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Supplementary Material

Bulk cloud microphysical properties as seen from numerical simulation and remote sensing products: case study of a hailstorm event over the La Plata Basin

Angel Liduvino Vara-Vela[A,F,*], *Natália Machado Crespo*[A,E], *Éder Paulo Vendrasco*[B], *Noelia Rojas Benavente*[A], *Marcos Vinicius Bueno de Morais*[A,C], *Jorge Alberto Martins*[C], *Vaughan Trevor James Phillips*[D], *Fabio Luiz Teixeira Gonçalves*[A] and *Maria Assunção Faus da Silva Dias*[A]

[A]Departamento de Ciências Atmosféricas, Instituto de Astronomia, Geofísica e Ciências Atmosféricas, Universidade de São Paulo, Rua do Matão 1226, São Paulo 05508-090, SP, Brazil

[B]Center for Weather Forecasting and Climate Studies, National Institute for Space Research, Cachoeira Paulista, Brazil

[C]Federal University of Technology – Parana, Avenida dos Pioneiros 3131, Londrina 86047-125, PR, Brazil

[D]Department of Physical Geography, University of Lund, Solvegatan 12, SE-22362 Lund, Sweden

[E]Department of Atmospheric Physics, Faculty of Mathematics and Physics, Charles University, V Holešovičkách 2, CZ-180 00 Prague, Czechia

[F]Department of Geoscience, Aarhus University, DK-8000 Aarhus, Denmark

*Correspondence to: Email: angel@geo.au.dk

Table S1. 24-hour surface accumulated precipitation (1200 hours UTC on 14 July to 1200 hours UTC on 15 July 2016) from MERGE estimates and BRAMS simulations at four National Institute of Meteorology (INMET) stations.

Station (State)	INMET	MERGE	BRAMS/GFS	BRAMS/CFSv2	BRAMS/ERA5
Florianópolis (SC)	44.2	38.7	0.7	45.7	41.4
São Miguel (SC)	22.6	8.5	17.1	0.6	44.1
Canela (RS)	39.8	37.2	46.6	34.3	1.3
Erechim (RS)	21.4	40.7	40.4	21.9	135.3

Precipitation is in millimetres.

Table S2. 48-hour surface accumulated precipitation (0000 hours UTC on 14 July to 2300 hours UTC on 15 July 2016) from CHIRPS estimates and BRAMS simulations at four National Institute of Meteorology (INMET) stations.

Station (State)	INMET	CHIRPS	BRAMS/GFS	BRAMS/CFSv2	BRAMS/ERA5
Florianópolis (SC)	81.2	40.1	3.2	47.5	97.7
São Miguel (SC)	23.2	45.2	17.1	0.6	46.7
Canela (RS)	63.6	77.9	72.2	38.9	1.5
Erechim (RS)	81.4	68.3	41.1	24.9	162.2

Precipitation is in millimetres.

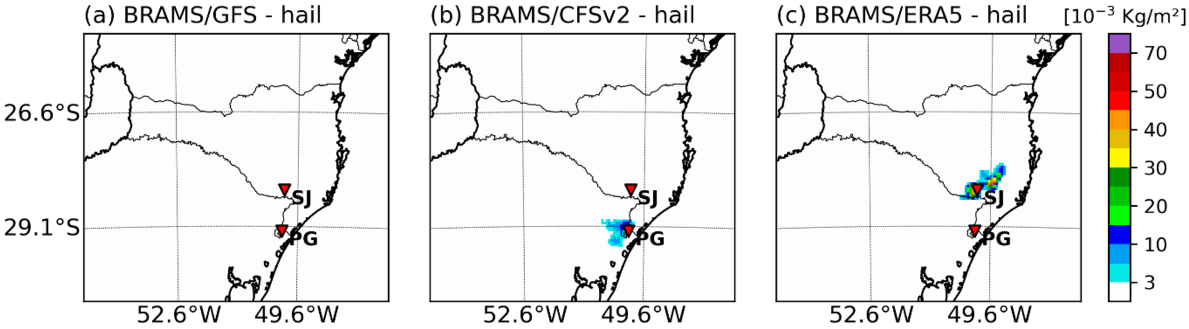

Fig. S1. Spatial distribution of surface accumulated hail concentrations derived from the (a) BRAMS/GFS, (b) BRAMS/CFSv2 and (c) BRAMS/ERA5 simulations during the period from 0000 hours UTC on 14 July to 0000 hours UTC on 16 July 2016. Spatial distributions from BRAMS/ERA5 and BRAMS/CFSv2 simulations covered locations where hail fall was reported, namely São Joaquim (SJ) and Praia Grande (PG), both indicated by the red triangles on the figure (https://estado.sc.gov.br/noticias/sc-registra-granizo-em-pelo-menos-nove-cidades/).

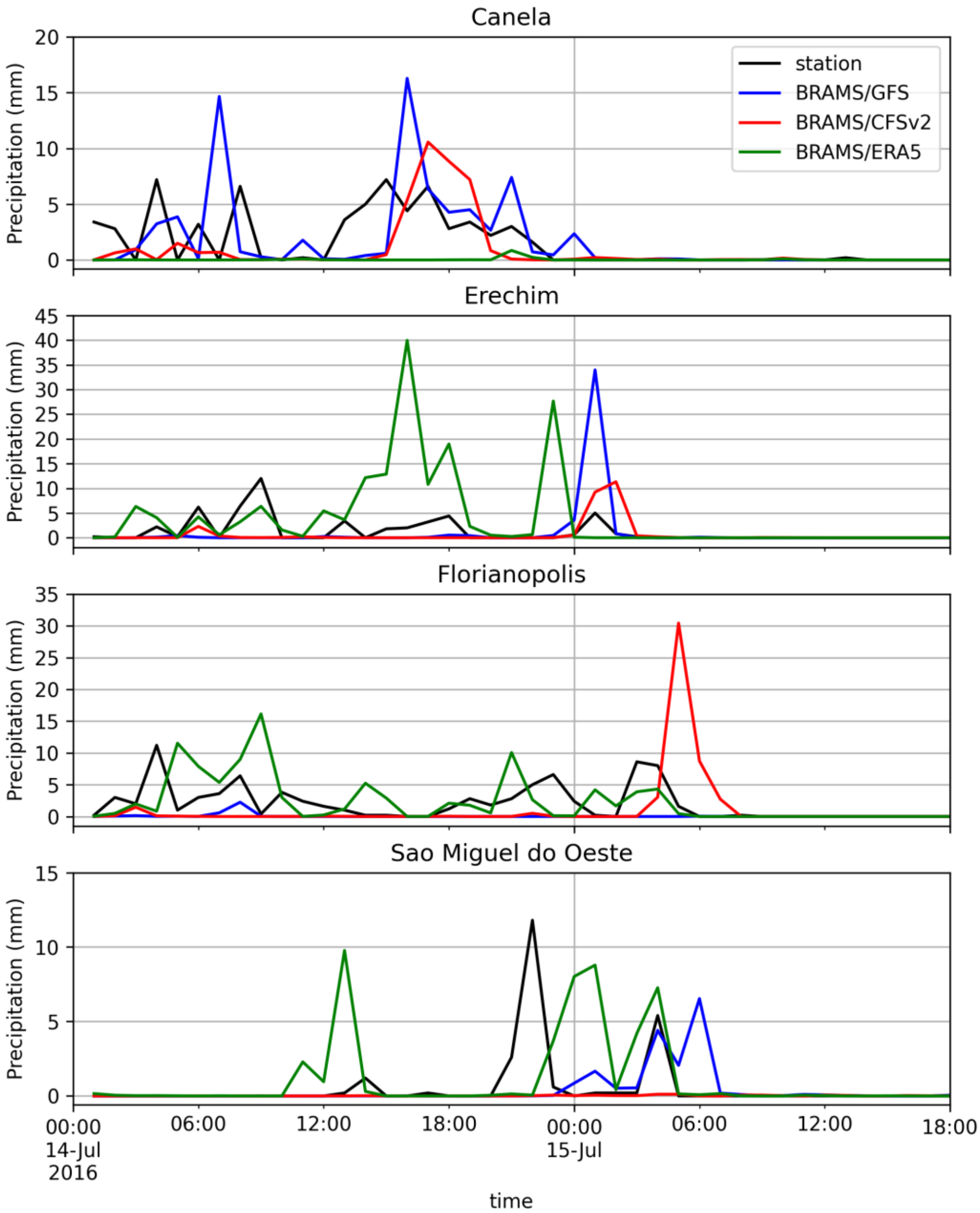

Fig. S2. Time series of hourly precipitation (mm) at four INMET stations during the period from 0000 hours UTC on 14 July to 2300 hours UTC on 15 July 2016.

