



Opinion paper

Coastal planning should be based on proven sea level data


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ABSTRACT

There are two related measures of sea level, the absolute sea level, which is the increase in the sea level in an absolute reference frame, and relative sea level, which is the increase in sea level recorded by tide gauges. The first measure is a rather abstract computation, far from being reliable, and is preferred by activists and politicians for no scientific reason. For local and global problems it is better to use local tide gauge data. Proper coastal management should be based on proved measurements of sea level. Tide gauges provide the most reliable measurements, and best data to assess the rate of change. We show as the naïve averaging of all the tide gauges included in the PSMSL surveys show “relative” rates of rise about +1.04 mm/year (570 tide gauges of any length). If we consider only 100 tide gauges with more than 80 years of recording the rise is only +0.25 mm/year. This naïve averaging has been stable and shows that the sea levels are slowly rising but not accelerating. We also show as the additional information provided by GPS and satellite altimetry is of very little help. Computations of “absolute” sea levels suffer from inaccuracies with errors larger than the estimated trends. The GPS is more reliable than satellite altimetry, but the accuracy of the estimation of the vertical velocity at GPS domes is still well above ± 1 mm/year and the relative motion of tide gauges vs. GPS domes is mostly unassessed. The satellite altimetry returns a noisy signal so that a +3.2 mm/year trend is only achieved by arbitrary “corrections”. We conclude that if the sea levels are only oscillating about constant trends everywhere as suggested by the tide gauges, then the effects of climate change are negligible, and the local patterns may be used for local coastal planning without any need of purely speculative global trends based on emission scenarios. Ocean and coastal management should acknowledge all these facts. As the relative rates of rises are stable worldwide, coastal protection should be introduced only where the rate of rise of sea levels as determined from historical data show a tangible short term threat. As the first signs the sea levels will rise catastrophically within few years are nowhere to be seen, people should start really thinking about the warnings not to demolish everything for a case nobody knows will indeed happen.

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1. Introduction

Sea levels have long been measured by tide gauges. The best examples go back to the 1800s and are mostly in the northern hemisphere (PSMSL, 2015). Tide gauge signals of sufficient quality and length permit the computation of relative rates of rise or fall (Parker et al., 2013; Parker, 2014a). Although this parameter is reliable to assess the rise or fall of sea level, over the last two decades the use of satellite-based systems has been used to compute both the local rates of rise or fall as well as the global volume of the

ocean waters.

The use of the Global Positioning System (GPS) has been proposed to compute the vertical velocity of the tide gauges themselves. This approach returns the vertical velocity of the GPS dome near to a tide gauge. A usually neglected survey of the vertical position of the tide gauge relative to the GPS dome may then be used to derive the absolute sea level velocity at a tide gauge location from the tide gauge signal.

Altimetry from the satellite missions Topex/Poseidon and Jason-1 & Jason-2 has also been used to compute the instantaneous Global Mean Sea Level (GMSL) (CU sea level research group, 2015). As the surface of the world oceans is continuously oscillating, the actual measure of this surface at any individual position is anything but simple. The accuracy of the GPS estimation of the position relative to a fixed point on land is much more reliable than the

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global estimation of the moving sea surface.

In the GMSL computation the calibration of the altimeter sea level measurements is performed against a network of tide gauges (CU sea level research group, 2015). This permits the discovery and monitoring of drift in the satellite and sometimes in the tide gauge measurements. While GMSL measurements are continuously calibrated against a network of tide gauges, it is stated that the GMSL result cannot be used to predict relative sea level changes along the coasts (CU sea level research group, 2015). The purpose of this statement is to discourage comparison of the purely speculative GMSL with actual measurements along the coast.

The relative sea level at the tide gauge is variable from one location to the other because of the different subsidence at the tide gauge, the different record length and the different phasing of the inter-annual and multi-decadal oscillations (Chambers et al., 2012; Baker and McGowan, 2015; Scafetta, 2014; Mazzarella and Scafetta, 2012). With record of length the time span of the satellite era, only 22 years right now, the variability is further amplified by the short record length. The selection of the calibrating network of tide gauges may therefore produce almost any result, from sharply rising to equally sharply decreasing sea levels.

The present work expands the analyses proposed in (Parker, 2014b) to show that the GPS and the satellite altimetry do not help to clarify the influence climate change has on sea levels. It will be shown that the GPS is returning a vertical velocity at the tide gauge with errors larger than the average rate of rise at the tide gauges while the GMSL is a non-reliable computation. The pattern of sea levels is already very clear from the analysis of the relative sea level measured by the tide gauges of sufficient quality and length (Chambers et al., 2012; Scafetta, 2014). If there is no indication of acceleration worldwide, then there is no sign of the influence of climate change (Burton, 2012; Hannah and Bell, 2012; Houston and Dean, 2012; Mörner, 2013, 2014; Watson, 2011; Wunsch et al., 2007), and the local, proven, reliable information from tide gauges may be used for local coastal planning (Carter et al., 2014).

2. Sea levels information

The Permanent Service on Mean Sea Levels (PSMSL) (PSMSL, 2015) has released the latest survey of relative mean sea level from worldwide tide gauges, while the Colorado University Sea Level research group (CU sea level research group, 2015) is updating monthly its computation of the Global Mean Sea Level (GMSL) by satellite altimetry. SONEL (SONEL, 2015) and JPL (JPL, 2015) provide estimation of vertical land motion of GPS domes a few km from the location of tide gauges used in the GPS monitoring. The analysis of these data permits interesting conclusions to be drawn about the relative rate of rise by tide gauges. For the analysis of the time series, the velocities are computed by linearly fitting the available data for the position, using the monthly average relative sea levels measured by the tide gauges or the vertical position of the nearby GPS domes periodically sampled by the GPS satellite monitoring. The accuracy of the vertical velocity of the tide gauges is unassessed.

