Convección y Microfísica de Nubes

Tema: Sistemas Convectivos de Mesoescala

1º Cuatrimestre 2010

Paola Salio

Las tormentas se pueden clasificar de acuerdo con la siguiente definición:

Celdas convectivas individuales: estos sistemas están constituidos por una sola celda y tienen, en general, tiempos de vida inferior a una hora. 10km

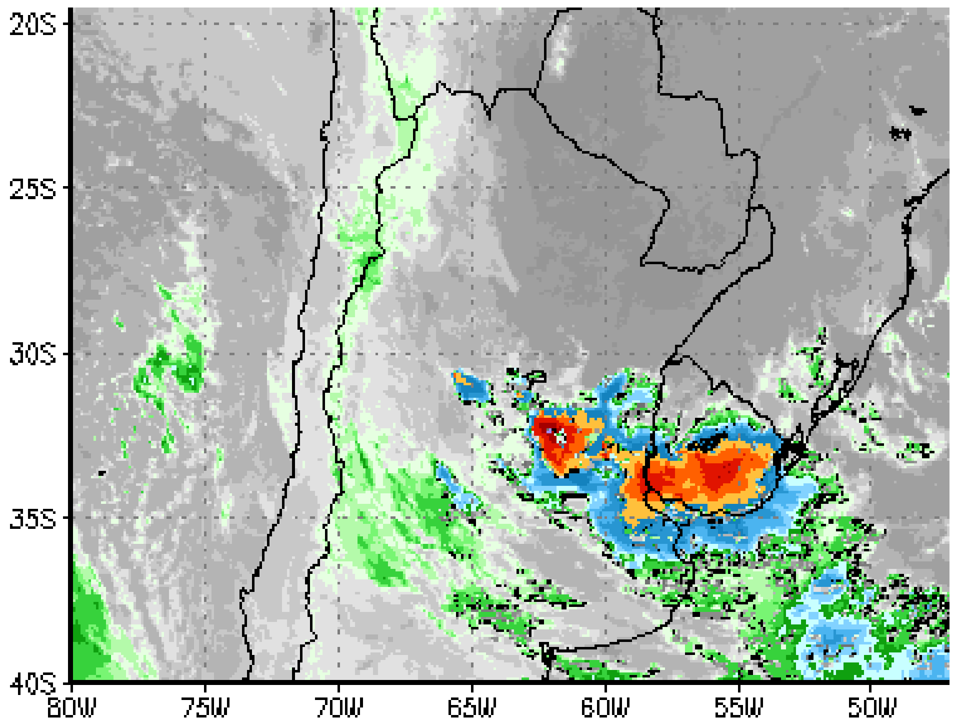
Superceldas**:** son sistemas formados por una gran celda convectiva cuyo tiempo de vida puede ser de varias horas. Normalmente asociados a la presencia de fenómenos severos (vientos fuertes, precipitación intensa, granizo, etc.). 50 km

Formaciones multicelulares**:** están constituidas por una gran cantidad de celdas convectivas en diferentes estadíos de su ciclo de vida. 50 km

S***istemas convectivos de mesoescala:*** resultan de la organización de sistemas celulares en conglomerados de tamaño más importante. Mas de 100 km con extremos de 300 a 400 km de radio

Houze (1993) definió un sistema convectivo de mesoescala de la siguiente forma:

"... un sistema convectivo de mesoescala es un sistema nuboso que aparece compuesto de numerosas tormentas y que produce una zona continua de precipitaciones de extensión horizontal del orden de los 100 km o más..."



Complejo convectivo de mesoescala (MCC) Maddox (1980)
a todo sistema convectivo de mesoescala
utilizando imágenes del canal 4 (10.8 micrones) del Infrarrojo:

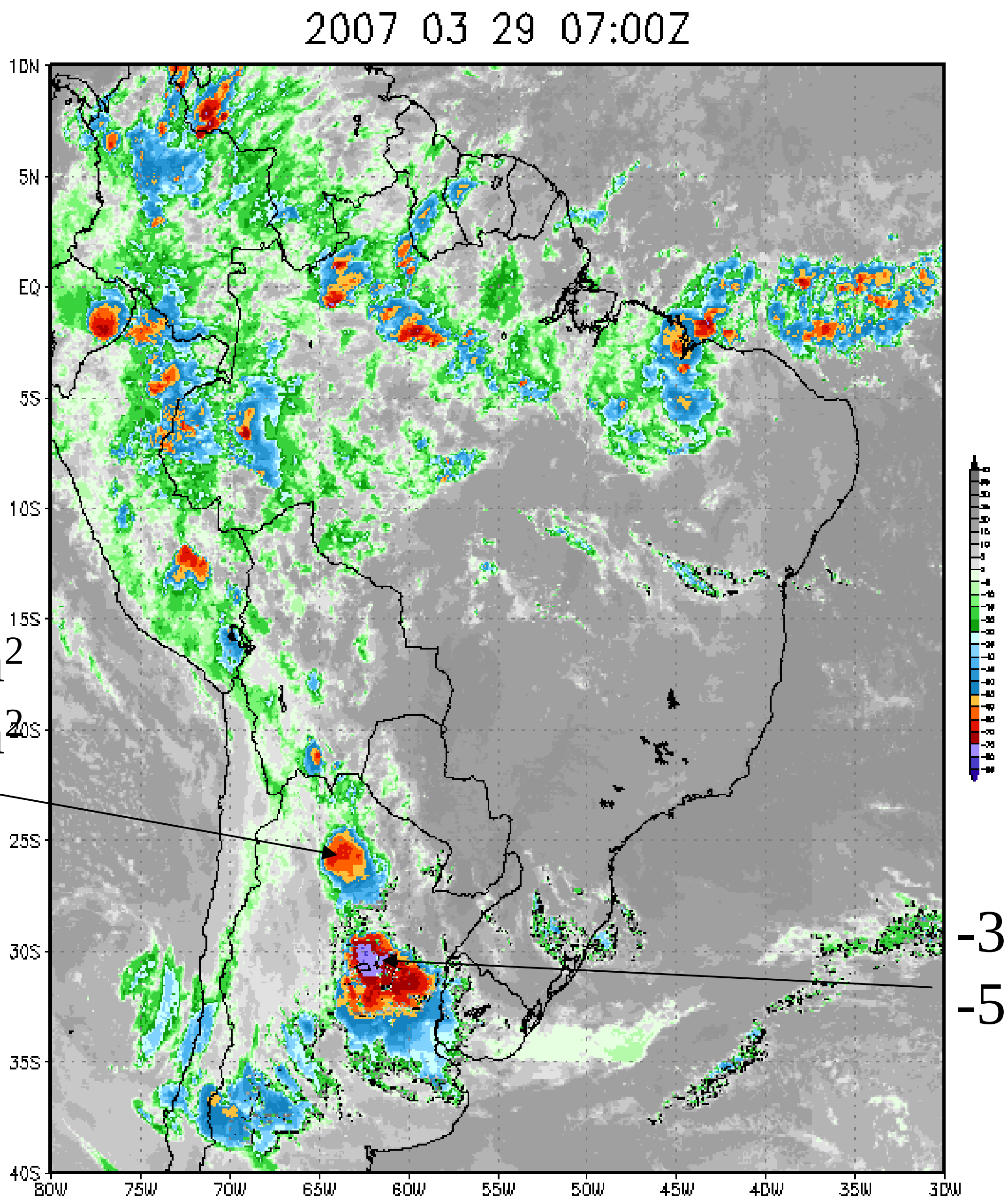
La superficie de la región con temperaturas inferiores o iguales a los **–32º debe superar los 100.000 km^2.**

La superficie de la región con temperaturas inferiores o iguales a los **–52º debe superar los 50.000 km^2.**

Las características de tamaño deben persistir por lo menos durante **6 horas**

El coeficiente de aspecto (relación entre los diámetros mayor y menor del sistema) en el umbral de –52º debe ser superior a **0.7** en el momento que esa región alcance su máxima extensión

ETAPAS	CRITERIO
Primeras Tormentas o pre MCS	Área cubierta por la isoterma de mínima alcanza los 50.000 km^2
Génesis	Cuando el área es mayor a $\geq$ 50.000 km^2
Madurez	Momento en que el área es máxima.
Disipación	Desde la madurez hasta que el área es $<$ 50.000 km^2
Post MCS	Hasta que el sistema desaparece



-32 103.000 km^2

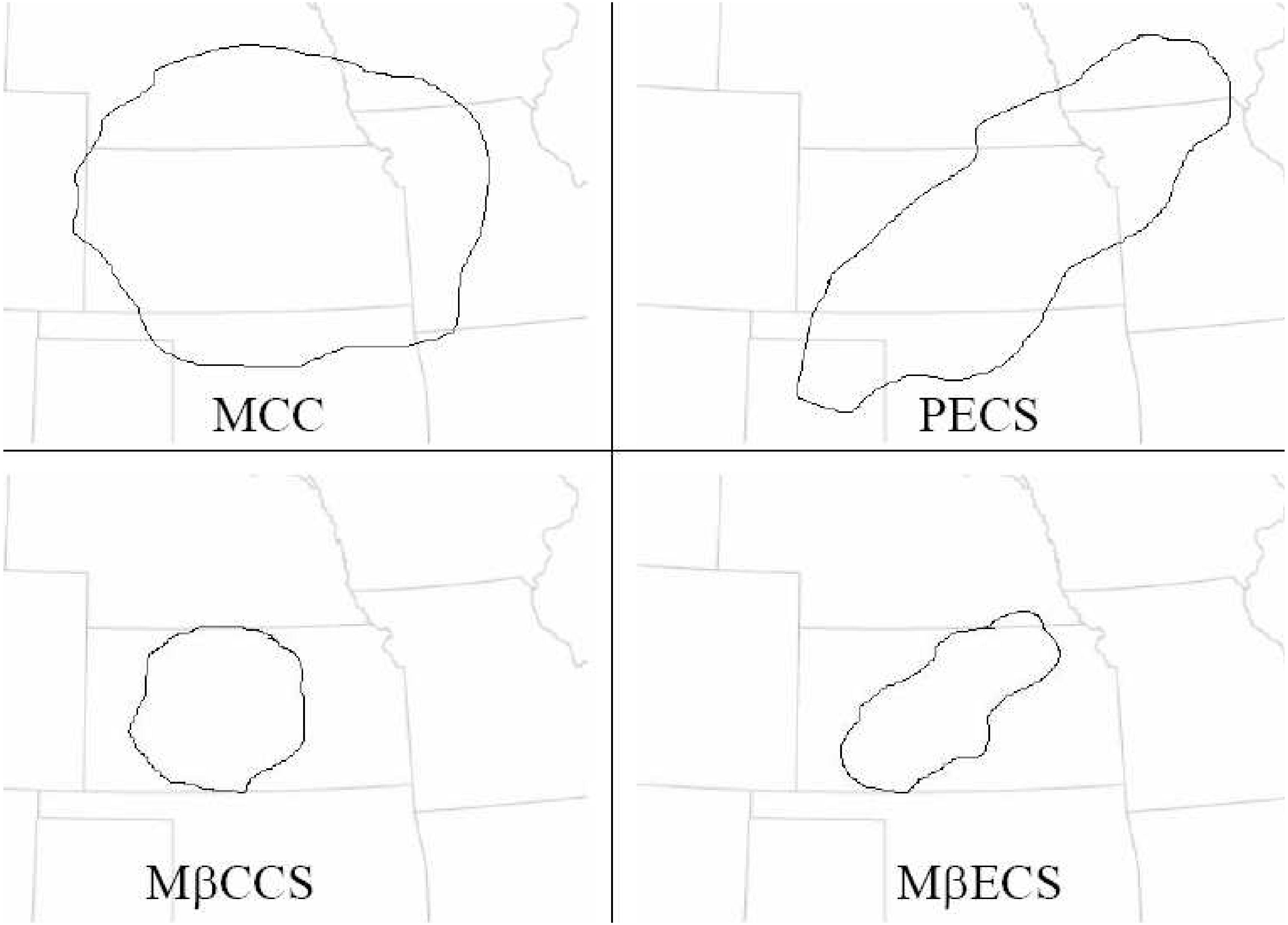
-52 50.500 km^2

0.99!!

-32 307.000 km^2

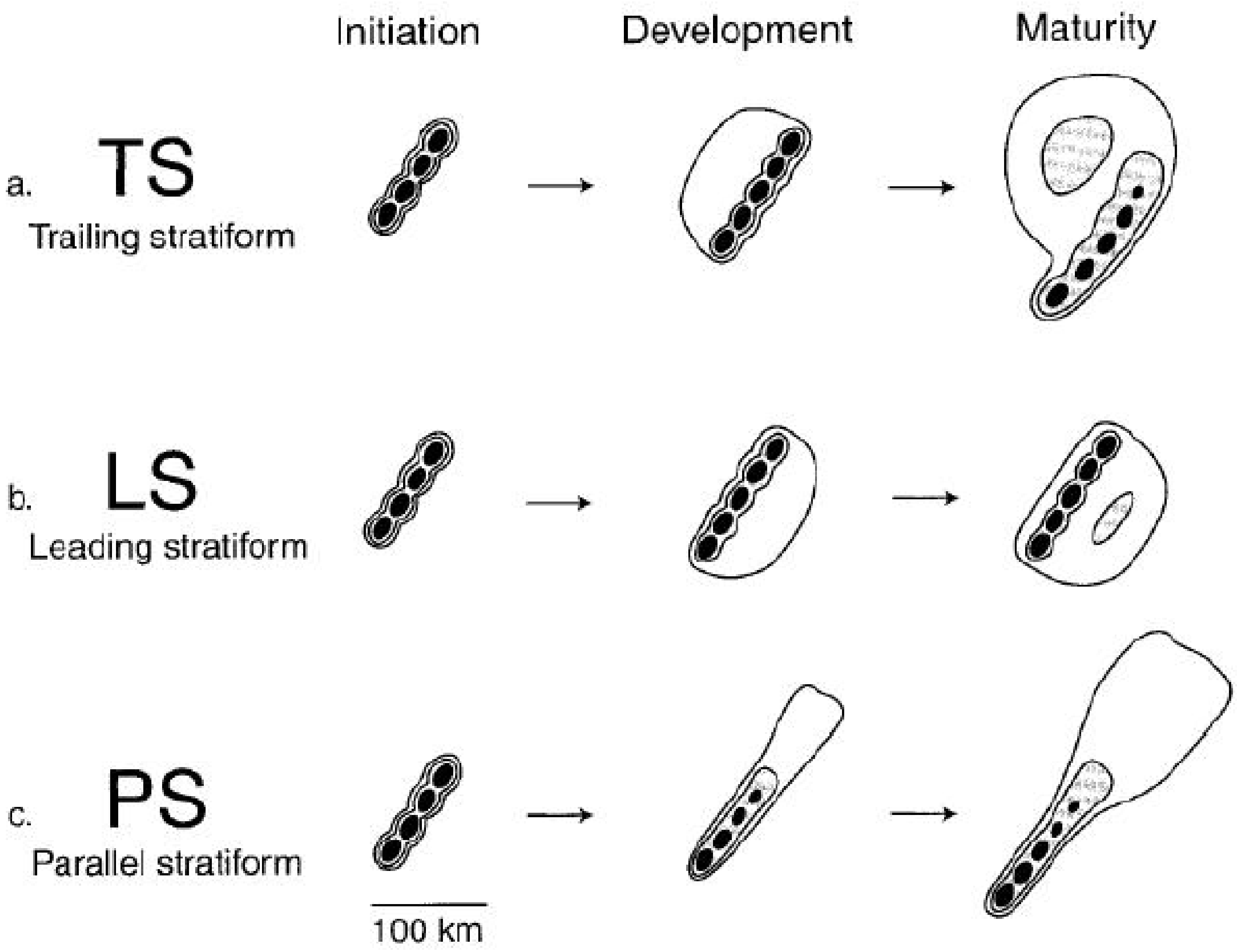
-52 188.000 km^2

0.76



MCC
PECS
MβCCS
MβECS

Linear MCS archetypes



Parker and Johnson (2000)]

Umbrales Considerados por otros autores:

▶-33ºC y -54ºC Mc Anelly y Cotton 1989 …
y todos los trabajos posteriores del grupo

▶–42ºC y –64ºC ; –40ºC y –62ºC Velasco y Fritsch (1987)
sobre América

▶ -28ºC y -55ºC Machado et al 1998

▶ umbrales entre -42 y -20 grados han sido utilizados por distintos autores a fin de detectar los bordes de los yunques de los sistemas.

▶ como así también -65 hasta -52 para identificar
las área convectivas

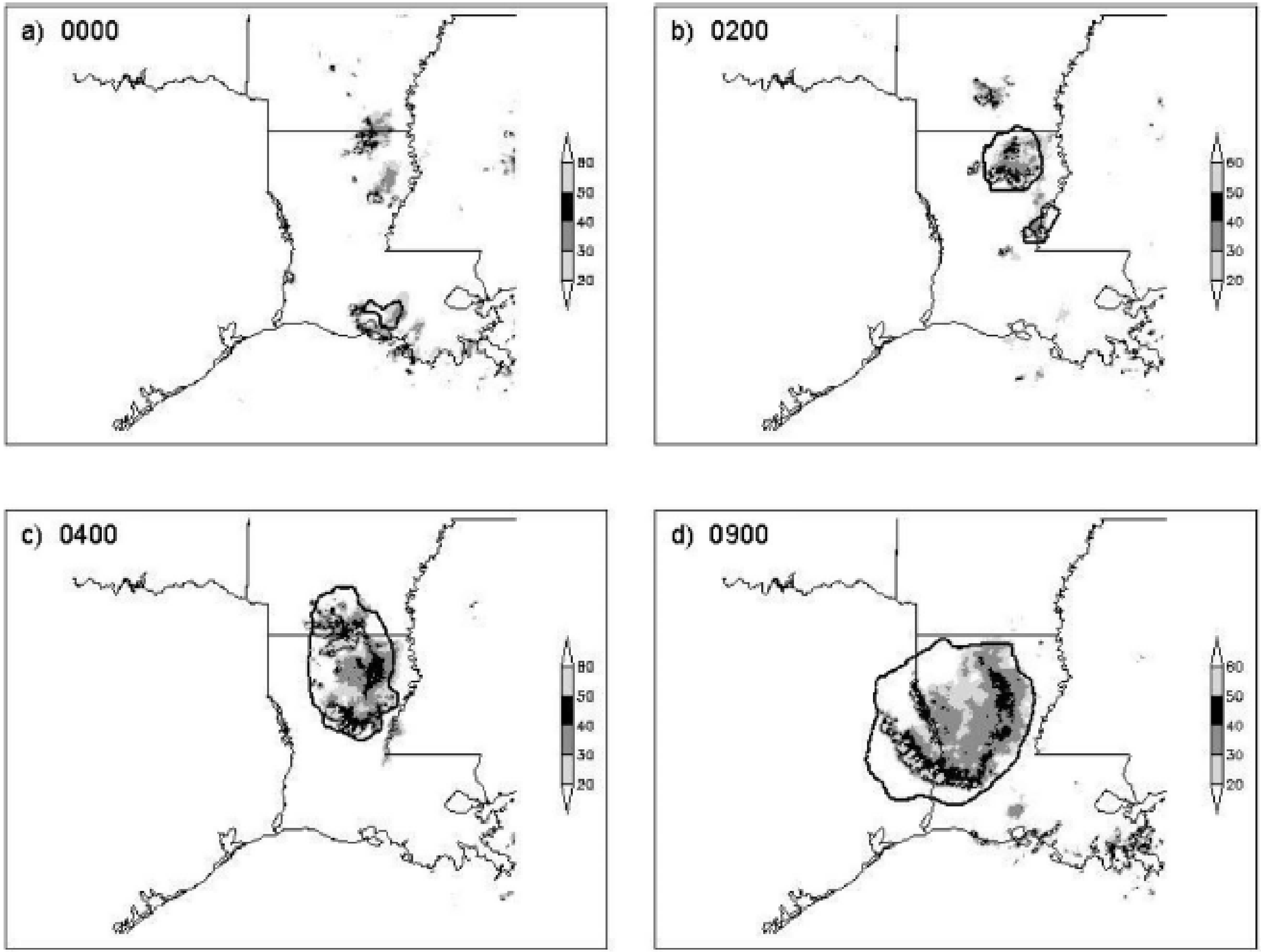


FIG. 9. Areal merger development of a MβCCS that occurred in southern Arkansas and northern Louisiana on 20 Jun 1996, as seen by radar imagery. The radar reflectivity images are from: (a) 0000, (b) 0200, (c) 0400, and (d) 0900 UTC. The solid black contours represent the outline of the −52°C cloud shield.

Jirak et al, 2003

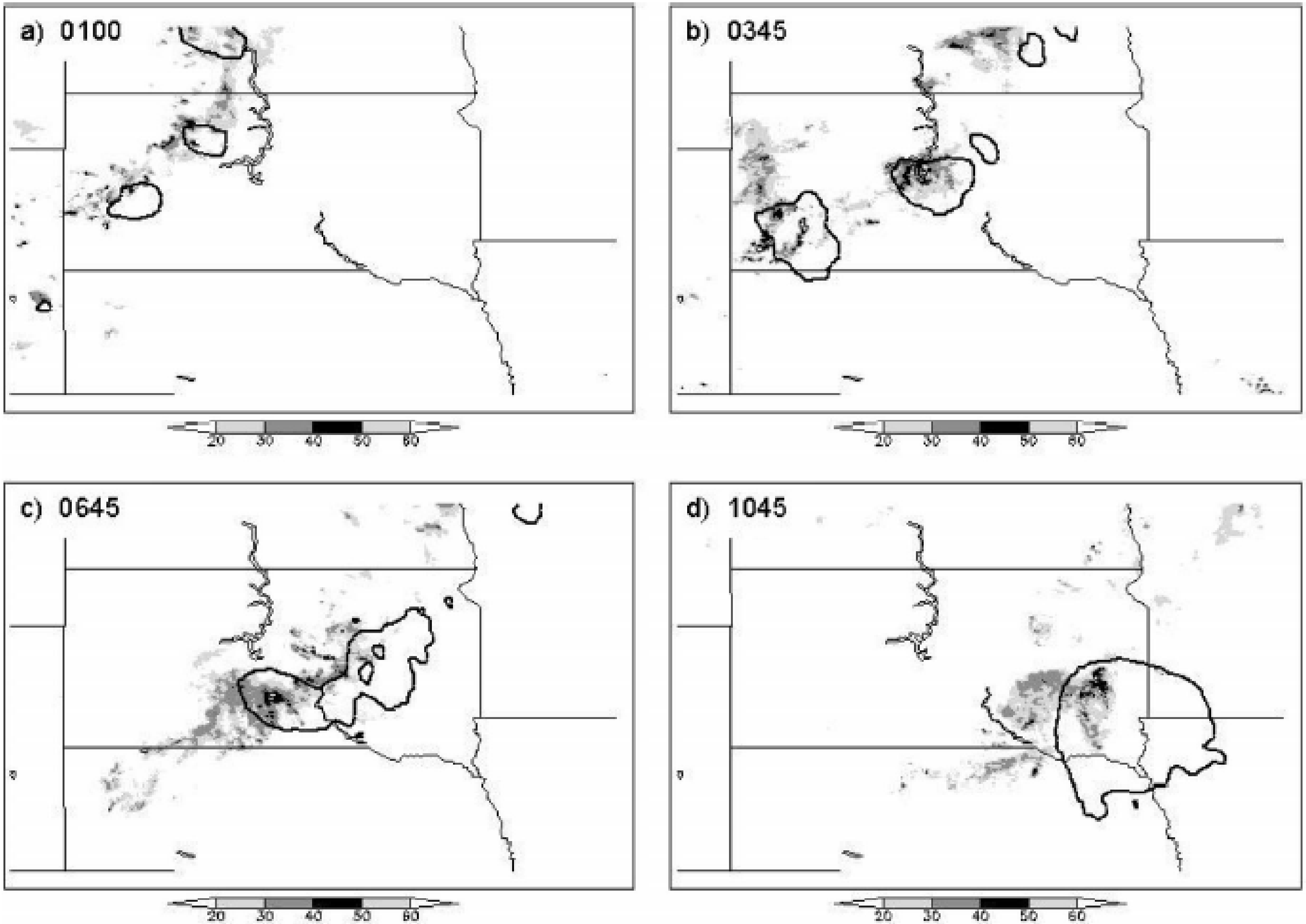


FIG. 13. Embedded areal merger development of a MβCCS that occurred in South Dakota on 25 Aug 1997, as seen by radar imagery. The radar reflectivity images are from: (a) 0100, (b) 0345, (c) 0645, and (d) 1045 UTC. The solid black contours represent the outline of the −52°C cloud shield.

Jirak et al, 2003

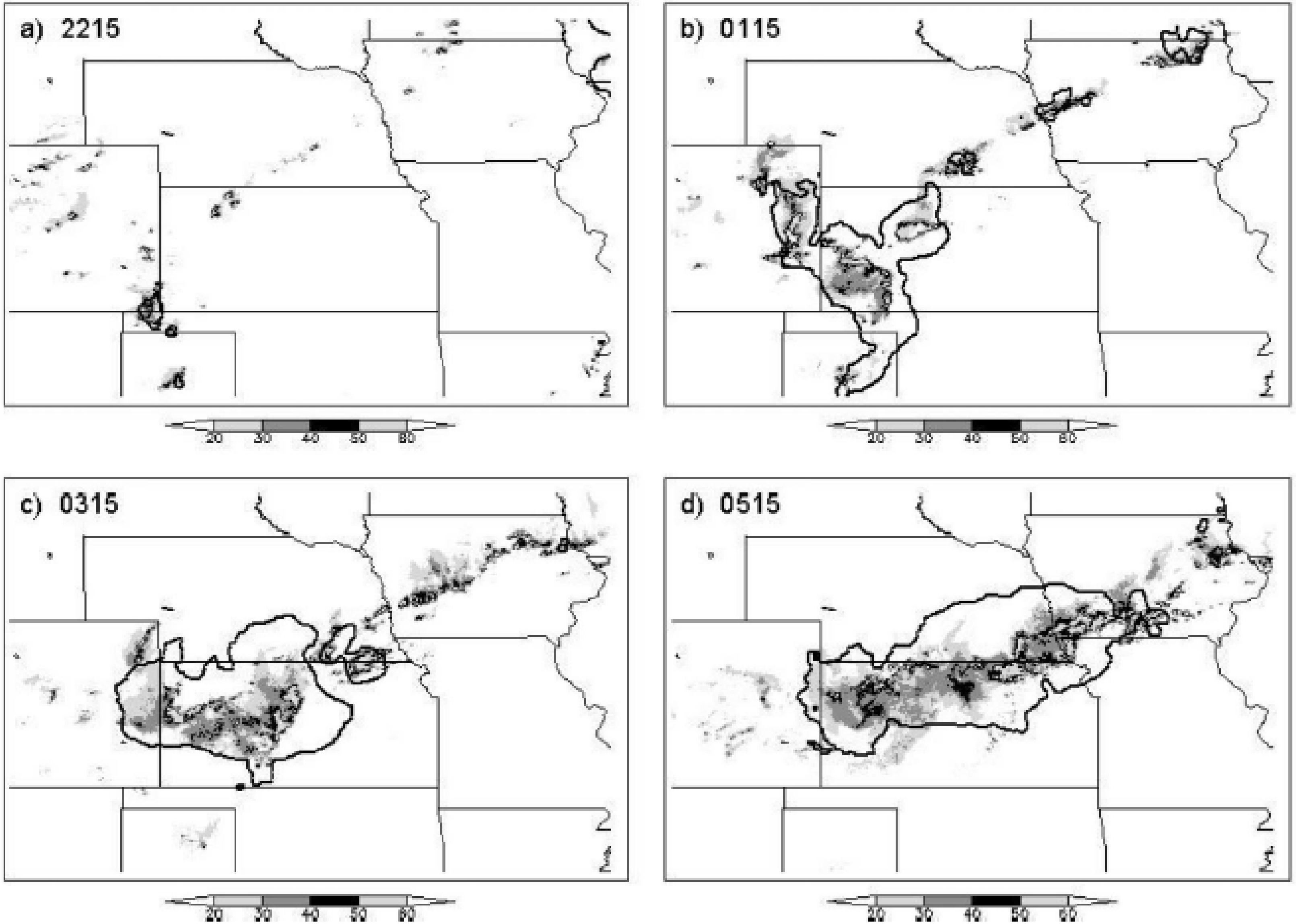


FIG. 10. Combination merger development of a PECS that occurred across CO, KS, and NE, on 24–25 Jun 1997, as seen by radar imagery. The radar reflectivity images are from: (a) 2215 UTC 24 Jun 1997, (b) 0115 UTC, (c) 0315 UTC, and (d) 0515 UTC 25 Jun 1997. The solid black contours represent the outline of the −52°C cloud shield.

Jirak et al, 2003

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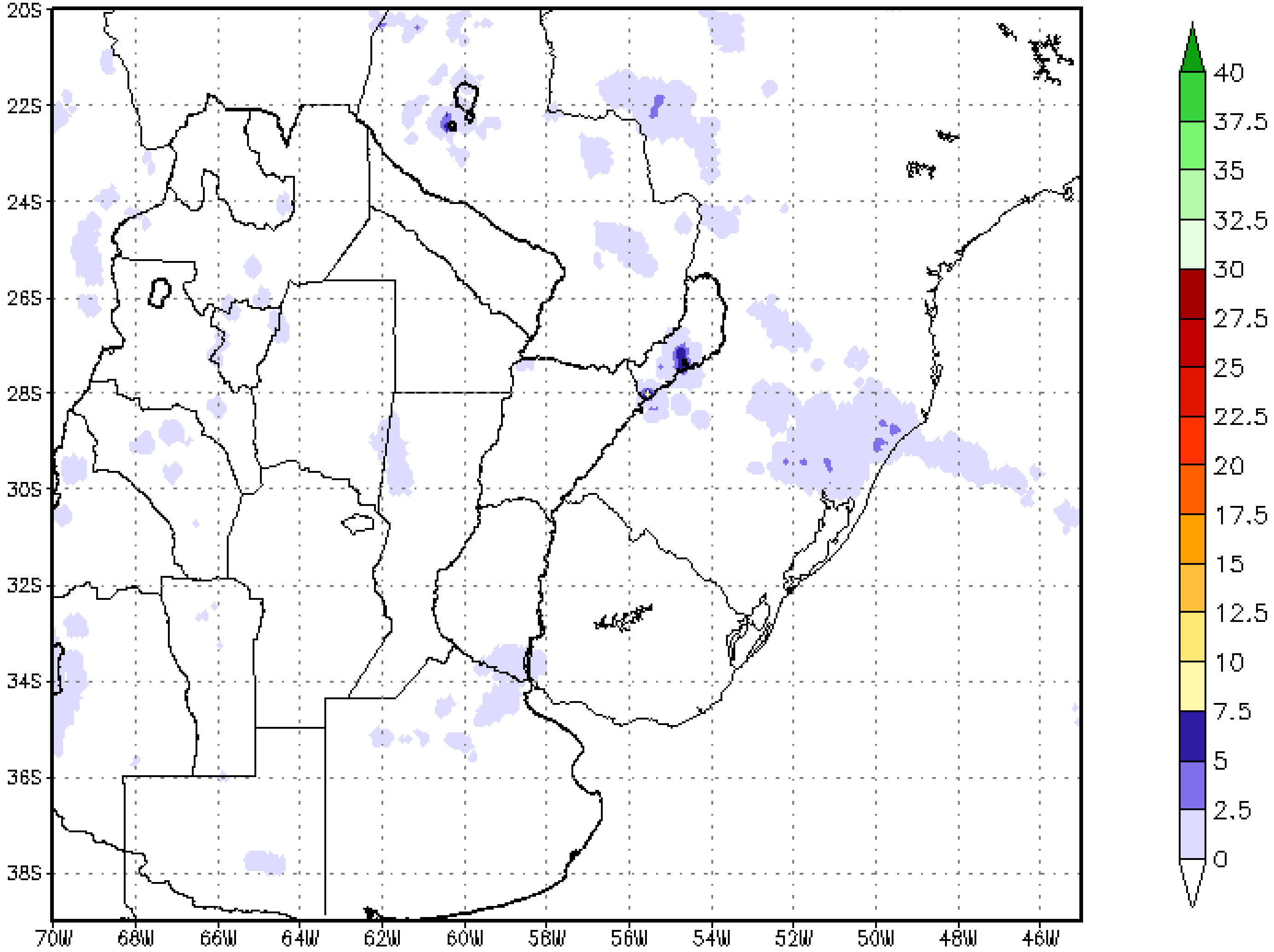

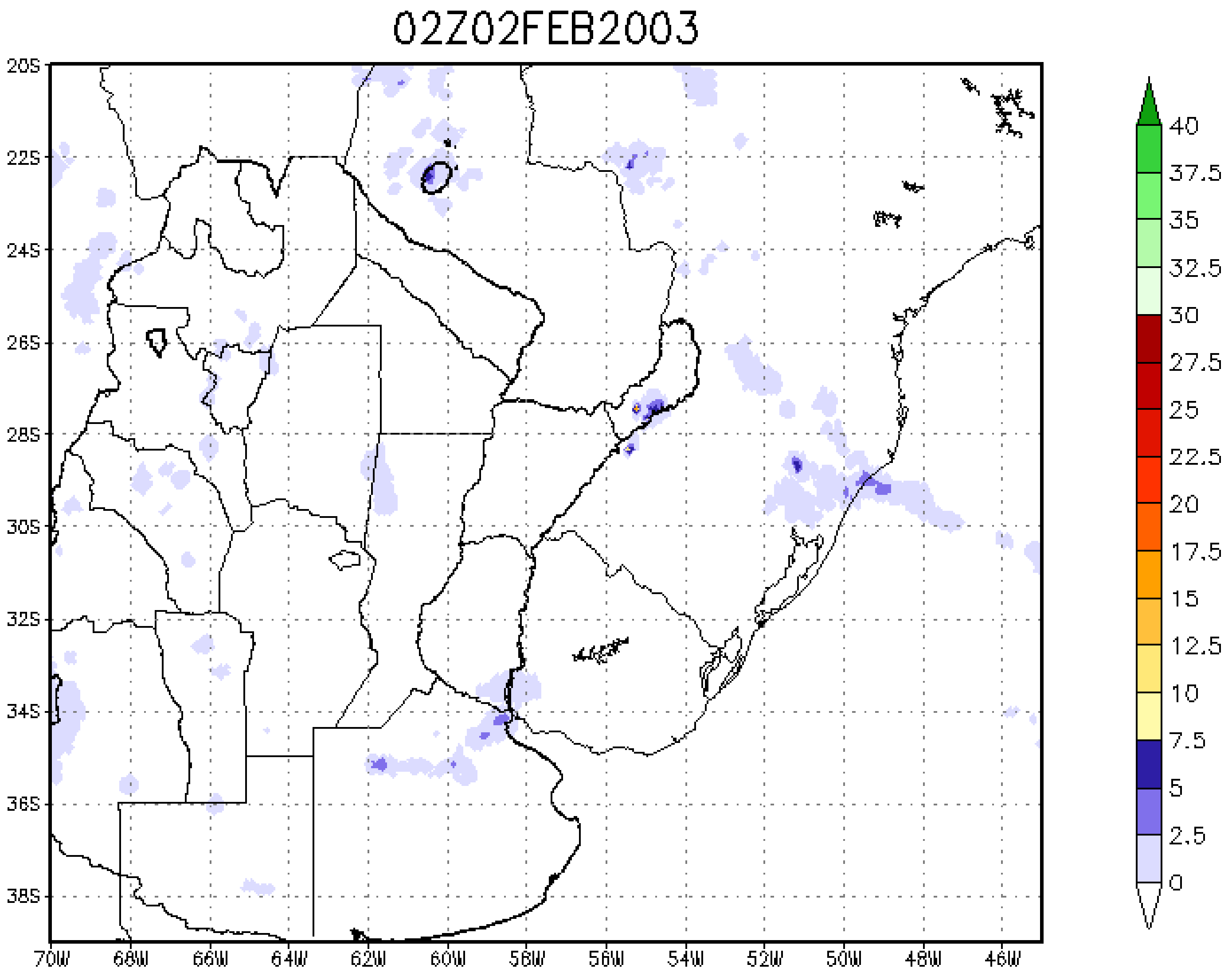
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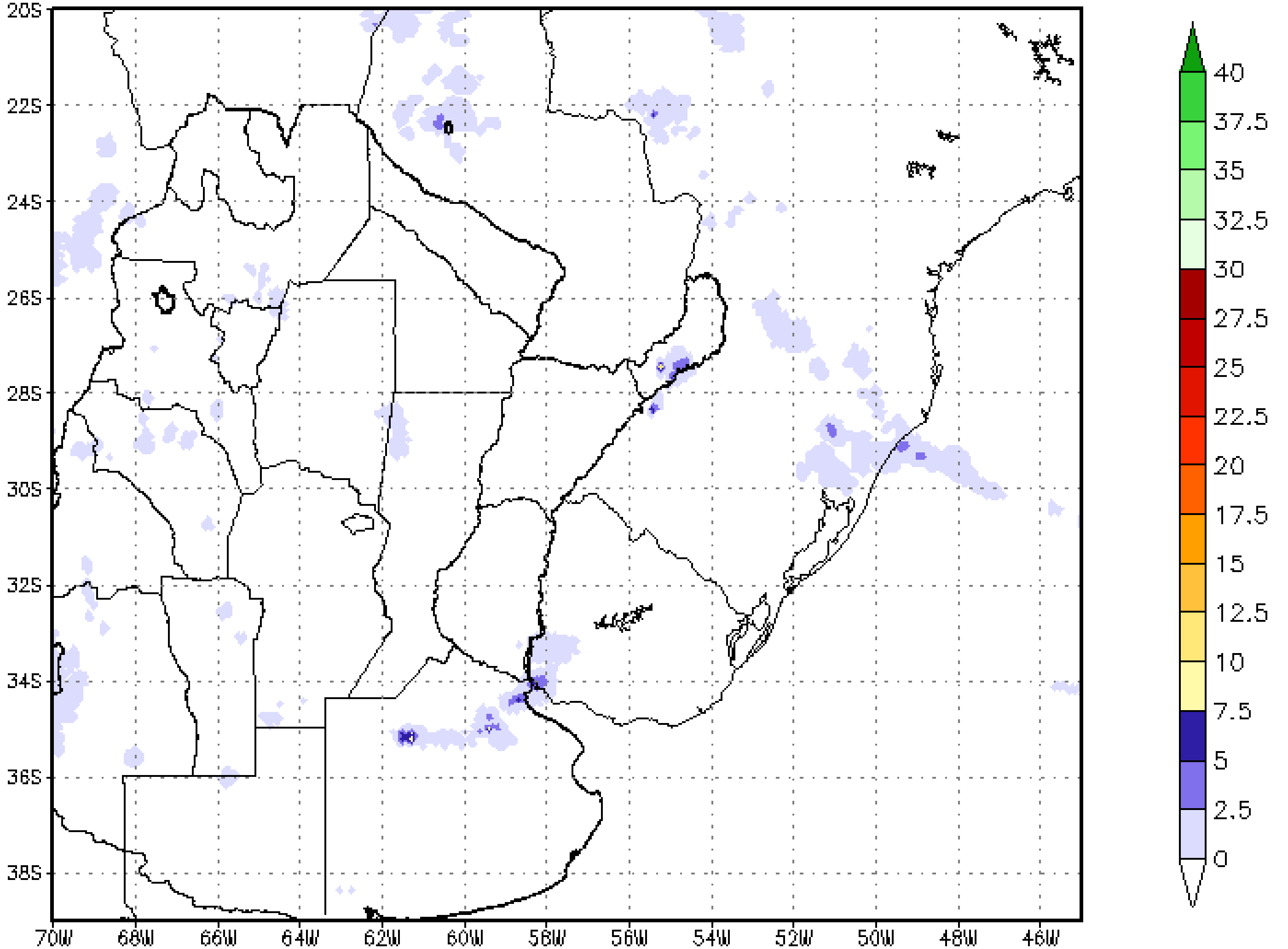

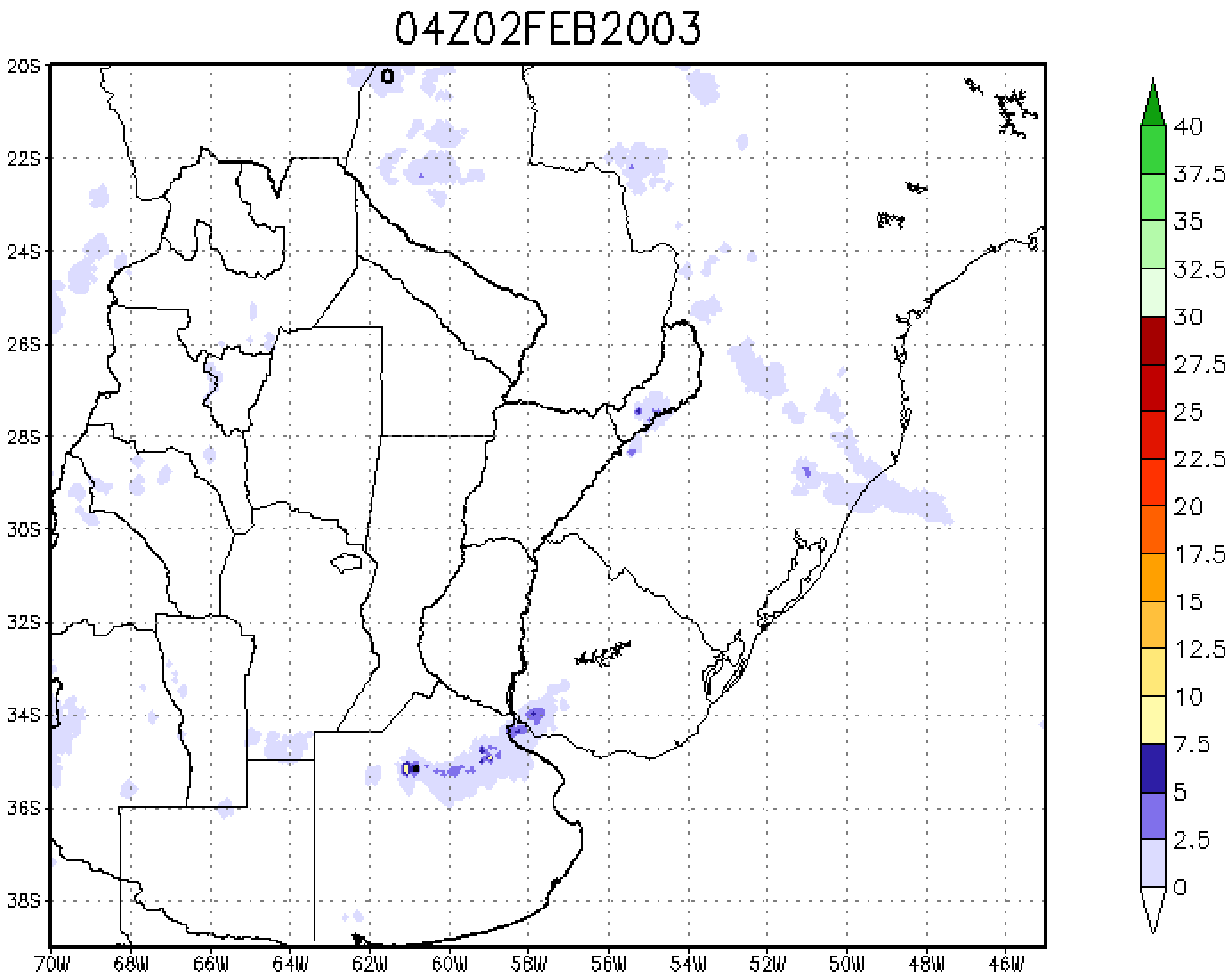
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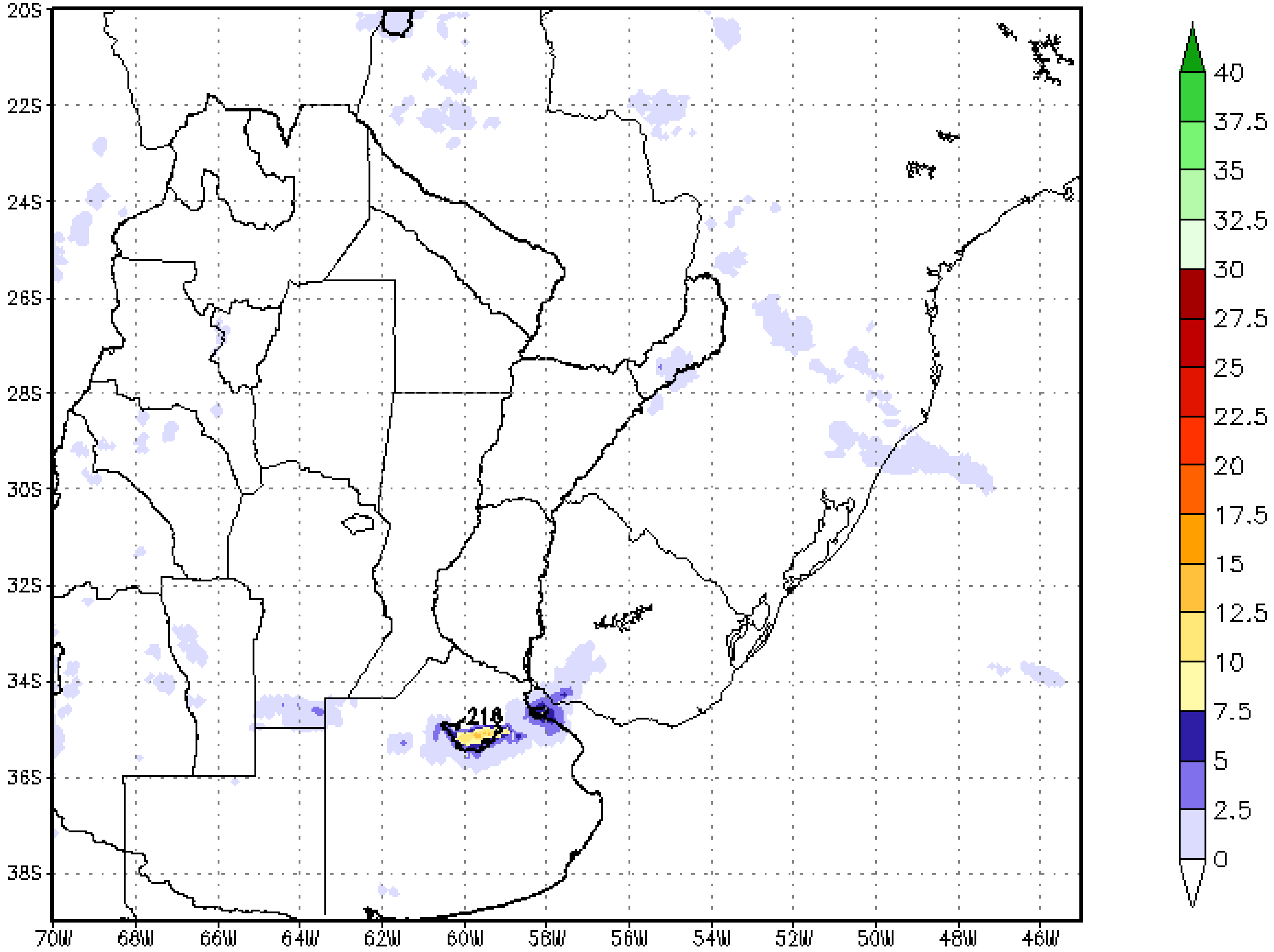

