

資料

003 世界各地におけるトリチウム降下量 (1953年～1971年)

— IAEA 資料のまとめ —

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— from the IAEA environmental isotope data —

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Tritium precipitations in the world from 1953 to 1971 are compared by year, latitude and zone. They had a sharp peak in the period of many nuclear tests made mainly by U.S.A. and U.S.S.R. in 1962 and 1963, and decreased to a few times the pre-test level. Tritium levels were highest in 40°~60°N zone in the whole period. The ones in the sea were lower than the ones in land. This is estimated to be due to dilution by evaporation of sea water. The ones in east Asia including Japan were lower than the ones in North America and Europe.

1. 序 論

本報告は、世界各地におけるトリチウム降下量（主として雨水）を International Atomic Energy Agency が主として測定集録したデータ集をもとにして、本学原子力研究所保健物理研究室においてまとめたものである。このデータ集は Environmental Isotope Data No. 1~5; World Survey of Isotope Concentration in Precipitation (1953-1963, 1964-1965, 1966-1967, 1968-1969, 1970-1971: Technical Report Series No. 96, 117, 129, 147, 165) の5冊で試料採集 Station 数224, 総ページ1795におよぶ。

データ集においては各月の雨水の量 (mm) トリチウム濃度 (TU) その他を記載してあるので、本報告では各年毎に各月のトリチウム濃度を $\mu\text{Ci}/\text{l}$ に換算し、雨量 (mm) を掛けてトリチウム総降下量 $\mu\text{Ci}/\text{m}^2$

にした後、月平均をとった。データの欠けた月は平均から除外した。月間トリチウム総降下量の1年間の和をとれば各地各年の比較に妥当と思われるが、データの欠けた月があるので上記のように $\mu\text{Ci}/\text{m}^2 \cdot \text{month}$ 単位にした。上記結果を **Table 1** に掲げる。

2. トリチウム降下量の年別変遷

年別変遷を緯度別に次の5ヶ所選んで調べた。

Isfjord Radio (Norway)	78.07° N
Adak (U. S. A.)	51.88° N
Tokyo (Japan)	35.68° N
Higashi-Osaka (Japan)	34.38° N
Guam (U. S. A.)	13.55° N

この結果を **Fig. 1** に示す。1962, 1963年における急上昇は太平洋における大気圏核実験による影響で、10倍以上の増加(たとえば Tokyo では1961年では $0.02 \mu\text{Ci}/\text{m}^2 \cdot \text{month}$ が1963年では $0.41 \mu\text{Ci}/\text{m}^2 \cdot \text{month}$

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Tabl 1 世界各地における年別トリチウム降下量 ($\mu\text{Ci}/\text{m}^2 \cdot \text{month}$)

地名	緯度	経度	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971
Nord, Greenland	81.60°N	16.67°W		.098	.227	.110	.054	.030	.017	.019	.017	.025	.015
Isfjord Radio, Norway	78.07	13.63E	.013	.057	.244	.119	.033	.030	.030	.015	.015	.018	.014
Thule, Greenland	76.52	68.83W						.065	.014	.001	.030	.001	
Tana, Norway	70.40	28.20E	.011	.044	.203	.116	.124	.086	.045				
Kiruna, Sweden	67.87	20.23E	.039	.147	.399	.114	.080	.076	.083				
Arjeplog, Sweden	66.05	17.90E	.057	.119	.363	.257	.124	.058	.071				
Reykjavik, Iceland	64.13	21.93W	.014	.063	.213	.154	.050	.045					
Bredkalen, Sweden	63.90	15.30E		.118	.507	.393	.103	.088	.046				
Robacksdalen, Sweden	63.80	20.20E	.033	.144	.263	.153	.072	.071	.070				
Gjermundnäs, Norway	62.62	7.17E	.040	.090	.330	.255	.081	.047	.035				
Fanaraken, Norway	61.52	7.90E	.027	.080	.263	.211	.110	.057	.029				
Trysil, Norway	61.33	12.25E	.033	.156	.795	.399	.146	.134	.085				
Groennedal, Denmark	61.22	48.12W		.275	.531	.374	.150	.105	.066	.012			
Anchorage, USA	61.17	150.02W						.090	.061	.016	.035	.051	.048
Bethel, Alaska, USA	60.78	161.80W		.057	.322	.081	.059	.031	.025	.018			
Whitehorse, Canada	60.72	135.07W	.021	.106	.283	.196	.045	.058	.022	.019	.011		
Forshult, Sweden	60.17	13.78E	.024	.155	.730			.069	.031				
Fort Smith, Canada	60.02	111.97W	.024	.212	.449	.273	.167	.057	.065	.037	.027		
As, Norway	59.67	10.68E	.035	.173	.659	.260	.117	.096	.051				
Kuarntorp, Sweden	59.20	15.50E	.026	.138	.528	.238	.085	.055	.041				
Lista, Norway	58.10	6.57E	.029	.139	.478	.217	.120	.067	.053	.031	.026	.026	.028
Goteborg, Sweden	57.70	11.97E	.020	.105	.398	.237	.086	.056	.031				
Flahult, Sweden	57.70	14.20E		.075	.402	.182	.098	.093	.041				
Plönninge, Sweden	56.70	12.70E	.027	.131	.630	.230	.079	.065	.041				
Smedby, Sweden	56.70	16.20E	.024	.062	.369	.114	.124	.063	.028				
Odum, Denmark	56.30	10.13E	.018	.170	.433	.206	.069	.075					
Taastrup, Denmark	55.67	12.30E					.042	.066	.031	.007	.021	.018	.013
Askov, Denmark	55.50	9.13E		.109	.487	.208	.086	.078	.030				
Skurup, Sweden	55.47	13.50E				.167	.112	.086	.030				
Tystofte, Denmark	55.20	11.17E		.039	.346			.091	.023				
Edmonton, Canada	53.57	113.52W	.034	.239	.475	.323	.255	.102	.062	.065	.033		
Goose Bay, Canada	53.32	60.42W	.052	.206	1.044	.612	.251	.167	.068	.056	.049		
Valentia, Ireland	51.93	10.25W	.016	.078	.343	.225	.085	.078	.026	.025	.020	.021	.014
Adak, Alaska, USA	51.88	176.65W		.115	.484	.253	.148	.058	.051	.029	.012	.031	.032
Milford Haven, UK	51.70						.066						
Liège, Belgium	50.70	5.47E						.080	.027	.033	.024		
Le Touquet, France	50.52	1.62E					.109	.059					
Cherbourg-Maupertus, Fr.	49.95	1.47W					.114	.074					
Beauvais, France	49.45	2.10E					.099	.121					
Reims, France	49.30	4.03E					.120	.089					
Stuttgart, W.Germany	48.83	9.20E	.013	.113	.587	.220	.223	.169	.036			.026	.042
Strasbourg, France	48.55	7.63E					.272	.089				.032	
Vienna, Austria	48.25	16.37E	.019	.138	.441	.276	.218	.113	.045	.031	.038	.036	.034
Petzenkir, Austria	48.15	15.15E					.061	.122	.057	.039	.037	.053	.035
Rennes, France	48.07	1.72W					.051	.052					
Bruck, Austria	48.02	16.75E					.344	.127	.047	.037			
Moosbrunn, Austria	47.98	19.45E				.191	.232	.113	.042	.034			

