RTCA Special Committee 186, Working Group 5
ADS-B UAT MOPS
Meeting #11

Multi-Aircraft UAT Simulator Results for Core Europe

Prepared by

Larry Bachman
Michael Castle

The Johns Hopkins University Applied Physics Laboratory

SUMMARY

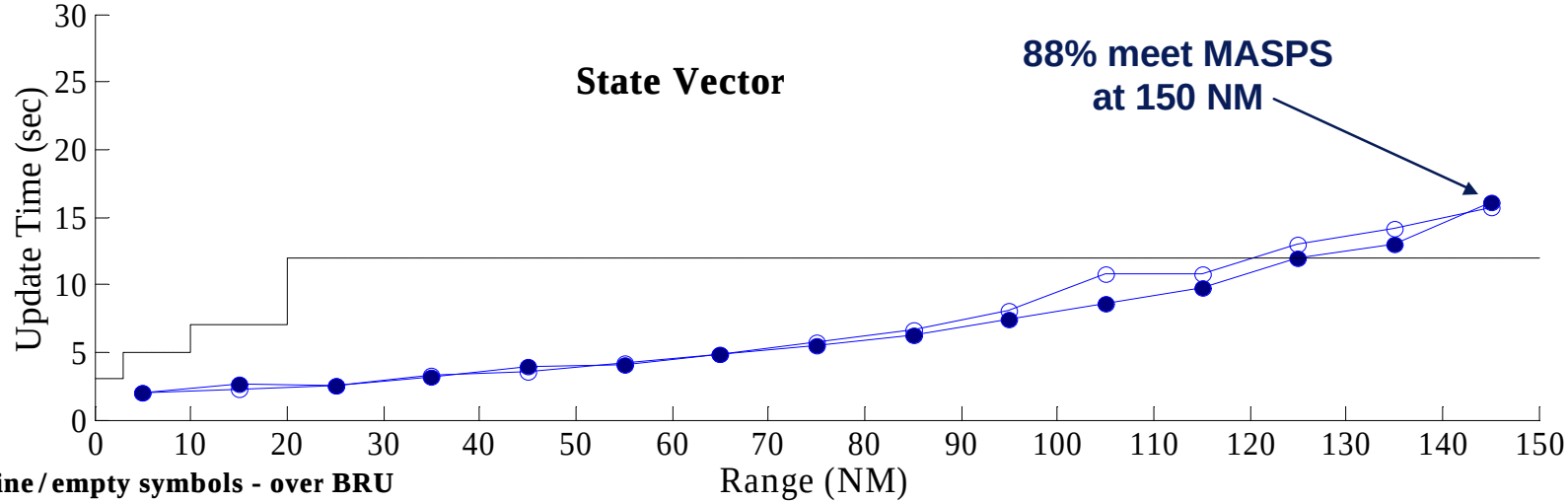
Model results from the Multi-Aircraft UAT Simulator in Core Europe for current and 2015 interference environments, in both a nominal position over Brussels and in the worst-case position with respect to Distance Measuring Equipment (DME) interference, are presented for review. Both Air-Air and Air-Ground performance is evaluated as well as receptions from ground vehicles from aircraft on approach.

Assumptions

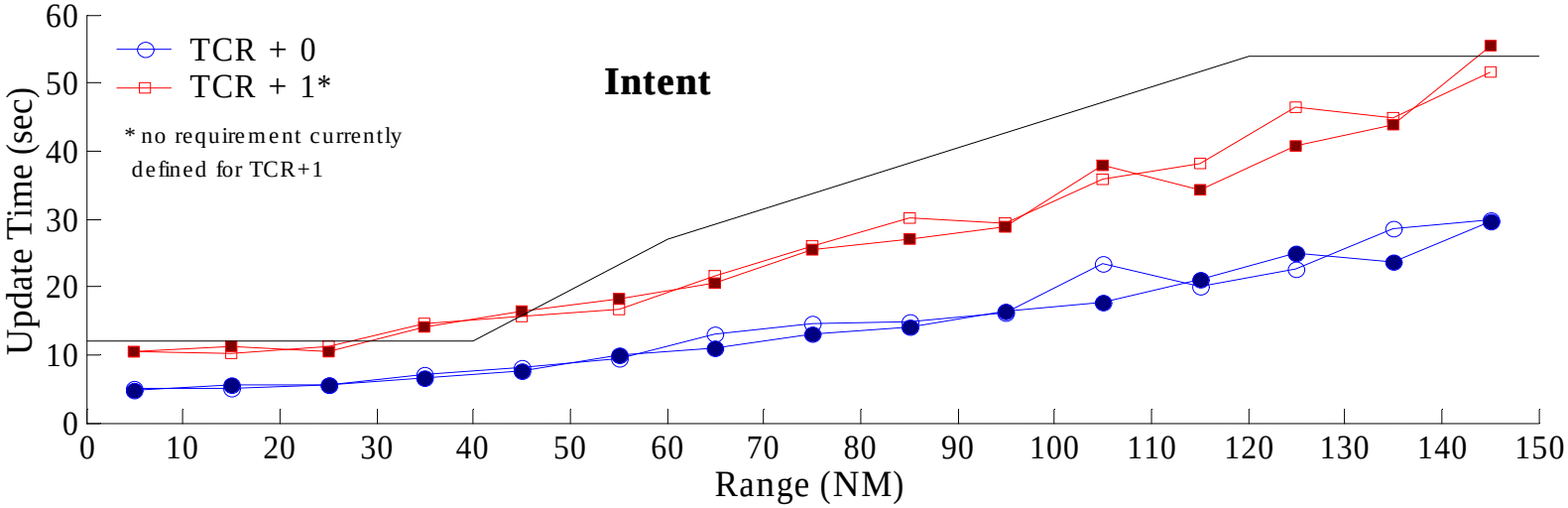
- Standard Interference Environments for the European Scenarios
- Message transmission sequences as outlined at Atlanta meeting
- Message information content as outlined in Atlanta
- 16-second epoch (4 blocks of 4 in rotating transmission sequence)
- MAUS version is final for MOPS

Europe 2015

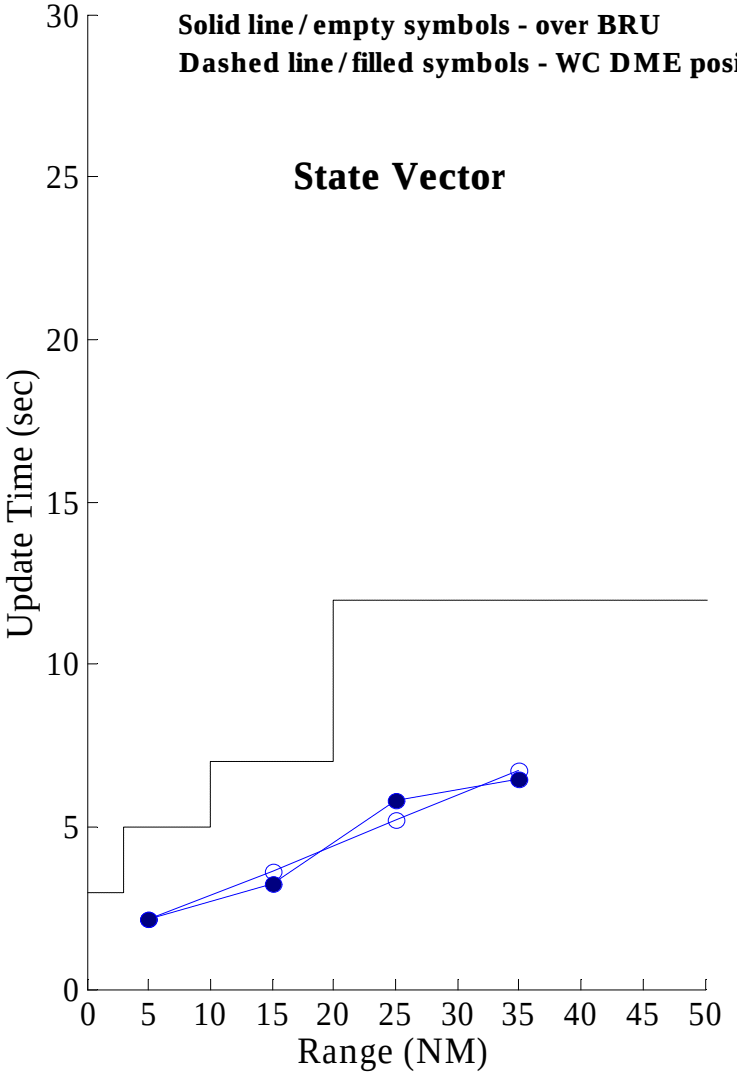
A3 Receiver at High Altitude Receiving A3 Transmitters in 2015

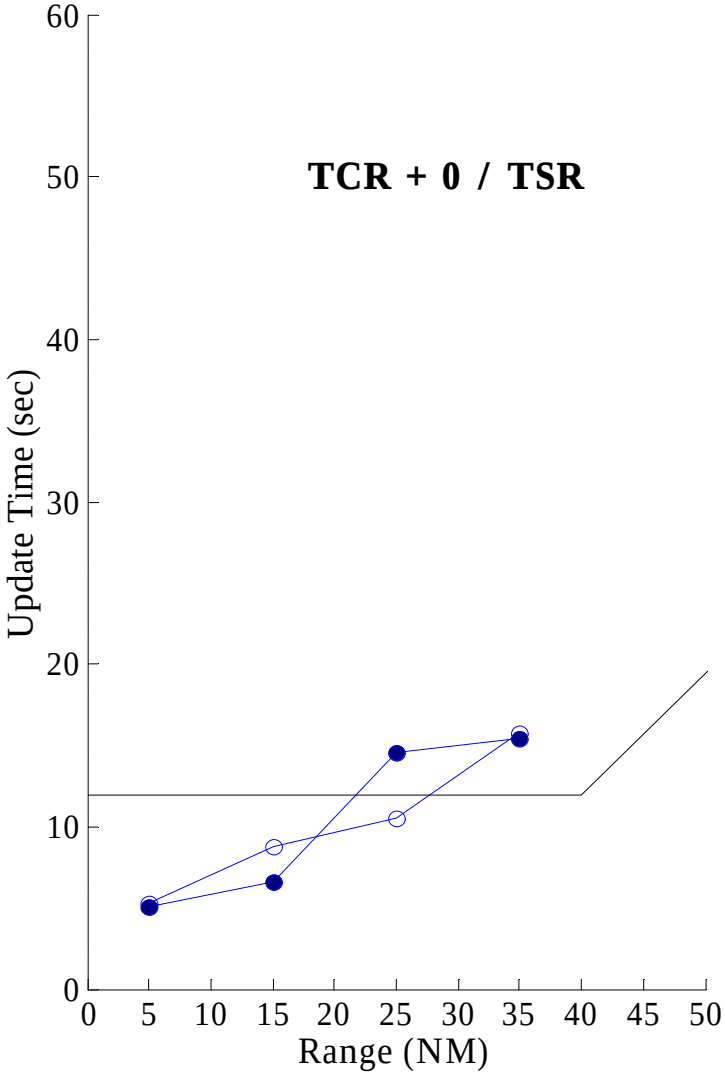


Solid line / empty symbols - over BRU
Dashed line / filled symbols - Worst Case DME position

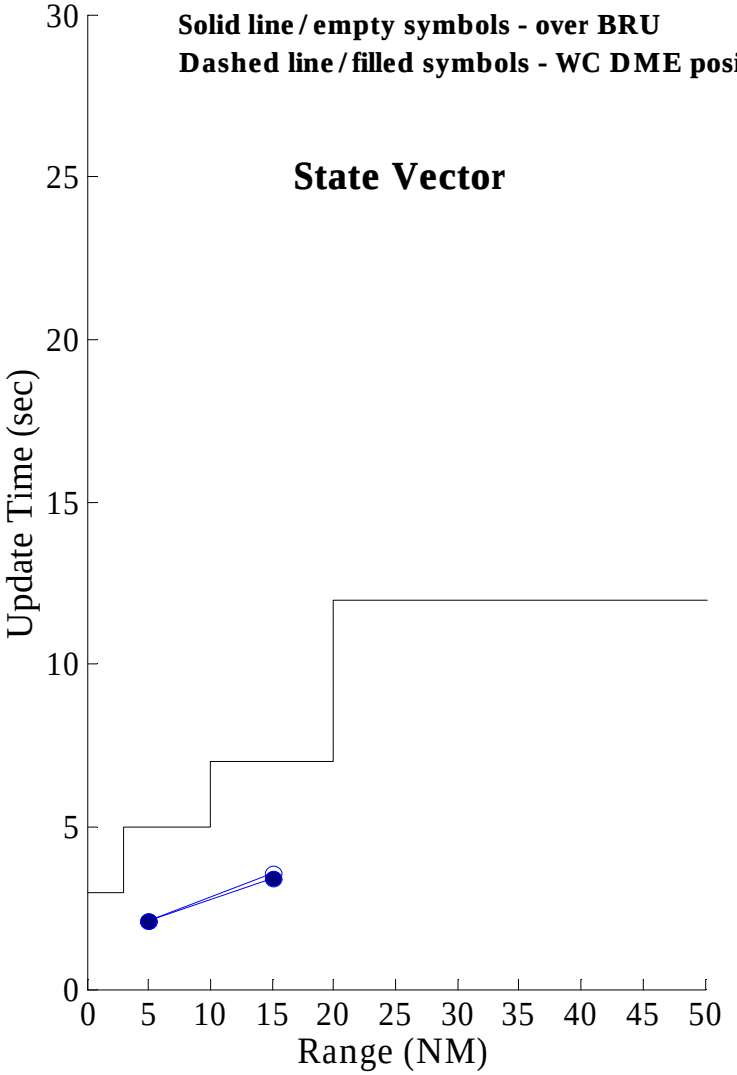


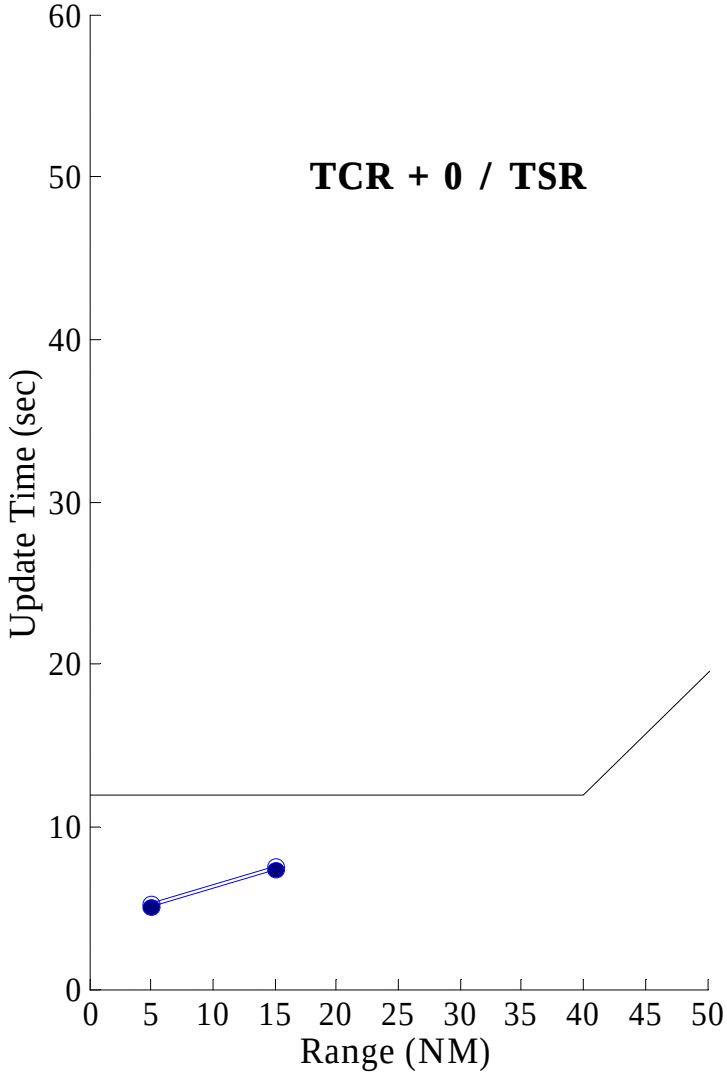
A3 Receiver at High Altitude Receiving A2 Transmitters in 2015



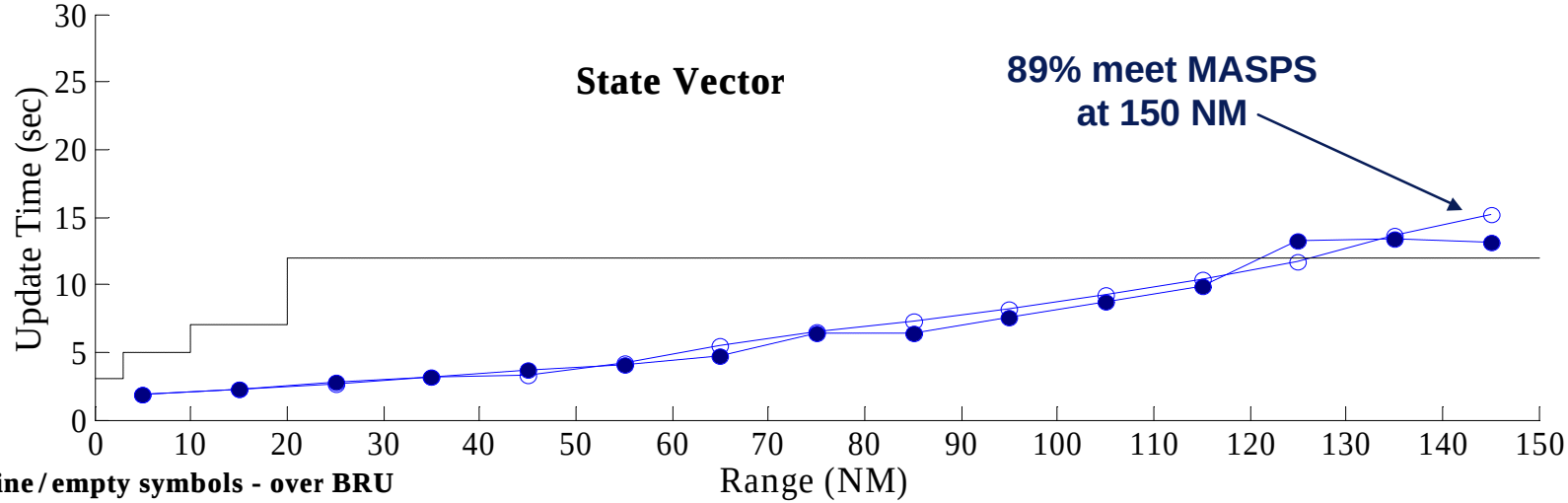


A3 Receiver at High Altitude Receiving A1H Transmitters in 2015

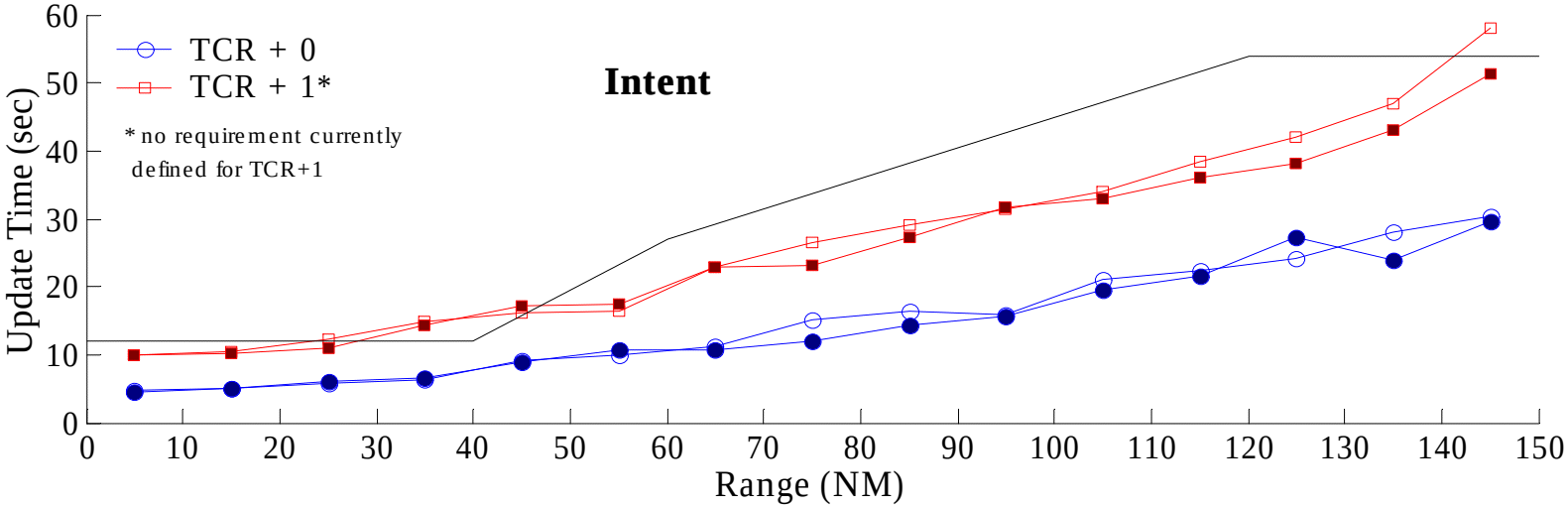




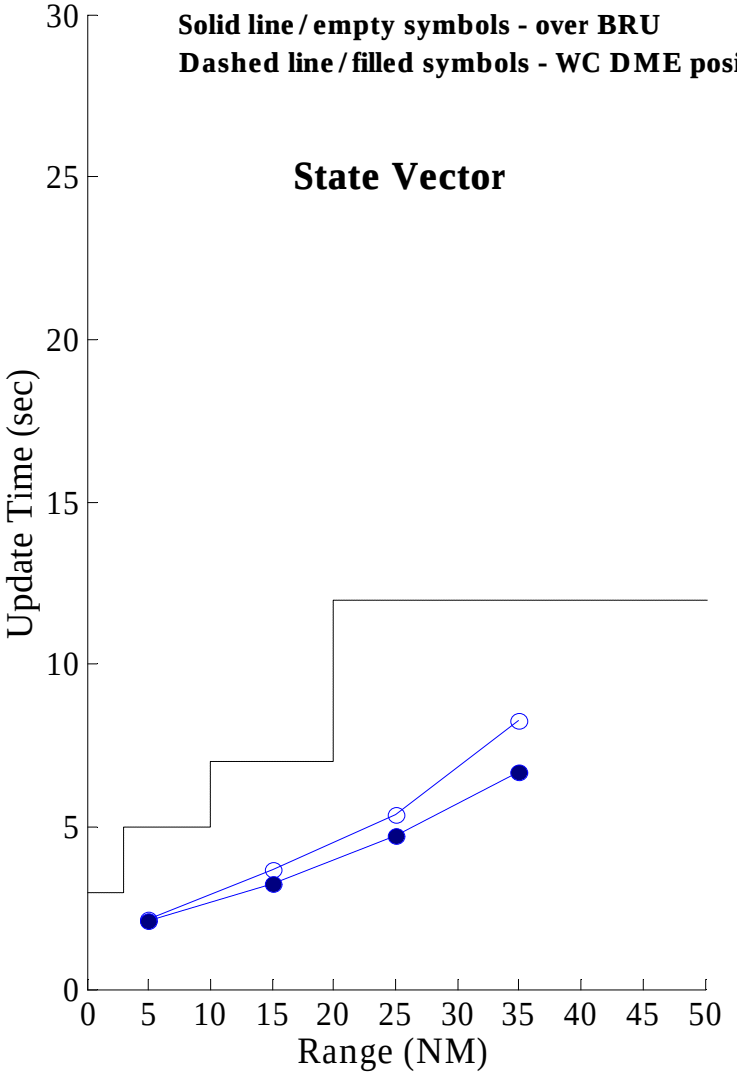
A3 Receiver at FL 150
Receiving A3 Transmitters in 2015

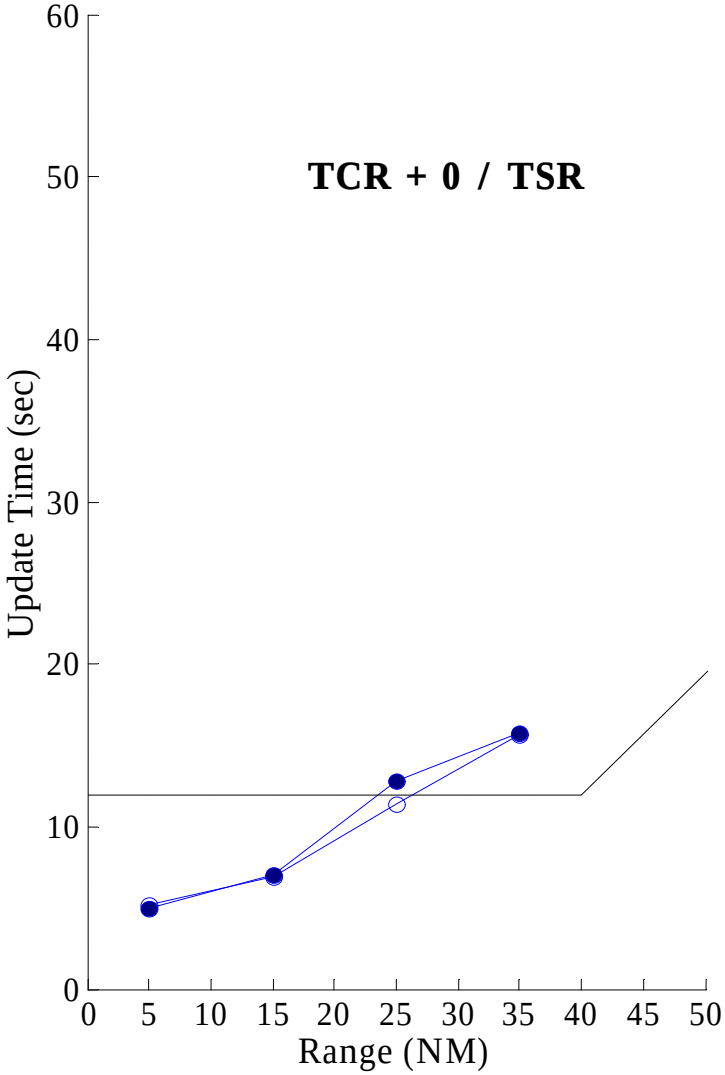


Solid line / empty symbols - over BRU
Dashed line / filled symbols - Worst Case DME position

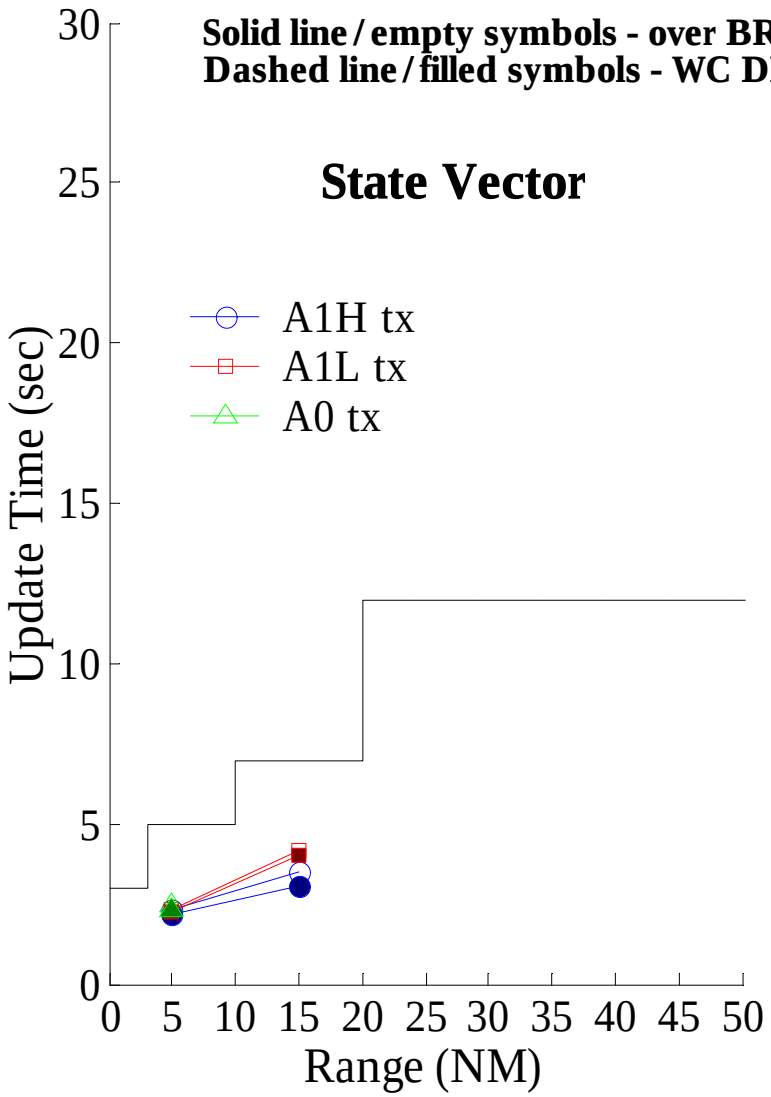


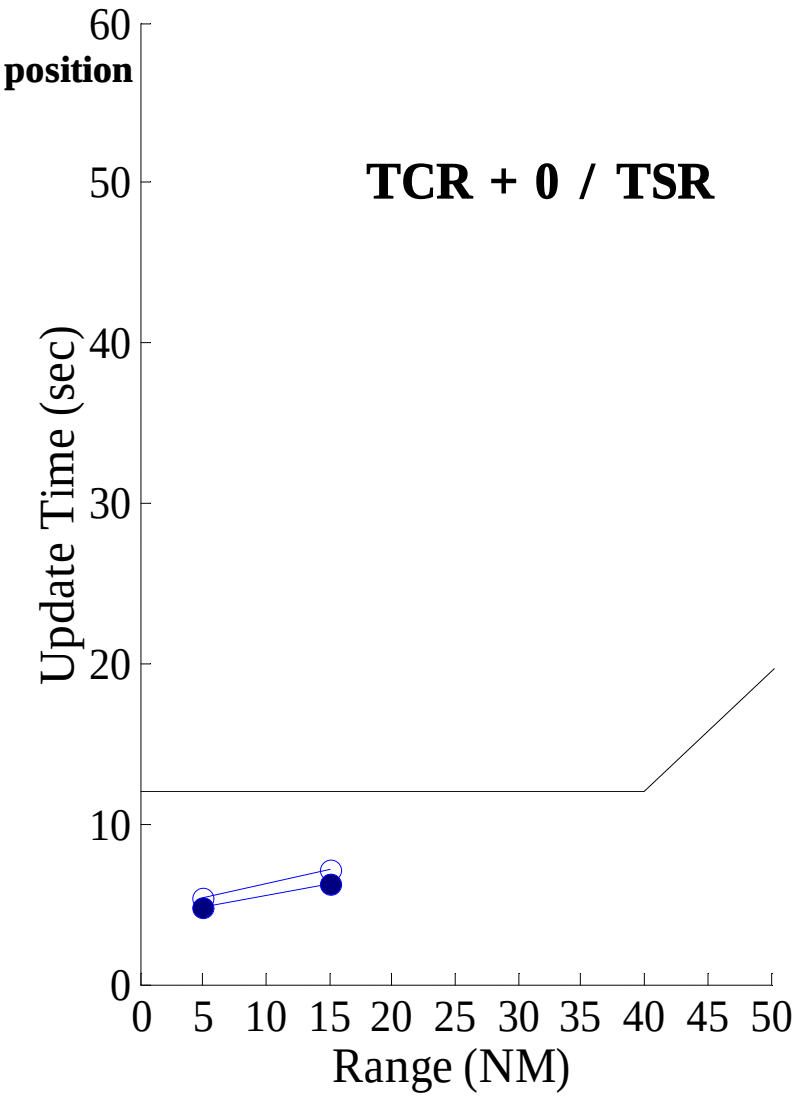
A3 Receiver at FL 150
Receiving A2 Transmitters in 2015



