

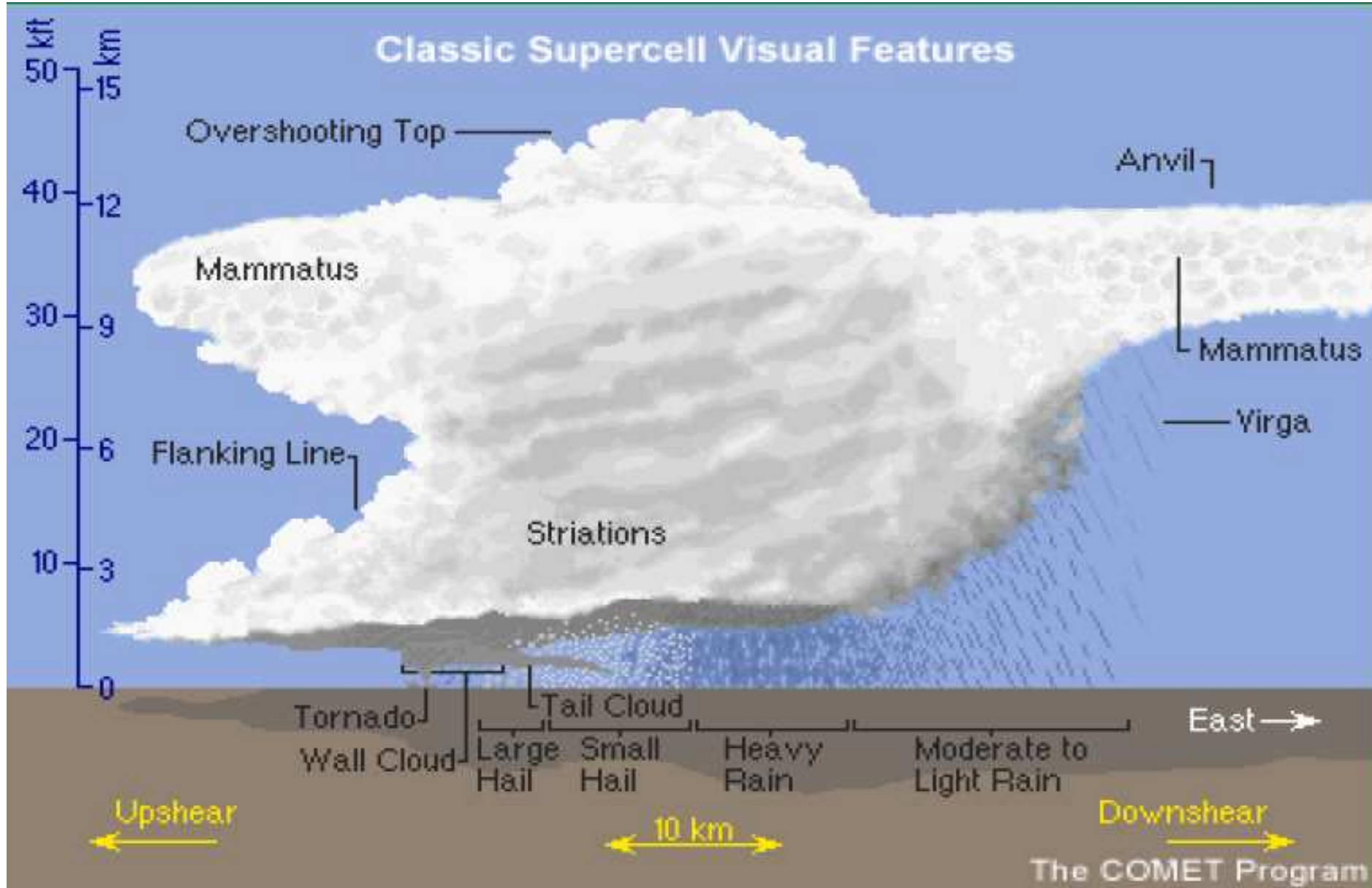
Convección y Microfísica de Nubes

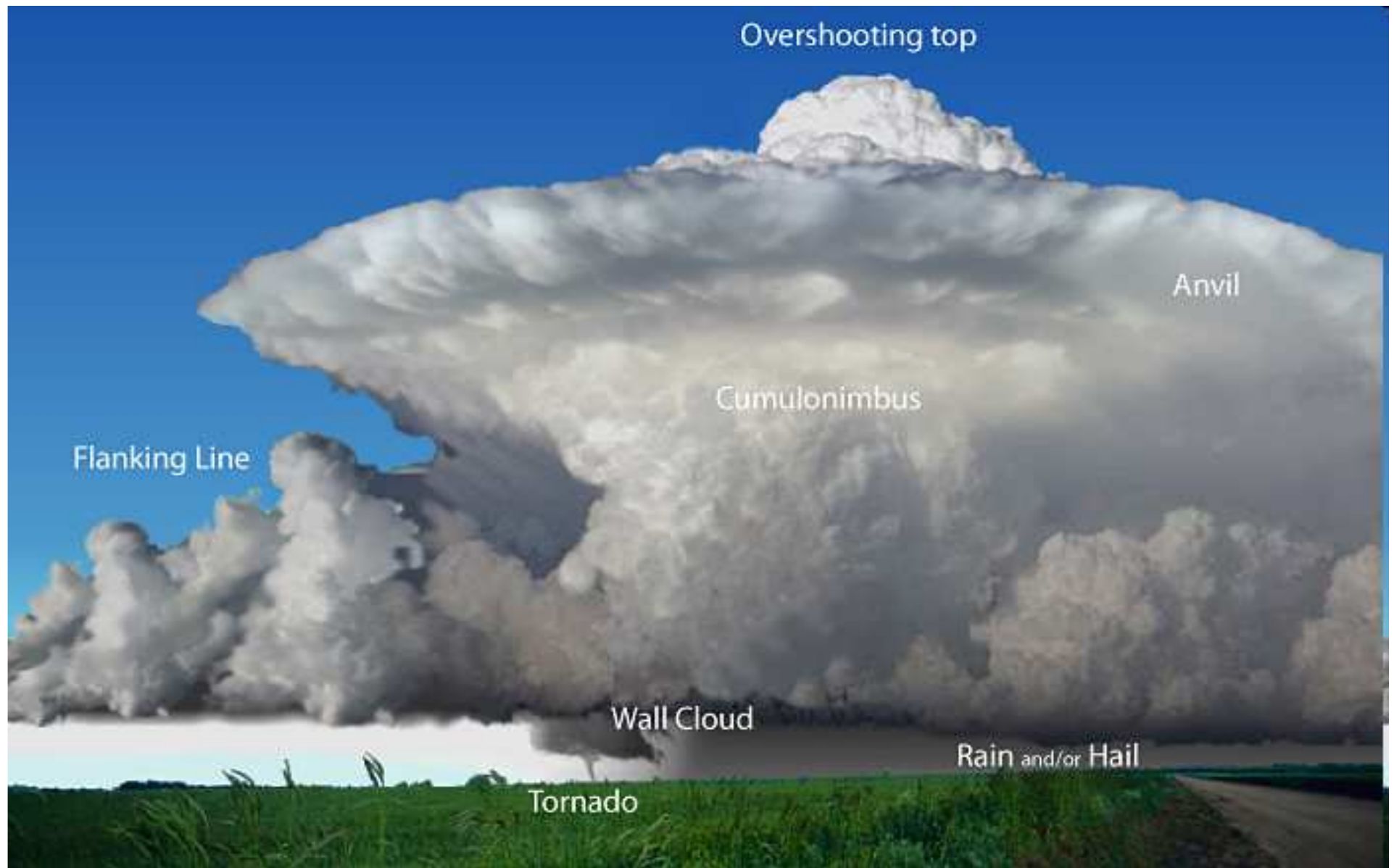
Tema: Superceldas

1º Cuatrimestre 2010

Paola Salio

Classic Supercell Visual Features





Overshooting top

Anvil

Cumulonimbus

Flanking Line

Wall Cloud

Rain and/or Hail

Tornado

Características de las SC

- Una gran celda conformada por una ascendente muy intensa
- Estructura física quasi-estacionaria
 - Ascendente continua
 - Descendente Continua
 - Persistencia en la evolución de la ascendente/descendente
- Ascendente Rotante – formación de un mesociclón
- Tiempo de vida de algunas horas
- Fuerte estructura tridimensional

Características de las SC

- Tipo de celda convectiva potencialmente asociada a fenómenos severos
- Tipo de fenómenos severos que pueden desarrollarse:
 - Fuertes vientos
 - Granizo muy grande
 - Actividad eléctrica
 - Tormandos grandes y durables

Estructura de una Supercelda en su estado maduro

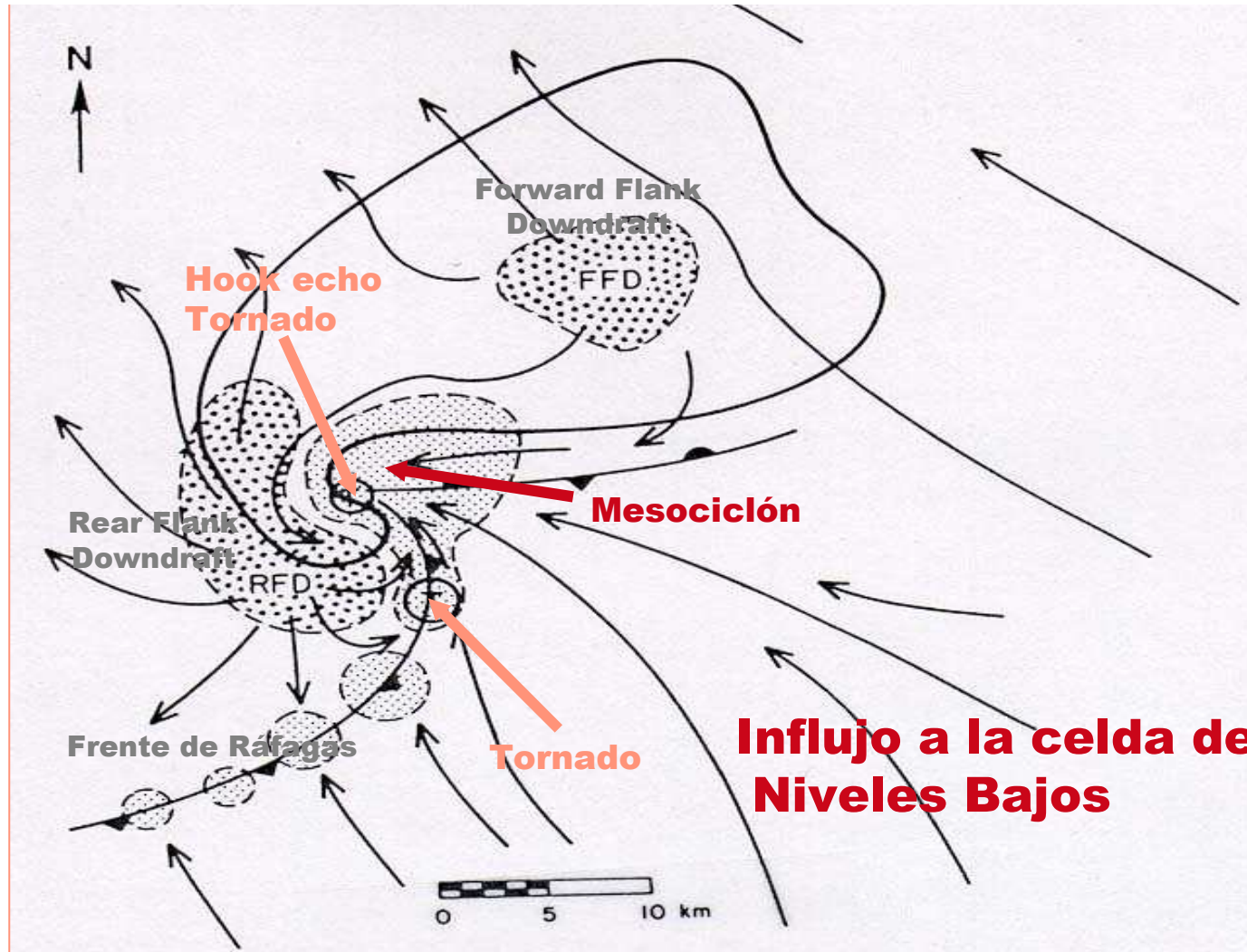
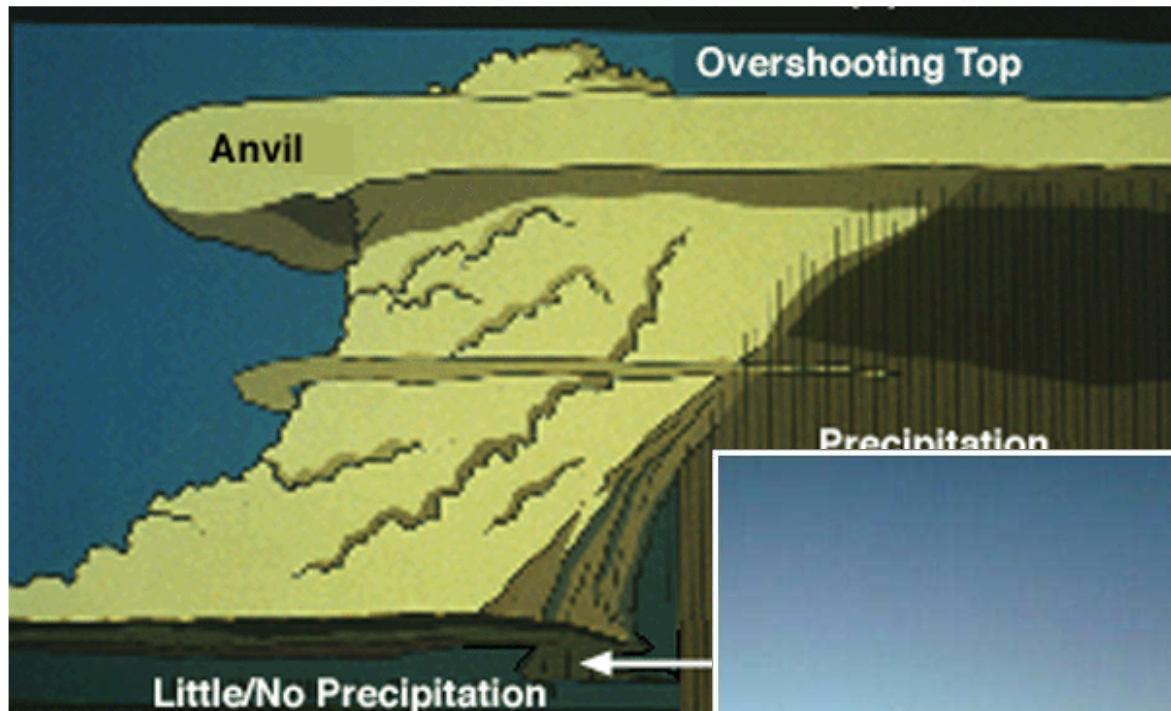


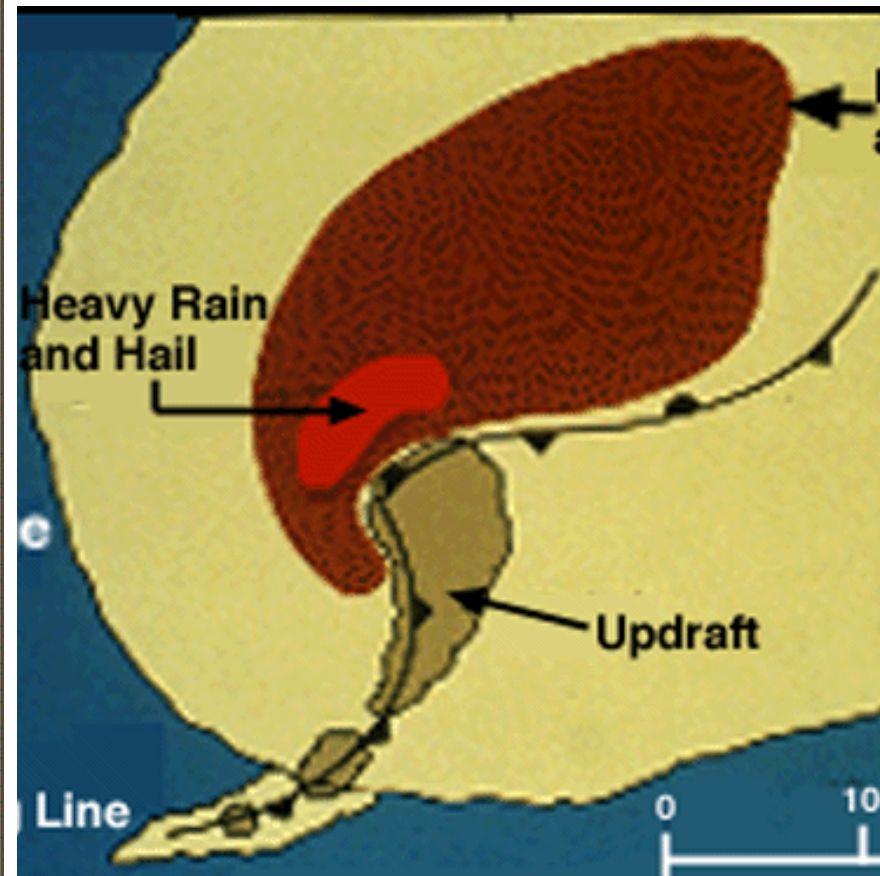
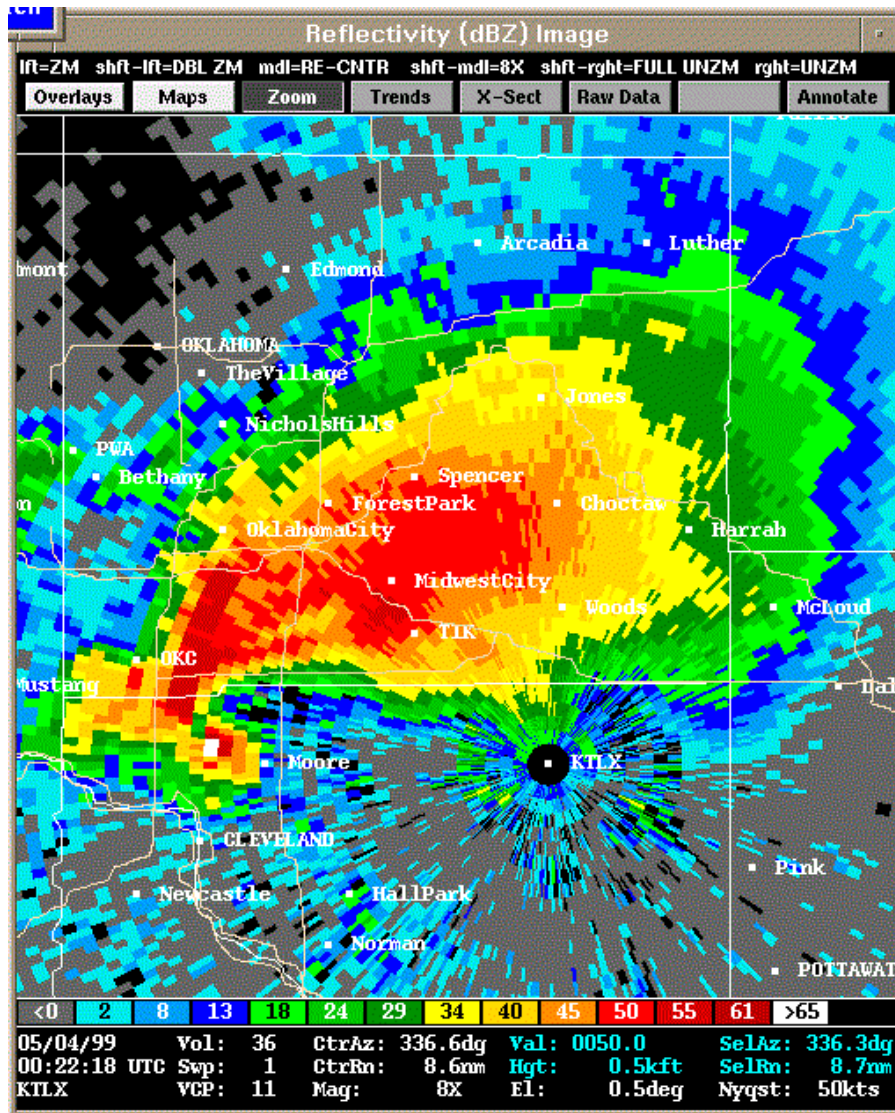
Gráfico de: Bluestein, *Synoptic-Dynamic Meteorology -- Volume II: Observations and Theory of Weather Systems*

Componentes más importantes de la SC

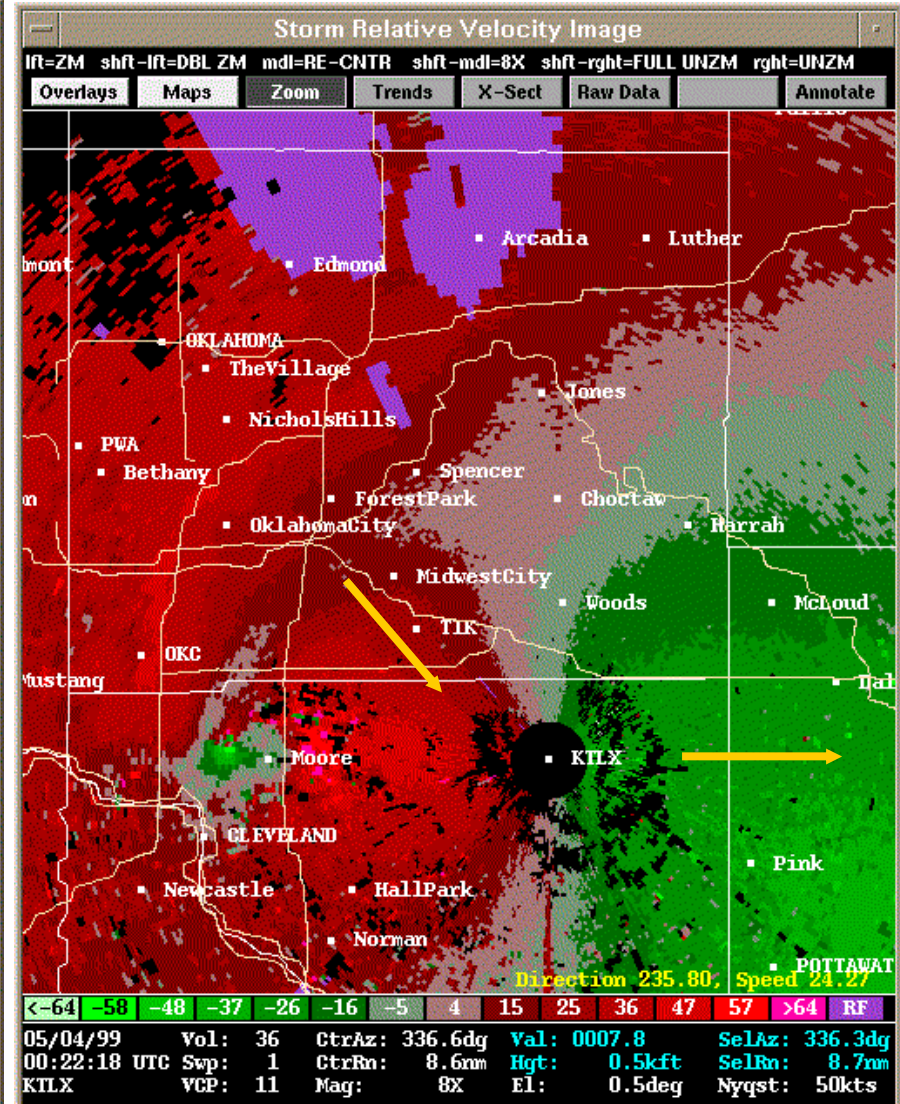
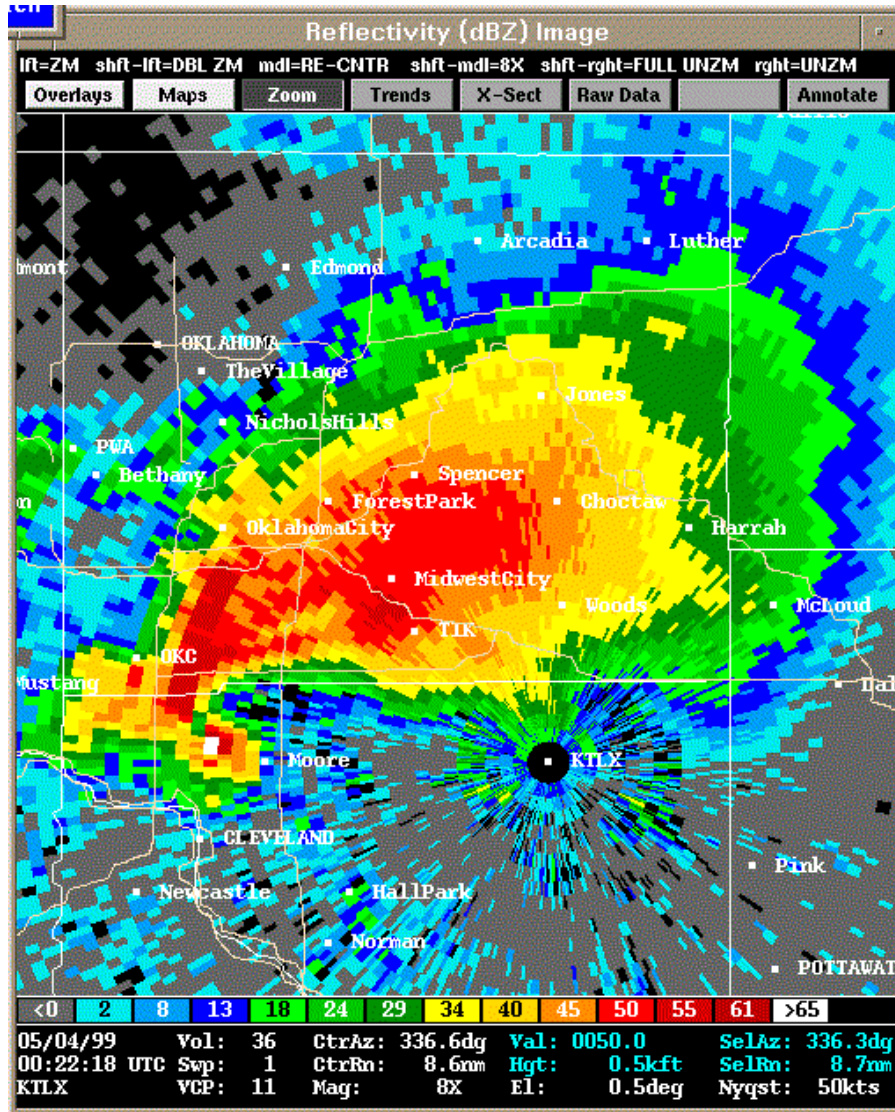
- Ascendente rotante – Mesociclón
- RFD (descendente de la parte trasera)
- FFD (descendente de la parte delantera)
- Hook echo - BWER
- Frente de Ráfagas
- Posible presencia de tornados en el frente de ráfagas y en el eco en forma de gancho



Una supercelda desde el Radar

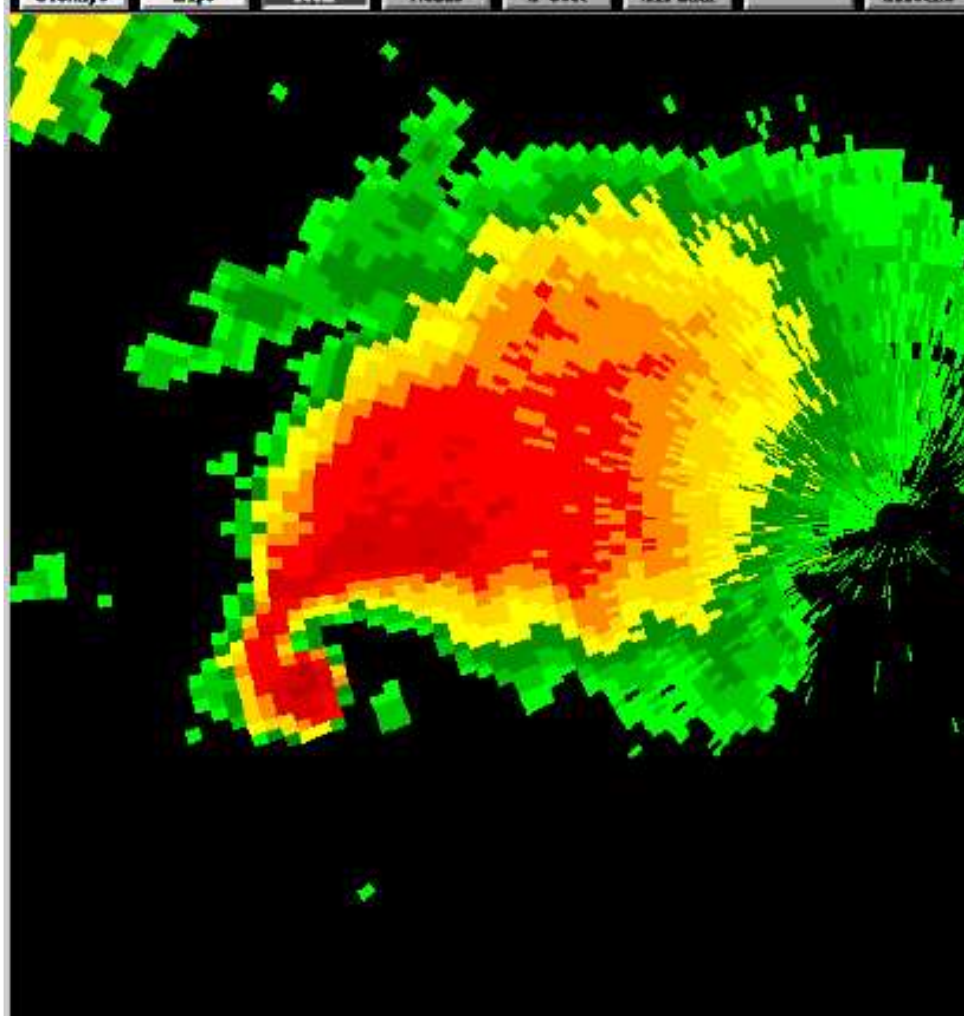


Una supercelda desde el Radar



Reflectivity (dBZ) Image

lft-2M shft-lft-DBL2M mdl-RE-CHTR shft-mdl-4X shft-rght-FULL UN2M rght-UN2M
 Overlays Maps Zoom Trends X-Sect Raw Data Annotate



<0 2 8 13 18 24 29 34 40 45 50 55 61 >65

05/03/99 Vol: 31 ChAr: 270 Rdr Val: 0051 S SelAr: 271 Ldr

Storm Relative Velocity Image

lft-2M shft-lft-DBL2M mdl-RE-CHTR shft-mdl-4X shft-rght-FULL UN2M rght-UN2M
 Overlays Maps Zoom Trends X-Sect Raw Data Annotate

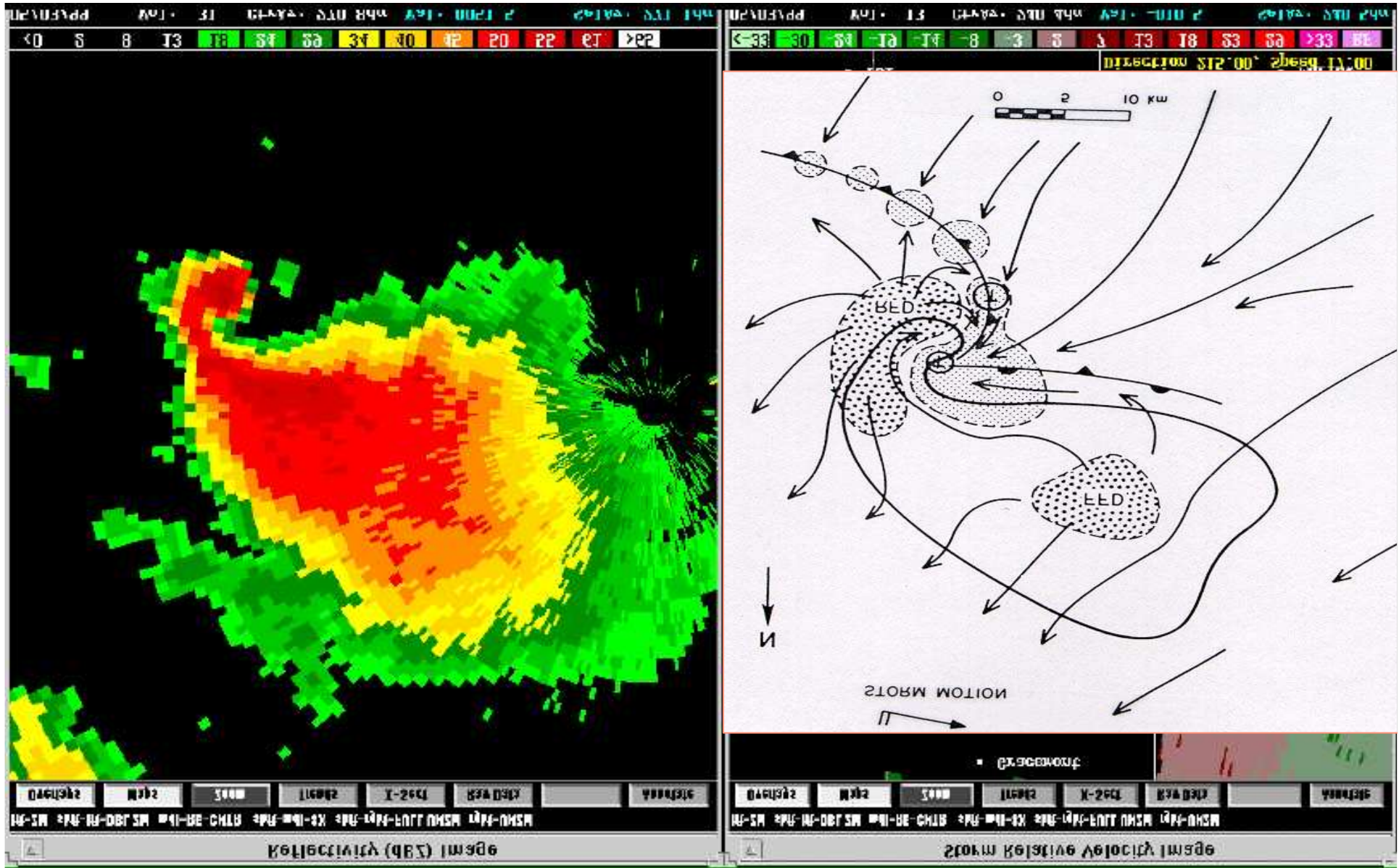


<38 30 24 19 14 8 3 2 7 13 18 23 29 >33 RF

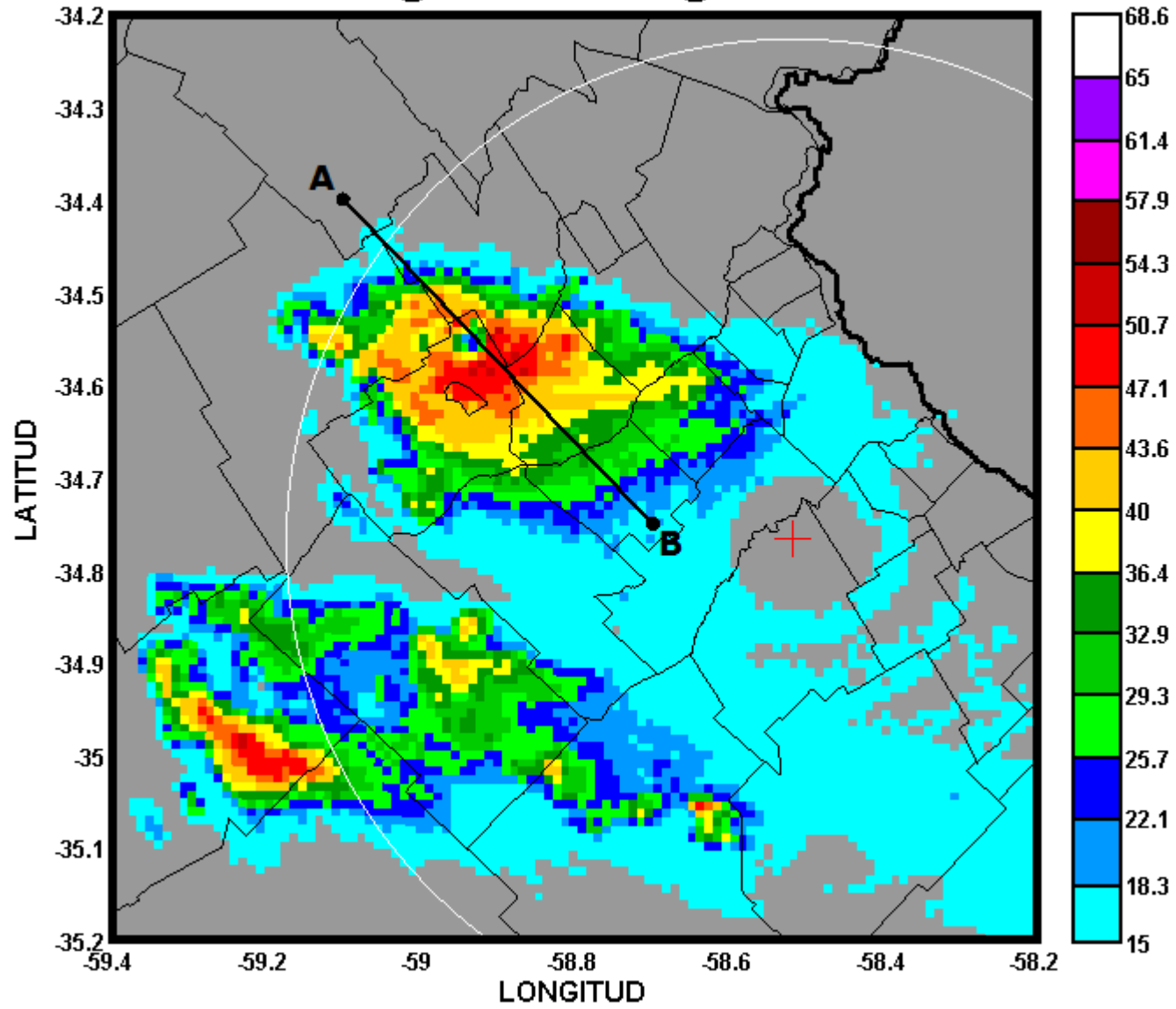
05/03/99 Vol: 17 ChAr: 240 Rdr Val: -010 S SelAr: 240 Ldr

Direction 215.00, Speed 17.00

....para nuestra región



CAPPI@6km - 18.04.2010@2200UTC

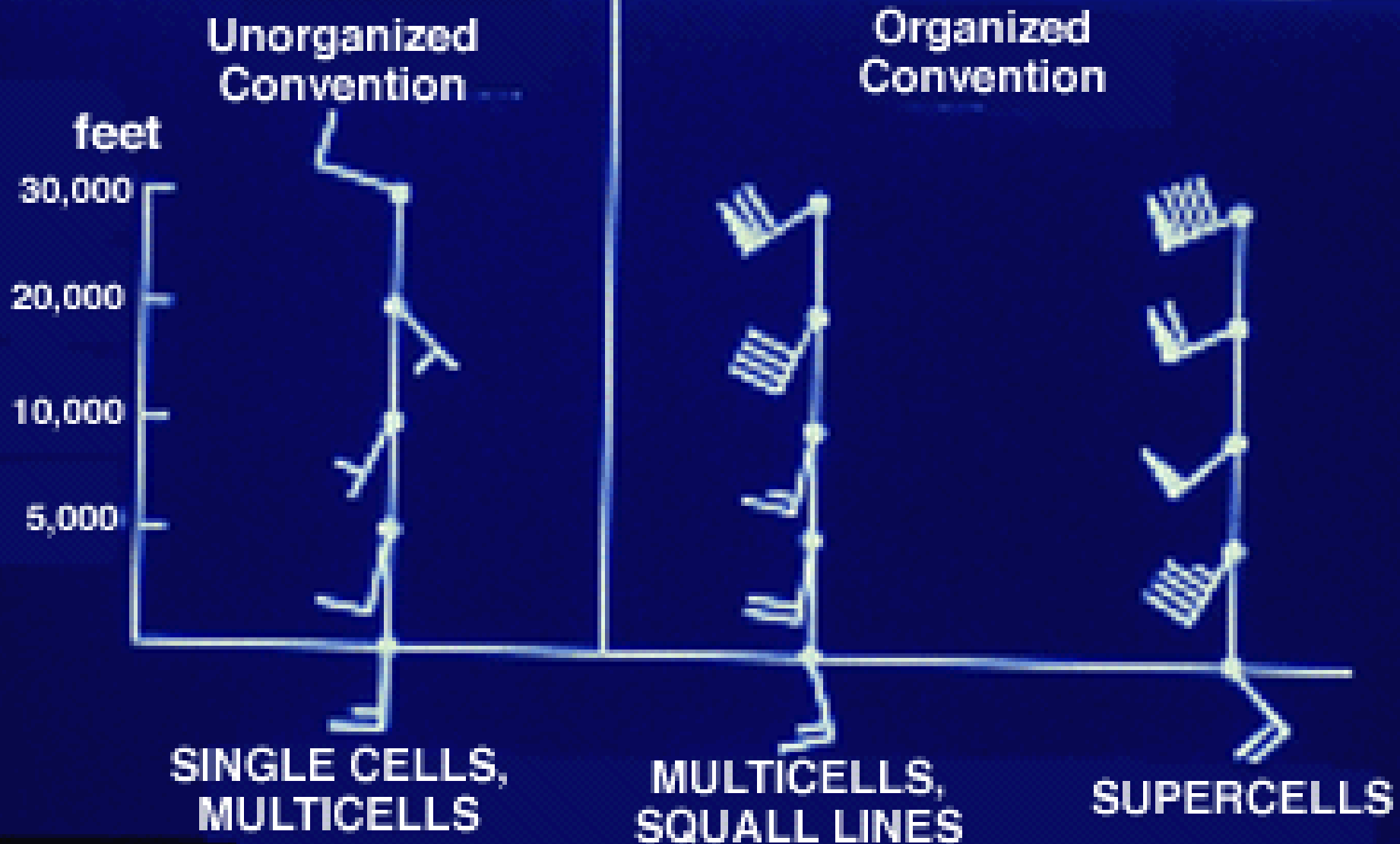




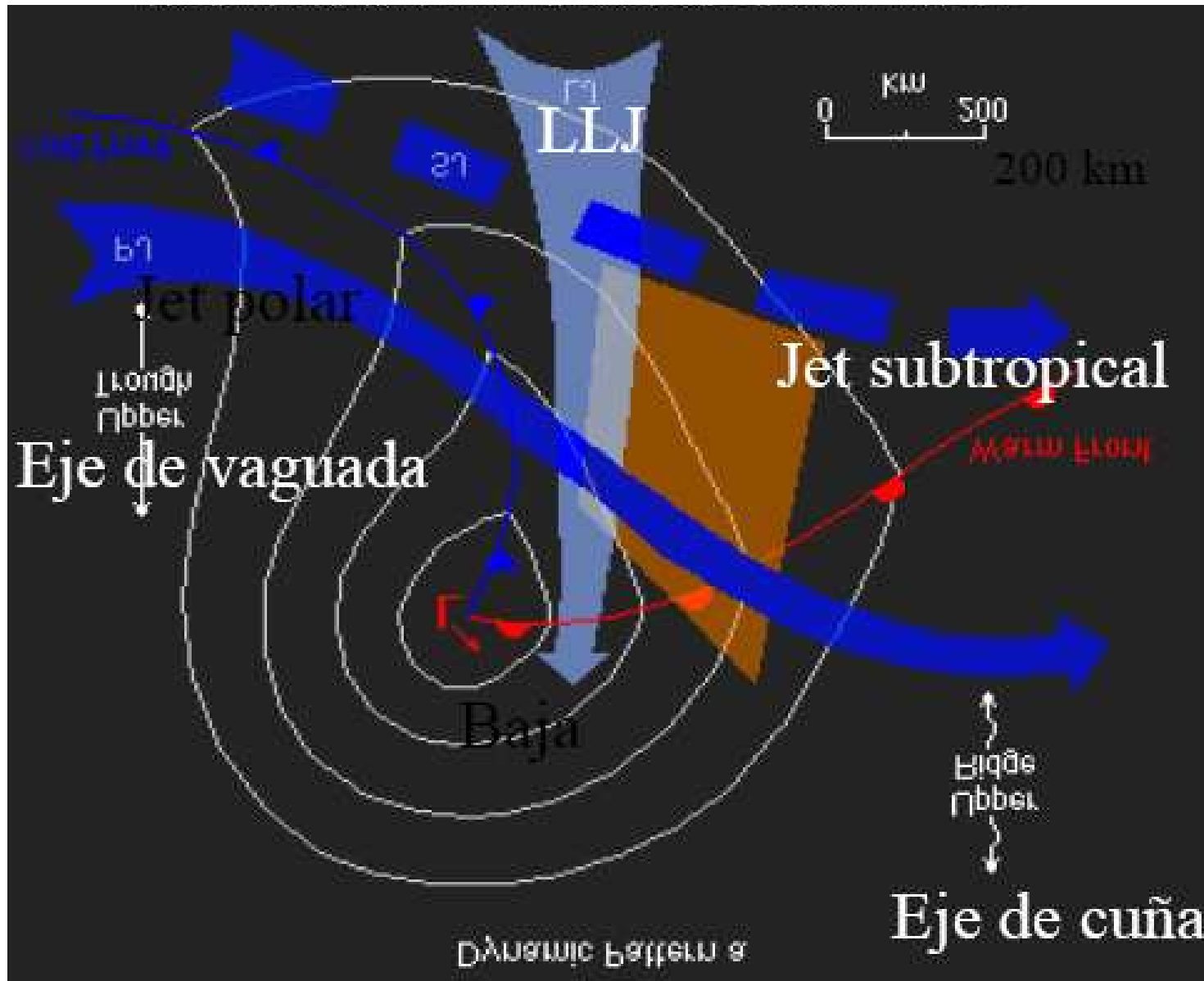
Entornos asociados a Superceldas

- Se forman en un entorno con fuertes vientos y cortantes
 - Esto provee un mecanismo eficiente de separación de celdas y grandes valores de vorticidad de eje horizontal
- Las superceldas, como otras tormentas severas, usualmente requieren inestabilidades significativas (valores de CAPE 1000-2000 J/kg o más)
- Tormentas muy severas con algunas características supercelulares pueden también formarse con valores de cortante despreciable, pero con valores de CAPE extremadamente grandes (> 5,000 J/kg).
- En algunos entornos altamente dinámicos pueden formarse superceldas con una cantidad mínima de CAPE y con cortante muy importante en niveles bajos.

