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Supplement of

**New strategies for vertical transport in chemistry transport models:
application to the case of the Mount Etna eruption on 18 March 2012 with
CHIMERE v2017r4**

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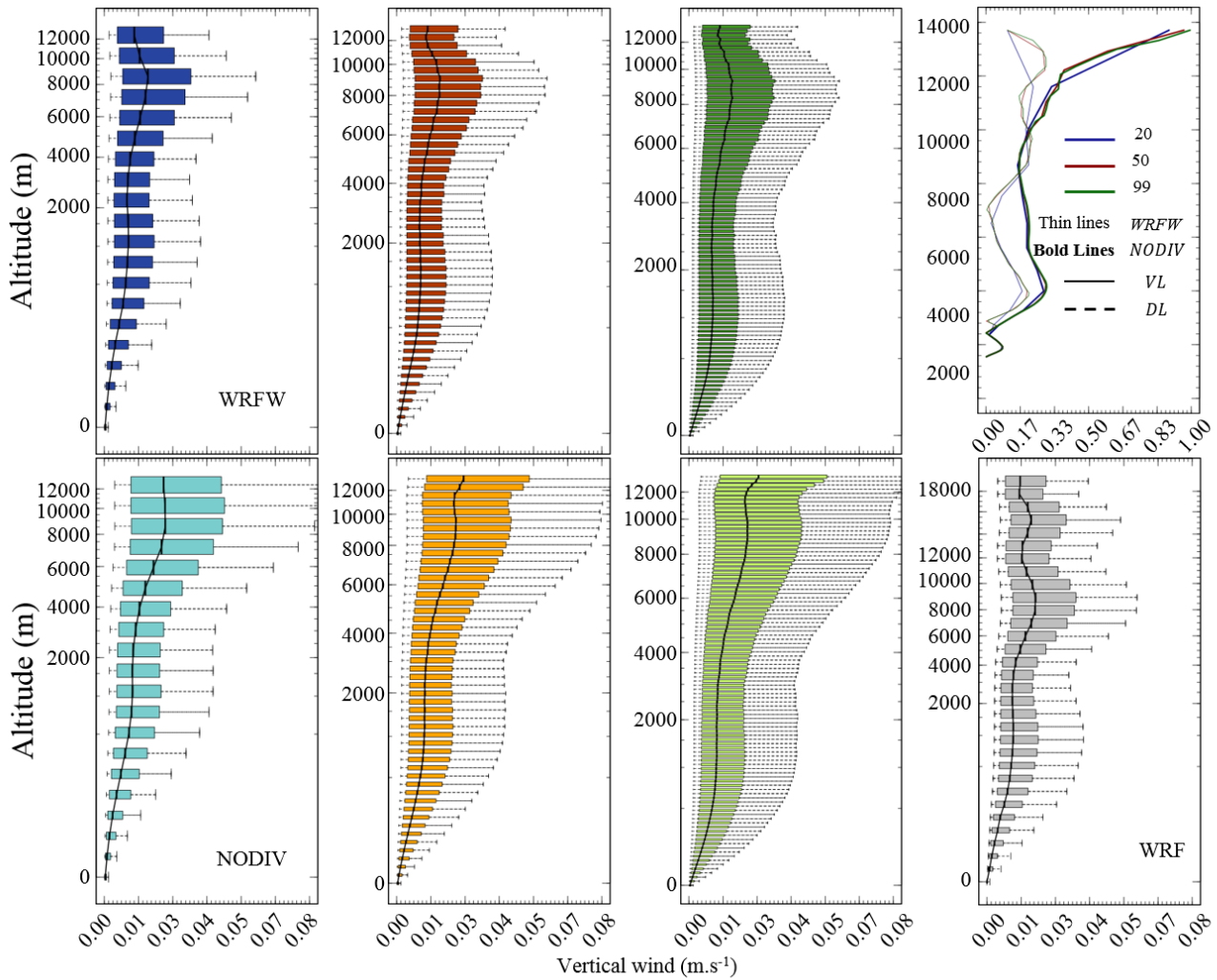


Figure S1. Absolute vertical wind speed distributions per vertical layers (Blue: 20, Red: 50 and Green: 99). Right: WRF outputs. Up: WRFW wind strategy, Down: NODIV wind strategy. end of the whiskers represents 10th and 90th percentiles.