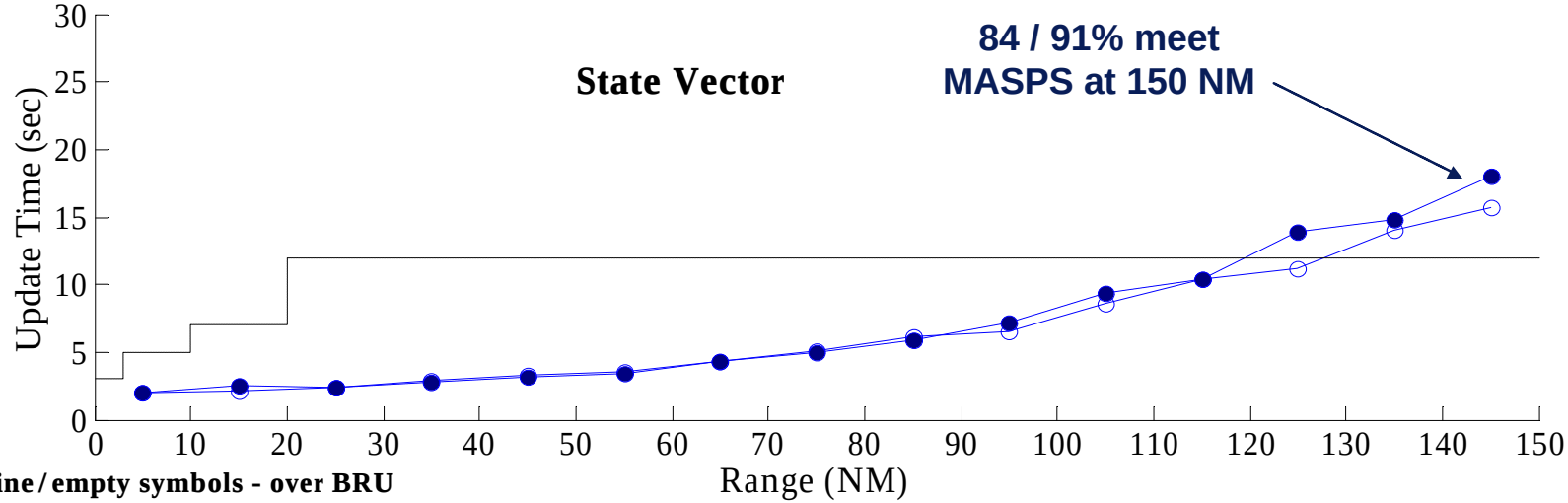


A3 Receiver at FL 150
Receiving A1 and A0 Transmitters in 2015

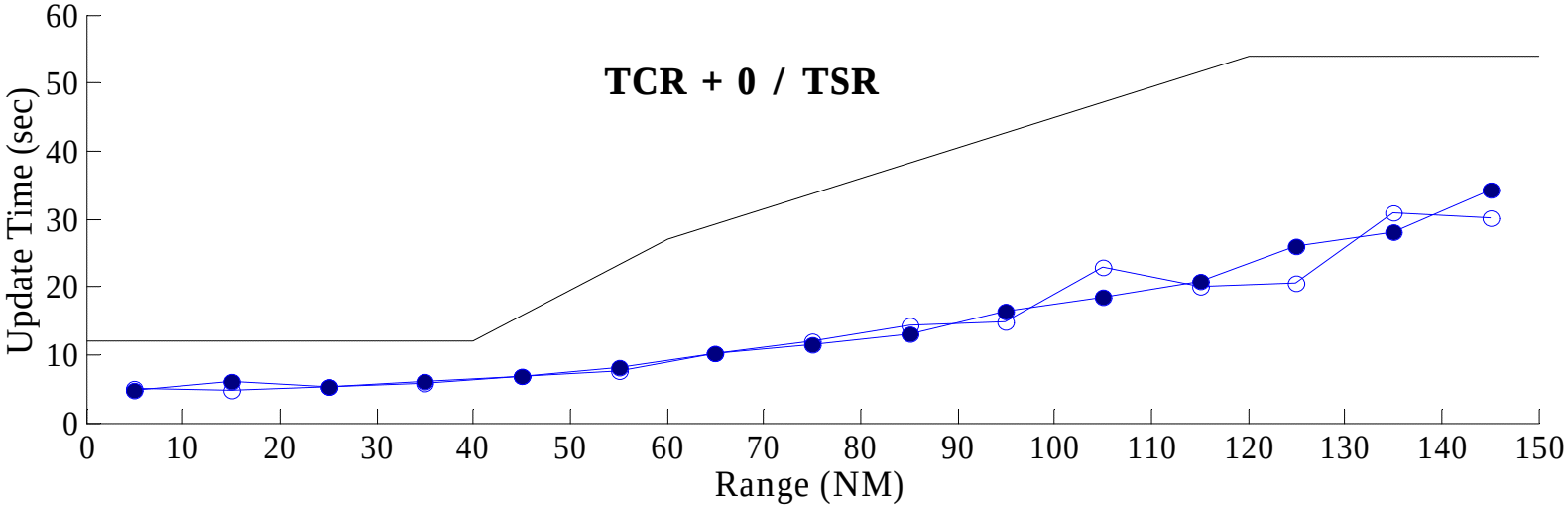




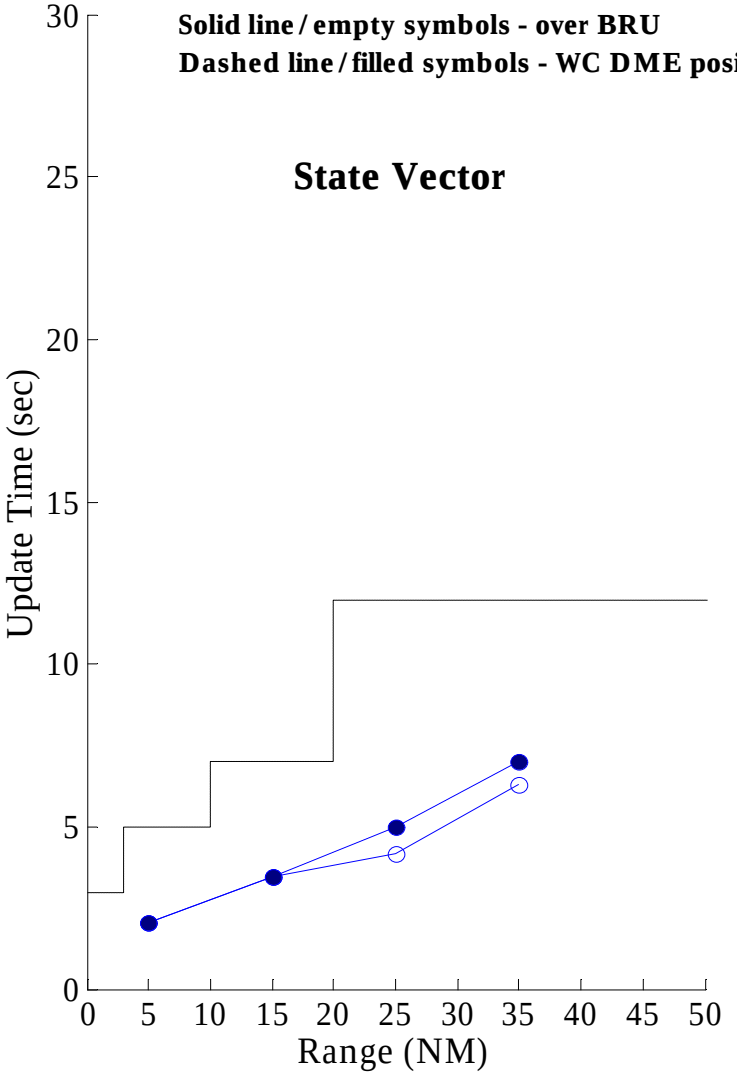
A2 Receiver at High Altitude Receiving A3 Transmitters in 2015

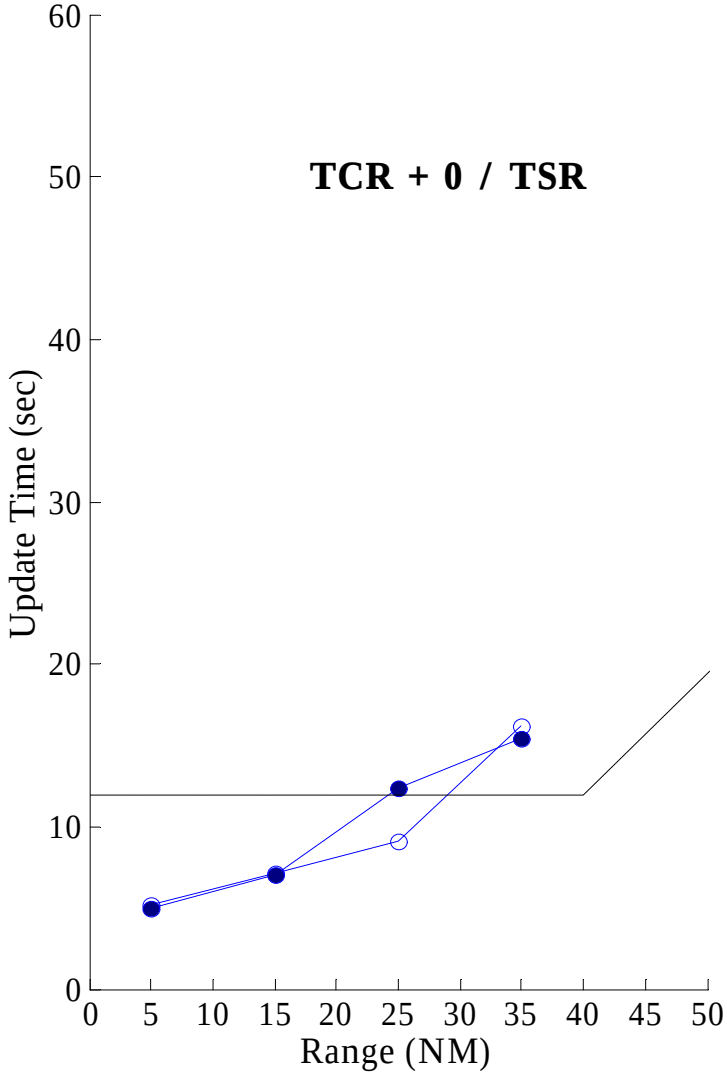


Solid line / empty symbols - over BRU
Dashed line / filled symbols - Worst Case DME position

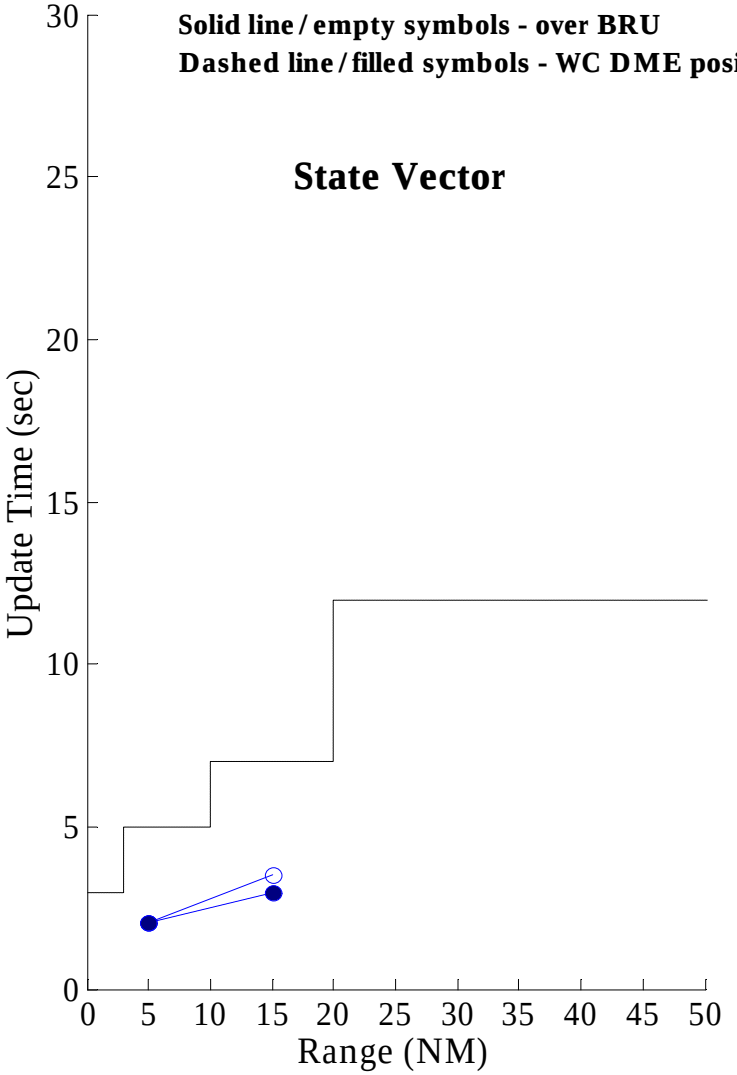


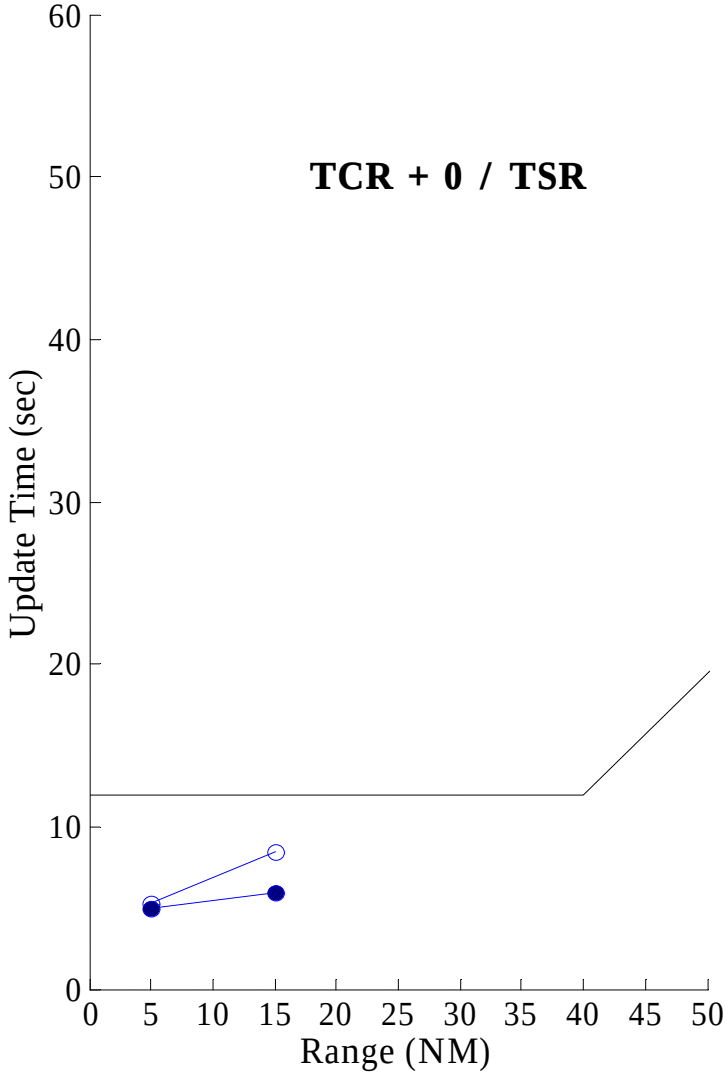
A2 Receiver at High Altitude
Receiving A2 Transmitters in 2015



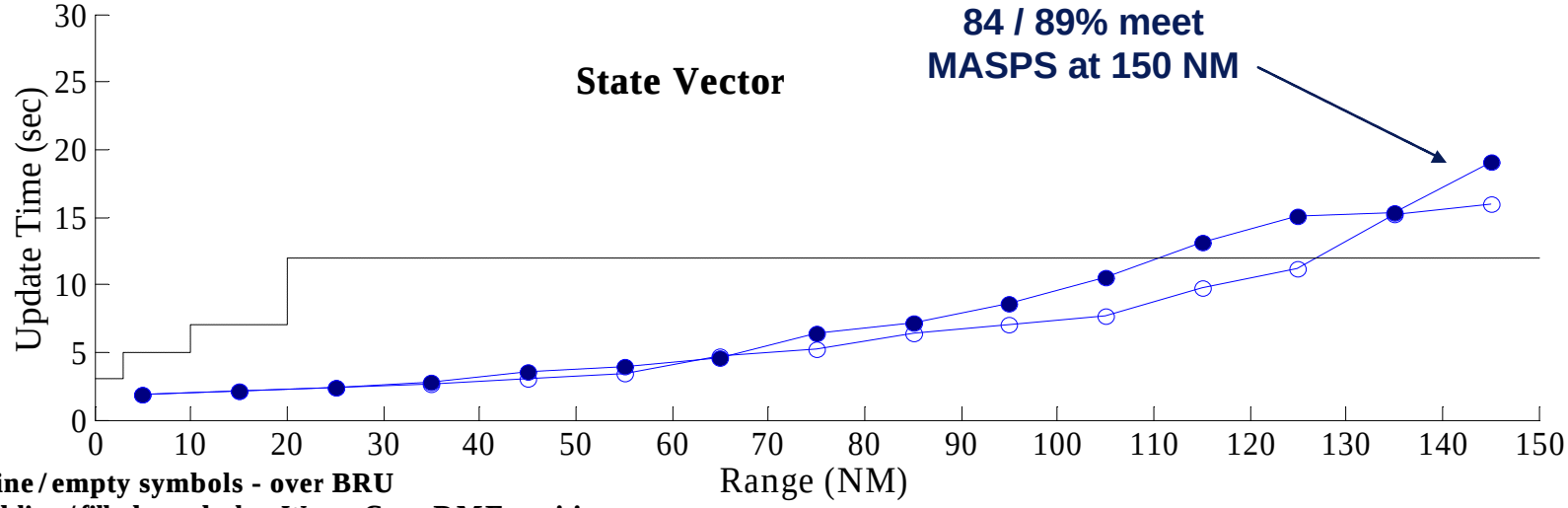


A2 Receiver at High Altitude Receiving A1H Transmitters in 2015

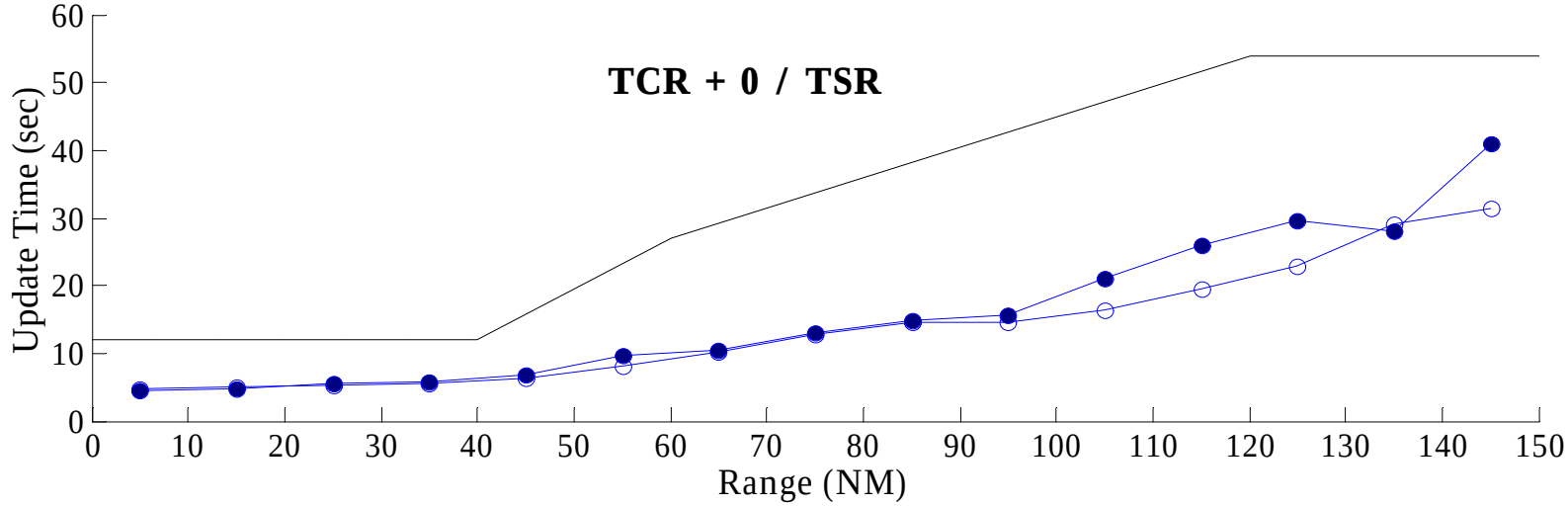




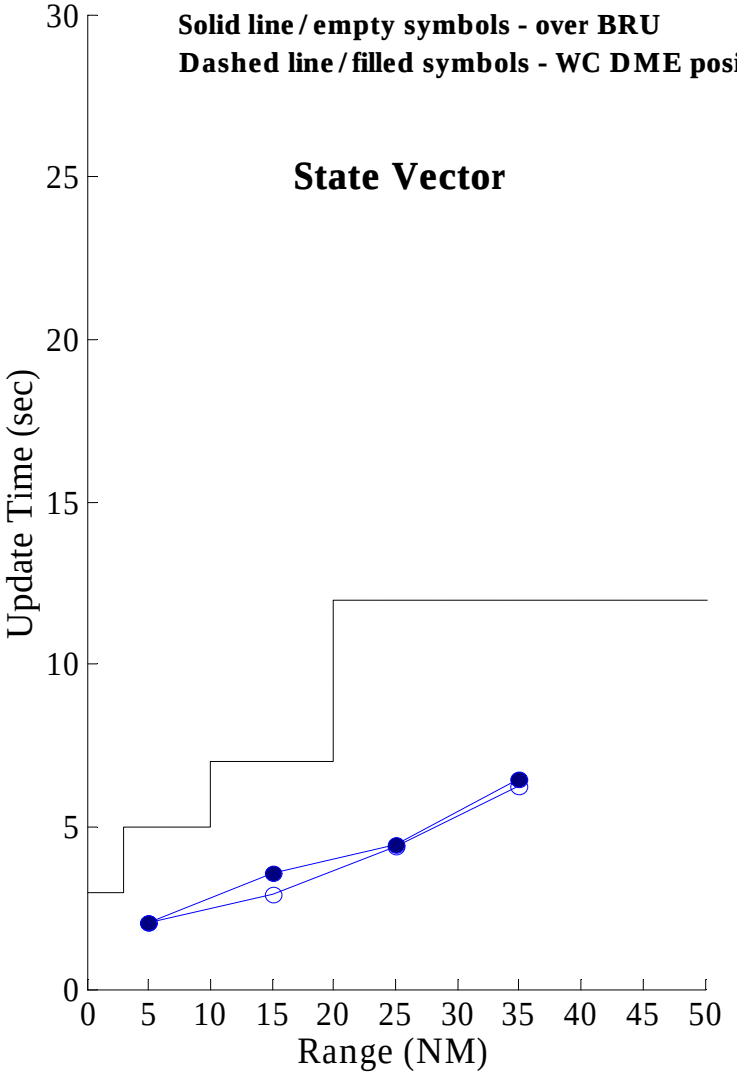
A2 Receiver at FL 150
Receiving A3 Transmitters in 2015

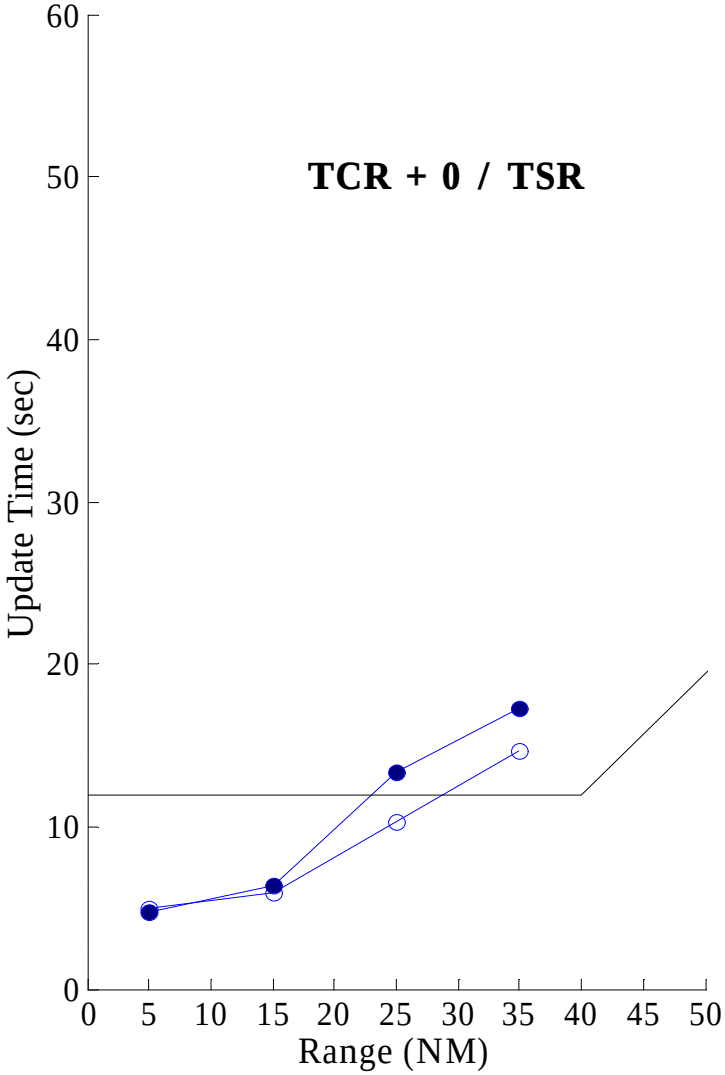


Solid line / empty symbols - over BRU
Dashed line / filled symbols - Worst Case DME position

