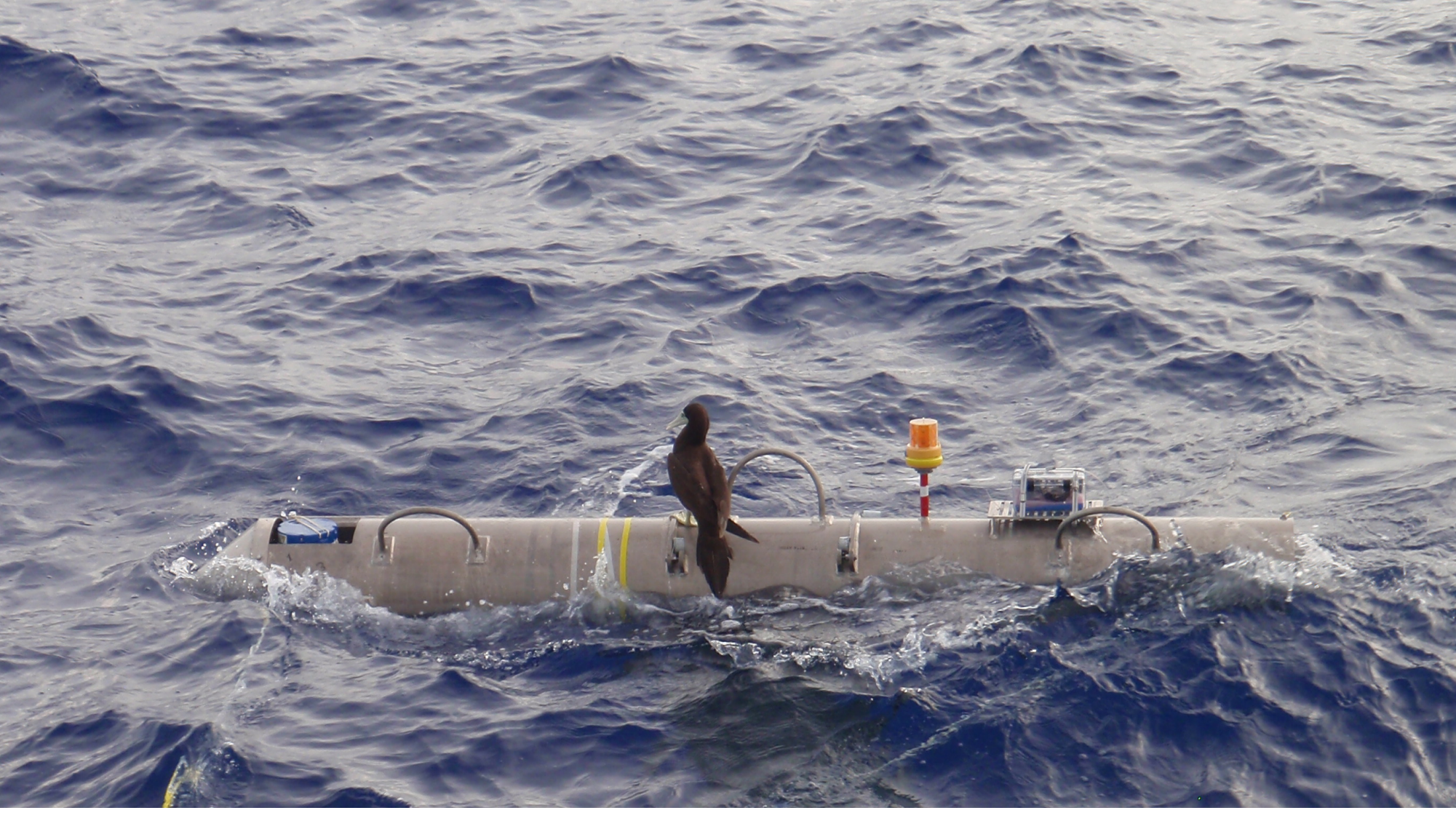
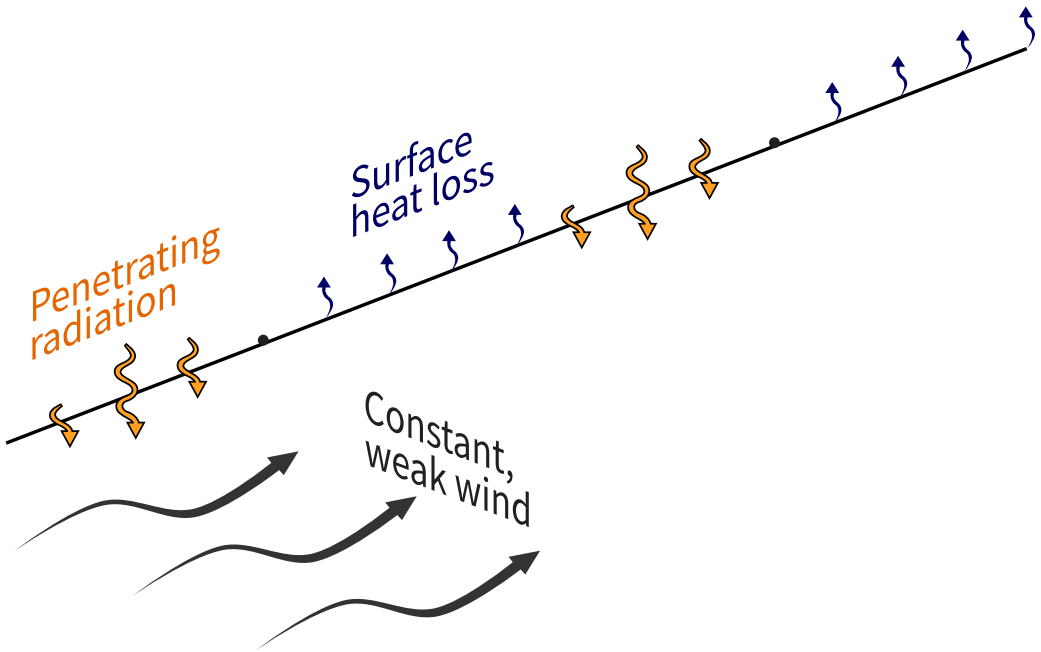


