

China's Environmental Overhaul (and What I Hope to Learn More About)

Chinese Economists Society 2023 North America Conference

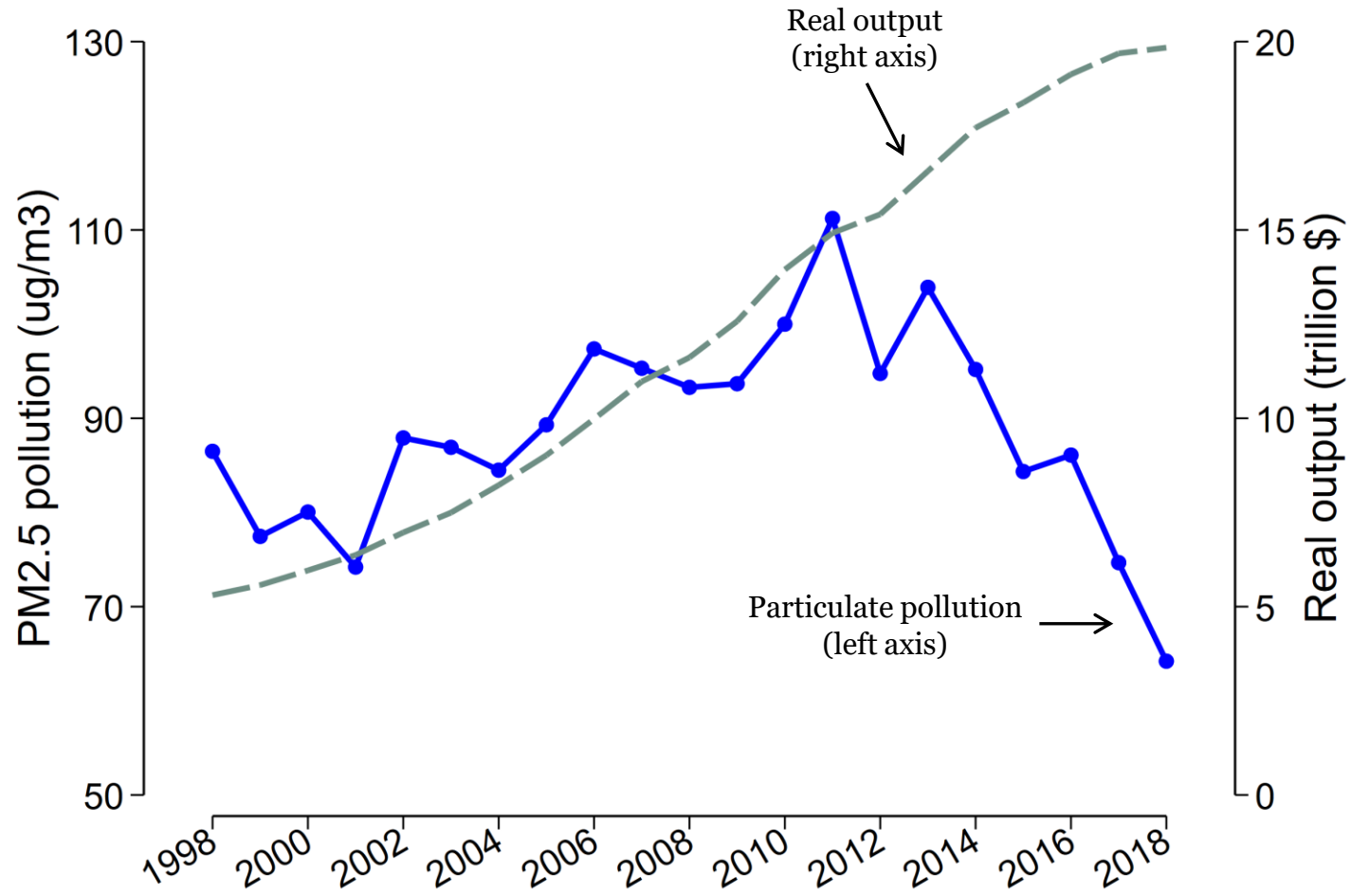
March 2023

Eric Zou

University of Oregon & NBER

The War on Pollution: China's Dramatic Air Pollution Cleanup Since 2014

National Real output and PM2.5, 1998-2018



Notes: Dashed line shows real output (trillion of 2007 USD). Solid line shows satellite-based PM2.5 estimates (van Donkelaar, 2016).

李克强：向雾霾宣战不是向老天宣战 要向粗放生产生活宣战

2014年03月13日12:05

来源：人民网

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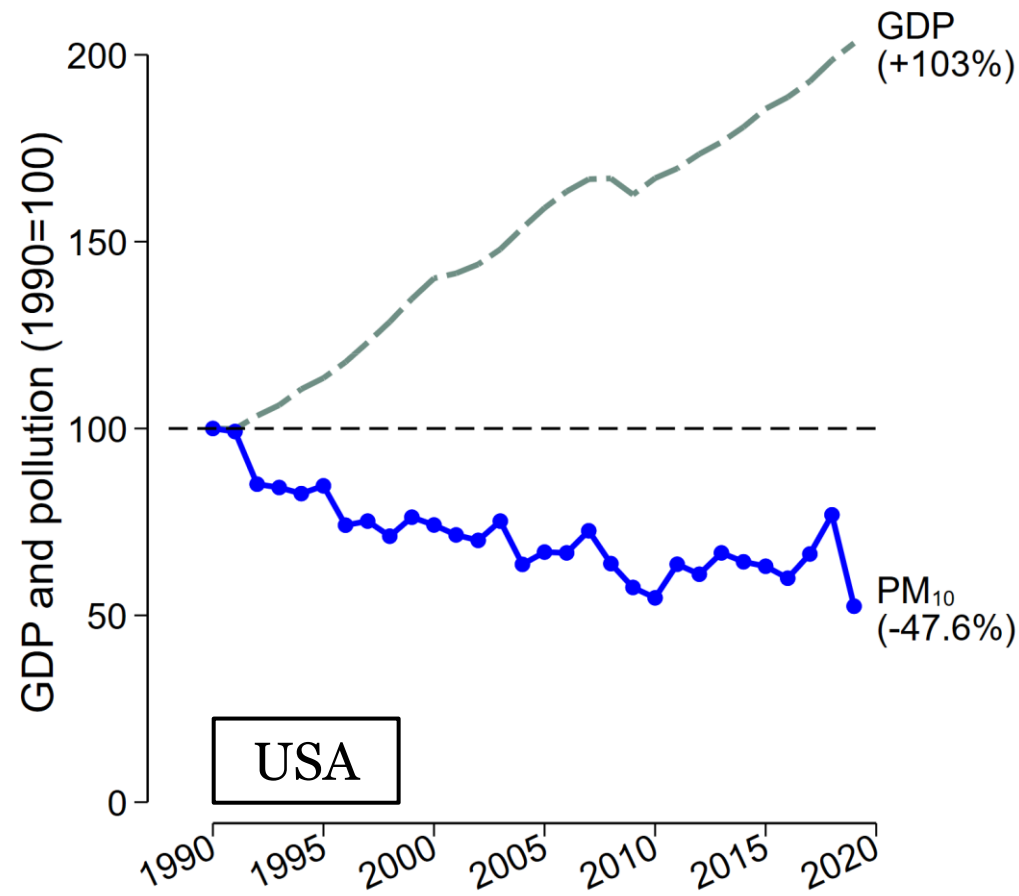
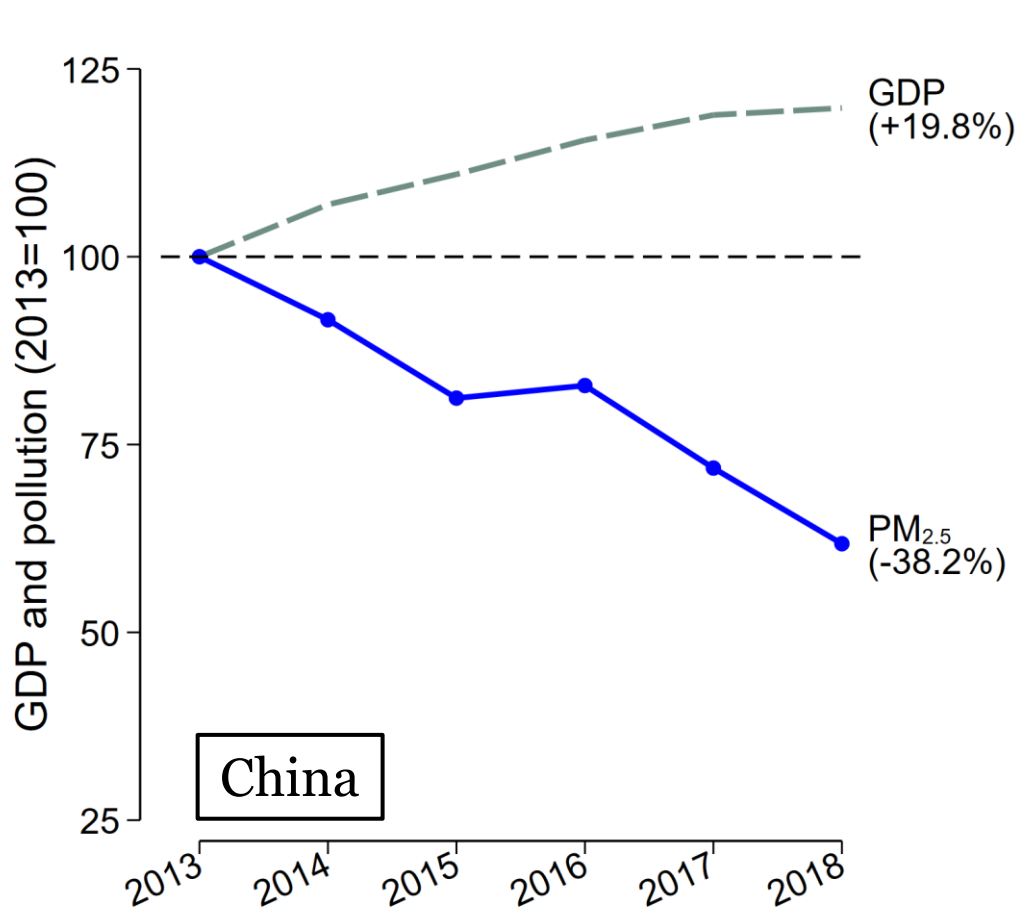
号 + -



3月13日，国务院总理李克强在人民大会堂会见中外记者并回答记者提出的问题。人民网记者 于凯 摄

The War on Pollution: China's Dramatic Air Pollution Cleanup Since 2014

China and USA



Notes: Both real GDP and pollution values are normalized to 100 for year 2013 (China) and 1990 (USA). China data from government monitoring. USA data from EPA.

Comments

- Highlight some areas warranting investigation
 1. Public perception and behavior
 2. Human and ecosystem health
 3. Regulation and enforcement
 4. Industry effects

Comments

- Highlight some areas warranting investigation

1. Public perception and behavior

2. Human and ecosystem health

3. Regulation and enforcement

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Public Perception and Behavior

- A part of China's environmental overhaul involves **information availability**
 - Public, real-time broadcast of air quality via news media, mobile phone apps, etc.
 - Public disclosure of firm's real-time pollution emissions
- Opportunity to understand the role of information (or the lack thereof) in shaping some key objects in the literature:
 - **Perception** = $f(\text{Pollution})$
 - **Behavior** = $f(\text{Pollution})$
 - **Health** = $f(\text{Pollution})$

“From Fog to Smog: the Value of Pollution Information” (Barwick, Li, Lin, and Zou, 2023 wp)

