How an ice sheet model sees the world

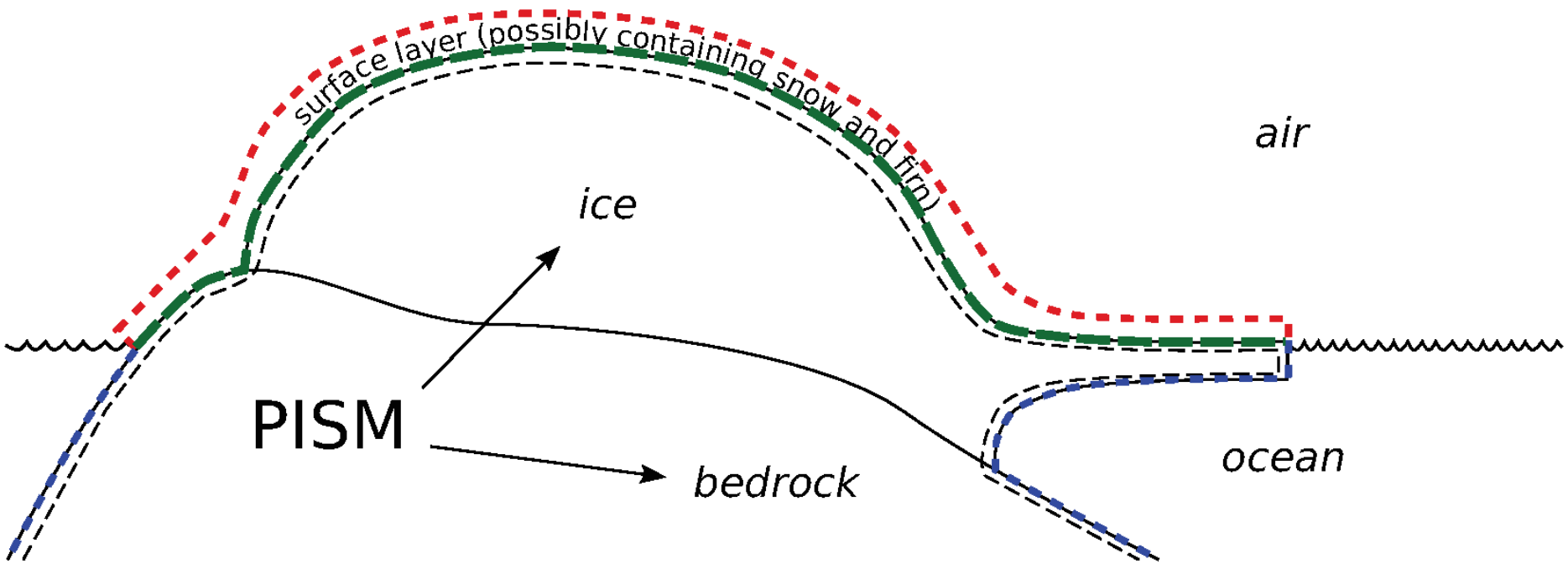
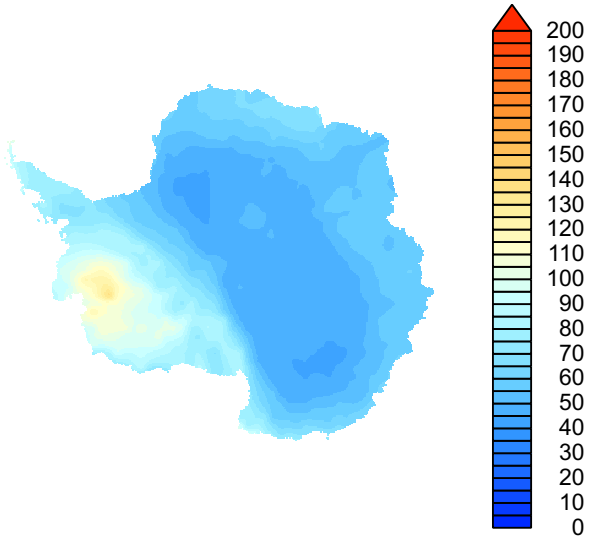


