Uncertainty analysis and conservativeness for REDD+

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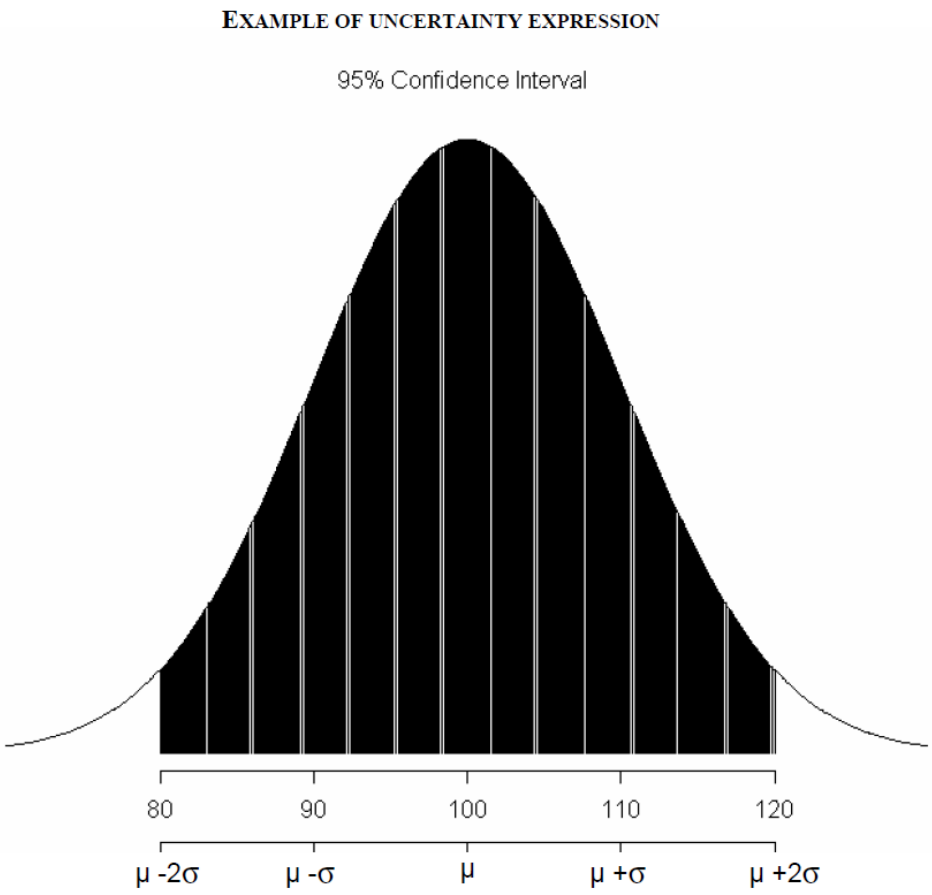
Outlook

- Talk will provide some cases where uncertainties of estimates show a likely bias
    - In area estimates
    - In emission factors
- …and a way, conservativeness, to address those likely bias in accounting (to ensure comparability)

Uncertainties

From 2006 IPCC Guidelines:

"Uncertainty is the lack of knowledge of the true value of a variable that can be described as a probability density function characterizing the range and likelihood of possible values."



In the *GPG2000*, the percentage uncertainty is defined as:

$$\% \text{ uncertainty} = \frac{\frac{1}{2}(95\% \text{ Confidence Interval width})}{\mu} \times 100$$

Uncertainties

The lack of knowledge of the true value is due to random and systematic errors

Systematic errors where possible are to be avoided or quantified and removed; otherwise (under KP rules) the estimates are to be adjusted

Uncertainties that stems from random errors at high level of aggregation of estimates tend to cancel out each other.

E.G. in a national forest inventory estimates at national level (e.g. total biomass, total forest area) have a lower uncertainty than estimates at regional level

Uncertainties in activity data

In estimating land-use areas, it is usually assumed that random errors cancel out so that the mean value of the PDF of the estimate is an unbiased estimator

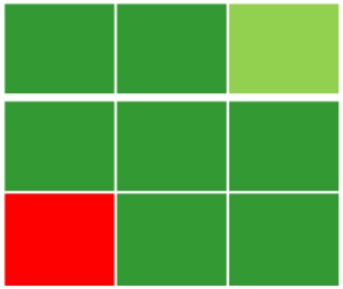
In estimating land-use change areas using a fully spatially explicit land representation (wall-to-wall, i.e. data are reported at the lowest level of aggregation: the map unit) when overlapping the maps random errors cause false changes being counted with associated emissions and removals.

