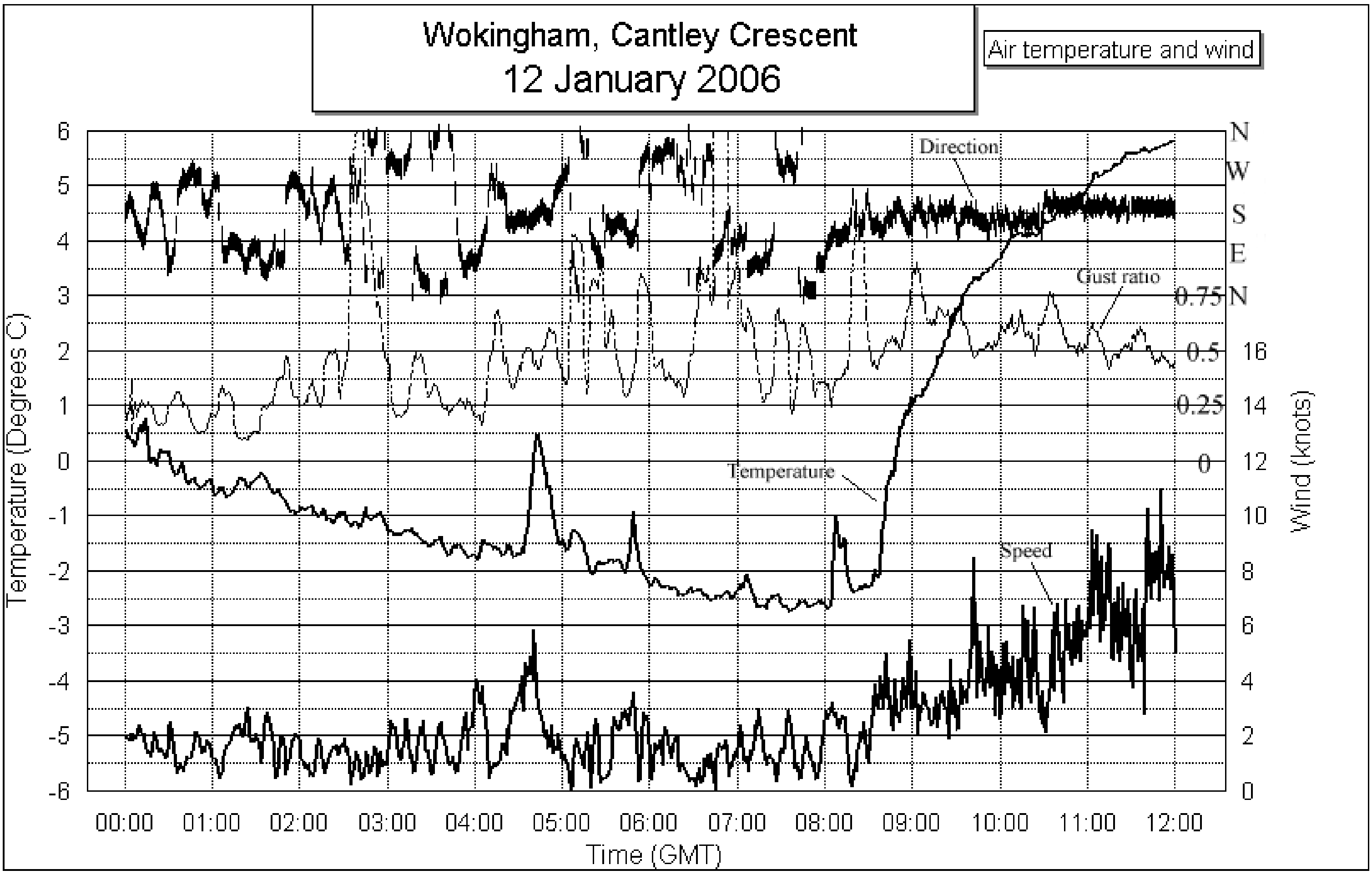

Fig1. Graph of temperature and wind for 12 January 2006, 00 to 12 GMT, Wokingham Cantley Crescent. The four parameters plotted are: 1) temperature, one minute average from aspirated psychrometer, 2) wind speed, 1 minute average from sonic anemometer at 8 metres, 3) wind direction, one minute average, 4) 10 minute average of normalised gust ratio, (max 3 sec gust per minute minus one minute average devided by one minute average).

