

Interactive
Comment

Interactive comment on “Ranges of moisture-source temperatures estimated from Antarctic ice core stable isotope records over the glacial-interglacial cycles” by R. Uemura et al.

Anonymous Referee #2

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Summary comments: The manuscript presents new isotopic ($d^{18}\text{O}$, $d\text{D}$, $d\text{excess}$) data for Dome Fuji (DF), Antarctica, and extends the DF record to ~ 360 kyr. This revised record is compared to Vostok and EPICA Dome C (EDC) ice cores. The authors apply an isotopic inversion methodology (based on MCIM model) on $d\text{D}$ and $d\text{excess}$ at DF to infer temperature changes from the moisture source (ΔT_{source}) and at the precipitation site (ΔT_{site}). This same methodology is used on $d\text{D}$ and $d\text{excess}$ data from Vostok and EDC, to illustrate that different temperature ranges and isotopic model outputs influence the ΔT_{source} and ΔT_{site} , with major uncertainty associated with the sensitivity of $d\text{excess}$ to ΔT_{site} . The authors further apply this methodology to reconstruct glacial-interglacial, and the imprint of obliquity on ΔT_{source} and

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Interactive Discussion

Discussion Paper



DeltaTsite at DF, Vostok and EDC. This methodology illustrates there are still large uncertainties with reconstructing moisture source temperatures using the three ice core sites, but there is a robustness with this method when reconstructing DeltaTsite at each site.

The following is a page-by-page list of questions, comments and suggestions that should be considered.

Detailed comments:

Consider changing the title from “Ranges of moisture-source temperature estimated from Antarctic ice core stable isotope records over the glacial-interglacial cycles” to “Ranges of moisture-source temperature estimated from Antarctic ice core stable isotope records over glacial-interglacial cycles”

Consider adding a Figure illustrating the spatial locations of the ice cores used in this study?

Page 392, line 3; Consider changing ‘ice cores’ to ‘ice core records’ Page 392, line 8; Consider changing ‘Fuji, Antarctica is produced spanning the past 360 000 yr’ to ‘Fuji, Antarctica spanning the past 360 000 years is presented and compared...’ Page 392, line10; Consider changing ‘have been’ to ‘are’ Page 392, line 14; Change ‘coefficient on the reconstructed temperatures’ to ‘coefficient on reconstructed temperatures’ Page 392, line 21; Change ‘Antarctic ice cores provide an important clue’ to ‘Antarctic ice cores provide important clues’ Page 392, line 26; Change ‘have been’ to ‘are’ Page 393, line 18; Change ‘can be’ to ‘are’ Page 393, line 25; Change ‘temperature inversions have been conducted with different’ to ‘temperature inversions are conducted using different’ Page 393, line 24; Change ‘allows us to correct site temperature estimate for’ to ‘allows corrections to site temperature estimates for’ Page 393, line 26; Insert ‘E.g.’ at start of parentheses to read ‘(E.g. different adjustments....)’ Page 393, line 29; Change ‘have revealed’ to ‘reveal’ Page 394, line 7; Insert ‘E.g.’ at start of parentheses to read ‘(E.g. source temperature, relative humidity...)’ Page 394, line

