Un modello statistico per lo sviluppo di fattori di emissione

.

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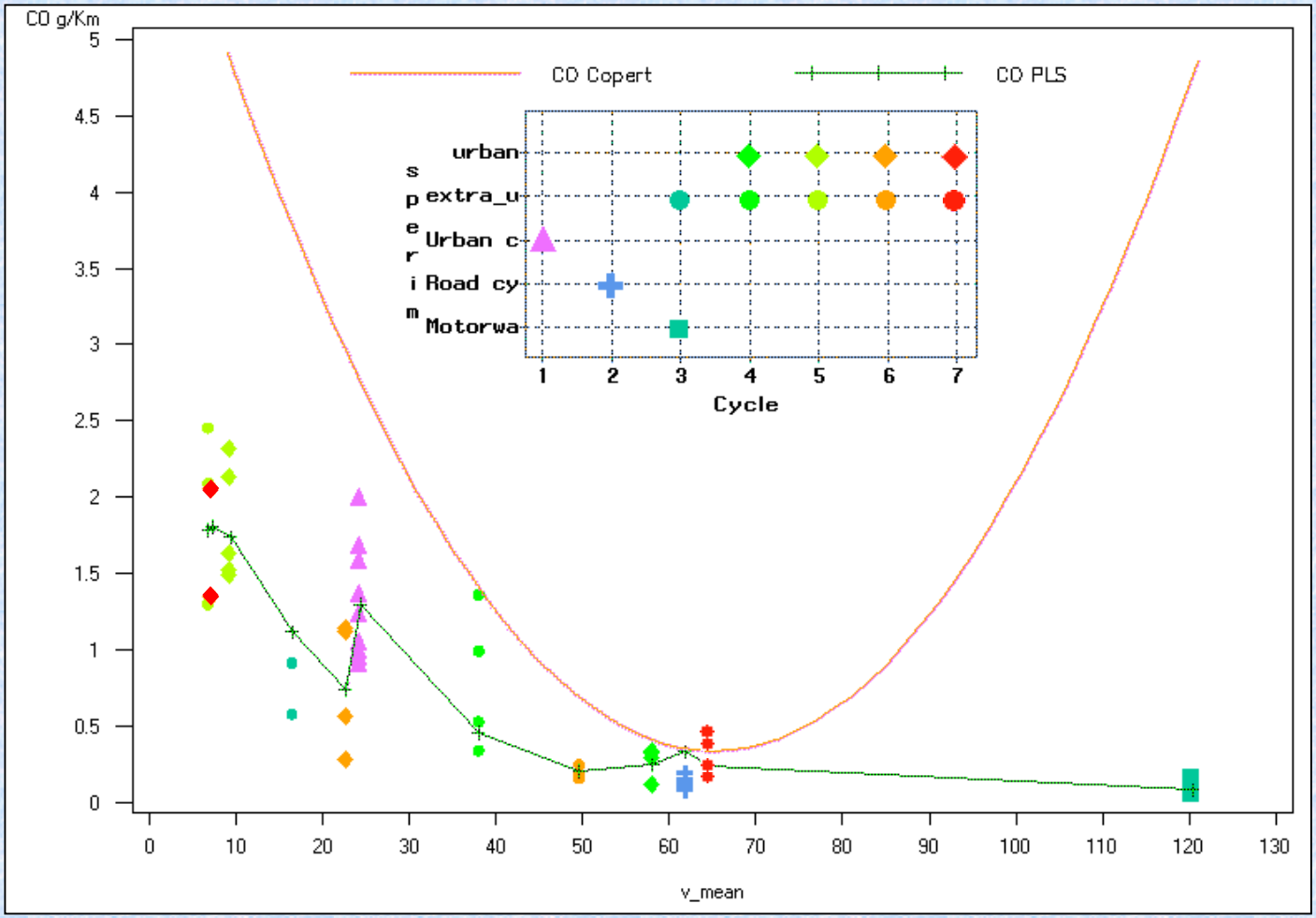
Gli obiettivi

- Definire quantita' che sono allo stesso tempo le piu' efficaci sia per la caratterizzazione dei cicli di guida che per lo sviluppo di modelli di emissione
- Migliorare i modelli delle emissioni medie

Comparison between experimental data, PLS

Predicted and Copert calculated CO emissions

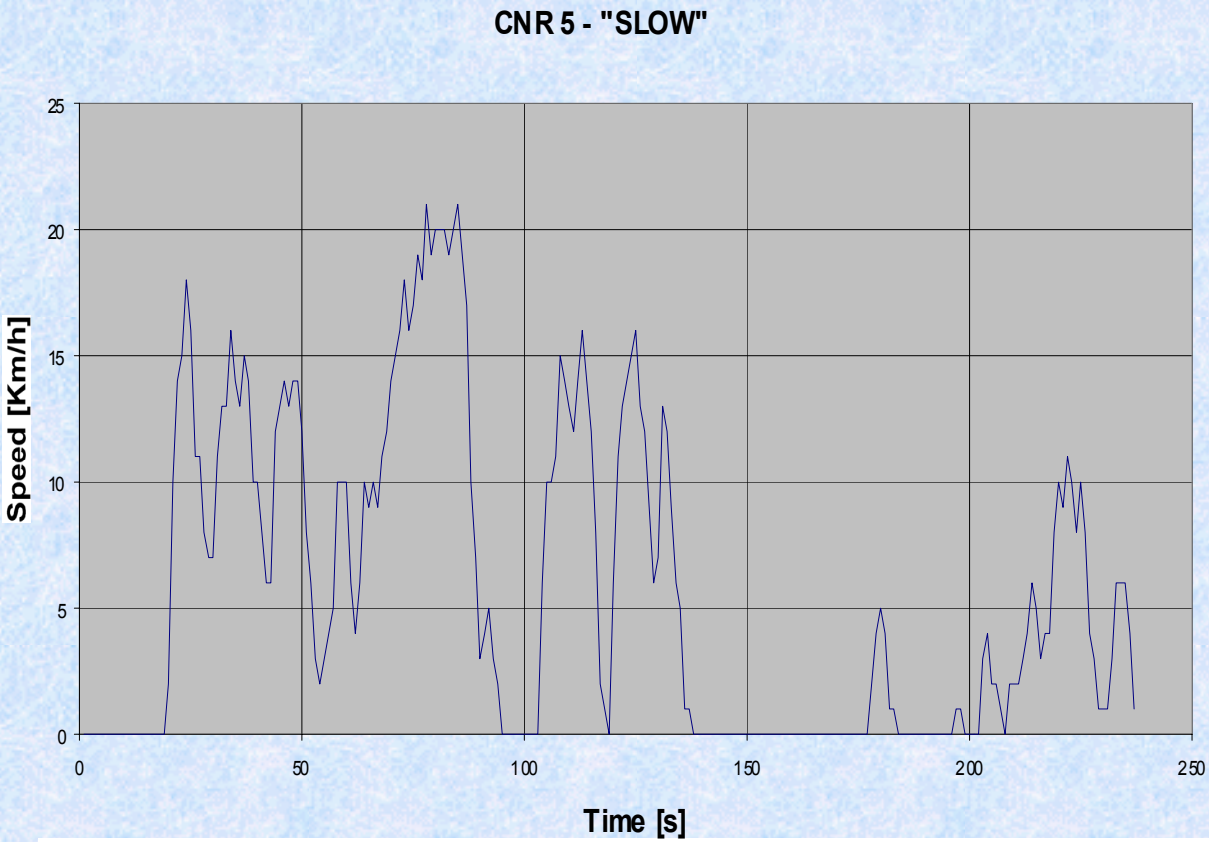


L’ approccio

- Considera le emissioni (CO,HC, NOx, CO_2) come un set di not variabili non independenti
- Considera piu’ variabili oltre alla velocita’ media per caratterizzare un ciclo
- Usa il metodo di regression Partial Least Square (PLS) per costruire il modello statistico

