Vertical and horizontal ground deformation in the South West Pacific islands: what accuracy can we currently reach?

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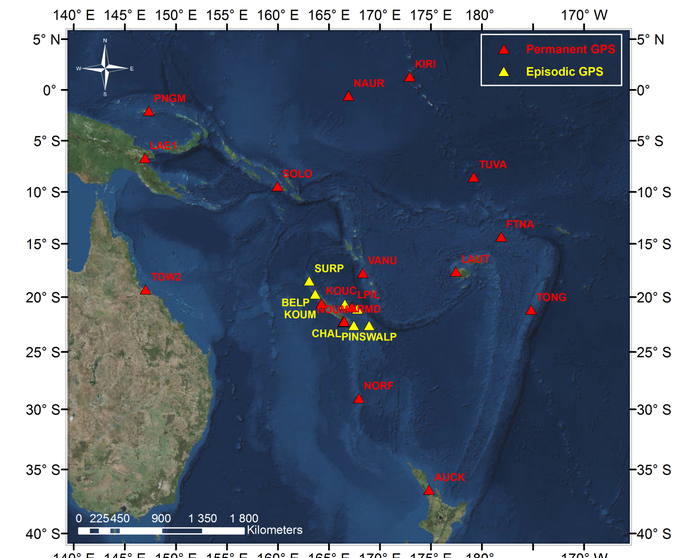
Many processes can contribute to horizontal or vertical ground motion at different space and time scales, with various types of consequences such as, for instance, relative sea-level variations or seismic hazard.

Our main motivation for this study is:

- **to assess the accuracy on velocity trends, especially vertical trends, that can be reached with continuous and network GNSS data and its dependancy on the processing strategy (method, software, products...),**
- **to compare results obtained if one uses the same processing software (here GINS software developped at CNES, France), with different orbits and clocks products (here we test 5 REPRO2 clock/orbits products),**
- **to evaluate precise vertical land motion and assess how significantly they could contribute to relative sea-level changes experienced around the South West Pacific coasts.**

We focus our interest on the whole South West Pacific area, mainly for relative sea-level related topics, as well as more specifically on New Caledonia to investigate current tectonic deformation, using network data

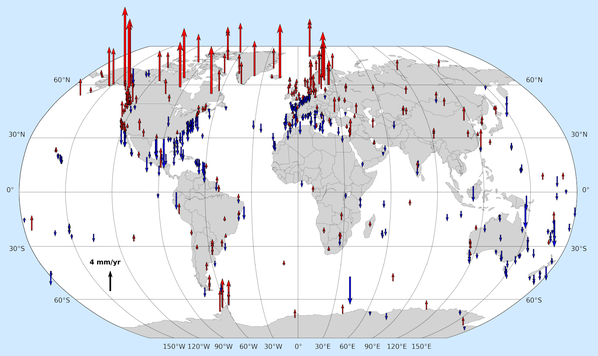


	METHOD	SOFTWARE	Orbits and clock products				Referencing on IGS08/IGb08b
ULR6	Double differences	GAMIT/GLOBK	estimated in the solution				YES, using CATREF (Altamimi, et al., 2011)
esa2	PPP	GINS	REPRO 2 products	es2			REPRO2 products are already aligned on to IGS08/IGb08
gfz2				gf2			
grg2				gr2			
jpl2				jp2			
mit2				mi2			
nasa JPL/NASA time series	PPP	Gipsy-OasisII	JPL non fiducial orbits				Daily application of transformation parameters to IGS08
neva Nevada Geodetic Lab. time series							
gips			JPL non fiducial before 2001. JPL Repro2 after 2001.				Application of transformation parameters to IGS08, before 2001.

Data processing

We have reprocessed available data using **a range of different processing strategies and products**.

We compare our results with timeseries produced by the Jet Propulsion Laboratory under a NASA contract http://sideshow.jpl.nasa.gov/post/series.html and by G. Blewitt at the Nevada Geodetic Lab. http://geodesy.unr.edu/ on a routine basis.

