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Challenges and Opportunities in Monitoring of Emission Reductions in World Bank Land Use Carbon Finance Programs

Andres Espejo

Forest Carbon Partnership Facility
BioCarbon Fund

May 25, 2017

Our Objectives

Promote and reward reduced greenhouse gas emissions and increased sequestration through better land management, climate-smart agriculture, and smarter land use planning and policies.

- Integrate sub-national development agenda with low-carbon pathways.
- Support forest countries to maintain and improve **livelihoods, conserve biodiversity** and leverage significant private and public sector finance to achieve transformational change.
- **Demonstrate approaches that can be applied nationally** i.e., national low-carbon strategies and global mechanisms of support such as REDD+.

World Bank Forest Climate Funds ($2.3 billion)

Forest Carbon Partnership Facility (2008)

FOREST CARBON PARTNERSHIP FACILITY

$1.1B

- Readiness $365M
- Carbon Fund $692M

Forest Investment Program (FIP) (2009)

MDBs $787M
World Bank $399M

FIP FOREST INVESTMENT PROGRAM

- **Investments (grants, co-financing), Preparation Grants, Dedicated Grant Mechanism**
- **Investments inside and outside forests; institutional capacity, forest governance, and information**

Initiative for Sustainable Forest Landscapes (ISFL)(2013)

BioCarbon Fund

$340M (ISFL)
$90M (Classic)

- Technical Assistance $98M
- Result-based payments $244M

BioCF Tranche 1 & 2 (CDM and voluntary markets) (2004)

- Result-based payments $83.3M
- Technical Assistance $6.3M

** For all MDB's

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Business Model

Enabling Environment

- Policy and strategy
- Capacity building
- Social inclusion
- Consultation

Development Action

- Investments in low carbon development
- Sustainable management of forests
- Climate-smart ag

Low-Carbon Development Benefits

- Poverty alleviation
- Shared prosperity
- Climate change mitigation and adaptation

We provide:

FOREST CARBON PARTNERSHIP FACILITY

BioCarbon Fund
Initiative for Sustainable Forest Landscapes

Grant Funding; Technical Assistance

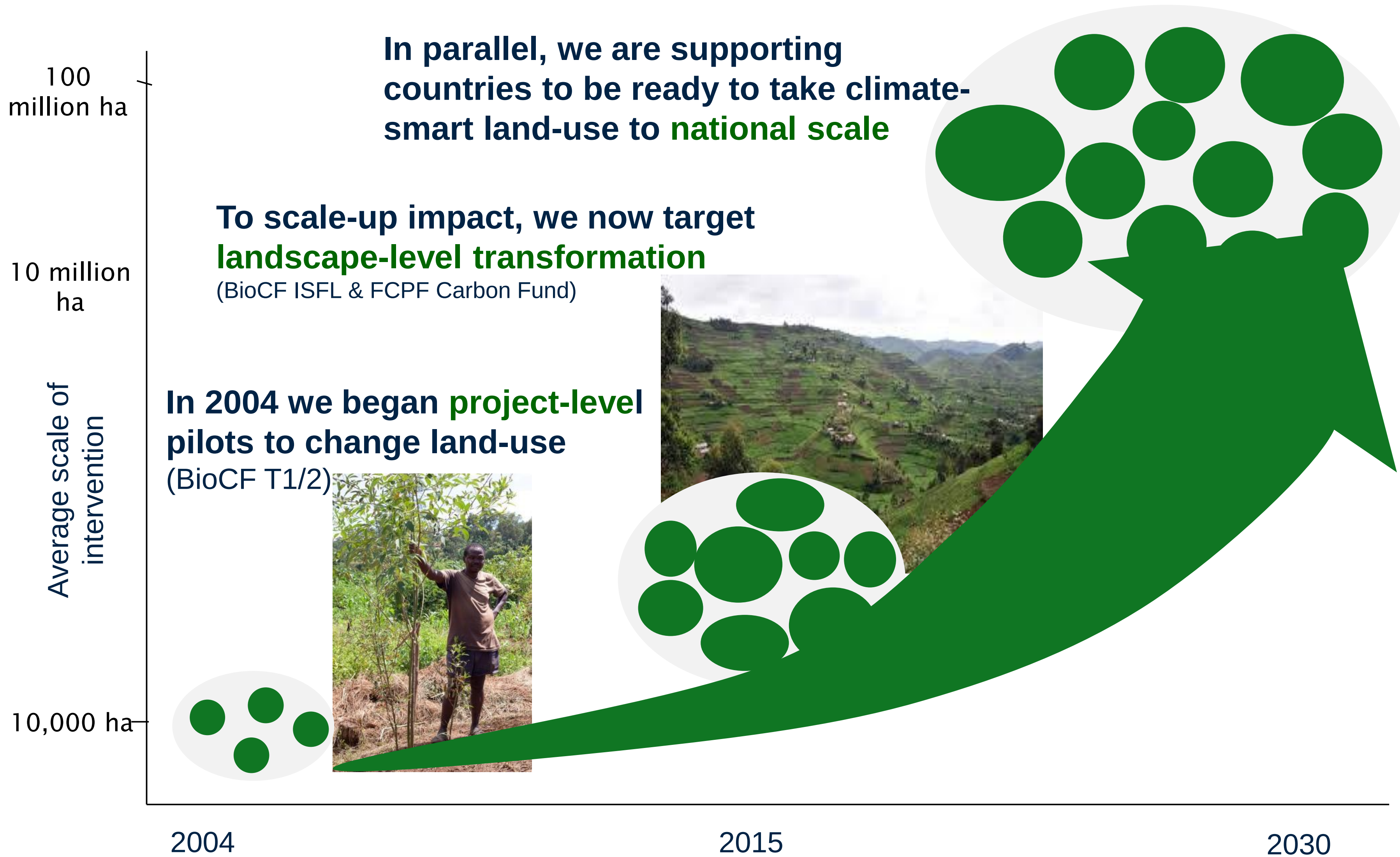
Results-Based Finance for Emission Reductions

We "crowd-in":

Private and Public Finance, including IDA, IBRD,GEF financing

FIP FOREST INVESTMENT PROGRAM

Why We are Scaling-up Our Programs



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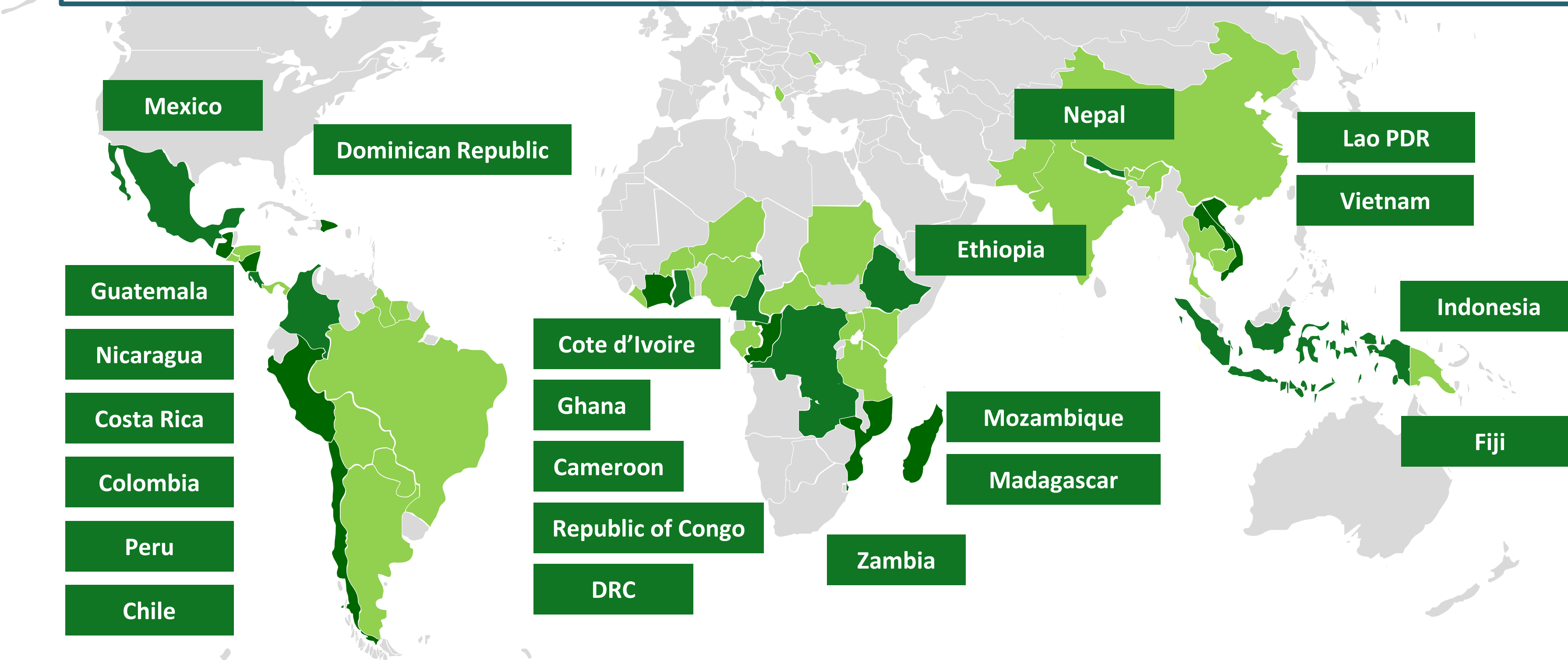
WHERE WE WORK

22 countries with large scale climate-smart land-use programs

54 countries with REDD+ readiness support or projects



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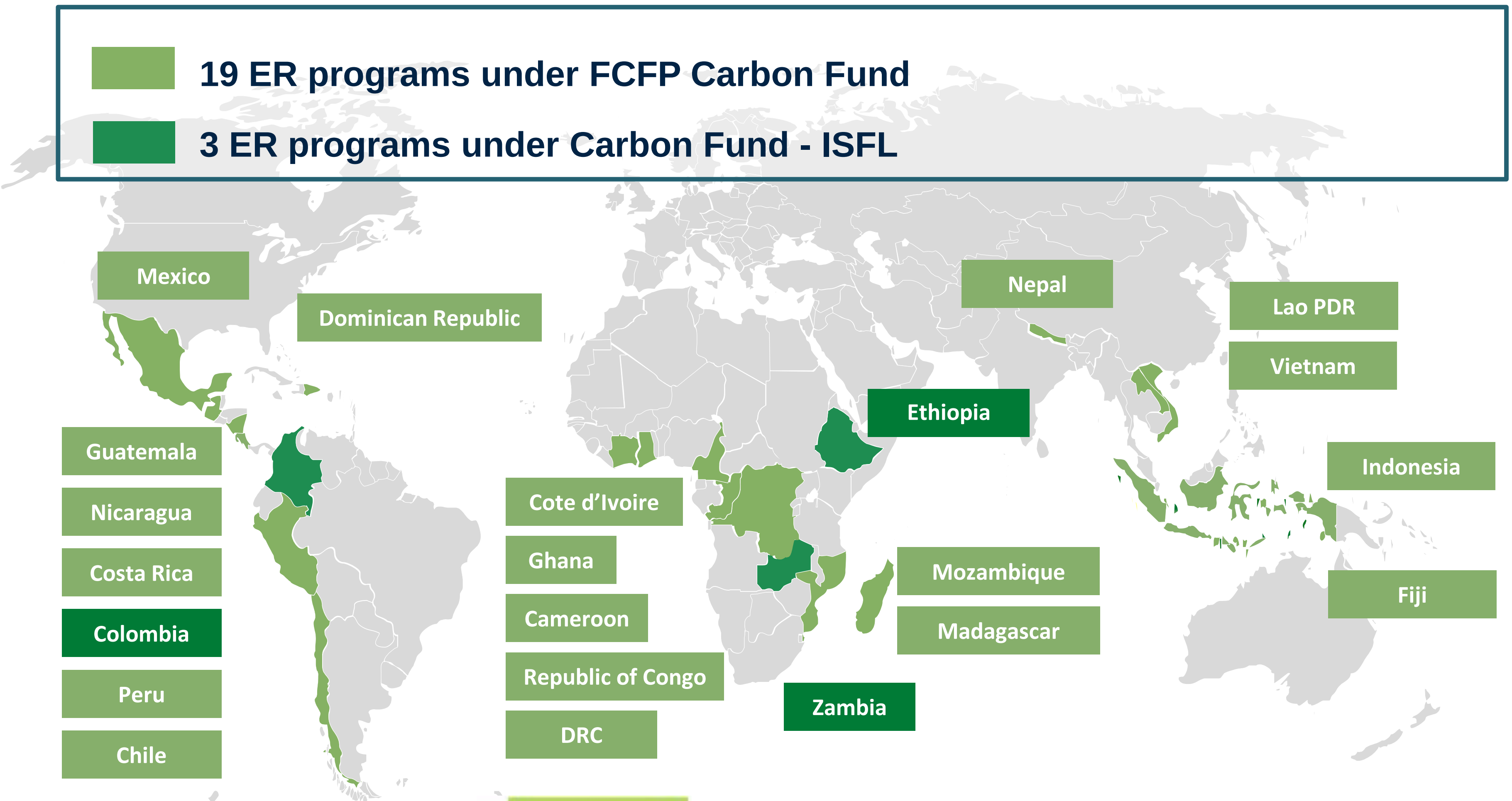
Where We Work – Land Use programs



