Reply for the comment on egusphere-2024-198 (Associate editor)

Title: Topographic metrics for unveiling fault segmentation and tectono-geomorphic evolution with insights into the impact of inherited topography, Ulsan Fault Zone, Korea

Comment	Reply
Lines 10–11: You don't need to change this if you don't want to, but I think it might sound better if you replace the two instances of "the present" with "today's" in this sentence.	Thanks, we changed it. **[Lines 10–11]** Quantifying today's topography can provide insights into landscape evolution and its controls, since it represents a cumulative expression of past and present surface processes.
Lines 12–13: Is this not redundant given the previous sentence? Consider revising.	We removed the type of fault but contained its strike and dip. **[Lines 12–13]** The UFZ strikes NNW–SSE and dips towards the east.
Lines 13–16: rates	We changed it. **[Lines 13–16]** This study investigates the relative tectonic activity along the UFZ and the landscape evolution of the hanging wall side of the UFZ, focusing on neotectonic perturbations using ^{10}Be-derived catchment-averaged denudation rates and bedrock incision rates topographic metrics, and a landscape evolution model.
Lines 16: Consider deleting this sentence. It is inferred from the previous sentence.	We deleted this sentence.
Line 17: their	We changed it. **[Line 17]** Five geological segments were identified along the fault, based on their relative tectonic activity and fault geometry.
Lines 44–46: I suggest replacing this with "has been"	We modified the sentence. **[Lines 44–46]** It has been applied to determine whether a landscape under specific conditions is in a steady state or transient state, and to assess long-term drainage mobility (Willett et al., 2014; Forte and Whipple, 2018; Kim et al., 2020; Hu et al., 2021; Lee et al., 2021).

Lines 47–50: I would put an “e.g.,” here, as this is a partial list.	Thanks, we added it. **[Lines 47–50]** We can test the site-specific parameters constrained by empirical data (e.g., coefficient of diffusivity, coefficient of fluvial erosion efficiency, and local uplift rate) and determine a range of reasonable values through modelling (e.g., Tucker et al., 2001; Braun and Willett, 2013; Goren et al., 2014; Campforts et al., 2017; Hobley et al., 2017; Barnhart et al., 2020; Hutton et al., 2020).
Lines 58–59: “is” implied this is true of all landscapes. In some situations the traces of initial topography can be erased. I suggest replacing “is” with “can be”. Alternatively you can specify that this hypothesis refers specifically to your study area.	We replaced “is” with “can be” and also constrained it to our study area. **[Lines 58–59]** We hypothesize that the influence of inherited topography can be non-negligible in our study area where the slip rate is low, and the erosion rate is high, and topographic metrics would indicate it.
Lines 107–108: Can you add a few words about how these are calculated? That is, what measurements are the rates based on? C14 on the terraces? Cosmogenics? A few words here will suffice.	We already documented the details in Table 1 but did not make it clear here. We added the information on the dated material and dating method in this sentence. **[Lines 107–108]** (a) Previously determined uplift rates (in mm kyr^{-1}) of marine terraces near the UFZ, based on the OSL ages of raised beach sediments (details about these rates are in Table 1; Choi et al., 2003a, b; Kim et al., 2007; Heo et al., 2014).
Lines 122–123: I would say “categorized based on their draining into the catchments either north or south of the valley floor divide”.	We modified the sentence. **[Lines 122–123]** The western-flank channels are categorized based on their draining into the catchments either north or south of the valley floor divide.
Lines 127–130: redundant, don’t need it.	We will delete those words.
Lines 139–141: based on what? Evidently OSL. Say that here.	We added dating method information. **[Lines 139–141]** Further, studies of marine terraces have proposed paleo-shoreline elevations and the OSL ages of beach-sediment layers for each terrace sequence (Choi et al., 2003a, b; Kim et al., 2007; Heo et al., 2014).
Lines 166–177: The normalised channel	We moved the Eq. (1) to the ‘3.3 Landscape evolution modelling’ section and deleted the Eq. (2). Then, we

