

LULUCF – Denmark KP accounting

JRC technical workshop on the LULULCF issues under the Kyoto Protocol

The Danish 2010 GHG inventory submission

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- Election of 3.4 for FM, CM and GM
- Annual accounting
 - Documentation program
 - Satellite monitoring for land use classification (1990, 2005 and 2012)
 - New soil map for agricultural organic soils
 - EF for organic soils
 - Estimation of hedgerows
 - Resampling in the Danish agricultural soil network (sampled 1987, 1998 and 2009) for independent verification, 600 locations
 - Further documentation of our modeling approach, C-TOOL
 - Resampling of 114 soil forest plots (1987, 2009)
 - Base line for C in forest soils in the NFI, 450 plots (2009)
 - BEF for Conifers, Beech and Oak

- Not all data are available yet – therefore
 - Recalculation on most topics in 2011
 - Improved land use matrix – updated maps and improved QA/QC
 - Changes areas with ARD
 - New map for organic soils means
 - New estimate for organic soils
 - New emission factors
 - Changed emission from mineral soils
 - New BEF data
 - New forest stocks
- Annual accounting – recalculation of the base year

- ICR 2010

Denmark - five pins on LULUCF

- › **Two pins for inadequate reporting**
 - › **Missing emission estimates from mineral soils from land use change and organic soils in forest**
 - › **Just bad handcraft and QA/QC from me**

Denmark - five pins on LULUCF

› **One pin for litter accumulation in afforestation with conifers**

- › We started litter accumulation after year 1
- › The ERT suggested a broken stick with no accumulation in the first years
- › We resubmitted with no accumulation in the first 8 years
- › The ERT suggested no accumulation within the first 20 years
- › We resubmitted with no accumulation in the first 20 years
- › The ERT accepted that 8 years was enough
- › We have kept 20 years because of lack of time and may revise it in the next submission

› **One pin for drainage of forest soils**

- › The Danish forest policy means that drainage of wet soils has been reduced
- › The ERT didn't in the first run accept this and requested further documentation
- › The ERT has received this
- › No final conclusion on this yet

Denmark - five pins on LULUCF

- › **One pin for averaging of the base year for Cropland Management (CM)**
 - › We have submitted with a 5-years averaging of the base year (1988-1992) for CM to take into account interannual variability cf. 2003 IPCC GPG 4.2.3.7
 - › We are using a dynamic 3-pooled model (C-TOOL) for estimating C stock changes in soil with actual C input from all different crops, crop residues and animal manure
 - › When using such a model it is the Danish opinion that it is NOT possible to distinguish between the effect of climate and management. This is in contradiction to a Tier 2 model
 - › Therefore averaging of both climate and management took place
 - › The ERT has found that the model is very good and has recommended Denmark to continue to report emissions from agricultural soils with C-TOOL
 - › The ERT has NOT accepted that averaging of management can take place but only on climate
 - › So far have we accepted the position of the ERT and resubmitted with no averaging of the base year neither for the management nor for the climate

Tier 2 versus Tier 3

- Tier 2
 - Fixed factors for F_{LU} , F_{MG} and F_I
 - These factors are to a certain extent adequate for Danish conditions but difficult to translate and not complete
 - The Danish problem is
 - the major increase in input of OM to soils took place in 1990 due to a ban on field burning of crop residues which is the base year
 - There is 22 years from 1990 to 2012 and the default period of 20 years should then be increased for not to get into trouble
 - If you chose CM it is for good, so if you first have an increase in the input you have to continue to have an increased input if a new base year (fx 2005) is in your period
 - So - look carefully on when you have your changes in your input relation to the accounting rules

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Tier 2 versus Tier 3

- Tier 3
 - More precise?
 - Can take into account all crops
 - Danish input are roots, stubble, straw, animal manure, different types of grass, set-a-side
 - Actual temperature and degradation rates
 - Regional level
 - For convention reporting the best model should be used
 - If used for accounting purposes - do only use Tier 3 if you expect that your soils are in equilibrium or loosing carbon from the soil in the base year, not if you are gaining carbon in soils

Guidelines

- **3.3.1.2.1 METHODOLOGICAL ISSUES**

- For Tiers 1 and 2 methods, changes in dead organic matter and inorganic carbon should be assumed to be zero. If dead organic matter is included in a Tier 3 approach, measurements should be based on the lowest amounts present **during an annual cycle to avoid including fresh post-harvest residues that represent a transient organic matter pool.**
- Selection of the most suitable tier will depend on: 1) type and level of detail of activity data on agricultural management and changes in management over time, 2) availability of suitable information to estimate base C stocks and stock change and emission factors, 3) availability of dedicated national inventory systems designed for soils.
- **All countries should strive for improving inventory and reporting approaches by advancing to the highest tier possible given national circumstances.** It is *good practice* for countries to use a Tier 2 or Tier 3 approach if carbon emissions and removals in cropland remaining cropland is a key category