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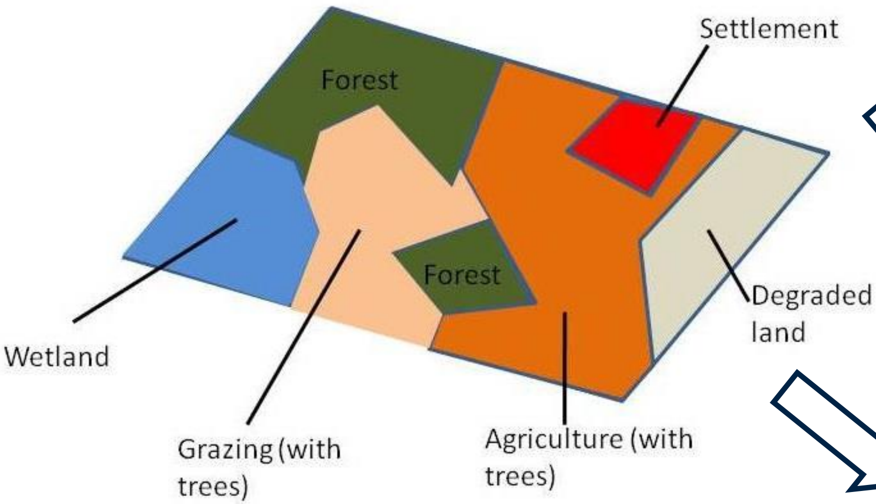
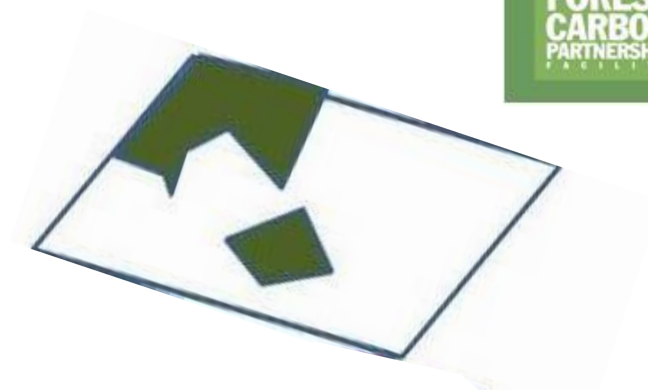
FOREST CARBON PARTNERSHIP FACILITY
Carbon Fund

BioCarbon Fund
Initiative for Sustainable Forest Landscapes

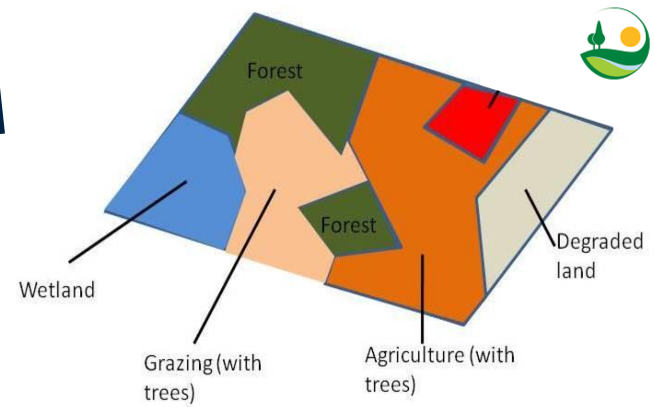
DIFFERENCE BETWEEN FCPF CF AND ISFL

Carbon Fund





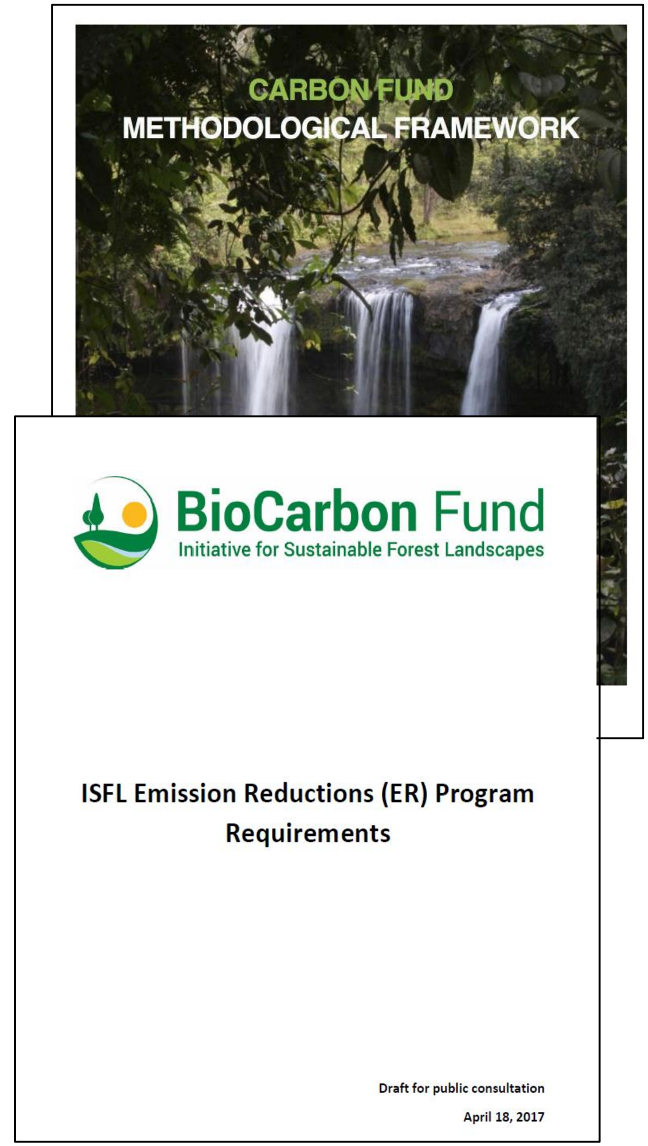
REDD+ ≈ Forestry sector



Landscape ≈ AFOLU sector

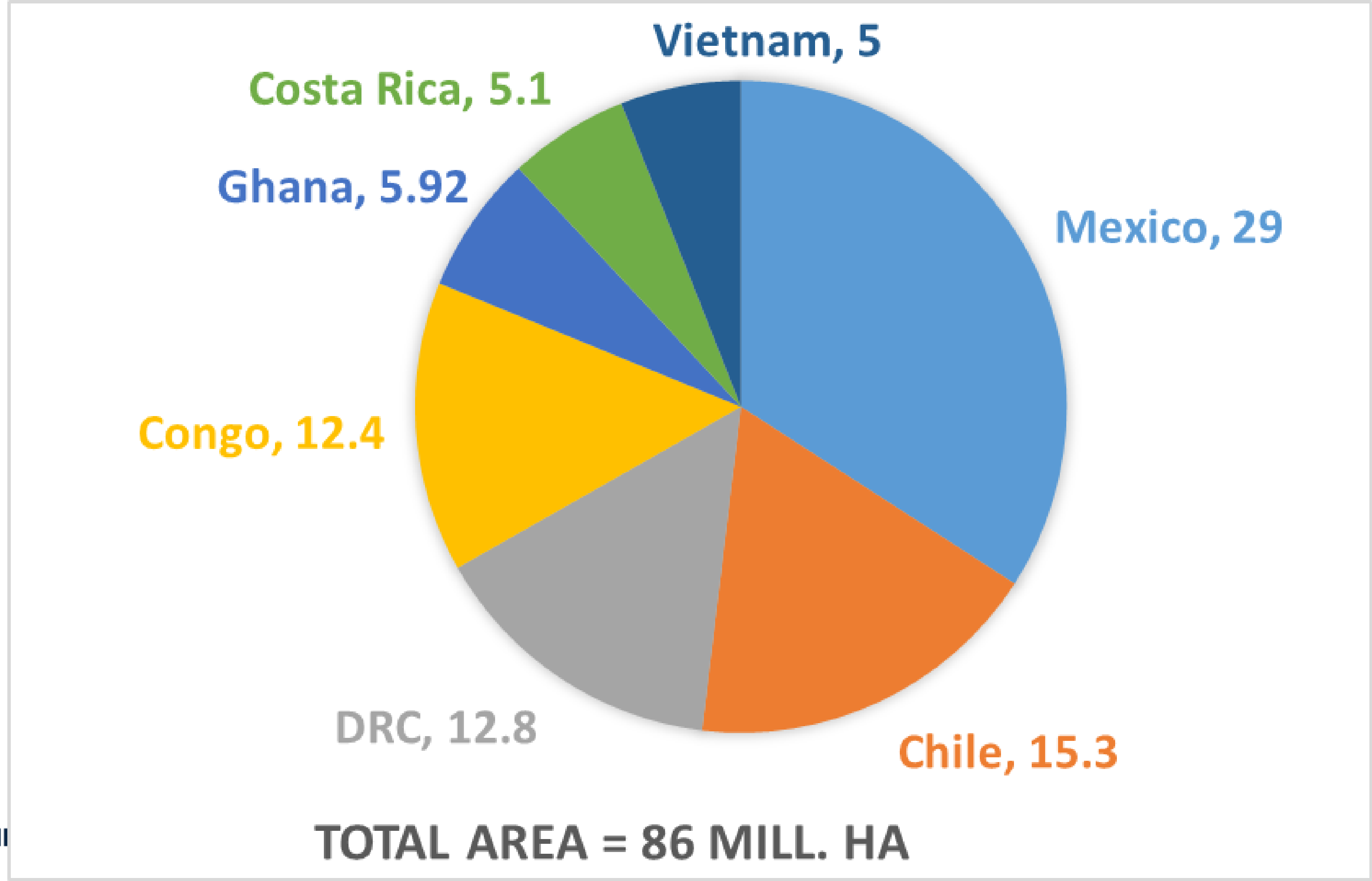
GHG ACCOUNTING REQUIREMENTS

- ER programs have to present RL and MRV system designs compliant with methodological requirements
- Some highlights:
  - ✓ GHG emissions from forest degradation or FL-FL must be accounted for
  - ✓ GHG emissions and removals have to be estimated with IPCC Tier 2, Tier 1 may be used exceptionally
  - ✓ Uncertainties estimated via Monte Carlo methods
  - ✓ Discounts are applied to ERs if HWCI >15% at 90% of confidence



Reference Levels of ER programs

- 7 ER programs have presented Reference Levels so far
- Some figures…



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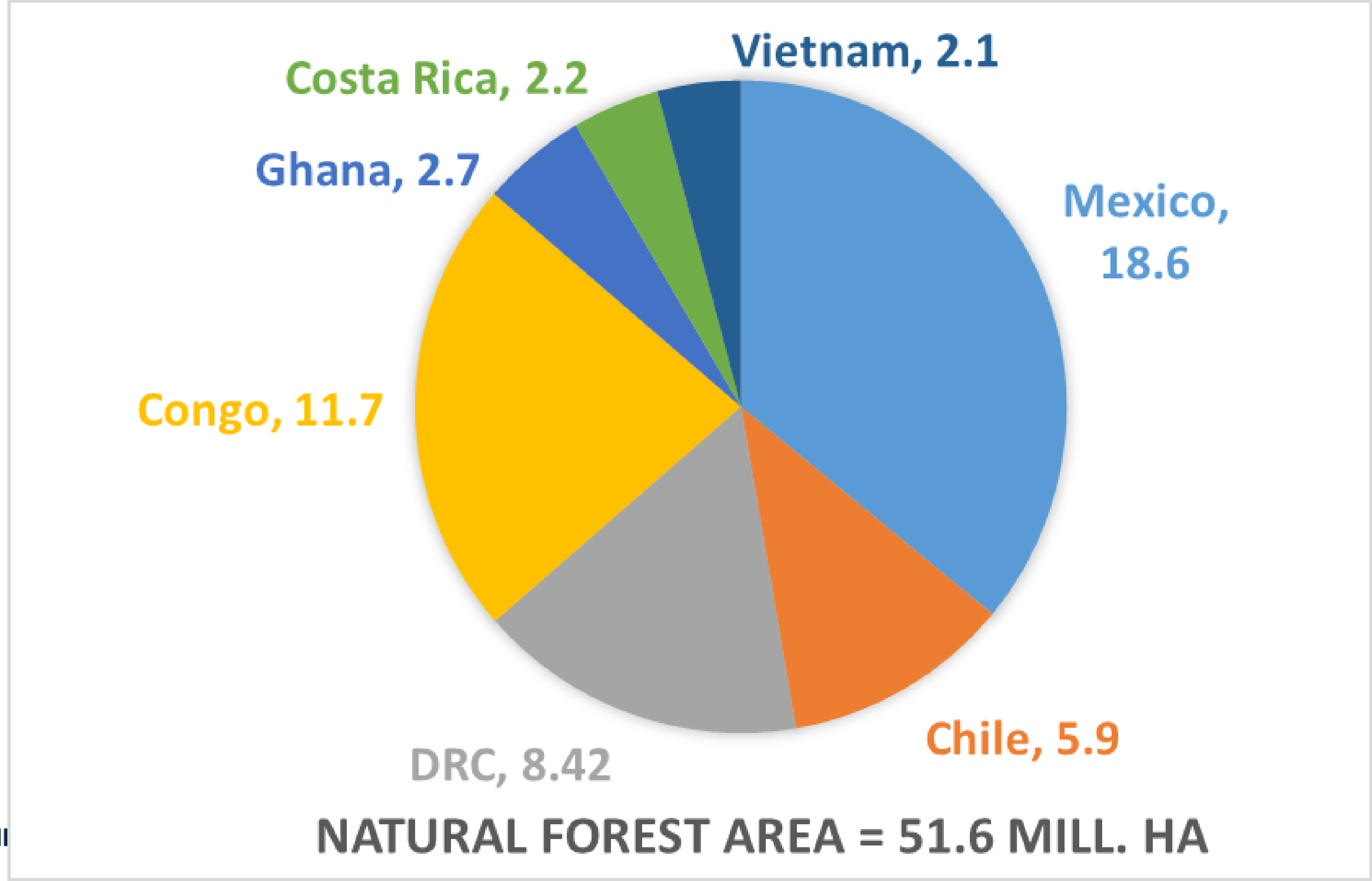

