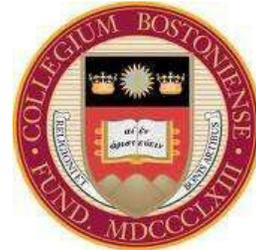


# 21<sup>st</sup> International Beacon Satellite Symposium August 1 - 5, 2022

**Hosted by:**  
**The Institute for Scientific Research**  
**Boston College**  
**Chestnut Hill, Massachusetts, USA**



*A triennial event organized by the Beacon Satellite Studies Group of the International Union of Radio Scientists (URSI) Commission G; an interdisciplinary group servicing science, research applications and engineering aspects of satellite signals observed from the ground and in space.*



## In Memoriam: Patricia Doherty (1950–2022)



Patricia Doherty, Chair of the 21<sup>st</sup> International Beacon Satellite Symposium, passed away on 14 July 2022. Pat had organized the BSS for over 20 years, hosting three BSS meetings at Boston College and participating in the organization of several others around the world. She was busy preparing for this meeting up until her sudden and unexpected passing.

Pat joined the Boston College Institute for Scientific Research in 1989, became Co-Director in 2005, and led the ISR as Director since 2008. Her research focused on space weather and ionospheric effects on Global Navigation Satellite Systems and their applications such as aviation and communications. One of her favorite activities was promoting research and education in the science of navigation in developing countries, organizing and sponsoring workshops and summer schools all over the world. Among her many roles, she was recently elected Vice President of the International Union of Radio Science (URSI), served as Scientific Secretary for the Scientific Committee on Solar-Terrestrial Physics (SCOSTEP), and was a member of the Board of Trustees for the Universities Space Research Association (USRA). Pat's numerous awards for her research and international outreach included the ION Burka Award, the ION Weems Award, the ION Distinguished Service Award, the 2017 GPS World Leadership Award and the 2018 AGU Carrington Education and Outreach Award. She was a Fellow of the Institute of Navigation (ION) and of the African Geospace Society.

Pat was more than an excellent scientist and mentor; she was our friend. She touched so many lives and will be sorely missed by all of us. We dedicate this Beacon Satellite Symposium to her memory.



*Dear Colleagues,*

*Welcome to the 21<sup>st</sup> International Beacon Satellite Symposium. This distinctive symposium represents the efforts of the Beacon Satellite Studies group sponsored by Commission G of the International Union of Radio Scientists (URSI). The current meeting has attracted a wide variety of international researchers from many countries who use Beacon satellites to study the earth's ionosphere and thermosphere for basic research and applications with societal impacts. This worldwide level of interest exemplifies the ever growing importance of ionospheric radio wave propagation in the modern world.*

*We are delighted to feature Dr. Chuck Rino as our keynote speaker in the opening session. Dr. Rino will share his thoughts on Remote Ionospheric "Radio" Diagnostics over the last century. In our scientific sessions we will hear a variety of innovative research presentations that cover ionospheric irregularities, scintillation theory, electron content measurement techniques, low and high latitude ionospheric phenomena, ionospheric modeling, space weather effects, monitoring natural hazards, radio occultation studies using low earth orbit satellites, ionospheric effects on navigation systems, data science applied to radio propagation, and recent advances in radio science techniques and capabilities.*

*As is traditional in the Beacon Symposia, a tour of the host city will be included and a final banquet will be enjoyed by all.*

*This symposium is an exceptional opportunity to initiate international collaborations and research that spans the globe. We sincerely hope that you find this meeting an enriching and productive event.*

*Sincerely,*

*Patricia Doherty, USA*

*Bruno Nava, Italy*

*Andrzej Krankowski, Poland*

*Chairs of the Beacon Satellite Studies Group*

*URSI Commission G*





## Local Organizing Committee

We thank Boston College for their gracious and generous support as hosts of this workshop.

We specifically thank the Local Organizing Committee for their tireless efforts:

Patricia Doherty  
Keith Groves  
Kathleen Kraemer  
Thomas Kuchar  
Andrea Murphy  
Sean O'Connell  
Teddy Surco  
Vadym Paznukhov  
Theodore Beach  
And the entire Institute for Scientific Research!



## Scientific Organizing Committee

This workshop was designed and organized by an international group of radio scientists:

Patricia Doherty	Boston College, USA
Lucilla Alfonsi	National Inst. Of Geophysics and Volcanology (INGV), Italy
Anthea Coster	MIT Haystack Observatory, USA
Eurico de Paula	National Institute for Space Research (INPE), Brazil
Keith Groves	Boston College, USA
Andrzej Krankowski	University of Warmia and Mazury, Poland
Zishen Li	Chinese Academy of Science (CAS), China
Bruno Nava	Abdus Salam International Centre for Theoretical Physics, IT
Manuel Hernández-Pajares	Universitat Politecnica de Catalunya (UPC), Spain
Ashik Paul	University of Calcutta, India
Babatunde Rabi	National Space Research and Development Agency, Nigeria

# Sponsors

The organizers of the International Beacon Satellite Symposium are grateful to the following sponsors for their contribution:

*International Union of Radio Scientists (URSI) Commission G*

*National Science Foundation (NSF)*

*International Committee on Global Navigation Satellite Systems (ICG)*

*International Space Weather Initiative (ISWI/NASA)*

*Scientific Committee on Solar-Terrestrial Physics (SCOSTEP)*

*Boston College Institute for Scientific Research*



# SYMPOSIUM LOGISTICS

**Technical Sessions:** All technical sessions will take place in **Room 300 at Higgins Hall** on Boston College's upper campus in Chestnut Hill, Massachusetts.



Boston College Higgins Hall

## **To get to Higgins Hall by Car:**

Navigate to St. Ignatius of Loyola Church, 28 Commonwealth Ave, Chestnut Hill, MA. Turn onto St. Thomas More Road or Fr. Herlihy Drive – passing in front of St. Ignatius Church. Enter the university via the gate next to the church. Drive along Campanella Way to the Commonwealth Avenue Garage. The parking garage is on the right, just past the curve. Park in designated visitor spaces, levels 3-6 only (follow signs).

Take the elevator in the garage to the top floor, then follow the map below to Higgins Hall.

**Parking:** If you are bringing a car onto the campus, you may park in the BC Commonwealth Avenue garage for a fee of \$12/day. Parking passes may be purchased at the registration desk.