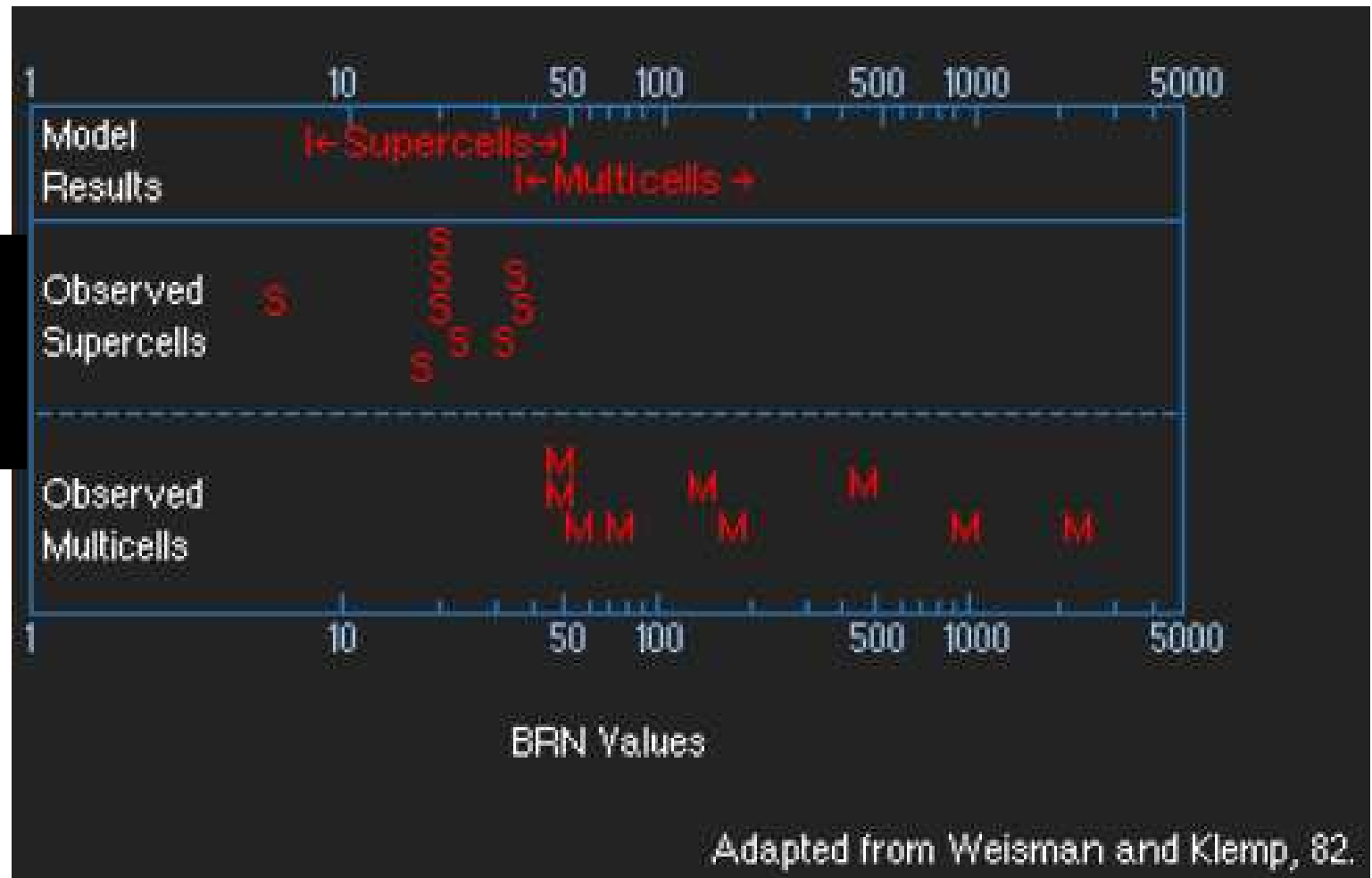
VERTICAL WIND PROFILES



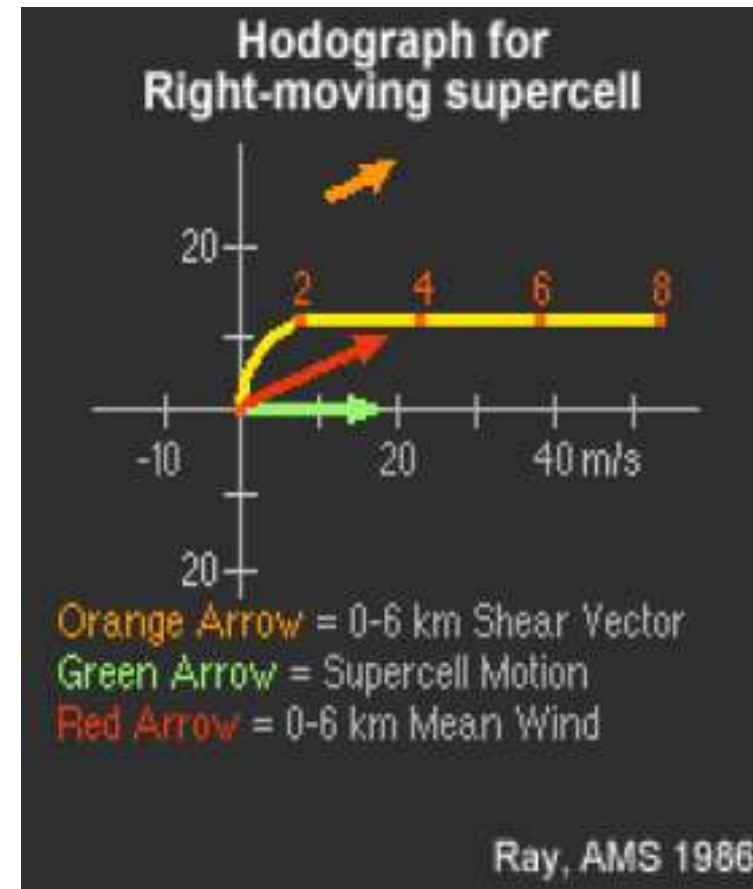
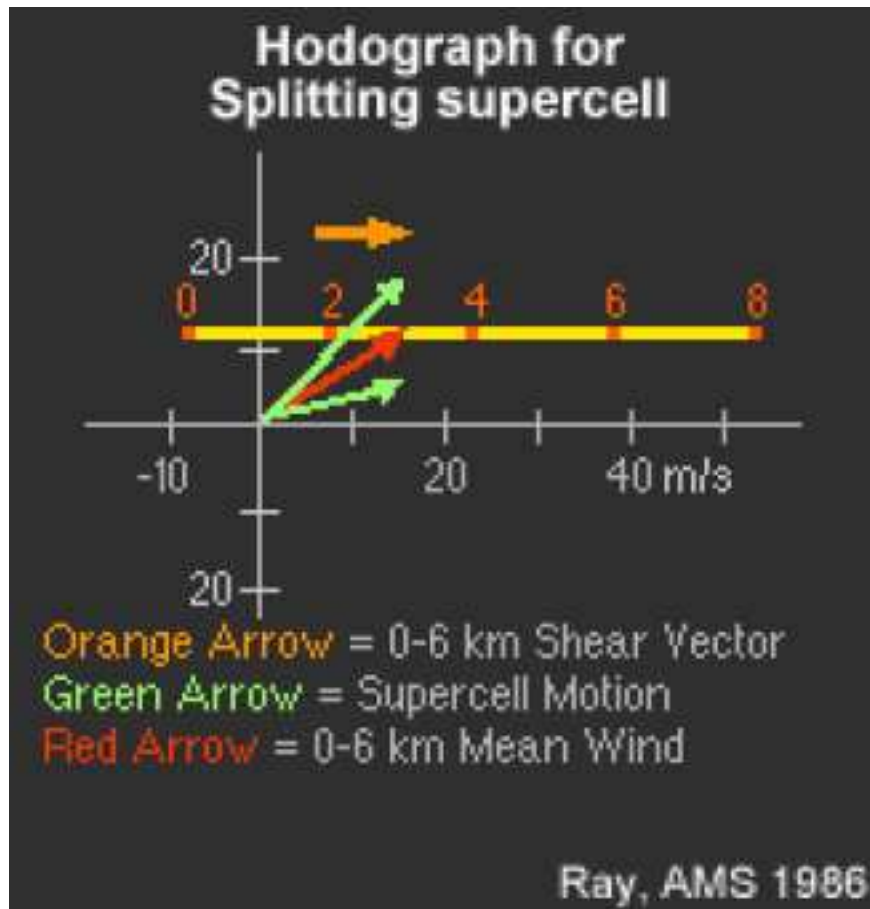
Entornos asociados a Convección Profunda



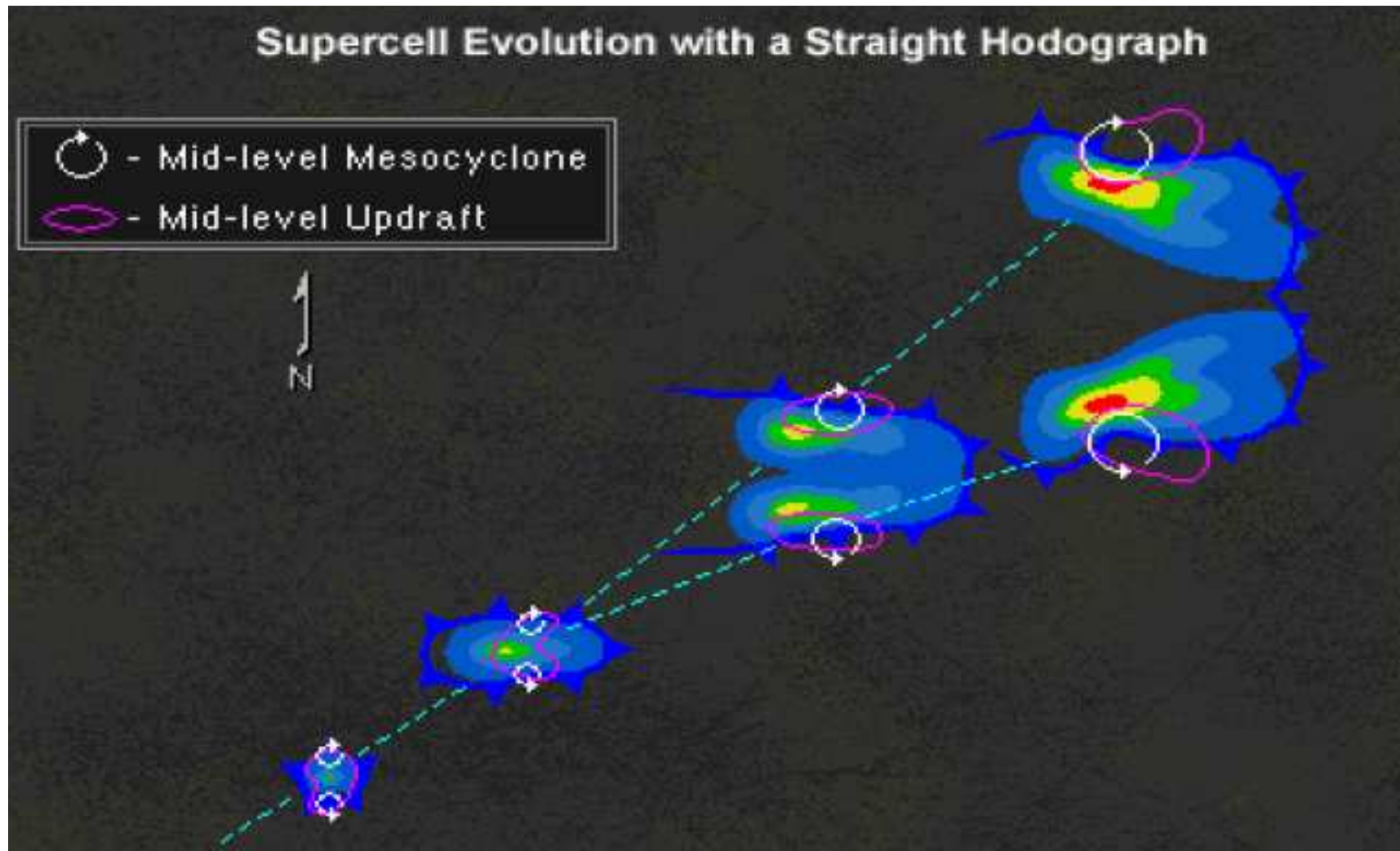
Entornos asociados a Convección Profunda



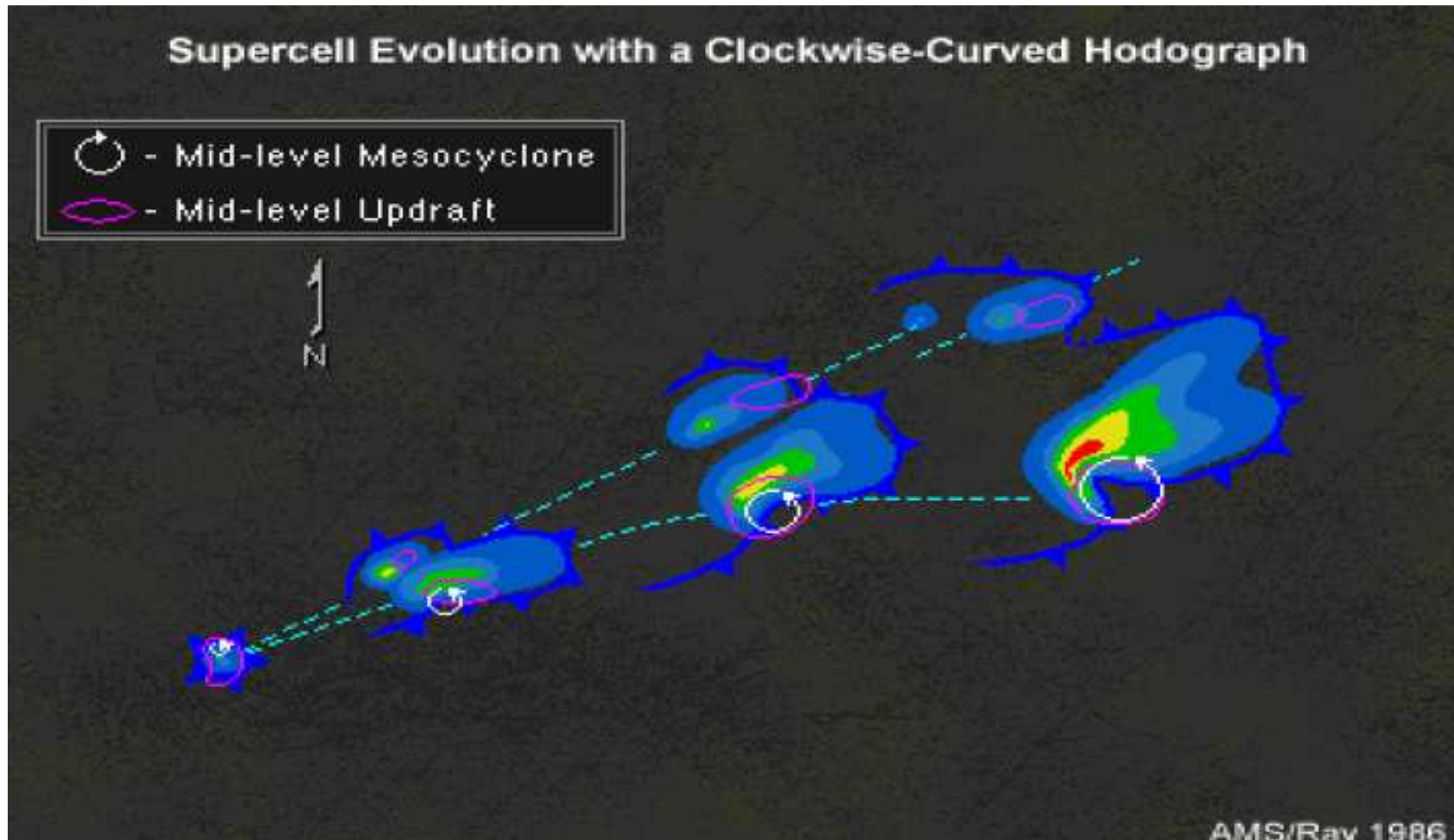
Hodografas asociadas a superceldas

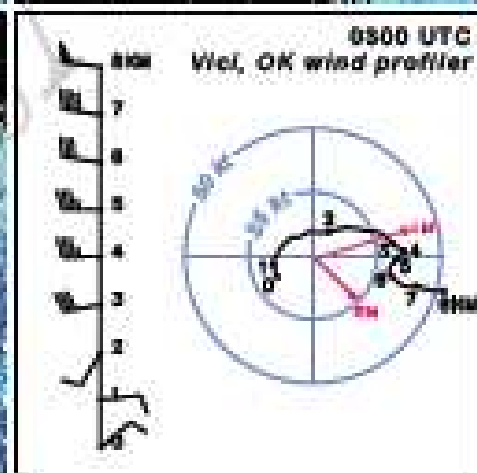
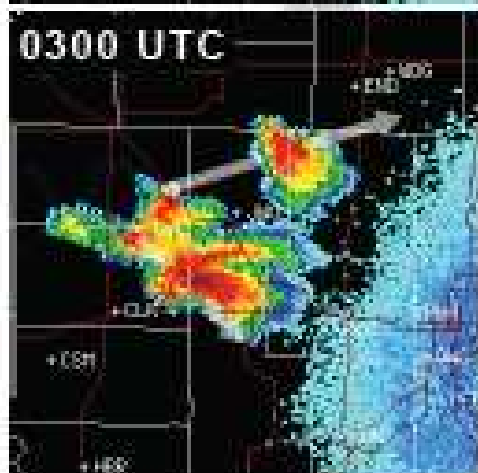
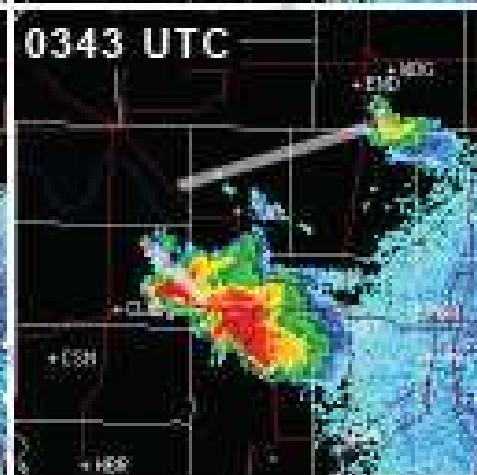
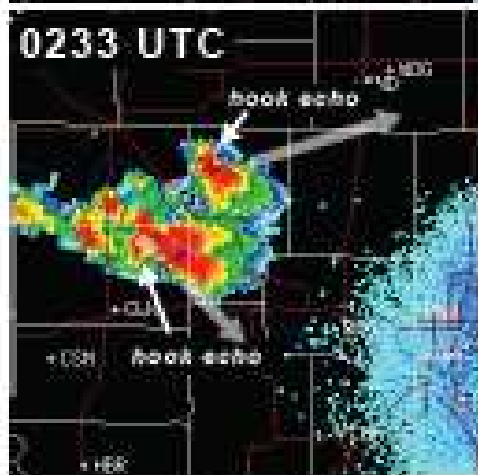
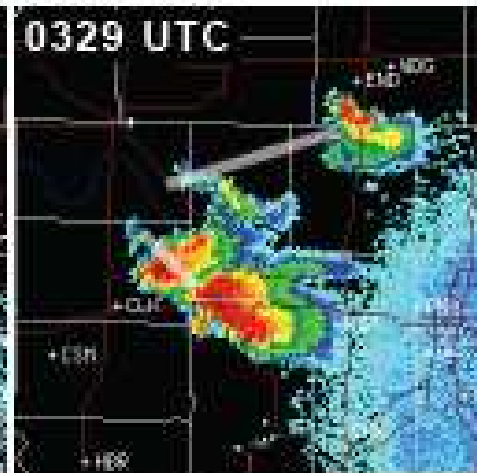
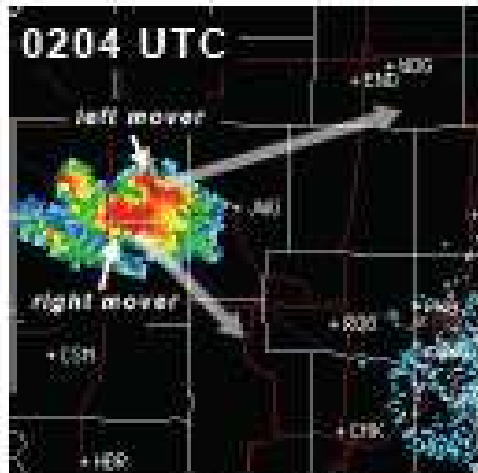


Entornos asociados a Superceldas Cortante lineal



Entornos asociados a Superceldas Cortante con giro horario





Entornos asociados a Superceldas Cortante con giro anti-horario

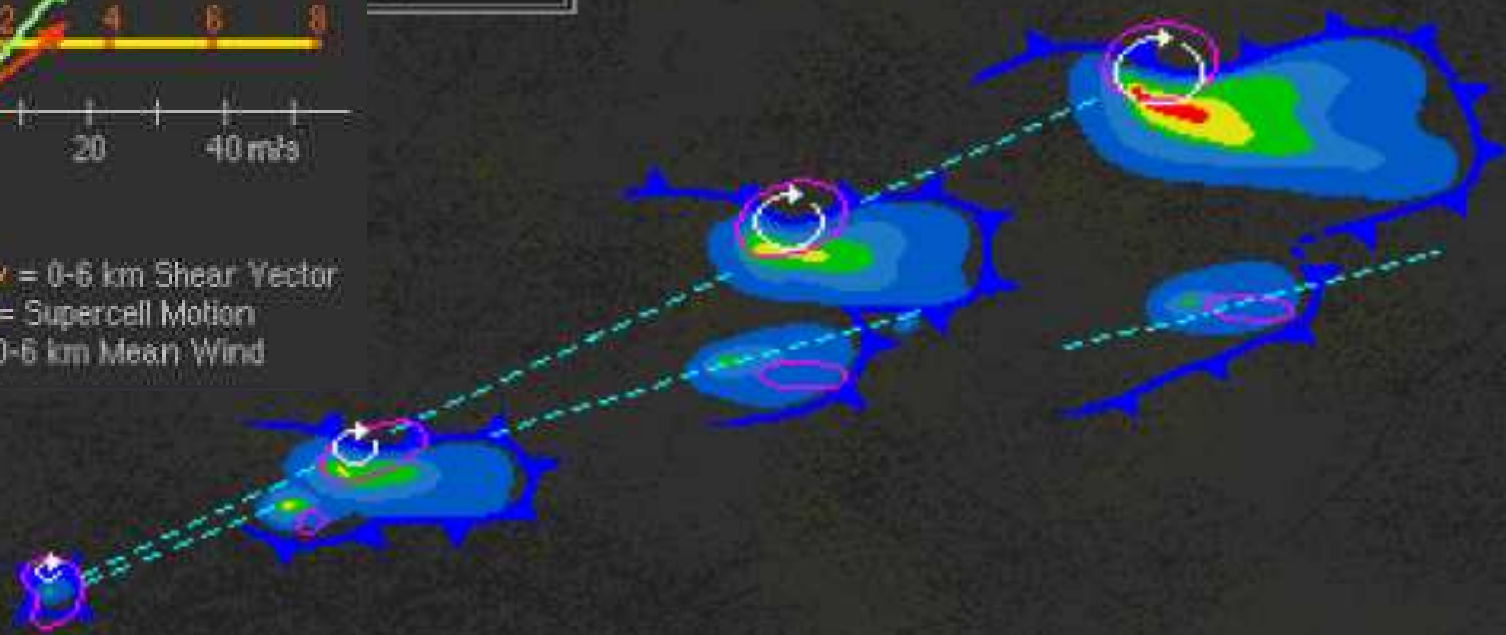
Supercell Evolution with a Counterclockwise-Curved Hodograph

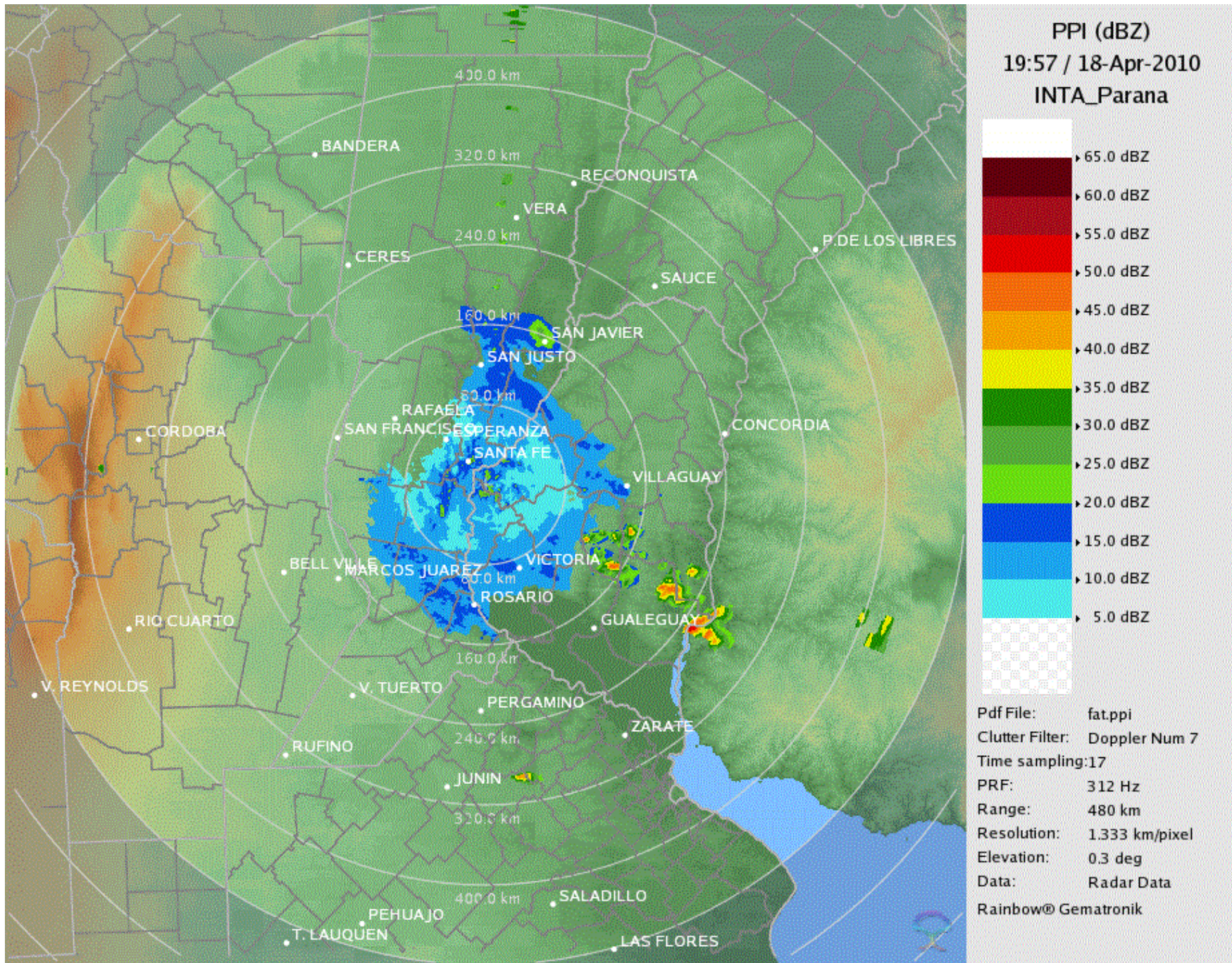
Left-moving supercell



Orange Arrow = 0-6 km Shear Vector
Green Arrow = Supercell Motion
Red Arrow = 0-6 km Mean Wind

Cyclone
left





Simulaciones numéricas

<http://twister.ou.edu/MM2007/supercell.html>

Cortante Rotante

4km: <http://twister.ou.edu/MM2007/supercell/4km-vort.html>

SFC: <http://twister.ou.edu/MM2007/supercell/sfc.html>

Cortante Lineal

4km: http://twister.ou.edu/MM2007/supercell/4km-vort_nov.html

SFC: http://twister.ou.edu/MM2007/supercell/sfc_nov.html

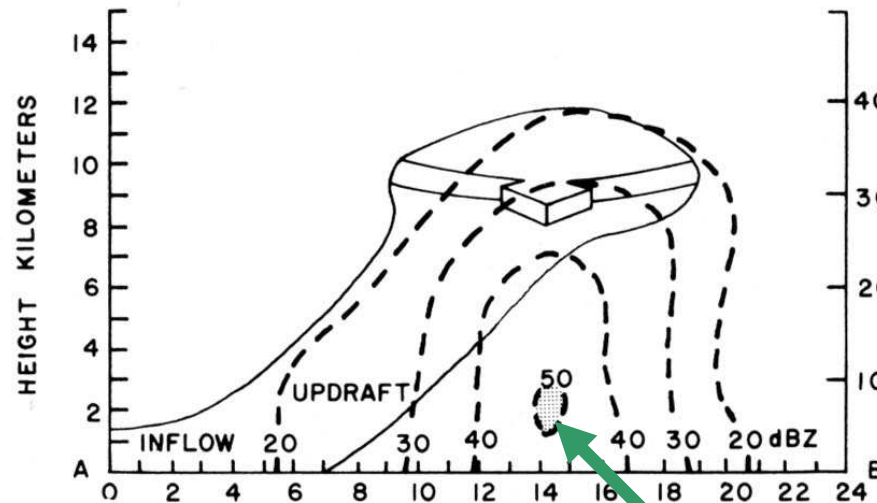
Evolución de la supercelda

Evolución de la SC

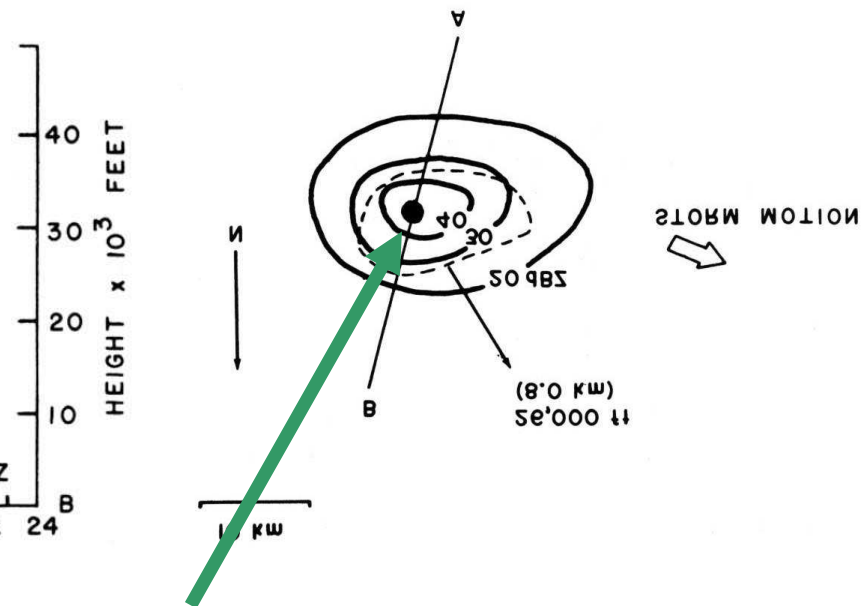
- Fase inicial
 - Desarrollo inicial de la celda al igual que una celda ordinaria
 - Patrón de reflectividad alineado en la vertical
 - Movimiento de la celda coincide débilmente con el movimiento de viento en niveles medios
 - Simetría cilíndrica del campos de nubes

Evolución de la SC – Fase Inicial

Corte Vertical



Corte Horizontal



Precipitación Intensa

Evolución de la SC – Fase Media

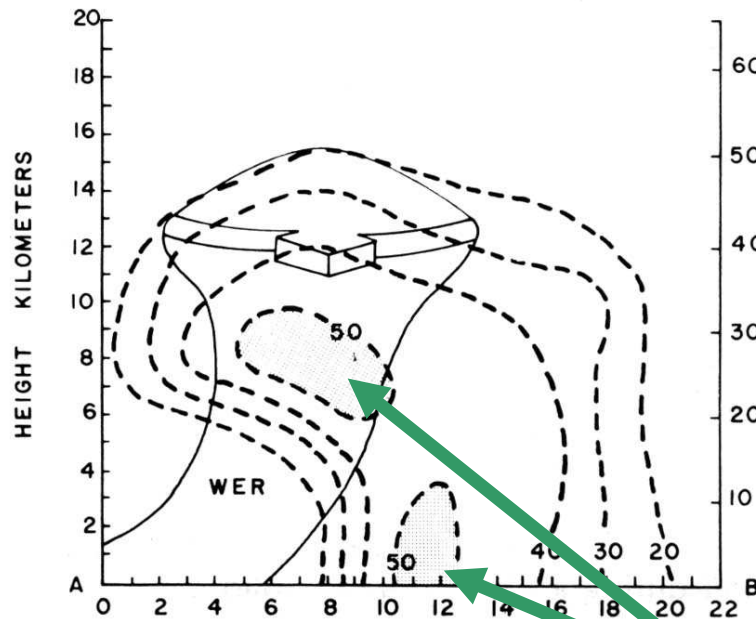
- ❑ A medida que la celda se va formando, los vientos fuertes alteran la característica de la celda ordinaria para dar lugar a los procesos asociados a la presencia de cortante rotante con la altura
- ❑ El patrón de reflectividad comienza a elongarse cortante abajo y empieza a generarse el yunque del sistema.
- ❑ El mayor gradiente de reflectividad se da en el borde NW (SW) para el caso de cortante antihoraria (horaria)
- ❑ Si bien se mantienen verticales, la ascendente y descendente comienzan a coexistir en áreas separadas

Evolución de la SC – Fase Media

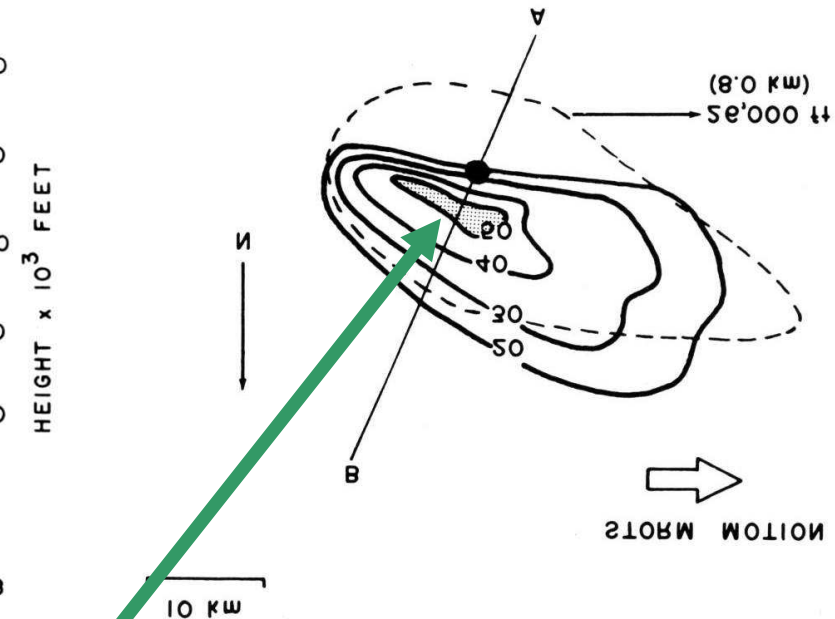
- ❑ Se inicia el WER. Esto indica que la ascendente es muy intensa y la precipitación comienza a observarse en SFC fuera del corazón de la ascendente.
- ❑ La precipitación que “colgada” de la ascendente
- ❑ La tormenta comienza a desplazarse hacia la izquierda de la cortante media (giro antiorario) en busca de las áreas más húmedas y cálidas

Evolución de la SC – Fase Media

Corte Vertical



Corte Horizontal



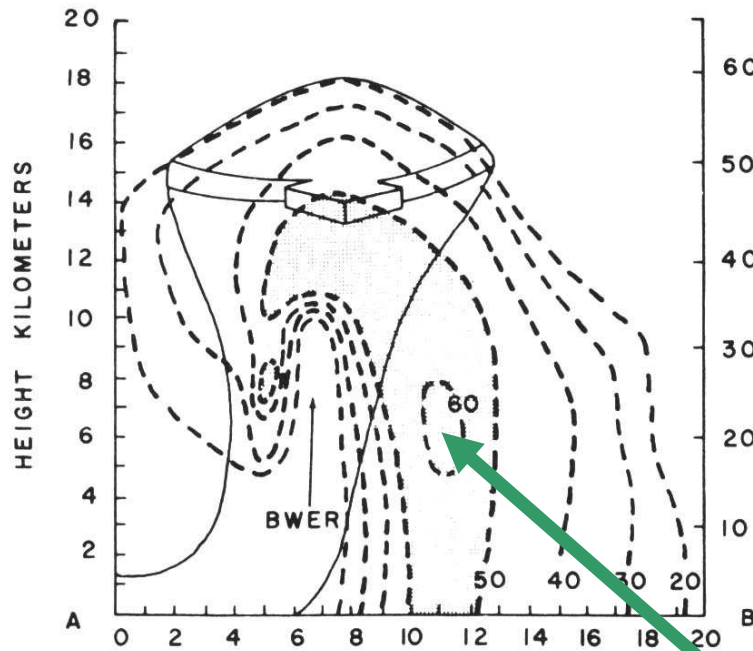
Precipitación Intensa

Evolución de la SC – Fase Madura

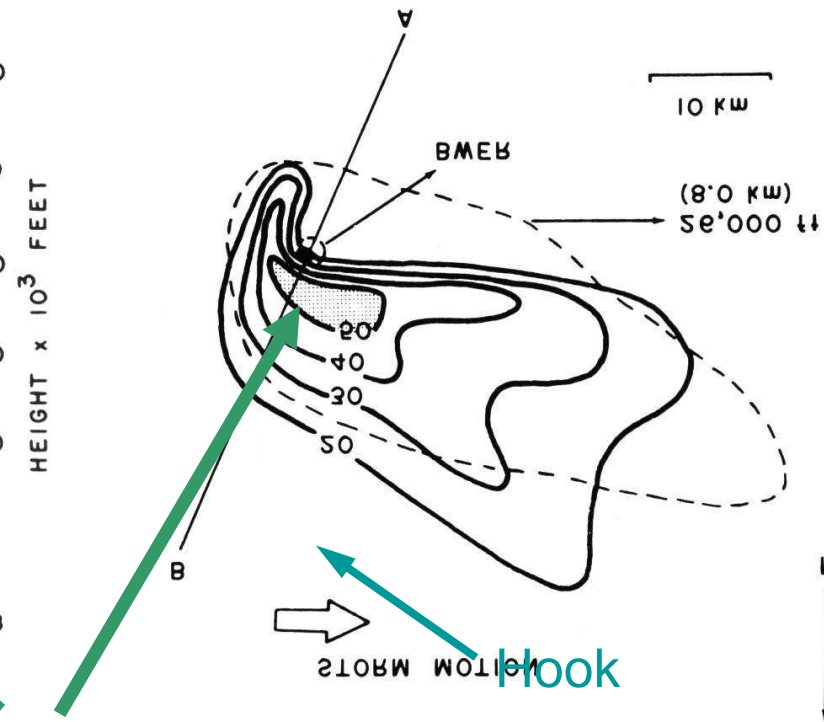
- ❑ Luego de aproximadamente 90 minutos, la SC alcanza un estado cuasi-estacionario a esto se la llama, estado maduro.
- ❑ La rotación es evidente y el mesociclón de niveles medios asociado a la ascendente se inicia
- ❑ Esta rotación genera el eco en forma de gancho en el flanco norte de la tormentas (giro antihorario)

Evolución de la SC – Fase Madura

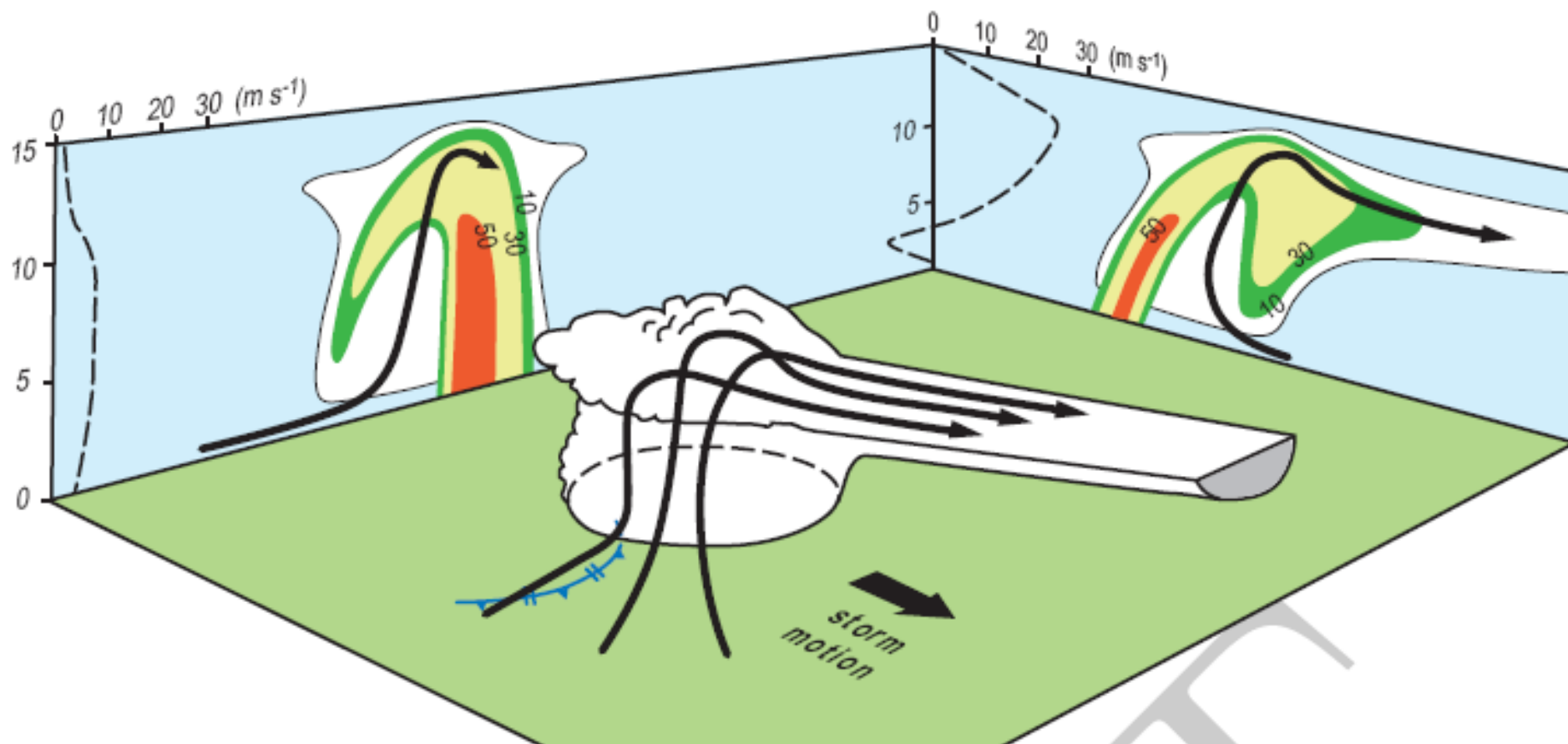
Corte Vertical



Corte Horizontal



Precipitación Intensa



Asdendente Rotante – Bifurcación de la celda

Ascendente

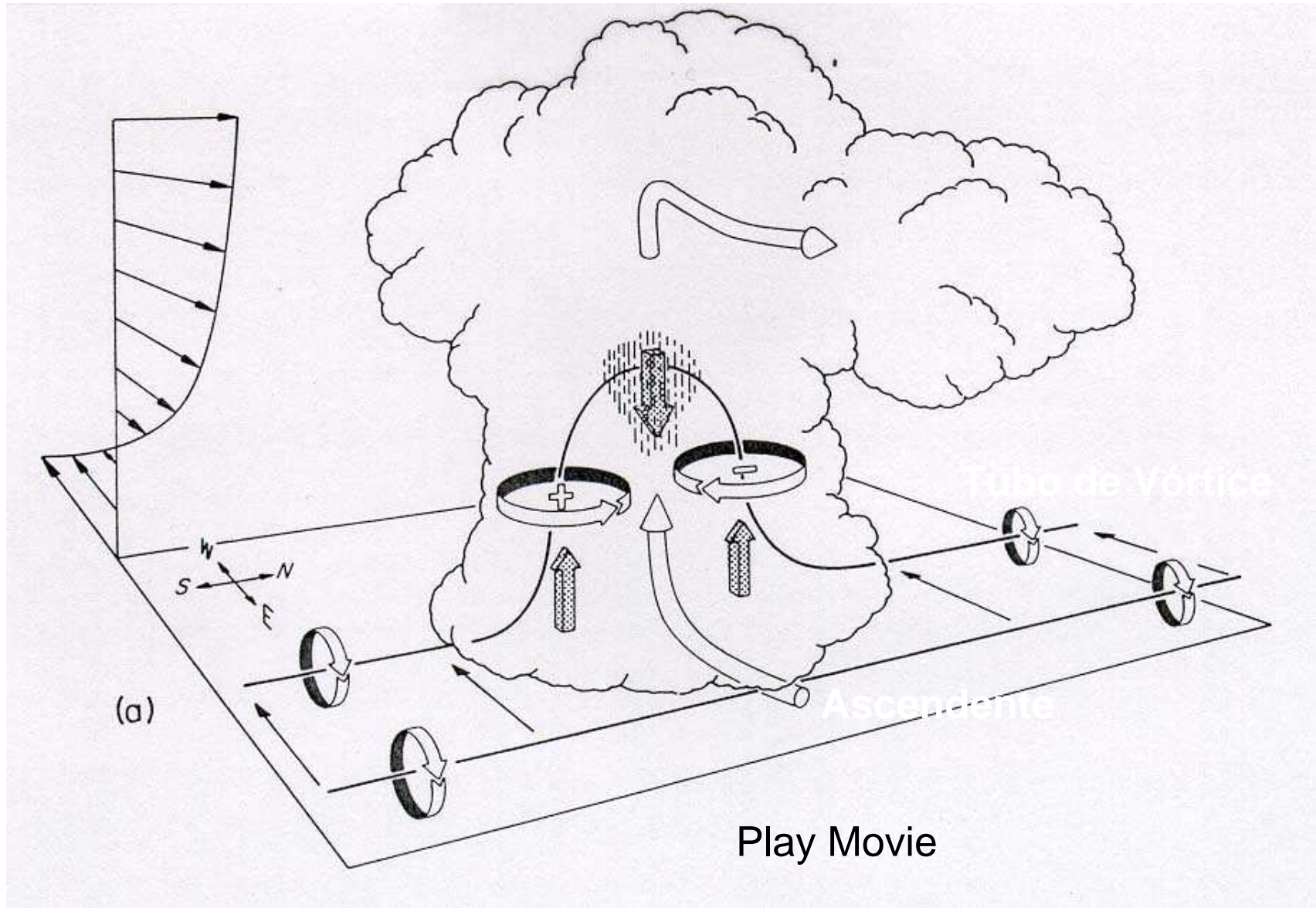
- Factores que afectan a la ascendente:

PGF

Empuje

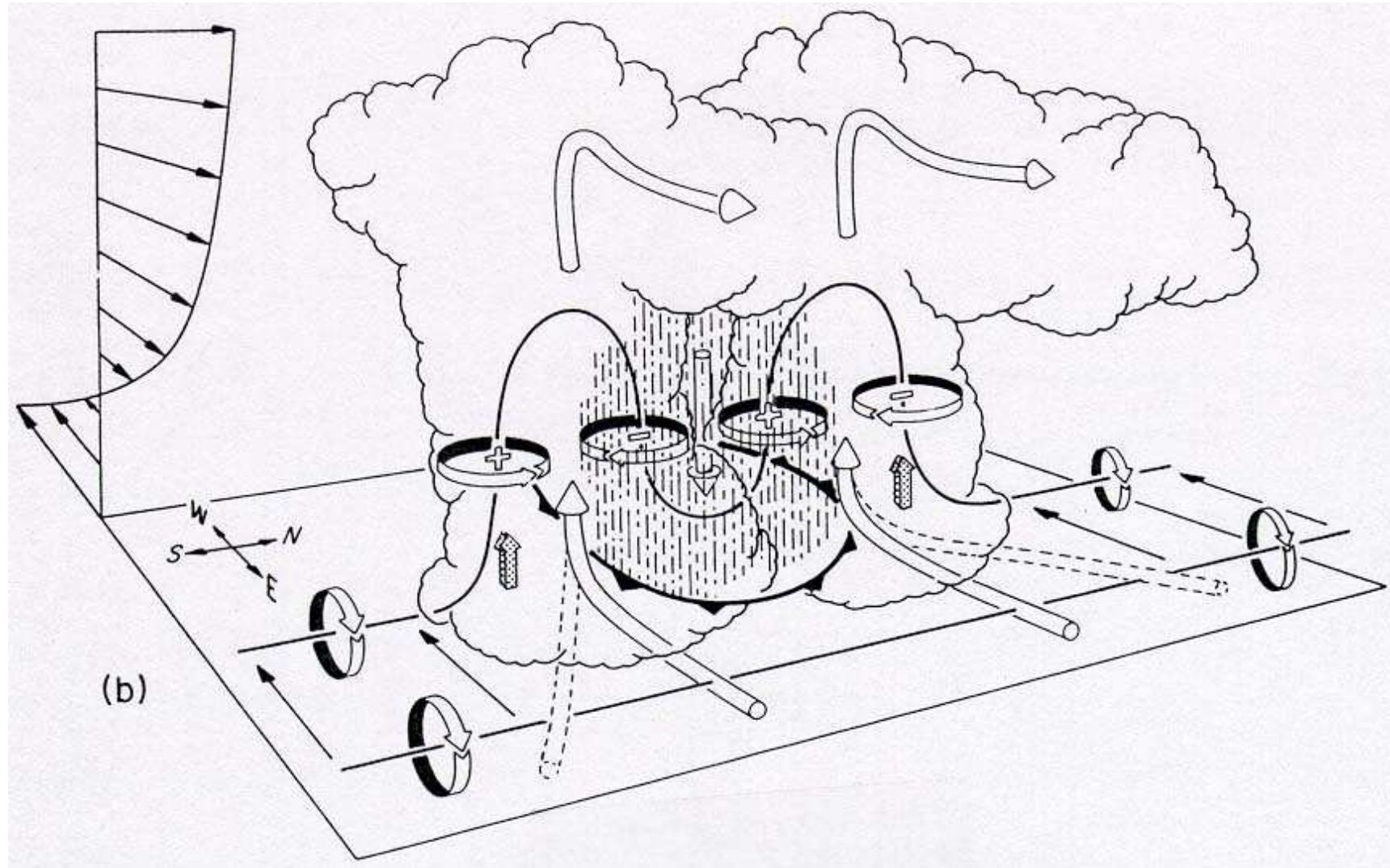
Turbulencia – Arrastre

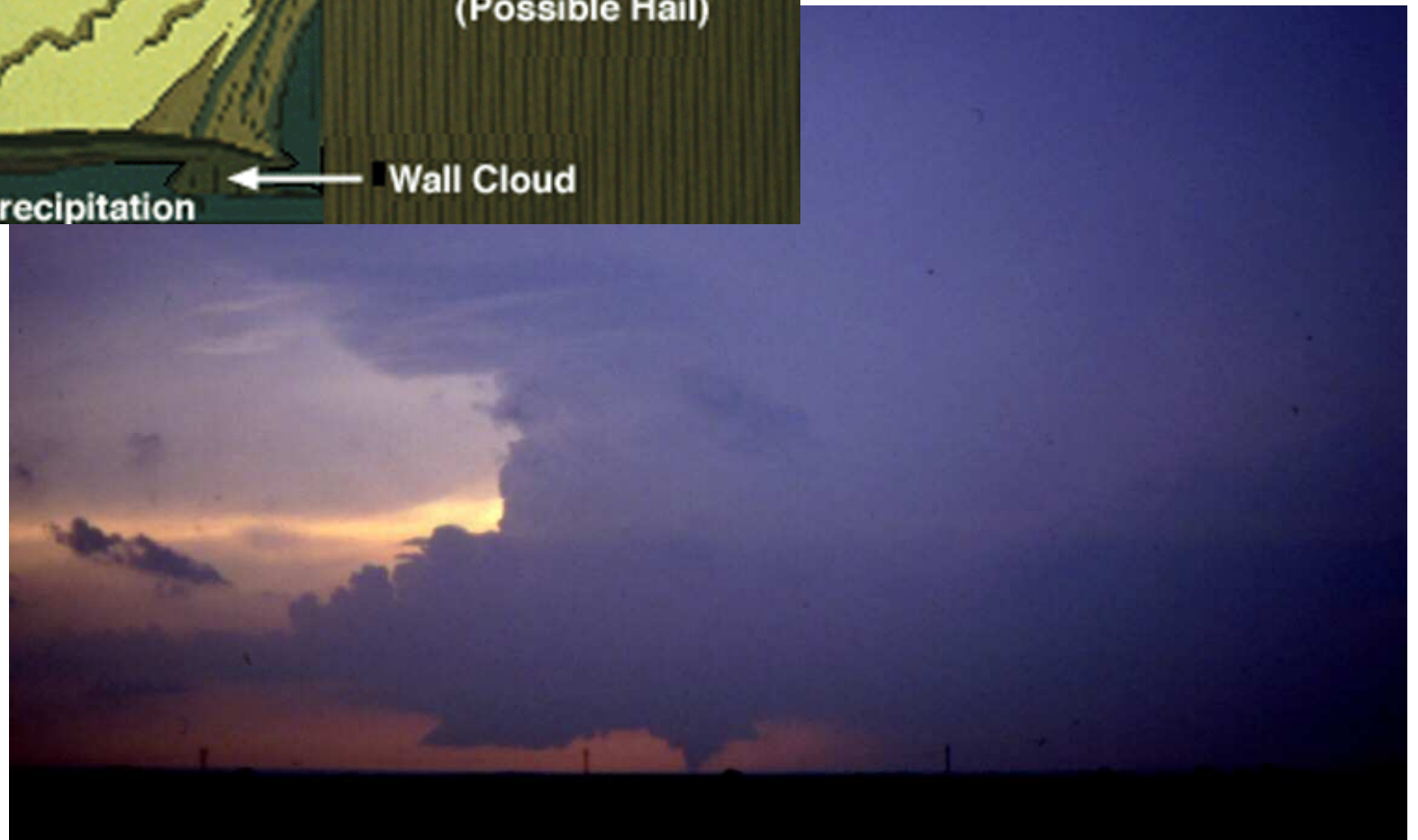
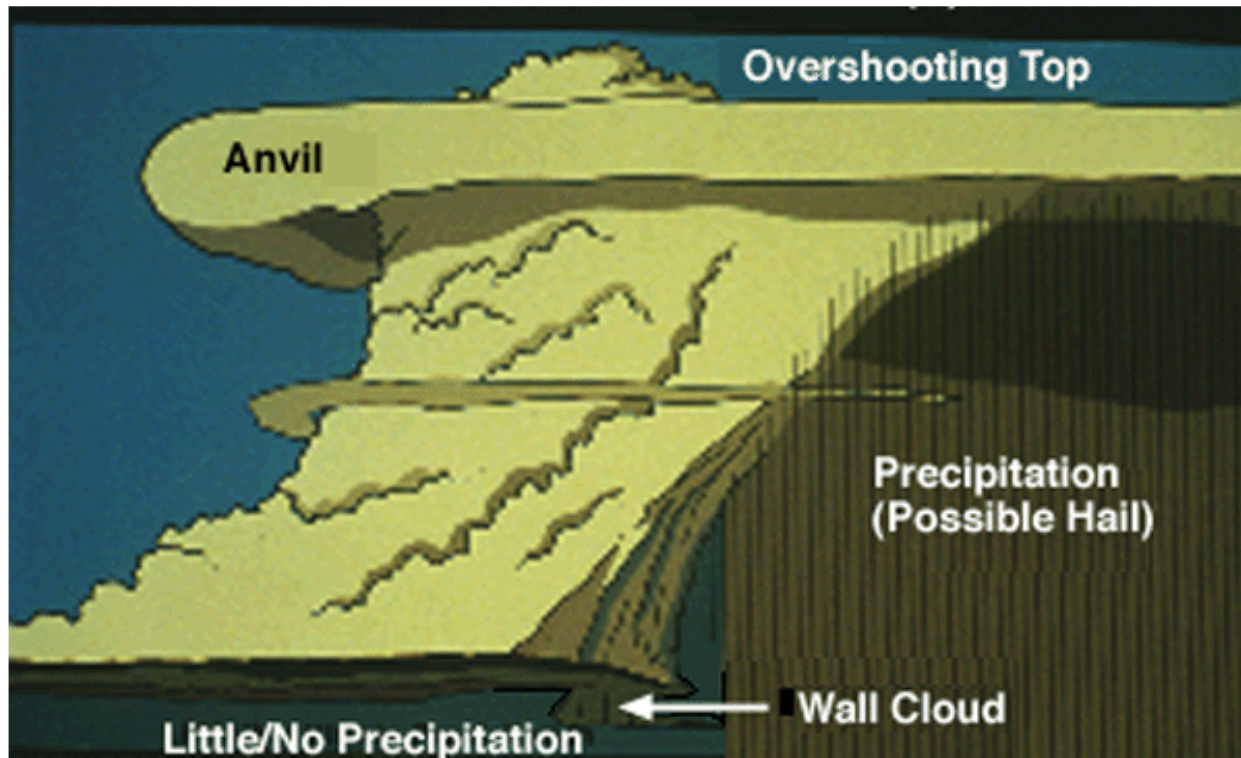
Presiones dinámicas



Play Movie

Bifurcación y rotación





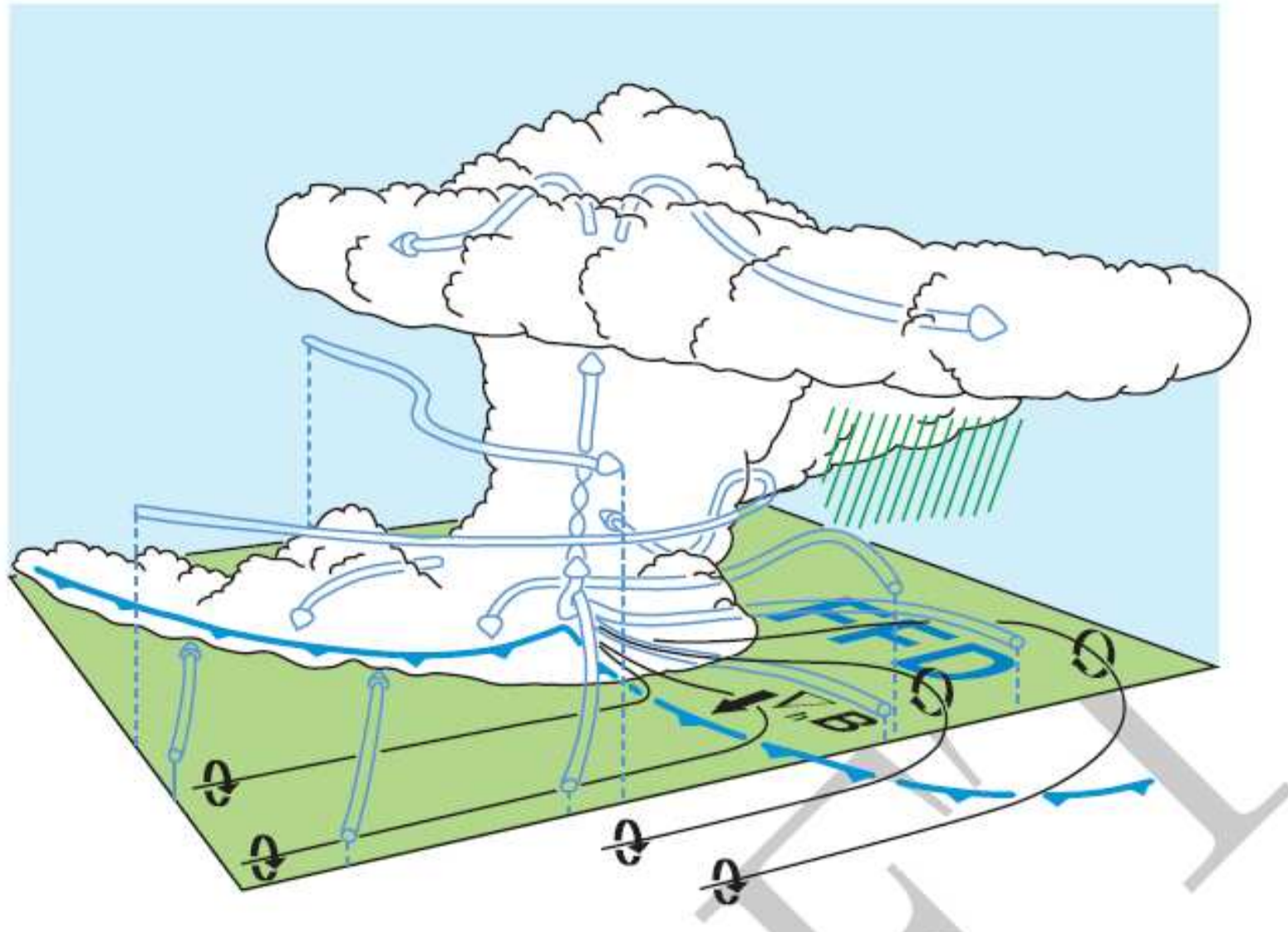
The Wall Cloud



The Wall Cloud



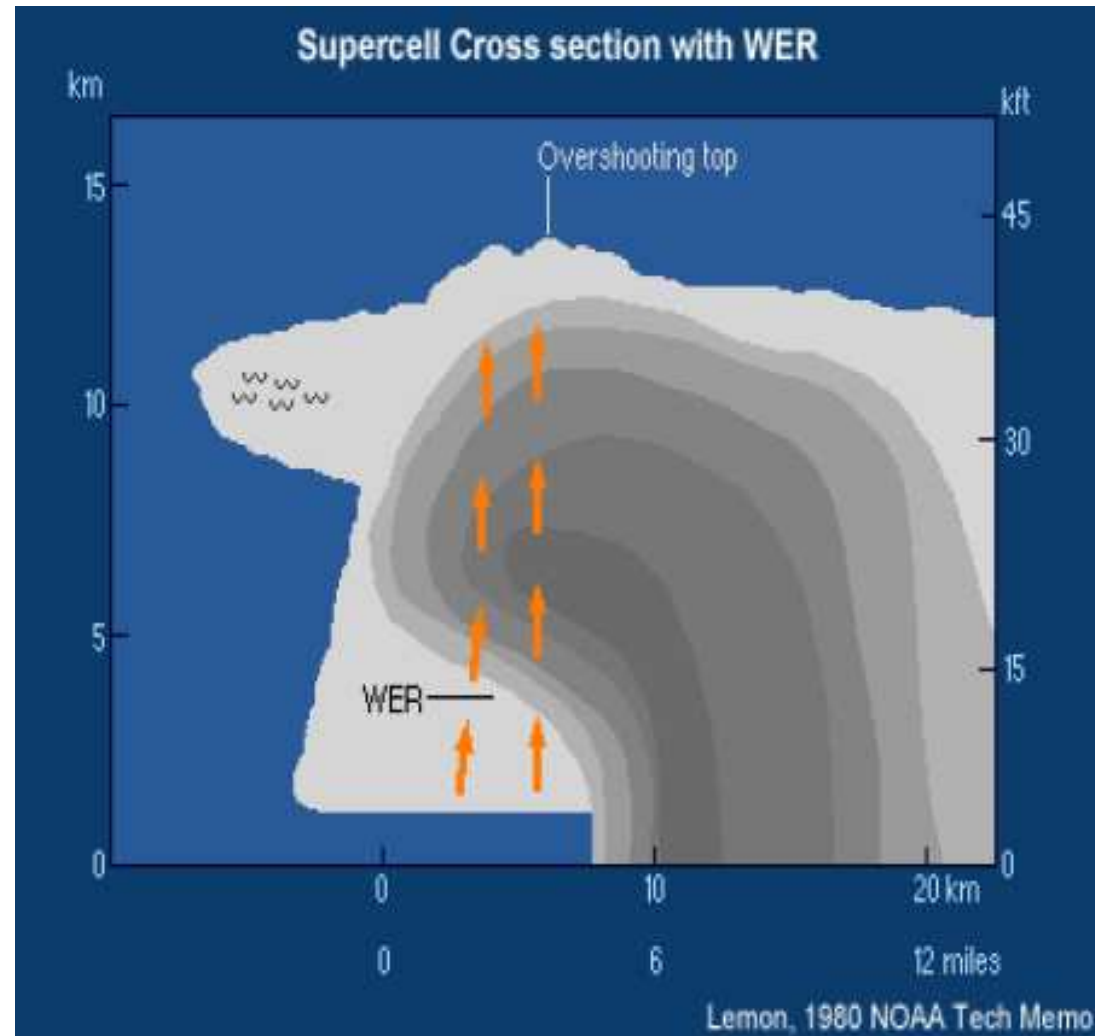
Contribución Baroclínica al Mesociclón



BWER- hook echo

Bounded weak echo region

- BWER debido a la ascendente intensa
- Característico de la SC capaz de suspender muchas partículas precipitantes en altura muy grandes
- Esta cortina de hidrometeoros crea un área libre de eco capaz de ser observada en el radar
- Una ascendente de magnitud y longevidad puede producir granizos muy grandes (>5 cm) y en el “estado más estacionario” de la SC puede resultar en una larga traza o manga de granizo en superficie.



