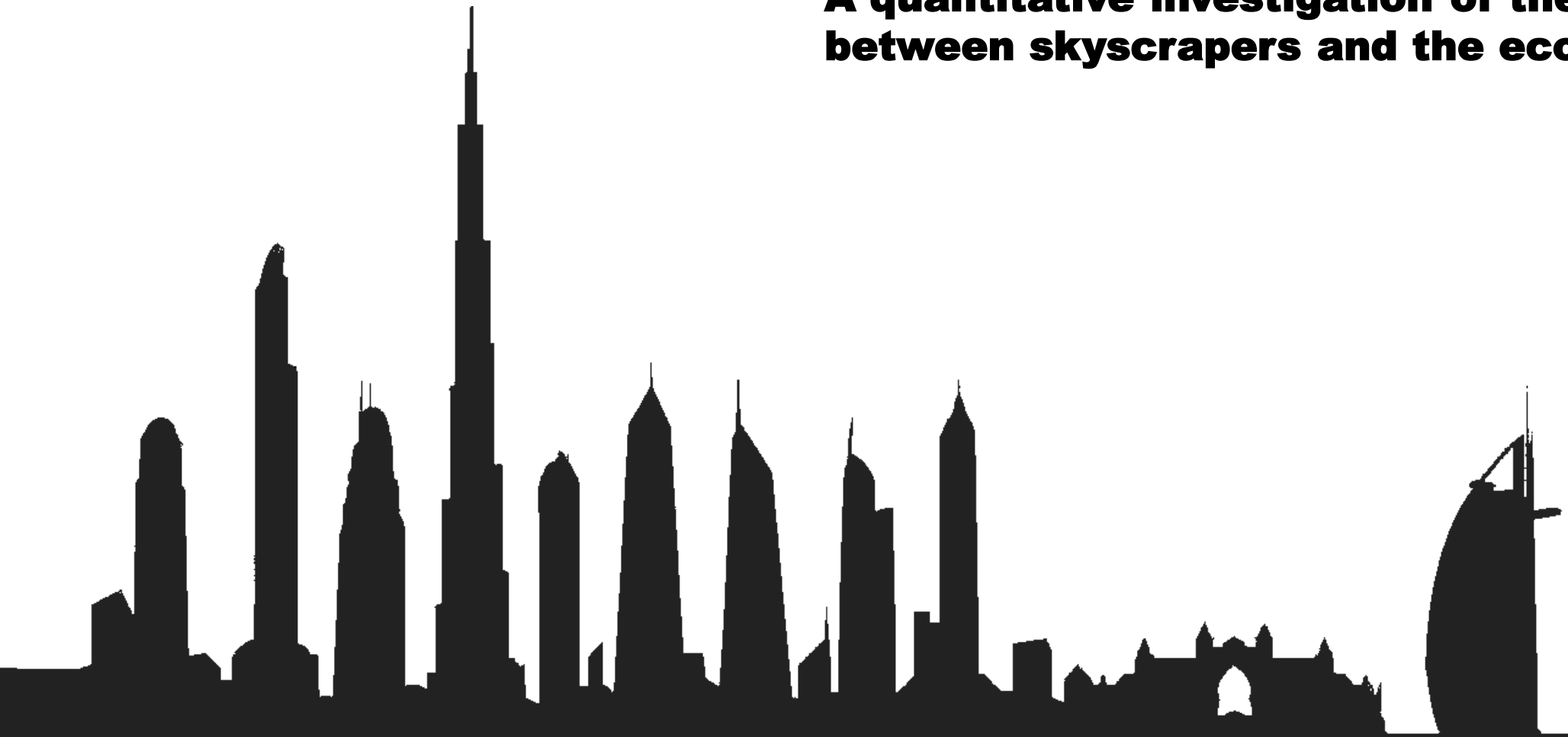
Differences in global economic development and skyscrapers construction.

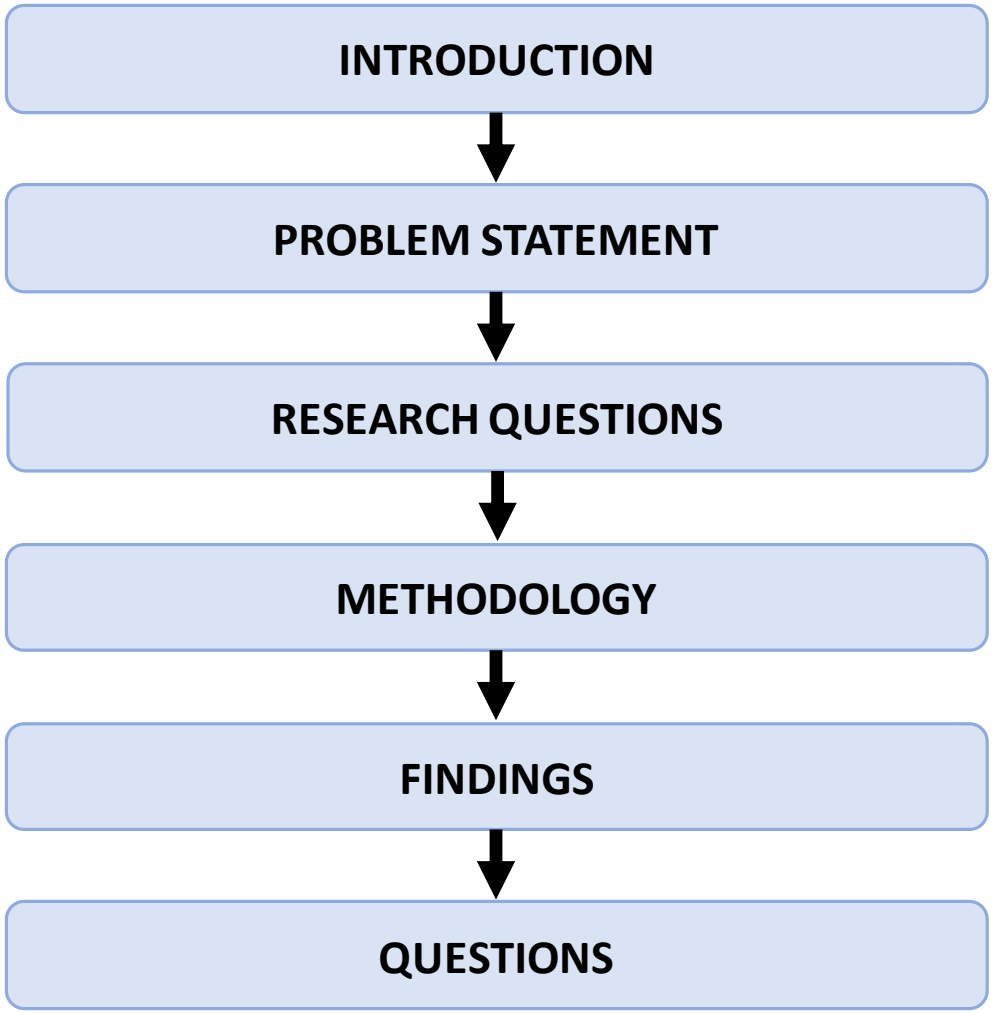
A quantitative investigation of the relationship between skyscrapers and the economic cycle.



TU Delft

Pietro Rovelli

Program


INTRODUCTION
PROBLEM STATEMENT
RESEARCH QUESTIONS
METHODOLOGY
FINDINGS
QUESTIONS

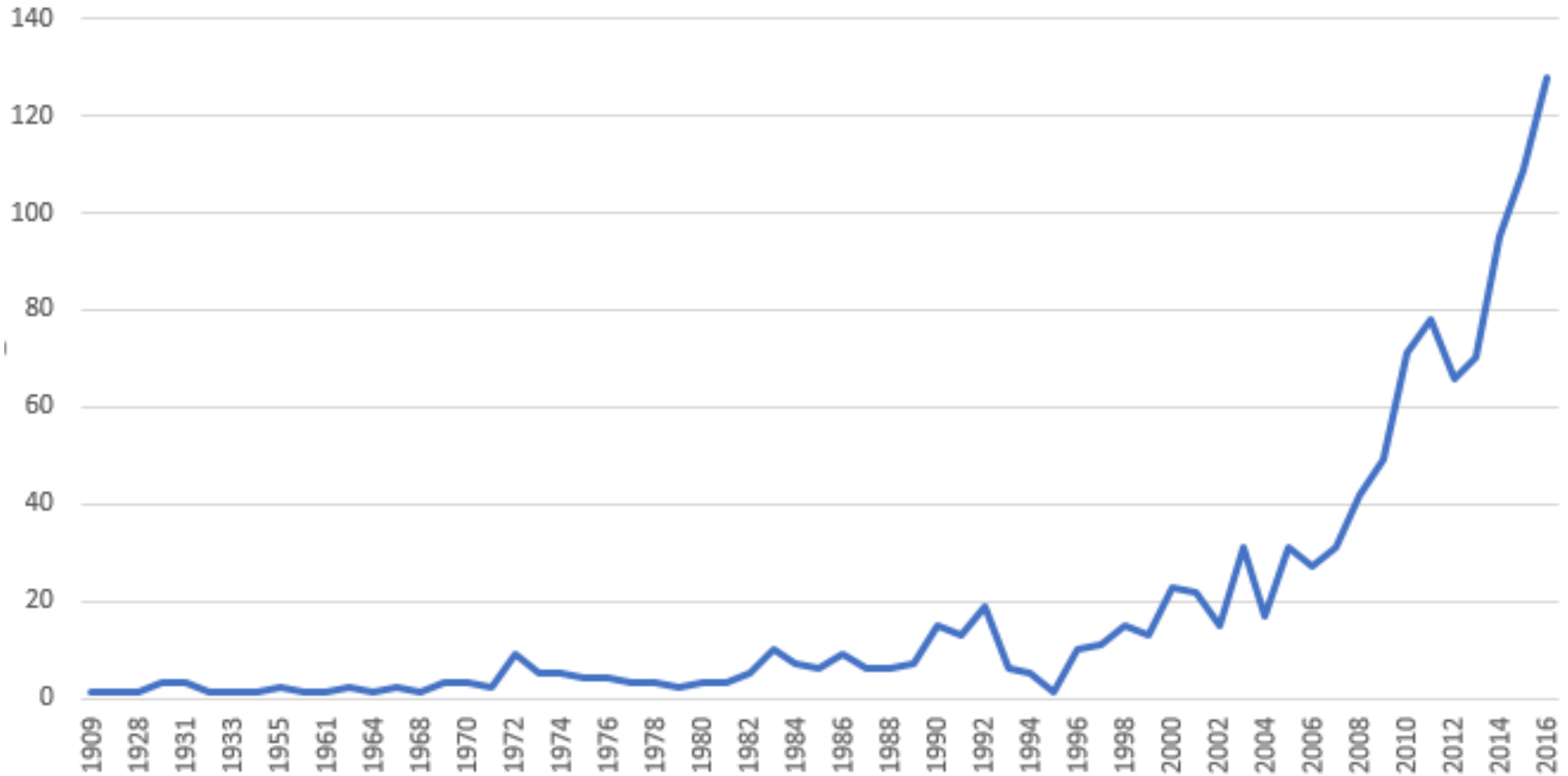
Introduction

- Consideration of buildings taller than 200 meters worldwide
- Current supply: 1.456 projects
- First project built in 1909
- 70% of global supply was built in last 10 years

Topics

- Economic cycles
- Geographic distribution
- Vanity Height
- Functions
- Technological cycles
- Construction costs

Problem statement



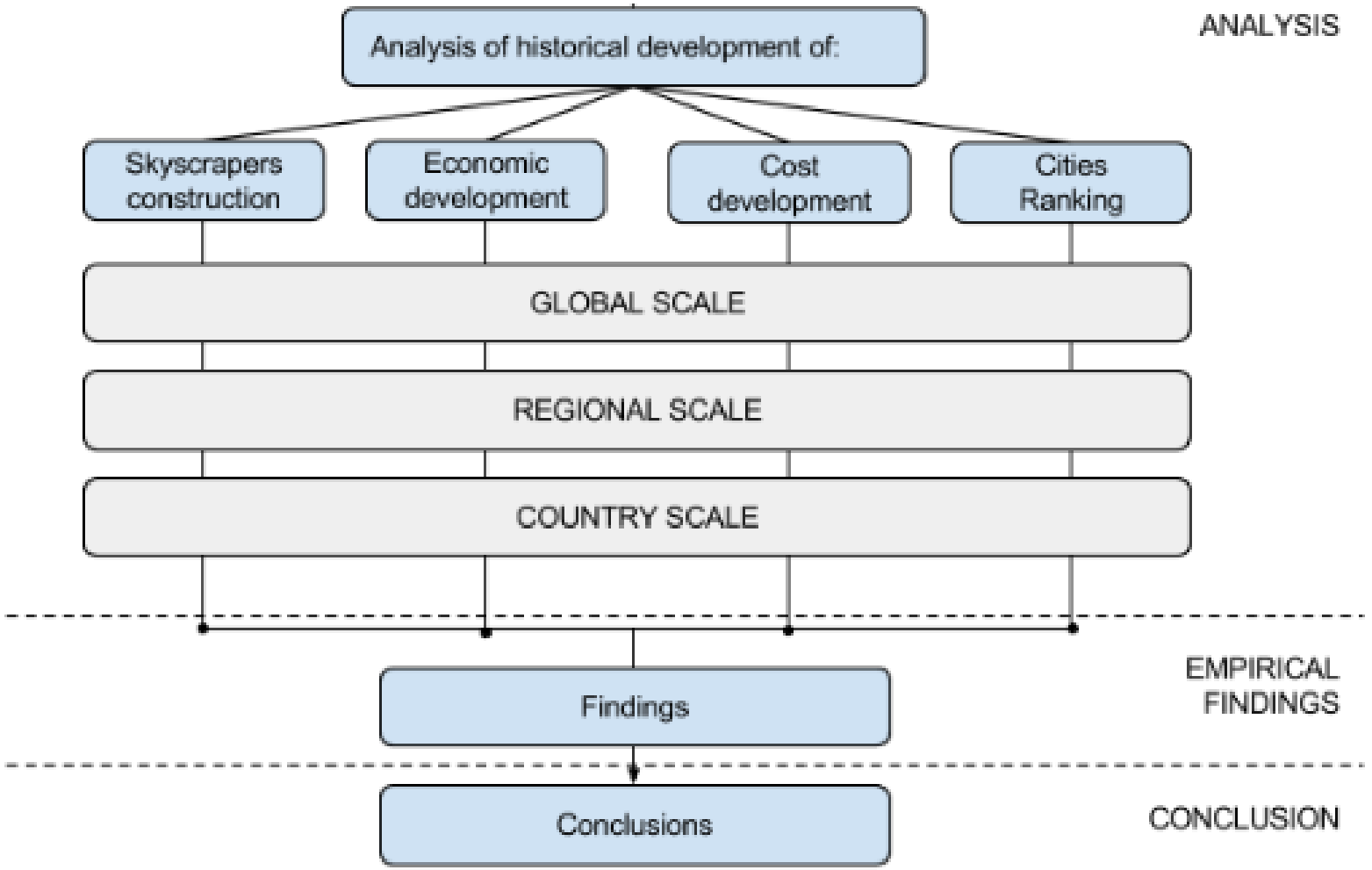
Research questions

- To what extent do national, regional and international economic cycles influence skyscrapers' construction?

Sub-questions:

- How are projects distributed globally, regionally and nationally?
- To what extent does Vanity Height influence projects' height?
- To what extent are specific functions employed? How are they distributed?
- To what extent are specific materials employed in skyscrapers' construction?
- To what extent do construction costs influence skyscrapers' construction?

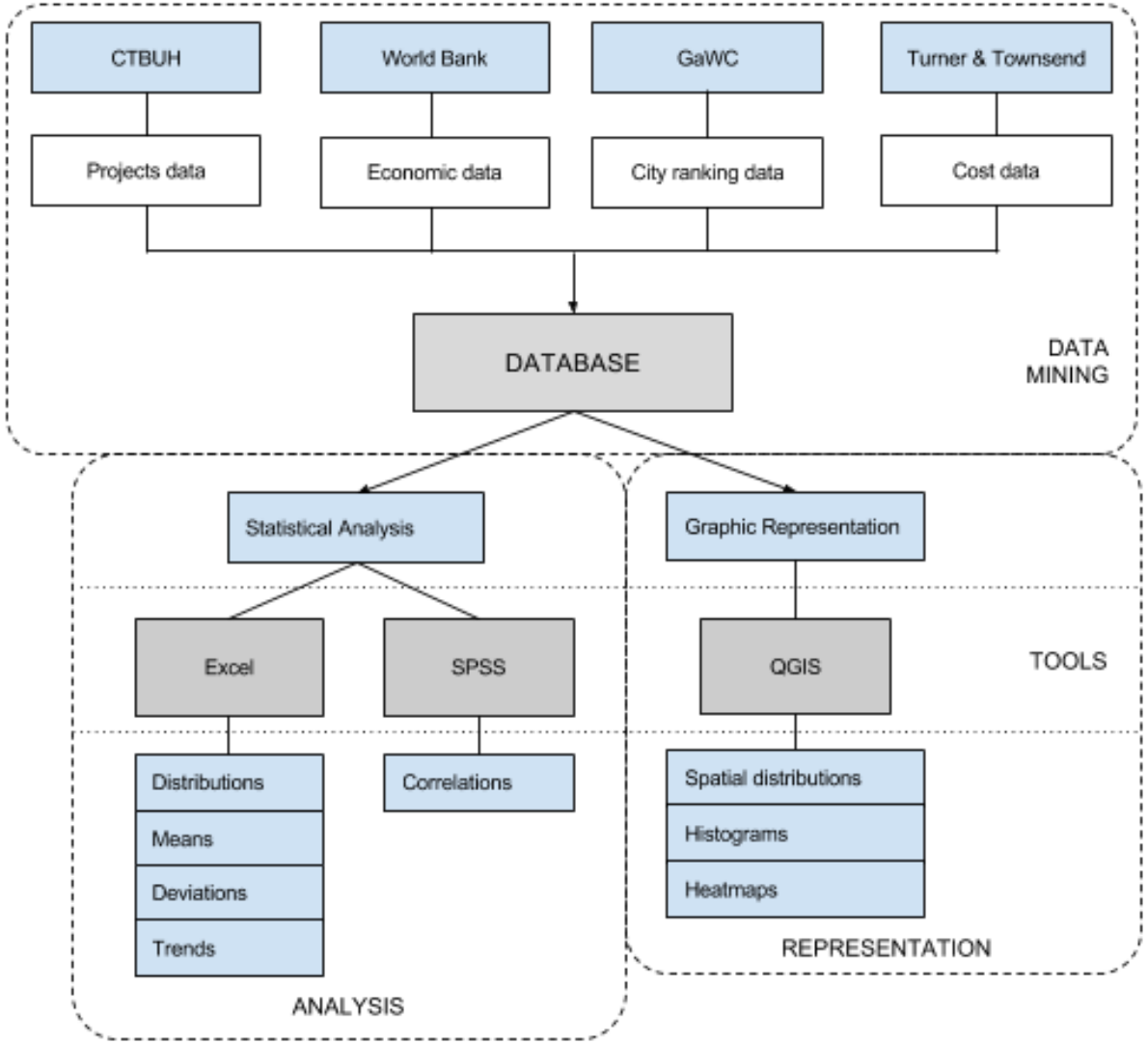
Process


Analysis of historical development of:
ANALYSIS
Skyscrapers construction
Economic development
Cost development
Cities Ranking
GLOBAL SCALE
REGIONAL SCALE
COUNTRY SCALE
Findings
EMPIRICAL FINDINGS
Conclusions
CONCLUSION

