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| Monitoring ground subsidence along the Gippsland coastline |
| Surveyor-General Victoria – Geodesy |

## In 2019, Surveyor-General Victoria (SGV) carried out a Global Navigation Satellite Systems (GNSS) monitoring survey along the Gippsland coast. Results of this survey were compared with a similar survey in 2004 to quantify any deformation across the region. Ground subsidence over the last 15 years was detected at rates of 2 - 6mm per year across the surveyed area.

## Background

Gippsland geodetic subsidence monitoring network, showing high stability benchmarks and change in height of these marks since 2004 (in metres)

Credit: Harrison McKinley, Geodetic Surveyor, DELWP

Localised and regional ground movement has been studied in Gippsland and the Latrobe Valley for many years. Precise measurement of this movement is important to understand long-term geological and hydrological processes and the risks they present to the environment and communities in this region. When combined with rising sea levels, coastal areas experiencing subsidence see an accelerated threat of inundation due to the relative effects of sinking land and rising seas. Unaccounted gradual subsidence degrades the accuracy of spatial datasets over time, which impacts their reliability for the management of water resources, engineering works and planning.

Deformation monitoring

SGV has reinitiated and expanded a long-term study of ground movement along the Gippsland coast. The project was established in 2004 with a GPS survey of 14 monitoring marks stretching from Port Albert in the south-west to the Gippsland Lakes in the north-east and inland approximately15 kilometres.

## High stability marks (HSM)

The marks monitored as part of this project consist of metal rods driven into the ground and isolated from the movement of soils near the ground surface. The depth of each mark varies between 2.8m and 17.8m depending on local ground conditions. The survey included an additional three concrete pillars attached to granite outcrops to serve as stable reference stations.

## Fieldwork

In July 2019, a GNSS survey was carried out across all previously observed marks to measure the extent of movement since 2004. An additional five HSMs were included in the 2019 survey to extend the study area for future monitoring. At each mark, high precision GNSS equipment was set up and recorded observations over a 24-hour period. To simultaneously observe 22 marks, the Australian Geophysical Observing System (AGOS) pool of GNSS equipment from Geoscience Australia was used.

## Processing

The observations recorded during the surveys were processed using specialised GNSS processing software. The three surrounding reference pillars were found to be stable from 2004 to 2019, and suitable as a constraint in separate network adjustments to obtain coordinates of each HSM. The 2019 and 2004 coordinates of each HSM were compared to obtain overall estimates of mark movement.

GNSS equipment near Giffard West, Victoria

Credit: Josh Batchelor, Senior Geodetic Surveyor, DELWP

## Findings

The results indicate that the horizontal position of the HSMs have remained stable over the 15-year period with an average horizontal movement of 4.5 mm. However, all of the HSMs have fallen in height between 2004 and 2019, with magnitudes of subsidence varying between -27 mm and -89 mm across the region. This equates to an average rate of subsidence of -3 mm per year along this section of the Gippsland coast. Interestingly, this rate of subsidence is similar in magnitude to average sea level rise estimates of +3 mm per year and should be considered in ongoing coastal monitoring activities.

## Future works

SGV will continue monitoring the rate of subsidence across this region with GNSS surveys every four years. This work complements other SGV monitoring projects which use space-based geodesy techniques such as Interferometric Synthetic Aperture Radar (InSAR). The objective of these programs is to accurately model deformation to support time-dependent reference frames and enhance the management of spatial information in Victoria.

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