Assessment of sun-glint effects on PLMR measurements over land and water during NAFE campaings

M. J. Escorihuela, Y. Kerr, K. Saleh, J. Walker, P. Steinle and J. P. Wigneron

presented by P. Maisongrande

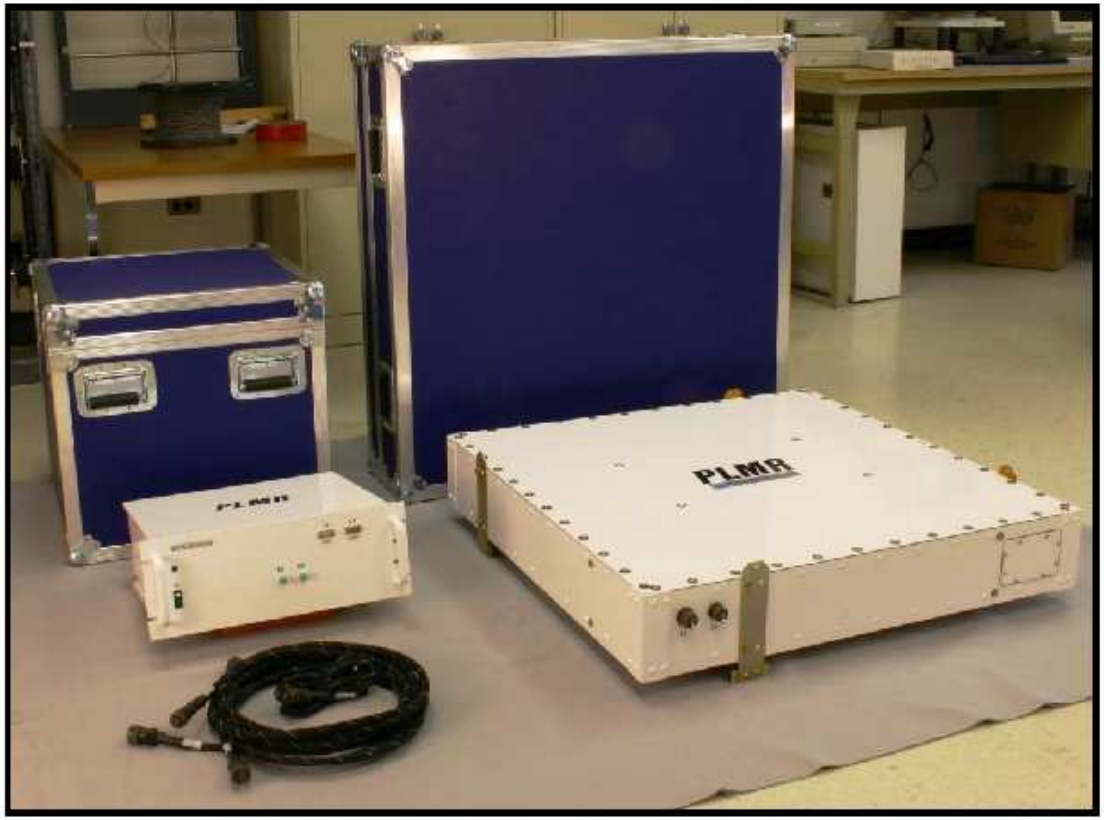
3rd NAFE Workshop, 17-18th September 2007

Summary

Objective

Sunglint effects over land are usually neglected because of the low reflectivity of land surfaces and scattering properties of the vegetation layer. The aim of this study was to assess sun-glint effects over land surfaces and compare observations and theoric calculations.

PLMR

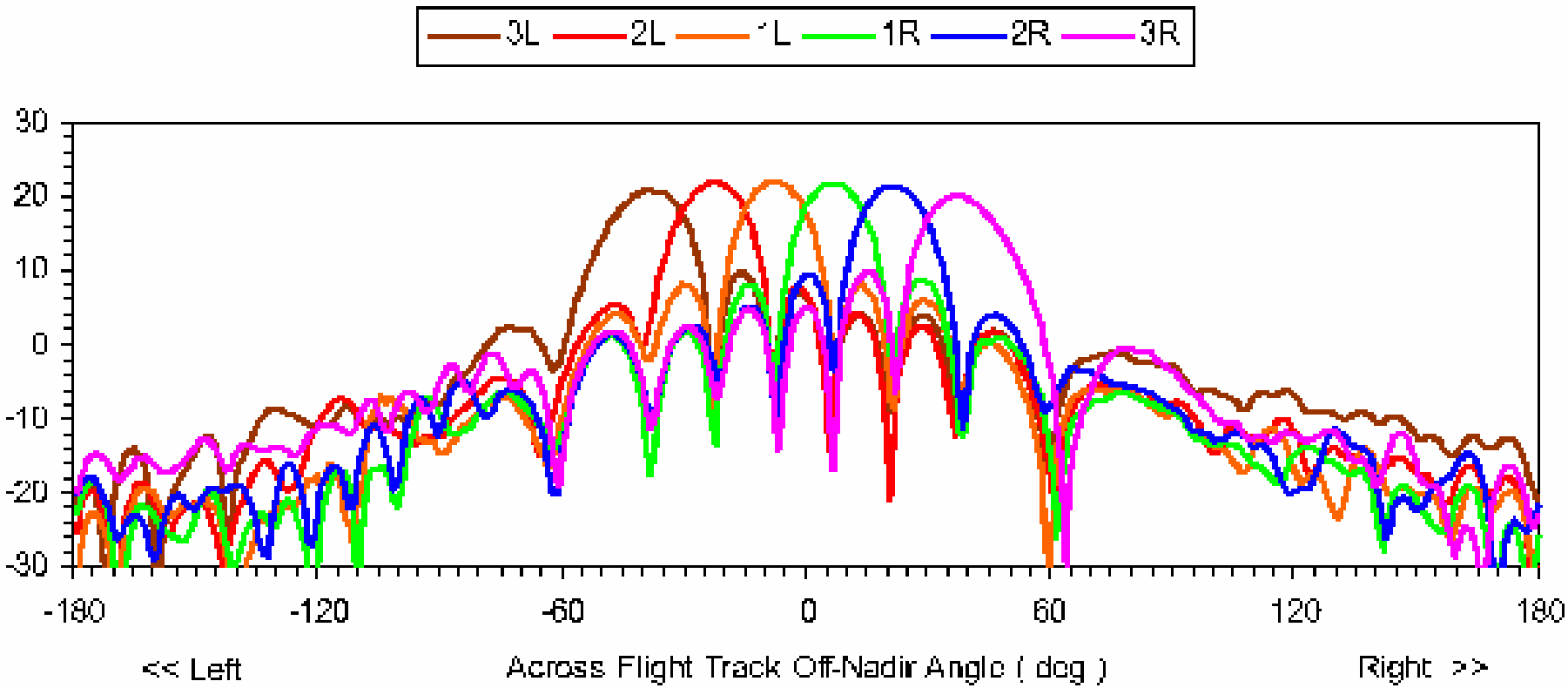


- PLMR 6 beam 3L, 2L, 1L, 1R, 2R, 3R (-38, -22, -7, 7, 22, 38)
- configuration along-track (multi-incidence), across-track (mapping)

