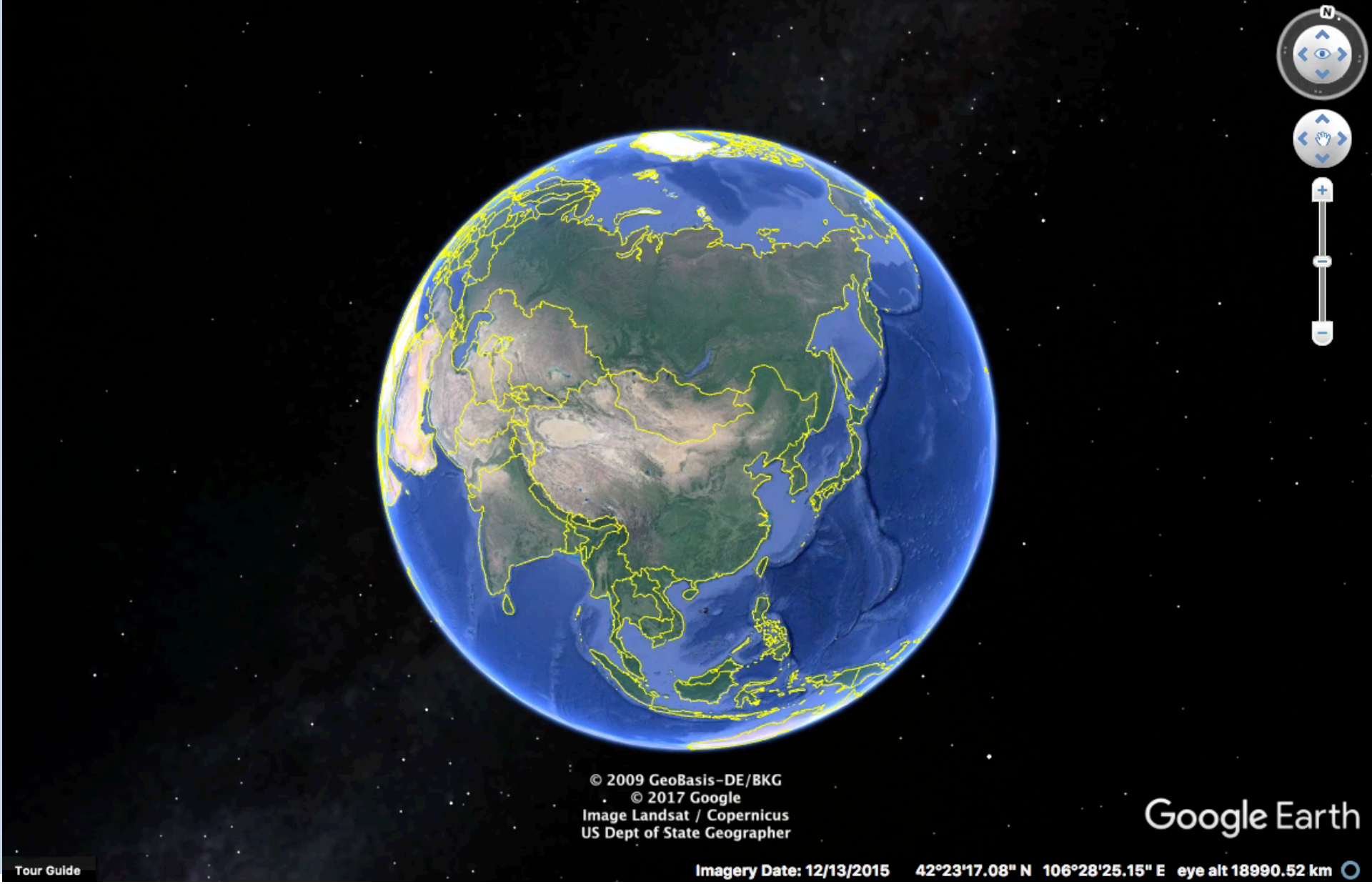
Environmental *Change* Institute

The spatial exposure of China's infrastructure system to flooding risks in the context of climate change

