Table S1. List of IGS stations used in this paper with their latitude, longitude, and altitude.

name	city	country	lat (°)	lon (°)	alt (m)
ALBH	Victoria	Canada	48.39	-123.49	50.18
ALGO	Algonquin Park	Canada	45.96	-78.07	236.98
ALIC	Alice Springs	Australia	-23.67	133.89	588.12
ANKR	Ankara	Turkey	39.89	32.76	938.82
AREQ	Arequipa	Peru	-16.47	-71.49	2449.07
AUCK	Whangaparaoa Peninsula	New Zealand	-36.60	174.83	97.79
AZU1	Azusa	United States	34.13	-117.90	178.44
BLYT	Blythe	United States	33.61	-114.72	118.99
BOGT	Bogota	Colombia	4.64	-74.08	2553.82
BOR1	Borowiec	Poland	52.28	17.07	88.84
BRAN	Burbank	United States	34.19	-118.28	280.41
BRAZ	Brasilia	Brazil	-15.95	-47.88	1118.61
BRMU	Bermuda	United Kingdom	32.37	-64.70	20.83
BRUS	Brussels	Belgium	50.80	4.36	104.22
CAGL	Cagliari	Italy	39.14	8.97	192.10
CAS1	Casey	Antarctica	-66.28	110.52	39.41
CCJM	Ogasawara	Japan	27.10	142.19	159.85
CEDU	Ceduna	Australia	-31.87	133.81	153.79
CFAG	Caucete	Argentina	-31.60	-68.23	678.26
CHAT	Chatham Islands	New Zealand	-43.96	-176.57	47.78
CHIL	San Gabriel Mountains	United States	34.33	-118.03	1599.88
CHUR	Churchill	Canada	58.76	-94.09	28.80
CIT1	Pasadena	United States	34.14	-118.13	249.45
CMP9	Sylmar	United States	34.35	-118.41	1171.52
COCO	Cocos (Keeling) Island	Australia	-12.19	96.83	3.29
COSO	Coso Junction	United States	35.98	-117.81	1484.55
CRFP	Yucaipa	United States	34.04	-117.10	721.13
CRO1	Christiansted	Virgin Islands, U.S.	17.76	-64.58	11.73
CSN1	Northridge	United States	34.25	-118.52	296.13
DARW	Darwin	Australia	-12.84	131.13	74.66
DAV1	Davis	Antarctica	-68.58	77.97	27.14
DGAR	Diego Garcia Island	United Kingdom	-7.27	72.37	8.95
DHLG	Durmid Hill	United States	33.39	-115.79	-49.01
DRAO	Penticton	Canada	49.32	-119.63	558.42
DUBO	Lac Du Bonnet	Canada	50.26	-95.87	274.96
EBRE	Roquetes	Spain	40.82	0.49	57.62
FAIR	Fairbanks	United States	64.98	-147.50	307.76
FALE	Faleolo	Samoa	-13.83	-172.00	9.73

FLIN	CFS FLIN FLON	Canada	54.73	-101.98	342.32
GODE	Greenbelt	United States	39.02	-76.83	47.77
GOLD	Goldstone	United States	35.43	-116.89	1017.35
GOPE	Ondrejov	Czech Republic	49.91	14.79	547.60
GRAS	Caussols	France	43.76	6.92	1268.25
GRAZ	Graz	Austria	47.07	15.49	490.83
GUAM	Dededo	Guam	13.59	144.87	146.38
HOB2	Hobart	Australia	-42.81	147.44	44.78
HOLB	Holberg	Canada	50.64	-128.14	575.22
HRAO	Krugersdorp	South Africa	-25.89	27.69	1388.81
IISC	Bangalore	India	13.02	77.57	929.62
IRKT	Irkutsk	Russia	52.22	104.32	540.79
JOZE	Jozefoslaw	Poland	52.10	21.03	109.90
JPLM	Pasadena	United States	34.21	-118.17	457.44
KARR	Karratha	Australia	-20.98	117.10	116.71
KERG	Port aux Francais	French Southern Territories	-49.35	70.26	32.76
KIRU	Kiruna	Sweden	67.86	20.97	362.08
KIT3	Kitab	Uzbekistan	39.14	66.89	659.59
KOKB	Kokee Park, Waimea	United States	22.13	-159.67	1150.34
KOSG	Kootwijk	Netherlands	52.18	5.81	53.36
KOUC	Koumac	New Caledonia	-20.56	164.29	23.71
KOUR	Kourou	French Guiana	5.25	-52.81	8.52
LAMA	Olsztyn	Poland	53.89	20.67	157.66
LBCH	Long Beach	United States	33.79	-118.20	8.27
LEEP	Hollywood	United States	34.14	-118.32	519.65
LONG	Irwindale	United States	34.11	-118.00	108.41
LPGS	La Plata	Argentina	-34.91	-57.93	13.93
MAC1	Macquarie Island	Australia	-54.50	158.94	12.22
MADR	Robledo	Spain	40.43	-4.25	776.37
MAS1	Maspalomas	Spain	27.76	-15.63	153.62
MATE	Matera	Italy	40.65	16.70	490.15
MAW1	Mawson	Antarctica	-67.61	62.87	30.48
MCM4	Ross Island	Antarctica	-77.84	166.67	150.46
MDO1	Fort Davis	United States	30.68	-104.02	2026.57
MEDI	Medicina	Italy	44.52	11.65	9.91
METS	Kirkkonummi	Finland	60.22	24.40	75.76
MKEA	Mauna Kea	United States	19.80	-155.46	3728.39
MONP	Laguna Mountains	United States	32.89	-116.42	1874.71
NANO	Nanoose Bay	Canada	49.30	-124.09	24.09
NLIB	North Liberty	United States	41.77	-91.58	239.92