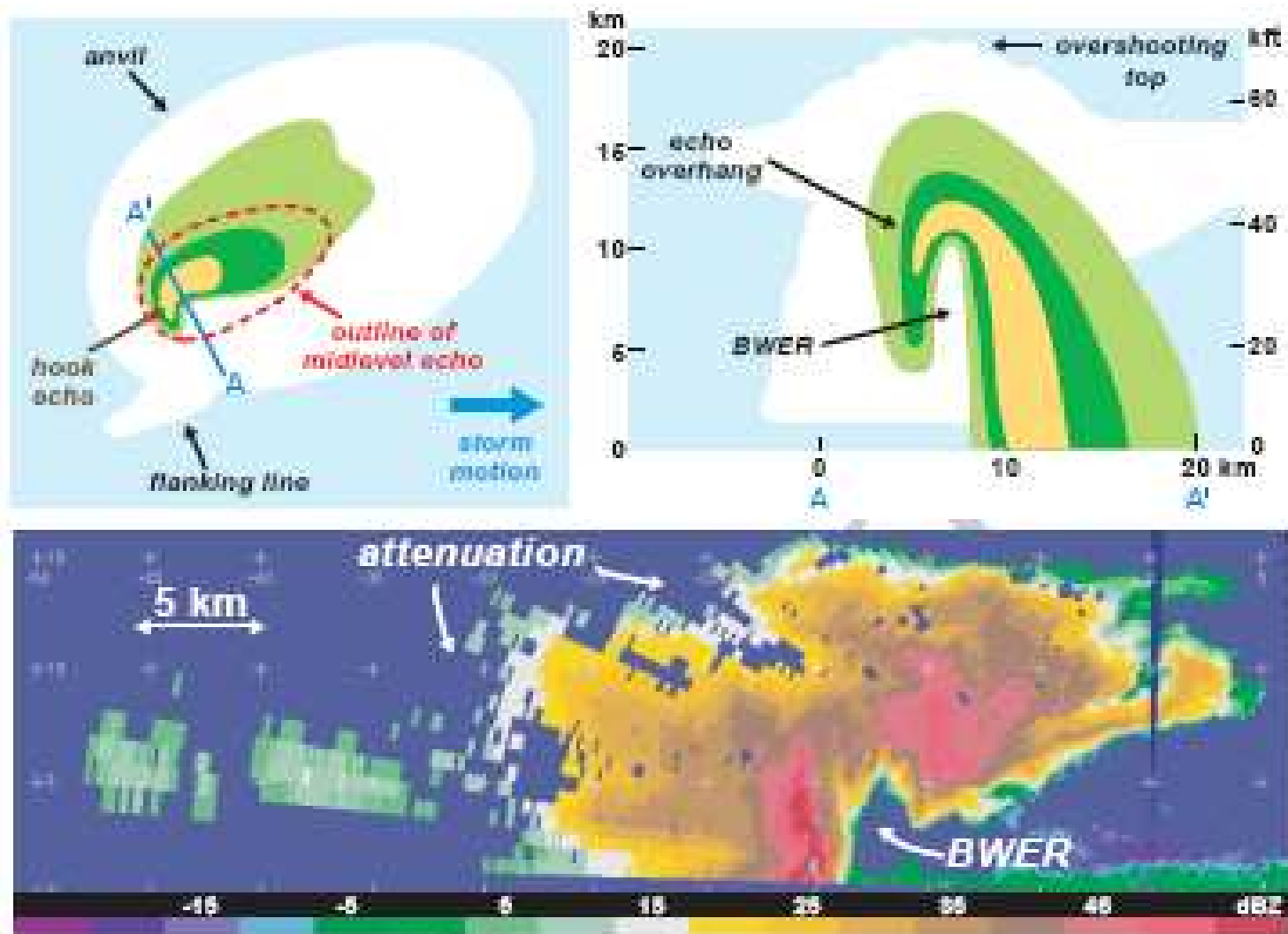
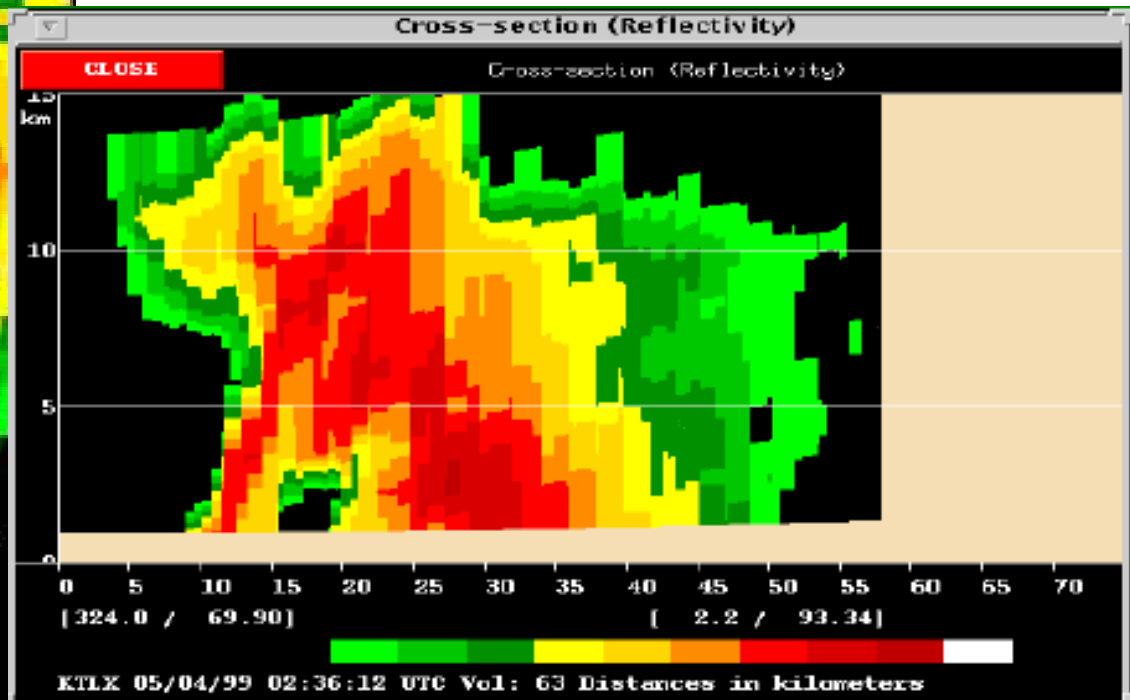
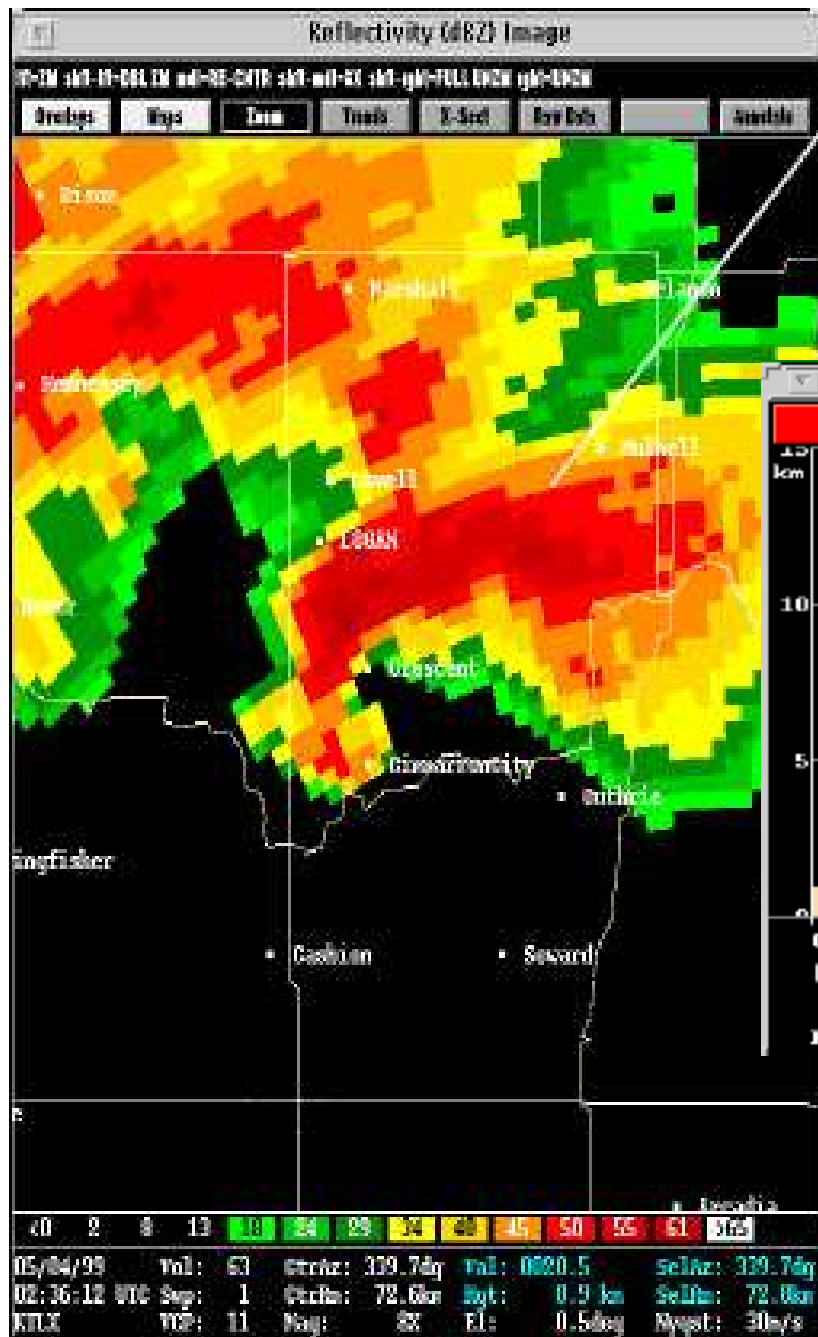
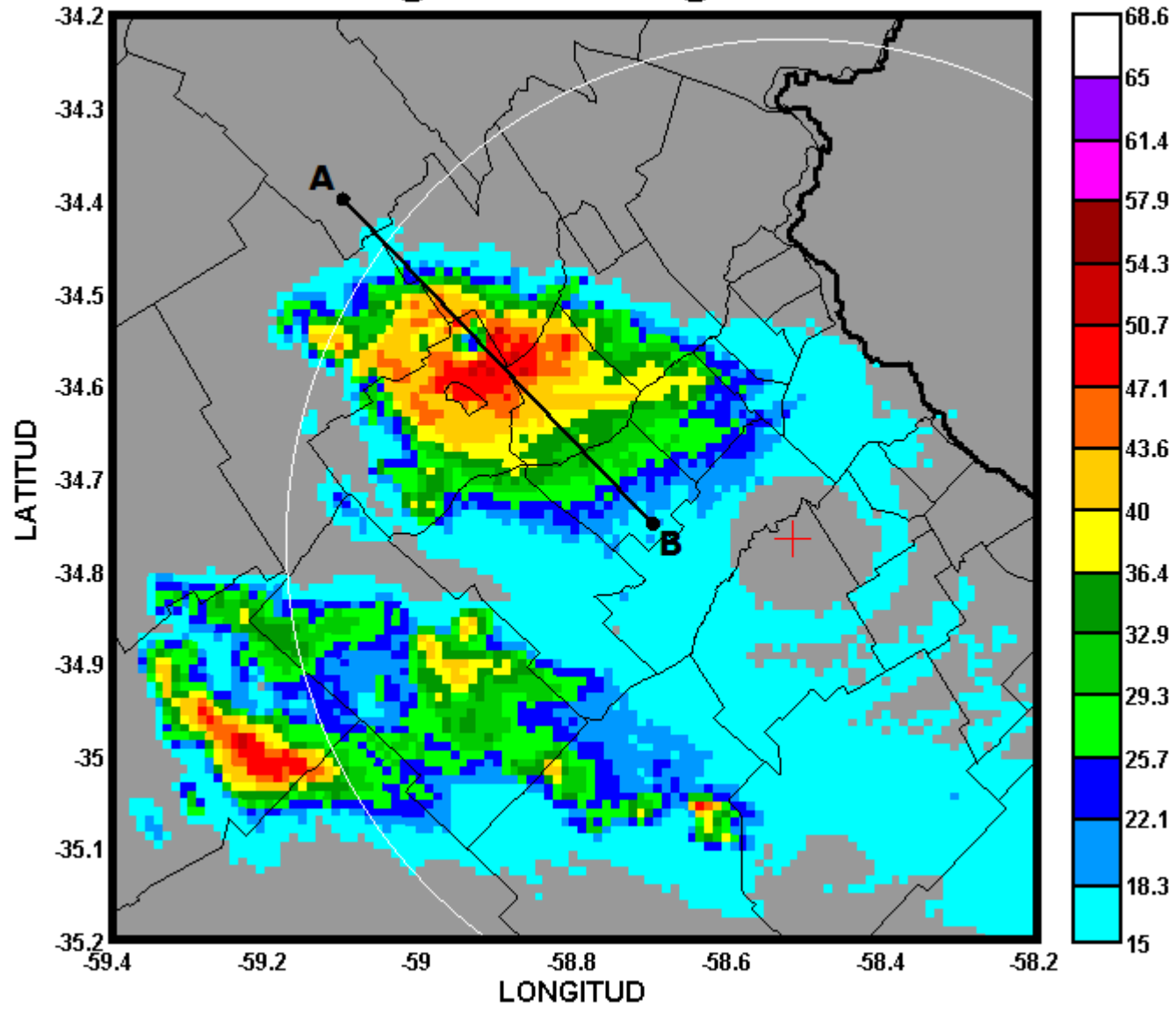


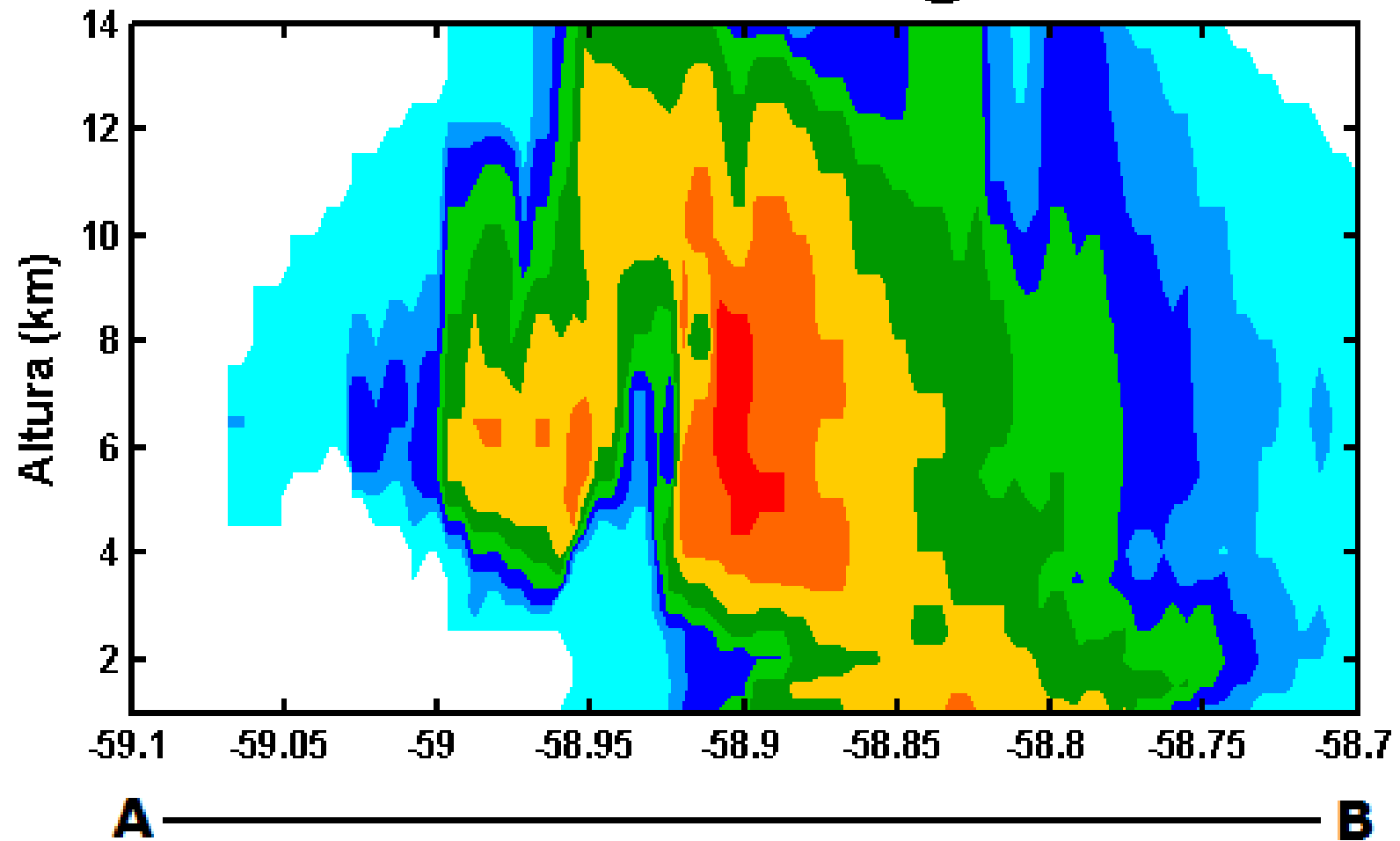
Figure 8.21. (Top) Schematic of the reflectivity structure of a supercell, showing the relationship between bounded weak echo region (BWER), overshooting top, and hook echo. The green and yellow shading indicates weak, moderate, and high radar reflectivity visible at (top left) low levels and (top right) in a vertical cross-section. (Bottom) Actual quasi-vertical cross-section of radar reflectivity factor in a supercell thunderstorm obtained from a helically scanning radar mounted in the tail of an aircraft at 2306 UTC 16 May 1995 during the Verification of the Origin of Rotation in Tornadoes Experiment (VORTEX).



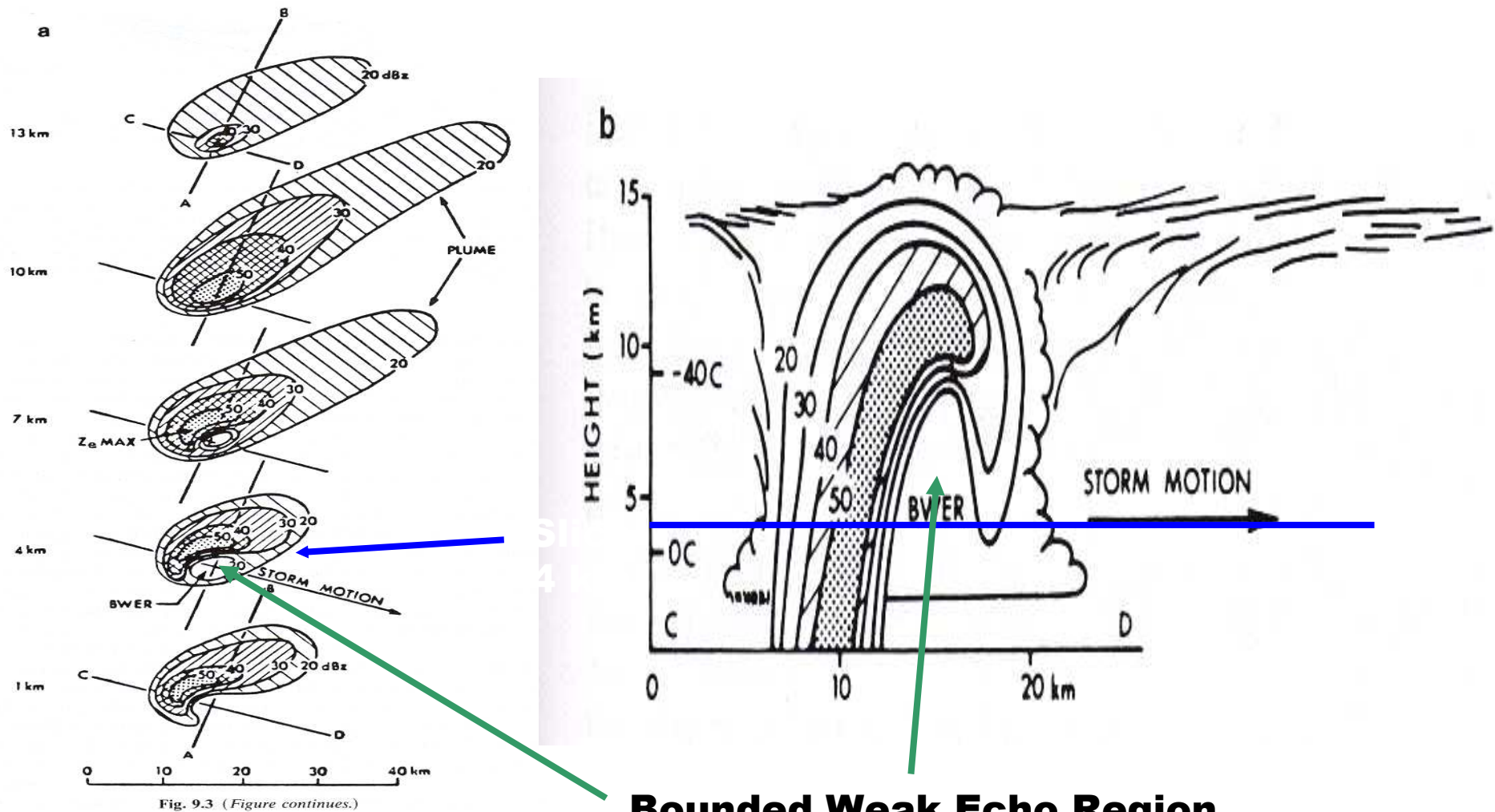
CAPPI@6km - 18.04.2010@2200UTC



Transecta A-B 18.04.2010@2200UTC



BWER en función de las etapas de vida de la SC



Bounded Weak Echo Region

Descendentes

Rear Flank Downdraft

Forward Flank Downdraft

Estructura de una Supercelda en su estado maduro

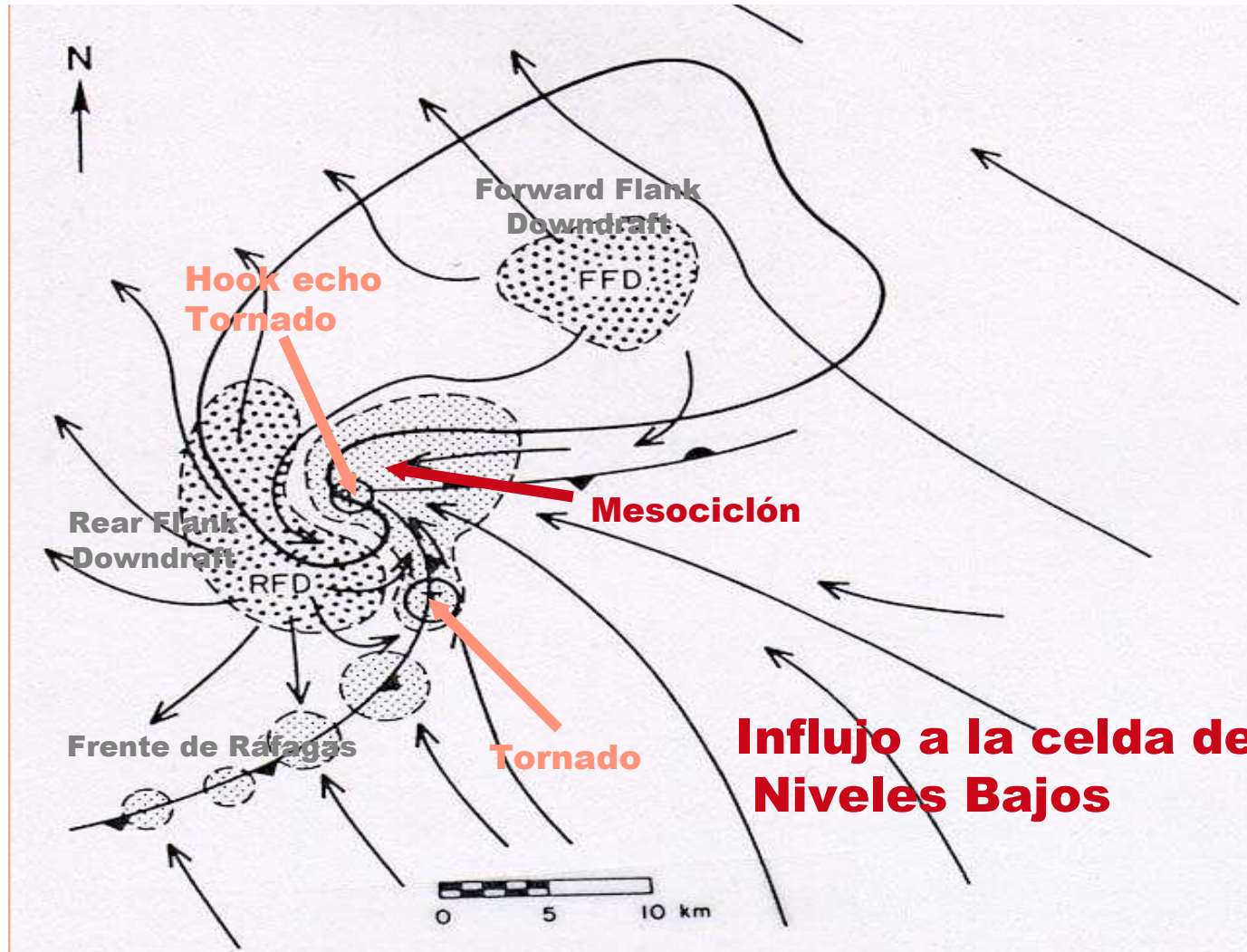


Gráfico de: Bluestein, *Synoptic-Dynamic Meteorology -- Volume II: Observations and Theory of Weather Systems*

Forward Flank Downdraft

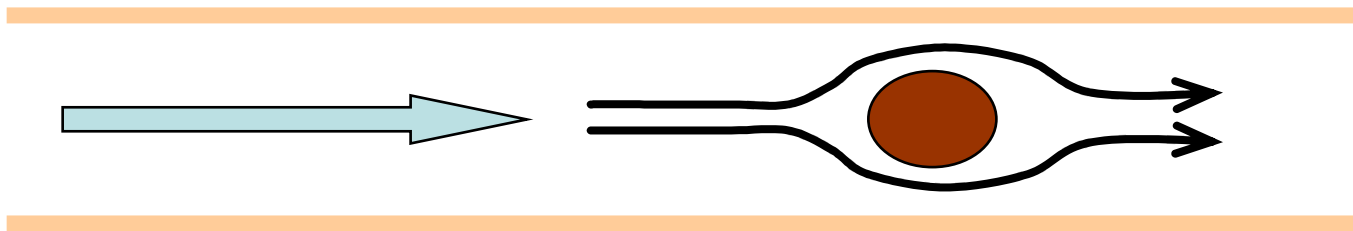
- Asociada con el corazón de la precipitación.
- Fuertemente influenciada por enfriamiento evaporativo debajo de la base de la nube
- Se forma en el flanco delantero de la celda respecto de su modo de desplazamiento.
- El aire asociado a la FFD es desparramado en la SFC generando el frente de ráfagas.

Rear Flank Downdraft

- Se forma en la parte trasera de la celda, corriente arriba de la cortante.
- Es el resultado del bloqueo de la tormenta respecto al flujo del entorno.
- Se mantiene y se intensifica por evaporación del yunque de la celda.
- En el caso de aire seco en niveles medios genera un fuerte enfriamiento evaporativo.
- Localizada muy cerca de la ascendente.

Formación de la RFD

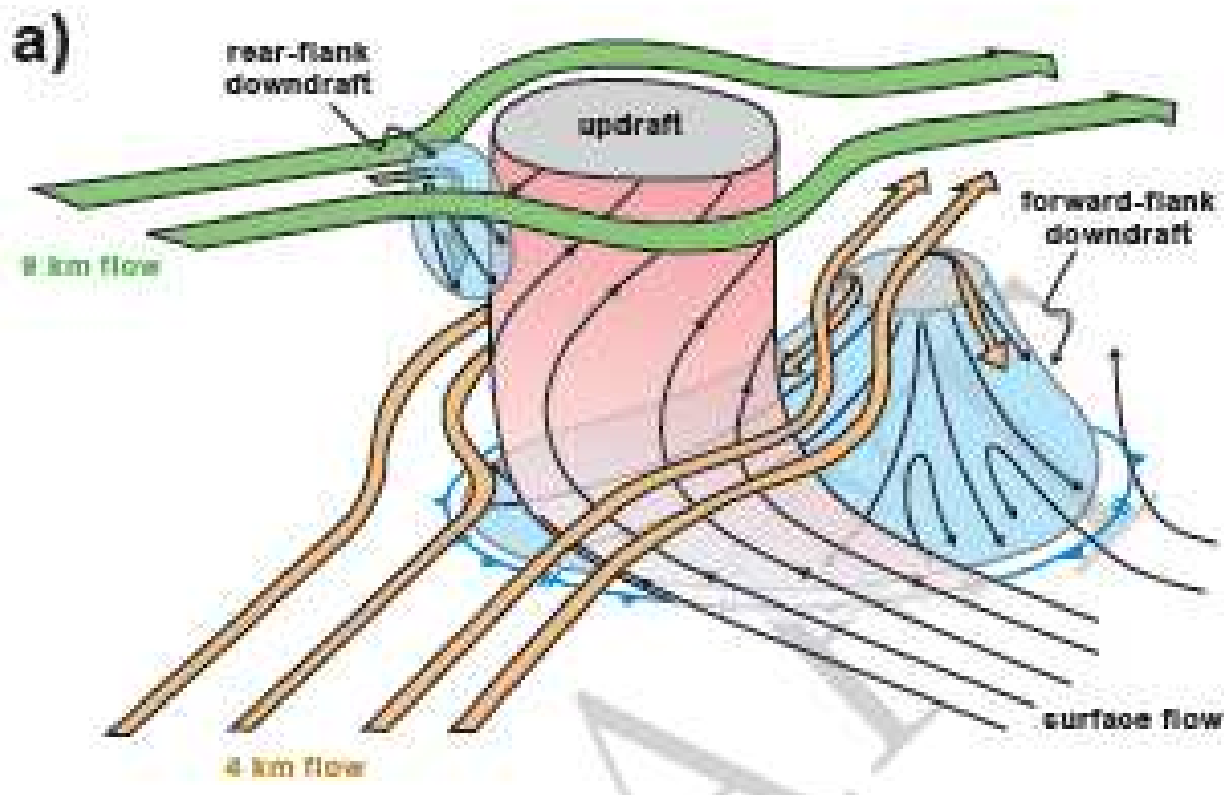
- Efecto de bloqueo generado por el corazón de la ascendente.



- El aire debe esquivar el escollo.
- Una región de alta presión se genera en cortante arriba de la ascendente generado un punto con movimiento estancado en la horizontal

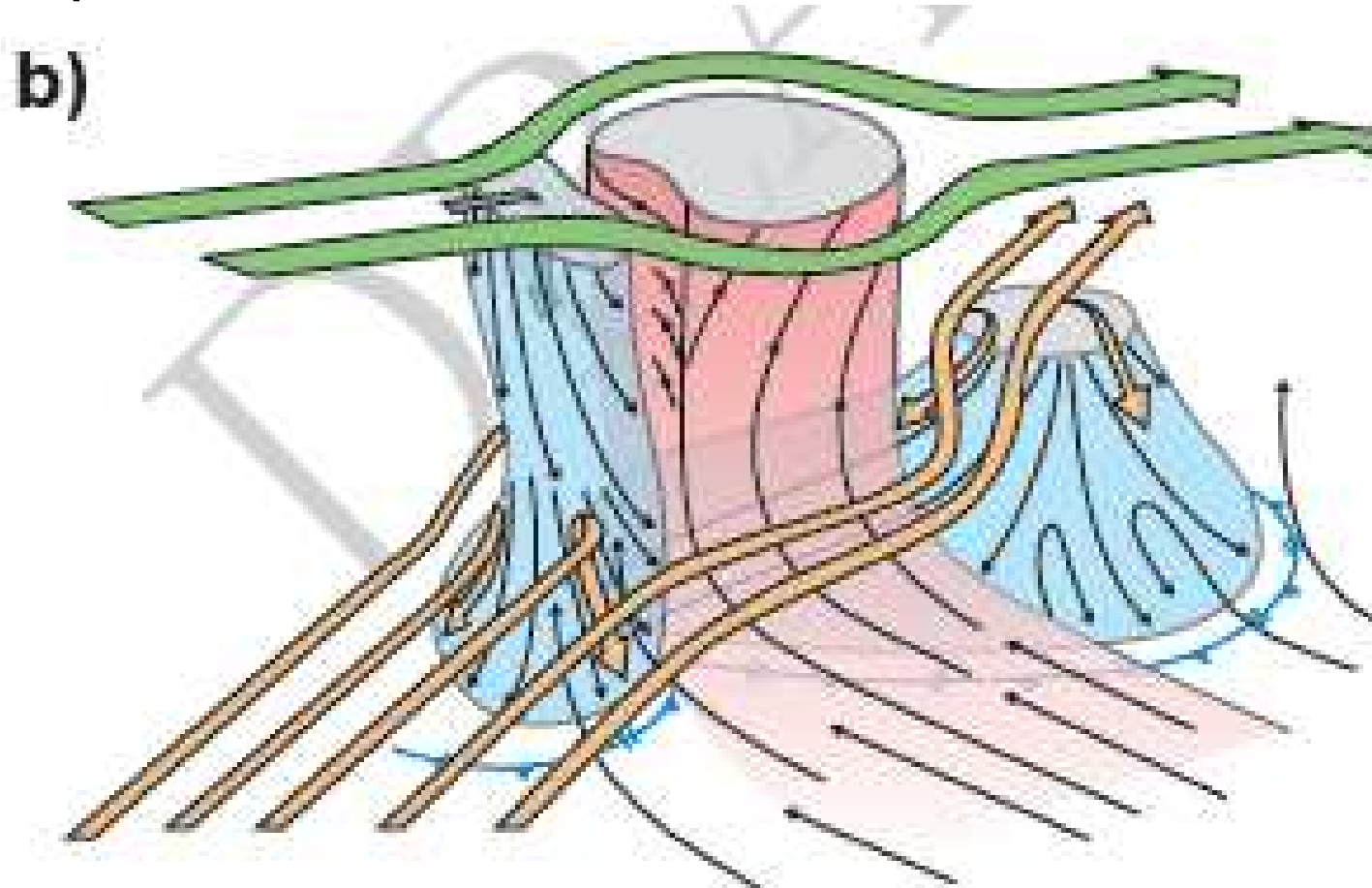
Formación de la RFD

- La ascendente actúa como un obstáculo en los niveles altos y medios



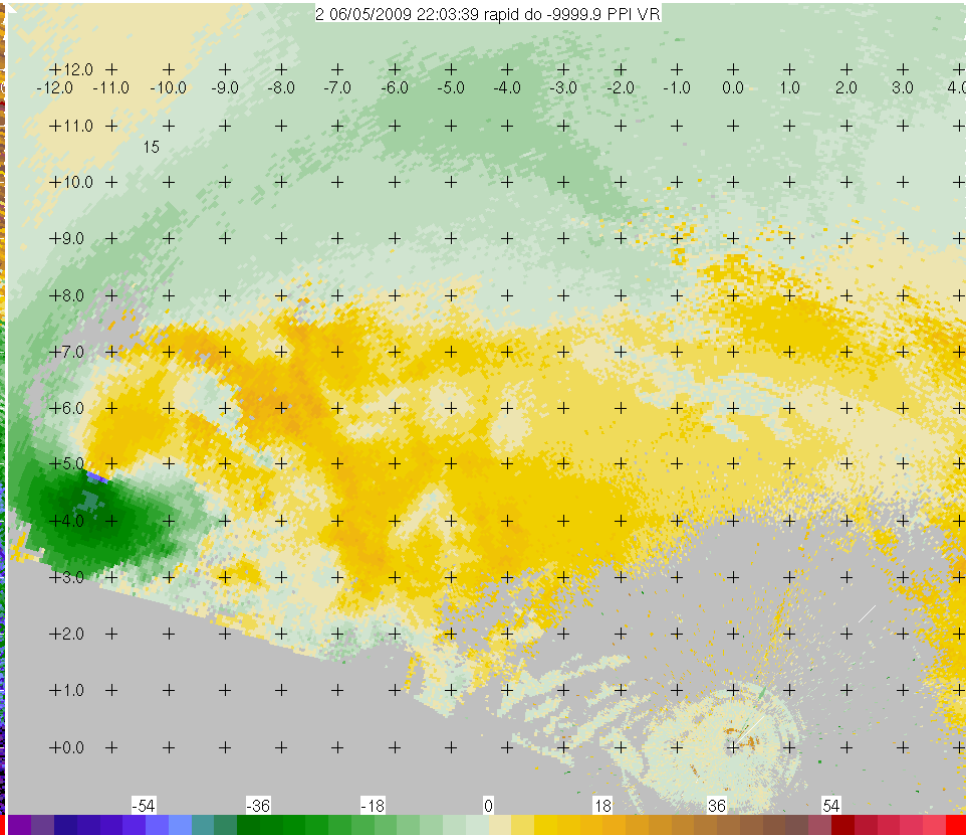
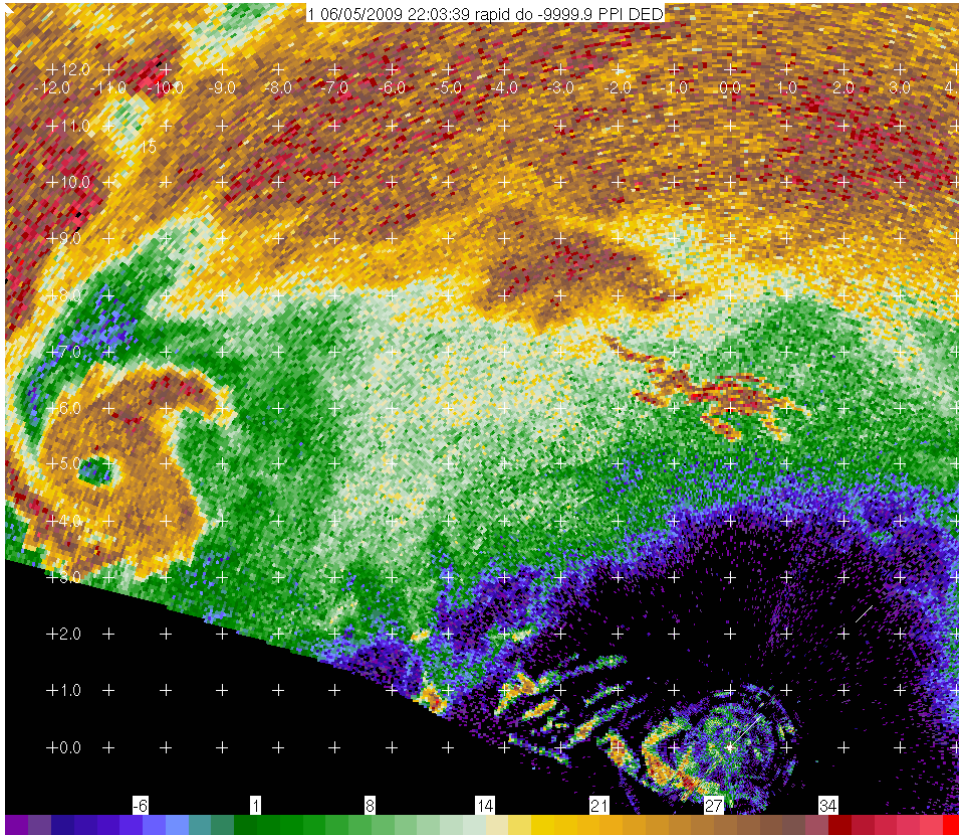
Formación de la RFD

- La RFD desciende por continuidad, ayudada por la evaporación del contenido de agua del yunque.
- Al llegar a SFC genera el frente de ráfagas en la parte posterior de la celda



Tornados

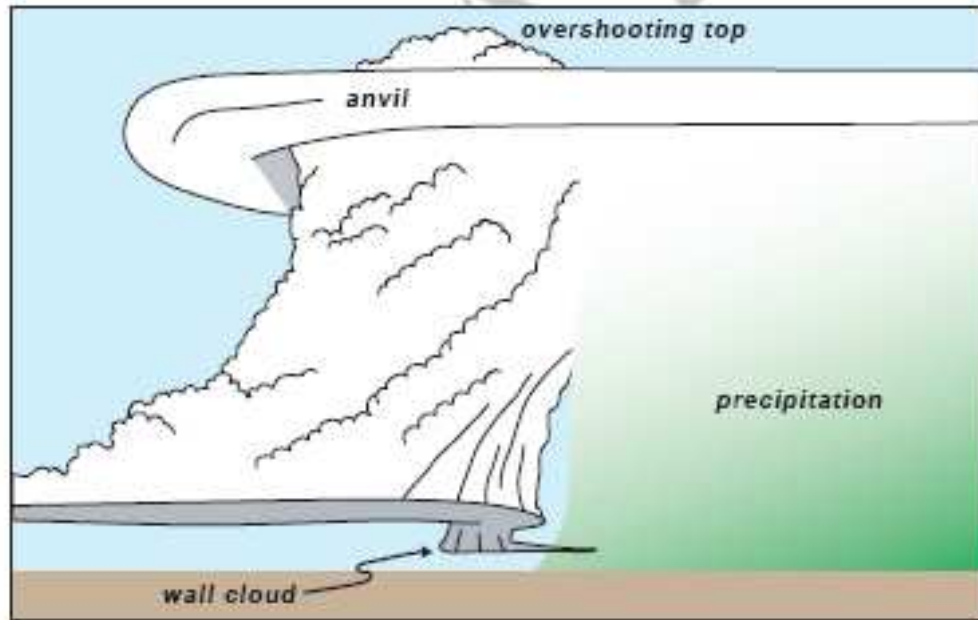
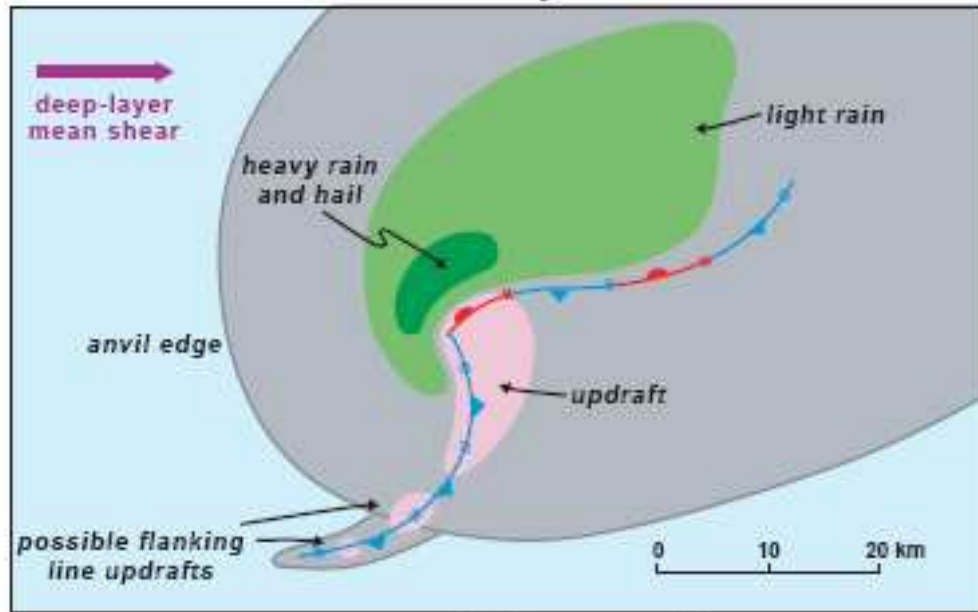
.....esperar 2 clases mas!