3. Relative local sea levels

Table 1 in the supplementary material is the PSMSL survey of relative rates of rise (PSMSL, 2015) limited to the 170 worldwide tide gauges of length exceeding the 60 years of records. The table presents the results proposed in the two latest surveys of 14-Feb-2014 and 30-Apr-2015. This result is complemented, when available, by the SONEL (SONEL, 2015) and JPL (JPL, 2015) vertical velocities of inland GPS domes near the tide gauges.

The idea that record length smaller than 60 years may overrate or underrate the rate of rise is a matter of fact. A sinus law $y = \sin(x)$ is not representing any rising or falling trend. While over a period of 2π or multiples, a linear fitting returns zero slope, over a period smaller than 2π , a linear fitting may return positive or negative slopes. If we start from $x = 3/2\pi$ then we will have always a positive slope except than for the time window $x = 3/2\pi - 7/2\pi$.

For everybody accepting the existence of climate oscillations of multi decadal periodicities up to quasi-60 years, then time windows of less than 60 years, as for example the 10–20 years used in the Australian and Pacific sea levels monitoring projects reports that incidentally also started in a clear valley of the peaks and valleys multi decadal oscillations in the early 1990s are therefore misleading.

The short time window may produce unrealistically high or unrealistically low relative rates of rises. This work is based on the analysis of all the tide gauges surveyed in the PSMSL data base over their full record, and not on a carefully selected subset chosen to illustrate a point.

The last update 30-Apr-2015 of the PSMSL survey (PSMSL, 2015) proposes 571 tide gauges of maximum record length 188 years, minimum record length 27 years and average record length 60 years located in areas subject to differential subsidence or uplift resulting in a naïve averaged relative sea level rise of +1.04 mm/year with maximum of +10.25 mm/year and minimum of −17.66 mm/year. Similar numbers were computed in previous surveys, despite the random addition or removal of tide gauges located in areas of subsidence or uplift and having different record length.

4. Absolute local sea levels

The information from the GPS does not return the precise absolute vertical land velocity at the tide gauge but a still non-accurate estimation of the absolute vertical velocity of nearby GPS domes. The GPS domes are several km distant from the tide gauges, even in the best case. The vertical velocity of the GPS dome is not the tide gauge vertical velocity. The position of the tide gauge vs. the GPS dome is usually not surveyed, and even if could be surveyed, it would be subject to further errors and dependent on the frequency of the surveying.

The error in assessing the vertical velocity of the GPS dome is still much larger of ± 1 mm/year in (SONEL, 2015). The use of GPS to monitor vertical land motions at tide gauges has proven to be not as straightforward as was supposed 15 years ago. Determining rates of vertical land motion with accuracy better than ± 1 mm/year is still very challenging (SONEL, 2015). This fact is made obvious by comparing computations by different groups for the same GPS domes, which may differ by more than 1 mm/year.

As an example, the vertical land velocity of the Tofino (UCLU) GPS dome near the TOFINO tide gauge is $+4.10 \pm 0.14$ mm/year in (SONEL, 2015) vs. $+2.54 \pm 0.30$ mm/year in (JPL, 2015). This GPS dome is active, and the time span of data is 1995–2011 in (SONEL, 2015) and 1995–2013 in (JPL, 2015). The difference in the time span does not seem to be the reason for the significant difference in the rates of uplift of 1.56 mm/year that mainly results from different computational methods.

The same is true for the vertical land velocity of Point Loma 3 (PLO3) near the SAN DIEGO (QUARANTINE STATION) tide gauge. This velocity is -1.65 ± 0.41 mm/year in (SONEL, 2015) vs. -2.39 ± 1.00 mm/year in (JPL, 2015). This GPS dome is decommissioned and the time span of data 1996 to 2006 is the same. In (SONEL, 2015), the vertical land velocity of PLO5 nearby PLO3 is -3.23 ± 0.17 mm/year over the time window 2006 to 2011. In (JPL, 2015), the data of P475 also close to the SAN DIEGO

(QUARANTINE STATION) suggest a vertical velocity of $+0.27 \pm 0.87$ mm/year. Differences are again substantial - up to 3.5 mm/year in the worst case. The small statistical error is therefore not a proper measure of the accuracy of the estimation.

If two groups still compute GPS dome velocities with such significant differences, then there is no reason to believe these different computations have accuracies one order of magnitude smaller than the differences.

The error in assessing the vertical velocity of the tide gauge, including of the error of a survey of the relative position tide gauge to GPS dome that is usually omitted, is definitively much larger than the error in assessing the vertical velocity of the nearby GPS dome. The actual error is therefore much larger than the module of the relative rates of rise or fall of sea levels. To suggest that the computation of rates of rise of sea levels provides a better assessment of the effects of climate change is misleading.

5. Hot or cold spots of sea level acceleration or deceleration

Fig. 1 presents as an example the measured monthly average mean sea levels for The Battery, NY on the East Coast of the United States, and San Francisco, CA on the West Coast of the United States. The linear fitting over the full time window suggest a similar relative rate of rise of the sea levels that is linked to the sinking of

the tide gauges. Since 1993, over the small time window of the satellite altimeter era, the two tide gauges indicate much larger or much smaller relative rates of rise. Despite of a subsidence rate very likely the long term relative sea level rise trend of +2.84 mm/year for The Battery, NY and +1.41 mm/year for San Francisco, CA, the short term relative sea level rise trend is +4.51 mm/year for The Battery, NY, but it is −0.94 mm/year for San Francisco, CA.

