

UNDERSTANDING SEA LEVEL RISE AND VARIABILITY

by Tony Sturges

As most of you will recognize, I have not been a contributor to this corner of science for some years; I have been off in another corner doing other things. And so, I have been asked to make some informal remarks from the point of view of an interested but outside observer. And since I have been on the outside for some years I may say some things that are very naive and if I do, I hope you will accept my apologies.

It is very nice to attend a meeting like this. You know, usually when we go to meetings there are lots of people who do what we do and so it is a very concentrated dose of what we already do. Whereas at a meeting like this, you have the opportunity to go to all the sessions rather than just your own field and in that sense this meeting is very stimulating. And I have enjoyed it very much.

One of the things that has not happened so far is that the competitiveness does not seem to have come out. Everybody is still hugging and kissing and the geodesists are suggesting that we need more tide gauges. In their recommendations, I think it was yesterday, I don't remember if they actually said that they wanted a GPS receiver at each tide gauge but I assume they meant that. I was trying to remember if they actually said that they thought that these instruments should come out of their budget. I don't remember that line. But there are certainly some very nice results such as the greatly improved the precision of the vertical motions at a tide gauge from the GPS receivers. The results are much more encouraging than I had expected and they will give us considerably improved horizontal resolutions in the GIA correction. That is very encouraging.

One of the things that I have noticed is that in many places – certainly in the United States -- there is a great deal of extraction of fluid out of the ground - petroleum or water, and as you know in many places the local ground has subsided by several meters. And then, somebody realizes that there is a problem and so they pump something else back down in the hole and bring it all back up again. Sometimes it's sea water, sometimes it's waste water. But it is motions of meters of the local ground that's a direct effect of this pumping. And I'm not sure that we have adequate records of that. And if you want to compare what you think you're seeing in a tide gauge and there is this huge unexplained vertical motion it can be a serious analysis problem. It's a question. This is what I would call a primary example of metadata. That it's really, really important in terms of what the accuracy of the numbers are, but I'm not aware that we have those data.

I was encouraged by a genuine breadth of coverage today; One of the things that we see is a sort of a split into two camps. You know there is science "over here" in this camp and yet we are talking to politicians over here in this other camp, because of very serious things like "will there be follow on missions for satellite altimeters"? And I'm sure we all agree that if you want to put a politician to sleep you start talking about global mean sea level. If I'm a politician from New York I care a very great deal whether New York City is going to be flooded. Local mean relative sea level is important. And you can sell that. You can sell patterns that change. I mean there is a lot of stuff that we are doing that is very relevant to what politicians respond to. But global mean sea level rise is probably the least interesting thing of all. I apologize for that but I'm afraid it's true.

Another thing along those same lines is that people here have said “we really want to do this but that’s too expensive”. I think any time you feel obliged to say that you should scratch that out of your talk or you should scratch that out of your vocabulary. We just use the wrong unit of measurement. You know, a modern fighter plane costs 20 million dollars **or more**. And they are expendable. And I think, certainly, cost is always a factor, but we need to decide what is important to do. It is our job to tell the politicians what is scientifically important, not what we think is inexpensive, and we shirk our responsibilities as keepers of the public trust when we forget that.

Now, this is a very obvious comment but I suspect you’ll all agree with me. We’ve all thought that our canary for global warming was the Arctic. And the other day we saw some maps from Suzuki from a slightly higher resolution model and suddenly the warm band round the top turned blue and I think we are all agreed, and I certainly want to understand, why that happened. It’s hard to understand why a slightly improved resolution could do that.

Another comment I’d like to make that’s more of a question. We see different maps that show different things and the warming scenarios in the Caribbean and for the Gulf of Mexico there’s almost no data on some of the maps for nudging the models. I’m not sure whether it was Dean Roemmick’s map. Because the Argo system didn’t have much there. And this is a problem not with the data source but with the funding as different funding agencies have funded different regions. And so I would assume that closing those data holes is not too terribly difficult of a problem to solve.

And this is a plea, with a great apology, but still it’s a plea. What I ~~do~~ usually study is very, very long records, very low frequencies, and we’re painfully aware that the records aren’t long enough. That the spectra are red. And so, if I were to submit a proposal that had a reasonably short record and straight line through it, and I claimed that the slope of the line was significant, that would be suicidal, because most of the people who do what I do want to see, not a correlation, because all slopes are correlated, but a coherence plot. Because if you can separate out different physical mechanisms at different frequencies, you might have some idea what’s causing it. And so, with apologies I would like very much for all of the correlations, that have been shown with a nice number like 0.8 or something, to please erase those, go back and do a coherence calculation and then we can have some better understanding of what it might mean.

Now I want to go further out on a limb and talk about something that you probably will think I’ve taken leave of my senses, but many years ago, a couple of decades or more, there was a programme called Ocean Thermal Energy Conversion (OTEC)¹, and it was just an engineering nightmare but the idea was to use the vertical temperature distribution in the ocean to drive a Carnot cycle. And, in principle, it’s simple. It’s just an engineering problem. Now, it was sold, or tried to be sold on the idea of extracting power from the ocean. Back then oil was very cheap, now oil is not cheap. But there’s another aspect to that now and that is that you’re “using” the warm layer on the top of the ocean, it would be interesting to ask “how many OTEC plants would it require to make a reduction in the apparent global warming of the sea surface layer? Actually these Carnot cycles use the heat energy of the surface. Can we use these OTEC plants to reduce the surface temperature of the ocean? Because if you could, then you have two reasons for extracting power from the ocean, and that might even be very useful. And if sea-surface warming is a significant fraction of global warming we might be able to fix that. I’m not saying you can, but it’s possible. You certainly can’t get glacial rebound out, (well I don’t know how), but extracting some heat out of the ocean could be possible. Thank you very much.

1. Note added in proof. We are told that two OTEC plants are now under contract to be constructed in Hawaii.