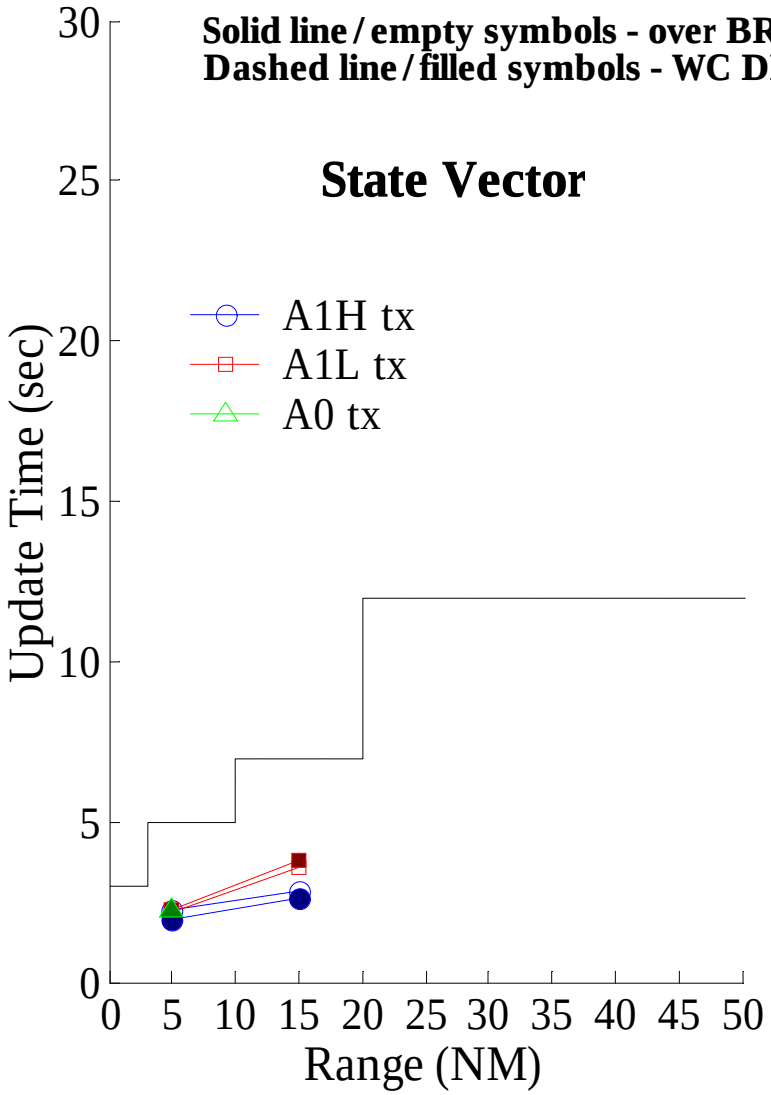


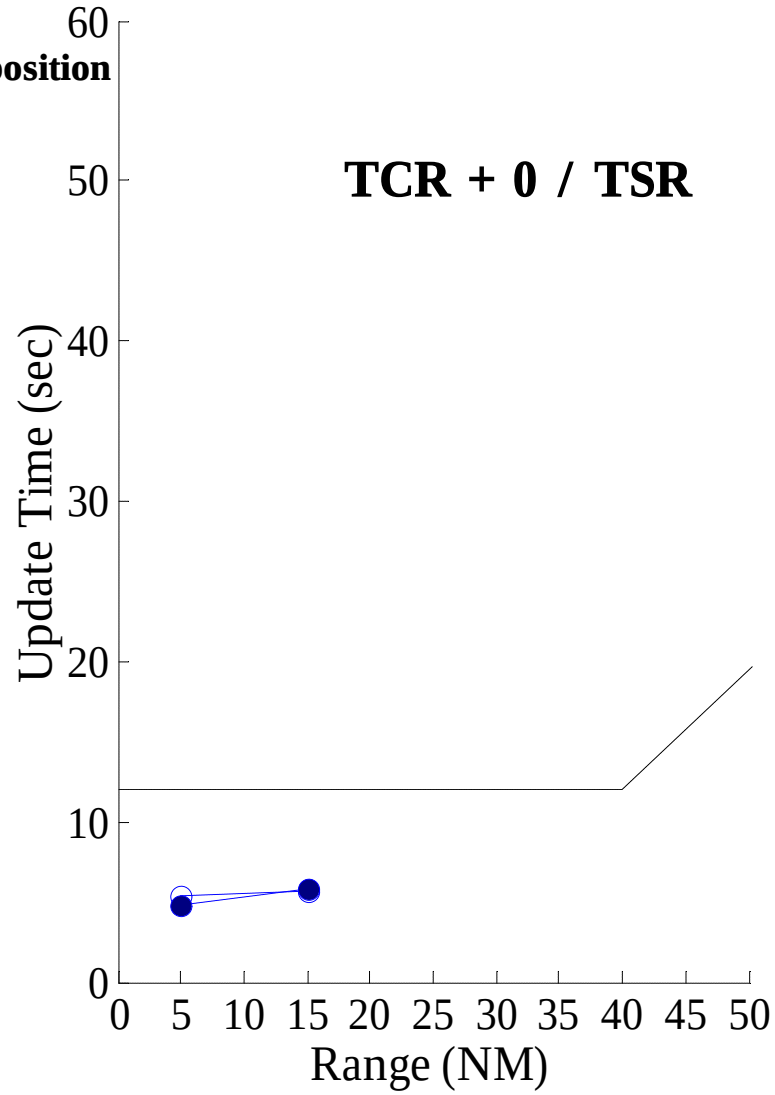
A2 Receiver at FL 150
Receiving A2 Transmitters in 2015



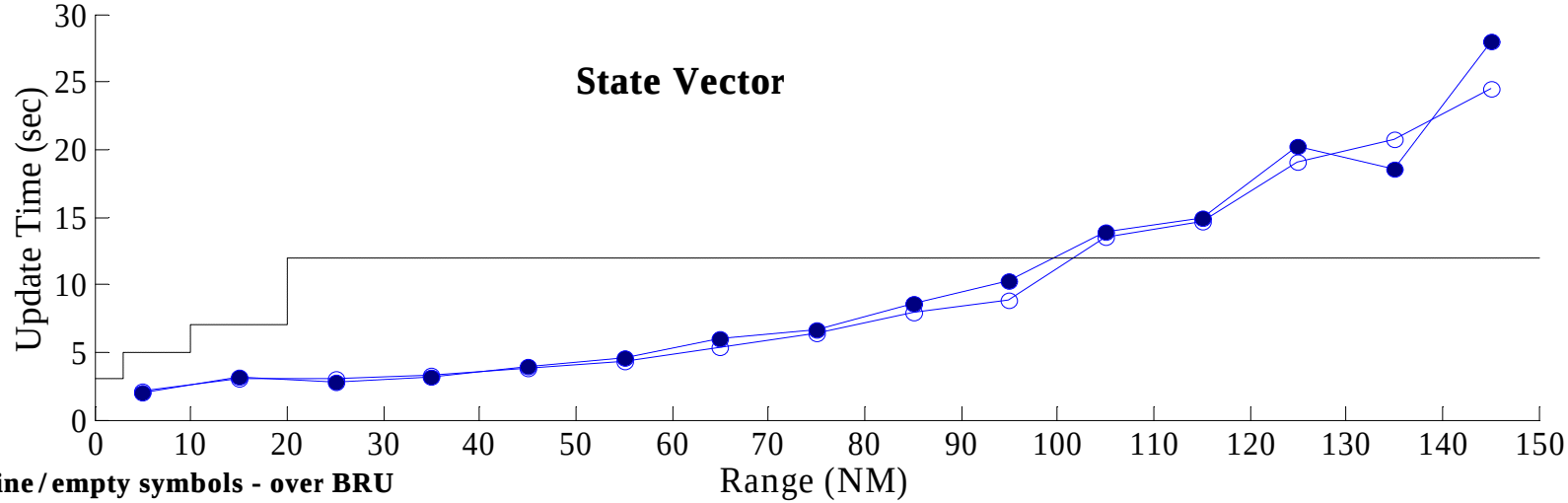


A2 Receiver at FL 150
Receiving A1 and A0 Transmitters in 2015

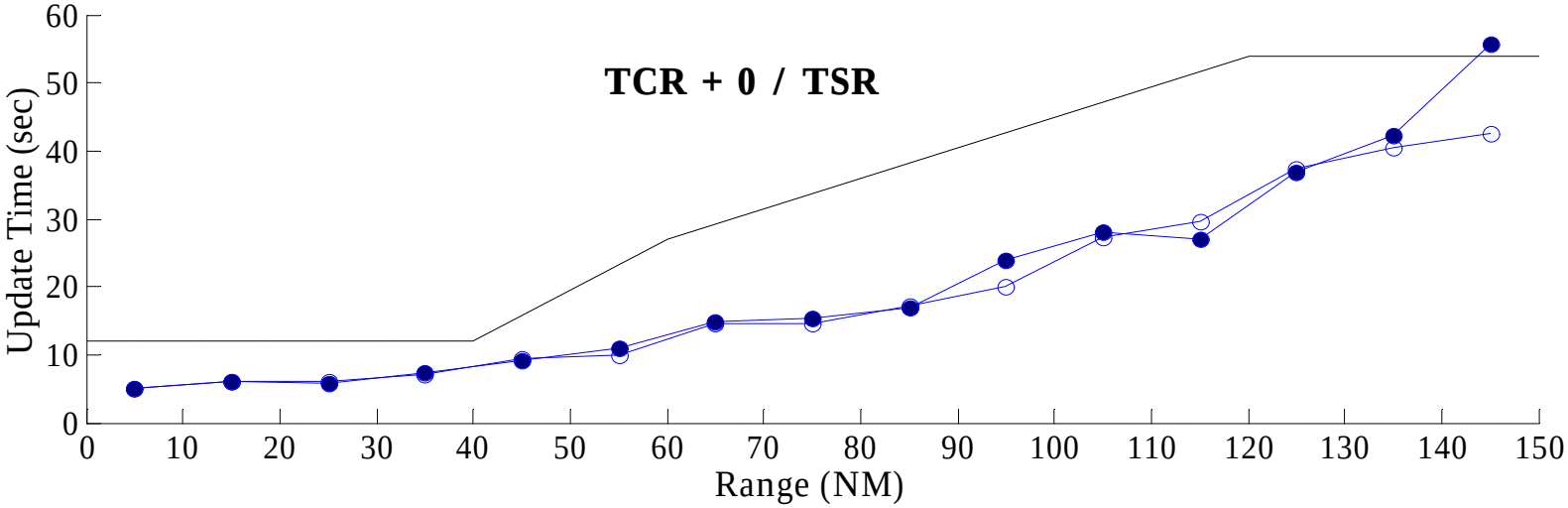




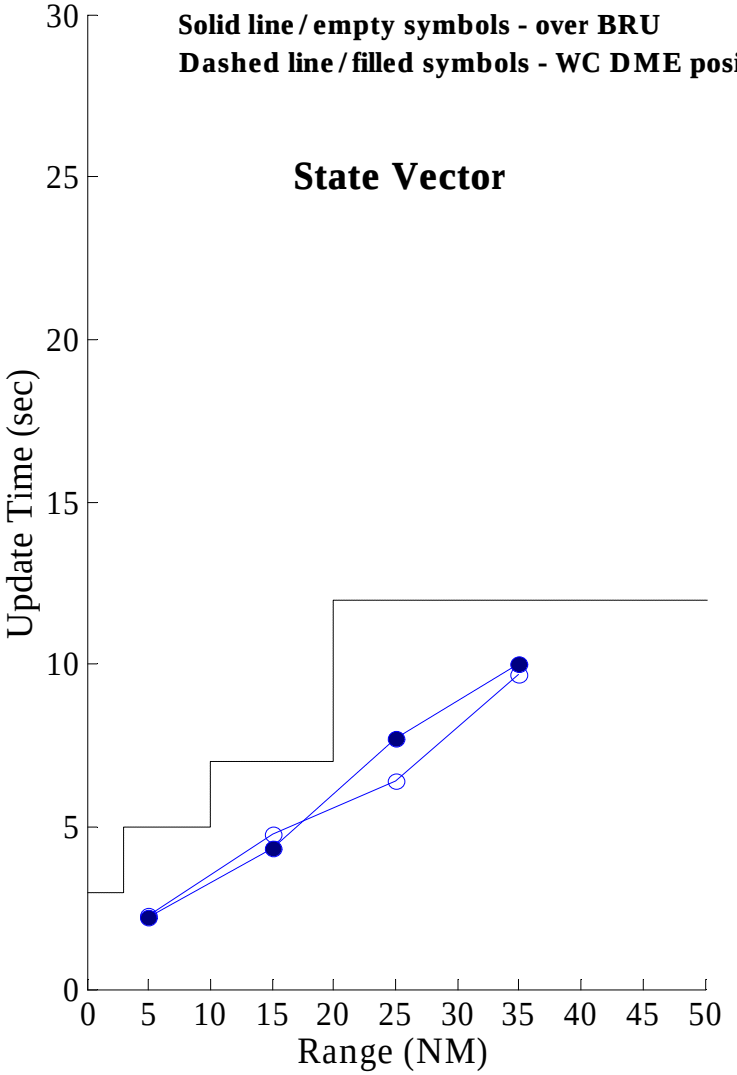
A1H Receiver at High Altitude Receiving A3 Transmitters in 2015

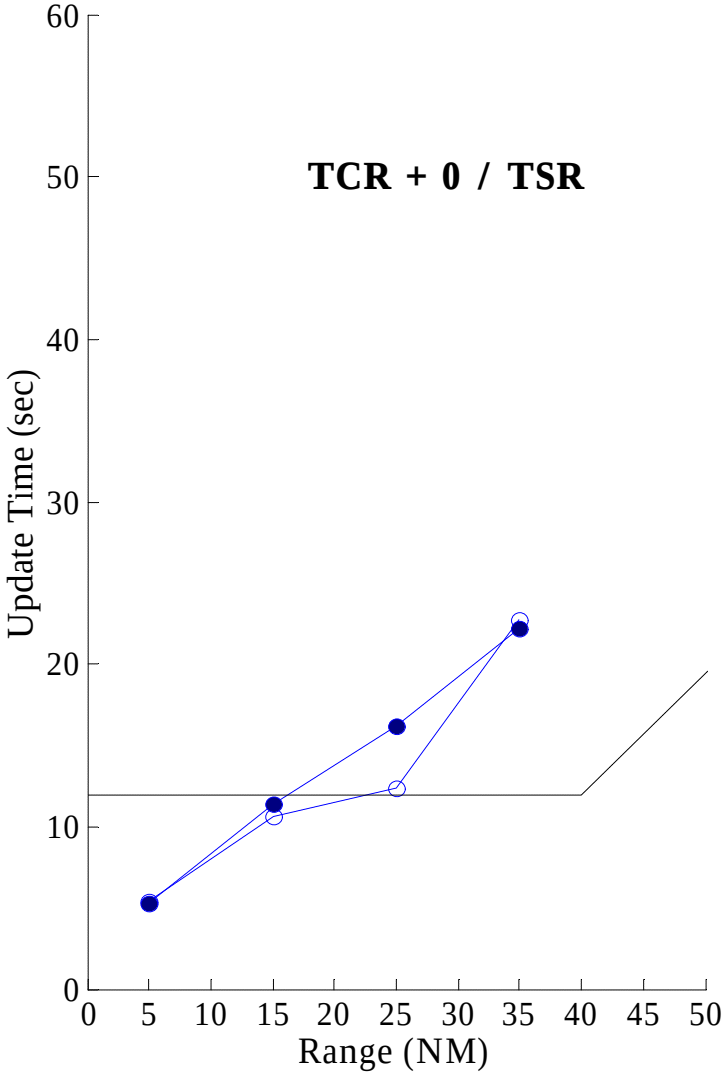


Solid line / empty symbols - over BRU
Dashed line / filled symbols - Worst Case DME position

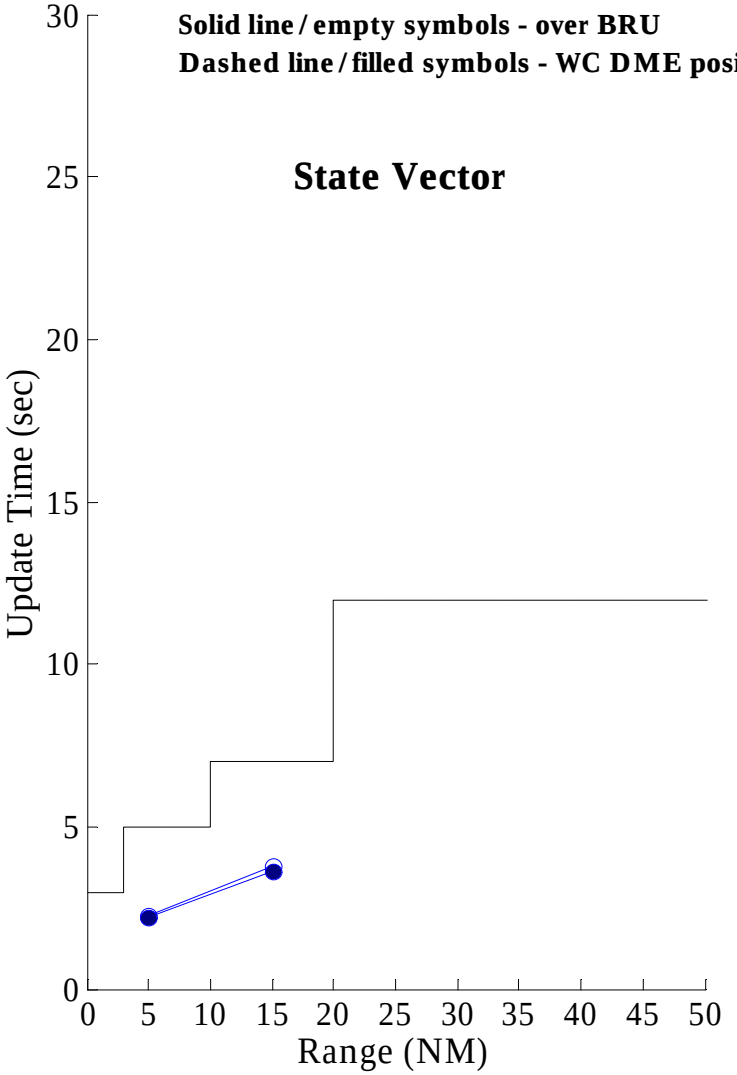


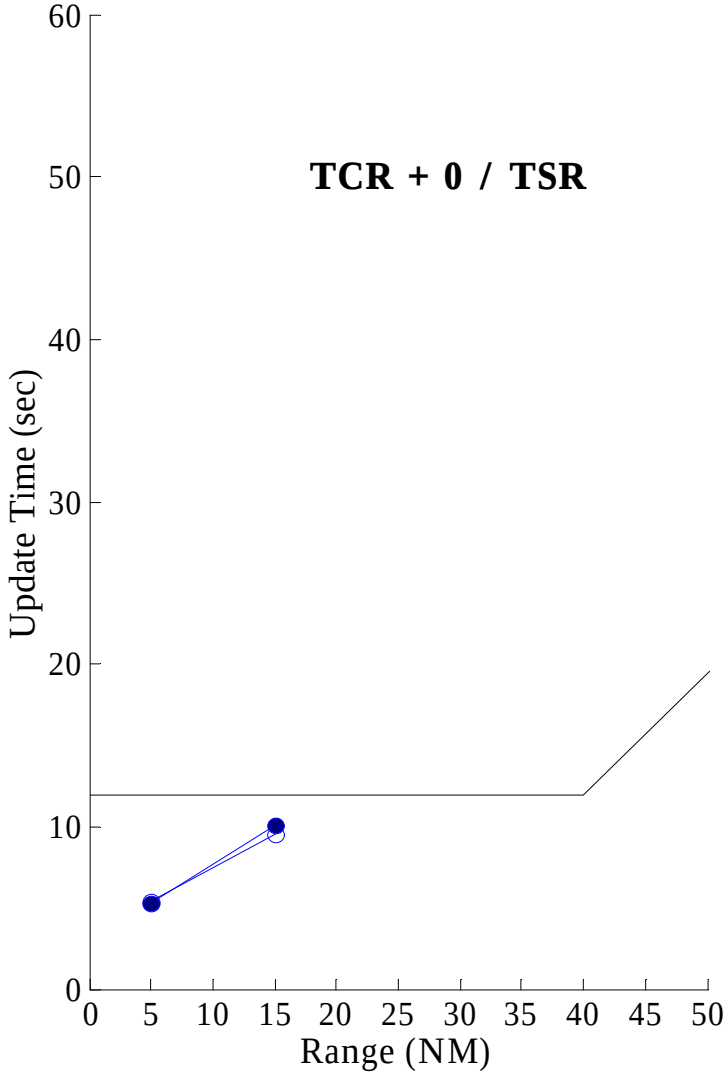
A1H Receiver at High Altitude Receiving A2 Transmitters in 2015



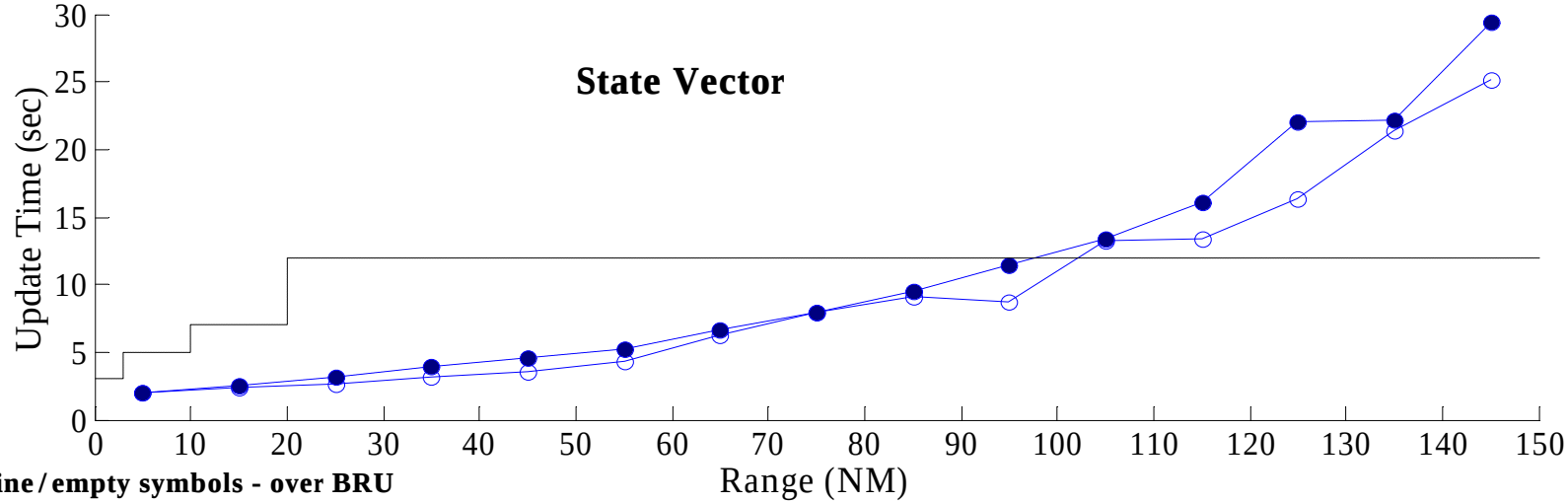


A1H Receiver at High Altitude Receiving A1H Transmitters in 2015

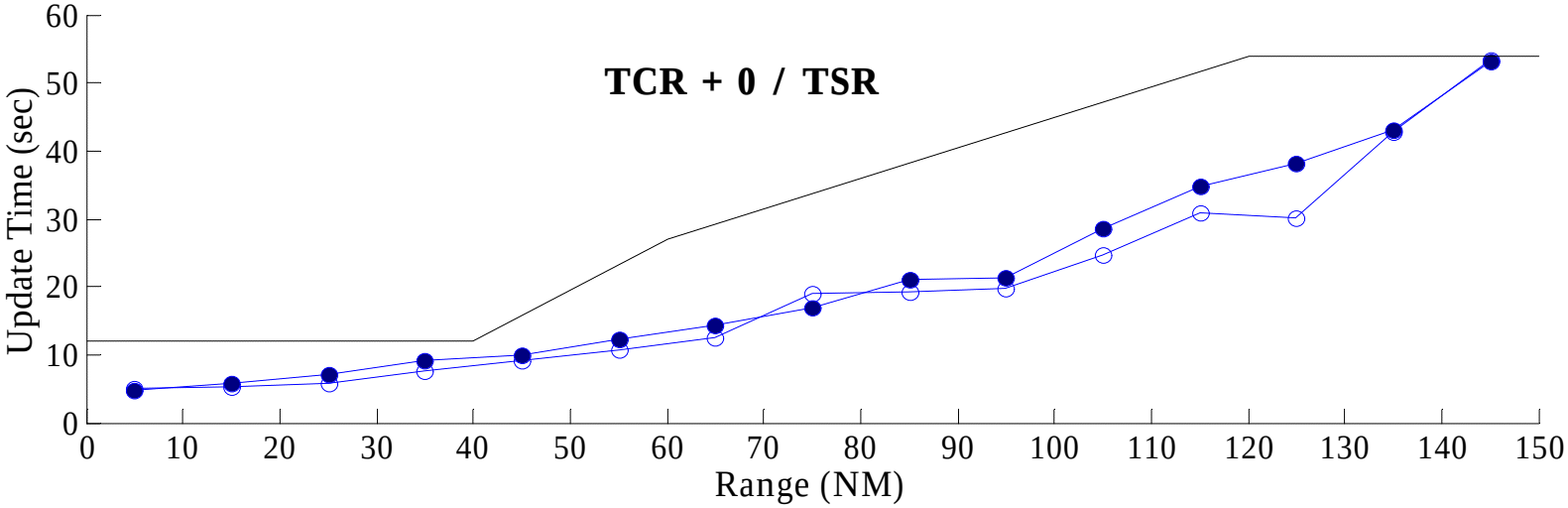




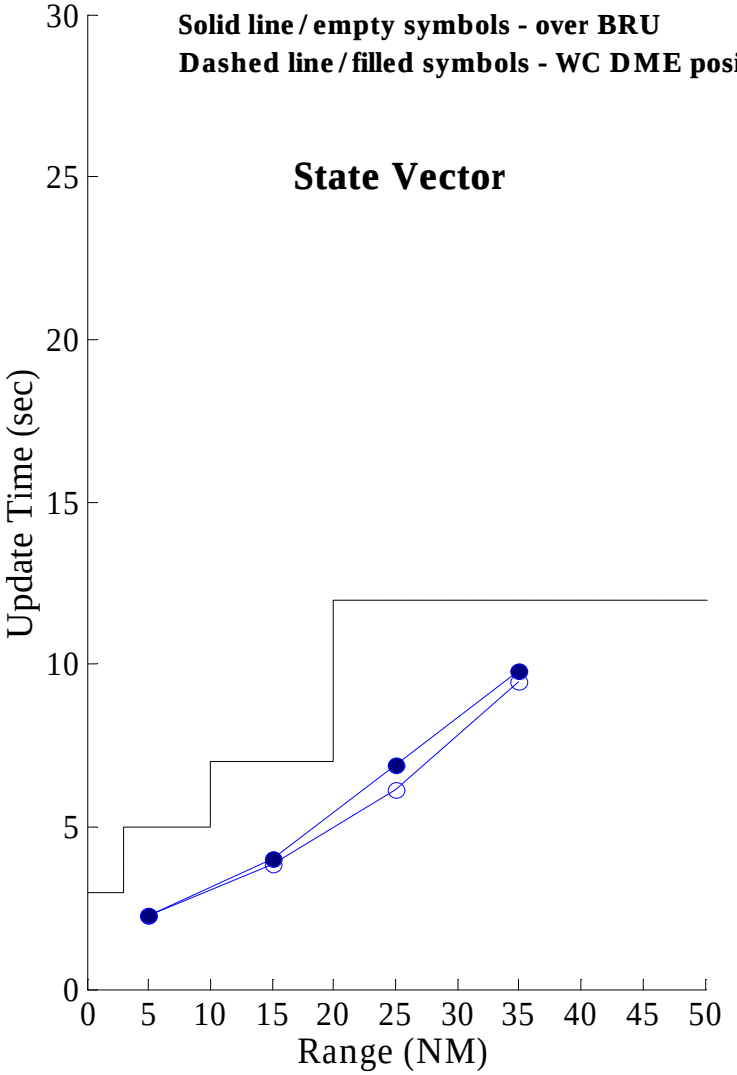
A1 Receiver at FL 150
Receiving A3 Transmitters in 2015

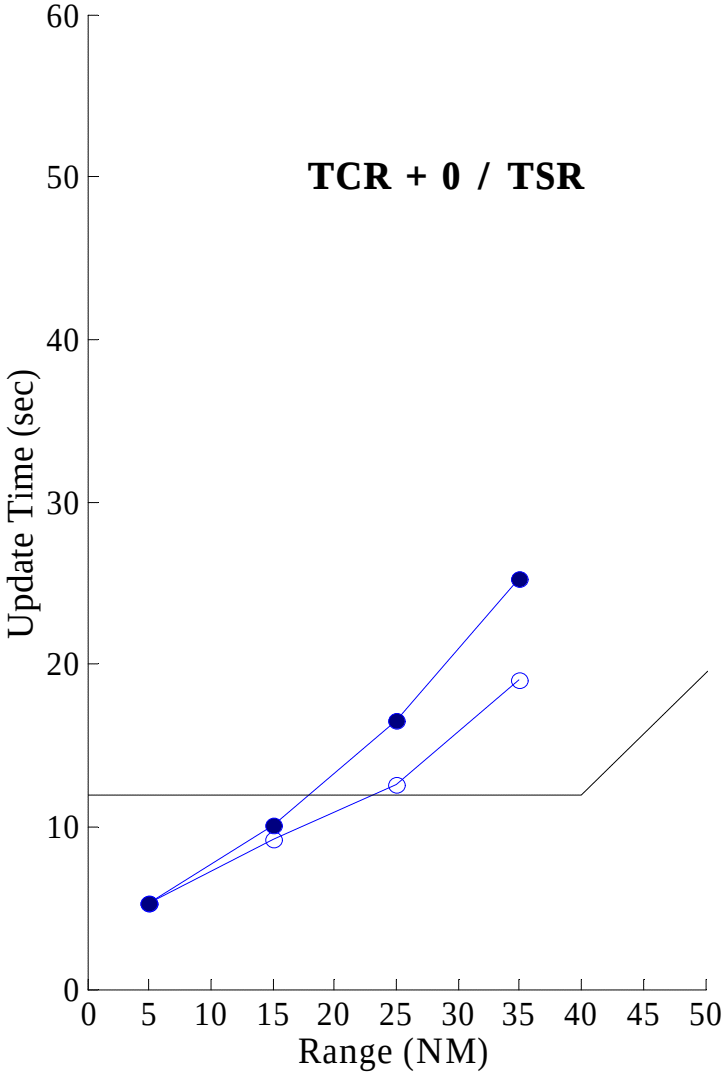


Solid line / empty symbols - over BRU
Dashed line / filled symbols - Worst Case DME position

