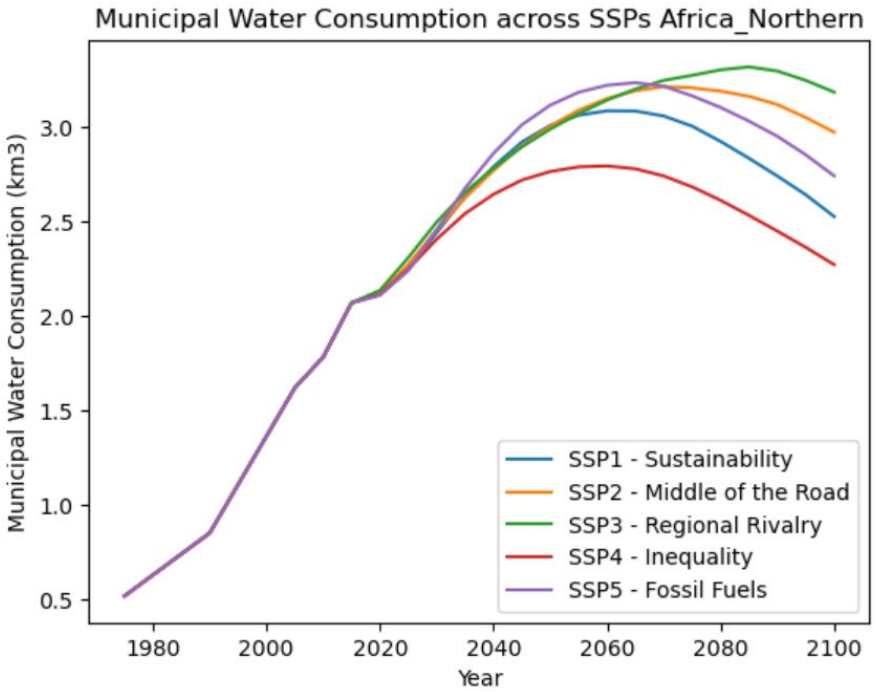
Project Updates

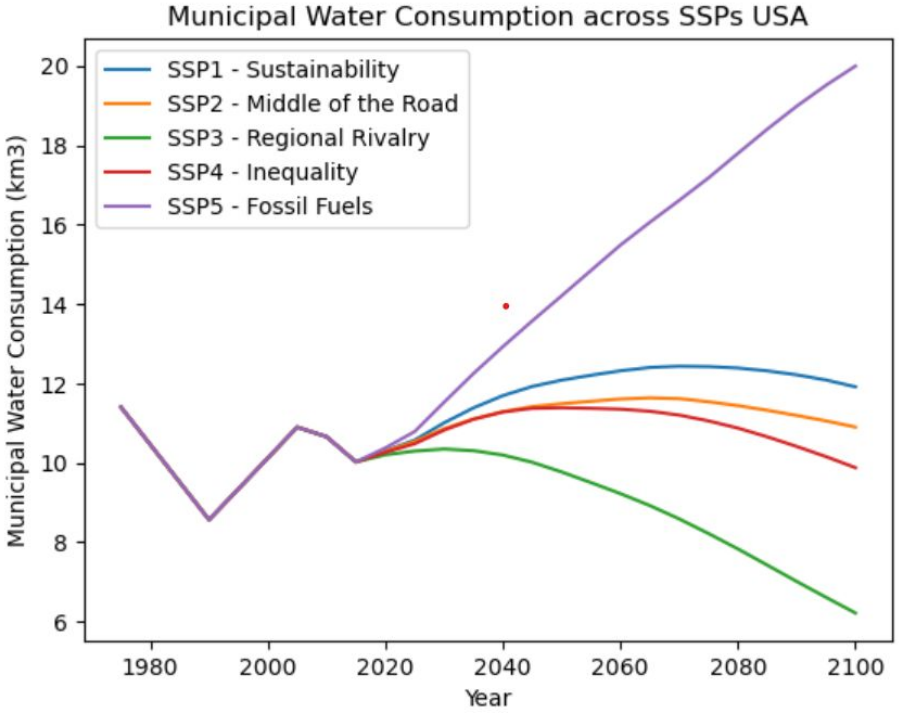
Conflict Group Project 1

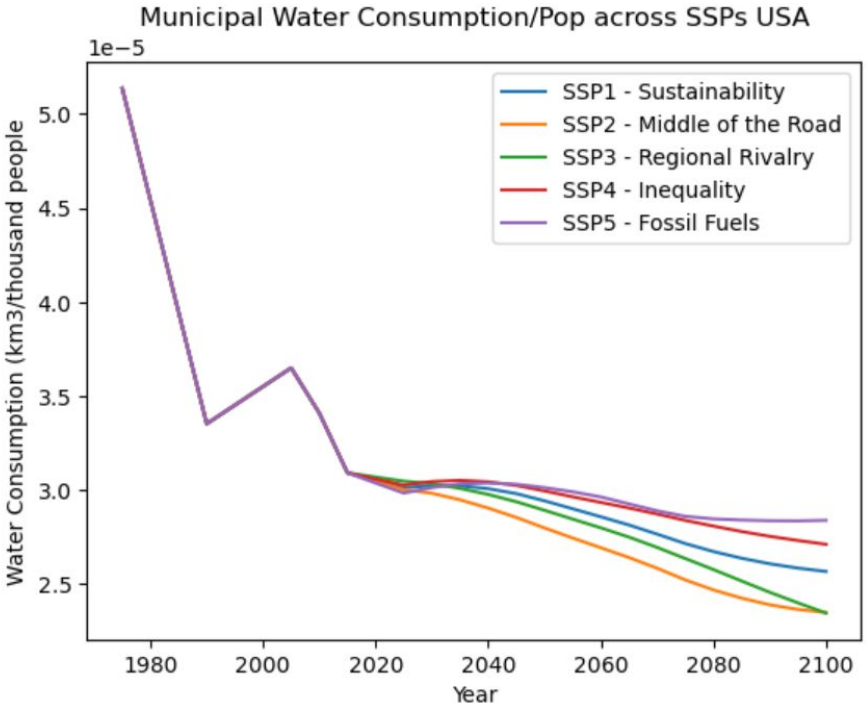
Summary

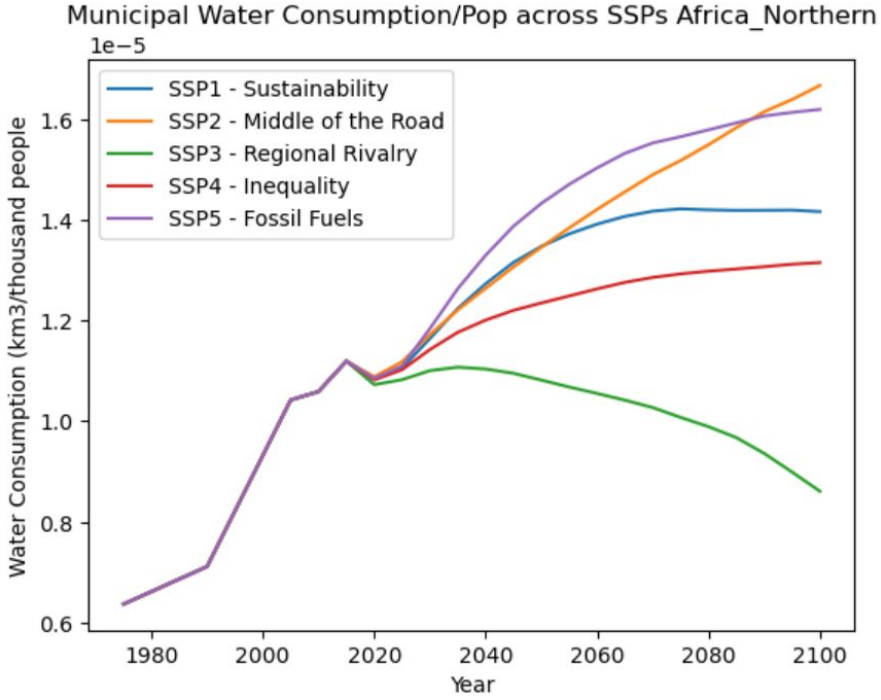
- Ran 5 ssp scenarios - every other parameter is reference
- GCAM/Cluster issues
  - Disc Quota Exceeded error (Maggie and I) - any way to get more space?
  - Error in packages means I need to rebuild GCAM every new time I run it- any ideas for why this happens?
- RGCAM working the best to query output databases
  - Figured out how to query multiple parameters
- Next steps: stop GCAM for a bit to determine final metrics

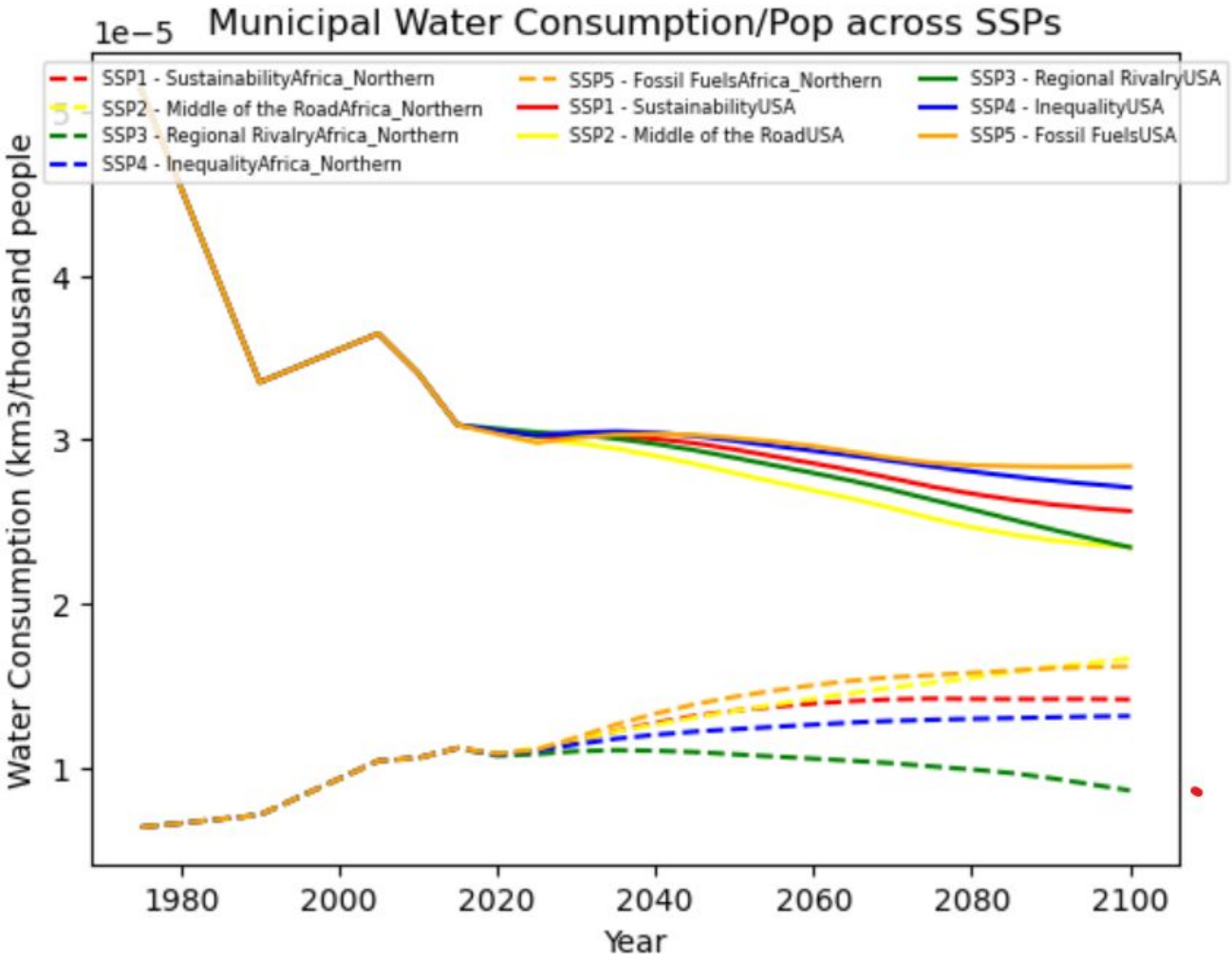
SSPs in Various Regions (Municipal Water Consumption)





