The influence of volcanic ash on GPS SNR signals through a laboratory experiment

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Recent studies carried out in different worldwide volcanoes (e.g. Mt. Redoubt in Alaska, Mt. Etna in Italy) have shown the capability to detect volcanic plumes by using GNSS Signal to Noise Ratio (SNR). Those studies are based on the direct satellite signal measured by the SNR. For the GNSS frequency bands, the SNR signal should not be sensitive to water vapour variations, and the direct signal can be only attenuated in presence of anomalies. In order to further investigate the interaction between GNSS SNR and volcanic ash, to constrain the limitations of the proposed approach, a laboratory experiment was conducted. In particular, the experiment set-up was designed to measure the interaction among the GPS L1, L2 carriers and volcanic ash and consisted of: i) n. 2 identical high-frequency GNSS receivers; ii) n. 1 weather station; iii) n. 1 container; iv) n. 1 ground humidity sensor. A conical container having the same length, width and height of 1 m was used to hold the volcanic ash having two different particle sizes (namely fine and coarse classes). The container was built using a material transparent to the GPS L1 and L2 carriers. The container shape was a truncated cone with a vertex angle of 100° able to contain a volume of about 60 dm3. One receiver was placed below the container while the other one, used as reference, was located nearby in free air. The differences between the L1 and L2 signals of the two receivers was used to study the contribution of the volcanic ash.. We performed different type of measurements: i) in absence of ash (bottom); ii) changing the height of the 'fine' ash inside the container in steps of quarter-wave; iii) changing the height of the 'coarse' ash inside the container in steps of quarter-wave. Preliminary important results are here shown and described.