehicle Orbit Dynamics Working Group Chair  
University College London  
United Kingdom

- 11:00-11:30 G. Beutler  
Modeling and estimating the orbits of GNSS: Key principles in history and future
- 11:30-12:00 J. Weiss et al.  
Orbit and Attitude Modeling at the JPL Analysis Center
- 12:00-12:30 R. Dach et al.  
Estimating the geocenter from GNSS data

# Workshop Agenda: Tuesday, 24 June

**Plenary PY06: Infrastructure, Formats, and Calibration:** *content related to the infrastructure committee, as well as the data center, antenna, and RINEX working groups*

**Ramo Auditorium**

Ignacio Romero, Co-Chair  
IGS Governing Board Member  
and Infrastructure Committee Chair  
ESA/European Space Operations Centre  
Germany

Ralf Schmid, Co-Chair  
IGS Governing Board Member and Antenna  
Working Group Chair  
Deutsches Geodätisches Forschungsinstitut  
Germany

- 14:00-14:15 I. Rodriguez Perez et al.  
Calibrating GNSS Satellite Antenna Group-Delay Variations using space and ground receivers
- 14:15-14:30 K. MacLeod et al.  
RINEX Working Group Report
- 14:30-14:45 C. Noll et al.  
IGS Data Centers Status and Progress
- 14:45-15:00 N. Romero  
IGS Infrastructure Status
- 15:00-15:15 G. Mader and A. Billich  
Experimental Results from "BigAnt", a Large Format Antenna for High Quality Geodetic Ground Stations
- 15:15-15:30 F. Blume et al.  
Stability of GNSS Monumentation: Analysis of Co-Located Monuments in the UNAVCO Plate Boundary Observatory
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## Tuesday Splinter Sessions

- 16:00-17:30 Analysis Center, Reference Frame, and Clock Splinter Session **Arms 155 (Sharp Lecture Hall)**  
(Chair: P. Rebischung)
- Ionosphere Splinter Session **Guggenheim 101 (Lees Kubota Lecture Hall)**  
(Chair: A. Krankowski)

# Workshop Agenda: Wednesday, 25 June

**Plenary PY07: Progress and Development of MGEX:** *reports on IGS-MGEX; status of the network, solutions, and challenges; as well as other content related to the MGEX working group and analysis centers*

**Ramo Auditorium**

Oliver Montenbruck, Co-Chair IGS Governing Board Member and Multi-GNSS Working Group Chair Deutsches Zentrum für Luft- und Raumfahrt Germany	Felix Perosanz, Co-Chair IGS Associate Member Centre National d'Etudes Spatiales France
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- 09:00-09:10 O. Montenbruck  
The IGS Multi-GNSS Experiment - Introduction
- 09:10-09:25 A. Rülke et al.  
MGEX Network and observation data
- 09:25-09:45 L. Prange et al.  
Orbit and Clock Determination - Galileo
- 09:45-10:00 Steigenberger et al.  
Orbit and Clock Determination - QZSS
- 10:00-10:15 Z. Deng et al.  
Orbit and Clock Determination – BeiDou
- 10:15-10:30 O. Montenbruck and T. Springer  
Multi-GNSS Biases

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## Poster Session 1

**Dabney Lounge**

11:00-12:30

### PS01 - Analysis Centers

Co-Chairs: T. Springer and R. Dach

### PS04 - Data Centers

Chair: C. Noll

### PS08 - Infrastructure and Formats

Co-Chairs: I. Romero and K. MacLeod

### PS09 - Impact of IGS Products on Science, Geodetic Infrastructure and Other Applications

Chair: C. Meertens

### PS10 - New Research and Ongoing Questions in Satellite Orbit Modeling

Chair: M. Ziebart

# Workshop Agenda: Wednesday, 25 June

## Poster Session 2

Dabney Lounge

14:00-15:30

### PS02 - Antenna Calibration

Chair: R. Schmid

### PS05 - Estimation and Application of GNSS-based Troposphere Delay

Chair: C. Hackman

### PS11 - Progress and Development of MGEX

Chair: O. Montenbruck

### PS12 - Real Time Service

Co-Chairs: L. Agrotis and M. Caissy

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## Wednesday Splinter Sessions

16:00-17:30 MGEX Splinter Session  
(Chair: O. Montenbruck)

Arms 155 (Sharp Lecture Hall)

Infrastructure Splinter Session  
(Chair: I. Romero)

Guggenheim 101 (Lees Kubota Lecture Hall)

Troposphere Splinter Session  
(Chair: C. Hackman)

Noyes 147

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## Workshop Dinner

Noor Banquet Hall

19:00-21:00

# Workshop Agenda: Thursday, 26 June

## **Plenary PY08: Ionosphere Modeling and Related GNSS Biases:**

**Ramo Auditorium**

*covering the status of the ionosphere modeling within the IGS and potential development, reports on GNSS bias modeling in the frame of ionosphere processing and multi-GNSS processing in general. Other content related to the ionosphere and bias/calibration working groups will be presented.*