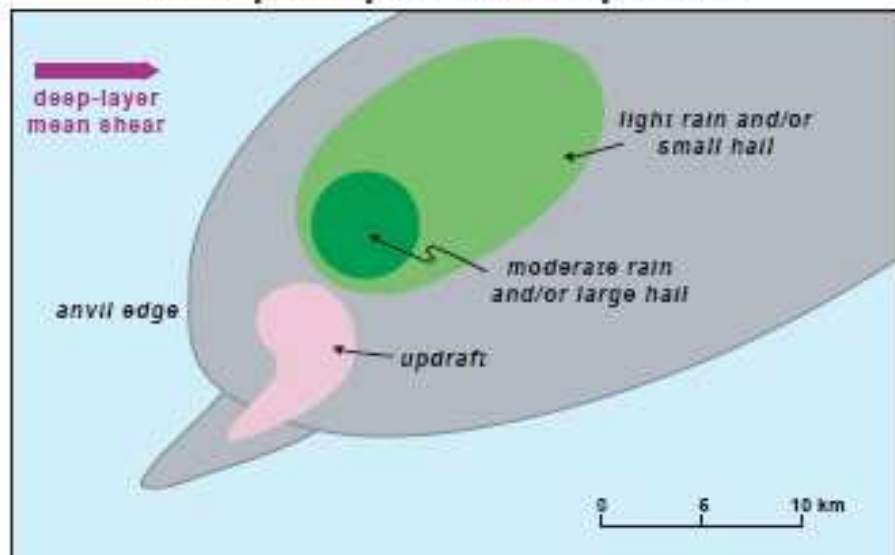
De VORTEX2 - 2009

Tipos de SC

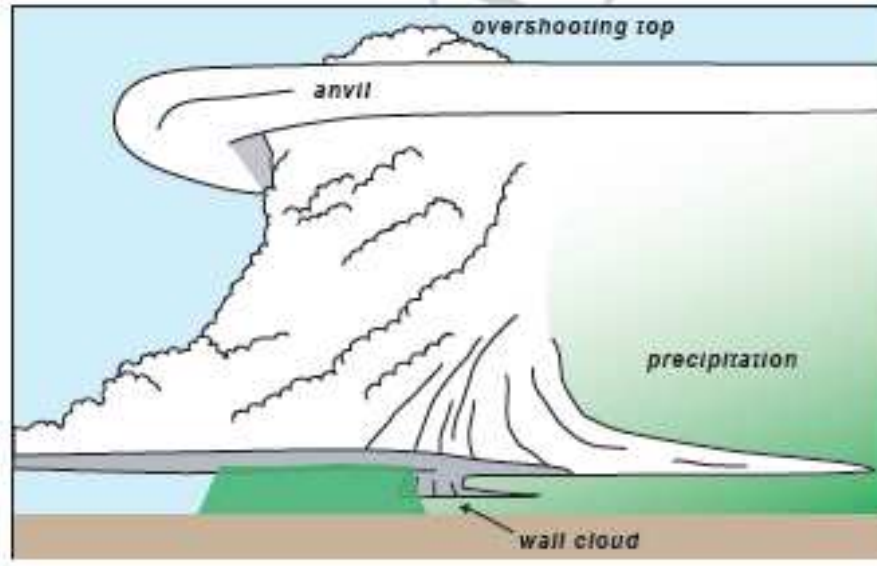
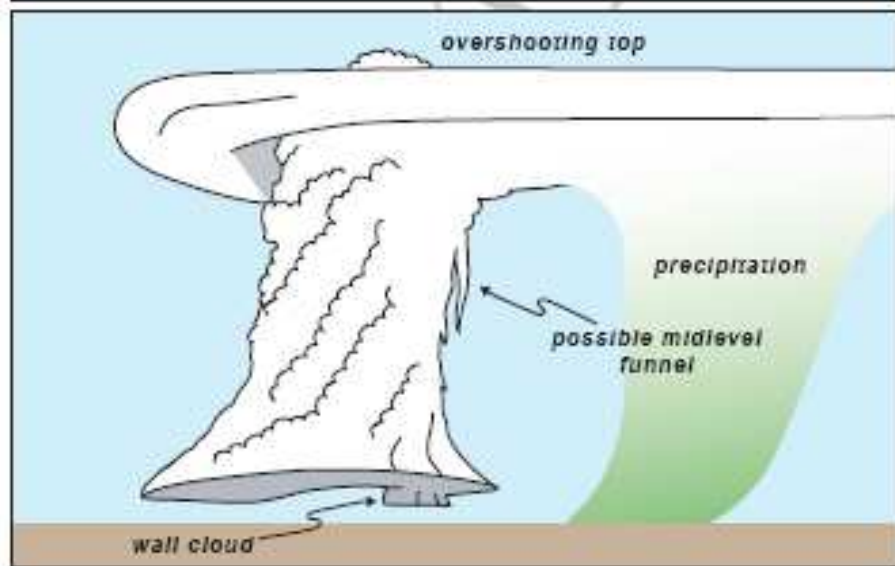
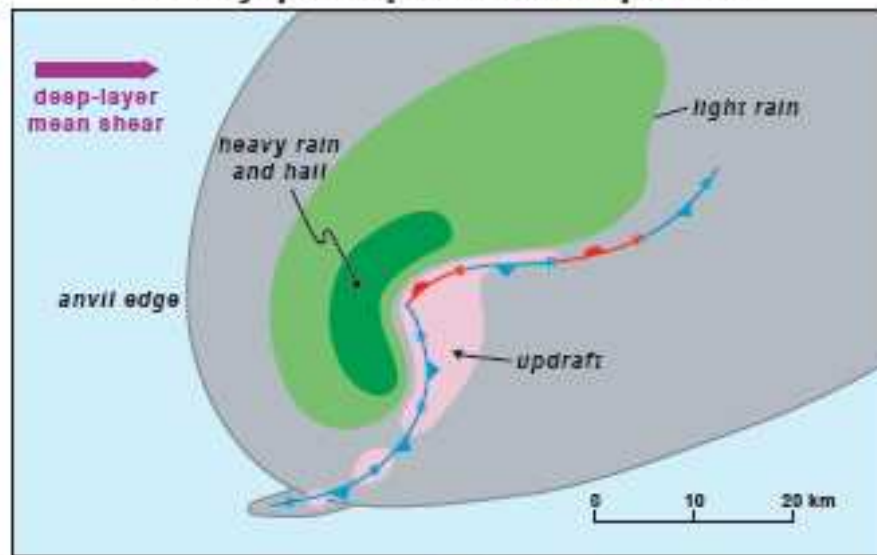
classic supercell