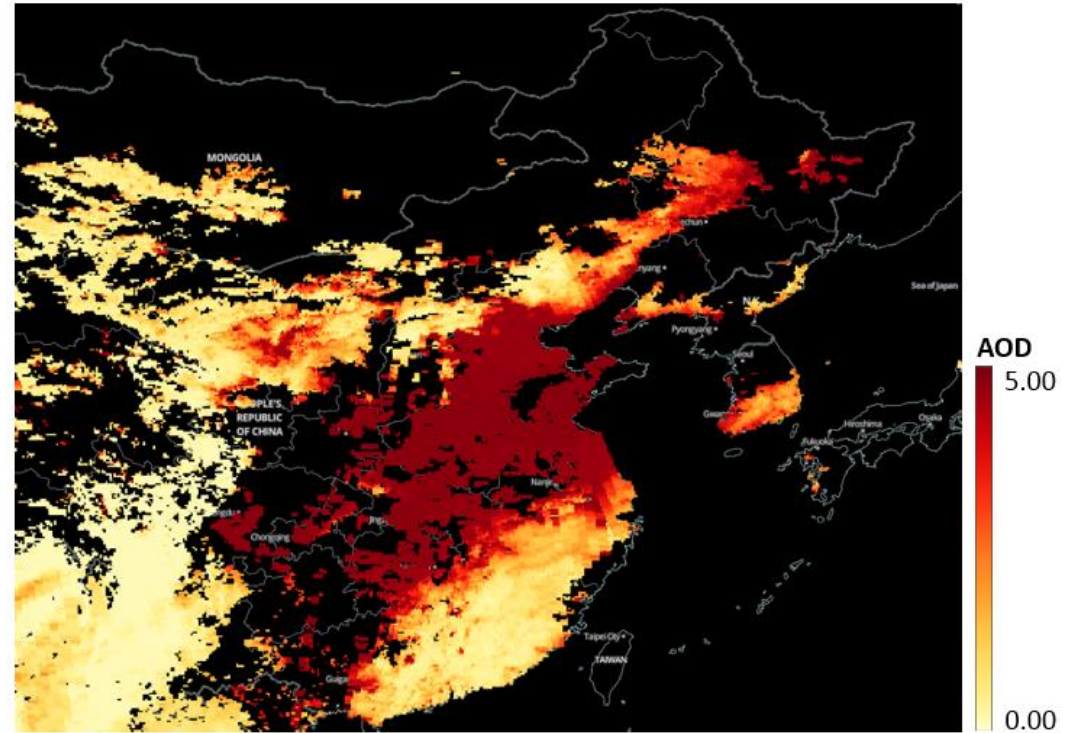
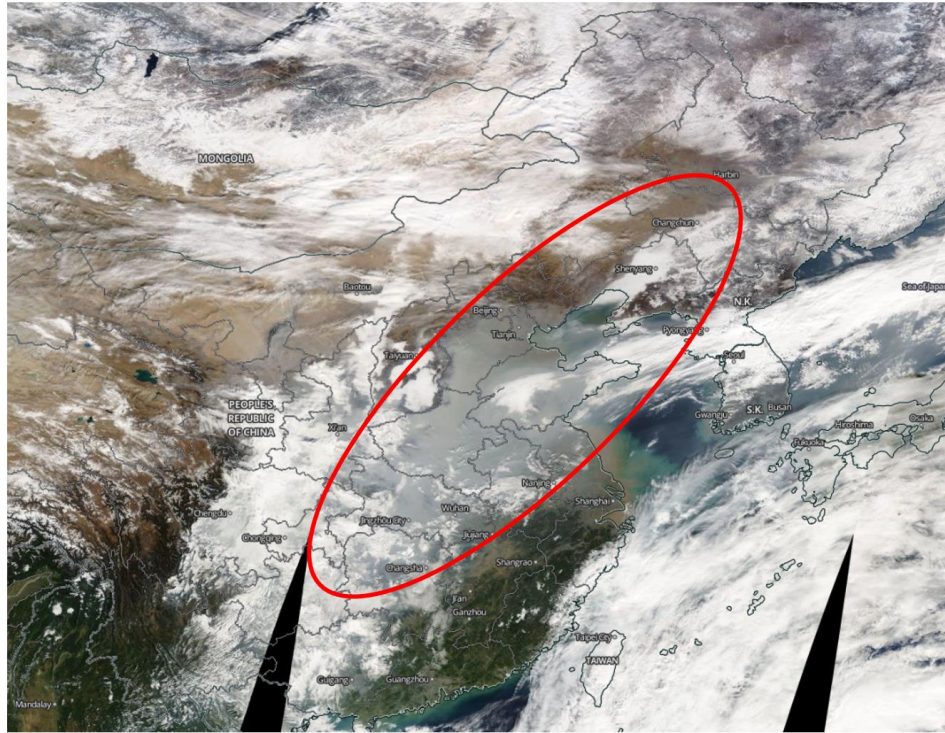
- What has char
- 1. Pollution
- 2. Information
- 3. Regulation
- 4. Industry

The screenshot shows the official website of the China Meteorological Administration (CMA). The header includes the CMA logo and name in Chinese (中国气象局) and English (China Meteorological Administration). A navigation bar contains links for Home, Leadership, Department Overview, News, Information Disclosure, Service, and Weather Forecast. A search bar is located on the right. The main content area displays a news article titled "大雾笼罩北方大部 多省市通行受阻" (Dense fog covers most of northern China, traffic in many provinces and cities is hindered). The article's source is listed as "来源:" and the publication time as "发布时间: 2011年11月27日 13:35". A social media sharing bar is visible below the title. A black box highlights the English translation of the title: "Dense Fog Causes Traffic Congestion in Many Northern Cities". Below the text is a photograph of a city shrouded in thick fog.

“From Fog to Smog: the Value of Pollution Information” (Barwick, Li, Lin, and Zou, 2023 wp)

• What has changed?

1. Fog
2. Pollution
3. Visibility
4. Air Quality



“From Fog to Smog: the Value of Pollution Information”

(Barwick, Li, Lin, and Zou, 2023 wp)

- What has changed?
- 1. Pollution
- 2. Information
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“From Fog to Smog: the Value of Pollution Information” (Barwick, Li, Lin, and Zou, 2023 wp)

- What has changed?
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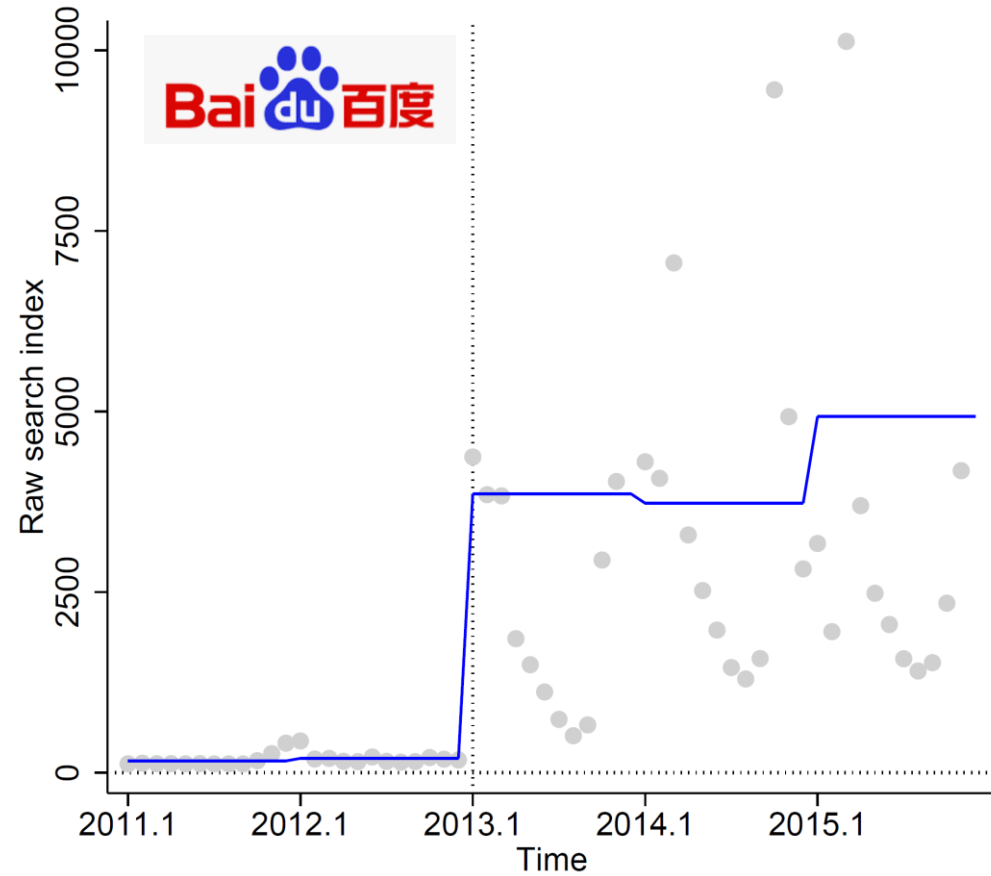
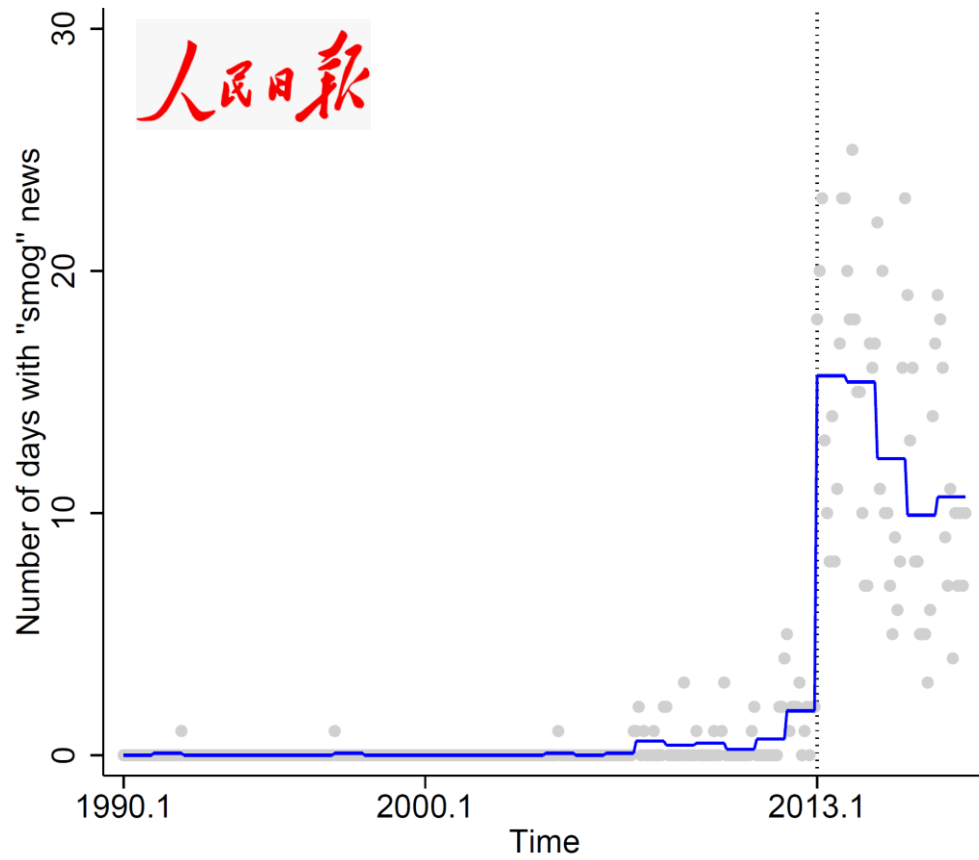


温馨提示

敏感人群症状易加剧, 应避免高强度户外锻炼, 外出时做好防护措施。

监测站点	PM _{2.5} (µg/m ³)	AQI
普陀	77	103 • 轻度
十五厂	72	97 • 良
虹口	74	99 • 良
杨浦四漂	73	98 • 良
青浦淀山湖	82	109 • 轻度
静安监测站	75	100 • 良
浦东川沙	73	98 • 良
浦东新区监测站	85	113 • 轻度
浦东张江	71	95 • 良

“From Fog to Smog: the Value of Pollution Information” (Barwick, Li, Lin, and Zou, 2023 wp)



