Dear Sir or Madam:

Thank you very much for your helpful review. We have carefully studied the comments and suggestions and revised our paper accordingly. The following are our point-by-point responses to the general and specific comments ("Part I: Response to comments from Referee #1" and "Part II: Response to comments from Referee #2") and a list of all relevant changes made in the manuscript ("Part III: List of relevant changes"). We hope that the revisions are acceptable and that our responses adequately address the comments. Thank you for your consideration.

Sincerely,

Zeng, Xin-Min and coauthors

Part I: Response to comments from Referee #1

1. General comments

(1) This manuscript presents simulations of surface air temperature with a weather research and forecast model using different soil moisture conditions as input variables. The aim is to study how the soil moisture conditions ranging between ±50% of those obtained from satellite measurements. In addition, the authors study the effect of moisture on the processes effecting the weather simulations e.g. latent and sensible heat fluxes and their effects on atmospheric air circulation.

Response: We agree with you that this manuscript presents simulations of surface air temperature with a weather research and forecast model using different soil moisture conditions as input variables. In this paper, we address model simulations in the context of land-atmosphere interactions for a high-temperature event. In particular, we focus on the extent to which the change of initial soil moisture modifies surface air temperature, and on how physical processes affect the temperature simulation, as induced by the soil moisture change. Our aim is to quantify and explain the "sensitivity of high-temperature weather to initial soil moisture", as is consistent with the title of the paper.

(2) I evaluated the manuscript mainly from the point of view of presentation quality, because I am not able to evaluate the methods and models behind the simulations. I am not a meteorologist, thus I am not able to estimate the novelty aspect of the study and the validity of model simulations and assumptions behind. This would require substantial understanding on the structure, function and assumptions behind the meteorological model used in this study.

Response: We agree with you. Thank you for the review from the point of view of

presentation quality.

(3) I would suggest letting a native English speaker to carry out language edition for the manuscript, because the text was at some points difficult to understand, even though the grammar may be technically correct. Also, the authors should pay attention to the text flow in the manuscript. The text could be condensed in many parts. Below, I have pointed out some parts where the text has repetetition or where the sentences nd logic are difficult to follow.

Response: As suggested, a native English speaker (a Senior English Editor; hereafter EE) has carried out language (British English used in ACP) edition for the manuscript. We appreciate your constructive comments below and have made revisions accordingly.

2. Detailed comments

(1) Abstract 11666 L4 hot event -> hot weather event

Response: We have made the correction accordingly, and then the relevant sentence has been further modified by the EE for better phrasing in the revised form of the manuscript.

(2) The aims of the study are rather general and no hypotheses are presented. You should explain in the aims of the study more specifically the simulations you are going to carry out. For example, it is not mentioned until the results and discussion that you actually used the WRF model also to simulate soil water conditions in different soil layers.

Response: As addressed in Point (1) of the response to general comments, the aim of the study is to quantify and explain the sensitivity of high-temperature weather to initial soil moisture. In the revised form of the text, we have explained in the aims of the study more specifically the simulations we would carry out. Please find the statements in the introduction section: "The objective of this paper is to quantify and explain the sensitivity of high-temperature weather to initial soil moisture by answering the above questions. Hence, using different soil moisture initialisations in the Noah land surface scheme in the WRF model, we perform sensitivity experiments to simulate the temperature change and related quantities (e.g., sensible and latent heat fluxes, radiative fluxes, and geopotential heights) for the East China high-temperature event of late July 2003. "

As for the comment for the hypotheses of this paper, we think that this point is a question of style. As we know, a hypothesis is often in the form of an if/then statement in a scientific paper, and can be tested. All these features can be found in the introduction section. In the revision, we have added more concepts and addressed the relationship for the hypotheses, as also described above.

(3) In addition, there are results on geopotential heights, latent and sensible heat fluxes etc. in the results and discussion section. The concepts to be presented in the results and discussion section should already be presented in the introduction, aims and hypotheses of the study. Otherwise the structure of the text becomes difficult to follow and is

inconsistent. Therefore I suggest that the concepts presented in the paragraphs of the results and discussion section should be presented also in the intro and aims of the study. Also, you should explain in the material and methods section what and how you simulated. Otherwise the different paragraphs are not consistent with each other. In the current manuscript, there are lot of concepts and results in the results and discussion section which pop out from nowhere.

Response: Thank you for the review. We have made the revision according to the comments and suggestions. For instance, please find these sentence: (in the introduction section) "Fischer et al. (2007) indicated that during the heat wave, the soil moisture was extremely low, which substantially reduced latent cooling (latent heat flux) and greatly increased the surface temperature anomaly; their regional climate model sensitivity simulations showed that soil moisture played a key role in the partitioning of net radiation into latent and sensible heat fluxes and in the evolution of the heat wave. Positive feedback was identified between soil moisture, atmospheric circulation, and temperature based on the summer anomalies of geopotential heights and air temperature in the troposphere"; "we perform sensitivity experiments to simulate the temperature change and related quantities (e.g., sensible and latent heat fluxes, radiative fluxes, and geopotential heights) for the East China high-temperature event of late July 2003"; (in the Methods and data section) "Once the initial and boundary conditions are defined, according to the WRF formulations, both the land and atmospheric variables (e.g., atmospheric wind speeds, pressure, temperature, geopotential height, soil temperature and soil moisture), as well as the surface fluxes (e.g., radiative, sensible heat and latent heat fluxes), vary over time during the model integrations; these simulation results are used for the analysis."