Indicators

DEVELOPMENTS	SOURCE	TIMEFRAME	INDICATOR
Skyscrapers construction	Council of Tall Buildings and Urban Habitat	1909 - 2016	Project name
			Country
			City
			Coordinates
			Height
			Number of floors
			Height / n. floors
			Function
			Material
			Date of proposal
			Start of construction
			Completion
Economic development	World Bank	1960 - 2015	GDP Level
			GDP deflated
			GDP growth
			Interest rates
		1970 - 2015	Foreign direct investment
Cities ranking	GaWC	2000 - 2016	Rank
Construction cost	Turner & Townsend	2009 - 2017	Residential high-rise
			Office high-rise

Analysis


CTBUH
World Bank
GaWC
Turner & Townsend
Projects data
Economic data
City ranking data
Cost data
DATABASE
DATA MINING
Statistical Analysis
Graphic Representation
Excel
SPSS
QGIS
TOOLS
Distributions
Means
Deviations
Trends
Correlations
Spatial distributions
Histograms
Heatmaps
REPRESENTATION
ANALYSIS

Economic cycles - World

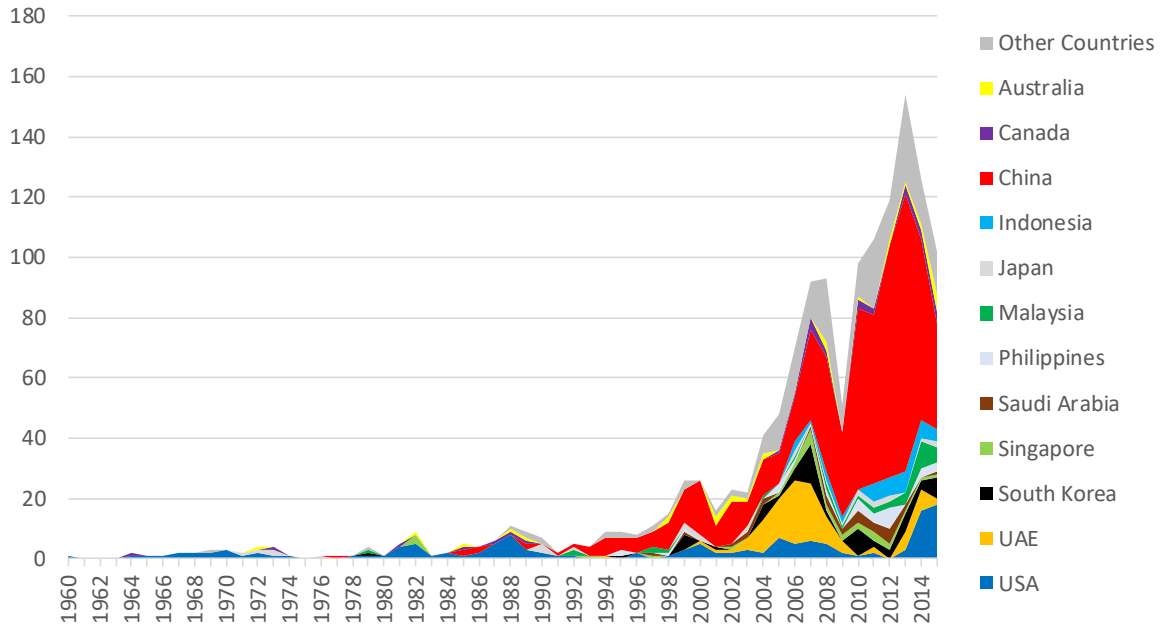
Correlations

		Started	Completed	Avg Height	World GDP %	World GDP Level	Global Investments
Started	Pearson Correlation	1	,908**	-,006	-,231	,921**	,911**
	Sig. (2-tailed)		,000	,964	,103	,000	,000
	N	52	50	52	51	52	45
Completed	Pearson Correlation	,908**	1	,086	-,280*	,898**	,802**
	Sig. (2-tailed)	,000		,551	,044	,000	,000
	N	50	53	50	52	53	46
Avg Height	Pearson Correlation	-,006	,086	1	-,118	,016	-,042
	Sig. (2-tailed)	,964	,551		,409	,913	,783
	N	52	50	52	51	52	45

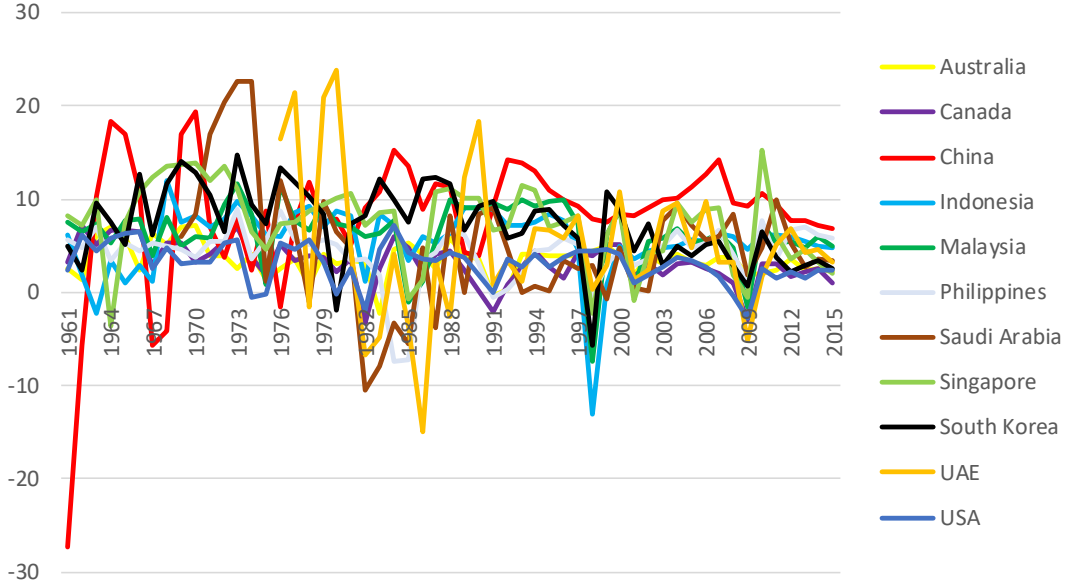
**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

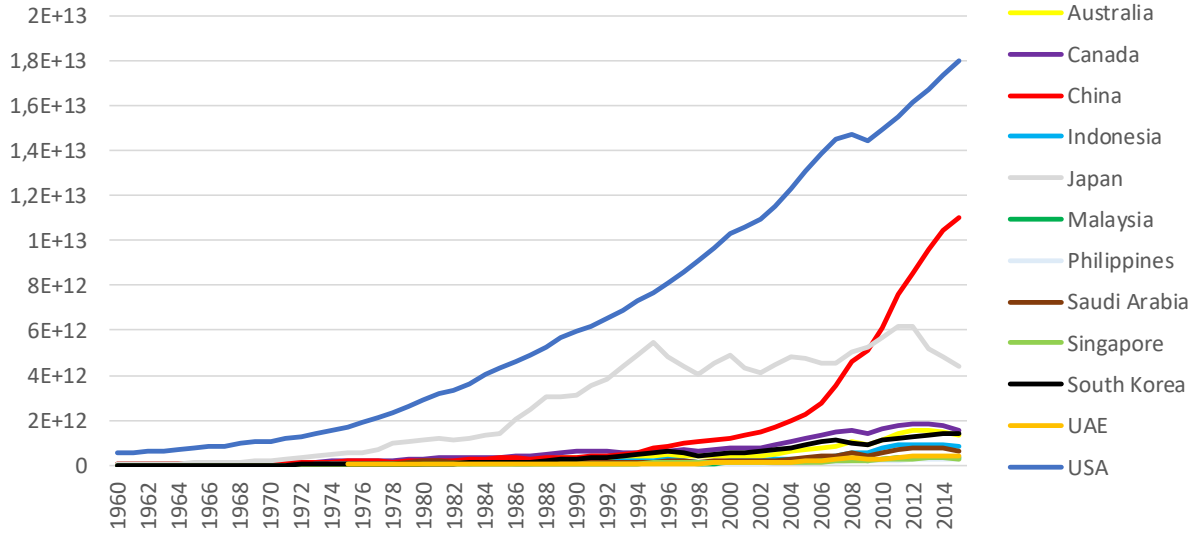
Global development of projects by country