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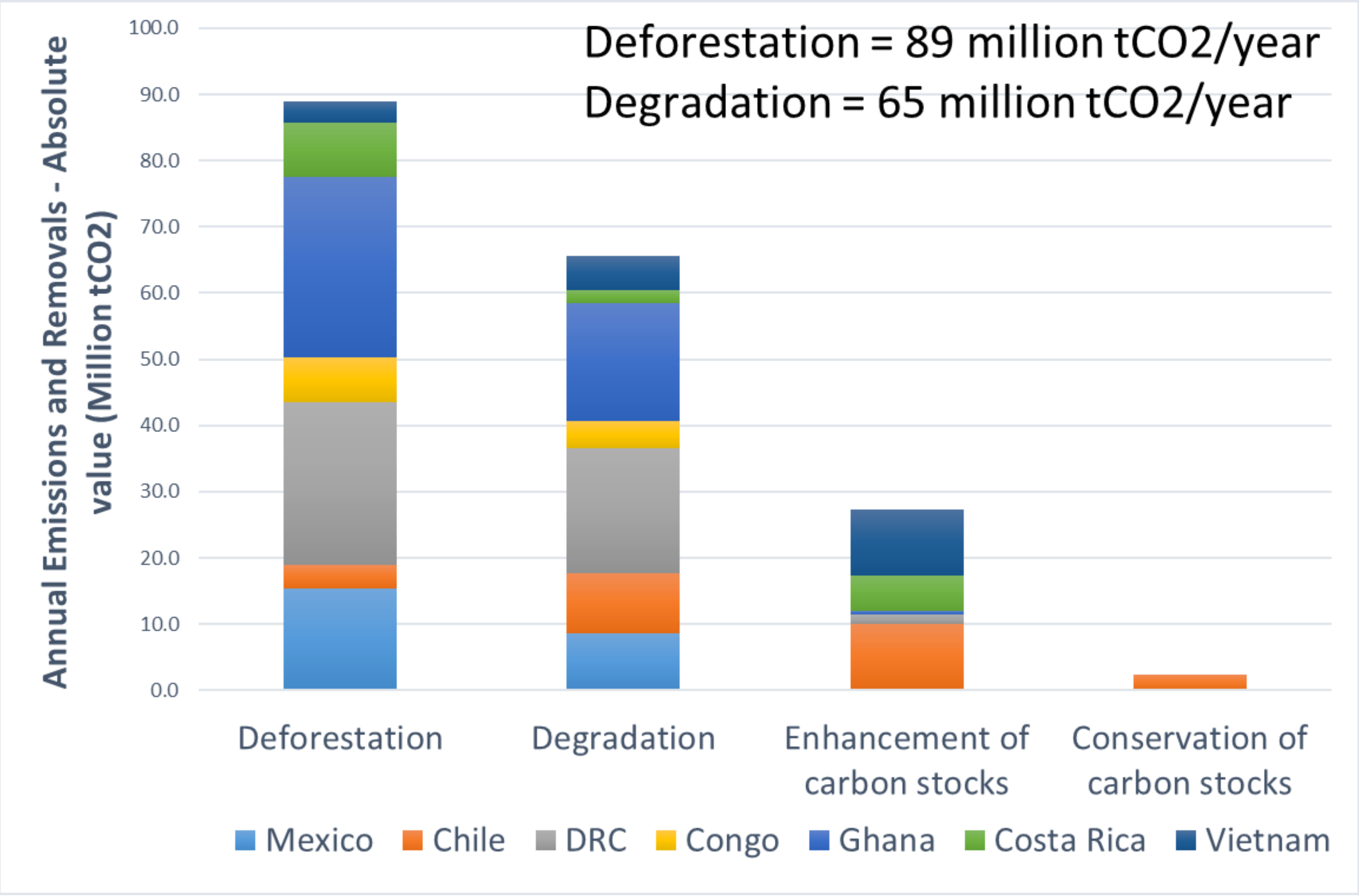

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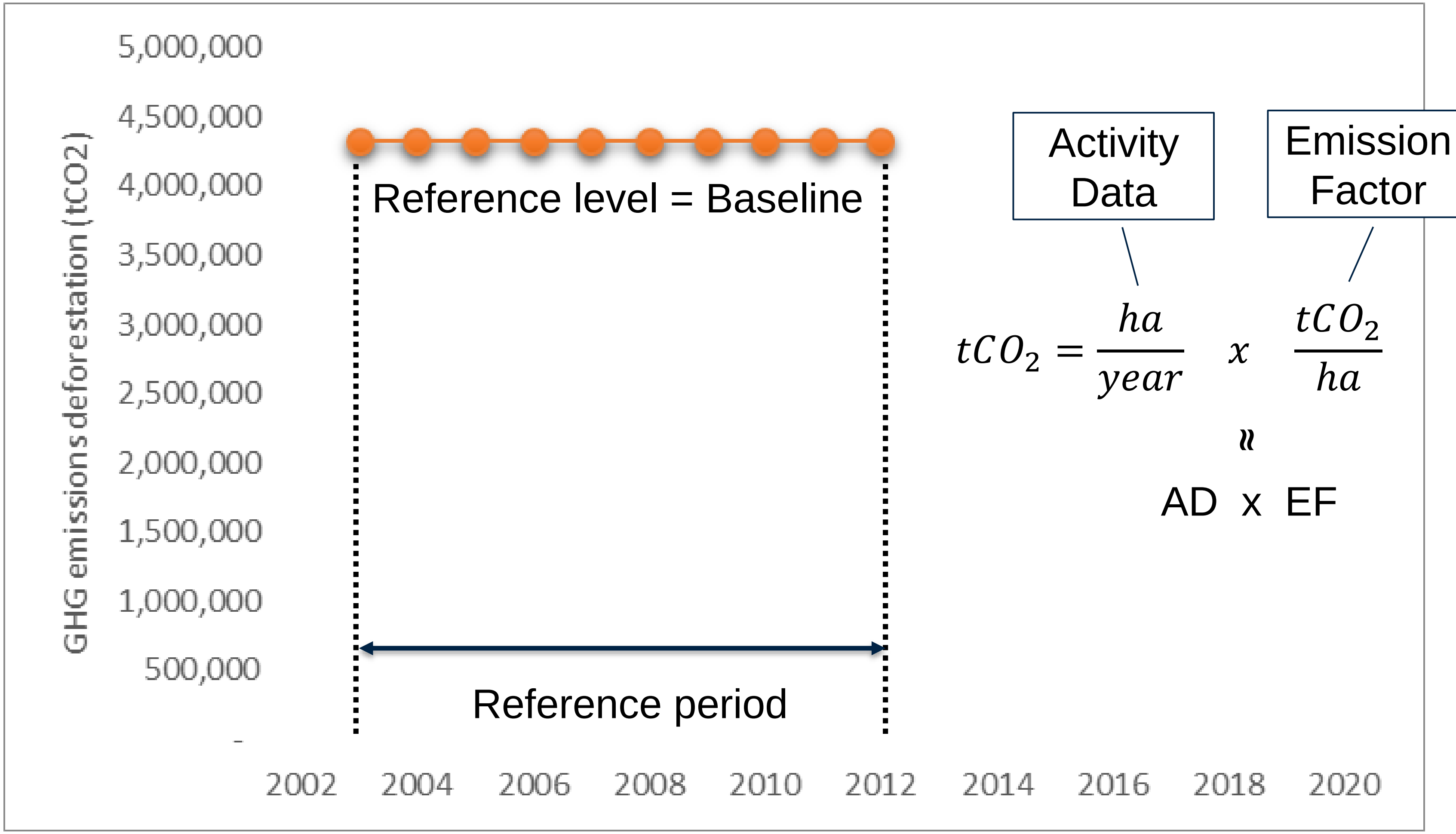
How to estimate Emission Reductions

- A simple case…



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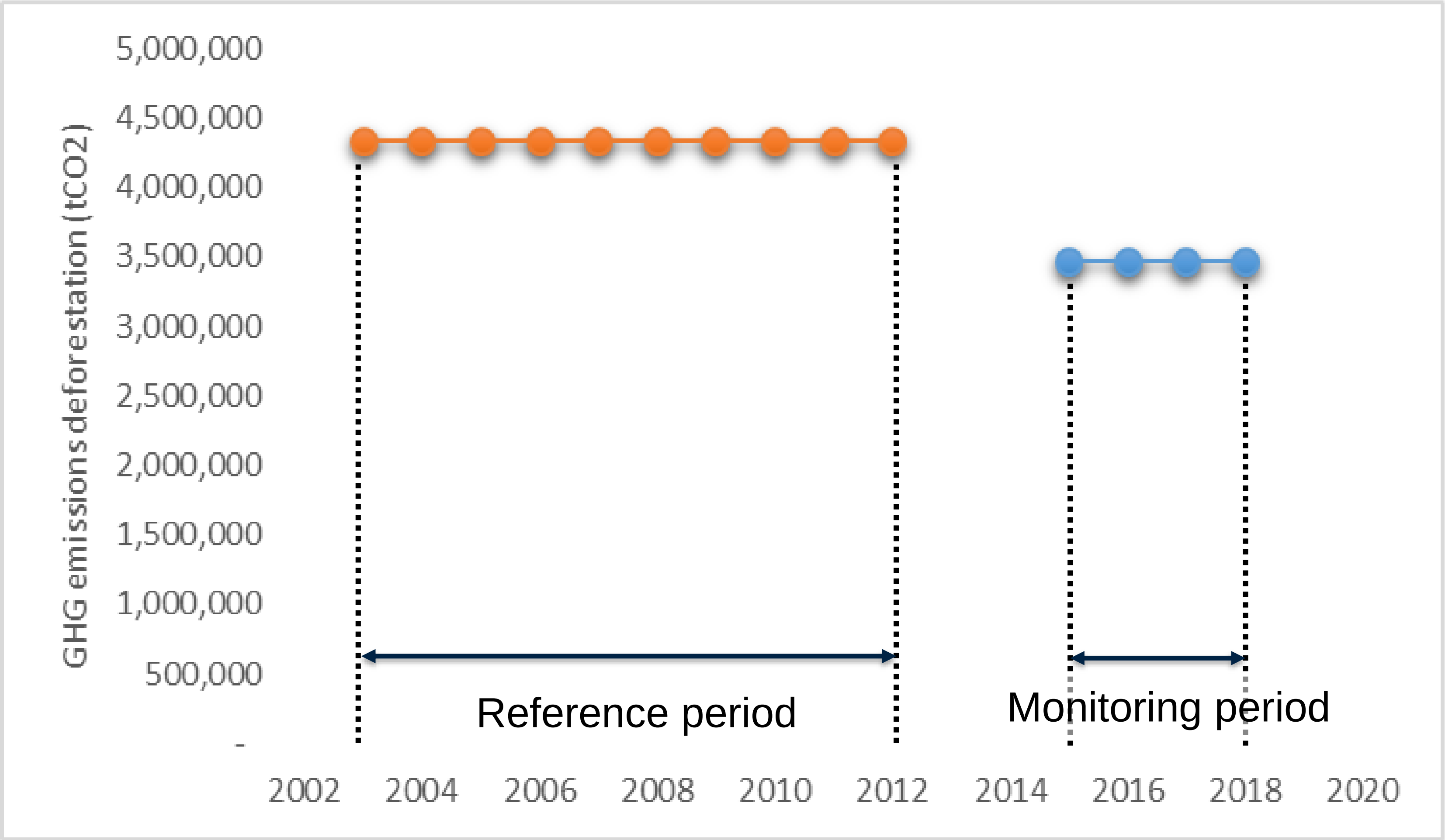

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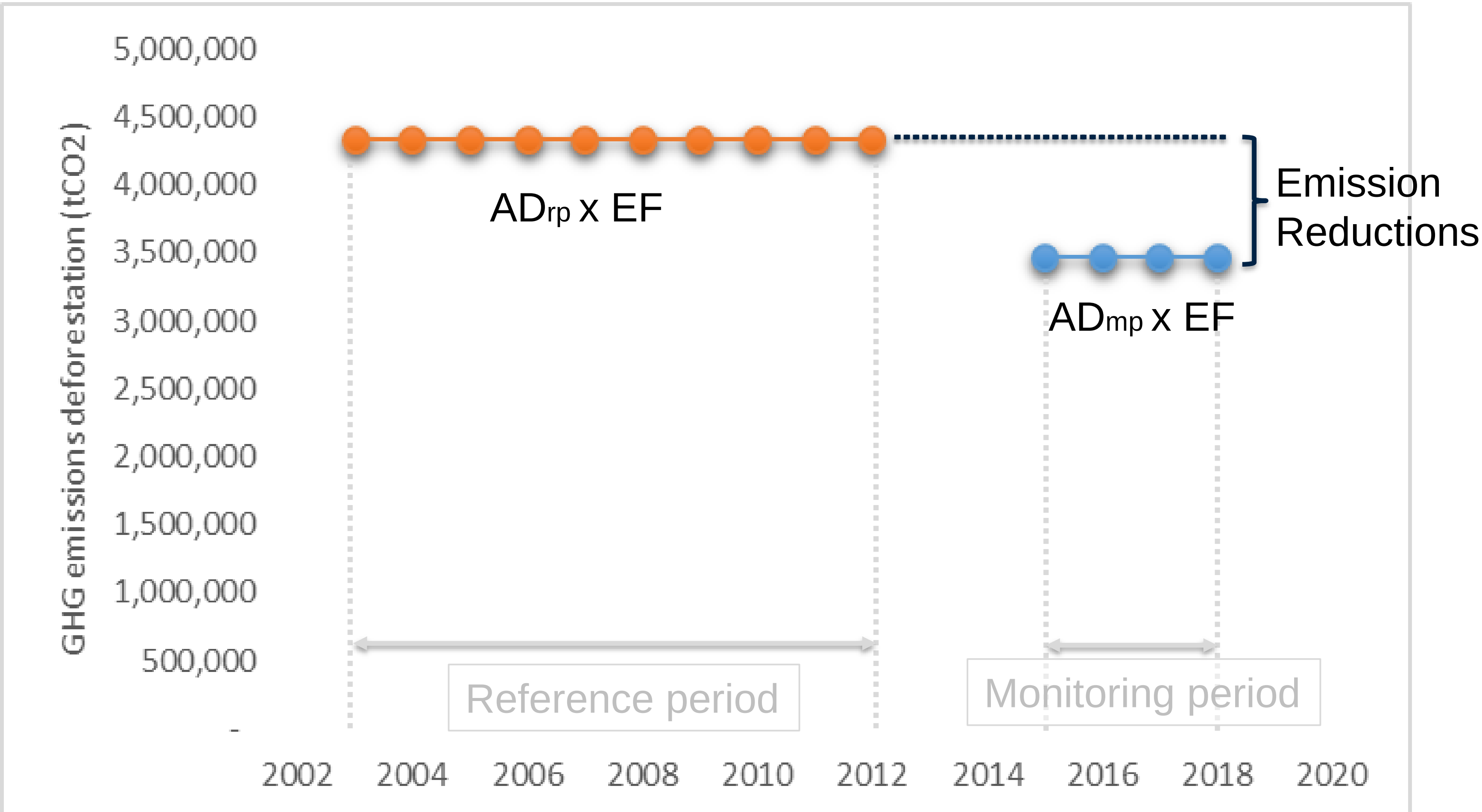

