



Review Report for

The Geospatial Revolution in Geomorphological Research

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Round 1 Review

Comments by reviewer 1 (anonymous)

Completed: 2026-03-17 01:09 AM

Recommendation: Reject

The author(s) set out to highlight the advances in remote sensing techniques and data availability and that the field of geomorphology is at the precipice of a "revolution" because of these advances. While the manuscript raises important points, it currently reads more like a brief review paper and needs substantial revisions to be suitable for publication as an opinion piece in Geomorphica. Here is why:

- The author(s) did not offer strong opinions in their manuscript. They promised to showcase examples of research that "ask questions that were unfathomable" before the recent advances of remote sensing techniques. However, the examples cited as novelty were studies expanded upon previous research questions derived from field observations. For example, historically we used stakes on glaciers and extrapolated the local velocity measurements to the larger glacier bodies and now this extrapolation can be applied at mass scale using satellite data. Yes, it is exciting, but these are the questions we asked before satellite data came to existence. The same can be said about fluvial processes. Lab experiments and gauge observations produced exciting results without remote sensing data. While it is exciting that we now can make watershed-scale extrapolations using satellite data, such questions have been raised and addressed before.
- The author(s) raised two important aspects of advances in remote sensing and computing technologies: distribution of this vast data and the emergence of AI models. This was the perfect place where the author(s) could have offered their opinion. It would have been highly effective if the author(s) identified the trends in the field and offered their opinion on where things are heading and the precautions we need to take as a field. Unfortunately, in this regard, the author(s) only highlighted the importance of coupling field observations and remote sensing data, which is something everyone is already aware of in geomorphology. Please see my comments for Ln 127-128 for details.
- LiDAR and SfM technology brought truly exciting and new data about landscapes. However, the author(s) of this manuscript did not successfully demonstrate why they were "revolutionary". The author(s) introduce a term "geospatial revolution", but they did not describe what a "revolution" is and did not demonstrate why the new technologies brought this undefined "revolution". In other words, the examples mentioned in this manuscript do not yet demonstrate that geomorphology as a field experienced a paradigm shift comparable to the CRISPR-like revolution in the field of medicine, for example.





- Diversity of opinions and participation is important to advance the field of geomorphology (e.g., Tooth & Viles, 2020: <https://doi.org/10.1002/esp.5026>). The author(s) of this opinion piece did not answer how the advances in remote sensing techniques may or may not improve equality and diversity. Currently, the references in the manuscript lean heavily toward research produced in the global north. For example, I reviewed the articles cited in this manuscript as examples of great advances in geomorphology. ~47% of the example papers focused on research problems in the global north, namely Canada, USA, Wales and Switzerland. ~26% of the cited papers had global and regional in scope, namely Arctic and Polar regions. ~17% of the cited papers focused on the Himalayan region and the remaining 10% were review articles. Only one paper had a study area in Argentina, and no example of studies done in Africa was cited in this manuscript. This current selection inadvertently overlooks authors from less developed countries and misses an entire continent. There are certainly interesting research problems in Africa, such as surface modifications due to rifting, rapid retreat of glaciers on Kilimanjaro, eolian processes in the Sahara, and the fluvial processes in the Nile river system. It would have been useful if the author(s) offered their opinion about the accessibility of these valuable datasets. Historically, paradigm-shifting ideas came from military-oriented expeditions sponsored by wealthy nations (e.g., HMS Beagle voyage with Darwin onboard and the seafloor mapping that led to plate tectonics). Is it still the case with the availability of global- and regional-scale datasets? Does commercialization of these data improve or worsen the inequality prevalent in the Earth sciences? Such insights would have been valuable in an opinion piece.
- Geographical diversity is not the only aspect that needs broadening. The diversity of research questions exemplified in this manuscript is also highly concentrated. ~37% of the references focused on glacial and periglacial processes and 20% of the references focused on fluvial processes. Another 23% of the references were review articles or global- to regional-scale DEM datasets. In other words, the two other erosional agents (wind and gravity) were barely mentioned as examples of great advances in modern geomorphology. I remain skeptical of the authors' claim that we are finally able to ask the correct questions only due to advances in remote sensing techniques. If the examples given in this manuscript are taken as the correct survey of geomorphology as a field, it currently leaves out large and important aspects of the discipline.

Below, I listed my specific comments in the manuscript to help the author(s) improve their manuscript.

Ln 9: "Earth observation technologies" is a very broad term that includes not only remote sensing methods but also in-situ observations. Please be specific.

Ln 9: "These ... developments" in this sentence doesn't refer to anything in the previous sentence. What developments are you referring to here? Is it referring to "advances"? In that case, the "advances" are not well described.

Ln 16: I'm not sure if it's necessary to include "that is".





