DETERring Deforestation in the Brazilian Amazon

Environmental Monitoring and Law Enforcement

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Agenda

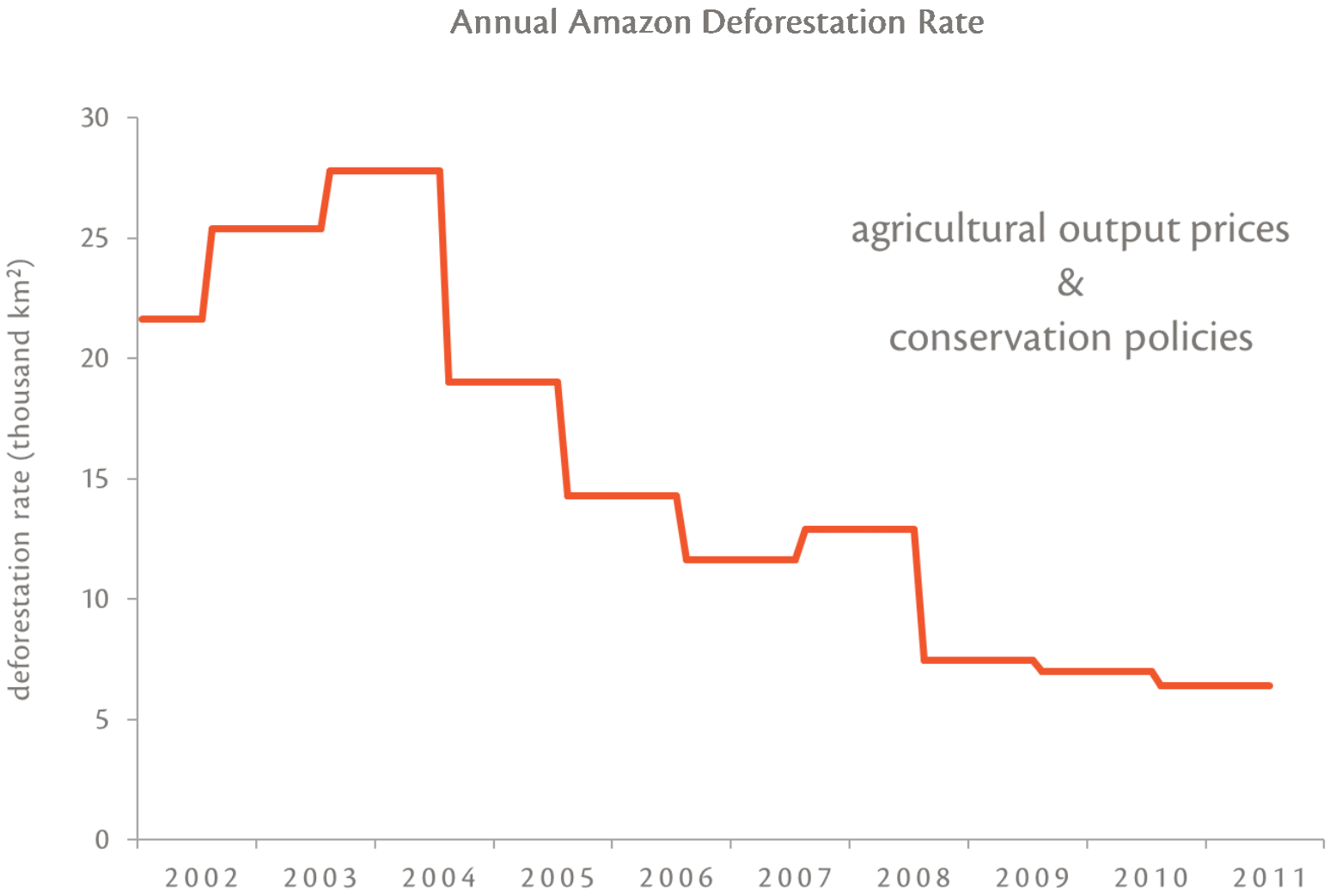
- Introduction
- Institutional context
- Methodology
- Key findings
- Policy implications
- CPI Rio projects
- Q&A

Introduction | The Brazilian Amazon

- The Brazilian Amazon
  - 4 million km^2
    - 80% remains covered by native vegetation
  - 20% of planet's fresh water
  - Unique biodiversity
  - Carbon sink

... combating illegal deforestation is an **immense challenge** !

