

Evento finale - Progetto RESBA



*Metodologia valutazione probabilistica volumi di piena -
Méthodes d'évaluation probabilistes des volumes de crue*

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Dipartimento di Ingegneria dell'Ambiente, del Territorio e
delle Infrastrutture (DIATI)*

Webinar

3-4 Dicembre 2020



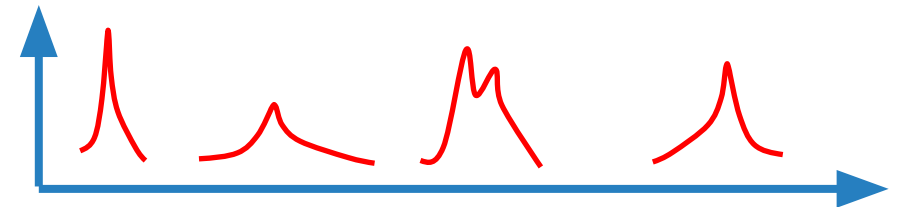
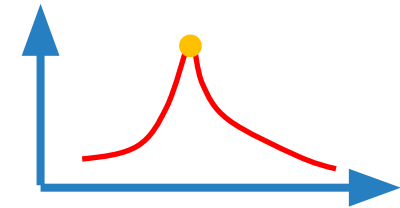
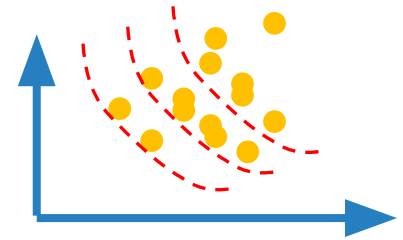
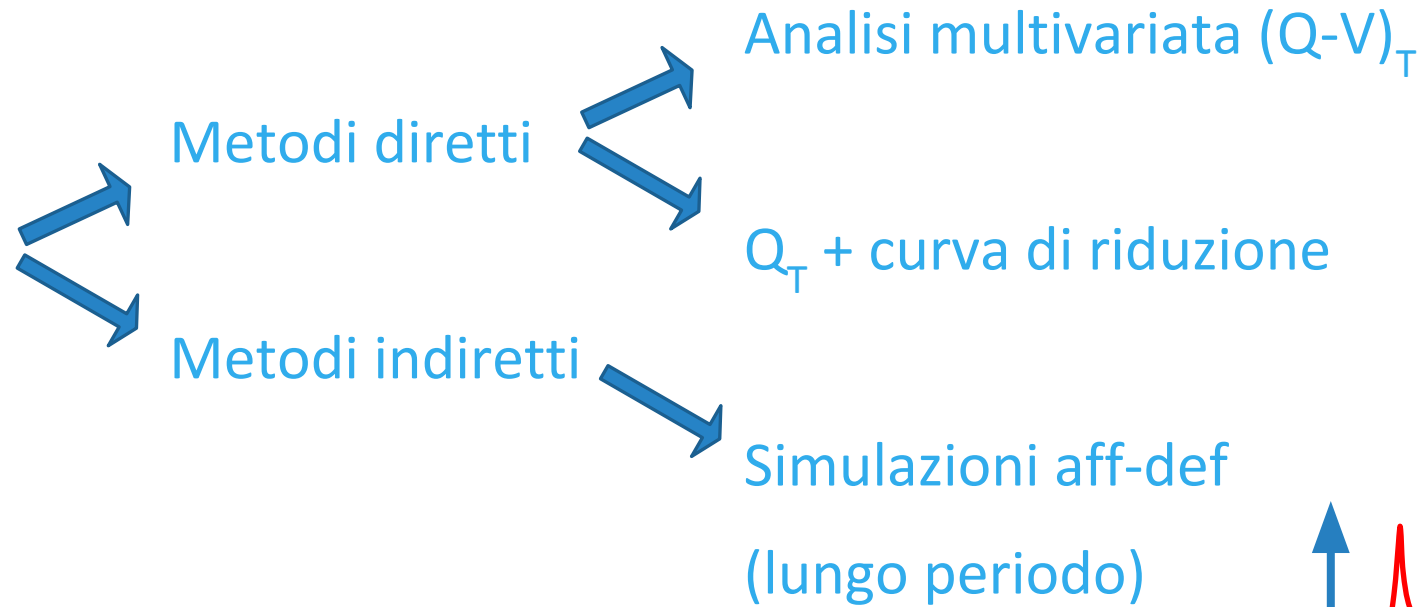
INRAE