low precipitation supercell



heavy precipitation supercell



LP



HP

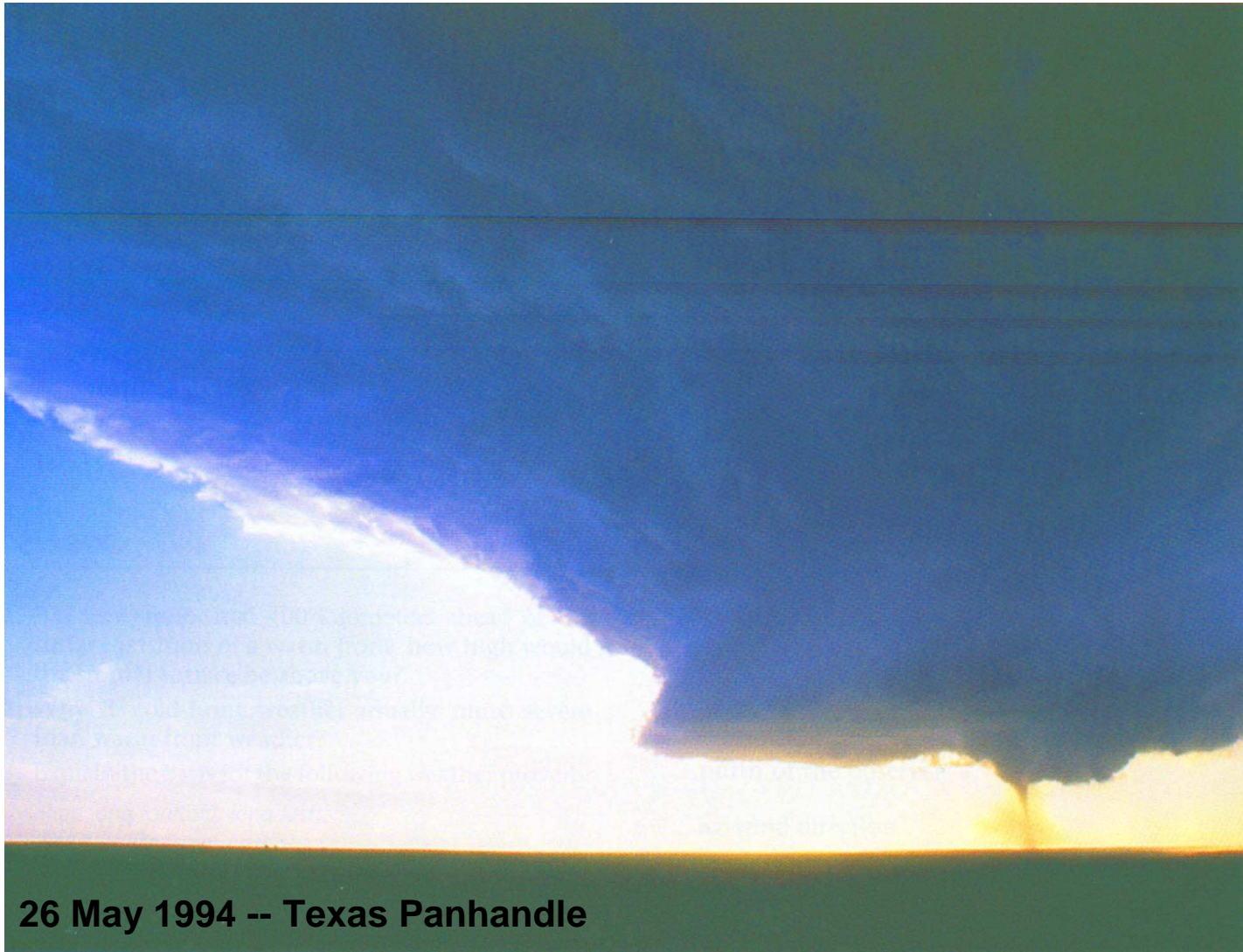


LP Supercelda

© 1995 Robert Prentice

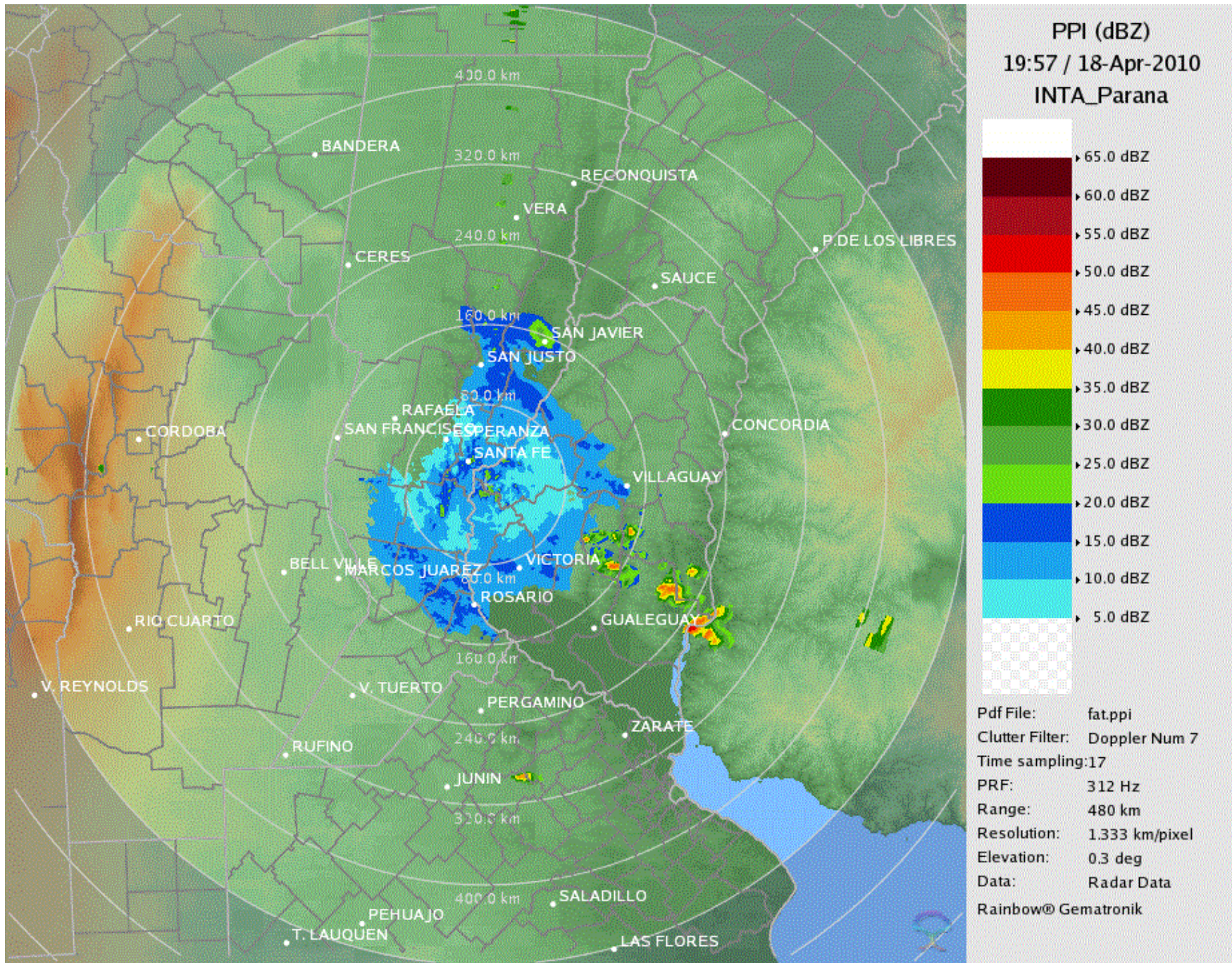


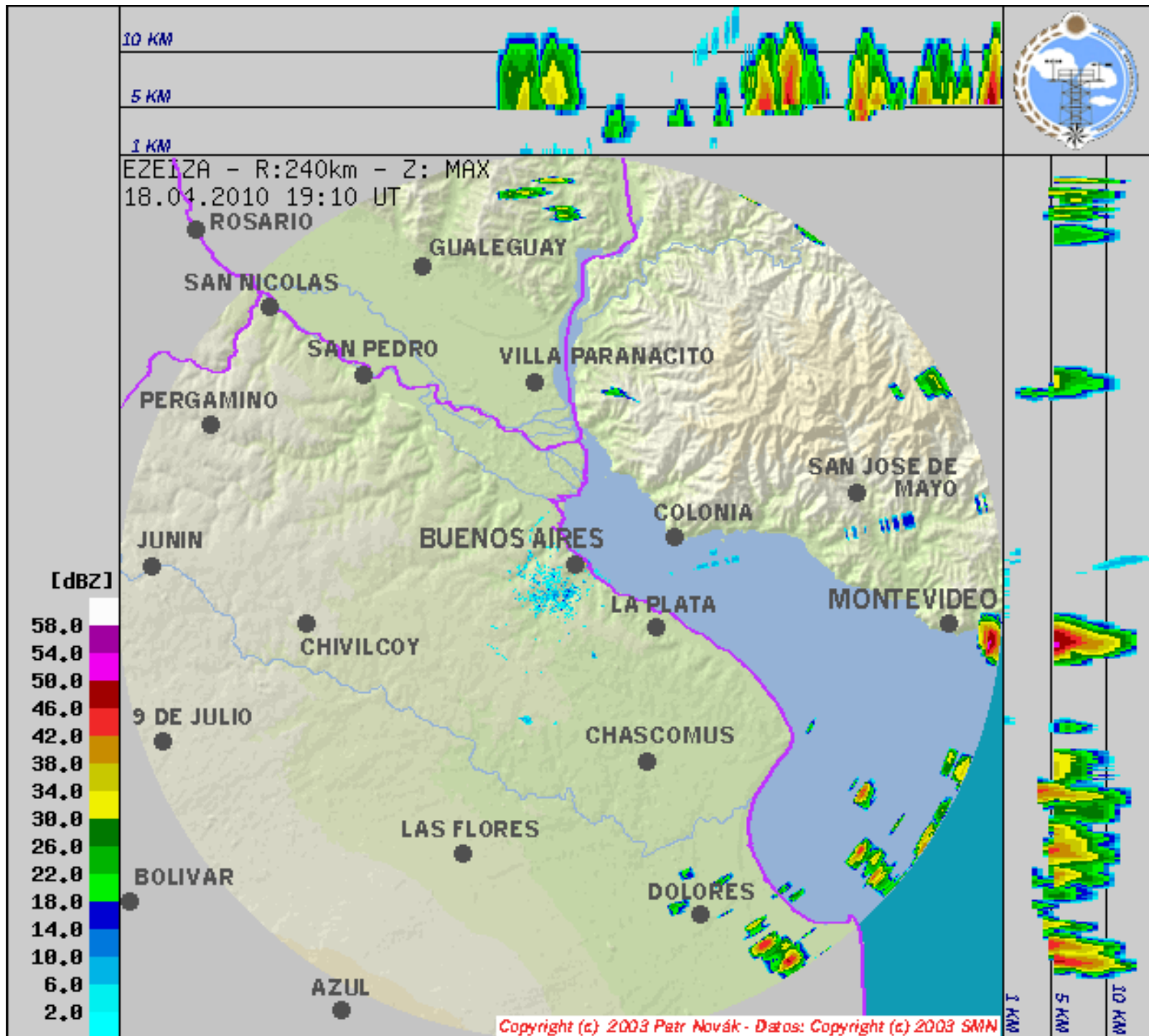
LP Supercelda

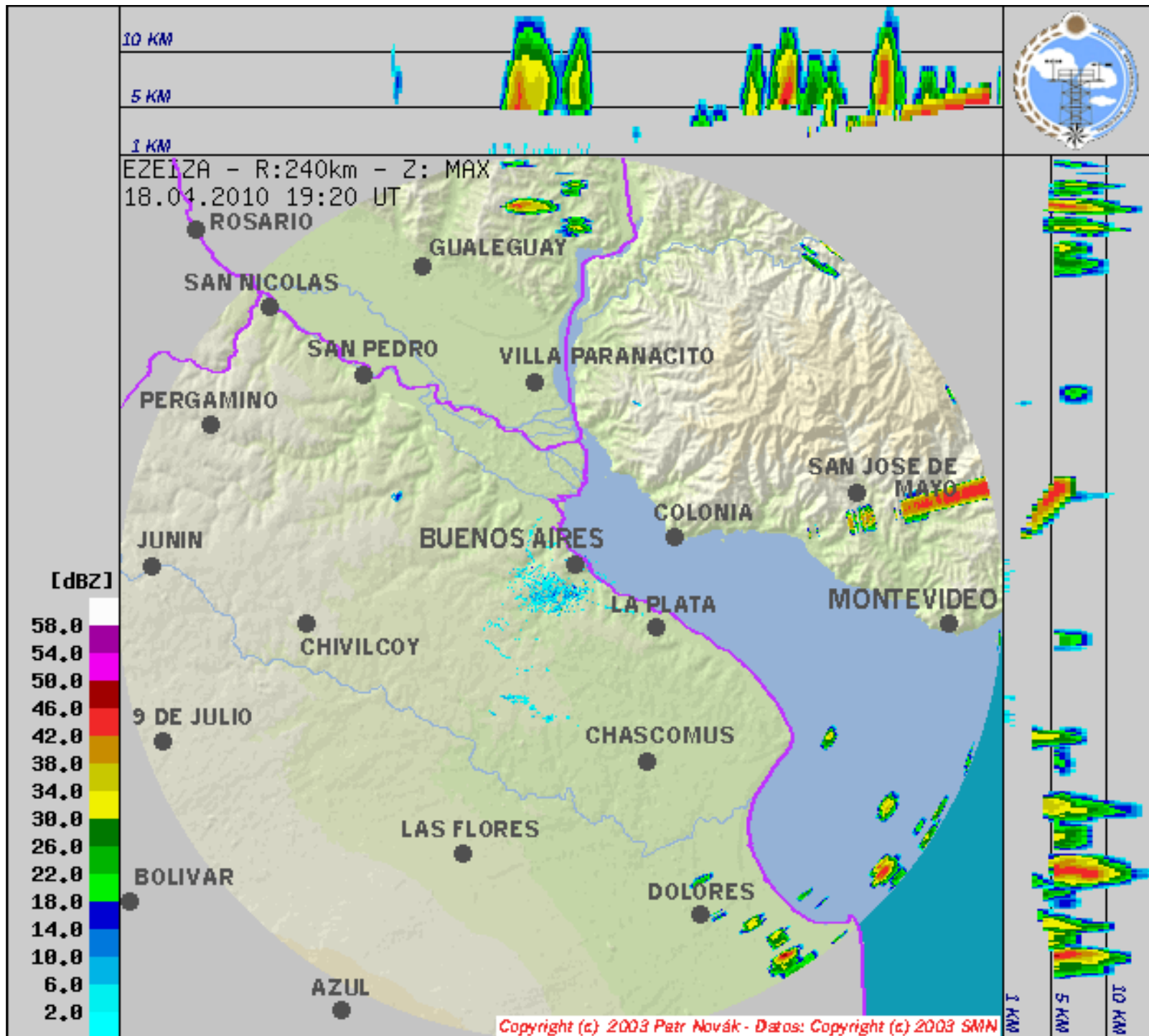


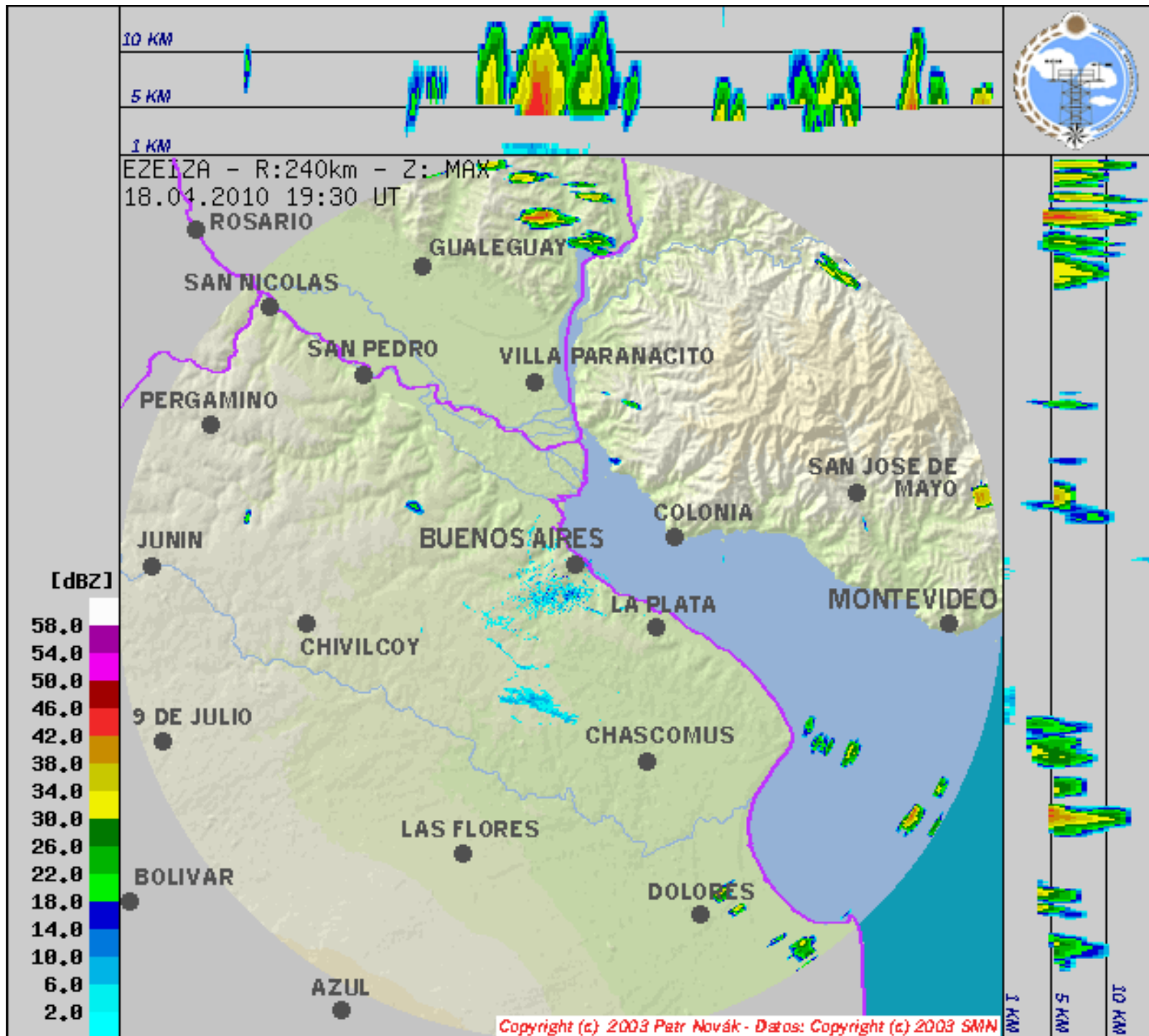
26 May 1994 -- Texas Panhandle

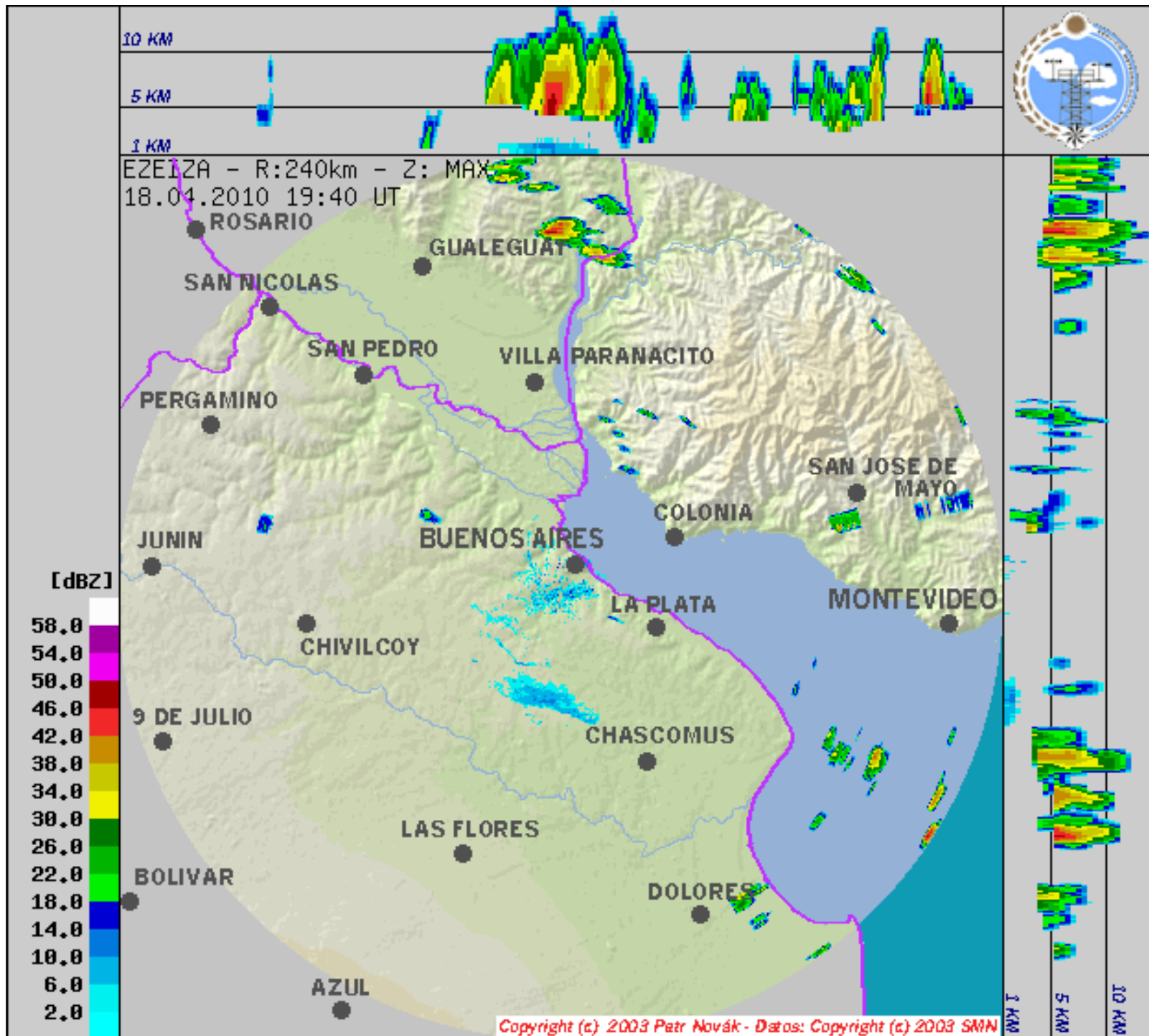
Caso del 18-4-2010

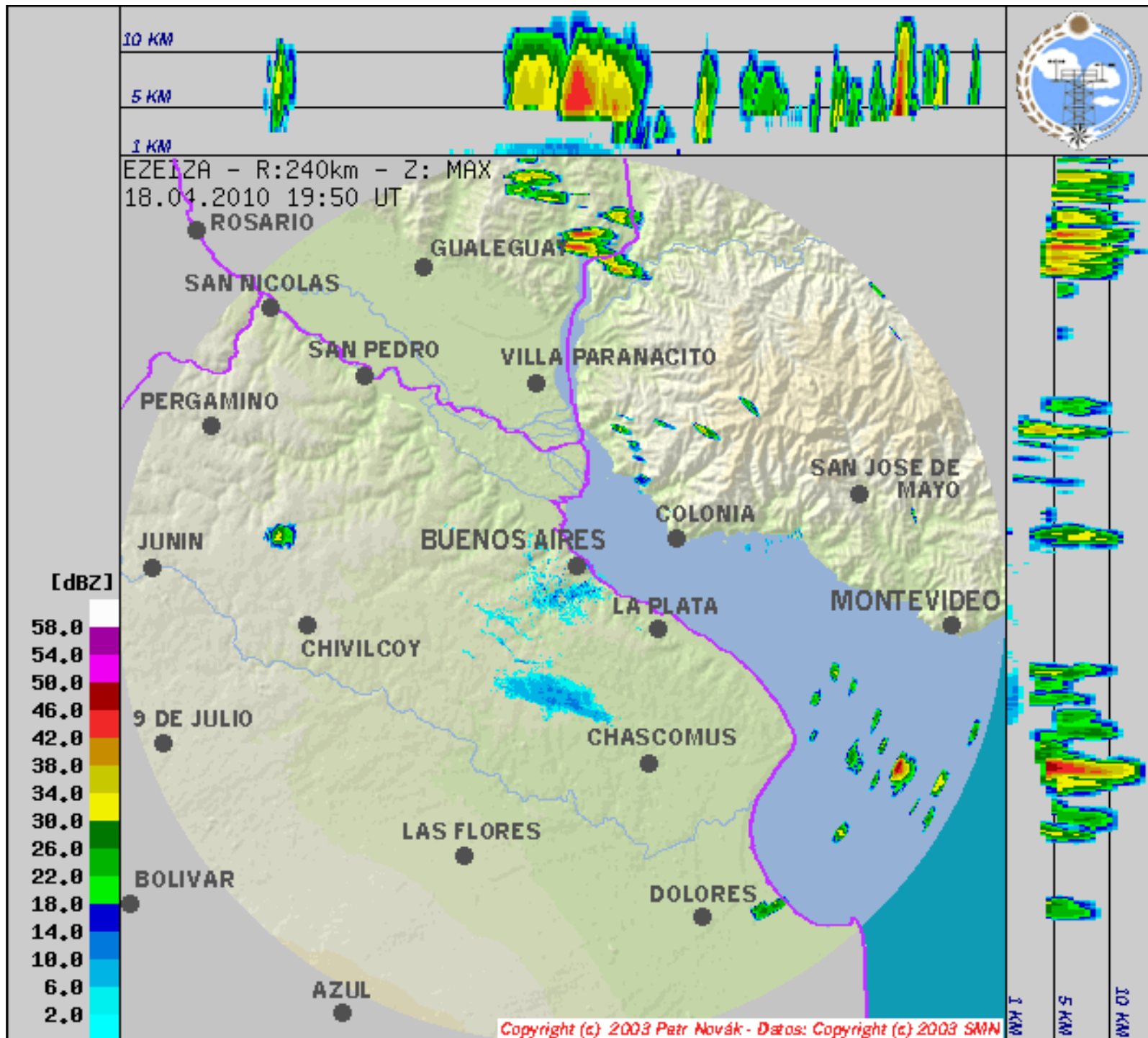


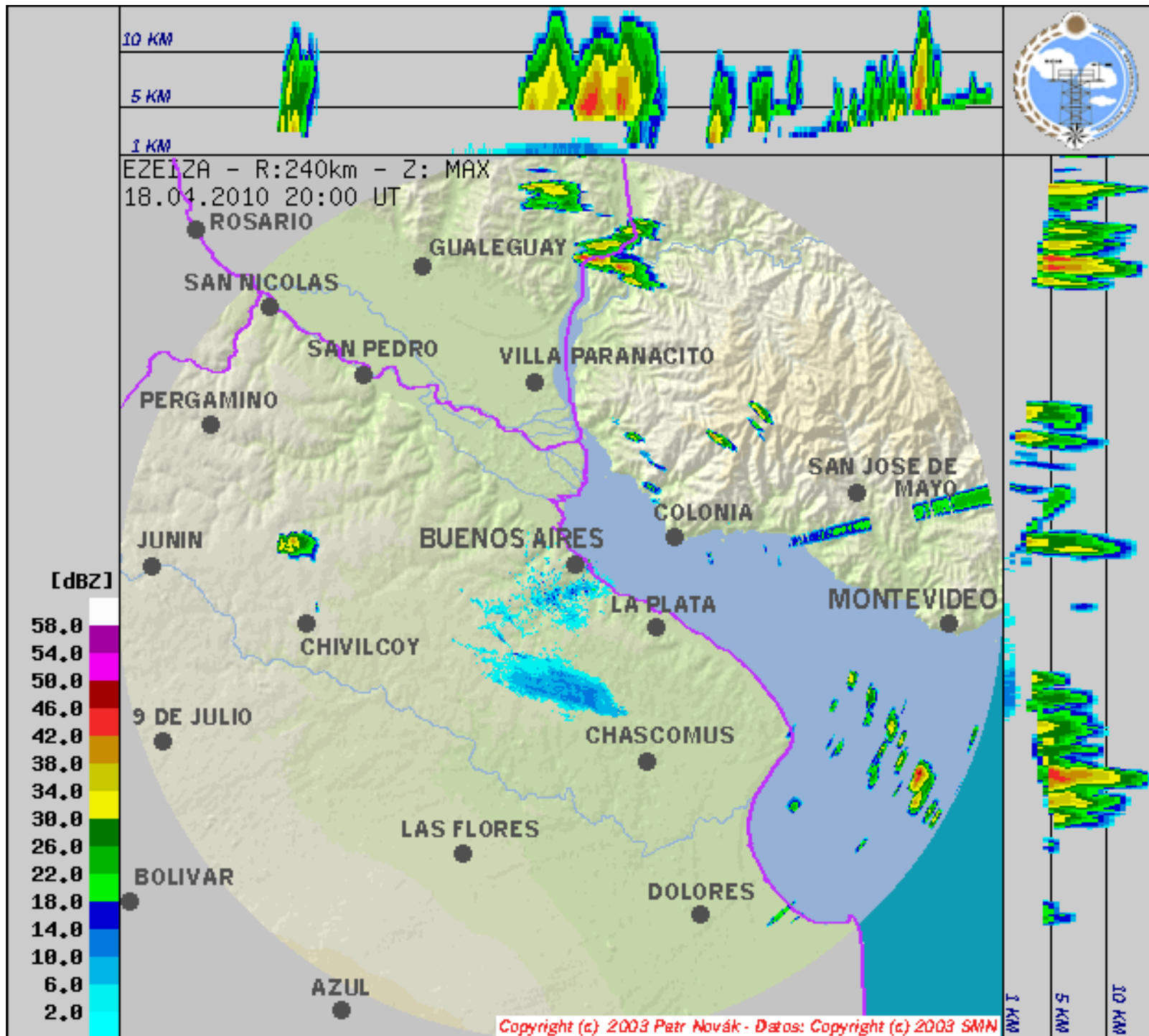


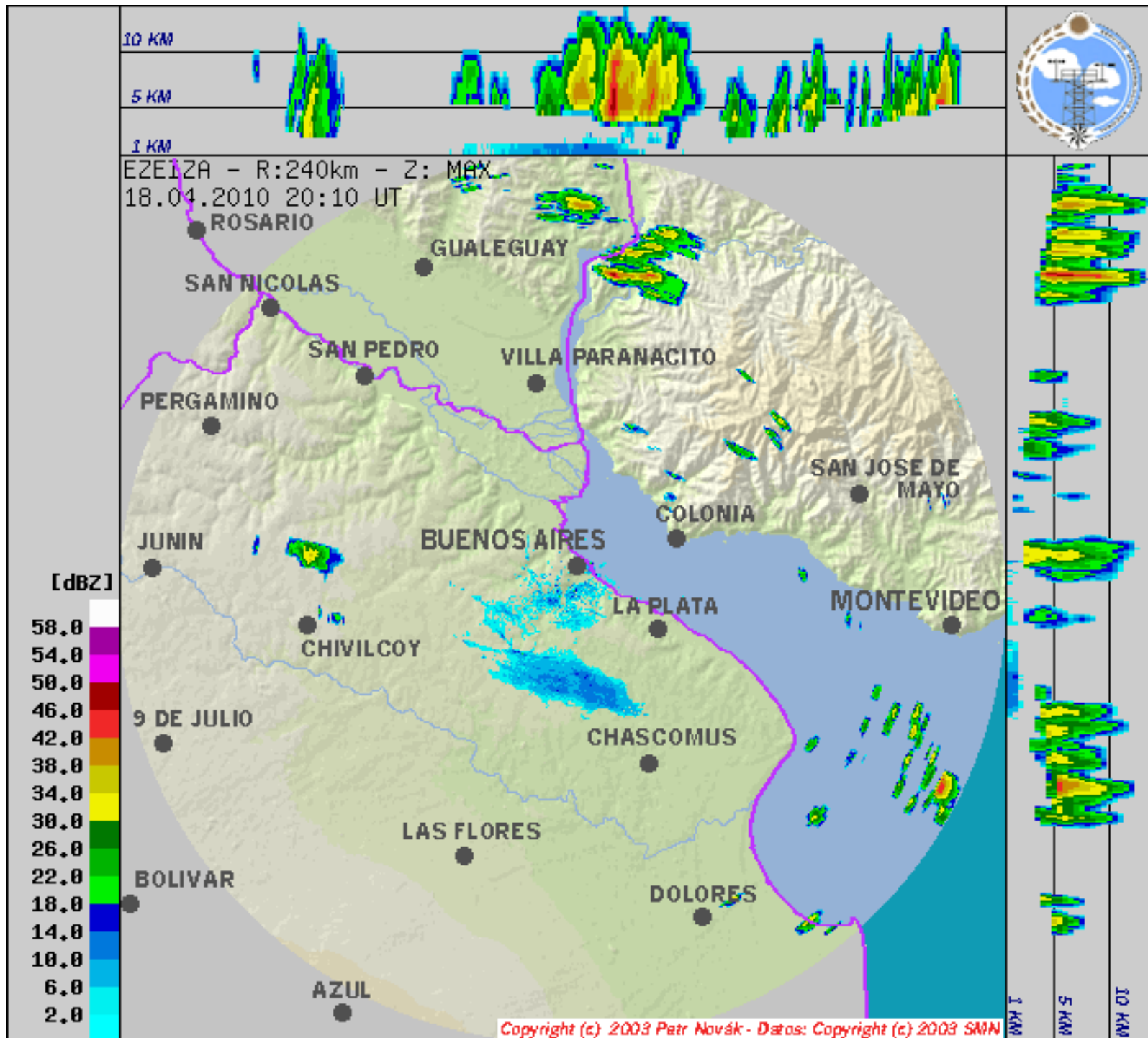


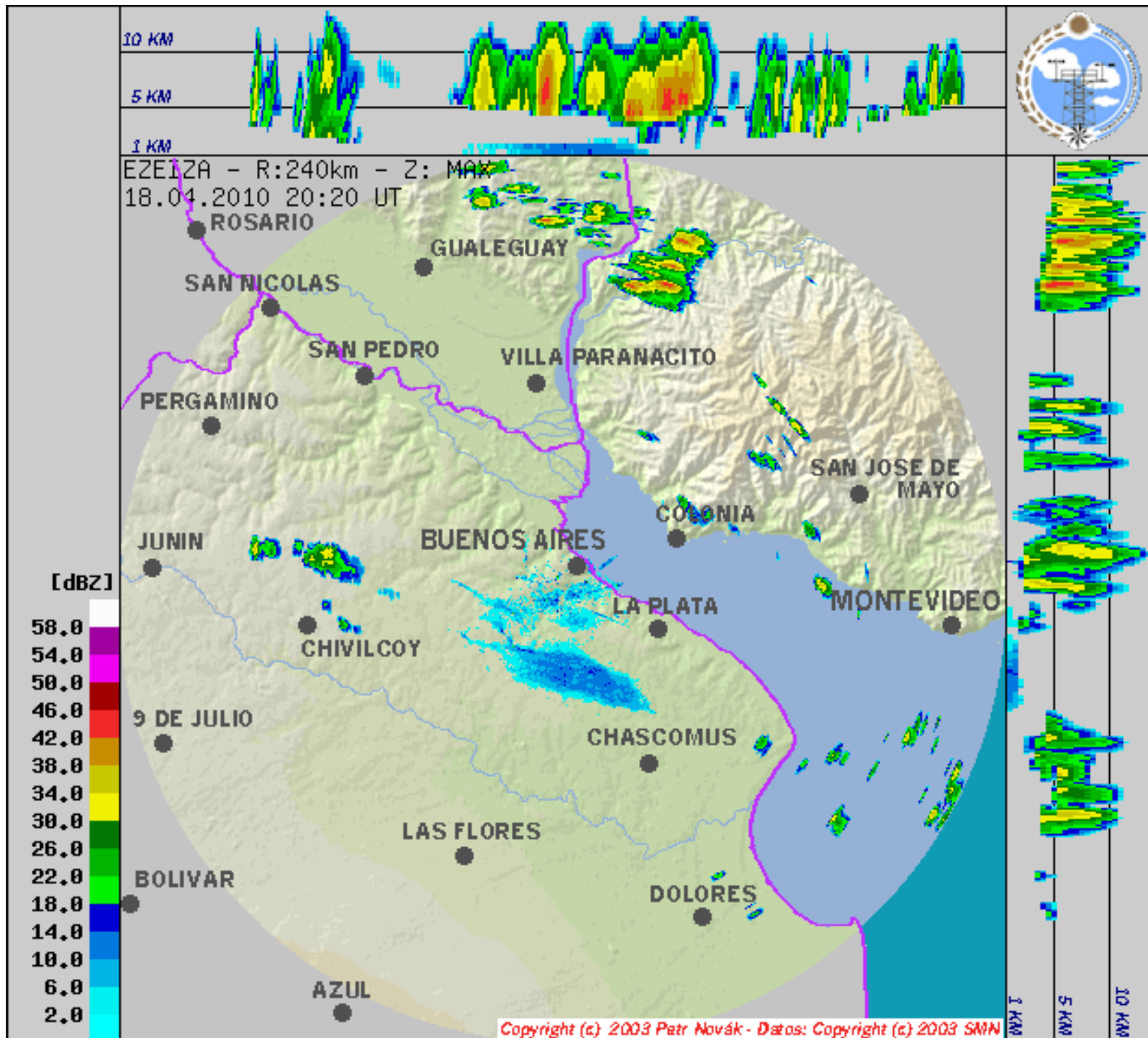


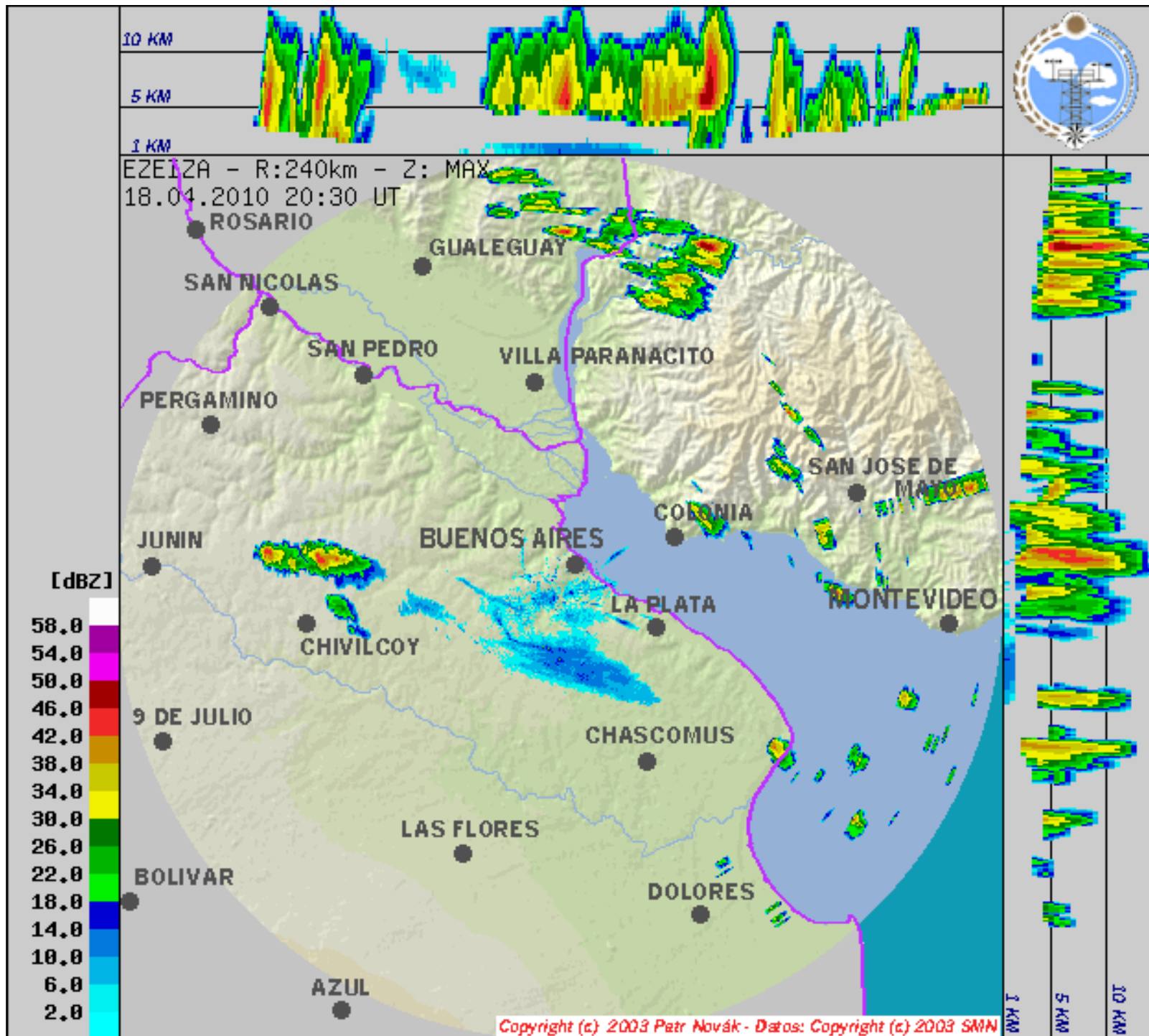


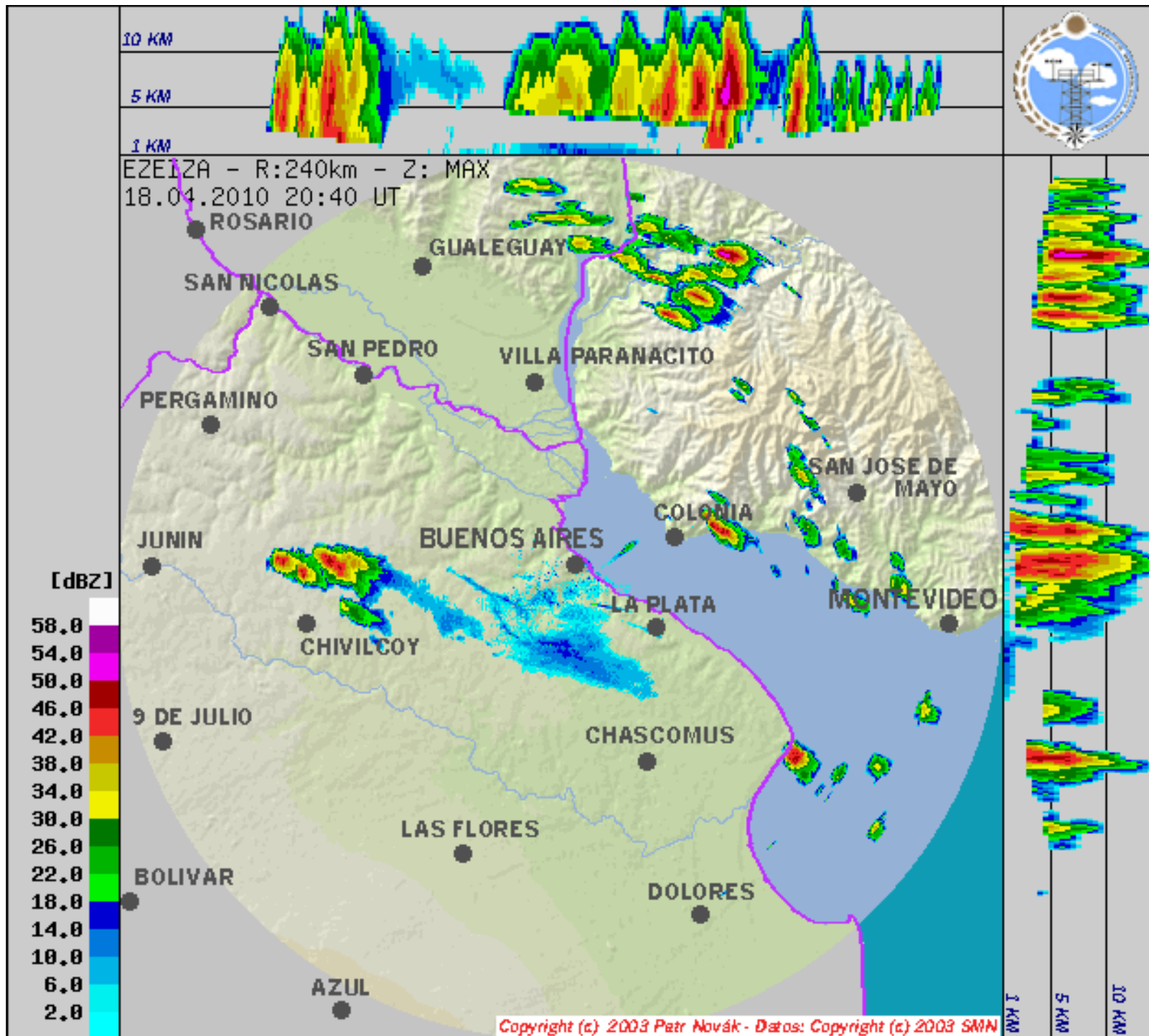


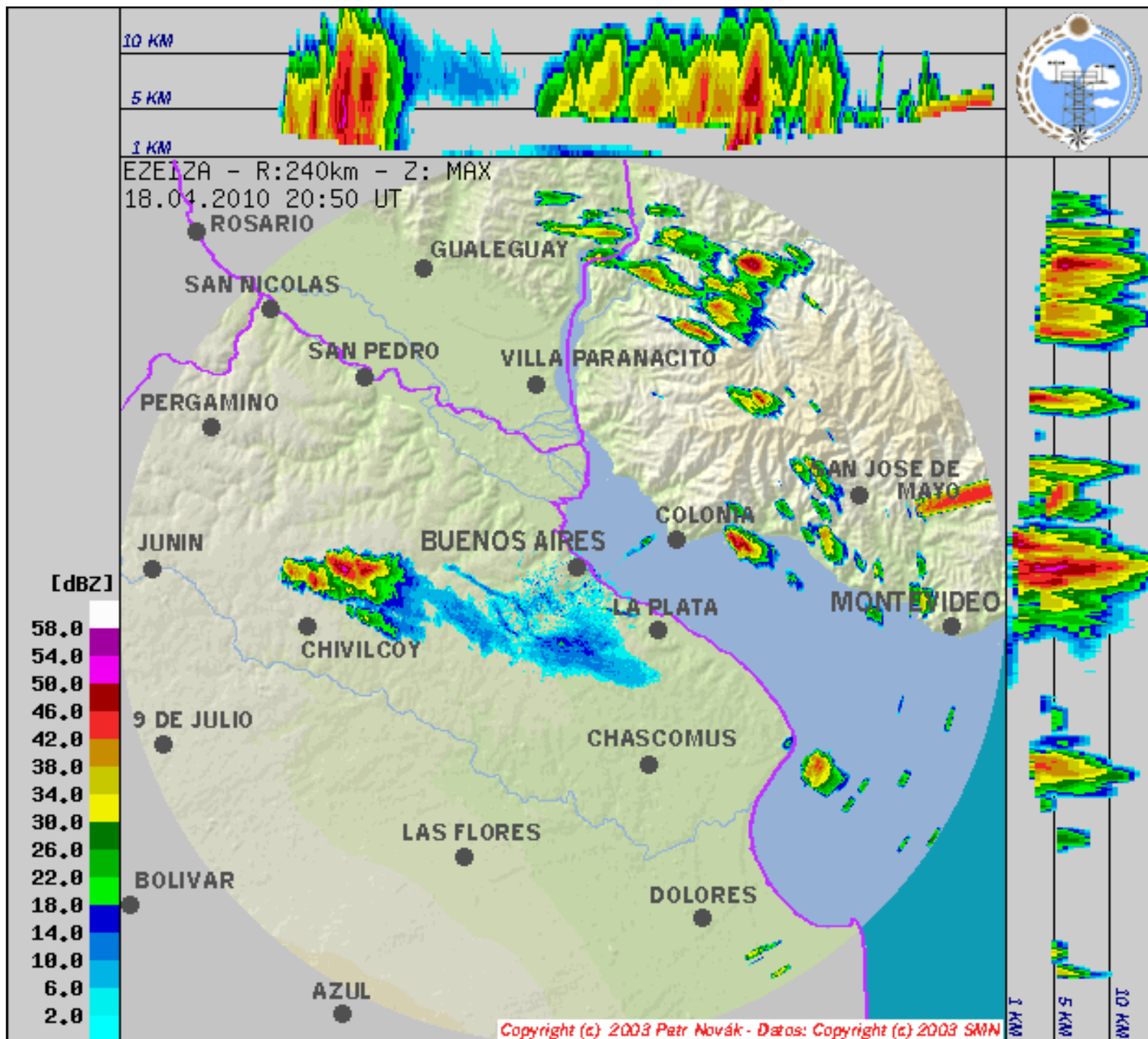


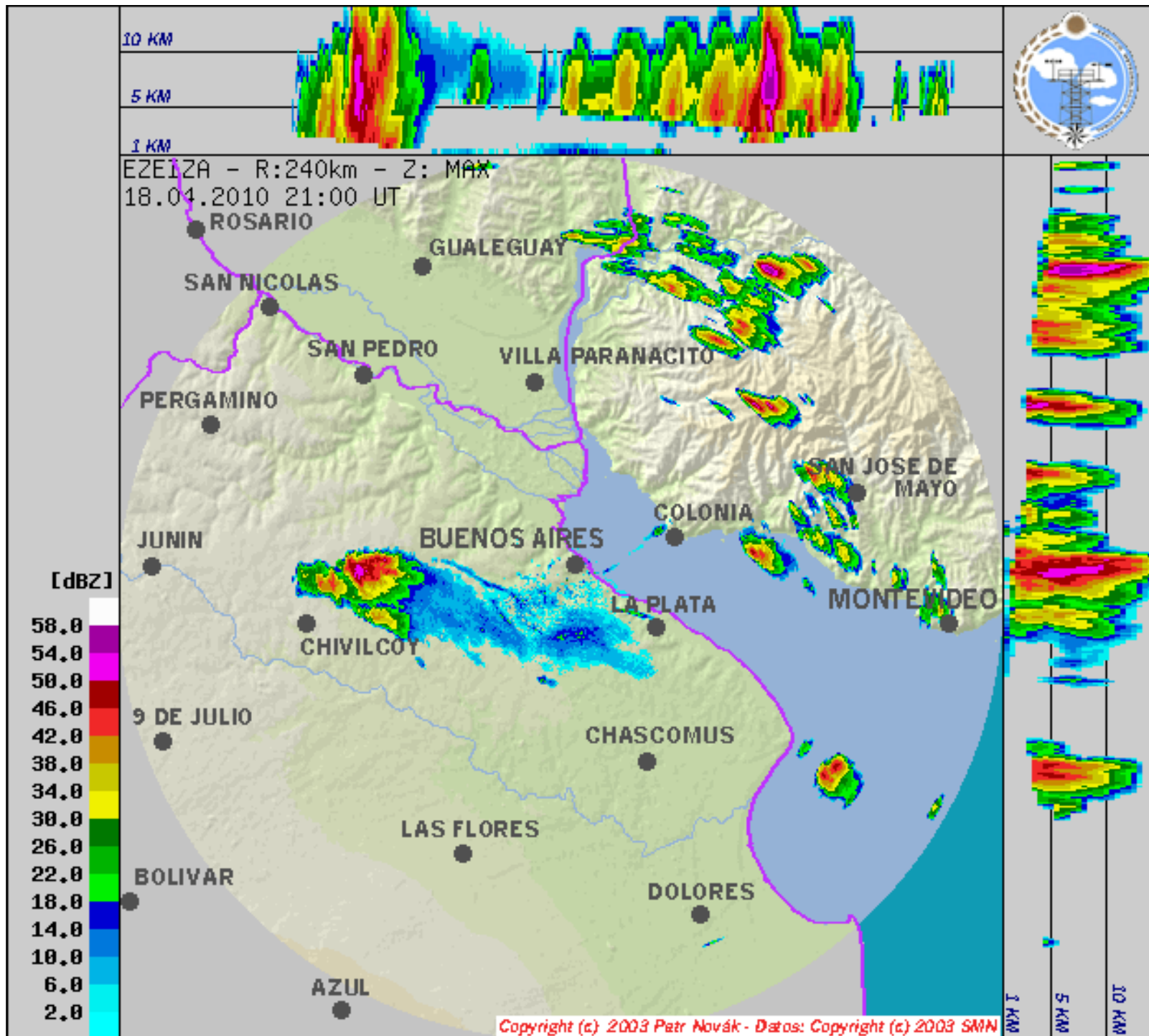


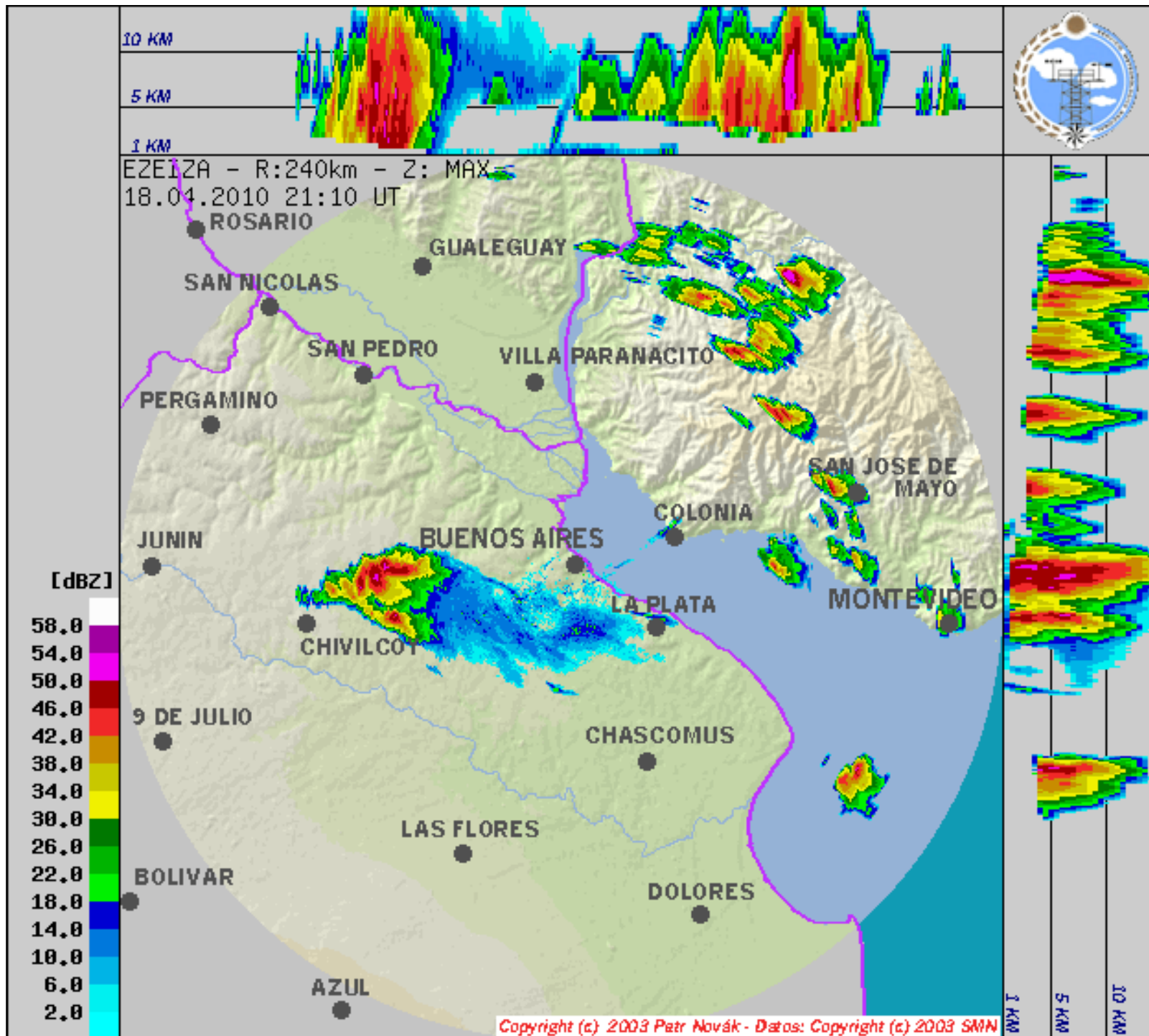


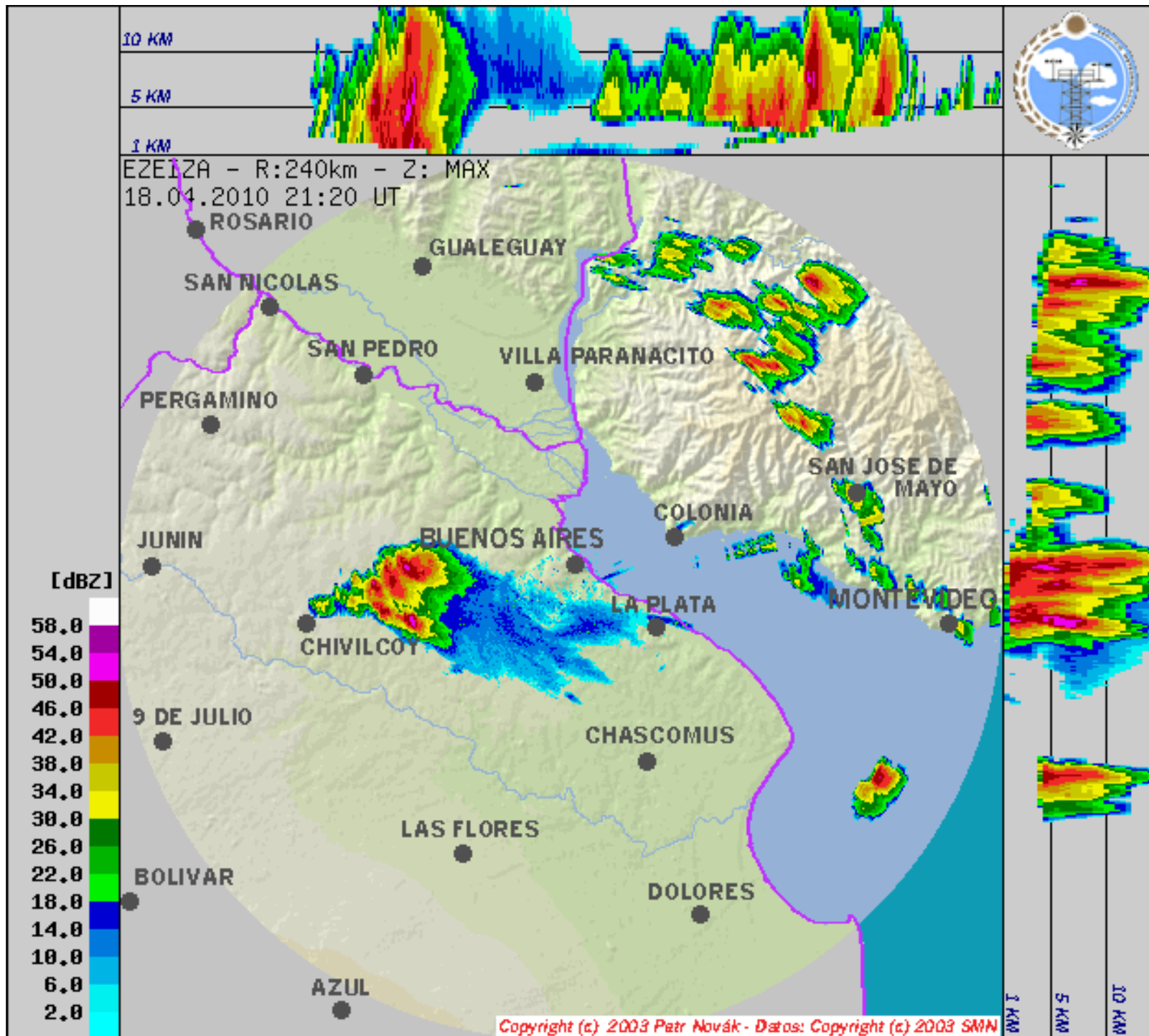


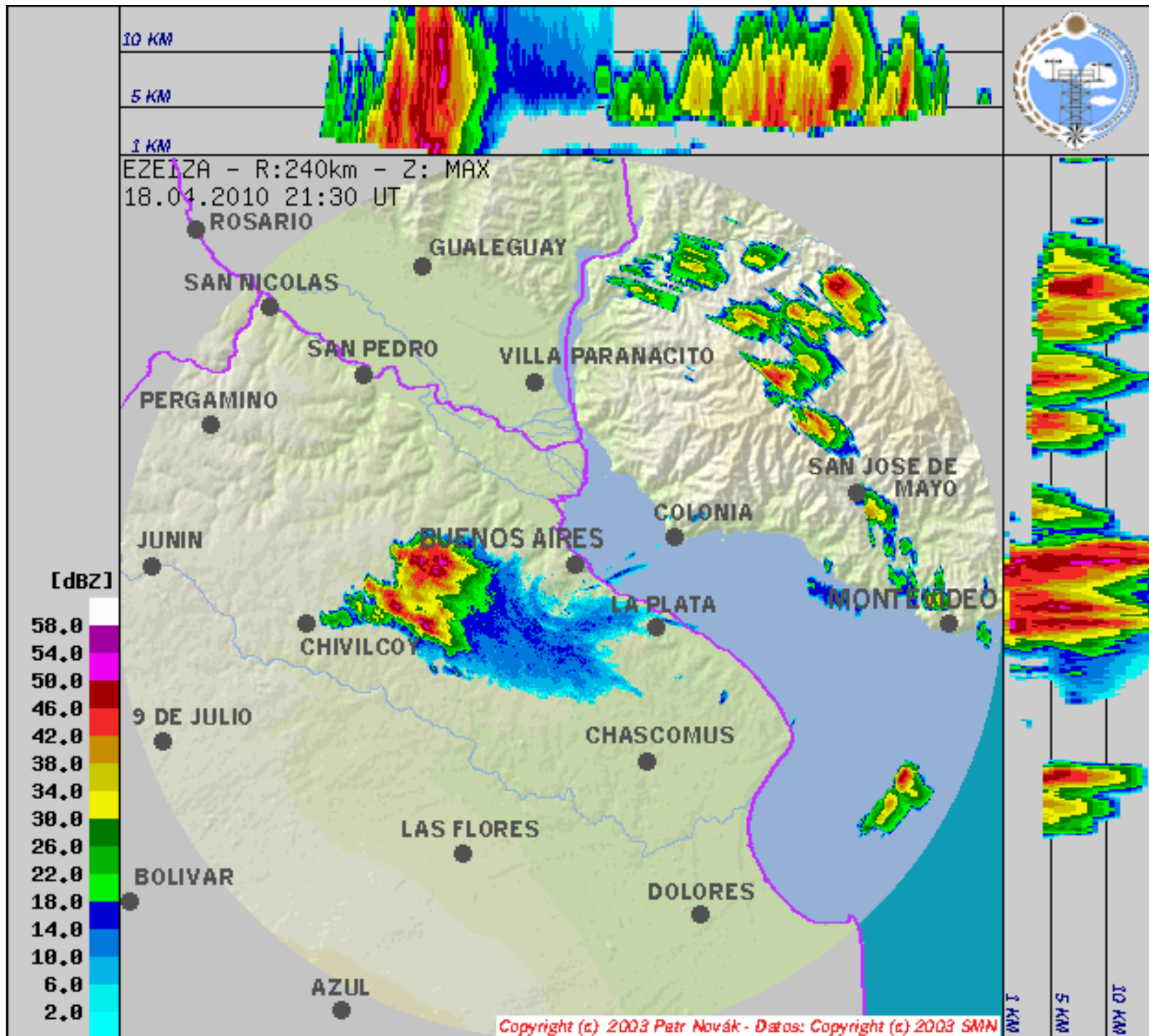


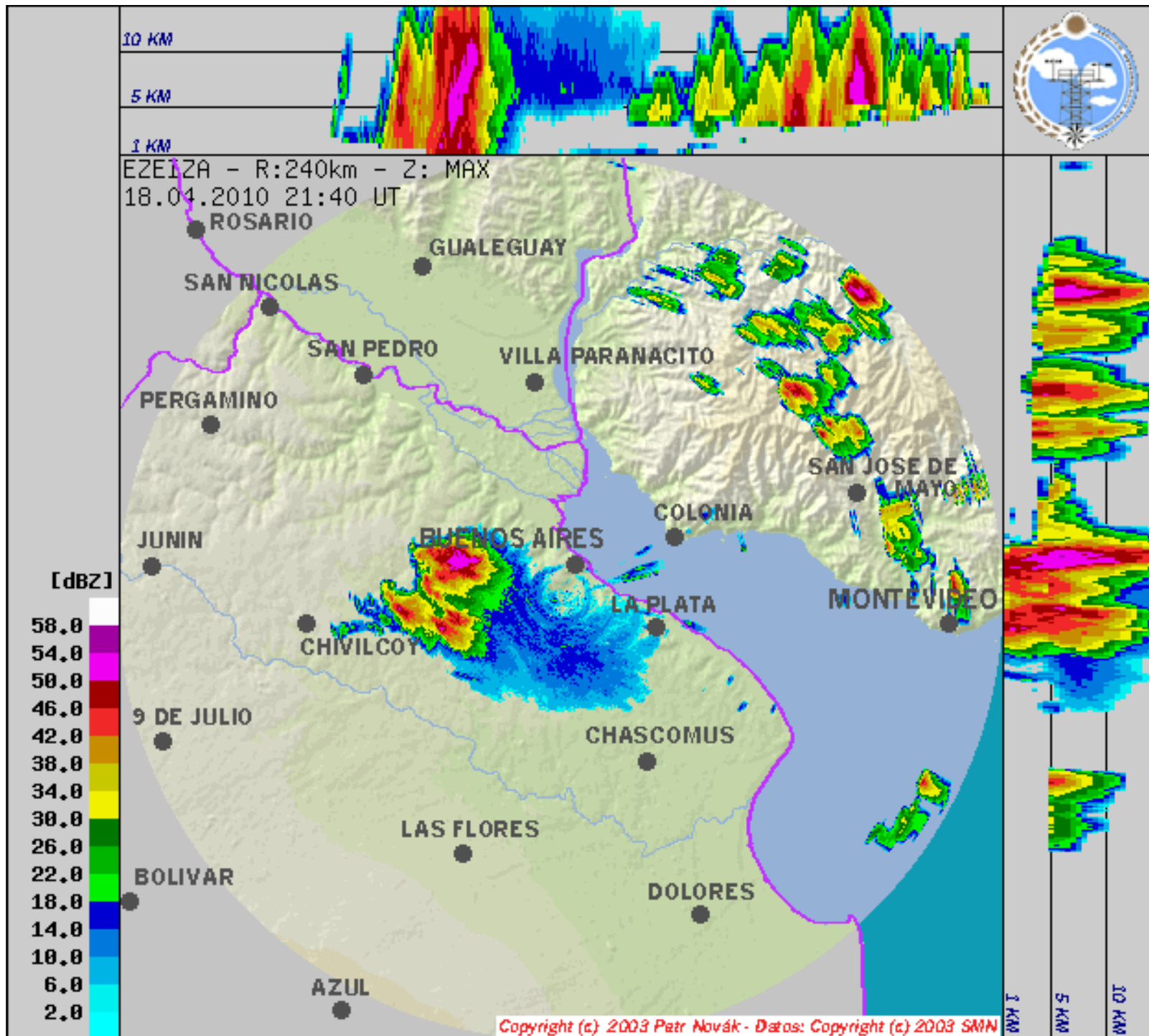


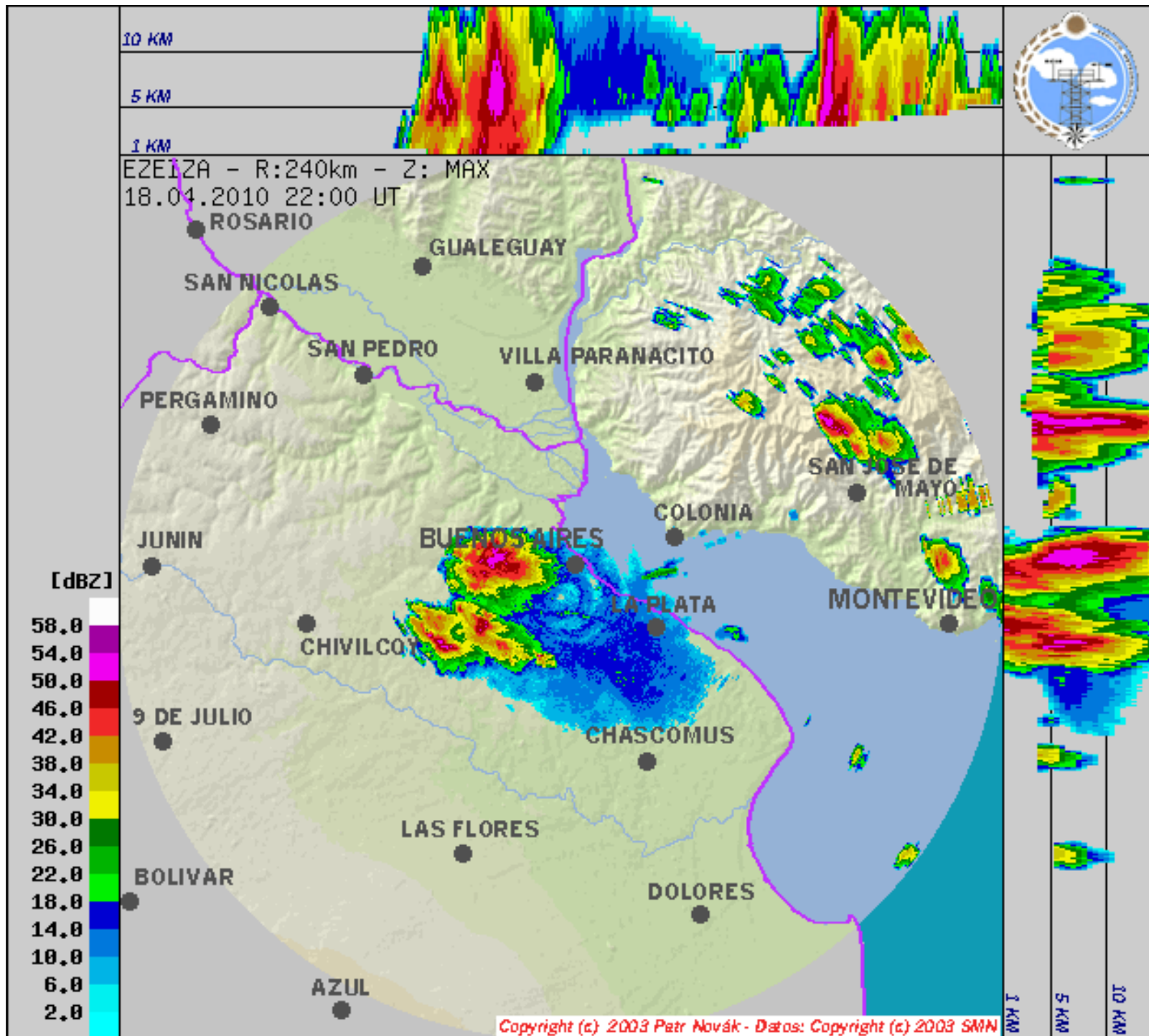


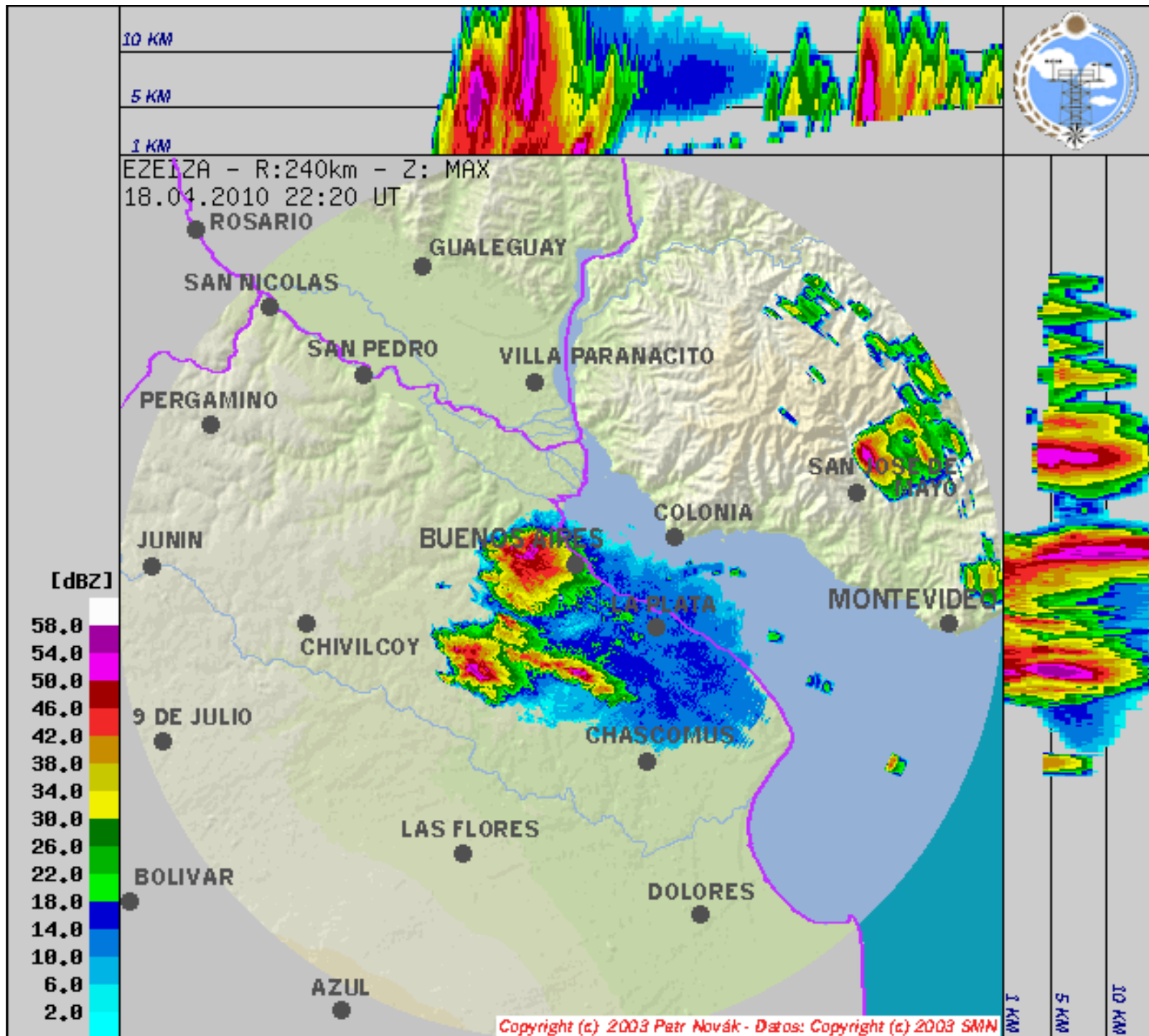


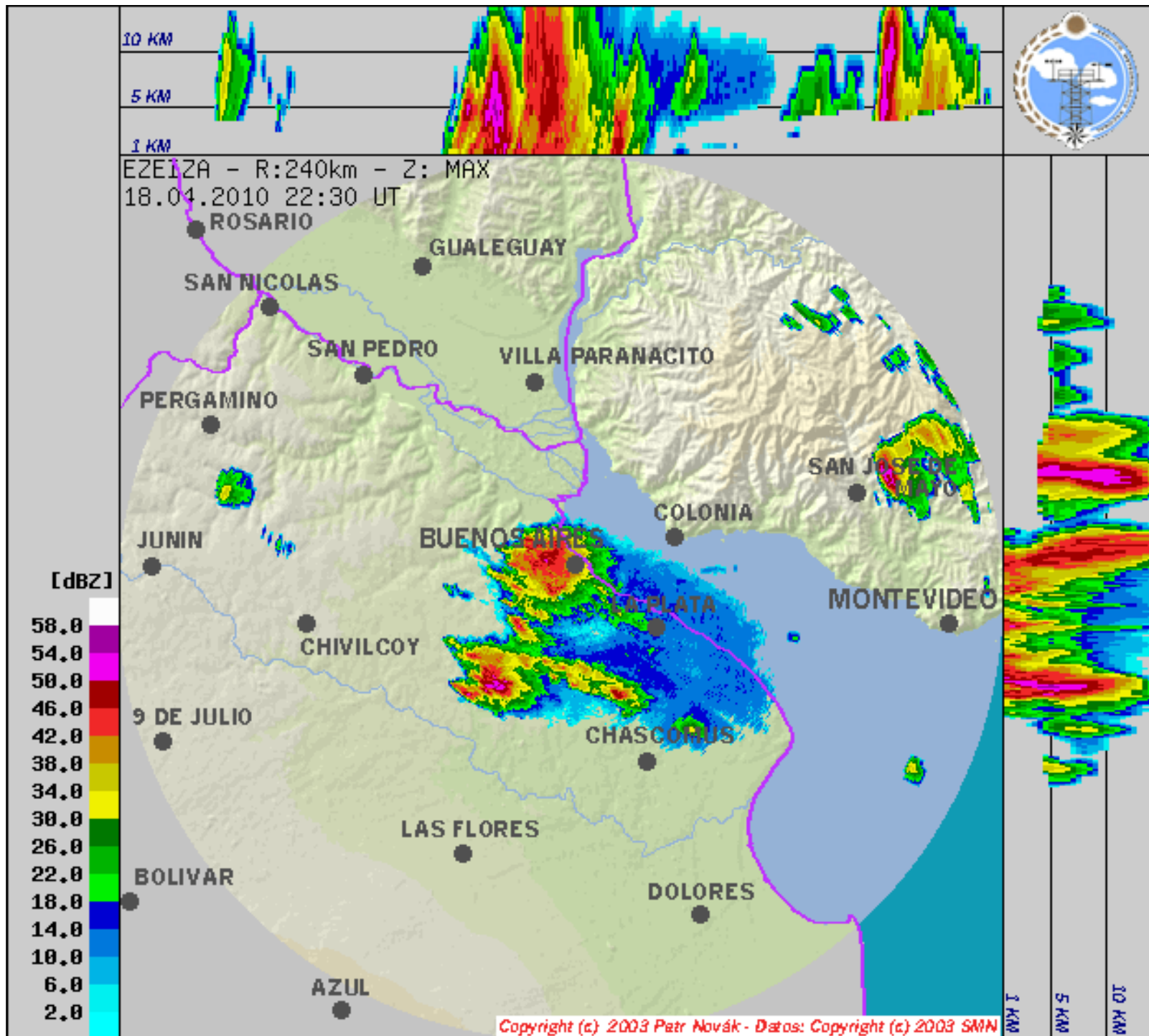


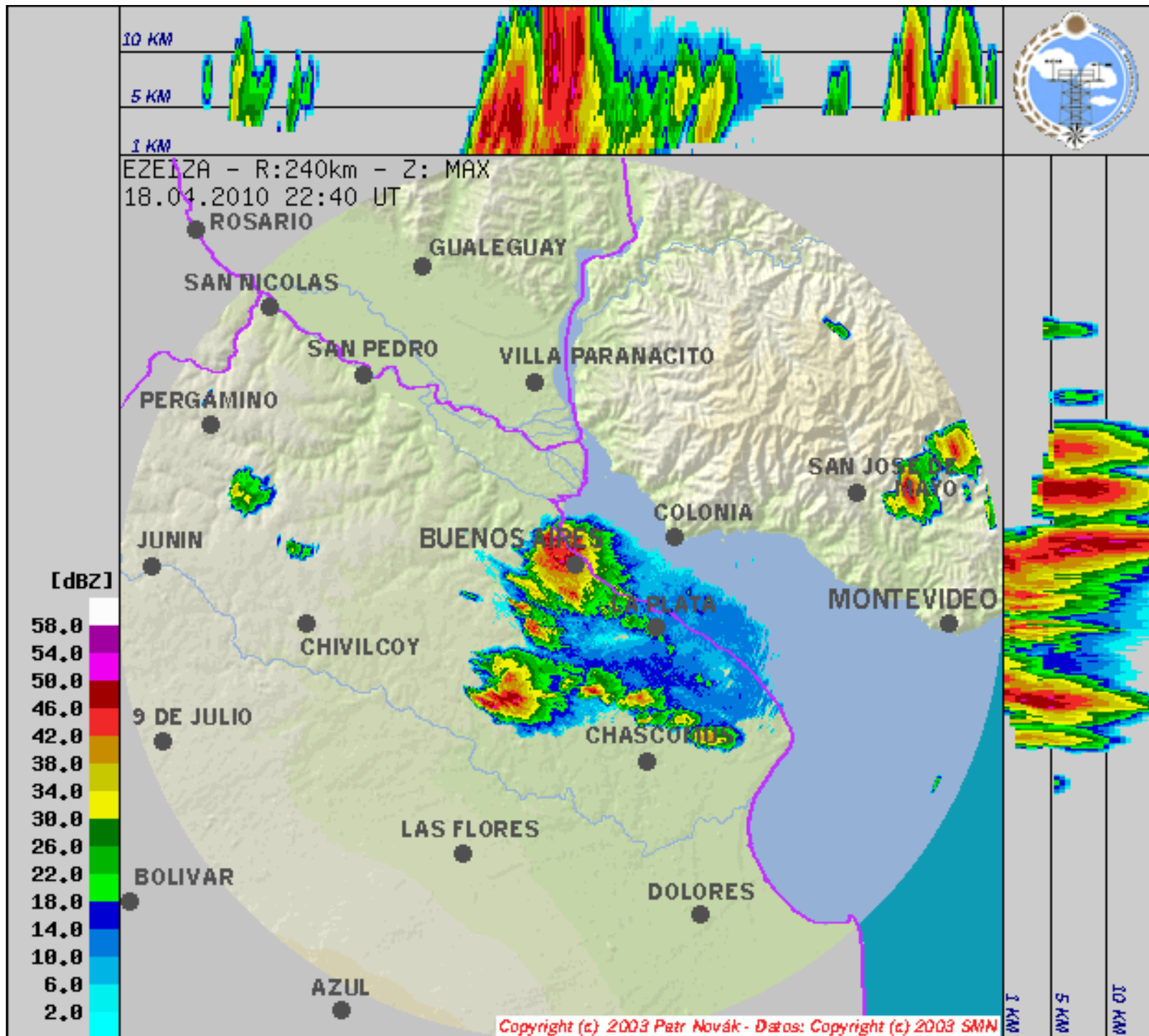


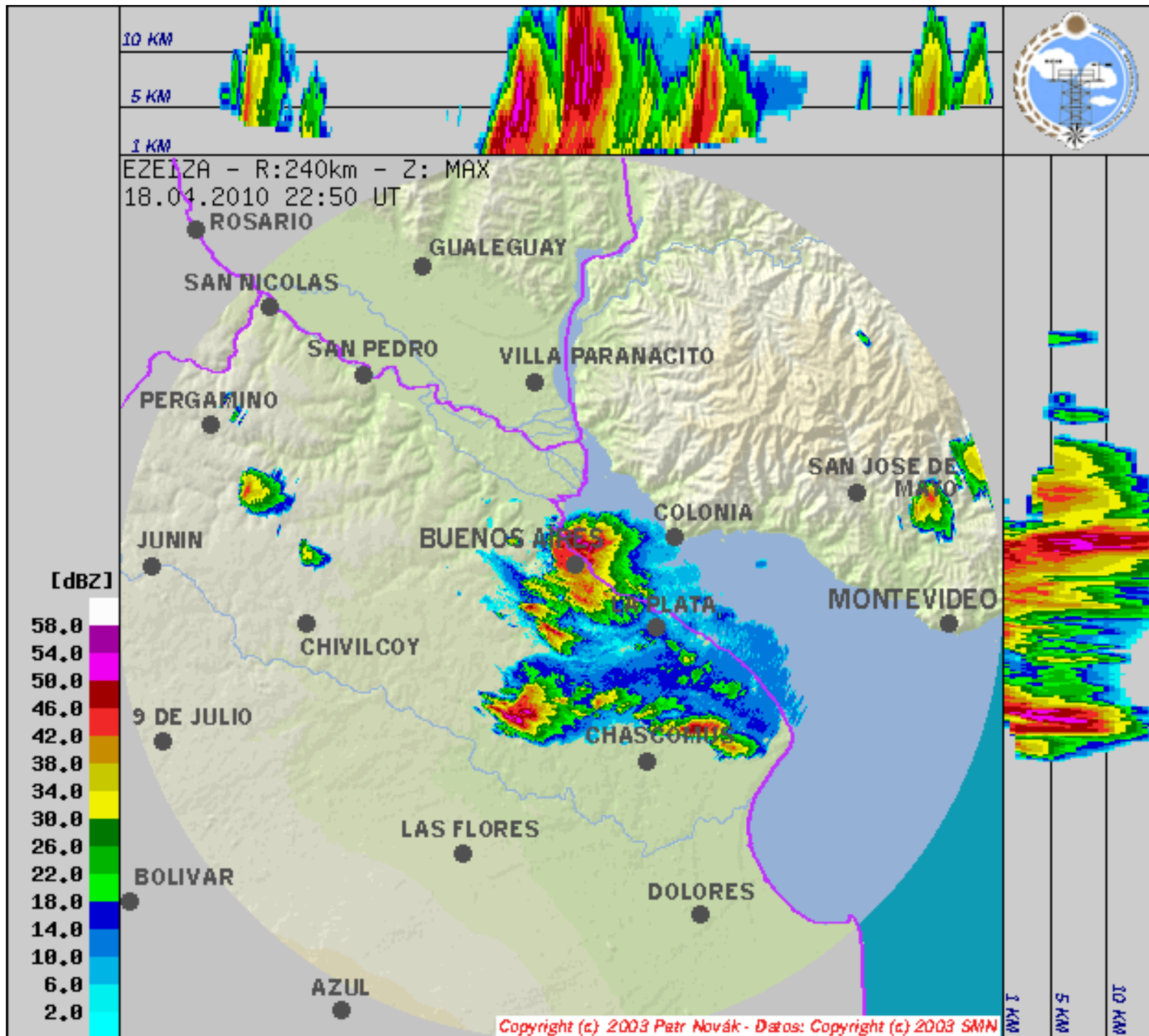


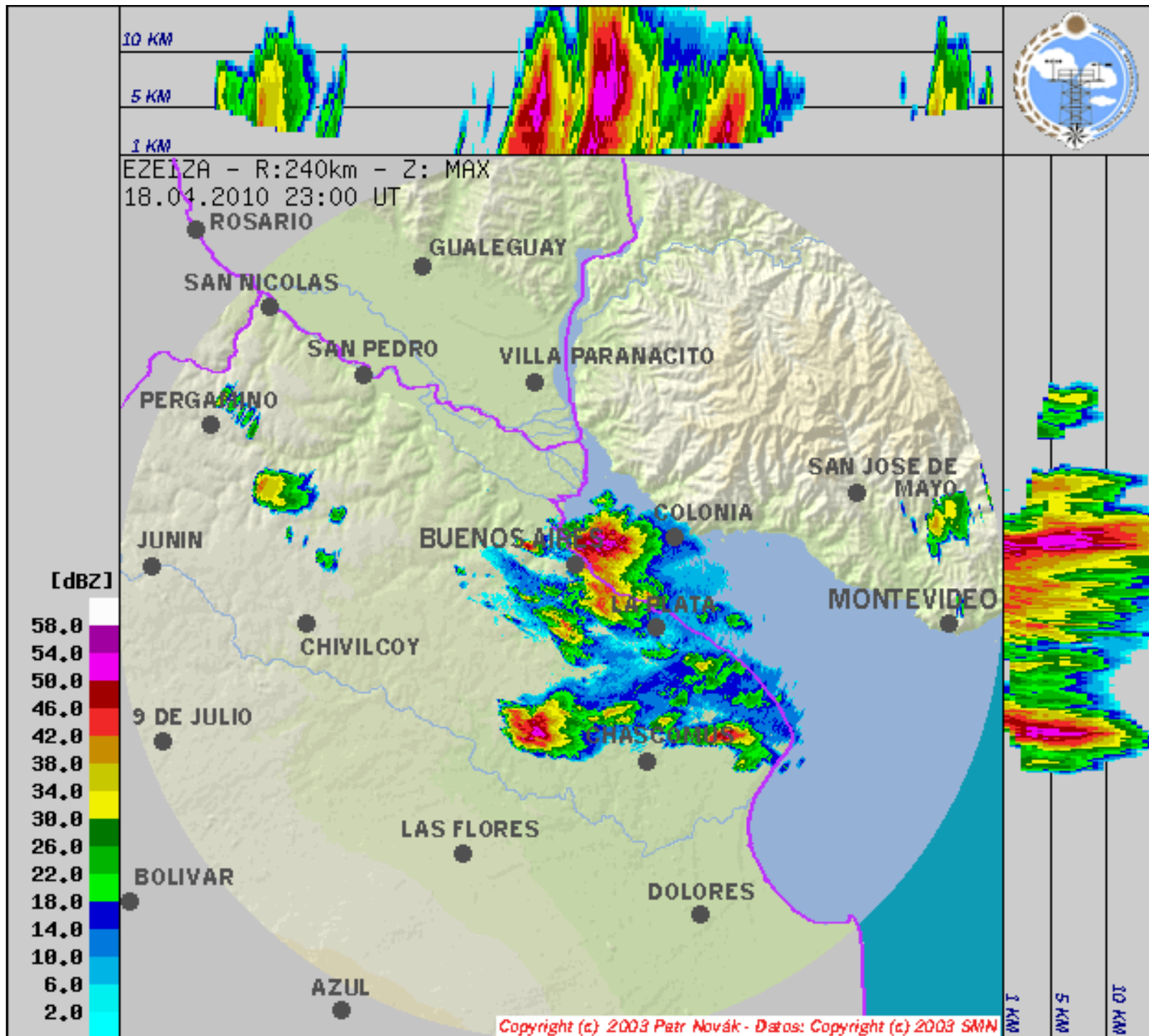


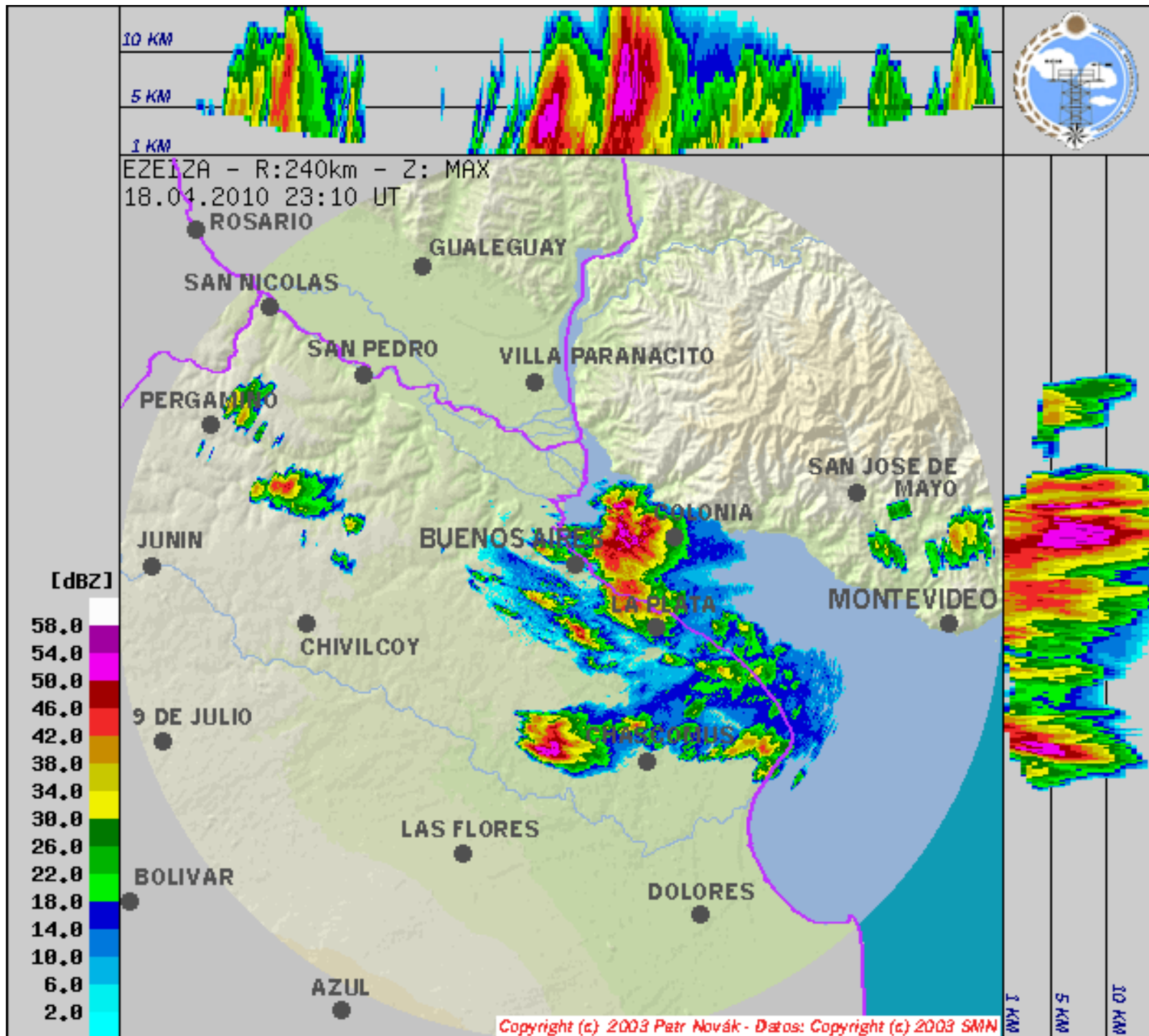


