DISAGGREGATING THE IMPACT OF HILLSLOPE CHANGES BY GEOMORPHOLOGY-BASED DECONVOLUTION OF OUTLET OBSERVATION

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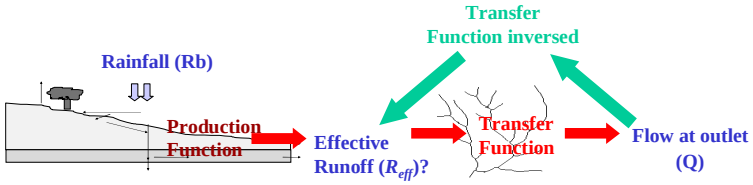
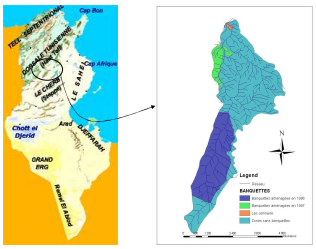
The inversion of a geomorphology-based unit hydrograph in semiarid basin

The geomorphological basis can be observed for any considered outlet, from information about the relief and the watercourses. It can be translated into basin-level transfer functions. The inversion of this type of linear function can propose an estimation of effective runoff.





El Gouazine Basin (18.1 km²), Central Tunisia.

River network and chronological contour ridges implementation.

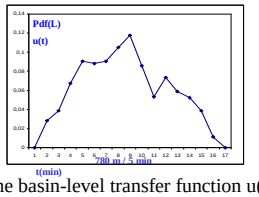
u(t) = *pdf* (L,v)

pdf: probability density function

L: length of stream course

v: average velocity

$$Q(t) = \frac{S}{\Delta t} \times \sum_{\tau=1}^{\min(t,\theta)} R_{eff}(t-\tau+1) \times u(\tau)$$



The basin-level transfer function u(t).

$$R_{eff} = R_{aprio} + C_{Reff}^{aprio} . M^T . \left(M . C_{Reff}^{aprio} . M^T + C_Q^{mes}\right)^{-1} . \left(Q_{mes} - M . R_{aprio}\right)$$

$\boldsymbol{M} = \left(\frac{\partial m_i}{\partial R_i}\right)$: Matrix of partial differential of the model / R_{eff}

$C_{Reff}^{aprio}, C_Q^{mes}$: Covariance matrices

R_{aprio}: *a priori* effective runoff

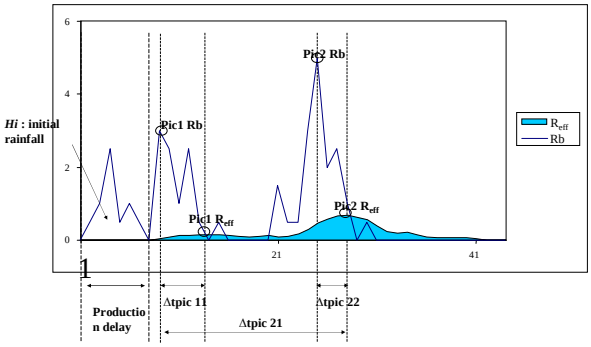
Deglobalising the impact of contour ridges by discharge deconvolution

Contour ridges are a widely and intensely developed water and soil conservation system at the hillslope scale. For El Gouazine basin :

1- sudden implementation of contour ridges during summers 1996 and 1997

2- existing data before and after implementation

Example of contour ridge



Application of the deconvolution on pre and post implementation runoff events, shows various significant changes in the hillslope-scale rainfall–net rainfall process which were not appearing in the basin-level rainfall–runoff process.

Events characteristics	Total rainfall (mm)	Maximum intensity (mm/h)	Runoff Coefficient	Volumes (m^3)	Production delay (pdt)	*Hi* (mm)
11 events pre-implementation						
Mean	**19.73**	**18.38**	**0.11**	**44648**	**20,64**	**5,32**
Standard deviation	**6.76**	**7.74**	**0.11**	**50905**	**30,71**	**5,11**
9 events post-implementation						
Mean	**39.33**	**30.27**	**0.03**	**23168**	**66,00**	**21,02**
Standard deviation	**20.80**	**7.07**	**0.03**	**40046**	**70,23**	**16,15**

Some production indicators are identified to look closely the contour ridges impact.

➔ Diminution of runoff coefficient (about 4 times)

➔ Existing of a Rb threshold for production : mean *Hi* = 16 mm

➔ Added mean production delay due to contour ridges = 230 min

Conclusions

A robust and generic geomorphology-based transfer, which is assumed to be stationary through time since changes occurred on hillslope and not in streams.

A promising impact assessment method from downstream, as an alternative to upscaling and aggregating hillslope approaches, in a catchment where a major hillslope sudden change occurred.

Perspectives

Quantitative perspectives are open to consider other types of sudden changes (e.g. wildfire), as well as progressive changes (e.g. ageing of landscape artefacts, including of contour ridges themselves).

Such assessment of the hillslope–river network coupling variable will allow to develop a library of production functions to be coupled with the geomorphology-based transfer function, according to hillslope types.

Ref: Boudhraâ H., 2007, Modélisation pluie-débit à base géomorphologique en milieu semi-aride rural tunisien : association d'approches directe et inverse. Thèse de Doctorat de l'INAT, 207p + annexes.

Boudhraâ H., Cudennec C., Slimani M., Andrieu H., 2006. In Predictions in Ungauged Basins: Promises and Progress (Proceedings of symposium S7 held during the Seventh IAHS Scientific Assembly at Foz do Iguaçu, Brazil, April 2005). IAHS Publ. 303, 2006.

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