Transport Corridors

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What is the Question? Was Adam Smith right about geographic factors and economic development?

- Smith: Economic growth came from **productivity gains from specialization**…
  - the degree of specialization was **shaped by the extent of the market**…
    - and the extent of the market was **bounded by geographic factors** (as well as **policies**).
- Thus, there is a **first order relationship between geographic factors** and **economic development**.

For Smith, the unit of analysis is the market.
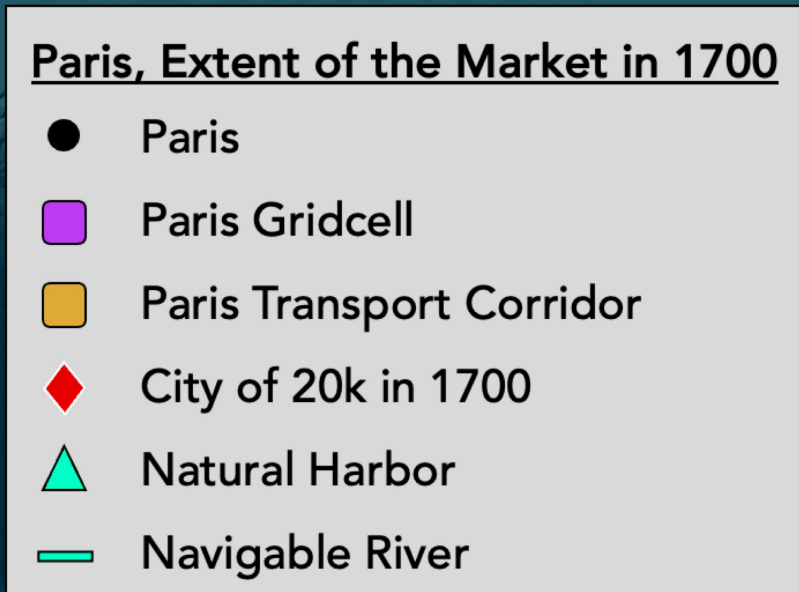# How should we measure a market?

- A first phase of research used **present-day nation states** as the unit of analysis (Easterly and Levine 2003; Hibbs and Olsson, 2004; Olsson and Hibbs, 2005; Putterman 2008; Zuleta, 2012)

- A second phase of research used **latitude-longitude grid cells** as the unit of analysis (Masters and McMillan, 2001; Nordhaus, 2006; Nordhaus and Chen, 2009; Motamed, Florax, and Masters, 2014; Henderson et. al., 2018)

- The challenge: **a market is neither a political jurisdiction nor a grid cell**. It is an **economic-geographic unit** in which **prices are integrated because factors of production and products move**. Markets are generated by **contiguous geographic features,** conditional on **human alterations** to those features at a point in time, given **transportation technologies** available at a point in time.

What do we do?

- **We estimate the extent of markets** in Smith's time, conditional on:
  - **transport technologies** of Smith's time,
    - the **navigability of rivers** in Smith's time,
      - **lakeshores** in Smith's time,
        - **sea ice density** in 1850,
          - (time invariant) **terrain slopes**,
            - (time invariant) **tsetse fly endemicity**,
              - (time invariant) **natural harbors**, and
                - (time invariant) **soil quality**.

- We measure economic development from 1500 to 2000 using a **novel, geocoded time-series dataset of urban places** with at least 20,000 inhabitants.

How would Smith have defined the market if he had a computer?

Paris, Extent of the Market in 1700
- ● Paris
- ■ Paris Gridcell
- ■ Paris Transport Corridor
- ◆ City of 20k in 1700
- ▲ Natural Harbor
- — Navigable River

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What we discover: Smith was right

Urban places and populations in the Old World **concentrated** in **large transport corridors** with **high soil quality** that had at least one **natural harbor**. Those transport corridors account for only **10% of Earth's surface area**, yet contained **76% of all cities** and **81% of total urban population in 1700**.

Large, Productive Transport Corridors
- At least 1 Natural Harbor
- No Natural Harbors
- City of at least 20,000 in 1700
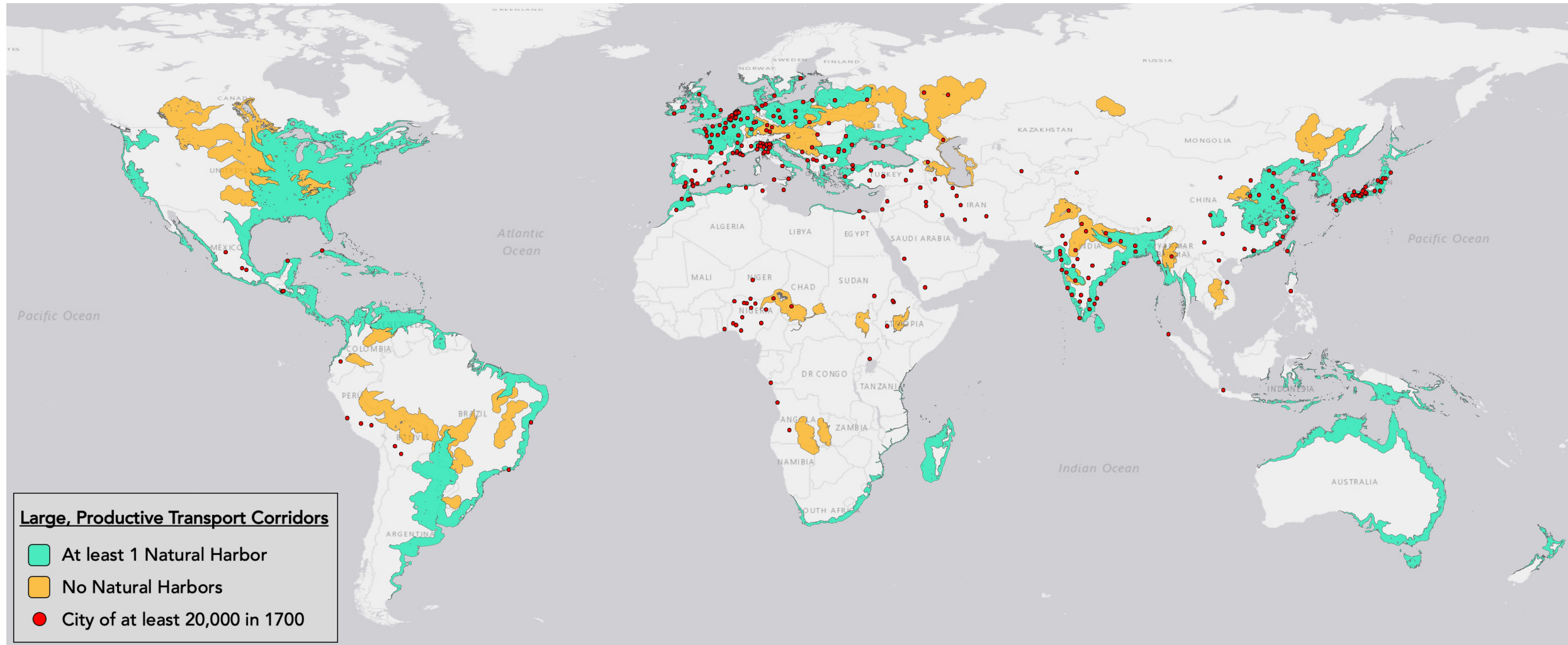
We also discover: The relationship between geographic factors and economic development held until the early-20th century