Introduction | The Brazilian Amazon



Introduction | This Study

- Main question
  - What role did monitoring and law enforcement play in the recent deforestation slowdown?

- Our approach
  - Empirical regression-based analysis
    - Sample: 526 Amazon municipalities from 2007 through 2011
  - Explore policy implementation details to assess policy effectiveness
    - Satellite-based targeting of monitoring and law enforcement

Introduction | This Study

- Main findings
  - Large deterrent effect of monitoring and law enforcement
    - 2007-2011: preserved over 59,500 km^2 of Amazon forest
  - Estimated monetary benefits are larger than costs
  - Forest preservation occurred at no apparent cost to local agricultural production

- Monitoring and law enforcement policy

effective & **low-cost**

monetary
agricultural

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Institutional Context | What is Ibama?

- Brazilian Institute for the Environment and Renewable Natural Resources [**Ibama**]
  - Environmental monitoring and law enforcement authority
  - Police force
  - Investigation of environmental infractions
  - Sanctioning of environmental crimes

Institutional Context | Policy Change

- Pivotal conservation effort of 2000s
  - Plan for the Prevention and Control of Deforestation in the Amazon [**PPCDAm**]

- Stricter monitoring and law enforcement
  - Real-Time System for Detection of Deforestation [**DETER**]
    - Satellite-based real-time monitoring

Institutional Context | How DETER Works

National Institute for Space Research

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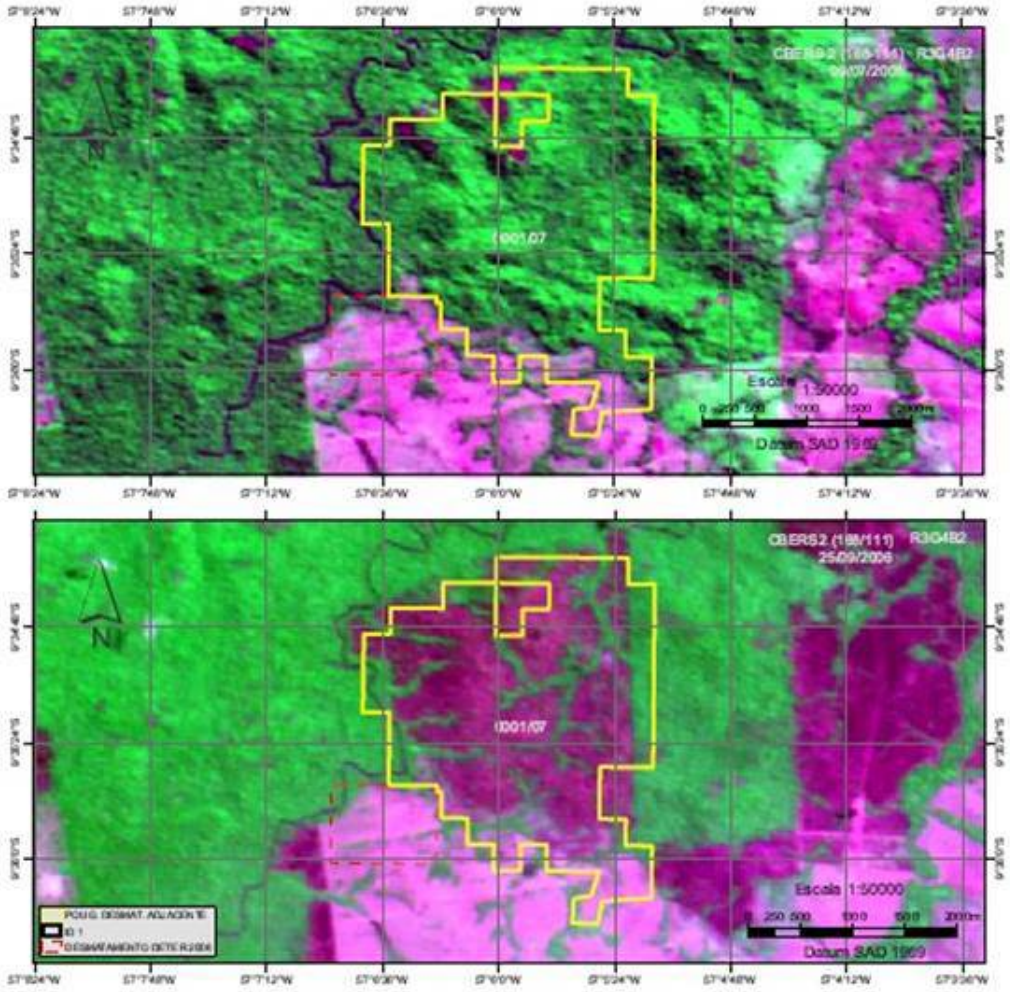
Remote Sensing Center

