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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Water vapor budget associated to overshoots in the tropical stratosphere: mesoscale modelling study of 4–5 August 2006 during SCOUT-AMMA" *by* X. M. Liu et al.

Anonymous Referee #2

Received and published: 7 April 2010

This work reports results from a numerical modelling study of two cases of overshooting convection over Niger and Chad (during SCOUT-AMMA). The overall idea of the modelling work is to quantify the amount of water injected into the lower stratosphere for each of these two cases, and to compare it to previous estimates from other modelling studies over different regions. This study provides some critical perspective on current knowledge on the mechanisms that set the water vapour mixing ratio in the lower stratosphere. It is a nice piece of work, especially in a technical sense. The modelling approach has been thought through and is sound. It would be an exaggeration

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to say that any new insight on the subject has been presented here. Having said that, I still recommend the manuscript for publication in Atmospheric Chemistry and Physics, after the authors clarify a few points, which are detailed in the following.

My main point of concern is as regards the calculation of the upward total water flux across isentropic surfaces. It would help if the net water flux would be presented as well. By 'net flux', I mean taking into account also the negative vertical velocity values in the calculation of the flux. This will affect the numbers reported in the manuscript and possibly some of the interpretations of the results. It would be interesting to show cross-sections of the vertical velocity field to have an idea of its range of values in the updrafts. I am a bit concerned by the differences between values of the flux reported in the manuscript and that reported by Chaboureau et al. (2007). The peak value of 8 ton s-1 reported by Chaboureau et al. (2007) is for the upward water vapour flux, and is more than twice that reported in the manuscript for total water. This might not be a problem but reasons for the differences should be clarified in the manuscript. I would suggest plotting the evolution of the flux for water vapour as well, so that one can appreciate the contribution of water vapour to the total water flux.

I have also a few other minor points and suggestions (some editorial).

Title: It is hard to understand and does not read well. I would suggest changing 'Water vapor budget associated to overshoots in the tropical stratosphere' to 'Stratospheric water vapour budget and convection overshooting the tropical tropopause layer'. Also, please use either 'vapor' or 'vapour' throughout the text of the manuscript.

P3977, L4: Please change 'entry of water vapour amount' to 'water vapour mixing ratio'.

P3977, L6: I would suggest deleting 'For this purpose'. Please change 'two overshooting cases' to 'two cases of overshooting convection'.

P3977, L14: Please correct 'thought' to 'though'.

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P3977, L16: Please add ‘displacement’ before ‘in latitude’.

P3978, L5: Please replace ‘when exiting’ by ‘outside’.

P3978, L22: This sentence is hard to understand and does not read well. To get to the point, which is about the dehydration process, I would suggest combining the first two sentences in ‘The most accepted mechanism driving the water vapour mixing ratio in the lower stratosphere is dehydration by freezing. . .’.

P3979, L2: Please change ‘This process is called the cold trap hypothesis’ to ‘This is often referred to as the cold trap hypothesis’.

P3979, L3: Please delete ‘In contrast to this hypothesis’.

P3979, L4: Please change ‘show’ to ‘have shown’.

P3979, L12: Please add ‘a’ before ‘duration’.

P3979, L13: Please change ‘for being’ to ‘to be’.

P3979, L14: Please change ‘impact’ to ‘representation’.

P3979, L22: Please change ‘from Niamey’ to ‘in Niamey’.

P3979, L29: Please change ‘However, the modelling approach, validated by this set of measurements’ to ‘Conversely, a modelling approach, evaluated by such a set of measurements’.

P3980, L3: Please add ‘that of’ before ‘cloud resolving simulations’.

P3980, L14: Please add ‘the’ before ‘local scale’.

P3980, L24: Please add ‘the’ before ‘local scale’.

P3980, L28: Please delete ‘different’.

P3980, L29: Please add ‘and’ before ‘the second’.

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P3981, L7: Please change ‘a local scale’ to ‘the local scale’.

P3981, L12: Please change ‘from Niamey’ to ‘in Niamey’.

P3982, L2: Please change ‘Balloon borne water vapor measurements’ to ‘Water vapour measurements using a balloon-borne system’, ‘of 5 August 2006’ to ‘on 5 August 2006’, and ‘from Niamey’ to ‘at Niamey’.

P3982, L18: Please change ‘We suspect this artefact could be due to’ to ‘We suspect that this bias could be due to’.

P3984, L12: Please change ‘for the 12:15 UT to 19:15 UT with a 15 min timestep period’ to ‘from 12:15 UT to 19:15 UT with a 15-min time resolution’.

P3984, L16: Please change ‘in the North of’ to ‘north of’.

P3985, L1: Please add ‘of’ before ‘the Aïr case’.

P3985, L4: Please add ‘the’ before ‘Aïr mountain area’.

P3986, L15: Please change ‘mother’ by ‘parent’.

P3986, L16: Please change ‘son’ by ‘child’.

P3986, L22: Please change ‘two moment scheme (Meyers et al., 1997)’ by ‘two moment scheme developed by Meyers et al. (1997)’.

P3986, L25: Please add ‘number’ before ‘concentrations’.

P3986, L26: Please add ‘a’ before ‘gamma’.

P3987, L15: Please change ‘nudging’ to ‘forcing’.

P3987, L21: Please add ‘convective’ before ‘system’.

P3988, L17: Please change ‘triply’ to ‘three’.

P3988, L19: Please change ‘part’ to ‘fraction’.