Ln 17: The reference to the "large boulder the size of a small boulder" meme may not translate well to readers unfamiliar with the internet reference. While engaging, it is not a scientifically accurate description of particle size.

Ln 34: Not necessary to say "considered another way".

Ln 35: Authors mentioned time scale in Ln 18-19, but emphasized only spatial scale in this sentence. Why?

Ln 60: The parody movie Spaceballs might be culturally significant to some in the U.S., but Geomorphica has a global audience, so the reference to this movie may not be appropriate for an opinion paper here.

Ln 61: It would be an excellent opportunity to highlight the capability of sub-cm scale data acquisition using lidar and why it was not possible to acquire such data previously, instead of describing it to have "ludicrous" resolution.

Ln 75: It is too vague what is being referred to as "geomorphology and glaciology purposes". What unique and novel questions were asked and/or answered because we now have ArcticDEM?

Ln 77: Please elaborate on the accessibility of these high-resolution datasets. Why is it not readily accessible? Is it due to cost or institutional embargo, or both?

Ln 83: Please specify what is being referred to as "cutting edge tools". Clarifying this will better illuminate the point for readers.

Ln 86: I don't agree with the statement "geomorphologists could never have even considered studying bedform processes". People have been doing this for years in small scales and with flume experiments.

Ln 86: Clarify what you mean by "such temporal and spatial granularity". Does this mean people didn't think of studying fluvial landforms changing daily or didn't think of interpolating small-scale studies to large regions?

Ln: 93: replace "has" with "have"

Ln 94: The statement is too vague. What temporal and spatial scales were not observable? Define "coarse" resolution and "low frequency" of satellite images. Explain why these specific scales are not enough.

Ln 101-104: Clarify how common it is to document rapid events such as debris flow and floods using satellite images. In other words, did the commercial satellites capture these rapid events by accident? What's the reproducibility of these observations in the future? Can we rely on the repeat times of these commercial satellites to ask and answer questions related to such rapid events?





Ln 105: Missing "used" between "was" and "to"

Ln 107: "unfathomable" may be an overstatement. We've measured discharges of rivers from gauges for years. The premise here is that the satellite images allow us to measure discharges more cheaply and/or in places with no access. The question is, what's the reliability of these satellites? Can we rely on these commercial satellites to make long-term measurements? What is the cost of making measurements from these commercial satellites vs. investment in the local research communities?

Ln 109-116: This paragraph mentions hypothetical benefits of deploying radar sensors, without actually demonstrating what kind of research questions can be addressed from these radar datasets. Currently, this paragraph is too generic and should be tied to specific examples.

Ln 117-132: The beginning of this paragraph raised an important question of data storage and distribution. However, it stopped short of offering an actual opinion on this important question. Who should be responsible for storing and distributing these large datasets? What is the trend? Are commercialization and private-contracting becoming more prevalent instead of large-scale initiatives that have historically been sponsored by governments? What are the benefits and drawbacks of increased commercialization of geospatial datasets? Would it exasperate the inequality that already exists?

Ln 127-128: It is also important to address the use of machine learning and AI models in analyzing geospatial data. I hoped that the author(s) would give their opinion on this. Unfortunately, the manuscript says very little except that the AI models have "potential for seeing the signal" that humans might not. It is important to clarify what this means, as humans train these models. Does the potential of AI models depend on how we train them? The manuscript should address concerns about the consequences of research outcomes if we train AI models with biased and/or oversampled datasets. Such insights are highly valuable in an opinion piece and should replace the current listing of examples of processing global- to regional-scale datasets.

Ln 132: Need to define "Earth Observation" better. Capitalizing the words doesn't make the term clear. As far as I understand it, earth observation also includes field observations.

Ln 134: I don't understand the purpose of the two sentences here. If you're suggesting that geomorphology as a field is accelerating in pace, please provide the evidence for it. It could be number of papers published, PhDs produced, money invested, or something similar. Without actual evidence, the claim in these sentences is unsupported.

Ln 138: Please clarify why only the "rapid" surface processes were highlighted. What about the "slow" tectonic processes shaping the Earth's surface? Are there no novel questions in "slow" processes that can be asked/answered from remote sensing data?





Comments by reviewer 2 (anonymous)

Completed: YYYY-MM-DD HH:MM am/pm

Recommendation: xxxxx

The Opinion Piece entitled 'The Geospatial Revolution in Geomorphological Research' summarizes the remote sensing technological advances that have triggered new study areas and diciplines within the geomorphological community. Although it has some strong points - such as the fieldwork appreciation- some things are lacking. For example, the 'authors' opinion' part. When I reached the 'Too much data?' section I thought the authors point of view would flourish but that was not the case. I felt is reads more as a short review with a whimsical twist (loved the movie reference), than an opinion piece.

