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Managing the effects of the weather on the Equestrian Events of the 2008 Beijing Olympic Games

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ABSTRACT

This paper describes a 3 year project to investigate and manage the effects of the local weather conditions on horses competing in the 2008 Olympic Games. The first part of the investigation involved estimating the expected heat load on horses during competition and suggesting measures to ensure their safety based on data collected from dedicated weather monitoring at both Olympic venues during August 2006, 2007 and 2008. The aim of the second part was to establish a reliable system of point forecasting to monitor and predict inclement weather that might affect the competitions. This involved setting up automatic monitoring systems and exploiting numerical weather prediction models. The monitoring and predicting capabilities were tested by running two 'virtual' or simulated cross country competitions in 2006 and 2007. They were further trialled with live horses during the Test Event in August 2007, when a rapid cooling system for horses using shade tents, misting fans and iced water was refined.

The results of both parts yielded valuable information which was used to establish a protocol to ensure that horses would not become heat stressed or subjected to dangerous weather conditions. Despite some very high temperatures and humidity, a number of storms and two serious tropical cyclones, there were no disruptions to the competition schedule and no serious injuries or heat stress to the horses throughout the 2008 Equestrian Events.

Introduction

The Equestrian Events of Eventing, Dressage and Jumping have been part of the Olympic Games (OG) since 1912 in Stockholm. For the 2008 Games it was not possible to stage the equestrian competitions at the main Olympic venue in Beijing, China, and they were held in Hong Kong, China from 8–21 August. The competitions took place at two locations. The main venue was converted from the Hong Kong Sports Institute adjacent to the Hong Kong Jockey Club's Sha Tin Racecourse where stabling, training and the dressage and jumping competitions took place. The cross country phase of Eventing was held at a second venue, Beas River, in the North-west New Territories, about 35 km north-west of Sha Tin.

Hong Kong's climate is subtropical, and in August it is hot and humid with air temperatures that can reach 35 °C and a relative humidity of 80–90%. These conditions are difficult and exhausting for horses, especially in the Eventing competition (Kohn and Hinchcliff, 1995; Jeffcott and Kohn, 1999; Kohn et al., 1999a). The situation is further complicated at that time of year by the sporadic occurrence of typhoons and rapidly developing thunderstorms, which pose great challenges to weather forecasting and can potentially disrupt the competition schedule.

It has been established after many years of research and investigation that horses can compete safely in high ambient temperatures (<40 °C), but when this is combined with high relative humidity (>60%) there can be profound effects on performance with the risk of exhaustion and heat stroke (Jeffcott and Kohn, 1999; Kohn et al., 1999a). The introduction in 1995 of the wet bulb globe temperature (WBGT) index has proved to be a much more valuable indicator of the heat load experienced by the horse than simply measuring ambient temperature and relative humidity (Schroter and Marlin, 1995; Schroter et al., 1996). Extensive studies on cooling horses under these conditions have also been undertaken (Bradbury and Allen, 1994; Kohn and Hinchcliff, 1995; Williamson et al., 1995; Marlin et al., 1998; Kohn et al., 1999b).

Despite the success of managing the 1996 Olympics in Atlanta (Jeffcott and Kohn, 1999), the issues we faced in Hong Kong were significantly more serious because of the persistent high humidity throughout the day and the threat of serious storms at this time of year. At the Atlanta OG the relative humidity tended to drop as the temperature increased during the morning. A preliminary study of Hong Kong weather in August 2005 (D.J. Marlin, personal

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communication) confirmed these difficult conditions. The best time for the horses to compete appeared to be in the evening, and this could be achieved using floodlights for Jumping and Dressage. Obviously this was not feasible for the cross country in Eventing. In the light of these difficulties and the necessity to ensure the safety of the horses at all times a study was conducted in the 3 years before the Games with five main objectives:

(1) to estimate the potential heat load on the horses and riders using the WBGT index and other parameters to assist in the planning of competitions, especially the cross country;
(2) to establish the optimum timing for the competitions particularly the cross country;
(3) to develop a protocol for forecasting 'bad weather' that may affect both the competition schedule and the horses' safety;
(4) to develop and test the decision-making process in the event of bad weather, and
(5) to implement, test and refine facilities at both venues to cool horses rapidly after training and competition and prevent the onset of heat stress or exhaustion.

