



## Morphological changes at Mt. Etna detected by TanDEM-X

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We produced a DEM of the Mt. Etna volcano using TanDEM-X data collected on October 9, 2012. The TanDEM-X data were acquired in bistatic mode with TSX as master sensor and TDX as receive only sensor. The pre-existing SRTM DEM was used for geometrical reference (geocoding, initial height model, large scale reference). The interferogram was computed with 4 looks in range and 4 looks in azimuth. After compensation of the SRTM heights, the differential TanDEM-X interferogram looked overall quite flat but showed local deviations related to noise (e.g. over the sea), topographic effects related to the low resolution of the SRTM DEM, and deviations related to actual changes of the topography, as observed in the Mount Etna peak region. After phase unwrapping, addressed with a minimum-cost flow algorithm and slight spatial filtering, the unwrapped phases were converted to relative heights. In order to move to absolute heights the SRTM height reference was used under the assumption that the deviation from the SRTM DEM is zero at large scale and without any linear trend. Finally, the height model was resampled into geographical coordinates.

In the framework of the MED-SUV project, and thanks to the availability of a dense GPS network of more than 100 benchmarks periodically measured by INGV\_OE, the TanDEM-X model has been validated. By computing the difference of the elevations provided by TanDEM-X with those measured by GPS we obtained a mean difference of 0.7 m and a standard deviation of 5.2 m. These values are biased by a few GPS benchmarks located in steep areas unfavorable illuminated by the radar. Without considerations of the two more unfavorable GPS stations, the height mean difference and a standard deviation are 0.6 m and 4.3 m respectively. We also performed correlation analyses of the height differences with respect to topography, latitude and longitude and we could exclude any elevation-related errors or geometrical ramp distortions.

In the following, we compared the 2012 TanDEM-X model with the 2000 SRTM DEM in order to evaluate the morphological changes occurred on the volcano during the 12 years time lap. The pixel size of SRTM-DEM is about 90 m and we resampled the TanDEM-X model to fit this value. The results show that most of the variations occurred in the Valle del Bove and on the summit crater areas.

In order to compare DEMs with the same pixel size, we performed a further comparison with a 5m ground resolution optical DEM, produced in 2004 and covering only the summit area. The variations in topography have been compared with ground mapping surveys, confirming a good correlation with the spatial extension of the lava flows and of the pyroclastic deposits occurred on Mt. Etna in the last seven years. The comparison between the two DEM's (2004-2012) allows calculating the amount of volcanics emitted and to clearly monitoring the growth and development of the New South East Crater (NSEC). TanDEM-X is a useful tools to monitor volcanic area characterized by a quit frequent activity (a paroxysm every 5-10 days), such us Mt. Etna, especially if concentrated in areas not easily accessible.