Those false emissions and false removals probably do not compensate

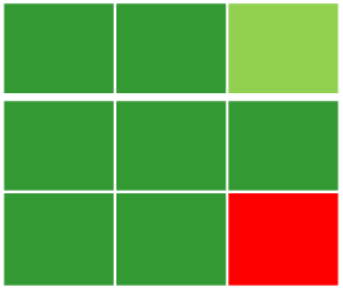
Likely bias

Example

Even if the estimate of forest land area in two consecutive maps may be accurate (because random errors cancelled out) when overlapping maps random errors in land classification (omissions and commission errors) will result in counting for false deforestation and afforestation.



Map at time 1



Map at time 2

Overlap (LUC)

Red	=	Omission error (forest reported as non-forest)
Light Green	=	Commission error (non forest reported as forest)
Yellow	=	False afforestation
Blue	=	False deforestation

In an annual or a short-period GHG balance emissions from deforestation are not paired by removals from afforestation so that a bias (overestimate of net emissions) may very likely occur

Uncertainties in emission factor

Emission factors are calculated to be the unbiased average of a given range of variability

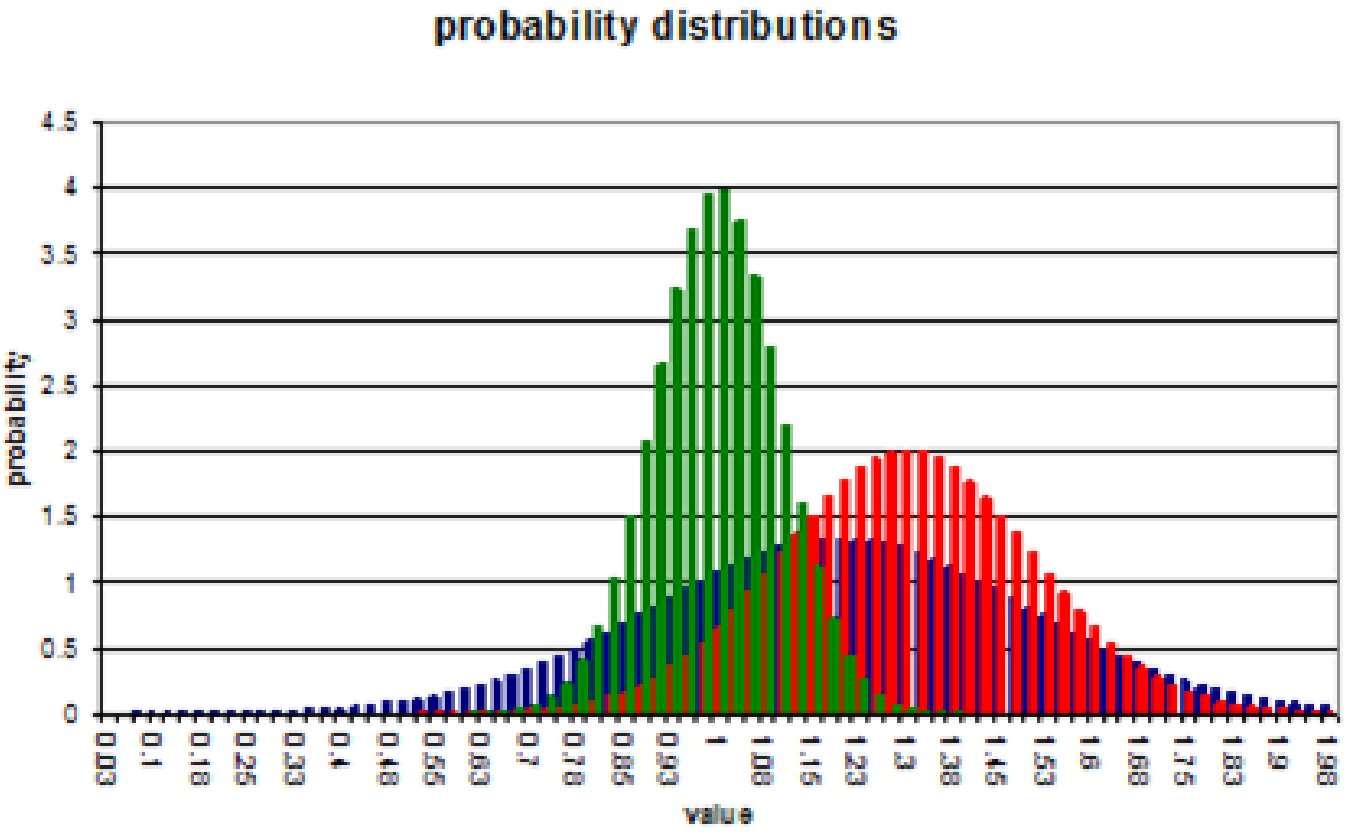
However, when a probability density function that estimates a variable at a certain level of aggregation is applied at a different level of aggregation of that variable, its average is likely to be a biased estimator of the true value

i.e. the PDF does not represent the actual variability

This may well be the case of when a factor that average out a large variability -e.g. an IPCC tier 1 factor- is applied to a lower aggregation level -e.g. a country or a region of a country- which has a lower variability, the likelihood of being an unbiased estimator of the variable of concern decreases

