UNIVERSITÀ DEGLI STUDI DI PADOVA

CISAS G. COLOMBO

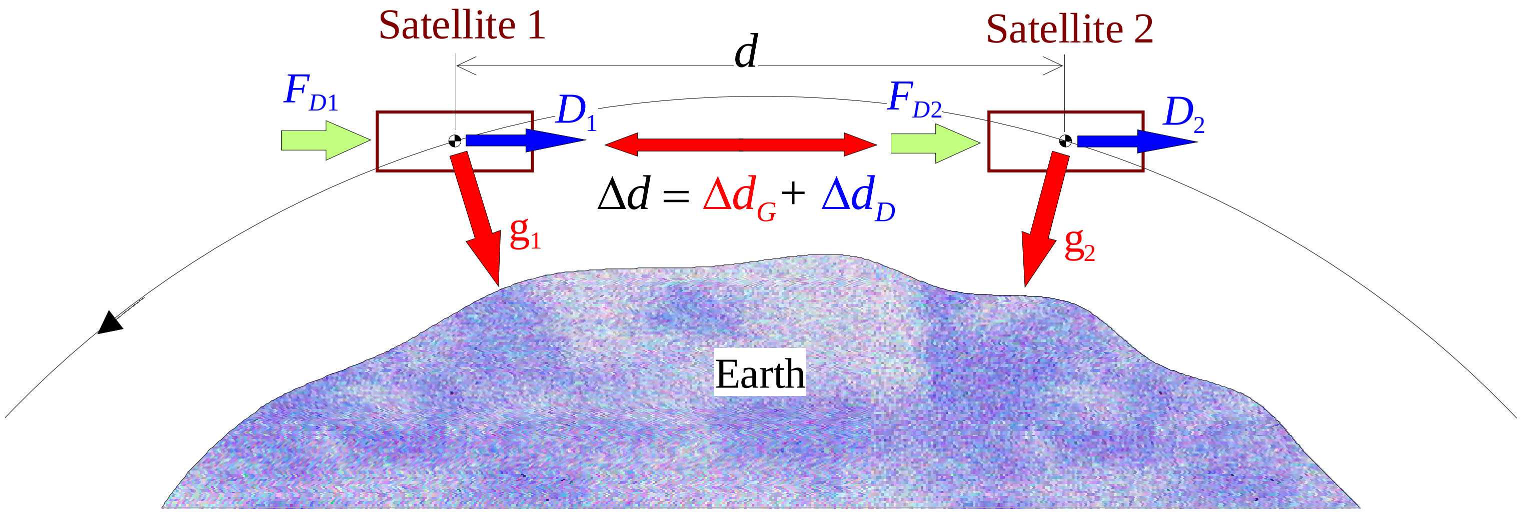
Ricostruzione del vettore di stato (posizione velocità e clock) del satellite mediante analisi dei dati del ricevitore GNSS di bordo, analisi delle anomalie di gravità specie nel settore Himalayano, Pakistan e Tibet/Sin Kiang

A. Caporali (analisi dati GNSS)
E. Lorenzini (volo in formazione)
S. Casotto (campo gravitazionale, tbc)
J.Zurutuza (analisi dati GNSS)
+ dottorandi CISAS

NGGM measurement technique

- Orbital height:340 to 420 km, depending on configurations, for ca. 11 years (nominal)

Satellite-satellite distance within each pair d ~ 100 km.



