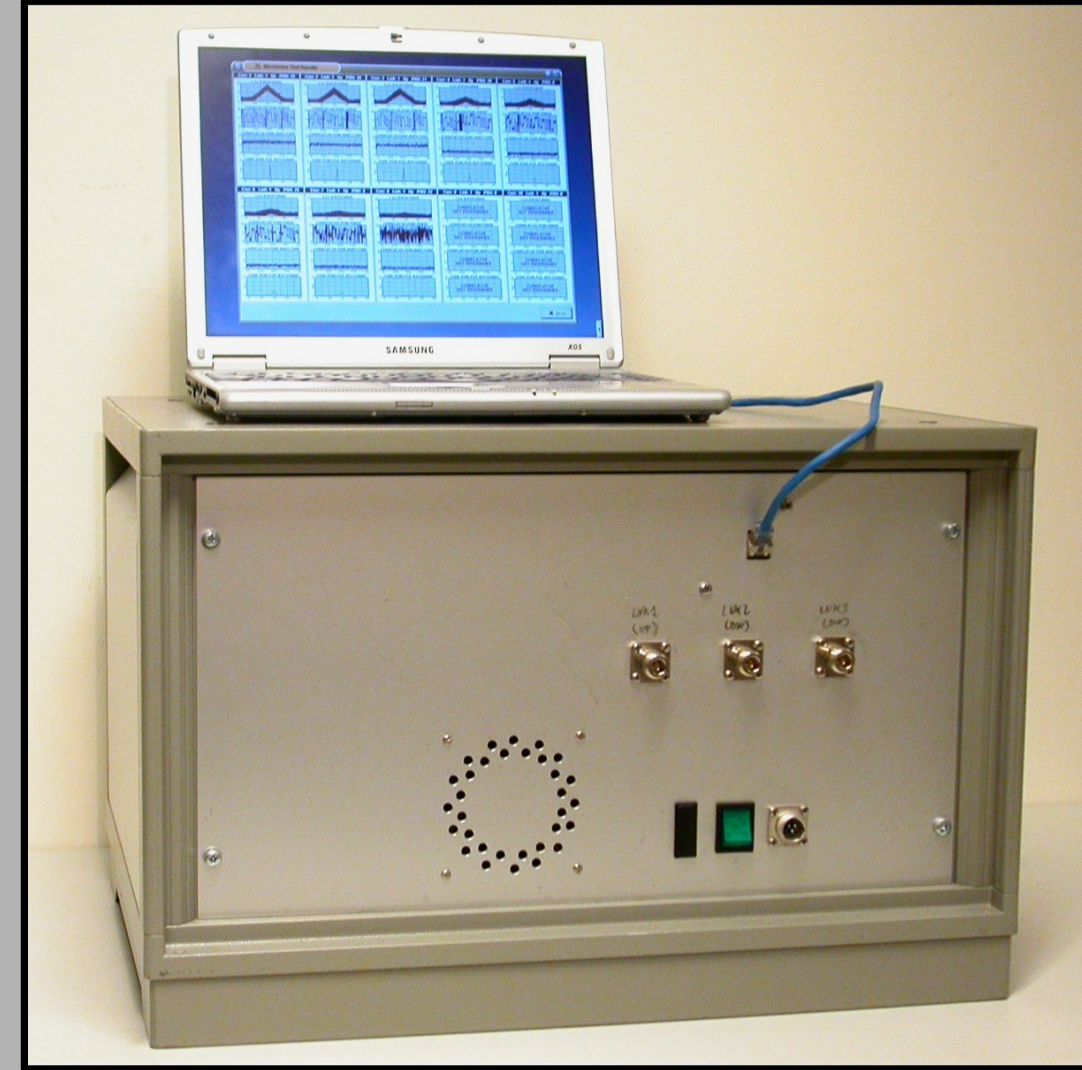


GOLD-RTR Mining: A Data Server of Experimental GNSS-R Campaigns

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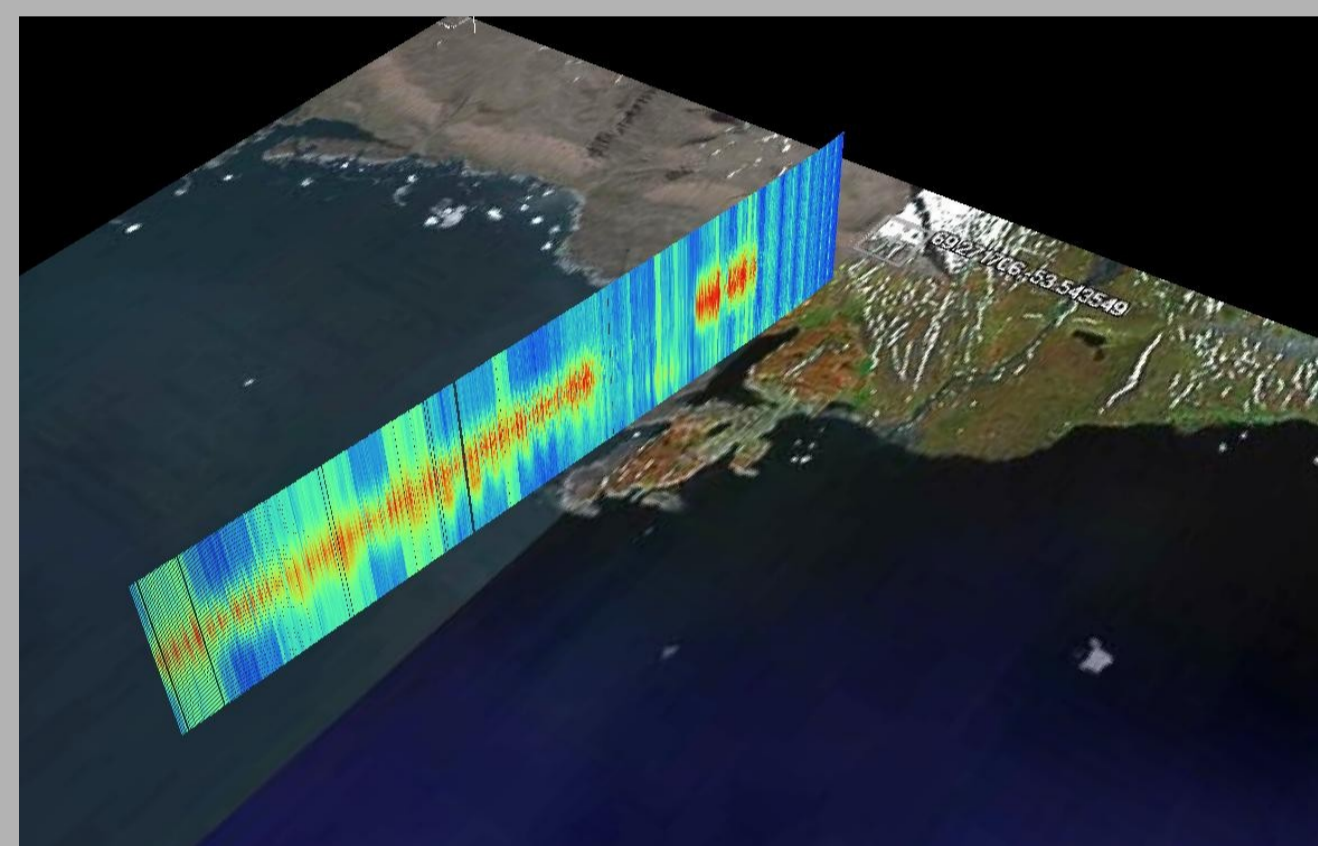
1. GOLD-RTR:

This dedicated hardware receiver contains 640 complex correlators organized into 10 channels of 64-lags each, computing 1 complex DM per channel simultaneously. The system can be programmed to correlate signals from 10 different satellites at each correlation channel to obtain DMs in different geometries, or it may be programmed to process the same signal in different channels under different frequency shifts (thus obtaining DDM). Or any combination of both, requiring up to 10 channels.



The instrument provides complex waveforms of 64-lags each, every millisecond, what we call complex **raw data**.

4. RESULTS:



Some of the results already obtained with these data sets can be found in:

O. Nogués-Correig, E. Cardellach, J. Sanz Campderròs, and A. Rius, A GPS-Reflections Receiver That Computes Doppler/Delay Maps in Real Time, IEEE Trans. Geo. Remote Sens., 45(1), 156-174, Jan. 2007.