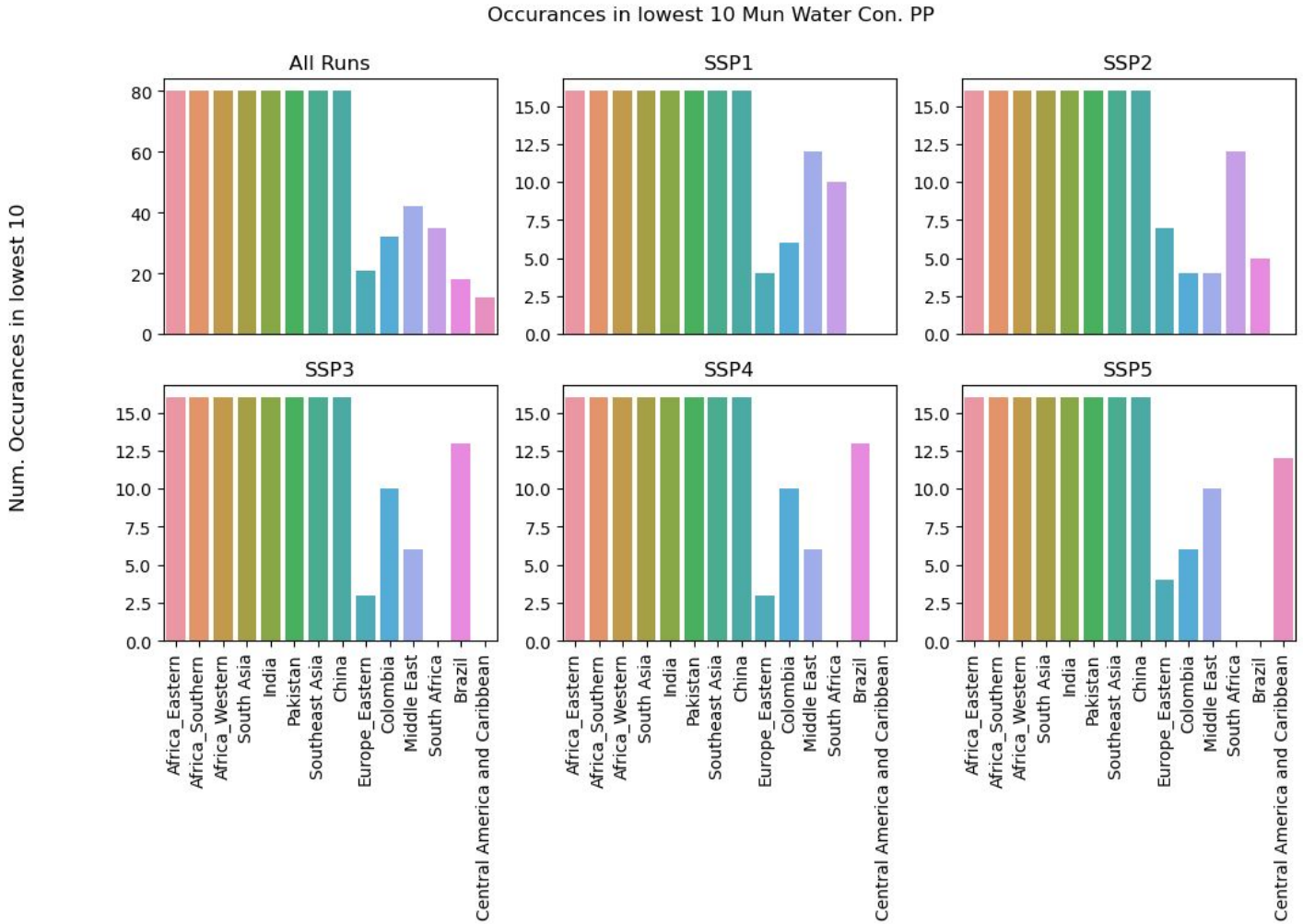

Municipal Water Consumption/Pop across SSPs USA
1e−5
Water Consumption (km3/thousand people
Year
SSP1 - Sustainability
SSP2 - Middle of the Road
SSP3 - Regional Rivalry
SSP4 - Inequality
SSP5 - Fossil Fuels
5.0
4.5
4.0
3.5
3.0
2.5
1980
2000
2020
2040
2060
2080
2100

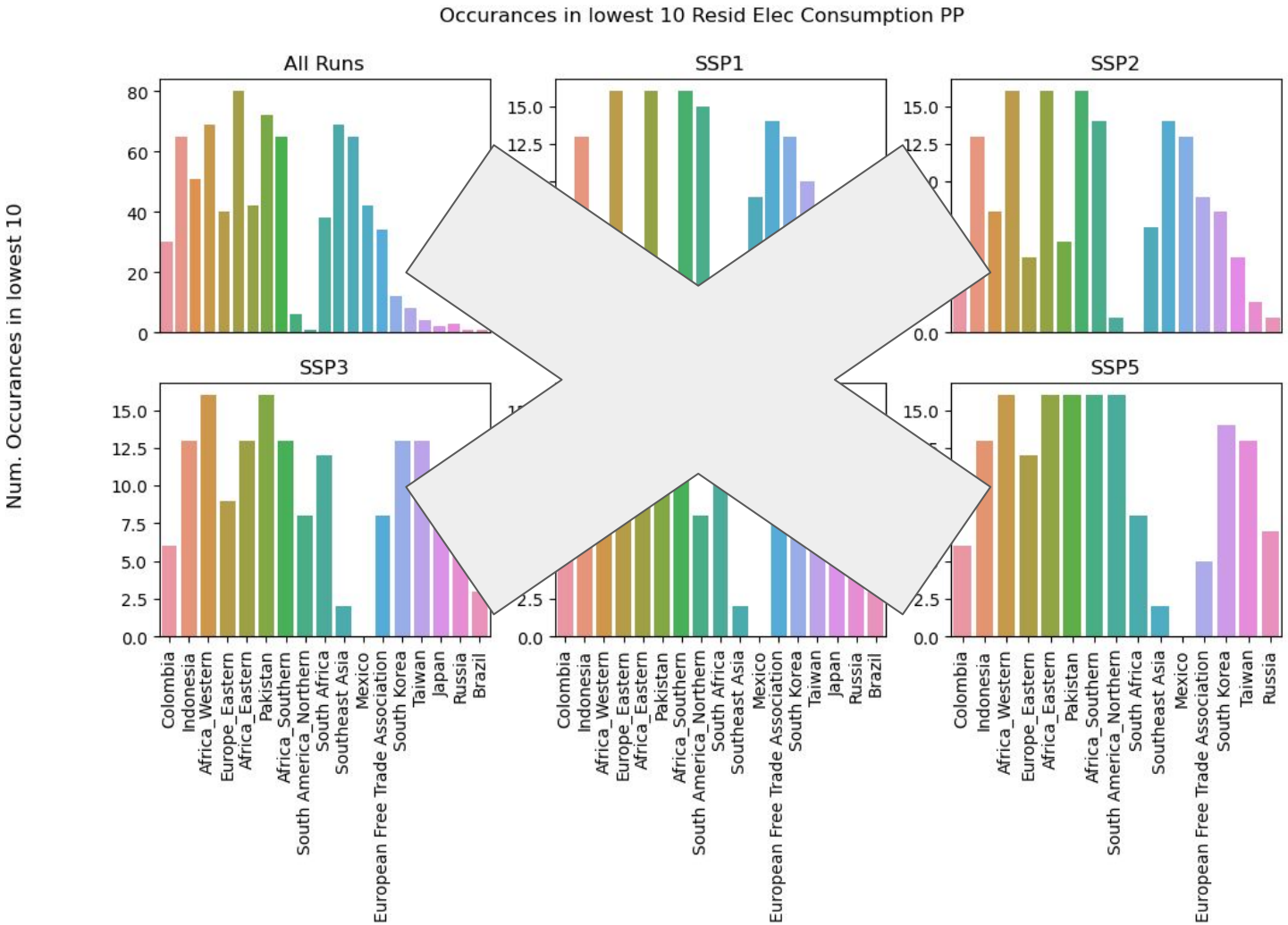

Municipal Water Consumption/Pop across SSPs Africa_Northern
1e−5
Water Consumption (km3/thousand people
Year
SSP1 - Sustainability
SSP2 - Middle of the Road
SSP3 - Regional Rivalry
SSP4 - Inequality
SSP5 - Fossil Fuels
1.6
1.4
1.2
1.0
0.8
0.6
1980
2000
2020
2040
2060
2080
2100


Municipal Water Consumption/Pop across SSPs
1e−5
SSP1 - SustainabilityAfrica_Northern
SSP2 - Middle of the RoadAfrica_Northern
SSP3 - Regional RivalryAfrica_Northern
SSP4 - InequalityAfrica_Northern
SSP5 - Fossil FuelsAfrica_Northern
SSP1 - SustainabilityUSA
SSP2 - Middle of the RoadUSA
SSP3 - Regional RivalryUSA
SSP4 - InequalityUSA
SSP5 - Fossil FuelsUSA
Water Consumption (km3/thousand people
5
4
3
2
1
1980
2000
2020
2040
2060
2080
2100
Year

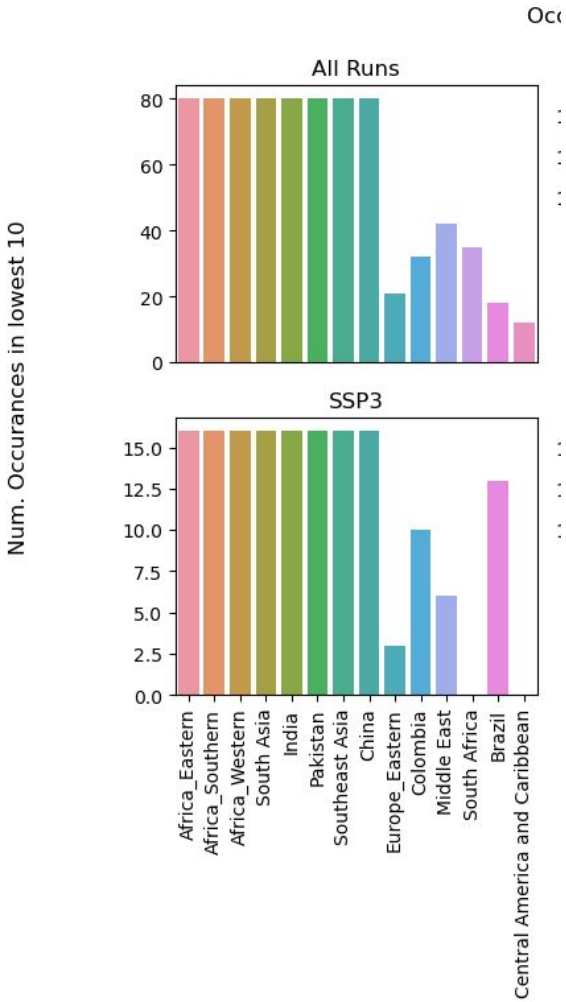
3/5/2024

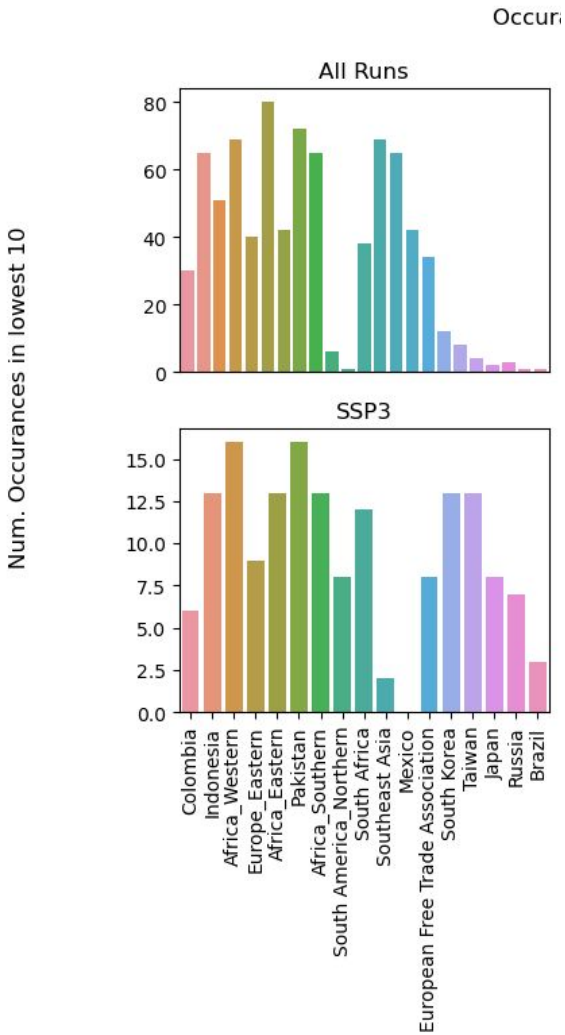
Goal: Mun Water Consumption per SSP- What early signs can we see?


Occurances in lowest 10 Mun Water Con. PP
Num. Occurances in lowest 10
All Runs
SSP1
SSP2
SSP3
SSP4
SSP5
Africa_Eastern
Africa_Southern
Africa_Western
South Asia
India
Pakistan
Southeast Asia
China
Europe_Eastern
Colombia
Middle East
South Africa
Brazil
Central America and Caribbean


Occurances in lowest 10 Resid Elec Consumption PP
Num. Occurances in lowest 10
All Runs
SSP1
SSP2
SSP3
SSP5
Colombia
Indonesia
Africa_Western
Europe_Eastern
Africa_Eastern
Pakistan
Africa_Southern
South America_Northern
South Africa
Southeast Asia
Mexico
European Free Trade Association
South Korea
Taiwan
Japan
Russia
Brazil

