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Signature of magmatic processes in ground deformation signals from Campi Flegrei (Italy)

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In the last 5 kyrs, eruptions at Campi Flegrei have often been shortly preceded by intrusion of primitive magmas from depth into already emplaced, relatively shallow reservoirs. The latter typically hosted volatile-poor, more evolved trachytic to phonolitic magmas. Numerical simulations of this scenario have been carried out in order to understand magma chamber replenishment and the resulting convection and mixing dynamics. These processes are characterized by a highly heterogeneous pressure distribution within the magmatic system. Pressure and stress variations at the boundary of the magmatic system caused by the convective motion can be used as sources of ground deformation for the volcanic edifice. Synthetic seismograms on the whole frequency range have been obtained and they show the largest energy content in the Ultra Long Period (ULP) band (10-4 – 10-2 Hz). Such small frequencies are hard to identify by standard broadband seismometers that are commonly installed for volcano-monitoring needs. Strainmeters and tiltmeters networks are the most promising means to identify ULP oscillations in the monitoring records. At Campi Flegrei these instruments have been installed during 2004-2005 by Universita' di Salerno. Two long--baseline tiltmeters were added to the network in 2008-2009. The data registered have been analyzed in order to detect possible markers of ongoing magmatic convection and mixing by comparison with the synthetics. We identified transient events in the recorded ground deformation time-series that correspond both in terms of waveform and frequency content to what is expected as a consequence of chamber replenishment. Such events have been detected in conjunction with the small-amplitude seismic swarm occurred at Campi Flegrei in October 2006. Extending the analysis to larger datasets and further improvement of the signal matching techniques can provide an unprecedented means to identify and detect volcanic unrest from routinely monitored ground deformation signals, thus enhancing eruption forecasting capabilities.