Xi (Sisi) Hu, Wee Ho Lim, Raghav Pant, Jim Hall, Xi Lu



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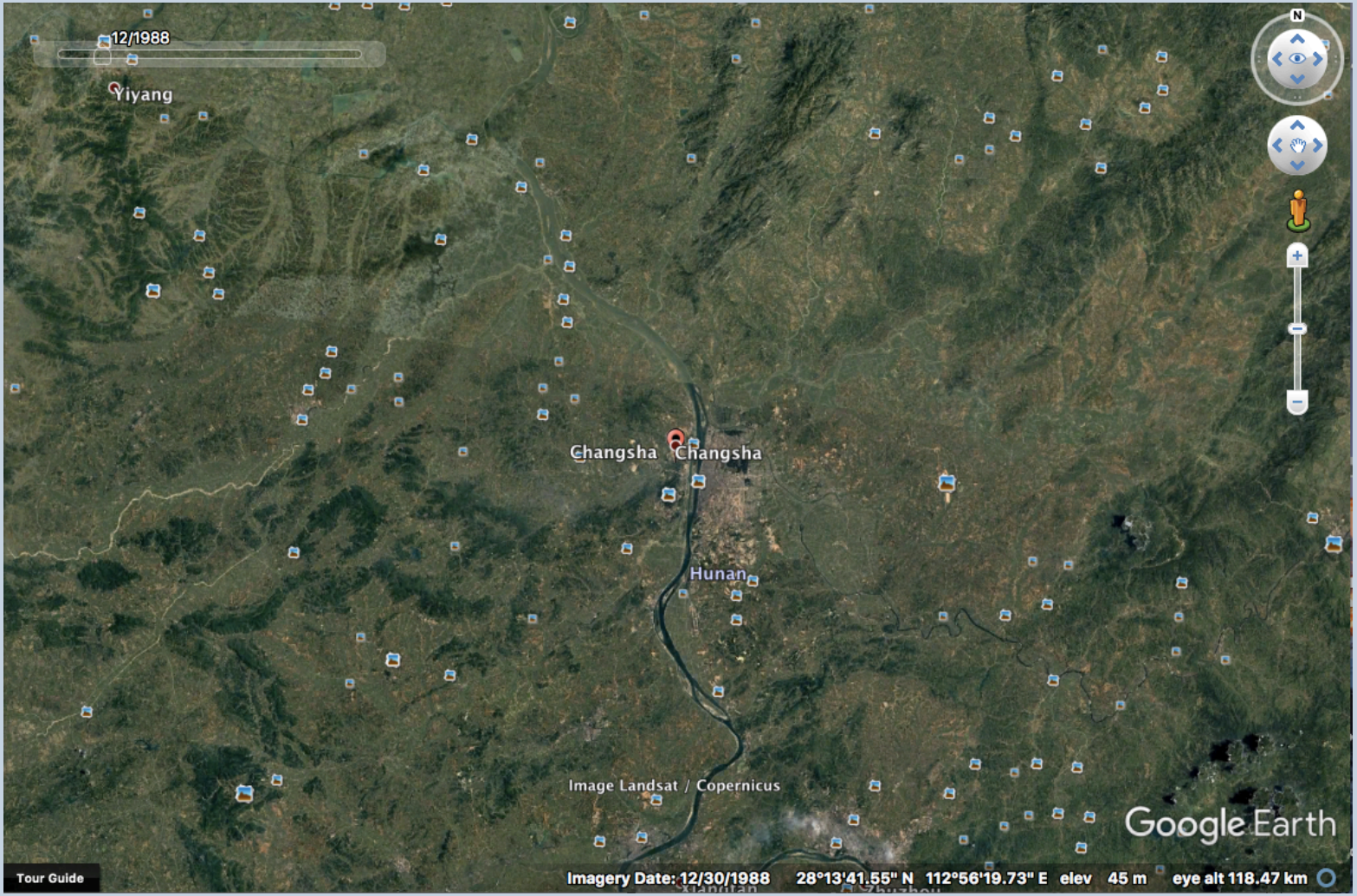
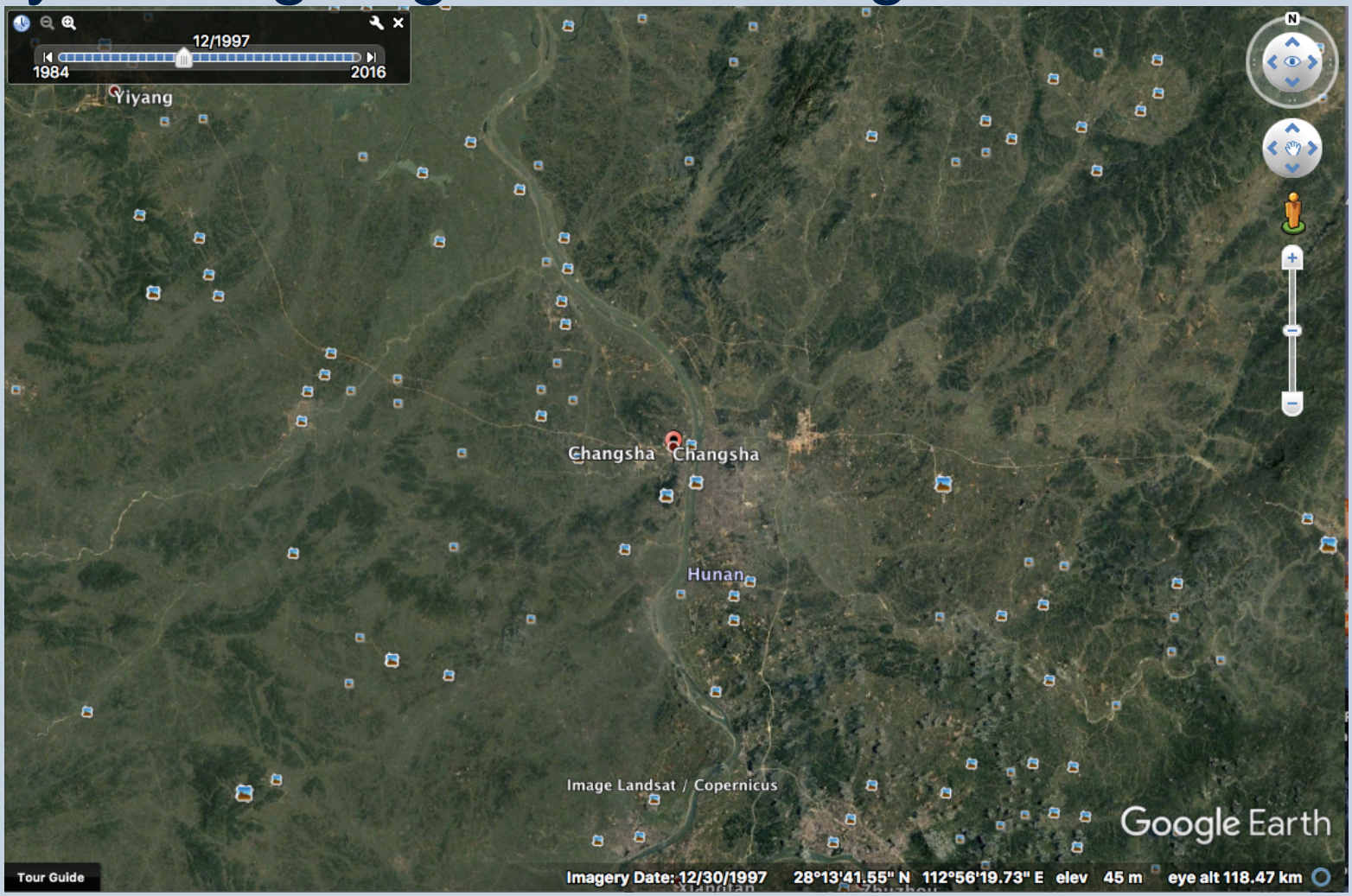
City undergoing drastic changes… 1988