CPD

8, C280–C285, 2012

Interactive
Comment

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Printer-friendly Version

Interactive Discussion

Discussion Paper



Interactive
Comment

9; Consider changing ‘deployed’ to ‘developed’ Page 394, line 11; Consider changing ‘The largest difference between these studies lies in the coefficient’ to ‘The largest difference between these studies is associated with the coefficient..’ Page 394, line 14; Change ‘In this manuscript, we will review the causes for these differences and their impact’ to ‘In this manuscript, we review the causes for differences in β site and the subsequent impacts on...’ Page 395, line 2; Change ‘Then, the other core’ to ‘A second core (Dome Fuji 2nd, DF2)’ Page 395, line 3; Change ‘and its d₁₈O record from a \sim 130 m-length’ to ‘and the d₁₈O record from a \sim 130 m-length section’ Page 395, line 4; Change ‘Here, we show dD and d records from the \sim 130 m-length part’ to ‘Here, we present dD and d records from the \sim 130 m-length section’ Page 395, lines 6-7; Change ‘The dD data from the overlapping part (2400-2500 m) shows remarkable similarity between DF1 and DF2 (Fig. 1.)’ to ‘The dD data from the overlapping section (2400-2500 m) of DF1 and DF2 shows remarkable similarity (Fig. 1.)’ Page 395, line 17; What do you mean by ‘but larger’? I am assuming that you mean there is a difference between the re-measured DF1 and the original DF1 results? What is the difference? Page 395, line 18; Again, what do you mean by ‘gap’? I am assuming that you mean the difference between the re-measured DF1 and the original DF1 results. Page 395, line 25; Change ‘the d data are available back to \sim 420 kyr BP’ to ‘the d data span the past \sim 420 kyr BP’ Page 396, line 6; Change ‘precisions’ to ‘precision’ Page 396, line 7; Change ‘differs one from the other.’ To ‘differs between records.’ Page 396, line 9; Change ‘For Vostok, the average temporal resolution is smaller than’ to ‘At Vostok, the average temporal resolution is’ Page 396, line 16; Change ‘for EDC’ to ‘EDC’ Page 397, line 1; Not sure what the authors mean by ‘Such difference, however, cannot be found in the older section (200-250 kyr BP) of DF and Vostok?’ Do the authors mean ‘However, there are periods of pronounced d minima in the older sections (200-250 kyr BP) at DF and Vostok?’ Page 397, line 15; Consider changing ‘We used a linear inversion method which is very similar procedure performed for Vostok’ to ‘We used a linear inversion method that is similar to method used for Vostok’ Page 397, line 21; Change ‘This coefficient, however, can be exactly calculated as

[Full Screen / Esc](#)[Printer-friendly Version](#)[Interactive Discussion](#)[Discussion Paper](#)

Interactive
Comment

a function of..’ to ‘This coefficient, is calculated as a function of..’ Page 398, line 5; Consider changing ‘The dDSW can be calculated on the assumption...’ to ‘The dDSW is calculated on the assumption...’. In the subsequent sentence, the authors use ‘can be’. Consider also changing this to ‘is’ Page 398, line 13; Consider changing ‘using a linear relation found in outputs of Atmospheric General Circulation Models...’ to ‘using a linear relationship identified in Atmospheric General Circulation Models.’ Page 398, line 24; Consider changing ‘This is of course an approximation as Antarctic inversion strength varies through places, time and weather conditions. A detailed analysis of condensation temperature conducted’ to ‘This is an approximation as the Antarctic inversion strength varies spatially and in time and with changing weather conditions. A detailed analysis of the condensation temperature was conducted’ Page 399, line 3; Consider changing ‘Finally, a kinetic isotope fractionation occurs during ice crystal growth because of super-saturation over ice, parameterized as a linear function of temperature..’ to ‘Finally, kinetic isotope fractionation occurs during ice crystal growth because of super-saturation over ice, and this is parameterized using a linear function of temperature..’ Page 399, line 19; Consider changing ‘The difficulties to simulate present-day d values might also reflect the difference between’ to ‘The difficulties in simulating present-day d values also reflects the difference between’ Page 399, line 22; Consider changing ‘In fact, the air pressure of DF is the lowest among the coring sites since its elevation is the highest’ to ‘In fact, the air pressure at DF is the lowest among the coring sites due to its high elevation’ Page 399, line 24; VK? This is the first time the authors have used ‘VK’. I am assuming ‘VK’ is Vostok? Page 400, line 1; Consider changing ‘We have therefore two options’ to ‘We therefore have two options’ Page 400, line 8; Consider changing ‘In the temperature range encountered in Central Antarctica’ to ‘The temperature range in Central Antarctica’ Page 400, line 18; Consider changing ‘values published in previous studies’ to ‘values from previous studies’ Page 401, line 13; Change ‘This can be explained’ to ‘This is explained’ Page 402, line 3; Change ‘In contrast, we propose now to restrict’ to ‘In contrast, we propose to restrict’ Page 402, line 3; Remove the word ‘now’ Page 402, line 12-13; Consider

[Full Screen / Esc](#)[Printer-friendly Version](#)[Interactive Discussion](#)[Discussion Paper](#)

