Institute for Health
Metrics and Evaluation

Forecasting iNTS for the Global Burden of Disease Study

13th International Conference on Typhoid and Other Invasive Salmonelloses, Kigali, Rwanda

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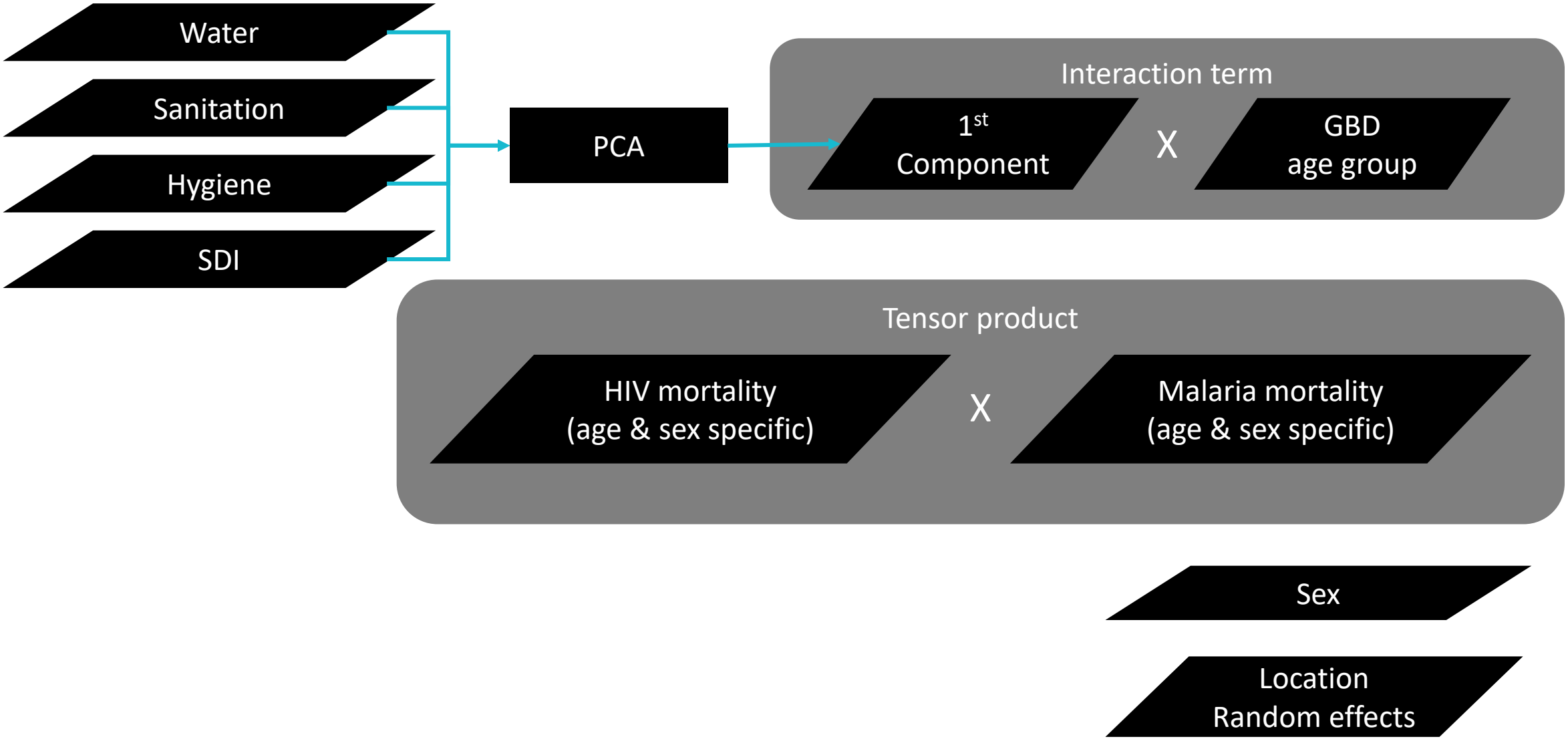
Background

- Future Health Scenario (FHS) = forecasting component of GBD
  - Forecast population, all-cause mortality, predictive covariates (e.g. SDI), cause-specific and risk-attributable burden by location, year, age, and sex to 2100
  - Employs standard methodology: well suited to most but not all outcomes
  - Bespoke approach necessary for some causes, including iNTS

