THE 6 APRIL 2009 L'AQUILA EARTHQUAKE: DIFFERENT APPROACHES FOR EVALUATION OF SURFACE DISPLACEMENTS

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ABSTRACT:

The 6 April 2009 earthquake caused the destruction of the city of L'Aquila and surrounding areas and the death of 300 people. The great desperation from a human perspective has been associated with a request for scientific knowledge of the movement, its magnitude, and the surface displacement caused.

The Region of Abruzzo is one of the most seismically active areas in Italy and has historically been hit by earthquakes including several of high magnitude. The earthquake of M=5.8 on the 6 April 2009 unfortunately caused great damage in the city of L'Aquila and surrounding areas; this event was preceded by a preseismic sequence with tremors of magnitude up to 4 and by an intense postseismic sequence in a south-east direction with regard to the epicenter (Chiarabba et al., 2009).

It is known that the spatial geodesy provides a valid and reliable contribution to understanding crustal movements, and in particular the GNSS technique is that which, with its continuous development, its accuracy and its versatility, has the greatest impact on geodynamic research. In recent years various Permanent Station networks have been realized, with the primary objective of supplying GNSS data so as to make it easier and more convenient to use them (Manzino, 2002), to carry out geodetic monitoring of the area and also to contribute to numerous scientific applications. Using the data from these networks and other permanent stations in the Region of Abruzzo and neighboring regions, it was possible to create an important series of spatial data that allowed the study and a first estimate of the co-seismic surface deformations.

Taken into consideration were, obviously, the 17 permanent stations of the Region of Abruzzo, which uniformly cover the regional territory, 3 stations in the RING network of the National Geophysics and Volcanology Institute (INGV), 3 stations belonging to the EUREF network, one of which run by the La Sapienza University of Rome (MOSE), one of the Italian Space Agency (AQUI) and one operated by the GPSUMBRIA network (UNTR). Also belonging to this last network is the Norcia station (RENO). Two other stations run by the Geotop company were also included. Almost all of the permanent stations have a materialization for geodetic-type applications according to IGS specifications. Daily data were collected with sampling at 30 seconds from 1 February 2009 to 31 May 2009. The range of the temporal distribution was chosen so as to be able to point out any displacements, but also according to the need to be able to collect and process the data rather quickly.

In the first stage, the data collected from the 26 permanent stations were processed using commercial software, so as to be able to obtain the first quick solutions, which were then checked against a second processing done with scientific software. This approach is justified by the fact that initially it was desired to define a quick, reliable method for monitoring the area with limited data time series.

The displacements were obtained by processing the data also with a scientific software: the Bernese GPS Software. The results obtained confirm the reliability of the solutions obtained with the commercial software. On the other hand the solutions obtained with the Bernese software showed greater stability and accuracy. Both approaches allow monitoring of the area almost in real time, useful toward the possible prevention of disastrous events. This is possible thanks to the implementation of automatic procedures that simplify and speed up the data processing strategies.

Following the April 6th earthquake and the subsequent seismic swarm, vertical displacements of a considerable extent took place in the L'Aquila area (above all for AQUI, AQRA, INGP, three permanent stations at L'Aquila and PAGA (Paganica), near L'Aquila) accompanied also by horizontal displacements (see Figure 1). Some stations then stabilized around the new values, whereas that of Paganica and the city of L'Aquila continued to show movements as a result of the seismic swarm after April 6th.

The displacements pointed out in this work may definitely be of help in the study of new dynamics arising as a consequence of this strong seismic shock.

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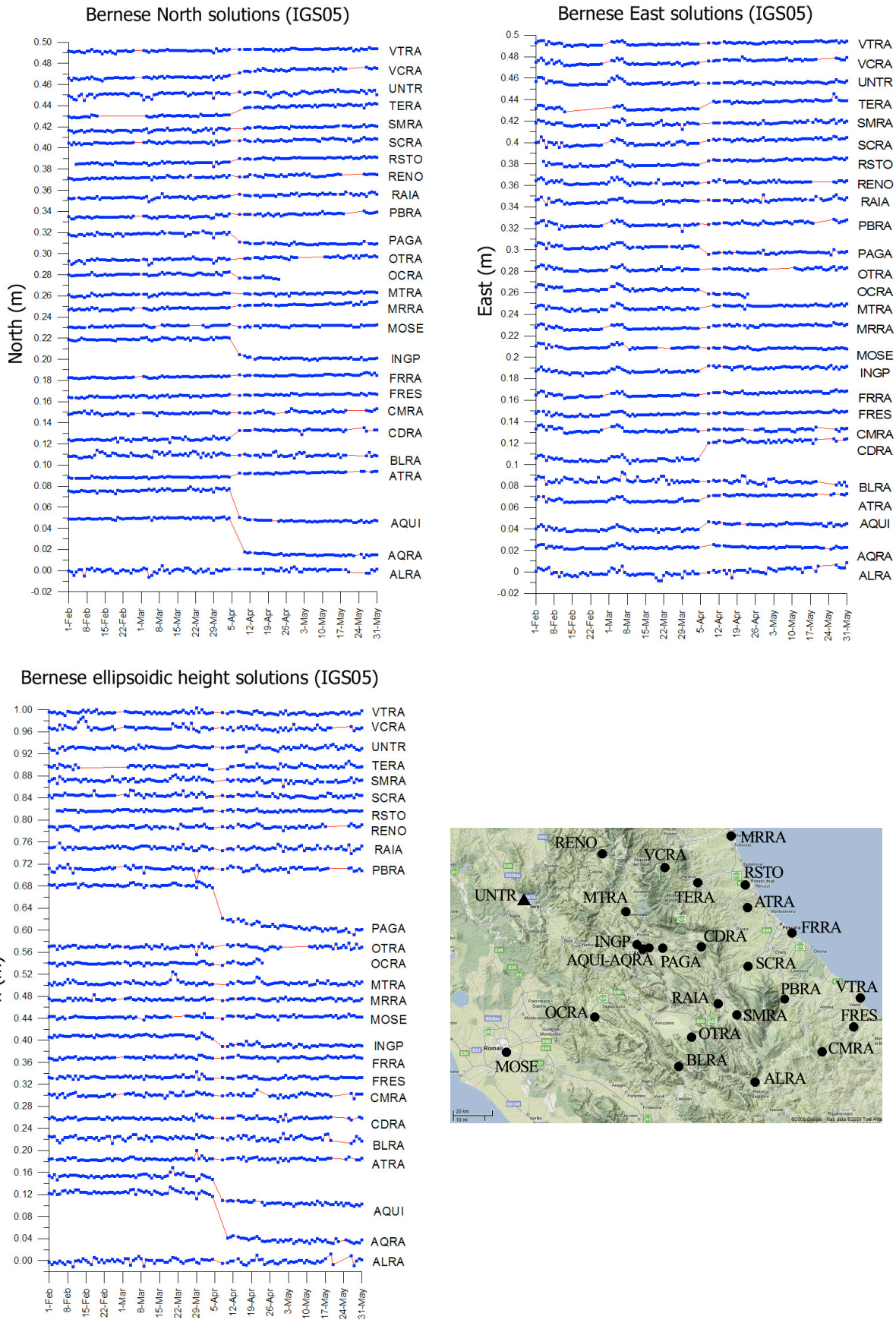

Figure 1-2. Time series of the 26 permanent stations processed with the Bernese GPS Software in the IGS05 Datum and map of the network (Image from *Google maps*)