The submission by Zhang et al, sets out to challenge the stated paradigm of no large scale glaciation of Eastern Siberia during the last few (?) glacial cycles. To progress, science needs such challenges. However, in this case the challenge is carried out with an inadequate model setup that relies on surface melt parameters that are hard to defend (or not defensible at all for the IDL configuration). These parameter values reduce surface melt, and yet the model is still unable to get adequate LGM ice volume in the Northern Hemisphere.  Furthermore, the presentation is often imprecise, and at times makes claims/comparison in reference to the litterature that are not supported by the given citation. The model description is also inadequate, and relies on boundary conditions that are not available from the cited source (ICE6G prior to 26 ka).

I would therefore recommend rejection and encourage the authors to:

1) revise the PISM setup to reasonable PDD melt factors (anything below the commonly used 3.0 and 8.0 mm/PDD water equivalent would need clear justification) and appropriate model resolution (if PISM doesn't have a subgrid massbalance/flow module, then run no coarser than 10 km, preferably at 5 km resolution if you want to have any confidence in Alaskan results). Extract the standard deviation of hourly temperatures (relative to the presumably monthly mean output passed to PISM) from CAM.

2) Ideally run CAM at T85. If not feasible, then explicitly consider resolution related uncertainties from the litterature to impose a resolution correction to your climate fields

3) provide adequate model description

4) make more careful and precise comparisons to the litterature and do not mis-represent the litterature

5) show the present-day ice sheet configuration with your chosen setup (to show you have not biased your model to a cold and/or reduced melt configuration)

# detailed comments #######

# Yes, but you should mention that limited local glaciation (eg alpine
# and valley glaciers) is inferred ( eg Elias and Brigham-Grette,
# 2013 (DOI: 10.1016/B978-0-444-53643-3.00116-3), who show multiple maps
# from cited litterature of Eastern Siberian glaciation.
One concept widely held is that during most glacials only the Laurentide-Eurasian 32 ice sheets across North America and Northwest Eurasia became expansive, while Northeast Siberia-Beringia 33 remained ice-sheet-free

# should also cite Andrews (1992, Nature) as well as Clark and Tarasov
# (2014, PNAS) concerning the LGM missing ice issue
A comparison between estimations of 68 Laurentide-Eurasian ice sheet volume and direct observations of sea level change during the LGM reveals a 69 discrepancy of unexplained missing ice with a volume of ~6-25 m ice-equivalent sea-level change (Simms 70 et al., 2019).

# This is not at all unexpected. Just because temperatures start to
# rise, doesn't mean ice volume can't keep increasing for a certain
# amount of time.
The 122 DH δ18O records show that towards the end of each of the last four full glacial cycles, the mean surface 123 temperature started increasing earlier in terrestrial regions on the mid-latitude North American west coast, 124 while the NH ice volume kept increasing (Fig. 1c). Such

# ICE6G has no pre-LGM constraint, so I don't see how this is a
# relevant boundary condition
In the result section below, our simulations forced with the ICE6G ice sheet reconstructions (Peltier et 138 al., 2015)will investigate whether the growth of the Laurentide-Eurasian ice sheets alone can explain the 139 early warming and the asymmetry changes from around the North Pacific.

# It is already well documented in the modelling litterature that T31
# (and to a still significant extent T42) does not adequately resolve
# atmospheric circulation, especially for the context of simulating
# Eurasian ice sheets, cf Lofverstrom and Liakka (2018, TC)
The resolution of spectral CAM4 is approximately 3.75° (T31) in the 147 horizontal and 26 levels in the vertical

# imprecise meaningless statement
has good skill in simulating paleoclimates (Zhang et al., 2013; 2014).

# what is the chosen relationship?
The snowfall is determined based on the 165 partitioned total precipitation following an empirical relationship relating total precipitation and air 166 temperature.

# This resolution is too coarse for the accurate modelling in
# topographically complex regions such as Alaska, which look like a
# bumpy plateau at this resolution. With currently available standard
# computational resources, there is also no justification for relying
# on an ice sheet model at only such a coarse resolution unless you
# are doing large ensembles of a Myr or longer. I would want to see no
# coarser than 20 km resolution along with a subgrid massbalance/flow
# model such as that of Marshall, 2002 (QI), or LeMorzadec et al, 2015
# (GMD) to have any confidence in modelling of Alaska.
three-dimensional, thermodynamically coupled continental-scale hybrid ice sheet 160 model (Winkelmann et al., 2011; Martin et al., 2011; The PISM authors, 2015), run at a resolution of 40 161 km×40 km in this study

