1D and 2D site amplification effects at Tarcento (Friuli, NE Italy), 30 years later

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Abstract A temporary accelerometer network has been installed in Tarcento (Friuli, NE Italy), a small town heavily hit by the 1976–1977 Friuli earthquake sequence, as a part of an ongoing research project aimed at ground motion simulation and generation of shakemaps in the near-field of an earthquake. The network operated from October 2008 to April 2010 and consisted of three K2 accelerographs with internal Episensor, distributed over a linear array of about 1.5 km length. Tarcento town had been chosen, at the end of the 1970s, as the ideal site for a pilot microzonation study, the first of this kind in Italy, in which a substantial number of field (and laboratory) tests were carried out in order to assess the mechanical properties of local alluvium deposits and their complex (3D) geometrical configuration. The data from the temporary network, illustrated herein, allow for proper verification and review of some of the quantitative predictions formulated in the 1980 study. As argued in the discussion section, we also believe that the data are apt to provide valuable information of more general interest on the complex seismic response of alluvium-filled valleys, and we show therein how the observations can be interpreted in the light of presently available parametric simulation studies and simplified criteria for handling basin amplification effects.

Keywords Seismic networks · Microzonation · Alluvium-filled valleys · Complex site effects

1 Introduction

This study originates from an Italian government-funded research project denominated “Prediction of ground motion and generation of shaking maps in the near-fault region of an earthquake”, sponsored within the so-called PRIN2007 national program. The project began in September 2008, with the challenging aim of improving, for earthquake engineering applications, the prediction of
strong earthquake ground motions in the near field of seismic sources highly representative of earthquake hazard in Italy, especially in its North-eastern regions.

The scarcity of available near-source acceleration records, even worldwide, naturally led the proposers to formulate the numerical simulation of strong ground motions at selected test sites as one of the main tasks of the Project. These sites were chosen at the beginning on the basis of three main criteria, i.e., (a) general near-fault location, (b) well-characterized geological configuration, and (c) potentially interesting or peculiar local seismic response features. Two sites were selected: Gemona del Friuli and Tarcento, in the Friuli Venezia Giulia region of NE Italy.

Both are small towns partially destroyed or heavily damaged by the 1976–1977 Friuli earthquake sequence, with a $M_W 6.4$ mainshock occurring on May 6, 1976.

Criterion (a) is apparent in Fig. 1, where the surface projections of the faults that caused the largest earthquakes of the Friuli 1976–1977 seismic sequence are depicted. Reconstructing the geometry of the faults rupturing in the sequence is still a debated issue, beyond the scope of this paper. Herein, we just show the selection of possible source representations adopted within the mentioned research project. The reader is referred to Aoudia et al. (2000), Basili et al. (2008), Burrato et al. (2008), Cipar (1981), DISS Working Group (2009), Galadini et al. (2005), Slejko et al. (1999), Aoudia et al. (2000), Basili et al. (2008), Burrato et al. (2008), Cipar (1981), DISS Working Group (2009), Galadini et al. (2005), Slejko et al. (1999),

![Fig. 1 Surface projections of the faults generating the largest earthquakes of the Friuli 1976–1977 seismic sequence. The solid rectangle represents the surface projection of the 1976 May 6 (20:00 UTC, $M_W 6.4$) earthquake source (Perniola et al. 2004). The related epicenter (Zonno and Kind 1984) is the black star. Dashed rectangles (faults) and white stars (epicenters) refer to the most energetic September 1976 events: Sept. 11 (16:31 UTC, $M_W 5.2$), Sept. 11 (16:35 UTC, $M_W 5.7$), Sept. 15 (03:15 UTC, $M_W 6$), and Sept. 15 (09:21 UTC, $M_W 6.1$). Fault geometry and epicenter locations are taken from Pondrelli et al. (2001). The circle symbols on the southern border of the 1976/05/06 fault are the accelerometer stations (TSH, TSC, and TSB) installed in the Tarcento municipal area, discussed in text. The black arrow indicates the town of Gemona del Friuli, lying upon a large alluvium fan.](Image)