

# Combined Sea Level Products from SONEL and PSMSL



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As the GNSS data center for GLOSS since 2011, SONEL strives to collect, analyze and provide data from continuous GNSS stations at tide gauges worldwide. From these data, the ULR Analysis Center has published the ULR5 GNSS vertical velocity field at 232 tide gauges in 2012 (Santamaria-Gomez et al, 2012). In collaboration with the Permanent Service for Mean Sea Level (PSMSL, Holgate et. al, 2013), SONEL has combined the rates of relative sea level change from tide gauges and the vertical land movements estimated from the ULR5 solution to develop a mapping tool to display the rates of geocentric (absolute) sea level change.

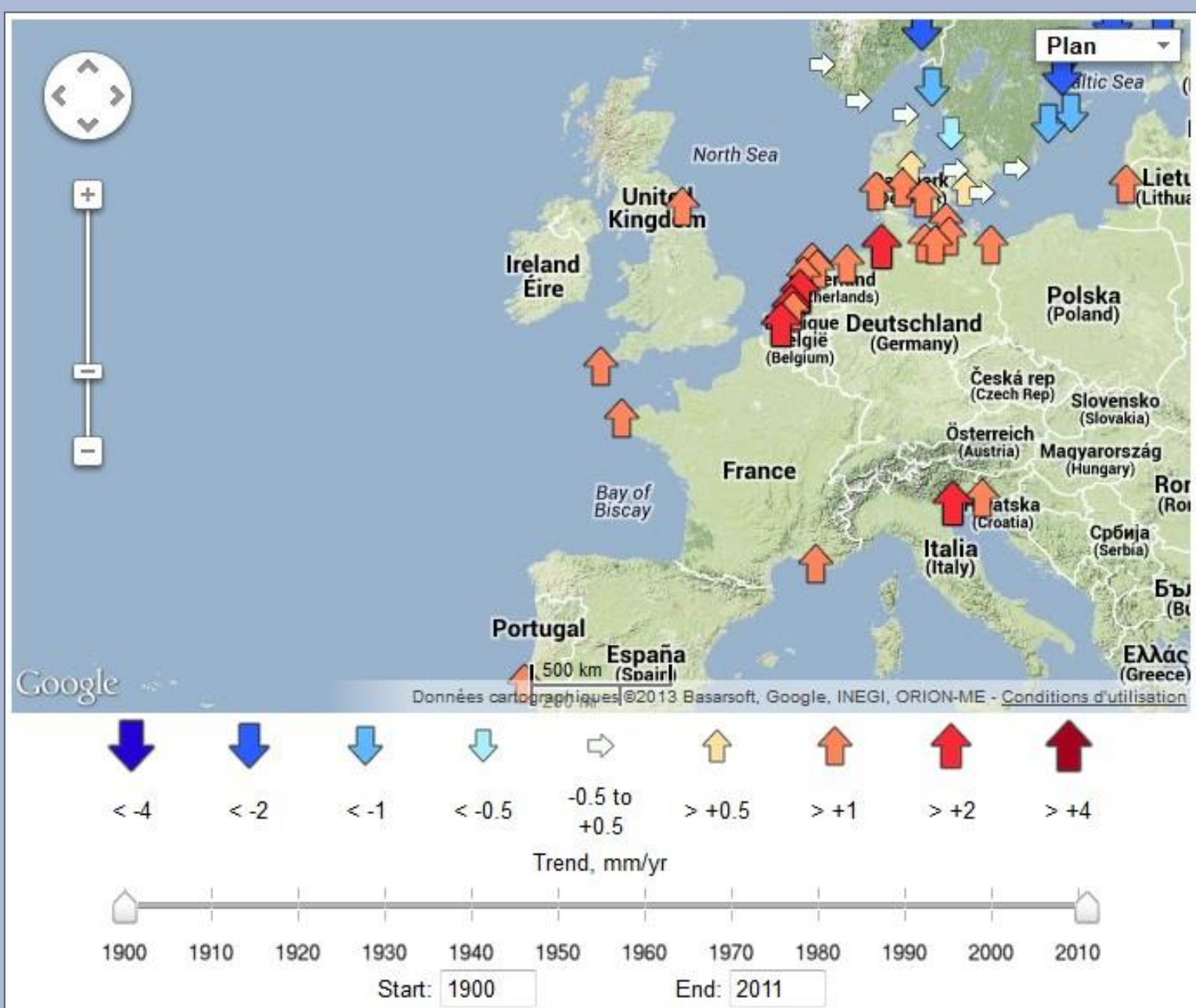


## Relative Sea Level Trends

As observed by tide gauges from the PSMSL RLR dataset

The rates of relative sea level change are provided by the PSMSL. These rates are calculated over a given period using the annual time series from the RLR dataset. The period can be chosen by the user between 1900 and 2011, with a minimum time span of 30 years. The computation requires 70% of data completeness over the chosen period.

