Constructing reference levels for REDD+: Insights from economic research

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FCPF/Winrock Workshop on Reference Levels

Washington, DC

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http://www.conservation.org/osiris

UNFCCC AWG-LCA Dec.1/CP.16 (Cancun Accords)

“Requests developing country Parties aiming to undertake [REDD+], in the context of the provision of adequate and predictable support, including financial resources and technical and technological support to developing country Parties, in accordance with national circumstances and respective capabilities, to develop…a national forest reference emission level and/or forest reference level or, if appropriate, as an interim measure, subnational forest reference emission levels and/or forest reference levels, in accordance with national circumstances, and with provisions contained in decision 4/CP.15, and with any further elaboration of those provisions adopted by the Conference of the Parties”

UNFCCC SBSTA Dec.4/CP.15 (Copenhagen)

"Recognizes that developing country Parties in establishing forest reference emission levels and forest reference levels should do so transparently taking into account historic data, and adjust for national circumstances, in accordance with relevant decisions of the Conference of the Parties;"

FCCC/SBSTA/2009/8 (Barcelona)

"At its 3rd meeting, the SBSTA considered and adopted conclusions proposed by the Chair. It was noted that national circumstances include those of countries with specific circumstances, such as high forest cover and low rates of deforestation."

An active academic literature on RLs…

TROPICAL DEFORESTATION AND THE KYOTO PROTOCOL
An Editorial Essay
MÁRCIO SANTILLI[1,2], PAULO MOUTINHO[2], STEPHAN SCHWARTZMAN[3], DANIEL NEPSTAD[2,4], LISA CURRAN[5] and CARLOS NOBRE[6]

An incentive mechanism for reducing emissions from conversion of intact and non-intact forests
Danilo Mollicone • Frédéric Achard • Sandro Federici • Hugh D. Eva • Giacomo Grassi • Alan Belward • Frank Raes • Günther Seufert • Hans-Jürgen Stibig • Giorgio Matteucci • Ernst-Detlef Schulze

No Forest Left Behind
Gustavo A. B. da Fonseca*, Carlos Manuel Rodriguez, Guy Midgley, Jonah Busch, Lee Hannah, Russell A. Mittermeier

On fair, effective and efficient REDD mechanism design
Michael Obersteiner*[1], Michael Huettner[2,3], Florian Kraxner[1], Ian McCallum[1], Kentaro Aoki[1], Hannes Böttcher[1], Steffen Fritz[1], Mykola Gusti[1], Petr Havlik[1], Georg Kindermann[1], Ewald Rametsteiner[1] and Belinda Reyers[4]

Targeting deforestation rates in climate change policy: a "Preservation Pathway" approach
Kevin R Gurney*[1] and Leigh Raymond[2]

Creating incentives for avoiding further deforestation: the nested approach
LUCIO PEDRONI[1], MICHAEL DUTSCHKE[2], CHARLOTTE STRECK[3]*, MANUEL ESTRADA PORRÚA[4]

Reducing emissions from deforestation—The "combined incentives" mechanism and empirical simulations
Bernardo Strassburg[a,c,*], R. Kerry Turner[a], Brendan Fisher[a], Roberto Schaeffer[b], Andrew Lovett[a]

Research — Open Access
A comparison of baseline methodologies for 'Reducing Emissions from Deforestation and Degradation'
Michael Huettner*[1], Rik Leemans†[2], Kasper Kok†[2] and Johannes Ebeling†[3]

Comparing climate and cost impacts of reference levels for reducing emissions from deforestation
Jonah Busch[1,6], Bernardo Strassburg[2,3], Andrea Cattaneo[4], Ruben Lubowski[5], Aaron Bruner[6], Richard Rice[6], Anna Creed[3], Ralph Ashton[3] and Frederick Boltz[6]

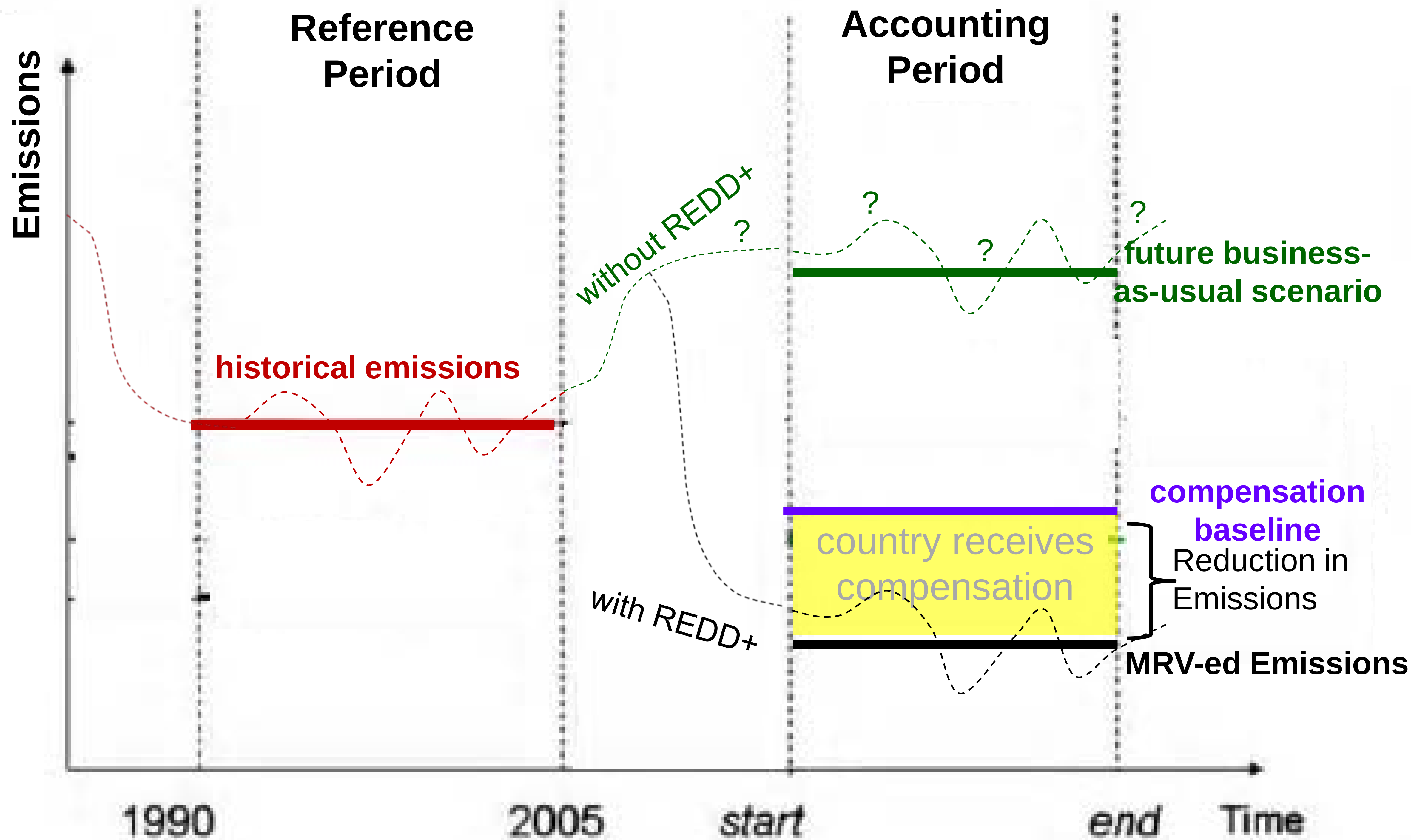
Sensitivity of amounts and distribution of tropical forest carbon credits depending on baseline rules
Bronson Griscom[a,], David Shoch[b], Bill Stanley[a], Rane Cortez[a], Nicole Virgilio[a]*

Biodiversity co-benefits of reducing emissions from deforestation under alternative reference levels and levels of finance
Jonah Busch, Fabiano Godoy, Will R. Turner, & Celia A. Harvey

On international equity in reducing emissions from deforestation
Andrea Cattaneo[a,], Ruben Lubowski[b], Jonah Busch[c], Anna Creed[d], Bernardo Strassburg[d,e], Frederick Boltz[c], Ralph Ashton[d]*

