Sea Level Variations at Tropical Pacific Islands since 1950

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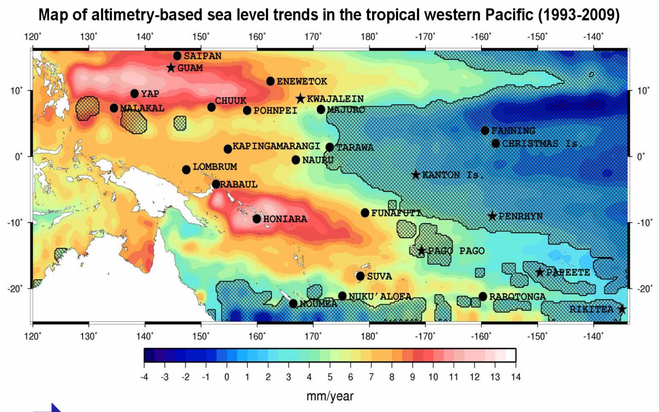
Abstract

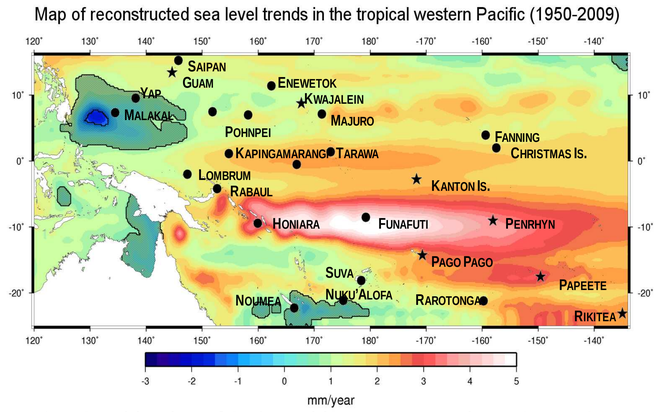
The western tropical Pacific is usually considered as one of the most vulnerable regions of the world under present-day and future global warming. It is often reported that some islands of the region already suffer significant sea level rise. To clarify the latter concern, we estimate sea level rise and variability since 1950 in the tropical Pacific region (20°S–15°N ; 120°E–135°W). We reconstruct a global sea level f ield from 1950 to 2009, combining long tide gauge records with 50-year-long gridded sea surface heights from the DRAKKAR model (Llovel et al. 2009, Meyssignac et al. 2011). We observe different characteristics depending on three sub-regions. We estimate the "total" sea level rise effectively felt by the populations at several tropical Pacific islands over the last 60 years, i.e., the superposition of 3 components : (1) global mean sea level rise), (2) multidecadal regional variability and (3) vertical ground motion (the latter estimated from GPS). We find that at Funafuti (Tuvalu islands), the rate of sea level rise since 1950 reached ~5 mm/yr, i.e., 3 times the global mean sea level rise.

1. Altimetry-based sea level



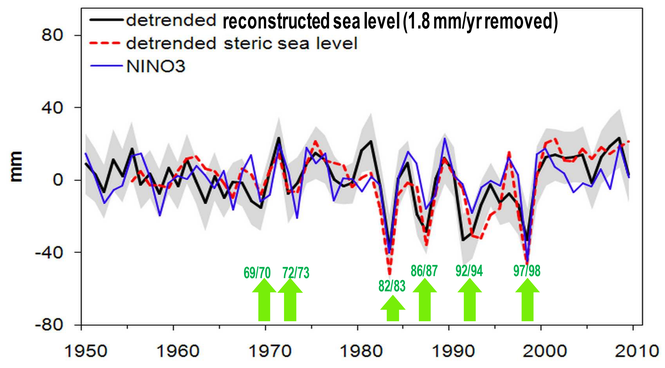
- Reflect interannual variability rather than long term trends.
- On time spans longer than the altimetry era, spatial trend patterns should be different.

2. Reconstructed Sea Level (RESL)

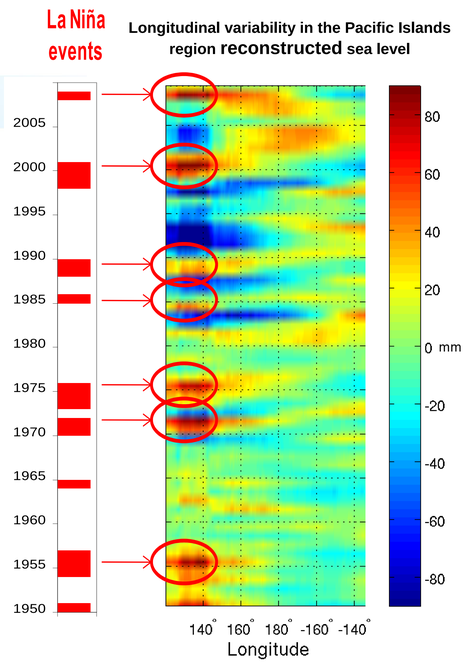


- Combination of 91 long tide gauge records + 50-year-long gridded sea surface height fields from an OGCM : DRAKKAR.
- 1950-2009 : strong positive trend pattern, almost centered on the Tuvalu.