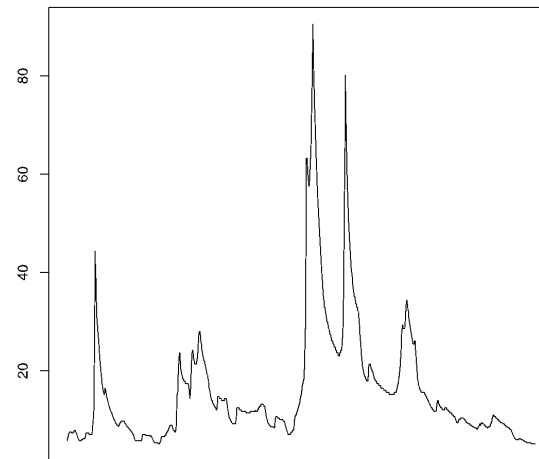
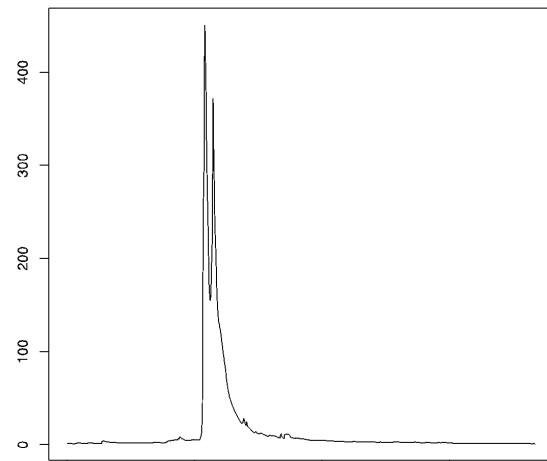
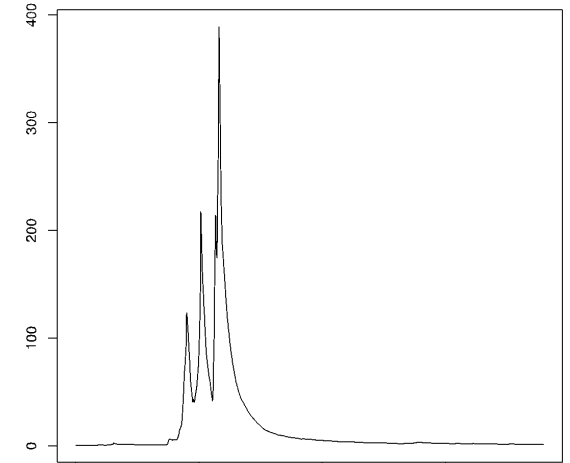
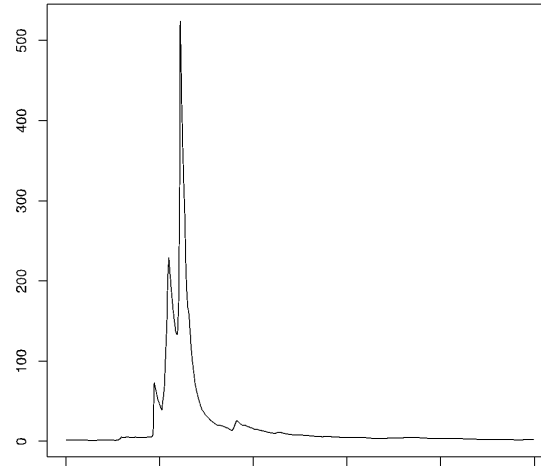
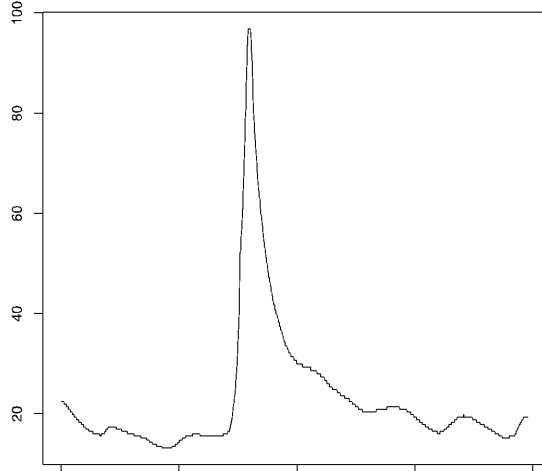
**POLITECNICO
DI TORINO**



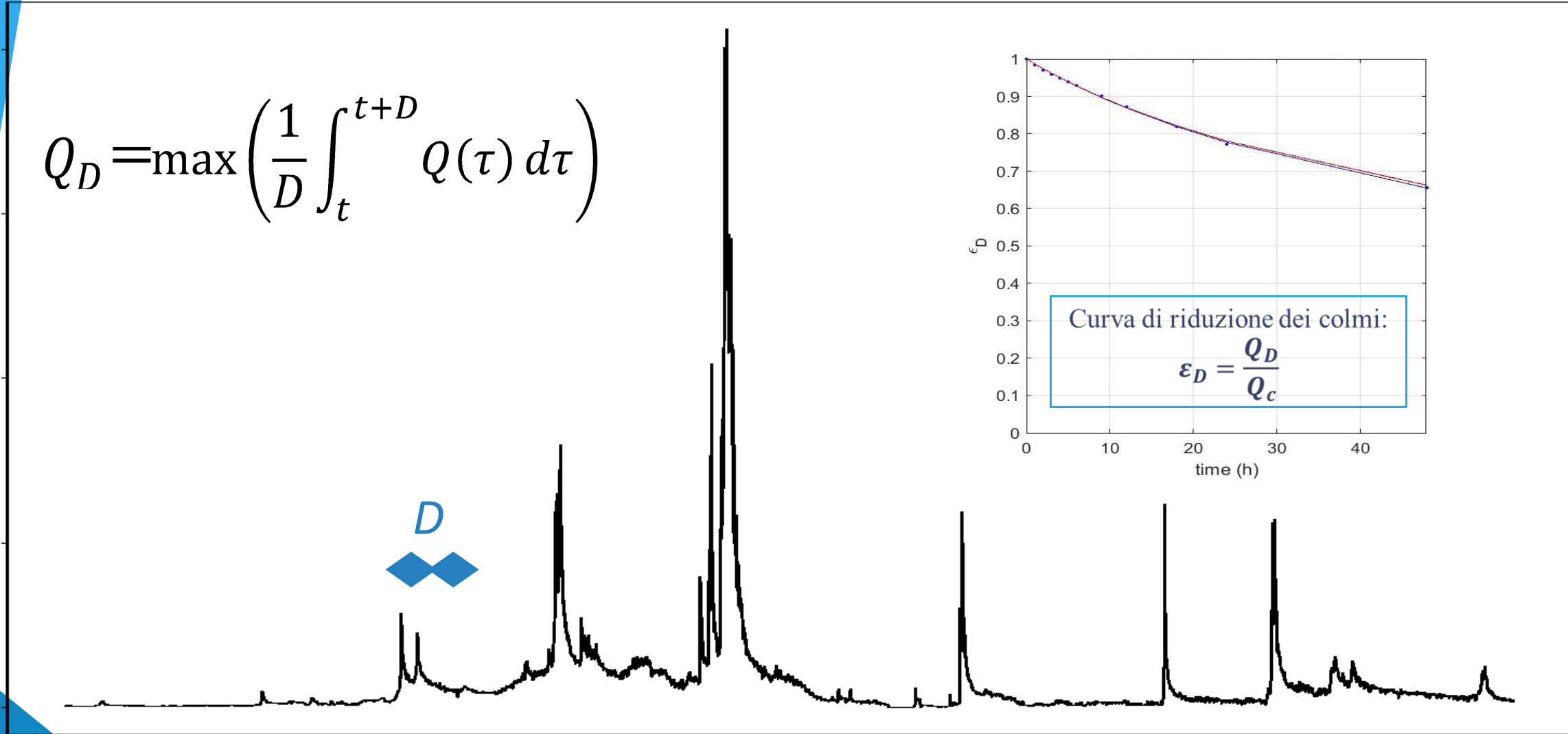
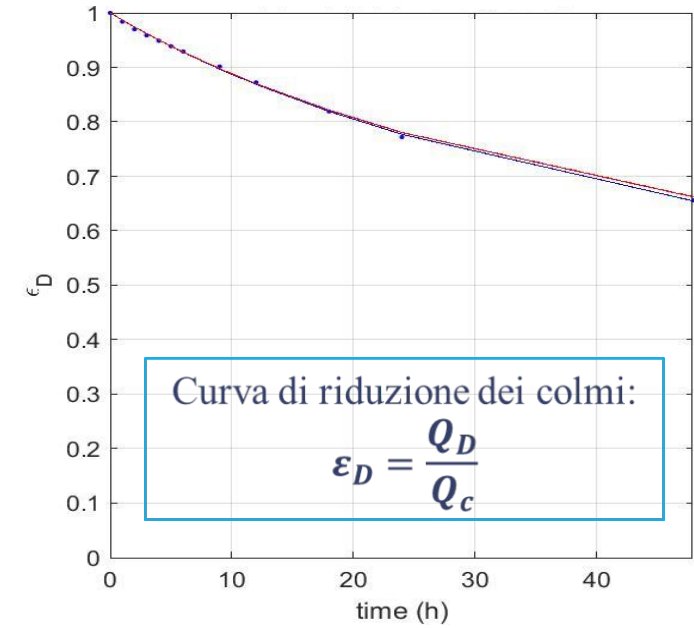
Idrogrammi (e volumi) di riferimento