There was also several incoherent phrases and sentences that were hard to follow, with unnecessarily complicated (or not suitable) adverbs, conectors and descriptive terms. [see attached file – ReviewerB-comments-77.pdf]

I would suggest Major Revisions. I appreciate the whimsical feel of the manuscript, it would be nice if you keep it, but some major modifications should be made so that it is comprehensible and so that it fits into the 'opinion piece' category.)





Decision by Editor-in-Chief (Larry Syu-Heng Lai)

YYYY-MM-DD HH:MM am/pm

Dear Dan Shugar,

Thank you for submitting your manuscript entitled "The Geospatial Revolution in Geomorphology Research" to Geomorphica. I have now received two anonymous reviews from our editorial members (included at the bottom and/or attached to this email). I have looked at the paper and the review recommendation myself.

On this basis, I would like you to undertake a **major revision** of your manuscript. As this is a major revision decision, after you revise your manuscript, it will be returned to one or both of the reviewers who have reviewed this paper.

I generally concur with the reviewers' assessment that there's ample room for improvement in this manuscript. I'd like to draw attention to a common critique shared by both reviewers. While your article presents valuable insights into remote sensing, it currently appears more like a brief review paper rather than a distinct opinion piece. The reviewers were eager to hear more about your specific perspectives on the future of the field, the implications of AI, and the effects of data commercialization and geographic accessibility. I strongly encourage you to expand and deepen the "opinion" aspect of the manuscript. Although we've set a 3000-word limit for opinion pieces, we're open to discussing flexibility in the word count if necessary. Additionally, when you're ready to submit your revised manuscript, please ensure that it includes a more comprehensive abstract and one representative figure, as requested by me and Alice (another Editor-in-Chief) before your initial submission.

Once again, thank you for submitting your manuscript to Geomorphica and I look forward to receiving your revision.

Best wishes,

Larry Syu-Heng Lai
Co-Editor-in-Chief, Geomorphica





Authors' responses to review comments

2024-05-24

Reviewer A

The author(s) set out to highlight the advances in remote sensing techniques and data availability and that the field of geomorphology is at the precipice of a "revolution" because of these advances. While the manuscript raises important points, it currently reads more like a brief review paper and needs substantial revisions to be suitable for publication as an opinion piece in Geomorphica.

This is a fair criticism and I hope my revised manuscript is a bit more opinionated.

The author(s) did not offer strong opinions in their manuscript. They promised to showcase examples of research that "ask questions that were unfathomable" before the recent advances of remote sensing techniques. However, the examples cited as novelty were studies expanded upon previous research questions derived from field observations. For example, historically we used stakes on glaciers and extrapolated the local velocity measurements to the larger glacier bodies and now this extrapolation can be applied at mass scale using satellite data. Yes, it is exciting, but these are the questions we asked before satellite data came to existence. The same can be said about fluvial processes. Lab experiments and gauge observations produced exciting results without remote sensing data. While it is exciting that we now can make watershed-scale extrapolations using satellite data, such questions have been raised and addressed before.

While it is true that glaciologists have measured surface melt using stakes, and that insights have been generated from flumes, my point was that geospatial tools and techniques now offer completely different ways of measuring surface melt or bedforms. It is clear to me that this point was poorly demonstrated in my original submission. I have added examples of research that would have been difficult or impossible to conduct without the advances in geospatial data and analysis.

The author(s) raised two important aspects of advances in remote sensing and computing technologies: distribution of this vast data and the emergence of AI models. This was the perfect place where the author(s) could have offered their opinion. It would have been highly effective if the author(s) identified the trends in the field and offered their opinion on where things are heading and the precautions we need to take as a field. Unfortunately, in this regard, the author(s) only highlighted the importance of coupling field observations and remote sensing data, which is something everyone is already aware of in geomorphology.

Please see my comments for Ln 127-128 for details.

I have substantially rewritten much of the manuscript and feel these points are now addressed.

LiDAR and SfM technology brought truly exciting and new data about landscapes.

However, the author(s) of this manuscript did not successfully demonstrate why they were "revolutionary". The author(s) introduce a term "geospatial revolution", but they did not describe what a "revolution" is and did not demonstrate why the new technologies brought this undefined "revolution". In other words, the examples mentioned in this manuscript do not yet demonstrate that geomorphology as a field experienced a paradigm shift comparable to the CRISPR-like revolution in the field of medicine, for example.





I agree with the reviewer that geomorphology has not undergone a CRISPR-like revolution, but I would argue that not all scientific revolutions need to be Nobel-worthy. Merriam-Webster defines a revolution as a “sudden, radical, or complete change”. I did a Google Scholar search for “geomorphology”, restricting the results to only 2026 (see below). Seven out of ten papers on the first page of results¹ relied on lidar or multibeam sonar. I have added a few sentences that I hope strengthen the argument at the end of the Introduction. Further, please see the response about EDI/DEI.