steepness is purely geometric. It is entirely defined by equation 3. It can be linked to equations 1 and 2, but equation 1 assumes some form of the erosion rule, which we know is, at best, an approximation, whereas equation 3 doesn't really include any assumptions: it is simply an empirical statement derived from topographic data. You will use equations 1 and 2 later in the paper, but I think you should introduce those equations when you begin to talk about modelling, and for the section on k_{sn} just start with equation 3 (since equations 1 and 2 are not used to measure k_{sn}).	defined the (normalised) channel steepness index with Eqs. (3a) and (3b) only related with the geometry. **[Lines 166–177]** The channel under the steady-state condition in which the uplift, climate, and rock resistance are spatially uniform, maintains a graded profile, following a power-law equation (Hack, 1973; Flint, 1974): [Lines 316–317] The bedrock channel incision rate, *E*, can be expressed by Eq. (3), which describes its relationship with channel bed shear stress (Howard and Kerby, 1983; Seidl and Dietrich, 1992; Sklar et al., 1998). $E = KA^m S^n$ (3) where *K* is a dimensional coefficient of fluvial erosion efficiency with a unit of $[L^{1-2m}T^{-1}]$ encapsulating different controls on erosion, such as rock resistance, climate, bedload sediment grain size, and channel width length relationship (Stock and Mongomery, 1999; Whipple and Tucker, 1999; Snyder et al., 2000; Whipple and Tucker, 2002); *A* $[L^2]$ is drainage area; *S* $[L\ L^{-1}]$ is the slope; and *m* and *n* are exponents of drainage area and slope, respectively. We also changed the equation numbers according to these modifications.
Lines 309–310: When you use version 3 to get dates, it outputs a version number. I did that on test data today (17 July) and the version number is 3.0.2. I recommend reporting this version number.	We added the version information. **[Lines 309–310]** We calculated exposure ages using the CRONUS-Earth online calculator (Balco et al., 2008; version 3.0.2), applying the LSDn scaling scheme (Lifton et al., 2014).
Lines 319–321: These numbers vary a lot between sites. I'm curious why you didn't use the basin averaged erosion rates alongside the chi profiles to back-calculate K? I agree with the reviewer that a sensitivity analysis would be welcome here (it doesn't need to be extensive, just some idea of how much the answers change if you pick 2 or 3 different values for these parameters, sensibly selected, and see	We carried out the simple sensitivity analysis for the parameters (e.g., channel slope exponent, channel concavity index, and erodibility coefficient) with several selected values. We attached all modelled results as an excel file (Supplementary 2) and their interpretation on how each model input parameter affects the modelling results as a text (Supplementary 1). Please refer to those supplementary files.

how they affect the result. The numbers you use are not arbitrary, but they are highly uncertain.	
Line 330: If you are using this equation in the model there is no need to report equation 2.	We deleted the equation 2.
Lines 433–434: Did you plot knickpoints in chi space? Or as a function of elevation (i.e., do a probability distribution of knickpoint elevation on the east and west flanks)? I ask because this could tell you how well knickpoints line up on one side of the MDD or across the MDD.	We plotted the knickpoints on the longitudinal profiles of the channels on the western and eastern flanks (Fig. 5d). However, we could not find any patterns in elevation of knickpoint's distribution on the either side of the MDD.
Line 469: In a basin, k_{sn} can vary a lot. Do you have the variability of this metric? It would be useful to have some kind of uncertainty plotted here.	We changed the Figure 7b, adding the 1σ uncertainty of the normalised steepness index values on the western and eastern sides (base-level elevation of 50 m). We also modified the caption, according to the changes in the figure. **[Line 469]** (b) Catchment-averaged k_{sn}. 1σ uncertainties of the k_{sn} values extracted with the base-level elevation of 50 m on the western and eastern flanks are marked with the red- and blue-shaded areas, respectively.

