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Interactive comment on "Estimation of the Antarctic surface mass balance using MAR (1979–2015) and identification of dominant processes" *by* Cécile Agosta et al.

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This paper presents comparison between the Surface Mass Balance outputs of two regional climate models MAR and RAMCO2. The paper contributes to on-going debate concerning the estimation of Antarctic SMB and the result of atmospheric model to reproduce SMB. The manuscript subject is appropriate for "The Cryosphere" and the result are very interesting and must be support, however the manuscript must be improved. My main concerns are the following issues: âĂć Snow precipitation is removed in atmosphere by wind driven process that are mainly due to katabatic wind that follow the downslope flow, on the large sloping glaciers in the Antarctica, the Cori-

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olis force becomes very significant force. The geological sedimentation process of erosion/deposition cannot be applied to the snow that sublimate when remain in dry atmosphere. Topographic slope and curvature MUST be calculated along the main katabatic wind direction, that due to Coriolis force can be very different to topographic slope used by Authors as curvature (see Frezzotti et al., 2002, 2004, 2007; Scambos et al., 2012, Das et al., 2013, 2015; Palm et al., 2011, 2017). âĂć Authors have supposed that “snow is usually eroded from topographic crests and collected in the valley”, this hypothesis is not corroborated from any field observation (see GPR profile of Talos Dome, Frezzotti et al. 2007, Fujita et al. 2011, Stake profile Syowa-Dome F, Zhongshan-Dome A etc.) in East Antarctica. âĂć On the ice divide (crest) the wind are slower and does not eroded/sublimate, whereas in the valley the katabatic wind speed increase and sublimate the drifting/blowing snow. SMB measurements point out that in East Antarctica there are very few evidence of erosion/deposition less than 10%, most of the process are snow erosion/blowing/sublimation without any redeposition (see Frezzotti et al., 2004, 2007; Scarchilli et al., 2010; Minghu et al., 2011, Ding et al., 2017). Erosion/deposition process can occur on saturated contion as ice shelf or where the slope along wind direction does not permit the sublimation because the atmosphere became saturated soon. âĂć It is not explained why the erosion/drifting module of MAR are not used. Drifting/sublimation snow is very important component of SMB, as also reported by authors. âĂć Authors point out that at regional and continental scale the results of the simulated SMB do not present significant difference and are in good agreement (pag 6), despite significant differences components in the negative value of SMB, in absolute value can be correct, but the comparison of the single SMB components are very different. âĂć Authors must be taking in account the coarse resolution used, in particular in the coastal and confluence area where 35 km of horizontal resolution are too coarse to simulate valley, this influence strongly the wind speed and relative sublimation process. âĂć Due to the different climatic condition, mainly melt and limited katabatic wind phenomena, the SMB components analysis of the Peninsula, West Antarctica and Ross/Filchner-Ronne ice shelves area should be analysed separately by EAIS.

Detail: Pag 2 line 6, also MB from GRACE or altimeter use extensively SMB estimation. Pag 3 line 28, “Fresh snow” density cannot be 400 kg m3, use “surface snow” Pag. 4 line 12, drifting snow is not a negligible components, and cannot compensate by higher surface sublimation, result from MAR drifting snow should be presented. Pag 6 line 24 76 kg/m2/yr is not a negligible value and represent about 60%!!! Please comment and integrating. Pag 6-7-8-9-10 see above main comments Pag 9 table 2 The different component of SMB must be tabled in different way, positive component: snowfall and rainfall; negative term: sublimation and run off; surface process: melt-refreezed into the snowpack and erosion-deposition. Pag 10 line 8-12 erosion-deposition is a "sedimentation" phenomenon, if snow sublimate and then redeposit under snowfall it is not exported in atmosphere/ocean, rewriting the text. Pag 11 line 5 I do not understand, MAR drifting module is used or not, why several repetition about MAR drifting module? Pag 12-13 The Grazioli paper is very interesting, but snowfall generally occurs under cyclonic storm and not under "pure" katabatic wind phenomena. Katabatic wind arrives later with strong blowing snow phenomena and related sublimation (see Palm et al., 2011, 2017; Scarchilli et al., 2010). Wind during cyclonic storm are variables and not from dry high-elevated inland plateau toward sea level. This does not exclude that wind sublimation occur during a storm, but normally during marine storm the atmosphere is already saturated with low capacity of sublimation. Pag 14 line 3-7 Wind crust area reported in Scambos et al. 2012 are related to hiatus in accumulation driven by sublimation wind process, it is not clear the relation with observed difference between MAR and RACMO2 snowfall. The wind crust is the extreme phenomena where the ratio between snowfall and wind sublimation conduct to hiatus in accumulation from several to thousand year (see Frezzotti et al., 2002, 2005). Due to the limit of method of Scambos et al., 2012, wind crust are surveyed only in the inland plateau (above 1500 m) where the coarse resolution of models have less impact on the slope along wind direction and therefore wind speed. Wind crust is the upper limit of hiatus, before became blue ice area, but they represent only a limited area of wind drive sublimation

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area (see Palm et al. 2011, Frezzotti et al., 2007; Minghu et al., 2011) those are more extended then permanent wind crust surface mapped by Scambos et al., 2011. Models firstly must be reproduce the wind crust hiatus, if they can be representative of the negative term of SMB.

If it could be useful, the SMB Talos Dome transect published on Frezzotti et al., 2007 paper is available for the comparison of models.

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