Guidelines

- **4.2.3.7 INTERANNUAL VARIABILITY**

- The annual rate of net carbon emissions or removals in an ecosystem is strongly influenced by local weather patterns, climate variability, management actions, natural disturbance variations and other factors **that alter growth and decomposition rates**. Consequently, the rate of net carbon emissions or removals in a given area may vary from year to year, and can shift between a net source and a net sink in successive years.
- There are two aspects to interannual variability, and they need to be addressed independently.
 - First, the national statistics **on the between-years variation in harvest rates**, land-use change, or natural disturbances such as the area burned, are usually available, and it is **good practice to include these in the calculation of carbon stock changes**.
 - Second, **the variations in growth and decomposition rates due to seasonal and annual variations in environmental conditions, such as moisture regimes, temperature, or growing season length are much more difficult to quantify**.
 - In addition to the carbon stock changes and non-CO₂ greenhouse gas emissions during the commitment period, the Kyoto Protocol also requires an estimate of carbon stock changes during the base year (1990 in most cases) for those elected activities for which net-net accounting applies (Table 4.1.1). **The impact of this estimate for a single year could be large because it will be compared against the estimates for each year in the commitment period in which this activity occurred. The effects of interannual variability in the base year could therefore be large. The direction of the impact depends on how the year 1990 deviated from the long-term climatic averages.** Moreover, it may be difficult to confirm the estimate for the base year using direct measurements, unless these were already taken in 1990. Where environmental conditions in the base year (e.g., 1990) caused major deviations in the carbon stock changes and non-CO₂ greenhouse gas emissions from their longer-term (e.g., 5-year) averages, **it is good practice to consistently report emissions using longer-term averages of environmental conditions or actual annual estimates of emissions when estimating stock changes** and non-CO₂ greenhouse gas emissions.

C input to agricultural soils

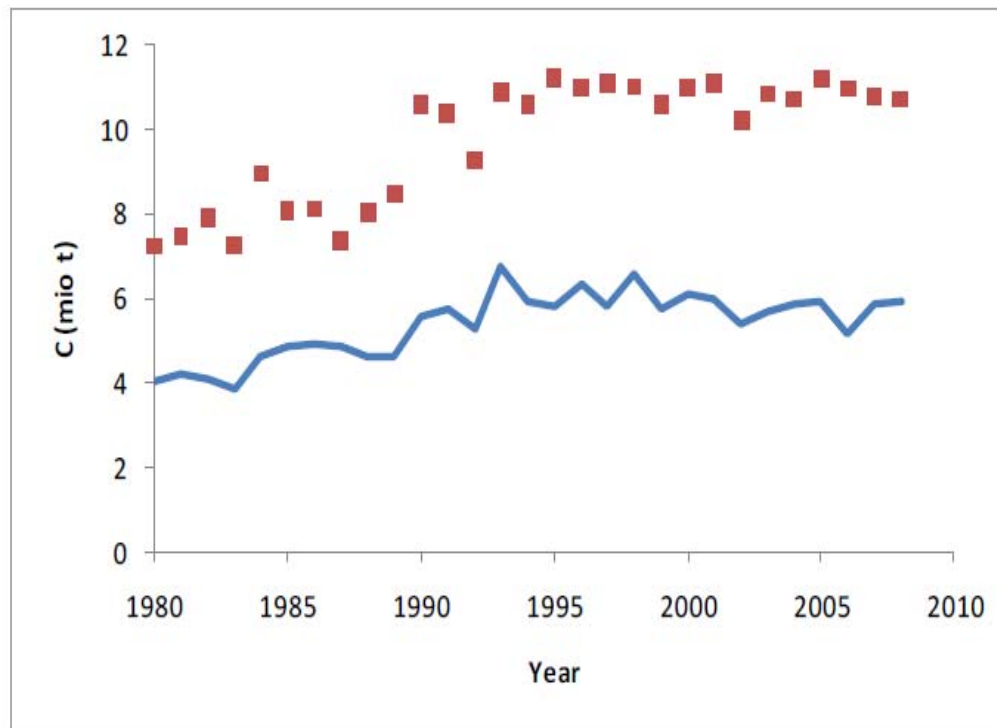
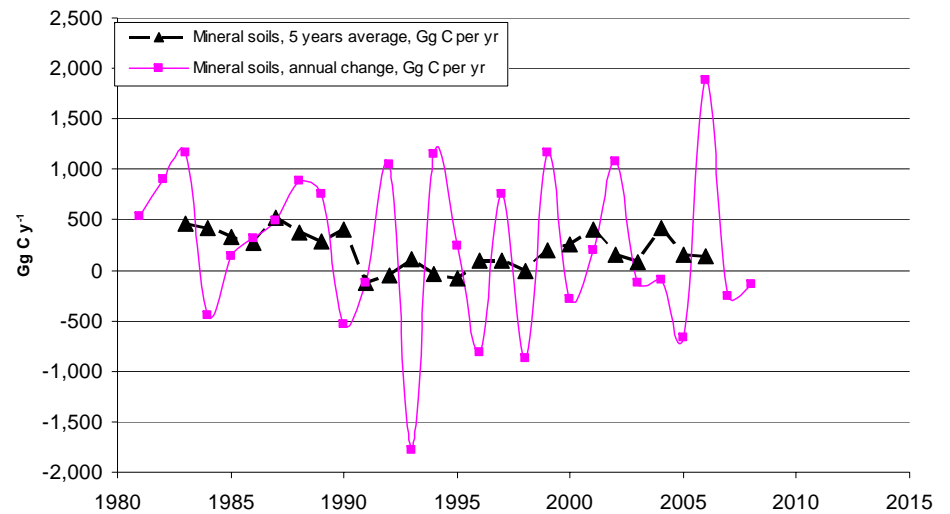
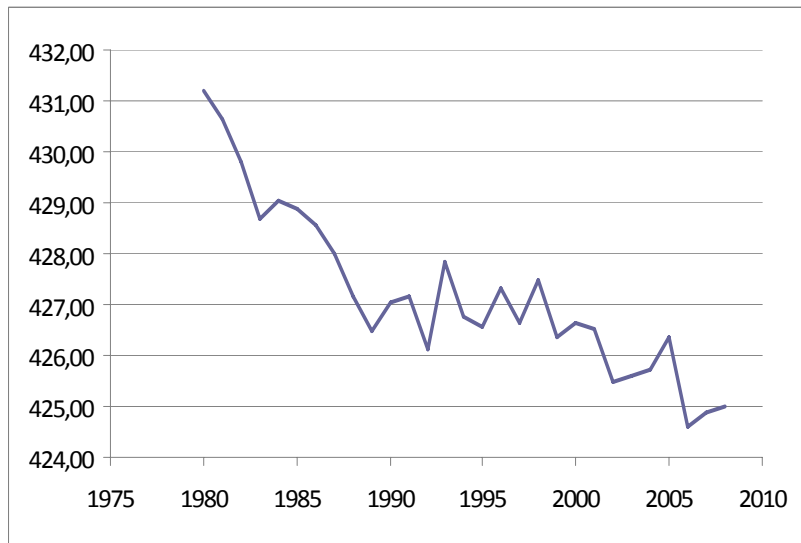