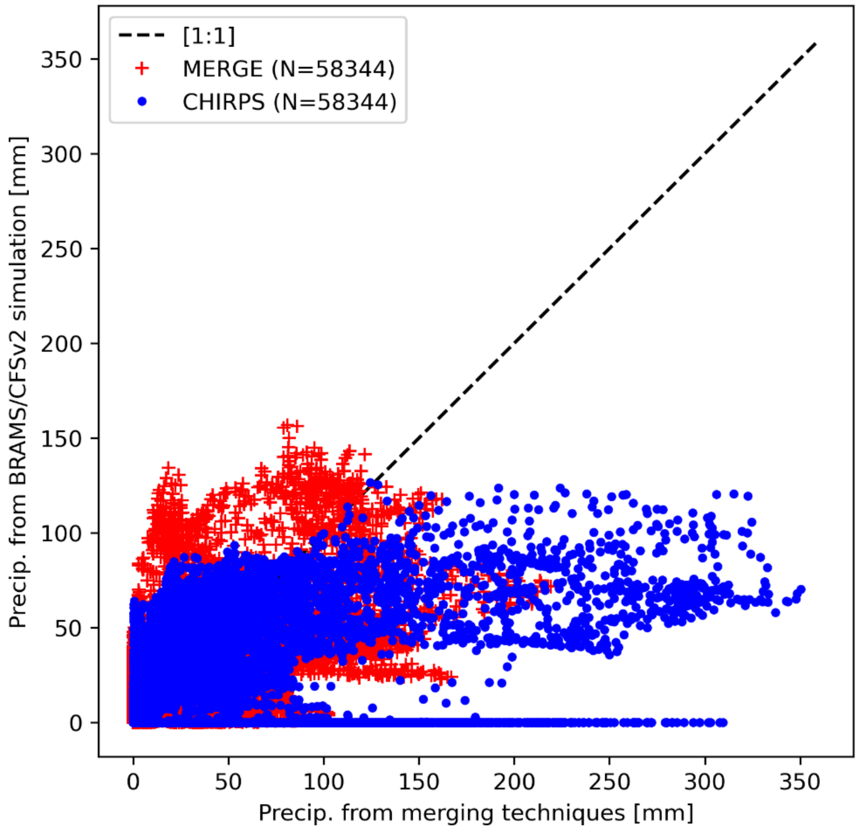

Fig. S3. Scatter plots depicting observed and simulated accumulated precipitation from MERGE and BRAMS/CFSv2 (in red), and from CHIRPS and BRAMS/CFSv2 (in blue), together with the corresponding number of valid observation-model pairs.

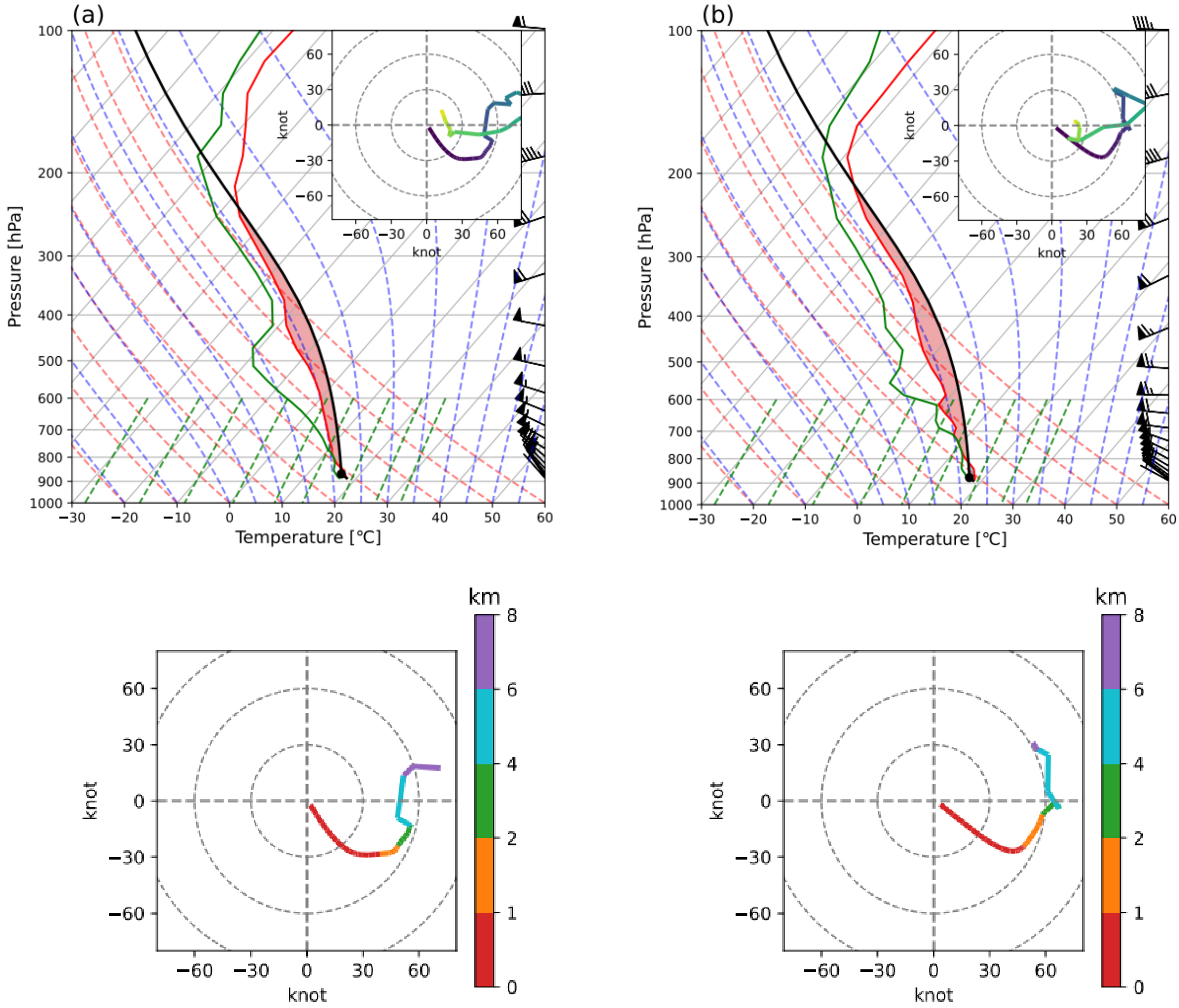

Fig. S4. Skew-T diagrams showing the profiles of temperature (red lines, °C), dew-point temperature (green lines, °C) and wind (barbs, knots) derived from (a) BRAMS/CFSv2 at Praia Grande (CAPE = 847.2 J kg^{-1}; CIN = –15.3 J kg^{-1}; 0–8-km bulk shear of 72.1 kt, ~36.6 m s^{-1}) and from (b) BRAMS/ERA5 at São Joaquim (CAPE = 1032.5 J kg^{-1}; CIN = -19.9 J kg^{-1}; 0–8-km bulk shear of 59.8 kt, ~30.8 m s^{-1}) at 0000 hours UTC on 15 July 2016. Praia Grande and São Joaquim in southern Santa Catarina State were among the areas covered by the simulations and where hail fall was reported (see Fig. S1).

