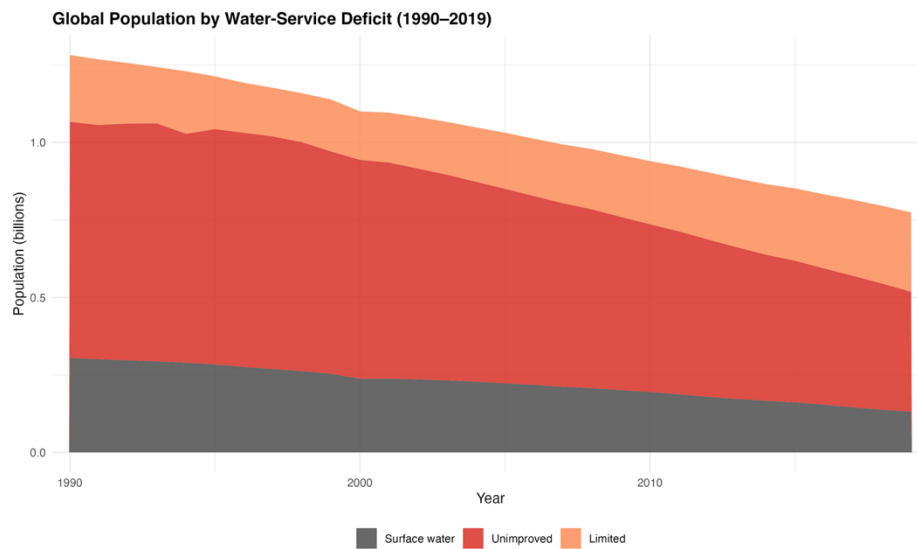


1 *Supplement to:*

2 Kallio et al: Global mapping of areas with a double burden of poor water quality and
3 unsafe drinking water access

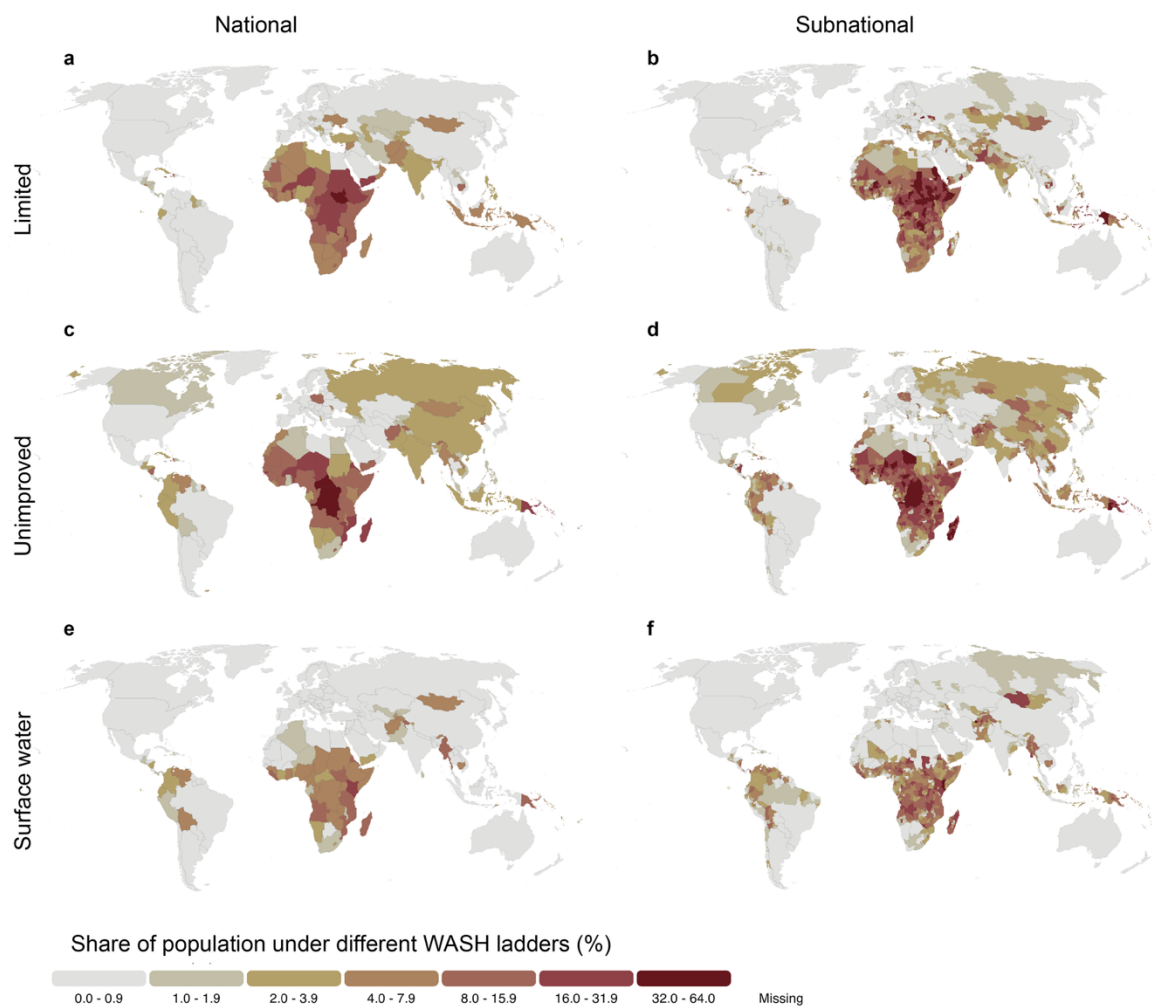