Fig. 2 presents the relative sea level rate of rise maps for the United States and Canada from (PSMSL, 2015). The maps are proposed over the time window 1934–1993 (60 years of recording at the time the satellite monitoring started, the minimum length to infer reasonable trends) and 1934–2013 (latest update in same locations). The figure also presents the absolute vertical velocities of inland GPS domes, image from (SONEL, 2015).

The mass addition from ice melting and thermal expansion from oceans' warming do not seem that significant, as over the last 20 years the relative rates of rise haven't changed too much, see figures a and b. The rate of relative sea level rise is indeed mostly dictated by the sinking of the instrument, usually larger than the inland subsidence, that is shown in figure c. Comparison of figures b and c show considerable consistency, especially when considering that the instrument may more likely experience extra subsidence vs. an inland GPS dome than uplift.

Fig. 3 presents the measured relative sea level rise trends this

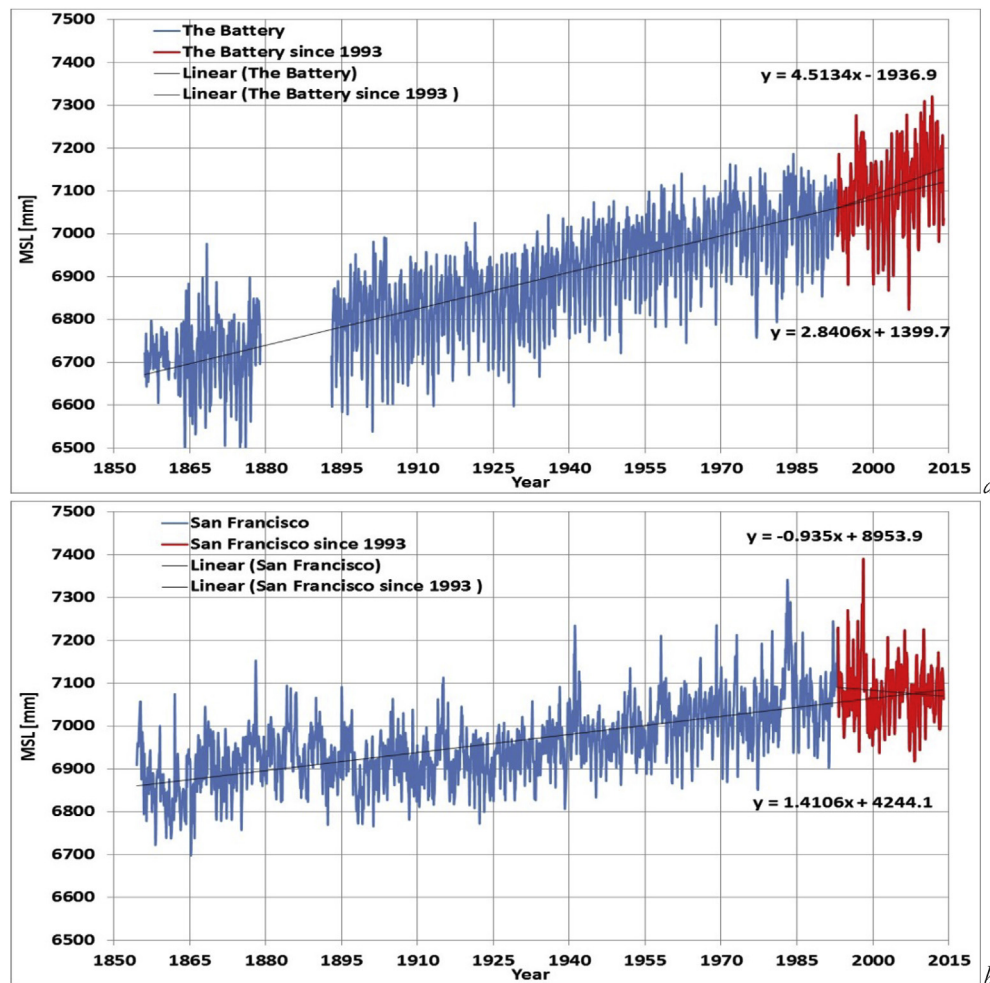


Fig. 1. a, b) measured monthly average mean sea levels for The Battery, NY on the East Coast of the United States, and San Francisco, CA on the West Coast of the United States. In the hot spot of positive acceleration The Battery, NY the latest 2 decades relative sea level rate of rise is +4.513 mm/year vs. the long term +2.841 mm/year. In the cold spot of negative acceleration San Francisco, CA the latest 2 decades relative sea level rate of rise is −0.935 mm/year vs. the long term +1.411 mm/year. Similar results to The Battery, NY are found along the East Coast of North America, as similar results to San Francisco, CA are found along the West Coast of North America.