The screenshot shows a Google Scholar search for "geomorphology" with filters set to "Any time", "Since 2026", "Sort by relevance", and "Review articles". The results list several papers, including "The need for open-source hardware, software, and data-sharing specifications in geomorphology" and "Detrending—a new trend in geomorphology? Unravelling erosional processes at the base of submarine landslides".

Diversity of opinions and participation is important to advance the field of geomorphology (e.g., Tooth & Viles, 2020: <https://doi.org/10.1002/esp.5026>). The author(s) of this opinion piece did not answer how the advances in remote sensing techniques may or may not improve equality and diversity. Currently, the references in the manuscript lean heavily toward research produced in the global north. For example, I reviewed the articles cited in this manuscript as examples of great advances in geomorphology. ~47% of the example papers focused on research problems in the global north, namely Canada, USA, Wales and Switzerland. ~26% of the cited papers had global and regional in scope, namely Arctic and Polar regions. ~17% of the cited papers focused on the Himalayan region and the remaining

¹ Scarselli et al. and Ocky Bayu Nugroho et al. used 3D seismic, while Yu et al. used well logs and seismic data. Mazzarini provides a book review and so was not included in my search.





10% were review articles. Only one paper had a study area in Argentina, and no example of studies done in Africa was cited in this manuscript. This current selection inadvertently overlooks authors from less developed countries and misses an entire continent. There are certainly interesting research problems in Africa, such as surface modifications due to mining, rapid retreat of glaciers on Kilimanjaro, eolian processes in the Sahara, and the fluvial processes in the Nile river system. It would have been useful if the author(s) offered their opinion about the accessibility of these valuable datasets. Historically, paradigm-shifting ideas came from military-oriented expeditions sponsored by wealthy nations (e.g., HMS Beagle voyage with Darwin onboard and the seafloor mapping that led to plate tectonics). Is it still the case with the availability of global- and regional-scale datasets? Does commercialization of these data improve or worsen the inequality prevalent in the Earth sciences? Such insights would have been valuable in an opinion piece.

I agree with the reviewer that diversity of opinions and participation is important for our field, and that my manuscript was biased towards North American, European, and Asian examples and authors. This was a blind spot, since most of my research focuses on those continents and with colleagues from there. I have attempted to add examples from Africa especially. Further, I have added a short section titled "Equity in the geospatial revolution" that I hope will address the reviewer's concerns. If the editor feels that section should be omitted from the paper, I am happy to discuss.

Geographical diversity is not the only aspect that needs broadening. The diversity of research questions exemplified in this manuscript is also highly concentrated. ~37% of the references focused on glacial and periglacial processes and 20% of the references focused on fluvial processes. Another 23% of the references were review articles or global- to regional-scale DEM datasets. In other words, the two other erosional agents (wind and gravity) were barely mentioned as examples of great advances in modern geomorphology. I remain skeptical of the authors' claim that we are finally able to ask the correct questions only due to advances in remote sensing techniques. If the examples given in this manuscript are taken as the correct survey of geomorphology as a field, it currently leaves out large and important aspects of the discipline.

I have attempted to broaden the diversity of landforms described in the paper, with addition of examples from colluvial, submarine, and aeolian sensors.

Ln 9: "Earth observation technologies" is a very broad term that includes not only remote sensing methods but also in-situ observations. Please be specific.

I have added parenthetically "(including both space- and airborne in addition to groundbased technologies)" in the Introduction paragraph.

Ln 9: "These ... developments" in this sentence doesn't refer to anything in the previous sentence. What developments are you referring to here? Is it referring to "advances"? In that case, the "advances" are not well described.

I have added "including lidar, synthetic aperture radar, multibeam sonar, structure-from-motion photogrammetry, and others" to the previous sentence.

Ln 16: I'm not sure if it's necessary to include "that is".
Removed.





Ln 17: The reference to the "large boulder the size of a small boulder" meme may not translate well to readers unfamiliar with the internet reference. While engaging, it is not a scientifically accurate description of parcel size.

Removed.

Ln 34: Not necessary to say "considered another way".

Removed.

Ln 35: Authors mentioned time scale in Ln 18-19, but emphasized only spatial scale in this sentence. Why?

Sentence on Ln 35 has been removed.

Ln 60: The parody movie Spaceballs might be culturally significant to some in the U.S., but Geomorphica has a global audience, so the reference to this movie may not be appropriate for an opinion paper here.

I have added "the cult parody movie" before the name of the film so that curious, but unfamiliar readers can also enjoy 96 minutes of the comedic chops of Mel Brooks, John Candy, Joan Rivers, and Rick Moranis.