(4) The lines 6-10 on P 11671 do not provide much information on the actual substance/aims of the study. I would rather delete those and instead present the above mentioned concepts and research aims in the introduction chapter.

Response: The revision has been made accordingly.

(5) P11669 L6 Explain acronym WRF when first used. P11670 L5 observations ->Observations P11670 L8 skill -> performance or accuracy P11670 L11 skill -> performance or accuracy P11670 L20 arise several questions in the following->arise following questions P11670 L24 delete “in the comparison” P11670 L26 understanding of -> understanding on, help us improve -> help us to improve P11670 L27 Delete "through better soil moisture initialization in the models." It is redundant. P11671 L1-4 You should explain here in more detail what you are going to do. For example, it is not mentioned until the results and discussion that you actually used the WRF model also to simulate soil water conditions in different soil layers. In addition, there will be results on geopotential heights, latent and sensible heat fluxes etc. in the results and discussion section. The concepts to be presented in the results and discussion section should already be presented in the introduction, aims and hypotheses of the study.

Response: The manuscript has been modified accordingly. Please refer to the revised version for details (or cf. Point 3 in response to detailed comments). Notably, after we

changed "help us improve" to "help us to improve", the EE then changed the phrasing back to " help us improve". Further, we asked more people, and the results is "both are correct".

(6) P11671 L4-6 This sentence should be in the methods section.

Response: The manuscript has been modified accordingly.

(7) P11671 L6-10 This sentence does not provide much information on the substance.

Response: The manuscript has been modified accordingly.

(8) P11671 L20 Explain acronym “gpm”.

Response: Done in the revision. The acronym “gpm” means geopotential meters for the height of a given pressure level; quantitatively, 1 gpm is very close to 1 m in the troposphere, as also described in the revised paper.

(9) P11672 L3 Explain acronym SAT when first time used in the main text.

Response: Done. The words “surface air temperature (SAT)” have been added in the main text of the revised version before “P11672 L3”.

(10) P11672 L7-10 Complicated sentence. Please re-word. Preferably, split into two separate sentences.

Response: Rewording has been made accordingly.

(11) P11672 L13 "Approximated" may not be a correct word in this case. It is rather "ex-tended to over 2 months".

Response: We have done accordingly. Then the EE modified the sentence as follows: " From the distribution of day-to-day SATs (not shown), the high-temperature climate in southern China, with 35°C or higher daily maximum SATs, lasted for over one month (over 2 months in some areas)."

(12)P11672 L20-22 I would rather formulate this as follows: I would rather say "...We investigated the sensitivity of the temperature predictions produced by the Advanced Research WRF model to initial soil moisture..."

Response: The EE has made the modification accordingly.

(13) P11674 L12 I do not understand the "amplitude" here.

Response: It has been explained in the revision (i.e., +25 and 50%).

(14)P11678 L23 – P11679 L5 This part I do not quite understand. Does the model also simulate soil moisture conditions? I assumed that the SMOIS values were given as input for the model. Based on this sentence it looks like the SMOIS is simulated by the model.

Response: Yes. We have added more information in the text (e.g., Point 3 in response to detailed comments).

(15) P11679 L 13-21 The results presented here seem to be somehow redundant, because the

same information was basically given on the previous page. Here you only report the differences in temperature simulations whereas on the previous you give the absolute simulated values? The manuscript is now quite long, so I would perhaps present either the absolute simulated values or the differences.

Response: We agree with you that here we only report the differences in temperature simulations whereas on the previous page we give the absolute simulated values. We present these results due to the following reasons:

i) We aim to quantify the sensitivity of high-temperature weather to initial soil moisture. Both the absolute simulated values and the differences are quantified, which are difficult to separate. Of course, we do want the paper to be concise. However, if we omitted the absolute values portion, some crucial results could not be shown. For example, P11678 L1-3: "The central position, range and strength of high temperature simulated in the CTL run are basically consistent with those in the NCEP FNL analysis field". Without this result, all the other results would become incredulous and further discussion would be meaningless. The presentation of "the absolute values" [P11678 L9-12] directly leads to the conclusions of the SMOIS-induced effects. If we omitted the part of "the differences" (P11679 L 13-21), issues regarding the quantification would be unclear, e.g., to what extent does the change in the initial soil moisture affect the temperature simulations over different locations within the domain? The answer to this question directly leads to conclusions in the abstract, e.g., "Areas with above-35˚C SAT06 are most affected". In addition, the subsequent conclusions would seem unexpected, and incongruity would be introduced, e.g., we could not conclude that "the amplitude of temperature rising (decreasing) differs in different areas, which is closely related with the forcings of surface energy balance, such as sensible and latent heat fluxes, in the areas" (P11679 L 18-20); furthermore, in the next section that explains how the sensitivity is induced, "the differences" are still needed, e.g., "Comparing Fig. 7b–e with Fig. 3g–j..." (P11682 L23-27) and "it is found that ...(Fig. 3g–j)" (P11683 L9-12).