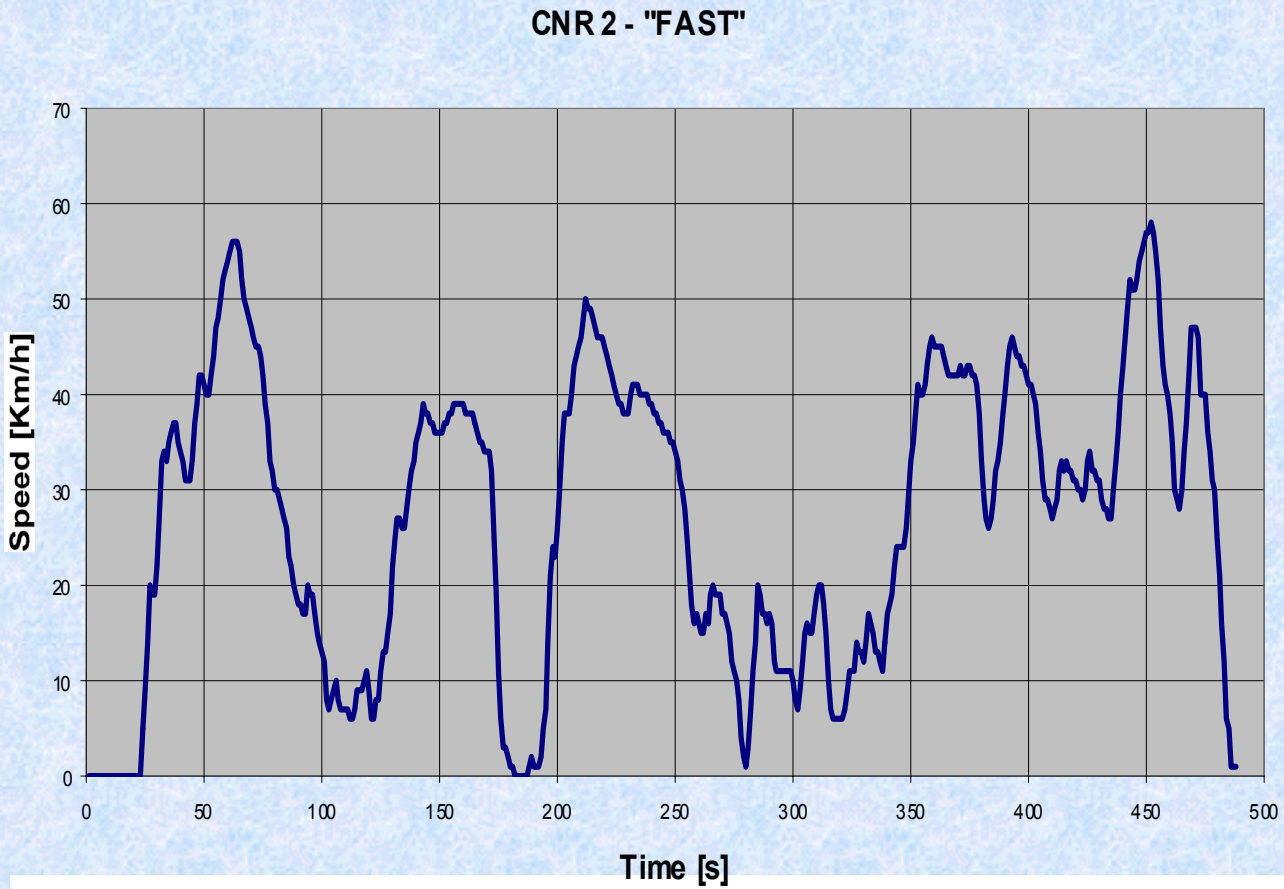
Cicli di guida

Un ciclo di guida lento

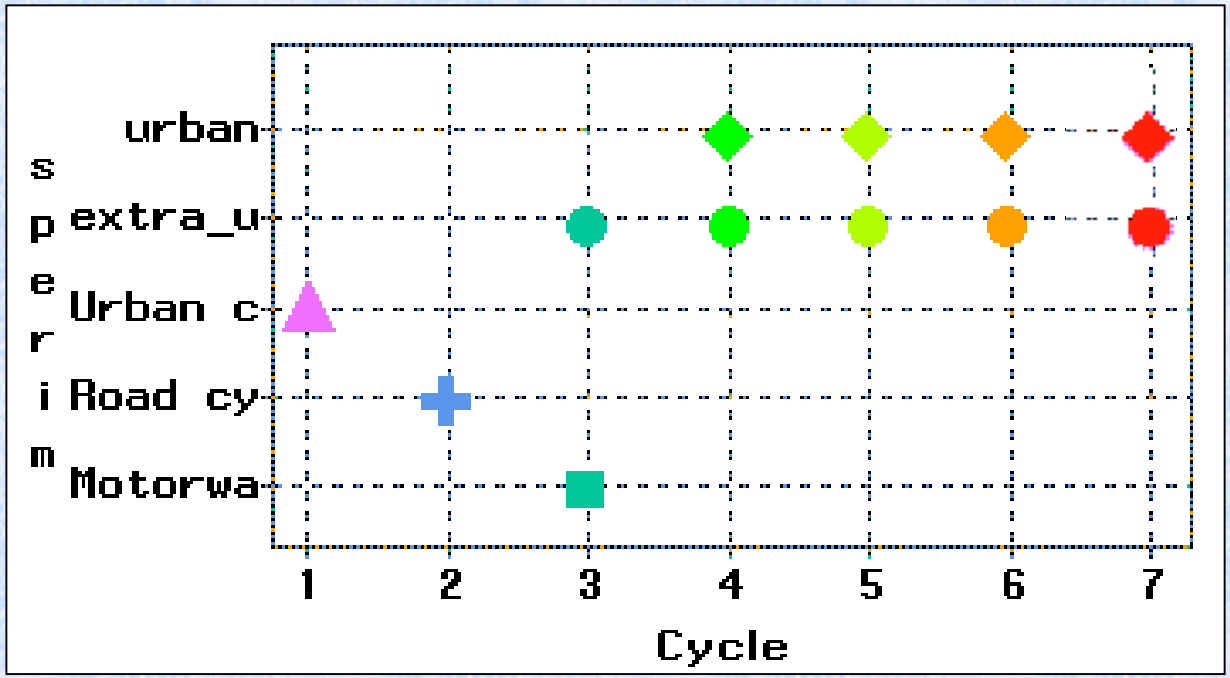


Cicli di guida

Un ciclo di guida veloce



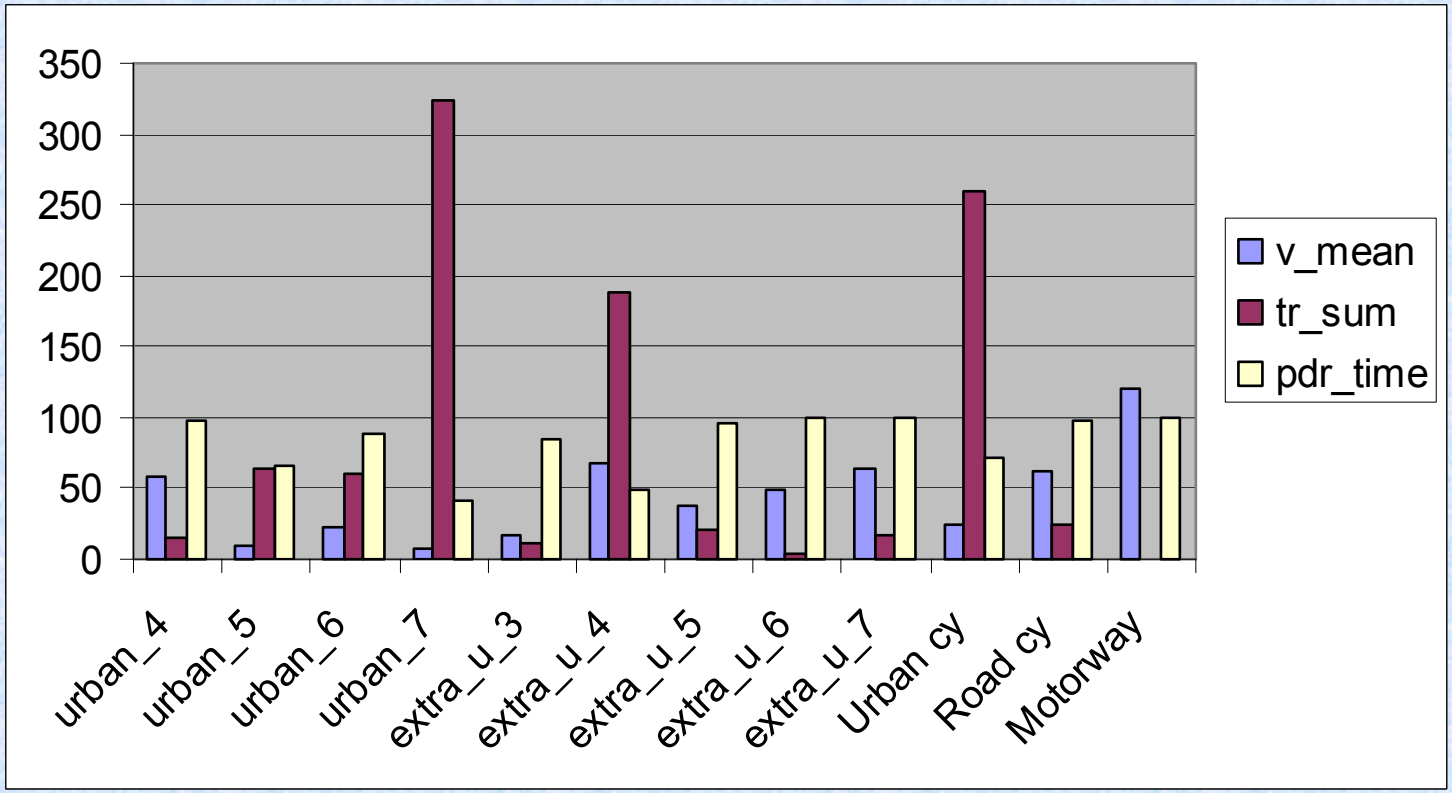
Experimental data



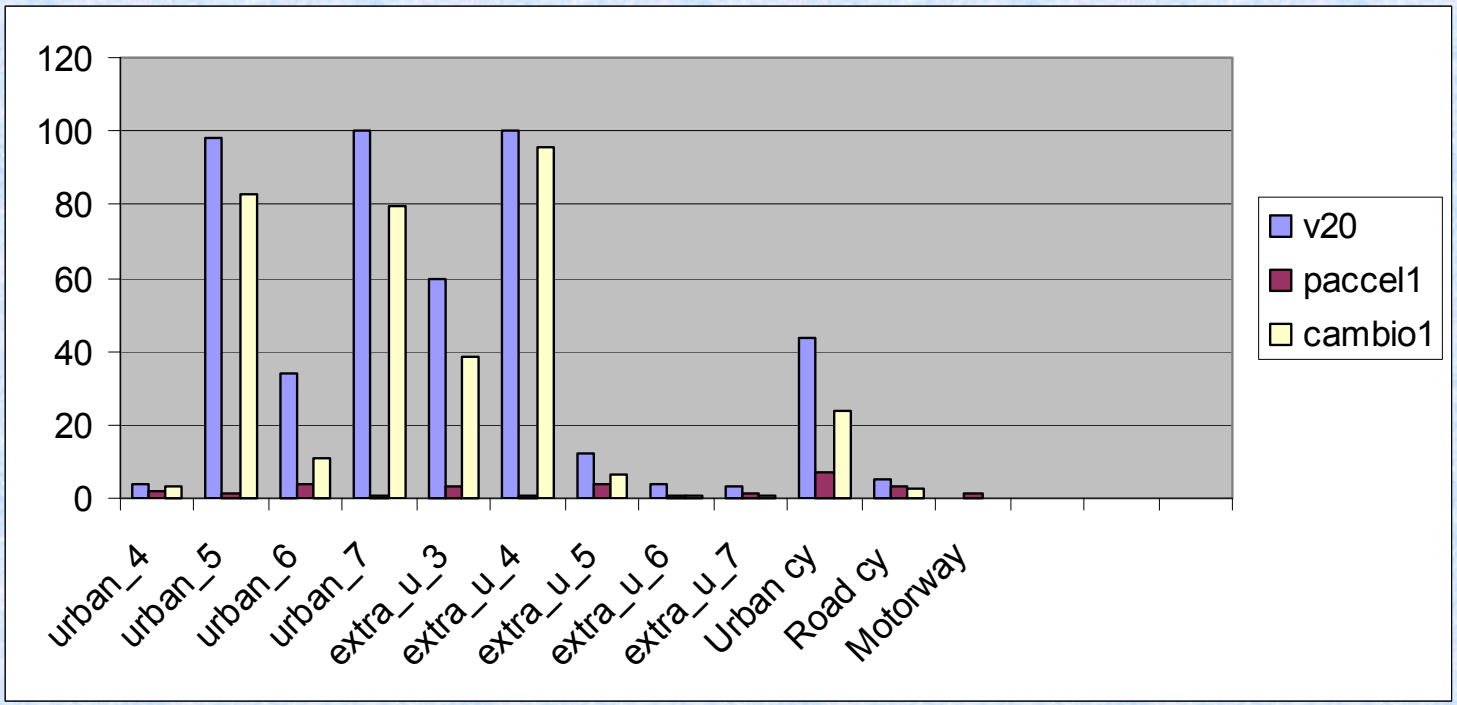
Experimental driving cycle characteristics

Sperim	cycle	v_mean	tr_sum	pdr_time	v20	paccel1	cambio1
urban	4	58.078	15	97.466	3.64	1.733	3.120
urban	5	9.350	64	66.667	98.43	1.563	82.813
urban	6	22.662	61	88.269	33.98	3.704	10.893