Sintesi e regolarizzazione degli idrogrammi



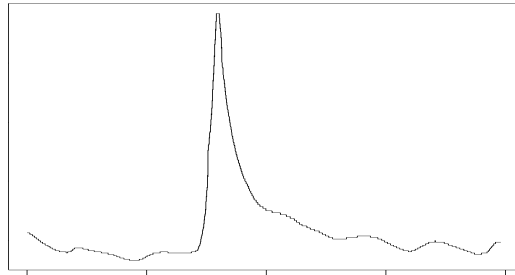
$$Q_D = \max \left(\frac{1}{D} \int_t^{t+D} Q(\tau) d\tau \right)$$



D = finestra mobile; durata variabile

Applicazione su tutto il territorio

**IDROGRAMMI OSSERVATI
SEZIONI STRUMENTATE**



CURVA DI RIDUZIONE EMPIRICA



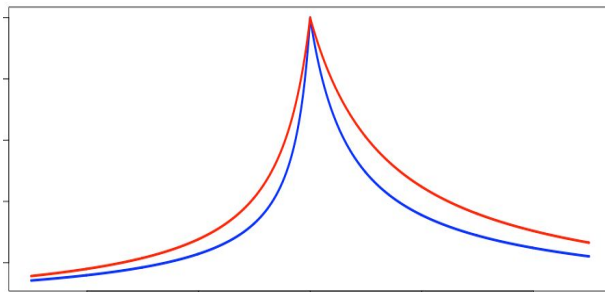
FORMULAZIONI ANALITICHE



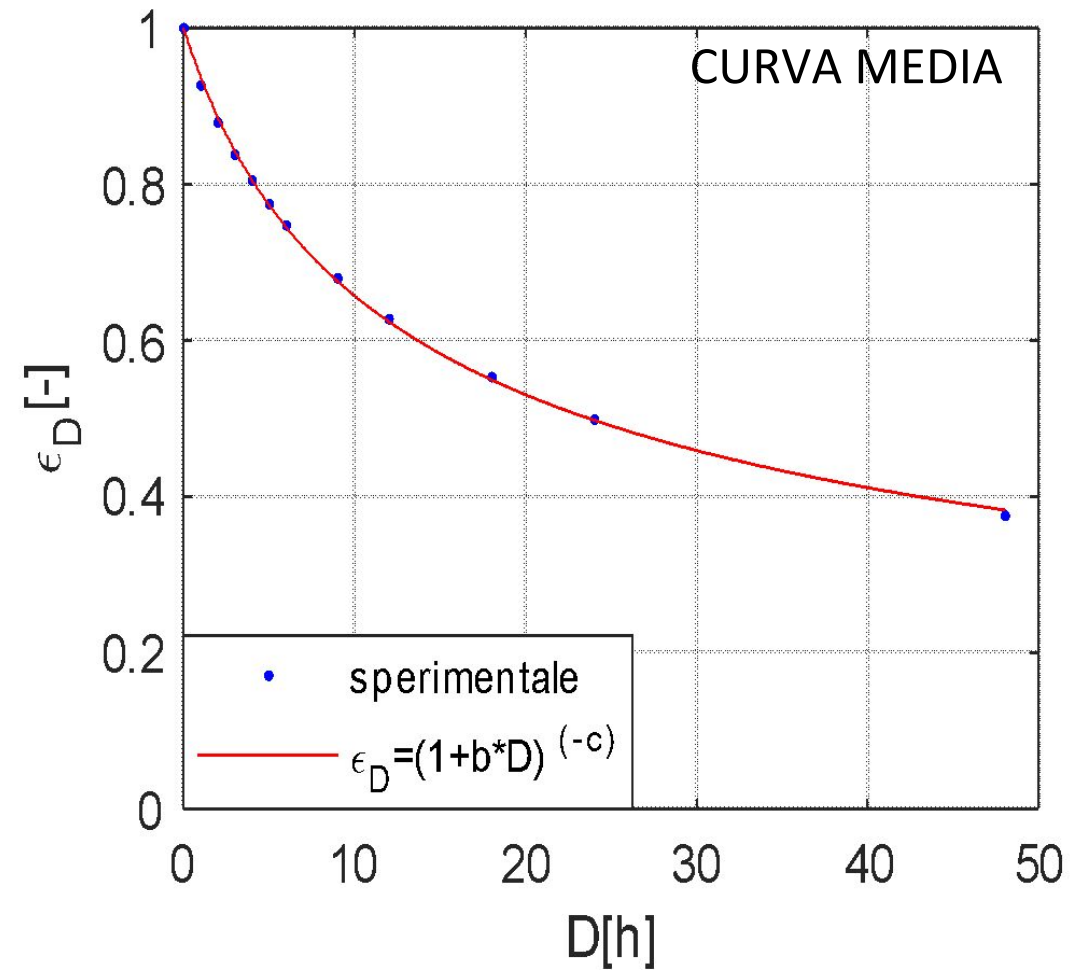
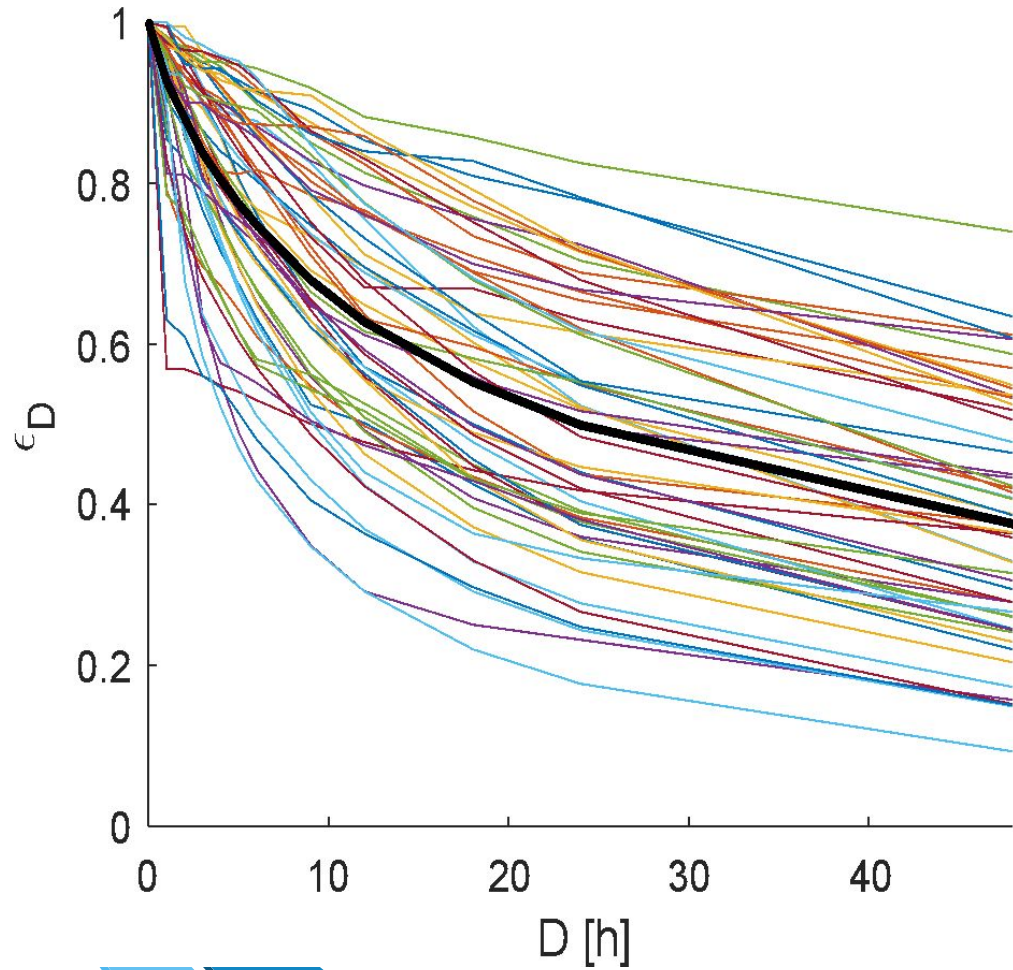
ANALISI REGIONALE PER STIME IN SEZ. QUALSIASI