City undergoing drastic changes… 1997



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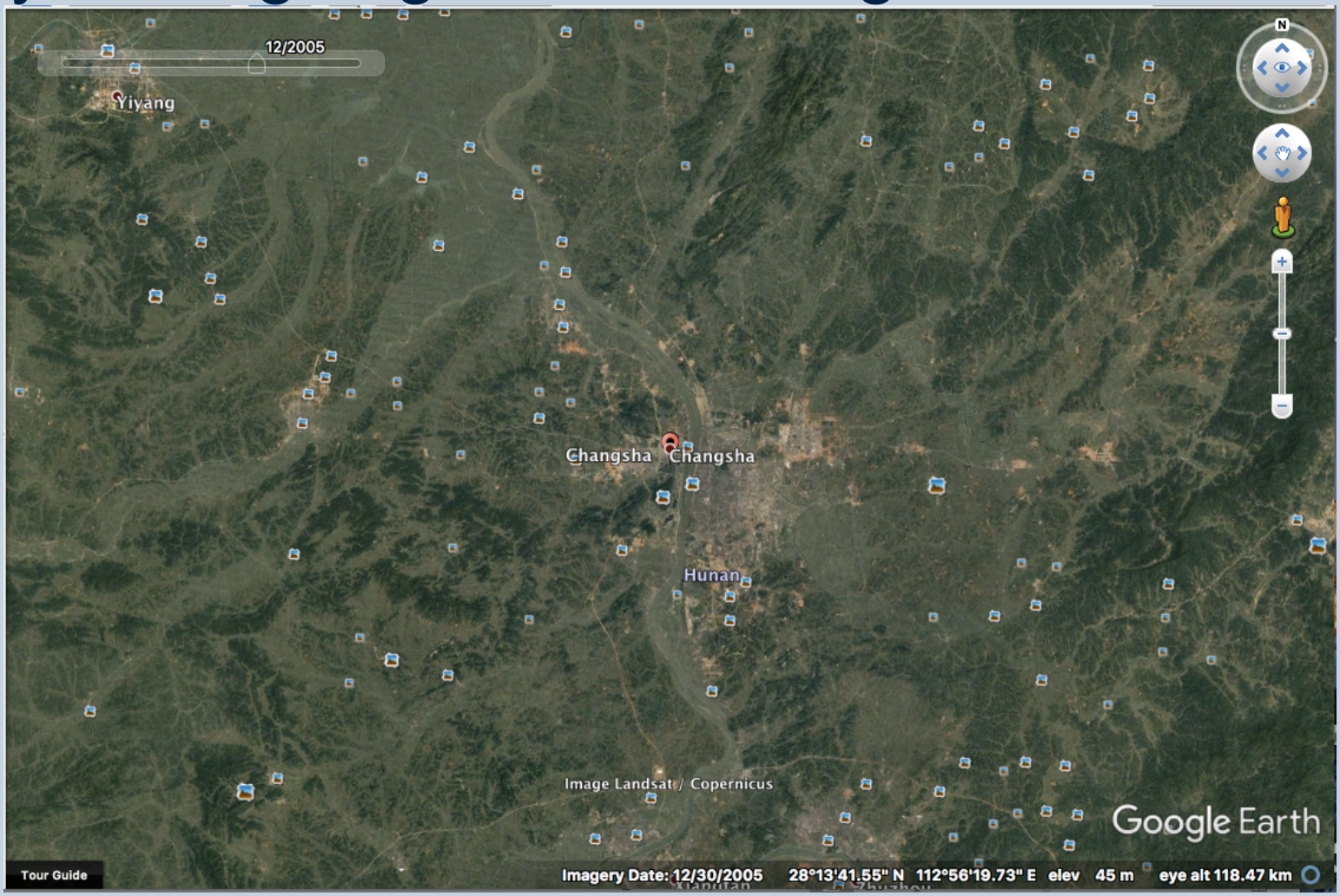
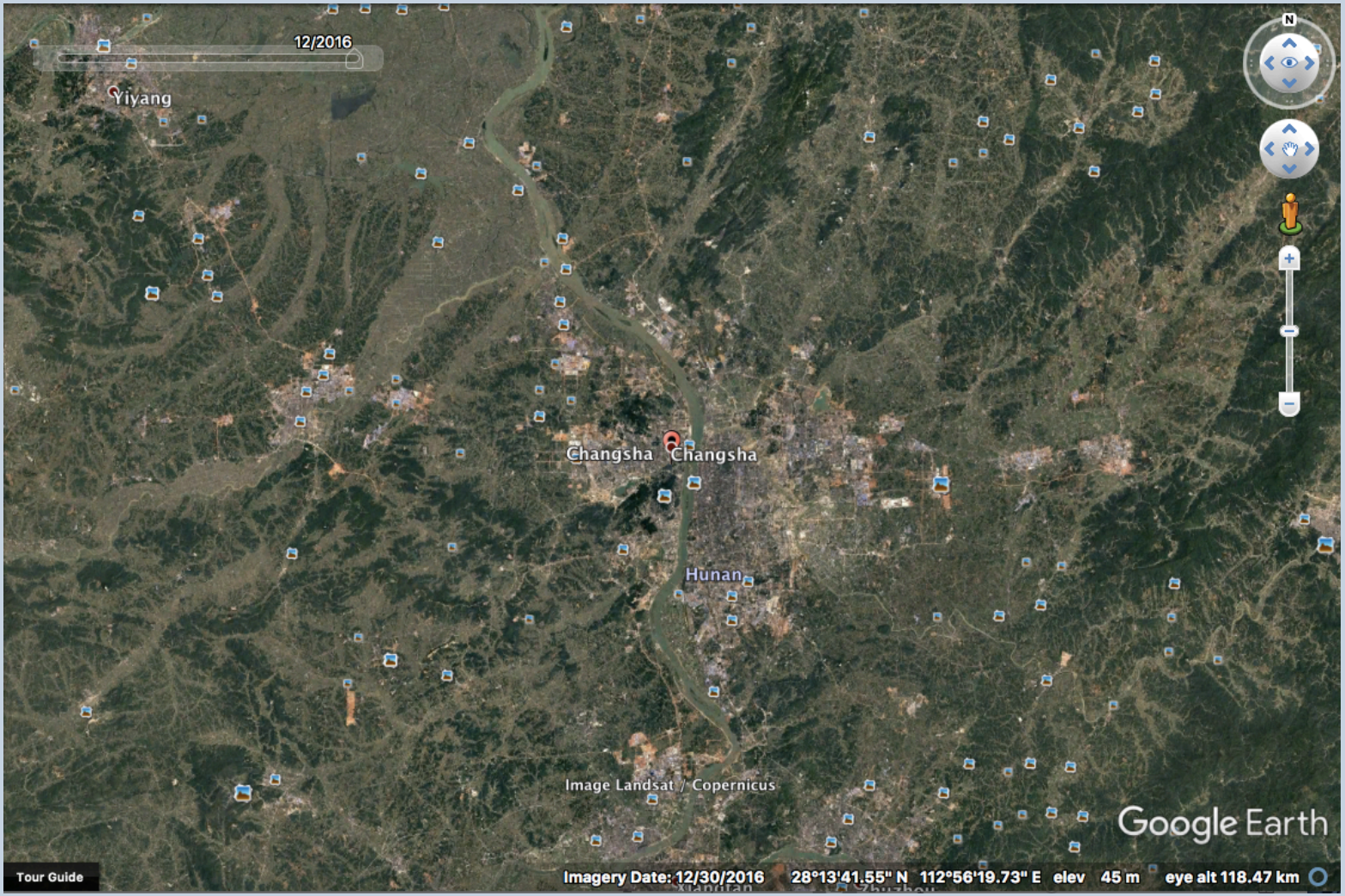
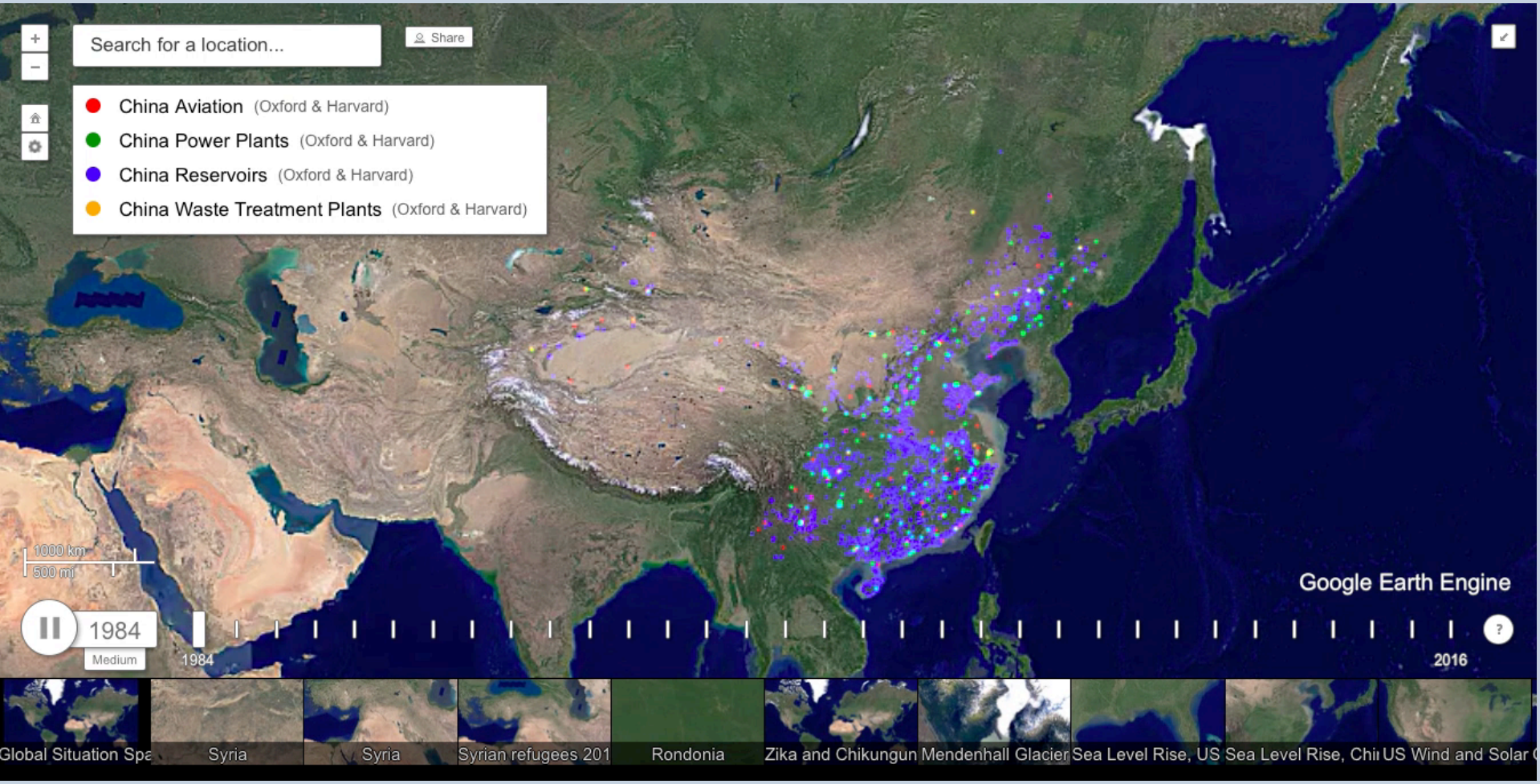
City undergoing drastic changes… 2005



