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Requirements to develop and implement a credible and transparent MRV system

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Worldforestry

University of Hamburg

ASEAN, Singapore, December, 12-13, 2016

Requirements to develop and implement a credible and transparent MRV system

or

The long way from political decisions to practical implementation

ASEAN, Singapore, December, 12-13, 2016

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What I will NOT present:

- Stipulations of IPCC on MRV-systems

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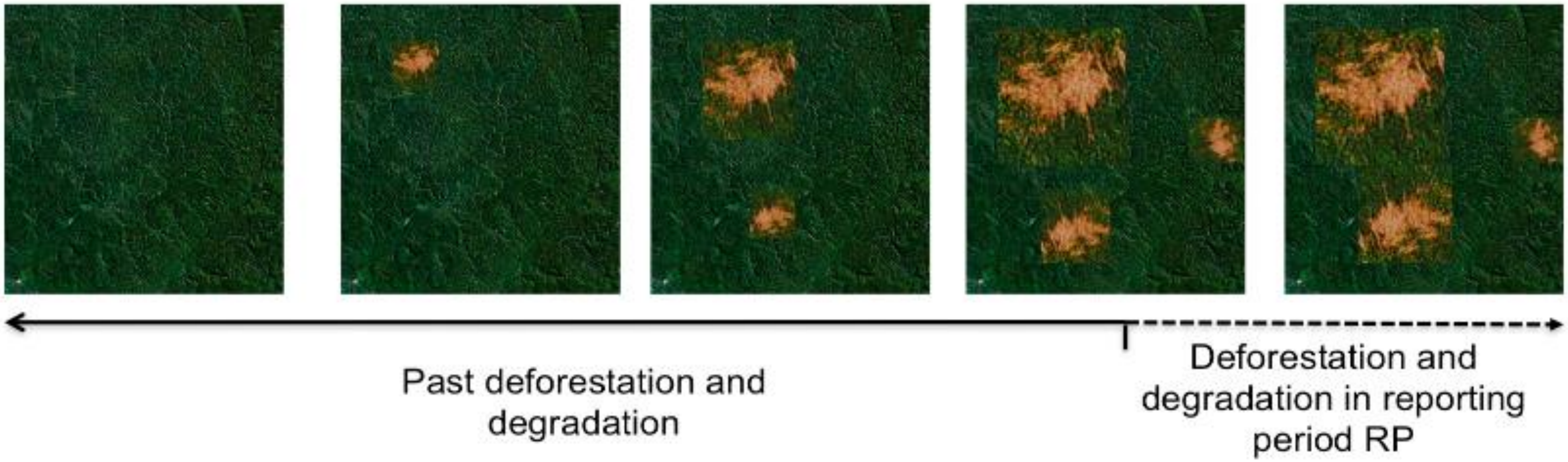
What I will NOT present:

- Stipulations of IPCC on MRV-systems

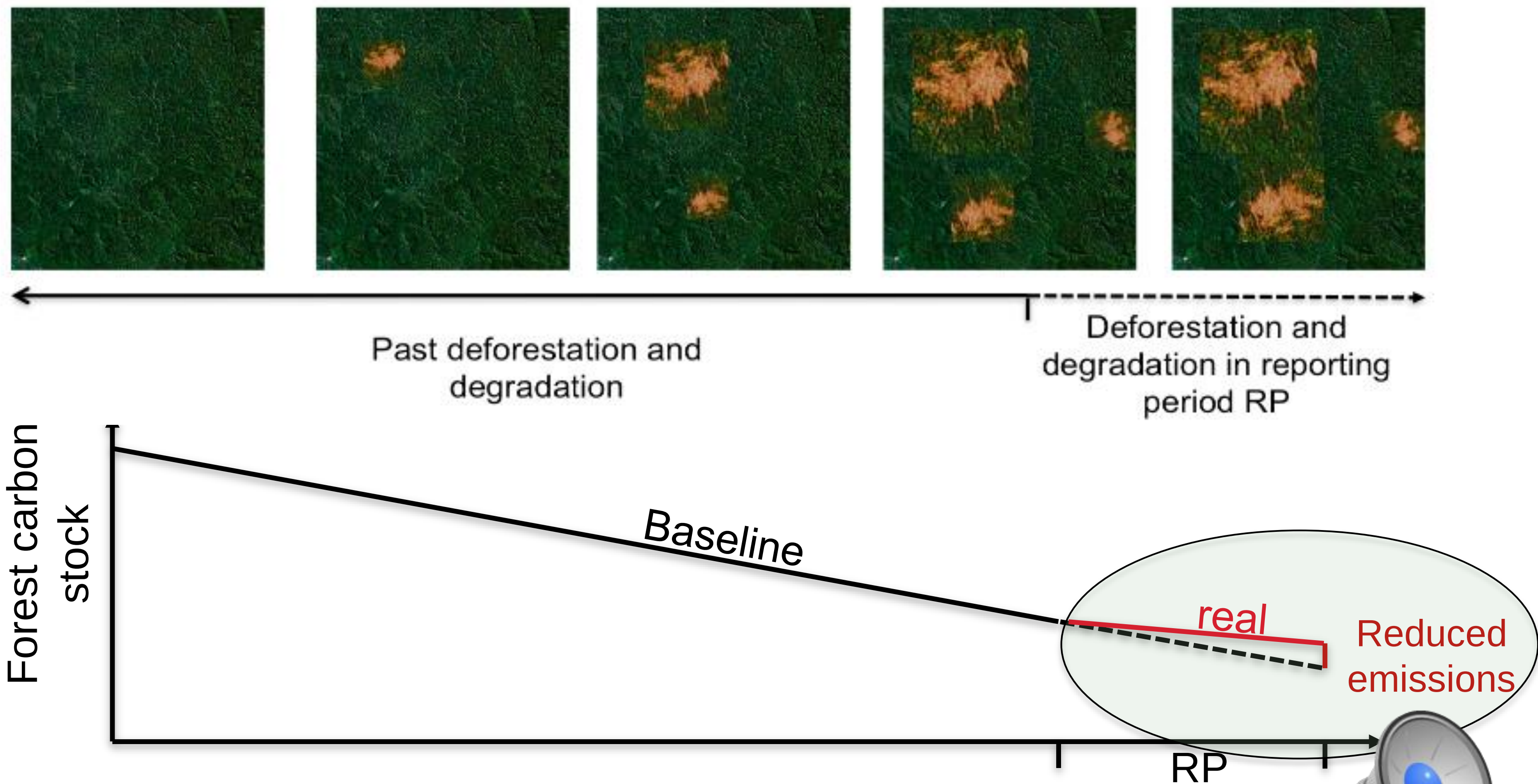
What I will present:

- Potential pitfalls in the development of MRV-methods
- Long-term implications of methodological procedures
- Warnings and possible solutions

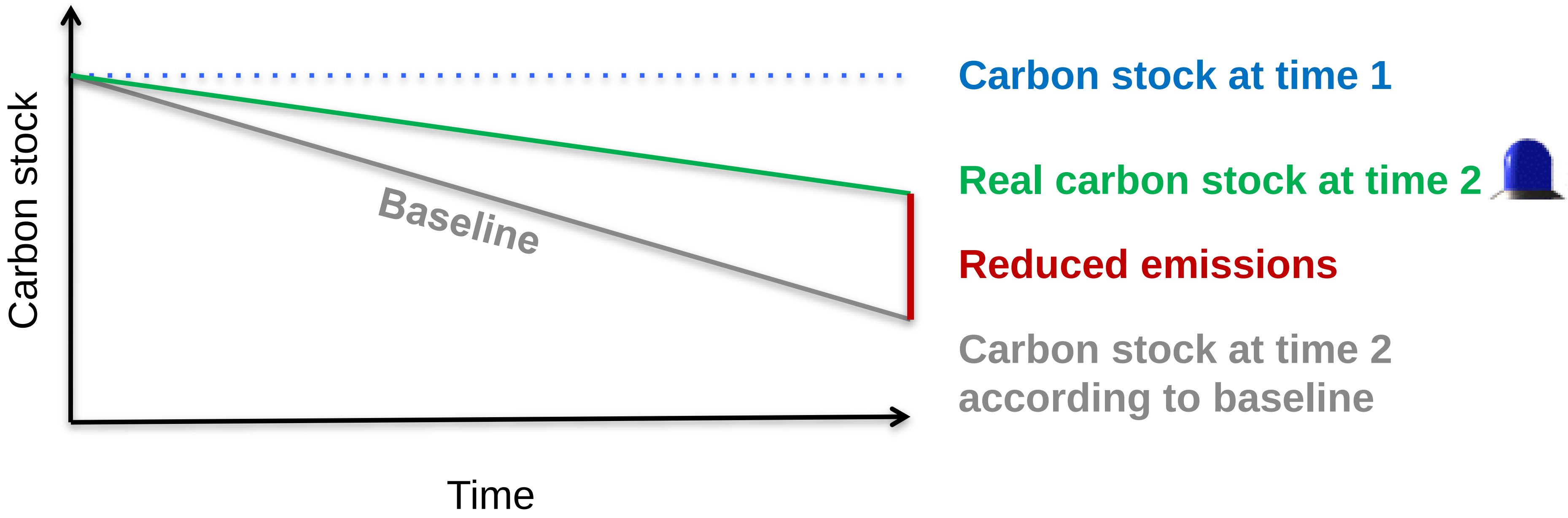
FREL/FRL


Past deforestation and degradation
Deforestation and degradation in reporting period RP