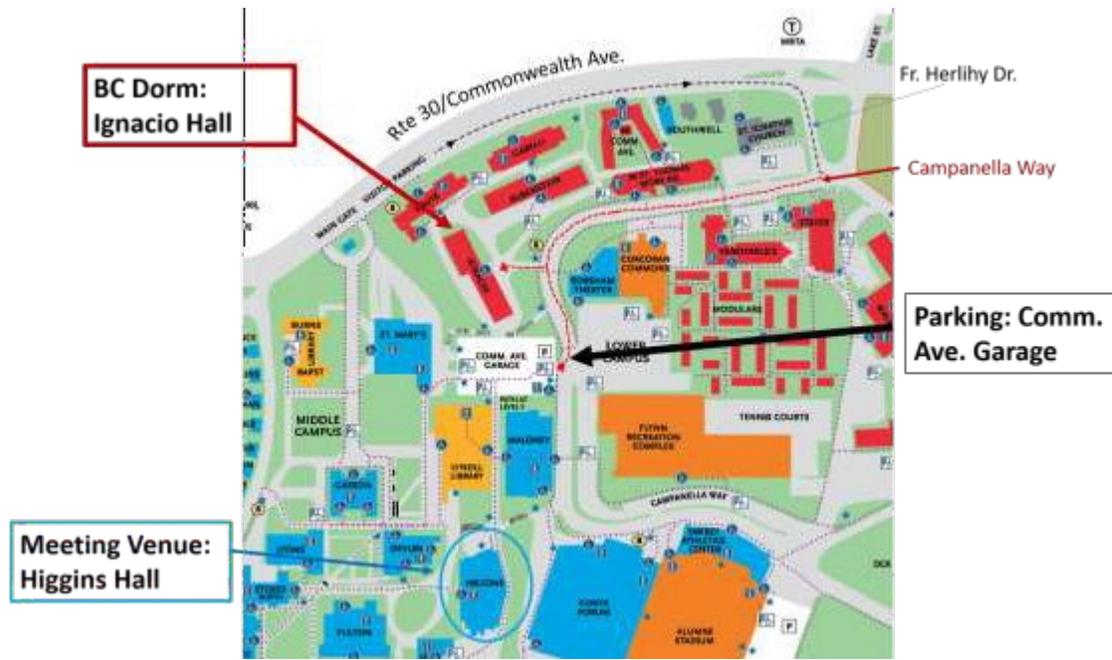
## **To get to Higgins Hall by Public Transportation:**

Take the Boston College branch of the MBTA's Green Line (B) to the last stop at Boston College on Commonwealth Avenue. Cross the street toward St. Ignatius Church. Take a right turn after the church onto the campus and walk to the Commonwealth Avenue Garage. The parking garage is on the right, just past the curve.

Take the elevator in the garage to the top floor, then follow the map to Higgins Hall.

### To get to Higgins Hall from Ignacio Hall:

For those staying on campus, accommodations will be in Ignacio Hall. From Ignacio Hall, walk to the Commonwealth Avenue Garage and take the elevator to the top floor, then follow the map to Higgins Hall.



Map 1: Campus map showing directions to the venue.

### To get the Higgins Hall by Taxi & Rideshare (Uber, Lyft etc):

Give the address: 231 Beacon Street, Chestnut Hill, MA 02467

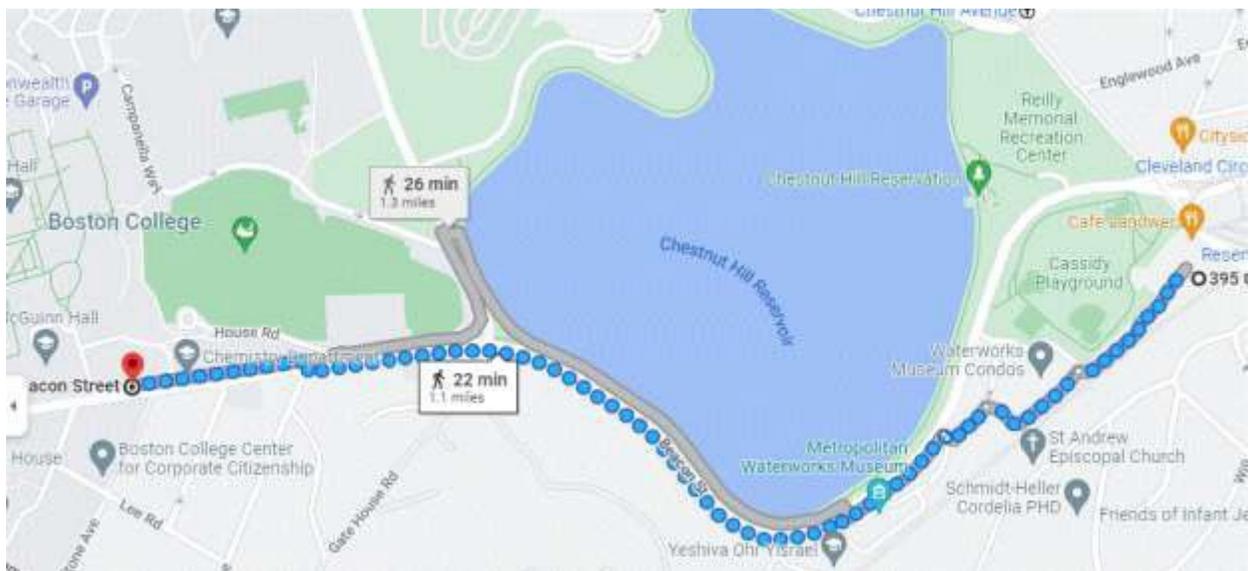
Pull forward to the loop and exit. Then walk a short way past Schiller & Fulton Hall to Higgins Hall (see Map 2 below).

### To get to Higgins Hall from the AC Marriott Hotel in Cleveland Circle:

Either take a taxi, rideshare or walk from the hotel to the venue. The walk will take you along Beacon Street past the Chestnut Hill Reservoir (see Map 3). Enter the campus between Campion Hall and McGuinn Hall. Then walk a short way past Schiller & Fulton Hall to Higgins Hall (see Map 2). This walk may take ~20+ minutes.



**Map 2 – For Approach by Taxi or Rideshare**



**Map 3 – Walking Path from AC Marriott Hotel to Boston College**

**Registration:**

The Registration Desk will be open every day beginning at 8:00AM. Please note that all participants must register for the symposium either online or on arrival. We are not able to permit non-registered participants to the symposium.

**Catering:** Coffee break refreshments and lunch will be provided daily for all participants in rooms adjacent to the meeting venue.

**Directions:** Please see our website for directions to the campus via all means of transportation ([www.bc.edu/bss2022](http://www.bc.edu/bss2022)).