NRC1	Ottawa	Canada	45.45	-75.62	116.02
ONSA	Onsala	Sweden	57.40	11.93	8.97
PENC	Penc	Hungary	47.79	19.28	248.27
PERT	Perth	Australia	-31.80	115.89	45.45
PIE1	Pie Town	United States	34.30	-108.12	2369.48
PIN1	Pinyon Flat	United States	33.61	-116.46	1287.75
POL2	Bishkek	Kyrgyzstan	42.68	74.69	1754.27
POTS	Potsdam	Germany	52.38	13.07	103.99
QUIN	Quincy	United States	39.98	-120.94	1129.41
REYK	Reykjavik	Iceland	64.14	-21.96	26.56
ROCK	Simi Valley	United States	34.24	-118.68	588.08
SANT	Santiago	Chile	-33.15	-70.67	695.17
SFER	San Fernando	Spain	36.46	-6.21	39.08
SHAO	Sheshan	China	31.10	121.20	11.26
SNI1	San Nicolas Island	United States	33.25	-119.52	276.75
SPK1	Saddle Peak	United States	34.06	-118.65	475.57
STJO	St. John's	Canada	47.60	-52.68	143.10
SVTL	Svetloe	Russia	60.53	29.78	60.98
SYOG	East Ongle Island	Antarctica	-69.01	39.58	27.76
TABL	Wrightwood	United States	34.38	-117.68	2259.20
TIDB	Tidbinbilla	Australia	-35.40	148.98	646.50
TOW2	Cape Ferguson	Australia	-19.27	147.06	30.20
TRAK	Irvine	United States	33.62	-117.80	150.29
TSKB	Tsukuba	Japan	36.11	140.09	27.35
UCLP	Los Angeles	United States	34.07	-118.44	146.83
UCLU	Ucluelet	Canada	48.93	-125.54	28.74
USC1	Los Angeles	United States	34.02	-118.29	57.41
USUD	Usuda	Japan	36.13	138.36	1465.31
VILL	Villafranca	Spain	40.44	-3.95	595.40
VNDP	Vandenberg Air Force Base	United States	34.56	-120.62	24.62
WES2	Westford	United States	42.61	-71.49	113.65
WHC1	Whittier	United States	33.98	-118.03	129.37
WHIT	Whitehorse	Canada	60.75	-135.22	1419.57
WILL	Williams Lake	Canada	52.24	-122.17	1110.42
WLSN	Mt. Wilson	United States	34.23	-118.06	1738.07
WSLR	Whistler	Canada	50.13	-122.92	924.11
WTZR	Bad Koetzting	Germany	49.14	12.88	619.21
WUHN	Wuhan	China	30.53	114.36	39.76
YELL	Yellowknife	Canada	62.48	-114.48	207.61
ZIMM	Zimmerwald	Switzerland	46.88	7.47	906.72

