NEREUS

Núcleo de Economia Regional e Urbana
da Universidade de São Paulo

Integrating GIS and Input-Output systems for assessing the impacts of floods in São Paulo

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Outline

✓ **The city of São Paulo**

Data

Scenarios

Methodology

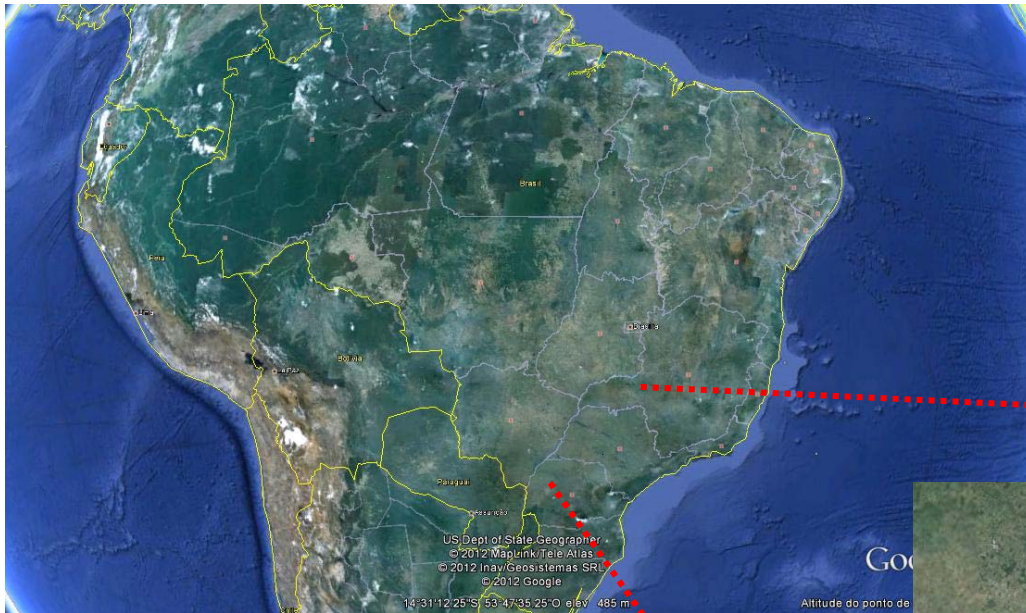Some results

