# Early detection of malfunctions in water networks: Establishing a statistical linkage between the rate of malfunctions and important physiographical and hydrological characteristics

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Only 0.7% of the available water globally rests in rivers, lakes, and underground aquifers and, therefore, can be easily used to sustain drinking water demand. Furthermore, in the past twenty years, variability of climatic conditions (see e.g., IPCC, 2007; Bates et al., 2008; Langousis and Kaleris, 2014; Langousis et al., 2016; Mamalakis et al., 2017, Emmanouil et al., 2021, 2022) and the continuously increasing needs for drinking water caused by population growth and the competitive water uses have created freshwater shortages. The aforementioned conditions make management and reduction of water losses in the supply and distribution parts of water networks a pressing problem, as water losses may exceed 30-40% of the total volume of water entering the network, imposing significant environmental and financial impacts to local economies (see Serafeim et al., 2022). In this context, pressure management strategies are adopted as a means of reducing water losses caused by leakages and bursts. Pressure reducing valves (PRVs) are playing an important role in this type of strategies as they are used to regulate pressures in the supply and distribution parts of water networks, by reducing the upstream pressure to a set outlet pressure (i.e., downstream of the PRV), usually referred to as set point. Perdios et al. (2022) developed a novel statistical framework and applied it to an existing pressure management area (PMA) of the city of Patras in western Greece, aiming at early detection of PRV malfunctions that may significantly influence network's operation and the corresponding lifetime of related infrastructure (see e.g., Changklom and Stoianov, 2017). In this study, we calibrate and implement the developed statistical framework to a number of important PMAs of the water distribution network of the city of Patras, aiming at establishing a statistical linkage between the parameters of the developed method and important physiographical and hydrological characteristics of the region.

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