

ARRL World Above 50 MHz Distance Records

Maintained by Ned Stearns, AA7A

Last Updated 15 June 2025

Propagation	Distance	Stations (grid locators)	QSO Date
Mode	(km)		
144 MHz			
Aurora	2,178	WA0TKJ (EM18ct) - KA1ZE (FN31tu)	08-Feb-86
Aurora	2,178	WB0DRL (EM18ct) - KA1ZE (FN31tu)	08-Feb-86
Aurora	2,145	K5CM (EM25ir) - WA1VTA (FN42am)	15-Jul-00
Aurora	2,106	K5CM (EM25ir) - W3EP (FN31vp)	15-Jul-00
Aurora E	2,446	NU7Z (CN87ts) - W9RPM (EN43jt)	10-Oct-03
Auroral E	2,295	WB7UZO (CN78qi) - VE3KNI (EN38hn)	15-Aug-89
Auroral E	2,236	VE4AQ (EN19lu) - K5MA (FN41qo)	09-Jun-91
Auroral E	2,128	W7FI (CN87ws) - VE3KNI (EN38hn)	15-Aug-89
Auroral E	2,044	W7MEM (DN17nt) - VE3KRP (EN58ij)	15-Aug-89
Auroral E	1,911	KB0ZQ (EN34it) - N1BUG (FN55mf)	14-Mar-89
FAI	2,370	W0LD (DM78pu) - W4CHA (EL88qa)	19-Jun-93
FAI	1,981	W5UN (DM82wa) - W5HUQ (EM90gc)	25-Jul-83
IFS	2,856	K5JL (EM15dp) - VE1ALQ (FN65vh)	08-Nov-99
IFS	2,587	K5JL (EM15dp) - W1REZ (FN55ea)	08-Nov-99
IFS	2,552	K5JL (EM15dp) - WA1JOF (FN44xw)	11-Nov-99
IFS	1,849	K0MQS (EN13uh) - WA1JOF (FN44xw)	31-Aug-00
Meteors	3,162	K5UR (EM35wa) - KP4EKG (FK68vg)	13-Dec-85
Meteors	2,528	N6RMJ (DM14cp) - K2DRH (EN41vr)	13-Aug-09
Meteors	2,496	KB5WMY (EM32dm) - W1REZ (FN55ea)	11-Aug-98
Meteors	2,406	VE4AMU (EN19kv) - AB4OO (EM81tg)	18-Nov-01
Meteors	2,364	W5ORH - K1ABR	12-Aug-68
Meteors	2,339	W2CRS (DM78lx) - KA2RDO (FN12ex)	12-Aug-96
Meteors	2,334	AF6O (DM14ej) - N0PB (EM39wo)	12-Aug-04
Meteors	2,293	W8BYA (EN70jt) - KE7NR (DM54ah)	12-Dec-18
Meteors	2,269	W8BYA (EN70jt) - K7NX/P (DM53gx)	13-Aug-13
Meteors	2,253	NY2NY (FN30rw) - ND0B (EN07gn)	12-Aug-12
Meteors	2,232	W0VB (DN84am) - K3SX (FM19dk)	08-Dec-20
Meteors	2,220	K7ULS (DN41cj) - W8BYA (EN70jt)	29-Apr-12
Meteors	2,192	XE2AT (DL81uu) - N0PB (EM39wo)	12-Aug-07
Meteors	2,175	W1VD (FN31ls) - ND0B (EN07gn)	03-Aug-18
Meteors	2,175	W1VD (FN31ls) - K5QE (EM31CJ)	19-Jul-20
Meteors	2,173	K5DOG (EM00wh) - K3SX (FM19dk)	24-Sep-20
Meteors	2,148	KC4PX (EL98QG) - N1BUG (FN55MF)	08-Aug-17
Sporadic E	3,635	WA7GSK (DN13so) - W4FF (EL96am)	29-May-98
Sporadic E	3,617	KF7UV (DM08dv) - W4UE (EM90gc)	29-May-98

Sporadic E	3,501	W7YOZ (CN87vr) - WA4CQG (EM72fo)	06-Jun-88
Sporadic E	3,472	K2DRH (EN41vr) - WP4KJJ (FK68xf)	13-Jul-21
Sporadic E	3,390	K2DRH (EN41vr) - NP4BM (FK68)	13-Jul-21
Sporadic E	3,389	W1VD (FN31ls) - W6OUU (DN22sn)	14-Jul-21
Sporadic E	3,389	W7FI (CN87ws) - KB4WM (EM63tg)	06-Jun-88
Sporadic E	3,224	K2DRH (EN41vr) - HI8T (FK58)	14-Jul-21
Sporadic E	3,223	KT6KT (DM26jg) - KD4ESV (EL87rl)	22-Jun-11
Sporadic E	3,221	K2DRH (EN41vr) - HI8DL (FK58)	13-Jul-21
Sporadic E	3,165	K7POJ (CN83if) - N4OGW (EM53nk)	12-Jun-23
Sporadic E	3,016	WA9DU (EM69su) - NP4BM (FK68lm)	13-Jul-21
Sporadic E	2,981	N7MWV (CN86LT) - K5IM (EM20FJ)	01-Jul-17
Sporadic E	2,946	K7KQA (DN06mf) - N4OGW (EM53nk)	12-Jun-23
Sporadic E	2,945	w9rm (dm58XN) - ve2dsb (fn35HS)	20-Jan-13
Sporadic E	2,798	K0GU (DM70mq) - N4QV (EL96vc)	19-Jun-10
Sporadic E	2,793	W1VD (FN31ls) - K0NR (DM78av)	20-Jul-19
Sporadic E	2,719	N0KE (DM69em) - N3LL (EL86tx)	18-Jun-10
Sporadic E	2,688	K5DYY (EL07ws) - KA7SAG/7 (CN92cj)	15-Jun-05
Sporadic E	2,674	W1VD (FN31ls) - W0ETT (DM79pm)	20-Jul-19
Sporadic E	2,605	KF6A (EN73pj) - WA7JTM (DM33xo)	25-May-17
TE	6,412	KP4EIT (FK68si) - LU8YYO (FF50)	05-Oct-91
TE	6,327	KP4EOR (FK78aj) - LU5DJZ (GF11lu)	12-Feb-78
TE	6,141	LU4DJC (GF05po) - HI3I (FK49ql)	15-Oct-23
TE	6,083	HI8DL (FK58al) - CX1DDO (GF15xd)	05-Nov-21
TE	6,079	HI8PLE (FK58AK) - CX1DDO (GF15XD)	20-Dec-14
TE	6,068	NP4BM (FK68lm) - CX2TQ (GF25wi)	04-Feb-24
TE	6,065	LU2EPO (GF14fx) - HI8DL (FK58al)	29-Nov-20
TE	6,031	LU7DW (GF05sh) - HI8PLE (FK58ak)	14-Dec-14
TE	5,966	LU7DW (GF05sh) - WP4JT (FK68mi)	02-Oct-12
TE	5,991	KP4EIT (FK68si) - CX1DDO (GF15xd)	26-Feb-89
TE	5,955	KP4EIT (FK68si) - LU2EG (GF05xd)	04-Jan-99
TE	5,750	WP4LNY - LU7FA	02-Feb-01
TE	5,555	KP3A (FK68ol) - LU5EJE (FF98jn)	04-Jan-99
TE	5,554	WP4IPM (FK68pl) - LU5EJU (FF98jn)	04-Jan-99
TE	4,267	J69DS (FK94ma) - PU2OAL (GG57ba)	01-Feb-13
Tropo (A)	2,715	WB4MJE (EL94hq) - VE1KG (FN84cm)	05-Nov-94
Tropo (A)	2,365	W1JSM (FN43nc) - VP5D (FL31ut)	10-May-88
Tropo (A)	2,340	CO2OJ (EL83td) - W1LP (FN41sr)	15-May-98
Tropo (A)	2,148	N0JK (EM17jq) - CO2OJ (EL83td)	14-May-98
Tropo (A)	1,931	N3LL (EL86tx) - WP3UX (FK68we)	03-Apr-10
Tropo (A)	1,892	N3LL (EL86tx) - KP4EIT (FK68si)	02-Apr-10
Tropo (A)	1,624	WB4MJE (EL94hq) - WP4O (FK68km)	18-Jan-95
Tropo (C)	2,639	W1VD (FN31ls) - N5WS (EL09ru)	20-Aug-23
Tropo (C)	2,567	KA5DWI (EM12ju) - K1WHS (FN43mj)	07-Sep-03