Figure 4. Calculated C input to the soil (red squares) and modelled (blue curve) development of the FOM pools.

Cropland – soil C – large fluctuations



Denmark and the ERT

- Denmark is using Tier 3
- The ERT has recommended Denmark to continue to use Tier 3
- Denmark says it is not possible to split management and climate when using highly sophisticated Tier 3 modeling and therefore 5 years averaging is good practice
- The ERT did not agree and is of the opinion that only climate can be averaged
- The ERT proposed three alternative methodologies and only using 1990 as base year

Different methods – different outcome

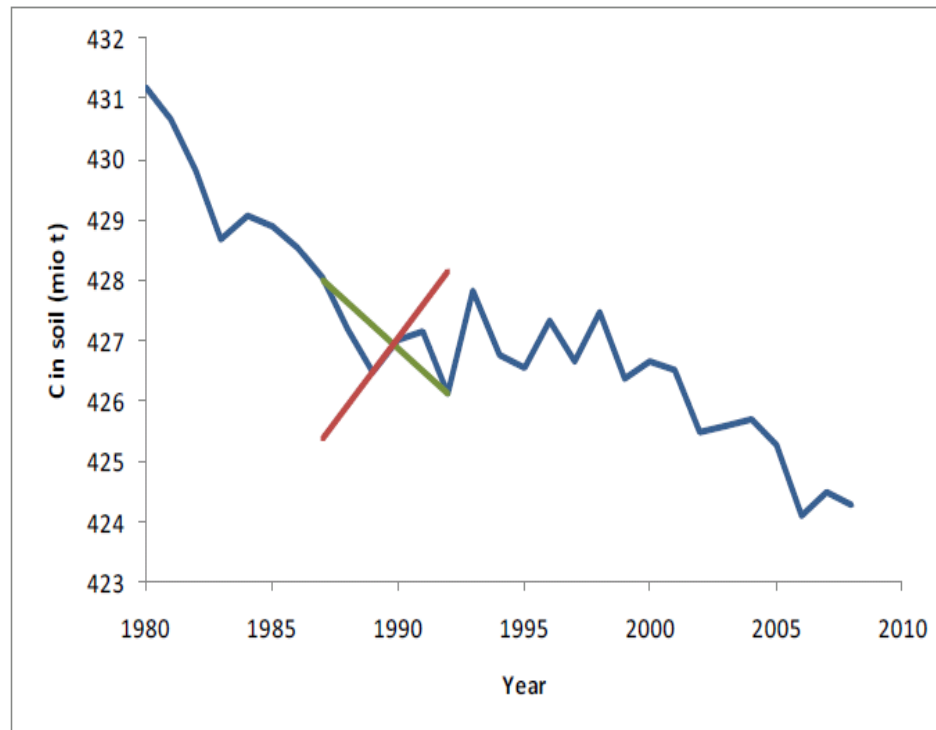


Figure 1. Illustration of the significance of two different methods for determining a trend for the development of C in Danish agricultural soils in 1990. The green line illustrates the original method proposed by Denmark, and the red line is obtained from ERT's proposition number one.

Size matter!

- Only a very small pool: 1-3% of total SOC is responsible for the result under KP 34

Year	C_total	HUM and ROM	FOM
1985	428,9	424,0	5,3
1986	428,5	423,6	5,4
1987	428,0	423,2	5,5
1988	427,2	422,6	5,3
1989	426,5	421,9	4,9
1990	427,0	421,6	5,5
1991	427,2	421,5	6,2
1992	426,1	420,9	5,0
1993	427,8	421,1	6,9
1994	426,8	420,9	5,9

Which pools shall be reported?

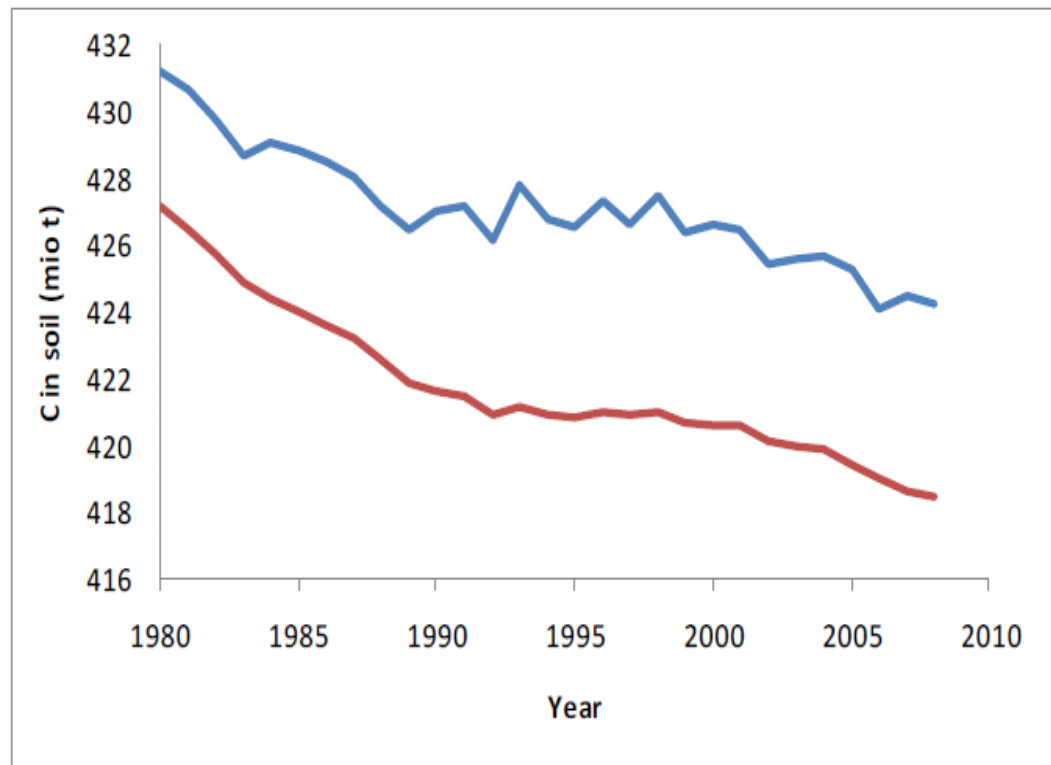


Figure 5. Alternative model set-up, with instant decay of the FOM pool (lower, red curve). For comparison, the model simulation with unchanged FOM turnover rate is displayed (blue curve).

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- The ERT proposal can not be justified scientifically
 - Denmark has in its resubmission only reported the two slower pools, HUM and ROM
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- **Denmark is still of the opinion that 5-years averaging is in accordance with good practice as long as there for the FOM pool is no a clear definition if this pool is belonging to the soil compartment or to the air**

Thank for your attention

National borders exists only in our minds