Tide gauges in the Indian Ocean

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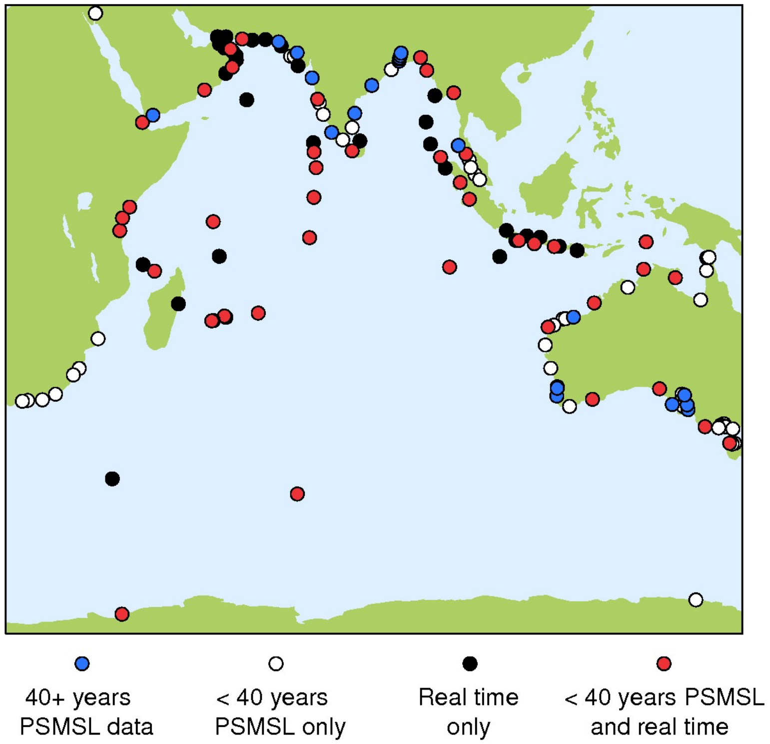
Tide gauge stations in the Indian Ocean



20 stations > 40 years record

2 stations > 100 years record length (Mumbai, Fremantle)

Source: Permanent Service for Mean Sea Level, U.K.

Tide-gauge network in the IO

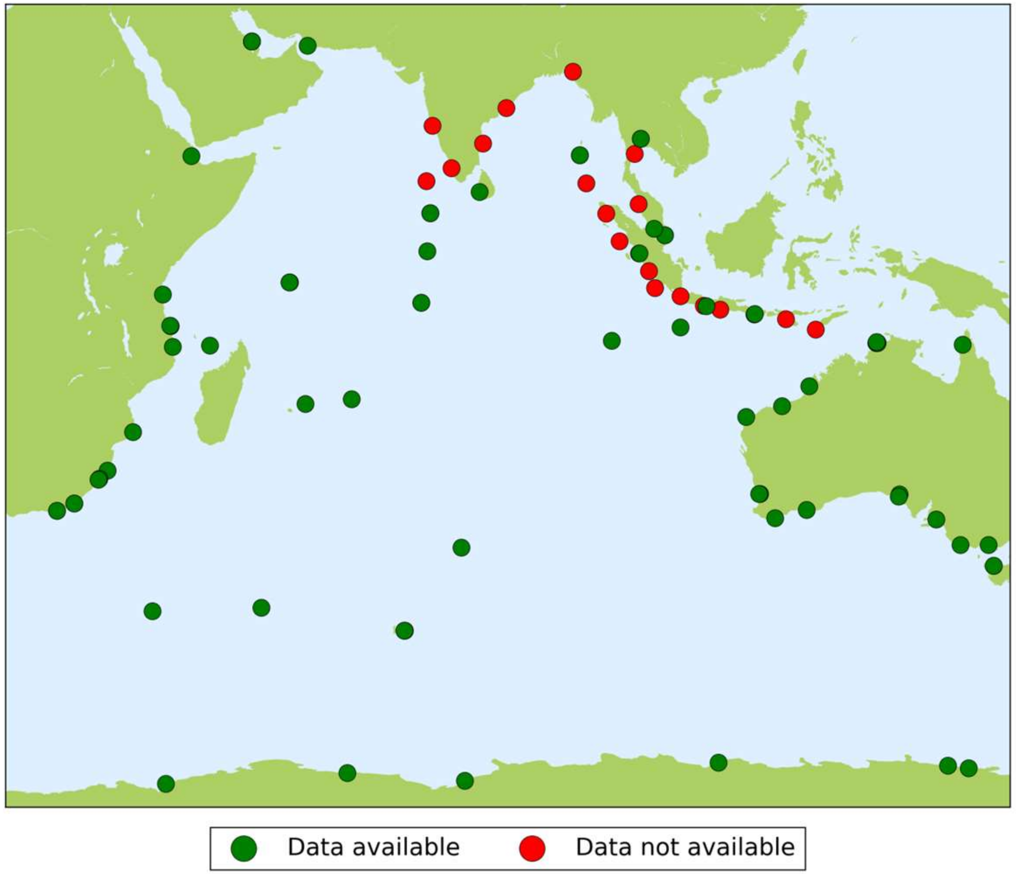
- Extended since the commencement of the Indian Ocean Tsunami Warning and Mitigation System (IOTWMS) following the 2004 Indian Ocean tsunami. This was achieved by upgrading some stations and with installations of some new stations.
- There are now more than 100 tide gauges in the Indian Ocean (GLOSS and non-GLOSS) that provide sea level data in real time (not quality controlled) via the IOC Sea Level Station Monitoring Facility.

