



Technical Program

May 24 - 26, 2023

All workshop sessions will take place in the Ann & H.J. Smead Department of Aerospace Engineering Sciences at the University of Colorado Boulder.
*All times are in MT. *Denotes presenting author. #Denotes remote presentation.*

Tuesday, May 23, 2023

17:00 - 19:00 Join us for a welcome reception on the rooftop of Avanti F&B!
Address: 1401 Pearl St., Boulder, Colorado. Take the elevator or stairs to the rooftop.

Wednesday, May 24, 2023

Please plan on arriving a few minutes early to pick up conference materials and enjoy some coffee before the workshop starts.

08:45 Opening remarks

Satellite Missions, Calibration, and Validation I

Session Chair: Scott Gleason, *Daaxa LLC Consulting Company*

- 09:00 Status of the ESA Scout HydroGNSS Reflectometry Mission
Martin Unwin, Peter Garner, Lily Rose, Reynolt de Vos Van Steenwijk, Jonathan Rawlinson, Andy Newton, Nazzareno Pierdicca, Davide Comite, Estel Cardellach, Weiqiang Li, Leila Guerriero, Laura Dente, Giuseppe Foti, Matt Hammond, Emanuele Santi, Paul Blunt, Kimmo Rautiainen, Jean-Pascal Lejault, Maria Paola Clarizia, Nicolas Floury, Manuel Martin-Neira, Massimiliano Pastena*
- 09:20 SNOOPI: Preparation for launch
*James Garrison**#, Rashmi Shah, Justin Mansell, Juan Raymond, Roger Banting, Rajat Bindlish, Kameron Larsen, Seho Kim, Weihang Li, Elisa Rivera, Mehmet Kurum, Jeffrey Piepmeier, Hasnaa Khalifi*
- 09:40 ESA PRETTY CubeSat mission for precise altimetric determination of water and ice surfaces at grazing incidence angles
Hossein Nahavandchi, Cardellach E., Semmling M., Hoseini, M., Wickert J., Fagner H., Asgarimehr, M., Dielacher A., Moreno M., and F. Zus*
- 10:00 An Airborne Multi-year Mission for GNSS-R Advancement: Operations and Initial Results
Delwyn Moller, Matthew Wilson, Andrew O'Brien, Chris Ruf, and Xiaoyou Lin*
- 10:20 - 10:40 Break

Satellite Missions, Calibration, and Validation II

Session Chair: Adriano Camps, *Universitat Politècnica de Catalunya, UAE University*

- 10:40 Spire Global's Operational GNSS-Reflectometry constellation for Earth surface observations

Philip Jales, Jessica Cartwright, Matthieu Talpe, Jake Mashburn, Takayuki Yuasa, Oleguer Nogués-Correig, Vu Nguyen, Vahid Freeman*

- 11:00 Signal of Opportunity Remote Sensing Enabled by the Muon Satellite Constellation
Dallas Masters, T. Maximillian Roberts, Clara Chew, Stephen Lowe, Linus Tan, Christopher Ruf, Scott Gleason*
- 11:20 In-Space Earth's Inland Water Monitoring by a Future GNSS-R Receiver
Hugo Carreno-Luengo, C.S. Ruf, S. Gleason, A. Russel, I.M. Russo, M. di Bisceglie, and C. Galdi*
- 11:40 Airborne P-band Signals of Opportunity Measurement for Remote Sensing of Snow and Soil Moisture
Rashmi Shah, Simon Yueh, Javier Bosch-Lluis, Mario J. Chaubell, Garth Franklin, Justin Nguyen, Xiaolan Xu, Steve Margulis, Kelly Elder, Manuela Giroto, Adrian Harpold, and Hans-Peter*
- 12:00 Applications of GNSS-R Data Products by Non Specialists
Chris Ruf, Clara Chew, Derek Posselt, and R. Brent Roberts*

12:20 – 13:20 Lunch

Satellite Missions, Calibration, and Validation III

Session Chair: Christopher Ruf, *University of Michigan*

- 13:20 SMAP-Reflectometry: Dataset, Calibration and Sensitivities to Geophysical Parameters of Compact Polarimetric GNSS-R
Joan Francesc Munoz-Martin, Nereida Rodriguez-Alvarez, Xavier Bosch-Lluis, Kamal Oudhiri*
- 13:40 Science with the HydroGNSS mission: Status and its End-to-End Simulator
Nazzareno Pierdicca, Davide Comite, Leila Guerriero, Laura Dente, Martin Unwin, Gabrielle Marigold, Tom Norris, Andy Newton, Estel Cardellach, Weiqiang Li, Jilun Peng, Emanuele Santi, Kimmo Rautiainen, Maria Paola Clarizia, Nicholas Floury*
- 14:00 The Rongowai GNSS-R Instrument
Andrew O'Brien, Stephen Musko, Chris Ruf, Xiaoyou Lin, and Delwyn Moller*
- 14:20 Calibration of the Airborne Polarimetric GNSS-R Sensor for the Rongowai Project
Dinan Bai, Chris Ruf, Andrew O'Brien, and Delwyn Moller*