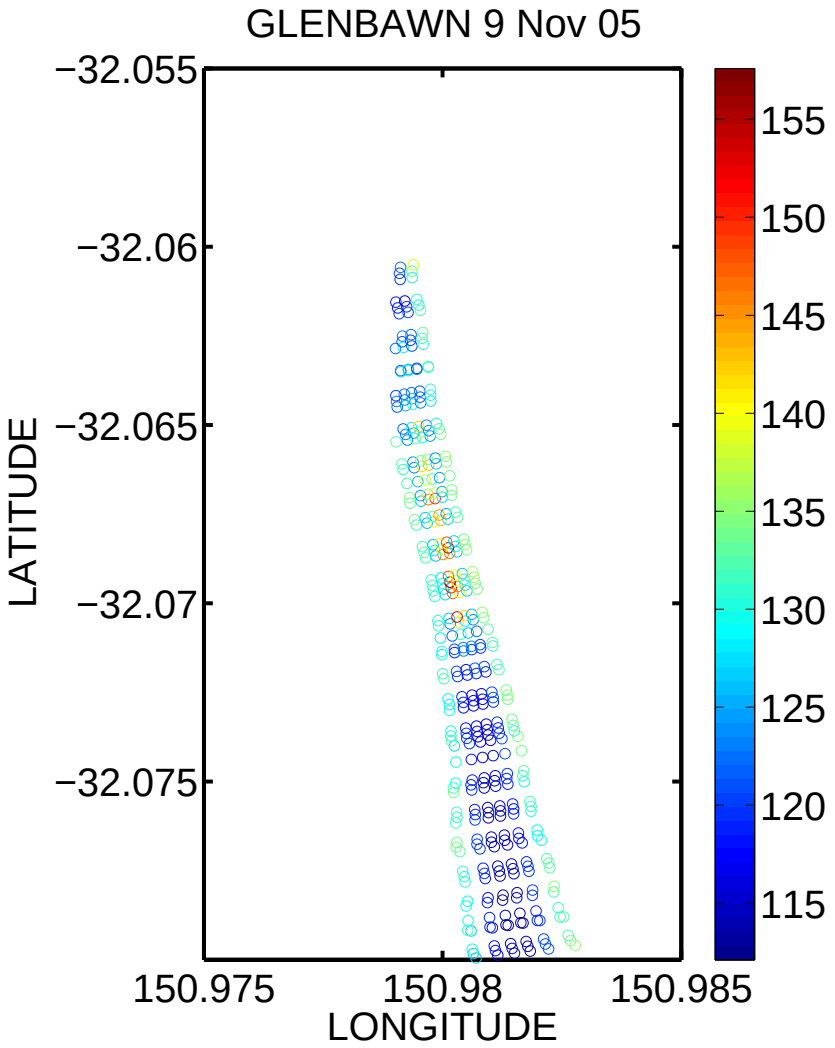
PLMR

- PLMR 6 beam 3L, 2L, 1L, 1R, 2R, 3R (-38, -22, -7, 7, 22, 38)
- configuration along-track (multi-incidence), across-track (mapping)
- no dedicated sun-glint flights

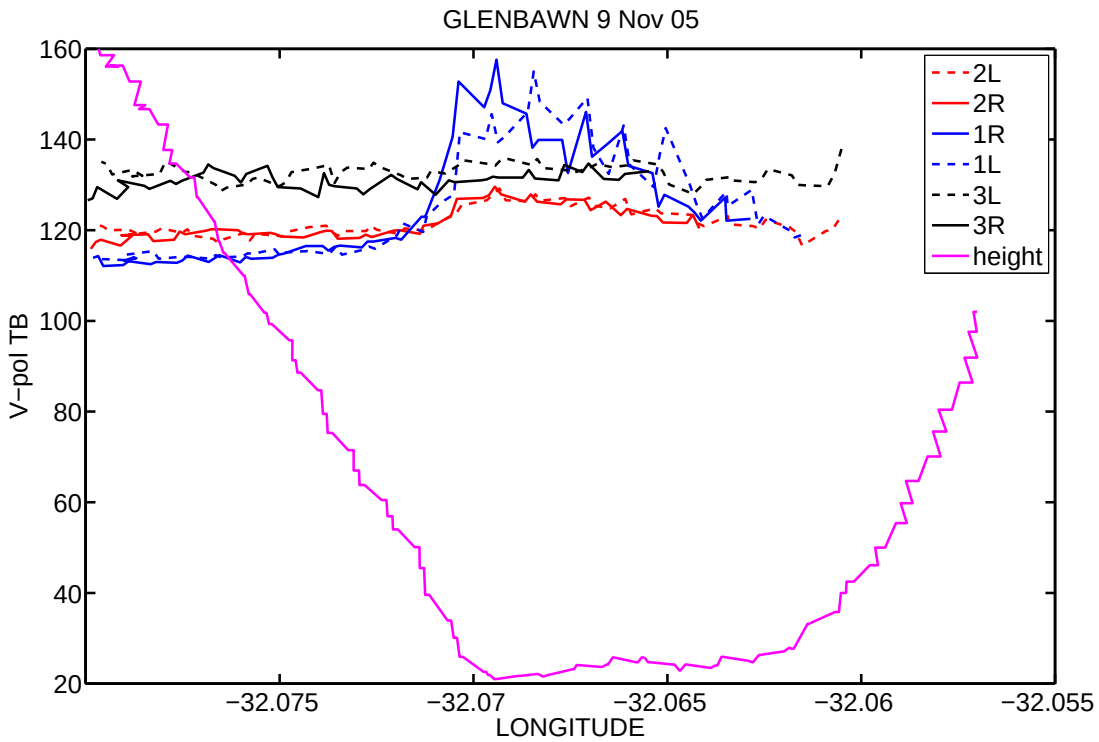
PLMR - antenna pattern



'hot spot'


GLENBAWN 9 Nov 05
−32.055
−32.06
−32.065
−32.07
−32.075
LATITUDE
150.975
150.98
150.985
LONGITUDE
155
150
145
140
135
130
125
120
115

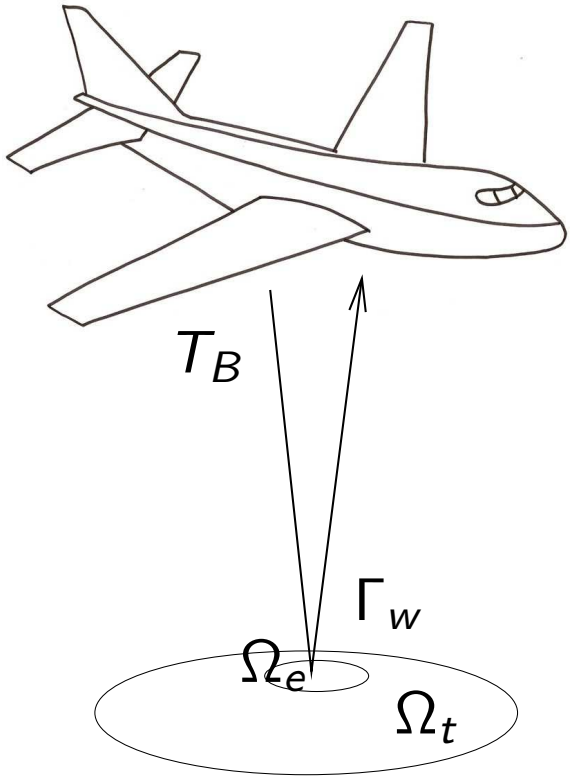
'hot spot'



- increase TB 40 K for angles close to nadir
- when flying very close (20 m) to water surface

'hot spot'

aircraft or some instrument emission is reflected on the water surface



$$T_a = TB_w + \Gamma_w T_B F_n \frac{\Omega_e}{\Omega_t}$$

'hot spot'