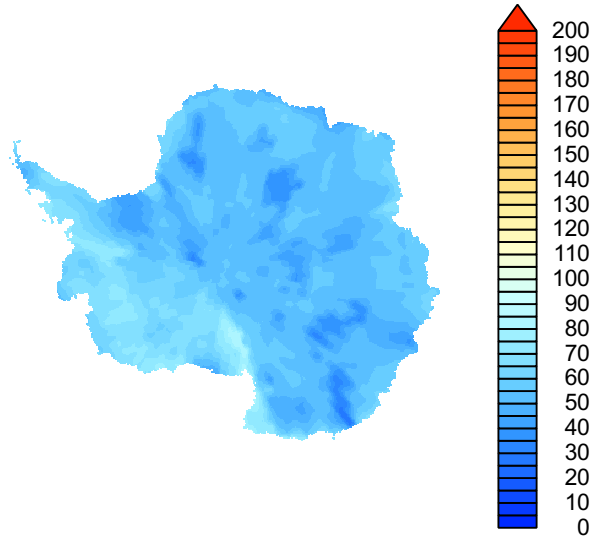
Figure 15: PISM's view of interfaces between an ice sheet and the outside world

Uncertainty in boundary conditions

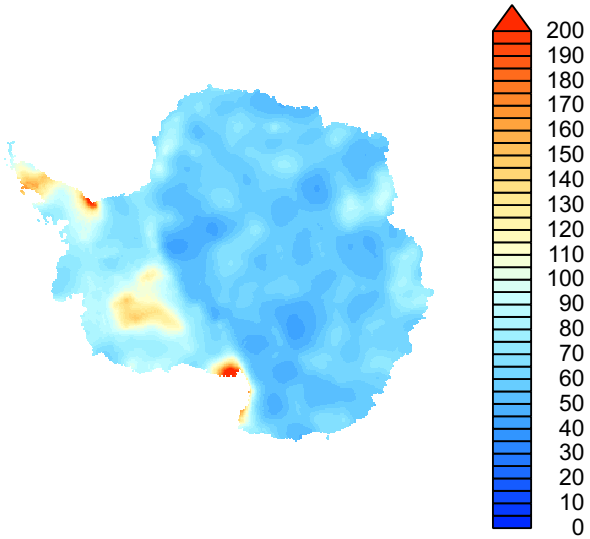
(a) Shapiro and Ritzwoller (2004)



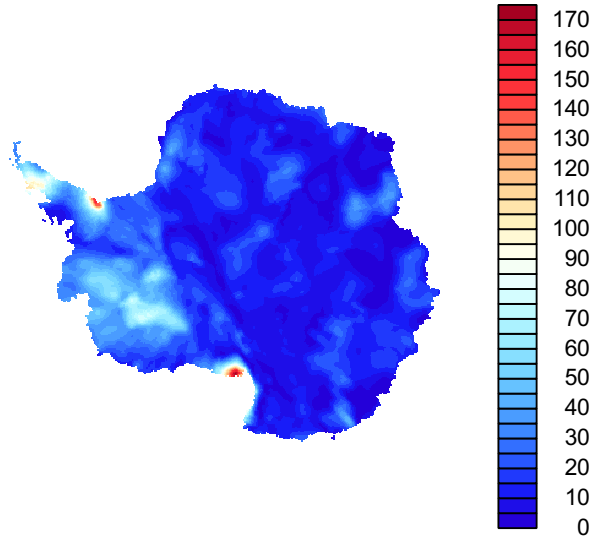
(b) An et al. (2015)