Same consideration can apply when a local factor is used at national scale

Likely bias



In **blue** the PDF of a default tier 1 factor that is applied to 2 countries where the unbiased PDF of that factor would be the **green** one, for a country, and the **red** one for the other.

Dealing with likely bias: the KP case

Under KP, which is the only accounting framework currently working under the UNFCCC, the accounting follows these steps:

-The Party has to report unbiased estimates

(Uncertainties are provided for information purposes, i.e. to prioritize future efforts, and NOT for accounting purposes)

-The review process assesses the fulfillment of reporting principles in order to evaluate accuracy (unbiasedness) of estimates;

Dealing with likely bias: the KP case

If the review concludes that the estimate is not likely over or under the true value the country may use the reported data for accounting purposes

Otherwise:

•either the Party needs to provide an unbiased value

•or, as a remedial measure, an IPCC Tier 1 estimate is applied and the likelihood of underestimating emissions or overestimating removals is reduced by applying a conservativeness factor (Decision 20/CMP1) – Adjustment

(i.e. the conservativeness factor equilibrate the probability of overestimating the true value with the probability of underestimating it)

The conservativeness factor

Decision 20/CMP1 contains tables of **conservativeness factors** linked to specific uncertainty ranges. Essentially, these factors consider the **50% confidence interval** (i.e. the value at the 50th percentile)

Table 1. Distribution of conservativeness factors within uncertainty bands

Estimated uncertainty range (%)	Assigned uncertainty band (%)	Conservativeness factors for emissions in the base year and/or removals in a year of the commitment period	Conservativeness factor for emissions in a year of the commitment period and/or removals in the base year
Less than or equal to 10	7	0.98	1.02
Greater than 10 and less than or equal to 30	20	0.94	1.06
Greater than 30 and less than or equal to 50	40	0.89	1.12
Greater than 50 and less than or equal to 100	75	0.82	1.21
Greater than 100	150	0.73	1.37

Dealing with likely bias

However, in the KP, during the CP, the base year estimate is fixed

This implies that when accounting for the trend (i.e. the difference between the current/actual value and the value in the base year/reference level) credits/debits may simply stem from differences in the uncertainties

i.e. differences between the average value (applied in the BY/RL) and the 50th-percentile value (applied in the actual estimate) of the PDF

Furthermore, correlation of uncertainties between BY/RL and current/actual estimates determines a lower uncertainty in **the trend**, which **is the accounted quantity**

A bias that equally affects actual estimate and base year/reference level does not impact the percentage trend (i.e. the ability of the Party to meet its target; However, whether the Party over-complies its target then for the access to an offset mechanism that bias does matter)

Applying conservativeness in REDD+

Let's make an example relevant for REDD+ (e.g. deforestation), using existing rules:

- REDD activities are key categories
- AD (e.g. area of D) is obtained with adequate methods (approach 3 or 2 + supplementary information)
-For the EF (C stock change), an IPCC default value (tier 1) has been used instead of a country specific value (tier 2/3).

The IPCC default value has a low probability of being an unbiased estimator for a key category (the difference between IPCC value and the true value is likely to be significant); It is GOOD PRACTICE to use country specific factors.