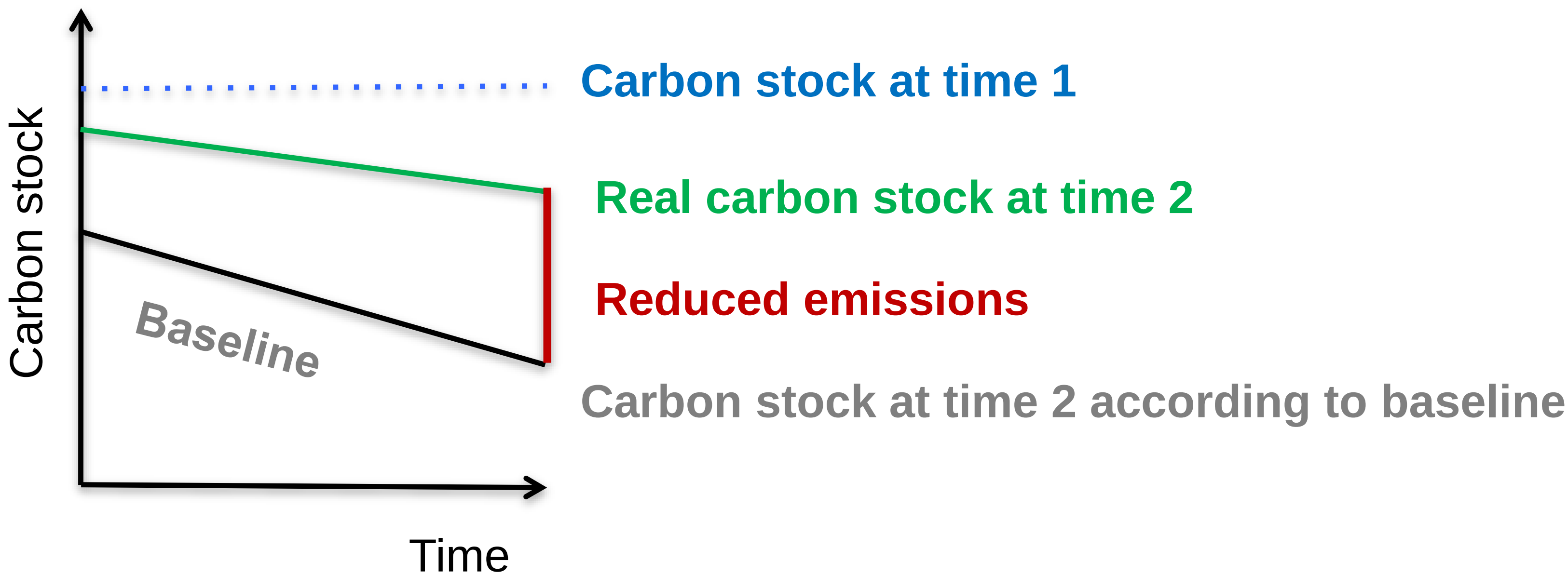
FREL/ FRL

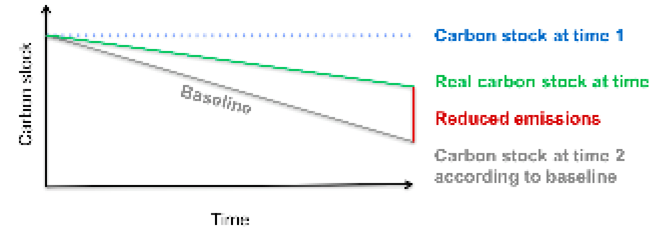

Past deforestation and degradation
Deforestation and degradation in reporting period RP
Forest carbon stock
Baseline
real
Reduced emissions
RP

Accountable emission reduction

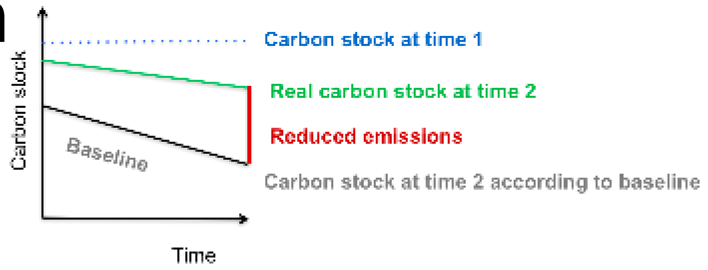


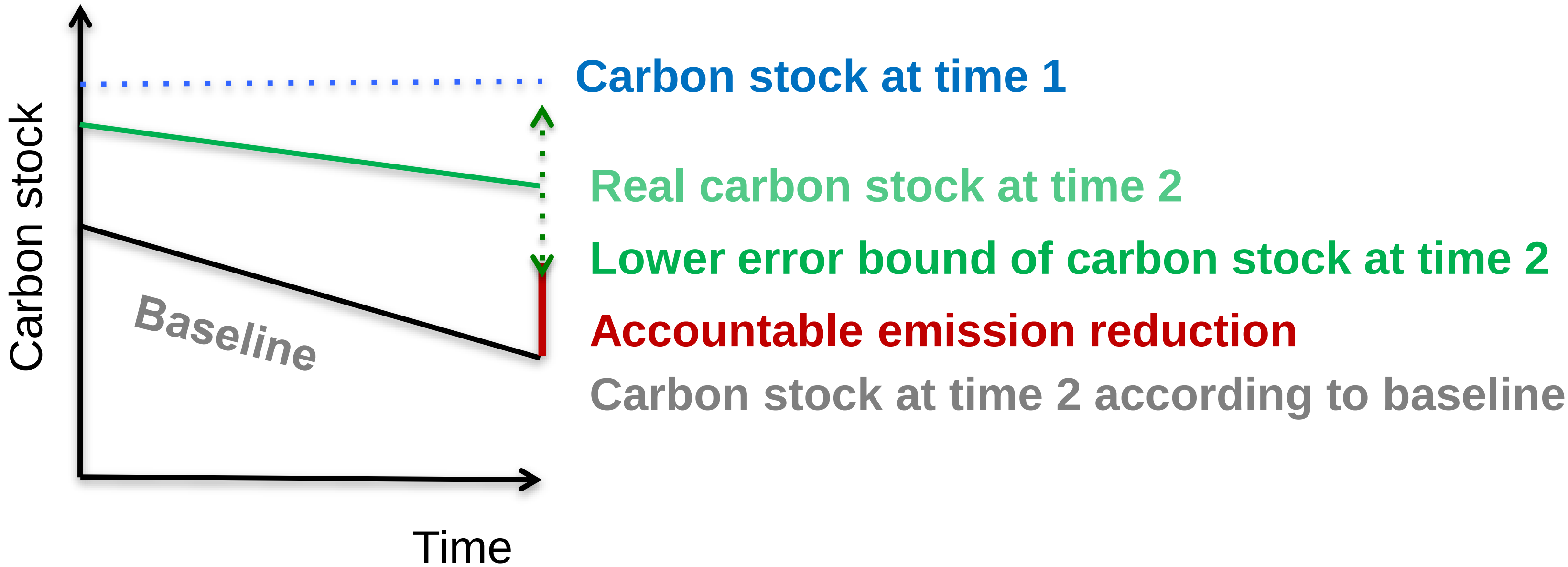
Accountable emission reduction



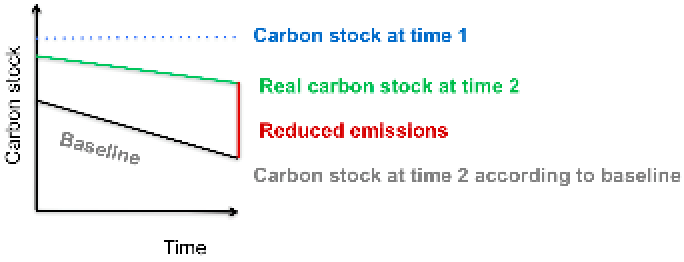


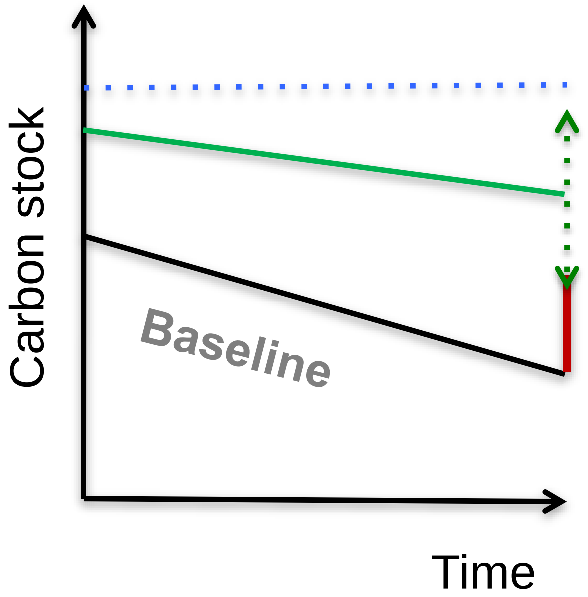
Accountable emission reduction





Accountable emission reduction





Minimum Reliable Estimate (MRE)

