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Short-term Glacial Dynamics Detection of a Maritime Glacier in Southeastern Tibetan Plateau using Cost-effective UAV and Rapid Photogrammetry Techniques

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Glacier mechanical ablation, such as ice calving, collapsing and flaking, plays a significant role in amplifying glacier recession. Mechanical ablation, as a non-linear response to climatic changes, caused by structural instabilities are mainly attributed to interactions of water-ice/glacier, which could be strengthened by the enhanced meltwater runoffs when rain season meets with ablation season. Similar to water-terminating glaciers, ice calving (or large-scale ice collapsing) events have happened in land-terminating glaciers in the southeastern Tibetan Plateau such as Hailuogou (HLG) glacier. However, other than ice calving events with water involved and dry calving events, ice calving of HLG glacier is roughly in the middle state between them. Previous studies have shown that HLG glacier have maintained negative mass balance in recent years with sustaining retreat, accompanied by mechanical ice loss events. Seven field trips to HLG glacier were conducted from 2017 to 2020 (concentrated from June to November). A cost-effective Unmanned Aerial Vehicle (UAV; DJI Mavic Pro) was used to capture images from ice fall to glacier terminus. Agisoft Metashape Pro was used to produce dense point cloud, digital surface model and ortho-images, etc. Results indicate that, under the intense interactions of water-ice/glacier, glacier terminus has been retreating continually, the terminal ice cliffs have gone through a succession of structural changes, the proglacial river have diverted several times, and the position of subglacial channel outlet had multi-times shifts accompanied with the periodic occurrences of terminal ice cave. The surrounding glacial landscapes have been altered accordingly such as the increasing runoffs from glacier river, the narrowing glacier ice fall, upward invasions by periglacial vegetation, and etc. The combination of repeated UAV mapping and rapidly streamlined terrain reconstruction technique provides a cost-effective option for short-term monitoring of glacier dynamics, especially for more precise detection on mechanical ablation, compared with datasets from commercial satellites.