Inconsistency in derived Decadal sea-level variability in various sea-level reconstruction products

- A recent study in the Indo-Pacific Ocean using various sea-level reconstruction products (Church and White, Meyssignac, Hamlington etc.) and reanalysis products (SODA, WOA etc.) showed a good consistency in the decadal variability derived from various products in the Pacific Ocean. However, in the Indian Ocean, the derived decadal variability is found to be inconsistent among the products.

Nidheesh et al., Geophysical Research Letters 2017

GNSS stations in the Indian Ocean region



SONEL (Système d'Observation du Niveau des Eaux Littorale)

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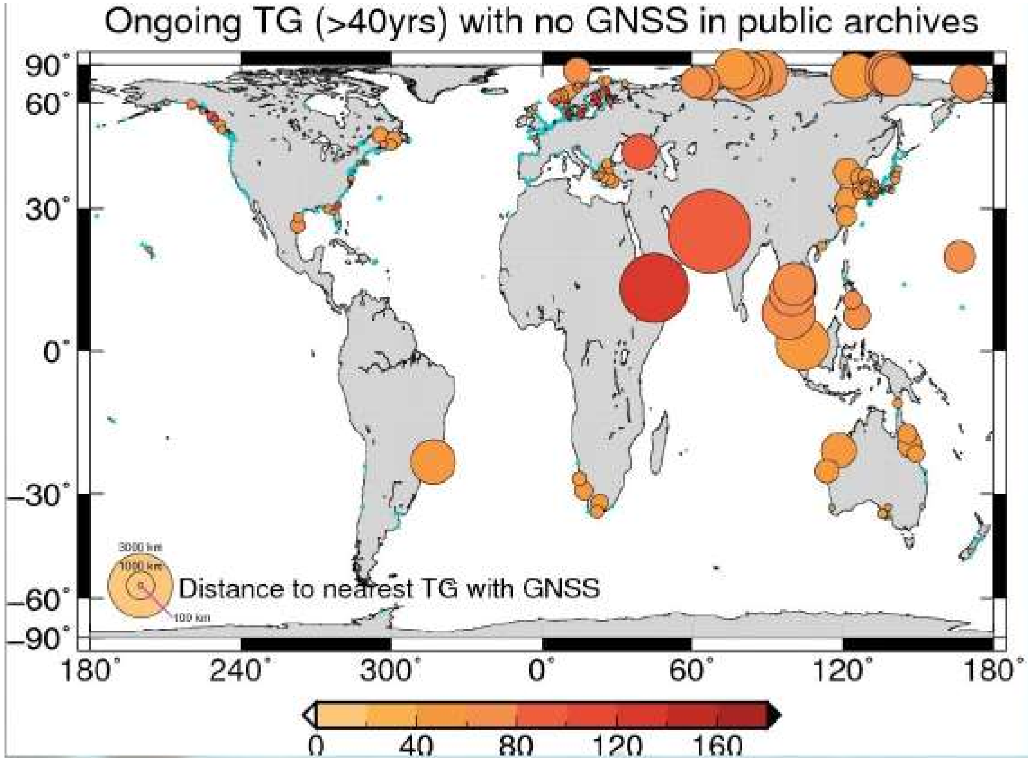
Woodworth et al., (2017) EOS Transactions P. L. Woodworth , G. Wöppelmann, M. Marcos, M. Gravelle, and R. M. Bingley 3 January 2017

Fig. 1. Locations of permanent GNSS stations near a tide gauge (closer than 1 kilometer) that have data in SONEL. Sites where local ties between tide gauge and GNSS have been made and the information included in the data bank are shown in red. Sites lacking such information are shown in blue (*Woodworth et al., 2017 EOS Transactions)*

TG (longer than 20 years) locations with no GNSS data



King et al. 2014

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.