Accountable emission reduction

Carbon stock at time 2 according to baseline

General Aspects of Uncertainties in Emission Estimates

Uncertainties are a composite of errors arising from

- observations (statistical uncertainty), and

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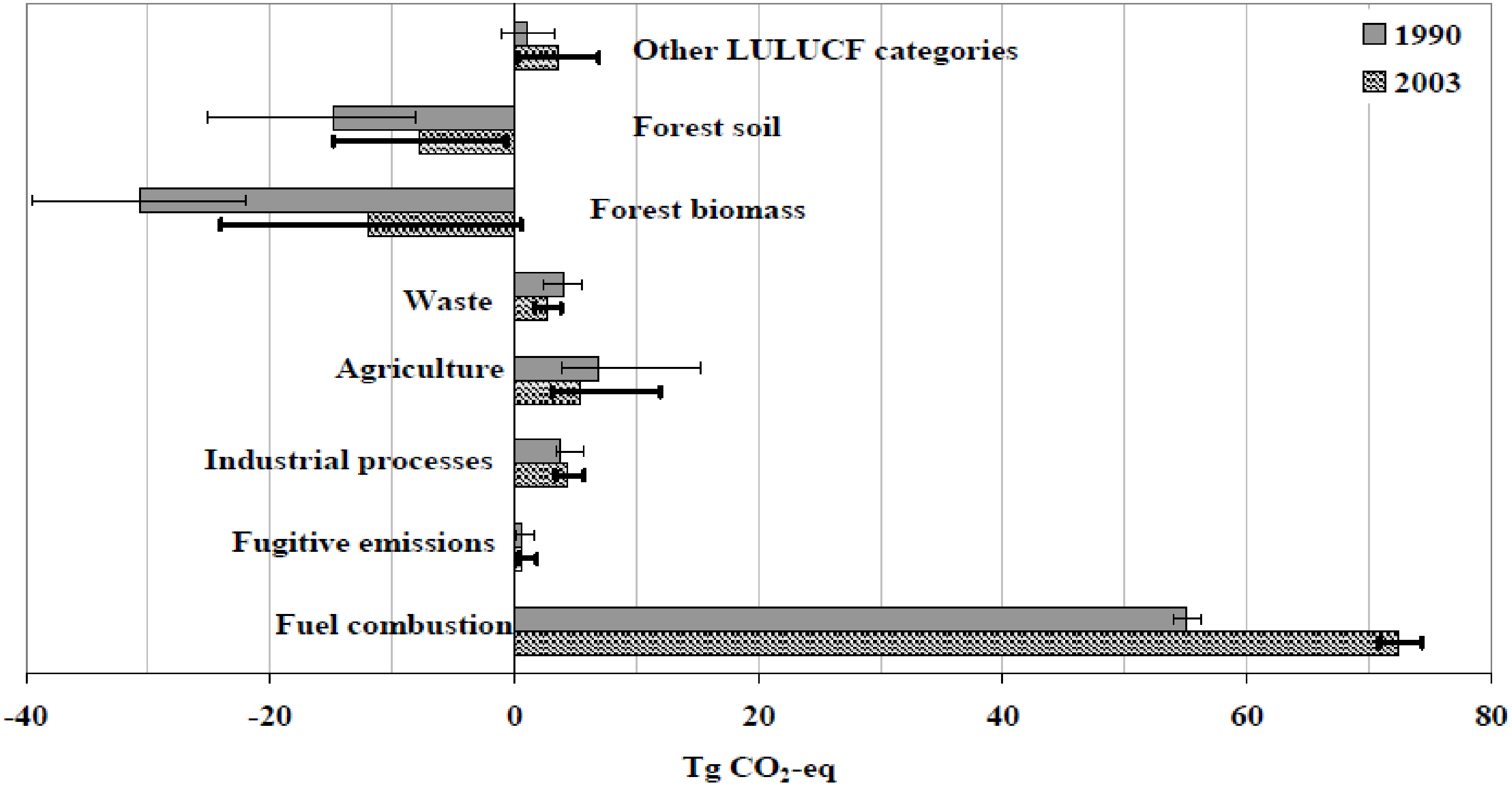
General Aspects of Uncertainties in Emission Estimates

Uncertainties are a composite of errors arising from

- observations (statistical uncertainty), and
- the appropriateness of models (systematic, structural, epistemic uncertainty)
- Non-statistical errors (e.g. measurement, classification, or calculation errors)

Uncertainties in GHG Emissions and Removals

National Inventory Report for Finland

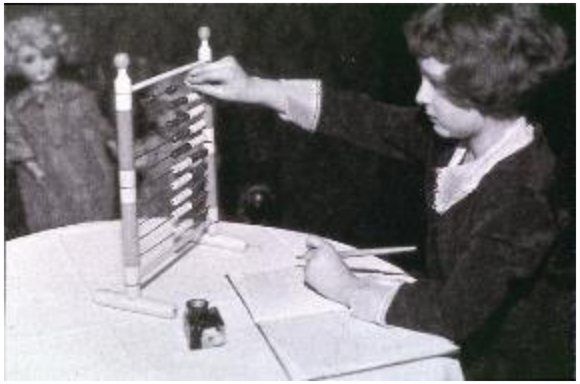


Source: Monni et al., Climatic Change (2007) 81:391-413

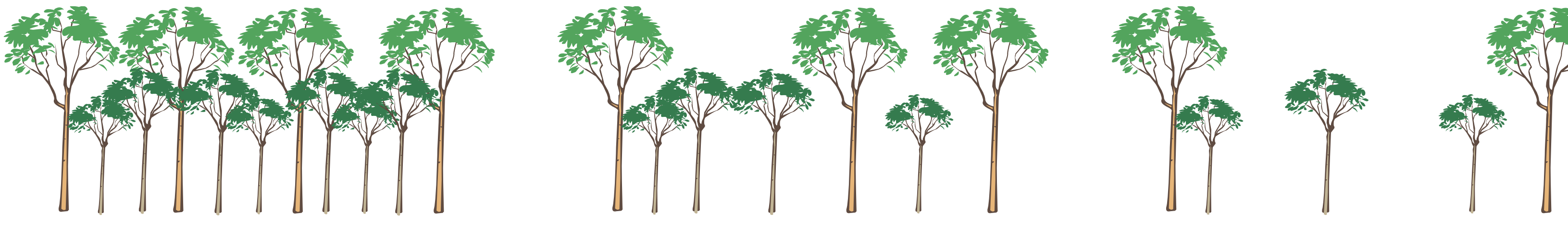
Data Sources and Uncertainties


Field assessments


Remote sensing


Models and analysis

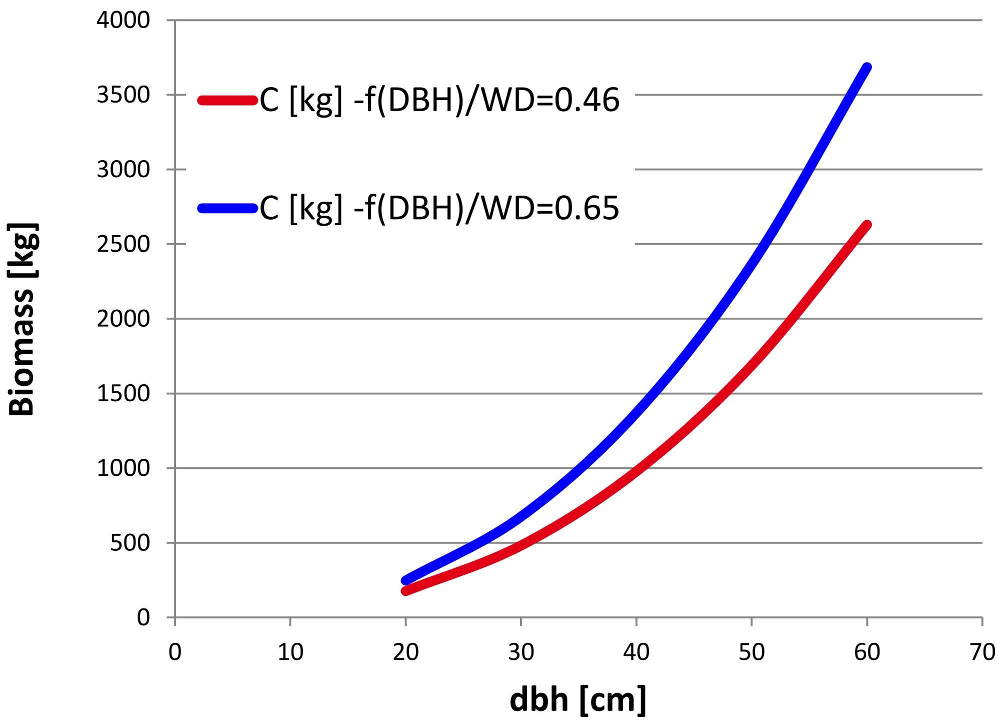
Problems with monitoring forest degradation by remote sensing



