Supplementary Material for

Distribution and sources of fallout ^{137}Cs and $^{239+240}$Pu in Equatorial and Southern Hemisphere reference soils

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Incl. Tables S1-S4 and Figure S1

Table S1. Covariates used in Random Forest implementation for ^{137}Cs and $^{239+240}Pu$ inventories prediction. Bioclimatic data were extracted from WorldClim 2.1 climate data for 1970-2000 (Fick and Hijmans 2017) at a 30 arc-second spatial resolution.

Code	Covariates Used
Latitude	Latitude
Longitude	Longitude
Elevation	Elevation
AnnualMeanTemp	Annual Mean Temperature
MeanDiurnalRange	Mean Diurnal Range (Mean of monthly (max temp - min temp))
Isothermality	Isothermality (Mean Dirunal Range/Temperature Annual Range) (×100)
TempSeasonality	Temperature Seasonality (standard deviation ×100)
MaxTempWarmMonth	Max Temperature of Warmest Month
MinTempColdMonth	Min Temperature of Coldest Month
TempAnnualRange	Temperature Annual Range (Max Temperature of Warmest Month-Min Temperature of Coldest Month)
MeanTempWetQ	Mean Temperature of Wettest Quarter
MeanTempDriQ	Mean Temperature of Driest Quarter
MeanTempWarmQ	Mean Temperature of Warmest Quarter
MeanTempColdQ	Mean Temperature of Coldest Quarter
AnnualPrec	Annual Precipitation
PrecipWetMonth	Precipitation of Wettest Month
PrecipDriMonth	Precipitation of Driest Month
PrecipSeasonality	Precipitation Seasonality (Coefficient of Variation)
PrecipWetQ	Precipitation of Wettest Quarter
PrecipDriQ	Precipitation of Driest Quarter
PrecipWarmQ	Precipitation of Warmest Quarter
PrecipColdQ	Precipitation of Coldest Quarter

Table S2. Summary statistics of ^{137}Cs and $^{239+240}Pu$ inventory data grouped by continent. Note that the French Polynesia was separated from Oceania to emphasize its high inventories within the latitudinal band.

FRN	Area	Latitudinal Band	Mean	Median	1st Quantile	3rd Quantile
^{137}Cs	Asia	0-10° N	88.78	76.54	68.89	109.85
		0-10° S	99.83	121.51	52.40	125.59
	French Polynesia	0-10° S	191.00	210.14	145.85	217.01
		20-30° S	367.76	386.32	285.88	450.92
	Oceania	10-20° S	34.08	18.93	14.71	23.83
		20-30° S	112.29	43.12	17.01	177.75
		30-40° S	150.01	42.62	30.70	312.21
		40-50° S	121.78	49.03	25.89	231.09
	South America	0-10° N	336.34	90.50	66.29	852.23
		0-10° S	134.80	58.00	20.45	64.97
		10-20° S	228.43	170.50	112.45	386.22
		20-30° S	291.87	206.95	149.23	353.95
		30-40° S	446.94	354.88	301.27	582.13
		40-50° S	659.04	391.79	336.57	589.00
		50-60° S	243.90	200.37	145.07	353.86
		60-70° S	241.56	241.56	215.86	267.26
	Sub-Saharan Africa	0-10° N	407.94	126.81	24.27	985.76
		10-20° N	899.91	872.72	483.34	1174.50
		10-20° S	107.64	108.70	100.63	113.61
		20-30° S	122.57	122.57	122.57	122.57
		30-40° S	316.26	316.26	291.29	341.22
$^{239+240}Pu$	French Polynesia	0-10° S	11.75	12.80	7.83	14.63
		20-30° S	76.26	82.50	24.00	120.78
	Oceania	0-10° S	7.76	7.76	7.76	7.76
		10-20° S	11.73	12.39	10.36	13.84
		20-30° S	12.11	12.95	7.21	15.23
		30-40° S	18.36	17.39	13.69	21.42
		40-60° S	16.13	14.40	9.99	23.15
	South America	0-20° N	6.85	6.85	4.81	8.88
		0-10° S	11.10	11.10	6.66	15.54
		10-20° S	9.62	9.62	4.44	14.80
		20-30° S	11.60	11.60	0.63	22.57
		30-40° S	22.65	12.60	5.77	44.57
		40-60° S	6.73	7.22	3.78	9.20
	Sub-Saharan Africa	0-20° N	19.33	19.00	15.75	21.75
		0-10° S	29.34	32.70	11.34	45.65
		10-20° S	5.92	5.92	5.55	6.29
		20-30° S	14.43	11.84	9.25	22.20
		30-40° S	9.62	9.62	9.62	9.62