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P3988, L24: Please change ‘under the scope of our study’ to ‘of interest’.

P3988, L26: Please change ‘is located at the South of’ to ‘is located south of’.

P3989, L5: Please change ‘Validation’ to ‘Evaluation’.

P3989, L9: I would suggest deleting ‘first’.

P3989, L15: I would suggest changing ‘Secondly, we compare’ to ‘We also compare’.

P3990, L2: Please delete ‘Thus’.

P3990, L9: Please change ‘on MSG observations’ to ‘using MSG observations’.

P3991, L2: Please change ‘both for’ to ‘for both’.

P3991, L8: Please change ‘computed’ to ‘visible’.

P3991, L9: Please change ‘validate’ to ‘evaluate’.

P3991, L11: Please justify why the 380 K level is used. By referring to Fig. 9?

P3991, L18: Please change ‘is well in agreement’ to ‘is in good agreement’.

P3991, L19: I would suggest changing ‘This good result’ to ‘This good agreement of the model with observations’.

P3991, L24: Please change ‘On the other hands’ to ‘On the other hand’.

P3991, L26: Please correct ‘ressources’ to ‘resources’.

P3992, L8: Please change ‘compute’ to ‘produce’.

P3992, L14: Please change ‘validate’ to ‘evaluate’ and ‘of 5 August 2006’ to ‘on 5 August 2006’.

P3992, L19: Please change ‘are expressed in the Grid 1 resolution in. . .’ to ‘are displayed for Grid 1 in. . .’.

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P3993, L1: Please change ‘play’ to ‘plays’.

P3993, L7: Please change ‘slightly propagates westward’ to ‘propagates slightly westward’.

P3993, L19: Please change ‘computes’ to ‘shows’.

P3993, L22: Please add ‘is’ before ‘not taken into account’.

P3994, L7: Please change ‘Contrarily to’ to ‘In contrast to’.

P3994, L10: Please change ‘computes’ to ‘produces’.

P3994, L12: Please change ‘Grid’ to ‘of the grid’.

P3994, L17: The sentence ‘Contrarily. . .’ seems to be a repetition of one of the previous sentences. This sentence should be deleted.

P3995, L3: Please change ‘This allows us to calculate’ to ‘In the following we calculate’.

P3995, L27: Please change ‘grid mesh’ to ‘all the grid meshes’.

P3996, L9: Please change ‘This is due to the very low altitude of the 380 K at that time’ to ‘This is due to the decrease in the altitude of the 380 K level at that time’.

P3996, L15: Please change ‘12b’ to ‘13b’.

P3997, L3: ‘When convection disappears from Grid 3’, please give the time in brackets.

P3998, L7: Please change ‘Integrated on’ to ‘Integrated over’ and ‘encompassing’ to ‘covering’.

P3998, L24: Please delete ‘its‘ before ‘horizontal diffusion’ and before ‘vertical diffusion’.

P3998, L25: Please change ‘larger’ to ‘large’.

P3998, L26: Please change ‘hydrated bulge’ to ‘area of maximum hydration’.

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P3999, L1: Please change ‘hydrated spot’ to ‘area of maximum hydration’.

P3999, L14: Please change ‘mandatory’ to ‘necessary’.

P4000, L4: Please add ‘in duration’ after ‘shorter’.

P4000, L5: Does this suggest that isolated convection transports more water to the lower stratosphere than widespread convection? It would be an interesting point to discuss in the manuscript, though the work might not be conclusive in that respect.

P4000, L11: Please change ‘from Niamey’ to ‘in Niamey’.

P4000, L15: Please delete ‘in order to achieve this goal’.

P4000, L26: Please delete ‘significantly’ before ‘after the overshoot’.

P4001, L17: Please clarify whether this is for the same duration.

P4001, L24: Please change ‘timescale’ to ‘time scale’.

P4001, L28: I would suggest changing ‘put to the fore’ to ‘pinpoint’.

P4001, L29: Please change ‘the reasons of the differences’ to ‘the reasons for the differences’.

P4002, L3: Please add ‘scale’ before ‘models’.

P4007, Table 1: ‘Local time of overshoot (UT)’ is confusing. Is local time UT? Please define BTD in the caption.

P4009, caption of Table 3: Please change ‘encompassing’ to ‘covering’ and ‘1 h 50” to ‘1 h 50 min’.

P4010, caption of Fig. 1: Please change ‘from Niamey’ to ‘in Niamey’.

P4015, caption of Fig. 6: Please change ‘for BRAMS simulation’ to ‘for the BRAMS simulations’. Please add a closing bracket after ‘and 3’ in the caption.

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P4016, caption of Fig. 7: Please change ‘on 3 h periods’ to ‘over 3 h periods’.

P4018, caption of Fig. 9: The caption needs some revision. I would suggest deleting ‘with iso-theta levels’ and adding, after ‘on 4 August 2006‘, ‘The solid lines indicate the isentropes 370, 380, 390, and 400 K’. Please change ‘the Grid 3’ to ‘Grid 3’ and delete ‘=’ before ‘12^{o} N latitude’.

P4019, caption of Fig. 10: Please change ‘on 3 h periods’ to ‘over 3 h periods’.

P4020, caption of Fig. 11: Please change ‘on the Grid 3’ to ‘on Grid 3’.

P4022, caption of Fig. 2=13: Please indicate which case this figure refers to, and explain why two colours (green and purple) are used.

Interactive comment on Atmos. Chem. Phys. Discuss., 10, 3975, 2010.