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.

Specific Recommendations

- Increased coverage required in the network- along the coast of Thailand, western IO (Somalia) and the Southern Ocean

  Stations near Antarctica, difficult to maintain, need to be sustained by countries involved in this
- GNSS stations to be co-located with tide gauge stations (priority stations – King, 2014)

CLIVAR linkages with GLOSS

- GLOSS network and Indian Ocean Tsunami warning network need to be sustained
- Data archeology to be pursued (digistisation of old charts), wherever possible
- Training (operators for Tide gauge and GNSS network)

Comments received

- Satellite data validation with tide-gauge data
- Altimetry in coastal regions
- Asian countries, in particular, need more GNSS deployments or data sharing
- More deployments by Europe, Australia & US are also required

- Any new tide gauge stations proposed in order to study ITF ?

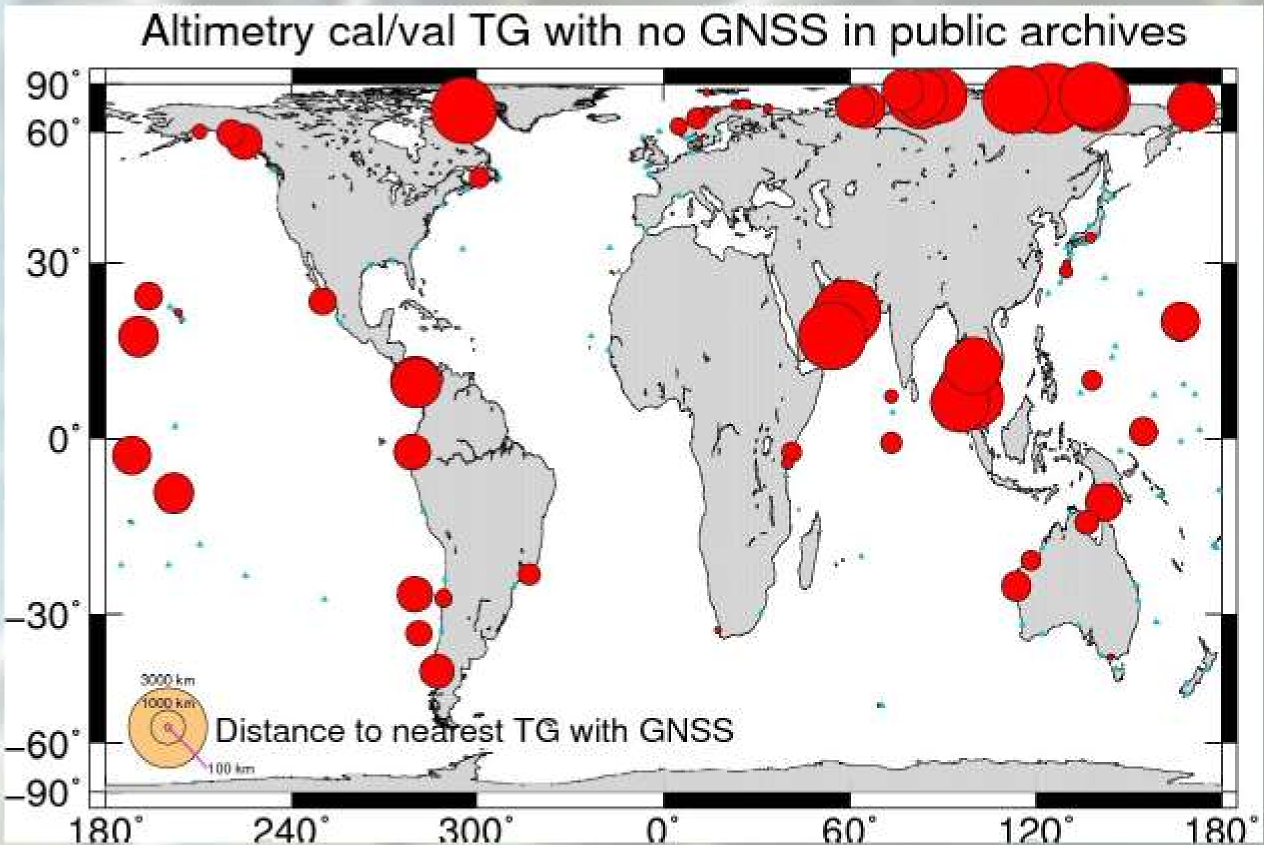


Figure 2: Locations of TGs used in altimetry calibration/validation that are far from a GNSS site with public data archives. Circle size scales with distance from nearest alternative TG with a nearby GNSS site with data in public data archives. The cyan triangles show TGs (±66° latitude) considered with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

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%).