In addition, showing both the absolute simulated values and the differences is a conventional way of quantifying two-dimensional meteorological characteristics for comparison/sensitivity studies (e.g., Bonan et al., 2002; Fischer et al., 2007; Solman and Pessacg 2012; among many others), where the differences are often emphasised.

ii) Regarding the paper length, the mentioned part (P11679 L 13-21) has a relatively small contribution; we have also condensed the section "Summary and conclusions" (cf. Point 29). The revised paper (including the title, names of the authors, text, figure captions, tables, and references) is approximately 11,500 words. We believe that this paper is a normal length for weather/climate model simulations, e.g., there are approximately 11,600, 11,800, and 14,200 words in the papers by Bonan et al. (2002), Fischer et al. (2007), and Flagg and Taylor (2011), respectively.

The authors respectfully hope that the above responses are acceptable. Thank you for your consideration.

(16) P11682 L5-8 You should indicate in the material and methods and aims of the study that you also simulate the soil water content. This is not clearly stated in the text yet.

Response: Modification has been done accordingly. Please find relevant statements in the text, or refer to Point. 3 in the response to detailed comments.

(17)P11682 L22 General comment concerning paragraph 3.2.2. The text should be streamlined and condensed. It contains repetitive information. Mane of the sentences are too complex and difficult to understand. I have pointed out the most difficult ones.

Response: Done accordingly. The text has been streamlined and condensed (reduced in length by roughly one third). Some revisions are also described below.

(18)P11683 L12-L17 Complicated and long sentence. Please reword.

Response: Rewording has been done.

(19) P11683 L17 SMIOS->SMOIS

Response: Thank you for catching the typo. The correction has been made.

(20) P11683 L23-L26 This sentence partly has the same information as the sentence on lines 12-16. There is some repetition in this section, and the text could be condensed to improve the readability.

Response: Modification has been done accordingly.

(21) P11684 L26-L29 The text here is partly repetition to the text on the previous pages. The whole section should be condensed to improve the readability and text flow.

Response: The words have been deleted (P11684 L26-L29). The revision has been made accordingly.

(22) P11685 L13-18 This sentence is too complicates, and nearly impossible to follow. Please reformulate. I am not very enthusiastic about presenting bi-directional results in the same sentence. The sentences where the words "increase (decrease)" are indicating two directions of the effects are rather confusing to follow. And they are throughout the manuscript which makes it difficult to read the text. I would suggest streamlining the text so that you express the bi-directional effects in separate sentences throughout the manuscript. Or replace them with " and vice versa" in the end of the sentence.

Response: Modification has been done accordingly. We have also replaced relevant expressions with "and vice versa" at the end of the sentences.

(23) P11686 L1-L4 This sentence is also too complex and nearly impossible to understand. I do not understand the logic in the sentences. Please split it into several sentences and streamline the structure of the sentences to improve the readability.

Response: We have made the revision accordingly.

(24) P11686 L8 suface->surface

Response: The typo has been corrected.

(25) P11686 L7-9 I do not understand what is the connection here to deforestation.

Response: This is because the deforestation of Amazon rain forest is one of the most

important scientific issues concerning land-atmosphere interactions. The comparison between the soil moisture change and the deforestation shows the significance of the SMOIS-induced sensitivity. In the revised text, we have made a little modification for the expression.

(26) P11686 L18 This doesn't say anything to a reader who does not have background in meteorology. Please explain what it means in practice.

Response: Modification has been done accordingly. The regional atmospheric circulations in the mid- and lower troposphere are characterized by the 500 and 850 hPa geopotential height fields, respectively.

(27) P11686 L20-25 I would suggest avoiding the use of these bi-directional expressions and replace them with "vice versa" in the end of the sentence.

Response: We have made the modifications accordingly.

(28) P11687 L8-15 Too long sentence. Needs to be cut into several shorter ones.

Response: It has been modified accordingly.

(29) P11691 L1 General comments concerning the summary and conclusions. It is way too long. It cannot be 3 1/2 pages long. It should be condensed and reduced in length by at least 50%. You do not need to present any more methods results in this chapter. Present only the big lines and conclusions. There is also no need to have citations and discussion to literature any more in this paragraph.

Response: Done according to the suggestions. Now the length of the section has been reduced from 1,158 to 549 words.

References:

Bonan, Gordon B., Keith W. Oleson, Mariana Vertenstein, Samuel Levis, Xubin Zeng, Yongjiu Dai, Robert E. Dickinson, Zong-Liang Yang, 2002: The Land Surface Climatology of the Community Land Model Coupled to the NCAR Community Climate Model. J. Climate, 15, 3123–3149.

Fennessy, M. J., J. Shukla, 1999: Impact of initial soil wetness on seasonal atmospheric prediction, J. Climate, 12, 3167–3180.

Fischer, E. M., S. I. Seneviratne, P. L. Vidale, D. Lüthi, C. Schär, 2007: Soil Moisture–Atmosphere Interactions during the 2003 European Summer Heat Wave. J. Climate, 20, 5081–5099.