DIURNAL WARM LAYERS

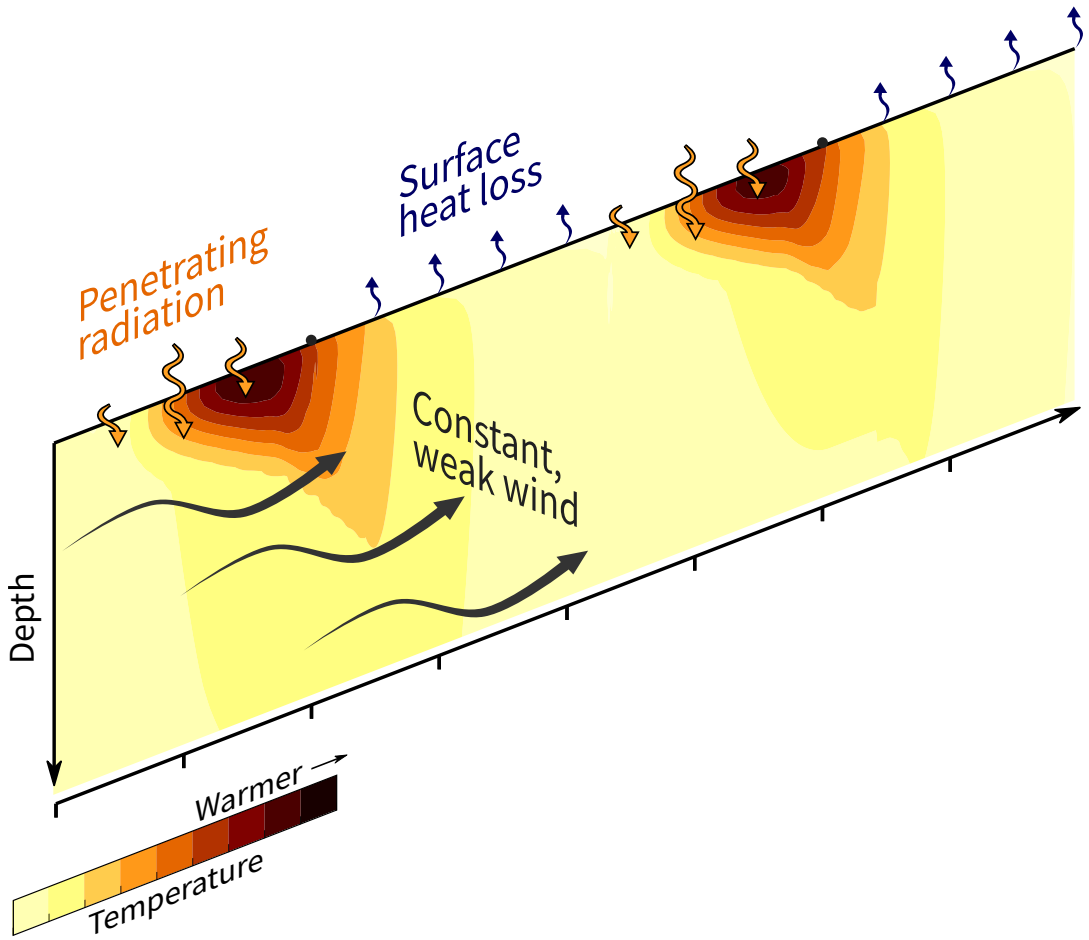
SHEAR AND HEAT FLUXES VS WIND SPEED

Ken Hughes, Jim Moum, Emily Shroyer

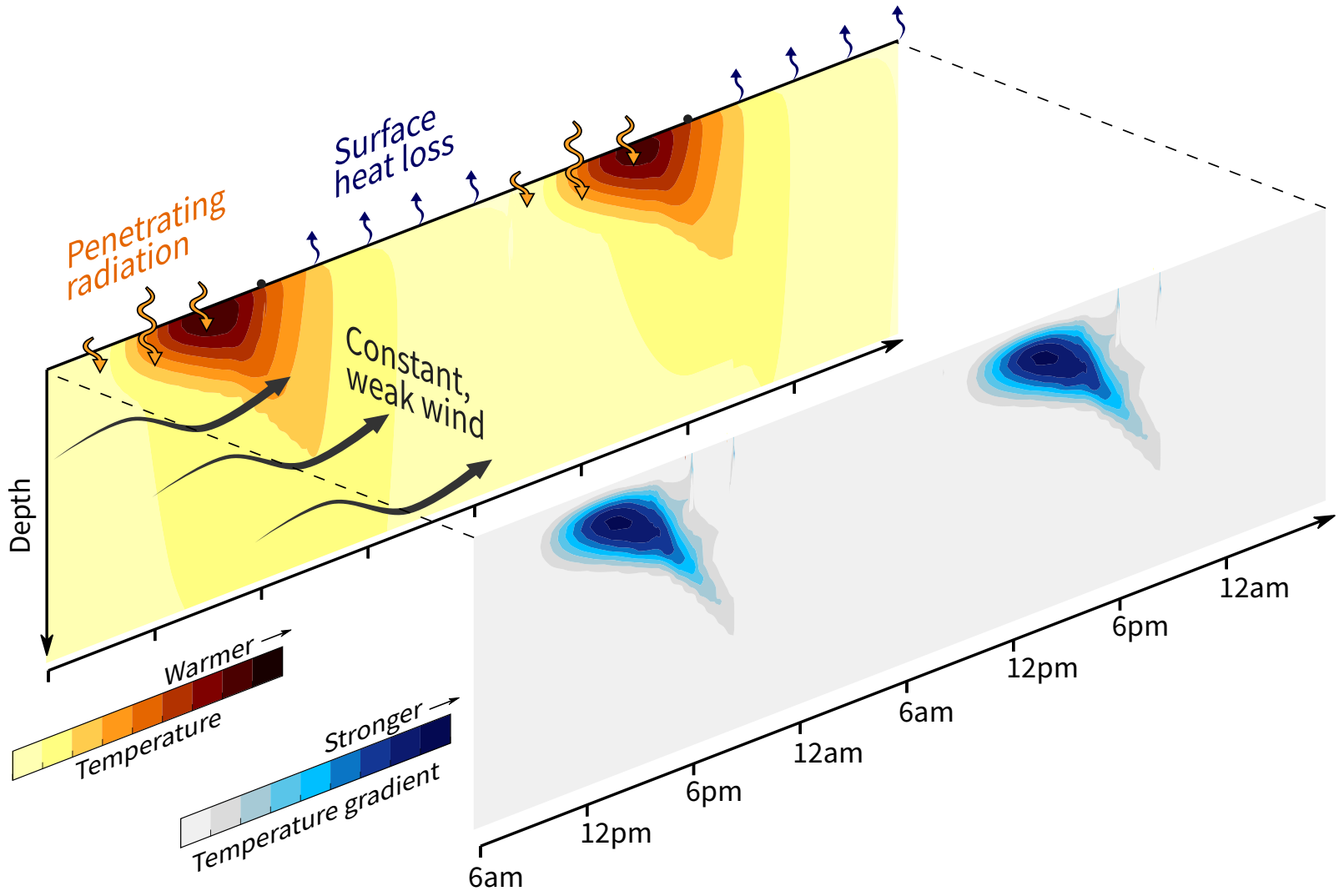
Near-surface temperature and velocity gradients



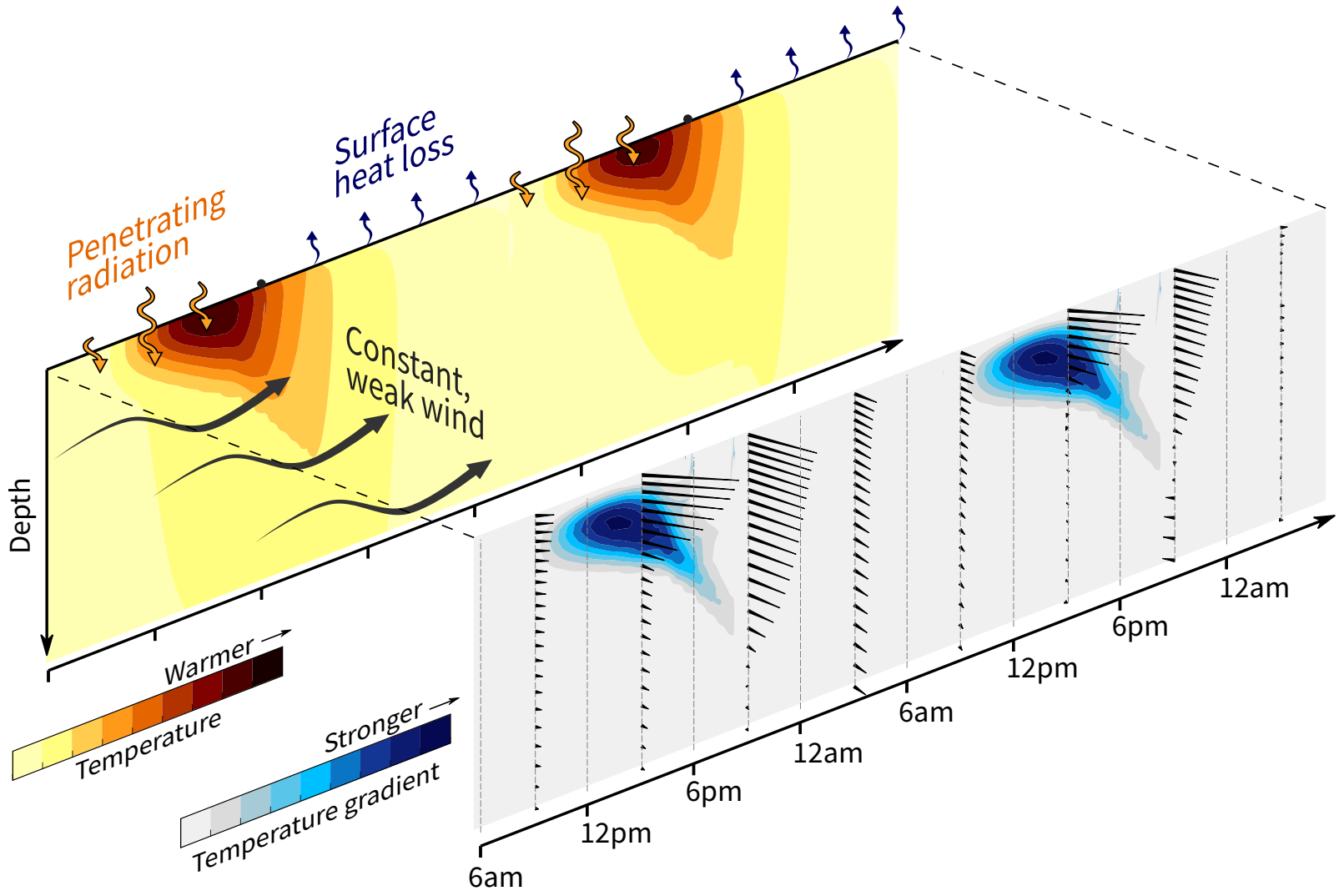
Near-surface temperature and velocity gradients