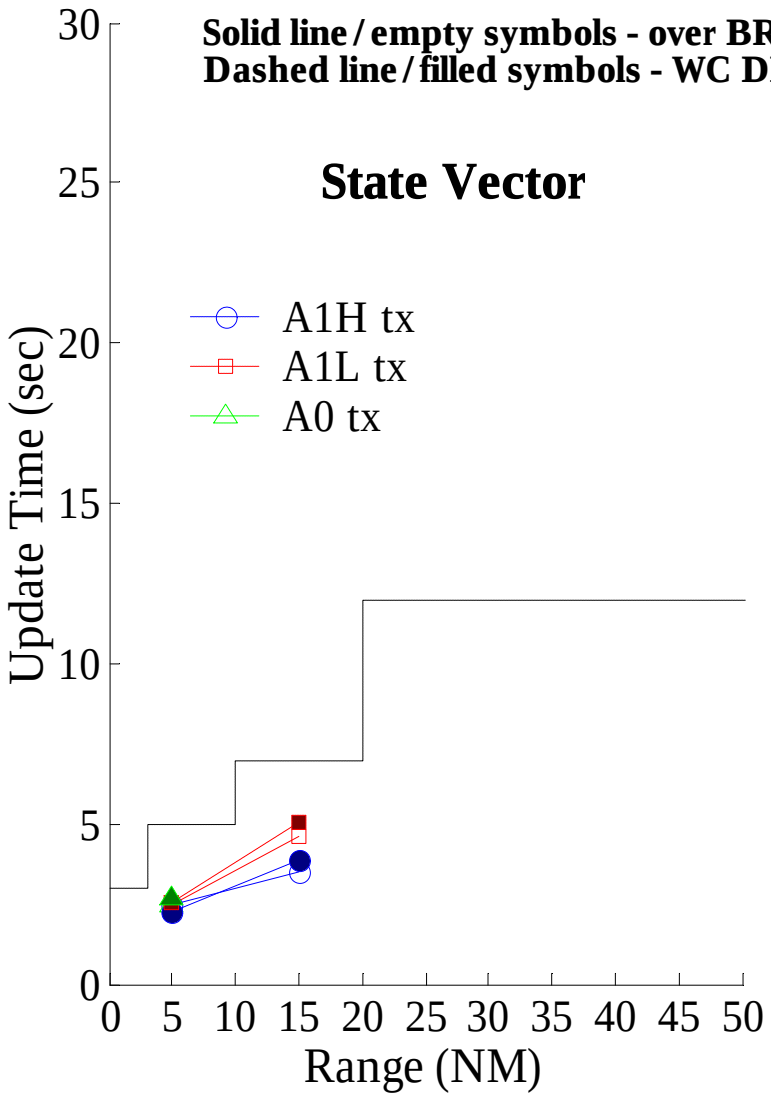


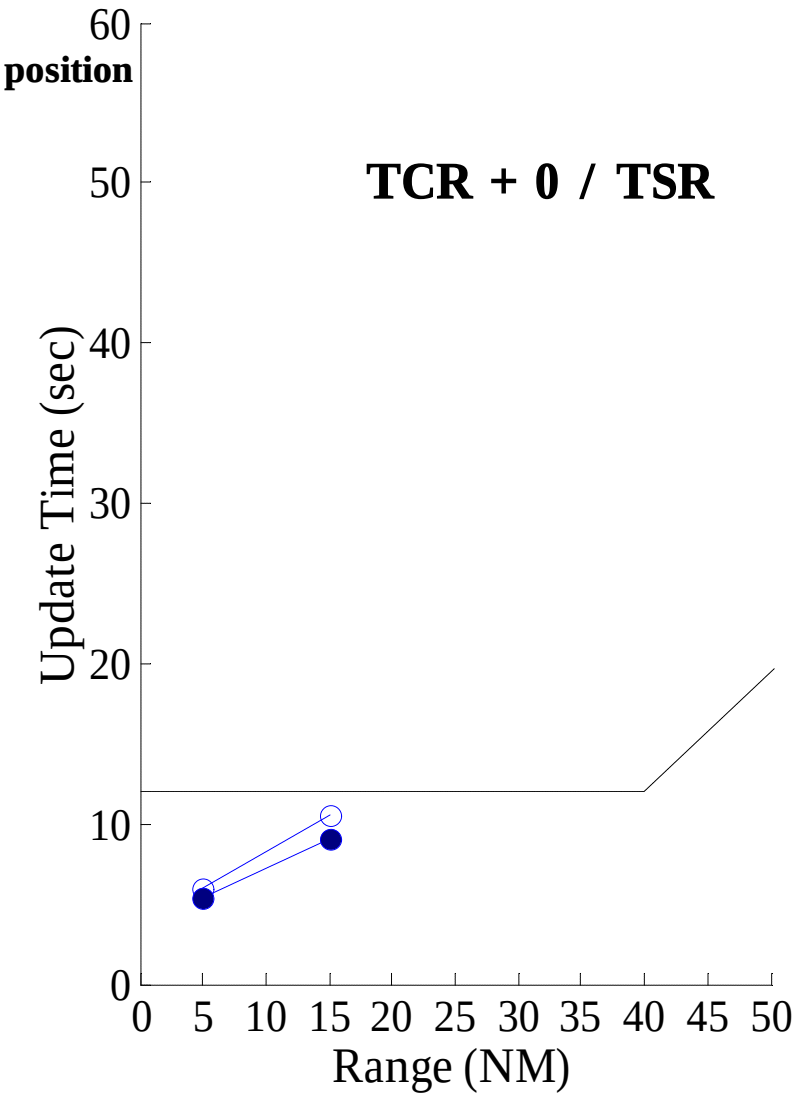
A1 Receiver at FL 150
Receiving A2 Transmitters in 2015



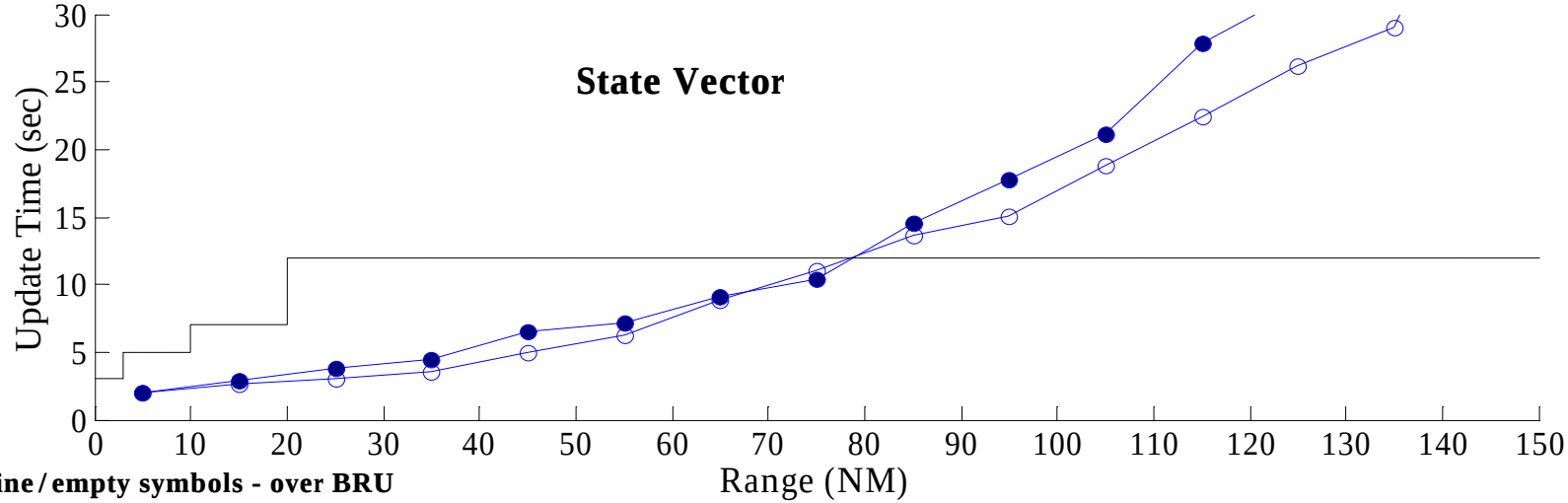


A1 Receiver at FL 150
Receiving A1 and A0 Transmitters in 2015

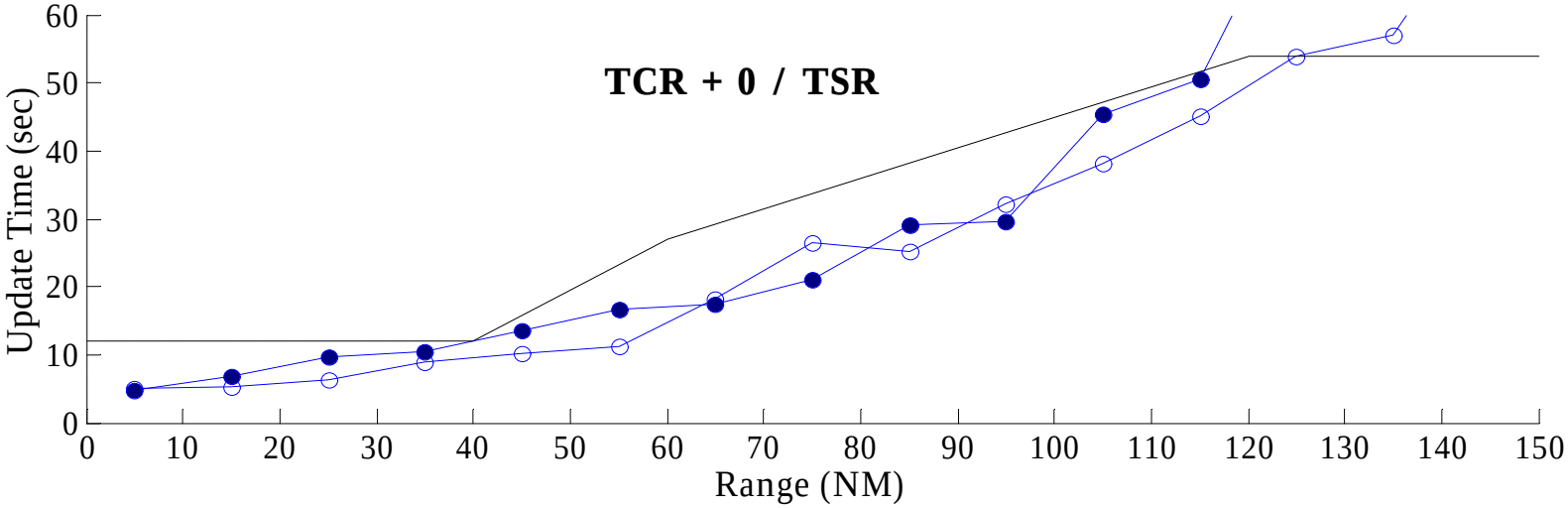




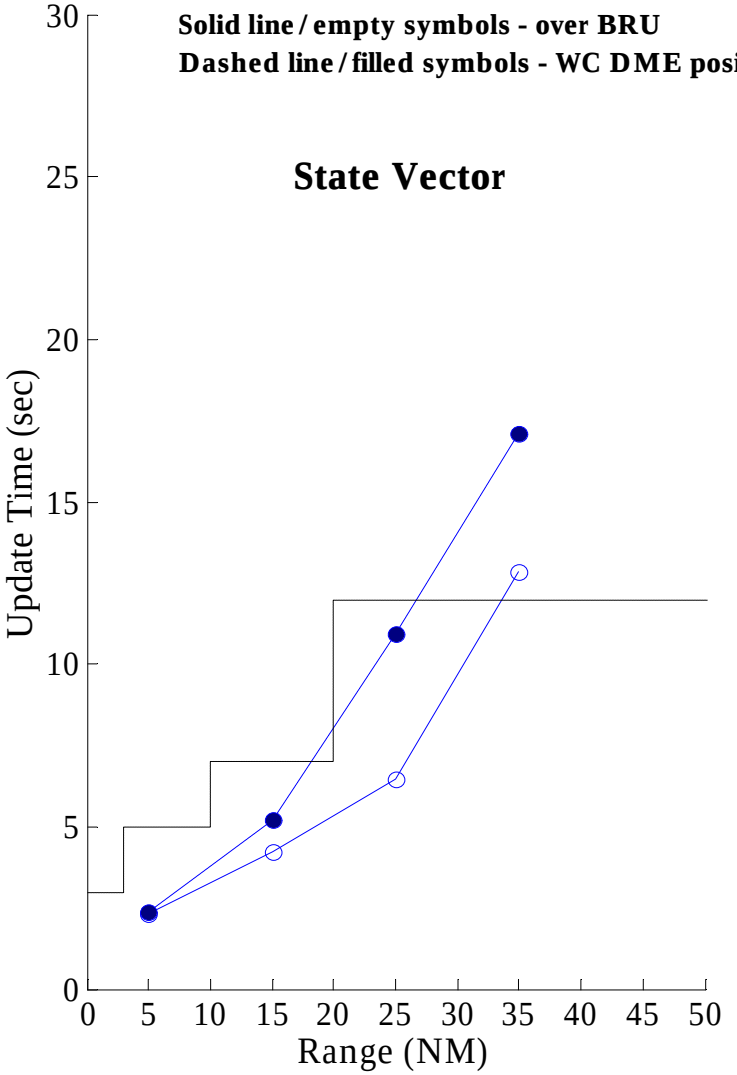
A0 Receiver at FL 150
Receiving A3 Transmitters in 2015

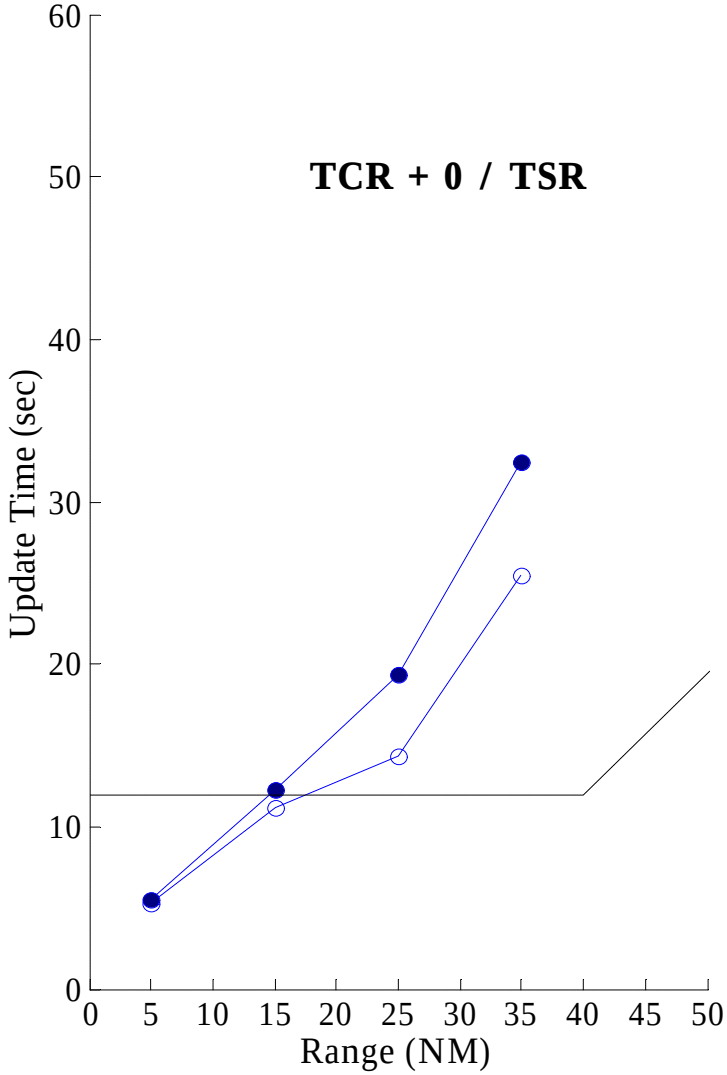


Solid line / empty symbols - over BRU
Dashed line / filled symbols - Worst Case DME position

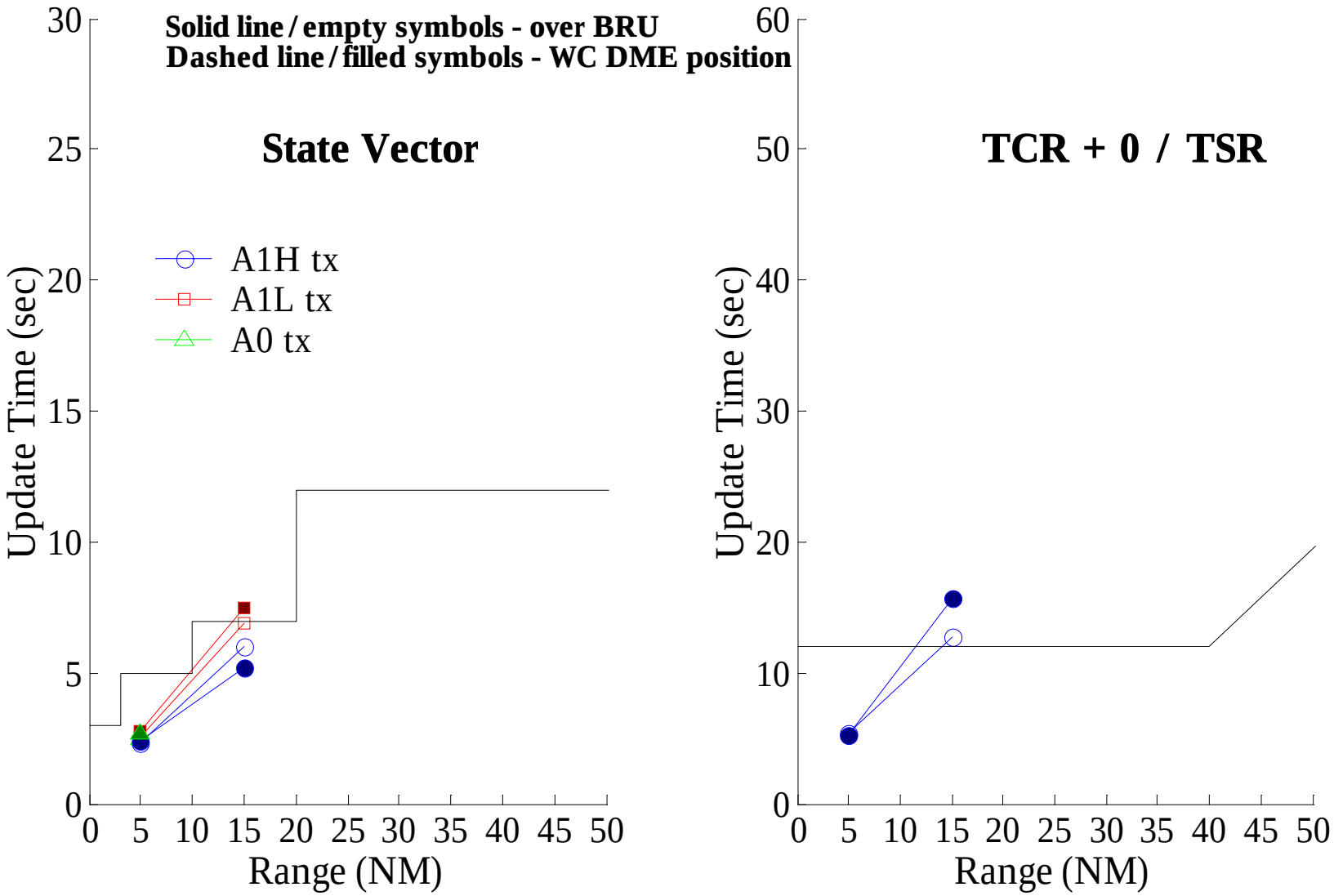


A0 Receiver at FL 150
Receiving A2 Transmitters in 2015





A0 Receiver at FL 150
Receiving A1 and A0 Transmitters in 2015

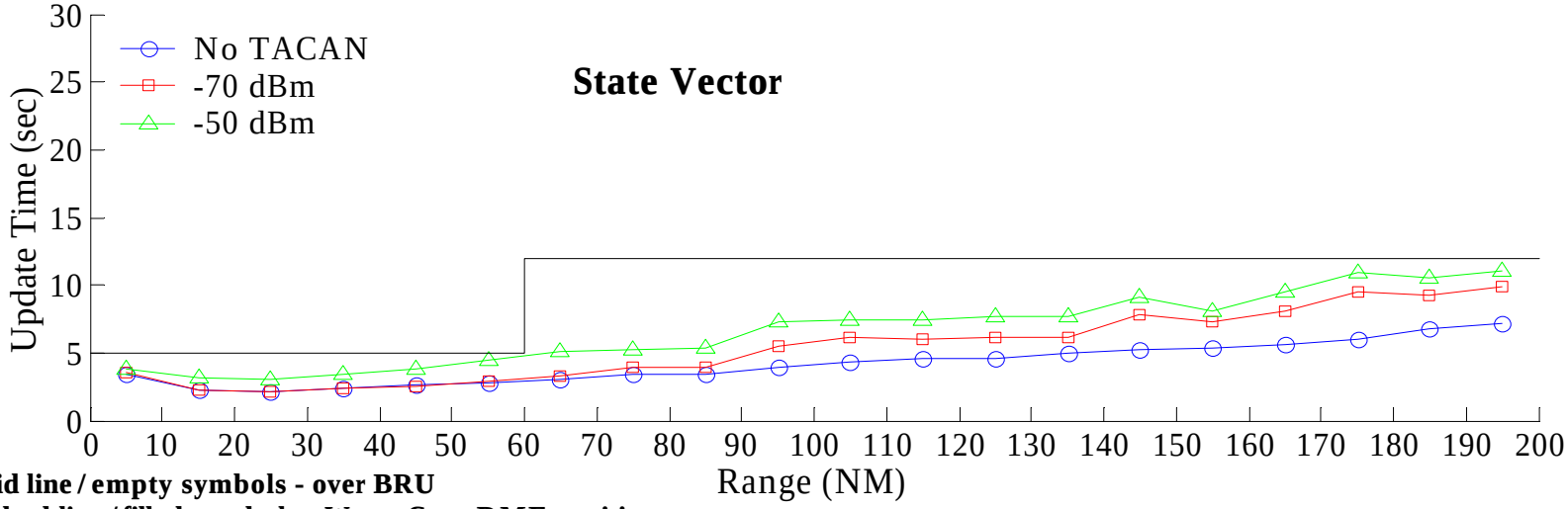


Approx. Distances of Air-Air MASPS Compliance for State Vectors and *TCR+0 / TSR* in 2015

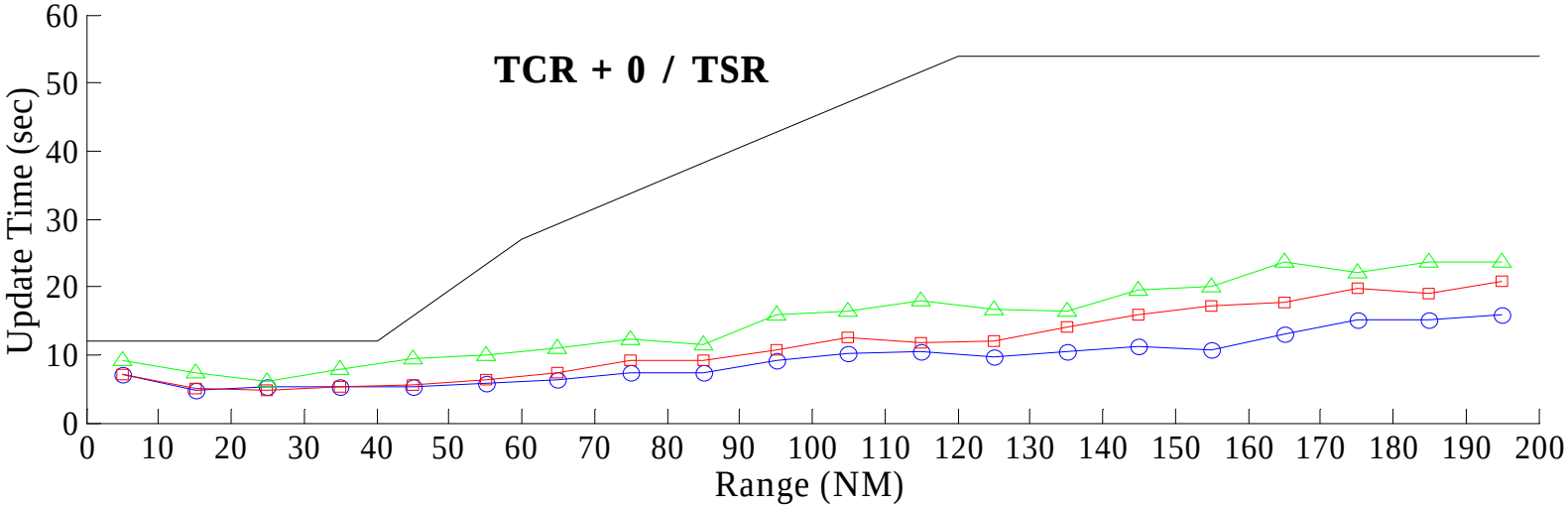
[BRU | WC DME]

	A3 tx	A2 tx	A1H tx	A1L tx	A0 tx
A3 High rx	120 | 125 *150 | 150*	40 | 40 *30 | 20*	20 | 20 *20 | 20*	-	-
A2 High rx	125 | 120 *150 | 150*	40 | 40 *30 | 25*	20 | 20 *20 | 20*	-	-
A1H High rx	100 | 100 *150 | 140*	40 | 40 *20 | 15*	20 | 20 *20 | 20*	-	-
A3 @ FL150 rx	125 | 125 *150 | 150*	40 | 40 *25 | 25*	20 | 20 *20 | 20*	20 | 20 *-*	10 | 10 *-*
A2 @ FL150 rx	130 | 110 *150 | 150*	40 | 40 *30 | 25*	20 | 20 *20 | 20*	20 | 20 *-*	10 | 10 *-*
A1 @ FL150 rx	100 | 95 *150 | 150*	40 | 40 *25 | 20*	20 | 20 *20 | 20*	20 | 20 *-*	10 | 10 *-*
A0 @ FL150 rx	80 | 80 *120 | 110*	30 | 25 *15 | 15*	20 | 20 *15 | 10*	10 | 10 *-*	10 | 10 *-*

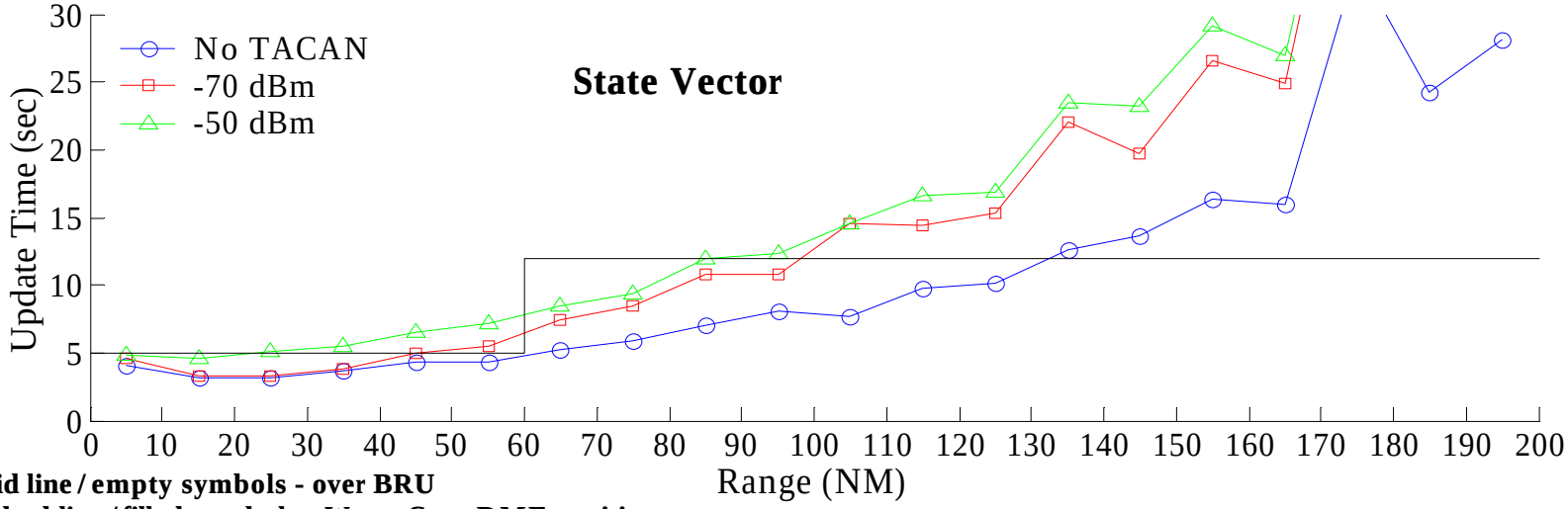
Ground Receiver Receiving A3 Tx for Various TACAN Power Levels