Flagg, D. D., P. A. Taylor, 2011: Sensitivity of mesoscale model urban boundary layer meteorology to the scale of urban representation, Atmos. Chem. Phys., 11, 2951-2972.

Koster, R. D., and coauthors, 2004: Regions of strong coupling between soil moisture and precipitation, Science, 305, 1138–1141.

Solman, S. A., N. L. Pessacg, 2012: Regional climate simulations over South America: sensitivity to model physics and to the treatment of lateral boundary conditions using the MM5 model, Clim Dyn, 38, 281–300.

Part II: Response to comments from Referee #2

1. General comments

This paper evaluates the impact of changing soil moisture on short-range forecasts in a heat-wave event. The study uses 10 consecutive days and a large area to obtain robust conclusions. The study has a good systematic approach and presents the results well. The methodology looks sound. While many of the results are not surprising, there is value added in some aspects of the analysis, especially using budget studies for the surface temperature. The relative importance of surface heating, radiation, adiabatic motion, and advection were evaluated, bringing up interesting aspects related to the greenhouse effect of the changing water vapor, and the importance of the prevailing subsidence in the heat budget, with some clarity provided by separating daytime and nighttime periods. I think this paper is quite acceptable and only have minor technical points.

Response: Thank you for your general comments on our paper. We appreciate them from the point of view of the meteorological science.

2. Detailed comments

(1) p11672, line 23. I believe the National Center for Atmospheric Research is responsible for the ARW version. Please correct this.

Response: The correction has been done in the revised form of the paper.

(2) p11673, line 16. "hottest late July"? Hottest in what sense. Please clarify this phrase.

Response: Late July 2003 is regarded as the "hottest" according to 10-day moving averages of SAT over the summer (June, July, and August, 2003) for the study area, as also added in the revision.

(3) p11676. I am a little concerned about the use of the term "convection" for the mean subsidence term. This is not really convection, but a mean adiabatic ascent term on the domain scale. Convection carries a very different meaning as a local eddy term often with diabatic effects. I would prefer this to be renamed carefully throughout the text.

Response: We agree with you. Although it comes from the "convection" term of Eq. (1), to be termed "subsidence" is more appropriate in the Results and Discussion section (and thereafter as well). We have made the revision accordingly.

(4) p11683, line 23 and Figure 9a and 9b. The zero values at hour 0 are just initialization values and should not be plotted. Also "pronounced differences after one hour" should be considered as an artifact of this too, if this phrase is referring to the initial false gradient.

Response: The revision has been made accordingly, both in the figure and in the text.

(5) p11687, line 1.Should enhancement be reduction?

Response: Yes. We have corrected it.

(6) p11693, line 22. adiabatic should be diabatic?

Response: Thank you. It has been revised accordingly.

(7) Conclusions. It appears that this period is characterized by mean subsidence. I don't know if this region is always characterized by this, or if it is a result of the synoptic situation. Some comment on this is needed because it the affects generality of the conclusions.

Response: The conclusion regarding the relative importance of the physic processes seems complex here. As listed in the text (Table 2), (a) in all of the five groups of simulations, the diabatic term dominates the subsidence term during daytime and nighttime separately, (b) only the DRY simulations show to be characterized by mean subsidence during the 24-hour periods, and (c) the CTL run shows to have a negative yet marginal value of the SAT change during the 24-hour periods. Therefore, regardless the sensitivity simulations (i.e., only CTL is taken into account), during the period of late July, the diabatic processes are slightly more important than mean subsidence over the region (i.e., the negative sign of the SAT change is opposite to that of the subsidence term during the 24 hours in CTL). This shows the feature of relative importance of physical processes for the hottest phase. For simulations of weather cases with lower temperatures, generally, values of both the diabatic and subsidence terms would be reduced. Given invariant signs for both in different cases, it is unlikely to get a definite conclusion of which term would dominate by theoretical analysis only. That is why follow-up numerical studies are needed. We have added some comments to the end of Sect. 3 ("Results and discussion).

Part III: List of relevant changes

1. All changes according to comments from Referee #1

(1) As suggested, a native English speaker (a Senior English Editor; hereafter EE) has carried out language (British English used in ACP) edition for the manuscript. We have paid attention to the text flow in the manuscript, and the text has been condensed in many parts (as addressed below). Therefore, the revised manuscript (hereafter RM) might be different from the ACP discussion paper (hereafter DP) in many details, e.g.,

even the title of the DP has been slightly changed ("Sensitivity of high-temperature weather to initial soil moisture: a case study with the WRF model" in the DP → "Sensitivity of high-temperature weather to initial soil moisture: A case study using the WRF model" in the RM) .

(2) We have made the correction ("P11666 L4 hot event → hot weather event") accordingly, and then the relevant sentence has been further modified by the EE for better phrasing in the RM, i.e., "hot weather event" has been merged into " high-temperature weather event " (P1 L13-14; RM).