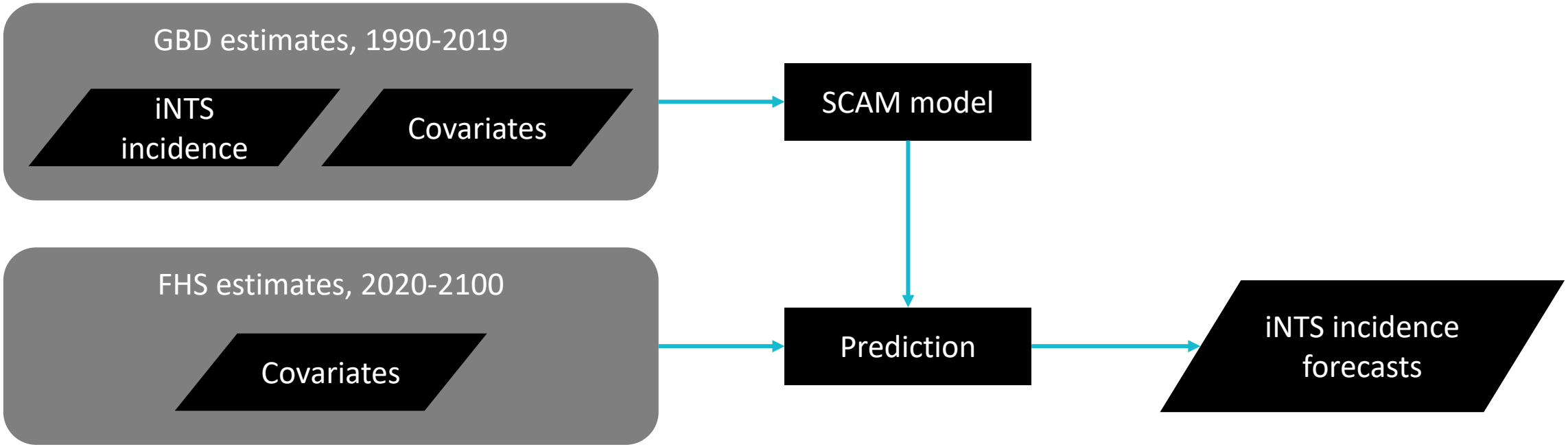
Methods

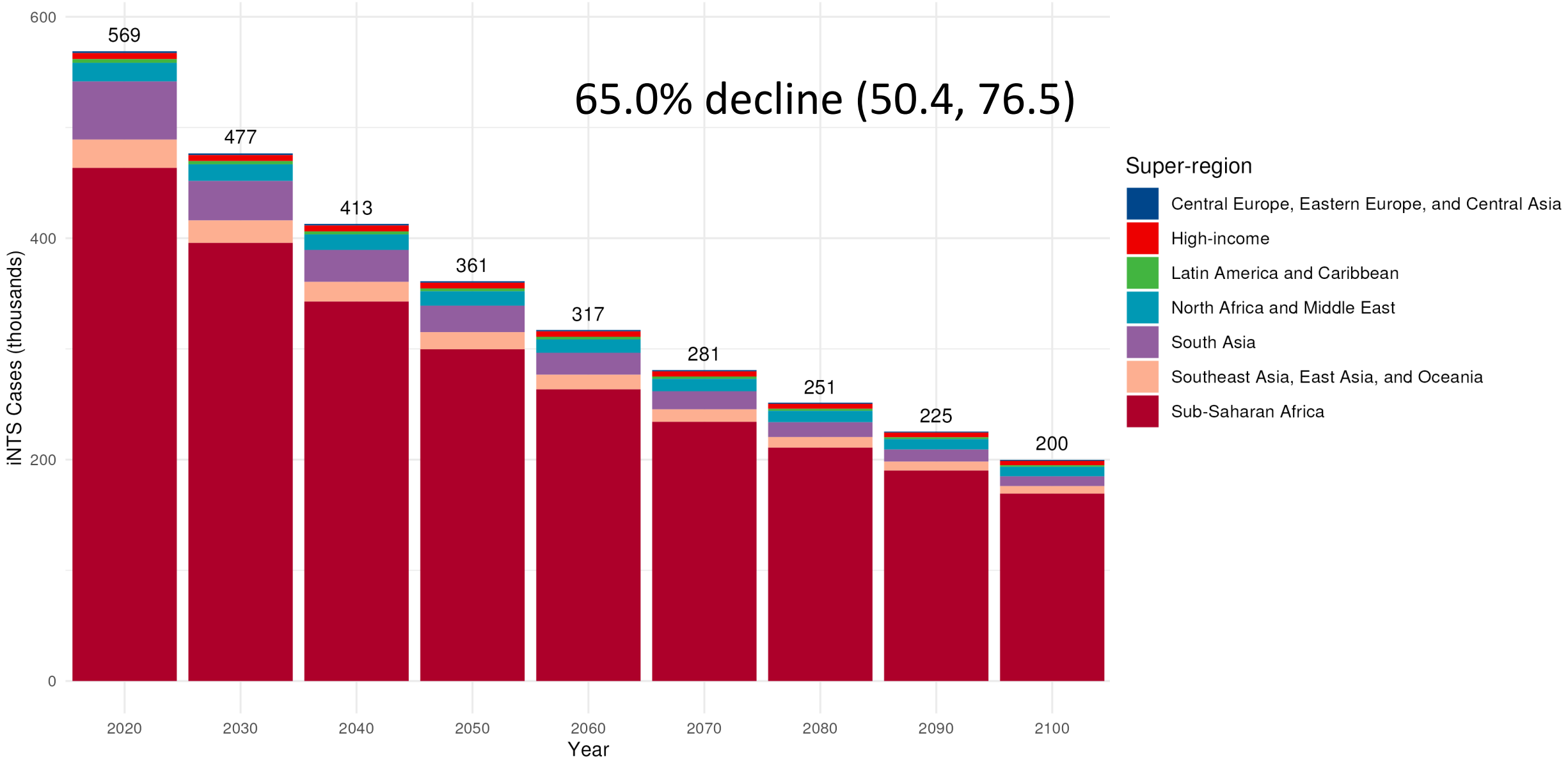
- **Inputs:** GBD estimates of iNTS and predictive covariates
- **Model:** shape constrained additive models (SCAMs) with varying combinations of predictive covariates and shape flexibility
- **Model selection:** Selected from collection of candidate models based on out-of-sample performance in cross-validation
- **Uncertainty:** propagate uncertainty from all model components using posterior simulation with 500 draws

