London Business School

Equatorial Sea Level Rise

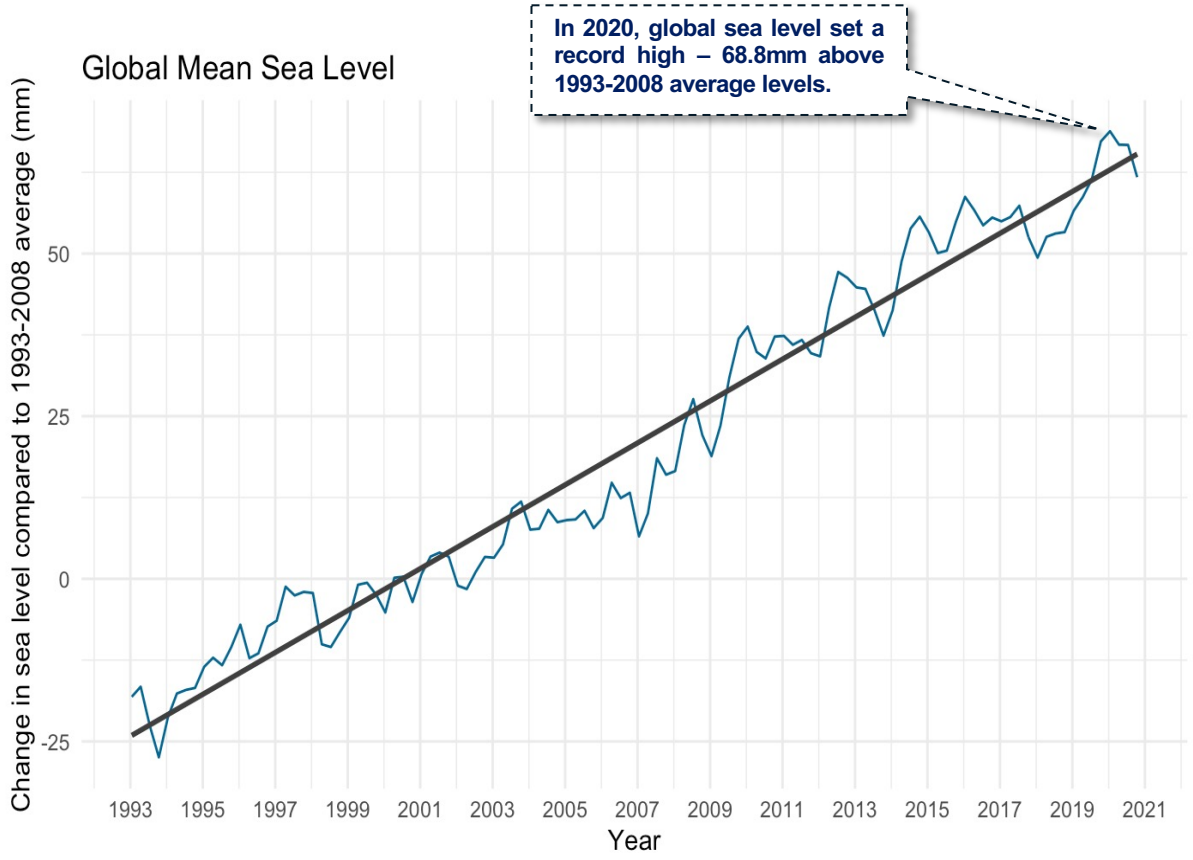
what drives it and why it matters

AM10 – Data Visualization, Study Group 3

Introduction

Overview

Sea level rise (SLR) has been considered one of the most severe impacts of climate change. Observations show that global mean sea level is on the rise, with rate accelerating in recent years.[1]



Problem Statement

*What are the **drivers** and **implications** of SLR?*

Drivers	Implications
1 Thermal Expansion	1 GDP
2 Polar Ice Melting	2 Land
	3 Population