Table S3. Summary of $^{240}Pu/^{239}Pu$ atomic $^{137}Cs/^{239+240}Pu$ activity ratios determined from different locations globally.

Fallout Source	Sample Location	Date of Sample Collection	N	Sample types	$^{240/239}Pu$	SD	$^{137}Cs/^{239+240}Pu$*	SD	Authors
Pre-moratorium (pre-1958)	Arctic	1975, 1980	2	ice core, sectioned	0.24	0.03			*Koide et al. 1985*
	Antarctic	1976, 1977	2	ice core, sectioned	0.29	0.05			*Koide et al. 1985*
	Ross Ice Shelf, Antarctica	1976	1	ice core, sectioned			11.54	5.23	*Koide et al. 1979*
	Arctic		1	ice core, sectioned			11.88		*Koide et al. 1982*
	Antarctic		1	ice core, sectioned			10.01		*Koide et al. 1982*
UK	Alpha Isle (within 500 m NEWS of test site), Montebello Islands	1972, 1978	8	soil	0.05				*Child and Hotchkis 2013*
	Emu Field (within 500 m NEWS of test site), Emu	1972, 1978	8	soil	0.023				*Child and Hotchkis 2013*
	Taranaki (2-3 km NW), Maralinga	2010-2012	6	soil	0.064	0.008			*Johansen et al. 2014*
	Trimouille Island, Montebello (Mosaic G1)	2015	2	soil	0.037	0.002			*Johansen et al. 2019*
	Alpha Island, Montebello (Mosaic G2)	2015	2	soil	0.053	0.003			*Johansen et al. 2019*
	Trimouille Island, Montebello (Hurricane)	2015	2	soil	0.027	0.001			*Johansen et al. 2019*
	Taranaki (<10 km W), Maralinga	2011	2	soil	0.047	0.008	0.17		*Tims et al. 2013*
Global	Global (31-70 N)	1970-1971	24	soil	0.18	0.014			*Kelley et al. 1999*
	Global (0-30 N)	1970-1971	7	soil	0.178	0.019			*Kelley et al. 1999*
	Global (0-30 S)	1970-1971	8	soil	0.173	0.027			*Kelley et al. 1999*
	Global (31-70 S)	1970-1971	6	soil	0.185	0.047			*Kelley et al. 1999*
	Swiss Alps	2014	10	soil	0.183	0.013			*Meusburger et al. 2018*
	Europe	2009-2015	160	soil	0.19	0.021			*Meusburger et al. 2020*
	US-wide	1970-1971	57	soil	0.176	0.014			*Krey et al. 1976*
	US-wide	1983, 1987	66	soil	0.18	0.006	18.34	1.95	*McArthur and Miller 1989*
	South Korea	2010	7	soil	0.182	0.015	24.44	4.75	*Meusburger et al. 2016*
	Utah	1979	4	soil	0.1817	0.002	19.94	2.49	*Krey and Beck 1981*
	Denver, Colorado	1994	15	soil			19.09	2.01	*Hodge et al. 1996*
	New York, San Francisco, and Cape Cod	1972-1973	10	soil			18.95	2.99	*Hardy 1975*
	South Korea-wide	1995	27	soil			20.93	3	*Kim et al. 1998*
	ISPRA, Italy	1961-1965	53	airfilter			18.74	3.01	*de Bortoli et al. 1968*
	Global (?)	1959-1970		airfilter	0.179				*HASL 1973 as cited in Bertine et al. 1983*
	Scotland, England	1977		soil			19.72	3.4	*Earkins et al. 1981 as cited in Hodge et al. 1996*