Table 1 世界各地における年別トリチウム降下量 ($\mu\text{Ci}/\text{m}^2 \cdot \text{month}$) (つづき)

地 名	緯 度	経 度	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971
Neusiedl, Austria	47.95°N	16.85°E					.444	.116	.043	.036			
Le Mans, France	47.93	0.20E					.058	.021		.021	.015	.022	
Gutenstein, Austria	47.88	15.88E				.399	.319	.169	.068	.059	.072		
Donnerskirchen, Austria	47.88	16.67E					.303	.133	.053	.042			
Podersdorf, Austria	47.85	16.85E					.251	.098	.036	.034			
Luxeuil, France	47.78	6.35E					.223	.054					
Damböckhaus, Austria	47.75	15.83E							.109	.072			
Apetlon, Austria	47.73	16.83E					.252	.123	.055	.039			
Gloggnitz, Austria	47.68	15.93E				.401	.288	.146	.077	.057			
Dijon, France	47.27	5.08W					.235	.085					
Nantes, France	47.17	1.62W					.076	.022					
Bourges, France	47.07	2.37E					.179	.111					
Hautes, Switzerland	47.05	6.80E						.051	.041				
Frigourg, Switzerland	46.80	7.13E						.038	.058				
Bismarck, USA	46.77	100.75W				.304	.206	.093	.041	.052	.038	.032	.018
Valsainte, Switzerland	46.65	7.15E						.071					
Locarno, Switzerland	46.17	8.78E						.109					
La Rouchelle, France	46.15	1.17W					.083	.073					
Ambérieu, France	45.98	5.33E					.226	.081					
Limoges, France	45.82	1.28E					.117	.106					
Clermont, France	45.80	3.15E					.165	.067					
Portland, USA	45.60	122.60W				.126	.067	.047	.029	.029	.029	.023	.015
Ottawa, Canada	45.32	75.67W						.116	.085	.049	.049	.045	.048
Grenoble, France	45.17	5.59E					.177	.143		.081	.076	.073	
Bordeaux, France	44.83	0.70W					.092	.111					
Genoa, Italy	44.42	8.85E	.097	.159	.656	.226	.079	.061	.024	.036	.024	.023	.030
Millau, France	44.10	3.05E					.108	.032					
Nice, France	43.65	7.20E					.035	.040					
Toulouse, France	43.62	1.37E					.100	.068					
Biarritz, France	43.47	1.53W					.121	.117					
Marseille, France	43.45	5.22E					.058	.017		.024	.017	.017	
Madison, USA	43.13	89.32W				.303	.173	.078	.062	.042	.178	.110	.078
Saint Girons, France	43.00	1.10E					.136	.110					
Perpignan, France	42.73	2.87E					.030	.015					
Boston, USA	42.37	71.03W				.321	.098	.084	.076	.034	.031	.042	.029
Sinop, Turkey	42.03	35.17E						.059	.055	.048			
Ajaccio, France	41.92	8.80E					.047	.013		.021	.025	.009	
Chicago, USA	41.78	87.75W	.169	.520	.258	.172	.110	.054	.028	.056	.049	.026	
Alexandropolis, Greece	40.85	25.88E							.024	.031			
Lincoln, USA	40.82	96.70W				.319	.189	.065	.059	.039	.040	.033	.032
Salt Lake City, USA	40.77	111.97W				.332	.121	.036	.052	.045	.029	.030	.025
Coshocton, USA	40.37	81.80W						.077	.076	.046			
Ankara, Turkey	39.95	32.88E				.304		.080	.034	.035	.027	.020	.013
Denver, USA	39.77	104.88W				.276	.215	.056	.086	.025	.114		
Washington, USA	38.85	77.03W				.220	.079	.068	.049	.039	.044	.036	.034
St. Louis, USA	38.75	90.38W				.830	.102	.078	.049	.025	.134	.106	.095
Hadim, Turkey	37.98	32.47E							.096	.080			

Table 1 世界各地における年別トリチウム降下量 ($\mu\text{Ci}/\text{m}^2 \cdot \text{month}$) (つづき)