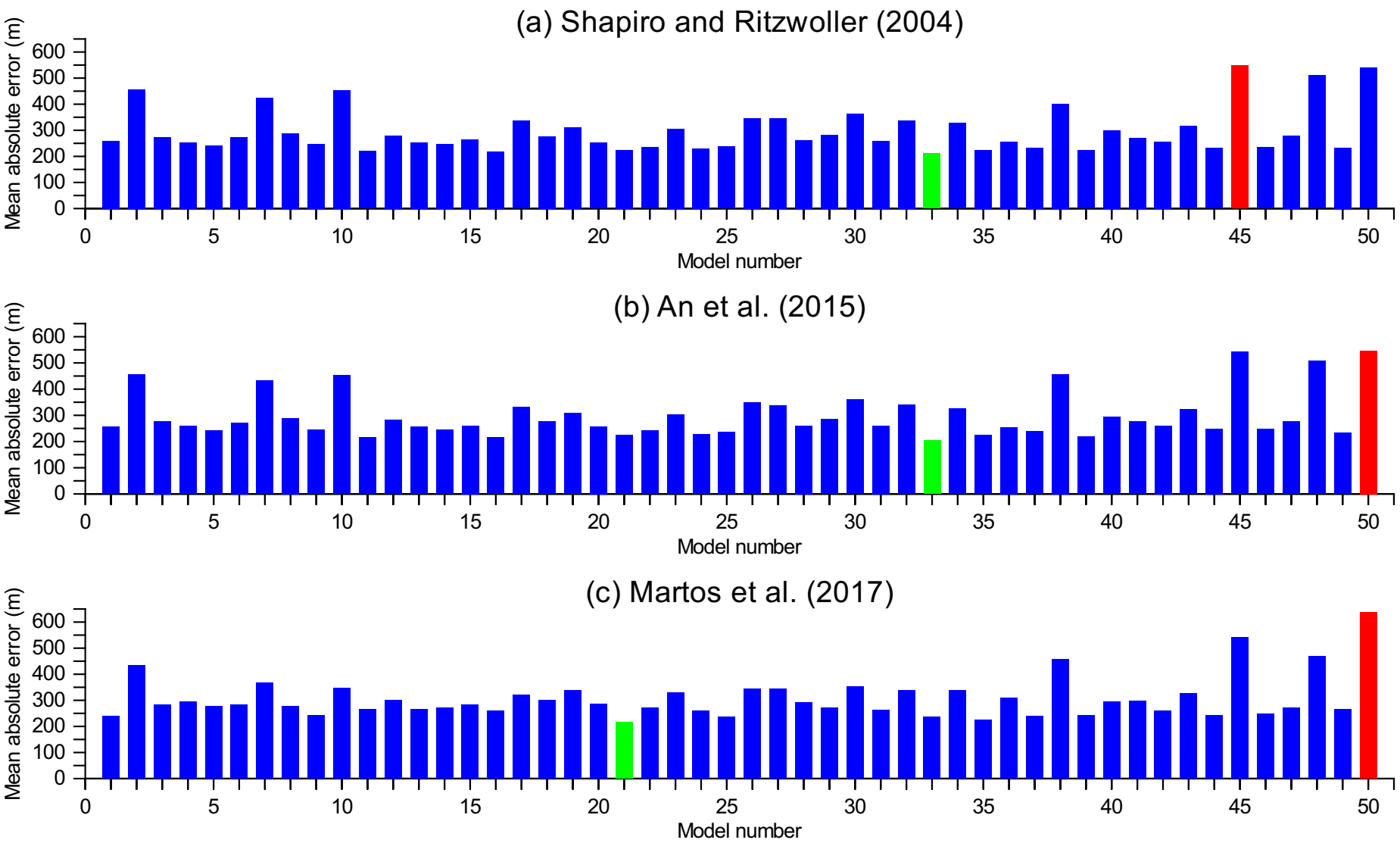
(c) Martos et al. (2017)