City undergoing drastic changes… 2016



Phenomenal rapid infrastructure growth ..



Showcased at World Economic Forum Summer Davos 2017

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2017

2016

2015

1982

o o o

Across China… infrastructure disruption

Power plant flooded, Laocheng, 2004

Transmission lines flooded, Guangdong, 2017

Rail lines flooded, Zhejiang, 2010

Shipping lane flooded, Nanjing, 2016

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Nation-wide infrastructures disrupted by flooding events

	2009	2010	2011	2012	2013	2014	2015	2016
No. of roads	20,354	58,606	21,961	81,523	37,166	33,569	28,274	55,743
No. of airport, ports	142	108	49	199	192	107	207	425
No. of transmission lines	7,386	23,063	8,516	39,082	18,498	14,316	17,617	22,692
No. of dikes	28,527	81,824	24,556	46,090	37,336	24,249	27,709	66,950

Source: Bulletin of flood and drought disaster in China 2009-2016

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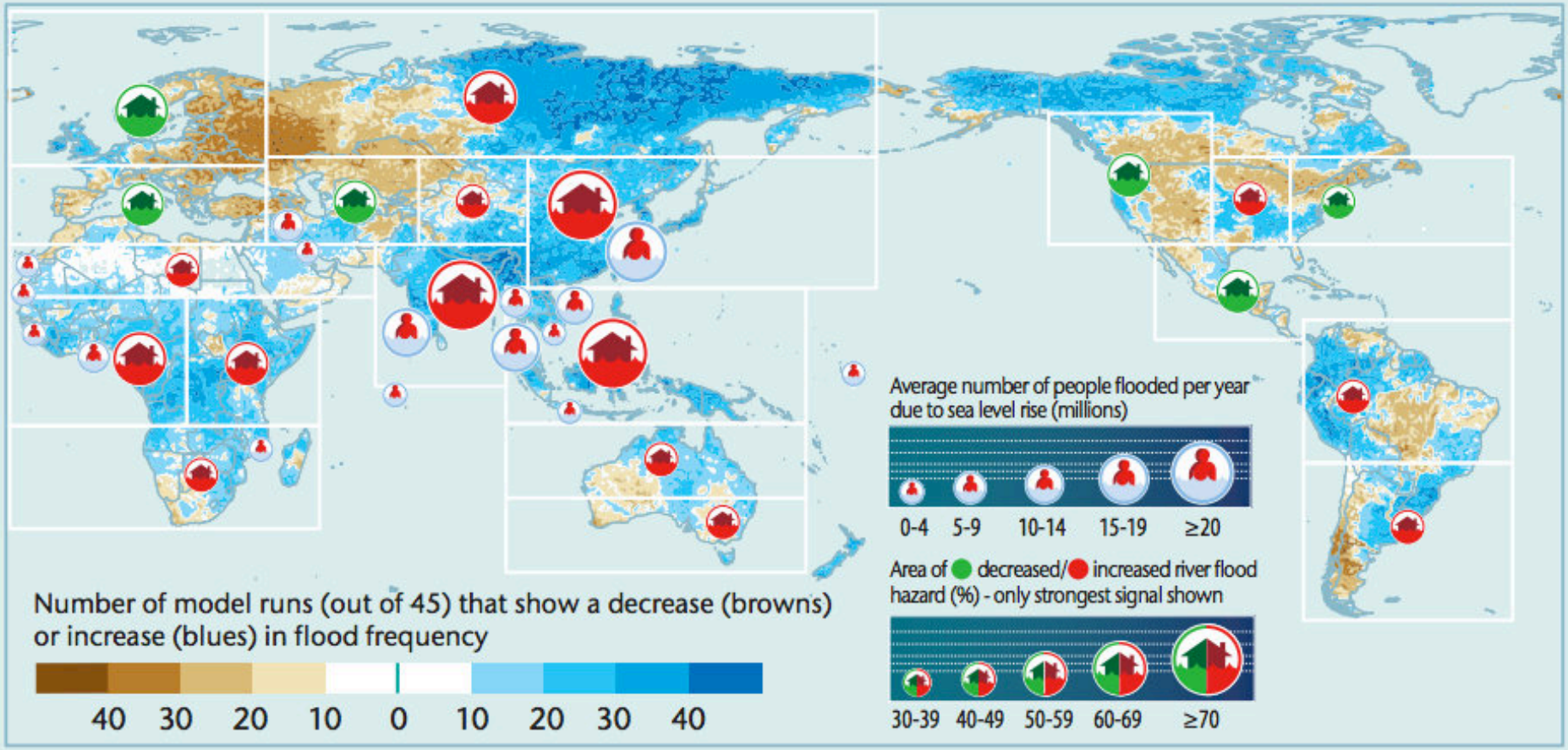
Future change in flood frequency and annual number of people affected by coastal flooding



The flood icons show the percentage of the area within a region that is projected to have an increase or decrease in flood frequency, while the background spatial pattern shows the level of confidence across the models in this change (increase or decrease). Also shown are the average numbers of people projected to be affected by coastal flooding, assuming no additional adaptation, for a selection of the worst affected countries.

