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MAKING THE BEST OF LITTLE INFORMATION: OPERATIONAL FORECASTING AND EARLY WARNING SYSTEMS IN A DATA-SCARCE ENVIRONMENT, THE BENI RIVER WATERSHED IN BOLIVIA.

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OBJECTIVES

NEED: establish a reliable ***Flood Early Warning System*** in a vulnerable watershed, suffering frequent and severe socio-economic impacts.

CHALLENGE: few and scattered data available to calibrate the model and, even more, to feed the operational flood forecasting chain.

(A POSSIBLE) SOLUTION: a *cocktail* of technological tools to enhance available datasets.

These technological solutions have been developed and refined, in coordination with SENAMHI Bolivia, through the years, in the framework of a multi-project (and multi-donor) programme started in 2013.

ITALIAN AGENCY FOR DEVELOPMENT COOPERATION

FAO FIAT PANIS

Civil Protection Humanitarian Aid

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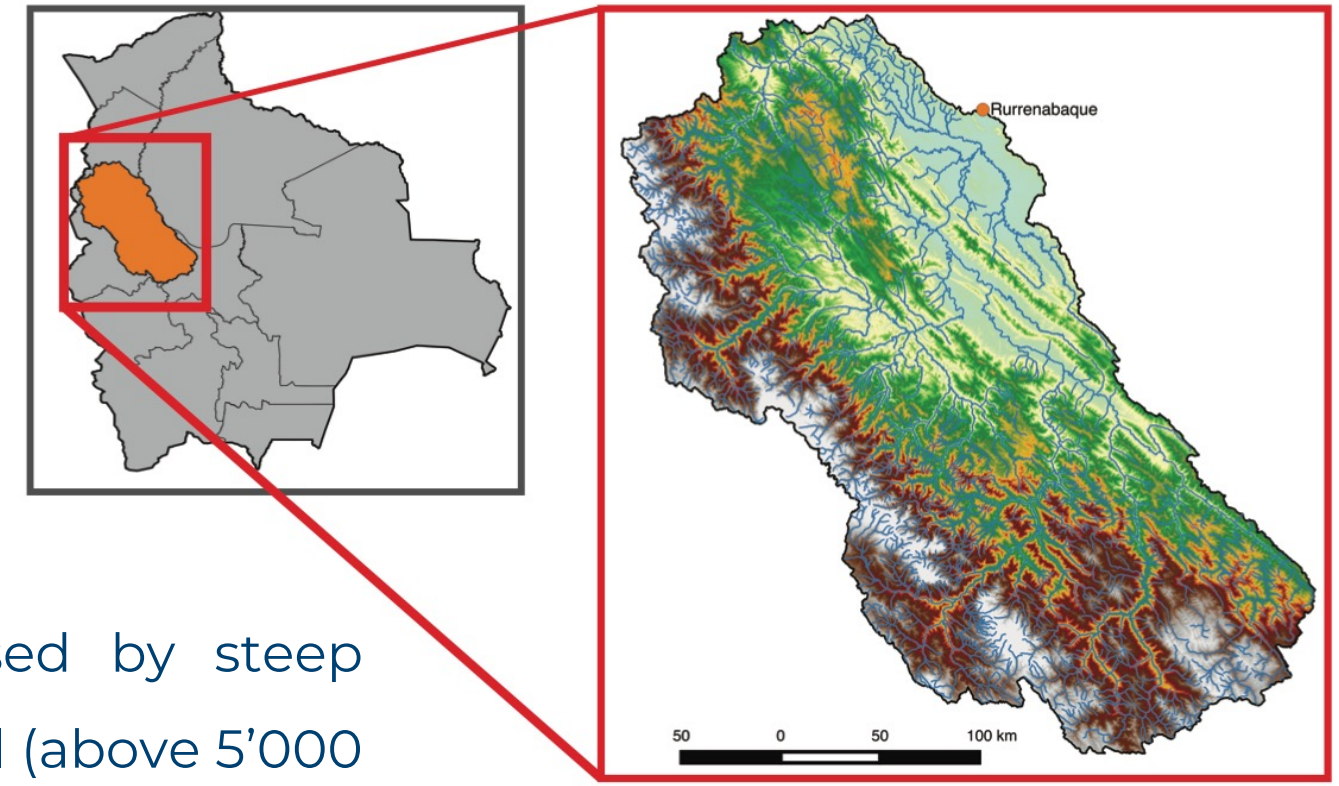
THE ALTO BENI WATERSHED