The city of São Paulo

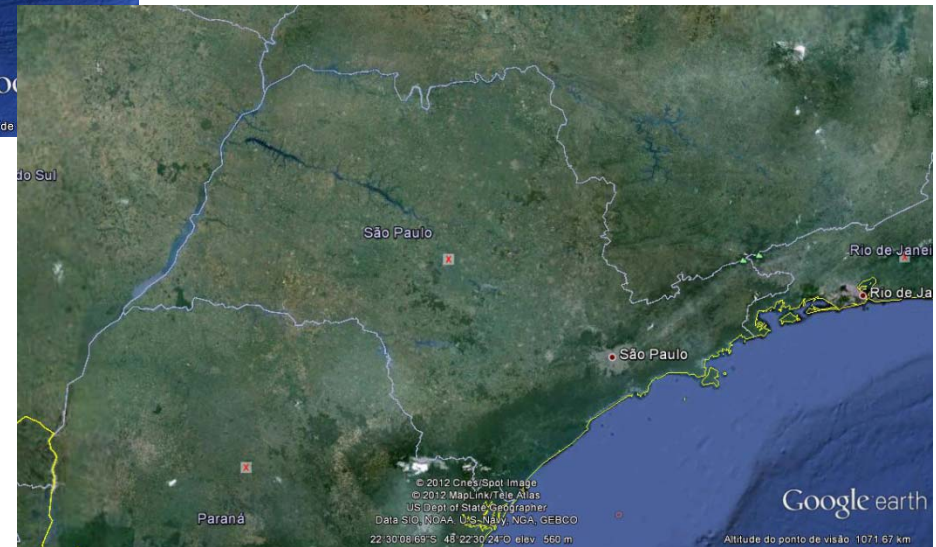**South America**

Brazil
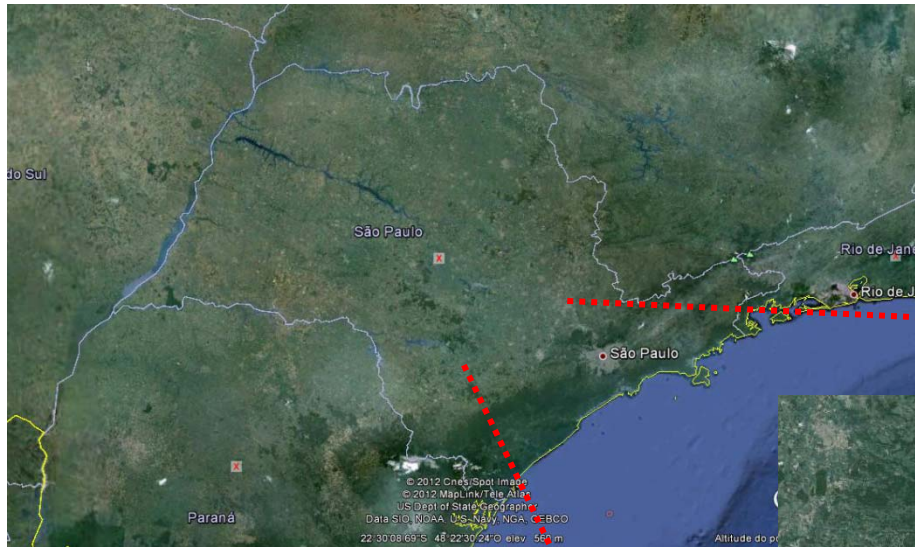
The city of São Paulo

Brazil

The state of São Paulo
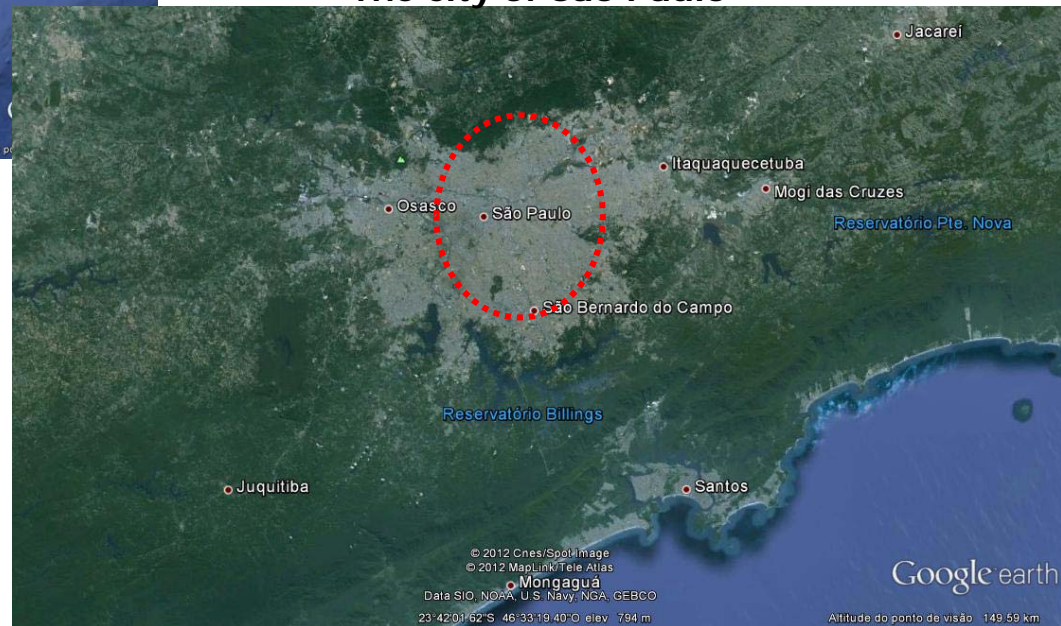
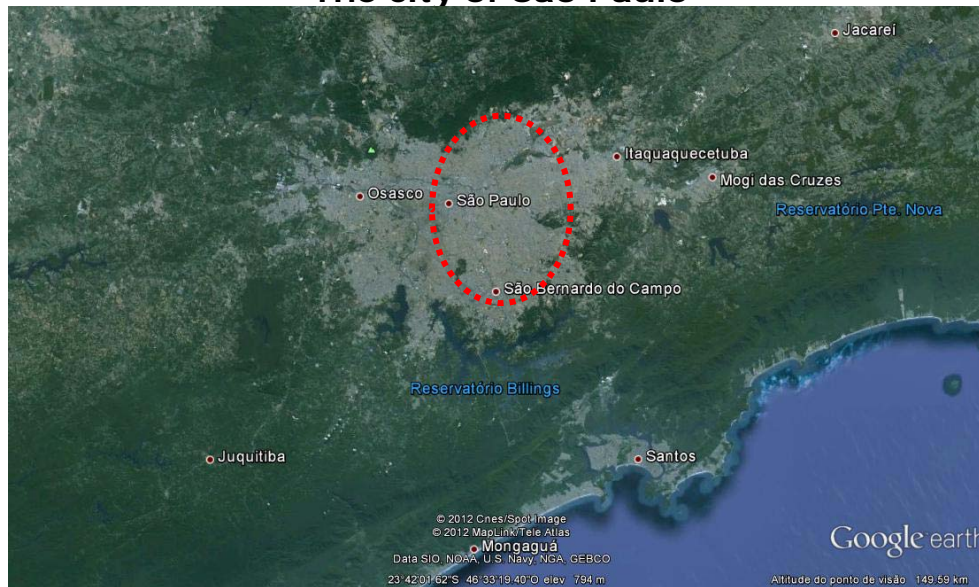# The city of São Paulo