French	Fangataufa, French Polynesia (Kilo)	1996	3	loose coral rocks	0.049	0.001			*Hrnecek et al. 2005*
	Mururoa, French Polynesia (Faucon)	1996	3	soil	0.018	0.001			*Hrnecek et al. 2005*
	Mururoa, French Polynesia (Colette)	1996		coral	0.019	0.002			*Hrnecek et al. 2005*
	Fangataufa, French Polynesia	1996		lagoon sediment	0.05				*Chiappini et al. 1999*
	Mururoa, French Polynesia	1996	4	lagoon sediment	0.033	0.022			*Chiappini et al. 1999*
	Mururoa, French Polynesia	1996 (?)	11	lagoon sediment	0.041	0.009			*Chiappini et al. 1996*
	Fangataufa, French Polynesia	1996	8	lagoon sediment	0.0501	0.003			*Chiappini et al. 1998*
	Gambier Islands, French Polynesia	2018	7	soil	0.0163	0.005	1.74	0.35	*Bouisset et al. 2021*

*Decay-corrected to 2024

Table S4. Relative contributions of the French and British fallouts in the Equatorial and Southern Hemisphere reference soils calculated from $^{239}Pu/^{240}Pu$ atomic ratios.

Authors	Year Published	Continent	Country	Sample Name or Label	$^{239}Pu/^{240}Pu$	Uncertainty	% French or British Fallout*	Uncertainty
Bouisset et al.	2018	Oceania	French Polynesia	Hv1	0.153333333	0.004041452	18.39	3.38
Bouisset et al.	2018	Oceania	French Polynesia	Hv4	0.143333333	0.010503968	25.29	7.70
Bouisset et al.	2018	Oceania	French Polynesia	Hv2	0.143	0.015099669	25.52	10.74
Bouisset et al.	2018	Oceania	French Polynesia	Hv5	0.129333333	0.002516611	34.94	4.01
Bouisset et al.	2021	Oceania	French Polynesia	Ga7	0.0566	0.008	85.10	10.39
Bouisset et al.	2021	Oceania	French Polynesia	Ga5	0.0418	0.0075	95.31	11.13
Bouisset et al.	2021	Oceania	French Polynesia	Ga3	0.0406	0.0078	96.14	11.31
Bouisset et al.	2021	Oceania	French Polynesia	Ga1	0.0383	0.0062	97.72	10.98
Bouisset et al.	2021	Oceania	French Polynesia	Ga2	0.0338	0.0052	100.83	11.03
Bouisset et al.	2021	Oceania	French Polynesia	Ga6	0.0301	0.0048	103.38	11.20
Lal et al.	2020	Oceania	Australia	Montebello Island	0.045	0.002	99.26	11.05
Lal et al.	2020	Oceania	Australia	Central Australia	0.069	0.005	81.62	9.72
Tims et al.	2013	Oceania	Australia	F1	0.069	0.005	81.62	9.72
Tims et al.	2013	Oceania	Australia	T6	0.098	0.005	60.29	7.60
Tims et al.	2013	Oceania	Australia	T5	0.107	0.031	53.68	23.55
Tims et al.	2013	Oceania	Australia	E	0.113	0.007	49.26	7.48
Lal et al.	2020	Oceania	Australia	Maralinga	0.113	0.007	49.26	7.48
Lal et al.	2020	Oceania	Australia	Alice Sprins	0.114	0.026	48.53	19.85
Lal et al.	2017	Oceania	Australia	A	0.120476	0.002234	43.77	5.10
Lal et al.	2017	Oceania	Australia	D	0.122224	0.00338	42.48	5.30
Lal et al.	2017	Oceania	Australia	C	0.12239	0.001776	42.36	4.85
Lal et al.	2020	Oceania	Australia	Devils Marbles	0.127	0.033	38.97	24.64
Tims et al.	2013	Oceania	Australia	T4	0.133	0.009	34.56	7.64
Lal et al.	2020	Oceania	Australia	Daly River	0.136	0.011	32.35	8.84
Lal et al.	2020	Oceania	Australia	Darwin	0.136	0.011	32.35	8.84
Lal et al.	2020	Oceania	Australia	Port Hedland	0.136	0.03	32.35	22.35
Tims et al.	2013	Oceania	Australia	T3	0.136	0.008	32.35	6.88
Lal et al.	2020	Oceania	Australia	Vlamingh Head	0.136	0.03	32.35	22.35
Tims et al.	2013	Oceania	Australia	D2b	0.137	0.005	31.62	5.07

