Bubble tiltmeters have successfully been used for years to monitor volcano ground deformation over hours to years, assuming in most cases that deformation is too slow to induce any ground acceleration effect on the tilt sensor. Conversely, high-rate tiltmeters have been shown to mimic well seismometers and capture ground acceleration for some large earthquakes. However, the assumption was that any tilt-meter signal due to actual ground tilt would be much smaller than that caused by ground acceleration. In all cases, assumptions are often made about the respective contribution of translational ground motion, ground tilt and acceleration. In this work, we present results from the joint analysis of co-located tilt, seismic and high-rate GPS data recorded during the 2010 Mw7.1 Darfield earthquake in New Zealand. We determined that for periods at least ranging between 2 and 20 seconds, the observed tilt signal was in fact not related to ground tilt, but, instead, to translational ground acceleration caused by passing S and surface waves. Results show that for short-lived transient deformation events recorded on tiltmeters and seismometers, co-located high-rate GPS are essential to discriminate translational motion from ground tilt for further modelling.