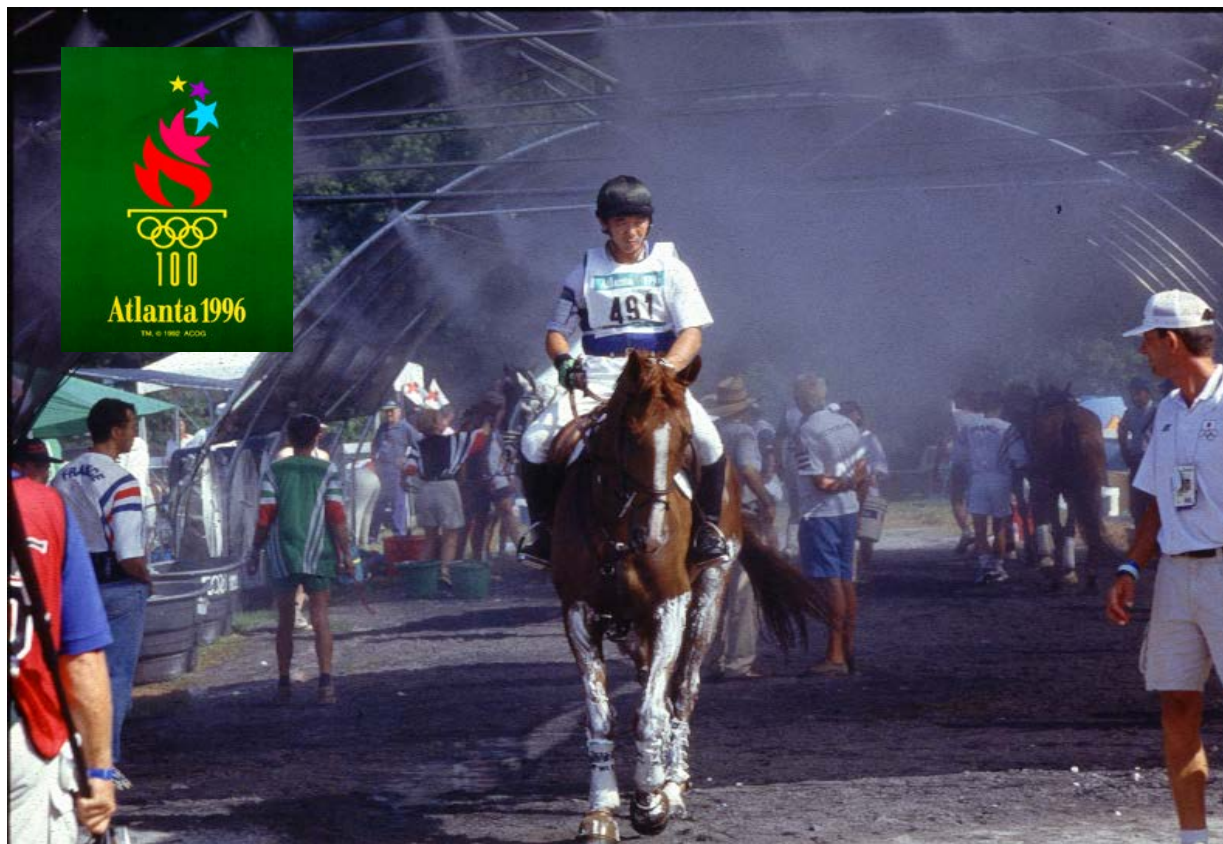


# **FEI™ SPORTS FORUM**

Setting the scene – Climate triggers and climate mitigation

Dr David Marlin, UK





# Implications of thermal stress for horses.....and human athletes

- **Reduced performance**
- **Earlier onset of fatigue**
- **Increased risk of mistakes**
- **Increased risk of injury**
- **Increased risk of illness**

# Effects of thermal stress

- Recovery from Transport
- Pre-Competition Training
- Immediate Pre-Competition Warm-Up
- Effect on actual Competition
- Recovery within Competition – i.e. Multi-day
- Recovery following end of competition to pre-departure

***THERMAL EFFECTS ARE ACUTE & CUMULATIVE***

# What determines how horses respond to thermal stress?

- Thermal environment (WBGT)
- Acclimatisation
- Management e.g. Cooling
- Individual variation – fitness, breed, ability, health, etc
- Intensity / Duration / Frequency of Exercise

