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*Supplement of*

## **Modeling the reactive halogen plume from Ambrym and its impact on the troposphere with the CCATT-BRAMS mesoscale model**

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1 **Supplementary material:**

2 **1. Sensitivity study to the height of the plume**

3 Knowledge of the injection altitude of volcanic emissions is critical to study the transport, the  
4 chemical evolution and the deposition of these emissions. We performed an additional  
5 simulation (S1\_HighT\_alt) in which emissions are injected at 2000 m into a grid-box of  
6 about 200-300 m depth. This higher plume altitude estimate was suggested by Bani et al.  
7 (2012) but is based only on visual estimations which are known to be rather uncertain.

8 Figure 1S shows that the SO<sub>2</sub> columns are less well simulated by the model in the  
9 S1\_HighT\_alt than in the S1\_HighT simulation. The plume seems to be transported too much  
10 towards the east relative to the observations. As a result, the simulation S1\_HighT\_alt  
11 underestimates the observation by 44 % for SO<sub>2</sub> (compared to 2% for S1\_HighT). The  
12 correlation between simulated and observed SO<sub>2</sub> is also reduced, 0.37 (compared to 0.61 for  
13 S1\_HighT). This difference with S1\_HighT is likely due to stronger and more north-westerly  
14 winds at 2000 m acting to decrease SO<sub>2</sub> columns. BrO columns are similarly underestimated  
15 by 83% in S1\_HighT\_alt (compared to 40% for the standard simulation S1\_HighT), mostly  
16 due to the fact that total bromine is reduced for the same reason as for SO<sub>2</sub> by the shift in  
17 direction of plume transport (Figure 2S).

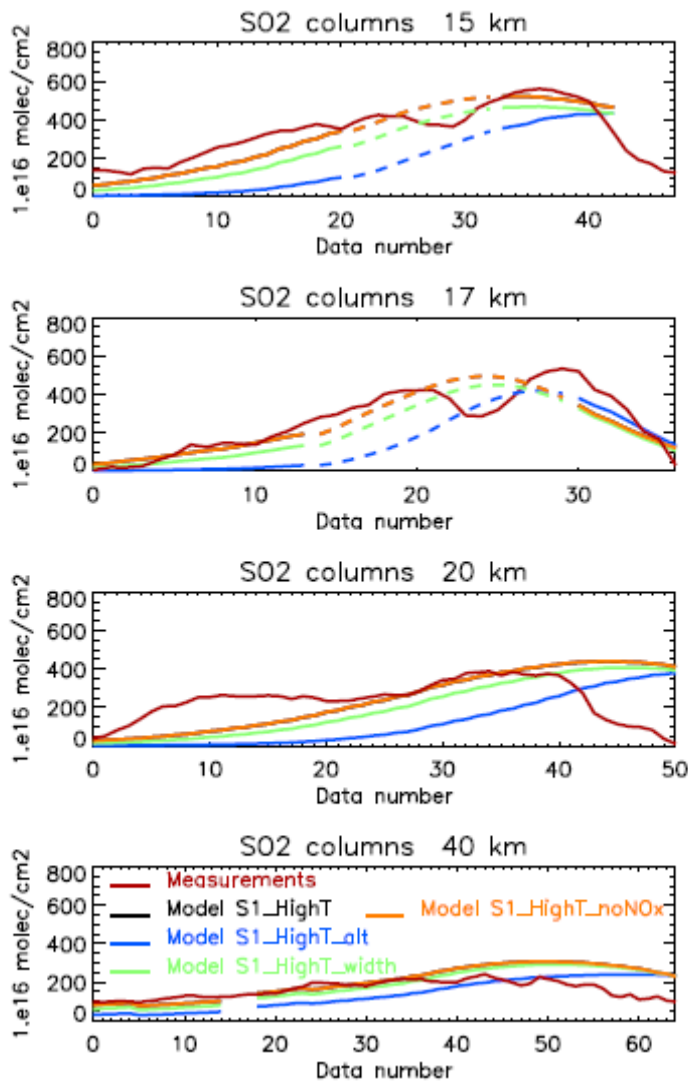
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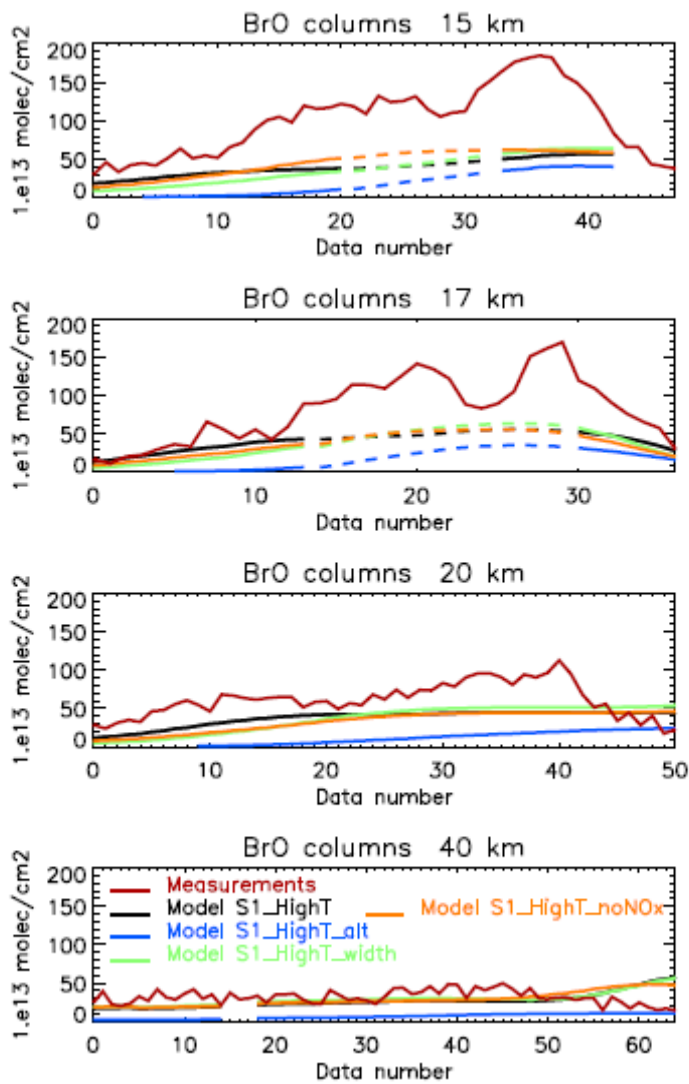