Large, Productive Transport Corridors

- 🟩 At least 1 Natural Harbor
- 🟧 No Natural Harbors
- 🔴 City of at least 20,000 in 1900
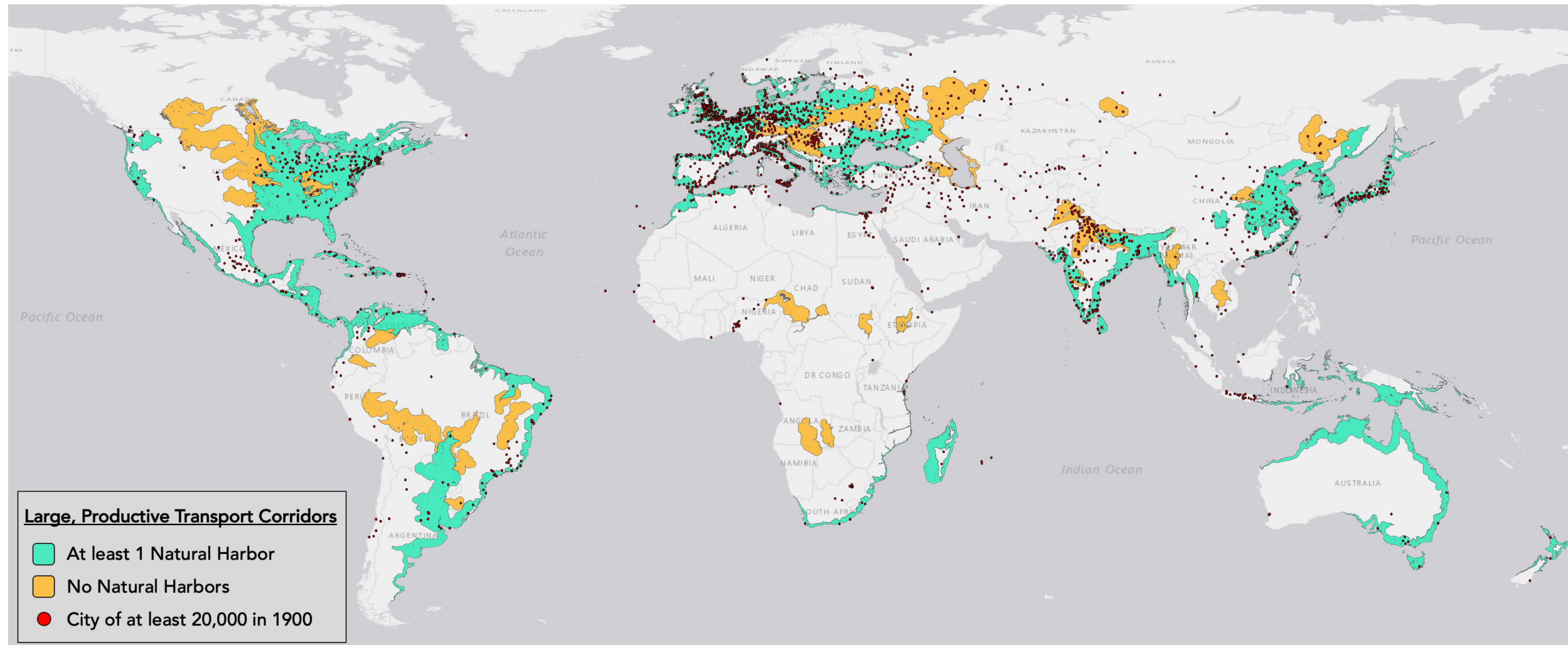
How do we measure the market?
- We start by placing 50,603 equidistant points on the terrestrial globe.
- Snap points if they are close to a navigable body of water.

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We model global river flows and lake extents as of 1800

We put historical lake extents back into terrestrial maps

We remove man-made canals from maps of navigable rivers

We restore sandbars, rapids, & waterfalls that historically hindered travel

Lake Texcoco, Mexico City

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We model transport costs using 18ᵗʰ century transport technologies, expressed in megajoules

Tumpline

Conestoga Wagon

Lewis & Clark Keelboat

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We specify **terrain slopes**, **navigable water**, **tsetse fly** endemicity, and potential **calorie production** of 22 staple crops (using traditional cultivars and technologies).
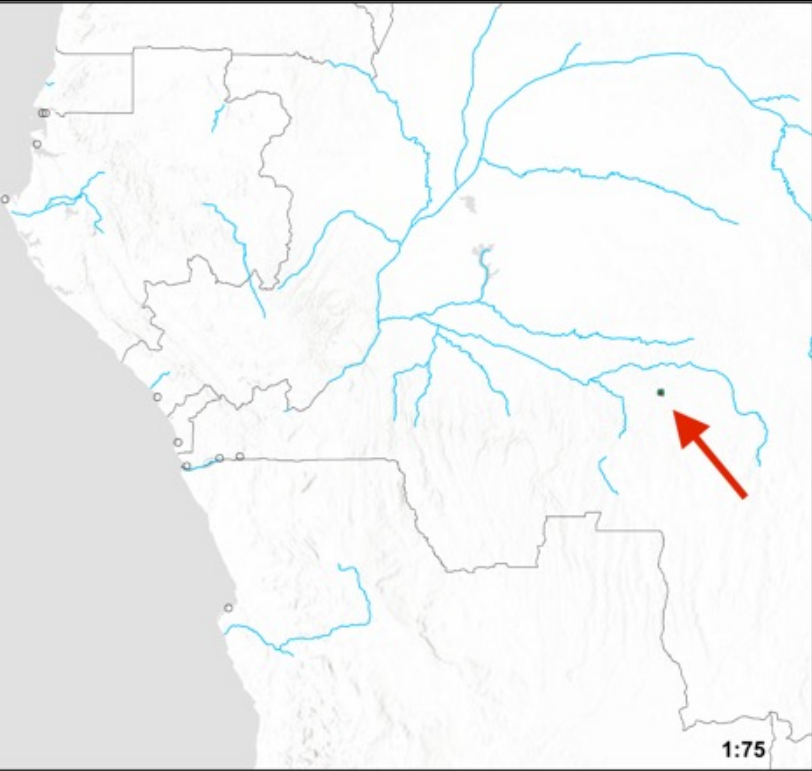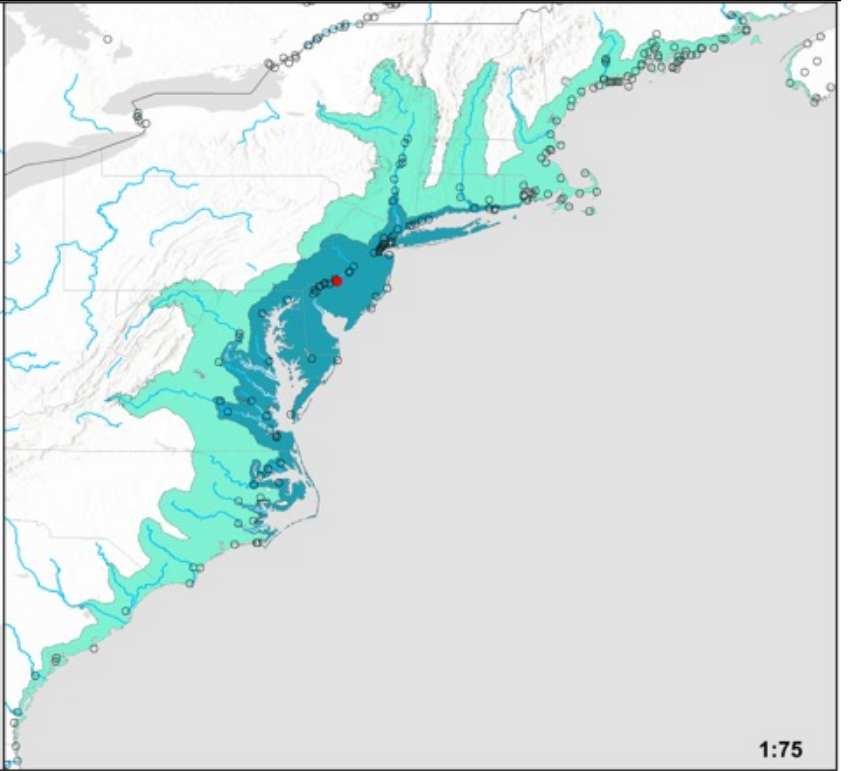