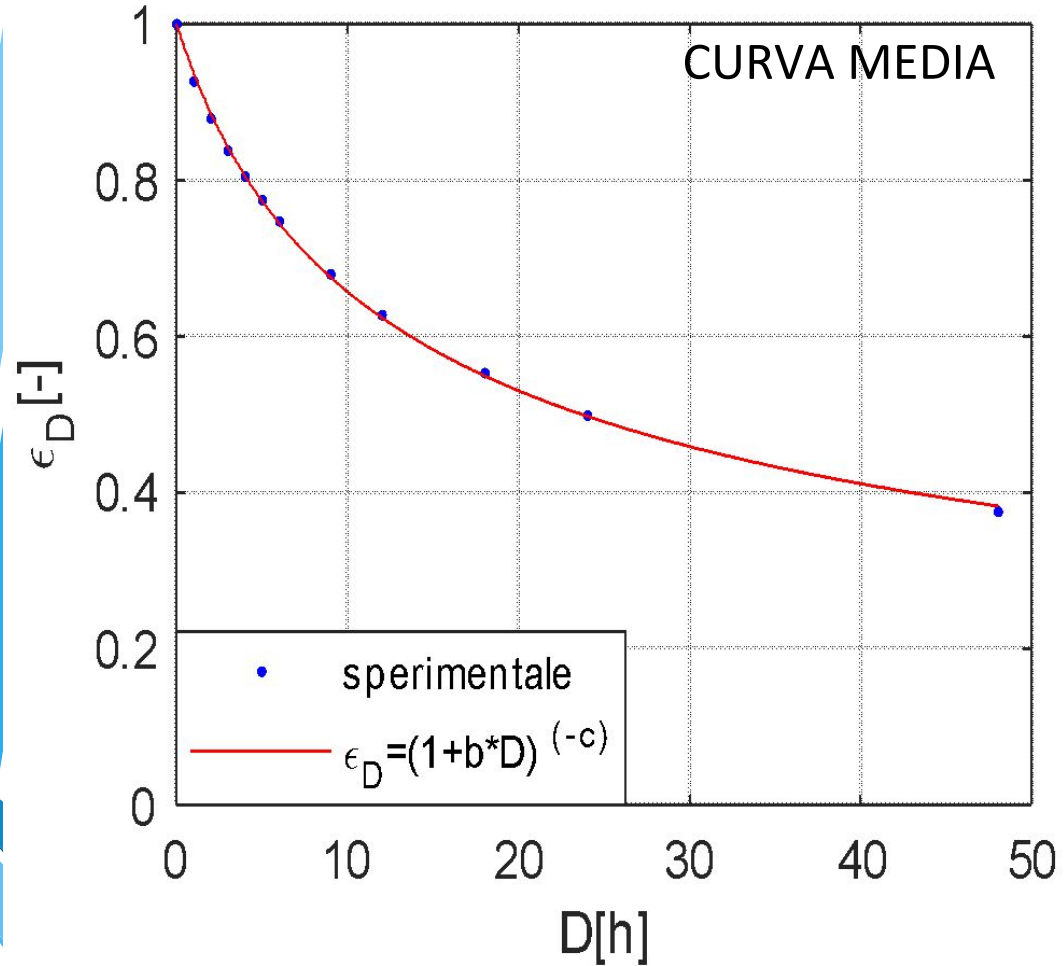
**IDROGRAMMI SINTETICI
QUALSIASI SEZIONE**



