



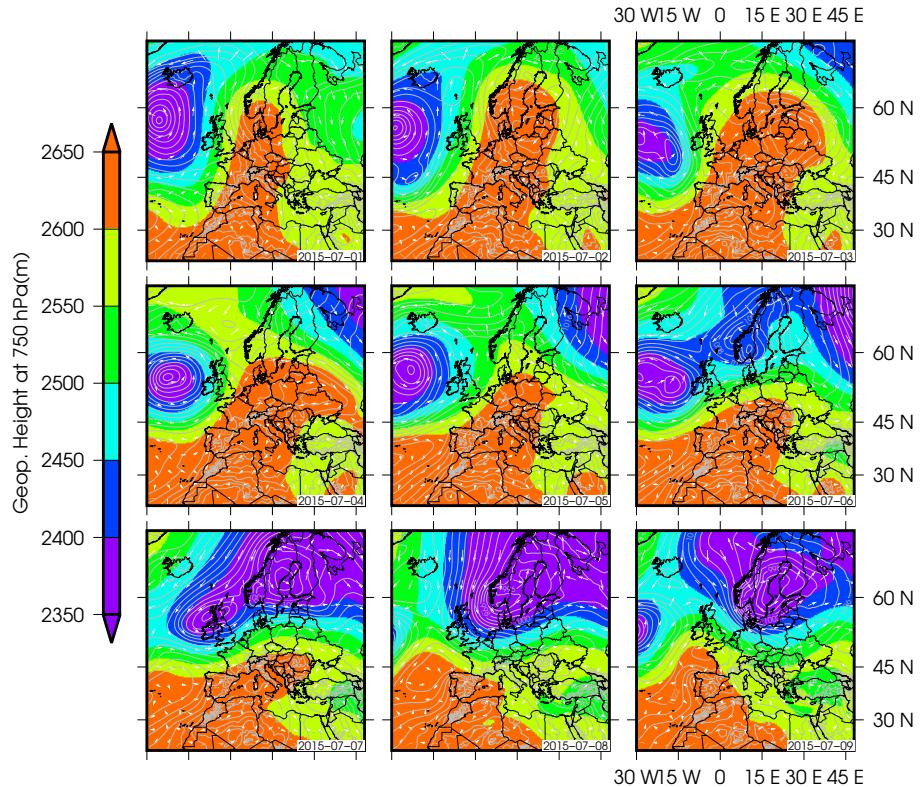
*Supplement of*

**Sensitivity of aerosol optical properties to the aerosol size distribution over central Europe and the Mediterranean Basin using the WRF-Chem v.3.9.1.1 coupled model**

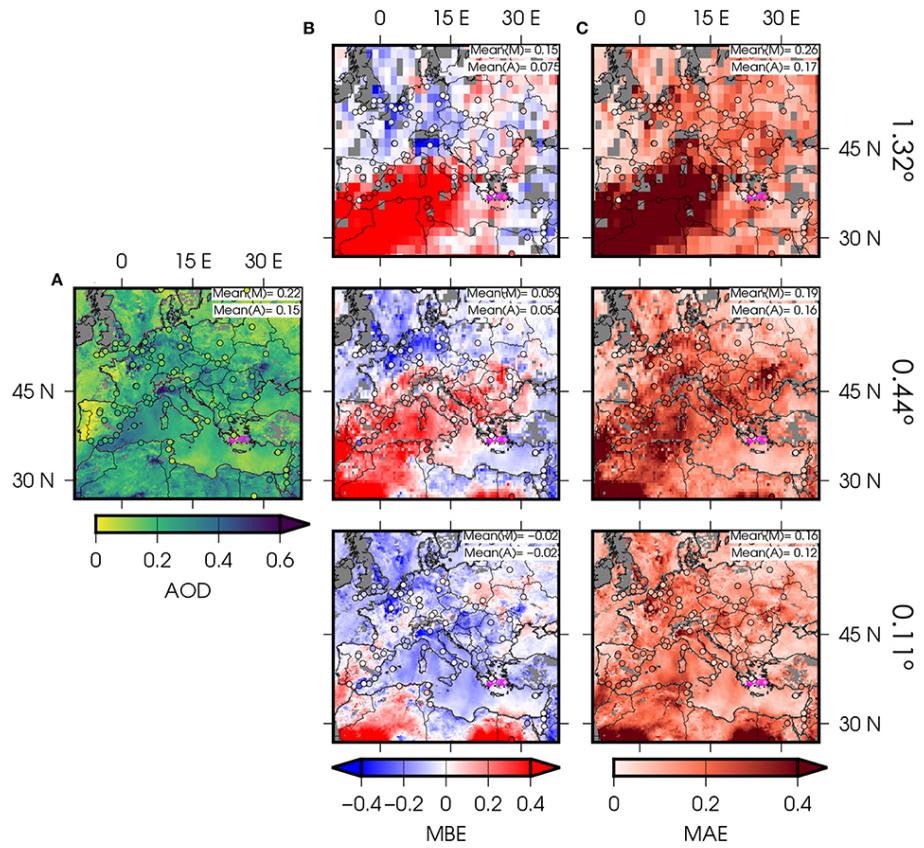
**Laura Palacios-Peña et al.**

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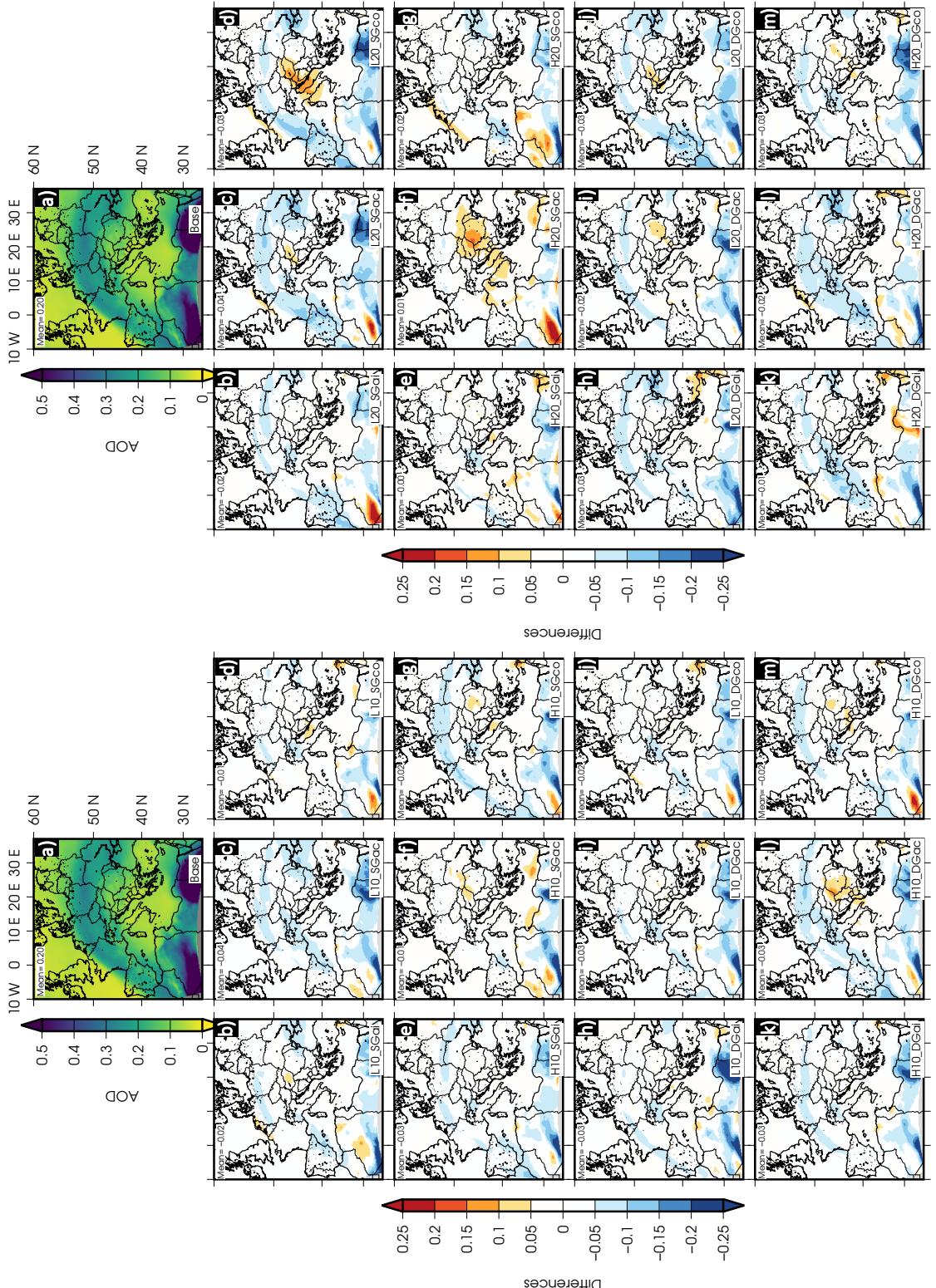
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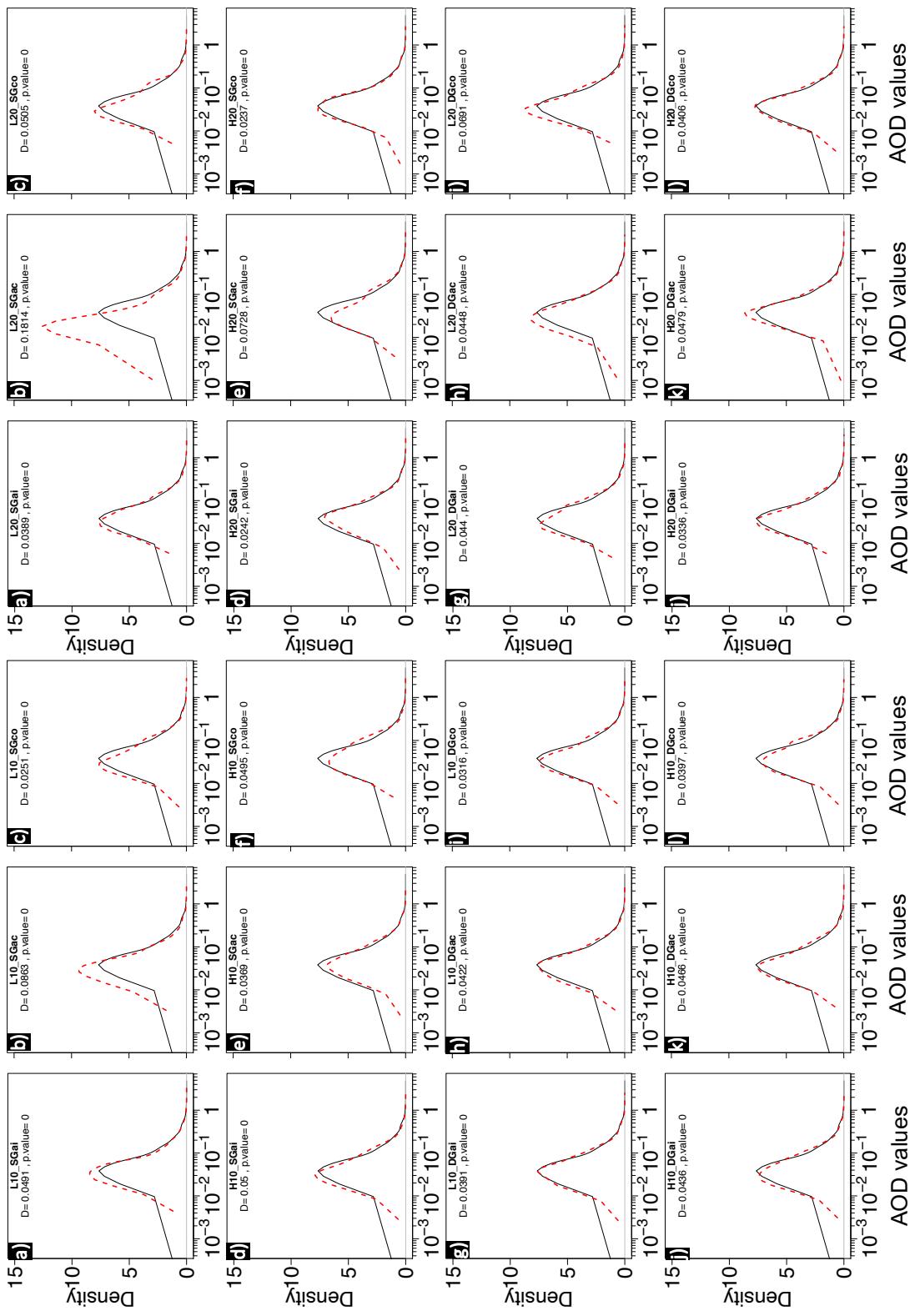
**Figure S1.** Figure from Palacios-Peña et al. (2019): Synoptic situation of Saharan desert dust outbreak between 1-9 July 2015. Colours display geopotential height (m) at 750 hPa; white arrows, wind direction at the same pressure level; and gray lines, the sea level pressure (SLP) in hPa.



