Estimation of natural carbon sinks with a simple file

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English text corrected by Stephanie Hayes

Introduction

In the activity **"Introduction to the principals of climate modelling",** a first calculation was made according to the hypothesis: *all CO_2 emitted as a result of human activities stays in the atmosphere.* By manipulating the data and creating a graph, this is found not to be true, because CO_2 emitted as a result of human activities is absorbed by natural sinks. By estimating this absorption as a percentage of 55%, a good picture of it can be obtained graphically. However, in reality, this percentage varies each year.

Aims

To estimate the yearly natural absorption of CO_2 by using a simple spreadsheet file (calculs1.xls) and by manipulating gross values and percentages

Activity type: data manipulation and analysis

Prior knowledge required

Pupils should have carried out the activity "Introduction to the principles of climate modelling".

Cost: none

Materials

- Computer room: ideally, students work in groups of two.
- Excel or openOffice file (calculs1) download on www.carboschools.org. Or data can be found here: http://lgmacweb.env.uea.ac.uk/lequere/co2/carbon_budget.htm (you will find at this address all explanations for data, but they are also in the file).

Part 1

Here gross values are used to calculate how much human-emitted CO_2 is absorbed by the terrestrial biosphere and the oceans from year to year.

Procedure

1. Look at the data in your spreadsheet. Try to find a formula which will allow you to calculate the amount of CO_2 that is absorbed by vegetation and oceans each year in billion tons of carbon.

Your calculation should be:
*Total human-emitted CO_2 absorbed naturally in year **n** = total human-emitted CO_2 in year **n** – total human emitted CO_2 staying in the atmosphere in year **n**.*

In other words:
*Total human-emitted CO_2 absorbed naturally in year **n** =*
*(CO_2 emitted by fossil fuels **+** CO_2 emitted by land use) – (total CO_2 in atmosphere in year **n** – total CO_2 in atmosphere in year **n-1**).*

2. Now apply your formula in the spreadsheet to produce figures for column F. You should have the following :

B, D, E, F : column
n: year we calculate the absorption
n-1: year before

$F_n = D_n + E_n - (B_n - B_{n-1})$

CO_2 emitted by Human activities

CO_2 that stayed in the atmosphere

Microsoft Excel - calculs1.xls

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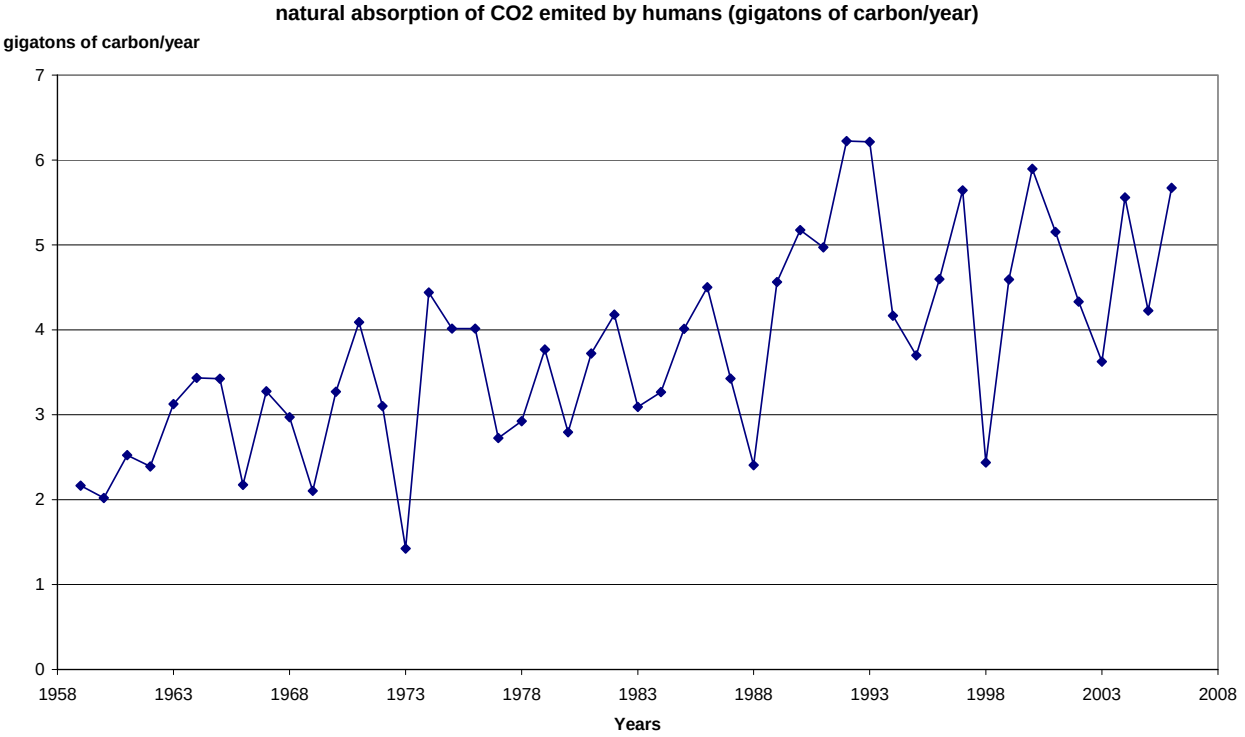
RACINE =D4+E4-(B4-B3)