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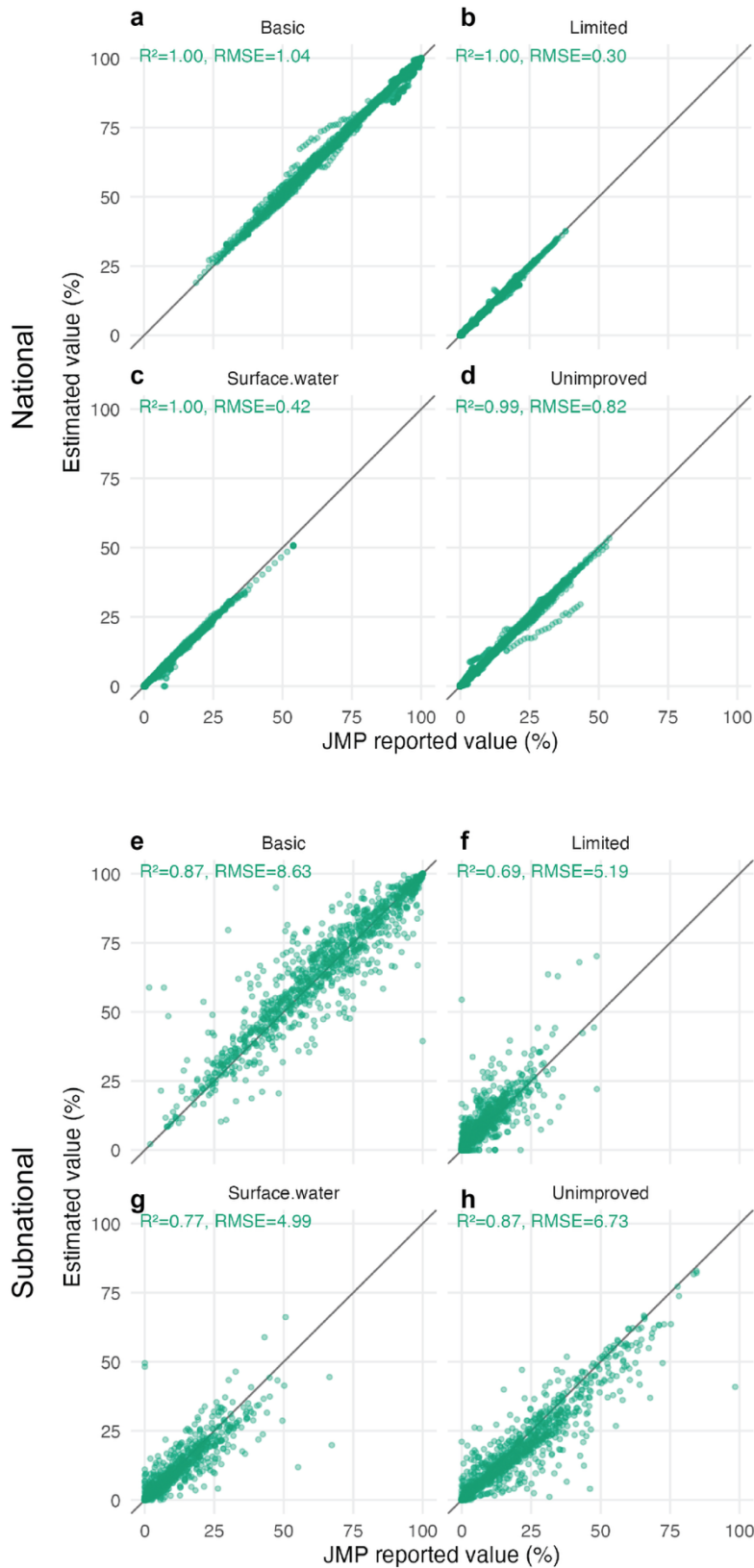
5

6 Supplementary Figure S1. The global population under limited, unimproved and surface water service
7 levels from 1990 to 2019.