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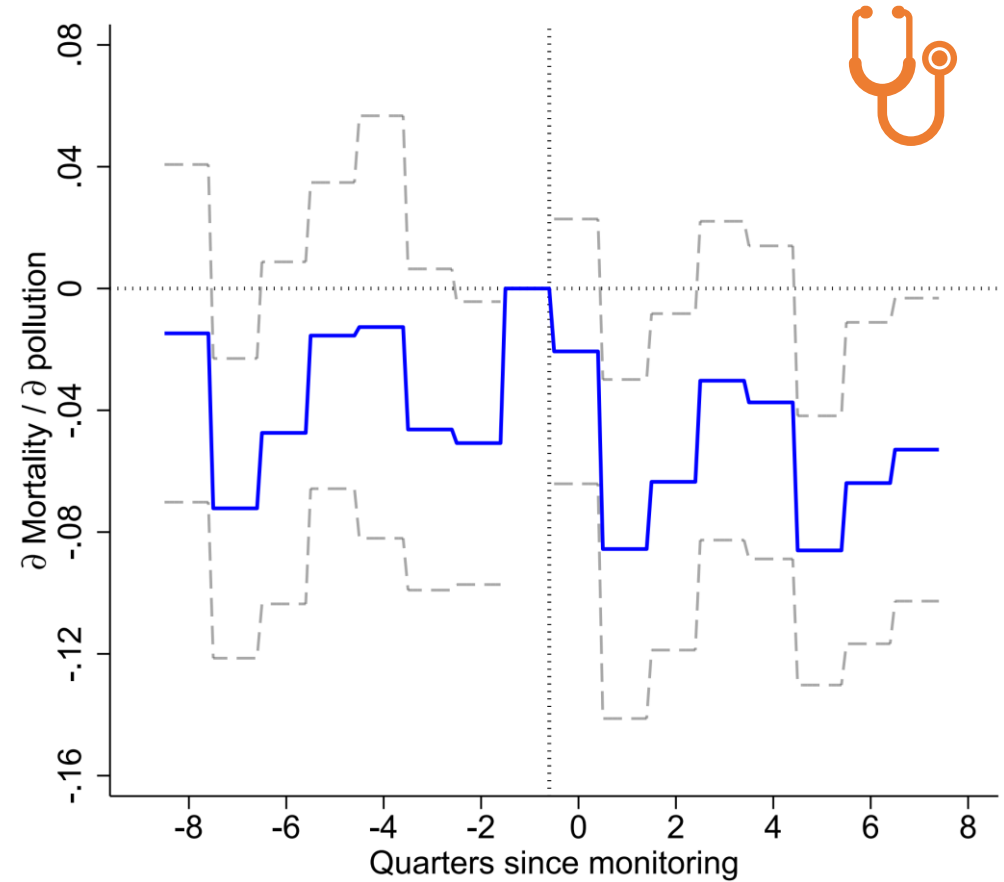
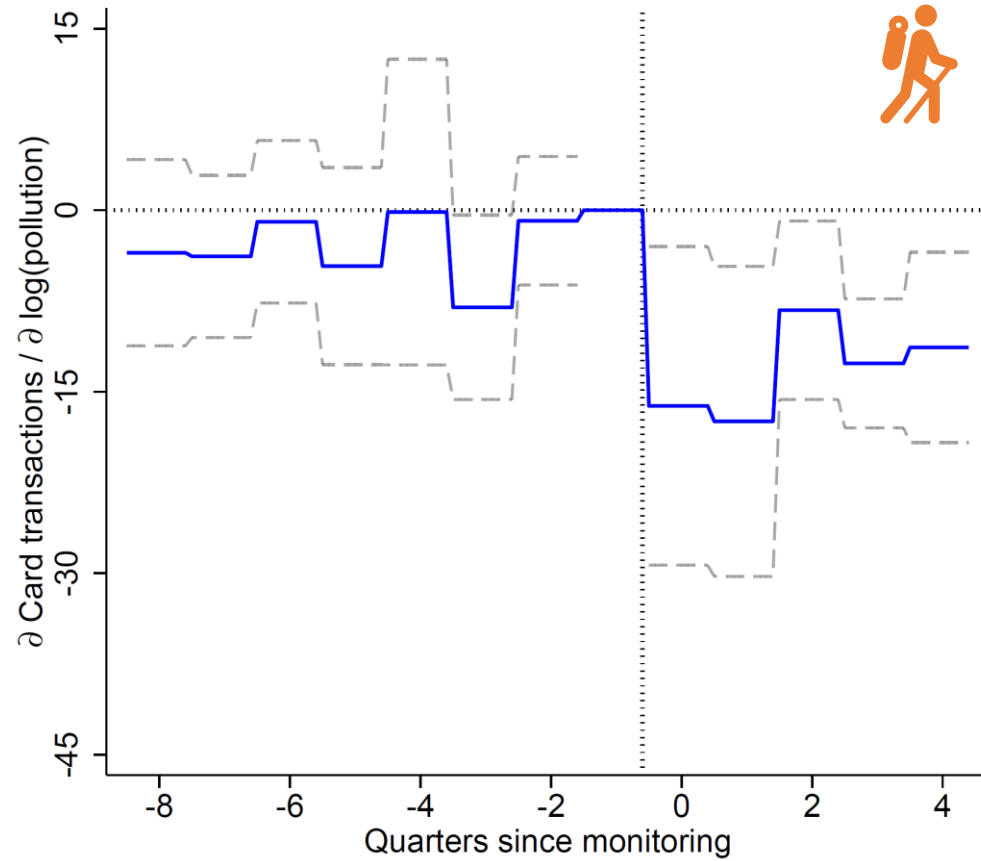
• What has changed?

1.

2.

3.

4.

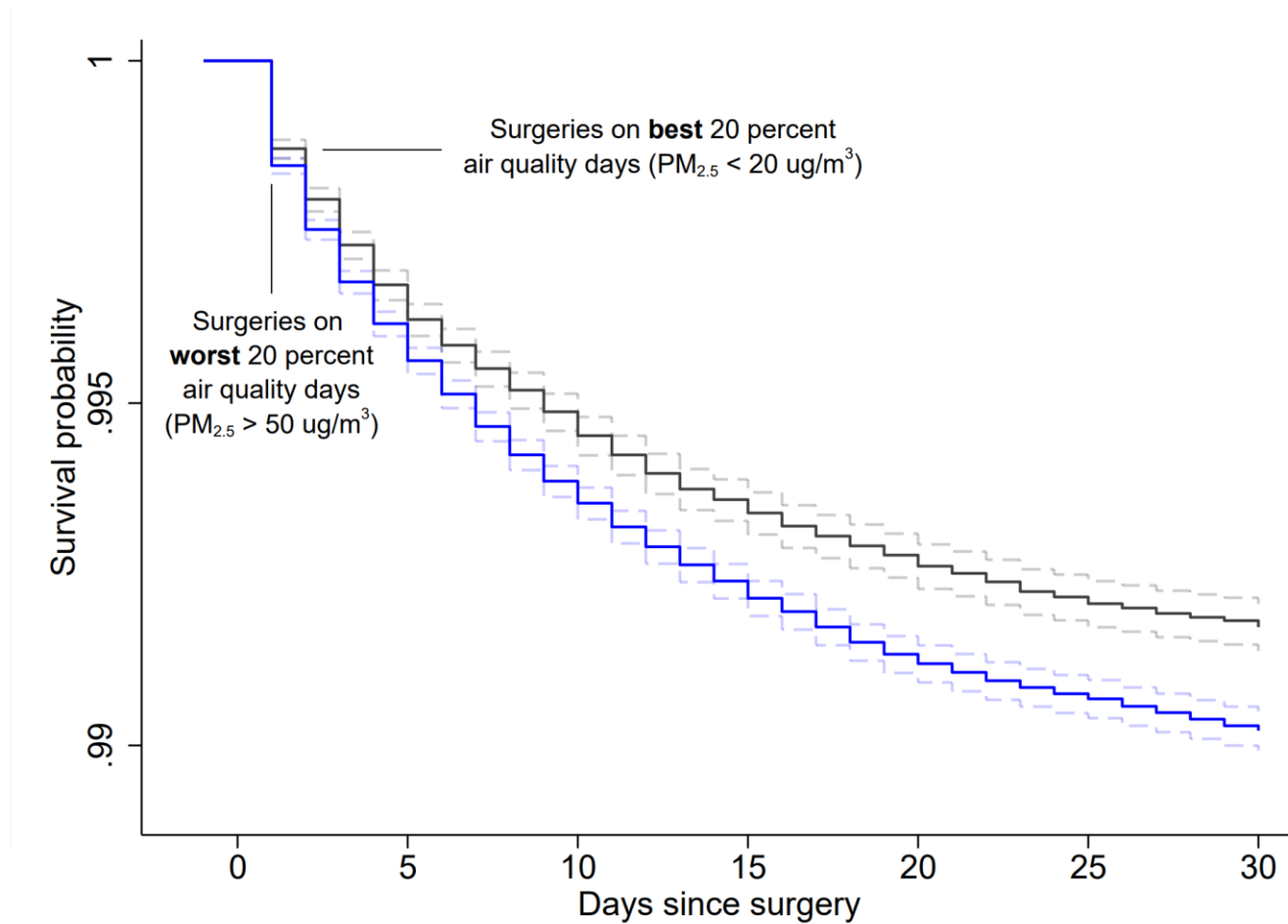


Public Perception and Behavior

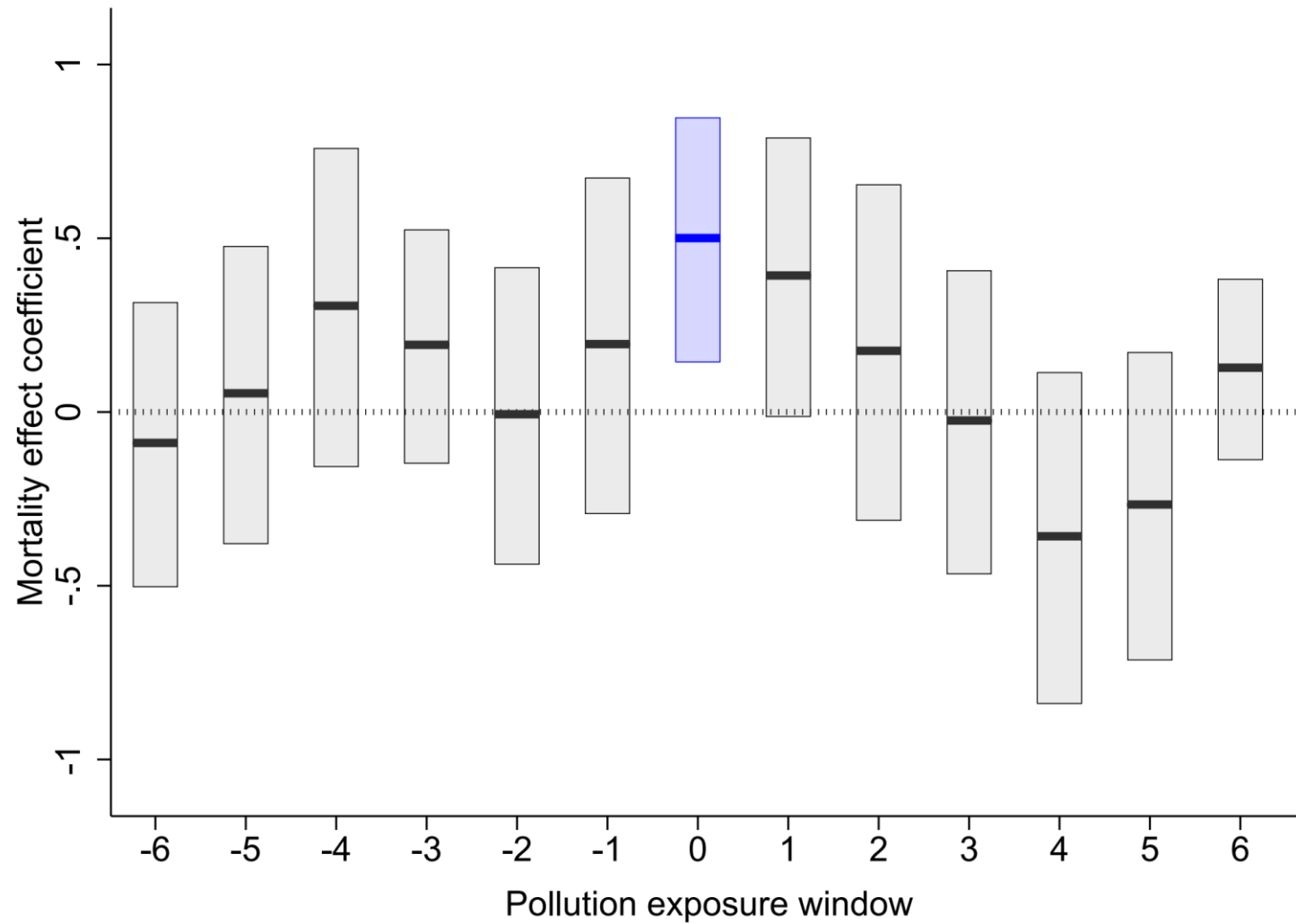
- An “engineering” perspective: How to **exploit** better information?
 - Ex: Now that we have new infrastructures to forecast/nowcast pollution, can and should we strategically plan high-stake activities to reduce exposure?

