RC1

I) General Comments:

The paper entitled "AscDAMs: Advanced SLAM-based channel detection and mapping system" by Tengfei Wang and co-authors presents a technical work that aims to improve the tools for better geomorphologic assessment of debris flows channels.

This is an interesting work that aims also to improve and cover the incertainties posed by satellite image.

The data for this study was acquired on field work, carried out on an experimental area in Chutou Gully, China, through two field experiments in 2023.

To achieve their goals, the authors have developed an advanced channel detection and mapping system (AscDAMs) to improve 3D mapping (SLAM - Simultaneous localization and mapping), through the development of several algorithms to overcome mapping inaccuracies and noise.

The proposed tool (AscDAMs), has an important contribution for post-process SLAM results, namely through algorithms for correcting deviation, smoothing point cloud, and cross-section extraction.

This is mostly a technical contribution to better assess natural hazards, whose technical and scientific advances my serve as the basis and support for future geomorphologic works aiming a better comprehension of the main mechanisms leading to debris flows.

The paper deserves publication in Natural Hazards and Earth System Sciences, however some issues should be considered.

I suggest minor revisions.

RESPONSE: We appreciate your time and recognition of our work, as well as your constructive feedback that we have found very helpful to improve the quality of our manuscript. Please find the point-to-point response and revision below.

II) Specific Comments:

Some aspects should be clarified

a) Section 5.3 - 1st paragraph, last sentence:

When you say that AscDAMs can be also successful for less demanding scenarios, do you think that this tool can be successful as well in gentler (less mountainous) areas, where geomorphology is not so steep, and channels are wider? Flatter areas can they be surveyed and assessed with such success, despite the lower altimetric and geomorphologic contrast?

RESPONSE: Thanks for the question. Yes, flatter areas can indeed be surveyed and assessed with such success. We have previously tested AscDAMs in gentler valleys and urban scenes. The complete test dataset has been released in: https://doi.org/10.6084/m9.figshare.c.7088278.v2. It includes a less demanding mountainous area with a gentler slope and wider channel (test site: Banzi Gully, Wenchuan County, Sichuan Province, China), an urban forest park with a gentler channel and some city scenes (test site: Honghuashan Forest Park, Zhuhai City, Guangdong Province, China), and an urban mountain park with relatively small elevation differences and small geomorphological contrast (test site: Parque do Alto de Coloane, Coloane, Macao SAR, China). It works well as expected. The citation for the dataset will also be updated in the manuscript.

b) Section 5.4 - (2): Considering the color contrast limitations, is AscDAMs an effective tool for non-vegetated areas, like unvegetated steep areas affected by debris flows, or other slope movements?

RESPONSE: Thanks for the question. Yes, it is still an effective tool for non-vegetated areas. The core output of AscDAMs is 3D point cloud map with elevation data. The original intention of coloring is to assist in providing additional vegetation information

inside channel. If no vegetation data is needed or there is no vegetation in the channel, we can have maps without RGB-color. AscDAMs can output maps with and without color information.

c) The conclusion is quite technical. However, it should give more attention to the geomorphological analysis, i.e., should be complemented with more explicit conclusions focused on geomorphology. It should be more emphasized the contribution of these findings for science in general, and for debris flow and geomorphological analysis in particular.

RESPONSE: Thanks for your constructive comments. We rewrite the conclusion part to let it focus more on the geomorphology and emphasize the contribution of current works on science. Please refer to the change below:

CHANGE IN MANUSCRIPT:

Chapter 6 Conclusion and Perspective: "Obtaining the high-resolution, accurate topographic channel map is the common key challenge for channelized debris flow research. At present, wide-used satellite images, UAV-based mapping, and other existing technologies cannot satisfy the requirements of accuracy and efficiency in observing channel interior conditions in mountainous long-deep gullies. SLAM is an emerging 3D mapping tech and has been applied across different platforms for numerous scenarios of topographic mapping. However, state-of-art SLAM mapping results contain large drift and abundant noise induced by the extremely rugged long-deep channel environment. Aiming to solve these problems, we proposed AscDAMs with a set of new algorithms including deviation correction, point cloud smoothing, cross section reconstruction to process the original SLAM results. In addition, a map coloring algorithm is developed to supplement more information to the map. A frequent debris flow gully named Chutou Gully in Wenchuan Earthquake region was selected as the research area. AscDAMs was successfully implemented in extremely harsh environments, resulting in the high-resolution full character morphological mapping of debris flow gullies. Compared to existing channel detection technologies, AscDAMs offers the following benefits:

(1) Improved accuracy. The proposed deviation correction and point cloud smoothing algorithms significantly enhance the accuracy of mapping results.