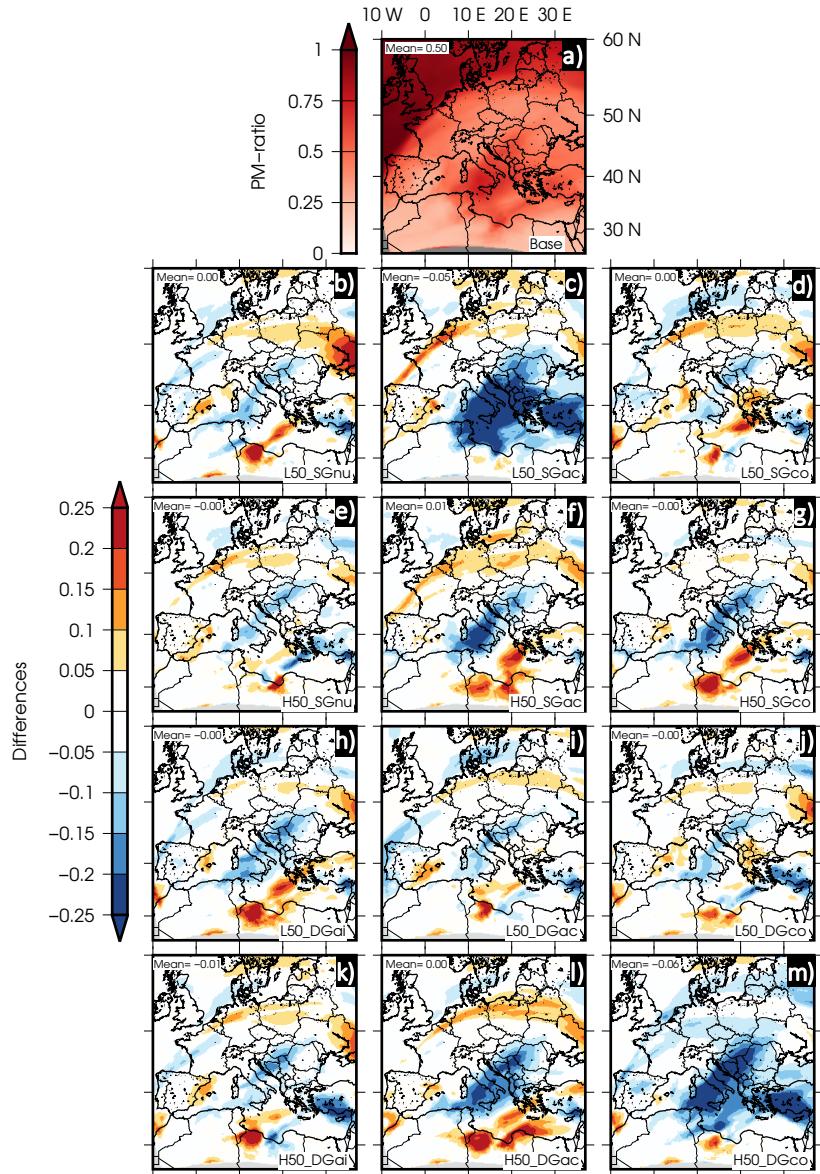
**Figure S2.** Figure from Palacios-Peña et al. (2019): Aerosol optical properties evaluation. (A) AOD (550 nm) from satellite (shadow), MAN network (diamonds) and AOD (675 nm) from AERONET (points). In second and third columns show the same as first but for: (B) MBE and (C) MAE. Top, the coarsest resolution ( $1.32^\circ$ ), center ( $0.44^\circ$ ), and bottom ( $0.11^\circ$ ), the finest resolution.



**Figure S3.** AOD at 550nm and differences for the sensitivity tests modifying the parameters by 10 (right) and 20 % (left). a) Base case; b) Aitken mode reduction in SG; c) accumulation mode reduction in SG; d) coarse mode reduction in SG; e) Aitken mode increase in SG; f) accumulation mode increase in SG; g) coarse mode increase in SG; h) Aitken mode reduction in DG; i) accumulation mode reduction in DG; j) coarse mode increase in DG; k) accumulation mode increase in DG; l) coarse mode increase in DG; m) coarse mode increase in DG.