E. Cardellach and A. Rius, A New Technique to Sense Non-Gaussian Features of the Sea Surface from L-band Bi-static GNSS Reflections, Remote Sensing of Environment, 112, 2927--2937, 10.1016/j.rse.2008.02.003, Jun. 2008.

A. Rius, E. Cardellach, and M. Martín-Neira, Altimetric Analysis of the Sea Surface GPS Reflected Signals, IEEE Trans. Geo. Remote Sens., 48(4), 2119-2127, 10.1109/TGRS.2009.2036721, Apr. 2010.

5. OPEN QUESTIONS:

In spite of the intensive work conducted with these data sets, there is a list of open questions on GNSS-R applications that the GOLD-RTR data might contribute to solve. Some of them are:

- **L-band roughness:** The L-band signals are sensitive to intermediate scales of the sea wave spectrum. They do not relate directly to the instantaneous wind, but a combination of wind, swell, waves age. It is needed to properly discern between those contributions, as well as to find potential new applications of these intermediate wave scales.

- **Co-polar model:** The received scattered co-polar component (RHCP) weakly matches the modelled waveforms. Proper models for the co-polar component of the scattering must be investigated. This data set provides co-polar scattering events.

- **Actual transmitted waveform:** It has been proved that some GPS transmitters are affected by significant multipath (up to 2 meter transmitted multipath delay in SV 49). Its impact on altimetry and scatterometry must be assessed. GOLD-RTR data (including complete direct waveforms) is also suitable to study these effects.

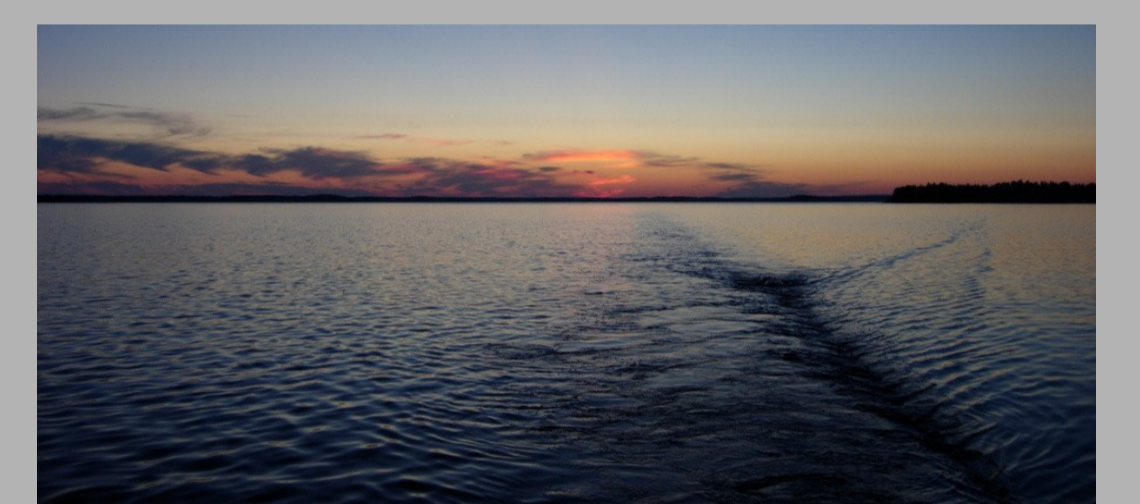
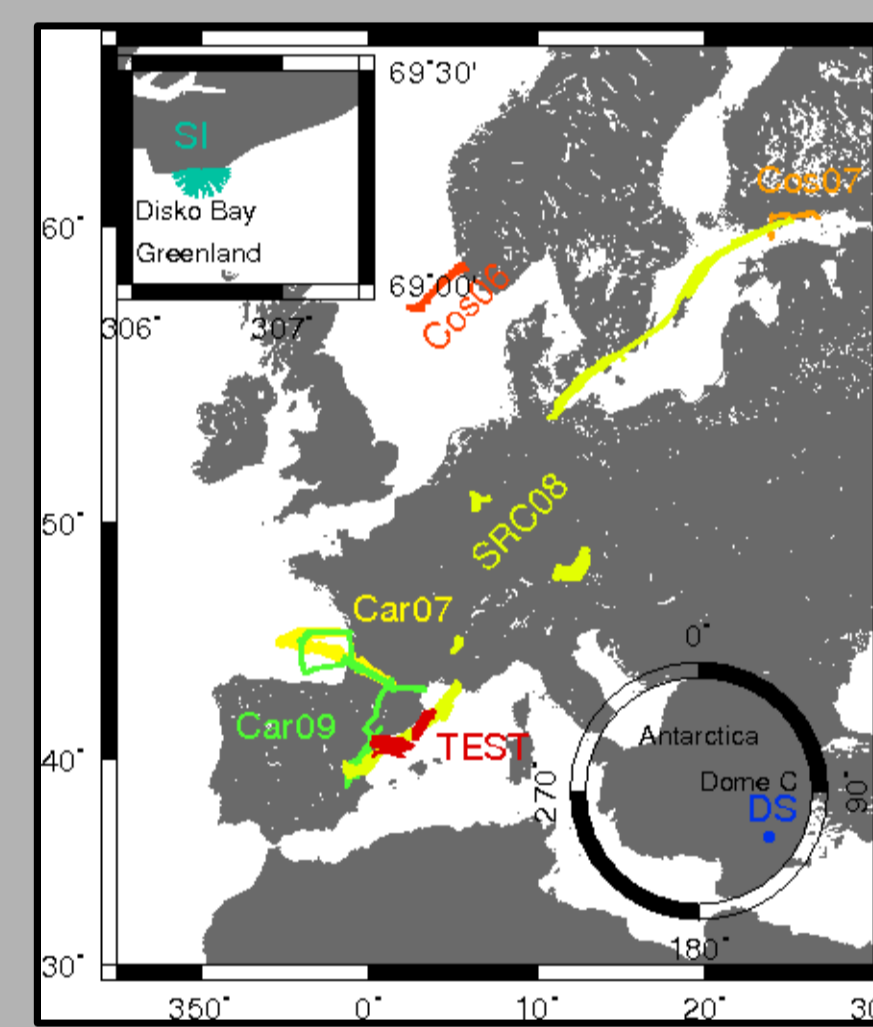
2. CAMPAIGNS:

Since 2005, when the GOLD-RTR was tested on two air-borne campaigns, Global Navigation Satellite System Reflections (GNSS-R) have been obtained with this dedicated receiver. More than 40 flights have been conducted so far, over oceans, lakes, and land; and more than 250 days of continuous monitoring of sea-ice and dry snow. The uniqueness of the data set, consisting of both integrated and also complex raw data; measuring the co- and cross-polar components of the reflected scattering; with delay and delay-Doppler maps, makes it suitable for testing a noticeable amount of **potential applications and techniques**.

Overall summary of each campaign

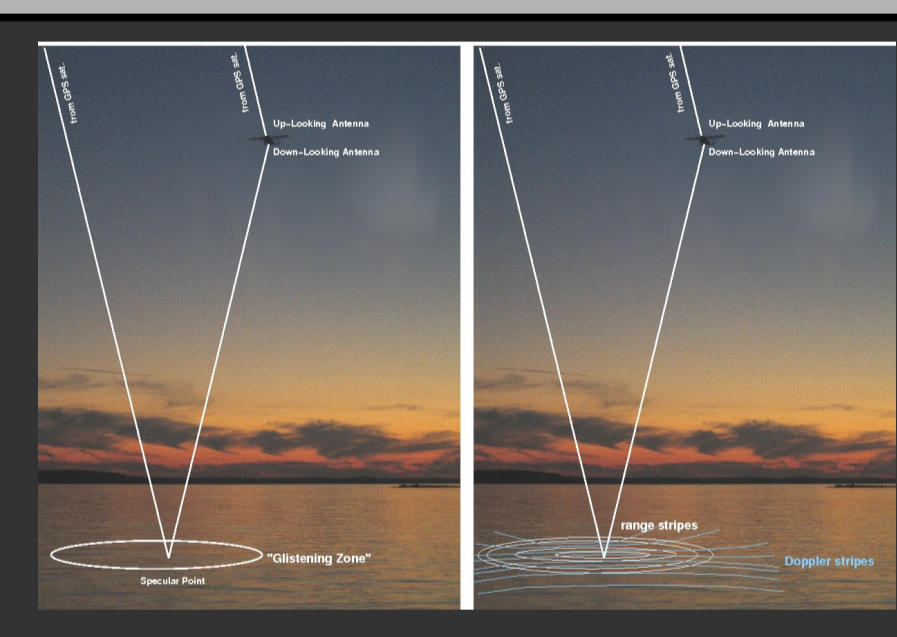
Campaign	Year	Funded by	Geographic area	Air/Ground	Ocean/Land ICE/Snow	LHCP + RHCP reflections
Gold Test	2005	IEEC/ICC	NW Mediterranean Sea (Spain)	A (3 flights)	O/L	yes
CoSMOS-OS	2006	ESA	North Sea (Norway)	A (12 flights)	O	yes
CoSMOS-OS	2007	ESA	Baltic Sea (Finland)	A (2 flights)	O	no
CAROLS	2007	CNES	South France, Bay Biscay (France)	A (3 flights)	O/L	yes
SMOS Calibration Rehearsal Campaign	2008	ESA	Finland to Valencia (Europe)	A (12 flights)	O/L	no
CAROLS	2009	CNES	South France, Bay Biscay (France), Valencia area (Spain)	A (11 flights)	O/L	yes
GPS-SI	2008 - 2009	ESA	Disko Bay (Greenland)	G (7 months)	O/I/S	yes
GPS-DS	2009	ESA	Dome-C (Antarctica)	G (10 days)	S	yes