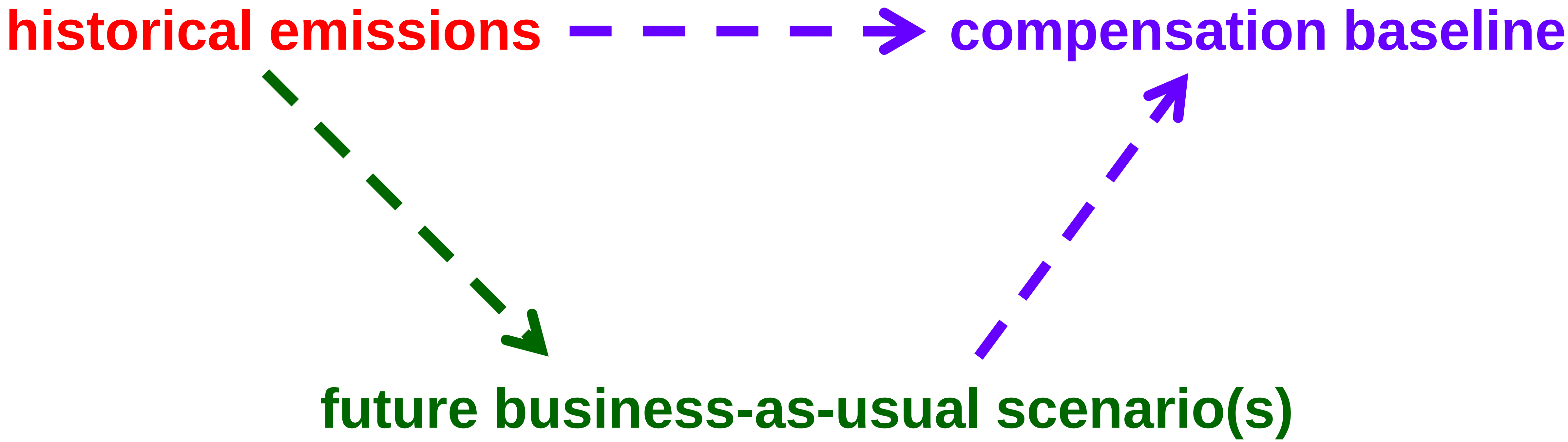
(and much more in grey literature)

Distinguishing three critical reference level concepts



Adapted from Mollicone et al., 2007

Distinguishing three critical reference level concepts



Distinguishing three critical reference level concepts

historical emissions → compensation baseline

future business-as-usual scenario(s)

- objective, science-based estimate of emissions [and removals] from forests over a recent historical period
- there is a true number, although we may never know it exactly
- requires data on forest cover change and emission factors
- requires decisions about scope, reference period, forest definition, etc.
- conservative accounting can provide incentive to reduce uncertainty
- could contribute to calculation of future BAU scenario(s); compensation baseline

Distinguishing three critical reference level concepts

historical emissions → compensation baseline

future business-as-usual scenario(s)

anticipated emissions in absence of REDD+ (ultimately unknowable)
can be projected with assumptions, extrapolations, and/or modeling
multiple scenarios could be justifiable
(e.g. w/ or w/o other countries taking actions to reduce deforestation)
useful as a benchmark of mitigation achieved
useful for national REDD+ strategy and planning
(e.g. geographically targeting pilot programs within a country)
could contribute to determination of compensation baseline
Meridian: “reference level”

Distinguishing three critical reference level concepts

historical emissions → **compensation baseline**

future business-as-usual scenario(s)

essential element of any results-based, pay-for-performance, REDD+ mechanism

produces incentives for countries to opt in/out, reduce/increase deforestation, affecting:

- climate change mitigation effectiveness
- amount and equity of payments
- cost-efficiency of mechanism

most lit to date: “reference level”

Compensation ($/yr) = [compensation baseline (tCO_2e/yr)
– MRV-ed emissions (tCO_2e/yr)]
* payment per ton of carbon ($\$tCO_2e$)

Distinguishing three critical reference level concepts

historical emissions → **compensation baseline**

future business-as-usual scenario(s)

Potential methodological components
("adjustments for national circumstances")

- Unadjusted historical emissions
- Adjustments to align with future BAU scenario(s)
- Upward adjustments to address anticipated international leakage
- Upward adjustments based on equity and/or development considerations
- Downward adjustments to leverage countries' "own effort"
- Downward adjustments reflecting additionality concerns
- Adjustments based on other global/system-wide integrity considerations
- Adjustments over time

Econometric modeling of future business-as-usual scenario(s): strengths and limitations

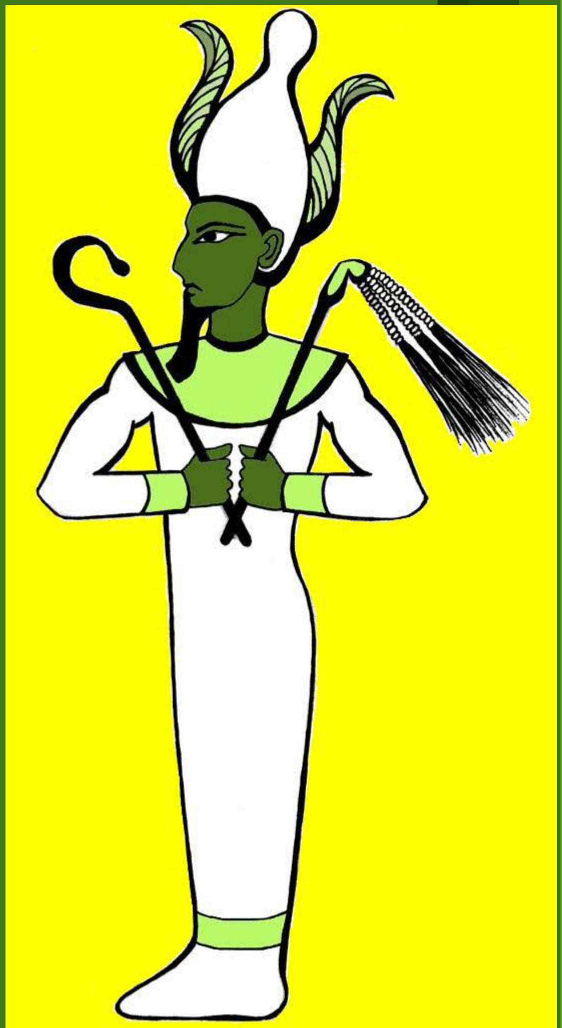
Insights from reference level modeling in Indonesia

•OSIRIS: A suite of free, transparent, online, open-source, spreadsheet-based decision support tools to estimate and map the climate and revenue benefits of alternative international and national REDD+ policy decisions

•Global model: 85-country partial equilibrium of agriculture, timber (Busch et al. 2009, *Environmental Research Letters*)
(Cattaneo et al. 2010, *Environmental Science and Policy)*

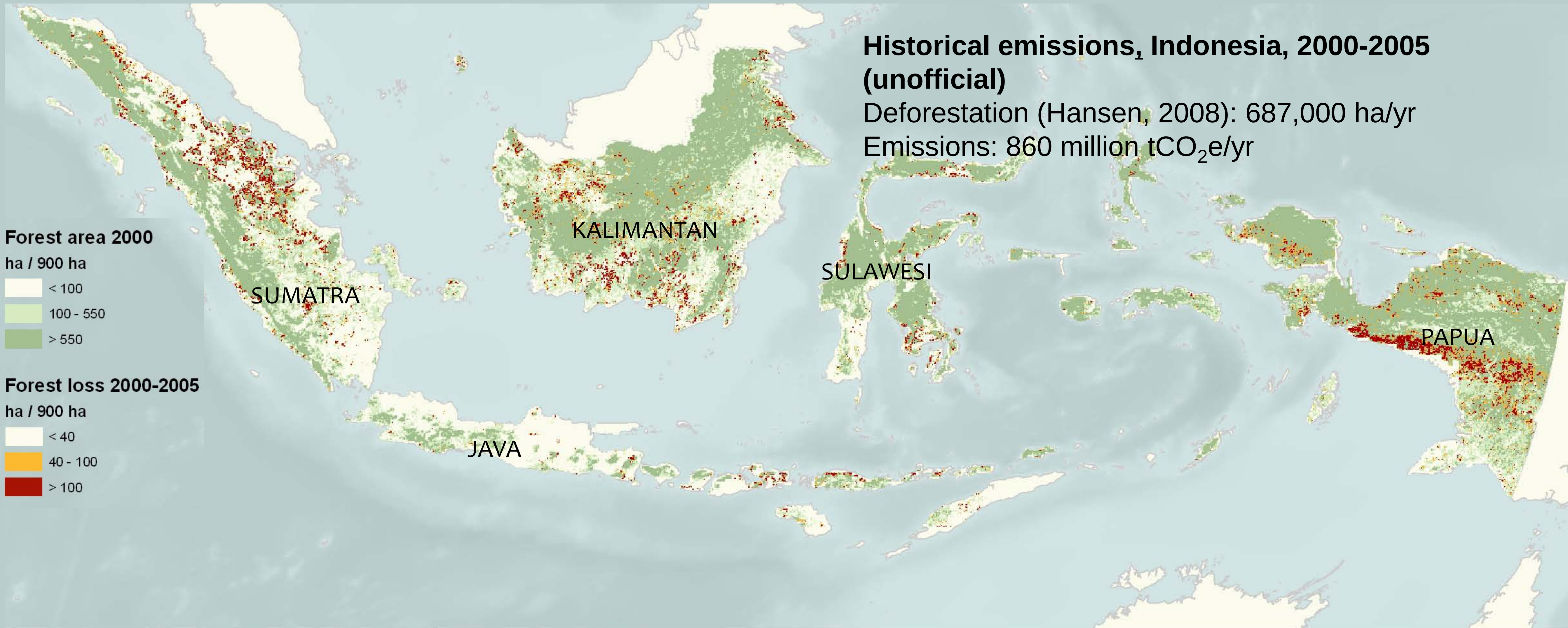
•National models: spatial econometric land-use change models for Indonesia, Peru, Madagascar…
(Busch et al. revision in review, *Proc Nat Acad Sci*)