(3) We have explained in the aims of the study more specifically the simulations we would carry out:

"Therefore, we perform sensitivity experiments using the Weather Research and Forecasting Model (WRF) for the East China high-temperature event in late July 2003"(P11671 L2-4; DP) →

"Hence, using different soil moisture initialisations in the Noah land surface scheme in the WRF model, we perform sensitivity experiments to simulate the temperature change and related quantities (e.g., sensible and latent heat fluxes, radiative fluxes, and geopotential heights) for the East China high-temperature event of late July 2003. " (P5 L13-17; RM)

(4) The concepts (geopotential heights, latent and sensible heat fluxes etc.) to be presented in the results and discussion section have been presented in the introduction and aims of the study:

"Fischer et al. (2007) indicated that during the heat wave, the soil moisture was extremely low, substantially reducing latent 25 cooling and greatly increasing the anomaly of surface temperature. Their regional climate model sensitivity simulations showed that soil moisture played a key role in the evolution of the heat wave, e.g., if there was no abnormally low soil moisture in spring, the positive surface air temperature anomaly in some areas would be reduced by about 40 %" (P11668 L23-29; DP)→

"Fischer et al. (2007) indicated that during the heat wave, the soil moisture was extremely low, which substantially reduced latent cooling (latent heat flux) and greatly increased the surface temperature anomaly; their regional climate model sensitivity simulations showed that soil moisture played a key role in the partitioning of net radiation into latent and sensible heat fluxes and in the evolution of the heat wave. Positive feedback was identified between soil moisture, atmospheric circulation, and temperature based on the summer anomalies of geopotential heights and air temperature in the troposphere"(P3 L19-25; RM).

"we perform sensitivity experiments using the Weather Research and Forecasting Model (WRF) for the East China high-temperature event in late July 2003"(P11671 L3-4; DP) →

"we perform sensitivity experiments to simulate the temperature change and related quantities (e.g., sensible and latent heat fluxes, radiative fluxes, and geopotential heights)

for the East China high-temperature event of late July 2003."(P5 L14-17; RM)

(5) We have added a paragraph into the Methods and data section to explain what and how we simulated:

"Once the initial and boundary conditions are defined, according to the WRF formulations, both the land and atmospheric variables (e.g., atmospheric wind speeds, pressure, temperature, geopotential height, soil temperature and soil moisture), as well as the surface fluxes (e.g., radiative, sensible heat and latent heat fluxes), vary over time during the model integrations; these simulation results are used for the analysis." (P8 L13-17; RM)

(6) "Therefore, this paper is arranged as follows: in Sect. 2, the climate background of the high temperature event is described and the experimental design is given, the simulation results as well as the mechanism responsible for the soil moisture-induced temperature change are analyzed in Sect. 3, and finally Sect. 4 gives summary and discussions of the paper. " (P11671 L6-10; DP) →

"Therefore, in Sect. 2 of this paper, we describe the climate background of the high-temperature event (e.g., anomalies in the 500-hPa geopotential heights and surface temperatures) and the experimental design. In Sect. 3, the simulation results are analysed using a comparison among the simulated surface air temperature (SAT) results and observations to quantify sensitivity and further explain how and to what extent the physical processes (e.g., surface heat transfer, atmospheric advection and convection) affect the soil moisture-induced temperature changes. Finally, Sect. 4 presents a summary and conclusions of the research." (P5 L17-24; RM)

(7) When first used, acronym WRF (P11669 L6; DP) has been explain (i.e., "... Weather Research and Forecasting model (WRF)..."; P3 L30-31 in RM).

(8) "Observations" (P11670 L5; DP) → "observations" (P4 L22; RM).

(9) " skill" (P11670 L8; DP) → "performance" (P4 L25; RM).

(10) "skill" (P11670 L11; DP) → "accuracy" (P4 L27; RM).

(11)"arise several questions in the following" (P11670 L20; DP) → "the following questions arise " (P5 L3-4 in RM; by the EE).

(12) “in the comparison” (P11670 L24; DP) →deleted in RM.

(13)" understanding of" (P11670 L26; DP) →" understanding on " (P5 L10; RM) .

(14)" help us improve" (P11670 L26; DP) →" help us to improve" (P5 L10; RM) .

(15) "through better soil moisture initialization in the models." (P11670 L27; DP) →deleted in RM.

(16)"What is the mechanism responsible for the change in simulated variables (e.g., air temperature) induced by initial soil moisture? Moreover, what is the relative importance in the comparison of physical processes that affect the simulated 25 temperature for the continental China?" (P11670 L22-25; DP) →

"What is the mechanism responsible for the change in simulated variables (e.g., air temperature) induced by the initial soil moisture? Moreover, what is the relative importance of the physical processes (e.g., surface heat transfer via sensible and latent heat fluxes and atmospheric processes via advection and convection) that affect the simulated temperature for continental China?" (P5 L5-9; RM).

(17) "We choose 24 h as the integration length, due to the fact that initial soil moisture is relatively less modified at this time scale of the short-range weather" (P11671 L4-6; in the Introduction section of DP) →

" We choose 24 hours as the integration length because initial soil moisture is relatively less modified at this time scale of short-range weather "(P7 L21-22; in the Methods section of RM).

