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News - Basic research

How high is the sea in 2214?

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A new study shows that the sea can rise by 40 - 70 cm over the next 200 years.

Figure 1. Prediction of future sea level change by thermal expansion with natural radiation application.

Changes in the volume of seawater (thermal expansion / contraction) as a result of natural temperature variation can lead to a drop in sea level of 10 cm or a rise of 25 cm over the next 200 years.

If we also take into account the increase in greenhouse gases caused by the consumption of almost all the world's oil and gas over the next 200 years, the global temperature will rise by between 0.2 and 1.2 ° C. This will lead to sea level rise of between 40 and 70 cm over the next 200 years as a result of thermal expansion.

We have previously shown that today's sea level rise is due to thermal expansion of seawater as a result of temperature rises after the end of the Little Ice Age 150 years ago. We have thus laid a foundation for being able to make predictions of future sea level rise.

We will look at two possible scenarios:

1) The radiation application remains as it is now (constant scenario).
2) The radiation application continues in a downward trend symmetrically to the current increase (symmetrical scenario).

Figure 1 (above) shows how thermal expansion will change the sea level over the next 200 years, based on the method discussed here and the two scenarios for the radiation application. Over the next 200 years, the thermal expansion will lead to a change in sea level varying from a sea level drop of 10 cm to a sea level rise of 25 cm.

This prediction is based on natural radiation application. Climate drives related to the burning of fossil fuels will be in addition to the natural radiation exposure.

Figure 2 (below) shows three scenarios for how the world can supply the earth's population of 10.5 billion people (which is the expected population in 100 years) with a European energy level of 7 kW per capita.

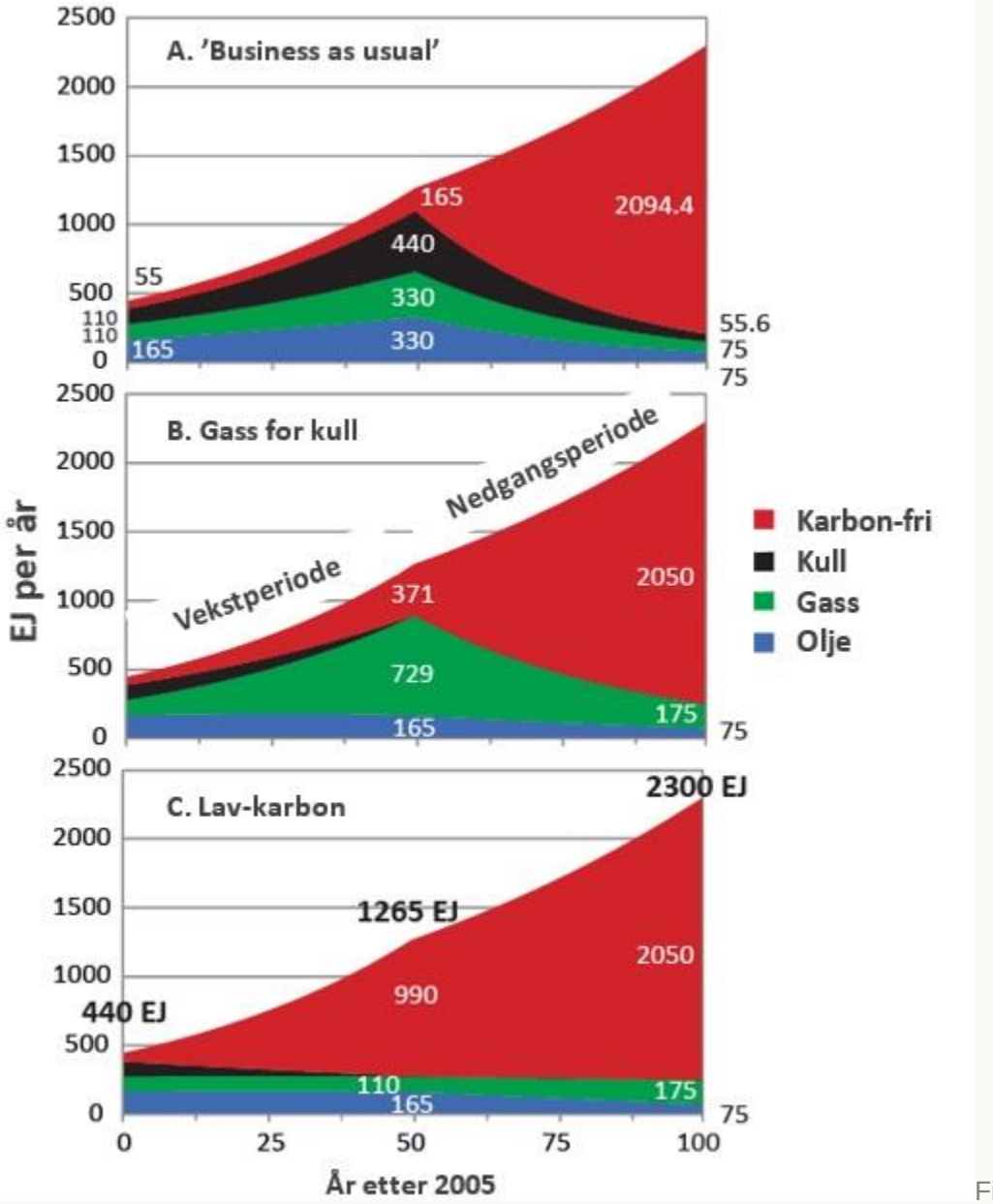

Figure 2. Three scenarios for global consumption of fossil fuels and of carbon-free fuels (red). In the 'business-as-usual' scenario, there is assumed to be exponential growth in fossil fuels for 50 years,

