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Modelling temporal gravity changes through the south of the Taiwan Orogen

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The Taiwan mountain belt results from the collision between Philippine Sea and Eurasian plates. Taiwan island experiences high tectonic deformation due to fast convergence between the two plates. It has been and is still widely studied and is often considered as a natural laboratory for orogeny studies. Since 2006, the French-Taiwanese scientific project AGTO (Absolute Gravity in the Taiwanese Orogen) measures the gravity change along a transect through the south of the island. It includes 10 absolute and 45 relative gravity measurements sites. The aim of this project is to validate the use of temporal gravity data for tectonic purposes. In particular, this method should be interesting to monitor deep mass transfers involved in the Taiwanese orogeny. Deep tectonic processes occuring in Taiwan are indeed still discussed, as shown by the existence of several tectonic hypotheses, and gravity can bring useful contribution to this discussion.

The value of g in a particular place physically depends on the density distribution around this place. Change of this density distribution will result in a change of g, to which we try to give a tectonic meaning. However it is worth noting that other factors, like hydrology, might also be responsible for temporal g variations. Gravity modelling should therefore provide significant help in interpreting measurements. First, it can be used to estimate non-tectonic factors like hydrology, erosion or landslides, which both are supposed to modify g value through time. Albeit interesting, these effects must be properly removed from our measures before attempting any tectonic interpretation. Second, modelling is a valuable step in this study as it can help to propose deep mass transfers hypothesis constrained by gravity data and in accordance with Taiwan tectonic context.

In this work, we present results of both types, computed for the south of the Taiwan orogen. Water effects on gravity have been estimated using rainfall data and global hydrological models, at every place where absolute gravity measurements are made. We find that it will act in a range of 1 to 5 μgal, which is important enough to contribute to measurements performed by absolute gravimeter (FG-5 type). Erosion also account for several μgal. Concerning deep mass transfers we perform gravity modelling using basic (purely elastic) and more sophisticated (thermo-mechanical) deformation models proposed for Taiwan. According to our first results, we only detect a small contribution of the deep mass transfers to g, which should become more significant considering several years of measurements.