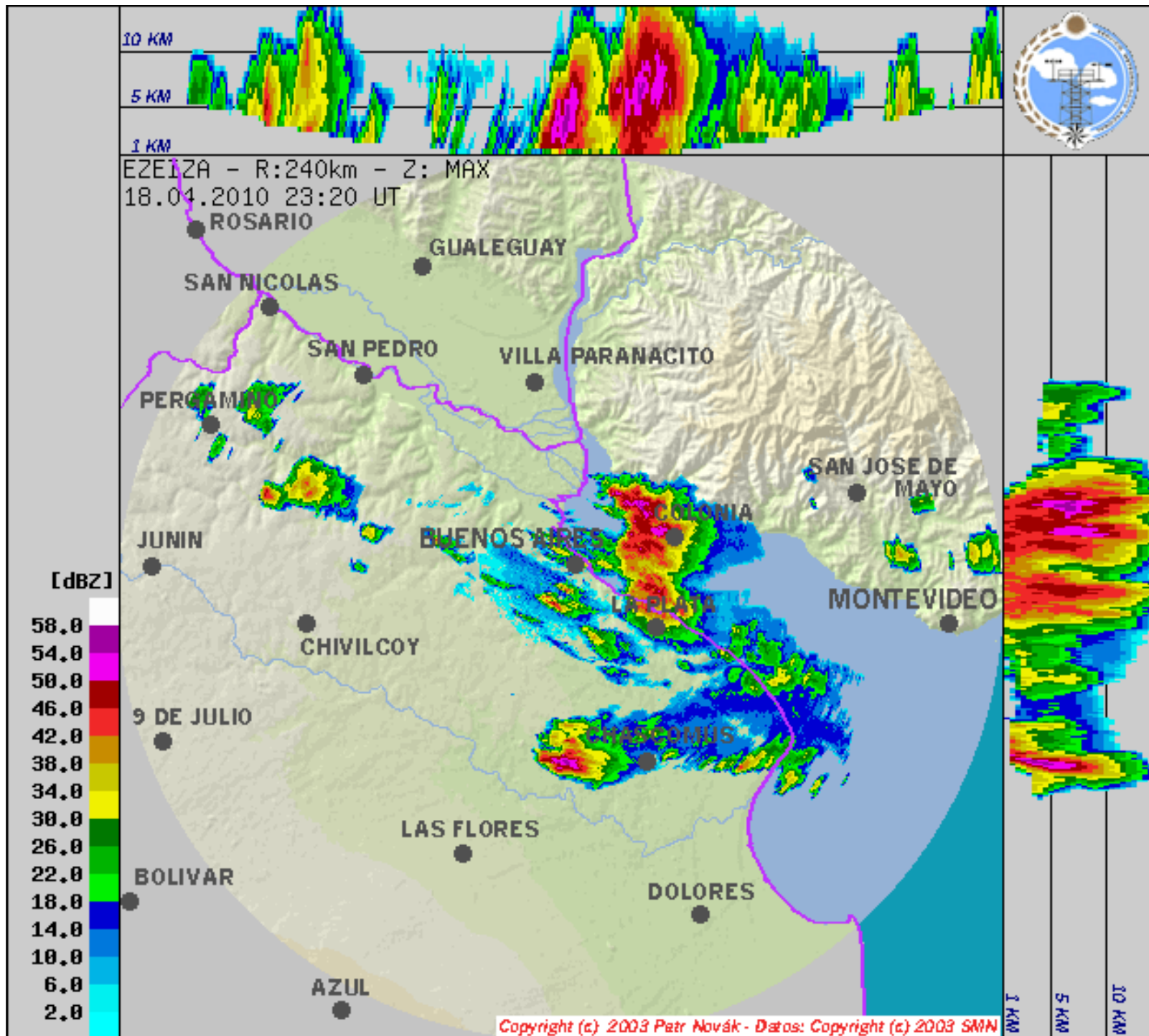


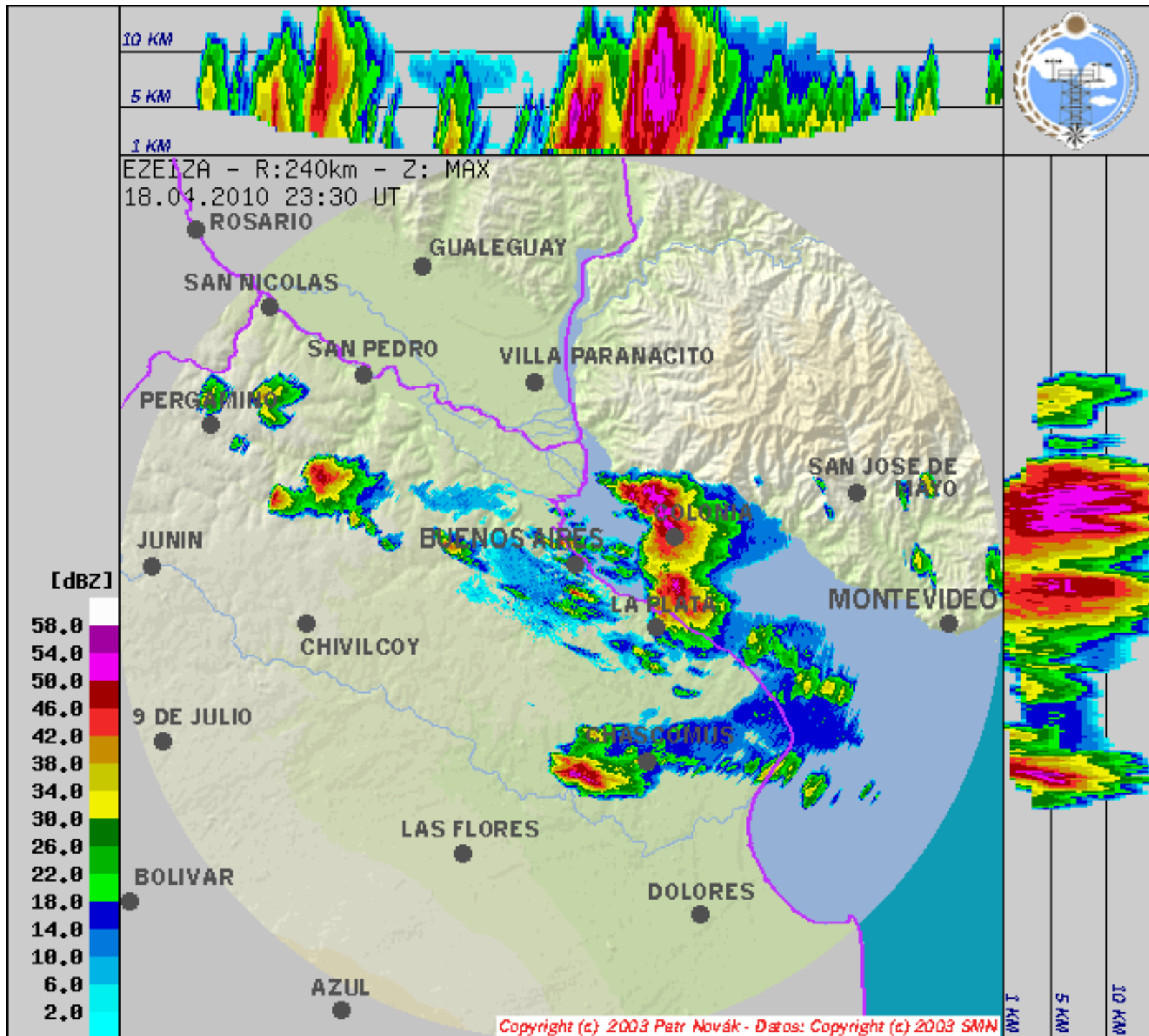


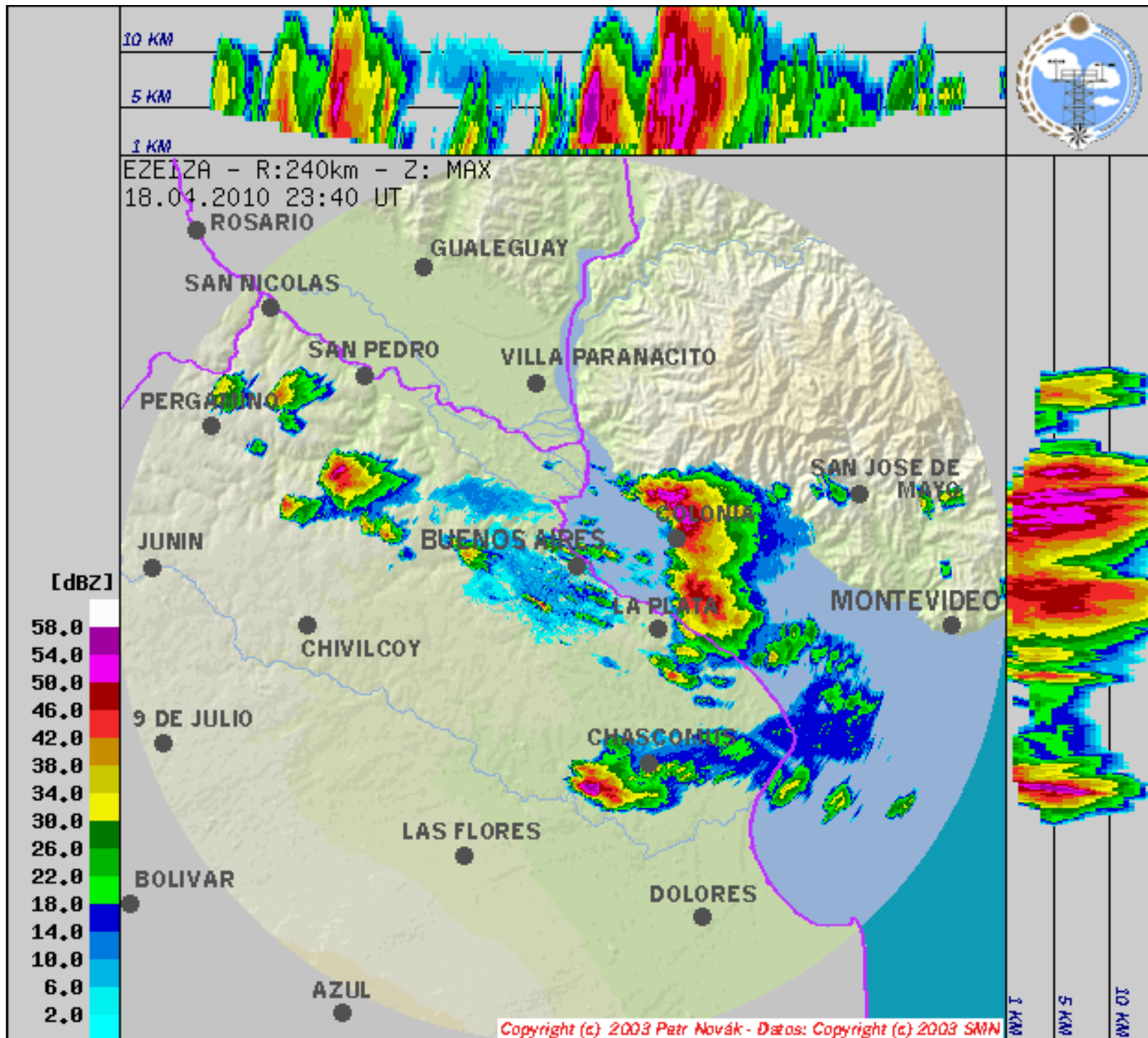


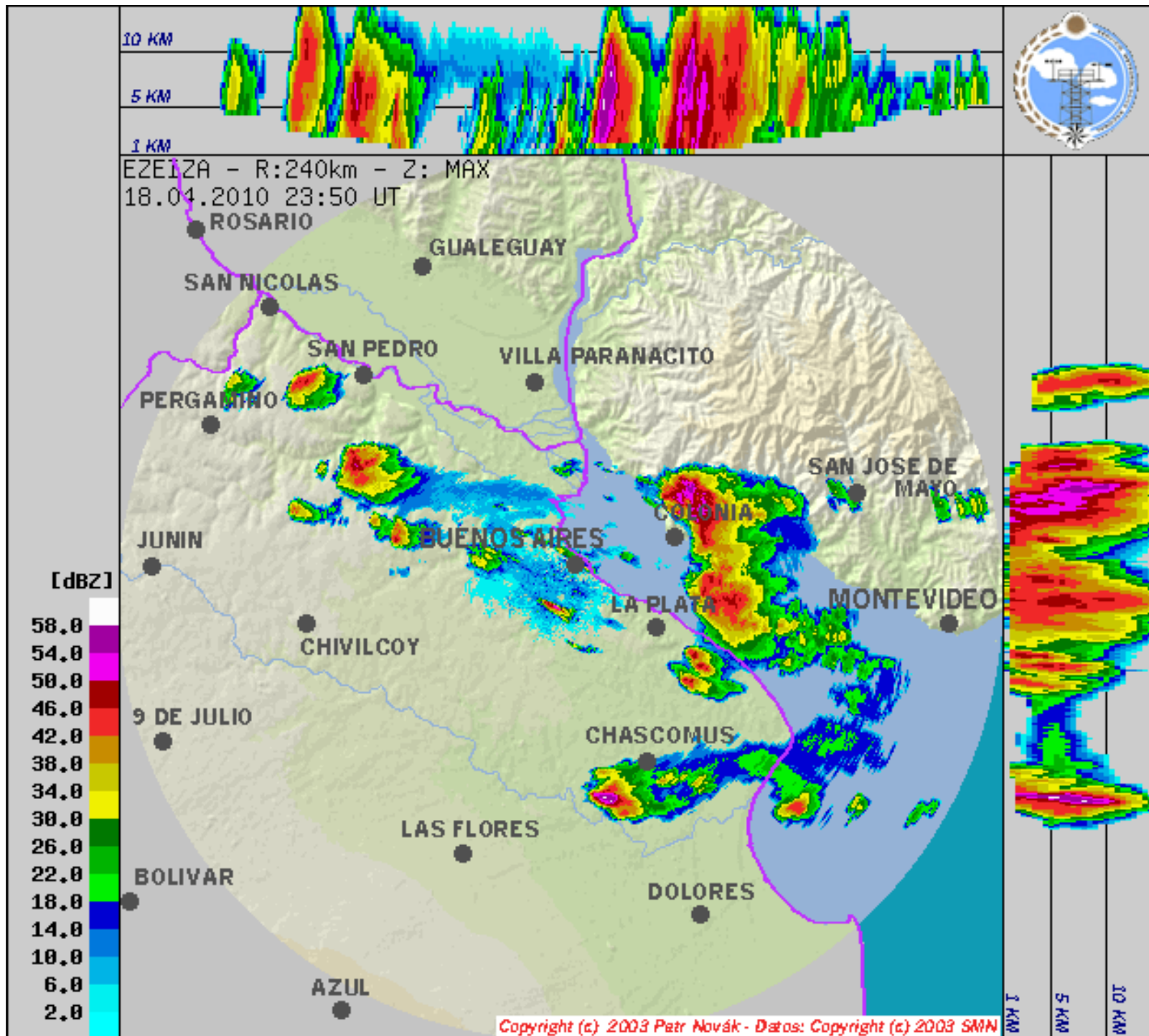


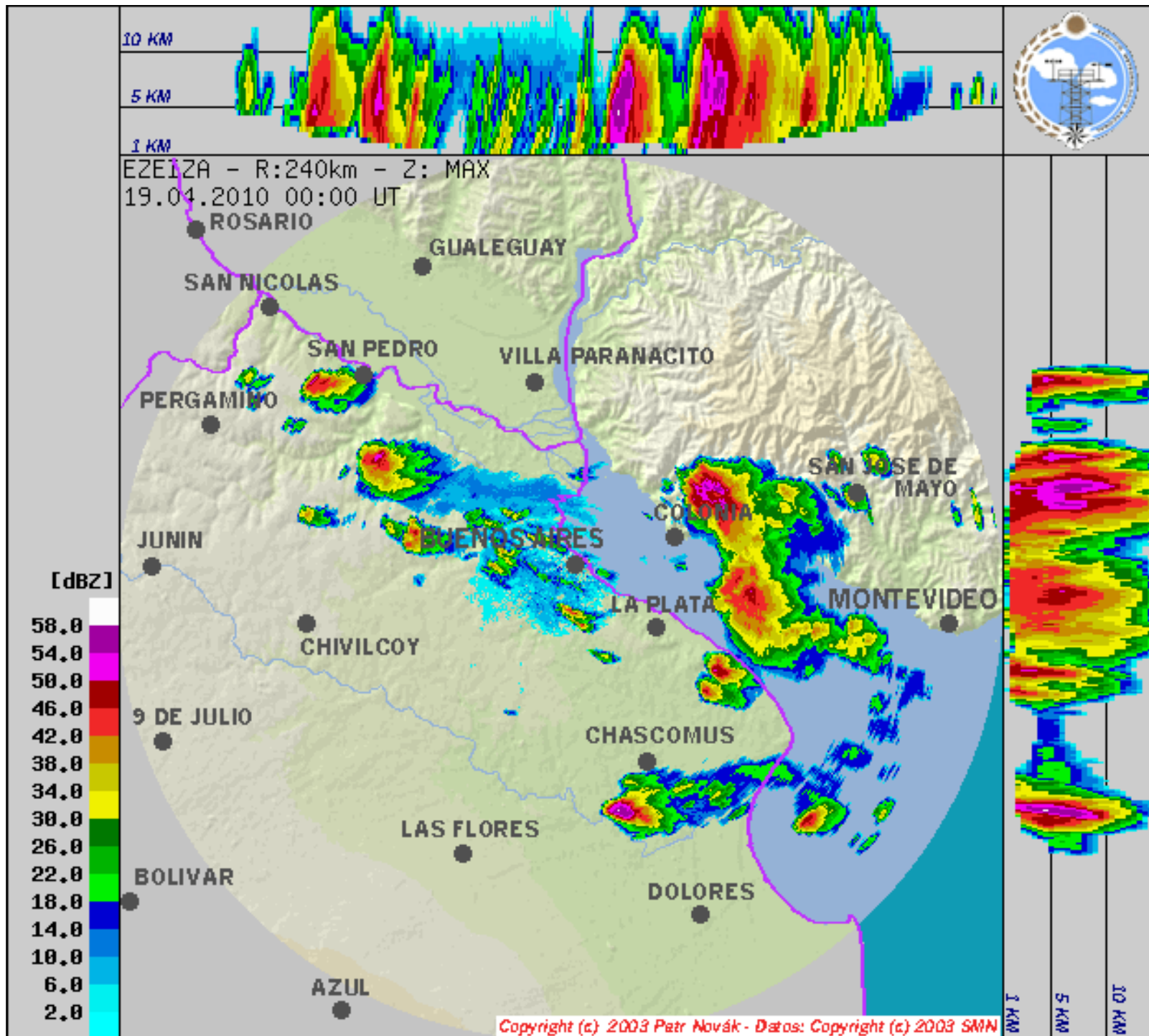


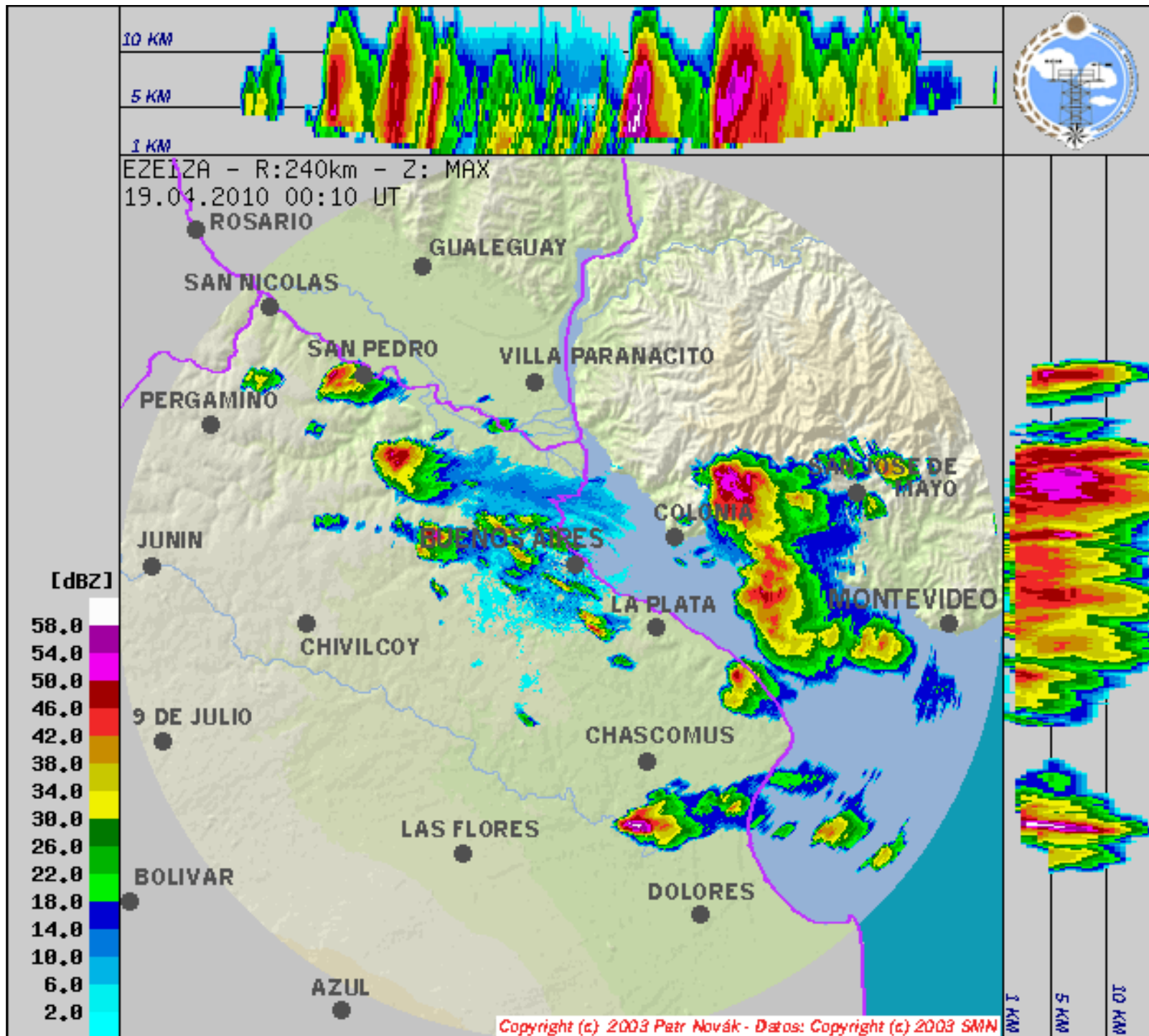


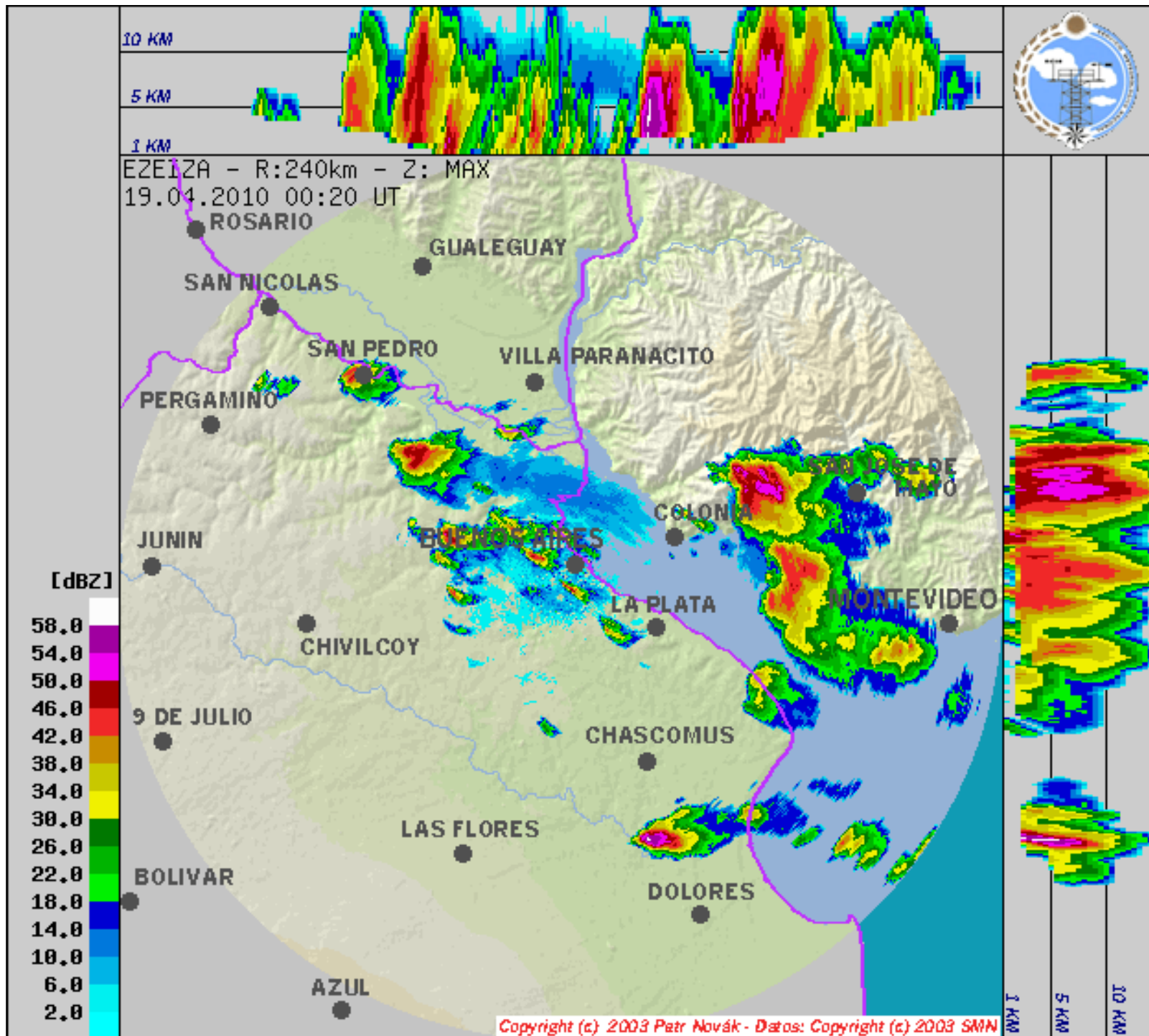


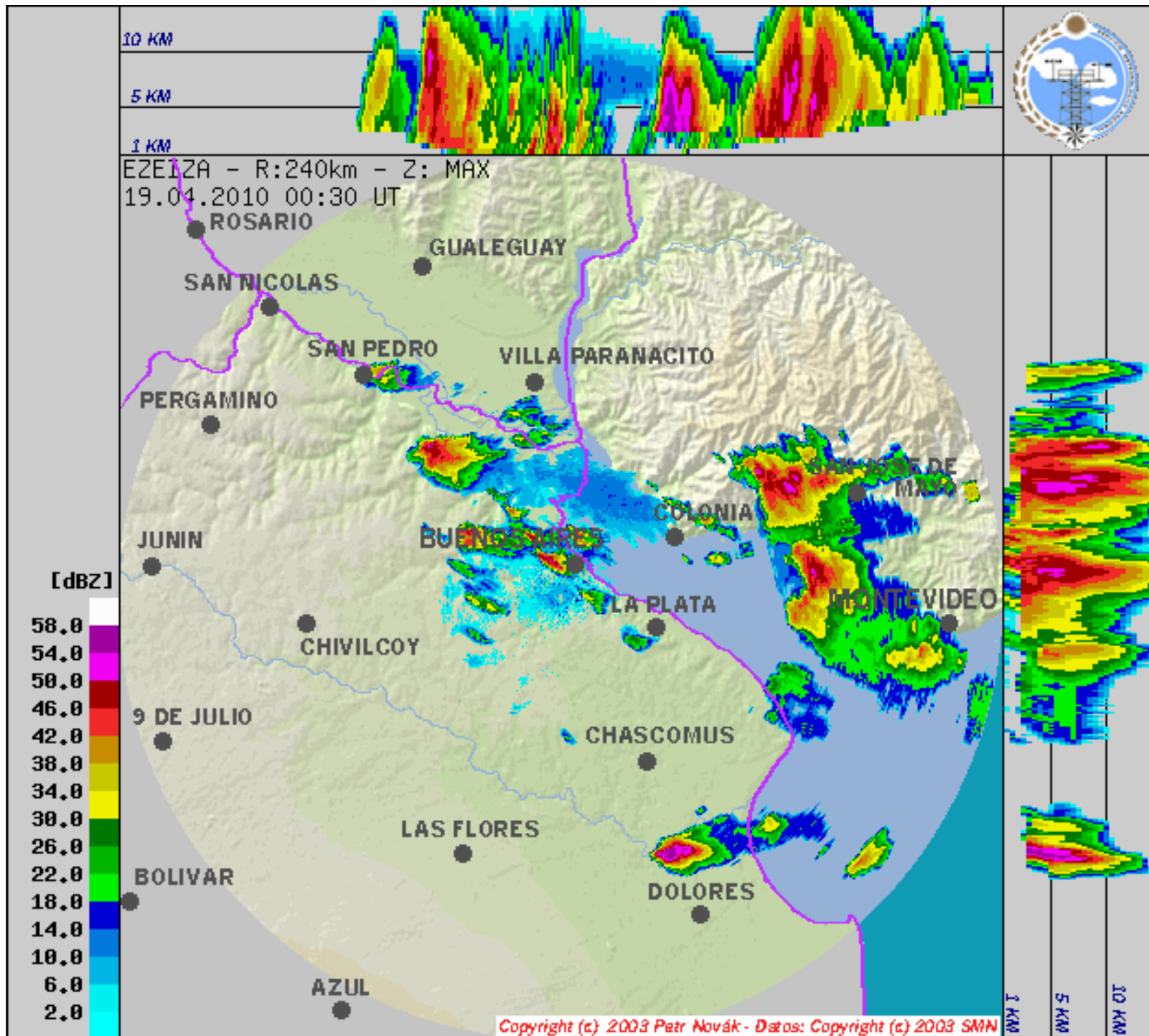


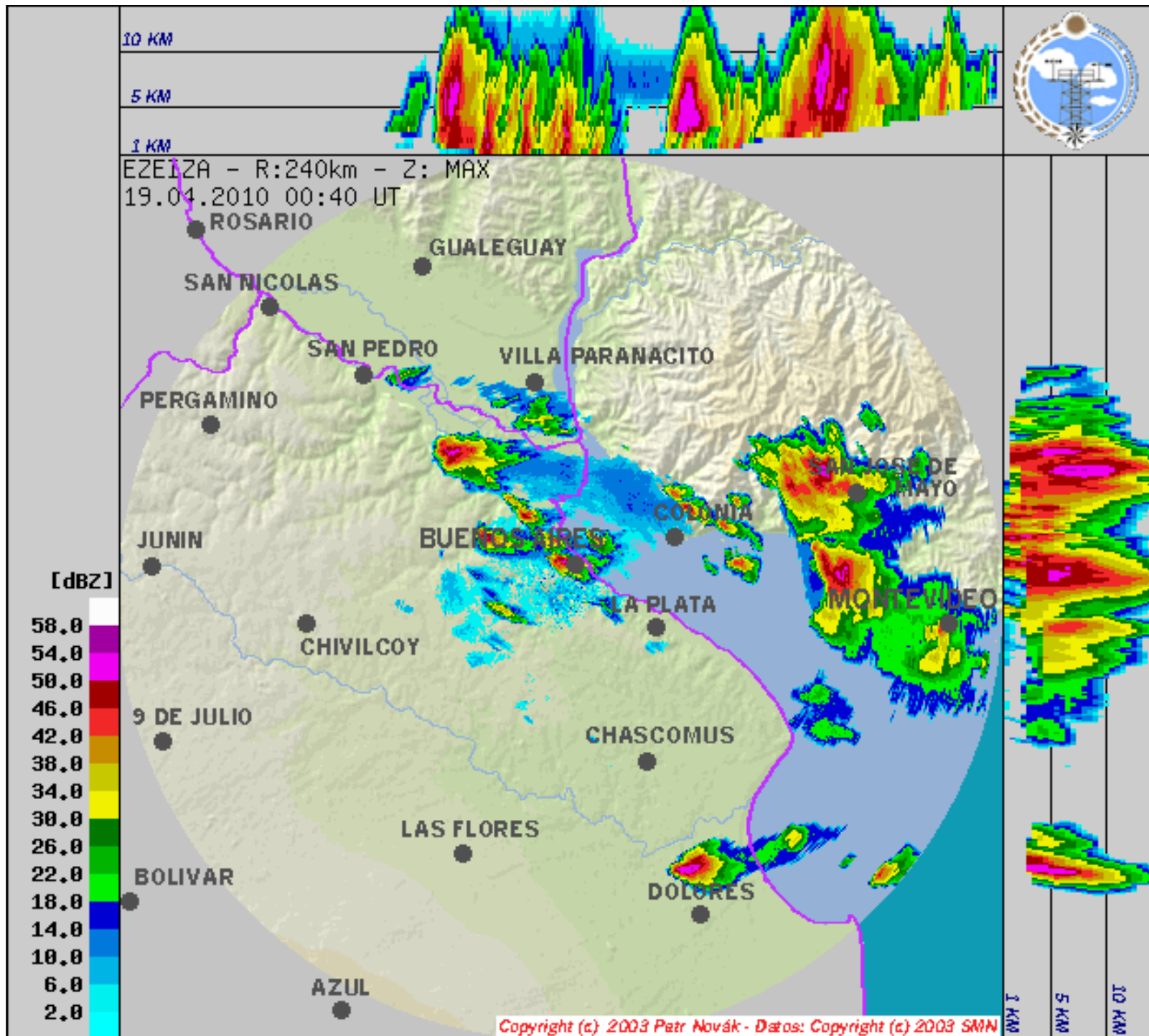


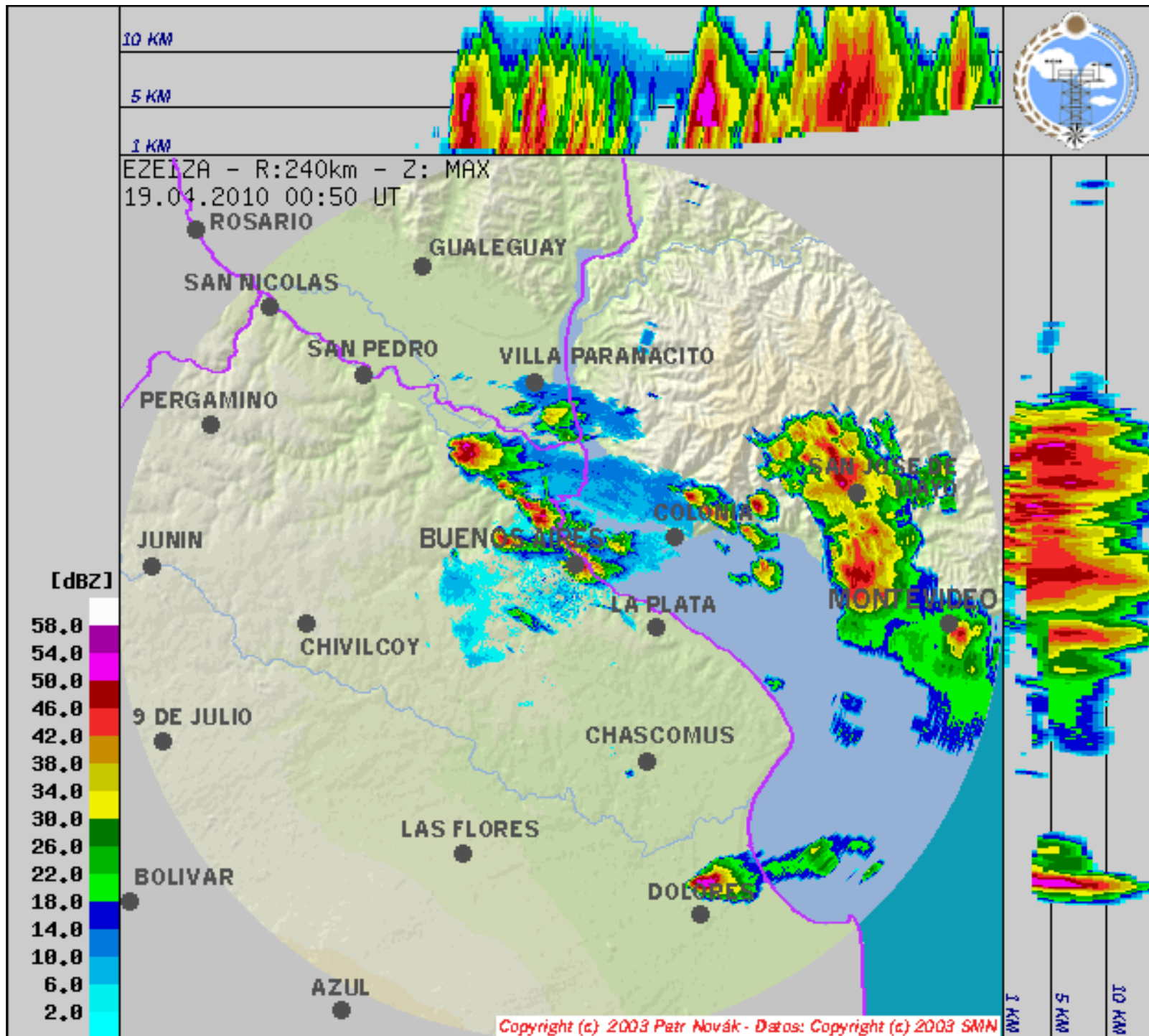


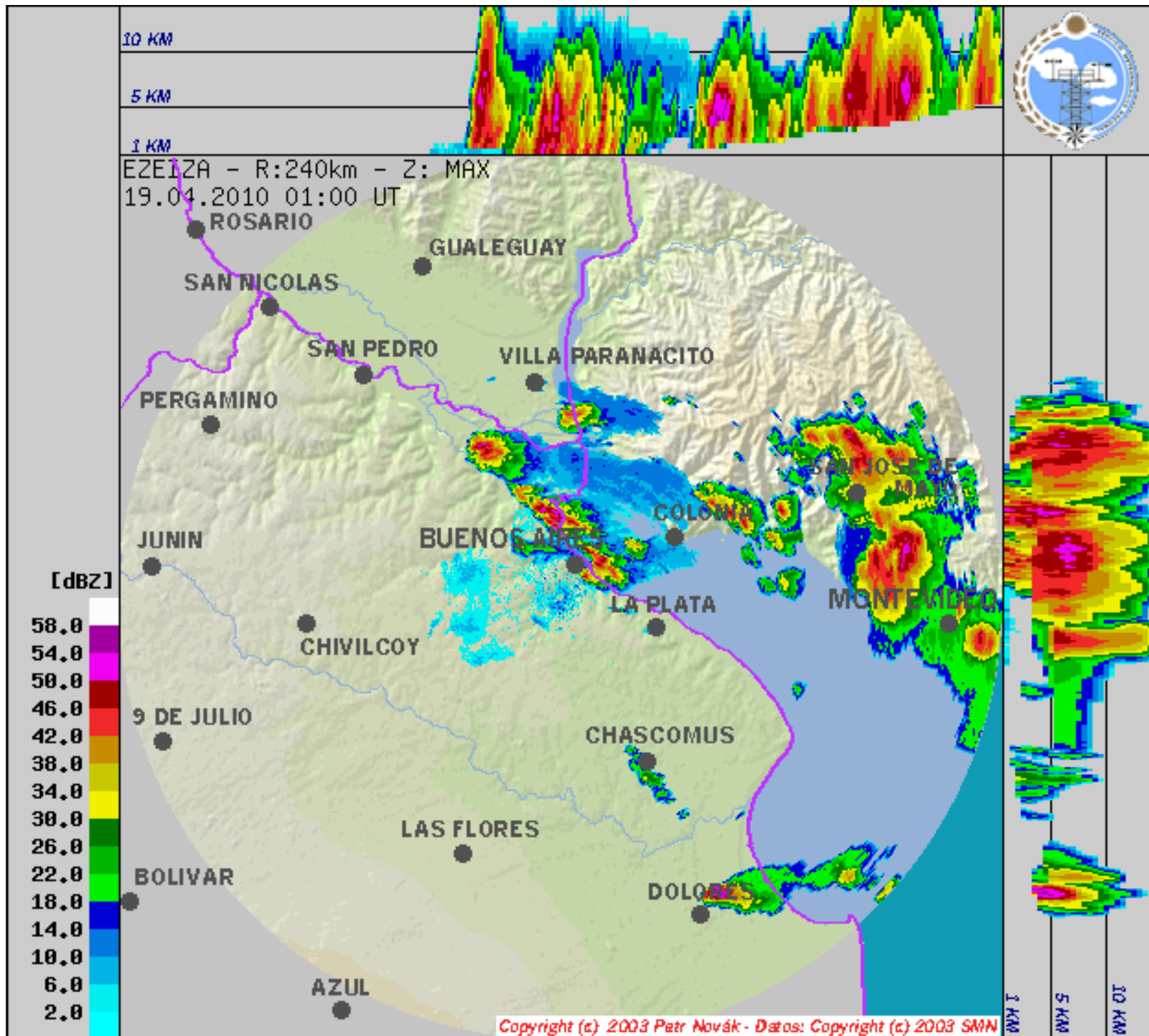


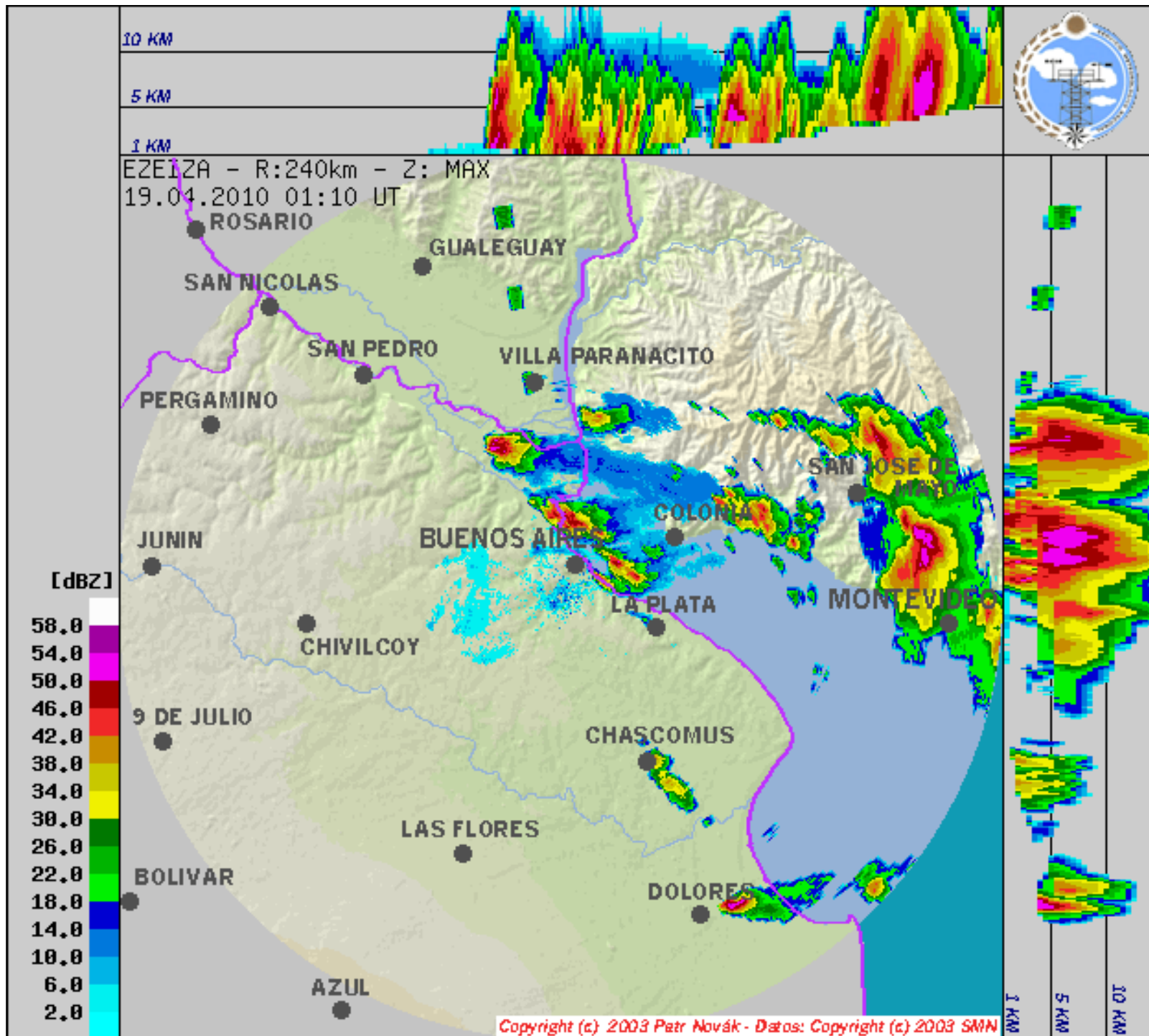


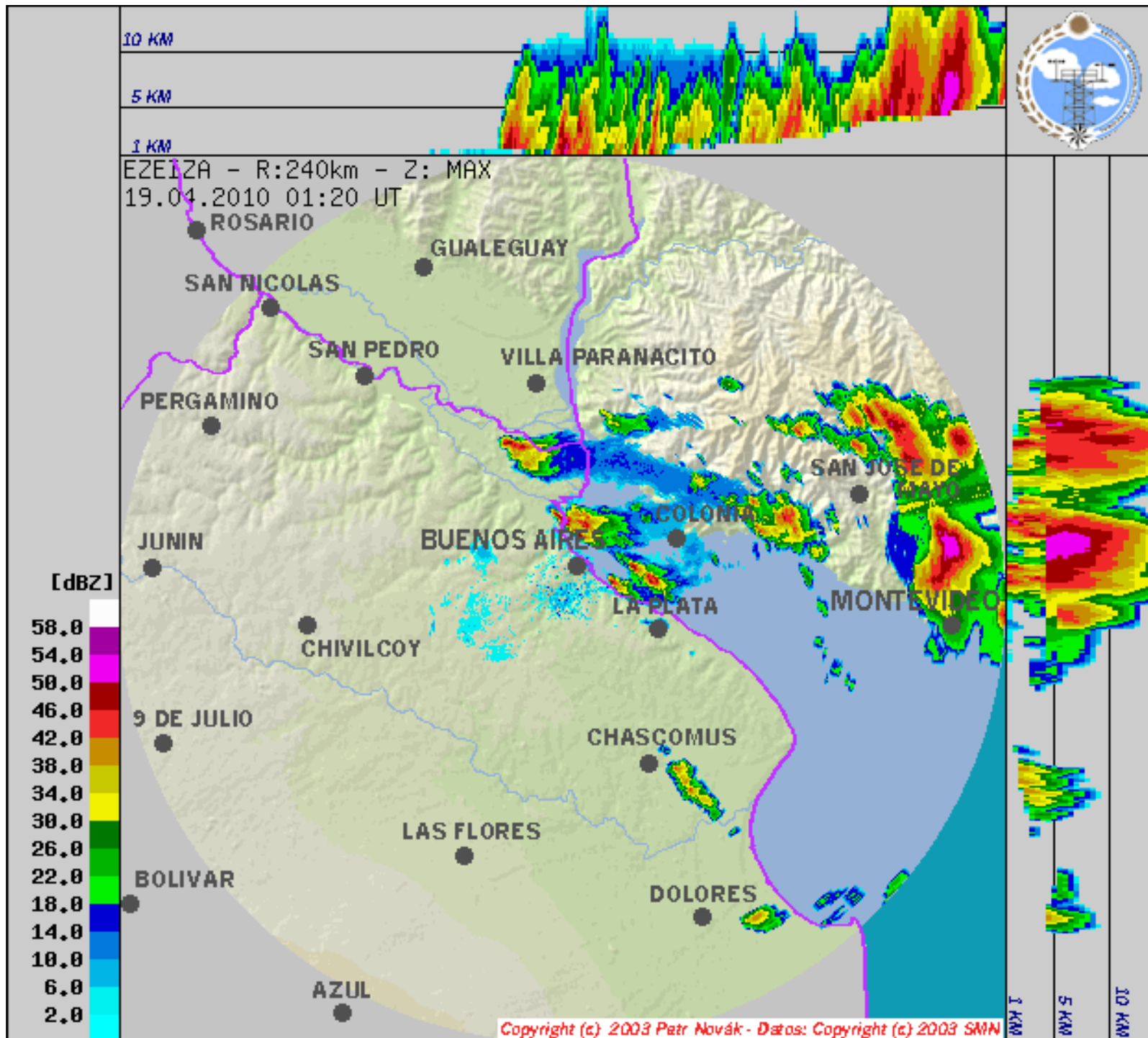


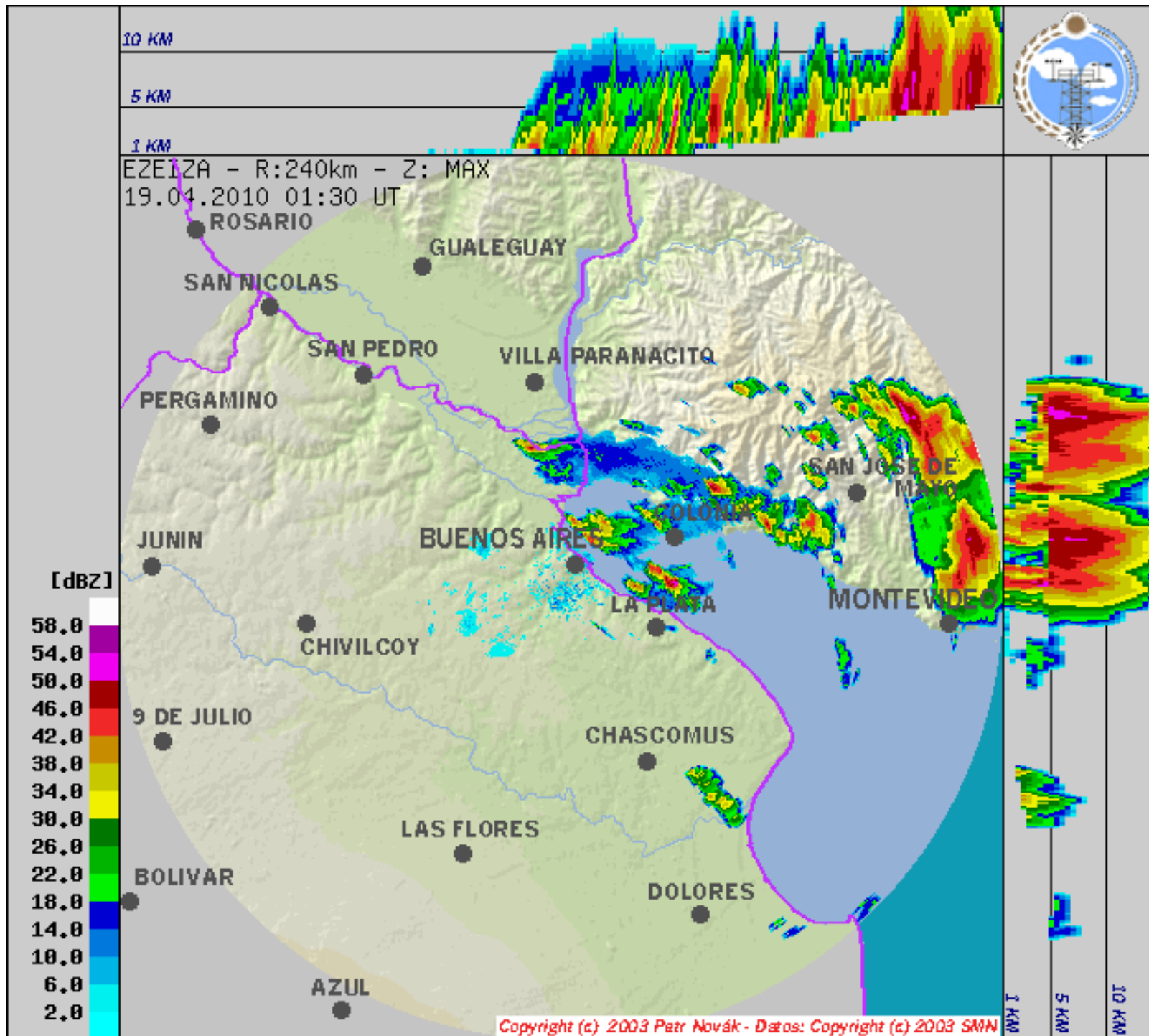


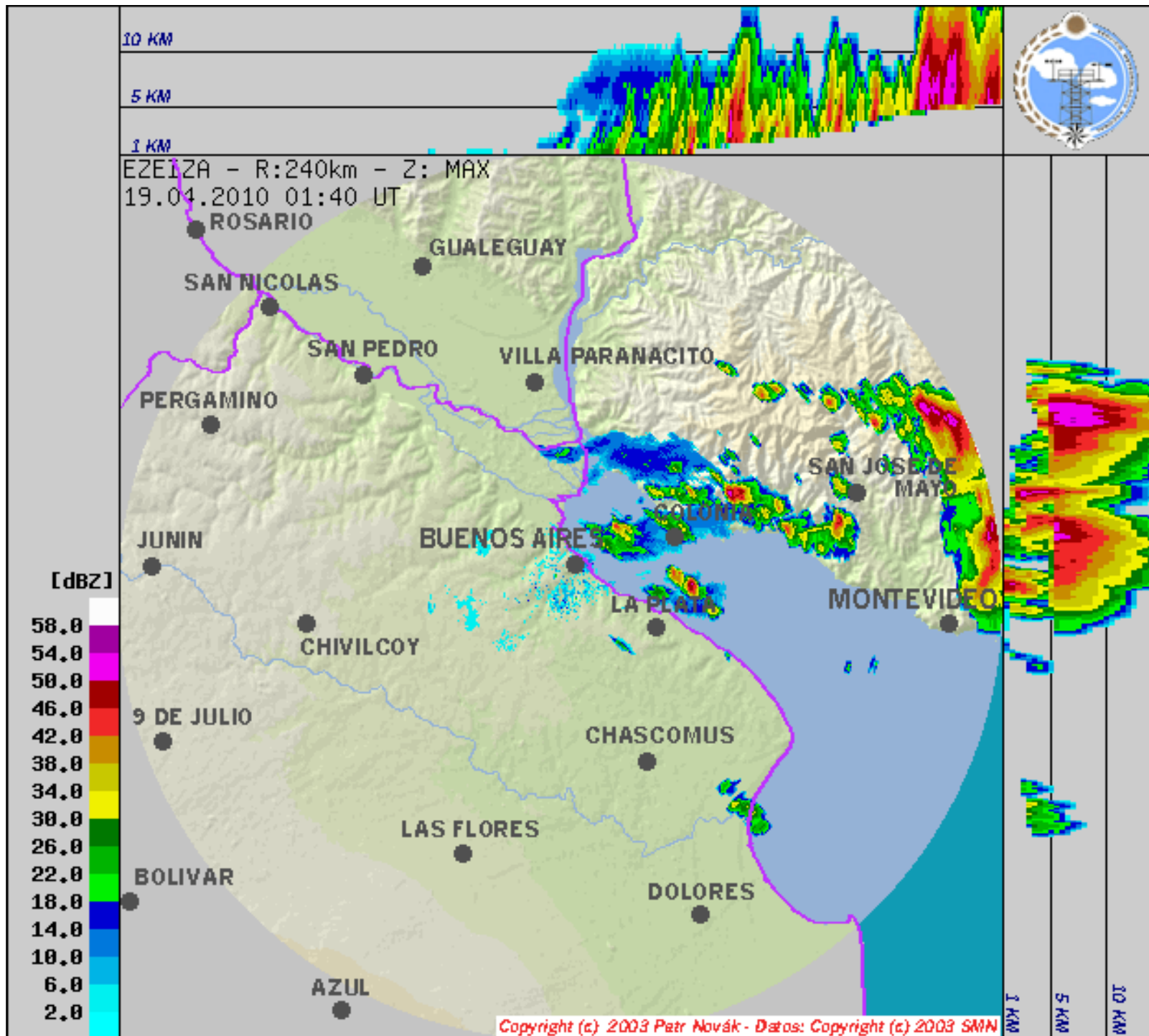


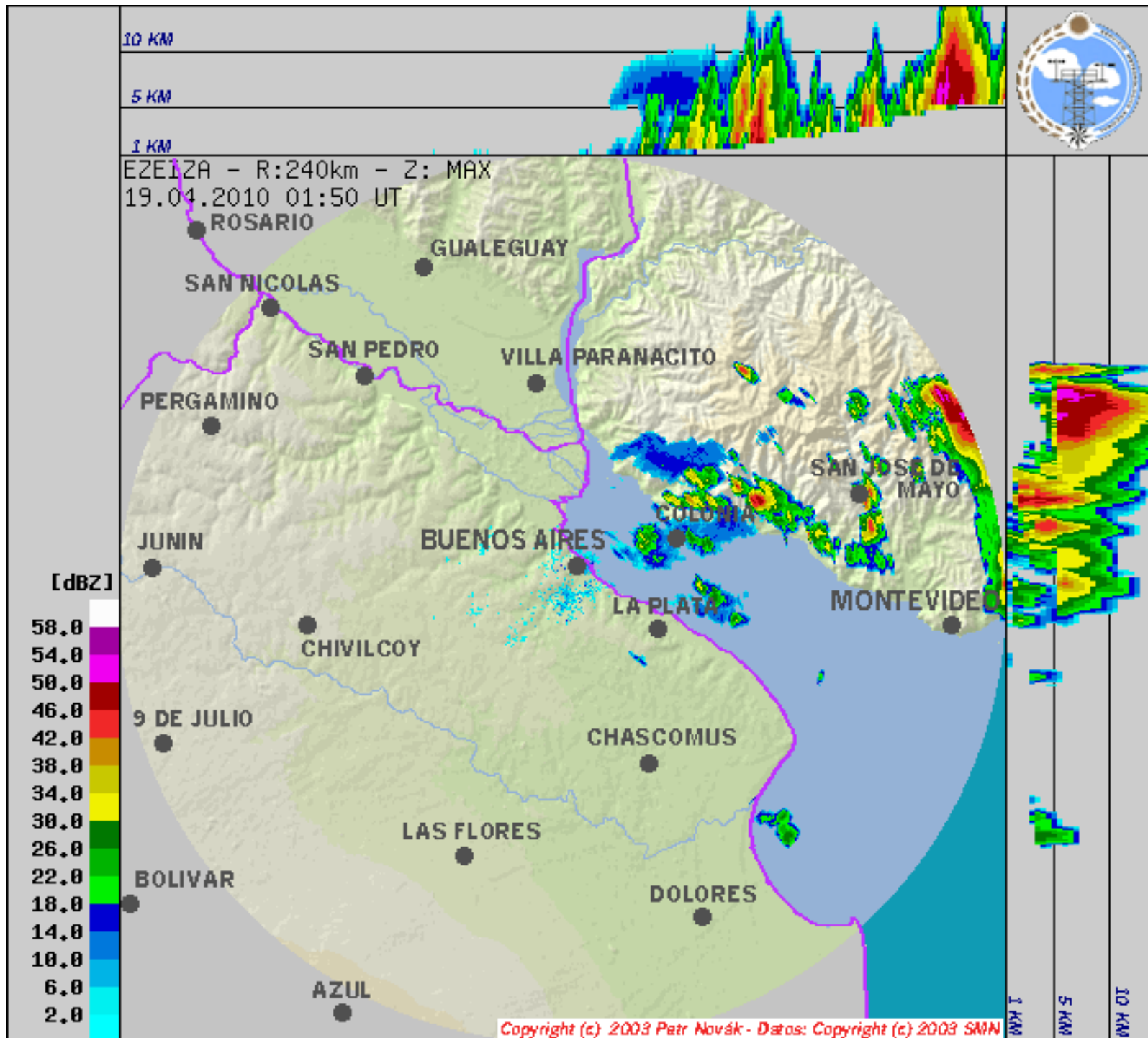


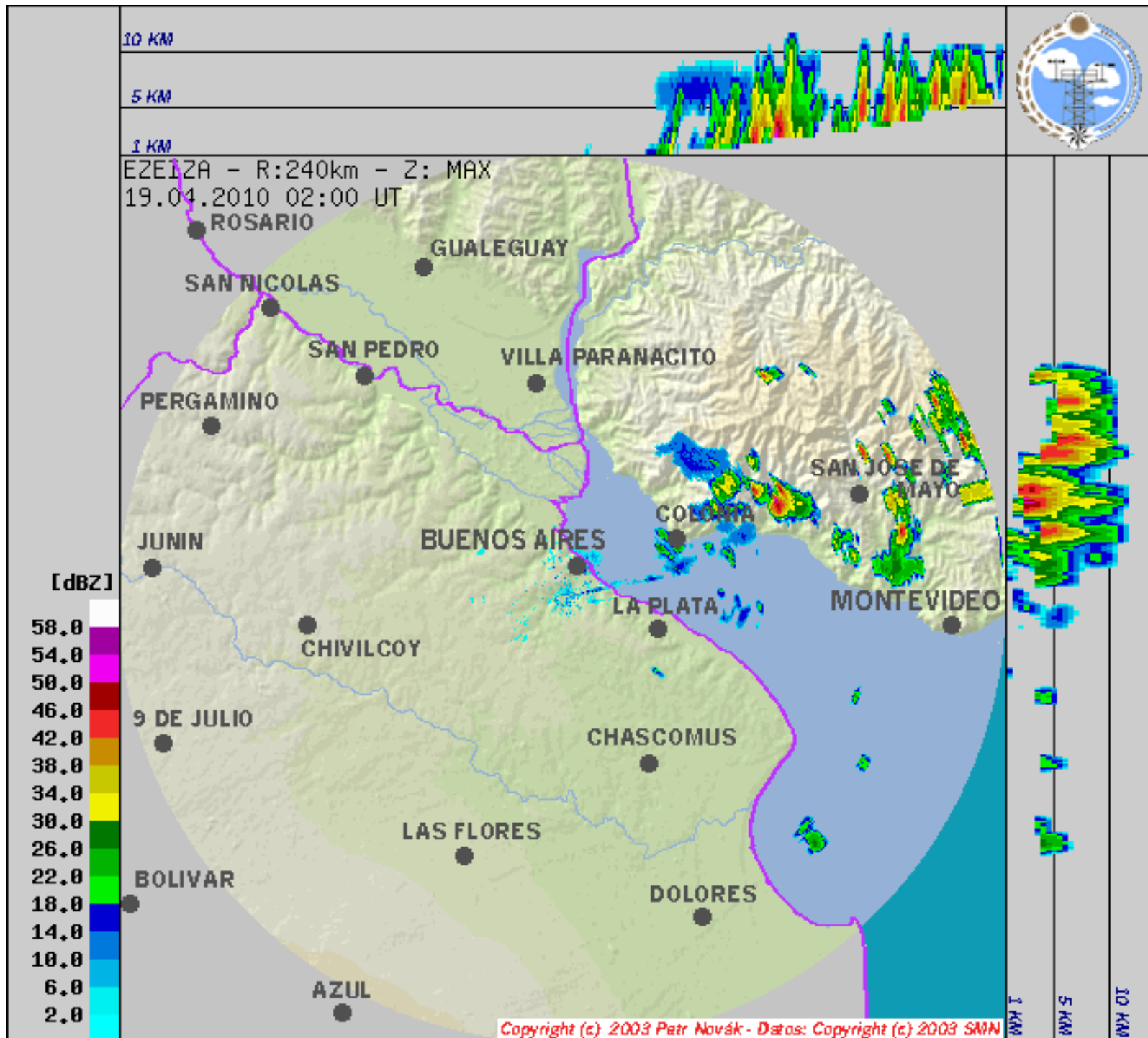


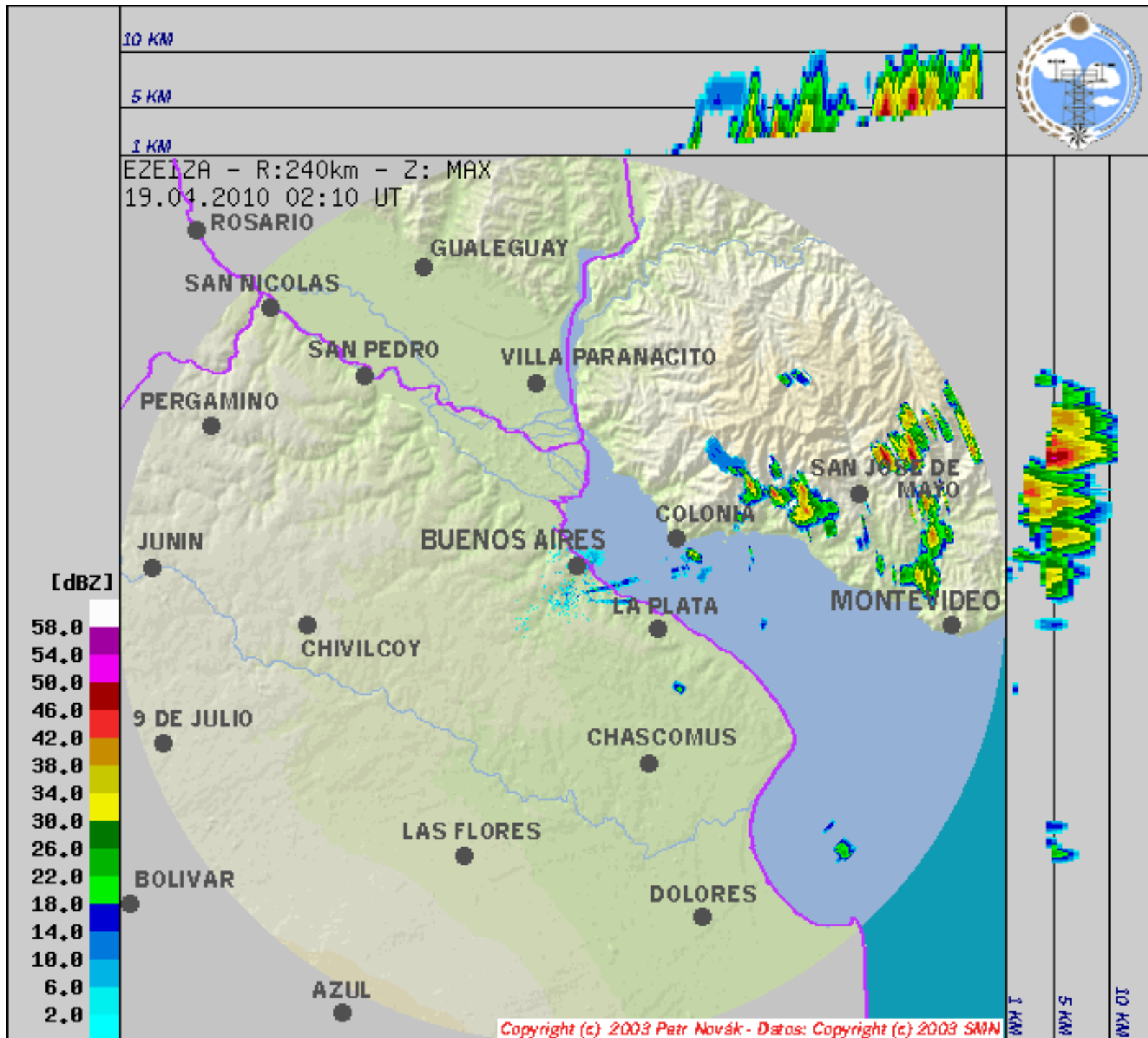


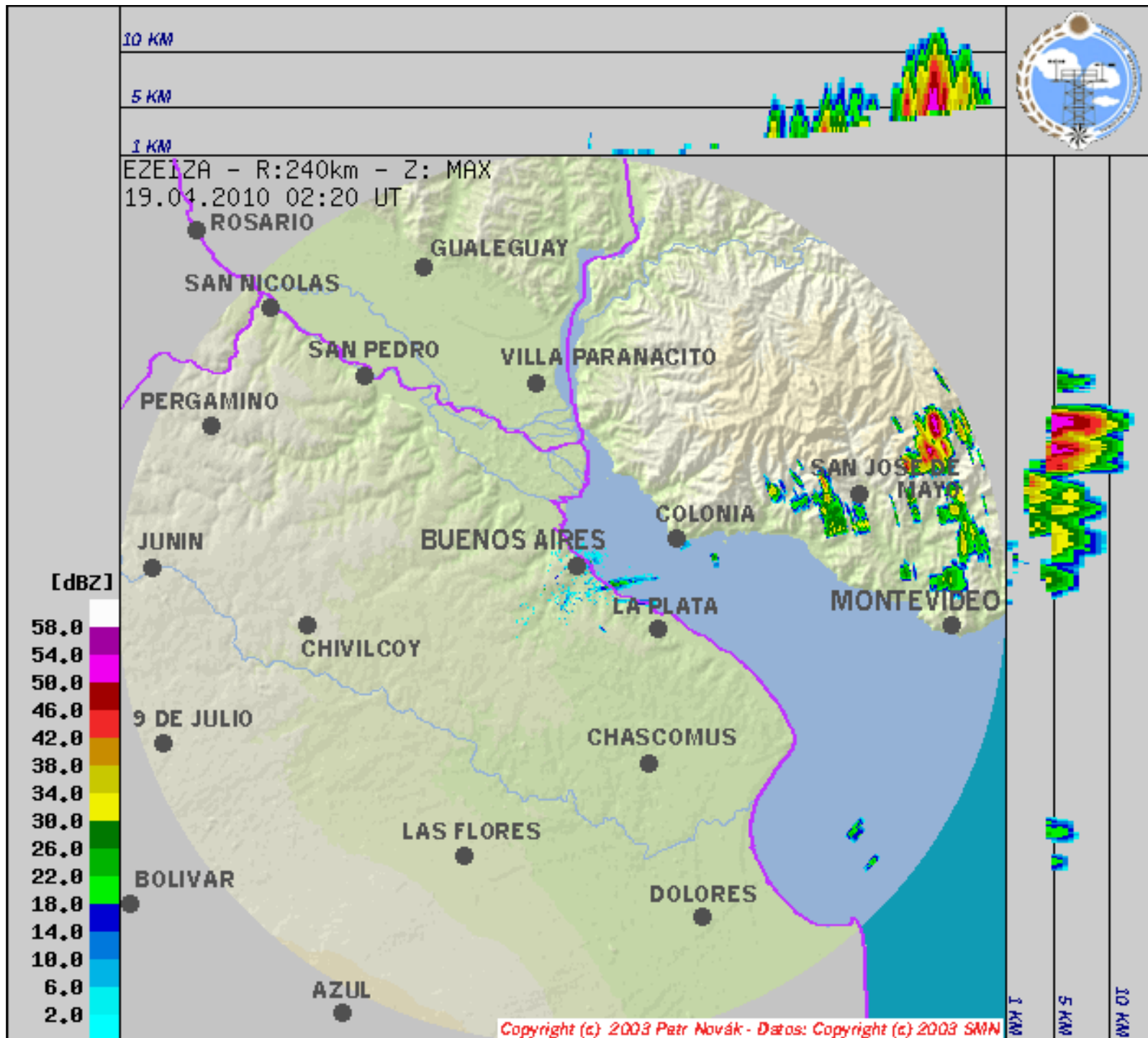




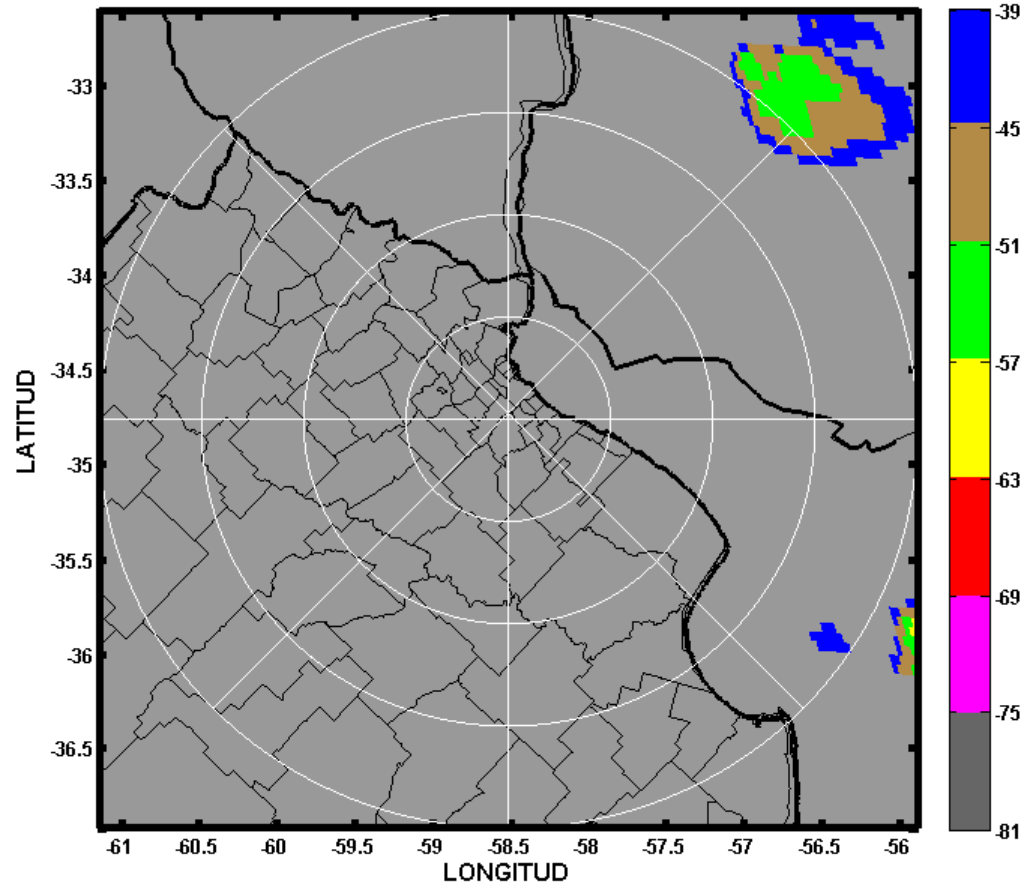




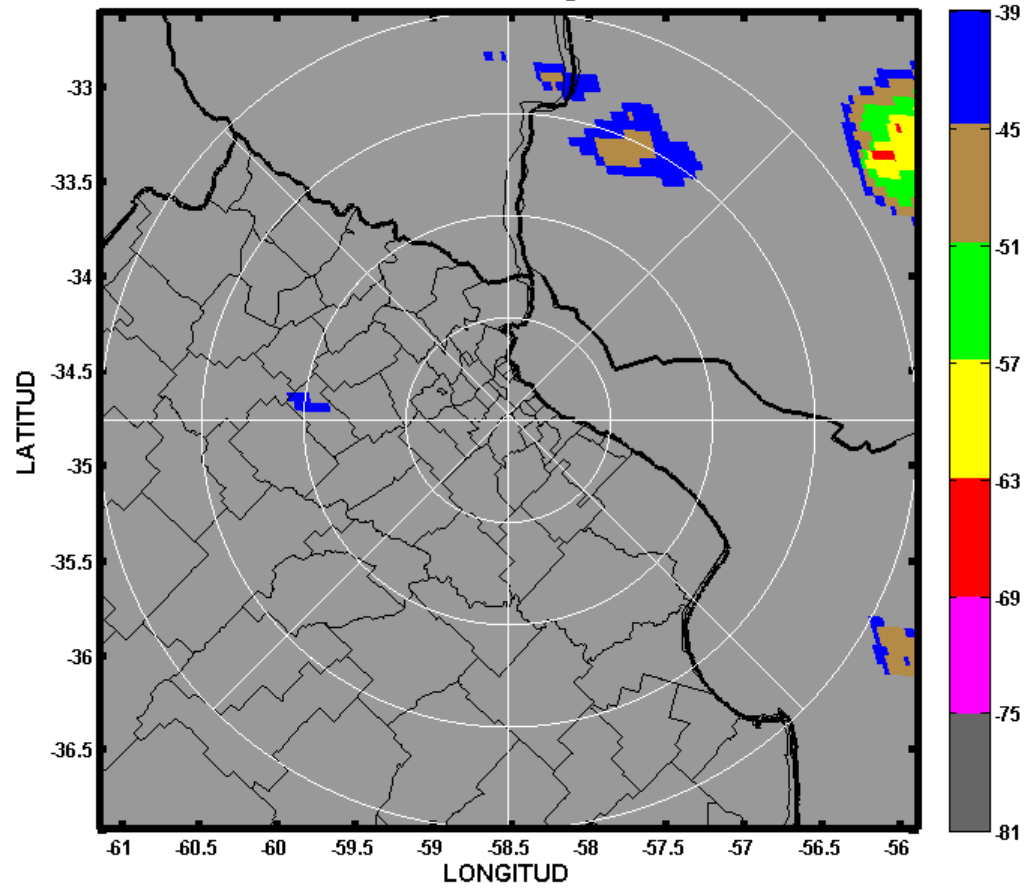




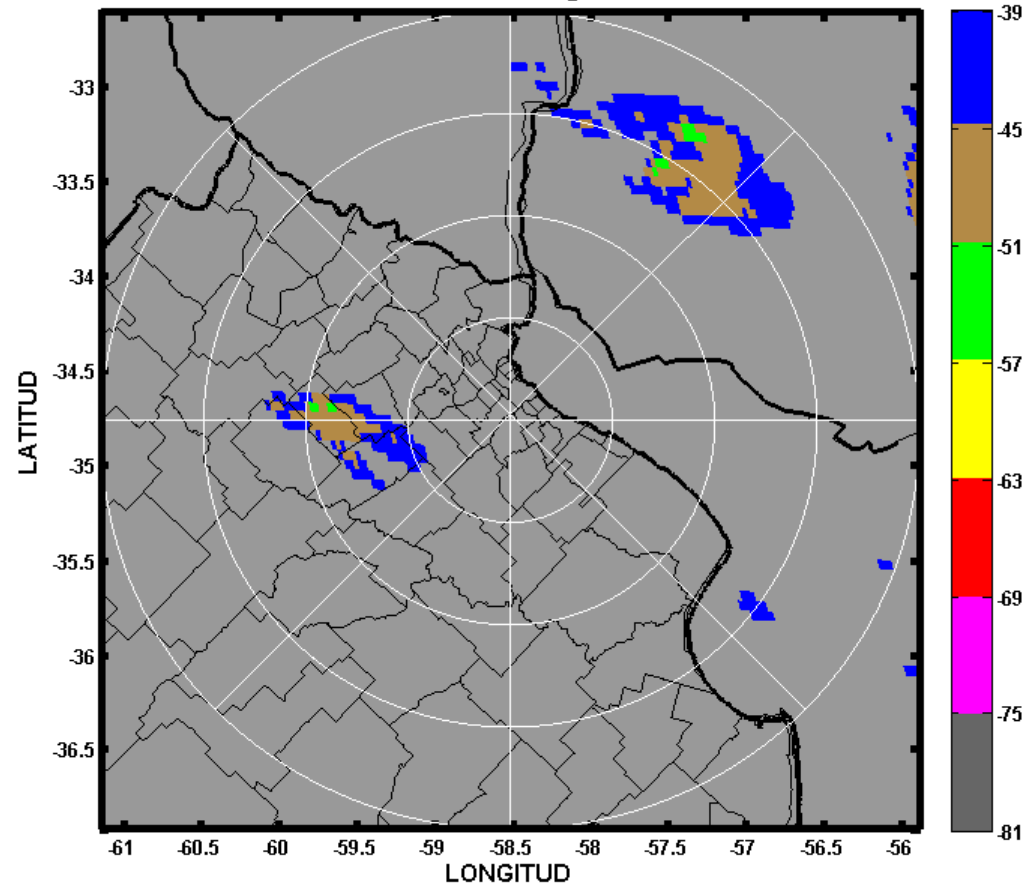
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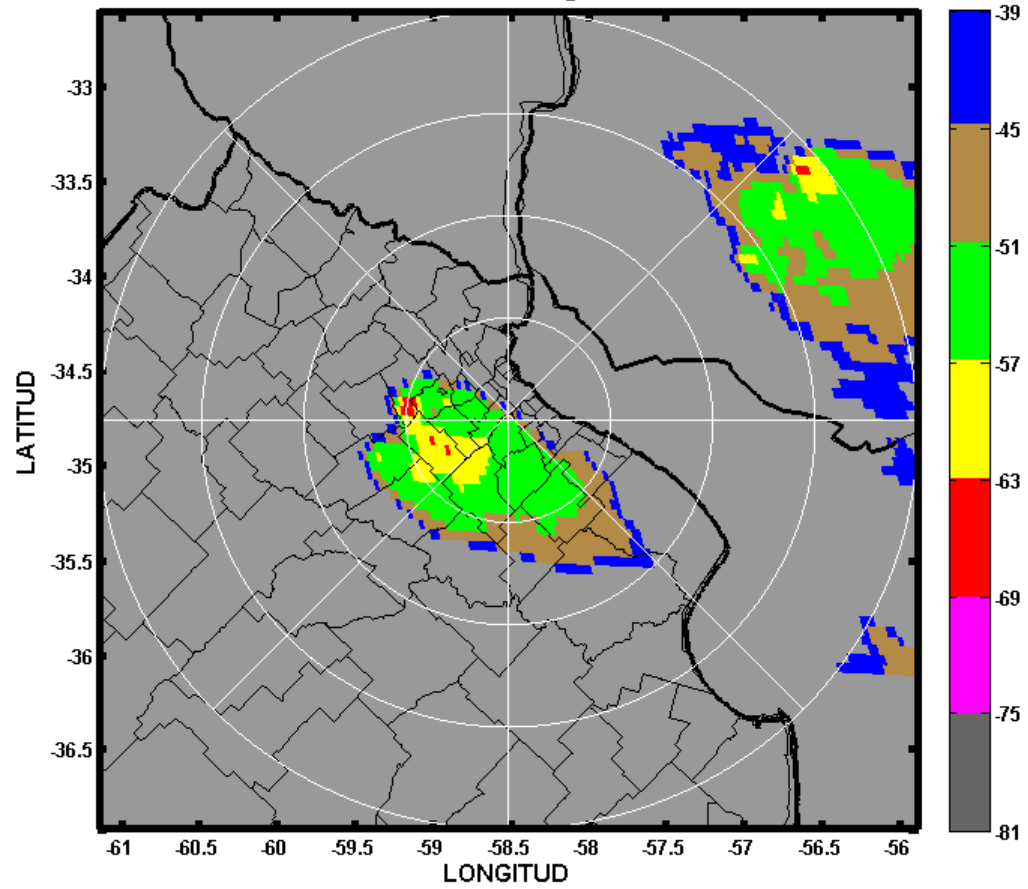
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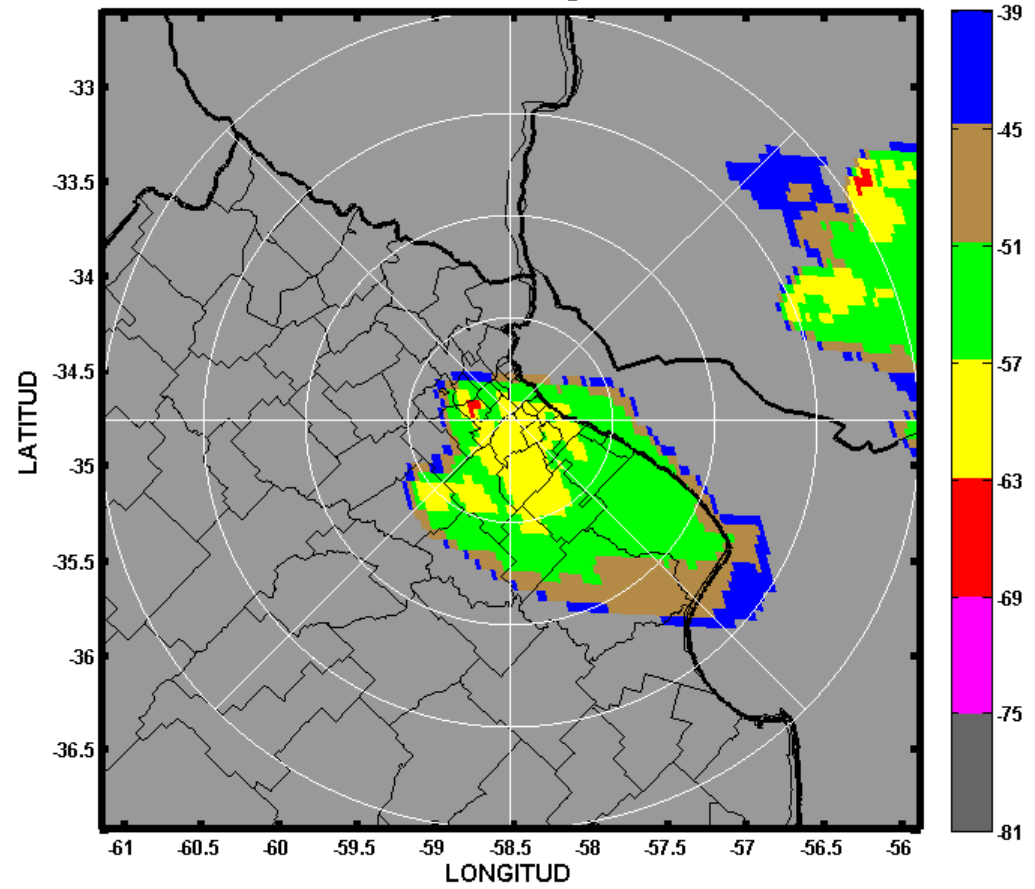
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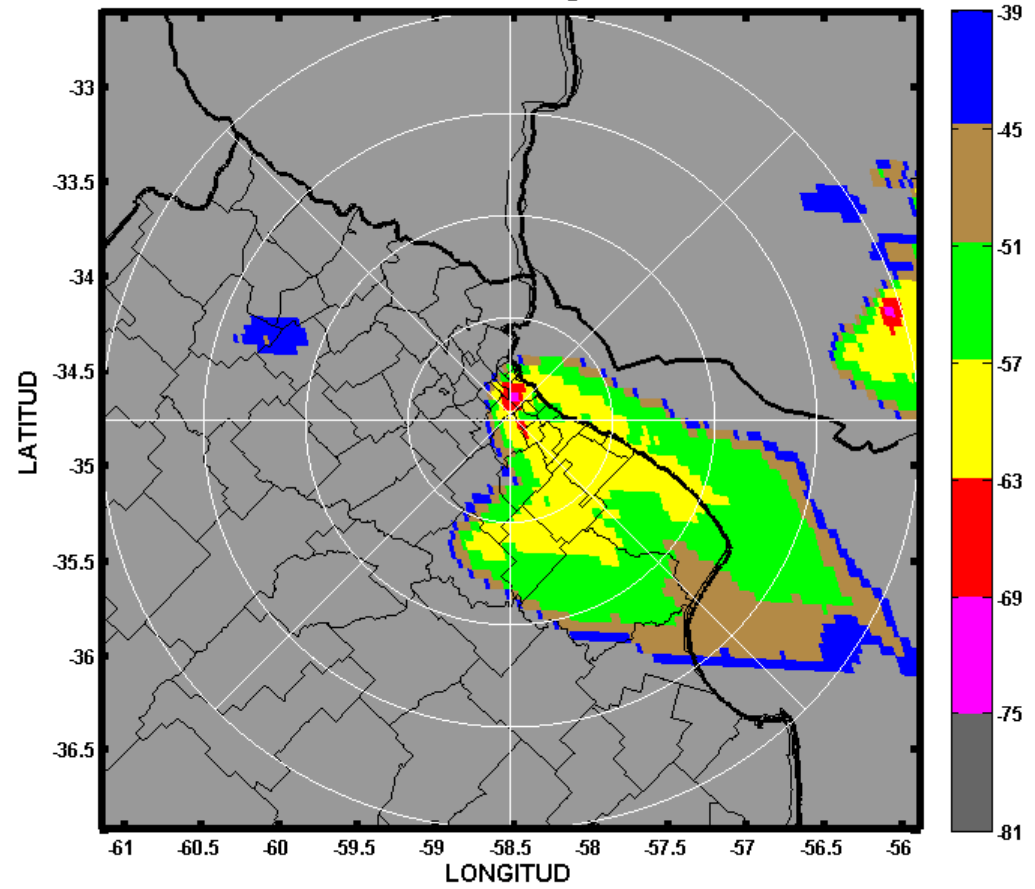
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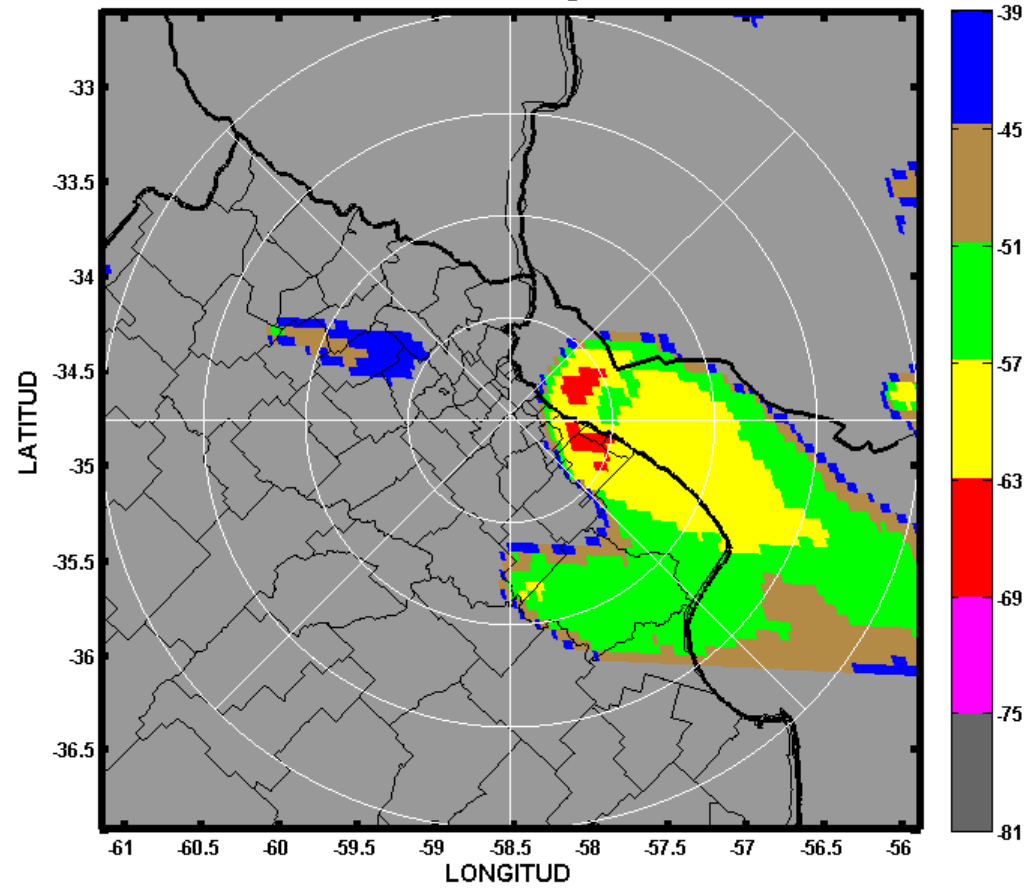