8



Supplementary Figure S2. Comparison of the share of people under limited (a,b), unimproved (c,d) and surface water (e,f) WASH service levels at national and subnational scale, respectively.



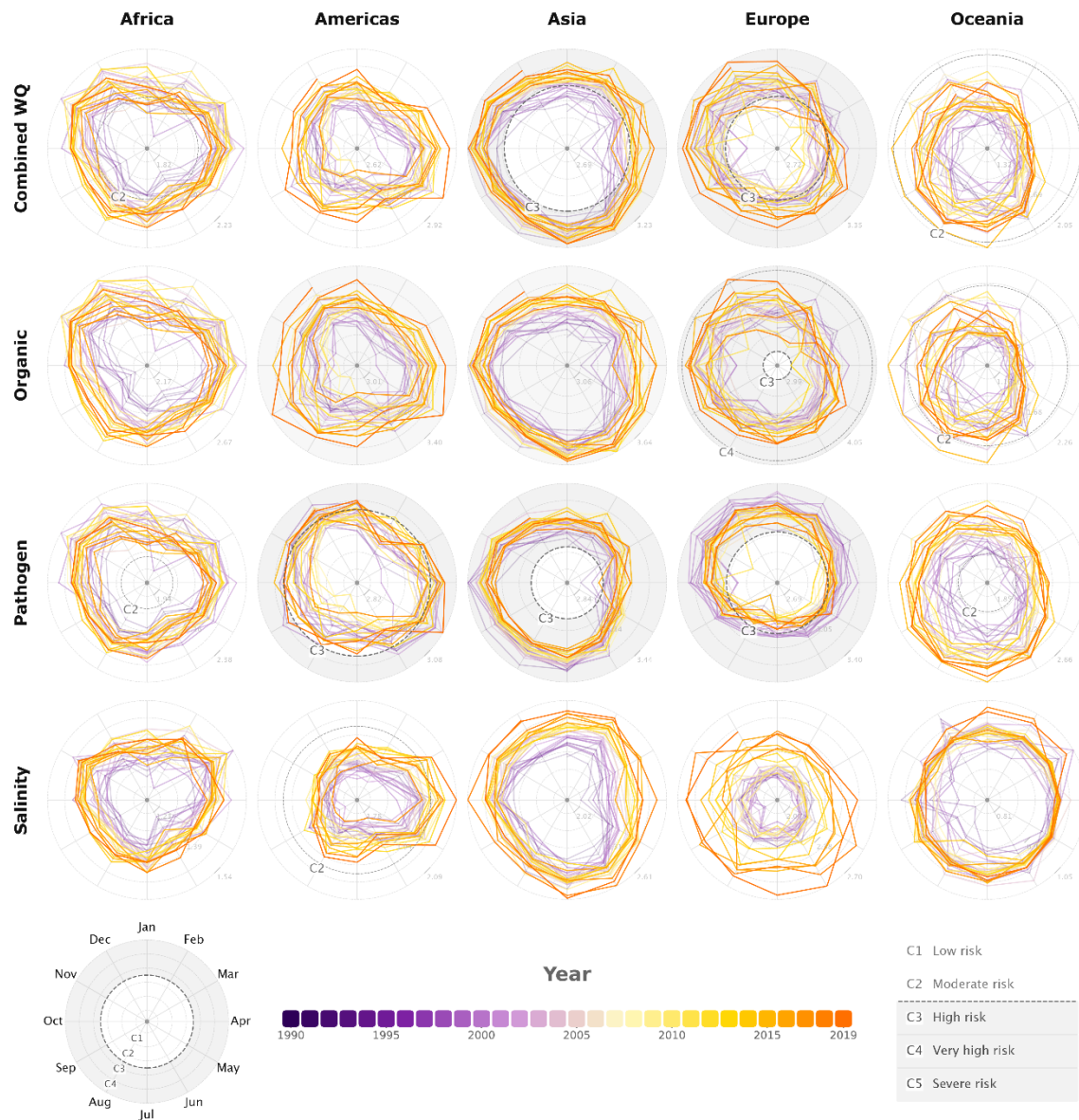
14

15 Supplementary Figure S3. Validation of G-HSDW against JMP reported shares. Panels a-d show the
 16 validation of basic, limited, surface water and unimproved service levels with national aggregation,
 17 respectively. Panels e-h give the validation at subnational level. The figures also give coefficient of
 18 determination R^2 and root mean square of error (RMSE) for each aggregation and service level.