Water



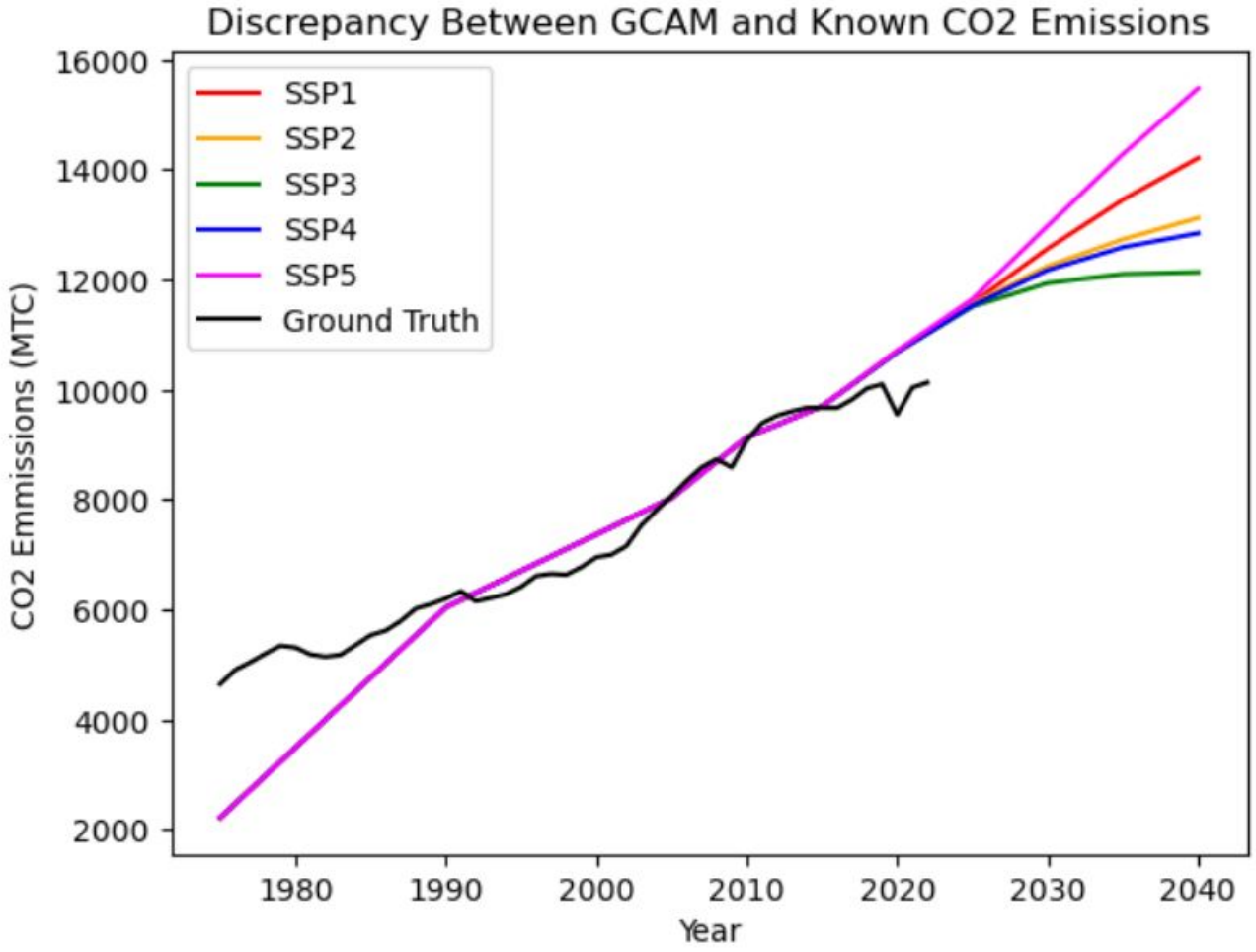


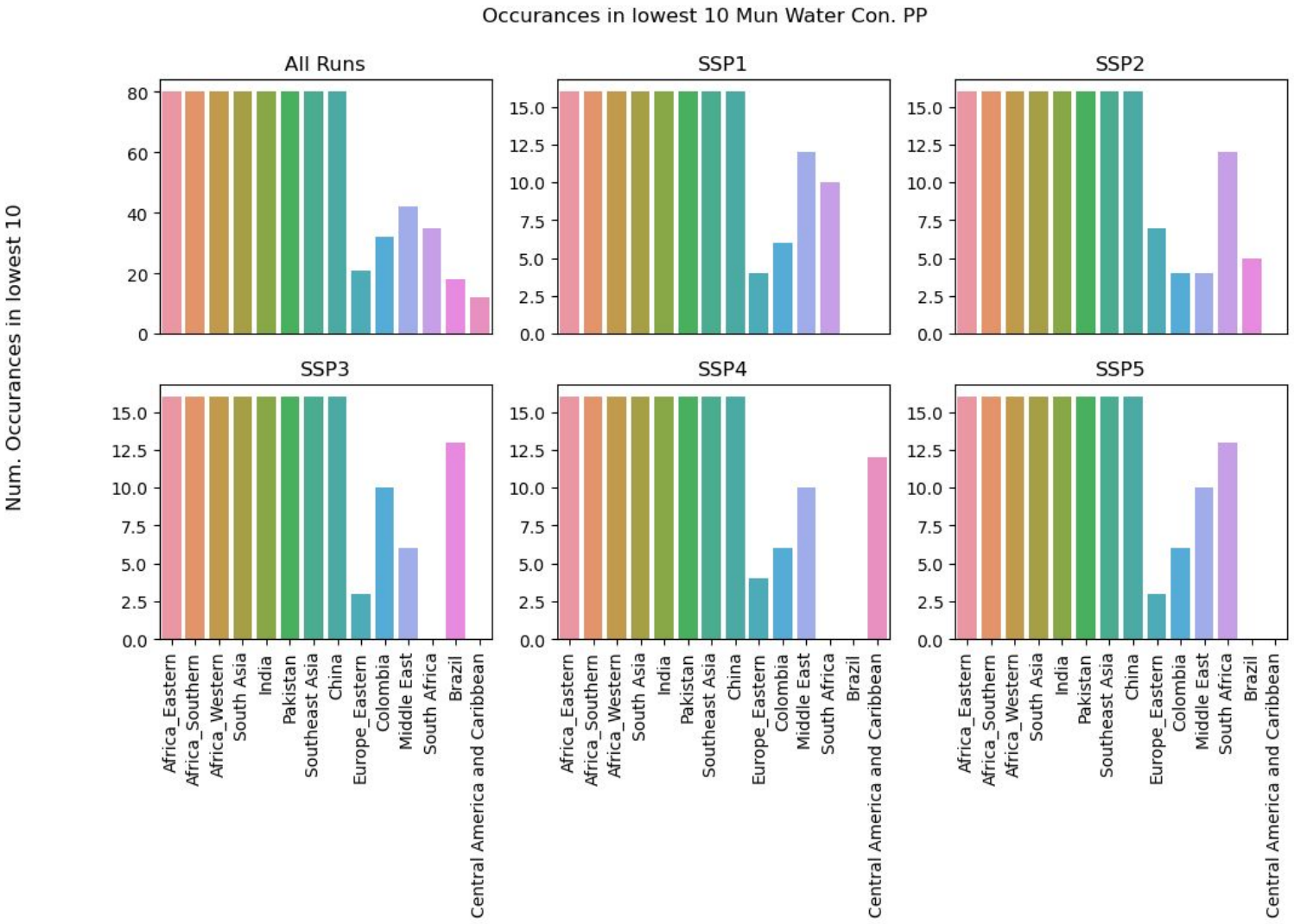
Residential Electricity

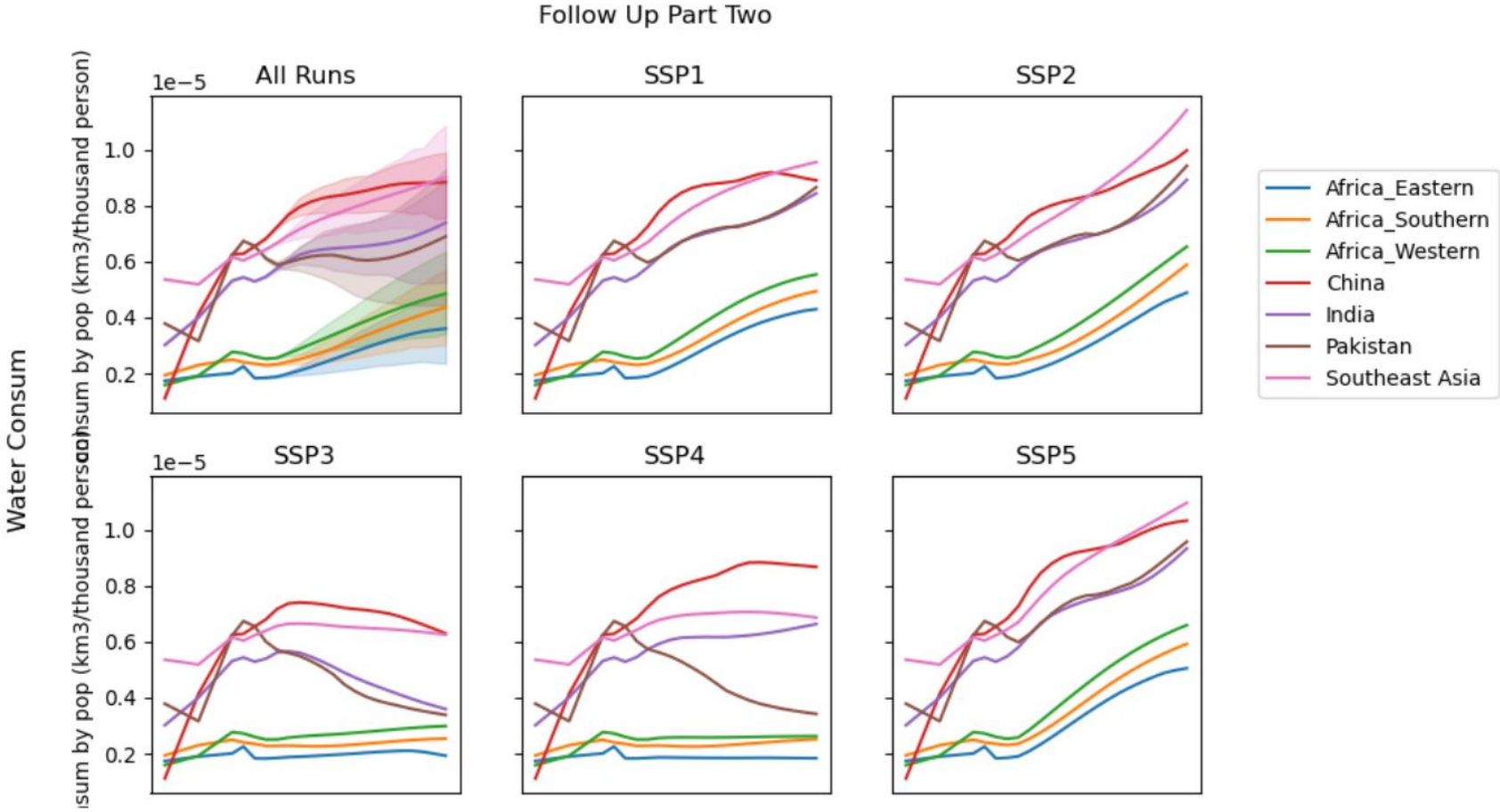
3/12/2024

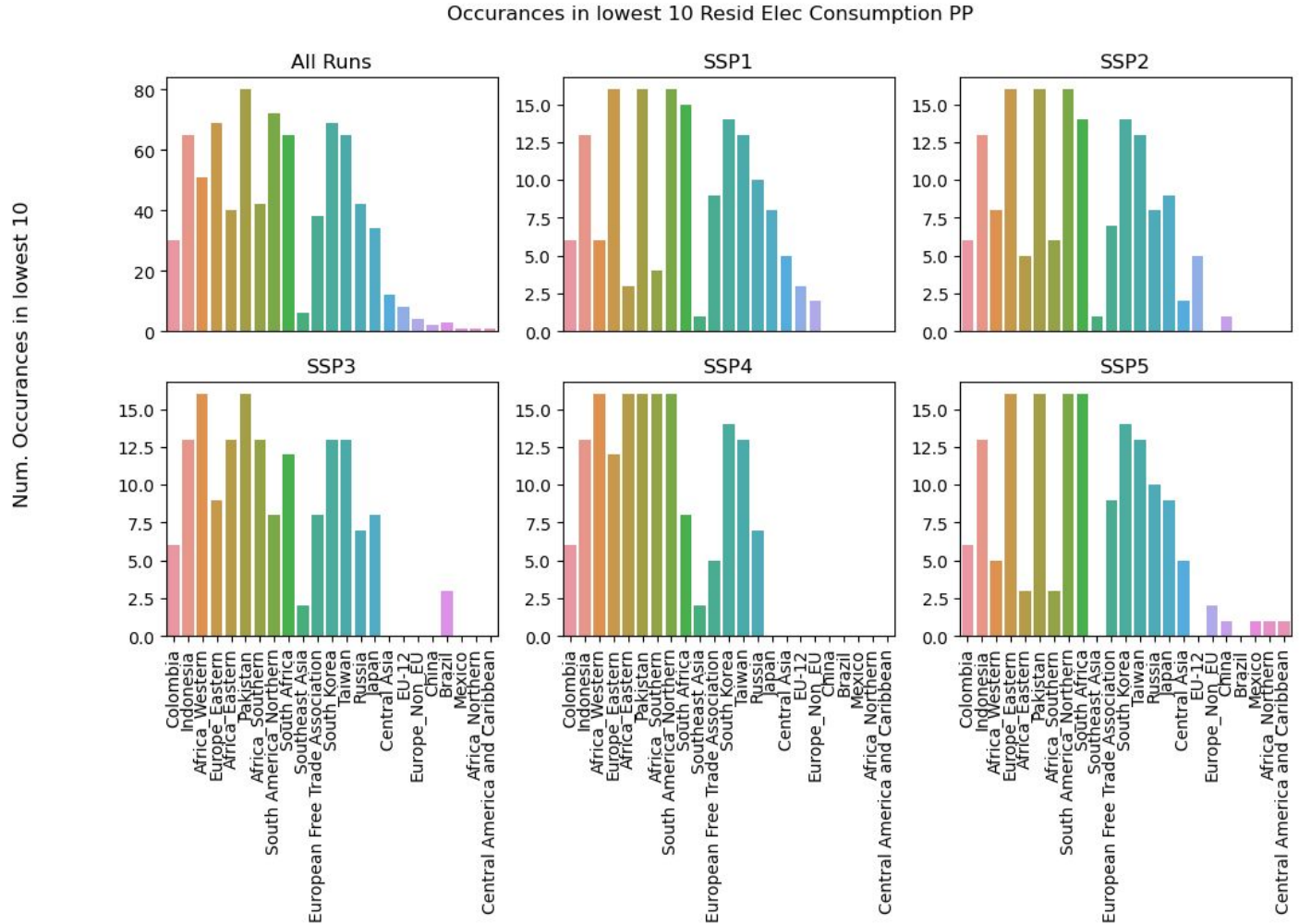
Questions

- Update on cluster storage?
  - Use our own databases or borrow someone else's given storage limitations?
    - If others, how to get access?
  - If our own - how many should/could we run?
    - Each scenario output is about 3 GB