laRazón Sociedad

Portada Nacional Voces La Revista Ciudades Marcas Economía Mundo

En Guanay y Tipuani evacuan a 552 familias por las inundaciones

Lluvias. Diez viviendas se desploman en el norte paceño por el desborde de 2 ríos

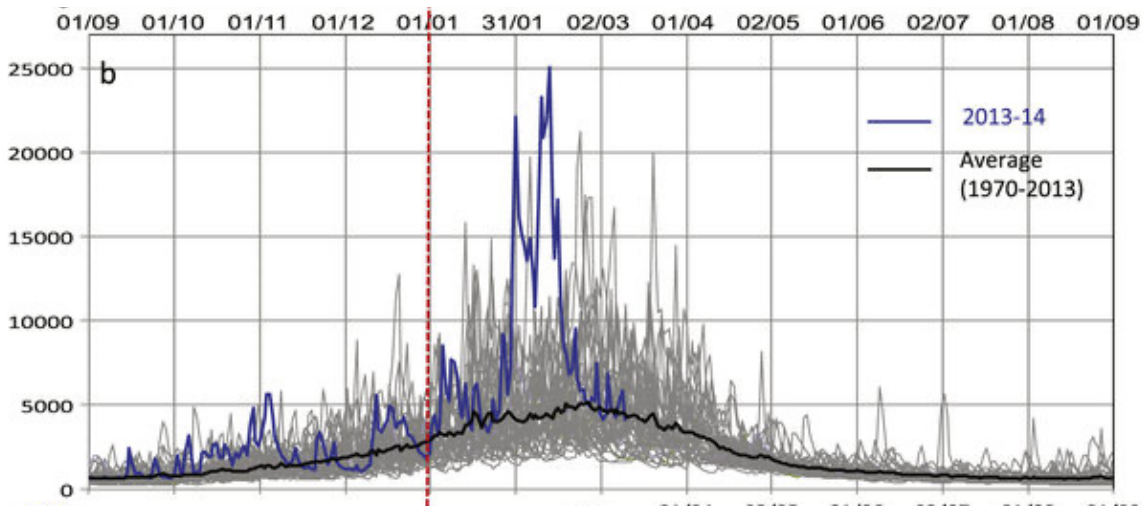


A 70’000 km² watershed characterised by steep slopes and significant amount of rainfall (above 5’000 mm/year), resulting in severe flooding in riverine communities.

SETTING THE MODEL WITH LIMITED DATA

Reconstructing the **historic 2014 flood** represented a major challenge. Several satellite derived products (ensuring coverage on the whole watershed) have been tested. To further decrease uncertainty in model results, two innovative data processing technologies have been undertaken:

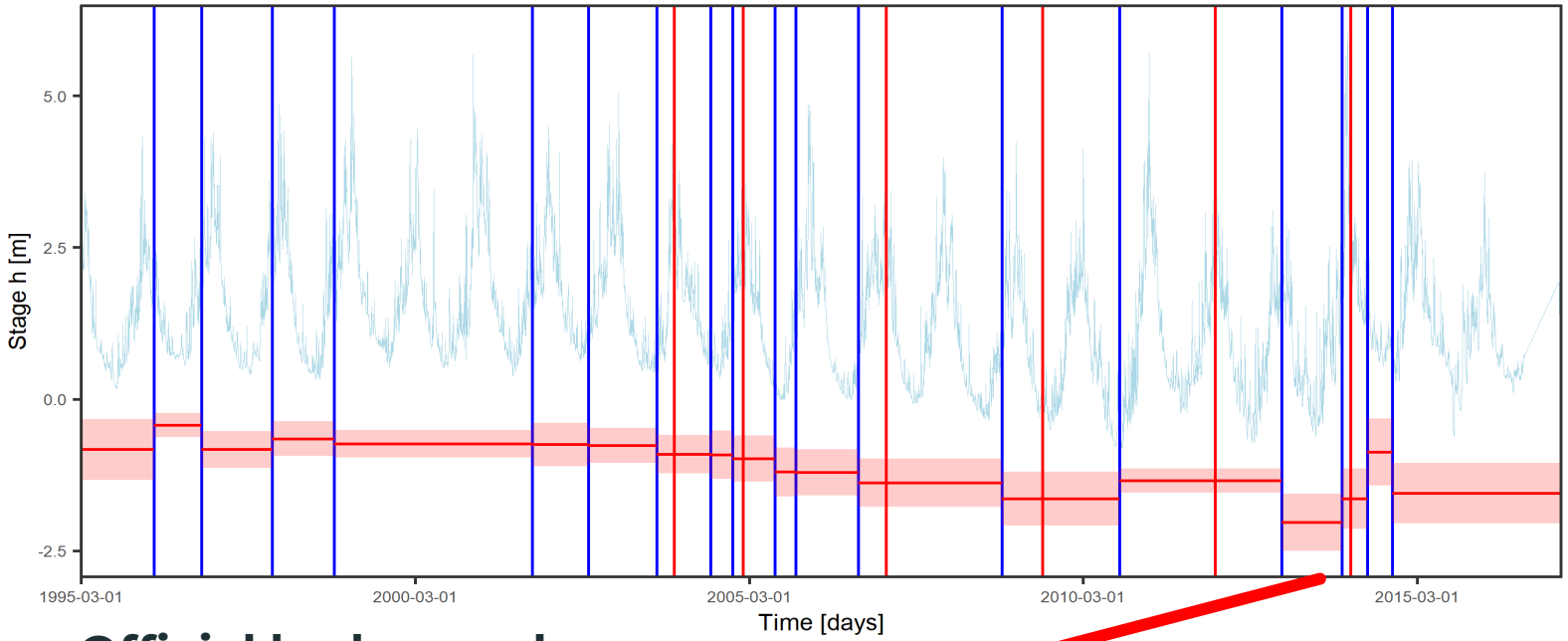
- Review of the available **rating curves**, considering possible shifts (*Darienzo, 2021*)
- Integrating ground station observations with a **conditional merging** technique (*Bruno, 2021*)