•http://www.conservation.org/osiris



Osiris, Egyptian god of vegetation. L. Busch

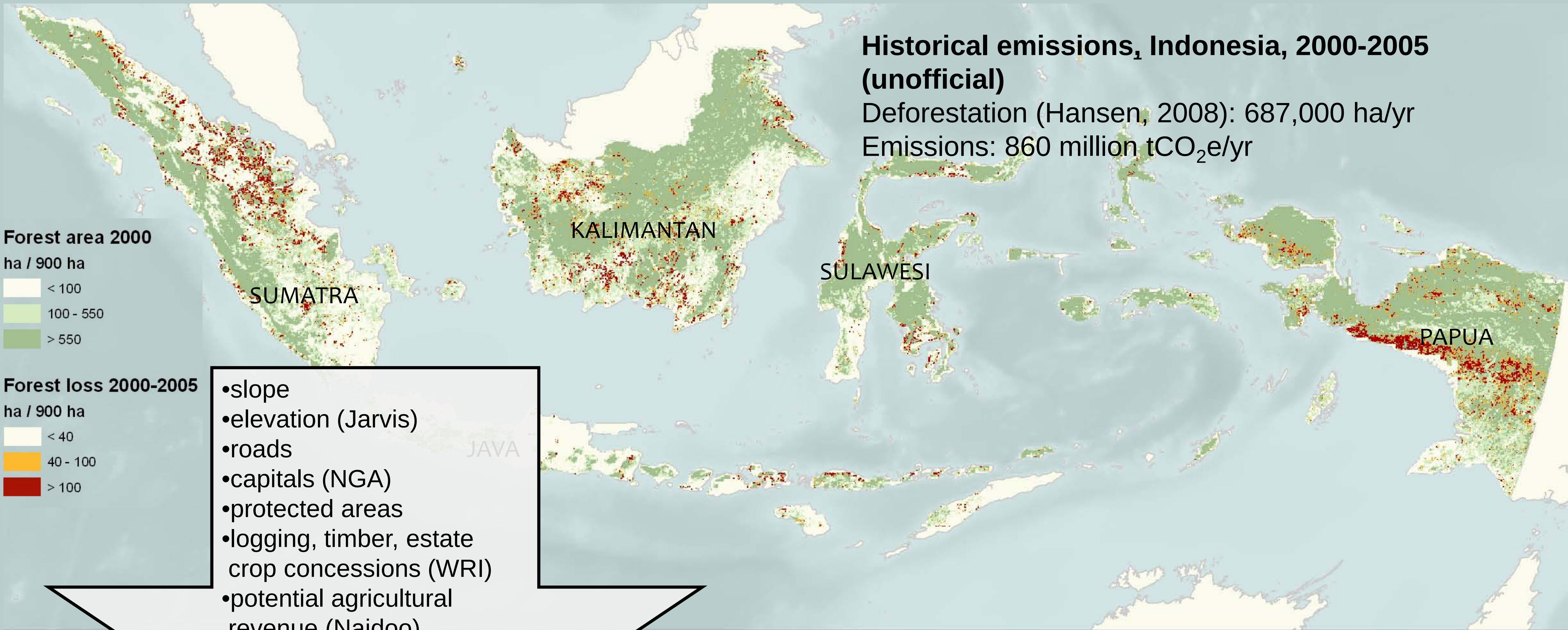
CONSERVATION INTERNATIONAL
EDF ENVIRONMENTAL DEFENSE FUND Finding the ways that work
The Woods Hole Research Center
Norad
Gordon and Betty MOORE FOUNDATION
the David & Lucile Packard FOUNDATION
CSERGE
The Terrestrial Carbon Group
WORLD RESOURCES INSTITUTE
UNIVERSITAS PADJADJARAN
IIASA
dewan nasional perubahan iklim



Estimating historical emissions

Reference Period: 2000-2005
Scale: National
Scope: Deforestation only
Classification of forest: >50% tree cover in 500m MODIS
Pools: aboveground biomass; belowground biomass; soil (peat)
Gases: carbon dioxide; methane

Transparent access to data: http://www.conservation.org/osiris



- slope
- elevation (Jarvis)
- roads
- capitals (NGA)
- protected areas
- logging, timber, estate crop concessions (WRI)
- potential agricultural revenue (Naidoo)

Poisson QMLE; robust; stratified
n~160,000; R^2=0.14

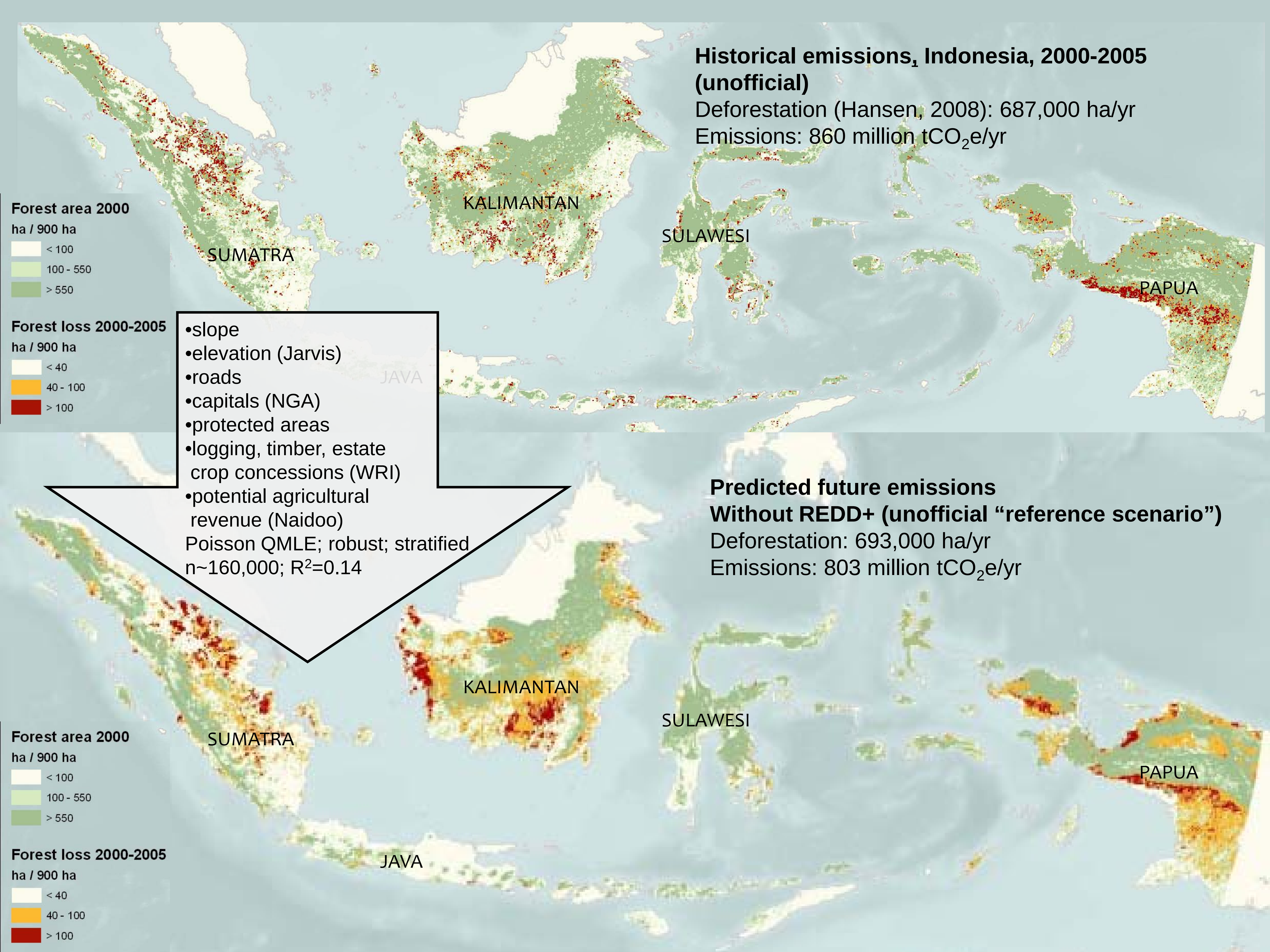
Predicting future business-as-usual emissions