Discrepancy Between GCAM and Known CO2 Emissions
SSP1
SSP2
SSP3
SSP4
SSP5
Ground Truth
CO2 Emmissions (MTC)
16000
14000
12000
10000
8000
6000
4000
2000
1980
1990
2000
2010
2020
2030
2040
Year


Occurances in lowest 10 Mun Water Con. PP
Num. Occurances in lowest 10
All Runs
SSP1
SSP2
SSP3
SSP4
SSP5
Africa_Eastern
Africa_Southern
Africa_Western
South Asia
India
Pakistan
Southeast Asia
China
Europe_Eastern
Colombia
Middle East
South Africa
Brazil
Central America and Caribbean


Follow Up Part Two
Water Consum
All Runs
SSP1
SSP2
SSP3
SSP4
SSP5
1e−5
1.0
0.8
0.6
0.4
0.2
sum by pop (km3/thousand person)
Africa_Eastern
Africa_Southern
Africa_Western
China
India
Pakistan
Southeast Asia

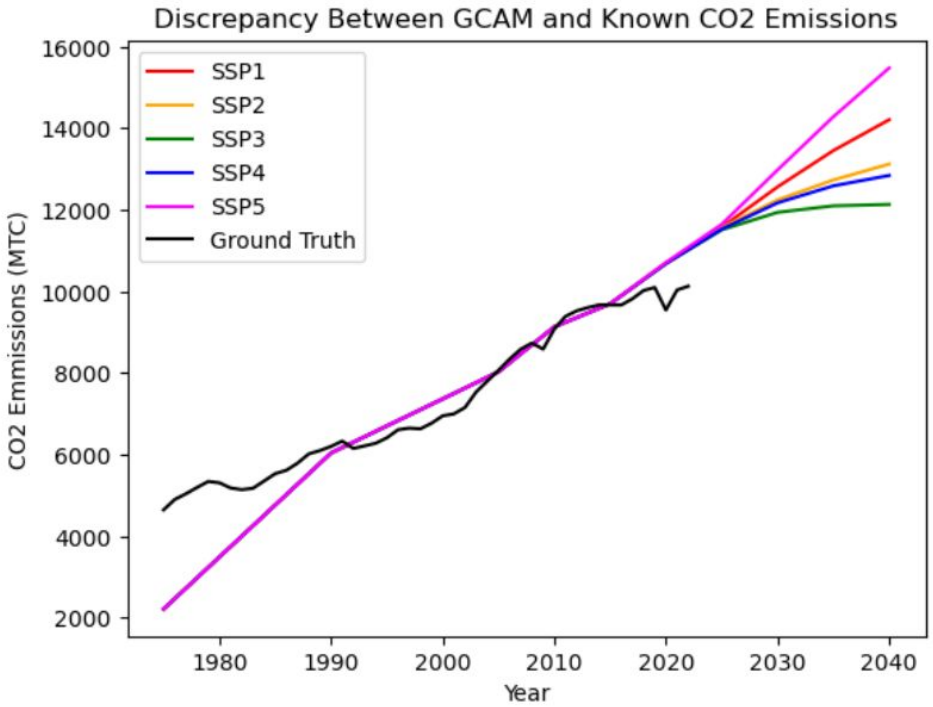

Occurances in lowest 10 Resid Elec Consumption PP
Num. Occurances in lowest 10
All Runs
SSP1
SSP2
SSP3
SSP4
SSP5
Colombia
Indonesia
Africa_Western
Europe_Eastern
Africa_Eastern
Pakistan
Africa_Southern
South America_Northern
South Africa
Southeast Asia
European Free Trade Association
South_Korea
Taiwan
Russia
Japan
Central Asia
EU-12
Europe_Non_EU
China
Brazil
Mexico
Africa_Northern
Central America and Caribbean

What is a successful presentation?

- Two groups should each have their own mini presentations
- Maybe other groups could go on as well
- Time is up to us - Abani isn't sure yet
- Case for D3M external committee
  - Some about D3M/PFI overall and conversations about it?
- Need example to push classes
- Alt. Organization -
  - IAMs + Critiques
  - Role of Models
  - Challenges of these models
  - Could we cover this to some extent?
    - Tap Ymbar for this?
- Start on the use of IAMs
  - Then, given the shortcomings, what can be done with IAMs?
  - Bottlenecks don't mean give up - it is the best alternative? Lack of data doesn't stop decision making
- Role of models in decision making/planning/negotiation
- Key takeaways handout

Conflict Project

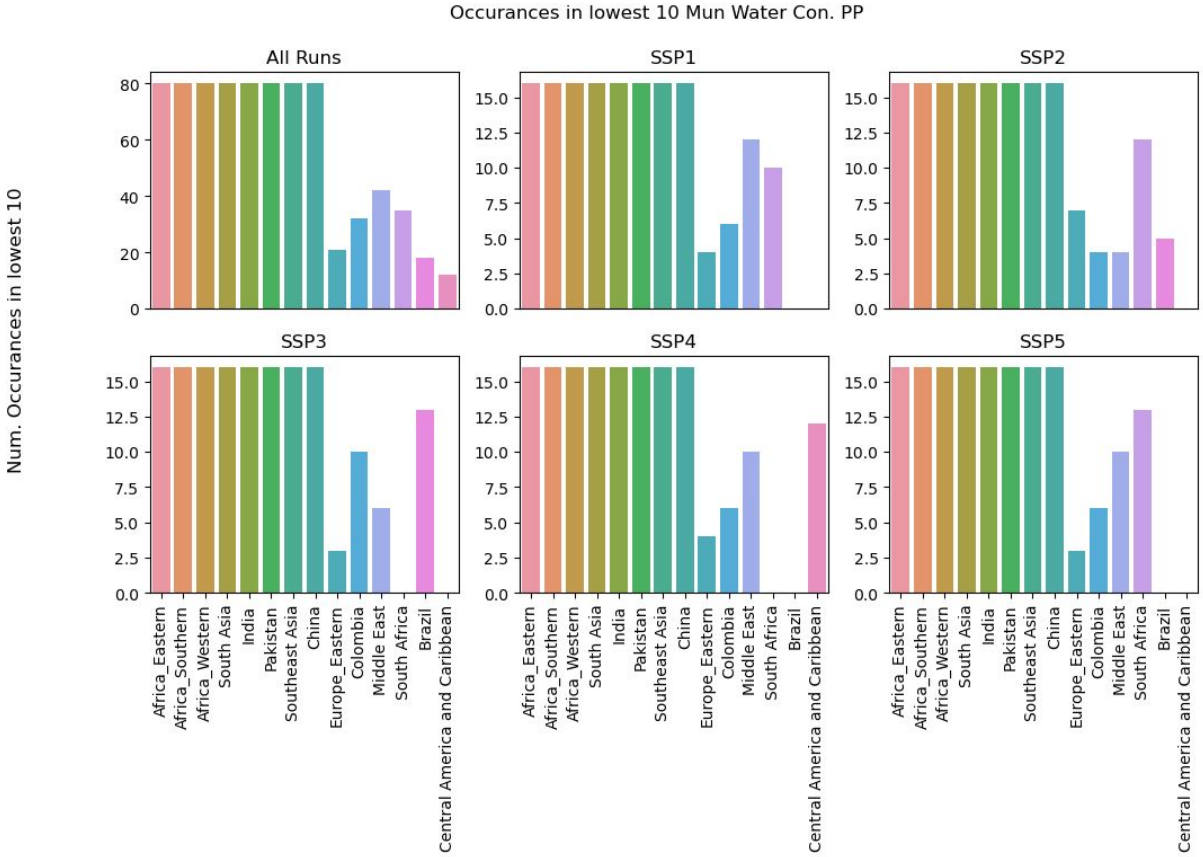
Validation Check- CO2 Emissions



Motivation

- FEW systems can be linked to increased risk of political insecurity and conflict
- Can GCAM demonstrate under what conditions some of these indicators co-locate, indicate an increased risk of conflict?

Step 1: Prove that there is variation in these parameters?



- Maybe the middle 50% is the most interesting
- The extremes always show up

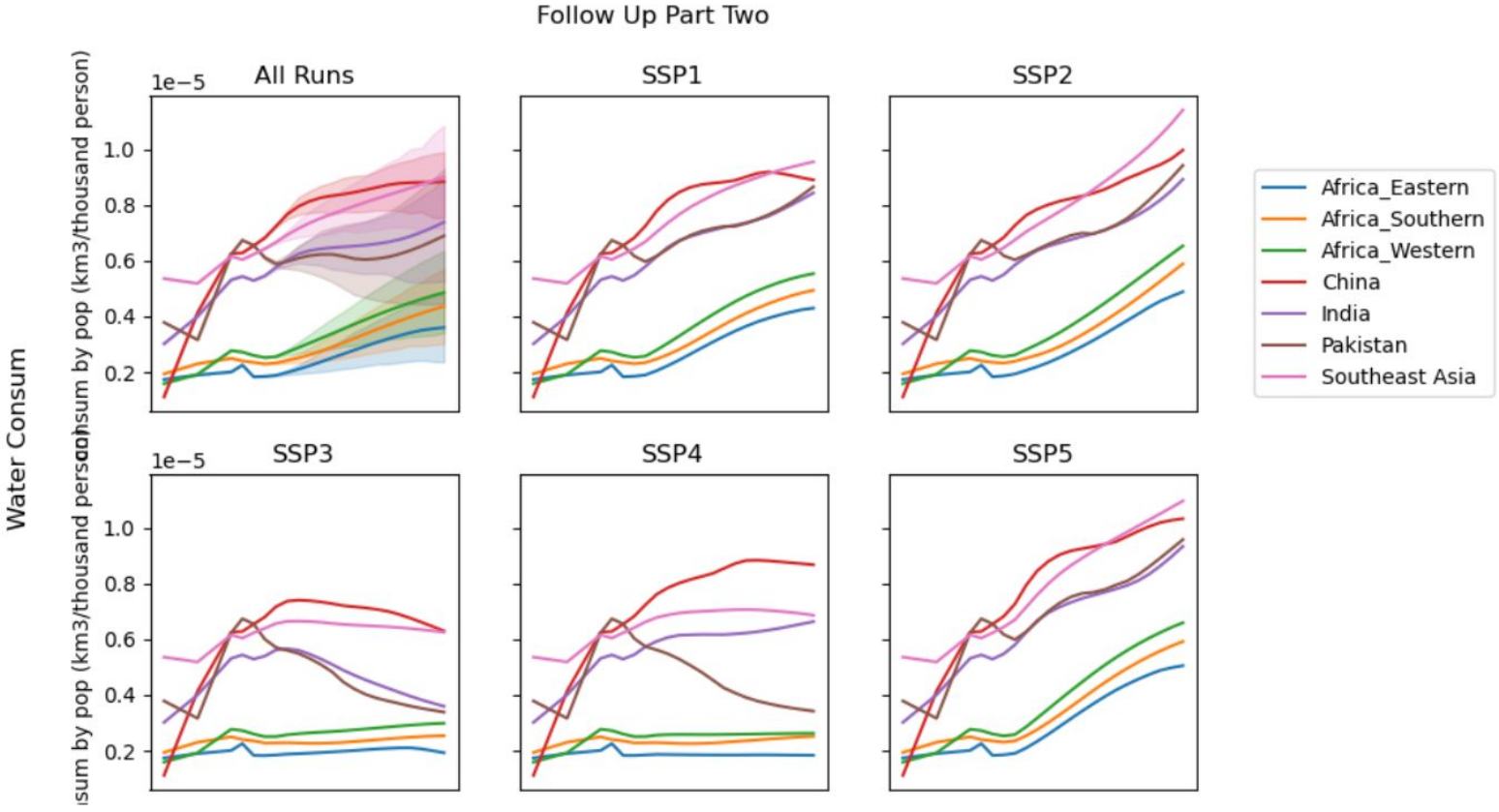
4/2

Goals this week:

- 1) Investigate some of the previous issues I had
- 2) What are some ways of generating figures for GCAM?
- 3) Explore possible indicator list for alignment to Pardee Rand

Previous Issues

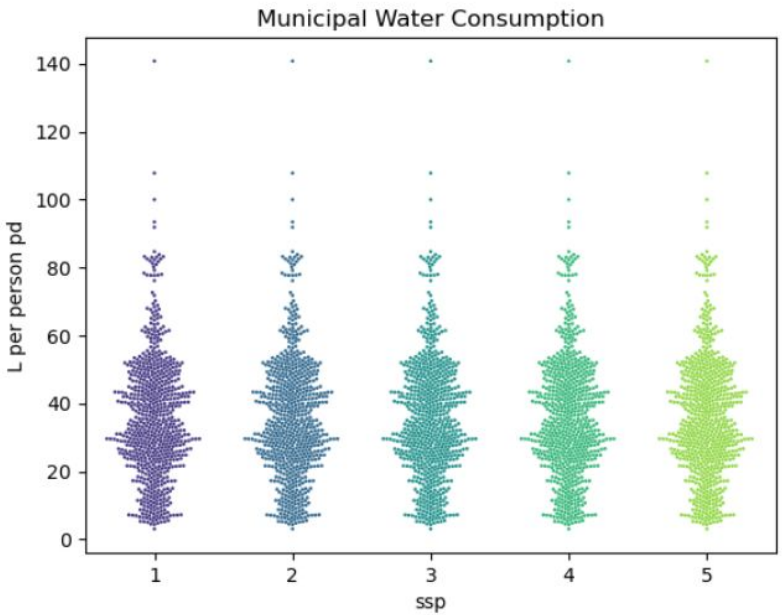
Do SSPs affect the ‘most water scarce’ areas equally?