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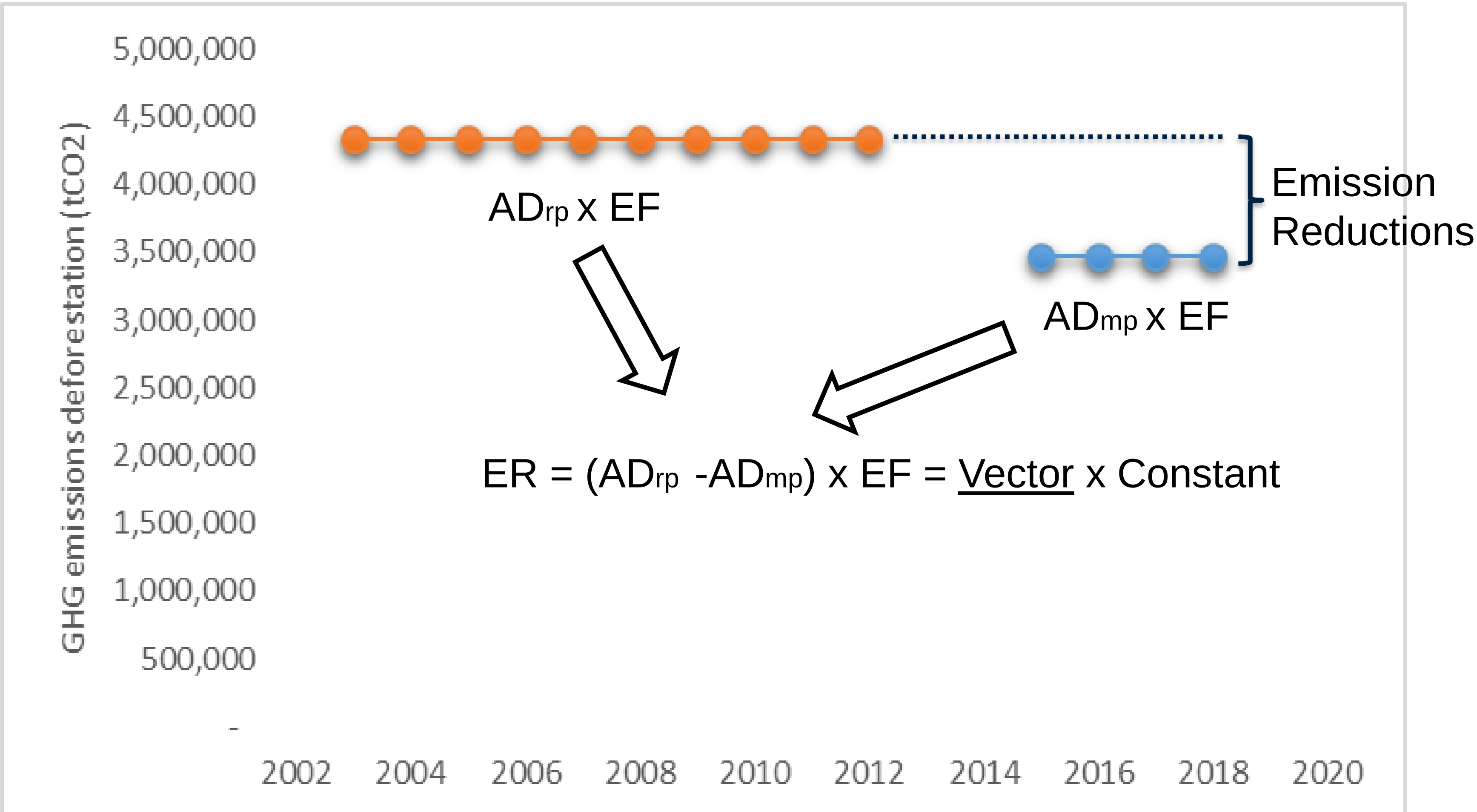

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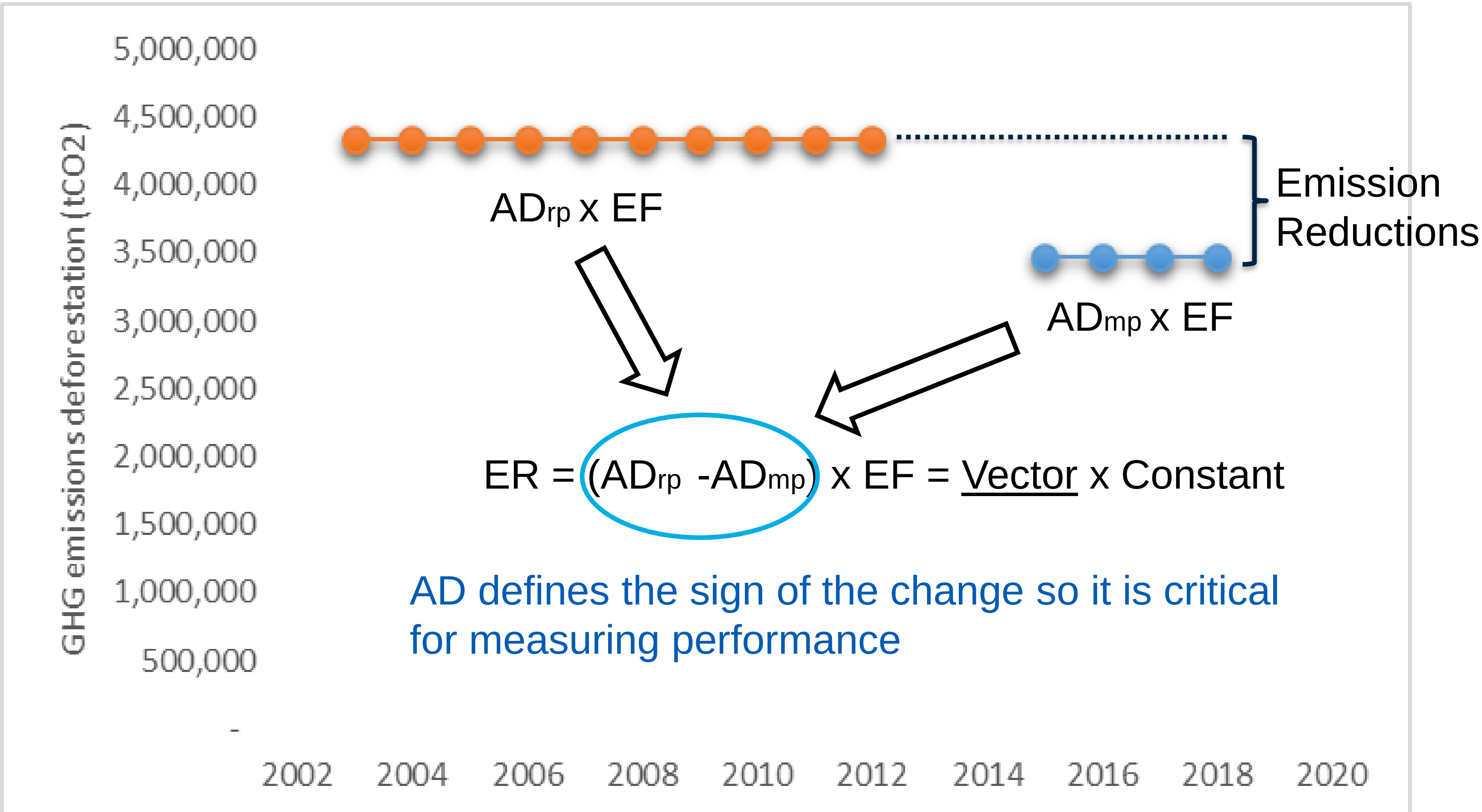

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Activity data estimation – Challenges

- Activity data has been usually estimated with EO data with two approaches:
  - Wall-to-wall approach, i.e. maps
  - Sampling approach
- However, the use of maps has some issues…

Activity data estimation – Challenges

- Example of probabilities matrix of change map

		Reference					
	Class	DF	AF	F	NF	Total	User's accuracy
Map	DF	0.03	0.00	0.01	0.01	0.04	0.62
	AF	0.00	0.03	0.00	0.01	0.04	0.75
	F	0.01	0.02	0.50	0.04	0.57	0.88
	NF	0.02	0.01	0.02	0.29	0.34	0.85
	Total	0.06	0.06	0.53	0.35	1.00	
	Producer's accuracy	0.49	0.50	0.94	0.84		
	Overall accuracy					0.85	

62% of pixels classified as deforested are actually deforested

49% of area actually deforested has been mapped

*DF = Deforestation
AF = Afforestation

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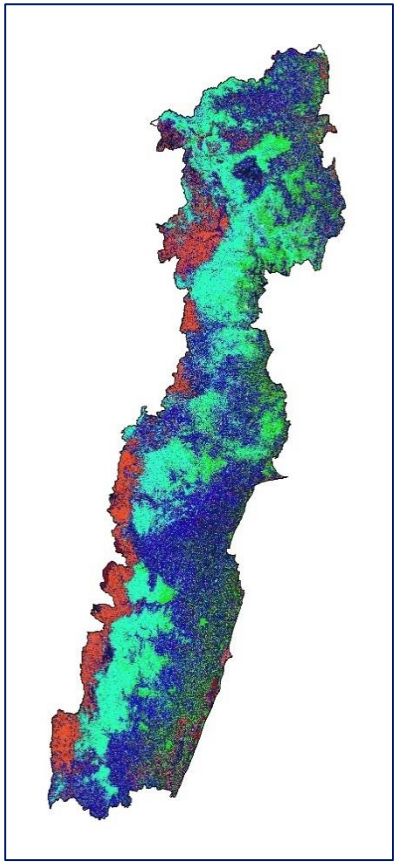
Activity data estimation – Challenges

Good practices for estimating area and assessing accuracy of land change

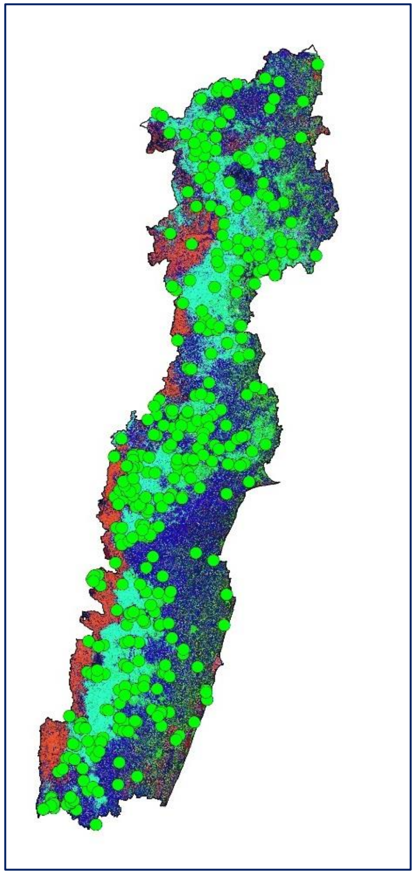
Pontus Olofsson [a,*], Giles M. Foody [b], Martin Herold [c], Stephen V. Stehman [d], Curtis E. Woodcock [a], Michael A. Wulder [e]

- Olofsson et al. (2014) is the first attempt to provide guidance in order to address the challenges of using maps to estimate Activity Data
- The approach is to use sample reference data and change maps for stratification, in order to obtain a stratified estimate (design-based inference)

ACTIVITY DATA ESTIMATION – CHALLENGES



Map = Strata



Sampling of reference data

$$\hat{\mu}_{STR} = \sum_{h=1}^{H} w_h \hat{\mu}_h$$

Change class		StRS estimate	U% 90%
SF	Stable Forest	0.407	3%
SNF	Stable Non-Forest	0.439	3%
AF	Afforestation	0.083	7%
DF	Deforestation	0.025	19%
FE	Forest Enhancement	0.018	7%
FD	Forest Degradation	0.028	19%

Inference

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ACTIVITY DATA ESTIMATION – CHALLENGES

Good practices for estimating area and assessing accuracy of land change

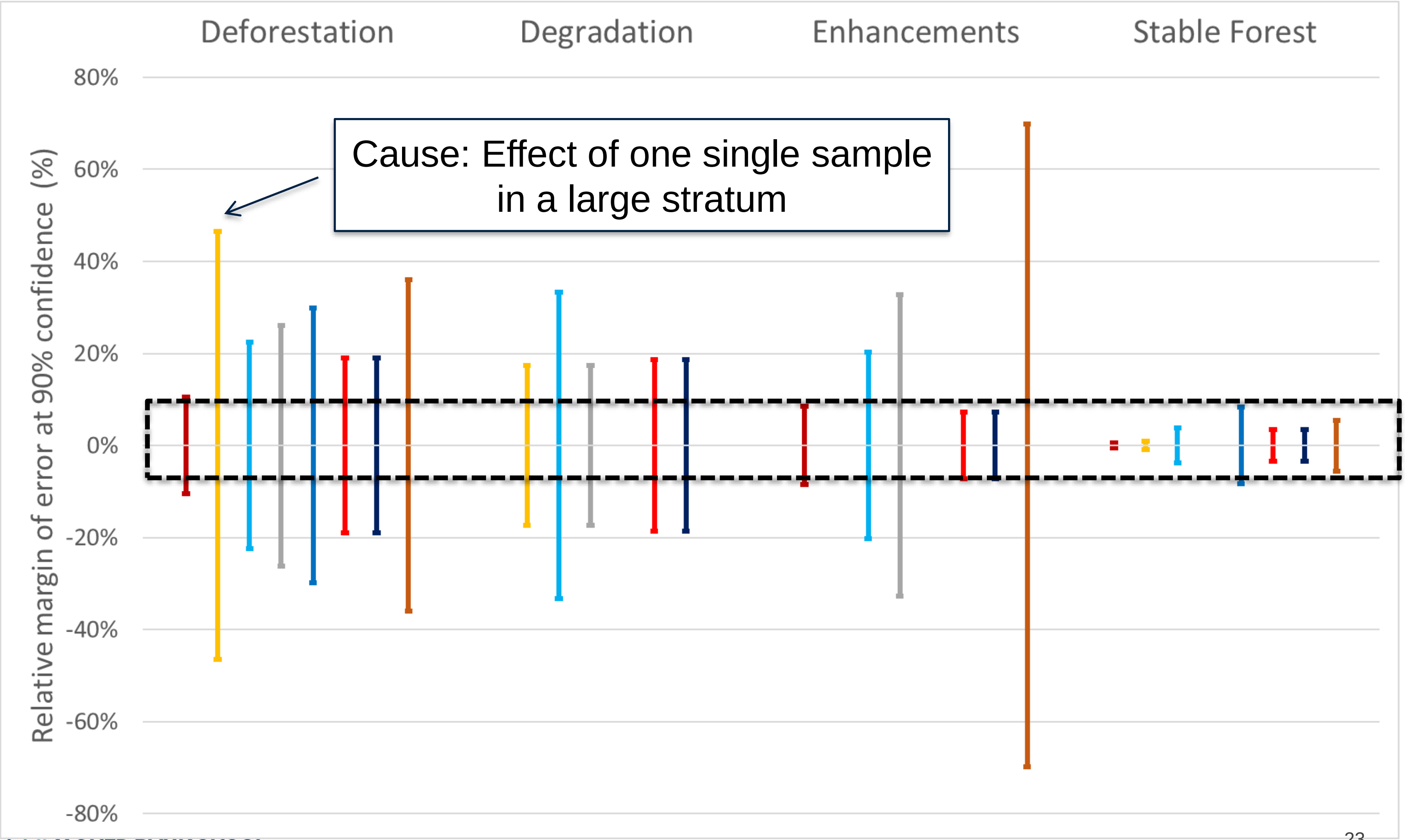
CrossMark

Pontus Olofsson [a,*], Giles M. Foody [b], Martin Herold [c], Stephen V. Stehman [d], Curtis E. Woodcock [a], Michael A. Wulder [e]