Biomass Stock time 1	**Biomass Stock time 2** **Not detectable by passive remote sensing**	**Biomass Stock time 3** **Detectable by passive remote sensing**

Stealthy degradation => Classification errors

Estimating individual tree biomass by biomass equations



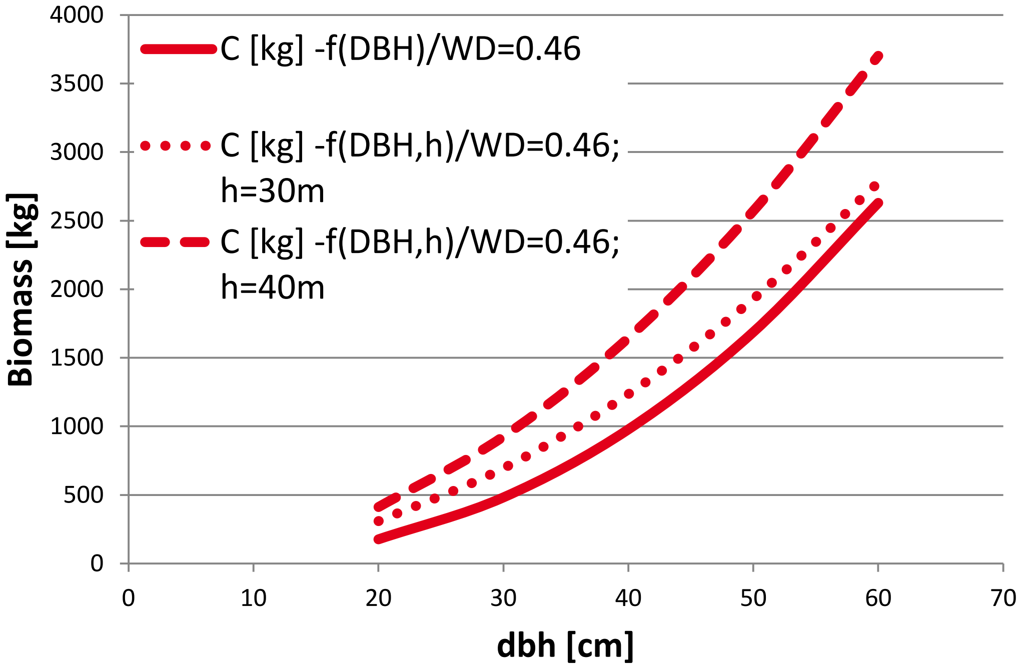
Biomass = f(dbh,WD, EF)

Assuming wood density (WD) of 0.46 kg/m³ vs. 0.65 kg/m³

Results for a tree with dbh=60 cm in a difference of <u>1055 kg (140%)</u>

Biomass equation: Chave et al., 2014

Estimating individual tree biomass by biomass equations



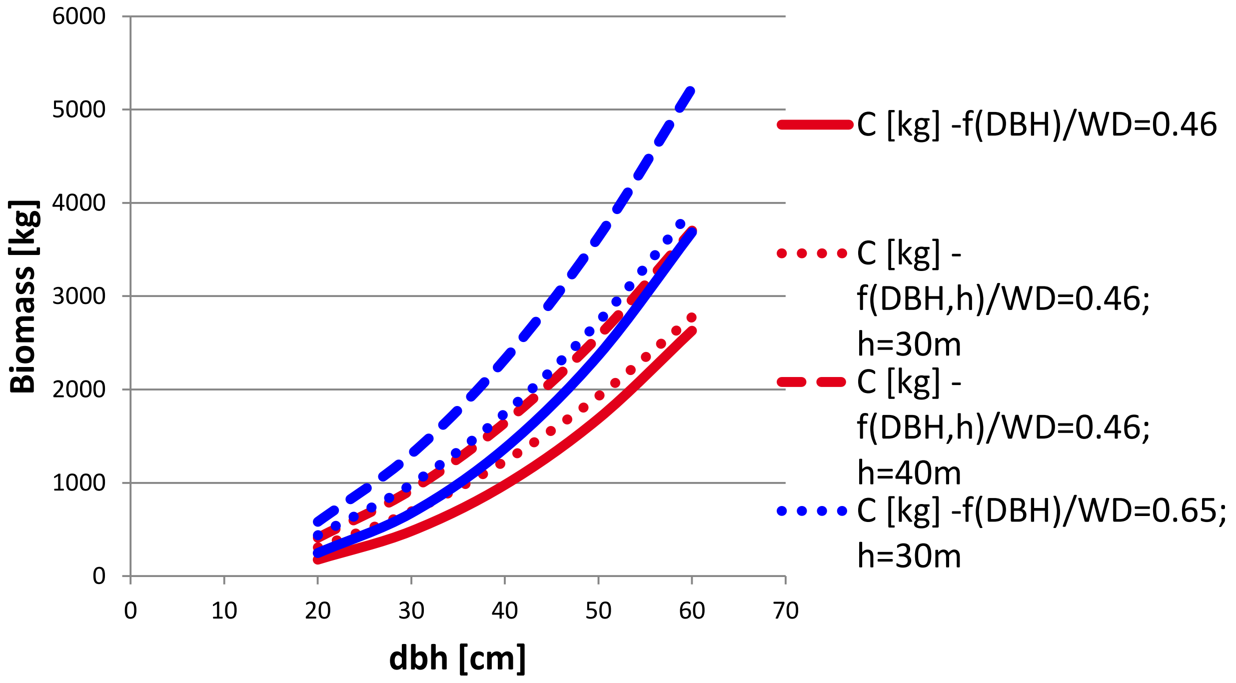
Biomass = f(dbh,WD)
Biomass = f(dbh,h,WD)

WD = 0.46 kg/m^3
Tree height: 30m/ 40m

Results for a tree with dbh=60 cm in a difference of 1073 kg (141%)

Biomass equation: Chave et al., 2014

Estimating individual tree biomass by biomass equations



Biomass = f(dbh,WD)
Biomass = f(dbh,h,WD)

WD [kg/m^3]= 0.46/ 0.65
Tree height [m]: 30/ 40

Biomass equation: Chave et al., 2014

How to deal with the uncertainty related to biomass functions

- Adopt a conservative estimate = principle of conservativeness

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- Selection of best-fitting allometric model for the respective forest types (results in ≈20 % error of tree AGB)

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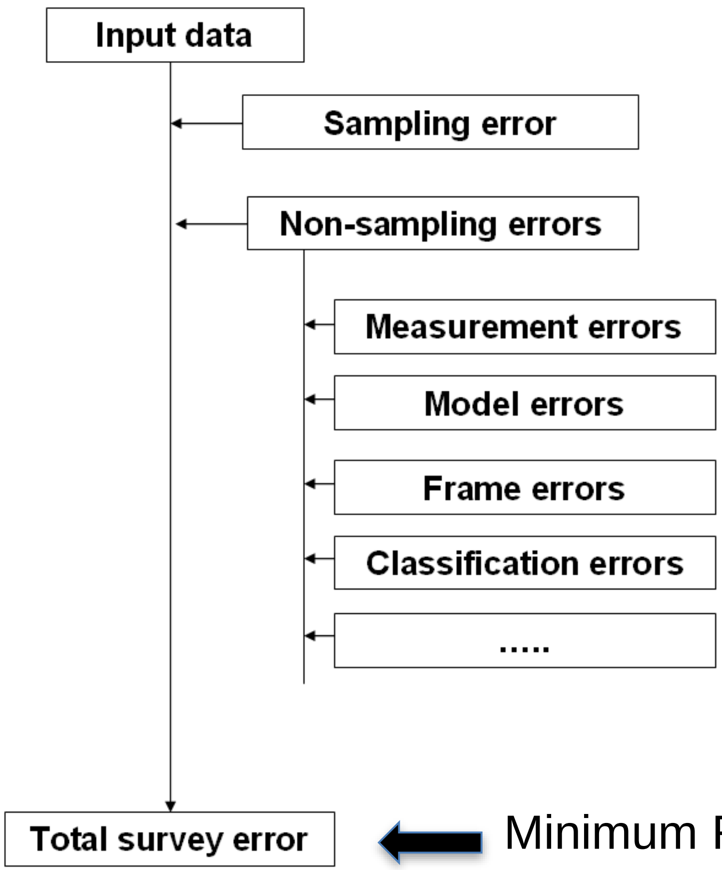
- Adopt a conservative estimate = principle of conservativeness