# Air Temperature & Humidity only tell part of the story.....

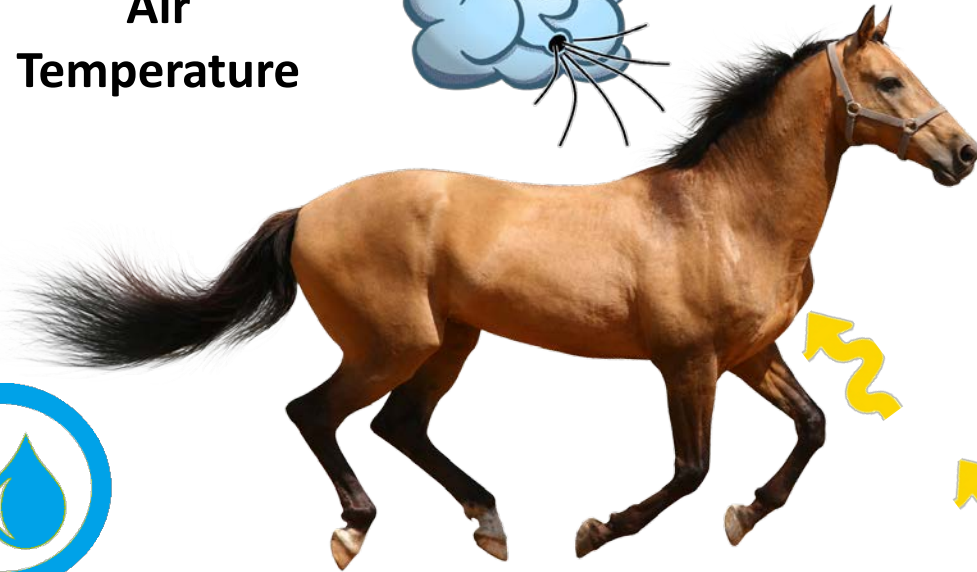


Air  
Temperature



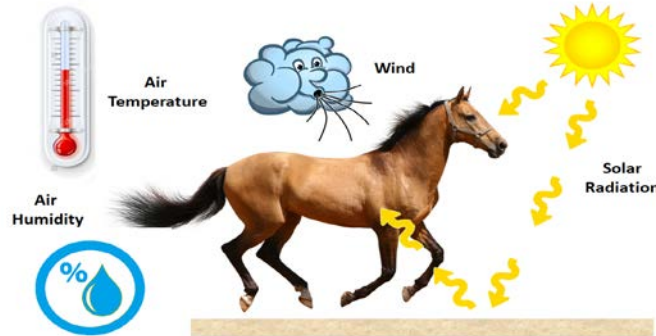
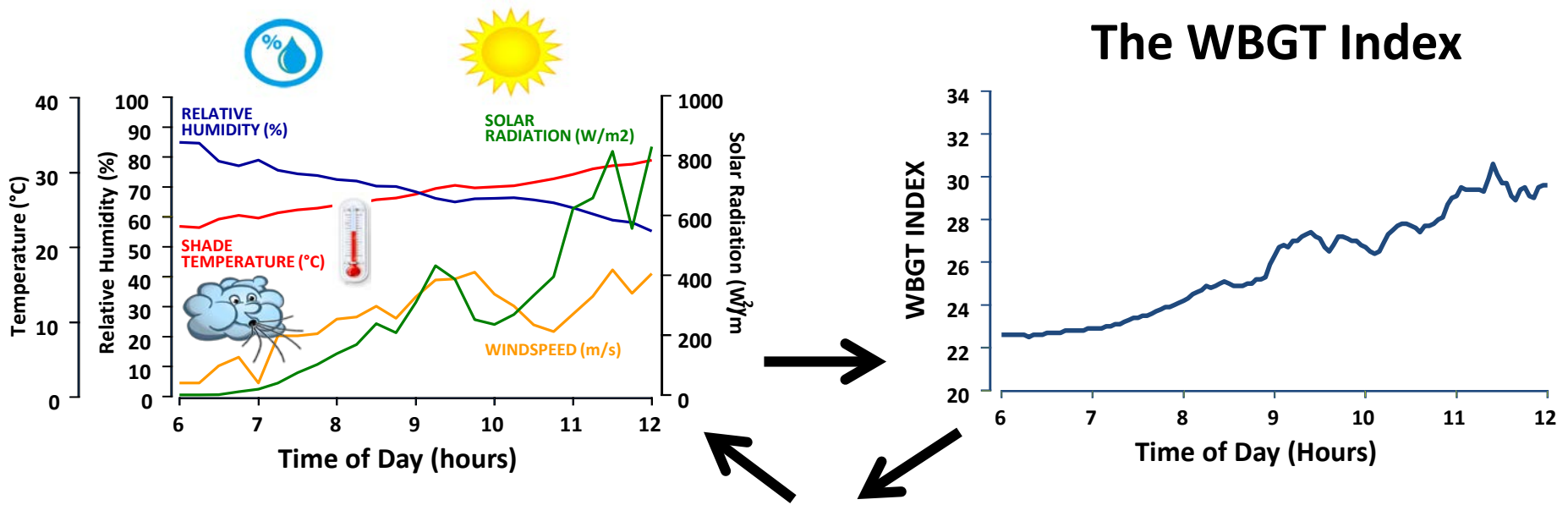
Wind