(2) Cross section extraction. The cross section extraction algorithm enables the full characterization of debris flow channel cross sections, facilitating the study of critical channel cross sections in terms of debris flow development, dynamics and erosion.

(3) Comprehensive 3D mapping. The 3D map with adequate detailed information is sufficient to quantitatively assess the position and spatial distribution of channel deposits. With reasonable simplification, it is also possible to estimate the deposition volume, which is vital for risk assessment and management.

(4) Morphological monitoring. Periodic re-surveys of the channel with AscDAMs enable the monitoring of gully morphology changes, such as the downward movement of slope loose material and sediment transport within the channel, from a quantitative standpoint.

(5) Vegetation recovery analysis. The additional color information captured can be utilized to study vegetation recovery inside the channel.

As a crucial supplement to existing channel morphology detection methods, AscDAMs works well in the complex channel environments. It provides the important but currently absent channel interior details, which is promising to promote deep understanding of debris flow mechanisms and post-seismic long-term evolution, and support precise hazard/risk assessment and mitigation, although it can be further improved in systemic error correction."

III) **Technical issues:**

d) Figure 5: the relative elevation legend you jumped from 100 m to 200 m and then to decreased to 150 and 250. It might be a typo error.

RESPONSE: Thank you very much for pointing out this typo error. 150 and 200 are reversed. I have made correction in Figure 5. Please see attached document.