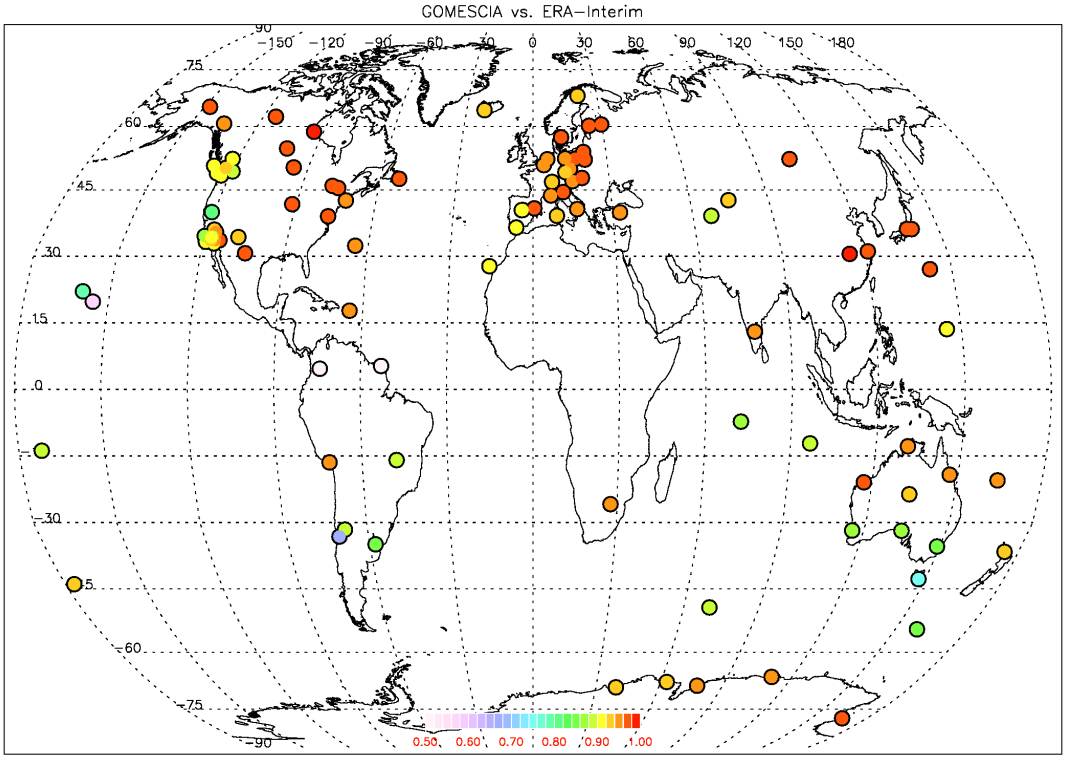


Figure S1. Correlation coefficients between the IWV monthly means of GOMESCIA and ERA-Interim.

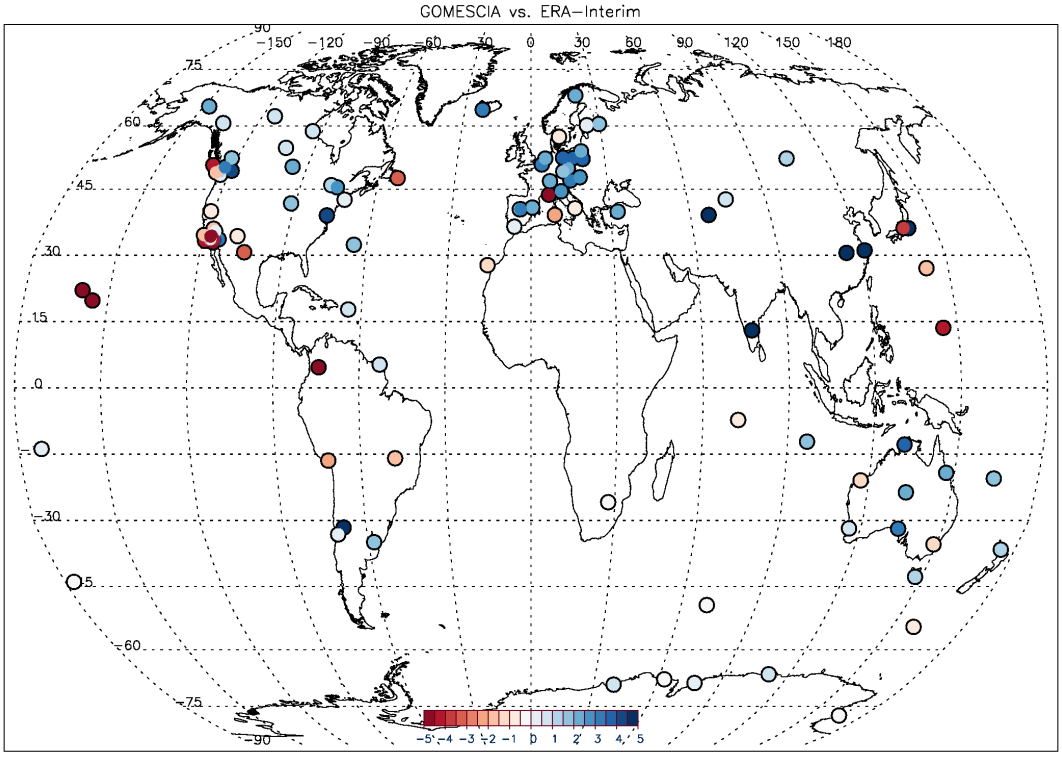


Figure S2. Mean differences between the IWV monthly means of GOMESCIA and GPS (GOMESCIA IWV minus ERA-Interim IWV).