Tropo (C)	2,558	W5FKN (EM13gh) - K1WHS (FN43mj)	07-Sep-03
Tropo (C)	2,508	N5TIF (EM12hl) - K1CMF (FN42bq)	07-Sep-03
Tropo (P)	4,754	KH6HME (BK29go) - W1LP/MM (DL51ce)	21-Aug-99
Tropo (P)	4,669	KH6HME (BK29go) - XE2HWP (DL44uc)	24-Jun-10
Tropo (P)	4,333	KH6HME (BK29go) - W7FI (CN87ws)	01-Jul-95
Tropo (P)	4,325	KH6HME (BK29go) - N7MWV (CN87vr)	01-Jul-95
Tropo (P)	4,325	KH6HME (BK29go) - W7YOZ (CN87vr)	01-Jul-95
Tropo (P)	4,281	KH6HME (BK29go) - XE2/N6XQ (DL28uq)	13-Jul-89
Tropo (P)	4,095	KH6/N6NB (BK29hq) - W6IT (DM14kf)	30-Jun-16
Tropo (P)	4,054	NC7K (DM090a) - KH6HME (BK29go)	13-Jul-94
Tropo (P)	4,047	KH6HME (BK29go) - NY7C (CN85ab)	12-Aug-87
222 MHz			
Aurora	2,094	WB5LUA (EM13qc) - WC2K (FM29pt)	13-Mar-89
Meteors	2,352	K5QE (EM31cj) - K1OR (FN42ir)	14-Aug-23
Meteors	2,260	ND0B (EN07gn) - K1OR (FN42ir)	10-Aug-16
Meteors	2,203	ND0B (EN07gn) - N1RJX (FN32vo)	14-Dec-13
Meteors	2,179	K5QE (EM31cj) - NY2NY (FN30rx)	13-Aug-16
Meteors	2,178	W5UWB (EL17ax) - ND0B (EN07gn)	10-Dec-12
Meteors	2,153	K5VH (EM00xe) - VE3AX (FN02cw)	19-Nov-02
Meteors	2,107	K7ULS (DN41di) - KU8Y (EN61uw)	09-Aug-20
Meteors	2,102	K1WHS (FN43mj) - W7XU (EN13lm)	13-Dec-98
Meteors	2,095	AC0RA (EM26px) - K1OR (FN42ir)	19-Dec-19
Meteors	2,089	K5LLL (EM10kf) - VE3AX (FN02cw)	18-Nov-01
Meteors	2,089	W7XU (EN13lm) - K1OR (FN42ir)	13-Aug-17
Meteors	2,077	K1OR (FN42ir) - N0LWF (EN10wm)	13-Dec-15
Meteors	2,060	K0ALL (EN16ou) - W1JR (FN42hn)	13-Aug-88
Meteors	2,043	AF6O (DM14ej) - W7XU (EN13lm)	12-Aug-07
Meteors	1,978	W7JF (DN55tt) - VE3EMS (EN86qj)	12-Aug-83
Meteors	1,944	K7ULS (DN41cj) - K5QE (EM31cj)	02-Aug-20
Sporadic E	2,195	W6QIW (DM04ck) - W5UWB (EL17ax)	14-Feb-00
Sporadic E	2,184	N6HKF (DM04fu) - W5UWB (EL17ax)	14-Feb-00
Sporadic E	2,099	K5LLL (EM10kf) - VE3AX (FN02cw)	08-Jul-01
Sporadic E	2,051	K5SW (EM25hr) - WZ1V (FN31mp)	06-Jul-04
Sporadic E	2,008	W4VC (EM81tg) - K0AWU (EN37ed)	06-Jul-04
TE	5,918	KP4EOR (FK78aj) - LU7DJZ (GF05rj)	09-Mar-83
Tropo (A)	1,950	KQ4PI (EL99hk) - KP4EIT (FK68si)	03-Apr-10
Tropo (A)	1,854	WA4LOX (EL87sk) - WP4O (FK68km)	26-Feb-98
Tropo (A)	1,707	KF4FWU (EL97st) - WP4O (FK68km)	26-Feb-98
Tropo (C)	2,421	WB5AFY (EM04id) - K1TEO (FN31jg)	07-Sep-03
Tropo (C)	2,311	K1WHS (FN31mj) - KF0M (EM17io)	02-Sep-23
Tropo (C)	2,279	K5VH (EM00xe) - K2AXX (FN12cs)	06-Sep-03
Tropo (C)	2,259	W5LUA (EM13qc) - K1TEO (FN31jg)	07-Sep-03