(18)" Therefore, this paper is arranged as follows: in Sect. 2, the climate background of the high temperature event is described and the experimental design is given, the simulation results as well as the mechanism responsible for the soil moisture-induced temperature change are analyzed in Sect. 3, and finally Sect. 4 gives summary and discussions of the paper." (P11671 L6-10; DP) →

"Therefore, in Sect. 2 of this paper, we describe the climate background of the high-temperature event (e.g., anomalies in the 500-hPa geopotential heights and surface temperatures) and the experimental design. In Sect. 3, the simulation results are analysed using a comparison among the simulated surface air temperature (SAT) results and observations to quantify sensitivity and further explain how and to what extent the physical processes (e.g., surface heat transfer, atmospheric advection and convection) affect the soil moisture-induced temperature changes. Finally, Sect. 4 presents a summary and conclusions of the research. "(P5 L17-24; RM).

(19)“gpm” (P11671 L20; DP) →

"gpm (geopotential meters; quantitatively, 1 gpm is very close to 1 m in the troposphere) "(P6 L4-5; RM).

(20) "SAT" (P11672 L3; DP) →" surface air temperature (SAT) "(P5 L20-21; RM).

(21) "Meanwhile, less precipitation in the regions south of the Yangtze River occurred, which is below normal by more than 2mmd−1 generally and by 4mmd−1 over half of the area, while there was substantially more precipitation in the Yangtze River and Huaihe River basins (Fig. 1d). " (P11672 L7-10; DP) →

"In the regions to the south of the Yangtze River, the precipitation was generally more than 2 mm d^{-1} below normal, or 4 mm d^{-1} below normal for half of the area (Fig. 1d). However, there was substantially more precipitation in the Yangtze River and Huaihe River basins (Fig. 1d)" (P6 L15-18; split into two separate sentences in RM).

(22) "the high-temperature climate with above-35°C daily maximum SATs in southern China lasted for over one month and approximated to 2 months in some areas." (P11672 L11-13; DP) →

"the high-temperature climate in southern China, with 35°C or higher daily maximum SATs, lasted for over one month (over 2 months in some areas)" (P6 L19-21; modified in RM by the EE).

(23)"To investigate the sensitivity of model-produced high-temperature weather to initial soil moisture for the above-mentioned hot event, the Advanced Research WRF (Version 3; Skamarock et al., 2008) is employed in this study."(P11672 L20-22; DP) →

"We investigated the sensitivity of the temperature simulations to initial soil moisture using the Advanced Research WRF model (Version 3; Skamarock et al., 2008)." (P6 L28-29; modified in RM by the EE).

(24) "In this case, the WET25 and WET50 soil moisture contents at the grid points can be increased by the amplitudes except for few grids that approach to saturation (Fig. 2d and e)."(P11674 L11-13; DP) →

"In this case, the WET25 and WET50 soil moisture contents at the grid points can be increased by 25 and 50%, respectively, except for few grids that approach saturation (Figs. 2d and e). " (P8 L10-12; RM).

(25)." Once the initial and boundary conditions are defined, according to the WRF formulations, both the land and atmospheric variables (e.g., atmospheric wind speeds, pressure, temperature, geopotential height, soil temperature and soil moisture), as well as the surface fluxes (e.g., radiative, sensible heat and latent heat fluxes), vary over time during the model integrations; these simulation results are used for the analysis." (P8 L13-17; added in RM).

(26)Section 3.2.2. has been streamlined and condensed (reduced in length by roughly one third; P11682 L21- P11686 L14 in DP →P15 L10-P17 L21 in RM).

(27) " The reason is that surface latent heat flux and sensible heat flux are different distribution forms partitioning net radiation; under the circumstance of stable net radiative energy at a specific time point, the decrease (increase) of latent heat flux 15 would lead to the increase (decrease) of sensible heat flux, and thus induce the rising (dropping) of low-level temperatures. In addition to the land surface changes, different SMIOS values which cause the change in surface latent heat flux would also, indirectly by modifying the radiative forcing and circulation of the atmosphere, lead to change in the SAT (addressed at the end of this subsection)."(P11683 L12-L19 ; DP) →

"This result is observed because the surface latent heat flux and sensible heat flux are two components that partition the surface net radiation. Given a stable forcing of net radiation, the decrease in latent heat flux leads to the increase in sensible heat flux; thus, low-level temperatures increase and vice versa. In addition to the land surface changes, different SMOIS values that cause changes in the surface latent heat flux would also indirectly lead to changes in the SAT by modifying the radiative forcing and circulation of the atmosphere (addressed at the end of this subsection)."(P15 L27-P16 L2 ; RM)

(28)"SMIOS " (P11683 L17; DP) →" SMOIS "(P15 L31; RM).

(29) "Because the surface sensible heat and latent heat are two of the main forms partitioning net radiation, the change in soil moisture can directly cause 25 the difference in partitioning of net radiation into sensible and latent heat fluxes at a given time. "(P11683 L23-L26; DP) →deleted.

(30)" Shown in Fig. 10d, high (low) average sensible heat flux well corresponds to high (low) SAT06, and low (high) latent heat flux is closely associated with high (low) SAT06, indicating that the SMOIS decrease (increase) leads to decreased (enhanced) surface evaporation or latent heat flux. " (P11684 L26-L29; DP) →deleted.

