Altimetry over rivers of Madagascar

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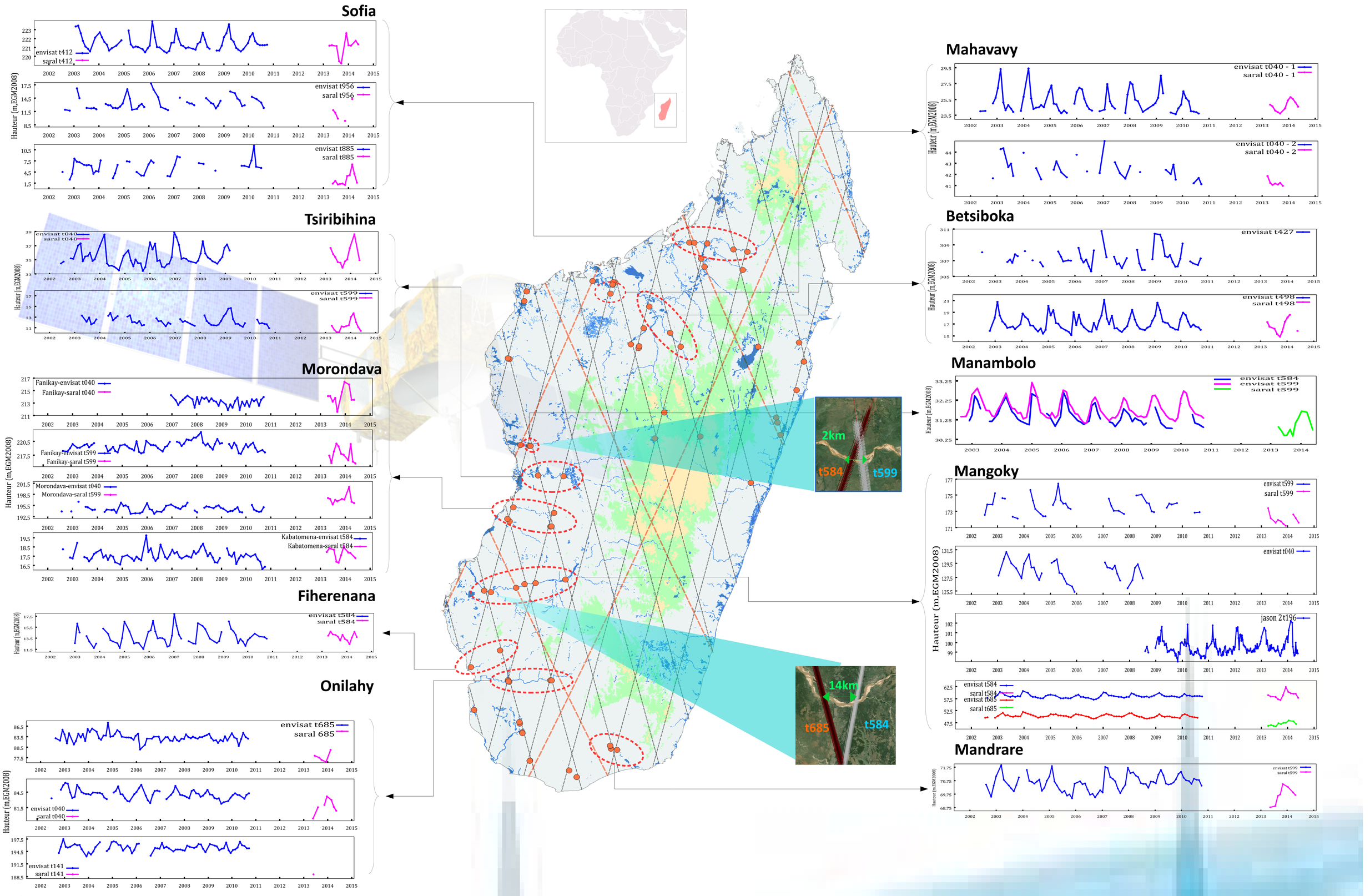
Abstract :