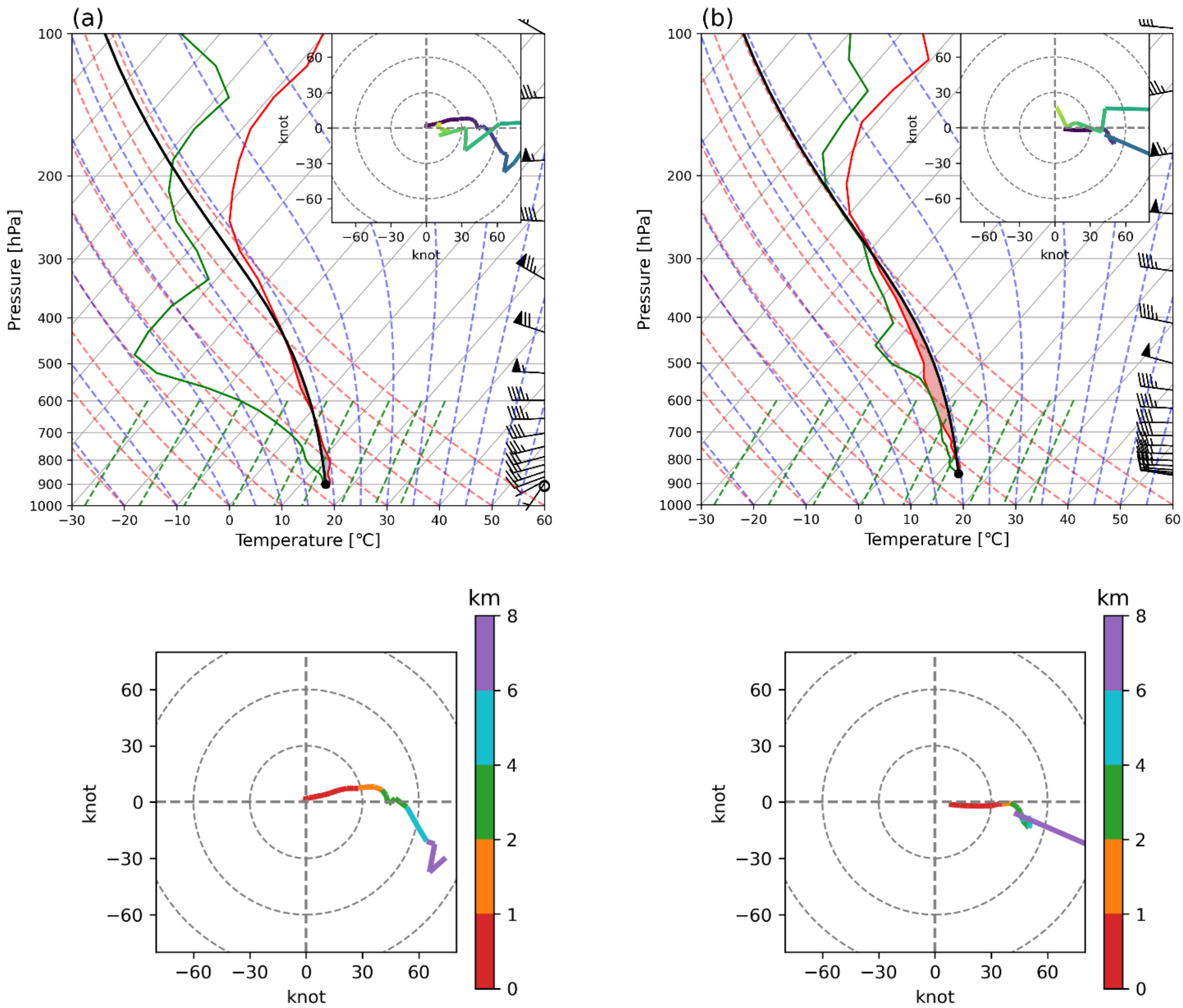

Fig. S5. Skew-T diagrams showing the profiles of temperature (red lines, °C), dew-point temperature (green lines, °C) and wind (barbs, knots) derived from (a) BRAMS/GFS at Praia Grande (CAPE = 52.7 J kg^{-1}; CIN = –66.8 J kg^{-1}; 0–8-km bulk shear of 74.8 kt, ~38.5 m s^{-1}) and from (b) BRAMS/GFS at São Joaquim (CAPE = 409.1 J kg^{-1}; CIN = –0.3 J kg^{-1}; 0–8-km bulk shear of 70.4 kt, ~36.2 m s^{-1}) at 0000 hours UTC on 15 July 2016. No concentrations of surface hail were derived from the BRAMS/GFS simulation.

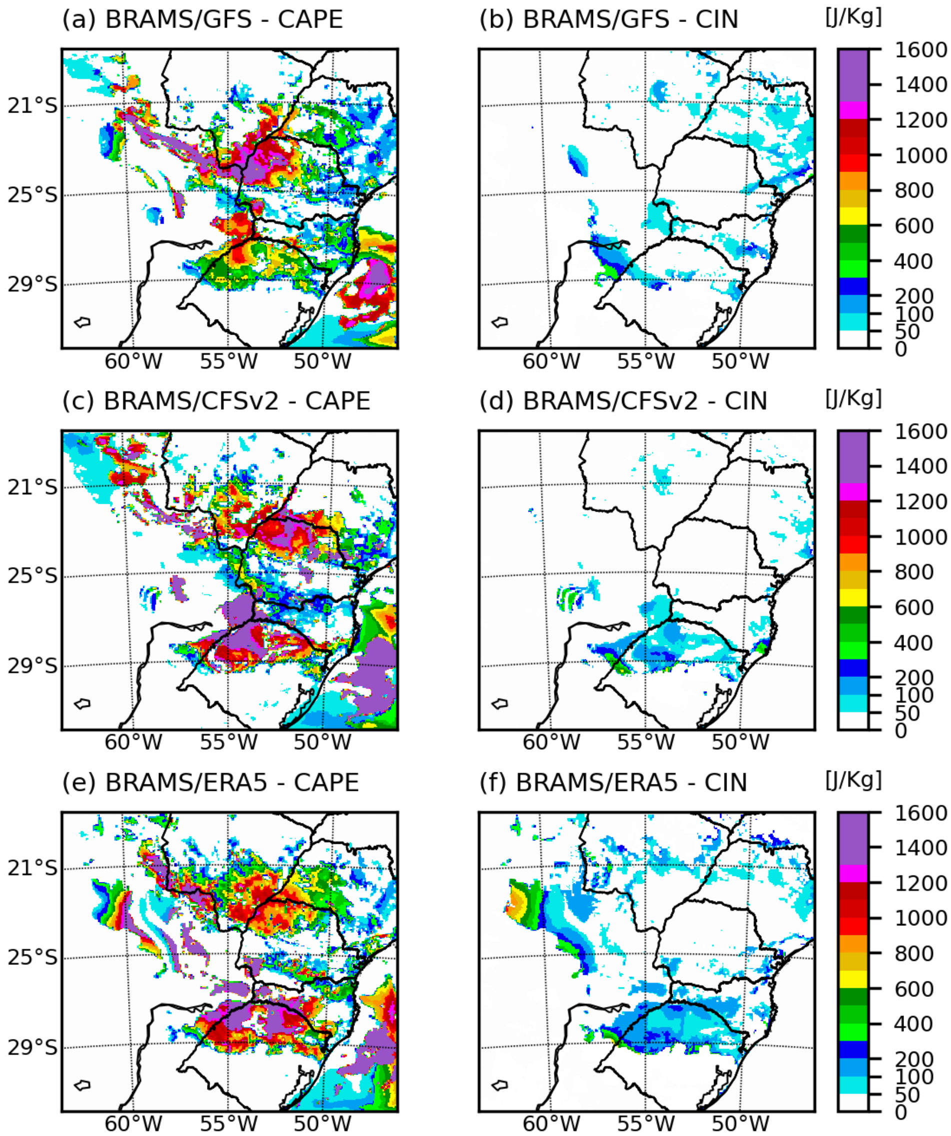

Fig. S6. Spatial distribution of averaged CAPE and CIN from BRAMS/GFS (a and b), BRAMS/CFSv2 (c and d), and BRAMS/ERA5 (e and f) simulations over the period from 2200 hours UTC on 14 July 2016 to 0200 hours UTC on 15 July 2016.