urban	7	7.260	323	41.802	100	0.862	79.741
extra_u	3	16.460	11	83.824	59.64	3.509	38.596
extra_u	5	6.805	188	49.462	100	0.543	95.652
extra_u	4	38.029	20	95.327	12.25	3.676	6.127
extra_u	6	49.642	3	99.787	4.06	0.641	0.427
extra_u	7	64.466	17	99.191	3.45	1.296	0.384
Urban cy	1	24.356	260	71.770	43.57	7.110	24.054
Road cy	2	61.848	24	97.554	5.22	2.926	2.717
Motorway	3	120.359	0	100	0	1.088	0

Experimental driving cycle characteristics



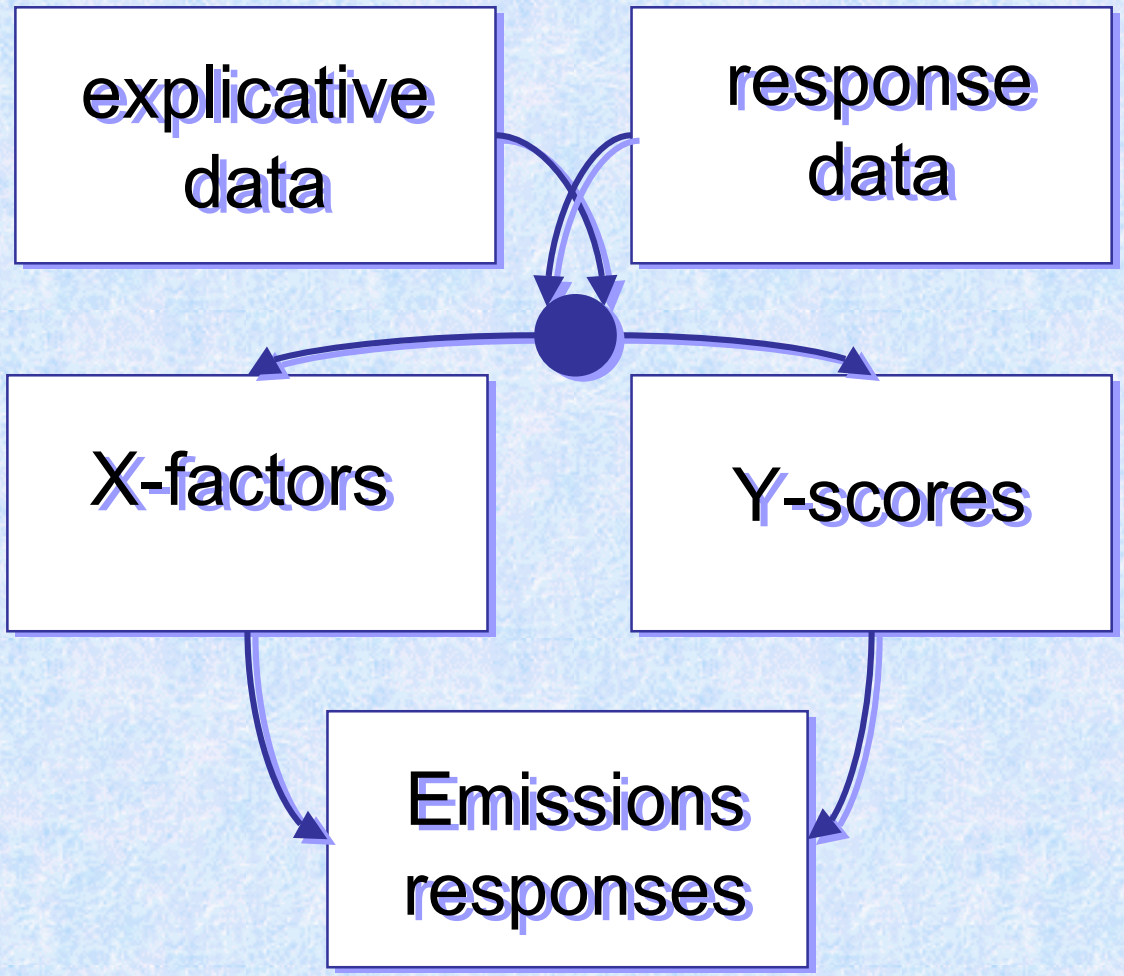
Experimental driving cycle characteristics