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Source: Carbonbrief 2017

What does climate change mean for China's infrastructures?

What are the policy implications?

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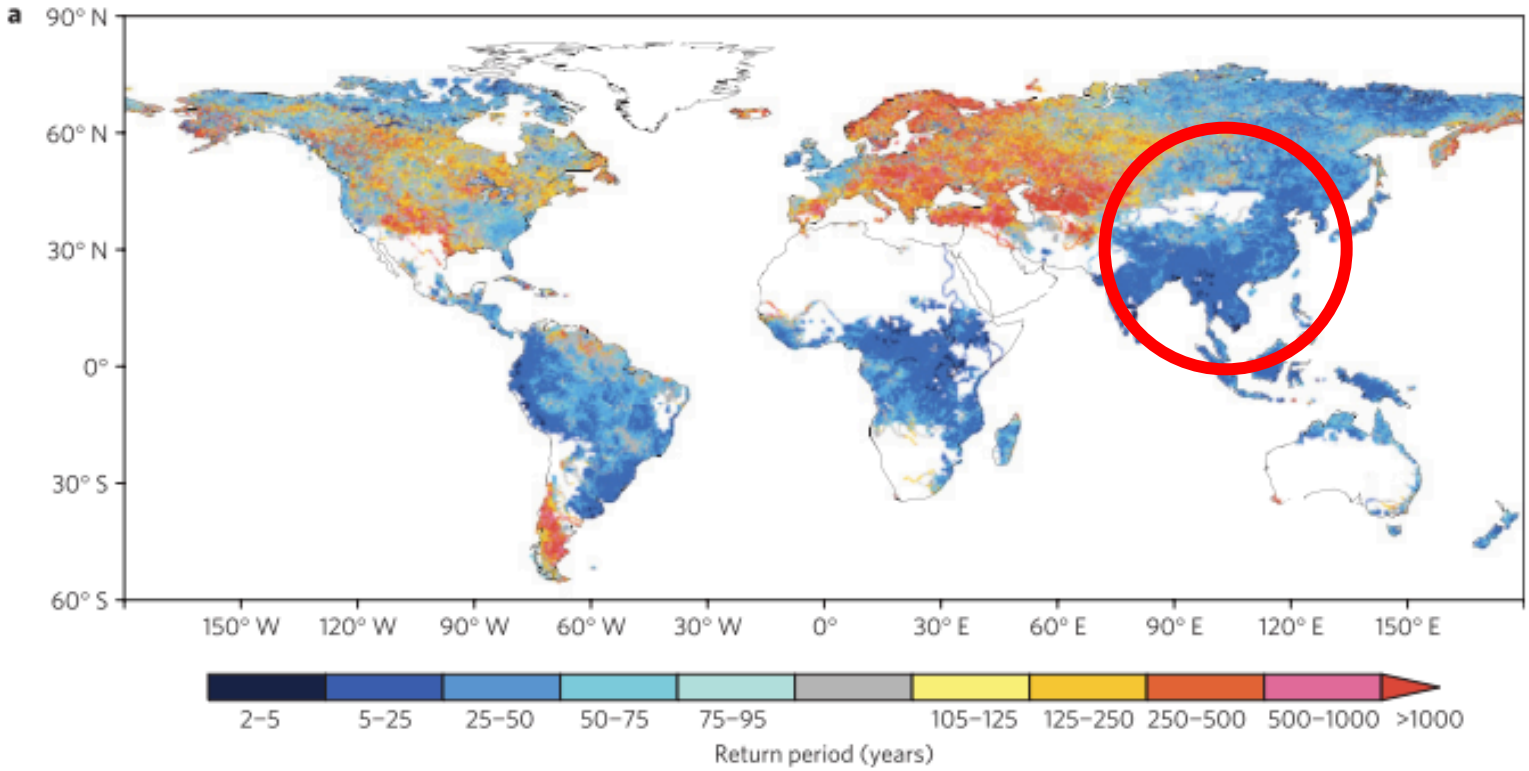
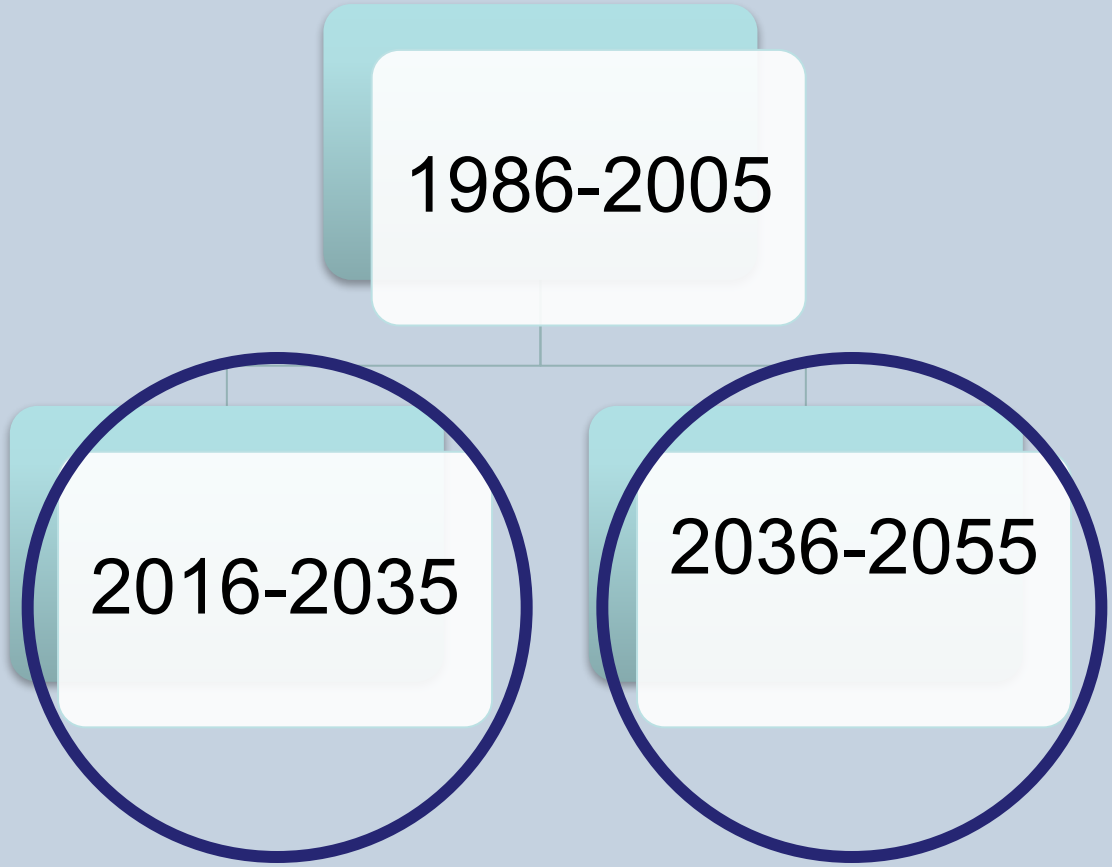
Cama-Flood Model