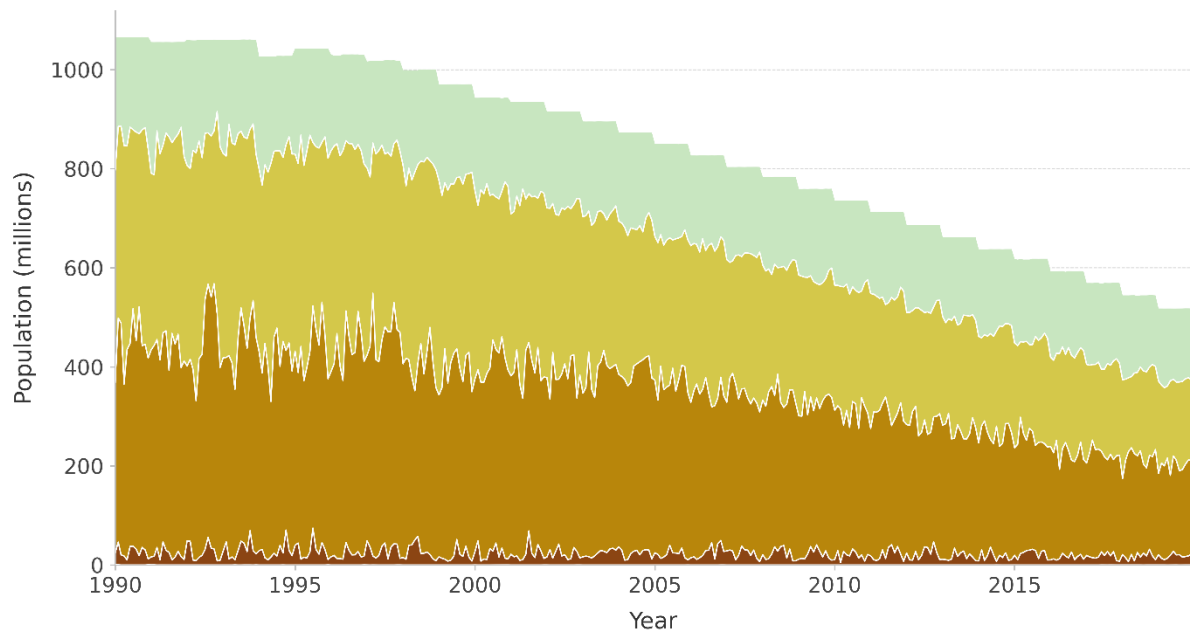
19 Supplementary Table S1. Mean and standard deviation (SD) of Pearson's ρ and Chatterjee's ξ_n correlation
20 coefficients computed for each admin area and water quality parameter pair separately and averaged
21 globally. Computed for annual water quality risk classes and for monthly contaminant concentrations.
22 Combined water quality indicator is risk level for both annual and monthly timeseries.

Variables		Annual water risk				Monthly contaminant concentrations			
X	Y	ρ		ξ_n		ρ		ξ_n	
		Mean	SD	Mean	SD	Mean	SD	Mean	SD
Organic	Pathogen	0.83	0.20	0.51	0.21	0.49	0.24	0.37	0.22
Organic	Salinity	0.74	0.29	0.42	0.23	0.70	0.27	0.52	0.24
Pathogen	Organic	-	-	0.50	0.22	-	-	0.34	0.22
Pathogen	Salinity	0.54	0.36	0.28	0.22	0.32	0.30	0.25	0.20
Salinity	Organic	-	-	0.42	0.23	-	-	0.53	0.24
Salinity	Pathogen	-	-	0.28	0.22	-	-	0.29	0.21
Organic	Combined risk	0.95	0.12	0.70	0.19	0.68	0.21	0.52	0.21
Pathogen	Combined risk	0.87	0.20	0.55	0.24	0.83	0.19	0.58	0.25
Salinity	Combined risk	0.77	0.26	0.45	0.23	0.56	0.24	0.43	0.22
Combined risk	Organic	-	-	0.72	0.16	-	-	0.52	0.21
Combined risk	Pathogen	-	-	0.58	0.22	-	-	0.63	0.23
Combined risk	Salinity	-	-	0.46	0.22	-	-	0.42	0.22

