Supplementary material for: Cui X., Du W., Xie H. & Sun B. 2020. The ice flux to the Lambert Glacier and Amery Ice Shelf along the Chinese inland traverse and implications for mass balance of the drainage basins, East Antarctica. *Polar Research 39*.
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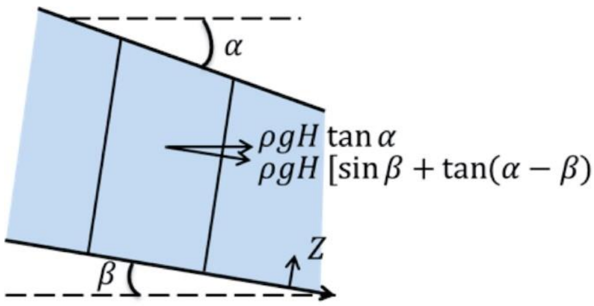
Surface velocity u_s is the sum of the deformational velocity u_d by creep and the sliding velocity u_b from basal slip, so the velocity changes with depth (Rignot, Mouginot et al. 2011). From the ice–bedrock interface up to the surface, the velocities are given by:

$$u(z) = u_s - \frac{2A}{n+1}\tau_b^n H[1 - \frac{z}{H}]^{n+1} , \qquad \text{Eqn. S1}$$

where $u(z)$ is the velocity at arbitrary depth H−z. A is a creep parameter, n is the flow law exponent, τ_d is the shear stress and H is the ice thickness. A is treated as a constant in our analysis using A=9±1×10 −25 s −1 Pa −3. n is taken as being equal to 3. The shear stress τ_d is calculated from the ice thickness and the surface slope by the model shown in Supplementary Fig. S1 (Cuffey & Paterson 2010).



Supplementary Fig. S1. Gravitational forces composing the driving stress (Cuffey & Paterson 2010).

We now consider the balance of forces parallel to the glacier bed on a wedge-shaped segment with sides perpendicular to the glacier bed (Nye et al. 1952; Waddington et al. 2013). As the bed slope is small, the driving stress τd can be written as:

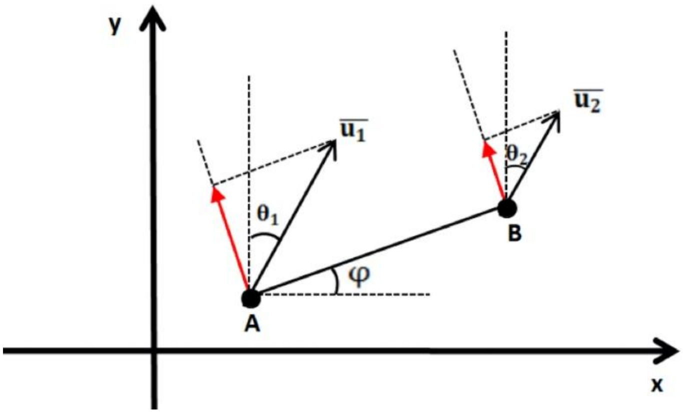
$$\tau_d \approx \rho g H \alpha \text{ and } \tau_b = f'\tau_d , \qquad \text{Eqn. S2}$$

where f' denotes a number, usually of order one.

With this expression for τ_b, the depth-averaged velocity $\bar{u}$ is given as:

$$\bar{u} = u_S - \frac{2A}{n+1}\tau_b^n H + \frac{2A}{n+2}\tau_b^n H \quad \text{Eqn. S3}$$

The two adjacent points form a segment, and for each segment, we take the component of the depth-averaged velocity which is perpendicular to the segment direction. We take one segment as an example in Supplementary Fig. S2.



Supplementary Fig. S2. The calculation method of the velocity for each segment. $\overline{u_1}$ and $\overline{u_2}$ are the depth-averaged velocities of points A and B; $\theta_1$and θ_2 are the azimuth of the velocities; and φ is the angle between the segment direction and the x axis.

The depth-averaged velocity of this segment can then be calculated as:

$$u = \frac{\overline{u_1}\cos(\theta_1+\varphi)+\overline{u_2}\cos(\theta_2+\varphi)}{2} \quad \text{Eqn. S4}$$

References

Cuffey K. & Paterson W. 2010. *The physics of glaciers.* 4th edn. Burlington, MA: Butterworth-Heinemann.

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