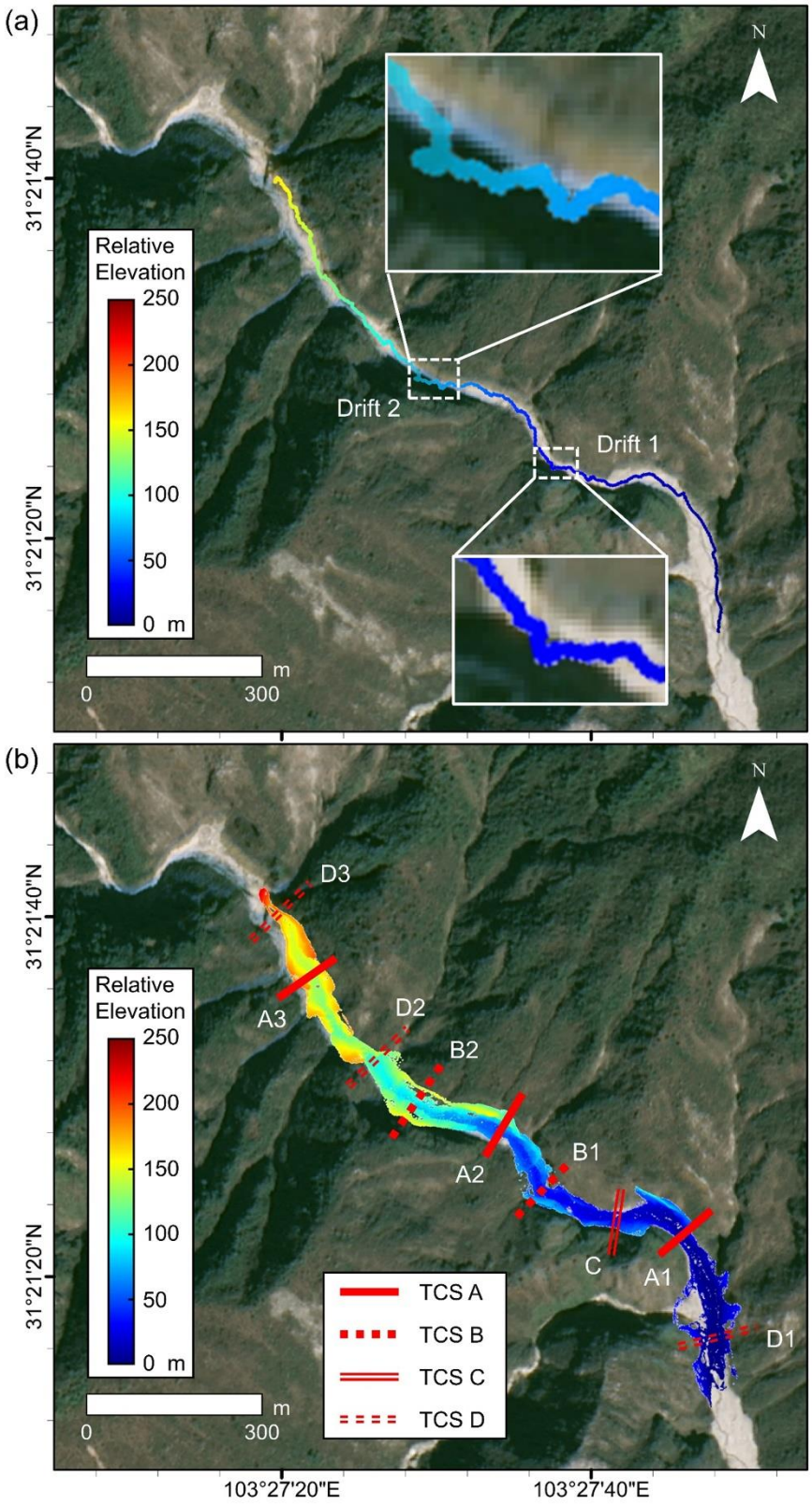

Figure 5. Overview of the AscDAMs map, projected on DOM of ZY03 satellite: (a) The trajectory and (b) the global map, TCS A~D are typical cross sections of the channel.

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This manuscript presents the research and development of technology and systems for waterway detection and mapping based on SLAM, which is of great importance for the mapping of debris flow terrains and disaster prevention and mitigation efforts related to debris flows. I have only one suggestion: in the final section of Conclusions and Prospects, the content related to prospects should be included in the Discussion section under the heading of limitations.

RESPONSE: Thank you very much for your recognition and suggestion. We have included the final section of Conclusions and Prospects in the limitation part. Please refer to the change below.

CHANGE IN MANUSCRIPT:

The last paragraph of Section 5.4: "(4) The systematic error inherent in the SLAM algorithm has not been entirely overcome. Although the proposed deviation correction algorithm significantly mitigates the systematic error of the SLAM algorithm, it remains impossible to completely eliminate the influence of this error."

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This is a very interesting method to study channel morphology. Thank you for sharing it.

I have a few quick suggestions for your work:

1. Please provide a general caption for the figures, for example, "Figure 1."

2. Figure 4 contains a lot of information, but the caption is too brief. It would be better to elaborate on the caption for this figure, even though you have explained it well in the manuscript.

RESPONSE: Thanks for the comments. We have added necessary captions for the Figures you have mentioned. Other figure captions are also improved following your advice. Please see attached document.

