A MODIFIED INDEX TO EVALUATE THE SEDIMENT CONNECTIVITY AT THE CATCHMENT SCALE IN MEDITERRANEAN TORRENTS

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INTRODUCTION

A simple but effective index ("Catchment Connectivity Index", CCI) was proposed by Quiñonero-Rubio et al. (2013), considering the geomorphological characteristics of the channels and the connectivity between hillslopes and channels was proposed for estimating the sediment connectivity in rivers.

$$CCI = \left(\frac{TC_{av}}{TC_{max}}\right) \cdot \left(\frac{100-TE_{av}}{100}\right) \cdot \left(\frac{GF_{av}}{GF_{max}}\right) \cdot \left(\frac{SP_{av}}{SP_{max}}\right) \cdot \left(\frac{FC_{av}}{FC_{av\_max}}\right)$$

In this study we propose a modification of the procedure to calculate the CCI, providing a modified CCI:

$$mCCI = \left| log_2 \left[\left(\frac{TC - TC_{min}}{TC_{max} - TC_{min}}\right) \cdot \left(\frac{GF_{\tan\_norm} + GF_{prof\_norm}}{2}\right) \cdot \left(\frac{SP - SP_{min}}{SP_{max} - SP_{min}}\right) \cdot \left(\frac{FC - FC_{min}}{FC_{max} - FC_{min}}\right) \cdot TE \right] \right|$$

The aim of this modification is to make simpler and more realistic the hydrological and geomorphological description of the landscape elements influencing the sediment connectivity. The new procedure to calculate the mCCI reduces the need of many field surveys (whose output is often affected by errors when carried out by low-experience operators) and makes quicker the CCI application on a catchment scale (thanks to the large use of GIS).

SUGGESTED IMPROVEMENTS OF CCI (mCCI)

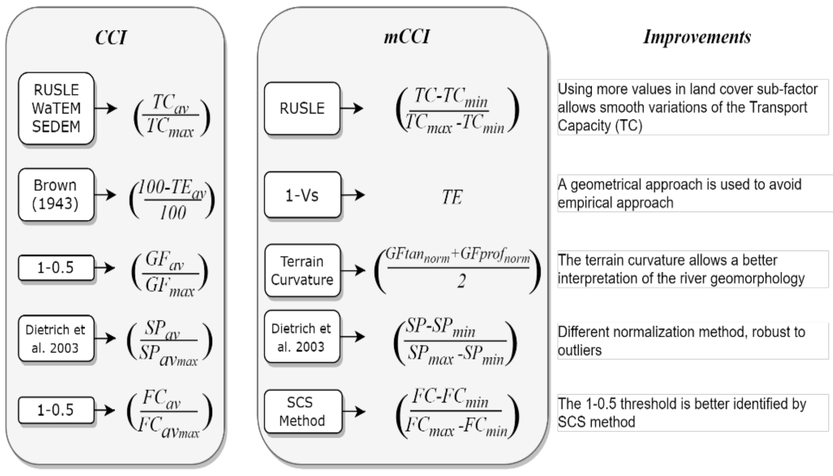
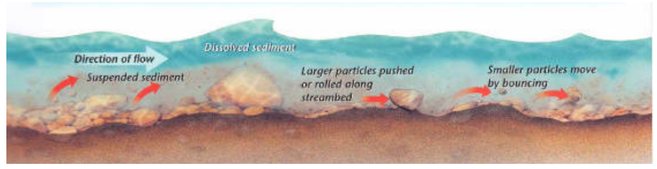


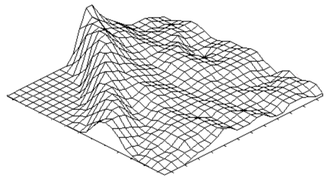
Table 1 Main differences between CCI and mCCI.

CCI	mCCI
Gives the sediment connectivity at the catchment or sub-catchment scales	Gives the sediment connectivity for each cell of DEM with the possibility to calculate at different spatial scales
Requires geomorphological training	Does not require experience for field operators
Some factors are binary in nature and left to the evaluation of operators	Every factor is continuous
Not automatable calculations for some factors	Quick and automatable calculation of all factors

TC: Transport Capacity

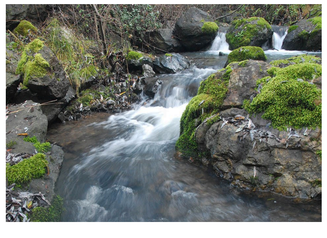


GF: Geomorphological Factor



TE: Trap Efficiency

SP: Stream Power (sediment transport capacity in channels)



FC: Flow Conditions (continuous or ephemeral channel)

RESULTS AND DISCUSSION

To calculate the modified CCI (mCCI), suggested by improving the calculation methods of CCI, some factors of the original index are replaced by alternative methods, which are based on DEM. This reduces the need of field surveys and allows the almost complete automation of the procedure.

The proposed mCCI may be used not only for the analysis of sediment connectivity of the individual elements of a catchment (spatial domain), but it allows also the possibility to catch the evolution of river connectivity from a diachronic perspective (temporal domain). The mCCI can be used as analytical tool to evaluate the influence of past or future changes in land use, climate and anthropogenic actions by comparing scenarios of torrent connectivity.

Practical applications in different environmental contexts are expected in order to verify the efficacy and efficiency of the suggested improvements. Finally, the mCCI could be more reliable in the case of high-resolution DEM availability (e.g., LIDAR), which may allow a more realistic estimation of the geomorphological factors of the index.

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