From: Archie Paulson <archie.paulson@colorado.edu>
Subject: **Re: improved climate model**
Date: February 11, 2008 3:55:15 PM MST
To: Chris Malley <cmalley@pixelzoom.com>
Cc: Wendy Kristine Adams <Wendy.Adams@colorado.edu>

Chris,

As I just said on the phone, there is a much easier way to get the critical elevation for the ablation function. I rewrote the ablation specification below that includes (step d) an easy calculation of 'min_ablation_elev'.

-Archie

##

```
5. ablation: (better)
   given
      (a) the constant melt_v_elev=30  (m/yr)
      (b) the constant melt_v_temp=200
      (c) the constants z0 and z1 which are the minimum
          and maximum elevations in the sim (m)
      (d) the value min_ablation_elev= ref_temp*melt_v_temp + z1 (m)
      (e) the ref_temp,
   first compute a temporary function of elevation (z):
      melt_v_elev* (1.-sin((z-z0-ref_temp*melt_v_temp)/((z1-z0)*2/pi)) )
   --call this function 'ablation_tmp'
   --this function will have a minimum value at the elevation
     given by 'min_ablation_elev' (this might the highest
     elevation); the values of this function should be set to
     zero for every elevation higher than min_ablation_elev
   --now add this offset to get the ablation function:
      ablation_tmp + arctan(ref_temp/2.5)/3.+0.5
```

On Friday 08 February 2008 17:24:29 Archie Paulson wrote:

> Chris,
>
> Based on discussion with Bob Anderson, I've created an improved climate model.
>
> The model is detailed below. It describes how the 'temperature' and 'snowfall' sliders control the accumulation and ablation at all elevations. I've used the same numbering scheme as before.
>
> I've attached the python code the implements it (note that this code also includes some experimental stuff in the glacier model that you should ignore). I have also attached a couple of plots of the mass balance, so you get an idea of what they look like.
>
> Let me know if you have any questions.
>
> -Archie
>
> ##

1. temperature control:
   (same as before)
   range from -15 to 10 (cold to warm)
   call this variable 'ref_temp' for reference temperature
   initial default ref_temp=0

2. snowfall control:
   range from -4e3 (lots of snowfall) to 3e3 (little snowfall)
   call this variable 'snow_ref_elev'
   initial default snow_ref_elev=0.0

4. accumulation:
   given
      (a) the constant snowfall_max=2.0 (m/yr)
      (b) the constant default_snow_level=4e3 (m)
      (c) the constant snow_transition_width=300 (m)
      (d) the snow_ref_elev
   the accumulation as a function of elevation (z) is
      snowfall_max* (.5+(1./pi)*
      arctan((z-snow_transition_elev)/snow_transition_width))

5. ablation:
   given
      (a) the constant melt_v_elev=30 (m/yr/m)
      (b) the constant melt_v_temp=200
      (c) the constants z0 and z1 which are the minimum
         and maximum elevations in the sim (m)
      (d) the ref_temp,
   first compute a temporary function of elevation (z):
      melt_v_elev* (1.-sin((z-z0-ref_temp*melt_v_temp)/((z1-z0)*2/pi)))
   --call this function 'ablation_tmp'
   --this function will have a minimum value at some high
     elevation (maybe at the highest elevation); the values
     of this function should be set to zero for every
     elevation higher than the elevation of this minimum
   --now add this offset to get the ablation function:
      ablation_tmp + arctan(ref_temp/2.5)/3.+0.5

6. mass_balance:
   (same as before)
   given
      (a) accumulation as a function of z,
      (b) ablation as a function of z,
   the mass_balance as a function of elevation (z) is
      accumulation - ablation
   note this is also called the 'glacial budget';

7. ELA:
   (same as before)
   given the mass_balance as a function of z,
      ELA = elevation at which mass_balance=0
   note: ELA stands for equilibrium line altitude; it is
      the elevation of the equilibrium line