Engine	Radiometer
$e_e T_e \sim 0.1 \times 450$ K	$T_B \sim 300K$
$\Gamma_w \sim 0.6$	$\Gamma_w \sim 0.6$
$\frac{\Omega_e}{\Omega_t} \sim \frac{\Omega_e}{25}$	$\frac{\Omega_r}{\Omega_t} \sim \frac{\Omega_r}{25}$
$25\frac{\Omega_e}{25}K$	$180\frac{\Omega_r}{25}K$

sunglint

no dedicated flights

maximum solar reflexion when sun and radiometer same zenith and azimuth

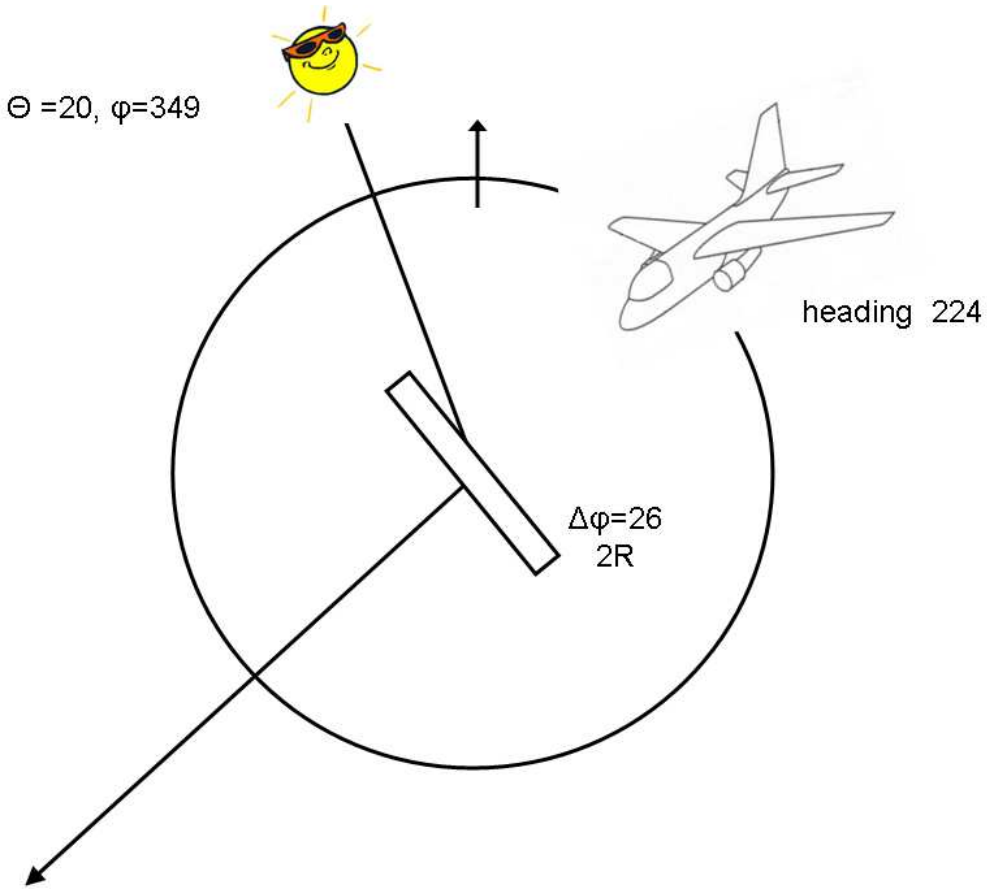
the 10th Novembre at the NAFE site.

TIME	θ_{sun}	ϕ_{sun}
9h00	39.5848	77.5668
10h00	27.6110	63.1156
11h00	17.8487	35.1207
12h00	15.5347	344.2503
13h00	23.0543	306.0185
14h00	34.4278	287.5106
15h00	46.8344	276.4033

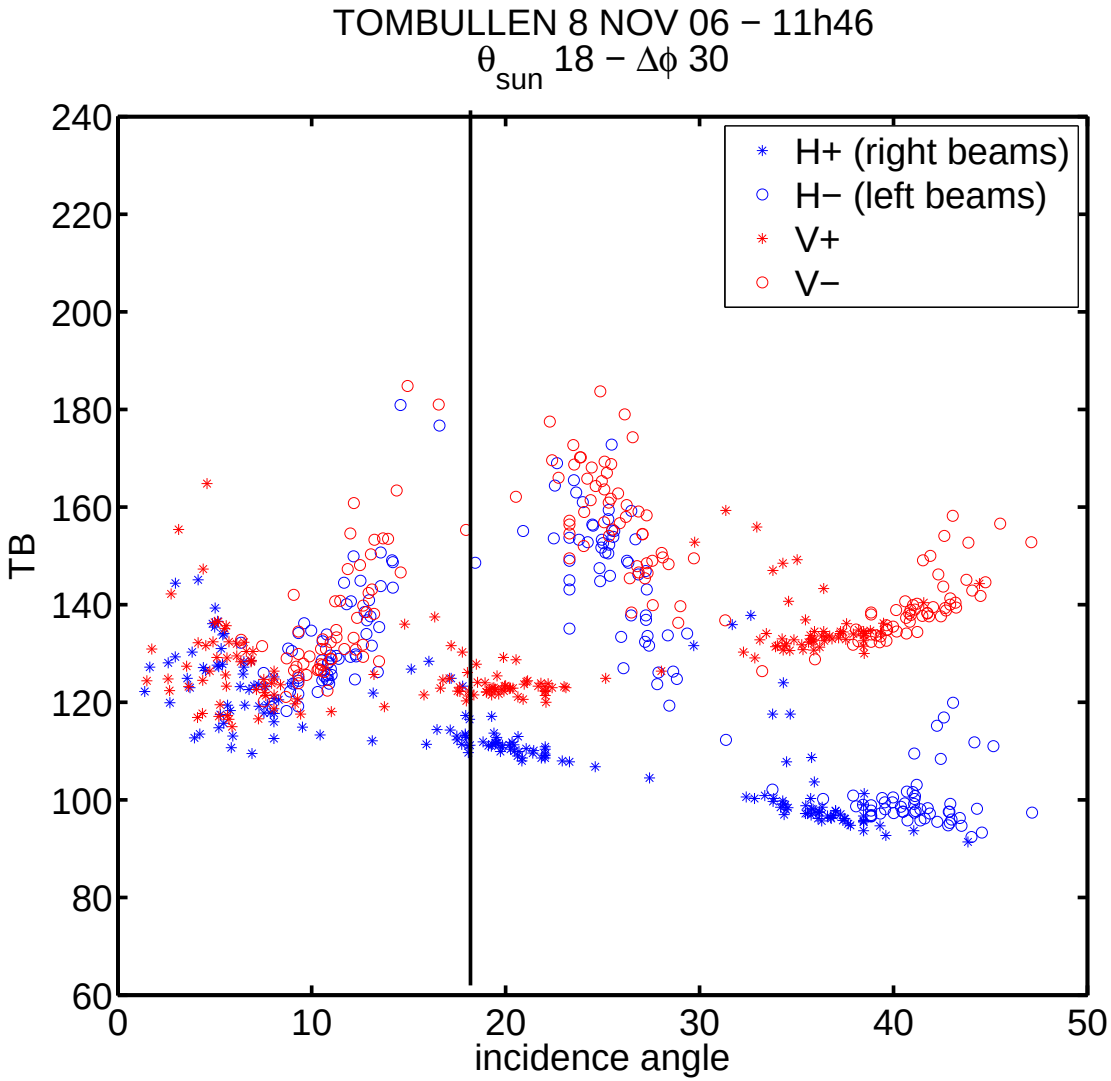
water

3 NOV 06 - 12h14

PLMR - across track



water


TOMBULLEN 8 NOV 06 − 11h46
θsun 18 − Δϕ 30
H+ (right beams)
H− (left beams)
V+
V−
TB
incidence angle
240
220
200
180
160
140
120
100
80
60
0
10
20
30
40
50