Predictive covariates

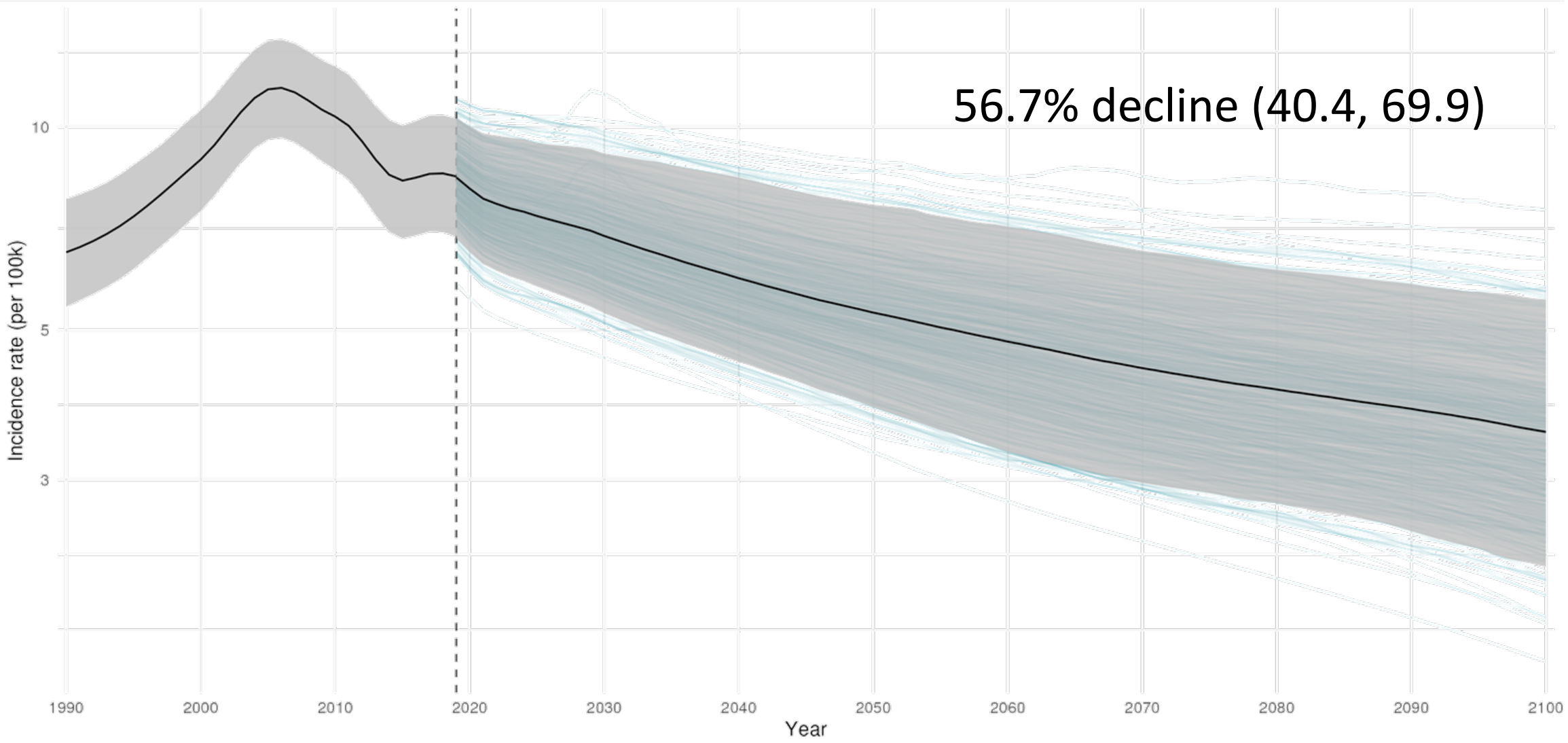


Incidence forecast




65.0% decline (50.4, 76.5)
iNTS Cases (thousands)
600
400
200
0
569
477
413
361
317
281
251
225
200
2020
2030
2040
2050
2060
2070
2080
2090
2100
Year
Super-region
Central Europe, Eastern Europe, and Central Asia
High-income
Latin America and Caribbean
North Africa and Middle East
South Asia
Southeast Asia, East Asia, and Oceania
Sub-Saharan Africa