(31) "What is interesting is that the variation of soil moisture can bring about the variation of net radiation and therefore lead to apparent differences between the amplitude of the change in sensible heat flux and that in latent heat flux, i.e., the SMOIS increase (decrease) results in the larger increase (decrease) amplitude of latent heat flux than the decrease (increase) amplitude of sensible heat flux, which leads to the increases (decreases) of the surface net radiation. " (P11685 L13-18; DP) →

" Interestingly, the variation of the soil moisture modifies the variation of the net radiation and leads to large differences between the change in sensible heat flux and the change in latent heat flux, i.e., the SMOIS increase results in the larger increase in latent heat flux compared with the decrease in sensible heat flux; thus, the surface net radiation increases, and vice versa." (P16 L23-27; RM).

(32) "Meanwhile, because sunny weather persisted during the simulation period, little was the change in clouds-induced reflected solar radiation and the SMOIS-induced effect of added water evaporation on shortwave radiation is suggested to be also small, thus the surface net radiative energy is largely increased with the greenhouse effect of water vapor. " (P11686 L1-L5; DP) →

"Further, because sunny weather persisted during the simulation period, the change in the cloud-induced reflected solar radiation was negligible. Therefore, the change in shortwave radiation, which is only slightly modified by the SMOIS-induced water evaporation, is also suggested to be very small. Hence, the SMOIS-induced pronounced change in the surface net radiative energy is largely modified by the greenhouse effect of water vapour (rather than by the shortwave radiation). "(P17 L8-13; RM).

(33) "which shows to be quite large as compared to the sensitivity of regional suface net radiation to deforestation in the Amazon Basin at a scale of 106 km2 (Dickinson and Kennedy, 1992); " (P11686 L7-9; DP) →

"which is quite large (e.g., in contrast to the sensitivity of the regional surface net radiation to deforestation in the Amazon Basin at a scale of 106 km2; Dickinson and Kennedy, 1992) "(P17 L15-17; RM).

(34)" Figures 11 and 12 respectively show the 500 and 850 hPa geopotential height fields and their differences caused by the SMOIS change. " (P11686 L17-19; DP) →

"Regarding the atmospheric circulations in the mid-level and low-level troposphere, Fig. 11 and Fig. 12 show the 500- and 850-hPa geopotential height fields, respectively, and the height differences caused by the SMOIS change. "(P17 L24-27; RM).

(35)". This indicates that the drop (rise) of geopotential height at a given pressure level means the weakening (intensifying) of the subtropic-high atmospheric circulation. Shown in Figs. 11a and 12a, the weather during late July 2003 was controlled by the subtropical high and the SMOIS decrease (increase) leads to strengthening (weakening) of the 500 hPa (850 hPa) geopotential

height. " (P11686 L20-25; DP) →

"; thus, a drop in the geopotential height at a given pressure level corresponds to a weakening of the subtropical high atmospheric circulation, and vice versa. Shown in Figs. 11 and 12, the weather during late July 2003 was controlled by the subtropical high, and the SMOIS decrease leads to the increase (decrease) in the 500-hPa (850-hPa) geopotential heights" (P17 L28-32; RM).

(36)"In previous studies of soil moisture sensitivity experiments over North America using different climate models, Oglesby and Erickson (1989) and Pal and Eltahir (2003) found a heat low at the surface and an enhanced positive height anomaly in the upper atmosphere because of reduced soil moisture, and Fischer et al. (2007) conducted sensitivity experiments for the 2003 European heat wave, also indicated a weak surface heat low and enhanced ridging in the mid-troposphere due to reduced soil moisture, and suggested a positive feedback mechanism between soil moisture, continental-scale circulation, and temperature. " (P11687 L8-15; DP) →

"In previous soil moisture sensitivity experiments over North America using various climate models, Oglesby and Erickson (1989) and Pal and Eltahir (2003) found heat lows at the surface and enhanced positive height anomalies in the upper atmosphere because of reduced soil moisture. Fischer et al. (2007) conducted sensitivity experiments for the 2003 European heat wave and found a weak surface heat low and enhanced ridging in the mid-troposphere due to reduced soil moisture; they suggested a positive feedback mechanism exists between soil moisture, continental-scale circulation, and temperature. "(P18 L10-16; RM).

(37) The length of the Summary and conclusions section has been reduced from 1,158 to 549 words, please refer to the RM for details.

2. All changes according to comments from Referee #2

(1) "As a community mesoscale model developed by the National Centers for Environmental Prediction (NCEP) and other research institutions... " (P11672 L22-24 in the Discussion paper-DP) →

"As a community mesoscale model developed by the National Center for Atmospheric Research and other research institutions..."(P6 L29-31 in the revised manuscript-RM).

(2) "...and even reached 40–43 °C in some areas of the south-eastern coastal region, especially in late July, the hottest phase of the summer " (P11672 L16; DP) →

"...; the values even reached 40-43°C in some areas of the south-eastern coastal region, especially in late July, which was the hottest period of the summer according to 10-day moving averages of SAT over the study area"(P6 L22-25; RM).