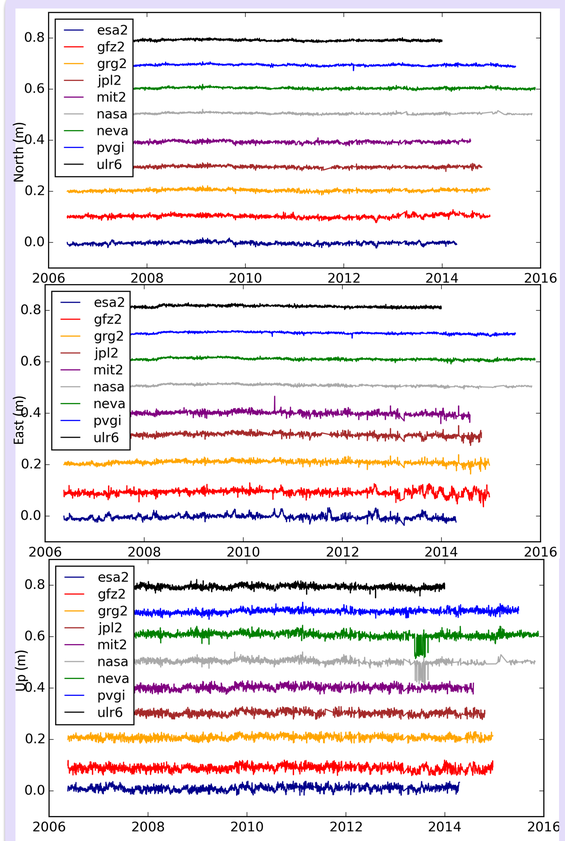


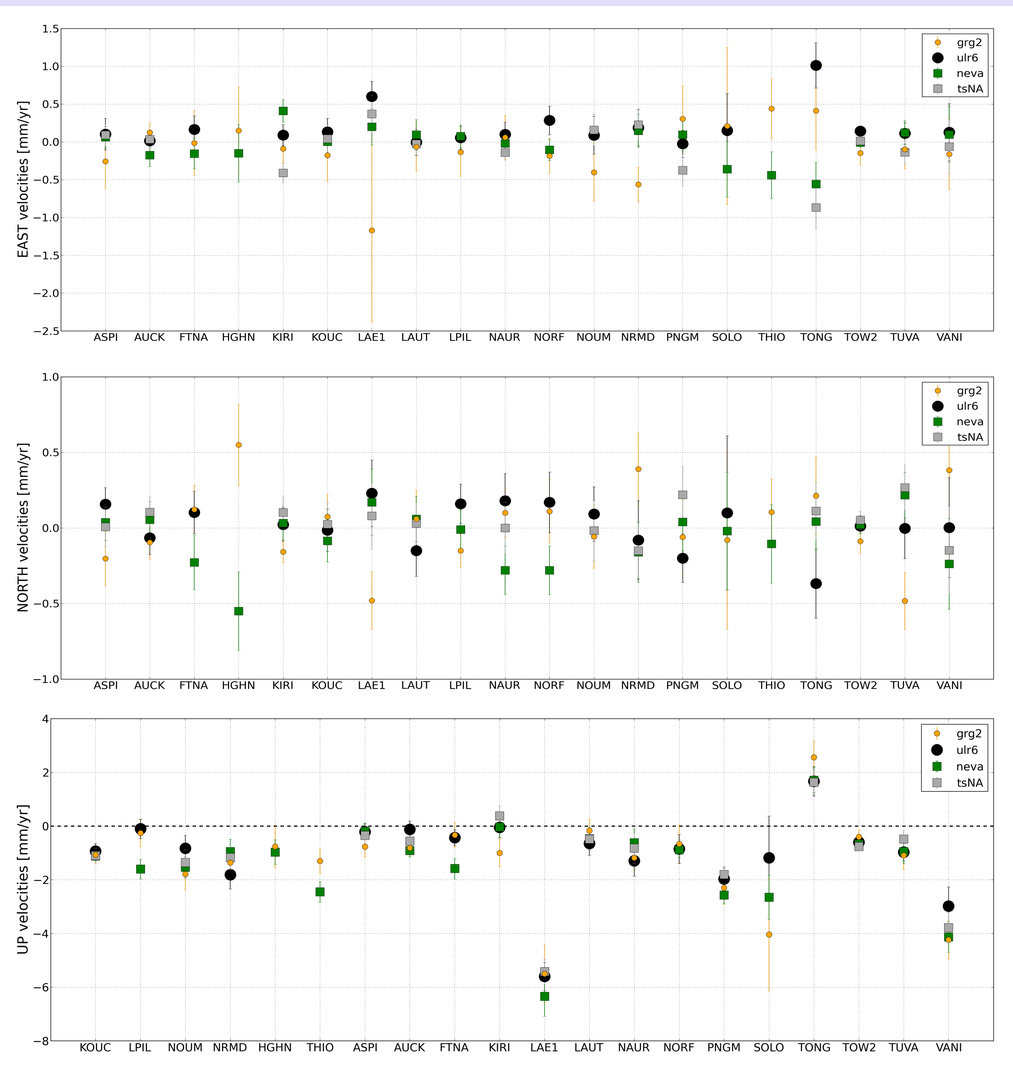
ULR6 global solution

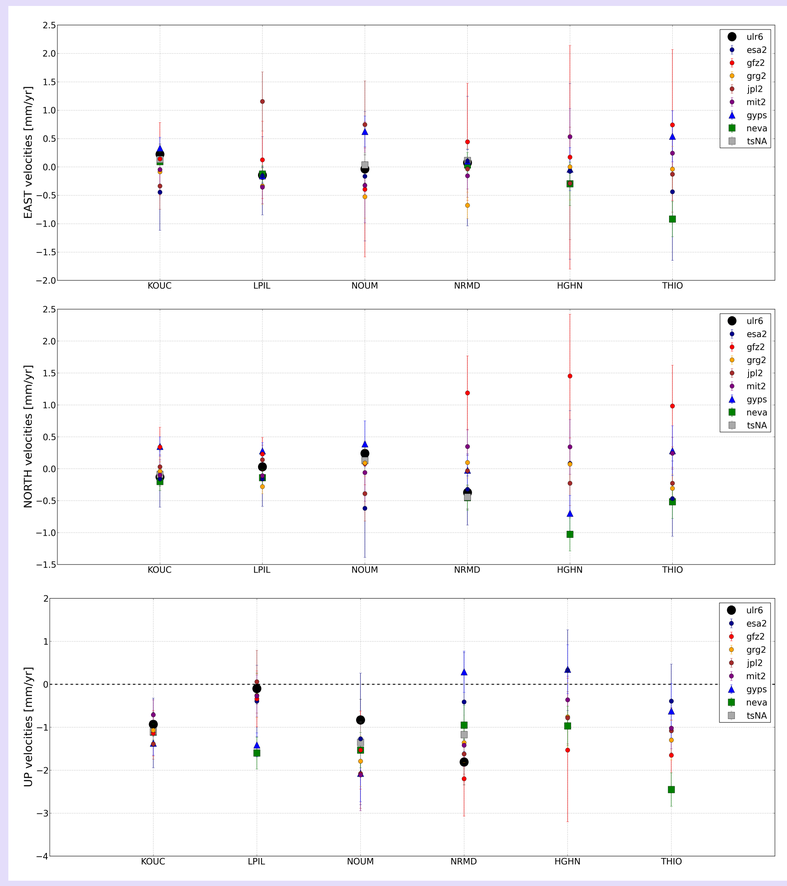
We calculated daily positions from double-differenced ionosphere-free carrier phase data in a global network using the GAMIT software. Daily positions are combined and aligned on the IGb08 using the CATREF software, according to the processing strategy developed as part of the current ULR6 (www.sonel.org) reprocessing campaign for IGS (Santamaria-Gomez, et al., 2012). ULR6 solution is taken as our reference solution.

Results of the comparison

All time series (including the downloaded Univ. Nevada and JPL/NASA time series) have been processed using HECTOR software package (Bos et al., 2013) to derive trends and uncertainties using temporal correlated noise; breaks in the time series have been taken exactly at the same date for each time series. An annual seasonal signal is modelled.