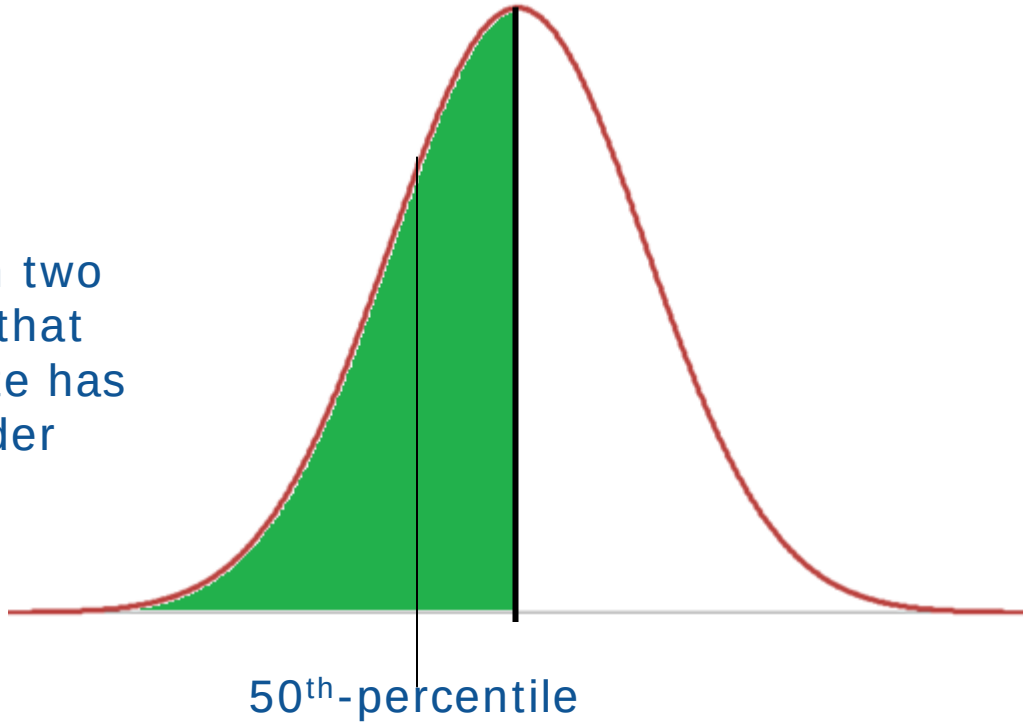
WHAT THE CONSEQUENCES?
1) Excluding the country from accessing REDD+ → leakage
2) Allow the country to access REDD+ with likely biased estimates? → lack of comparability with other countries
3) Allow the country to access REDD with some "SAFEGUARD": HOW ?

Applying conservativeness in REDD+ --- A proposal

Simply, in analogy with what is done under KP, making equal the probability of the estimate to overestimate or underestimate the true value (i.e. this means removing the bias)

Having the PDF a likely bias –i.e. an overestimation- the true value is in the left (**green**) side (the negative field) of the PDF

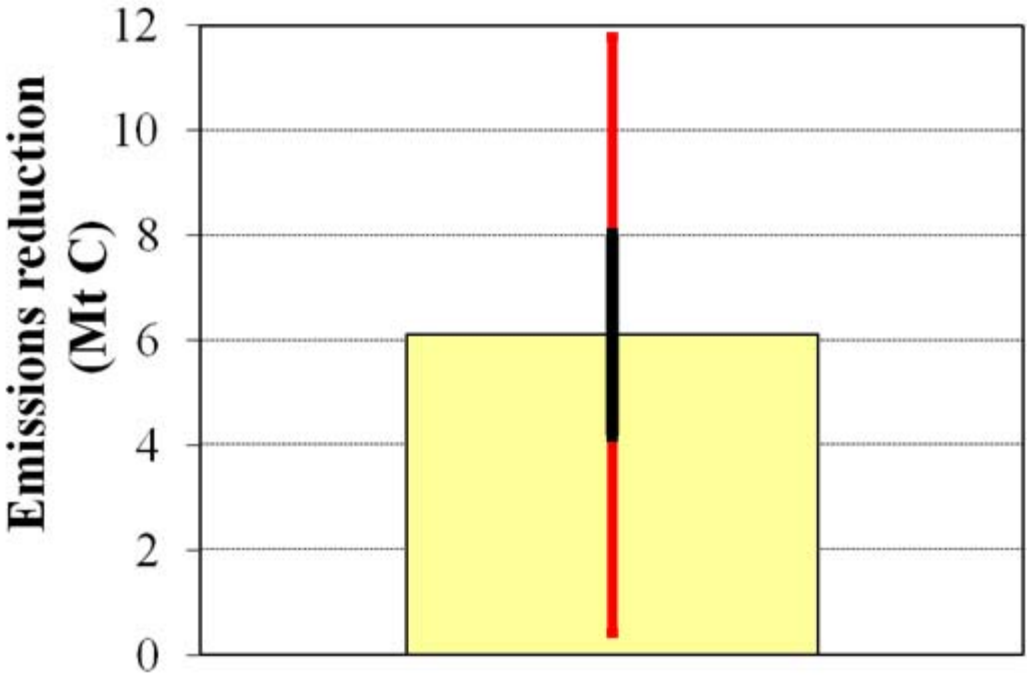
The 50th-percentile divide the field in two areas with equivalent probability so that Using the 50th-percentile the estimate has the same probability of over and under estimating the true value (like an unbiased distribution)



