Priorities for installation of new continuous GPS/GNSS near to tide gauges

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Introduction

Satellite altimeter bias-drift estimates are sensitive to the adopted vertical land movement correction applied at tide gauges (TGs) [Watson et al., 2015]. In the absence of direct GNSS measurements, correction for vertical land movement is often made via models of glacial isostatic adjustment (GIA), believed to be the dominant relevant geophysical process globally. At TG locations where GPS/GNSS have been deployed, comparison with GIA models has revealed differences commonly reaching $\pm$0.5mm/yr over continental scales (**Fig.1**) and locally much larger [e.g., King et al., 2012].

GPS/GNSS monitoring of TGs has gradually increased over the last decade but King et al. [2012] concluded that such monitoring is

"hampered by the fact that only 1/3 of the tide gauges used in the most widely cited sea-level reconstructions presently have a GPS located within a tolerable distance, and only about 2/3 of those have time series of sufficient quality."

Here we summarise a set of priorities [King, 2014] for new GPS/GNSS deployments near to TGs as is useful for determining altimetry bias-drift and for centennial studies of sea-level change from TGs.

Methodology

GNSS sites: locations sourced from a variety of international public archives including TIGA, IGS, and national public archives with an English web interface and with data (>3 years or ongoing data collection) in RINEX format and full metadata. Time series quality was not assessed in the present study. TGs with a GNSS within 20 km were deemed to be satisfactorily monitored for the purposes of this study (cyan triangles **Figs. 2&3**).

Altimeter tide gauges: TGs within the TOPEX/Poseidon mission series calibration/validation studies being undertaken at UTAS/CSIRO were supplemented by operational RLR TGs at higher latitudes to allow consideration of future altimeter missions. 200 TGs satisfied these criteria (**Fig. 2**), with 66 not having a nearby GNSS receiver with data in a public archive (33%).

Long-running tide gauges: TGs spanning >= 40 years and that are currently (or recently) operational (defined as 2010 or newer data within the PSMSL RLR database). 376 TGs were found that satisfied those criteria and these are shown in **Fig. 3**.

Conclusions

Almost 50% of considered TGs remain long distances from GNSS receivers with data in public archives (**Figs. 2&3**). Countries within the Asian continent most need new GNSS deployments, or public release of existing GNSS datasets, but new US, Australian and European deployments are also required.

GNSS located less than 20 km from a TG may still not sufficiently accurately represent TG land movement due to localised ground deformation; either regular monitoring or location of GNSS on TGs is required to overcome this uncertainty.