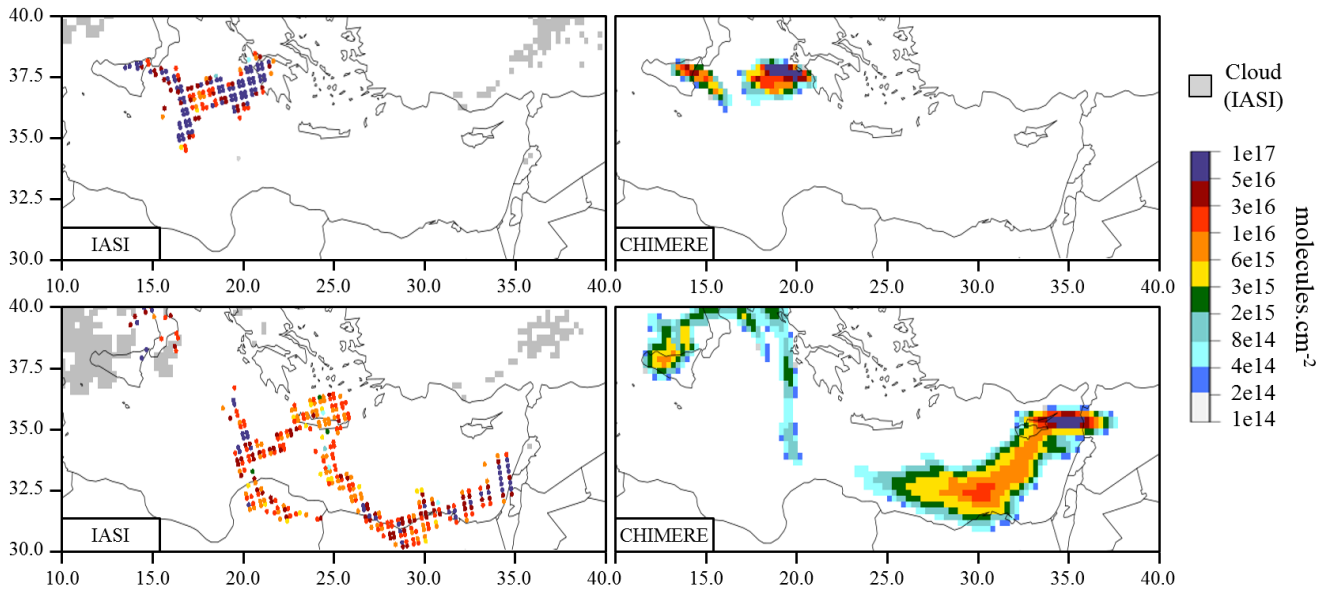


Figure S2. SO₂ plume (molecules.cm⁻²) from IASI (left) and CHIMERE (right). IASI soundings respectively for march 18 2012 05PM and march 19 05PM UTC. In this example, CHIMERE simulation WRFW-DL-20 is displayed. CHIMERE and OMI data are represented with OMI's 0.25° × 0.25° resolution grid. Clouds are based on Advanced Very High Resolution Radiometer (AVHRR) data for IASI.