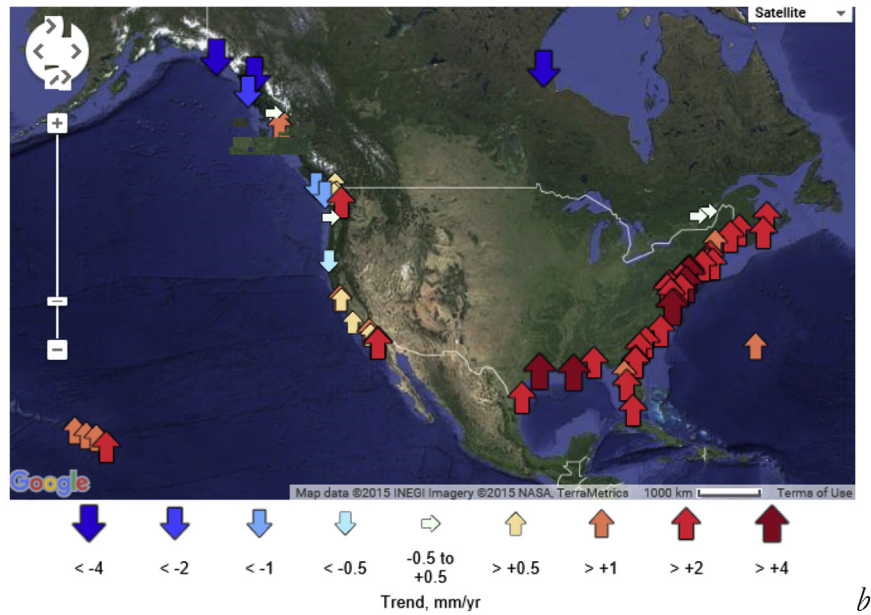
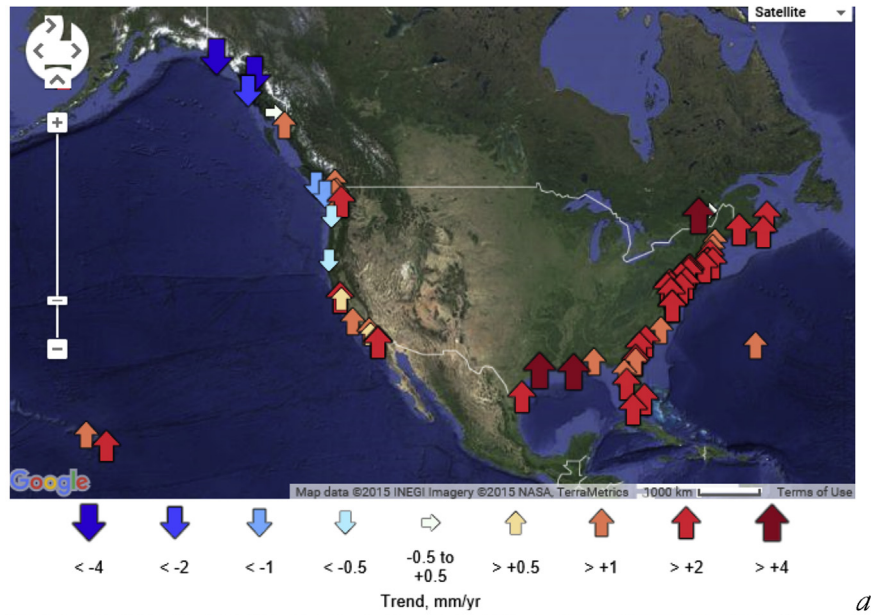


Fig. 2. a, b) measured relative sea level rise trends over the time window 1934–1993 and 1934–2013, images from (PSMSL, 2015). c) absolute vertical velocities of inland GPS domes, image from (SONEL, 2015). The mass addition from ice melting and thermal expansion from oceans' warming do not seem that significant, as over the last 20 years the relative rates of rise haven't changed too much, see figures a and b. The rate of relative sea level rise is mostly dictated by the sinking of the instrument, usually larger than the inland subsidence, see figures b and c.

time over the short time window 1984–2013 compared to 1934–2013, images from (PSMSL, 2015). With short time windows, as for example the 30 years of figure a, the rate of relative sea level rise may be overestimated or underestimated. The temporary oscillations above or below the instrument subsidence rate are the result of the multi-decadal oscillations. There are no hot spot of positive sea level acceleration as there are no cold spot of sea level decelerations. Only the sea levels oscillate. The short term window is larger than the satellite monitoring time window, as the online facility only permits to visualize the relative rates of rise computed with a 30 years' time window.

If the East coast is a “hot-spot” of positive acceleration, the West coast is a “cold-spot” of negative accelerations. As the sea levels oscillate in space and time, it is no surprise that “hot-spots” of positive acceleration in some areas – recently the East Coast of North America – are coupled to “cold-spots” of negative acceleration – over the same time window the West Coast of North

America.

6. Relative sea levels in the correct time perspective

As the climate indices are very well known to oscillate with a quasi-60 years periodicity (Schlesinger and Ramankutty, 1994), and the sea levels also oscillating worldwide with a quasi-60 years periodicity of different amplitudes and phases from one tide gauge to the other (Chambers et al., 2012; Baker and McGowan, 2015; Scafetta, 2014), tide gauge records of length less than 60 years overestimate or underestimate the relative rate of rise (Parker et al., 2013; Parker, 2014a).