23

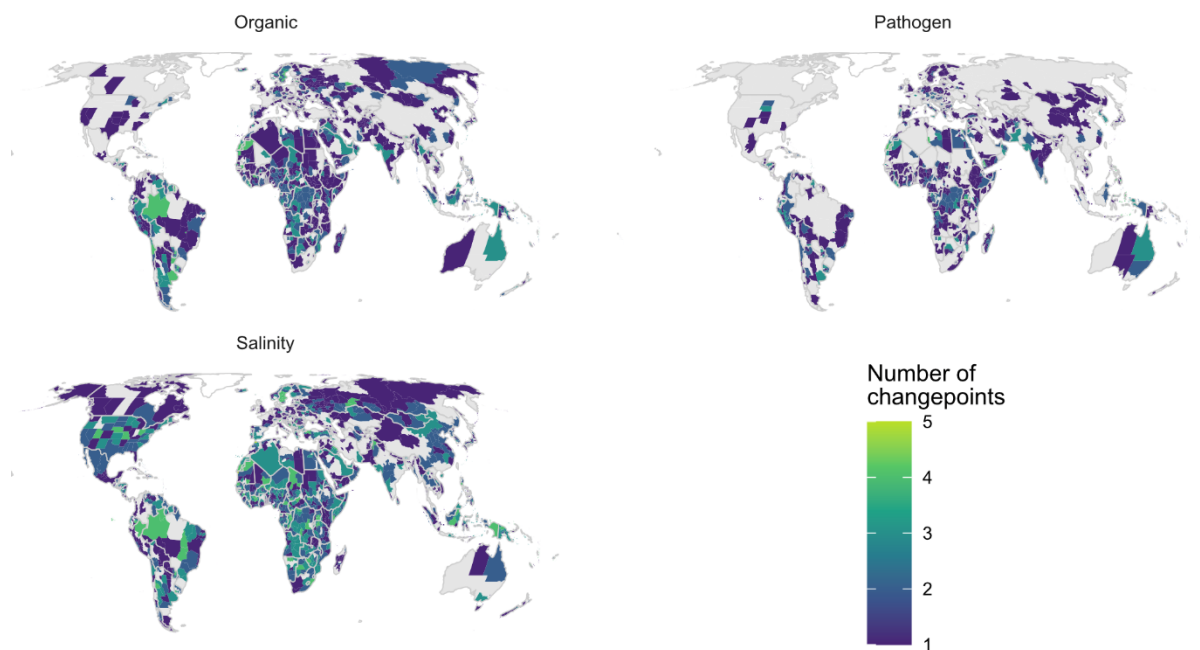


Supplementary Figure S4. Water quality risk spirals showing the seasonality and evolution of the risks over 1990-2019. The mean water quality indicators have been weighted using the population under surface water and unimproved service levels, and do not consider population under higher service levels. Similar to Figure 3 in the main text, but with each panel independently scaled from its own minimum to maximum.