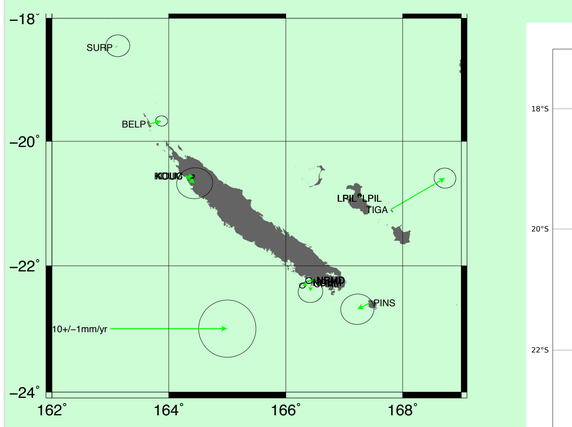


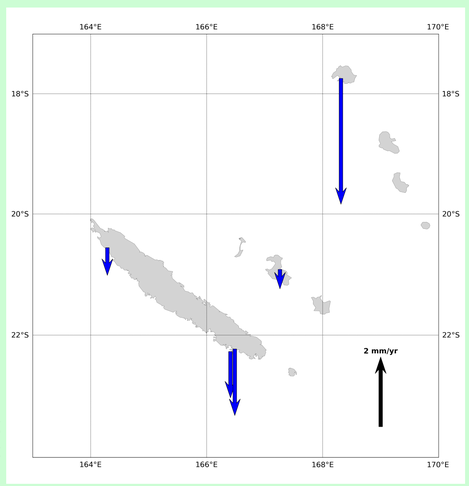
PS: VANI and ASPI acronyms correspond to VANU and ASPA stations before major earthquake, for trends computations

- Results are generally in good agreement between different PPP solutions and ULR6 double differences solution.
- On the East component, results are generally noisier (cf. NRMD) using GINS PPP, however results are comparable on the vertical component.

Deformation in New Caledonia

To investigate deformation, we remove the movement of the Australian plate (determined by the stations TOW2, CEDU, NOUM, NRMD, KOUC and LPIL) and look at the residuals with respect to a fixed Australian plate (for the ULR6 solution). The pole removed here for Australia is: 32.3N/38.3W Ang. vel.: 0.629 deg/Myr.

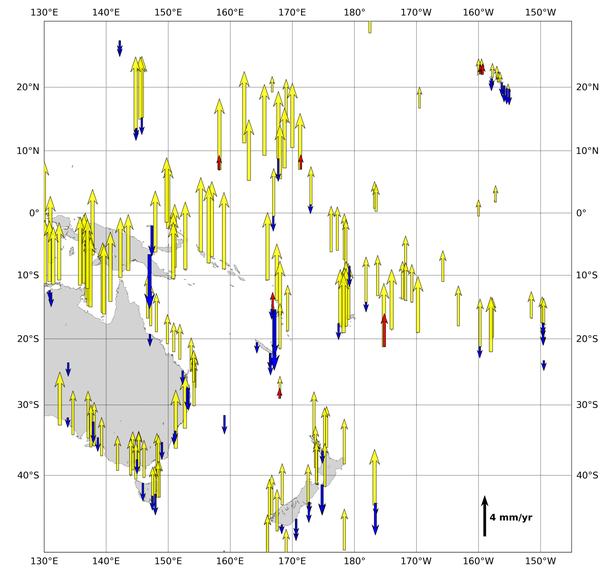




Horizontal deformation: campaign points are still being reviewed; the motion of TIGA may reflect different problems, including earthquakes.

Conclusion and perspectives

- We have tested different methods and products to process GNSS data in the South West Pacific.
- long term trends on the series are sensitive to the computation strategy and confirm the need for carefully selecting the strategy according to needed accuracy, even when working with REPRO2 products.
- Our work is still in progress; however, our results are in favor of a subsidence around Noumea, which is of relevance for sea-level related work (long term tide-gauge reconstruction, Aucan, et al.).
- We still need to investigate the noise source on some of our GINS-GRG2 results, in particular on the East component.



Yellow arrows indicate sea level variations from altimetry to illustrate how land motion may contribute significantly to relative sea level changes.

Altamimi, Z., Collilieux, X., Métivier, L., ITRF2008: an improved solution of the international terrestrial reference frame. J. Geodesy, 85: 457-473, 2011.

Bos, M. S., Fernandez, R. M. S., Williams, S.D.P. and Bastos, L., Fast error analysis of continuous GNSS observations with missing data, J. Geod., 87(4), 351-360, 2013.

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