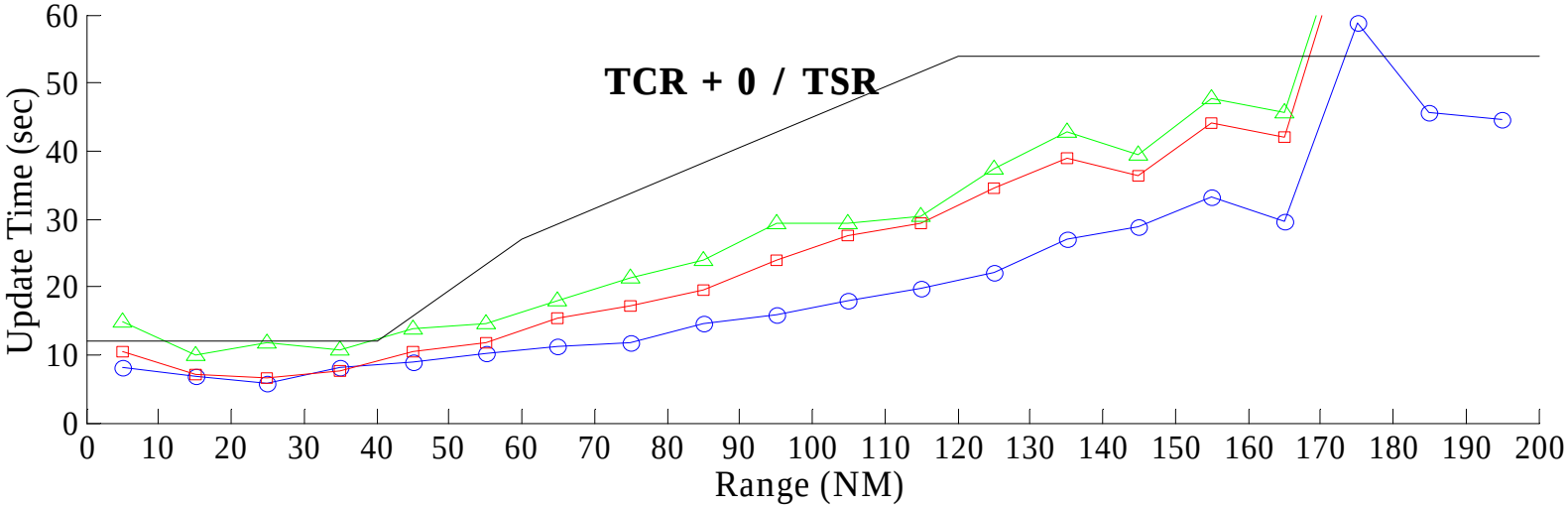
Solid line / empty symbols - over BRU
Dashed line / filled symbols - Worst Case DME position



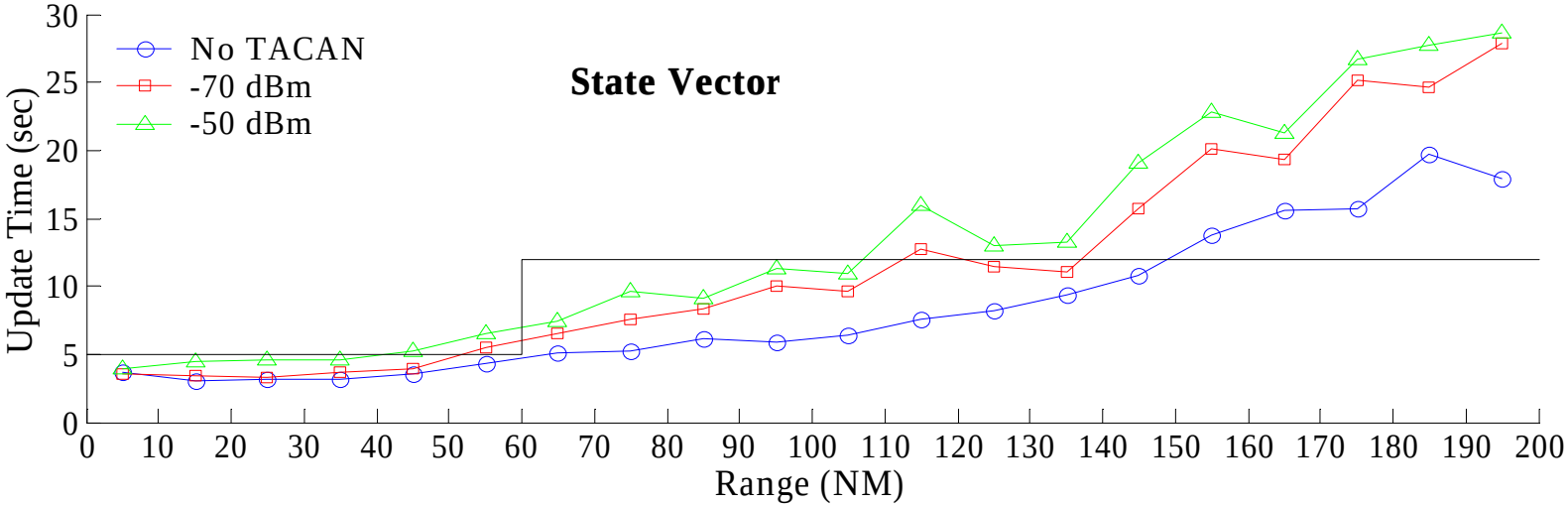
Ground Receiver Receiving A2 Tx for Various TACAN Power Levels

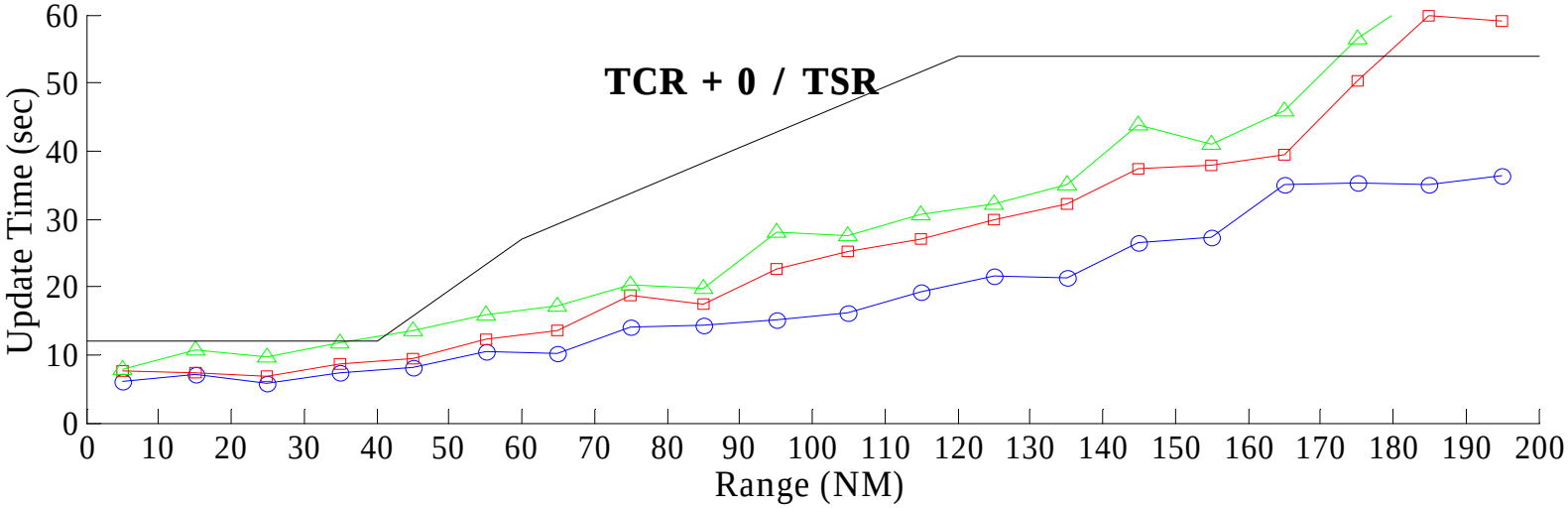


Solid line / empty symbols - over BRU
Dashed line / filled symbols - Worst Case DME position

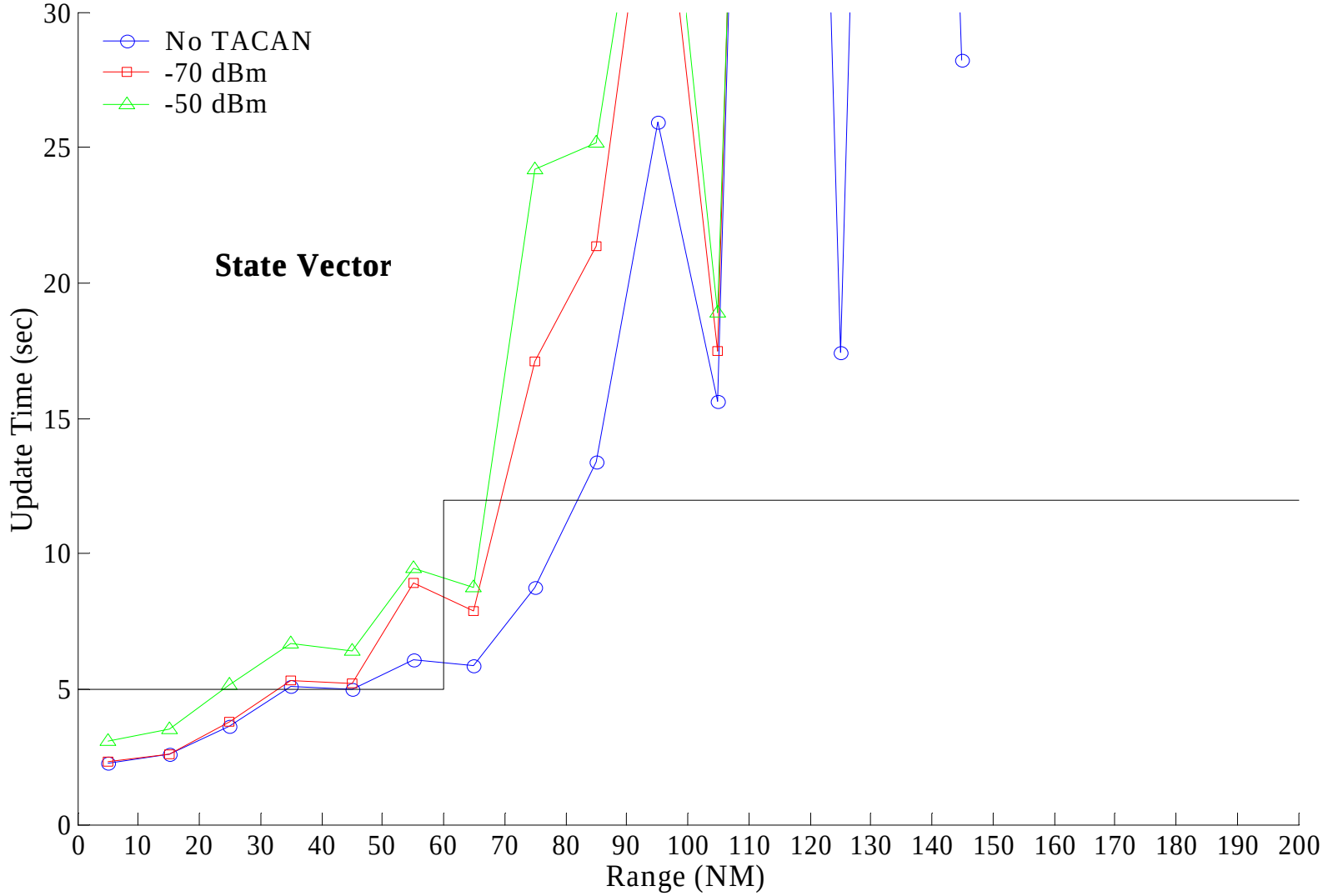


Ground Receiver Receiving A1H Tx for Various TACAN Power Levels

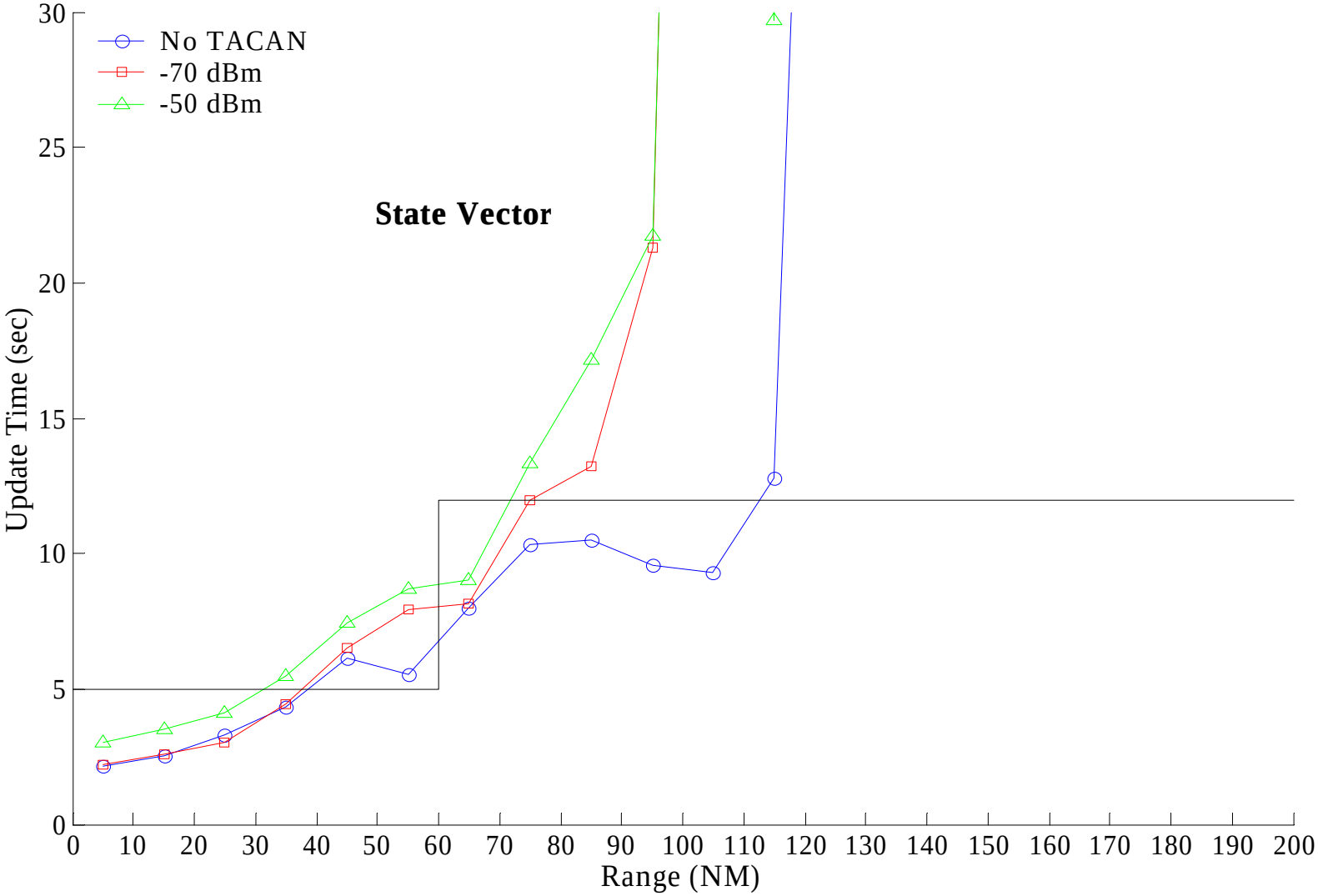




Ground Receiver Receiving A1L Tx for Various TACAN Power Levels



Ground Receiver Receiving A0 Tx for Various TACAN Power Levels



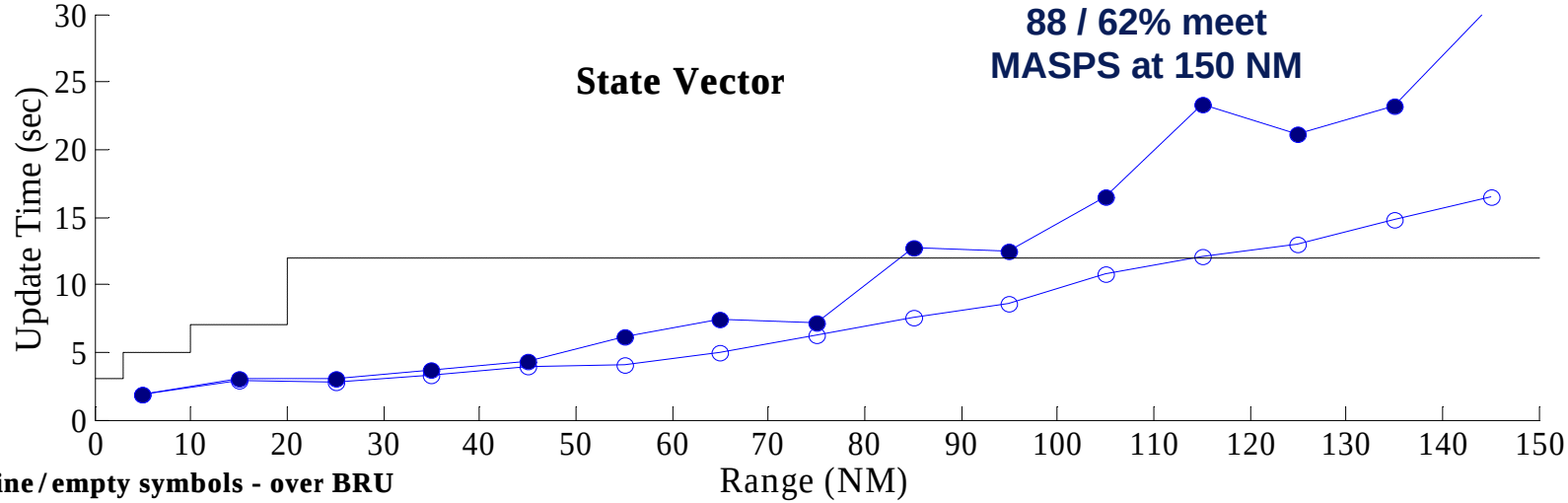
Ground Vehicle Transmissions to A/C on Approach

- Various aircraft on approach at 2000 feet
- Update times are 95th percentile at 0-10 NM range bin

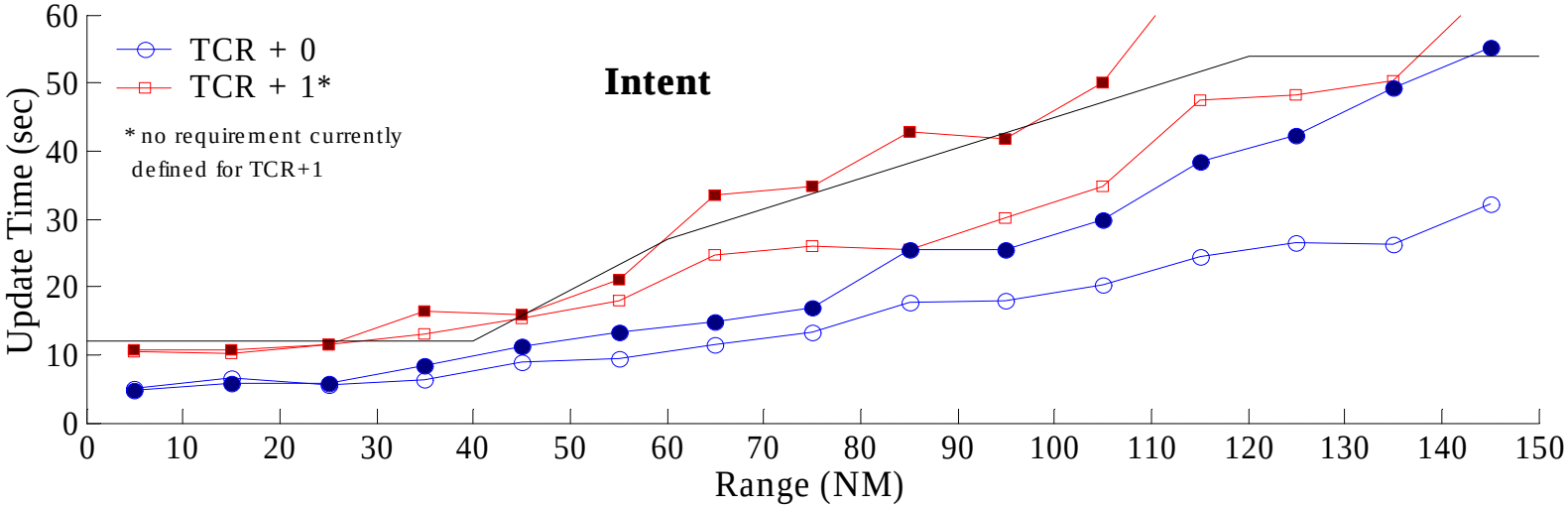
Receiver	Update (sec)
A3	3.8
A2	3.8
A1	9.6
A0	3.8

Current Europe

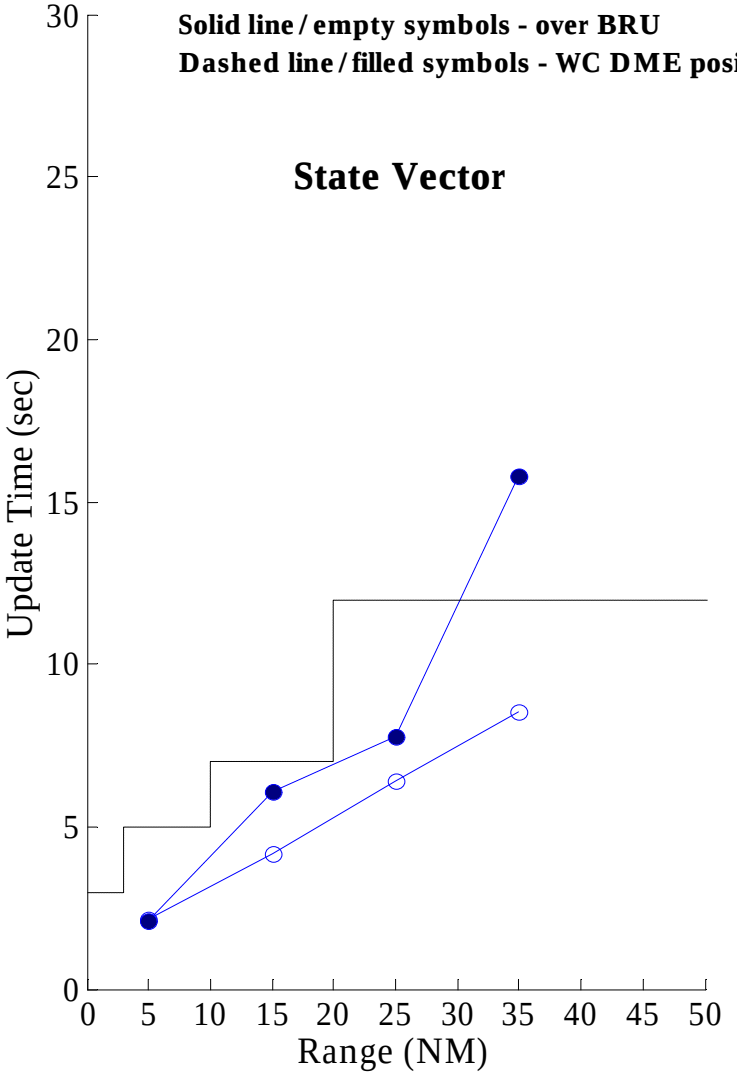
A3 Receiver at High Altitude
Receiving A3 Transmitters in Current Europe

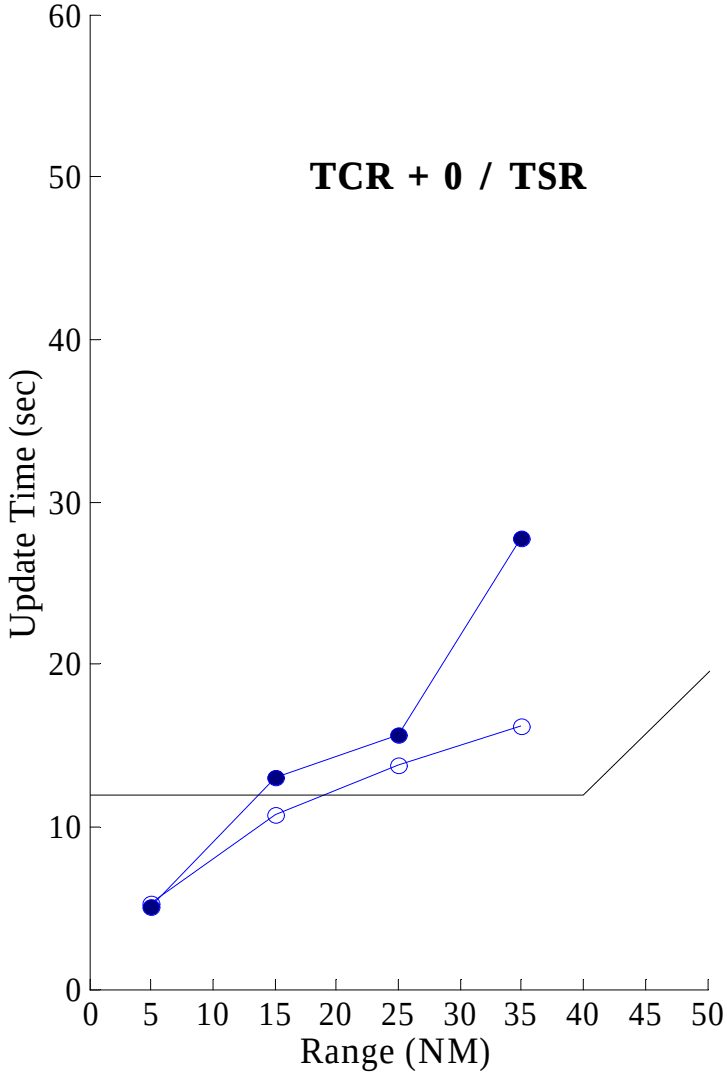


Solid line / empty symbols - over BRU
Dashed line / filled symbols - Worst Case DME position

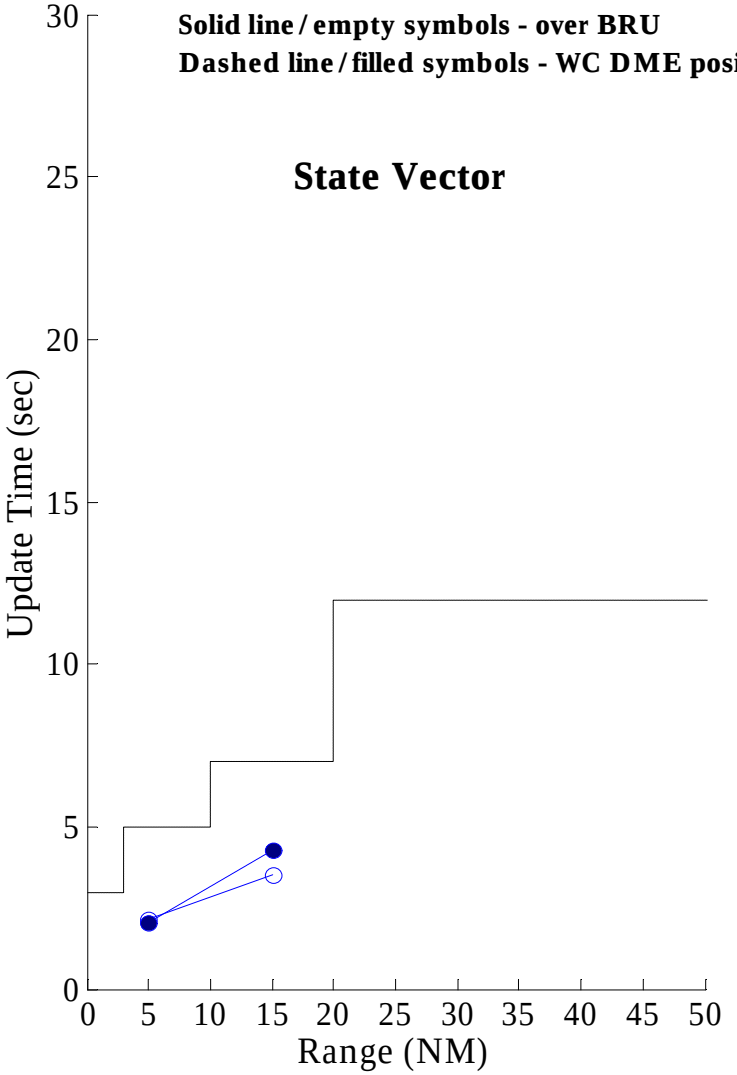


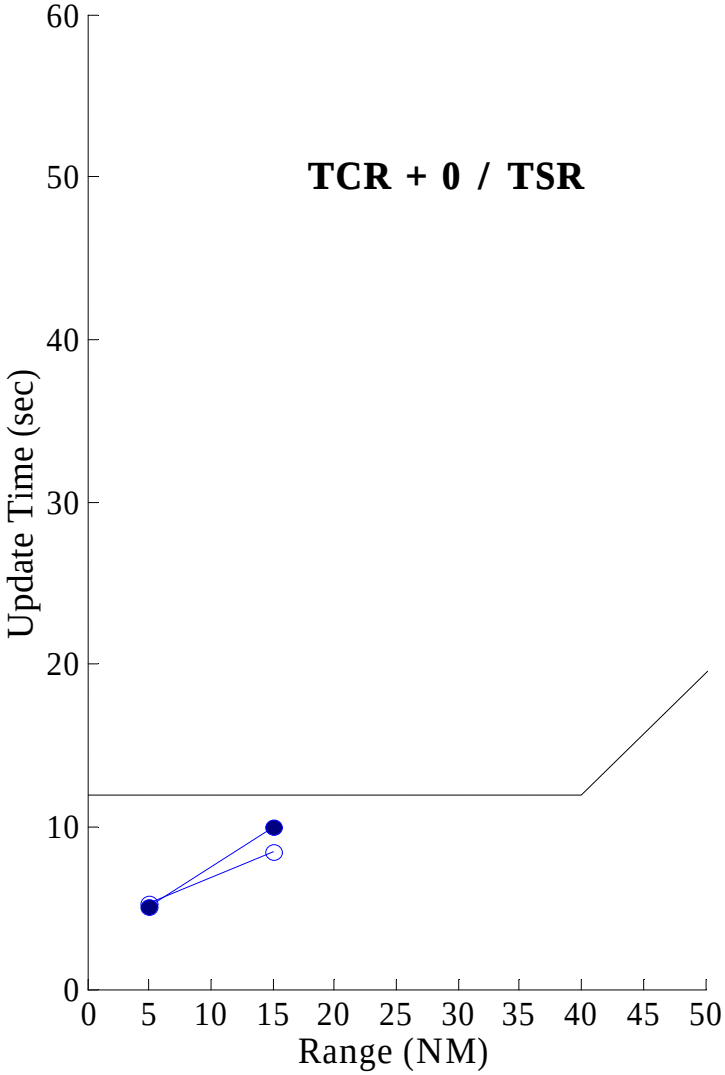
A3 Receiver at High Altitude
Receiving A2 Transmitters in Current Europe