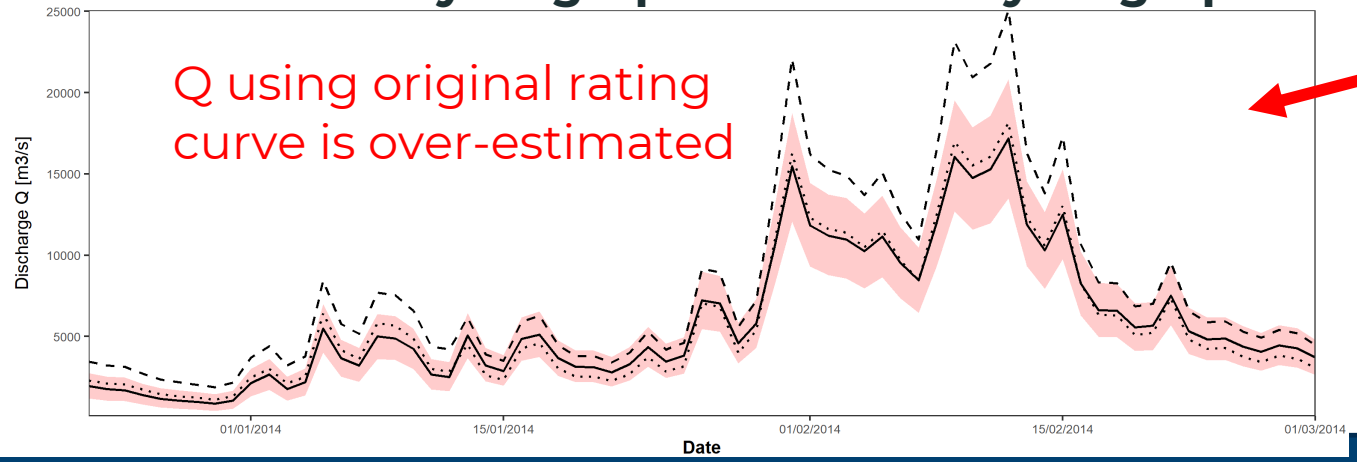
Espinoza et al, 2014

BayDERS (Darienzo et al. [2021], *https://github.com/MatteoDarienzo/BayDERS*)

UPDATING THE RATING CURVE

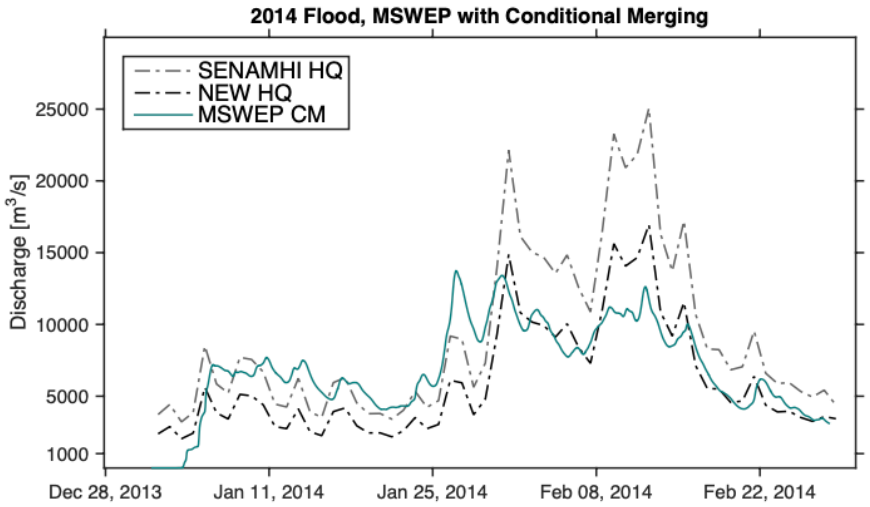


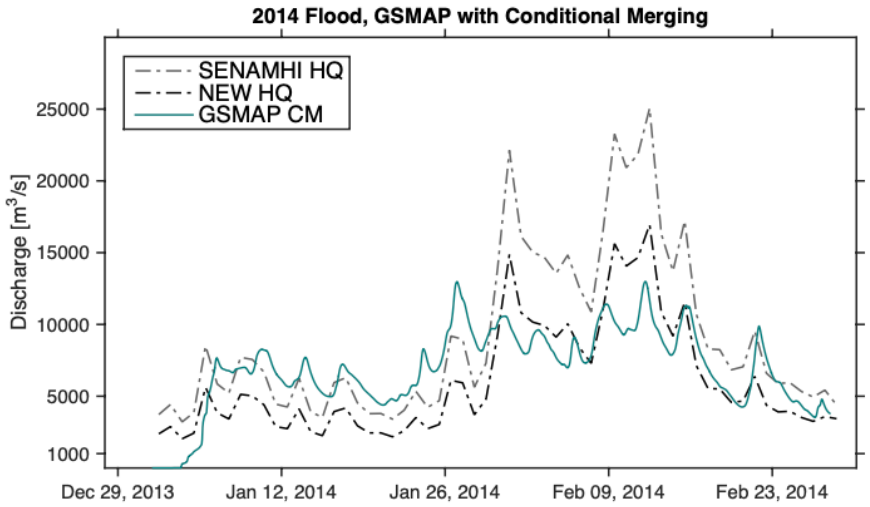
Reconstructed hydrograph vs Official hydrograph