Curve di riduzione annuali e media



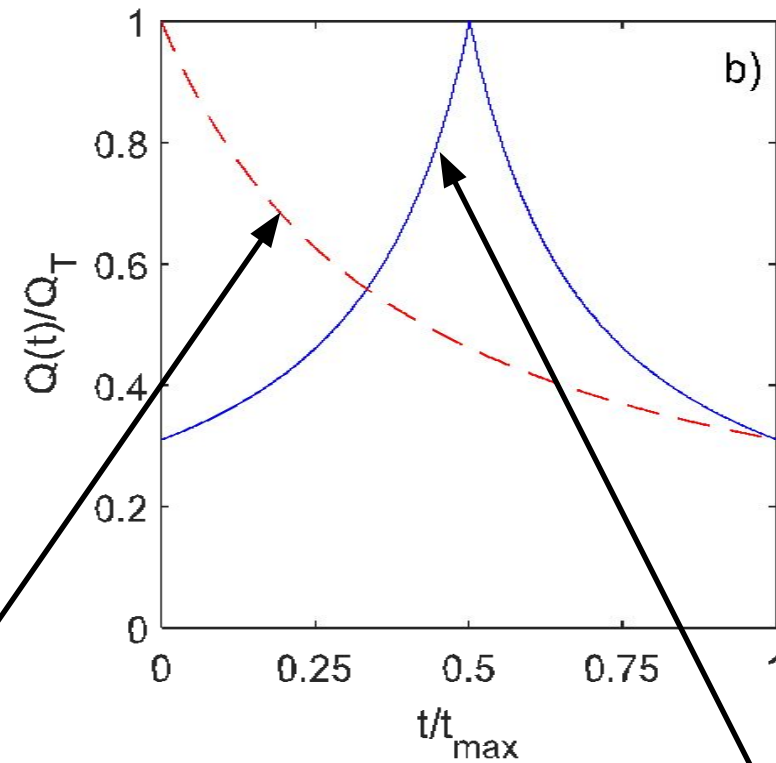
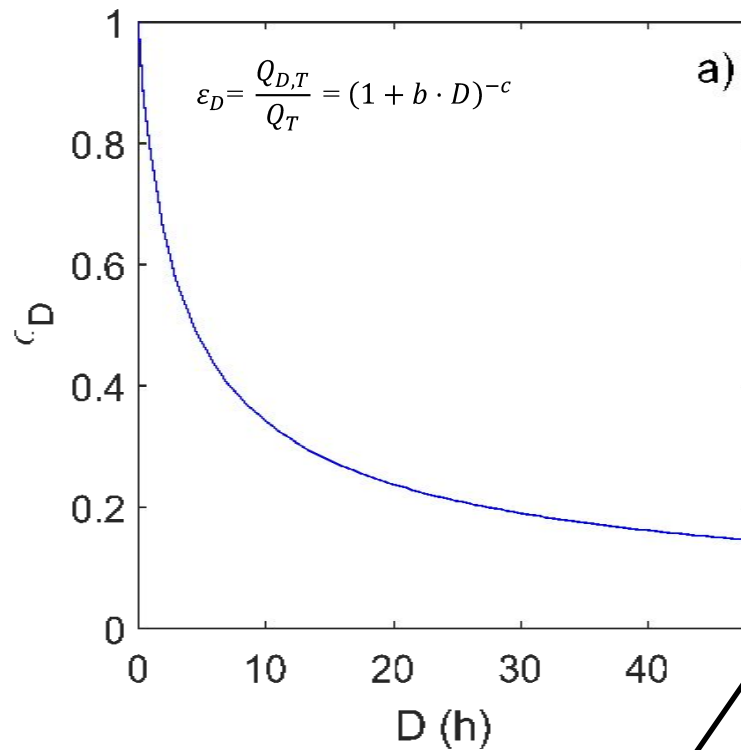
Forma analitica



$$\epsilon_D = (1 + b \cdot D)^{-c} \quad (\text{NERC})$$

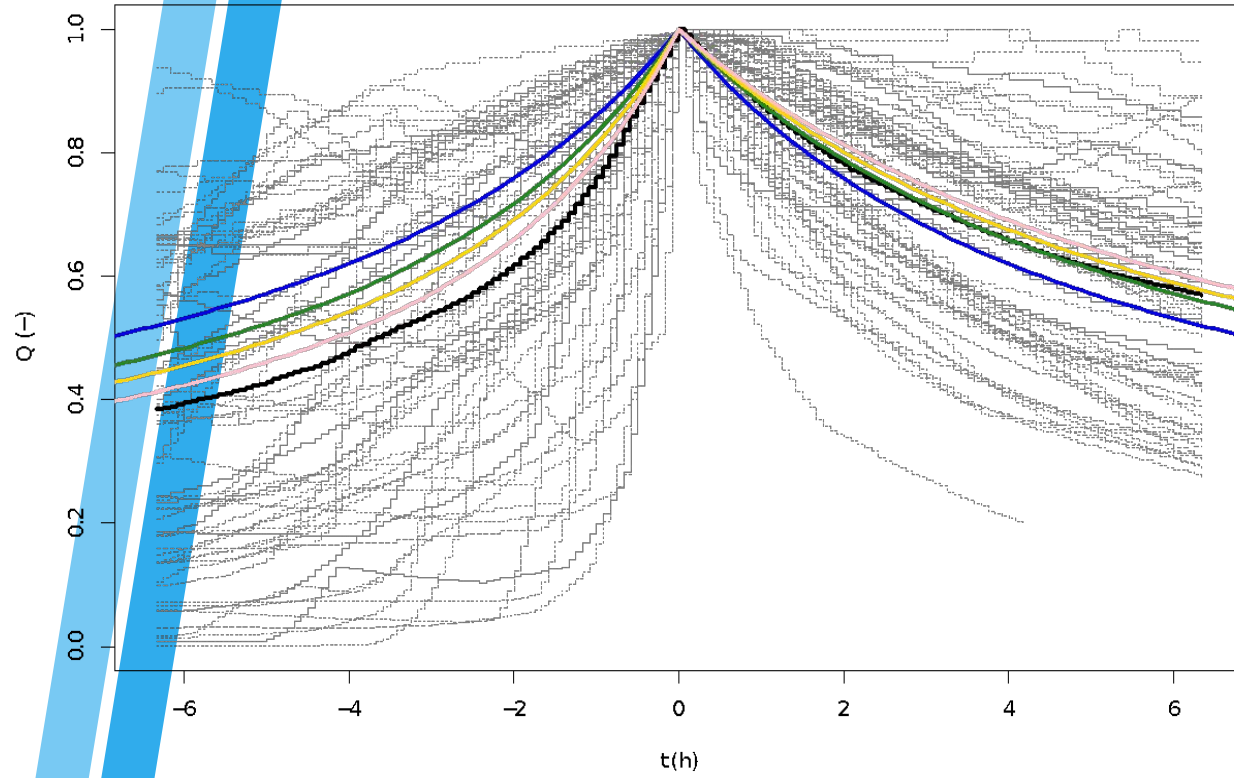
In letteratura: $b = \frac{1}{2t_r}$ e $c = 1 - \text{IDFn}$ (Silvagni, 1984)