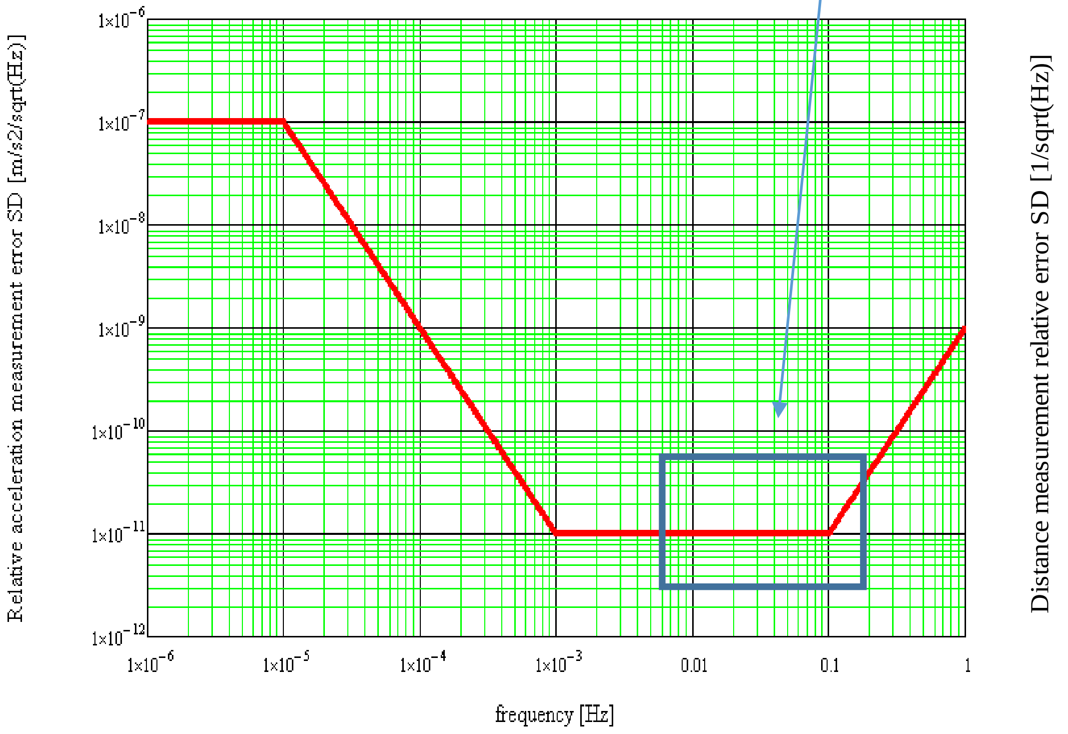
“gravity sensor” consisting of a pair of satellites flying in loose formation;

gravity field recovered from measuring (with a laser ranging system) the distance variation (Δd) induced between the satellites;

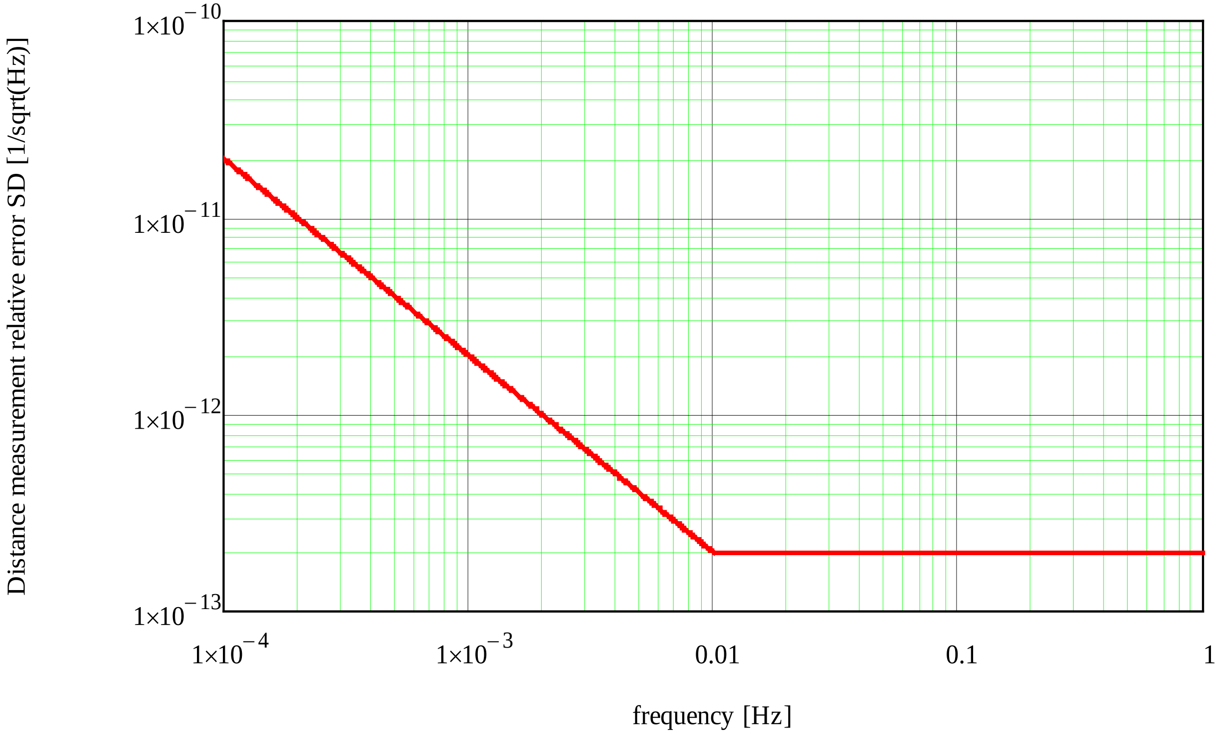
non-gravitational effects produced by atmospheric drag (Δd_G) separately measured by accelerometers and accounted for in the data processing.