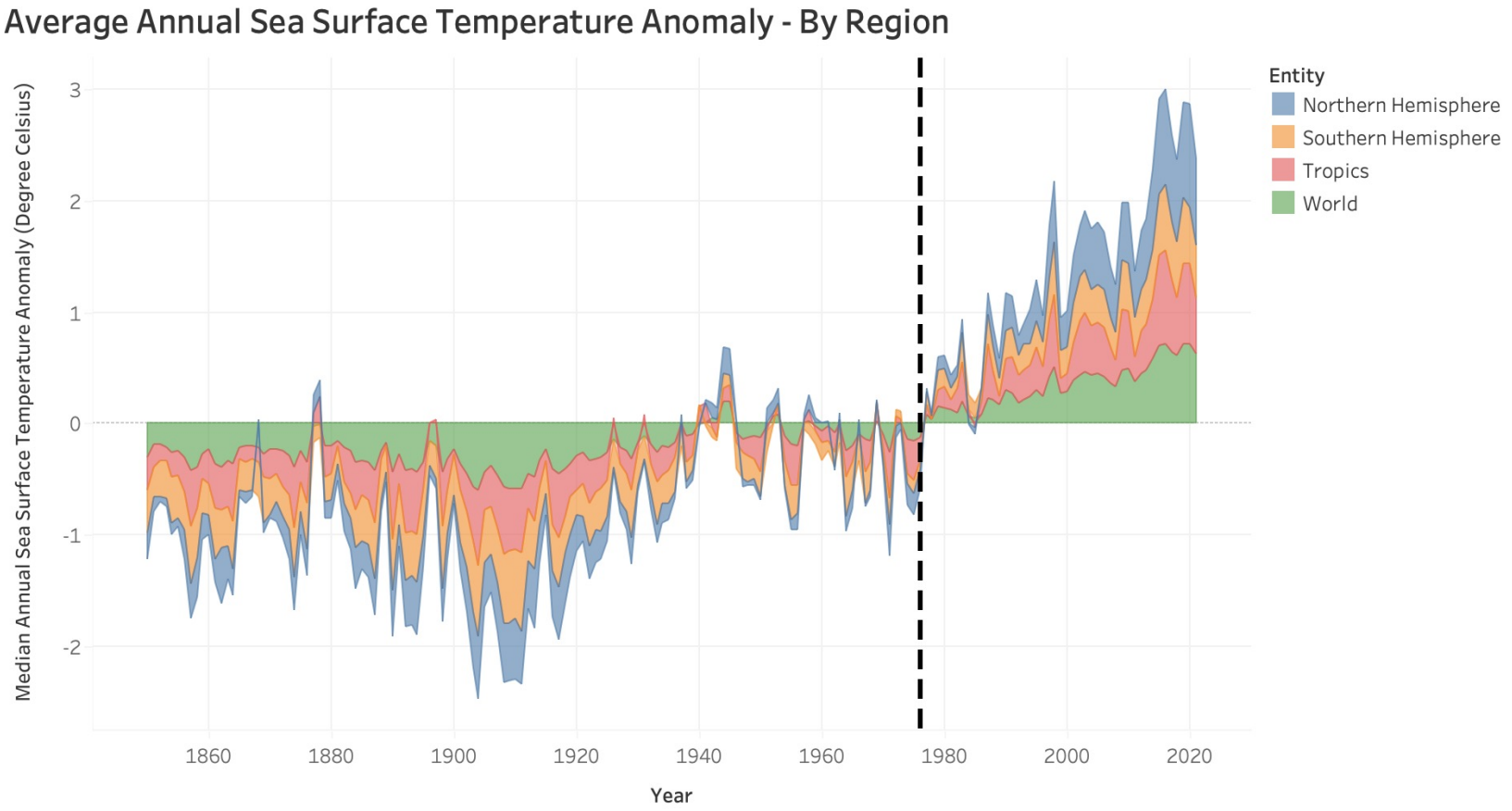
(National Geographic, 2019)

[1] *Our world in data:: Global mean sea level rise is measured relative to the 1993 - 2008 average sea level. The dataset used here is the average from the two datasets: the widely-cited Church & White dataset, and the University of Hawaii Sea Level Center (UHLSC).*

Ocean Temperatures have spiked globally

Drivers of Sea Level Rise

Thermal Expansion: Sea Levels are rising as ocean surface temperatures warm up and expand in volume. [1]



The plot of median of Annual Sea Surface Temperature Anomaly for years 1850-2021, relative to the average temperature from 1961-1990. Color shows details about Entity. The view is filtered on Entity, which keeps Northern Hemisphere, Southern Hemisphere, Tropics and the World.