- Selection of best-fitting allometric model for the respective forest types (results in ≈20 % error of tree AGB)

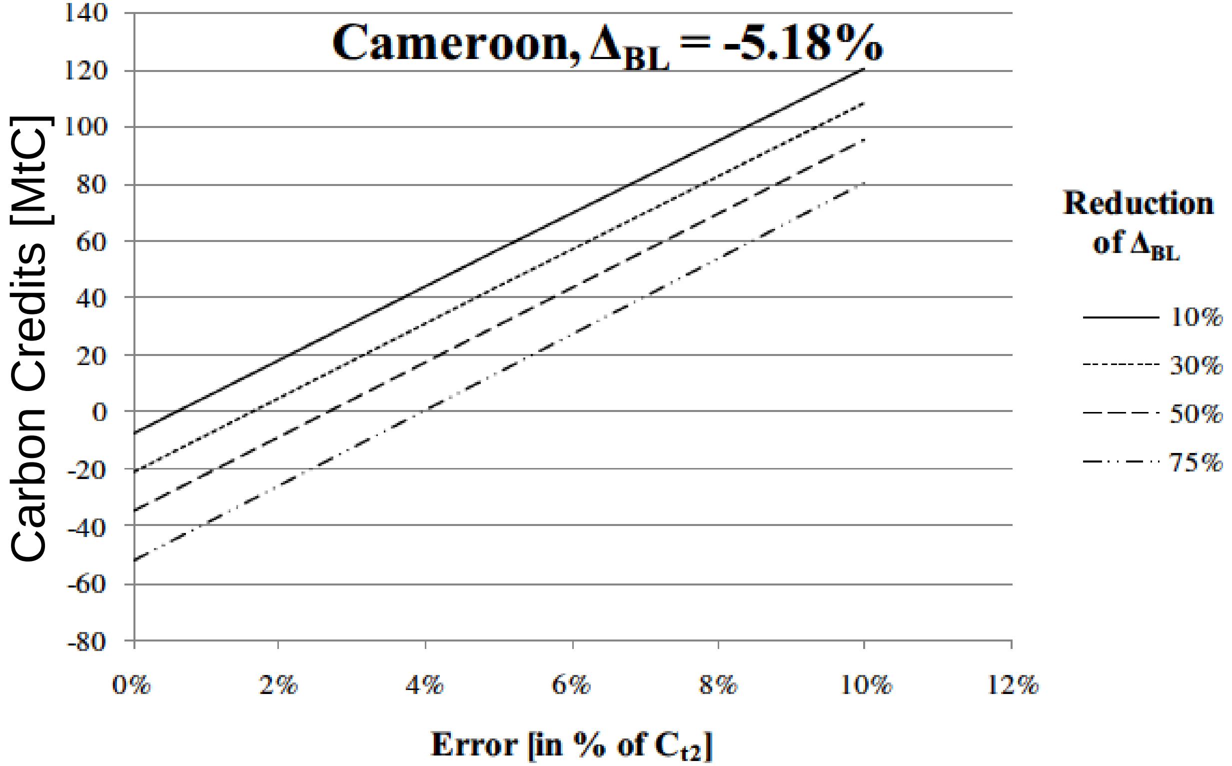
- Sampling approach
  - select a sub-sample of trees
  - on sub-sample intensive individual tree biomass assessment (e.g. accurate height measurement, stem taper, crown dimensions)
  - Update the sample with the biomass values assessed in the sub-sample

Sources of Uncertainties



Minimum Reliable Estimate (MRE)

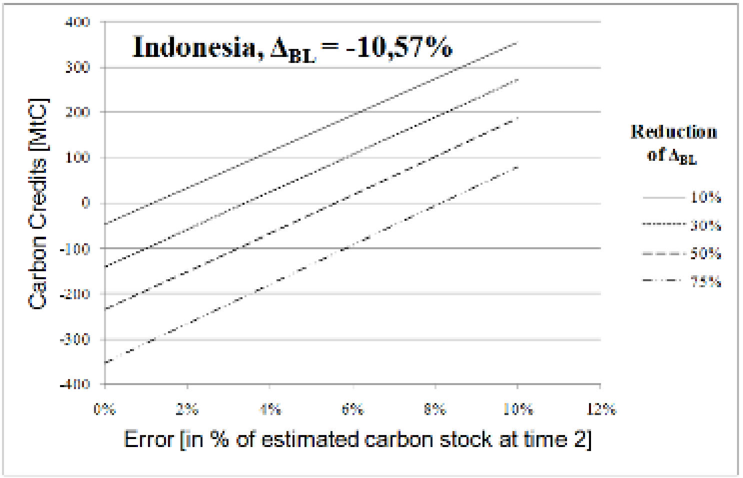
The Effect of Uncertainties on Accountable Carbon Credits

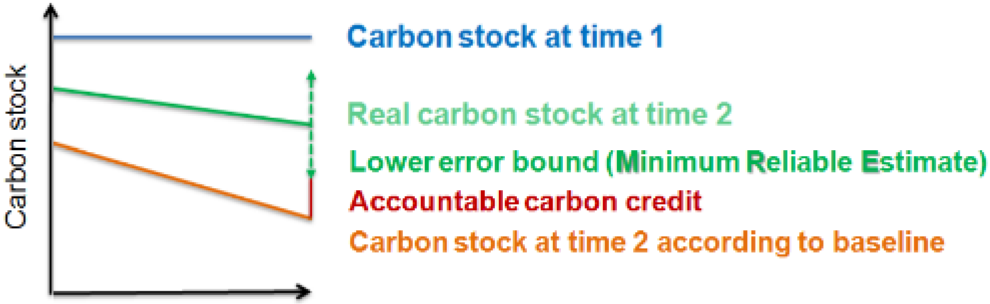


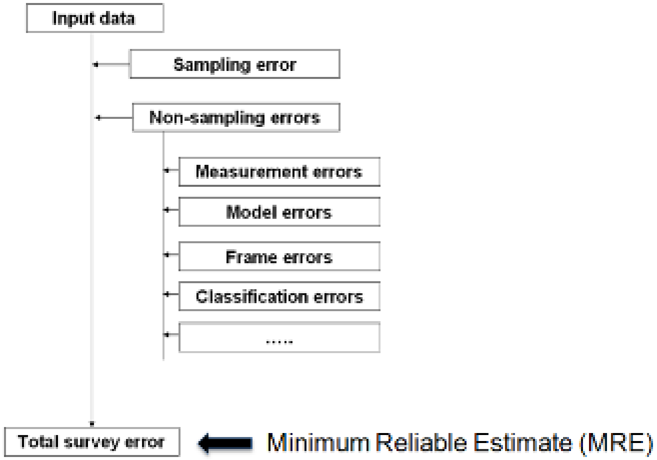
Source: Köhl et al., 2009

Error [in % of estimated carbon stock at time 2]

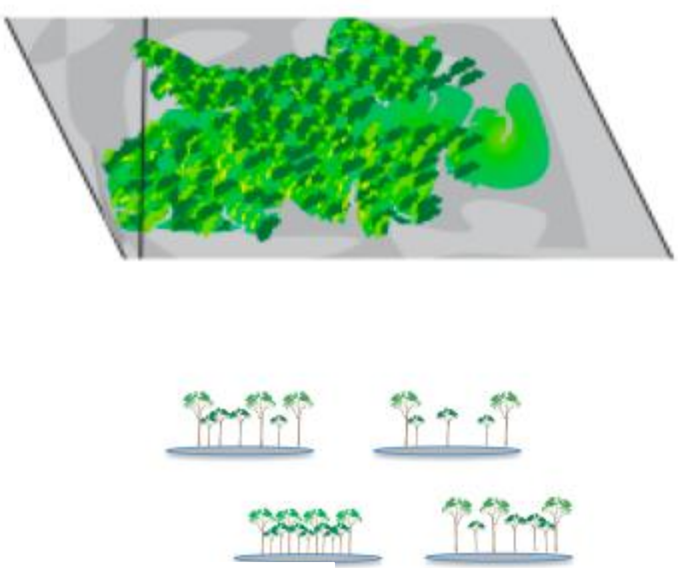
The amount of accountable carbon credits depends on the uncertainties underlying a national REDD monitoring concept