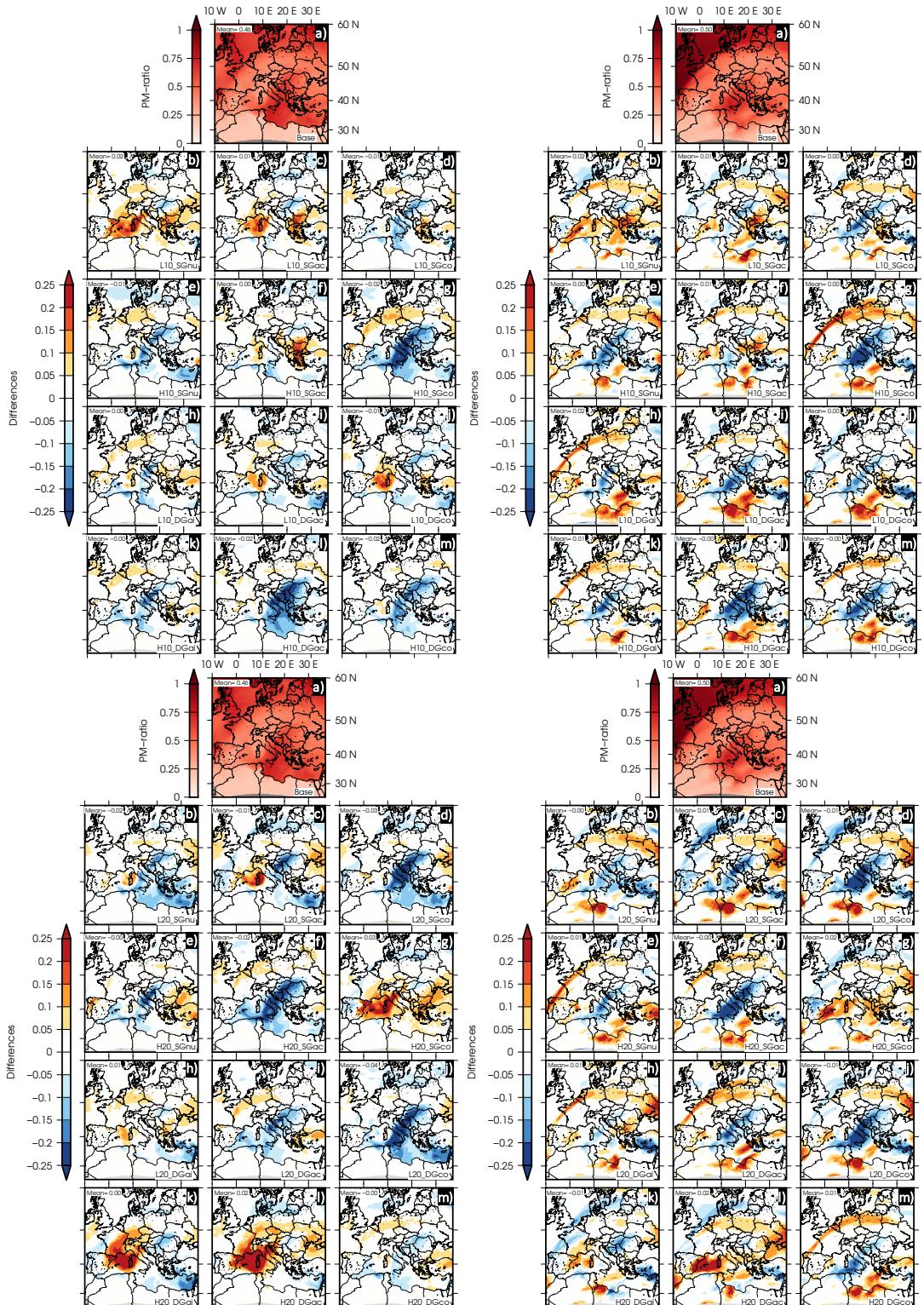
**Figure S4.** PDF of AOD values for the base case (black line) and each of the sensitivity test simulations at 10 (dashed-red line, left). Values in Figures represent the results of the statistic from the Kolmogorov-Smirnov test. a) Aitken mode reduction in SG; b) accumulation mode reduction in SG; c) coarse mode reduction in SG; d) Aitken mode increase in SG; e) accumulation mode increase in SG; f) coarse mode reduction in DG; g) Aitken mode reduction in DG; h) accumulation mode reduction in DG; i) coarse mode increase in DG; j) Aitken mode increase in DG; k) accumulation mode increase in DG; l) coarse mode increase in DG.



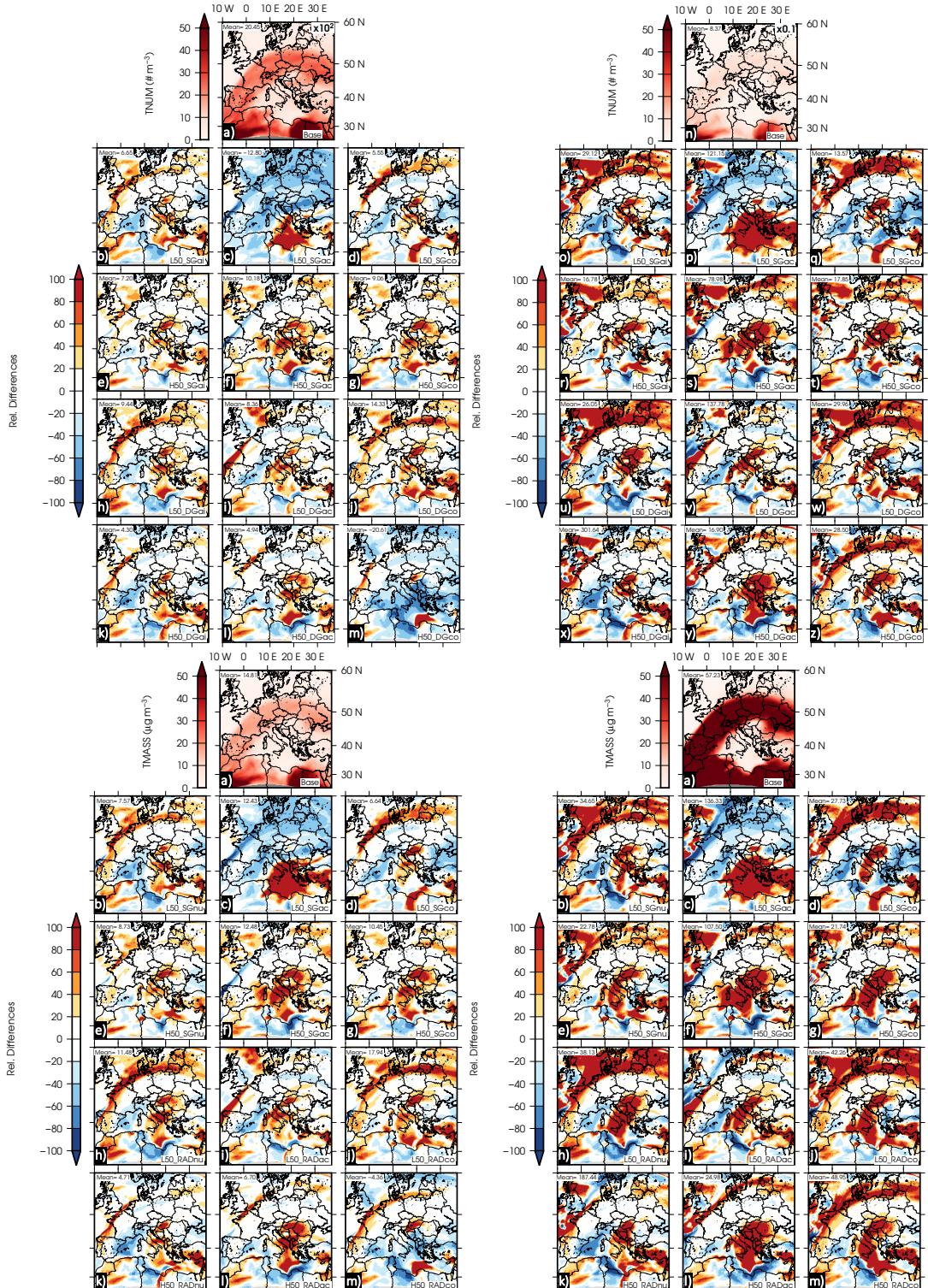
**Figure S5.** PM-ratio at 750 hPa for the base case and differences for sensitivity simulations at 50 %. a) Base case; b) Aitken mode 50% reduction in SG; c) accumulation mode 50% reduction in SG; d) coarse mode 50% reduction in SG; e) Aitken mode 50% increase in SG; f) accumulation mode 50% increase in SG; g) coarse mode 50% increase in SG; h) Aitken mode 50% reduction in DG; i) accumulation mode 50% reduction in DG; j) coarse mode 50% reduction in DG; k) Aitken mode 50% increase in DG; l) accumulation mode 50% increase in DG; m) coarse mode 50% increase in DG.