14:40 Review of Products from the Muon Space Deep-Learning Framework for Generalized Retrievals from GNSS-R
T. Maximillian Roberts, Ian Colwell, Clara Chew, Dallas Masters, and Stephen Lowe*

15:00 – 15:20 Break

Modeling

Session Chair: Joel Johnson, *The Ohio State University*

15:20 On the origin of CYGNSS NBRCS anomalies over the ocean
Daniel Pascual and Christopher Ruf*

15:40 On the Potential of 130-370 MHz Reflections for Monitoring Sea Surface Wind Speed and Sea Surface Height
Joel Johnson, James L. Garrison, Jeffrey D. Ouellette, Mark Sletten, C. K. Shum, Dallas Masters*

16:00 Adaptive subspace analysis of coherent components for GNSS-R
Pia Addabbo, Maurizio di Bisceglie, Carmela Galdi, Danilo Orlando, Giuseppe Ricci*

16:20 Modeling S-Band Sea Surface Reflections Observed from an Oil Platform
James Gaudreau, Ethan Raines, Joel T. Johnson, James L. Garrison, Jeffrey D. Ouellette, Rashmi Shah*

16:40 Estimating Instrument-derived Sources of Correlated Error for the Cyclone Global Navigation Satellite System (CYGNSS)
Charles Powell and Christopher Ruf*

17:00 A fast algorithm for coherency entropy metric and its performance
Maurizio di Bisceglie, Carmela Galdi, Ilaria Mara Russo, Cinzia Zuffada*

17:20 **Poster Session: List of posters at the end of the agenda**

Thursday, May 25, 2023

Ocean I

Session Chair: Estel Cardellach, *ICE-CSIC, IEEC*

09:00 TES: A calibration-free method for wind speed retrieval of CYGNSS surface wind speeds
*Steve Katzberg***

09:20 Performance analysis of the CYGNSS wind speed products under storm conditions using the MAXSS storm atlas
Daniel Pascual and Jennifer King*

09:40 Investigating Ocean Wave Angular Spreading using Platform- or Ship-Based Reflectometry: A Feasibility Study
Jeffrey D. Ouellette, Jakov V. Toporkov, Joel T. Johnson, Mark A. Sletten, David J. Dowgiallo*

10:00 The Detection of Algal Blooms and Microplastics via Suppression of Ocean Surface Roughness using a GNSS+R Spaceborne Radar
Gopal Sundaram, Christopher Ruf, and Madeline Evans*

10:20 - 10:40 Break

Ocean II

Session Chair: Rashmi Shah, *Jet Propulsion Laboratory*

10:40 GNSS-R off sea ice at different elevation angles: draft of freeboard measurements?
Estel Cardellach, Weiqiang Li, Serni Ribó, Antonio Rius, Pushyami Kaveti, Isobel Lawrence, Inès Otosaka, Carl Robinson, Andrew Shepherd, Sebastian B. Simonsen, Hanumant Singh, Henriette Skourup, Gaëlle Veyssière, Jeremy Wilkinson*

11:00 Characterisation of Frozen Surfaces from the Spire Nanosatellite Constellation
Jessica Cartwright, Mohammed Ashour, Philip Jales, Vu Nguyen, Matthieu Talpe, Takayuki Yuasa, Oleguer Nogues-Correig*

11:20 Potential of Spire grazing angle GNSS-R data for lake ice detection
*Yusuf Ghiasi** and C.R. Duguay*

11:40 SMAP-Reflectometry: Advances on Sea Ice and Ice Sheet Thickness Studies with Polarimetric GNSS-R
*Nereida Rodriguez-Alvarez**, *Joan Francesc Munoz-Martin*, *Xavier Bosch-Lluis*, and *Kamal Oudrhiri*

12:00 gnsrefl: an open source python package for GNSS Interferometric Reflectometry (GNSS-IR)
Kristine M. Larson, *Simon D.P. Williams*, *Felipe Geremia-Nievinski*, *Kelly Enloe*, *Tim Dittmann**, *Makan Karegar*, and *David Purnell*