Ln 61: It would be an excellent opportunity to highlight the capability of sub-cm scale data acquisition using lidar and why it was not possible to acquire such data previously, instead of describing it to have "ludicrous" resolution.

I have added several citations to this effect.

Ln 75: It is too vague what is being referred to as "geomorphology and glaciology purposes". What unique and novel questions were asked and/or answered because we now have ArcGIS/DEM?

I have added an example of a study that was only possible due to ArcGIS/DEM (and deep learning).

Ln 77: Please elaborate on the accessibility of these high-resolution datasets. Why is it not readily accessible? Is it due to cost or institutional embargo, or both?

I have revised to specify that the data are only available to US government or funded scientists.

Ln 83: Please specify what is being referred to as "cupping edge tools". Clarifying this will better illuminate the point for readers.

I have added examples of fluvial geomorphology studies that were only possible due to advances in multibeam sonar and ADCP.

Ln 86: I don't agree with the statement "geomorphologists could never have even considered studying bedform processes". People have been doing this for years in small scales and with flume experiments. I have modified to sentence to indicate that we meant subaqueous processes at field scale.

Ln 86: Clarify what you mean by "such temporal and spatial granularity". Does this mean people didn't think of studying fluvial landforms changing daily or didn't think of interpolating small scale studies to large regions?





We have modified the sentence as follows: "...temporal and spatial granularity afforded by tools such as multibeam sonar."

Ln 93: replace "has" with "have" Done.

Ln 94: The statement is too vague. What temporal and spatial scales were not observable? Define "coarse" resolution and "low frequency" of satellite images. Explain why these specific scales are not enough.

I've added parenthetical values for coarse spatial resolution (≥ 30 m) and temporal revisit times (≥ 1 week).

Ln 101-104: Clarify how common it is to document rapid events such as debris flow and floods using satellite images. In other words, did the commercial satellites capture these rapid events by accident? What's the reproducibility of these observations in the future? Can we rely on the repeat cycles of these commercial satellites to ask and answer questions related to such rapid events?

The reviewer raises a good point that these particular events were captured purely by chance rather than by design. I have clarified the text as follows: "While the satellite observations of these examples were happenstance rather than by design, such insights were unfathomable a decade or two ago and will no doubt become more common as the number and capabilities of Earth observing satellites increases."

Ln 105: Missing "used" between "was" and "to" Done.

Ln 107: "unfathomable" may be an overstatement. We've measured discharges of rivers from gauges for years. The premise here is that the satellite images allow us to measure discharges more cheaply and/or in places with no access. The question is, what's the reliability of these satellites? Can we rely on these commercial satellites to make long-term measurements? What is the cost of making measurements from these commercial satellites vs. investment in the local research communities?

I disagree – if you had asked most geomorphologists whether measuring remote river velocity from space videos was possible 10 or 20 years ago, most likely would have considered it science fiction. Furthermore, whether commercial satellite companies are to be trusted to make longterm measurements is irrelevant to the points I am making. The point is that these observations were made, contributing to the step change in our ability to make measurements of geomorphic change.

Ln 109-116: This paragraph mentions hypothesized benefits of deploying radar sensors, without actually demonstrating what kind of research questions can be addressed from these radar datasets. Currently, this paragraph is too generic and should be tied to specific examples.

The reviewer raises a good point here and I have added a citation to a paper describing a novel use of InSAR for landslide early warning. I also added a figure of previously unknown landslides that were discovered due to openly accessible InSAR portals.

Ln 117-132: The beginning of this paragraph raised an important question of data storage and distribution. However, it stopped short of offering an actual opinion on this important question. Who should be responsible for storing and distributing these large datasets? What is the trend? Are commercialization and private-contracting becoming more prevalent instead of large-scale initiatives





that have historically been sponsored by governments? What are the benefits and drawbacks of increased commercialization of geospatial datasets? Would it exasperate the inequality that already exists?

I have expanded upon these ideas.

Ln 127-128: It is also important to address the use of machine learning and AI models in analyzing geospatial data. I hoped that the author(s) would give their opinion on this. Unfortunately, the manuscript says very little except that the AI models have "potential for seeing the signal" that humans might not. It is important to clarify what this means, as humans train these models. Does the potential of AI models depend on how we train them? The manuscript should address concerns about the consequences of research outcomes if we train AI models with biased and/or oversampled datasets. Such insights are highly valuable in an opinion piece and should replace the current listing of examples of processing global- to regional-scale datasets.

I am not an expert in AI/ML but have expanded on these topics.

Ln 132: Need to define "Earth Observation" better. Capitalizing the words doesn't make the term clear. As far as I understand it, earth observation also includes field observations. I now clarify "(including both space- and airborne in addition to ground-based sensors)" in the Introduction.