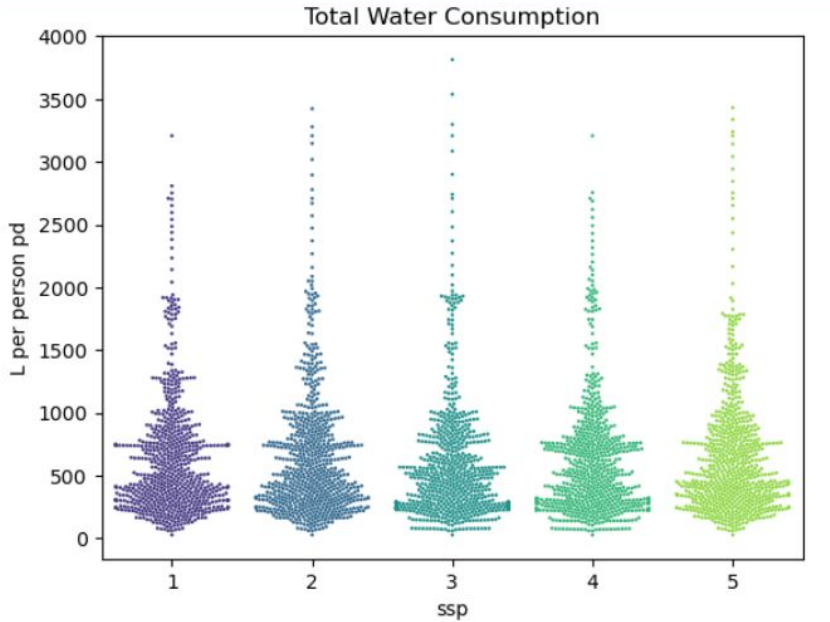


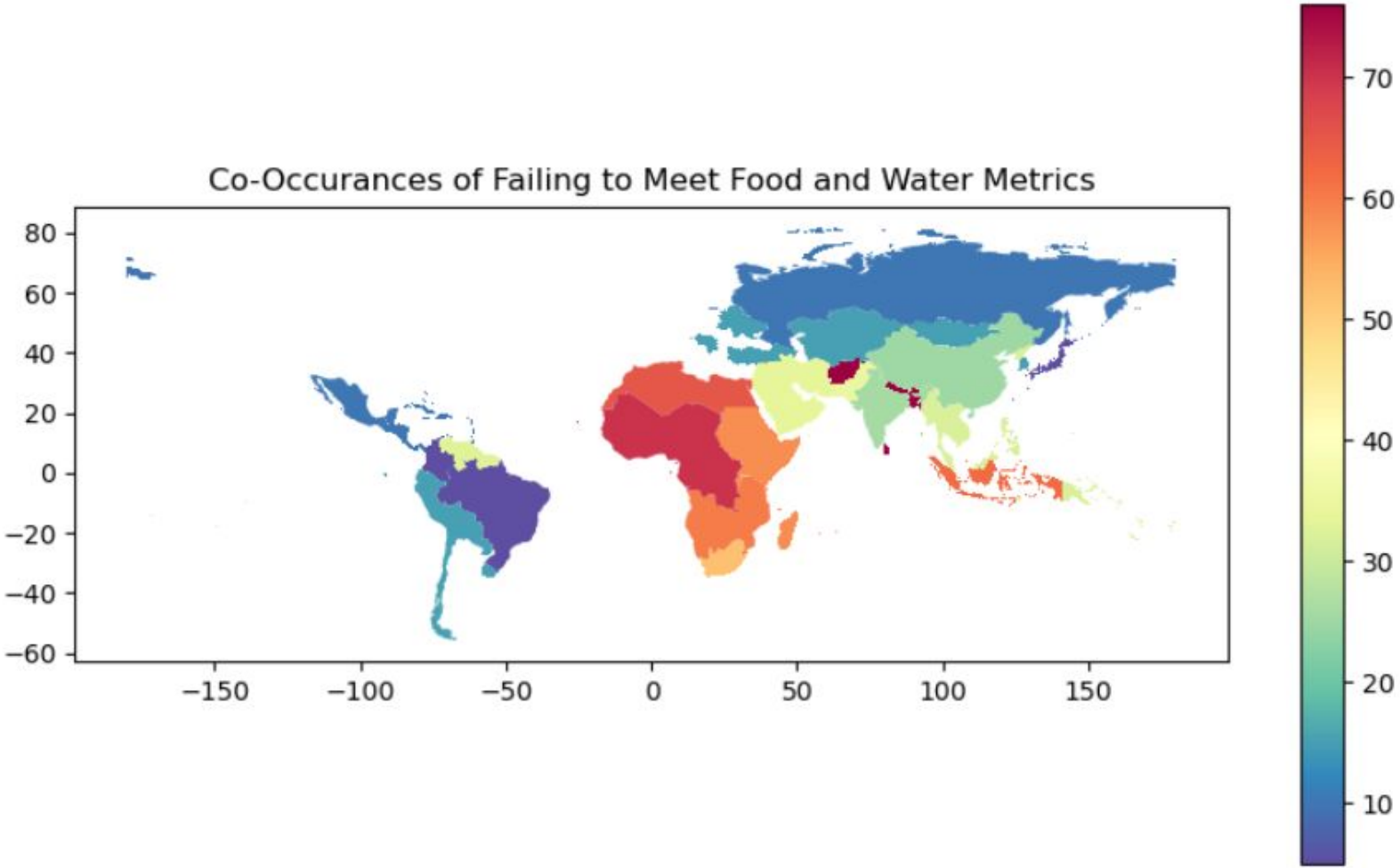
Municipal Water Follow-up- Where is less than 25 L pp pd?

- In 2100, in all 4 scenarios, just Africa
  - Africa East
  - Africa Southern
  - Africa West
  - South African
- Patterns continue to indicate municipal water use may be incorrect withdrawal
- However, the 50 L pp pd metric showed a wider range of location

Total water consumption has much more variety in outputs than municipal demand in the 5 scenarios- both could be combined?

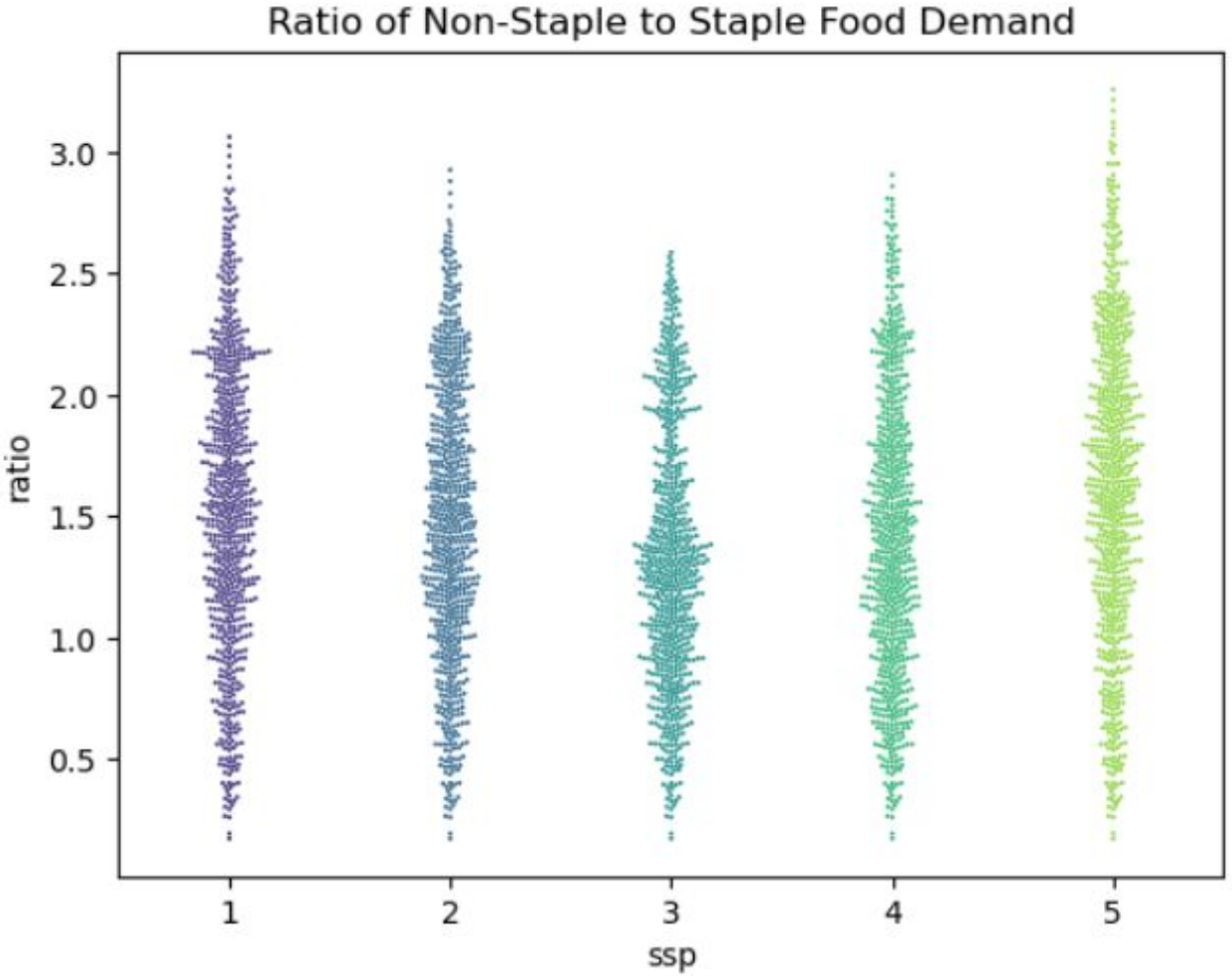





Co-Occurances of Failing to Meet Food and Water Metrics
80
60
40
20
0
−20
−40
−60
−150
−100
−50
0
50
100
150
70
60
50
40
30
20
10