MRV: Inventory systems and sampling designs



Remote Sensing

Field assessments

Stratification

Regression estimates

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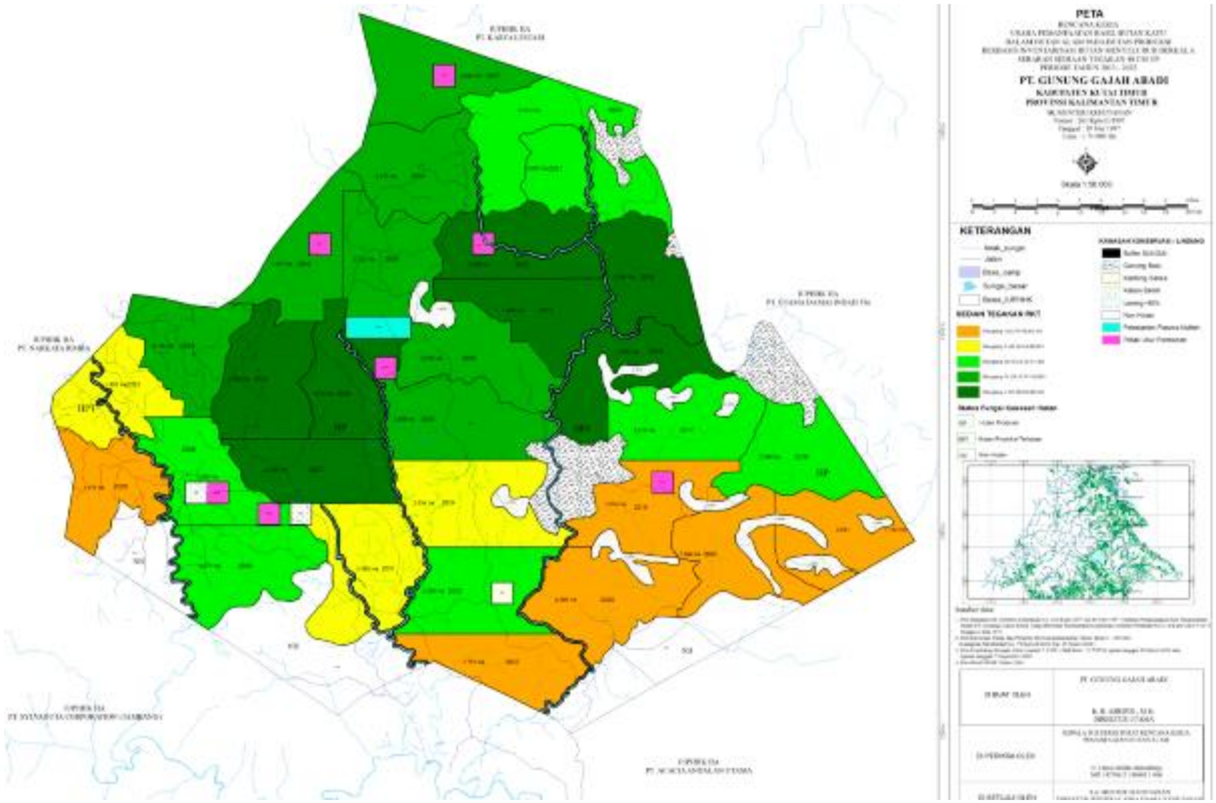
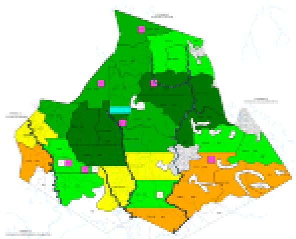
MRV: Inventory systems and sampling designs

Stratification



MRV: Inventory systems and sampling designs

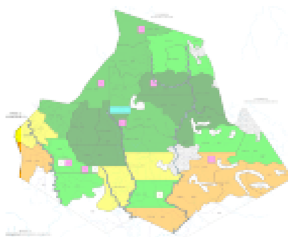
Stratification



Stratum 1		**Stratum 2**		....	**Stratum h**	
Size [ha]		Size [ha]			Size [ha]	
Mean biomass		Mean biomass			Mean biomass	
Variance		Variance			Variance	
Plot	Biomass	Plot	Biomass		Plot	Biomass
1	12984	1	5432		1	45232
2	23097	2	6349		2	54395
3	28358	3	4875		3	69745
...	...	...	....		...	....

MRV: Inventory systems and sampling designs

Stratification



Total
Size [ha]
Total biomass
Variance

Stratum 1	
Size [ha]	
Mean biomass	
Variance	
Plot	Biomass
1	12984
2	23097
3	28358
...	...

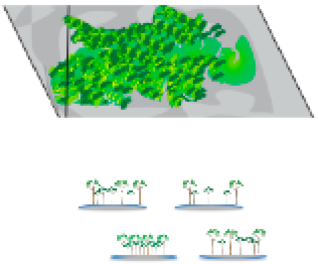
Stratum 2	
Size [ha]	
Mean biomass	
Variance	
Plot	Biomass
1	5432
2	6349
3	4875
...	....

....

Stratum h	
Size [ha]	
Mean biomass	
Variance	
Plot	Biomass
1	45232
2	54395
3	69745
...	....

MRV: Inventory systems and sampling designs

Regression estimate



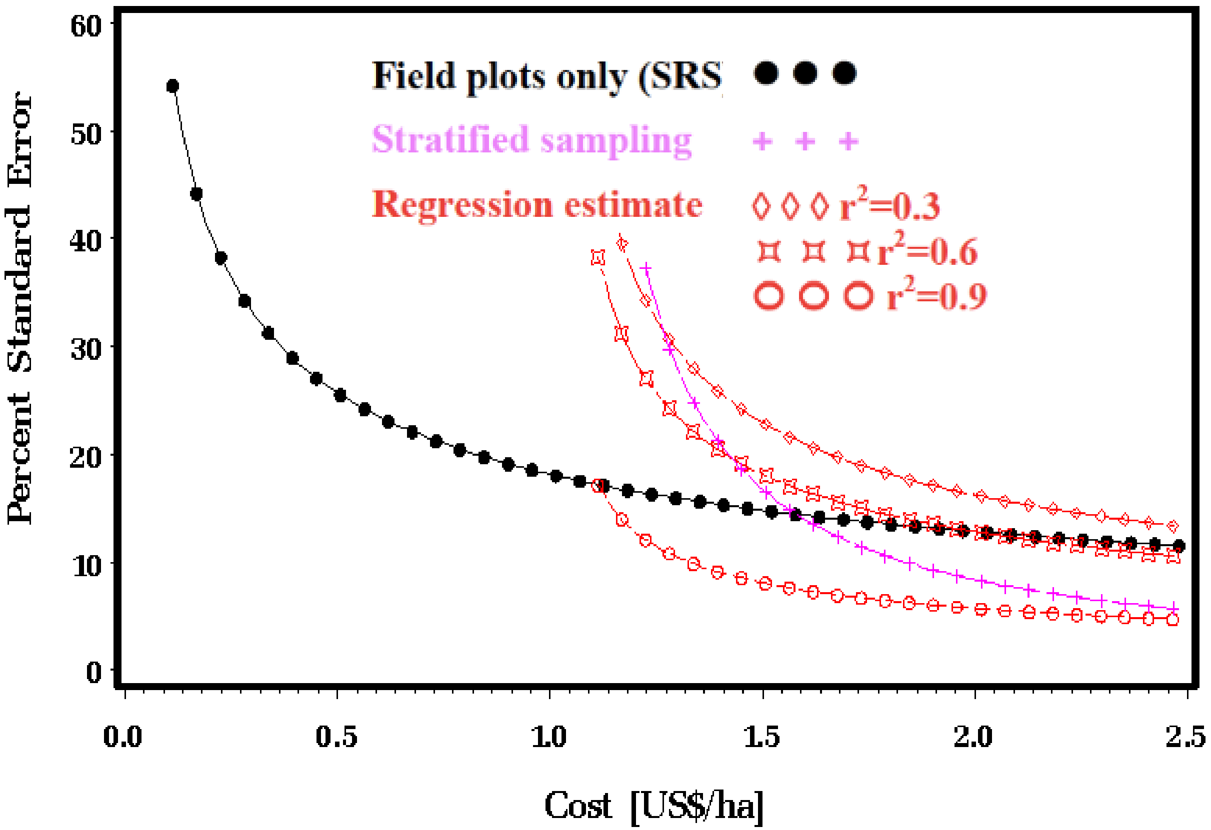
Plot	Biomass Remote Sensing	Biomass Field assessment
1	12984	18745
2	43097	41984
3	8358	8874
4	30863	29734
……..	…….	…….

estimated biomass =
mean biomass field plots + ß(mean biomass all pixels – mean biomass paired pixels)