NATURE CLIMATE CHANGE DOI: 10.1038/NCLIMATE1911 LETTERS



Hirabayashi (2013)

Changing probabilities of flooding



Baseline flood extent

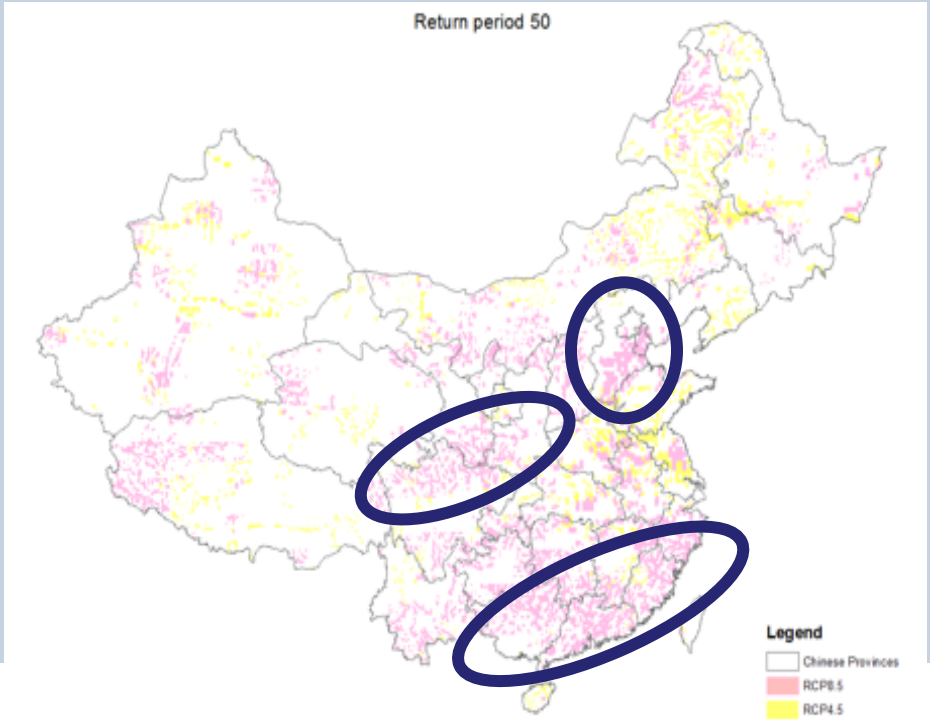
Future flood extent

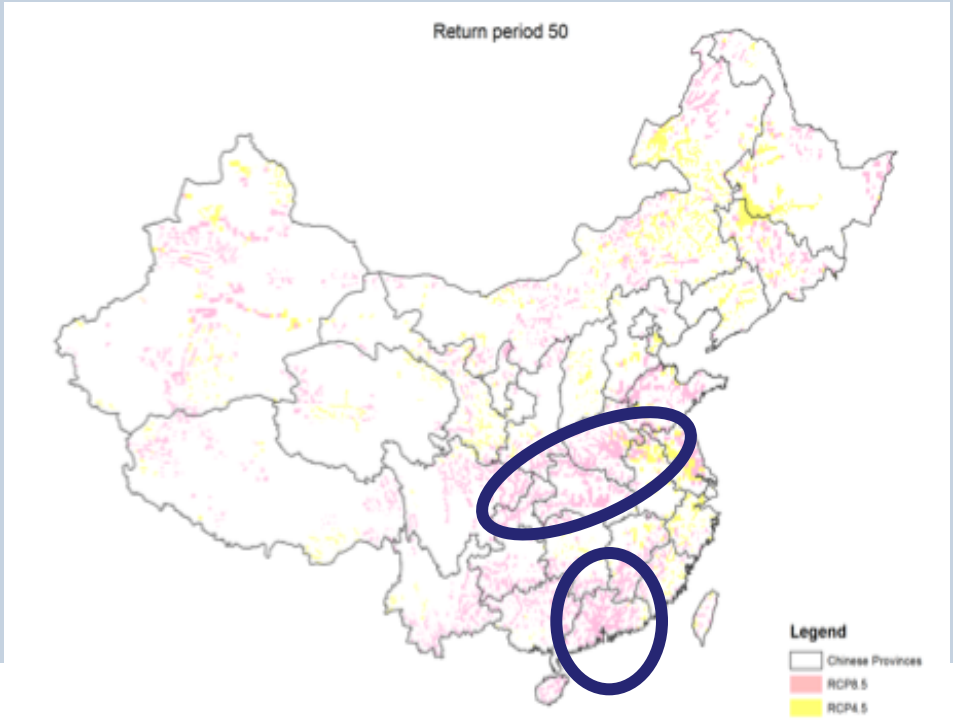
Increasing probabilities of flooding in China (most optimistic scenario - Model: INM-CM4)

1986-2005

2016-2035

2036-2055





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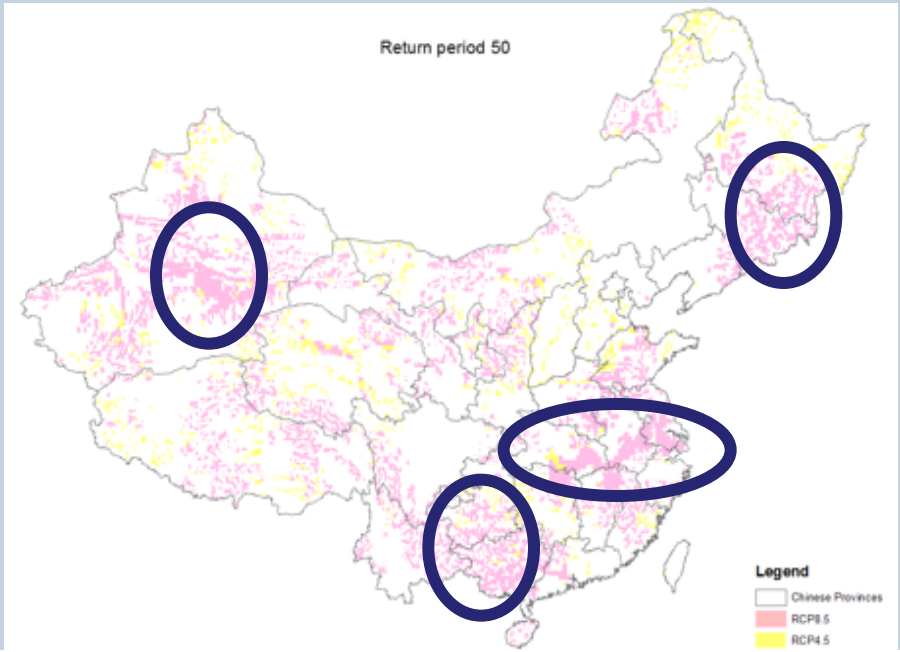
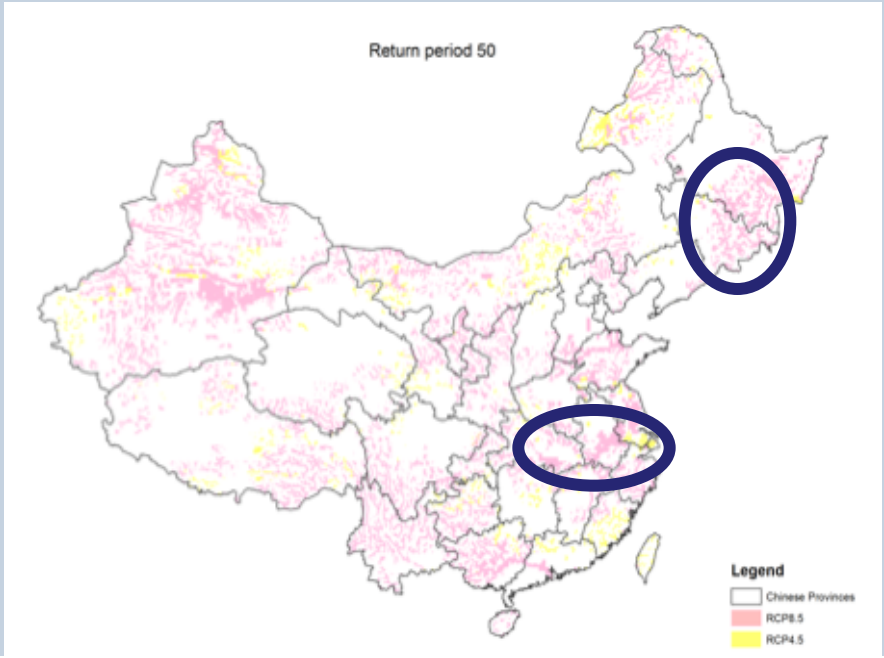
Increasing probabilities of flooding in China (medium scenario - Model: MPI-ESM-LR)