Explanatory "driver" variables included:

terrain, remoteness, land-use zoning, potential agricultural revenue

Combination of drivers selected to maximize explanatory power

Sites stratified into four classes by starting forest cover to account for different deforestation processes at remote vs. accessible sites

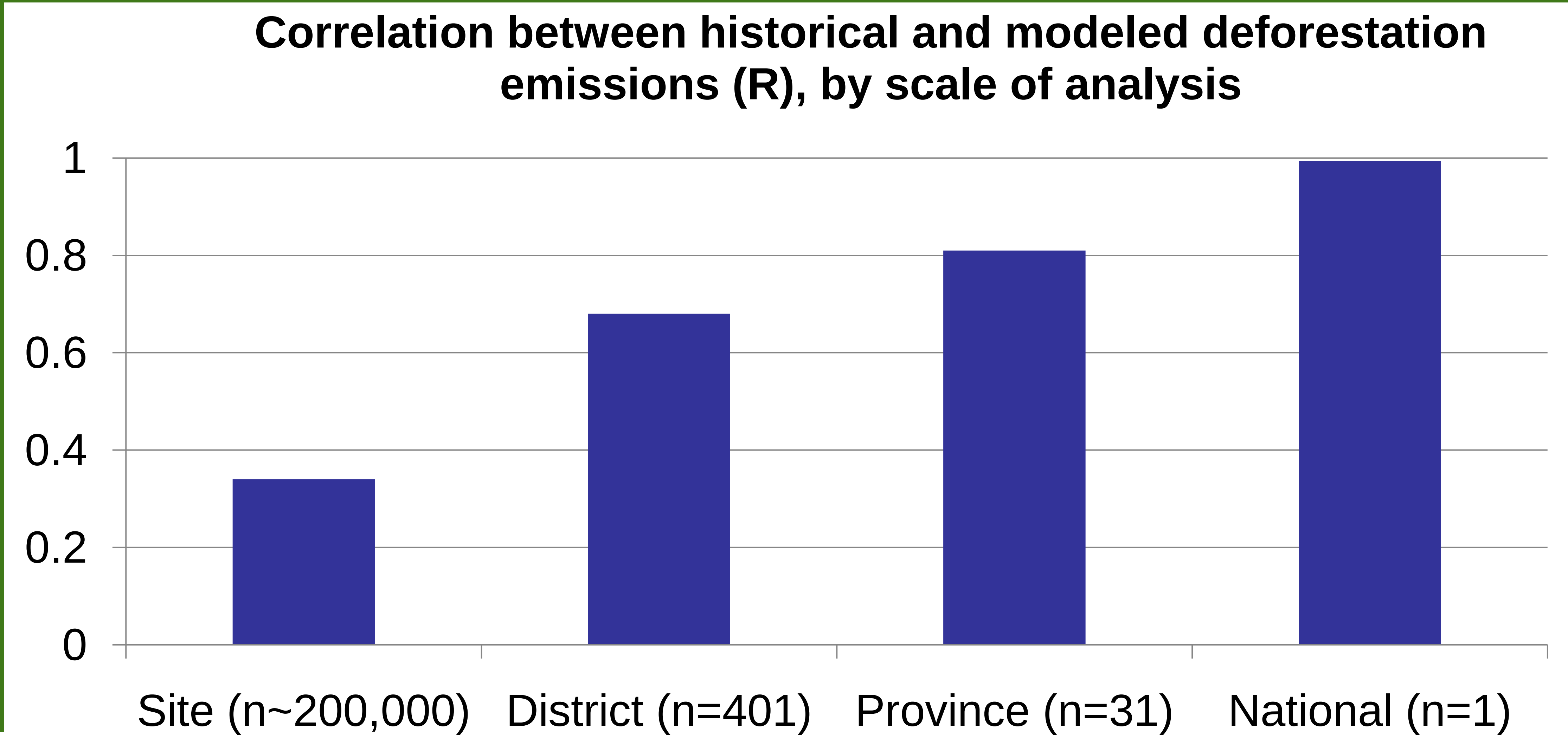


Historical emissions, Indonesia, 2000-2005 (unofficial)
Deforestation (Hansen, 2008): 687,000 ha/yr
Emissions: 860 million tCO_2e/yr
KALIMANTAN
SULAWESI
SUMATRA
PAPUA
JAVA
Forest area 2000
ha / 900 ha
< 100
100 - 550
> 550
Forest loss 2000-2005
ha / 900 ha
< 40
40 - 100
> 100
•slope
•elevation (Jarvis)
•roads
•capitals (NGA)
•protected areas
•logging, timber, estate crop concessions (WRI)
•potential agricultural revenue (Naidoo)
Poisson QMLE; robust; stratified
n~160,000; R^2=0.14
Predicted future emissions
Without REDD+ (unofficial "reference scenario")
Deforestation: 693,000 ha/yr
Emissions: 803 million tCO_2e/yr
KALIMANTAN
SULAWESI
SUMATRA
PAPUA
JAVA
Forest area 2000
ha / 900 ha
< 100
100 - 550
> 550
Forest loss 2000-2005
ha / 900 ha
< 40
40 - 100
> 100

Strengths of econometric modeling

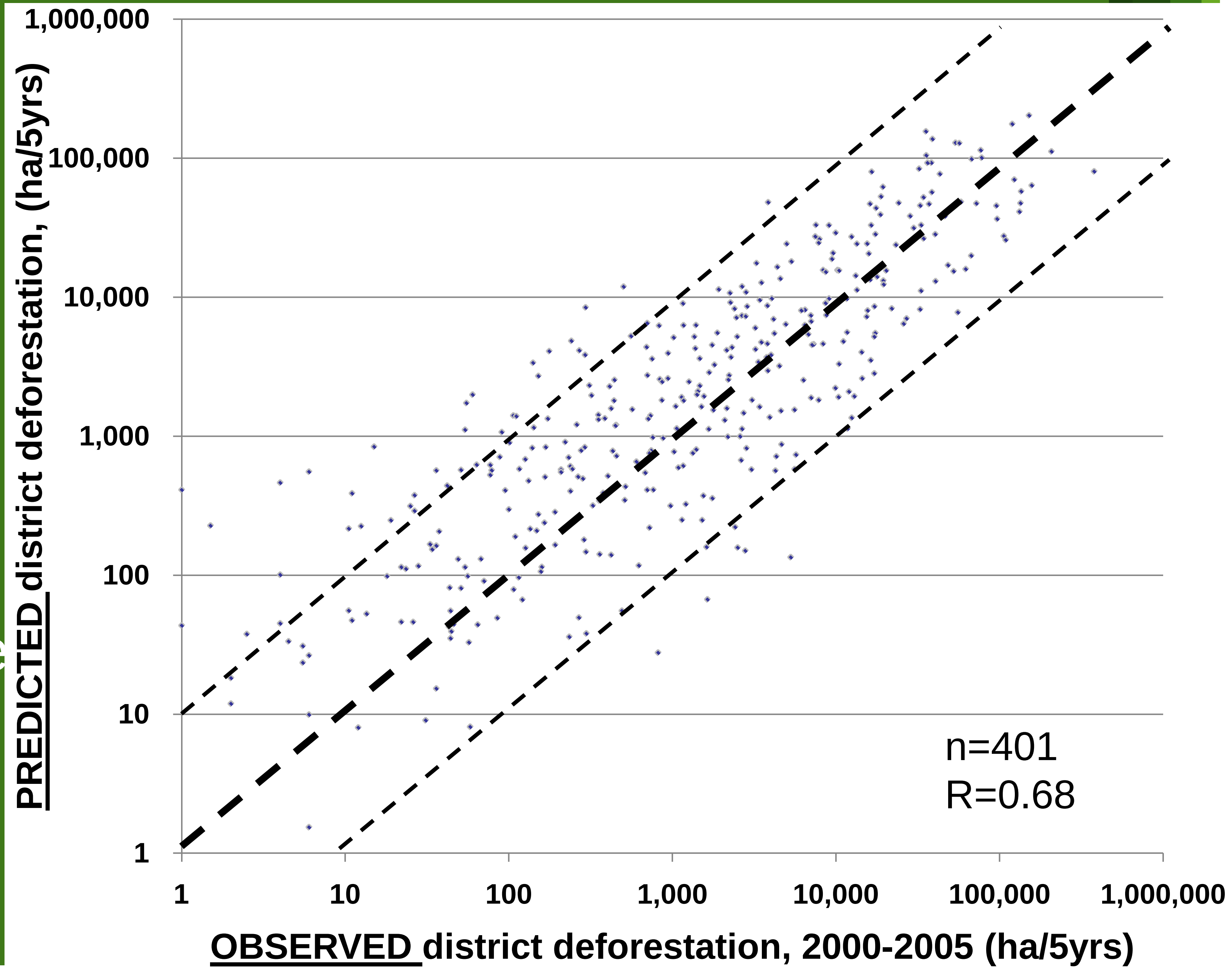
- Good at detecting underlying spatial patterns in deforestation
- Good at disentangling multiple causal factors
- Forecasting future trends in "driver" variables (e.g. population; infrastructure; agricultural prices) may (or may not) be easier than forecasting future trends in deforestation directly