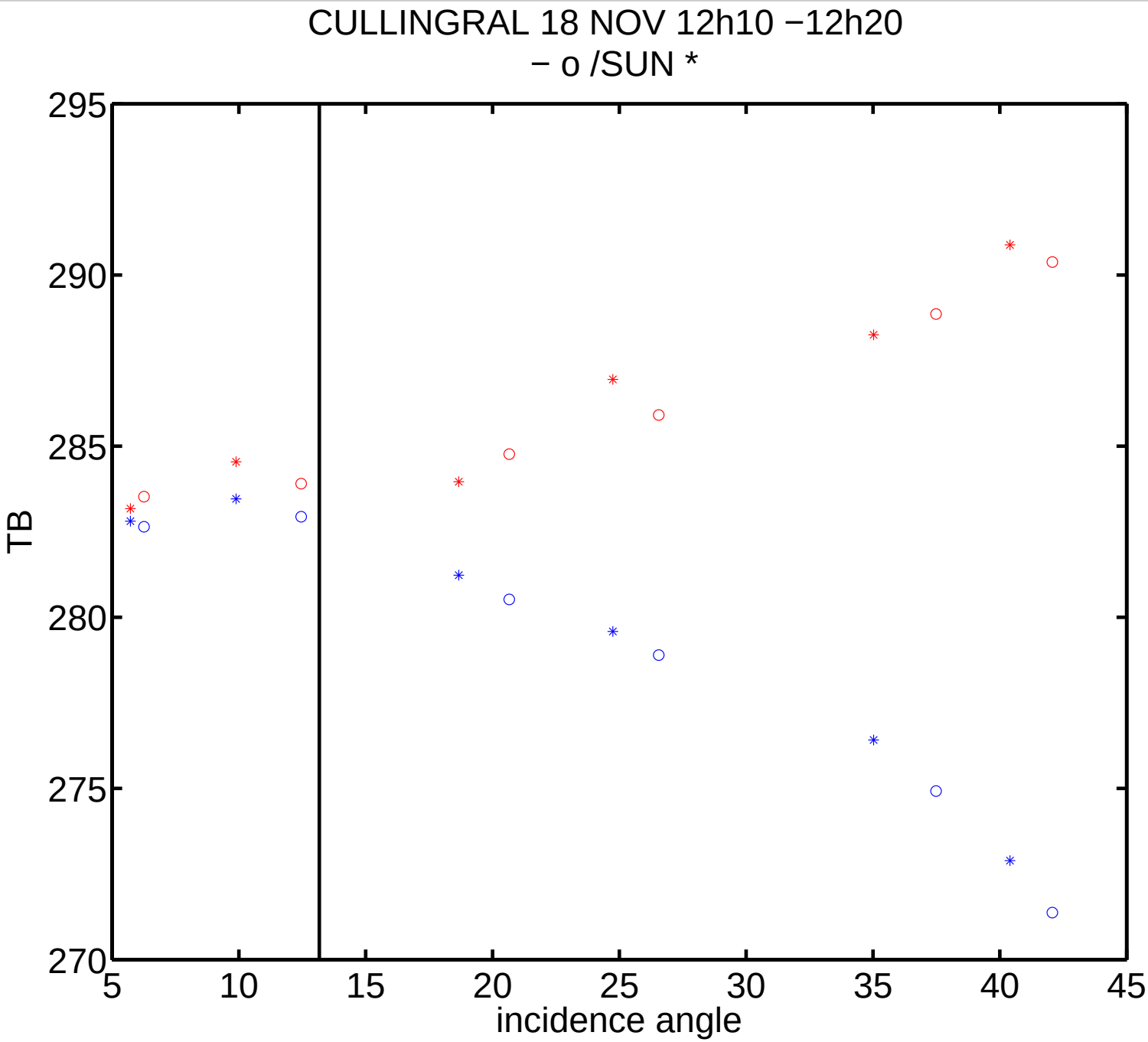
results sunglint WATER

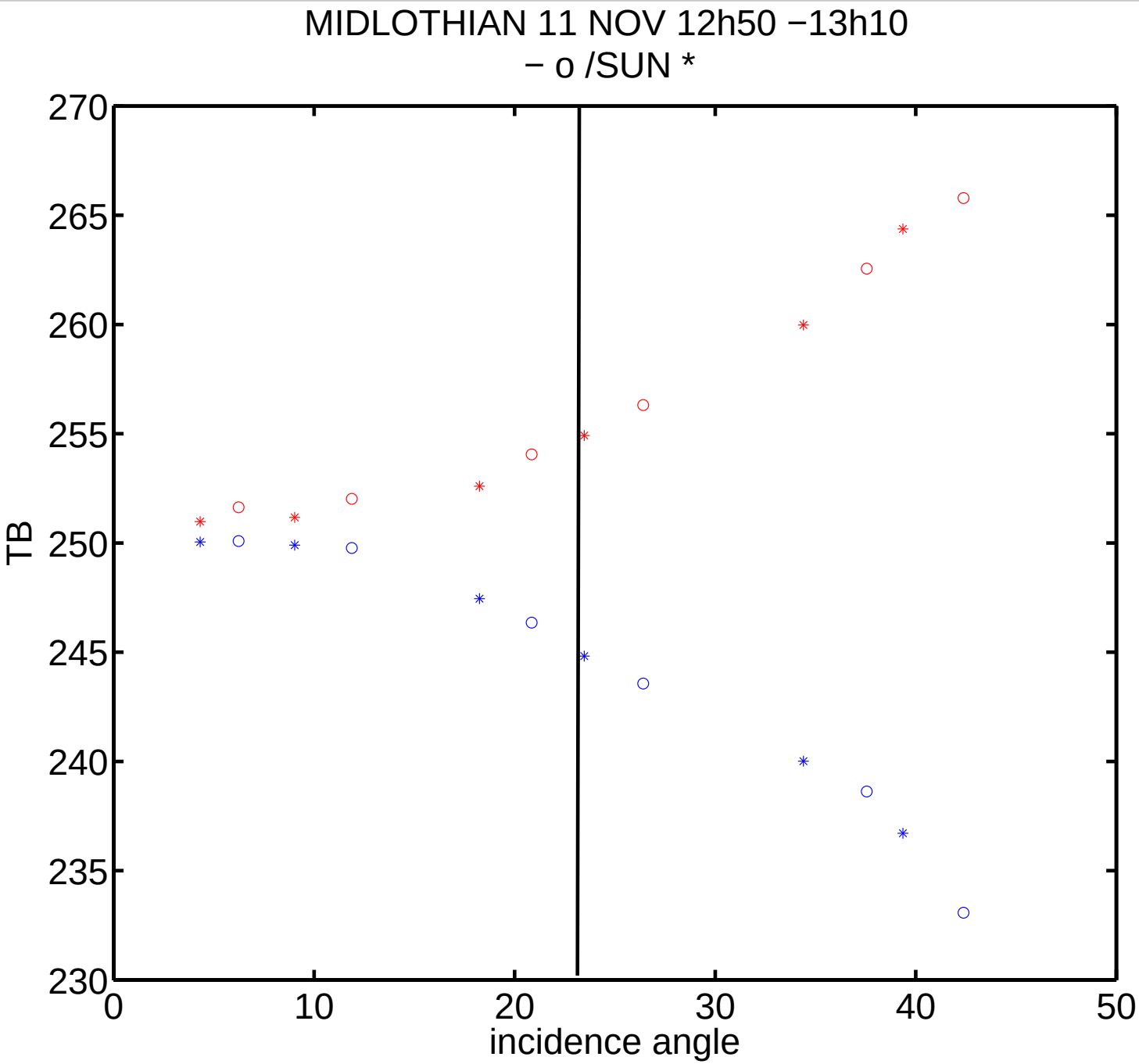
DAY	18NOV05	14NOV05	3NOV06	8NOV06
TIME	11h43	9h55	12h14	11h46
θ_{sun}	13	27	20	18
ϕ_{sun}	0	66	349	10
PLMR	along-track	across-track	across-track	across-track
heading	180	165	224	70
$\Delta\phi$	0	9	26	30
beam	2-3L	2L	2R	2L
$\Delta T_{B_{max}}$	100 K	70 K	60 K	60 K

sunglint over LAND

- land = heterogeneous surface
- along track configuration is preferred, same surface at different incidence angles