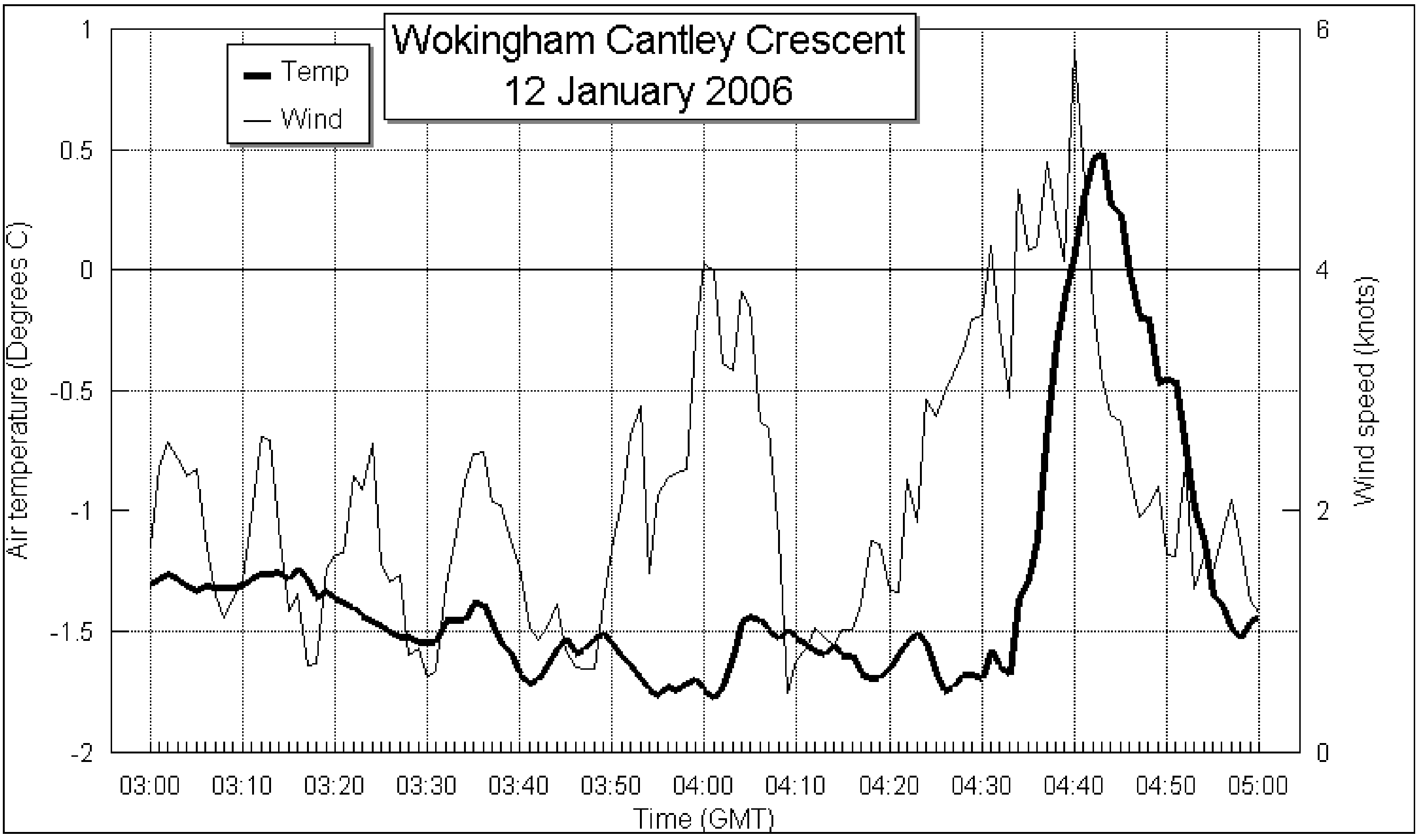

Fig2. Expanded view of temperature and wind speed, 12 January 2006, 03 to 05 GMT, Wokingham Cantley Crescent.