- Deforestation is easier to predict at higher spatial scales



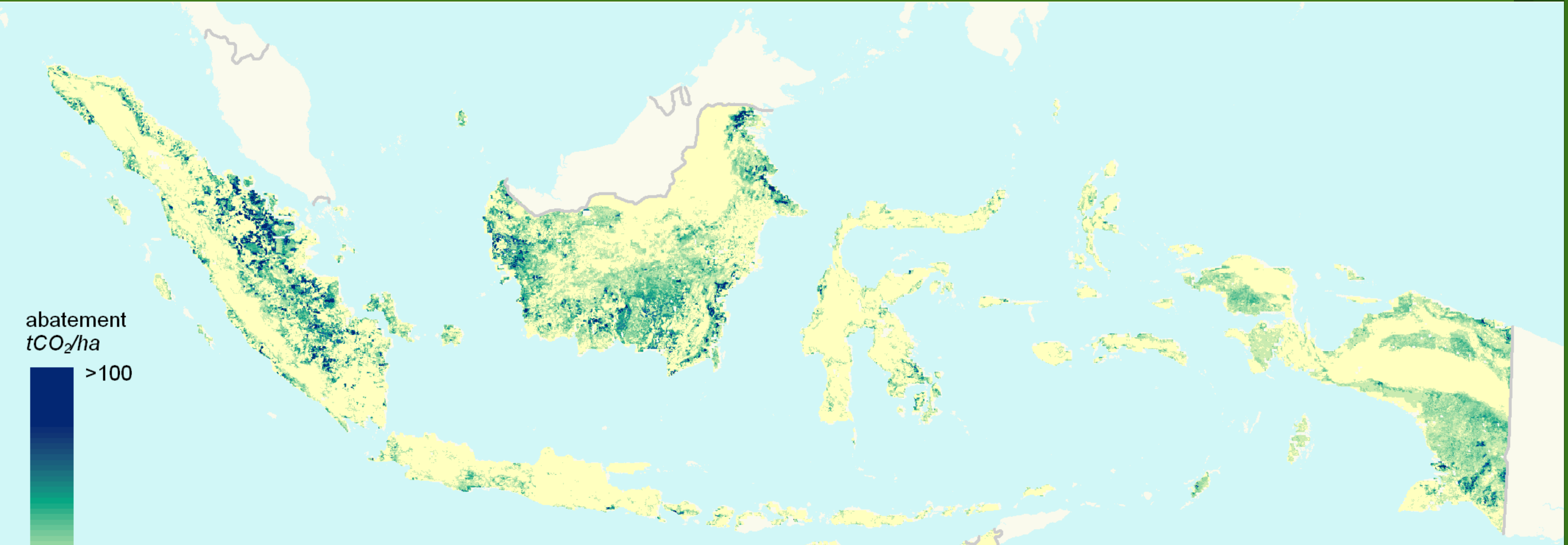
Limitations of econometric modeling

- Different data sets, different combinations of driver variables, or different assumptions can lead to different predictions
- Even after including many variables, drivers still explain only a portion of spatial variation in deforestation
- Complex econometric methods may be difficult to explain
- Does econometric modeling of drivers outperform simple extrapolation of historic trends at predicting deforestation? Without more evidence from multi-time period deforestation datasets, we don't know.



Econometric BAU emission scenario(s) can be very useful for national planning

- Predicting impacts of payments (“marginal abatement cost curves”)
- Evaluating achievability of national commitments
- Geographically targeting pilot programs for greatest impact
- Geographically distributing RLs, quotas or allowances within countries
- Designing efficient, effective, equitable multi-scale economic incentive structures for REDD+ within countries (e.g. basic voluntary incentives vs. improved voluntary incentives vs. cap-and-trade)



Expected spatial distribution of abatement under REDD+

In summary:

- An exact, “true” level of historical emissions does exist, but the level of certainty with which it can be estimated depends on data
- The crediting baseline, along with MRV, are the two absolutely essential components of a results-based, pay-for-performance REDD+ mechanism
- Predictions of business-as-usual emissions, even when technically sound, are sensitive to subjective choices about data, included variables, and assumptions
- Econometric methods can be used to detect spatial patterns in deforestation, and increase in explanatory power at higher spatial scales, but complex methods may be difficult to explain
- Future business-as-usual emissions scenario(s) are useful as a benchmark of performance, and very useful for national planning

deforestation emissions

“Did you know that ~~disco record sales~~ were up 400% for the year ending 1976? If these trends continue… AAY!”

Thank you!

Thanks to:
FCPF
Winrock International
Norwegian Agency for Development Cooperatio
Many collaborators and partners