Tropo (C)	2,213	K5LLL (EM10kf) - K2AXX (FN12cs)	06-Sep-03
Tropo (C)	2,160	N0LL (EM09os) - K1TEO (FN31jh)	21-Aug-23
Tropo (C)	2,095	AC0RA (EM26px) - K1OR (FN42IR)	19-Dec-19
Tropo (P)	4,150	KH6HME (BK29go) - XE2/N6XQ (DL29cx)	15-Jul-89
Tropo (P)	4,095	KH6/N6NB (BK29hq) - W6IT (DM14kf)	30-Jun-16
Tropo (P)	4,087	KH6UK - W6NLZ	22-Jun-59
Tropo (P)	4,035	KH6HME (BK29go) - N6PEQ (DM13cr)	13-Jul-03
432 MHz			
Aurora	1,909	WB5LUA (EM13qc) - W3IP (FM19pd)	08-Feb-86
Meteors	2,208	K5DOG (EM00wh) - VA3ELE (FN03eq)	03-Aug-21
Meteors	2,040	N6RMJ (DM14cp) - W7XU (EN13lm)	17-Nov-98
Meteors	1,999	WB5LUA (EM13qc) - KD5RO (FN13fb)	13-Dec-88
Meteors	1,641	W0LER - W2AZL	12-Aug-72
Tropo (A)	5,189	KP4EIT (FK68sh) - EA8BPX (IL18sk)	14-Aug-23
Tropo (A)	4,442	NP4BM (FK68lm) - D4VHF (HK78mj)	11-Apr-20
Tropo (A)	2,273	W1RIL (FN42ah) - VP5D (FL31ut)	10-May-88
Tropo (A)	1,954	NN5DX(DM80nv) - W4VC (EM81tg)	21-May-06
Tropo (A)	1,707	KF4FWU (ELO97st) - WP4O (FK68km)	01-Oct-98
Tropo (A)	1,662	W4MOS (EL97te) - WP4O (FK68km)	01-Oct-98
Tropo (C)	2,201	KM1H (FN42hr) - WB4MJE (EL94hq)	16-Dec-92
Tropo (C)	2,166	W5UWB (EL17ax) - K2YAZ (EN74ax)	11-Oct-98
Tropo (C)	2,161	K0VXM (EL98pj) - NN5DX (DM80nv)	21-May-06
Tropo (C)	2,160	N0LL (EM09os) - K1TEO (FN31jh)	21-Aug-23
Tropo (C)	2,126	WA5VJB (EM12lq) - WB3CZG (FN21ax)	29-Nov-86
Tropo (C)	2,068	W5UWB (EL17ax) - K8MD (EN82bq)	11-Oct-98
Tropo (C)	2,063	W8CM (DM91rl) - K1FJM/4 (EL95rm)	22-Apr-88
Tropo (C)	2,053	WS5C (DM91sj) - K1FJM/4 (EL95rm)	22-Apr-88
Tropo (P)	4,150	KH6HME (BK29go) - XE2/N6XQ (DL29cx)	15-Jul-89
Tropo (P)	4,109	KH6IAA (BK29go) - KD6R (DM13ni)	28-Jul-80
Tropo (P)	4,095	KH6/N6NB (BK29hq) - W6IT (DM14kf)	30-Jun-16
Tropo (P)	4,035	KH6HME (BK29go) - N6PEQ (DM13cr)	13-Jul-03
Tropo (P)	4,013	KH6HME (BK29go) - K7JA (DM03xs)	11-Jul-99
903 MHz			
Aurora	86	K3HZO (FM18qp) - WA3NZL (FM19jg)	08-Nov-91
Rain Scatter	328	KM0T (EN13vc) - W0GHZ (EN34lx)	13-Sep-05
Tropo (C)	1,741	N5WS (EL09ru) - K0VXM (EL98pj)	22-May-98
Tropo (C)	1,730	WB5LUA (EM13qc) - W4WSR (EL96ww)	14-Mar-89
Tropo (C)	1,674	K5AND (EM00xh) - K8TQK (EM89je)	07-May-14
Tropo (C)	1,596	AA5C (EM13se) - K0VXM (EL98pj)	23-May-98
Tropo (C)	1,350	W4VC (EM81sh) - WW2R (EM13QD)	21-May-06
Tropo (P)	4,095	KH6/N6NB (BK29hq) - W6IT (DM14kf)	30-Jun-16