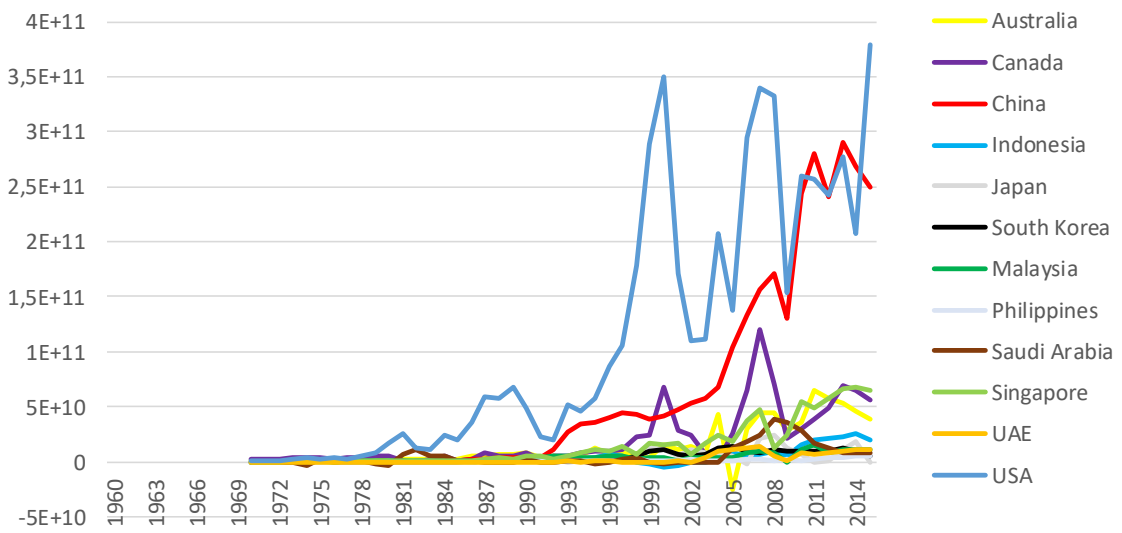
Growth of GDP by country

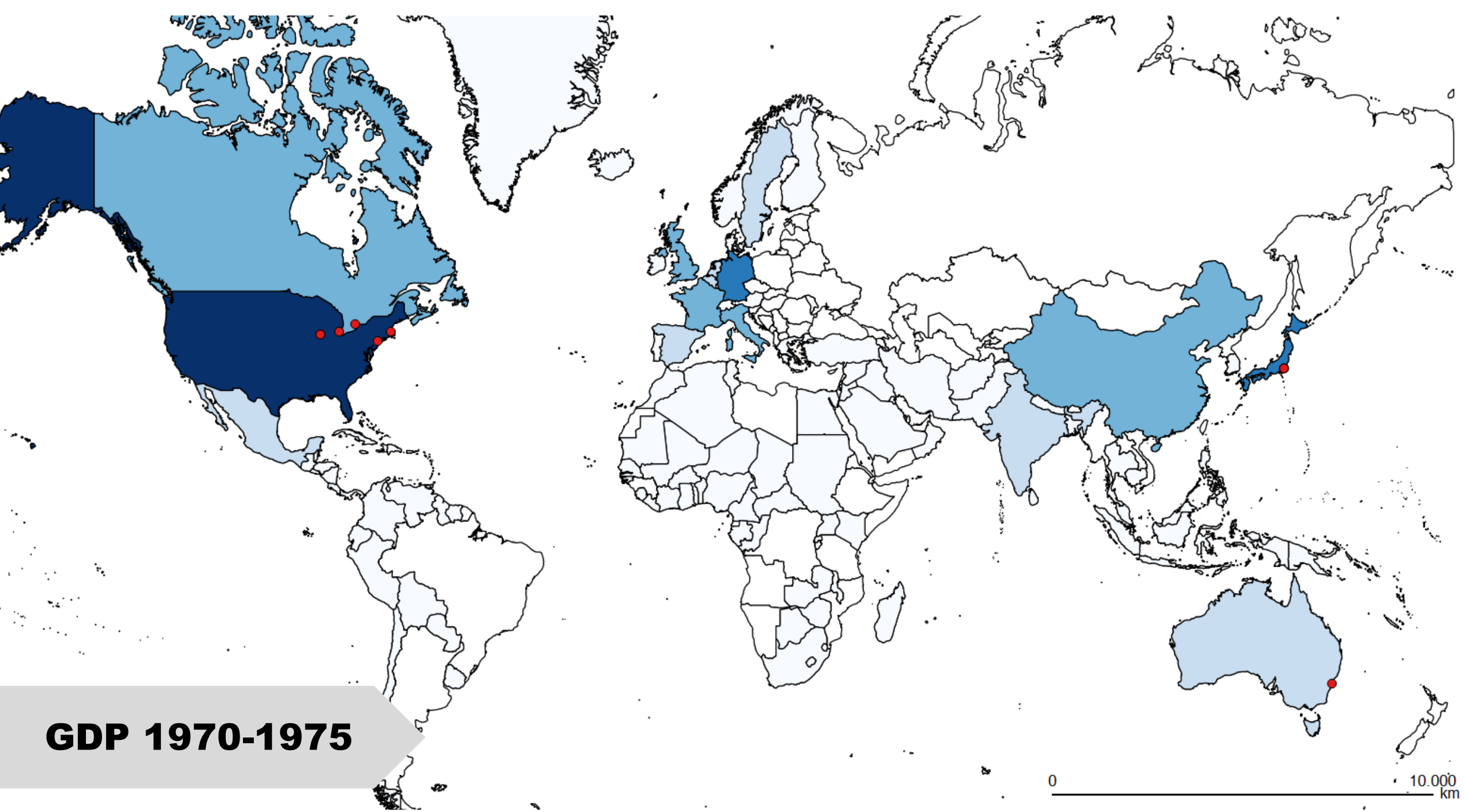


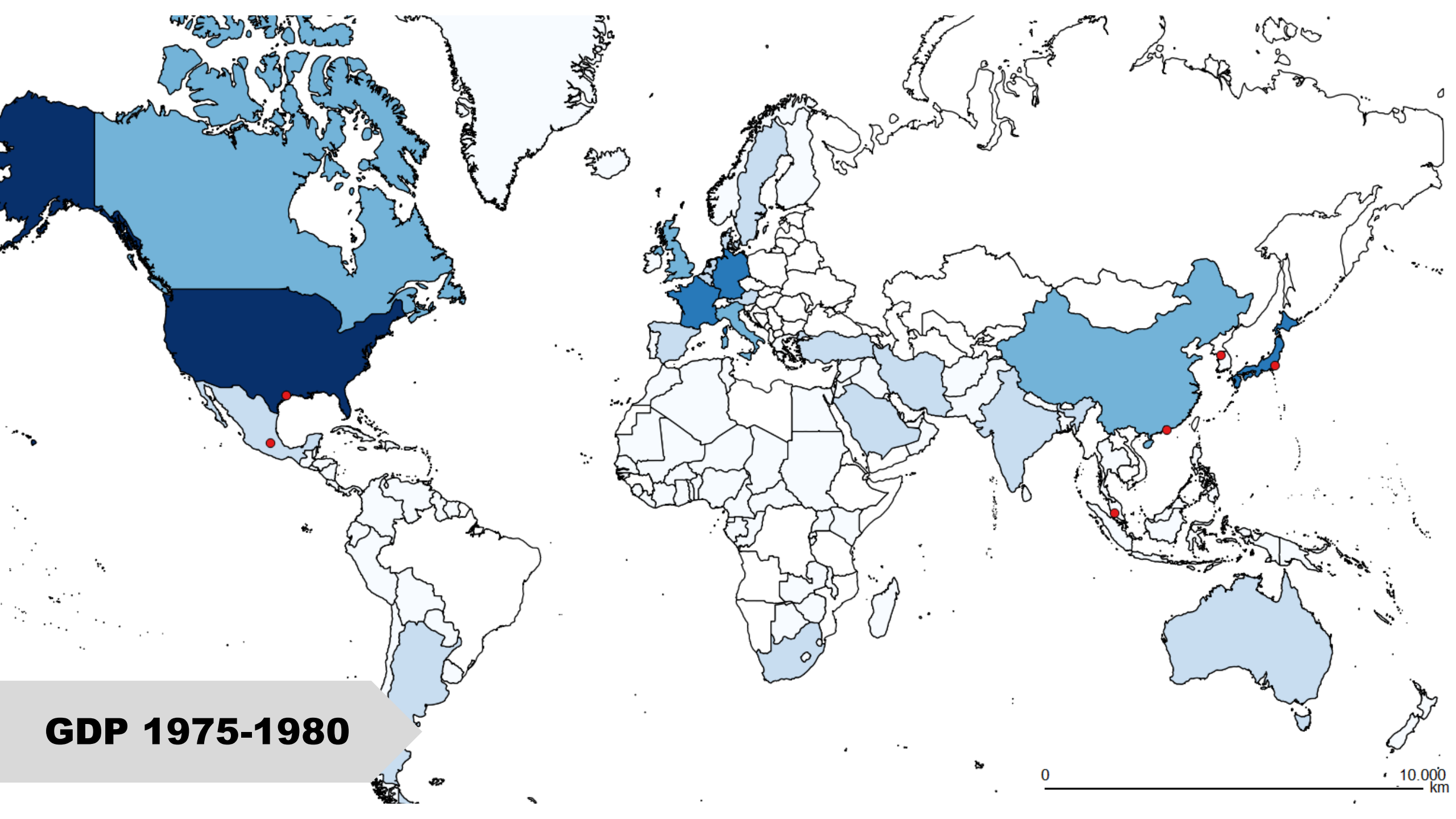
Changes of GDP level by country

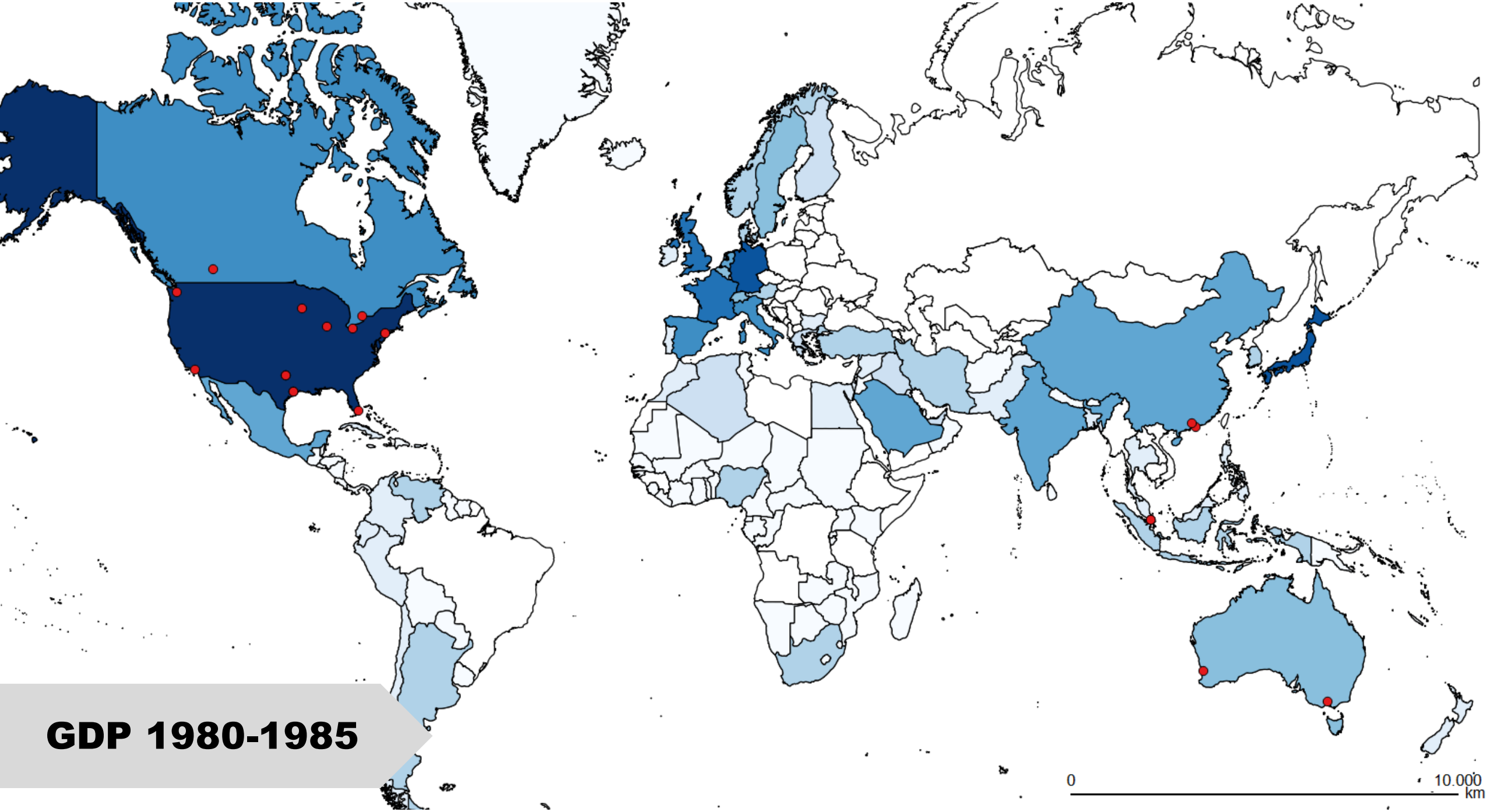


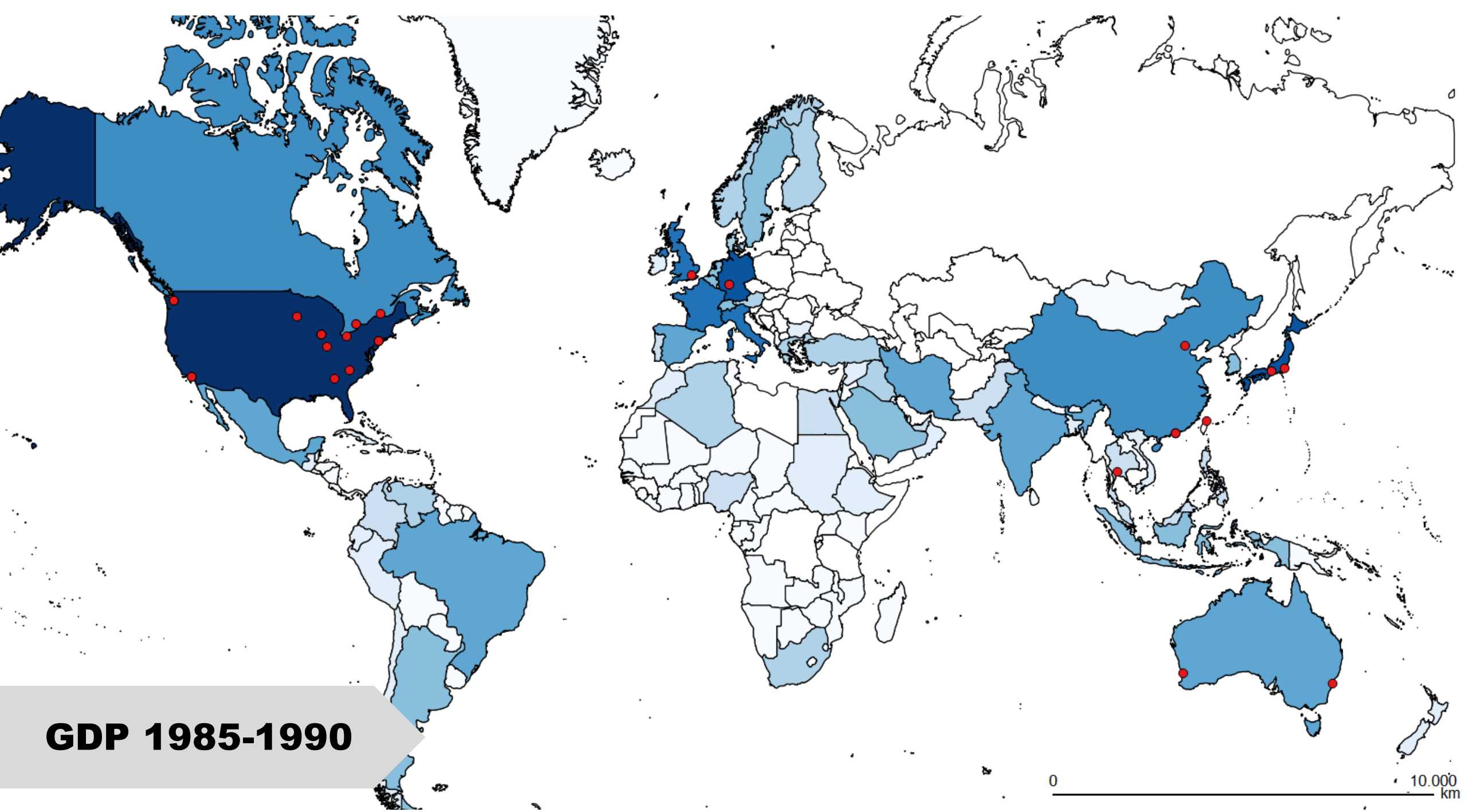
Changes of FDI by country

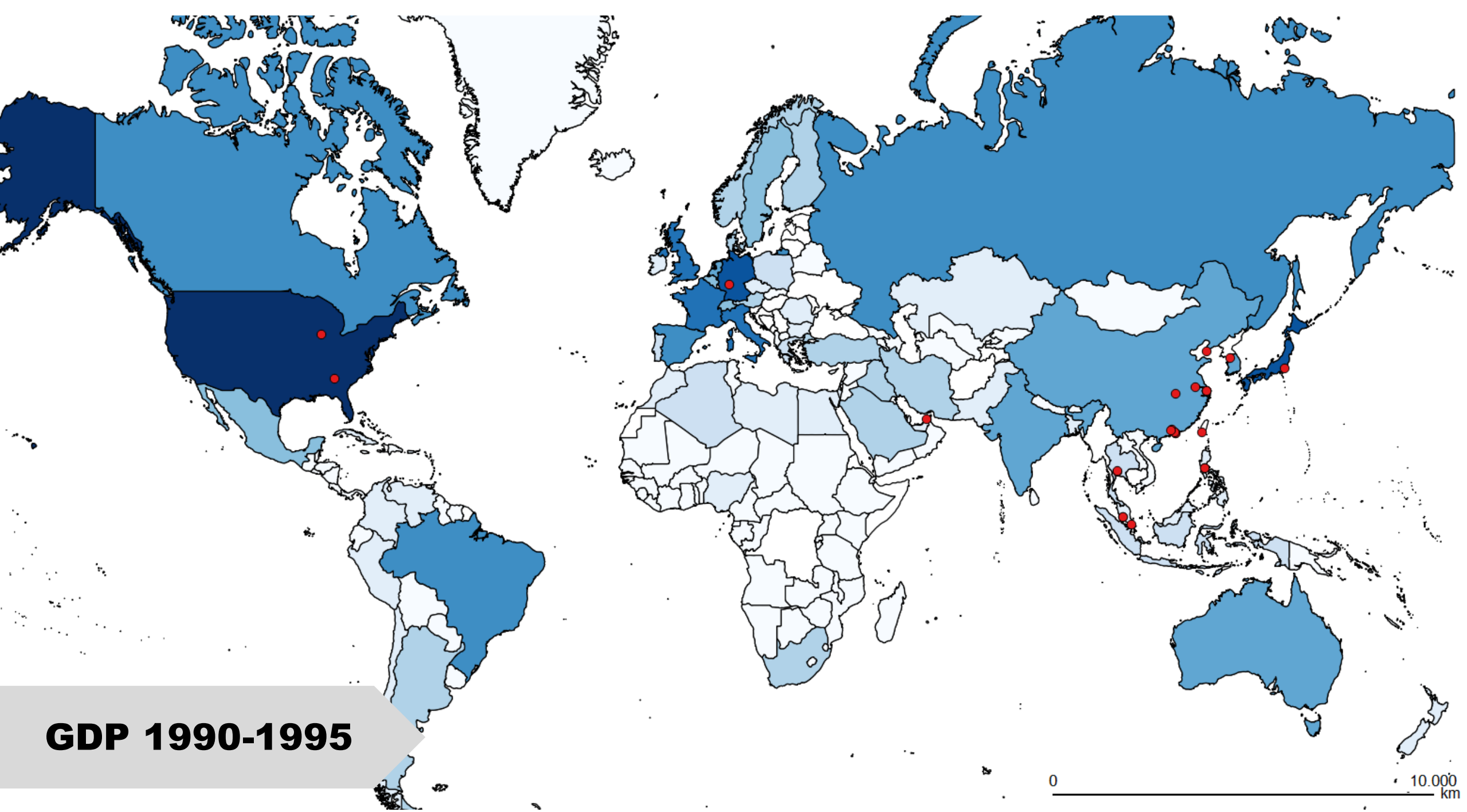


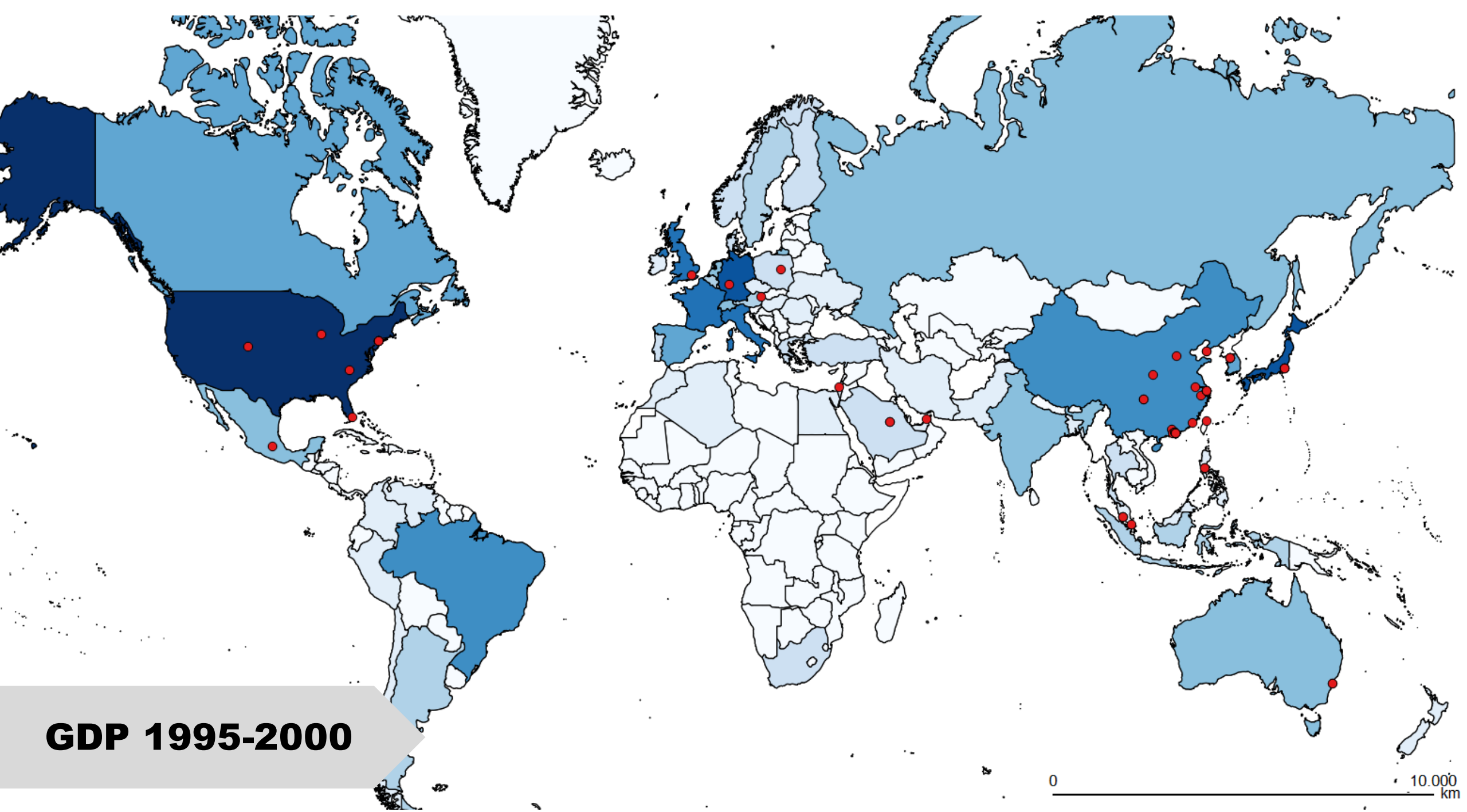

GDP 1970-1975
0
10.000
km

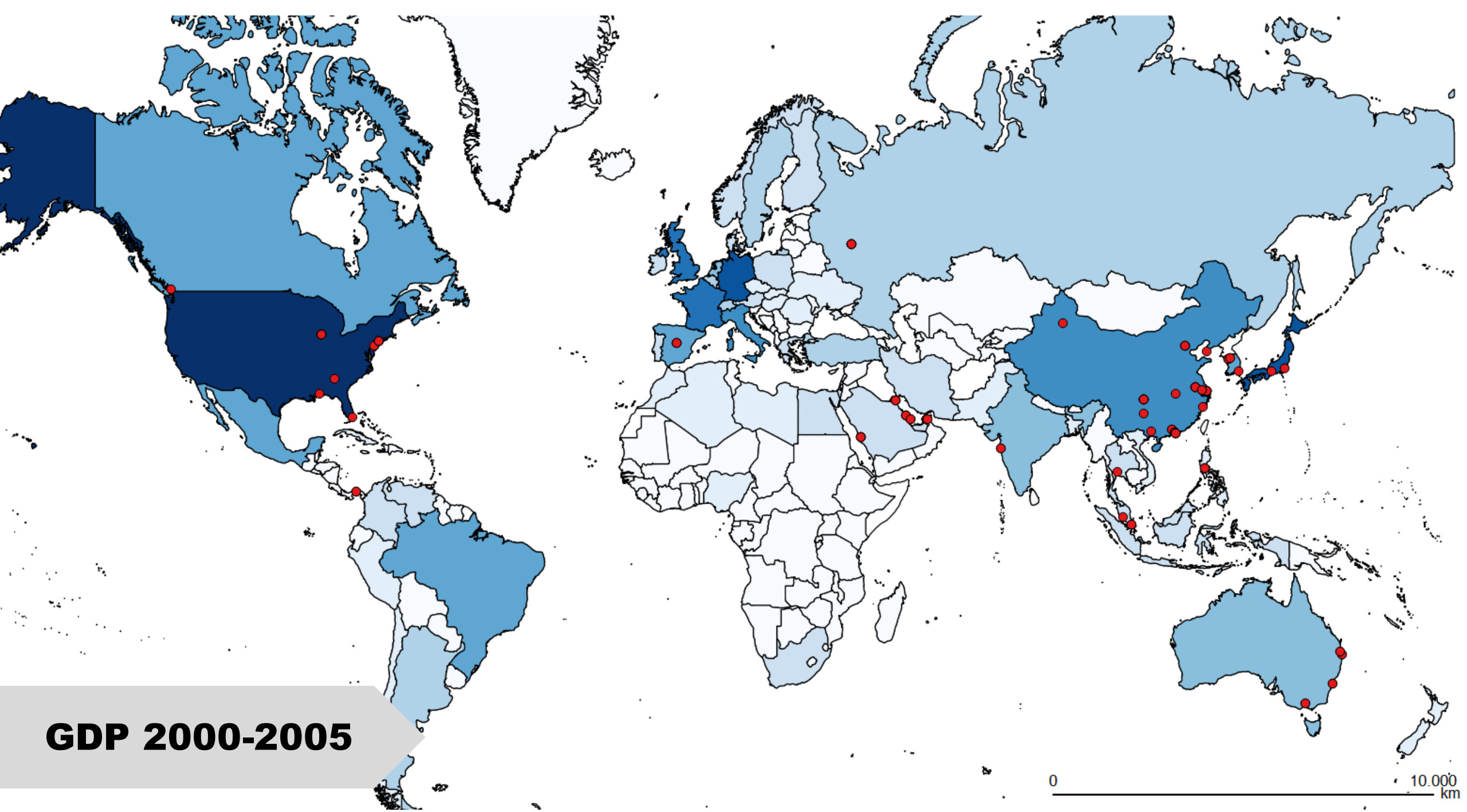

GDP 1975-1980
0
10.000
km

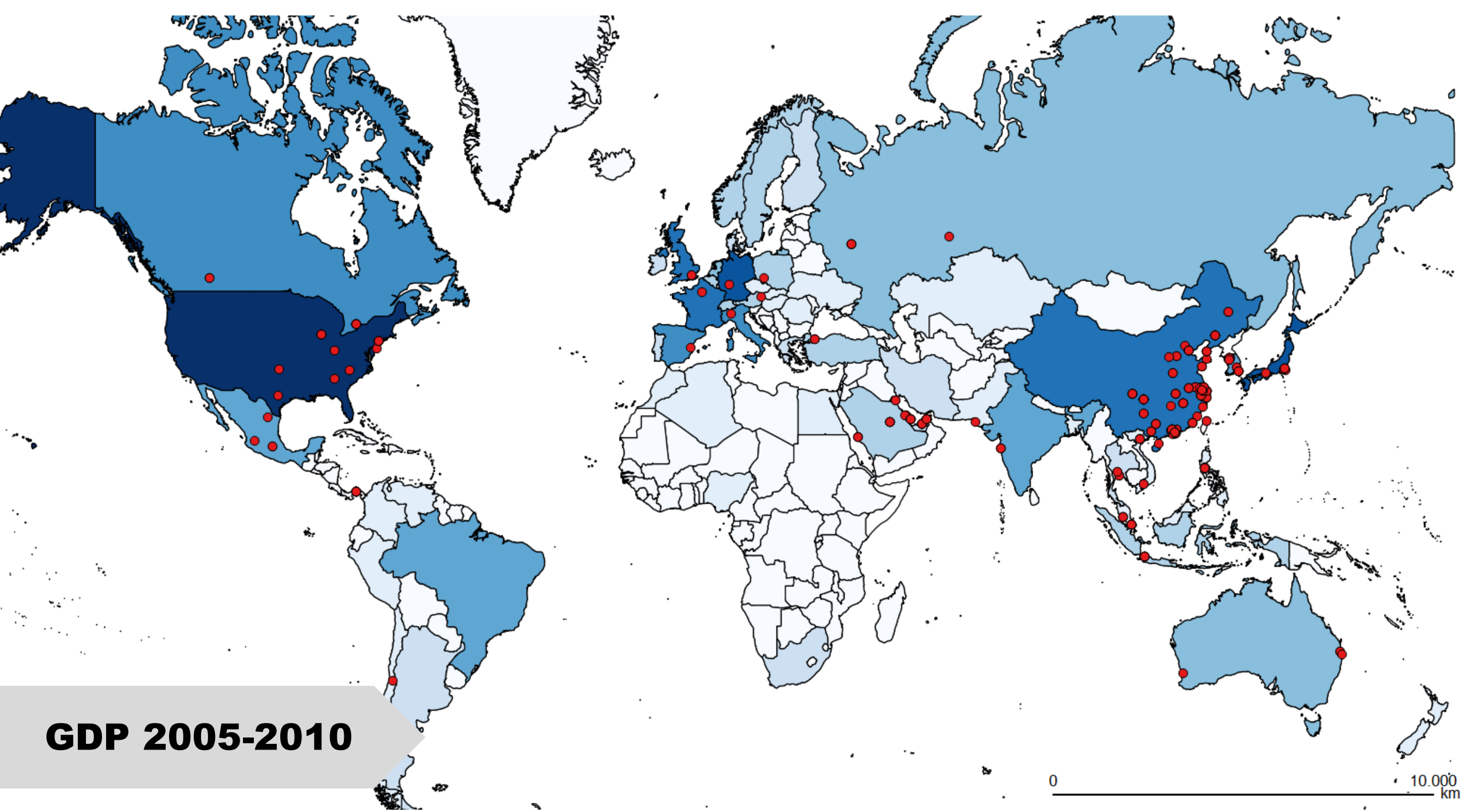

GDP 1980-1985
0
10.000
km

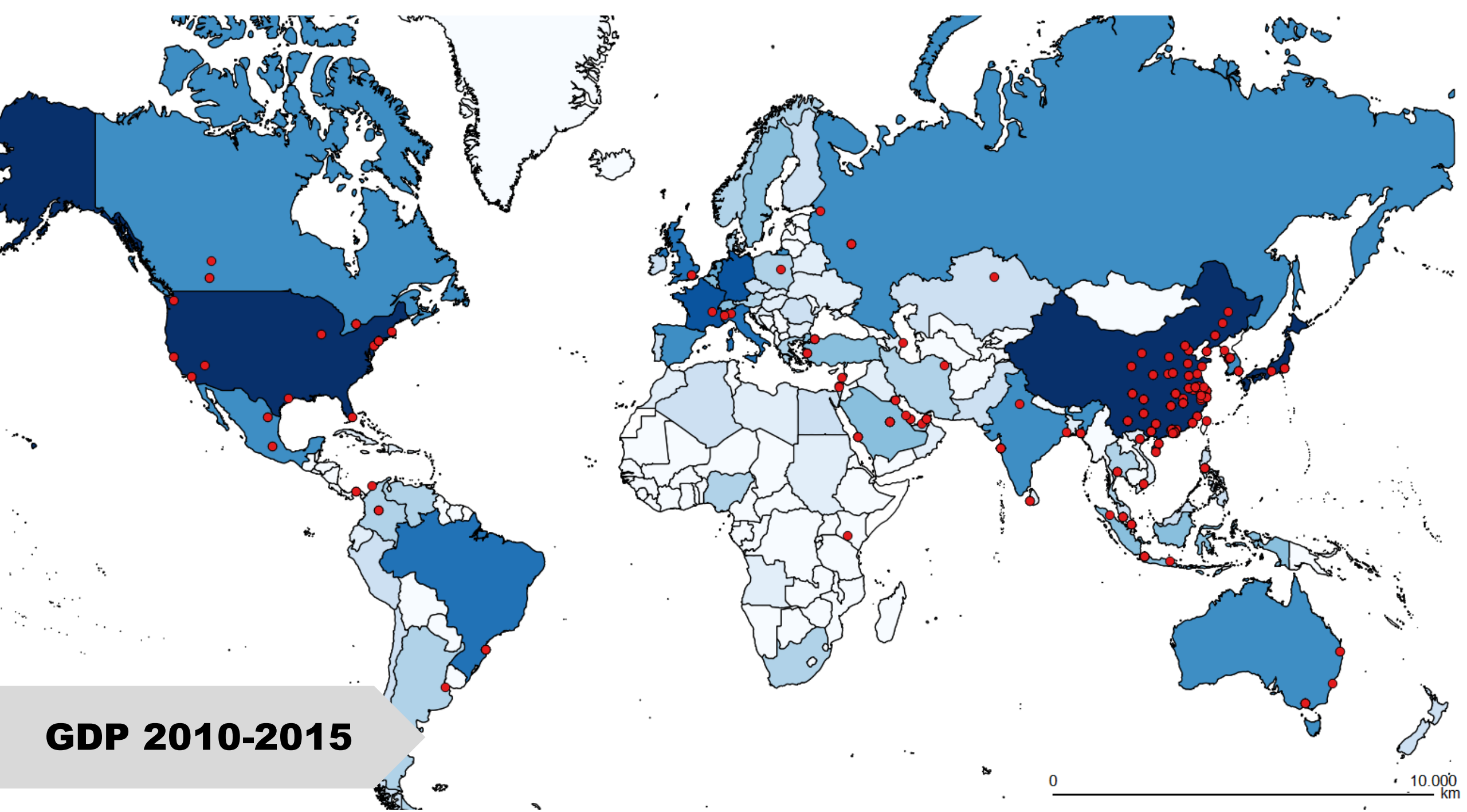