Comments and feedback welcome:
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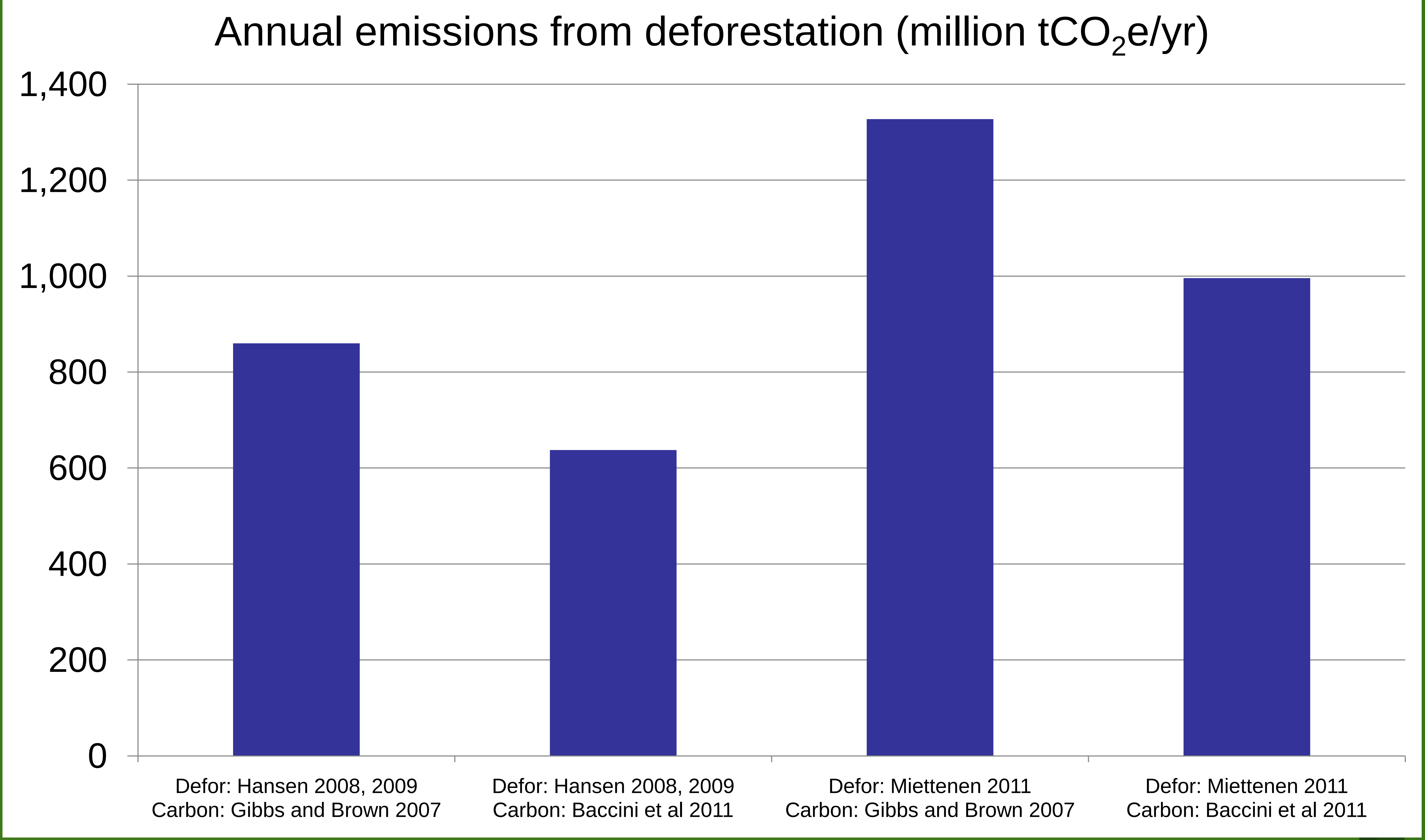
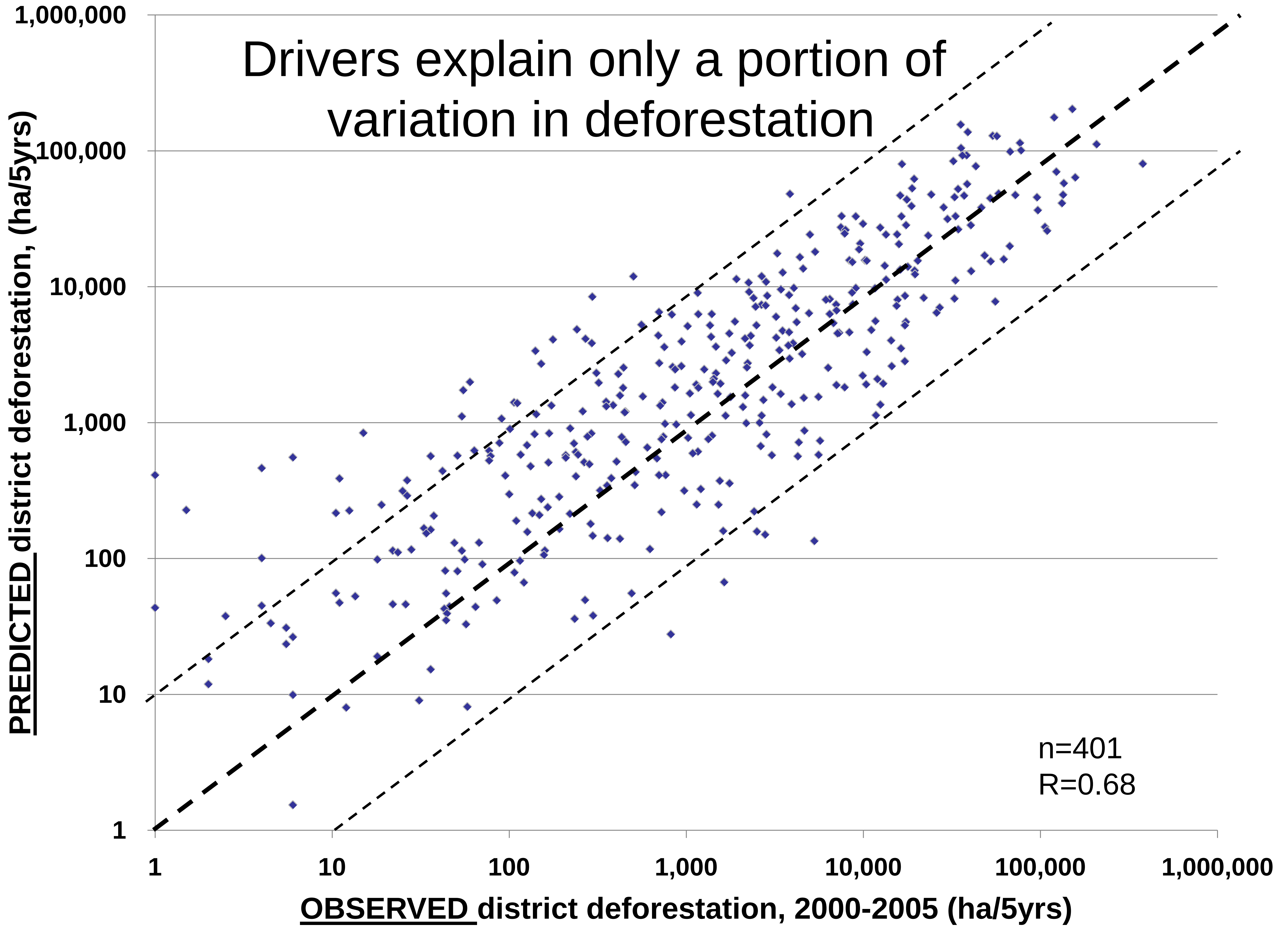
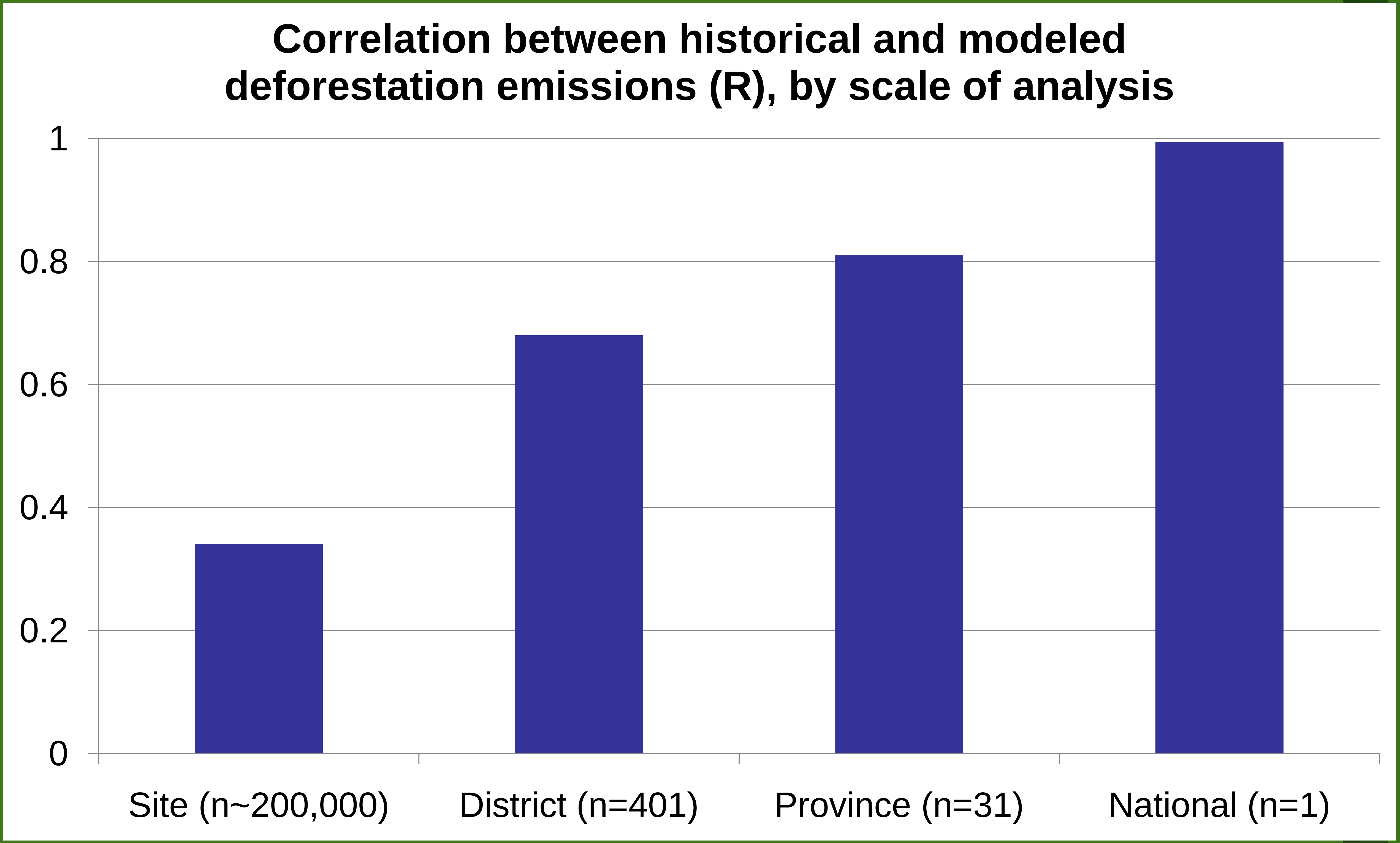
Estimation of “true” historic emissions is complicated by uncertain data