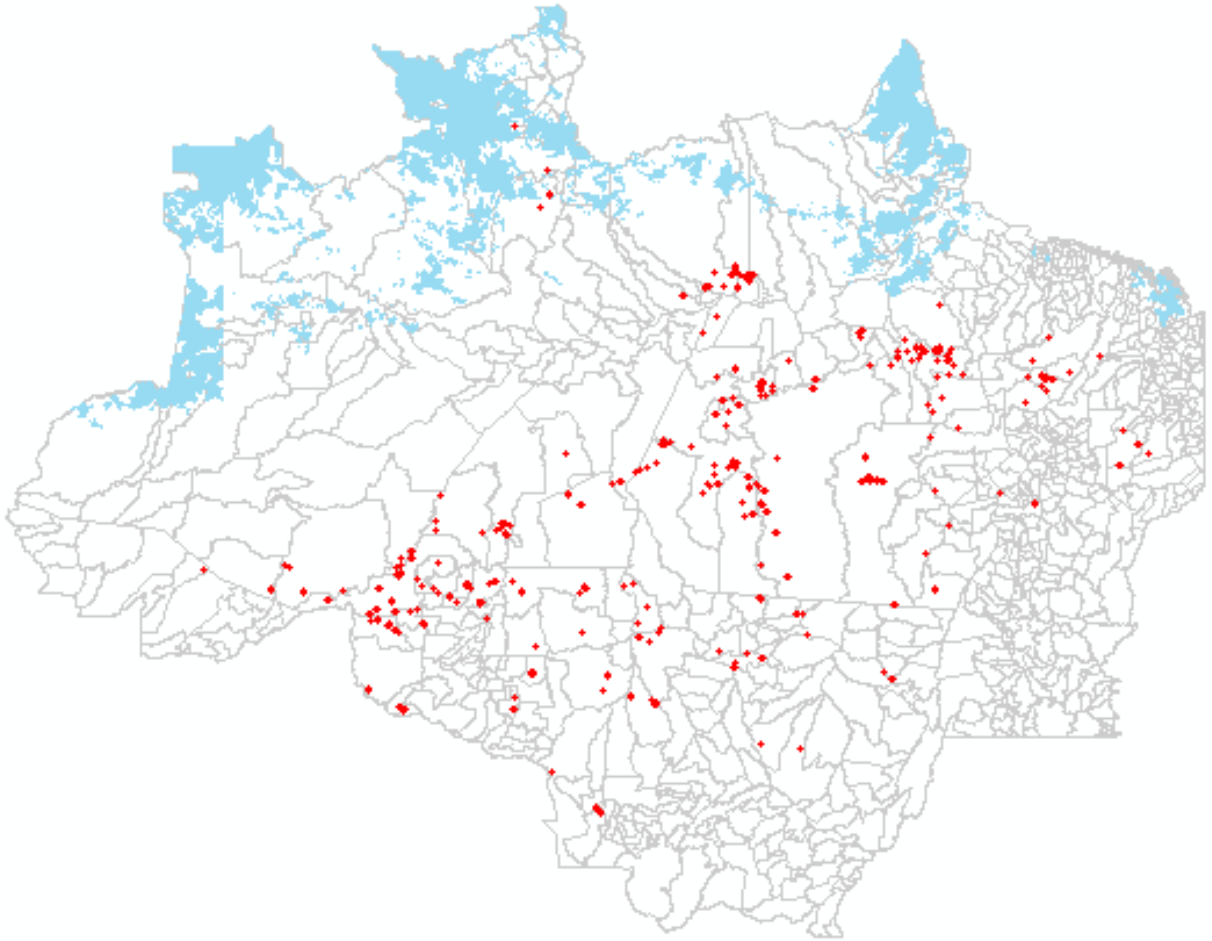
Institutional Context | How DETER Works

before

after



Institutional Context | How DETER Works



Institutional Context | How DETER Works

National Institute for Space Research

+

Remote Censing Center

PT-HMP
IBAMA

POLÍCIA
RODOVIÁRIA
FEDERAL

Institutional Context | How DETER Works

- Targeting before DETER
  - Voluntary reports of deforestation activity

