

# **The utility of a global tree cover map for estimating local forest area**

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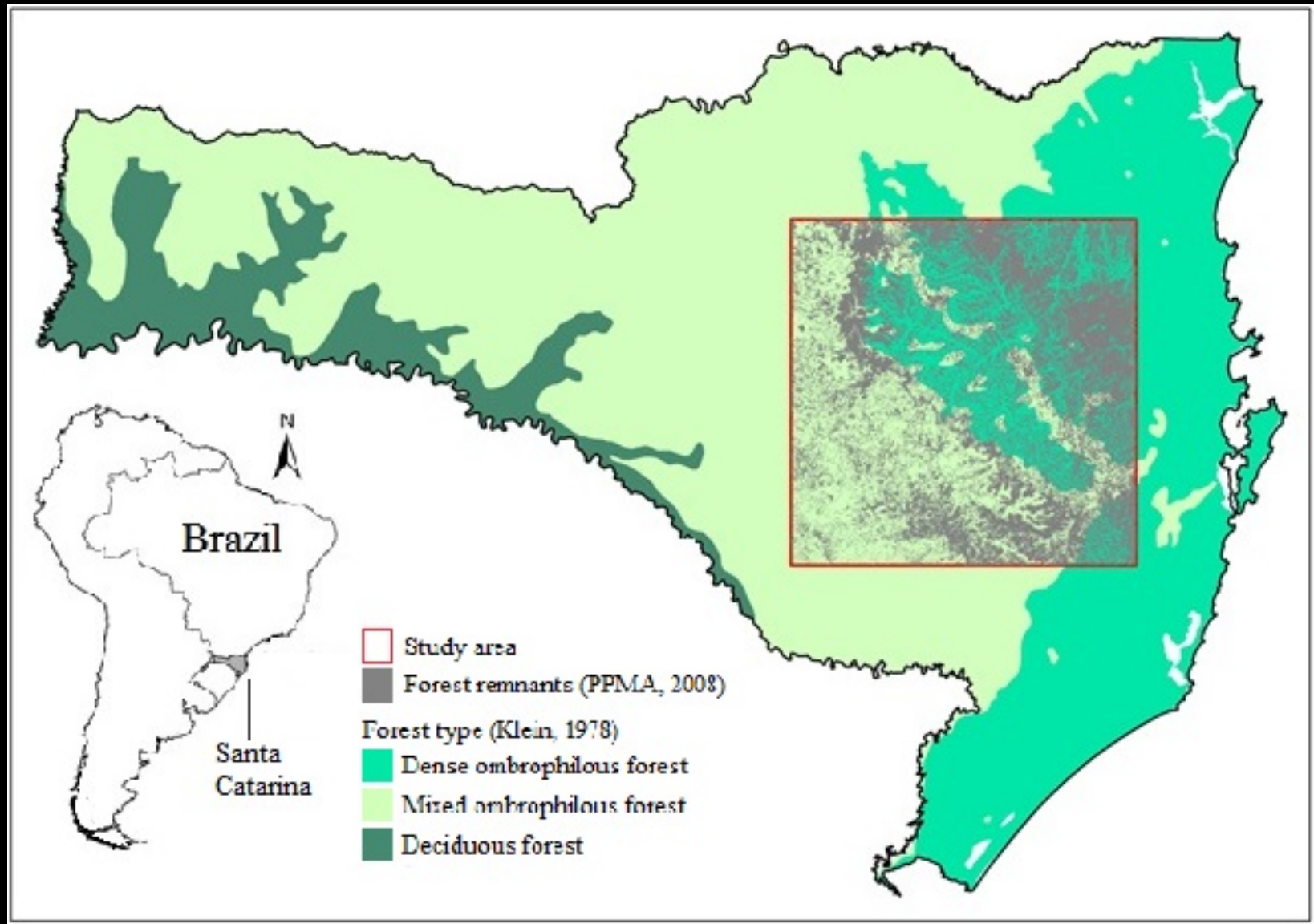
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# Objective:

- To compare estimates of forest area obtained using the University of Maryland global tree cover maps and a local map
- To compare stratified and model-assisted estimators

# Study area (150-km x 150-km)



# Data

- Global Forest Change (GFC) maps
  - University of Maryland
  - Percent tree canopy cover
- Local maps
  - Four local maps combined using logistic regression
  - Probability of forest
- Reference data
  - Santa Catarina Forest and Floristic Inventory
  - 255 forest/non-forest inventory plots
  - Systematic sample

# Statistical estimators

- **Maps are not truth!**
- Simple random sampling estimators
- Stratified estimators
- Model-assisted estimators

# Simple random sampling estimators:

- $\hat{\mu}_{\text{SRS}} = \frac{1}{n} \sum_{i=1}^n y_i$
- $\text{Vâr}(\hat{\mu}_{\text{SRS}}) = \frac{1}{n \cdot (n-1)} \sum_{i=1}^n (y_i - \hat{\mu}_{\text{SRS}})^2$
- Do not use the maps

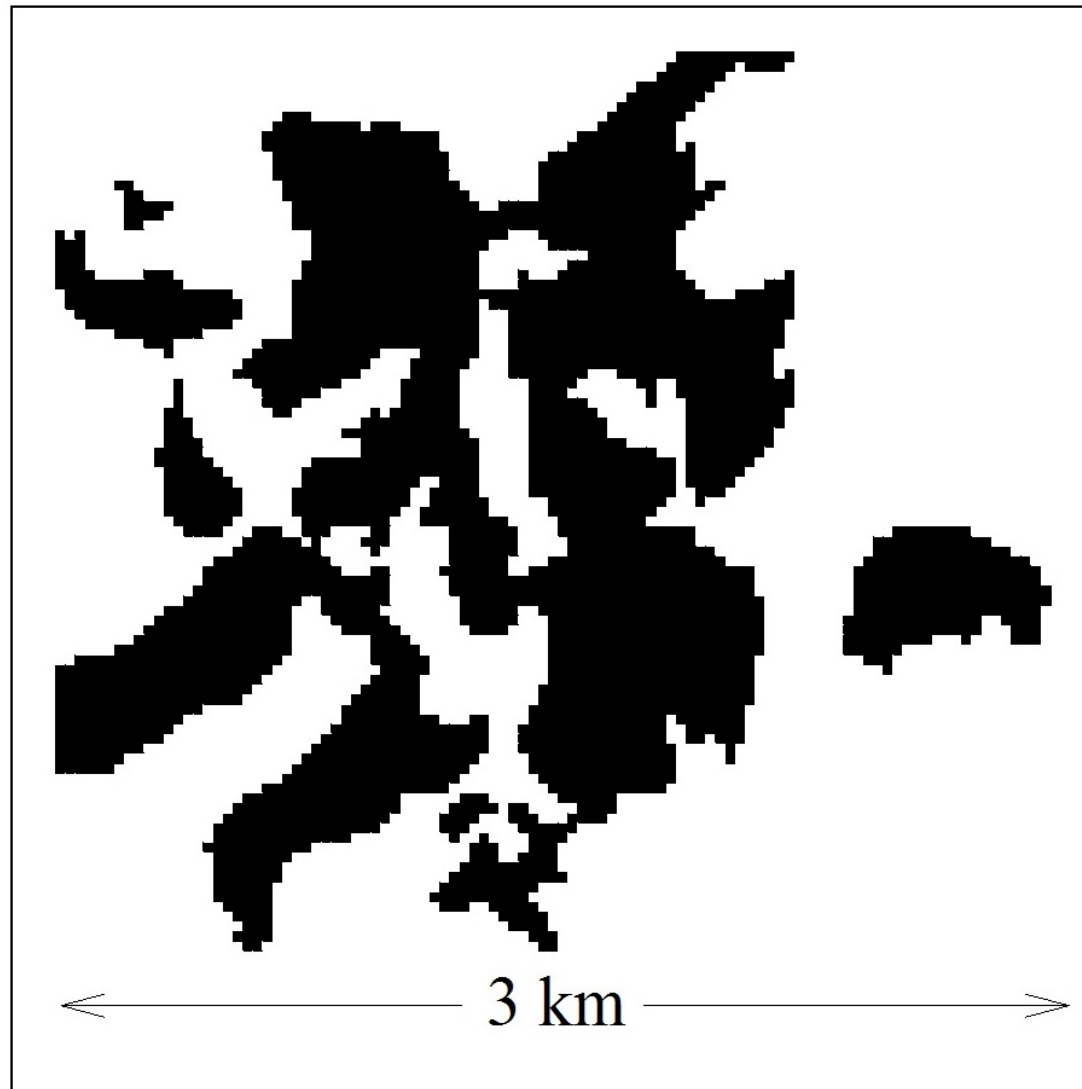
# Stratified estimators:

- $$\hat{\mu}_{\text{Str}} = \sum_{h=0}^1 w_h \cdot \bar{y}_h$$

- $$\text{Var}(\hat{\mu}_{\text{Str}}) = \sum_{h=0}^1 w_h^2 \cdot \frac{\hat{\sigma}_h^2}{n_h}$$

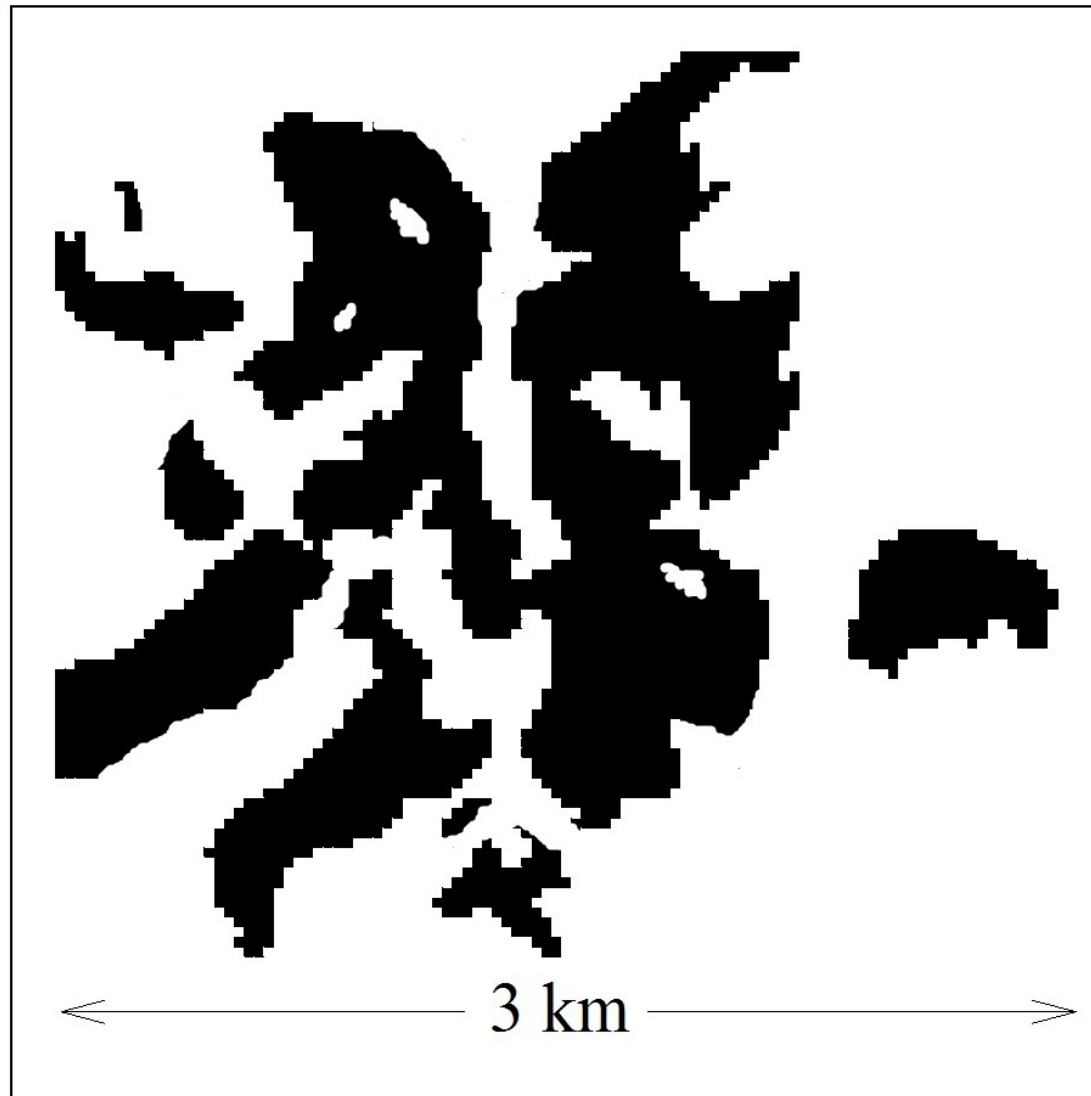
- What should be the stratum boundary?