Drivers explain only a portion of variation in deforestation
PREDICTED district deforestation, (ha/5yrs)
OBSERVED district deforestation, 2000-2005 (ha/5yrs)
1,000,000
100,000
10,000
1,000
100
10
1
n=401
R=0.68

Deforestation is easier to predict at higher spatial scales



Little evidence from multi-time period datasets

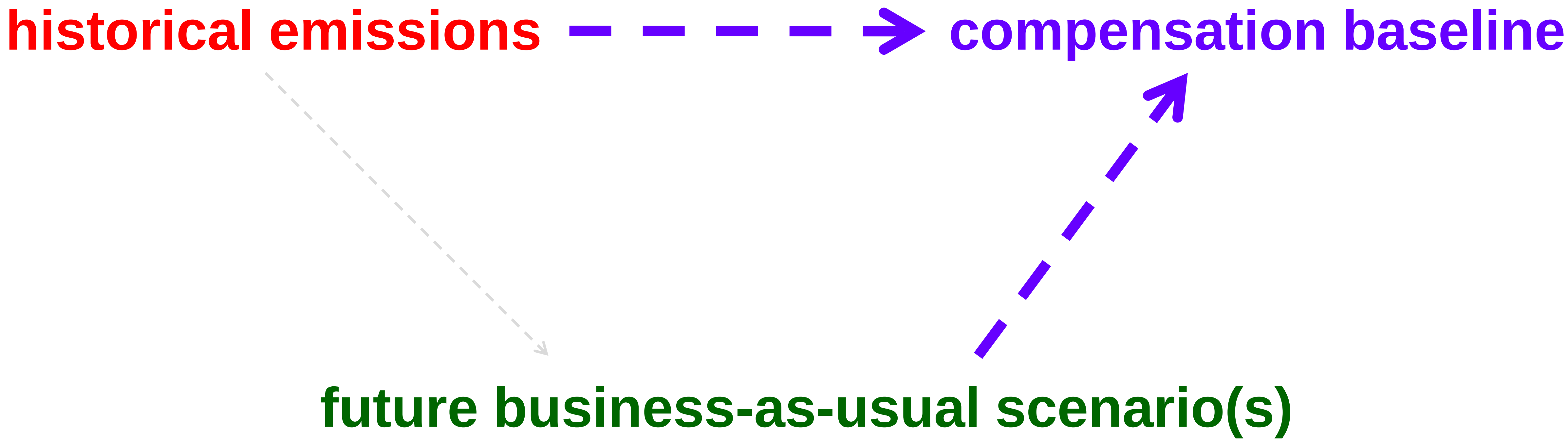
- FAO Forest Resources Assessment 2010:

  1990-2000-2005-2010 data indicates short-term persistence of national deforestation rates for many countries, but data is of mixed quality and successive time periods often do not represent independent data points.

- Country case studies are few and far between

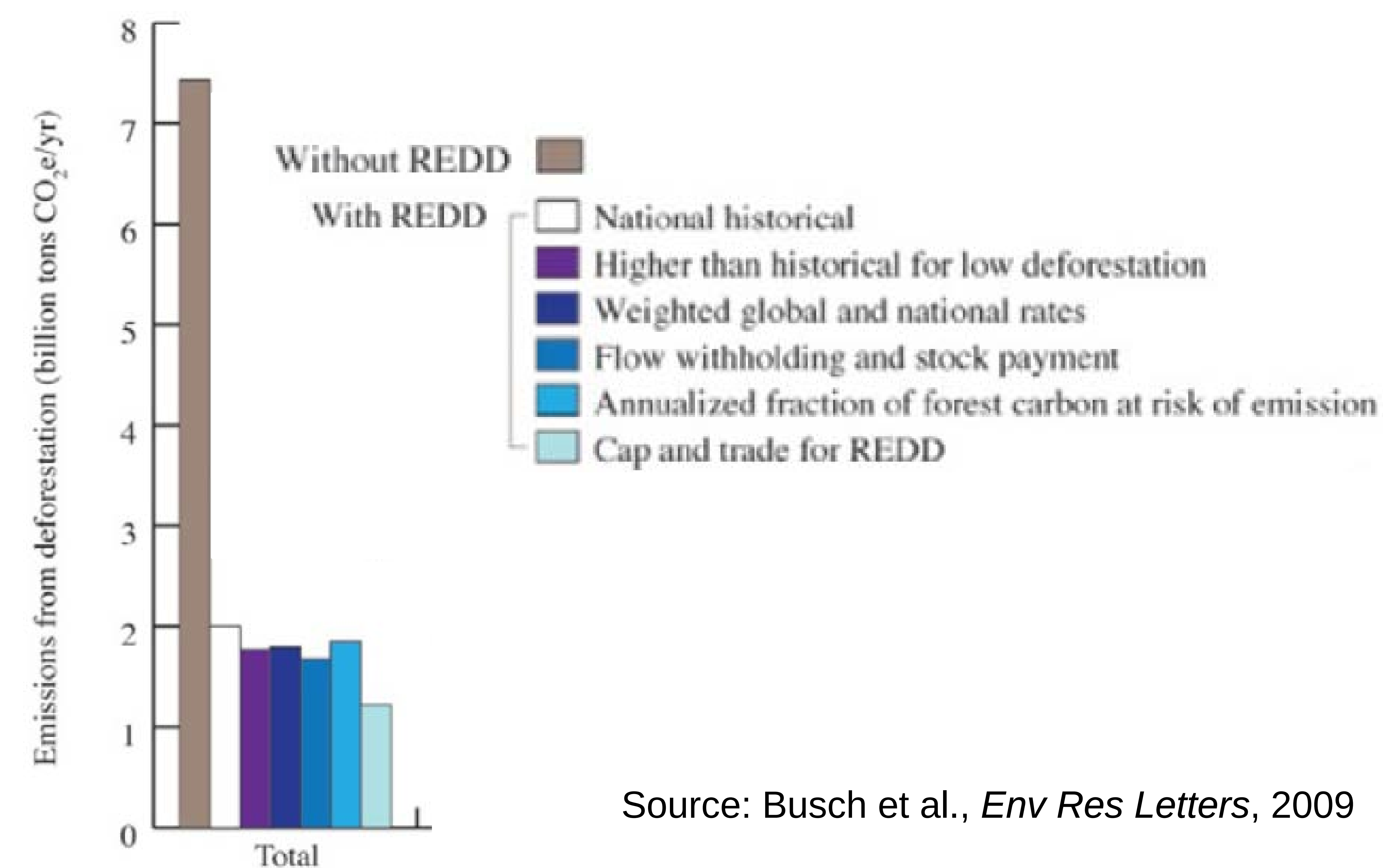
  not many national multi-time period spatial data sets on deforestation, and even less data on historical changes in forest carbon stock (e.g. degradation, enhancement)

What do we know about setting compensation baselines?



Effectiveness and efficiency

"REDD can provide cost-efficient climate change mitigation under a broad range of reference level designs…the most effective designs balance incentives to reduce high emissions and maintain low emissions"



Source: Busch et al., *Env Res Letters*, 2009

Equity: distribution of payments varies considerably by RL design

Griscom et al. *Env Sci & Pol*, 2009: "relative distribution of credits generated were especially variable for countries with high remaining forest and low rates of deforestation (HFLD)."

Cattaneo et al. *Env Sci & Pol*, 2010: "If equity is evaluated relative to opportunity costs, then the most equitable approach would compensate emissions reductions but withhold a part of the payments to compensate for carbon stocks"