By considering only the tide gauges where 60 years of data were already collected worldwide at the start of the satellite altimeter era, these 100 tide gauges have a naïve averaged relative sea level rise of +0.23 mm/year with maximum of +6.75 mm/year and minimum of −8.06 mm/year. In the same long term 100 tide

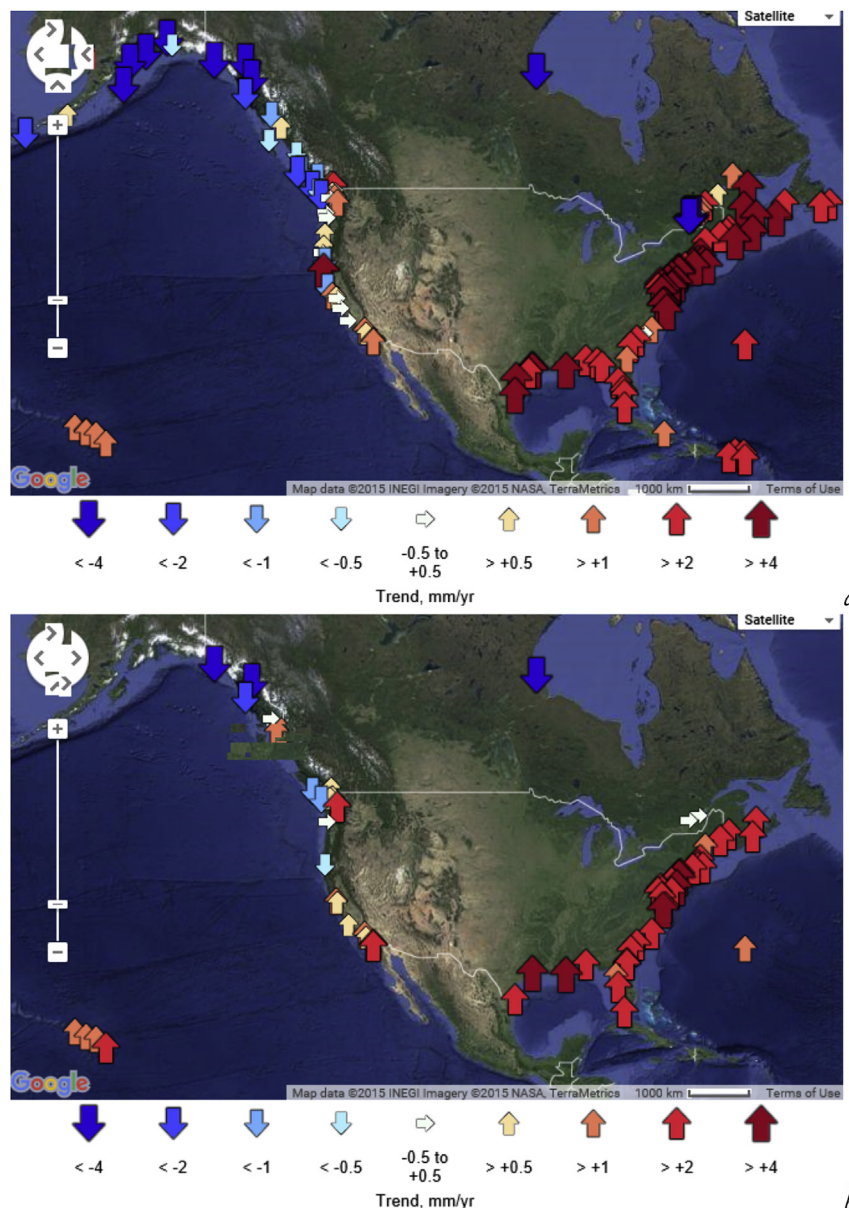


Fig. 3. a, b) measured relative sea level rise trends over the time window 1984–2013 and 1934–2013, images from (PSMSL, 2015). With short time windows, as for example the 30 years of figure a, the rate of relative sea level rise may be overestimated or underestimated. The temporary oscillations above or below the instrument subsidence rate are the result of the multi-decadal oscillations. There are no hot spot of positive sea level acceleration as there are no cold spot of sea level decelerations. Only the sea levels oscillate.

gauges, the relative sea level rises have been stable since the start of the satellite altimeter era. No acceleration has been detected so far at the tide gauges.

Considering only the tide gauges where 60 years of data were already collected in 2014, these 170 tide gauges (Table 1) have a naïve averaged relative sea level rise of +0.25 mm/year with maximum of +9.06 mm/year and minimum of –13.25 mm/year. Differences between the 2014 and 2015 surveys are minimal, and the difference is eventually negative, that is rates of rise are possibly decreasing rather than increasing.

Every single tide gauge and the global the naïve average show the sea level is stable. The relative rates of rise at the individual tide gauges satisfying the minimum length requirements haven't changed from one update to the next over the last few decades. On average the relative rate of rise is small, and the relative rate of rise is not changing.

The GPS information adds nothing to the result of Table 1. Most of the tide gauges are possibly subject to extra subsidence compared to inland GPS domes due to local factors such as land compaction. The very inaccurate GPS measure of the vertical tide gauge velocity only confuses a result that otherwise is very clear. If the average relative sea level rate of rise of a compilation of tide gauges of sufficient quality and length is a small number, and if this result does not change from one update to the other, it means that the effect of global warming on sea levels is negligible.

7. Global absolute mean sea levels

The slow, steady rise in sea level shown by tide gauge is in striking conflict with the claim that the absolute sea level is rising at a rate of +3.2 mm/year (CU sea level research group, 2015). This rate of rise contrasts not only with the results of the tide gauges but also with the actual raw signal of the altimeter.

What is actually measured is a noisy signal with a zero slope trend line. It is only after corrections and adjustments that the result has a significant slope. The graph of the raw satellite trends from the Topex/Poseidon satellite up to 2000 of (Nils-Axel Mörner, 2004) does not show any sea level rise, but a constant noisy signal from 1993 to 1996, plus rises and falls from 1997 to 1999, probably related to the 1997–98 El Niño event. As shown by (Menard, 2000), the GMSL changes from Topex/Poseidon satellite observations cycle 11 (October 1992) to cycle 276 (April 2000) suggest a rising trend of +1.0 mm/year only after a first round of corrections. The linear fitting approach was overrating the ENSO event in cycles 175–200 biasing the rising trend upwards. If the 1997 ENSO peak is regarded as a separate event superimposed on the long-term trend, the GMSL was actually stable over the first 5 years of the record and possibly over the whole period covered (Nils-Axel Mörner, 2004). After another round of calibration in 2003 (AVISO, 2003), the processed satellite altimeter GMSL record from Topex/Poseidon and Jason suddenly showed a new trend of +2.3 mm/year, with the original records presented by (Menard, 2000) tilted by a factor of +2.3 mm/year.

