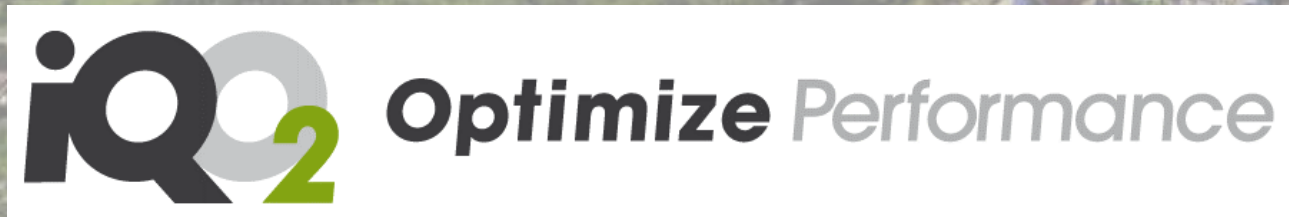


Analysis of Mean Maximal Power in Cycling with a modified Critical Power model allowing for a variable Anaerobic Work Capacity

Charles Dauwe D. Sc.



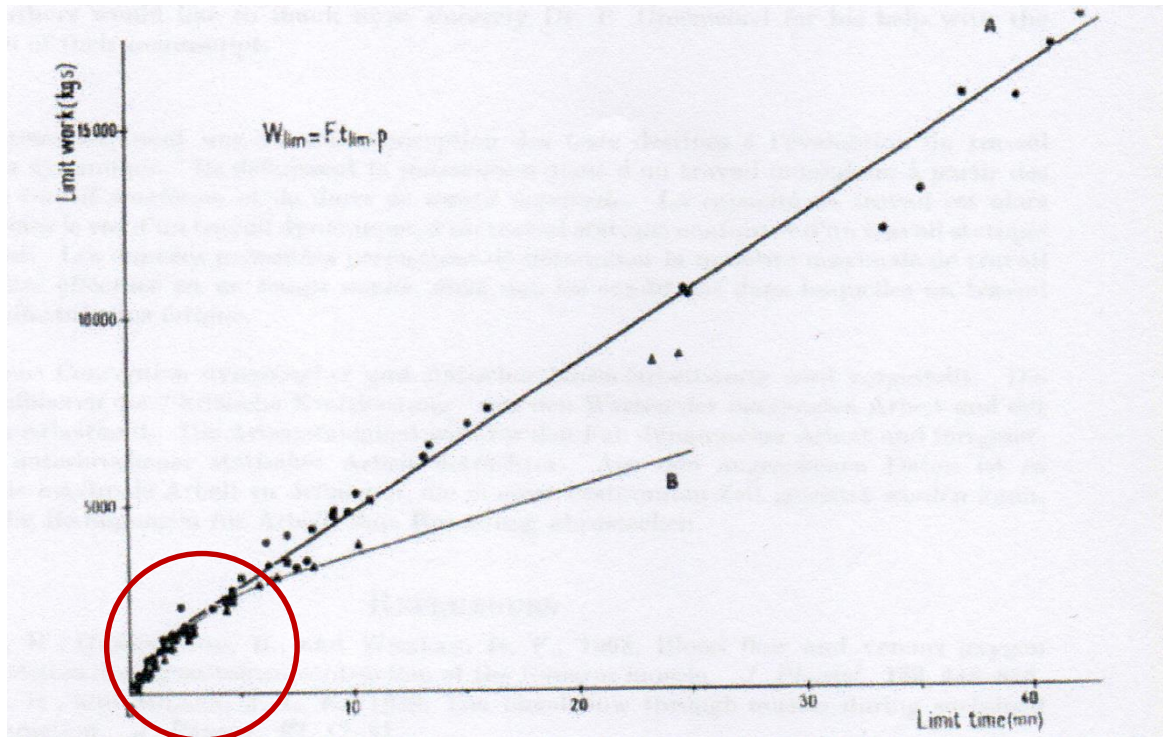
Johan Strobbe MD.



