Estimating bias and precision of biomass estimates in miombo woodlands with global and local maps

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IPCC compliance – useful guidelines for map assessment

- IPCC guidelines – how should they be interpreted?
  1. "*neither over- nor underestimates so far as can be judged*"

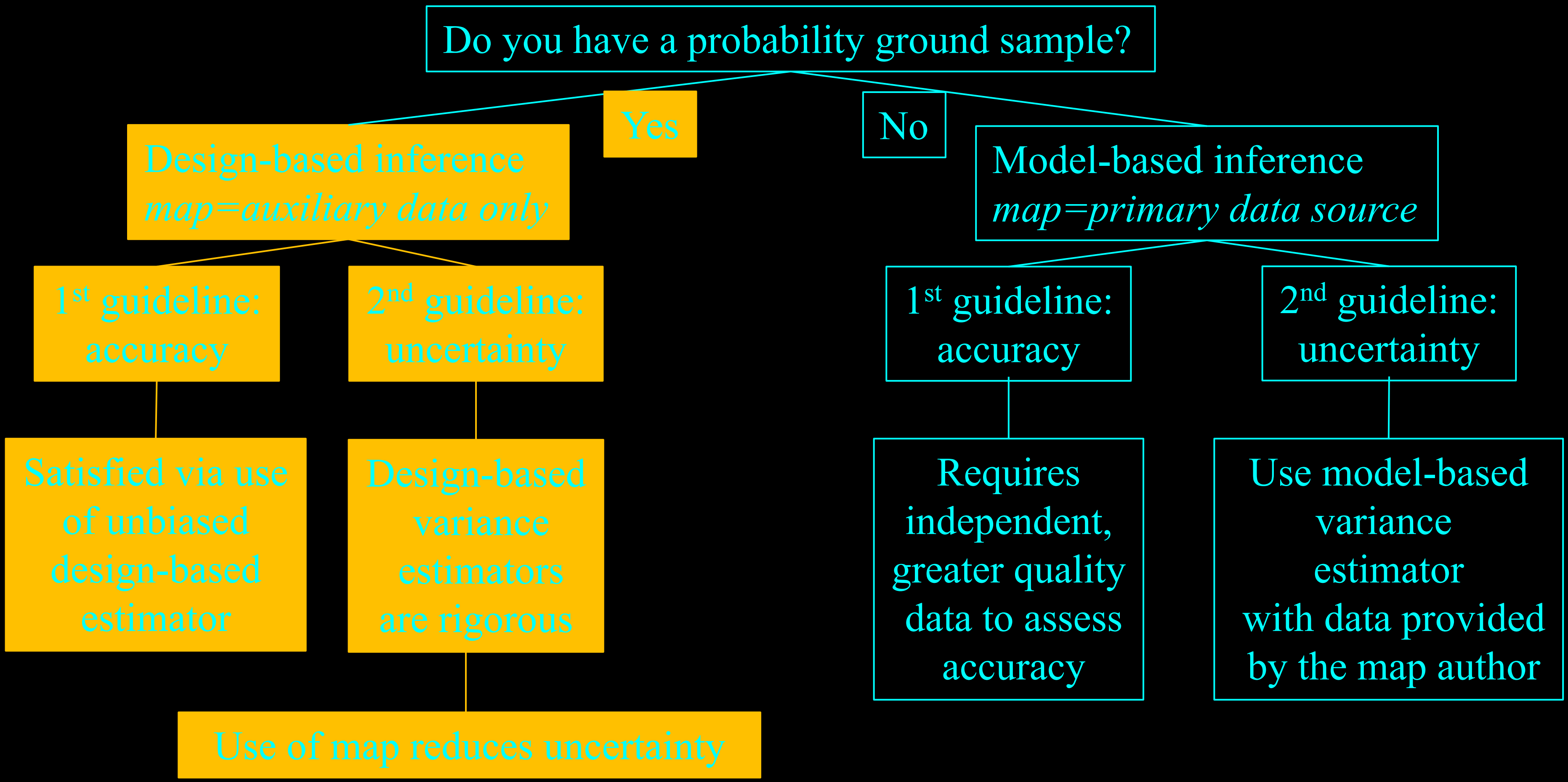
     Methodology:

     a) Either use a «benchmark» value to assess estimates, or
     b) use statistical estimators that are known to be unbiased, e.g. design-based estimators
  2. "*uncertainties are reduced as far as is practicable*"