Terrain Slopes

Navigable Water

Tsetse Fly Endemicity

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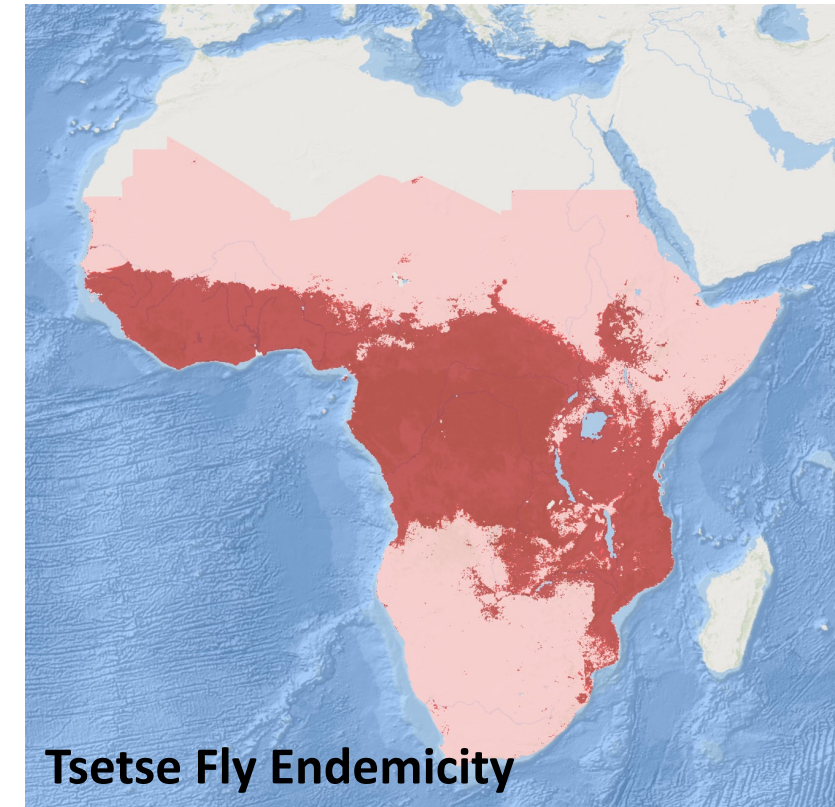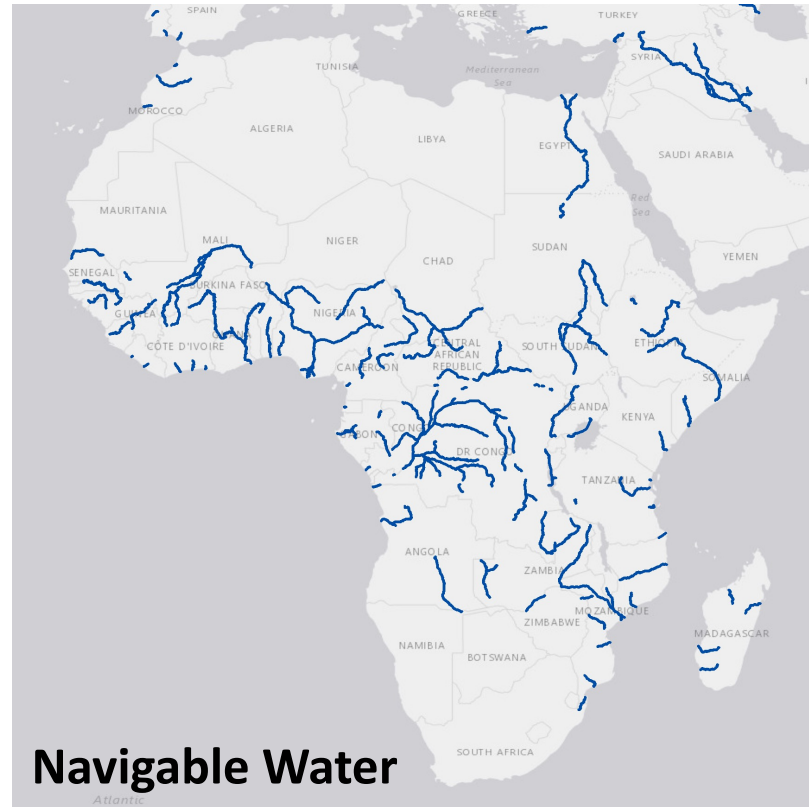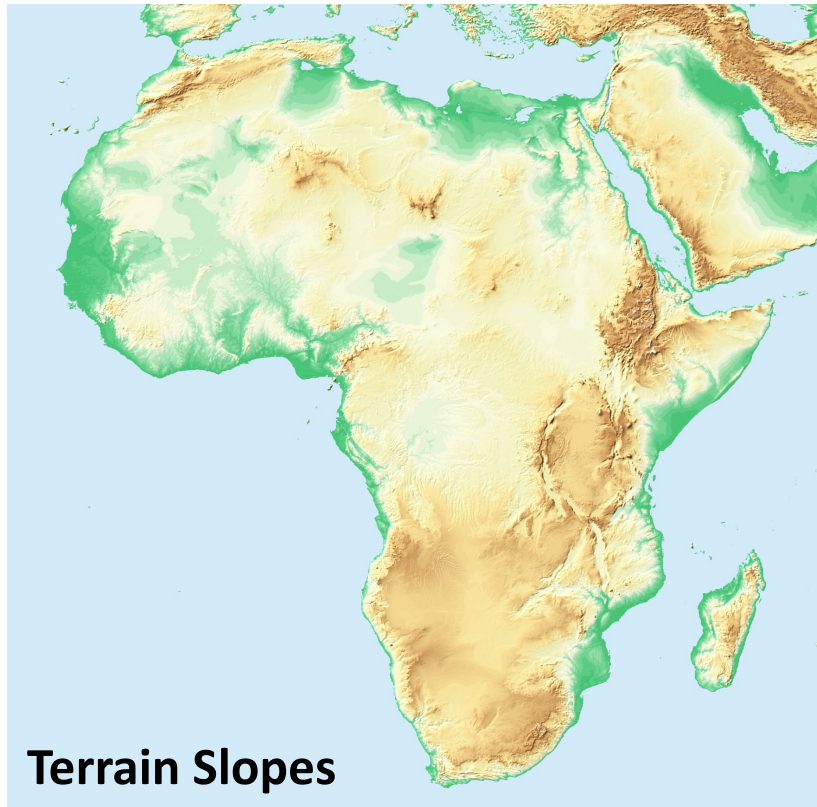
We specify natural harbors based on surveys from the 1940's and 1950's (including undeveloped harbors)


Legend

● Naturally Occurring Harbor

From every point we estimate the **hinterland** (area you can reach) and **transport corridor** (other hinterlands that can reach your centroid).

| Nshenge, Dem. Rep. Congo		Santiago, Chile		Philadelphia, USA	
• Hinterland:	199 km^2	• Hinterland:	8,375 km^2	• Hinterland:	94,713 km^2
• Transport Corridor:	199 km^2	• Transport Corridor:	15,630 km^2	• Transport Corridor:	355,245 km^2
• Natural Harbors:	0	• Natural Harbors:	0	• Natural Harbors:	185

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Transport Corridors, by Size