GDP 1985-1990
0
10.000
km

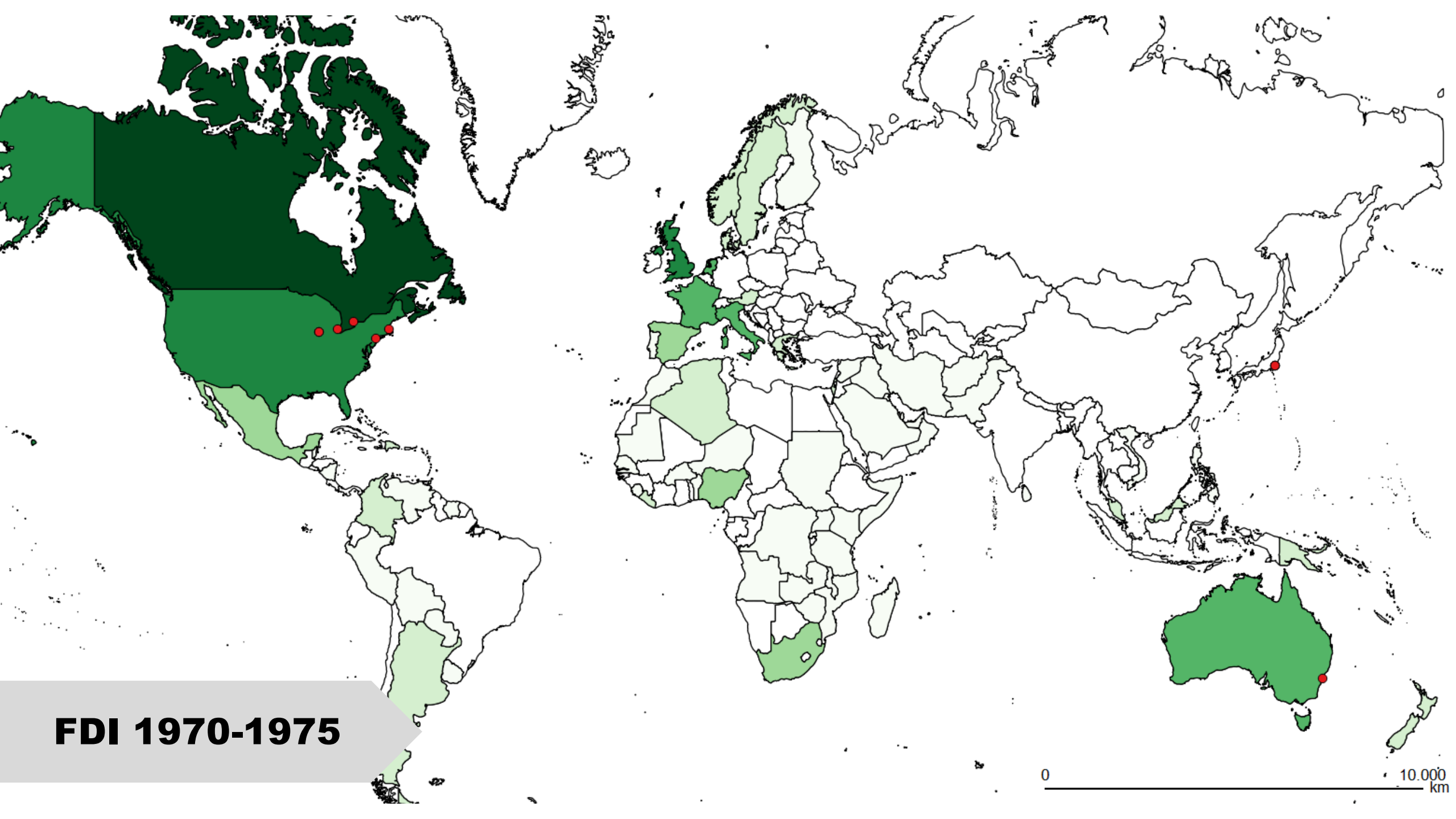

GDP 1990-1995
0
10.000
km

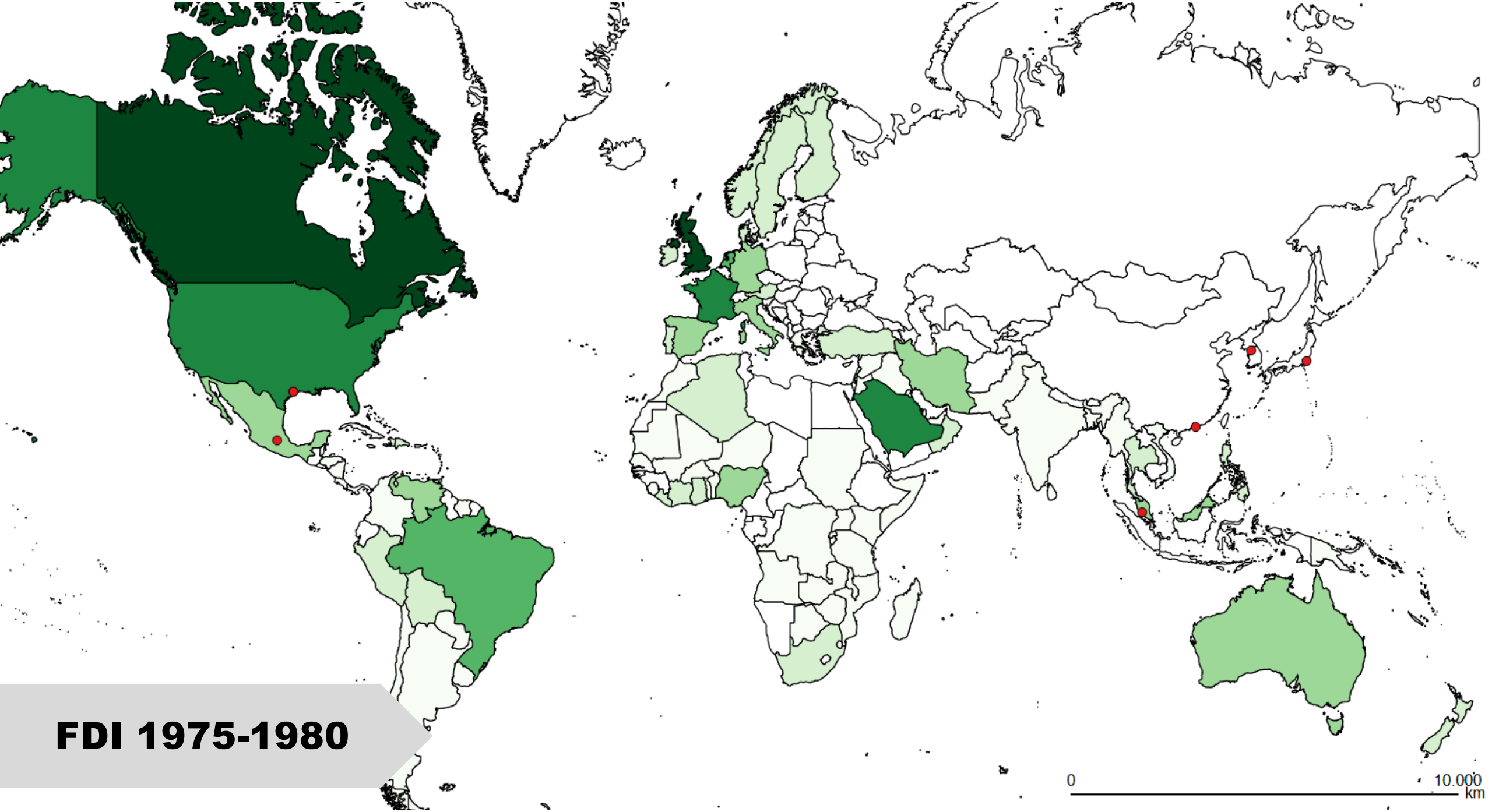

GDP 1995-2000
0
10.000
km

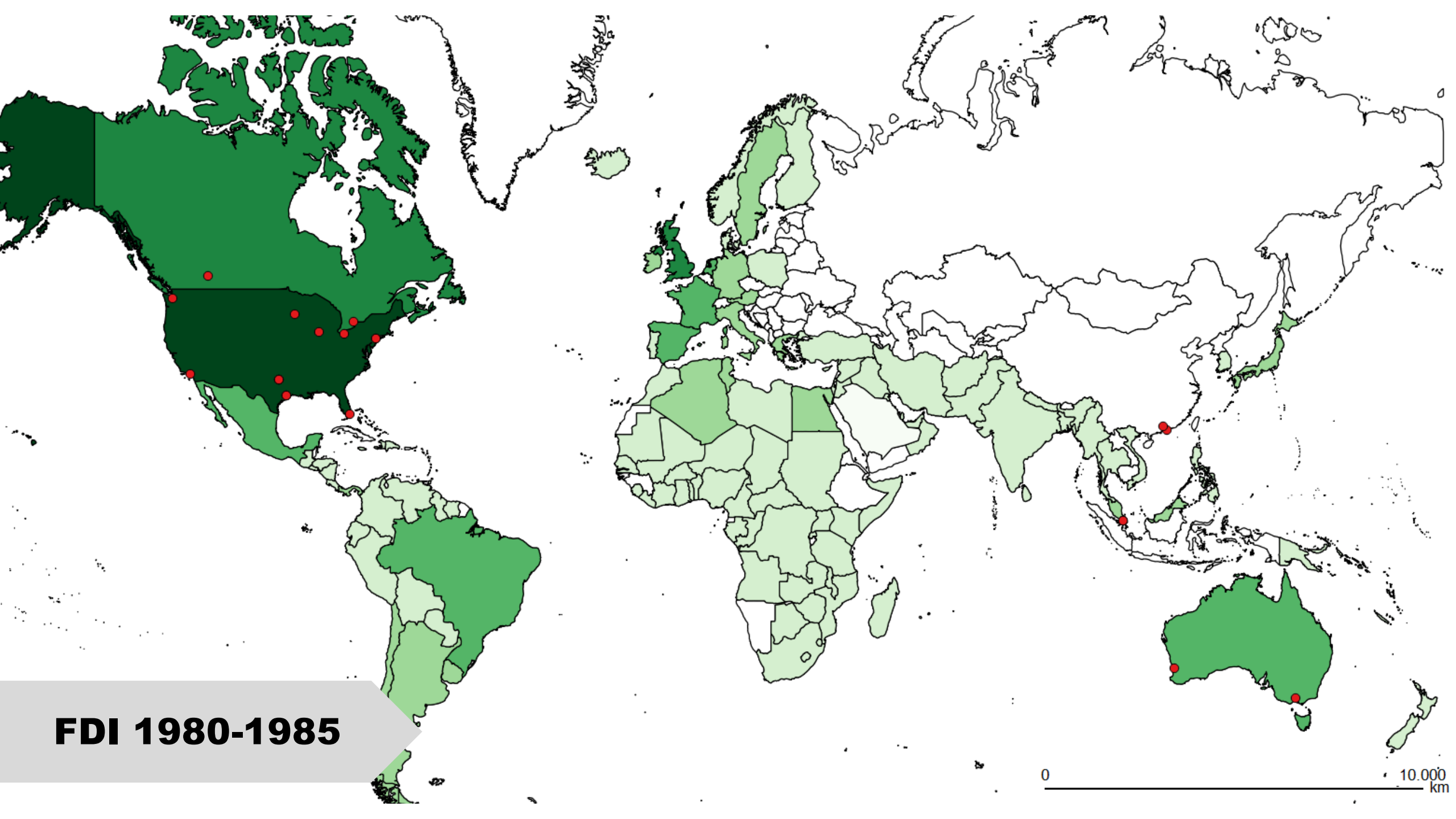

GDP 2000-2005
0
10.000
km

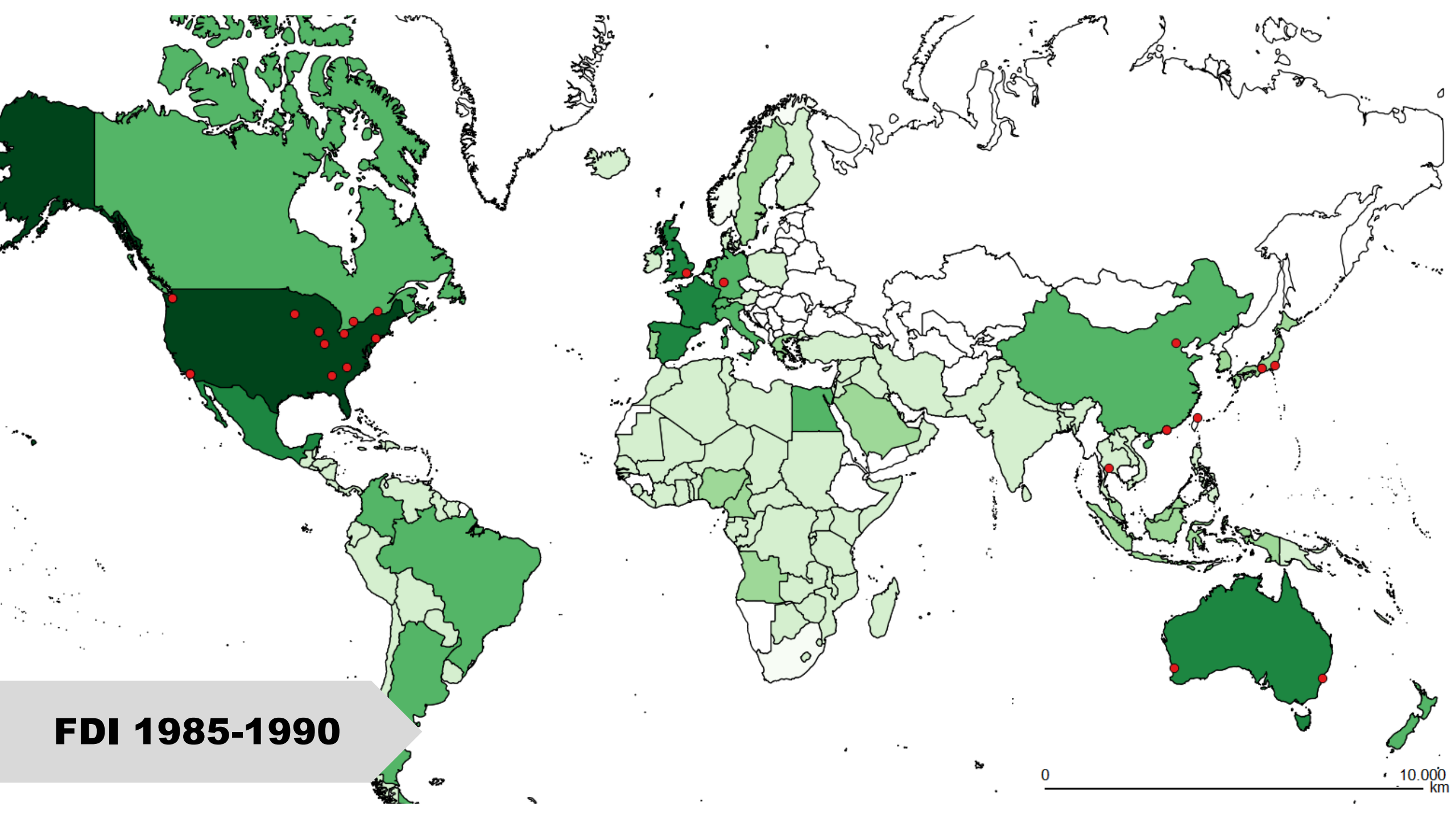

GDP 2005-2010
0
10.000
km

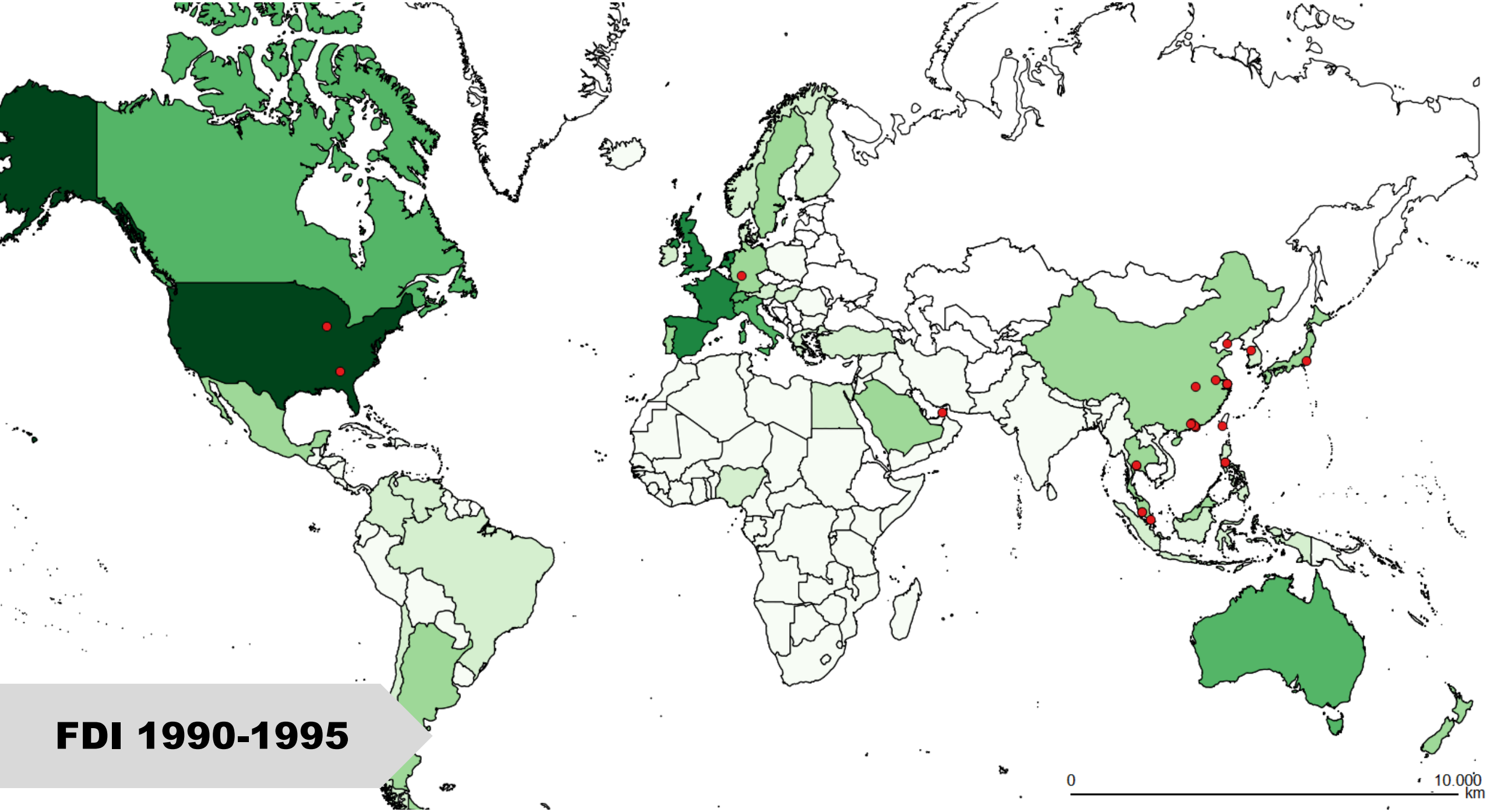

GDP 2010-2015
0
10.000
km

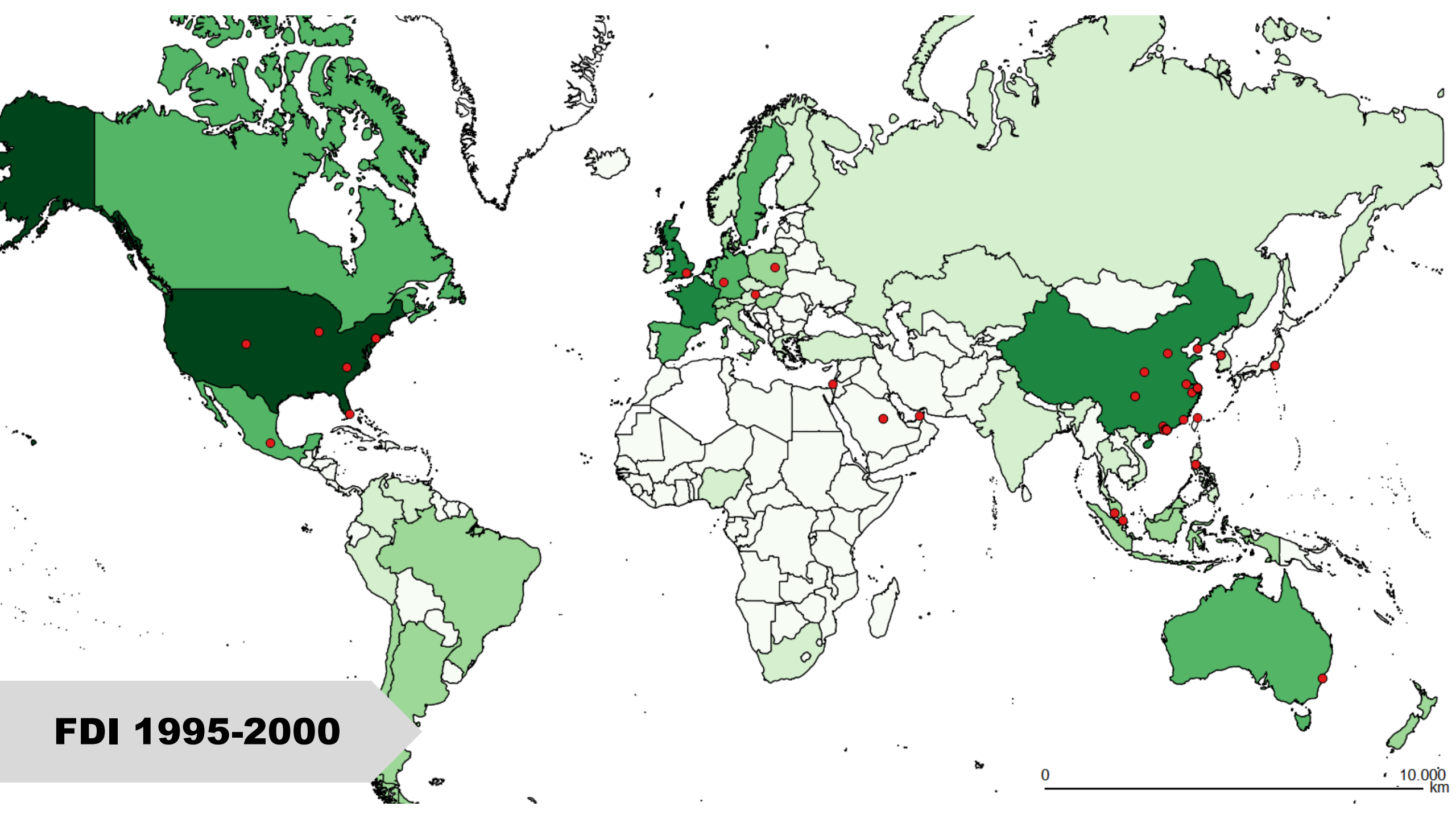

FDI 1970-1975
0
10.000
km

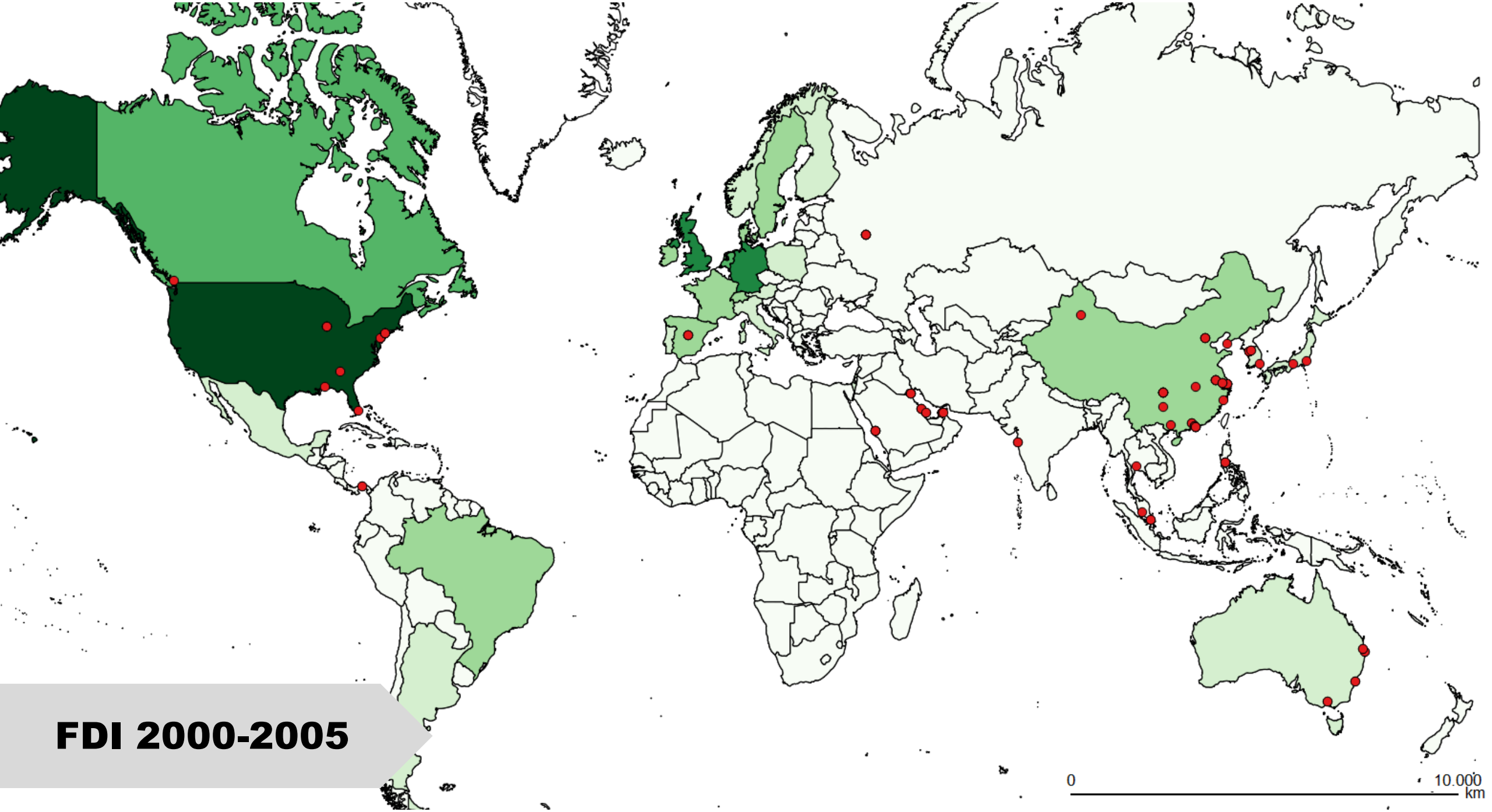

FDI 1975-1980
0
10.000
km

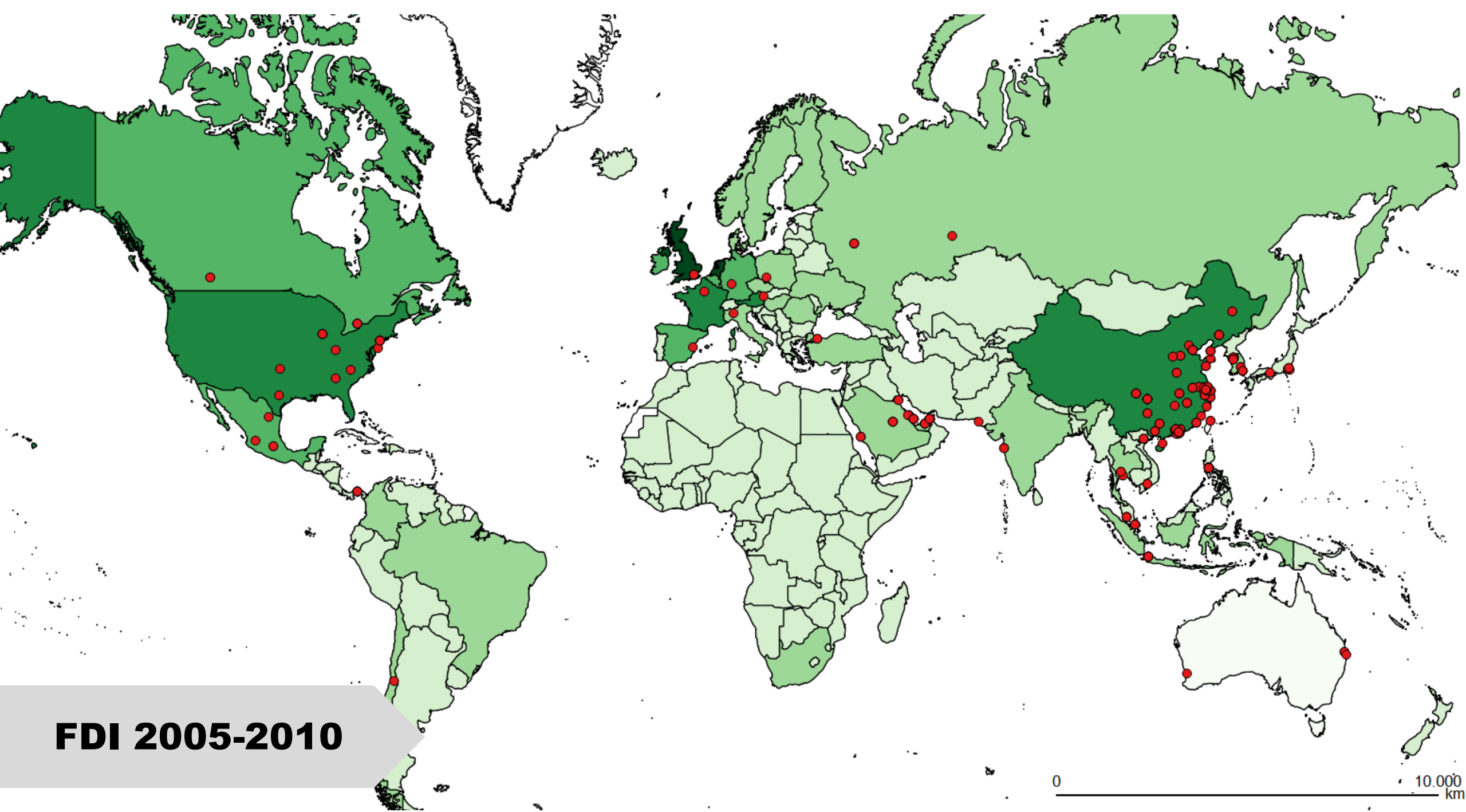

FDI 1980-1985
0
10.000