and then a decline. In the gas-for-coal scenario, coal is replaced with gas and new oil. In the low-carbon scenario, fossil fuels will be phased out over the next 50 years. The numbers show Exajoules (EJ = 10^{18} joules); the large numbers in the lower part of the figure show the total energy consumption. 2,300 EJ means that 10.5 billion people will be supplied with 7 kW p^{-1} . From Cathles (2012).

In the first scenario, business-as-usual, fossil fuel consumption is increasing exponentially as it is today, and is expected to continue to do so for the first 50 years before declining over the next 50 years. For the gas-for-coal scenario, coal is replaced with gas and new oil. In the third scenario, low-carbon sources will immediately replace coal, new oil and gas for the first 50 years, and gas will gradually replace oil for the next 50 years.

The total energy production is the same for all scenarios, and the total energy consumption is also the same after 100 years. The modest consumption of oil and gas after 100 years is assumed to continue throughout the 200-year period, which is our prediction period.

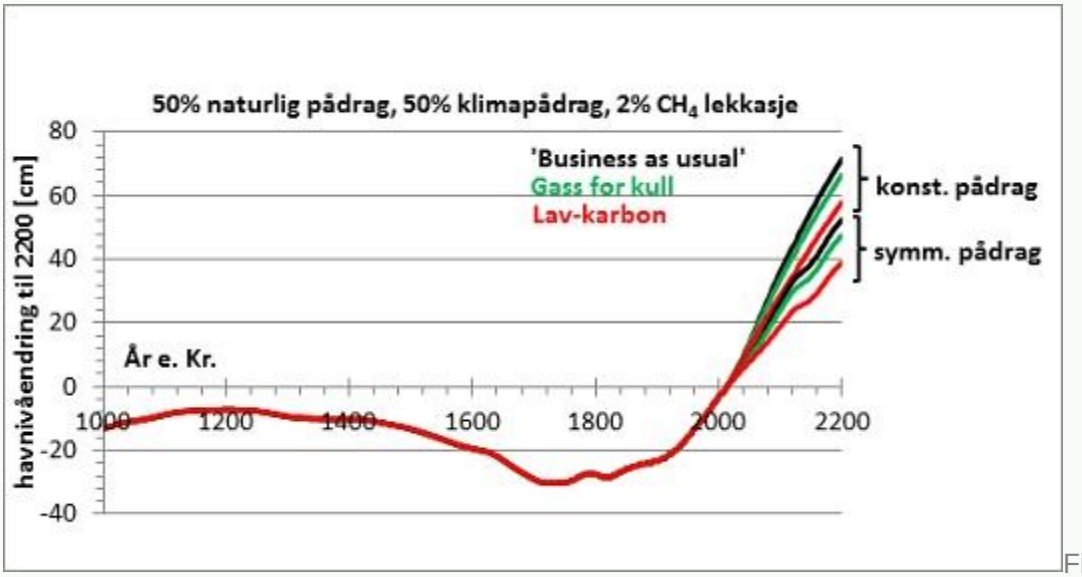

Figure 3. Prediction of sea level change by thermal expansion when climate action is in addition to natural (constant and symmetrical) radiation action.

Figure 3 shows sea level change during thermal expansion when heating by greenhouse gases is taken into account in addition to natural radiation exposure; in that we assume that they contribute equally to today's warming. We further assume that 2 percent of natural gas leaks into the atmosphere ('The United States Environmental Protection Agency' has estimated the total leakage in the United States to be 1.7 percent of energy consumption).

When the greenhouse gases are in addition to the natural radiation application, the temperature will rise by 0.2 to 1.2 ° C from the current level over the next 200 years, and the sea level will rise by between 40 and 70 cm with thermal expansion over the same period. Sea levels will continue to rise for the next 200 years as they have risen in the last century.

If the climate impact were to be 100 per cent, sea levels would rise by 130 cm over 200 years under the worst-case 'business-as-usual' scenario.

We have previously seen that in today's sea level rise there is no significant supply of meltwater in the oceans now . If there will be significant ice melting in Greenland and Antarctica in the future, this will be in addition to our predictions. Developments in temperature and sea level over the next few decades will improve these predictions.

Referanser

Cathles, L.M., 2012. Assessing the greenhouse impact of natural gas. Geochemistry, Geophysics, Geosystems, Volume 13, Issue 6, June 2012. doi:10.1029/2012GC004032.