12:20 – 13:20 Lunch

Land I

Session Chair: *Mary Morris*, *Jet Propulsion Laboratory*

13:20 Exploiting a semiempirical model for soil moisture estimation at global scale using CYGNSS Reflectometry data and comparing it to an Artificial Neural Network algorithm
*Hamed Izadgoshasb***, *Emanuele Santi*, *Leila Guerriero*, *Leonardo Chiavini*, *Nazzareno Pierdicca*

13:40 Foundations of a Blended CYGNSS Soil Moisture Product
*Erik Hodges**, *Ruzbeh Akbar*, *Clara Chew*, *Eric Small*, *Mohammad Al-Khalidi*, *Jeffrey D. Ouellette*, *Joel T. Johnson*, *Fangni Lei*, *Mehmet Kurum*, *Ali Gurbuz*, *Volkan Senyurek*, *Xiaolan Xu*, *Rashmi Shah*, *Simon Yueh*, *Akiko Hayashi*, *Paulo T. Setti Jr.*, *Sajad Tabibi*, *Emanuele Santi*, *Simone Pettinato*, *T. Max Roberts*, *Ian Colwell*, *Stephen Lowe*, *Christopher S. Ruf*, and *Mahta Moghaddam*

14:00 Analysis of polarimetric GNSS-R GLORI airborne data as a function of soil moisture and land use
*Mehrez Zribi***, *Karin Dassas*, *Pascal Fanise*, *Vincent Dehaye*

14:20 Evaluation of Deep-Learning Approach for Quasi-Global Soil Moisture Retrieval using CYGNSS
M M Nabi, *Volkan Senyurek*, *Fangni Lei*, *Mehmet Kurum*, *Ali C. Gurbuz**

14:40 GNSS-R reveals diurnal vegetation moisture dynamics
*Milad Asgarimehr***, *Jens Wickert*, and *Dara Entekhabi*

15:00 – 15:20 Break

Land II

Session Chair: Nereida Rodriguez-Alvarez, *Jet Propulsion Laboratory*

15:20 Inland Water Bodies Tracking with Power DDMs: a Combination of Detectors

Hugo Carreno-Luengo, Christopher Ruf, Scott Gleason, and Anthony Russel*

15:40 Towards The Use of GNSS-R Specular Measurements For Remotely Sensing Reservoir Water Storage Levels From LEO

Nicholas Brendle, Steven Chan, George Hajj, Mohammad Al-Khaldi, and Joel Johnson*

16:00 Data Fusion of GNSS-R with Optical Observations to Estimate Surface Water

Mary Morris, Hai Nguyen, Matthew Bonnema, Cedric David, and Eric Loria*

16:20 Using Intermittent GNSS Signal Coherent Reflections for River Slope Estimation

Yang Wang and Jade Morton*

16:40 Integrating CYGNSS and DEM Data with Computer Vision Algorithm, RawIF-based Validation for High Spatio-Temporal Mapping of Inundation

Tianjiao Pu and Cynthia Gerlein-Safdi*

17:00 - 21:00

Group dinner at Chautauqua Dining Hall

Friday, May 26, 2023

Altimetry/Atmosphere I

Session Chair: Carmela Galdi, *Università degli Studi del Sannio*

- 09:00 The road to polar altimetry monitoring using Spire grazing angle GNSS-R
Matthieu Talpe, Vu Nguyen, Philip Jales, Jessica Cartwright, Takayuki Yuasa, and Oleguer Nogues-Correig*
- 09:20 Lake altimetry using carrier phase measurements from airborne GNSS reflectometry
Nolan Varais, Jerome Verdun, Jose Cali, and Laurent Lestarquit*
- 09:40 Spaceborne GNSS-R for the Ionospheric and Tropospheric Sensing
*Yang Wang**
- 10:00 Model-based analysis of ionospheric delays in grazing angle reflectometry from space
Mario Moreno, M. Semmling, M. Hoque, J. Wickert, and N. Mahmood*
- 10:20 – 10:40 Break

