

Interactive comment on “Rapid decline of Arctic sea ice volume: Causes and consequences” by Jean-Claude Gascard et al.

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On Figure 3 of the main text we described different functions relating Freezing Degree Days (FDD) and sea ice thickness (SIT) and in particular a linear relationship and two quadratic relationship with a 5cm snow layer thickness on top of sea ice for one and no snow at all for the other. On figure 4 we described the FDD spatial distribution deduced from ERA Interim 2m altitude air temperature above Arctic sea ice in 2017 and 2018. Based on FDD-SIT relationships we deduced sea ice thickness for each ERA Interim grid cell. Knowing the area of each ERA Interim grid cell, we calculated sea ice volume for each grid cell by multiplying SIT and the area of the grid cell and the total Arctic sea ice volume by adding up each grid cell sea ice volume at any given time. On the new figure we represented the sea ice volume obtained from the

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three theoretical FDD-SIT relationships (linear and quadratic with or without a snow layer $h_s = 5\text{ cm}$ or 0) that we compared with PIOMAS sea ice volume estimations for the same period (from September 2017 to May 2018). We noticed that FDD sea ice volume estimations are always less than PIOMAS sea ice volume except for the FDD-Sea Ice thickness (SIT) quadratic relationship without any snow (cyan). This is mainly due to the fact that FDD does not explicitly take MYI into account. At the end of the summer (in September) PIOMAS indicated almost 5000 km³ of sea ice that survived the summer melt and mainly representing the sea ice replenishment for the next year made partially of Multiyear and Second year ice (MYI, SYI). At the start of the winter season FDD sea ice volume estimates are 0 by definition as shown on the new figure. The best fit between PIOMAS (red circles) and FDD based sea ice volume estimations is represented by a FDD-SIT quadratic relationship including a 5cm snow layer on top of sea ice (blue crosses on the new figure). The sea ice volume differences are about 3000 km³ between the two estimates during most of the freezing period (mainly due to MYI and SYI as we already said). The sea ice growth rate is nearly 100 km³ per day for both FDD and PIOMAS as well. This is why we mentioned a high correlation between FDD and PIOMAS sea ice volume estimates in addition to the fact that the interannual variability for sea ice volume based on FDD and PIOMAS was also highly correlated as shown on figure 11 (see the main text) in particular for recent years.

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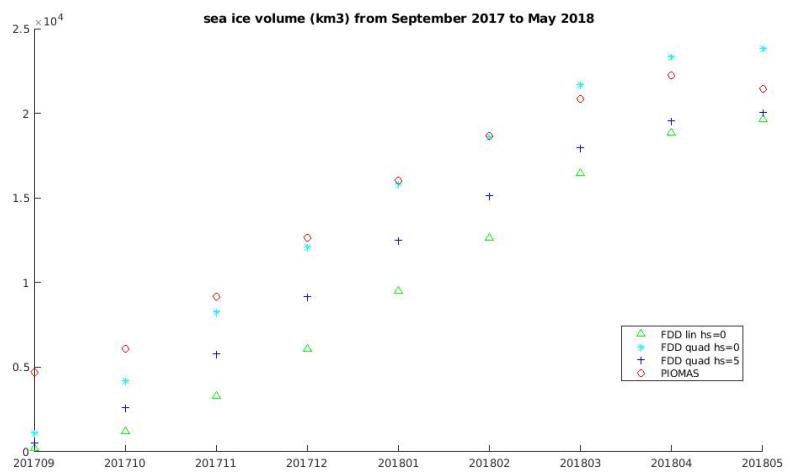


Fig. 1. sea ice volume (km3) from September 2017 to May 2018 deduced from FDD and PIOMAS

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