

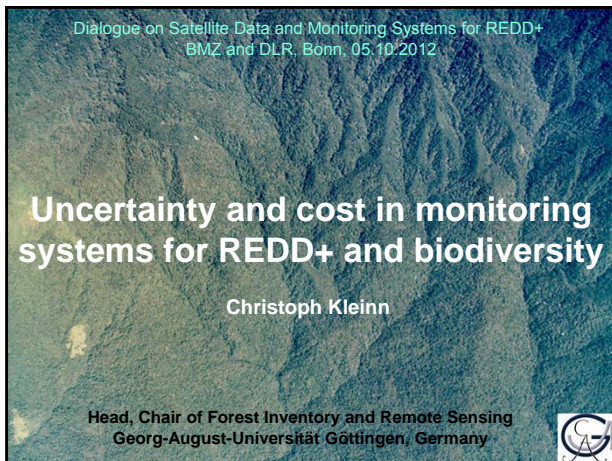


Dialogue on Satellite Data and Monitoring Systems for REDD+  
BMZ and DLR, Bonn, 05.10.2012

# Uncertainty and cost in monitoring systems for REDD+ and biodiversity

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## Uncertainty and cost in monitoring systems for REDD+ and biodiversity

**“Cost”**  
is easily understood and has always been a major and explicit concern in forest monitoring.

**“Uncertainty”**  
is an ever present component in forest monitoring systems. Lesser easily understood; receiving increasing attention.

**“Forest monitoring systems”**  
have been in place in many regions. Many efforts since decades (FAO, TC projects). But commonly: relatively low national priority, also for cost reasons. A counterexample is FSI, India. Currently: fundamental change – growing interest.

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## When financial compensations shall be established for the five REDD+ activities

→ good information is needed / helpful

- The need for “good” information on status and change of the forest resource and for “robust” methods is expressed with increasing frequency.
- It is the first time that large area forest information is being discussed also in an immediate market context !
- Methods development and related technical capacity building is a booming business in itself.
- Monitoring is but one component in a set of complex processes towards a common goal  
→ **mitigating climate change.**

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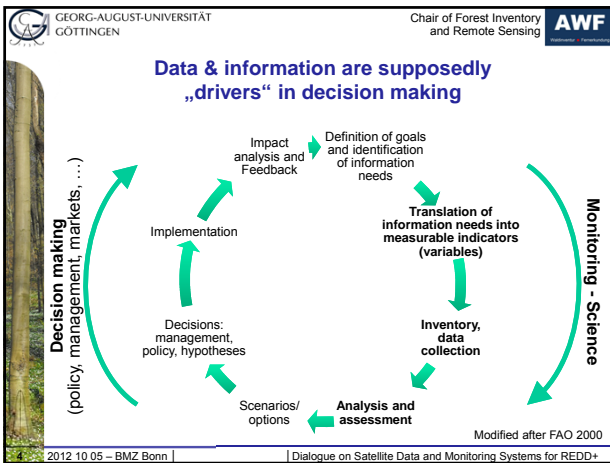
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**“Carbon” and “biodiversity” as target variables of monitoring systems**

- Complex variables both regarding definition and observation.
- Scale-dependent.
- Not directly “measurable” – despite of many claims.
- Need to be modeled from indicator variables – regardless of data source used.
- There are hardly any “true values” for reference and/or verification.
- Variability is high – *within regions, within stands, within trees*  
 → models and allometric relationships to measurable variables exhibit such variability.

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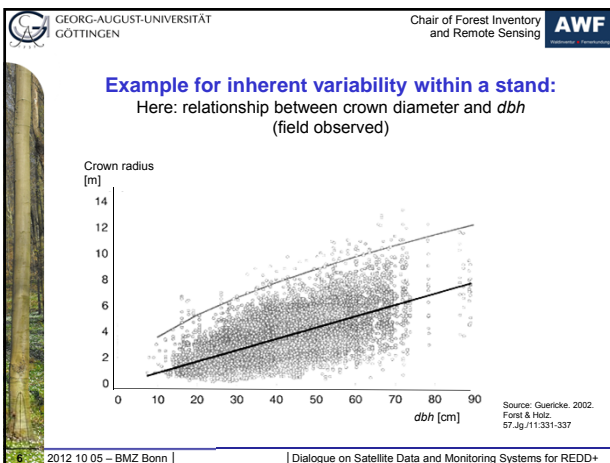
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### Data source and approaches