“(Re)scheduling Pollution Exposure: The Case of Surgery Schedules” (Huang, Xing, and Zou, 2023 JPubE)

Figure 1. Patient Survival after Surgeries on High versus Low Pollution Days



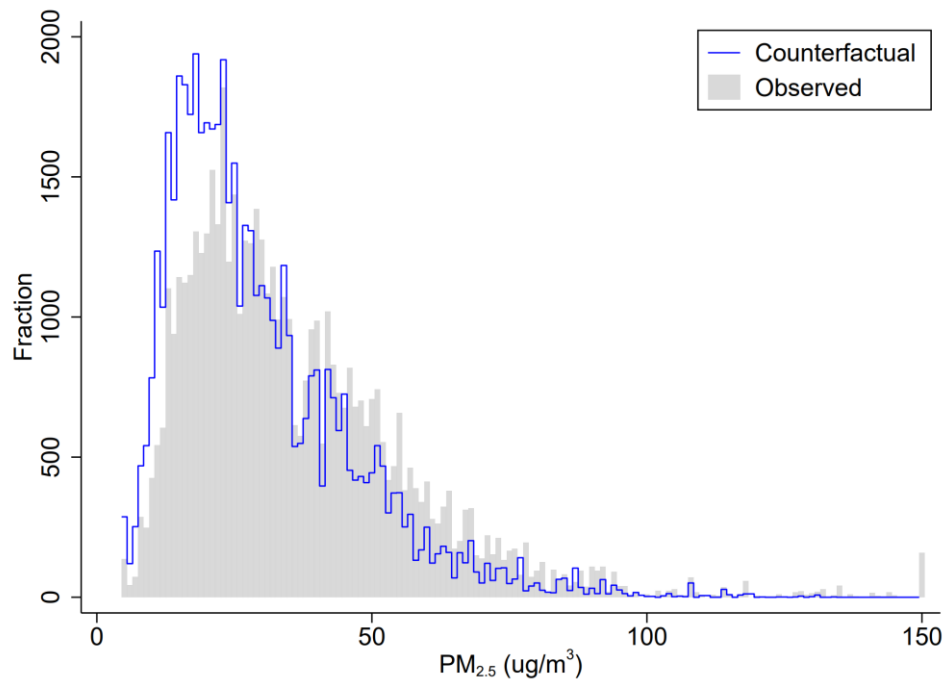
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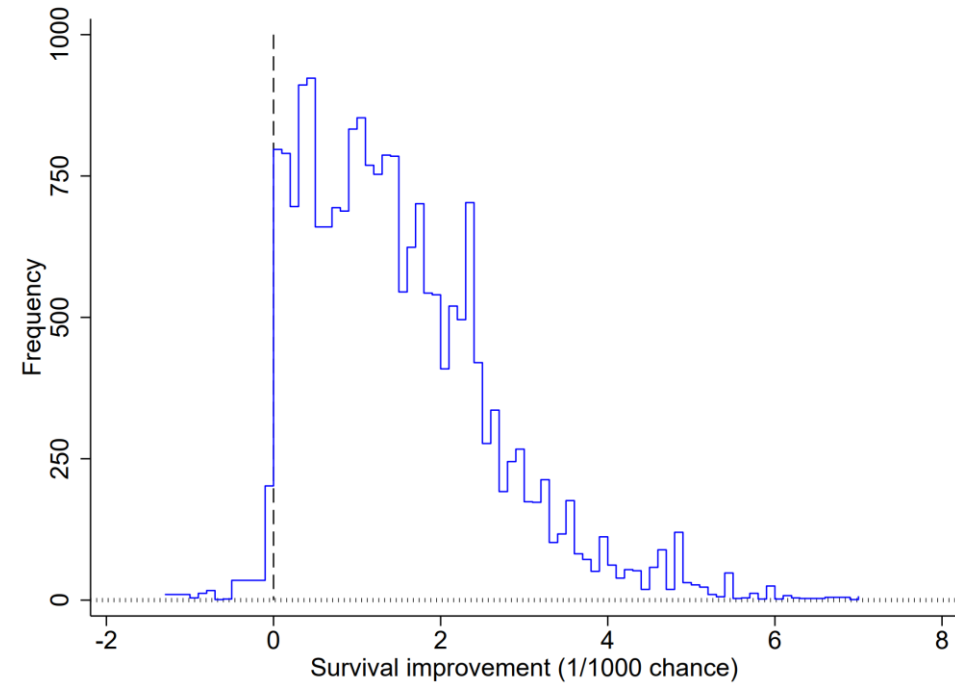
“(Re)scheduling Pollution Exposure: The Case of Surgery Schedules” (Huang, Xing, and Zou, 2023 JPubE)

- A part of the environmental overhaul is information

Panel A. Impact on pollution exposure



Panel C. Impact on post-surgery survival (switchers only)



Outcome = $F(\text{exposure} | \text{behavior}) - G(\text{behavior} | \text{information})$

Comments

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 1. Public perception and behavior
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 4. Industry effects

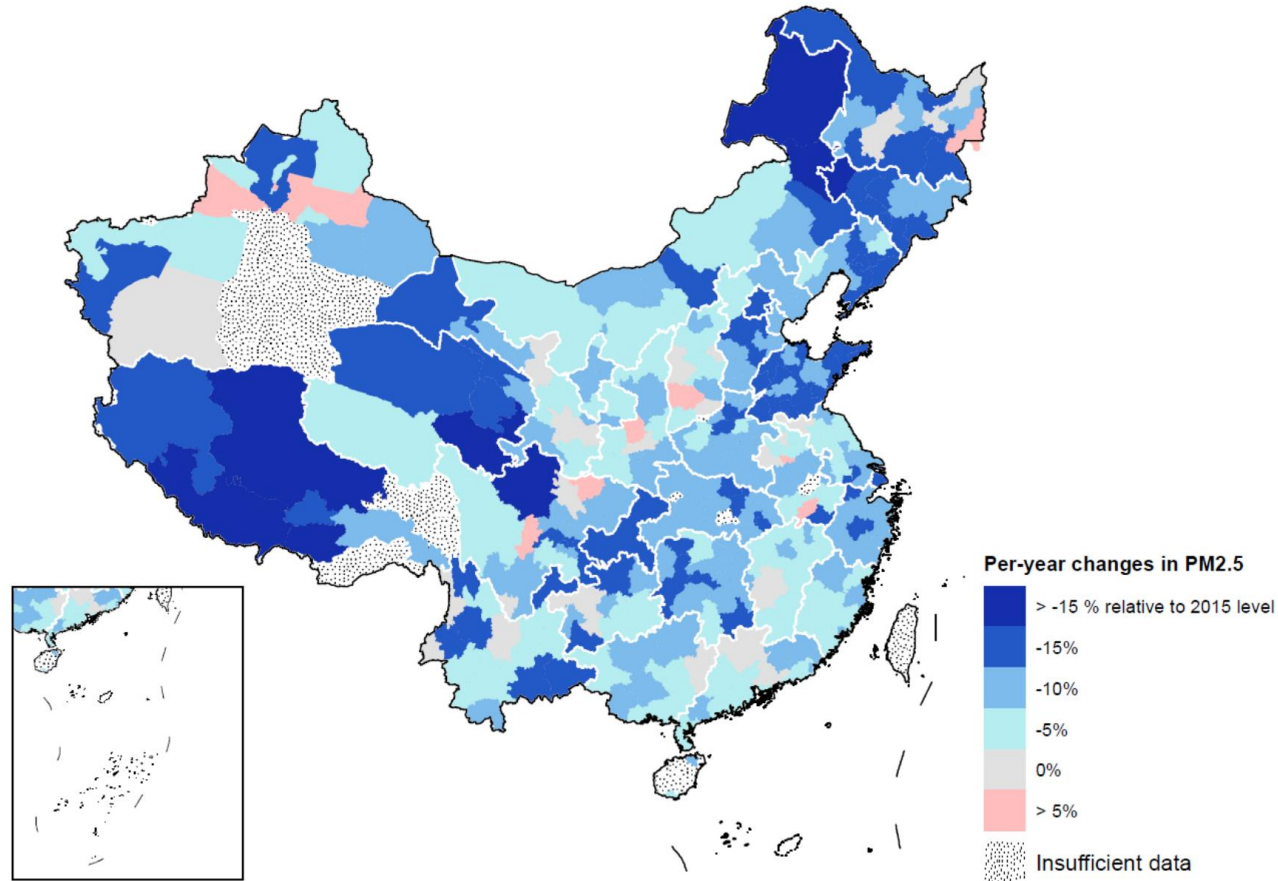
Human and Ecosystem Health

- Many cities are seeing air quality not seen in decades
 - Lots of evidence on effects of **short-term** pollution shocks
 - Health effects of a **permanent** pollution decline?
Ex: Ebenstein et al. (2019 PNAS); Anderson (2020 JEEA)

“China’s War on Pollution: Evidence from the First Five Years”

(Greenstone, He, Li, and Zou, 2021 REEP)

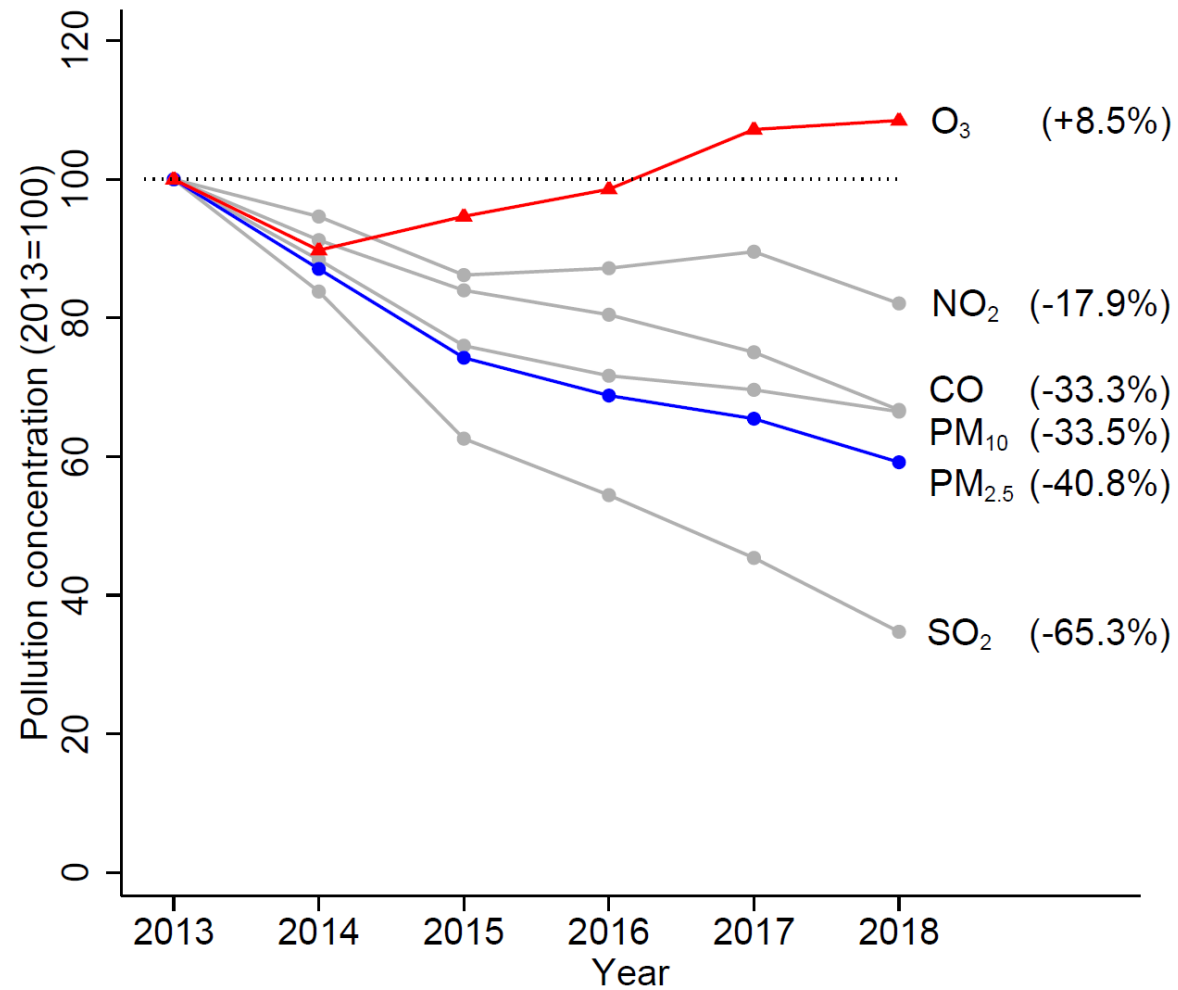
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“China’s War on Pollution: Evidence from the First Five Years”