地 名	緯 度	経 度	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971
Athens, Greece	37.97° N	23.72° E		.098	.413	.051	.089	.058	.033	.017		.011	.011
Acores, Portugal	37.77	25.65W				.078	.029	.027	.027	.011	.013	.009	
Sutculer, Turkey	37.50	30.97E						.013	.042	.023			
Menlo Park, USA	37.45	122.13W				.039	.033	.015	.017	.007	.034	.029	.008
Diyarbakir, Turkey	37.20	40.92E						.045	.103	.041			
Adana, Turkey	36.98	35.30E			.370	.142	.099	.040	.045	.036	.025	.011	.016
Antalya, Turkey	36.88	30.70E			.169	.168	.036	.036	.058	.044	.045	.021	.020
Methoni, Greece	36.83	21.72E						.046	.037	.028			
Tunis, Tunisia	36.83	10.23E								.007	.015	.009	.012
Rhodes, Greece	36.38	28.10E			.325	.089	.145	.048	.027	.044	.037	.015	.031
Gibraltar, UK	36.15	5.35W		.118	.207	.039	.055	.023	.024	.013	.026	.018	.020
Pohang, South Korea	36.03	129.38E	.021	.047	.418	.219	.104	.066	.036	.027	.034	.023	.015
Teheran, Iran	35.68	51.32E		.169	.168	.069	.037	.018	.014	.016	.016	.011	.009
Tokyo, Japan	35.68	139.77E	.021	.075	.407	.241	.099	.070	.026	.029	.025	.027	.026
Heraklion, Greece	35.33	25.18E			1.129	.164	.116	.073	.036	.025	.014	.009	.011
Hatteras, USA	35.27	75.55W		.148	.297	.174	.057	.044	.027	.027	.021	.022	.024
Nicosia, Cyprus	35.15	33.28E			.172	.131	.067	.018	.037	.014	.097	.006	.026
Flagstaff, USA	35.13	111.67W		.098	.160	.157	.119	.027		.008	.032	.018	.020
Albuquerque, USA	35.05	106.62W				.100	.032	.016	.015	.014	.017	.012	.027
Weathership E, USA	35.00	48.00W				.053	.032		.011	.010	.009	.005	.006
Prodhromos, Cyprus	34.95	32.83E			.332	.227	.129	.070	.068			.018	.041
Santa Maria, USA	34.90	120.45W		.008	.083	.026	.040	.011	.007	.004	.015	.008	.003
Karizimir, Afghanistan	34.67	69.08E		.013	1.110	.963			.054	.030	.019	.015	.023
Higashi-Osaka, Japan	34.38	135.35E					.057	.028	.021	.022	.024	.017	.013
Tirat Yael, Israel	32.97	35.42E	.741	.031	.459	.450	.305	.046	.068	.025		.012	.029
Irbid, Jordan	32.53	35.85E						.041	.043				
Bet Dagan, Israel	32.00	34.82E	.012		.153	.184	.067	.025	.025	.031	.015	.010	.016
Amman, Jordan	31.98	35.93E						.049	.036	.002			
Ouargla, Algeria	31.92	5.40E					.012	.006	.021	.003			
Waco, Texas, USA	31.62	97.22W	.037	.071	.163	.075	.063	.045	.017	.019	.017	.014	.009
Beer Sheva, Israel	31.23	34.78E			.060	.030	.065	.020	.016	.008	.006		
Alexandria, UAR	31.20	29.95E	.041	.030	.043	.064	.021	.013	.005	.004	.008	.007	.006
Rabba, Jordan	31.20	35.75E						.026	.026				
Weathership V, USA	31.00	164.00E						.019	.010	.010	.010	.008	
Shubak, Jordan	30.27	35.58E						.025	.029				
Ocala, Florida, USA	29.18	82.13W				.151	.068	.048	.029	.023	.019	.019	.011
Chihuahua, Mexico	28.63	106.07W				.064	.025	.031	.058	.039			
New Delhi, India	28.58	77.20E	.044	.041	.354	.433		.114	.087	.006	.034	.040	.046
Midway Is. USA	28.22	177.37W		.008	.079	.048	.028	.011	.013	.009	.004	.011	.005
Bahrain Is. UK	26.27	50.62E	.003	.008	.083	.044	.007			.004	.005	.000	.003
Tamiami, USA	25.76	80.83W				.065	.023	.031	.014	.012	.016		
Miami, Florida, USA	25.75	80.16W				.053	.018	.023	.010	.013	.012	.012	.008
Flamingo, USA	25.20	80.92W				.045	.015	.033	.010	.016	.013		
Karachi, Pakistan	24.90	67.13E	.033	.117	.042	.091	.101	.037	.056	.002	.009	.013	.005
Hong Kong, UK	22.32	114.17E	.042	.110	.110	.117	.122	.061	.014	.018	.031	.020	.015
Hilo, Hawaii, USA	19.72	155.07W		.029	.173	.123	.055	.024	.028	.025	.013	.003	
Wake Island, USA	19.28	166.65E		.013	.029	.025	.007	.005	.009			.004	.004

Table 1 世界各地における年別トリチウム降下量 ($\mu\text{Ci}/\text{m}^2 \cdot \text{month}$) (つづき)