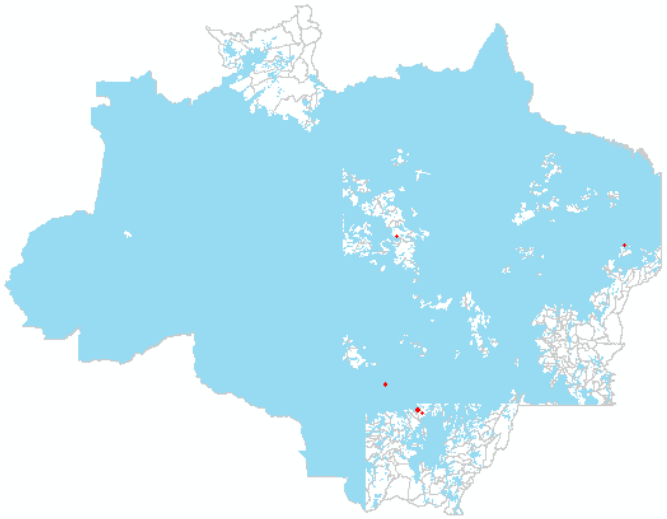
- Targeting after DETER
  - Satellite imagery: 3-day intervals, year-round
  - More timely law enforcement action

… **significant improvement** in Amazon monitoring and law enforcement capability

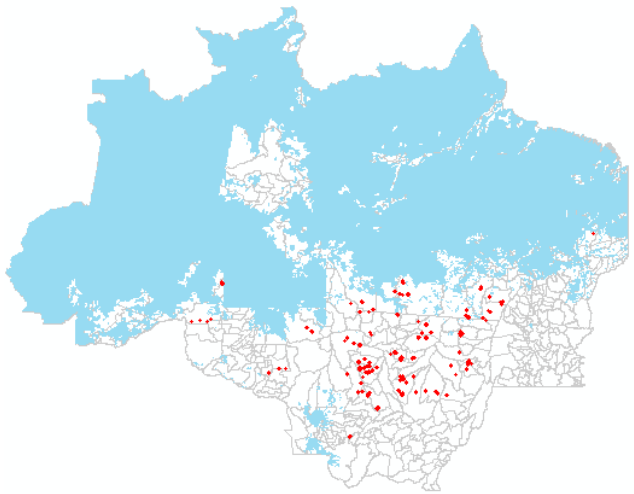
- DETER is incapable of capturing land cover patterns beneath cloud coverage