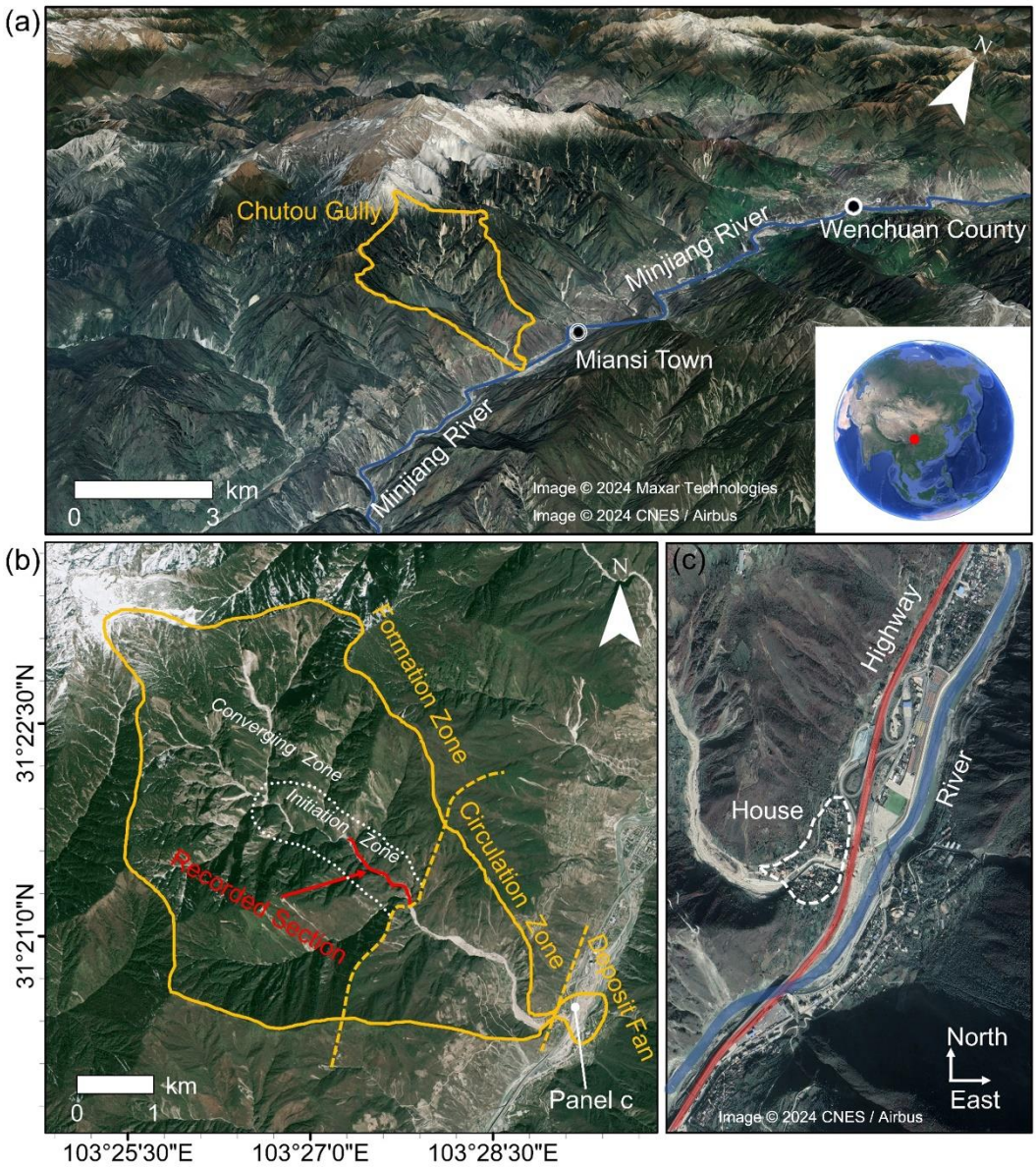


Figure 1. A typical mountainous area in Wenchuan County, Sichuan Province, China: (a) 3D map of the mountainous area of Wenchuan on 14 November 2021 from Google Earth; (b) Overview of Chutou Gully on 25 March 2020 from ZY03 satellite image; (c) Accumulation zone on 14 November 2021 from Google Earth.