DAY	TIME	θ_{sun}	ϕ_{sun}	farm	$\Delta\phi$
18NOV05	12h10 - 12h23	14	330	Cullingral	30
11NOV05	12h50 - 13h10	23	306	Midlothian	54


CULLINGRAL 18 NOV 12h10 −12h20
− o /SUN *
TB
incidence angle
295
290
285
280
275
270
5
10
15
20
25
30
35
40
45


MIDLOTHIAN 11 NOV 12h50 −13h10
− o /SUN *
TB
incidence angle
270
265
260
255
250
245
240
235
230
0
10
20
30
40
50

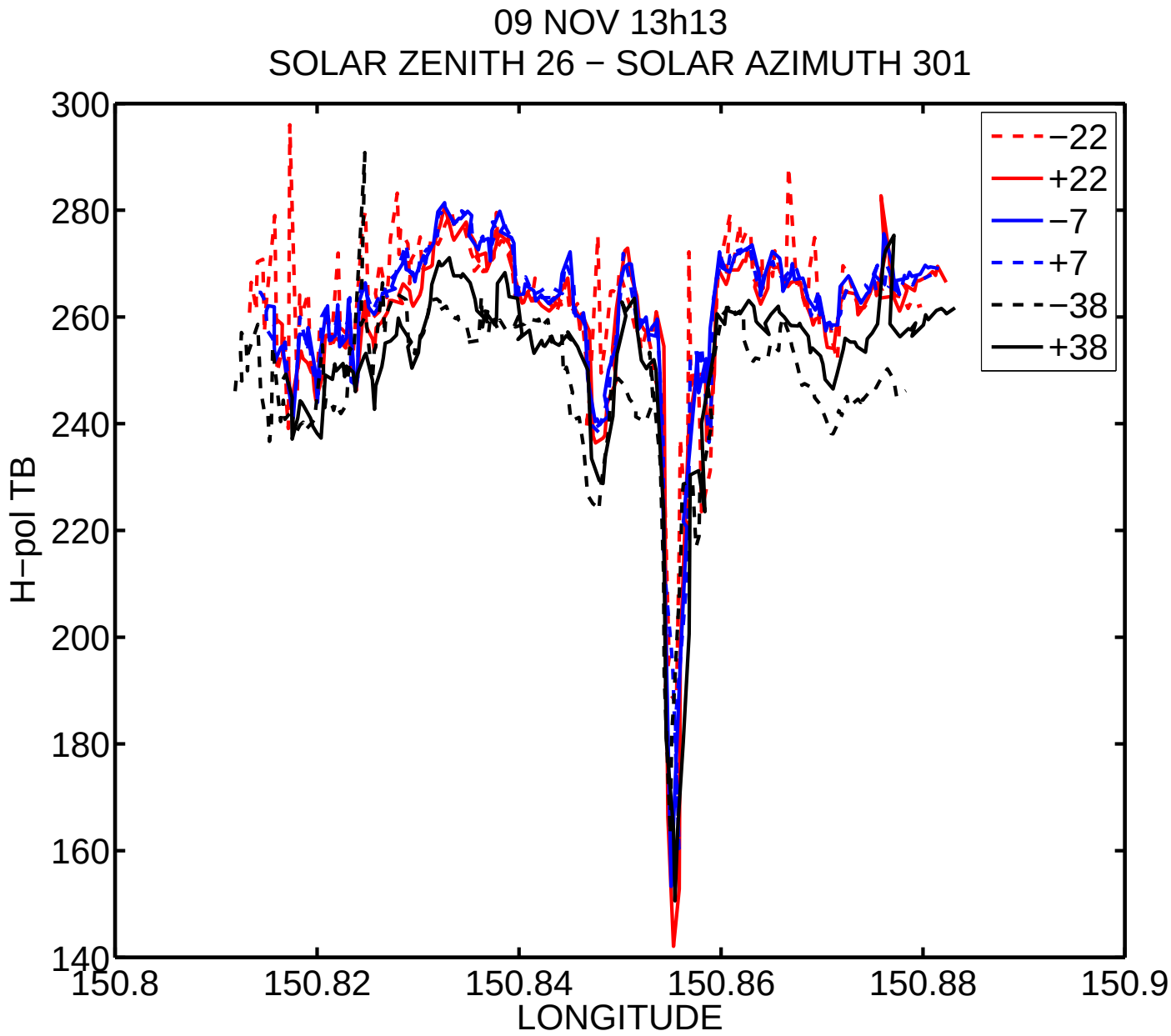
no clear sunglint effects over farms

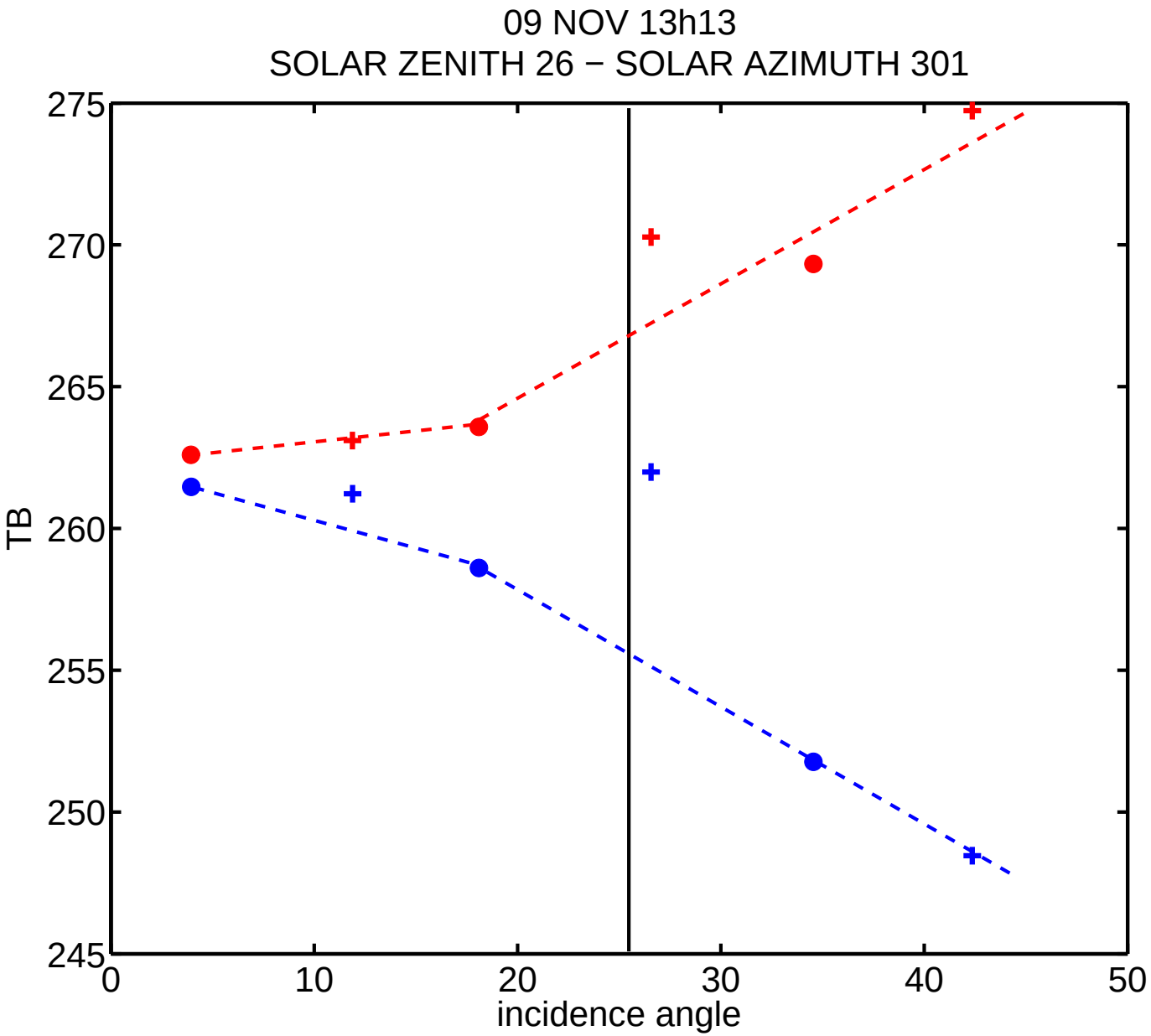
BUT

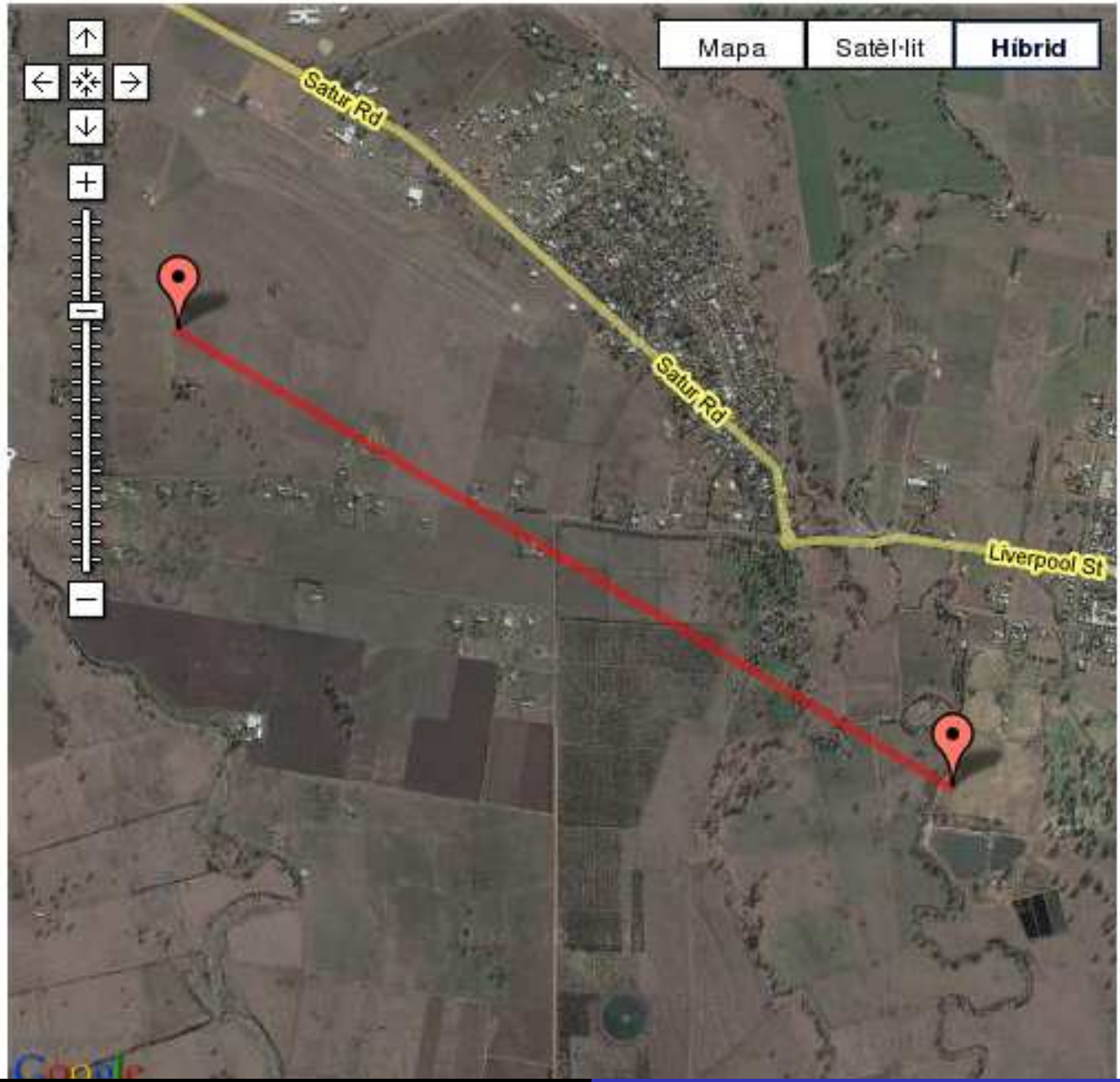
- 18th Nov, $\Delta\phi = 30$, reflectivity 0.05 (very dry soil)
- 11th Nov, reflectivity 0.17 but $\Delta\phi = 54$!

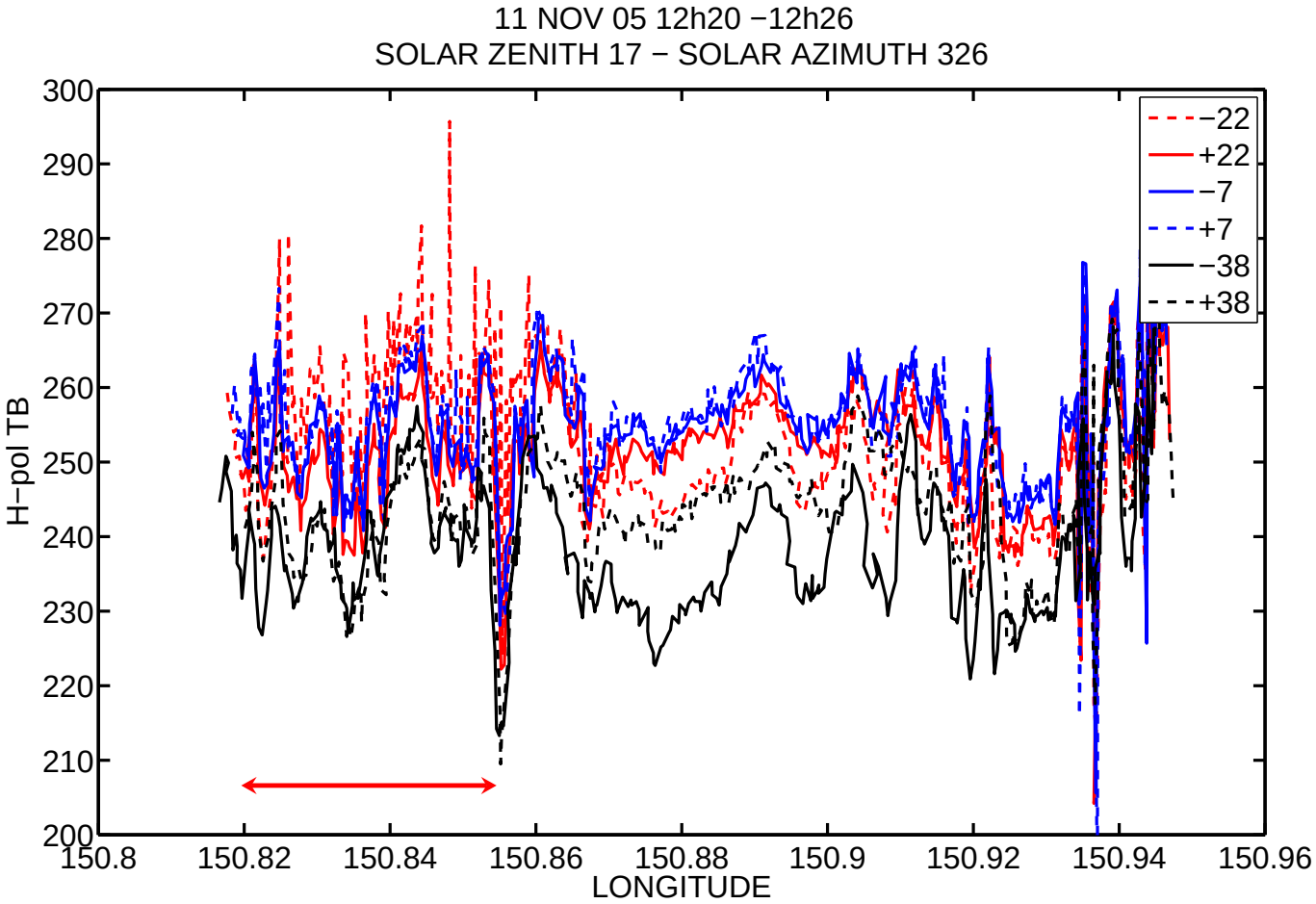
conclusion: NO conditions for the study over known surfaces