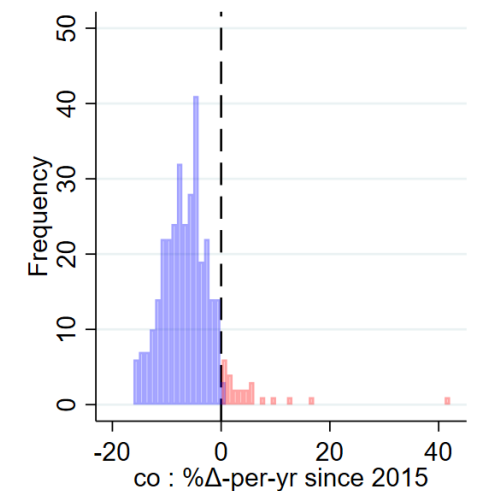
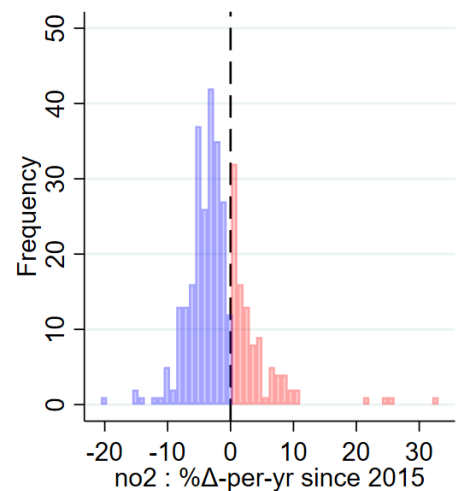
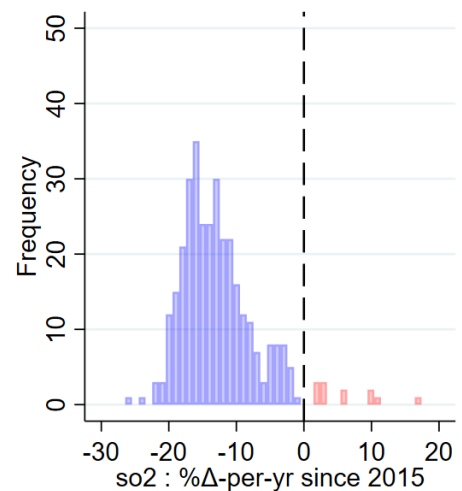
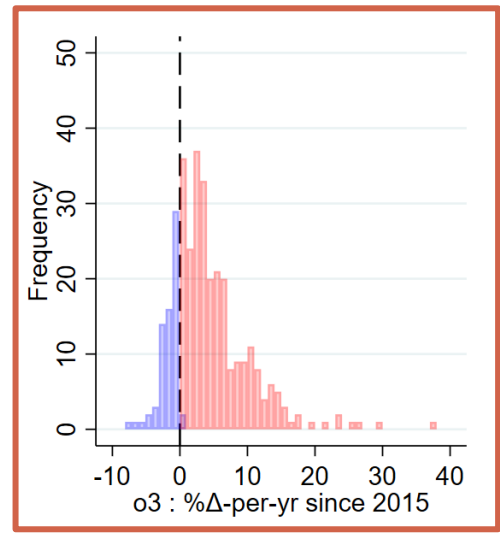
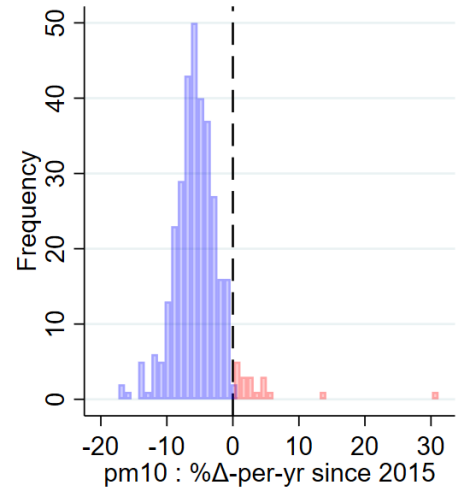
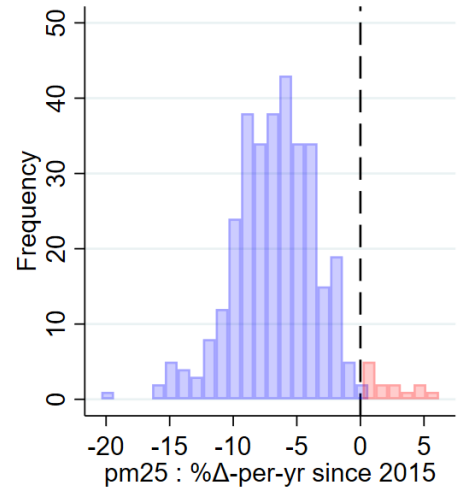
(Greenstone, He, Li, and Zou, 2021 REEP)

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The Ozone Problem: Majority of Cities Saw Ozone *Increases*

Histogram of city-level pollution trends (% Δ pollutant per year, 2015-2019)



Notes: Estimation uses 2015-2019 government ground monitoring data.

Human and Ecosystem Health

- Despite particulate pollution cleanups, the majority of cities saw *ozone increases*
 - Health effects of co-pollutants (which *pollution species* are the worse)?
Ex: Schlenker and Walker (2015 REStud); Di et al. (2017 NEJM)

Human and Ecosystem Health

- What are the effects on **ecosystems** more broadly?
 - Impacts of environmental changes extend way beyond those directly affecting **humans**
 - Pollution can disrupt a wide range of wildlife, diminishing their ability to provide **ecosystem services**
 - This part of the literature seems particularly silent
 - Ex: Frank and Sudarshan (2023 wp)
“The Social Costs of Keystone Species Collapse: Evidence From The Decline of Vultures in India”

“Conservation Co-Benefits from Air Pollution Regulation: Evidence from Birds”

(Liang et al., 2020 PNAS)

- What are the effects on ecosystems more broadly?

- Impacts of environmental

- Pollution can disrupt ecosystem services

- This part of the literature

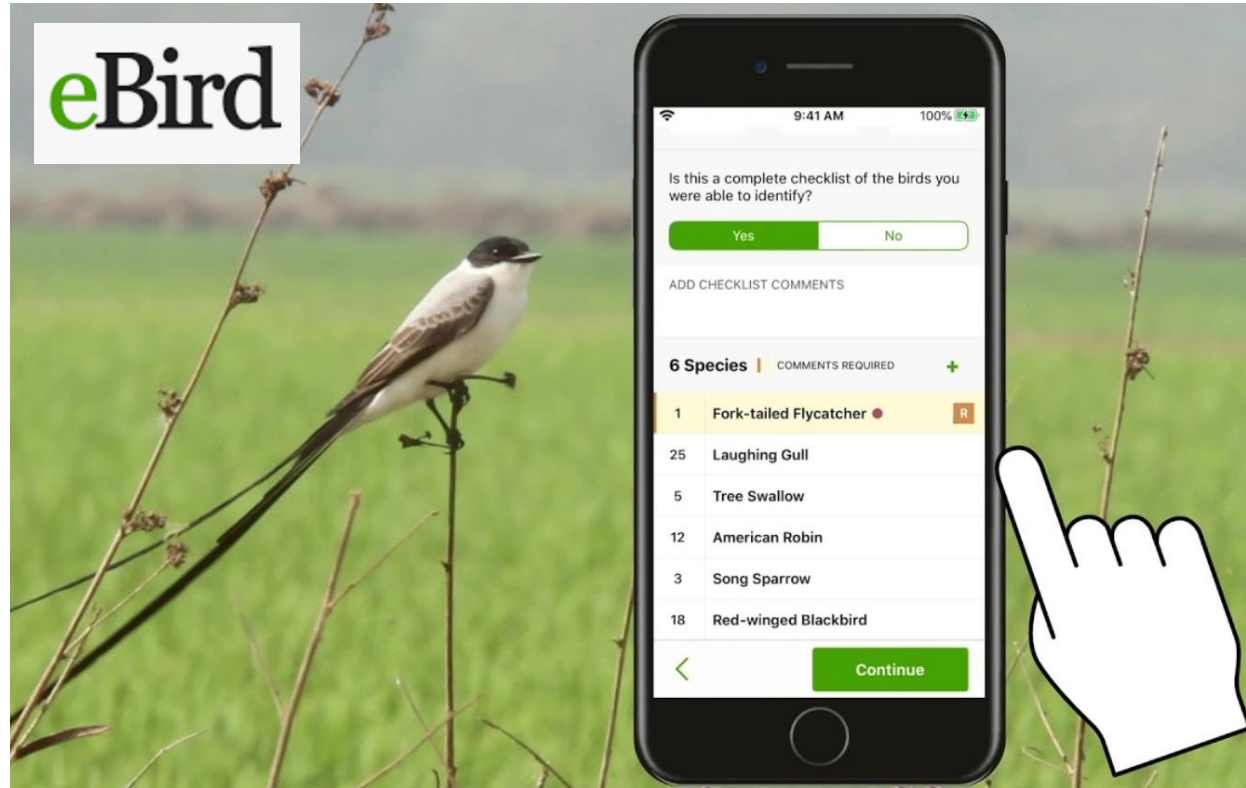
- Read Frank and Sudek

“The Social Costs of Ke

ing humans

provide ecosystem

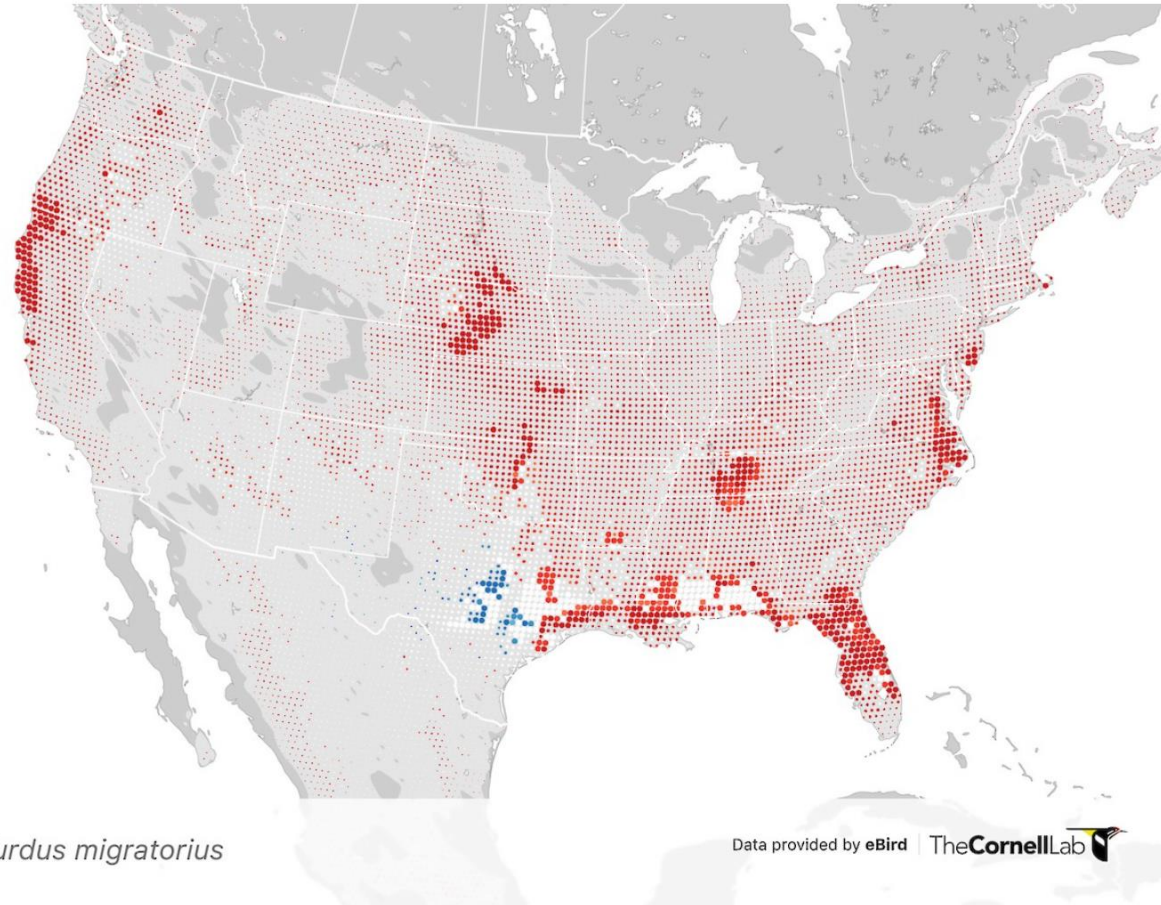
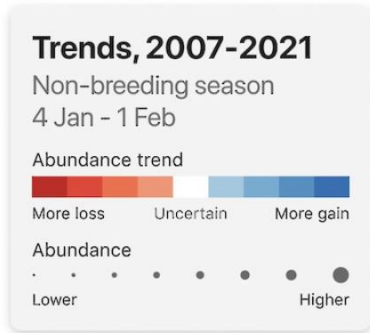
of Vultures in India”



“Conservation Co-Benefits from Air Pollution Regulation: Evidence from Birds”