Institutional Context | How DETER Works

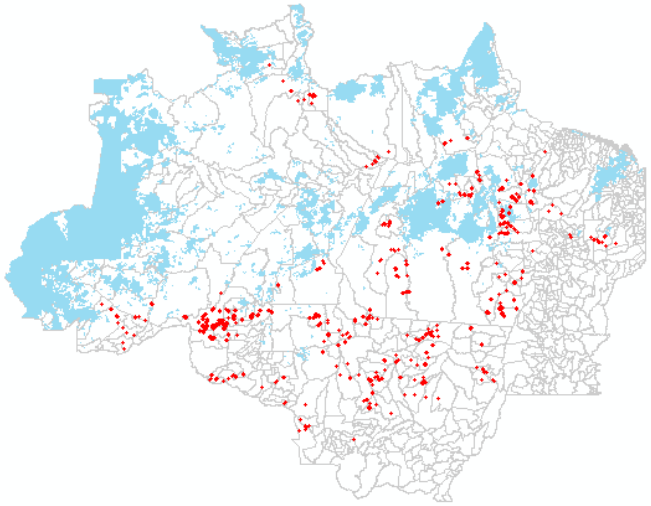
Jan 2011



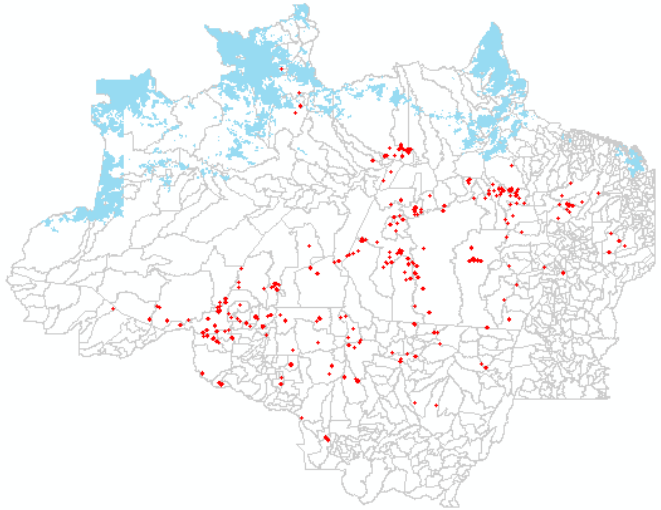
Apr 2011



Jul 2011



Oct 2011



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A Word on Methodology

- Goal: identify **causal effect** of Ibama's presence on deforestation activity
  - Environmental fines as measure of Ibama's presence

- Challenge: address **two-way causality**

monitoring and law enforcement deforestation

A Word on Methodology

- Use DETER cloud coverage as source of exogenous variation in law enforcement
  - What does this mean?
  - For a given area, systematically:

Greater DETER cloud coverage

↓

Lower chance of DETER issuing alert

↓

Lower chance of Ibama targeting the area

↓

Lower intensity of monitoring and law enforcement

... unrelated to deforestation!