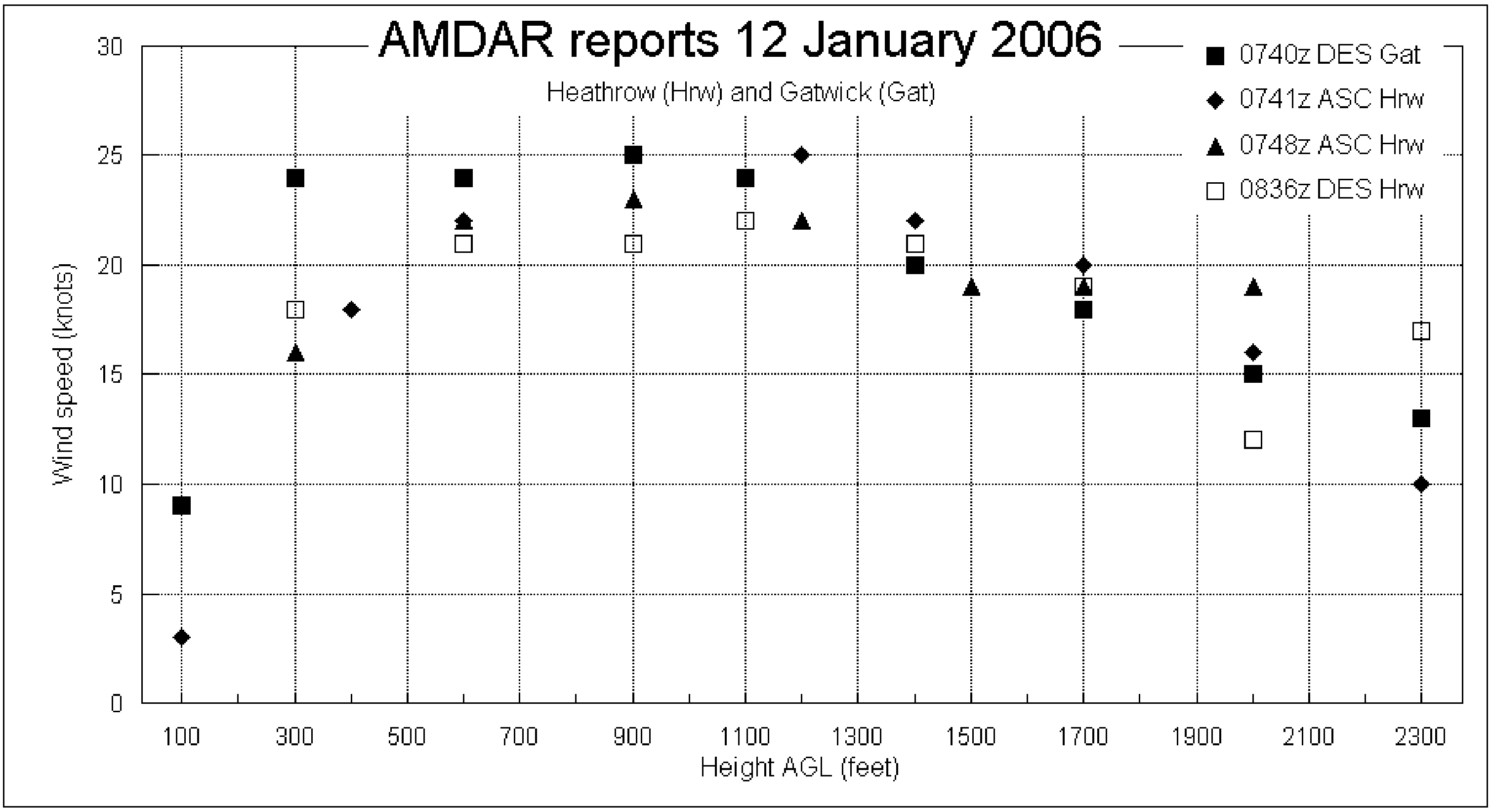

Fig3. Plot of AMDAR windspeeds between 100 and 2300 ft, 12 January 2006, 0740 to 0836 GMT, Heathrow and Gatwick vicinity.