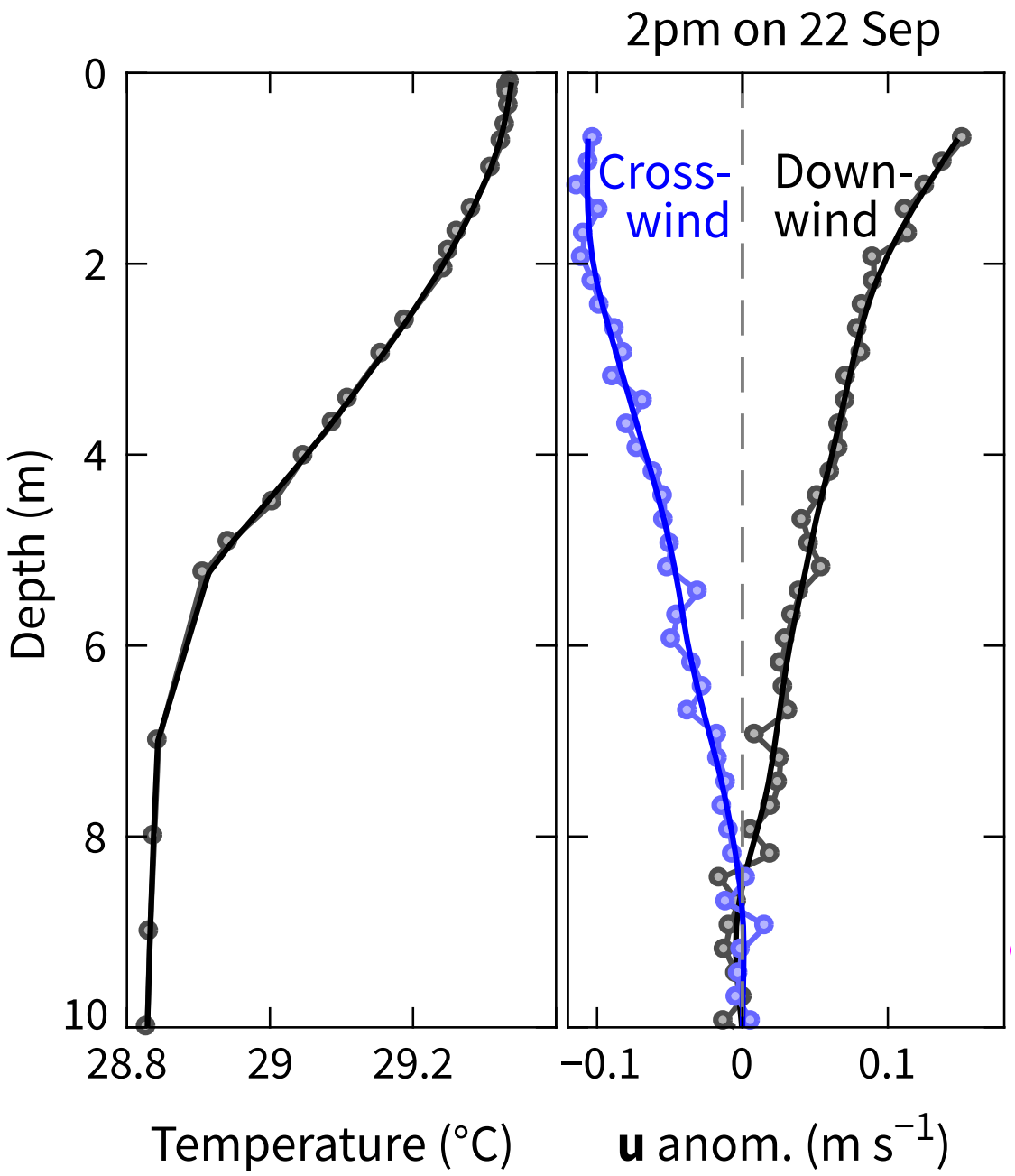


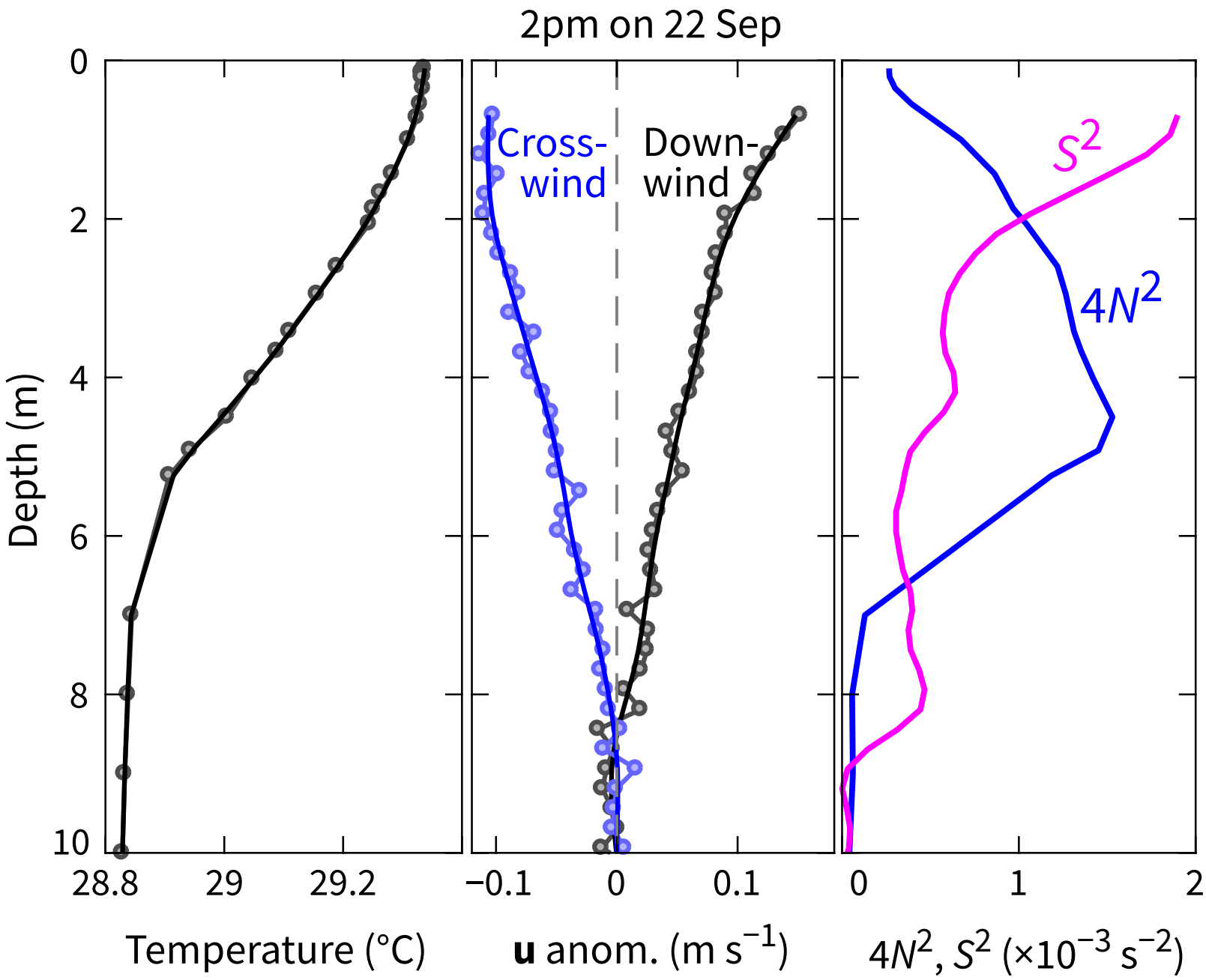
Near-surface temperature and velocity gradients