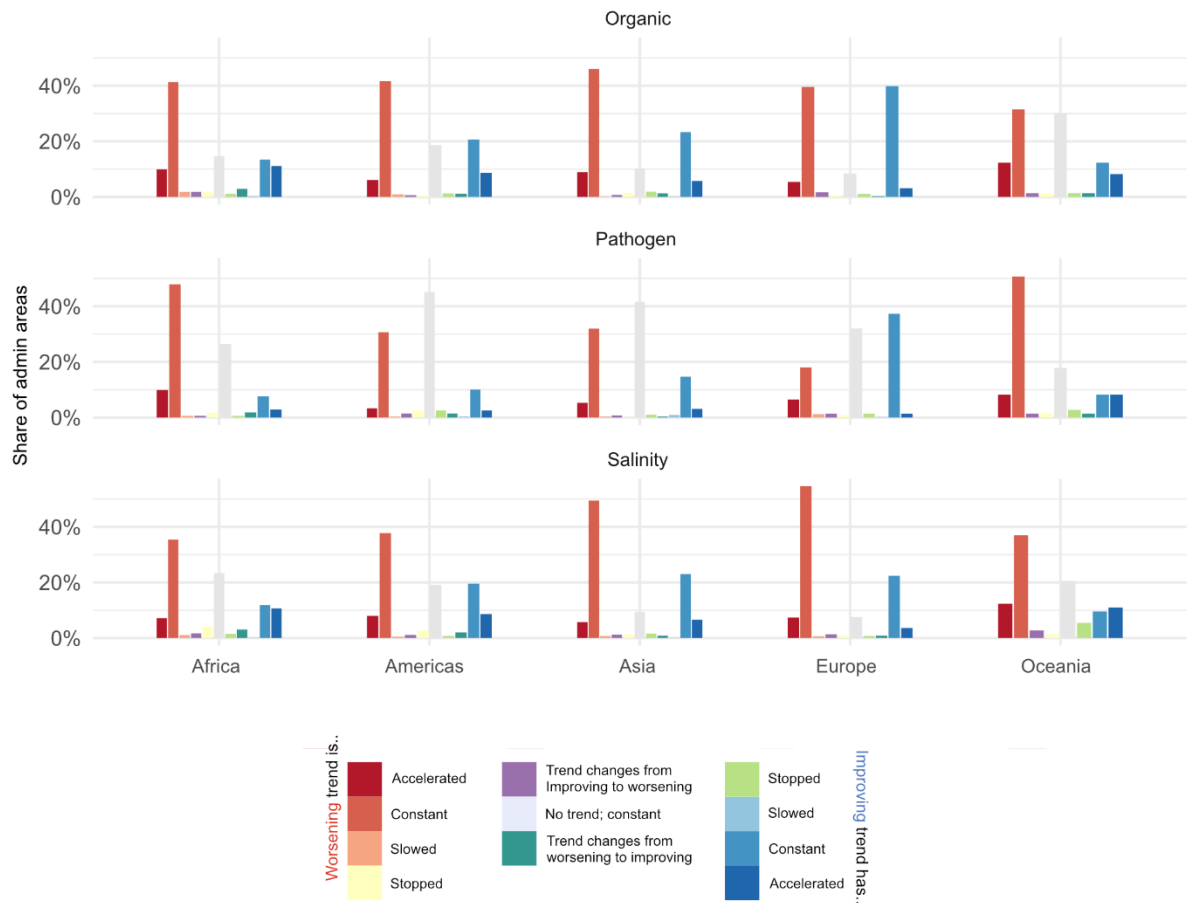


Low risk Moderate risk High risk Very high / severe risk

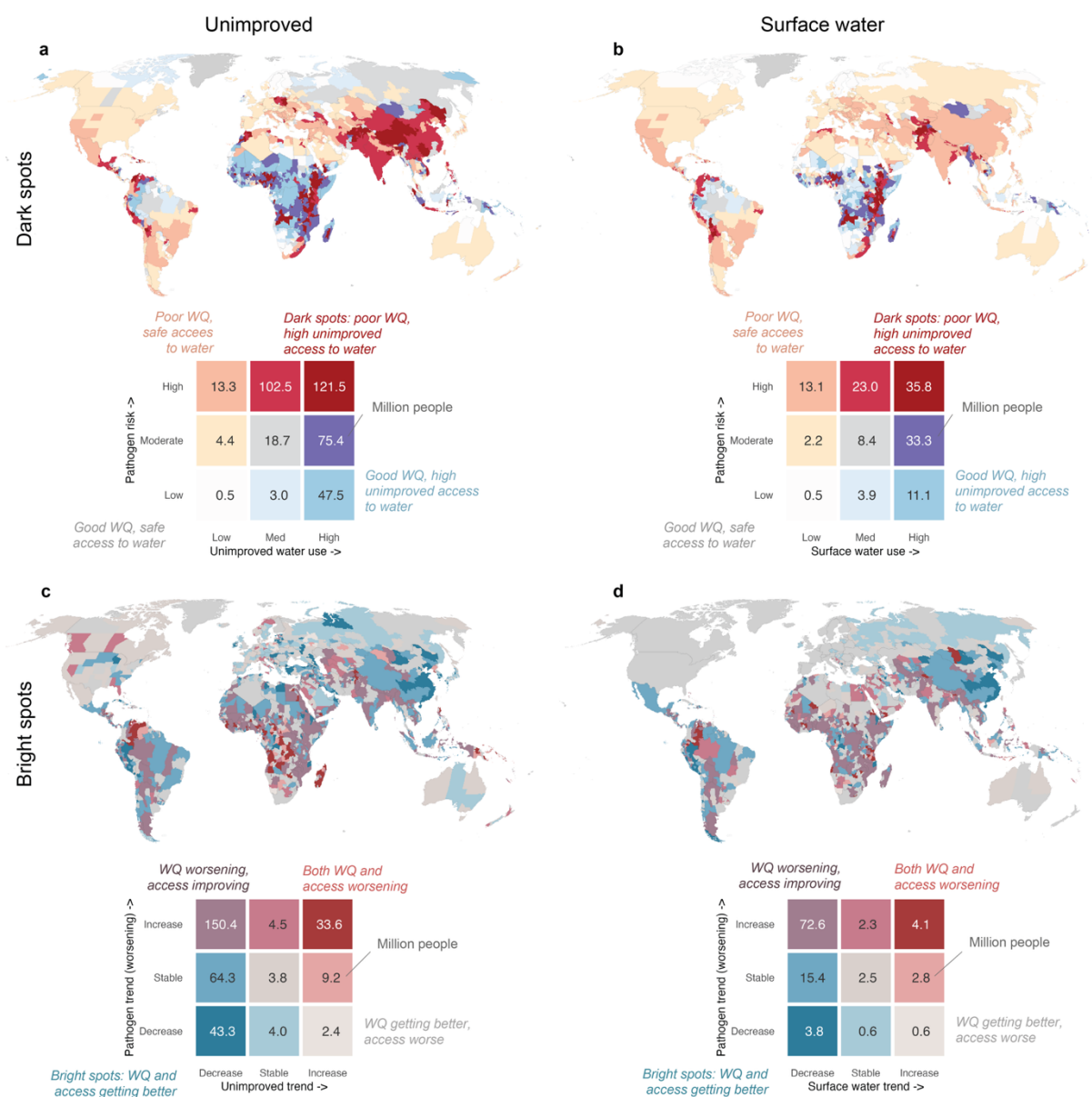
Supplementary Figure S5. Population relying on unimproved or surface water sources by monthly water quality risk class.