Interactive
Comment

changing 'Our approach, thus, will result in larger Bsite coefficient, compared to the previous approach' to 'Our approach, results in a larger Bsite coefficient, compared to the previous approaches' Page 403, line 6; Insert a closed bracket after '....humidity' to read '....humidity)' Page 403, line 21; After 'A logarithm', put 'd' in italic Page 403, line 23; Delete 'anything', and also change 'act' to 'acts' on line 24. Page 404, line 5; When the author uses 'between' I would use 'and' instead of 'to'. Considering changing 'vary between -5.9C to 2.9C' to 'vary between -5.9C and 2.9C'. Alternatively, change to 'ranges from -5.9C to 2.9C' Page 404, line 12; See above comment for 'between -7.8+-0.2C to 4.8+-0.5C' Page 405, line 1; Consider changing 'The previously published DF DTsite (which corresponds to DTlow site) estimated MIS 9e' to 'Published DF DTsite (which corresponds to DTlow site) estimate MIS 9e' Page 405, line 3; Consider changing 'Our revised estimate lies above this previous value, as it produces a MIS 9e DTsite estimate of 4.8+-0.5C.' to 'Our revised estimate of 4.8+-0.5C is slightly warmer than previous MIS 9e DTsite estimates.' Page 405, line 8; Consider changing 'isotope temperature could be 6 to 10C higher than that of present day (Sime et al., 2009). This estimation is still significantly' to 'isotope temperatures are 6 to 10C warmer than present day (Sime et al., 2009). This estimate is significantly' Page 405, line 13; Consider changing 'We applied the same procedure as DF for Vostok and EDC data, and obtainedin this study' to 'The methodology used to obtain DTsite and DTsource at DF, is also used on Vostok and EDC data.' Page 405, line 16; Delete 'again' Page 405, line 19; Consider changing 'which is lower than previous estimation' to 'which is cooler than previous estimates' Page 405, line 20; Delete 'about' Page 405, line 22; Delete 'a larger'. This is repeated in this line. Also, consider changing 'means that' to 'results in' Page 405, line 23; Delete 'is' Page 405, line 27; Consider changing 'estimation' to 'estimates'. Likewise, consider the same change at page 406, line 3, and page 406, line 6. Page 406, line 5; Change 'value' to 'values' Page 406, line 14; Delete 'ones' Page 406, line 16; Consider changing 'The gradient' to 'The temperature gradient' Page 406, line 22-23; Consider changing 'Here, we take advantage.... with SST estimates' to 'Here we use sea surface temperature (SST) estimates obtained from ocean sediment proxy

[Full Screen / Esc](#)[Printer-friendly Version](#)[Interactive Discussion](#)[Discussion Paper](#)

Interactive
Comment

records, and compare these to our reconstructed DTsource estimates.' Page 407, line 7; Consider changing 'Another sediment' to 'Another sediment core' Page 407, line 11; Do you mean 'Termination II' not 'Termination V'? Page 408, line 10; Delete 'very' Page 409, line 4; VK? Do you mean 'Vostok' Page 409, line 8; Consider changing 'gradient should be conducted' to 'gradient are required' Page 409, line 9; Consider changing 'It will be important independent' to 'It will provide independent' Page 409, line 15; Consider changing 'with' to 'this with' Page 409, line 17; Consider changing 'we used and isotopic inversion based on the MCIM' to 'we used an isotopic inversion methodology based on the MCIM' Page 409, line 20; Delete 'may' Page 409, line 21-24. Consider changing 'The results suggests that the causes for the differences of Bsite between the previous...' to 'The results suggest that the differences of Bsite from previous studies are due to the isotopic model tuning for the present-day, and the dD ranges selected for regression analyses. We have shown that Bsite strongly depends on the range of temperature and or isotopic depletion used. Page 409, line 27; Delete 'very' Page 410, line 2; Change '-5.9C to 2.9C' to '-5.9C and 2.9C' Page 410, line 16; Consider changing 'could be very useful, combined with' to 'is useful when combined with' Page 410, line 18; Delete 'what are the correct or incorrect' Page 422, Reference for EDC1 is incorrect. Should be Stenni, not Senni.

Interactive comment on Clim. Past Discuss., 8, 391, 2012.

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Interactive Discussion

Discussion Paper

