

Clima de Sudamérica

M.Barreiro

N.Diaz

2024

TEMARIO

1) Sistemas meteorológicos que afectan el tiempo en Sudamérica

Zona de Convergencia Intertropical
Zona de Convergencia del Atlántico Sur, alta boliviana
Corrientes en chorro
Ciclones, ciclogénesis y corredores de tormentas
Frentes fríos
Jets de capas bajas
Complejos convectivos de mesoescala
(4 semanas)

3) Clima de Uruguay y región subtropical (1 semana)

2) Variabilidad Climática

Bloqueos atmosféricos
Monsón de América del Sur
Teleconexiones y su influencia en la región subtropical
Variabilidad intra-estacional
Variabilidad interanual y de mayor escala temporal
(4 semanas)

4) Circulación regional oceánica

Masas de agua
Corrientes de borde oeste
Frente Subtropical de Plataforma
Interacción océano-atmósfera regional
(2 semanas)

BIBLIOGRAFÍA

- Meteorology of the Southern Hemisphere, Ed. Karoly, G. Vincent
- Tempo e Clima no Brasil, Ed. Cavalcanti et al.
- Artículos científicos a definir.
 - Ya hay 3 colgados para el 1er tema.

GANANCIA DEL CURSO

- 3 Prácticos
- 1 presentación de artículo



Deben sumar > 60%
para dar
Trabajo Final

- Asistencia: 85%
- Trabajo Final (escrito + presentación oral individual) – 4 semanas

PREVIAS

Licenciatura en Cs de la Atmósfera

Requisitos previos: El curso supone conocimientos de meteorología avanzados y una base de estadística multivariada.

Ejemplos de unidades curriculares de Facultad de Ciencias u otros que aportan dichos conocimientos: Examen aprobado de Dinámica de la Atmósfera u Oceanografía Dinámica y el examen de Análisis Estadística de Datos Climáticos o curso de estadística multivariada.

Maestría en Geociencias

3.5 Conocimientos previos requeridos:

El curso requiere conocimientos de meteorología avanzados y una base de estadística multivariada. Asimismo, se recomienda habilidad en programación y conocimientos de inglés suficientes para comprender la literatura técnica específica.

DATOS

- **Reanalysis NCEP DOE (Reanalysis 2)**

1/1/1979 - presente

<https://psl.noaa.gov/data/gridded/data.ncep.reanalysis2.html>

- **Reanalysis ERA5**

1/1/1940 - presente

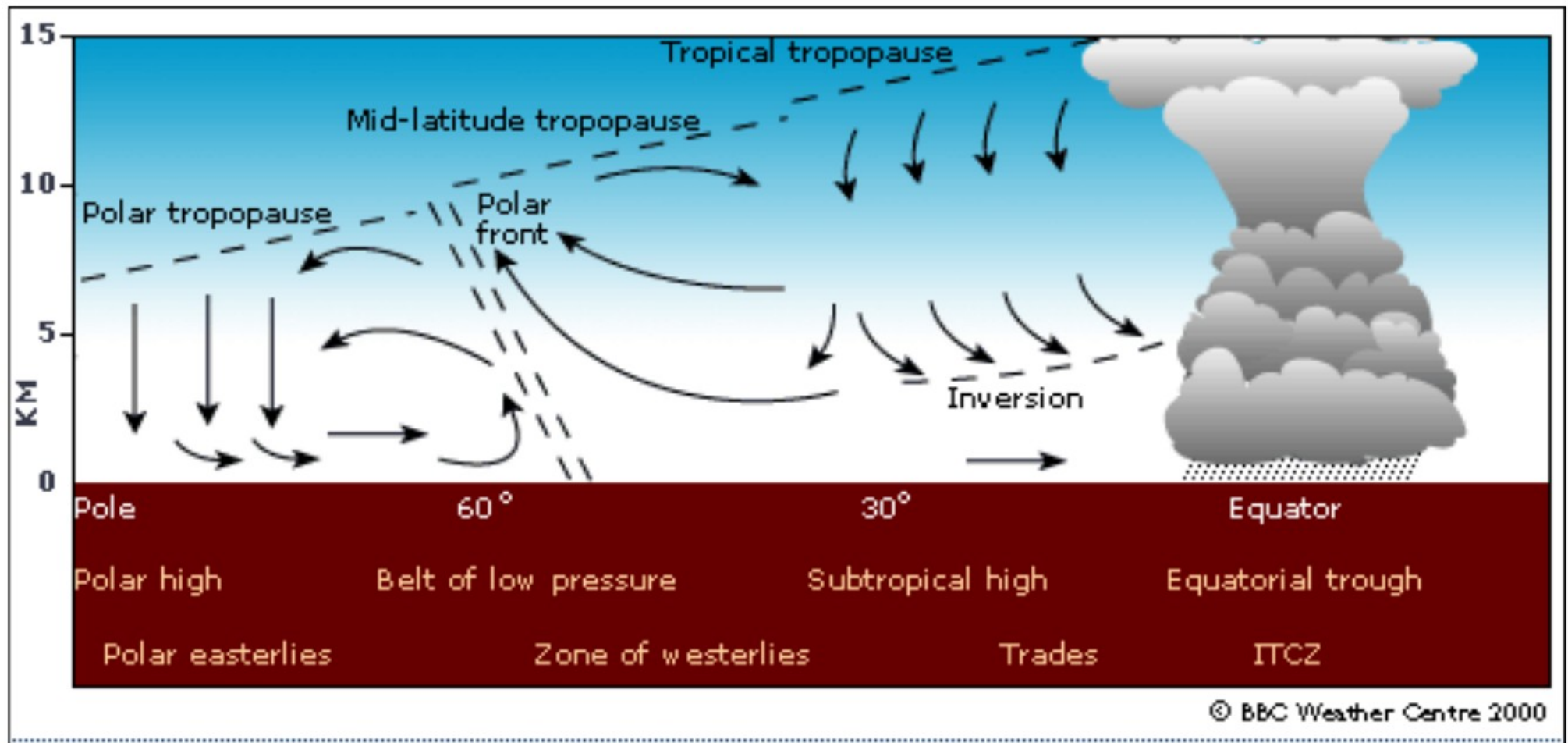
<https://www.ecmwf.int/en/forecasts/dataset/ecmwf-reanalysis-v5>

- **Otros....**

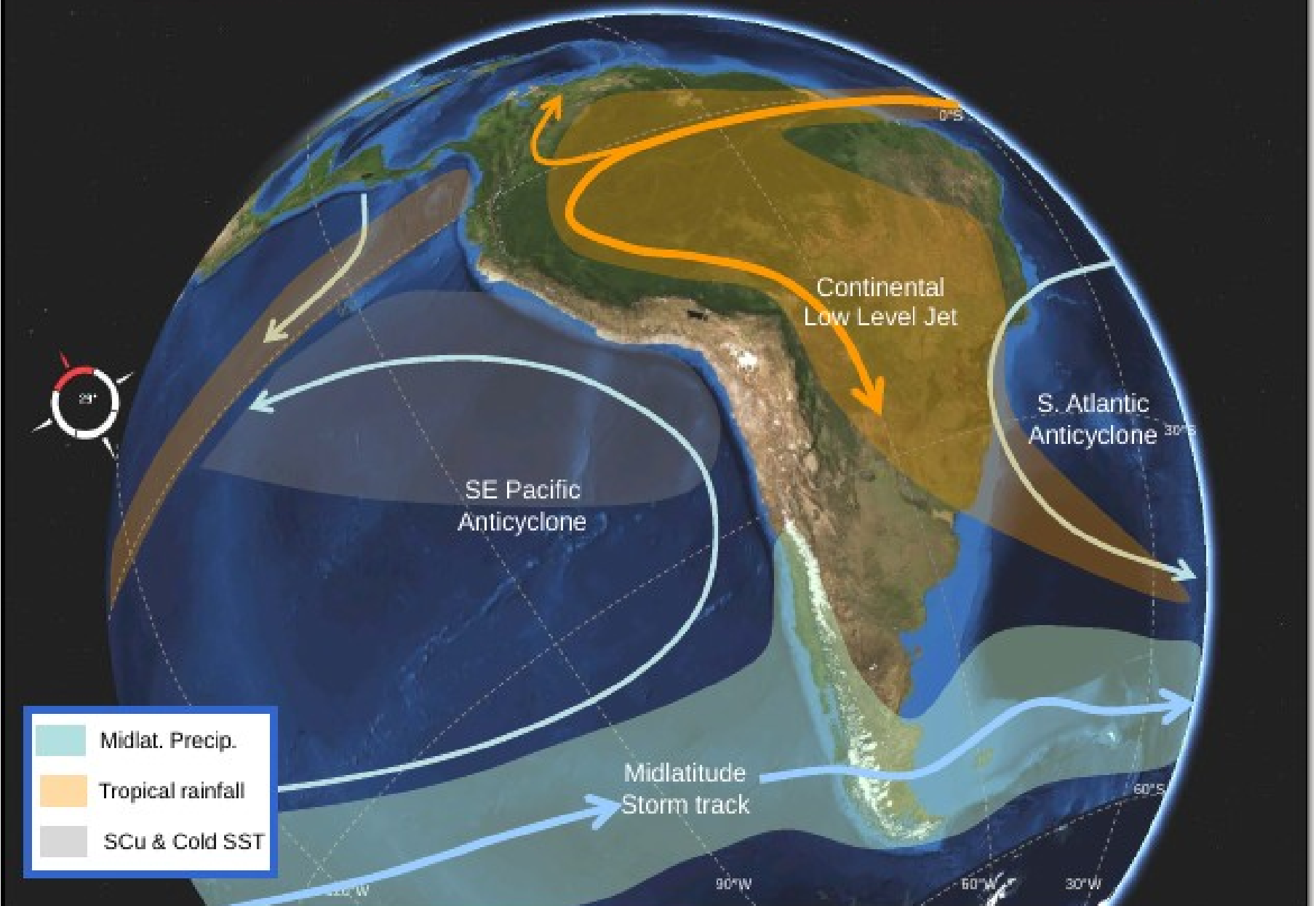
Introducción



Debido a su gran extensión latitudinal Sudamérica tiene climas tropicales, subtropicales y extratropicales.



The big picture



Océanos tropicales cercanos

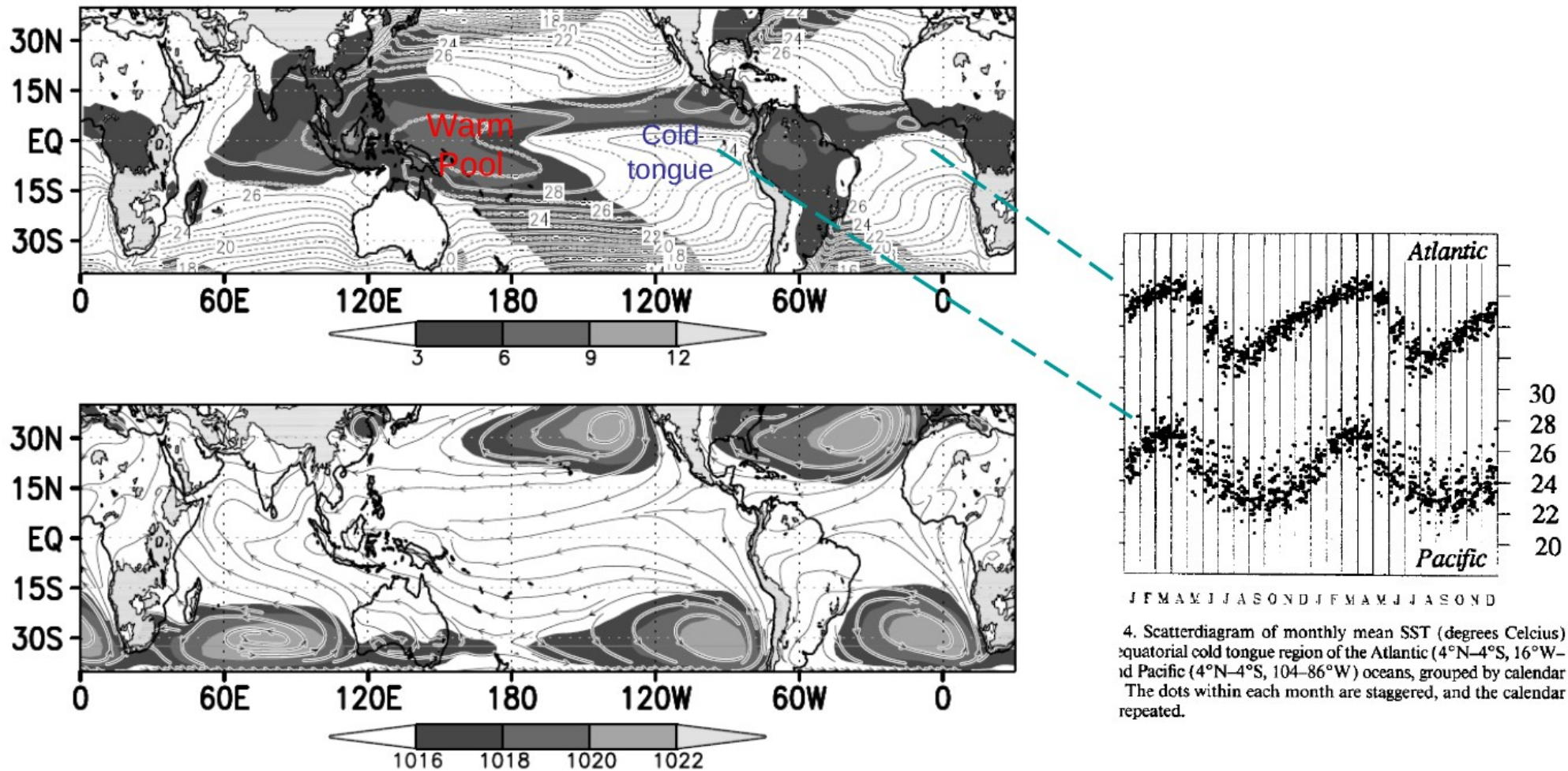


FIG. 1. Top: Climatological mean rainfall rate (shaded; mm/day; data from GPCP, Huffman et al, 1997) and sea surface temperature (contours; °C; data from NCEP OI SST v2, Reynolds et al, 2002). Bottom: Climatological mean 925 mb streamlines and mean sea level pressure (shaded, mb) from NCEP/NCAR Reanalysis (Kalnay et al, 1996; Kistler et al, 2001). Land elevation greater than 1000 m is lightly shaded and bounded by a thin contour.