WCSS World Congress on Cycling Science – Utrecht 1-2 July 2015

The Monod-Sherrerr CP model

$$P(t) = \mathbf{CP} + \frac{W'}{t}$$

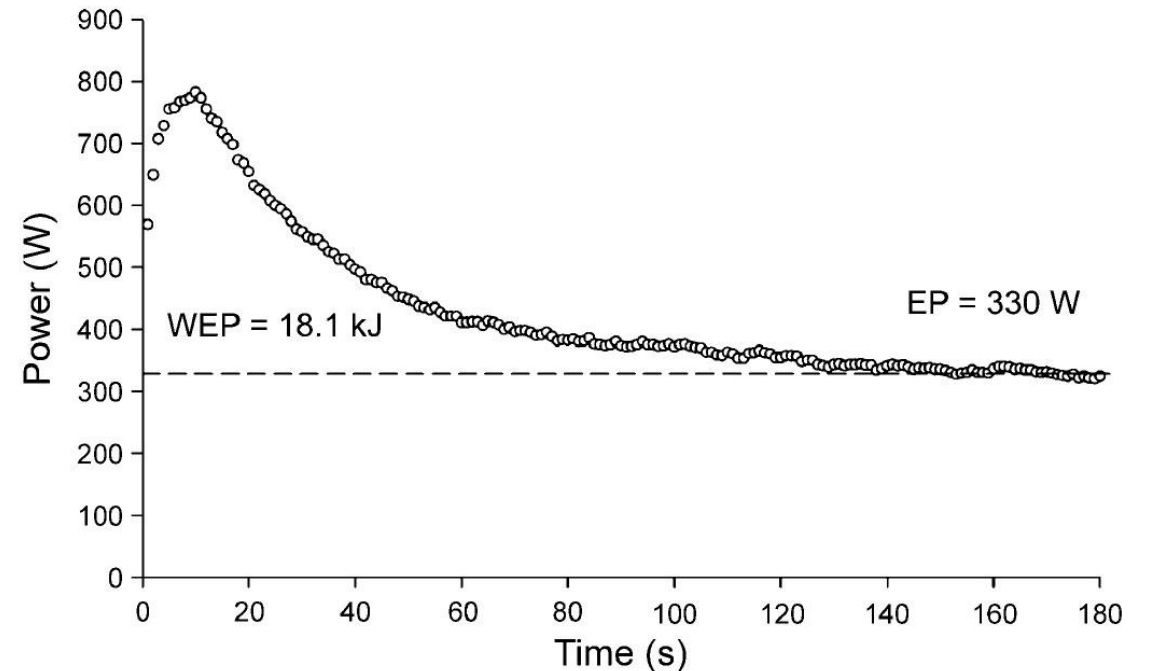


T > 5 min

Poole's recipe

3 or more tests at power levels leading to exhaustion in **1 – 10** minutes

The **3'** All-out test



Major problems with the standard CP model and a short testing protocol

- The zero-time catastrophe: Infinite Power ?
- CP is not sustainable for long times
- $CP > P_{MLSS}$
- CP does not predict performance in long GT climbing stages or TT
- How to apply to Real-time wide range performance data? Mean Maximal Power , Record Power Curve...

The Modified CP model

$$P(t) = \left\{ MAP + \frac{W'_S}{t} (1 - e^{-\frac{t}{\tau}}) \right\} U(t_{sw} - t)$$



Short ROI
Sprinting, 4k Pursuit

$$+ \left\{ CP + \frac{W'}{t} \left[1 - \left(1 - \frac{t}{T_{scp}} \right)^2 U(T_{scp} - t) \right] \right\} U(t - t_{sw})$$



Long ROI
Climbing TDF, TT

$$P_{max} = MAP + \frac{W'_S}{\tau}$$

Effective Anaerobic Capacity

$$W'_{eff}(t) = (P(t) - CP)t$$

Relevant parameters of The Modified CP model

CP = Critical Power, limit between non-fatigueable and fatigueable efforts.