- Five out of seven programs of the CF have applied this guidance
- Costa Rica has not applied it as it has applied complex Tier 3 integration frameworks for estimating the RL
- However, some challenges have been faced when establishing their Reference Levels…

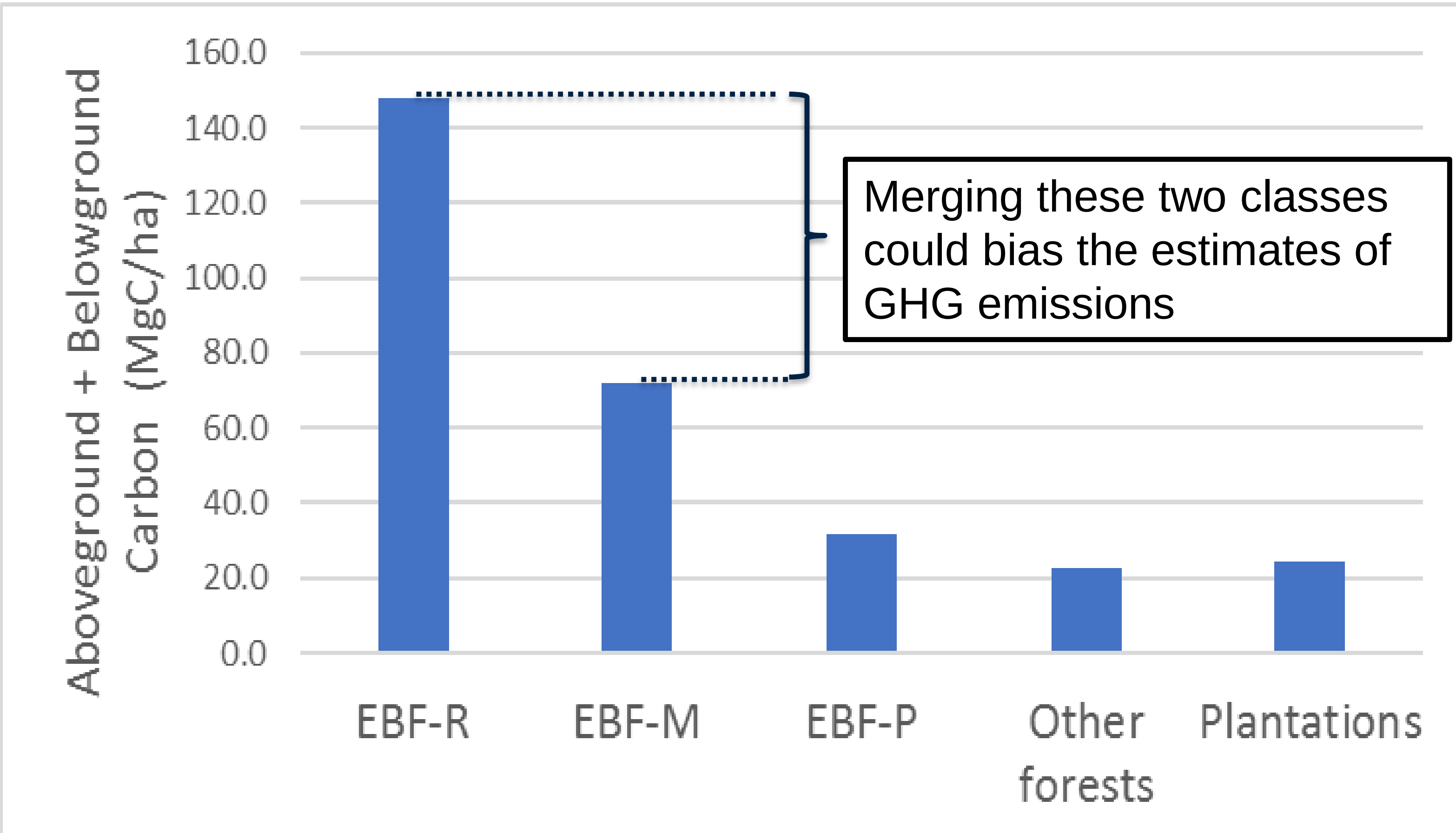
ACTIVITY DATA ESTIMATION – CHALLENGES

- <u>Challenge 1</u>: Too large statistical uncertainty



ACTIVITY DATA ESTIMATION – CHALLENGES

- Challenge 2: Difficulty in the application when large complex classes (e.g. complex integrated methods)



*Ministry of Agriculture and Rural Development. 2016. Vietnam's ER program document

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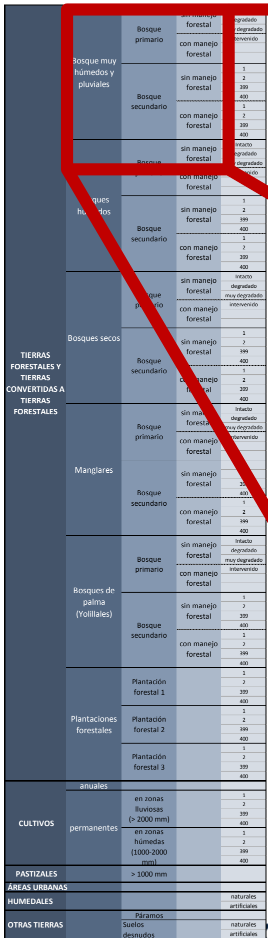
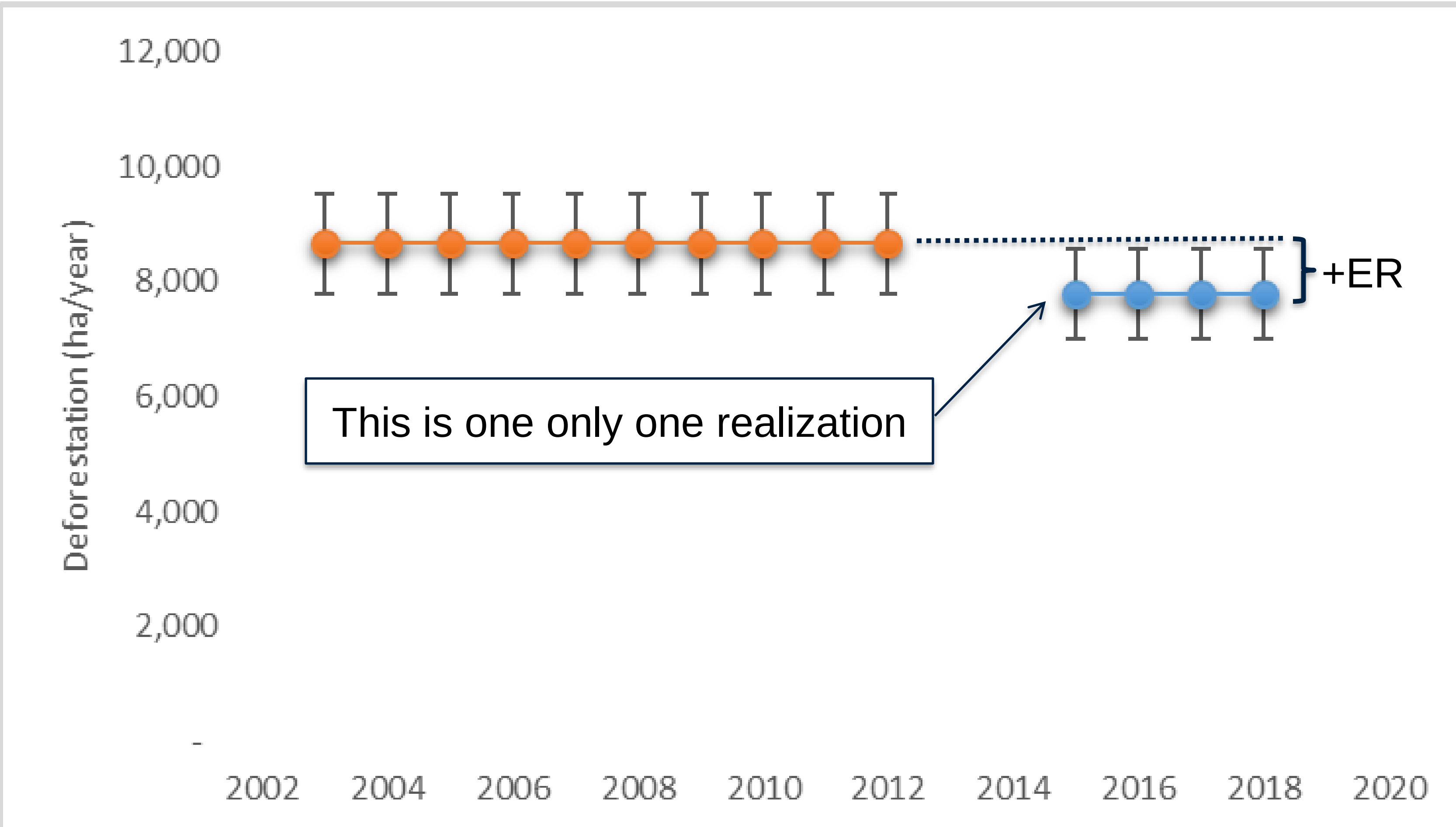


Bosque muy húmedos y pluviales	Bosque primario	sin manejo forestal	Intacto	238.14
			degradado	
			muy degradado	
		con manejo	intervenido	
	Bosque secundario	sin manejo forestal	... - 1985	24.75
			1986 - 1991	84.15
			1992 - 1997	56.88
			1998 - 2000	64.98
			2001 - 2007	358.74
			2008 - 2011	386.55
		con manejo forestal	... - 1985	
			1986 - 1991	
			1992 - 1997	
			1998 - 2000	
			2001 - 2007	
			2008 - 2011	
			2012 - 2013	

ACTIVITY DATA ESTIMATION – CHALLENGES

- Challenge 3: How to estimate ERs with precision?



Activity data estimation – Challenges

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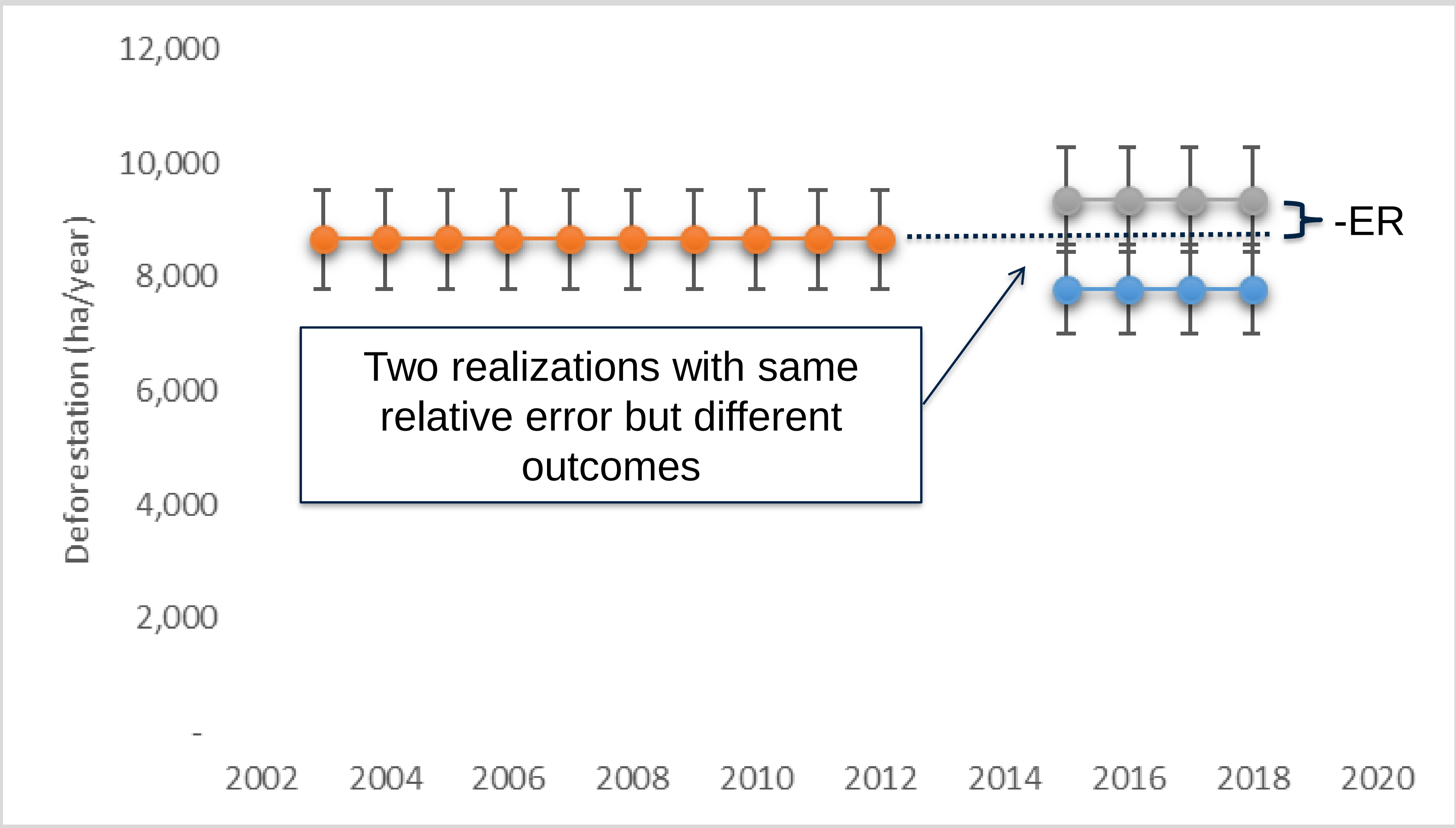