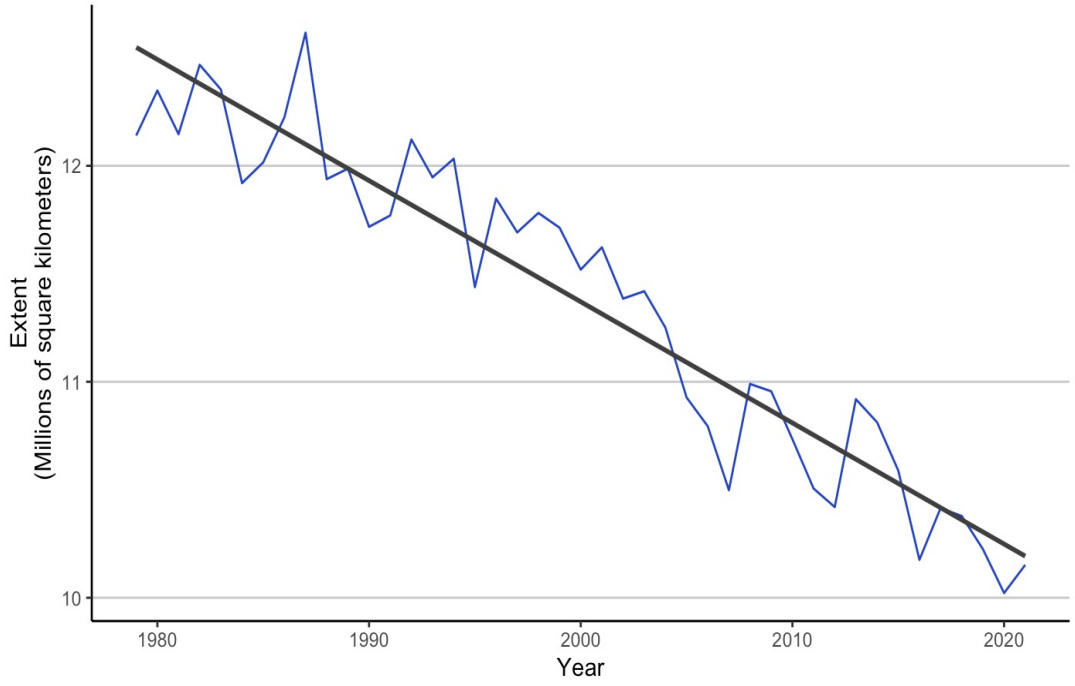
1. Positive temperature anomalies indicate observed temperature is warmer than the baseline
2. 1977 is the beginning of high ocean temperatures, affecting mostly the Northern Hemisphere
3. Warming of ocean surface caused roughly 1/3 of global sea level rise since 2004

[1] Chen et al. (2013) Contribution of ice sheet and mountain glacier melt to recent sea level rise. Nature Geoscience.