Air  
Humidity

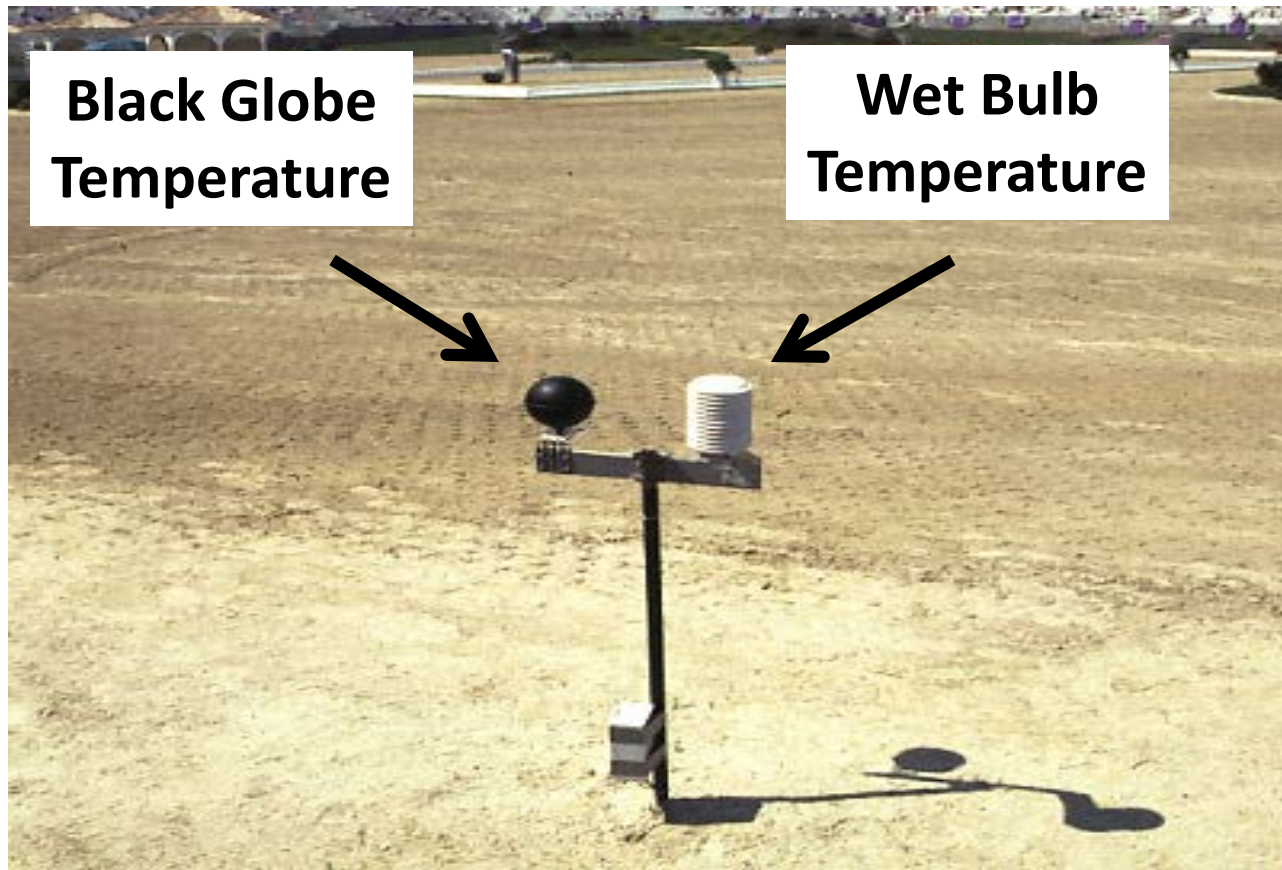


Solar  
Radiation

# The WBGT Index







**Black Globe  
Temperature**

**Wet Bulb  
Temperature**

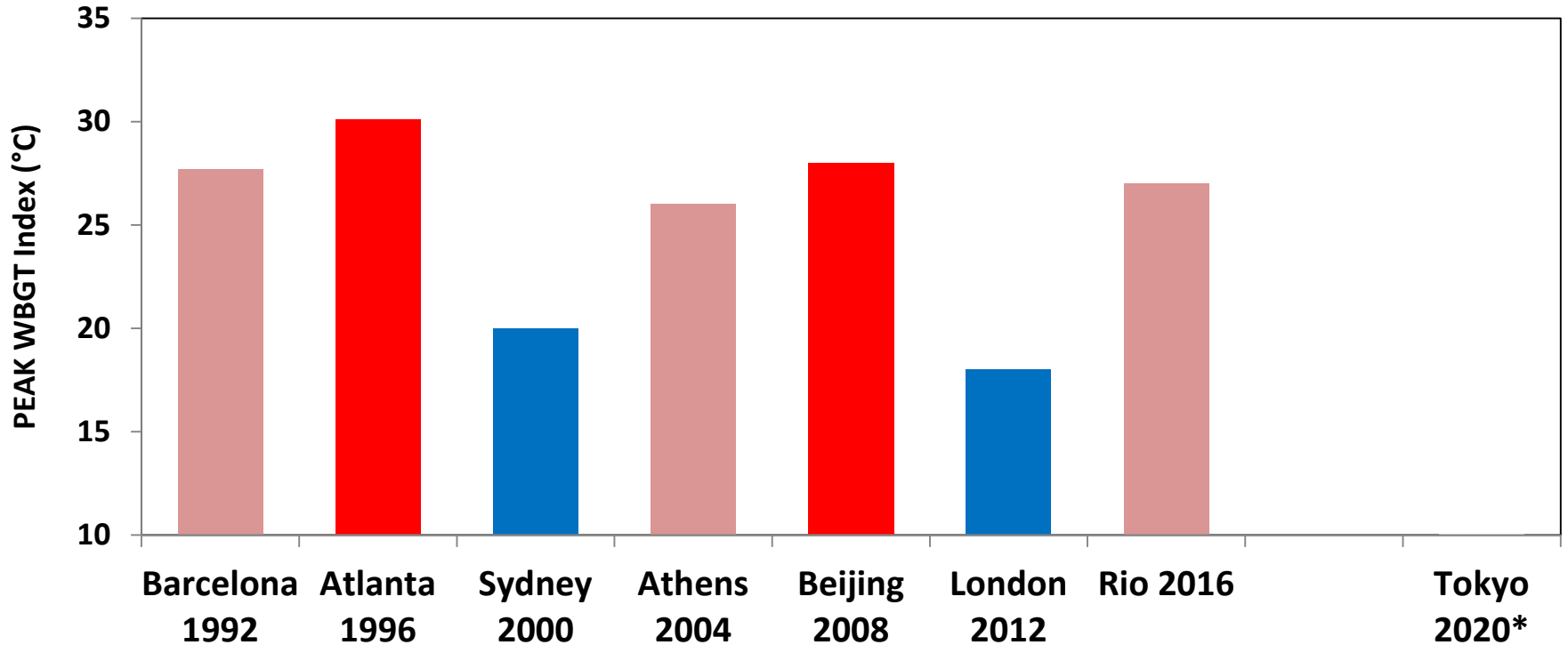
**WBGT Index = 0.7\*Wet Bulb Temperature + 0.3\*Globe Temperature**