Altimetry/Atmosphere II

Session Chair: Yang Wang, *University of Colorado Boulder*

- 10:40 Evaluation of Spire Grazing Angle GNSS-R Data Over Time: Data Volume, Geographic Distribution, and Signal Coherency
Sophie Anderson, Yang Wang, and Jade Morton*
- 11:00 GNSS-R altimetry correction for atmospheric refraction - Initial improvements considering the curvature of Earth
Vitor Hugo Almeida Junior and Felipe Geremia-Nievinski*
- 11:20 Sea Level Anomalies in the Indonesian Seas Observed from Spire Grazing Angle GNSS-R Measurements
Carolyn Roesler, Jade Morton, and Steven Nerem*
- 11:40 Study of Pre-Earthquake Ionospheric Scintillation Using GNSS-R Data from NASA CYGNSS Mission Between 2017 And 2022
Badr-Eddine Boudriki Semlali#, Carlos Molina, Hyuk Park, and Adriano Camps*
- 12:00 Concluding remarks, *Optional tour of the NCAR Mesa Lab*

List of Poster Presentations

Development of the CYGNSS Fully Developed Seas wind speed product version 3.2

Daniel Pascual, Christopher Ruf, Darren McKague, and Anthony Russel*

SURFACE INUNDATION ALGORITHM FOR HYDROGNSS MISSION

JILUN PENG#, E. Cardellach, W. Li, S. Ribo, and A. Rius*

A Study of the Second Order Small Slope Approximation for the Coherent Reflection Coefficient of the Sea Surface

Ethan Raines and Joel Johnson*

Antenna gain assessment for improving sensitivity to hurricane force winds for future space-borne GNSS-R missions

Rajeswari Balasubramaniam and Christopher Ruf*

GNSS-IR based Soil Moisture Inversion Model for Vegetated Cover using NavIC L-band

Sushant Shekhar#, Rishi Prakash, Dharmendra Kumar Pandey, Anurag Vidyarthi, Deepak Putrevu, and Nilesh M. Desai*

Characterizing Land Surface Properties Using Airborne and In-situ Lidar Measurements for GNSS-R Land Cal/Val

Tianlin Wang, Joel Johnson, Alexandra Bringer, Yuchan Yi, and Mohammad Al-Khaldi*

Artificial Intelligence for GNSS Reflectometry: First insights from the AI4GNSSR project

Tianqi Xiao, Milad Asgarimehr, Caroline Arnold, Daixin Zhao, Lichao Mou, and Jens Wickert*

GNSS-MR Synthetic Vertical Array Analysis: Simulation of the Scotch-yoke Device Approach Limitation

*Mauricio Kenji Yamawaki and Felipe Geremia-Nievinski**

Can GNSS Reflections Indicate Presence of Surface Vegetation on a Small Lake?

Weston Hustace, Jihye Park, and Meghna Babbar-Sebens*

Analysis of Reflected Carrier Phase Smoothness for the Haleakala Mountaintop GNSS-R Experiment

Brian Breitsch and Jade Morton*

Coherency Statistics of Discontinuously Distributed Windows of Reflections over Surface Water Detected using Spire GNSS-R Grazing Angle Data

Swastik Bhattacharya, Yang Wang, and Jade Morton*

Measurement of Airborne GNSS-R Phase Coherence Using Angular Change Detection
Ali Chamseddine[#], H. Issa, G. Stienne, S. Reboul, and G. Faour*

Flood mapping in Pakistan using CYGNSS observations
Paulo T. Setti Jr. and Sajad Tabibi*

An Improved Change Detection Approach for Airborne GNSS Signals Segmentation
in the Presence of Speckle Noise
Sarah El Hajj Chehade[#], Hamza Issa, Georges Stienne, and Serge Reboul*

Comparison of Sea Surface Height Anomaly Measurements from Grazing Angle GNSS-
R Altimetry and Sentinel-3
Raquel Navarro Buendía, Sajad Tabibi, and Matthieu Talpe*

Triband Dual Polarization Ground-based GNSS Reflectometry System
Ananya Ray[#], Ashok Rohada, Diksha Gupta, Anish Mishra, Akshay Pande, Renuka Tandan,
Aayush Sohgoura, Devendra Sharma, Kashish Grover, Saumi De, Saurabh Bhalla, Shivani
Tyagi, Dharmendra Kr. Pandey, Deepak Putrevu, Jogeswara Rao and Ch. V. N Rao*

Polarimetry and Reflectivity-based GNSS-R system for marine litter detection in a
controlled flume
Adrian Perez-Portero, Amadeu Gongga, Adriano Camps, Daniel Pascual, Anton de Fockert, and Peter de
Maagt*

The SGR-ReSI-Z GNSS-R Payload for the HydroGNSS Mission
Jonathan Rawlinson, Reynolt de Vos Van Steenwijk, Martin Unwin, Peter Garner, Lily Rose, Paul Blunt,
Maria Paola Clarizia, Jean-Pascal Lejault, Massimiliano Pastena, Manuel Martin-Neira, and Thomas Burger*