Activity data estimation – Opportunities

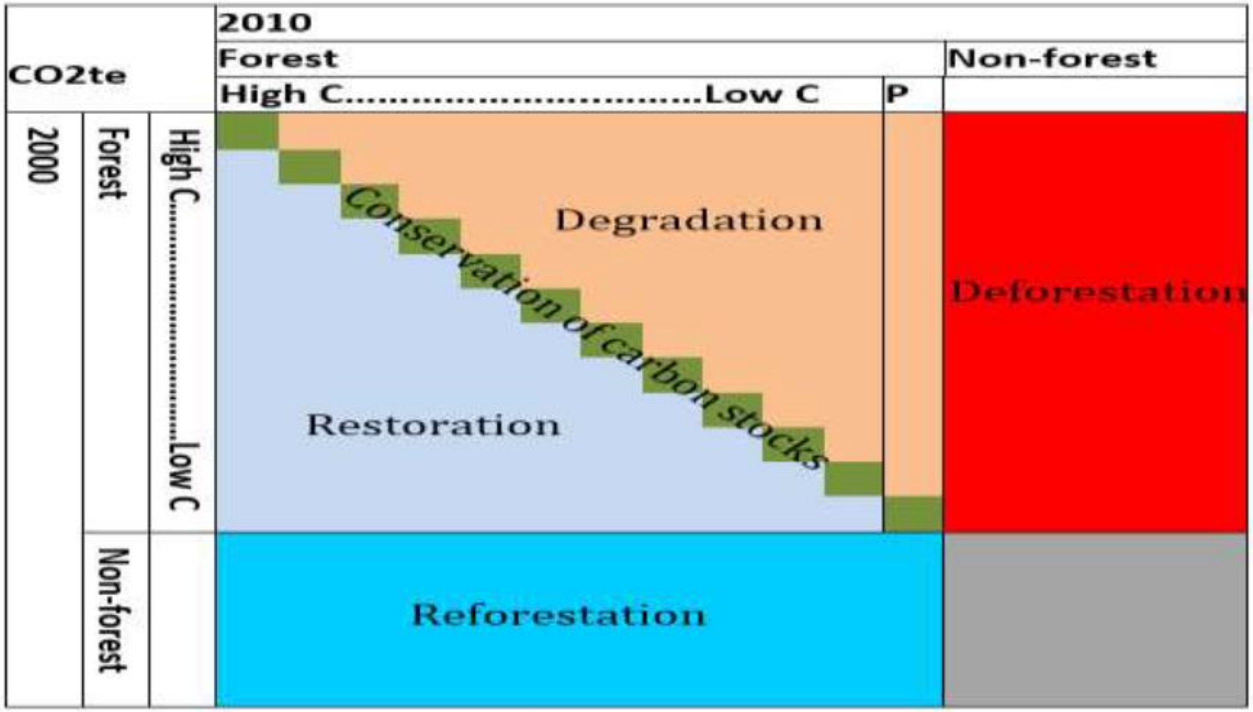
1. How to reduce uncertainty of AD in design-based inference?
2. How to estimate uncertainty in complex legends or high integration methods?
    1. Options in design-based inference
    2. Options in model-based inference
3. How to estimate the change of AD and its uncertainty?
    1. Options of sampling designs
    2. Montecarlo simulations

Other challenges and opportunities - degradation

- The methodological requirements of the CF/ISFL require accounting of GHG emissions from degradation
- ER programs have piloted different methods to estimate degradation
- ER programs have successfully estimated GHG emissions from degradation…
- …yet, still many uncertainties and limitations

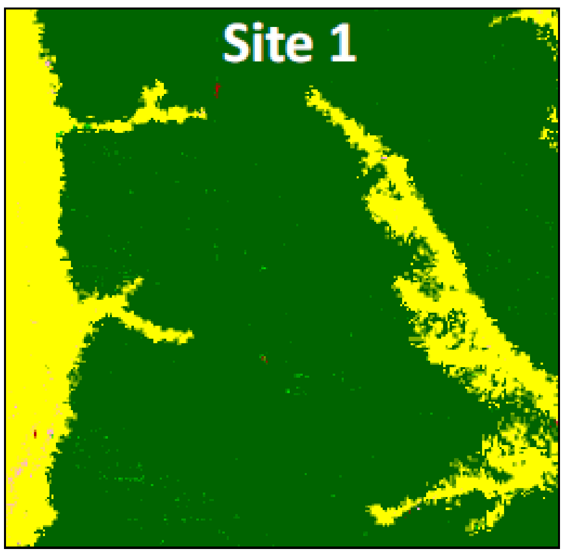
OTHER CHALLENGES AND OPPORTUNITIES - DEGRADATION

- **Mexico, Vietnam and DRC**: Degradation detected as transitions between forest types (e.g. primary to secondary forest)
- <u>Some issues</u>: only detects high disturbance degradation, high uncertainty in the classification

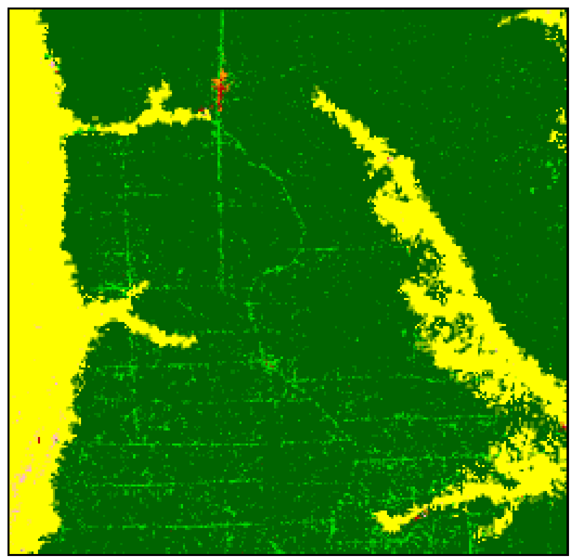


OTHER CHALLENGES AND OPPORTUNITIES - DEGRADATION

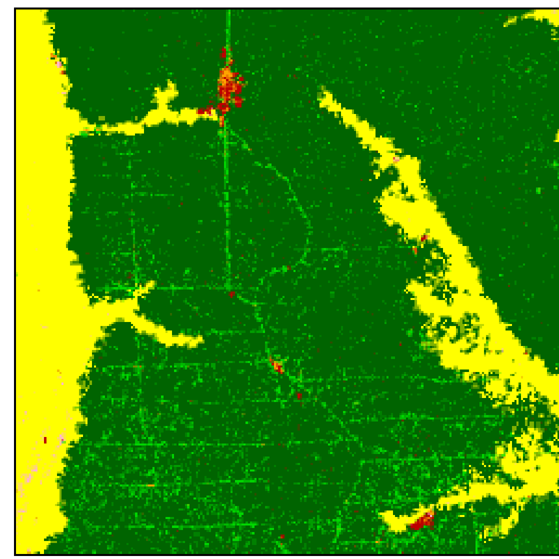
- **Congo, Madagascar**: Degradation is detected through changes in vegetation indices in a temporal series of medium resolution imagery
- Some issues: High commission errors, no VHR imagery available for validation,



2003



2012



2015

Other challenges and opportunities - degradation

- **Costa Rica, Madagascar**: Degradation is detected through changes canopy cover observed in VHR imagery
- Some issues: coverage of VHR imagery, impossibility to detect small changes in canopy

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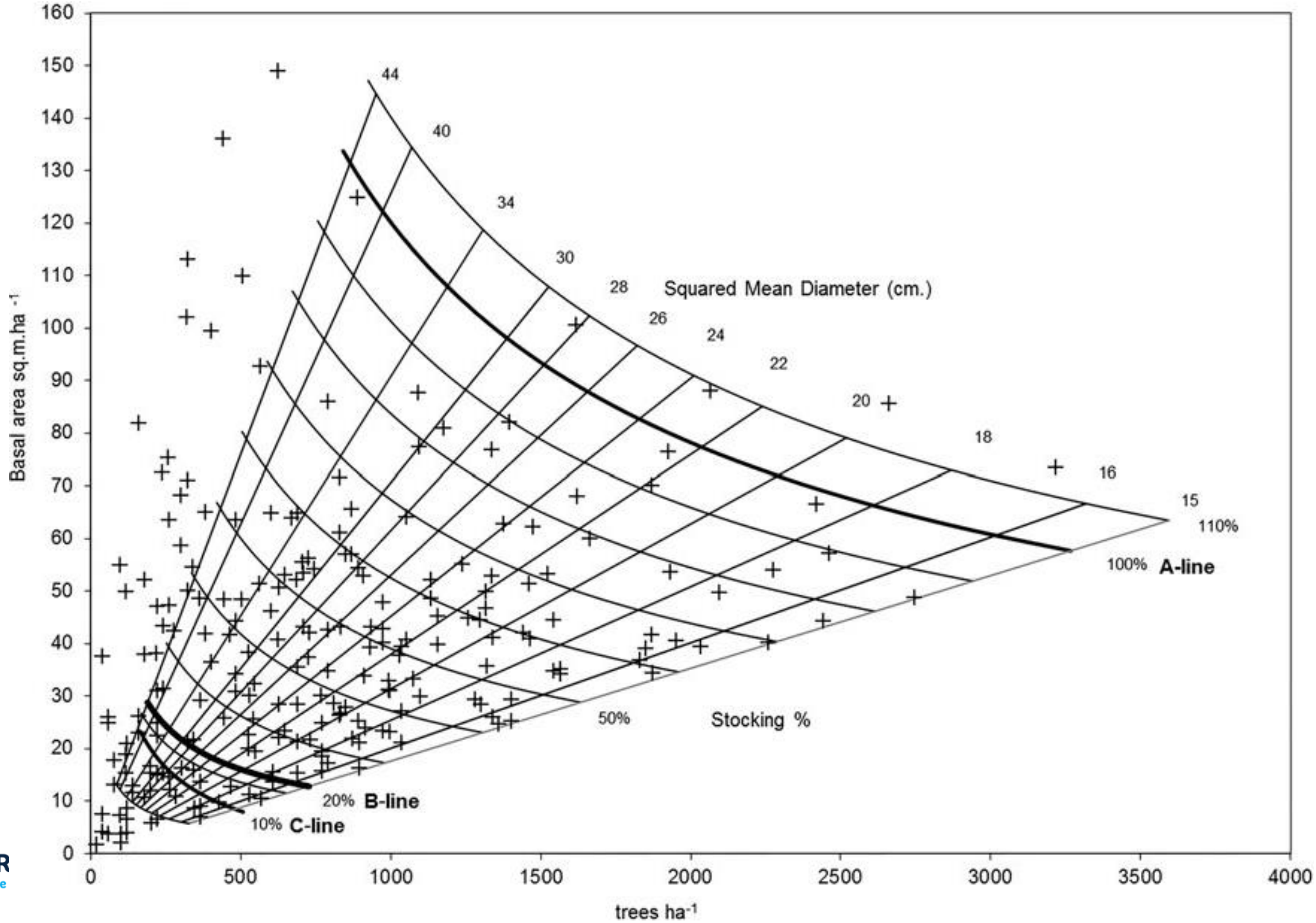
OTHER CHALLENGES AND OPPORTUNITIES - DEGRADATION

- **Chile**: Using stocking tables built with NFI data, and they are applied to spatial explicit stocking models



OTHER CHALLENGES AND OPPORTUNITIES - DEGRADATION

- **Ghana, Congo**: Using extracted timber volumes as proxies of degradation by multiplying volumes to damage factors
- **Issues**: uncertain extracted volumes, volumes of illegal logging not available

Factor		Value (tCO_2/m^3)	Uncertainty
Emission from Extracted Log	ELE	0.79	0.02
Logging Damage Factor	LDF	2.46	0.17
Logging Infrastructure Factor	LIF	0.50	0.13
Total Emission Factor	TEF	3.75	0.21

OTHER CHALLENGES AND OPPORTUNITIES - WETLANDS

Age, extent and carbon storage of the central Congo Basin peatland complex

Greta C. Dargie[1,2]*, Simon L. Lewis[1,2]*, Ian T. Lawson[3], Edward T. A. Mitchard[4], Susan E. Page[5], Yannick E. Bocko[6] & Suspense A. Ifo[6]

- Peatlands in the Congo basin store a quantity that is equivalent to <u>95% of the above-ground carbon stocks of the tropical forests of the entire Congo Basin</u>
- These areas are not yet under threat
- However, research is needed in order to understand the carbon dynamics and estimate potential impact of future policies over these areas