## Use of the Wet Bulb Globe Temperature (WBGT) Index to quantify environmental heat loads during Three-day-event competitions

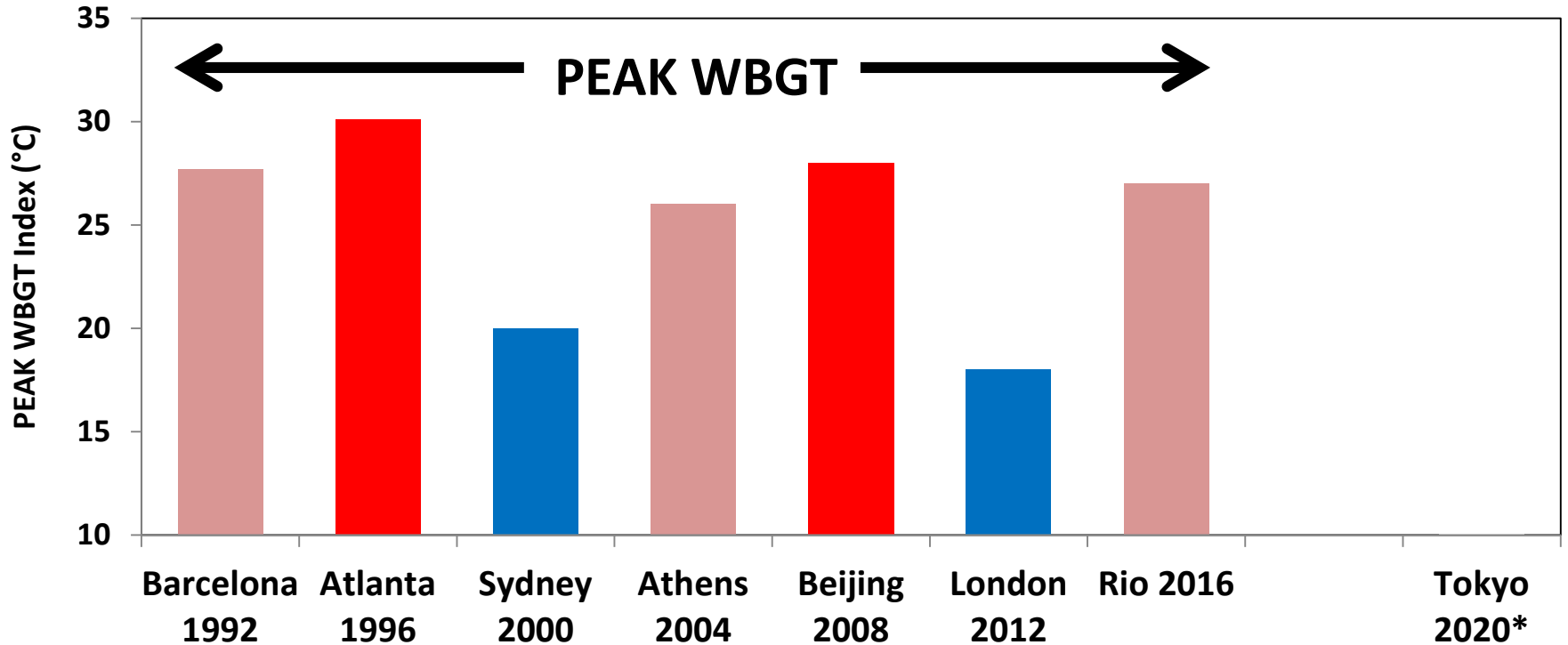
R. C. SCHROTER, D. J. MARLIN\* and L. B. JEFFCOTT†

*Centre for Biological and Medical Systems, Imperial College of Science, Technology and Medicine, London, SW7 2BZ and \*Equine Centre, Animal Health Trust, Newmarket, Suffolk CB8 7DW and †Department of Clinical Veterinary Medicine, University of Cambridge, Cambridge CB3 0ES, UK.*