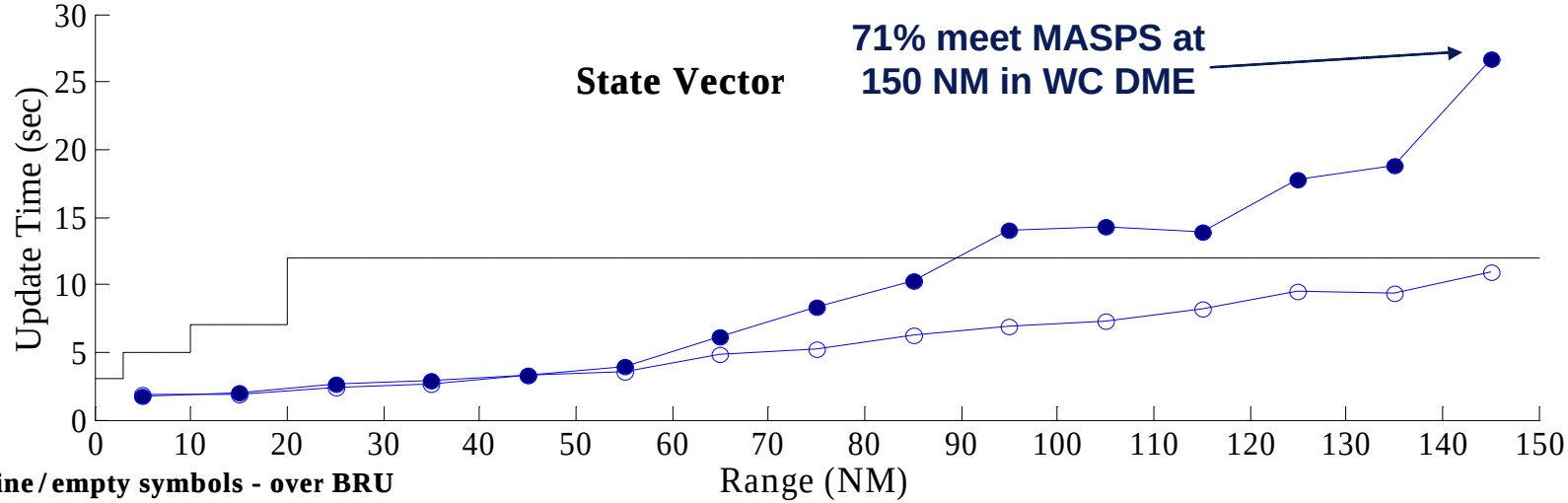


A3 Receiver at High Altitude
Receiving A1H Transmitters in Current Europe

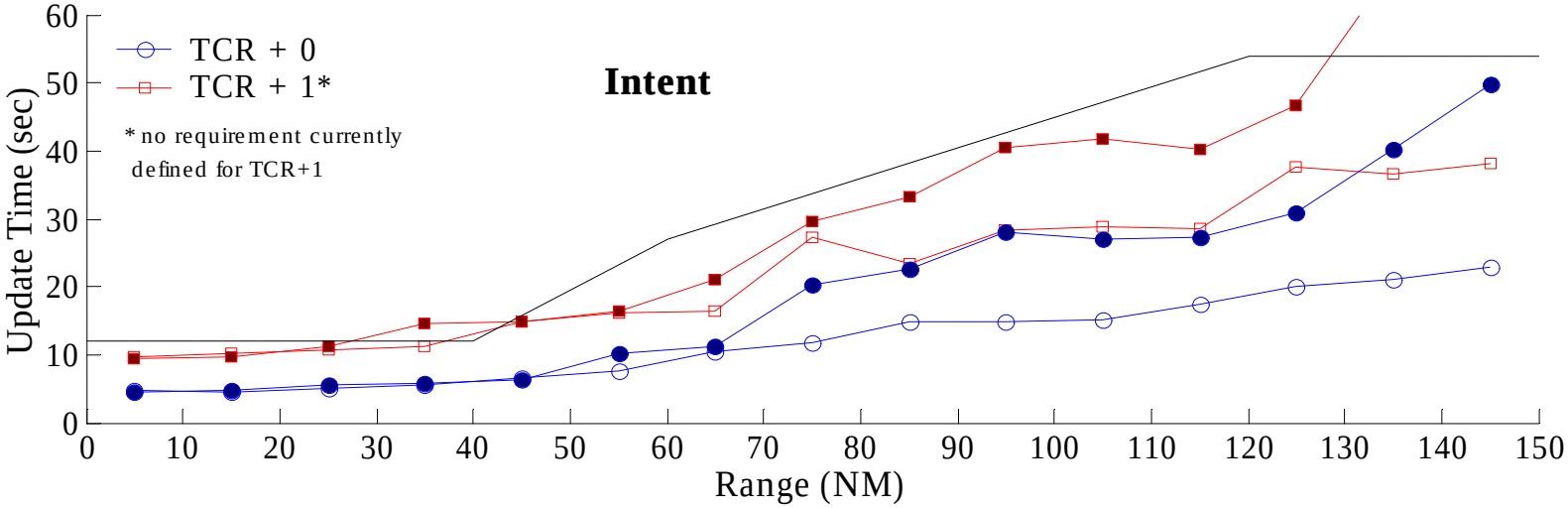




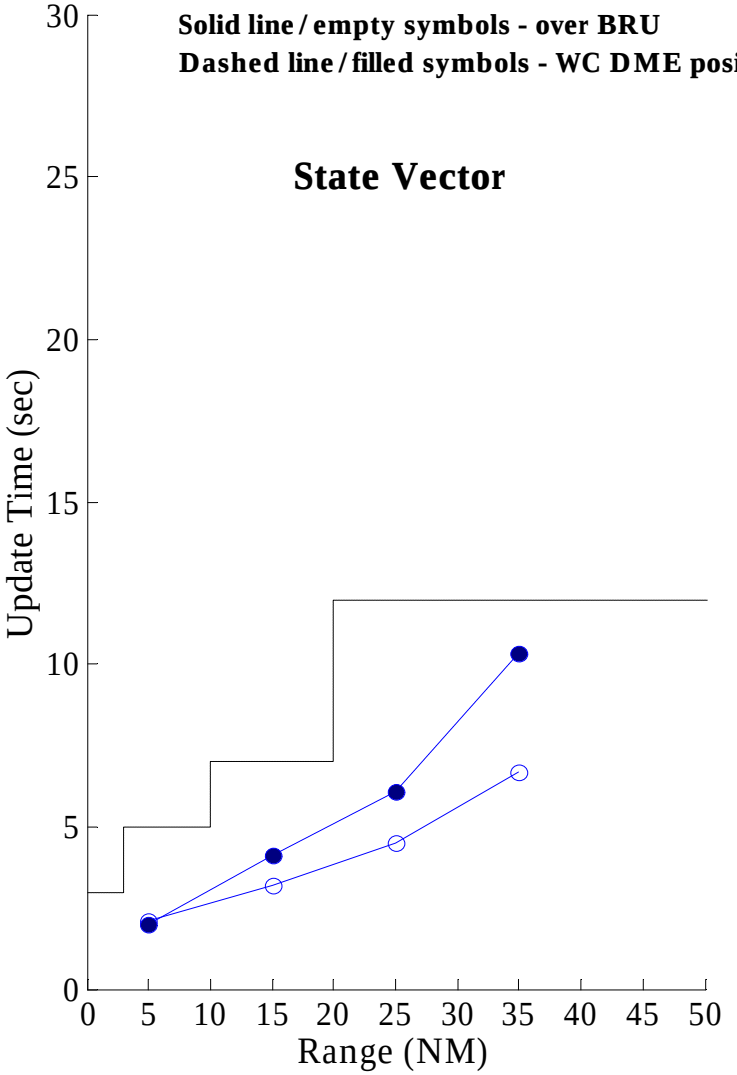
A3 Receiver at FL 150
Receiving A3 Transmitters in Current Europe

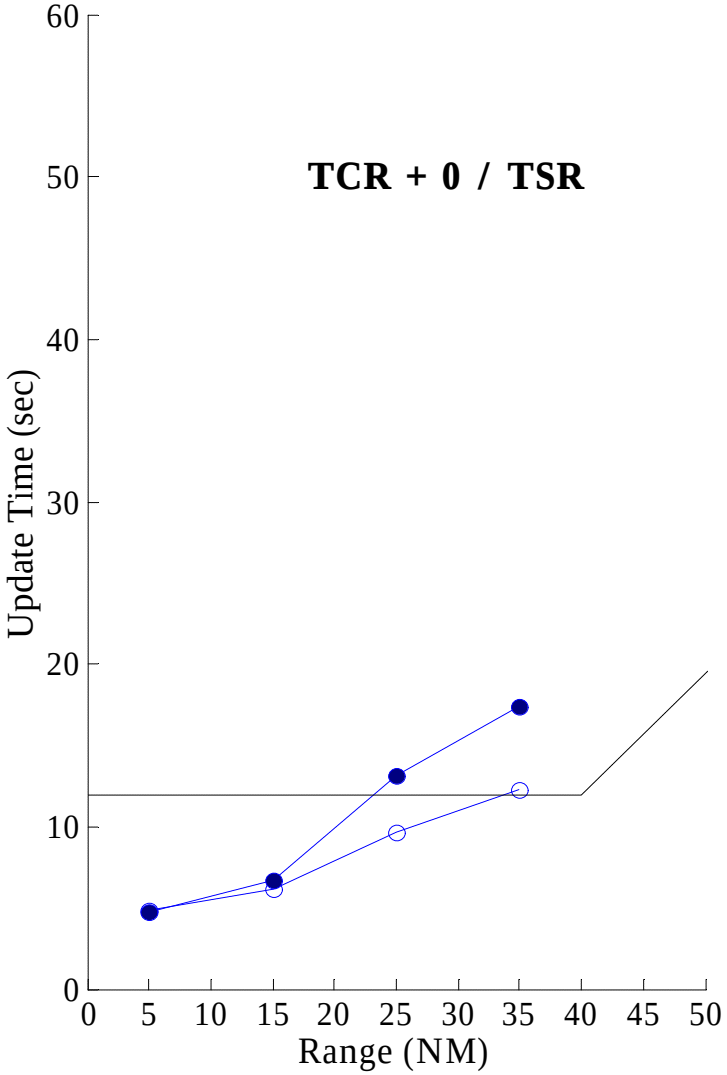


Solid line / empty symbols - over BRU
Dashed line / filled symbols - Worst Case DME position

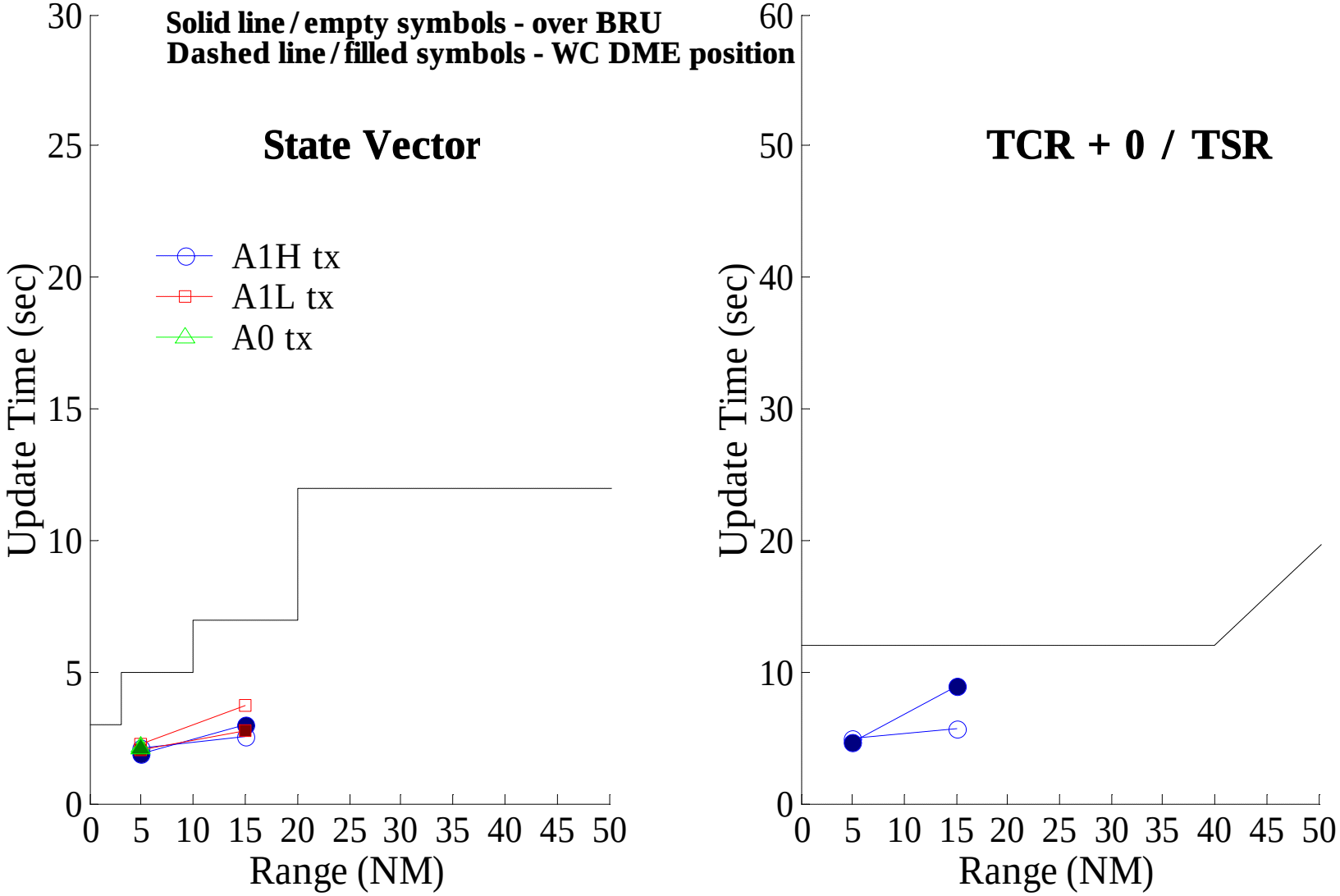


A3 Receiver at FL 150
Receiving A2 Transmitters in Current Europe

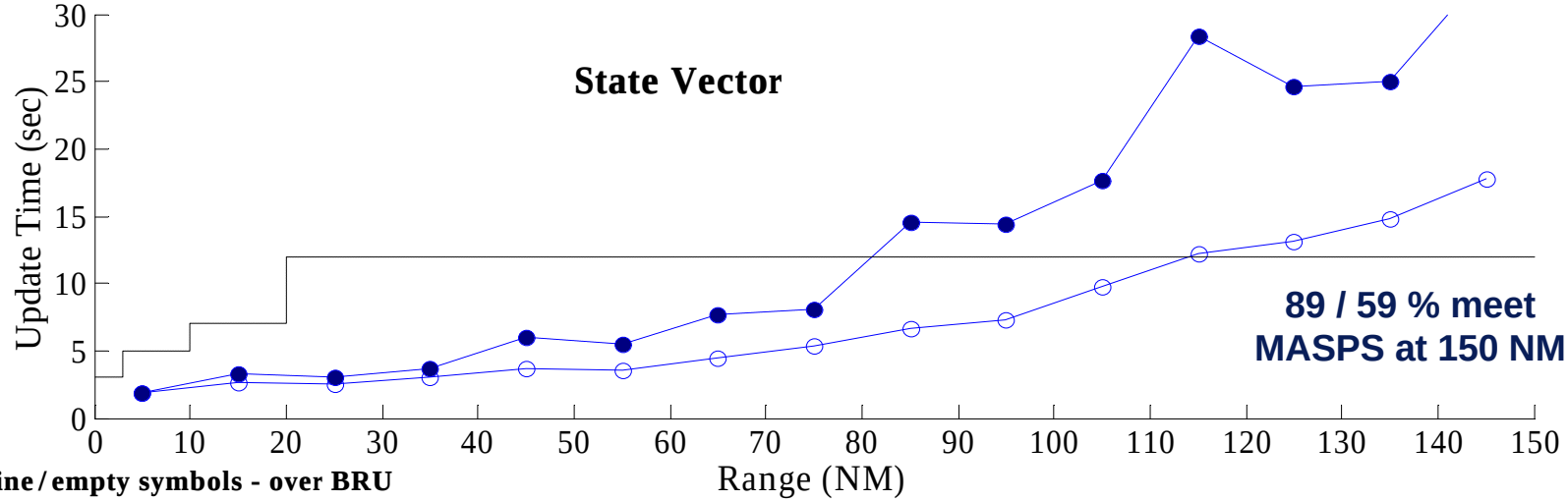




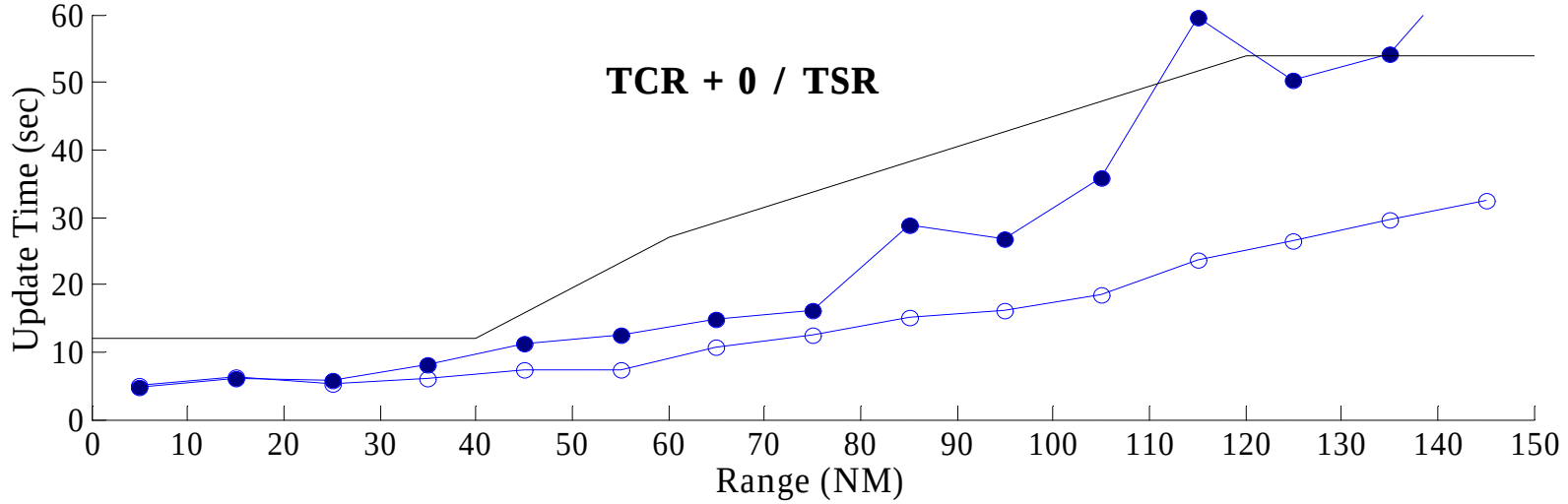
A3 Receiver at FL 150 Receiving A1 and A0 Transmitters in Current Europe



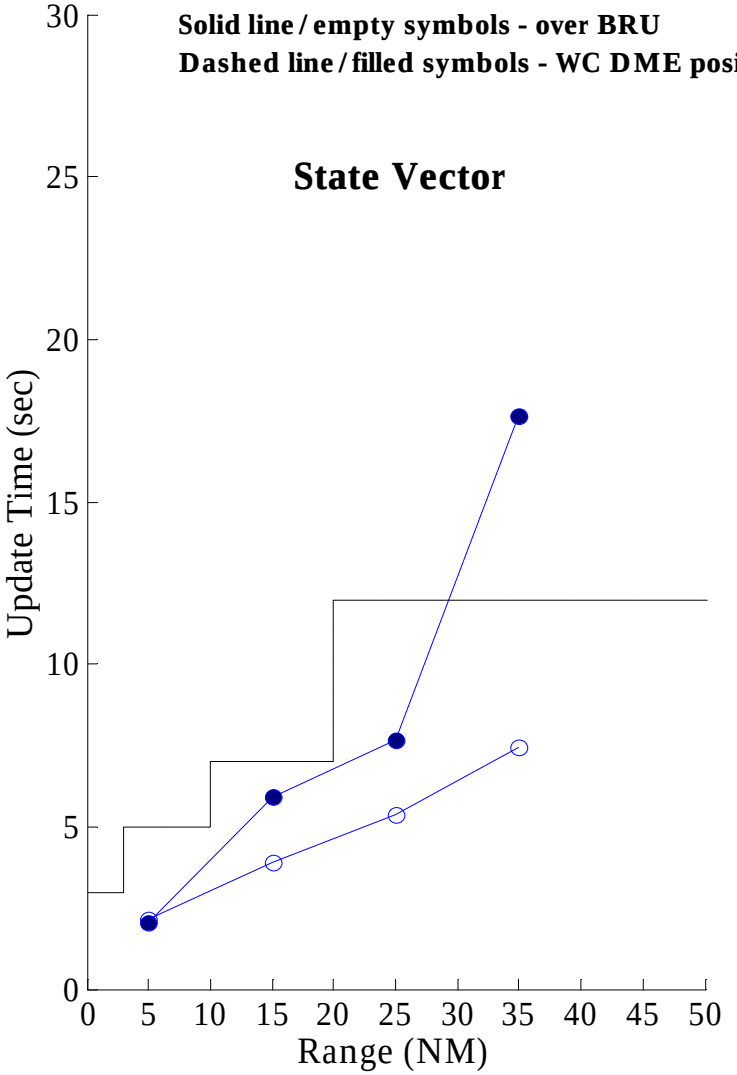
A2 Receiver at High Altitude
Receiving A3 Transmitters in Current Europe

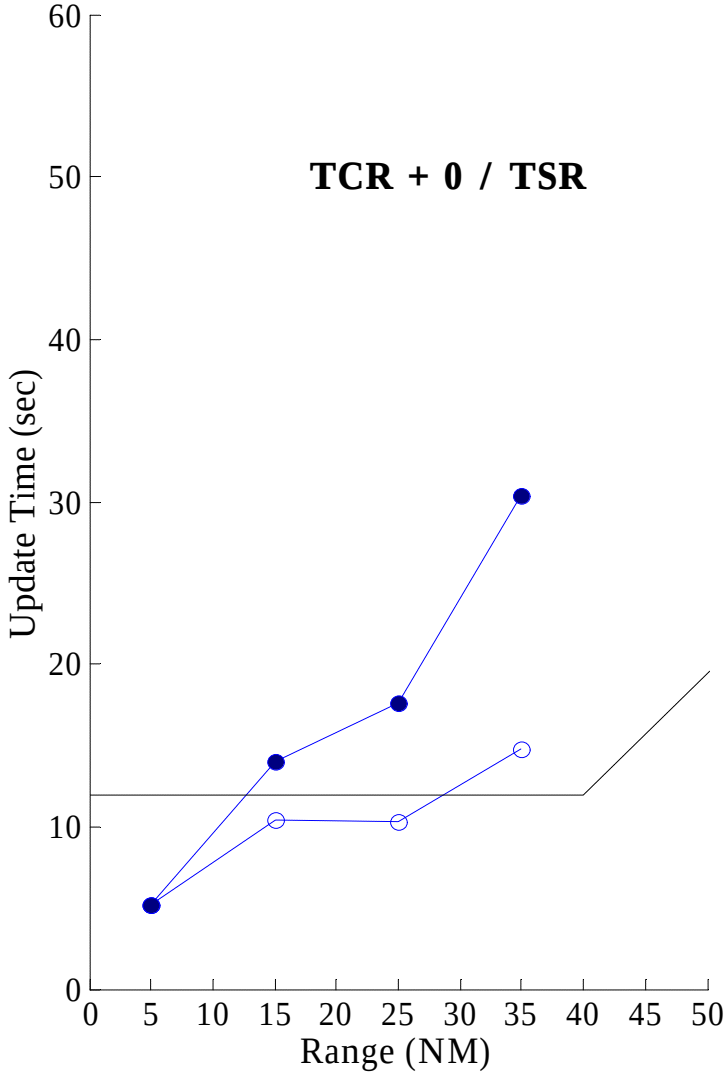


Solid line / empty symbols - over BRU
Dashed line / filled symbols - Worst Case DME position

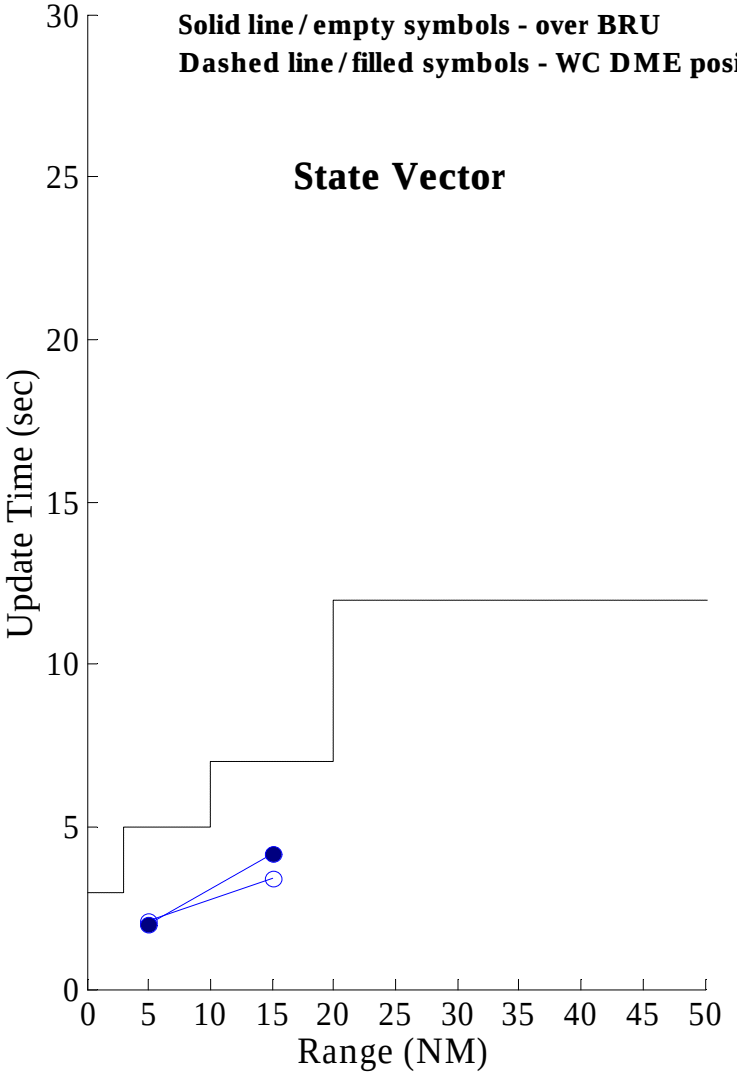


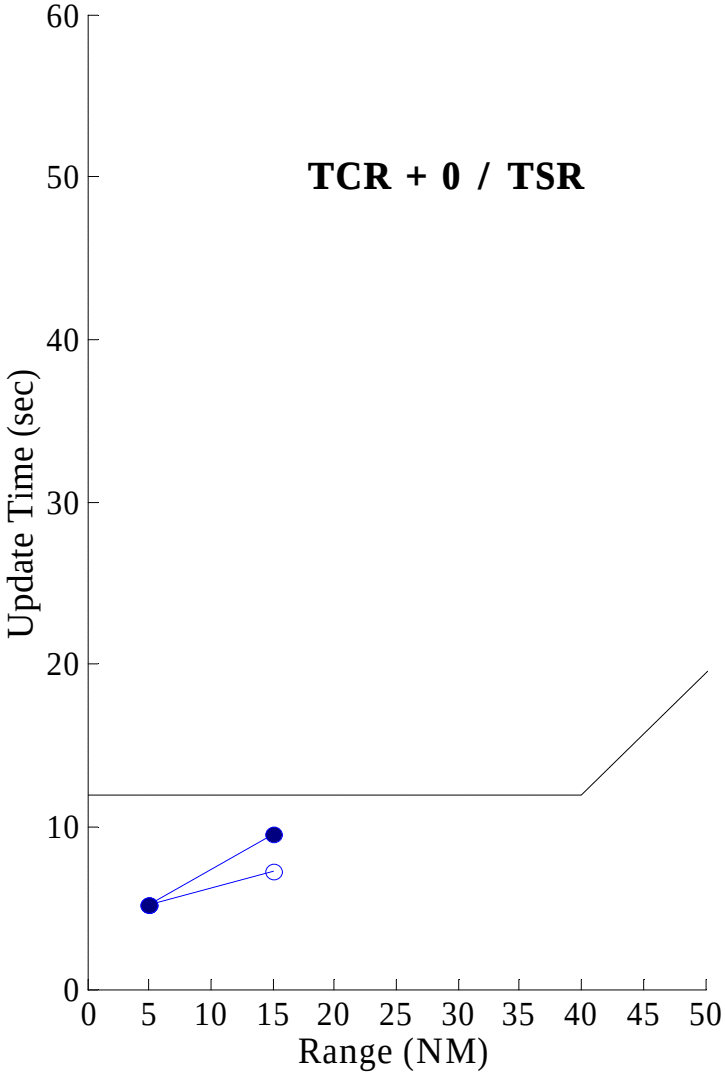
A2 Receiver at High Altitude
Receiving A2 Transmitters in Current Europe