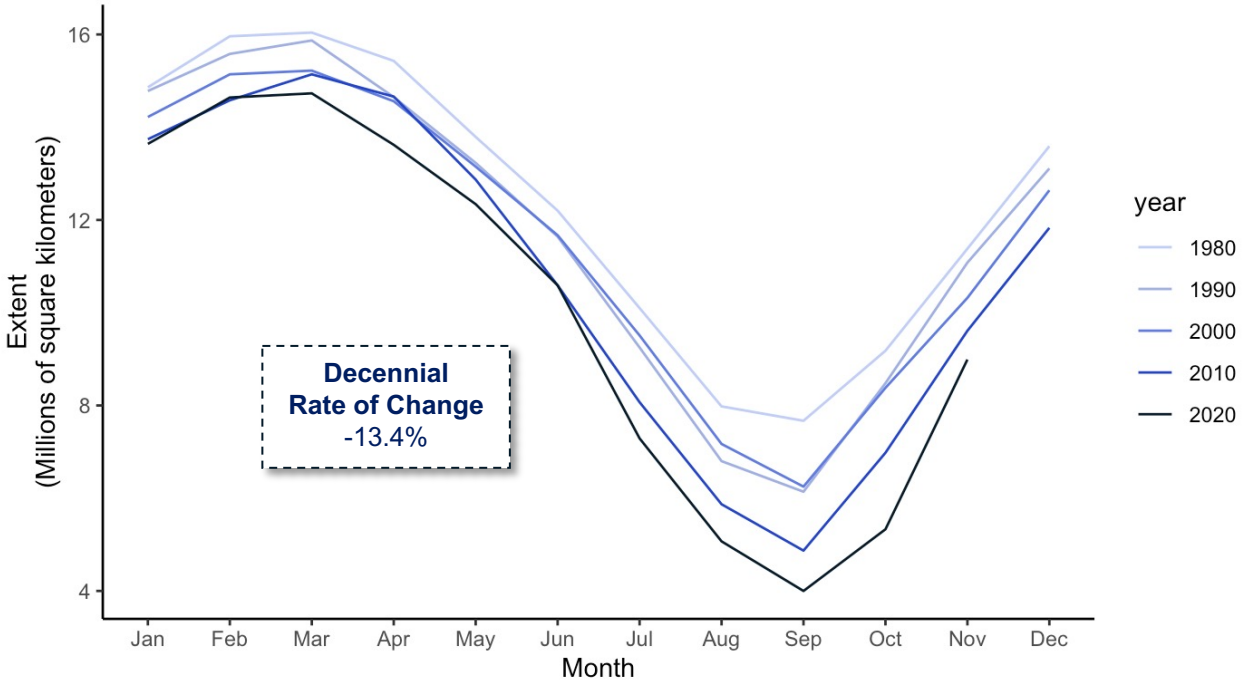
Polar warming has wiped out ice extent

Drivers of Sea Level Rise

Average Arctic Sea Ice Extent



Annual Arctic Sea Ice Trend



1. Arctic Ice Extent has decreased by ~ 30%
2. Seasonal consistency
3. Ice Extent/Volume ↓ Sea Level Rise ↑

The future of Sea Level Rise

Driver analysis and prediction

Key Driver Analysis

Linear Regression Model[1]

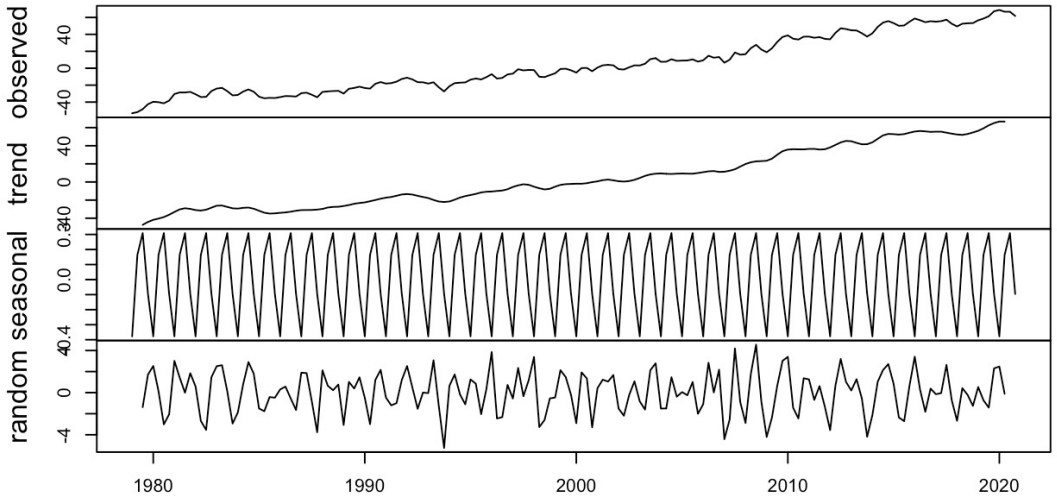
Variable	Estimate (mm)	P-Value
Temperature Anomaly (C°)	65.408	< 2e-16 ***
Sea Ice Extent Anomaly (M Km^2)	-14.734	7.41e-11 ***