Dalla curva di riduzione all'idrogramma

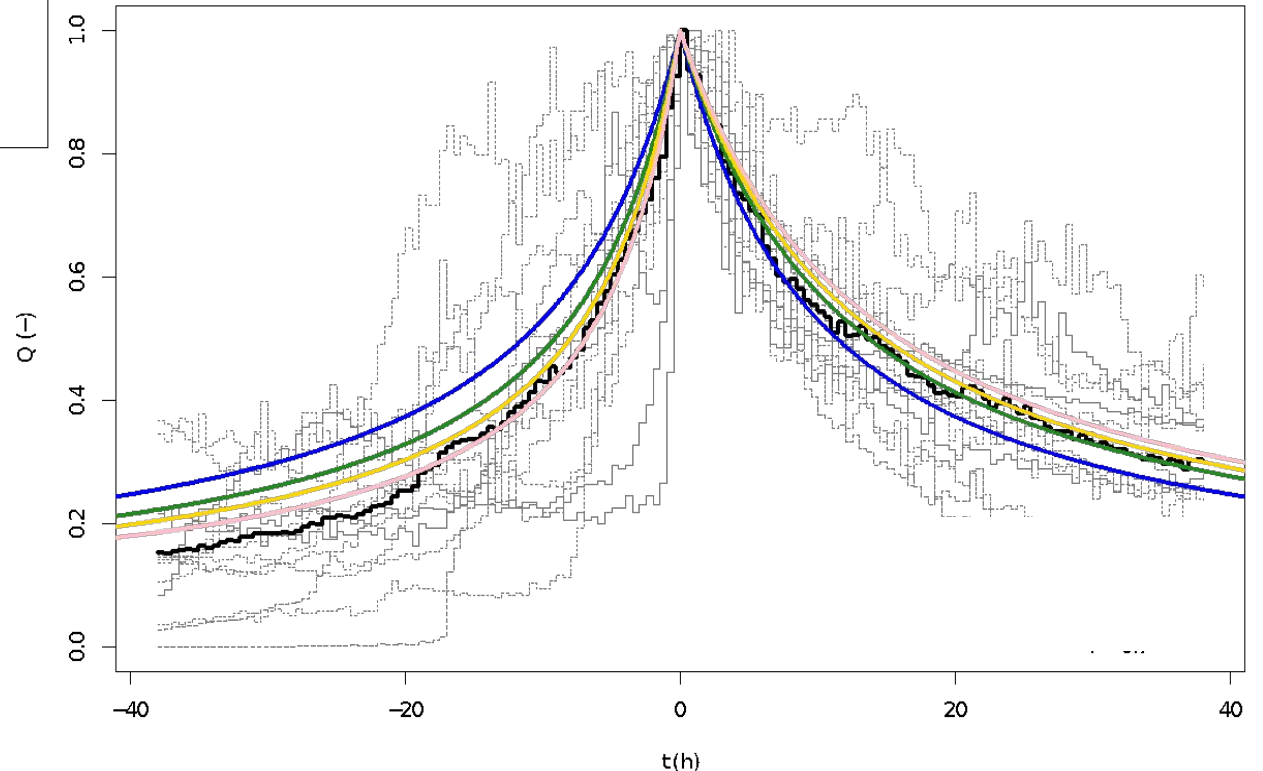
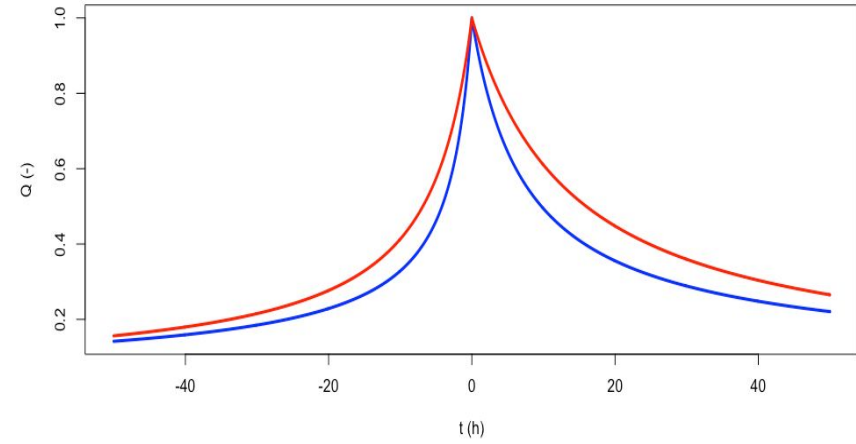


$$\hat{Q}(t) = Q_T \cdot [(1 + bt)^{-c} - cbt(1 + bt)^{-c-1}]$$

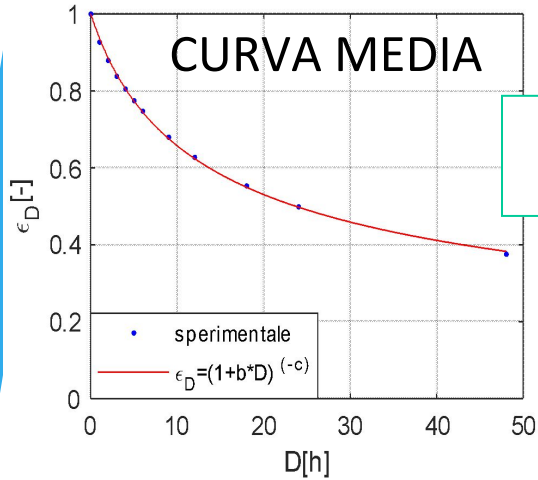
$$\hat{Q}(t) = Q_T \cdot \left[(1 + 2b \cdot |t - t_p|)^{-c} - 2b \cdot c \cdot |t - t_p| \cdot (1 + 2b \cdot |t - t_p|)^{-c-1} \right]$$



Grigio = singoli idrogrammi normalizzati
Nero = idrogramma "medio"
Colori = idrogrammi NERC (varie asimmetrie)