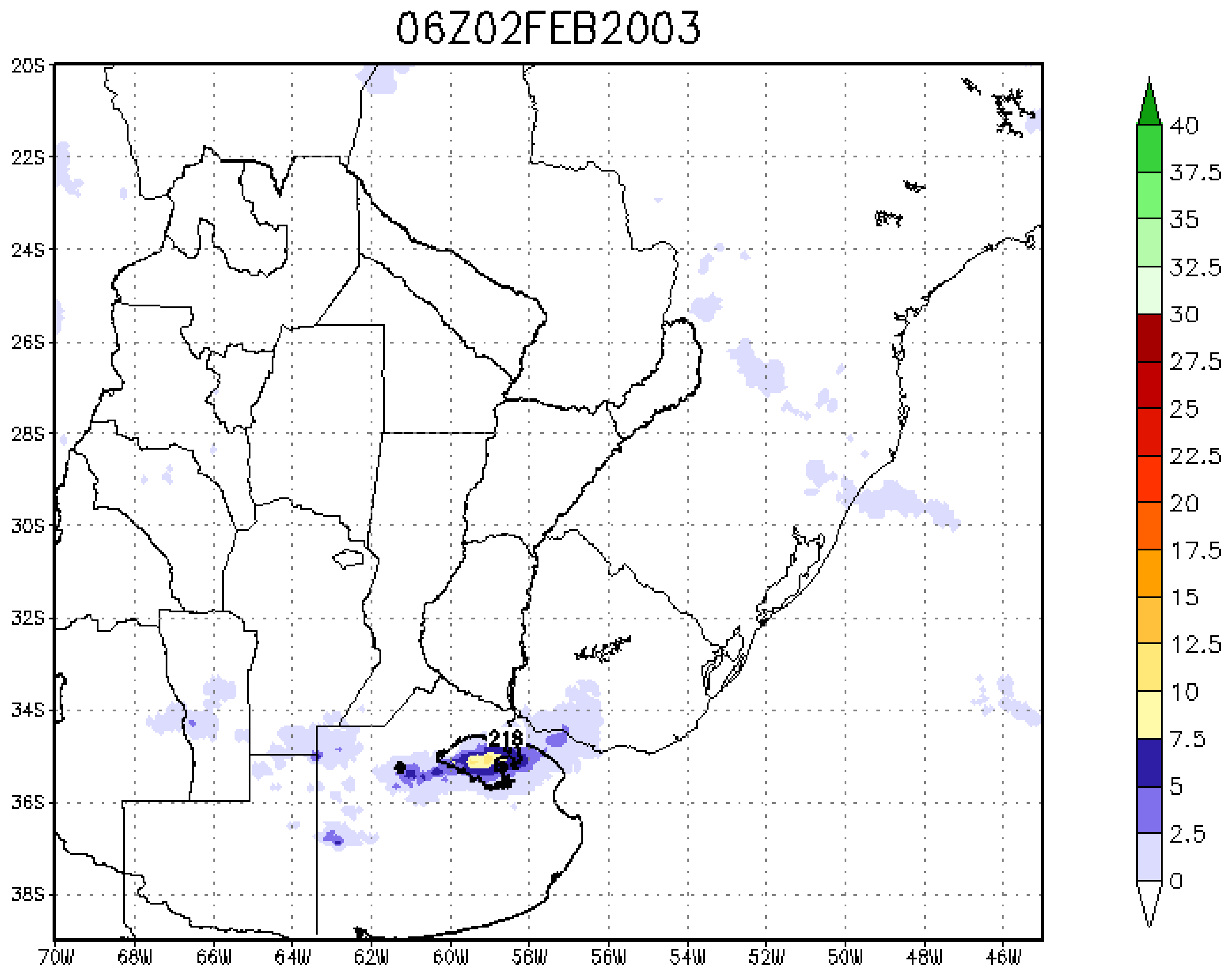

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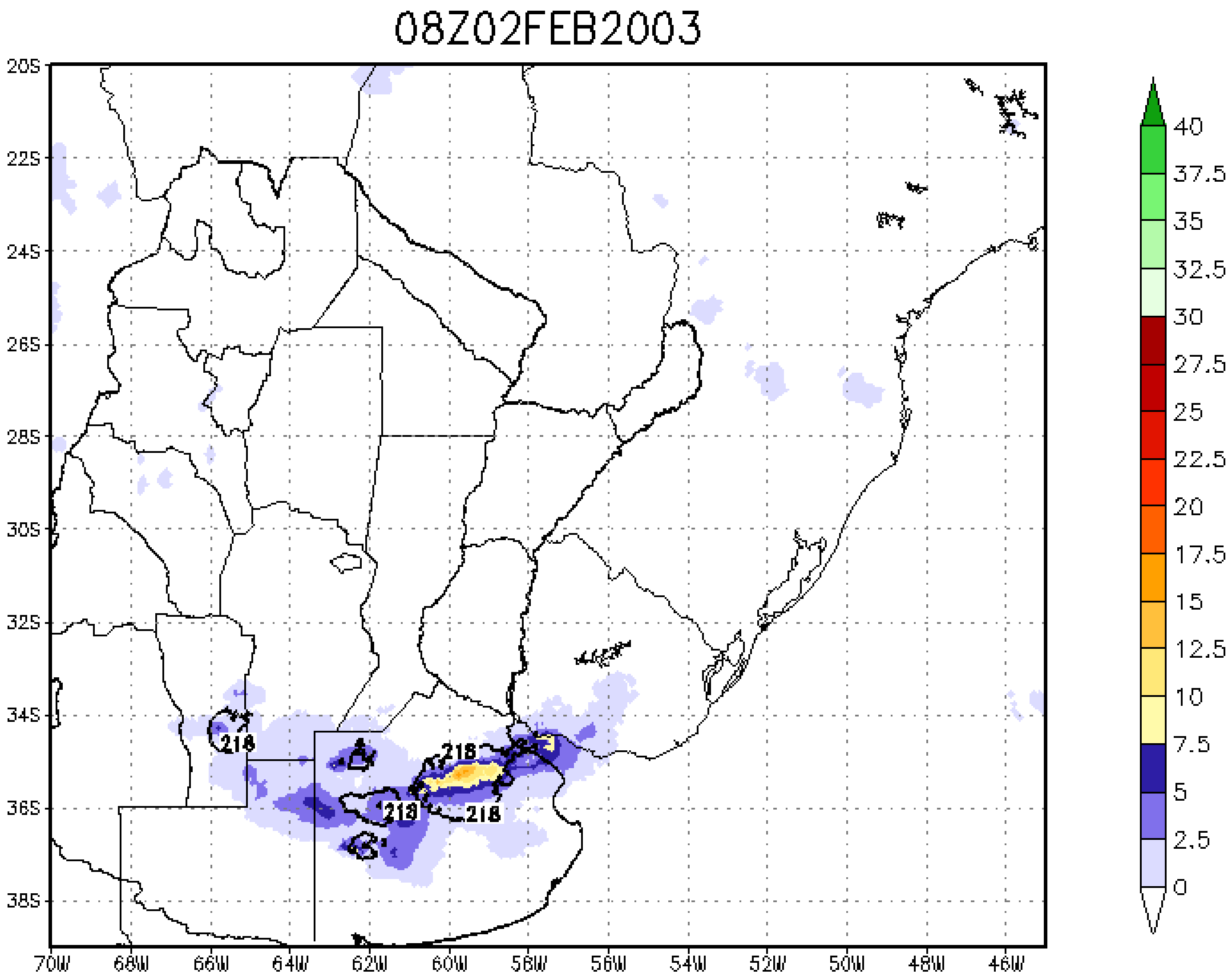
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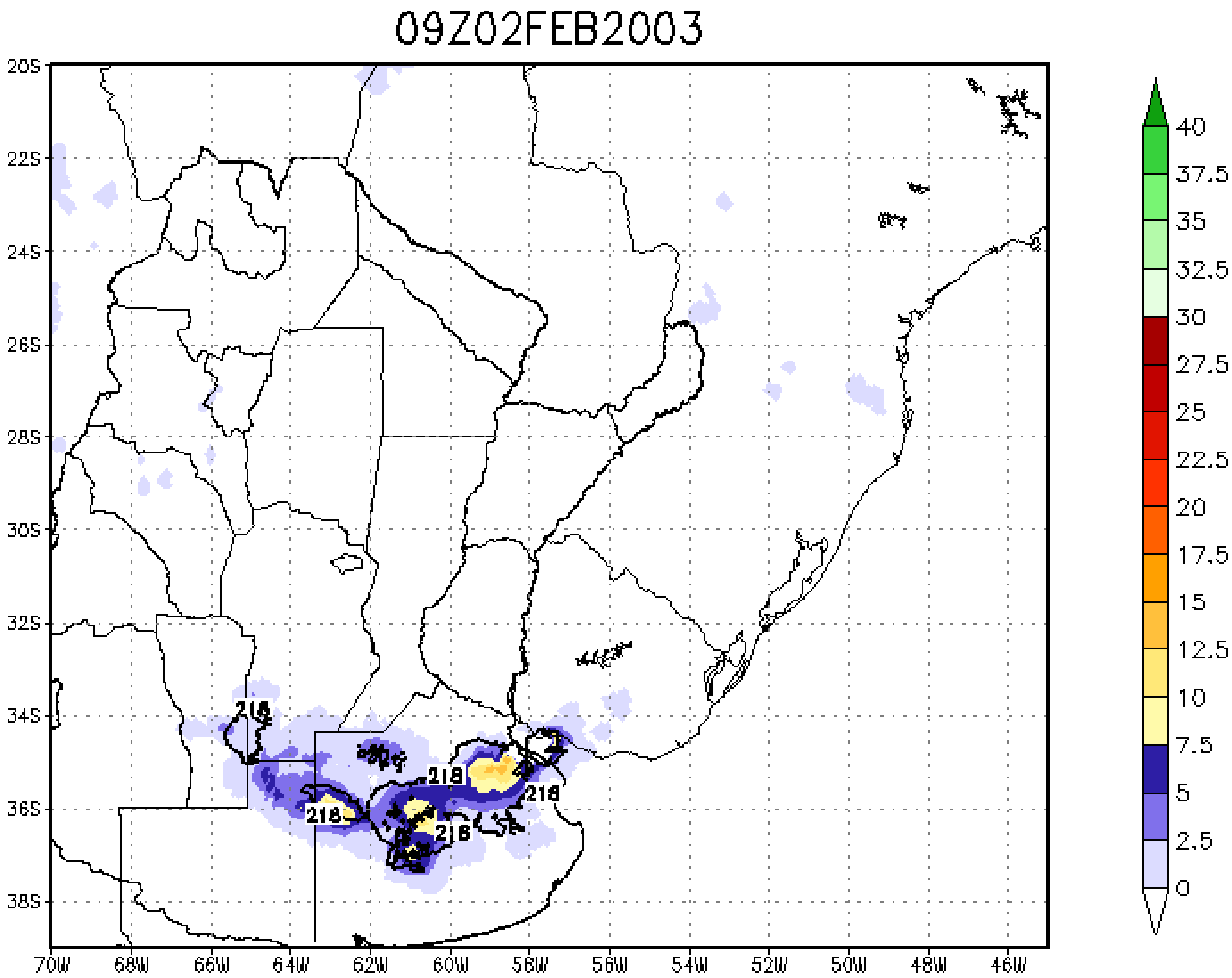

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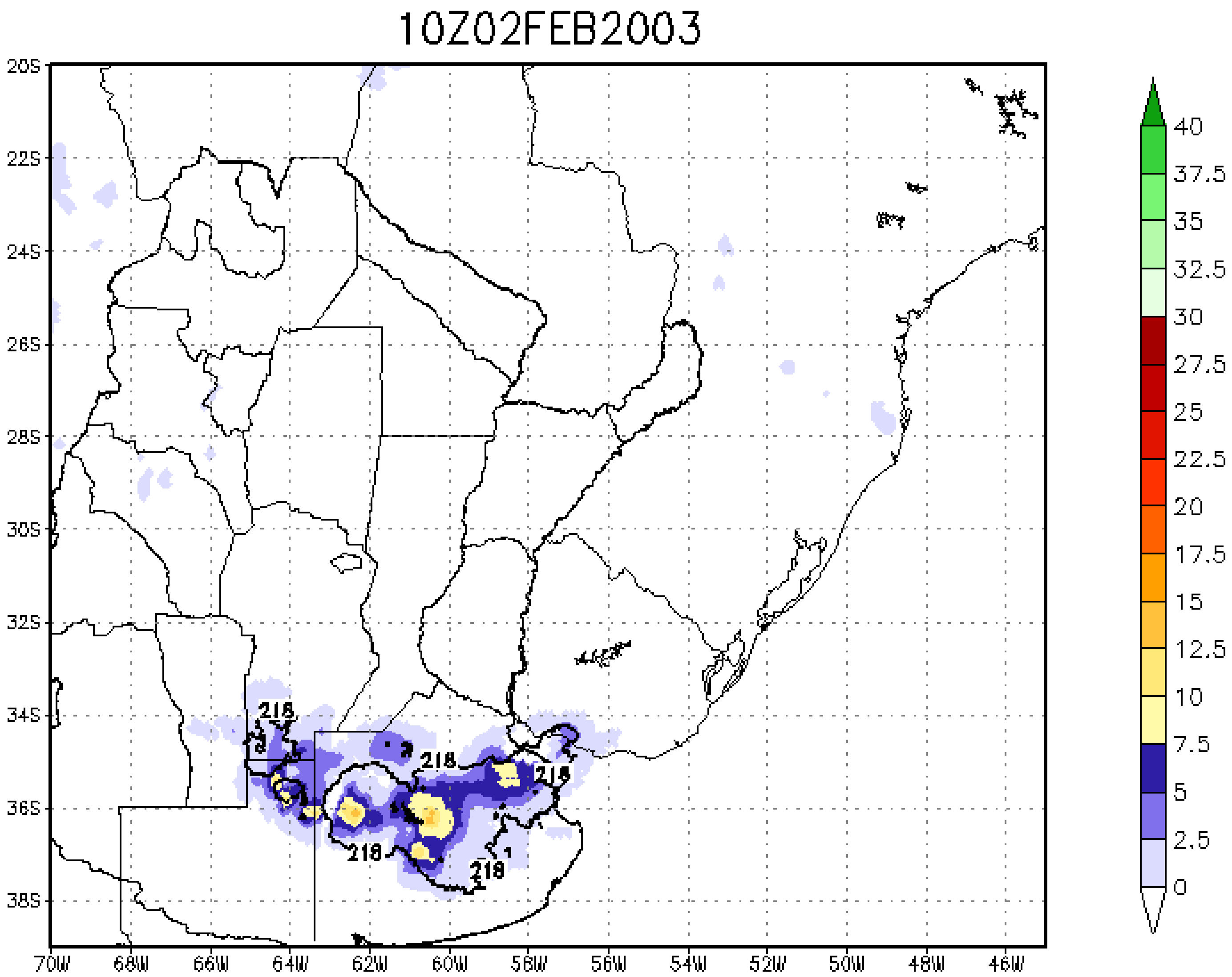

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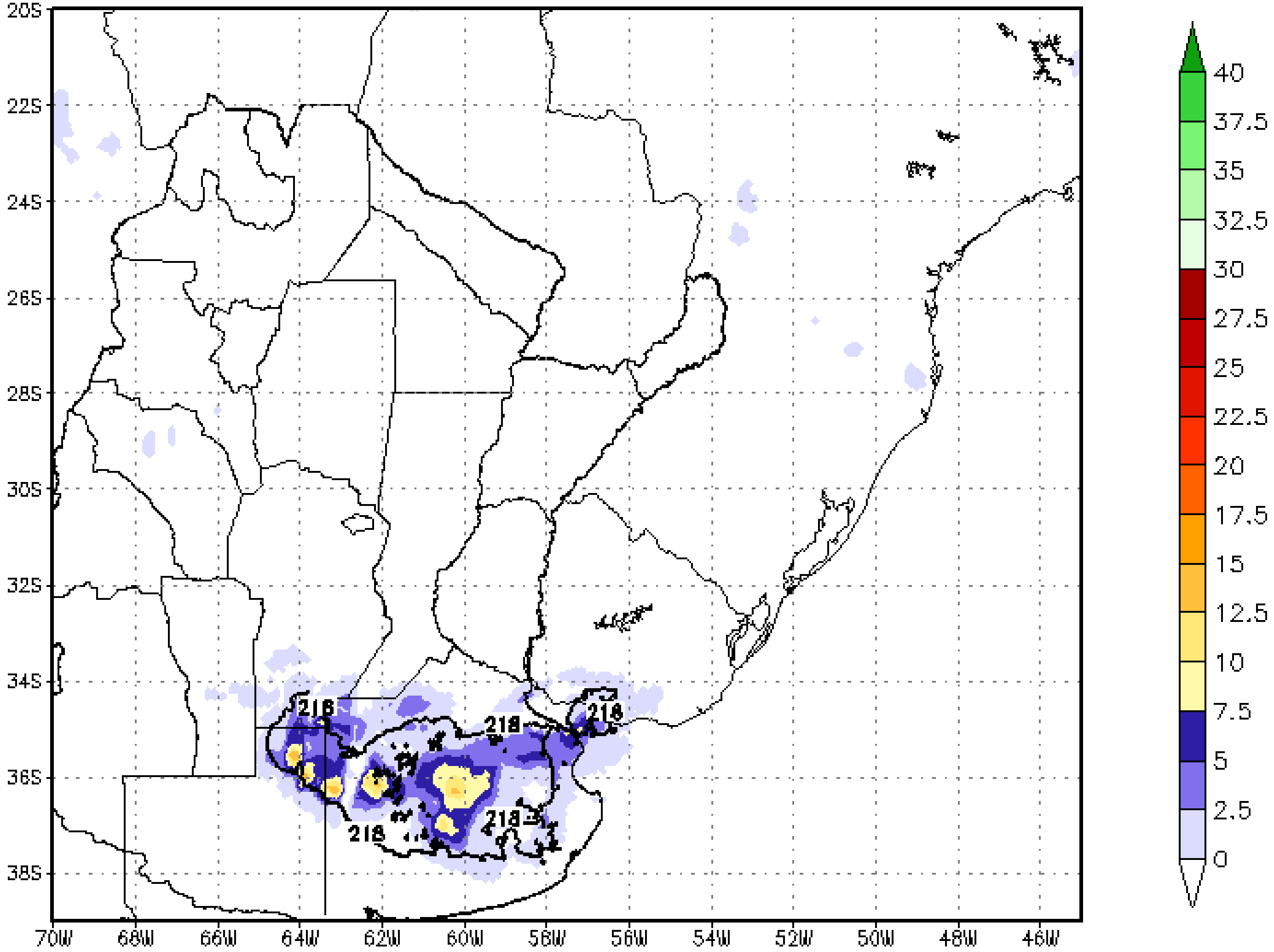

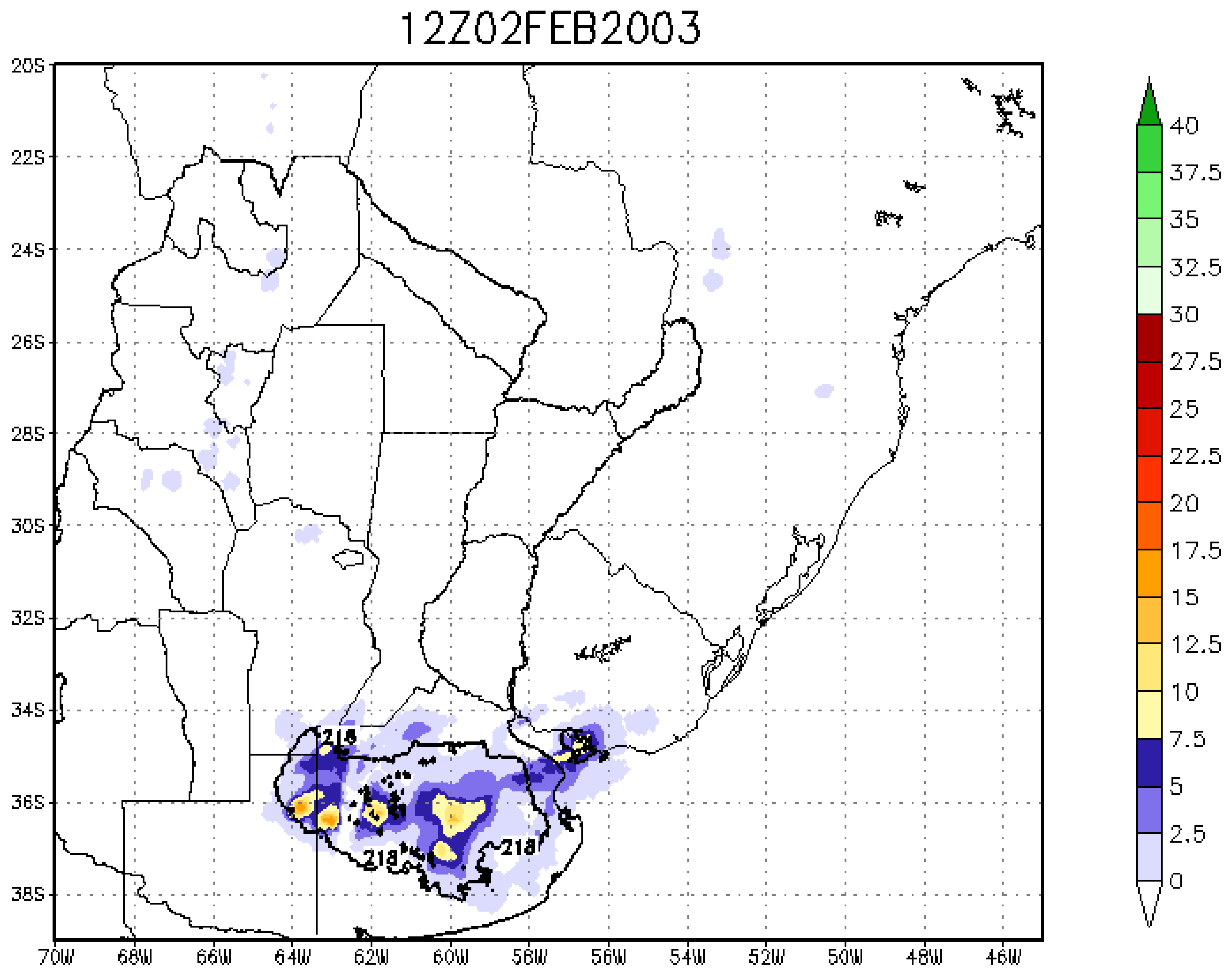

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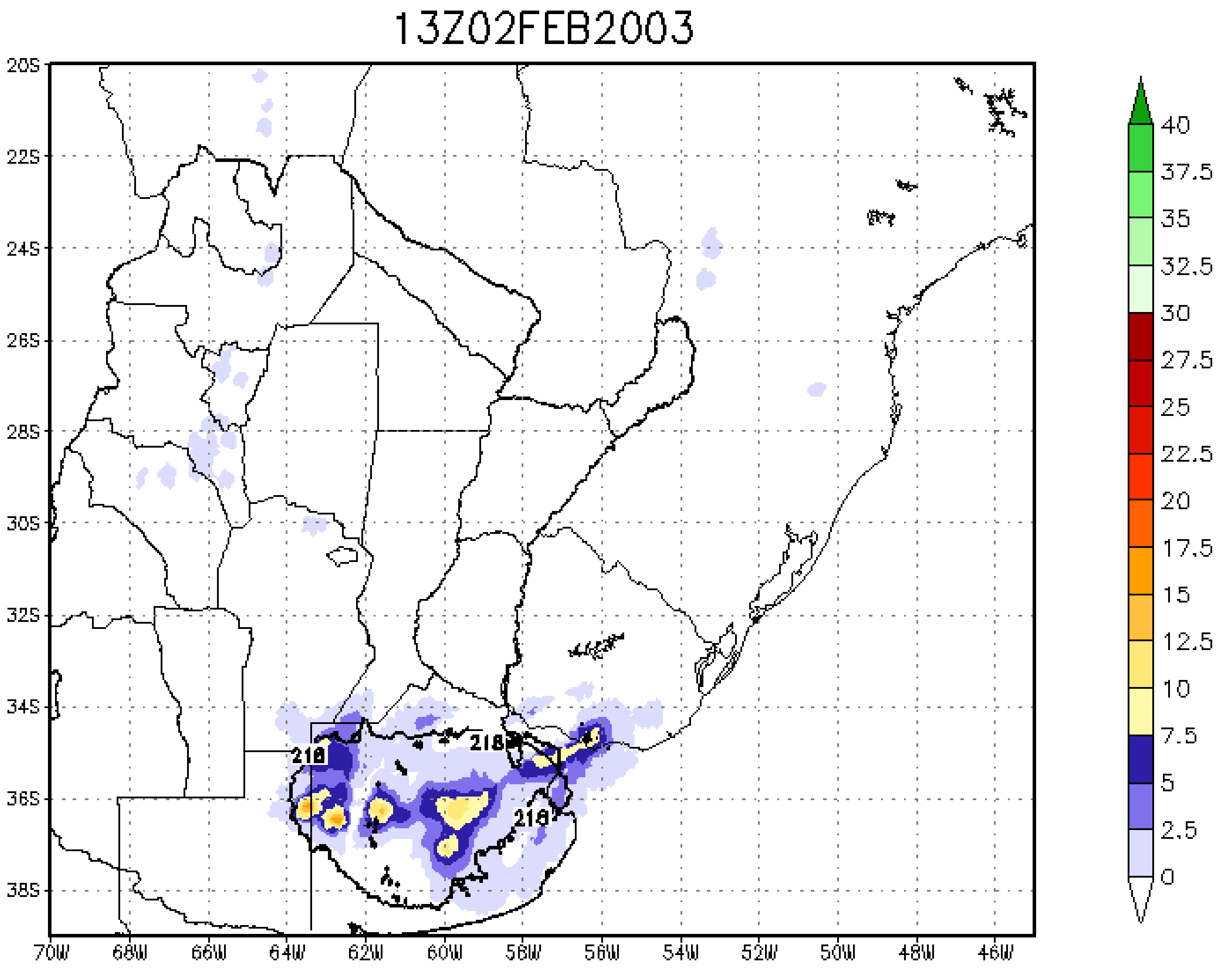
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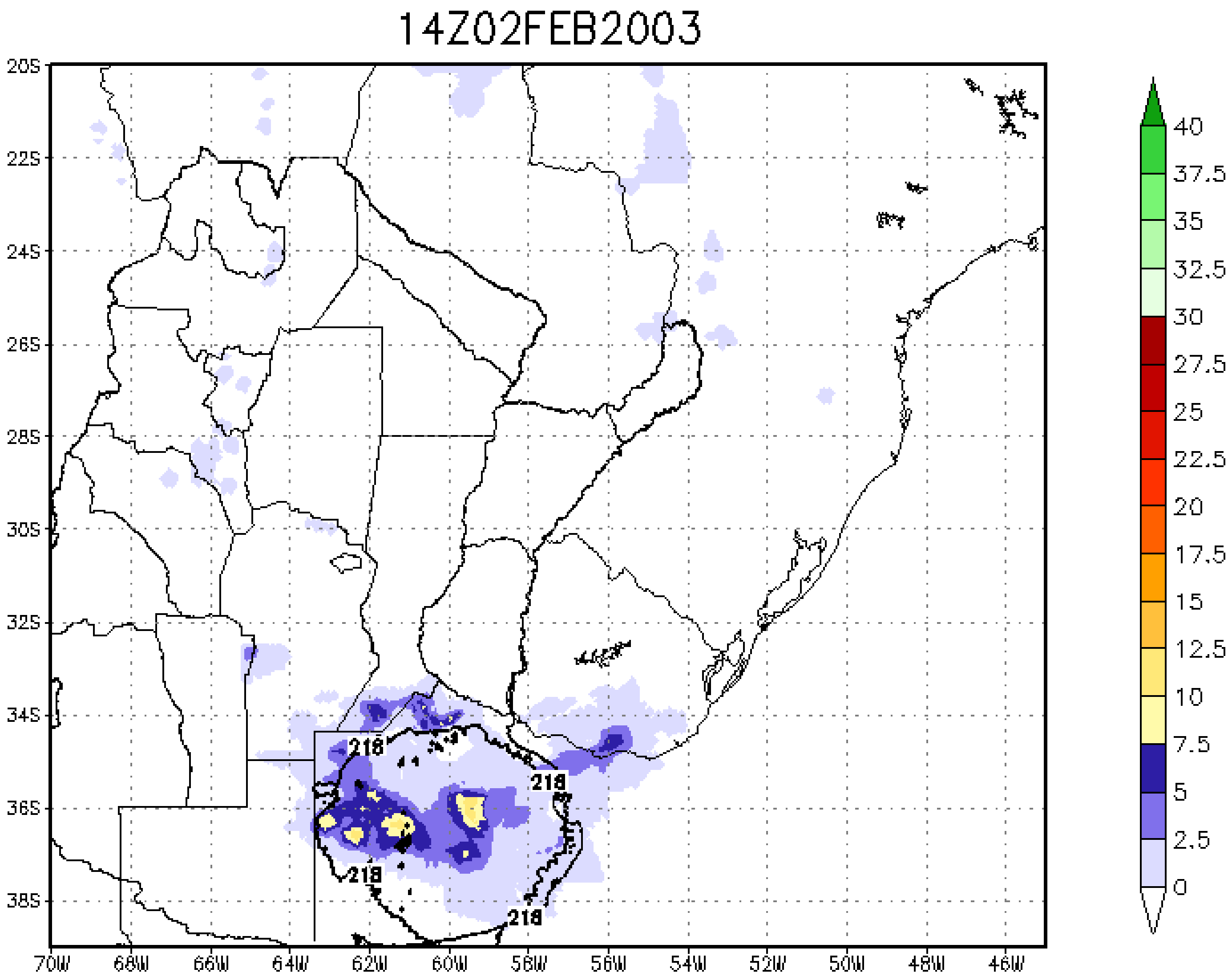

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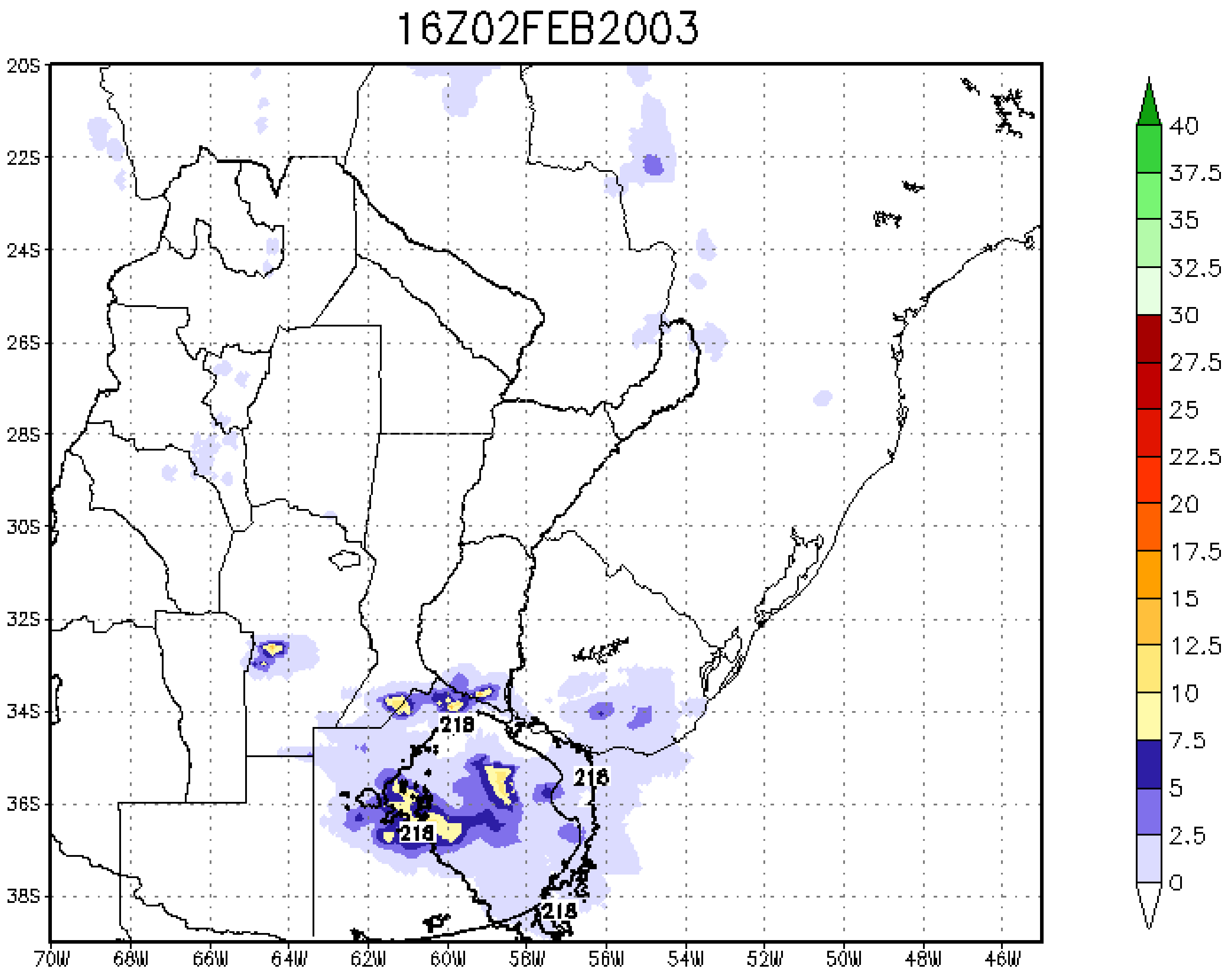

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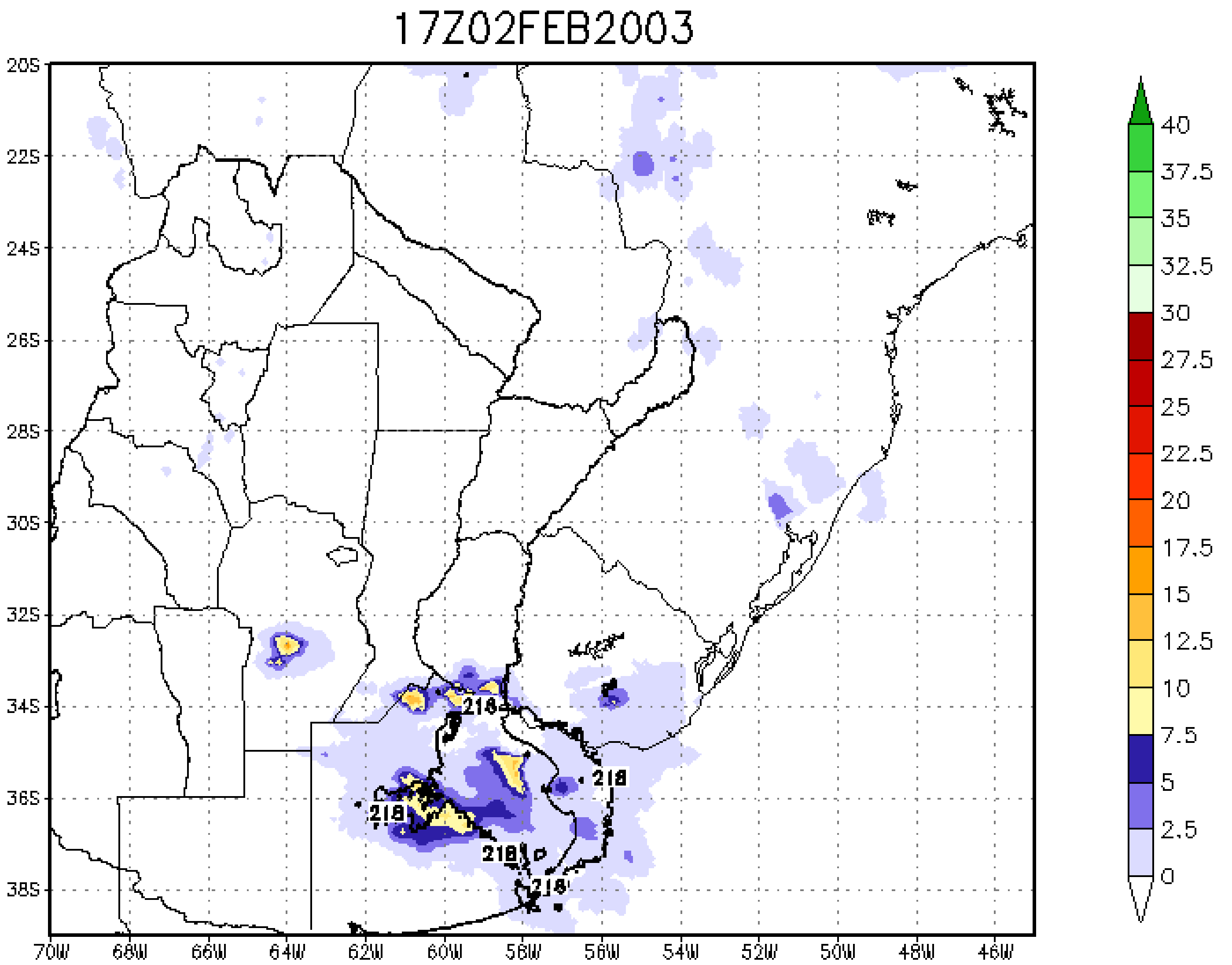
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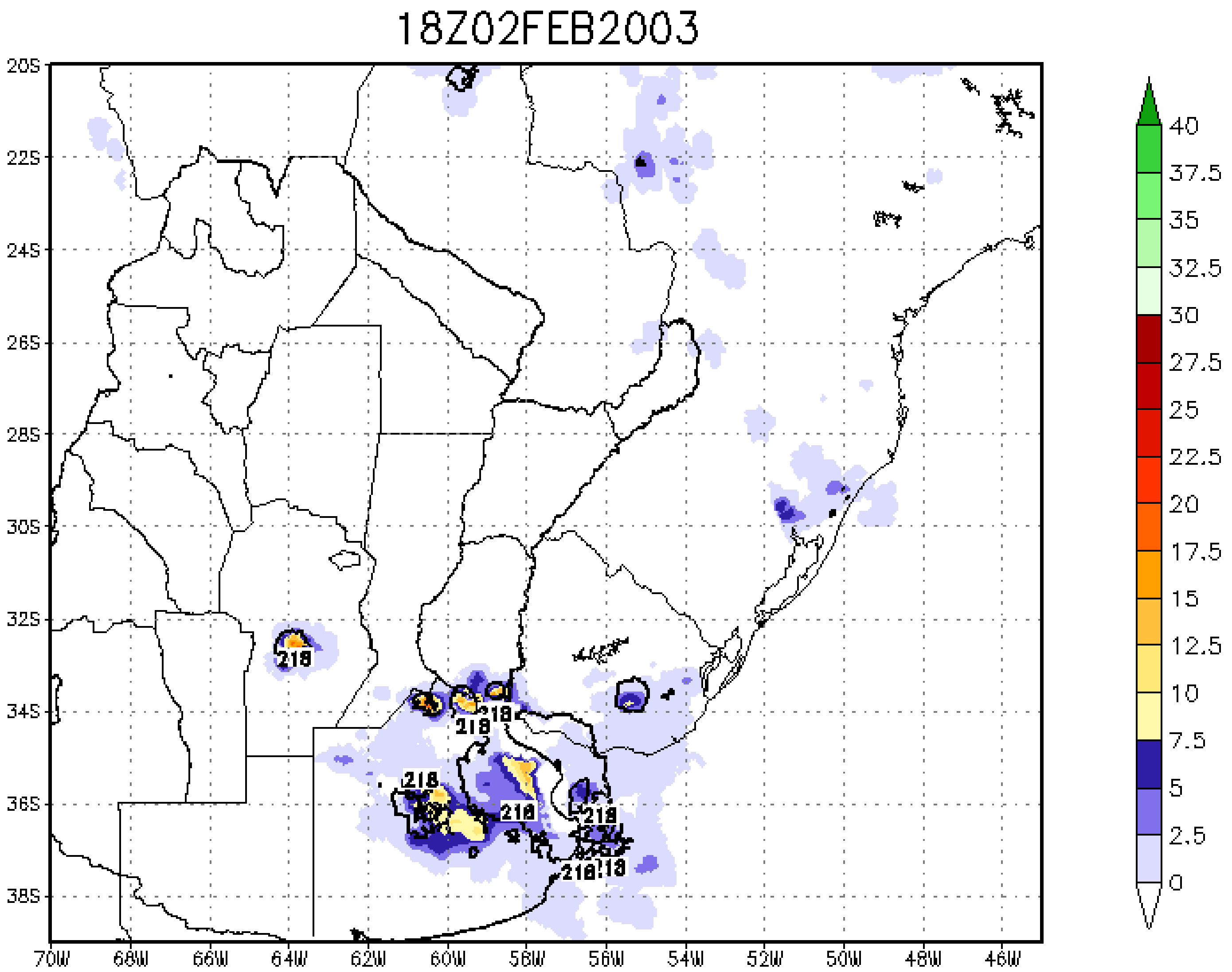

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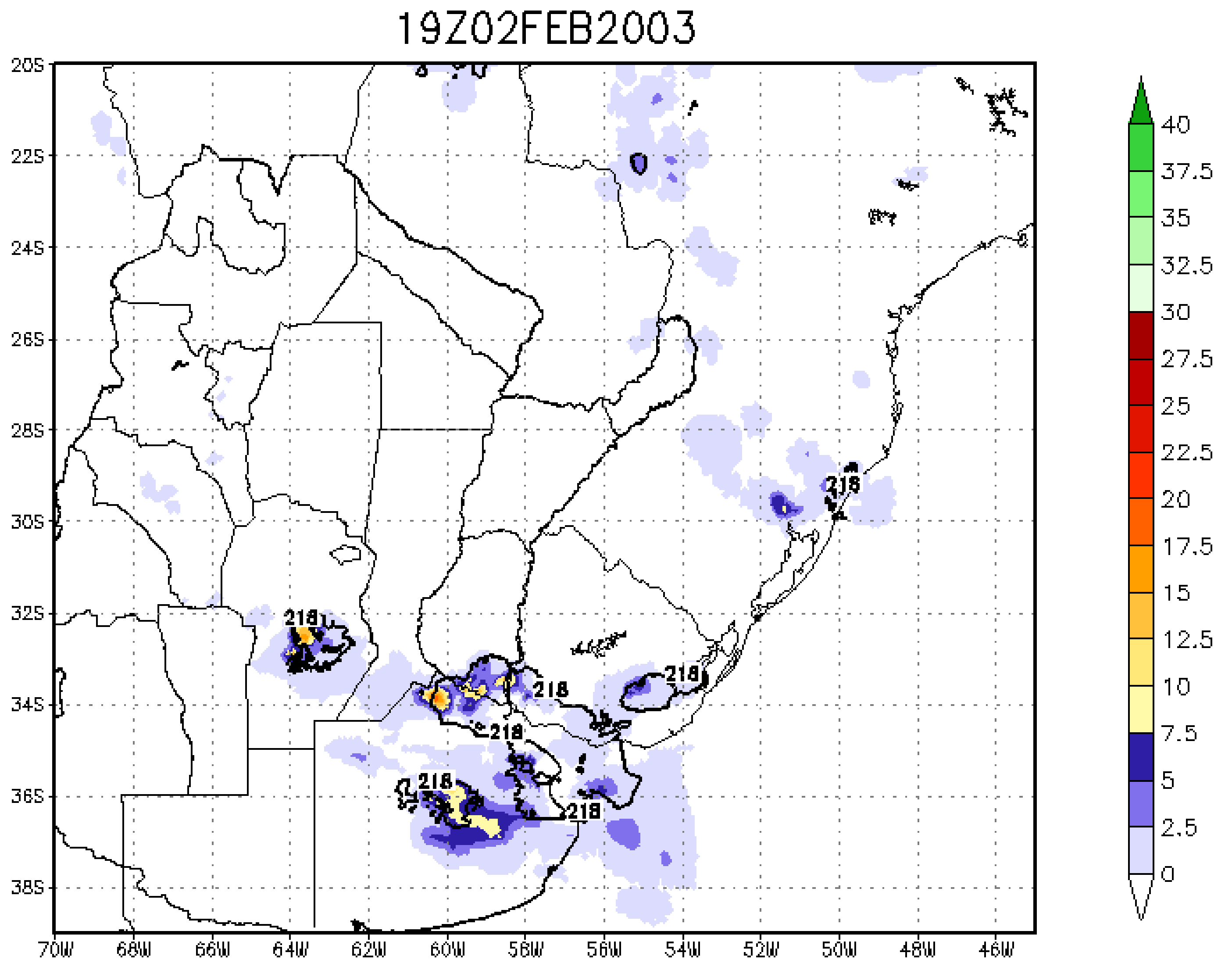
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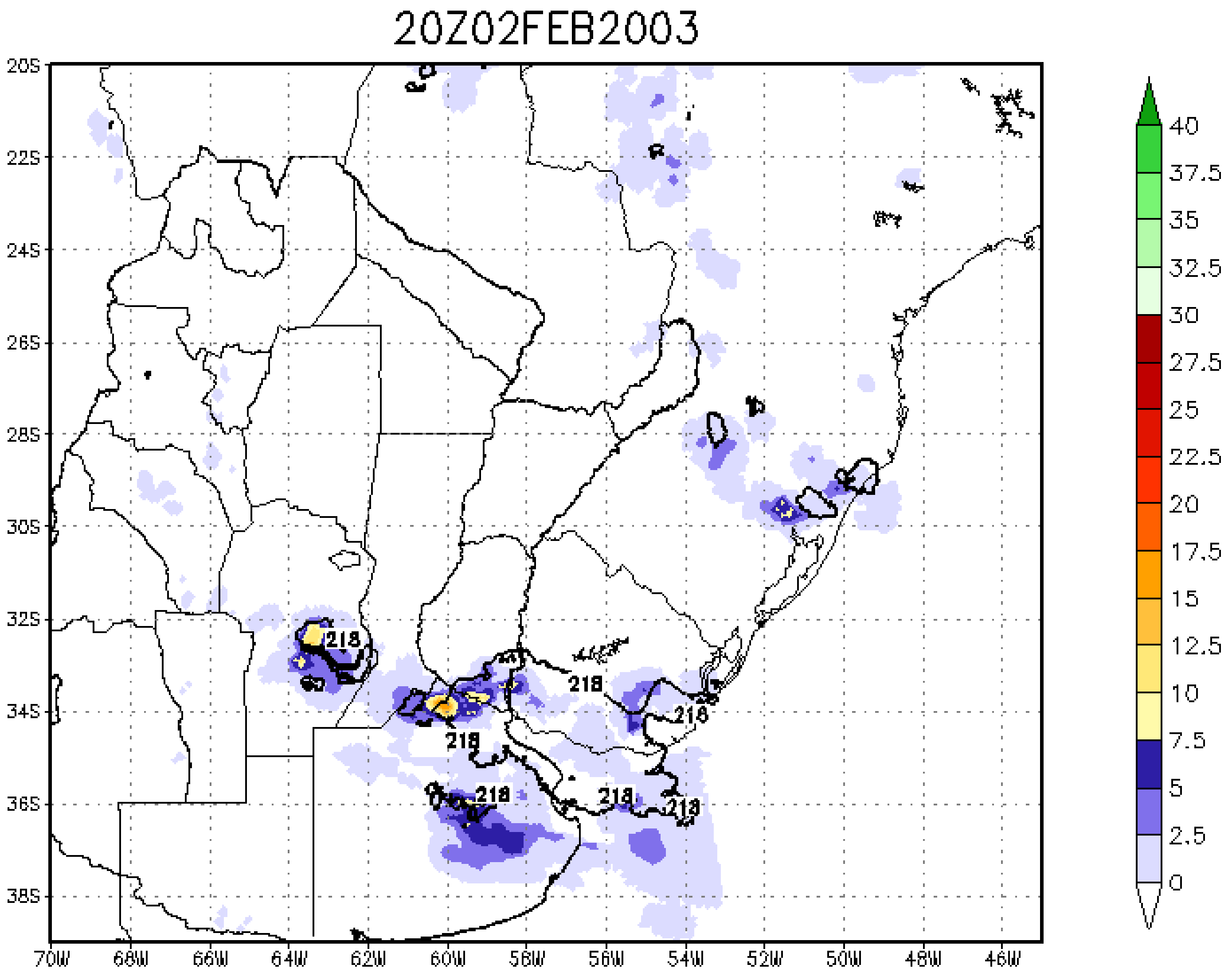

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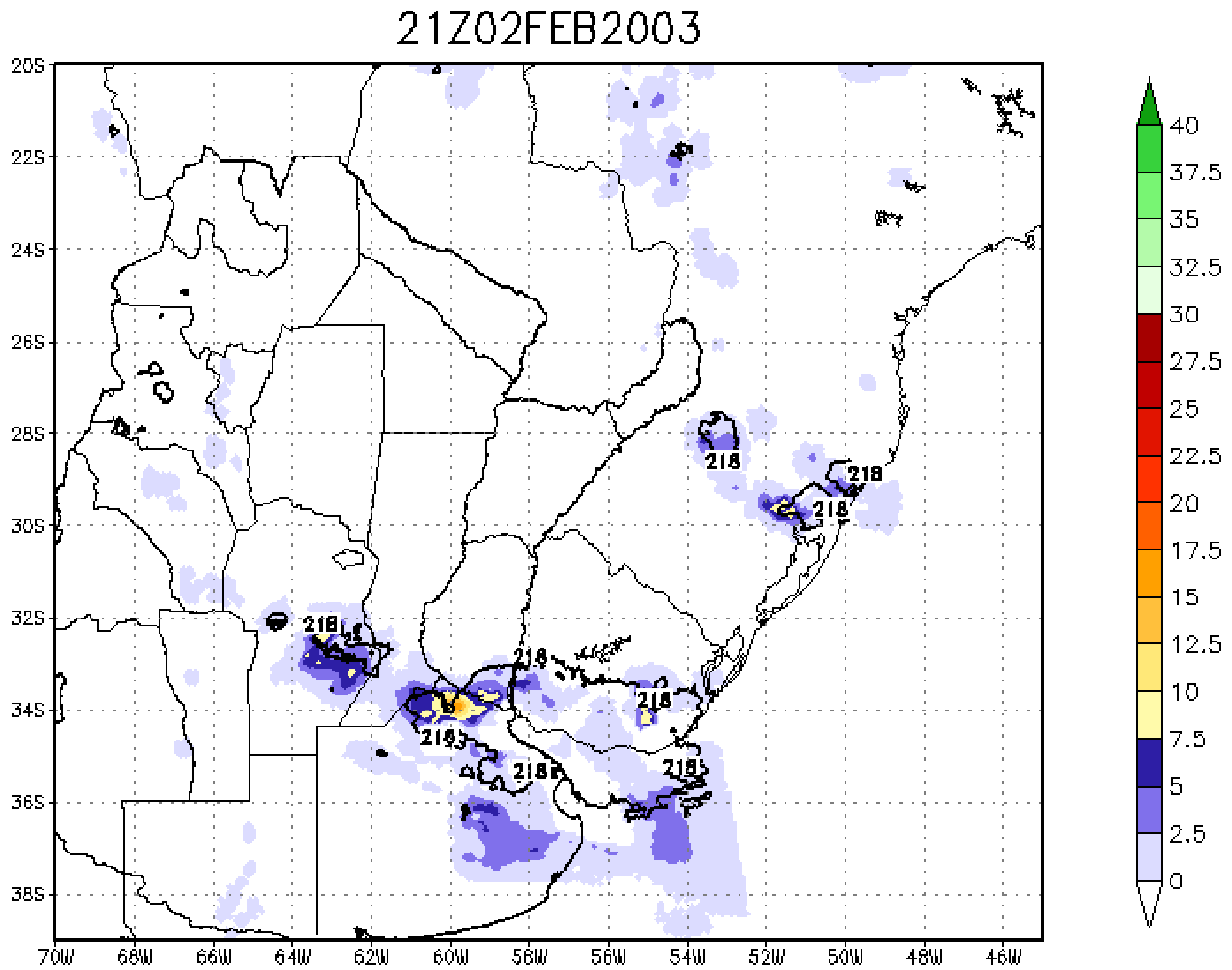

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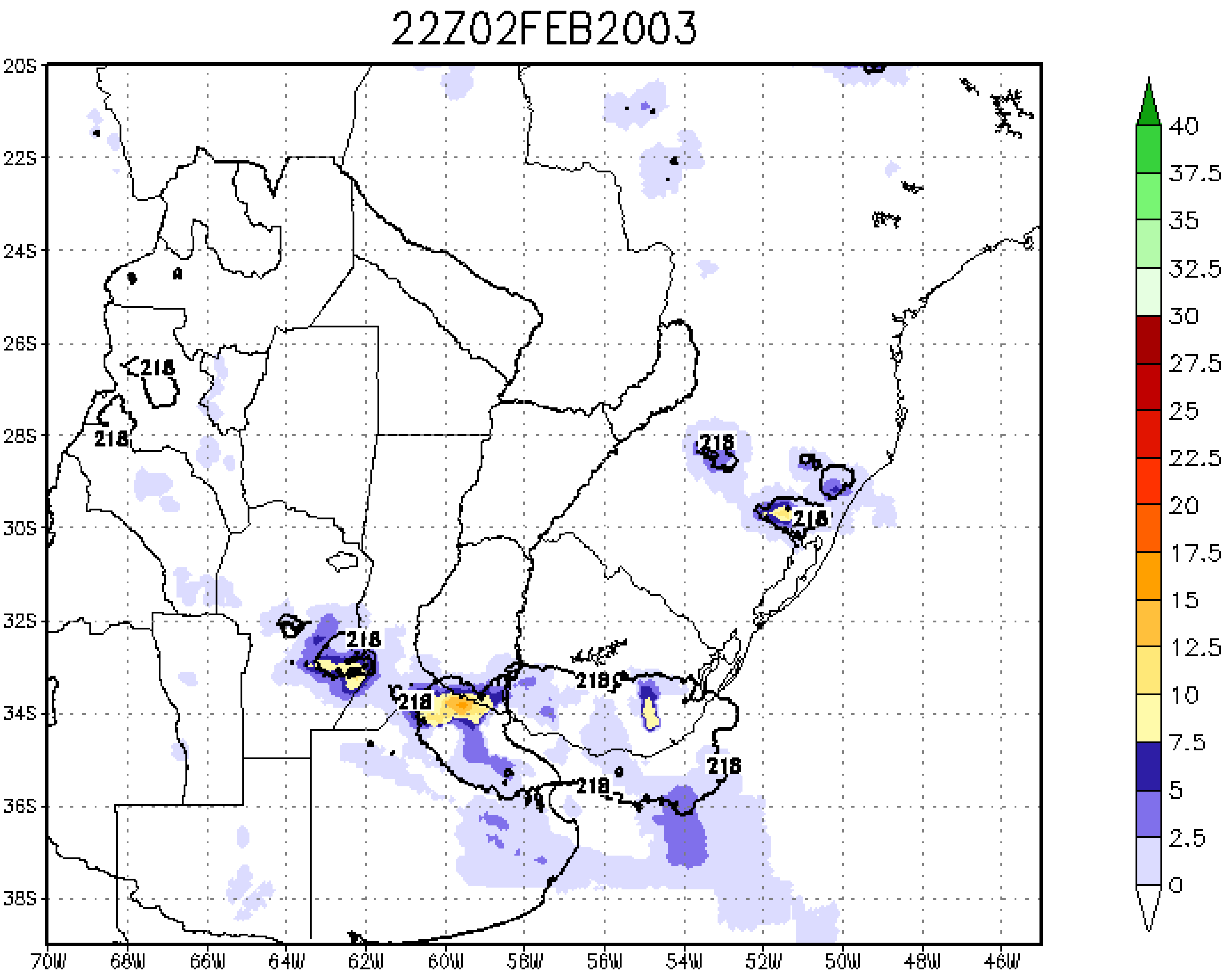