地名	緯度	経度	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971
Veracruz, Mexico	19.20°N	96.13°W		.033	.004			.021	.019	.012	.003	.016	.013
Bombay, India	18.90	72.82E	.029	.078	.545	.241	.126	.066	.091	.011	.022	.058	.073
San Juan, USA	18.43	66.00W				.054	.022	.014	.006	.009	.008	.017	.005
Faya-Largeau, Chad	18.00	19.17E						.002	.002	.005			
Johnston Is., USA	16.73	169.52W		.002	.038	.021	.006	.003	.004	.004	.006	.002	.002
Khartoum, Sudan	15.60	32.55E	.001	.052	.164	.363	.017	.033	.046	.014	.012	.014	.017
Manila, Philippines	14.52	121.00E	.010			.059	.031	.025					
Bangkok, Thailand	13.73	100.50E								.024	.012	.014	.013
San Salvador, El Salvad.	13.70	89.12W								.024	.015	.024	.017
Guam, USA	13.55	144.83E	.030	.065	.080	.036	.014	.010	.014	.003	.004	.006	.010
Geneina, Sudan	13.48	22.45E								.073	.062	.036	.035
Seawell, Barbados	13.07	59.48W				.029	.007	.017	.005	.004	.006	.005	.006
Bamako, Mali	12.63	8.03W			.216	.405	.166	.173	.059	.048	.039	.031	.044
Fort-Lamy, Chad	12.13	15.03E			.330		.125	.080	.051	.037	.042	.040	.066
Maracay, Venezuela	10.25	67.65W								.008	.009	.006	.002
Yap, W. Caro. Is., USA	9.49	138.09E								.008	.010	.008	.011
Addis Ababa, Ethiopia	9.00	38.73E				.009	.011				.054	.069	.073
Howard AFB, USA	8.92	79.60W								.004	.006	.008	.009
Minicoy Island, India	8.30	73.00E					.035	.030	.039	.017			
Truk, USA	7.47	151.85E								.014	.014	.011	.014
Majuro, USA	7.09	171.11E						.010	.008	.005		.004	.007
Cayenne, French Guiana	4.83	52.37W				.079	.039					.014	.015
Singapore, Singapore	1.35	103.90E								.013	.010	.011	.006
Sao Tome Is., Portugal	0.38	6.72E				.045	.032	.021	.013	.010	.001	.011	.008
Entebbe, Uganda	0.05	32.45E	.007	.002	.043	.081	.017	.015	.013	.013	.007	.019	.009
Uaupes, Brazil	0.13S	67.08W						.023	.045	.017			.009
Izobamba, Ecuador	0.37	78.55W								.007	.012		
Belem, Brazil	1.43	48.48W					.017	.015	.011	.010	.006	.008	.008
Sukarnapura, Indonesia	2.53	140.72E				.019	.001	.005					
Canton Island, USA	2.77	171.72W		.007	.002	.005	.003	.003	.001				
Manaus, Brazil	3.12	60.02W					.014	.018	.021	.013	.009	.012	.010
Fortaleza, Brazil	3.72	38.55W					.035			.003	.004	.003	.004
Kinshasa, Congo	4.37	15.25E	.014	.019	.060	.040	.022	.026	.021	.016			
Madang, New Guinea	5.22	145.80E								.010	.007	.006	.008
Natal, Brazil	5.80	35.20W	.003	.022			.007	.004	.004	.003	.003	.003	.003
Djakarta, Indonesia	6.18	106.83E			.005	.014	.013	.008		.005	.004	.010	
Dar es Salaam, Tanzania	6.88	39.20E	.005	.003	.010	.013	.004	.004	.004	.006	.004	.007	.003
Diego Garcia Is. UK	7.23	72.43E		.011	.043	.052	.027	.026	.210	.011		.012	.013
Ascension, UK	7.92	14.42W		.000	.002	.001	.001	.000	.007	.002	.001	.000	
Funafuti Atoll, Paci. O.	8.52	179.22E											.003
Porto Velho, Brazil	8.77	63.92W					.013	.045	.019	.020	.020		.021
Malange, Angola	9.55	16.37E									.012	.013	.019
Darwin, Australia	12.43	130.87E			.014	.024	.026	.007	.010	.009	.045	.007	.010
Ndola, Zambia	13.00	28.65E								.019	.016	.021	.021
Salvador, Brazil	13.00	38.52W					.014	.007	.005	.008	.005	.004	.005
Cuzco, Peru	13.53	71.93W									.004	.018	.008
Apia, Samoa, New Zealand	13.80	171.78W			.027	.011	.008	.007	.007	.006	.005	.005	.004

Table 1 世界各地における年別トリチウム降下量 ($\mu\text{Ci}/\text{m}^2 \cdot \text{month}$) (つづき)

地 名	緯 度	経 度	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971
Serpa Pinto, Angola	14.67° S	17.70° E									.017	.014	.008
Cuiaba, Brazil	15.60	56.10W					.030	.016	.027	.023	.009	.014	.008
Brasilia, Brazil	15.85	47.93W					.025	.024	.014	.011	.013	.015	.011
St. Helena, UK	15.97	5.70W		.001	.002	.002	.002	.002	.002	.002	.004	.002	.002
Salisbury, Rhodesia	17.83	31.02E	.004	.011	.018	.010	.012	.009	.010	.004	.011	.005	
Fiji, Pacific O.	18.25	178.75 E											.007
Tananarive, Madagascar	18.90	47.53E		.028	.026	.011	.016	.012	.019	.005	.013	.012	.017
Rarotonga, New Zealand	21.20	159.80W			.005	.006	.005	.003	.010	.004	.006	.008	.002
Windhoek, South Africa	22.57	17.10 E	.002	.005	.013	.006		.012	.005	.009	.006	.007	.009
Rio de Janeiro, Brazil	22.90	43.17W					.018	.015	.010	.006	.006	.007	.006
Alice Springs Australia	23.80	133.88 E				.002	.001	.006	.003	.004	.002	.002	.001
Pretoria, South Africa	25.73	28.23 E		.008	.011	.016		.006	.010	.008	.010	.006	.009
Isla de Pascua, Chile	27.17	109.43W				.010	.004	.021	.003	.003	.002	.004	.002
Brisbane, Australia	27.43	153.08 E		.025	.011	.012	.008	.006	.008	.004	.007	.007	.006
Porto Alegre, Brazil	30.08	51.18W					.021	.023	.014	.013	.009	.013	.009
Perth, Australia	31.95	115.97 E			.008	.015	.010	.004	.006	.006	.003	.006	.004
Santiago, Chile	33.45	70.70W					.003	.005	.010		.005		
Juan Fernandez, Chile	33.62	78.83W				.013				.005	.001	.007	.015
Malan, South Africa	33.97	18.60 E	.001	.007	.002	.001		.004	.004	.003	.003	.003	.002
Adelaide, Australia	34.93	138.58 E		.013	.010	.019	.006	.007	.004	.005	.009	.005	.005
Kaitaia, New Zealand	35.07	173.28 E		.007	.008	.010	.010	.010	.008	.011	.009	.008	.008
Melbourne, Australia	37.82	144.97 E		.003	.010	.010	.010	.010	.005	.006	.007	.009	.007
Gough Is., South Africa	40.35	9.88W	.007	.005	.024	.014		.019	.022	.020	.023	.016	.014
Kaitoke, New Zealand	41.10	175.17 E			.011	.021	.023	.022	.017	.017	.011	.016	.014
Puerto Montt, Chile	41.47	72.93W				.026	.018		.022		.022		
Christchurch, N. Zealand	43.08	172.12 E									.008	.006	.003
Invercargill, N. Zealand	46.42	168.32 E		.009	.007	.008	.012	.008	.010	.009	.009	.008	.007
Marion Is., S. Africa	46.88	37.87 E	.005	.009	.016			.023	.056	.012	.021	.018	.013
Stanley Falkland, Is. UK	51.70	57.87W	.003	.006	.006	.008	.009	.006	.007	.007	.005	.009	.004
Campbell Is. N. Zealand	52.55	169.15 E			.012	.010	.013	.008	.009	.010	.011	.012	.007
Argentine Island, UK	65.25	64.27W				.013	.012		.005	.006	.008	.003	.006