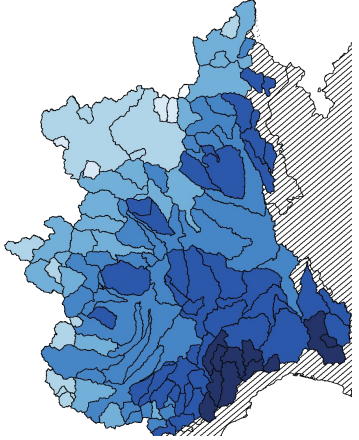


Modelli di regionalizzazione



CRCP Osservate
parametri **b e c**

100+
descrittori



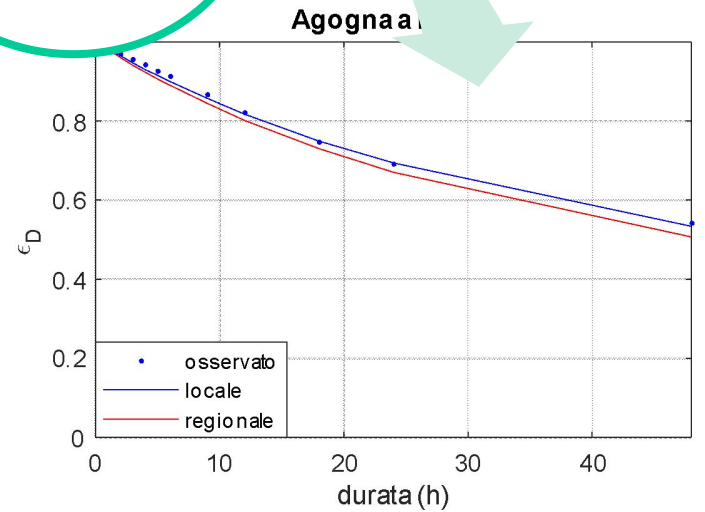
Descrittori di bacino

Parametri stimati (b e c)

Forma analitica
CRCP



- Agogna a Momo
- Stazioni pluviometriche
- Stazioni idrometriche



Modelli di regionalizzazione

Migliori modelli (87 stazioni)

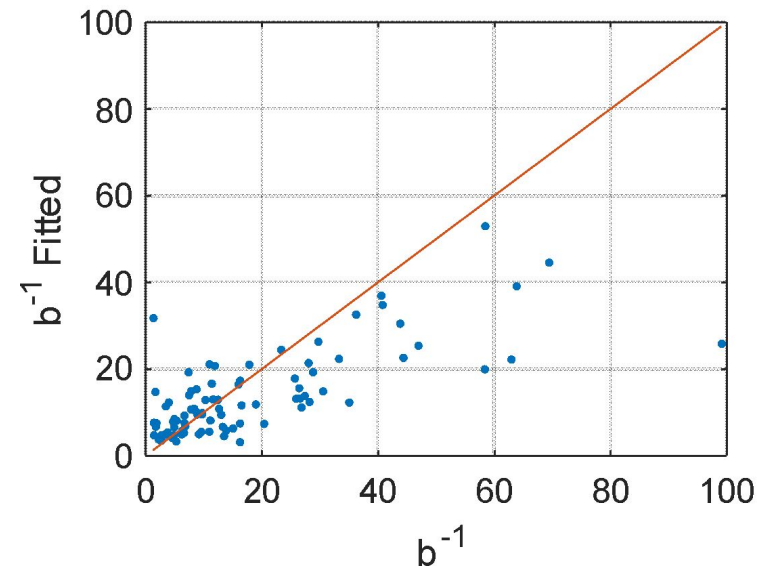
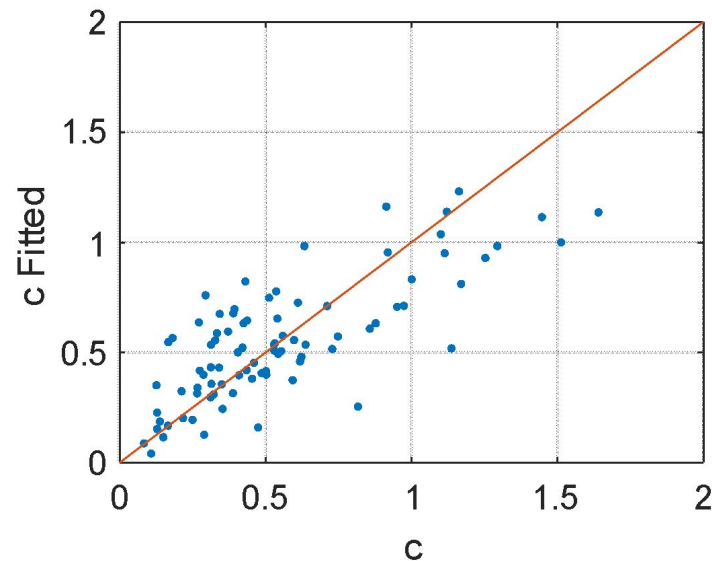
Tipo	ID	y	x	regionalizzazione		cross-validazione	
				R ² _{adj}	RRMSE	R ² _{adj}	RRMSE
reg.lin.	c3ln	c	ln(H _{media} ', LDP, IDF _n)	0.5879	0.40	0.5374	0.42
reg.lin.	b3ln	ln(b ⁻¹)	ln(ku _{fa} ', LDPLDPs)	0.4287	0.74	0.3669	0.78
ACE	c3	c	H _{media} ', LDP, IDF _n	0.6483	0.36	0.5250	0.43
ACE	c2	c	H _{media} ', LDP	0.6115	0.39	0.5377	0.42
ACE	b3	b ⁻¹	A, H _{media} ', F _f	0.4881	0.70	0.3005	0.82
ACE	b2	b ⁻¹	H _{media} ', LDP	0.4306	0.75	0.2997	0.83
CCA	cca10	b ⁻¹	descrittori indice 1	0.4432	0.7314	0.2130	0.87
		c		0.5800	0.3993	0.4109	0.47

