

Upper Air Observation Gaps in the South Pacific

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- Sustained surface pressure and upper air wind observations made globally, meeting the minimum WMO requirements, are vital to maintain and improve the global numerical weather prediction (NWP) and climate models and reanalysis products.
- These observations are a global good: all nations will benefit from a global network of observations, while the local benefit of a single station may be limited.
- Both the spatial density and observing frequency of the upper air network over the South Pacific region currently fall far short of GCOS and WMO requirements. Due to the unique geography of the region – vast swathes of ocean surface with relative little land mass distributed over some 20 small island states with modest populations and correspondingly modest GDPs – systematic observation is particularly challenging in this region.
- The upper air network over the South Pacific therefore needs sustained international support.



Figure 1: Map of the Pacific Island region (<https://www.geographicguide.com/oceania-map.html>).

IMPORTANCE OF UPPER AIR OBSERVATIONS

Climate prediction and risk analysis, vital for planning adaptation to climate change, depend on outputs of reanalysis and climate models which are driven by the same global NWP models, that themselves, depend on the observational data across the globe. By making and freely exchanging the data, countries can benefit from the outputs of these models.

Radiosondes are critical for climate reanalysis produced by Global NWP systems. Langland et al. (2011) show that local uncertainties in analysis are substantially larger in areas with no conventional (non-satellite) upper air observations. Isolated radiosonde stations have a large impact and twice daily soundings more so than a single daily sounding. This has implications for trend analysis, process understanding, adaptation and potential inputs into the UNFCCC Global Stocktake under the 2015 Paris Agreement.

For global NWP we should focus on improving surface pressure and upper air wind observations. These parameters are amongst the fundamental variables for NWP (the others are temperature and humidity) and both provide driving requirements for surface-based observing systems, since – as opposed to temperature or humidity - neither is currently measured from space.

Satellite observations cannot replace radiosonde observations. Surface pressure can be derived in experimental mode from total CO₂ column measurements and satellite imagers provide horizontal wind components by feature tracking, but only for a single layer with no vertical resolution and limited height information: wind observations are particularly important in the tropics.

“Radiosondes in PNG can help capture the amplitude and phase of the MJO, and the Kelvin waves, and help predict when Rossby wave trains may be triggered from that area, and then propagate across the Pacific to N. America, and where they influence the mid-latitude storms tracks and ultimately the weather in Europe”
“Isolated radiosondes are individually much more valuable and bring much more benefit to forecast quality than observations in a dense network (benefit per station that is!)”



The ECMWF Deputy Director of Forecasts noted in September 2017 regarding the potential value of rehabilitating the upper air network over Papua New Guinea.

OBSERVATION CHALLENGES IN THE SOUTH PACIFIC

- The large distances between islands and the remoteness of monitoring sites poses special challenges. Access to some islands by ship may be infrequent and time consuming.
- Communications between monitoring sites and central offices can be difficult without internet, land lines or reliable electrical power.
- Costs of consumables can be prohibitive for small low-GDP countries, and are often at a premium price owing to the low quantities being ordered and cost of shipping.
- Training and capacity building are important widespread needs. This covers all aspects of meteorological service provision from observations, maintenance and repair, to reporting and using data. Assistance is needed to ensure that procurements deliver high-quality, cost-effective equipment.
- The threshold requirement for radiosonde observations (given in WMO’s OSCAR database) is 500 km, which means that in principle every grid cell of 500 km x 500 km = 250,000 km² should have a radiosonde station as a minimum. This may make sense for the continental landmasses: in Europe and over North America the design separation is 200 to 250 km. However, a 500 km resolution is unachievable in the Pacific.