Takahashi and Battisti 2001

Características de circulación regionales

Maximo

La alta subtrop del Atlántico es mas debil en verano por el desarrollo de la SACZ

Maximo

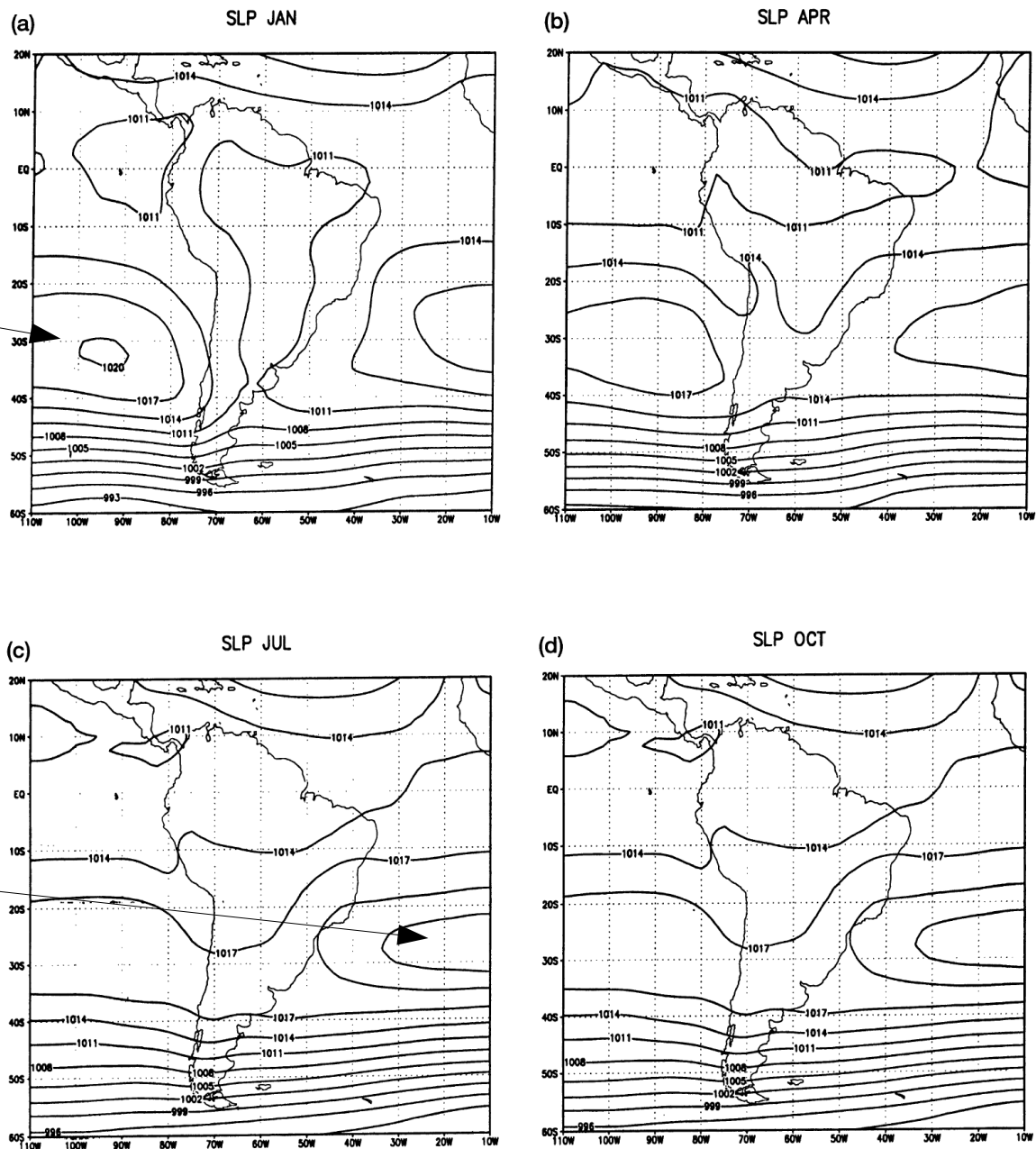
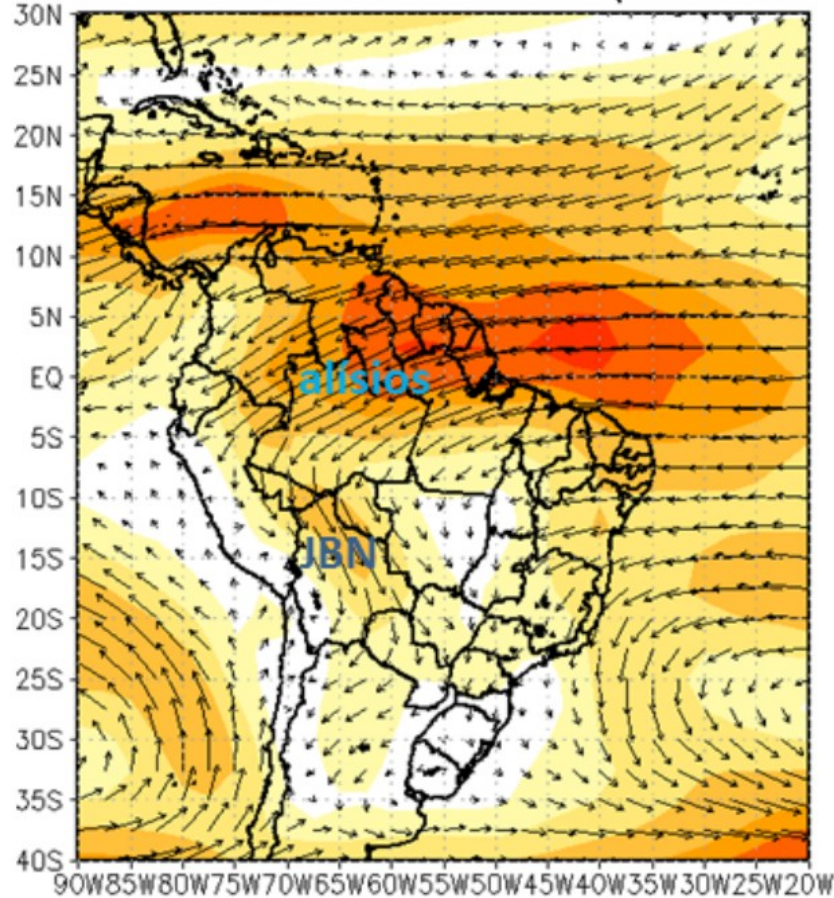
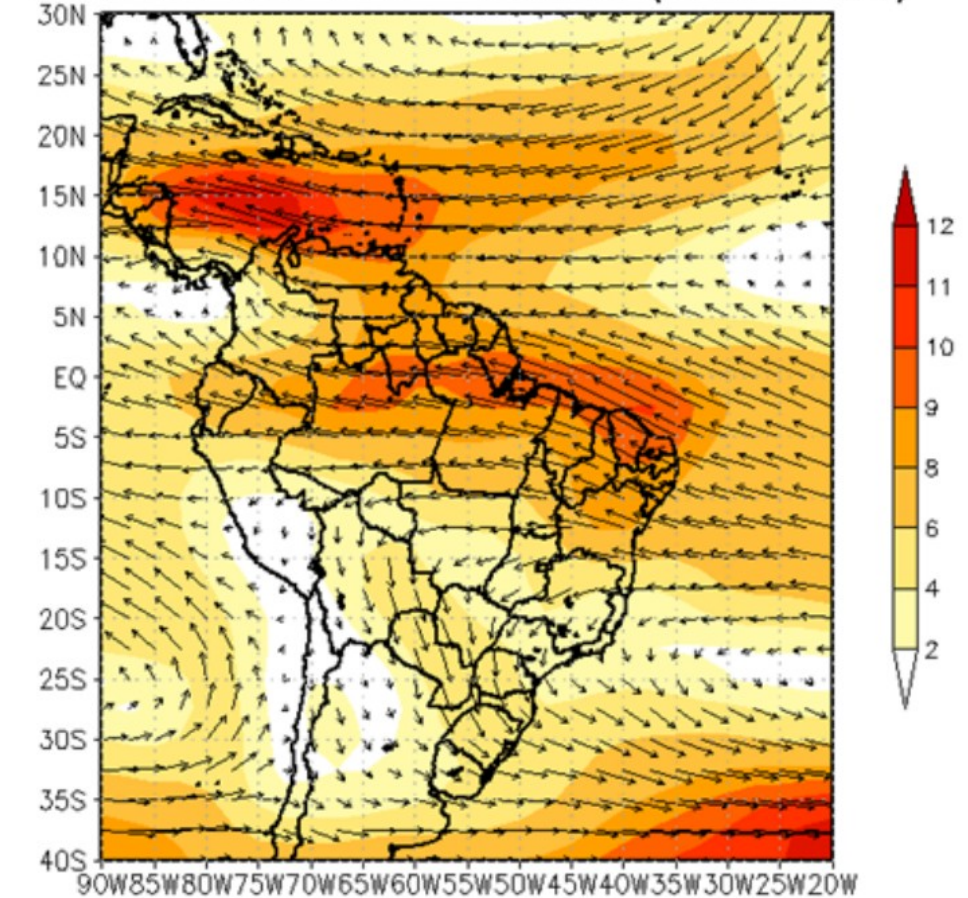


FIG. 3C.1. MSLP (hPa) distribution for January, April, July, and October.

a) Vento em 850 hPa – Verão (1979–2008)



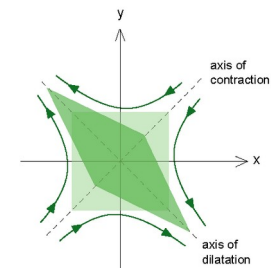
b) Vento em 850 hPa – Inverno (1979–2008)



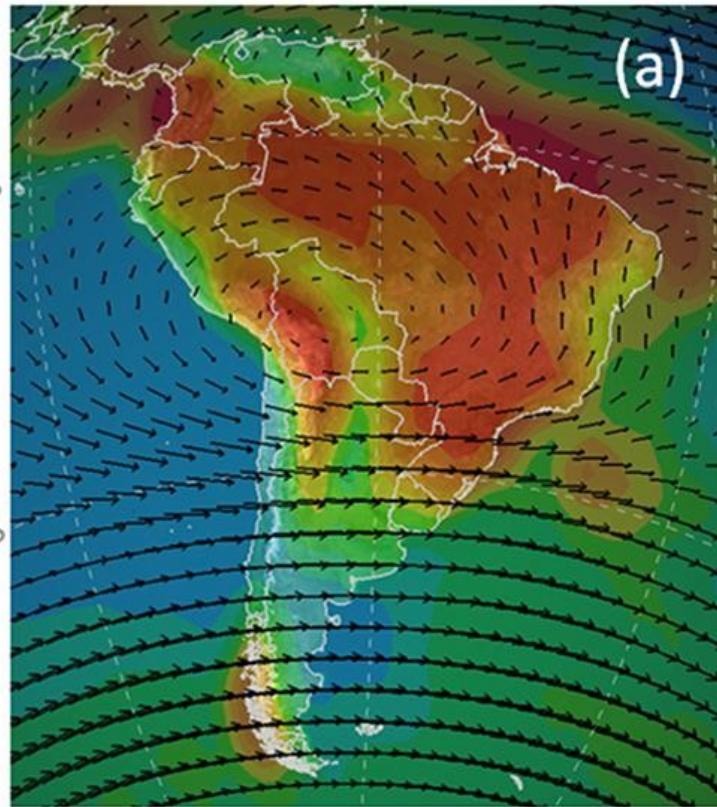
Reanálise do NCEP/DOE

Figura 9. Direção (setas) e magnitude (colorido) do vento em 850 hPa no (a) verão e (b) inverno. Médias calculadas a partir da reanálise do NCEP/DOE (Kanamitsu et al. 2002) no período de 1979 a 2008

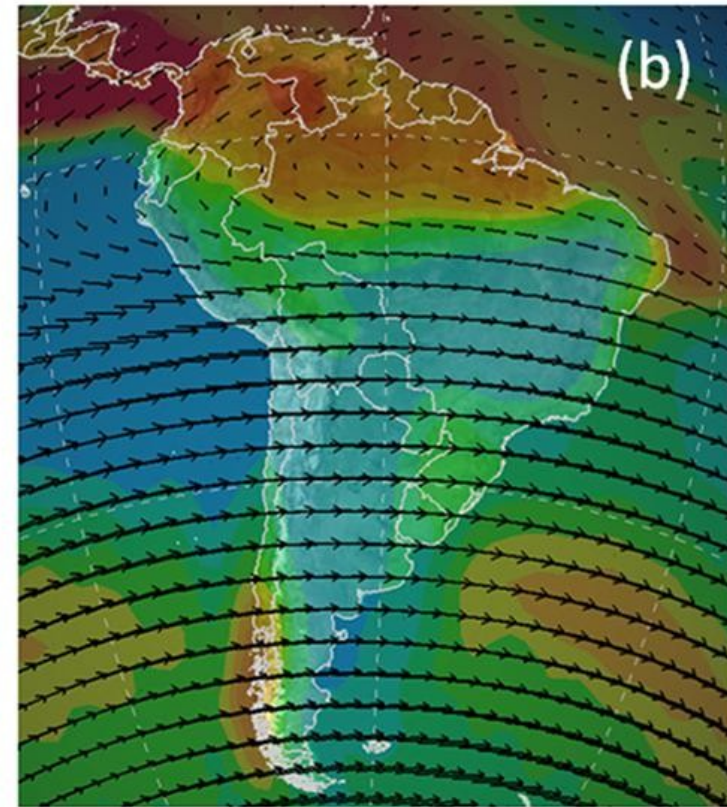
En verano, la región definida entre los anticiclones semipermanentes y la baja continental, entre 15S y 40S es frontogenética debido al campo de deformación asociado a los vientos.