Lal et al.	2017	Oceania	Australia	B	0.137838	0.003002	31.00	4.07
Srnik et al.	2014	Oceania	Australia	Herbert River	0.142	0.005	27.94	4.80
Tims et al.	2013	Oceania	Australia	T2	0.144	0.008	26.47	6.57
Lal et al.	2020	Oceania	Australia	Sydney	0.146	0.013	25.00	9.95
Froehlick et al.	2019	Oceania	Cook Islands	Raemaru	0.148		23.53	2.60
Lal et al.	2020	Oceania	Australia	Herbert River	0.149	0.003	22.79	3.35
Everett et al.	2008	Oceania	Australia	Herbert River catchment	0.149		22.79	2.52
Froehlick et al.	2019	Oceania	Cook Islands	Raemaru	0.149		22.79	2.52
Lal et al.	2020	Oceania	Australia	Townsville	0.149	0.003	22.79	3.35
Tims et al.	2013	Oceania	Australia	K1	0.151	0.006	21.32	5.00
Tims et al.	2013	Oceania	Australia	M1a	0.16	0.011	14.71	8.25
Tims et al.	2013	Oceania	Australia	M1c	0.16	0.003	14.71	2.74
Lal et al.	2020	Oceania	Australia	Namadgi	0.16	0.011	14.71	8.25
Lal et al.	2020	Oceania	Australia	Sydney	0.171	0.001	6.62	1.04
Hardy et al.	1973	Oceania	Australia	Melbourne	0.1716	0.0014	6.18	1.24
Lal et al.	2020	Oceania	Australia	Melbourne	0.172	0.001	5.88	0.99
Lal et al.	2020	Oceania	Australia	Melbourne	0.172	0.001	5.88	0.99
Hardy et al.	1973	Oceania	Australia	Brisbane	0.1768	0.0027	2.35	2.01
Lal et al.	2020	Oceania	Australia	Adelaide	0.177	0.002	2.21	1.49
Lal et al.	2020	Oceania	Australia	Brisbane	0.177	0.003	2.21	2.22
Lal et al.	2020	Oceania	Australia	Brisbane	0.177	0.003	2.21	2.22
Hardy et al.	1973	Oceania	New Zealand	Greymouth	0.1845	0.0015	0.00	0.00
Lal et al.	2020	Oceania	Australia	Perth	0.182	0.011	0.00	0.00
Raab et al.	2022	Oceania	New Zealand	R1	0.194198855	0.035573866	0.00	0.00
Raab et al.	2022	Oceania	New Zealand	R2	0.206301325	0.014208609	0.00	0.00
Hardy et al.	1973	Oceania	New Zealand	S. Canterbury	0.1901	0.0036	0.00	0.00
Tims et al.	2013	Oceania	Australia	T1	0.194	0.018	0.00	0.00
Chaboche et al.	2022	South America	Antarctica	A1	0.195	0.015	0.00	0.00
Chaboche et al.	2022	South America	Antarctica	A2	0.184	0.018	0.00	0.00
Kelley et al.	1999	South America	Brazil	Belem S-1607	0.1825	0.0029	0.00	0.00
Chaboche et al.	2022	South America	Peru	PASO05	0.181	0.015	0.00	0.00
Kelley et al.	1999	South America	Chile	Punta Arenas S-1707	0.2045	0.0046	0.00	0.00

