

We would like to thank the referee for the valuable comments and suggestions, which all have been considered in the final version of the manuscript. Then, we re-define the hydrological connectivity index model, and strengthen the methodology explanation.

*Interactive comments: Have the authors considered the correlations between relative altitude and average slope of the upslope contributing area? If these variables are closely correlated, it would be questionable to use both of them in equation 3. In equation 4, the summation of cells size multiplied by the cosine of the slope angle adequately describes the flow path from each cell to the target (i.e., the receiving river). It is thus not clear why also the ratio of horizontal to vertical distance has been used in the computation of the downstream component of the model.*

Response: Thanks for L. Marchi kind advice. We consider the mass wasting processes as the potential energy release processes, both the relative altitude and slope of the upslope contributing area have strong influences on these processes. And, we use the sine values (ranges from 0.0 to 1.0) of average slope of the upslope contributing area, which mainly controls the initiation and processes of mass wasting in the upslope contributing area. And, the relative altitude mainly controls the magnitude of the potential energy in the upslope contributing area. In addition, we re-define the hydrological connectivity model, and we use the equation 4 to describe the horizontal and vertical processes of mass wasting along the downslope path.

The mainly revised parts of the manuscript as the following show;

## **1 Hydrological connectivity index model**

Mass wasting processes in mountainous terrain are not only dependent on the overall terrain, but also on the spatial organization and the internal connectivity of various topographic units (Bracken et al., 2014; Borselli et al., 2008; Blahut et al., 2010; Croke et al., 2005; Rogelis and Werner, 2014). Bracken et al (2014) proposed that the sediment connectivity can be used to explain the continuity of sediment transfer from a source to a sink in a catchment, and movement of sediment between different zones within a catchment: over hillslopes, between hillslopes and channels, and within channels (Bracken et al., 2014). Borselli et al (2008) defined one connectivity index (*IC*) to evaluate the potential connection between hillslopes and sinks. Based on the existing models, this paper presents one definition of hydrological connectivity index (*HCI*). The definition is based on the fact that mass wasting processes depend on its size of upslope source zone and position in the mountainous catchment (Fig.5), which consists of two components: the upslope component  $F_u$  and downslope component  $F_d$ . And, the definition model can be expressed as:

$$HCI = \ln\left(\frac{F_u}{F_d}\right). \quad (2)$$

This defined model is presented linking hydrological connectivity with the ecological processes in the Wenchuan Earthquake-hit region, for it assesses the weight factor of slope materials through monitoring the vegetation changes before and after the earthquake.

### **1.1 The upslope component $F_u$**

The upslope component  $F_u$  depends on the conditions of the upslope contributing area, such as topographic environments, and vegetative conditions. It is aimed at estimating the sediment

production and the flow accumulation of the upslope contributing area. And,  $F_u$  depends on the topographic conditions (e.g. size, relative relief, and slope gradient) and surface materials of the upslope contributing area. Among these, the topographic factors can be calculated from DEM data. Then,  $F_u$  can be estimated as follows:

$$F_u = \overline{W}_u \sin(\overline{S}_u) \overline{H}_u \sqrt{A_u}. \quad (3)$$

Where,  $\overline{W}_u$  is the weighting factor of the upslope contributing area,  $\overline{S}_u$  is the average slope gradient of the upslope contributing area (°),  $\overline{H}_u$  is the average relative altitude of the upslope contributing area (m),  $\sqrt{A_u}$  is the size of the upslope contributing area (m<sup>2</sup>).

## 1.2 The downslope component $F_d$

The downslope component  $F_d$  is used to describe the transport processes of the upslope sediment.  $F_d$  is strongly influenced by the flow pathway conditions, e.g. flow length, slope gradient along pathway, and surface materials along pathway. Hence, the upslope component  $F_d$  can be estimated as follows:

$$F_d = L \sum_i \frac{\cos(s_i) C_i}{w_{di}}. \quad (4)$$

Where,  $L$  is the horizontal distance to river (m),  $w_{di}$  is the weighting factor of the  $i^{\text{th}}$  cell along the downslope path,  $s_i$  is the slope gradient of the the  $i^{\text{th}}$  cell (°), and  $C_i$  is length of the the  $i^{\text{th}}$  cell along the downslope path (m).

## 1.3 The weight factor $W$ of the slope materials

In the Wenchuan Earthquake-hit area, the earthquake-induced landslides destroyed large areas of vegetation that made the vegetation hydrological adjusting function diminished, and the large amounts of unconsolidated loose materials deposited on the steep slopes that changed the hydrologic progresses (i.e. infiltration reduced, runoff increased and flow concentration expedited) in catchment (Cui et al., 2012). In addition, vegetation roots add strength to the slope materials by the vertically anchoring to fractures in the bedrock through the slope materials and by laterally binding the materials across potential zones of the failures (Endo and Tsuruta, 1969; Prandini et al., 1977). Therefore, the weight factor of the slope materials can be evaluated by monitoring the vegetation changes before and after the earthquake.

In practice, the slope materials stability susceptibility ( $w$ ) model was trained through multivariate analysis of damaged vegetation and its survival environments in one given mountainous basin. And, the weight factor of upslope contributing area ( $W_u$ ) can be simplified and expressed as the slope materials stability susceptibility ( $w$ ), which is related to the sediment production. Then, the weight factor ( $w_{di}$ ) along the downslope path can be calculated as ( $\frac{1}{1-w}$ ).

## References

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