

## CHINESE DUST STORMS OF APRIL 2006: ADDITIONAL NOTE

By PAUL R. BROWN

11, Wytherlies Drive, Stapleton, Bristol, BS16 1HX

I read with interest the account by Matthew Clark in the October 2006 issue of the *International Journal of Meteorology* of the dust storms over China in April 2006, because I too began studying this event with a view to writing an article for the *Journal*; but in the end I felt that I could not produce a frontal analysis with sufficient certainty to justify submitting it for publication. Perhaps, however, I might be permitted to expand a little on one or two of the points made in the published article.

As noted by Clark, a characteristic feature of the weather pattern that produces these seasonal dust storms in most springs in China is the development of a very strong northwest to southeast pressure gradient between an area of low pressure in the warm air to the south (in the Takla Makan) and a developing anticyclone in the much colder air to the north (over Russia). Over the flat lands of west Siberia there is nothing to stop the southward spread of a cold airmass if the pressure pattern is favourable, but as it reaches the mountainous regions of central Asia its progress becomes blocked. A formidable barrier is presented by the Tien Shan range in western China, which rises to over 12,000 ft (4000 m) directly across the path of airflow from the north. At this point the air becomes dammed up on the upwind side of the mountains, leading to an accumulation of atmospheric mass and consequent rise of surface pressure there; while downwind of the mountains, over the Takla Makan desert and the Tarim Basin, there is a corresponding deficit of mass, with a marked fall of pressure (in exceptional cases to as low as 980 mb m.s.l. equivalent). The result is an extreme bunching of the isobars over the Tien Shan, as in Figure 1, which shows the pressure pattern at 1200 GMT on 9 April 2006. (Conventional wind and temperature plots are included for a selection of stations, as are present weather symbols, though the latter may be too small to be legible after reduction.) Eventually the cold air finds its way over or through or round the mountains and enters the Takla Makan, to replenish the deficit of air there, and atmospheric pressure begins to recover. But any further southward progress is barred by the insuperable barrier of the Tibetan Plateau, and the cold air then turns away towards the east.

The deep depression of 983 mb over the Takla Makan in Figure 1 is largely produced by this topographical forcing in the lee of the Tien Shan, rather than from dynamical processes within the atmosphere, and hence it does not have the sort of bad weather at its centre that would normally be associated with such a depression (the other centre to the northeast, over Mongolia, is the dynamically-produced one); and while the strong anticyclone to the north is a dynamic feature, the pressure gradient between it and the southern depression is greatly affected by topography. It must be remembered, however, that in this area of generally high relief the sea-level isobars are purely theoretical (they do not really exist), and it would be unrealistic to expect surface winds fully to respond to such a gradient. Nevertheless, stations with suitable exposure do experience very strong winds on these occasions, e.g. Qijiaojing (WMO no. 51495), situated in a high pass at 874 m a.s.l., reported a northerly wind of mean speed 36 m/s (70 knots) with gusts to 51 m/s (99 knots) at 1800 GMT on 9 April – accompanied by freezing dust storms and temperature 0 °C.

Another feature, which was especially marked on this occasion, is the great fall of temperature that often accompanies these 'cold waves' over China. The Chinese meteorological office defines a cold wave as a fall of temperature by 10 deg C or more in 48 hours to a value below 4 °C, accompanied by winds exceeding Beaufort Force 5; if the fall of temperature exceeds 14 deg C it is defined as a strong cold wave (Zhang and Lin 1992). In the present case, at several stations in central north China the temperature fell more than 30 deg C in 24 hours: e.g. at Jining (WMO no. 53480) from 24.2 °C at 0900 GMT (late afternoon local time) on 10 April to -8.4 °C by the same time on the following day; and at Hequ (53564) from 29.0 °C to -1.9 °C in the same period.

### REFERENCES

- CLARK, M. (2006) Chinese dust storms of April 2006. *International Journal of Meteorology*, 31, 288-295.  
ZHANG, J. and LIN, Z. (1992) *Climate of China*. New York, Wiley.