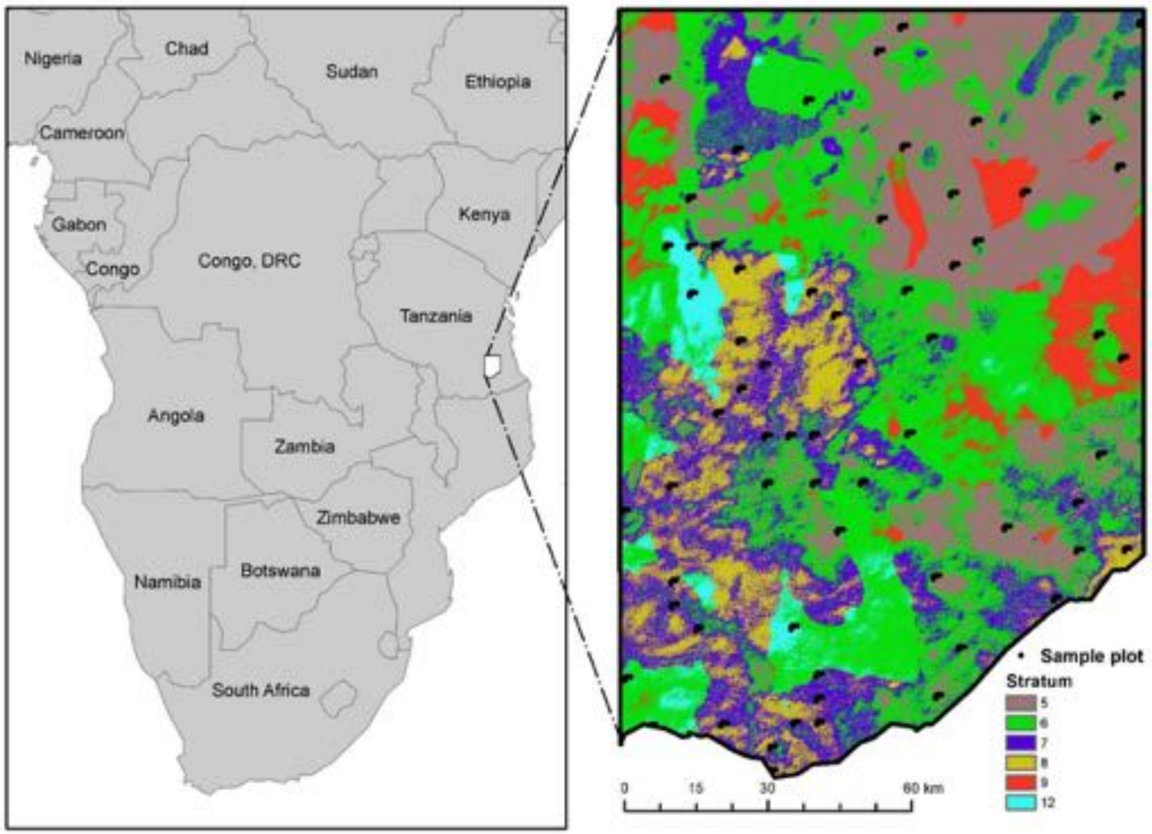
     Use the map either

     a) as the primary source of information, or
     b) as auxiliary information to improve precision of the estimates.

Biomass map assessment



Study area and design



Sampling design:

Systematic stratified cluster sample with unequal cluster sizes

Allows design-based analysis and inference

Reference data – field survey

National forest inventory sample plots

Map products

Map products:

1. Global maps (Saatchi, Yu et al.)
   a. A global height map (Lorey’s height)
   b. A global biomass map

2. A local height map (Trier et al.)

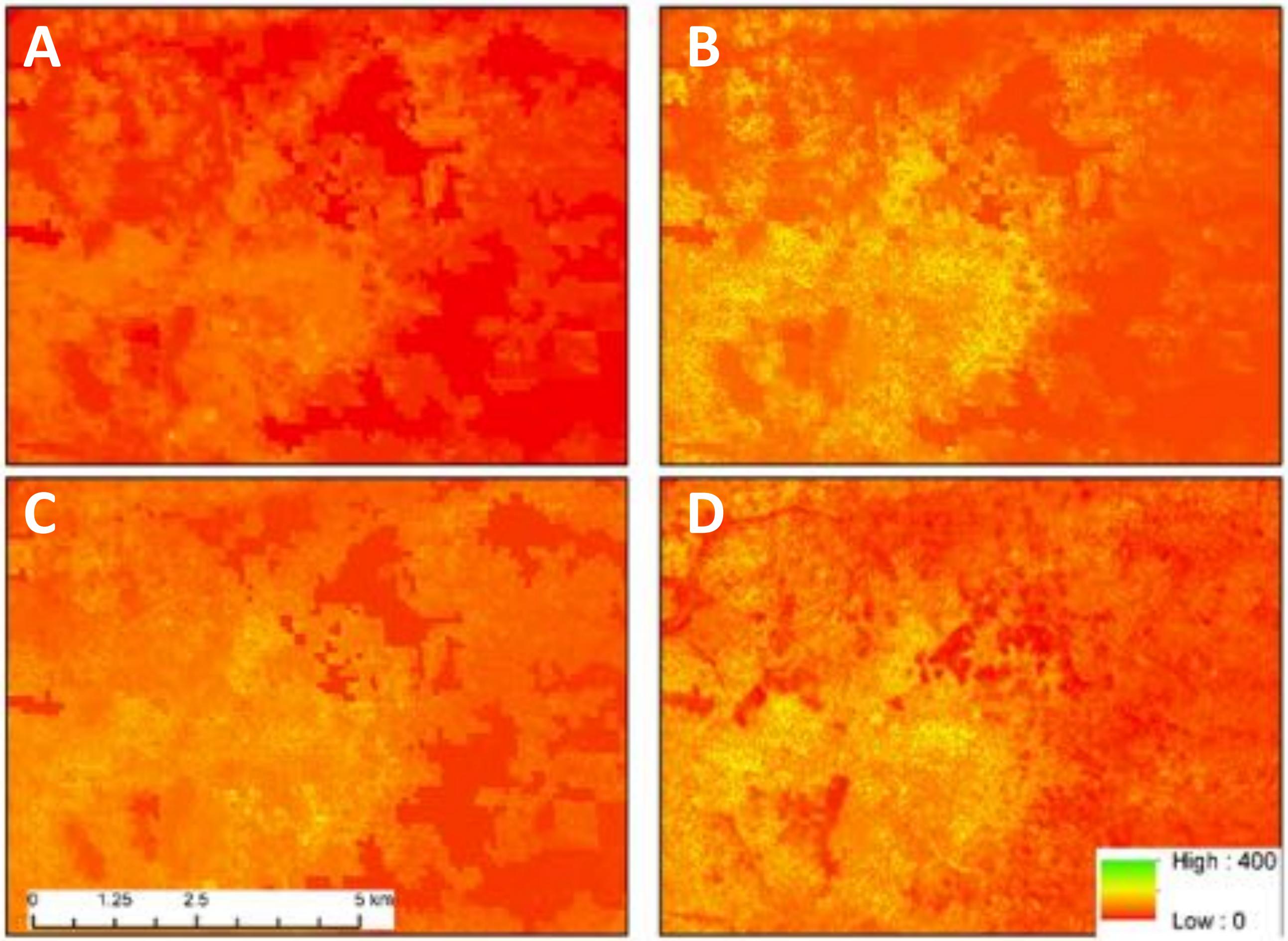
Biomass map assessment

Estimation strategies:

1. Global and local height maps
   a. Use the maps to fit local biomass models: $AGB = \alpha + \beta H + \varepsilon$
   b. Produce a biomass prediction map
   c. Use the map as auxiliary data in a model-assisted estimation
2. Global biomass map, uncalibrated

   Use the map as is in a model-assisted estimation
3. Global biomass map, locally calibrated
   a. Use the map to fit local biomass model: $AGB_L = \alpha + \beta\, AGB_G + \varepsilon$
   b. Produce a locally calibrated biomass prediction map
   c. Use the map as auxiliary data in a model-assisted estimation

Biomass map assessment



A: Global biomass map uncalibratred

Calibrated maps:

B: Locally calibrated global biomass map

C: Biomass prediction map from global height map

D: Biomass prediction map from local height map

Biomass map assessment

Evaluation criteria:

1. Precision of biomass estimates (standard error) when maps are used to support the estimation relative to precision of other estimates (relative efficiency; RE*)
2. Bias estimate for stratum *h*

$$\hat{B}_h = \frac{1}{N_h}\sum_{k\in U_h}\hat{b}_k + \frac{1}{\sum_{U_i\in S_h} N_i}\sum_{k\in S_h}\left(b_k - \hat{b}_k\right)$$

Synthetic estimator

HT-like bias estimator

*Calculated with variances rather than standard errors

Biomass map assessment

Main findings:

1. Uncalibrated global biomass map:
   a. Statistically significantly biased: 44-76%
   b. Precision much poorer than using only the field sample (RE=0.4)

2. Locally calibrated global biomass map
   a. Greater precision than using only the field sample (RE=1.7)

3. Local biomass maps from global and local height maps
   a. Equally precise, no additional benefit of local height map (RE=1.9)
   b. More precise than locally calibrated biomass map

Biomass map assessment

Conclusions:

1. Global biomass map has no value without local calibration
2. When calibrated locally, global biomass map can still help improving precision of estimates – potentially representing great savings in monetary terms
3. No benefits found for local maps versus global maps, given available local calibration data