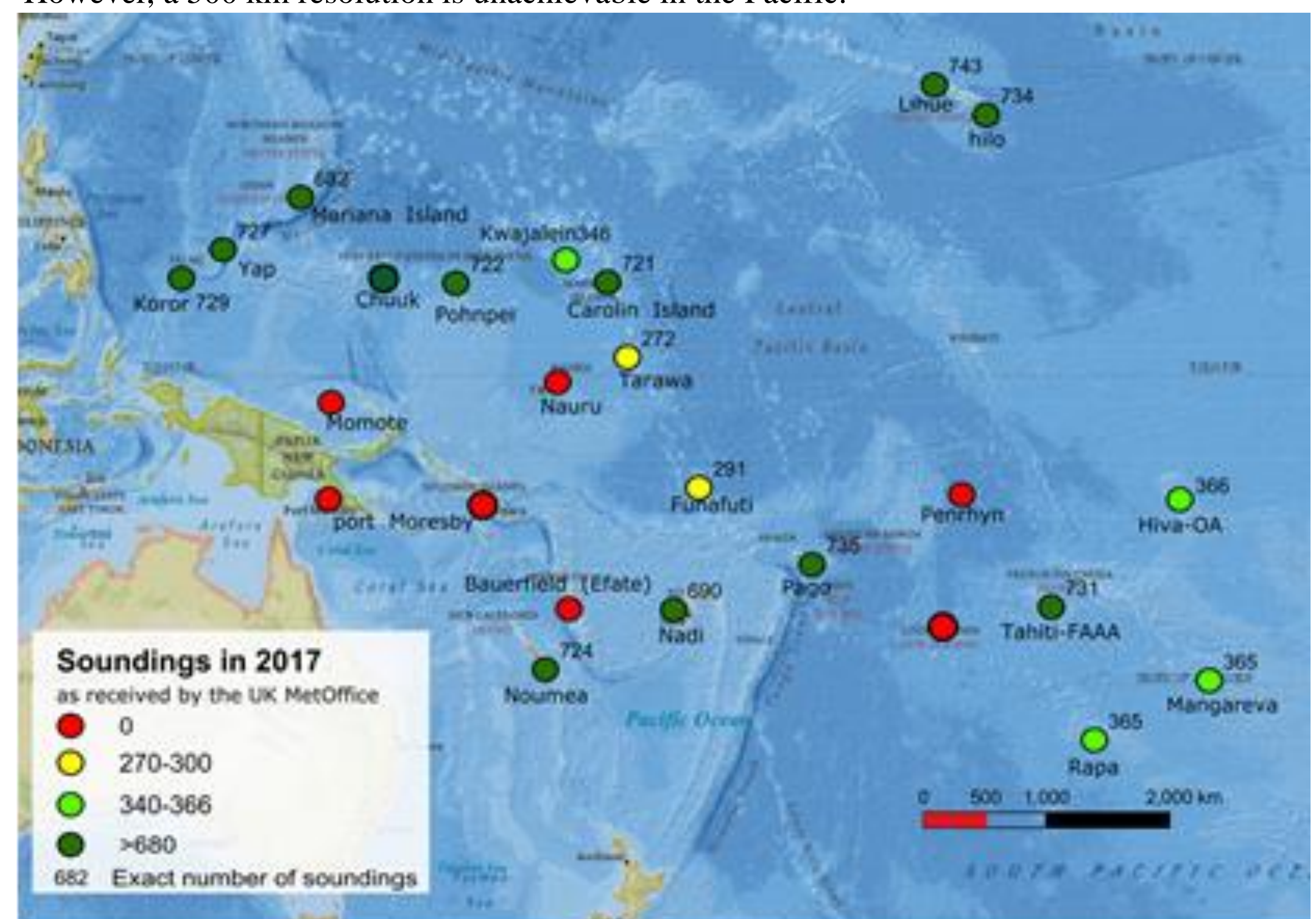


Figure 2: Radiosonde availability (UK Met Office – 2017).

PLAN FOR A REGIONAL UPPER AIR OBSERVING NETWORK FOR THE SOUTH PACIFIC

Following the Joint GCOS-WIGOS Workshop for the Pacific Small Island Developing States (SIDS) in October 2017, the following plan for a regional upper air observing network for the South Pacific was developed:

- Establishing a network of 20 stations (with a minimum of one per country). This will be based on existing operational stations, upgrading existing stations that are not reporting 2 observations per day and by establishing some new stations.
- Supporting the existing station in Nadi, Fiji, to become a GCOS Reference Upper Air Network (GRUAN) station and then using this as a centre of expertise to support the other stations in the region by sharing this expertise.
- Establishing a network of trained personnel across the region to support each other, share expertise and experiences and support capacity development. This includes some support for communications, training and data sharing.