(Liang et al., 2020 PNAS)

- What are the
- Impacts of
- Pollution of
- services
- This part of
- Read Frank
-



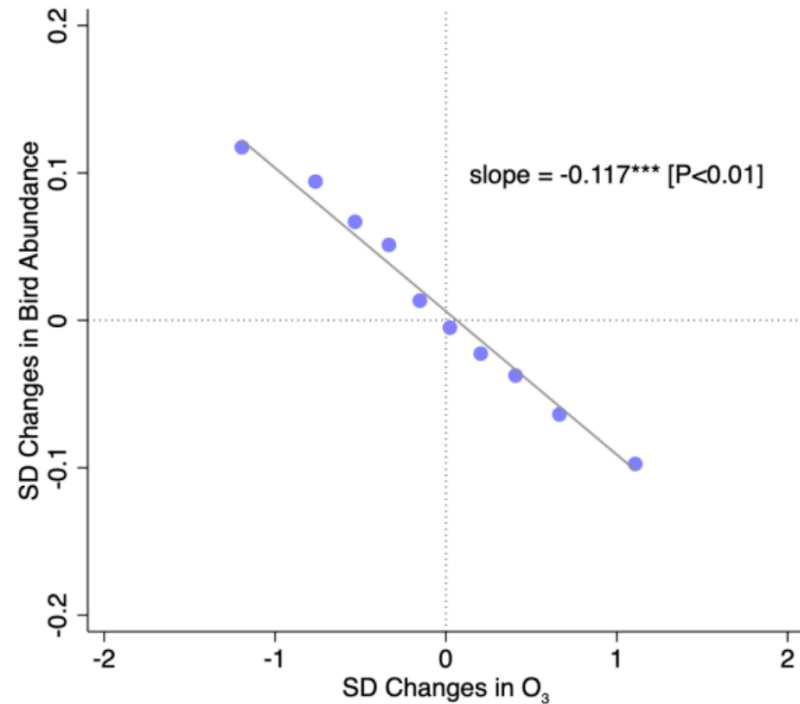
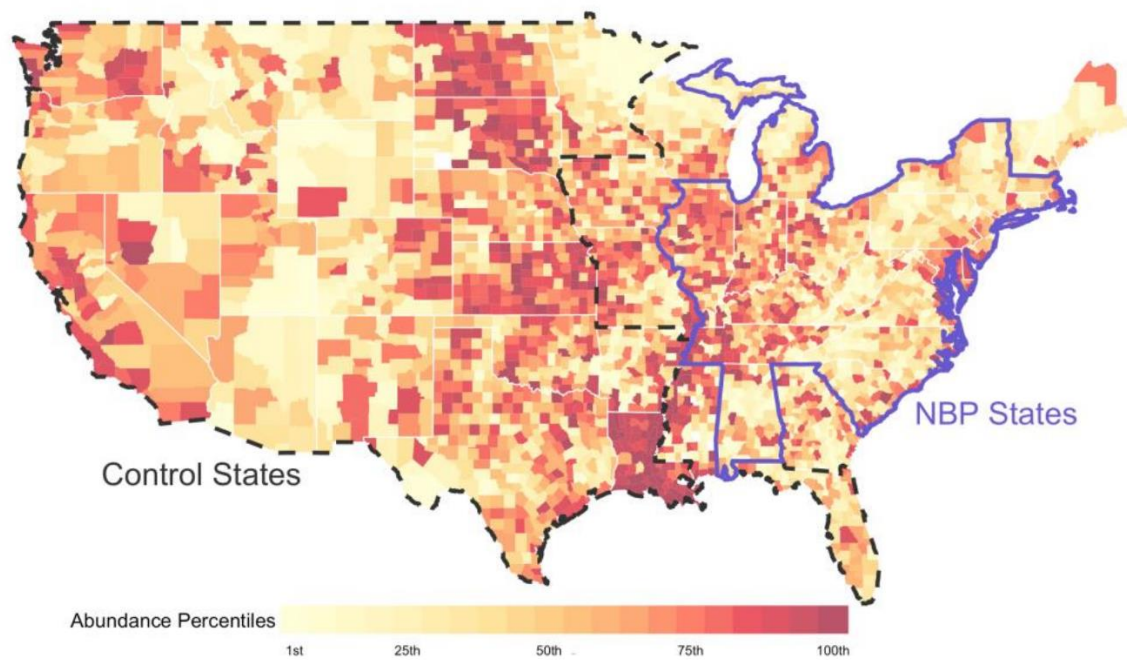
American Robin *Turdus migratorius*

Data provided by eBird | TheCornellLab

“Conservation Co-Benefits from Air Pollution Regulation: Evidence from Birds”

(Liang et al., 2020 PNAS)

- What are the effects on ecosystems more broadly?



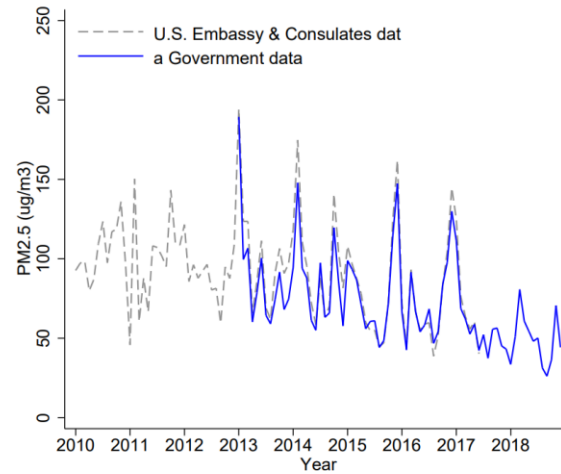
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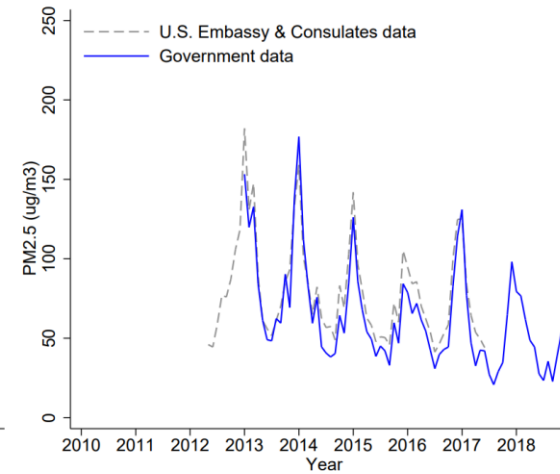
Reliability of Government Data: The “Post-War” Data

Good consistency between U.S. Embassy vs. Chinese government data

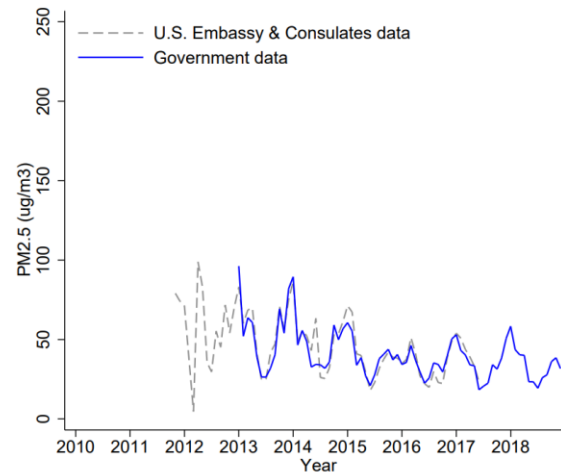
(a) Beijing



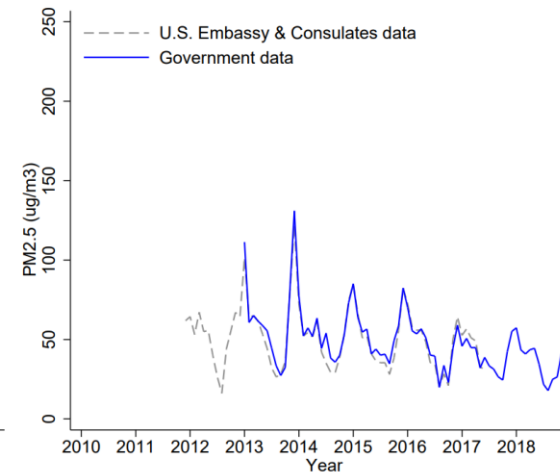
(b) Chengdu



(c) Guangzhou



(d) Shanghai



Reliability of Government Data: The “Post-War” Data

Prevalence of certain “rogue” method of enforcement worth investigation



Reliability of Government Data: The “Post-War” Data

Prevalence of certain “rogue” method of enforcement worth investigation



Regulation and Enforcement

- Political agitation
 - How should regulator think about the tradeoff between **disclosure/enforcement** and potential **public backlash**?
 - Important question for other developing countries looking to tighten up environmental monitoring and enforcement

Political Agitation: Public Response when Learning About Bad Pollution

Environmental protection vs. political/public backlash



Source: [Greenstone et al. \(2021 REEP\)](#)

Political Agitation: Public Response when Learning About Bad Pollution

Environmental protection vs. political/public backlash



江苏省重点监控企业自行监测信息发布平台

企业用户登录 环保用户登录

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企业基本信息 自行监测方案 自动监测 手动监测 未监测原因 年度报告

废水集中排放 废气有组织排放

序号	监测点位	监测项目	监测方式	监测频次	标准值下限	标准值上限
1	废水监测点	PH值	自动监测	连续/日/次	6	9
2		化学需氧量	自动监测	连续/日/次		500 mg/l
3	废气监测点1	烟尘	自动监测	连续/日/次		5 mg/m3
4		二氧化硫	自动监测	连续/日/次	0 mg/m3	35 mg/m3
5	废气监测点2	氮氧化物	自动监测	连续/日/次	0 mg/m3	50 mg/m3
6		烟尘	自动监测	连续/日/次	0 mg/m3	5 mg/m3
7	废气监测点1	二氧化硫	自动监测	连续/日/次	0 mg/m3	35 mg/m3
8		氮氧化物	自动监测	连续/日/次	0 mg/m3	50 mg/m3

监测点位: 废气监测点1 监测项目: 氮氧化物 监测时间: 2019-12-04 至 2019-12-04

序号	监测点位	监测时间	监测项目	监测值	标准值下限	标准值上限	数据状态	超标倍数	备注说明
13	废气监测点1	2019-12-04 11	氮氧化物	8.70 mg/m3 折 8.70 mg/m3	0 mg/m3	50 mg/m3	正常		
14	废气监测点1	2019-12-04 10	氮氧化物	8.69 mg/m3 折 2600.20 m...	0 mg/m3	50 mg/m3	超标	51.00	
15	废气监测点1	2019-12-04 09	氮氧化物	8.74 mg/m3 折 871.79 mg...	0 mg/m3	50 mg/m3	超标	16.44	
16	废气监测点1	2019-12-04 08	氮氧化物	8.80 mg/m3 折 600.02 mg...	0 mg/m3	50 mg/m3	超标	11.00	
17	废气监测点1	2019-12-04 07	氮氧化物	8.82 mg/m3 折 503.09 mg...	0 mg/m3	50 mg/m3	超标	9.06	
18	废气监测点1	2019-12-04 06	氮氧化物	8.80 mg/m3 折 494.29 mg...	0 mg/m3	50 mg/m3	超标	8.89	
19	废气监测点1	2019-12-04 05	氮氧化物	8.82 mg/m3 折 487.29 mg...	0 mg/m3	50 mg/m3	超标	8.75	
20	废气监测点1	2019-12-04 04	氮氧化物	8.78 mg/m3 折 539.64 mg...	0 mg/m3	50 mg/m3	超标	9.79	

每页 20 条, 共 24 条

Political Agitation: Public Response when Learning About Bad Pollution

Environmental protection vs. political/public backlash



江苏省重点监控企业自行监测信息发布平台

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2		化学需氧量	自动监测	连续/日/次	
3		烟尘	自动监测	连续/日/次	
4	废气监测点1	二氧化硫	自动监测	连续/日/次	0 mg/m
5		氮氧化物	自动监测	连续/日/次	0 mg/m
6	废气监测点2	烟尘	自动监测	连续/日/次	0 mg/m
7		二氧化硫	自动监测	连续/日/次	0 mg/m
8		氮氧化物	自动监测	连续/日/次	0 mg/m