## **References**

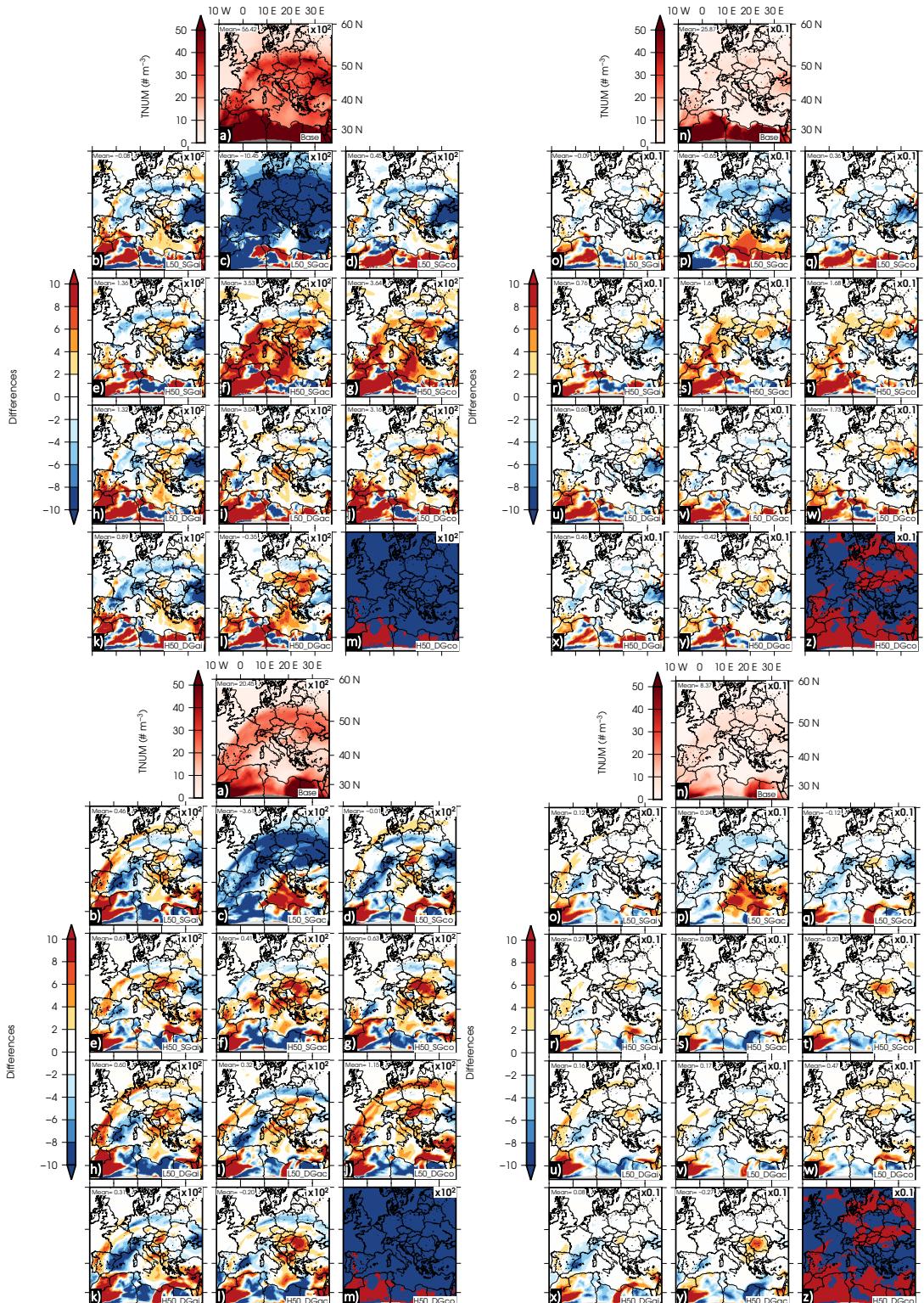
Palacios-Peña, L., Lorente-Plazas, R., Montávez, J. P., and Jiménez-Guerrero, P.: Saharan Dust Modeling Over the Mediterranean Basin and Central Europe: Does the Resolution Matter?, *Frontiers in Earth Science*, 7, 290, doi: 10.3389/feart.2019.00290, 2019.



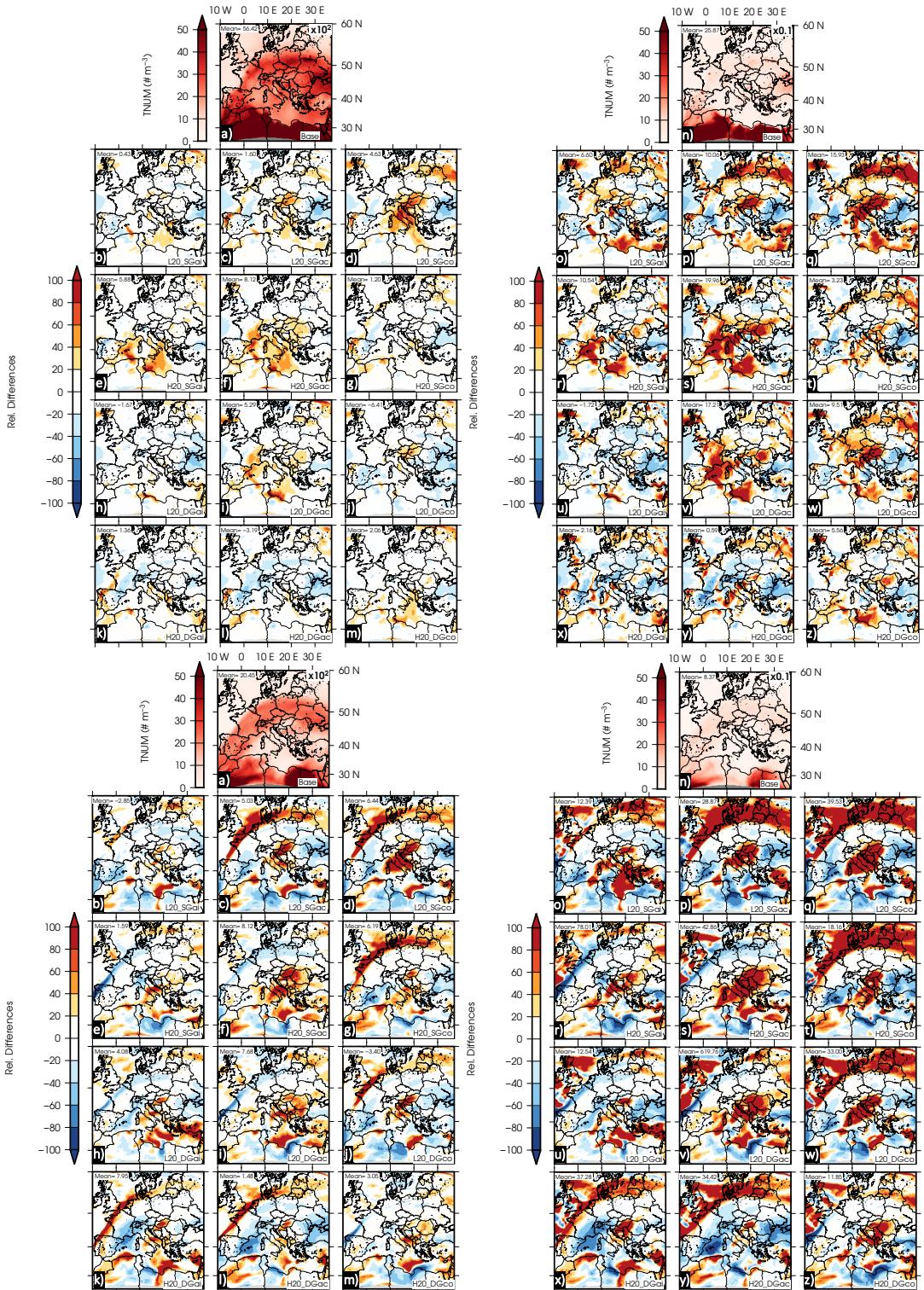
**Figure S6.** PM-ratio at 1000 (left) and 750hPa (right) for the base case and differences for sensitivity simulations at 10 % (top) and 20 % (bottom). a) Base case; b) Aitken mode reduction in SG; c) accumulation mode reduction in SG; d) coarse mode reduction in SG; e) Aitken mode increase in SG; f) accumulation mode increase in SG; g) coarse mode increase in SG; h) Aitken mode reduction in DG; i) accumulation mode reduction in DG; j) coarse mode reduction in DG; k) Aitken mode increase in DG; l) accumulation mode increase in DG; m) coarse mode increase in DG.



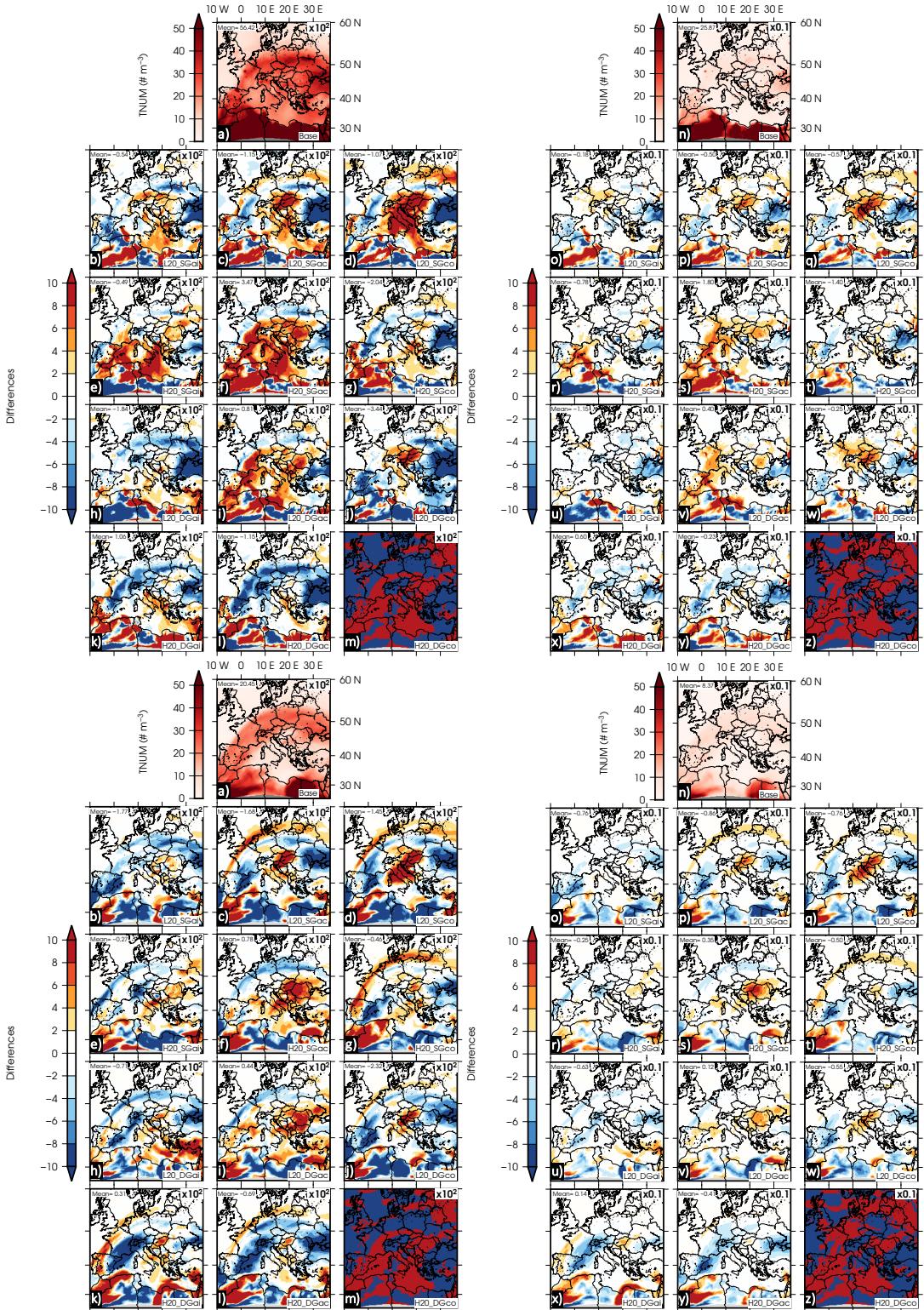
**Figure S7.** Total number concentration of particles (top) and total mass concentration (bottom) at 750 hPa in the Aitken and accumulation (left) and coarse (right) modes for the base case and relative differences for sensitivity test simulations at 50 %. Accumulation mode: a) Base case; b) Aitken mode 50% reduction in SG; c) accumulation mode 50% reduction in SG; d) coarse mode 50% reduction in SG; e) Aitken mode 50% increase in SG; f) accumulation mode 50% increase in SG; g) coarse mode 50% increase in SG; h) Aitken mode 50% reduction in DG; i) accumulation mode 50% reduction in DG; j) coarse mode 50% reduction in DG; k) Aitken mode 50% increase in DG; l) accumulation mode 50% increase in DG; m) coarse mode 50% increase in DG. n-z) Id. for the coarse mode.