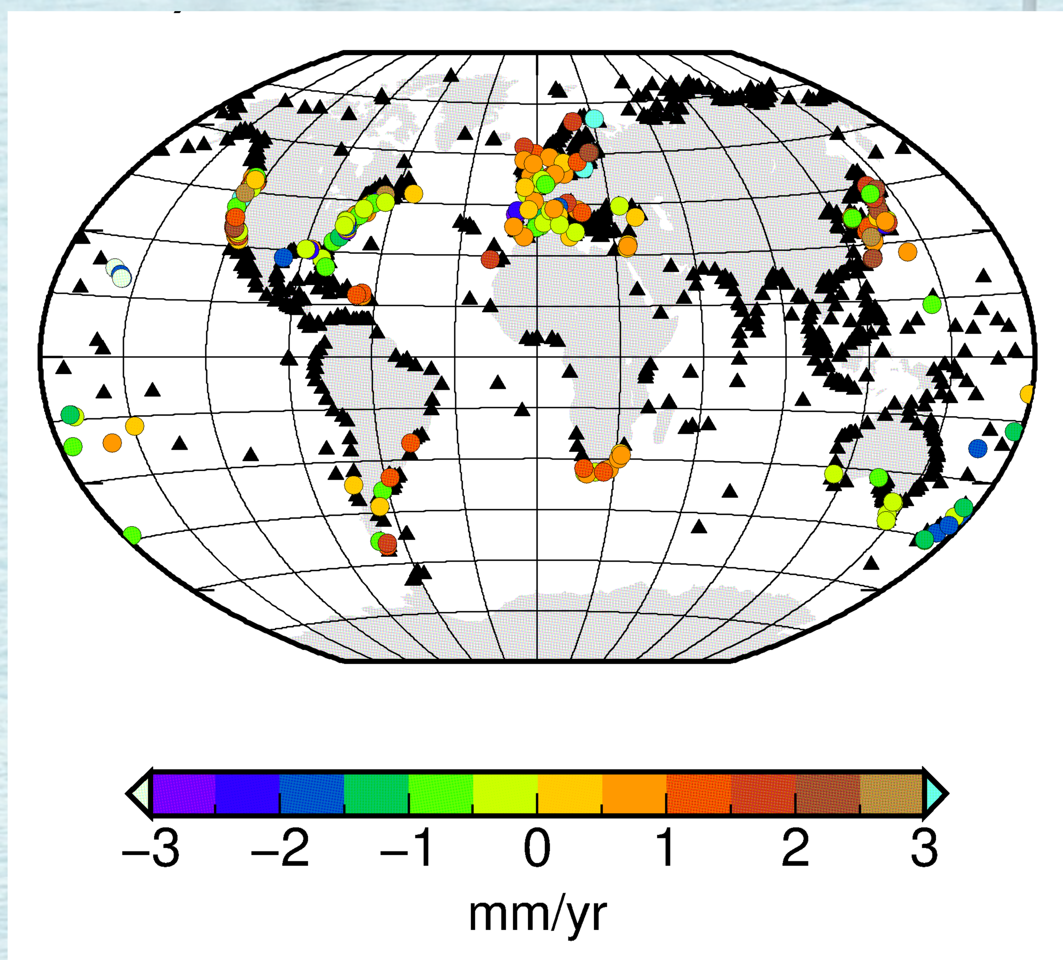

Figure 1: Difference between GPS-observed vertical land movement observed and modeled GIA uplift (ICE-5G + VM2(v1.2)). Black triangles are tide gauge locations used in sea-level reconstructions without GPS VLM, mainly due to a lack of GPS installations. The GPS sites with the greatest precision are plotted last. Reproduced from King et al. [2012].