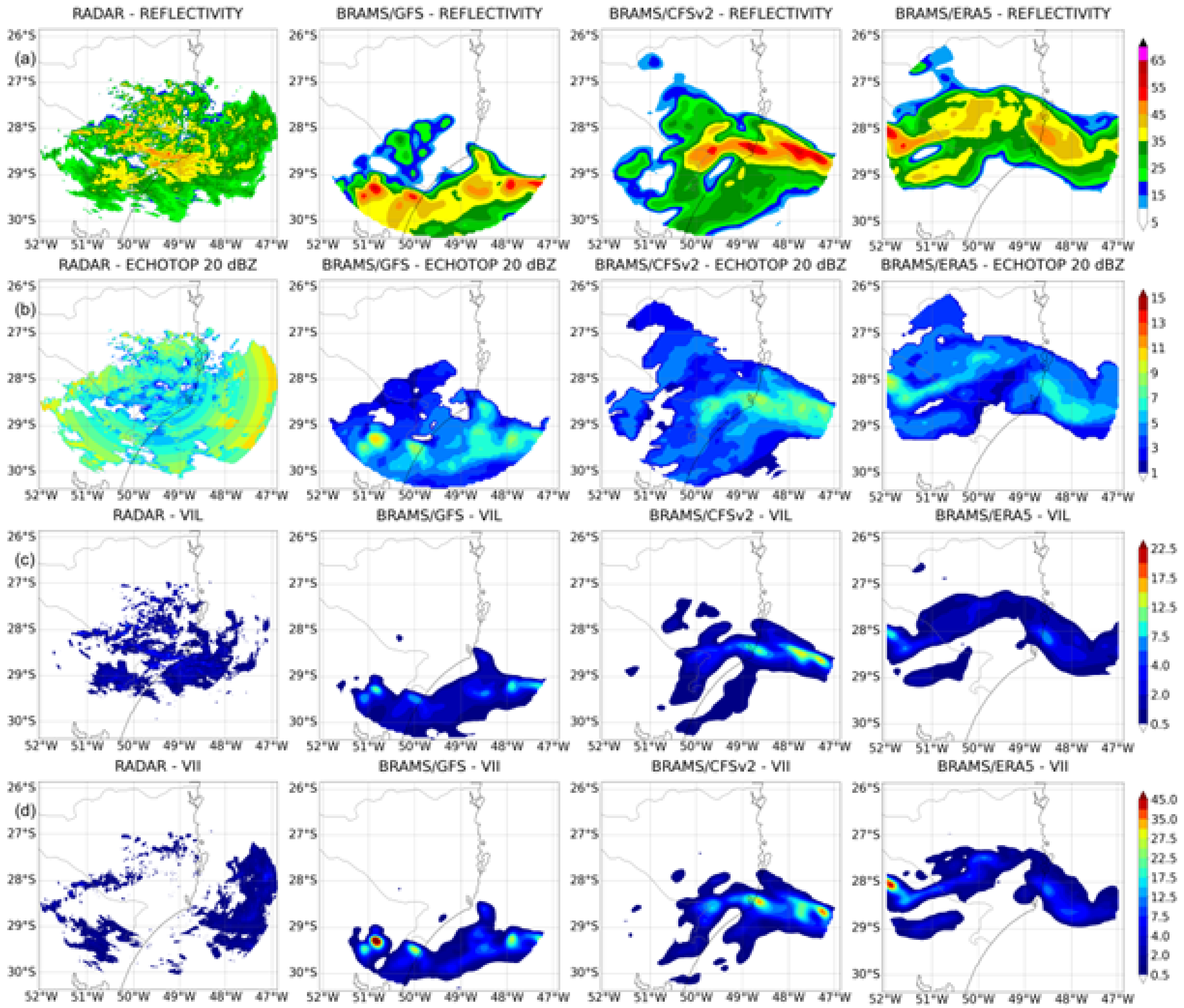

Fig. S7. Spatial distribution of reflectivity (a), Echo Top of 20 dBZ (b), vertically integrated liquid (c), and vertically integrated ice (d) derived from the DWR instrument (first column) and from BRAMS/GFS, BRAMS/CFSv2 and BRAMS/ERA5 simulations (second, third and fourth columns respectively), at 2000 hours UTC on 14 July 2016.

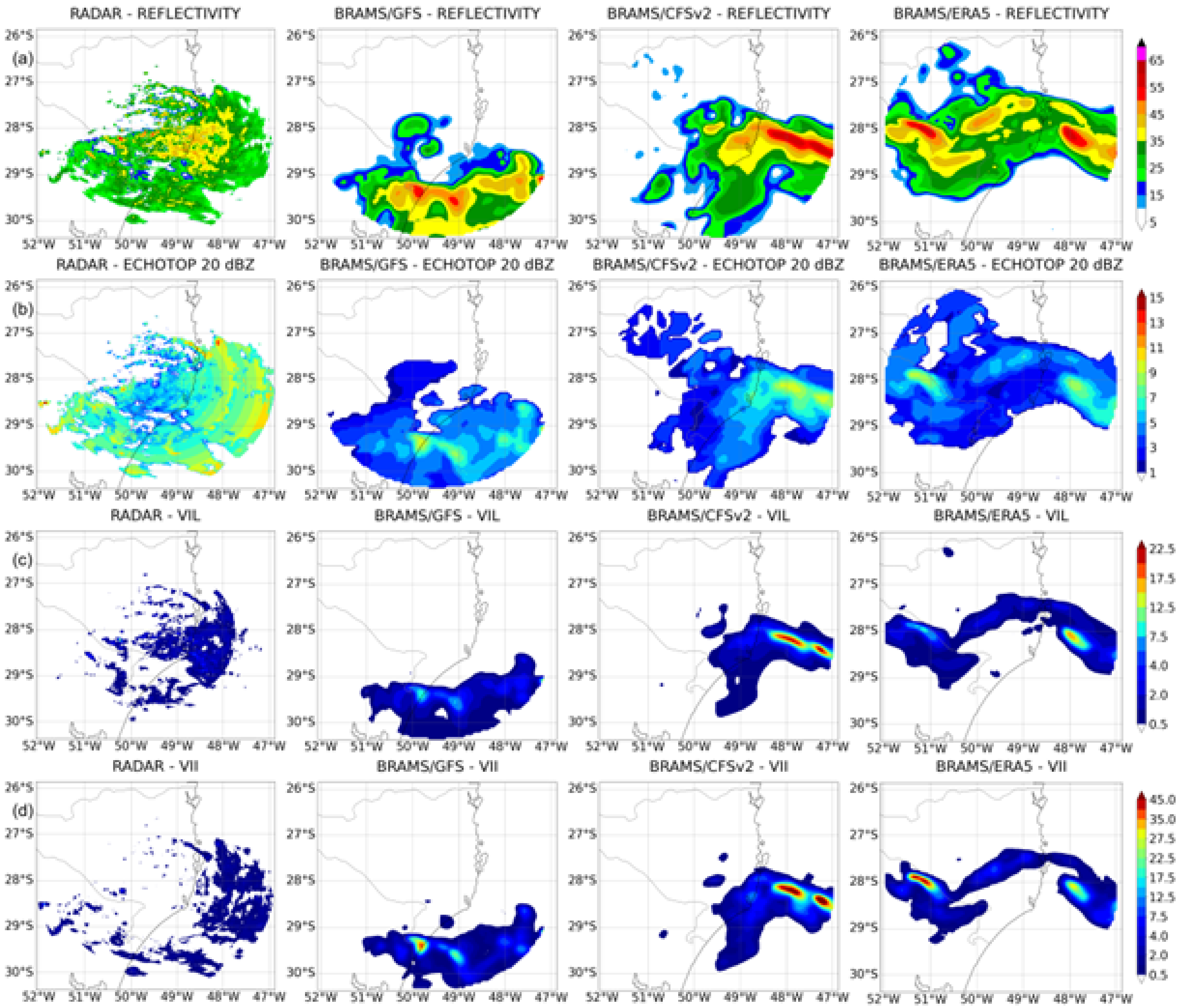

Fig. S8. Spatial distribution of reflectivity (a), Echo Top of 20 dBZ (b), vertically integrated liquid (c), and vertically integrated ice (d) derived from the DWR instrument (first column) and from BRAMS/GFS, BRAMS/CFSv2 and BRAMS/ERA5 simulations (second, third and fourth columns respectively), at 2100 hours UTC on 14 July 2016.