Global iNTS incidence, age-standardized rates

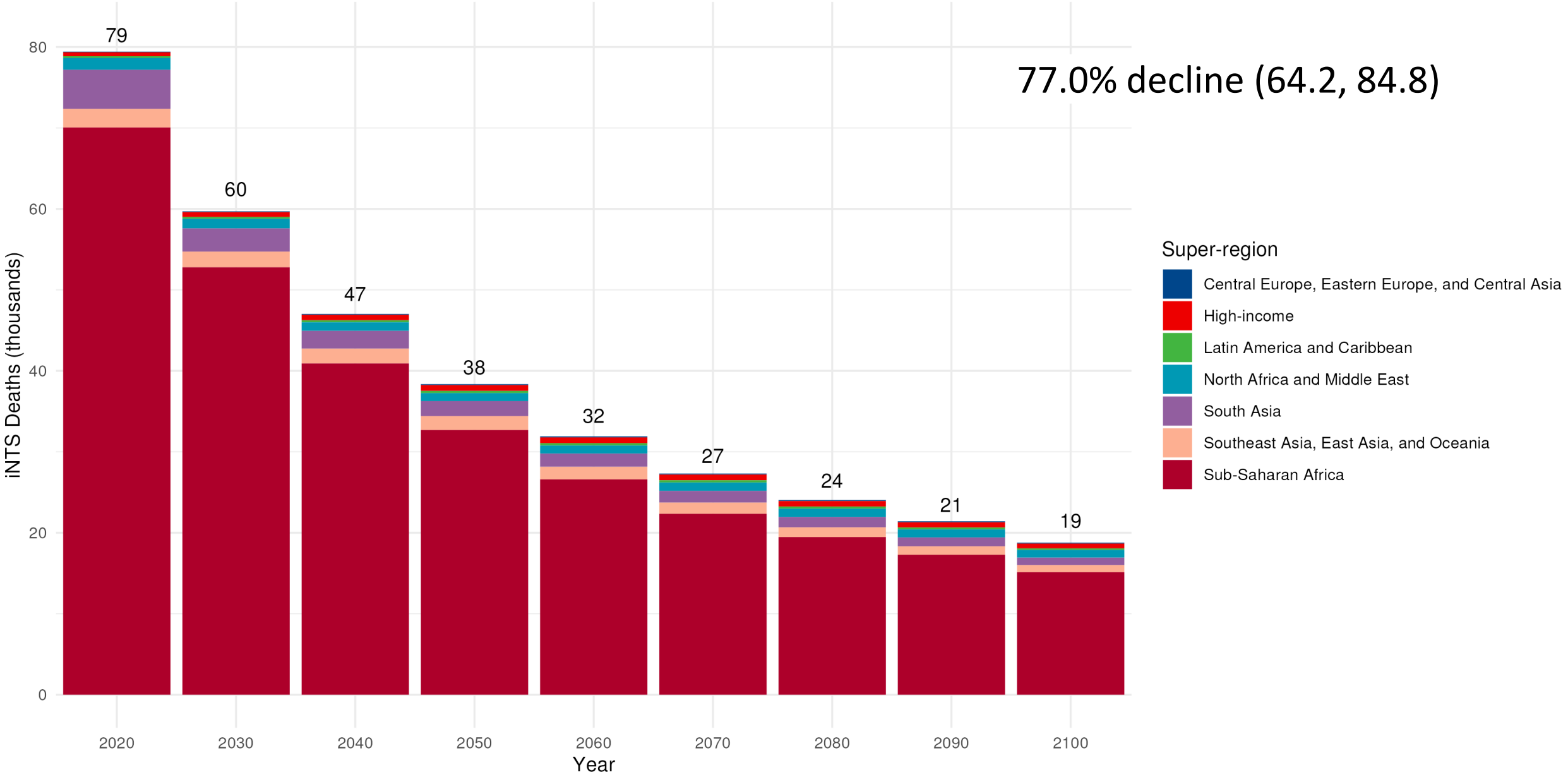


Mortality estimation

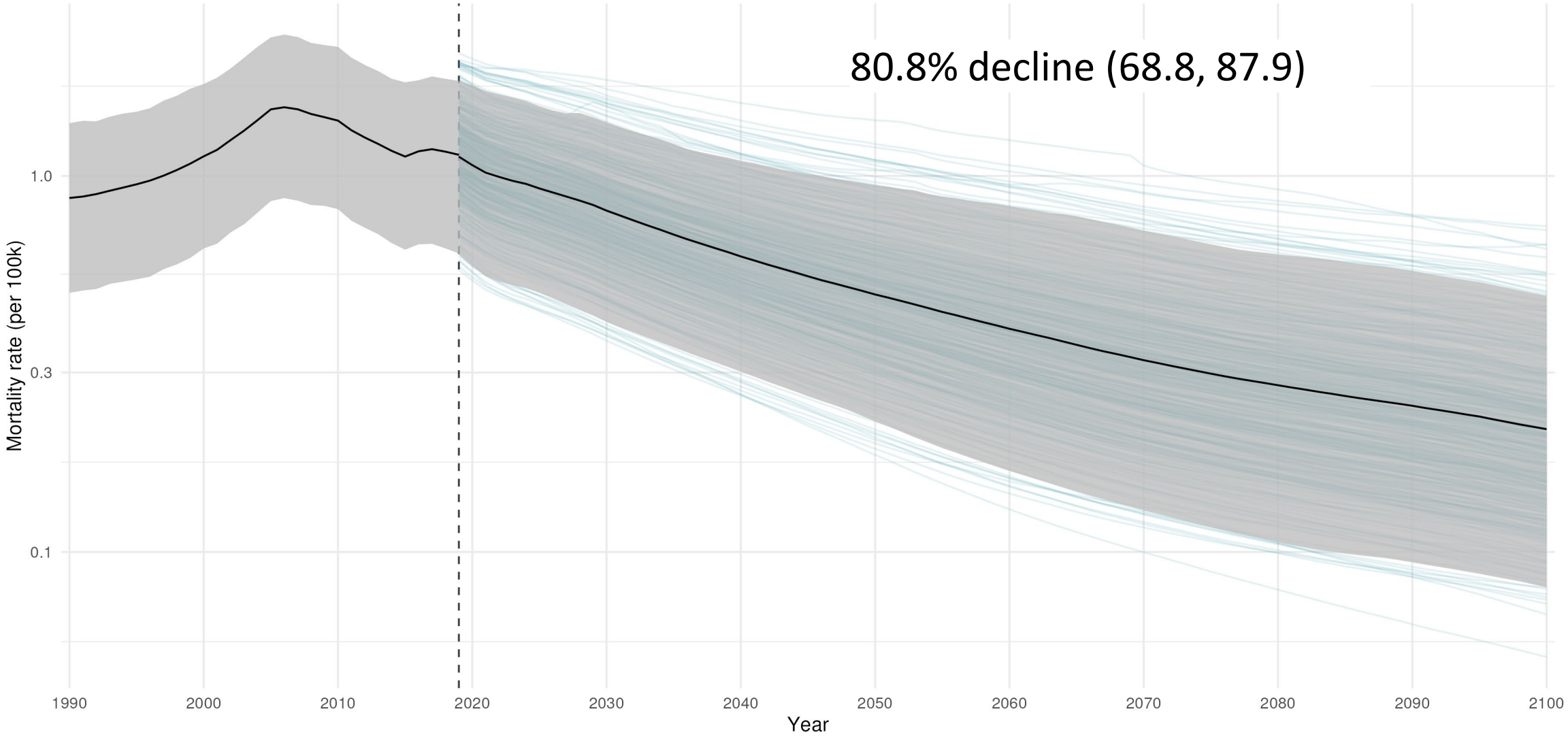
- HIV attribution using PAF approach
- Estimate CFR by HIV, age, and SDI