	A	B	C	D	E	F
1						
2	years	amount of atmospheric CO2 measured (gigatons of carbon)	amount of atmospheric CO2 calculated (gigatons of carbon)	fuel emission (gigatons of carbon/year)	land use (gigatons of carbon/year)	Natural absorption (gigatons of carbon/year)
3	1958	672,05	672,05			
4	1959	673,76	675,92	2,47	1,40	=D4+E4-(B4-B3)
5	1960	675,70	679,88	2,57	1,39	2,020
6	1961	677,23	683,94	2,60	1,46	2,525
7	1962	679,00	688,10	2,70	1,46	2,390
8	1963	680,20	692,42	2,85	1,47	3,126
9	1964	681,26	696,92	3,01	1,49	3,434

calcul sources Feuil3

3. Use the new data to produce a graph showing the pattern of natural absorption of human-emitted CO_2.

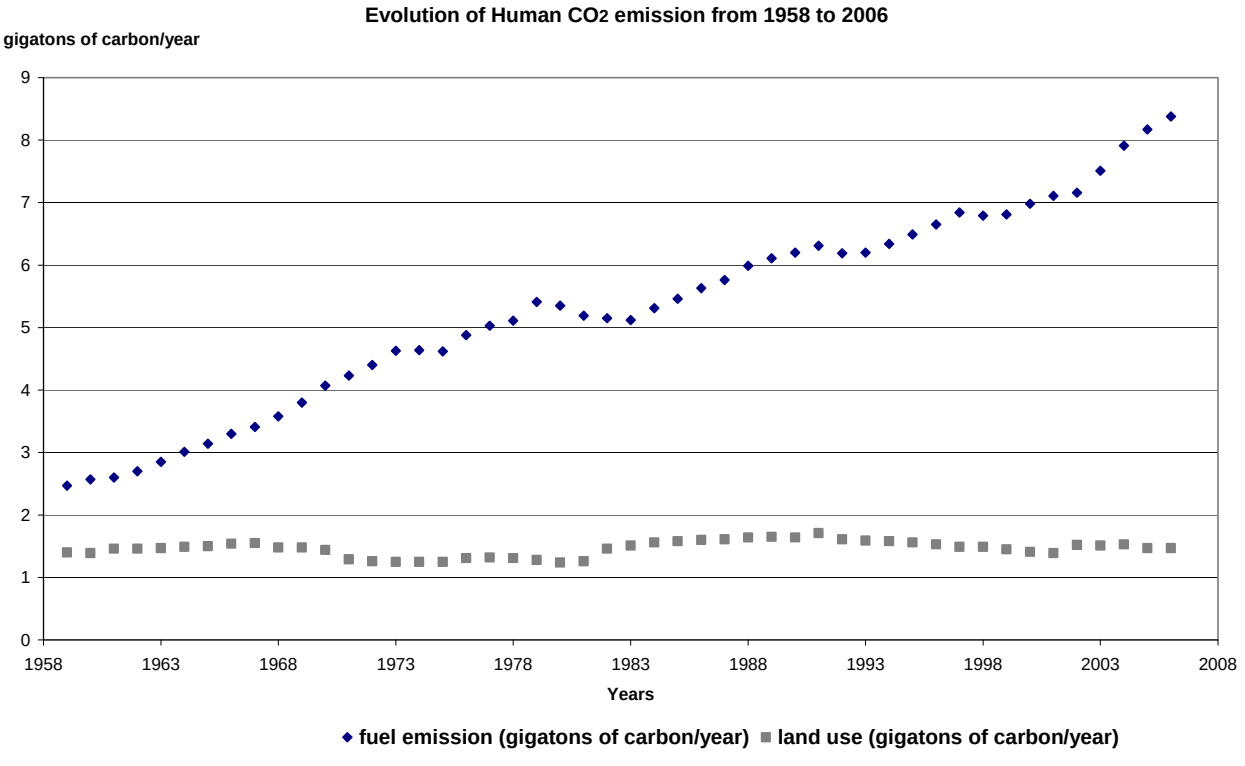


4. Describe what you see in your graph, what conclusions you can draw from it and suggest reasons.

Discussion

The line in the graph fluctuates, but never-the-less it is clearly rising. We can deduce from this that the phenomenon of natural absorption of human CO_2 emissions is irregular, but that it is increasing. The reason for this is that human CO_2 emissions are increasing.

Human emissions between 1959 and 2007



By just using gross values, it is difficult to see the efficiency of natural absorption each year in the graph, because we do not know how much total human-emitted CO_2 each point on the graph relates to. In other words, we cannot see what proportion of the total human CO_2 emissions that the vegetation and the ocean are absorbing each year.

Part 2

Using percentages in order to answer the question: Is natural absorption more or less efficient over the years?