*Drawn overlapping each other. Greener is larger, redder is smaller.*
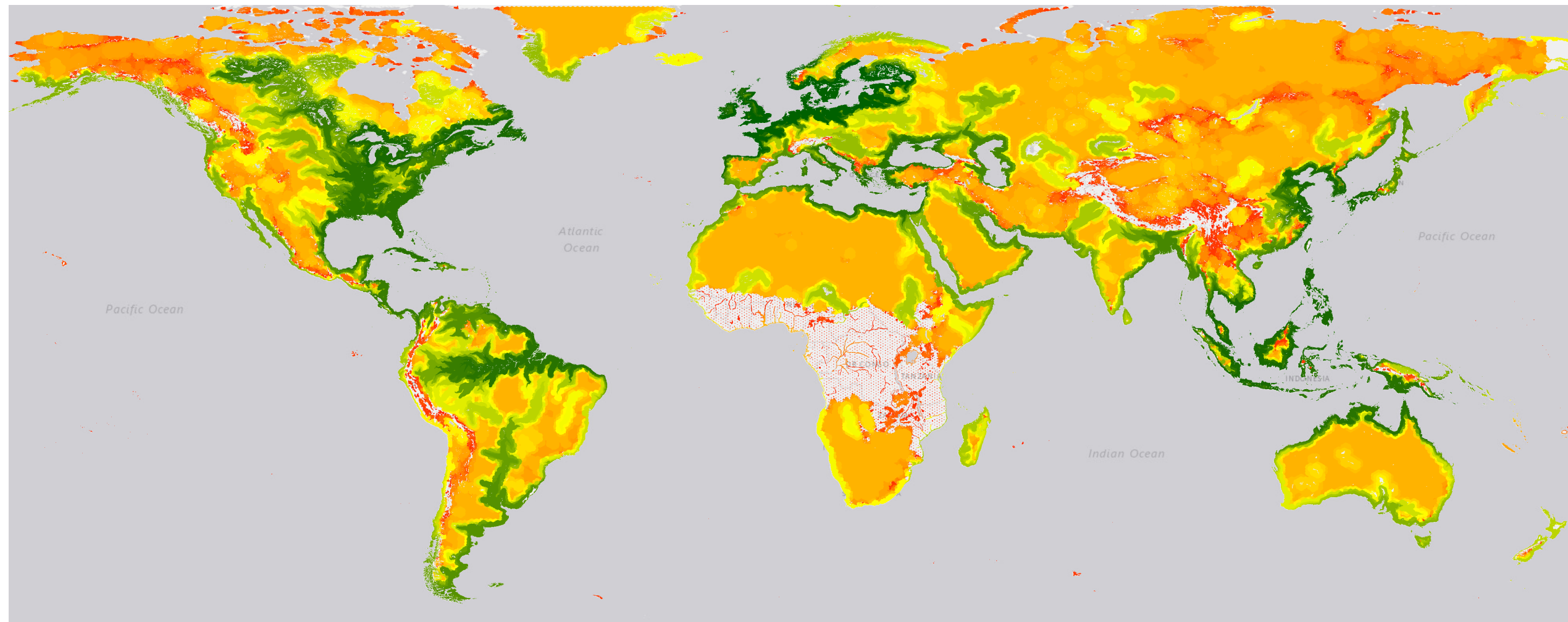
Transport Corridors, by Density of Potential Rainfed Agricultural Production
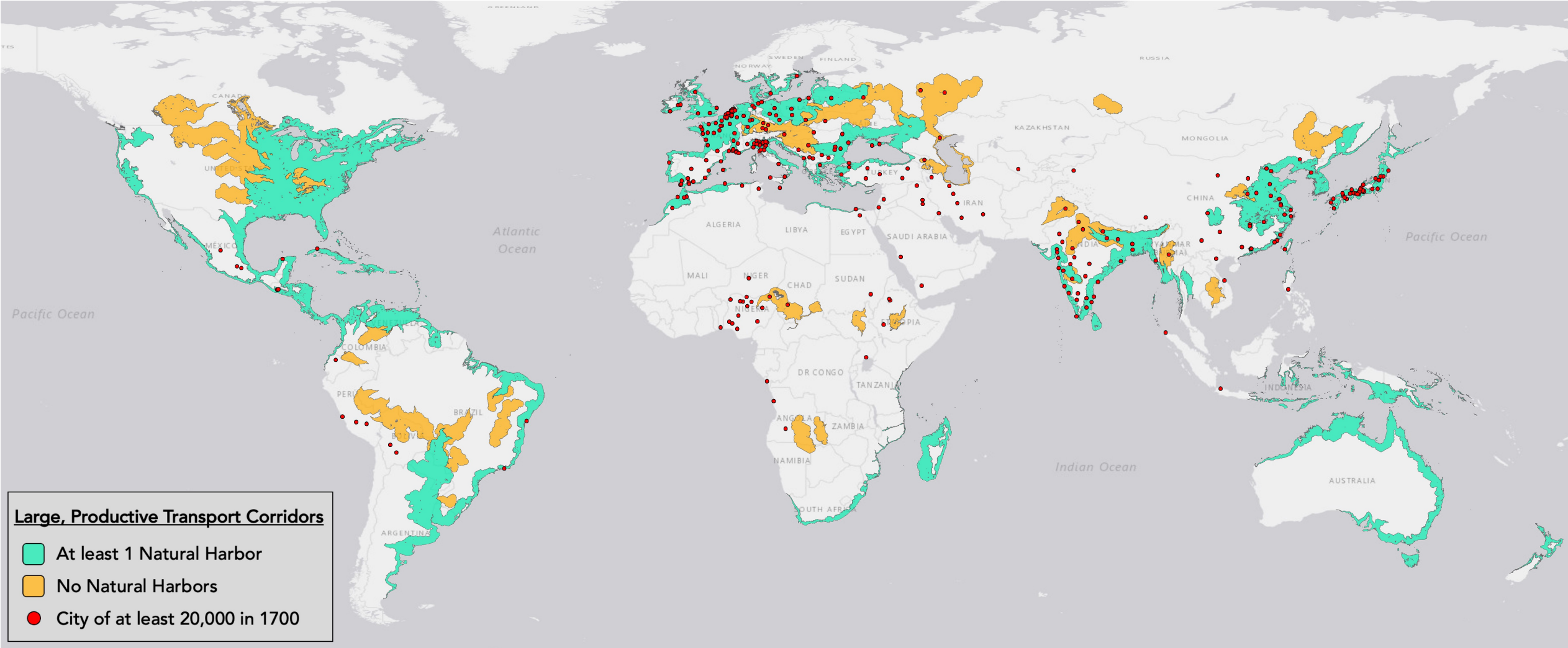*Greener is more productive, redder is less productive (kilocalories per hectare)*
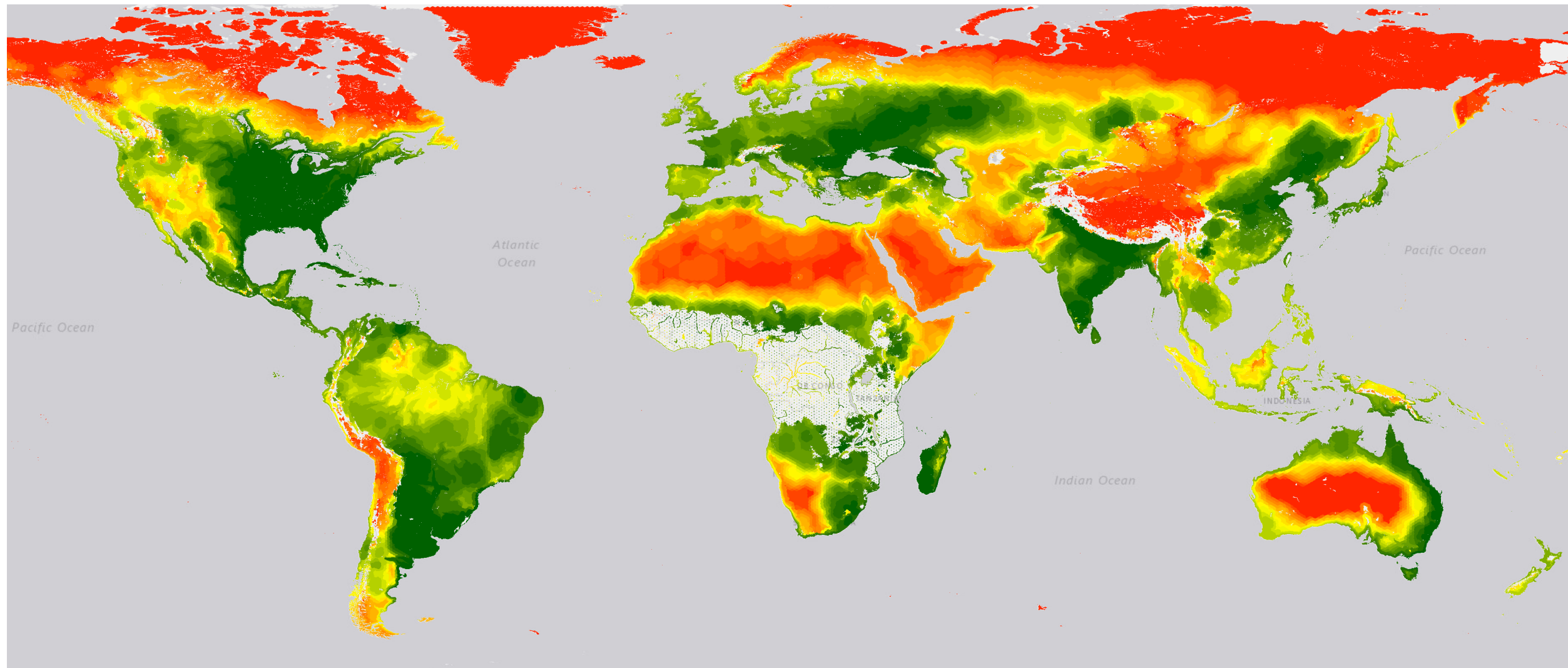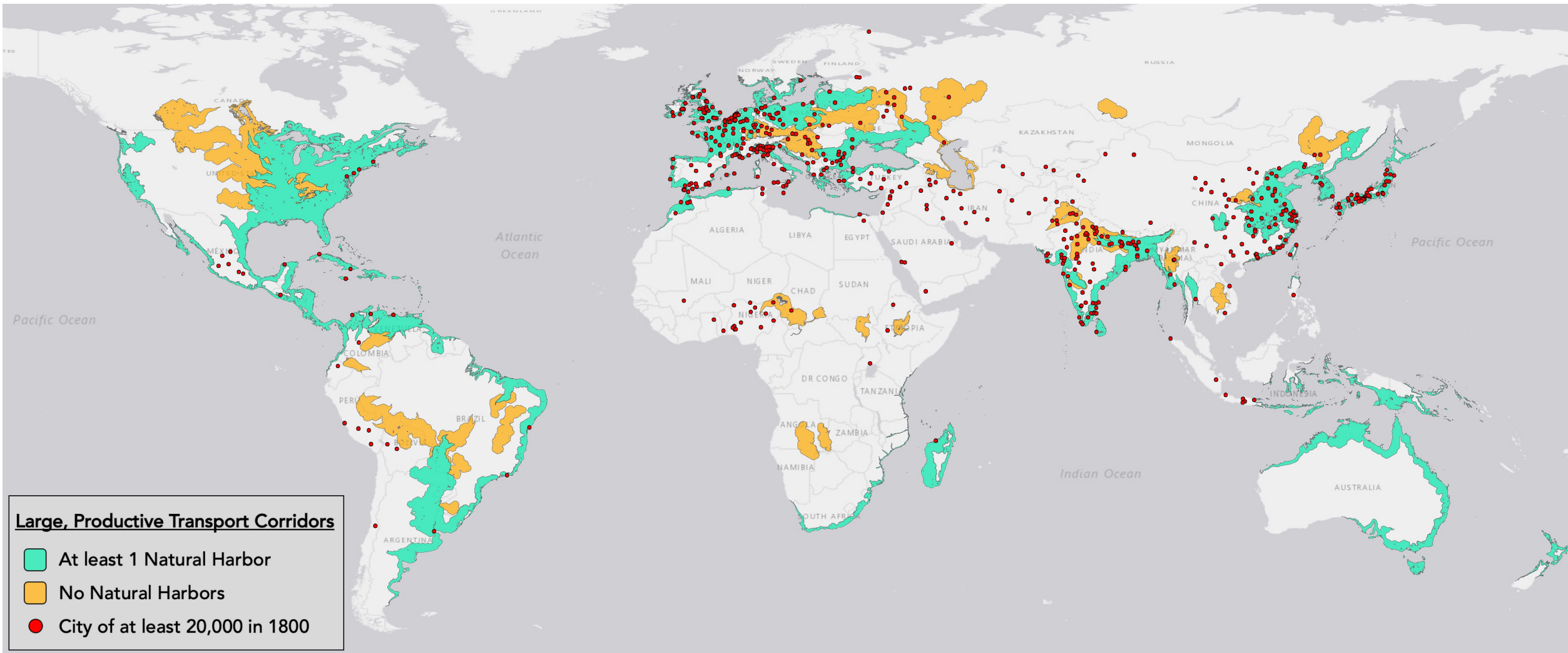
Putting together large corridors (top 25%) & productive corridors (top 25%) — with (teal) and without (orange) natural harbors