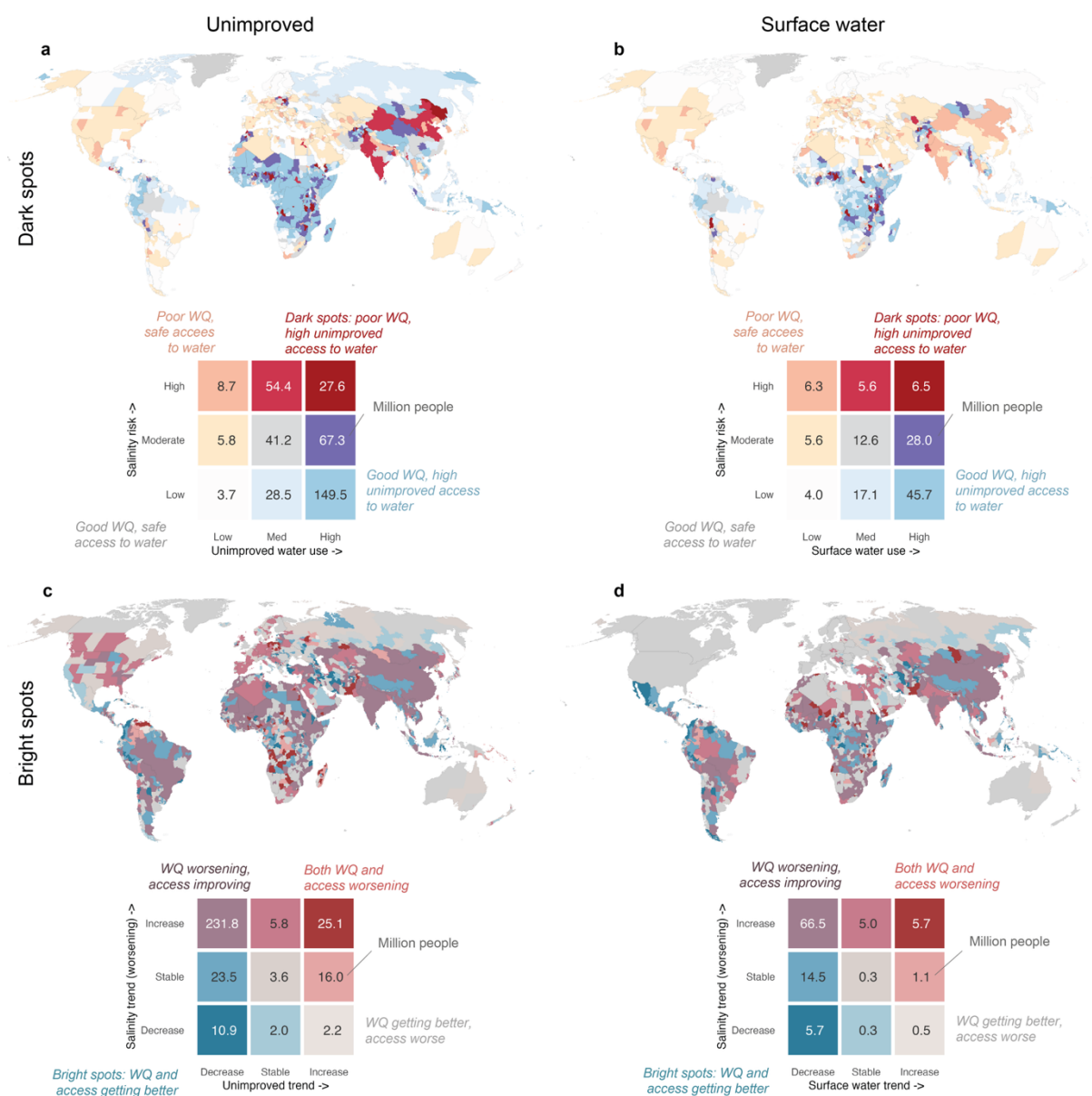
Supplementary Figure S6. Number of identified changepoints for each contaminant. Where no change points were not detected, contaminant timeseries showed no significant changes in mean or variance over the study period 1990-2019. The maximum number of possible change points is five because each period must last at least 5 years.