Chaboche et al.	2022	South America	French Guiana	ROC	0.189	0.032	0.00	0.00
Chaboche et al.	2022	South America	Peru	PASO02	0.178	0.013	1.38	8.97
Kelley et al.	1999	South America	Colombia	Bogota S-1599	0.1774	0.0039	1.79	2.70
Chamizo et al.	2011	South America	Chile	Chaiten	0.176	0.015	2.76	10.35
Kelley et al.	1999	South America	Venezuela	Maracay S-1598	0.1721	0.0034	5.45	2.41
Hardy et al.	1973	South America	Brazil	Rio de Janeiro	0.1676	0.0025	8.55	1.94
Chamizo et al.	2011	South America	Chile	Iquique	0.166	0.008	9.66	5.61
Kelley et al.	1999	South America	Equador	Guayaquil S-1627	0.1602	0.0023	13.66	2.13
Kelley et al.	1999	South America	Peru	Lima S-1632	0.1565	0.003	16.21	2.66
Kelley et al.	1999	South America	Chile	Puerto Montt S-1690	0.1563	0.0013	16.34	1.92
Salmani-Ghabeshi et al.	2018	South America	Chile	Valle Alegre	0.156	0.027	16.55	18.70
Salmani-Ghabeshi et al.	2018	South America	Chile	Los Maitenes	0.155	0.057	17.24	39.35
Salmani-Ghabeshi et al.	2018	South America	Chile	La Greda	0.149	0.016	21.38	11.25
Salmani-Ghabeshi et al.	2018	South America	Chile	Santa Barbara	0.144	0.007	24.83	5.47
Chaboche et al.	2022	South America	Brazil	Conceicao	0.135	0.006	31.03	5.24
Chamizo et al.	2011	South America	Chile	Santa Barbara	0.134	0.007	31.72	5.84
Chamizo et al.	2011	South America	Chile	Punchuncavi	0.13	0.02	34.48	14.25
Salmani-Ghabeshi et al.	2018	South America	Chile	Puchuncavi	0.128	0.013	35.86	9.70
Chamizo et al.	2011	South America	Chile	Antofagasta	0.12	0.04	41.38	27.92
Hardy et al.	1973	South America	Chile	Santiago	0.1156	0.0017	44.41	4.74
Chamizo et al.	2011	South America	Chile	Chillan	0.111	0.008	47.59	7.39
Hardy et al.	1973	South America	Argentina	Buenos Aires	0.1075	0.0007	50.00	5.20
Chamizo et al.	2011	South America	Chile	La Parva	0.041	0.003	95.86	10.13
Salmani-Ghabeshi et al.	2018	Sub-Saharan Africa	Mozambique	Maputo MA1/11	0.171	0.022	0.00	0.00
Salmani-Ghabeshi et al.	2018	Sub-Saharan Africa	South Africa	Durban DU1/11	0.172	0.012	0.00	0.00
Kelley et al.	1999	Sub-Saharan Africa	Angola	Luanda	0.174	0.014	0.00	0.00
Hardy et al.	1973	Sub-Saharan Africa	South Africa	Angra dos Reis	0.178	0.0015	0.00	0.00
Kelley et al.	1999	Sub-Saharan Africa	Zimbabwe	Harare	0.1793	0.0029	0.00	0.00
Kelley et al.	1999	Sub-Saharan Africa	Kenya	Muguga	0.1897	0.0026	0.00	0.00
Hardy et al.	1973	Sub-Saharan Africa	S. Africa	Stellenbosch	0.2011	0.0027	0.00	0.00

*Calculated using the values from Table 1. Zero values indicate sole contribution from global fallout.