Materials and methods

Weather monitoring facilities and forecasting

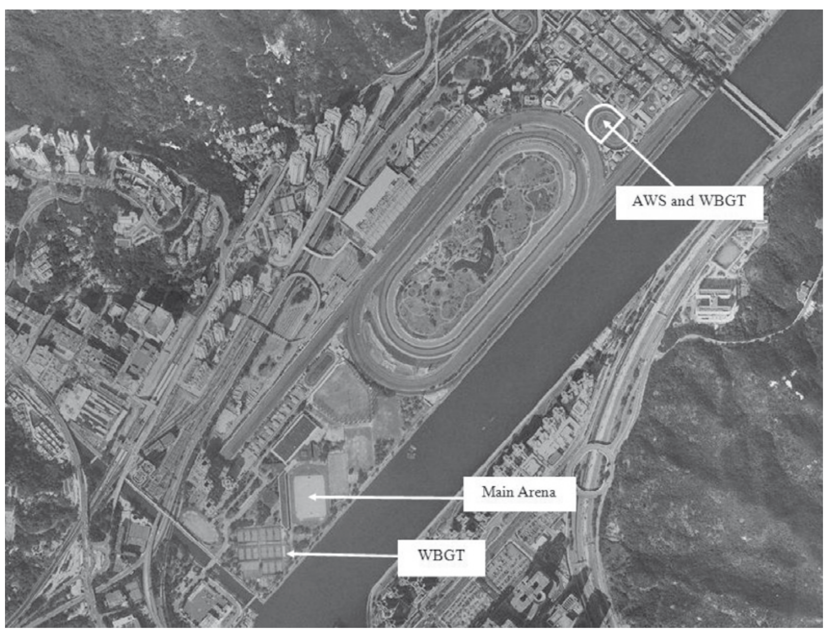
In early 2006, the Hong Kong Observatory (HKO) erected automatic weather stations at the two venues. The location of the instruments and specific elements measured are shown in Figs. 1 and 2. Data of ambient temperature (°C), relative humidity (%), WBGT (°C), wind speed and direction, and rainfall were continuously collected at 1 min intervals starting mid-2006. Running hourly averages for the previous 24 h (updated every 5 min) were produced from these data in both graphic and tabular form. The data from 1–31 August for the 3 years, 2006–2008, were used in the study.

As WBGT is one of the key elements in monitoring the risk of heat stress in horses, it was important that such information could be accessed in real-time (Schroter and Marlin, 1995). The index used here was defined by the equation:

$$WBGT = 0.7t_{nw} + 0.2t_g + 0.1t_a$$

where t_{nw} is the natural wet-bulb temperature, t_g the globe temperature, and t_a is the dry bulb temperature.

Since a system for monitoring heat load with the capability for real-time data transmission and data quality assurance was not available, the HKO developed its own system in late 2005 for use in the summer of 2006. The system not only fulfilled the ISO 7243 standards for heat load measurement, but also incorporated an additional solar radiation measurement unit and real-time data quality monitor-



Weather station	Elements measured	Instrument elevations (metres above ground level)
Automatic Weather Station (AWS)	• Wind speed and direction dry • Bulb temperature • Wet bulb temperature • Relative humidity (derived) • Rainfall • Pressure	• Anemometer: 10.0 m • Barometer: 8.1 m • Thermometer: 1.40 m
WBGT measurement system (WBGT)	• Dry bulb temperature • Natural wet bulb temperature* • Globe Temperature (black globe) • WBGT** • Solar radiation	all sensors: 1.5 m

Natural Wet Bulb Temperature sensor exposed to direct sunlight
** Wet Bulb Globe Temperature (WBGT) is derived based on the formula
$WBGT = 0.7\ t_{nw} + 0.2\ t_g + 0.1\ t_a$
where t_{nw} = natural wet-bulb temperature, t_g = globe temperature, t_a = dry bulb temperature

Fig. 1. Location of automatic weather stations at the main venue, Sha Tin, and the accompanying instrumentation.