Geophysical Research Abstracts
Vol. 19, EGU2017-4799, 2017
EGU General Assembly 2017

Rotational motions from the 2016, Central Italy seismic sequence, as observed by an underground ring laser gyroscope

Andreino Simonelli (1,2), Jacopo Belfi (2), Nicolò Beverini (5,2), Angela Di Virgilio (2), Enrico Maccioni (5), Gaetano De Luca (4), Gilberto Saccorotti (3), Joachim Wassermann (1), and Heiner Igel (1)

(1) Department of Earth and Environmental Sciences, LMU Munich, Germany, (2) Istituto Nazionale di Fisica Nucleare, Pisa, Italy, (3) Istituto Nazionale di Geofisica e Vulcanologia, Pisa, Italy, (4) Istituto Nazionale di Geofisica e Vulcanologia, Centro Nazionale Terremoti, Rome, Italy, (5) Università di Pisa, Dipartimento di Fisica "E. Fermi", Pisa, Italy

We present analyses of rotational and translational ground motions from earthquakes recorded during October-November, 2016, in association with the Central Italy seismic-sequence. We use co-located measurements of the vertical ground rotation rate from a large ring laser gyroscope (RLG), and the three components of ground velocity from a broadband seismometer. Both instruments are positioned in a deep underground environment, within the Gran Sasso National Laboratories (LNGS) of the Istituto Nazionale di Fisica Nucleare (INFN). We collected dozen of events spanning the 3.5-5.9 Magnitude range, and epicentral distances between 40 km and 80 km. This data set constitutes an unprecedented observation of the vertical rotational motions associated with an intense seismic sequence at local distance. In theory - assuming plane wave propagation - the ratio between the vertical rotation rate and the transverse acceleration permits, in a single station approach, the estimation of apparent phase velocity in the case of SH arrivals or real phase velocity in the case of Love surface waves. This is a standard approach for the analysis of earthquakes at teleseismic distances, and the results reported by the literature are compatible with the expected phase velocities from the PREM model. Here we extend the application of the same approach to local events, thus exploring higher frequency ranges and larger rotation rate amplitudes.
We use a novel approach to joint rotation/acceleration analysis based on the continuous wavelet transform (CWT). Wavelet coherence (WTC) is used as a filter for identifying those regions of the time-period plane where the rotation rate and transverse acceleration signals exhibit significant coherence. This allows retrieving estimates of phase velocities over the period range spanned by correlated arrivals.
Coherency among ground rotation and translation is also observed throughout the coda of the P-wave arrival, an observation which is interpreted in terms of near-receiver P-SH converted energy due to 3D effects. Those particular coda waves, however, do exhibit a large variability in the rotation/acceleration ratio, as a likely consequence of differences in the wavepath and/or source mechanism.