The state of São Paulo

The city of São Paulo

The city of São Paulo

The city of São Paulo

Impact assessment of floods in São Paulo

Climate forecasts present changes in frequency and intensity of short-lasting extreme events [*]
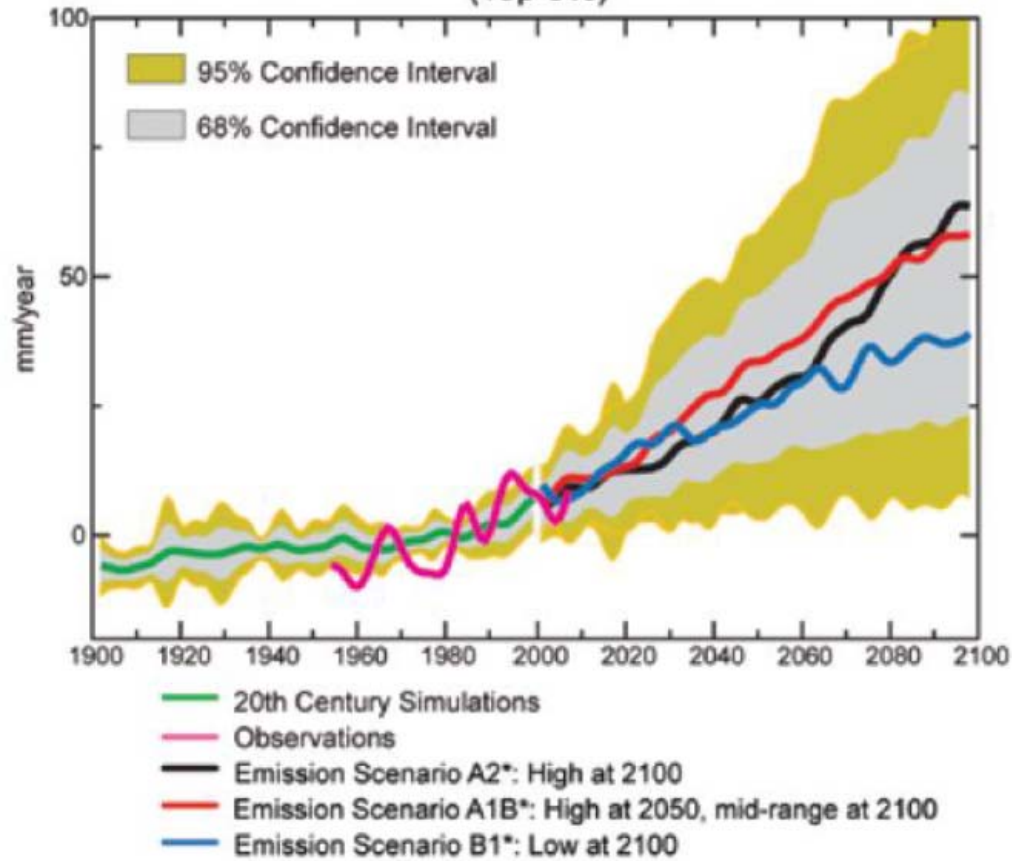
Preliminary climate change studies suggests that between 2070 and 2100 a rise between 2°C to 3°C in São Paulo can double the number of days with intense rain (above 10 mm).