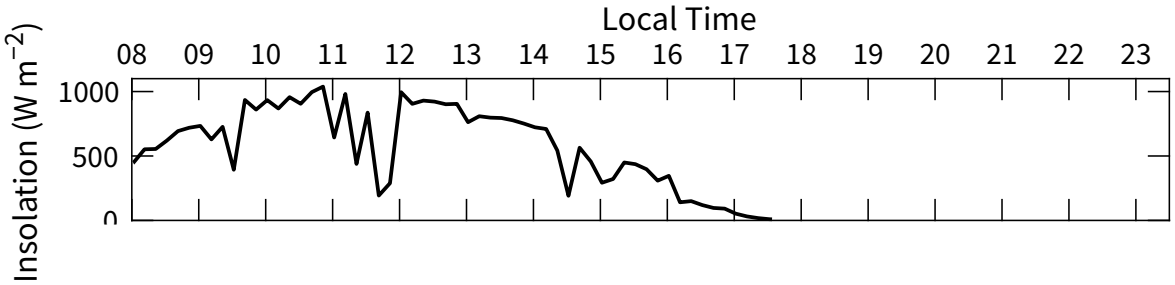


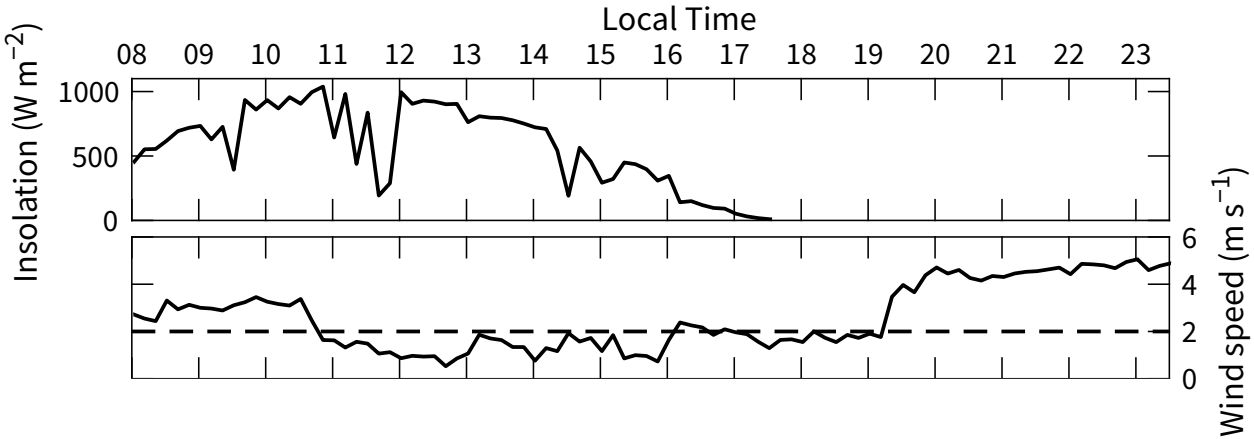
Near-surface temperature and velocity gradients

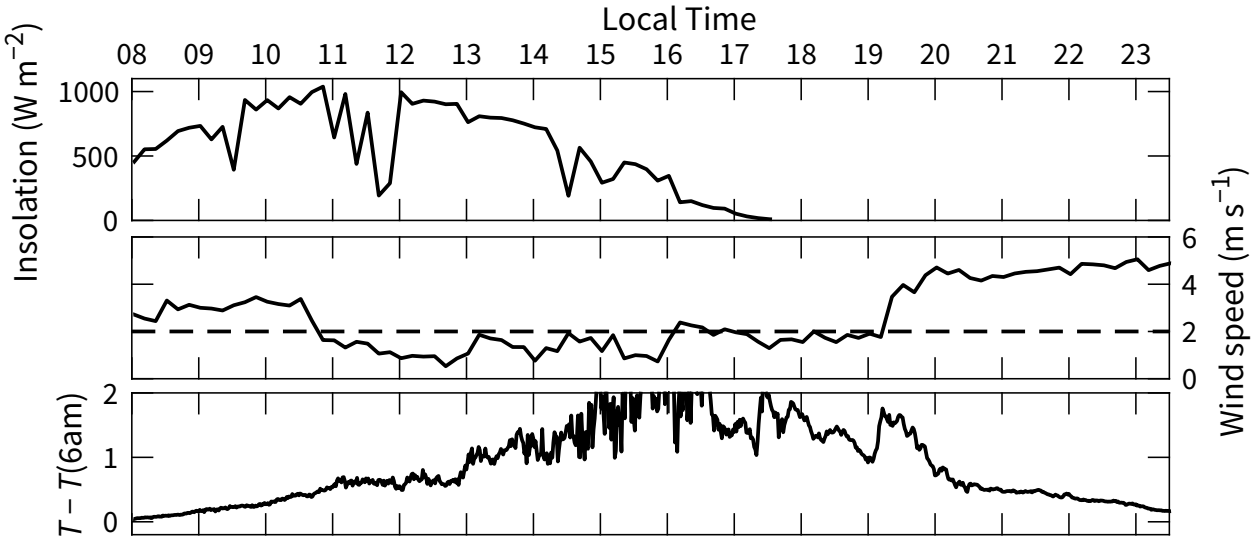


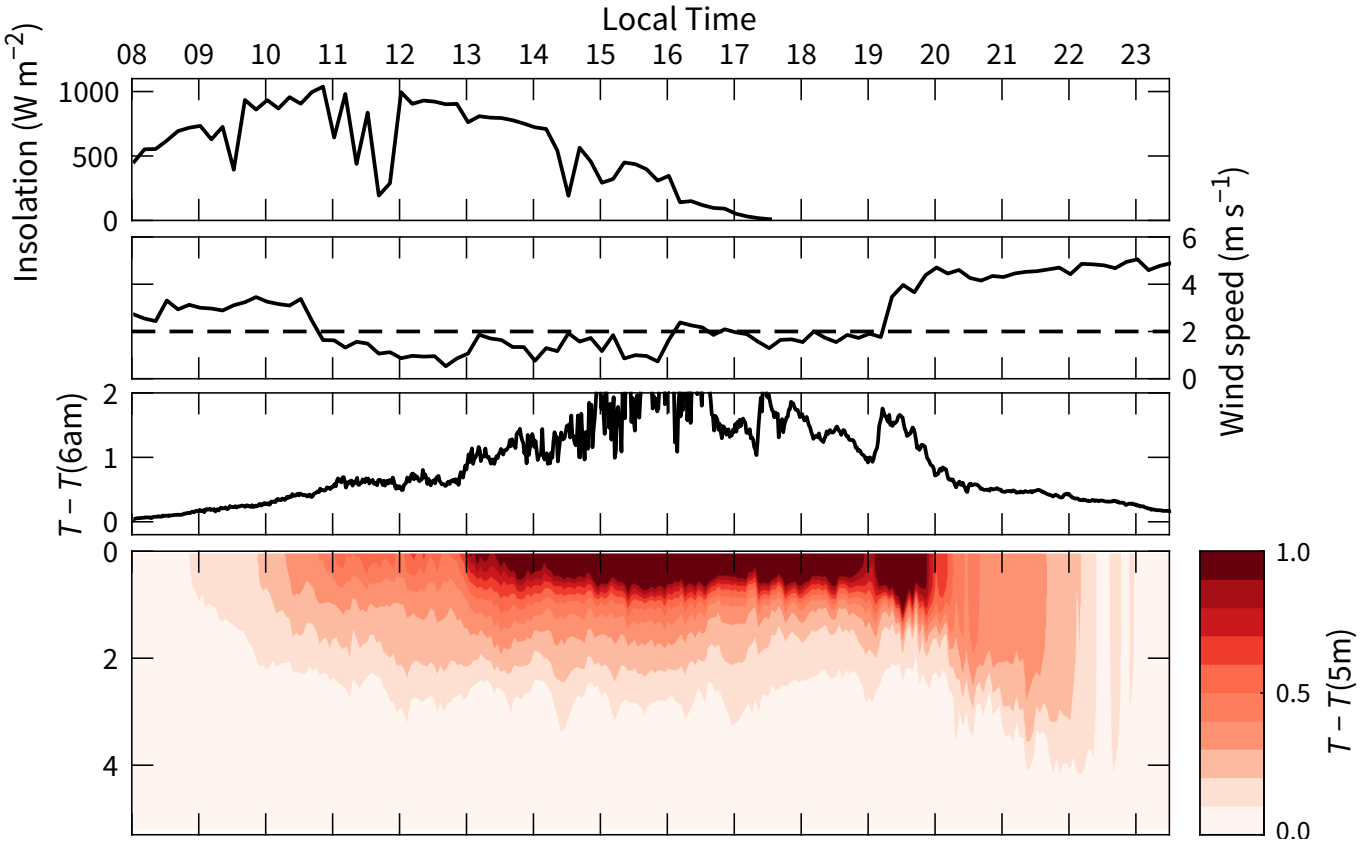

2pm on 22 Sep
Depth (m)
0
2
4
6
8
10
28.8
29
29.2
Temperature (°C)
Cross-
wind
Down-
wind
−0.1
0
0.1
u anom. (m s−1)