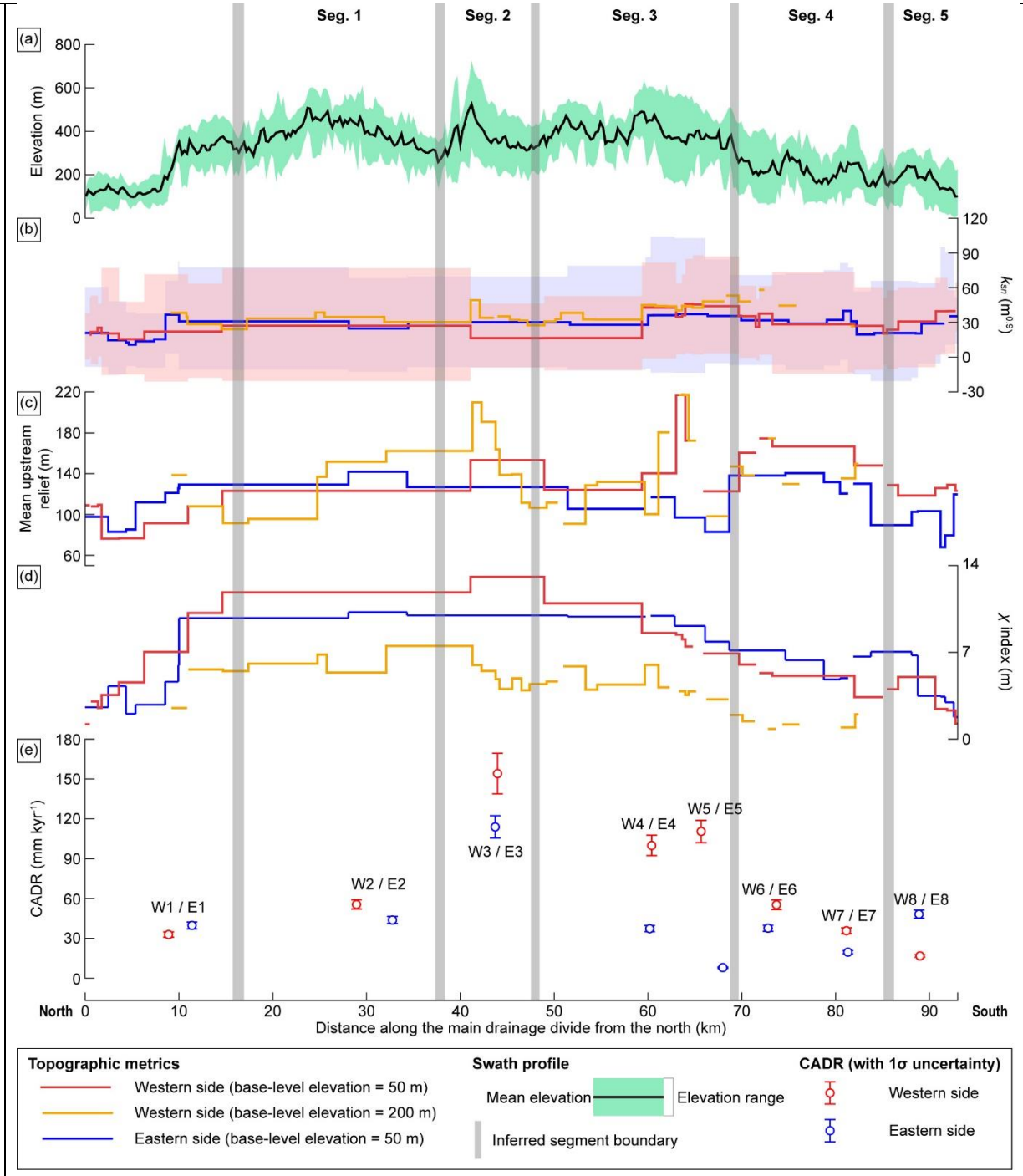
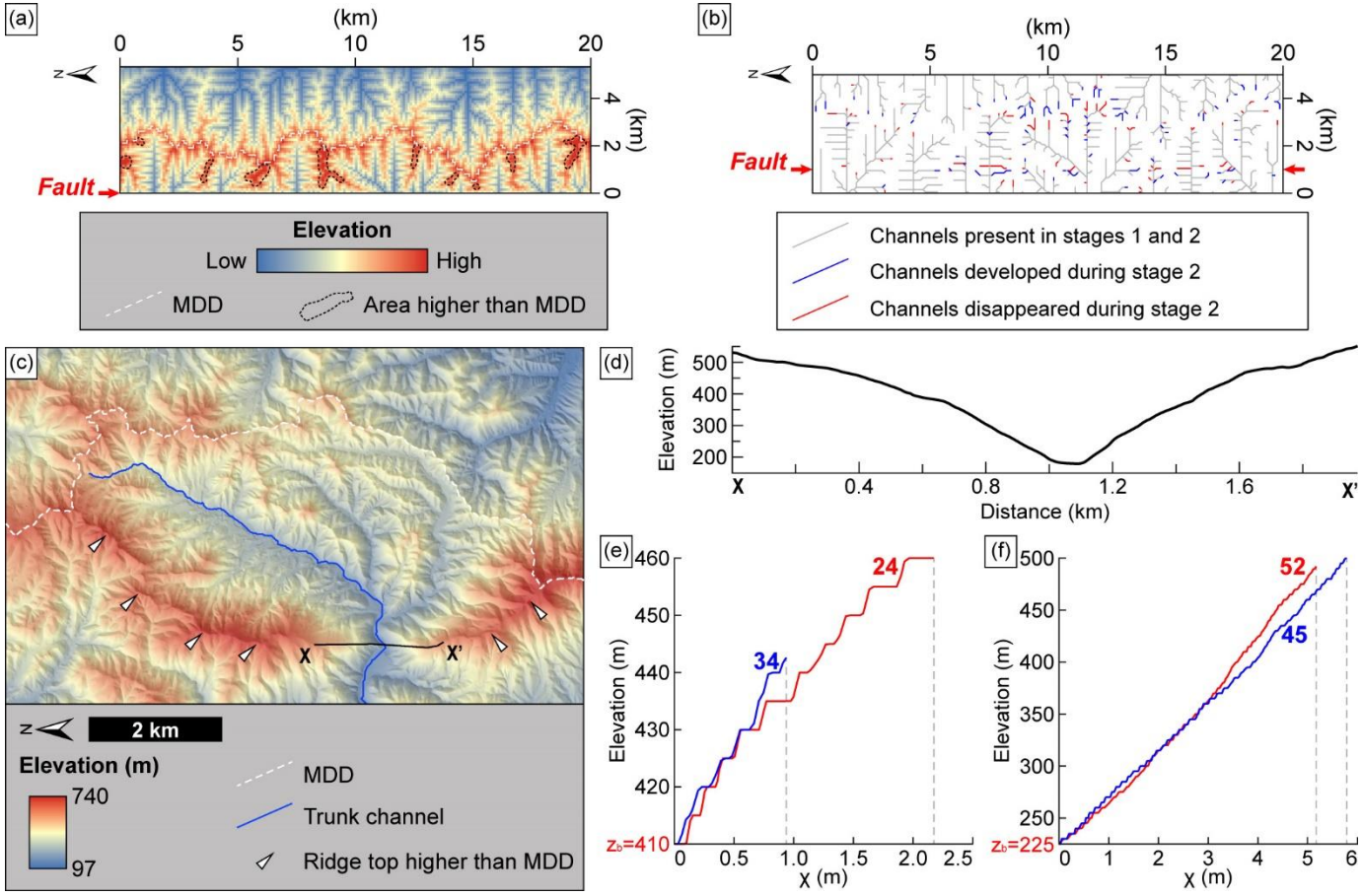