km

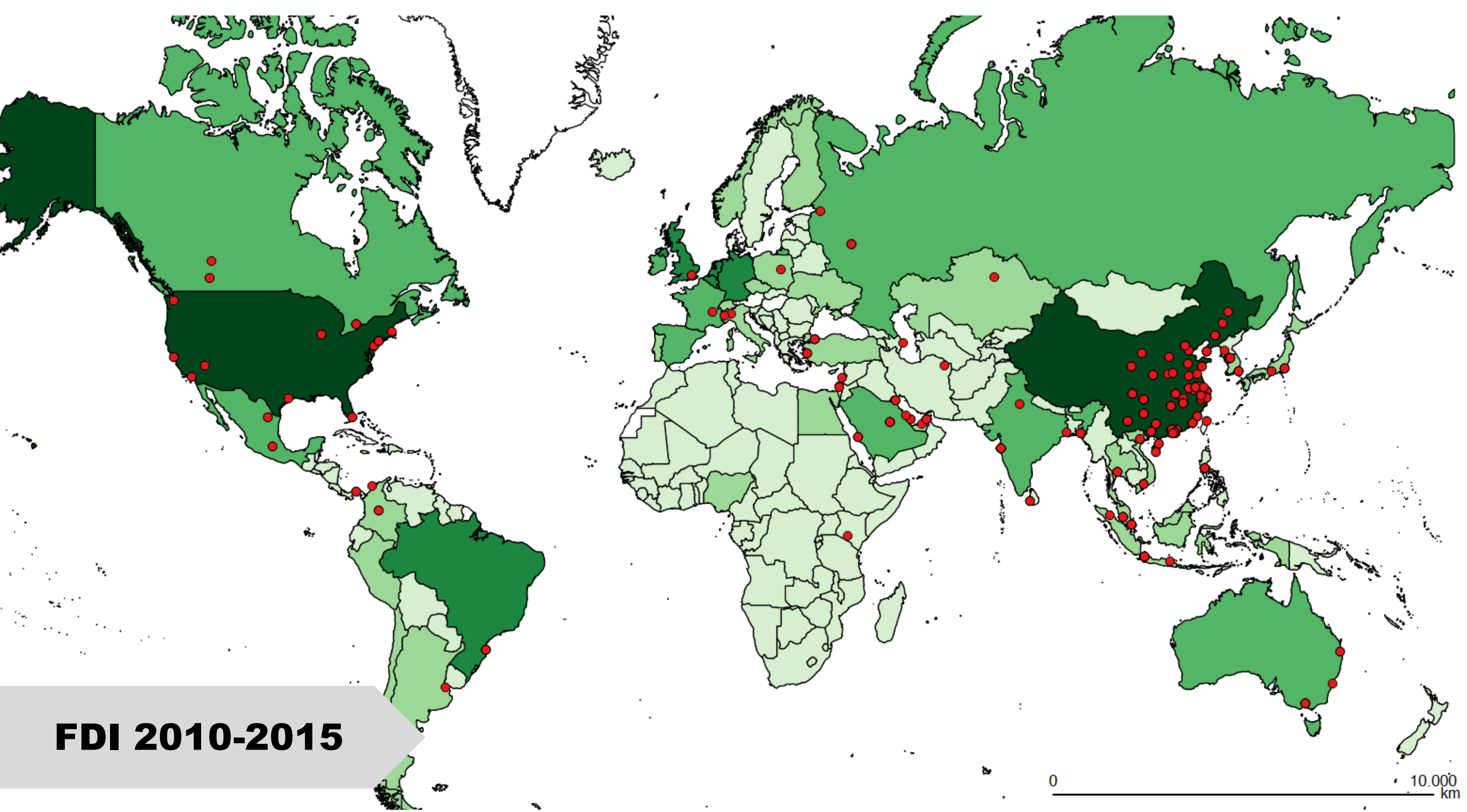

FDI 1985-1990
0
10.000
km


FDI 1990-1995
0
10.000
km


FDI 1995-2000
0
10.000
km


FDI 2000-2005
0
10.000
km


FDI 2005-2010
0
10.000
km


FDI 2010-2015
0
10.000
km

Economic cycles - regions

PROJECTS STARTED	ECONOMIC DEVELOPMENT					
	REGIONAL			GLOBAL		
	GDP GROWTH	GDP LEVEL	FDI	GDP GROWTH	GDP LEVEL	FDI
EAST ASIA & PACIFIC	0	+ + +	+ + +	0	+ + +	+ + +
EUROPE & CENTRAL ASIA	0	+ +	+ +	0	+ +	+ +
LATIN AMERICA & CARIBBEAN	0	0	+	0	+	+ +
MIDDLE EAST & N. AFRICA	+	0	+ +	0	0	+ +
NORTH AMERICA	0	+ +	+	0	+ +	+
SOUTH ASIA	0	0	0	0	0	0