**TECHNICAL PROGRAM AT A GLANCE**

 <b>Program at a Glance</b>						
Time	MONDAY August 1	TUESDAY August 2	WEDNESDAY August 3	THURSDAY August 4	FRIDAY August 5	
8:15	Registration and Light Breakfast	Registration and Light Breakfast	Registration and Light Breakfast	Registration and Light Breakfast	Registration and Light Breakfast	
9:00	Opening Ceremony	Ionospheric Effects on GNSS Augmentation	Space-based Radio Occultation Techniques and Measurements	Space Weather Effects (Part 1)	Space Weather Effects (Part 2)	
9:20						
9:40	Keynote Presentation					
10:00						
10:20	Coffee Break	Coffee Break	Coffee Break	Coffee Break	Coffee Break	
10:40	Irregularities and Scintillation Measurements and Effects (Part 1)	Irregularities and Scintillation Measurements and Effects (Part 2)	Space-based Radio Occultation Techniques and Measurements	Theory and Modeling of Ionospheric Scintillation and Irregularities (Part 2)	Polar (high-latitude) Effects on GNSS	
11:00						
11:20						
11:40						
12:00						
12:20			Modeling and Validation			
12:40	Lunch	Lunch	Lunch	Lunch	Lunch	
13:00						
13:20	Monitoring Natural Hazards (Part 1)	Space- and Ground-based TEC Techniques and Measurements	Modeling and Validation	Data Assimilation Modeling	Recent Advances in Radio Science Techniques, Measurements, and Capabilities for Geospace Remote Sensing	
13:40						
14:00						
14:20						
14:40						
15:00					Closing Ceremony	
15:20	Coffee Break			Coffee Break		
15:40	Monitoring Natural Hazards (Part 2)	Poster Sessions (16:00 to 18:30)	EXCURSION Duck Tour - Buses depart BC at 15:30; Return at 19:00 	Data Science Analysis Applied to Ionospheric Specification, Forecast and Effects on Radio Propagation	Thank you for attending the Beacon Satellite Symposium 2022  Hope to see you in 2025!	
16:00						
16:20						
16:40						
17:00						
17:20	Enjoy your free evening!					
17:40						
18:00						
18:20						
18:40				Symposium Dinner 18:45 to 21:00		
19:00						

**Oral presentations are 20 minutes in duration and includes time for questions.**

# TECHNICAL PROGRAM

**Monday, 1 August**

**08:00 Registration**

**09:00 Opening Remarks, Acting Chair: Anthea Coster, MIT Haystack Observatory**

Fr. James F. Keenan, S.J., Vice Provost for Global Engagement, Boston College  
Dr. Thomas Chiles, Vice Provost for Research, Boston College  
Dr. Piergiorgio Uslenghi, President, International Union of Radio Scientists (URSI)  
Ms. Sharafat Gadimova, International Committee for GNSS, United Nations  
Dr. Nat Gopalswamy, International Space Weather Initiative, NASA

**09:40 Keynote Presentation**

Dr. Charles Rino, A Century of Remote Ionospheric “Radio” Diagnostics

**10:20 Coffee Break**

**10:40-12:40: Irregularities and Scintillation Measurements and Effects (Part 1)**

Chairs: Eurico de Paula (Brazil), Keith Groves (USA)

10:40	Accurate and Efficient Full-Wave Modeling of HF Propagation in the Birefringent Ionosphere <i>Charles S. Carrano, Charles L. Rino and Louis Fishman</i>
11:00	Characteristics of VHF/UHF Scintillation and Mitigation Techniques <i>Chaosong Huang, Ronald Caton and Jeffrey Holmes</i>
11:20*	Scintillation of VHF and UHF signals due to ionospheric irregularity observed by GNU Radio Beacon Receiver <i>Toru Takahashi and Susumu Saito</i>
11:40	Studies of low-latitude Field-Aligned Ionospheric Irregularities observed using University of Calcutta VHF Radar <i>Ashik Paul, Tanmay Das and P. Nandakumar</i>
12:00	Storm-time Multi-scale Irregularities and GPS Scintillations at Midlatitudes <i>Sebastijan Mrak, Toshi Nishimura and Joshua Semeter</i>
12:20*	GNSS Measurements of Artificial Ionospheric Irregularities <i>Hiroatsu Sato, Victoria Yaroshenko, Norbert Jakowski, Erik Varberg, Mike Rietveld</i>

\*Denotes online remote presentation (annotation used throughout program)

**12:40-13:20 Lunch Break – Boxed lunches will be provided**

## Monday, August 1 (continued)

### 13:20-15:20 Monitoring Natural Hazards

Chairs: Attila Komjathy (USA), Sergey Pulinetz (Russia)

13:20	Real-Time Ionospheric Monitoring of the 2022 Tonga Eruption <i>Léo Martire, Siddharth Krishnamoorthy, Attila Komjathy and Yoaz Bar-Sever</i>
13:40	Multi-Instrument Detection in Europe of Ionospheric Disturbances caused by the 15 January 2022 Eruption of the Hunga Tonga Volcano <i>Claudio Cesaroni, T. Verhulst, D. Altadill, V. Barta, A. Belehaki, D. Buresova, I. Galkin, M. Guerra, A. Ippolito, T. Herekakis, D. Kouba, J. Mielich, A. Segarra, L. Spogli and I. Tsagouri</i>
14:00	Global ionospheric disturbances following the Tonga volcanic eruption <i>Shun-Rong Zhang, E. Aa, J. Vierinen, P. Erickson, L. Goncharenko, A. Coster, W. Wang, L. Qian, B. Rideout, A. Spicher, R. Eastes and T. Immel</i>
14:20	Global propagation of ionospheric disturbances associated with the 2022 Tonga Volcanic Eruption <i>David R. Themens, Chris Watson, Nedjeljka Žagar, Sergiy Vasylykevych, Sean Elvidge, Anthony McCaffrey, Paul Prikryl, Ben Reid, Alan Wood and P.T. Jayachandran</i>
14:40	Near-field ionospheric response to the 15 January 2022 Hunga Tonga – Hunga Ha’apai volcanic eruption <i>Elvira Astafyeva, B. Maletckii, T. D. Mikesell, L. Rolland, E. Munaibari, M. Ravanelli, P. Coisson and F. Manta</i>
15:00*	Observational Assessment for the 2022 Hunga Tonga-Hunga Ha’apai Volcanic Impact on Ocean, Atmosphere, and Ionosphere in the South Pacific <i>Mohamed Freeshah, Erman Şentürk, Muhammad Arqim Adil, Xiaohong Zhang, Xiaodong Ren and Nahed Osama</i>