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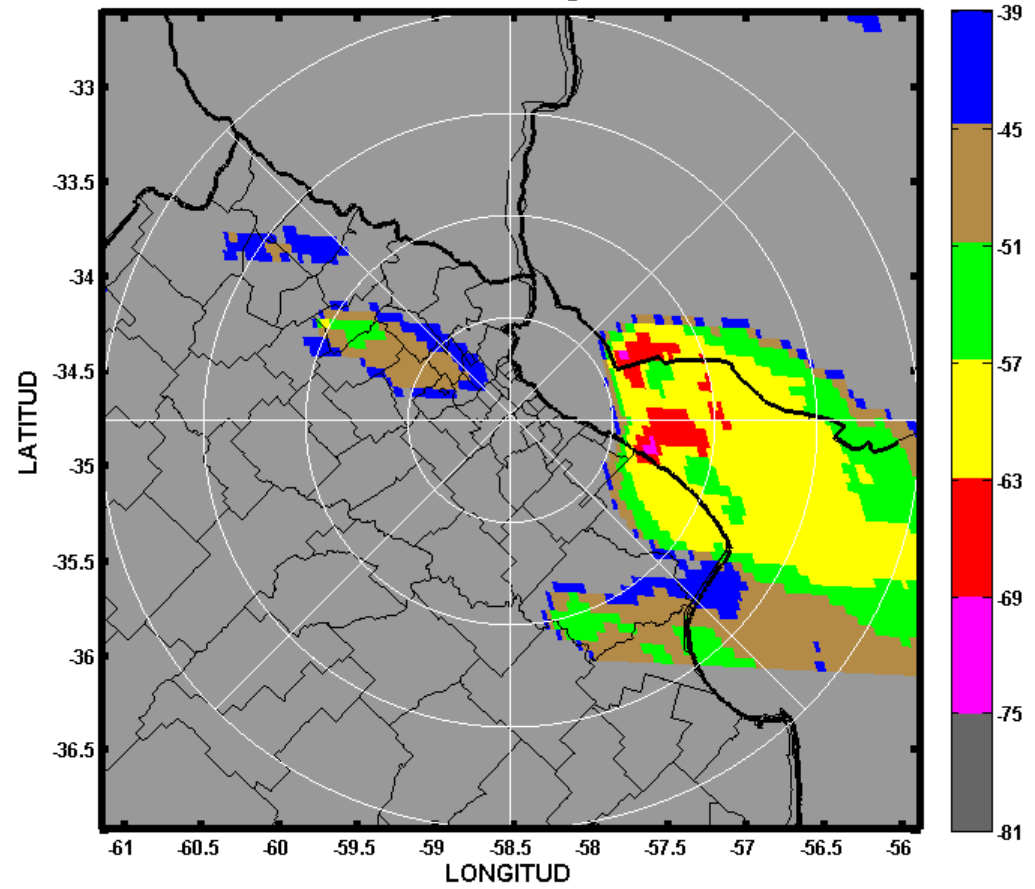
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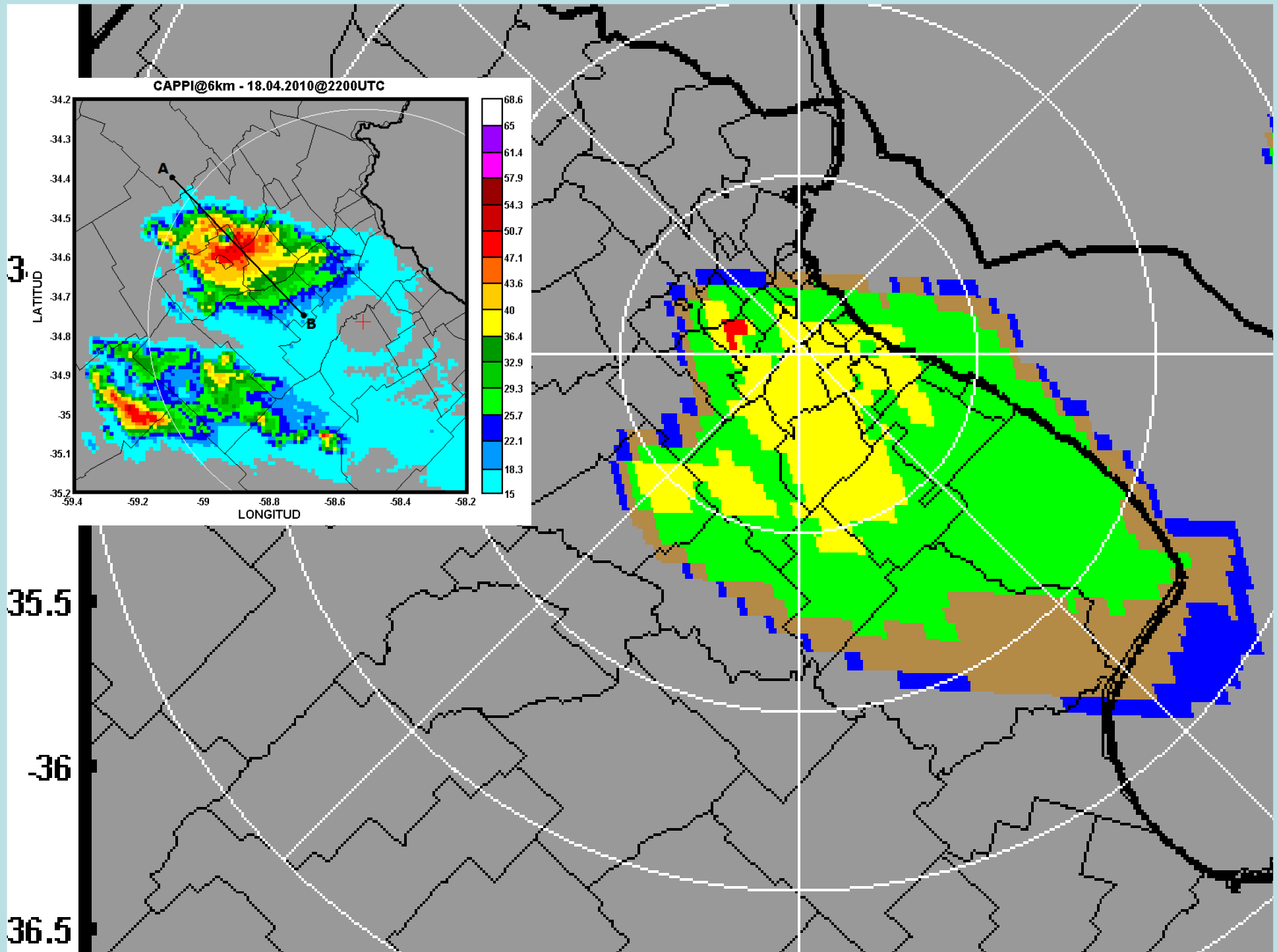


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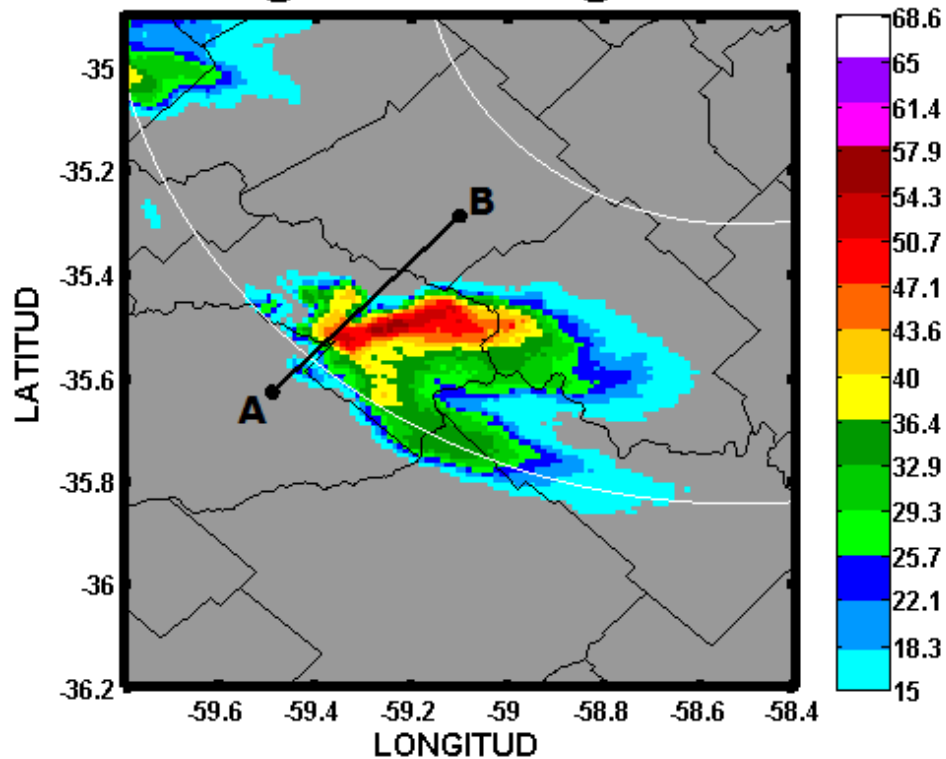




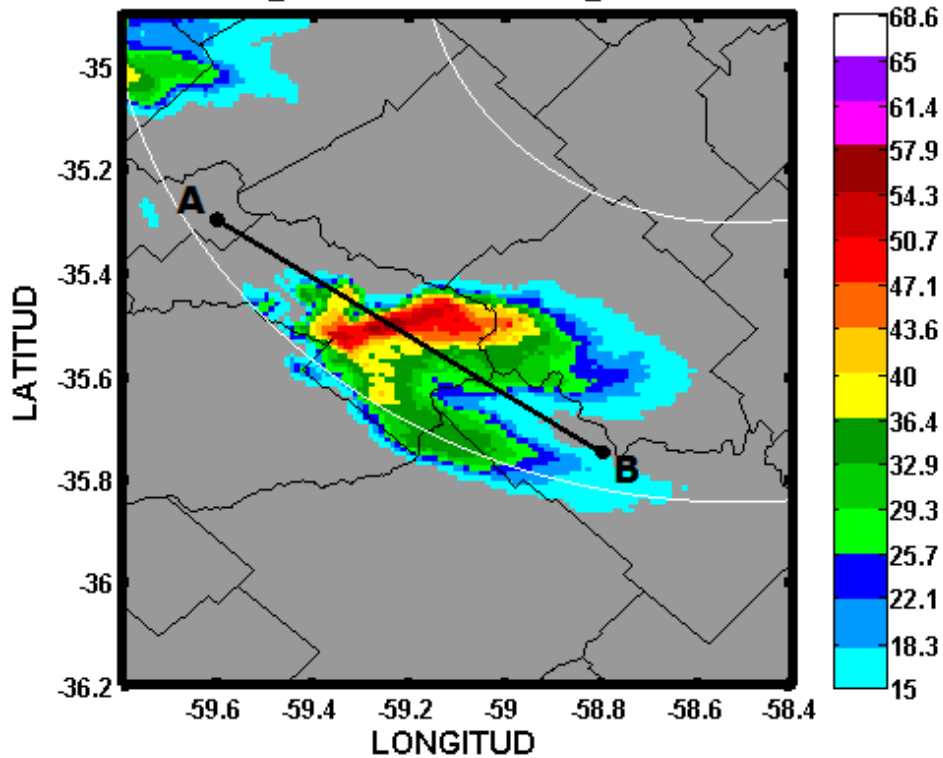
CASO 2: 16 de diciembre de 2006

Multiples superceldas sobre el NE de
Buenos Aires

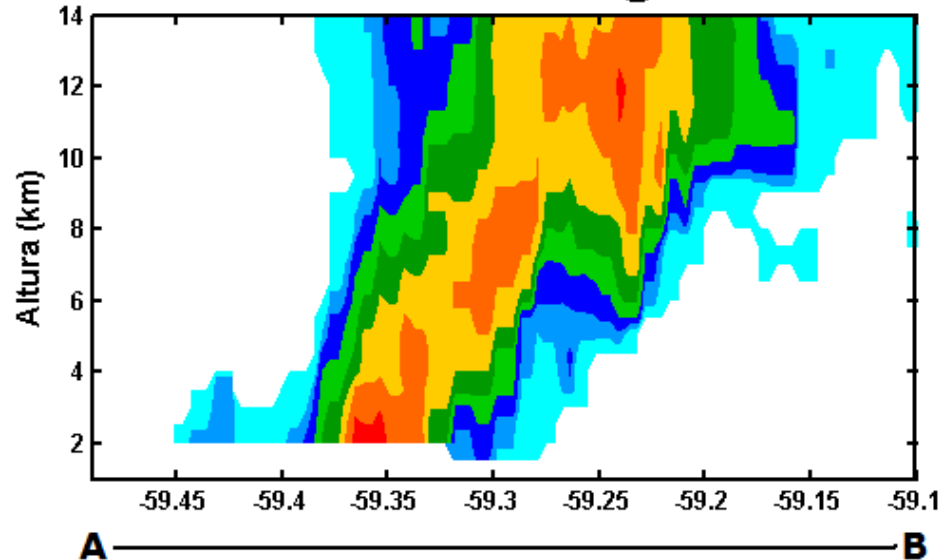
CAPPI@2km - 16.12.2006@2136UTC



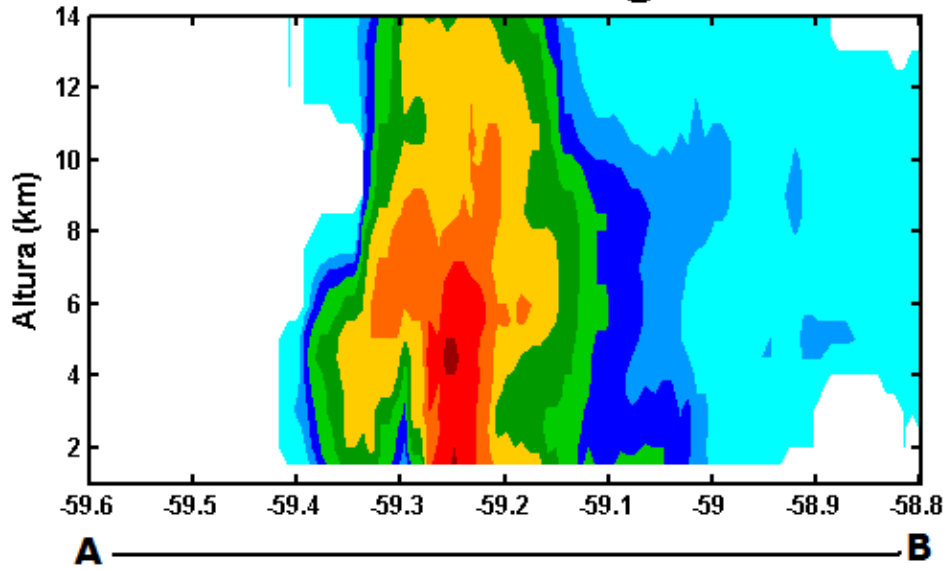
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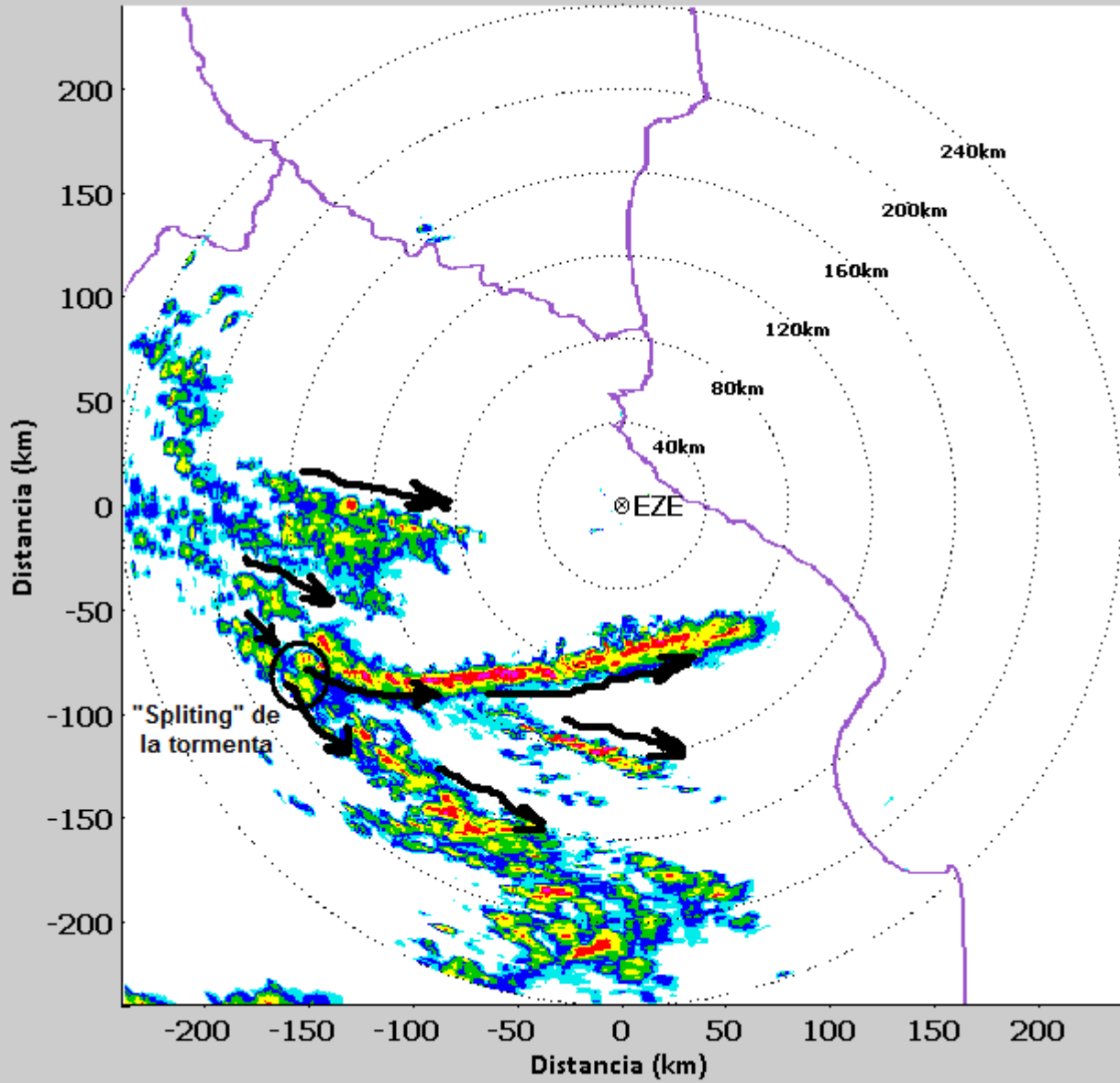
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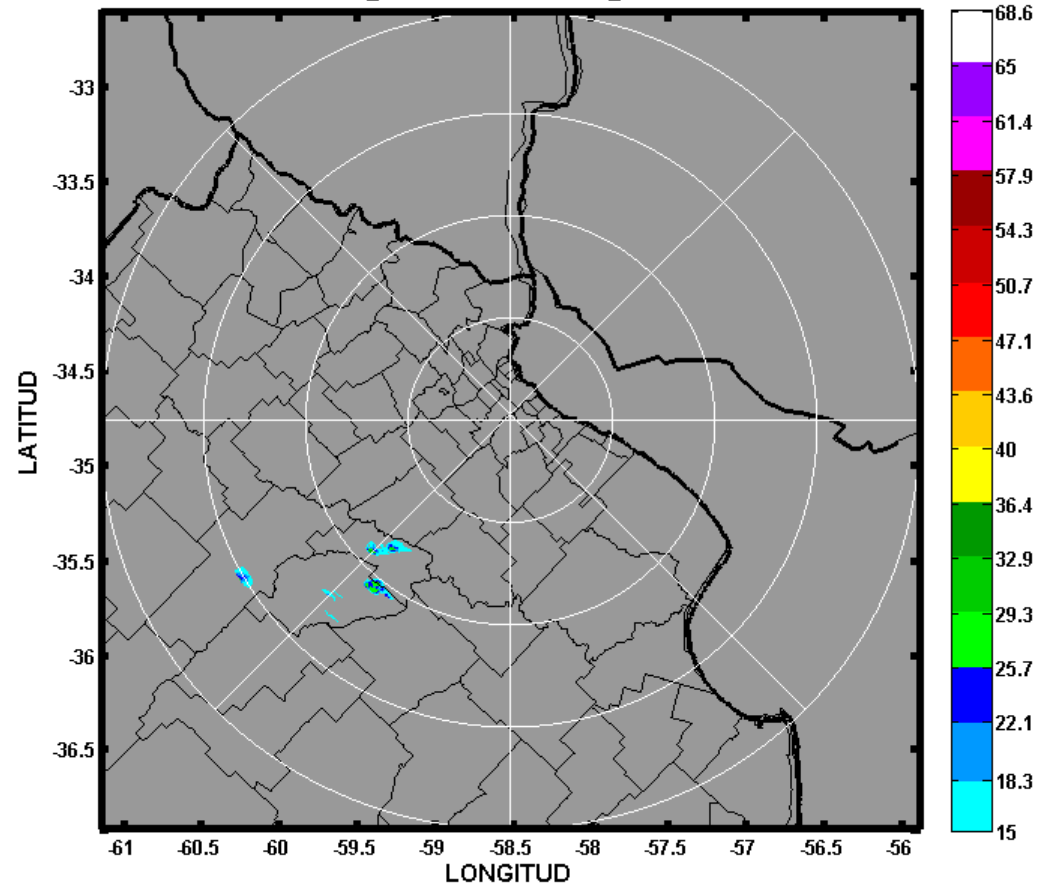
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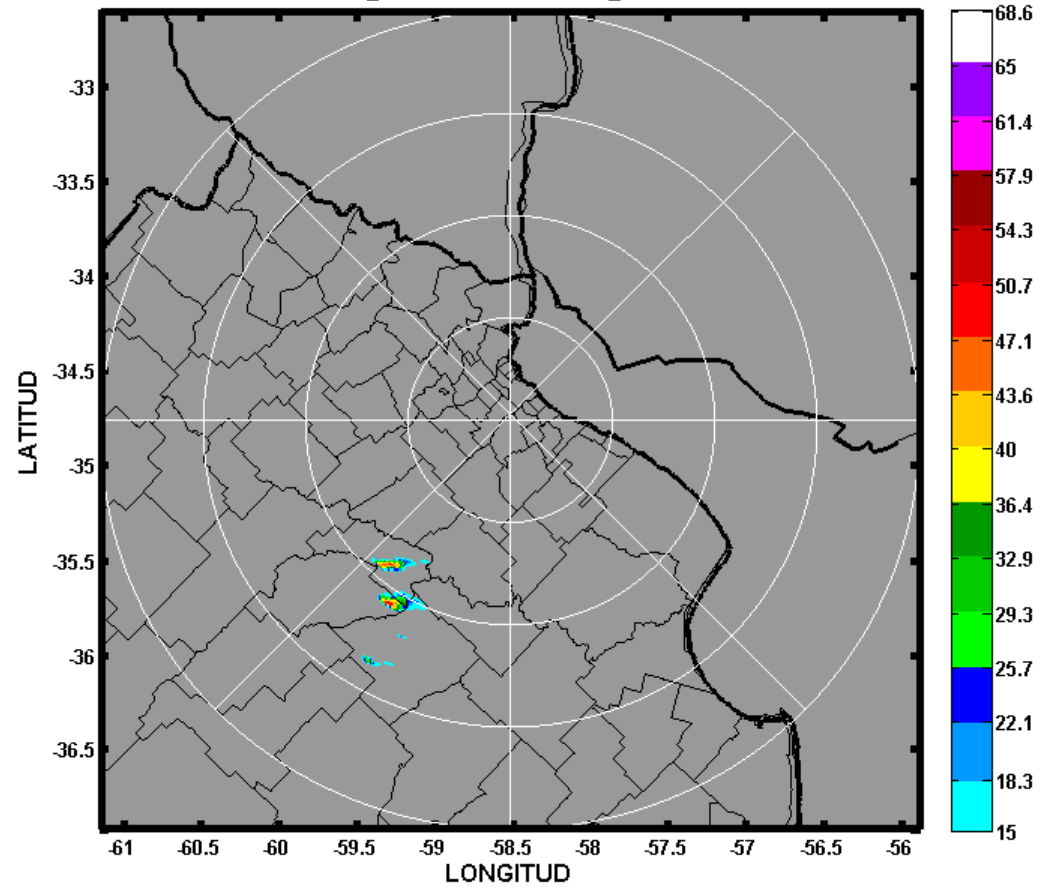
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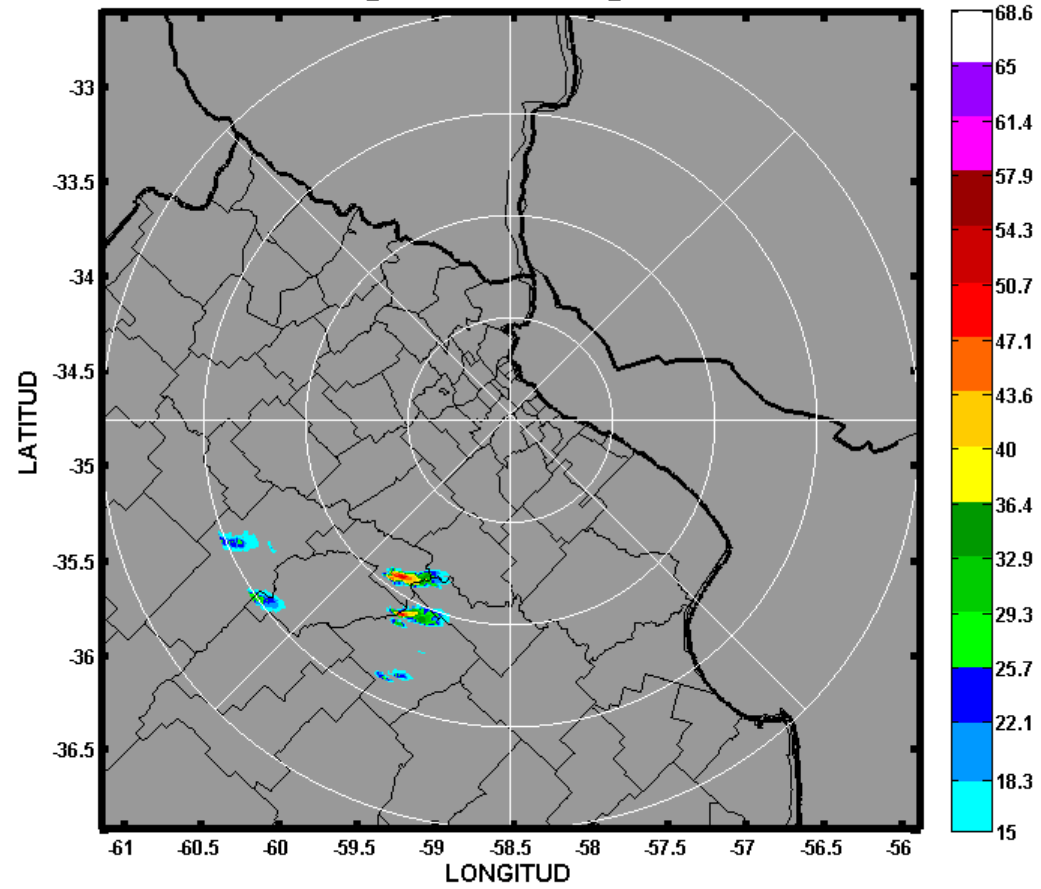
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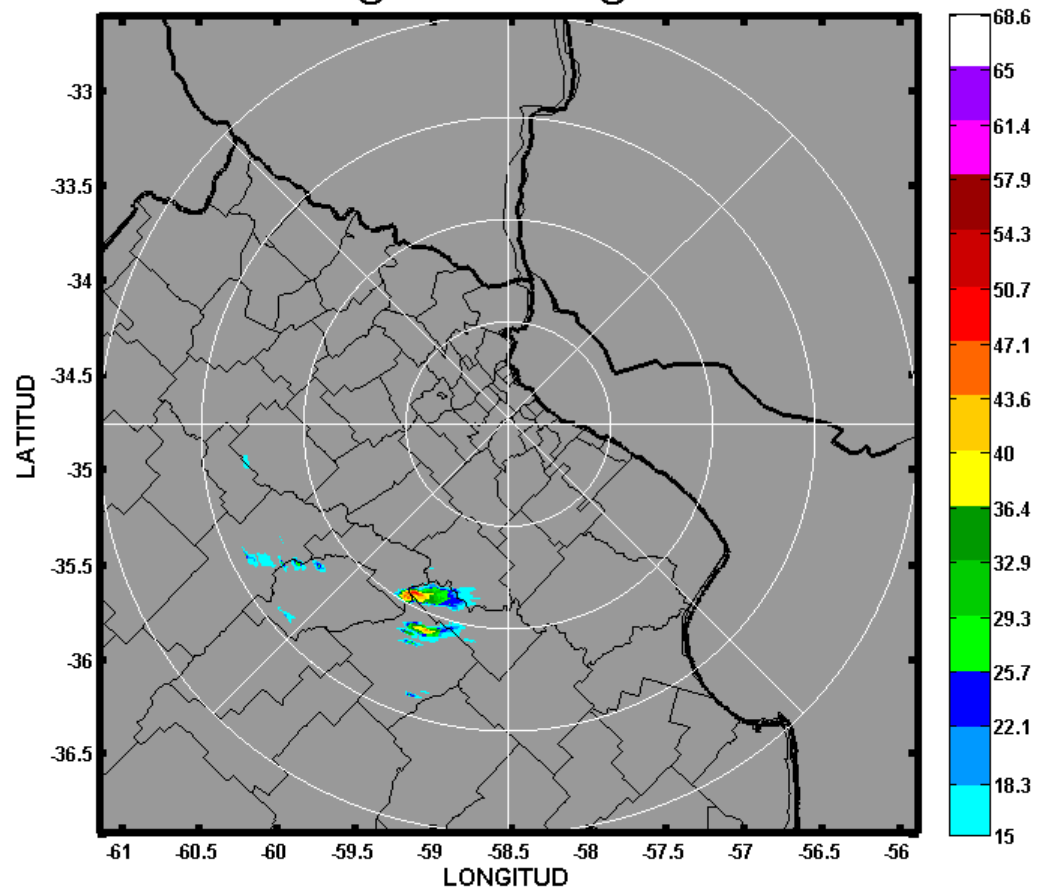
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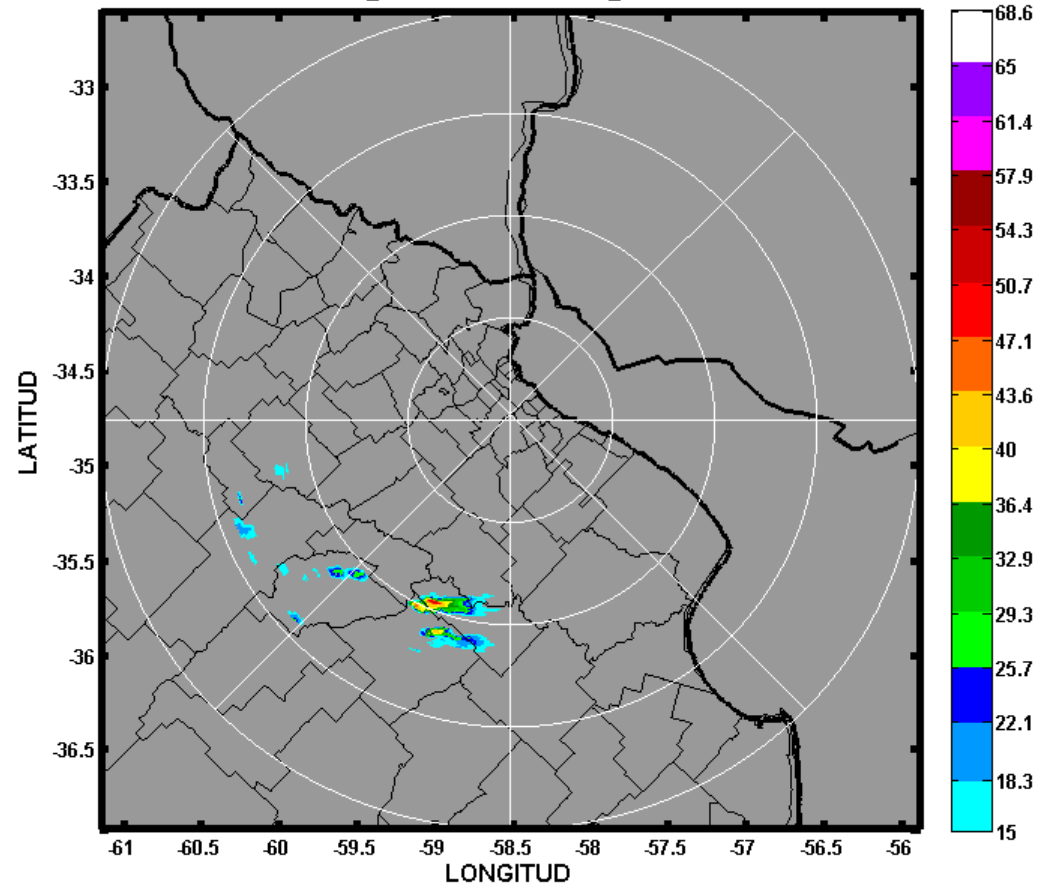
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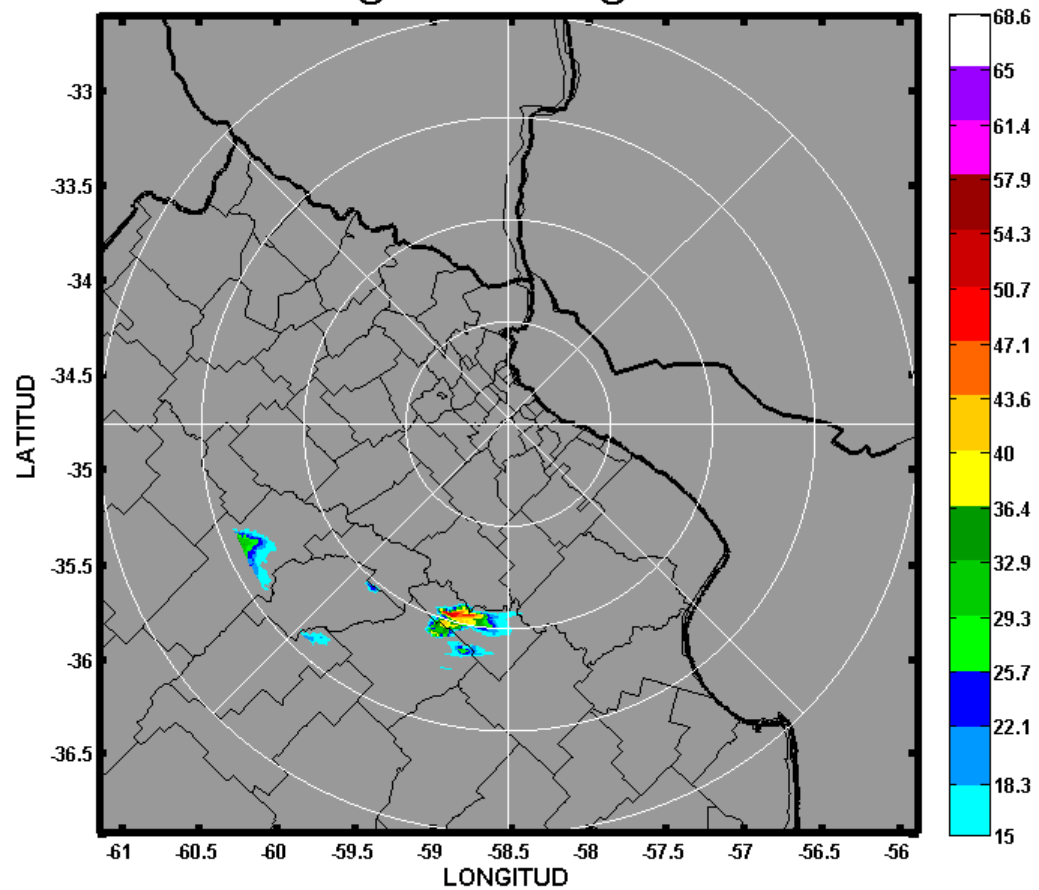
CAPPI@3km - 16.12.2006@1936UTC