Austral summer (DJF)



Austral winter (JJA)



200 hPa winds
& Precip

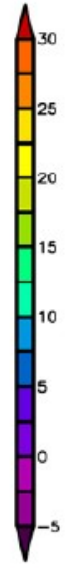
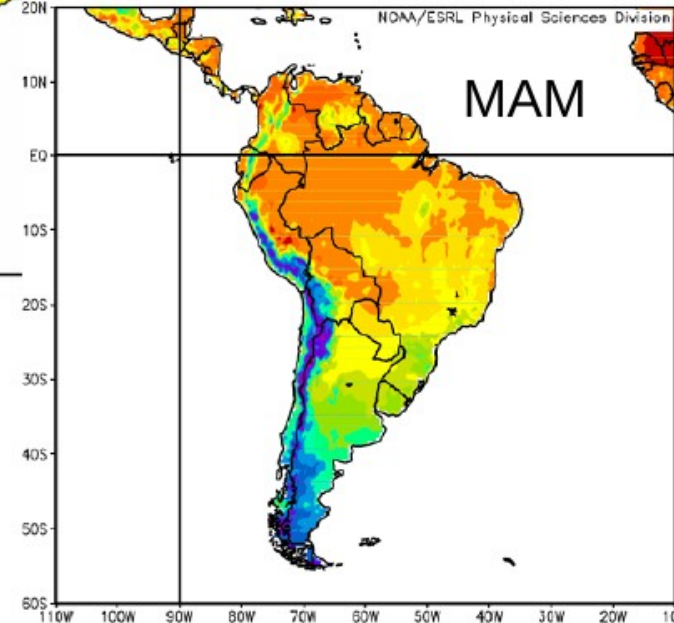
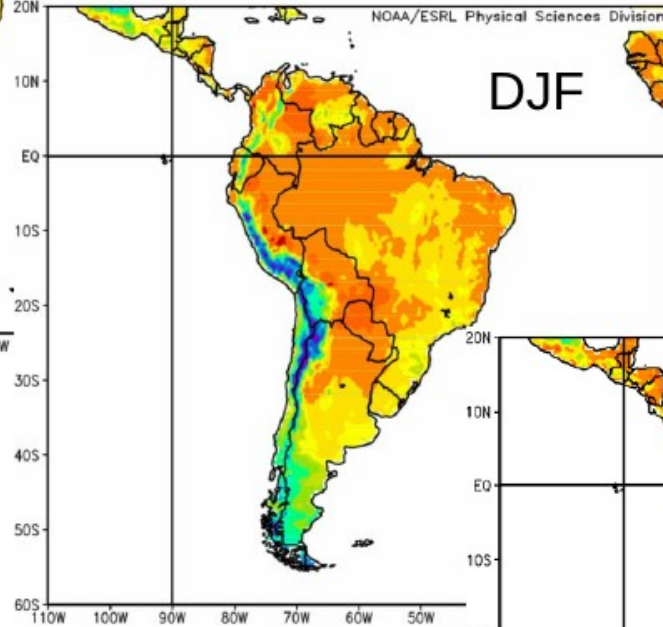
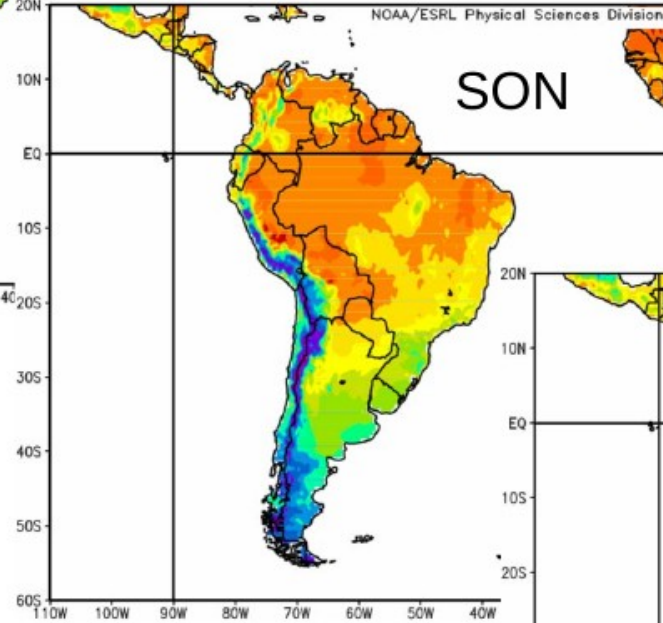
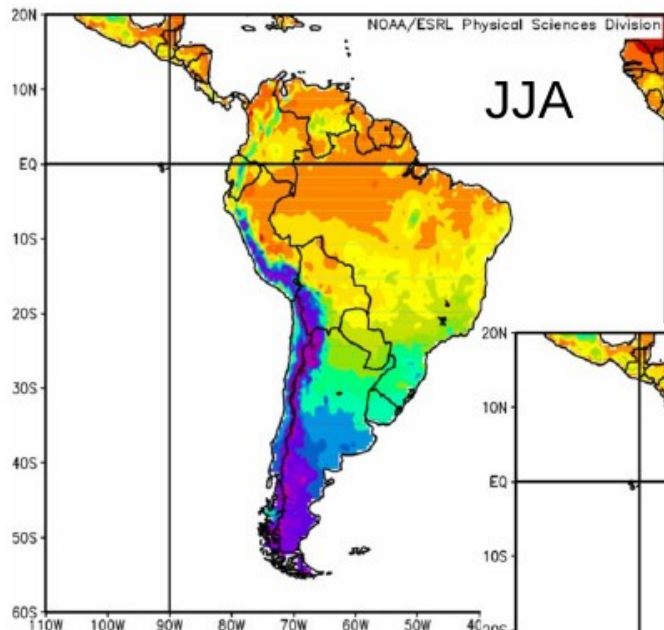
mm/month

300

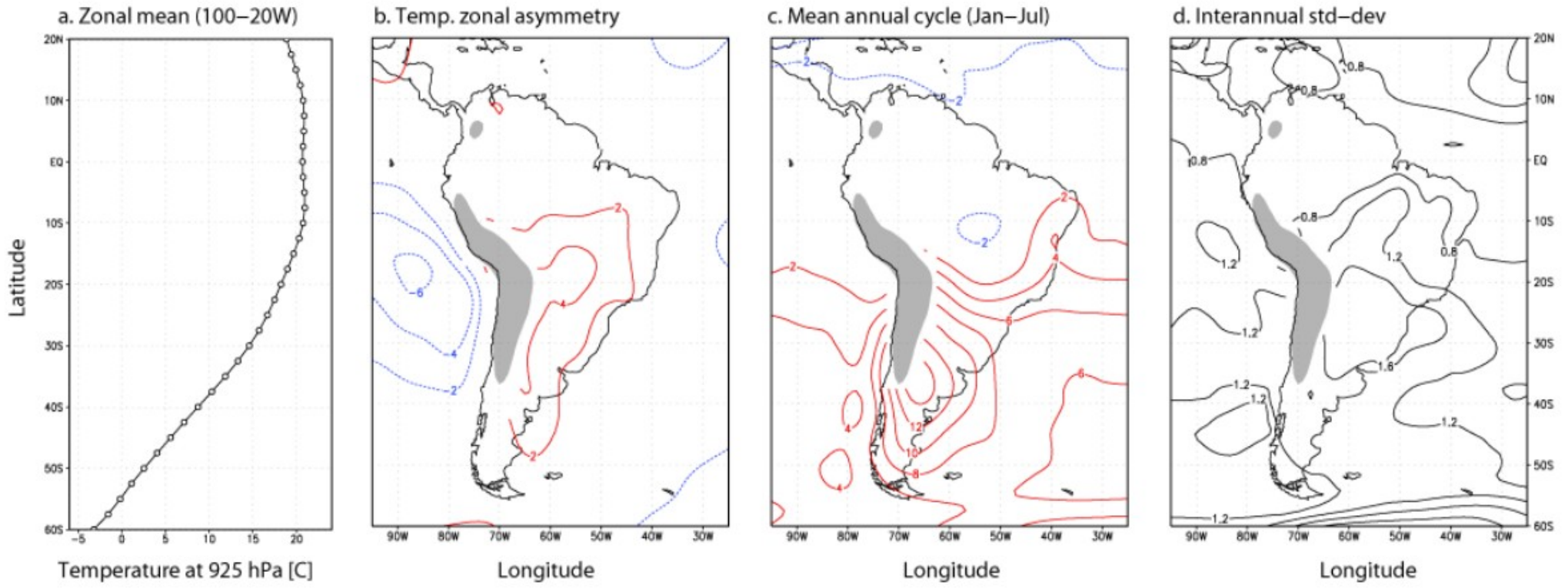
150

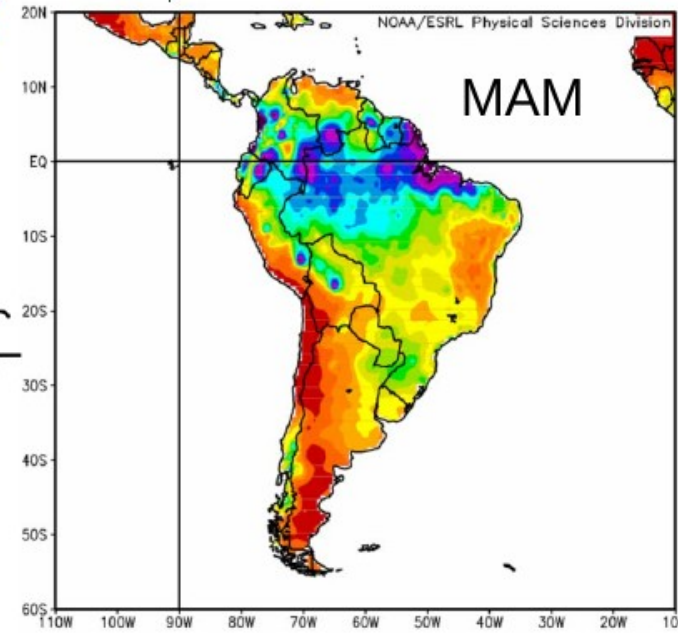
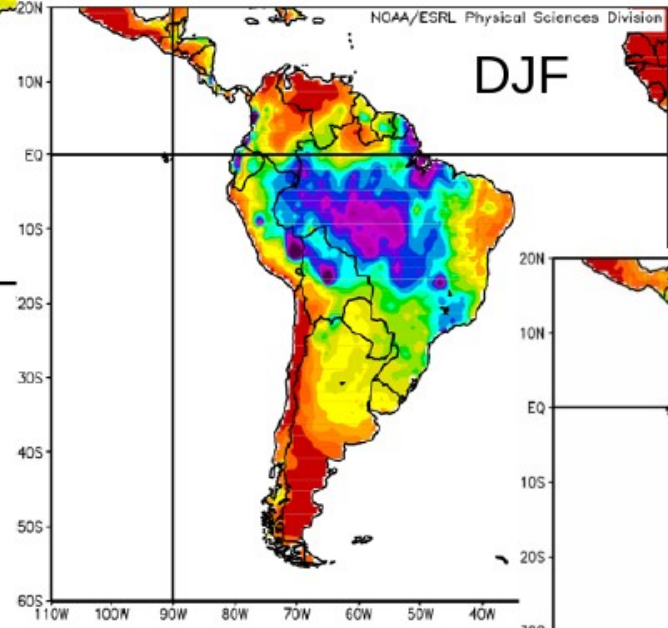
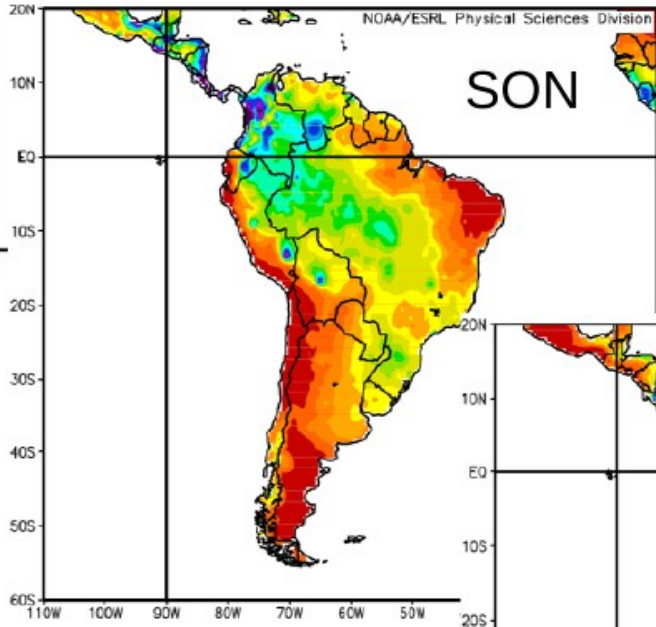
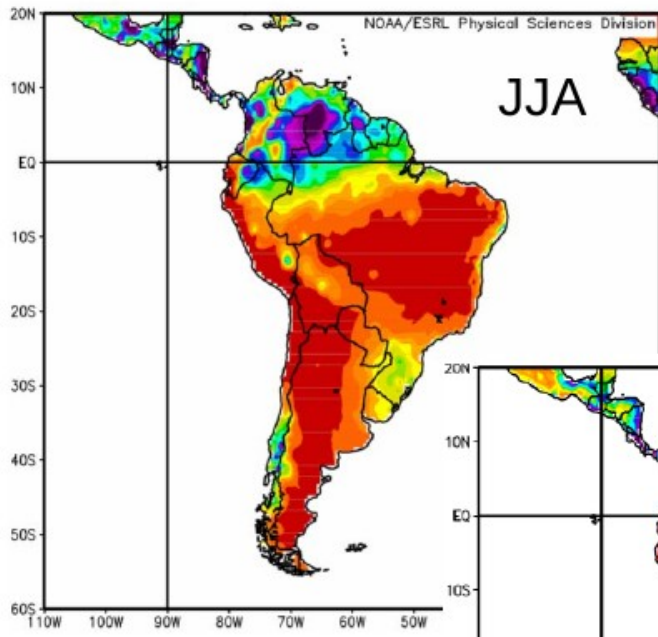
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Seasonal long-term mean 2-m air temperature [°C] U. Delaware

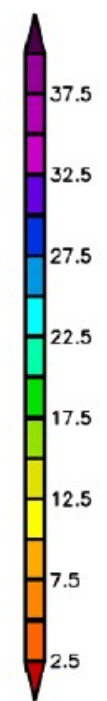


Otra mirada...