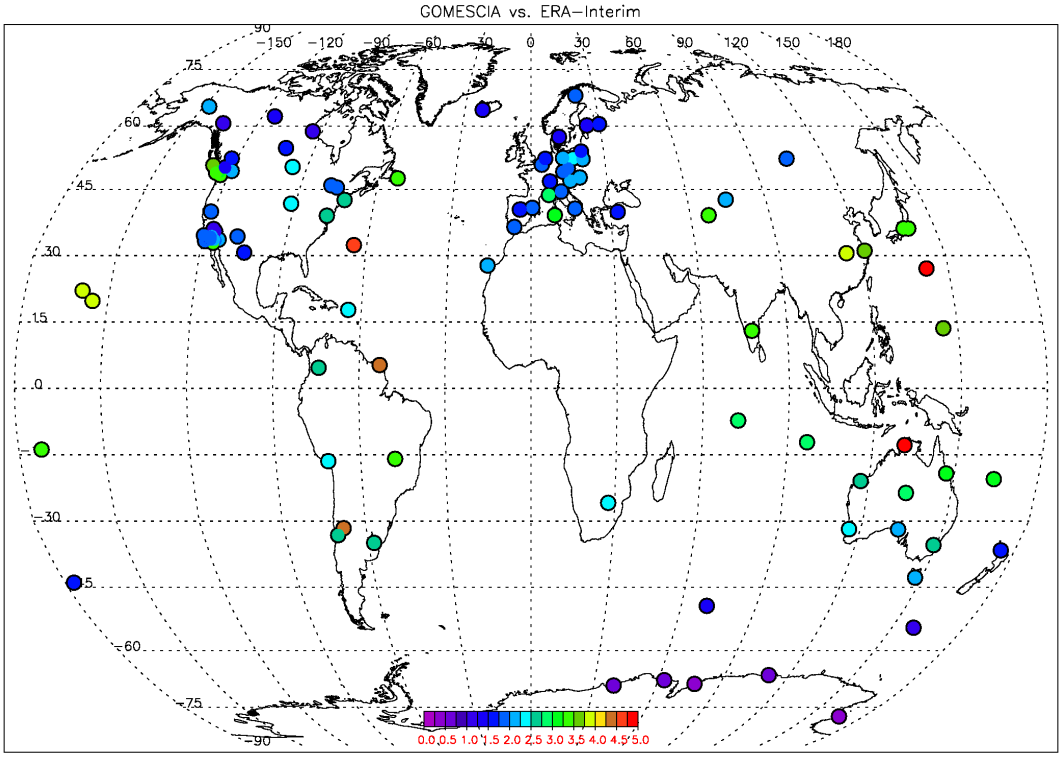


Figure S3. Standard deviations of the differences between the IWV monthly means of GOMESCIA and ERA-Interim.

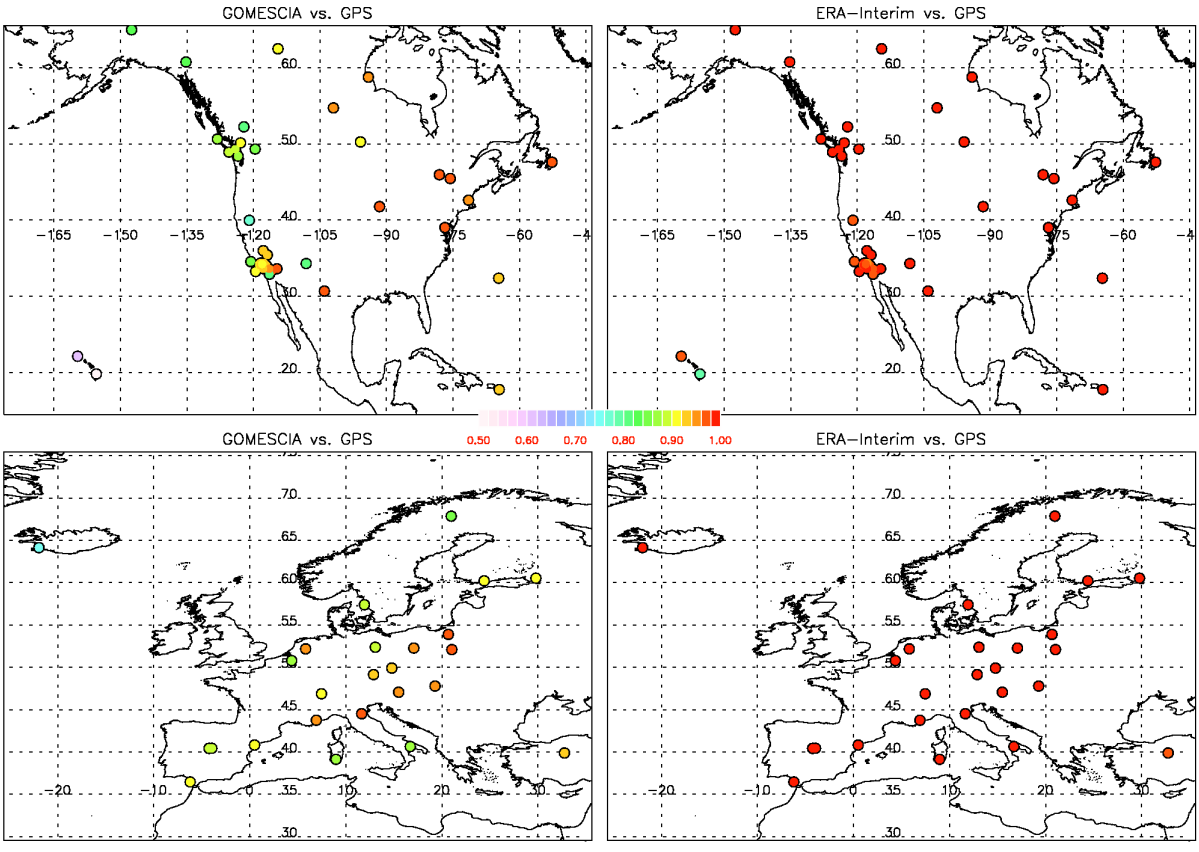


Figure S4. Similar as for Figure 2: correlation coefficients between the IWV monthly means of GOMESCIA and GPS (left) and ERA-Interim and GPS (right), but now zoomed in on North America (upper panels) and Europe (lower panels).