OTHER CHALLENGES – NEW RESEARCH

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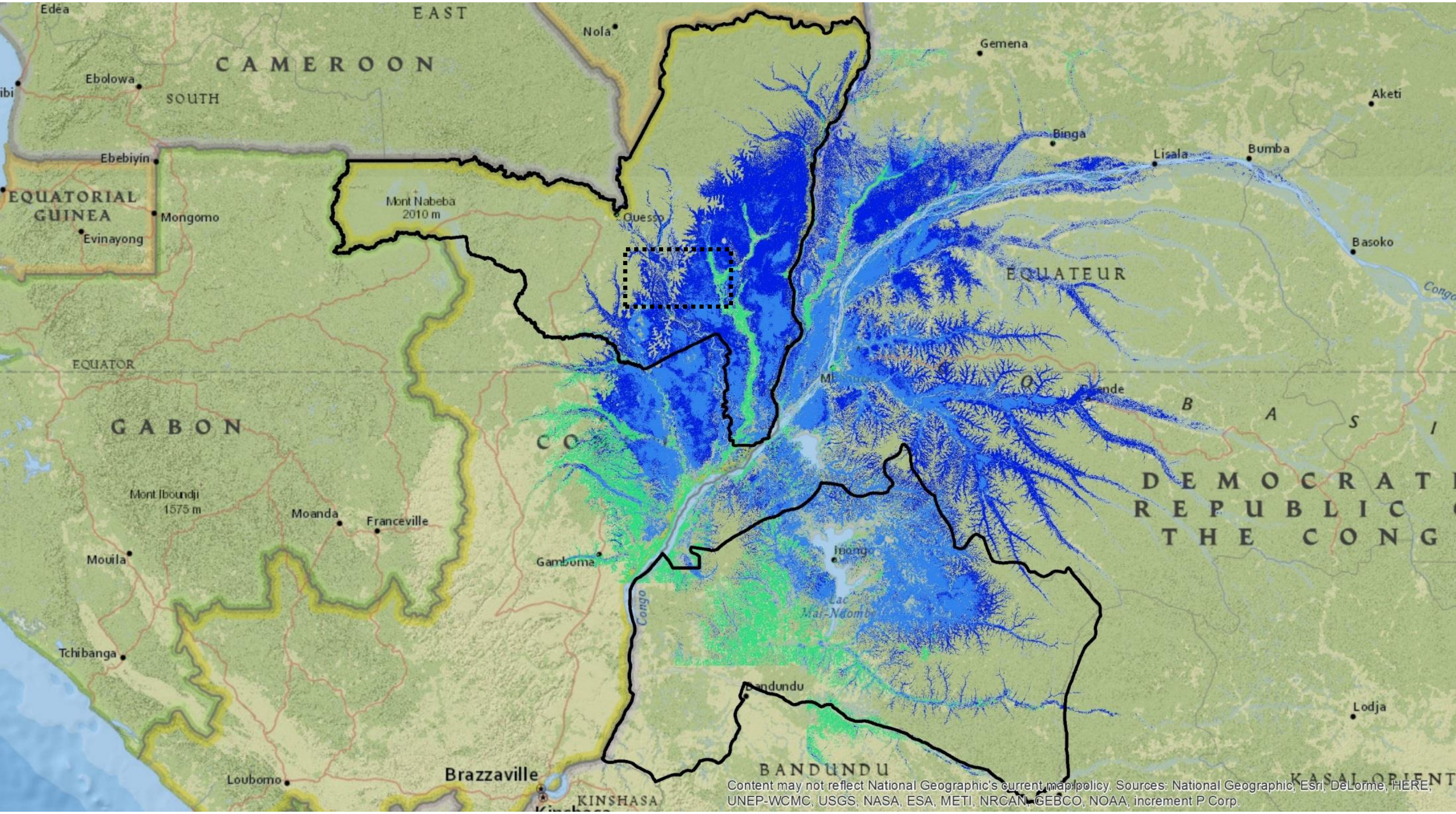

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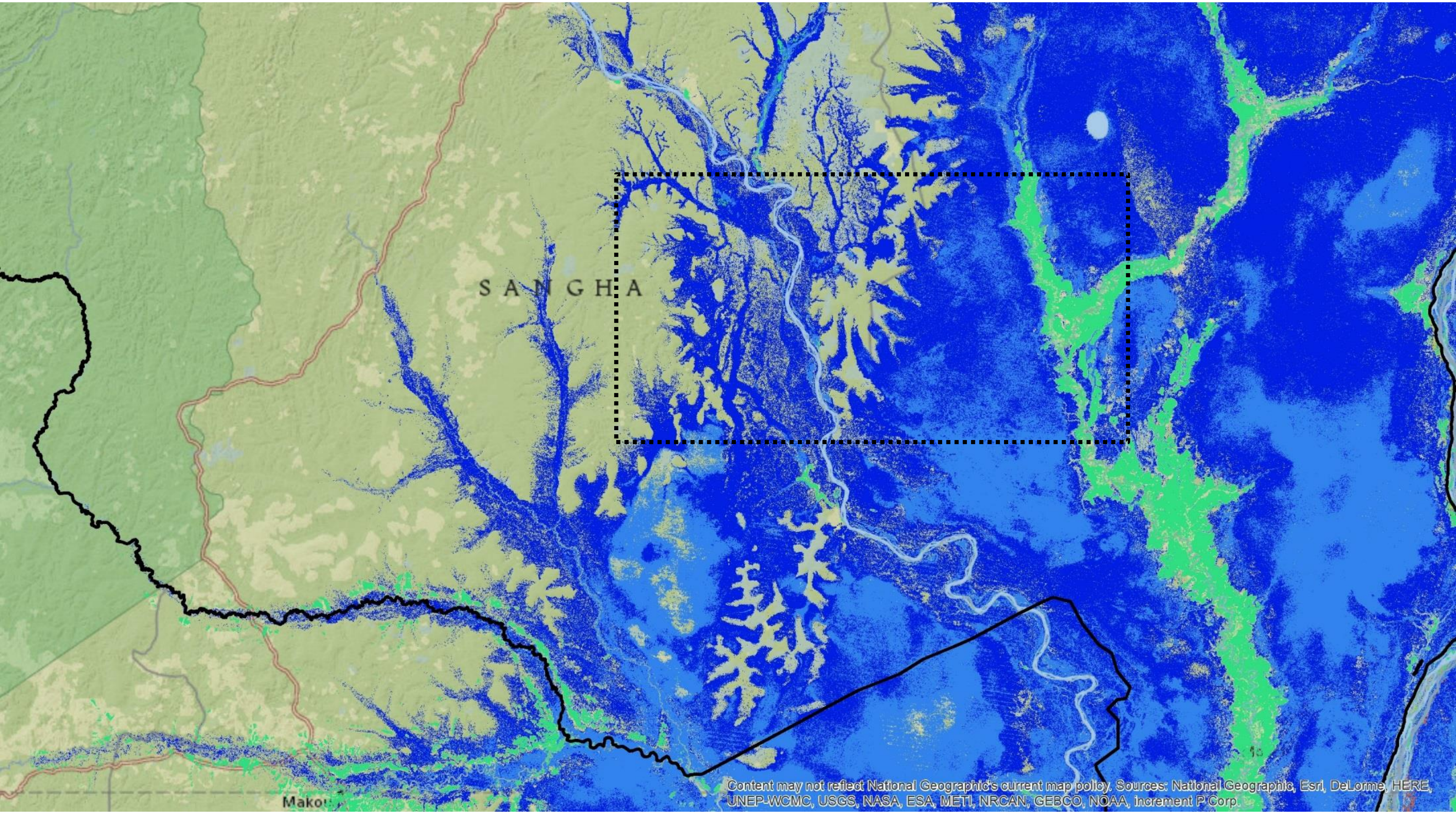
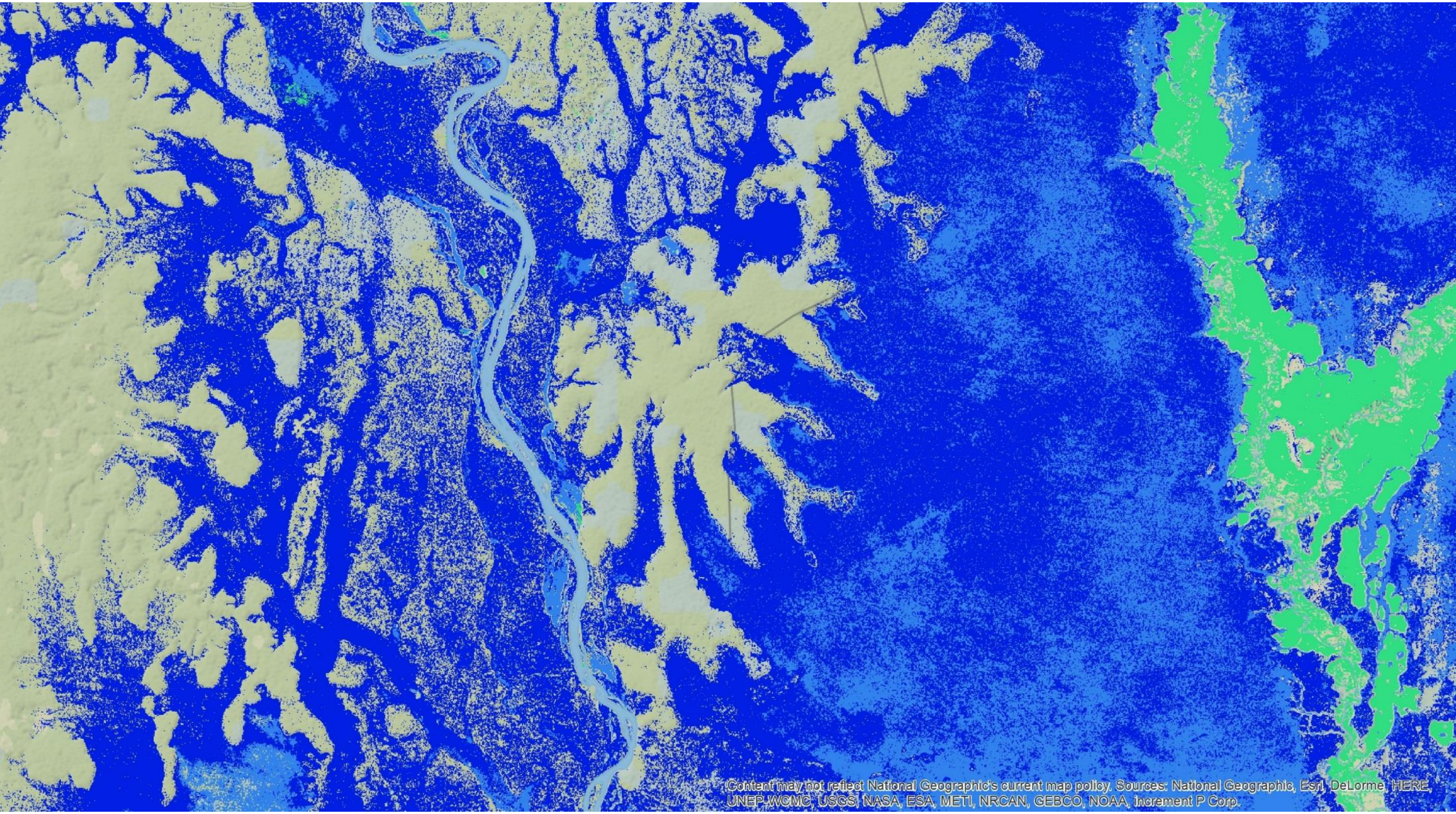


Other challenges – New research



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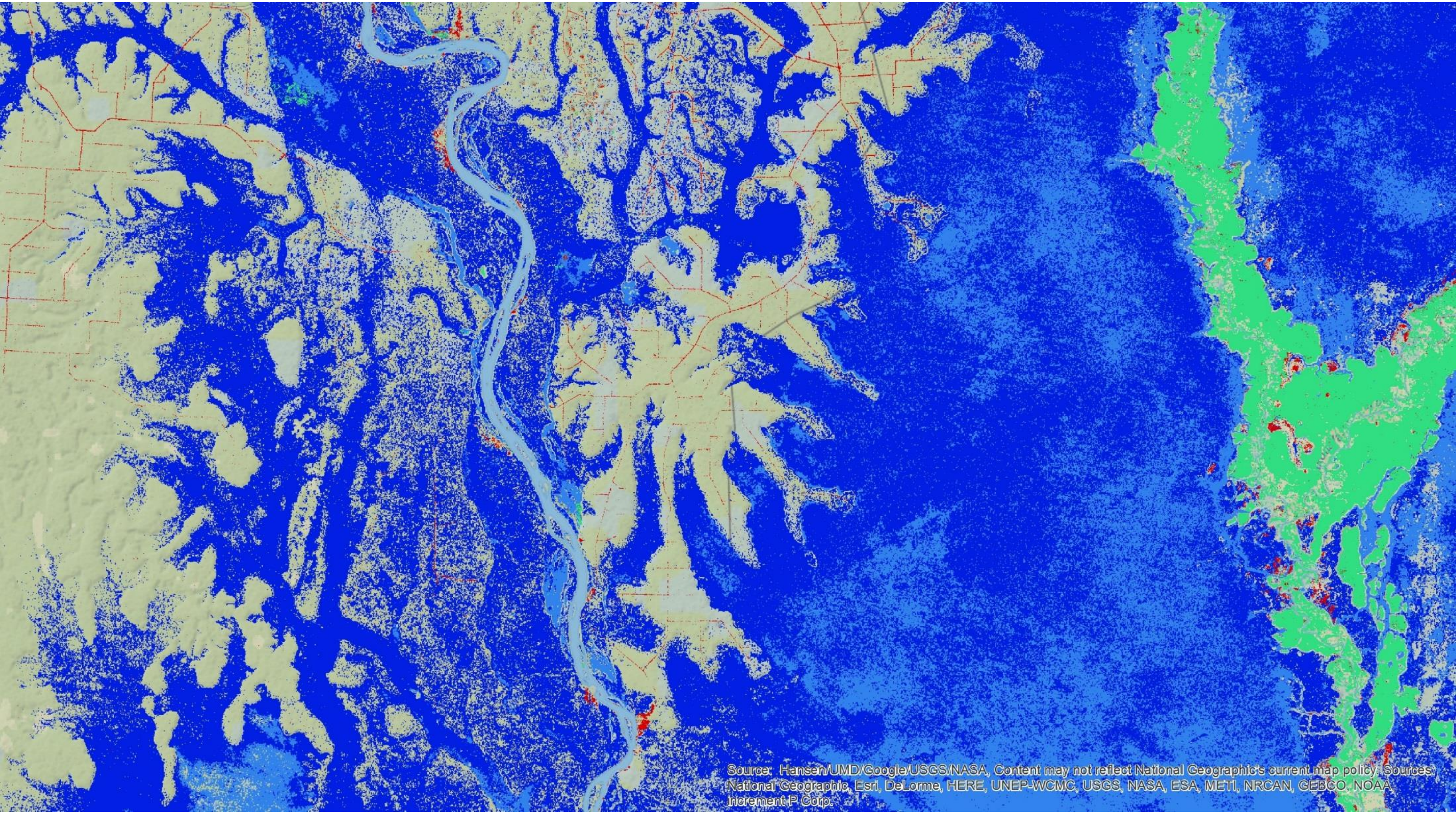