Seasonal long-term mean Precipitation [mm/day] U. Delaware



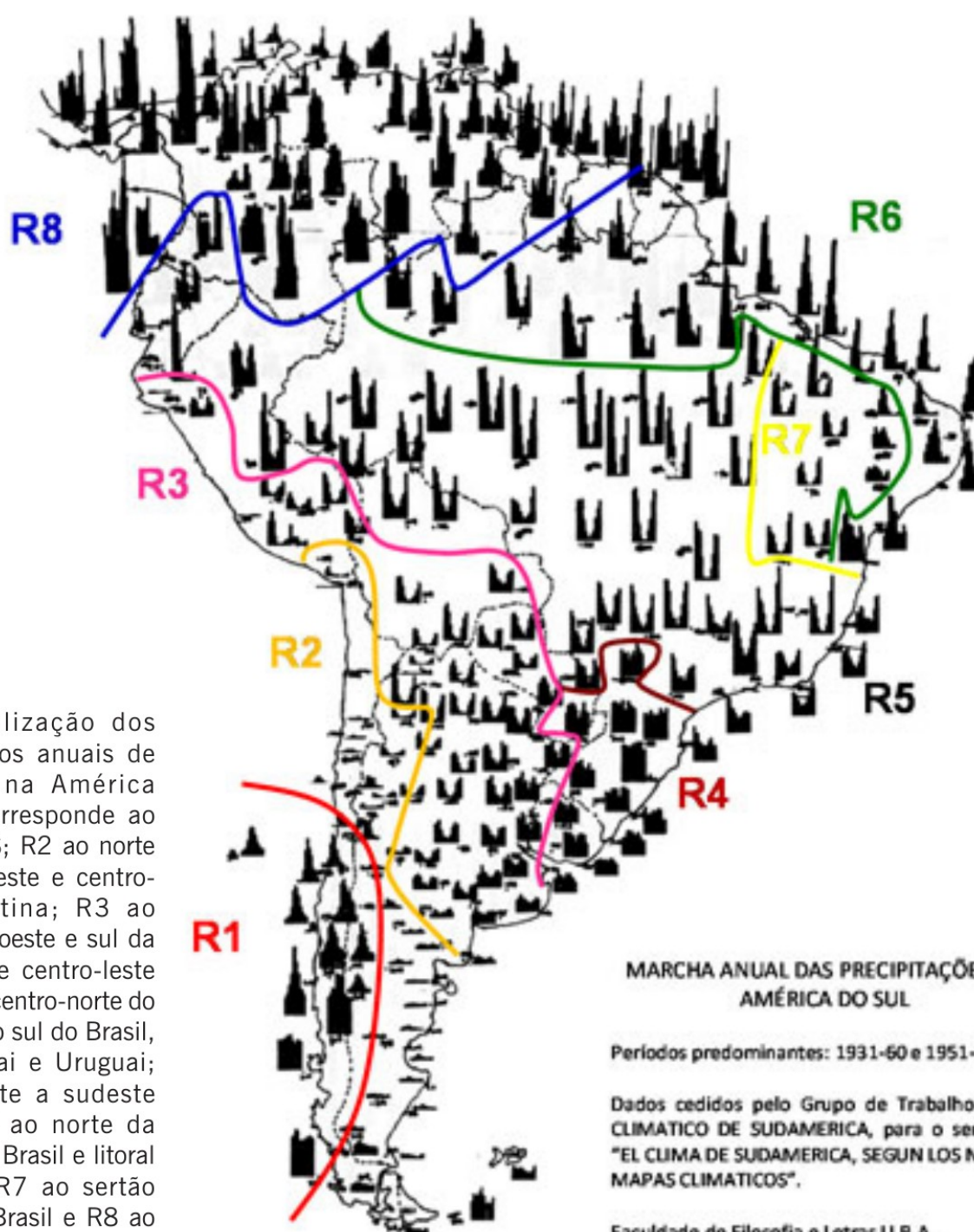


Figura 8. Regionalização dos diferentes ciclos anuais de precipitação na América do Sul. R1 corresponde ao sudoeste da AS; R2 ao norte do Chile, noroeste e centro-sul da Argentina; R3 ao oeste do Peru, oeste e sul da Bolívia, norte e centro-leste da Argentina e centro-norte do Paraguai; R4 ao sul do Brasil, sul do Paraguai e Uruguai; R5 ao noroeste a sudeste do Brasil; R6 ao norte da região norte do Brasil e litoral do nordeste; R7 ao sertão nordestino do Brasil e R8 ao norte da AS incluindo o estado de Roraima. Fonte: Reboita et al. (2010a)

MARCHA ANUAL DAS PRECIPITAÇÕES NA AMÉRICA DO SUL

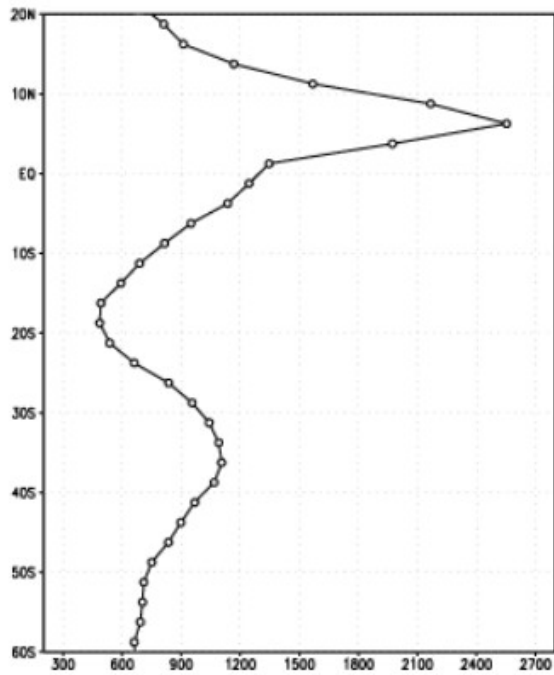
Períodos predominantes: 1931-60 e 1951-60

Dados cedidos pelo Grupo de Trabalho ATLAS CLIMÁTICO DE SUDAMÉRICA, para o seminário "EL CLIMA DE SUDAMÉRICA, SEGUN LOS NUEVOS MAPAS CLIMÁTICOS".

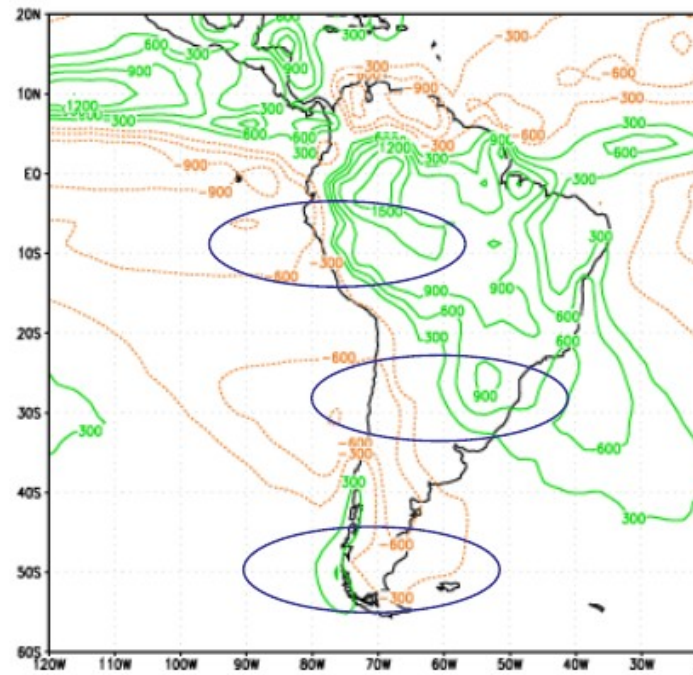
Faculdade de Filosofia e Letras U.B.A.

Desde otro punto de vista...

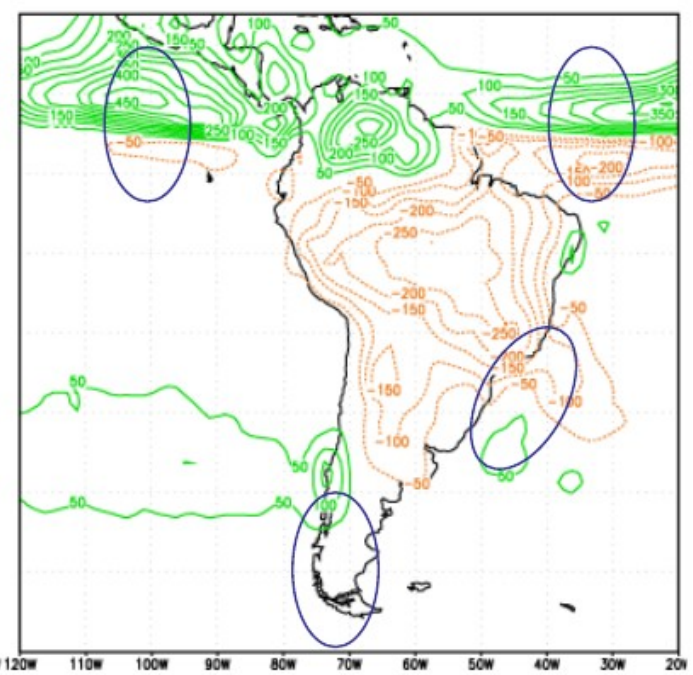
Annual Mean / Zonal Mean



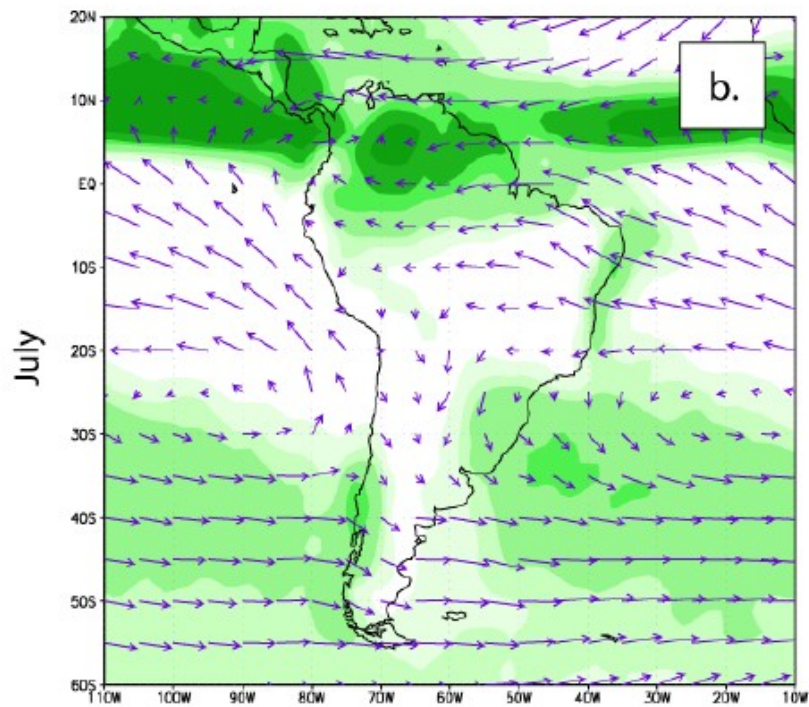
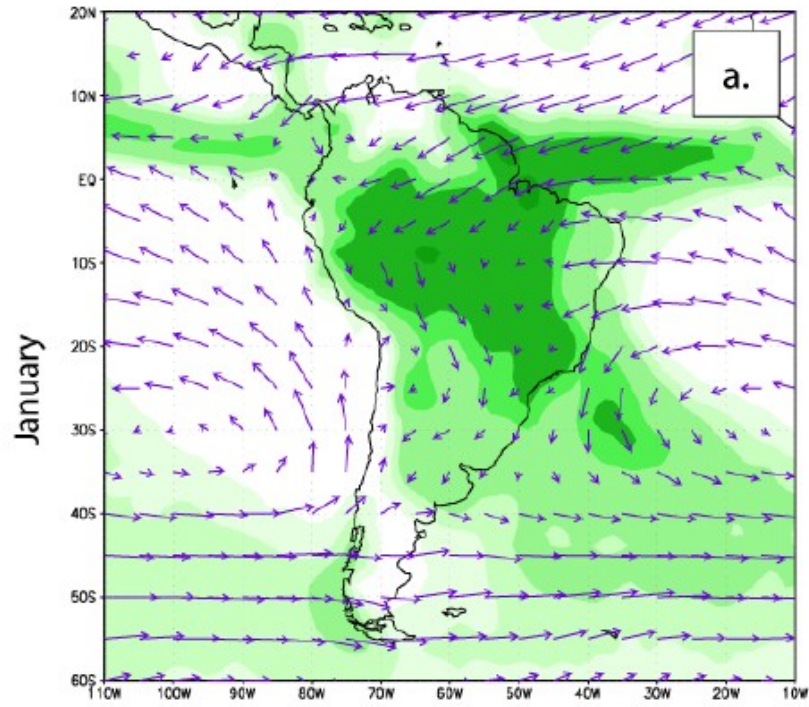
Annual Mean / Zonal asymmetry



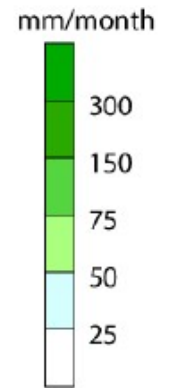
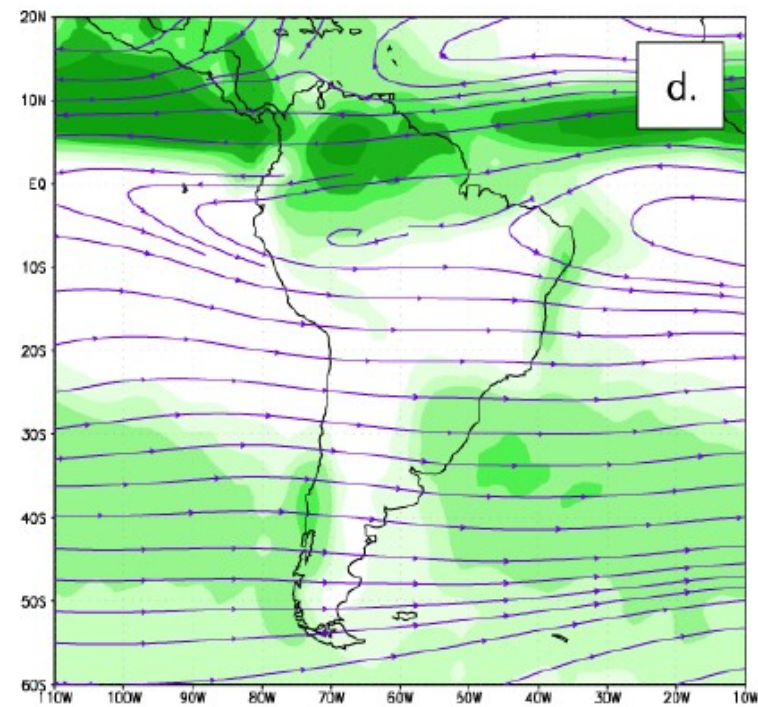
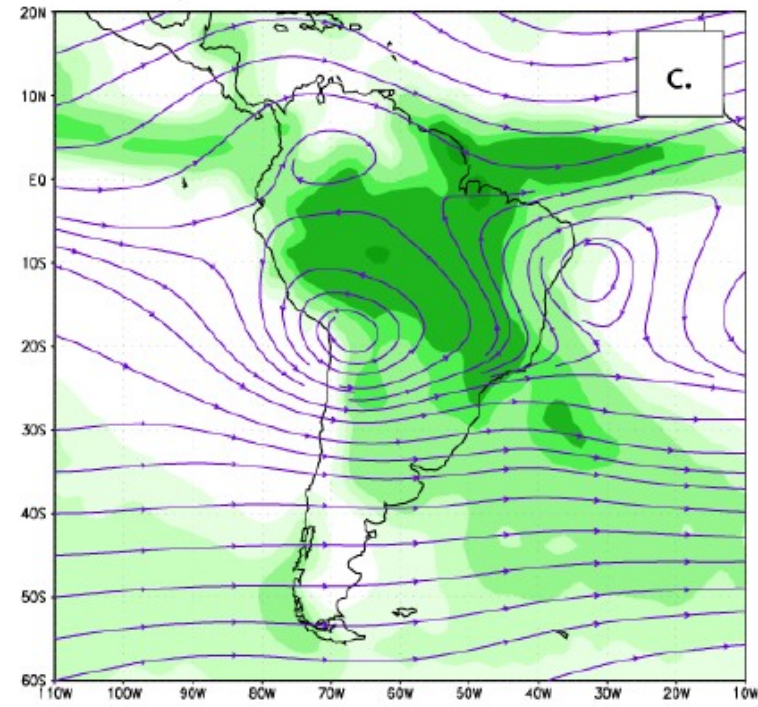
January - July Mean