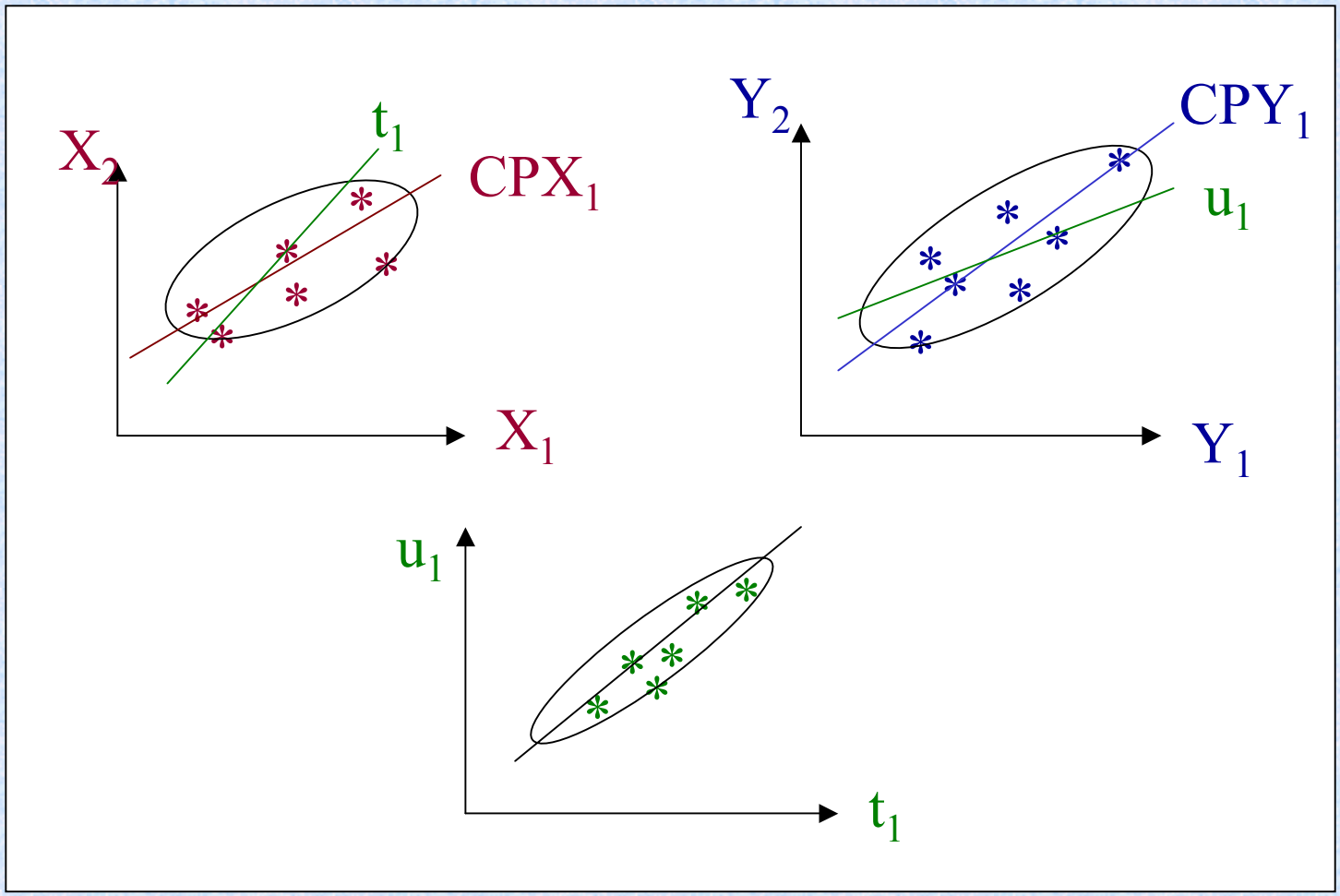
Variables used for the determination of driving cycles.

Variables	Description	Variables	Description
v_mean	average speed	cambio0	%time gear = 0
v_quad	squared average speed	cambio1	%time gear = 1
v_max_t_c	Ratio vmax/driving time	cambio2	%time gear = 2
v20	%time speed <20	cambio3	%time gear = 3
v30	%time 20<speed<30	cambio4	%time gear = 4
v40	%time 30<speed<40	cambio5	%time gear = 5
v100	%time speed>40	paccel1	class of acceleration (m/s^2) [-∞;-1.4]
t_sum	time duration	paccel2	class of acceleration (m/s^2) [-1.4;-0.6]
d_sum	distance covered	paccel3	class of acceleration (m/s^2) [-0.6;-0.2]
tr_sum	idling time	paccel4	class of acceleration (m/s^2) [-0.2;0.2]
pdr_time	driving time	paccel5	class of acceleration (m/s^2) [0.2;0.6]
n_seq	number of sequences	paccel6	class of acceleration (m/s^2) [0.6;1.4]
acc1t	time with acc>0.15 m/s^2	paccel7	class of acceleration (m/s^2) [1.4;+∞]

La procedura PLS



Step 1 of PLS2 Regression



Variable Importance in the Projection (VIP)

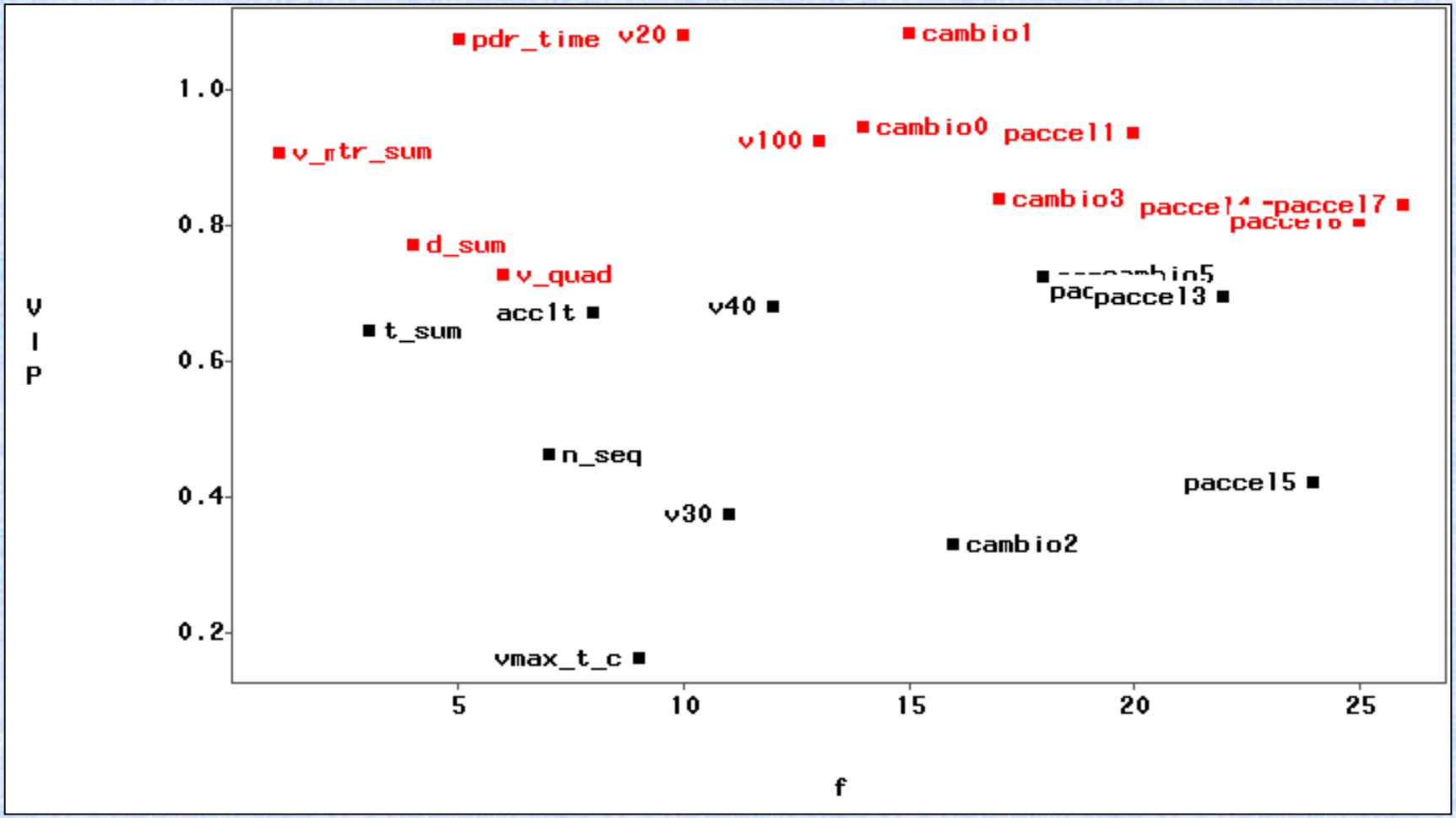
- Componenti PLS : $t_h = X_{h-1} b_h$, with $\|b_h\| = 1$
- Importanza della variabile x_j per la predizione di Y modello a *m*-componenti :

