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Commentary

Comment on "Sea-level trend analysis for coastal management" by A. Parker, M. Saad Saleem and M. Lawson

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ABSTRACT

A key conclusion of the article 'Sea-Level Trend Analysis for Coastal Management' (Parker et al., 2013) is that:

Coastal management should consider sea level rises much smaller than those based on modelling activities presently considered in Australia as well as in the other parts of the world at least for the next 30 years. The projections by the relevant state bodies should therefore be revised considering lower bounds to future sea level scenarios the continuation of the trend measured up to the present point.

Apart from the fact that the second sentence barely makes any sense, the authors provide nothing to support their claim that the models are incorrect; in fact most of what they say about models is demonstrably wrong. The two most obvious errors relating to models are indicated here.

1. Introduction

The article 'Sea-Level Trend Analysis for Coastal Management' (Parker et al., 2013) suggests that projections of sea-level rise may be made using a rudimentary form of curve-fitting and extrapolation, while at the same time dismissing, with no sound justification, the conventional models that are normally used to project sea-level rise during this century. Virtually everything they say about model projections is incorrect. The following sections describe two examples in which the authors display a remarkable lack of knowledge of these models.

2. The 'exponential growth' claim

In the abstract, the authors state that 'it is claimed that the sea levels are rising following an exponential growth since the 1990s', 'it is shown here that the exponential growth claim is not supported by any measurement of enough length and quality when properly analysed' and 'the tide gauge results do not support the exponential growth theory'. In the Introduction, they say that 'sea levels are supposed to follow over the period 1990 to 2100 an exponential curve'. They support these claims with Equation (1), which shows sea level (y) increasing as an exponential function of time (x), with y_0, R_0 (and, presumably, A, although they don't define it) being constants:

$$y = y_0 + Ae^{R_0 x} \tag{1}$$

Under 'Linear Fitting of Tide Gauge Data' they refer to 'the claimed exponential growth of global sea level linked to the anthropogenic carbon dioxide emissions'. These statements are made with absolutely no supporting references, are wrong, and are no more than straw men. The only projections actually given are the 'three scenarios developed by CSIRO for sea level rise between 2030 and 2100 (relative to 1990)', which are shown in their Table 1. The first two of these ('Scenario 1' and 'Scenario 2') come from the climate-model projections reported by the Intergovernmental Panel on Climate Change (IPCC) in their Third and Fourth Assessment Reports (TAR and AR4; Church et al., 2001; Meehl et al., 2007). The third scenario ('Scenario 3') comes from a consideration of modelling carried out since the AR4. Contrary to the authors' claim, none of these scenarios involves any assumption about exponential growth. Each scenario involves four points in time (including the starting point of zero rise in 1990), and Equation (1) contains three constants. If a scenario was indeed exponential, then any three points from the scenario could be used to fit an exponential (as in Equation (1)) and the fourth point should necessarily fall on that curve. This is clearly not the case, as shown in Fig. 1, which contains a panel for each scenario. Each panel shows three exponential curves, which pass through the starting point at 1990 and through two other points; none of these curves passes through the fourth