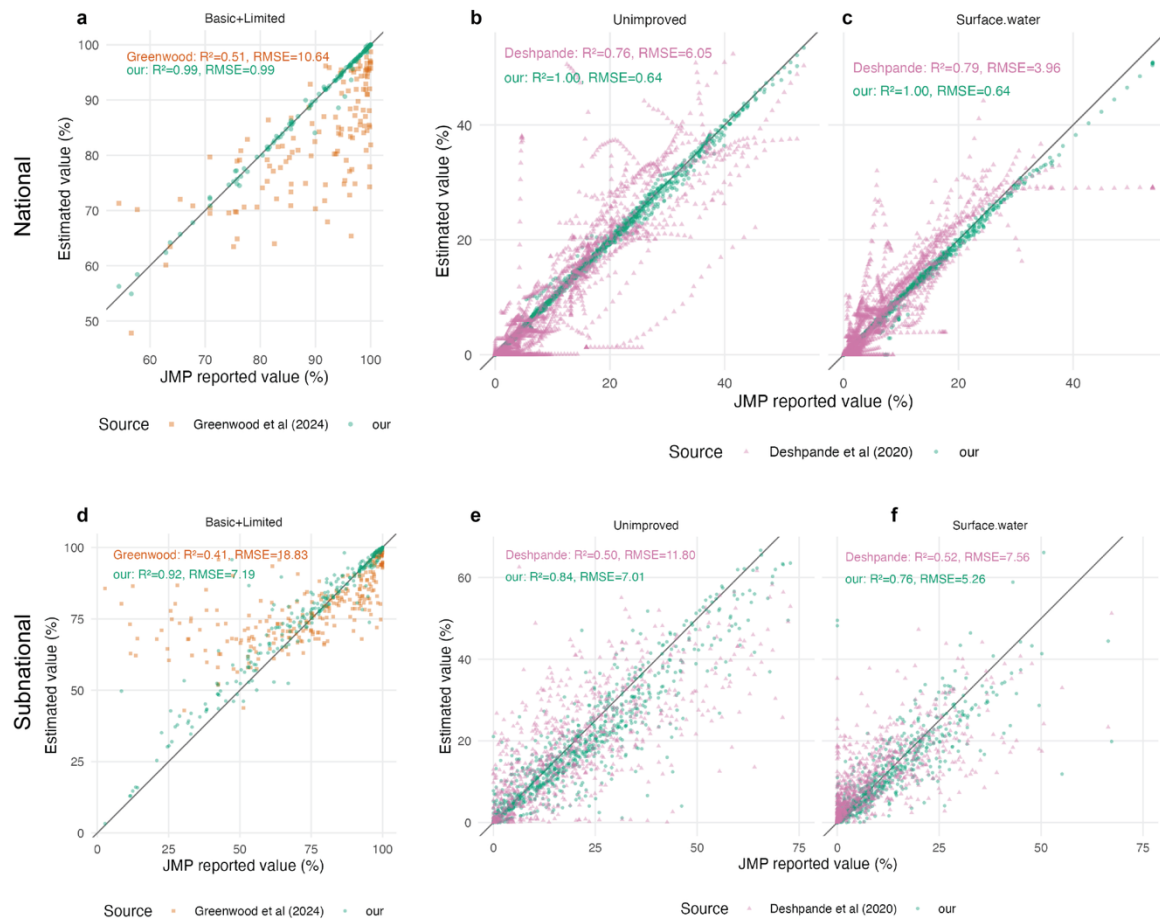
Supplementary Figure S7. The share of admin areas with a trend change classification over 2010-2019 at different continents.



Supplementary Figure S9. Bright spot and dark spot analysis using the current status and trends of **pathogen** water quality class and unimproved and surface water service levels. Bivariate maps show an intersection between pathogen water quality class and unimproved (a) and surface water (b) service levels, and trends of combined water quality and unimproved (c) and surface water (d) service levels. The bivariate legends show the population count in each category.



Supplementary Figure S10. Bright spot and dark spot analysis using the current status and trends of **salinity** water quality class and unimproved and surface water service levels. Bivariate maps show an intersection between salinity water quality class and unimproved (a) and surface water (b) service levels, and trends of combined water quality and unimproved (c) and surface water (d) service levels. The bivariate legends show the population count in each category.



Supplementary Figure S11. Comparison of the validation of G-HSDW, and Greenwood *et al* (2024) at national (a) and subnational level (d), and G-HSDW and Deshpande *et al* (2020) at national (b, c) and subnational (e, f). Comparison against Greenwood *et al* is made with combined basic and limited service levels. Comparison against Deshpande *et al* is made for unimproved (b, e) and surface water (c, f) service levels.