1986-2005

2016-2035



2036-2055



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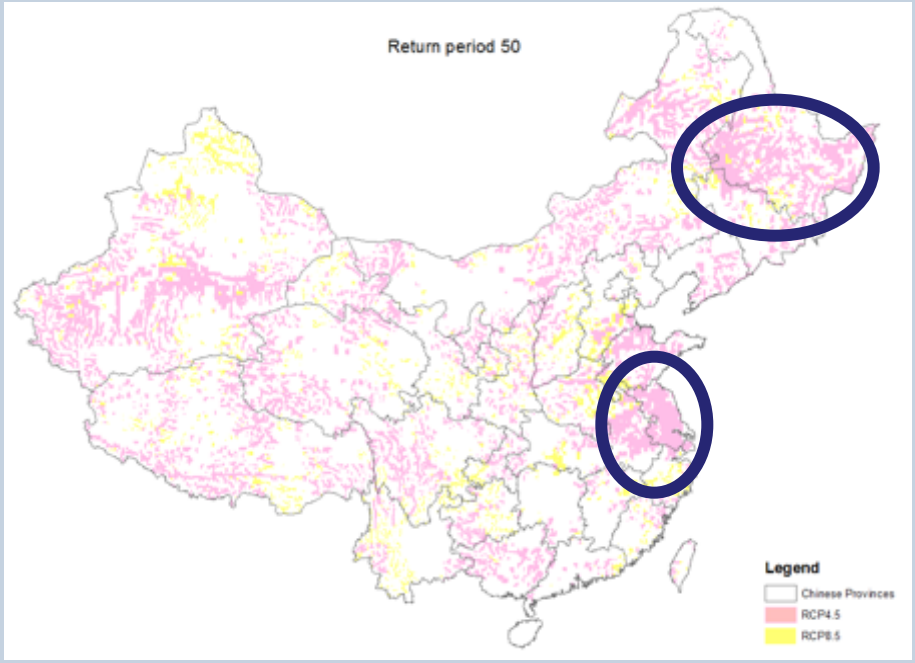
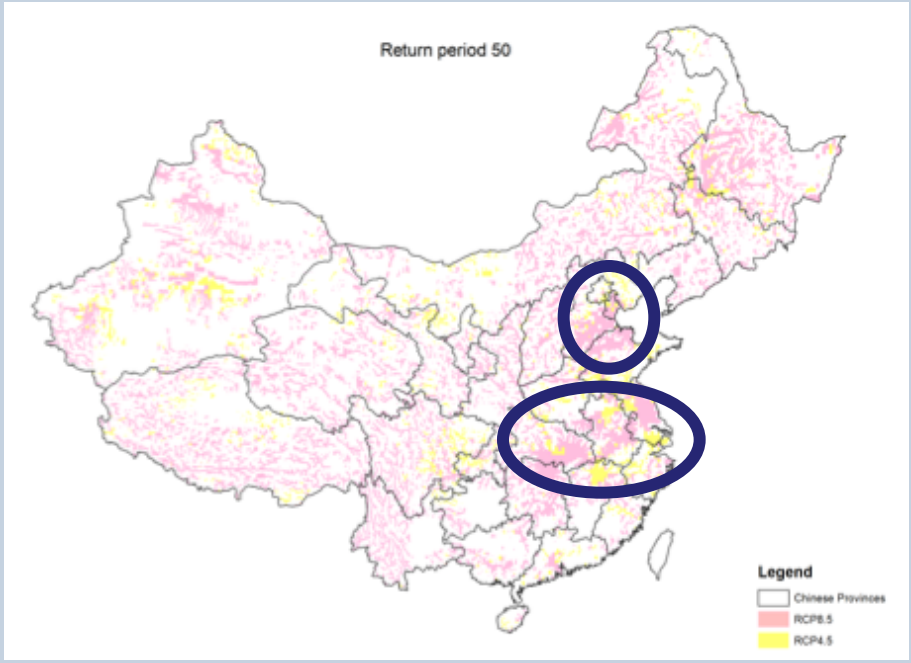
Increasing probabilities of flooding in China (worst scenario – Model: MIROC5)