R^2	**84%**
Adjusted R^2	**83.8%**
Number of observations	168

Thermal Expansion 5°C + **Ice Extent** -47.6M km^2 = **SLR** 1 m

Time Series Decomposition & Prediction

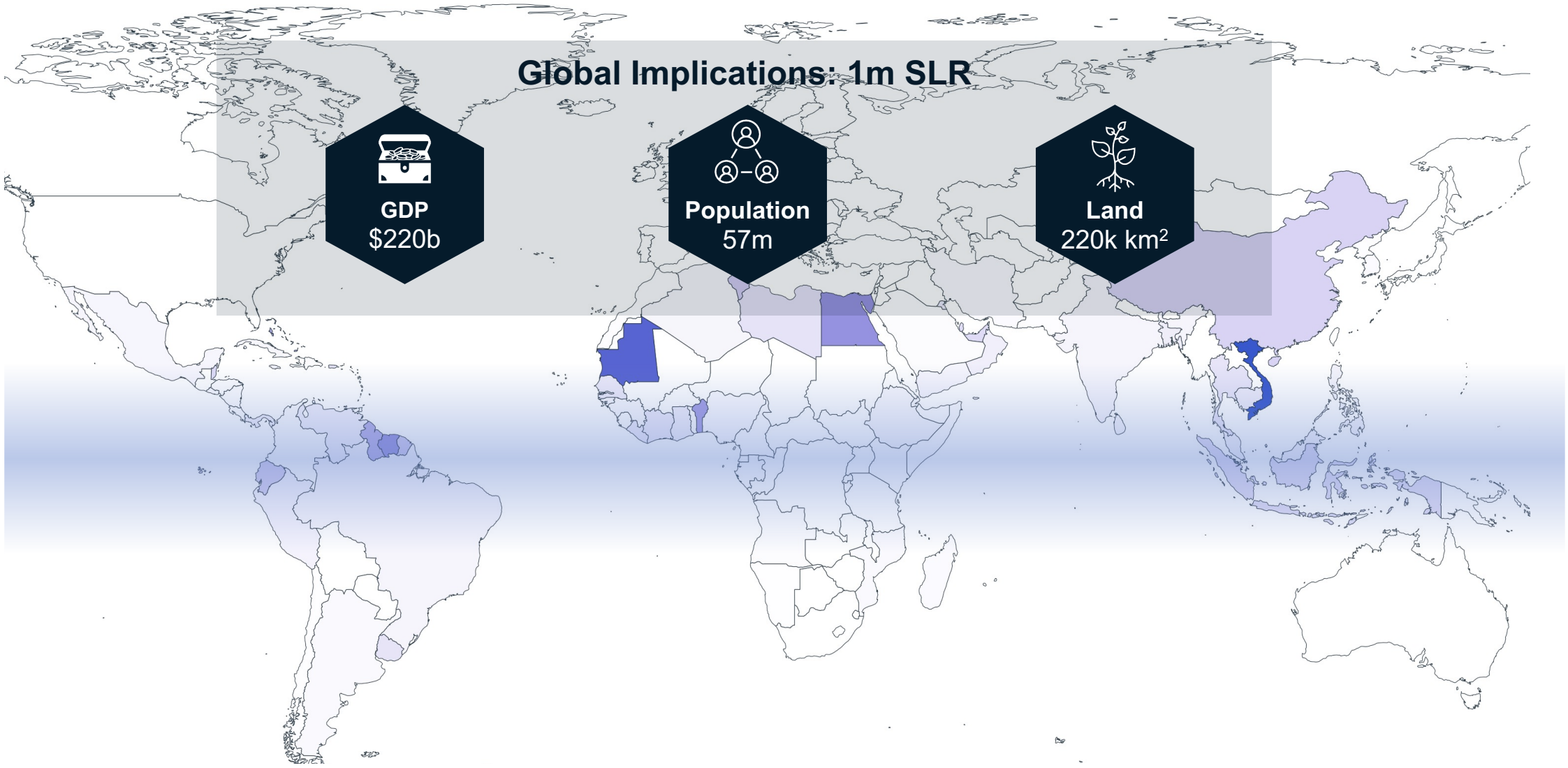
Decomposition of additive time series



1. There is a **clear increasing** trend in sea level
2. Monthly average sea level has obvious **seasonal characters**
3. **HoltWinters**: Sea level will increase by **1 m** by **2120** in 95% confidence interval upper level