Large, Productive Transport Corridors
- At least 1 Natural Harbor
- No Natural Harbors

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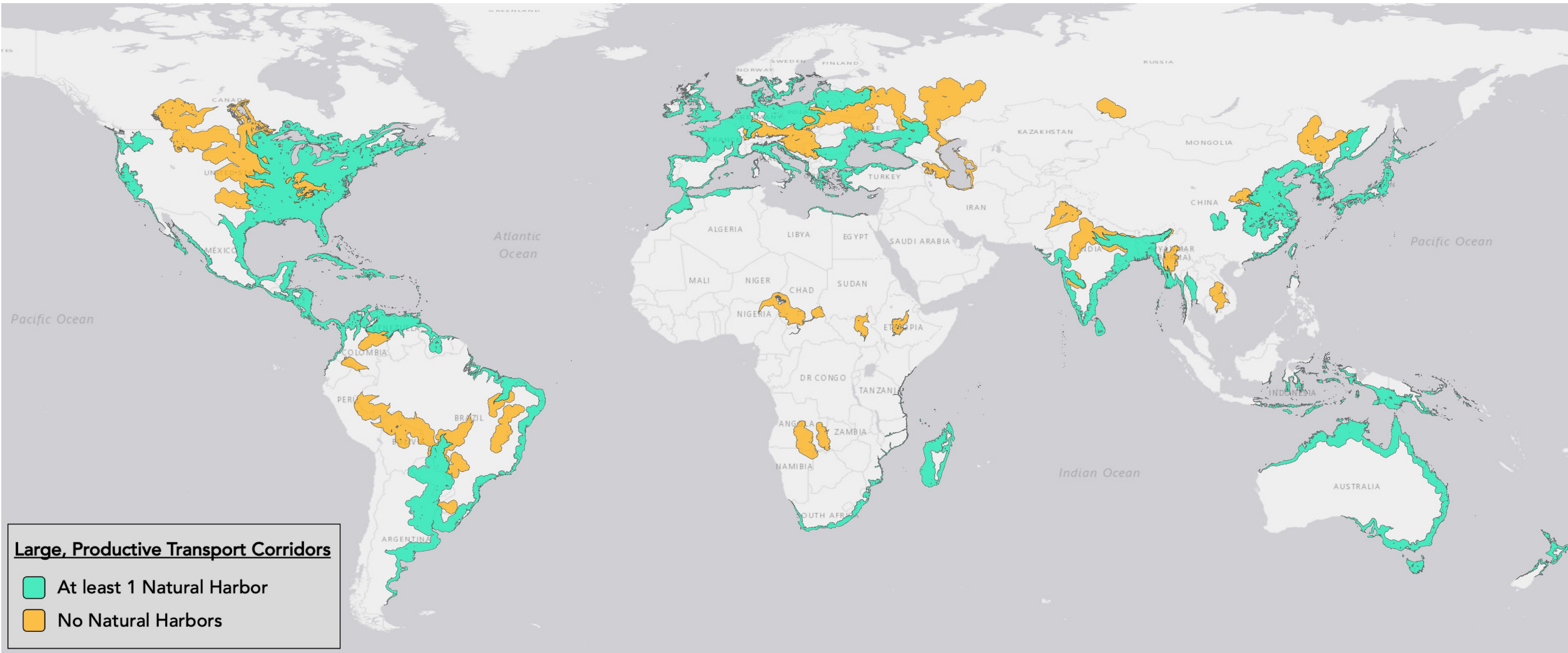
By 1700, where had economic development been taking place? Within the world's **large, deep, and connected** markets.

Large, Productive Transport Corridors
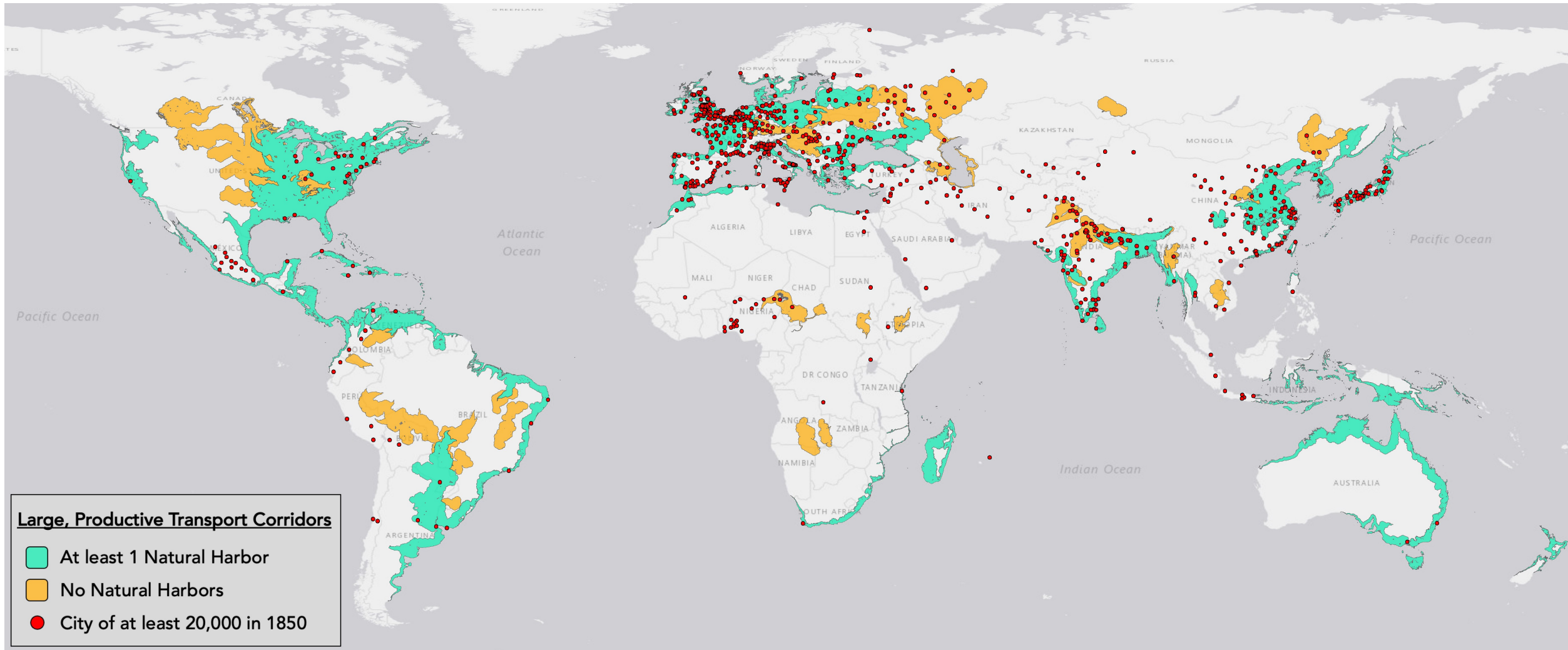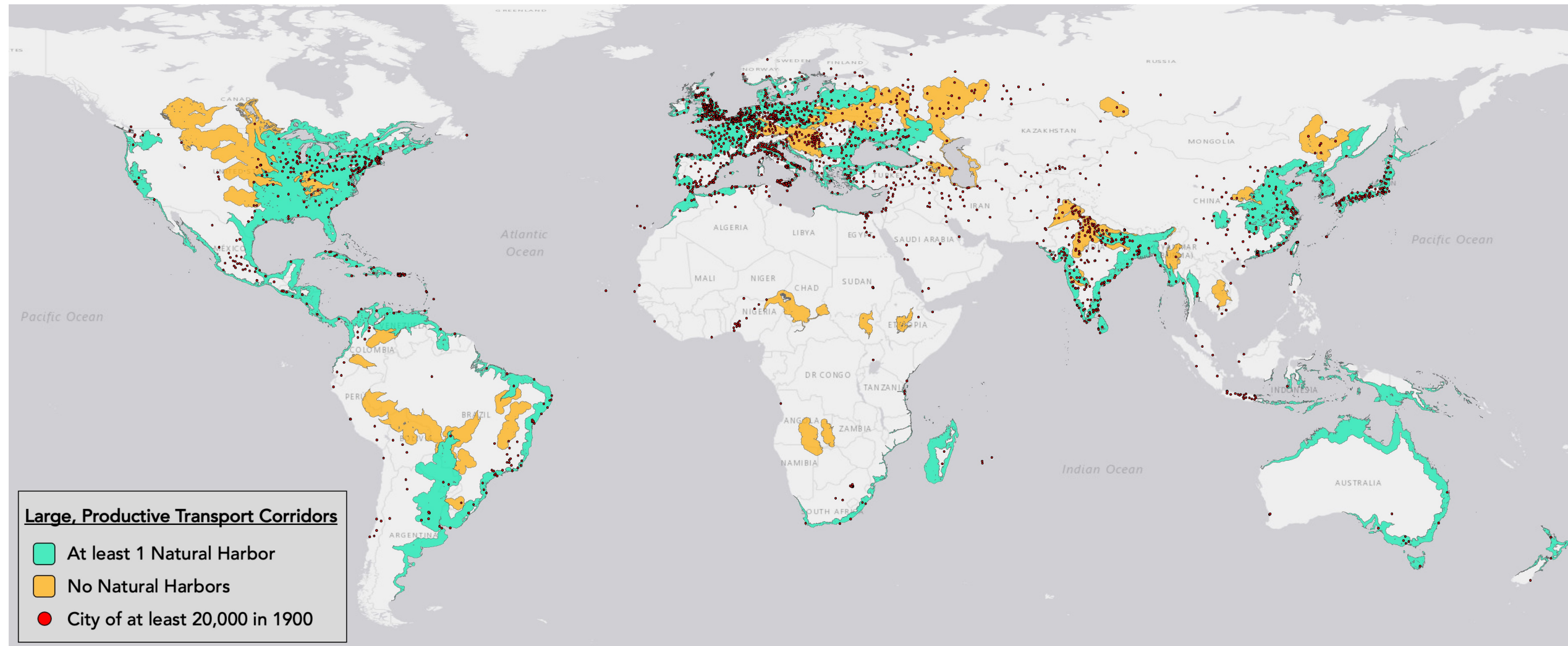
- 🟩 At least 1 Natural Harbor
- 🟧 No Natural Harbors
- 🔴 City of at least 20,000 in 1700

