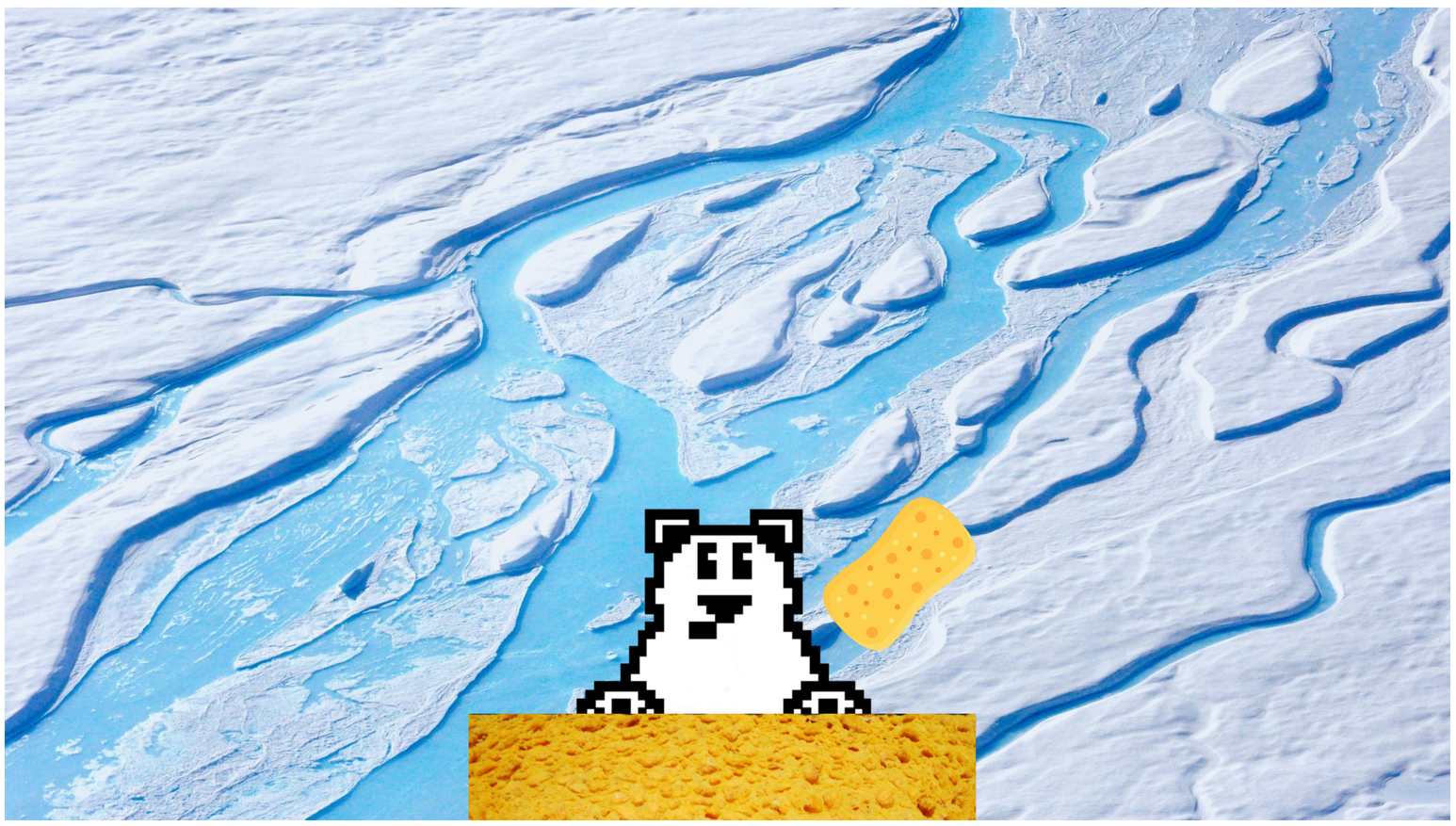
How long can firn buffer Greenland melt?



Meltwater runoff draining the Greenland ice sheet in summer 2012 (Photo courtesy: Paul Smeets).