(3) We have added the text in the revision: "Note that the strong western Pacific subtropical high was the dominant weather system during the period, when mean subsidence prevailed. Specifically, the CON term reflects the adiabatic effect of subsidence." (P19 L15-17 in the RM). Except for few wordings of the "convection" term of Eq. (1), the word "subsidence" has been employed to

replace "convection". For instance:

"... the diabatic processes (e.g., surface fluxes) are affected more strongly by the SMOIS change than the adiabatic process (i.e., downward airflow, or convection)... " (P11666 L28- P11667 L1; DP) →

"... the SMOIS change affects diabatic processes (e.g., surface fluxes) more strongly than the adiabatic process of subsidence ..."(P2, L5-6; RM);

"... the nighttime convection effect... " (P11689 L7; DP) →

"... the nighttime subsidence effect ..."(P20, L3; RM).

(4)"Figure 9 shows hourly variations of ten-day mean surface quantities, showing that the simulated sensible and latent heat fluxes and the SAT are sensitive to the changes in initial soil moisture and the response is very fast with pronounced differences after one hour of integration. " (P11683, L20-23; DP) →

"In addition to the above consistency of the overall spatial patterns of the SAT and fluxes, the hourly variations of the ten-day mean surface quantities clearly show the high SMOIS-induced sensitivities (Fig. 9) during the 24-hour periods"(P16 L3-5; RM).

(5) Figure 9 and the caption have been modified as follows:

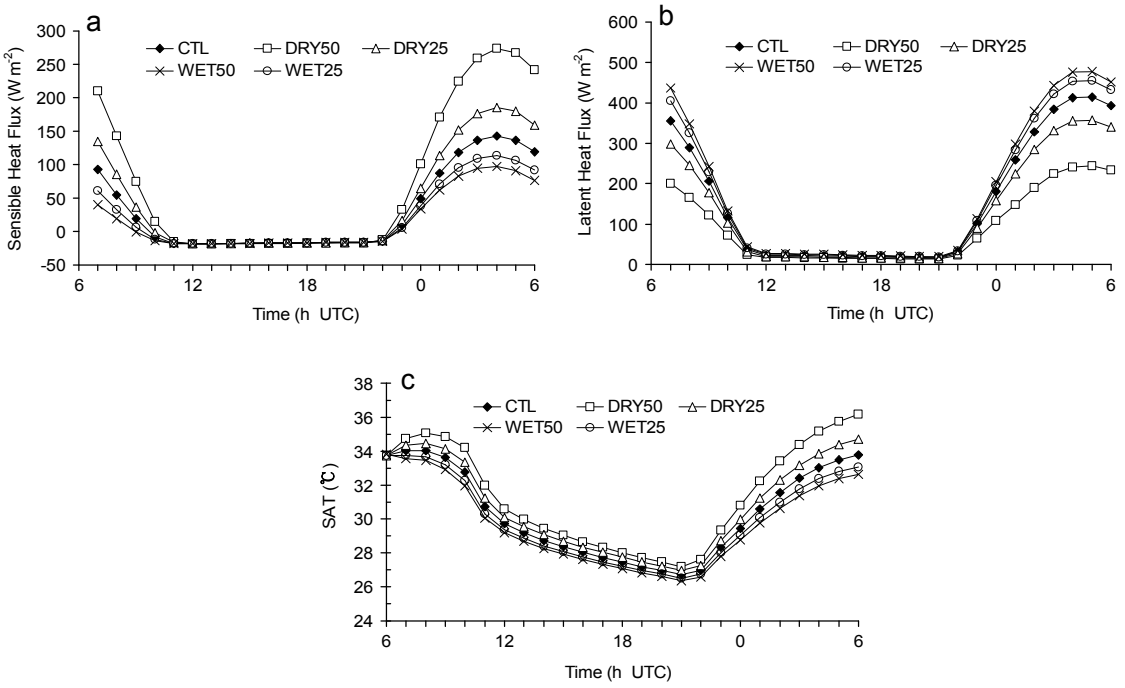

Fig. 9. The mean hourly variations in the area-averaged (area D3) surface quantities for the five groups of simulations during 20–29 July 2003, where the initial flux values are zero (not shown) and the initial temperatures are the same value. (a) Sensible heat flux. (b) Latent heat flux. (c) SAT.

(6) " i.e., the SMOIS decrease (increase) leads to the enhancement (reduction) of the 850 hPa

geopotential height in most of the simulated areas." (P11686 L28-P11687, L2; DP) →

" i.e., the SMOIS decrease leads to reduced 850-hPa geopotential heights in most of the simulated areas, and vice versa"(P18 L3-4; RM).

(7) "although the adiabatic processes dominate over the convection process during daytime and during nighttime" (P11693, L21-23; DP) →

"although the diabatic processes dominate over subsidence during the daytime and nighttime "(P23 L6-7; RM).

(8) Some comment on the relative importance of the physic processes have been added, i.e.," Notably, when only CTL is taken into account, during late July, the diabatic processes are slightly more important than mean subsidence over the region (i.e., the sign of the SAT change is opposite of the subsidence term during the 24-hour periods in CTL; Table 2). This shows the relative importance of physical processes in the hottest phase. For periods with lower temperatures, the values of both the diabatic and subsidence terms are reduced. Given invariant signs for both, it is unlikely to pinpoint which term would dominate using a theoretical analysis only; thus, follow-up numerical studies are needed for other cases." (P21 L22-28; RM)