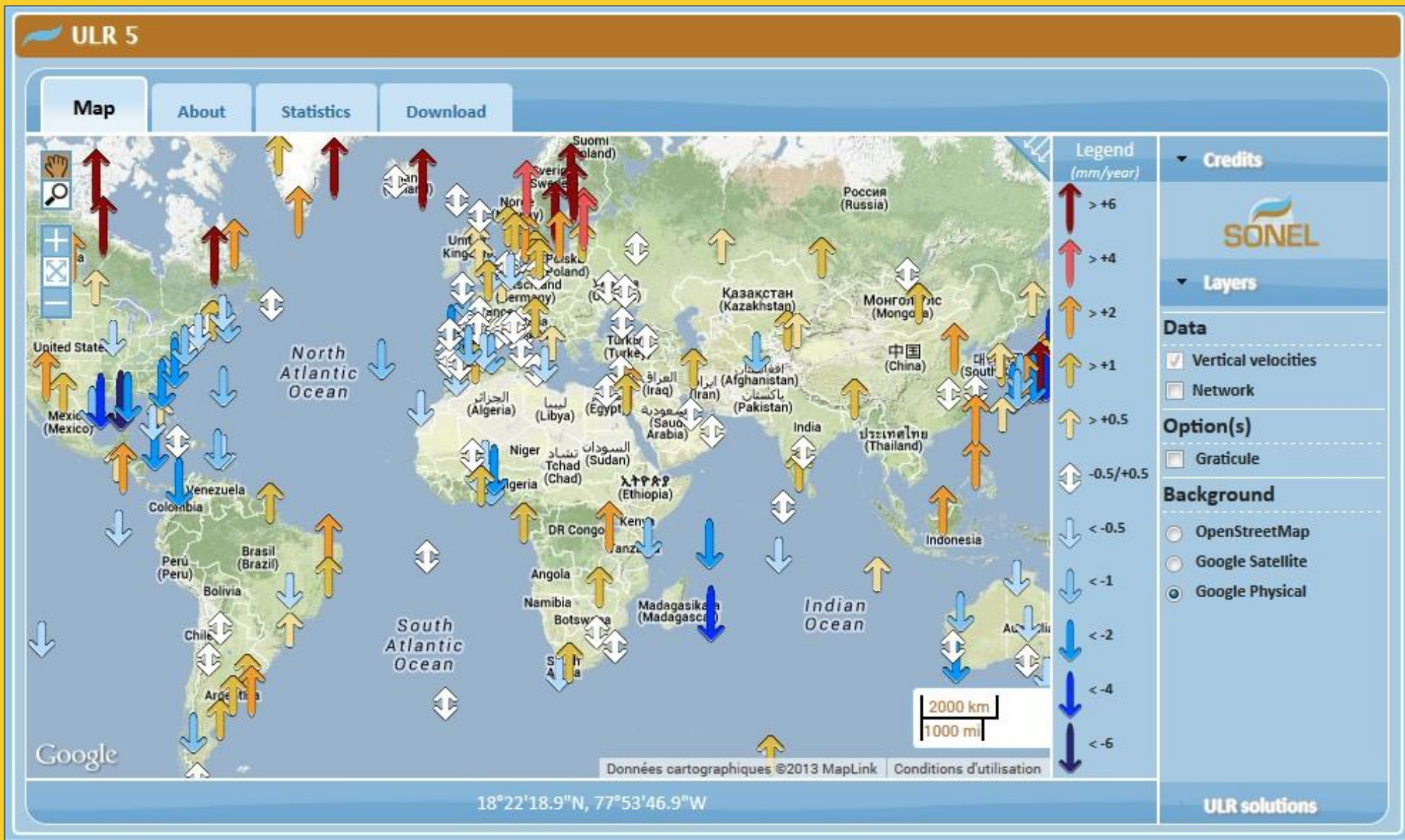
<http://www.psmsl.org/products/trends/>



## Vertical Land Movements

As observed by the GPS velocities from the ULR5 solution

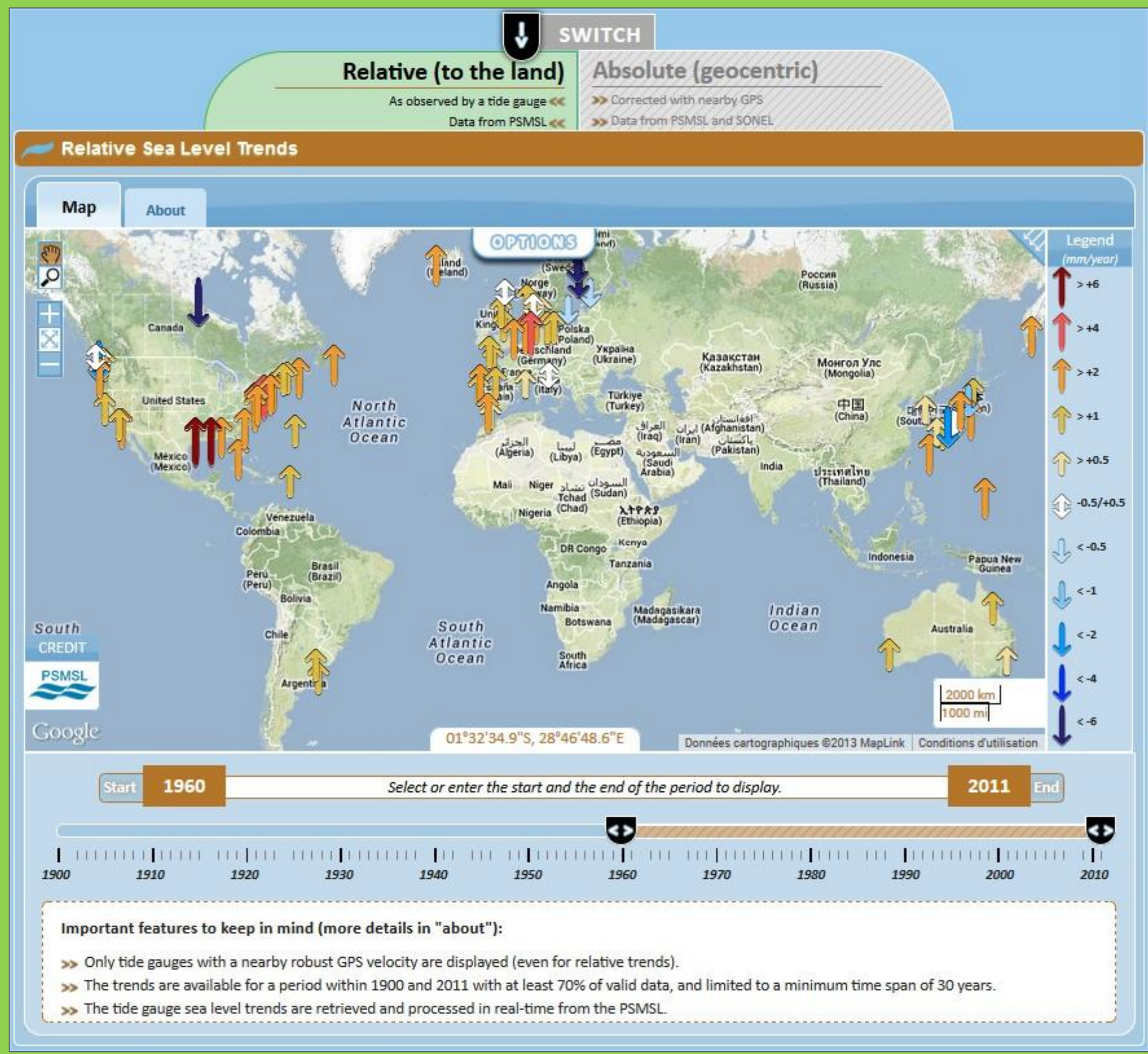
The vertical land movements are estimated using the latest GNSS solution available on SONEL (ULR5). A minimum of three continuous years without an offset in the time series were required to estimate a “robust” vertical velocity. This is the minimum duration needed to limit bias from seasonal cycles. Ultimately, there were 232 GNSS stations nearby a tide gauge for which a GNSS velocity was estimated. The median uncertainty on the estimated vertical velocities is 0.3 mm/year.