Tropo (P)	4,064	KH6HME (BK29go) - N6XQ (DM12jr)	13-Jul-94
Tropo (P)	3,982	KH6HME (BK29go) - N6CA (DM03tr)	23-Aug-93
1296 MHz			
Rain Scatter	580	W0ZQ (EN34it) - K2YAZ (EN74av)	17-Jun-07
Rain Scatter	328	KM0T (EN13vc) - W0GHZ (EN34lx)	13-Sep-05
Tropo (C)	2,079	KD5RO (EM13pa) - WB3CZG (FN21ax)	29-Nov-86
Tropo (C)	2,067	WB5LUA (EM13qc) - WB3CZG (FN21ax)	29-Nov-86
Tropo (C)	1,906	W3XO (EM00kb) - K2RTH (EL95tq1)	22-May-98
Tropo (C)	1,856	W1RIL (FN42ah) - WA4CHA (EL88qa)	16-Dec-92
Tropo (C)	1,854	N5WS (EM12pw) - W2DRZ (FN02lb)	29-Nov-86
Tropo (C)	1,680	W4VC (EM81sh) - K1WHS 9FN43mj)	23-Oct-07
Tropo (P)	4,150	KH6HME (BK29go) - XE2/N6XQ (DL29cx)	15-Jul-89
Tropo (P)	4,024	KH6/N6NB (BK29hq) - W6IT (DM13cs)	19-Jun-15
2304 MHz			
Rain Scatter	654	KM0T (EN13vc) - K3SIW (EN52ta)	19-Jul-06
Rain Scatter	580	W0ZQ (EN34it) - K2YAZ (EN74av)	17-Jun-07
Rain Scatter	328	KM0T (EN13vc) - W0GHZ (EN34lx)	13-Sep-05
Tropo (C)	1,784	W4ERP (EL95WV) - W5LUA (EM13QC)	15-May-25
Tropo (C)	1,716	W3XO (EM00kd) - KQ4PI (EL99hk)	21-May-06
Tropo (C)	1,609	W5LUA (EM13qc) - K0VXM (EL98pj)	01-May-02
Tropo (C)	1,596	AA5C (EM13se) - K0VXM (EL98pj)	01-May-02
Tropo (C)	1,553	K5VH (EM00xe) - KB4DFO (EL89xc)	12-Jan-00
Tropo (C)	1,553	K5VH (EM00xe) - K1YV (EL89xc)	17-Jul-00
Tropo (P)	4,024	KH6/N6NB (BK29hq) - W6IT (DM13cs)	19-Jun-15
Tropo (P)	3,982	KH6HME (BK29go) - N6CA (DM03tr)	14-Jul-94
3456 MHz			
Rain Scatter	654	KM0T (EN13vc) - K3SIW (EN52ta)	17-Jul-06
Rain Scatter	580	K2YAZ (EN74av) - W0ZQ (EN34it)	08-Jul-07
Rain Scatter	481	W0GHZ(EN34lx) - W9ZIH(EN51lv)	24-Jun-05
Rain Scatter	435	KM0T (EN13vc) - N0DQS (EN42nx)	28-Jun-03
Rain Scatter	328	KM0T (EN13vc) - W0GHZ (EN34lx)	13-Sep-05
Tropo (C)	1,798	W3XO (EM00kd) - K0VXM (EL98pj)	21-May-06
Tropo (C)	1,609	W5LUA (EM13qc) – K0VXM (EL98pj)	01-May-02
Tropo (C)	1,606	K5LLL (EM10kf) - K0VXM (EL98pj)	20-May-06
Tropo (C)	1,539	K5VH (EM00xe) - WA8TTM (EL98dp)	15-Apr-03
Tropo (C)	1,509	WW2R (EM13qd) - WA8TTM (EL98dp)	03-Feb-03
Tropo (C)	1,508	W5LUA (EM13qc) - WA8TTM (EL98dp)	03-Feb-03
Tropo (C)	1,507	W5LUA (EM13qc) - KQ4PI (EL99hk)	02-May-02
Tropo (P)	4,024	KH6/N6NB (BK29hq) - W6IT (DM13cs)	19-Jun-15
Tropo (P)	3,982	KH6HME (BK29go) - N6CA (DM03tr)	28-Jul-91

5760 MHz			
Rain Scatter	848	KM0T (EN13vc) - K8EB (EN73cb)	22-Jun-07
Rain Scatter	654	KM0T (EN13vc) - K3SIW (EN52ta)	19-Jul-06
Rain Scatter	635	KC0IYT/0 (EN34js) - VE4MA (EN19lu)	05-Jul-11
Rain Scatter	627	W0ZQ/0 (EN34ju) - VE4MA (EN19lu)	17-Jun-10
Rain Scatter	617	KM0T (EN13vc) - W9ZIH (EN51nv)	24-May-04
Rain Scatter	517	W5ZN (EM45dh) - WW2R (EM13qd)	03-Aug-03
Rain Scatter	516	W5ZN (EM45dh) - W5LUA (EM13qc)	03-Aug-03
Rain Scatter	481	W0GHZ(EN34lx) - W9ZIH(EN51lv)	24-Jun-05
Tropo (C)	1,609	W5LUA (EM13qc) - K0VXM (EL98pj)	04-Jun-12
Tropo (C)	1,212	W4DEX (EM95tg) - K1WHS (FN43mj)	25-Sep-04
Tropo (C)	1,187	WB5LUA(EM13qc) - W9ZIH (EN51nv)	12-Nov-94
Tropo (C)	1,175	AA5C (EM13se) - W9ZIH (EN51nv)	12-Nov-94
Tropo (C)	1,005	AA5C (EN13se) - WB9OJR (EN50ej)	12-Nov-94
Tropo (C)	990	XE2/N6XQ (DL37ck) - N6CA (CM94xn)	23-Jul-89
Tropo (C)	915	W5LUA (EM13qc) - K4XR (EM64nl)	09-Aug-07
Tropo (P)	3,982	KH6HME (BK29go) - N6CA (DM03tr)	29-Jul-91
10 GHz Zero			
Rain Scatter	848	KM0T (EN13vc) - K8EB (EN73cb)	22-Jun-07
Rain Scatter	825	N0OY (EM18ct) - W9ZIH (EN51nv)	13-Apr-22
Rain Scatter	804	N0UK (EN34hw) - W8BYA (EN70jt)	19-Sep-22
Rain Scatter	791	N0OY (EM18ct) - W0GHZ (EN34lx)	26-Aug-21
Rain Scatter	791	KM0T (EN13vc) - VE3KRP (EN58gk)	14-Aug-07
Rain Scatter	791	N0OY (EM18ct) - W0GHZ (EN34ix)	22-Aug-21
Rain Scatter	778.5	N0OY (EM18ct) - N0UK (EN34lw)	26-Aug-21
Rain Scatter	776	N0OY (EM18ct) - N0UK (EN34iw)	26-Aug-21
Rain Scatter	753	KM0T (EN13vc) - VE4MA (EN19lu)	25-Aug-05
Rain Scatter	711.6	WQ0P (EM19wf) - KM5PO (EM12jt)	15-May-22
Rain Scatter	704	W7XU (EN13lm) - VE4MA (EN19lu)	17-Jun-10
Rain Scatter	695	K0AWU (EN37ed) - W9ZIH (EN51nv)	23-Jul-05
Rain Scatter	676	KC0IYT (EN34nl) - VE4MA (EN91lu)	24-Jun-05
Rain Scatter	676	W0ZQ (EN34it) - VE4MA (EN19lu)	24-Jun-05
Rain Scatter	654	K0AWU (EN37ed) - N4PZ (EN52gb)	19-Jul-06
Rain Scatter	644	K0AWU (EN37ed) - K2YAZ (EN74av)	26-Jun-07
Rain Scatter	641	W7XU (EN13lm) - N4PZ (EN52gb)	17-Jun-10
Rain Scatter	627	N0OY (EM18ct) - AA5AM (EM13sg)	21-Aug-21
Rain Scatter	617	KM0T (EN13vc) - W9ZIH (EN51nv)	24-May-04
Rain Scatter	590	NT0V (EN08oc) - KM0T (EN13vc)	18-Aug-05
Tropo (C)	1226	N0OY (EM18ct) - VE4MA (EN19lu)	14-Aug-22
Tropo (C)	1098	N0OY (EM18ct) - W8BYA (EN70jt)	11-Jul-22
Tropo (C)	765	W7XU (EN15lj) - W9ZIH (EN51nv)	22-Aug-10