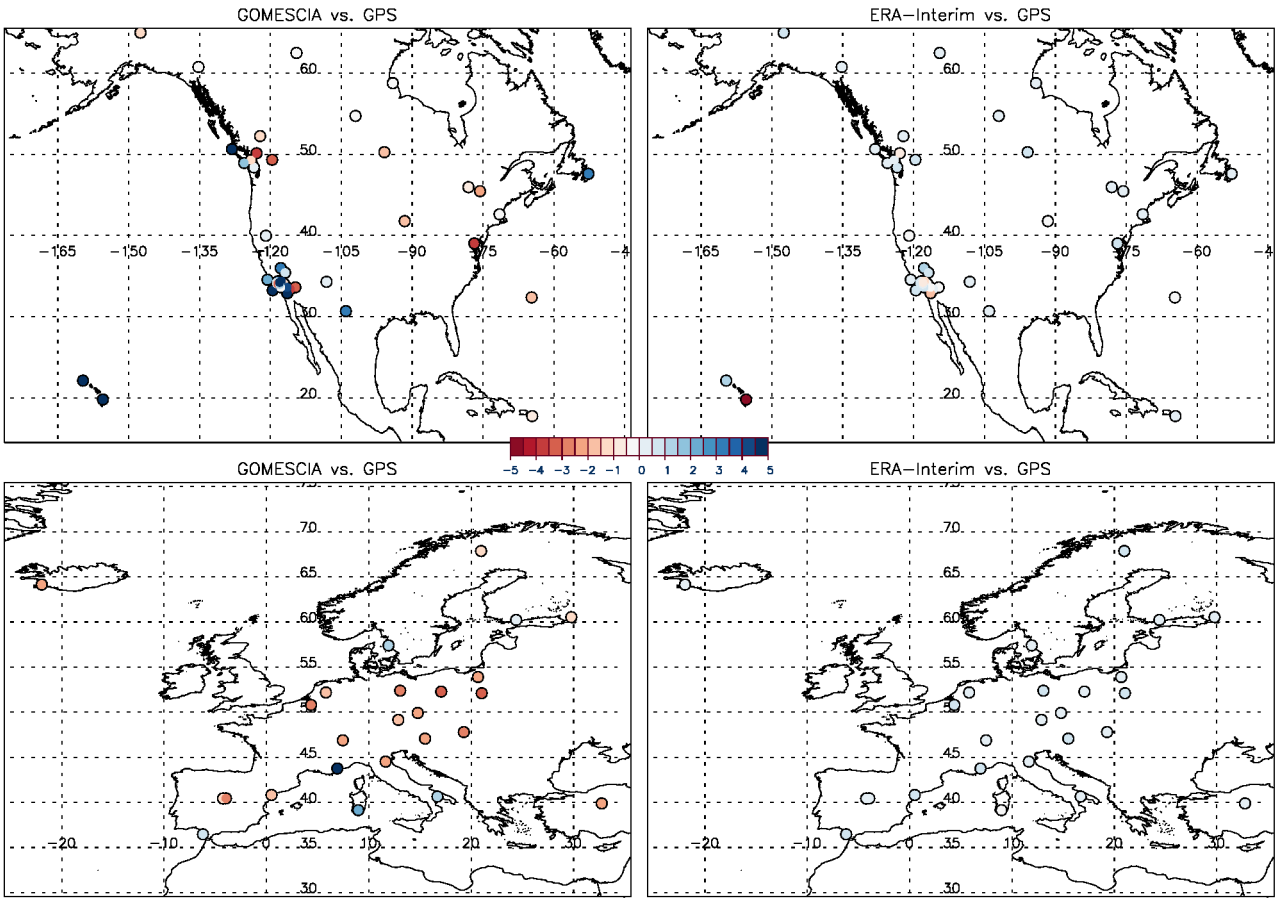


Figure S5. Similar as for Figure.3: mean differences between the IWV monthly means of GOMESCIA and GPS (GOMESCIA IWV minus GPS IWV) (left) and ERA-Interim and GPS (ERA-Interim IWV minus GPS IWV) (right), but now zoomed in on North America (upper panels) and Europe (lower panels).