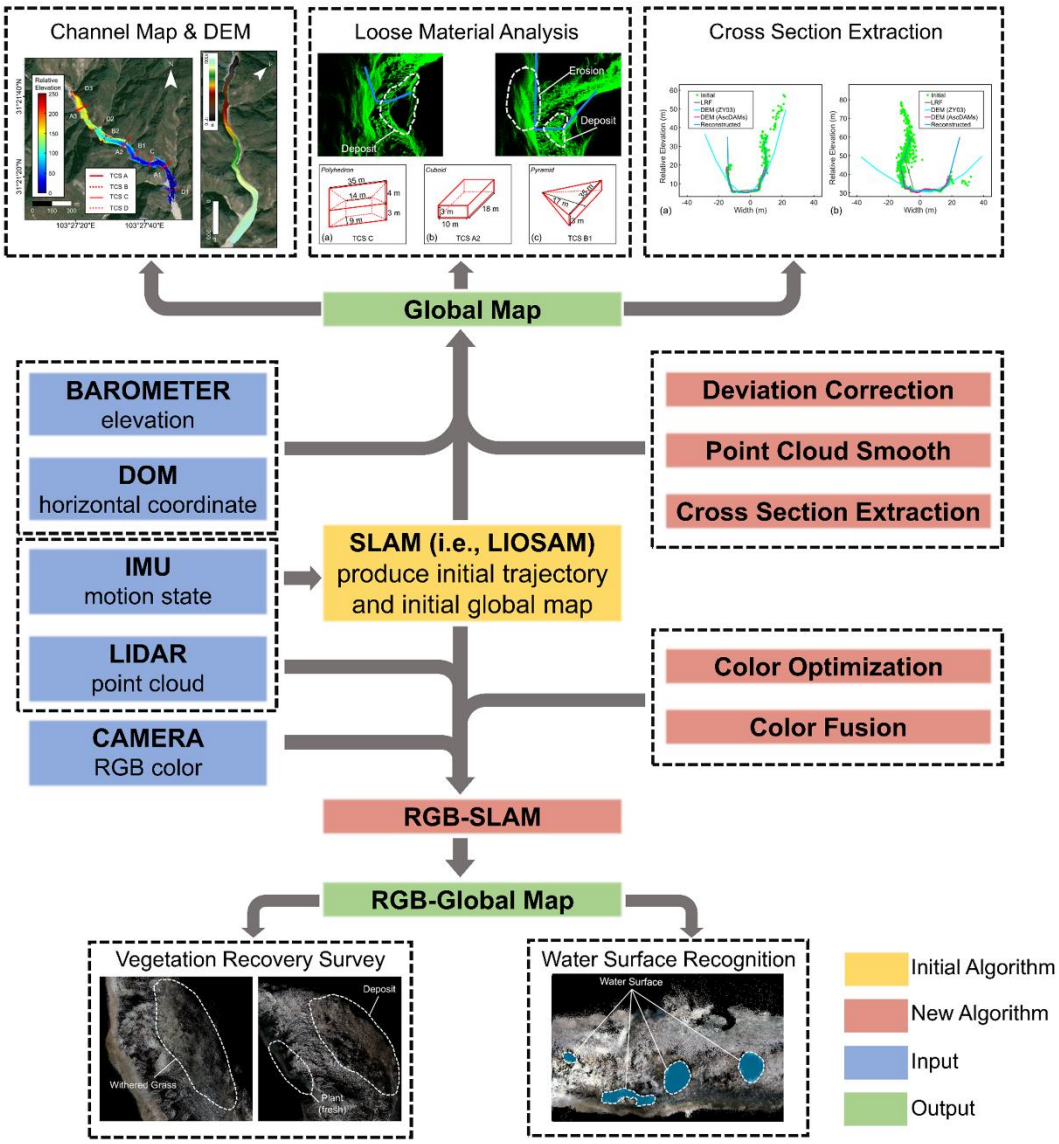
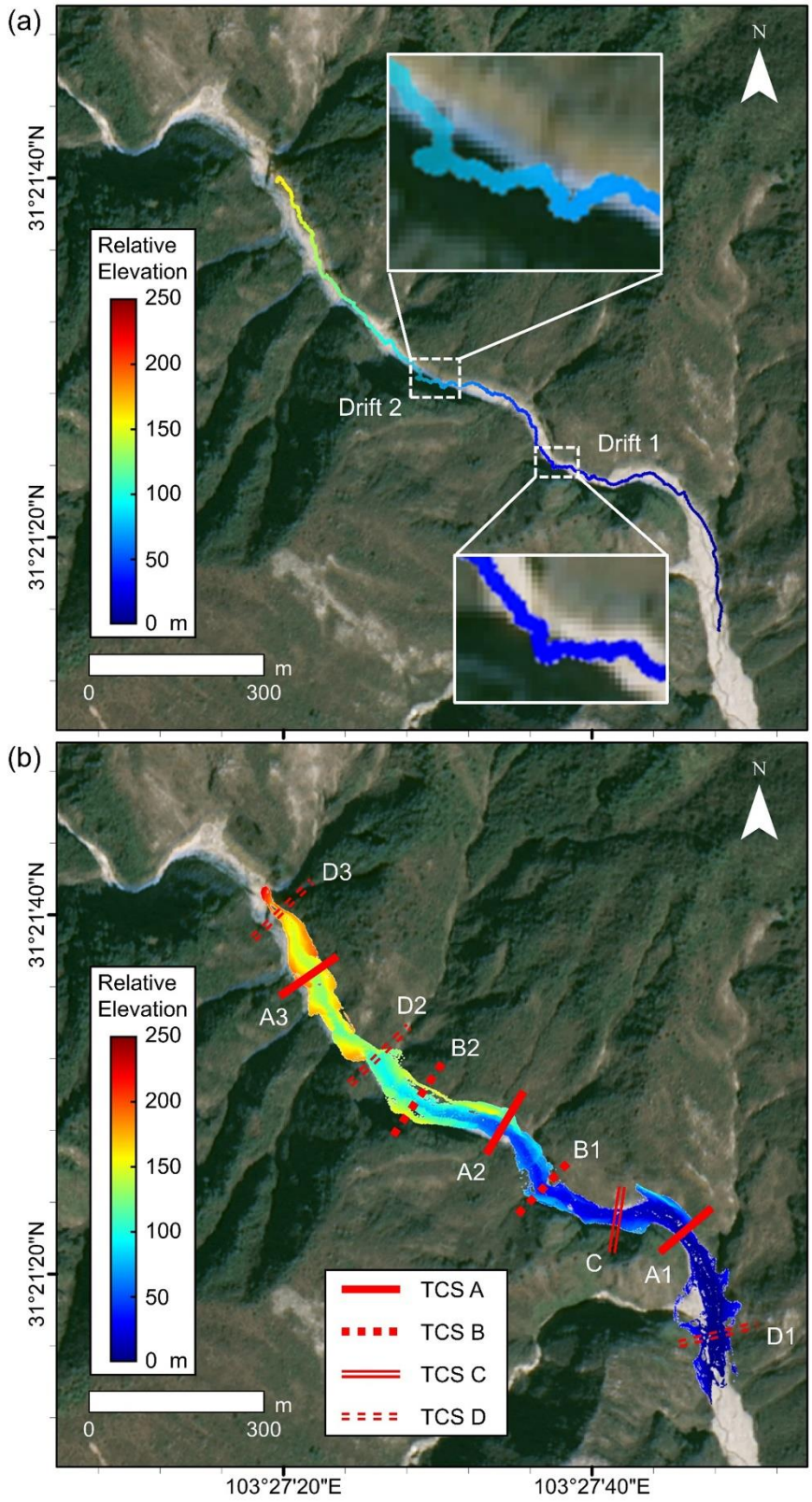