# These are very low PDD melt factors and standard deviation compared
# to other modelling studies as well as observations. Hock (2003
# J. Hydrol.) in her Table 1, lists PDD melt factors. The lowest
# values for glacial conditions are 2.7 and 5.4 mm/PDD (melt water
# equivalent) with averages above 4.0 and 8.0 mm/PDD. The unjustified
# lack of SIA enhancement will also promote thick ice favouring your
# hypothesis, though this depends on what ice rheology relationship
# you are using and which you do not provide. As stated (daily cycle),
# are you implying that you use daily mean temperatures from the GCM
# in PISM? Or are you using a more standard mean monthly or mean
# monthly climatology? It would also make more sense to extract the
# standard deviation from CAM than chose a relatively low value of 2.5

# K.
# This low melt biasing of your setup is evident is clearly evident in
# the excessive MIS3/2 Beringian ice shown in your supplemental fig 5
Here, we set the daily melt rate to 5 mm/doC for ice 168 (PDD_ice),
and 2 mm/doC for snow (PDD_snow), with a standard deviation of 2.5 °C
for the daily cycle of 169 surface air temperature (Temp_std). Ice
velocities are modulated by means of enhancement factors set to 1 170
for flow treated with SIA (ENF_SIA), and 0.1 for flow treated with SSA
(ENF_SSA)

# write down the power law. A reader should not have to refer to
# another paper to understand core components of the experimental
# setup.
Basal sliding is based on 173 a pseudo-plastic power law model (Greve
and Blatter, 2009) in which the exponent q is set to 0.25 174
(pseudo_plastic_q).

# downscaling of GCM fields to PISM grid needs to be described.

# close in what sense? Your modelling LGM ice volume is evidently way
# too small.
Laurentide
181 ice sheet close to reconstructions

# These parameters are totally unjustified. Observed PDD melt factors
# are never this low. And do you really expect eg that the standard
# deviation of hourly temperatures around the monthly (or even daily
# mean) is 1 K?
We set PDD_ice to 2 mm/d°C, PDD_snow to 1 mm/d°C, Temp_std to 1 °C,
183 ENF_SIA to 1, ENF_SSA to 0.1

# what present-day extent and ice volume do your chosen configurations
# give?

# Peltier's website (as cited in this submission) does not provide
# ICE6G prior to 26ka, so where does ICE6G-70ka come from? Nor does
# the cited Peltier et al, 2015 provide any results prior to 26 ka.
The comparison
201 between the ICE6G-22ka (ICE6G-70ka)

SH ice sheet extent is fixed and uses the modern condition
# why? Why not use ICE6G for SH as well?

# at some point need to discuss the issue that ice sheets were
# unlikely to be in equilibrium with climate
use this simulated climate to force PISM to get the NH ice sheets in
equilibrium 211 with the simulated climate of 126 ka

# It clearly does not for Alaska if I compare figure 5 to fig 33.1
# all-time glacial extents in Kaufman et al., 2011 as Darrell Kaufman
# has already made clear
The simulated extent (Fig. 5, 7 and Supplementary Fig.5, 6) agrees 279
nicely with the mapped distribution of glacial landforms across NE
Siberia-Beringia (Stauch and Gualtieri, 280 2008; Darrell et al.,
2011; Kaufman et al., 2011; Glushkova, 2011; Barr and Clark, 2012a,b;

Niessen et al., 281 2013; Barr and Solomina, 2014; O’Regan et al., 2017; Nikolskiy et al., 2017; Tulenko et al., 2018; Batchelor

# Are you now claiming that there was this much ice in this region at
# LGM? If not, then what is the point of this statement?
282 et al., 2019). The simulated ice volume accounts for ~10-25 m ice-equivalent sea-level change (~20-30% or 283 more of simulated NH ice volume, Supplementary Fig. 5), coinciding with the volume of the missing ice 284 during the last glacial (Simms et al., 2019)

# This validation is very limited and "realistically simulates" is a judgment you are making
# that ignores the issue I raised above concerning required minimum resolution to adequately
# resolved atmospheric circulation changes.
Second, we validate the climate model, 319 NorESM-L, and show it realistically simulates the climate responses caused by the Laurentide-Eurasian ice 320 sheets (Fig. 4a-d), in agreement with earlier studies

# not for Alaska
The simulated BerIS (Fig.  325 7) agrees reasonably with the direct glacial evidence across NE Siberia-Beringia

# Even with a subglacial lake present, the normal stress from surface
# loading should be evident in the sediment structure (extent of
# consolidation).  Furthermore, a subglacial lake would indicate warm
# based conditions. And this lake could not have been continuously
# maintained right through deglaciation. At some point, drainage of the
# lake would have placed warm based ice on top of the warm near surface
# sediments, resulting in some subglacial till deformation if there were
# any significant driving stress on the ice
cp-2020-38-AC1-supplement.pdf : Lake El’gygytgyn could be a subglacial lake when there is an ice sheet on it.