Seg. 1
Seg. 2
Seg. 3
Seg. 4
Seg. 5
(a)
Elevation (m)
800
600
400
200
0
(b)
120
90
60
30
0
-30
k_{sn} ($m^{0.9}$)
(c)
Mean upstream relief (m)
220
180
140
100
60
(d)
14
7
0
χ index (m)
(e)
CADR (mm kyr^{-1})
180
150
120
90
60
30
0
W1 / E1
W2 / E2
W3 / E3
W4 / E4
W5 / E5
W6 / E6
W7 / E7
W8 / E8
North
0
10
20
30
40
50
60
70
80
90
South
Distance along the main drainage divide from the north (km)
Topographic metrics
Western side (base-level elevation = 50 m)
Western side (base-level elevation = 200 m)
Eastern side (base-level elevation = 50 m)
Swath profile
Mean elevation
Elevation range
Inferred segment boundary
CADR (with 1σ uncertainty)
Western side
Eastern side

Figure 10: Awkward phrasing. Perhaps better to say “Channels present in stages 1 and 2”?	We changed it. **[Figure 10b]** Channels present in stages 1 and 2 
Line 651: Somewhere in this discussion there needs to be some explanation of why the strath-based incision rates are so different from the CADR rates.	We acknowledge the need of explanation on the difference between the (bedrock) channel incision rate and CADR. However, the section ‘5.2 Geomorphic evolution of the eastern block of the UFZ in response to tectonic movement’ is not about the difference between them. So, we added several sentences in the caption of Figure 3, which shows the results of CADR and the exposure age of the strath surface. **[Line 262]** The discrepancy between CADR and bedrock incision rate is tentatively caused by (1) the difference

	between the integration time of CADR and the exposure age of strath surface and (2) the difference of spatial scales which is represented by those two methods.