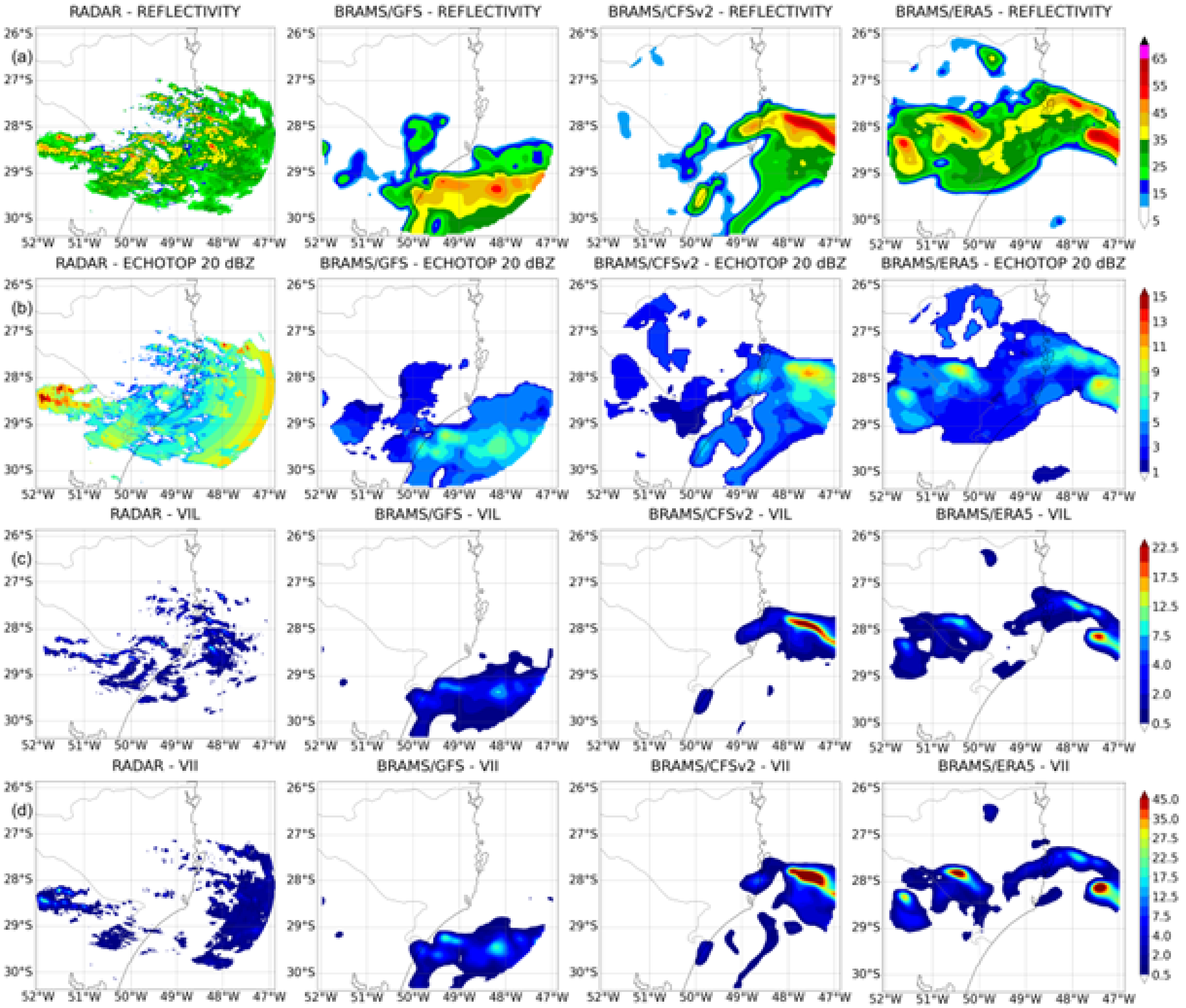

Fig. S9. Spatial distribution of reflectivity (a), Echo Top of 20 dBZ (b), vertically integrated liquid (c), and vertically integrated ice (d) derived from the DWR instrument (first column) and from BRAMS/GFS, BRAMS/CFSv2 and BRAMS/ERA5 simulations (second, third and fourth columns respectively), at 2200 hours UTC on 14 July 2016.