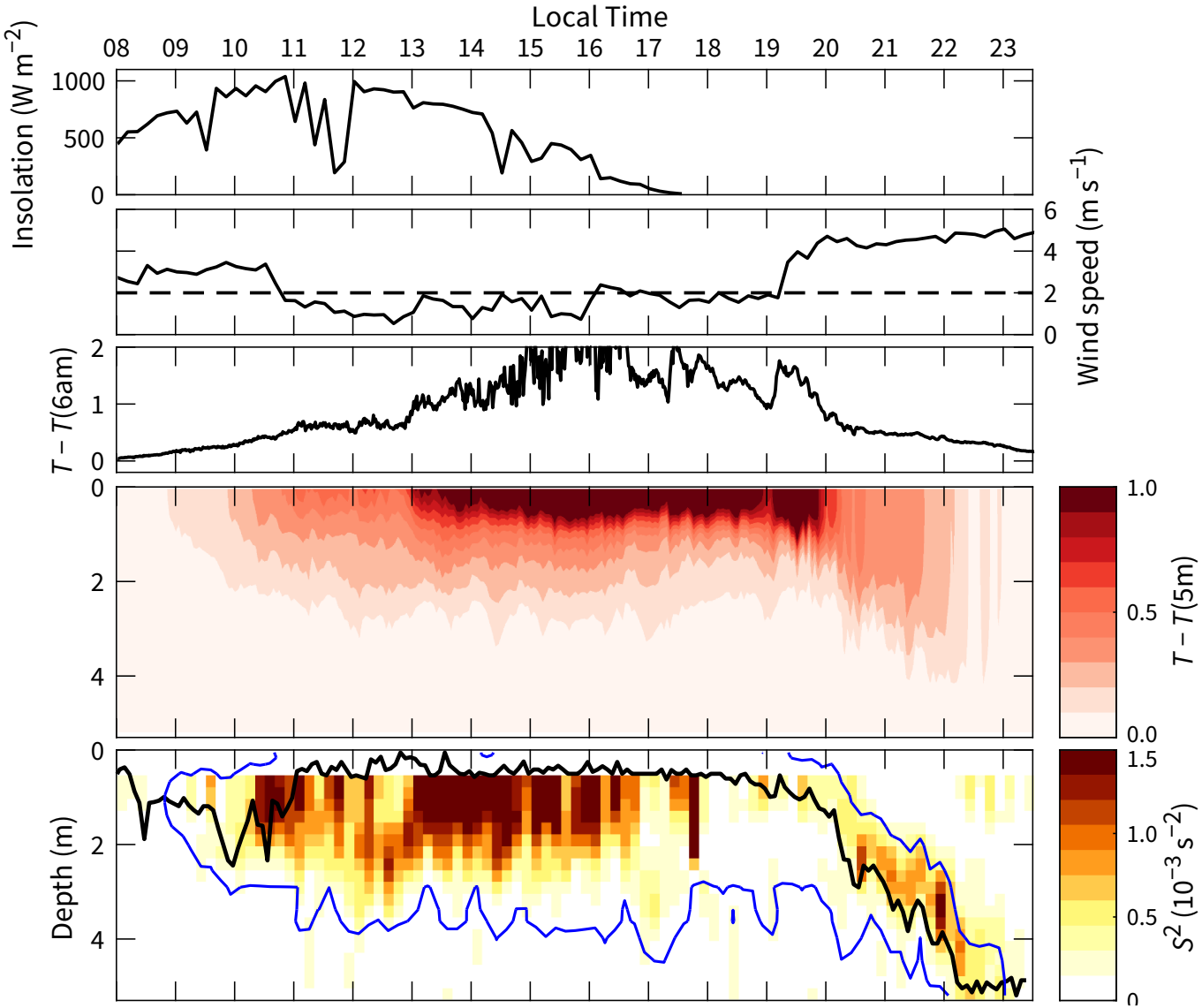

2pm on 22 Sep
Depth (m)
0
2
4
6
8
10
28.8
29
29.2
Temperature (°C)
Cross-
wind
Down-
wind
−0.1
0
0.1
u anom. (m s−1)
S2
4N2
0
1
2
4N2, S2 (×10−3 s−2)

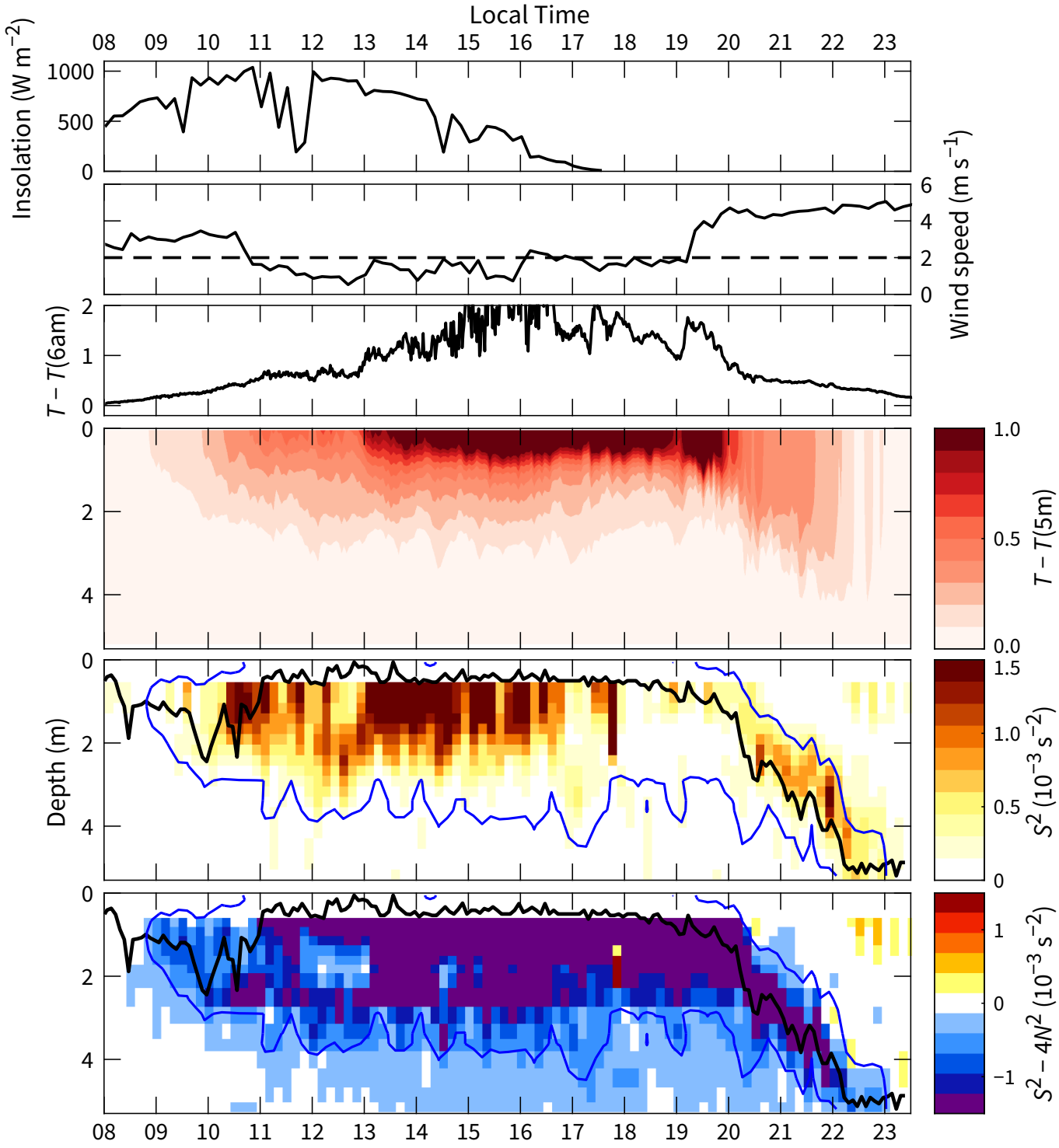

Local Time
08
09
10
11
12
13
14
15
16
17
18
19
20
21
22
23
Insolation (W m^{-2})
1000
500
0

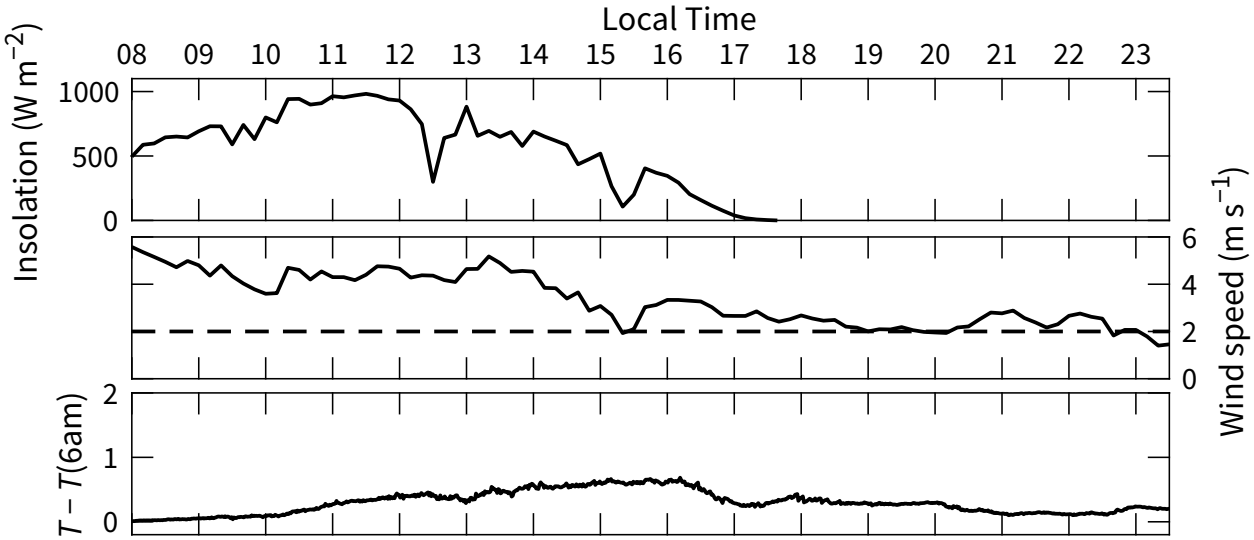

Local Time
08
09
10
11
12
13
14
15
16
17
18
19
20
21
22
23
Insolation (W m^{-2})
1000
500
0
Wind speed (m s^{-1})
6
4
2
0