W' = Maximal value of Anaerobic Capacity in excess of CP

MAP = Maximal Aerobic Power, asymptotic value for short efforts

P_{\max} = Maximal Sprinting Power at $t = 0$

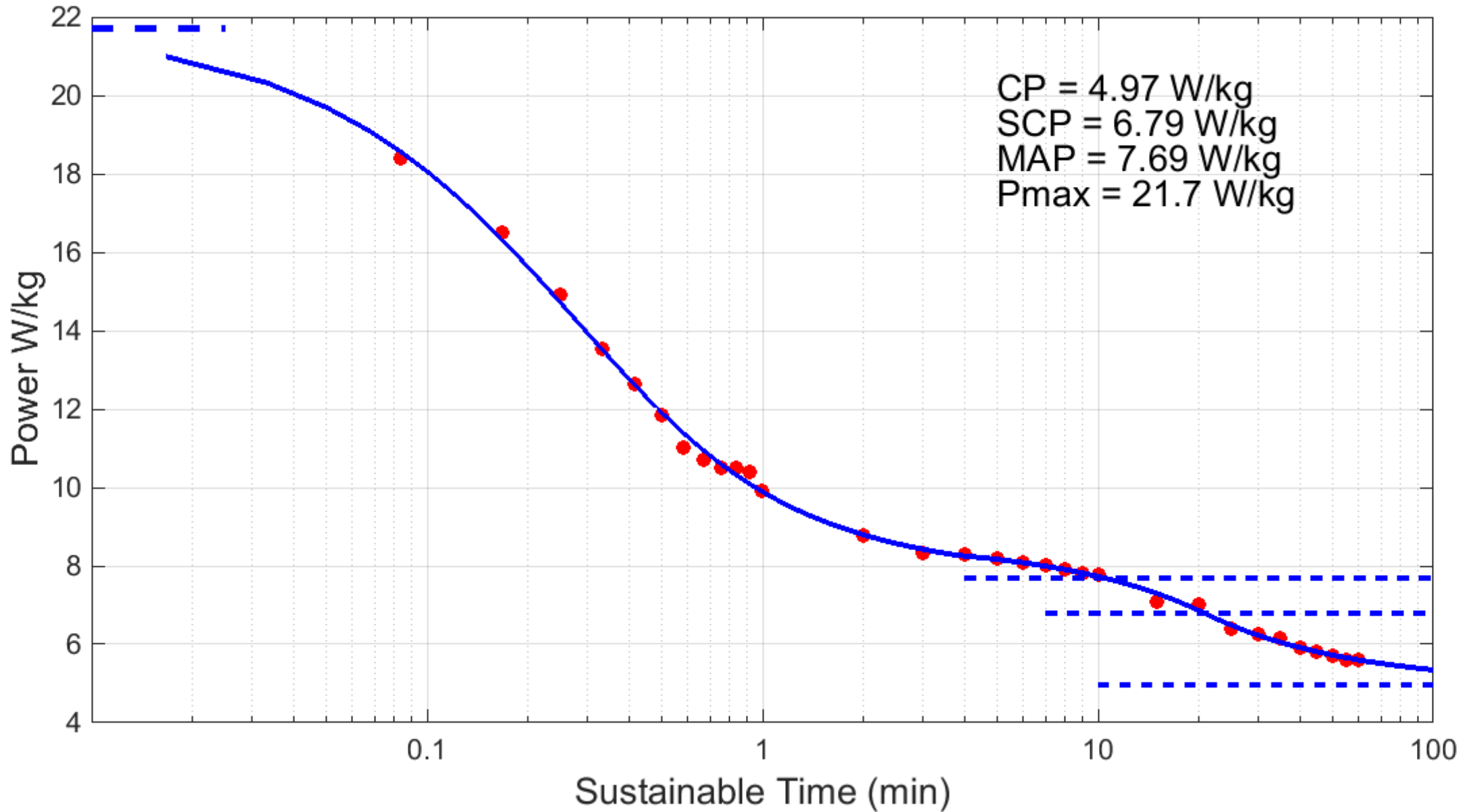
τ = Time constant of declining sprinting power.

T_{SCP} = Minimal duration for availability of W'