### 15:20 Coffee Break



## Monday, August 1 (continued)

### 15:40-17:20 Monitoring Natural Hazards (continued)

15:40	Concentric Traveling Ionospheric Disturbances Triggered by 2022 Tonga Volcanic Eruption <i>Lei Liu, Y. Jade Morton and Pin-Xuan Cheng</i>
16:00	Conjugate Ionospheric Disturbances Driven by Tsunami and Volcanic Eruption <i>Min-Yang Chou, Jia Yue, Charles Lin, Jia-Ting Lin, P. K. Rajesh and N. M. Pedatella</i>
16:20	Identification of Meteotsunami through GNSS Traveling Ionospheric Disturbance Observations <i>Pin-Hsuan Cheng, Jade Morton, Sebastijan Mrak, Attila Komjathy and Panagiotis Vergados</i>
16:40*	Direct Three-Dimensional Simulations of Seismic Natural Hazard Coupling Processes in the Atmosphere and Ionosphere <i>Pavel Inchin, J. B. Snively, M. D. Zettergren, A. Komjathy and E. Astafyeva</i>
17:00	Impact of Tonga volcanic eruption on ionosphere over Indian subcontinent <i>Surendra Sunda, Mahesh Lanka and Vineet Gera</i>



Group Photo, 20<sup>th</sup> Beacon Satellite Symposium, August 2019, Poland

## Tuesday, 2 August

### 09:00-10:20 Ionospheric Effects on GNSS Augmentation Systems

Chairs: Sharafat Gadimova (Austria), Ashik Paul (India)

9:00	Augmented space weather situation awareness as the means for GNSS resilience development in self-adaptive SDR GNSS position estimation <i>Renato Filjar and M. Chantale Damas</i>
9:20	Multi-wavelength scintillation observations at L- and S-band from an anomaly crest location <i>Ashik Paul, Trisani Biswas and Jan-Peter Weiss</i>
9:40	Assessment of the relationship between the Rate of Change of Total Electron Content Index (ROTI) and the Scintillation Index (S4) in Low Latitudes <i>Teddy M. Surco Espejo, Charles Carrano, Keith Groves and Theodore Beach</i>
10:00*	Multi-Band Propagation Technique in Addressing Ionospheric Effects on GNSS Augmentation Systems <i>Capt. Alloyce Were, Elvis Kimaru and Duncan Koech</i>

### 10:20 Coffee Break



## Tuesday, 2 August (continued)

### 10:40-12:40 Irregularities and Scintillation Measurements and Effects (Part 2)

Chairs: Eurico de Paula (Brazil), Keith Groves (USA)

10:40	Conjunction observations of GPS scintillations measured by the GPS RO receivers onboard the constellation of COSMIC-2/FORMOSAT-7 satellites with the electron density and neutral wind measured by the ICON satellite in the equatorial evening F region during magnetic storms <i>Chin S. Lin, Guiping Liu, Christoph R. Englert and Thomas J. Immel</i>
11:00	A Large Vertical Flow Spike Related to the Reviving of a Dead Bubble Observed by FORMOSAT-5 at Topside Ionosphere <i>Shin-Yi Su, Chi-Kwan Chao, Yang-Yi Sun, Lung-Chi Tsai and Chao Hang Liu</i>
11:20	Adaptive Phase Detrending for GNSS Scintillation Detection: A Case Study Over Antarctica <i>Luca Spogli, Lucilla Alfonsi, Antonio Cicone, Claudio Cesaroni, Vincenzo Romano, Hossein Ghobadi and Massimo Cafaro</i>
11:40	Storm-time Subauroral Ionospheric Plasma Density Irregularities and Substorm Current Wedge <i>Rezy Pradipta, Evgeny Mishin and Keith M. Groves</i>
12:00	Turbulence Strength Decay Rate Derived from Equatorial Scintillation Data <i>Theodore Beach, K. Groves, W. McNeil, C. Bridgwood, R. Caton and C. Carrano</i>
12:20	Global Distribution of The Unintended Sources of Radio Frequency Interference <i>Endawoke Yizengaw, Paul Straus and Bonnie L Valant-Weiss</i>

### 12:40-13:20 Lunch Break – Boxed lunches will be provided

**Group Photo: BSS 2010  
Barcelona, Spain**



## Tuesday, 2 August (continued)

### 13:20-16:00 Space- and Ground-based TEC Techniques and Measurements

Chairs: David Themens (UK, CA), Babatunde Rabiou (Nigeria), Sandro Radicella (Italy)

13:20	Augmenting High-latitude Ionosphere Observation with Spaceborne GNSS Reflectometry Measurements during Geomagnetic Storms <i>Yang Wang and Jade Morton</i>
13:40	On the TEC bias of altimeter satellites <i>Bruno Nava and Francisco Azpilicueta</i>
14:00	New lightning-derived vertical total electron content data provides unique global ionospheric measurements <i>Erin H. Lay, Jeffery D. Tippmann, Kyle C. Wiens, Sarah E. McDonald, Anthony J. Mannucci, Xiaoqing Pi, Anthea Coster, R. Marc Kippen and Rob Redmon</i>
14:20	Can the GEC be used as Space Weather index? <i>Josep Maria Aroca-Farrerons, Manuel Hernandez Pajares and Haixia Lyu</i>
14:40*	GNSS/LEO ionospheric 2D/3D modeling and its application in GNSS precise positioning <i>Xiaodong Ren, Dengkui Mei and Xiaohong Zhang</i>
15:00	Performance and Prospects of Low-cost Global Navigation Satellite System Receiver in Measurements of Ionospheric Total Electron Content within Equatorial Anomaly Region in Africa <i>Babatunde Rabiou, Aderonke Obafaye, Daniel Okoh, Oluwakemi Dare-Idowu, Gopi Seemala, Anton Kashcheyev and Bruno Nava</i>
15:20*	Consistency of DORIS and multi-GNSS dSTEC assessments for RT-GIM validation <i>Ningbo Wang, Ang Liu, Yan Zhang, Zishen Li and Andrzej Krankowski</i>
15:40	Observations and Modeling of Scintillation in the Vicinity of a Polar Cap Patch <i>Leslie Lamarche, Kshitija B. Deshpande and Matthew Zettergren</i>