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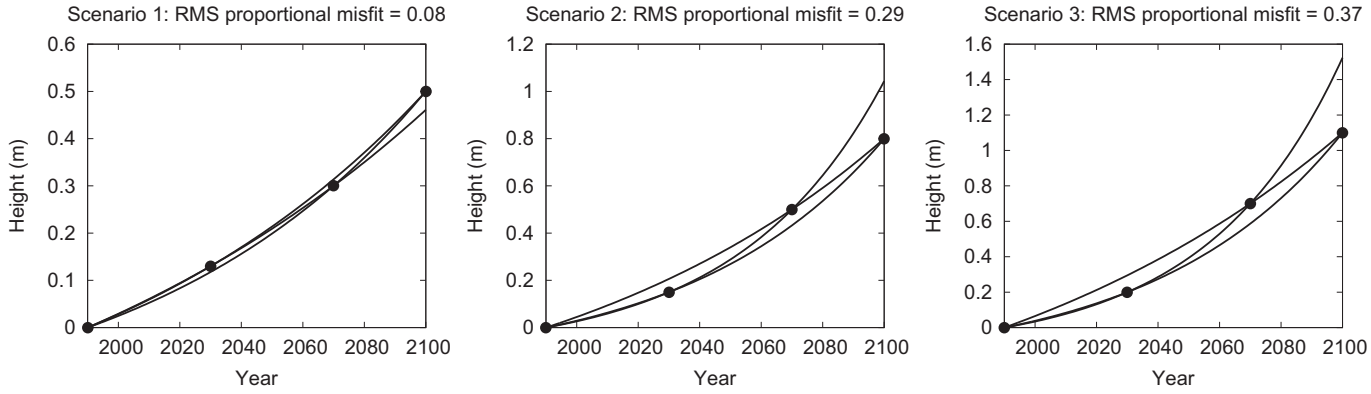

Fig. 1. Exponential fits through three of the four points in each of the projections defined by the three scenarios. For the definition of 'RMS proportional misfit', see text. It is clear that exponential curves cannot be fitted through all four points for any of the scenarios.

point, indicating that none of the scenarios are exponential. As an indication of the misfit of this fourth point, the root-mean-square value of the quantity $(y_{\text{scen}} - y_{\text{exp}})/y_{\text{scen}}$ (the 'RMS proportional misfit') is shown for each scenario, where y_{scen} is the value prescribed for that scenario, y_{exp} is the corresponding value from the exponential fit, and the average is taken over the fourth points of each of the three fitted curves. The RMS proportional misfits are in the range 0.08–0.37.

It would appear that the authors simple made up 'the exponential growth theory', in order to discredit it.

3. The claims about climate models

In the Introduction, the authors make the demonstrably inaccurate statement that 'the most popular models used to estimate the impacts of climate-change are based on very simplistic assumption', giving the example of the semi-empirical model of Rahmstorf (2007), and completely ignoring the complex atmosphere-ocean general circulation models (AOGCMs), and models of land ice, which together are used to generate the IPCC sea-level projections (Meehl et al., 2007). They then claim that the Rahmstorf model is represented by the simple relationship between sea-level rise and 'anthropogenic emission of carbon dioxide', given by:

$$\frac{\mathrm{dSLR}}{\mathrm{d}t} = \frac{\mathrm{dCO_{2-a}}}{\mathrm{d}t} \tag{2}$$

where SLR is the sea-level rise and $\mathrm{CO_{2-a}}$ is the 'anthropogenic emission of carbon dioxide'.

In fact, Rahmstorf (2007) gave two equations:

$$\frac{\mathrm{d}H}{\mathrm{d}t} = a(T - T_0) \tag{3}$$

and an integrated version of this equation.

Here, H is the global mean sea level, t is time, a is a proportionality constant, T is the global temperature, and T_0 is an equilibrium temperature value. In other words, the model of Rahmstorf (2007) relates sea-level rise to observations and projections of global-average temperature, and not to 'anthropogenic emission of carbon dioxide'. Rahmstorf (2007) doesn't even mention the words 'carbon dioxide'. Equation (2), like the authors' 'exponential growth theory' of Equation (1), is again something that they have just made up.

4. Summary

The authors' claims concerning the application of the first two equations in the article are plain wrong. They represent a gross misrepresentation of the models that are commonly used to project future sea level.

The problem with articles like this is that planners and policy makers may take seriously statements such as:

Coastal management should consider sea level rises much smaller than those based on modelling activities presently considered in Australia as well as in the other parts of the world at least for the next 30 years. The projections by the relevant state bodies should therefore be revised considering lower bounds to future sea level scenarios the continuation of the trend measured up to the present point.

Given the errors noted above, these statements represent quite dangerous and foolhardy advice.

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