Global Case Fatality Estimates		
	2020	2100
Total	13.7%	9.2%

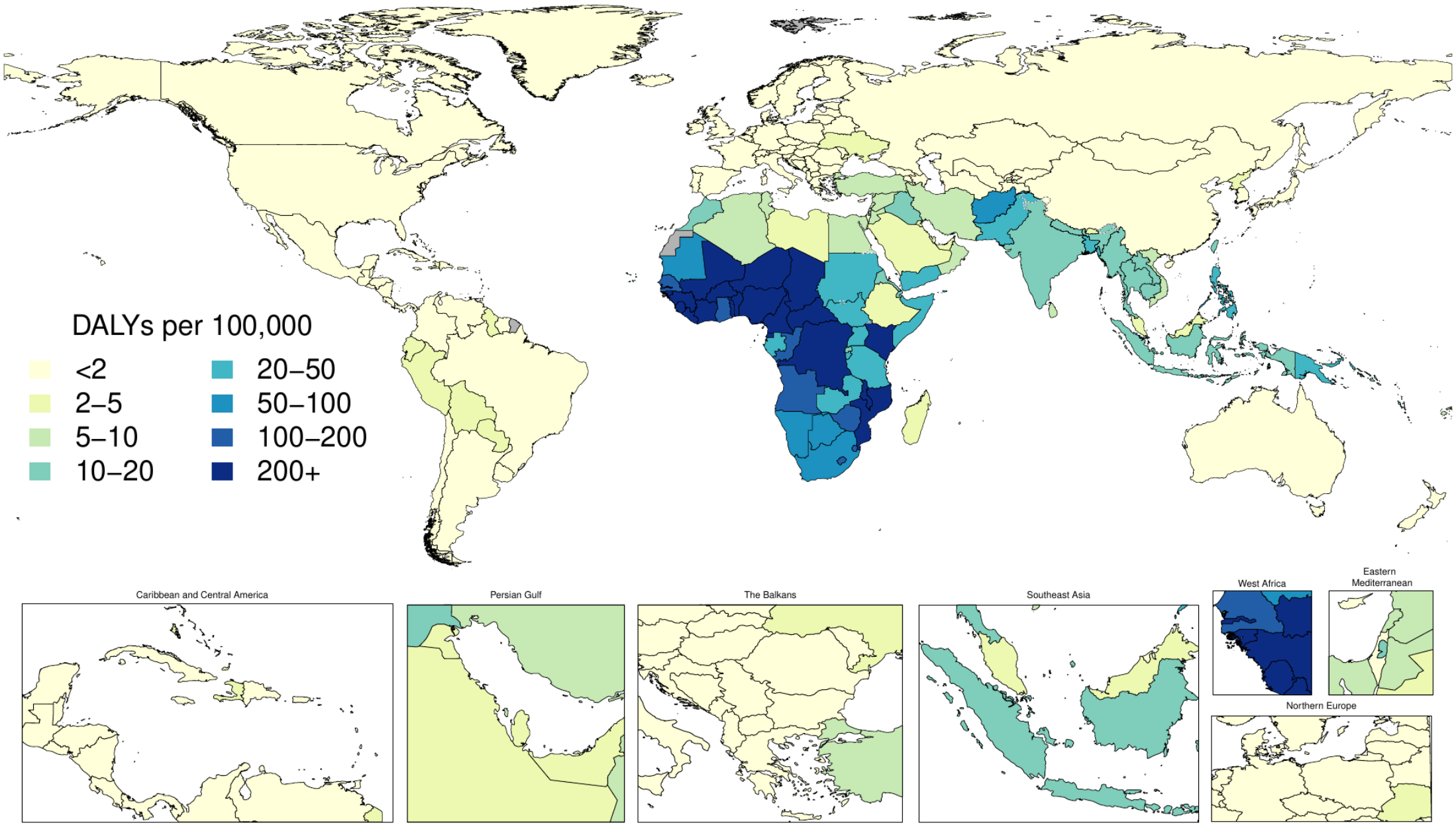
- Estimate mortality as product of incidence and CFR


77.0% decline (64.2, 84.8)
iNTS Deaths (thousands)
Year
0
20
40
60
80
2020
2030
2040
2050
2060
2070
2080
2090
2100
79
60
47
38
32
27
24
21
19
Super-region
Central Europe, Eastern Europe, and Central Asia
High-income
Latin America and Caribbean
North Africa and Middle East
South Asia
Southeast Asia, East Asia, and Oceania
Sub-Saharan Africa