[*] Vulnerability of Brazilian megacities to climate changes: São Paulo Metropolitan Region (2010) - INPE, UNICAMP, USP, IPT, UNESP
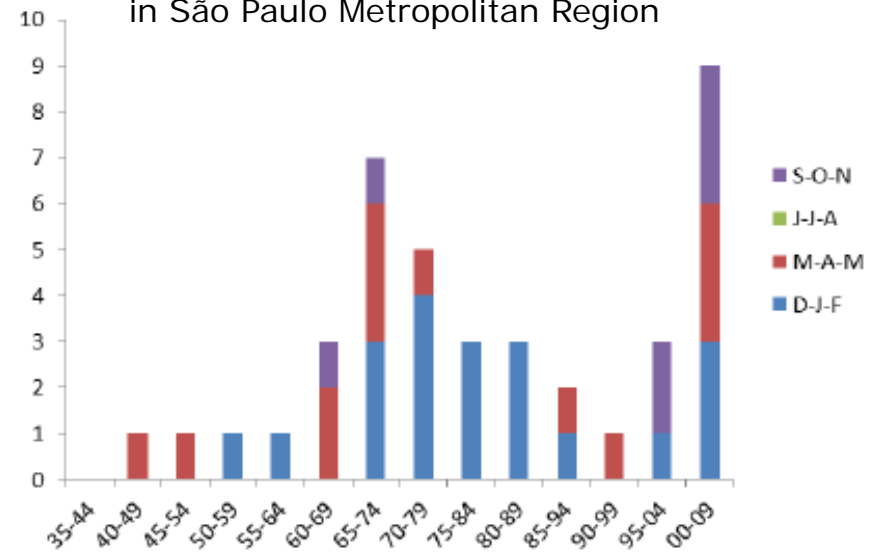
Impact assessment of floods in São Paulo

IPCC 2007

Increase in Heavy Daily Precipitation
(Top 5%)

- 95% Confidence Interval
- 68% Confidence Interval

- 20th Century Simulations
- Observations
- Emission Scenario A2*: High at 2100
- Emission Scenario A1B*: High at 2050, mid-range at 2100
- Emission Scenario B1*: Low at 2100

Number of days with **rain above 80mm**
in São Paulo Metropolitan Region

- S-O-N
- J-J-A
- M-A-M
- D-J-F

Source: Maria Assunção Faus da Silva, IAG/USP

Impact assessment of floods in São Paulo

Outline

The city of São Paulo

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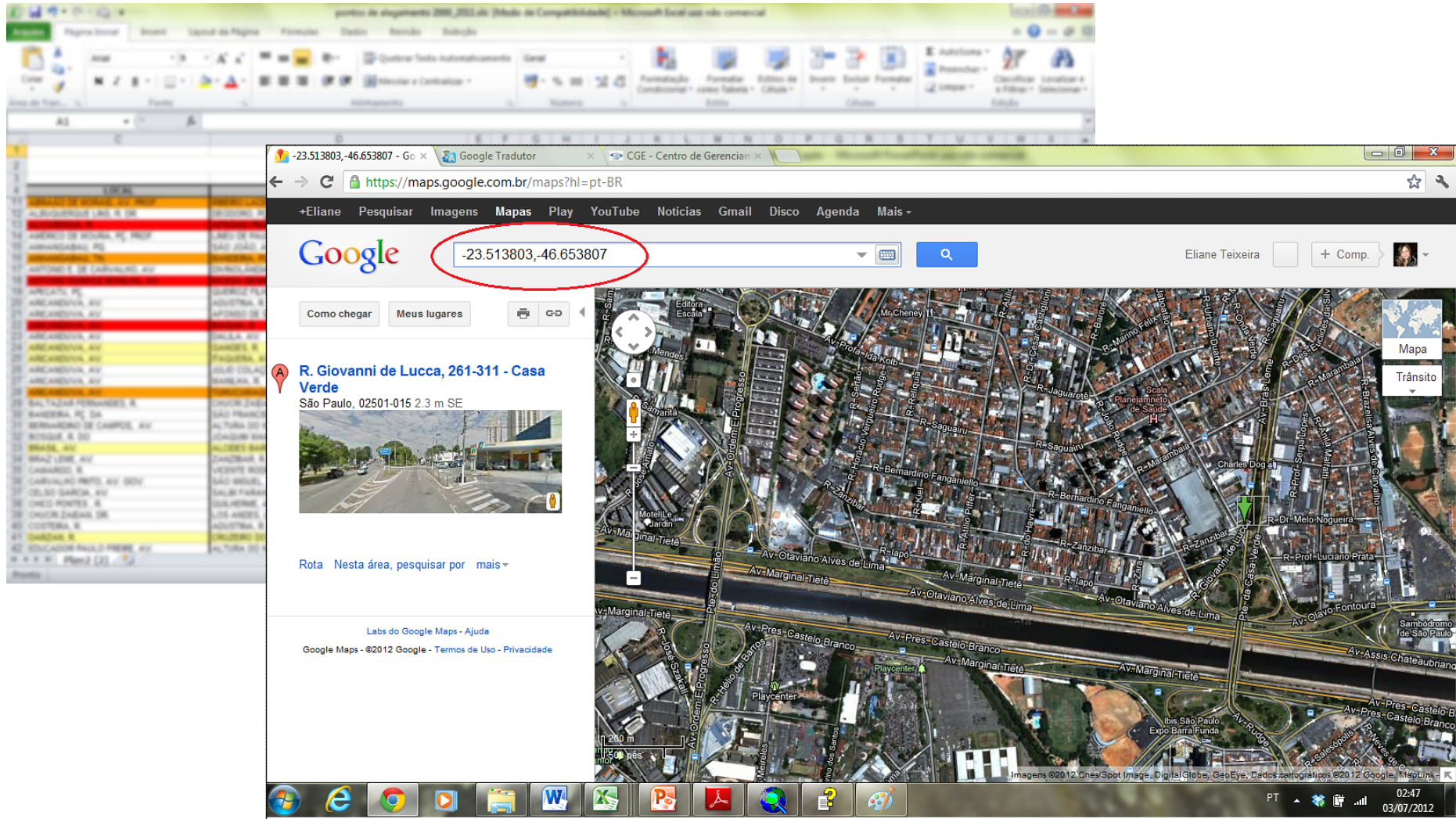Some results