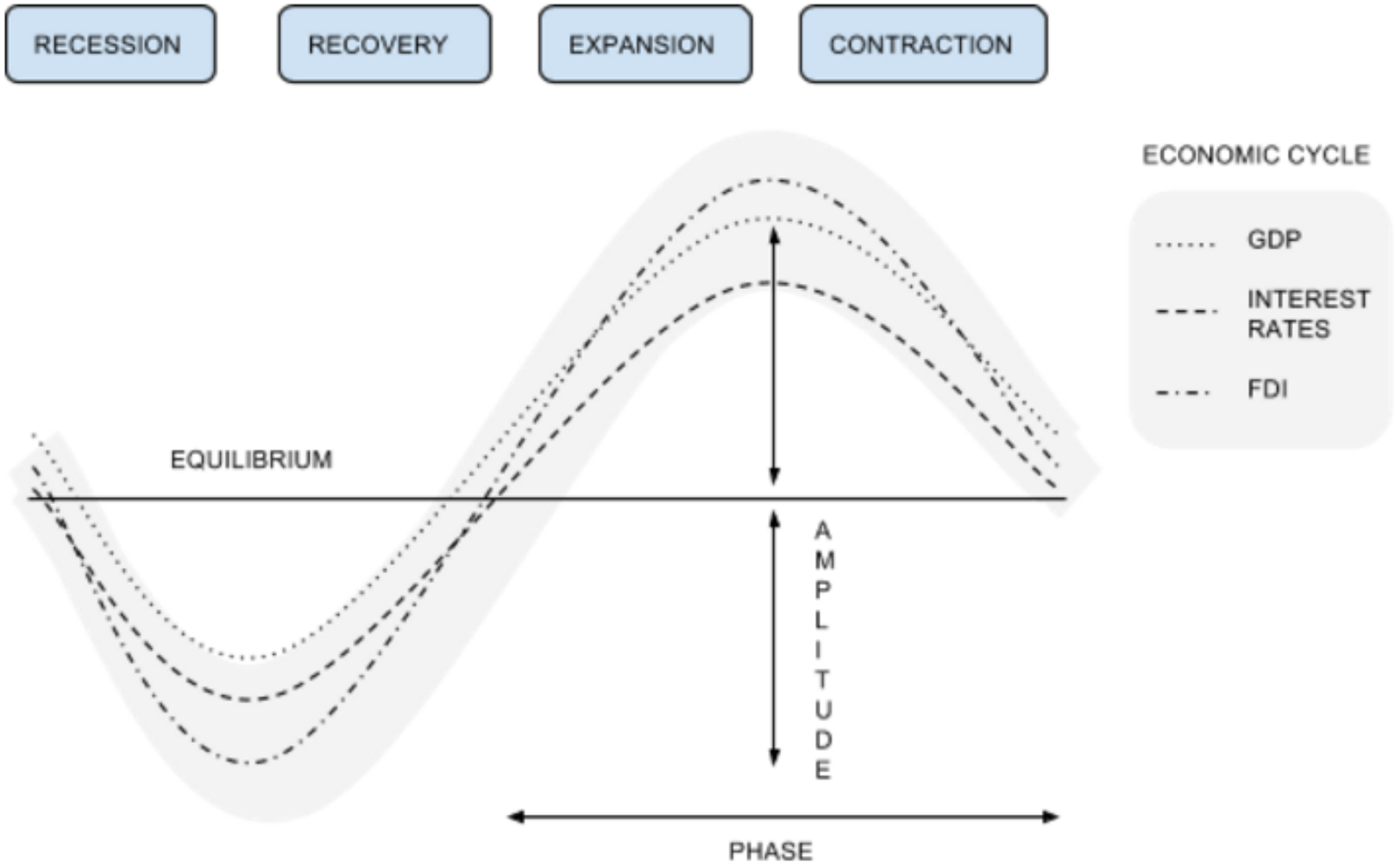
SIMBOL	CORRELATION
+ + +	High (0.8-1)
+ +	Medium (0.6-0.79)
+	Low (0.4-0.59)

Economic cycles - countries

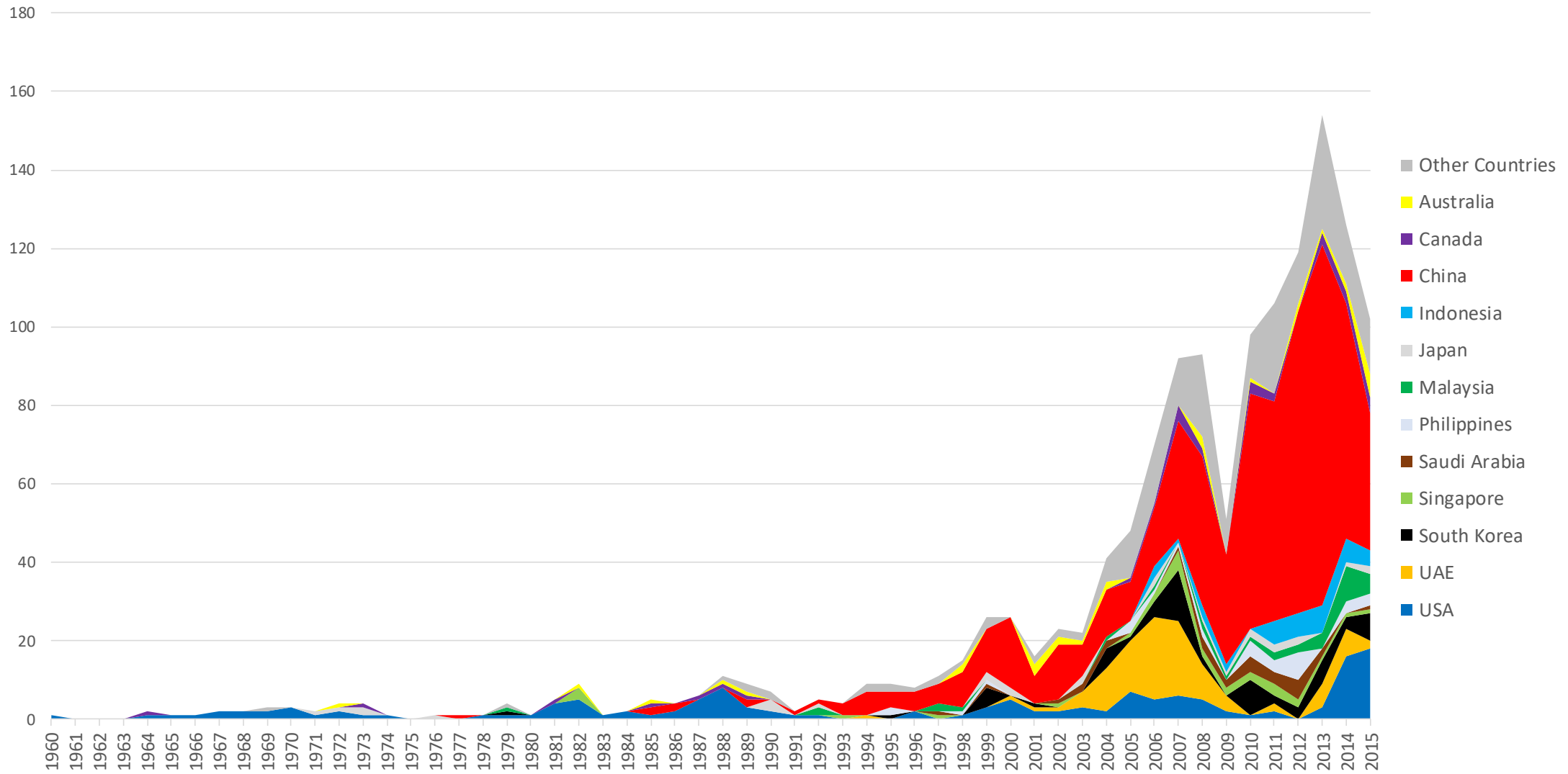
		ECONOMIC DEVELOPMENT							
		NATIONAL					GLOBAL		
		GDP GROWTH	GDP LEVEL	GDP LEVEL DEFLATED	INTEREST RATES	FDI	GDP GROWTH	GDP LEVEL	FDI
PROJECTS STARTED	AUSTRALIA	0	0	0	0	0	0	0	+
	CANADA	- -	+ +	+ +	-	+ +	0	+ +	+ +
	CHINA	0	+ + +	+ + +	-	+ + +	0	+ + +	+ +
	INDONESIA	0	+ + +	+ + +	- -	+ + +	0	+ + +	0
	JAPAN	0	0	0	0	-	0	0	0
	MALAYSIA	0	+	+	0	0	0	0	0
	PHILIPPINES	0	+ +	+	-	0	0	+ +	0
	SAUDI ARABIA	0	+	0	NN	0	0	+	0
	SINGAPORE	0	0	0	0	0	0	0	0
	SOUTH KOREA	0	0	0	0	0	0	0	+
	UAE	-	0	0	NN	0	0	0	0
	USA	0	+	+	0	+	0	+	+

SIMBOL	CORRELATION
+ + +	High (0.8-1)
+ +	Medium (0.6-0.79)
+	Low (0.4-0.59)
-	Neg Low (-0.44-0.59)
- -	Neg Medium (0.6-0.79)
- - -	Neg High (0.8-1)