- Measurement accuracy at 1Hz $2*10^{-13}$ at 100 km implies $2*10^{-8}$ m or 20 nm

Optimal frequency range for measure of distance and non grav accelerations Integration time from 10 to 100 sec



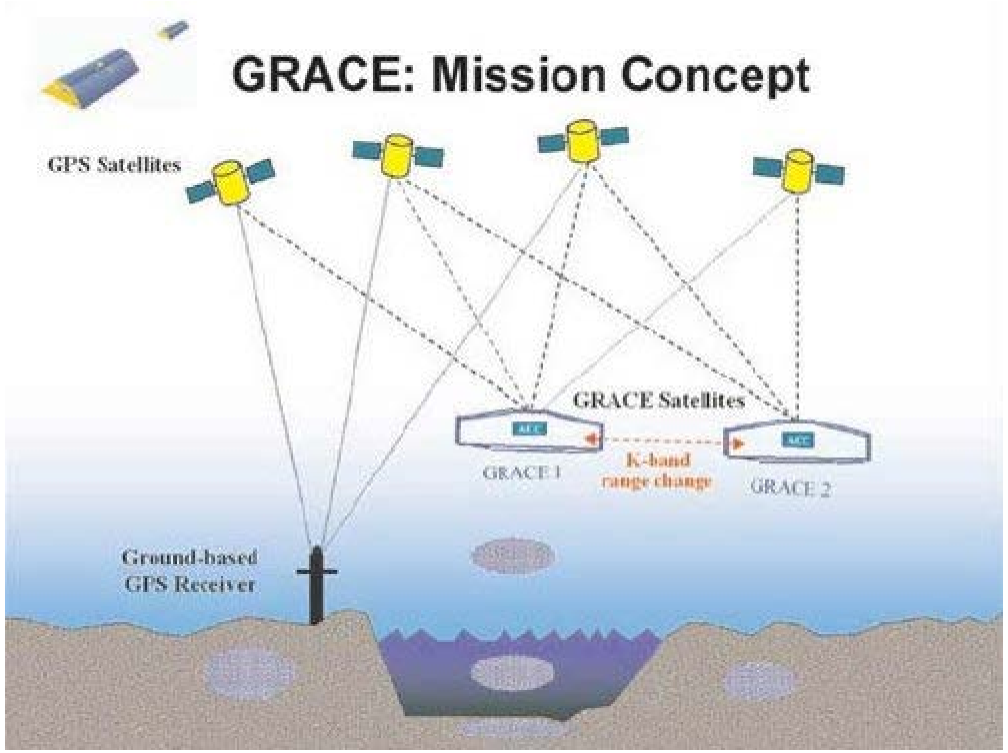
Estimated limit to the measurement error spectral density of the relative non-gravitational acceleration of the two satellites along the line joining the satellite COMs



Estimated limit to the spectral density of the relative error in the distance variation measurement

Proposal: add differential GNSS measurements satellite to satellite

- Double differences of L1/L2 carrier phase remove receiver and satellite clock errors
- GNSS: GPS, Glonass and Galileo now; in near future add BeiDou + Navic + SBAS: total of 30-40 satellites simultaneously visible
- Limited ionospheric delay due to orbit altitude in medium/upper ionosphere
- Precise ephemeris of CoM of both S/C (as input) imply high percentage of ambiguity resolution; accuracy of baseline measurement ca. 1-5 mm in the range 0.1 – 0.01 Hz
- Antenna Phase Center to Center of Mass (APC2CoM) offset and attitude required to translate the intersatellite distance to distance between CoMs
- Agreement between laser data (distance between CoM) and GNSS data (distance between APC) help constraining relative pitch angle
- No additional payload required, use existing data