Data: floods

EMC – Emergency Management Center

streets flooded

frequency of floods

Data: georeferencing floods

Data: georeferenced floods
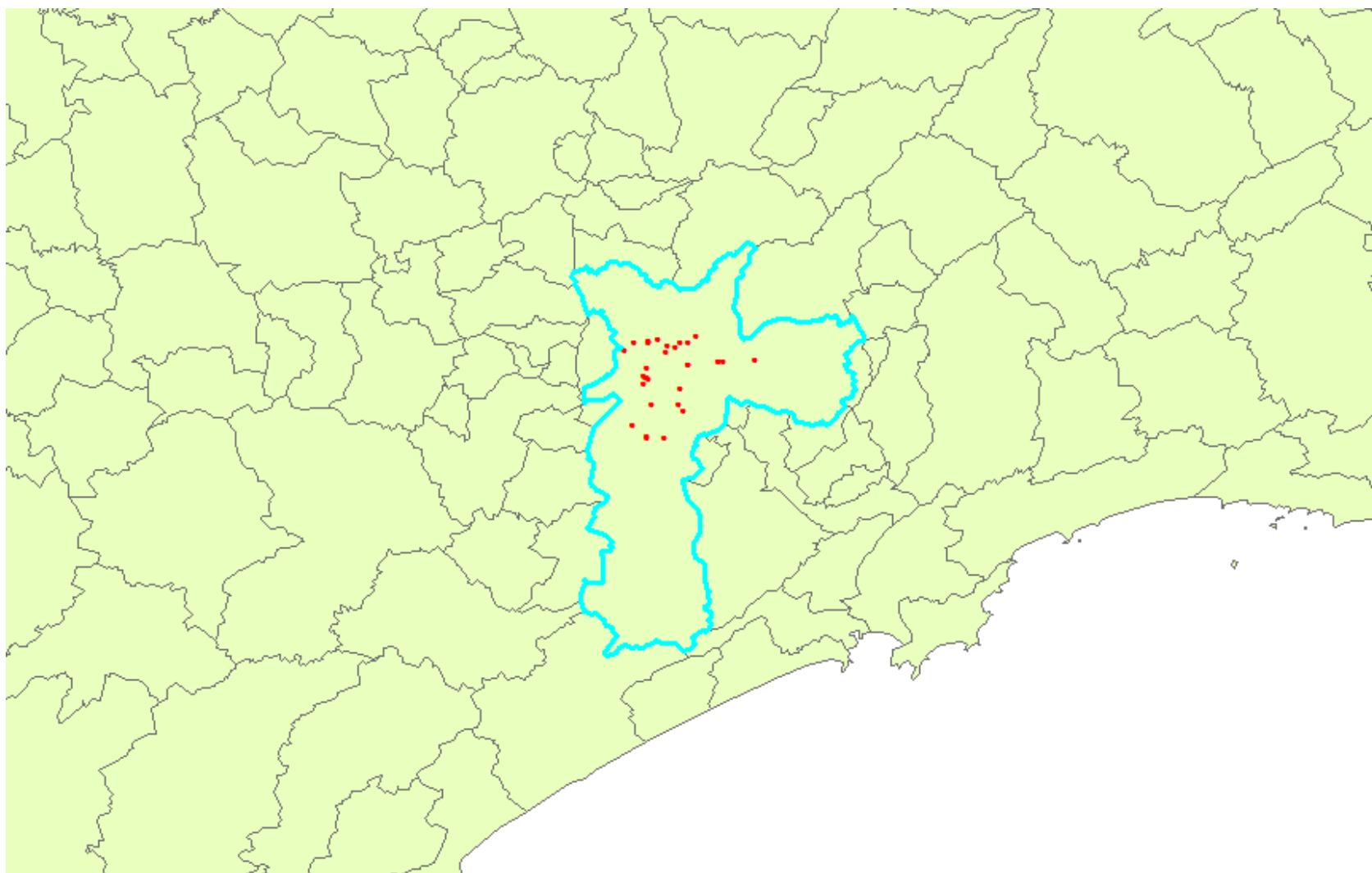
Data: ARSI (RAIS)