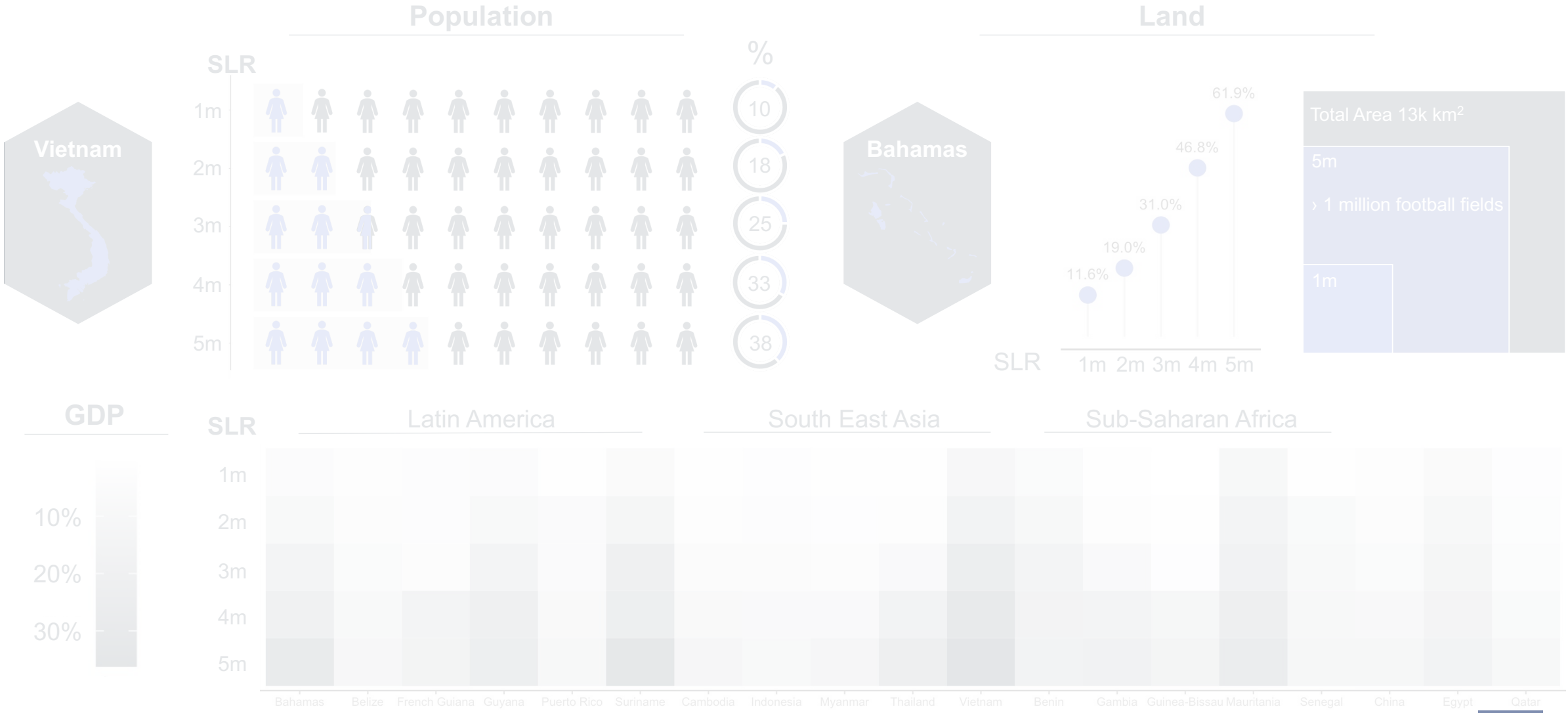
[1] Regression model run on Northern Hemisphere Sea Level

SLR most impactful surrounding equator



SLR consequences distributed unevenly

A look at the most affected regions



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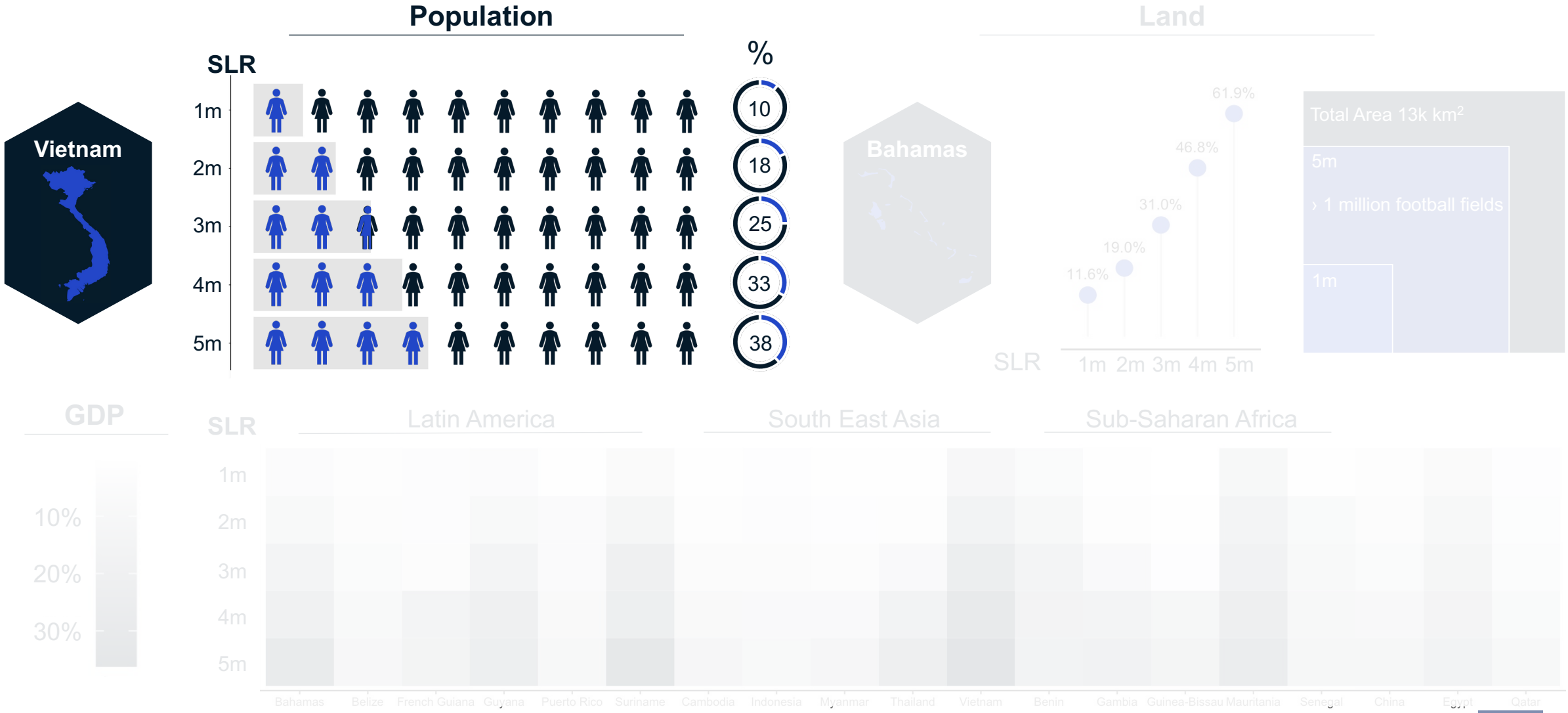