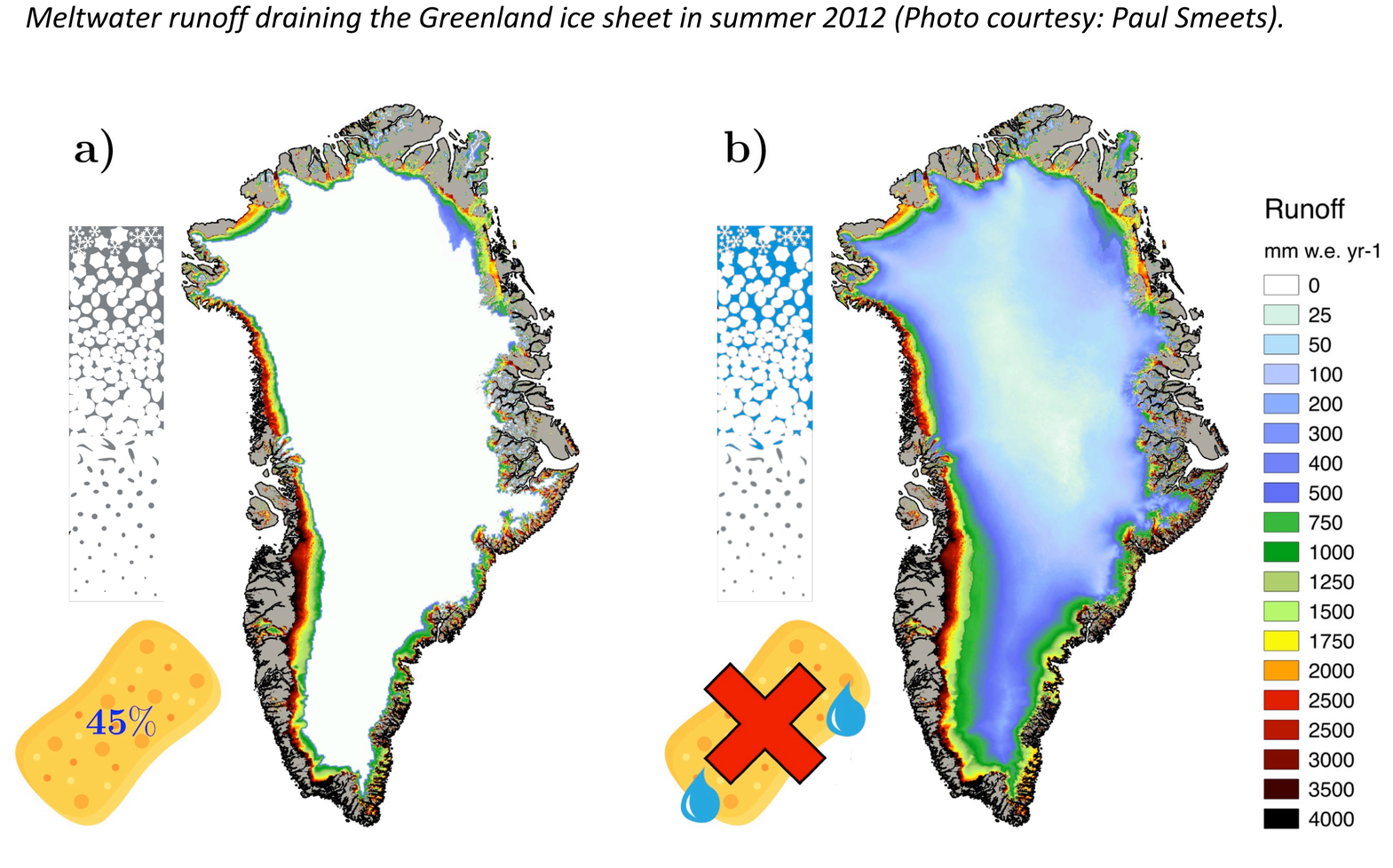


Figure: a) Meltwater runoff (mm w.e. yr^{-1}) for the extreme melt year of 2012 in the presence of an healthy firn layer. Runoff is restricted to low-lying regions as ~45% of surface melt is retained and refrozen in the porous firn covering the highest sectors of the ice sheet. b) Potential runoff for a saturated firn layer in a future warmer climate, i.e. all surface melt is forced to run-off to the ocean.

Firn, the multi-year snow layer covering ~90% of the Greenland ice sheet, acts as a sponge that retains ~45% of surface melt, mitigating runoff (Fig. a).

In a future warmer climate, increased melt will rapidly saturate the firn, forcing additional meltwater to run-off at all elevations (Fig. b).

The collapse of the firn buffer could double runoff, tipping Greenland into a state of sustained mass loss.

How long will firn buffer additional melt? What are the acting mechanisms?

Let's discuss!

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