**Group Photo:  
BSS 2004  
ICTP, Trieste, IT**



## **POSTER SESSION AND RECEPTION**

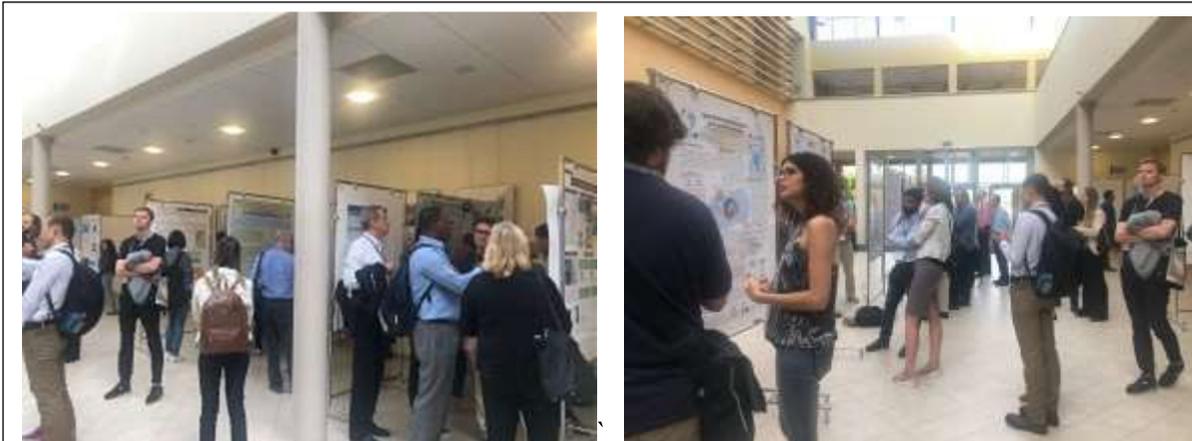
**Tuesday, 2 August 16:00 – 18:30**  
**In the foyer of Higgins Hall**

Please have posters up today before the afternoon session.  
Whiteboards and pins will be provided.  
Whiteboard size is 48” wide (~122 cm) x 36” high (~91cm).



Refreshments will be served.

List of posters are at the end  
of this program.



Pictures from the Poster Session for the BSS2019 held at the University of Warmia and Mazury, Olsztyn, Poland

## Wednesday, 3 August

### 09:00-10:20 Space-based Radio Occultation Techniques and Measurements

Chairs: Jan-Peter Weiss (USA), Giorgio Savastano (Luxemborg)

9:00	Evaluation of ionospheric and Space Weather products derived from commercial missions GNSS Radio Occultation observations <i>Iurii Cherniak, Douglas Hunt, Jan-Peter Weiss and Irina Zakharenkova</i>
9:20	Real-Time Monitoring of Equatorial Plasma Bubbles with COSMIC-2 Radio Occultation Data <i>Charles S Carrano, Keith M Groves, Charles L Rino, William J McNeil, Ronald G Caton and Paul R. Straus</i>
9:40	Validation of radio occultation electron density profiles over a low latitude region: an ongoing strategy <i>Gabriel O. Jerez, Manuel Hernández-Pajares, Daniele B. M. Alves and Joao Galera</i>
10:00	Optimization of the Abel Vary Chapman Hybrid Ionospheric Radio Occultation (AVHIRO) technique in the retrieval of truncated ionospheric GNSS radio occultations from LEO-based receivers <i>Manuel Hernandez Pajares, Haixia Lyu, Enric Monte-Moreno, Germán Olivares-Pulido, Victoria Graffigna and Estel Cardellach</i>

### 10:20 Coffee Break

### 10:40-11:20 Space-based Radio Occultation Techniques and Measurements (continued)

10:40	A New Technique of RO Electron Density Retrieval from MetOp-A Truncated Measurements <i>M. Mainul Hoque, Liangliang Yuan, Fabricio S. Prol, Manuel Hernandez Pajares and Riccardo Notarpietro</i>
11:00	Radio occultation experiments between ExoMars Trace Gas Orbiter and Mars Express <i>Bruno Nava, Y. Migoya-Orue, A. Kashcheyev, B. Sánchez-Cano, O. Witasse, C. Wilson, D. Titov, A. Toni, C. Ao, H. Svedhem and J. Parrott</i>

## Wednesday, 3 August (continued)

### 11:20-12:40 Modeling and Validation

Chairs: Manuel Hernandez-Pajares (Spain), Anna Belehaki (Greece)

11:20	A lack of F10.7 consensus: Impacts of varying F10.7 smoothing approaches on global models <i>Elizabeth Donegan-Lawley, Sean Elvidge, Luke Nugent, Alan G. Wood and David R. Themens</i>
11:40	Performances of Magnetohydrodynamics based models towards predictions of auroral parameters during adverse space weather conditions <i>Dibyendu Sur, Robert Robinson and Katherine Garcia-Sage</i>
12:00	Signature of Nighttime Winter Anomaly in the Neural Network-based TEC model <i>M. Mainul Hoque, Marjolijn Adolfs and Norbert Jakowski</i>
12:20	E-CHAIM v2 – v4: Updates to the model since COVID <i>David R. Themens, Ben Reid, Chris Watson, Anthony McCaffrey, P.T. Jayachandran, Neil Rogers and Farideh Honary</i>

### 12:40-13:20 Lunch Break – Boxed lunches will be provided

### 13:20-14:00 Modeling and Validation (continued)

13:20	Automatic detection of Travelling Ionospheric Disturbances (TIDS) based on GNSS data over Italy <i>Marco Guerra, Claudio Cesaroni and Luca Spogli</i>
13:40	Ionospheric Constraint Precise Point Positioning with Ambiguity Resolution during Geomagnetic Storm <i>Reza Ghoddousi-Fard, Elyes Hassen and Micah Walker</i>

### 14:00-14:40 Theory and Modeling of Ionospheric Scintillation (Part 1)

Chairs: Charles Rino (USA), Luca Spogli (Italy)

14:00	Forecasting equatorial ionospheric convective instability using a regional ionospheric direct numerical simulation and WAM-IPE <i>David L. Hysell, T. W. Fang and T. J. Fuller-Rowell</i>
14:20	Invited: Plasma Irregularities in the Earth's Ionosphere and Plasmasphere <i>Joe D. Huba</i>

## **EXCURSION – 15:30 to 19:00 – Wednesday, 3 August**

Please join us for an unforgettable historic tour of Boston in a DUCK boat; a W.W.II style amphibious landing vehicle that travels on land and water. We will be greeted by legendary ConDUCKtors who will narrate our tour. We will cruise by all the places that make Boston the birthplace of freedom and a city of firsts; from the golden domed State House to the Boston Common, the historic North End to fashionable Newbury Street, Quincy Market to the Prudential Tower, and more. Just when you think you've seen it all, it's time for a big splash as your ConDUCKtor drives the Duck right into the Charles River for a breathtaking view of the Boston and Cambridge skylines. (From: BostonDuckTours.com)



Pictures from: BostonDuckTours.com

Bus transport to the Duck Boats will depart the university at 15:30. The duration of the Duck tour is 90 minutes. After the tour, you are welcome to return to the university by bus transport or stay in the Faneuil Hall/Quincy Market area for shopping and/or dinner. If you stay, you will need to take a taxi, uber or public transportation back to the university.

We hope you enjoy your tour of Boston!