# How thermally stressful has it been at previous Olympics?

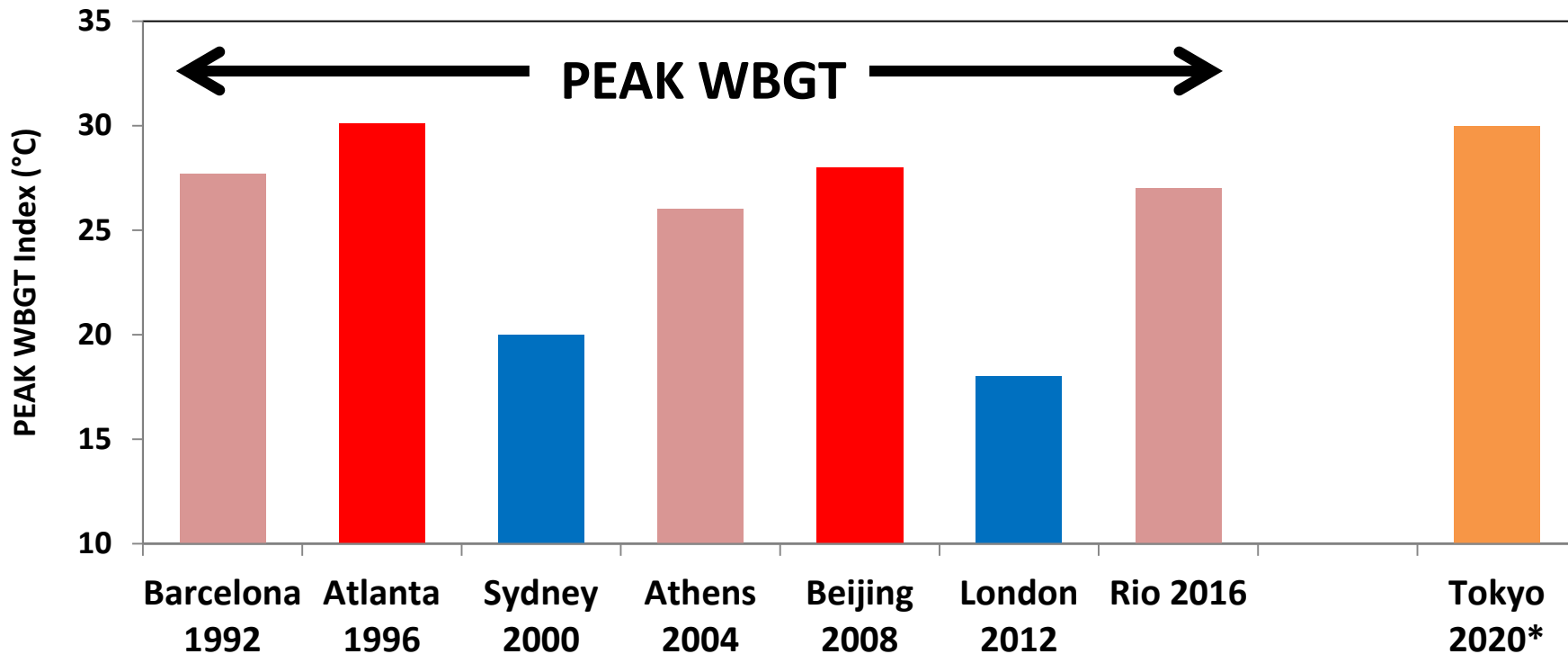


# How thermally stressful has it been at previous Olympics?



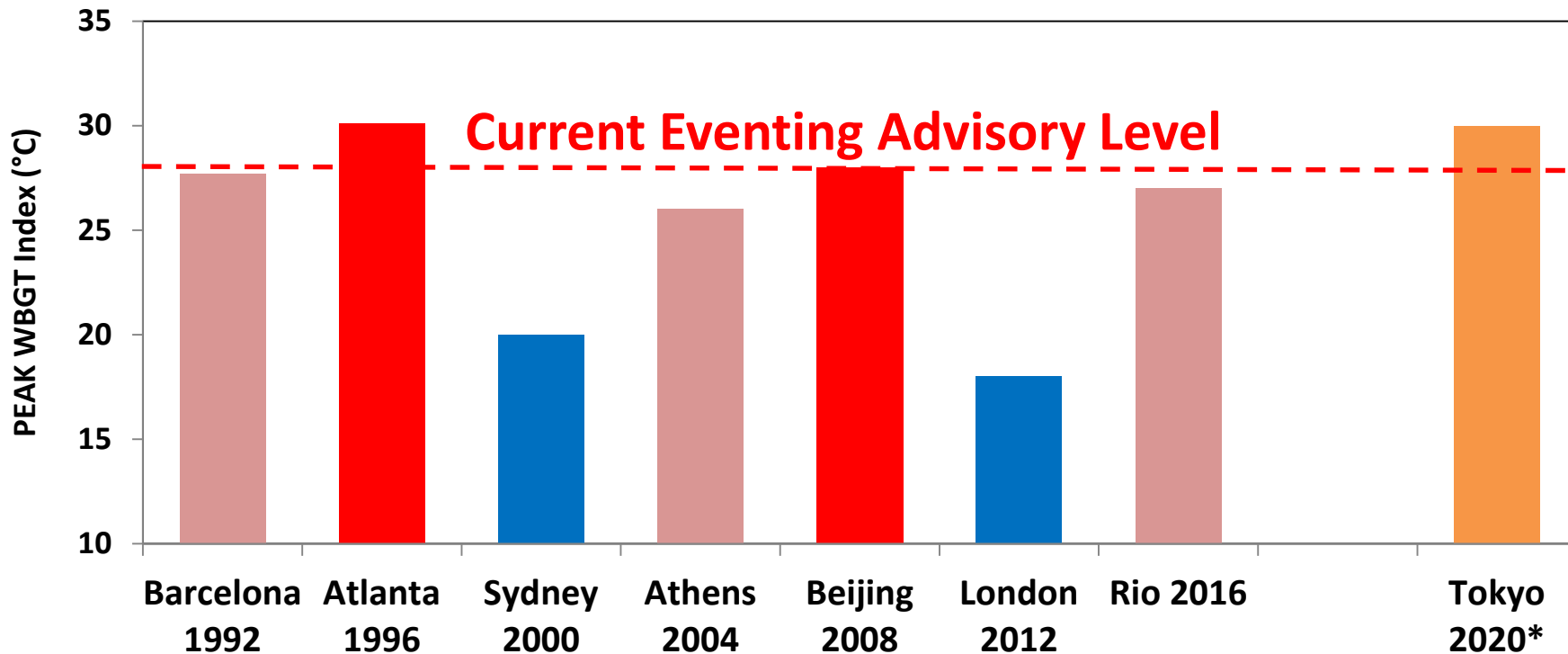
# How thermally stressful has it been at previous Olympics?