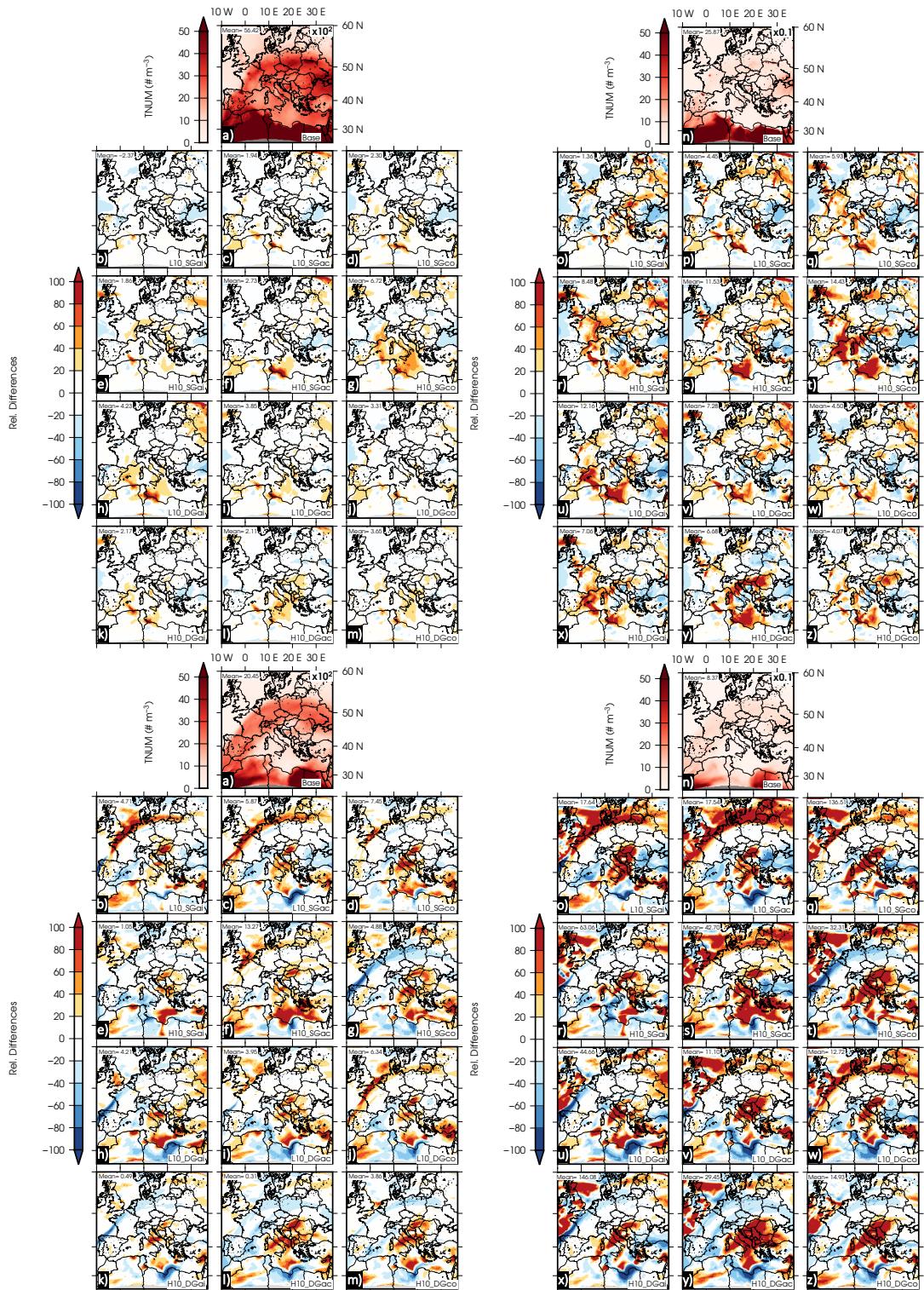
**Figure S8.** Total number concentration of particles (top) and total mass concentration (bottom) at 750 hPa in the Aitken and accumulation (left) and coarse (right) modes for the base case and non-relative differences for sensitivity test simulations at 50 %. Accumulation mode:  
 a) Base case; b) Aitken mode 50% reduction in SG; c) accumulation mode 50% reduction in SG; d) coarse mode 50% reduction in SG; e) Aitken mode 50% increase in SG; f) accumulation mode 50% increase in SG; g) coarse mode 50% increase in SG; h) Aitken mode 50% reduction in DG; i) accumulation mode 50% reduction in DG; j) coarse mode 50% reduction in DG; k) Aitken mode 50% increase in DG; l) accumulation mode 50% increase in DG. n-z) Id. for the coarse mode.



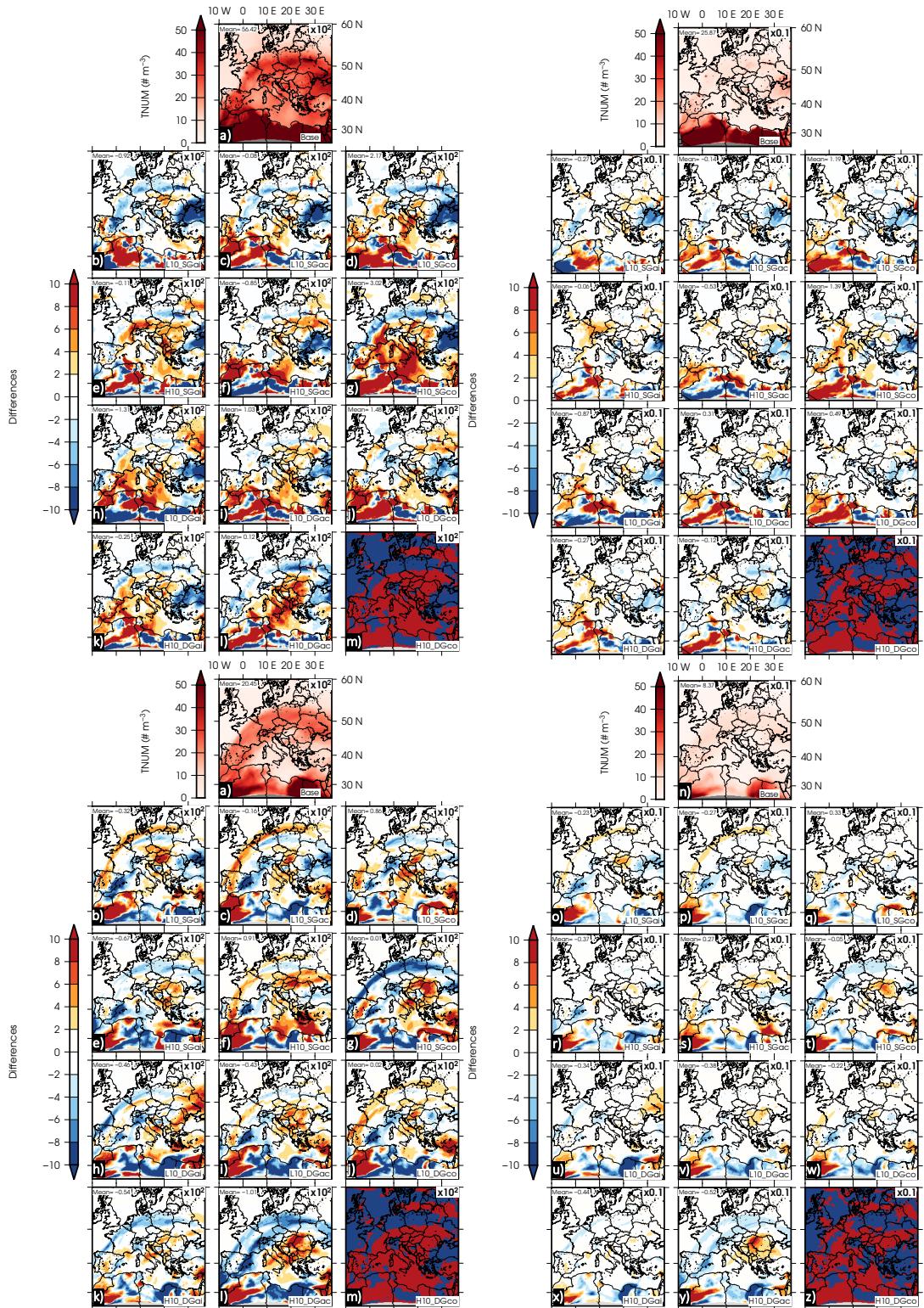
**Figure S9.** Total number concentration of particles at 1000 (top) and 750 hPa (bottom) in the Aitken and accumulation (left) and coarse (right) modes for the base case and relative differences for sensitivity test simulations at 20 %. Accumulation mode: a) Base case; b) Aitken mode 20% reduction in SG; c) accumulation mode 20% reduction in SG; d) coarse mode 20% reduction in SG; e) Aitken mode 20% increase in SG; f) accumulation mode 20% increase in SG; g) coarse mode 20% increase in SG; h) Aitken mode 20% reduction in DG; i) accumulation mode 20% reduction in DG; j) coarse mode 20% reduction in DG; k) Aitken mode 20% increase in DG; l) accumulation mode 20% increase in DG. n-z Id. for the coarse mode.