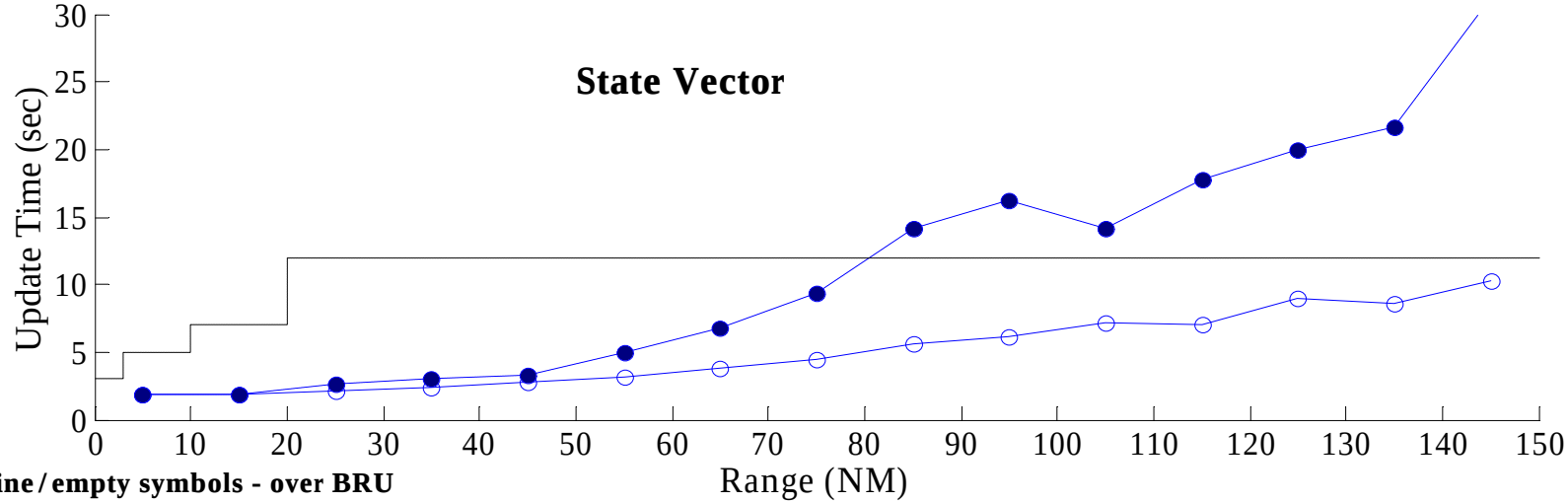


A2 Receiver at High Altitude
Receiving A1H Transmitters in Current Europe

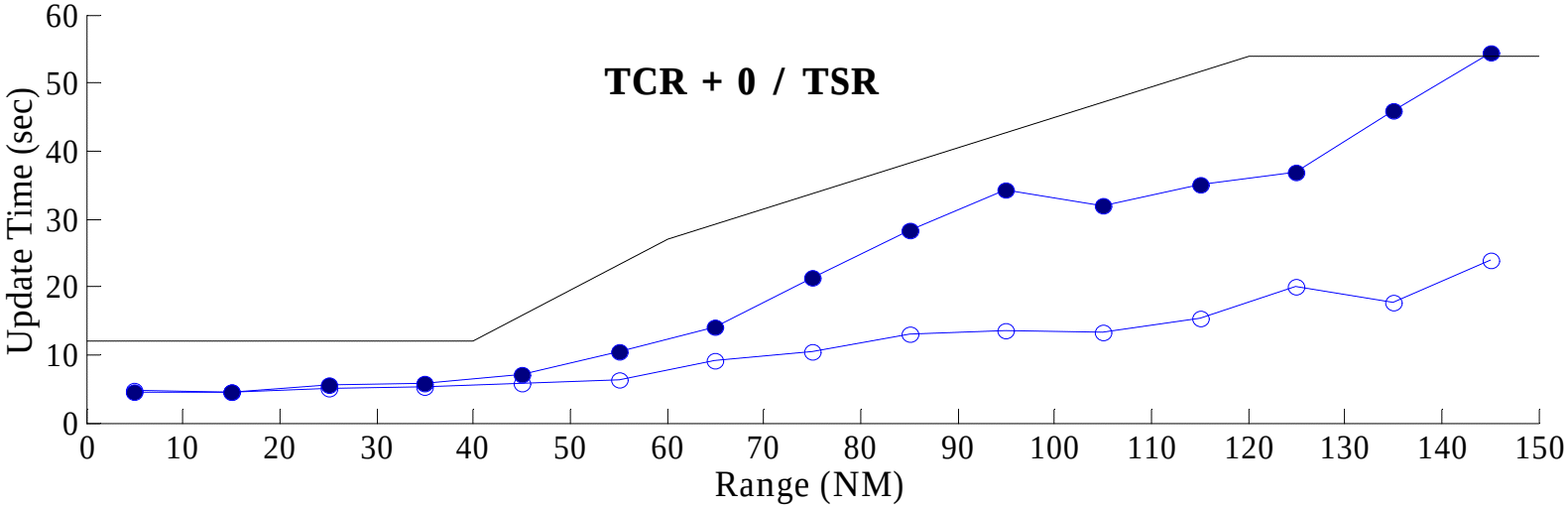




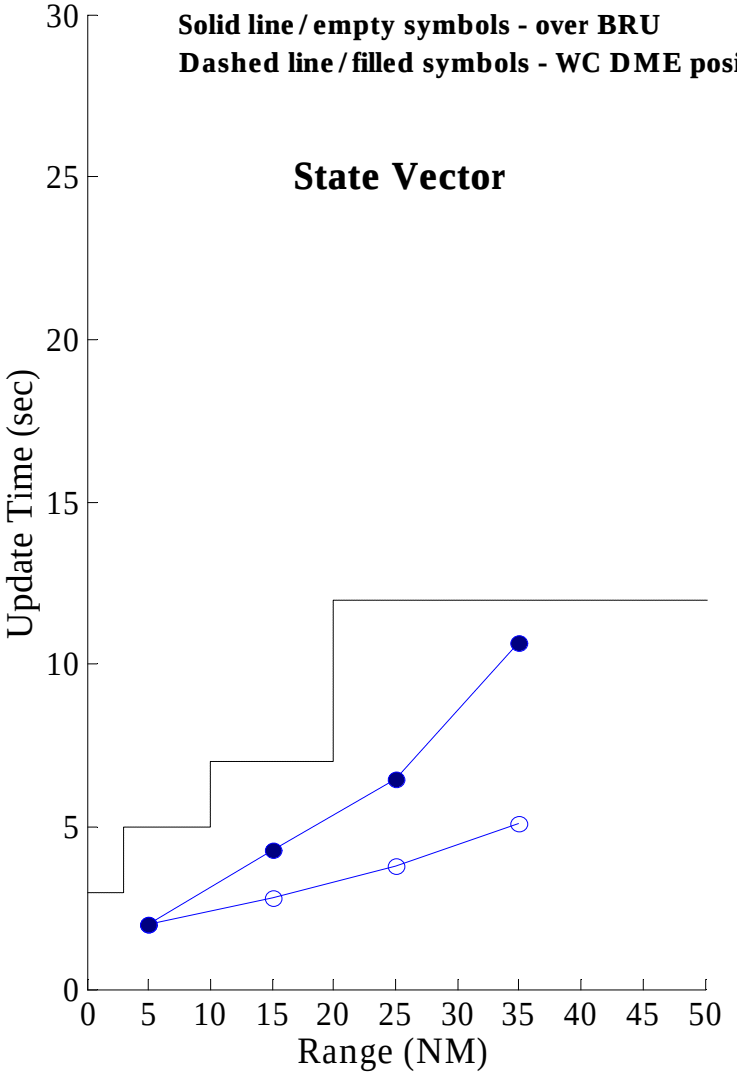
A2 Receiver at FL 150
Receiving A3 Transmitters in Current Europe

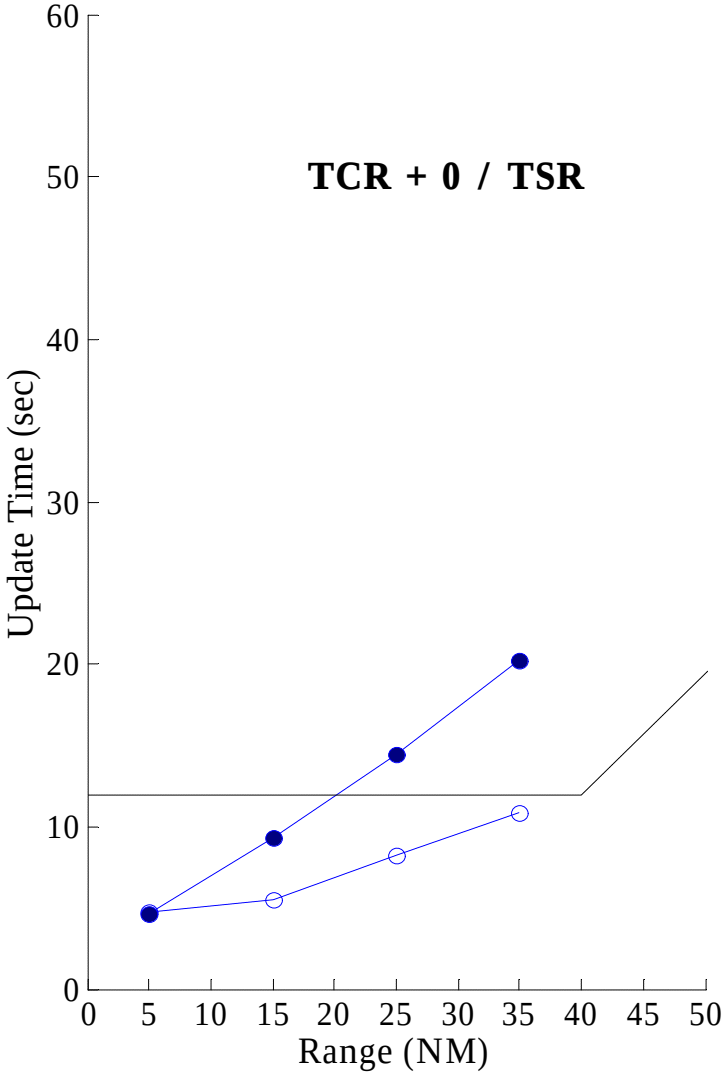


Solid line / empty symbols - over BRU
Dashed line / filled symbols - Worst Case DME position

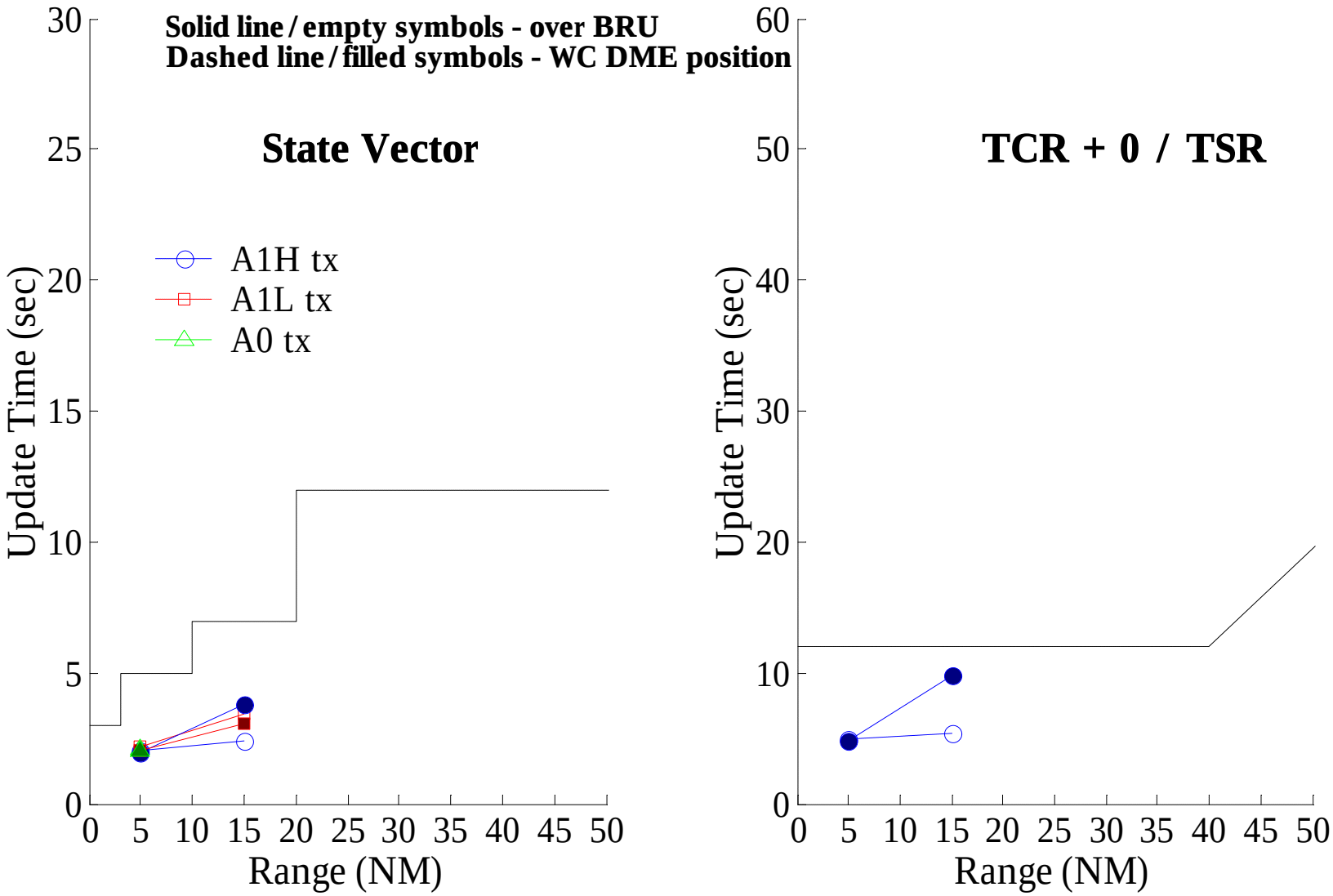


A2 Receiver at FL 150
Receiving A2 Transmitters in Current Europe

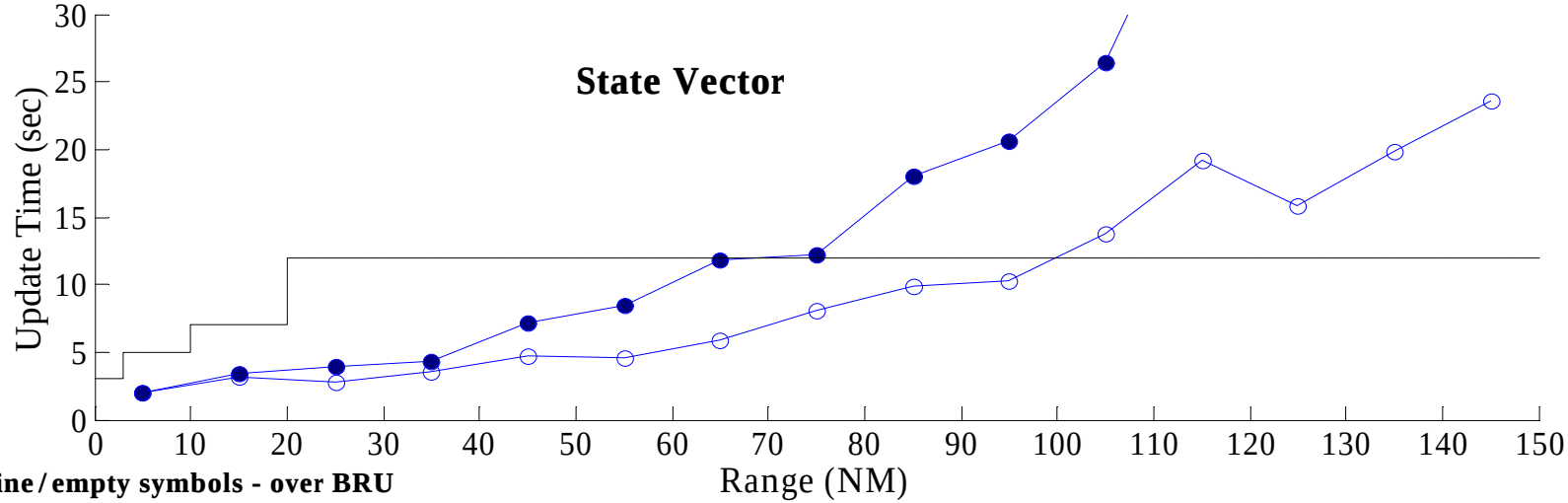




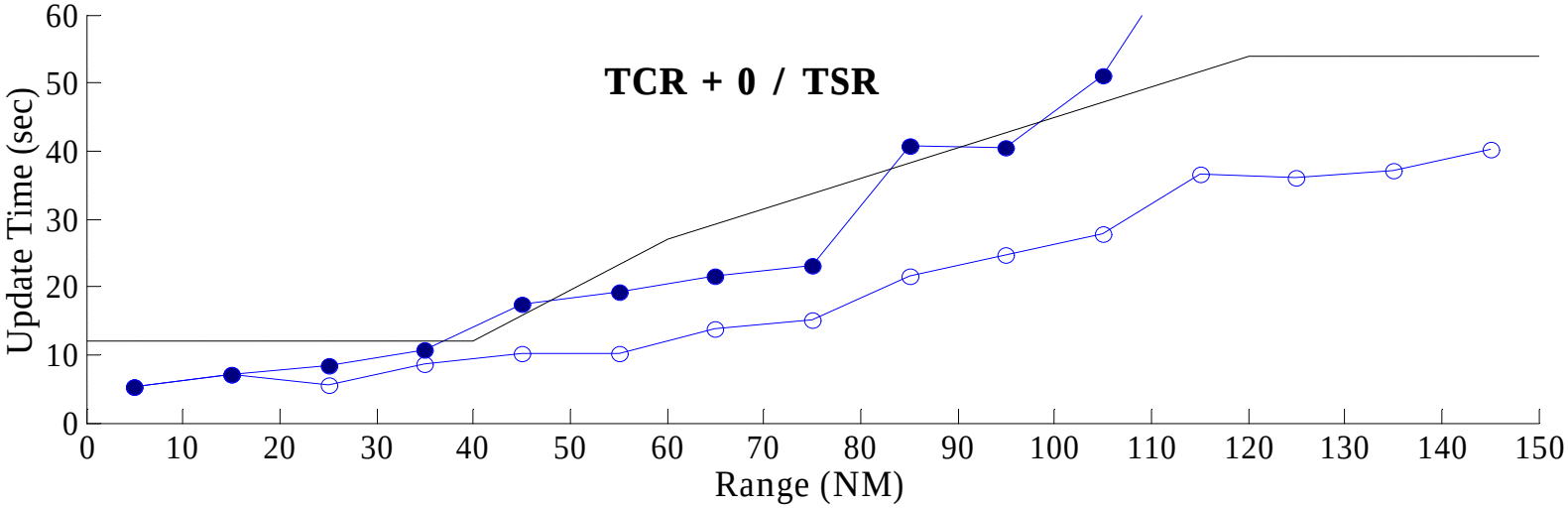
A2 Receiver at FL 150 Receiving A1 and A0 Transmitters in Current Europe



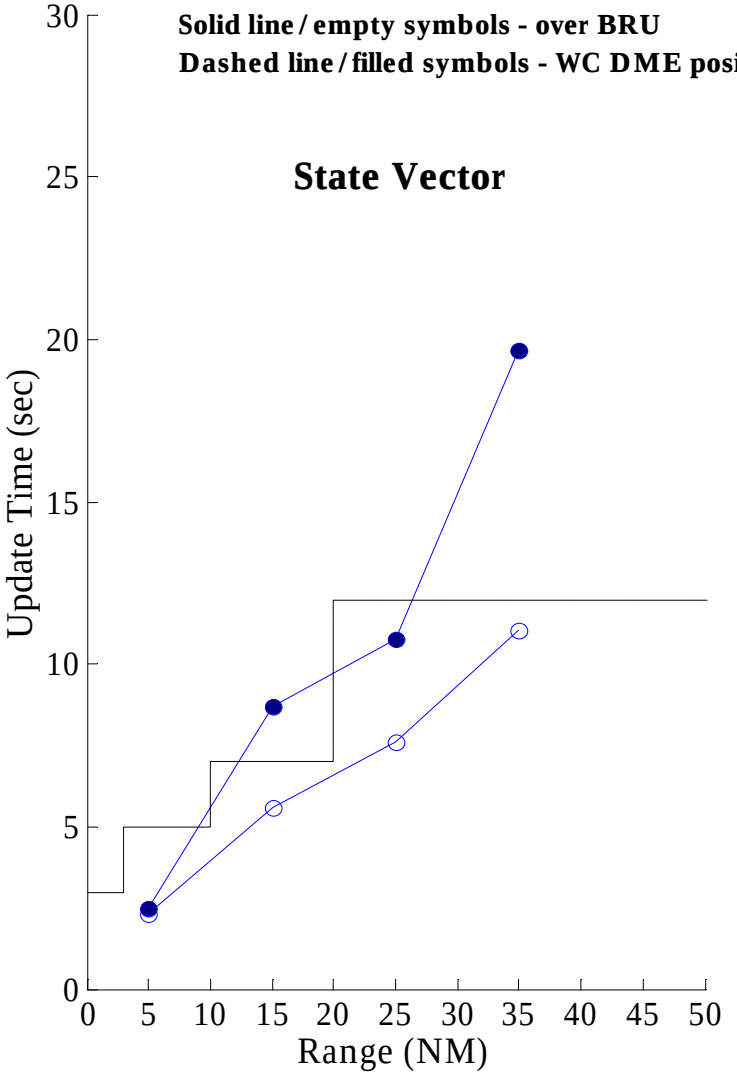
A1H Receiver at High Altitude Receiving A3 Transmitters in Current Europe

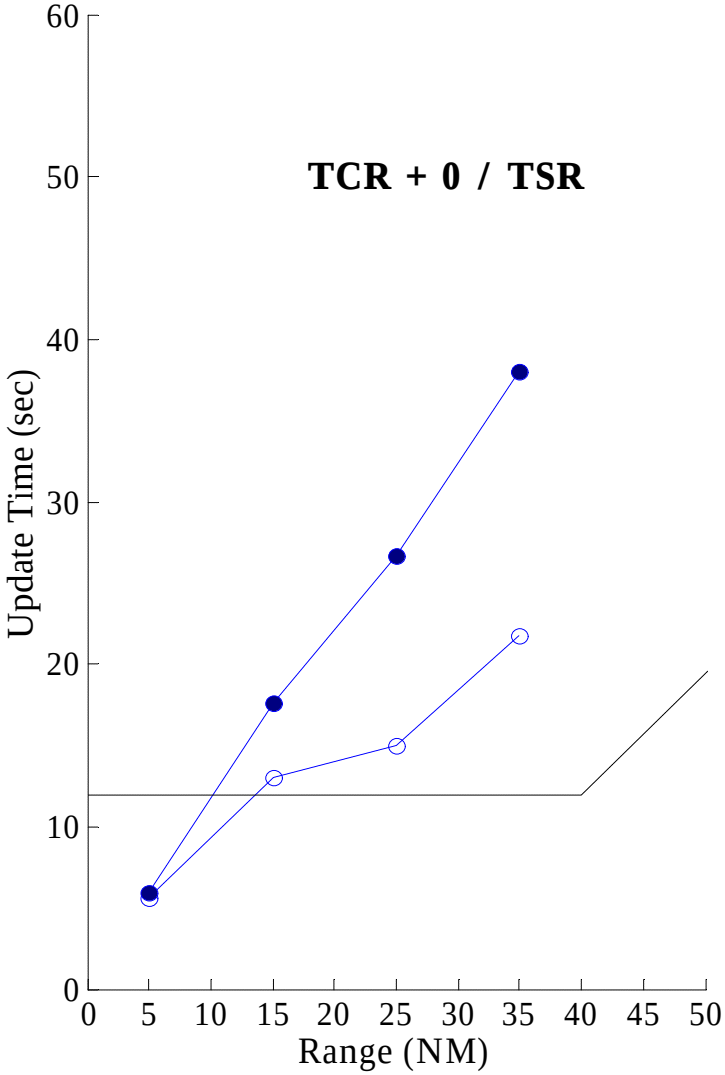


Solid line / empty symbols - over BRU
Dashed line / filled symbols - Worst Case DME position

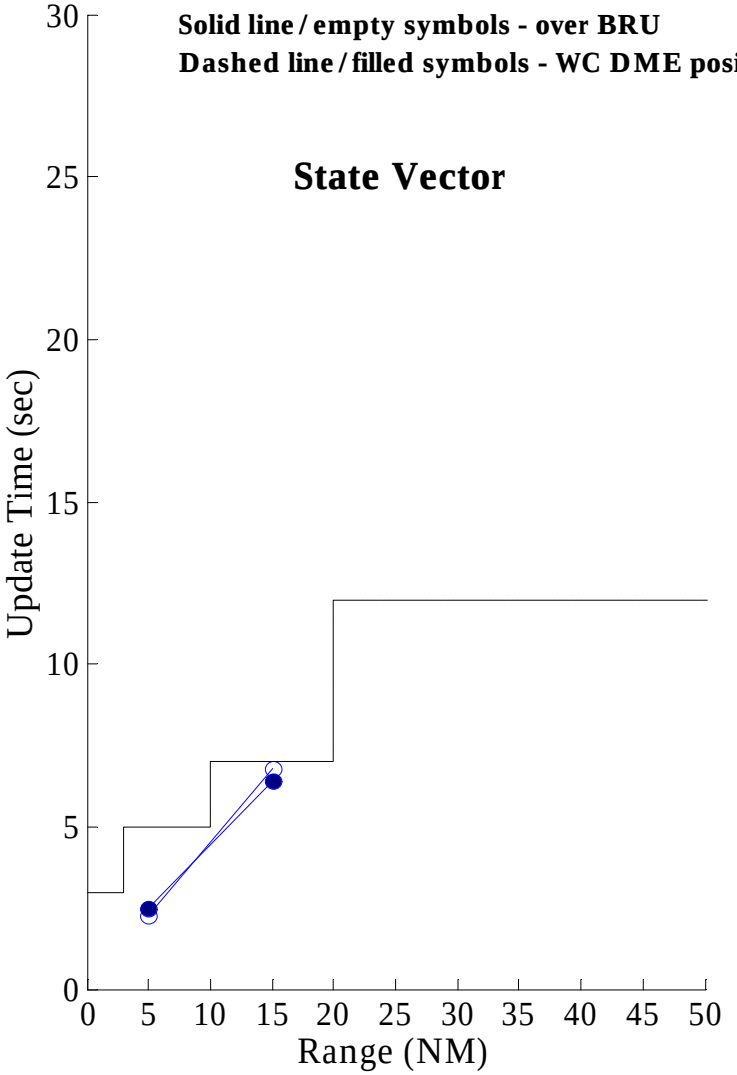


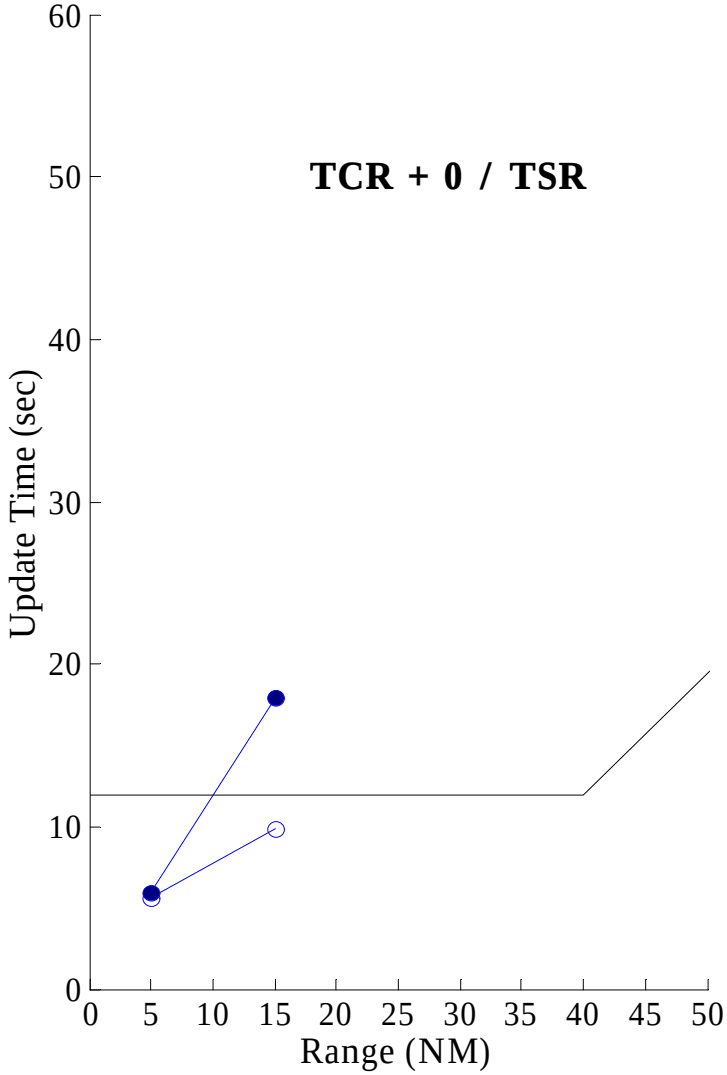
A1H Receiver at High Altitude Receiving A2 Transmitters in Current Europe