Tropo (C)	714	W7XU (EN15lj) - N4PZ (EN52gb)	22-Aug-10
10 GHz 9th			
Rain Scatter	889	W8BYA (EN70jt) - W0LGQ (EN21ci	22-Jun-22
Rain Scatter	851	K9PW (EN62ad) - K0SM/2 (FN12eu)	20-Jul-23
Rain Scatter	781	W8BYA (EN70jt) - N3FL (FM19ua)	12-Aug-23
Rain Scatter	772	W8BYA (EN70jt) - K3TUF (FN10we)	16-Jun-22
Rain Scatter	738	WB9SNR (EN62ac) - W2DRZ (FN02la)	16-Aug-97
Rain Scatter	727	W9ZIH (EN51nv) - VE3KRP (EN58jk)	08-Jul-07
Rain Scatter	709	N4PZ (EN52gb) - VE3KRP (EN58jk)	08-Jul-07
Rain Scatter	701	W8BYA (EN70jt) - K1RZ (FM19jh)	16-Jul-20
Rain Scatter	695	W9ZIH (EN51nv) - K0AWU (EN37ed)	23-Jul-05
Rain Scatter	662	N8PUM (EN66dl) - W8BYA (EN70jt)	11-Aug-21
Rain Scatter	654	N4PZ (EN52gb) - K0AWU (EN37ed)	19-Jul-06
Rain Scatter	641	N4PZ (EN52gb) - W7XU (EN13lm)	17-Jun-10
Rain Scatter	617	W9ZIH (EN51nv) - KM0T (EN13vc)	24-May-04
Tropo (C)	1,098	W8BYA (EN70jt) - N0OY (EM18ct)	11-Jul-22
Tropo (C)	1,086	W9ZIH (EN51nv) - WA2FGK (FN21bf)	25-Aug-09
Tropo (C)	1,046	N4PZ (EN52gb) - VE4MA (EN19lu)	22-Aug-10
Tropo (C)	765	W9ZIH (EN51nv) - W7XU (EN15lj)	22-Aug-10
Tropo (C)	714	N4PZ (EN52gb) - W7XU (EN15lj)	22-Aug-10
Tropo (C)	701	W8BYA (EN70jt) - K1RZ (FM19jh)	26-Aug-20
Tropo (C)	465	N4PZ (EN52gb) - K8MD (EN82bq)	21-Sep-08
10 GHz 8th			
Rain Scatter	848	K8EB (EN73cb) - KM0T (EN13vc)	22-Jun-07
Rain Scatter	764	KB8VAO (EN91kt) _ VE2UG (FN35gs)	23-Jul-22
Rain Scatter	763	WA8TTM (EL98cl) - W4DEX (EM95tg)	22-Aug-05
Rain Scatter	644	K2YAZ (EN74av) - K0AWU (EN37ed)	26-Jun-07
Rain Scatter	573	K2YAZ (EN74av) - N0UK/0 (EN34jv)	26-Jun-07
Rain Scatter	558	N8PUM (EN66dl) - KB8U (EN82em)	04-Sep-11
Rain Scatter	547	N8PUM (EN66dl) - WA8VPD (EN82em)	04-Sep-11
Tropo (C)	1,039	WA8WZG (EN81om) - W5ZN (EM45dh)	17-Aug-99
Tropo (C)	937	KB8U (EN71sw) - K1TEO (FN31jh)	16-Sep-20
Tropo (C)	919	KB8U (EN71sw) - W4ZRZ (EM63st)	13-Nov-06
Tropo (C)	465	K8MD (EN82bq) - N4PZ (EN52gb)	21-Sep-08
10 GHz 7th			
Rain Scatter	79	W7GLF (CN87vr) - W7LHL (CN87ua)	17-Feb-03
Tropo (C)	315	W7PUA (CN84io) - KD7TS (CN87ui)	30-Jan-03
10 GHz 6th			
Rain Scatter	660	W6OYJ (DM12mq) - WB6CWN (DM08pk)	06-Sep-96