<http://www.sonel.org/-Vertical-land-movement-estimate-.html?lang=en>

## Relative & Geocentric Rates of Sea Level Change

With respect to the ellipsoid : Relative rates corrected with the GPS vertical velocities

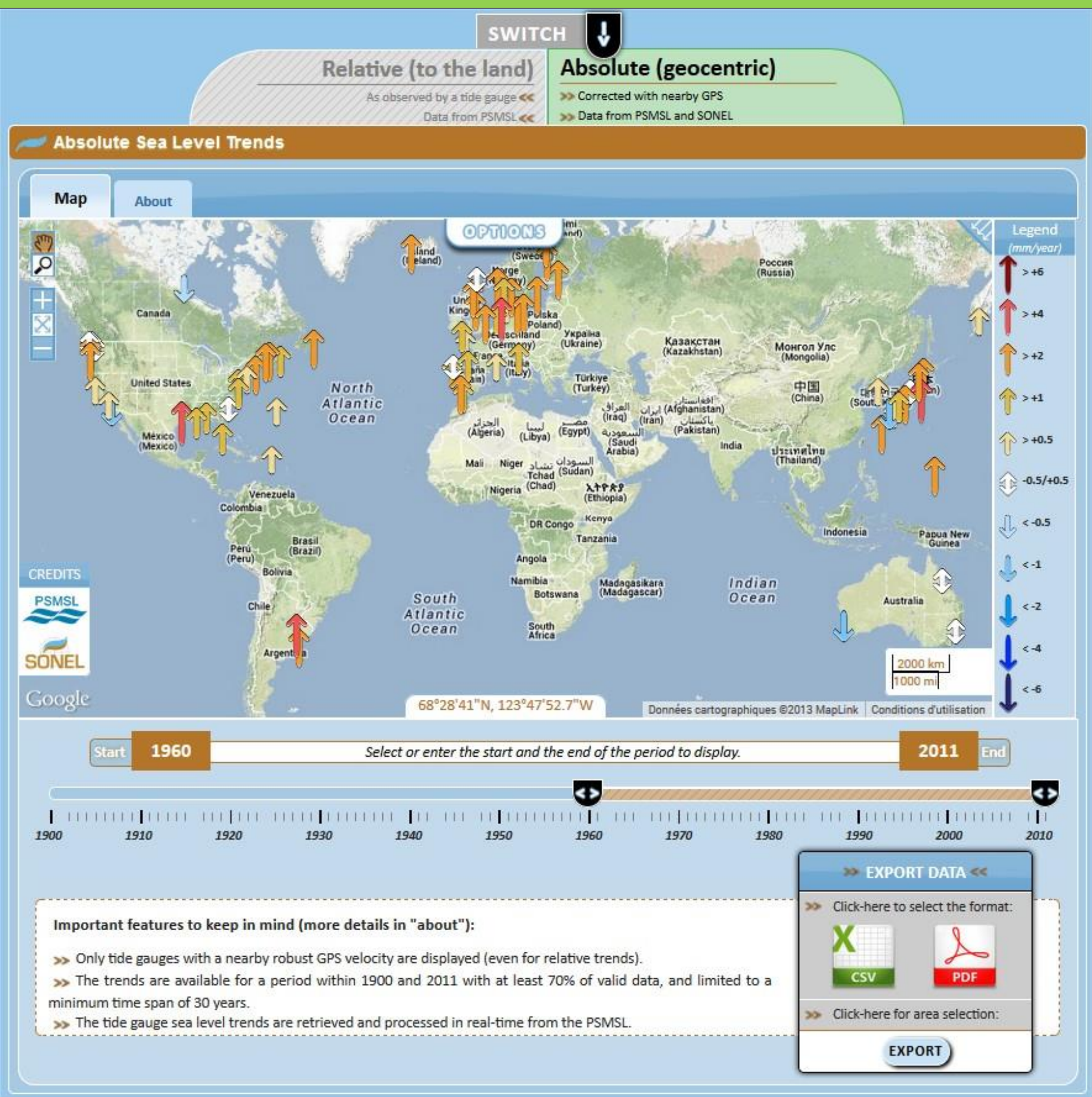


The geocentric (absolute) rates of sea level change (ASL) have been obtained by combining the PSMSL rates of relative sea level change (RSL, as recorded by the tide gauges) with the vertical land movements (VLM) estimated from the ULR5 GNSS vertical velocities following the relationship:

$$ASL = RSL + VLM$$

Only results from tide gauges for which a robust GPS velocity is available are displayed. The rates of absolute sea level trends can be exported as CSV or PDF files, either for the stations in the displayed region or for all the stations in the world for which the computation was performed.

<http://www.sonel.org/-Sea-level-trends-.html?lang=en>



## Future work

Integration of other GNSS solutions to correct the relative sea level trends:

- Next ULR solution: **ULR6 (2014)**  
Network of 487 GNSS@TG stations processed over the 1995.0-2012.9 period

- Solutions from other groups within the GNSS (e.g., TIGA) or from other geodetic techniques (e.g. DORIS).

Extending to the relative sea level trends from the PSMSL “longest” rates table.

- Trends estimated over the entire time series
- Sea level records from the annual mean RLR datasets, longer than 30 years and with more than 70% of data completeness
- Among the 543 relative sea level trends of the PSMSL table, **132** are nearby a robust ULR5 velocity, and **246** are closer than 15 km of a ULR6 station (Figure 1).

