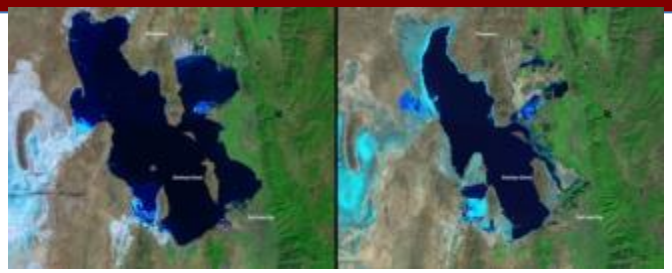
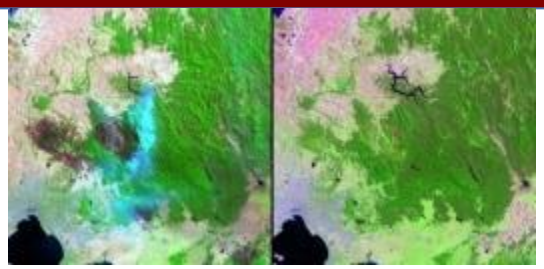
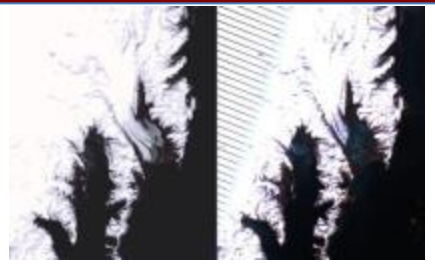




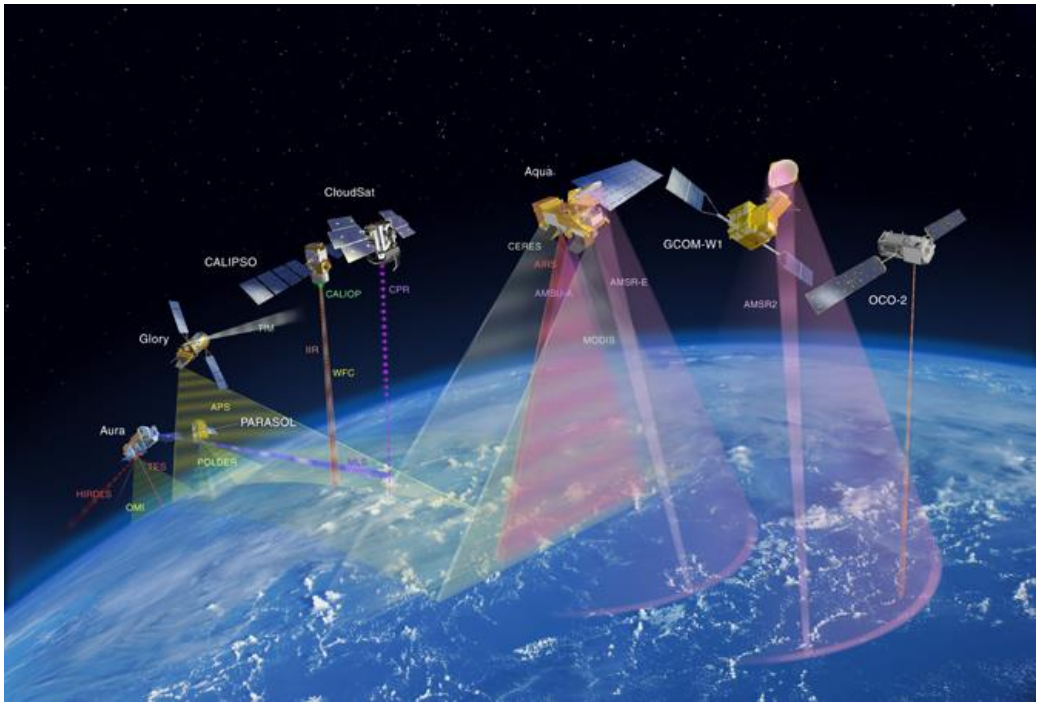
International Cooperation on Climate Monitoring via Satellite:

Incentives and Barriers to Data Sharing

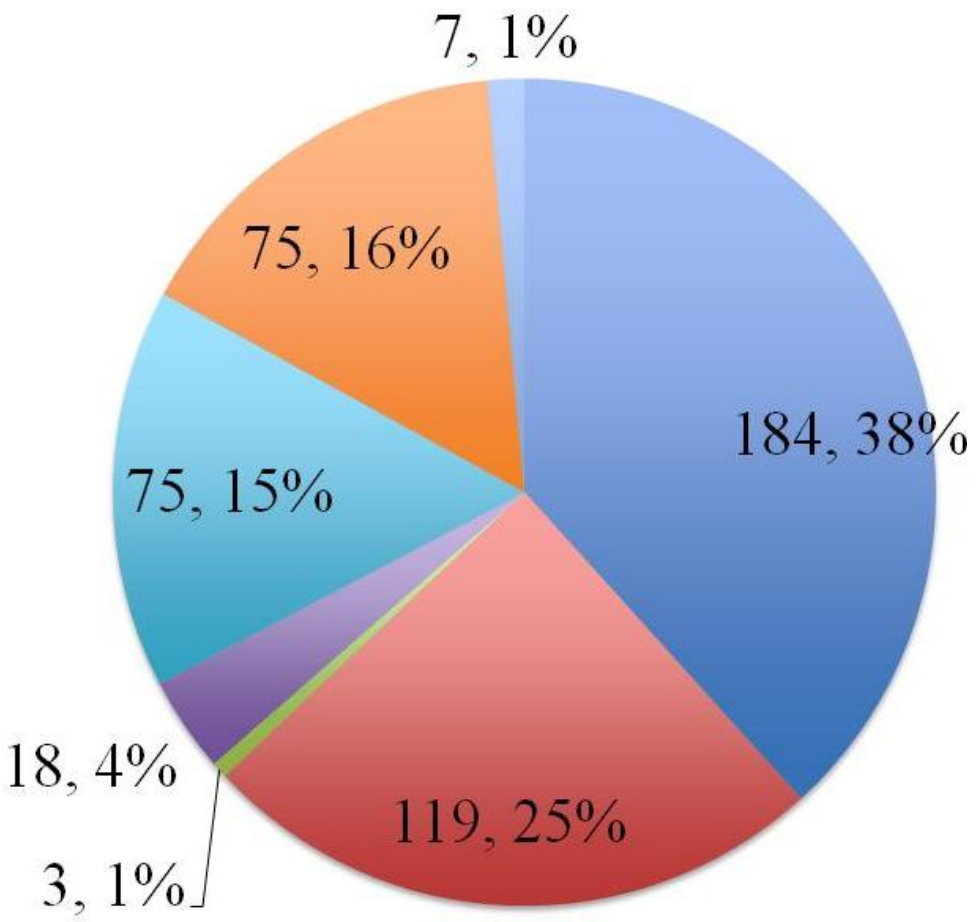
Mariel Borowitz, PhD
Sam Nunn School of International Affairs
Georgia Institute of Technology

Technical Background: Satellite Data

Essential Climate Variables largely dependent on satellites
Atmospheric: Precipitation, Earth radiation budget (including solar irradiance), Upper-air temperature, Wind speed and direction, Water vapour, Cloud properties, Carbon dioxide, Ozone, Aerosol properties
Oceanic: Sea-surface temperature, Sea level, Sea ice, Ocean color (for biological activity), Sea state, Ocean salinity
Terrestrial: Lakes, Snow cover, Glaciers and ice caps, Albedo, Land cover (including vegetation type), Fraction of absorbed photosynthetically active radiation (FAPAR), Leaf area index (LAI), Biomass, Fire disturbance, Soil moisture