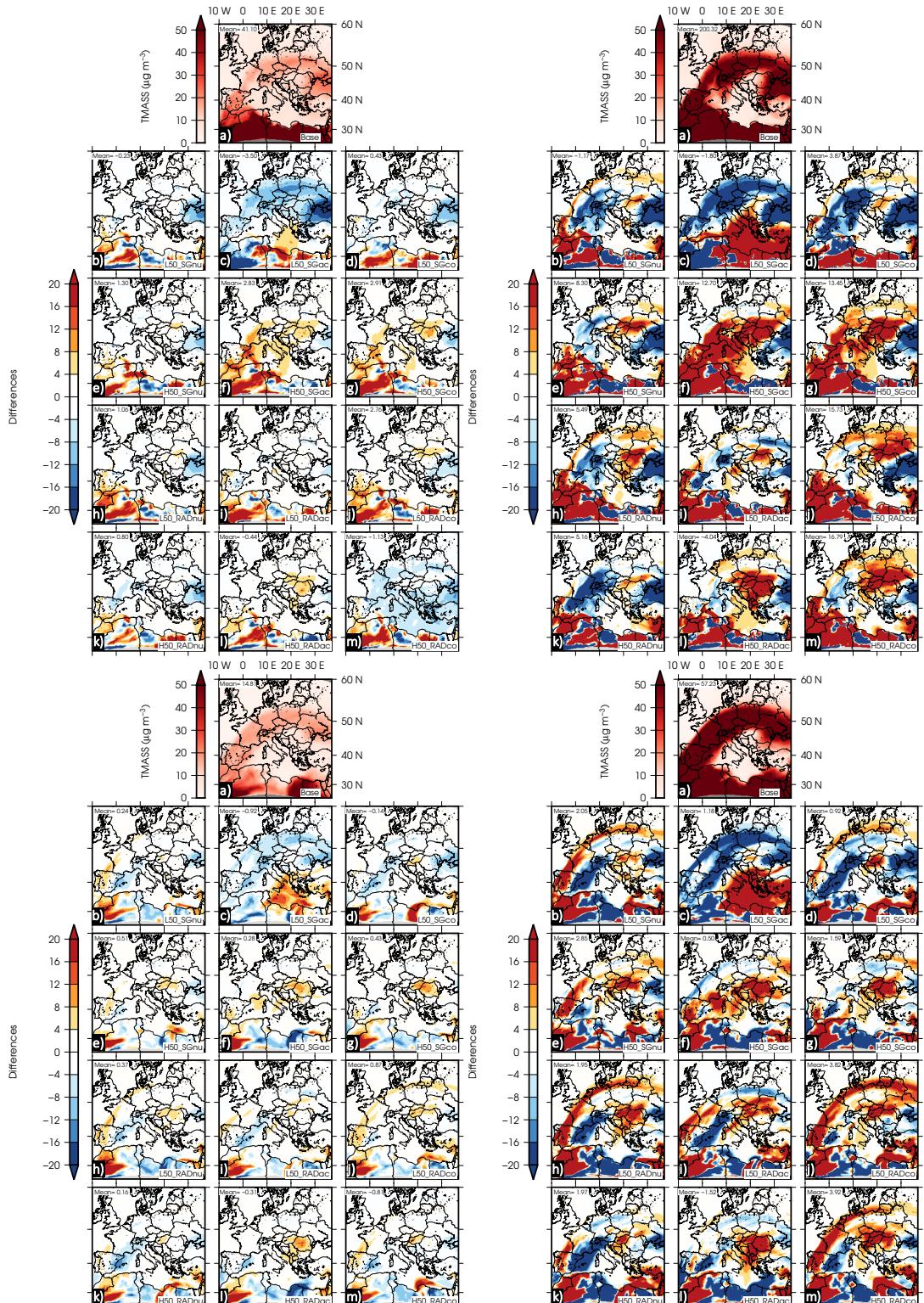
**Figure S10.** Id. Figure S8 but for sensitivity test at 20 %.



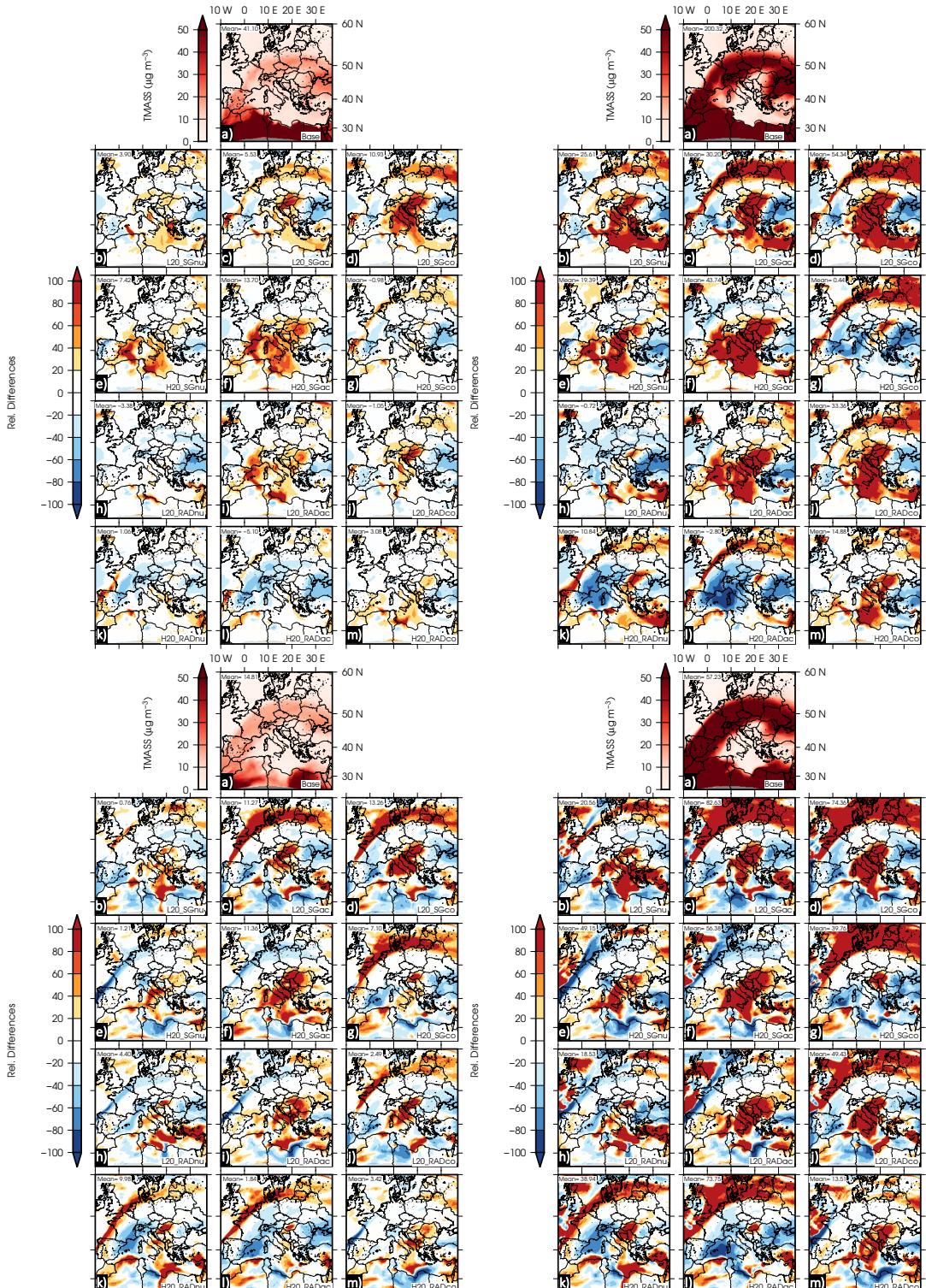
**Figure S11.** Id. Figure S9 but for sensitivity test at 10 %.