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The results are even stronger by 1800

Large, Productive Transport Corridors
- At least 1 Natural Harbor
- No Natural Harbors
- City of at least 20,000 in 1800

The pattern is even stronger in 1850—even though transportation technologies have changed

Large, Productive Transport Corridors

- 🟩 At least 1 Natural Harbor
- 🟧 No Natural Harbors
- 🔴 City of at least 20,000 in 1850

The pattern largely holds in 1900

Large, Productive Transport Corridors
- 🟩 At least 1 Natural Harbor
- 🟧 No Natural Harbors
- 🔴 City of at least 20,000 in 1900

The pattern largely holds in 1950

Large, Productive Transport Corridors
- 🟩 At least 1 Natural Harbor
- 🟧 No Natural Harbors
- 🔴 City of at least 20,000 in 1950
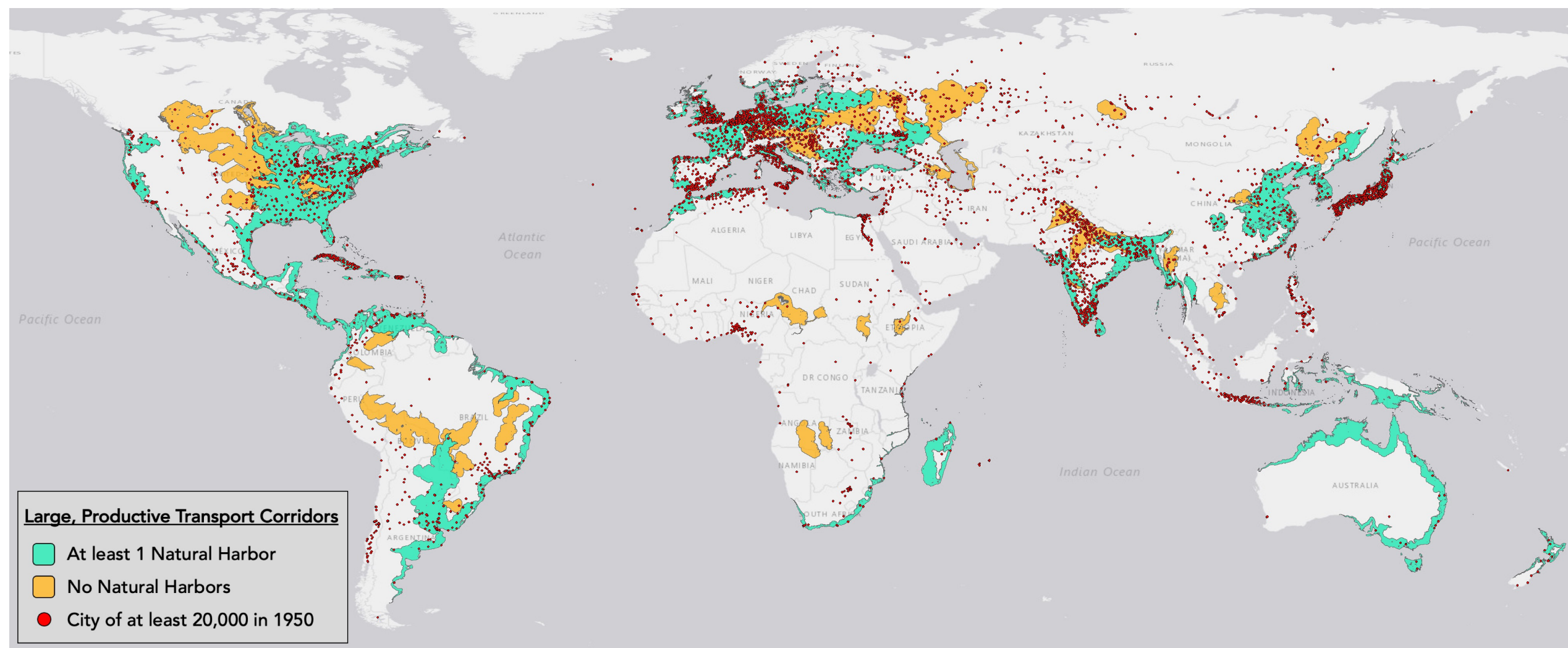
But begins to break down circa 2000