监测点位: 废气监测点1 监测项目: 氮氧化物 监测时间: 2019-12-04 至 2019-12-04

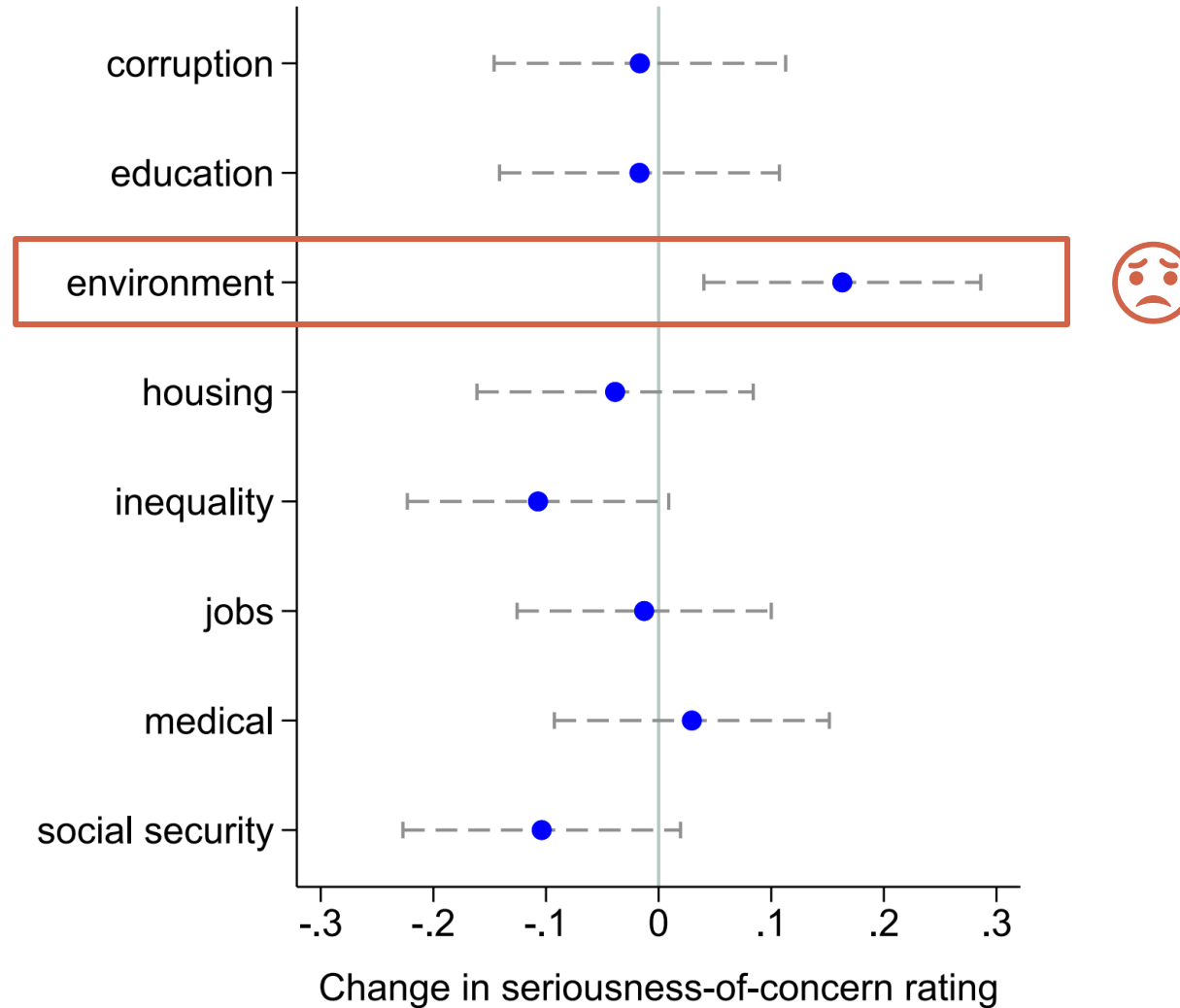
序号	监测点位	监测时间	监测项目	监测值	标准值下限	标准值上限	数据状态
13	废气监测点1	2019-12-04 11	氮氧化物	8.70 mg/m3 折 8.70 mg/m3	0 mg/m3	50 mg/m3	正常
14	废气监测点1	2019-12-04 10	氮氧化物	8.69 mg/m3 折 2600.20 m...	0 mg/m3	50 mg/m3	超标
15	废气监测点1	2019-12-04 09	氮氧化物	8.74 mg/m3 折 871.79 mg...	0 mg/m3	50 mg/m3	超标
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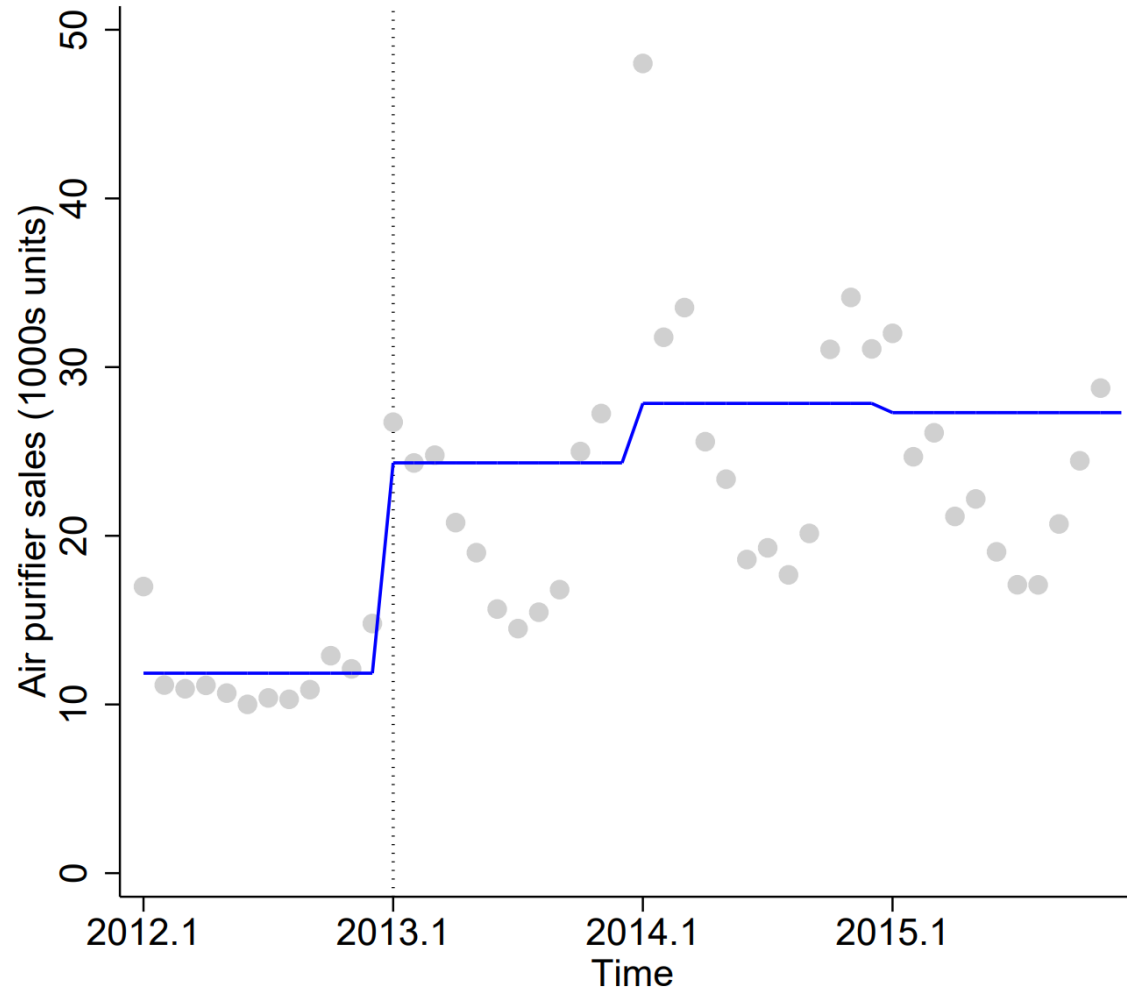
The Pollution Worry: Survey Data

Respondents expressed more concerns over the environment after pollution disclosure



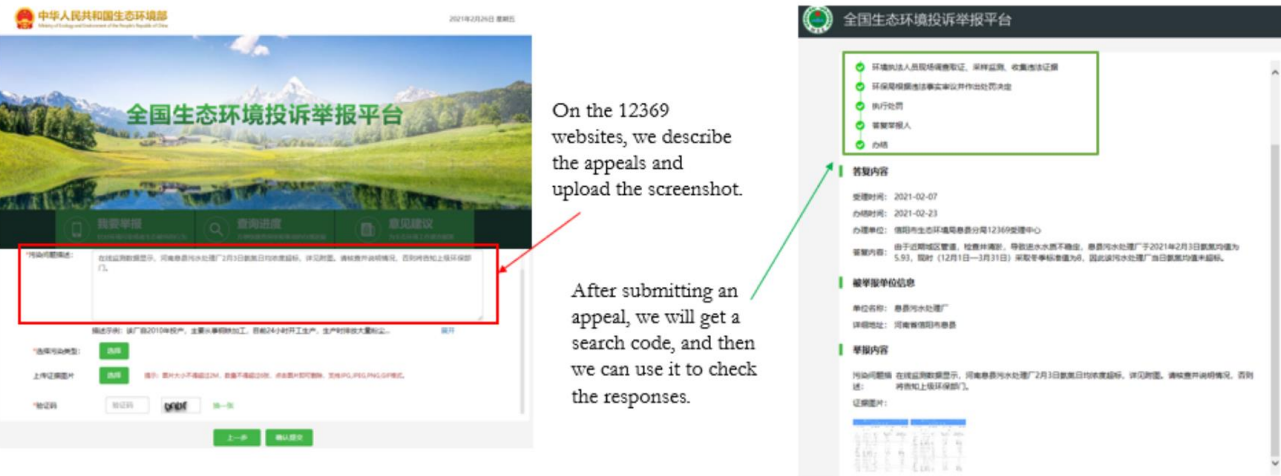
How Do People Respond to Pollution Worry: Defensive Investment

Air purifier purchases almost double after China's pollution disclosure



How Can People *Benefit* from Pollution Worry: Citizen Participation

Buntaine et al. (2022 wp) “Does the Squeaky Wheel Get More Grease? The Direct and Indirect Effects of Citizen Participation on Environmental Governance in China”



On the 12369 websites, we describe the appeals and upload the screenshot.

After submitting an appeal, we will get a search code, and then we can use it to check the responses.

The image shows two parts of the '全国生态环境投诉举报平台' (National Environmental Complaints Reporting Platform) website. The left part is the complaint submission form, with a red box highlighting the '投诉内容' (Complaint Content) field. The right part is a detailed response page for a specific complaint, with a green box highlighting the '答复内容' (Response Content) section. The response text includes dates (2021-02-07, 2021-02-23), the handling unit (生态环境部环境应急司), and details about a water pollution incident at a cement plant in Henan province.

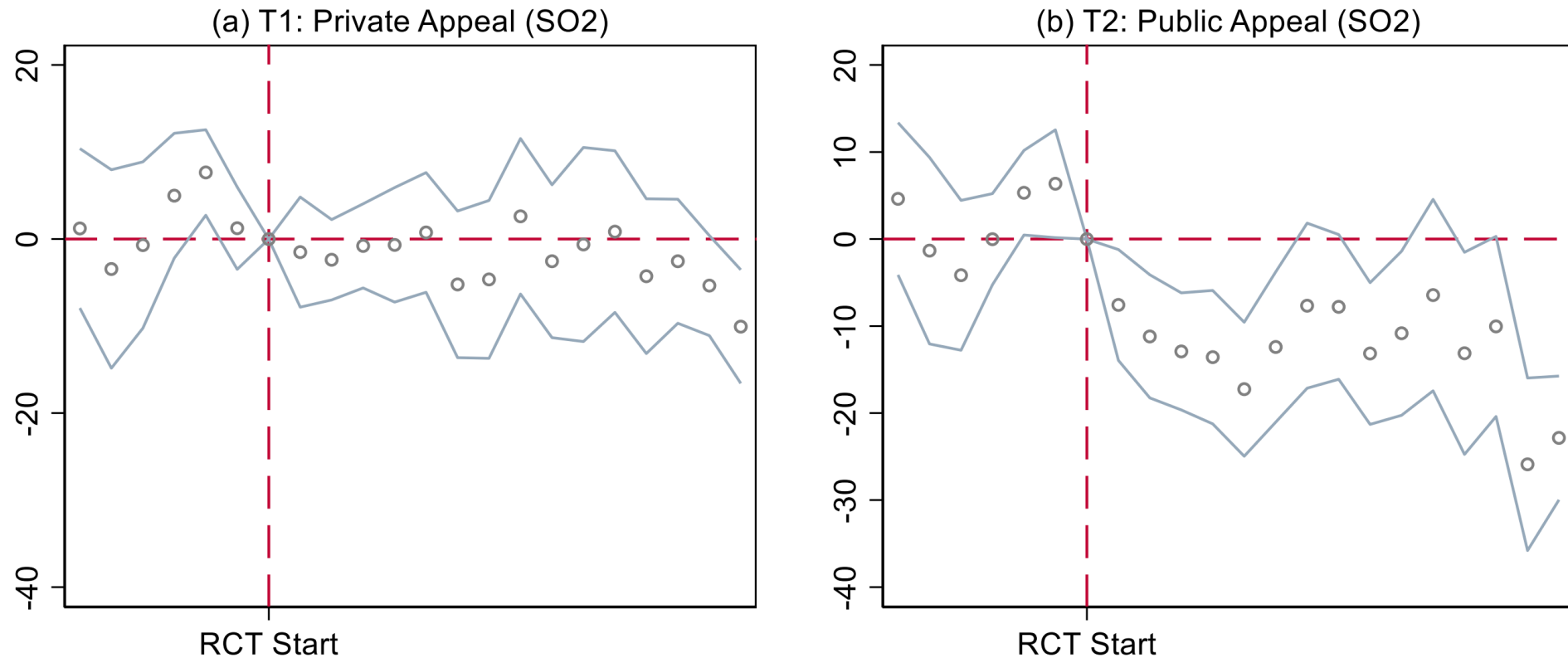
- On Weibo, we publish the company's violation information and relevant screenshots
- Use the @ function of Weibo to remind the official accounts of relevant local environmental protection bureaus to pay attention to this complaint and respond