**BSS 2013, Bath, UK**

## Thursday, 4 August

### 09:00-10:20 Space Weather Effects (Part 1)

Chairs: Joao Francisco Galera (Brazil), Iwona Stanislawska (Poland), Endawoke Yizengaw (USA)

9:00	Invited: Automatic detection of travelling ionospheric disturbances (TIDs) in near-real-time  <i>Elvira Astafyeva, B. Maletckii and Q. Brissaud</i>
9:20*	Detection of Global Traveling Ionospheric Disturbances Using GNSS and LEO Satellites during the St. Patrick's Day Storm  <i>Dengkui Mei, Xiaodong Ren and Xiaohong Zhang</i>
9:40*	The novel tools for Space Weather purposes based on LOFAR ground-based radio-telescope infrastructures and in situ satellite diagnostics  <i>Hanna Rothkaehl, Barbara Matyjasiak, Mariusz Pożoga, Marcin Grzesiak, Katarzyna Beser, Agata Chuchra Konrad, Dorota Przepiórka and Roman Wronowski</i>
10:00	Mitigation of ionospheric scintillation over Brazil by “Brevetti+” project  <i>Vincenzo Romano, C. Cesaroni, L. Spogli, A. Fiorini, M. Fermi, L. Benvenuto, T. Cosso, M. Grzesiak, J.F. Galera, I. Tsuchiya, G. Oliveira and M. Guandalini</i>

### 10:20 Coffee Break

### 10:40-12:40 Theory and Modeling of Ionospheric Scintillation (Part 2)

Chairs: Charles Rino (USA), Luca Spogli (Italy)

10:40	Modeling of scintillation Climatology from GNSS data  <i>Vincent Fabbro, Arnaud Remy and Laurent Feral</i>
11:00	A Stochastic Model for Scintillation and Total Electron Content  <i>Charles Rino, Charles Carrano, Tatsuhiro Yokoyama, Luca Spogli and Antonio Cicone</i>
11:20	Geometric enhancement for scintillation modeling  <i>Dmytro Vasylyev, Y. Bèniguel, M. Kriegel, V. Wilken and J. Berdermann</i>
11:40	Drivers of the variability of ionospheric plasma observed by the Swarm satellites  <i>Elizabeth Donegan-Lawley, Alan Wood, Gareth Dorrian, Lasse Clausen, Luca Spogli, Lucilla Alfonsi, James Rawlings, Golnaz Shahtahmasebi, Jaroslav Urbar, Antonio Cicone, Yaqi Jin, Claudio Cesaroni, Per Høeg and Wojciech Miloch</i>
12:00	Diversity Effects on the Propagation of Transionospheric Wideband Signals  <i>Emanoel Costa, Chaosong Huang, Ronald G. Caton, Patrick A. Roddy and John O. Ballenthin</i>
12:20	Skewness and Kurtosis Associated with Ionospheric Amplitude Scintillation  <i>Abdelhaq M. Hamza, K. Meziane and P. T. Jayachandran</i>

**12:40-13:20 Lunch Break – Boxed lunches will be provided**

**13:20-15:20 Data Assimilation Modeling**

Chairs: Bruno Nava (Italy), Matthew Angling (UK)

13:20	A-CHAIM: High Latitude Data Assimilation in Near-Real-Time using a Particle Filter <i>Benjamin Reid, David Themens and Anthony McCaffrey</i>
13:40	Model-free multi-instrument ionospheric imaging <i>Johannes Norberg, Sebastian Käki, Kirsti Kauristie and Lassi Roininen</i>
14:00	Assimilating ground-based GNSS-derived TEC data into NeQuick at low latitudes <i>Bruno Nava, D. Themens, S. Pires de Moraes Santos, A. Kashcheyev and F. Azpilicueta</i>
14:20	Developing 3-D ionospheric specification over U.S. with a new TEC-based ionospheric data assimilation system (TIDAS) <i>Ercha Aa, Shun-Rong Zhang, Philip J. Erickson, Wenbin Wang, Anthea Coster and Bill Rideout</i>
14:40	Assimilation of vTEC IONORING data into IRI-UP technique to predict foF2 over Italy <i>A. Pignalberi, M. Pezzopane, C. Cesaroni and L. Spogli</i>
15:00	Application of Classical Kalman filtering technique in assimilation of multiple data types to NeQuick model <i>Patrick Mungufeni and Y. Migoya-Orue</i>

**15:20 Coffee Break**



**Beacon Satellite Symposium 2001, Boston College**

## 15:40-18:00 Data Science Analysis Applied to Ionospheric Specification, Forecast and Effects on Radio Propagation

Chairs: Shasha Zou (USA), Claudio Cesaroni (Italy), Ryan McGranaghan (USA)

15:40*	On high latitude phase scintillation detection using TEC provided by ISM and IGS professional GNSS receivers <i>Rayan Imam, Lucilla Alfonsi, Fabio DAVIS, Claudio Cesaroni and Luca Spogli</i>
16:00	High latitude ionospheric scintillation forecasting using Deep Learning <i>Arnaud Remy, Vincent Fabbro and Knut Stanley Jacobsen</i>
16:20	Characterization of high-latitude ionospheric scintillation signatures through supervised and unsupervised Machine Learning for five different geomagnetic storm days <i>Anna-Marie Bals and Kshitija B. Deshpande</i>
16:40*	Short-term forecast of TEC based on VISTA dataset <i>Zihan Wang, Shasha Zou, Yang Chen and Hu Sun</i>
17:00	Precise Ionosphere Prediction: A Machine Learning based Approach and Results <i>Yang Gao and Jianping Chen</i>
17:20	Estimation of the uncertainty of the ionospheric conditions with the WAM-IPE model <i>Weijia Zhan, Eric Sutton, Alireza Doostan and Tzu-Wei Fang</i>
17:40	Reliable Predictive Intervals for HF spectral occupancy <i>Haris Haralambous, Antonios Constantinides and Harris Papadopoulos</i>
18:00*	Optimal Formation of a GNSS Network for Ionospheric Imaging through Newly Developed Unsupervised Machine Learning Algorithm <i>P Babu Sree Harsha and Nirvikar Dashora</i>

## 18:45 – 21:00 SYMPOSIUM BANQUET

Please join us for a banquet at the Boston College Murray Room. The Murray Room is located on the top floor of Boston College's Yawkey Center on the lower campus.