F/NF boundary = 10% tree canopy cover

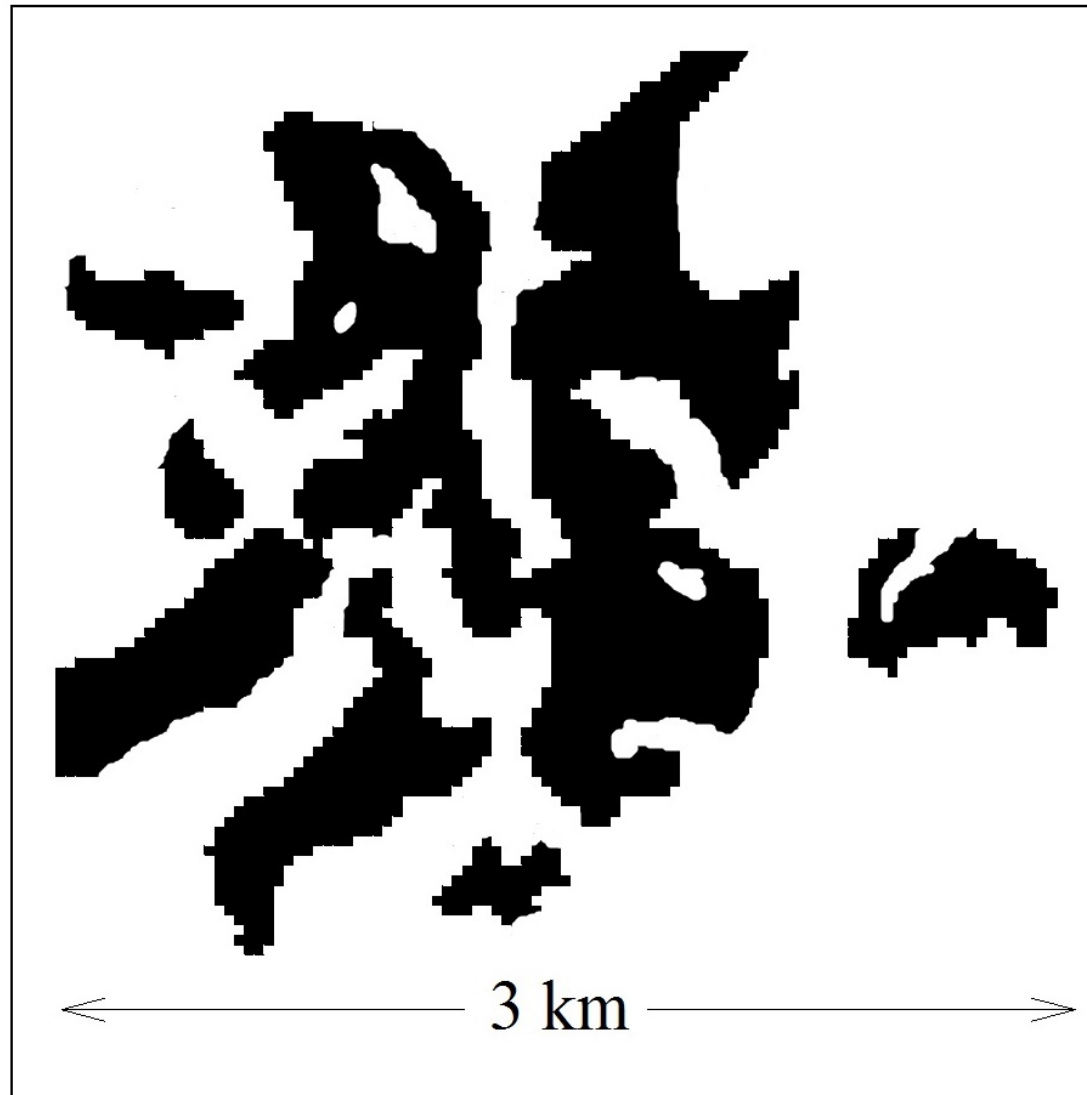




F/NF boundary = 20% tree canopy cover



F/NF boundary = 30% tree canopy cover



## Model-assisted estimators:

- $\hat{\mu}_{MA} = \frac{1}{N} \sum_{i=1}^N \hat{y}_i - \frac{1}{n} \sum_{i=1}^n (\hat{y}_i - y_i)$
- $V\hat{a}r(\hat{\mu}_{SRS}) = \frac{1}{n \cdot (n-1)} \sum_{i=1}^n (\varepsilon_i - \bar{\varepsilon})^2$

where  $\varepsilon_i = y_i - \hat{y}_i$



<b>Map</b>	<b>Stratified</b>				<b>Model-assisted</b>			
	Bdry	$\hat{\mu}_{\text{Str}}$	$\text{SE}(\hat{\mu}_{\text{Str}})$	RE	Bdry	$\hat{\mu}_{\text{MA}}$	$\text{SE}(\hat{\mu}_{\text{MA}})$	RE
SC	10	–	–	–				
	30	0.44	0.024	1.67				
	50	0.44	0.024	1.69				
	<i>50</i>	<i>0.44</i>	<i>0.024</i>	<i>1.69</i>				
GFC	10	0.46	0.030	1.13				
	30	0.46	0.029	1.15				
	50	0.45	0.028	1.21				
	<i>95</i>	<i>0.47</i>	<i>0.027</i>	<i>1.37</i>				

<b>Map</b>	<b>Stratified</b>				<b>Model-assisted</b>			
	Bdry	$\hat{\mu}_{\text{Str}}$	$\text{SE}(\hat{\mu}_{\text{Str}})$	RE	Bdry	$\hat{\mu}_{\text{MA}}$	$\text{SE}(\hat{\mu}_{\text{MA}})$	RE
SC	10	–	–	–	10	0.48	0.031	1.00
	30	0.44	0.024	1.67	30	0.43	0.027	1.36
	50	0.44	0.024	1.69	50	0.42	0.027	1.39
	50	0.44	0.024	1.69	<i>Contin.</i>	0.44	0.024	1.77
GFC	10	0.46	0.030	1.13				
	30	0.46	0.029	1.15				
	50	0.45	0.028	1.21				
	95	0.47	0.027	1.37				

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	50	0.44	0.024	1.69	<i>Contin.</i>	0.44	0.024	1.77
GFC	10	0.46	0.030	1.13	10	0.45	0.032	0.93
	30	0.46	0.029	1.15	30	0.44	0.033	0.93
	50	0.45	0.028	1.21	50	0.43	0.032	0.95
	95	0.47	0.027	1.37	<i>Contin.</i>	0.44	0.030	1.08

# Summary

- **Maps are not truth!**
- The local maps produced more precise estimates than the global maps
- In the absence of a local map, the global maps produced estimates that were more precise than if the maps had not been used
- The tree canopy cover threshold may have to be adjusted to conform to the local definition of forest
- For forest/non-forest, stratified estimators produced more precise estimates