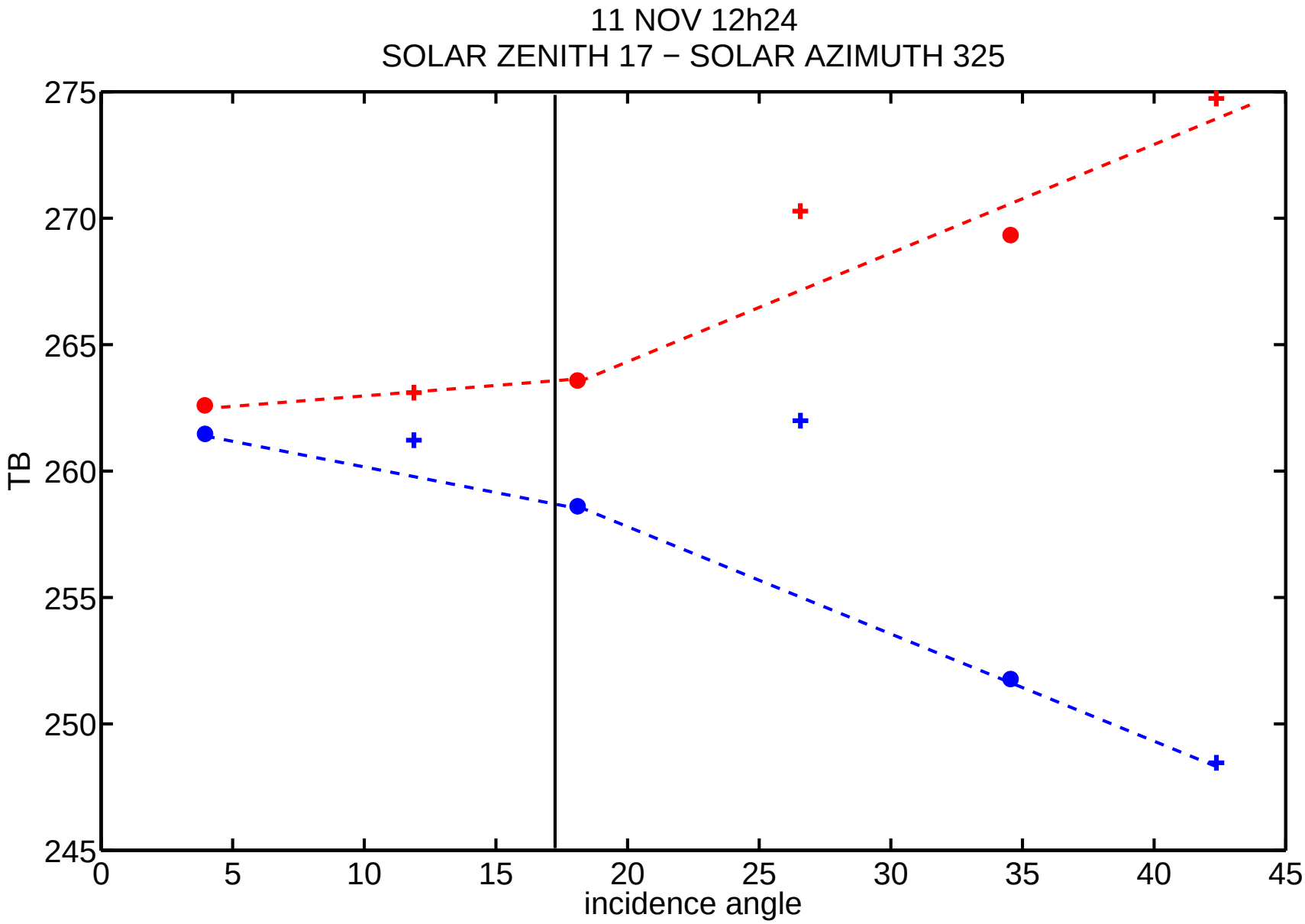

Mapa
Satèl·lit
Hibrid
New England Hwy
15
Brushy Hill
Satur Rd
Satur
Scone
Gundy Rd
Moobi
15


09 NOV 13h13
SOLAR ZENITH 26 − SOLAR AZIMUTH 301
H−pol TB
LONGITUDE
300
280
260
240
220
200
180
160
140
150.8
150.82
150.84
150.86
150.88
150.9
−22
+22
−7
+7
−38
+38


09 NOV 13h13
SOLAR ZENITH 26 − SOLAR AZIMUTH 301
TB
incidence angle
275
270
265
260
255
250
245
0
10
20
30
40
50


Mapa
Satèl·lit
Híbrid
Satur Rd
Satur Rd
Liverpool St


11 NOV 05 12h20 −12h26
SOLAR ZENITH 17 − SOLAR AZIMUTH 326
H−pol TB
LONGITUDE
300
290
280
270
260
250
240
230
220
210
200
150.8
150.82
150.84
150.86
150.88
150.9
150.92
150.94
150.96
−22
+22
−7
+7
−38
+38


11 NOV 12h24
SOLAR ZENITH 17 − SOLAR AZIMUTH 325
TB
incidence angle
275
270
265
260
255
250
245
0
5
10
15
20
25
30
35
40
45

results sunglint LAND

DAY	TIME	θ_{sun}	ϕ_{sun}	heading	$\Delta\phi$	beam	ΔT_B
9NOV05	13h10	25	302	108	14	2L	10K
11NOV05	12h20	17	328	115	33	2L	10K

THEORIC CALCULATIONS

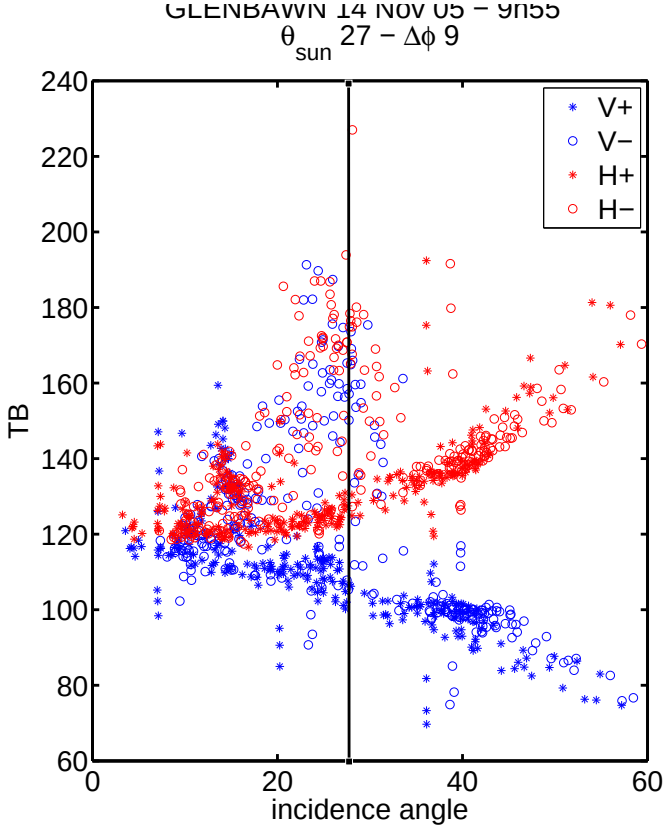
$$T_{sun} = \frac{\lambda^2}{2k\Omega_{sun}} SFU 10^{-22}$$