$$VIP_{mj} = \sqrt{\frac{p}{\sum_{k=1}^{q} R^2(y_k; t_1, \ldots, t_p)} \sum_{h=1}^{m} [\sum_{k=1}^{q} R^2(y_k, t_h)] b_{hj}^2}$$

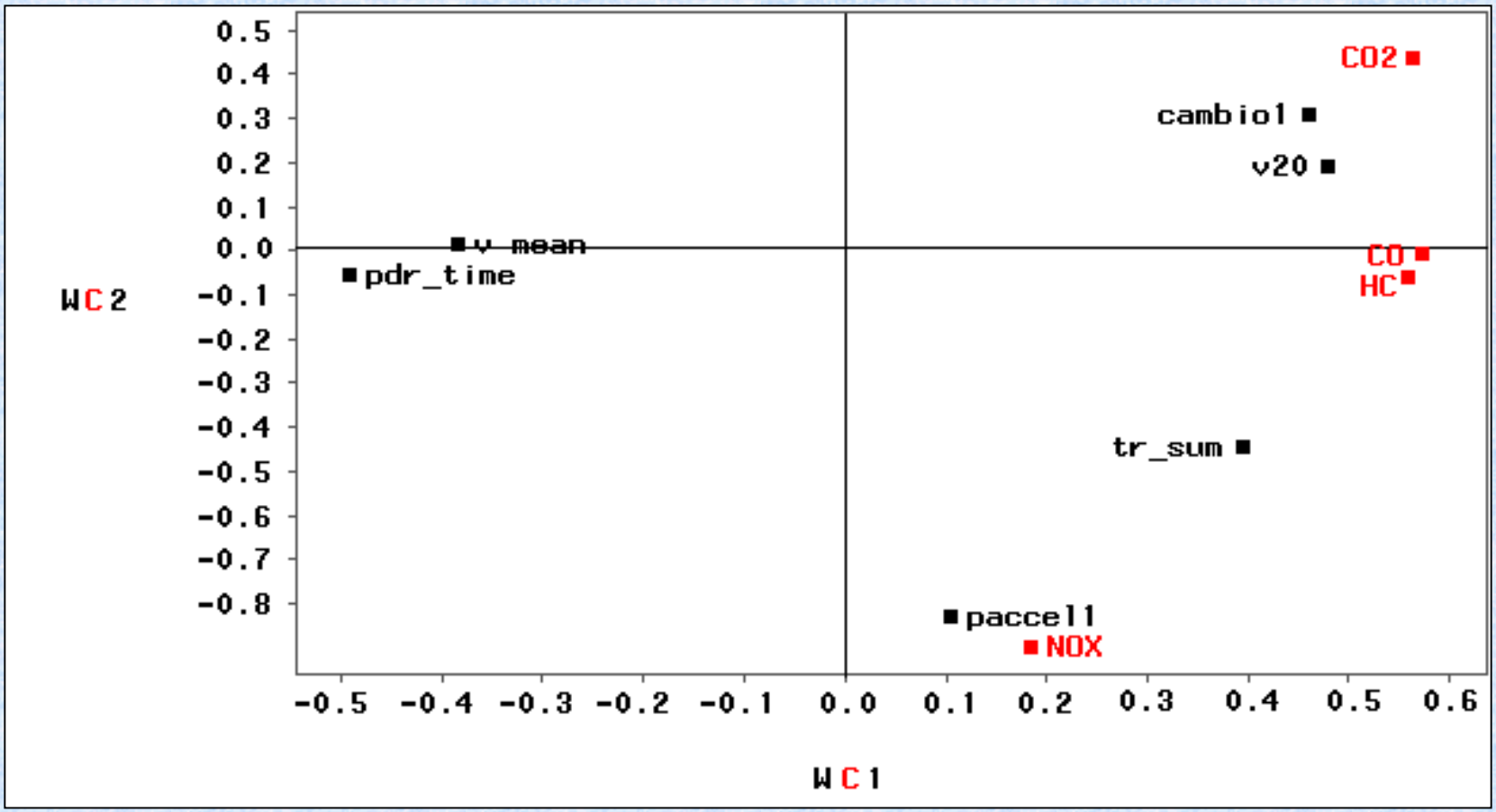
- Media del VIP al quadrato= 1.

(by M. Tenehaus)