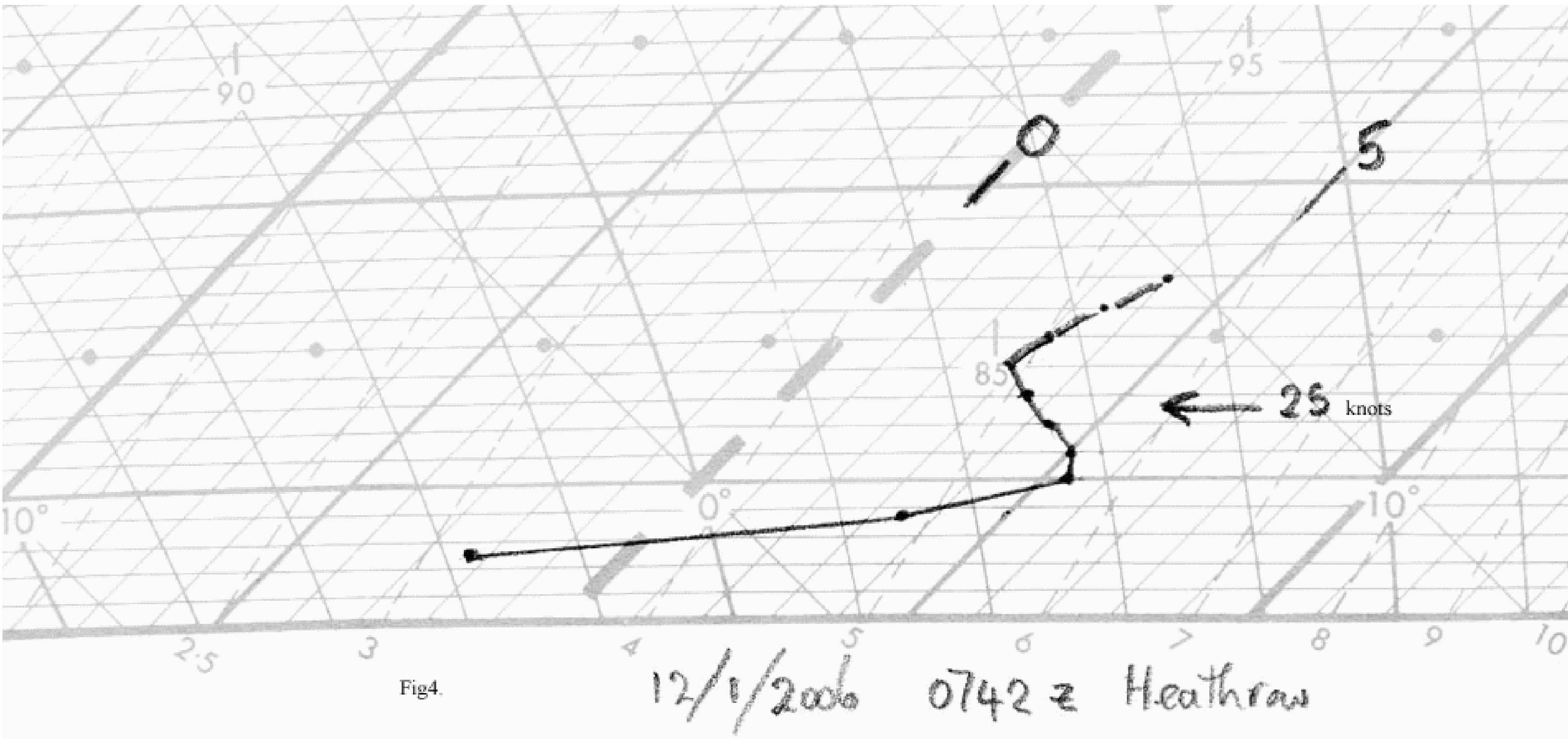

Fig4.