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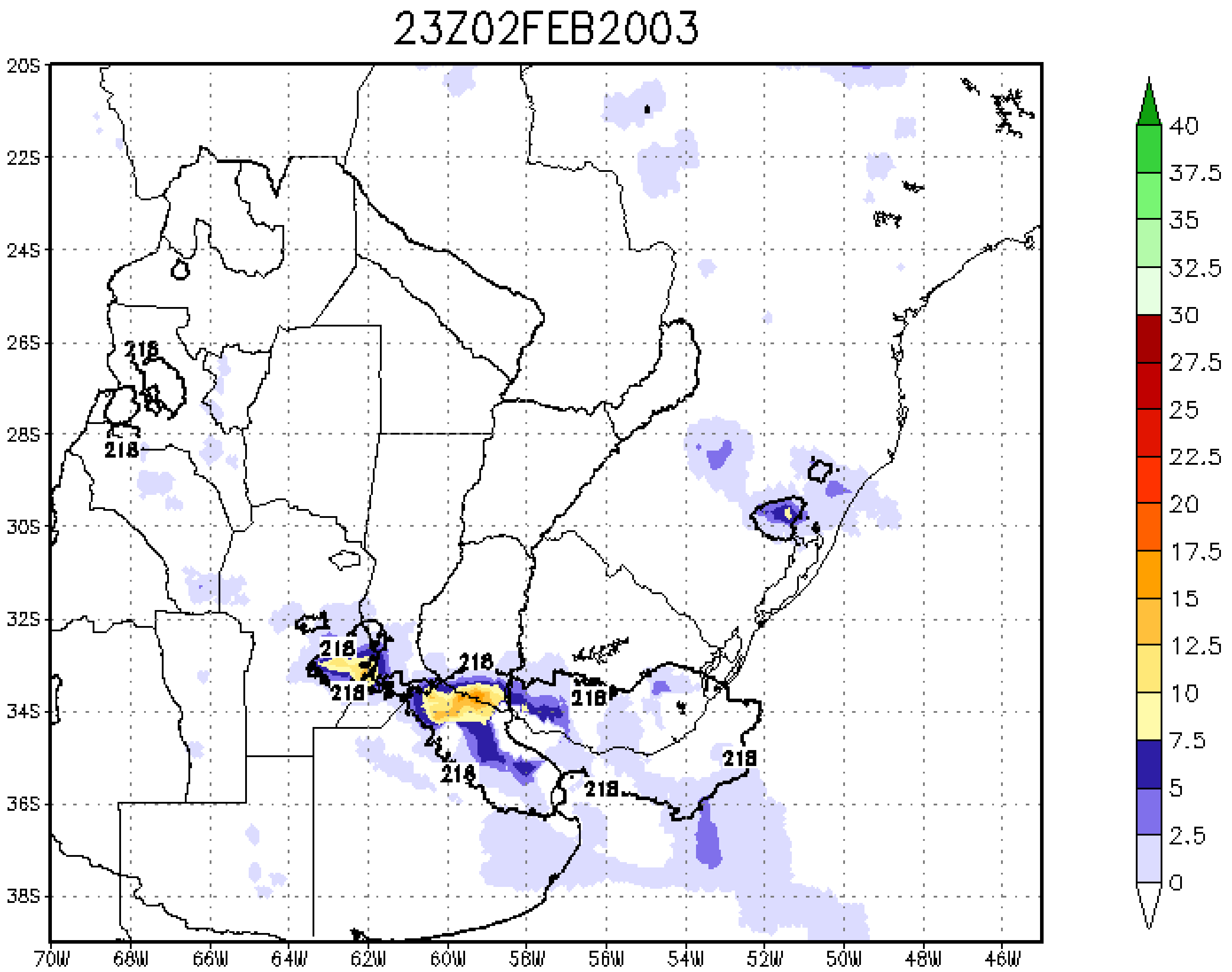

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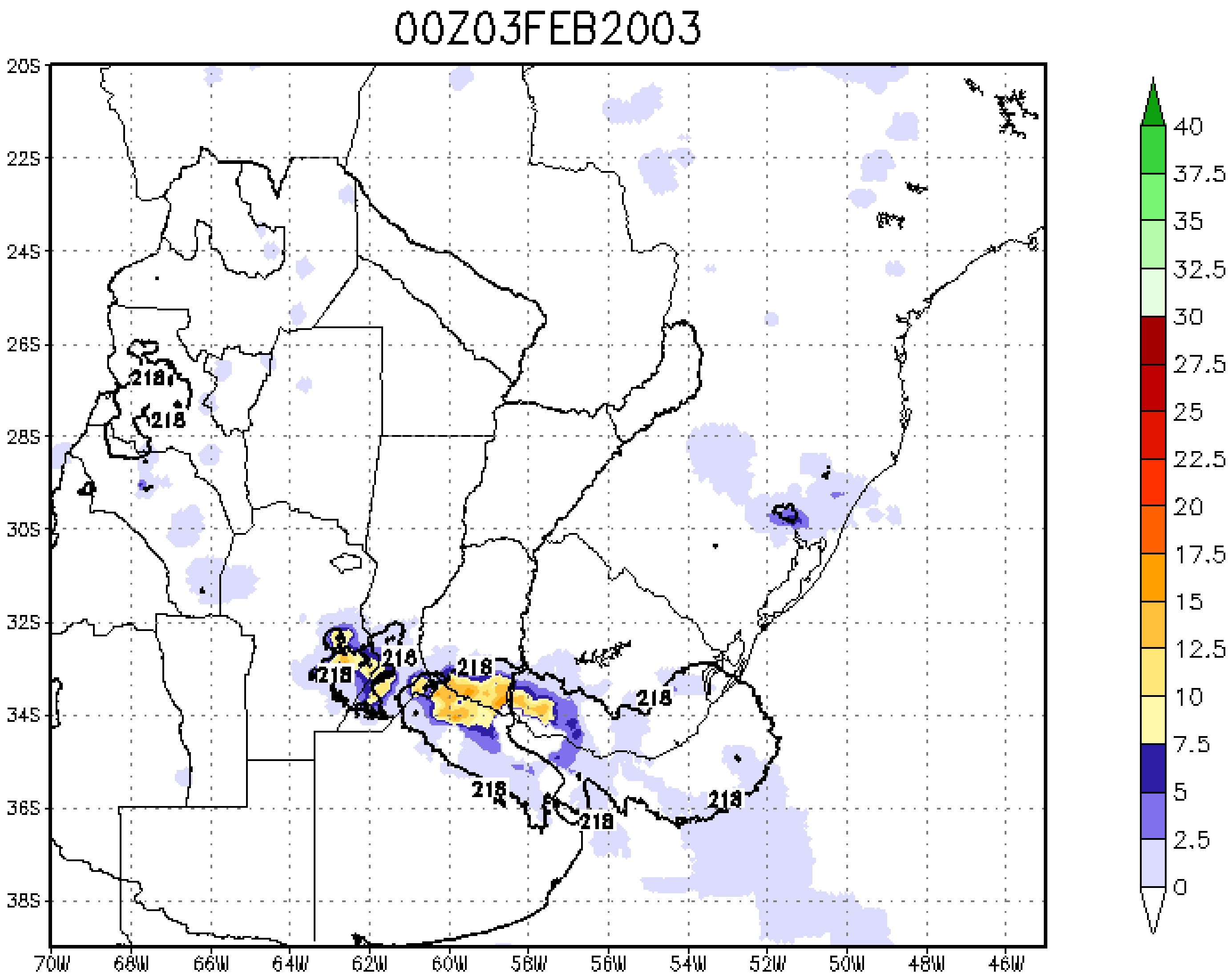
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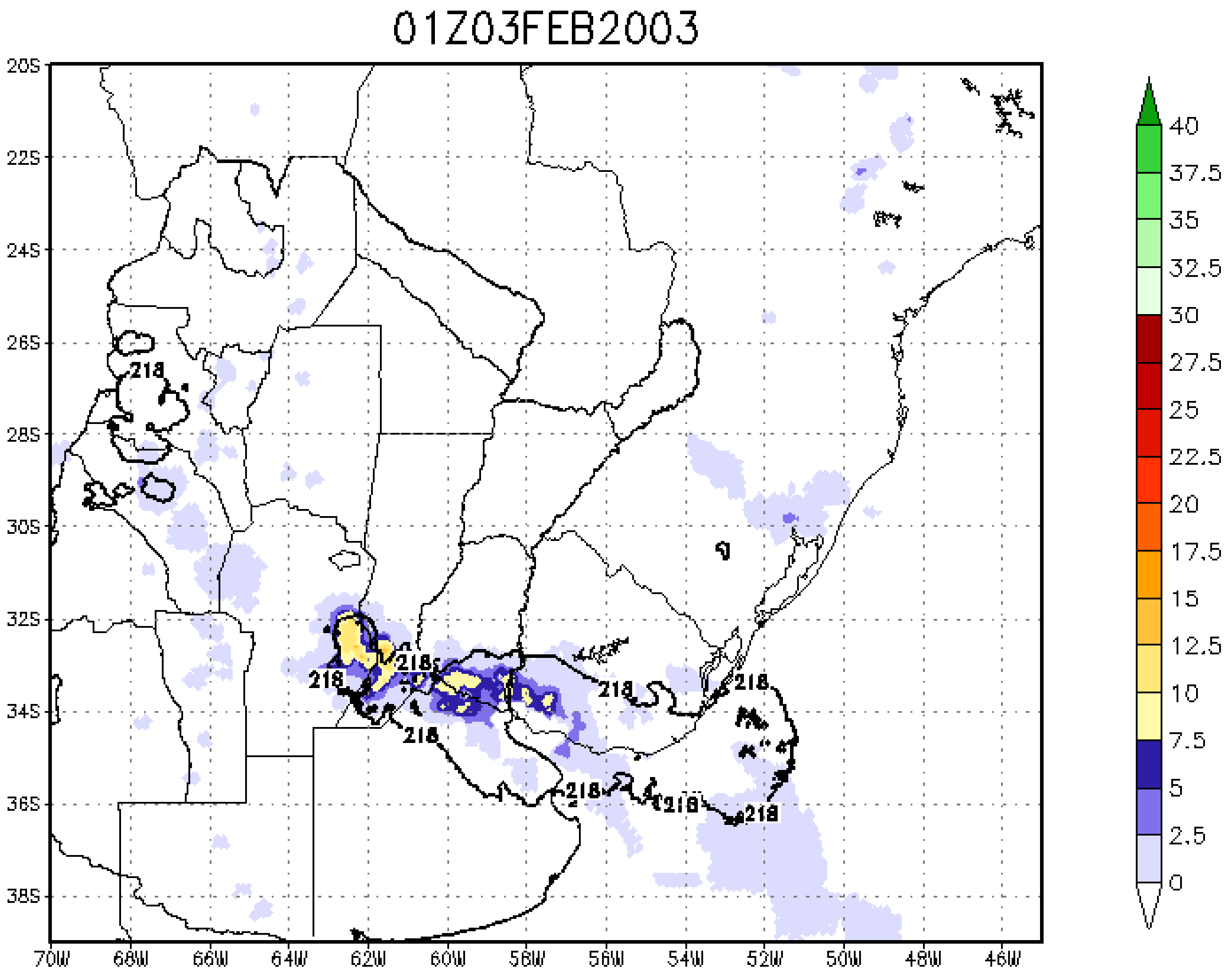
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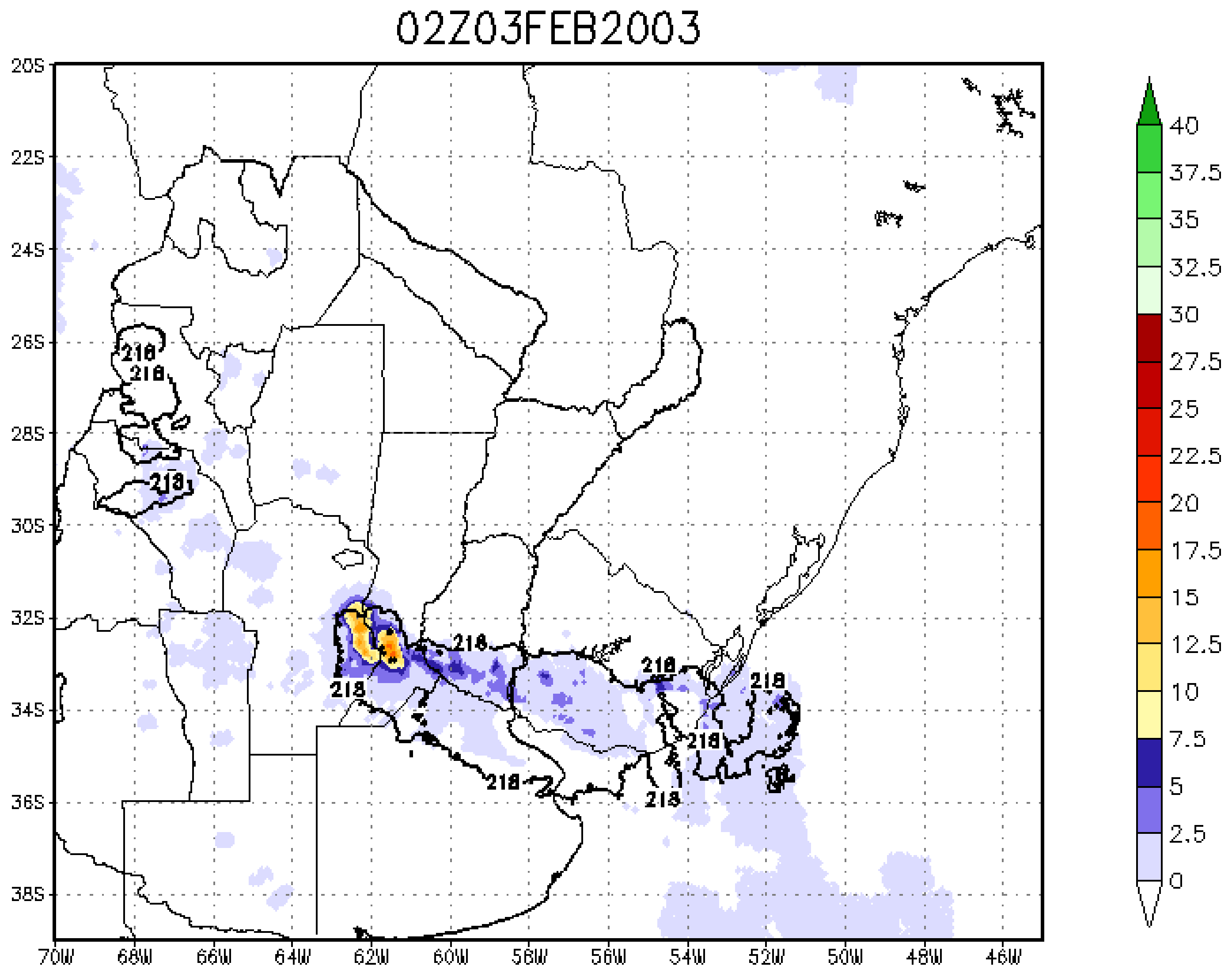

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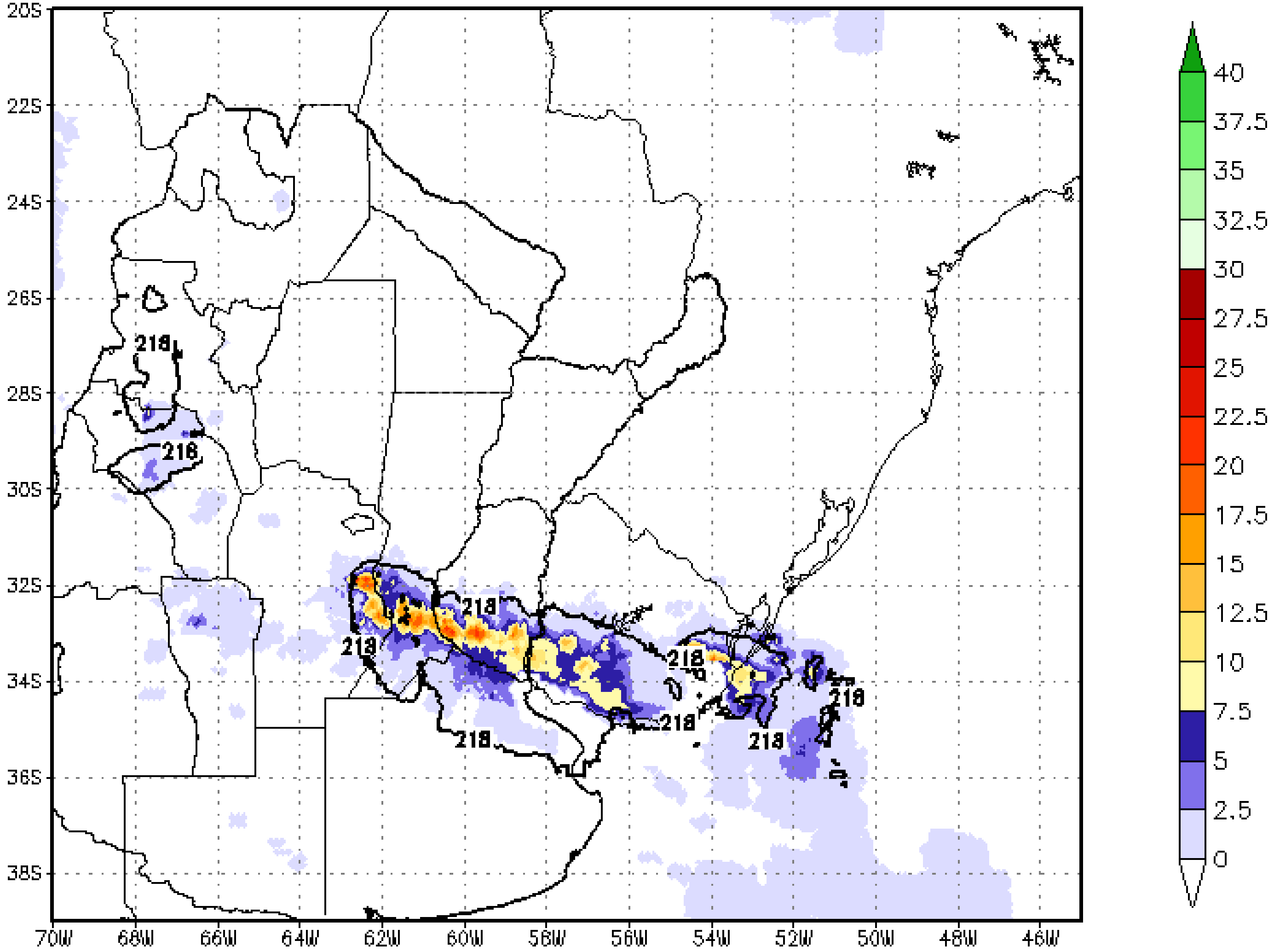

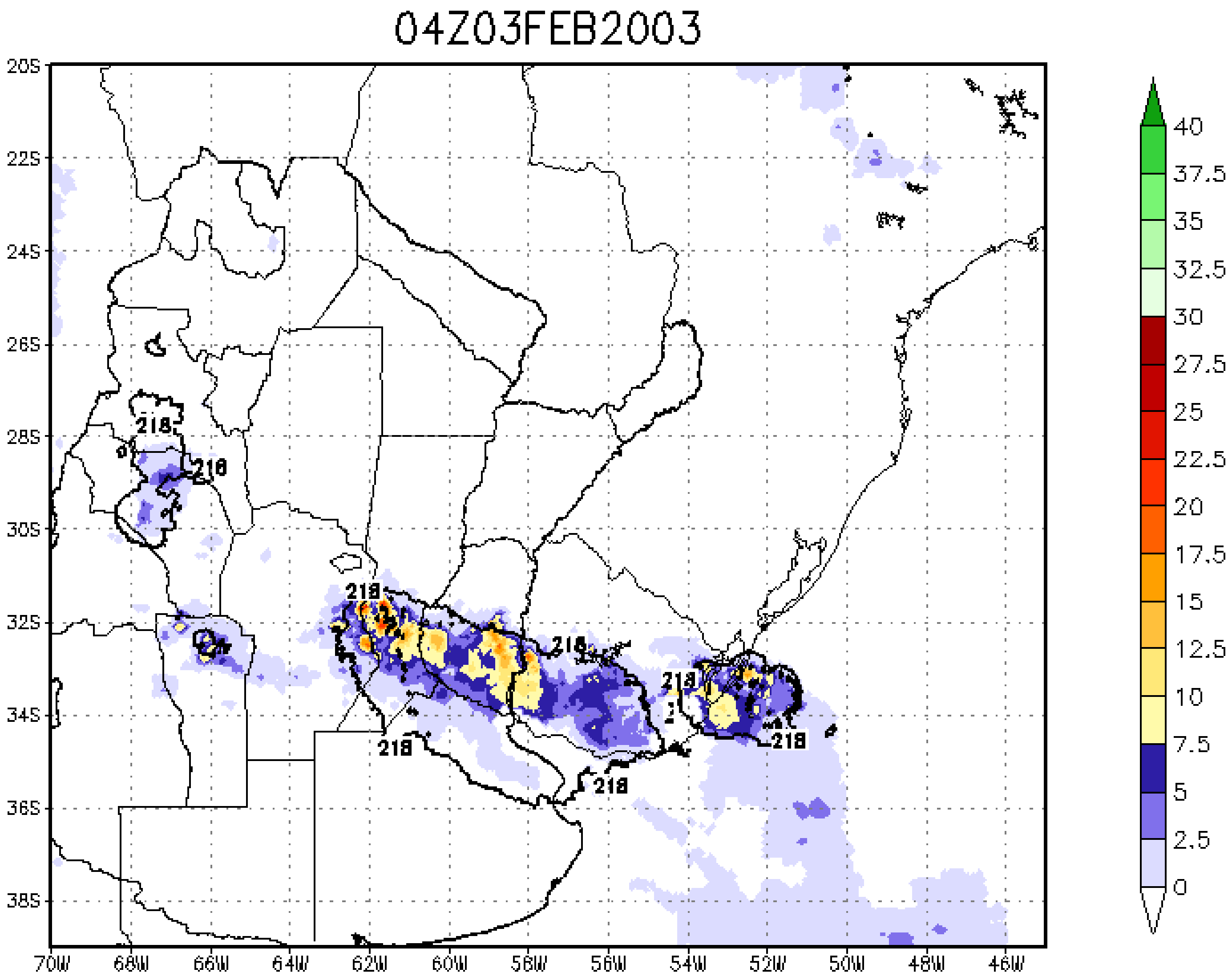
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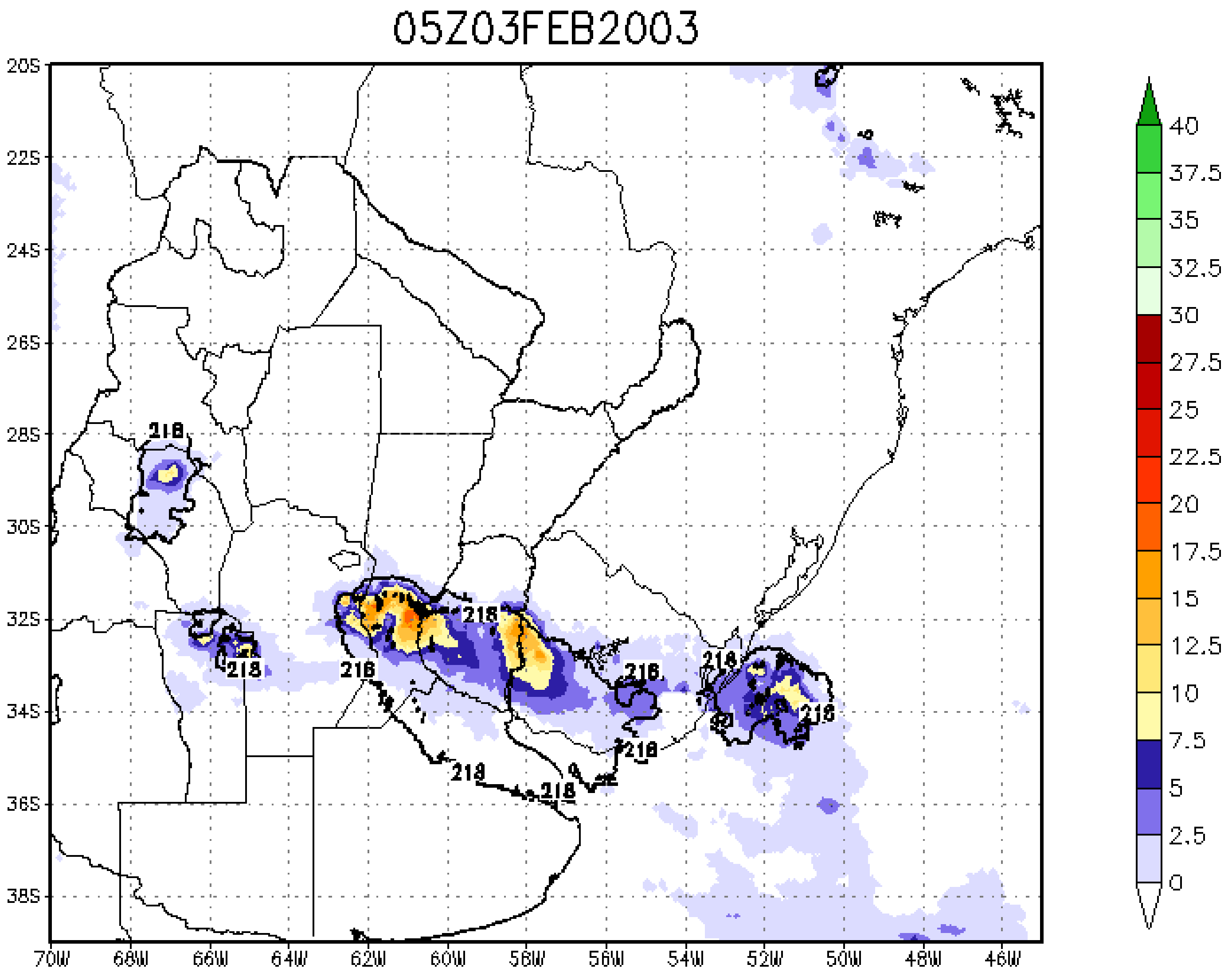

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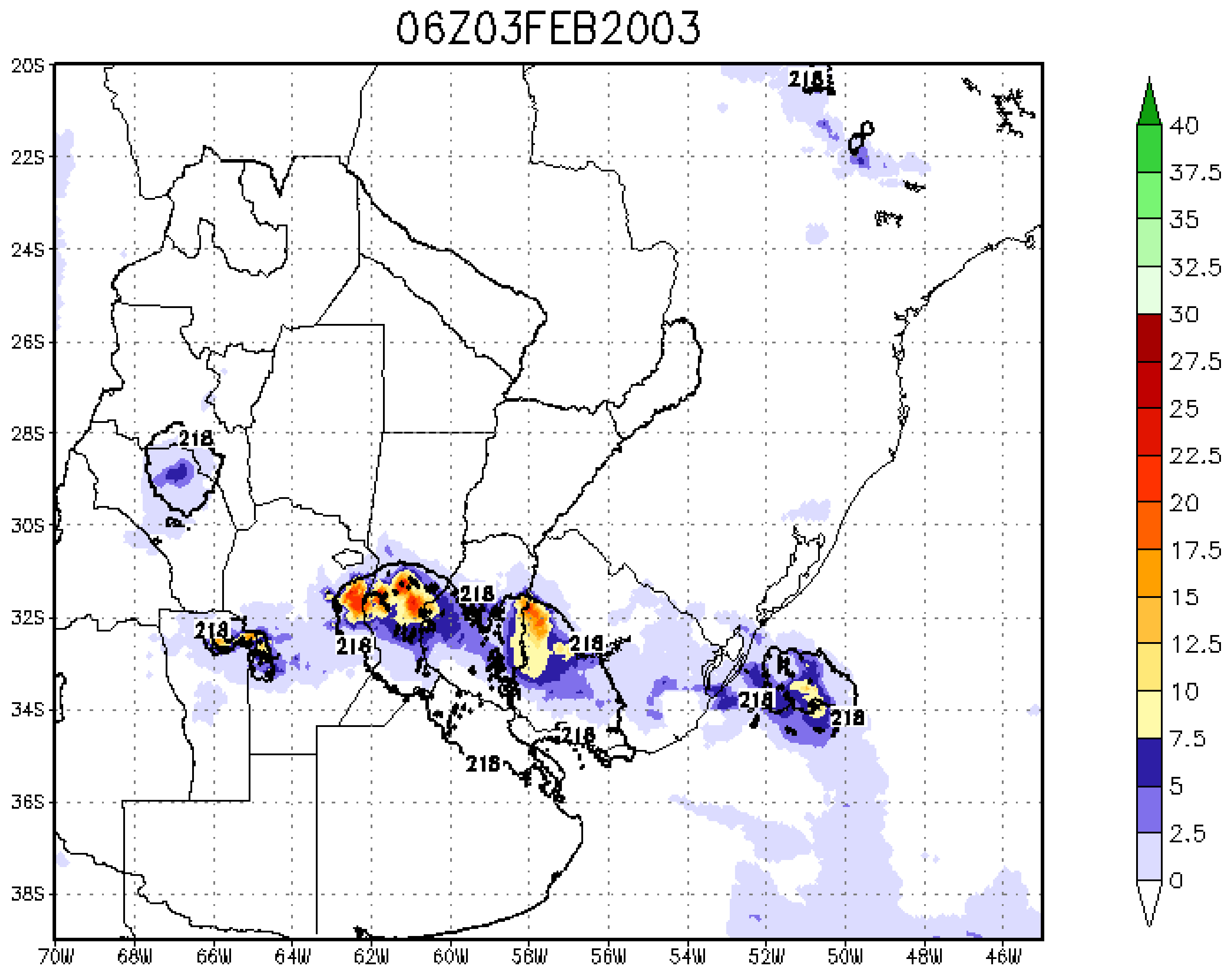
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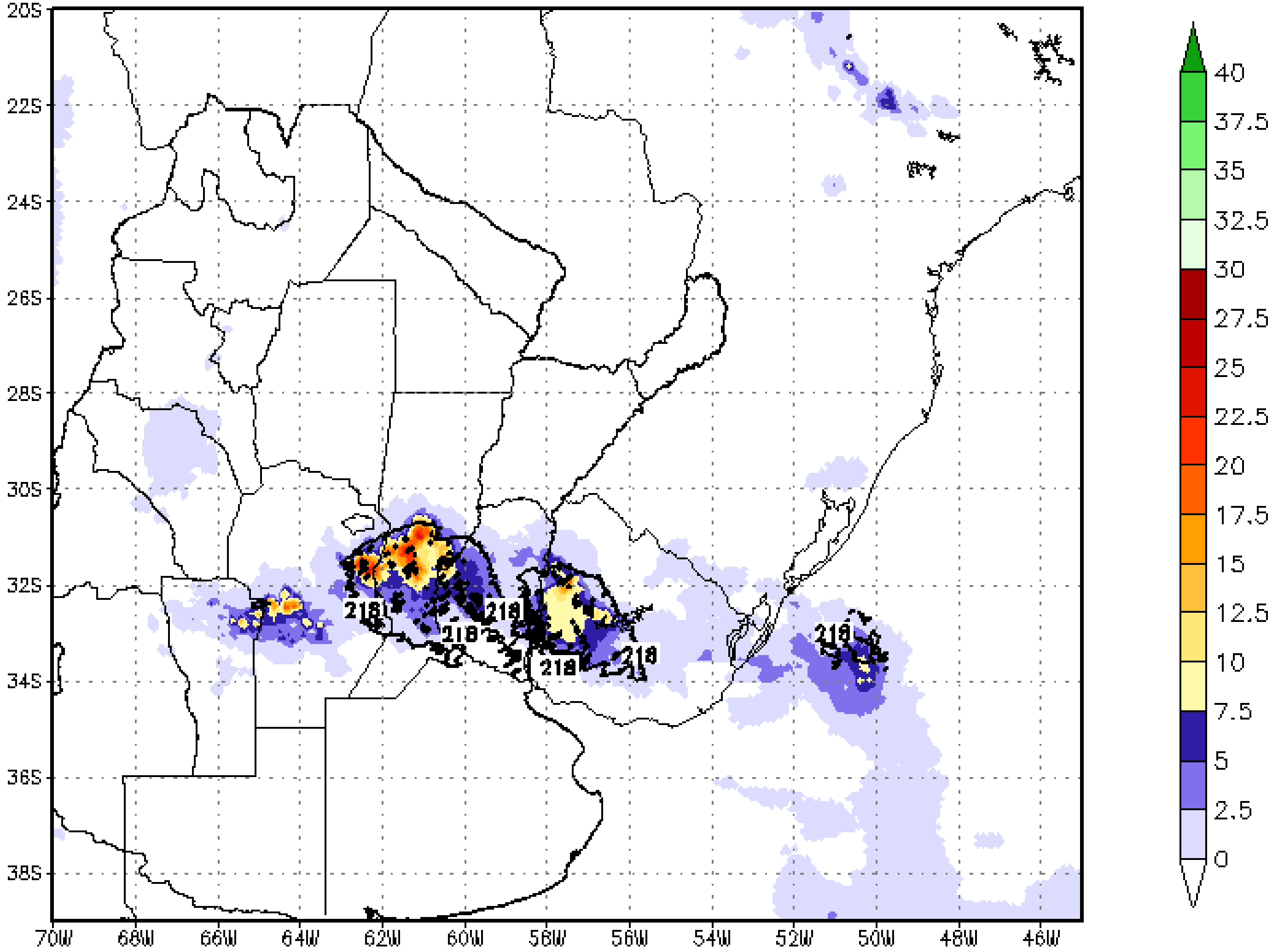

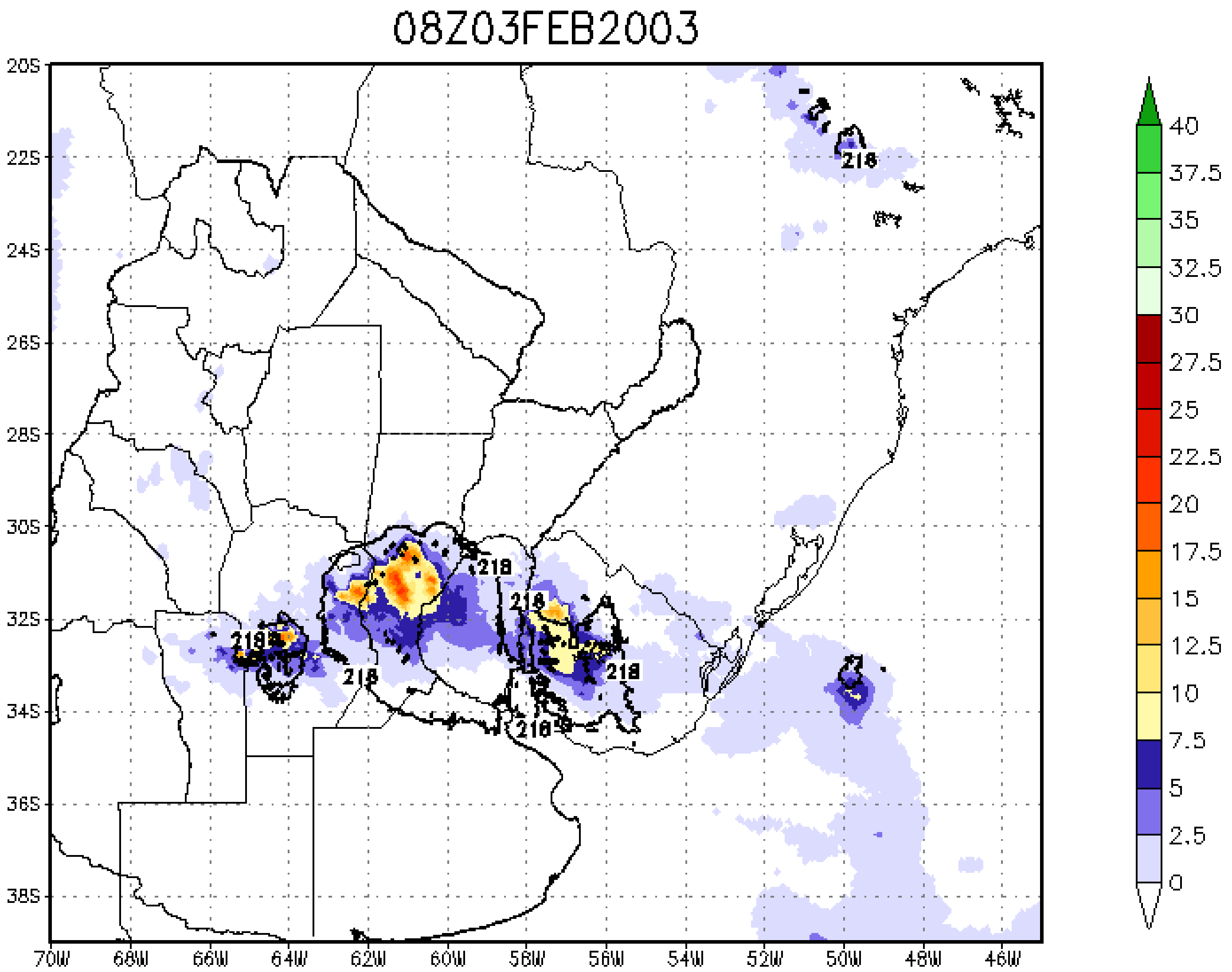

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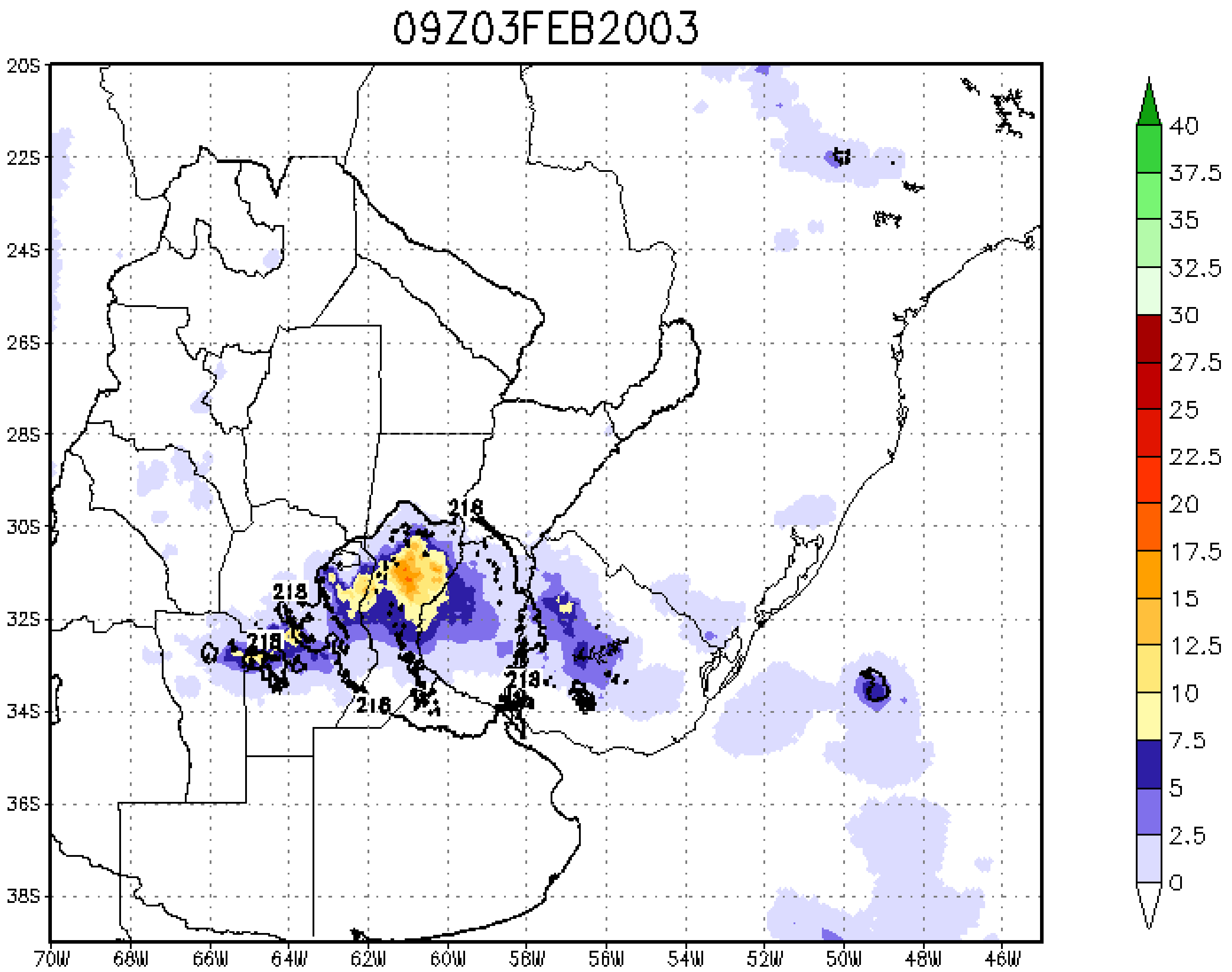
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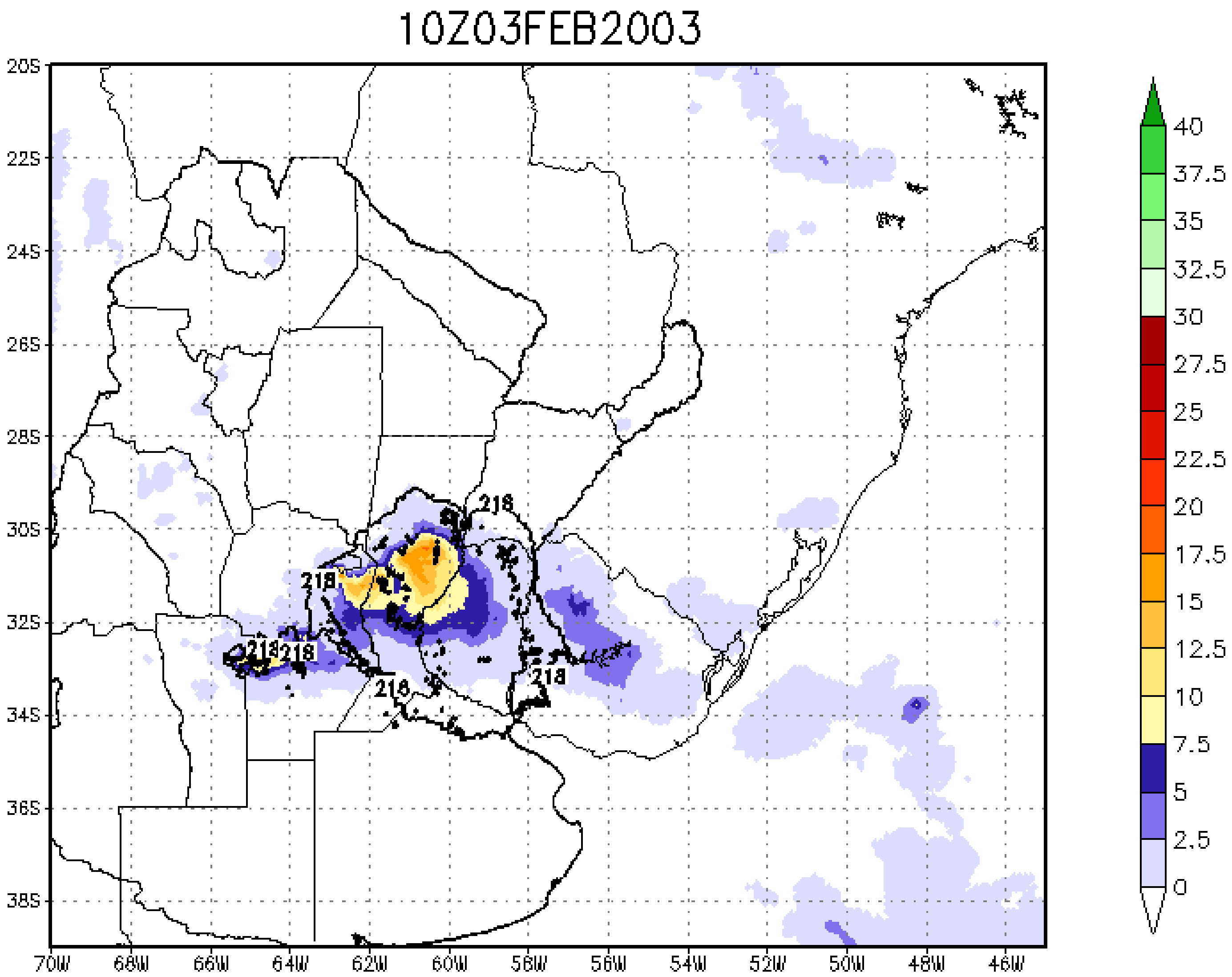
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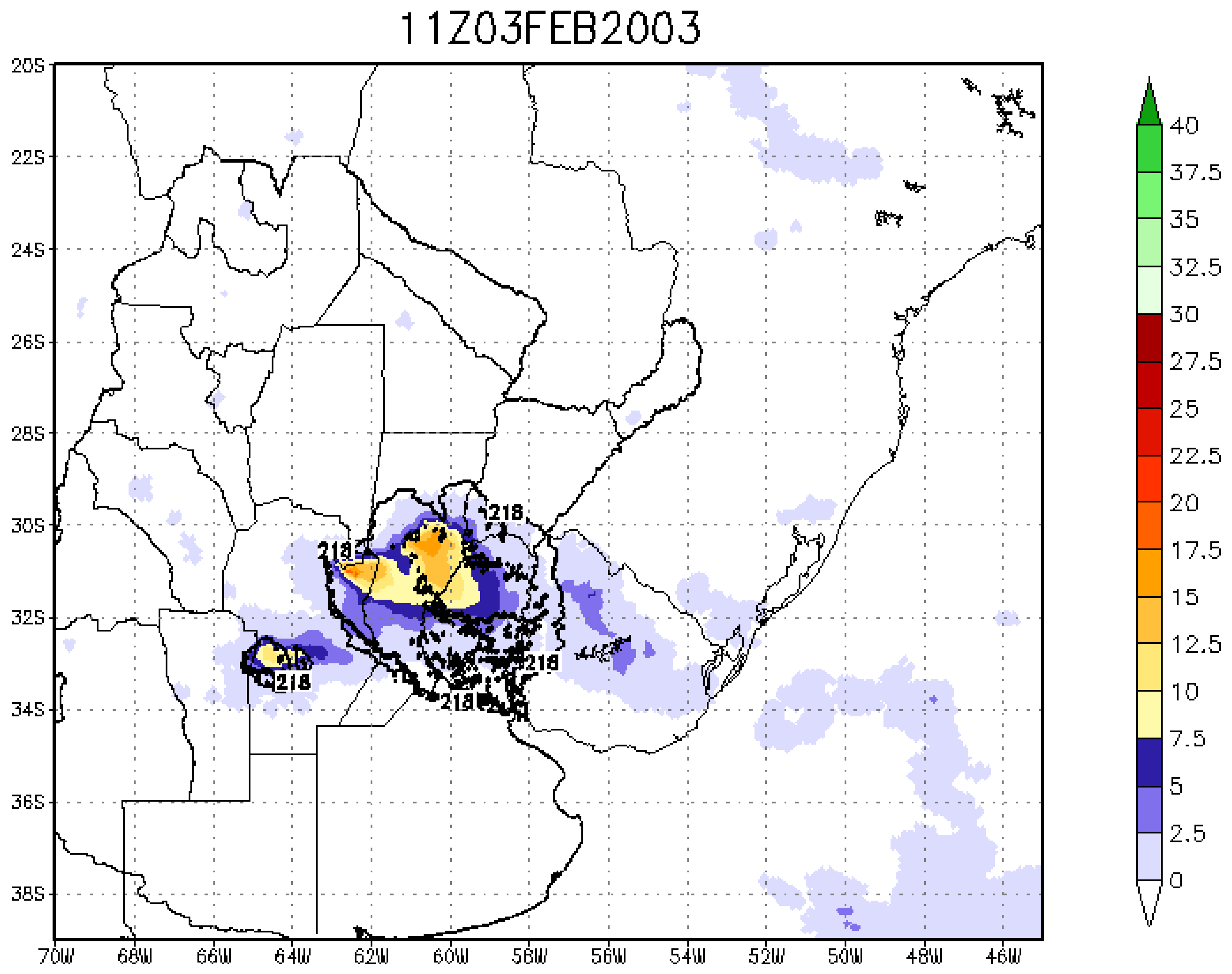
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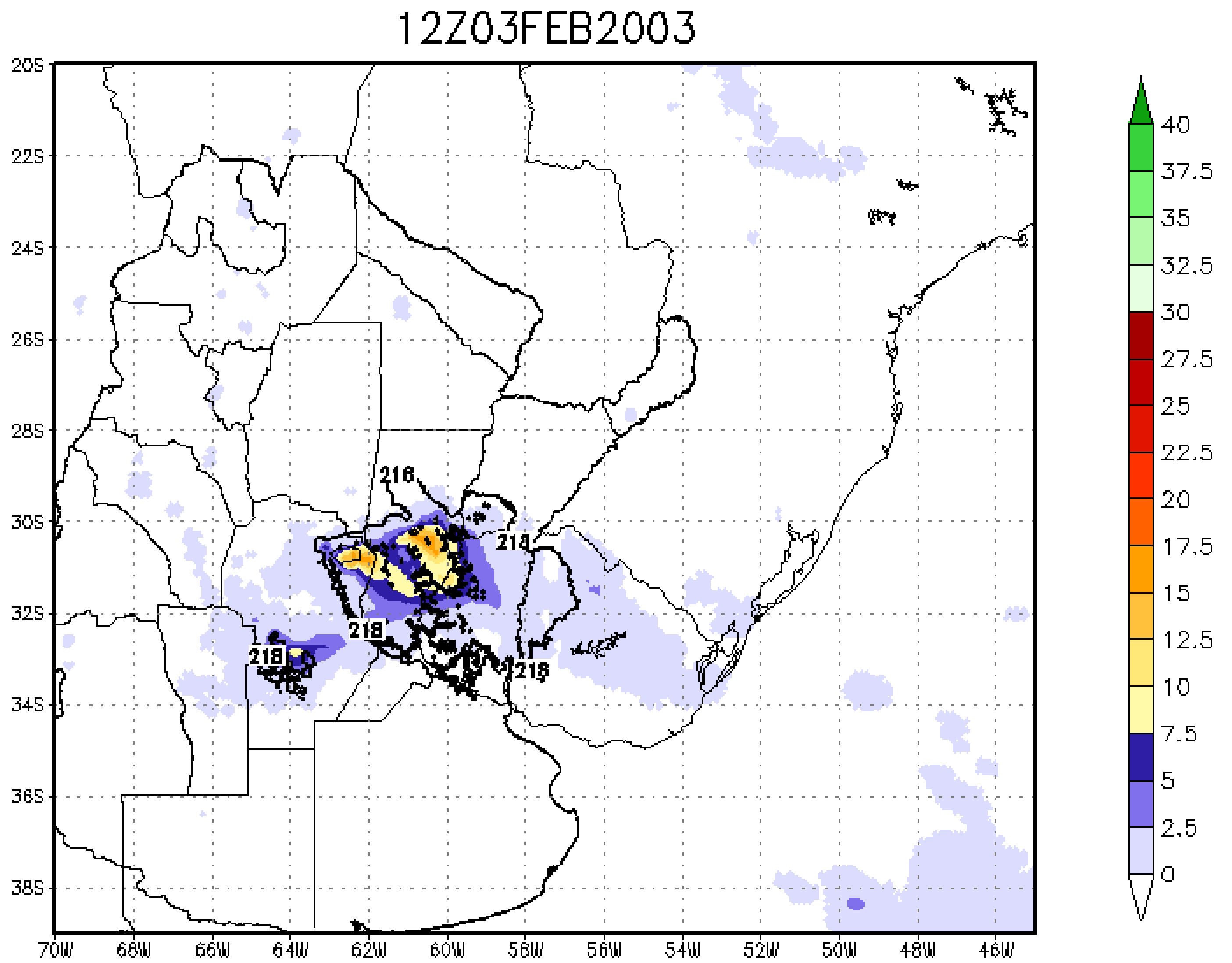
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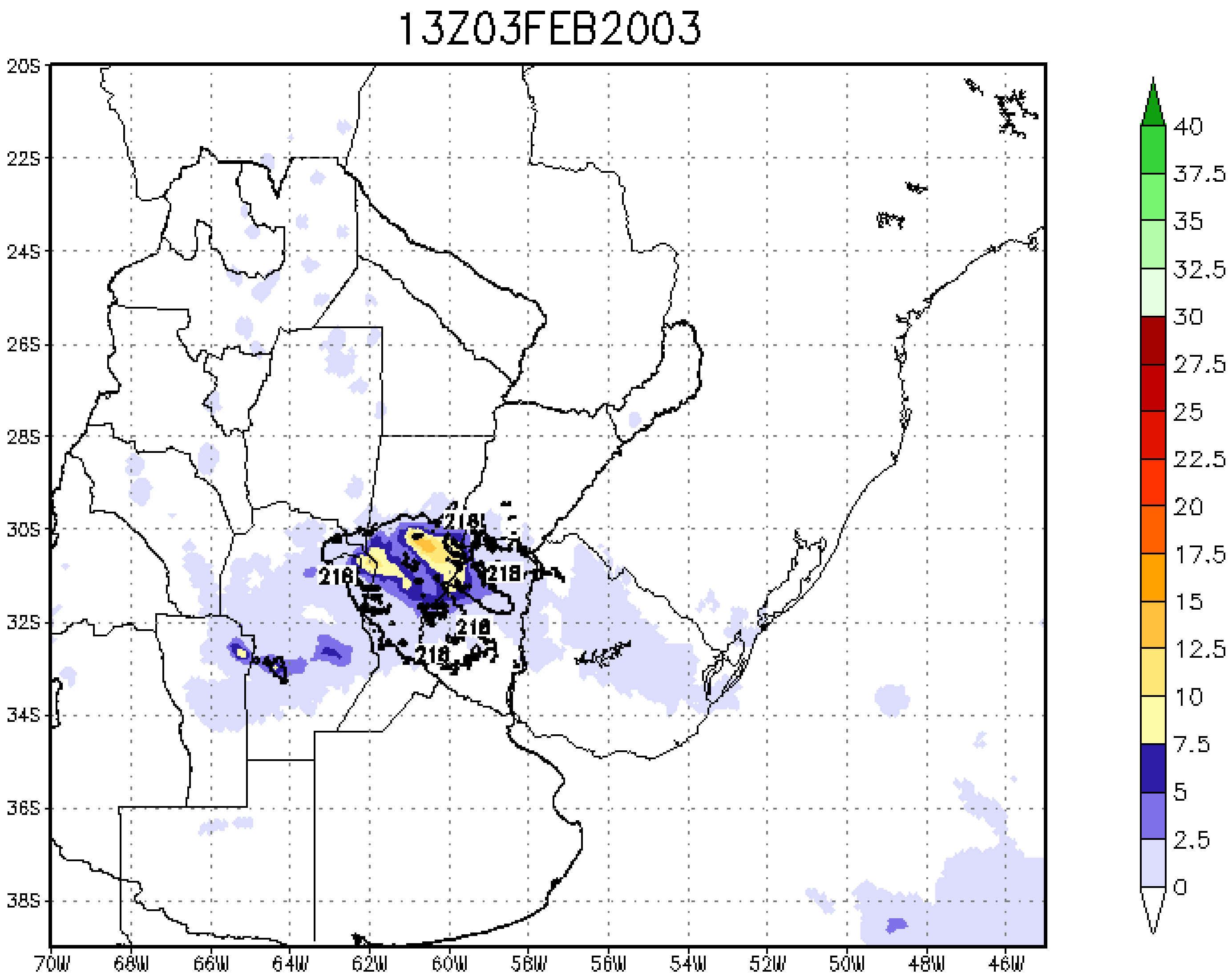

