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SAR偏移量跟踪技术估计天山南依内里切克冰川运动

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Using SAR offset-tracking approach to estimate surface motion of the South Inylchek Glacier in Tianshan

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摘要

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摘要

流动性是冰川的一个主要特征, 监测其流速变化可以为冰川物质平衡和冰川灾害研究提供重要信息. 本文研究利用2007—2008年的7景ALOS/PALSAR影像和偏移量跟踪技术提取亚洲最大的山岳冰川之一——南伊内里切克冰川的运动场. ALOS/PALSAR影像的时间连续性和南伊内里切克冰川的冰碛覆盖为SAR偏移量跟踪技术获取连续的冰川表面流速提供了基础, 然而冰川积累区降雪、附加冰带消融、陡坡区域裂缝发育等客观事件的发生对速度的获取仍有局部影响. 尽管如此, 本文仍得到了整个冰川不同季节的平面运动场, 并且在所有6个时间段内观测到的运动场非常吻合. 详细地分析揭示南伊内里切克冰川运动具备以下规律: 流速由轴部向两侧递减, 由源头向下至雪线处运动速度逐渐增加, 然后再向末端逐渐递减; 流速大小和坡度大小呈非线性正相关, 坡度从 1° 突变至 16° 时, 冰川运动加速会导致裂缝发育; 夏季受冰川湖影响, 尾部分支流流速能激增至 96 cm/d ; 暖季速度会高于寒季 $5\sim 10\text{ cm/d}$. 该冰川的冰舌主体日平均速度为 $20\sim 50\text{ cm/d}$, 局部最高速度可以达到 65 cm/d . 在冰舌上提取了一些样点的速度作统计, 结果显示各个时段中所有样点的平均速度最高可达 33.3 cm/d , 最低可至 27.9 cm/d . 冰舌部分的速度和2004年的数据相比下降了约 5 cm/d .

关键词 南伊内里切克, 冰川, 偏移量跟踪技术, 流动速度, 物质平衡

Abstract:

Glaciers are characterized by their flowability. Measurement of their velocity can provide important information for the study of glacier mass balance and glacier involved hazards. This paper applies seven ALOS/PALSAR images and the offset-tracking method to derive the displacement field of the largest mountain glacier in Asia, i.e., the South Inylchek Glacier. The temporal continuity of SAR images and the debris coverage of South Inylchek Glacier make the offset-tracking method successfully acquire continuous surface displacements. Several natural events such as snowfall in the firn basins, ablation of superimposed ice and development of crevasses in steep sections still have some influence on the results. However, the derived surface displacement maps of different periods are highly consistent with each other. The detail analysis reveals the following rules of the South Inylchek Glacier's motion: the velocity reduces from glacier axis to both sides, and increases from its origin to snowline and then reduces towards the end; the velocity is positively and nonlinearly correlated with the slope, especially when the slope increases sharply from 1° to 16° , the surge velocity will give rise to crevasses on the glacier; under the influence of glacial lake level changes, the velocity of tributary at the tail can surge to 96 cm/d ; the summer velocity is $5\sim 10\text{ cm/d}$ higher than winter one. Seen from all results, the normal velocity of the glacier trunk is between 20 and 50 cm/d , but can reach 65 cm/d in special place. The statistics of sampling points in the tongue indicates that mean velocity of different periods lies between 27.9 and 33.3 cm/d . Compared to the record in 2004, velocity derived in this research reduces about 5 cm/d .

Keywords South Inylchek, Glacier, Offset-tracking, Flow velocity, Mass balance

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