The banquet will feature traditional Irish music organized by:

Ms. Sheila Falls Keohane  
Irish Fiddler and Director of the Gaelic Roots Program at Boston College



## Friday, 5 August

### 09:00-10:20 Space Weather Effects (Part 2)

Chairs: Joao Francisco Galera (Brazil), Iwona Stanislawska (Poland), Endawoke Yizengaw (USA)

9:00	A Risk Assessment of Space Weather-caused GPS Positioning Accuracy Degradation for GPS Applications in Polar Regions <i>Renato Filjar, Nenad Sikirica, Teodor B Iliev and Oliver Jukić</i>
9:20*	Space Weather Services of CBK PAN operating within PECASUS <i>Andriy Zalizovski, Iwona Stanislawska and Lukasz Tomasik</i>
9:40	Climatology of ionospheric perturbations associated with Pc3-6 ULF waves, as observed using ground-based GPS total electron content measurements <i>Chris Watson and P.T. Jayachandran</i>
10:00*	Ionosphere response to the solar event of 30 March 2022 <i>Emilia Correia, Eduardo Perez Macho, Juliano Moro, Christiano Brum, Jose Henrique Fernandez and Jose Valentin Bageston</i>

### 10:20 Coffee Break

### 10:40-12:40 Polar (high-latitude) Effects on GNSS

Chairs: Lucilla Alfonsi (Italy), Nicolas Bergeot (France)

10:40	Invited: Is Ionospheric Radio Scintillation an Issue in the Polar Regions for GNSS-based PNT Applications? <i>P. T. Jayachandran and the RSPL Team</i>
11:00	Invited: Polar Ionosphere Research at University of Colorado Boulder Satellite Navigation and Sensing Lab <i>Jade Morton, Harrison Bourne, Brian Breitsch, Lei Liu, Yunxiang Liu, Steve Taylor, Yang Wang and Zhe Yang</i>
11:20	Invited: Development and evolution of the storm-induced ionospheric irregularities during the 25–26 August 2018 geomagnetic storm <i>Iurii Cherniak and Irina Zakharenkova</i>
11:40	Analysis of 2022 Space Weather Events in the Arctic using the MACAWS network <i>Anthea J. Coster, Nestor Aponte, William C. Rideout, Susan Skone, Eric Donovan, Emma Spanswick and Don Hampton</i>
12:00	Radio Sciences Research on AntarCtic AtmosphEre <i>Lucilla Alfonsi, N. Bergeot, P. J. Cilliers and G. De Franceschi</i>
12:20	Study of time- and distance-dependent degradations of network RTK performance at high latitudes in Norway <i>Knut Stanley Jacobsen, Nadezda Sokolova, Anders Martin Solberg and Mohammed Ouassou</i>

**12:40-13:20 Lunch Break – Boxed lunches will be provided**

**13:20-15:00 Recent Advances in Radio Science Techniques, Measurements, and Capabilities for Geospace Remote Sensing**

Chairs: Anthea Coster (USA), Jade Morton (USA), Andrzej Krankowski (Poland)

13:20*	Ionospheric irregularities description based on simultaneous observations of VHF LOFAR and L-band GNSS <i>Paweł Flisek, Biagio Forte, Kacper Kotulak, Richard Fallows, Andrzej Krankowski, Mario Bisi, Leszek Błaszkiwicz and Adam Froń</i>
13:40*	Application of LOFAR calibration solutions in space weather studies <i>Katarzyna Beser, M. Mevius, M. Grzesiak and H. Rothkaehl</i>
14:00*	DLITE: A Low-cost Radio Telescope Array for Ionospheric Remote Sensing <i>Joseph F. Helmboldt, B. B. Markowski, D. J. Bonanno, T. E. Clarke, J. Dowell, B. C. Hicks, N. E. Kassim and G. B. Taylor</i>
14:20	An Open Source Beacon Recording and Processing Package <i>John Swoboda, Anthea Coster and Ryan Volz</i>
14:40	Low-cost SDR-based ionosondes as a tool for geospace research <i>Oleksandr Koloskov, Anton Kashcheyev, Andriy Zalizovski and Oleksandr Bogomaz</i>

**15:00 – 15:30 CLOSING CEREMONY**

**Thank you for attending the  
21<sup>th</sup> International Beacon Satellite Symposium**



# List of Posters

**Tuesday, 2 August, 16:00-18:30**

Poster Chairs: Teddy Surco (BC, USA), Yenca Migoye Orue (ICTP, Italy)

## Irregularities and Scintillation Measurements and Effects

1	Feasibility Analysis of a CubeSat Constellation for Low-Latitude Ionospheric Monitoring <i>Lucas Salles, Alison Moraes and Nilton Renno</i>
2	February 2022 Magnetic Storms Effects on Ionospheric Scintillation <i>Ivan Kantor, André Martinon, Vinicius Stuani Pereira, Joao Francisco Galera and Eurico de Paula</i>
3	Spectral Analysis of Phase Scintillation at Low Latitudes <i>Eurico de Paula and Alison Moraes</i>
4	Ionospheric Irregularities Over South America During Intense Geomagnetic Storms <i>Gilda Gonzalez and Jorgelina López</i>
5	Multifrequency Observation of Ionospheric Scintillation in the Polar Regions <i>Kaili Song</i>
6	Ionospheric Scintillation Climatology over Ethiopia During the Raising Phase of Solar Cycle 24 <i>Tesfay Tesfu, Gizaw Tsidu, Luca Spogli and Nat Gopalswamy</i>
7	Large-scale Ionospheric Irregularities Pattern During Solar Cycle 24 at Ilorin, Nigeria <i>Olushola A. Oladipo, Jacob O. Adeniyi, Isaac A. Adimula, Adeniji O. Olawepo and Patricia H. Doherty</i>
8	Study of Ionospheric Scintillations During Ascending Phase of 25th Solar Cycle Over Low Latitude Station Varanasi <i>Abhay Kumar Singh, Mukulika Mondal and Sanjay Kumar</i>
9	Multi-station and Multi-instrument Observations of F-Region Irregularities in the Taiwan-Philippines Sector <i>Lung-Chi Tsai, Shin-Yi Su and Chao-Han Liu</i>
10	Analysis of Equatorial and Low-Latitude Ionospheric TEC Responses to Plasma Bubbles Over the Brazilian Region Using a Disturbance Ionosphere Index <i>Giorgio Picanço, Clezio M. Denardini, Paulo A. Bronzato Nogueira, Laysa C. Araujo Resende, Carolina Sousa do Carmo, Sony Su Chen, Paulo F. Barbosa-Neto and Esmeralda Romero-Hernandez</i>
11	Unusual low-latitude ionospheric irregularities in the dawn on the South American sector <i>Carolina Sousa do Carmo, Xiaoqing Pi, Clezio Marcos Denardini, Cosme A. Figueiredo, Olga Verkhoglyadova and Ludger Scherliess</i>
12	Impact of ionization density depletions on transionospheric satellite links as observed around the northern crest of Equatorial Ionization Anomaly <i>Tanmay Das and Ashik Paul</i>

## Theory and Modeling of Ionospheric Scintillation and Irregularities

13	Validating Drift Estimation Models
	<i>Marcin Grzesiak</i>
14	Turbulence Signatures in High-Latitude Ionospheric Scintillation
	<i>Abdelhaq M. Hamza, Karim Meziane and P. Thayyil Jayachandran</i>