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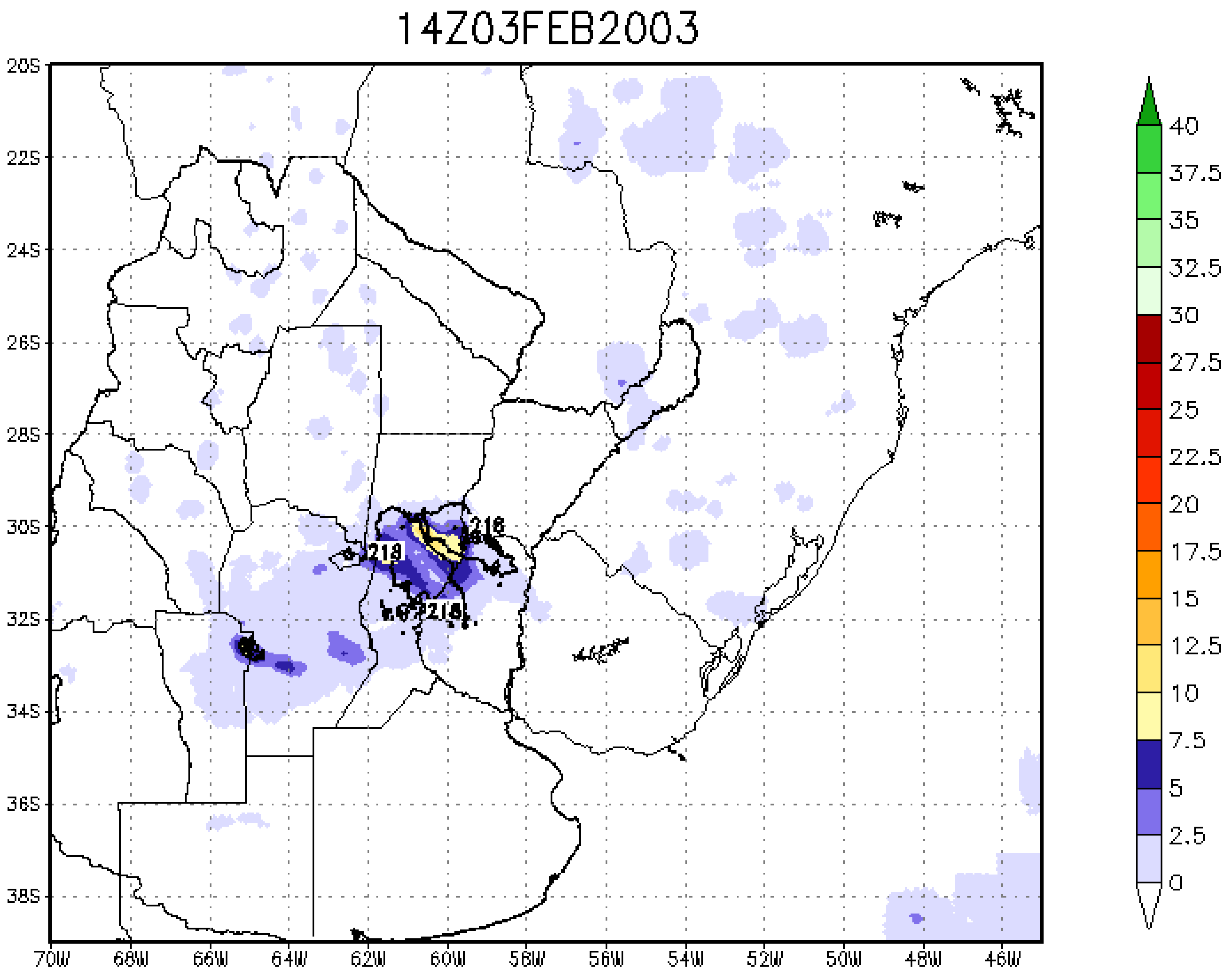
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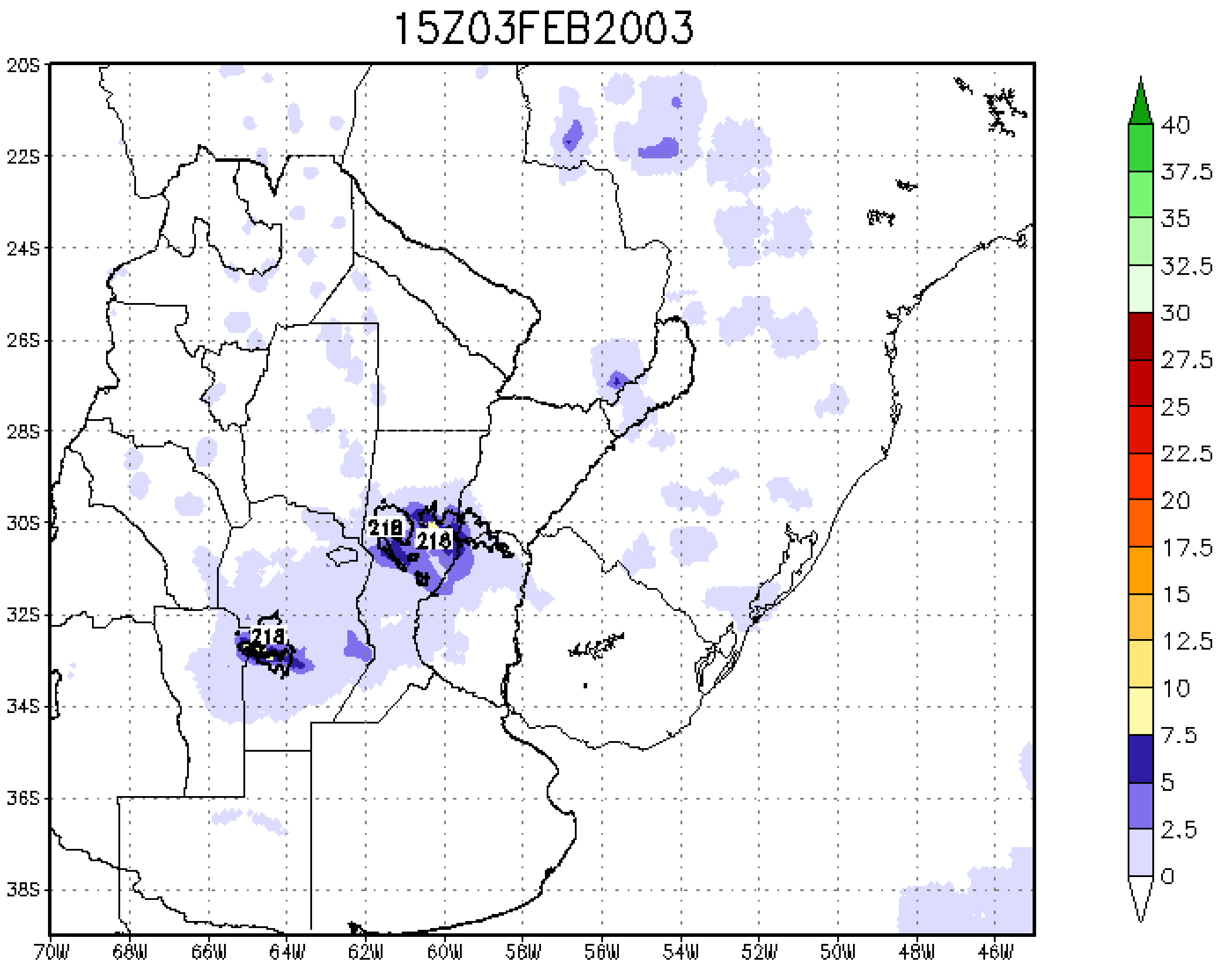
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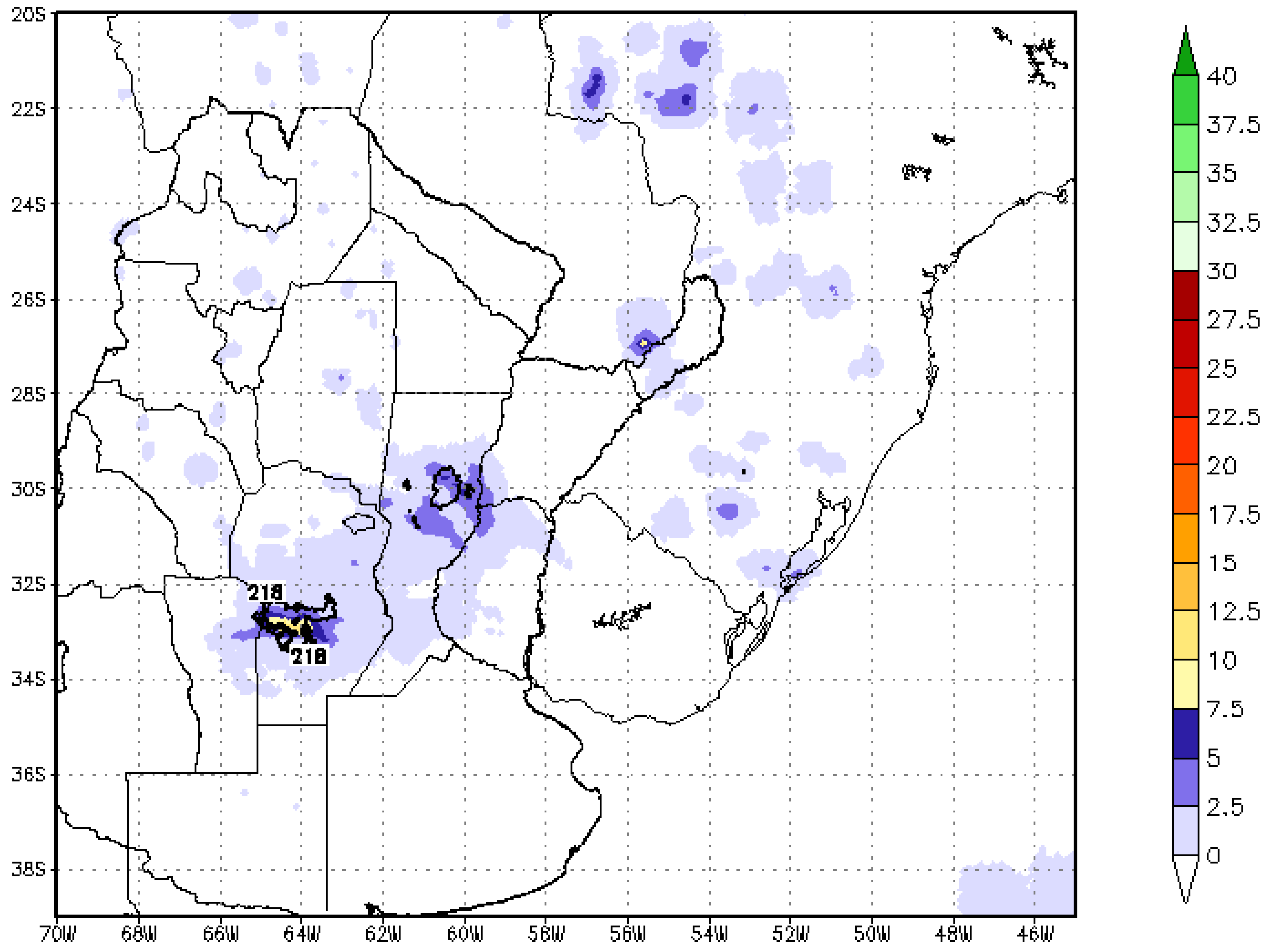

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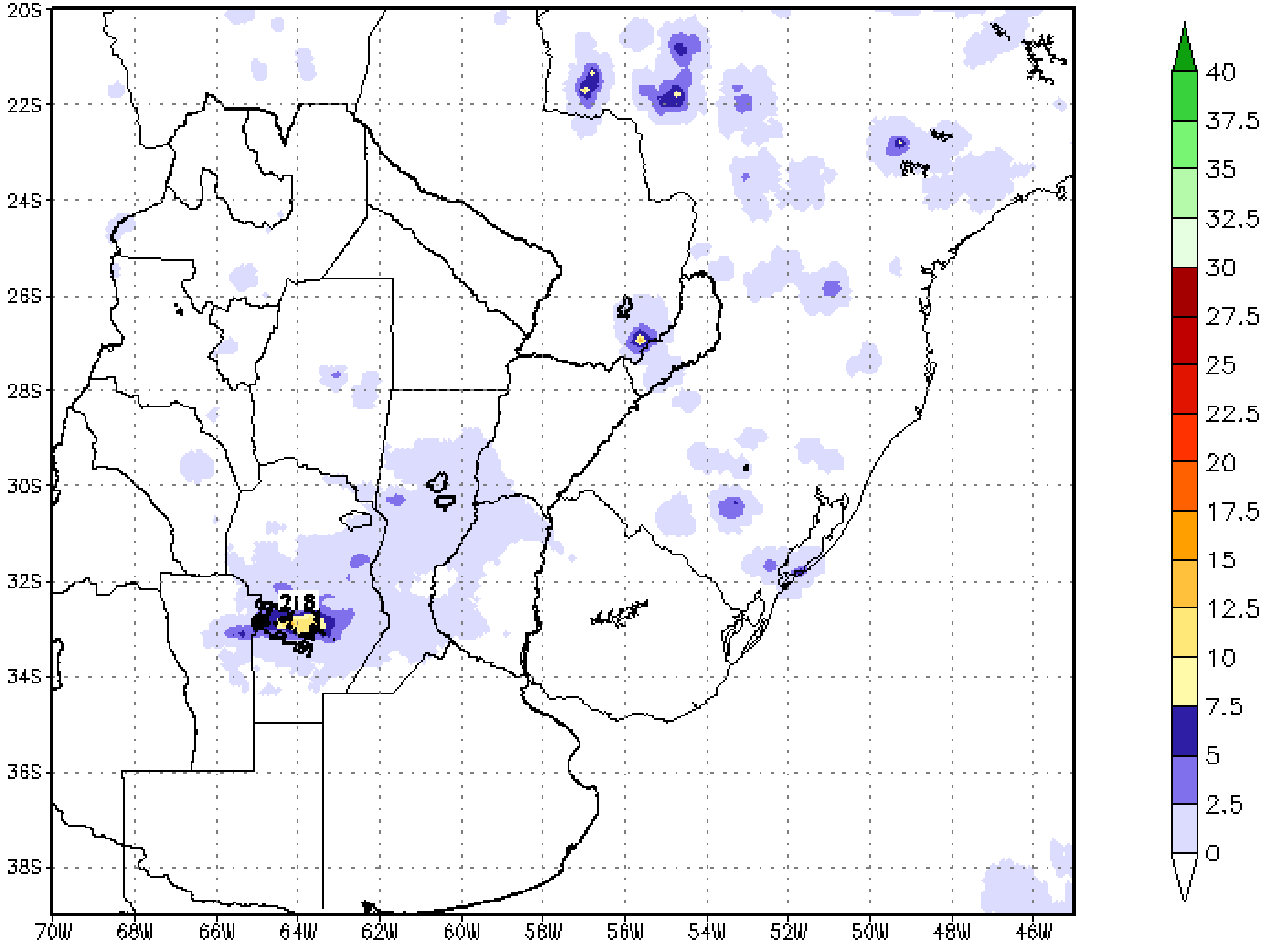

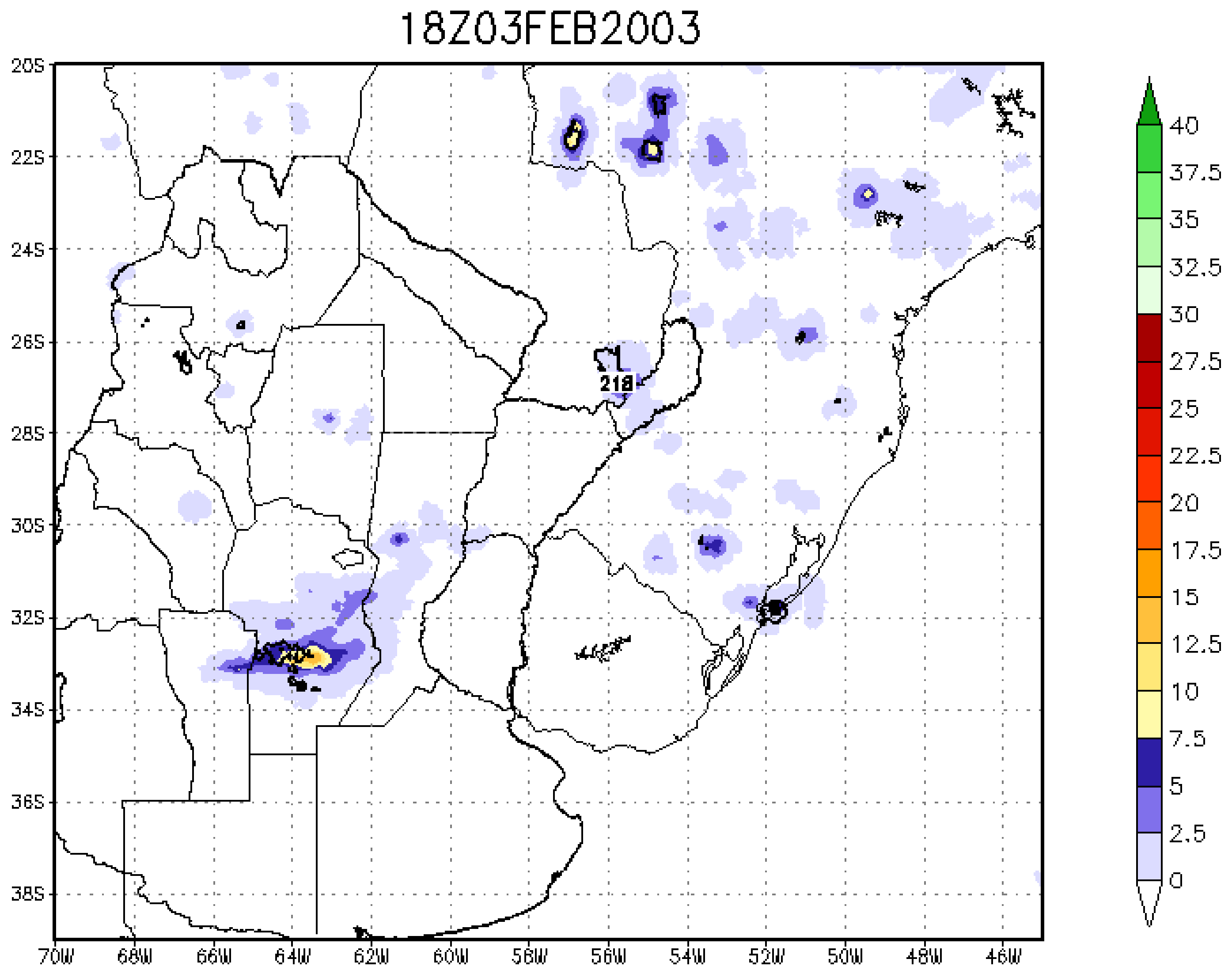
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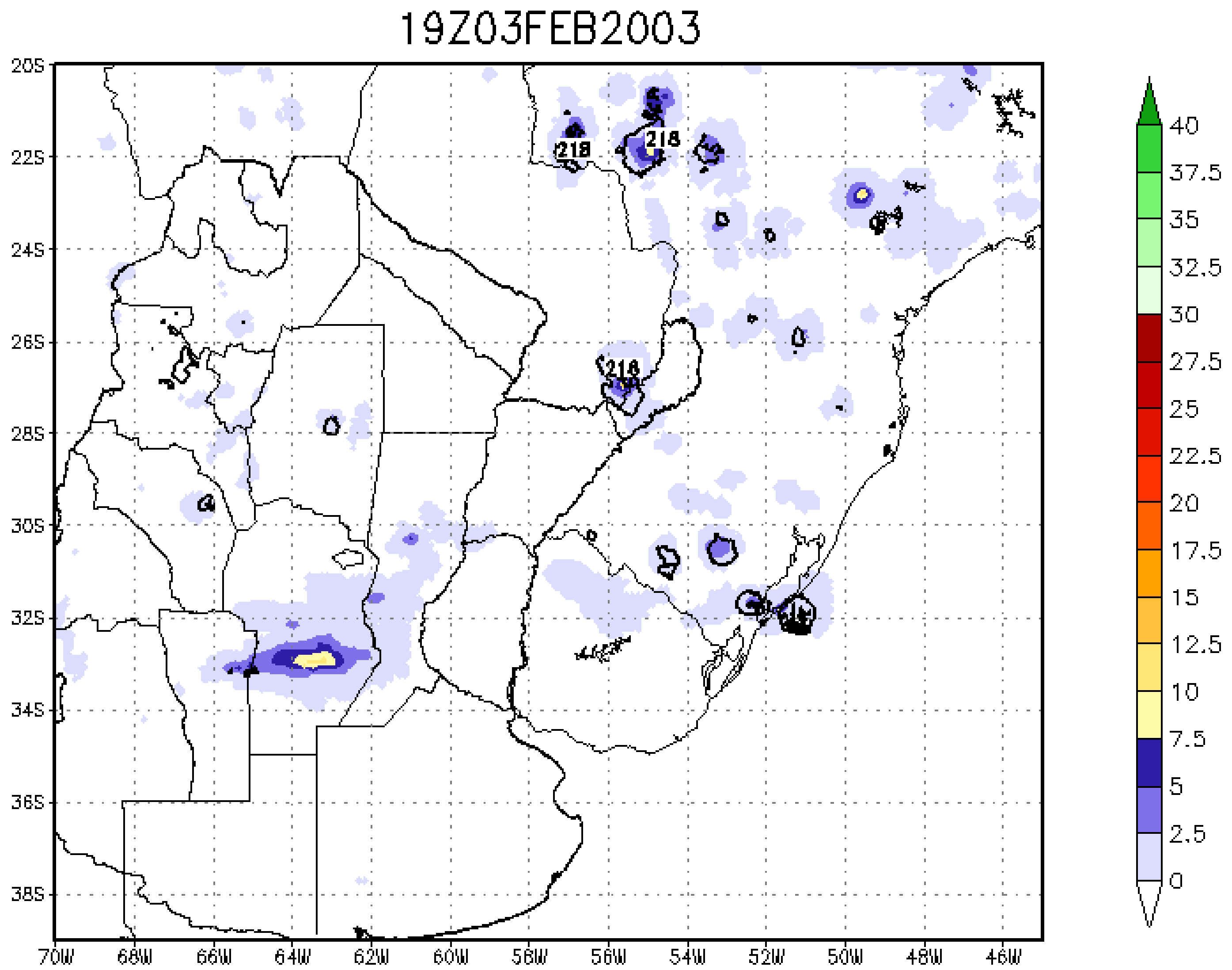
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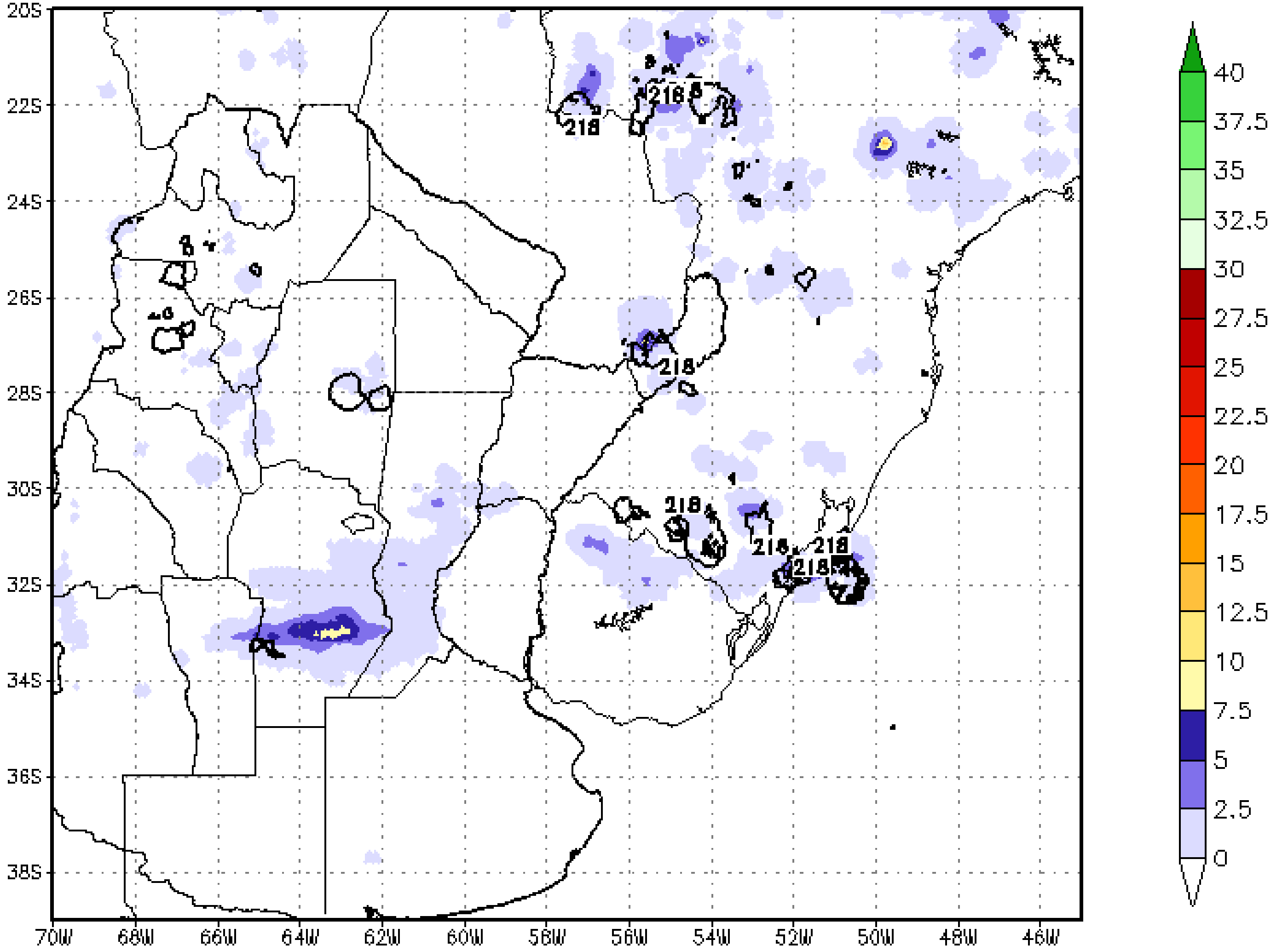

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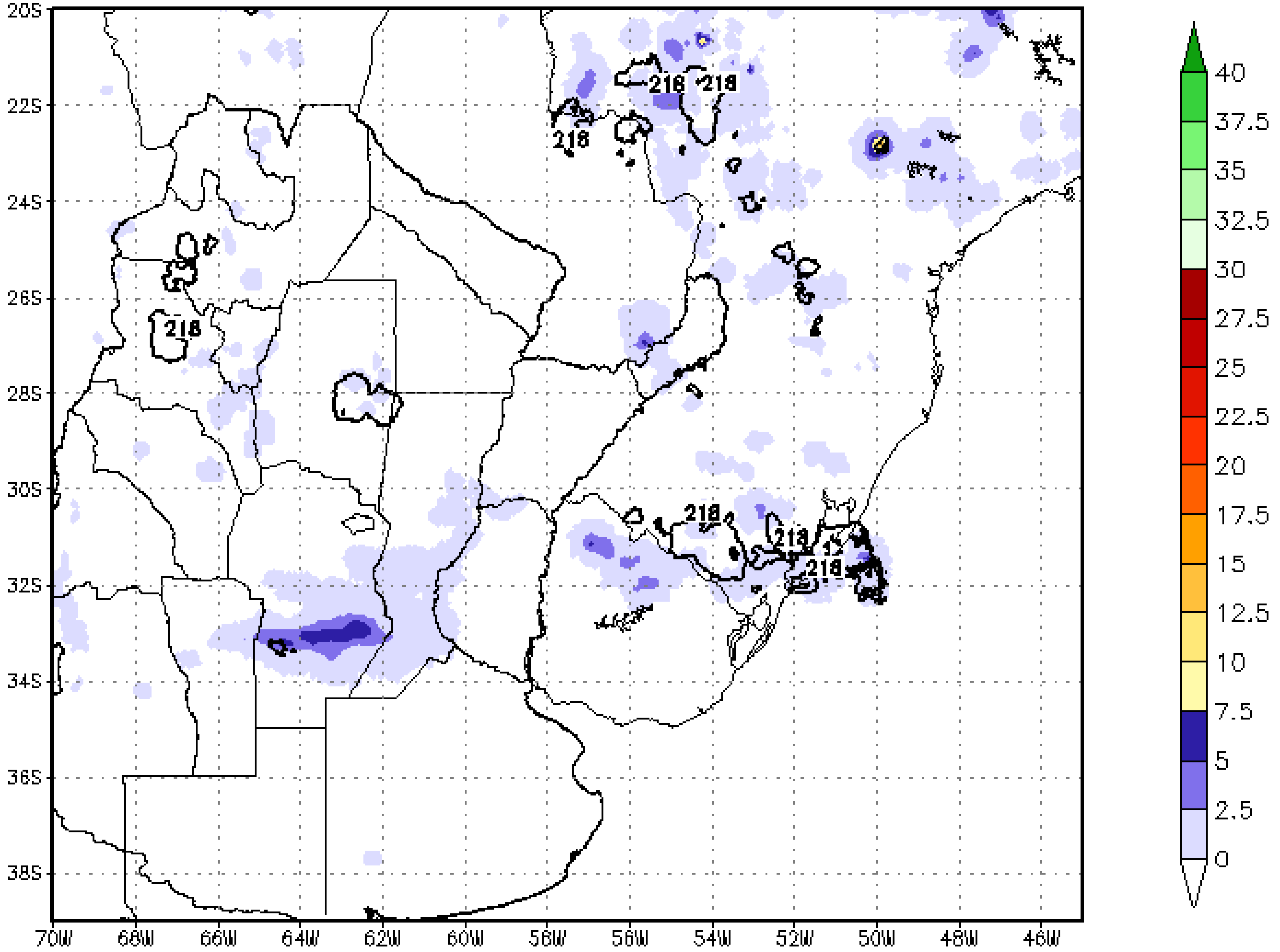

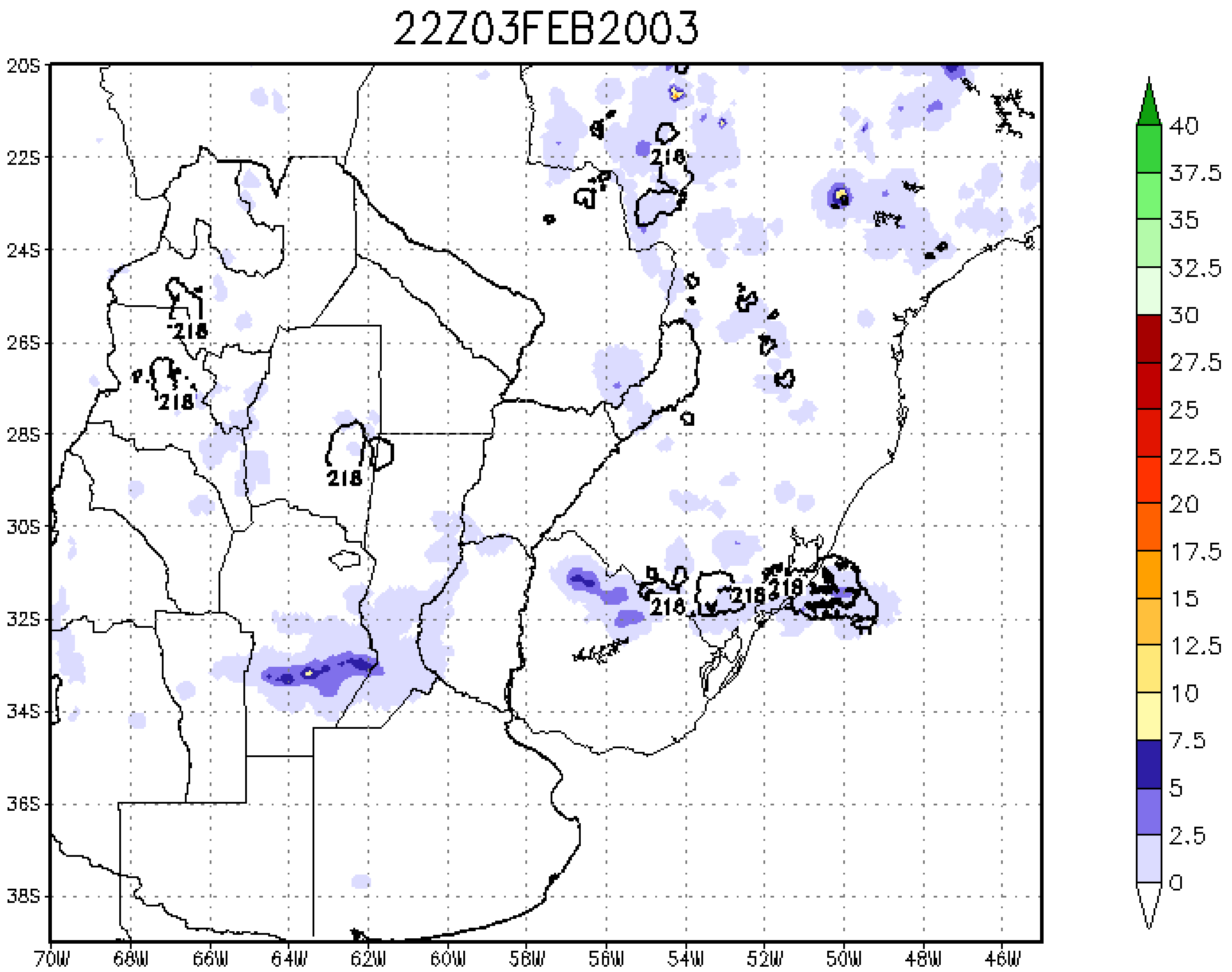

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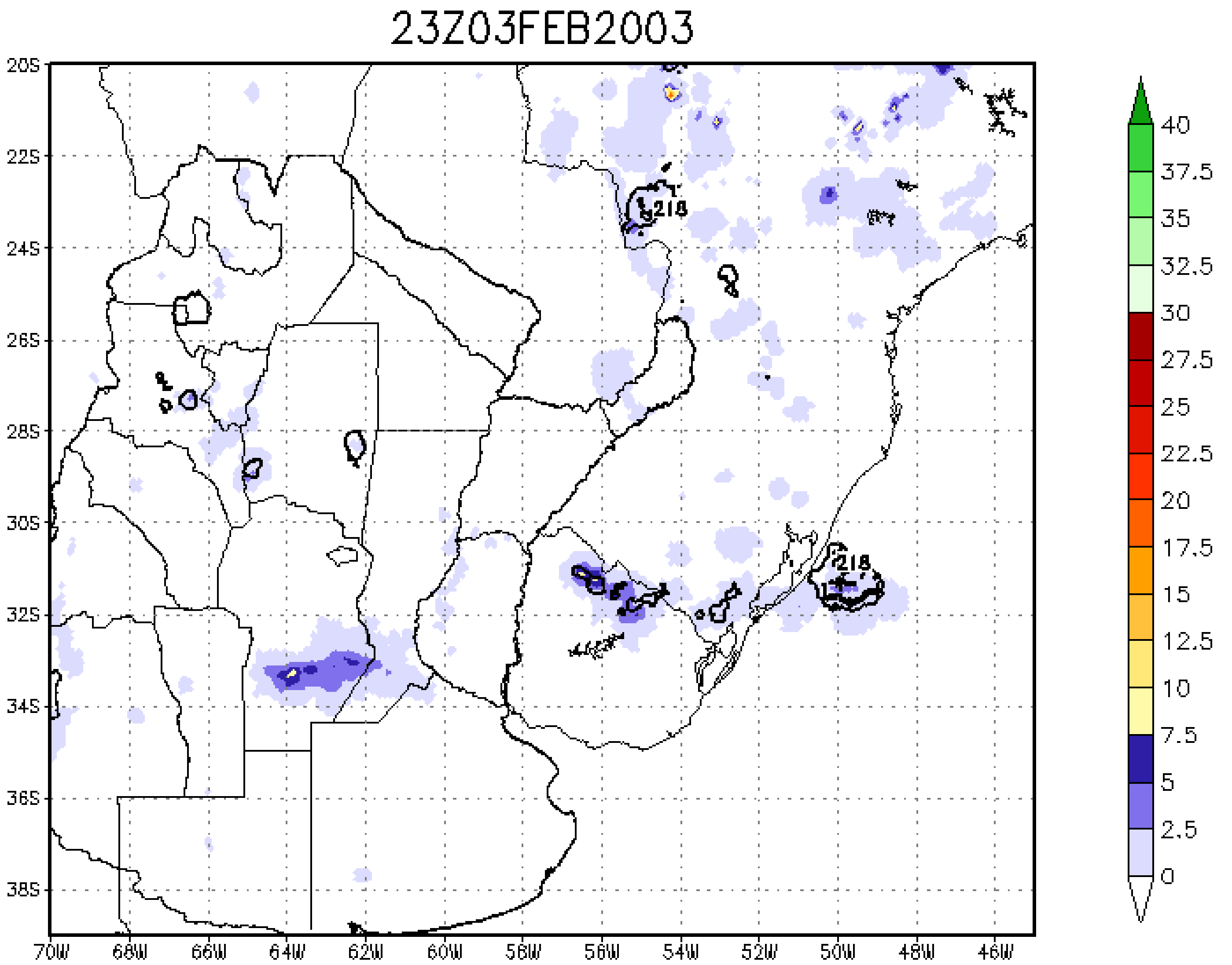
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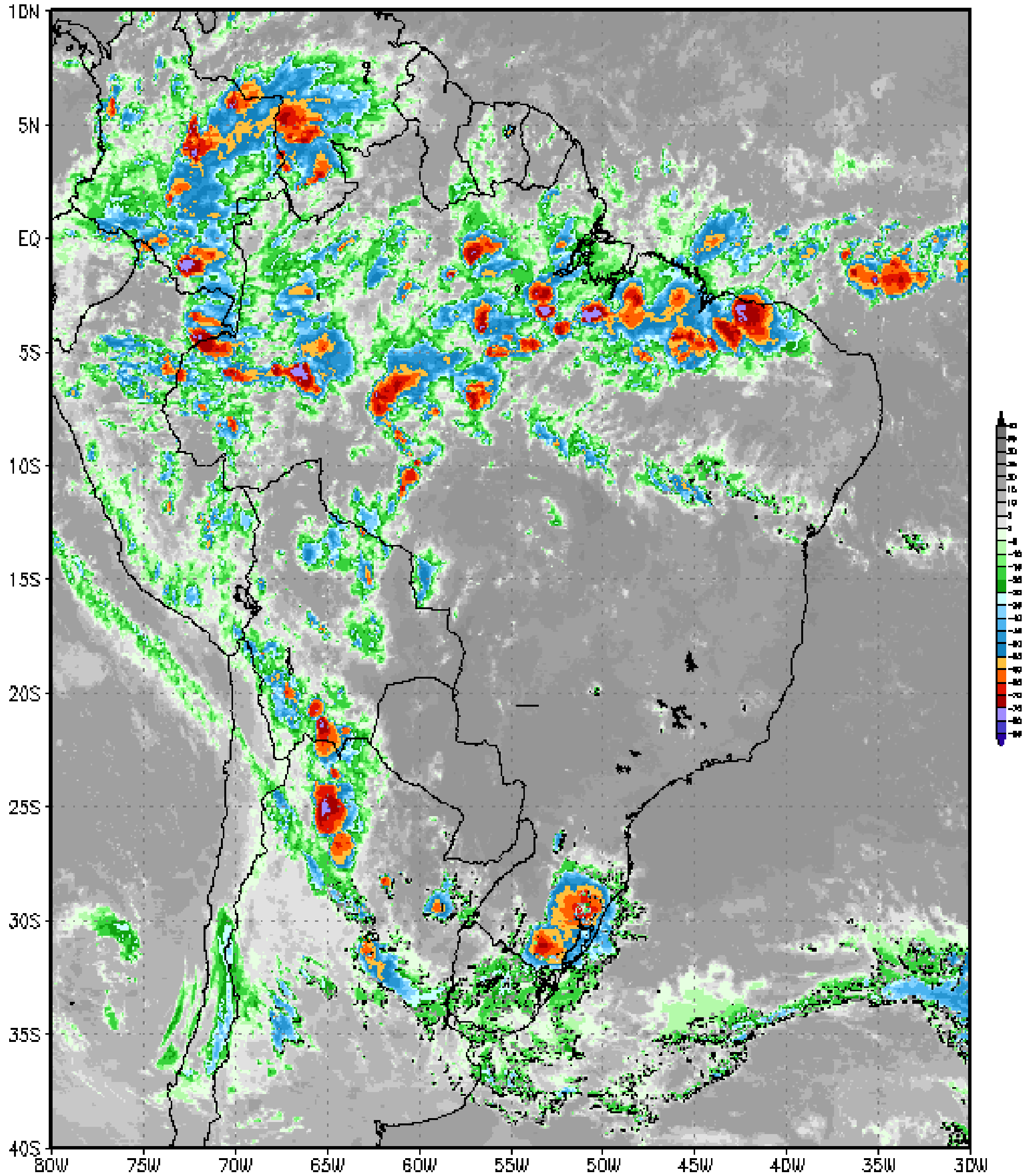

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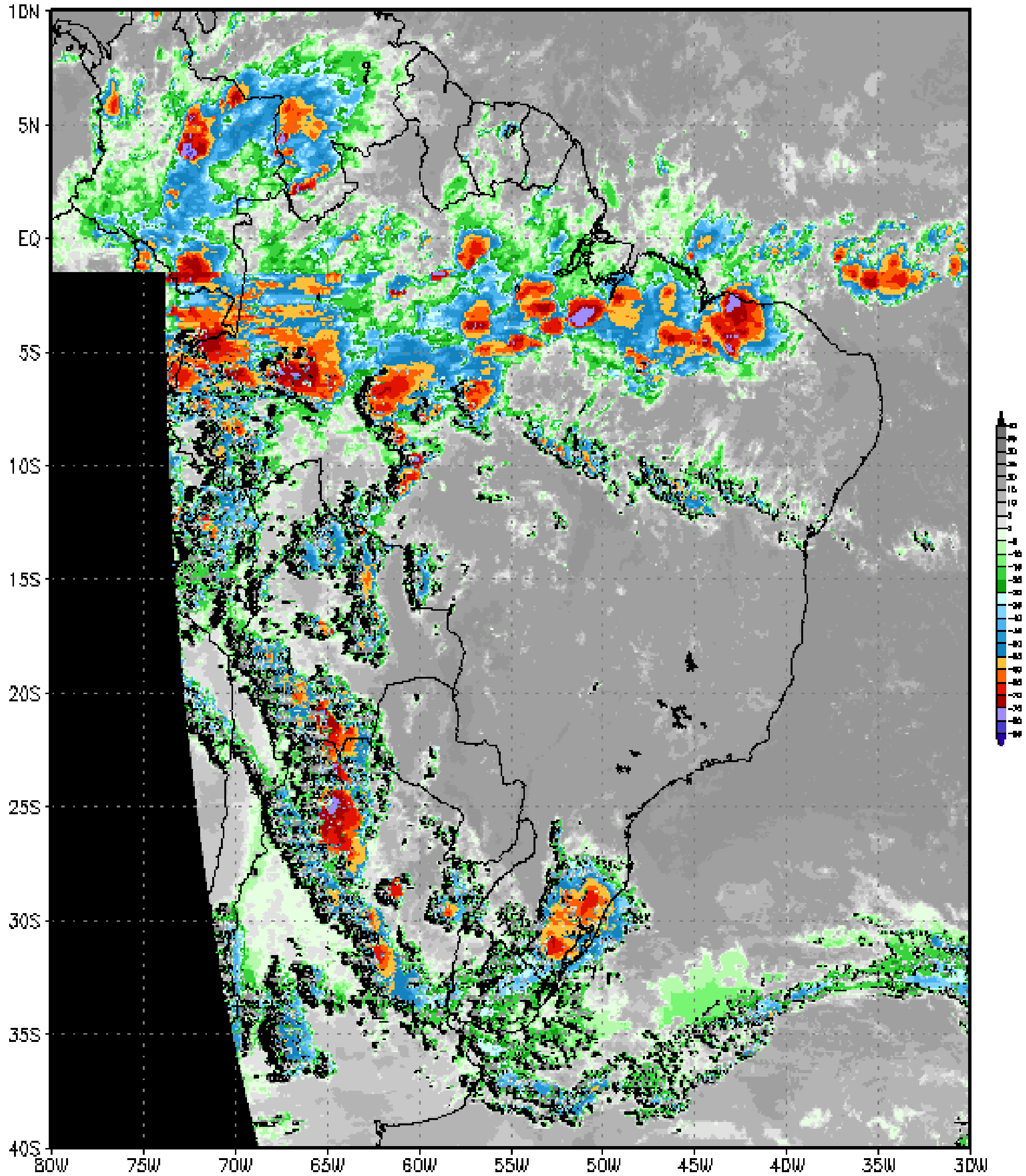