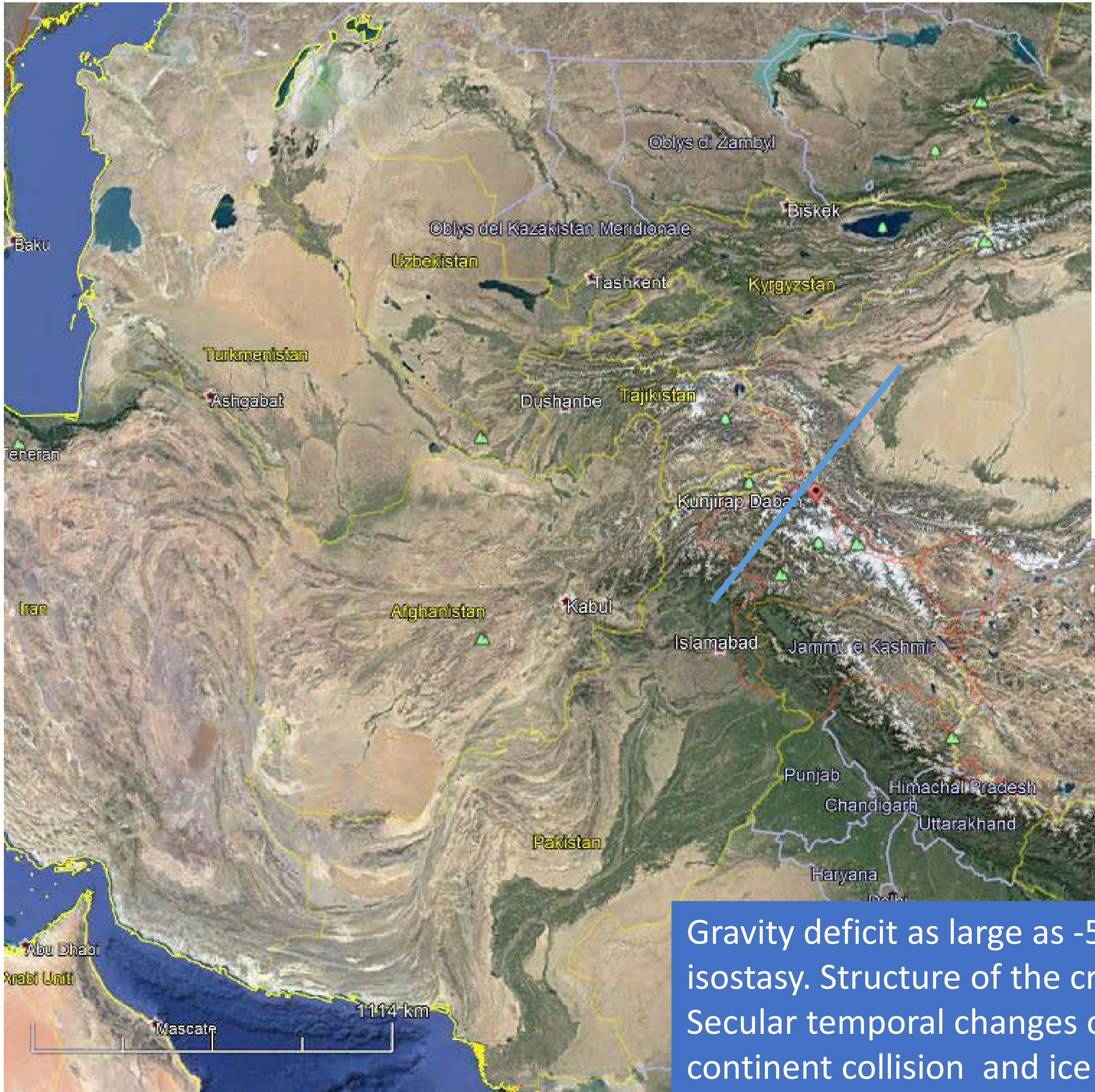
Concept of SST between two LEOs s/c using GNSS was demonstrated with the GRACE mission