The variable Importance in the Projection (VIP) index

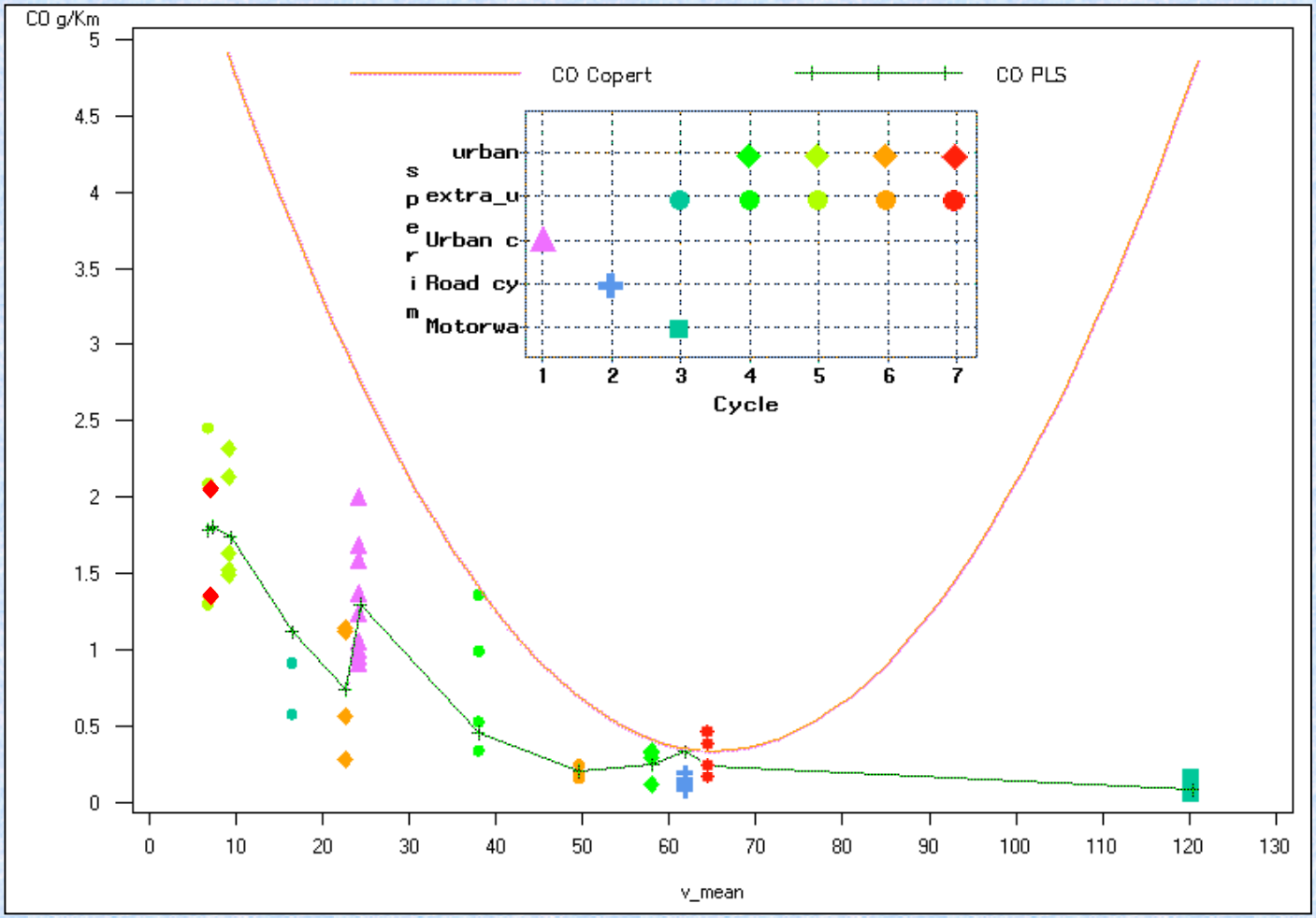


Dependent and explicative variables correlation



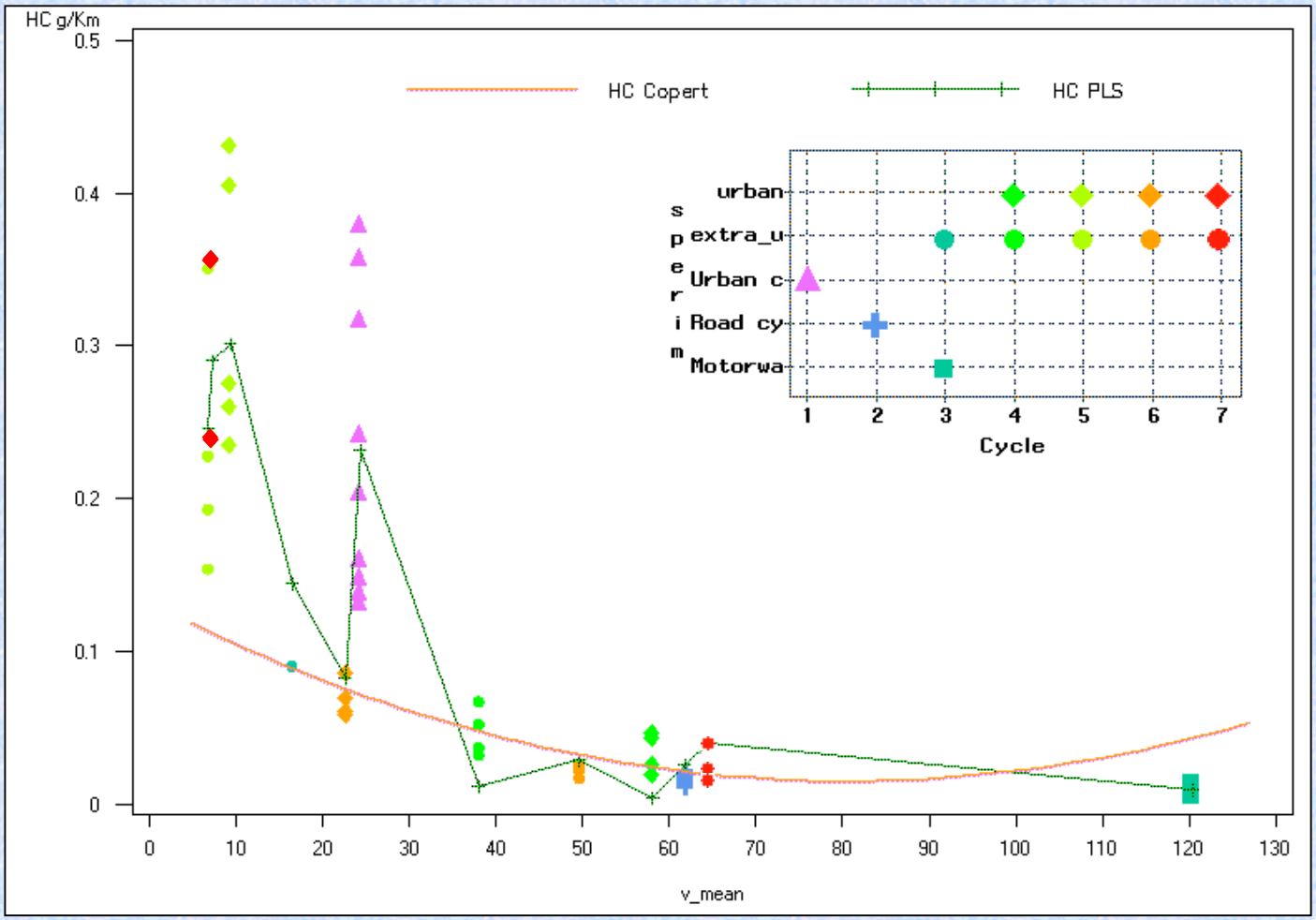
Comparison between experimental data, PLS

Predicted and Copert calculated CO emissions



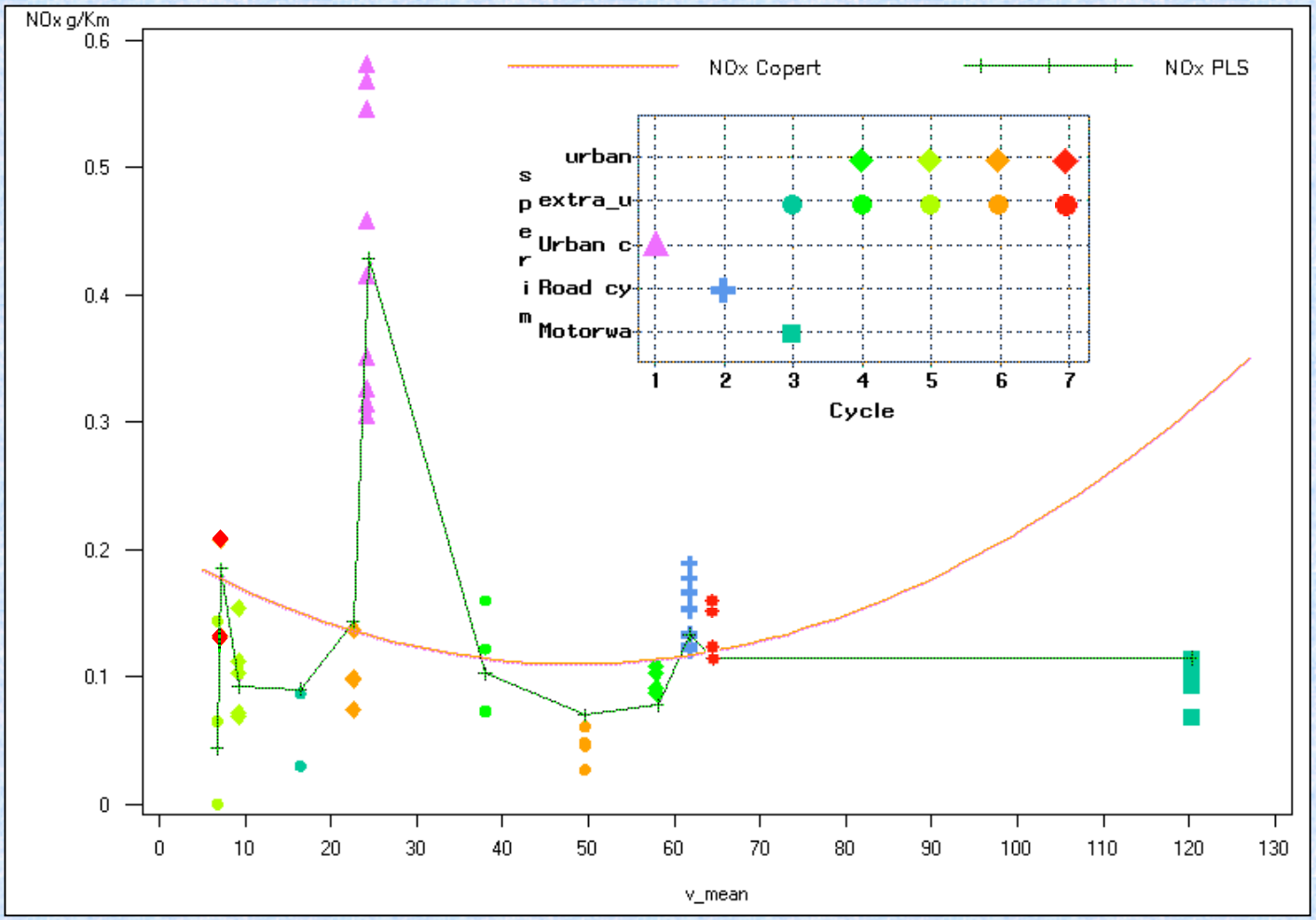
Comparison between experimental data, PLS