(d) Range



Impact on "tuning" an ice sheet model



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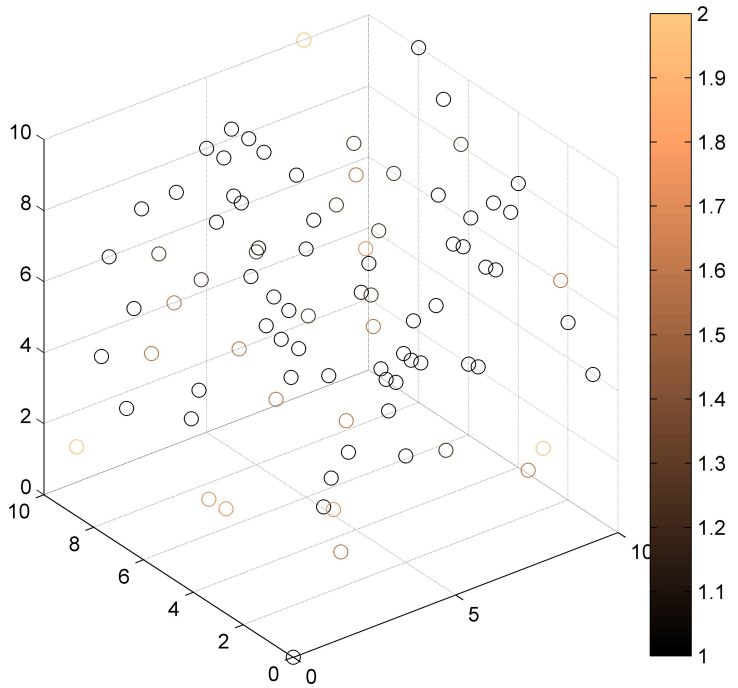
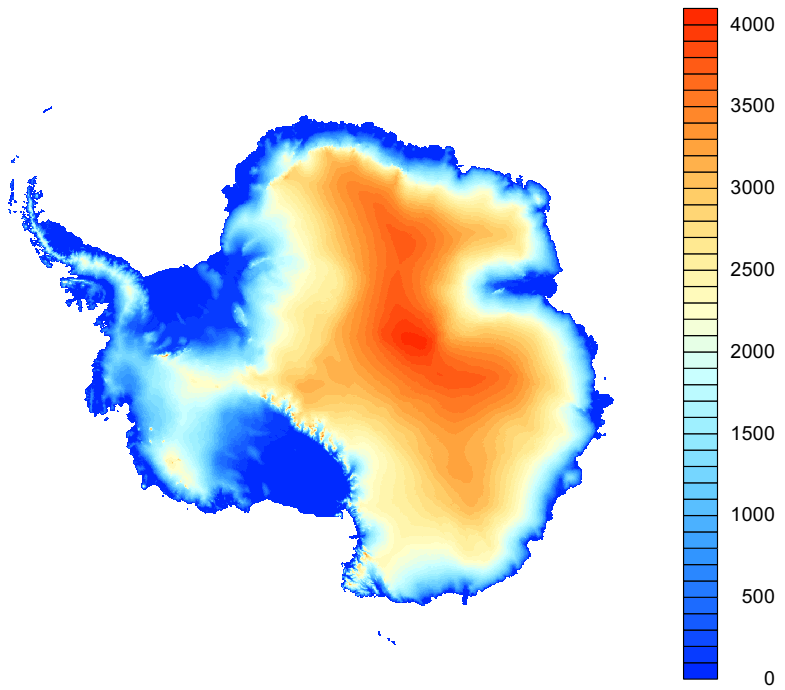
Ice sheet models are under-constrained

```
mpiexec -n 4 pismr -skip -skip_max 10 -i nomass_20km.nc
-sia_e 3.0 -atmosphere given -atmosphere_given_file
pism_Antarctica_5km.nc -surface simple -ocean pik
-meltfactor_pik 5e-3 -ssa_method fd -ssa_e 0.6 -pik -calving
eigen_calving,thickness_calving -eigen_calving_K 2.0e18
-thickness_calving_threshold 200.0 -stress_balance ssa+sia
-hydrology null -pseudo_plastic -pseudo_plastic_q 0.25
-till_effective_fraction_overburden 0.02
-tauc_slippery_grounding_lines -topg_to_phi 15.0,40.0,
-300.0,700.0 -ys 0 -y 100000 -ts_file ts_run_20km.nc
-ts_times 0:1:100000 -extra_file extra_run_20km.nc
-extra_times 0:1000:100000 -extra_vars thk,usurf,
velbase_mag,velbar_mag,mask,diffusivity,tauc,bmelt,
tillwat,temppabase,hardav,Href,gl_mask -o run_20km.nc
-o_size big
```