Modelli di regionalizzazione

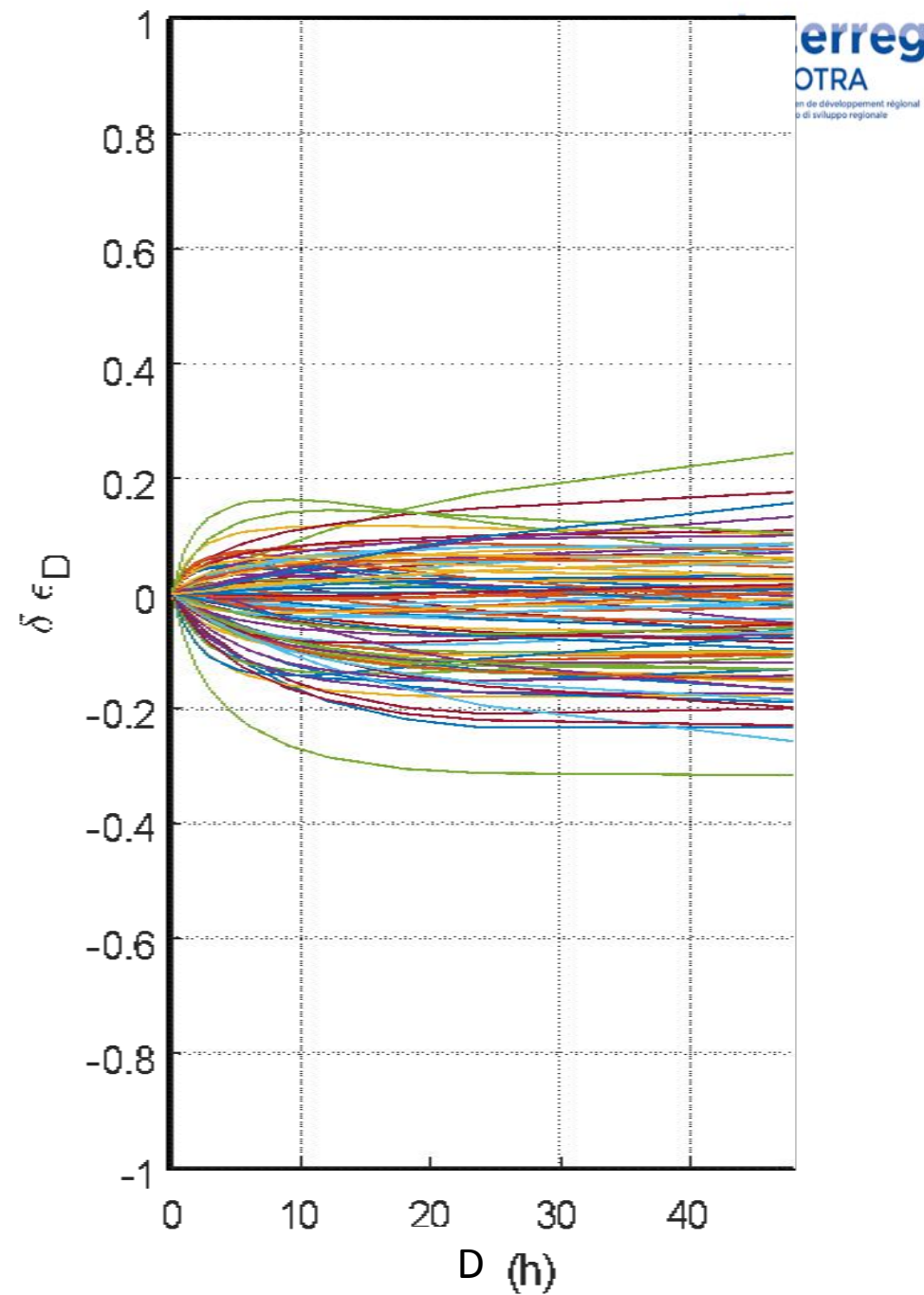
$$\ln\left(\frac{1}{b}\right) = \beta_1 + \beta_2 \cdot \ln(ku_{fa}) + \beta_3 \cdot \ln(LDP) + \beta_4 \cdot \ln(LDP_S)$$

$$c = \beta_5 + \beta_6 \cdot \ln(H_{media}) + \beta_7 \cdot \ln(LDP) + \beta_8 \cdot \ln(IDFn)$$

	Coefficienti	p-value
β_1	3.7285	0.0002
β_2	-2.0775	0.0020
β_3	0.5006	0.0016
β_4	-0.7715	0.0001
β_5	4.8403	$7.2 \cdot 10^{-8}$
β_6	-0.58869	$1.7 \cdot 10^{-10}$
β_7	0.13813	0.0003
β_8	0.80202	0.0151

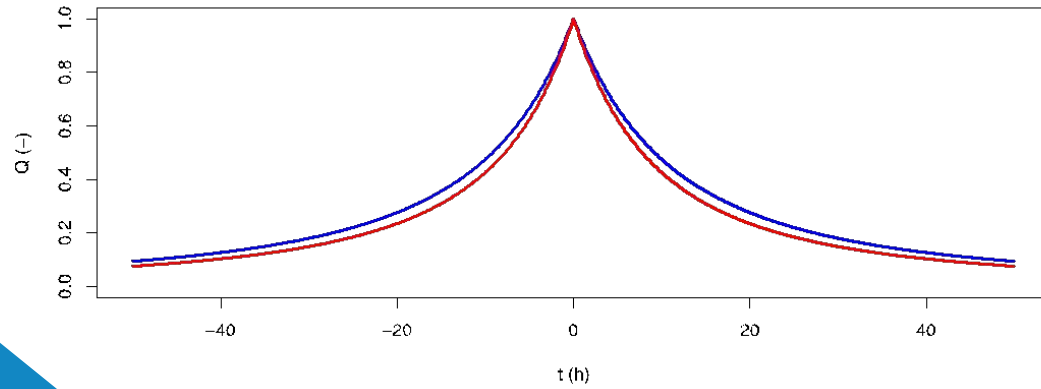
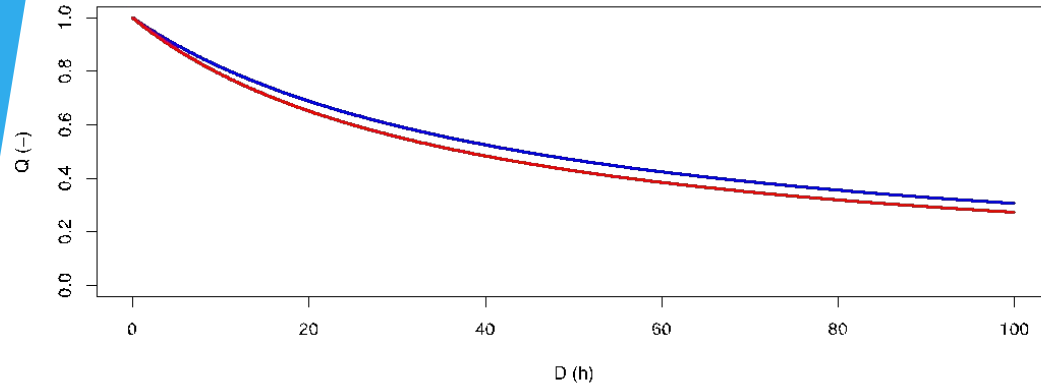


Entità delle differenze tra
CRCP osservate e CRCP ottenute localmente
mediante applicazione analisi regionale



Ricostruzione idrogrammi regionali

Belbo a Canelli



Dora Baltea a Tavagnasco