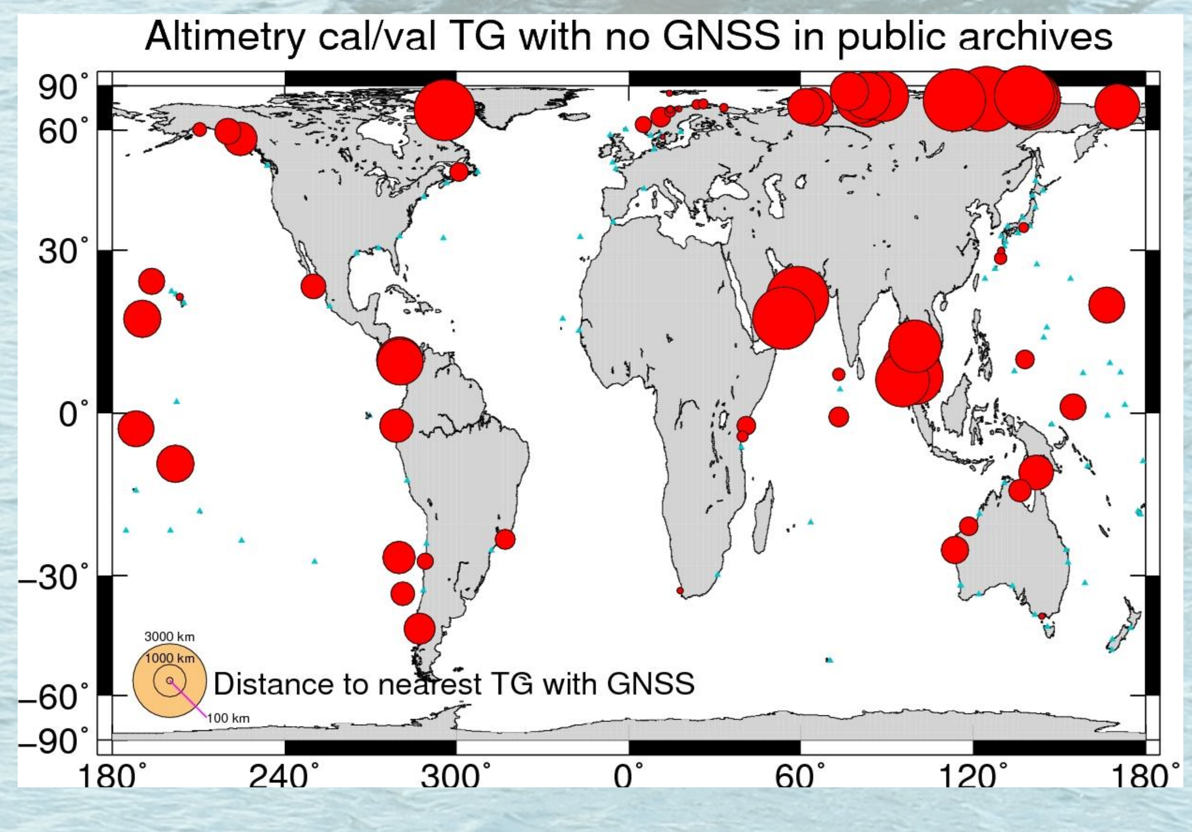

Figure 2: Locations of TGs used in altimetry calibration/validation that are far from a GNSS site with public data archives. Circle size scales with distance from nearest alternative TG with a nearby GNSS site with data in public data archives. The cyan triangles show TGs (±66° latitude) considered with sufficiently close GNSS.

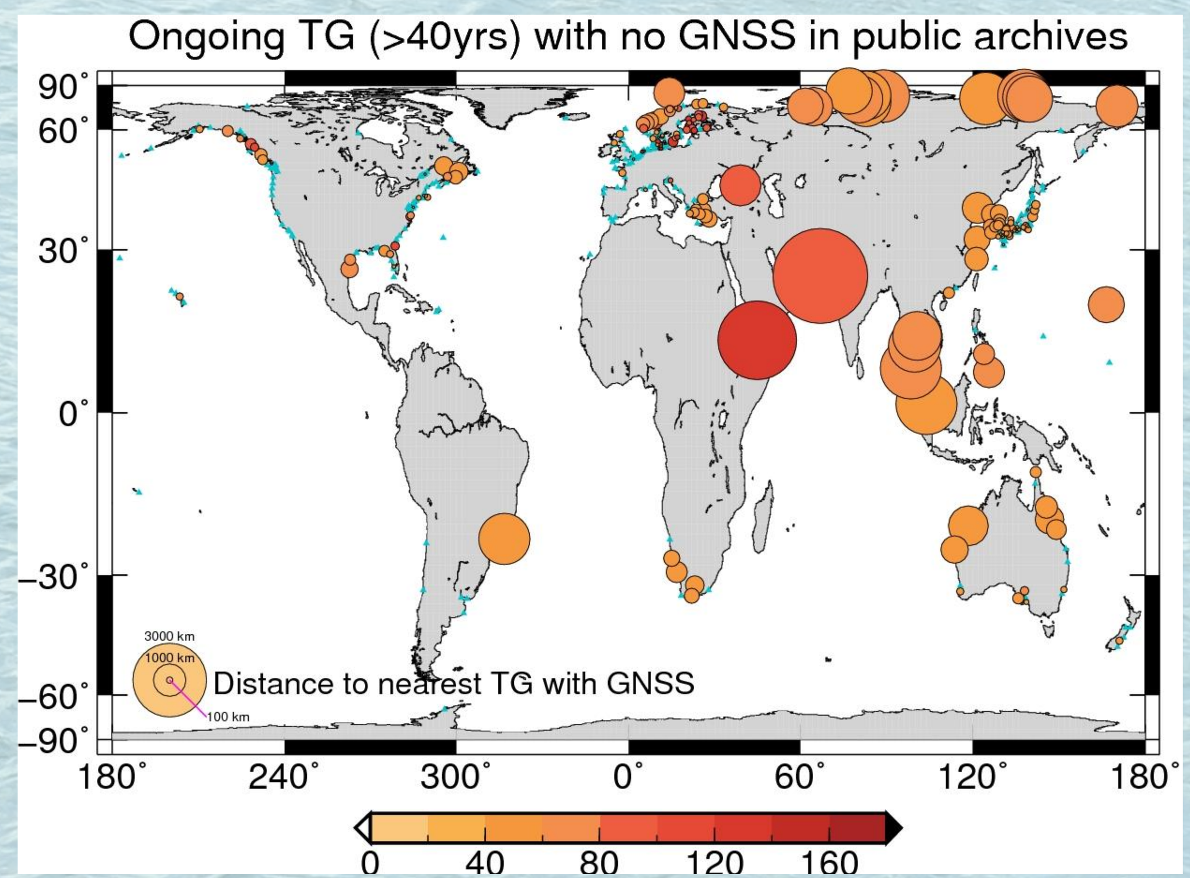

Figure 3: Locations of long-running TGs (coloured circles, data span in years) that are far from a GNSS site with data in public archives. Circle size scales with distance from nearest alternative TG with a nearby GNSS site with data in public data archives. The cyan triangles show TGs considered with sufficiently close GNSS.

References:

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