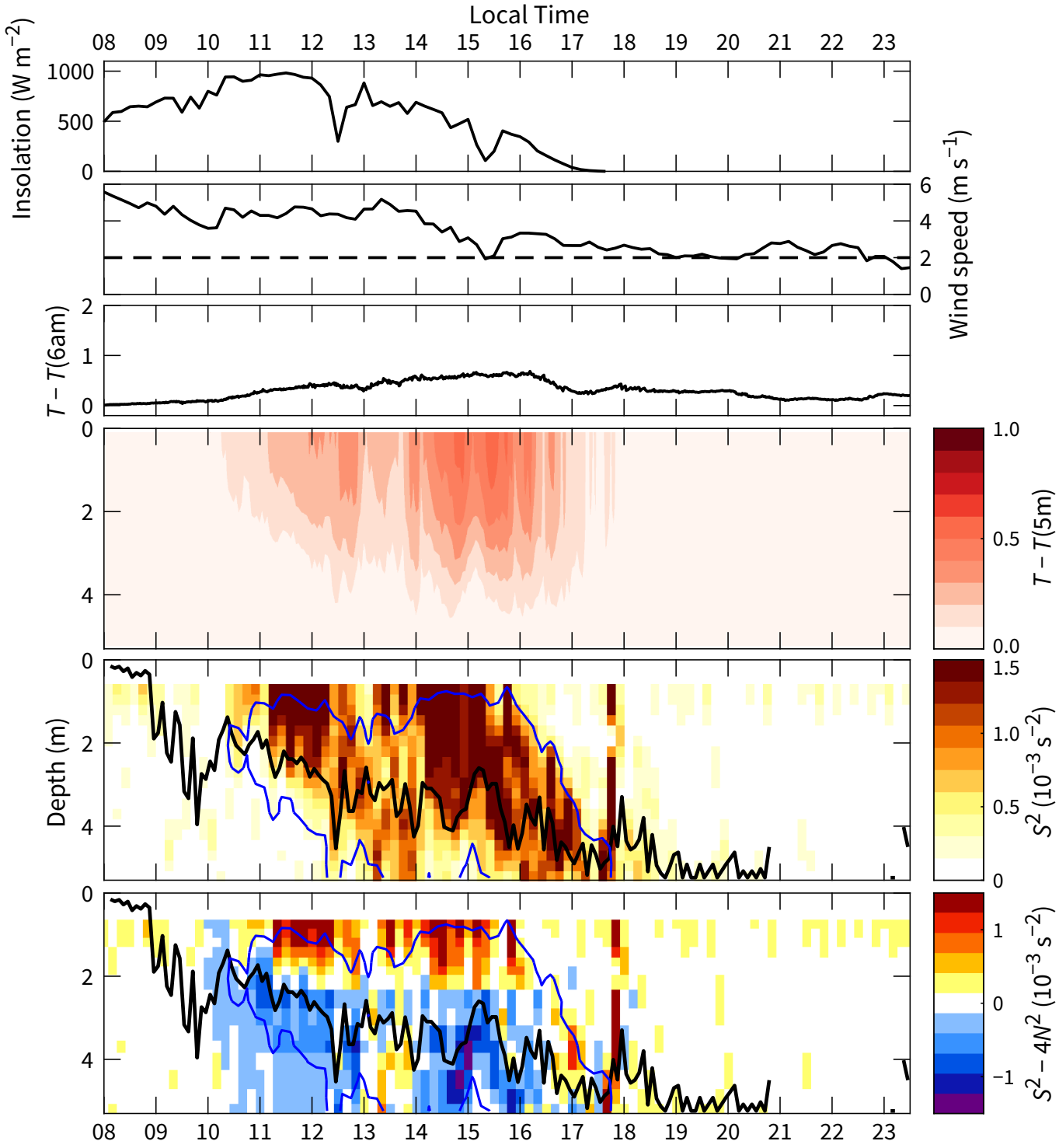

Local Time
08
09
10
11
12
13
14
15
16
17
18
19
20
21
22
23
Insolation (W m^{-2})
1000
500
0
6
4
2
0
Wind speed (m s^{-1})
2
1
0
$T - T$(6am)


Local Time
08
09
10
11
12
13
14
15
16
17
18
19
20
21
22
23
Insolation (W m^{-2})
1000
500
0
Wind speed (m s^{-1})
6
4
2
0
$T - T$(6am)
2
1
0
0
2
4
1.0
0.5
0.0
$T - T$(5m)


Local Time
08
09
10
11
12
13
14
15
16
17
18
19
20
21
22
23
Insolation (W m^{-2})
1000
500
0
Wind speed (m s^{-1})
6
4
2
0
$T - T$(6am)
2
1
0
0
2
4
Depth (m)
$T - T$(5m)
1.0
0.5
0.0
S^2 (10^{-3} s^{-2})
1.5
1.0
0.5
0


Local Time
08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23
Insolation (W m^{-2})
1000
500
0
Wind speed (m s^{-1})
6
4
2
0
$T - T$(6am)
2
1
0
Depth (m)
0
2
4
$T - T$(5m)
1.0
0.5
0.0
S^2 (10^{-3} s^{-2})
1.5
1.0
0.5
0
$S^2 - 4N^2$ (10^{-3} s^{-2})
1
0
−1


Local Time
08
09
10
11
12
13
14
15
16
17
18
19
20
21
22
23
Insolation (W m^{-2})
1000
500
0
Wind speed (m s^{-1})
6
4
2
0
$T - T$(6am)
2
1
0


Local Time
08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23
Insolation (W m^{-2})
1000
500
0
Wind speed (m s^{-1})
6
4
2
0
$T - T$(6am)
2
1
0
Depth (m)
0
2
4
$T - T$(5m)
1.0
0.5
0.0
S^2 (10^{-3} s^{-2})
1.5
1.0
0.5
0
$S^2 - 4N^2$ (10^{-3} s^{-2})
1
0
−1

Mixing is minimal at low wind speeds

Kinetic energy input:

$$\frac{u^2 + v^2}{2} = \frac{1}{2}\left(\frac{\tau}{h\rho_{\mathrm{w}} f}\right)^2 (2 - 2\cos(ft))$$

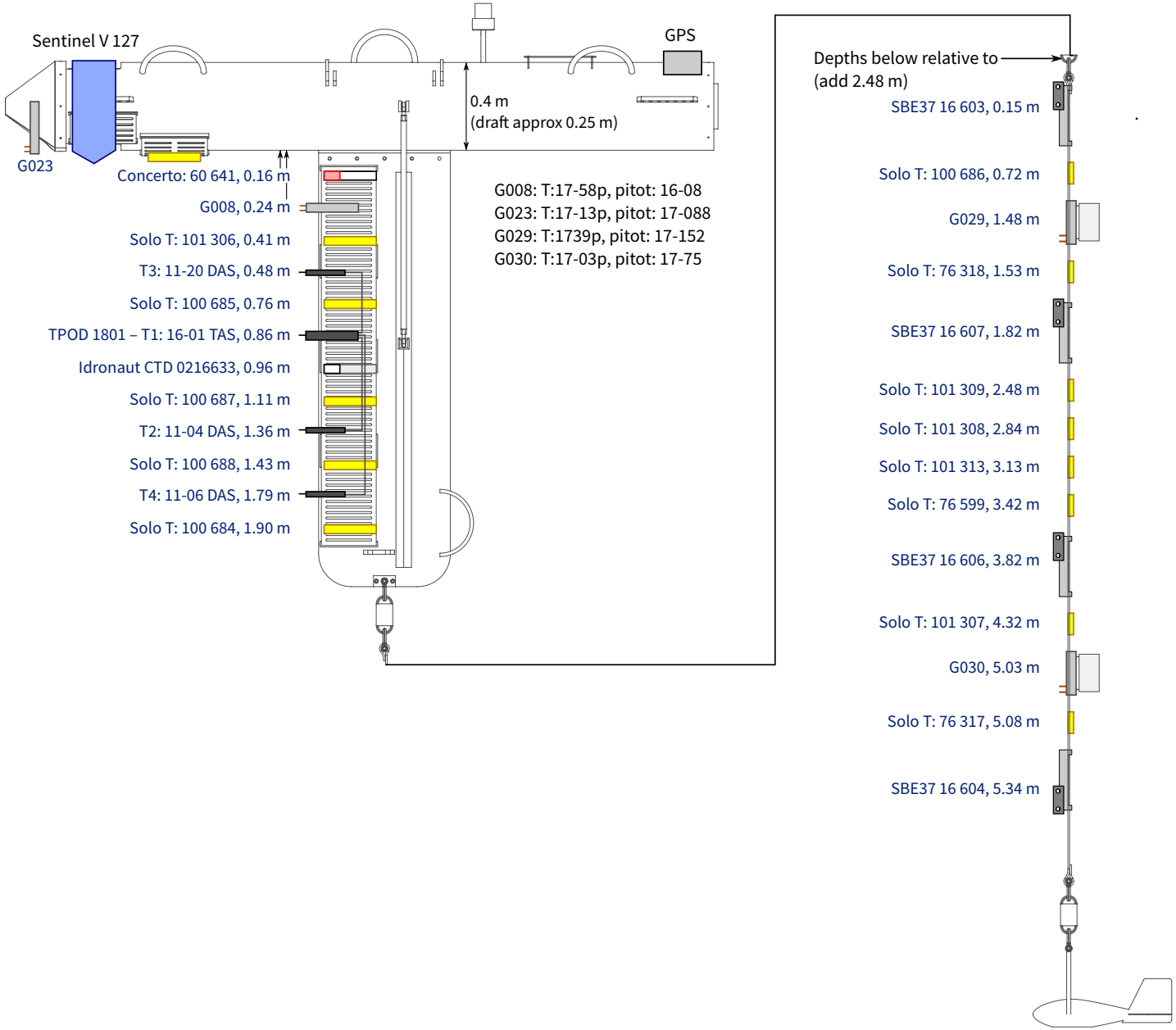
Potential energy input:

$$J_b t = \frac{g\alpha}{\rho_{\mathrm{w}} c_p} J_q t,$$

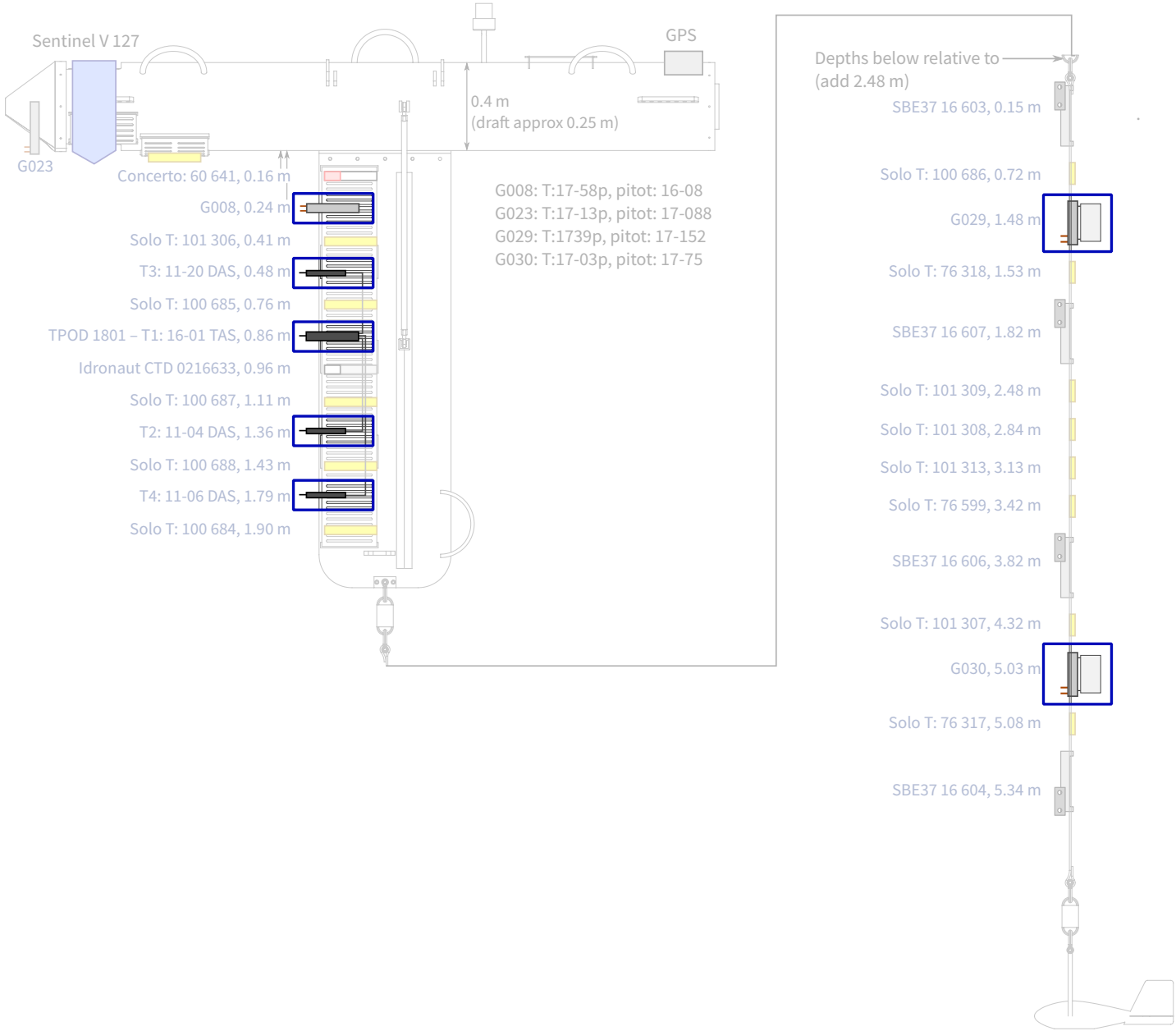
$$U_{\mathrm{cr}} \approx 2\,\mathrm{m\,s^{-1}}$$

Hughes et al. (under review, JPO)