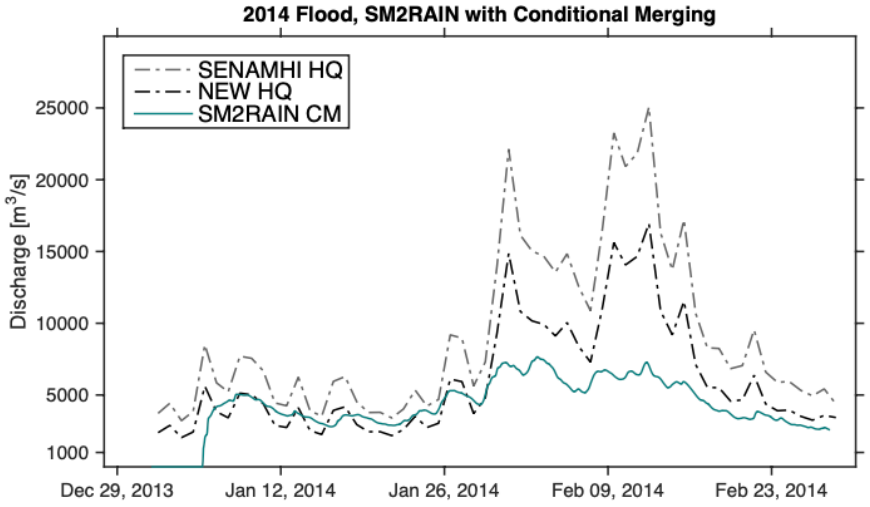


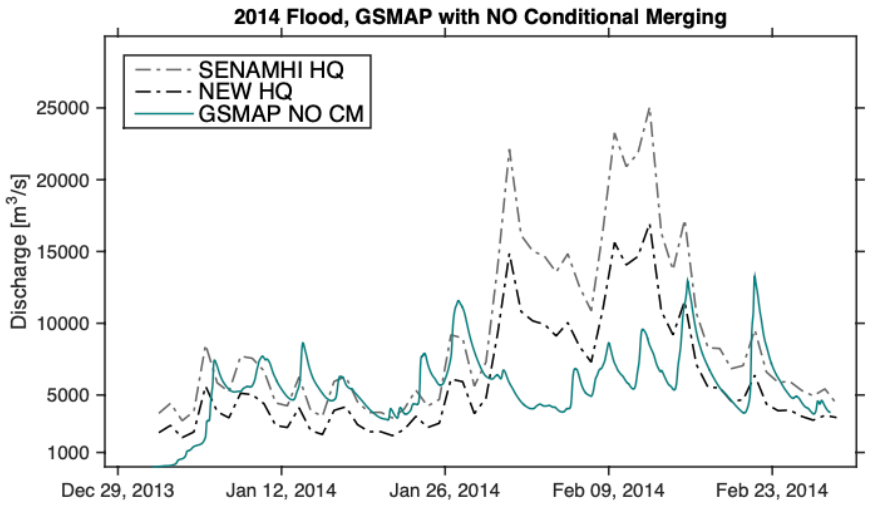
- Bayesian Segmentation of gaugings
- Bayesian analysis of stage-recessions

SELECTING THE BEST AVAILABLE INPUT









The combination of **GSMaP** and ground stations performed the best. Moreover, GSMaP, given its near-real-time availability, is a solid data source to feed the operational EWS.

IMPROVING THE OPERATIONAL RESULTS

For improving the real-time application of the hydrological model, the flood forecasting chain (**Flood-PROOFS**) has been further improved by:

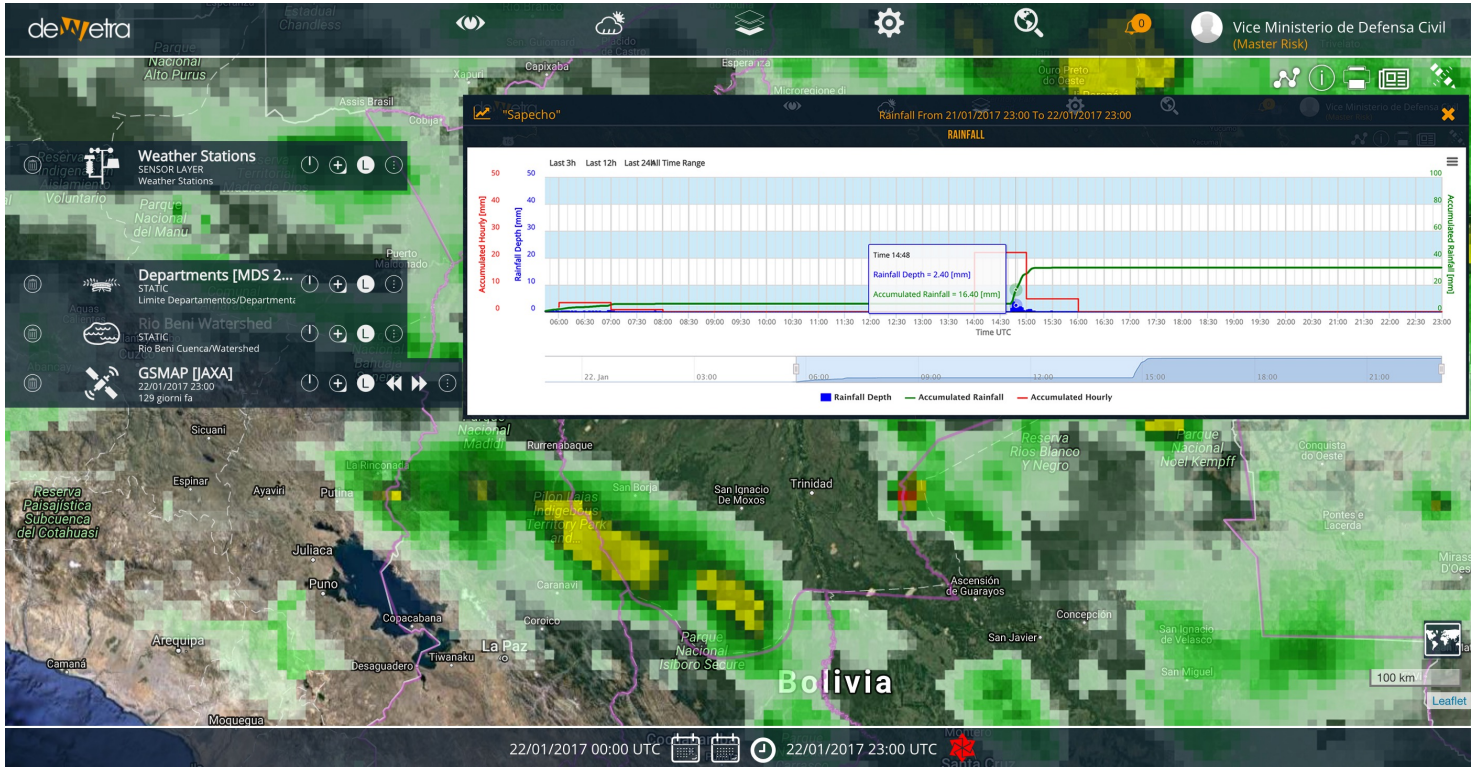
- Rehabilitating existing rain gauges, with new datalogger based on a low-cost open-hardware technology (*Acronet*)
- Configuring tailored flood forecasting chain according to local hydrologist needs.

Operational results are available in the ***myDEWETRA*** platform, key tool of the National Disaster Early Warning System (SNATD) managed by VIDECI and SENAMHI Bolivia.

https://www.infomydewetra.world/

REVAMPING THE MONITORING NETWORK

4 non-transmitting rain gauges in the watershed have been rehabilitated with the *Acronet* open-hardware technology, becoming able to provide rain records in **real-time at a 5 minutes resolution**.



Sapecho rain gauge visualised in myDewetra Bolivia

EXPANDING THE OPERATIONAL FORECASTS

A set of operational chains, configured and scheduled taking in consideration IT infrastructure challenges and needed warning times:

- **multi-deterministic**, fed by three NWP models (available before 11.00 local time)

- **probabilistic**, with rainfall downscaling (available after 11.00 local time, and executed only if threshold are exceeded)