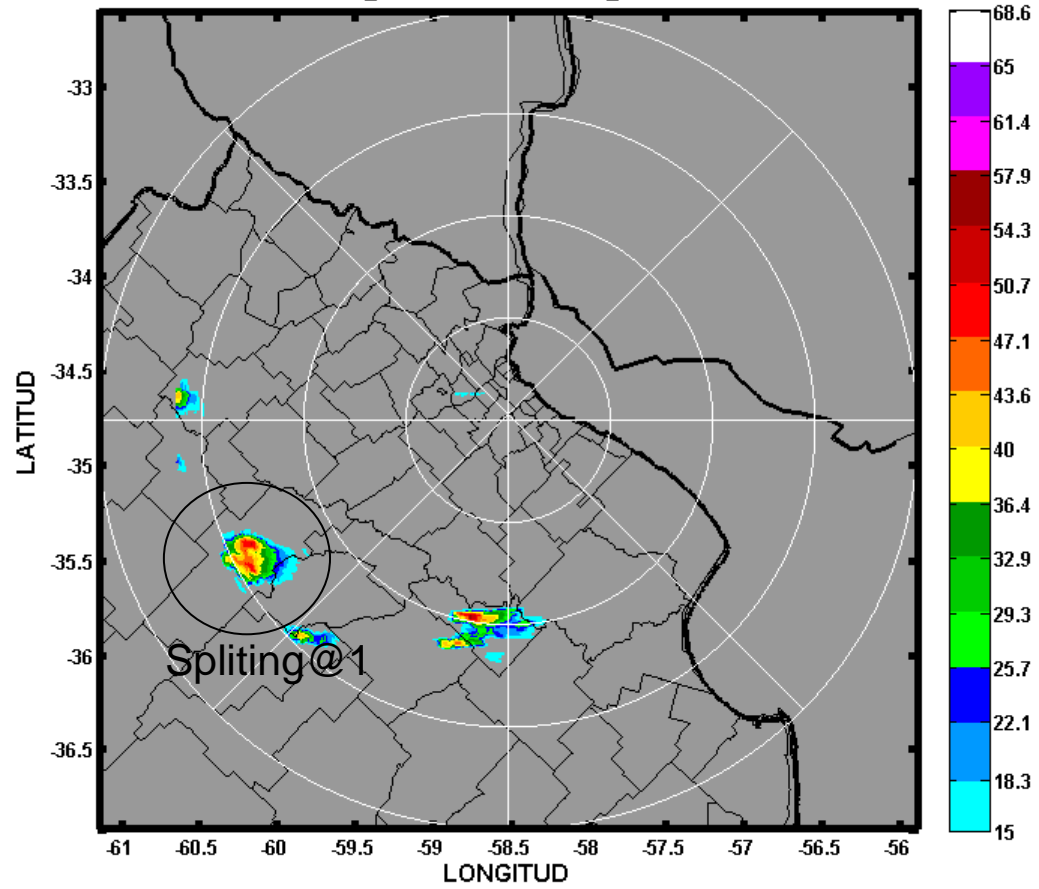
CAPPI@3km - 16.12.2006@1948UTC



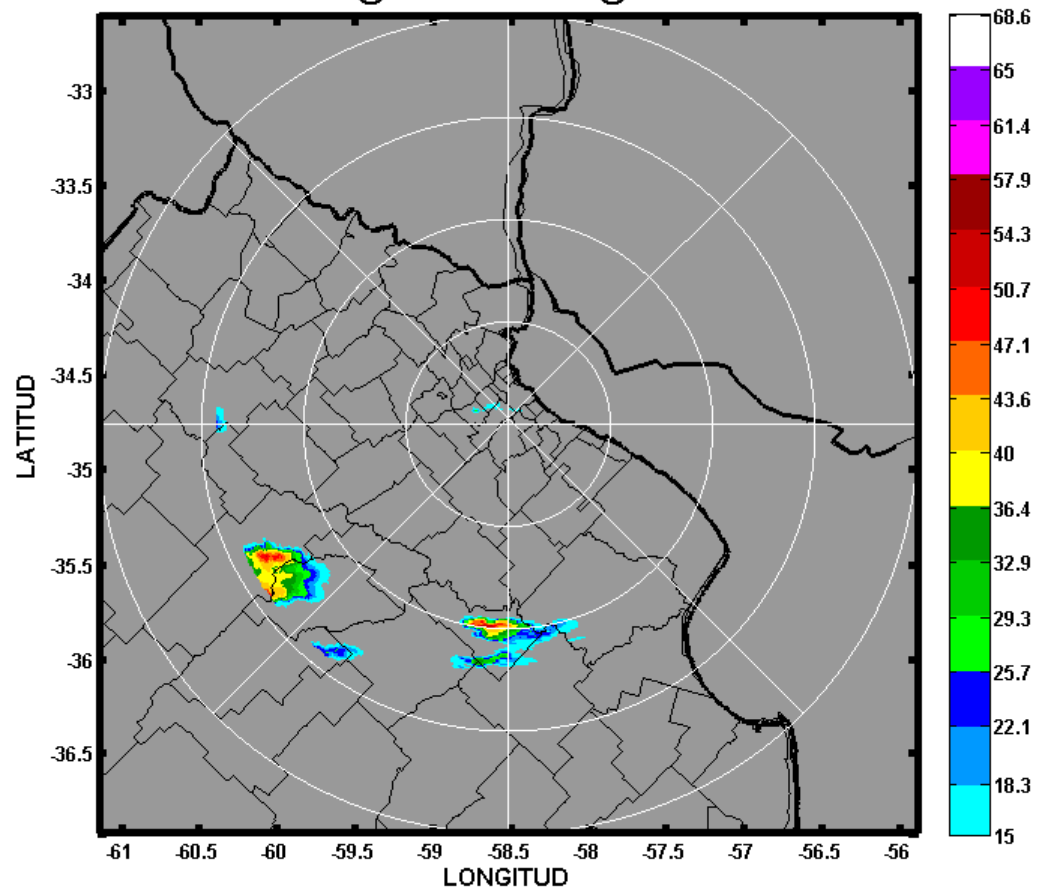
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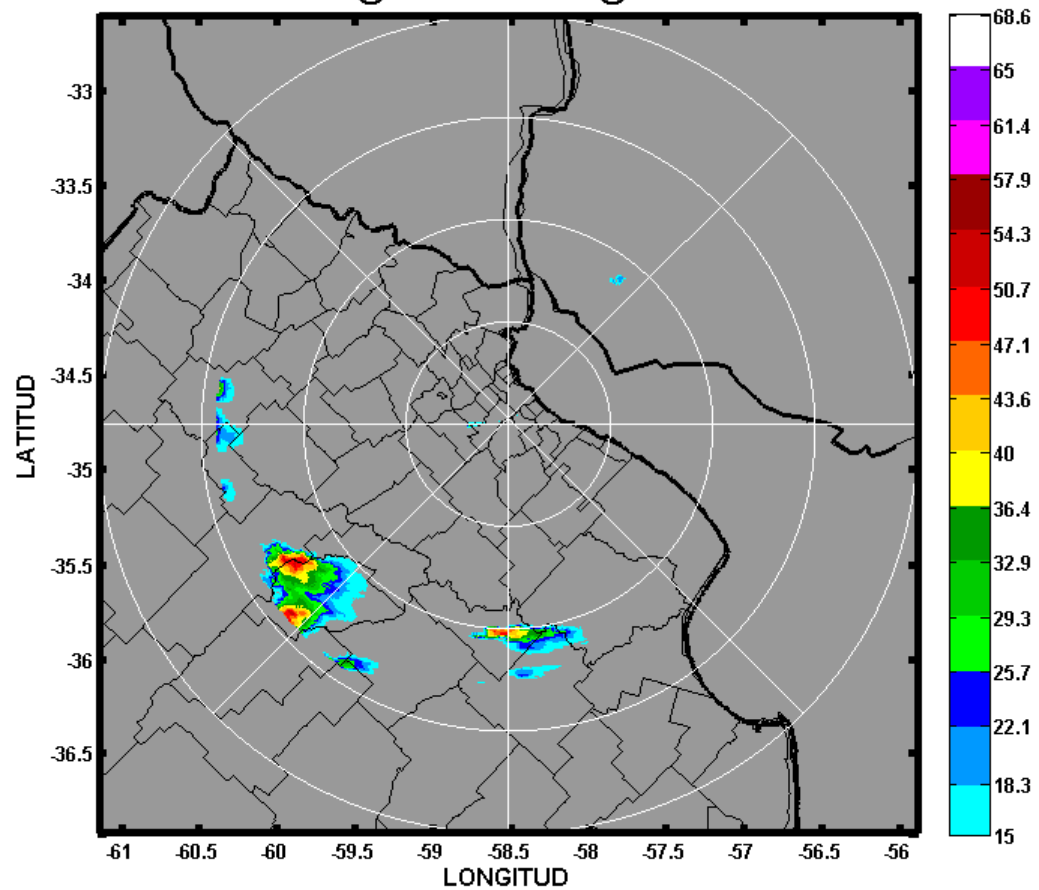
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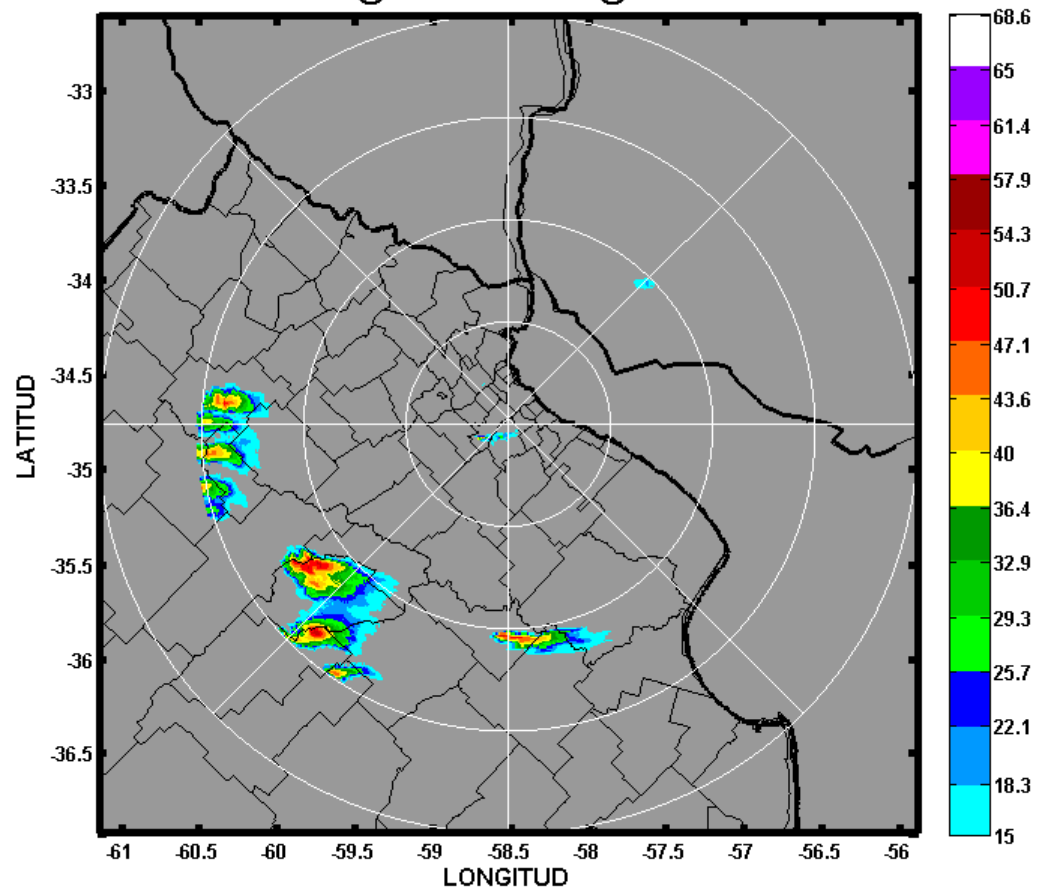
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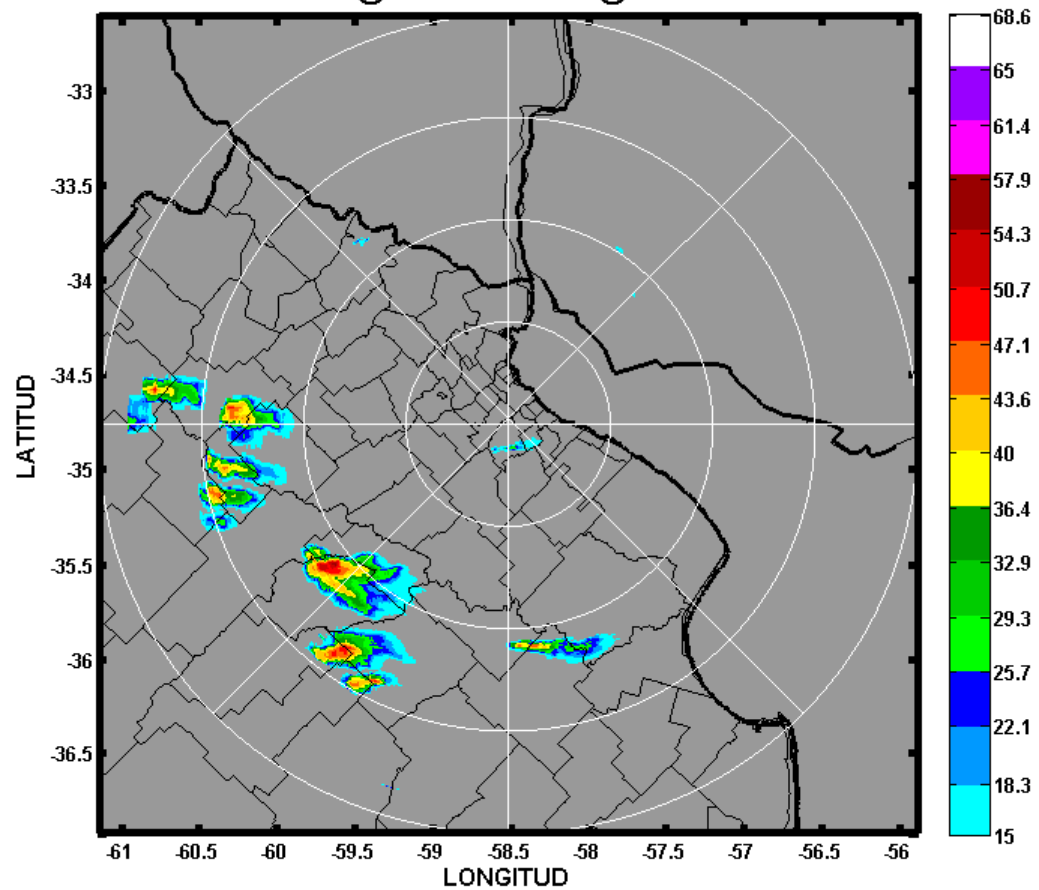
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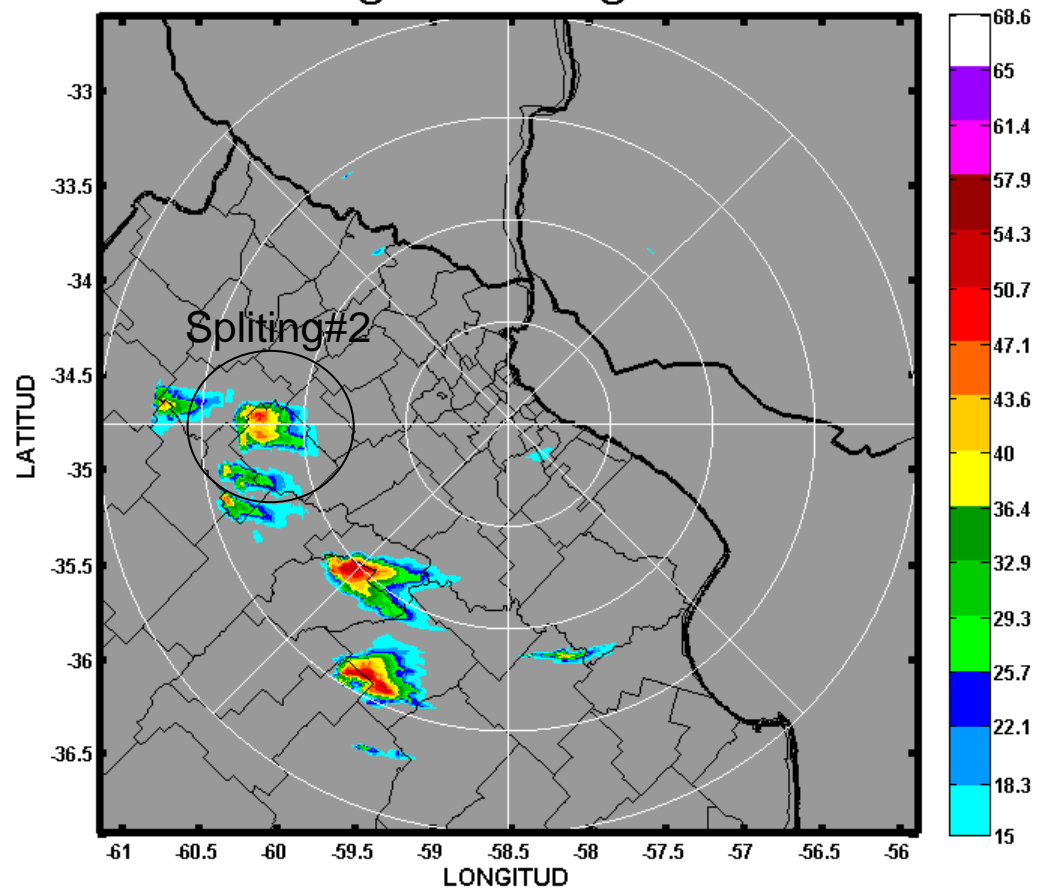
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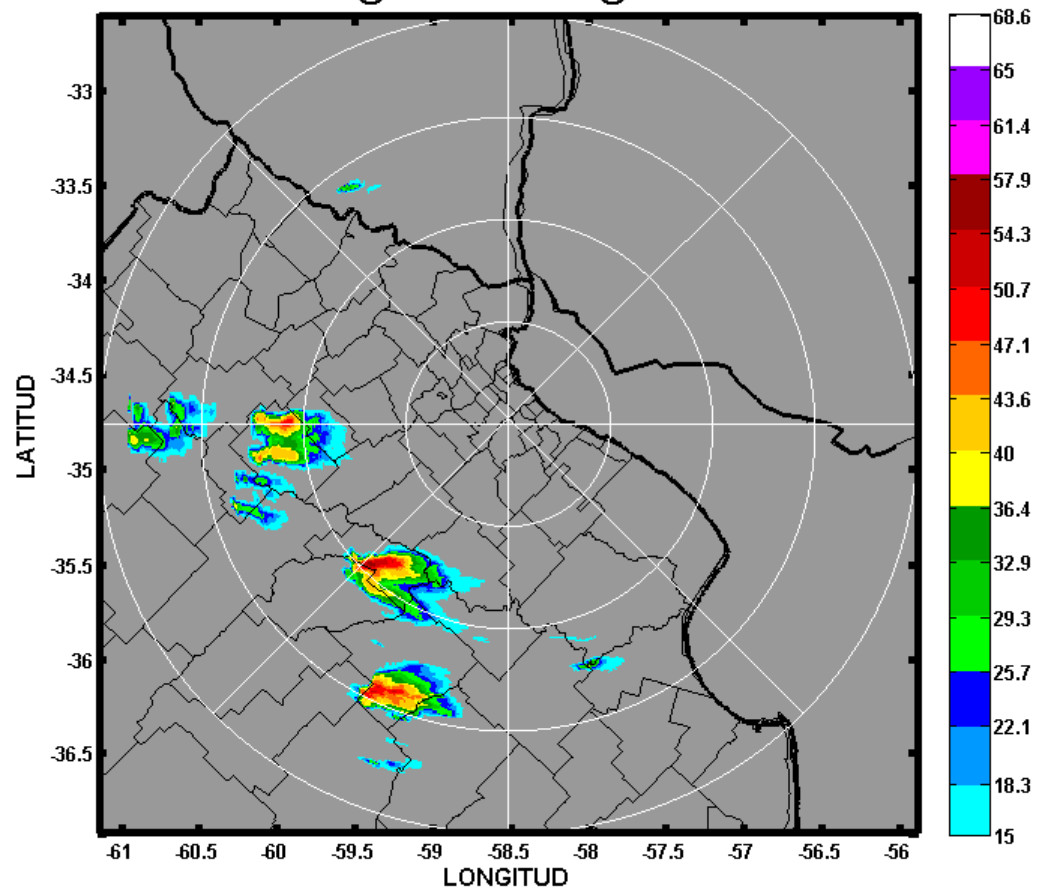
CAPPI@3km - 16.12.2006@2100UTC



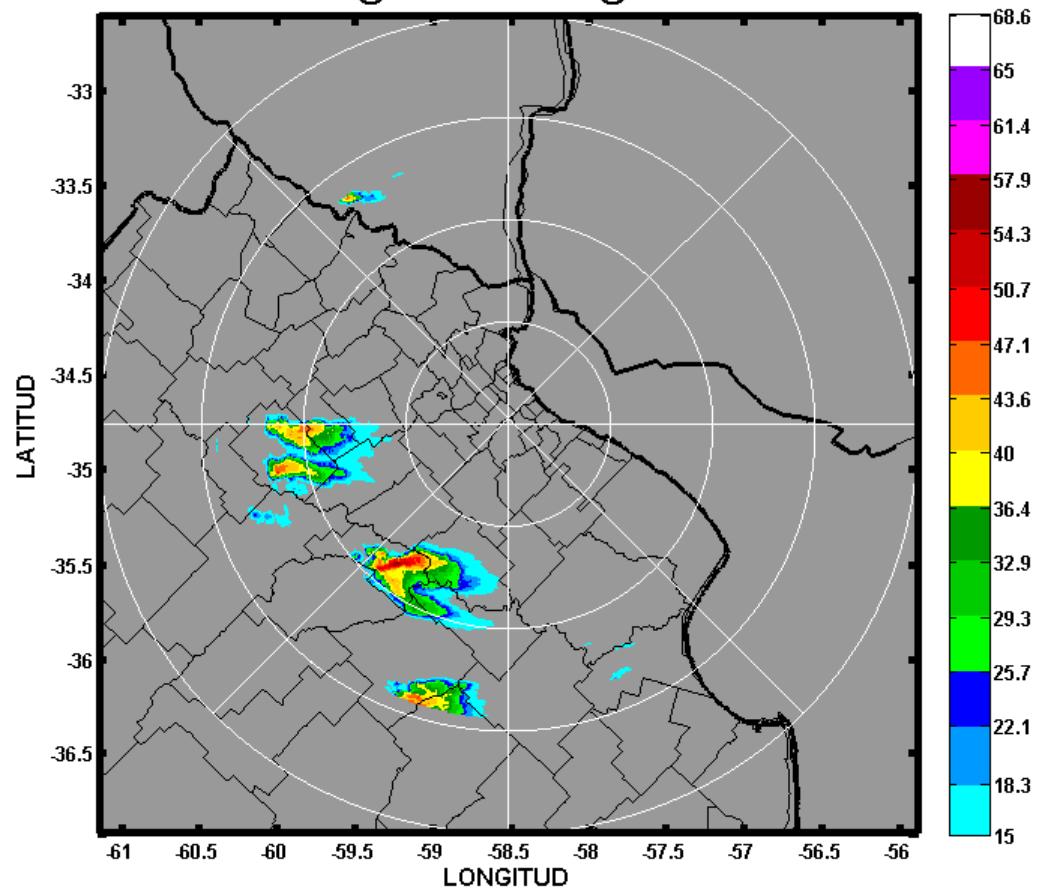
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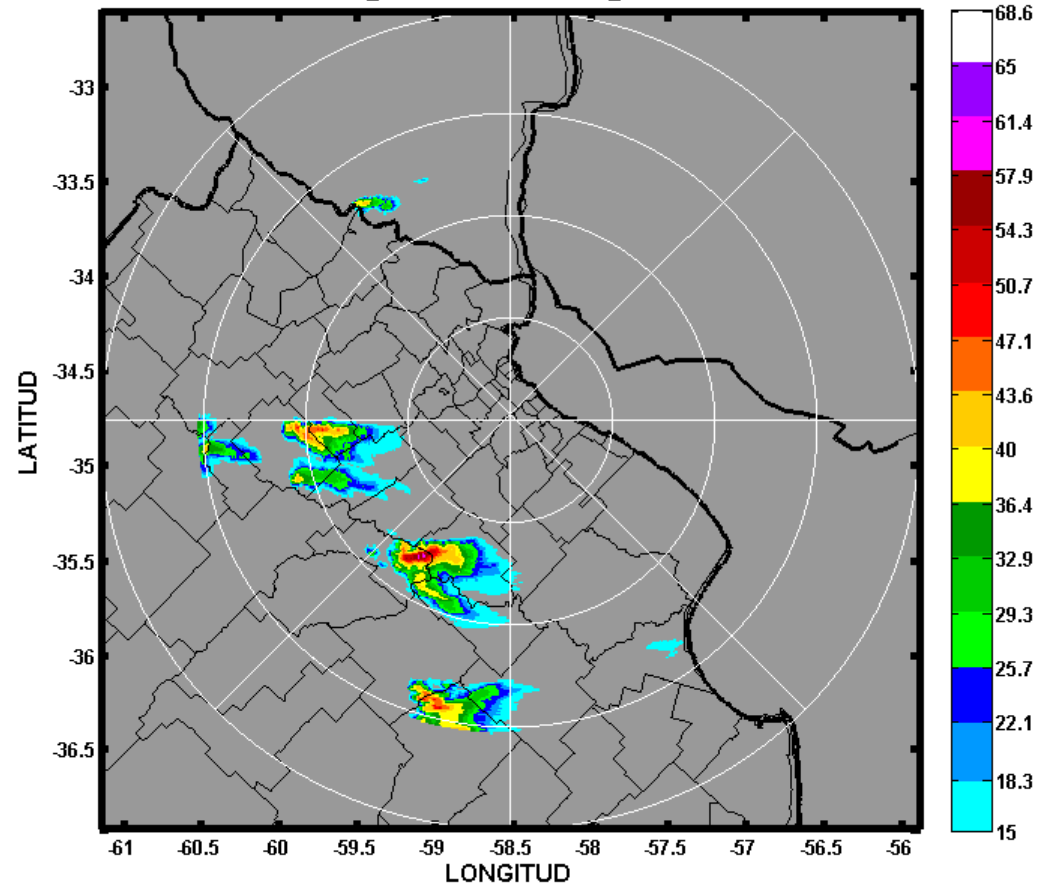
CAPPI@3km - 16.12.2006@2124UTC



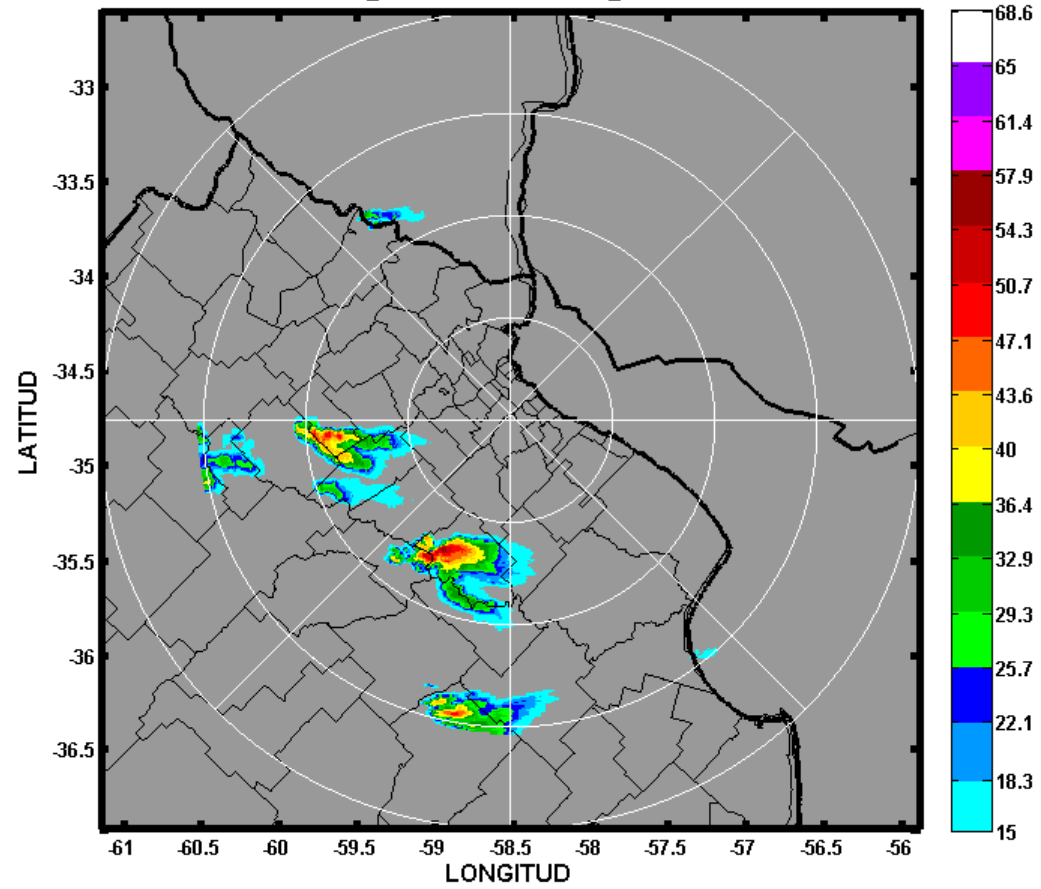
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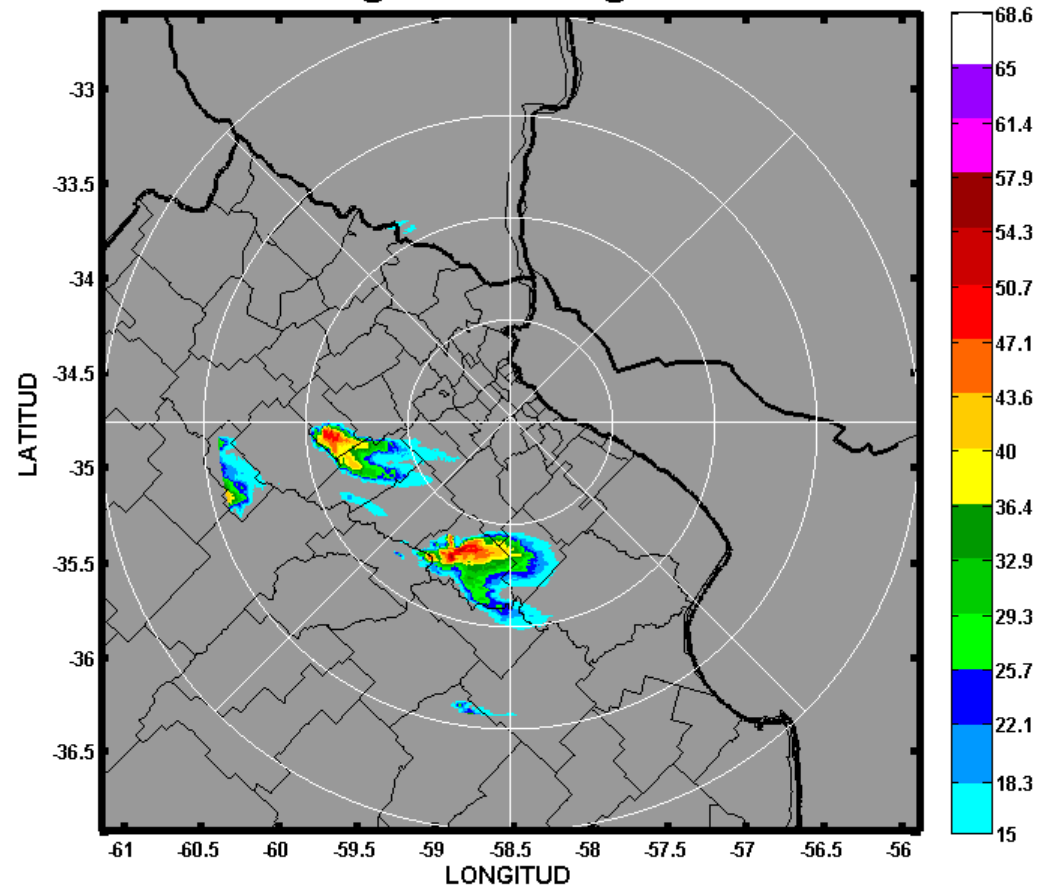
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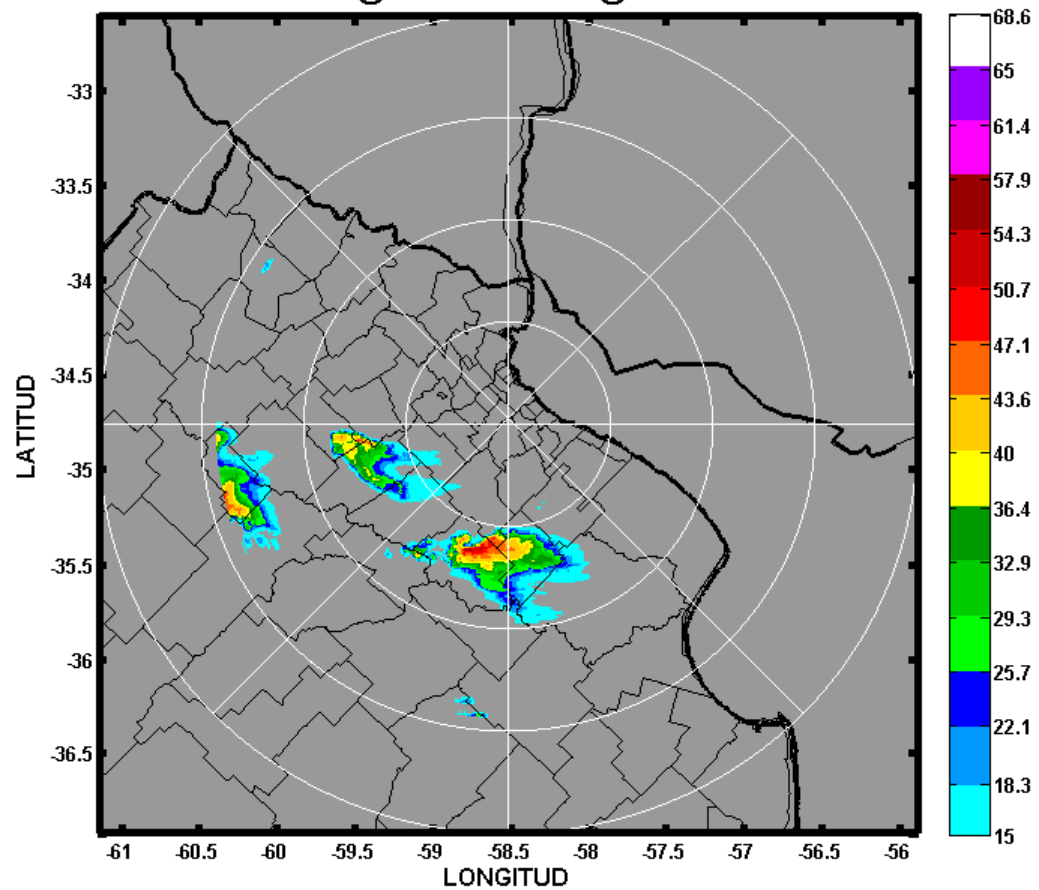
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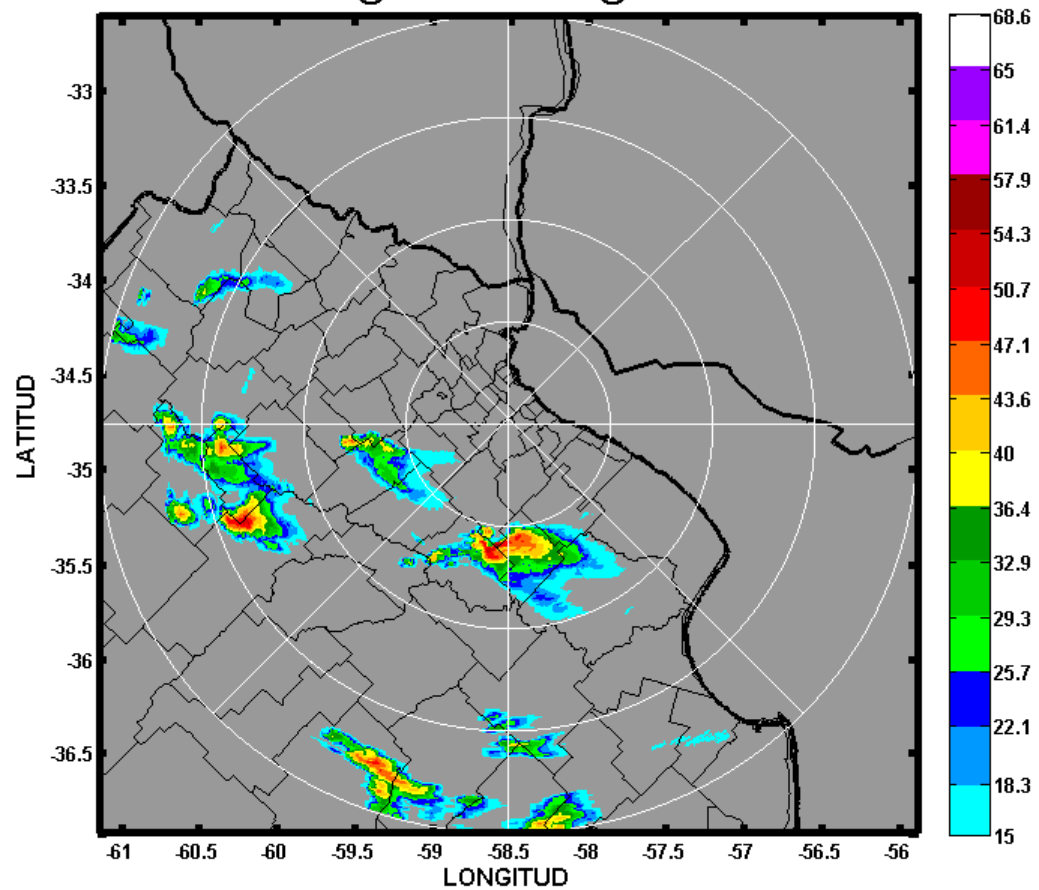
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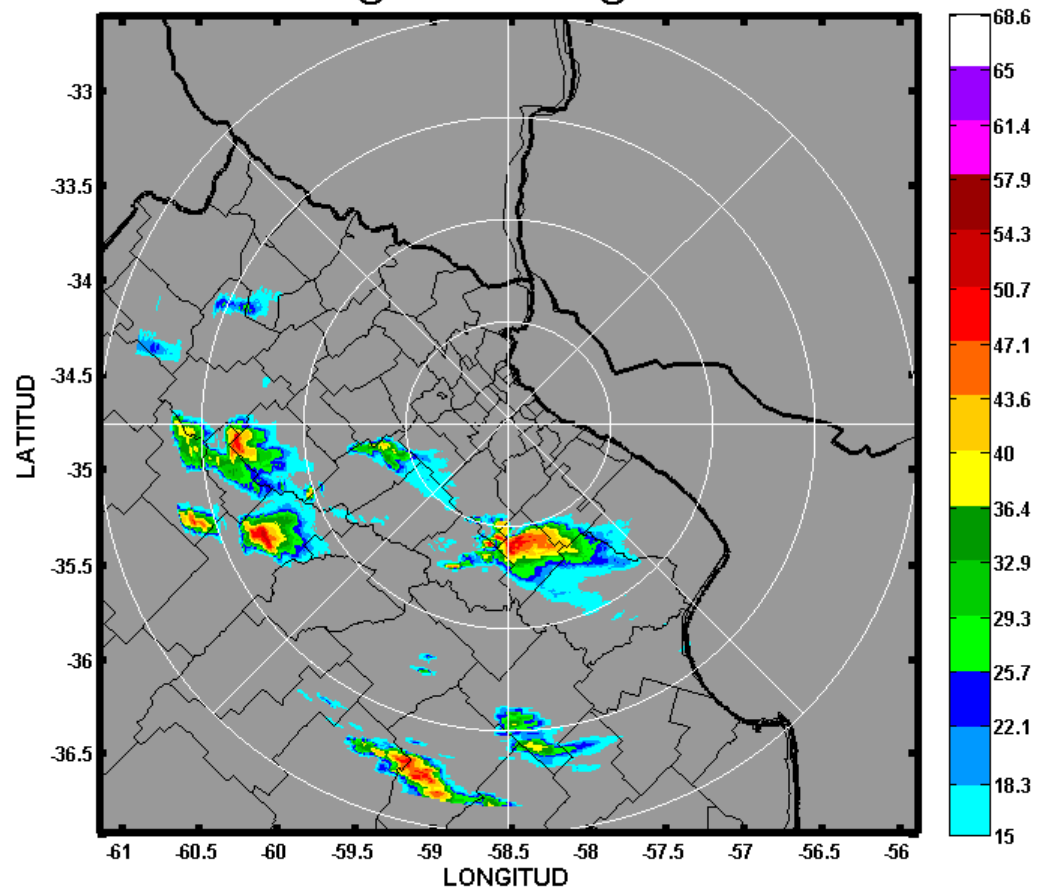
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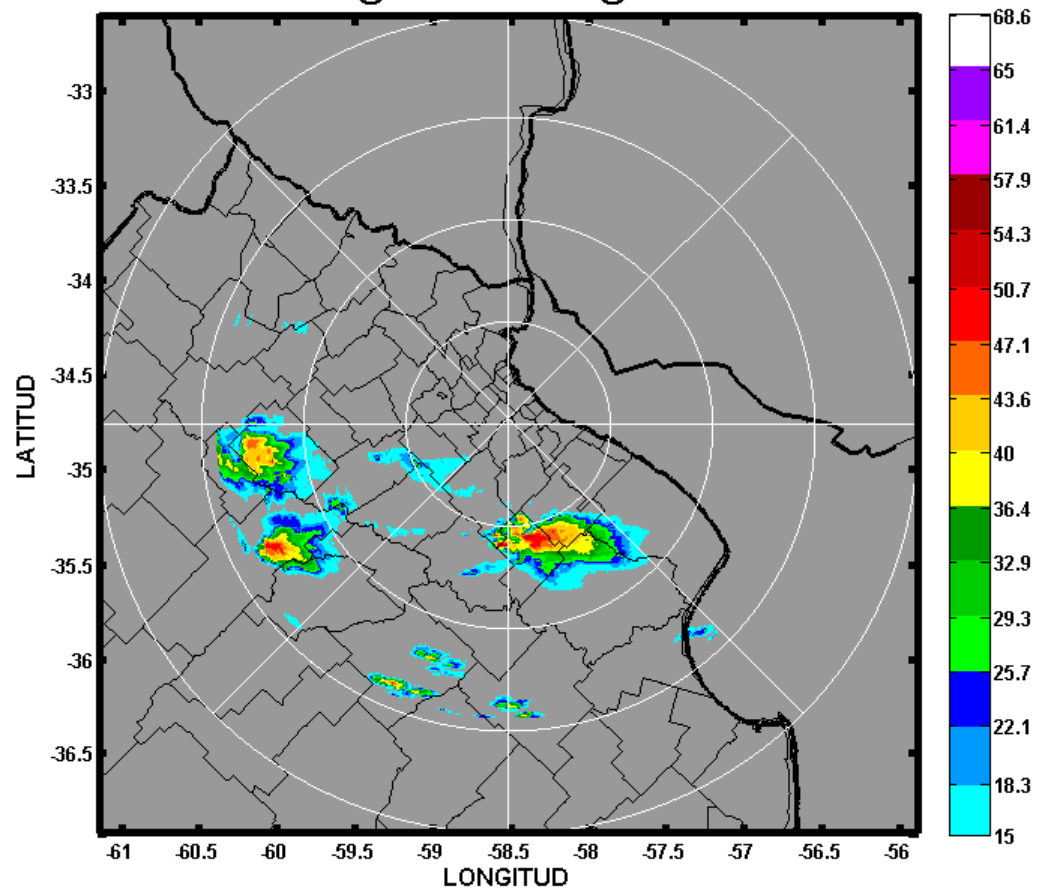
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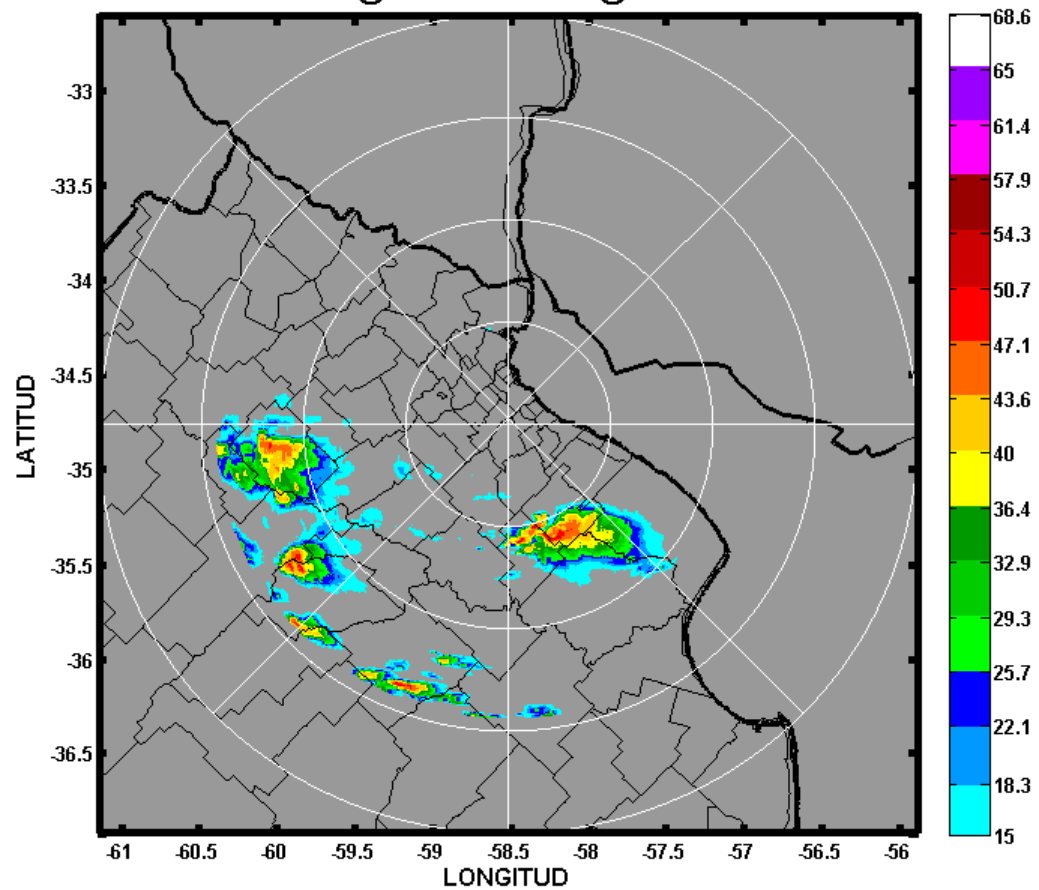
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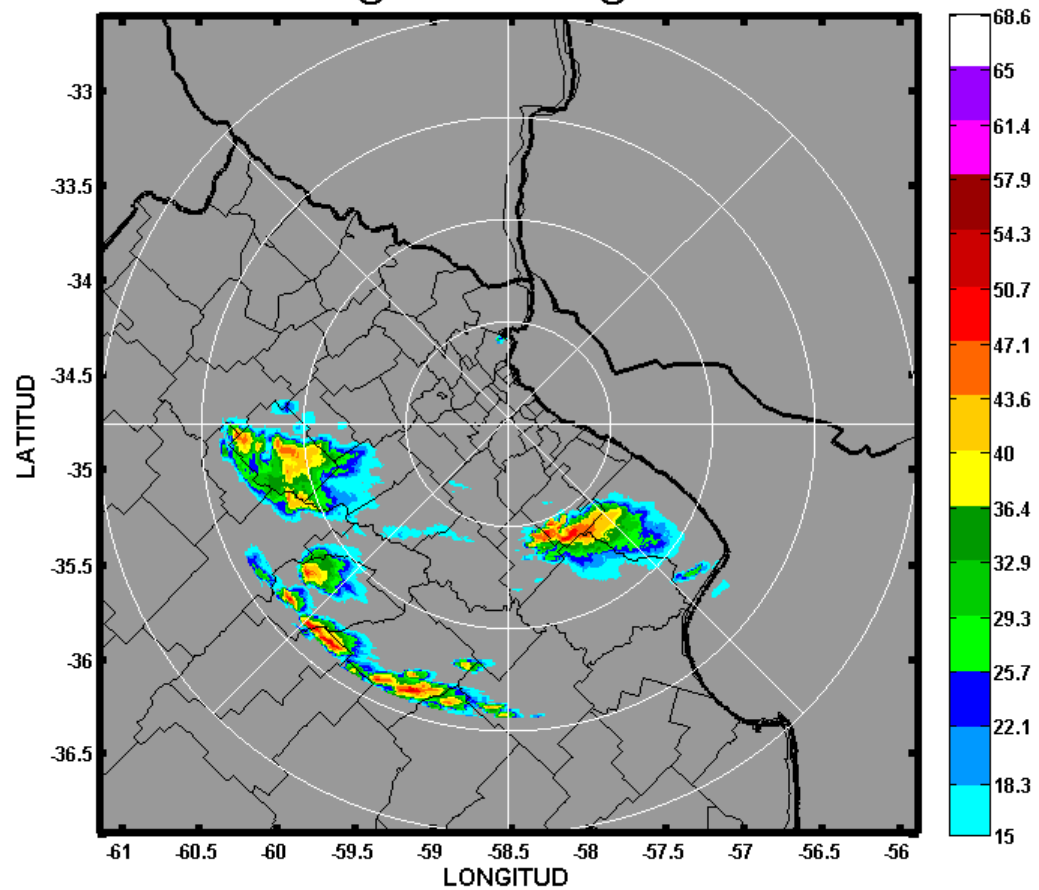
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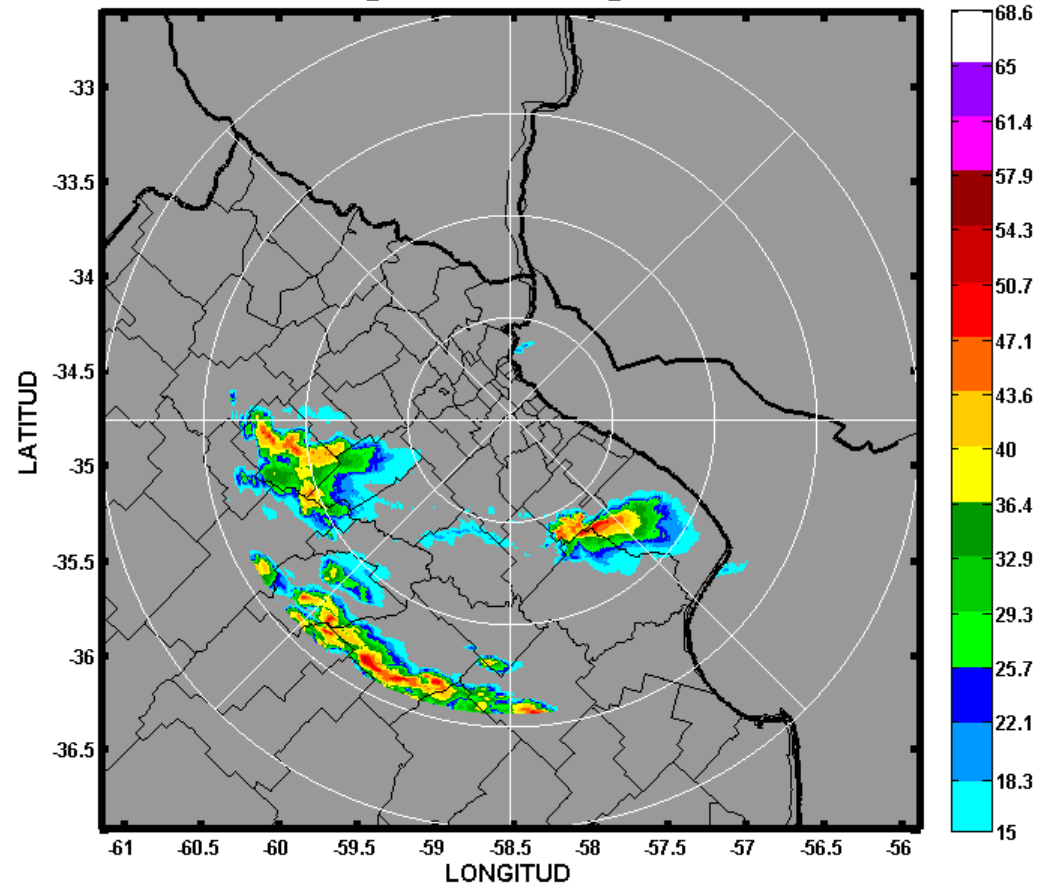
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