Tropo (C)	1,460	AD6FP (CM96wa) - 4C2WH (DL34wt)	19-Aug-07
Tropo (C)	1,448	KH6WZ (DM05ax) - 4C2WH (DL34wt)	19-Aug-07
Tropo (C)	1,448	N6CA (DM05ax) - 4C2WH (DL34wt)	19-Aug-07
Tropo (C)	1,315	KN6VR (DM04am) - 4C2WH (DL34wt)	18-Aug-07
Tropo (C)	1,315	W6QIW (DM04am) - 4C2WH (DL34wt)	18-Aug-07
Tropo (C)	1,303	WA6QYR (DM04bk) - 4C2WH (DL34wt)	18-Aug-07
Tropo (C)	1,290	AA6IW (DM04ek) - 4C2WH (DL34wt)	18-Aug-07
Tropo (C)	1,290	KE6HPZ (DM04ek) - 4C2WH (DL34wt)	18-Aug-07
Tropo (C)	1,286	KB8VAO (DM04ms) - 4C2WH (DL34wt)	18-Aug-07
Tropo (C)	1,286	N6DN (DM04ms) - 4C2WH (DL34wt)	18-Aug-07
Tropo (C)	1,286	WT6K (DM04ms) - 4C2WH (DL34wt)	18-Aug-07
Tropo (P)	1,282	W1LP/mm (DL34ja) - WB6CWN (DM04eg)	20-Sep-01
10 GHz 5th			
Rain Scatter	682	W5LUA (EM13qc) - WQ0P (EM19wf)	15-May-22
Rain Scatter	643	W5LUA (EM13qc) - N0OY (EM18ct)	13-May-22
Rain Scatter	627	AA5AM (EM13sg) - N0OY (EM18ct)	21-Aug-21
Rain Scatter	515	W5LUA (EM13qc) - W5ZN (EM45dh)	17-Jun-00
Tropo (C)	1,609	W5LUA (EM13qc) - K0VXM (EL98pj)	04-Jun-12
Tropo (C)	1,039	W5ZN (EM45dh) - WA8WZG (EN81om)	17-Aug-99
Tropo (C)	915	W5LUA (EM13qc) - K4XR (EM64nl)	09-Aug-07
Tropo (C)	335	AA5AM (EM13sg) - WA5YWC (DM93xn)	16-Sep-18
10 GHz 4th			
Rain Scatter	1,008	W4DEX (EM95tg) - AF1T (FN41ee)	21-Aug-05
Rain Scatter	763	W4DEX (EM95tg) - WA8TTM (EL98cl)	22-Aug-05
Rain Scatter	710	W4DEX (EM95tg) - K2TXB (FM29pt)	21-Aug-04
Tropo (C)	1,609	K0VXM (EL98pj) - W5LUA (EM13qc)	04-Jun-12
Tropo (C)	1,212	W4DEX (EM95tg) - K1WHS (FN43mj)	25-Sep-04
Tropo (C)	1,041	K1MAP/4 (FM14ux) - K1WHS (FN43mj)	22-Sep-09
Tropo (C)	919	W4ZRZ (EM63st) - KB8U (EN71sw)	13-Nov-06
Tropo (C)	917	W4DEX (EM95tg) - K1TEO (FN31jh)	03-Oct-05
Tropo (C)	915	K4XR (EM64nl) - W5LUA (EM13qc)	09-Aug-07
Tropo (C)	845	NA4M (FM08us) - N1JEZ/1 (FN44ig)	18-Sep-10
Tropo (C)	802	K1MAP/4 (FM14ux) - W1AIM/1 (FN41ee)	21-Sep-09
Tropo (C)	802	K1MAP/4 (FM14ux) - W1GHZ/1 (FN41ee)	21-Sep-09
Tropo (C)	797	K1MAP/4 (FM15ua) - W1AIM/1 (FN41ee)	21-Sep-09
Tropo (C)	797	K1MAP/4 (FM15ua) - W1GHZ/1 (FN41ee)	21-Sep-09
Tropo (C)	704	K1MAP/4 (FM26aq) - K2TXB/1 (FN41ql)	20-Sep-09
Tropo (C)	704	K1MAP/4 (FM26aq) - W1MKY/1 (FN41ql)	20-Sep-09
Tropo (C)	704	K1MAP/4 (FM26qa) - AF1T/1 (FN41ql)	20-Sep-09
Tropo (C)	537	ND3F (FM26aw) - K1TEO (FN31jg)	

10 GHz 3rd			
Rain Scatter	593	KB8VAO/3 (FN00rg) - AF1T/1 (FN41ee)	17-Aug-03
Tropo (C)	1,086	WA2FGK (FN21bf) - W9ZIH (EN51nv)	25-Aug-09
10 GHz 2nd			
Rain Scatter	738	W2DRZ (FN02la) - WB9SNR (EN62ac)	16-Aug-97
Rain Scatter	710	K2TXB (FM29pt) - W4DEX (EM95tg)	21-Aug-04
10 GHz 1st			
Rain Scatter	1,008	AF1T/1 (FN41ee) - W4DEX (EM95tg)	21-Aug-05
Rain Scatter	721.5	AF1T (FN41ee) - VE3SMA (FN03bi)	18-Aug-19
Rain Scatter	721.5	K1RZ (FN41ee) - VE3SMA (FN03bi)	18-Aug-19
Rain Scatter	721.5	K3WHC (FN41ee) - VE3SMA (FN03bi)	18-Aug-19
Rain Scatter	721.5	W1MKY (FN41ee) - VE3SMA (FN03bi)	18-Aug-19
Rain Scatter	593	AF1T/1 (FN41ee) - KB8VAO/3 (FN00rg)	17-Aug-03
Tropo (C)	1,212	K1WHS (FN43mj) - W4DEX (EM95tg)	25-Sep-04
Tropo (C)	937	K1TEO (FN31jh) - KB8U (EN71sw)	16-Sep-20
Tropo (C)	917	K1TEO (FN31jh) - W4DEX (EM95tg)	03-Oct-05
Tropo (C)	845	N1JEZ/1 (FN44ig) - NA4N (FM08us)	18-Sep-10
Tropo (C)	537	K1TEO (FN31jg) - ND3F (FM26aw)	
10 GHz XE			
Tropo (C)	1,460	4C2WH (DL34wt) - AD6FP (CM96wa)	19-Aug-07
Tropo (C)	1,448	4C2WH (DL34wt) - KH6WZ (DM05ax)	19-Aug-07
Tropo (C)	1,448	4C2WH (DL34wt) - N6CA (DM05ax)	19-Aug-07
Tropo (C)	1,315	4C2WH (DL34wt) - W6QIW (DM04am)	18-Aug-07
Tropo (C)	1,303	4C2WH (DL34wt) - WA6QYR (DM04bk)	18-Aug-07
Tropo (C)	1,290	4C2WH (DL34wt) - AA6IW (DM04ek)	18-Aug-07
Tropo (C)	1,290	4C2WH (DL34wt) - KE6HPZ (DM04ek)	18-Aug-07
Tropo (C)	1,286	4C2WH (DL34wt) - KB8VAO (DM04ms)	18-Aug-07
Tropo (C)	1,286	4C2WH (DL34wt) - N6DN (DM04ms)	18-Aug-07
Tropo (C)	1,286	4C2WH (DL34wt) - WT6K (DM04ms)	18-Aug-07
10 GHz VE			
Rain Scatter	791	VE3KRP (EN58gk) - KM0T (EN13vc)	14-Aug-07
Rain Scatter	753	VE4MA (EN19lu) - KM0T (EN13vc)	25-Aug-05
Rain Scatter	727	VE3KRP (EN58jk) - W9ZIH (EN51nv)	08-Jul-07
Rain Scatter	726	VA3TO (FN03cn) - K1RZ (FN41ee)	20-Aug-22
Rain Scatter	726	VA3TO (FN03cn) - AF1T (FN41ee)	20-Aug-22
Rain Scatter	726	VA3TO (FN03cn) - K3WHC (FN41ee)	20-Aug-22
Rain Scatter	726	VA3TO (FN03cn) - W1MKY (FN41ee)	20-Aug-22
Rain Scatter	721.5	VE3SMA (FN03c) - AF1T (FN41ee)	18-Aug-19
Rain Scatter	721.5	VE3SMA (FN03c) - K1RZ (FN41ee)	18-Aug-19