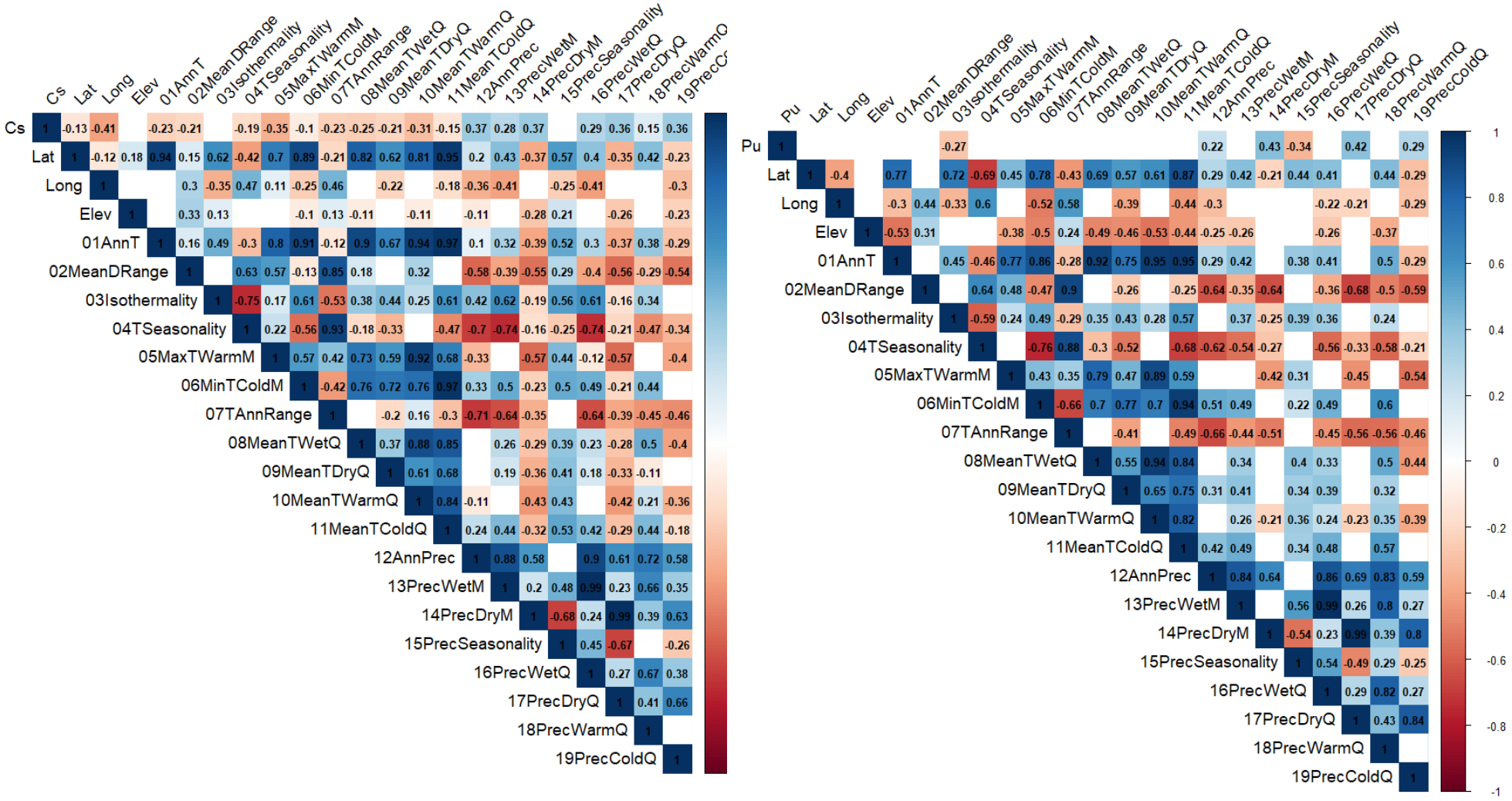

Figure S1. Spearman rank correlation between ^{137}Cs and $^{239+240}Pu$ inventories with location, elevation, and bioclimatic variables from 1970-2000 from WorldClim.org. White blocks indicate correlations that are not significant ($p > 0.05$).