Current Instrument Data Sharing



Not Available

Unknown

Above Marginal Cost

Possible Cost, Possible Restrictions

Marginal Cost, Some Restrictions

No Cost, Some Restrictions

No Cost, No Restrictions

Current Thinking/ Past Reports

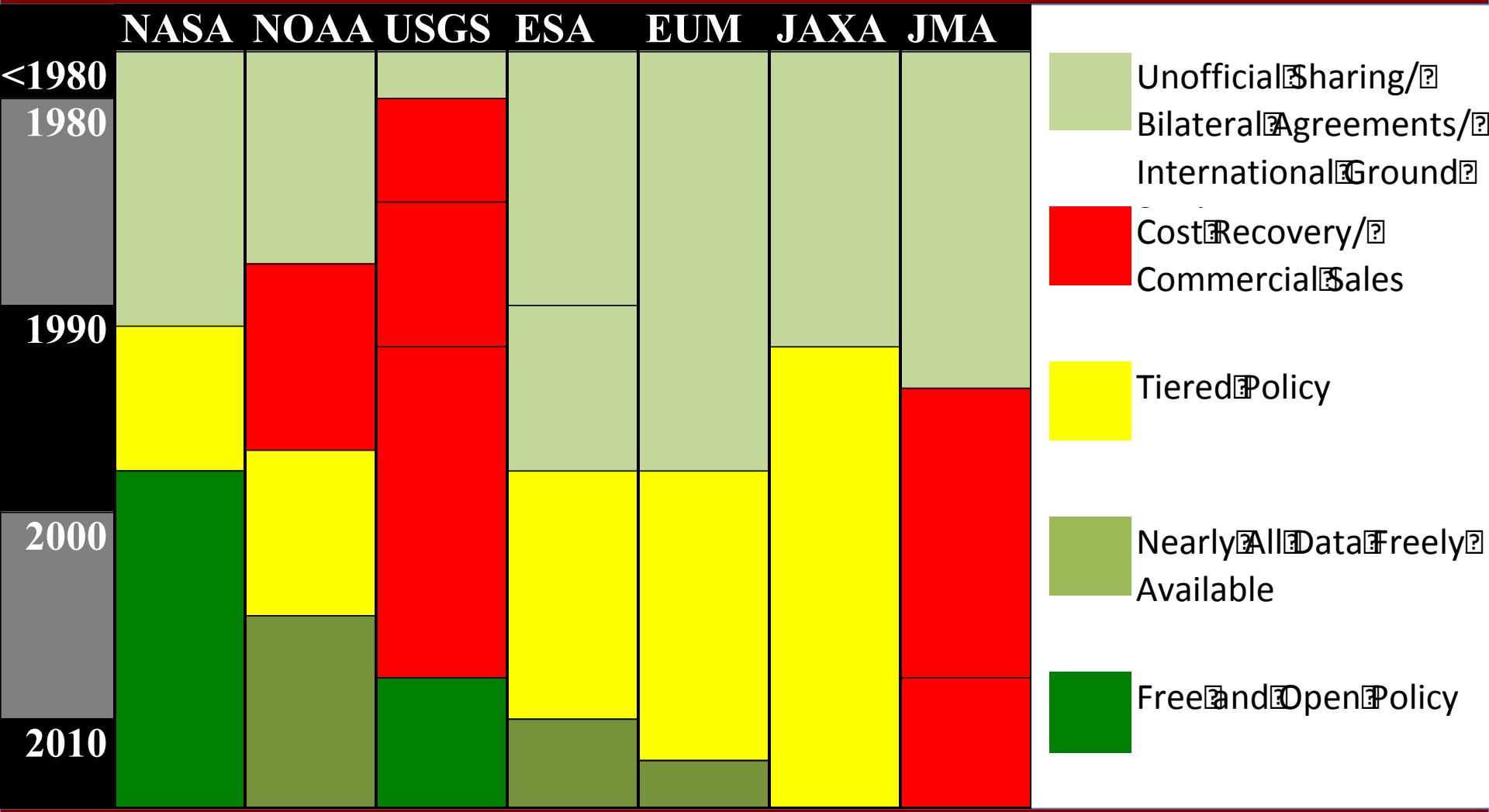
- Economic Arguments
  - Characteristics of Information
  - Public Good vs. Commodity
- Normative Arguments
  - Public Trust vs. Public Ownership
  - Transparency
- Institutional Arguments
  - Global public good characteristics/ problem structure
  - Role of existing international organizations
- Organizational Arguments
  - Conflicting Agency Goals
  - Program resources and power
  - Professional culture
- Security Arguments
  - Dual-use data: security risk vs. value of use
- Political Considerations
  - Demonstrating value and getting credit

Case Studies

- Domestic Agencies
  - US: NASA, NOAA, USGS
  - Europe: ESA, EUMETSAT
  - Japan: JAXA, JMA
- International organizations
  - WMO and GEO
- Key Questions
  - Policy development over time
  - Motivation for changes

EUMETSAT

Case Studies



Model of Data Sharing Policy Development

	Economic	Normative	Institutional
Agency Officials	Free and open data sharing Best achieve mission	Moral obligation to share climate data? Save lives and property Climate vs. weather	International cooperation required to address climate? Climate vs. weather
Legislative/ Other Budget Officials	Data Sales Reduce Costs Increase Efficiency		
Key Uncertainties	Viable commercial market? Elasticity of Demand? Quantify Benefits?	Link between climate and loss of life/ property Climate forecasting	How much data needed? Priorities? How to share?
Conclusions/ Policy Implications	Free and open data sharing maximize efficiency; commercial not viable	Moral responsibility to share climate data	Need WMO resolution for climate data sharing

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Policy Implications

- Focus on evidence related to economic efficiency, climate impacts/ forecasting, and operational climate requirements
- Free and open policies maximize economic efficiency
- Moral responsibility to share climate data similar to weather
- WMO Resolution 40 for climate
- GEO continue visibility, info sharing efforts

Questions?