Map with all campaigns



3. DATA TYPES:

OCEAN



SOIL MOISTURE



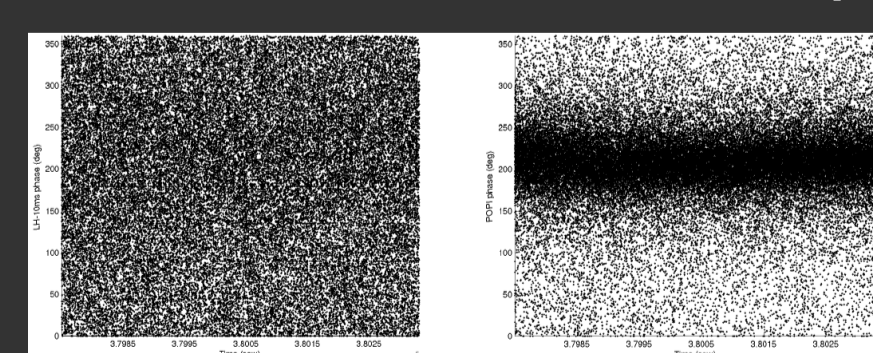
SEA-ICE



DRY-SNOW

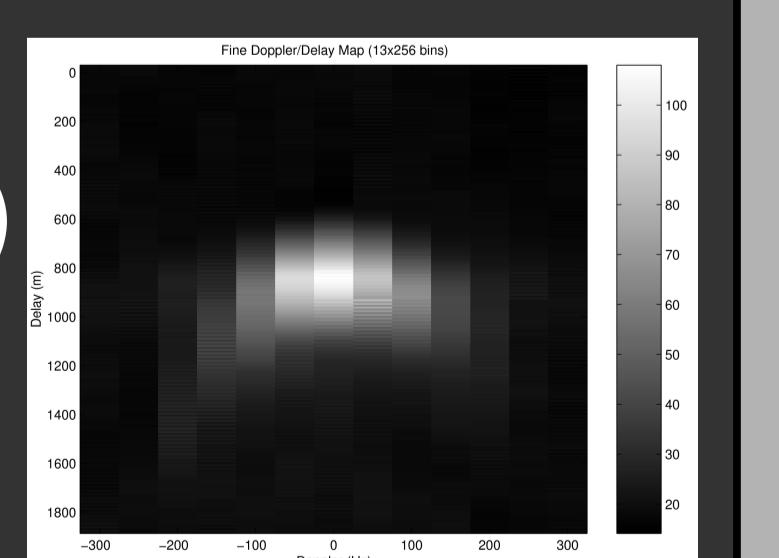


POLARIMETRIC REFLECTIONS (CO- & CROSS-)



[left] 10 minutes time series of 10-ms GPS-Reflected LH field, non-coherent due to the roughness of the scattering surface.
[right] Polarimetric phase interferometry (RH-to-LH phase) for the same time series.

DM AND DDM COMPLEX (I/Q)



DATA SETS FREELY AVAILABLE FOR RESEARCH:

http://www.ice.csic.es/research/gold_rtr_mining/