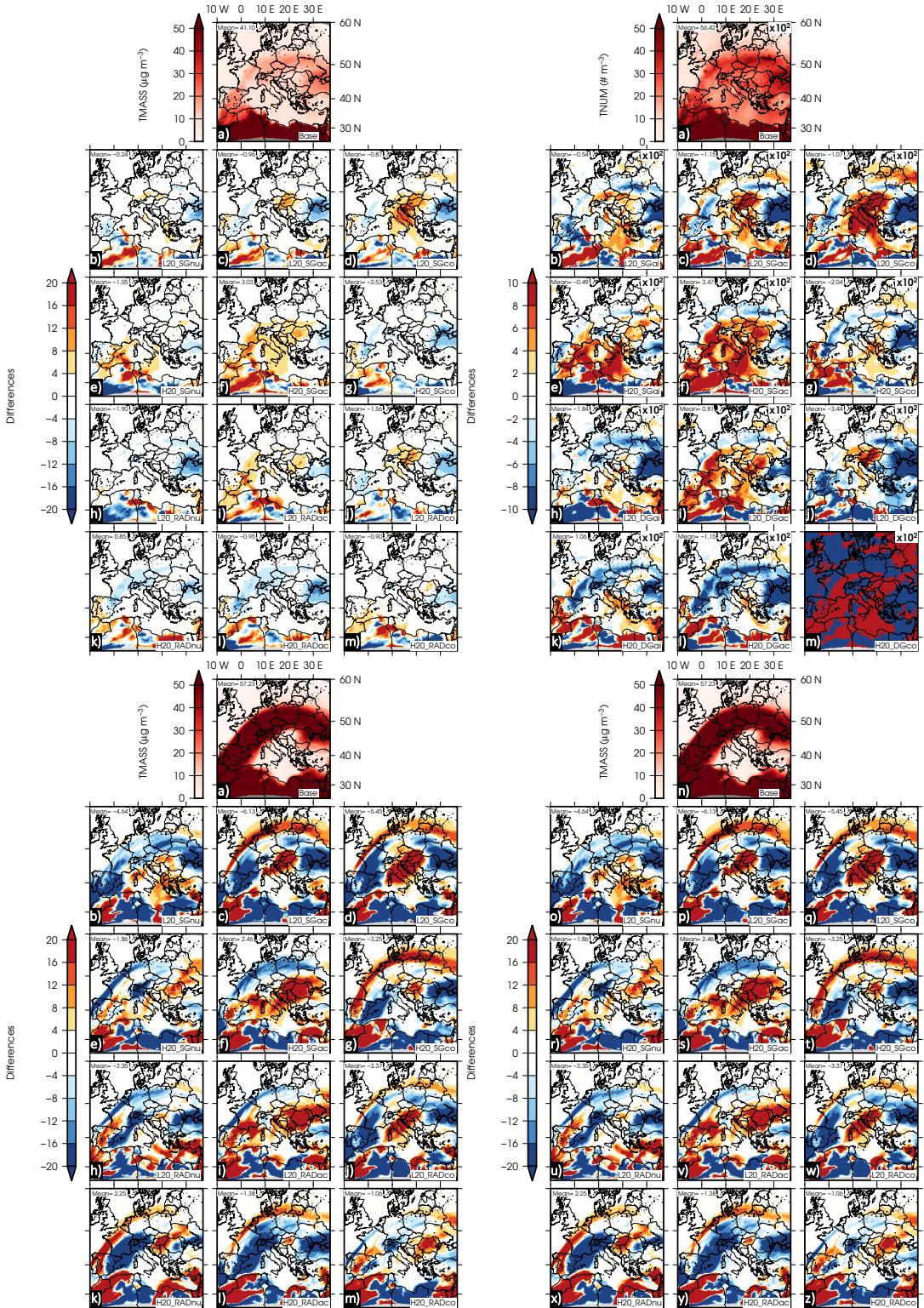
**Figure S12.** Id. Figure S8 but for sensitivity test at 10 %.



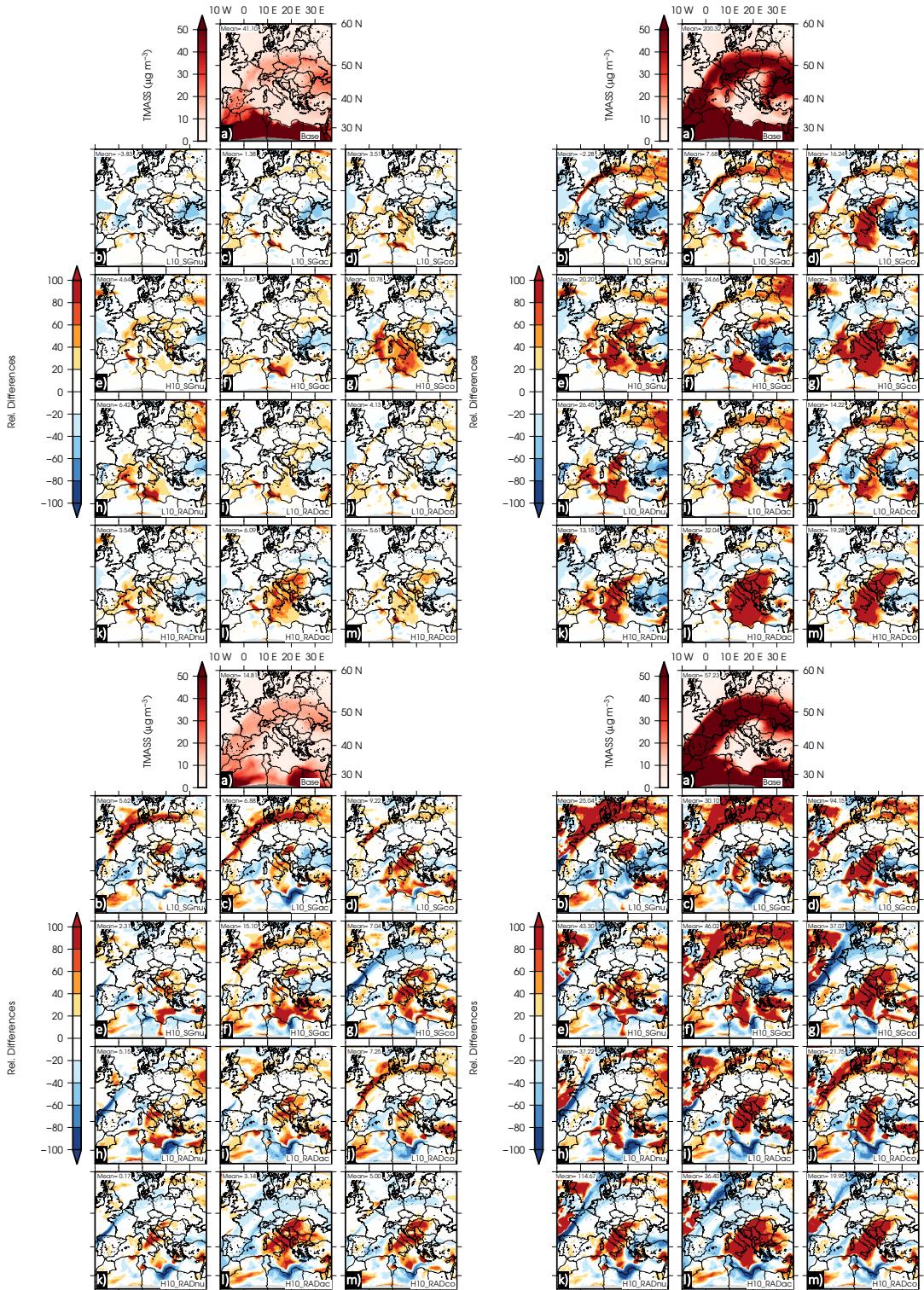
**Figure S13.** Total mass concentration at 1000 (top) and 750 hPa (bottom) in the Aitken and accumulation (left) and coarse (right) modes for the base case and non-relative differences for sensitivity test simulations at 50 %. Accumulation mode: a) Base case; b) Aitken mode 50% reduction in SG; c) accumulation mode 50% reduction in SG; d) coarse mode 50% reduction in SG; e) Aitken mode 50% increase in SG; f) accumulation mode 50% increase in SG; g) coarse mode 50% increase in SG; h) Aitken mode 50% reduction in DG; i) accumulation mode 50% reduction in DG; j) coarse mode 50% reduction in DG; k) Aitken mode 50% increase in DG; l) accumulation mode 50% increase in DG; m) coarse mode 50% increase in DG.  $\Delta$  is the difference between the base case and the simulation with the parameter change.