The fact that the satellite altimeter signal does not show any slope is implicitly admitted in the criticism of (Nils-Axel Mörner, 2004) by (Nerem et al., 2007), where the authors agreed that the original satellite data did not show a sea level rise, but they claimed that their adjusted data was the only result to consider. But this result is merely a computation and not a measurement. The author of (Nils-Axel Mörner, 2008) correctly suggests that the unadjusted satellite altimeter trends of roughly zero slope is the actual instrumental record. The +3.2 mm/year trend of the adjusted GMSL product is only a computation.

Fig. 4 presents the results of the CU sea level research group of 1998. Top on the left are the basin averages of the Mean Sea Level

(MSL) height in the northern and southern Pacific, Atlantic, and Indian Oceans. Top on the right are the global and hemispheric MSL. The thin solid lines represent the TOPEX/Poseidon computed result after applying a correction to the raw satellite signal. The thick solid lines are the steric model predictions. The MSL was stable and not rising at a rate of 3.2 mm/year as shown in (Parker, 2014b). The images are reproduced from (Chen et al., 2000). In addition to the Topex and Jason series of satellite radar altimeters, data were also provided by the Envisat mission. In this case, the untampered results, not showing the desired sea level rise, were replaced by 'corrected' results. As shown in Fig. 2, until August 4, 2011 the European Space Agency's Envisat satellite was showing less than +0.976 mm/year sea level rise since 2004 (image stored in (<http://web.archive.org/we, 2011>)). A few months later, thanks entirely to further corrections, the same data set showed +2.97 mm/year of sea level rise (image stored in (<http://web.archive.org/we, 2013>)) and shortly afterwards the uncooperative satellite mission was "terminated".

The GRACE satellite recorded gravimetry between 2003 and 2008 and showed changes in the ocean mass which approximate a negative trend in sea level of –0.12 mm/year. This was transformed by a round of corrections to +1.9 mm/year (Cazenave et al., 2009). As the satellite altimeter or gravimeter records are very severely affected by corrections, the records are no longer considered as being reliable but unreliable. The adjusted satellite altimeter record should therefore be back-tilted to its uncorrected original trend (Mörner, 2011), and when this is done it shows variability around a stable zero trend line. The arbitrary correction from a –0.12 to a 1.9 mm/year is further discussed in (Parker, 2015).

8. Tilting back the absolute global mean sea level

As the latest trend table of PSMSL (PSMSL, 2015) returns an average relative rate of rise of sea levels of +0.25 mm/year when only the 170 long-term tide gauges are considered, we may back-tilt the latest GMSL (CU sea level research group, 2015) to this trend to have a likely pattern of GMSL. Bearing in mind the relative rates of rise in the individual tide gauges haven't changed from one update to the next over the last few decades, the actual GMSL rate of rise should not be far from zero.

Fig. 5 presents the map of the regional trends for the GMSL computations from (Parker, 2014b), the GMSL computations of (Parker, 2014b) for the Gulf of Mexico and the Gulf of Alaska, plus the tilted, untilted and likely global mean sea level. Some differences in the trend are clear, but there are only slow rising or very high rising seas. East and West coast of North America the sea levels are rising about the same.

The tilted results are the GMSL computations of (Parker, 2014b) which suffer from arbitrary corrections. As what was actually measured until the year 2000 was a noisy signal with a slope trend line about zero (Nils-Axel Mörner, 2004; Nils-Axel Mörner, 2008), the untilted result is the same distribution as (Parker, 2014b) back-tilted to a zero trend line. As the tide gauge result should be used to validate the procedure, the most likely GMSL is obtained by tilting the distribution of (Parker, 2014b) to a 0.24 mm/year trend line. The only reason different groups are able to compute the same GMSL rate of rise is simply that these groups are not independent. The computational algorithms and assumptions are basically the same for every group.

9. Ocean and coastal management implications

The global warming story is that an increase in the global mean sea level over the last century results from increasing greenhouse gas concentrations in the atmosphere. These rising global sea levels

