

Table S1. Instrumentation and measurement methods reported for the compiled atmospheric water vapor isotope records.

Data source	Region	Longitude	Latitude	Elevation (m)	Instrument	method	model	Serial number	Reference	Data source
PANGAEA	Bremerhaven, Germany	8.56	53.57	5.72	Picarro	CRDS	L2140-i	NA	Bonne et al.(2019)	https://doi.org/10.1594/PANGAEA.897578
PANGAEA	Cape Town Harbour	18.44	-33.86	9.79	Picarro	CRDS	L2140-i	NA	Bonne et al.(2019)	https://doi.org/10.1594/PANGAEA.897578
PANGAEA	POLARSTERN	-2.14	78.42	4.67	Picarro	CRDS	L2140-i	NA	Bonne et al.(2019)	https://doi.org/10.1594/PANGAEA.897578
PANGAEA	Tromsø, Norway	19	69.68	7.29	Picarro	CRDS	L2140-i	NA	Bonne et al.(2019)	https://doi.org/10.1594/PANGAEA.897578
PANGAEA	EastGRIP site	-35.99	75.63	2658	Picarro, LGR	CRDS, OA-ICOS	L1102-i, 908-0004-0003	HBDS-48, HBDS-12, 10-0037	Steen-Larsen et al.(2022)	https://doi.org/10.1594/PANGAEA.946740
PANGAEA	Northern Patagonia	-71.57	-41.79	1175	Picarro	CRDS	L2130-i	NA	Penchenat et al.(2020)	https://doi.org/10.1594/PANGAEA.914066
PANGAEA	Bermuda	-64.88	32.27	2.5	Picarro	CRDS	NA	HBDS-2120	Steen-Larsen et al.(2022)	https://doi.org/10.1594/PANGAEA.949607
PANGAEA	Nordmela	15.68	69.14	NA	Picarro	CRDS	NA	NA	Seidl et al.(2024)	https://doi.org/10.1594/PANGAEA.971241
PANGAEA	GrIS	-35.99	75.63	2658.2	Picarro	CRDS	L2140-i	NA	Steen-Larsen et al.(2021)	https://doi.org/10.1594/PANGAEA.928823
PANGAEA	China	102.80	24.90	1934.6	Picarro	CRDS	L2130-i	NA	Wang et al.(2022)	https://doi.org/10.1594/PANGAEA.947606
References	Pavia	9.16	45.19	1784	Finnigan	IRMS	MAT 250	NA	Elmi et al.(2013)	https://doi.org/10.1016/j.apgeochem.2012.12.010
References	Lhasa	91.03	29.65	4651	Picarro	CRDS	L2130-i	NA	Tian et al.(2020)	https://doi.org/10.1016/j.jhydrol.2019.12.4237
References	Nanjing	118.95	32.12	32	Picarro	CRDS	L2120-i	NA	Zhan et al.(2023)	https://doi.org/10.1016/j.epsl.2022.117912
References	Sri Lanka	80.57	5.94	5	LGR	OA-ICOS	NA	NA	Wu et al.(2025)	https://doi.org/10.5194/acp-25-4013-2025
References	North-East Greenland	-35.99	75.63	2850	Picarro	CRDS	L2140-i	NA	Wahl et al.(2021)	https://doi.org/10.1029/2020JD034400
References	Chajnantor	-67.47	-23.58	2432	Picarro	CRDS	L1115-i	NA	Galewsky et al.(2011)	https://doi.org/10.1029/2011GL048557
References	Lulang	94.73	29.77	5177	Picarro	CRDS	L2140-i	NA	Chen et	https://doi.org/10.10

Data source	Region	Longitude	Latitude	Elevation (m)	Instrument	method	model	Serial number	Reference	Data source
	station								al.(2024)	16/j.atmosres.2024.107328
References	Selvogsviti	-21.47	63.83	NA	LGR	OA-ICOS	908-0004	NA	Steen-Larsenet al.(2015)	https://doi.org/10.1002/2015JD023234
References	Observations Bermuda Island	-64.88	32.26	NA	Picarro	CRDS	L2120-i	NA	Bonne et al.(2015)	https://doi.org/10.1002/2014JD022602
References	LMDz-iso Bermuda Island	-63.75	31.69	NA	Picarro	CRDS	L2120-i	NA	Bonne et al.(2015)	https://doi.org/10.1002/2014JD022602
References	Lake Annecy	6.13	45.90	446	Picarro	CRDS	L2130-i	HIDS2254	Chazette et al.(2021)	https://doi.org/10.5194/acp-21-10911-2021
References	Cairn	145.69	-16.79	13	Picarro	CRDS	L2130-i	NA	Munksgaard et al.(2017)	https://doi.org/10.1111/nph.18113
References	Tinaroo	145.54	-17.17	665	Picarro	CRDS	L2130-i	NA	Munksgaard et al.(2017)	https://doi.org/10.1111/nph.18113
References	Mt Garnet	145.10	17.67	NA	Picarro	CRDS	L2130-i	NA	Munksgaard et al.(2017)	https://link.springer.com/article/10.1007/s00442-016-3761-8
References	Zurich	8.6	47.38	499	Picarro	CRDS	L1115-i	NA	Aemiseger et al.(2015)	https://doi.org/10.1002/2015GL063988
References	Douala	9.7	4.08	NA	TES	satellite remote sensing	NA	NA	Nlend et al.(2020)	https://doi.org/10.1016/j.jhydrol.2020.124650
References	Liaodong Bay, China	121.9	40.94	1	LGR	OA-ICOS	TIWA-912	NA	Du et al.(2024)	https://doi.org/10.1002/hyp.15070
References	The Greater Khingan	121.5	50.83	732	LGR	OA-ICOS	NA	NA	Zhang et al.(2021)	https://doi.org/10.1007/s11368-021-03025-7
References	Ca' Foscari	12.26	45.48	2	LGR	OA-ICOS	DLT-100	NA	Zannoni et al.(2019)	https://doi.org/10.1016/j.jhydrol.2019.03.033
References	EastGRIP ice core field site	-35.99	75.63	2700	Picarro	CRDS	L2130-i	NA	Rozmiarek et al.(2021)	https://doi.org/10.5194/amt-14-7045-2021
References	Niamey	2.08	13.5	184	Picarro	CRDS	L1102-i	NA	Tremoy et al.(2014)	https://doi.org/10.1002/2013JD020968
References	Concordia station	123.40	-75.10	3233	Picarro	CRDS	L2130-i	NA	Casado et al.(2016)	https://doi.org/10.5194/acp-16-8521-2016
References	Tongji University	121.50	31.29	3	Picarro	CRDS	L2130-i	NA	Wang et al.(2021)	https://doi.org/10.1002/j.atmosres.2021.105822
References	The north of Qinghai Lake	100.24	37.26	3220	LGR	OA-ICOS	DLT-100	NA	Wu et al.(2019)	https://doi.org/10.1002/hyp.13541

Data source	Region	Longitude	Latitude	Elevation (m)	Instrument	method	model	Serial number	Reference	Data source
References	Taipei	121.50	25.02	14	Picarro	CRDS	L2120-i	NA	Laskar et al.(2014)	https://doi.org/10.1016/j.jhydrol.2014.10.017