Figure 4. Algorithm flow scheme of AscDAMs. The initial SLAM algorithm calculates the initial maps utilizing IMU and LIADR. After optimizing the maps by deviation correction, point cloud smoothing, cross-section extraction, and map coloring, the channel global map with and without RGB-color can be obtained and employed in debris flow study.



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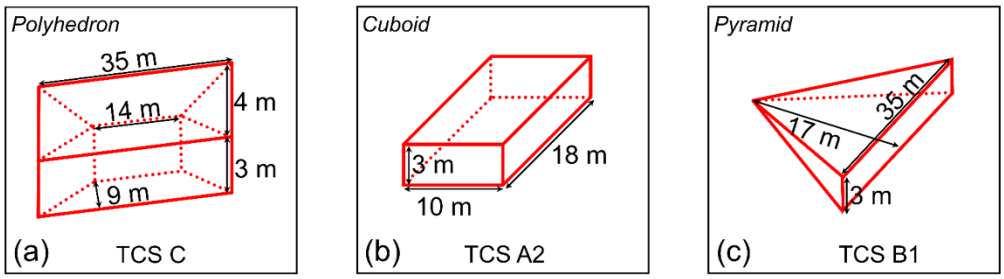

Figure 10. Deposit volume estimation in TCS C, TCS A2, and TSC B1, approximated