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Relationship Between the GNSS Signals and Soil Moisture During the SMOS Validation Rehearsal Campaign in 2008

Ernesto Lopez-Baeza (1), Alejandro Buil Martinez (2), Virgilio Gomez Rubio (3), Francesc Fabra (4), Estel Cardellach (5), and Antonio Rius (6)

(1) Dept. Earth Physics and Thermodynamics, University of Valencia, Valencia, Spain (Ernesto.Lopez@uv.es / +34 96 3543385), (2) Dept. Earth Physics and Thermodynamics, University of Valencia, Valencia, Spain (Alejandro.Buil@uv.es / +34 96 3543385), (3) Dept. of Mathematics, University of Castilla-La Mancha, Spain (Virgilio.Gomez@uclm.es, (4) Dept. of Earth Observation, Institute for Space Sciences of Catalunya, Barcelona (fabra@ieec.uab.es) , (5) Dept. of Earth Observation, Institute for Space Sciences of Catalunya, Barcelona (estel@ieec.uab.es) , (6) Dept. of Earth Observation, Institute for Space Sciences of Catalunya, Barcelona (rius@ieec.uab.es)

The objective of this work has been to gain more knowledge to relate the Global Navigation Satellite Systems (GNSS) signals reflected by the land surface to soil moisture.

The GPS constellation consists of 24 satellites that orbit the Earth at an altitude of 20.126,61 km above the equator. These satellites are designed so that at least four of them are available for tridimensional navigation at any location on Earth. Each satellite transmits with a PRN, a pseudo-random number that is always the same for each satellite and orthonormal with respect to each other.

During the ESA SMOS Validation Rehearsal Camping (April-May, 2008), the Short SC.7 Skyvan 3A-100 from the Technical University of Helsinki included the GOLD-RTR (FPS open-loop differential real-time receiver) receptor as part of the payload, acquiring the signals proceeding from the GPS constellation. At the same time, a comprehensive volumetric soil moisture sampling was performed in the 10 km x 10 km Valencia Anchor Station control area by means of volumetric soil cylinder samples and Delta-T ThetaProbe sensors.

We have firstly analyzed the raw data over homogeneous areas (crop types, texture, ...). Once we achieved acceptable relationships, geo-statistical models (Universal Kriging) were used and validated, taking advantage of the maximum possible quantity of data. We also used the Environmental Unit map used by our research group in SMOS validation activities where we could compare soil moisture for each Environmental Unit to GOLD-RTR data, thus determining the units that offered better results.

Alternatively, we used two regression models such as Kernel Ridge Regression (KRR) and Neural Network Regression (NNR) trying to relate the GPS constellation signal (band-L) to the various parameters involved in the process such as clay and sand content, elevation angle and soil moisture.