Current Status and Future Activities of the IAG/GGOS Joint Working Group 4.3.9 on GNSS reflectometry

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Introduction

Global Navigation Satellite Systems (GNSS) have revolutionized positioning, navigation, and timing. In recent years, the usage of reflected GNSS signals has become a novel application for remote sensing. GNSS reflectometry (GNSS-R) thus enables the retrieval of environmental properties of natural surfaces, such as the sea, soil, vegetation, snow, ice, etc. (Figures 1 and 2). A joint working group (JWG 4.3.9) on GNSS-R was created under the auspices of the International Association of Geodesy (IAG) and the Global Geodetic Observing System (GGOS).

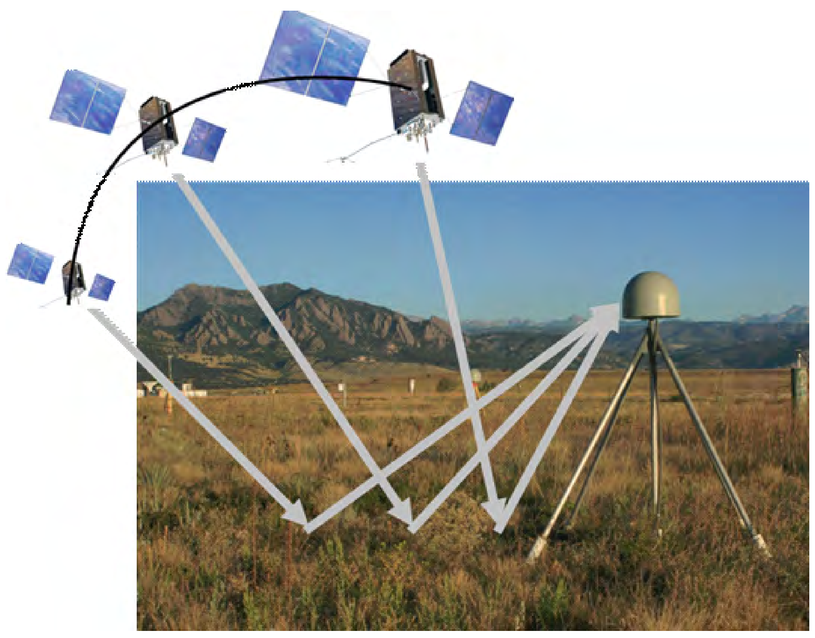

Figure 1 (left): as GNSS satellites rise and set in the sky, their reflections off natural surfaces (such as soil, sea, and snow) allow monitoring soil moisture, sea level, and snow depth, among other enviromental targets.

Scope

JWG 4.3.9 had its kick-off meeting at the EGU General Assembly in April 2016. Its scope has been clarified so as to contemplate two types of geodetic GNSS-R. It now includes both the generation of GNSS-R data by means of geodetic instrumentation and the utilization of generic GNSS-R information to aid in geodetic positioning. Ground-based soil moisture retrievals derived from IGS tracking station data would be an example of the former type of geodetic GNSS-R. Airborne GNSS-R soil moisture retrievals, later used to correct for seasonal loading at co-located ITRF sites, would be an example of the latter type.
Our goals have been refined since the JWG 4.3.9 inception at the end of 2015, as follows.

Figure 3 (below): GTGU station located at the Onsala Space Observatory, on the west coast of Sweden. Data collected over a 1-year period at 1-Hz rate will be made available for the JWG 4.3.9 intercomparison campaign.

Goals

We succeeded in establishing liaisons with neighboring organizations, such as the Permanent Service for Mean Sea Level (PSMSL) and the IEEE Geosciences and Remote Sensing Society (GRSS). It should be noted that IEEEE GRSS has its own GNSS-R working group, though it has a broader scope than JWG 4.3.9. Other ongoing goals are as follows.
- The benefits of open science data for research reproducibility have been discussed. As a consequence, there is a proposal for JWG 4.3.9 to curate a topical data repository on geodetic GNSS-R. It would offer output retrievals, input measurements, and *in situ* validation associated with selected article publications.
- The need for standardization in GNSS-R data and metadata formats is under consideration.
- A number of recommended modifications for the IGS Site Guidelines are being studied. The intent is to maximize the usefulness of shared GNSS site installations for GNSS-R purposes. These proposals are to be compiled by JWG 4.3.9 members and submitted for appreciation of the IGS Central Bureau.

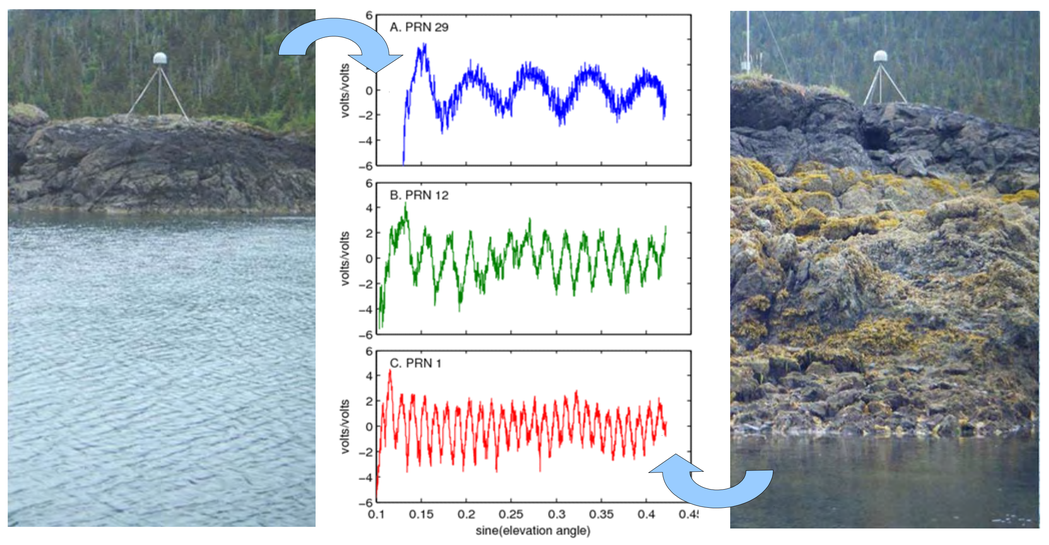

Figure 2 (above): photograph of PBAY GNSS site at low and high tides (left and right panels, respectively); SNR data (middle panel) for three satellite tracks at low, medium, and high tides.

Campaign

An intercomparison campaign is being planned on GNSS-R for sea level monitoring. It would be an opportunity to validate retrieval solutions from independent research groups under comparable conditions. Measurements were collected at a sea-facing location having a conventional tide gauge nearby (Figure 3). Results will serve to showcase the level of maturity attained with this technique as a potential GGOS data product.

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