## Data Assimilation Modeling

15	Assimilating GNSS Measurements Into Regional Parametric Ionosphere Model
	<i>Nina Servan-Schreiber and Dima Paznukhov</i>

## Modeling and Validation

16	Modeling of TIDs Generated by Lower Atmospheric Disturbances, Plasma Irregularity Formation, and Radio Effects
	<i>Matthew Zettergren, Jonathan Snively, Kshitija B. Deshpande, Pavel Inchin, Pralay Vaggu and Leslie Lamarche</i>

## Data Science Analysis Applied to Ionospheric Specification, Forecast and Effects on Radio Propagation

17	Ionospheric TEC Modeling over Brazilian Region Using Neural Networks
	<i>André Luiz Almeida Silva, Moises Freitas, Marcos Maximo, Bruno Vani, Jonas Sousasantos and Alison Moraes</i>

## Space and Ground-based TEC Techniques and Measurements

18	Ionosphere Response Over the Iberian Peninsula of the 27 February 2014 moderate geomagnetic storm using different data sources <i>Saioa A. Campuzano, Fernando Delgado-Gómez, Sandro M. Radicella, Yenca Migoya-Orue, Miguel Herraiz-Sarachaga and Gracia Rodríguez-Caderot</i>
19	The Impact of Temporal Resolution on the Behavior of Global Ionospheric Maps <i>Manuel Hernández-Pajares, Qi Liu, Zishen Li and Ningbo Wang</i>
20	Plasmasphere Effects for Middle and Low Latitude GPS Sites <i>Andrew Mazzella</i>
21	Simultaneous Response of the Ionosphere to Solar Events Along African Equatorial Sector <i>Bola Abdulrahim, Babatunde Rabiou and Daniel Okoh</i>
22	Automated System for High Rate GNSS Data Processing with Swarm Conjunctions <i>Gytis Blinstrubas</i>
23	Performance of a Locally Adapted NeQuick-2 Model During High Solar Activity Over the Brazilian Equatorial and Low-latitude Region Using GNSS Derived Data <i>Osanyin Taiwo, Claudia Candido, Fabio Becker and Yenca Migoya-Orue</i>
24	Performance of the IRI Model Over EIA Region Varanasi During Two Recent Solar Minimum Periods 2016-2018 and 2007-2009 <i>Abhay Kumar Singh, Mukulika Mondal and Sanjay Kumar</i>
25	Ionospheric Response to an Intense Geomagnetic Storm (26 August 2018) over Low latitudes and Southern Hemisphere <i>Uma Pandey and Javed N. Malik</i>

## Polar (High-latitude) Effects on GNSS

26	IGS ROTI Maps: Current Status and Its Extension Towards Low Latitudes and Southern Hemisphere <i>Kacper Kotulak, Andrzej Krankowski, Iurii Cherniak and Irina Zakharenkova</i>
27	Statistical and Event Analysis of Phase and Amplitude Scintillations Associated with Polar Cap Patches <i>Alanah Cardenas-O'Toole, Jiaen Ren, Shasha Zou, P. Thayyil Jayachandran</i>
28	Degradation of NRTK at High Latitudes During a Space Weather Event <i>Arnlaug Høgås Skjæveland and Knut Stanley Jacobsen</i>

## Space Weather Effects

29	Ionospheric Response to a G4 and G1-Class Geomagnetic Storm from an Anomaly Crest Location Using GPS/GNSS Based Computerized Ionospheric Tomography
	<i>Samiddha Goswami, Sripada Haldar and Ashik Paul</i>
30	Effect of the Heliospheric State on CME Evolution
	<i>Fithanegest Dagneu, Nat Gopalswamy, Sachiko Akiyama, Solomon Tessema and Seiji Yashiro</i>
31	Ionospheric Response to CIR induced Geomagnetic Storms in Declining Phase of Solar Cycle 24
	<i>Sarbani Ray, Anamika Das and Ashik Paul</i>
32	Influence of Moderate Geomagnetic Storm on the Post-Sunset Ionosphere Over South America During Solar Minimum of Solar Cycle 25
	<i>Frank Chimgarandi, Fabio Becker, Claudia Candido, Osanyin Taiwo and Olusegun Jonah</i>
33	Hemispherical Asymmetry between Mid-Latitude Ionospheric Electron Density and Magnetospheric Quasi-Static Poynting Flux
	<i>Brenna Royersmith, Delores Knipp, Lei, Liu, Sebastijan Mrak, Greg Starr and Jade Morton</i>
34	Conquering Space Weather Using Superconductivity Principle
	<i>Duncan Koech</i>
35	Manifestation of Seasonal Coupling between Geomagnetic and Ionospheric Storms Supporting Space Weather Services
	<i>Tamara Gulyeva and Iwona Stanislawska</i>
36	On the Brazilian low latitude vertical total electron content during high-speed solar wind streams and corotating interaction regions-driven storms
	<i>Stella Pires de Moraes Santos, Claudia Candido, Fabio Becker, Bruno Nava, Virginia Klausner and Claudia Borries</i>

## Ionospheric Effects on GNSS Augmentation Systems

37	Satellite Augmentation Systems for Airnavigation and the Influence of the Ionosphere/SW
	<i>Jorge Garcia Villalobos</i>
38	Performance Analysis of GBAS MFMC Under Ionospheric Scintillation in Presidente Prudente – Brazil
	<i>Weverton Silva, Joao Francisco Galera Monico, Crislaine Menezes da Silva and Vinicius Stuani Pereira</i>

## Monitoring National Hazards: Signatures of Earth-Ocean Coupling to the Ionosphere

39	ULF and VLF Activity in the Ionosphere: Signal Processing and Modeling Wave Propagation <i>Kacper Kotulak, Yuriy Rapoport, Asen Grytsai, Volodymyr Reshetnyk, Masashi Hayakawa, Volodymyr Grimalsky, Alexander Liashchuk, Alla Fedorenko, Sergei Petrishchevskii, Andrzej Krankowski and Leszek Błazkiewicz</i>
40	Ionospheric and Atmospheric Observations of Hunga Tonga–Hunga Ha’apai Eruption-Generated Acoustic-Gravity Waves over the Continental United States <i>Pavel Inchin, Steven Cummer, Asti Bhatt and Jonathan Snively</i>

## Recent Advances in Radio Science Techniques, Measurements & Capabilities for Geospace Remote Sensing

41	Dense Radio Imaging Network Enabled by Next-Generation Beacon Sensors <i>Romina Nikoukar, Hyosub Kil, Matthew Zettergren, Meghan Burleigh and Kristina Lynch</i>
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