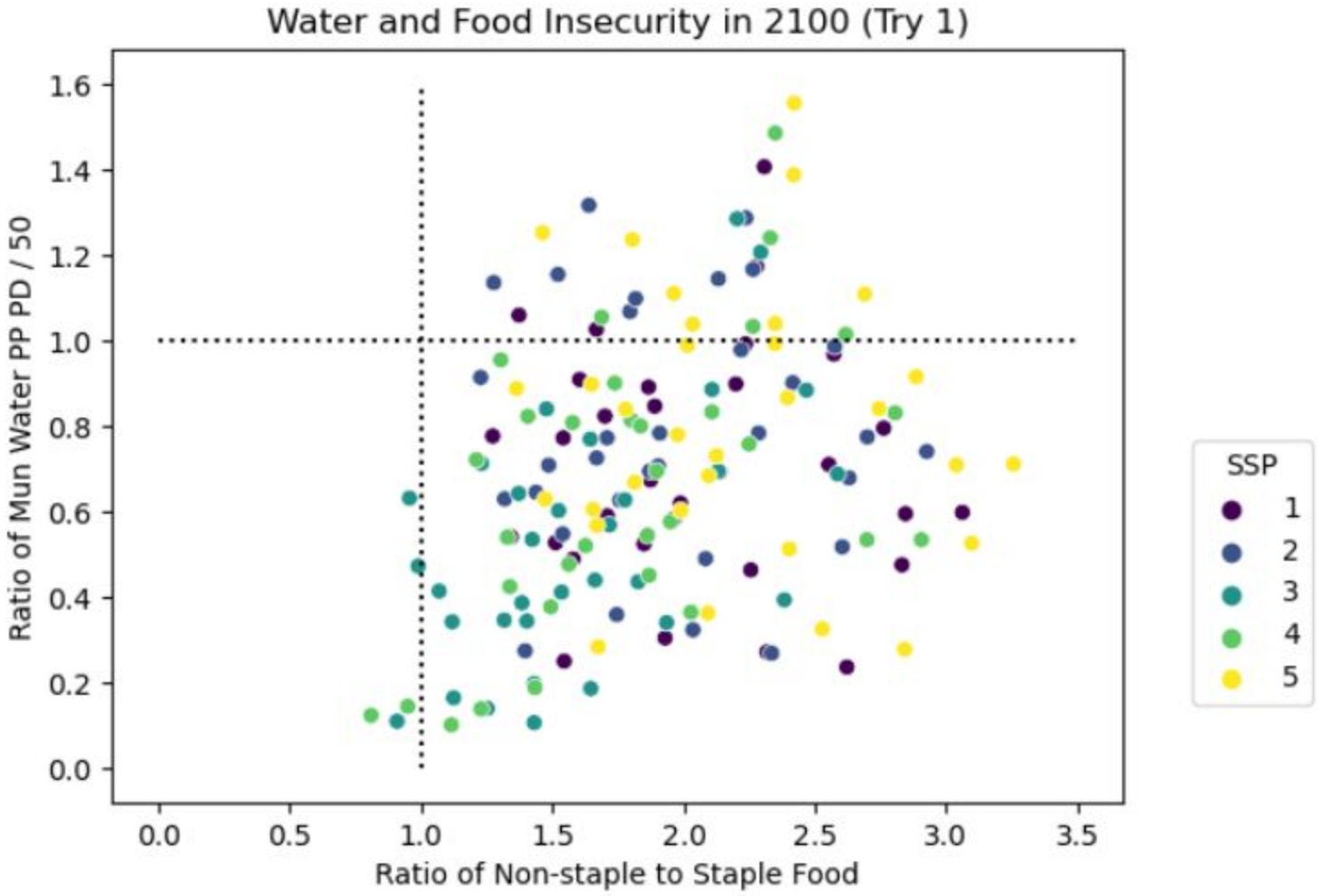
Food Indicators

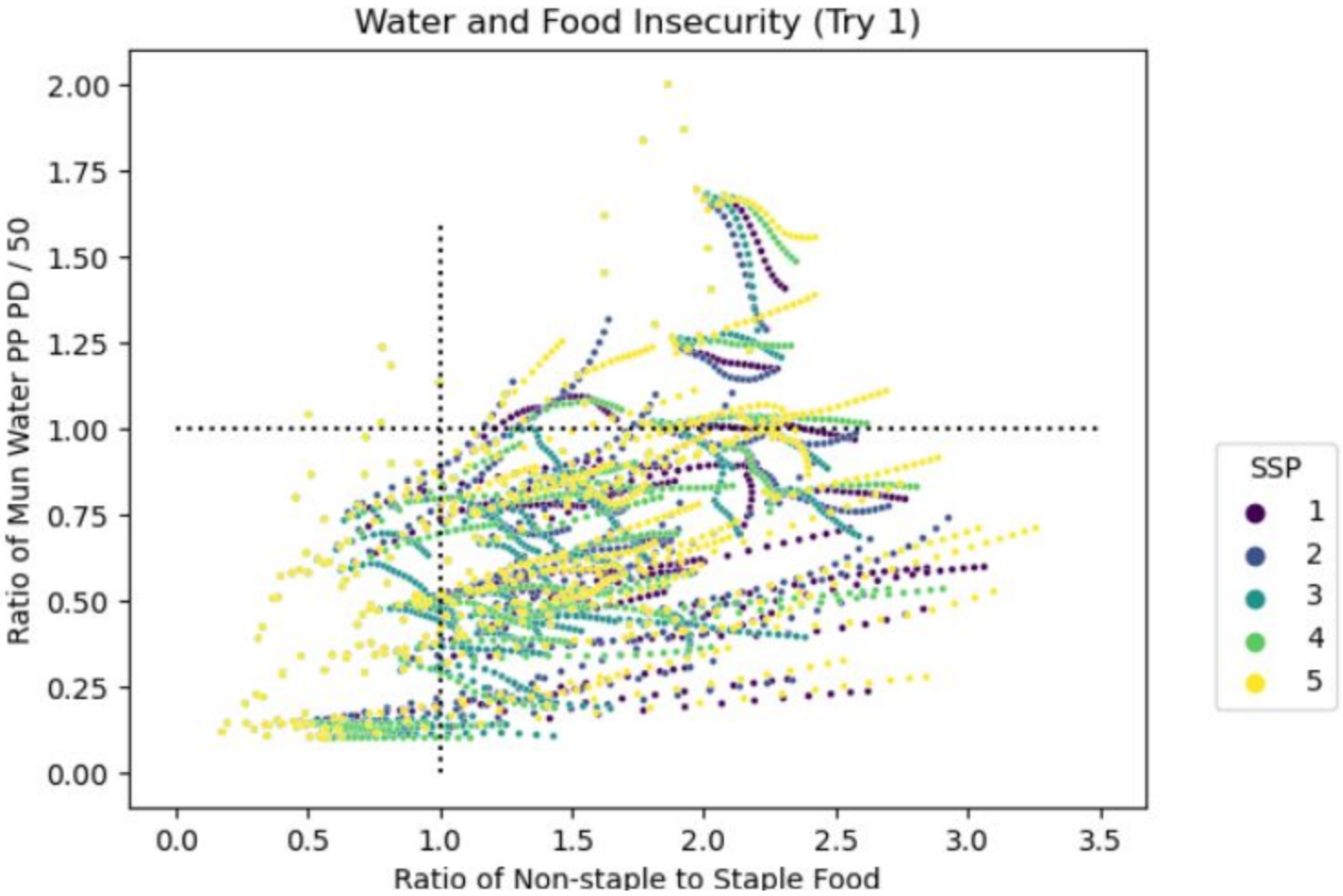
- “Share of Dietary Supply from Nonstarchy Foods—This indicator is calculated as the energy supply (in kilocalories per capita per day) provided by all foods except cereals, roots, and tubers divided by total dietary energy supply (also in kilocalories per capita per day).”
    - Representation with non-staple food group???


Ratio of Non-Staple to Staple Food Demand
ratio
3.0
2.5
2.0
1.5
1.0
0.5
1
2
3
4
5
ssp

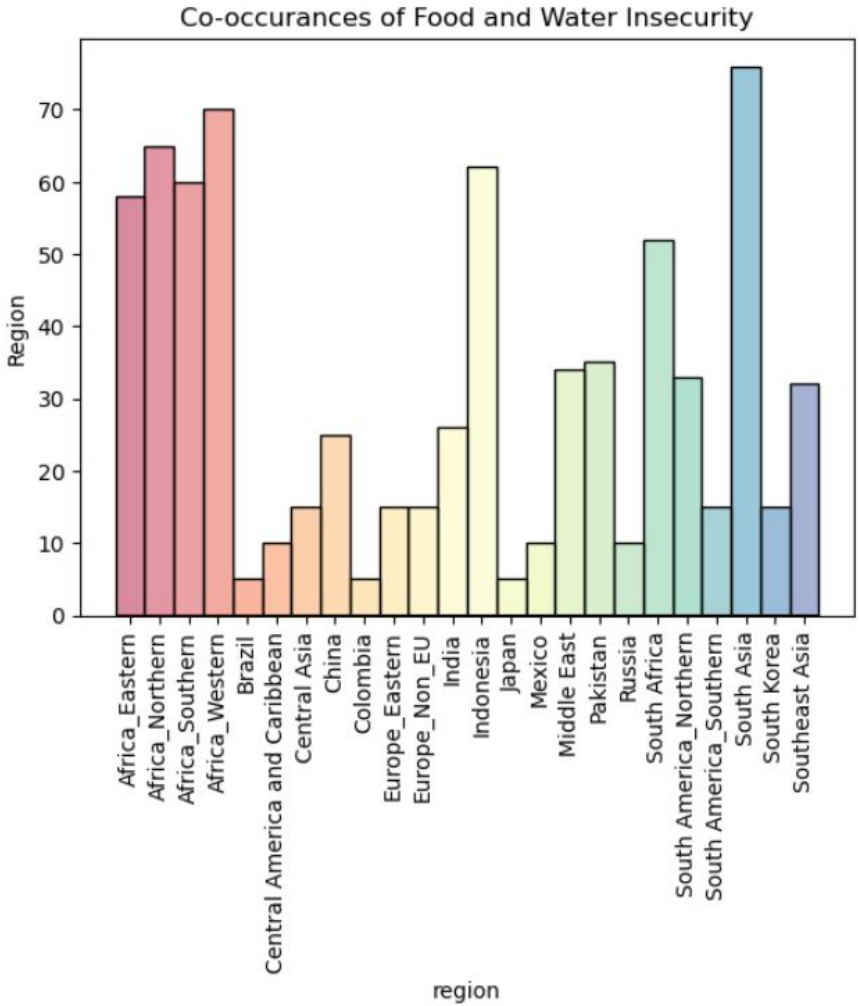
Three indicators- where do these appear and do they align with expectations?

- Original test -> water/pp/day / 50 + ratio nonstaple/staple
    - Gets units around the same area


Water and Food Insecurity in 2100 (Try 1)
Ratio of Mun Water PP PD / 50
Ratio of Non-staple to Staple Food
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
SSP
1
2
3
4
5


Water and Food Insecurity (Try 1)
Ratio of Mun Water PP PD / 50
Ratio of Non-staple to Staple Food
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.00
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
SSP
1
2
3
4
5

All SSPs, all Time



Index: Food

- What is in the index?
  - Food
    - Domestic Food Price Level Index (food purchasing power/normal purchasing power)
    - Share of Dietary Supply from Nonstarchy Foods
    - Supply of daily dietary calories Relative to Minimum Dietary Requirement
  - Energy
    - log of per capita electricity to the log of the per capita electricity consumption required to meet basic needs
    - Geometric mean of percentage of population with access to electricity and percentage of population using modern fuels for cooking and heating.
  - Water
    - country-wide total water withdrawals for municipal uses with the country-wide water requirements for basic municipal purposes. (50 L per day) *some normalization
    - proportion of the population that uses an improved source of drinking water and the proportion of the population using improved sanitation facilities.
    - For adaptive capacity, we evaluated the total per capita internally available renewable water.
- What can we do with GCAM?

Pardee	GCAM
Domestic Food Price Level Index	Price staple foods/GDP per capita
Share of Dietary Supply from Non-starchy Foods	Supply nonstaple to staple
Supply of daily dietary calories Relative to Minimum Dietary Requirement	Supply to some baseline per person
log of per capita electricity to the log of the per capita electricity consumption required to meet basic needs	Can this be done?
Geometric mean of percentage of population with access to electricity	Amount of electricity?
percentage of population using modern fuels for cooking and heating.	Traditional Biomass/total energy
total water withdrawals for municipal uses with the country-wide water requirements	Working on this
proportion of the population that uses an improved source of drinking water and the proportion of the population using improved sanitation facilities.	Not applicable
total per capita internally available renewable water.	Should be doable

For more methodology, details on truncation, normalization:

https://www.rand.org/content/dam/rand/pubs/tools/TLA2900/TLA2942-1/RAND_TLA2942-3.pdf

Caveats

- FEW-Nexus insecurity does not always lead to conflict
  - Some studies suggest water scarcity might even be an incentive for cooperation

MATH

$$\text{FEW Index} = \sqrt[3]{(\text{Food Sub-Index}) \times (\text{Energy Sub-Index}) \times (\text{Water Sub-Index})}$$

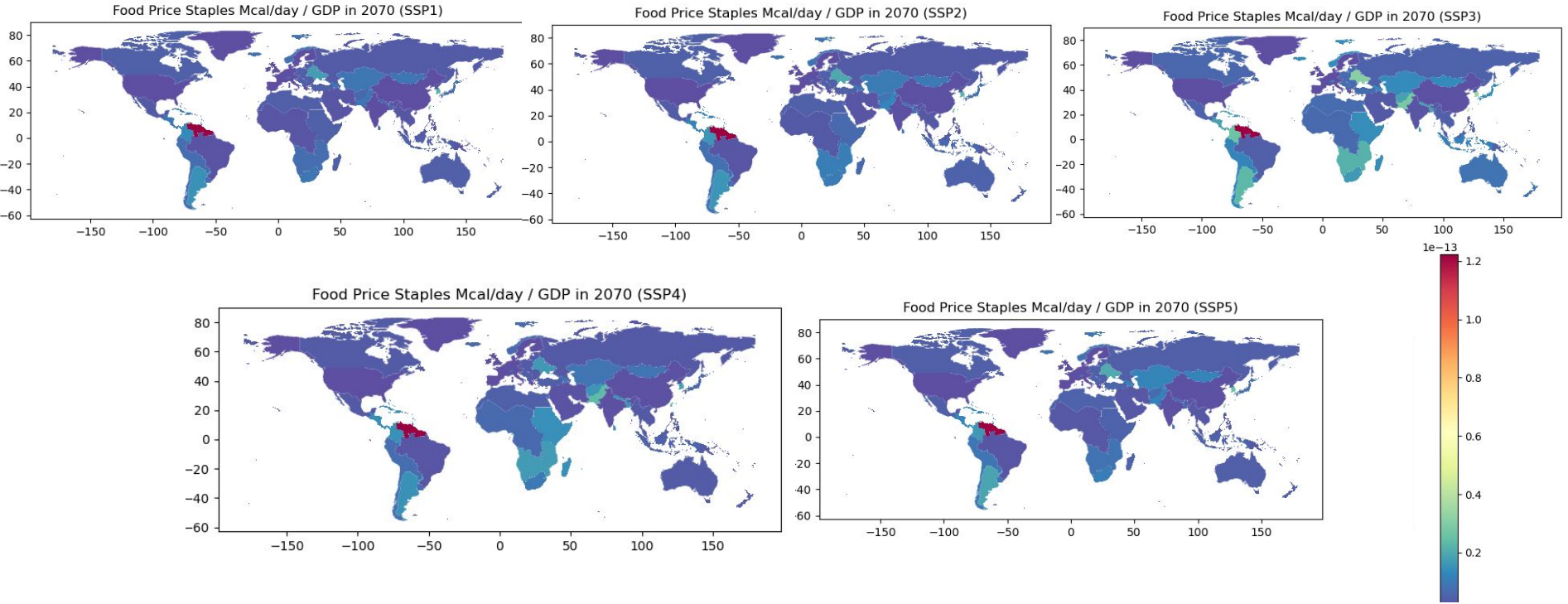
tion to normalization and aggregation of scales. We normalized all indicators to span the range of observed values using the following formula, such that higher values are associated with greater levels of security:

$$\text{Normalized Value} = \frac{(\text{Actual Value} - \text{Logical Minimum})}{(\text{Logical Maximum Value} - \text{Logical Minimum})}$$

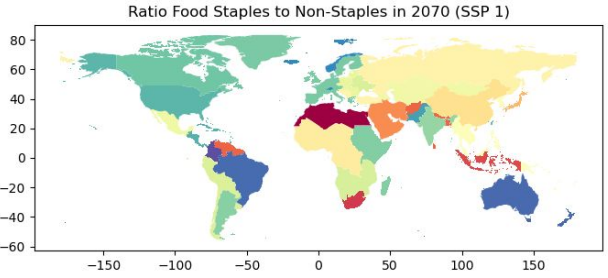
Individual Indicators

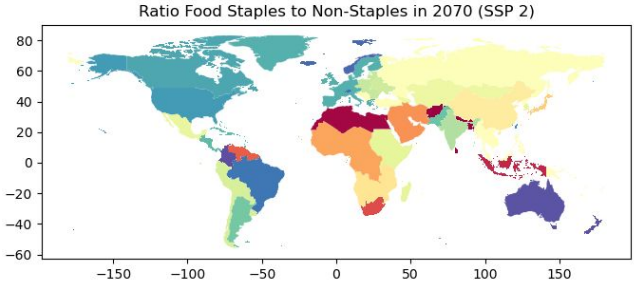
Food indicators

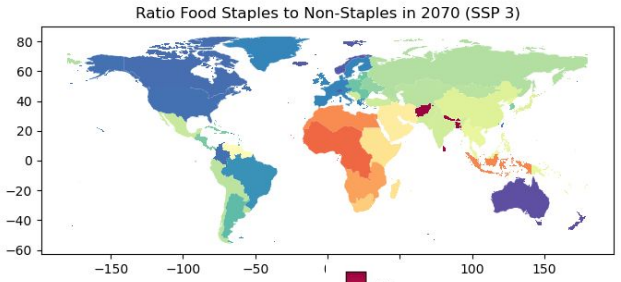
Food Cost Burden (> 1 Bad)