ARSI - Annual Relation of Social Information

Scope: national territory
           municipal level
           97% of formal labor market

Firms: localization
          total wages
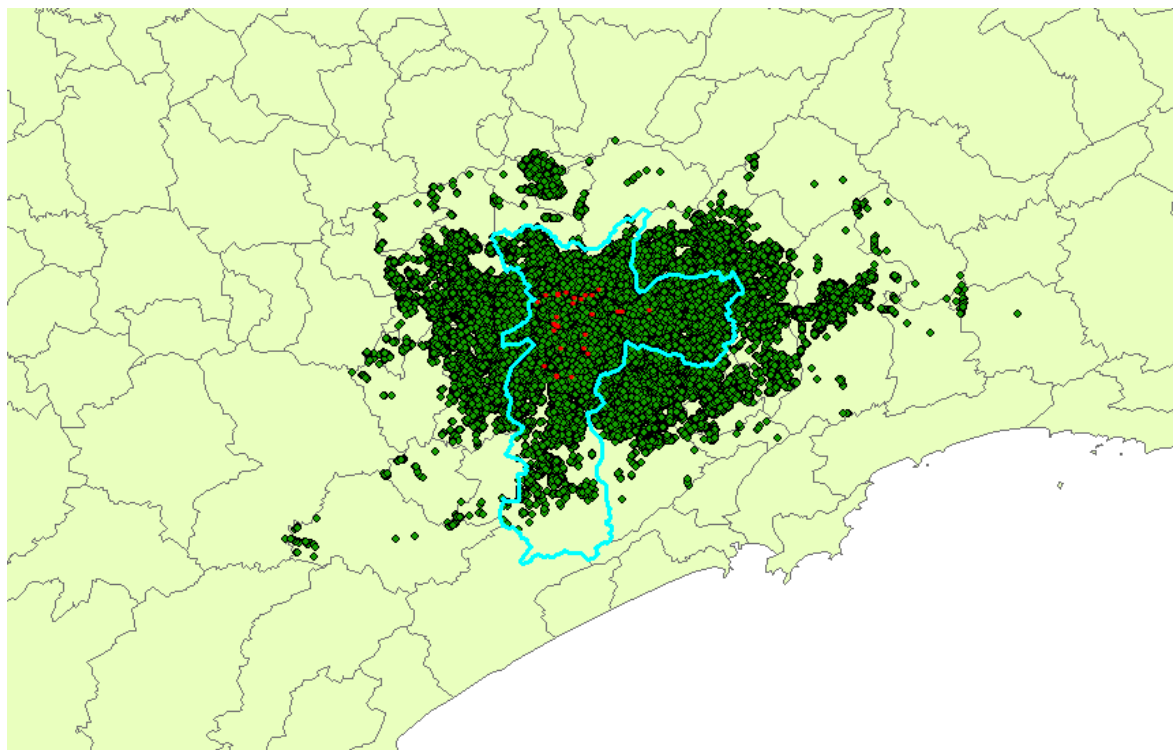
Data: Extented Input-Output Model [2008]