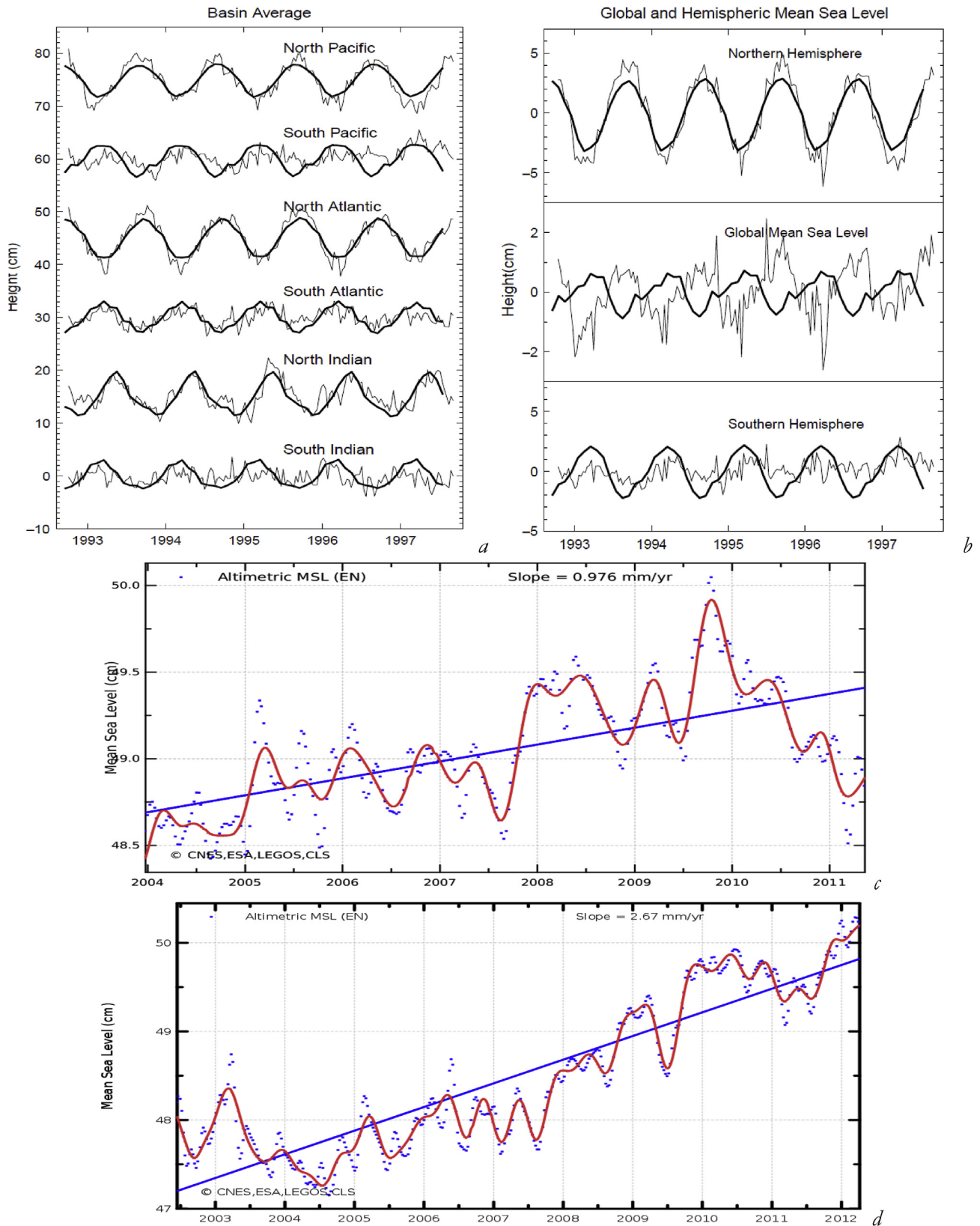


Fig. 4. a, b) results of the CU sea level research group of 1998. Left: Basin averages of MSL height in the northern and southern Pacific, Atlantic, and Indian Oceans. Right: global and hemispheric MSL. The thin solid lines represent the TOPEX/Poseidon computations while the thick solid lines are the steric model predictions. The MSL was stable and not rising at a rate of 3.2 mm/year as presently shown. Images from (<http://web.archive.org/we, 2013>). c, d) Envisat GMSL results before and after the August 4, 2011 correction tilting a +0.976 mm/year sea level rise (top, image stored in (<http://web.archive.org/we, 2011>)) to a +2.97 mm/year sea level rise (bottom, image stored in (<http://web.archive.org/we, 2013>)). Abrupt changes of past representations that suddenly disappear from the public domain are unfortunately the norm more than the exception.