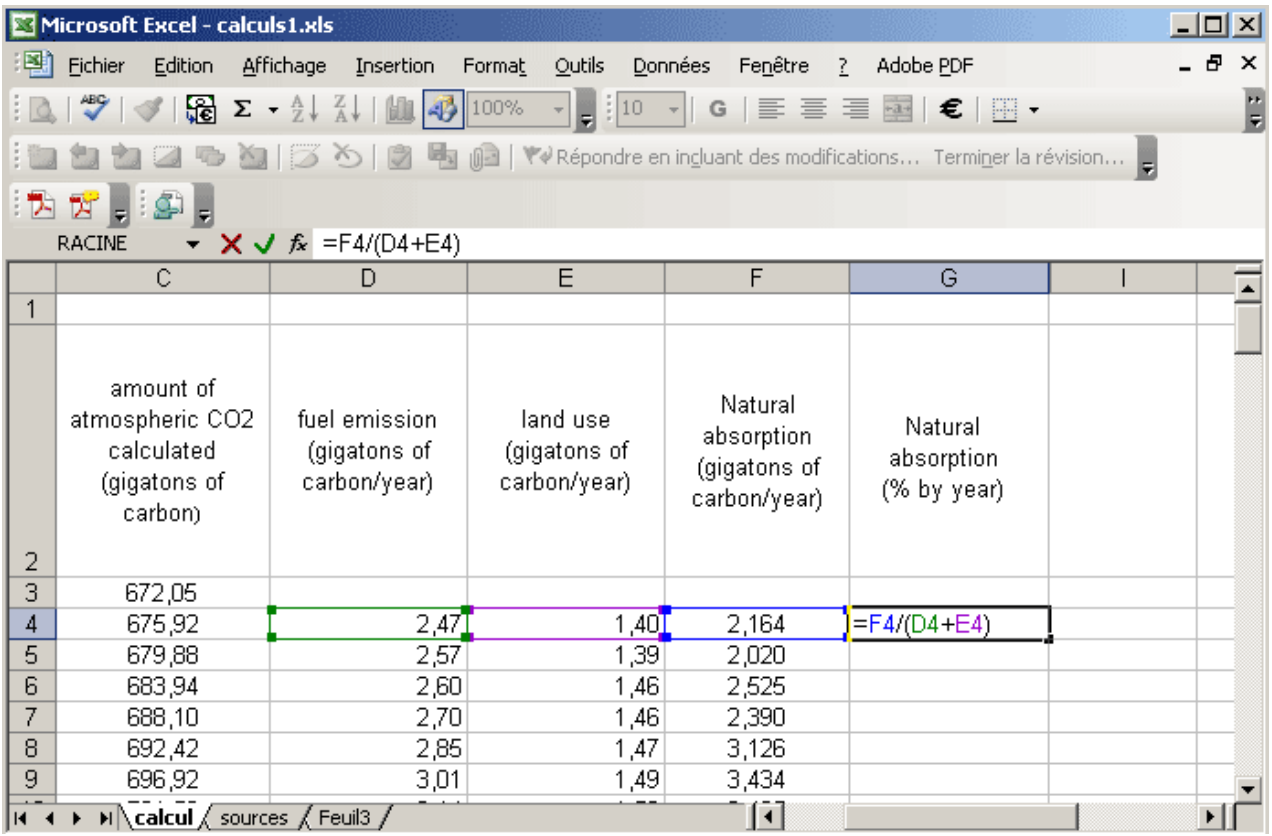
Procedure

1. Find a formula in order to calculate the percentage of human-emitted CO_2 that is absorbed each year.

Your formula should be:

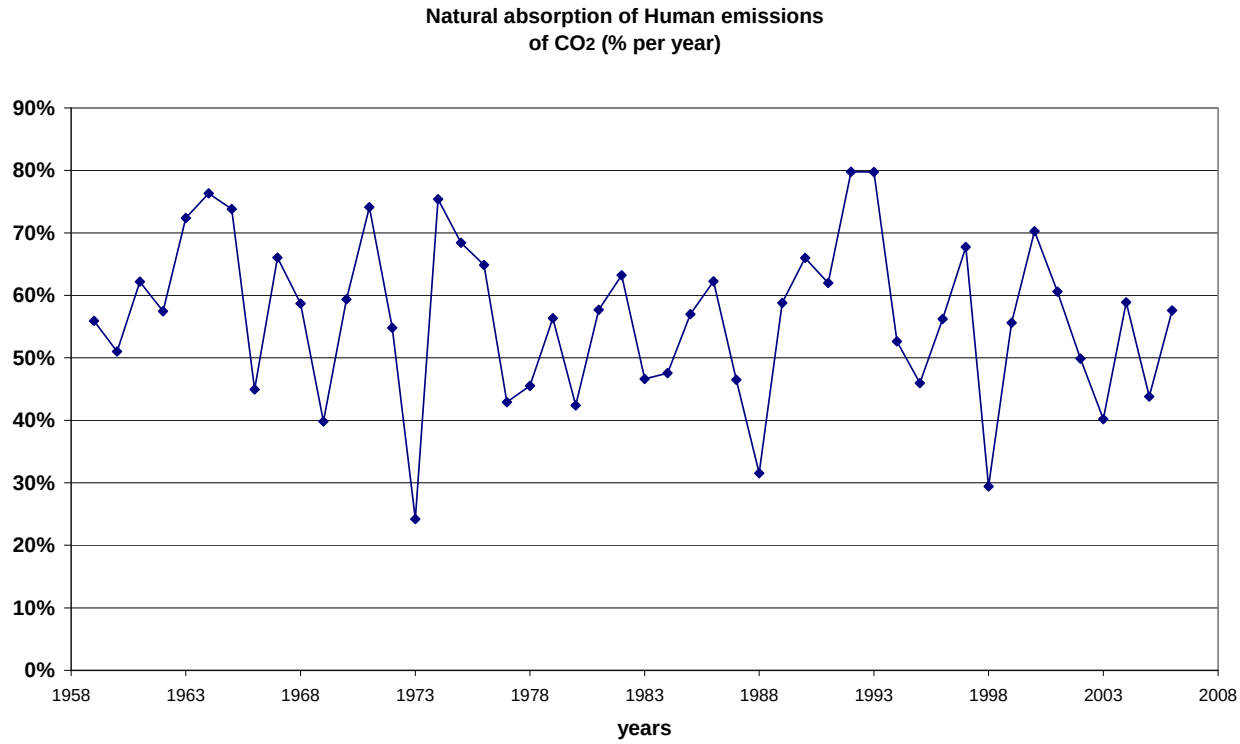
Percentage of human-emitted CO_2 that is absorbed naturally =
amount of human-emitted CO_2 that is absorbed naturally / amount of CO_2 emitted by human activities.