Ln 134: I don't understand the purpose of the two sentences here. If you're suggesting that geomorphology as a field is accelerating in pace, please provide the evidence for it. It could be number of papers published, PhDs produced, money invested, or something similar.

Without actual evidence, the claim in these sentences is unsupported. This criticism feels unnecessarily pedantic.

Ln 138: Please clarify why only the "rapid" surface processes were highlighted. What about the "slow" tectonic processes shaping the Earth's surface? Are there no novel questions in "slow" processes that can be asked/answered from remote sensing data?

Removed.

Reviewer B comments from manuscript

L16 This sentence is extremely long and grammatically incorrect. I have attempted to simplify it.

L22 I don't like the phrase 'The arrival of computer...' It sounds like they arrived on their own. Maybe...'With the implementation of larger scale computational capabilities...' Done.

L24 This sentence is too large, it needs a period in the middle. '...approach. This so-called quantitative revolution (Keylock, 2003), allowed processes to be understood based on their underlying...'

I have modified the sentence, but the suggestion from the reviewer is not grammatically correct.

"...approach. This so-called quantitative revolution (Keylock, 2003) allowed processes could be understood based on their underlying..."

L26 This whole sentence sounds off





Modified to “Both descrip*ve and quan*ta*ve approaches are common, complementary, and have benefited immensely from what we term the *geospa)al revolu)on*, which is ongoing.”

L30 How do you 'more completely' answer ques<ons? The word selec<on is off

Modified to “Not only can today’s geomorphologists answer research ques*ons in different and exci*ng ways, but we can ask ques*ons that were unfathomable or at least exceedingly difficult even a couple of decades ago.”

L34 'Considered another way' doesn't make sense. Maybe use another adverb. I have removed this sentence.

L41 Also small scale processes, due to limited resolu<on

Modified to “Earth surface changes opera*ng on shorter *mescales, or small spa*al scales, could not be easily understood.”

L52 Who is prohibi<ng what? I guess you are inferring that it is too expensive and most researchers can't access to the technology. But please use another word

Modified to “And while costs are decreasing, acquiring lidar data especially over large areas can be well beyond the budgets available to many geomorphologists due to both sensor costs and aircrah *me.”

L53 This en<re phrase is off. 'and, because photons can penetrate water, even the bathymetry of a water body can be performed remotely' Is this what you mean?

Modified to “...and because photons penetrate water, even bathymetric measurements can be made from space (Fricker et al., 2021; Parrish et al., 2019).”

L58 Add “(SfM)”

Done.

L60 I understand the reference, it is funny, but please rephrase it in a way it doesn't complicate the reading. Maybe put it between hyphens ?? And 'ludicrously' between quota<on marks

Modified to “...has facilitated produc*on of – to paraphrase Dark Helmet from the cult parody movie Spaceballs – “ludicrously” high-resolu*on DEMs with limited effort...”

L61 What is this is referencing to? Westoby et al 2012

I am not sure what the reviewer is asking here. Do they mean that Westoby didn’t reference Spaceballs? I am ci*ng Westoby here because they wrote a seminal paper about SfM and described the low effort and costs involved.

L63 wether they were acquired from an UAV or from what? This sentence is missing something.

My intent here was for the next sentence to describe an example of “from what”. But I realize that this was not obvious and so have modified to “The SfM technique works with overlapping images acquired from a UAV, crewed aircrah, satellite, or even a smartphone (Michelen et al., 2015).”

L75 geomorphological and glaciological studies Done.





L77 the data is not free.

The issue isn't that the earthDEM products aren't free. Rather it's that they are simply not available to non-US people. I have modified the sentence to "More recently, earthDEM (Porter et al., 2024) extends this product to the rest of the planet's land masses, although the data are unfortunately currently only available to US federal employees or federally funded researchers."

L81 What type of processes? Can you describe very briefly what they (Parsons, Clarke, Vende^uoli) did for readers that are not familiarized with the authors?

I have completely rewriCen this paragraph as follows:

"Likewise, the widespread adop*on of mul*beam sonar has resulted in similar advances in the marine and freshwater realms. For example, Parsons et al. (2005) provided an early example using mul*beam sonar for what might be called descrip*ve geomorphology, although they also used other cunng edge tools for more quan*ta*ve analyses. In a series of landmark studies combining high-resolu*on mul*beam sonar maps with 3D velocity data from an acous*c Doppler current profiler (aDcp), Parsons and colleagues made substan*al strides in understanding confluence dynamics (Lane et al., 2008; Parsons et al., 2007) and sediment transport over dunes in the Rio Paran in Argen*na (Kostaschuk et al., 2009; Shugar et al., 2010). Similarly, many of the same authors (Best et al., 2010; Simmons et al., 2010) proposed a methodology for visualizing water column turbulence and suspended sediment from the acous*c backscaCer from mul*beam sonar. Such whole flow field observa*ons were not possible prior to the advent of swath bathymetry and aDcp instruments.