3. ENSO signature

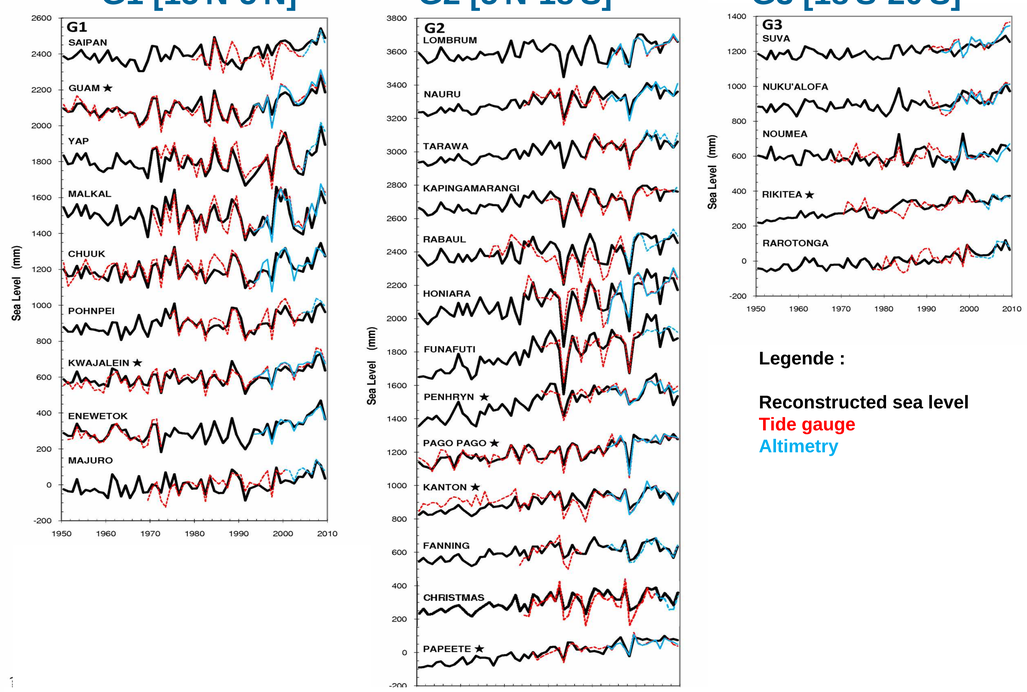


- Interannual variability of both thermal expansion and sea level are driven by ENSO



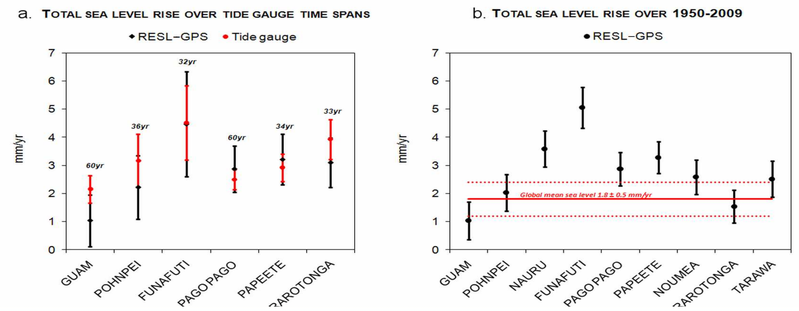
- Positive anomalies concentrated in the Philippines and the New Guinea region
- Intensification of ENSO signature since 1970
- Increased occurrence of El Niño Modoki-type signature events since 2002 in the central basin.

4. Tide gauges, reconstruction and altimetry



5. 'Total' sea level rise

= climatic components + vertical ground motion (GPS)



More details in : M. Becker, B. Meyssignac, C. Letetrel, W. Llovel, A. Cazenave, T. Delcroix, Sea Level Variations at Tropical Pacific Islands since 1950, Global and Planetary Change , 2011, doi:10.1016/ j.gloplacha. 2011.09.004, in press.