TEN YEAR  
AVERAGE



# How thermally stressful has it been at previous Olympics?

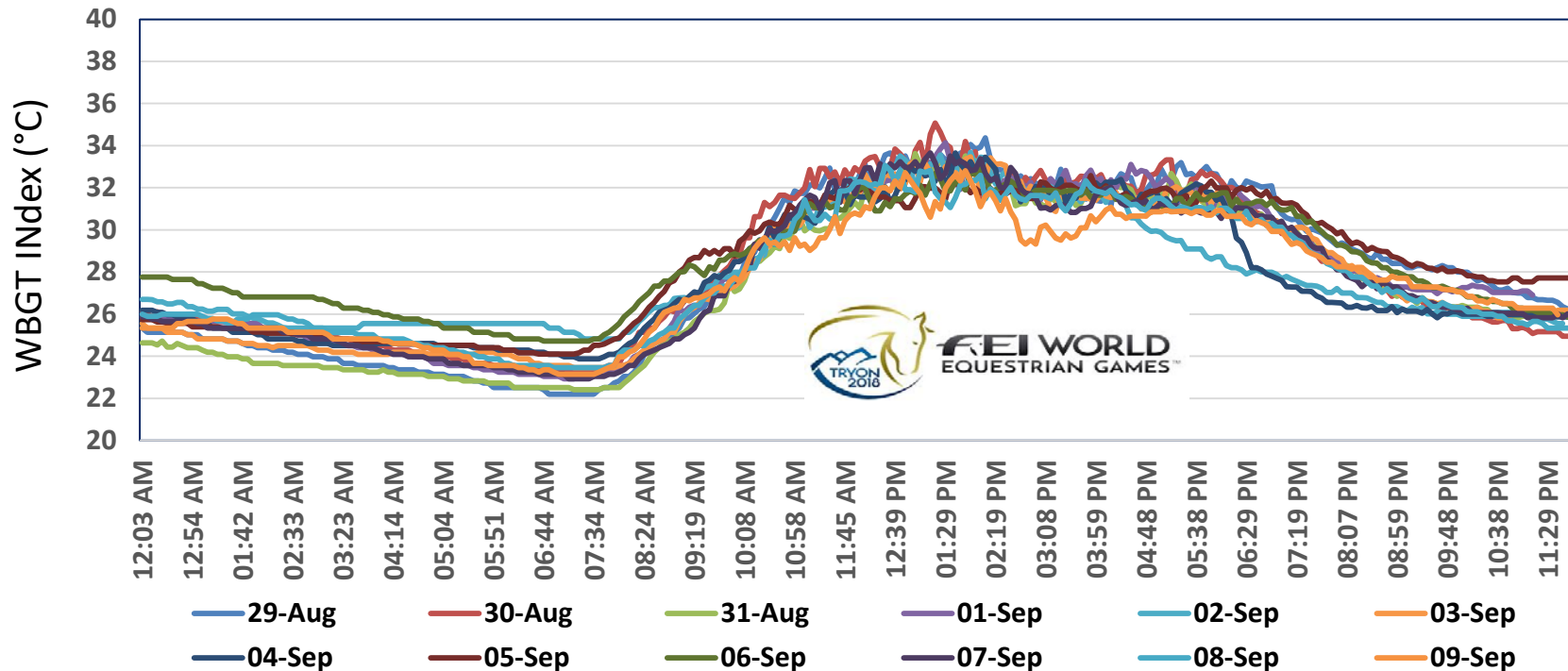
TEN YEAR  
AVERAGE





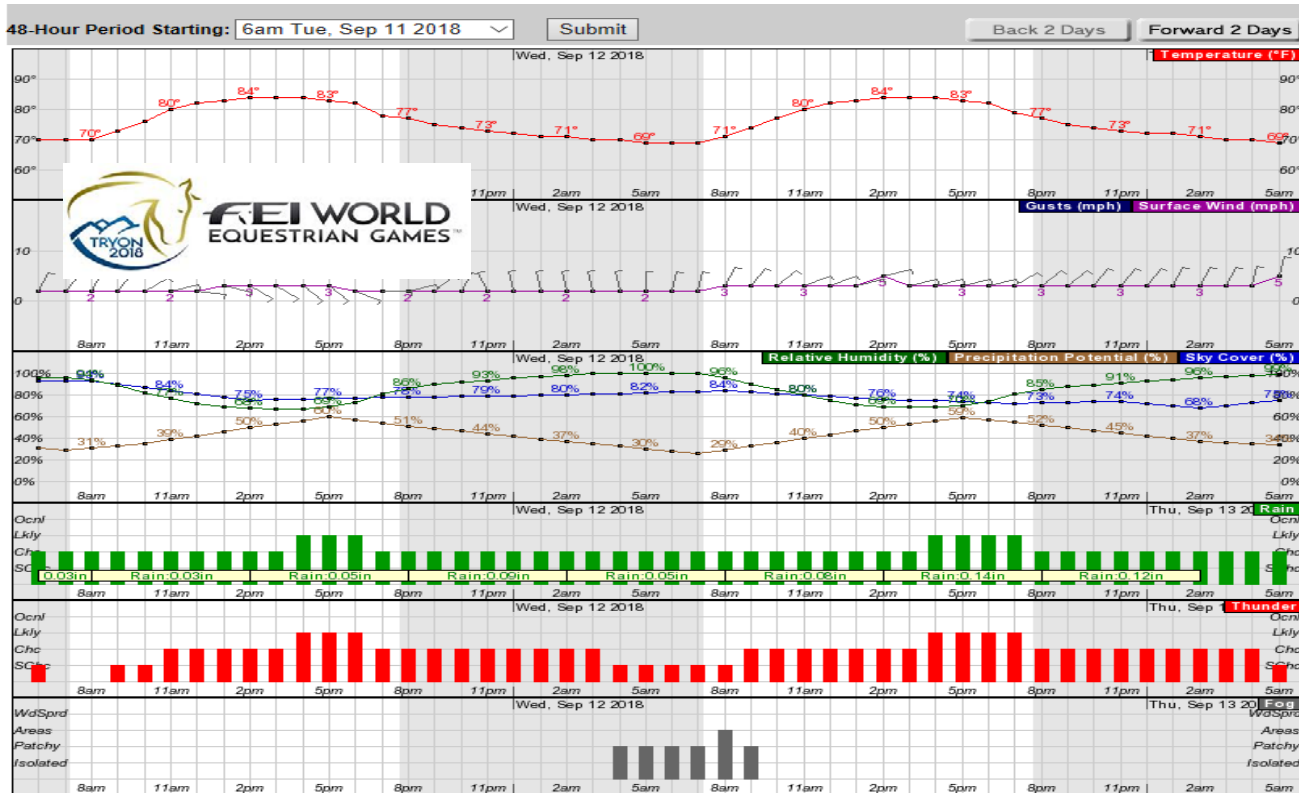
# Experience from the World Equestrian Games in Tryon, 2018