More recently, Hughes Clarke (2016) and VendeCuoli et al. (2019) quan*fied submarine processes from bathymetric surveys and water column measurements on the Squamish prodelta using mul*beam sonar and aDcp, similar to what Parsons and colleagues did in South America. Never before have the geomorphic implica*ons of turbidity currents been quan*fied in such detail, including from acous*c backscaCer visualiza*ons. For example, VendeCuoli et al. (2019) provided key insights into stra*graphic evolu*on of submarine channels by daily mapping of the topography, finding that the overwhelming majority of stra*graphy is reworked and not preserved in the record. Without these technologies providing such high-resolu*on bathymetric and flow-field data, geomorphologists could never have even considered studying subaqueous processes with such temporal and spa*al granularity."

L87 What does granularity means?

The Cambridge Dic*onary defines it as "the quality of including a lot of small details:", whereas ESRI defines it (in a geoma*cs context) as "The coarseness or resolu*on of data. Granularity describes the clarity and detail of data during its capture and visualiza*on." As a result, I feel that my use is appropriate in this context.

L101 Strikethrough Text

I have modified the text to "...every day or even more frequently."

L105 Add "a" and "used"

Done





L110 Add “, in par<cular”

I did not accept this sugges*on. Rapid processes, irrespec*ve of liquid water at the surface, will decorrelate with InSAR.

L114 Add “surface”

Done

L127 – Replace “seeing” with “finding”

Done

L131 – Replace “submit” with “believe”

Done

L134 I love this sentence

Thank you ☺ I came up with it while wri*ng an op-ed for a newspaper several months ago.

L134 Replace “of” with “for”

Done





Round 2 Review

Comments by reviewer 2 (anonymous)

Completed: 2026-06-22 02:50 PM

Recommendation: Accept

The resubmitted opinion piece entitled 'The geospatial revolution in geomorphological research' has greatly improved and I can now see the author(s)' perspective (aka opinion) while providing an insightful and updated view on geomorphological studies nowadays and to the future. I also value their opinion towards the democratization of satellite data which is in line with the scope of Geomorphica and their attempt to include more information regarding the global south.

I really enjoyed reading this new version.

My only observation is modifying the term 'lidar' with the correct term 'LiDAR'.

Also line 180 needs a connector, the paragraph seems disconnected with the previous.





Comments by copy editor/co-Editor-in-Chief (Alice Lefebvre)

Completed: 2026-06-23 09:06 AM

Recommendation: minor revisions

There are just a couple of things which need to be adapted (mainly copy editing, but I try to have all those copy edits done before acceptance to reduce the work of copy editors), and I guess as a marine geomorphologist, I picked on the part about marine stuff.

I would recommend minor revisions.

I feel the non-technical summary should be changed. Words like multibeam echosounder, Lidar or synthetic aperture sonar do not belong to a non-technical summary. It should be something really easy to read, that for example a social scientist who does now the type of data we use may understand

L42. Don't use "don't" but rather "do not"

L 43. Define all acronyms SfM (defined L82), InSAR (defined L182);

L49. Define DEMs

L52 Laser scanning (lidar) ==> light detection and ranging or laser imaging, detection, and ranging (LiDAR)

L59. "fundamentally changed how geomorphologists approach and conduct their work" as long as we don't work underwater

L 73. "bathymetric measurements can be made from space (Fricker et al., 2021; Parrish et al., 2019)." as long as the water is shallow and clear. I think it is important to remember that we still have a very large portion of the ocean bottom which is extremely difficult to map at high resolution. Reading on, it comes later (l118 and after), with a big advertisement for Dan Parsons papers. I completely agree that we have made enormous advances with MBES, especially in shallow water, and down to the continental slope. There are still very large portions of the ocean bottom which have not been mapped

"London, 20 April 2026 – The Nippon Foundation-GEBCO Seabed 2030 Project today announces that 28.7% of the world's ocean floor has now been mapped,..."

<https://seabed2030.org/2026/04/20/global-seabed-mapping-reaches-new-milestone-as-five-million-square-kilometres-added-in-a-year/>

I am probably biased and I'm not sure if it is necessary, but it may be good to have a different section for underwater, saying that the revolution in marine geomorphology is not completely there yet. Underwater might be more progressive than above water. And I think that's important, because most of the Earth surface is underwater.

Check consistency between Earth-surface processes and Earth surface processes

L293 "co-authors from South Africa" Should it be South America?