ß = regression coefficient

r^2 = coefficient of determination = {0,...,1}

Optimal REDD+/ MRV design

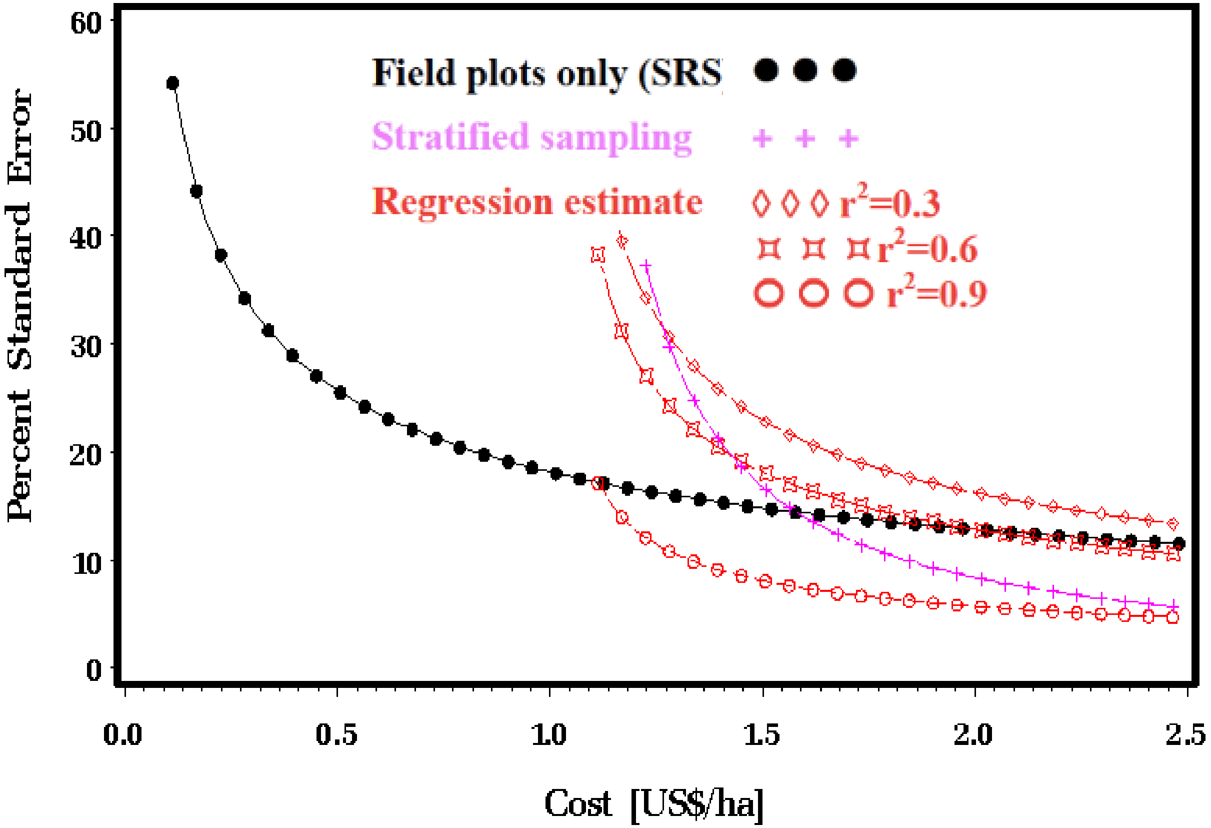


Wall-to-wall remote sensing coverage

Cost
Field = 500 US$/plot

Remote sensing = 1 US$/ha

Optimal REDD+/ MRV design



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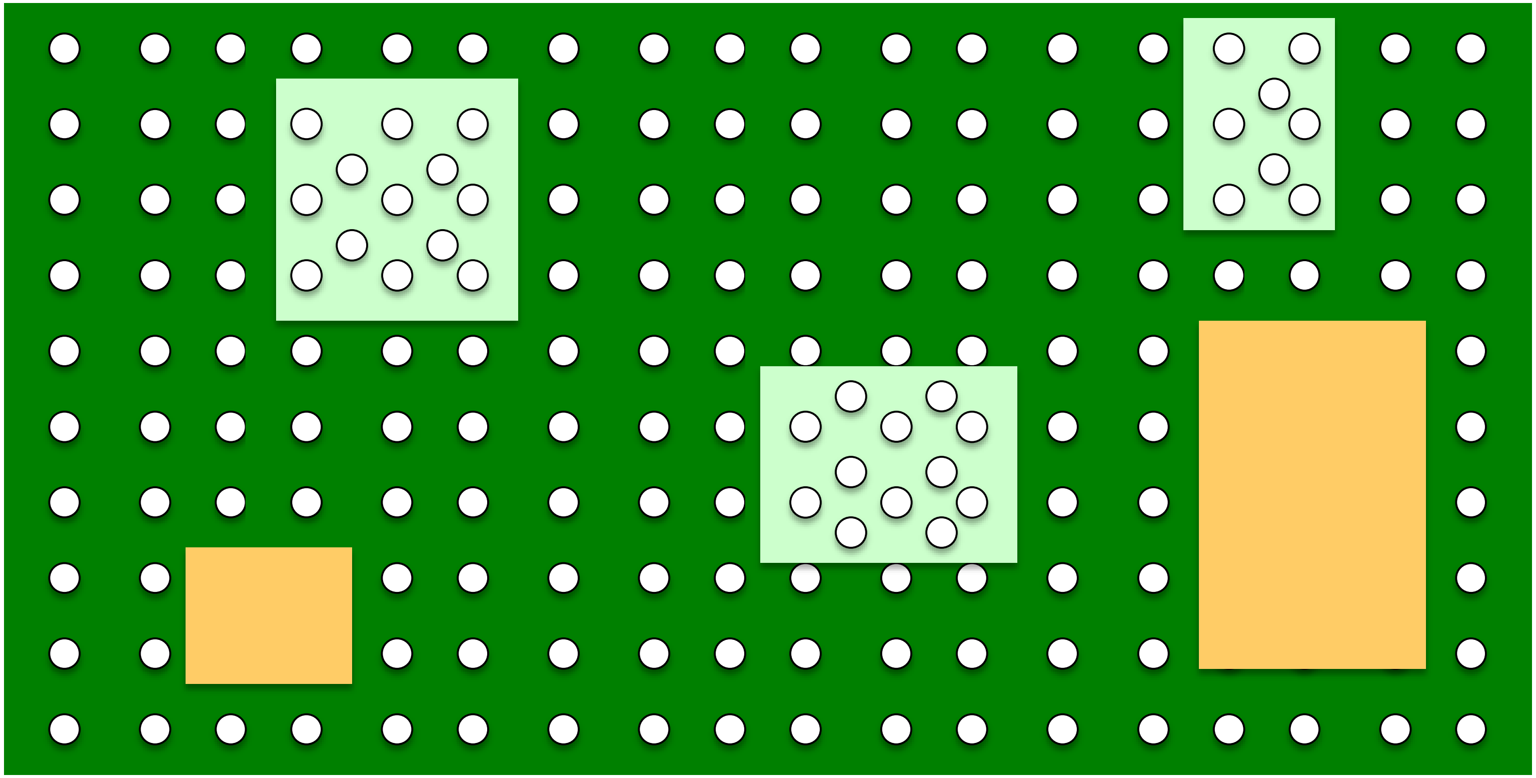
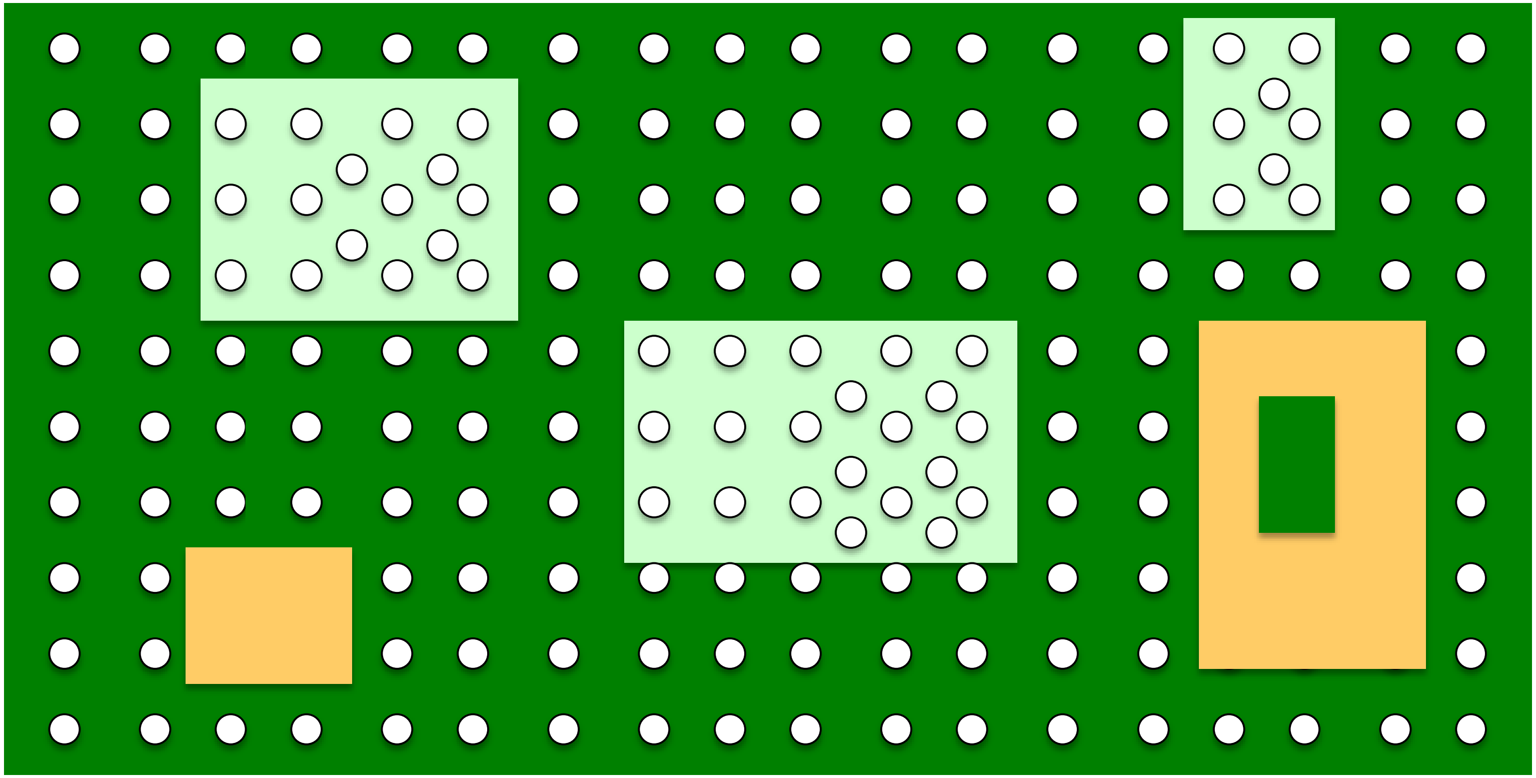
Sampling at Successive Occasions