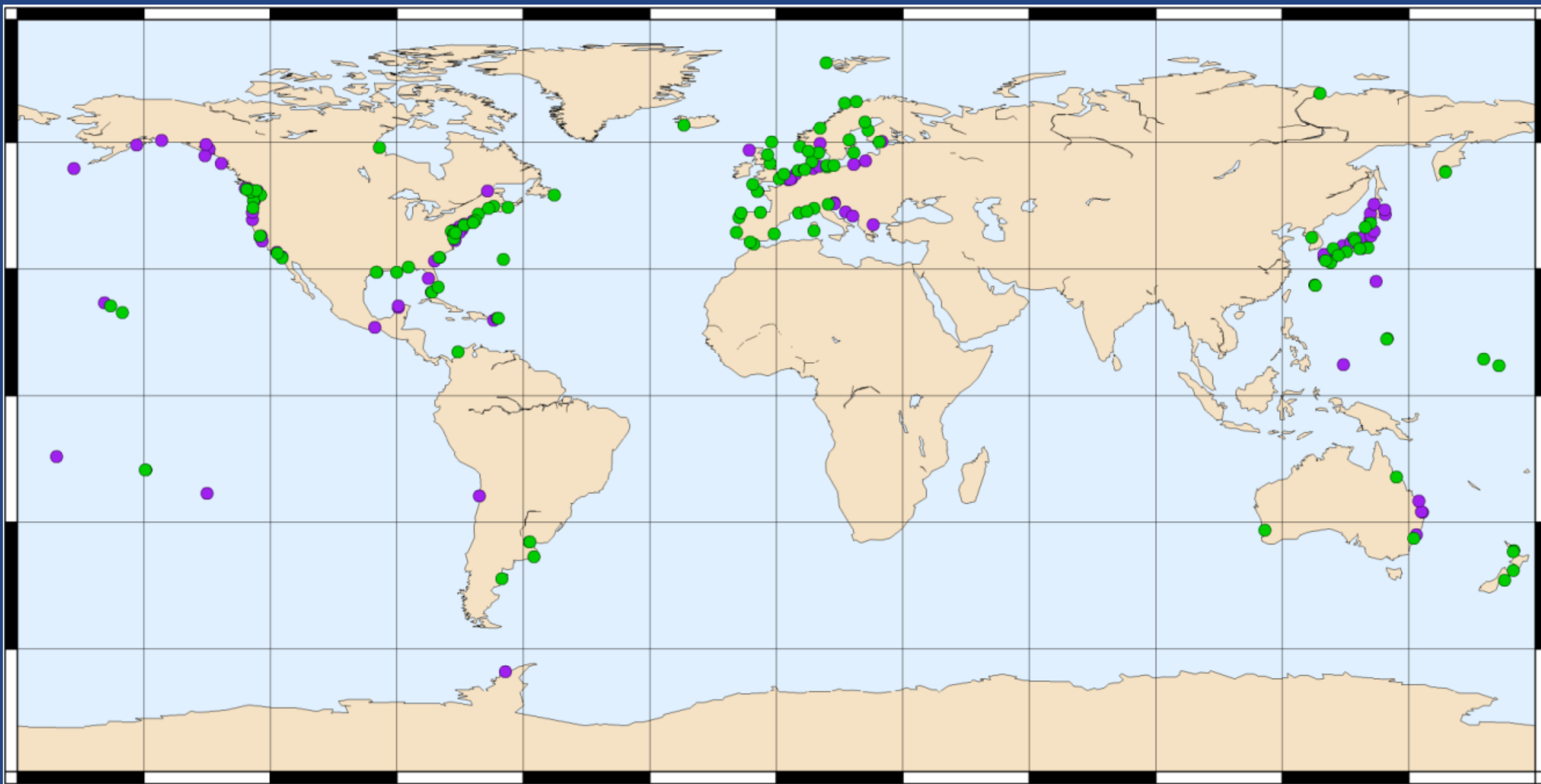


Figure 1: Tide gauges from the PSMSL « longest » rates table that are nearby a robust ULR5 velocity (green) and nearby a station from the forthcoming ULR6 solution (purple)

**References:**  
Holgate, Simon J.; Matthews, Andrew; Woodworth, Philip L.; Rickards, Lesley J.; Tamisiea, Mark E.; Bradshaw, Elizabeth; Foden, Peter R.; Gordon, Kathleen M.; Jevrejeva, Svetlana; Pugh, Jeff. 2013 New Data Systems and Products at the Permanent Service for Mean Sea Level. Journal of Coastal Research, 29 (3). 493-504. 10.2112/JCOASTRES-D-12-00175.1  
Santamaría-Gómez A, Gravelle M, Collilieux X, Guichard M, Míguez BM, Tiphaneau P, Wöppelmann G (2012) Mitigating the effects of vertical land motion in tide gauge records using a state-of-the-art GPS velocity field. Global and Planetary Change, 98-99, 6-17.