The numbering of headings should be changed. I think it should be

1. Introduction
 2. Mapping and quantifying elevation and mass changes
- etc.





Decision by Editor-in-Chief (Larry Syu-Heng Lai)

2026-06-23

Dear Dan Shugar,

Thank you for submitting your manuscript entitled "The Geospatial Revolution in Geomorphology Research" (77) to Geomorphica. I have now received the comments from reviewers and Alice (another Editor-in-Chief). The comments are included/attached at the bottom of this email. I have looked at the paper, the reviews, and recommendations myself.

On this basis, I would like you to undertake a **minor revision** of your manuscript. I really appreciate the efforts you did in the last revisions, and I think the current manuscript is **very close to being accepted for publication**. Some points brought up by Alice may require a little more work, and I agree that those edits are necessary. I expect that this is a rather short turnaround revision process, but we allow a **maximum of one month** for this type of decision. Once you resubmit your revision, I will assess it directly before the final decision (without another round of review), and I intend to skip the copy-editing stage to expedite the production process.

Once again, thank you for submitting your manuscript to Geomorphica and we look forward to receiving your revision.

Best wishes,

Larry Syu-Heng Lai
Co-Editor-in-Chief, Geomorphica





Authors' responses to review comments

2026-06-26

Anonymous Reviewer 2:
Recommendation: Accept

Comments to the authors and editors.

The resubmitted opinion piece entitled 'The geospatial revolution in geomorphological research' has greatly improved and I can now see the author(s)' perspective (aka opinion) while providing an insightful and updated view on geomorphological studies nowadays and to the future. I also value their opinion towards the democratization of satellite data which is in line with the scope of Geomorphica and their attempt to include more information regarding the global south.

I really enjoyed reading this new version.

My only observation is modifying the term 'lidar' with the correct term 'LiDAR'.

On lidar vs LiDAR, I don't believe we need to capitalize it anymore, per a UNAVCO workshop I attended about a decade ago. See <https://opentopography.org/> for example. However, I have changed it to LiDAR everywhere to speed review.

Also line 180 needs a connector, the paragraph seems disconnected with the previous.

Done.

Review comments by Alice (Copy editor/Editor-in-Chief):
Recommendation: Minor revisions

There are just a couple of things which need to be adapted (mainly copy editing, but I try to have all those copy edits done before acceptance to reduce the work of copy editors), and I guess as a marine geomorphologist, I picked on the part about marine stuff.

I would recommend minor revisions.

I feel the non-technical summary should be changed. Words like multibeam echosounder, Lidar or synthetic aperture sonar do not belong to a non-technical summary. It should be something really easy to read, that for example a social scientist who does now the type of data we use may understand





I understand the sentiment here, but as this is a paper about technological advances, and in a disciplinary journal, I feel the terminology is appropriate.

L42. Don't use "don't" but rather "do not"

Changed (also on L80).

L 43. Define all acronyms SfM (defined L82), InSAR (defined L182);

Done.

L49. Define DEMs

Done.

L52 Laser scanning (lidar) ==> light detection and ranging or laser imaging, detection, and ranging (LiDAR)

Changed to light detection and ranging.

L59. "fundamentally changed how geomorphologists approach and conduct their work" as long as we don't work underwater

I have added "terrestrial", although I'll point out that topobathy lidars are now available for relatively shallow water.

L 73. "bathymetric measurements can be made from space (Fricker et al., 2021; Parrish et al., 2019)." as long as the water is shallow and clear. I think it is important to remember that we still have a very large portion of the ocean bottom which is extremely difficult to map at high resolution. Reading on, it comes later (L118 and after), with a big advertisement for Dan Parsons papers. I completely agree that we have made enormous advances with MBES, especially in shallow water, and down to the continental slope. There are still very large portions of the ocean bottom which have not been mapped

"London, 20 April 2026 – The Nippon Foundation-GEBCO Seabed 2030 Project today announces that 28.7% of the world's ocean floor has now been mapped,..." <https://seabed2030.org/2026/04/20/global-seabed-mapping-reaches-new-milestone-as-five-million-square-kilometres-added-in-a-year/>

I am probably biased and I'm not sure if it is necessary, but it may be good to have a different section for underwater, saying that the revolution in marine geomorphology is not completely there yet. Underwater might be more progressive than above water. And I think that's important, because most of the Earth surface is underwater.





I agree and have modified the initial sentence about spaceborne bathymetric measurements. Additionally, I've added some text about mapping the seabed around L156.

Check consistency between Earth-surface processes and Earth surface processes

Done.

L293 "co-authors from South Africa" Should it be South America?

Good catch!

The numbering of headings should be changed. I think it should be

1. Introduction
 2. Mapping and quantifying elevation and mass changes
- etc.

Done.





Round 3 Review

Decision by Editor-in-Chief (Larry Syu-Heng Lai)

2026-06-27

Accept