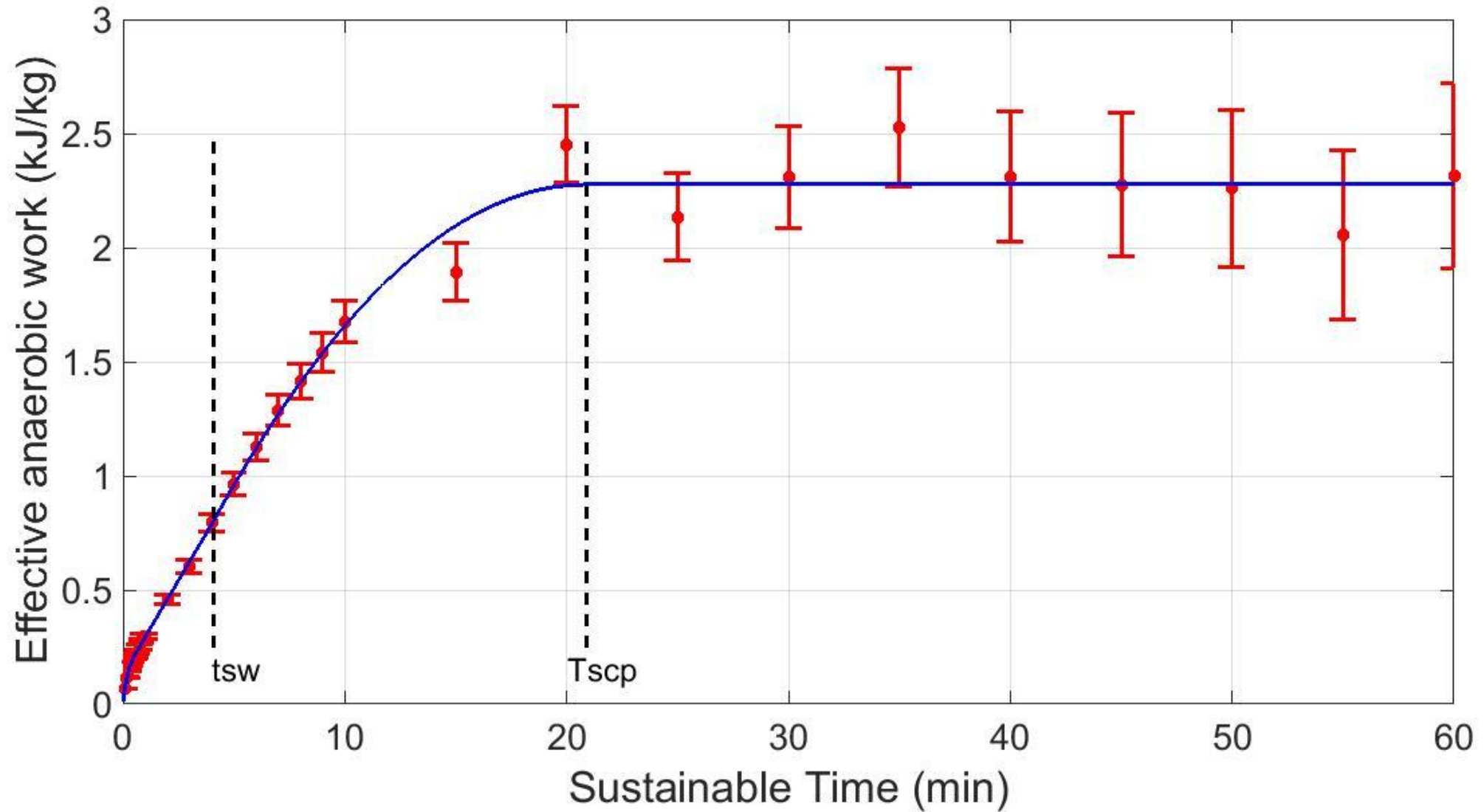
SCP = Supercritical Power (M. Puchowicz)