Applying conservativeness in REDD+ --- A proposal

To avoid to generate credits/benefits from differences in uncertainties between the BY/RL estimate and the current/actual estimate conservativeness is applied to the uncertainty of the trend

CI at 95% confidence level
CI at 50% confidence level



In this case the emissions reduction is discounted by about 30%

Applying conservativeness in REDD+ --- A proposal

Additional elements:

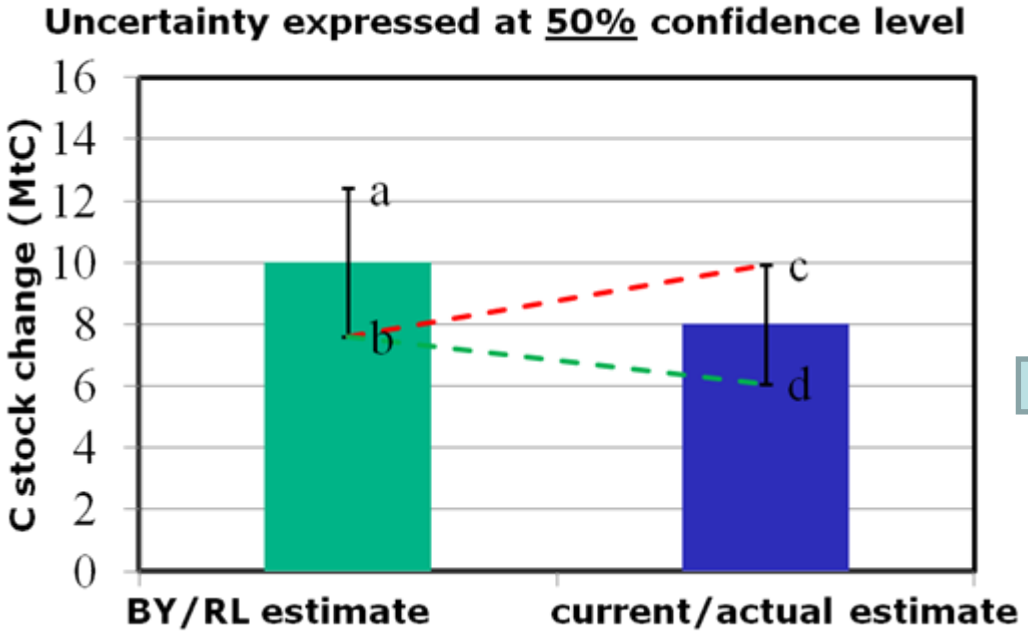
The likely bias affects only one of the elements used for preparing the estimate -i.e. either activity data or emission factor-

However, the PDF of the estimate is determined by the uncertainties of the activity data and the emission factor.

A way to implement conservativeness is to apply the uncertainty of the likely biased element to the estimate, so using its 50^{th}-percentile to calculate the conservative value

Applying conservativeness in REDD+ --- A proposal

A global default emission factor with a fully correlated uncertainty of 70% (95%CL), is applied to calculate deforestation emissions; the factor likely overestimate carbon stock losses



Potential credits of 2 (if likely bias ignored)

(b) – (c): **debits of 2.3 (RME)**

(b) – (d): **credits of 1,6 (JRC)**

Conclusion

REDD+ estimates should be accurate

If you can't be accurate, be conservative

Likely biased estimates can be corrected easily and conservatively based on uncertainty of the trend: lower REDD+ credits but higher credibility!

So, conservativeness allows to obtain robust estimates of REDD+ even with large uncertainties in the data

The more accurate are the estimates, the more credits could be potentially claimed.

Conservativeness is a **win-win** option:
- **no money to "hot air"** (even when accuracy is not achieved);
- **broader participation** (even when the Party still lack capacity)

Dealing with likely bias

Example A (bias in BY/RL and in current/actual estimate)

BY / RL: activity data 1,000; emission factor 110 (true value 100);
estimate = 11,000 --------- Target to be achieved – 10%

current / actual estimate: AD = 900; EF = 110 (true value 100);
estimate = 9,900 --------- Reduction achieved -10%

Example B (bias in BY/RL only)

BY / RL: activity data 1,000; emission factor 110 (true value 100);
estimate = 11,000 --------- Target to be achieved – 10%

current / actual estimate: AD = 990; EF = 100 (unbiased/adjusted);
estimate = 9,900 --------- Reduction achieved -10%