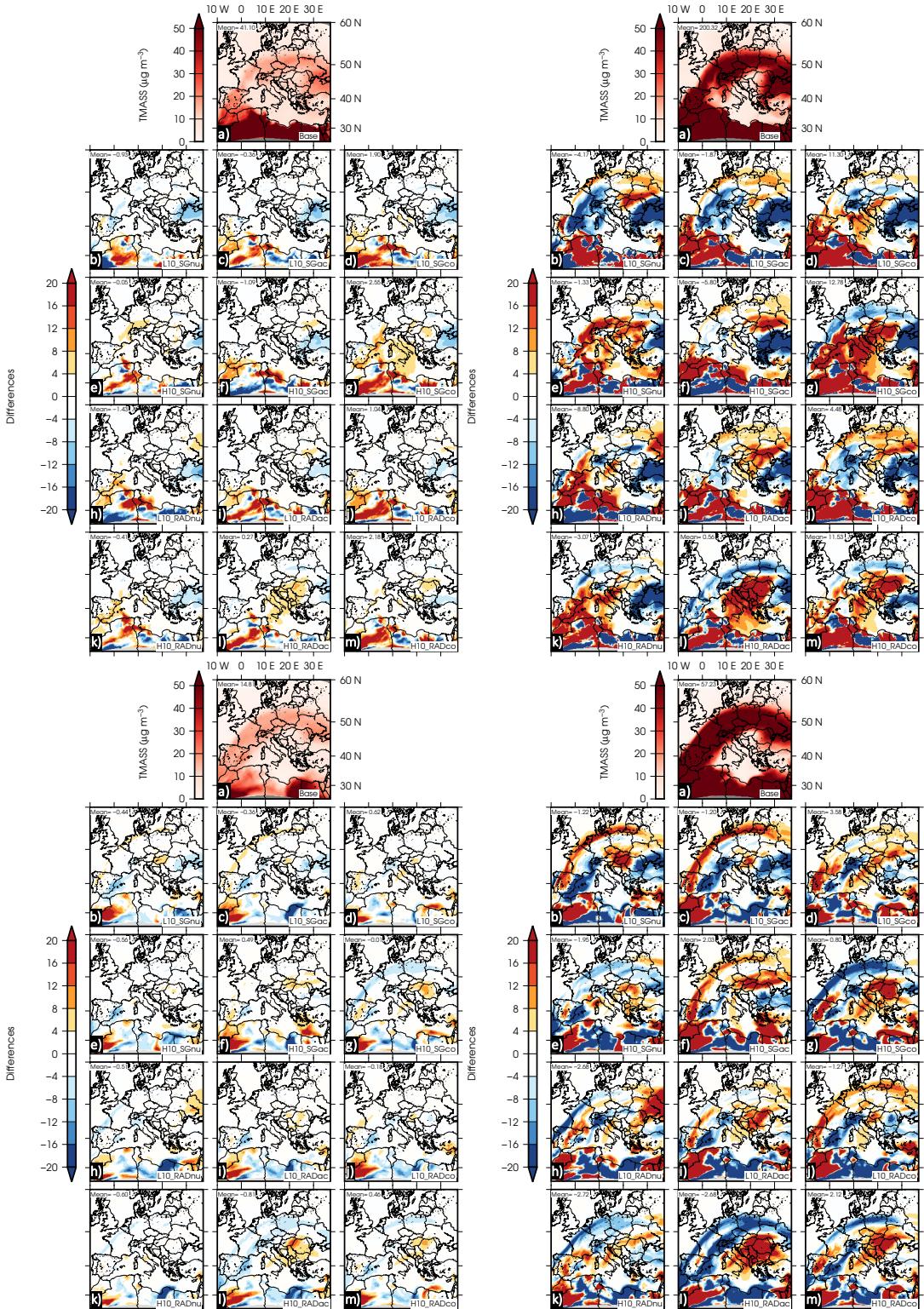
**Figure S14.** Total mass concentration of particles at 1000 (top) and 750 hPa (bottom) in the Aitken and accumulation (left) and coarse (right) modes for the base case and relative differences for sensitivity test simulations at 20 %. Accumulation mode: a) Base case; b) Aitken mode 20% reduction in SG; c) accumulation mode 20% reduction in SG; d) coarse mode 20% reduction in SG; e) Aitken mode 20% increase in SG; f) accumulation mode 20% increase in SG; g) coarse mode 20% increase in SG; h) Aitken mode 20% reduction in DG; i) accumulation mode 20% reduction in DG; j) coarse mode 20% reduction in DG; k) Aitken mode 20% increase in DG; l) accumulation mode 20% increase in DG; m) coarse mode 20% increase in DG. n-z Id. for the coarse mode.



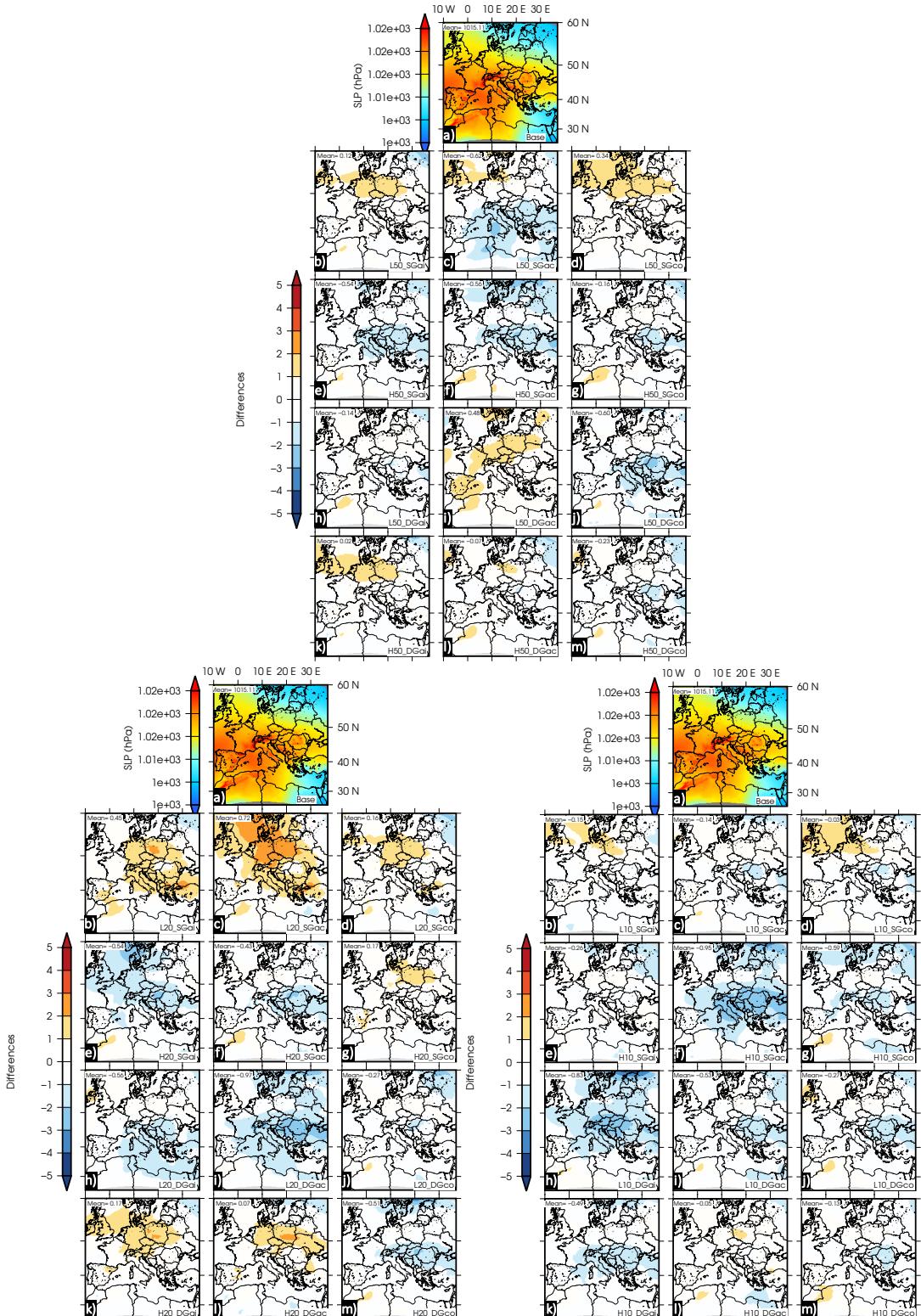
**Figure S15.** Id. Figure S13 but for sensitivity test at 20 %.



**Figure S16.** Id. Figure S14 but for sensitivity test at 10 %.



**Figure S17.** Id. Figure S13 but for sensitivity test at 10 %.



**Figure S18.** SLP for the base case and its variations for sensitivity test simulations at 50 (top), 20 (bottom-left) and 10 % (bottom-right). a) Base case; b) Aitken mode reduction in SG; c) accumulation mode reduction in SG; d) coarse mode reduction in SG; e) Aitken mode increase in SG; f) accumulation mode increase in SG; g) coarse mode increase in SG; h) Aitken mode reduction in DG; i) accumulation mode reduction in DG; j) coarse mode reduction in DG; k) Aitken mode increase in DG; l) accumulation mode increase in DG; m) coarse mode 20% increase in DG. n-z) Id. for the coarse mode.