



Photo credit Brad Lipovsky









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#### Lakes are everywhere Carter et al., 2007 G-cubed





#### **Conceptual model**

- A. Sheetflow clears lake dam but does not erode
- B. Sheetflow increases, initiating erosion of tillchannel
- C. Lower pressure in channel siphons water from lake as its level declines
- Lower pressure in channel increases deformation closrure. Lower lake level provides less gradient and energy for erosion
- E. Channel ceases



#### Model formulation Sheetflow:



Q ~  $h_{wat}$  \* gradient<sub>H20</sub>  $\Delta h_{wat}$  ~ inflow - outflow N ~ roughness /  $h_{wat}$ 



## Model formulation

#### Till Channel:



 $( \mathbf{0} )$ 

# 

$$C_{VT} = \operatorname{sgn}(N_T) \frac{A_T S_T \left( \begin{vmatrix} N_T \\ a \end{vmatrix} \right)^s}{2N_s^{\ b}} -$$

Creep closure ~ f (Water pressure / till pressure)

 $\frac{\partial Q_{T}}{\partial X} = \frac{m_{T}}{\frac{1}{\rho_{T}} - \frac{1}{\rho_{T}}} + C_{vT} + T_{T}$  Conservation of mass

 $\frac{\partial N_{T}}{\partial x} = \rho_{w} g \left( f_{T} \frac{Q_{T} |Q_{T}|}{S_{T}^{\frac{8}{3}}} - \frac{\partial \theta_{T}}{\partial x} \right) \qquad \qquad Q = f \text{ (Area * Gradient)}$ 

## Study area / Model inputs



## Results



## Results









# All models are wrong some models are useful



- •Channels should not be semicircular
- •We address this with a "geometry correction"
- •Channel instantly continuous between lake and next major low

Table Scale Models of water flow Catania and Paola 2001, Geology)



Figure 2.15b: Experiment P.L 3, Q=131 cm<sup>3</sup> s<sup>-1</sup>, t=27 hours

Figure 2.15c: Experiment P.L 3, Q=210 cm<sup>3</sup> s<sup>-1</sup>, t=36.1 hours

## Implications for ice flow



## Implications for Ice flow





# Half full or Half empty



## Conclusions

- •Lake drainage requires siphoning
- •Given low slopes and polar ice of Antarctica, siphoning trough sediments is more likely.
- Active lakes = basal sediment
- •Outflow and sliding begin before lake approaches maximum volume.
- •Active lakes SHOULD fail most Carter et al., 2007 radar lake classification criteria.



Distance from McMurdo station (km)