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Dynamics of Vulcano Island investigated by long-term (40 years) geophysical data

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Vulcano island is a composite volcanic edifice located in the south-central sector of the Aeolian Archipelago (Tyrrhenian Sea, Italy) and it is an important tourist destination. Historic activity has been characterized by frequent transitions from phereatomagmatic to minor magmatic activity. The last eruption in 1888-90 was characterized by energetic explosive pulses and defines the “vulcanian” type of activity. Since then, volcanic activity has taken the form of fumarolic emanations of variable intensity and temperature, mainly concentrated at “La Fossa” crater, with maximum temperatures ranging between 200° and 300° C; temperature increases and changes in the gas chemistry, were often observed. The most recent episode began in the 80’s when fumarole temperature progressively increased to 690°C in May 1993. Vulcano is active and this favoured monitoring and research studies, in particular focussed on the most recent structures.

In the frame of DPC-INGV “V3” project, we investigate the Vulcano dynamics through ca. 40 years of ground deformation and seismicity data collected by the discrete and continuous INGV monitoring networks. We considered levelling, GPS, EDM, seismic and tilt data. EDM and levelling measurements began in the middle 1970s and since

the late 1990s the EDM benchmarks have been measurered using GPS.

We observed three scales of ground deformation: the first one seems to be linked to the regional tectonics, with a general transpressive kinematics; the second one affects the northern half of the island and could be related to the caldera dynamics; the third one affects only the cone of La Fossa. Regional tectonic stress seems to play an important role in the transition of the volcanic system from a phase of stability to a phase of unrest, inducing the heating and the expansion of shallow hydrothermal fluids. Ground deformation at Vulcano may be linked to the geothermal system rather than magmatic sources.

Keywords : Caldera, tectonics, ground deformation, seismicity, volcano-tectonics, slope stability, hydrothermal activity