Precipitation and 925 hPa winds

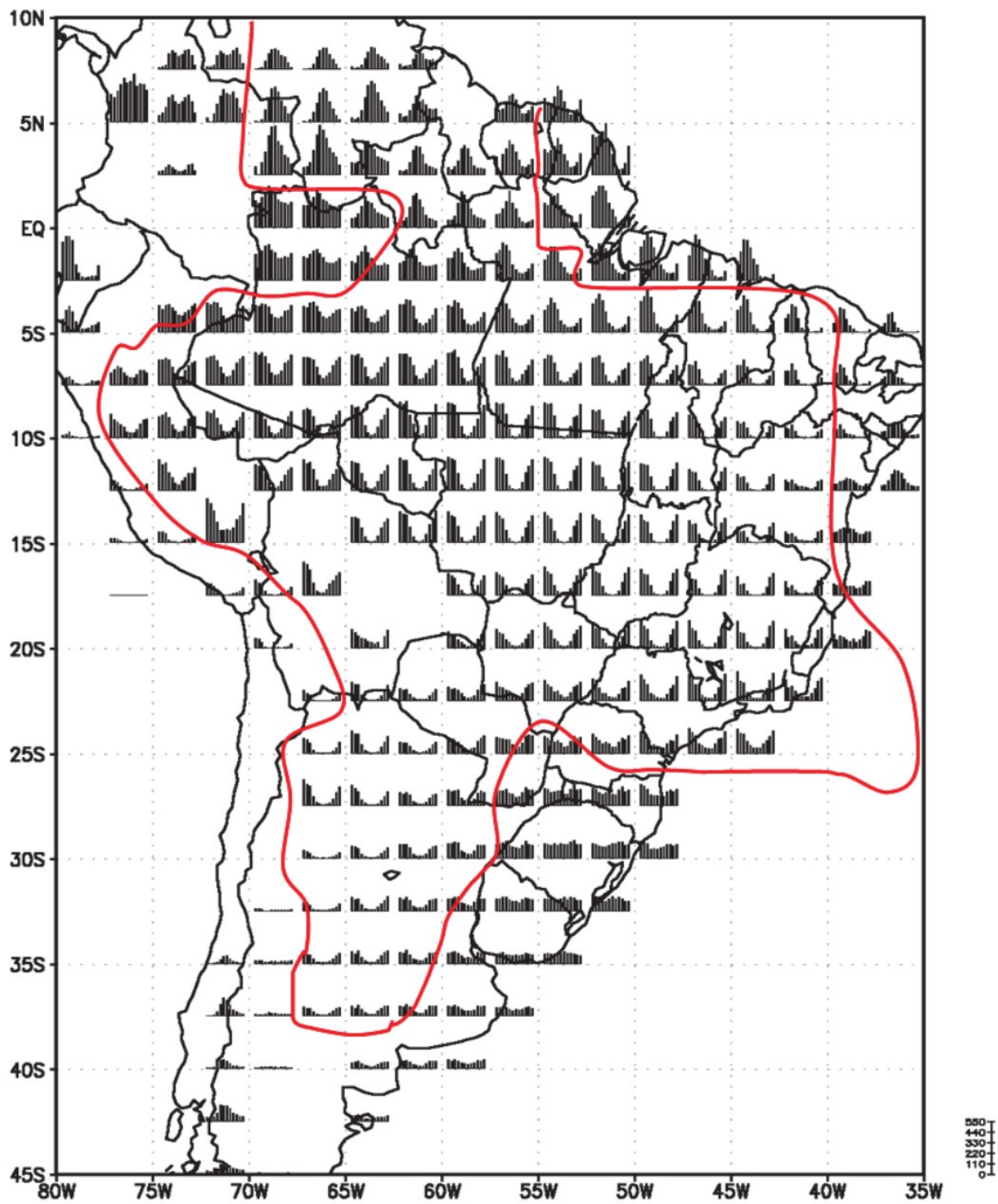


Precipitation and 300 hPa winds



Pagina de la NOAA Global Monsoons

[http://www.cpc.ncep.noaa.gov/products/Global_Monsoons/
American_Monsoons/American_Monsoons.shtml](http://www.cpc.ncep.noaa.gov/products/Global_Monsoons/American_Monsoons/American_Monsoons.shtml)



Grimm et al 2021

Fig. 1. Annual cycles of precipitation over South America. The monsoon domain is delimited in red, according to the regions defined by Wang *et al.* (2012) (adapted from Grimm 2011).

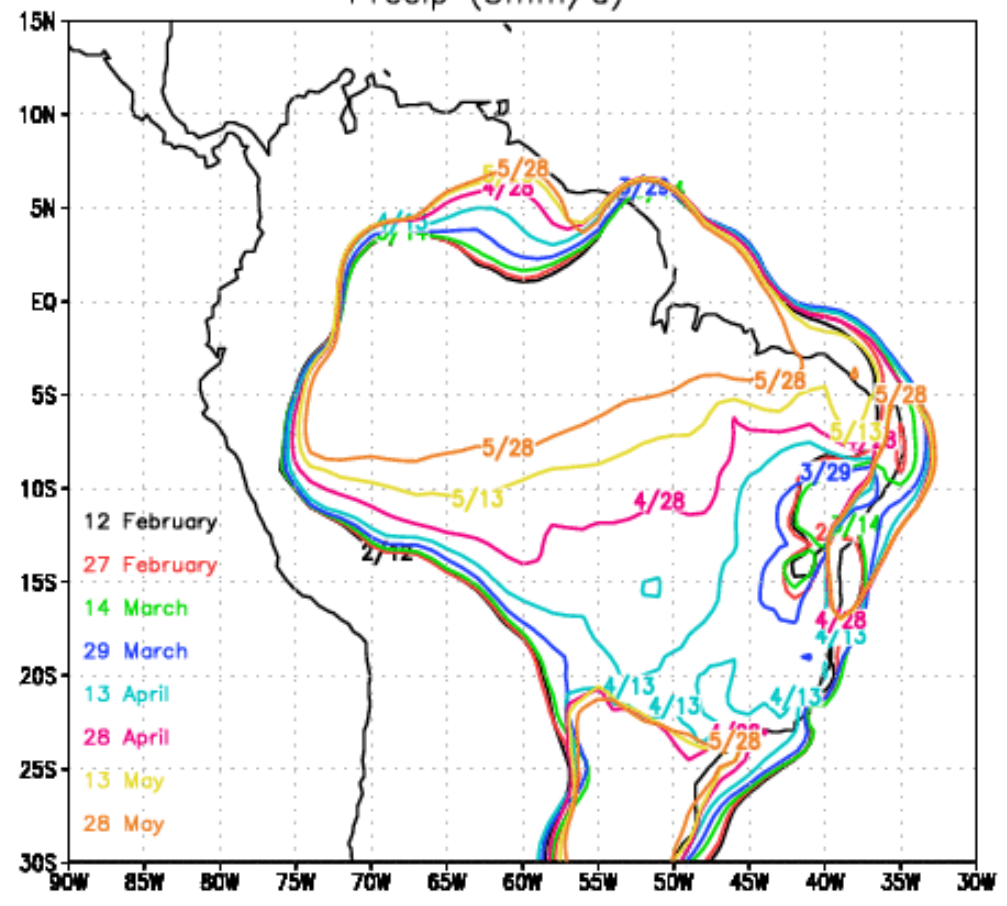
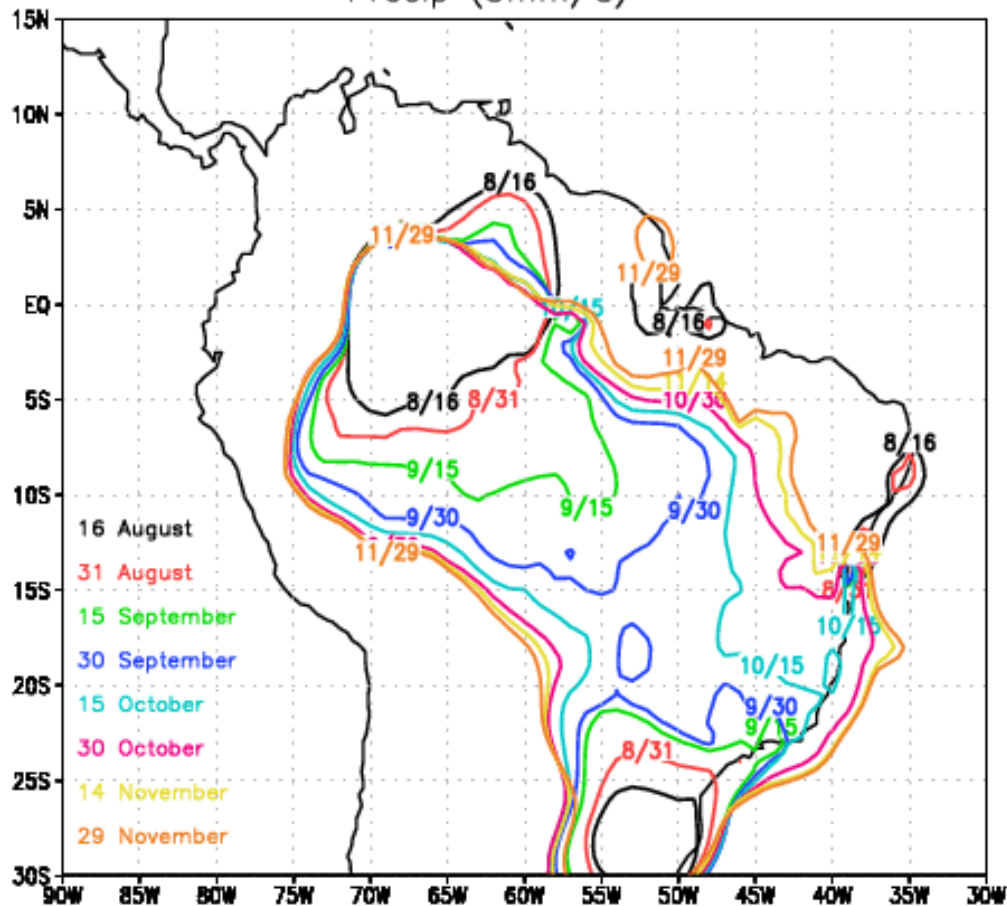
Climatología monsón

Comienzo

Final

Precip (3mm/d)

Precip (3mm/d)