に上昇)している。1963年をピークとして以後太平洋における大気圏核実験が停止されたため次第に減少してきている。Table 2 に 1945~1973年間の各国の核実験の回数を示す。1963年8月以降は米国、英国、ソ連の核実験はすべて地下実験である。このため1964年から1967年の4年間でいずれも $0.05 \mu\text{Ci}/\text{m}^2 \cdot \text{month}$ 以下に、すなわち $1/10$ 以下に減少し、以後漸次減少あるいはほぼ一定になっている。

3. トリチウム降下量の緯度別変動

トリチウム降下量の最も多かった1963年および大気圏核実験が停止されて降下量がほぼ安定してきた

1971年について各地の緯度とトリチウム降下量の関係を Fig. 2 および Fig. 3 に示す。いずれも $40 \sim 60^\circ \text{N}$ の間が最も多く南半球では非常に少ない。更に同緯度でも海と陸など地域による違いも考えられるので、次節にそれを調べた結果をのべる。

4. 地域別トリチウム降下量

Fig. 4 に示すように、1963年は111ヶ所、1970年は145ヶ所におけるトリチウム降下量測定値を図のような地区別に平均した。Table 3 に分割した地域に含まれる station 名をあげる。この中には、IAEA の表にはないが、近畿大学における測定値を Higashi-

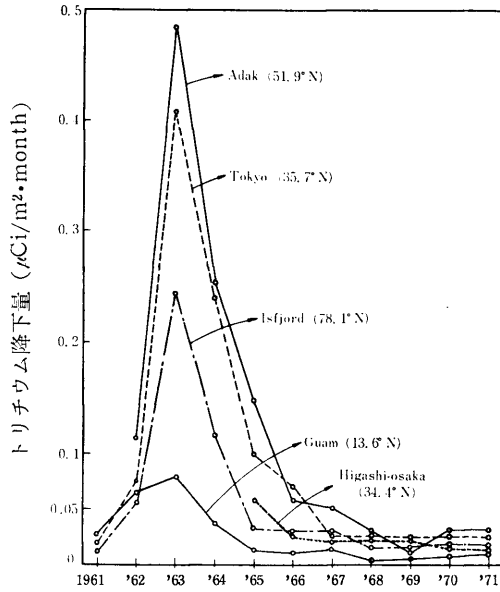


Fig. 1 年別トリチウム降下量の変動

Table 2 1945~1973年の核実験の回数

年	米	英	ソ	仏	中
1945 ~ 1950	8		1		
1951	16		2		
1952	10	1			
1953	11	2	2		
1954	6		1		
1955	15		4		
1956	14	6	7		
1957	28	7	13		
1958	66	5	25		
1959					
1960				3	
1961	9		31	1	
1962	88	2	38	1	
1963	34		1	1	
1964	31	1			1
1965	30	1	3		1
1966	37		4	5	3
1967	27		3	3	2
1968	29		5	5	1
1969	25		10		2
1970	29		10	8	1
1971	11		12	5	1
1972	7		21	3	2
1973	7		13	5	1

注 1. この数字は地下核実験も含む
 2. 1963年8月以降米英ソの核実験はすべて地下実験

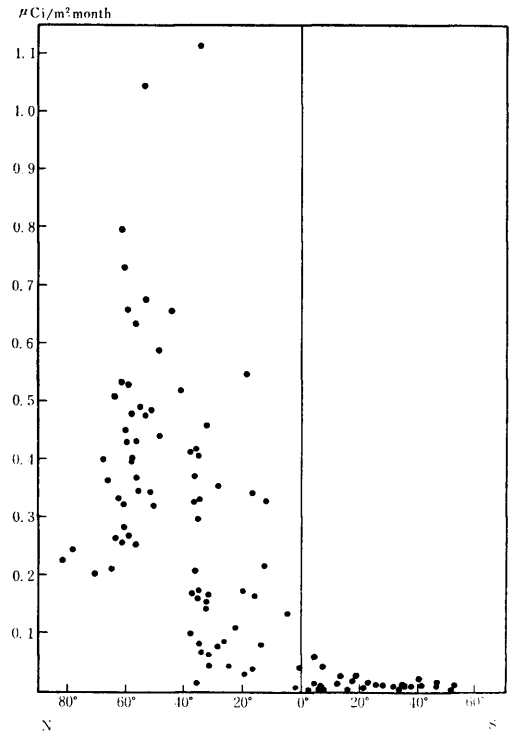


Fig. 2 緯度によるトリチウム降下量の変動 (1963年)