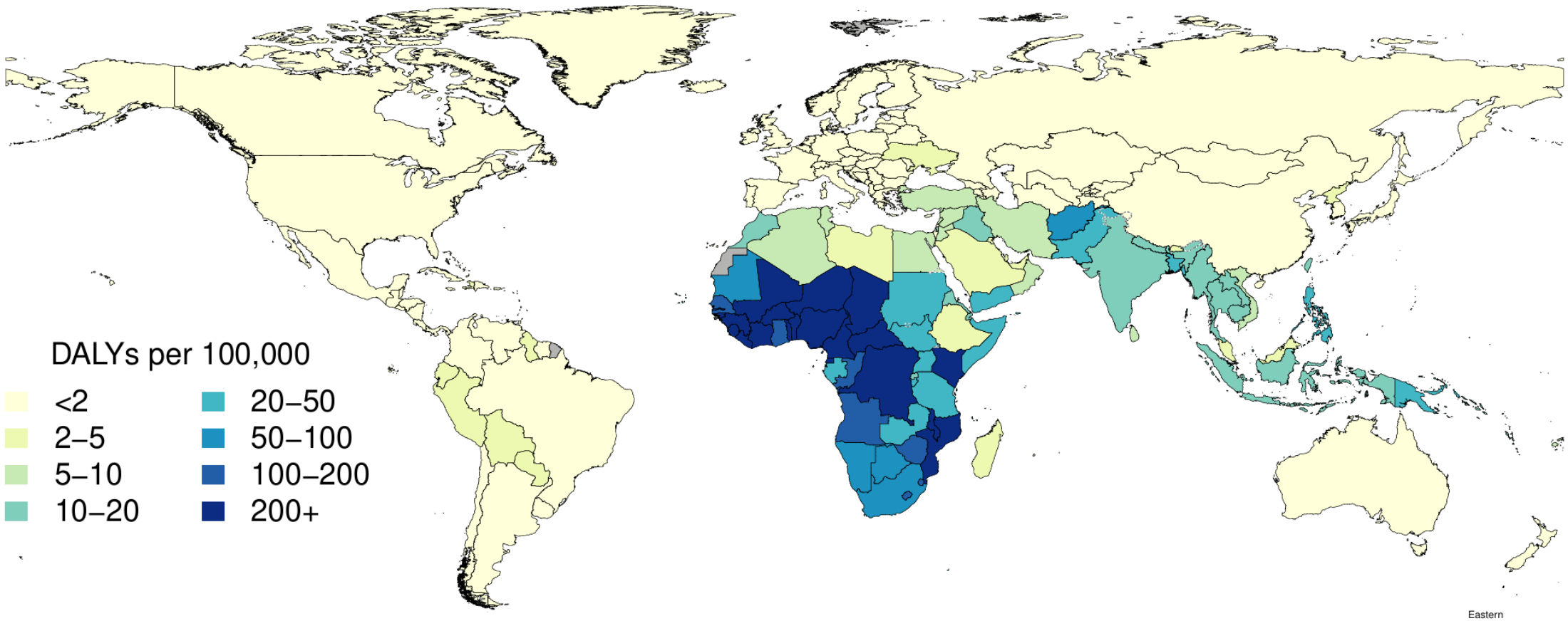
Global iNTS mortality, age-standardized rates

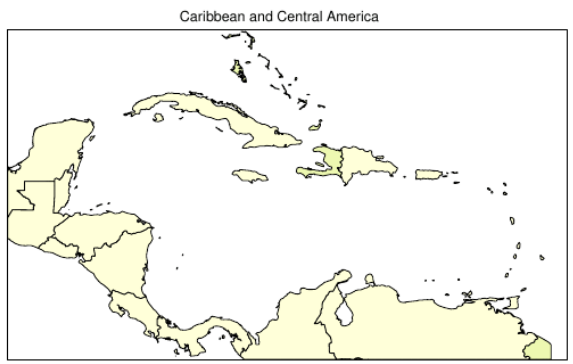


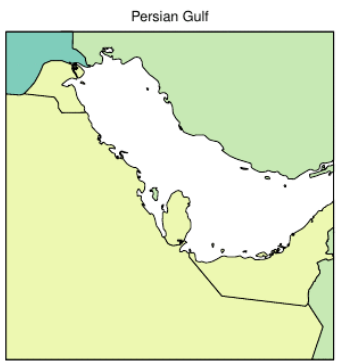
Age−standardized DALY Rate (per 100k), 2020

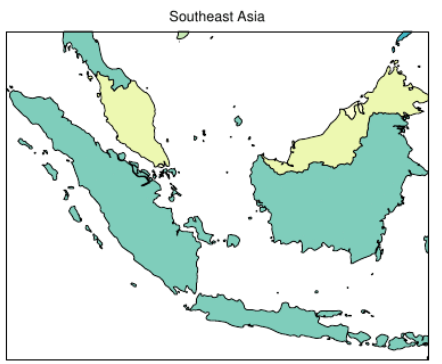


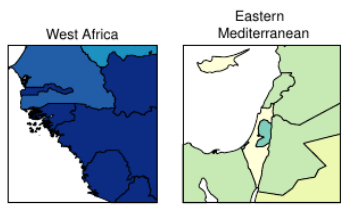
Age−standardized DALY Rate (per 100k), 2020











Conclusions

- Expected improvements in iNTS drivers/risk-factors likely to effect dramatic improvements in iNTS burden
- Expected population growth in SSA with stable or declining populations in other regions → larger proportion of global population living in higher risk locations
- R code for scenario-based forecasting to be published