Rain Scatter	721.5	VE3SMA (FN03c) - K3WHC (FN41ee)	18-Aug-19
Rain Scatter	721.5	VE3SMA (FN03c) - W1MKY (FN41ee)	18-Aug-19
Rain Scatter	709	VE3KRP (EN58jk) - N4PZ (EN52gb)	08-Jul-07
Rain Scatter	704	VE4MA (EN19lu) - W7XU (EN13lm)	17-Jun-10
Rain Scatter	676	VE4MA (EN19lu) - KC0IYT/0 (EN34nl)	24-Jun-05
Rain Scatter	676	VE4MA (EN19lu) - W0ZQ/0 (EN34nl)	24-Jun-05
Tropo (C)	1223	VE4MA (EN19lu) - N0OY (EM18ct)	14-Aug-22
Tropo (C)	1,046	VE4MA (EN19lu) - N4PZ (EN52gb)	22-Aug-10
24 GHz			
Snow Scatter	259	VA3TO (EN93qj) - K2UA (FN12fs)	04-Feb-23
Snow Scatter	259	VA3ELE (EN93qj) - K2UA (FN12fs)	04-Feb-23
Rain Scatter	285	W6QIW (DM04MS) - N9JIM (CM97TB)	15-Aug-20
Rain Scatter	283	KM0T (EN13vc) - W0ZQ/0 (EN35ab)	31-Dec-05
Rain Scatter	220	VA3ELE (FN13ku) - VA3TO (FN03df)	30-Apr-22
Rain Scatter	218	KM0T (EN13vc) - W0ZQ/0 (EN15wb)	02-Apr-06
Rain Scatter	206	VA3ELE (EN95xk) - VA3TO/VE3GHZ (FN03an)	17-May-22
Rain Scatter	195	KD7TS (CN87ui) - W7SZ (CN85uo)	28-Sep-07
Rain Scatter	119	KM0T (EN13vc) - N0DQS (EN22ge)	26-Aug-03
Tropo (C)	543	W5LUA (EM13qc) - WW2R/5 (EM41hc)	07-Sep-02
Tropo (C)	526	WB6CWN/6 (DM04ms) - AD6FP/6 (CM88ws)	21-Aug-10
Tropo (C)	412	KC6QHP/6 (DM04ms) - AD6FP/6 (CM98qf)	22-Aug-10
Tropo (C)	375	K6GZA/6 (CM97hm) - AD6FP/6 (DM04ms)	16-Sep-00
Tropo (C)	375	AD6FP/6 (CM97hm) - W6QI/6 (DM04ms)	20-Aug-05
Tropo (C)	313	W6QI/6 (DM04ms) - AD6FP/6 (DM07dm)	21-Aug-05
Tropo (C)	311	N1JEZ/1 (FN44ig) - KA1OJ/1 (FN41ll)	19-Aug-12
Tropo (C)	290	KB8VAO/6 (DM04ms) - W6QI/6 (DM07gi)	20-Sep-04
Tropo (C)	285	N1JEZ/1 (FN44ig) - KA1OJ/1 (FN51av)	17-Sep-06
Tropo (C)	278	VA3TO (FN03an) - WB2WGH (FN13rl)	27-May-23
Tropo (C)	277	K9PW (EN62ck) - K3SIW/8 EN64vp)	20-Sep-15
Tropo (C)	266	WA6EXV (DM06wl) - K6OW (DM14kf)	05-Jul-97
Tropo (C)	257	KK6TG (CM98mr) - WB7ABP (CN80on)	12-Sep-92
Tropo (C)	253	VA3ELE (EN94wc) - K2UA (FN12fs)	13-Aug-22
Tropo (C)	222	VA3ELE (FN13ku) - VA3TO (FN03df)	07-Sep-19
47 GHz			
Snow Scatter	125	VA3TO (EN92mv) - VA3ELE (FN03dm)	13-Nov-22
Snow Scatter	117	VA3ELE (FN03qv) - VA3TO (FN03df)	02-Jan-22
Rain scatter	132	VA3TO (FN03cf) - VE3ELE (FN03rx)	16-Dec-22
Rain scatter	88	VA3ELE (FN03ab) - VE3KH (FN03cg)	05-Apr-22
Rain scatter	75	VA3ELE (FN03dm) - VA3TO	26-Mar-22
Tropo (C)	344.8	AD6FP /6 (DM07as) - W6QIW/6 (DM04ms)	19-Sep-15
Tropo (C)	343	W6QI/6 (DM04ms) - AD6FP/6 (DM07bs)	30-Oct-05