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29 **Figure 1S:** Comparison between SO<sub>2</sub> columns observed by Bani et al. (2009) (red line) and  
 30 simulated by the model for S1\_HighT (black line) and for the sensitivity simulations:  
 31 S1\_HighT\_alt (blue line), S1\_HighT\_width (green line), S1\_HighT\_noNOx (orange line).  
 32 Note that black and orange lines are on top of each other (superimposed). The method of  
 33 comparison is the same than Figure 3.

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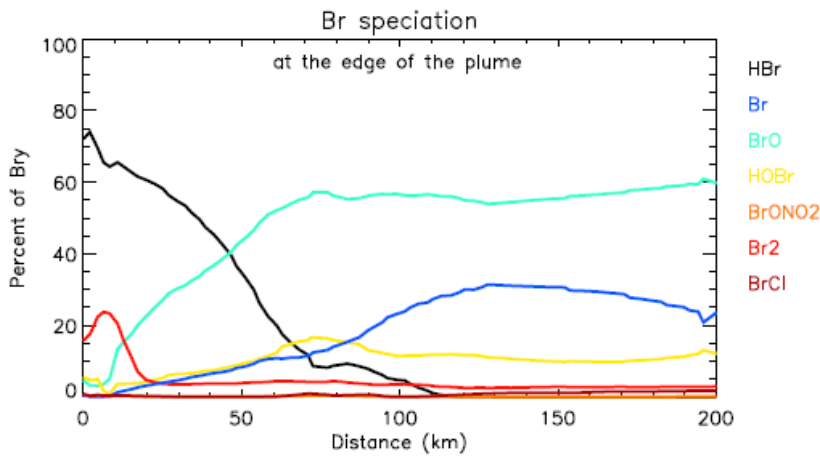
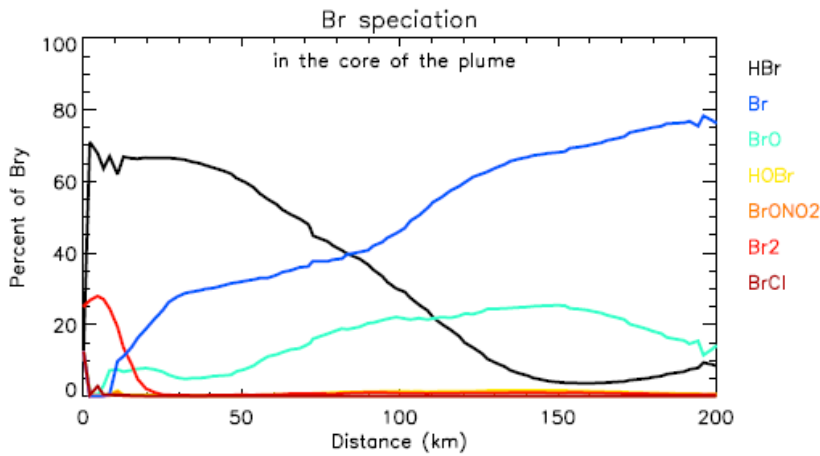
36 **Figure 2S:** Comparison between BrO columns observed by Bani et al. (2009) (red line) and  
 37 simulated by the model for S1\_HighT (black line) and for the sensitivity simulations:  
 38 S1\_HighT\_alt (blue line), S1\_HighT\_width (green line), S1\_HighT\_noNOx (orange line).