Acknowledgements

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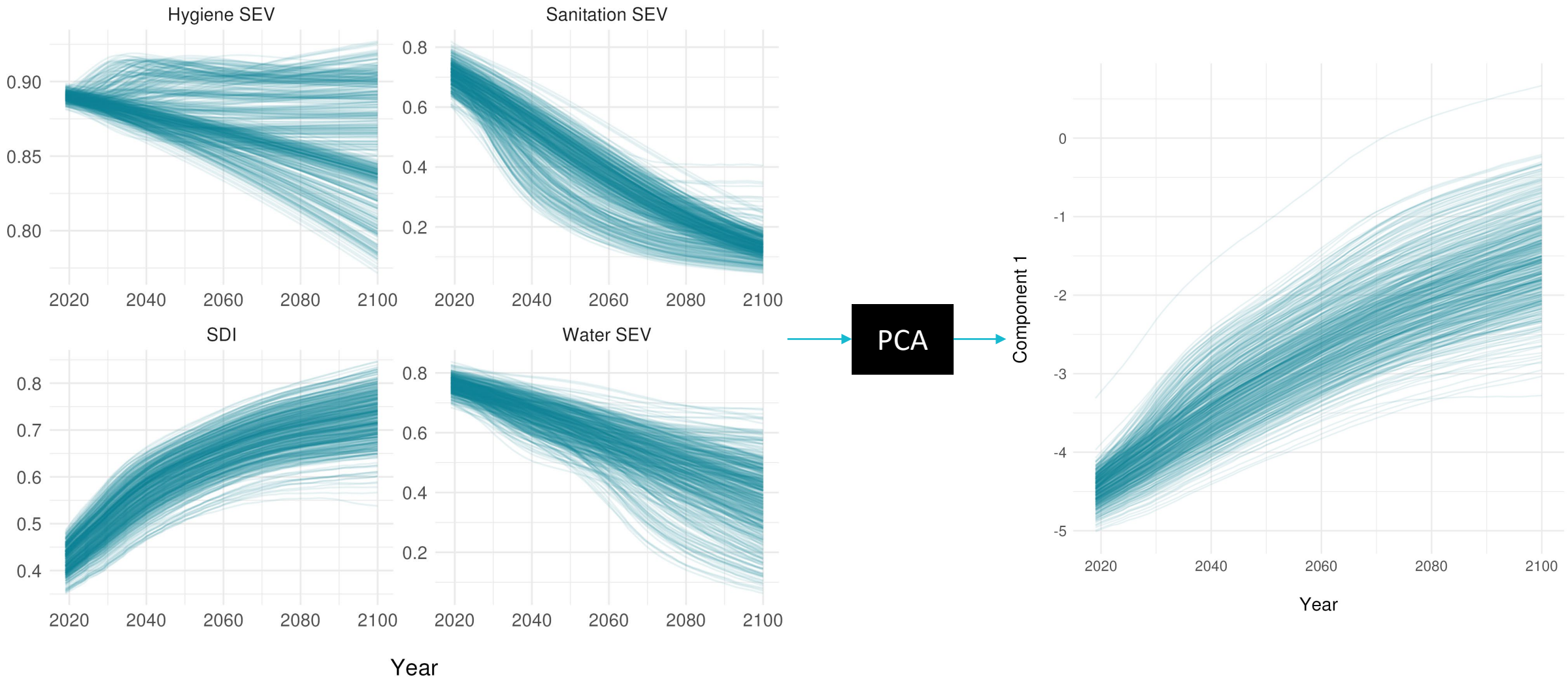
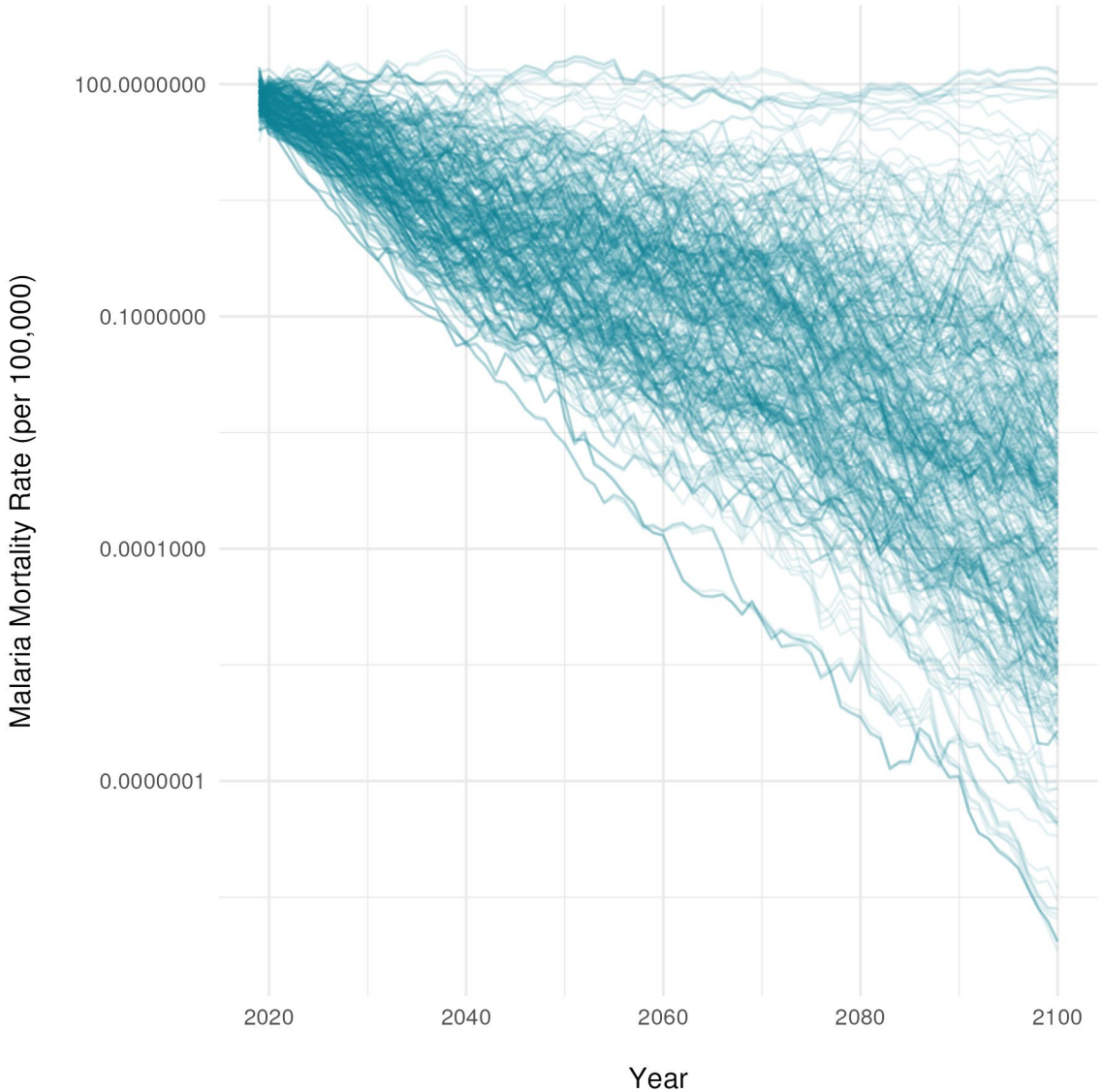
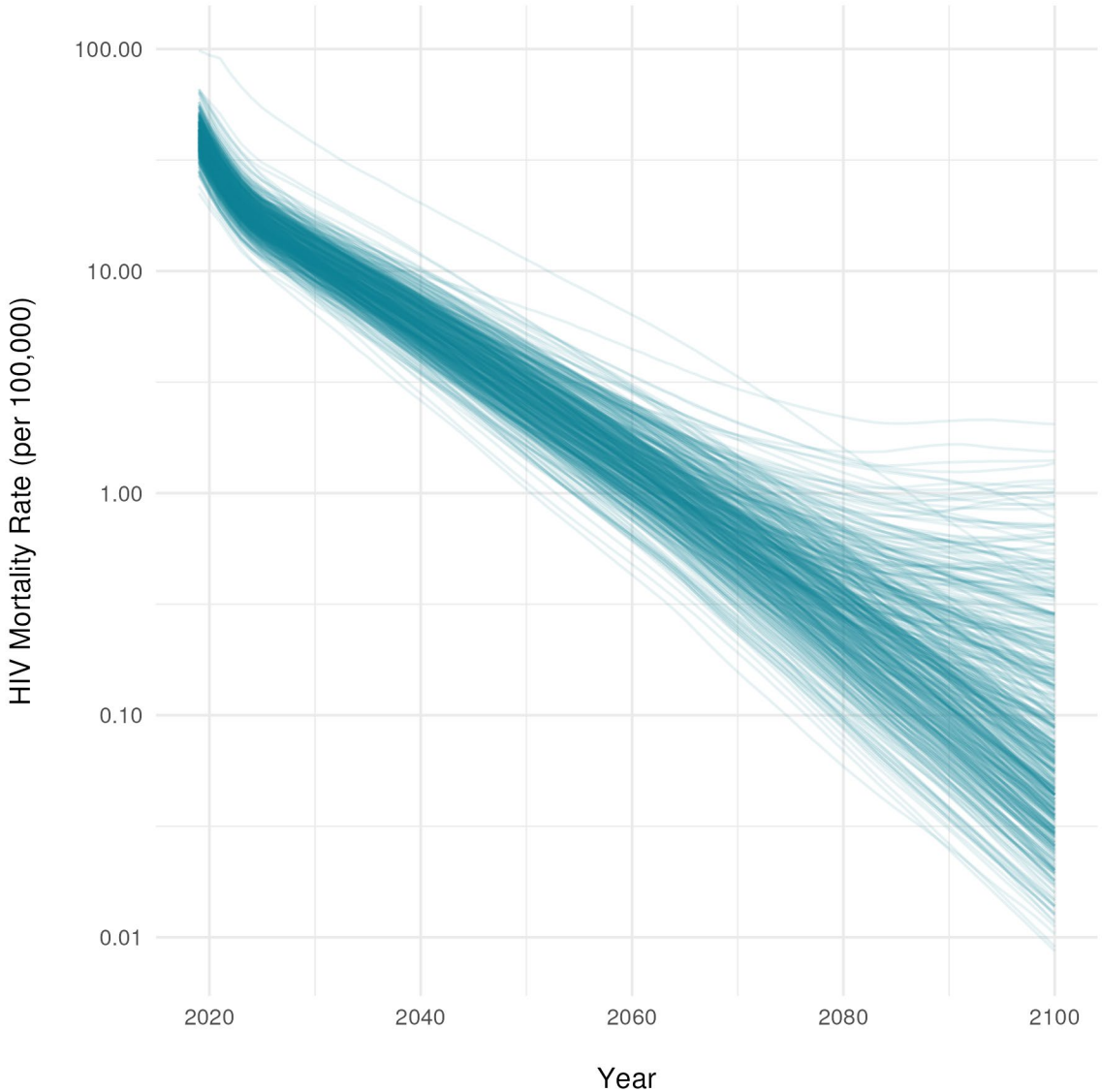

Hygiene SEV
Sanitation SEV
SDI
Water SEV
0.90
0.85
0.80
0.8
0.6
0.4
0.2
0.7
0.5
2020
2040
2060
2080
2100
Year
PCA
Component 1
0
-1
-2
-3
-4
-5


Malaria Mortality Rate (per 100,000)
100.0000000
0.1000000
0.0001000
0.0000001
2020
2040
2060
2080
2100
Year


HIV Mortality Rate (per 100,000)
100.00
10.00
1.00
0.10
0.01
2020
2040
2060
2080
2100
Year

Gap metric estimation

$$YLDs = incidence \times duration \times disability\ weight$$

$$YLLs = deaths \times target\ life\ expectancy$$

$$DALYs = YLLs + YLDs$$