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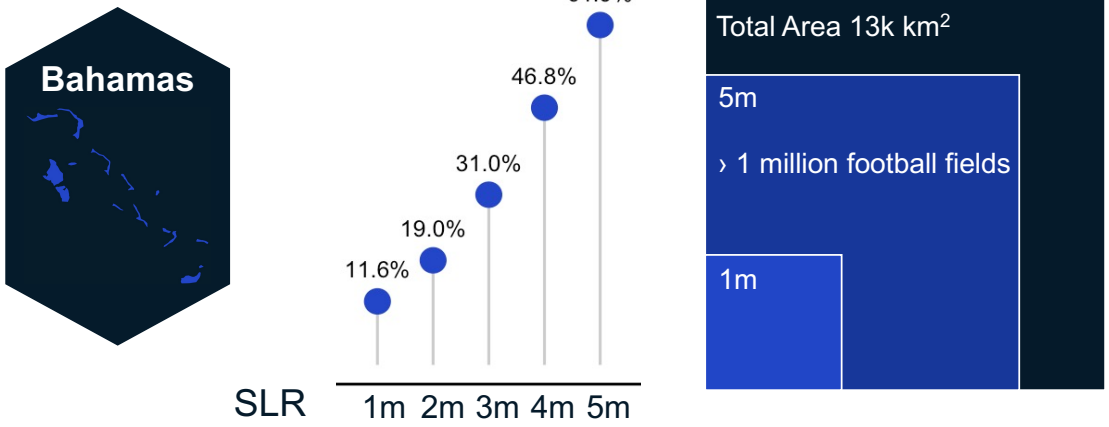
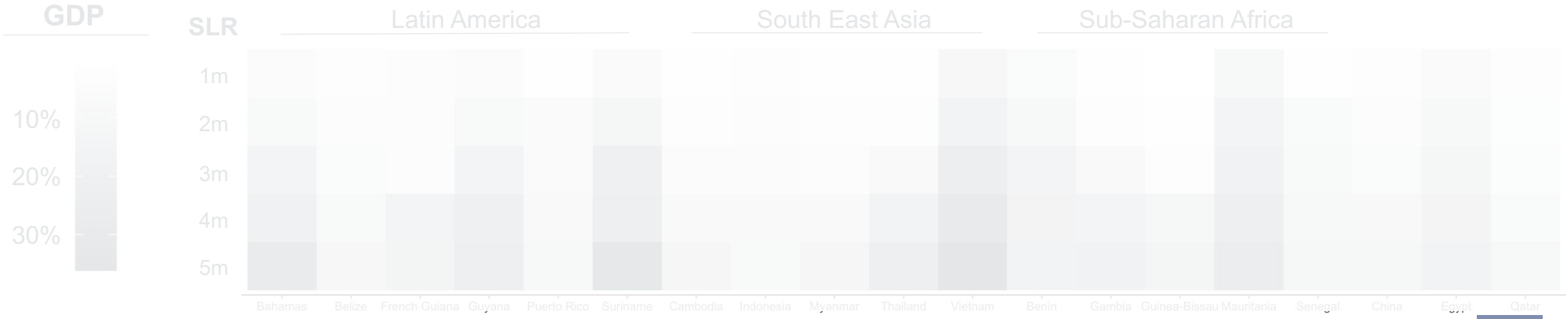
Population