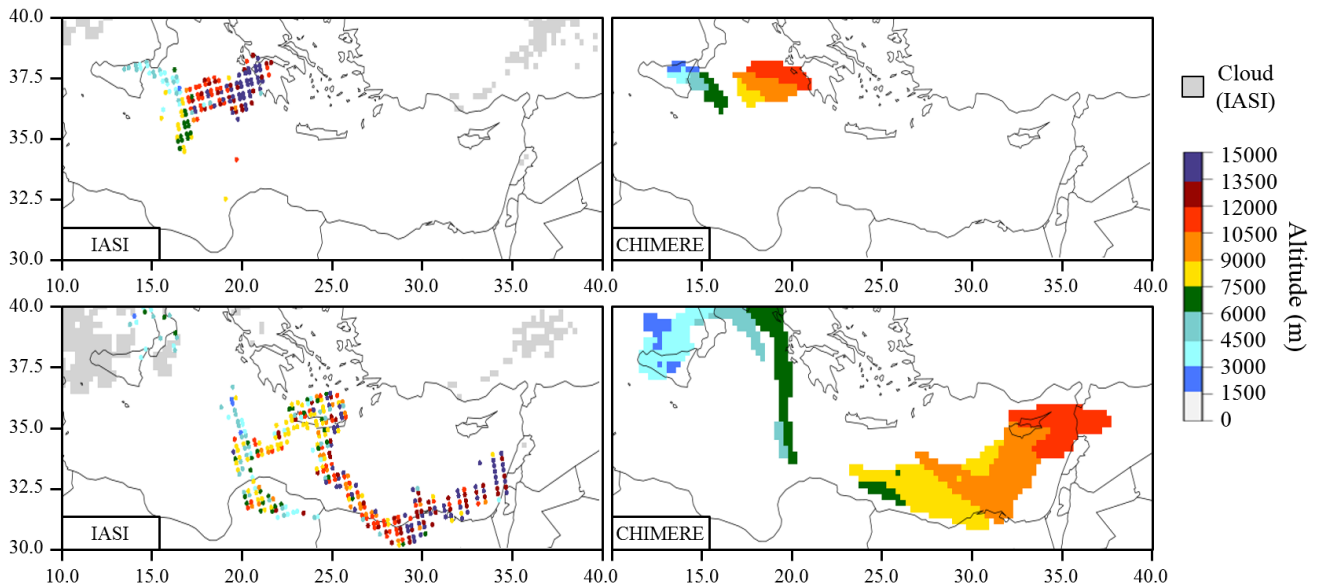


Figure S3. SO₂ maximum concentrations' altitude (meters) from IASI (left) and CHIMERE (right). IASI soundings respectively for march 18 2012 05PM and march 19 05PM UTC. In this example, CHIMERE simulation WRFW-DL-20 is displayed. CHIMERE and OMI data are represented with OMI's 0.25° × 0.25° resolution grid. Clouds are based on Advanced Very High Resolution Radiometer (AVHRR) data for IASI.