Nocturnal boundary-layer fluctuations.

The sky was clear throughout the night of 12th January 2006 in Wokingham. A strong radiation inversion developed in the boundary layer, and the wind near the surface became decoupled from that above, producing a very light drift of between 0 and 2 knots and a variable direction. Between 0400 and 0500 GMT the air temperature temporarily rose from –1.7° to +0.5°. There were two other similar temperature excursions, although of a lesser amplitude, followed by a rapid rise near 0830 GMT.

The clue to the cause of these temperature anomalies is to be found in the graph of wind speed on Fig1. Several times during the night, and especially between 0300 and 0400, a regular oscillation can be seen in the speed of the wind. (See also Fig 2). Similar oscillations can be seen on Fig1 affecting the wind direction between 0000 and 0230.

Around 0400 the amplitude of the speed oscillation increases and the period lengthens until the major peak at 0440. The temperature starts to increase at 0433 and reaches a maximum at 0442, by which time the wind peak had passed. This type of behaviour of surface wind is a typical signature of gravity waves generated by wind shear near the top of the boundary layer inversion. Under the right conditions these waves can amplify until they break, and the action of breaking mixes warmer air towards the surface, usually from a few tens of metres up. The same effect is seen in Fig 1 around 0545 and again near 0800, before the inversion breaks down completely near 0840, producing a steep rise in temperature. The coincident mixing down of momentum produces a marked change in the character of the wind speed, it becoming more turbulent, while the direction settles down to somewhere near South.

To gauge the degree of turbulence, a normalised gust ratio is plotted in Fig1. In essence, the closer to zero that this is, the more laminar the flow, the further from zero the greater the degree of turbulence. Rather surprisingly, I would say counter intuitively, the period of wind and temperature increase at 0440z is not associated with a marked increase in gustiness, although there is a slight general increase from about 0410z onwards. When the flow picks up more generally near 0900z there is a more definite increase in gustiness. Examples of extremely laminar flow can be seen between 0000z and 0130z. Marked peaks in gustiness seem to be associated with extremely low one minute average wind speeds, below 0.5 knots. One reason for this is that it is be an artefact of the method of calculation. As the one minute average flow tends to zero, the normalised gustiness will tend to infinity, so it seems fair to ignore those peaks.

To test the validity of the wind shear hypothesis, the AMDAR reports for the morning of 12th January were examined, and 4 blocks of data found, 3 for Heathrow vicinity and 1 for Gatwick, giving detailed wind data from the surface to 2700 ft (FL027), in 300 ft steps near the surface, and covering the period 0740z to 0836z. These are plotted in Fig3, and clearly show that a low-level 'jet' in the order of 25 knots was present between 600 and 1300 ft, the speed falling off to about 15 knots at 2000ft. A tephigram is also shown in Fig 4, with the AMDAR temperature reports for 0742z plotted, together with the air temperature at Wokingham at the same time. The steepness of the surface-based temperature inversion can be seen. There is also a marked well mixed layer between 960 and 1000 mbar, no doubt a result of the speed jet, with the wind speed maxima in the centre of this layer at 975 mbar, and a further temperature inversion above 960 mbar.

In conclusion, the temperature events shown in Fig1 for the night of 12th January 2006 can be ascribed to the development of breaking gravity waves at the top of a surface based nocturnal radiation temperature inversion in the presence of strong wind shear. During the wave breaking, both momentum and temperature are mixed downwards towards the surface, and appear in the records as wind and temperature 'events'. It is interesting to note how localised these particular events were, as scrutiny of the temperature data logger in the screen at the Wokingham Met Station, about 500 m away from the Cantley Crescent instruments, and about 15 m lower, reveals no temperature fluctuations at all until the steep rise near 0900z. Also, the screen minimum was –3.4° compared with –2.7° at the psychrometer. It is quite possible that the 15 m difference in altitude of the two stations played a key role to the different outcomes at the two locations.

B J Burton 16 January 2006