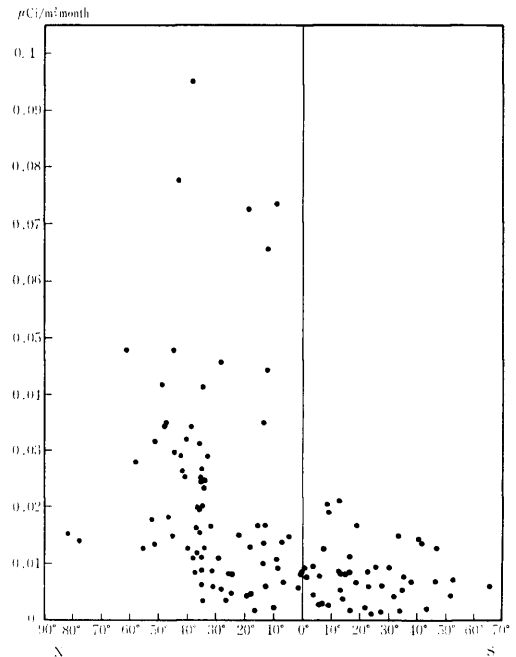


Fig. 3 緯度によるトリチウム降下量の変動 (1971年)

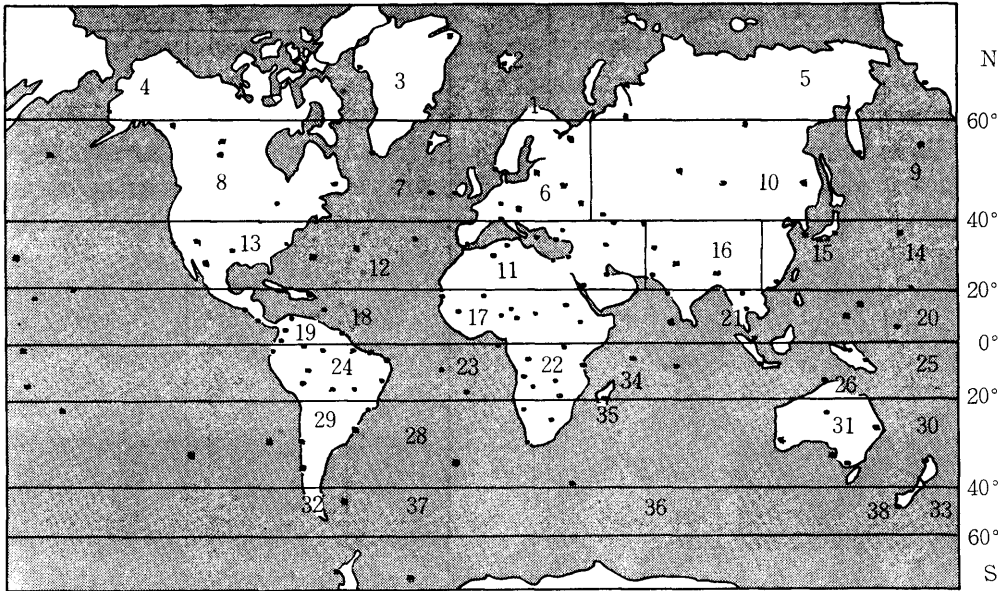


Fig. 4 地区分割図

Table 3 地域別 Station

1963 年

1. Tana (Norway), Gjermundnäs (Norway), Fanaraken (Norway), Trysil (Norway), Forshult (Sweden), Arjeplog (Sweden), Robacksdalen (Sweden), Bredkalen (Sweden), Sala (Sweden), Sodankyla (Finland).
2. Isfjord Radio (Norway), Reykjavik (Iceland).
3. Groennedal, Greenland (Denmark), Nord, Greenland (Denmark).
4. Bethel, Alaska (USA), Fort Smith, Alberta (Canada), Whitehorse, Yukon (Canada).
6. Lista (Norway), As (Norway), Kvarntorp (Sweden), Flahult (Sweden), Plönninge (Sweden), Smedby (Sweden), Kiruna (Sweden), Huddinge (Sweden), Göteborg (Sweden), Erken (Sweden), Simlangsdalen (Sweden), Skurua (Sweden), Odum (Denmark), Askov (Denmark), Tystofte (Denmark), Vitry-Sur-Seine (France), Sindorf (West Germany), Stuttgart (W. Germany), Vienna (Austria), Genoa (Italy).
7. Valentia Observatory (Ireland).
8. Chicago, Illinois (USA), Goose Bay, Newfoundland (Canada), Edmonton, Alberta (Canada).
9. Adak, Alaska (USA).
11. Gibraltar (UK), Athens (Greece), Rhodes (Greece), Heraklion, Crete (Greece), Antalya (Turkey), Adana (Turkey), Prodhromos (Cyprus), Nicosia (Cyprus), Tirat Yael (Israel), Bet Dagan (Israel), Beer Sheva (Israel), Alexandria (UAR).
12. Azores (Portugal), Bermuda Island (USA).
13. Waco, Texas (USA), Hatteras, North Carolina (USA), Flagstaff, Arizona (USA), Santa Maria, California (USA).
14. Weather ship V (USA), Midway Is. (USA).
15. Hong Kong (UK), Pohang (South Korea), Tokyo (Japan).
16. Bahrain Island (UK), Teheran (Iran), Karizimir (Afghanistan), Karachi (Pakistan), New Delhi (India).