$W_{\text{eff}}(t)$ = Effective Anaerobic work available

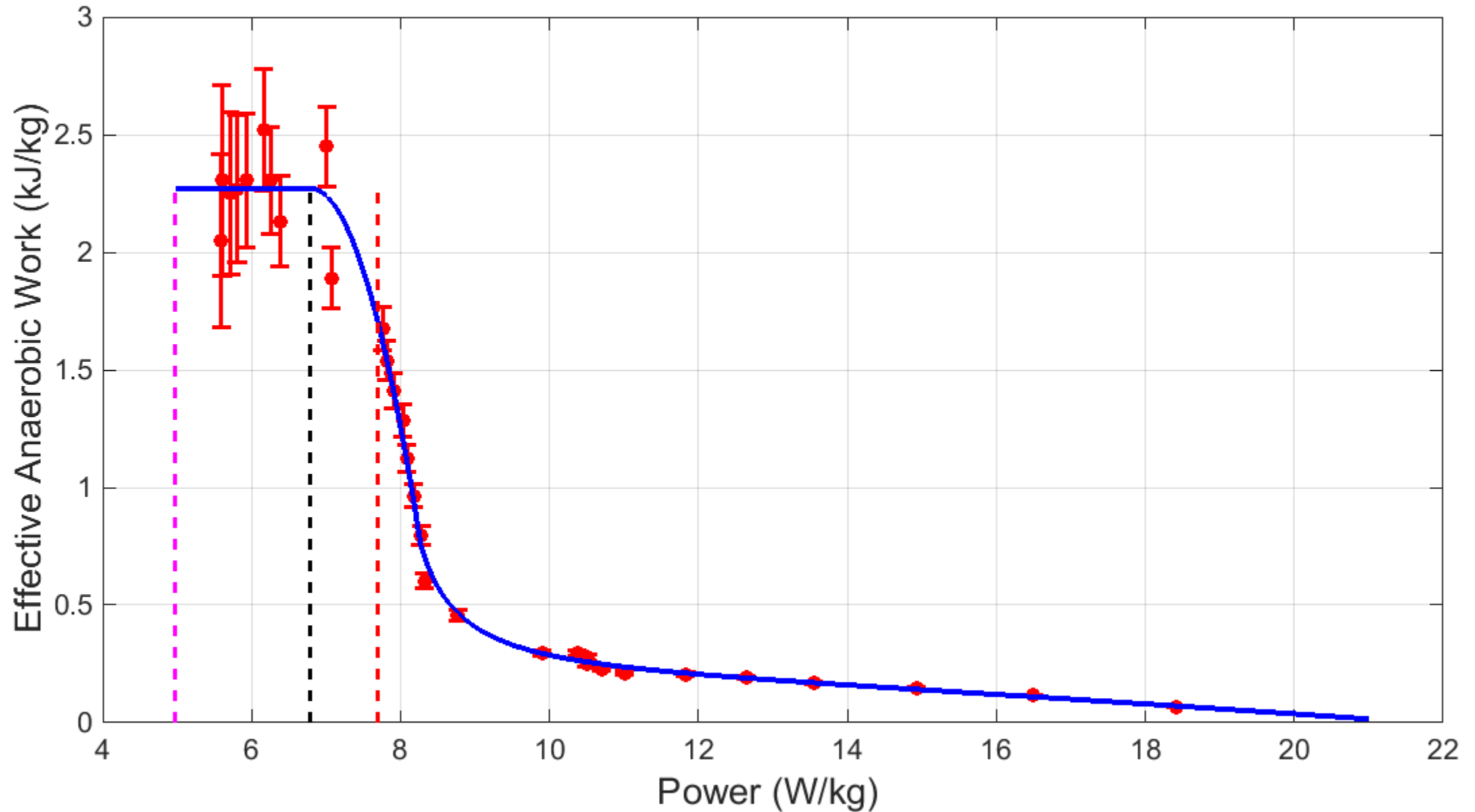
Season Record Power Curve



$[W_{\text{eff}}, t]$ or F-Plot



$[W_{\text{eff}}, P]$ or VC-Plot



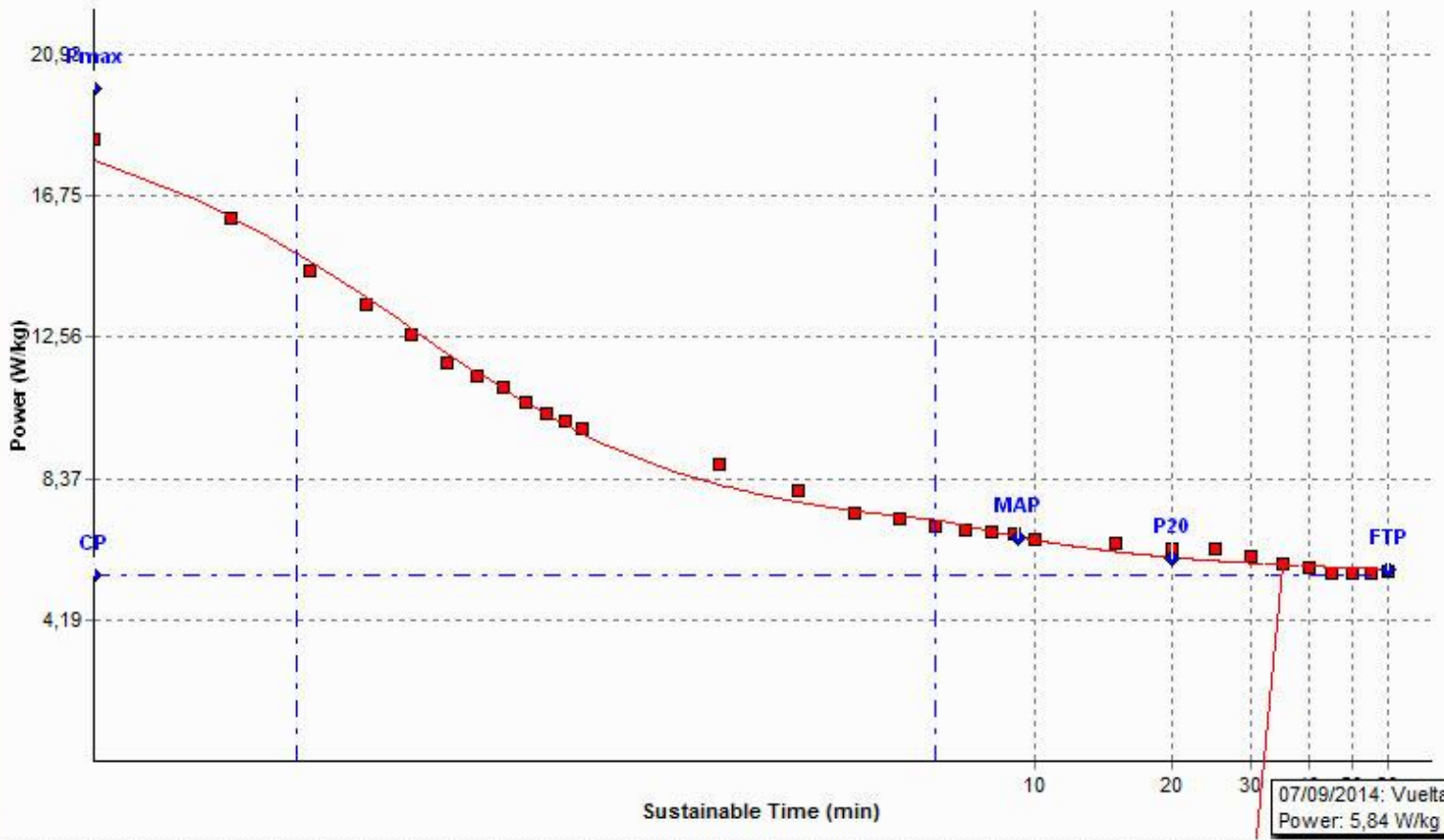
Some results

	CP W/kg	W' kJ/kg	MAP W/kg	W's kJ/kg	Pmax W/kg	τ sec	SCP W/kg	T SCP min
Climber Male	5.07	1.69	5.90	0.24	16.6	23.0	5.97	31
Climber Male	5.04	1.35	6.50	0.19	16.5	19.2	6.23	19
Sprinter Male	4.31	2.25	5.63	0.32	23.6	18.0	5.52	31
Allround Female	5.10	0.34	5.43	0.21	15.3	22.0	6.13	5.4

su 07/09/2014

Critical Power Model

21/05/2014 - 21/05/2015 (366 days = 52 weeks and 2 days)



- Power
- ◆ Pmax 19,94 W/kg
- Tau 14 sec
- ◆ MAP 6,64 W/kg
- ◆ P20 6,04 W/kg
- ◆ FTP 5,7 W/kg
- ◆ CP 5,53 W/kg
- Tsw 359 sec

Chart

- Power over Time
- Power over Inverse Time
- Weff over Time
- Weff over Power

Options

- per kg bodymass
- Logarithmic x-axis

07/09/2014: Vuelta et.15
Power: 5.84 W/kg over 35'

Points

Conclusions

- Well-chosen MMP data can be used for Performance Analysis
- Extended CP-model describes the full MMP data
- P_{\max} , MAP and τ describe sprinting performance
- CP, W'_{eff} and SCP describe endurance performance
- W'_{eff} is constant in the power zone $CP < P < SCP$
- W'_{eff} drops to 0 for $P > SCP$