Predicted and Copert calculated HC emissions



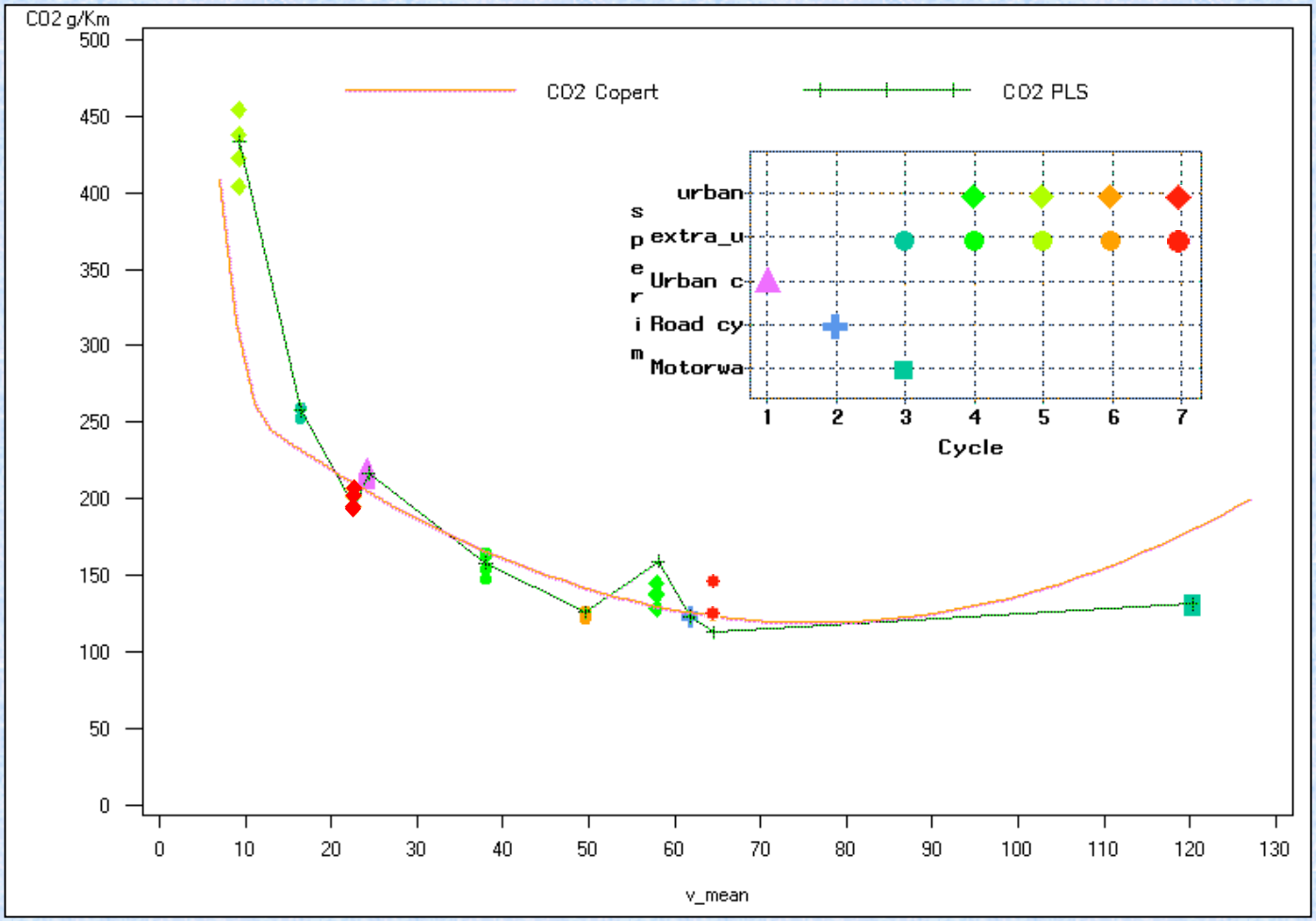
Comparison between experimental data, PLS

Predicted and Copert calculated NOx emissions

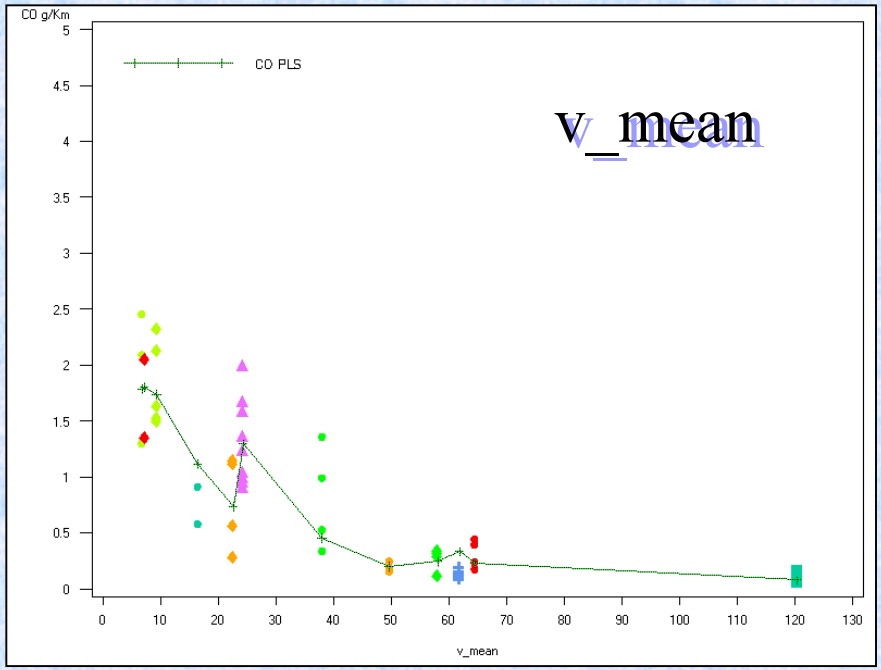


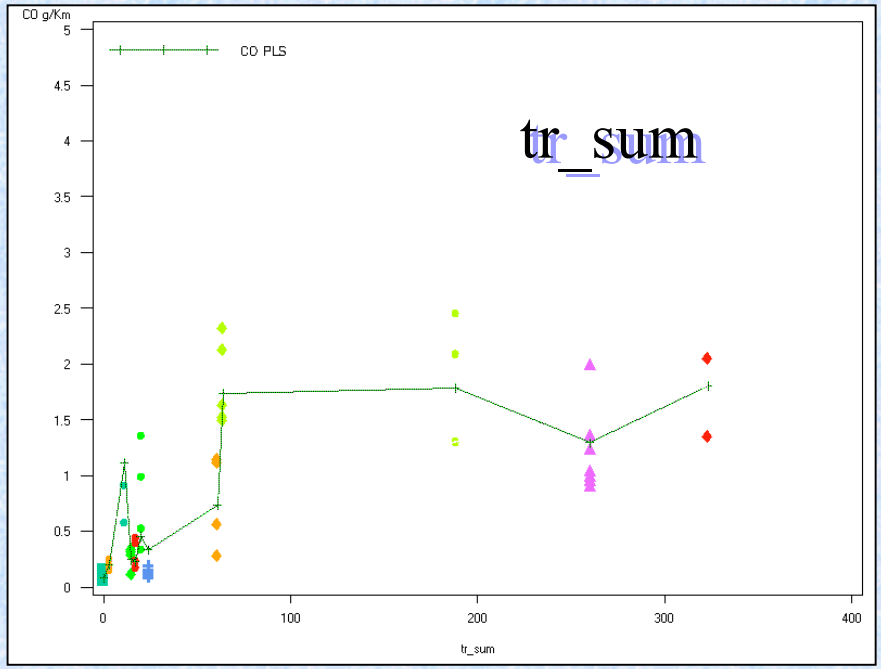
Comparison between experimental data, PLS

