



Australian Government

Department of Climate Change

Issues arising from the use of Tier 3 models in AFOLU and inter-annual variability

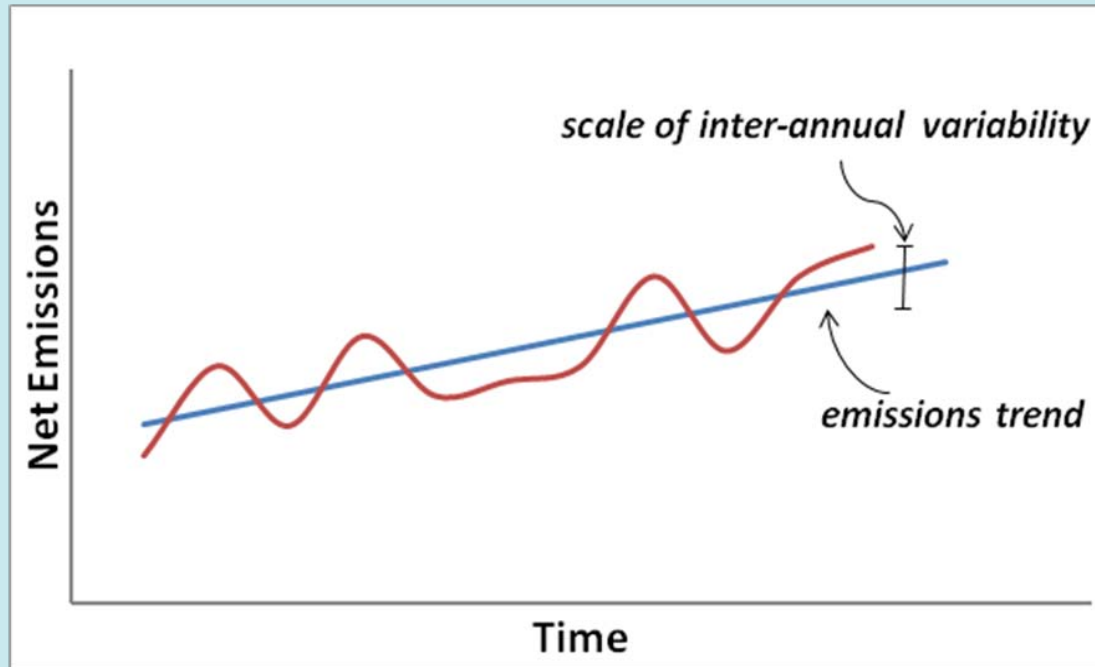
Prof. Gary Richards



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What is inter-annual variability?



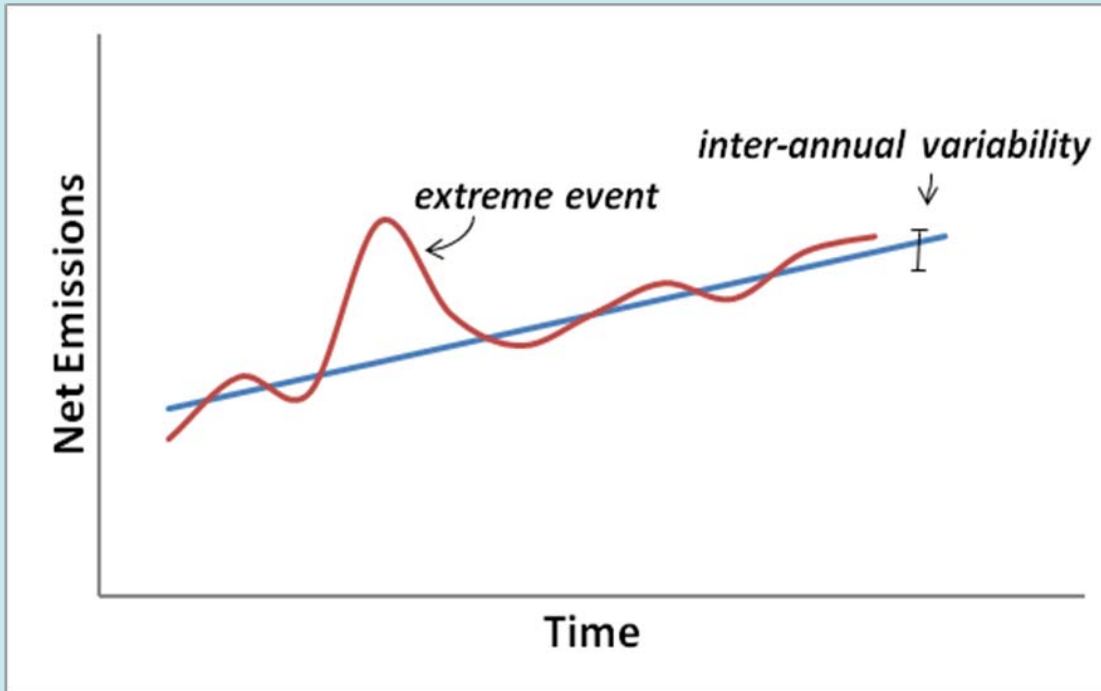
Inter-annual variability is the year-by-year variations in inventory estimates caused by changes in either or both human activity and natural conditions.



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Inter-annual variability v extreme events



Extreme events are more episodic, exceed normal variability and are usually driven by natural disturbances.



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What should be estimated?

Chapter 2, Volume ,1 2006 Guidelines, section 2.2.3, Adapting data for inventory use.