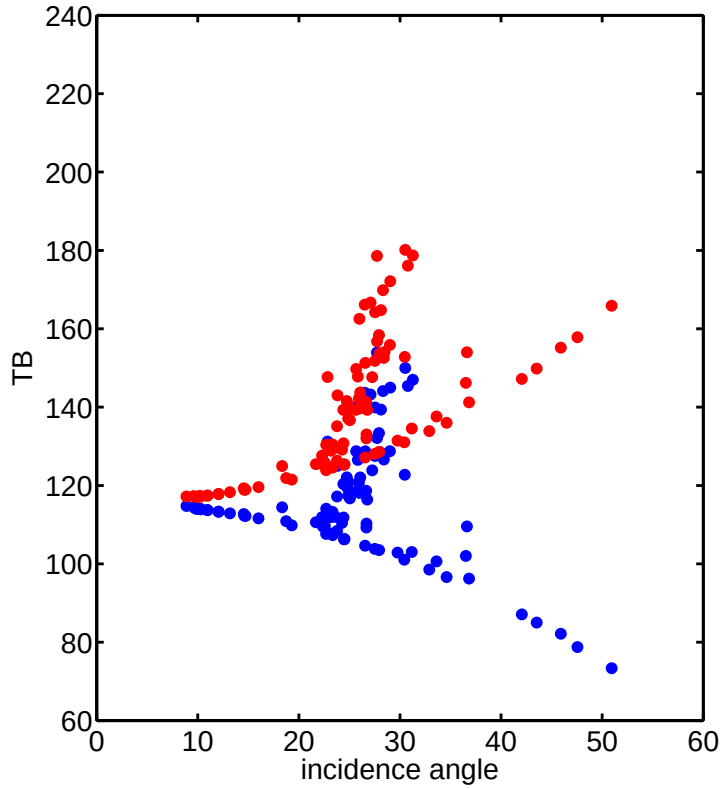
Radio Solar Telecope Network
Learmonth Australia 22S 114E

$$T_a = F_n \Gamma T_{sun} \frac{\Omega_{sun}}{\Omega_t}$$

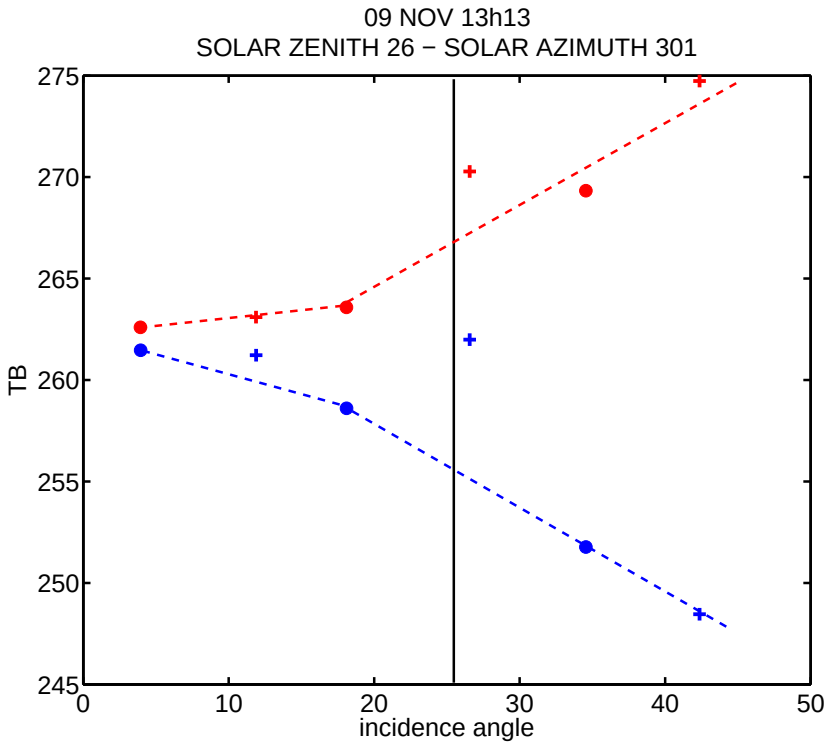
specular reflexion

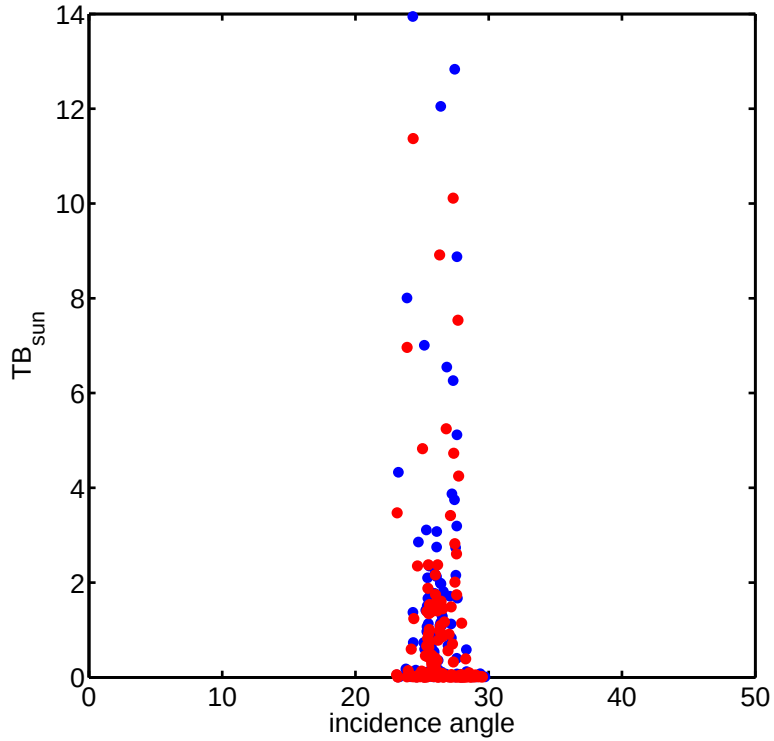
water


GLENBAWN 14 Nov 05 – 9h55
θ sun 27 – Δϕ 9
V+
V−
H+
H−
TB
incidence angle
240
220
200
180
160
140
120
100
80
60
0
20
40
60


TB
incidence angle
240
220
200
180
160
140
120
100
80
60
0
10
20
30
40
50
60

land


09 NOV 13h13
SOLAR ZENITH 26 − SOLAR AZIMUTH 301
TB
incidence angle
275
270
265
260
255
250
245
0
10
20
30
40
50


TB_sun
incidence angle
14
12
10
8
6
4
2
0
0
10
20
30
40
50

conclusions

- 'hot-spot' over the lake when flying close to water surface, probably aircraft or radiometer emission reflected on water
- sunglint effects over water Δ TB 100K
- over land Δ TB $\sim$ 10K
- good agreement with theoric calculations considering specular reflectivity both over land and water

perspectives

- calculations over better known land surfaces to assess impact in SMOS mission