Time 1

Sampling at Successive Occasions



Time 2

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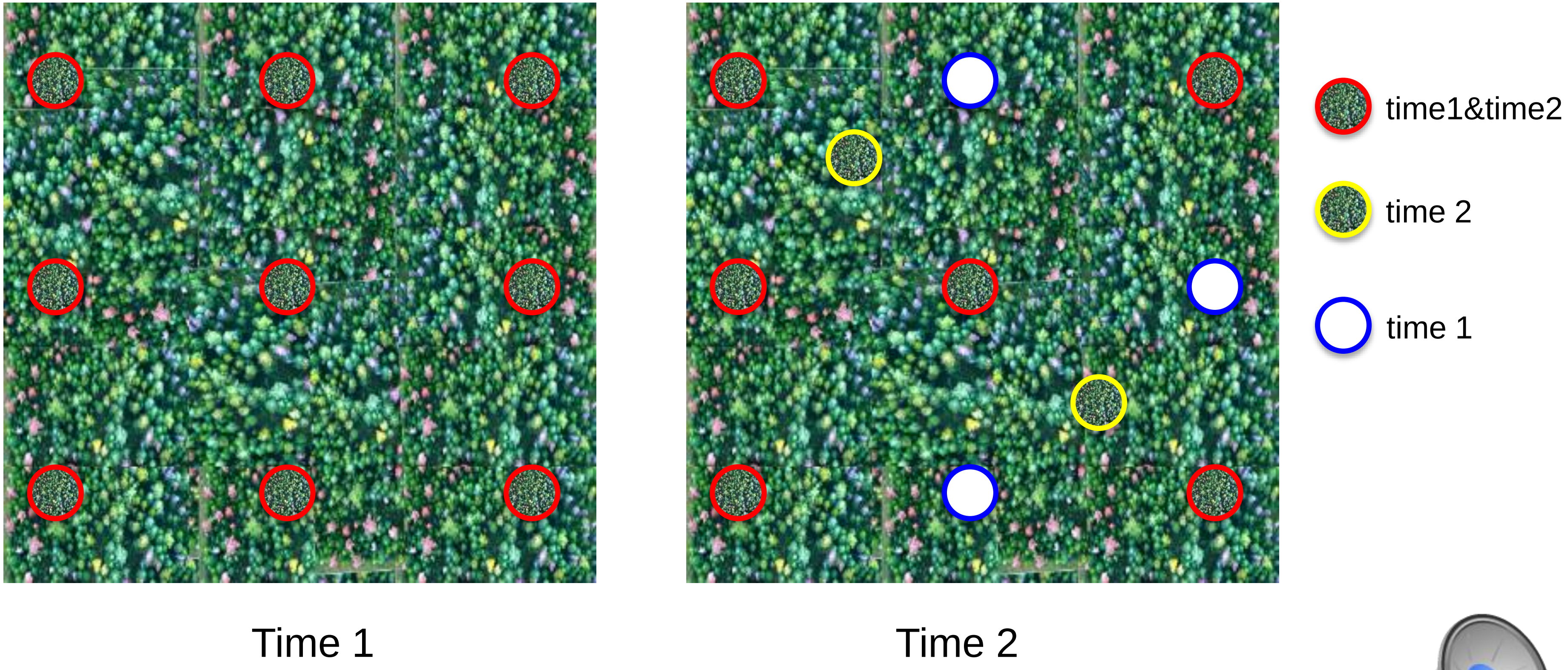
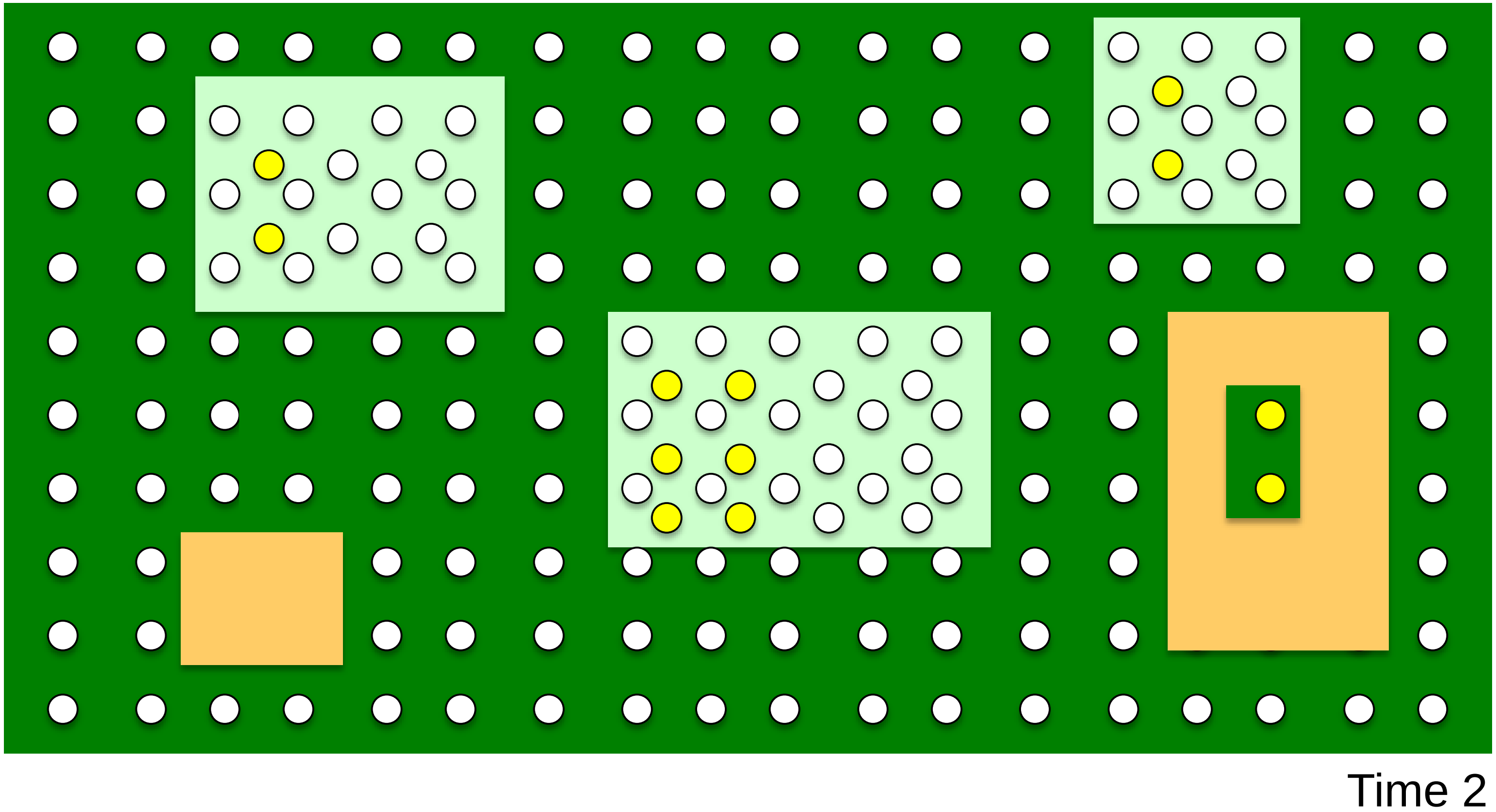
Sampling with Partial Replacement (SPR)



Sampling with Partial Replacement (SPR)



General Aspects of Uncertainties in Emissions

Uncertainties arise from different error sources

Reductions of uncertainty carry a cost

From an economic perspective a certain level of uncertainty is inevitable

Conclusion

Thank you!

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