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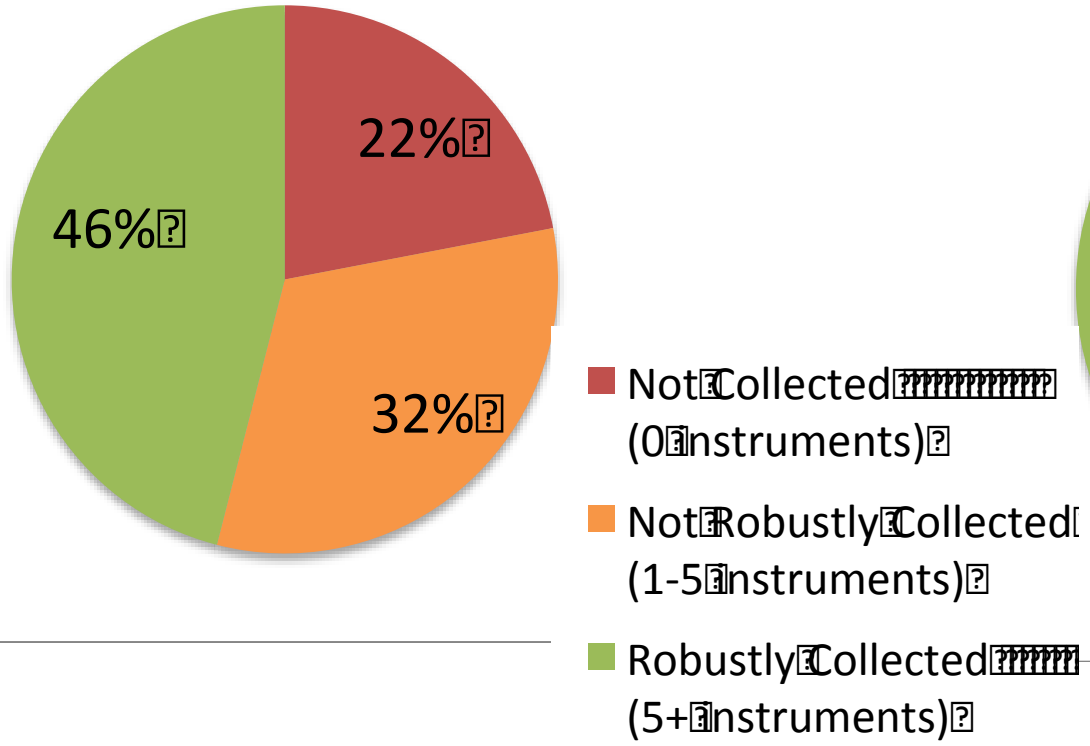
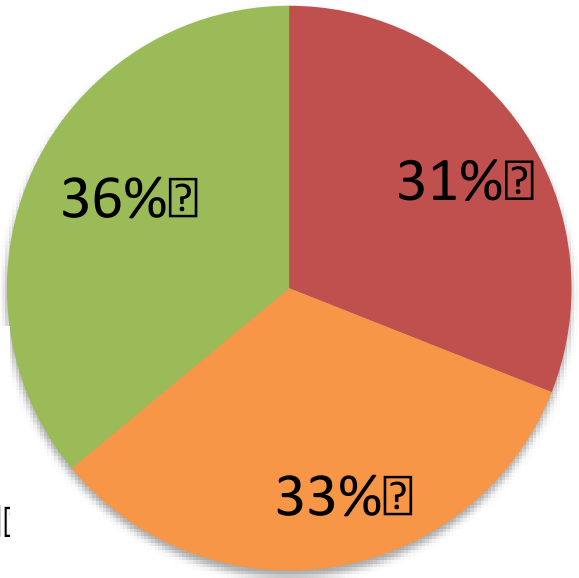
Climate Data Collection & Sharing 2000-2012