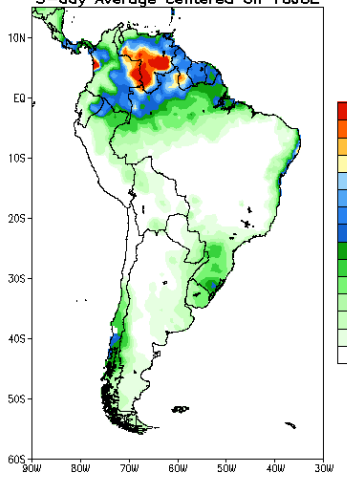




Climatología lluvias

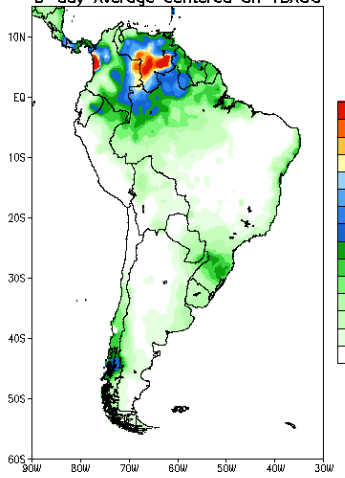
Precip. Climatology (mm/d) 1979–2006

5-day Average centered on 16JUL



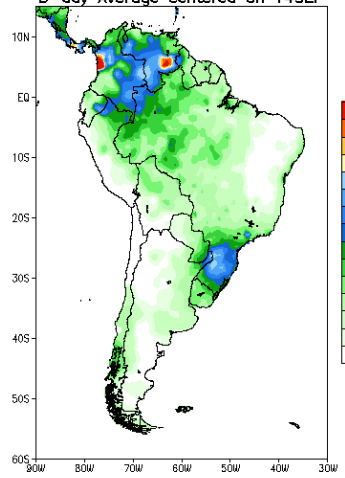
Precip. Climatology (mm/d) 1979–2006

5-day Average centered on 15AUG



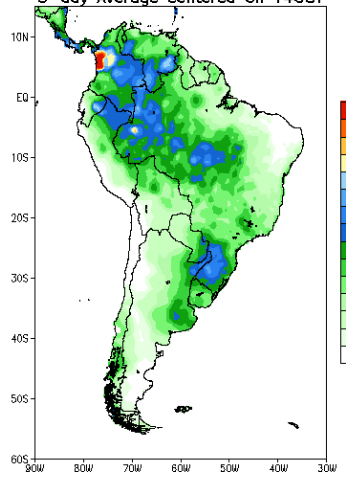
Precip. Climatology (mm/d) 1979–2006

5-day Average centered on 14SEP



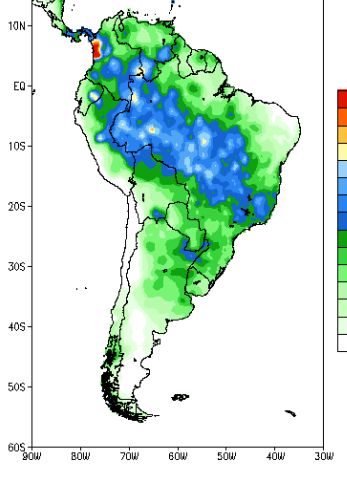
Precip. Climatology (mm/d) 1979–2006

5-day Average centered on 14OCT



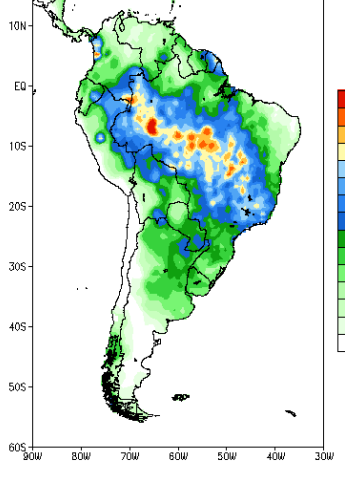
Precip. Climatology (mm/d) 1979–2006

5-day Average centered on 18NOV



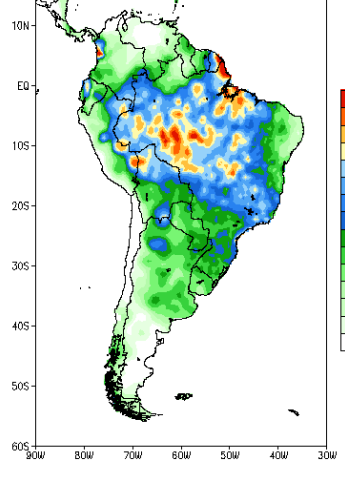
Precip. Climatology (mm/d) 1979–2006

5-day Average centered on 18DEC



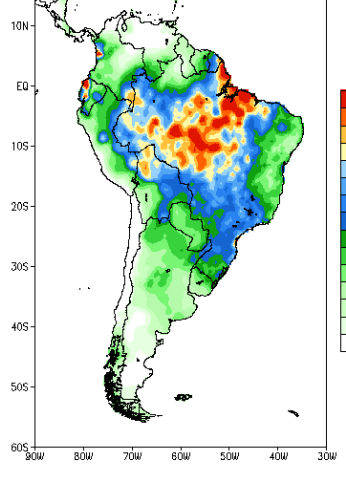
Precip. Climatology (mm/d) 1979–2006

5-day Average centered on 17JAN



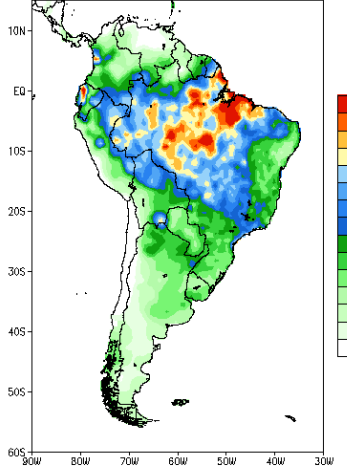
Precip. Climatology (mm/d) 1979–2006

5-day Average centered on 16FEB



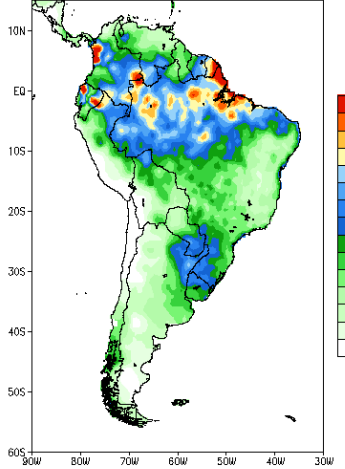
Precip. Climatology (mm/d) 1979–2006

5-day Average centered on 18MAR



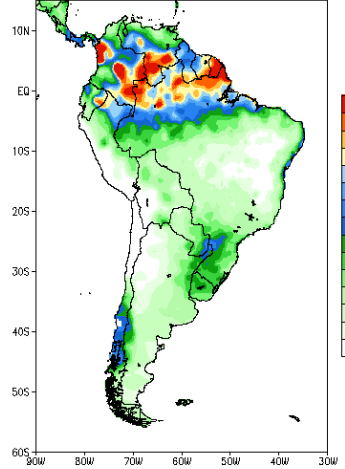
Precip. Climatology (mm/d) 1979–2006

5-day Average centered on 17APR



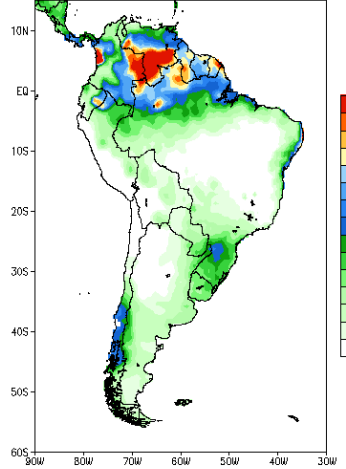
Precip. Climatology (mm/d) 1979–2006

5-day Average centered on 17MAY



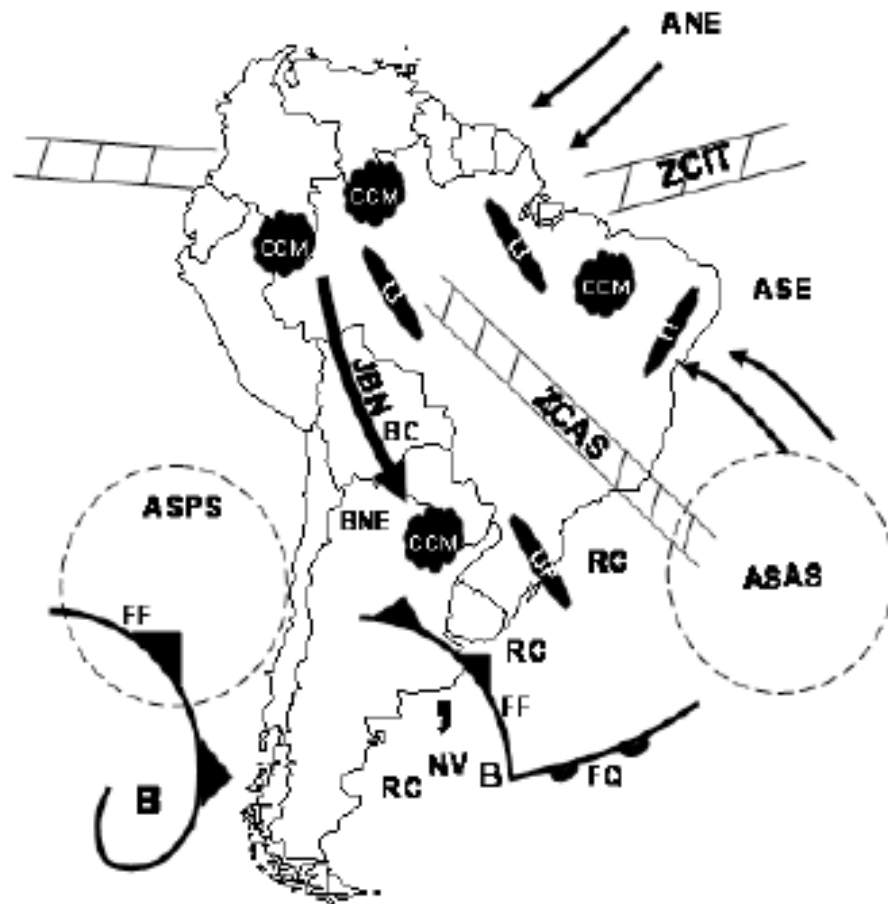
Precip. Climatology (mm/d) 1979–2006

5-day Average centered on 16JUN

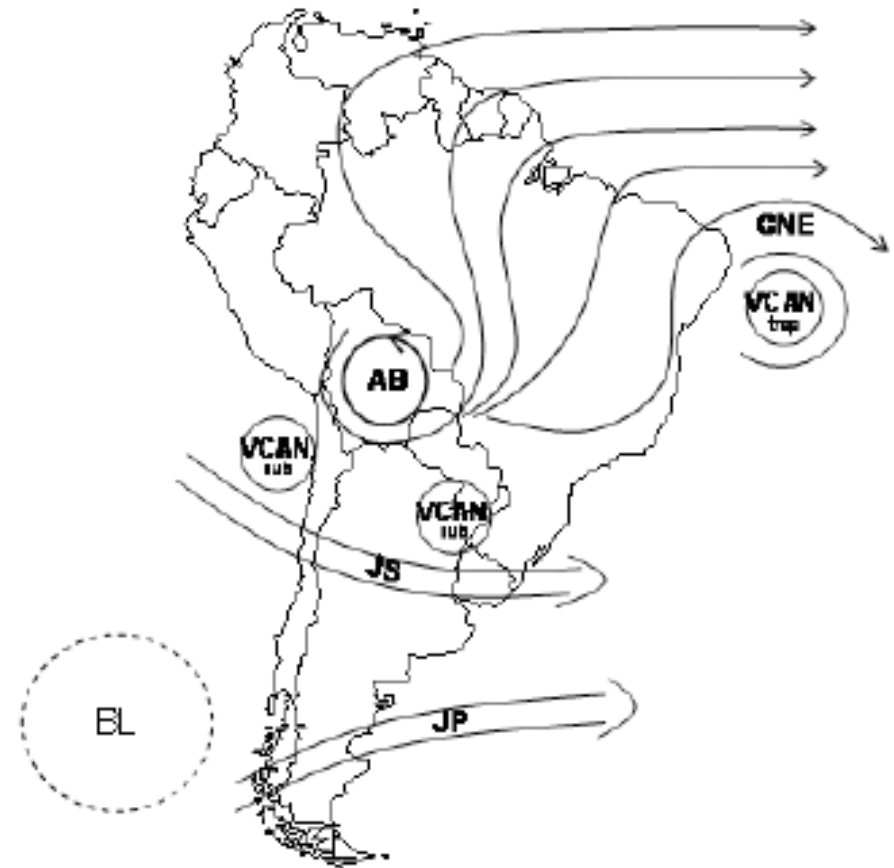


Sistemas atmosféricos de America del Sur

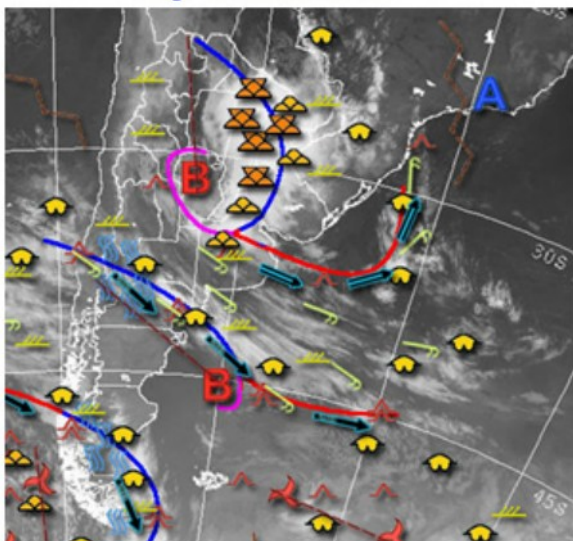
En niveles bajos



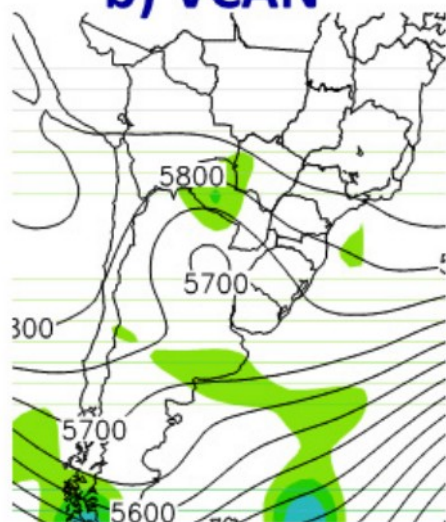
En niveles altos



a) Ciclone



b) VCAN



c) Frentes Frias

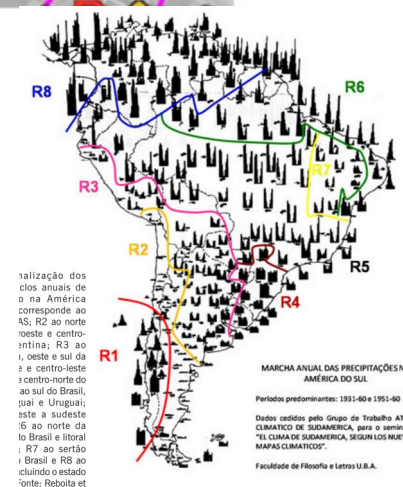
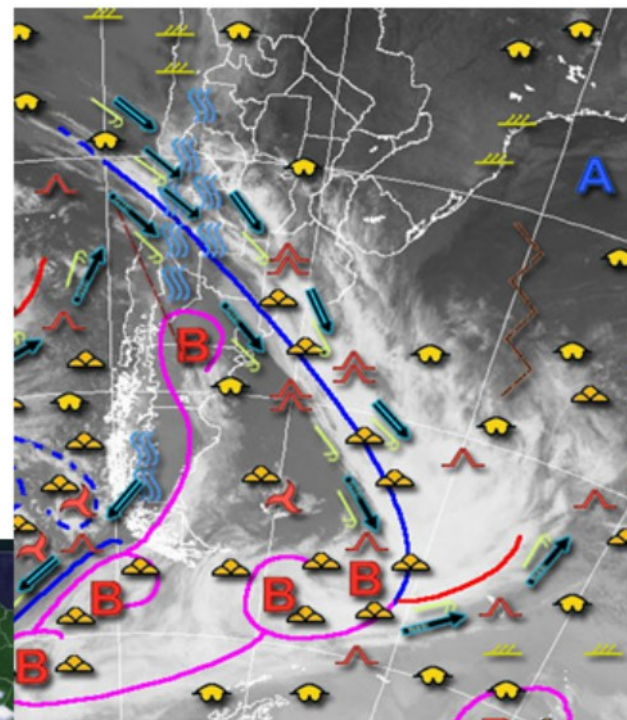
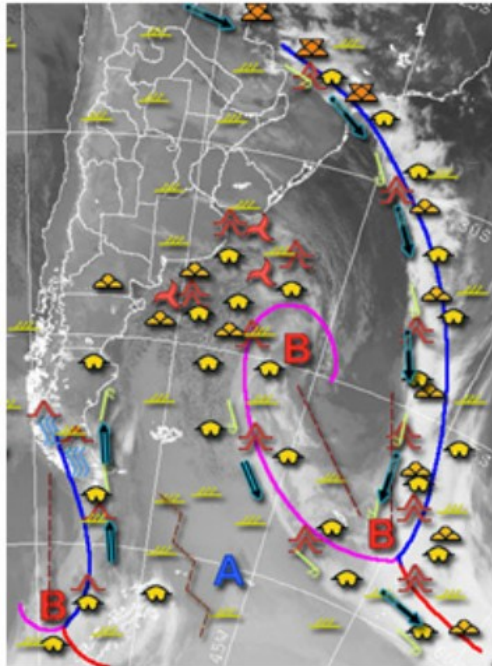
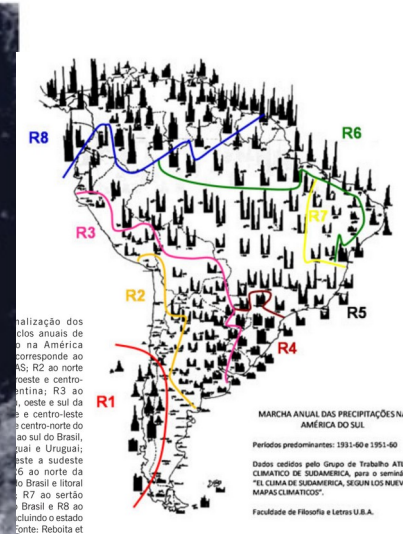


Figura 11. Exemplos de ciclone (a), VCAN (b) e frentes frias (c) atuando no centro-sul da R3. A imagem com o ciclone bem como a do sistema frontal no topo da figura foram obtidas das refoanálises do Serviço Meteorológico Nacional da Argentina, o campo de geopotencial em 500 hPa indicando a presença de um VCAN foi produzido por Michelle Reboita e Clara Iwabe e imagem de satélite colorida foi adquirida da DAS/INPE