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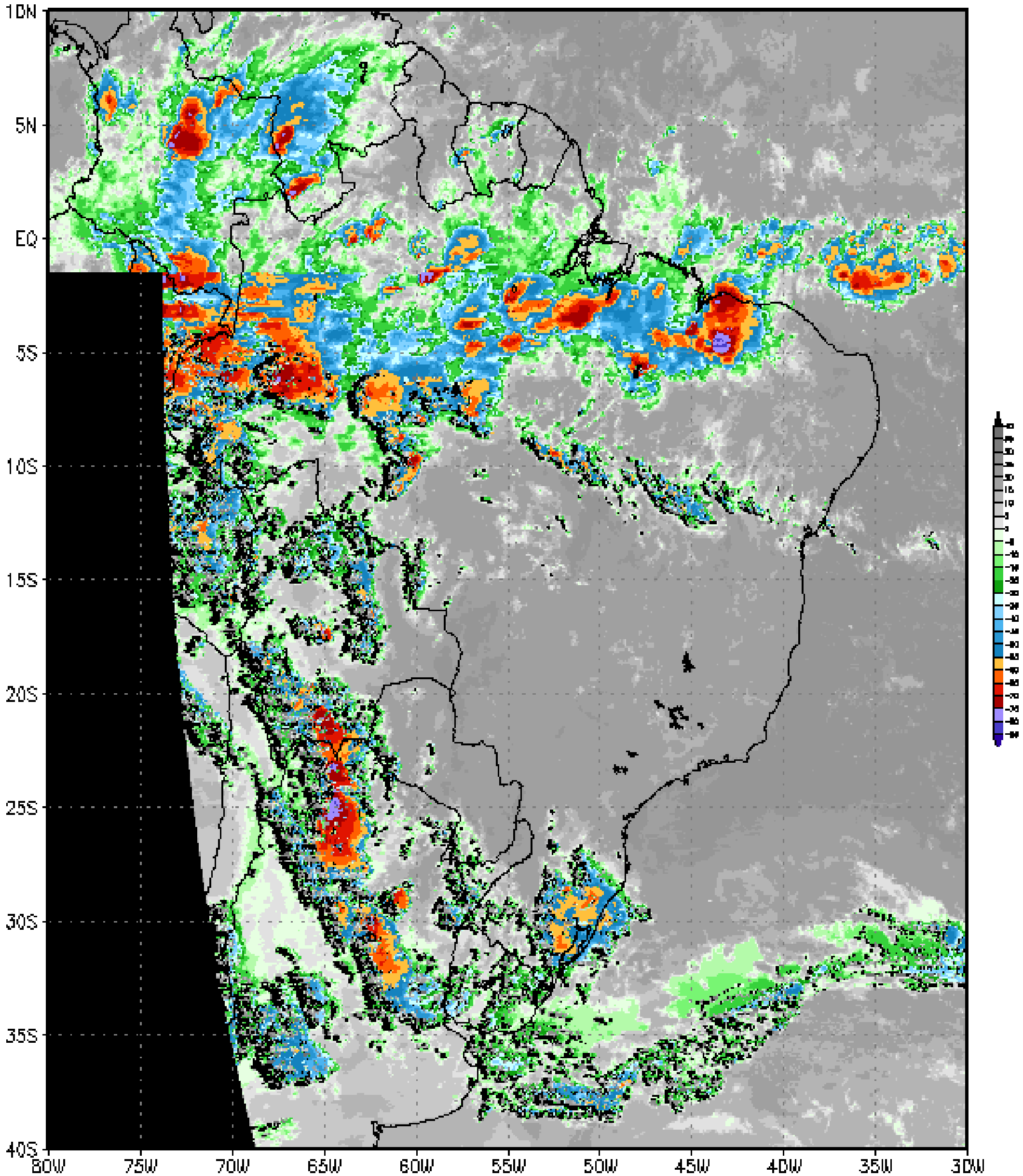

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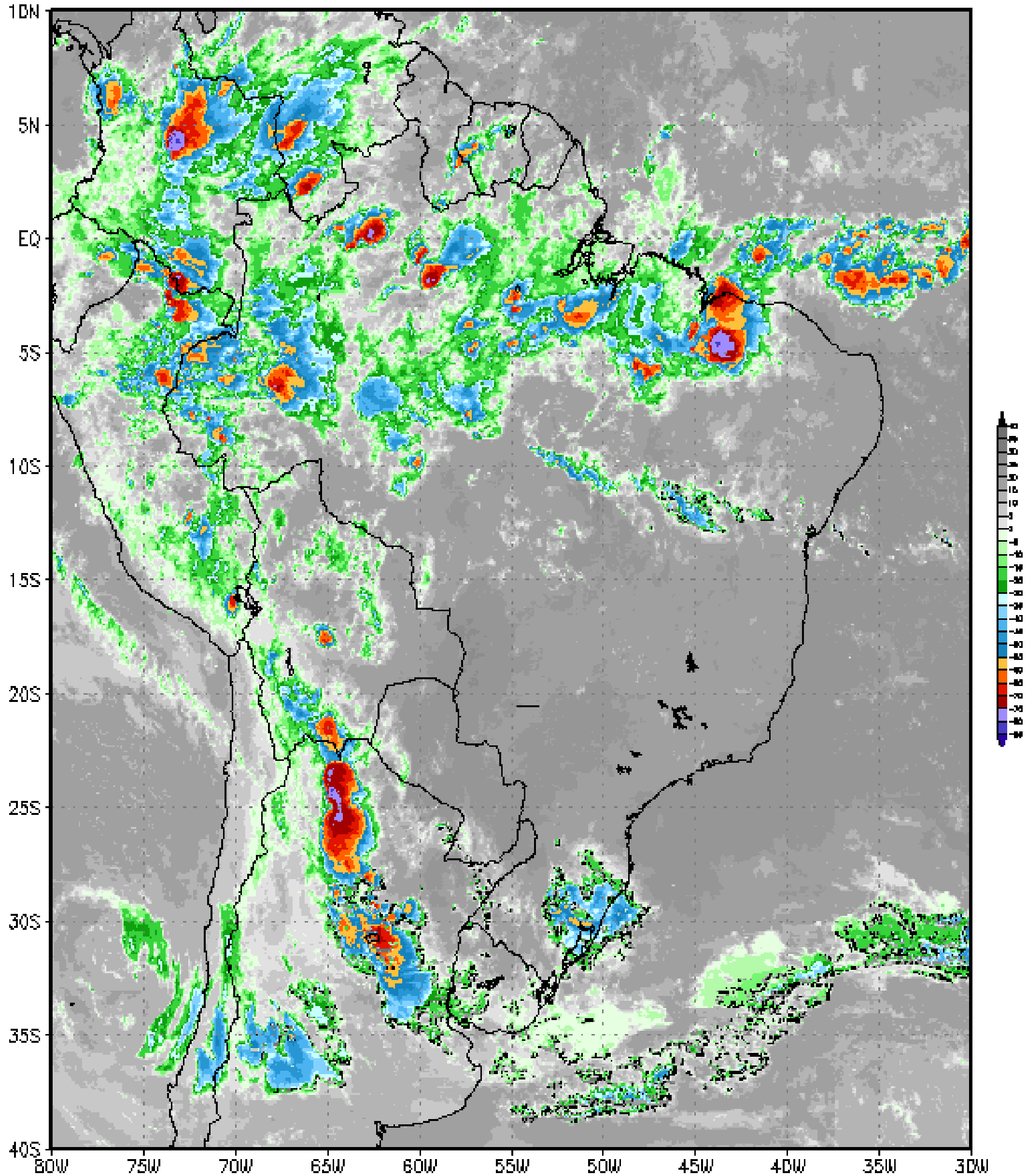

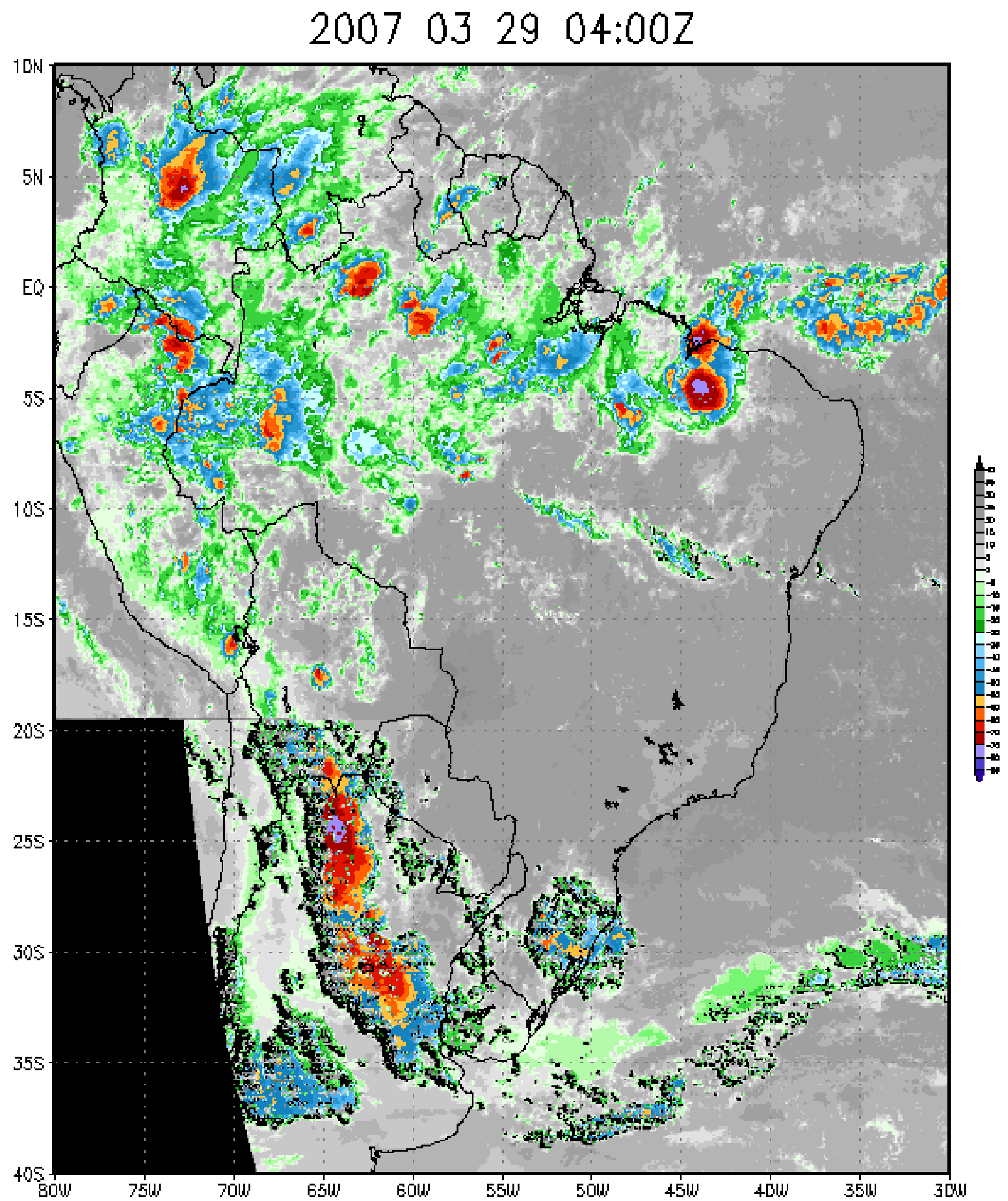
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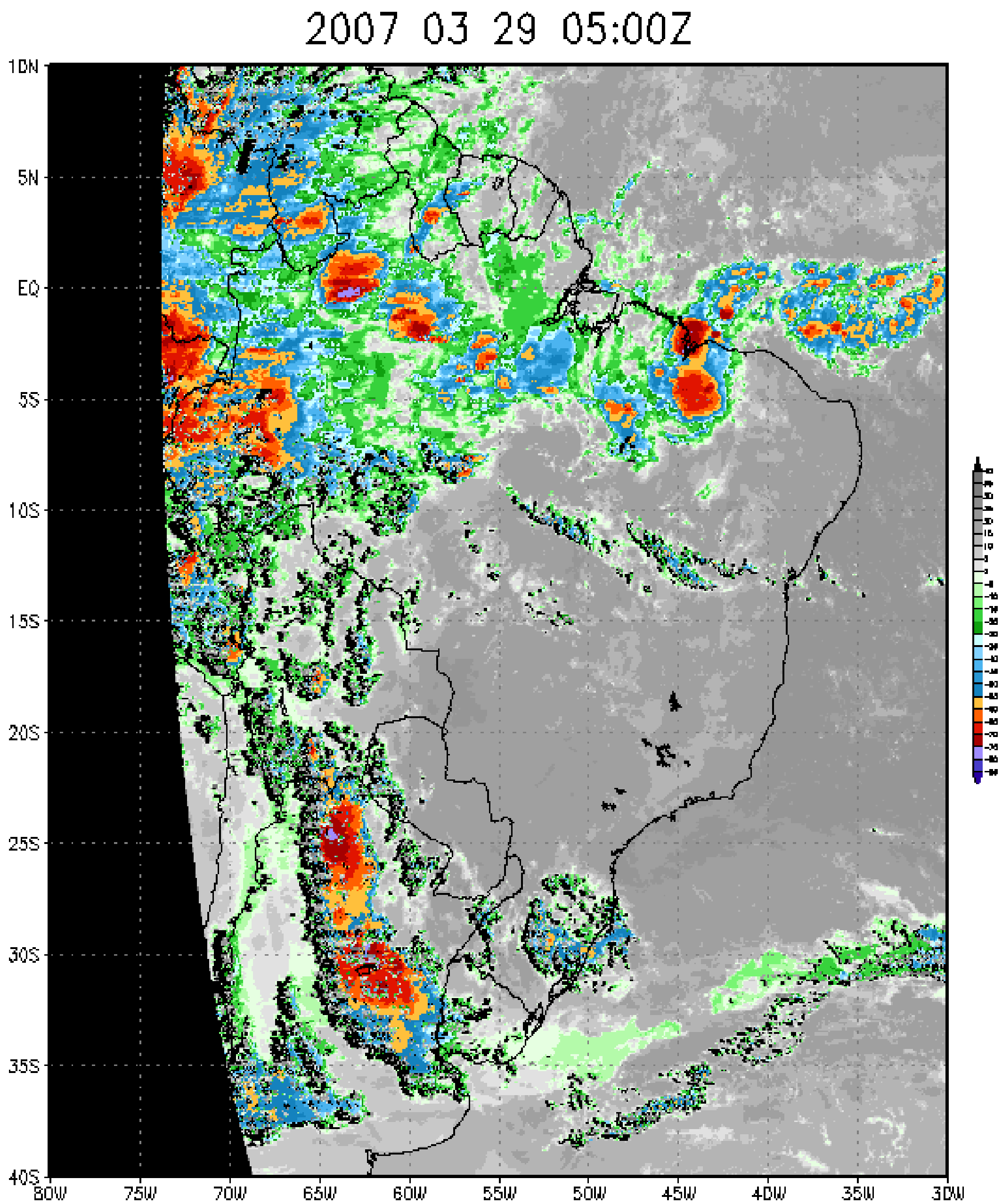
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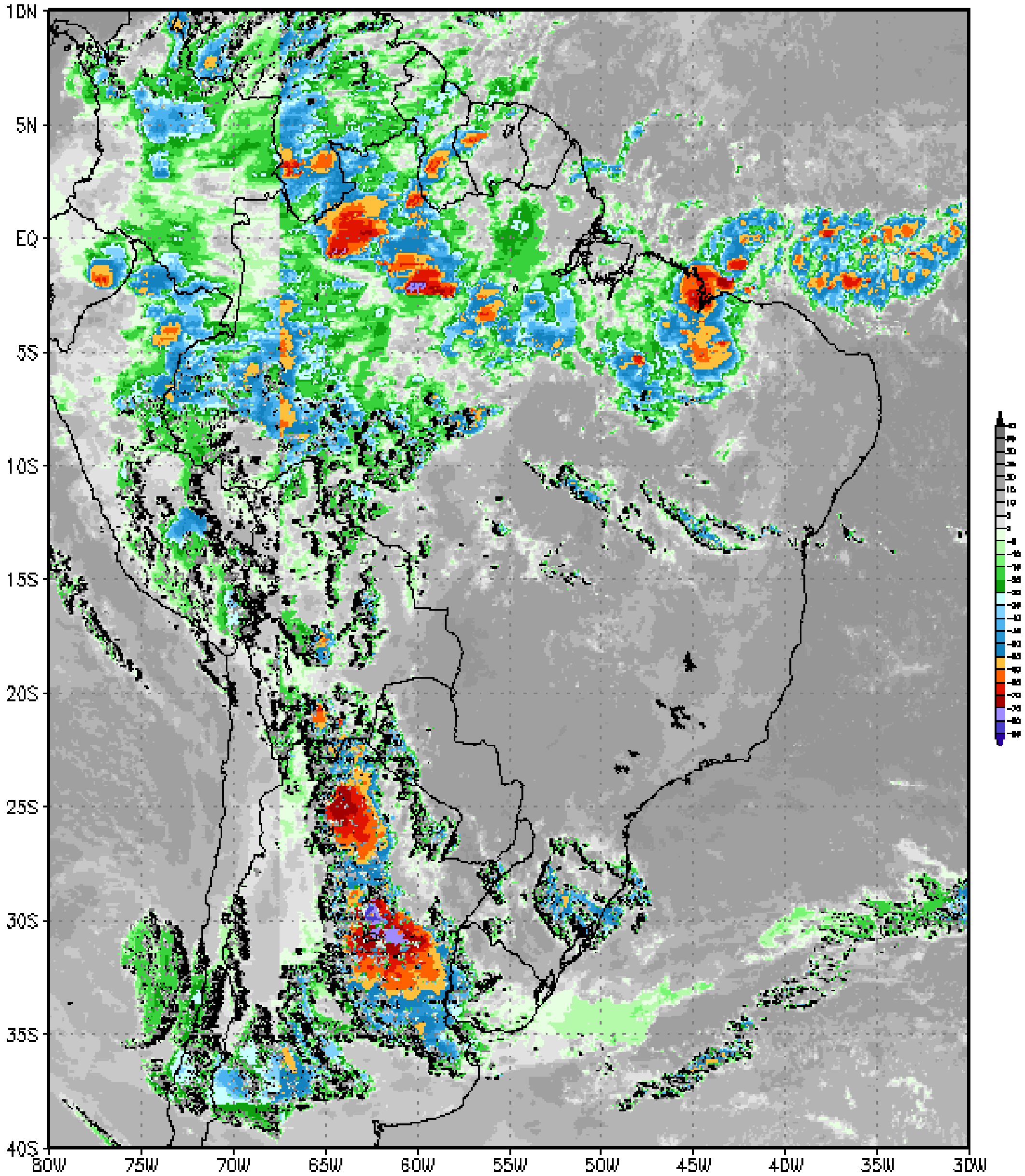

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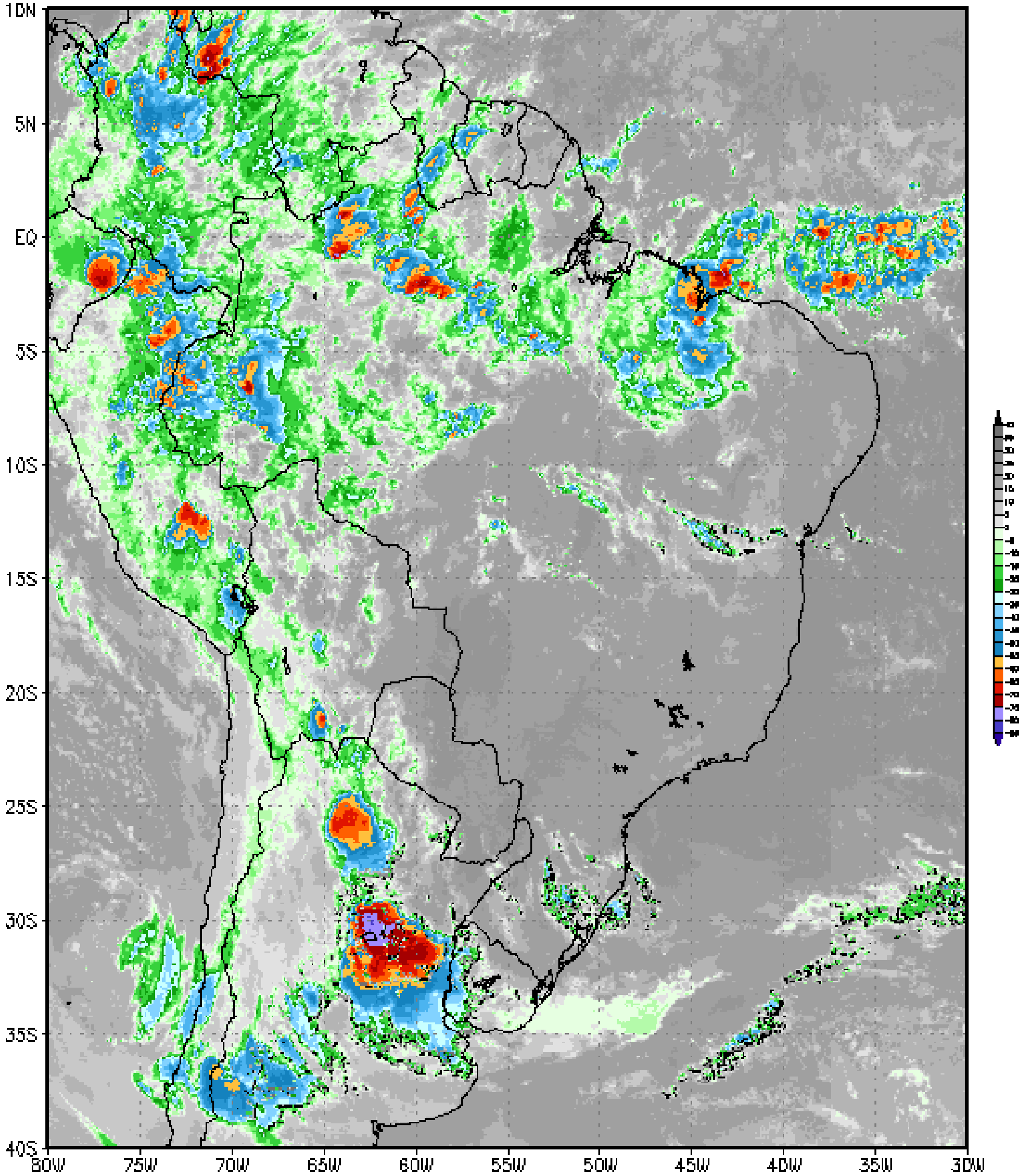

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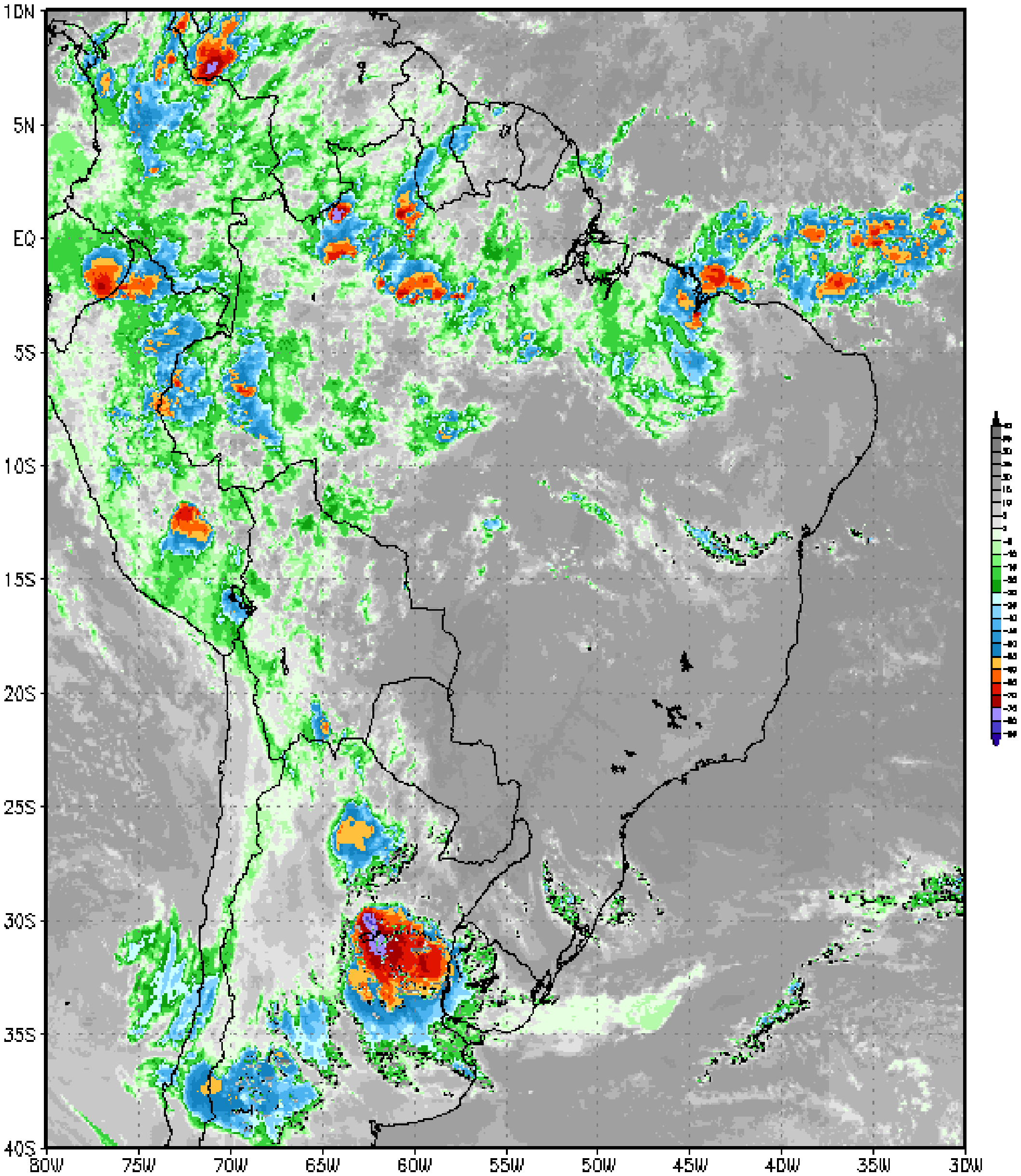

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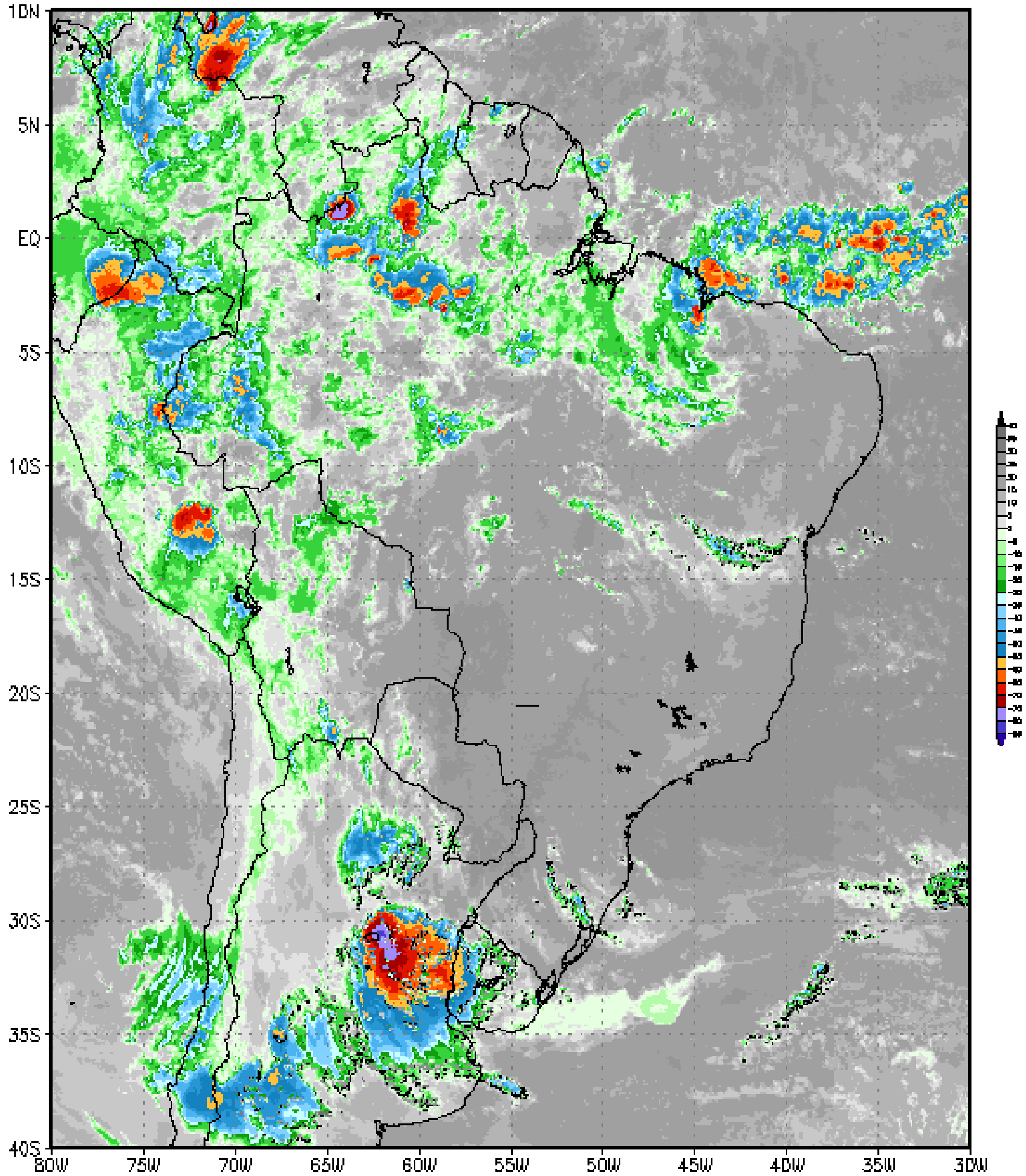

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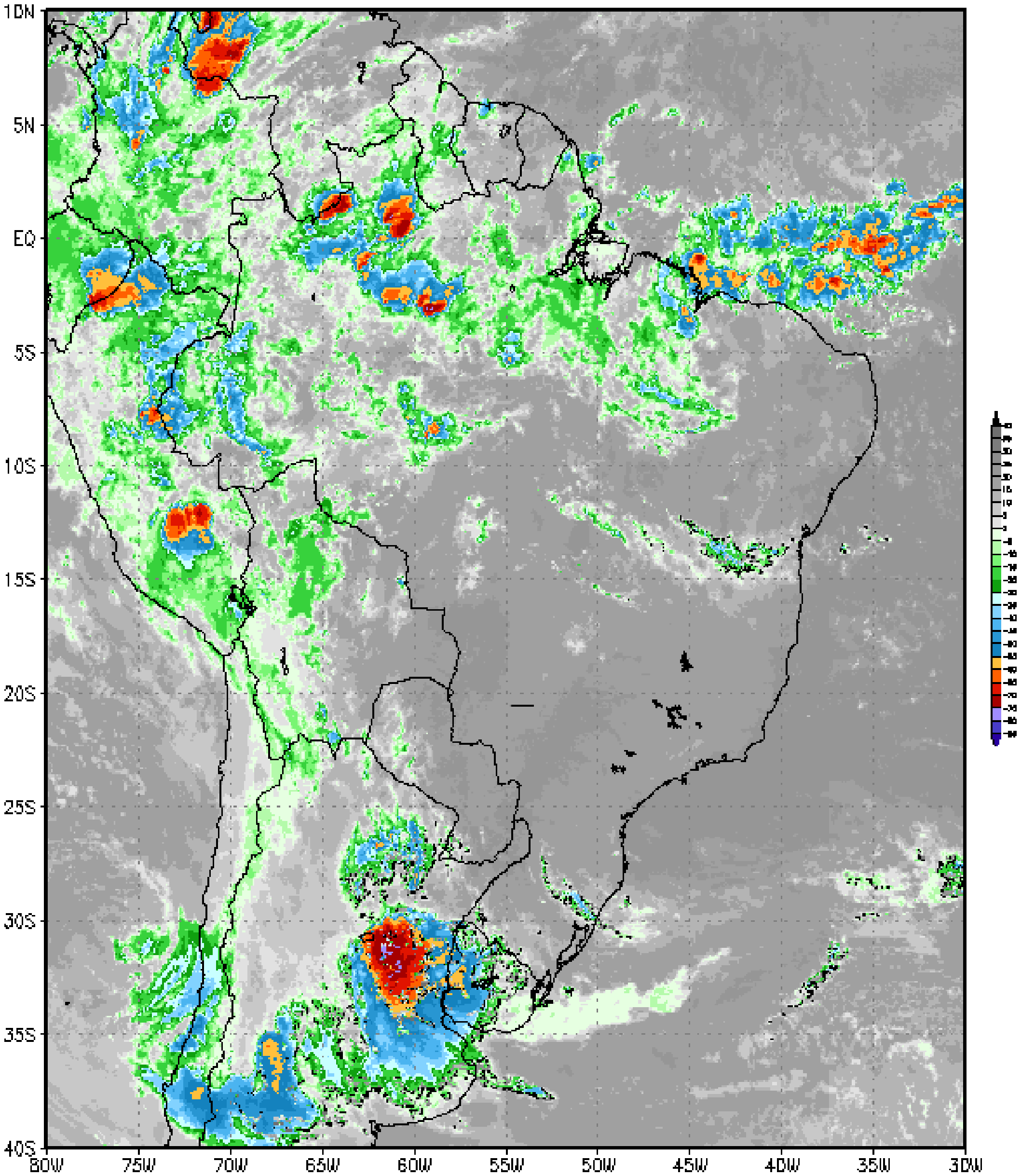

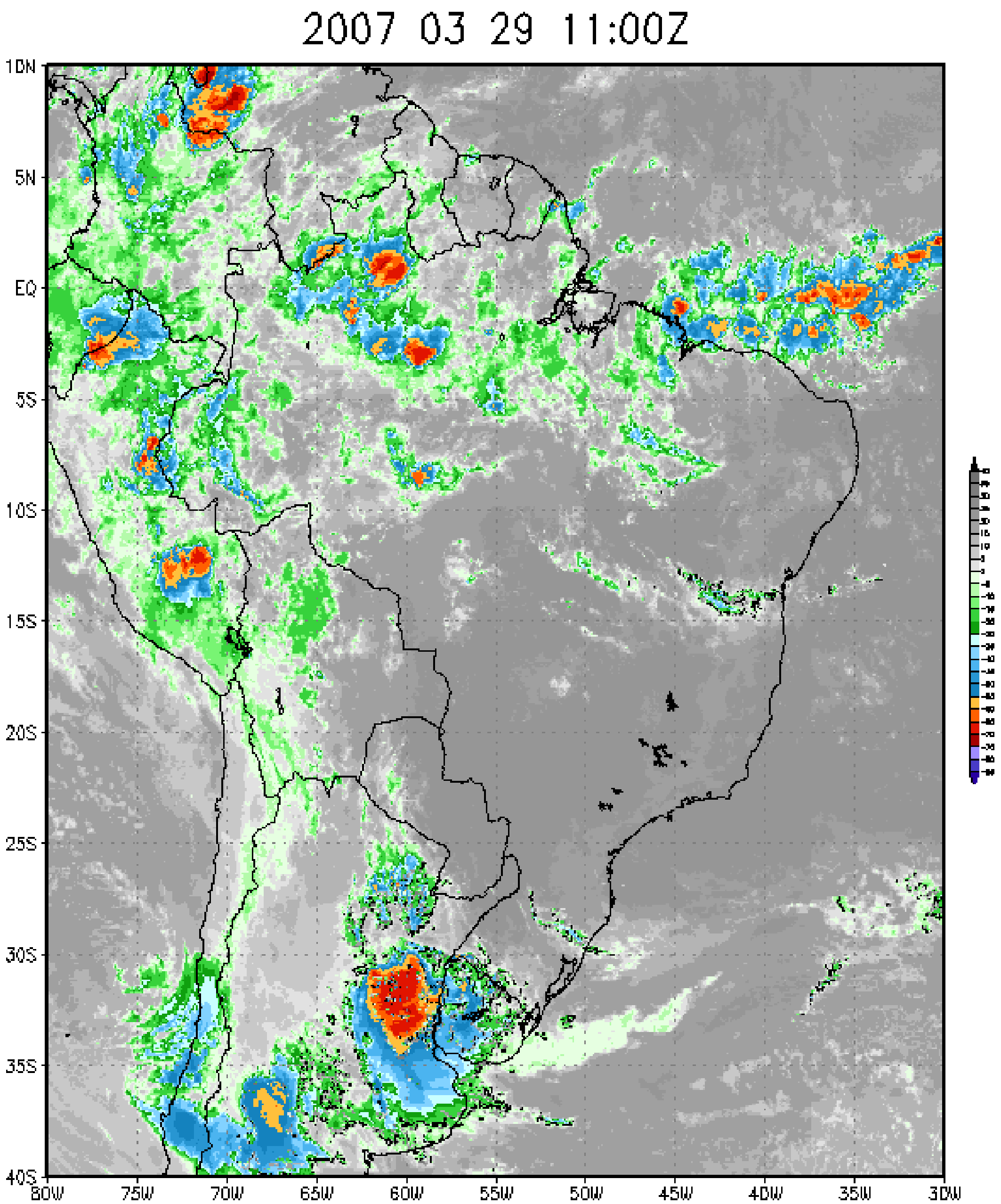
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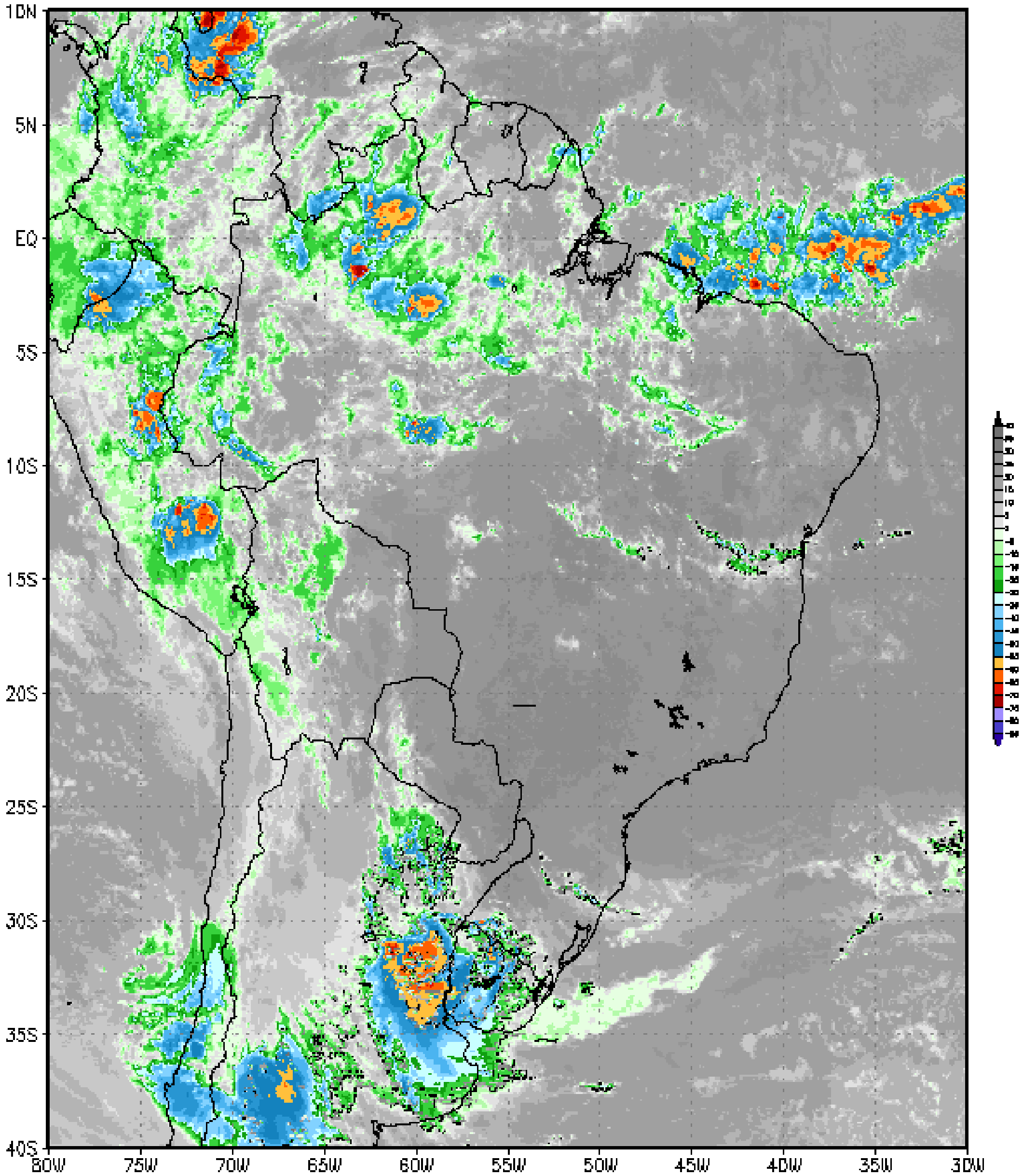

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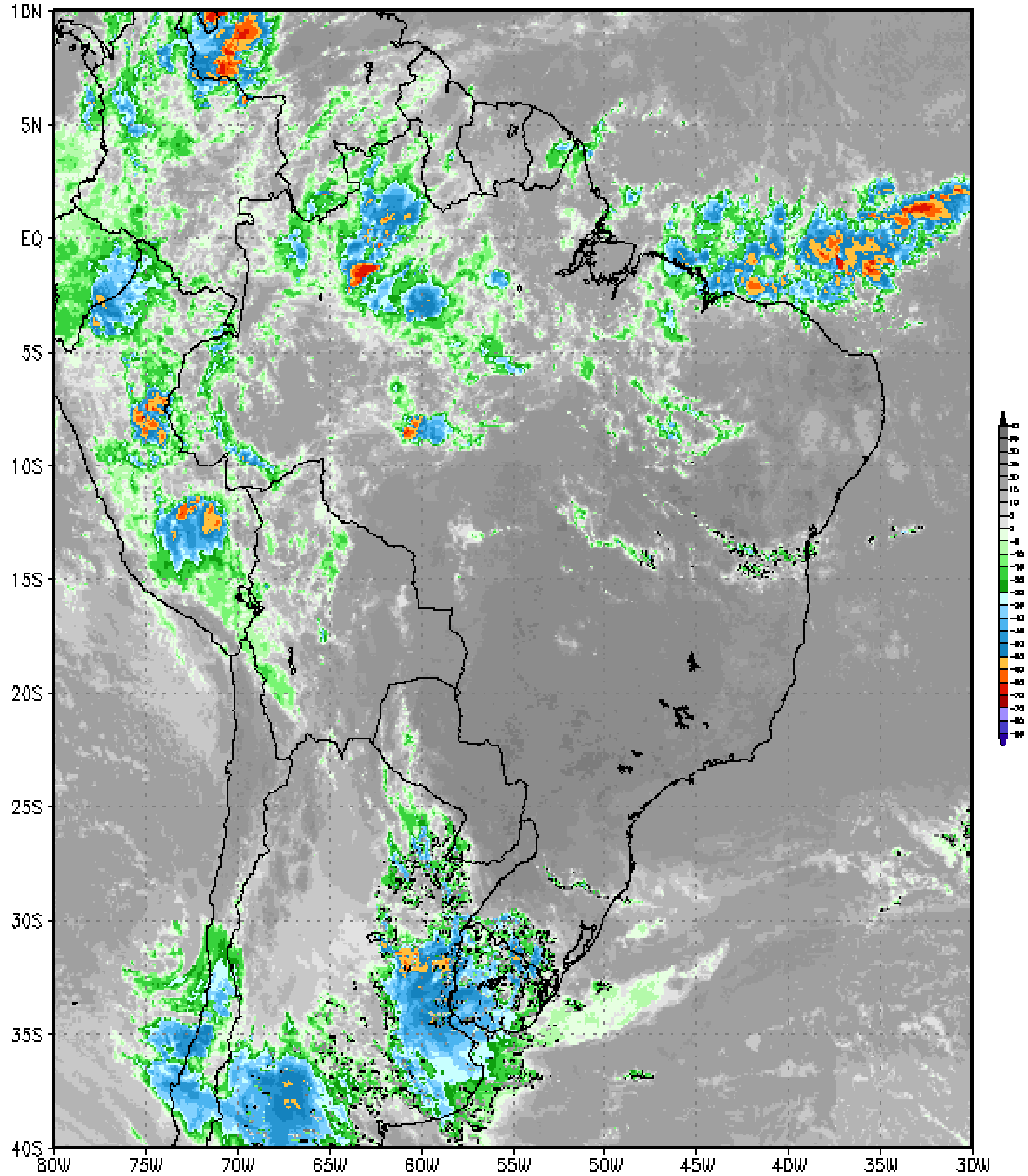

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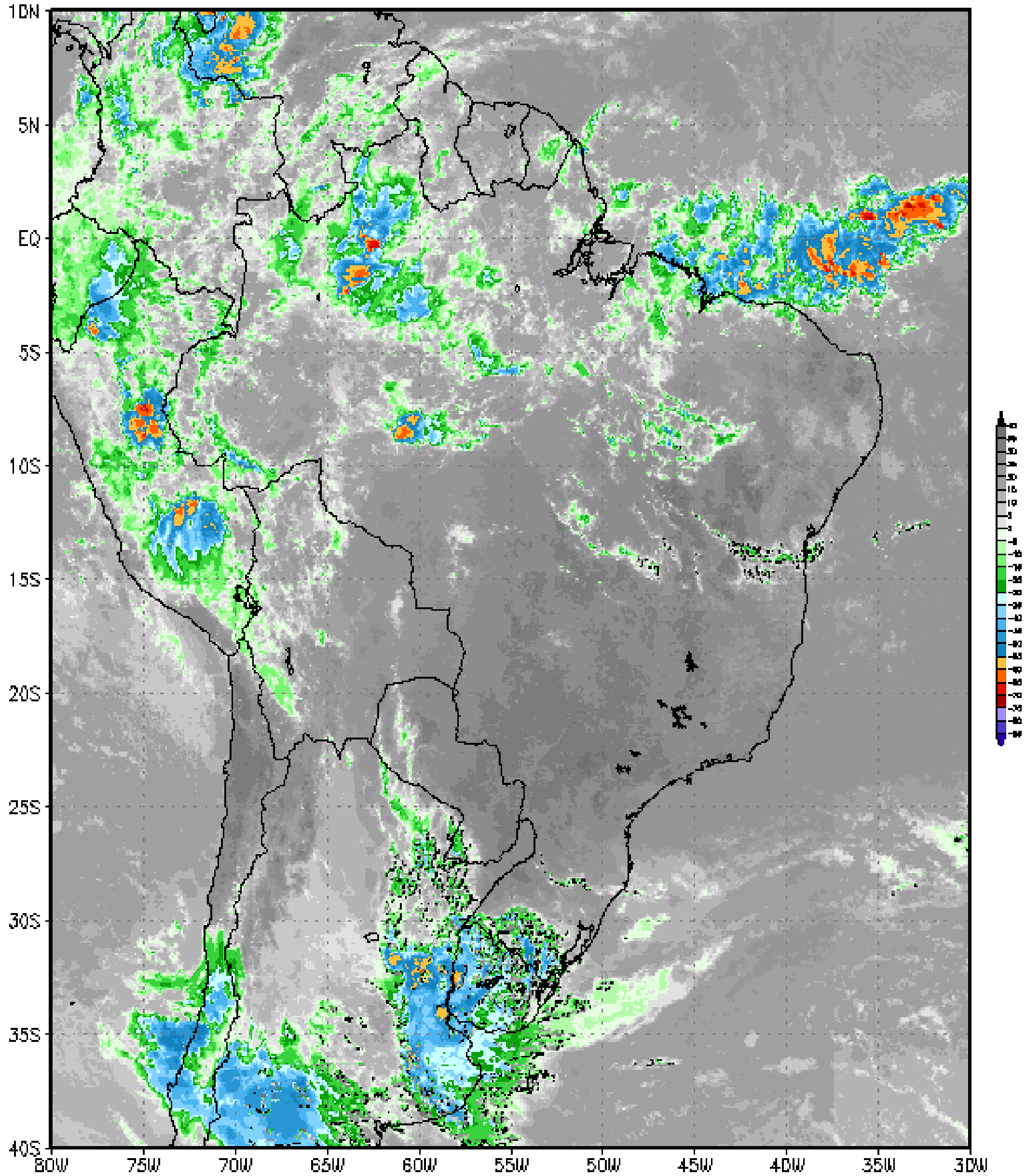