Large, Productive Transport Corridors
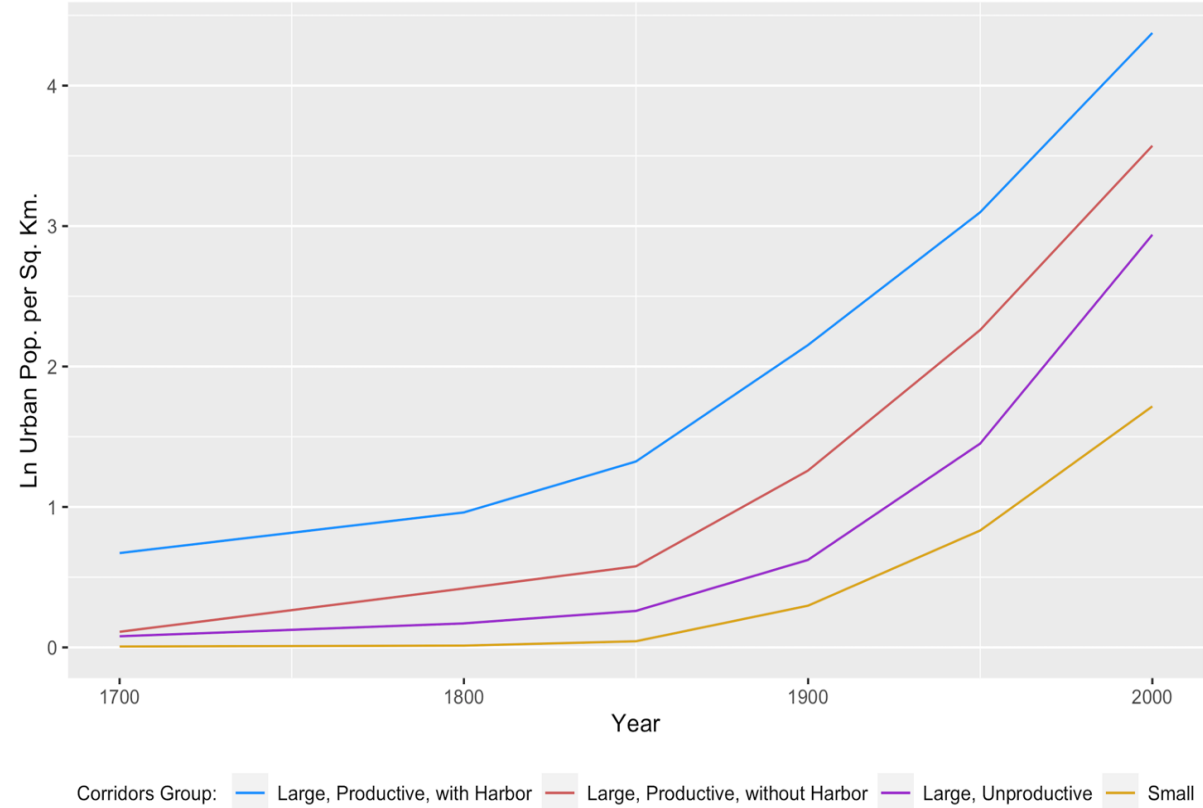- At least 1 Natural Harbor
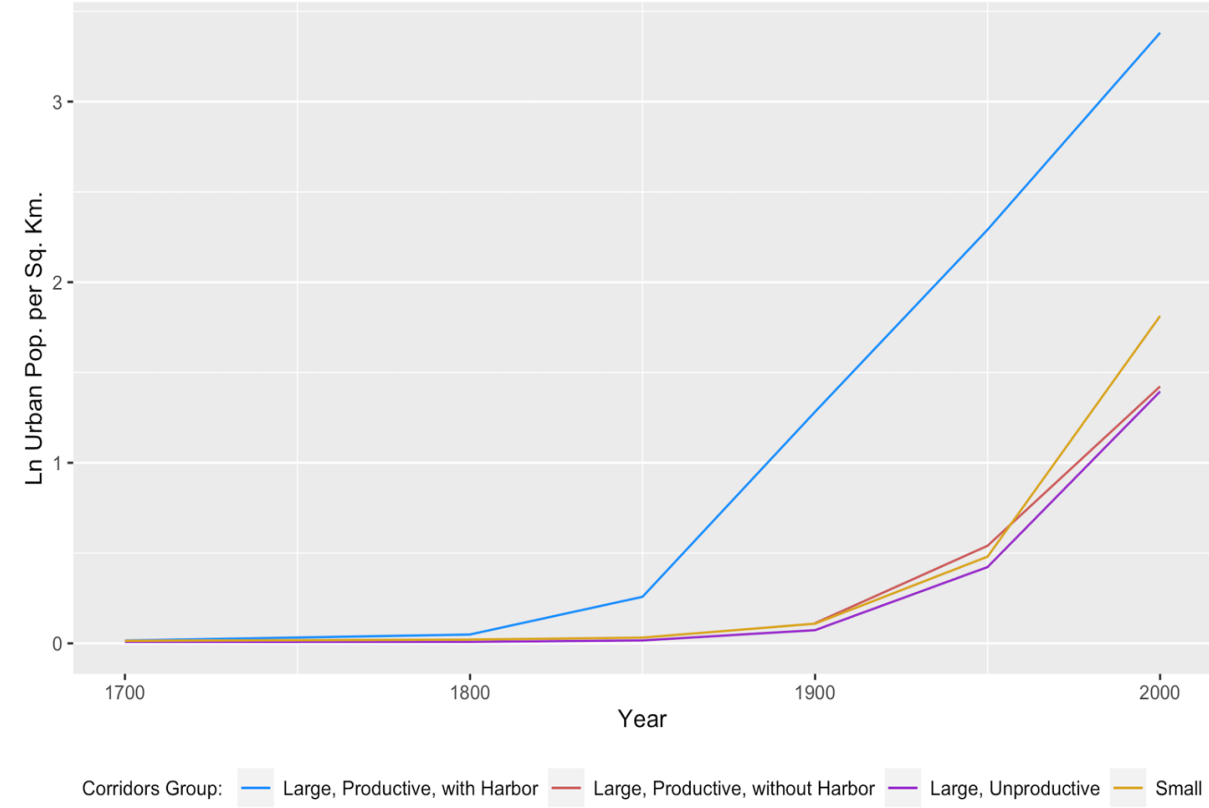- No Natural Harbors
- City of at least 20,000 in 2000
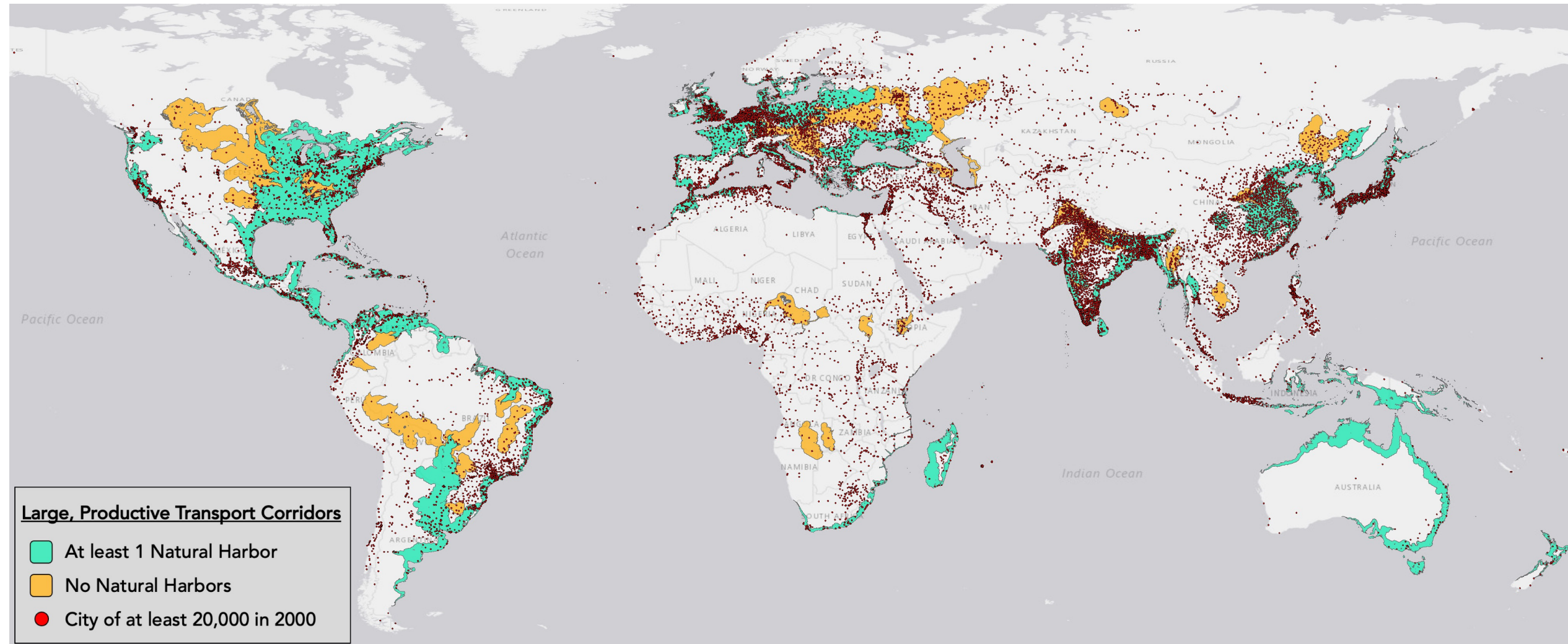
What we discover: Smith's hypothesis held until the mid-20th century