Andrzej Krankowski, Co-Chair

IGS Governing Board Member and Ionosphere Working Group Chair  
University of Warmia and Mazury in Olsztyn  
Poland

Stefan Schaer, Co-Chair

IGS Governing Board Member and Calibration and Bias Working Group Chair  
Federal Office of Topography  
Switzerland

- 09:00-09:15 A. Krankowski and I. Cherniak  
Current and future IGS Iono WG activities, new IGS iono product – monitoring of TEC fluctuations
- 09:15-09:30 H. Rothkaehl at al.  
The multi instrument radio diagnostics as a new tool for improved the GNSS services
- 09:30-09:45 B. Nava and S. M. Radicella  
The NeQuick model: characteristics and uses
- 09:45-10:10 S. Schaer  
Biases Relevant to GPS and GLONASS Data Processing
- 10:10-10:30 O. Montenbruck et al.  
Differential Code Bias Estimation for New Signals and Constellations

# Workshop Agenda: Thursday, 26 June

## **Plenary PY09: 9A - GNSS-derived Troposphere Delays and 9B - Applications of IGS Products for Geodesy and Geophysics**

**Ramo Auditorium**

**Research** *presentations on the status of the troposphere modeling within the IGS and potential future development, as well as other relevant applications*

Christine Hackman, Co-Chair  
IGS Governing Board Member  
and Troposphere Working Group Chair  
United States Naval Observatory  
United States

Charles Meertens, Co-Chair  
IGS Governing Board Member  
UNAVCO  
United States

- 11:00-11:05 C.Hackman  
2-5 min very short introduction on IGS tropo products/activities.
- 11:05-11:20 J. Dousa et al.  
Development towards inter-technique tropospheric parameter comparisons and their exploitation
- 11:20-11:35 J. Wang et al.  
Global Water Vapor Trend and its Diurnal Asymmetry during 1995-2011 Based on GPS, Radiosonde and Microwave Satellite Measurements
- 11:35-11:50 G. Guerova et al.  
COST Action ES1206: Advanced GNSS Tropospheric Products for Monitoring Severe Weather Events and Climate (GNSS4SWEC)
- 11:50-12:10 G. Blewitt et al.  
Detecting topological dark matter with GNSS
- 12:10-12:30 M. Simons et al.  
From the earthquake cycle to mantle structure and InSAR time series – current and future uses of dense GPS networks.

# Workshop Agenda: Thursday, 26 June

## **Poster Session 3:**

14:00-15:30

**Dabney Lounge**

### **PS03 - Bias and Calibration**

Chair: S. Schaer

### **PS06 - GNSS Clocks and Clock Products**

Chair: M. Coleman

### **PS07 - Ionosphere Observations and Modeling**

Chair: A. Krankowski

### **PS13 - Reference Frame Issues and Reprocessing Results**

Co-Chairs: P. Rebischung and B. Garayt

### **PS14 - TIGA: Tide Gauge Working Group**

Chair: T. Schöne

# Workshop Agenda: Thursday, 26 June

## Thursday Splinter Sessions

13:30-15:30	ICG IGMA Meeting	Guggenheim 202
16:00-17:30	Antenna Splinter Session <i>(Chair: R. Schmid)</i>	Arms 155 (Sharp Lecture Hall)
	TIGA Splinter Session <i>(Chair: T. Schöne)</i>	Guggenheim 101 (Lees Kubota Lecture Hall)
	Data Center Splinter Session <i>(Chair: C. Noll)</i>	Noyes 147

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**Anniversary Colloquium:** *Celebrating 20 years of service through stories and speeches*

**Dabney Gardens and Lounge**

17:30-19:30

# Workshop Agenda: Friday, 27 June

**Plenary PY10: Applications and Theory of GNSS Processing:** *A review of GPS/GLONASS processing strategies in the IGS and other content relevant to application-oriented working groups*

**Ramo Auditorium**

Norman Teferle  
University of Luxembourg  
Luxembourg

Tilo Schöne  
IGS Governing Board Member and TIGA  
Working Group Chair  
DeutschesGeoForschungsZentrum Potsdam  
Germany

- 09:00-09:18 K. Sosnica et al.  
Impact of temporal gravity field parameters determined from GNSS satellites on the GNSS-derived Earth rotation parameters
- 09:18-09:36 R. Tjoelker  
GNSS Clocks: Challenges and Developments
- 09:36-09:54 J. Geng et al.  
Ambiguity resolution in precise point positioning: benefits and challenges from multi- constellation and multi-frequency GNSS signals
- 09:54-10:12 M. Pearlman et al.  
Space Geodesy Core Sites and the Role of GNSS
- 10:12-10:30 D. Argus  
Technical Advances in GNSS Vertical Positioning: Results on Water Change in California and Postglacial Rebound in Antarctica
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**Closing Session:** *Splinter working group reports and recommendations*

**Ramo Auditorium**

11:00-12:30

U. Hugentobler, Chair  
IGS Governing Board Chair and Analysis Center  
Representative  
Technische Universität München  
Germany











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