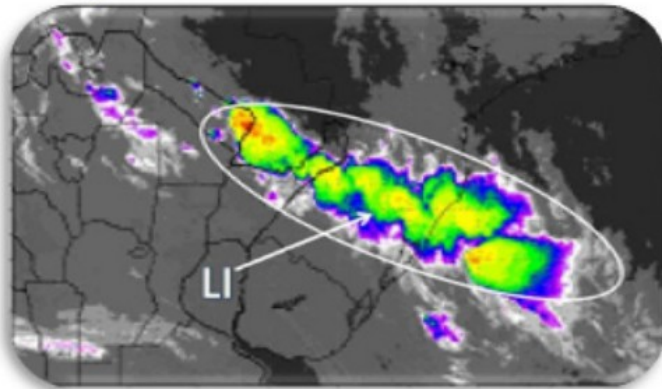
a) Frente Fria



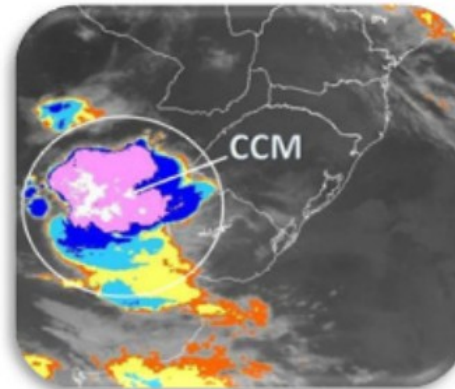
b) Ciclone: 09/03/10



c) Linha de Instabilidade



d) Complexo Convectivo de Mesoescala



e) Sistema Convectivo Alongado

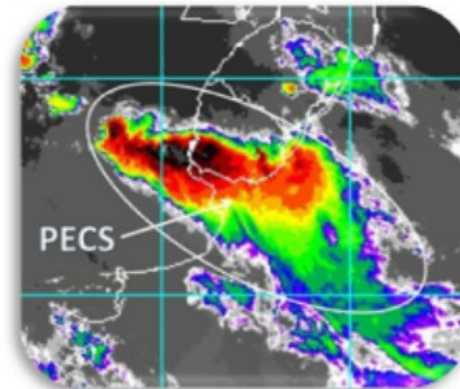
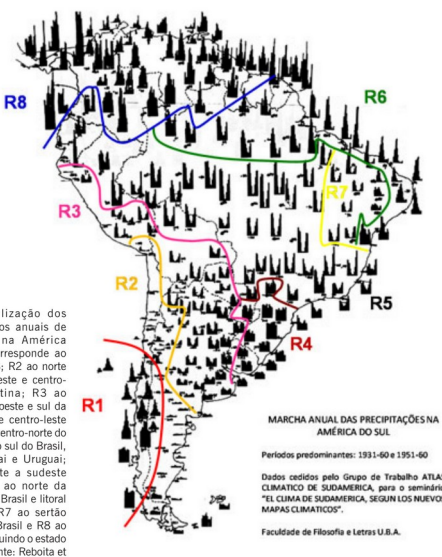


Figura 12. Exemplos de frente fria (a), ciclone (b) e sistemas convectivos de mesoescala (c-e) atuando na R4. A imagem a) foi obtida das neofanálises do Serviço Meteorológico Nacional da Argentina e b) do National Aeronautics and Space Administration (NASA). Já as imagens c, d e e foram selecionadas no banco de dados da DAS/INPE por Fernandes (2010)

Tabela 1 -Características dos oito regimes de precipitação sobre a AS.



Região		Característica do Ciclo Anual de Precipitação	Sistemas Atmosféricos Atuentes
R1	Sudoeste da AS (Centro-Sul do Chile e Extremo Oeste do Centro-Sul da Argentina)	Máximos de precipitação no inverno e mínimos no verão, exceto na parte mais austral da R1 onde a precipitação é praticamente homogênea ao longo do ano. Total anual varia entre 1000 e 1700 mm.	ASPS; frentes; ciclones Anticiclón Permanente del Pacífico Sur
R2	Norte do Chile, Noroeste e Centro-Sul da Argentina	A precipitação é praticamente homogênea ao longo do ano e com baixo total anual (inferior a 350 mm/ano). No deserto do Atacama, norte do Chile, a precipitação é inferior a 100 mm/ano.	ASPS; frentes; ciclones
R3	Oeste do Peru, Oeste e Sul da Bolívia, Norte e Centro-Leste da Argentina e Centro-Norte do Paraguai	Máximos de precipitação no verão e mínimos no inverno. O total anual varia entre 350 e 700 mm, exceto no centro-leste da Argentina e Paraguai que varia entre 700 e 1400 mm.	Convecção por aquecimento radiativo da superfície; CCMs subtropicais, frentes, ciclones, VCANs subtropicais; JBN a leste dos Andes
R4	Sul do Brasil, Sul do Paraguai e Uruguai	A precipitação é praticamente homogênea ao longo do ano. O total anual é elevado (1050-1750 mm/ano) sendo ainda maior no oeste do sul do Brasil na fronteira com o Paraguai (1750-2100 mm/ano).	Frentes; ciclones; VCANs subtropicais; LI pré-frontais; nuvens vírgula; CCMs subtropicais, bloqueios atmosféricos; ZCAS; ASAS; JBN a leste dos Andes; circulação de brisa
R5	Noroeste a Sudeste do Brasil incluindo ainda o Equador e Norte do Peru	Máximos de precipitação no verão e mínimos no inverno. O total anual varia ao longo da R5: no setor norte é superior a ~2450 mm, já no centro-oeste e sudeste é de ~1500 mm.	Ventos alísios; JBN a leste dos Andes; ASAS; convecção por aquecimento radiativo da superfície; AB; ZCIT; circulação de brisa; LI tropicais e pré-frontais; CCMs tropicais; frentes; VCANs subtropicais; ciclones
R6	Norte da Região Norte do Brasil e Litoral do Nordeste do Brasil	Máximos de precipitação no primeiro semestre do ano. No norte da região norte do Brasil o total anual é de 2000 mm, enquanto no litoral do nordeste do Brasil é de 1500 mm.	ZCIT; convecção por aquecimento radiativo da superfície; CCMs tropicais; ventos alísios, circulação de brisa; LI; ondas de leste; cavado do nordeste do Brasil; VCANs tropicais; ASAS; frentes
R7	Sertão Nordestino do Brasil	Máximos de precipitação no verão e mínimos no inverno, mas os totais são reduzidos (entre 200 e 500 mm/ano).	Ramo descendente da circulação zonal propiciada pela atividade convectiva na Amazônia; ZCIT; VCANs tropicais; frentes; ASAS
R8	Norte da América do Sul (Colômbia, Venezuela e Guiana)	A precipitação é abundante o ano todo, mas com maiores totais no inverno. O total anual é superior a 1500 mm.	Ventos alísios; ZCIT; ondas de leste; cavados em altos níveis; convecção por aquecimento radiativo da superfície; CCMs tropicais; circulação de brisa; LI tropicais

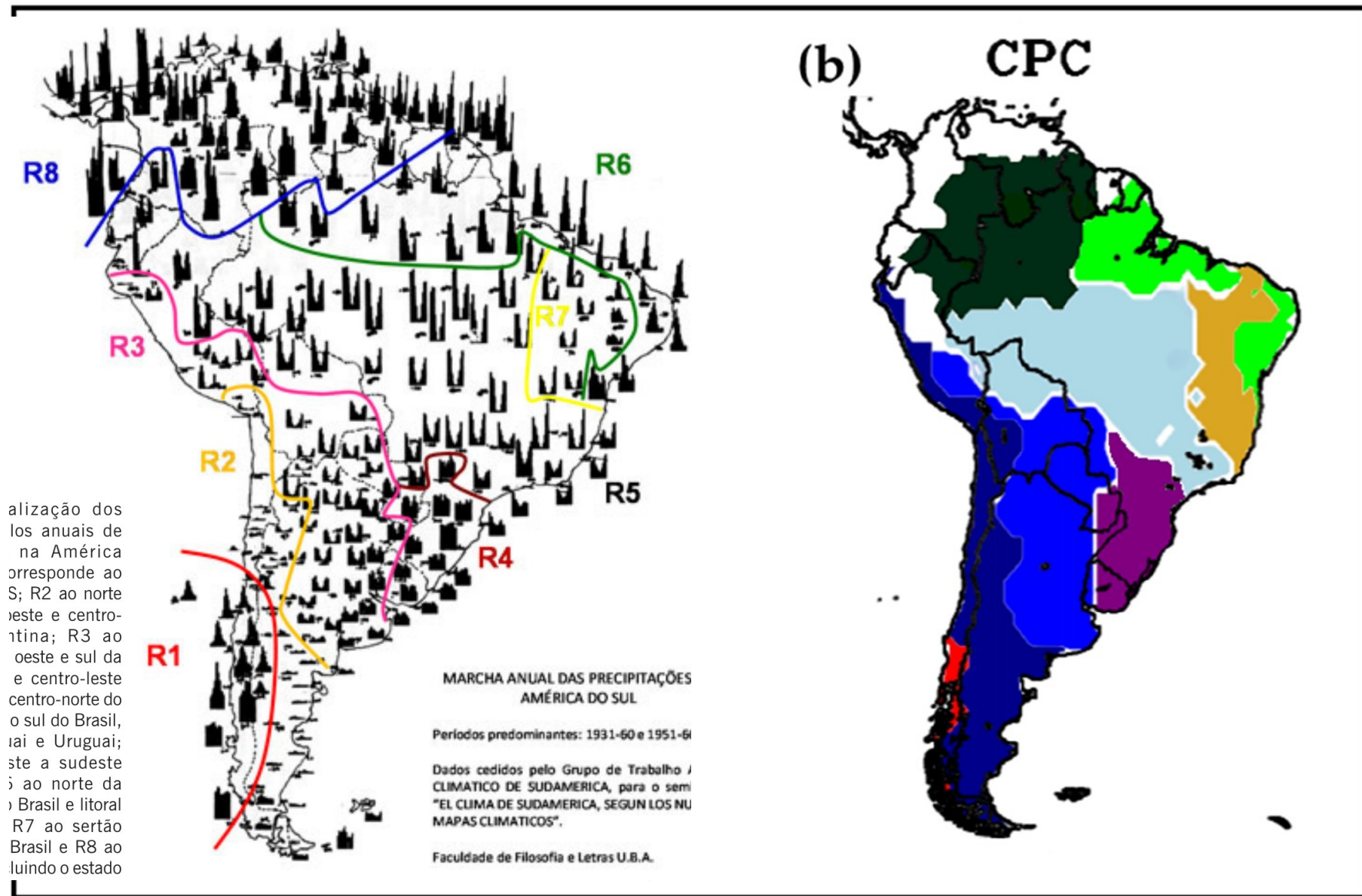


Figure 5. Clusters provided by the K-means method (represented by different colors) applied to (a,b) monthly precipitation climatology (1993 to 2016) in South America.

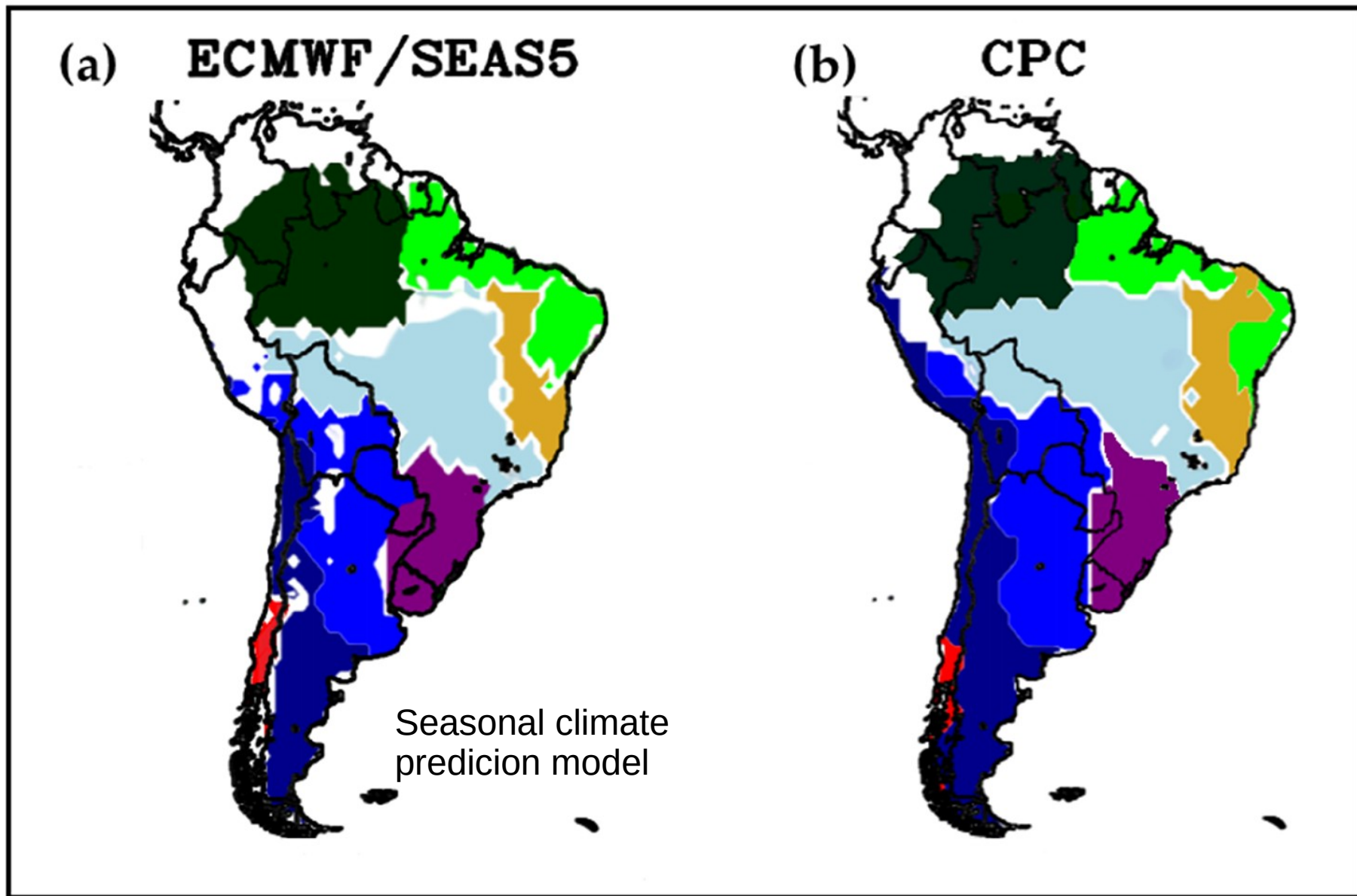
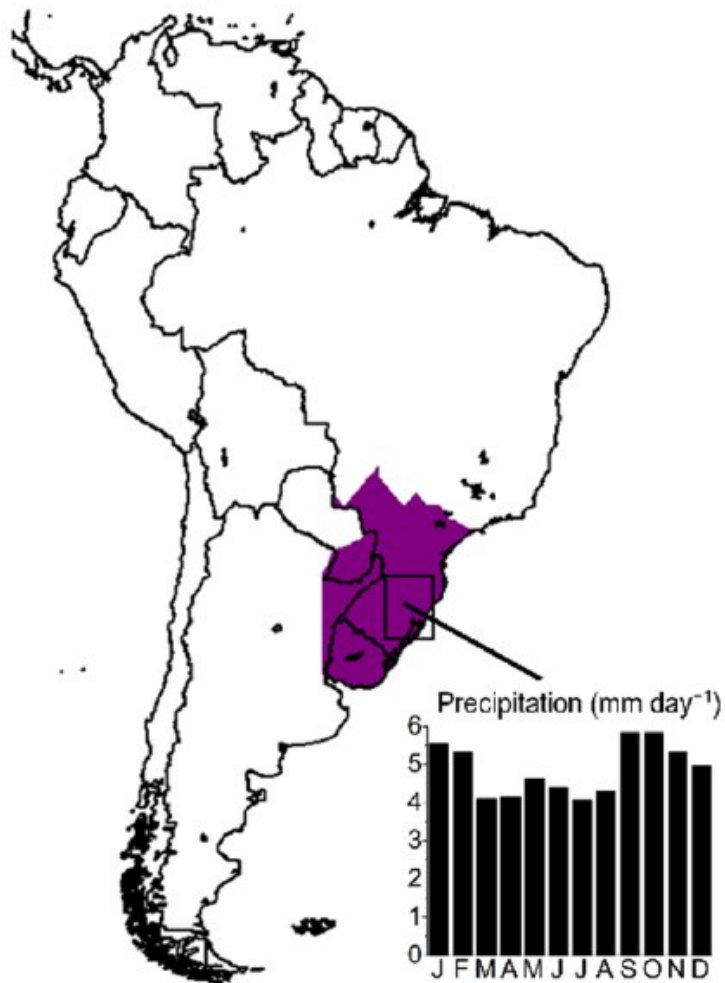
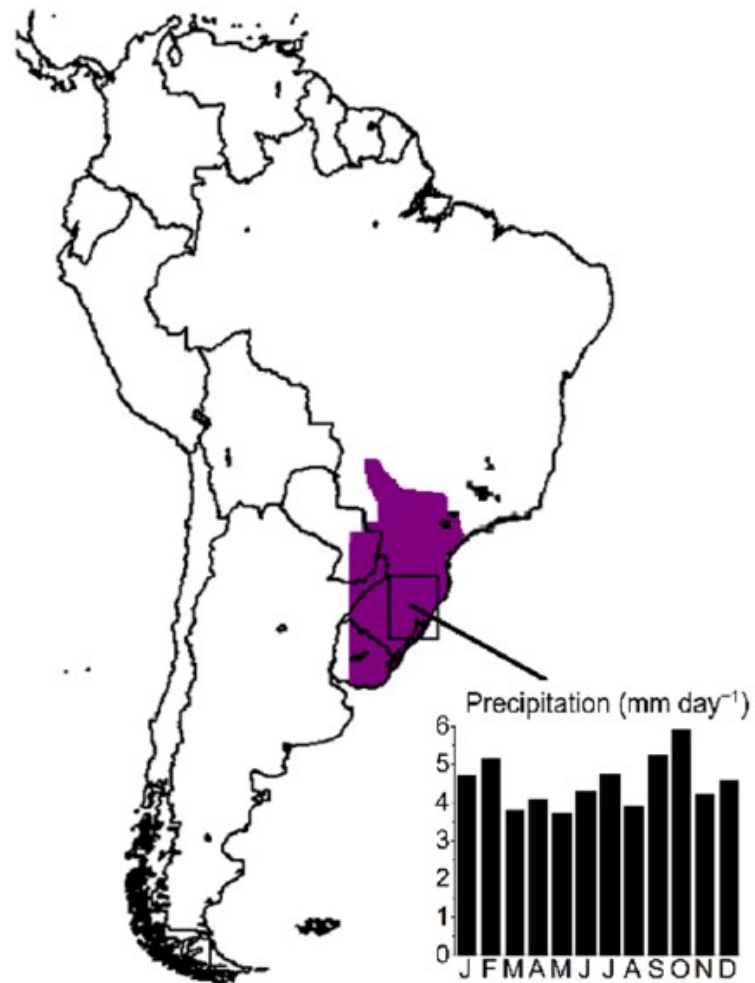