Establising additional way for observing surface waters is an important key for better understanding and management of the water ressource of Madagascar. Many in-situ observation stations aren't any longer working and the few lasting are too sparse to provide sufficient spatial coverage of the big island. Hence, spatial altimetry have been tested for the first time in Madagascar over the rivers, generally narrow and shallow. Preliminary results are reported here and have been obtained by processing Envisat (old orbit), Saral and Jason 2 data. Some virtual stations (ground tracks crossing rivers) were found and associated time series have been produced. No validation by comparison with gauge measurements were performed here. However, some internal cross-track validation was possible at some virtual stations. Good correlation were obtained as well as relatively low root mean squared error, comparable with previous studies on rivers of another country.



Method :

Envisat data (old orbit), Saral and Jason 2 data were processed under VALS tool [1]. ICE-1 [2] and ICE-3 retracked data were then used to build respectively the Envisat/Saral and Jason-2 time series. Off-nadir corrections were performed for most of the virtual stations as the rivers are all narrow, ie. some hundred meters wide (about 100m to 600m). Computation of heights are based on examination of mean or median of at least 5 points; median only especially for off-nadir corrections. Typical value that is considered to provide good estimate was choosen as less than 10cm. But, greater values but less than 20cm were kept for some points if they were judged to be acceptable. No validation were made by comparison with gauge measurements. For the internal cross-track validation, correlation and root mean squared error were computed. Mean surface water slope was also estimated.

River	Manambolo	Mangoky
Tracks	584-599	584-685
Inter-track Distance	2km	14km
Correlation coefficient	0.86	0.72
RMSE	23cm	50cm
Slope	19cm/km	~60cm/km

Table 1 : Results of internal-cross validation

Results :

For most of the estimated heights, median values turned arround 4cm to 6cm. Anyway, they do not mean any real assesment of the precision. Comparison with jauge measurements are needed for real validation, if they are avilable. Some results of cross-track validation of Envisat data are given in the table 1. Such results are comparable with those obtained in [3]. For some virtual stations, time series from SARAL couldn't be processed due to lost of lock while it's passing above the rivers or, if not, the latters were not depicted well in the 40Hz points of the along-track profiles. However, time series from SARAL need some improvement as, visually, seasonnal variations aren't even shown. Also, bias between Envisat and Saral were found on most of the time series and seems to be diffrerent from one place one another. The origin of this is still under investigations, waiting for longer series. Concerning Jason 2, at this point of the work, visually and globally the time serie for the river Mangoky is very good. Correlation analysis with surrounding Envisat/ Saral virtual stations should be performed.

Conclusion :

These preliminary results have shown tthe interesting potentiality of the application of altimetry overs rivers of Madagascar. Future tasks for the continuation of the work are (1) improving the time series, especially with Saral data ; (2) validation with gauge measurements if possible ; (3) their exploitation for hydrological purpose like estimating discharge.

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References :

[1] VALS Tool (2009). Virtual ALtimetry Station. Version 1.08.3. August 2009. http://www.mpl.ird.fr/hybam/outils/logiciels_test.php.
[2] Calmant Stéphane, Santos da Silva J., Medeiros Moreira D., Seyler Frédérique, Shum C.K., Crétaux J.F., Gabalda Germina, Mercier F., Shum C.K. Detection of Envisat RA2/ICE-1 retracked radar altimetry bias over the Amazon basin rivers using GPS. Advances in Space Research, 2013, 51 (8), p. 1551-1564. ISSN 0273-1177
[3] Santos da Silva, J., Seyler, F., Calmant, S., Corrêa Rotuno Filho, O., Roux, E., Magalhaes, A.A., and Guyot, J.-L. (2012). Water level dynamics of Amazon wetlands at the watershed scale by satellite altimetry. Int. J. Remote Sens. *33*, 200–206.