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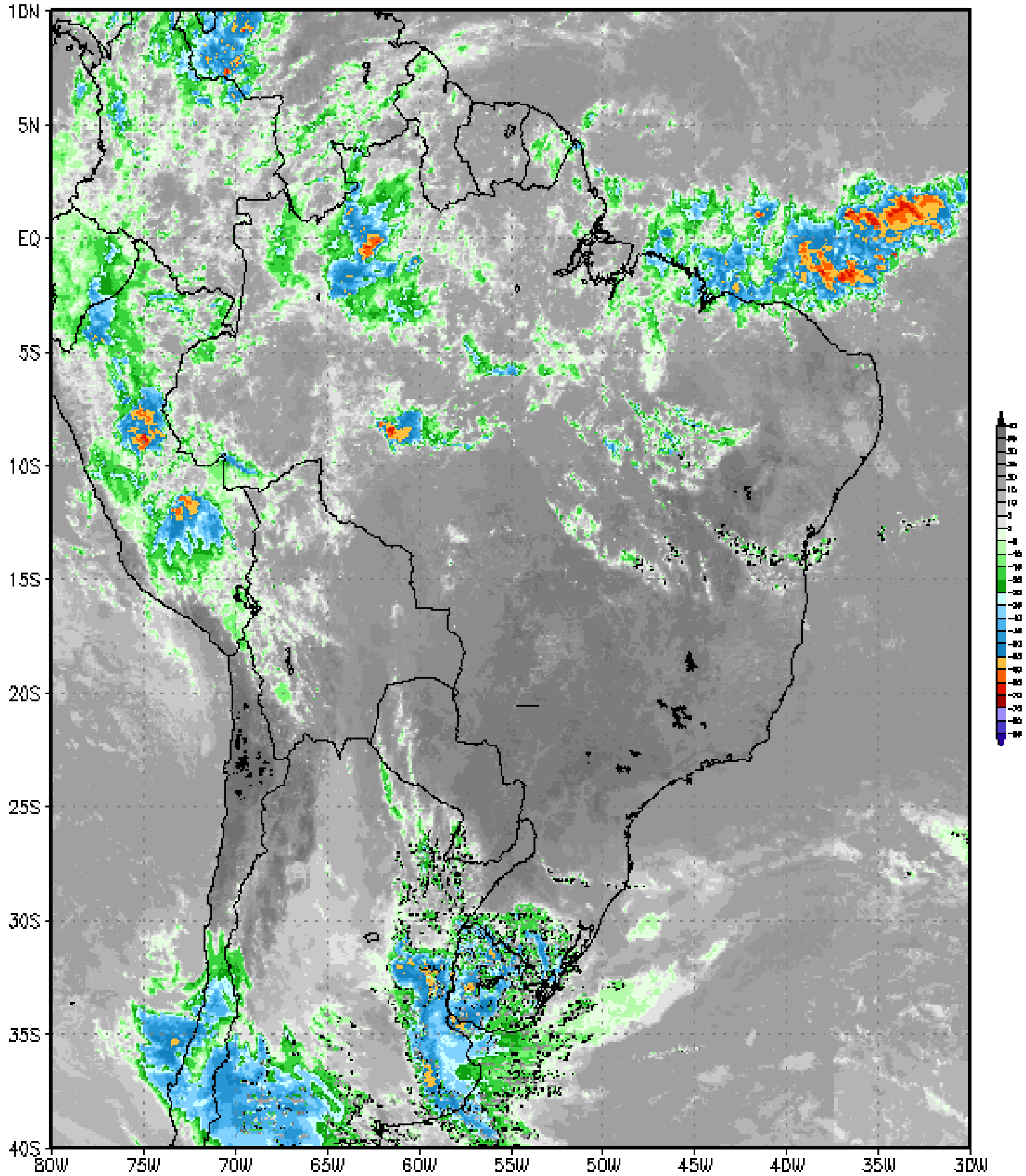

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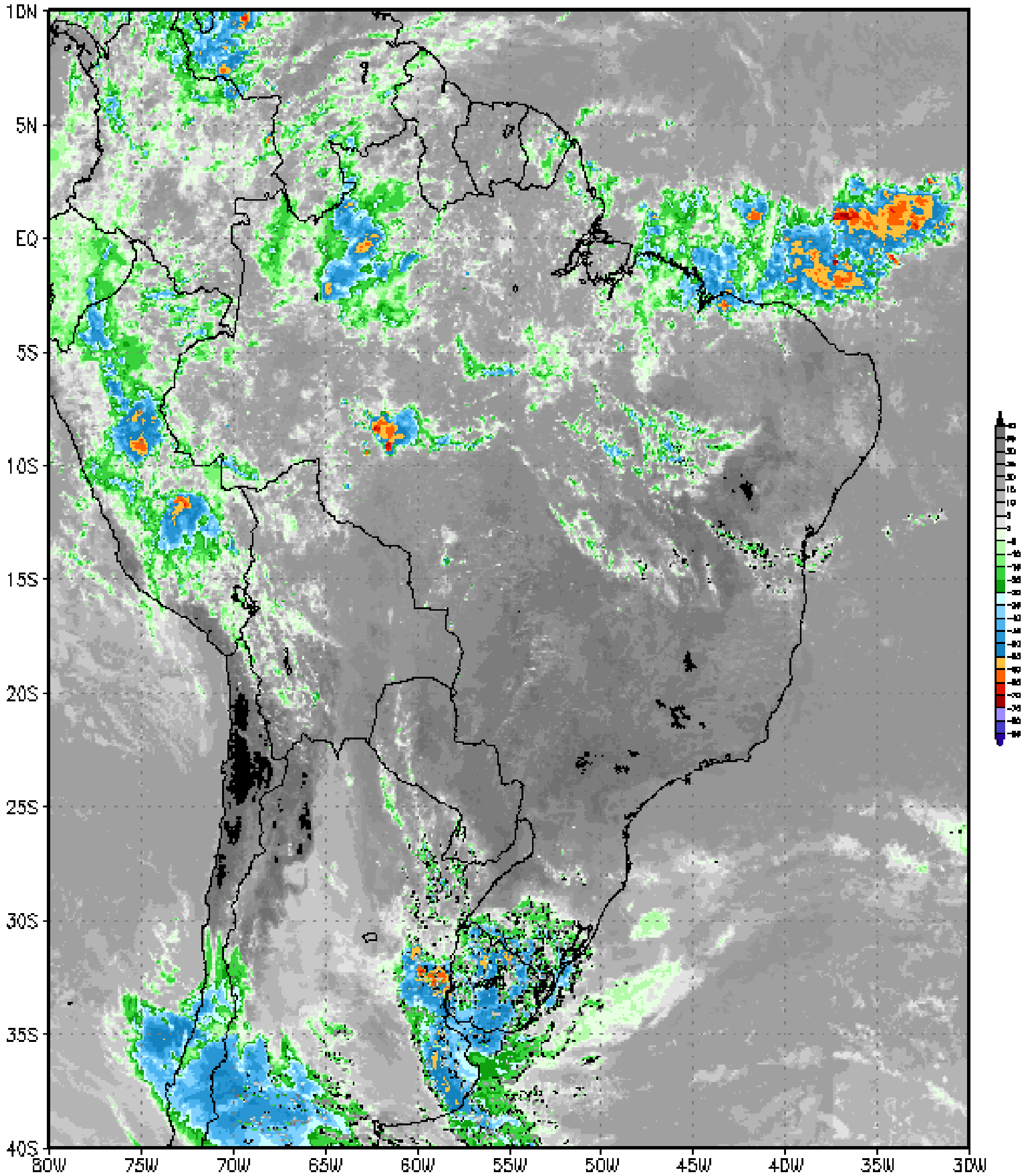

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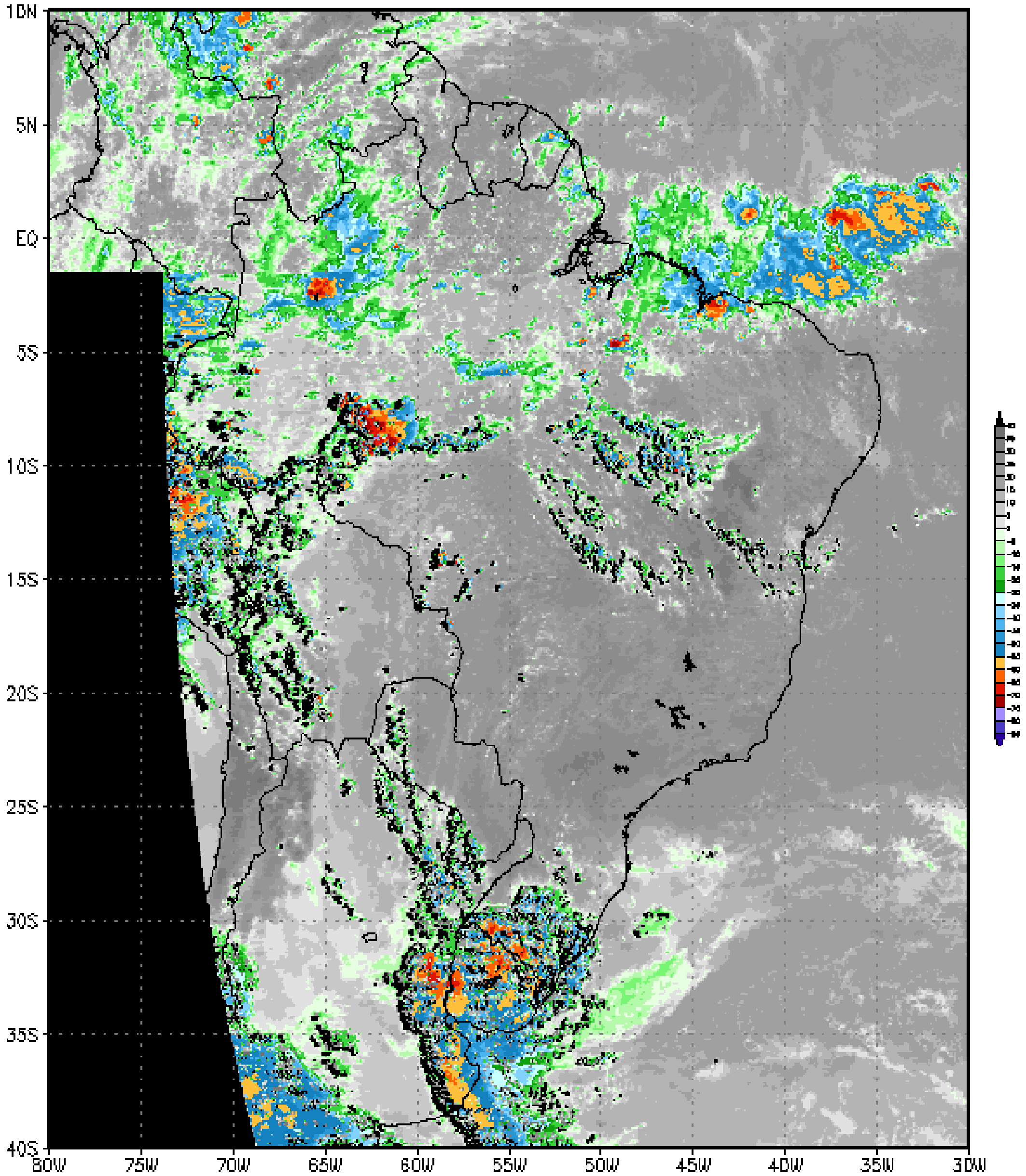

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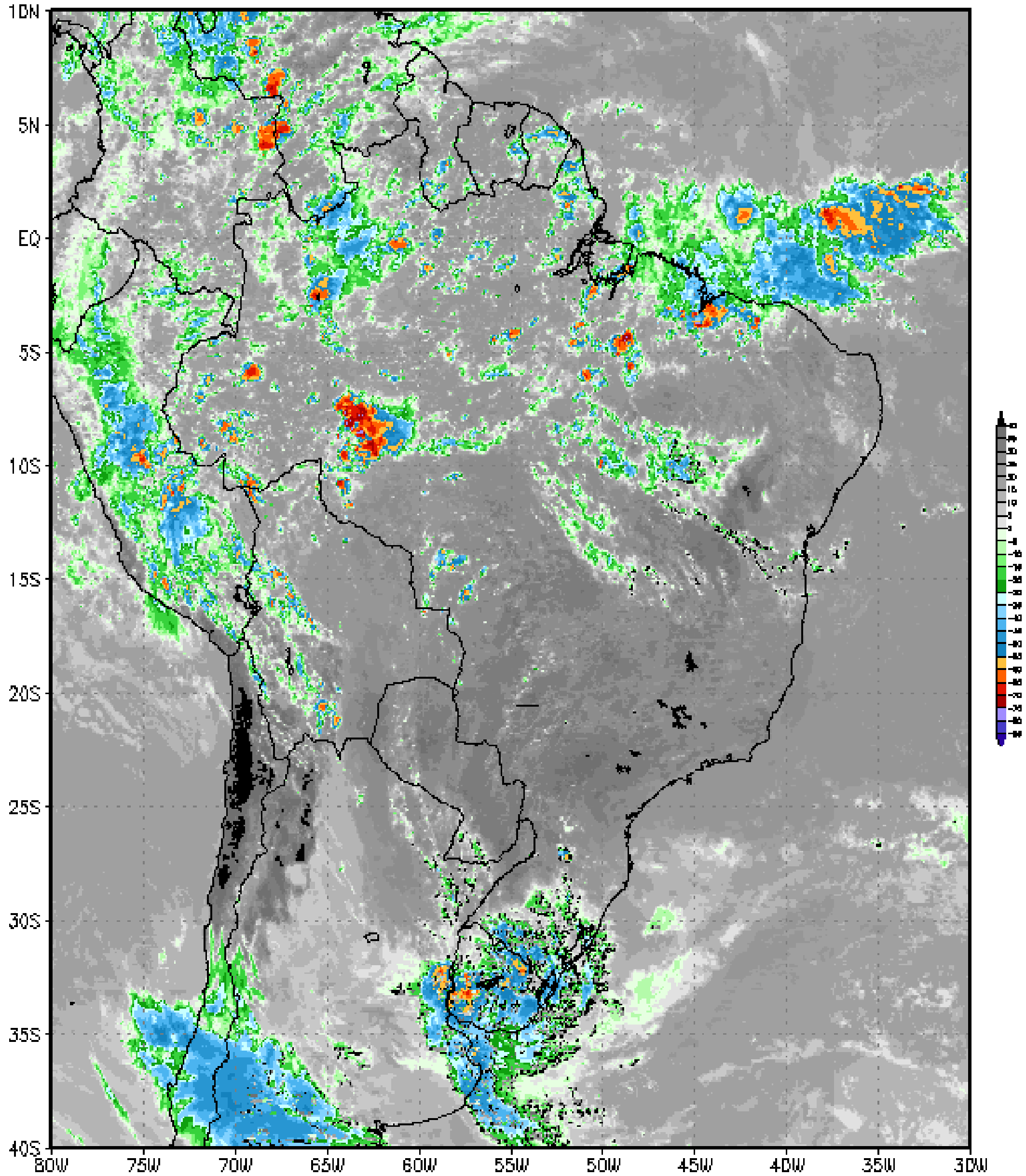

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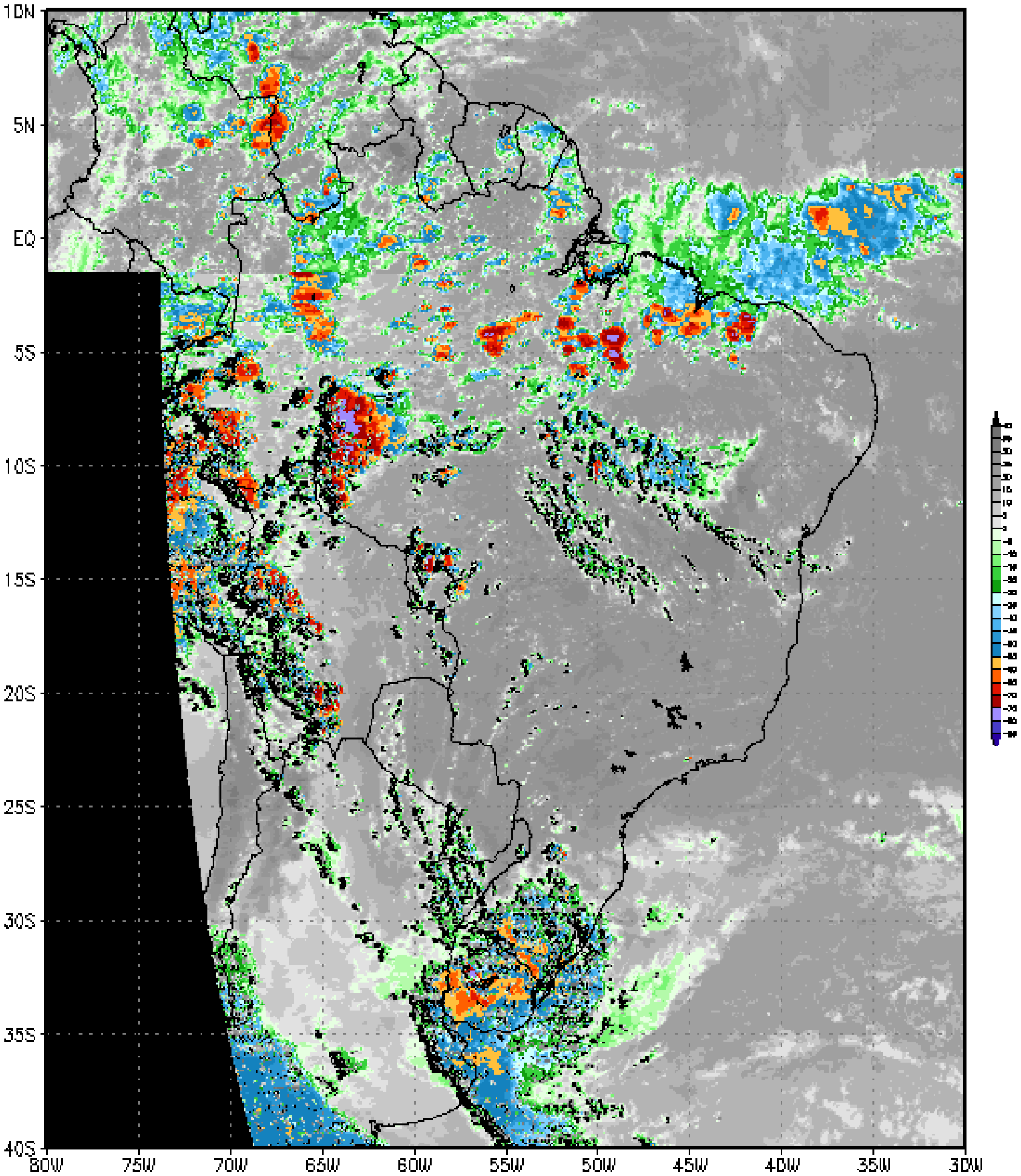

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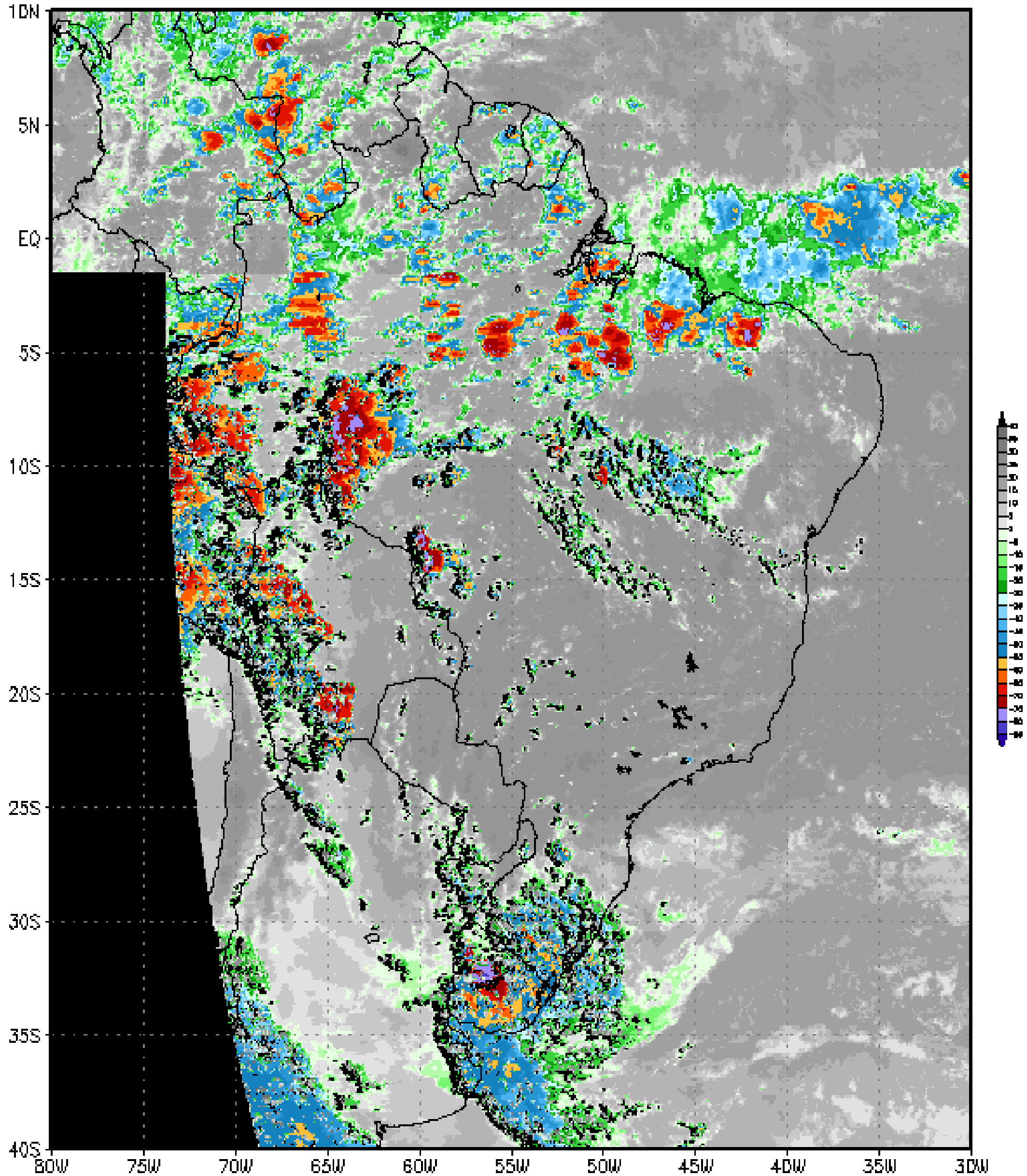

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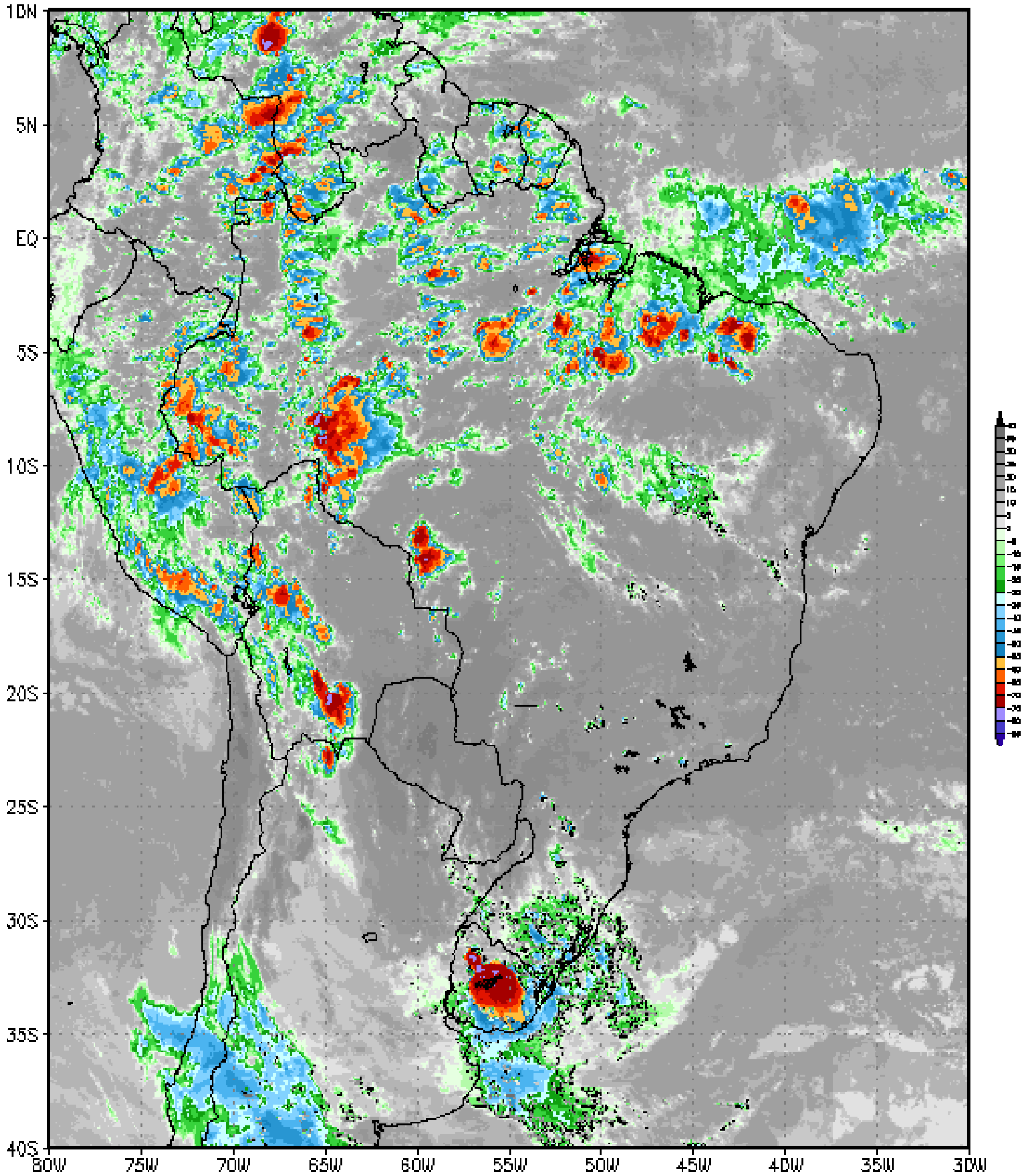

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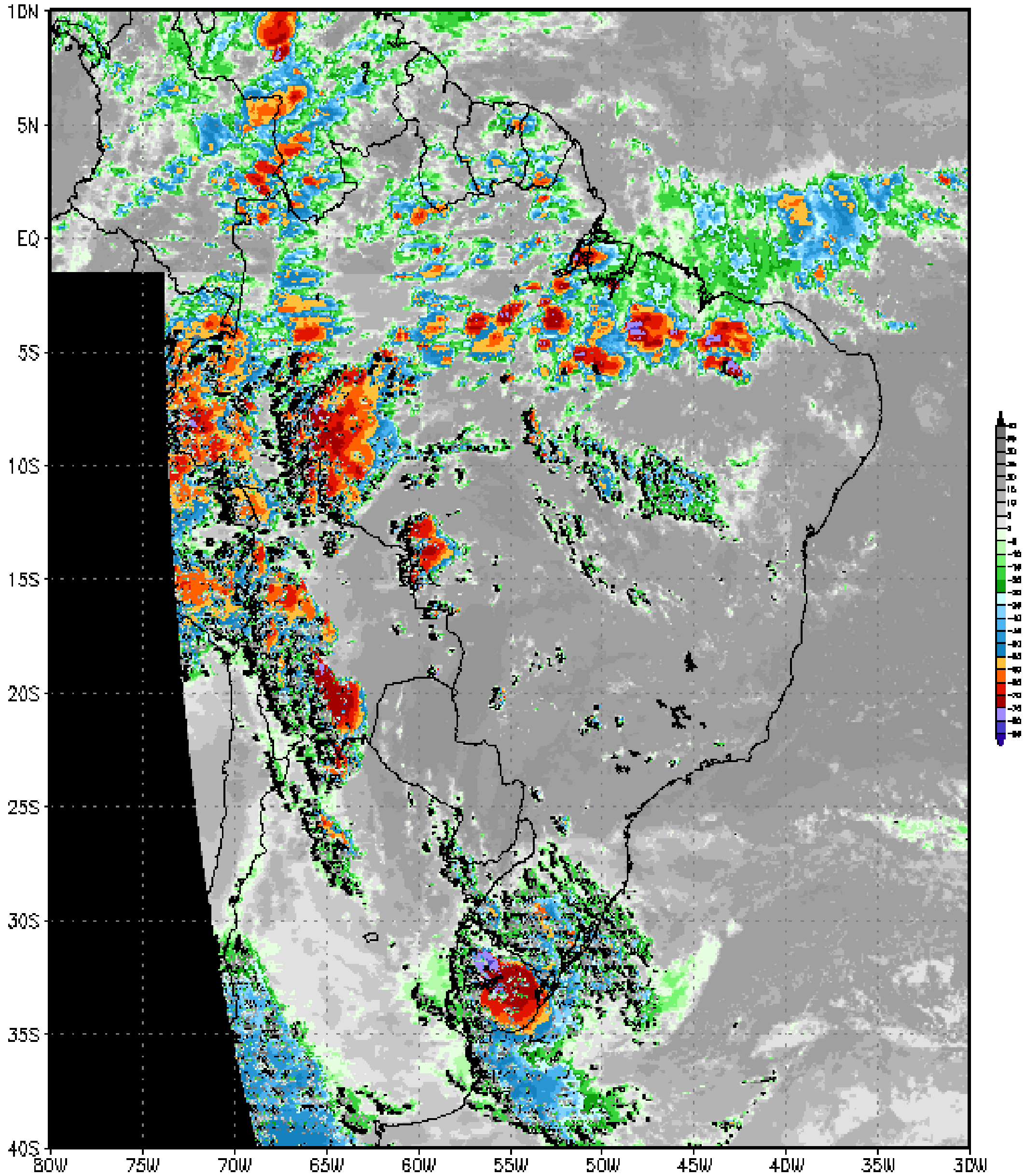

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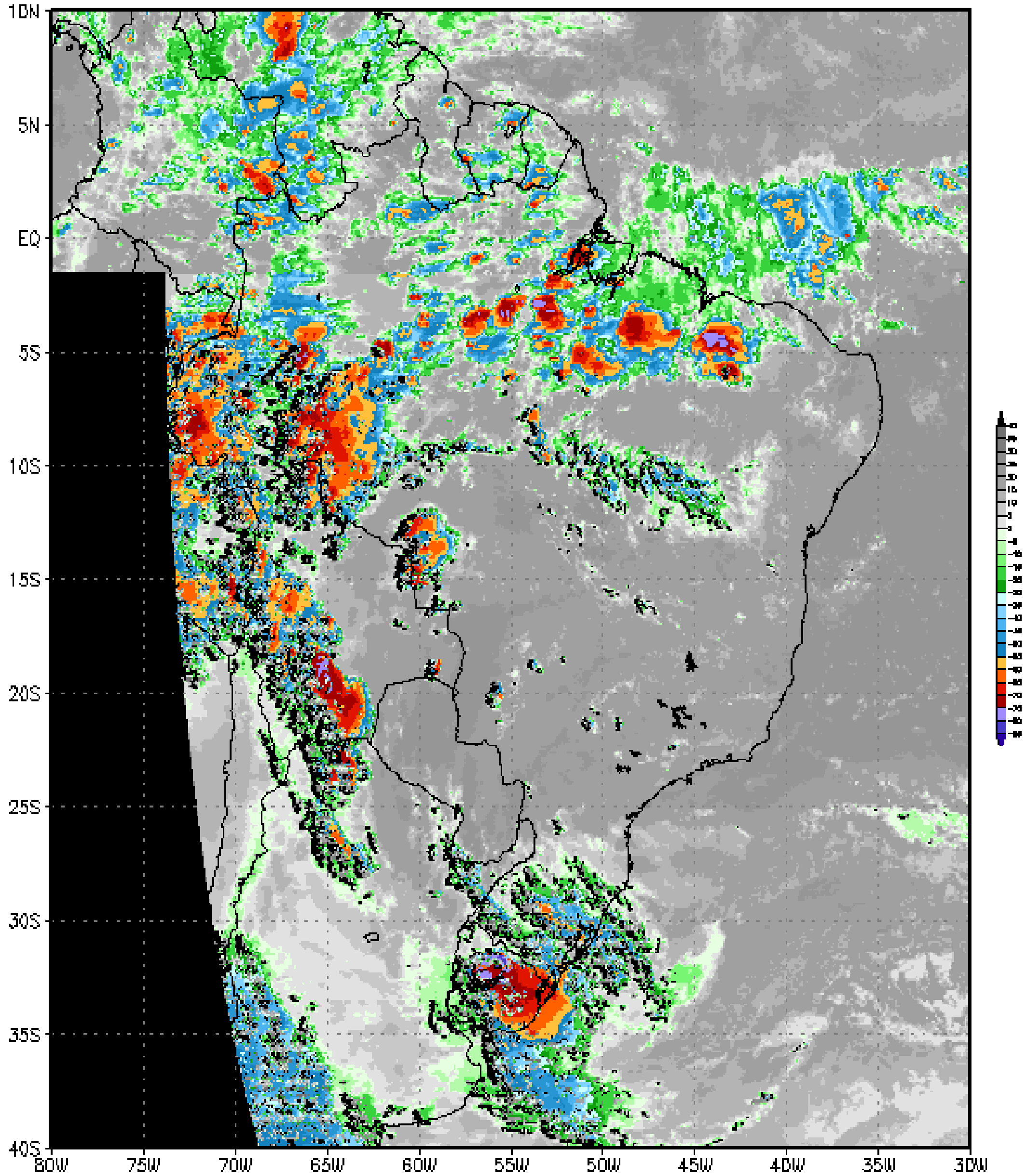

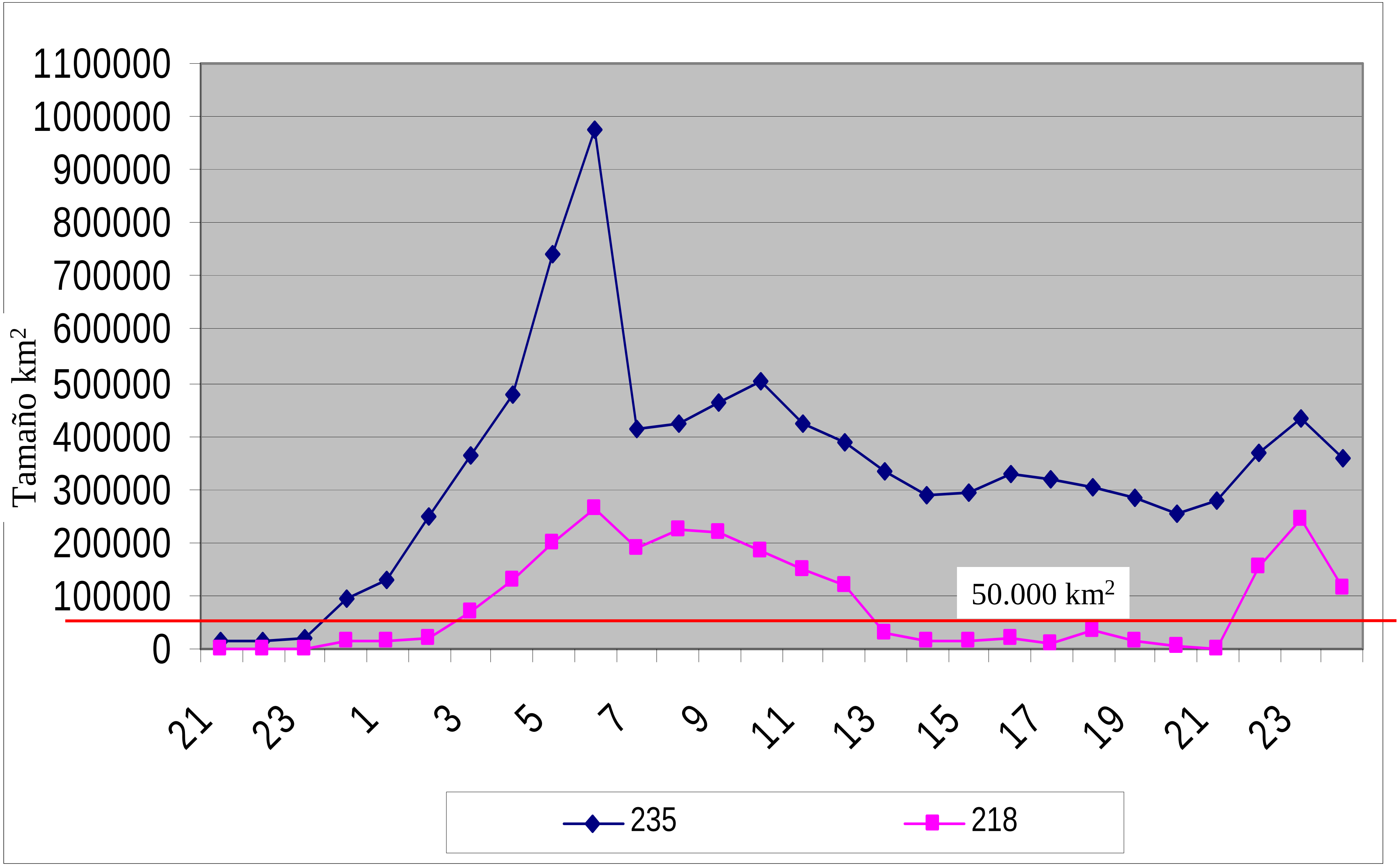
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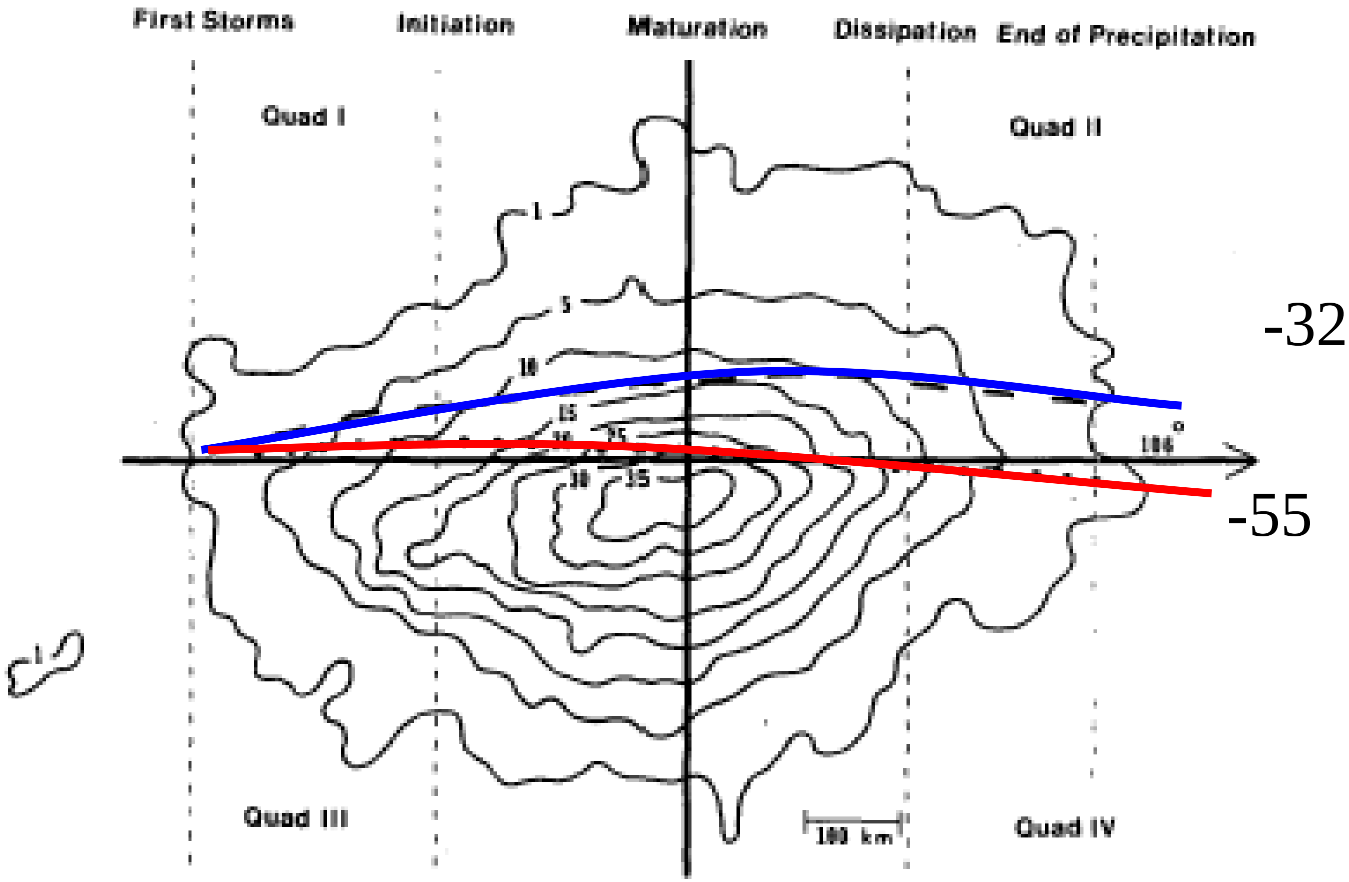
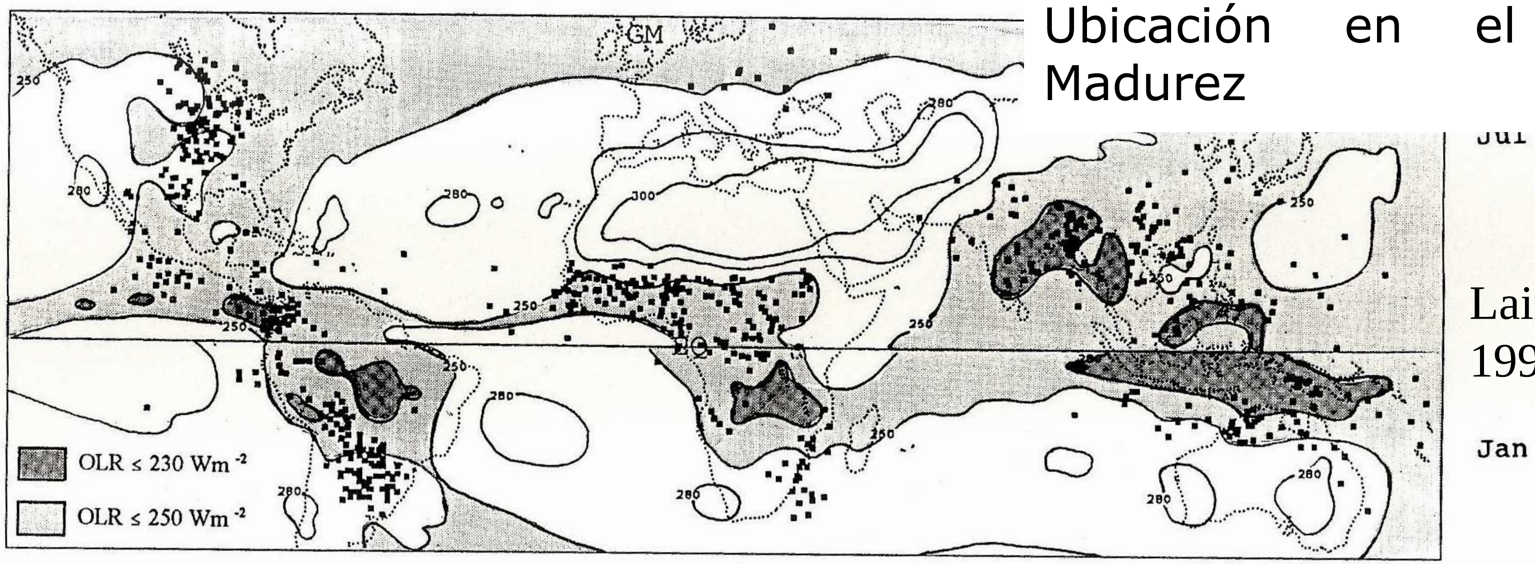


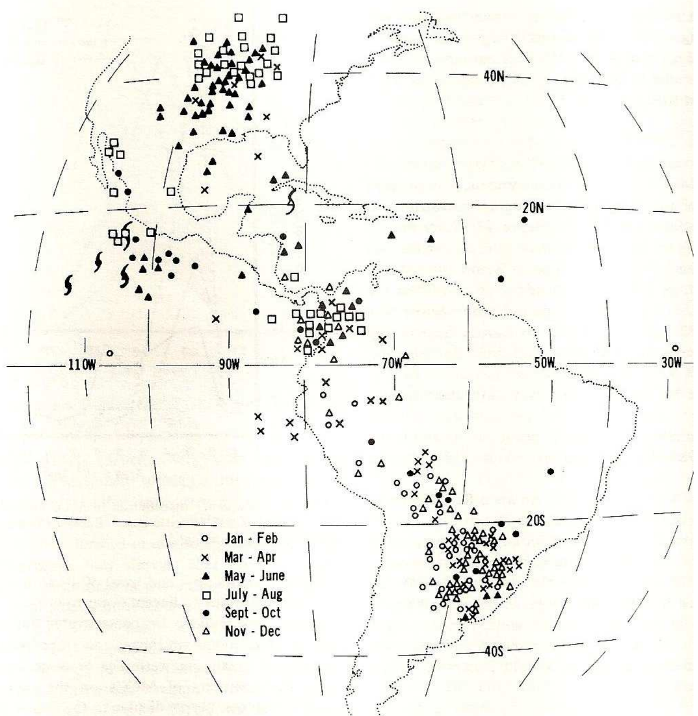
FIG. 2. Normalized composite precipitation (millimeters) pattern for 74 MCCs. The dashed and dotted lines are the approximate average centroid tracks of the −32°C and −52°C cold-cloud shields, respectively. The horizontal axis is the axis of propagation and indicates the average storm heading. Vertical dashed lines indicate approximate locations of various stages in the life cycle of the MCCs.

Kane et al,1987

Ubicación en el estado de Madurez



Laing and Fristch, 1997



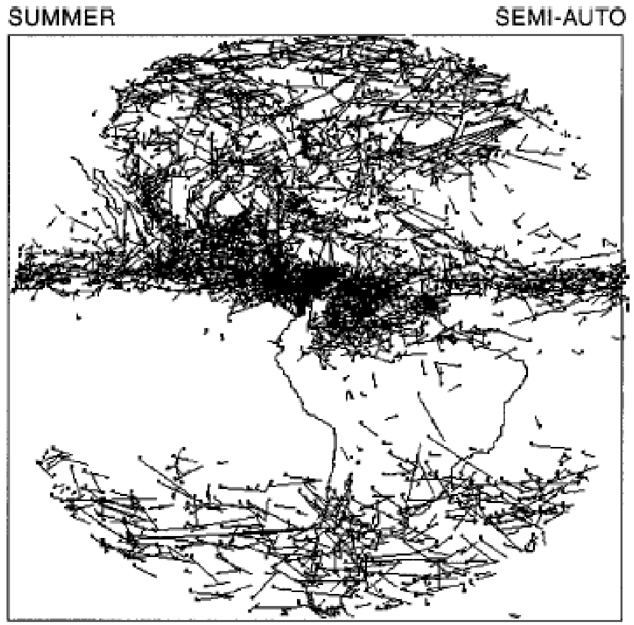


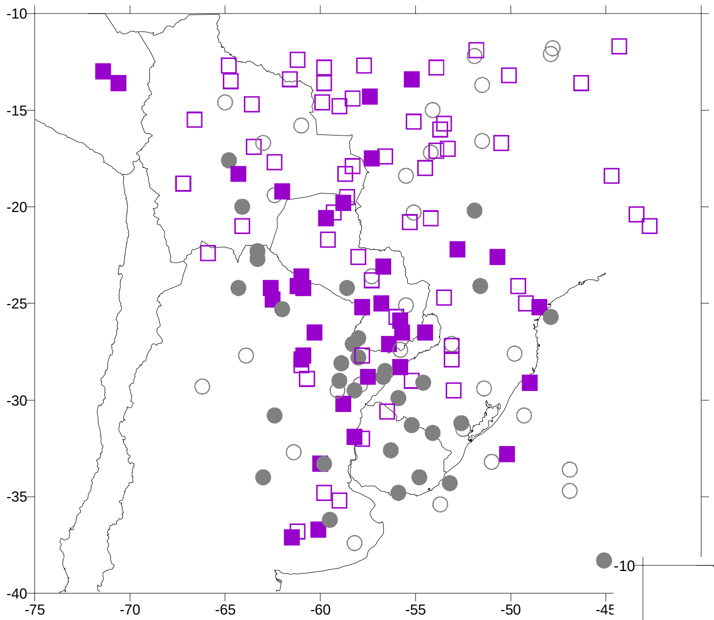
FIG. 4. Trajectories of individual convective systems for boreal summer. The dot at one end of each line identifies the beginning of the trajectory.