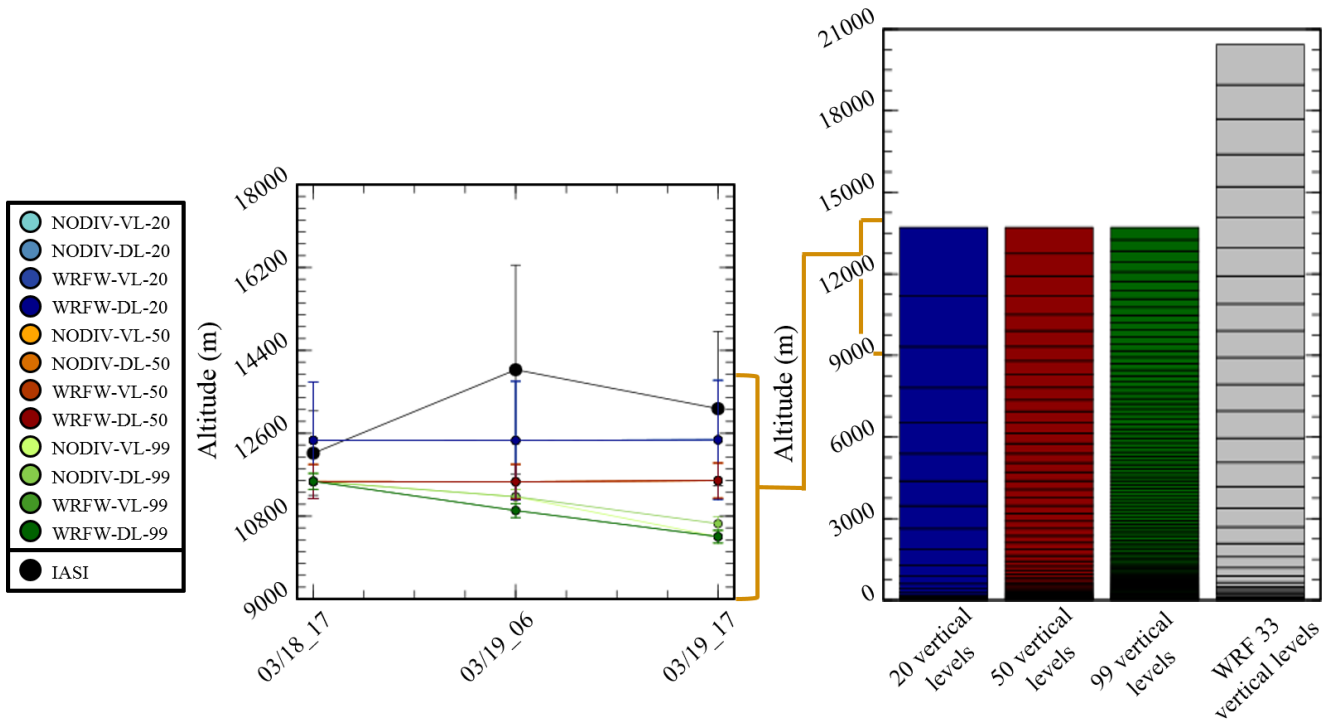


Figure S4. Center : Maximum concentration altitude evolution (IASI and CHIMERE), IASI brackets indicate values' uncertainties and CHIMERE brackets indicates cell's bottom and top. Right : Model vertical levels distribution for the 3 configurations from surface to top.

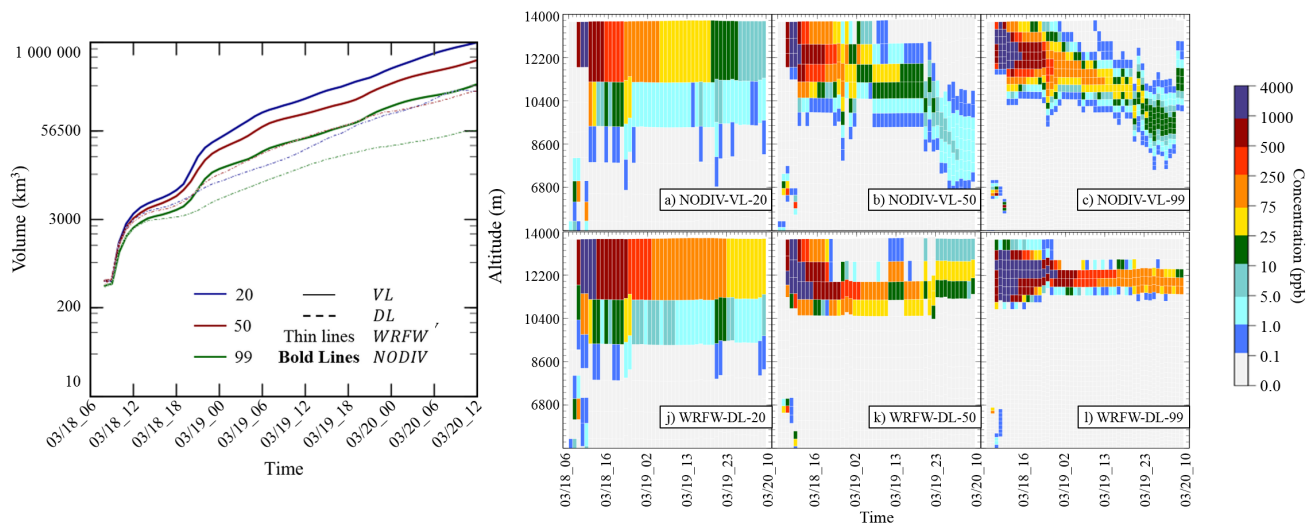


Figure S5. Left) Minimum volume evolution calculated for 50 % of SO₂ total mass in the atmosphere. Right) Evolution of SO₂ vertical profile (in ppb) corresponding to the maximum column for each step after the Etna eruption, for each tested model configurations. 1st row: NODIV-VL; 2nd row: WRFW-DL. Left: 20 vertical levels; Center: 50 vertical levels; Right: 99 vertical levels. WRFW simulations values have been corrected to fit NODIV strategy masses.