Predicted and Copert calculated CO2 emissions

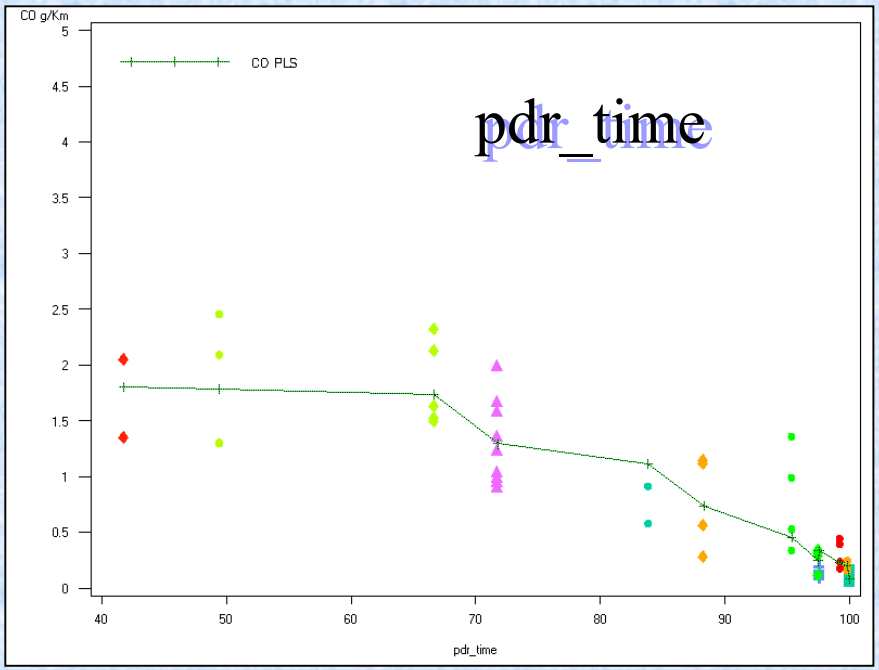


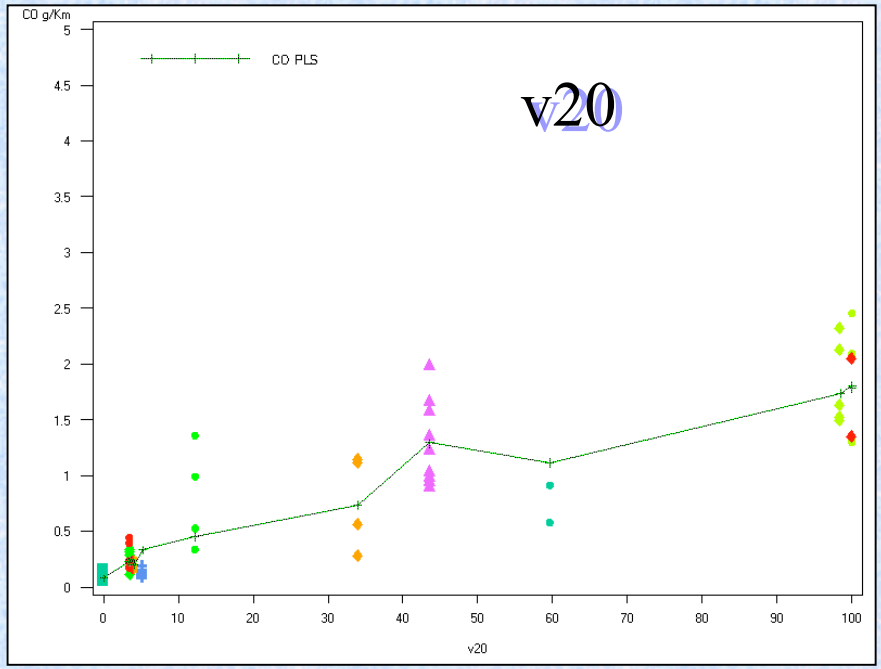
CO measured dispersion respect to PLS variables (v_mean , tr_sum)



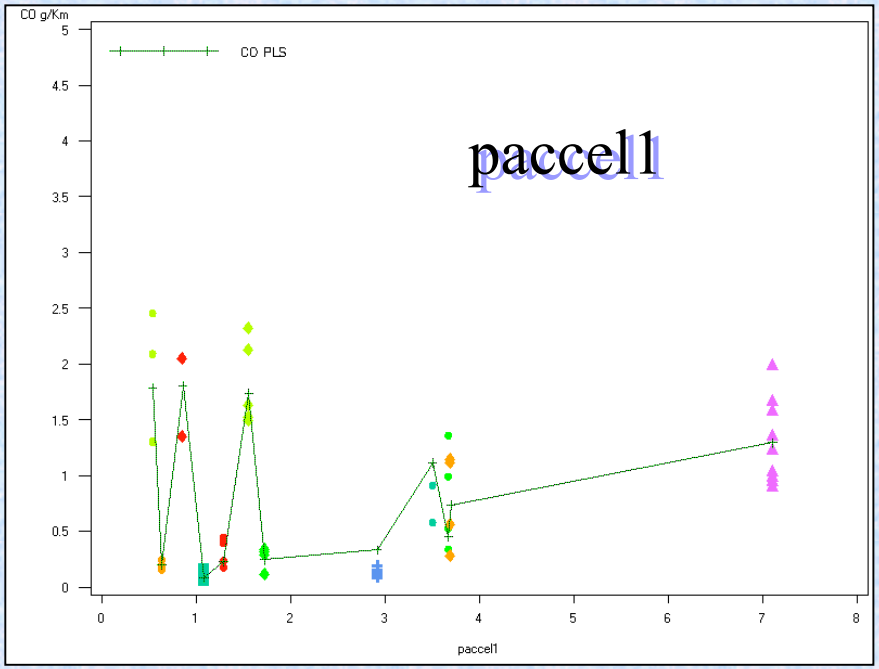


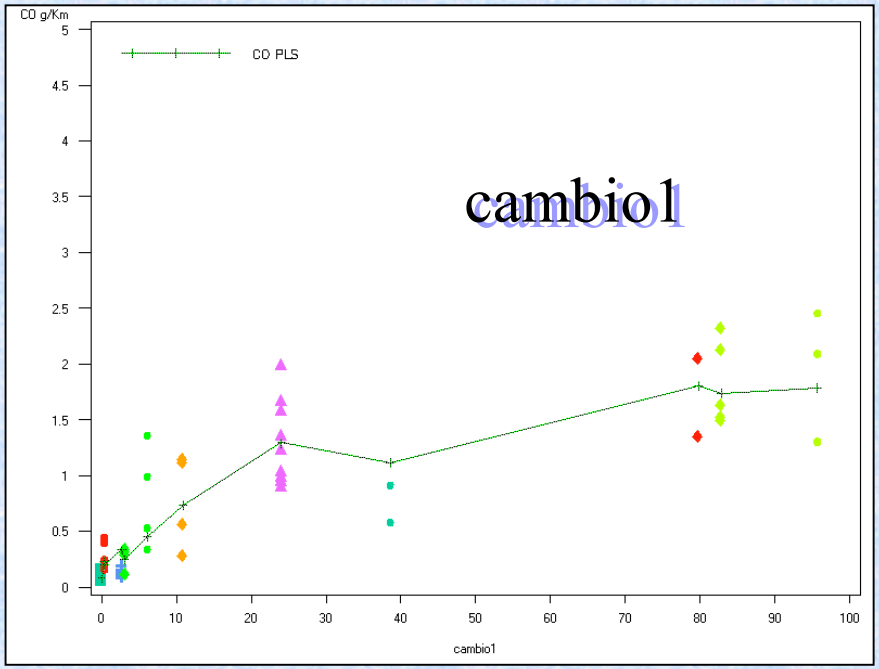
CO measured dispersion respect to PLS variables (pdr_time , v_20)





CO measured dispersion respect to PLS variables (paccel , cambio1)





Riconoscimenti

- Questa ricerca e' finanziata dal progetto ARTEMIS condotto nell'ambito del Vth EU framework programme