Machado et al 1998

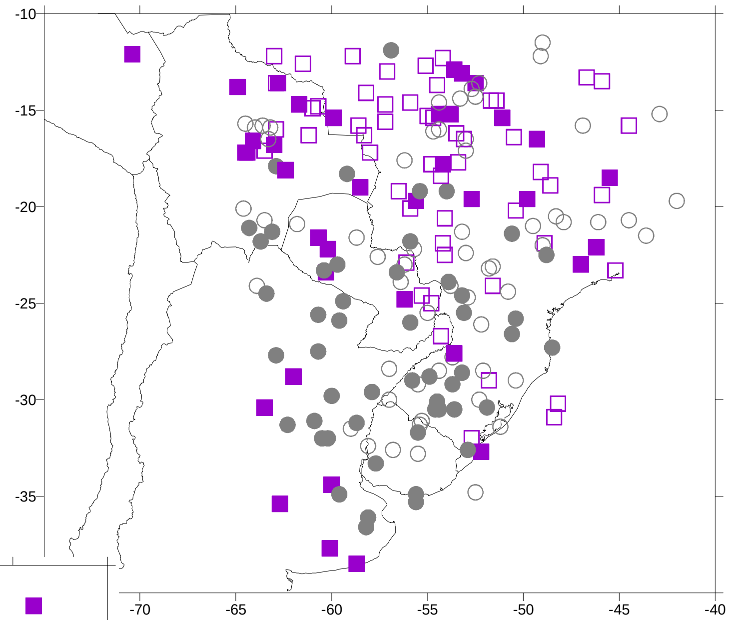
Velasco and Fristch, 1987

Ubicación en el estado de Madurez en latitudes subtropicales (2000-2003)

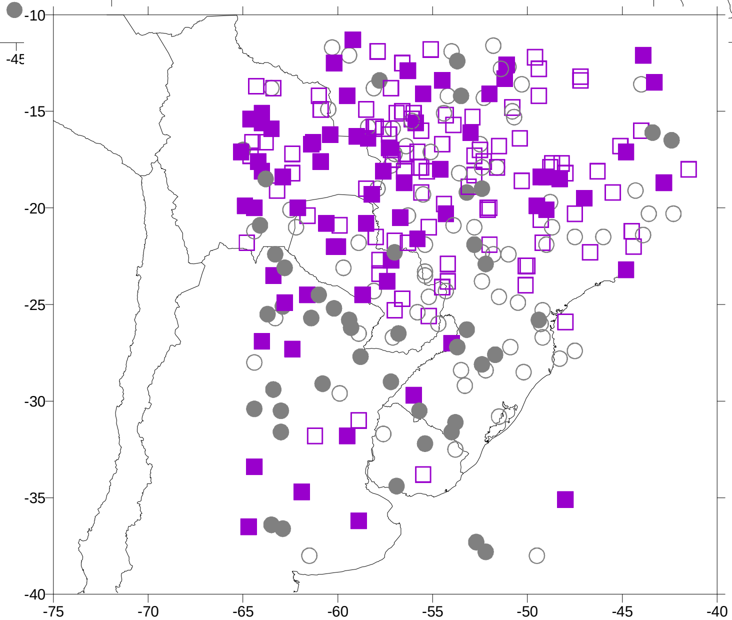
Otoño



Primavera

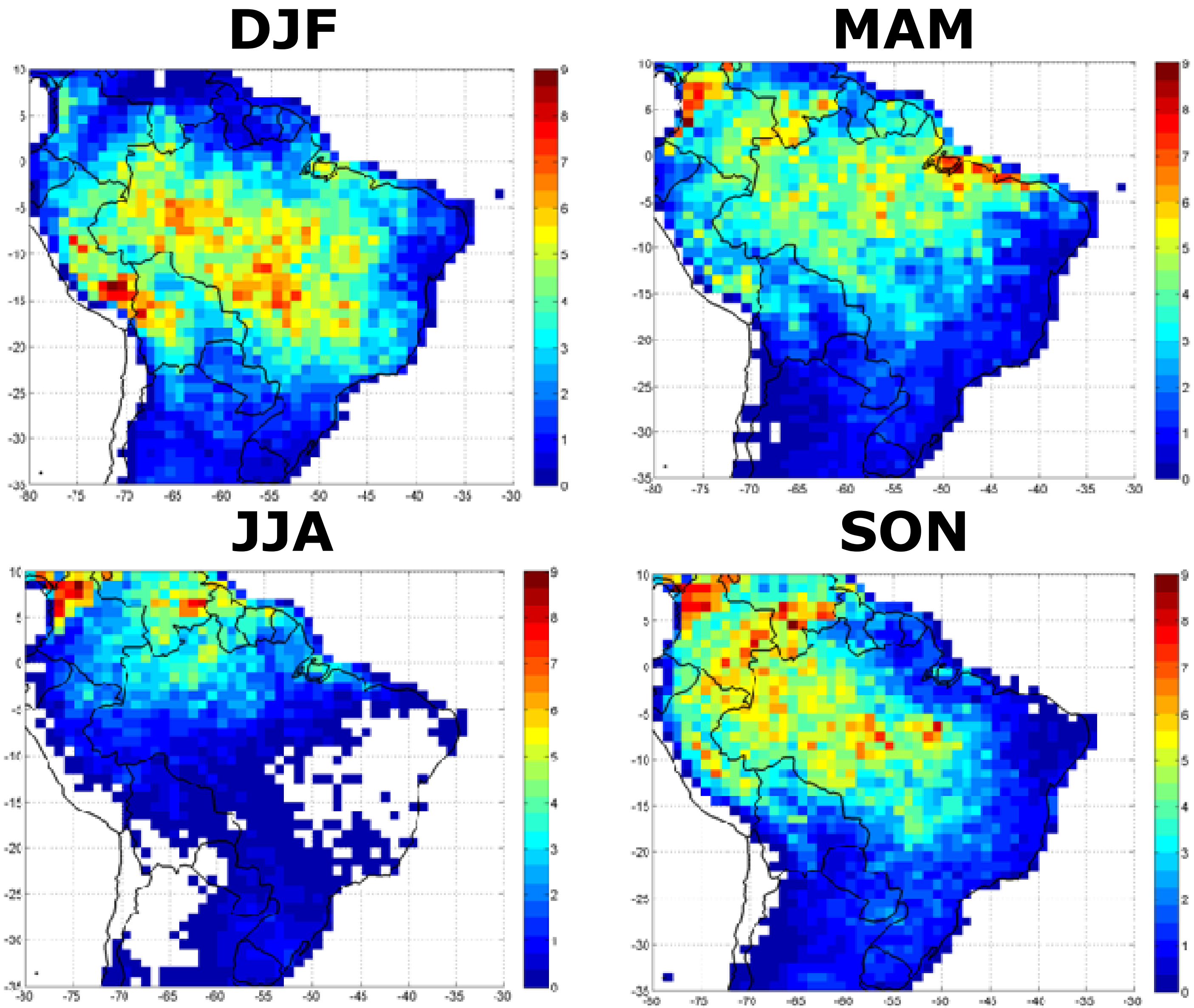


Verano



Salio et al 2007

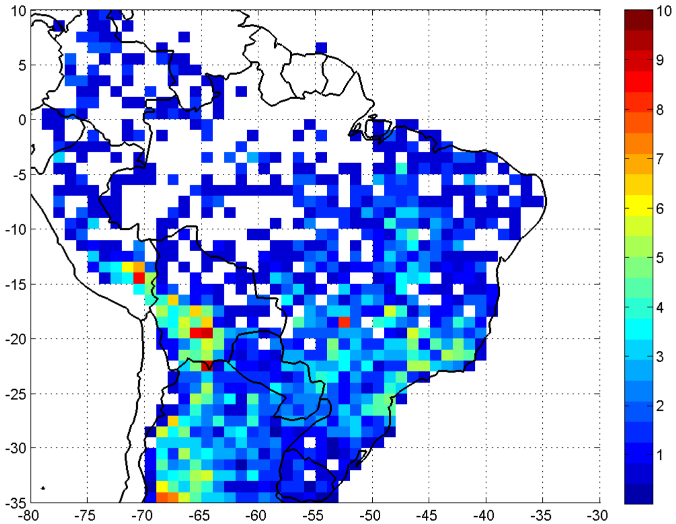
Distribución Estacional de sistemas precipitantes con Tb11 < 218 K



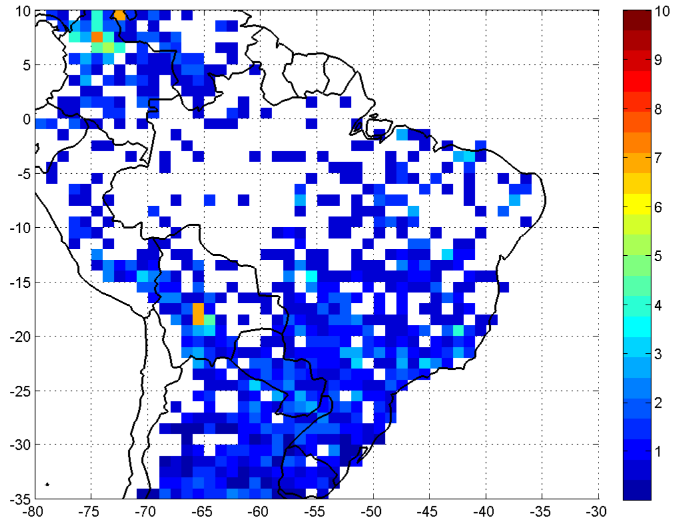
Vidal 2009

Distribución Estacional de sistemas precipitantes con tope de 40 dBz > 8 km

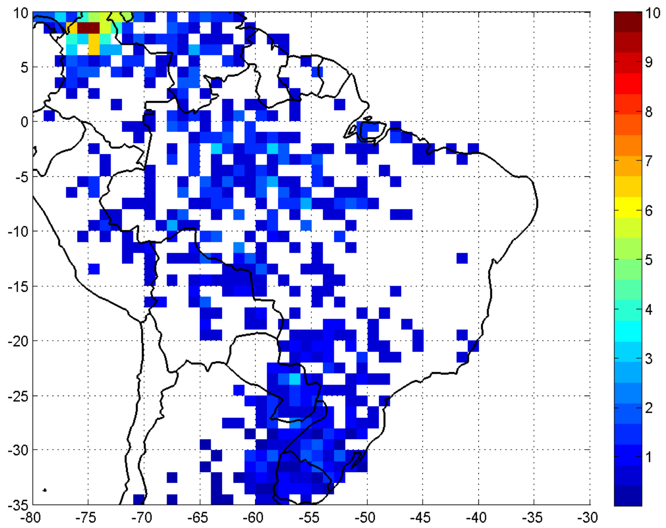
DJF



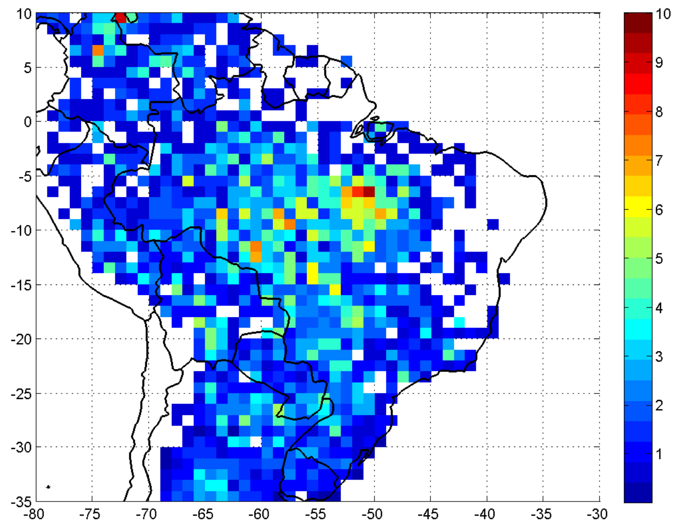
MAM



JJA



SON



Vidal 2009

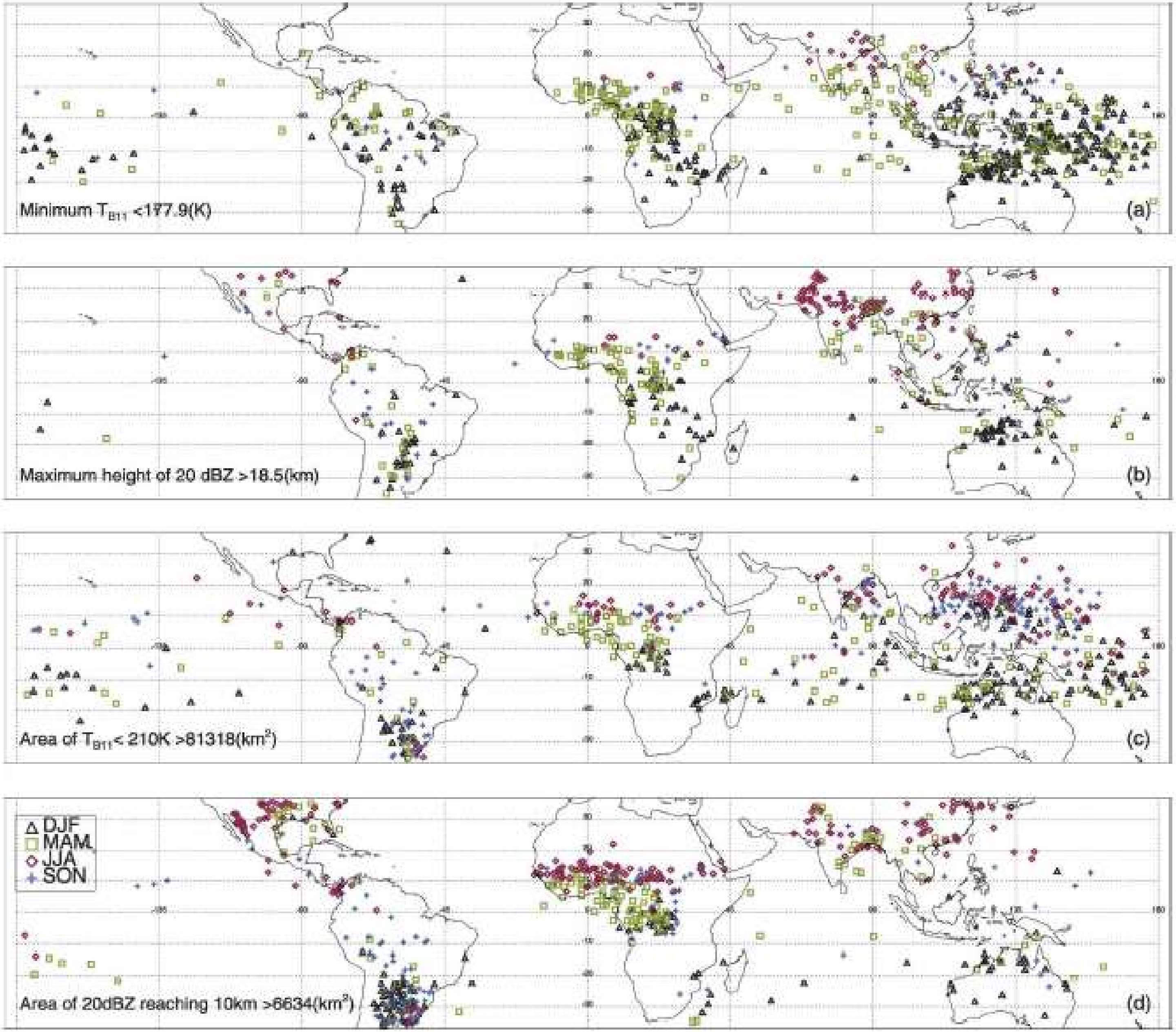


FIG. 9. Color- and symbol-coded seasonal cycle of the most extreme events (purple and black categories in Fig. 8).

Eventos
Extremos
TRMM

0.11 % de la muestra total

Liuct et al 2007

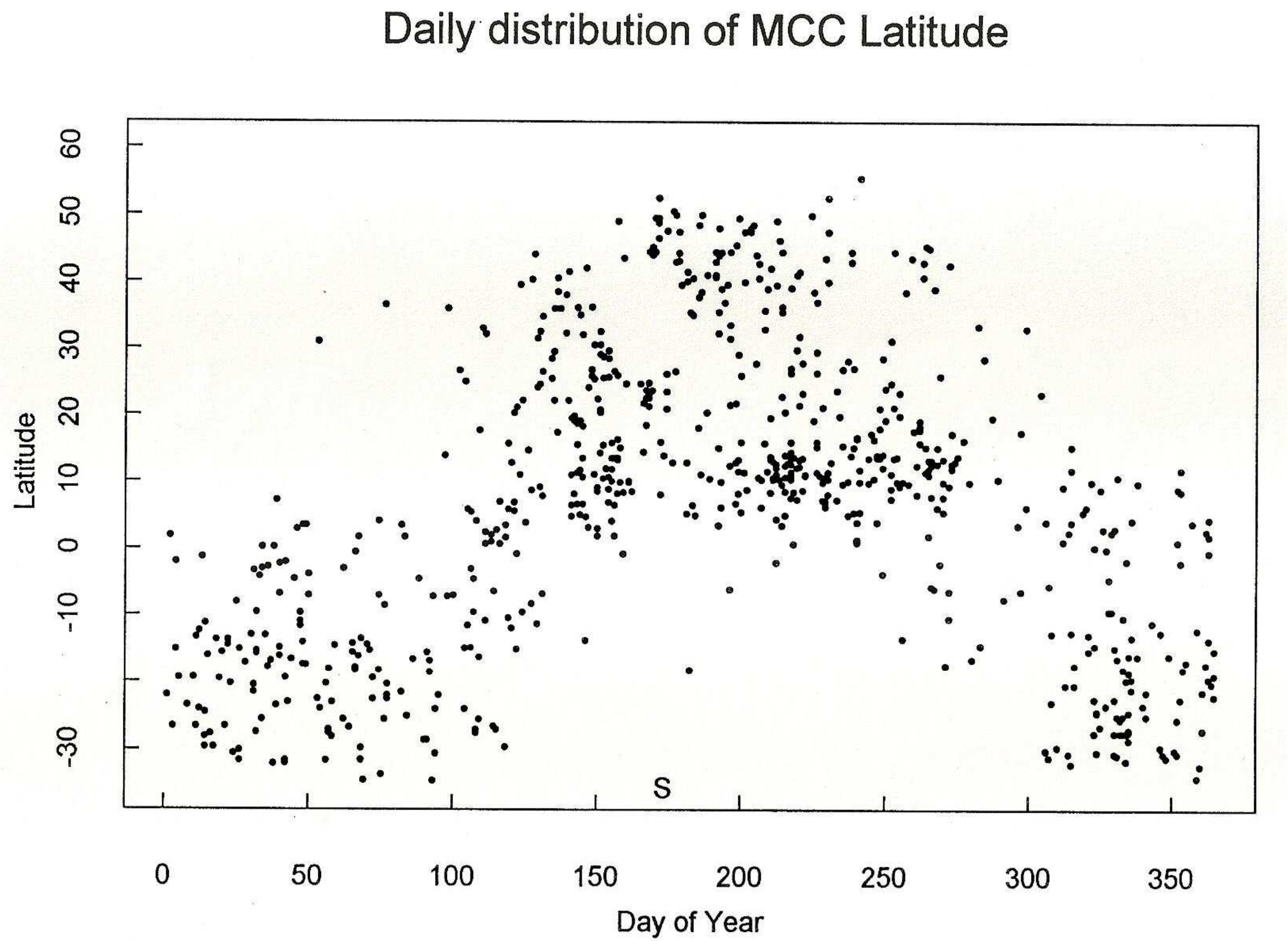


Fig. 5. Daily distribution of MCC latitude. "S" marks the northern hemisphere summer solstice.

Laing and Fristch, 1997

Tamaño

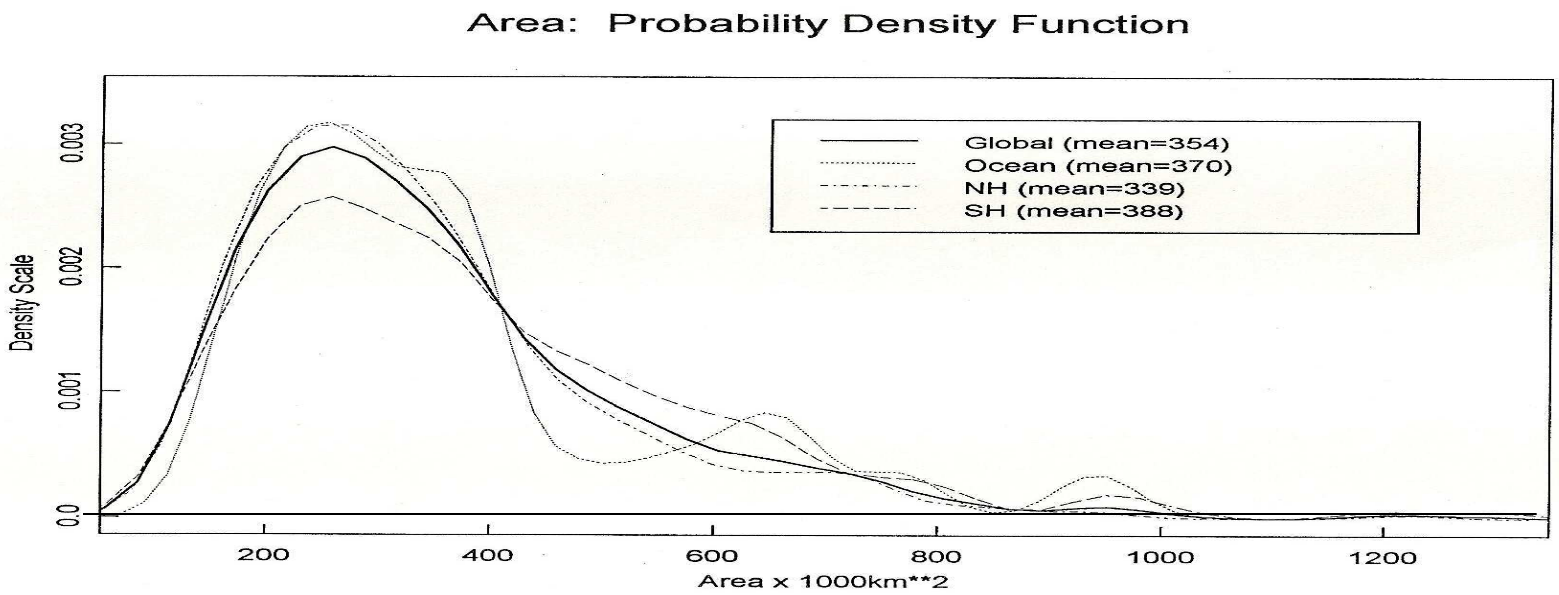
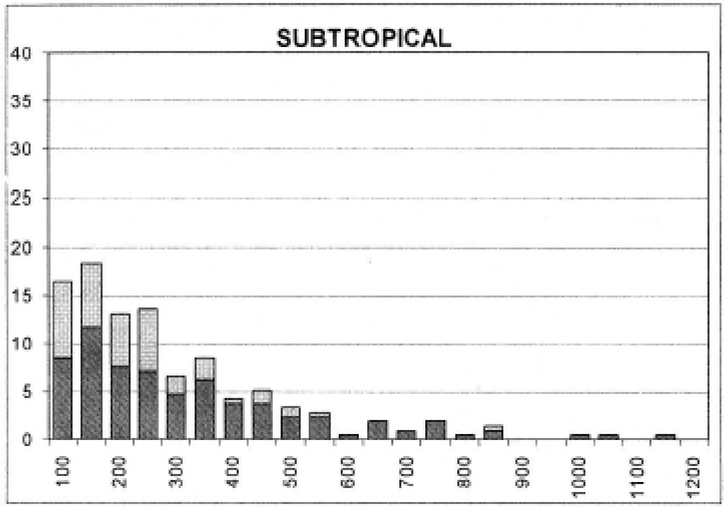
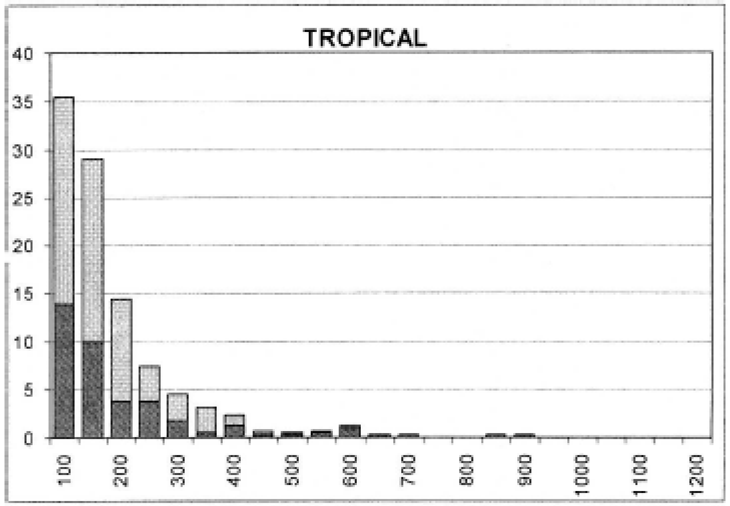


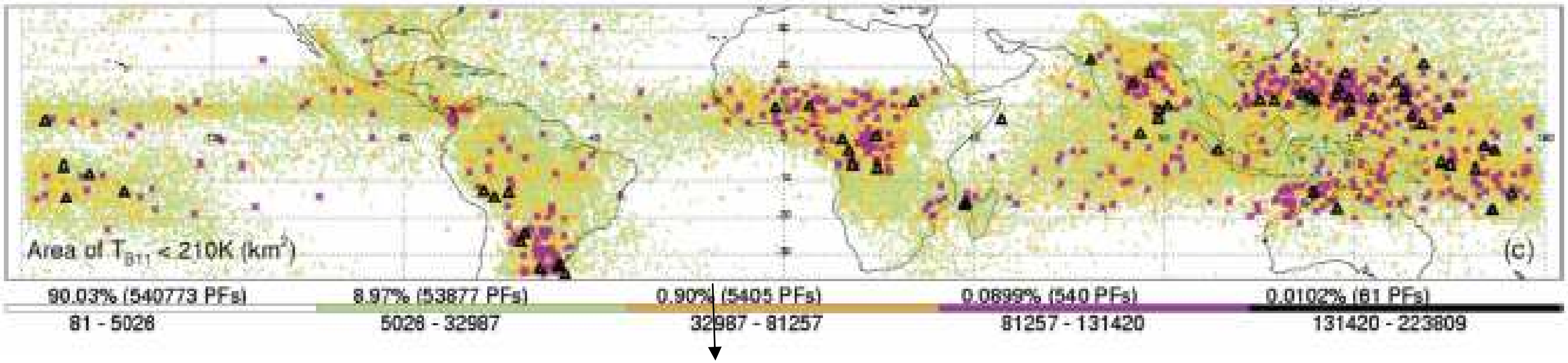
Fig. 8. Probability density distribution of area for global population, northern hemisphere, southern hemisphere, and ocean.

Laing and Fristch, 1997

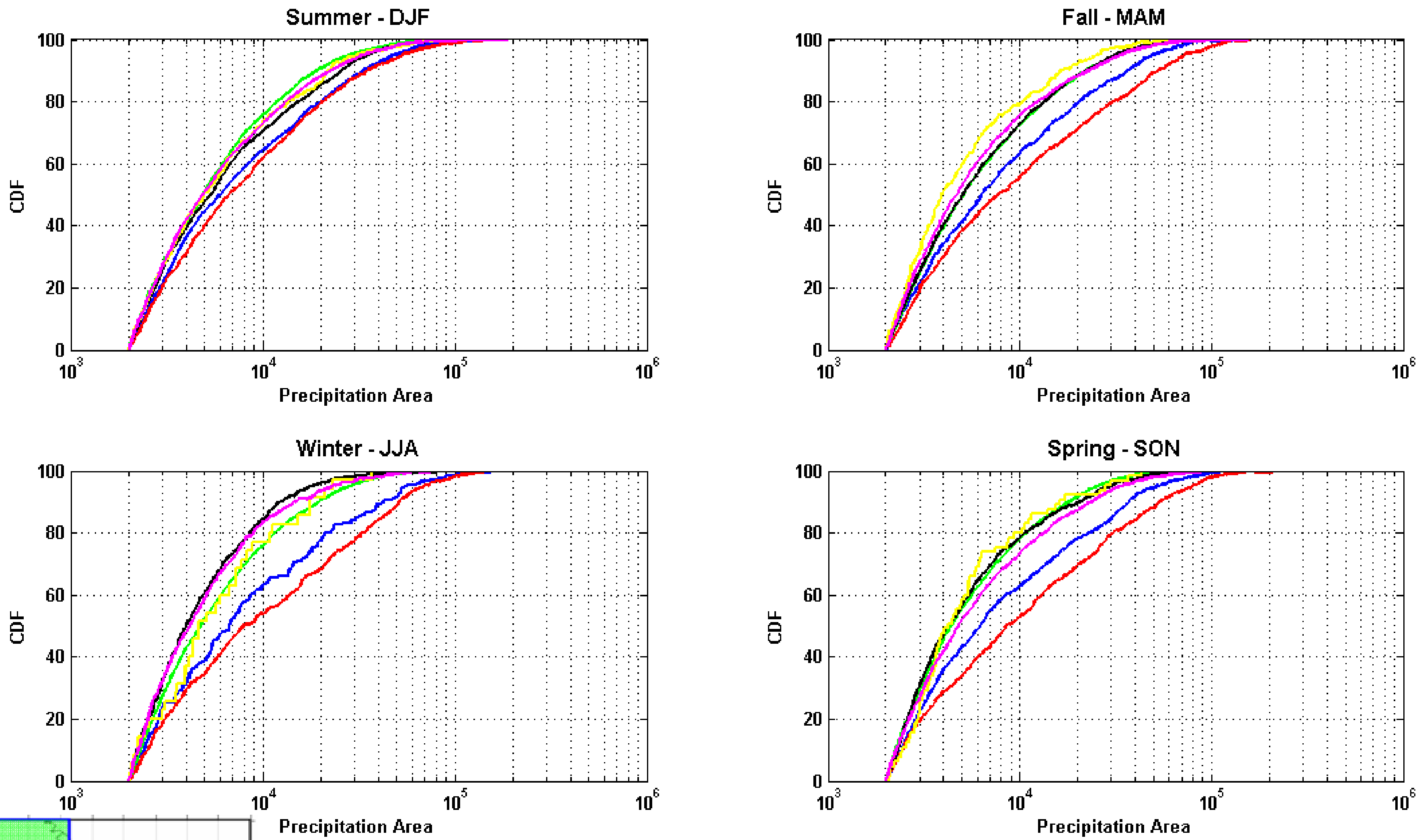


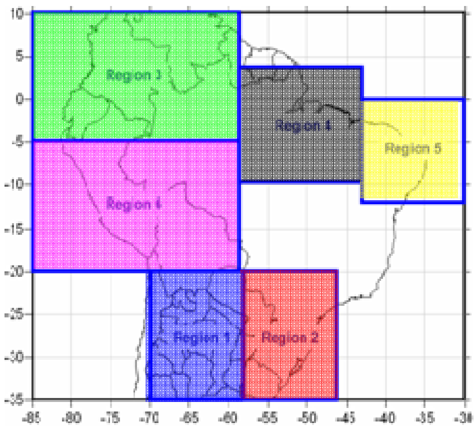


Salio et al 2007



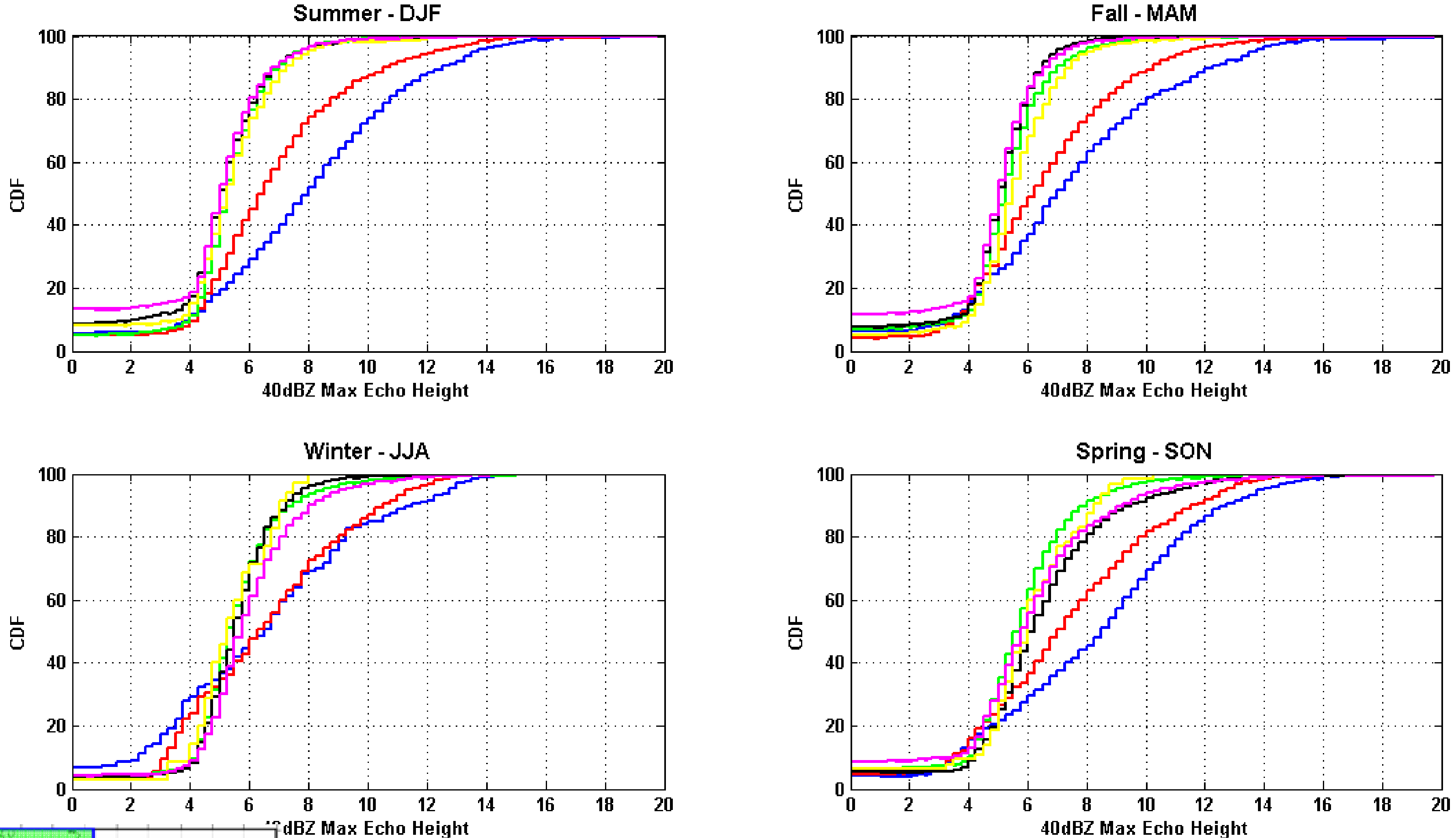
Liuct et al 2007

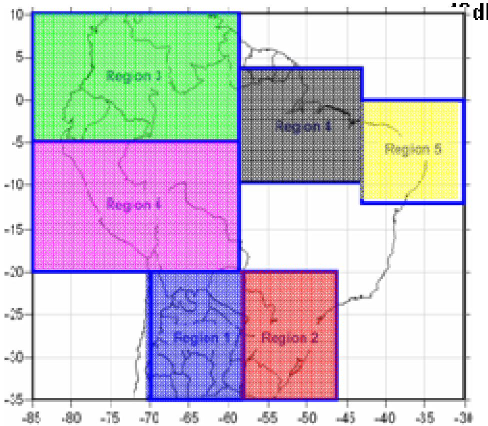




CDF de area precipitante km^2

area mayor a 2000 km^2 y Tb11 < 218 K

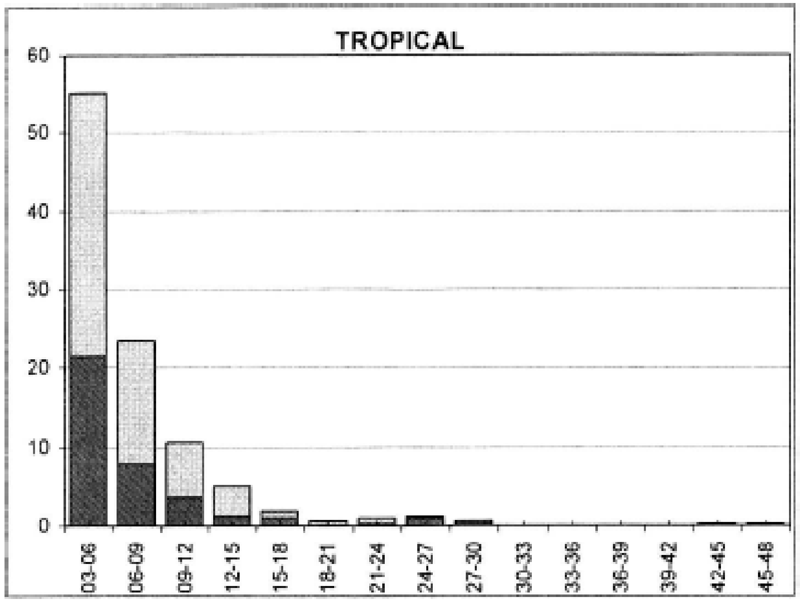


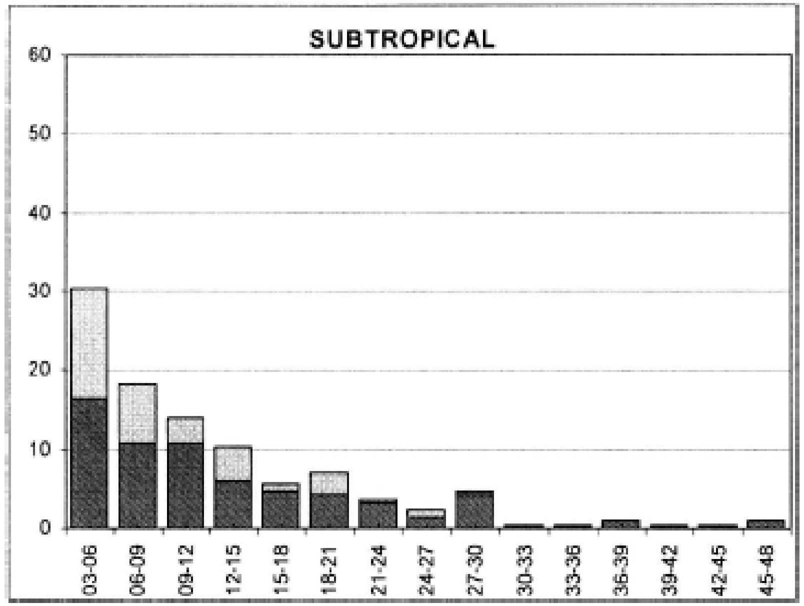


CDF altura del tope del contorno de 40 dBz

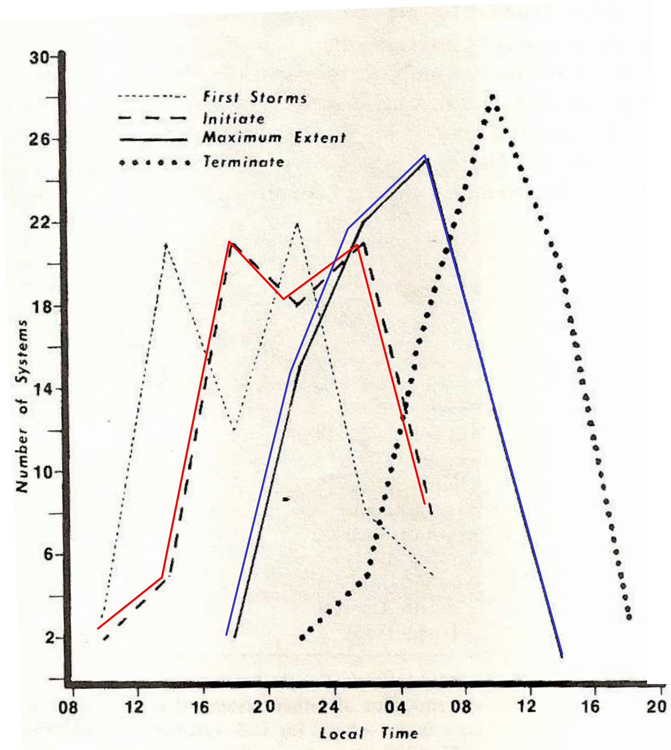
area mayor a 2000 km² y Tb11 < 218 K

Duración de los Sistemas en Sudamérica

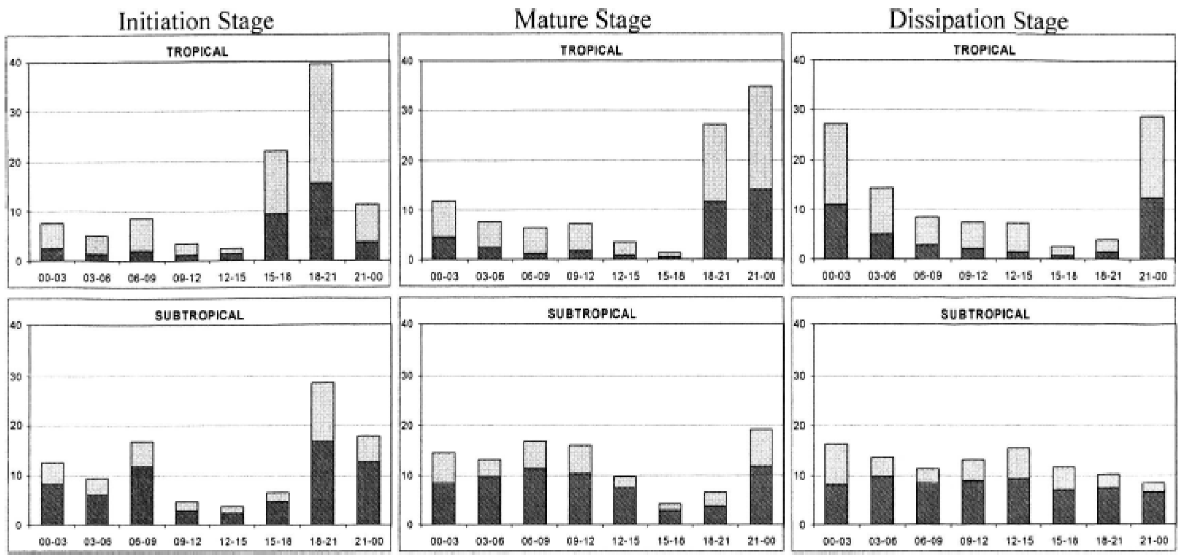




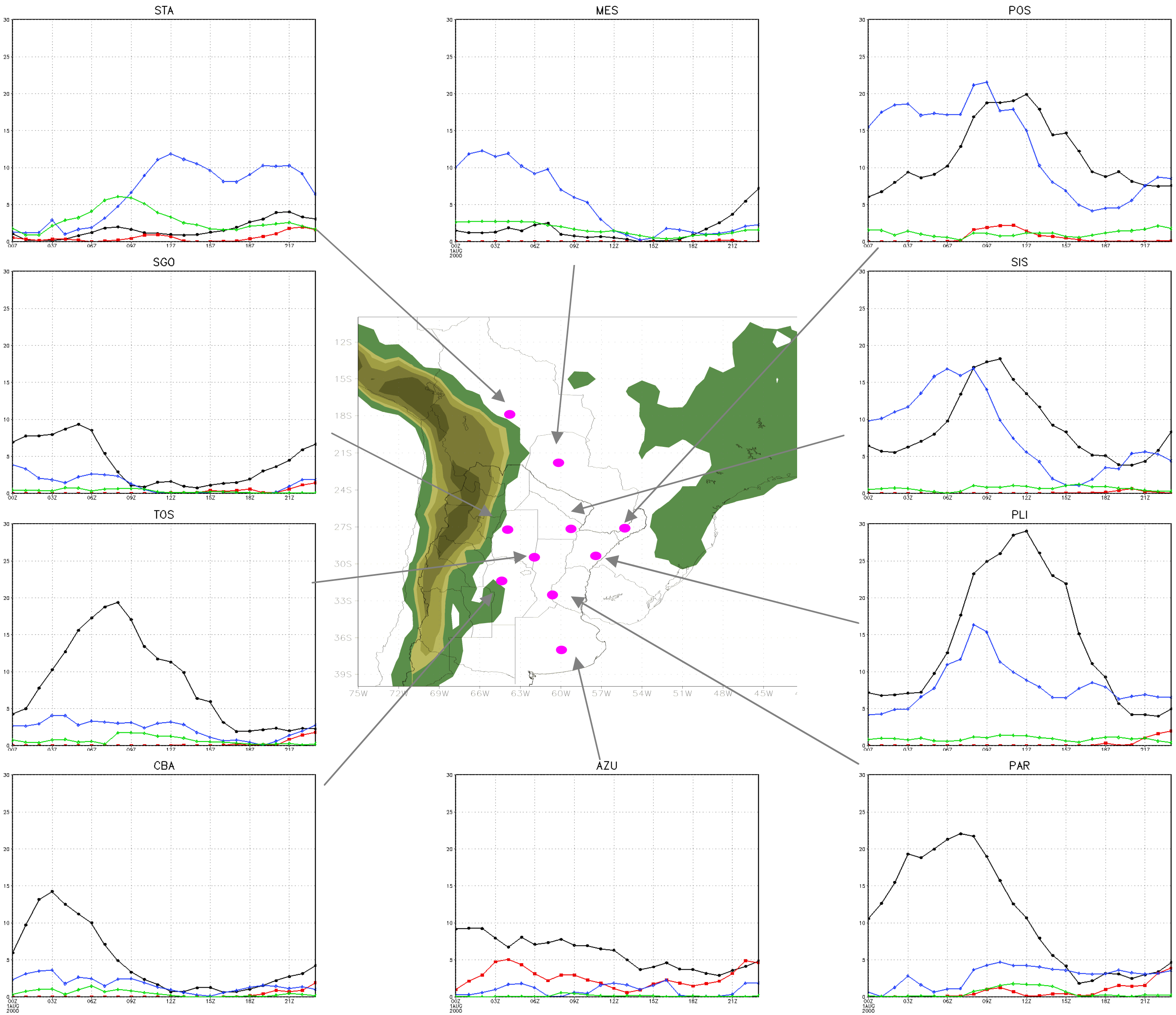
Ciclo de Vida de los Sistemas en Sudamérica



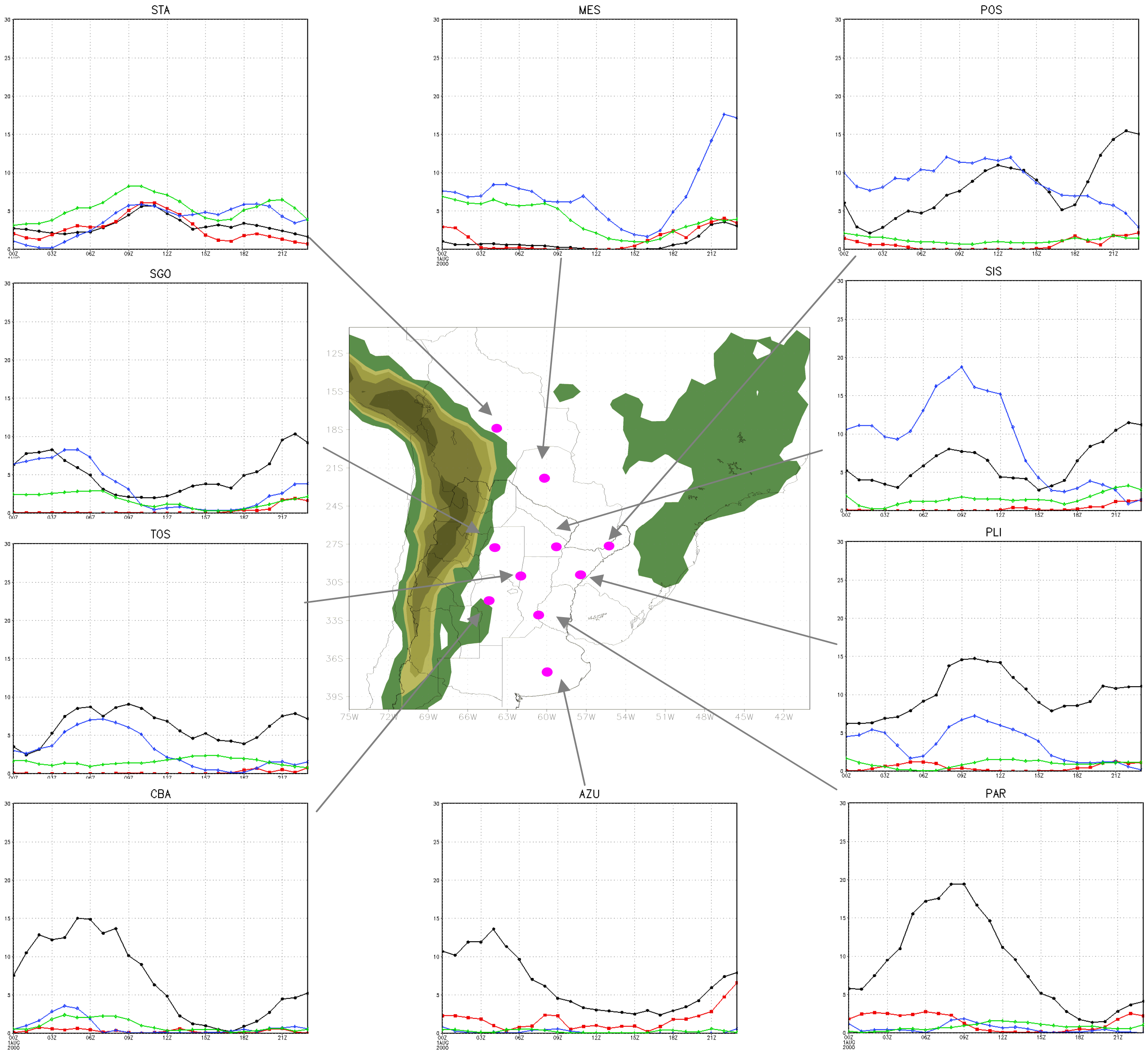
'ig. 3. Life cycle of MCCs over mid-latitude South America for the 1981–1982 and 1982–1983 warm seasons (see Table 1).