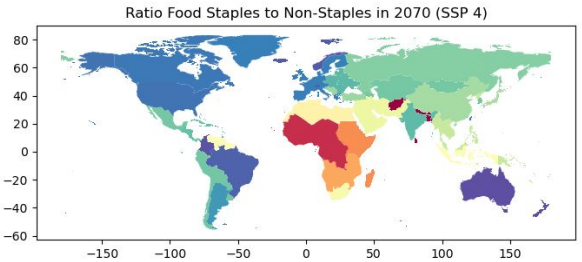


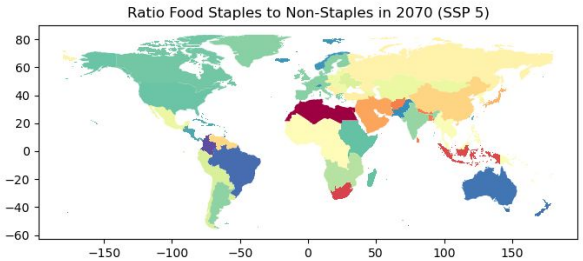
Ratio Food Staples to Non Staples (> 1 bad)

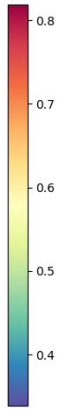


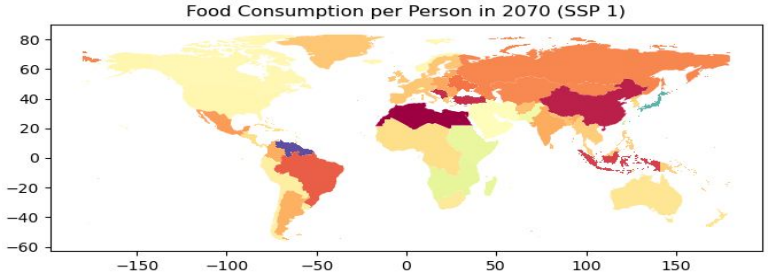


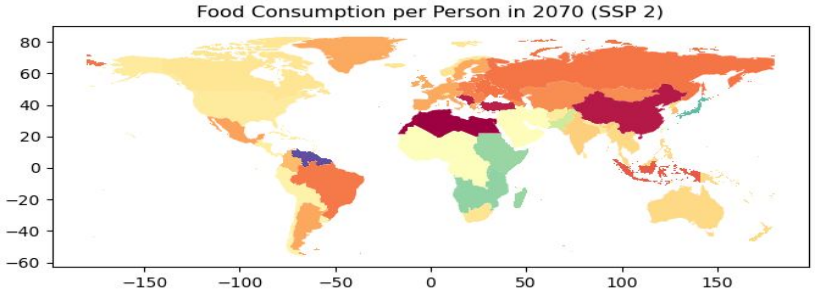


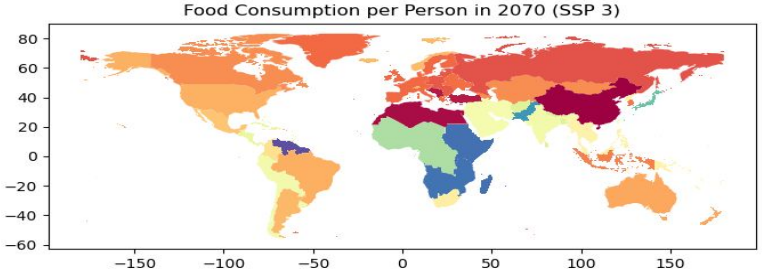


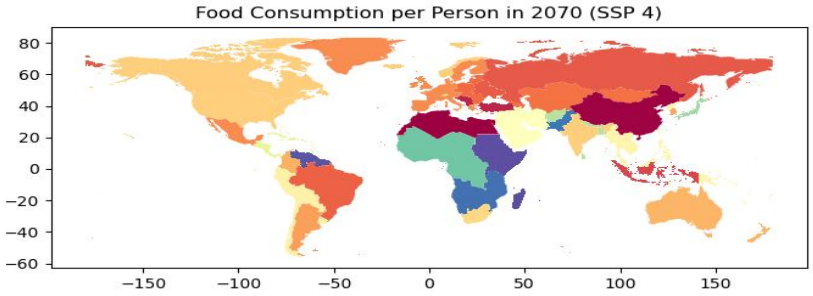


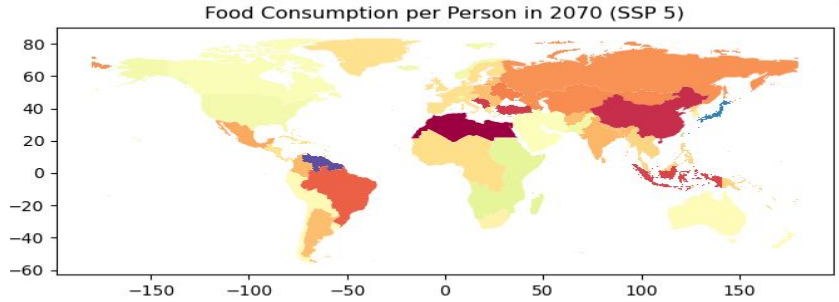


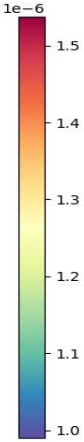

Food Consumption per Person in 2070 (SSP 1)


Food Consumption per Person in 2070 (SSP 2)

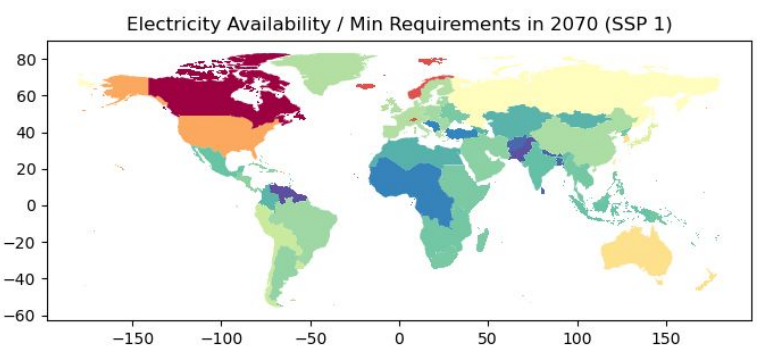

Food Consumption per Person in 2070 (SSP 3)

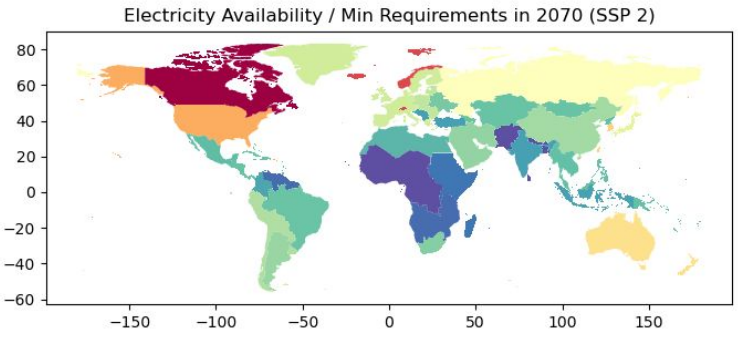

Food Consumption per Person in 2070 (SSP 4)

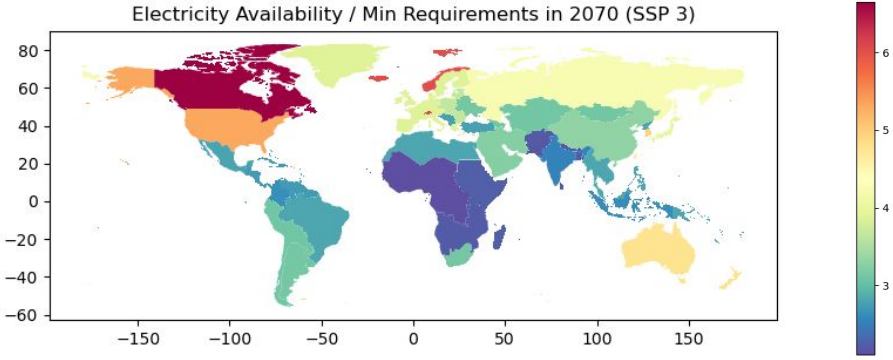

Food Consumption per Person in 2070 (SSP 5)

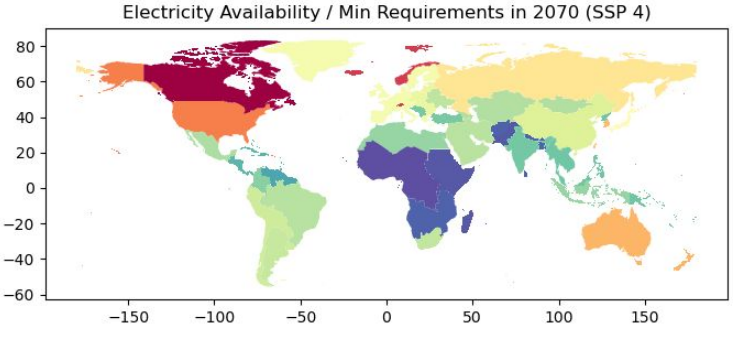

1e−6
1.5
1.4
1.3
1.2
1.1
1.0

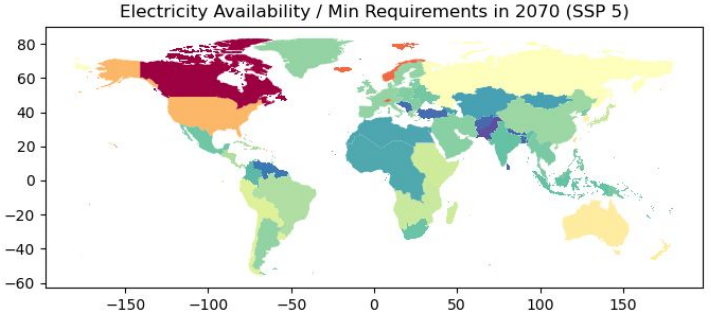
Energy Indicators

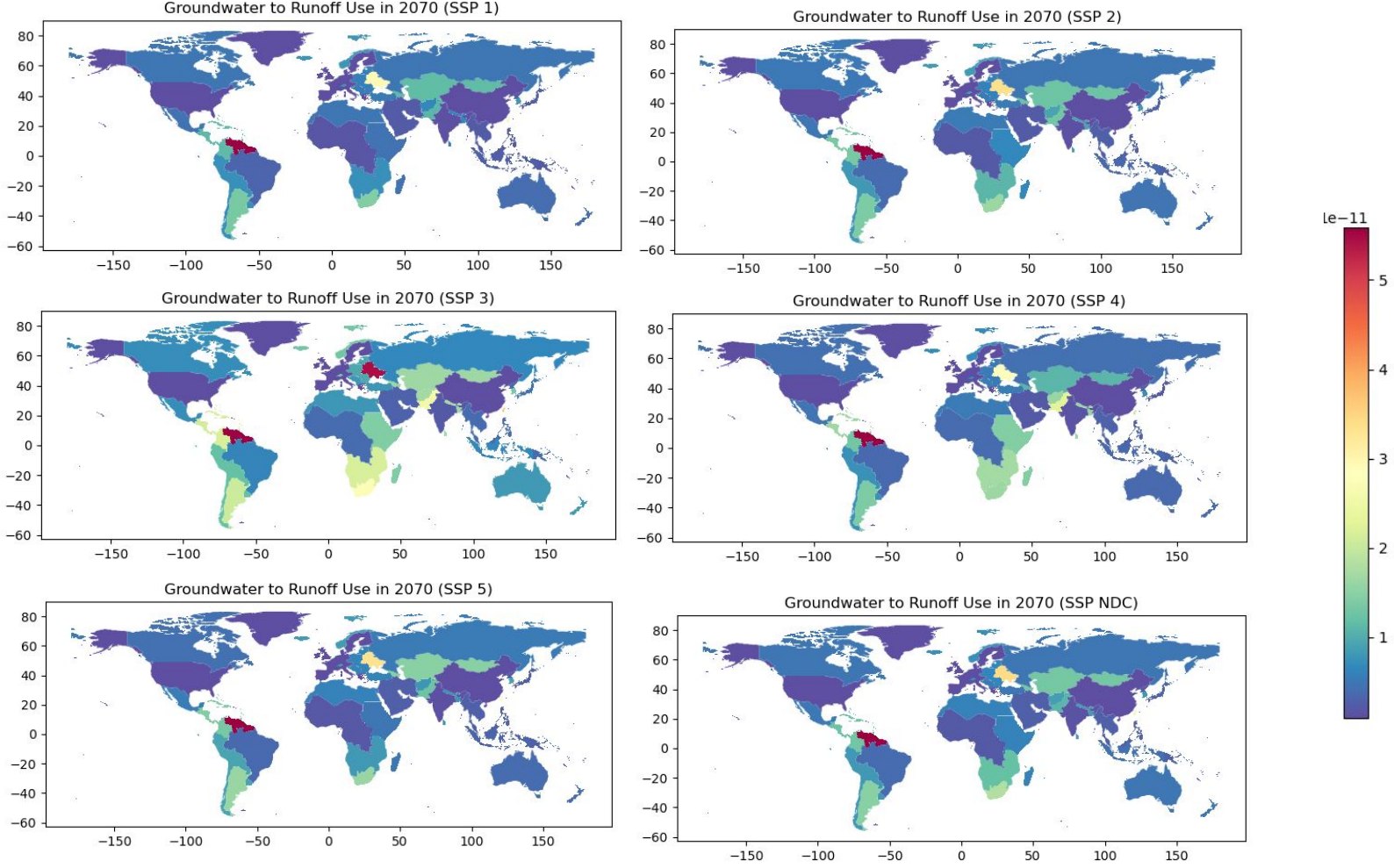

Electricity Availability / Min Requirements in 2070 (SSP 1)