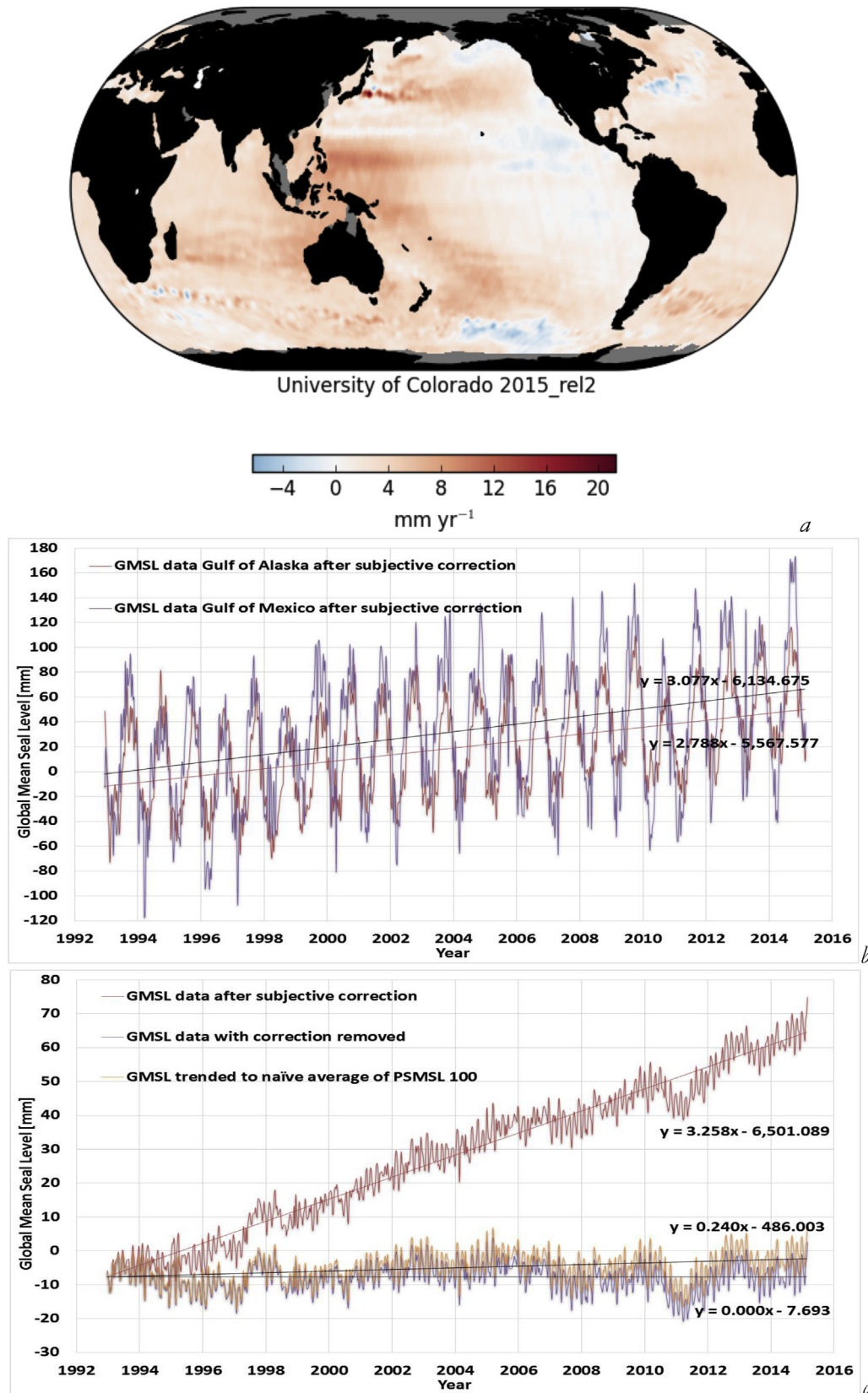


Fig. 5. a) computed regional GMSL trends. Image from (Parker, 2014b). b) Gulf of Alaska and Gulf of Mexico computed trends. Data from (Parker, 2014b). c) computed GMSL from (Parker, 2014b), untilted and likely global mean sea level. Globally the computed sea levels are generally rising. In the Gulf of Alaska, the computations suggest a +2.79 mm/year sea level rise about same of the +3.08 of the Gulf of Mexico. In the Gulf of Alaska the sea levels are sharply falling at an increasing rate. The results clearly suffer of a generalised tilting towards high rates of rise. The computations of (Parker, 2014b) suffer of arbitrary corrections. As what was actually measured until the year 2000 was a noisy signal with about zero slope trend line (Nils-Axel Mörner, 2004; Nils-Axel Mörner, 2008), the untilted result is same distribution of (Parker, 2014b) back-tilted to a zero trend line. As the tide gauge result should be used to validate the procedure, the most likely GMSL is however obtained by tilting the distribution of (Parker, 2014b) to a 0.24 mm/year trend line.

increase the risk to coastal communities from inundation and erosion and this drives today's coastal management policies. However, the actual measurements do not support this story so coastal management policies should be focused on real local threats. This is very difficult to achieve as politics over-rides science in climate-related subjects.

There are two related measures of sea level, the absolute sea level, which is the increase in the sea level in an absolute reference frame, and relative sea level, which is the increase in sea level recorded by tide gauges. The first measure is a rather abstract computation, far from being reliable, and is preferred by activists and politicians for no scientific reason. For local and global problems it is better to use local tide gauge data.

The implementation of good responses to coastal problems is full of political and economic hurdles. In Australia most State Governments prescribe state-wide sea level rise projections for use by councils. Only the councils of NSW were recently permitted the flexibility to determine their own sea level rise projections to suit their local conditions. Coastal alarm is too much based on projections of the IPCC. These projections are made even worse by Australian Government organisations as CSIRO and BoM.

In response to new planning regulations based entirely on flawed computer model projections as (Whitehead & Associates, 2014) (Carter et al., 2014), recommended three key policy guidelines for application by councils and other public bodies responsible for sea level rise related coastal hazard. These guidelines rejection of “let's stop global sea level rise” policies, recognition of the local or regional nature of the sea level rise and use of flexible and adaptive planning controls. These guidelines apply not just to the NSW shoreline, but also to shorelines anywhere else in the world.

As R. S. Pindyck wrote in his US National Bureau of Economic Research working paper 19244 of July 2013, what the climate models tell us is very little. “*The models have crucial flaws that make them close to useless as tools for policy analysis*”. “*The models' descriptions of the impact of climate change are completely ad hoc, with no theoretical or empirical foundation*”. As the first signs the sea levels will rise catastrophically within few years are nowhere to be seen, people should start really thinking about the warnings not to demolish everything for a case nobody knows will indeed happen.

10. Conclusions

This analysis shows that the global network of tide gauges provide the best available measurement of the sea levels while the additional or substitutional information provided by GPS or satellite altimeter is of little help. The work is based on all the tide gauges included in the PSMSL surveys. The satellite altimeter GMSL models have crucial flaws that make them close to useless. These findings are important for coastal management.

The tide gauge results of sufficient quality and length permit the computation of local relative rates of rise or fall of sea level. The absence of acceleration in the naïve averaging of the tide gauges in the network and every local tide gauge indicate these rates are stable. Local planning should be locally based on these local rates and not on unrealistic computations.

Appendix A. Supplementary data

Supplementary data related to this article can be found at <http://dx.doi.org/10.1016/j.ocecoaman.2016.02.005>.

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