Data: Interregional Input-Output Model

Brazil

The State of São Paulo

São Paulo Metropolitan Region

The city of São Paulo
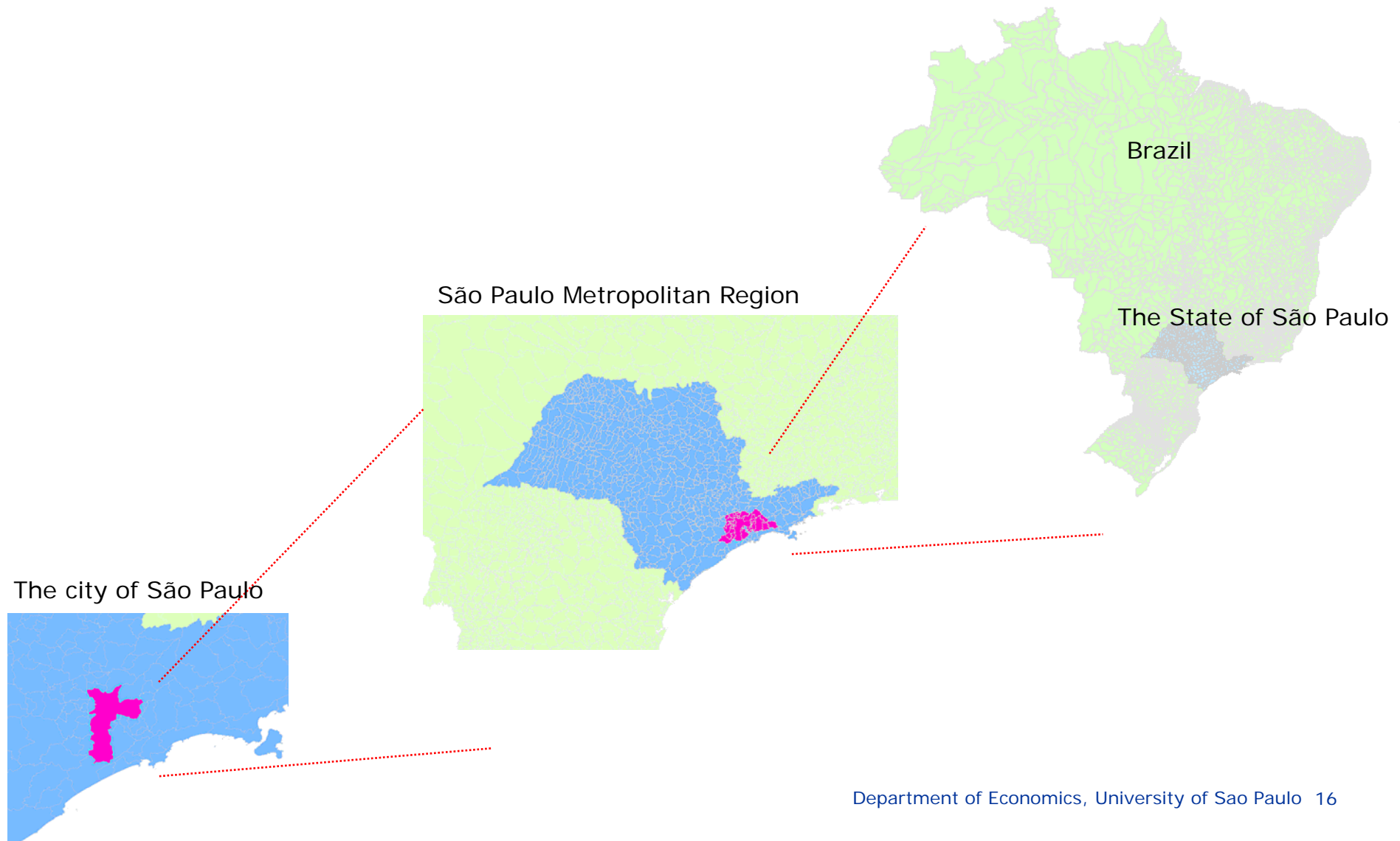
Outline

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Some results

Scenarios

Scenario 1		Scenario 2		Scenario 3		Scenario 4	
Influence Zone	Affected Firms	Influence Zone	Affected Firms	Influence Zone	Affected Firms	Influence Zone	Affected Firms
50 m	352	100 m	1.004	200 m	3.905	500 m	21.395

