

### General comments:

The paper addresses very important issue of the long-term climate changes and the interaction between sea ice growth, ocean circulation and CO<sub>2</sub> concentrations in the atmosphere.

The dataset uses diatom-based Modern Analogue Technique to reconstruct SST and SIC utilizing a large dataset of surface sediment samples from the Southern Ocean. The problem of past oceanic conditions is handled in a broad perspective, analyzing other core data in the region. Overall, the paper is very interesting and very clearly written.

However, there are several issues corresponding to the sediment cores described in this study and the presentation of their results. These are listed below:

(1) Methods, section 2.1 – it's not entirely clear which cores are recalculated for SIC and which for SST as part of this study; I think all the cores should be mentioned in the methods and clarified which are analysed from the scratch and which have had their results recalculated; and which are just cited. Caption to Figure 1 is confusing in this matter.

(2) Results – what is missing here is the figure and description for the results of the recalculated core SO136-111; it is a part of this study and needs to be described.

(3) Discussion, section 4.1 – this part belongs to Results, not in Discussion and the sentences that do belong to Discussion should just briefly describe the past conditions and trends for SIC and SST, e.g. line 276-278 and 282-283 so I suggest restructuring. And please provide time intervals for the periods you describe in text. Also, there is first mention of the core E27-23, which was not mentioned in Methods or Results and if it is a part of recalculation then it should be properly described. Otherwise, please provide a citation for this core.

The paper can be accepted after revision, which is mainly centered on proper presentation of all analysed/recalculated core data in Methods and Results, as well clarity regarding the types of analyses done on these cores.

### Specific comments:

Abstract

l. 26 – what quantitative technique was used to reconstruct SIC and SST? Transfer function? Please clarify

l. 30 – please provide percentage info for the SIC (consolidated)

Abstract overall – seems like there might be too much detail regarding the past conditions, could be simplified and generalized a bit, e.g. SST values could be mentioned only for the minimum and maximum values and otherwise just refer to trends

## Introduction

I. 51 – what does it mean ‘dynamically linked’?

I. 66 – either 23 to 19 ka or 23.000 to 19.000, please use consistent time scale; also is it BP?

I. 64-84 – are there any other proxies providing information on reconstructed oceanic variability in the region? Such as foraminifera etc? Would be nice to mention

I. 88-92 – this belongs to methods; introduction should mainly state general information on the materials studied

## Methods

2.2. – very nice with the 2-method approach!

I. 196-206 – this part belongs to Results section

I. 201 – what is the sea ice concentration range for this group?

Table 1 – just curious, did you identify any *Thalassiosira antarctica* var. *antarctica*? Its northern equivalent is pretty common in the Arctic and sub-Arctic region

I. 212 – why did you choose this period only? Is the present-day diatom succession limited to January-March? Please clarify

I. 227-228 – it would be nice to consider other quantitative, transfer function tests at some point, such as ML (MLRC) and WA-PLS to show that MAT is indeed the best choice.

## Results

I. 242 – which periods specifically? Looks like MIS 1, 4 and 5

## Discussion

I. 289 – I can't find the description of cores MD06 in Discussion

Line 308 – please clarify that you mean explanation no. 3

Line 308-330 – I suggest to put this text in a separate sub-chapter as it stands out of the description of past conditions

Section 4.2. – I like the description!

I. 462 – reference for the core is needed here

I. 528 – again, if these two cores are a key element of Discussion and overall conclusions, then we need more info in Methods and Results

I. 549-556 – perhaps this part fits better to Introduction

Technical corrections:

I. 29 - coordinates etc should be removed from Abstract, too much detail

I. 36 – ‘...coolest values, respectively...’

I. 38 – SSST – too many S or sSSTs

I. 87 – SSSTs – should it be singular?

I. 114 – ‘published cores providing recalculated sea ice extent data’?

Figure 1 – please add abbreviations SSI and WSI in legend