Tropo (C)	246	W0EOM/6 (CM97ei) - KF6KVG/6 (DM06ms)	09-Feb-03
Tropo (C)	244	VA3ELE (EN93wv) - K2UA (FN12fs)	13-Aug-22
Tropo (C)	232	KB8VAO/6 (CM96qi) - AD6FP/6 (DM04ms)	18-Sep-04
Tropo (C)	222	VA3ELE (FN13ku) - VA3TO (FN03df)	30-Apr-22
Tropo (C)	215	KT1J/N1JEZ (FN34bi) - VE2UG/VE3FN (FN26rf)	30-Jun-16
Tropo (C)	207.5	W5LUA/7 (DM42ok56ig) - N0IO/7 (DM33rn26sp)	09-Mar-19
Tropo (C)	207.5	W5LUA/7 (DM42ok56ig) - W7QQ/7 (DM33rn26sp)	09-Mar-19
Tropo (C)	205	N1JEZ/1 (FN44ig) - WA1MBA/1 (FN42bl)	03-Jul-05
Tropo (C)	174	W3IY/4 (FN10ff) - W4SW/4 (FM08us)	14-Nov-01
Tropo (C)	167	K9PW/8 (EN47ur09) - K8ZR (EN57vk36)	21-Aug-21
Tropo (C)	167	K9PW/8 (EN47ur09) - K3SIW/8 (EN57vk36)	21-Aug-21
Tropo (C)	167	K9PW/8 (EN47ur09) - WB8TGY (EN57vk36)	21-Aug-21
Tropo (C)	167	K9PW/8 (EN47ur09) - AA9IL/8 (EN57vk36)	21-Aug-21
Tropo (C)	120	NU7Z (CN87ms) - KD7TS (CN96aw)	04-Oct-03
75 GHz			
RainScatter	103.4	VE3KH (FN03cg) - VE3SST/R (FN03ou)	09-Jun-24
LOS	289	AD6IW (CN90fl) - KF6KVG (CM97av)	23-Jun-14
LOS	289	AD6IW (CN90fl) - K6GZA (CM97av)	23-Jun-14
LOS	207.5	W5LUA/7 (DM42ok56ig) - N0IO/7 (DM33rn26sp)	09-Mar-19
LOS	207.5	W5LUA/7 (DM42ok56ig) - W7QQ/7 (DM33rn26sp)	09-Mar-19
LOS	207.5	VE4MA/W7 (DM42ok56ig) - W7QQ/7 (DM33rn26sp)	09-Mar-19
LOS	207.5	VE4MA/W7 (DM42ok56ig) - N0IO/7 (DM33rn26sp)	09-Mar-19
LOS	207.5	K8ZR/7 (DM42ok56ig) - W7QQ/7 (DM33rn26sp)	09-Mar-19
LOS	207.5	K8ZR/7 (DM42ok56ig) - N0IO/7 (DM33rn26sp)	09-Mar-19
LOS	205	N1JEZ/1 (FN44ig) - WA1MBA/1 (FN42bl)	19-Sep-14
LOS	177	AD6FP/6 (CM88qp) - KF6KVG/6 (CM97ad)	01-Mar-02
LOS	177	W0EOM/6 (CM88qp) - KF6KVG/6 (CM97ad)	01-Mar-02
LOS	132.3	KB8VAO (EN81pm46lk) - K8ZR (EN91ktooix)	22-Feb-20
LOS	118	KB8VAO (EN81pm46lk) - K8ZR (EN91hq17pi)	22-Feb-20
LOS	110	K2AD (EM96ur) - W2SZ (FM07fm)	20-May-99
LOS	98	KB8VAO (EN81pm46lk) - K8ZR (EN91fo33rf)	22-Feb-20
LOS	86.6	KB8VAO (EN81pm46lk) - K8ZR (EN91em28co)	22-Dec-19
LOS	60	W2SZ (FM07fm) - WA4RTS (FM08ia)	01-May-99
122 GHz			
LOS	139	K6ML (CM88wj75on) - KB6BA (CM97bd18vj)	17-Feb-20
LOS	139	K6ML (CM88wj75on) - N9JIM (CM97bd18vj)	17-Feb-20
LOS	114	WA1ZMS/4 (EM96ur) - W4WWQ/4 (FM07fm)	18-Jan-05
LOS	80.2	K6ML (CM97av91) - KB6BA (CM97bd18vj)	16-Dec-19
LOS	32	K9PW/W8 (EN74ax92cf) - KB8U (EN75ee40al)	25-Oct-21
LOS	30	WA1ZMS/4 (FM07fm) - W4WWQ/4 (FM07ji)	02-Apr-03
LOS	24.8	W0EOM/6 (CM97cj) - KF6KVG/6 (CM87xh)	27-Aug-04

LOS	20.7	W4WWQ/4 (FM07hj) - WA1ZMS/4 (FM07fl)	11-Mar-03
LOS	12.7	VA3TO (FN03al) - VA3ELE (FN03co)	12-Nov-20
LOS	3.5	AA5AM (EM13sg) - W5LUA (EM13sb)	17-Sep-20
LOS	1.1	WA1MBA (FN32ri) - WB2BYW (FN32rj)	11-Jul-94
LOS	1	N1JEZ/1 (FN34ha) - KT1J (FN34ha)	23-Aug-08
134 GHz			
LOS	114.4	WA1ZMS/4 (EM96ur) - W4WWQ/4 (FM07fm)	26-Feb-06
LOS	1.3	N1JEZ/4 (FM18gx) - WA1ZMS/4 (FM18gx)	25-Apr-19
LOS	1.3	N1JEZ/4 (FM18gx) - WA1MBA/4 (FM18gx)	25-Apr-19
142 GHz			
LOS	79.7	W2SZ/4 (FM07fm) - WA1ZMS/4 (EM96wx)	12-Jan-03
LOS	61.6	W2SZ/4 (FM07fm) - WA4RTS/4 (FM08ib)	01-Jan-01
LOS	34	WA1ZMS (FM05fm) - WA4RTS (FM05ji)	06-Nov-00
LOS	11.7	KF6KVG (CM87uk) - W0EOM (CM87wj)	19-Oct-99
241 GHz			
LOS	114	WA1ZMS/4 (FM07fm) - W4WWQ/4 (EM96ur)	21-Jan-08
LOS	79.7	WA1ZMS/4 (EM96wx) - W2SZ/4 (FM07fm)	17-Feb-04
LOS	61.8	W2SZ/4 (FM07fm) - W4WWQ/4 (EM97xe)	03-Dec-03
LOS	11.4	WA1ZMS/4 (FM07ln) - W4WWQ/4 (FM07jn)	11-Mar-02
LOS	7.3	WA1ZMS (FM07jj) - W4WWQ (FM07ji)	23-Feb-02
LOS	1.12	N1JEZ (FN34ha) - W1GHZ (FN34ha)	01-Mar-23
Micrometer Radio			
322 GHz	1.4	WA1ZMS/4 (FM07ji) - W4WWQ/4 (FM07ji)	04-Mar-03
322 GHz	1.12	N1JEZ (FN34ha) - W1GHZ (FN34ha)	01-Mar-23
322 GHz	0.5	WA1ZMS/4 (FM07ji) - W4WWQ/4 (FM07ji)	01-Mar-02
322 GHz	0.05	W2SZ (FM07ji) - WA4RTS (FM07ji)	15-Dec-01
403 GHz	1.42	WA1ZMS/4 (FM07ji) - W4WWQ/4 (FM07ji)	21-Dec-04
403 GHz	0.52	WA1ZMS/4 (FM07ji) - W4WWQ/4 (FM07ji)	11-Apr-03
Light			
474 THz	192.6	WB7VVD (DM34hb) - KC7AED (DM43iq)	21-Sep-97
474 THz	92.8	K6KWQ (CM94) - W2ODH (DM04)	08-Jun-90
474 THz	81.6	XE2AT (DL81vq) - XE2ZB (DL80vx)	25-Aug-05
475 THz	1.15	N1JEZ/1 (FN35pa) - VE2JWH (FN35pa)	03-Oct-14
678 THz	248	WA7LYI (DM34tf) - KY7B (DM42ok)	08-Jun-91