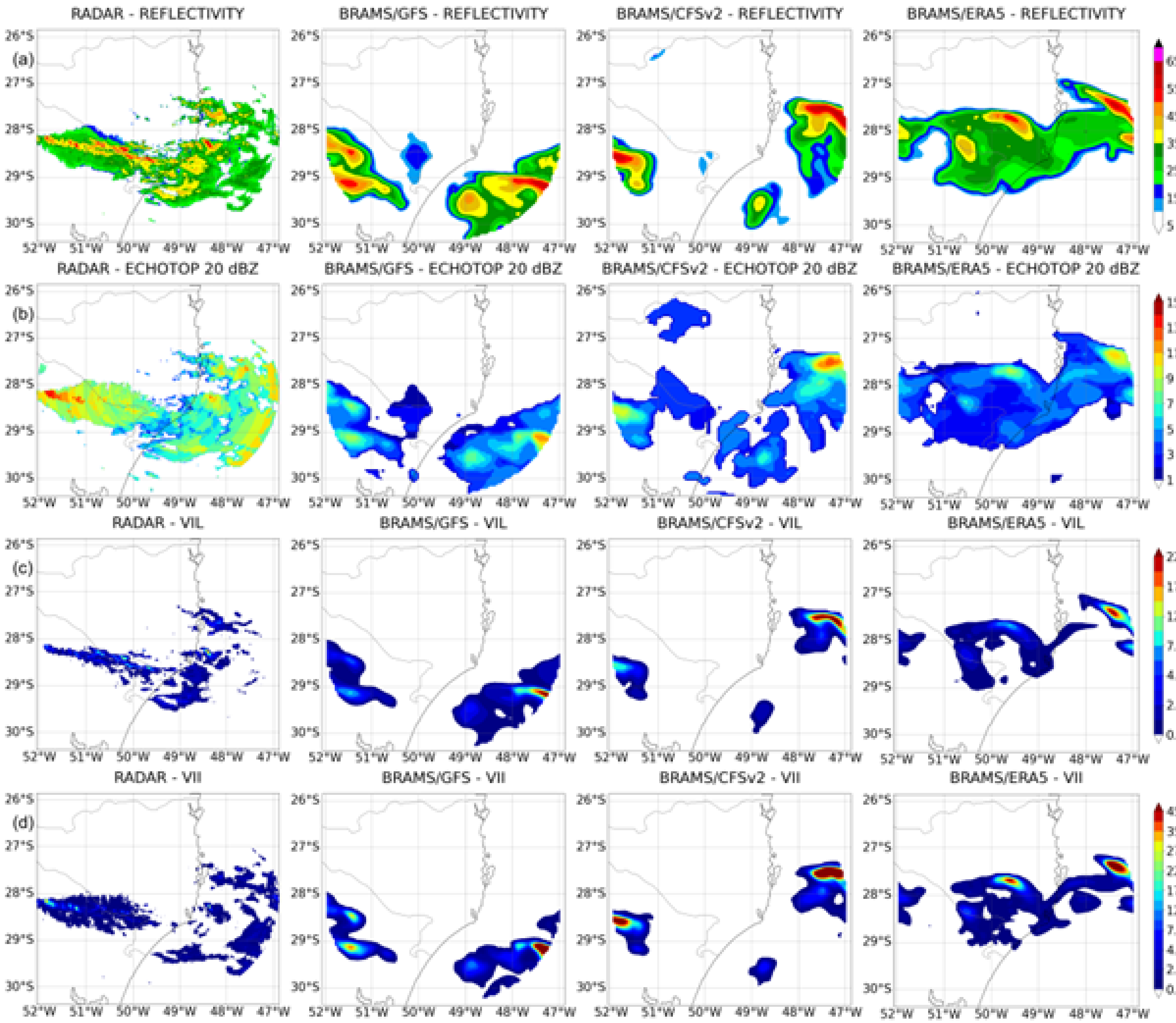

Fig. S10. Spatial distribution of reflectivity (a), Echo Top of 20 dBZ (b), vertically integrated liquid (c), and vertically integrated ice (d) derived from the DWR instrument (first column) and from BRAMS/GFS, BRAMS/CFSv2 and BRAMS/ERA5 simulations (second, third and fourth columns respectively), at 2300 hours UTC on 14 July 2016.

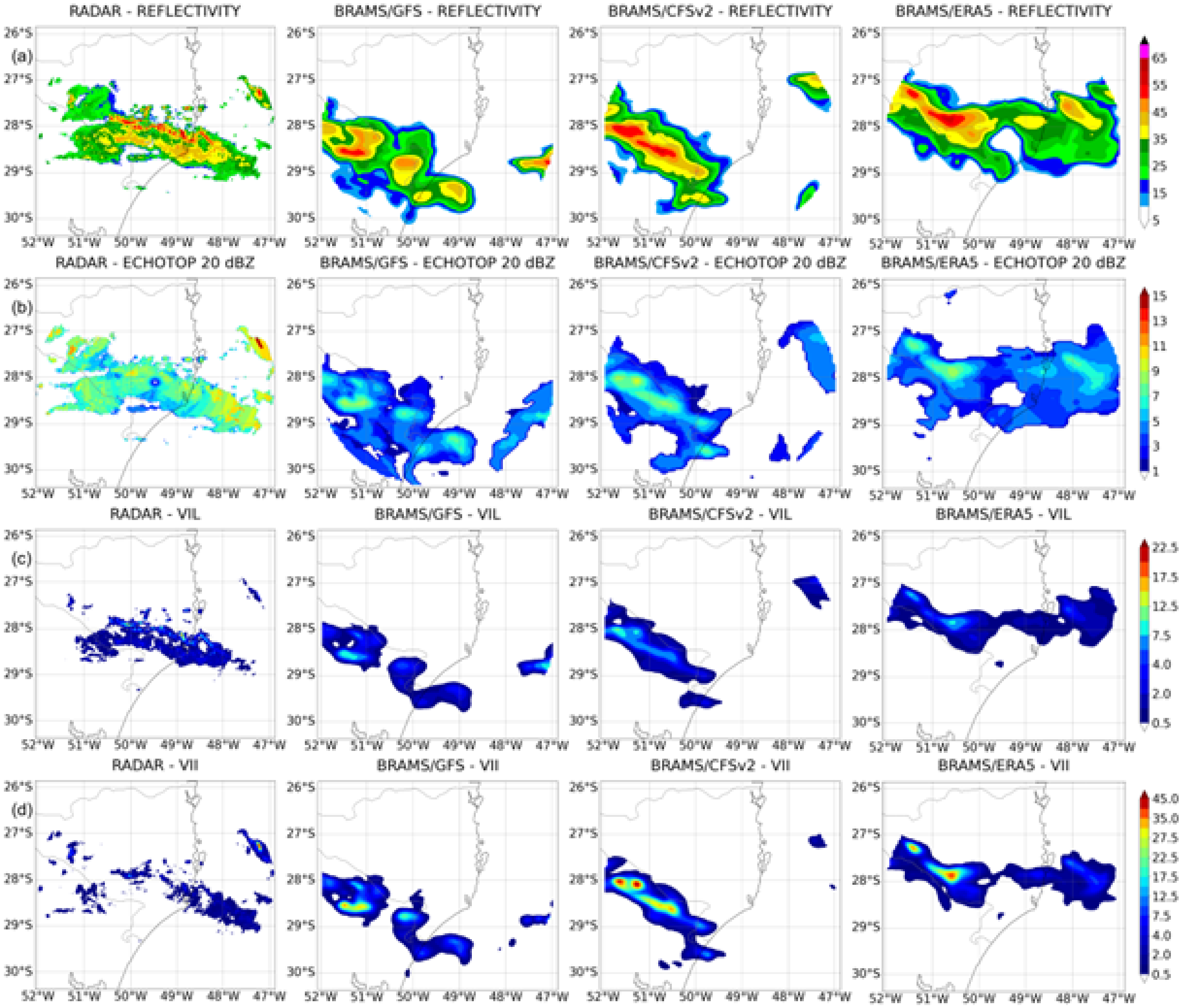

Fig. S11. Spatial distribution of reflectivity (a), Echo Top of 20 dBZ (b), vertically integrated liquid (c), and vertically integrated ice (d) derived from the DWR instrument (first column) and from BRAMS/GFS, BRAMS/CFSv2 and BRAMS/ERA5 simulations (second, third and fourth columns respectively), at 0100 hours UTC on 15 July 2016.