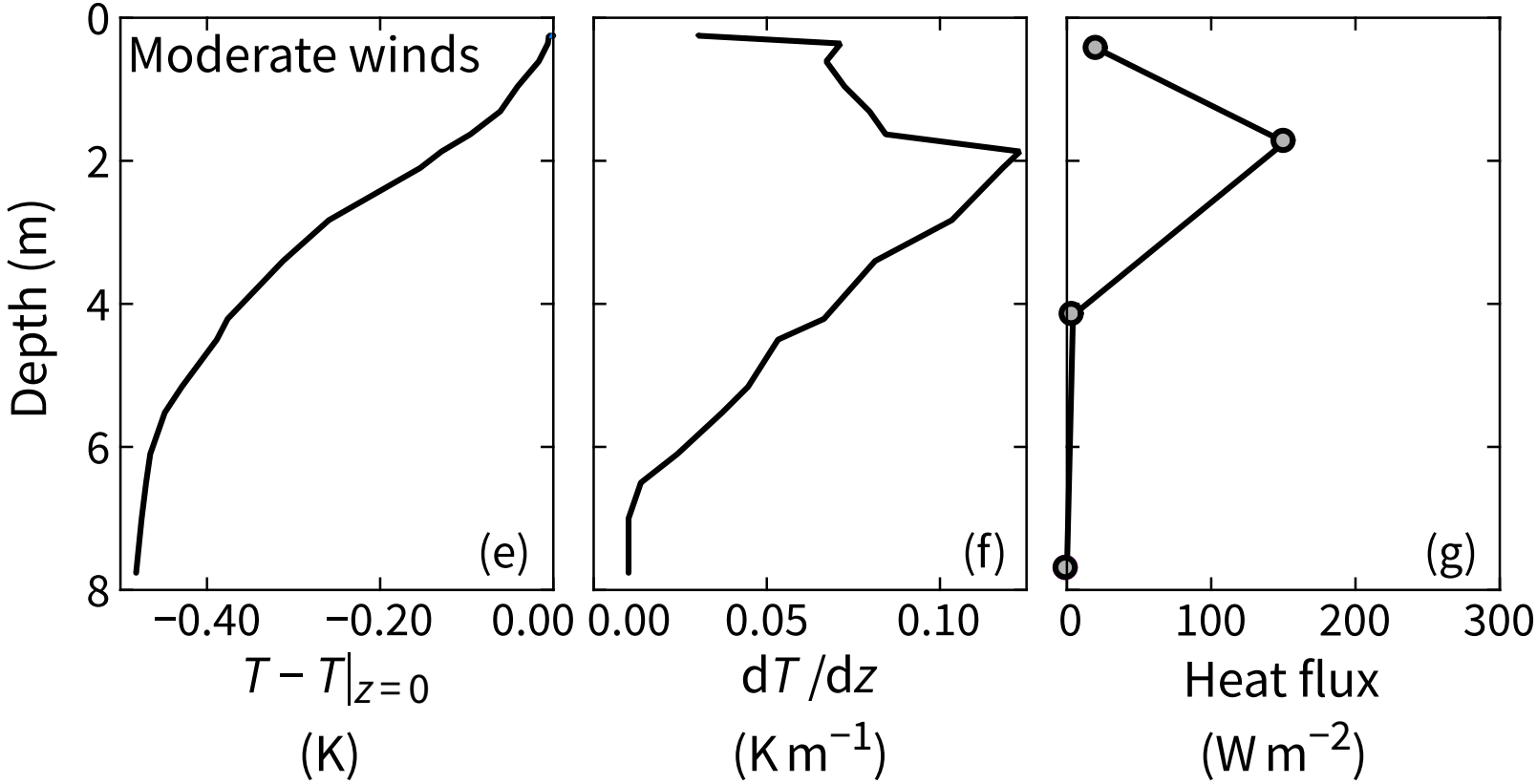
Direct turbulence measurements



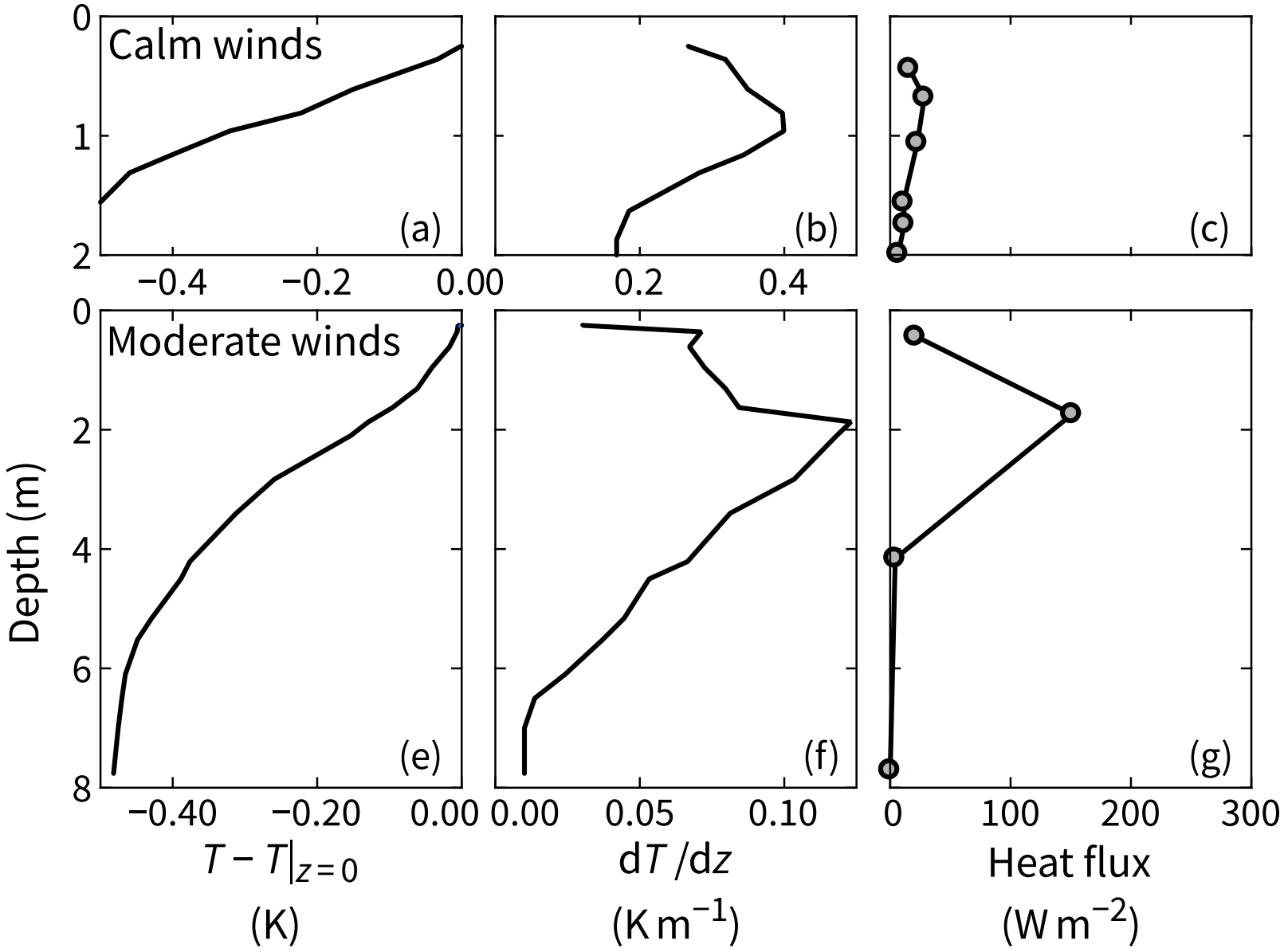
Direct turbulence measurements



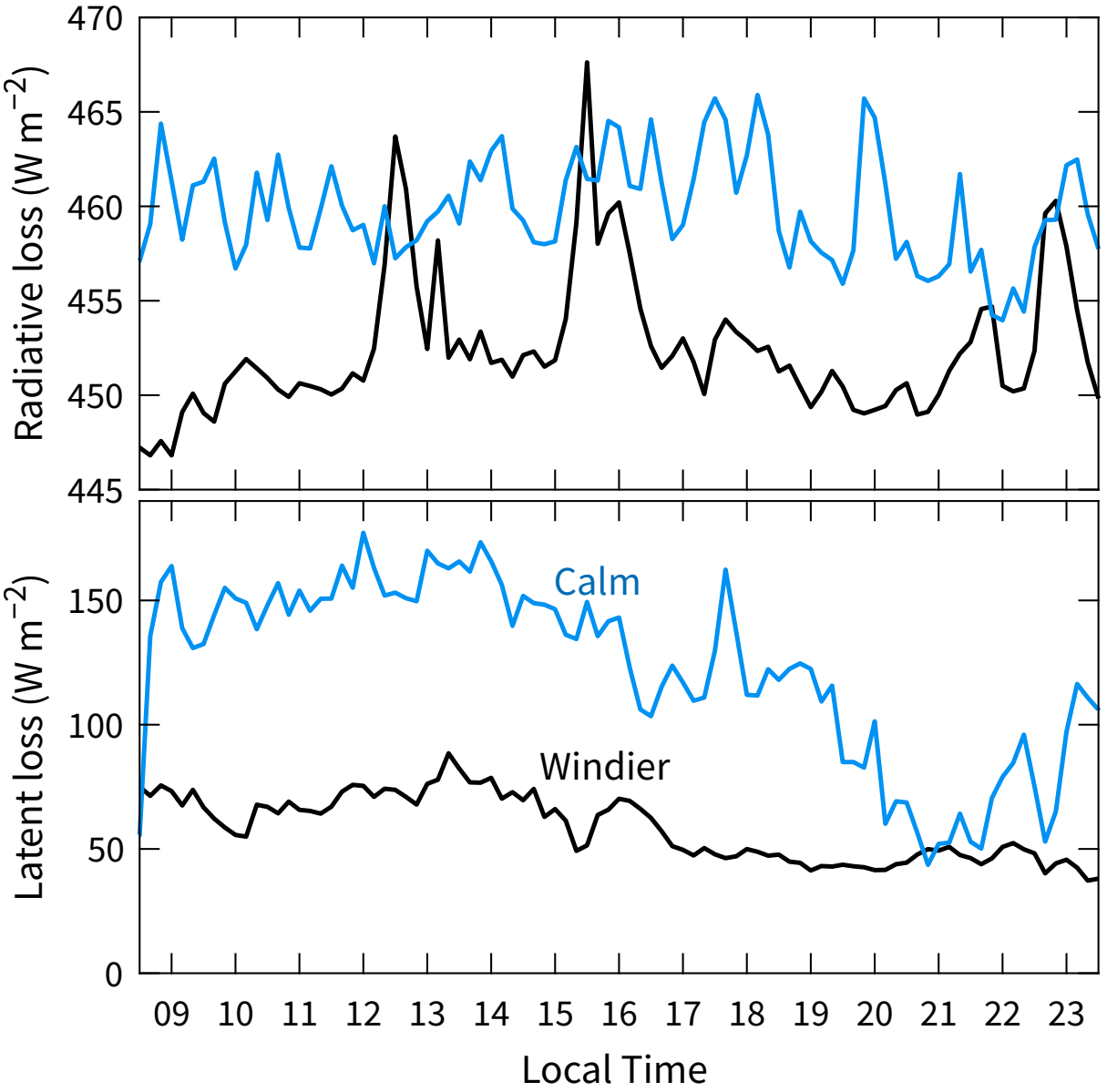
Direct turbulent heat flux estimates



Direct turbulent heat flux estimates



Warm layers alter surface heat budget



Fluxes courtesy of Elizabeth Thompson