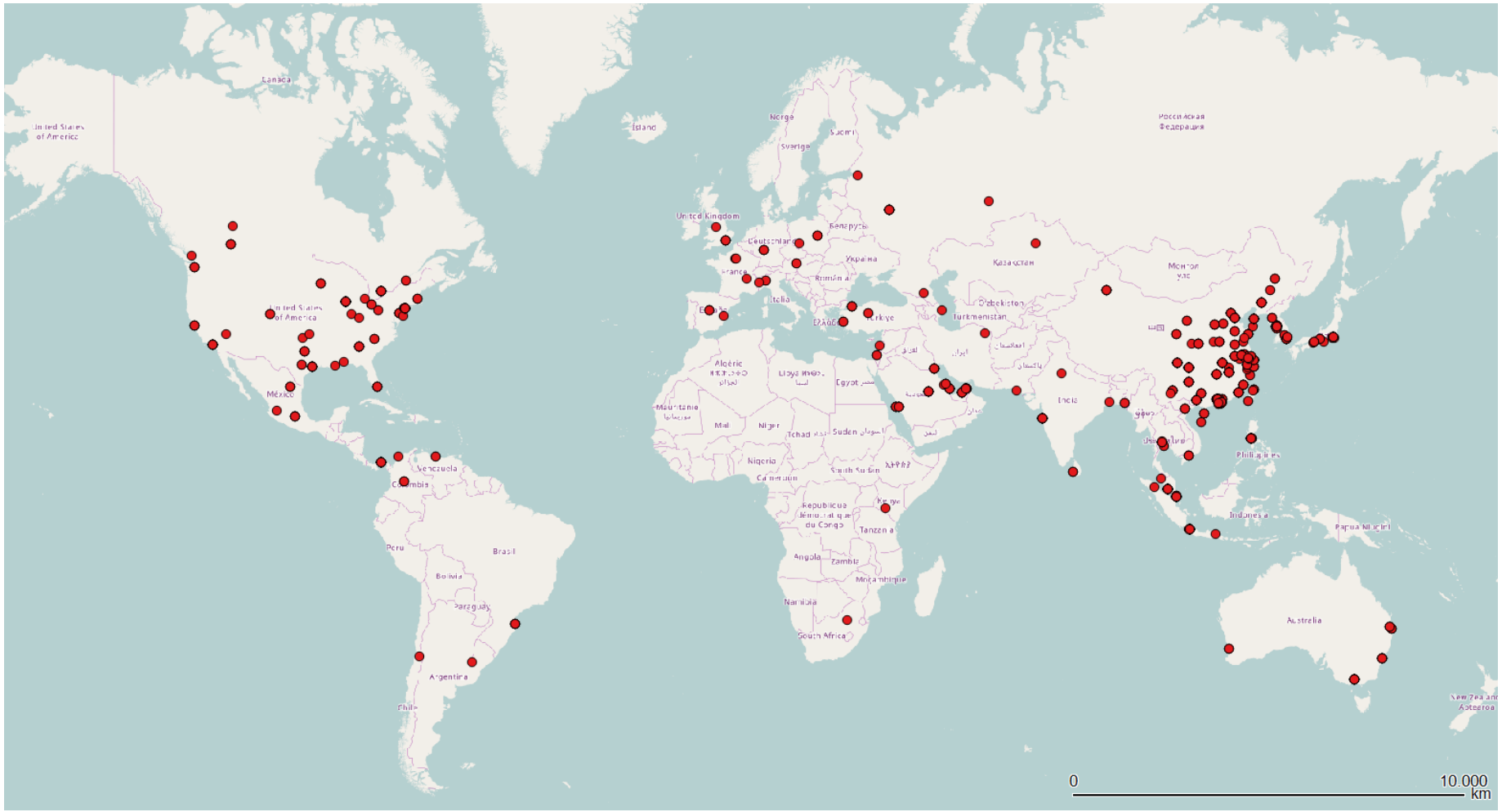
Economic cycles

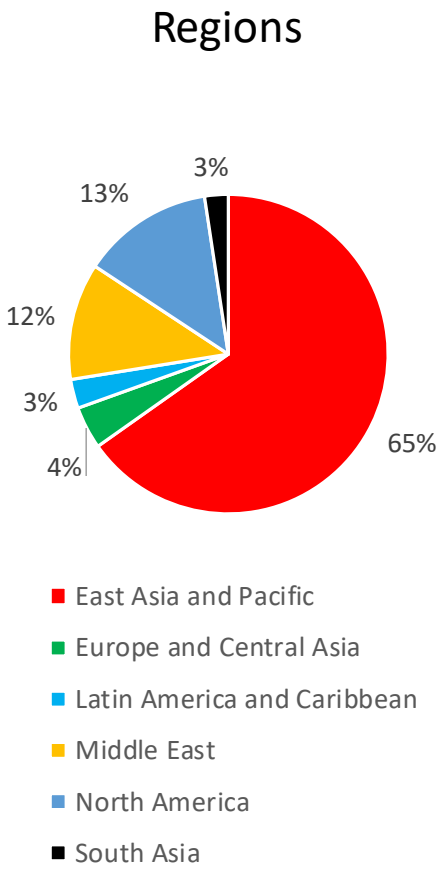


Economic cycles - countries

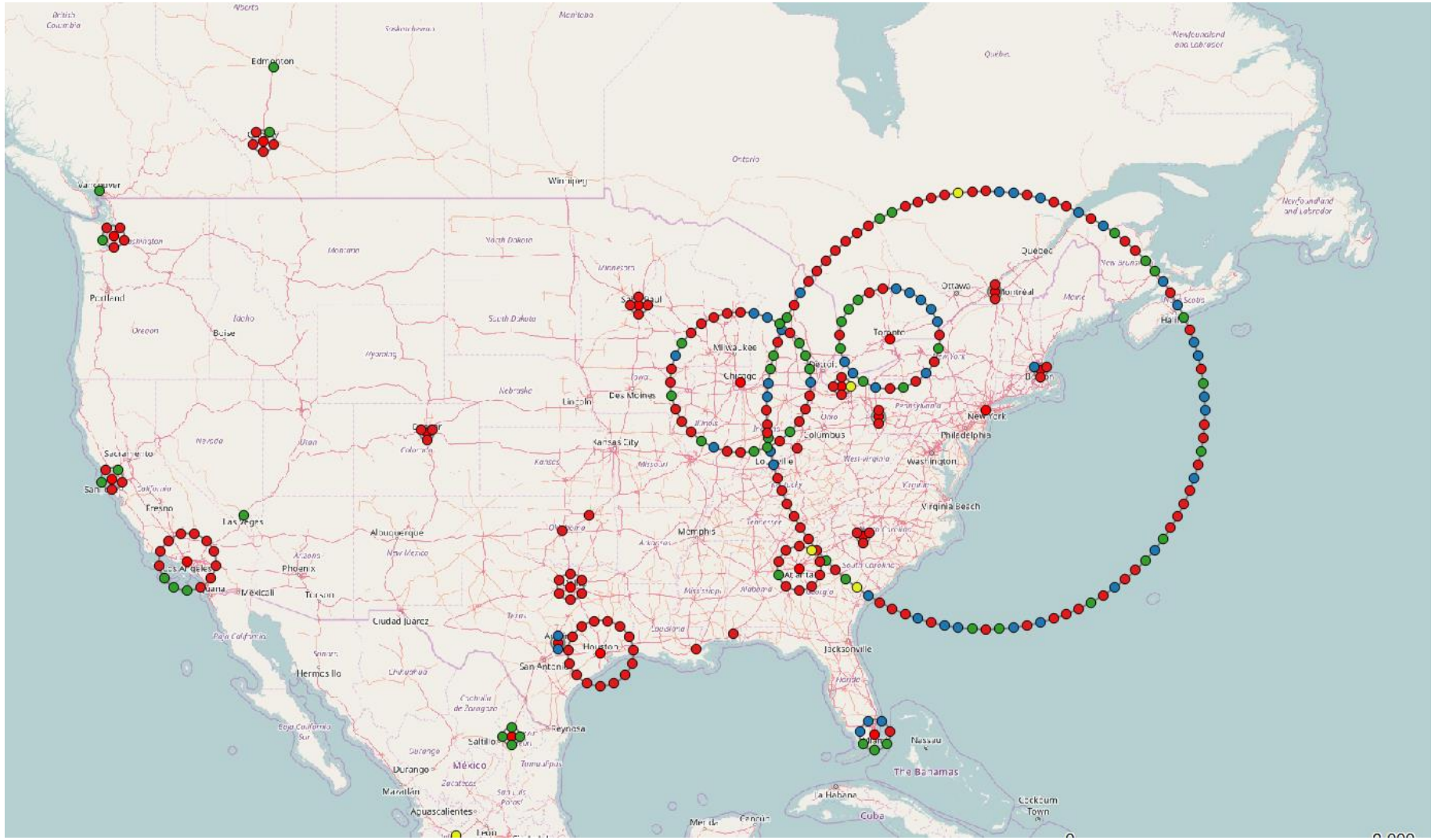


Geographic distribution



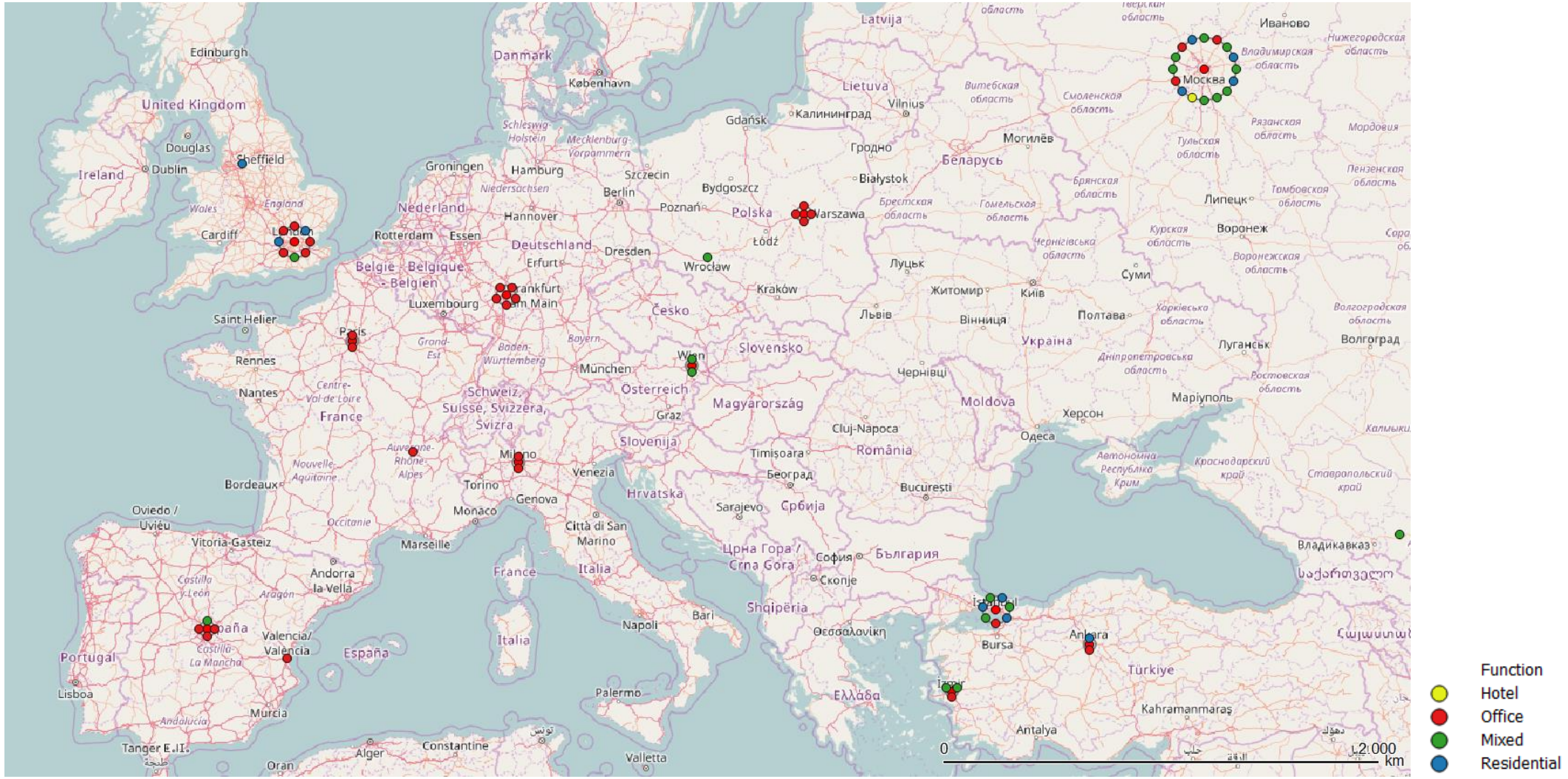


Geographic distribution – North America

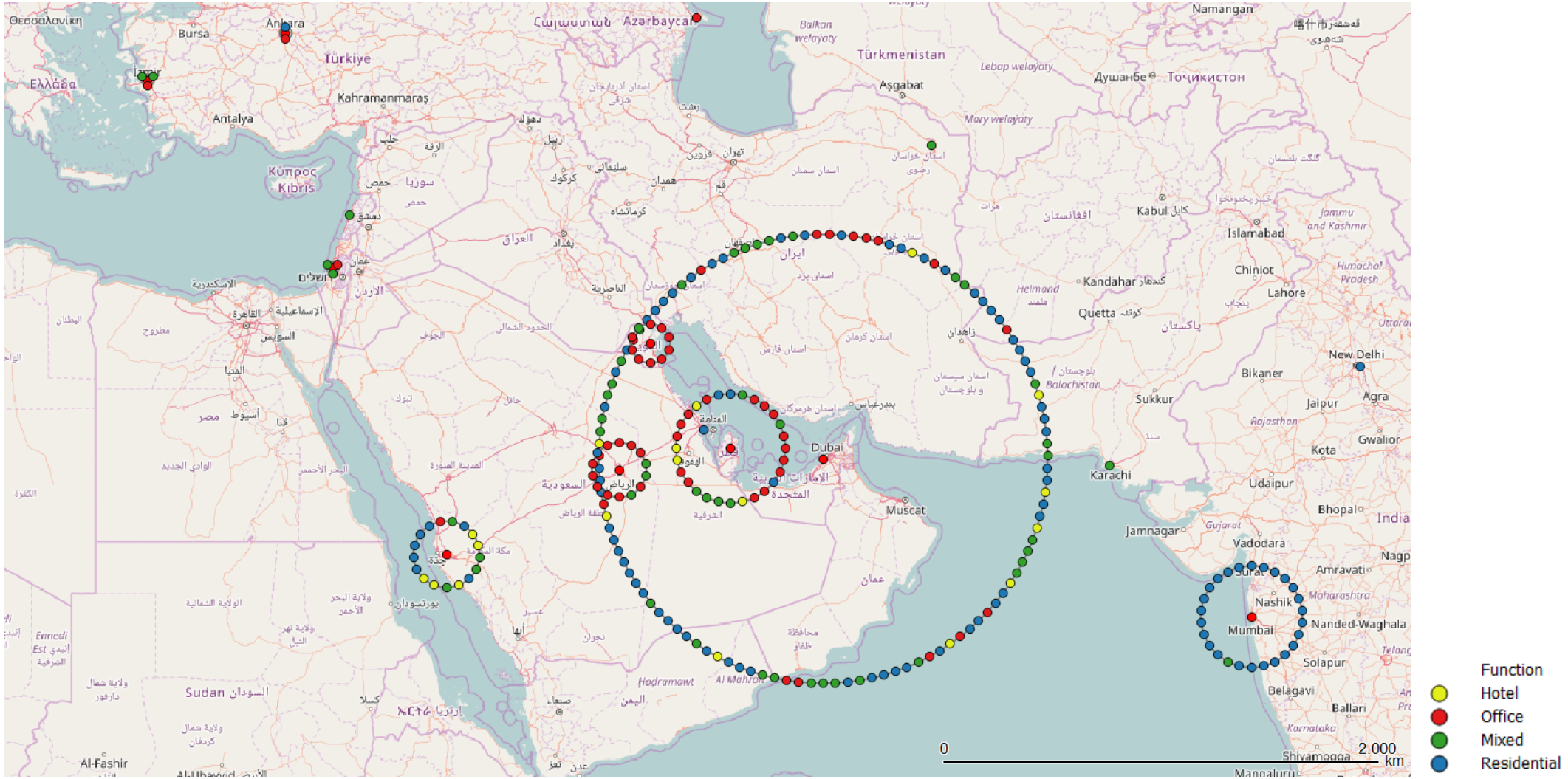


Geographic distribution – South America & Caribbean

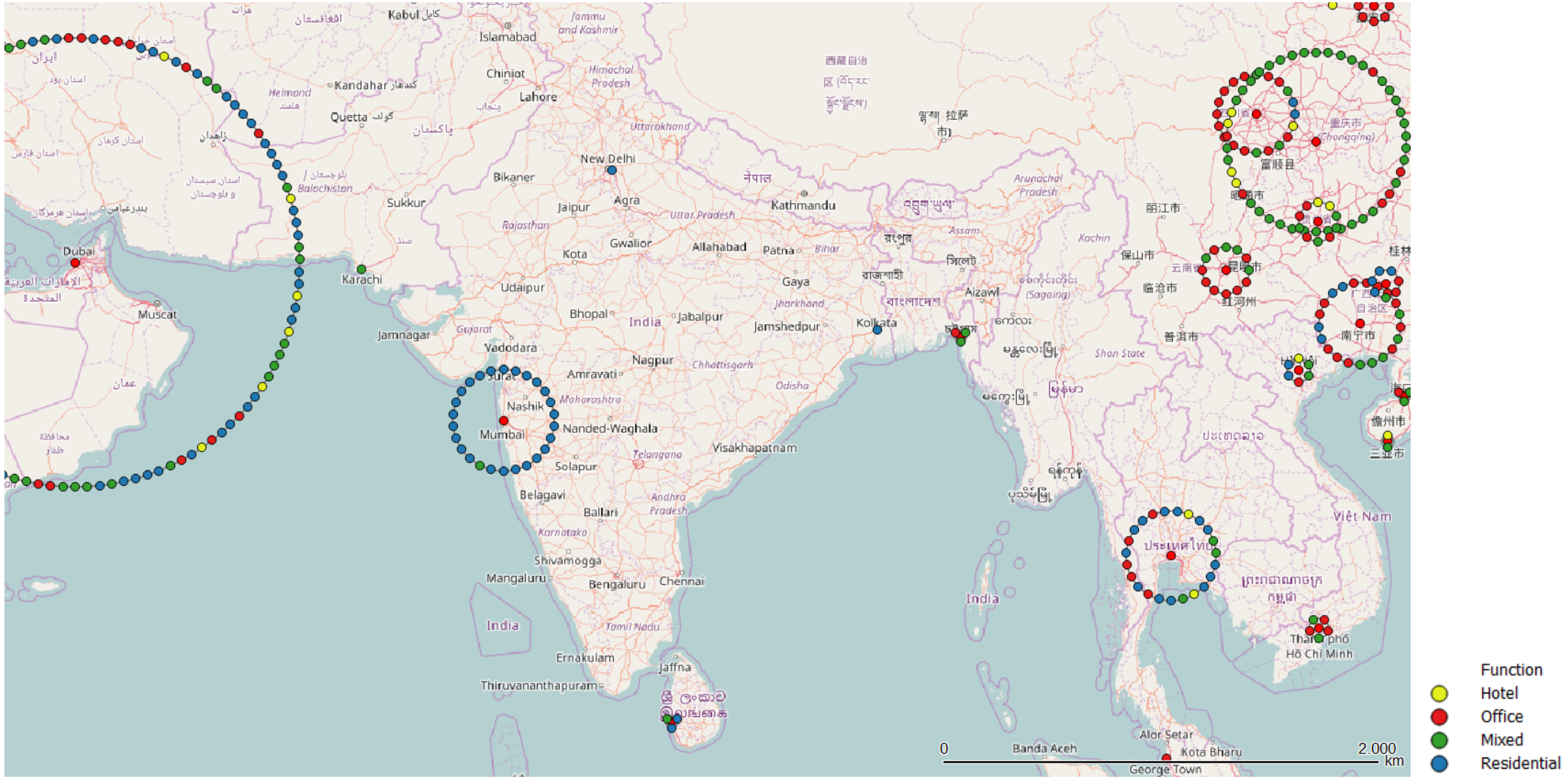
Geographic distribution Europe & Central Asia



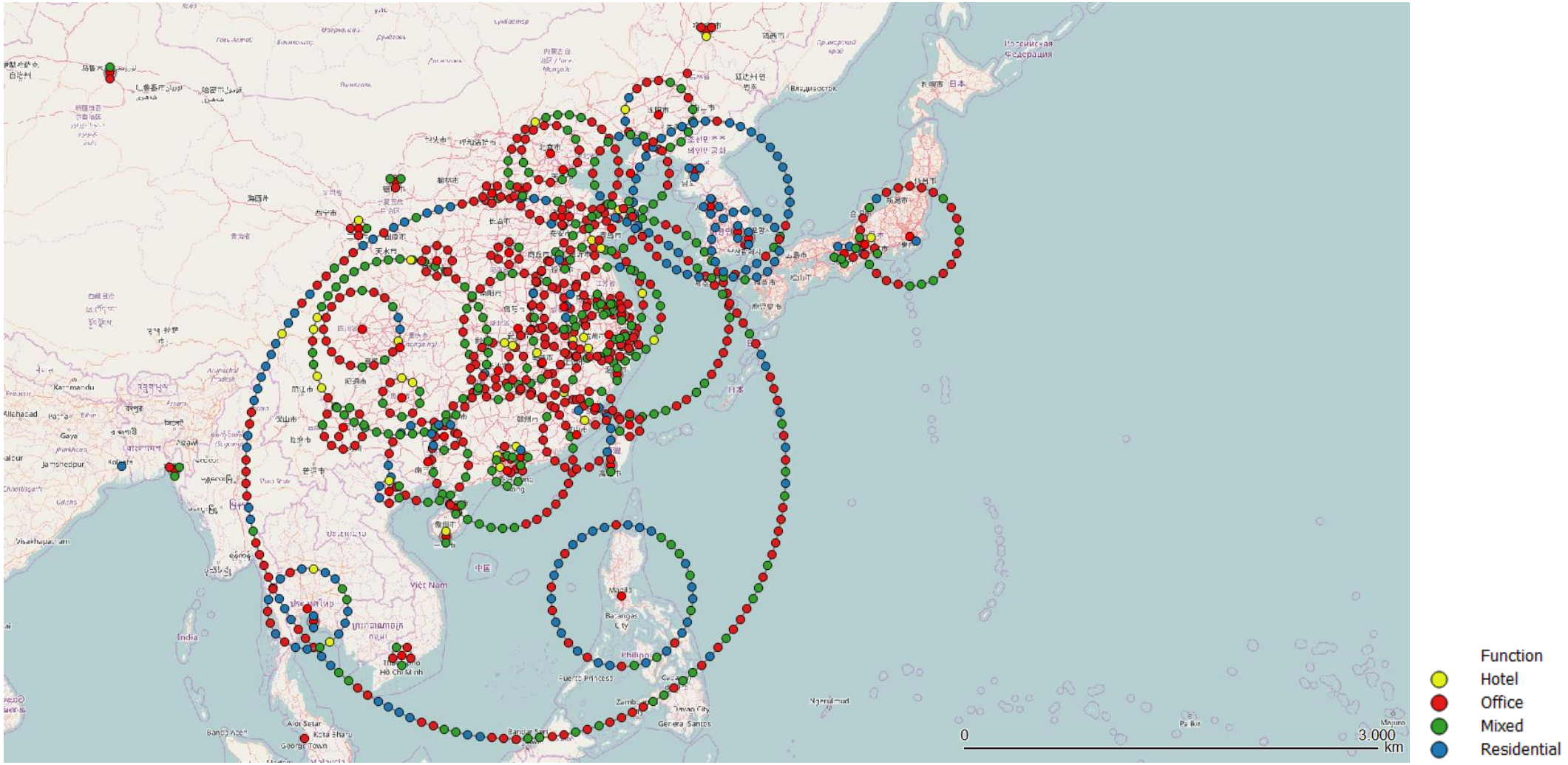
Geographic distribution – Middle East



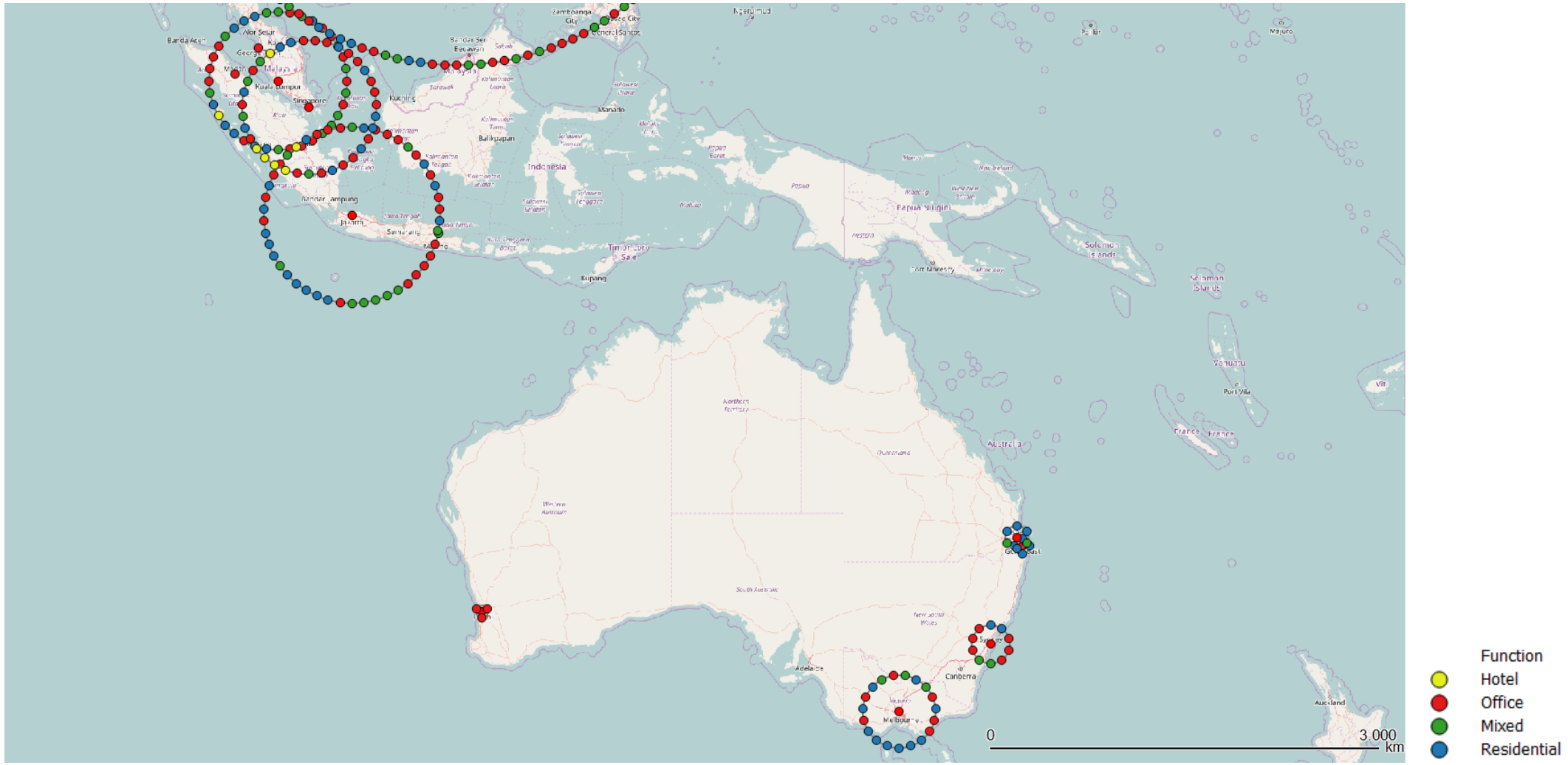
Geographic distribution – South Asia



Geographic distribution East Asia & Pacific 1



Geographic distribution – East Asia & Pacific 2

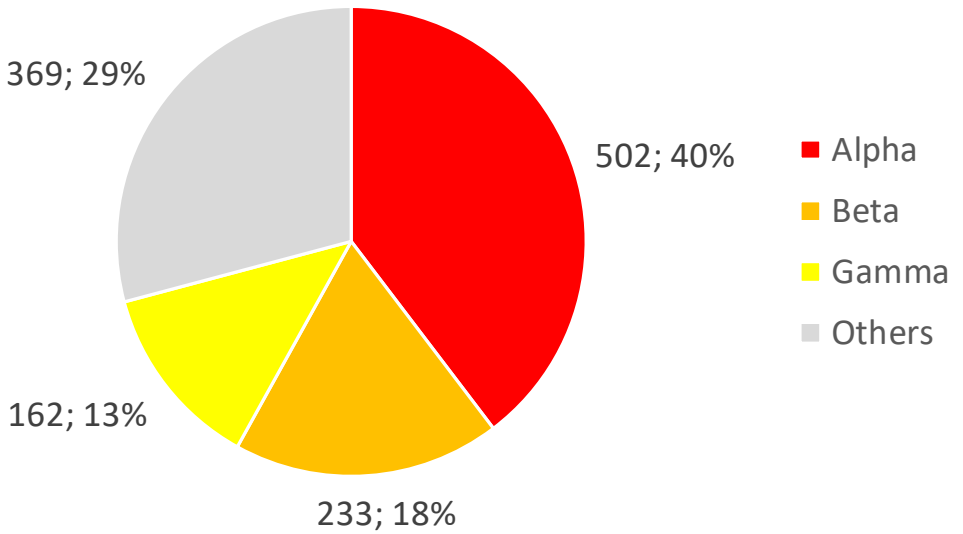


Global cities

Nodes of the global network

Global City Index 2000-2016

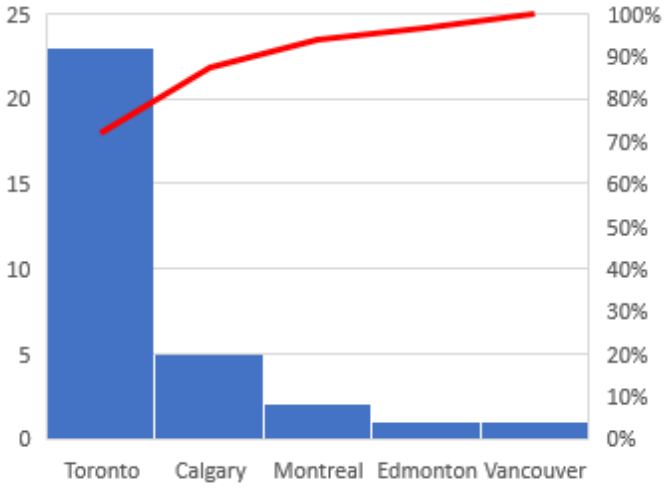
226 global cities



Percentage of projects built in global cities and others (2000-2016).