2. Now apply your formula to the data in the spreadsheet.

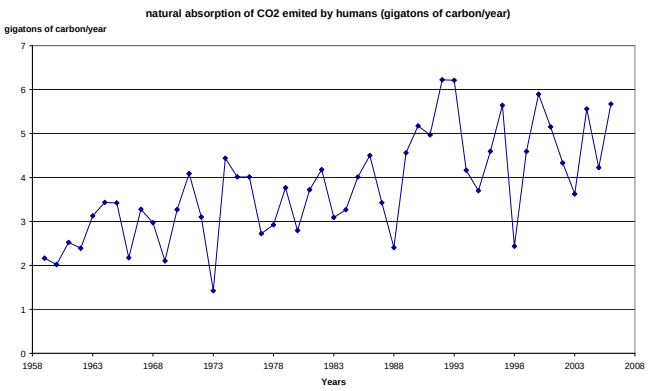


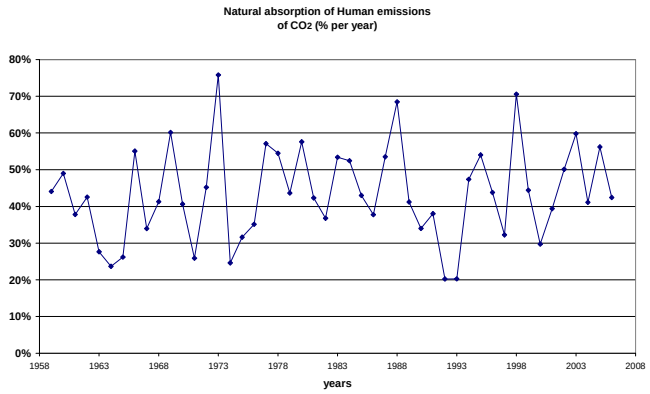
3. Using the new percentage data, create a graph to show the percentage of human-emitted CO_2 that is absorbed naturally each year.

And the graphic is:



4. Now compare your new graph with the first one. Can you explain any similarities and any differences between the two graphs?





Discussion

As in the first graph, the line in the percentages graph fluctuates from year to year. Therefore, we can still see that natural absorption is irregular over time. However, in contrast to the first graph, the line does not rise; it remains quite stable over time. Therefore, we can conclude that vegetation and oceans absorb more or less the same percentage of CO_2 over time, regardless of the amount of CO_2 in the atmosphere.

If we calculate the mean of these percentages we arrive back at our initial best fit percentage of 55% (see activity “Introduction to the principals of climate modelling”).

The question that we can ask ourselves is, will natural absorption levels remain stable as atmospheric CO_2 continues to increase as a result of human emissions?

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