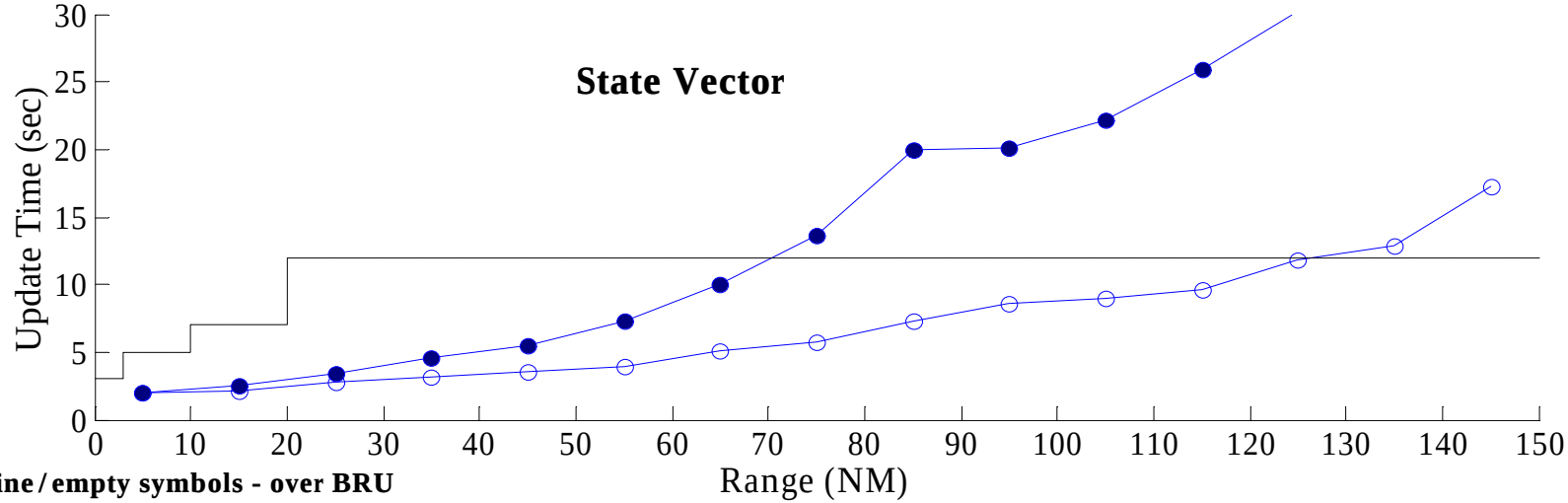


A1H Receiver at High Altitude Receiving A1H Transmitters in Current Europe

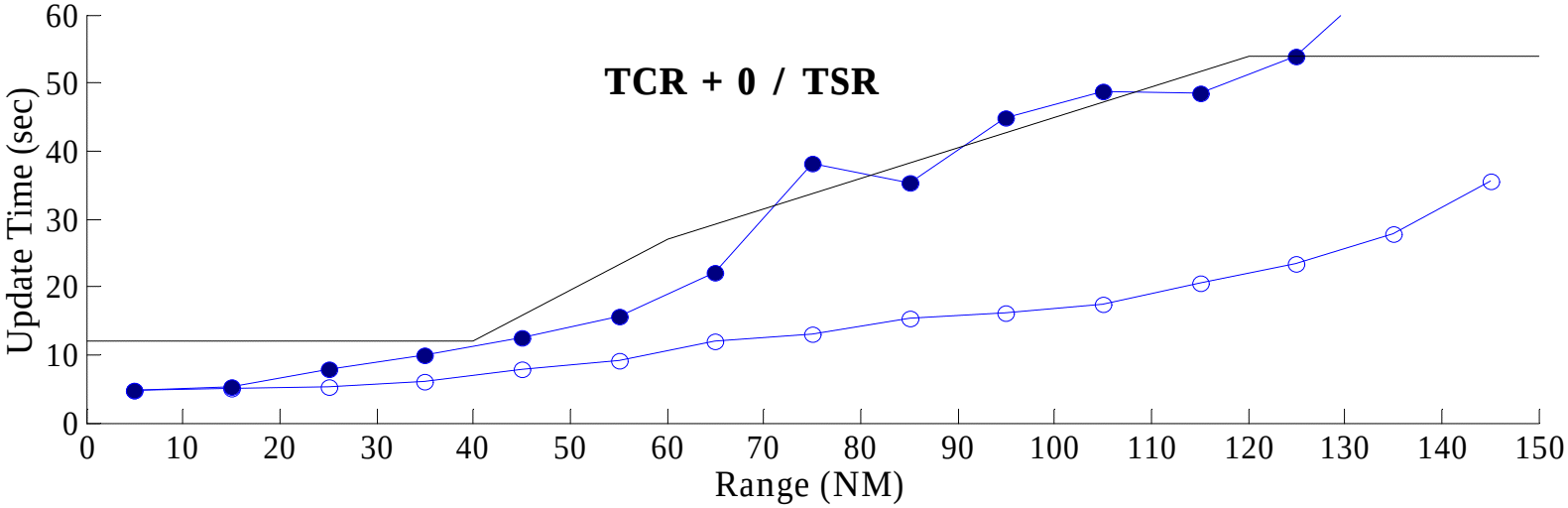




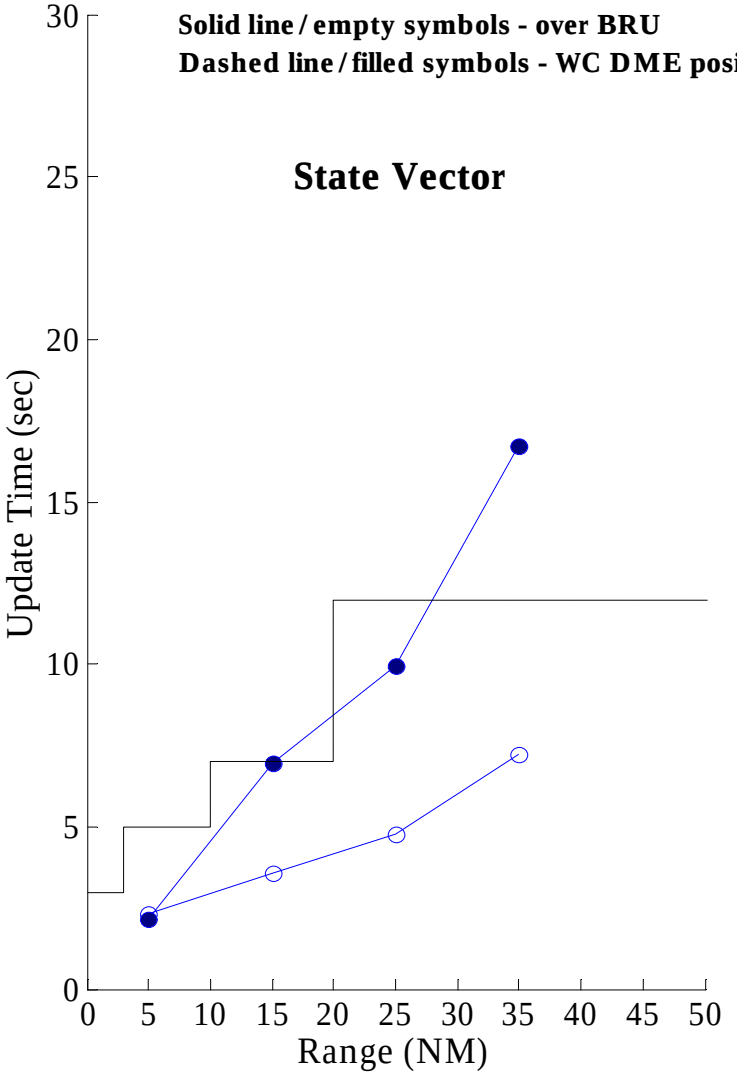
A1 Receiver at FL 150
Receiving A3 Transmitters in Current Europe

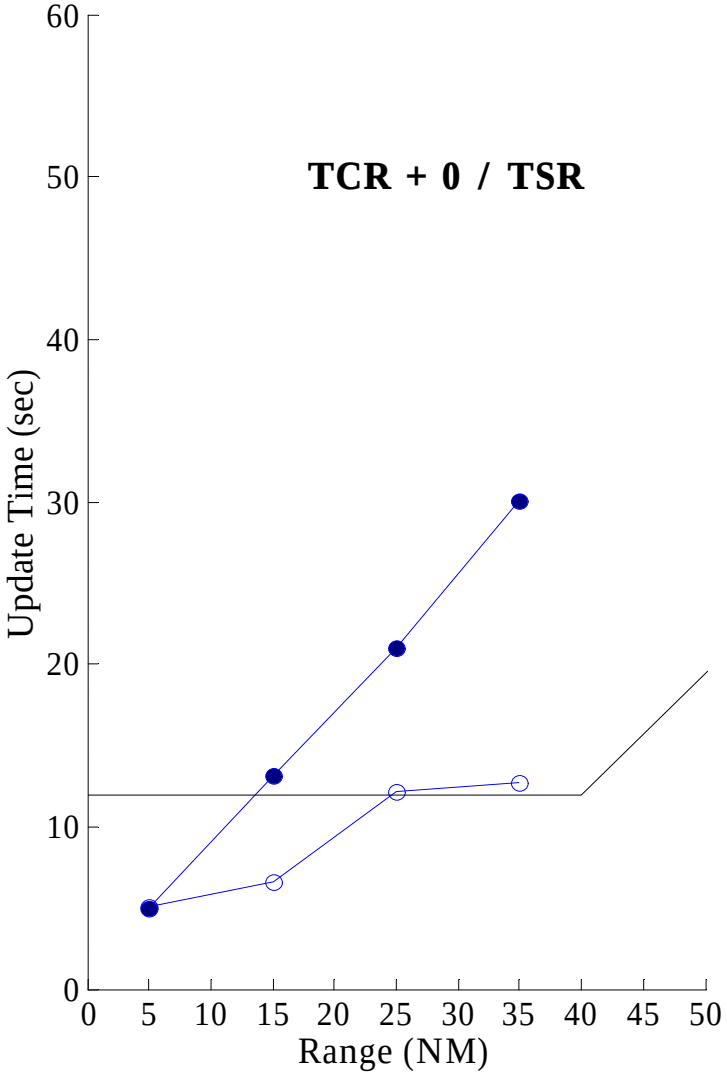


Solid line / empty symbols - over BRU
Dashed line / filled symbols - Worst Case DME position

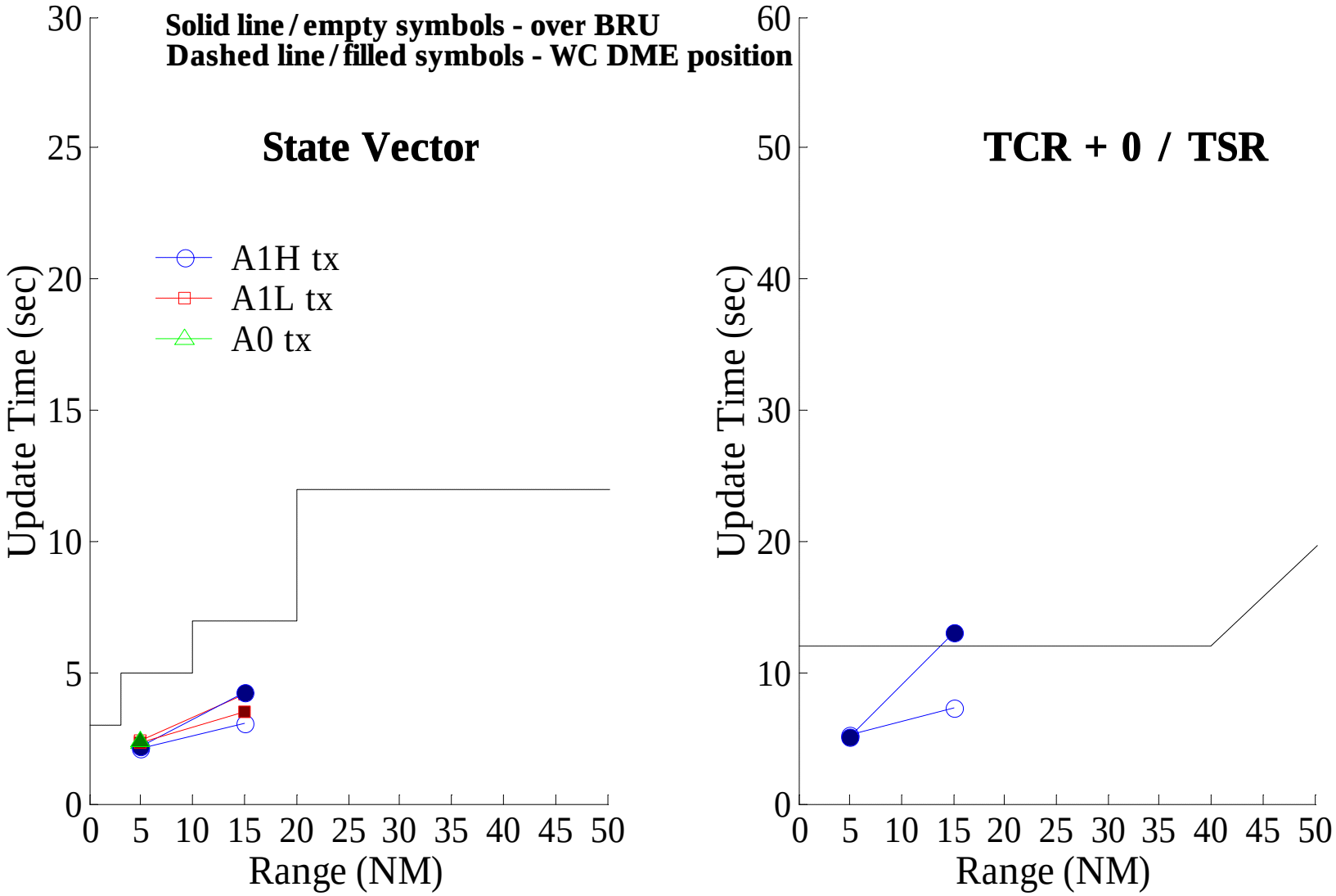


A1 Receiver at FL 150
Receiving A2 Transmitters in Current Europe

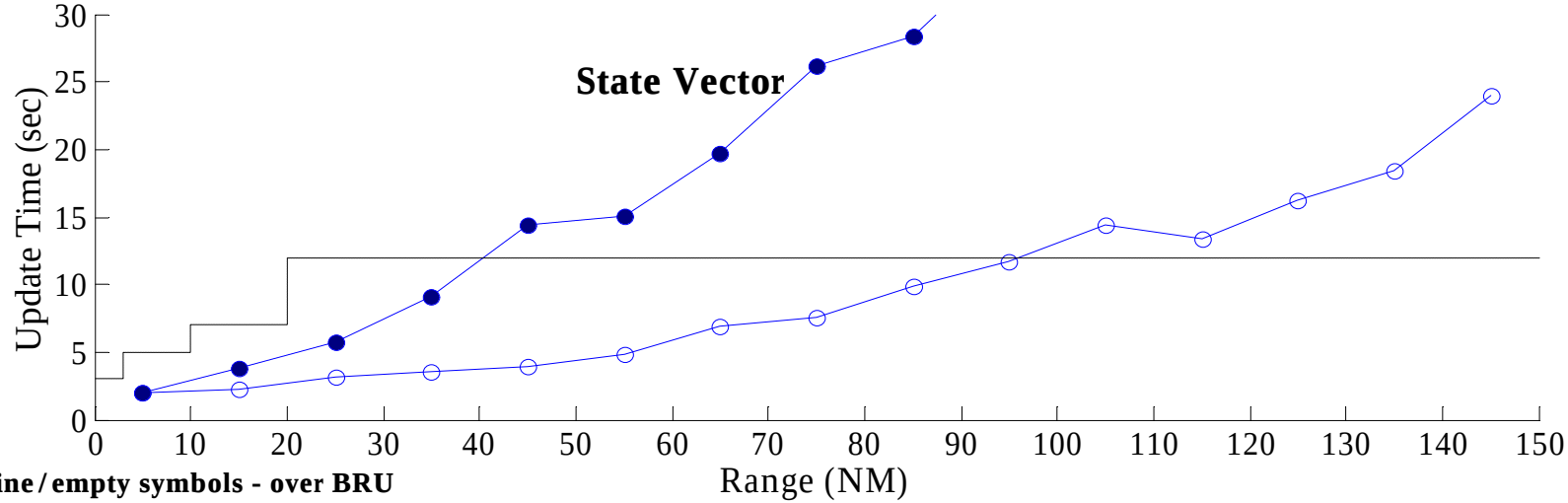




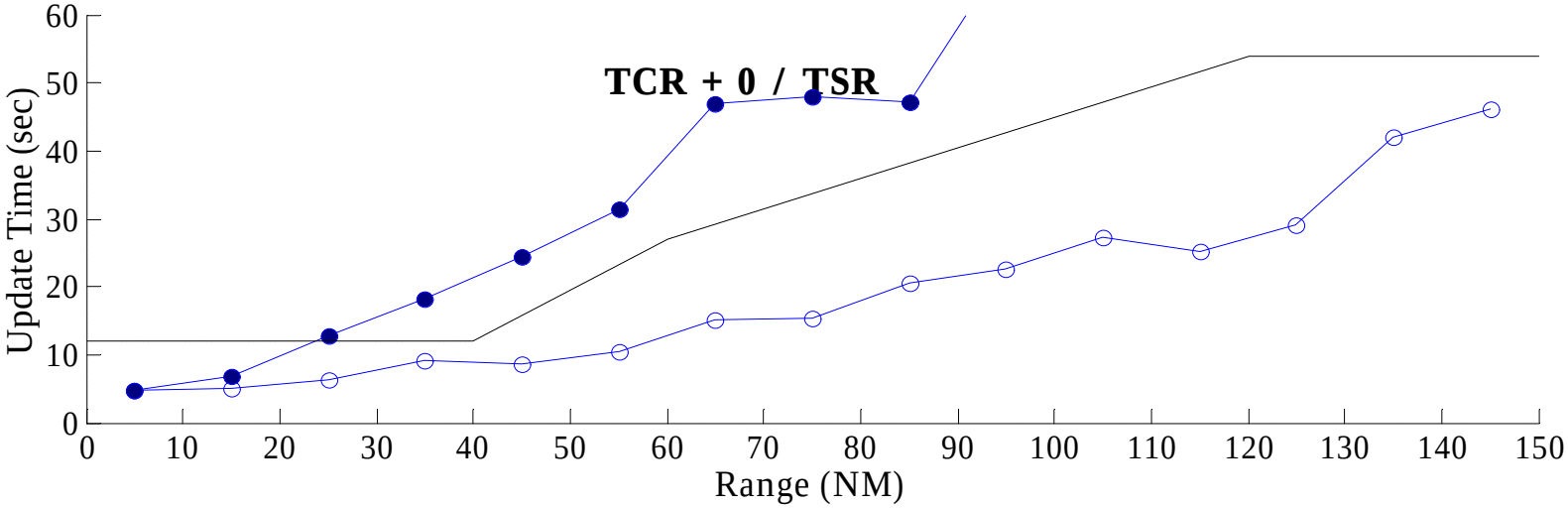
A1 Receiver at FL 150 Receiving A1 and A0 Transmitters in Current Europe



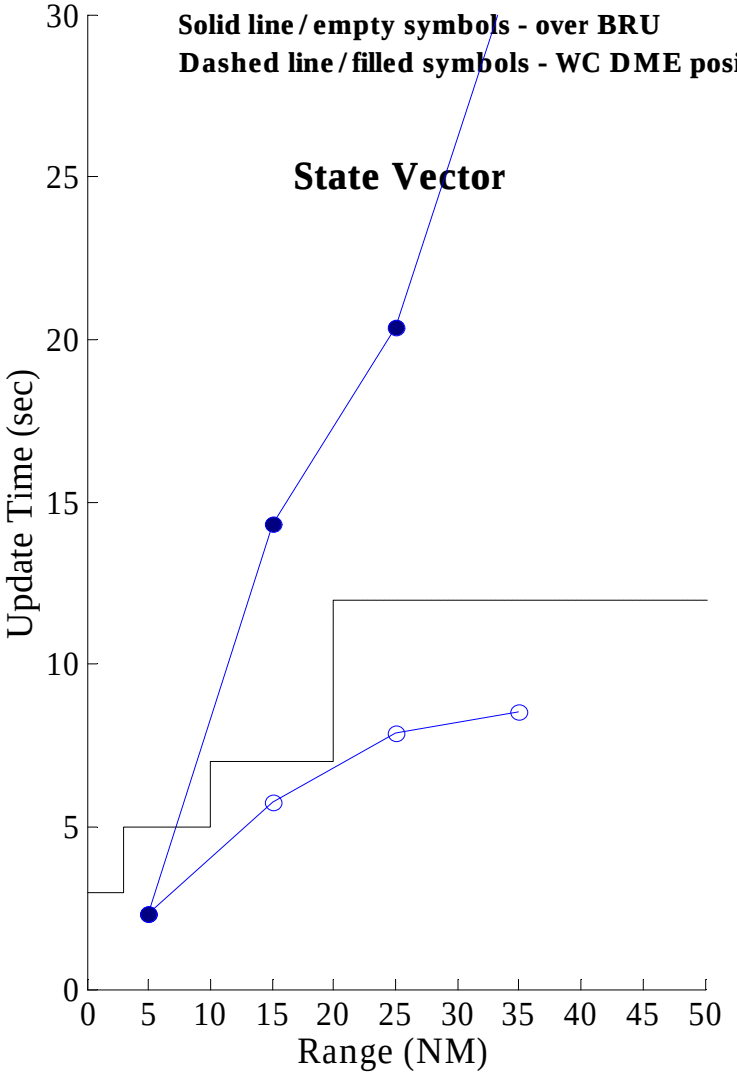
A0 Receiver at FL 150
Receiving A3 Transmitters in Current Europe

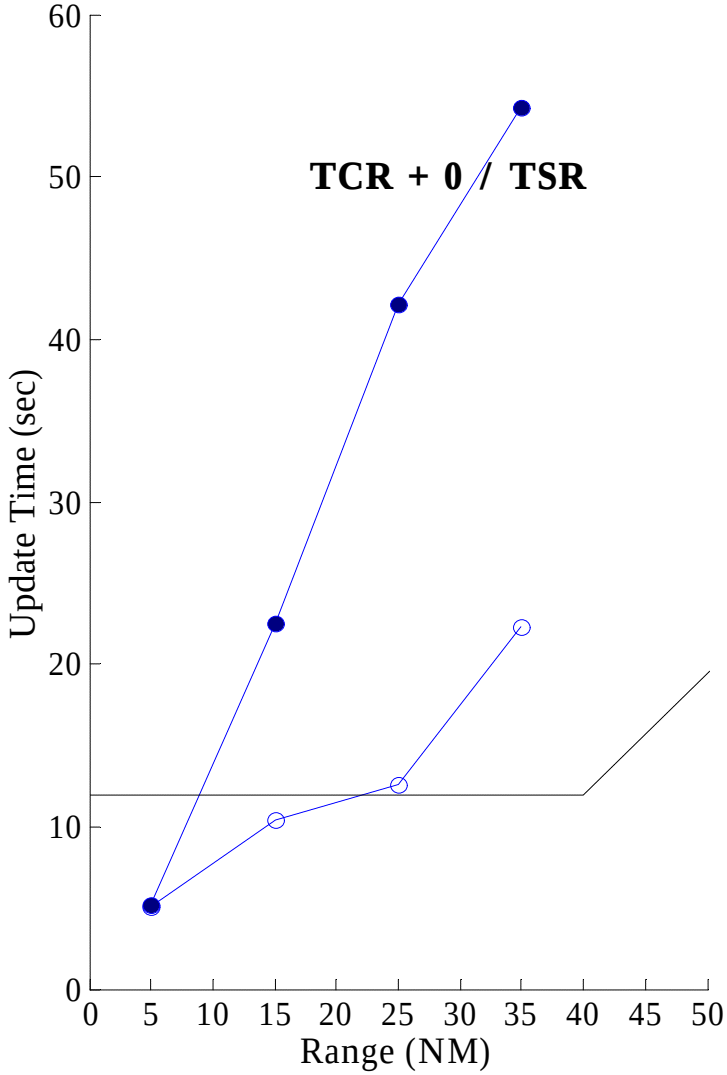


Solid line / empty symbols - over BRU
Dashed line / filled symbols - Worst Case DME position

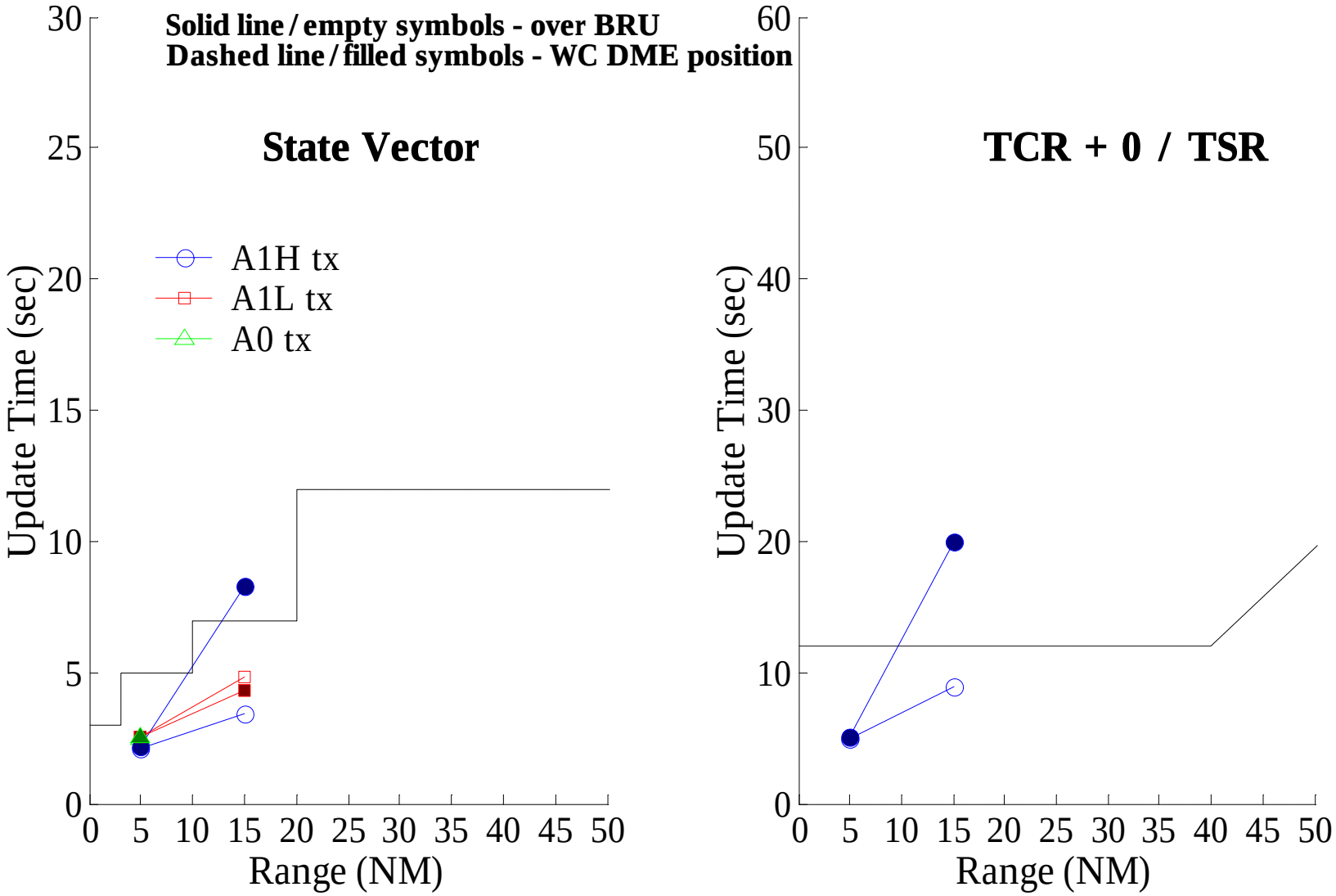


A0 Receiver at FL 150
Receiving A2 Transmitters in Current Europe





A0 Receiver at FL 150 Receiving A1 and A0 Transmitters in Current Europe



Approx. Distances of Air-Air MASPS Compliance for State Vectors and *TCR+0 / TSR* in Current Europe

[BRU | WC DME]

	A3 tx	A2 tx	A1H tx	A1L tx	A0 tx
A3 High rx	115 | 85 *150 | 140*	40 | 30 *20 | 15*	20 | 20 *20 | 20*	-	-
A2 High rx	115 | 85 *150 | 120*	40 | 25 *30 | 15*	20 | 20 *20 | 20*	-	-
A1H High rx	100 | 70 *150 | 90(?)*	40 | 12(?) *15 | 10*	20 | 20 *20 | 10*	-	-
A3 @ FL150 rx	150 | 95 *150 | 150*	40 | 40 *40 | 20*	20 | 20 *20 | 20*	20 | 20 *-*	10 | 10 *-*
A2 @ FL150 rx	150 | 85 *150 | 150*	40 | 40 *40 | 20*	20 | 20 *20 | 20*	20 | 20 *-*	10 | 10 *-*
A1 @ FL150 rx	125 | 70 *150 | 90(?)*	40 | 25 *25 | 15*	20 | 20 *20 | 15*	20 | 20 *-*	10 | 10 *-*
A0 @ FL150 rx	100 | 40 *150 | 25*	40 | 5-10 *20 | 10*	20 | 15 *20 | 10*	20 | 20 *-*	10 | 10 *-*