# Continuous WBGT Monitoring Onsite 29th August to 10th September 2018





# NOAA Detailed Advance Forecasting

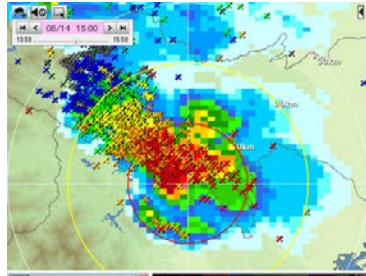


● These contents will be more detailed than open access contents on the Internet.

• Hourly forecast in Two days(weather, temperature, humidity, wind, rainfall, possibility of thunder)

		明日 2018年11月09日(金) [大安]																							
		未明			明け方			朝			昼前			昼過ぎ			夕方			夜のはじめ頃			夜遅く		
時間		01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
天気		曇り	曇り	曇り	曇り	曇り	曇り	小雨	小雨	小雨	小雨	小雨	小雨	小雨	小雨	小雨	弱雨	弱雨	弱雨	小雨	小雨	小雨	晴れ	晴れ	晴れ
気温	(°C)	15.1	15.0	15.1	15.0	15.1	15.4	15.9	16.4	16.6	17.2	18.2	19.1	19.9	20.0	20.4	19.6	18.9	18.0	17.6	17.4	16.6	15.9	16.0	15.9
湿度	(%)	15.1	15.0	15.1	15.0	15.1	15.4	15.9	16.4	16.6	17.2	18.2	19.1	19.9	20.0	20.4	19.6	18.8	18.0	17.6	17.4	16.6	15.9	16.0	15.9
降水確率	(%)	10	10	10	10	20	40	60	60	70	70	70	70	70	80	80	80	70	70	60	60	50	20	20	20
降水量	(mm/h)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0
風向		東南東	東南東	東南東	東南東	東南東	東南東	東南東	東南東	東南東	東南東	東南東	東南東	東南東	東南東	東南東	東南東	東南東	東南東	東南東	東南西	西北西	北西	北西	北西
風速	(m/s)	1	1	1	1	1	1	2	2	3	3	4	4	4	4	3	3	3	2	1	2	3	4	4	4

• Short range thunderstorm forecasting



• Wet-bulb globe temperature forecast (hourly) (effect of temperature, humidity, wind and sunlight on humans )

	3時	6時	9時	12時	15時	18時	21時	24時
今日(9月29日)							18	17
明日(9月30日)	17	19	21	22	23	22	21	21
明後日(10月1日)	22	23	27	30	28	22	20	18

! images are for illustration purposes (all of these contents will be available in both English and Japanese texts)

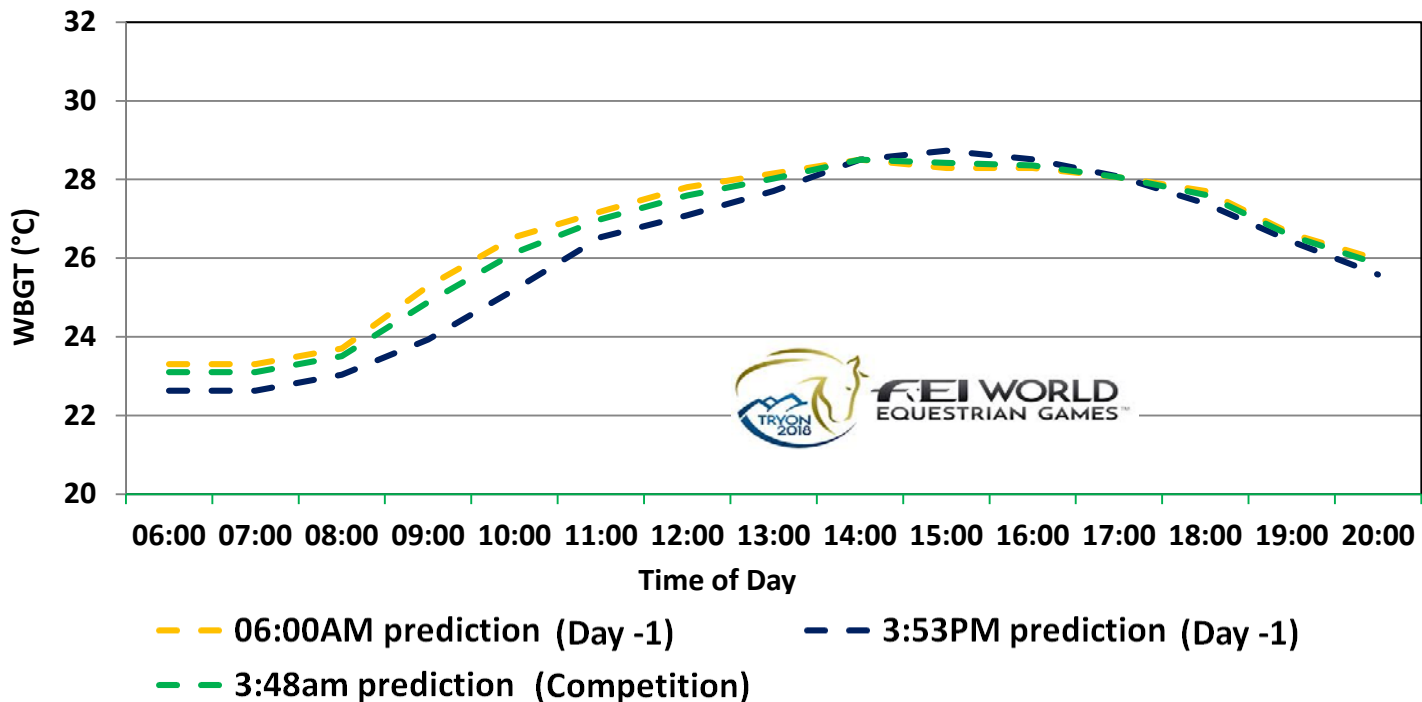
• 6 Hourly forecast in Seven days (weather, temperature, wind, chance of rain)