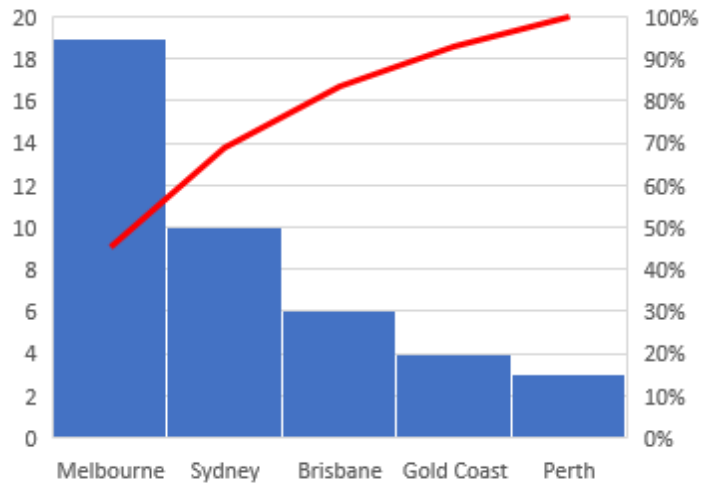
Geographic distribution - Countries

PRIMACY



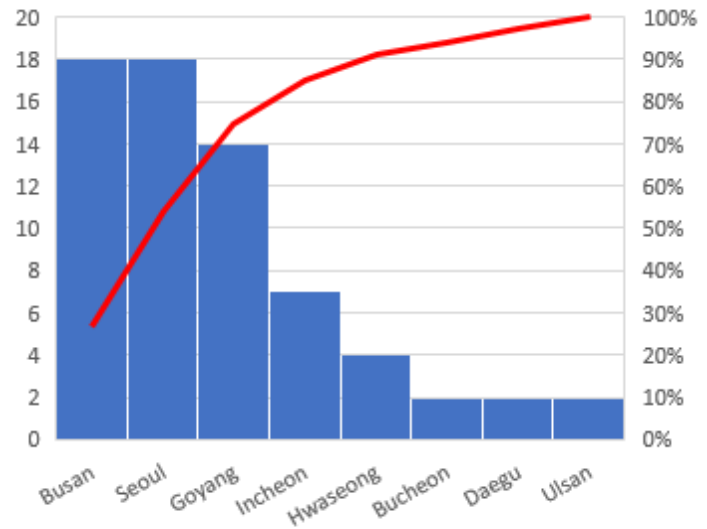
Canada, Indonesia, Japan, Malaysia, UAE, United States

RANK SIZE



Australia, Philippines

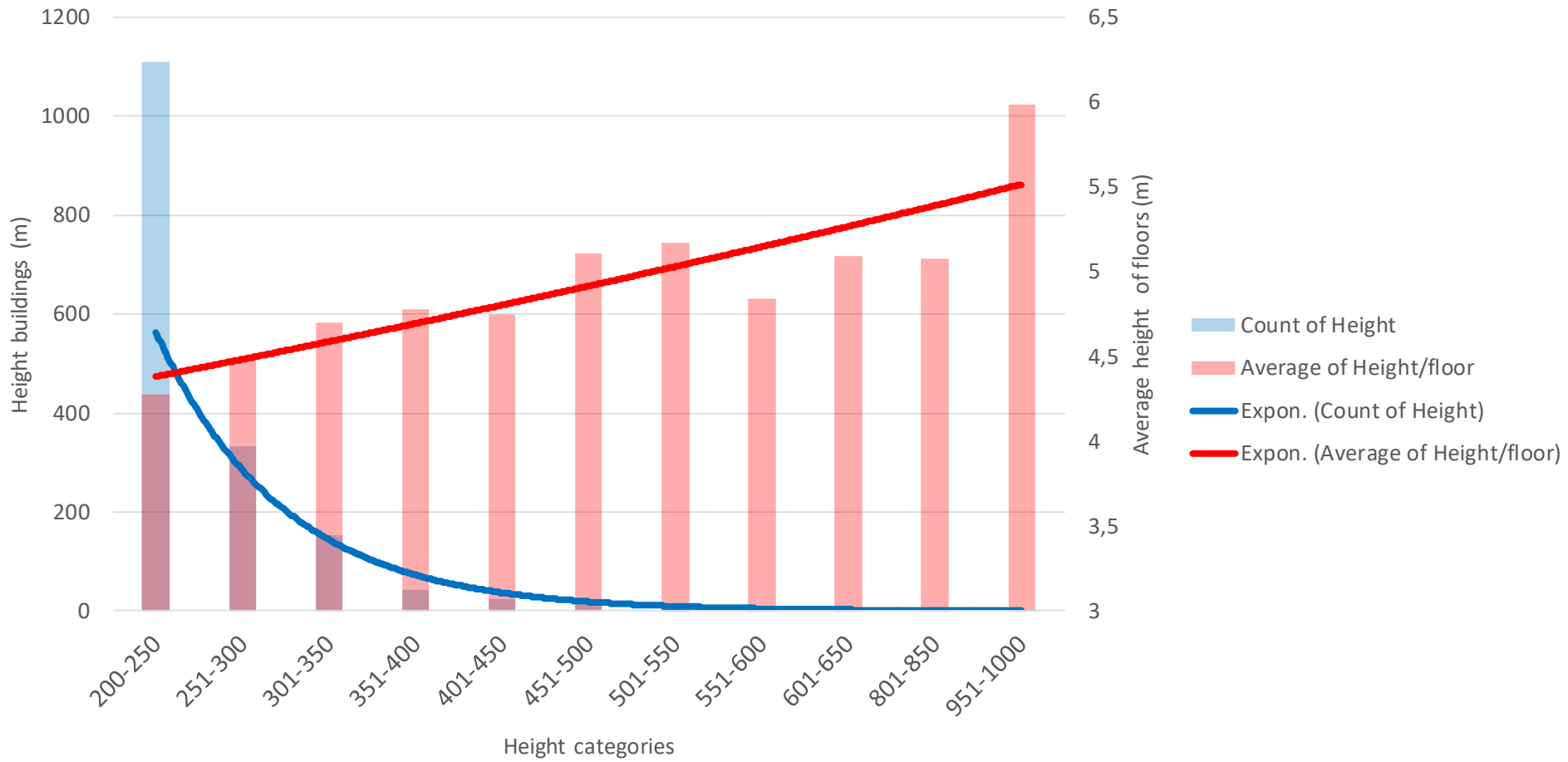
SATURATED



South Korea, China, Saudi Arabia

Vanity Height

Vanity Height



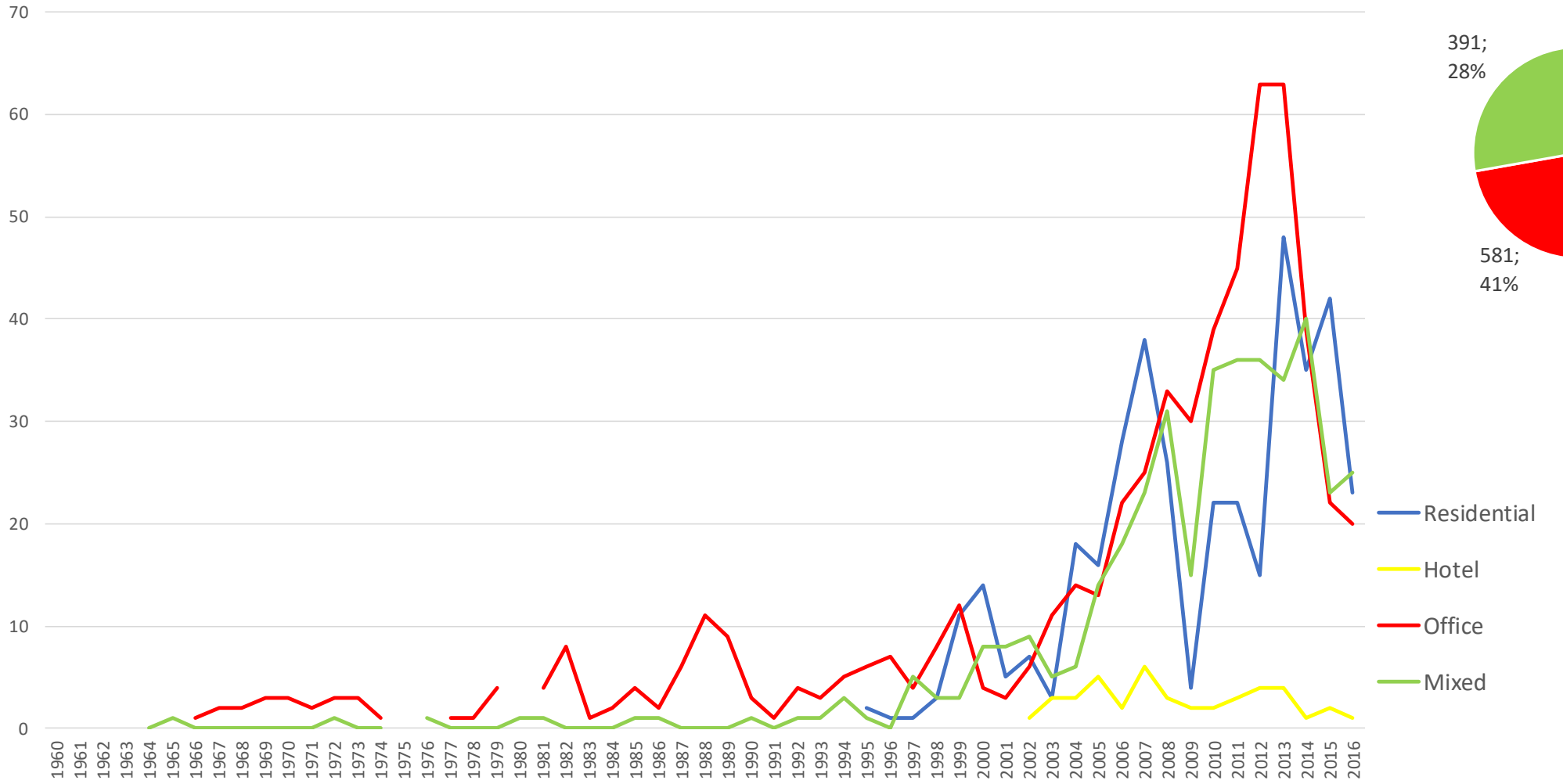
Functions

Correlations

		Residential	Hotel	Office	Mixed	World GDP %	World GDP Level	Global Investments
Residential	Pearson Correlation	1	,283	,641**	,750**	,227	,791**	,837**
	Sig. (2-tailed)		,288	,001	,000	,309	,000	,000
	N	23	16	23	23	22	22	22
Hotel	Pearson Correlation	,283	1	,418	,322	,110	,435	,628**
	Sig. (2-tailed)	,288		,060	,155	,645	,055	,003
	N	16	21	21	21	20	20	20
Office	Pearson Correlation	,641**	,418	1	,921**	-,268	,867**	,805**
	Sig. (2-tailed)	,001	,060		,000	,065	,000	,000
	N	23	21	50	50	48	49	43
Mixed	Pearson Correlation	,750**	,322	,921**	1	-,235	,908**	,896**
	Sig. (2-tailed)	,000	,155	,000		,096	,000	,000
	N	23	21	50	53	51	52	45

**. Correlation is significant at the 0.01 level (2-tailed).

Functions


70
60
50
40
30
20
10
0
1960
1961
1962
1963
1964
1965
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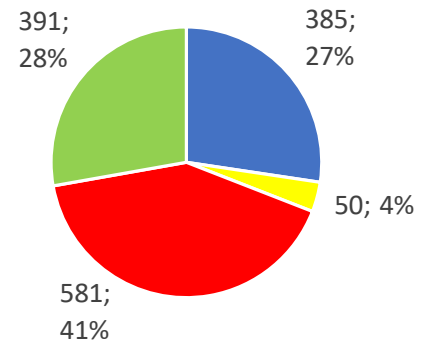
2015
2016
Residential
Hotel
Office
Mixed


391;
28%
385;
27%
50; 4%
581;
41%

Technology cycles

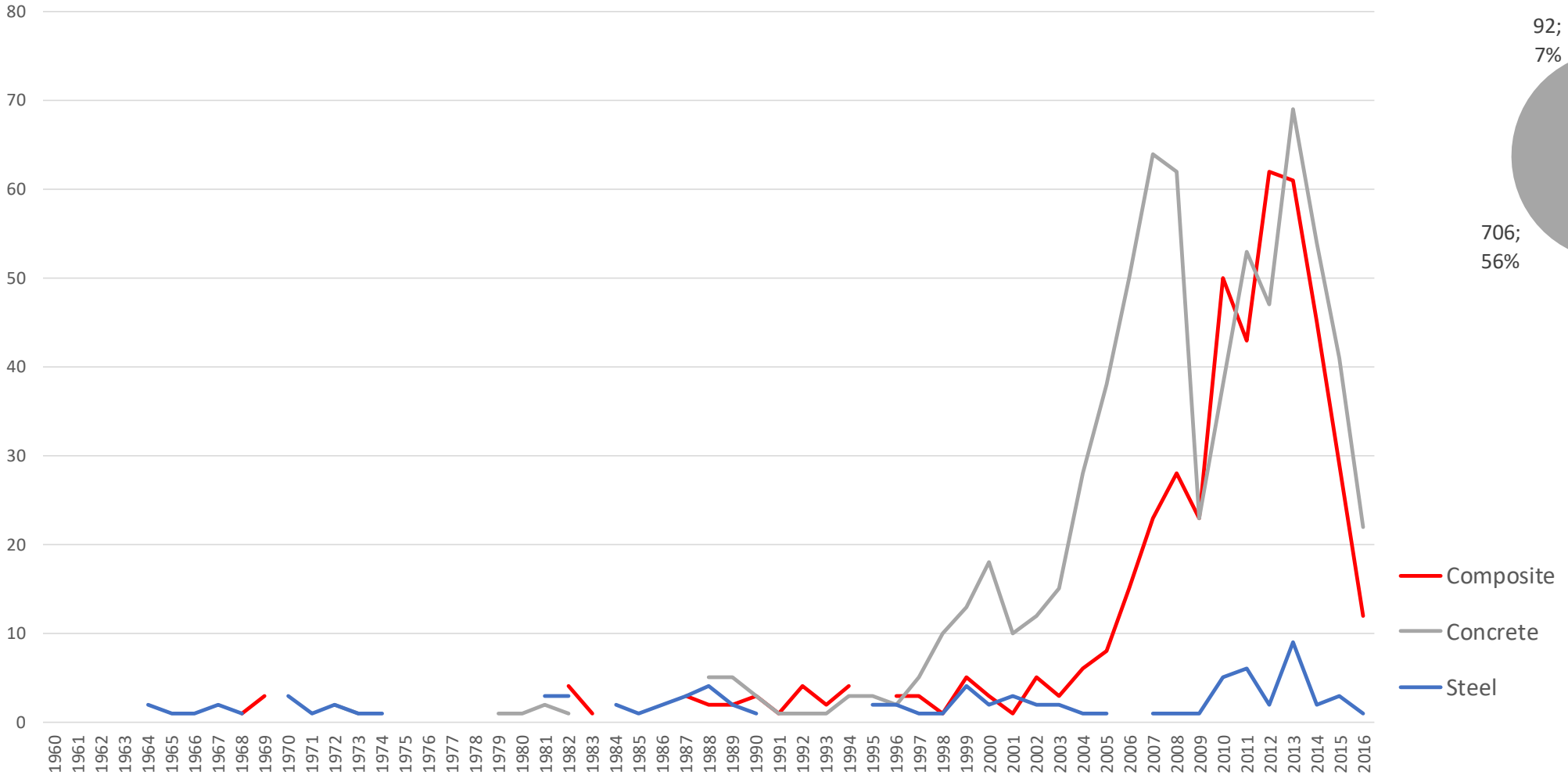
Correlations

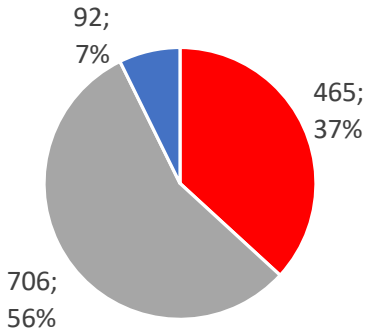
		Composite	Concrete	Steel	World GDP %	World GDP Level	Global Investments
Composite	Pearson Correlation	1	,813**	,549**	-,185	,856**	,763**
	Sig. (2-tailed)		,000	,002	,279	,000	,000
	N	37	31	29	36	36	34
Concrete	Pearson Correlation	,813**	1	,334	-,012	,897**	,958**
	Sig. (2-tailed)	,000		,071	,945	,000	,000
	N	31	37	30	36	36	36
Steel	Pearson Correlation	,549**	,334	1	-,141	,393*	,256
	Sig. (2-tailed)	,002	,071		,385	,011	,137
	N	29	30	42	40	41	35

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Technology cycles





Conclusion

Global factors influencing demand

Local factors influencing supply

Height as product of economics and strategies


Questions?