Figure 5. Clusters provided by the K-means method (represented by different colors) applied to (a,b) monthly precipitation climatology (1993 to 2016) in South America.

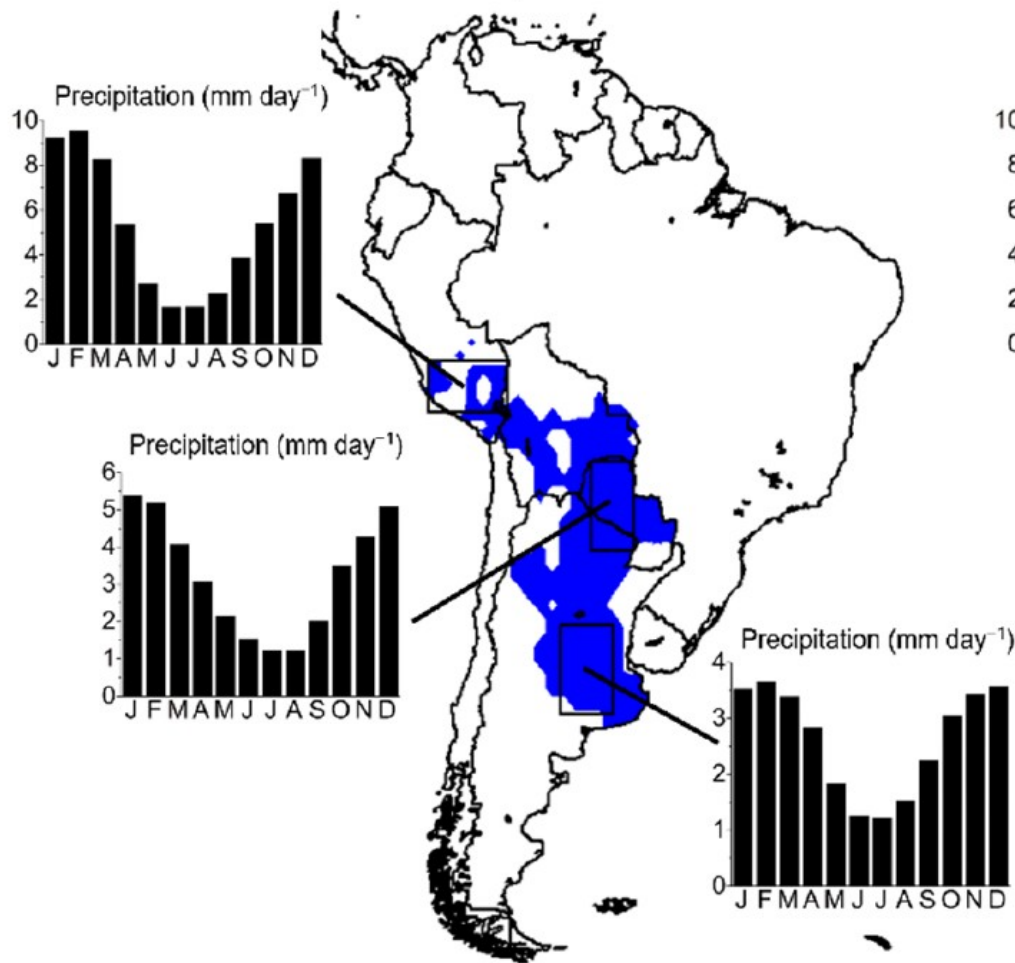
(a) ECMWF/SEAS5 – R4



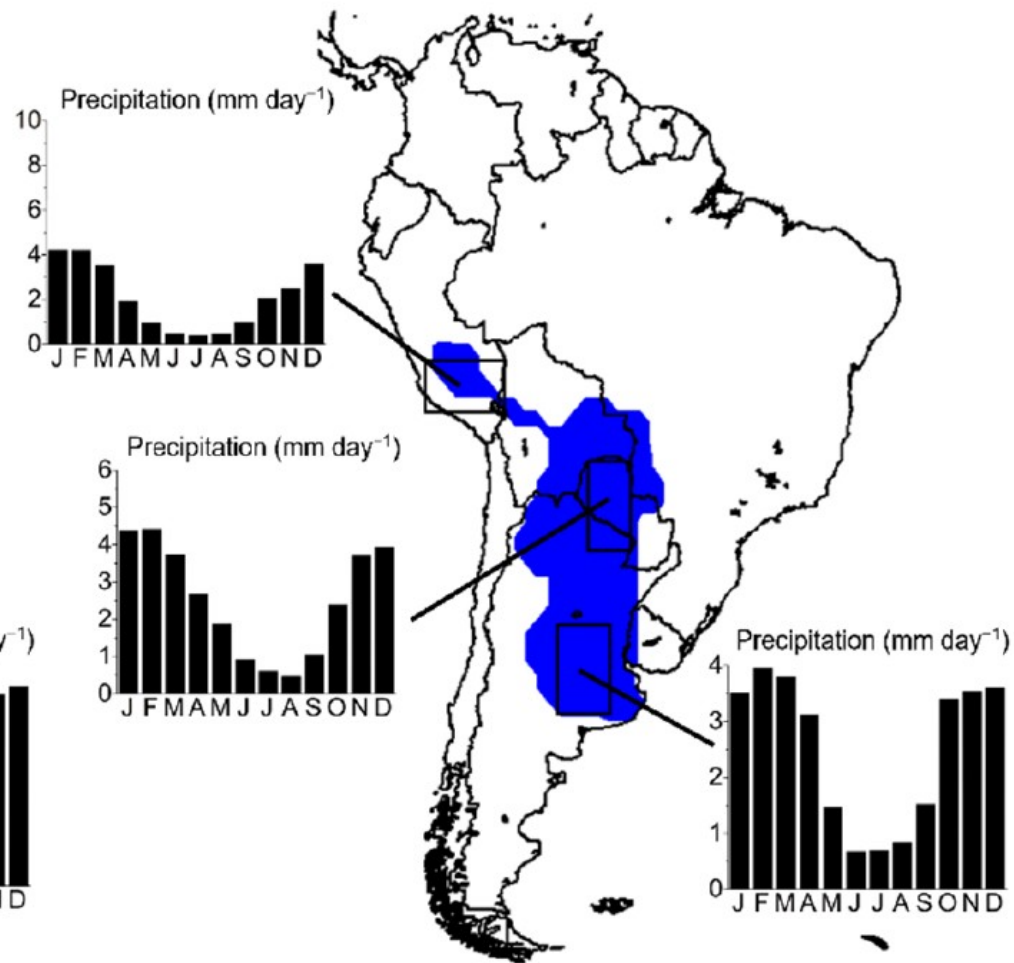
(b) CPC – R4



(a) ECMWF/SEAS5 - R3

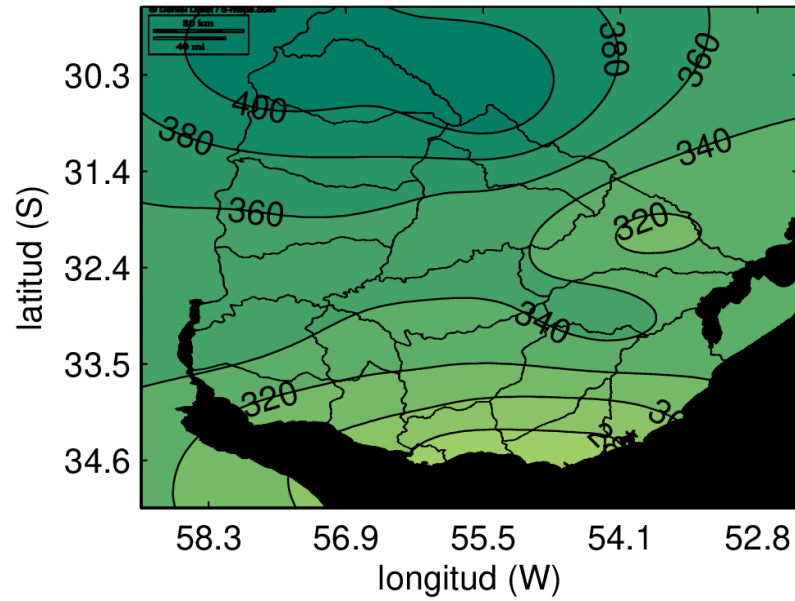


(b) CPC - R3

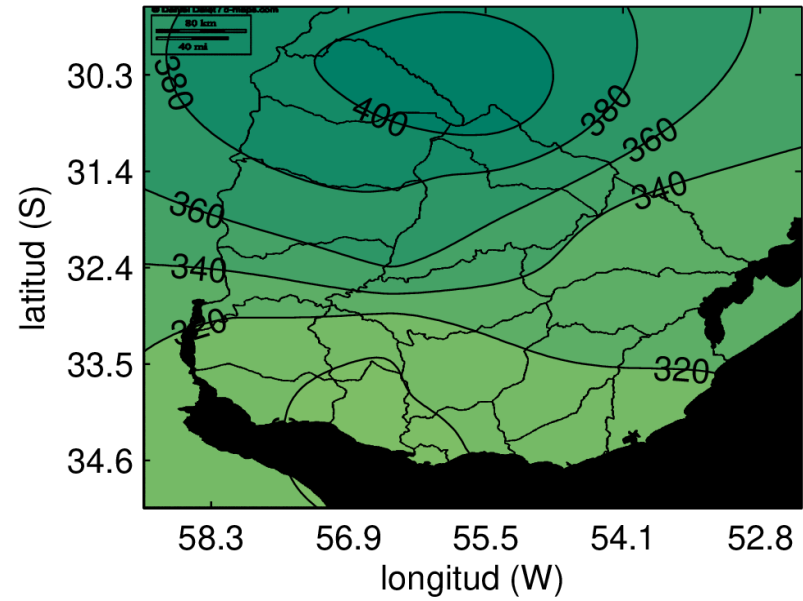


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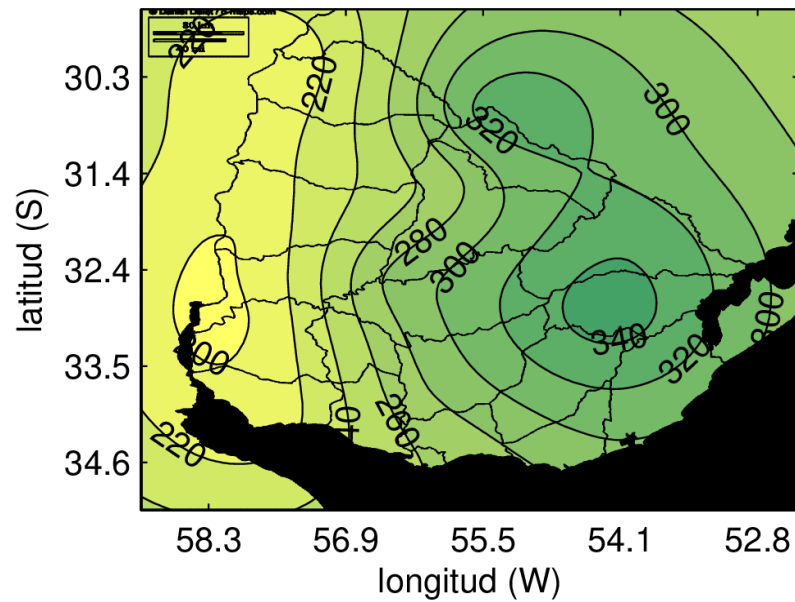
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