1986-2005

2016-2035



2036-2055



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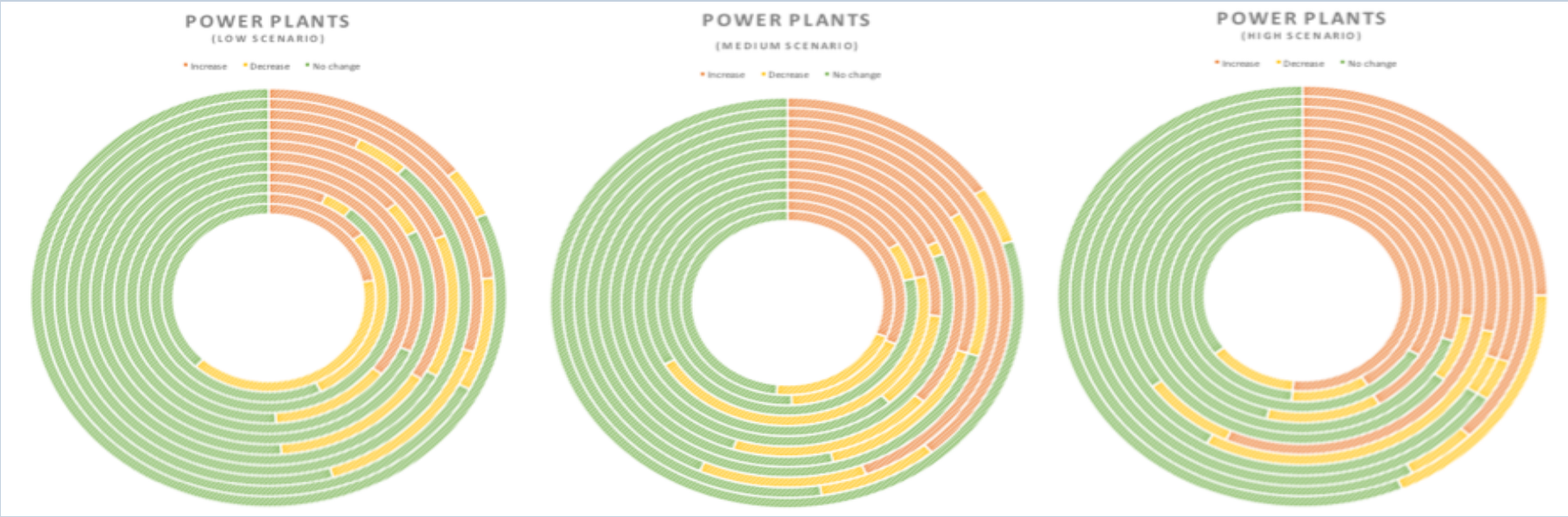
What does this mean for China's infrastructures?

Electricity sector: case study



132 scenarios in total:

- Return periods 1 in 30, 50, 100 years
- RCP 4.5 and 8.5
- Two future time periods 2006-2035; 2036-2055

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What are the policy implications?

Policy implications

- National Adaptation Plan on Climate Change (2014-2020)《国家应对气候变化规划(2014 —2020 年)》

  Chapter 4. Improving adaptive capacity of infrastructures

  - New urban areas
    1. New cities/sites must go through climate risk assessment
    2. Improve building standards/codes for infrastructures
    3. Technical standards improved for coping with extreme weather events
  - Water infrastructure
    1. Flood protection standards
  - Transport infrastructure
    1. Improve building standards
    2. Improve monitoring of transport infrastructure conditions
  - Energy infrastructure – require climate risk assessments

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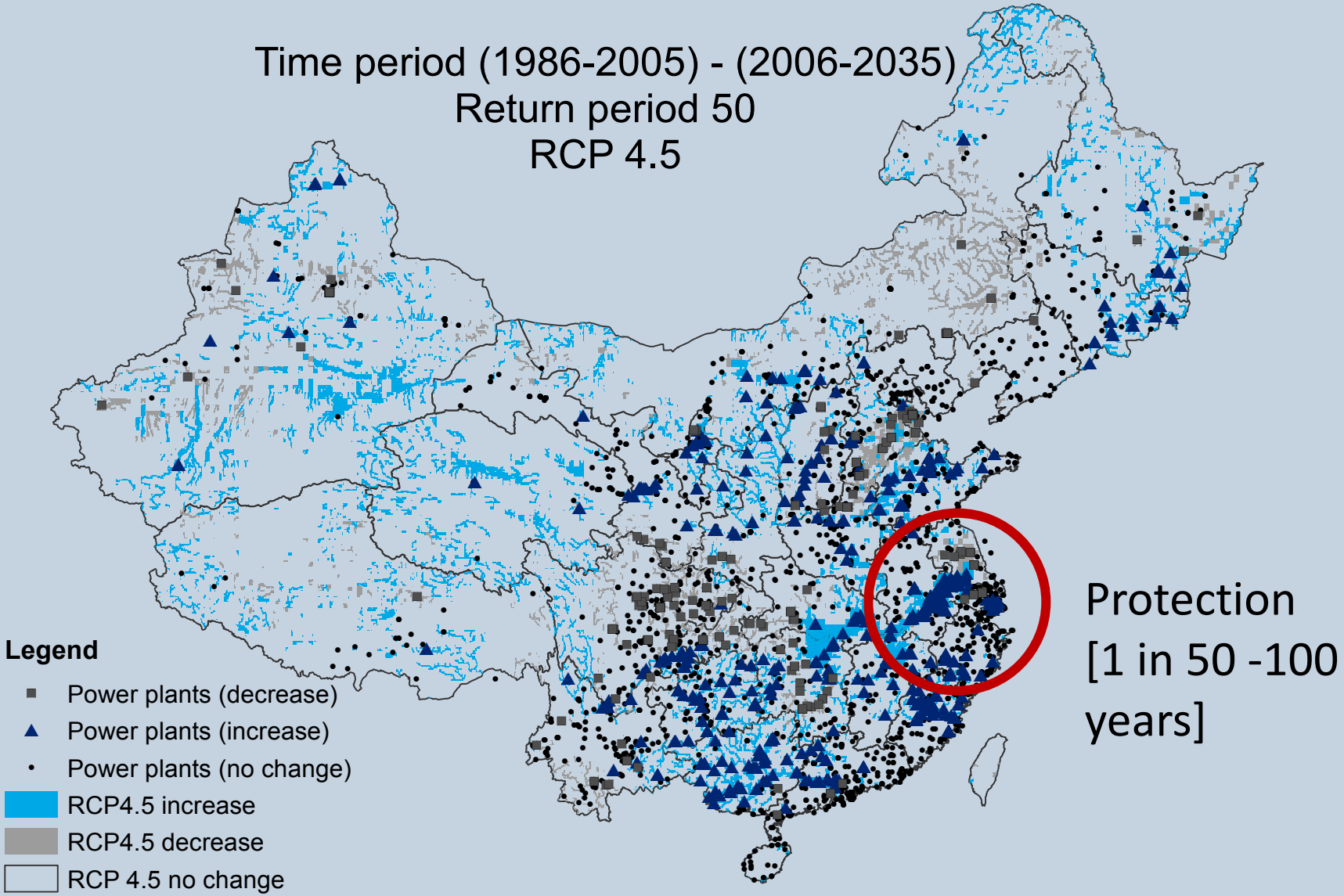
Time period (1986-2005) - (2006-2035)
Return period 50
RCP 4.5



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Current work

First of its kind national geospatial infrastructure network database for China (~60,000 nodes and edges)

Flood protection for individual assets

Table 1 Infrastructure asset datasets

Sector	Sub-sector	Asset type
Energy	Electricity	Power plants
		Transmission network
	Natural Gas, Liquid and Solid Fuels	Pipelines
Transport	Roads	Road network
	Rail	Rail tracks
		Stations
	Shipping	Ports
		Waterways
	Aviation	Airports
Water	Water supply	Reservoirs
		Dams
		Rivers
Waste	Waste water	Waste treatment
	Solid waste	Landfill sites
ICT	Mass data and computation facilities	Telecoms

Hu et al (2016)

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Thank you!

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