39 The method of comparison is the same than Figure 3.

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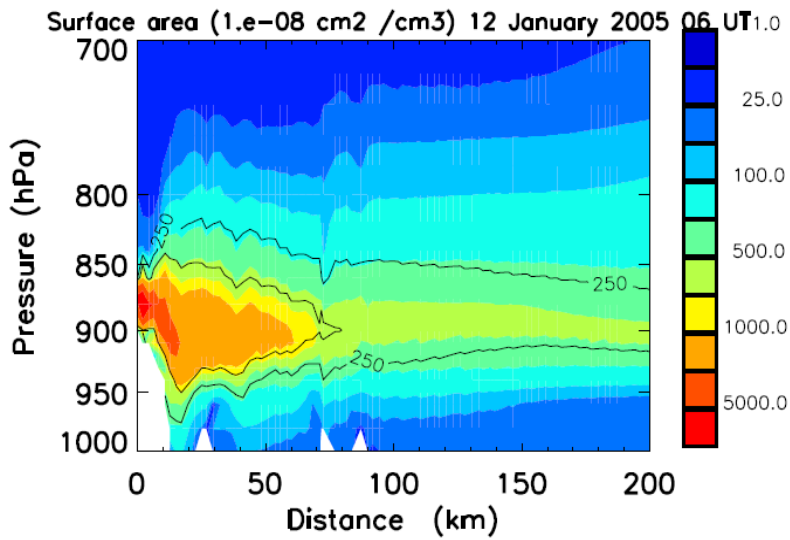


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44 **Figure 3S:** Br speciation along the plume (in the core and at the edge) in the simulation  
 45 S1\_HighT\_noNO<sub>x</sub> and the grid 2 km x 2 km the 12th of January 2005 at 06 UT. The Br  
 46 speciation has been calculated as the percent of Bry ( $Bry = HBr + 2Br_2 + BrCl + Br + BrO +$   
 47  $HOBr + BrONO_2$ ). Distance is calculated from the middle of the gridbox containing Marum  
 48 and Benbow

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52 **Figure 4S:** Distance-Pressure cross section of the aerosol surface area density ( $\mu\text{m}^{-2} / \text{cm}^3$ ) in  
 53 the plume of Ambrym on the 12<sup>th</sup> January 2005 in the simulation S1\_HighT.

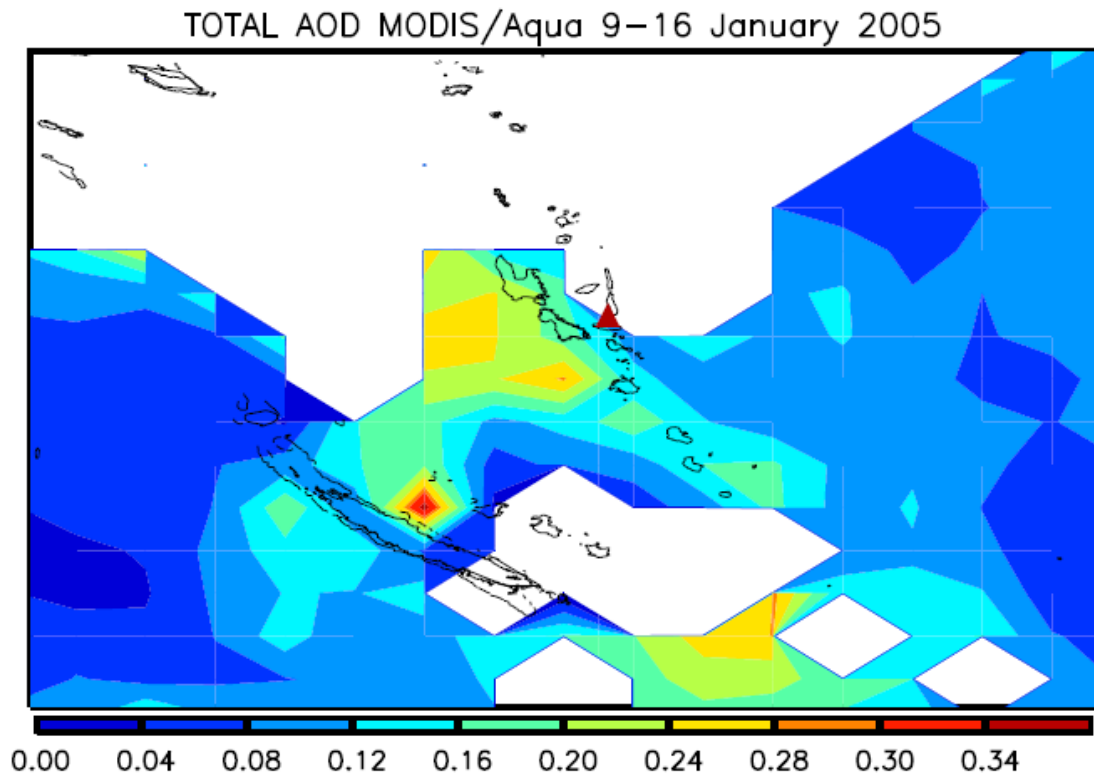
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60 **Figure 5S:** Eight-day average (9-16 January 2005) of the total aerosol optical depth at 550  
61 nm from MODIS/Aqua (MYD08\_E3). Ambrym is indicated by a red triangle.

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