Scenarios: an example
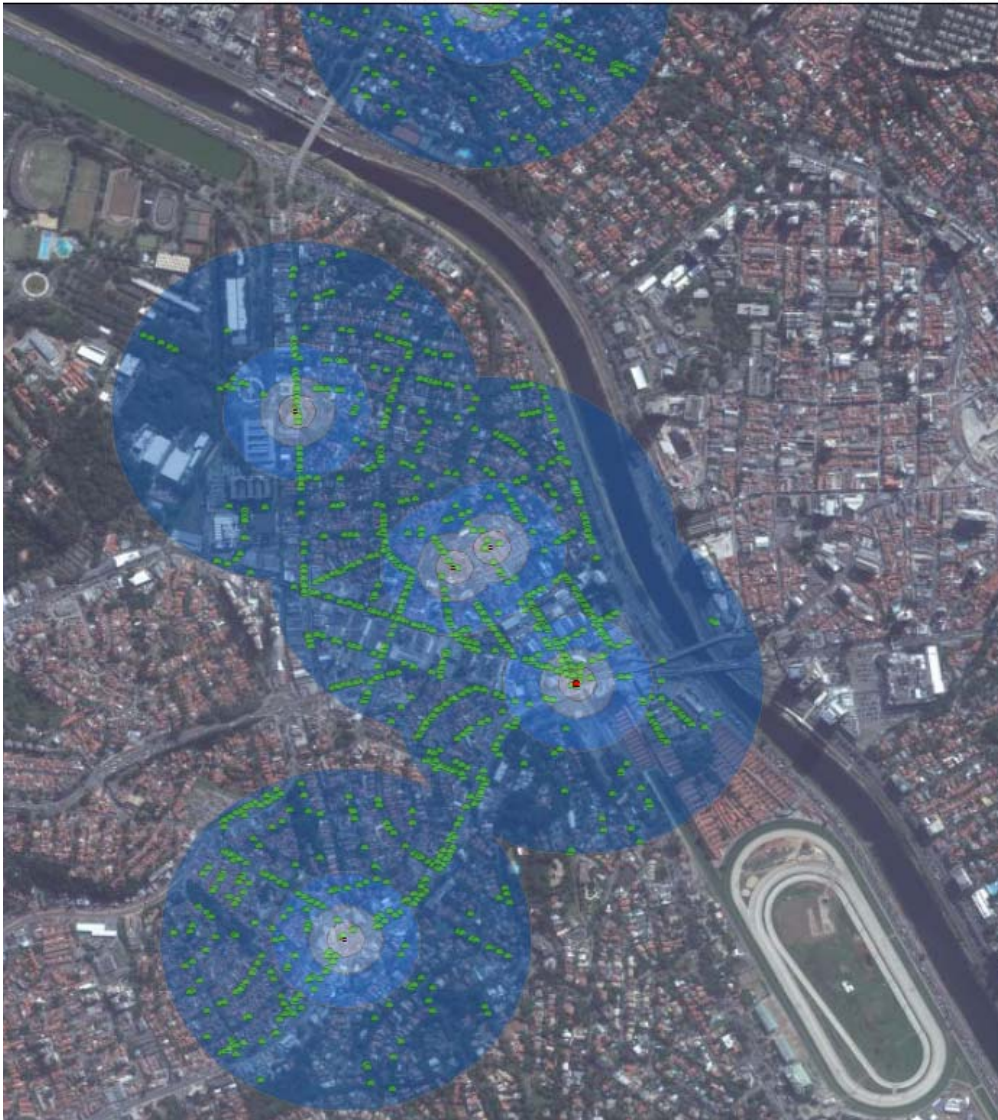
The most problematic flood point in 2008

Latitude -23.57267	
Longitude -46.70449	

Influence Zone	Affected Firms
100 m	137

Outline

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✓ Methodology

Some results

Methodology: Interregional I-O System, closed in households

$$\Delta X = \overbrace{(I - A)^{-1}}^{Leontief\ Inverse}\ \underbrace{f}_{shock\ vector}$$

$$a_{ij}^{rs} = \frac{Z_{ij}^{rs}}{X_j^s}$$

Methodology

$$Shock\ Vector = \underbrace{Productivity\ Coefficient}_{average\ sectoral\ productivity} * Total\ wages\ in\ Flood\ Days$$

$$Productivity\ Coefficient = \frac{Gross\ Output}{Cost\ of\ Labor}$$

Underlying Assumptions:

- Continuous production in business days

- 1 day of flood impacts 1 day of production

Outline

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✓ Some results

Some results: Potential Product Losses

Direct Damage (in R$)

	Scenario 1 50 m	Scenario 2 100 m	Scenario 3 200 m	Scenario 4 500 m
São Paulo	6.296.382	16.888.093	47.584.343	565.876.814
Rest of São Paulo Metropolitan Region	0	0	0	0
Rest of São Paulo (state)	0	0	0	0
Rest of Brazil	0	0	0	0
	6.296.382	**16.888.093**	**47.584.343**	**565.876.814**

Total Damage (in R$)

	Scenario 1 50 m	Scenario 2 100 m	Scenario 3 200 m	Scenario 4 500 m
São Paulo	8.971.487	24.679.478	72.637.226	938.946.439
Rest of São Paulo Metropolitan Region	1.225.752	3.177.525	8.667.814	113.064.773
Rest of São Paulo (state)	2.187.005	5.083.498	11.898.803	143.264.062
Rest of Brazil	3.715.509	7.480.972	16.074.355	185.498.488
	16.099.752	**40.421.473**	**109.278.198**	**1.380.773.763**

Some results: Potential Product Losses

Total Damage (in %)

	Scenario 1 50 m	Scenario 2 100 m	Scenario 3 200 m	Scenario 4 500 m
São Paulo	56	61	66	68
Rest of São Paulo Metropolitan Region	8	8	8	8
Rest of São Paulo (state)	14	13	11	10
Rest of Brazil	23	19	15	13
	100	**100**	**100**	**100**

Damage ratio = Total Damage / Direct Damage

	Scenario 1 50 m	Scenario 2 100 m	Scenario 3 200 m	Scenario 4 500 m
Damage Ratio	3,0	2,8	2,8	3,1

Thank you!