Table 3 地域別 Station (つづき)

17. Bamako (Mali), Khartoum (Sudan), Entebbe (Uganda), Fort-lamy (Chad), Kano (Nigeria).
19. Veracruz (Mexico), Cayenne (French Guiana).
20. Guam (USA), Wake Island (USA), Johnston Island (USA), Hilo, Hawaii (USA), Christmas Island (UK).
21. Bombay (India), Rangoon (Burma).
22. Dar es Salaam (Tanzania), Kinshasa (Congo), Salisbury (Rhodesia).
23. Ascension Island (UK), St. Helena (UK).
25. Canton Island (USA), Apia, Samoa (New Zealand).
26. Darwin (Australia), Djakarta (Indonesia).
27. Windhoek (South Africa), Pretoria (South Africa), Malan (South Africa).
30. Rarotonga, Cook Island (New Zealand).
31. Brisbane (Australia), Perth (Australia), Adelaide (Australia), Melbourne (Australia).
33. Campbell Island (New Zealand).
34. Diego Garcia Island (UK), Mahe, Seychelles (UK).
35. Tananarive (Madagascar).
36. Marion Island (South Africa).
37. Gough Island (South Africa), Stanley, Falkland Islands (UK).
38. Kaitaia (New Zealand), Kaitoke (New Zealand), Invercargill (New Zealand).

1970 年

1. Arhangelsk (USSR)
2. Isfjord Radio (Norway).
3. Thule, Greenland (Denmark), Nord, Greenland (Denmark).
4. Anchorage, Alaska (USA)
5. Jakutsk (USSR)
6. Lista (Norway), Frescati (Sweden), Velentia Observatory (Ireland), Taastrup (Denmark), Bern (Switzerland), Strasbourg (France), Le Mans (France), Grenoble (France), Marseille (France), Stuttgart (West Germany), Petzenkirchen (Austria), Vienna (Austria), Genoa (Italy), Riga (USSR), Moskva (USSR), Rostov-na-Donu (USSR), Tbilisi (USSR).
7. Ajaccio (France).
8. Boston, Massachusetts (USA), Chicago, Illinois (USA), Lincoln, Nebraska (USA), Salt Lake City, Utah (USA), Ottawa, Ontario (Canada), Madison, Wisconsin (USA), Portland, Oregon (USA), Bismarck, North Dakota (USA).
9. Adak Alaska (USA).
10. Novosibirsk (USSR), Irkutsk (USSR), Habarovsk (USSR), Taskent (USSR).
11. Gibraltar (UK), Acores (Portugal), Athens (Greece), Rhodes (Greece), Heraklion, Crete (Greece), Ankara (Turkey), Antalya (Turkey), Adana (Turkey), Rrodhromos (Cyprus), Nicosia (Cyprus), Har Kua'an, (Israel), Bet Dagan (Israel), Beer Sheva (Israel), Bahrain Island (UK), Jeddah (Saudi Arabia), Teheran (Iran), Tunis-Carthage (Tunisia), Alexandria (Egypt).
12. Weathership E (USA).
13. Miami, Florida (USA), Ocala, Florida (USA), Waco, Texas (USA), Hatteras, North Carolina (USA), Albuquerque, New Mexico (USA), Flagstaff, Arizona (USA), Santa Maria, California (USA), Washington, D. C. (USA), St. Louis, Missouri (USA), Boston, Massachusetts (USA).
14. Weathership E (USA), Midway Island (USA).

Table 3 地域別 Station (つづき)

15. Hong Kong (UK), Pohang (South Korea), Tokyo (Japan), Higashi-Csaka (Japan).
16. Karizimir (Afghanistan), Karachi (Pakistan), New Delhi (India), Shillong (India).
17. Bamako (Mali), Khartoum (Sudan), Geneina (Sudan), Addis Ababa (Ethiopia), Entebbe (Uganda), Fort-lamy (Chad).
18. Sao Tome Island (Portugal), San Juan, Puertorico (USA), Seawell Airport (Barbados).
19. San Juan, Puertorico (USA), San Salvador (El Salvador), Howard AFB, Canal zone (USA), Maracay (Venezuela), Cayenne (French Guiana).
20. Guam (USA), Wake Island (USA), Johnston Island (USA), Hilo, Hawaii (USA), Truk, Eastern Caroline Island (USA), Ponape, Caroline Island (USA), Majuro, Marshall Island (USA), Yap, Western Caroline Island (USA), Christmas Island (UK).
21. Bombay (India), Bangkok (Thailand), Singapore Airport (Singapore).
22. Dar es Salaam (Tanzania), Malange (Angola), Serpa Pinto (Angola), Ndola (Zambia), Salisbury (Rhodesia).
23. Ascension Island (UK), St. Helena (UK).
24. Belem (Brazil), Manaus (Brazil), Fortaleza (Brazil), Natal (Brazil), Salvador (Brazil), Cuiaba (Brazil), Brasilia (Brazil), Cuzco (Peru), Isla de Pascua (Chile).
25. Apia, Samoa (New Zealand), Pago Pago, American Samoa (USA).
26. Madang (Australian New Guinea), Darwin (Australia), Djakarta (Indonesia).
27. Windhoek (South Africa), Pretoria (South Africa), Malan (South Africa).
28. Gough Island (South Africa).
29. Rio de Janeiro (Brazil), Porto Alegre (Brazil), Juan Fernandez Island (Chile).
30. Rarotonga (New Zealand).
31. Alice Springs (Australia), Brisbane (Australia), Perth (Australia), Adelaide (Australia), Melbourne (Australia).
33. Campbell Island (New Zealand).
34. Diego Garcia Island (UK).
35. Tananarive (Madagascar).
36. Marion Island (South Africa).
37. Stanley, Falkland Islands (UK), Argentine Island (UK).
38. Kaitoke (New Zealand), Kaitaia (New Zealand), Christchurch (New Zealand), Invercargill (New Zealand).