Multi-year averaging:

- *Countries should report annual inventory estimates that are based on best estimates for actual emissions and removals in that year. Generally, single year estimates provide the best approximation of real emissions/removals ...*
- *Countries should, where possible, avoid using multi-year averaging of data that would result in over- or under-estimates of emissions over time, increased uncertainty, or reduced transparency, comparability or time-series consistency ...*
- *However, in some specific cases that are described for specific sectors in Volume 2-5, multi-year averaging may be the best or even the only way to estimate data for a single year.*



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What do the IPCC methods provide for?

The methods considered as good practice may:

- (1) derive averages of multi-year estimates,
- (2) reflect inter-annual variability in only activity data, that is, for the human caused but not the biological variation, and
- (3) may fully reflect, on an annual basis, inter-annual variability in both human activity rates and biological variations due to externalities such as climate.



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Approaches to multi-year averaging

For activity data, multi-year averaging could be by:

- statistical collections, surveys etc., conducted over multiple years;
- observations, e.g., satellite data, at a frequency exceeding a single year.

For stock changes multi-year averaging of input data can be achieved by:

- the use of emissions factors that remain static year-by-year;
- measurement programs with a return frequency of more than one year;
- use of empirical models (not driven by climate) that average responses over time;
- use of process models (driven by climate) but using long-term (greater than one year) averaged climate.



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Averaging inputs v outputs

The IPCC Guidelines state:

Countries should, where possible, avoid using multi-year averaging of data that would result in over- or under-estimates of emissions over time, increased uncertainty, or reduced transparency, comparability or time-series consistency of the estimates.

For any calculations containing non-linear functions, the temporal pattern or total emissions reported using averaged inputs may not be the same as the averaged sum of actual annual emissions.

Multi-year averaging removes the effects of extremes e.g., a period of drought followed by waterlogging does not equate to an average growth period.



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Is it a Tier issue?

- The way that estimates reflect inter-annual variability is more to do with method chosen and measurement frequency than to do with estimation Tier.
- Tier 3 systems more typically reflect the inter-annual variability from both human activity and biological variations.
- Tier 3 models do not create inter-annual variability:
 - Tier 3 models typically provide more of a reflection of the actual inter-annual variability than Tier 3 measurement methods
 - Tier 3 measurement methods frequently use multi-year averaged inputs and reflect multi-year averaged emissions estimates.



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Extracting natural variations

The use of models to factor out the non-anthropogenic effects has been considered by an IPCC expert workshop as a method to isolate non-anthropogenic emissions.

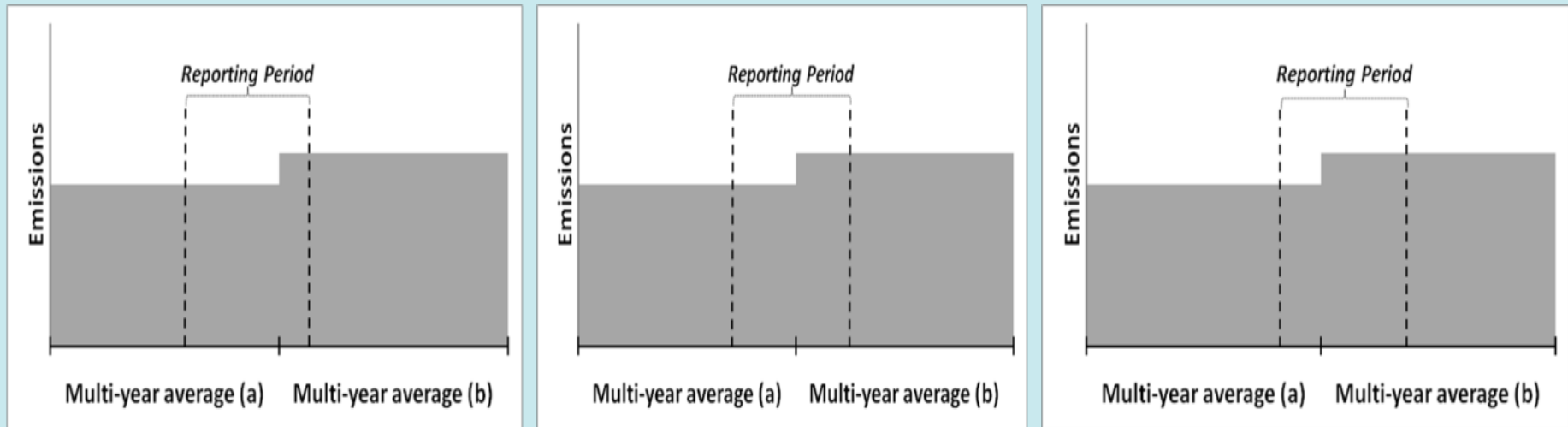
- The meeting 'Revisiting the use of managed land as a proxy for estimating national anthropogenic emissions and removals' (Brazil, May 2009) considered the use of Tier 3 models to provide a comparison of two time-series of emissions estimates, with and without human activities included.



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An estimation, reporting or accounting problem?



The problem becomes one of accounting when short accounting periods are affected by either the inter-annual variability or the multi-year averaging.



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What can be done?

For reasons of transparency in estimation the IPCC recommends that only inputs be the subject of multi-year averaging

- For accounting, it is more logical to apply some form of smoothing *post hoc* to these transparent estimates
- Models could be used to extract the natural effects – this is subject to ongoing research
- Reporting periods could be extended (but extreme events will still be a problem)



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