"Tuning" an ice sheet model

- Use the model to simulate the present state of the Antarctic Ice Sheet.
- Run the model many times. Perturb the model physics each time, sampling as many different parameter combinations as possible.
- Identify the model configuration(s) where the simulated ice sheet geometry agrees best with observations.

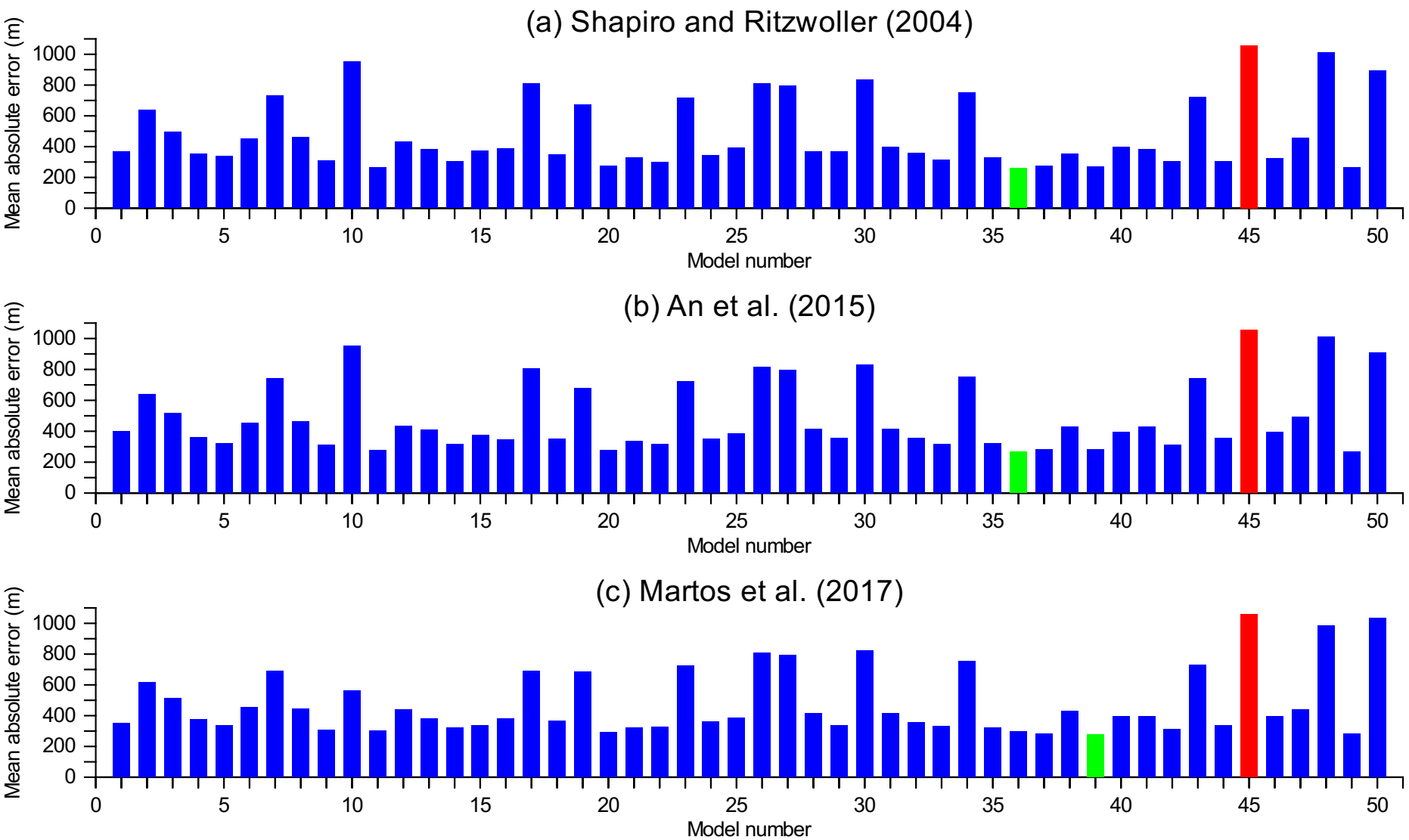




"Tuning" an ice sheet model: Parameters

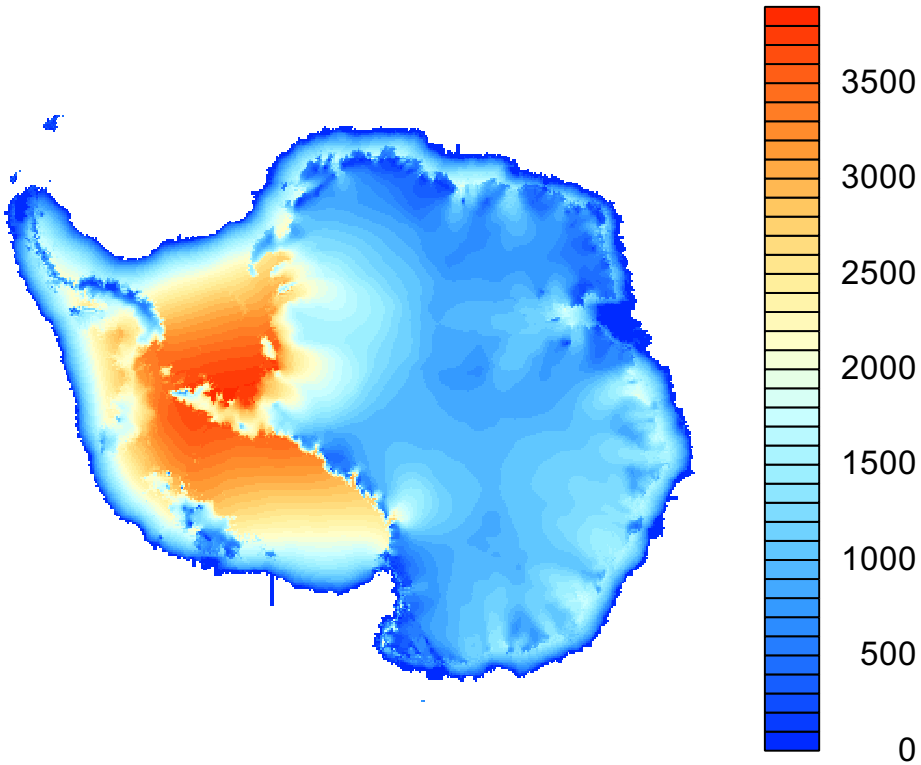
Parameter	Description	Minimum	Maximum
`-sia_e`	Shallow ice enhancement factor	1.0	4.5
`-ssa_e`	Shallow shelf enhancement factor	0.5	1.6
`-pseudo_plastic_q`	Exponent of basal resistance model	0.15	1.00
`-till_effective_fraction_overburden`	Effective till pressure scaling factor	0.01	0.04
`-eigen_calving_K`	Calving rate scaling factor	3.0e16	1.0e19
`-thickness_calving_threshold`	Minimum thickness of floating ice shelves	150.0	300.0

"Tuning" an ice sheet model: Ice thickness



"Tuning" an ice sheet model: Roles of physics and GHF

(a) Intra-ensemble range



(b) Inter-ensemble range