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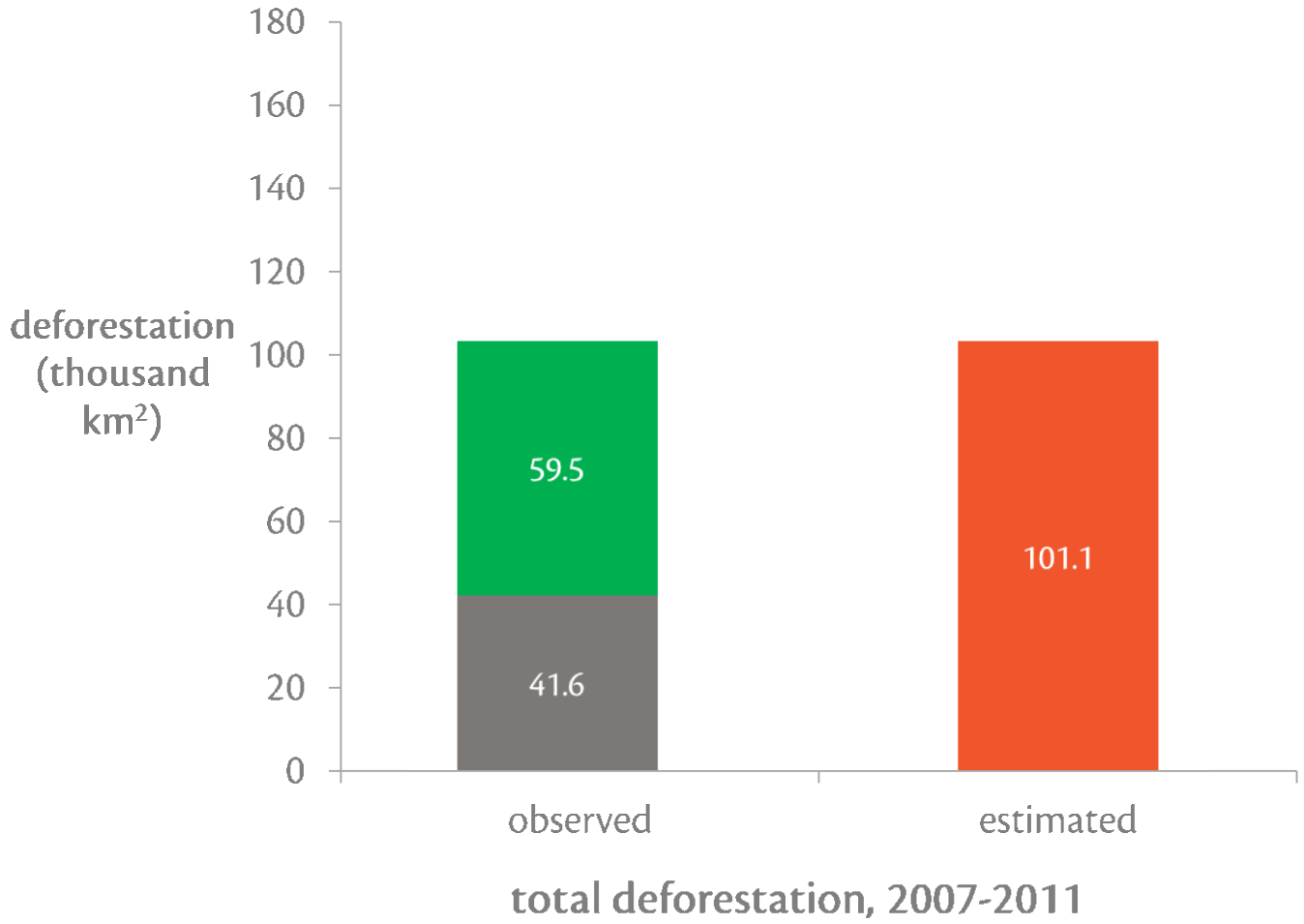
Results | Key Findings

- DETER cloud coverage affects Ibama's presence
  - Lower cloud coverage leads to greater number of fines

- Ibama's presence affects deforestation activity
  - Greater number of fines in current year leads to lower deforestation in following year
  - Deterrent effect dissipates over time