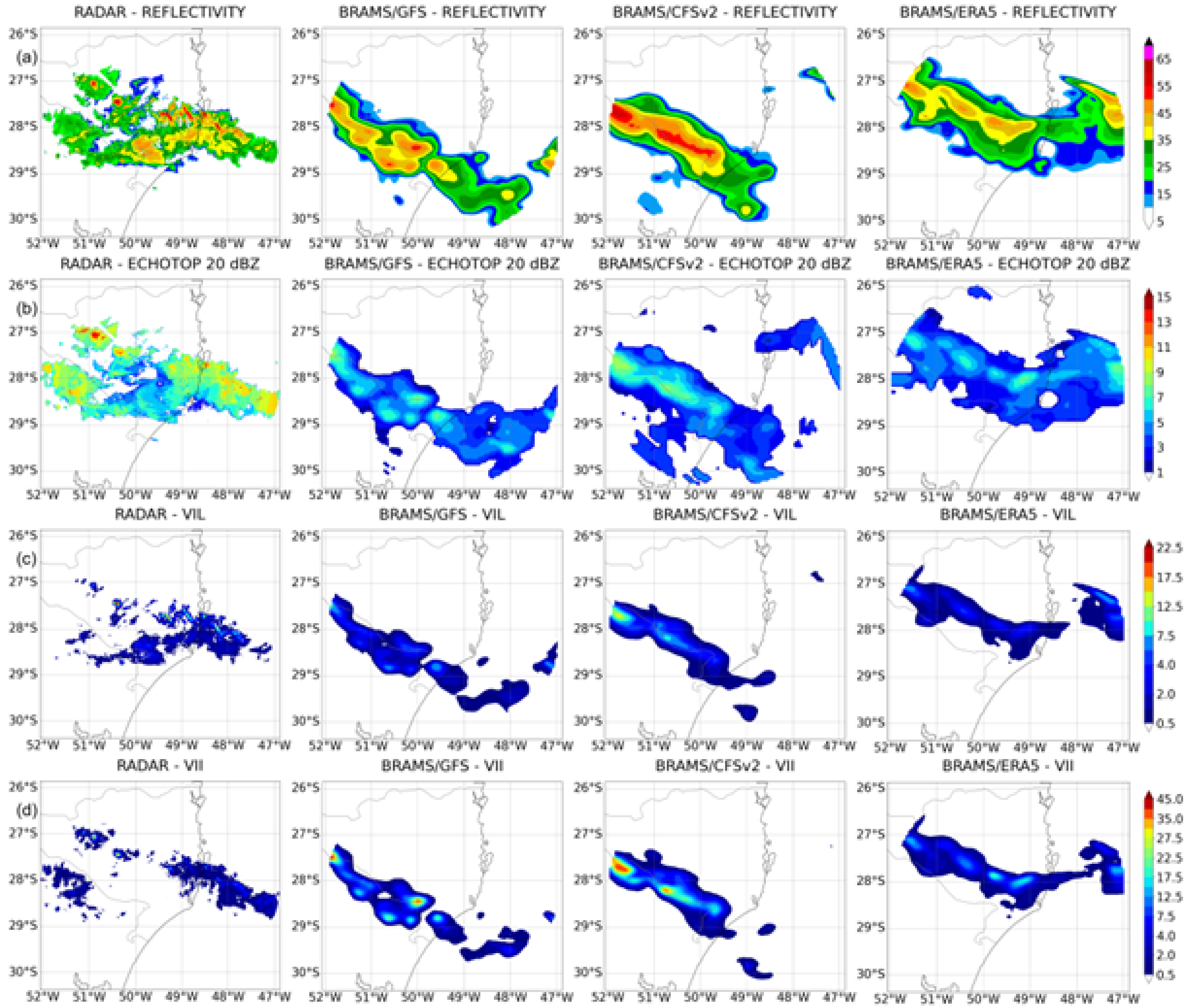

Fig. S12. Spatial distribution of reflectivity (a), Echo Top of 20 dBZ (b), vertically integrated liquid (c), and vertically integrated ice (d) derived from the DWR instrument (first column) and from BRAMS/GFS, BRAMS/CFSv2 and BRAMS/ERA5 simulations (second, third and fourth columns respectively), at 0200 hours UTC on 15 July 2016.

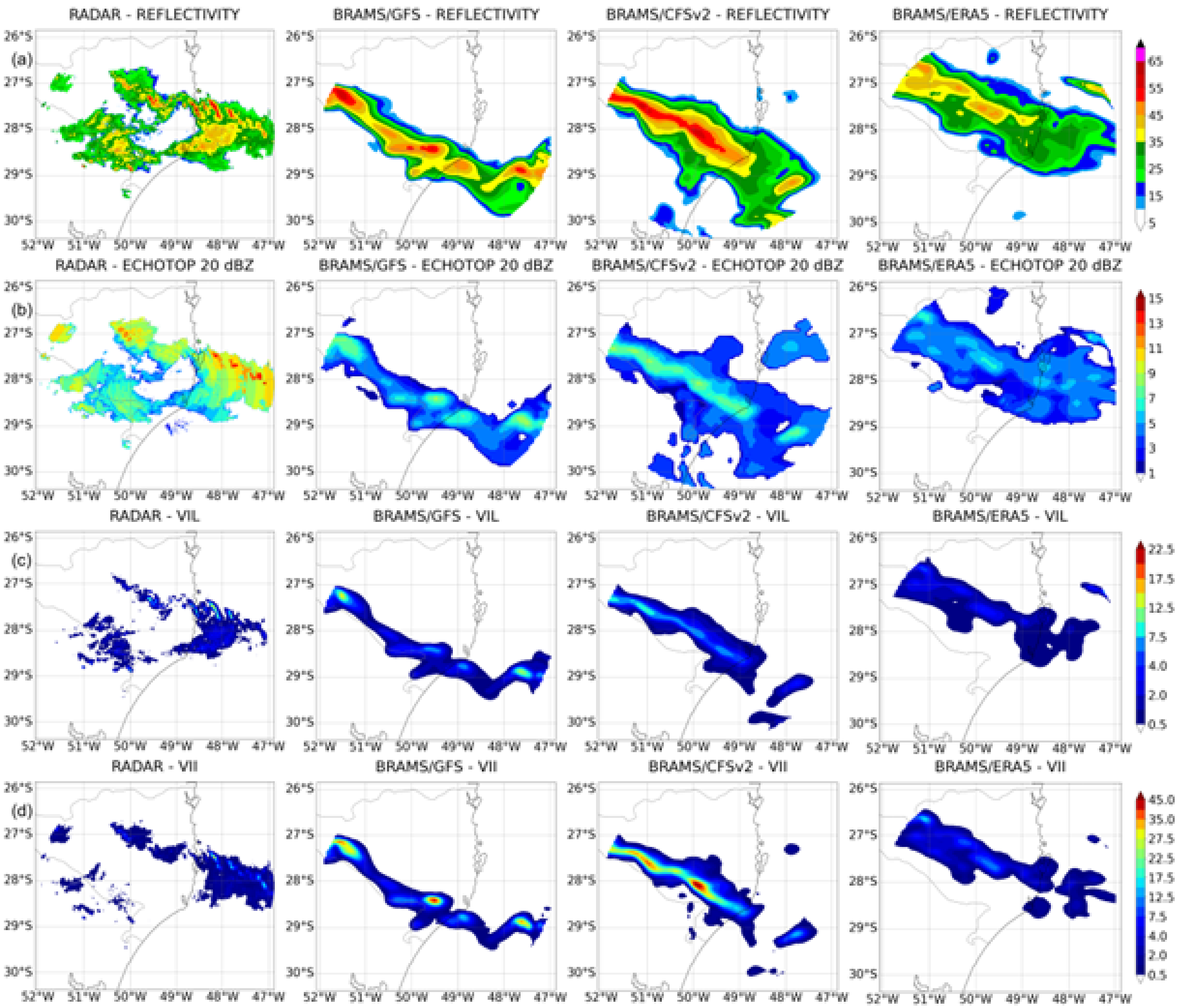

Fig. S13. Spatial distribution of reflectivity (a), Echo Top of 20 dBZ (b), vertically integrated liquid (c), and vertically integrated ice (d) derived from the DWR instrument (first column) and from BRAMS/GFS, BRAMS/CFSv2 and BRAMS/ERA5 simulations (second, third and fourth columns respectively), at 0300 hours UTC on 15 July 2016.