**Activity data = estimation of area changes**

- RS based / field based
- Integrated approaches → compatibility of definitions!
- 3 approaches (IPCC)
- Estimation error in changes in forest cover in the range of 5-20% from mid-resolution imagery for two classes (Achard et al. 2007)

**Emission factors = estimating carbon stock changes**

- For all pools: depending on suitable models.
- 3 tiers (IPCC)
- Field observations.
- Regionalization with remote sensing.
- 95% CI of AGB estimation between 20% and 40% (various sources listed in Grassi et al. 2008)

- Both estimations carry various sources of uncertainty
- Both estimations benefit from prior experiences and research studies.
- Both estimations need to be done (1) for the reference period and (2) for the assessment period; carrying on uncertainties from both periods to the final estimation of emission reduction.
- Both estimations need to focus to human induced changes (establishing cause-effect relationships is **not** standard in observational studies)!

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### Examples for uncertainty statements (simple standard errors) in forest monitoring (example: forest area / growing stock)

	Area	Growing stock	n (number of field cluster plots)
2 <sup>nd</sup> German NFI (2001):	0.7%	0.5%	44998
Costa Rica (2001)	9.3%	17.4%	40 (field)
FAO-NFMA pilot inventory:	3.8%	--	159 (air photos)
NFI Burkina Faso (2010): research project, BEAF-GIZ	9.9%	18.3%	46

Question: What is "good" / what is "good enough" ?

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### The meaning of "uncertainty"

- The term "uncertainty" refers to the lack of knowledge about specific parameters, models or factors (USEPA 1997, after Wang et al. 2005)
- "Uncertainty" is not clearly defined in sampling statistics
- "Standard error", "error variance", "root mean square error", or, in descriptive terms: "residual variability"

→ Always referring to the idea of probability distributions of estimates: how widely / narrowly are the estimates distributed around the expected value ... if one would very often repeat the same study

- In case of probabilistic approaches: the expected distribution is known / can be estimated ... and confidence intervals can be specified.

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### "Uncertainty" and decision making in policy processes ?

- A largely un-researched field at the science-policy interface.
- Related issue:  
 How can the monitoring budget (and research funds) be optimally allocated ?
- "... finding an adequate sampling method ... will depend on accuracy and precision requirements from the policy process" (Böttcher et al. 2009).
- Side-observation:  
 In general terms, governments use to invest a lot in information procurement - monetary cost-benefit analysis is often difficult.  
 Information about the forest resource is useful and forests need to be sustainable managed , anyway.

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**Overall goal (global):**  
 contribute to mitigating climate change  
 - by fostering forests and forest development  
 - with optimized overall benefits

Market mechanisms ↔ Policy processes

„Natural“ sciences

Remote sensing, Mapping and GIS, Modelling, Silviculture and forest management, Growth and yield sciences, Sampling statistics, Forest mensuration, Forest inventory

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### Concluding ...

- The most relevant characteristic of forest monitoring results is "overall credibility" (Iles 1986) – that appears to be unchanged.
- Ongoing rapid advances in forest monitoring, in particular in remote sensing techniques → demand or technology driven ?
- The assumption / hypothesis "better information leads to better decisions" is still to be scientifically proven !
- A relatively high degree of uncertainty of information has always been an element in forestry planning (including risks of natural disasters ...).
- Long term capacity building strategies towards forest monitoring (beyond technical projects) ?
- Science must not give reasons for slowing the speed of the process down – but neither pretending there being simple solutions.

AWF-WIKI  
 [Forest Inventory] [Remote Sensing]

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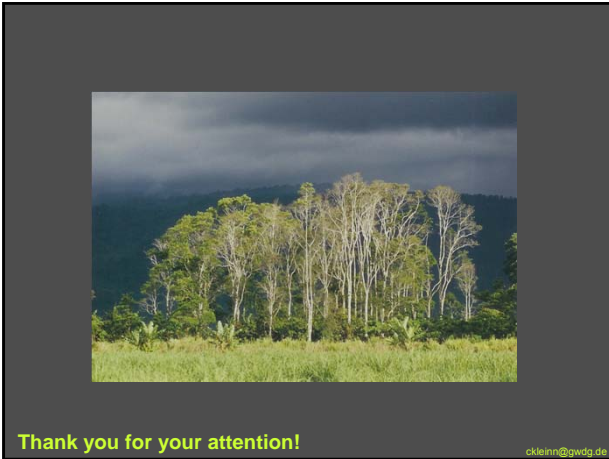
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