Land



GDP



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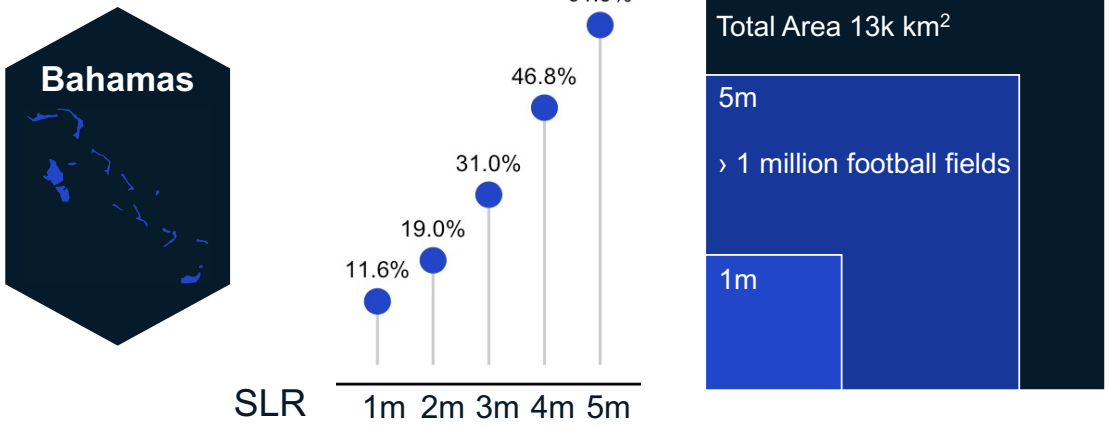

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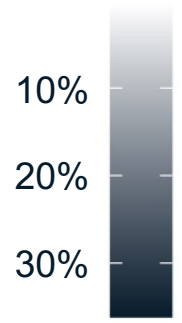

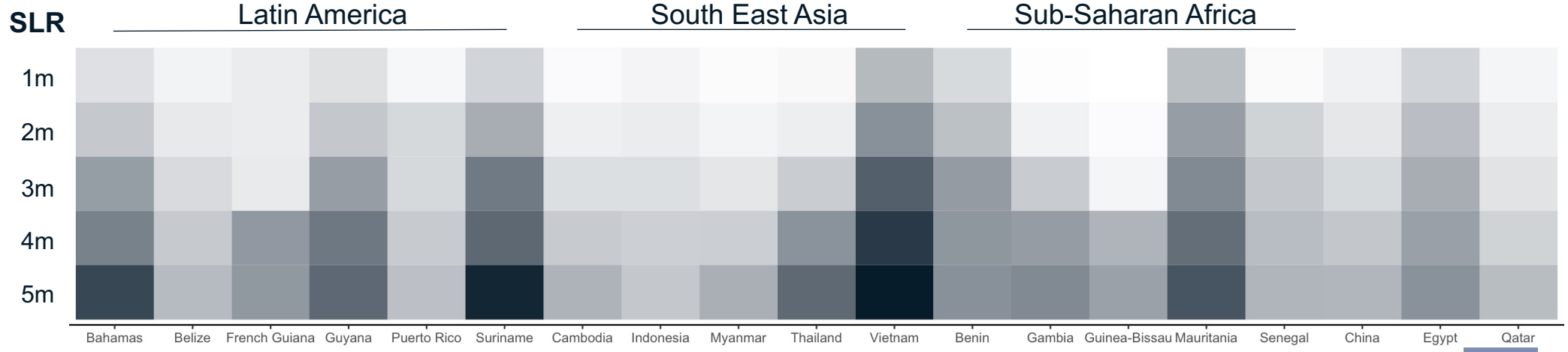

Conclusion

Key Takeaways and Limitations

What drives it

Thermal Expansion

2020 witnessed 0.7C rise in sea surface temperature

Polar Ice Melting

Average Arctic Sea Ice Extent has decreased

Why it matters

If trends continue…

57m people affected

220k km^2 land flooded

Sea level will rise by 1m

Limitations

1. Limited confidence about prediction due to insufficient historical data of key drivers
2. Overlooking critical implications due to analysis of only two main drivers

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