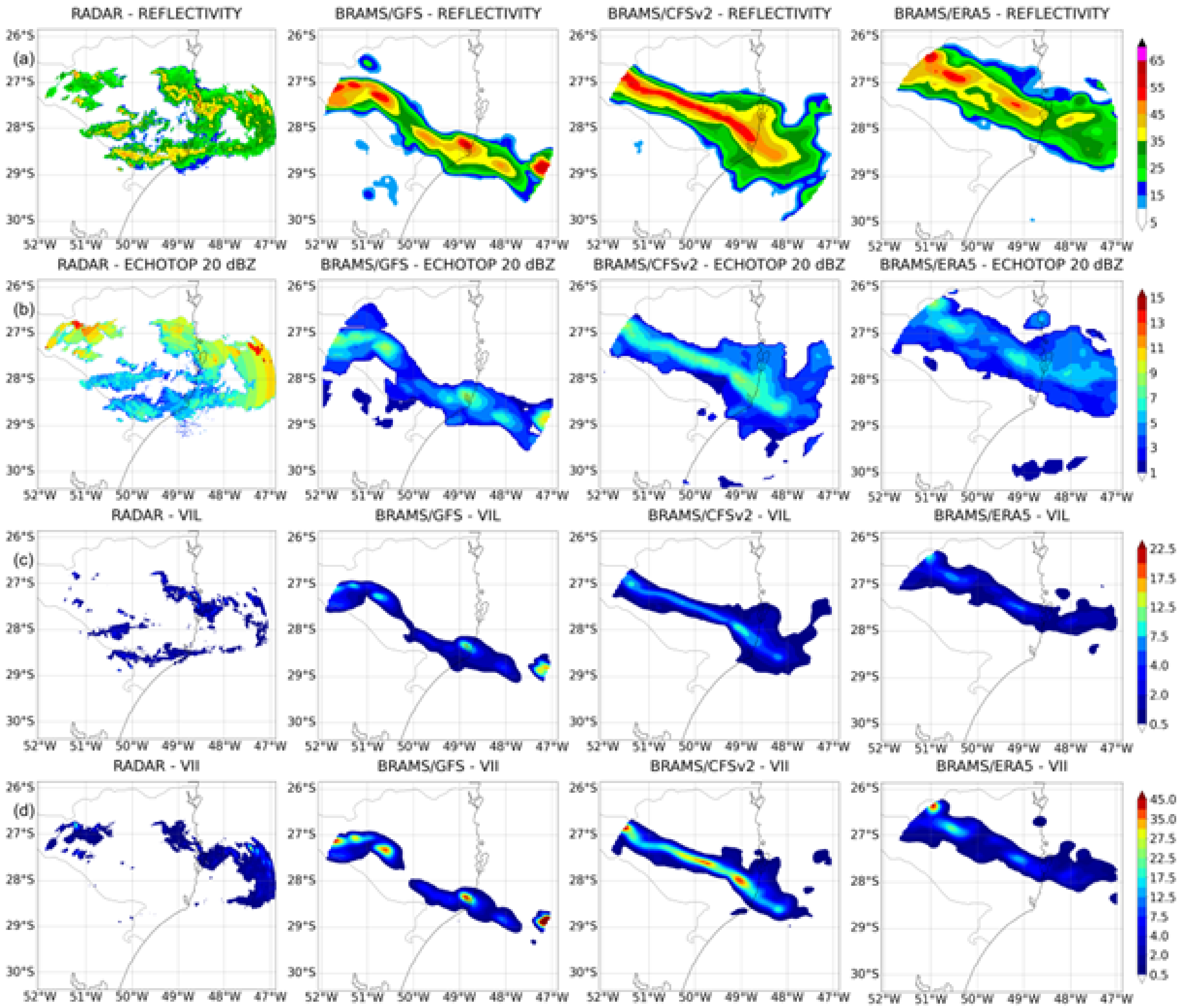

Fig. S14. Spatial distribution of reflectivity (a), Echo Top of 20 dBZ (b), vertically integrated liquid (c), and vertically integrated ice (d) derived from the DWR instrument (first column) and from BRAMS/GFS, BRAMS/CFSv2 and BRAMS/ERA5 simulations (second, third and fourth columns respectively), at 0400 hours UTC on 15 July 2016.

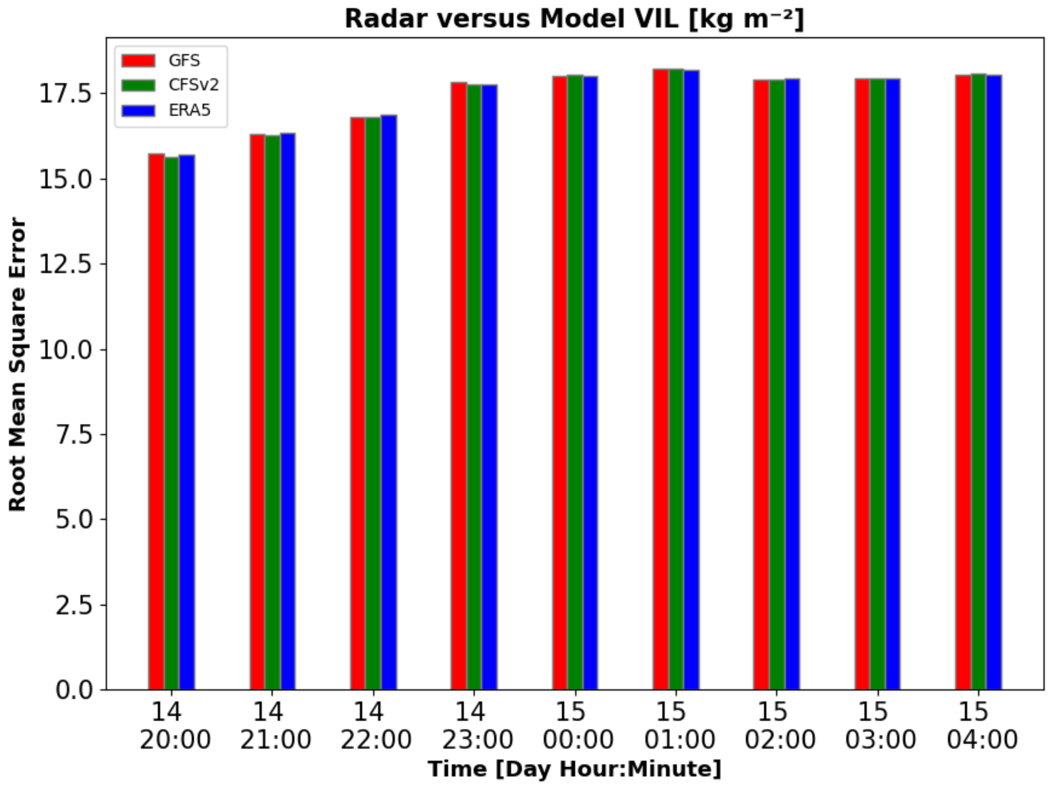

Fig. S15. Domain-wide RMSE for vertical integrated liquid for the period from 2000 hours UTC on 14 July 2016 to 0400 hours UTC on 15 July 2016.

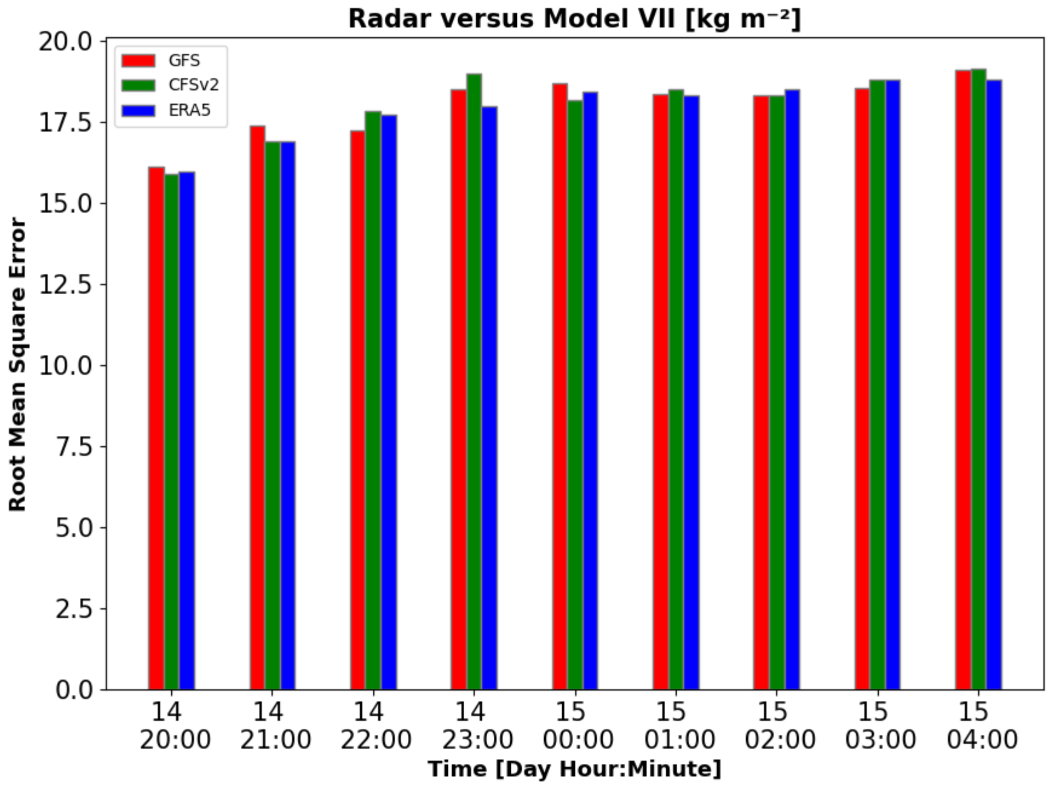

Fig. S16. Domain-wide RMSE for vertical integrated ice for the period from 2000 hours UTC on 14 July 2016 to 0400 hours UTC on 15 July 2016.