Accounting for covariance in emissions' inventories

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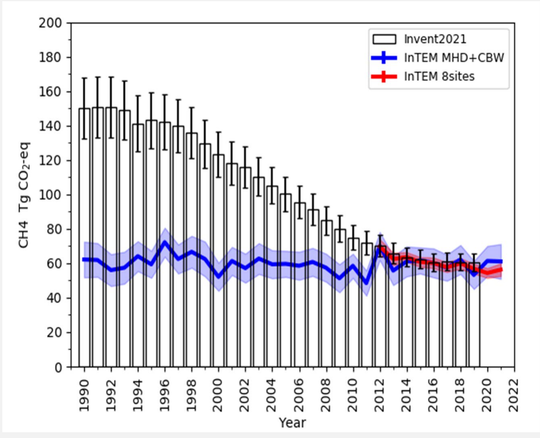
Global and UK emissions

Uncertainties highly relevant when estimating trends and accelerations

Key factor: influence of covariance



Heart of the matter

Approach in Kyoto Protocol expresses total emissions in terms of CO_2e (CO_2 equivalent')

Based on sum of contributions of form

$$\underbrace{\text{Global Warming Potential}}_{\text{GWP100}} \times \underbrace{\text{Activity}}_{A} \times \underbrace{\text{Emissions' factor}}_{F}$$

GWP100: factor converting emissions for a particular gas to CO_2e on 100 year basis

A: activity for a specific source category

F: emissions of a given pollutant from that category

Agriculture sector data from UK National Atmospheric Emissions Inventory

Activity rate data, emission factors with expanded uncertainties U (95 % conf.)

2 sets of 3 equal values of A implies commonality (correlation)

Also, should GWP factors be applied separately or collectively?

Fuel	Gas	A/(TJ)	$U(A)$/%	F/ktTJ^{-1}	$U(F)$/%
Gas oil	CO_2	0.020438	38.6	2.0438×10^{-2}	2.7
Gas oil	CH_4	0.020438	1.6	3.5368×10^{-6}	80.0
Gas oil	N_2O	0.020438	1.6	3.0984×10^{-6}	216.3
Petrol	CO_2	67.19	50.7	1.9127×10^{-2}	4.8654×10^{-5}
Petrol	CH_4	67.19	1.6	4.8654×10^{-5}	80.0
Petrol	N_2O	67.19	1.6	3.3578×10^{-7}	216.3

Including such factors independently ignores correlation

Model just involving CO2 emissions

Apply GUM (JCGM 100)

Gives emissions E = 4282 $ktCO_2e$

Assuming independence: relative standard uncertainty 19 %

Accounting for correlation: 24 %

Some 200 $ktCO_2e$ difference: meaningful

Account also for contributions from other GHGs

More details in recorded presentation

Recommendations

Always scrutinize origins of data: often challenging to source raw data from reputable sources

Look for commonalities, perceived correlations, . . .

Pay regard to involvement of single party or multiple parties

(As always in science) be transparent and state assumptions