

CALIBRATING GNSS SATELLITE ANTENNA GROUP-DELAY VARIATIONS USING SPACE AND GROUND RECEIVERS

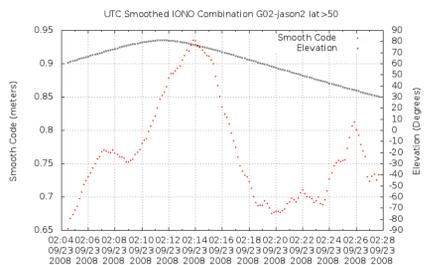
GBICS PROJECT (ESA'S GSP)

- GNSS Bias Calibration System (GBICS)
- GNSS observations from LEO satellites

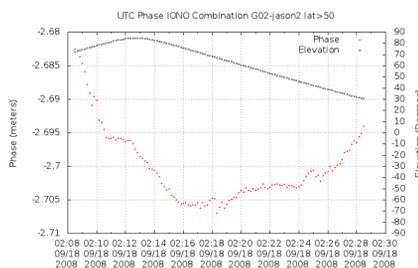
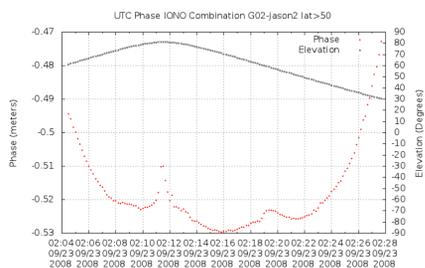
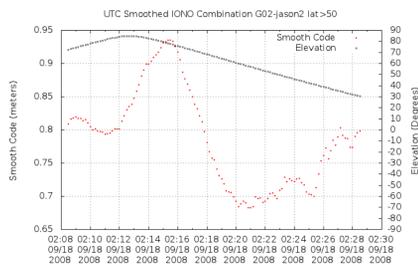
IONOSPHERE & PLASMASPHERE IMPACT

- Data from Jason 1, Jason-2 (height: 1336 Km)
- P1-P2 and L1-L2 ionosphere combination
- Code combination shows significant variations
- High dependency with elevation and nadir angles
- **A clear repeatable pattern was detected** for periods with the same geometry disposition of the sun, the GPS satellite and the LEO GNSS receiver

2008/267



2008/262



Code and phase HW biases have two components:

1. User dependent and attributed to the antenna (DOT Direction of transmission).
2. Common for all users and attributed to the payload, and to the mean behavior (amongst DOT) of the antenna.

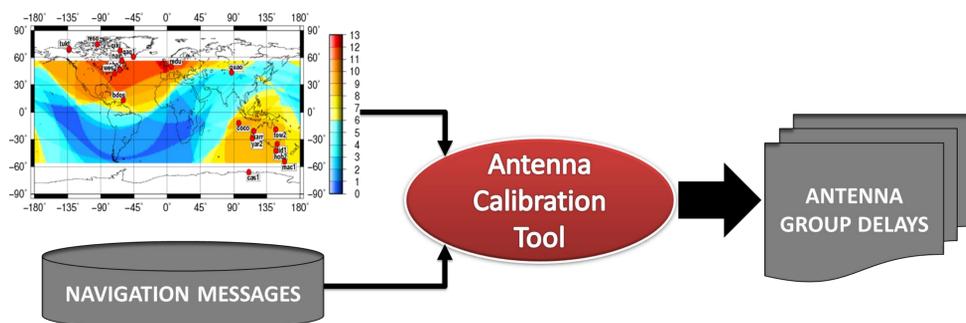
NEW CALIBRATION ALGORITHM

Input data:

- Ionosphere-free and geometry-free combination of phase and code observations
- Several weeks of data from a dense station network (receivers without smoothing)

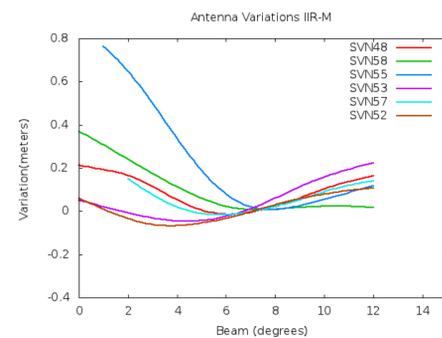
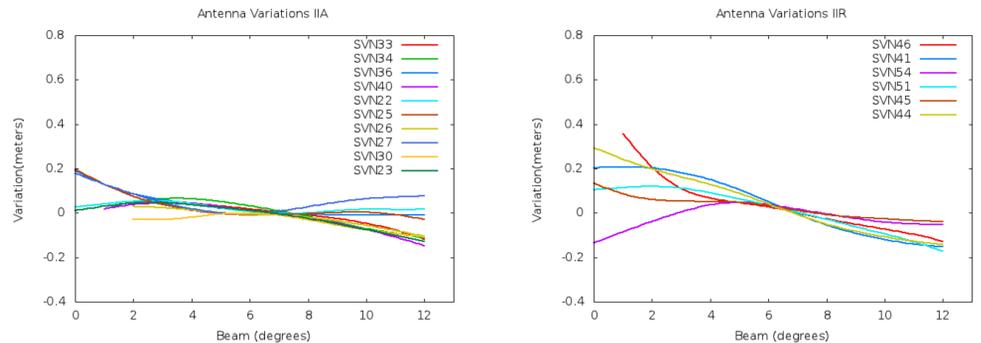
Processing:

- Observables processed in bins, depending on the nadir angle
- Antenna contribution to phase measurements is corrected using IGS antex values



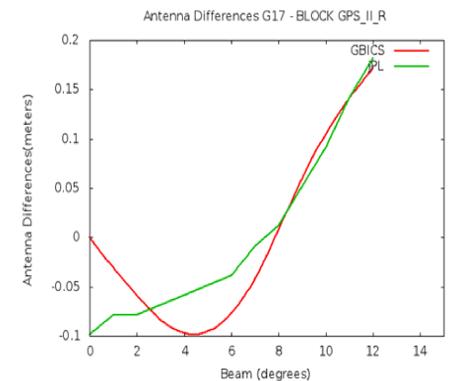
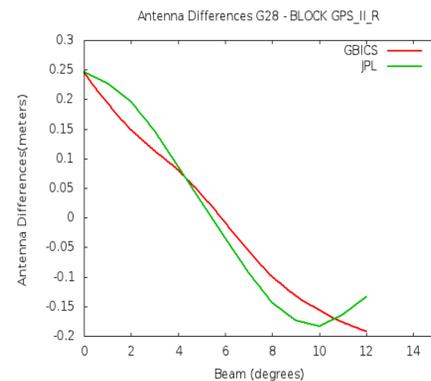
GROUP DELAY CALIBRATION RESULTS

- Important variations depending on the nadir angle
- Highly correlated with the GPS satellite block
- For blocks IIR and IIR-M satellites' antennae, the variation range sometimes goes up to 80-90 cm



Comparison with JPL's results

- Differences with calibrations obtained by JPL¹ are normally below 5 cm (RMS)



Satellite	Block	RMS
G03	BLOCK-IIA	0.05 m
G28	BLOCK-IIR	0.03 m
G15	BLOCK-IIRM	0.04 m

1. Haines, B. et al "Characterizing the GPS Satellite Antenna Phase- and Group-Delay Variations Using Data from Low-Earth Orbiters", Jet Propulsion Laboratory, 2012

FUTURE WORK

- Data from receivers with same antenna model and with the same configuration
- Correct contribution of the receiver's antenna
- Discard measurements from satellites in eclipse
- Discard measurements during periods of fast attitude change (singular points of the attitude law)