The image shows a Weibo post with the text: "我观察到位于山西西县的红河天宝水泥有限公司1月1日烟尘日均值超标 (见附图)。请核查并作出说明 @红河州生态环境局" (I observed that the daily average value of dust emission at the Honghe Tianbao Cement Co., Ltd. in Xixian County, Shanxi, exceeded the standard on January 1st (see attached photo). Please check and provide an explanation @Honghe State Environmental Protection Administration). A red arrow points to the @tag. The post also shows the user's profile information: 456 followers, 224 fans, and 2498 followers.

How Can People *Benefit* from Pollution Worry: Citizen Participation

Buntaine et al. (2022 wp) “Does the Squeaky Wheel Get More Grease? The Direct and Indirect Effects of Citizen Participation on Environmental Governance in China”



Industry Effects

- How can a regulator *possibly* cut national pollution by 40% in 5 years?
 -  in the room?

Industry Effects: Anecdote on Massive Plant Shutdowns

Evidence needed on the economic costs of the environmental overhaul



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首页 > 新闻 > 地方报道

北京：今年关停一般制造及污染企业300家

中央政府门户网站 www.gov.cn 2016-01-22 08:25 来源：北京日报

【字体：大 中 小】 打印本页 分享▼

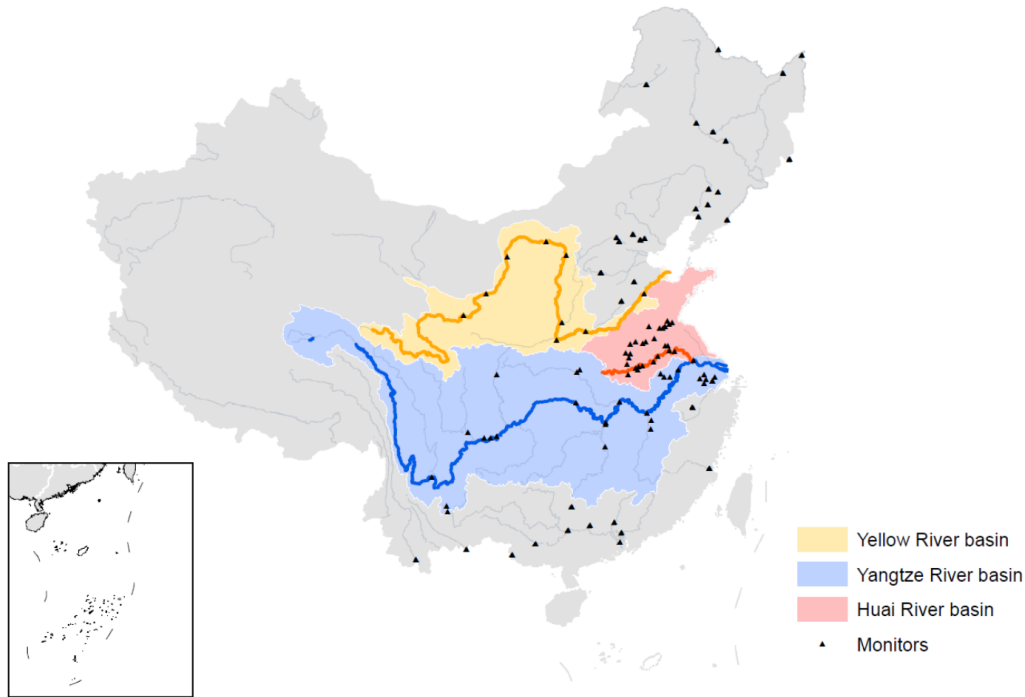
有序疏解非首都功能中，一般性制造业和污染企业、区域性批发市场都是疏解的重中之重。去年，北京市在这两项疏解上“双达标”；而在今年，北京一般制造业和污染企业将继续关停300家，提前一年完成关停1200家的目标。这是记者21日晚从市人大代表、政协委员对市发改委的咨询活动中获悉的。

“今年依然会关停300家一般性制造业和污染企业。”北京市发改委委员李素芳对记者说，而此前制定的目标是从2013年到2017年关停1200家，今年关停300家后，也就意味着提前一年完成了这个目标。而在区域性批发市场疏解方面，目前没有具体的目标，依然会对存量继续推进疏解。

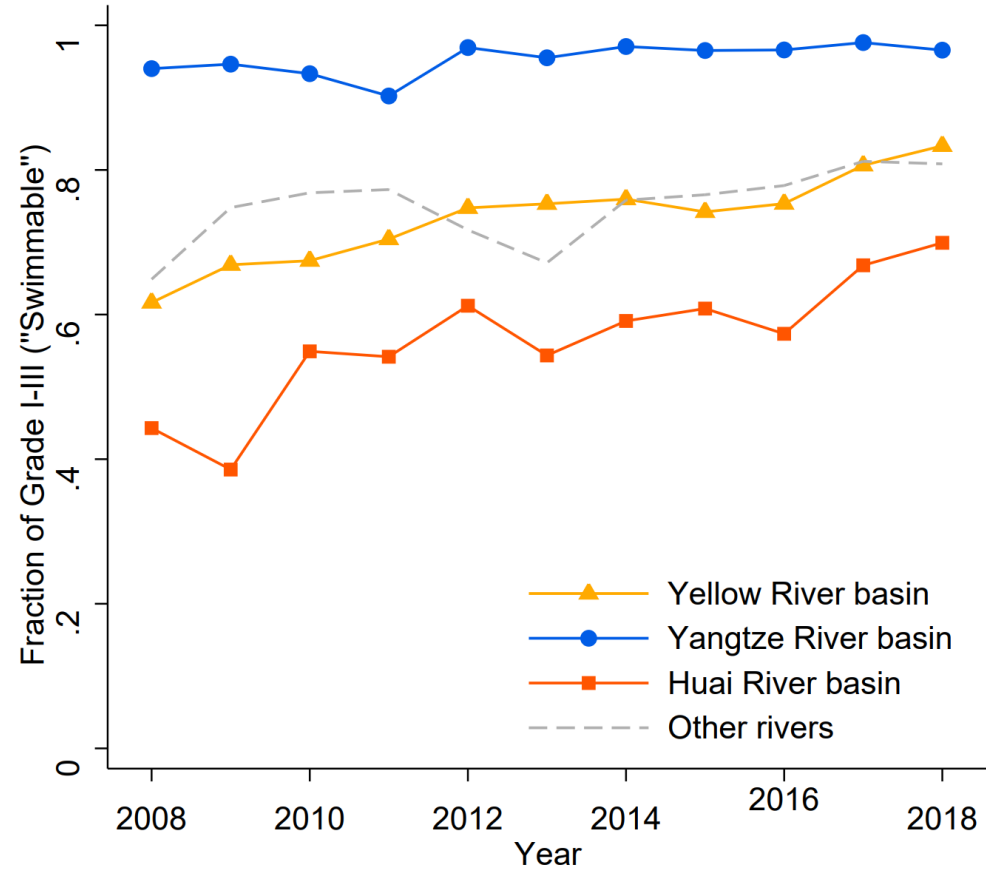
Don't Forget Water: The Water Quality Improvement

Limited data show water quality steadily increasing over time

(a) Location

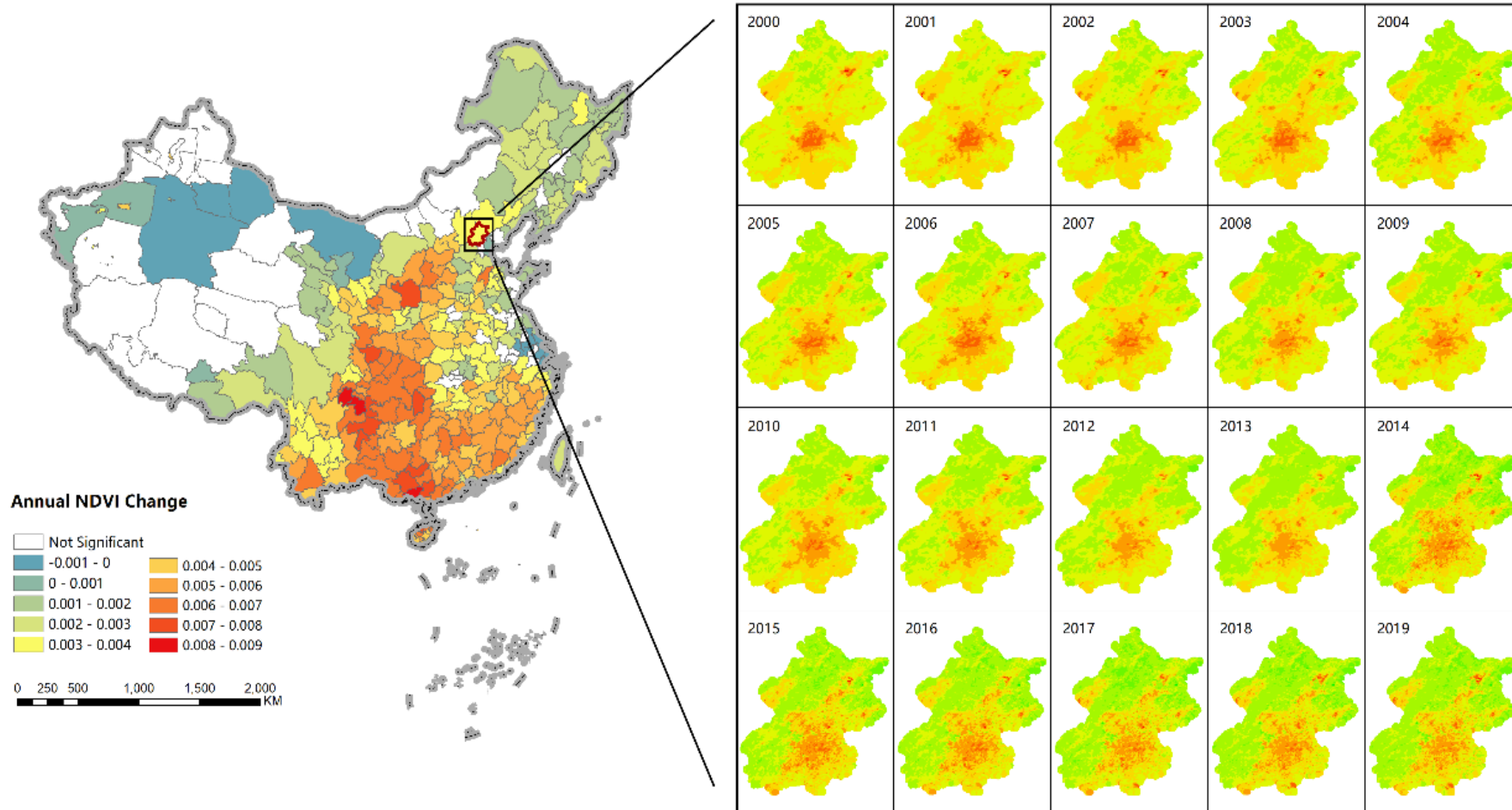


(b) Quality



Don't Forget Forests: China is Greening Up

Remote-sensing data show quick increase in vegetation index across the country



Thank you!

Eric Zou (eric-zou.com)