Old World Transport Corridors and Urban Population Densities, 1700-2000

New World Transport Corridors and Urban Population Densities, 1700-2000

Corridors Group: —— Large, Productive, with Harbor —— Large, Productive, without Harbor —— Large, Unproductive —— Small
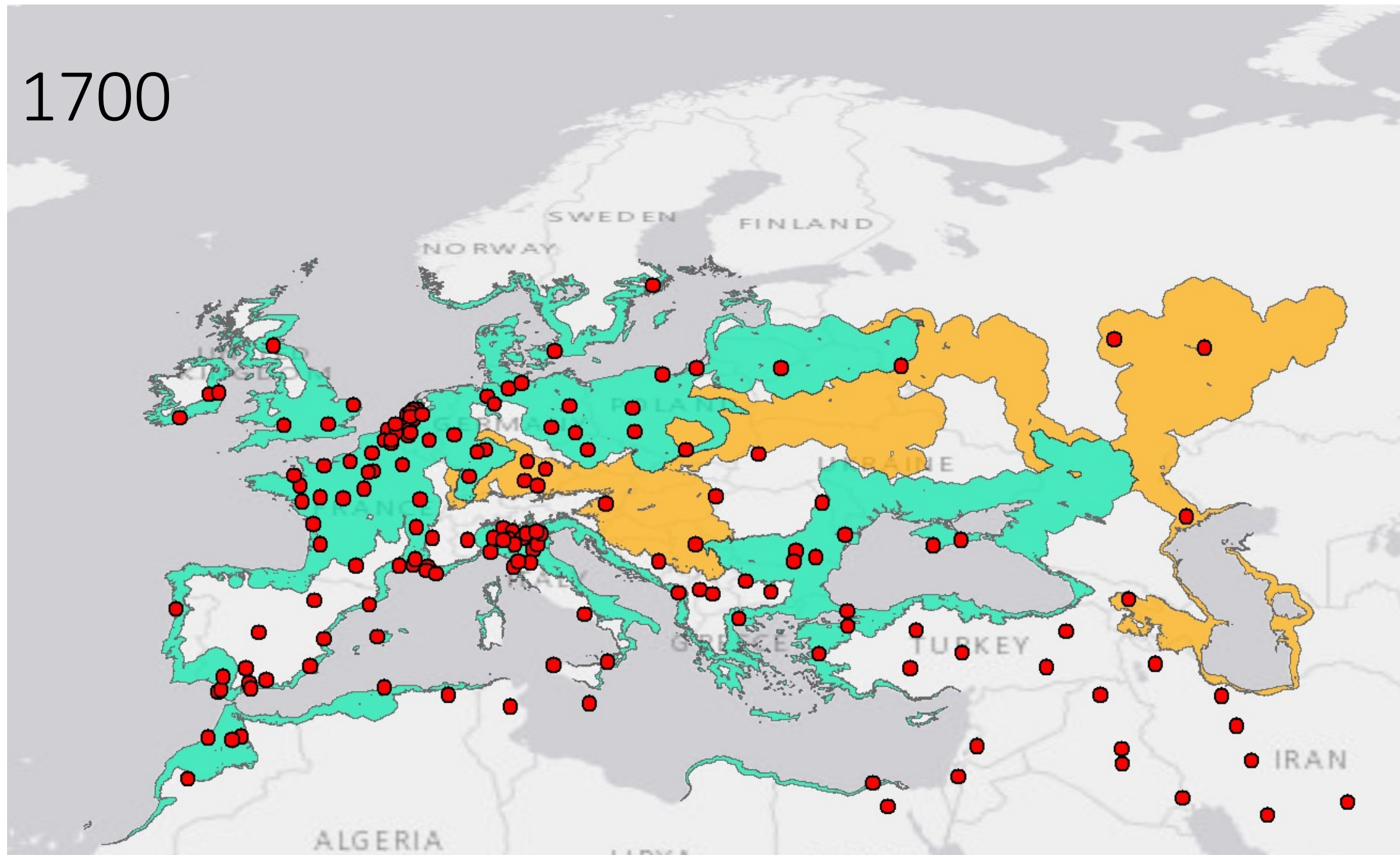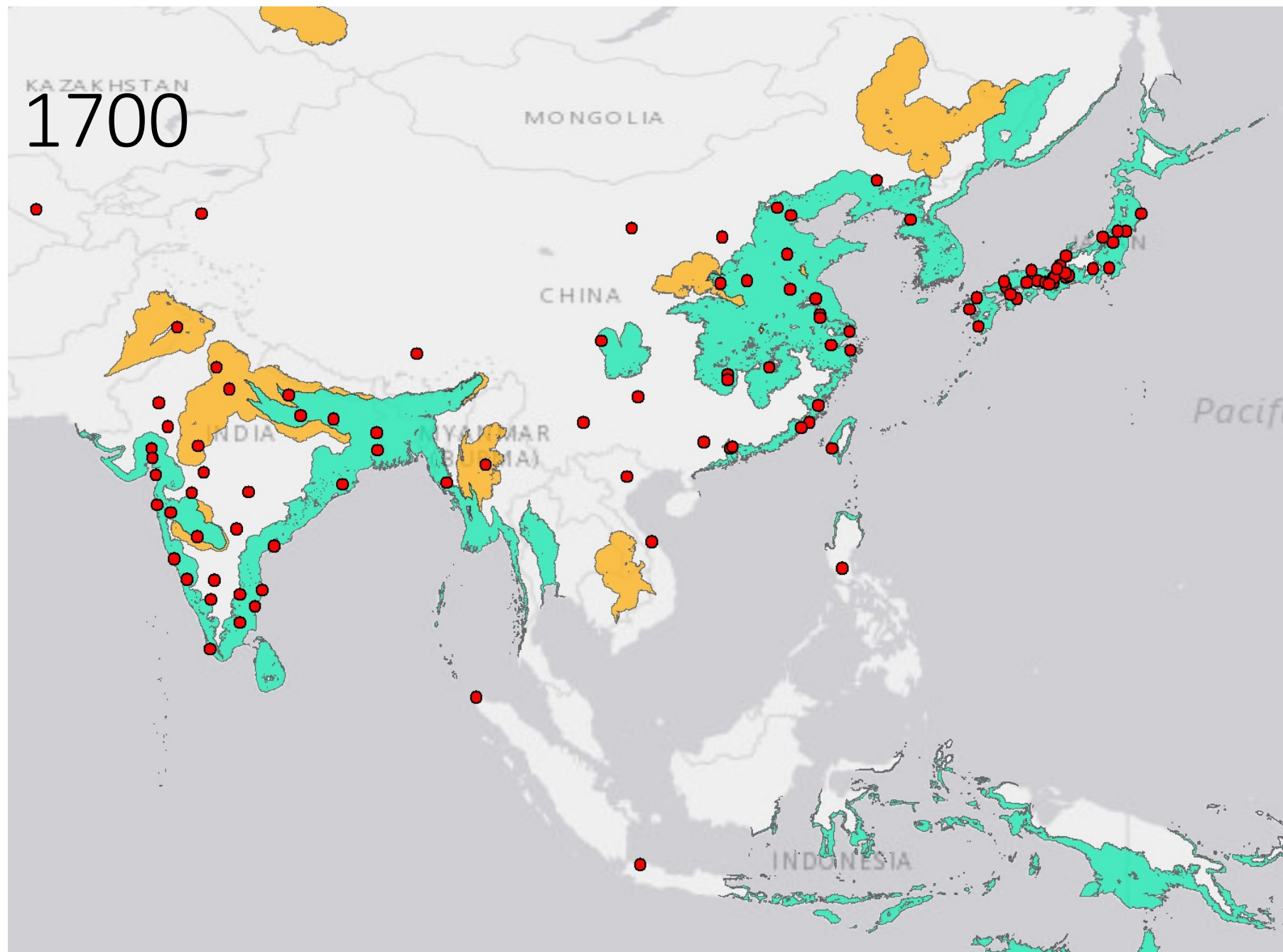
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Implications

- Geographic factors did not just play a big role in economic development in Smith's time, they continued to do so even after fossil fuel technologies made it possible to move goods vast distances at low cost.

- Human beings make a broad range of decisions —such as where to rebel, wage war, extend political influence, establish territorial control, or pollute—based on spatial reasoning, but scholars tend to use grid cells as the unit of analysis.
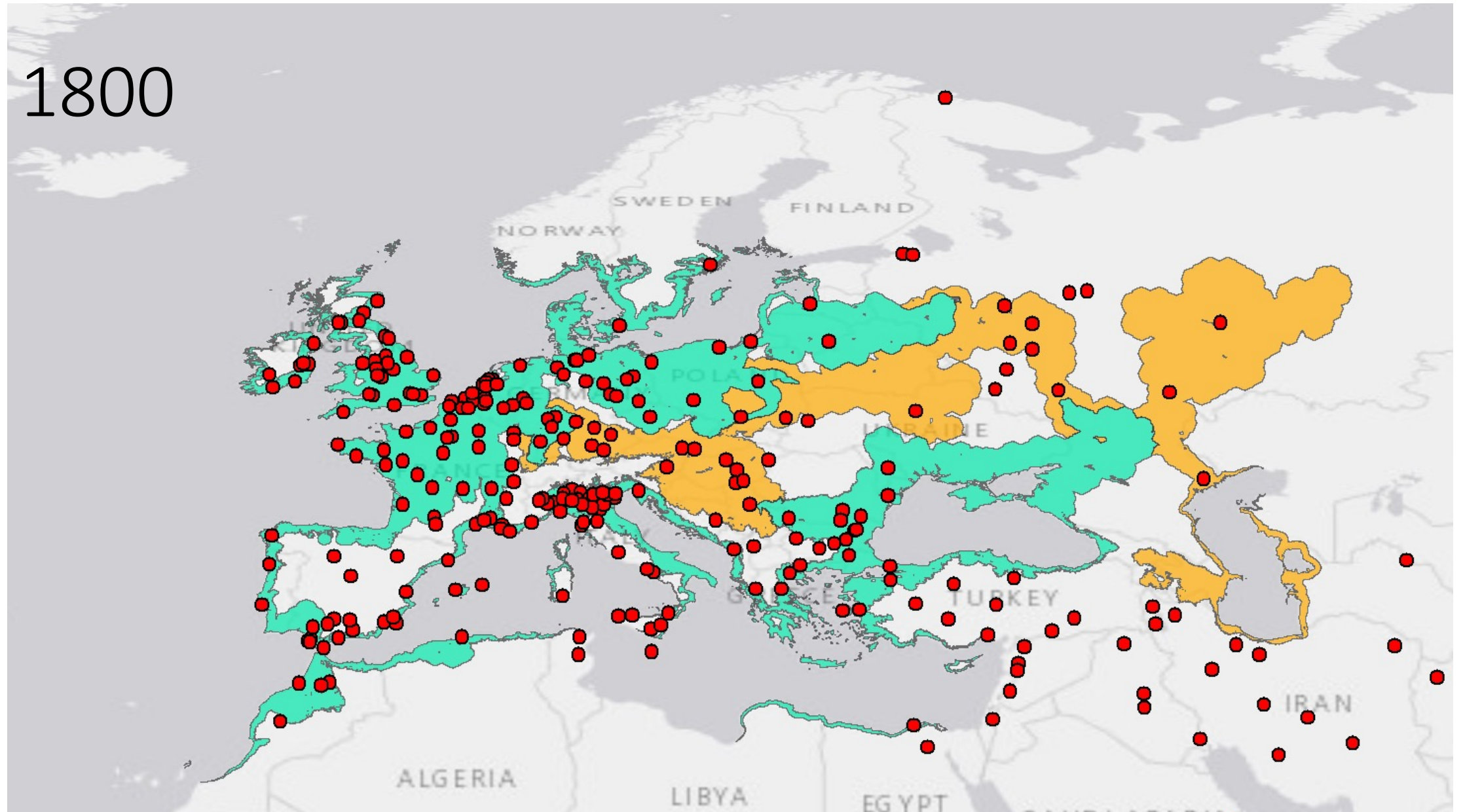
Thank you

1700

1700

1800

1800