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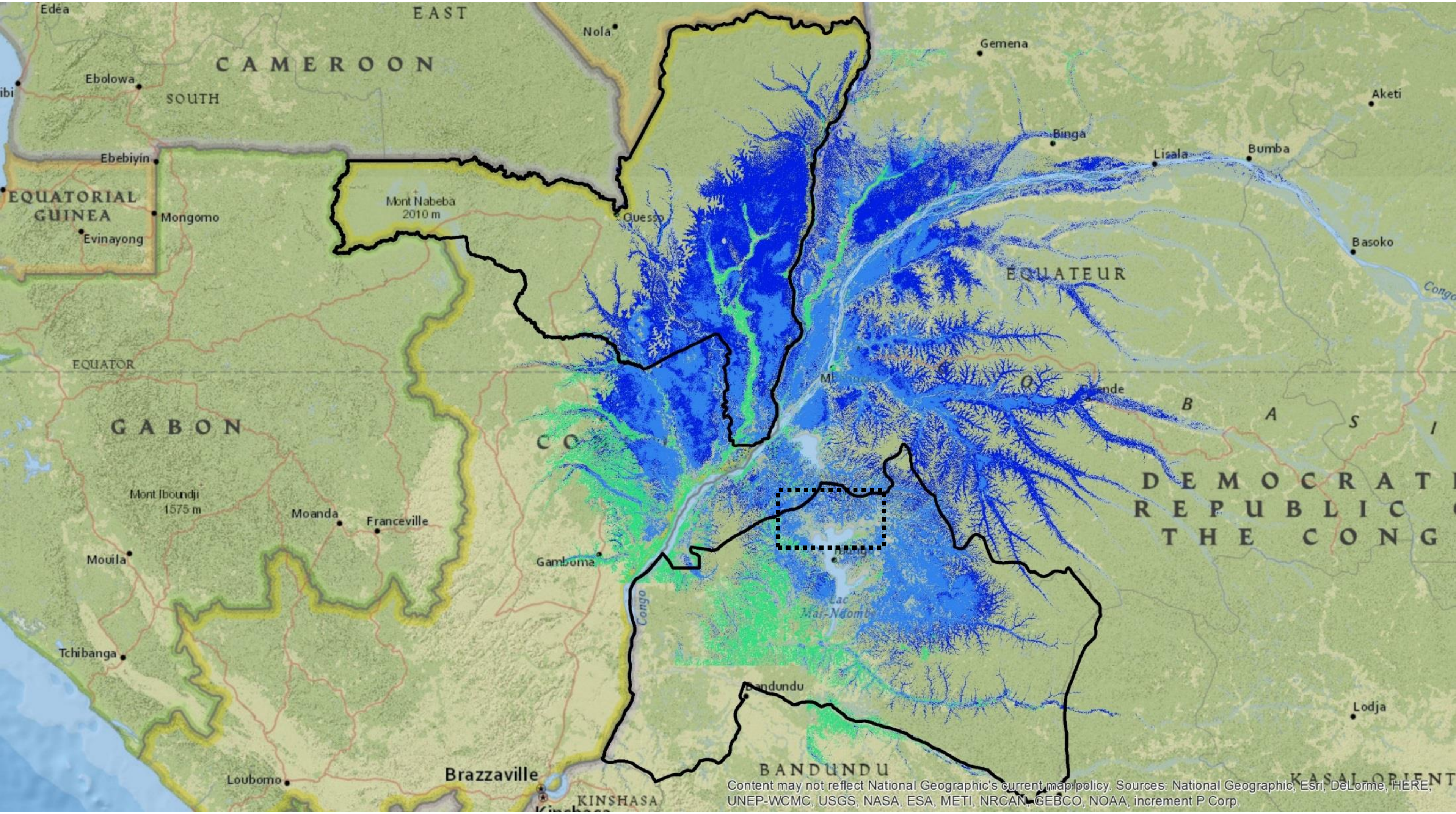

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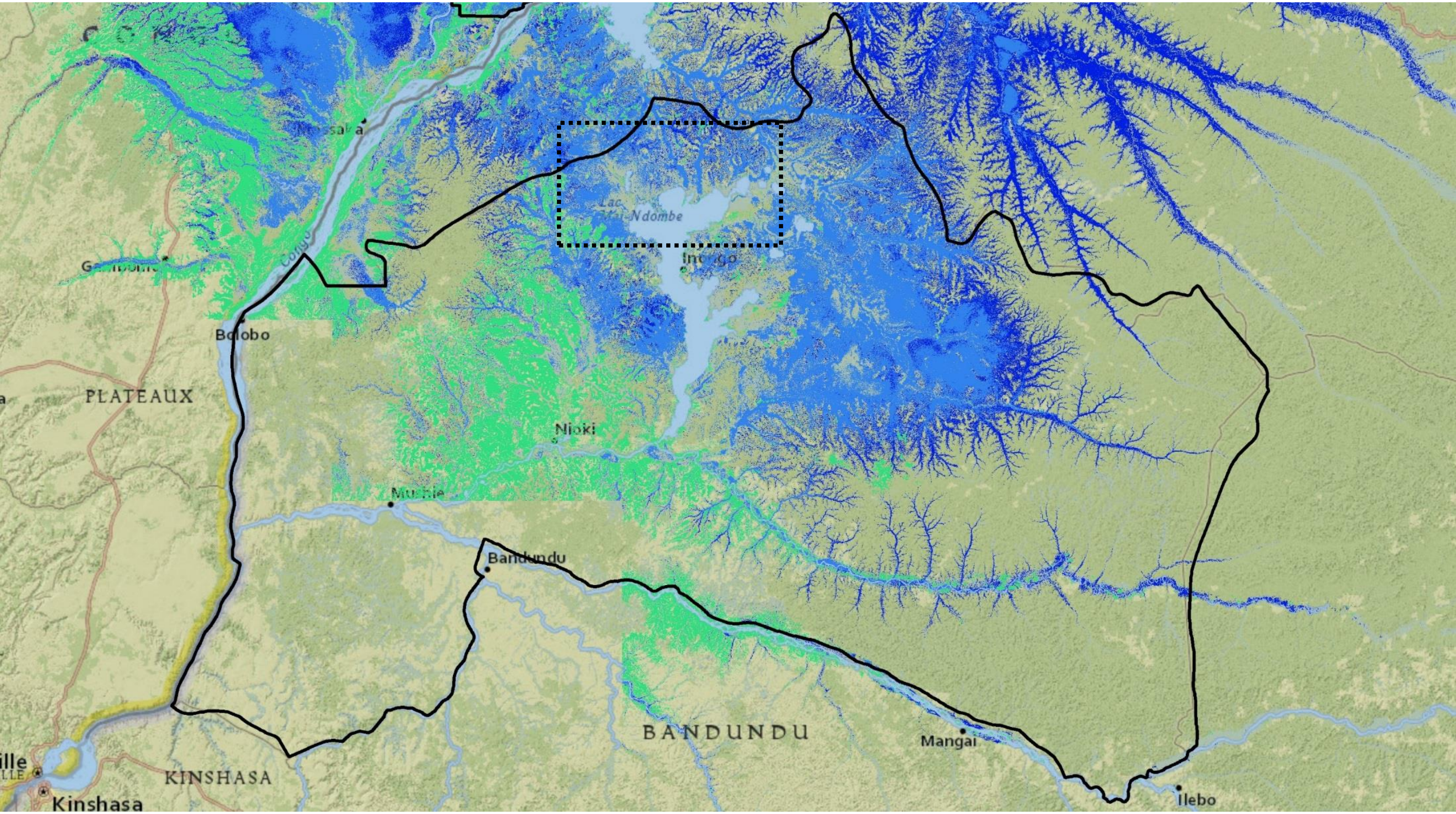

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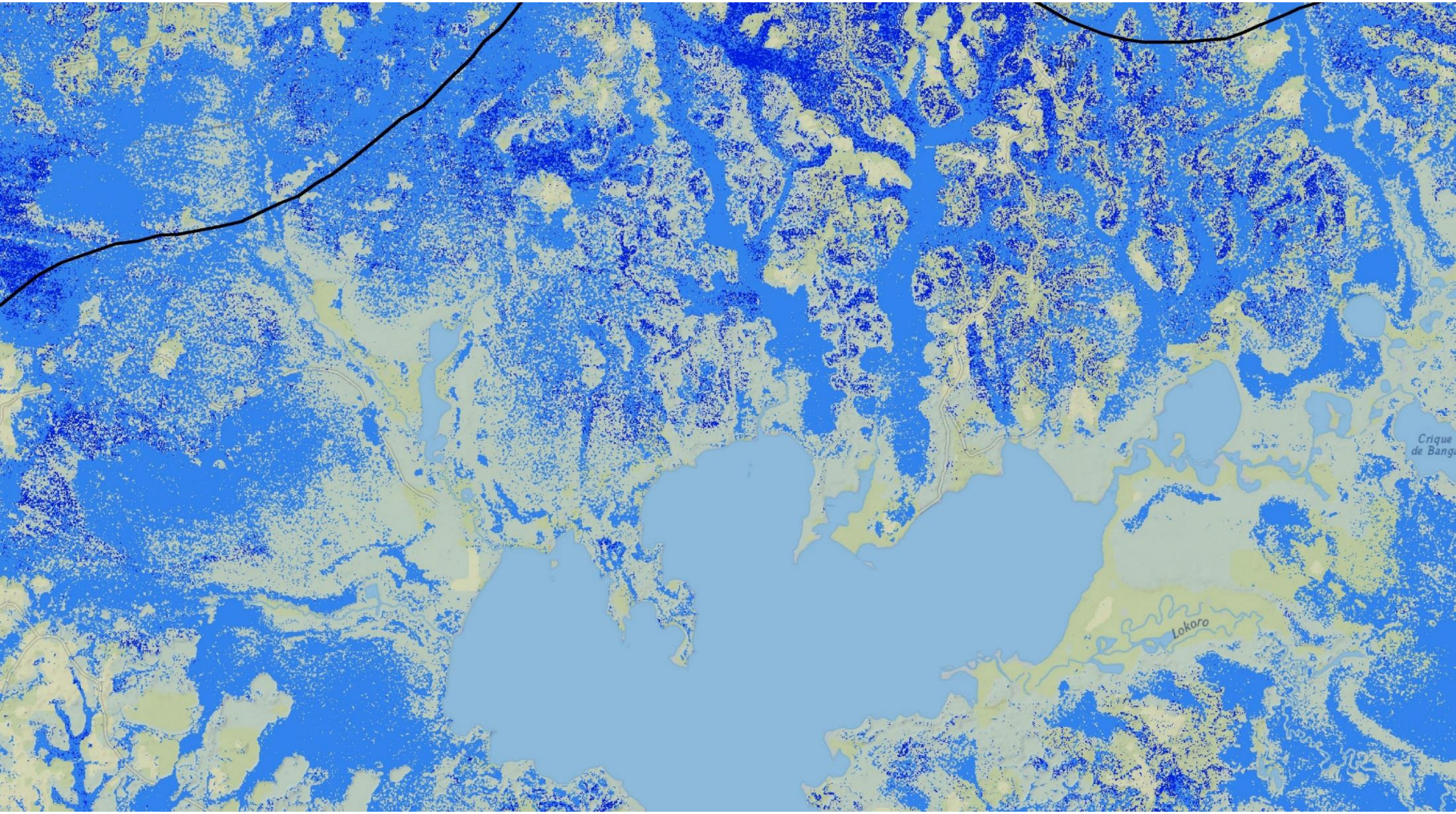

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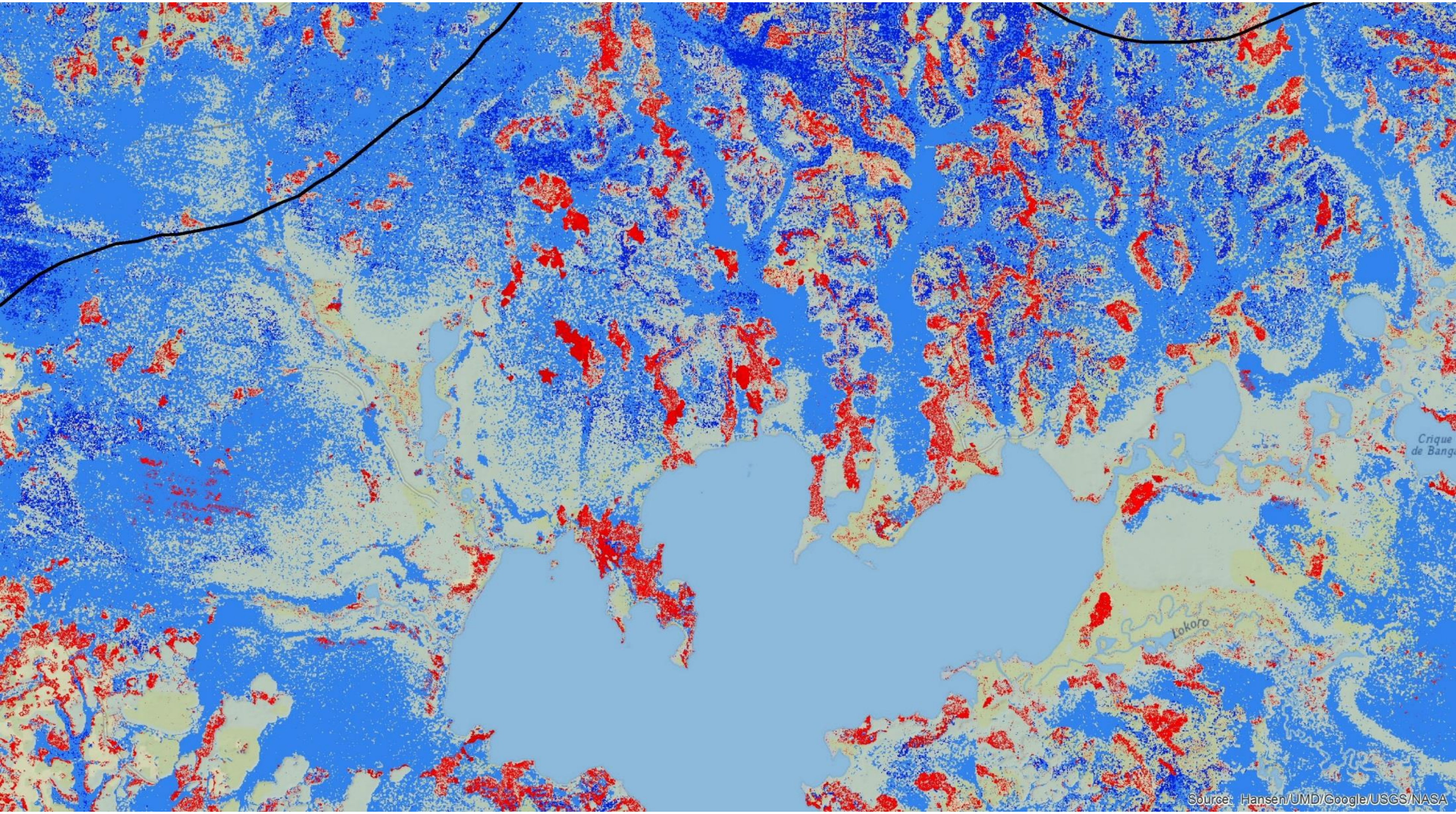

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THANK YOU