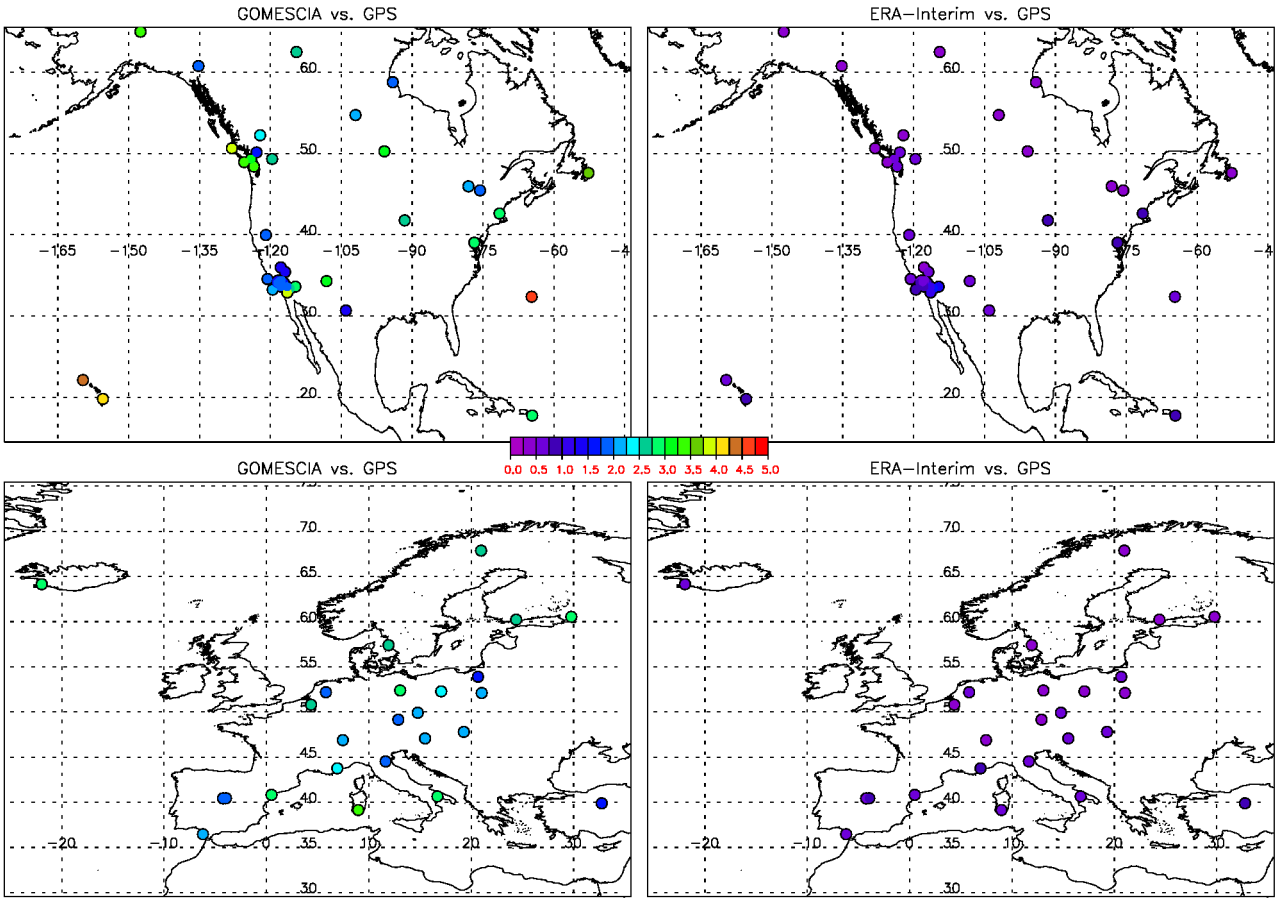
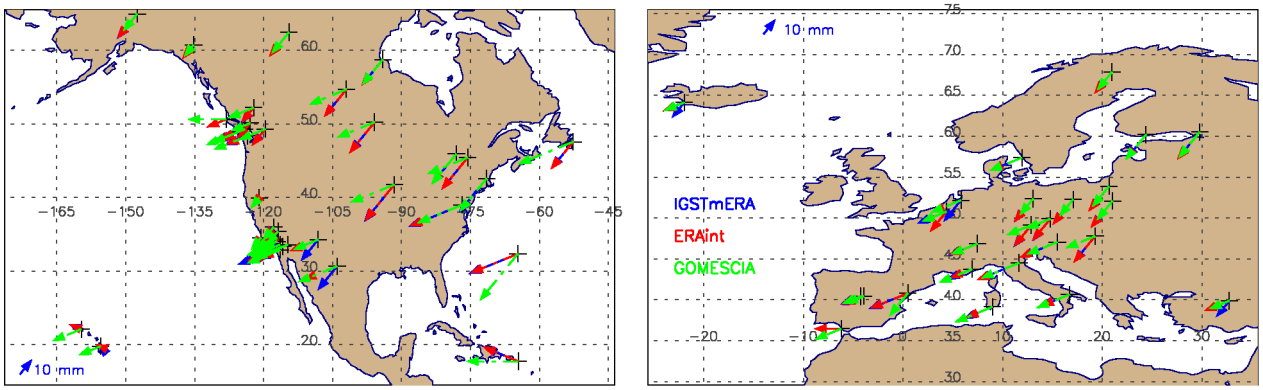
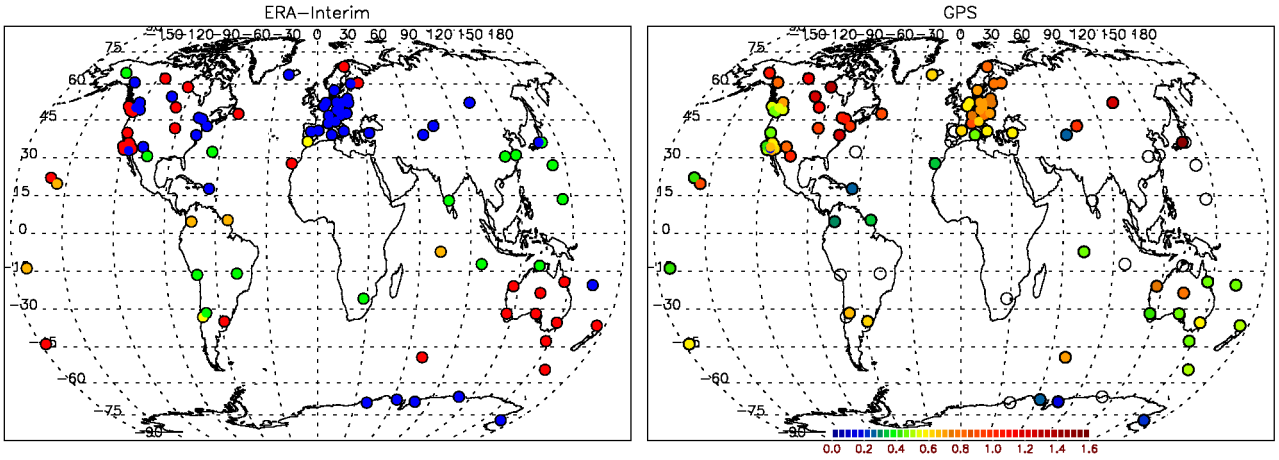