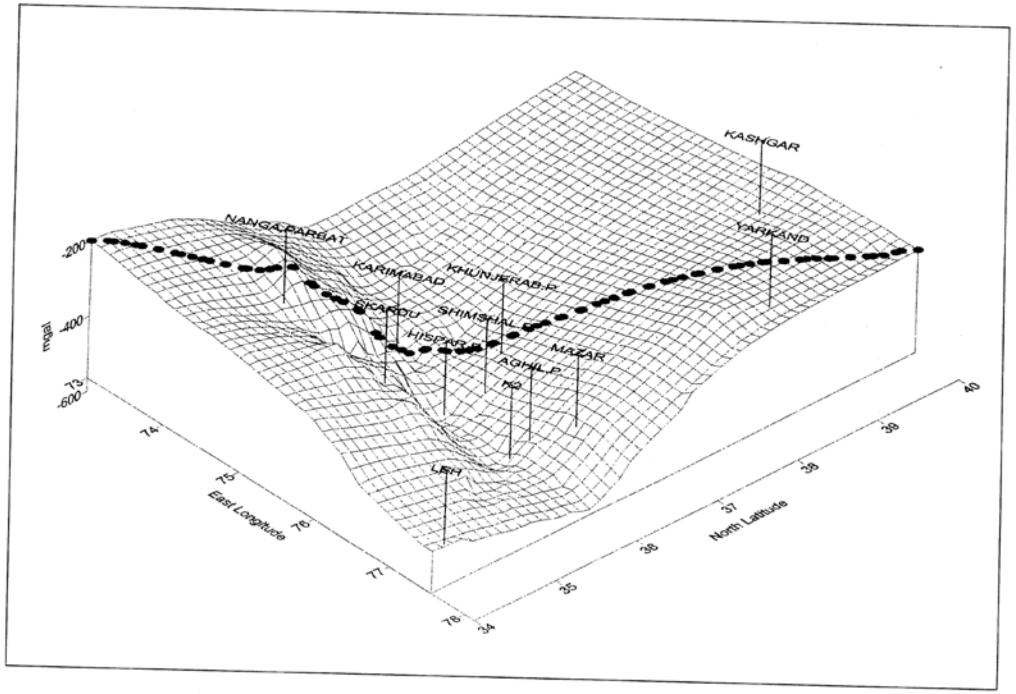
SRL assessement

- SRL 4 – Proof of Concept
  - Development of a prototype performance simulator; evaluate GRACE SST data
  - Simulated SST laser measurements from CoM of Sat1 to CoM of Sat2 can be generated by propagating an initial vector of state for anyone of the proposed orbital configurations
  - Likewise double differenced carrier phase data from the available GNSS satellites can be simulated and inverted to obtain the intersatellite baseline vector

Steps to SRL 5 -End-to-End Performance Simulations-

- Development of an end to end performance simulator
- Detailed assessement of the sensitivity of measurements on error sources: CoM to APC changes in orientation, multipath, phase noise, antenna model (azimuth and elevation dependent Phase Center Variations)
- Sensitivity of the Differential Phase measurements to the targeted parameter is demonstrated through extensive analyses using realistic data





Gravity deficit as large as -500 mGal in Pakistan-SinKiang (China) due to isostasy. Structure of the crust can be studied with detailed gravity data. Secular temporal changes of gravity due to ongoing continent to continent collision and ice melting can be studied.

SRL for the geophysical interpretation of the gravity data in Pakistan Himalaya: SRL8/9

- SRL8: Validated and Matured Science
  - Data products are systematically generated and disseminated. The Mission Activity scientific goals and objective are tested and evaluated. The scientific aim is tested. Science linked to the Mission Activity is advancing leading to a growing scientific community, new applications, and new scientific insights.
- SRL9: Science Impact Quantification
  - The measurements and observations have been re-processed ensuring high quality data sets. The scientific aim and objective of the Mission Activity are evaluated. The end-to-end scientific impact across the Mission Activity with respect to the user requirements is assessed and quantified. The requirements have been revised and based on the outcome future strategies are being discussed.