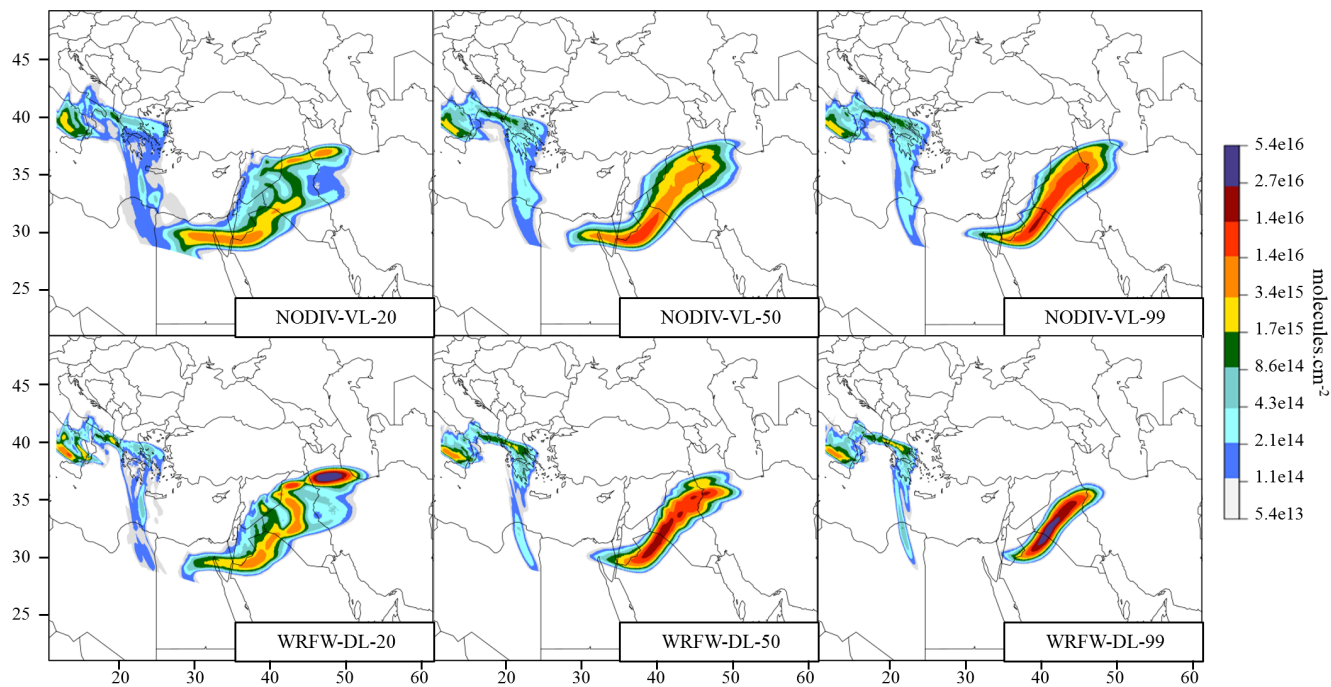


Figure S6. Volcanic plume integrated column dispersion on March 20th at 11 A.M. UTC (2 days after the eruption).

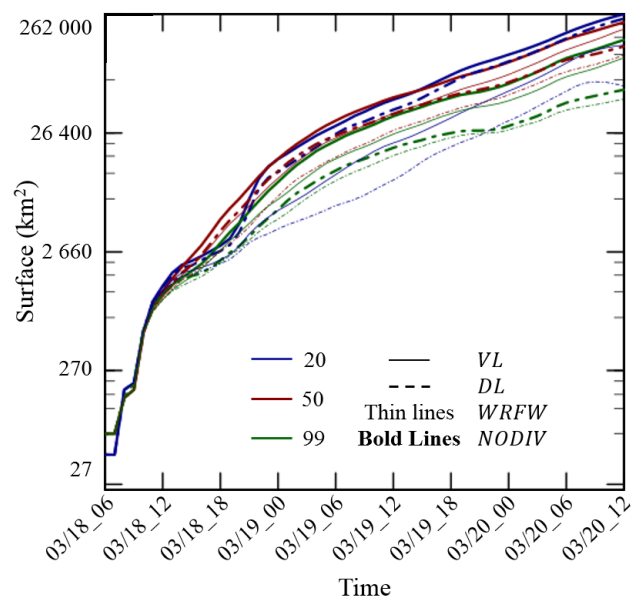


Figure S7. Minimum surface evolution calculated for 50 % of SO₂ total mass in the atmosphere.