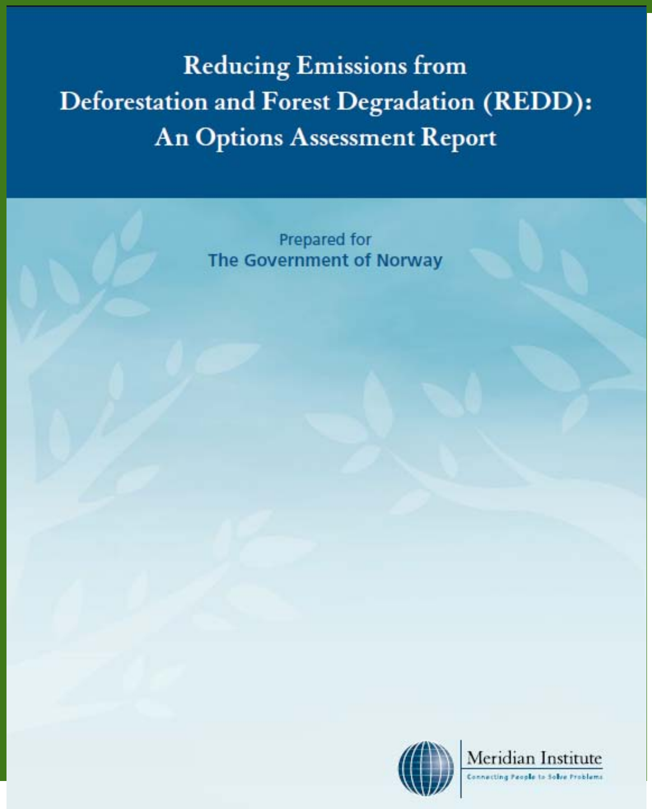
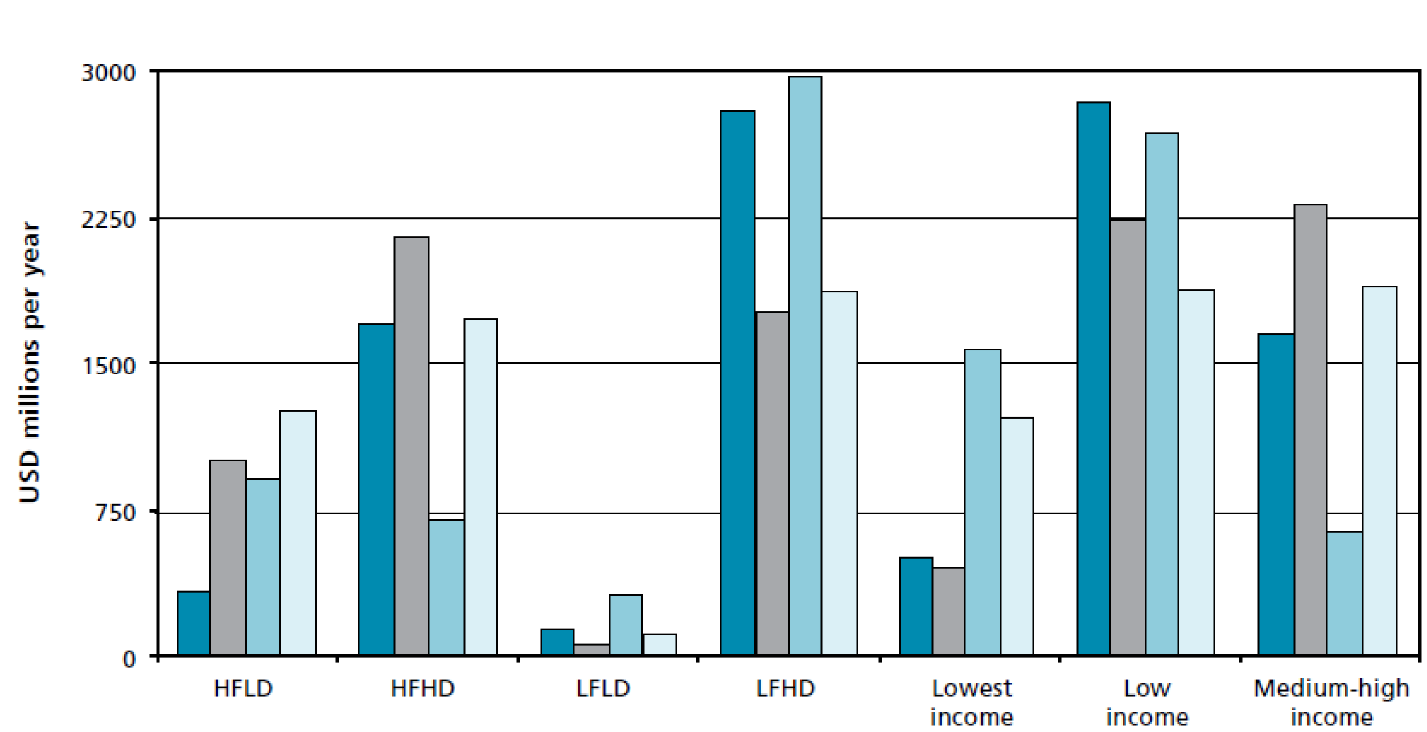


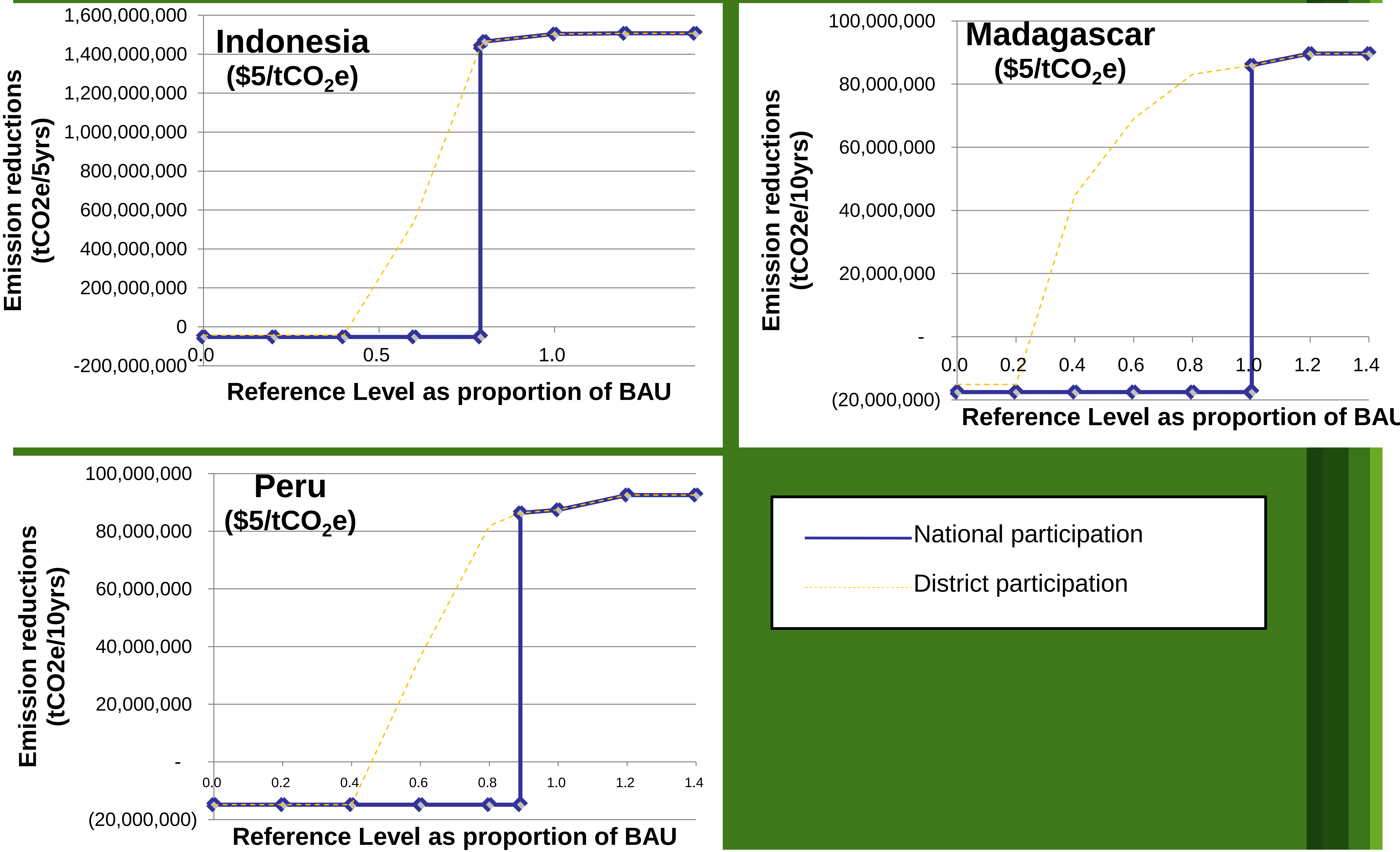
Figure 3.2 REDD transfers to groups of countries under different RL options



Insights for setting compensation baselines in a “bottom-up” world

- Adjusting reference levels upward above BAU emission rate:
  - CON: can lower efficiency by paying for “hot air”
  - PRO: can raise effectiveness by preventing increases in emissions (e.g. “leakage”)
- Adjusting reference levels downward below BAU emission rate
  - PRO: raises efficiency by leveraging uncompensated reductions
  - CON: increases risk that countries will “opt out” of REDD, lowering effectiveness
- BAU emission rate remains an important knowledge gap for setting effective, efficient reference levels
- Standard rules and/or guidelines from the COP for adjusting reference levels from historical data based on national circumstances minimize the need for after-the-fact review of case-by-case adjustments

Higher reference levels can lead to greater participation, more emission reductions



Lower reference levels can leverage more uncredited emission reductions, but risk "opt-out"