Figure S6. Similar as for Figure.4: standard deviations of the differences between the IWV monthly means of GOMESCIA and GPS (left) and ERA-Interim and GPS (right), but now zoomed in on North America (upper panels) and Europe (lower panels).



(**a**) (**b**)

Figure S7. Same as for Figure 5, but now zoomed in on (**a**) North America and (**b**) Europe.



(**a**) (**b**)

Figure S8. Similar as for Figure 8, but now: (**a**) Classification of the ERA-Interim IWV time series according to their frequency distributions: Gaussian (yellow), standard lognormal (red), reverse lognormal (orange), shouldered lognormal (blue), and bimodal (green).(**b**) Distribution of the geometric standard deviation (GSD) of a single lognormal distribution fitted through the GPS IWV histograms. The sites with unfilled circles have bimodal distributions.

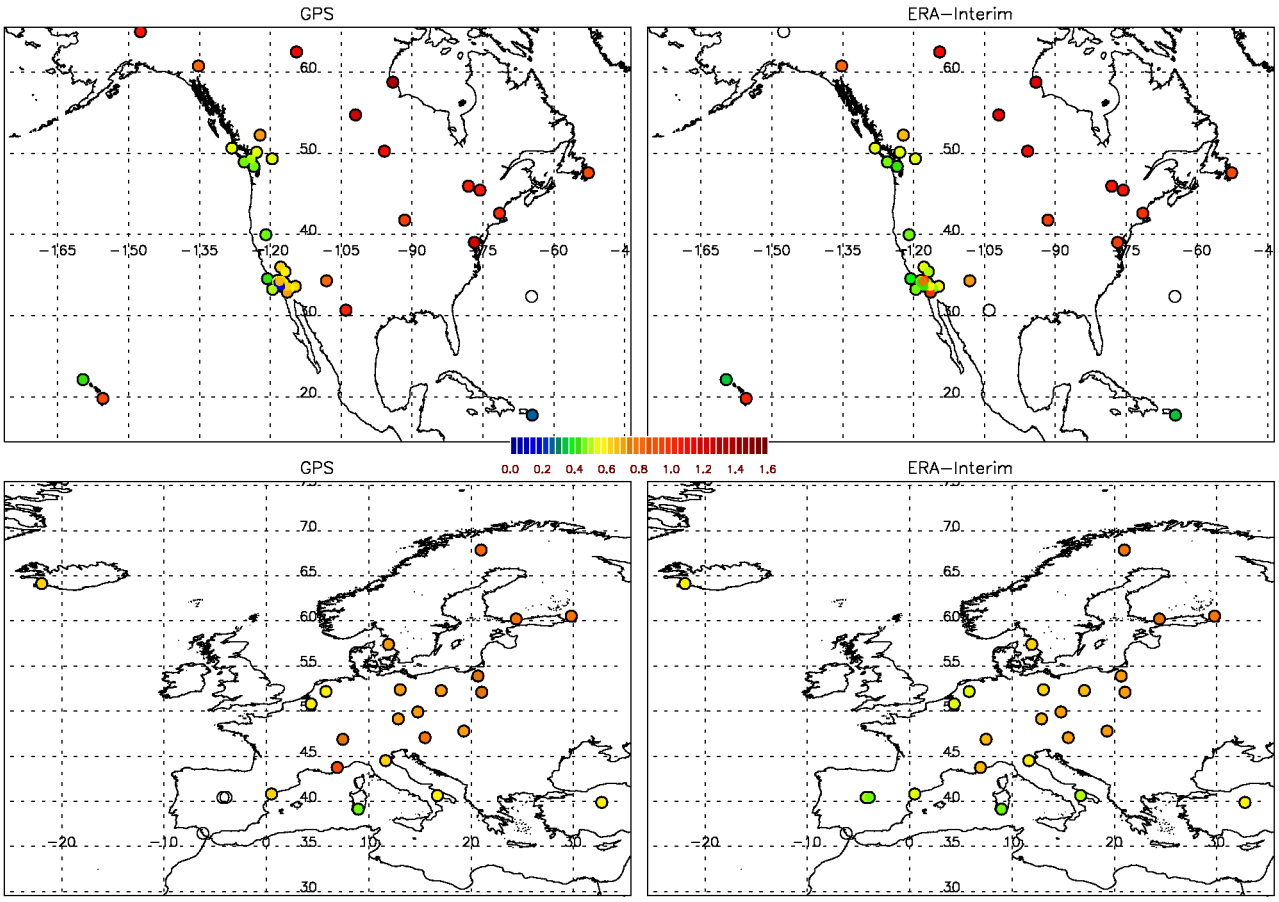


Figure S9. Zoom-in on North America (upper plots) and Europe (lower plots) for the GSD distributions of a single lognormal distribution fitted through the GPS (left) and ERA-Interim (right) IWV histograms, as in Figures 8b and S5b.

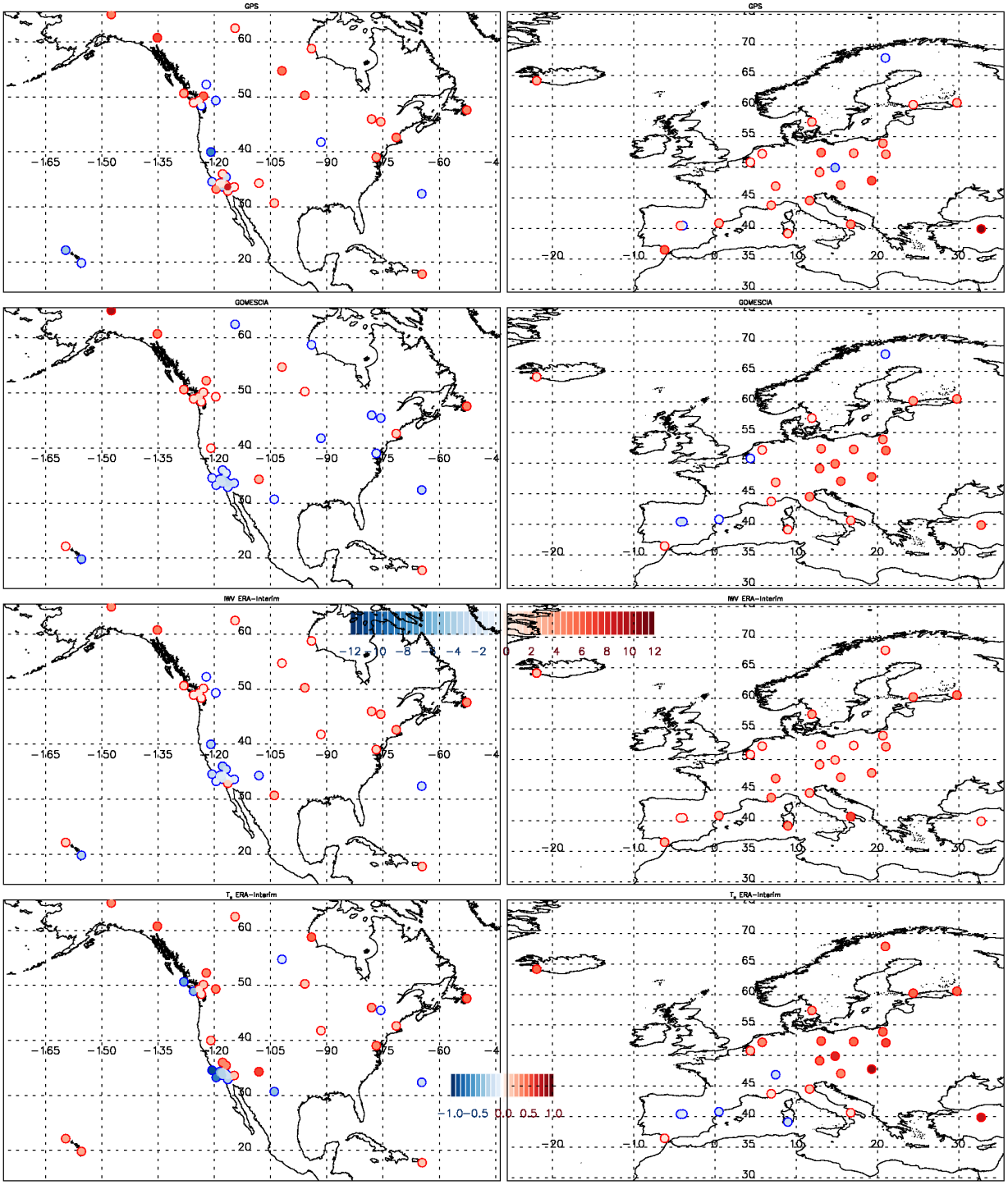


Figure S10. IWV trends [% dec^{-1}] for GPS, GOMESCIA, and ERA-Interim (resp. from upper to lower plots) for the period Jan 1996 – Dec 2010 over North America (left) and Europe (right). For illustration, the lower panels show the ERA-Interim surface temperature trends for the same period in °C dec^{-1} for the same regions.