Measurements Collected, 2000-2012



Measurements Collected and Shared, 2000-2012



Future Research

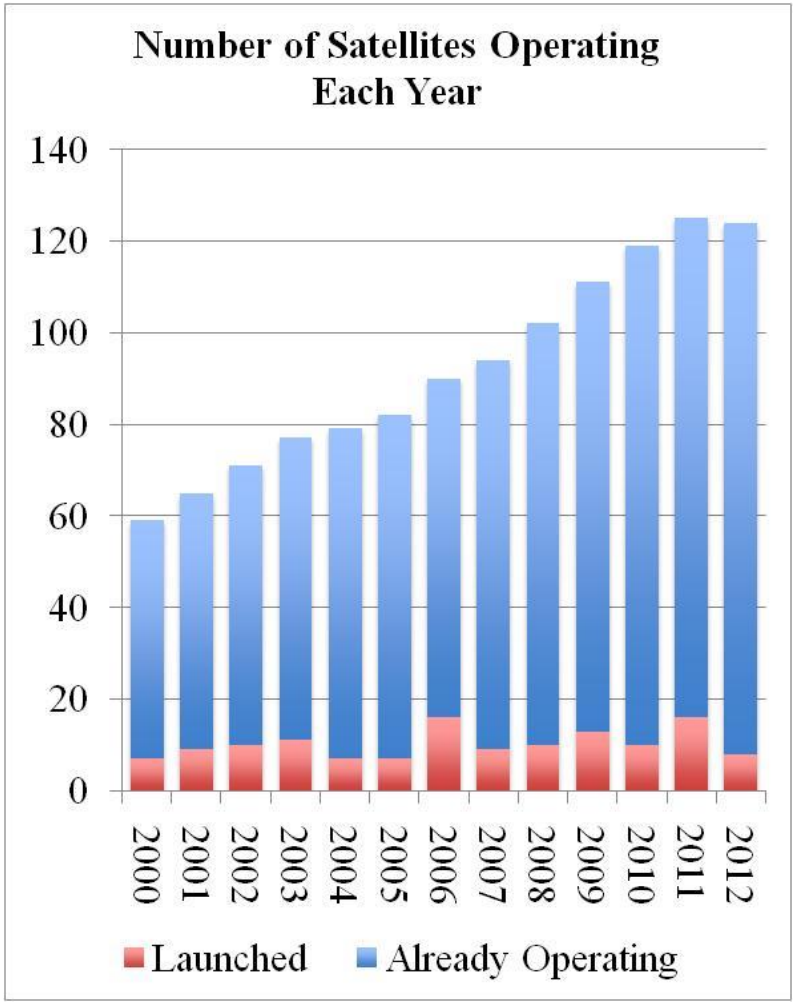
- Future Research
  - Quantitative analysis of Landsat
    - Price, use, and output data
    - Determine economic impacts
  - Future of commercial remote sensing
    - Existing models, sustainability
    - Maximizing public interest uses
  - Focus on data-sharing policies in developing countries
    - Different constraints
    - Different policy development path?

Methodology

- Ordered Probit Regression Model
  - Relationship between policy and other observables
  - Proxy variables suggested by literature
- Multi-level Case Studies
  - Space and meteorological agencies in U.S., Europe, and Japan
  - International organizations: Group on Earth Observations and World Meteorological Organization

Dataset: Earth Observation Satellites

- Unclassified government satellites, 2000-2012
- Technical characteristics
  - Instrument, resolution, measurement, etc.
  - Mapping to Essential Climate Variables
- Non-technical characteristics
  - Lead country, other countries involved, satellite mission, etc.
- Data sharing policy as of 2012
  - Instrument level



Proxy Variables

Proxy for	Variable	n	Mean	Std Dev	Min	Max
	Data Sharing	483	3.3	2.5	1	8
Economic	**Spatial Resolution**	267	7,233m	24,750m	0.7m	174,000m
Ethics	**Voice and Accountability**	483	66.3	30	4.7	99.1
Institutional	**Mission Includes Climate**	483	0.42	0.49	0	1
Int'l Relations	**Number of Countries**	483	1.3	0.6	1	4
Int'l Relations	**International Participation Index**	483	3.3	0.9	0	4
Organizational	**National Portion of Global EO Climate Satellites**	483	0.159	0.124	0.005	0.323
Organizational	**Operational**	483	0.43	0.50	0	1
Security	**Military or Dual-Use**	483	0.34	0.47	0	1

Orderd Probit Results

Dependent Variable: Data sharing category (by instrument)

	Unweighted	Weighted	Unweighted
Voice and Accountability	0.00245**	0.00368*	0.00179**
	(2.64)	(2.15)	(2.77)
Number of Countries Involved	0.0727	-0.0723	0.00379
	(1.35)	(-1.35)	(0.13)
International Participation Index	-0.0721	-0.0233	0.0383
	(-1.24)	(-0.29)	(1.29)
National Portion of Climate Satellites	3.481***	4.029***	1.333***
	(6.89)	(5.64)	(4.40)
Operational	0.160*	0.0502	0.0741
	(2.42)	(0.62)	(1.83)
Mission Includes Climate	0.443***	0.280**	0.257***
	(4.78)	(2.97)	(5.22)
Military or Dual-Use	-0.176**	-0.216**	-0.0811*
	(-2.63)	(-3.23)	(-2.14)
Spatial Resolution			0.00000276
			(1.91)
N	483	483	267