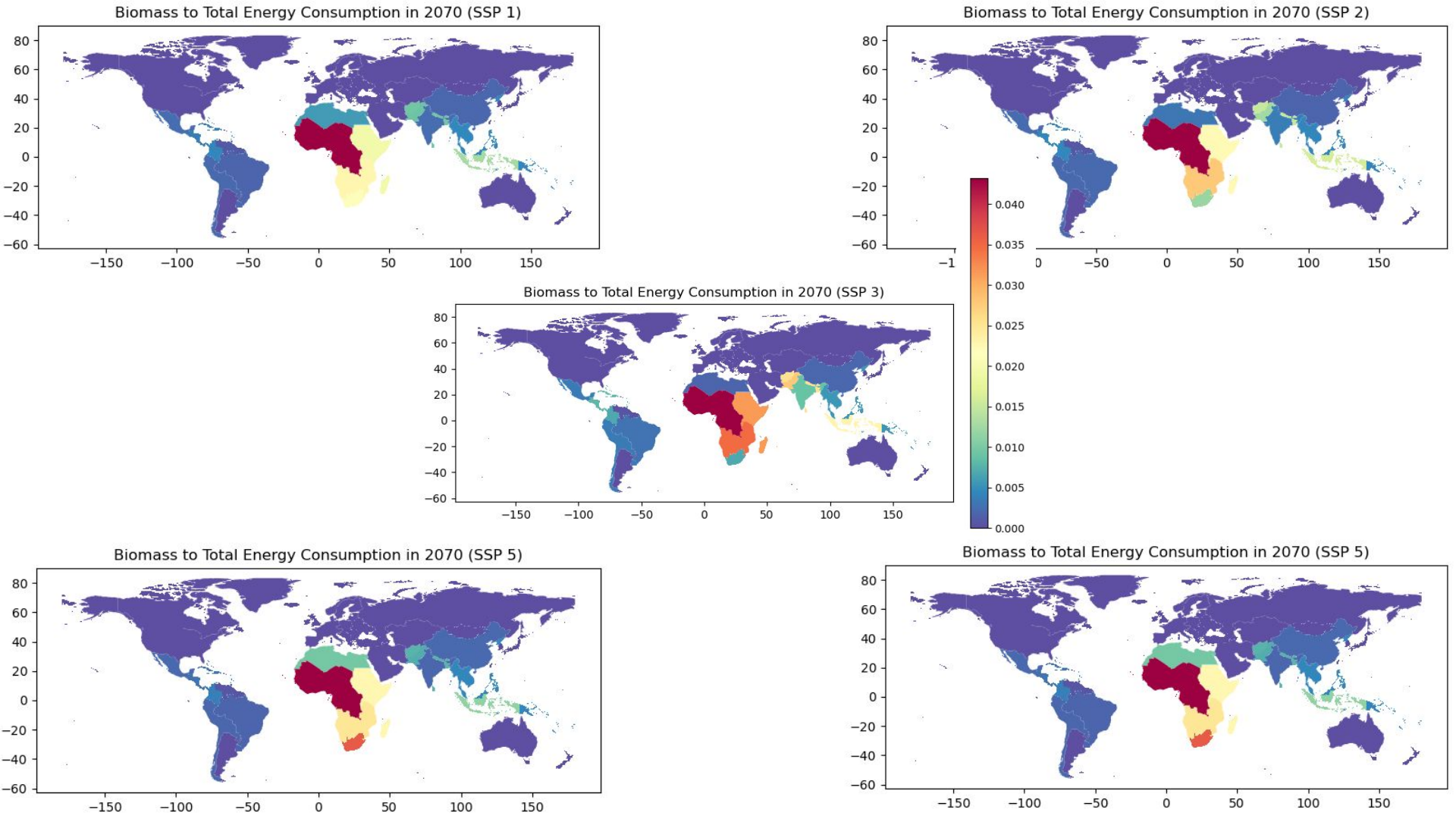

Electricity Availability / Min Requirements in 2070 (SSP 2)


Electricity Availability / Min Requirements in 2070 (SSP 3)


Electricity Availability / Min Requirements in 2070 (SSP 4)

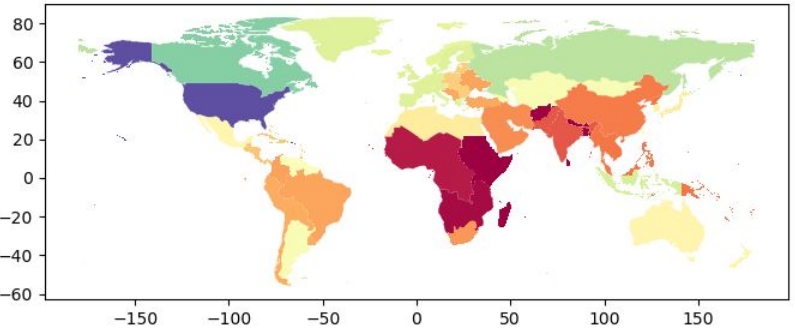

Electricity Availability / Min Requirements in 2070 (SSP 5)


Groundwater to Runoff Use in 2070 (SSP 1)
Groundwater to Runoff Use in 2070 (SSP 2)
Groundwater to Runoff Use in 2070 (SSP 3)
Groundwater to Runoff Use in 2070 (SSP 4)
Groundwater to Runoff Use in 2070 (SSP 5)
Groundwater to Runoff Use in 2070 (SSP NDC)
le−11
1
2
3
4
5

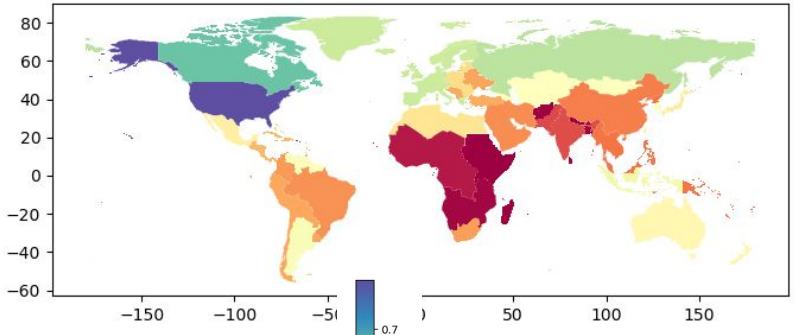

Biomass to Total Energy Consumption in 2070 (SSP 1)
Biomass to Total Energy Consumption in 2070 (SSP 2)
Biomass to Total Energy Consumption in 2070 (SSP 3)
Biomass to Total Energy Consumption in 2070 (SSP 5)
Biomass to Total Energy Consumption in 2070 (SSP 5)
0.040
0.035
0.030
0.025
0.020
0.015
0.010
0.005
0.000

Water Indicators

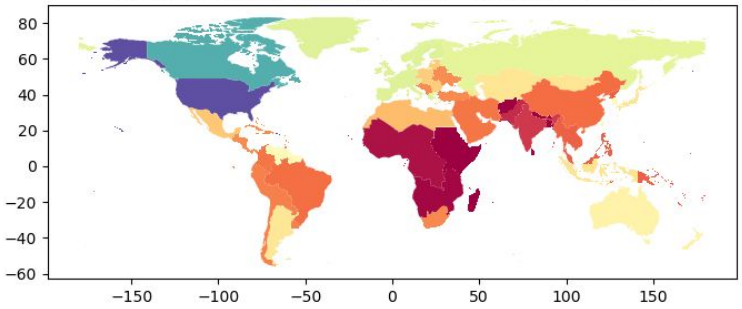
Normalized Water Consumption Per Capita in 2070 (SSP 1)

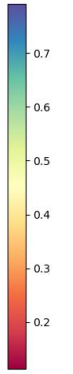


Normalized Water Consumption Per Capita in 2070 (SSP 2)

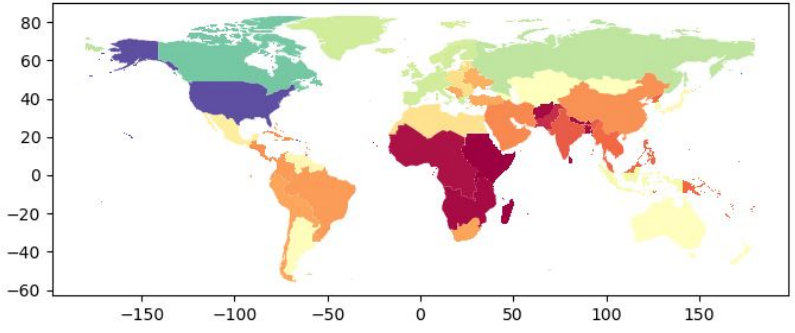


Normalized Water Consumption Per Capita in 2070 (SSP 3)

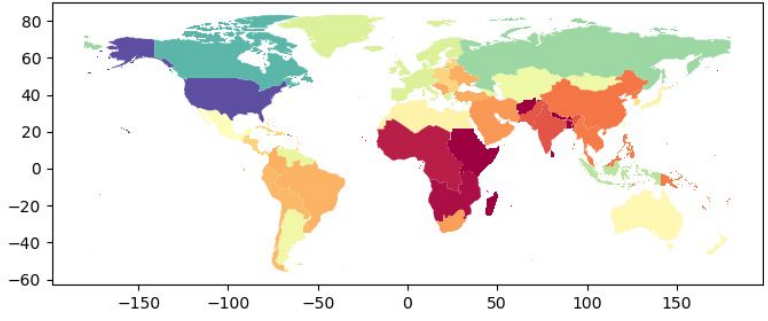


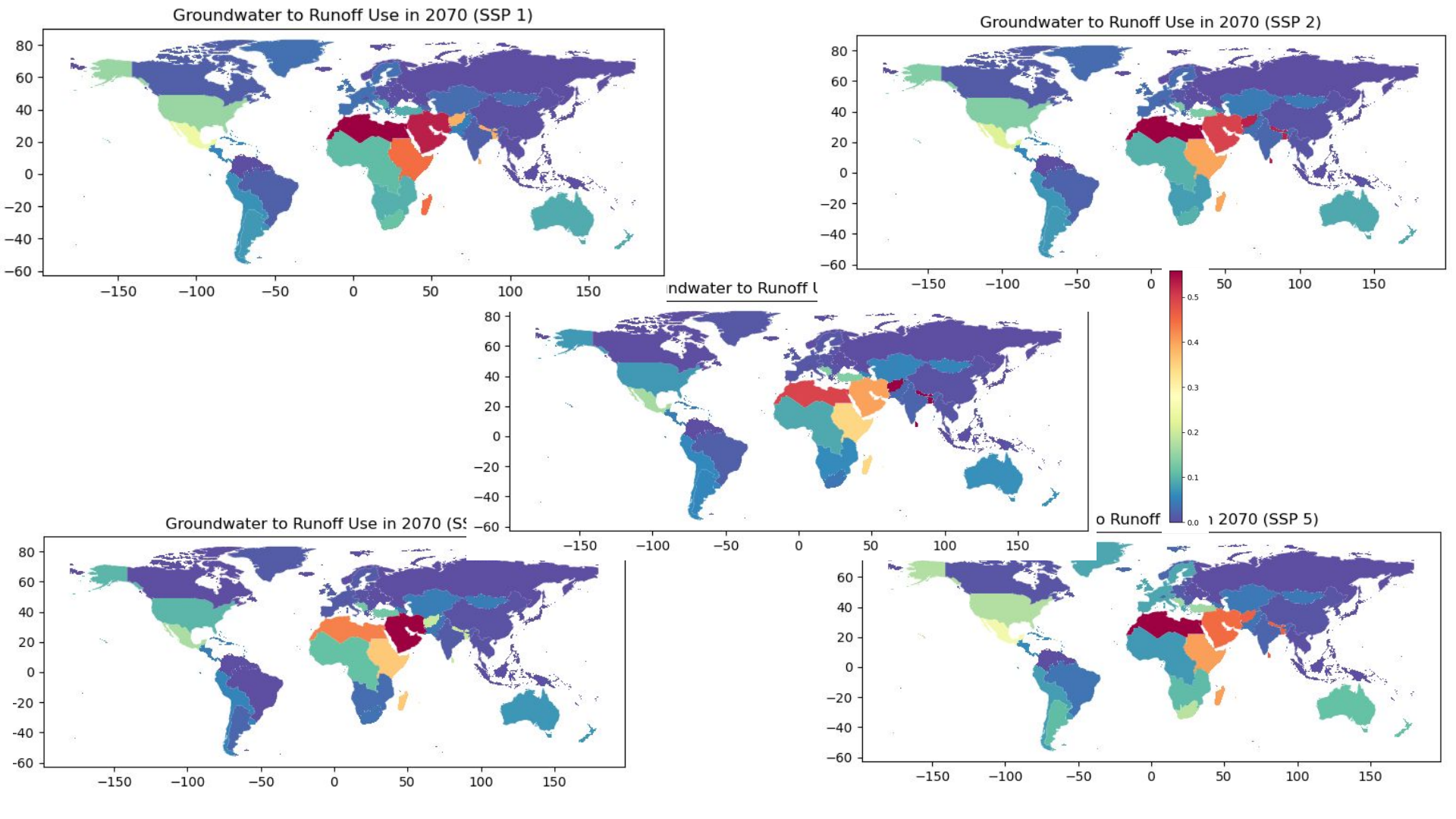


Normalized Water Consumption Per Capita in 2070 (SSP 4)



Normalized Water Consumption Per Capita in 2070 (SSP 5)




Groundwater to Runoff Use in 2070 (SSP 1)
Groundwater to Runoff Use in 2070 (SSP 2)
ndwater to Runoff
Groundwater to Runoff Use in 2070 (S
o Runoff
2070 (SSP 5)