日付	天気	気温	降水確率	降水量
11月13日(火)	曇	17℃ 12℃	40%	曇れ
03:00	曇り	12.5℃	40%	0mm
06:00	曇り	12.0℃	30%	0mm
15:00	曇り	17.0℃	30%	0mm
21:00	曇り	14.0℃	20%	0mm
11月14日(水)	晴時々曇	16℃ 9℃	20%	曇れ
03:00	晴れ	9.8℃	20%	0mm
09:00	曇り	10.6℃	10%	0mm

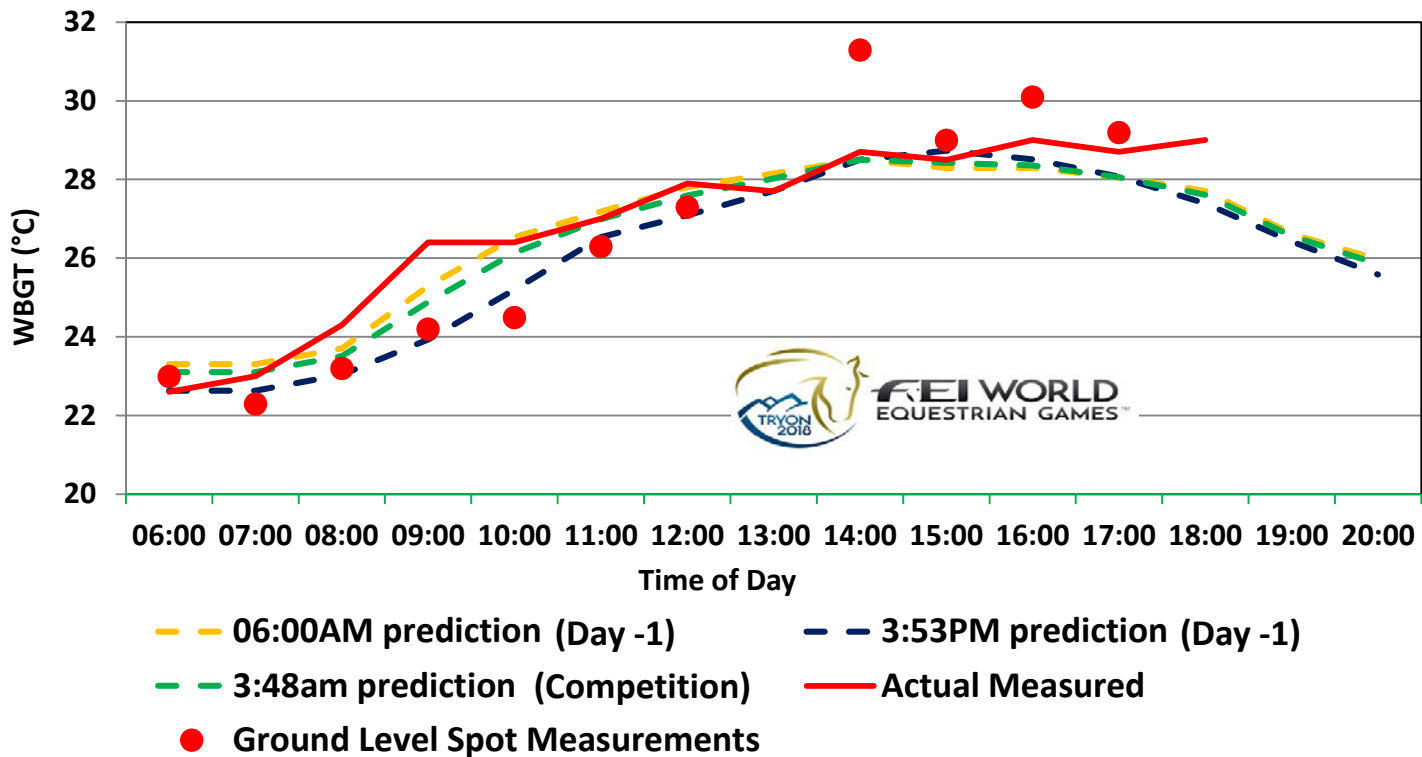
# EXAMPLES OF FORECASTING OUTPUT FOR TOKYO 2020

Courtesy Tim Hadaway

# WBGT Forecast for 11<sup>th</sup> September 2018



# WBGT Forecast for 11<sup>th</sup> September 2018



# Climate Triggers?

- **THE WBGT INDEX is robust, fit for purpose and is used for...**
  - Long-term trends e.g. years
  - Medium-term trends e.g. months, weeks
  - Immediate pre-competition monitoring, e.g. days
  - In-competition monitoring