Primavera


STA
MES
POS
SGO
SIS
TOS
PLI
CBA
AZU
PAR
12S
15S
18S
21S
24S
27S
30S
33S
36S
39S
75W
72W
69W
66W
63W
60W
57W
54W
51W
48W
45W

Verano



Importancia de los MCS al aporte de la precipitación total

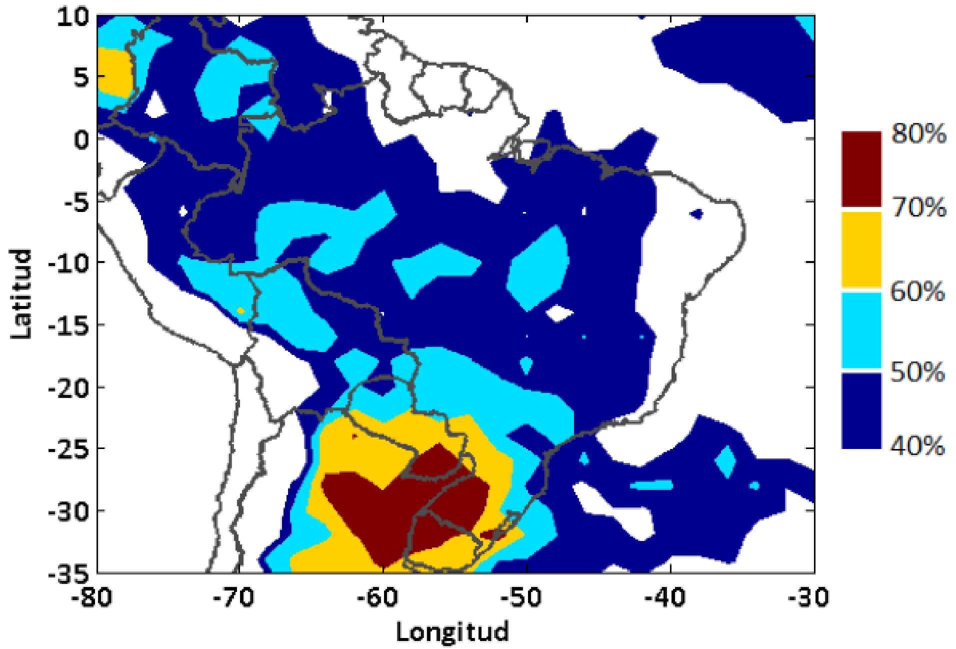
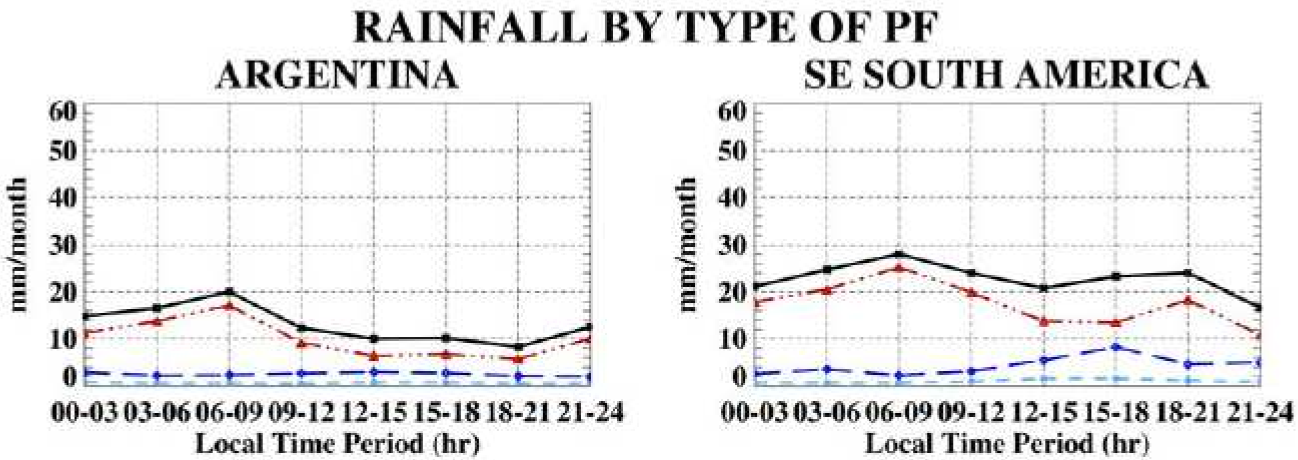


Figura 4.9 Porcentaje anual de precipitación volumétrica explicada por los MRPFs respecto de la precipitación volumétrica total

Vidal 2009



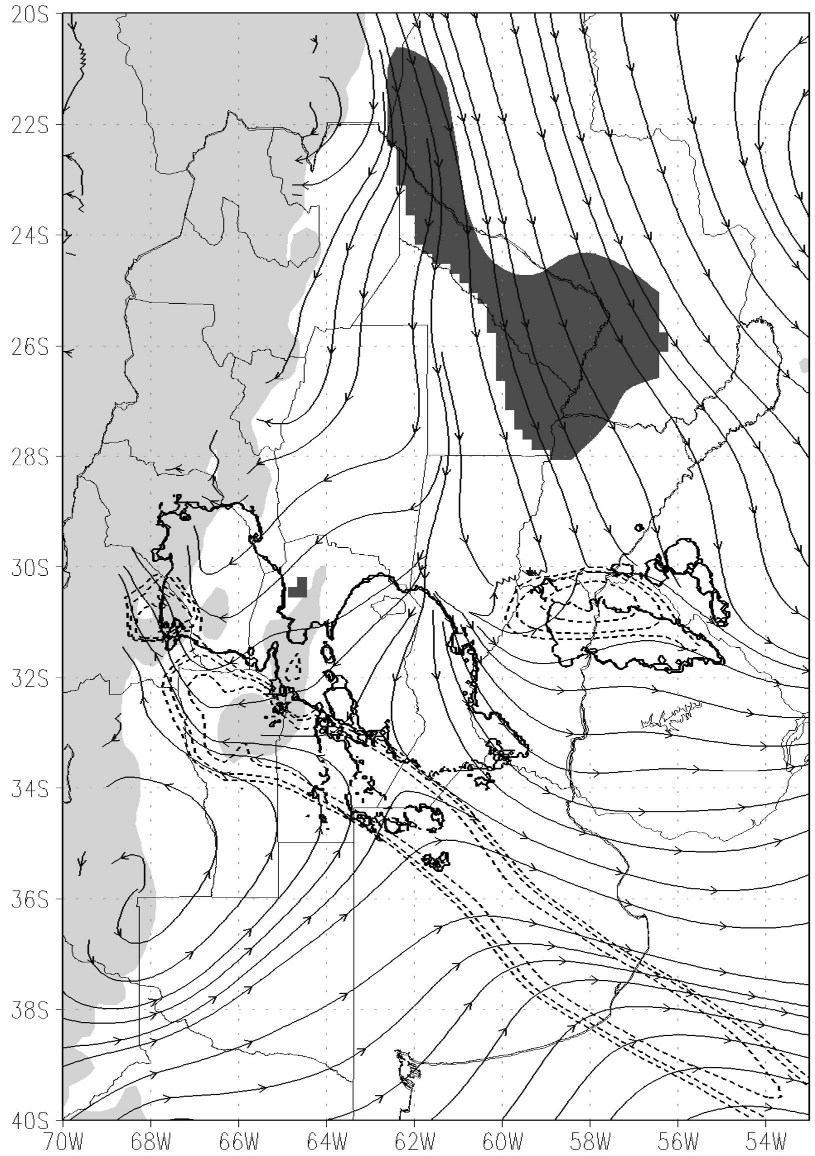
Mota 2003

Condiciones de gran escala asociada a la presencia de los MCS subtropicales en Sudamérica

▶SALLJ que provee una zona altos valores de θe y un aumento progresivo de la inestabilidad por advección de T y q.

▶Ascenso de mayor escala generado por la presencia de una zona baroclínica.

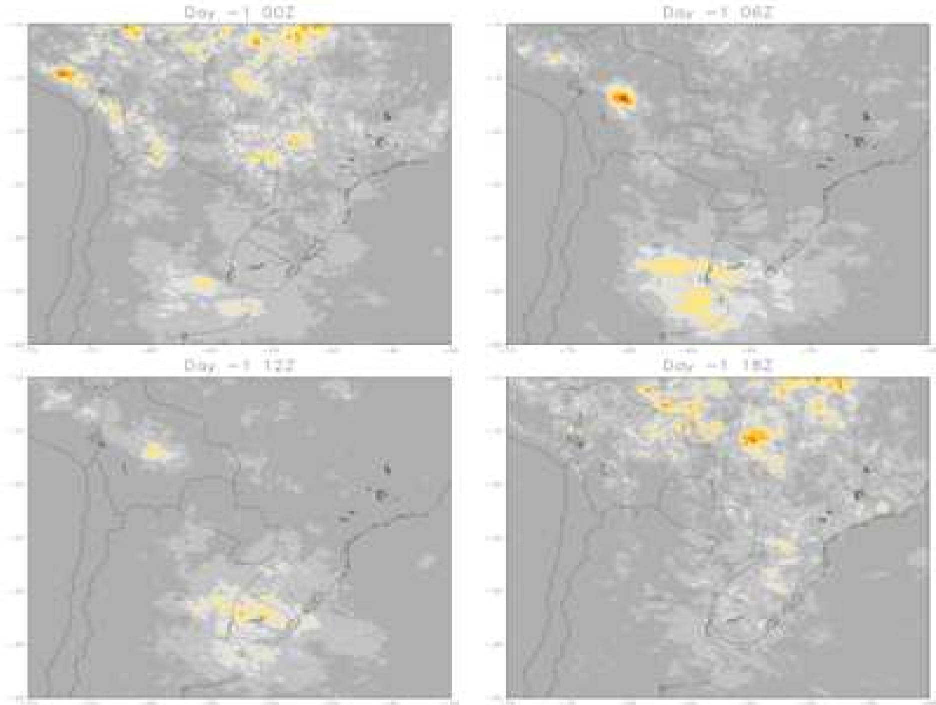
▶Sistemas en entornos mas barotrópicos.

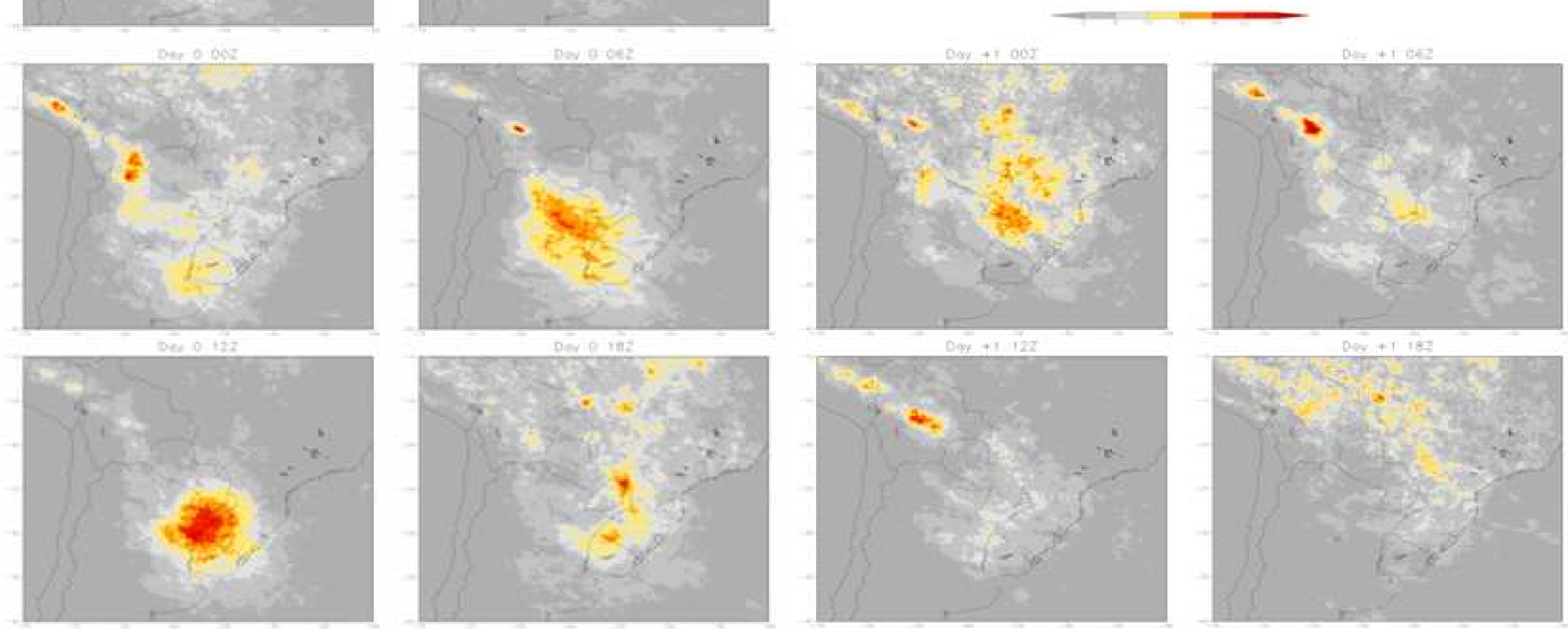


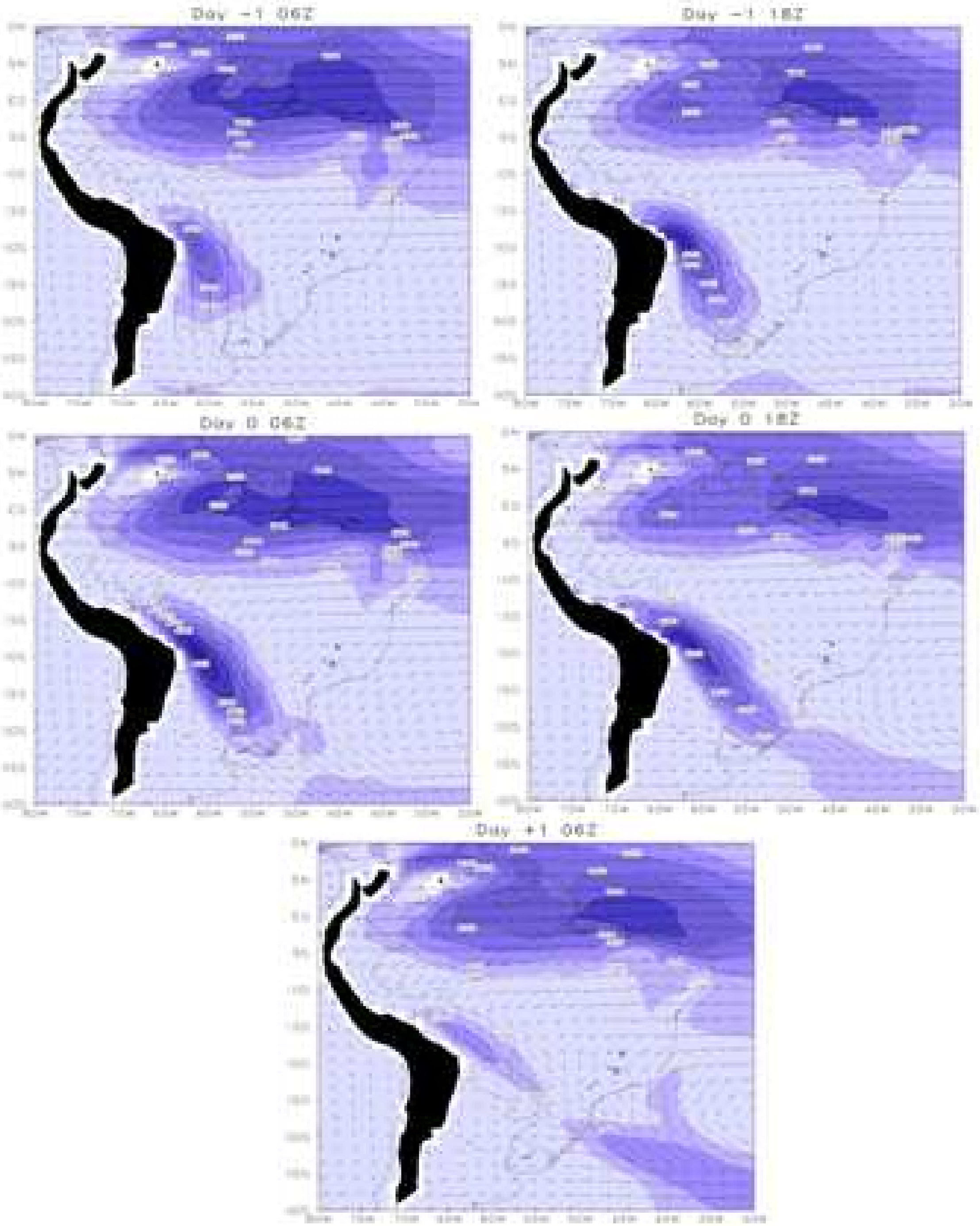
Velasco and Fisch 1987
Machado et al 1998
Nieto Ferreira 1999
entre otros

Torres 2003
Vila 2004
Salio et al 2007

Frecuencia
de ocurrencia de la
isoterma de 218 K
SALLJ-MCSs







Flujo de vapor integrado en la vertical

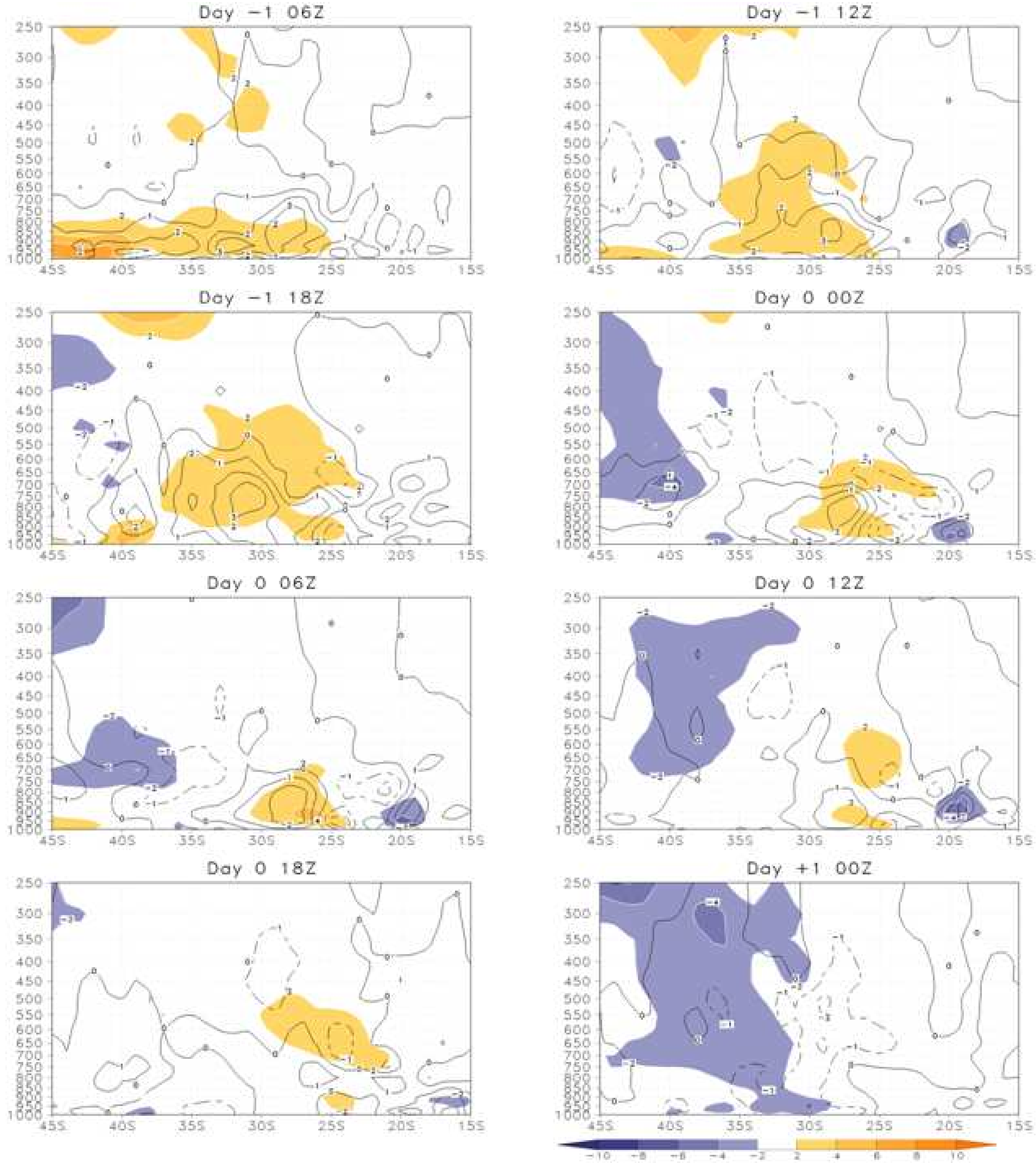
SALLJ-MCSs

Salio et al 2007

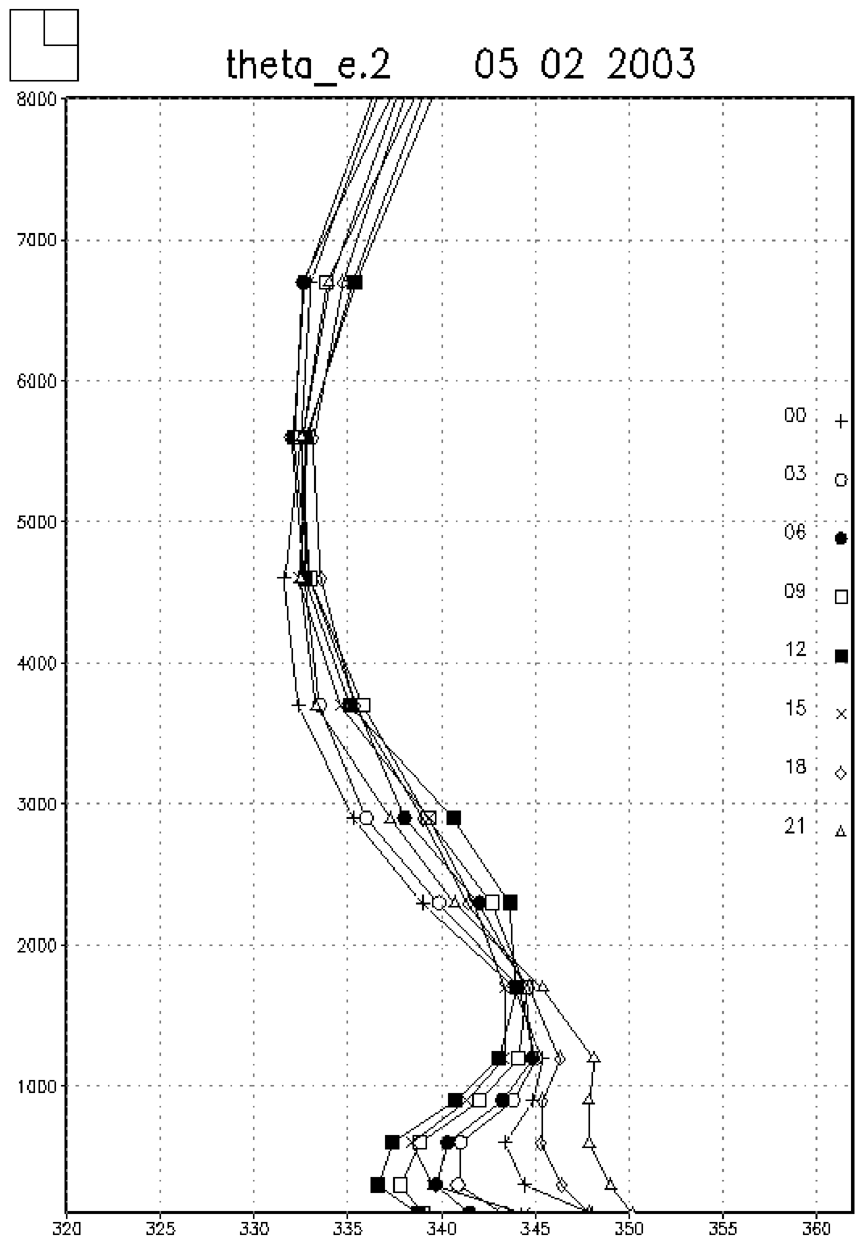
Advección temperatura y humedad especifica en

60 O

SALLJ-MCSs



Sombreado T y linea q


theta_e.2 05 02 2003
8000
7000
6000
5000
4000
3000
2000
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325
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360
00
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12
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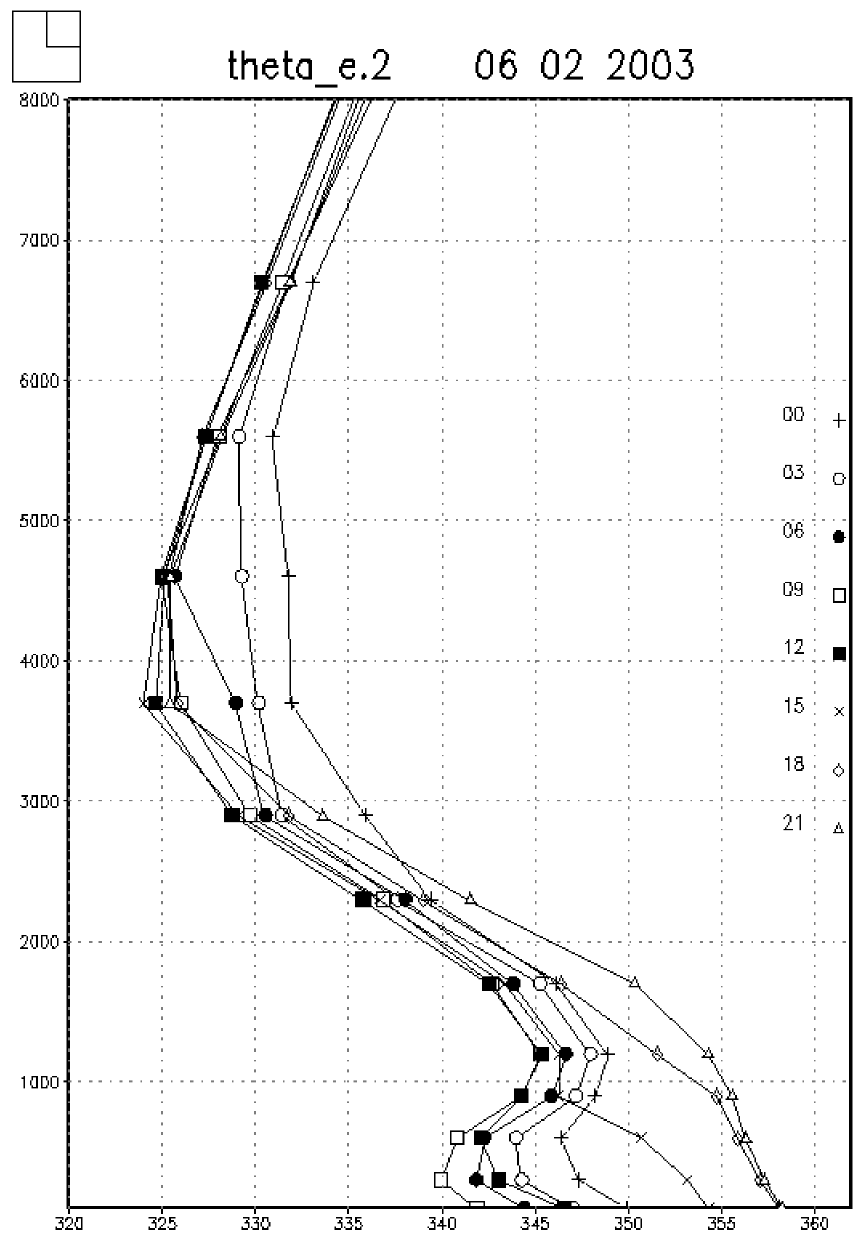
theta_e.2 06 02 2003
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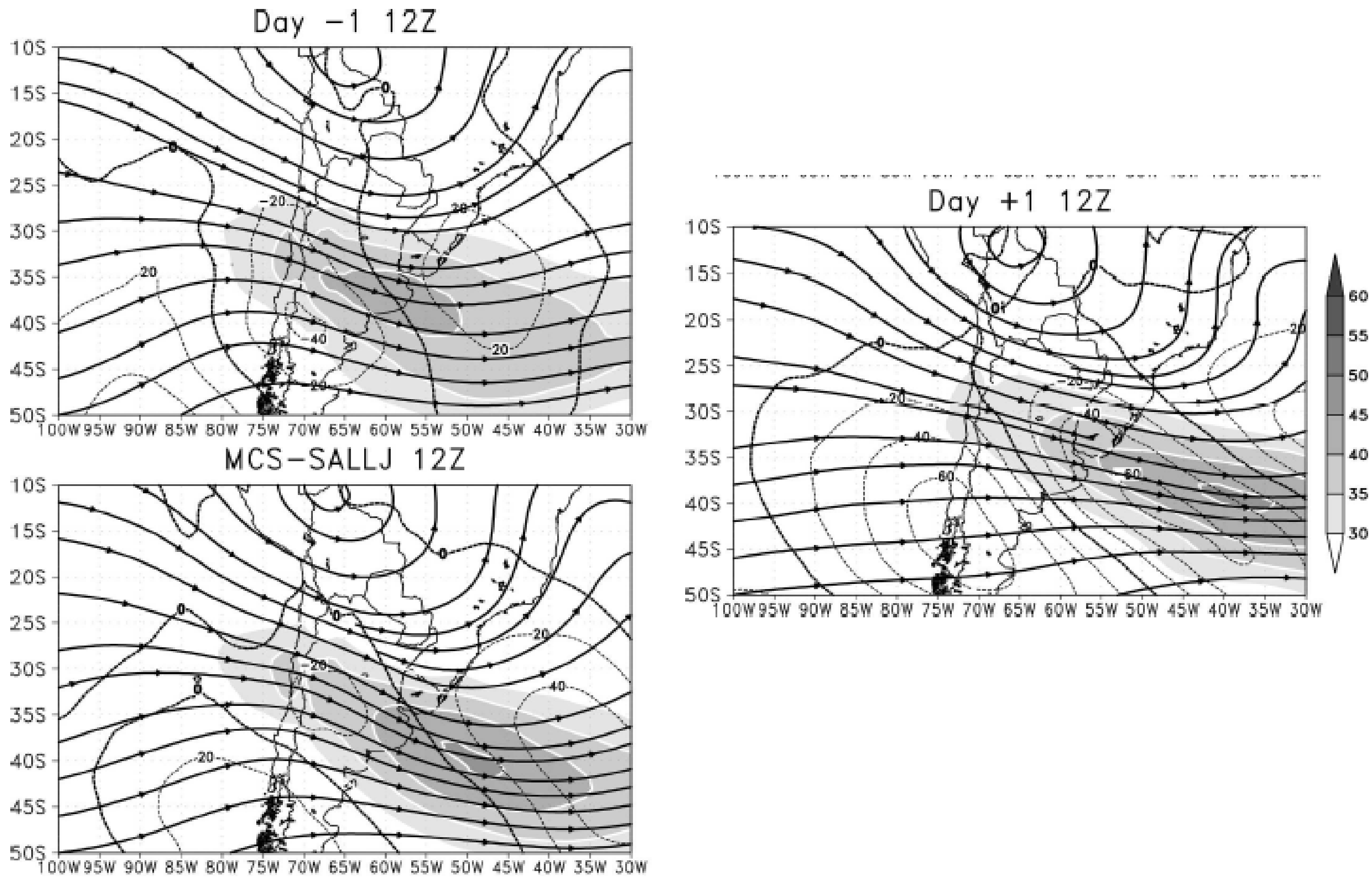
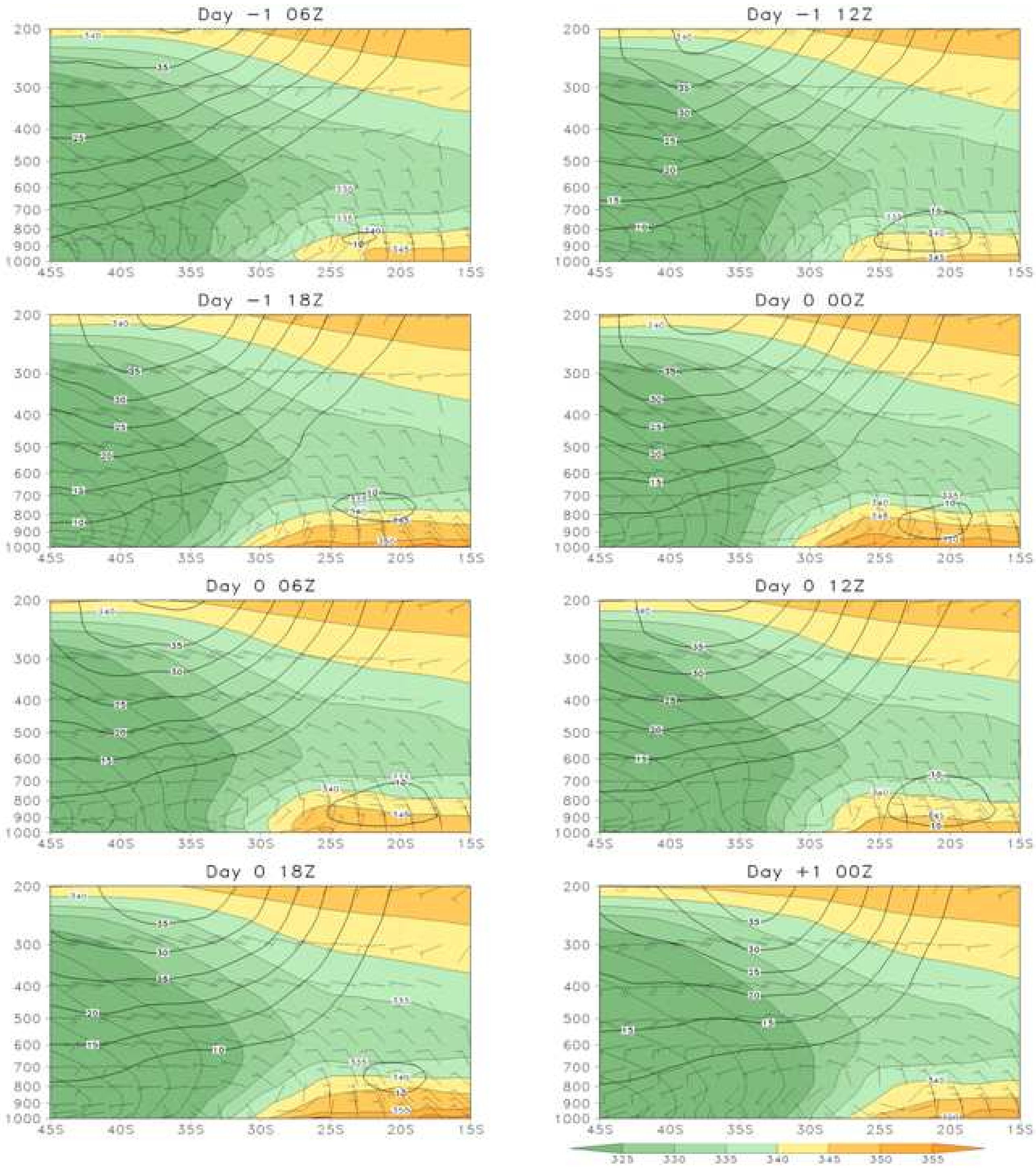
Condiciones en 200 hPa
SALLJ-MCSs



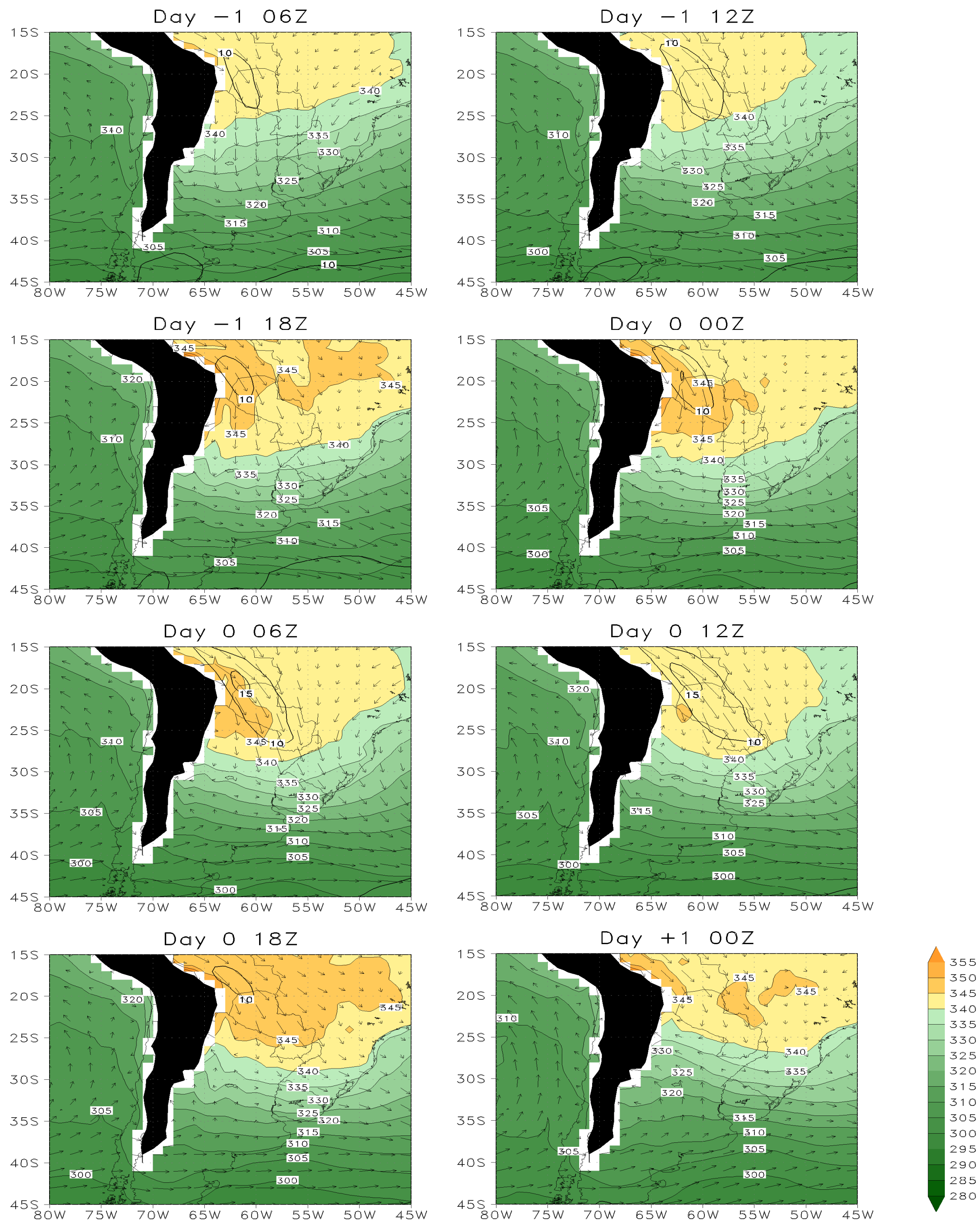
θ_e y viento

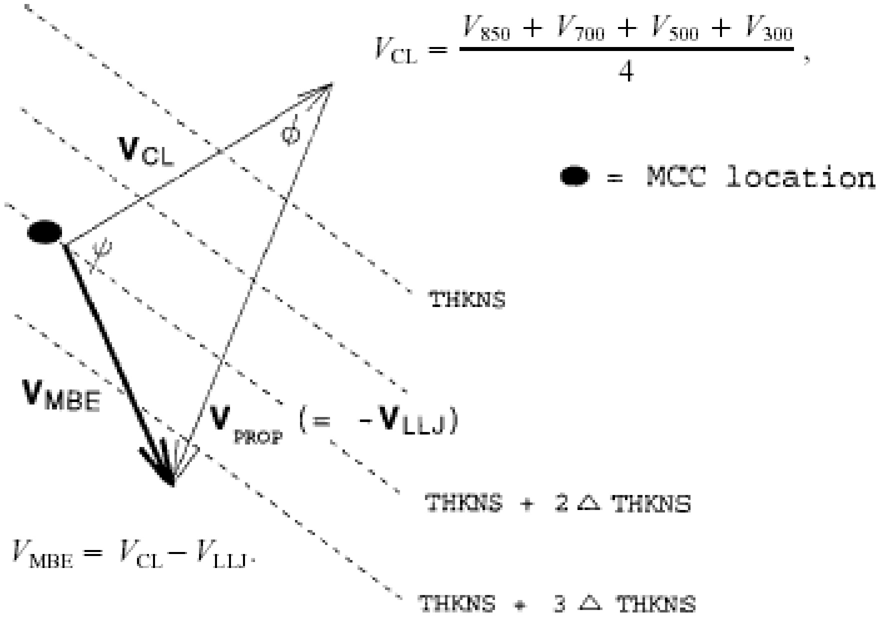
en 60 O

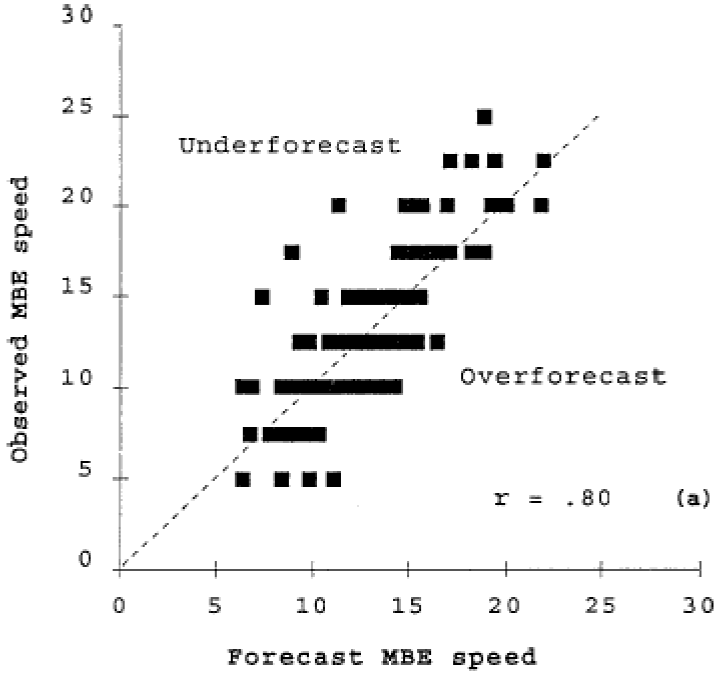
SALLJ-MCSs

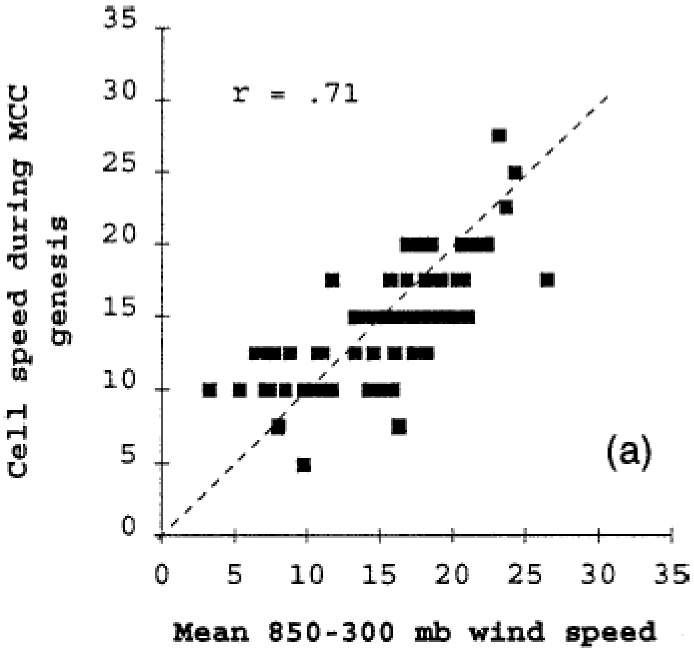


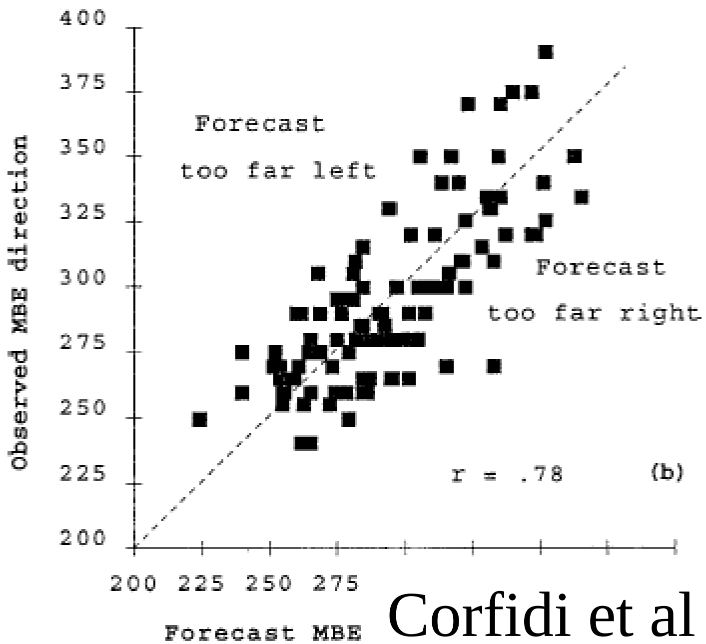
θ_e y viento 850 hPa
SALLJ-MCSs



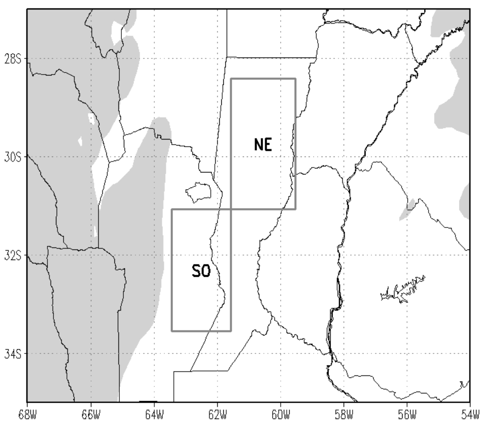


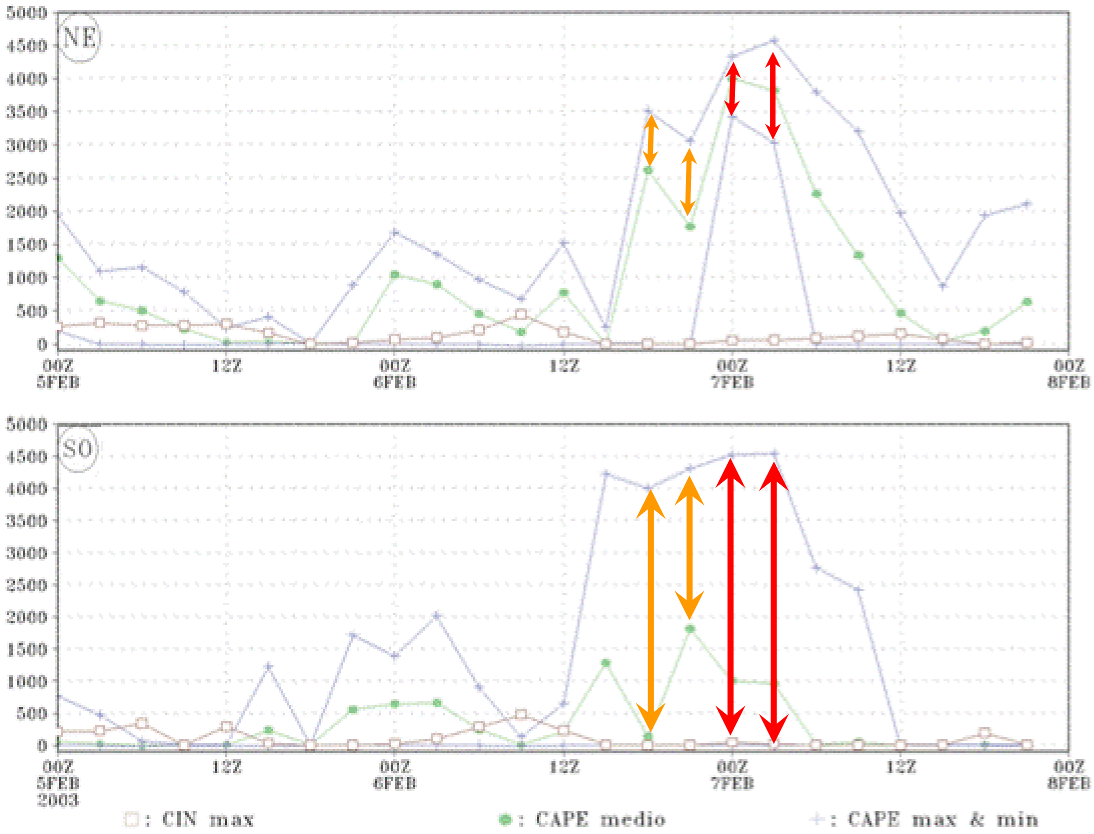






Corfidi et al 1996

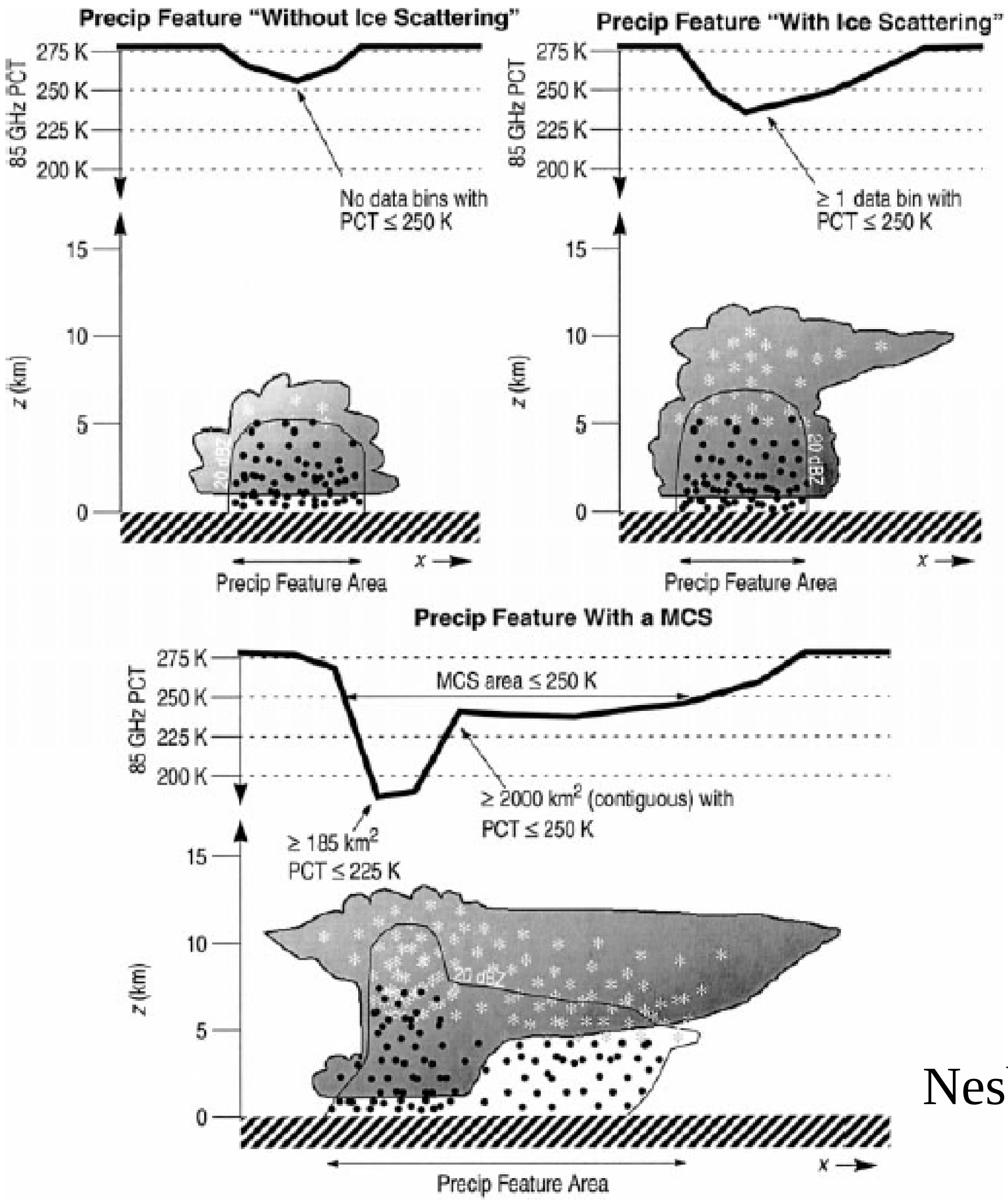




A partir de las 0Z del 6 de Feb, el CIN aumenta a la vez que el CAPE disminuye. A partir de las 12Z el CIN permanece cercano a 0 mientras que el CAPE registra abrupto incremento de más de 3500 J kg^{-1}, alcanzando valores superiores a los 4000 J kg^{-1}.

El CAPE medio se encuentra muy próximo a cero mientras que el CAPE máximo está alrededor de 2500 J kg^{-1}, la inestabilización se encuentra localizada y con variabilidad espacial entre las 15Z del 6 de febrero y las 12Z del día siguiente

El CAPE máximo y mínimo presentan una diferencia menor a 1500 J kg^{-1} en la zona hacia la cual se desplazan los MCSs, siendo más homogénea que la región de origen permitiendo los desarrollos en toda el área de estudio.



Nesbitt et al 2000