Osaka (Japan) として加えた。この地区別平均結果を **Fig. 5** および **Fig. 6** に示す。1963年 (**Fig. 5**) においては $40\sim 60^\circ\text{N}$ の北アメリカが最も高く ($0.680 \mu\text{Ci}/\text{m}^2 \cdot \text{month}$) 次いでインド、東南アジア、 $40\sim 60^\circ\text{N}$ のヨーロッパおよびカナダ、 60°N 以上の各地で、低い方は南アフリカ ($0.009 \mu\text{Ci}/\text{m}^2 \cdot \text{month}$)、オーストラリアなど赤道以南である。海については同緯度の陸と比べると温帯では太平洋の $0.073 \mu\text{Ci}/\text{m}^2 \cdot \text{month}$ 大西洋の $0.122 \mu\text{Ci}/\text{m}^2 \cdot \text{month}$ 対しアメリカ南部、東アジア、アフリカがそれぞれ 0.175 , 0.373 , $0.229 \mu\text{Ci}/\text{m}^2 \cdot \text{month}$ といずれも陸が高く、また海では北へ行くほど高くなることは陸地の場合と

同様である。海では、特に赤道に近い方では、トリチウムの少い海水の蒸発が大きく、トリチウム降水量をうすめる効果が考えられるため陸地より低いことは理解できる。1970年 (**Fig. 6**) では 60°N 以上のカナダおよびアラスカの $0.051 \mu\text{Ci}/\text{m}^2 \cdot \text{month}$ 、オーストラリア、南アメリカなどである。これらの数値は、南北半球の海の数値とあまり変わらない。海は陸地よりは低く南北半球を通じて海の地域別の差は非常に少なくなっている。

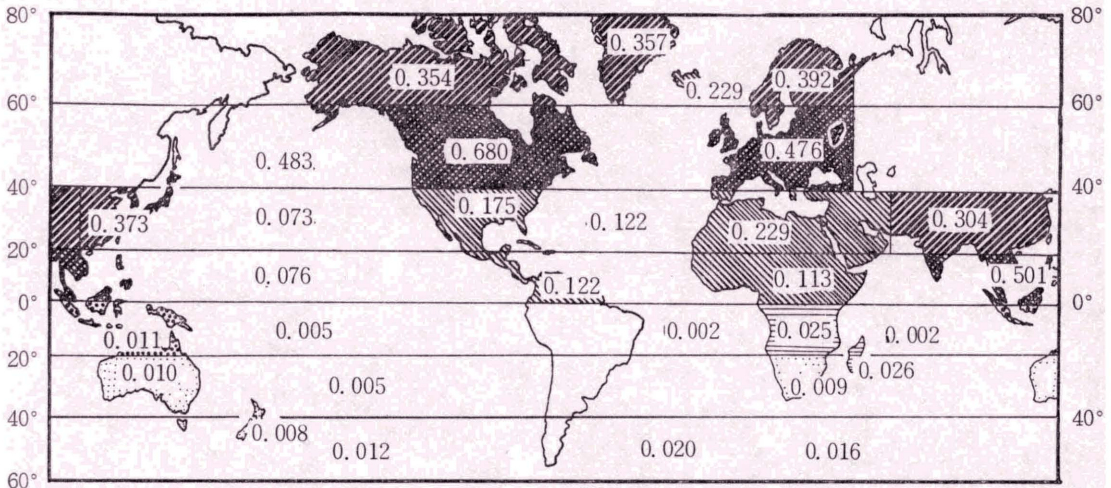


Fig. 5 地区別トリチウム降下量の分布 (1963年)

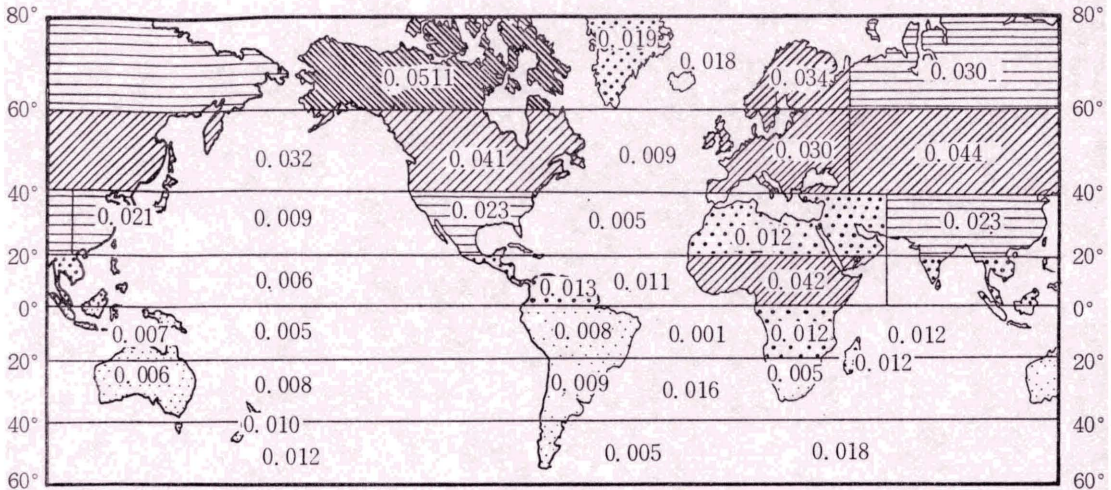
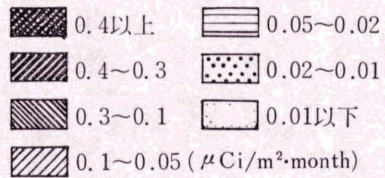
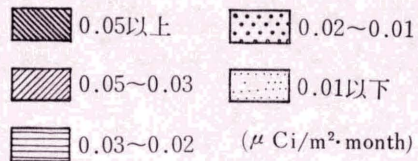


Fig. 6 地区別トリチウム降下量の分布 (1970年)



5. ま と め

1953年～1971年間世界各地のトリチウム降下量を年別、緯度別、地域別の比較をした。年別変化については、大気圏核実験が盛んであった1962、1963年をピークとして以後急激に漸次減少し一定値に近づいて

いる。緯度別変動については、核実験中もその7、8年後も40～60°Nが最も高く、南半球では核実験の影響をあまり受けていない。地域による差については、陸地は海より高く、また同緯度でも東アジアはアメリカ、ヨーロッパよりも低い。