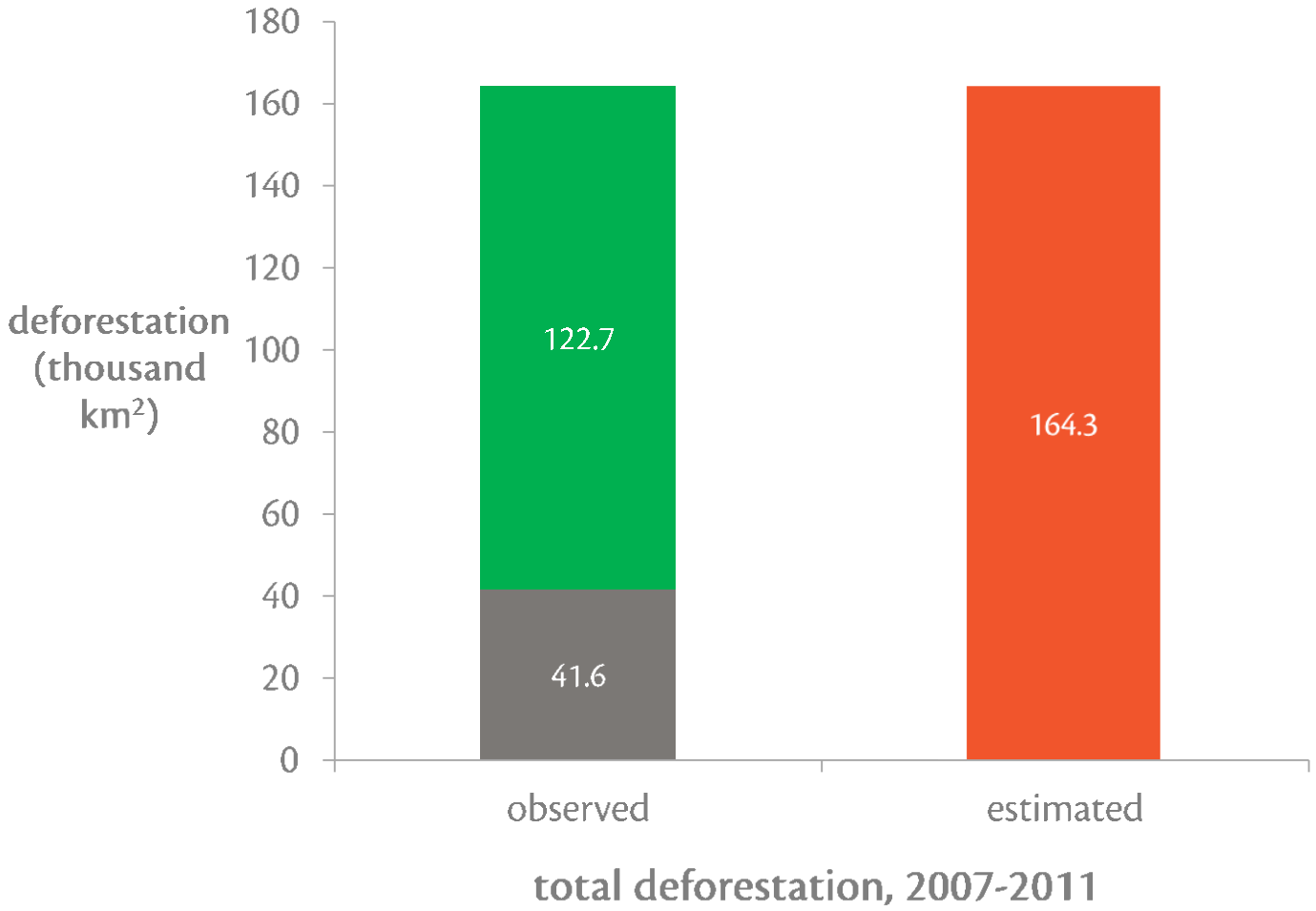
Results | What Does This Mean?

- What if Amazon monitoring and law enforcement capability had not improved starting in 2004?



Results | What Does This Mean?

- What if Amazon monitoring and law enforcement had been entirely inactive?



Results | What Does This Mean?

- Simulation 1: 59,500 km^2
  - $\approx {}^{2}/_{3}$ area of Portugal

- Simulation 2: 122,000 km^2
  - ≈ area of Nicaragua
  - Avoided emissions equivalency: 900 million tCO_2 per year
    - ½ US 2011 transport sector emissions
    - 2.5–3 times average annual emissions savings from European renewables sector

Results | Worth It?

- Cost-benefit analysis

24,500 km^2
average forest area preserved per year

=

900 million tCO_2
avoided emissions per year

benefit

560 million USD
125 million USD
annual budgets for Ibama and INPE

=

685 million USD
annual budget for Amazon monitoring and law enforcement

cost

5 USD/tCO_2
common current price of carbon

>>

0.76 USD/tCO_2
break-even price of carbon

low monetary cost

Results | Key Findings

- Tradeoff between economic growth and preservation?

- Ibama's presence does not affect local agricultural production
  - Greater number of fines has no impact on local agricultural GDP or crop production

low agricultural cost

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Policy Implications

- Maintain Amazon monitoring and law enforcement efforts
  - Strong deterrent effect at relatively low cost
  - Need for continuous policy action
  - Complementary nature of other conservation policies

- Promote strategic use of technology and information
  - Improve monitoring technology
  - Further enhance law enforcement capability

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CPI Rio Projects | Land Use

- Deforestation
  - Prices or policies?
    - Conditional rural credit
    - Monitoring and law enforcement
    - Net impact of protected areas
  - Socioeconomic impact of conservation policies
  - Forest clearing behavior

- Agriculture
  - Enhanced productivity
    - Technological adoption
    - Insurance for rural producers

Questions?

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for full paper and executive summary, click here