



GF3003
Ciencias Atmosféricas

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Departamento de Geofísica de la Universidad de Chile

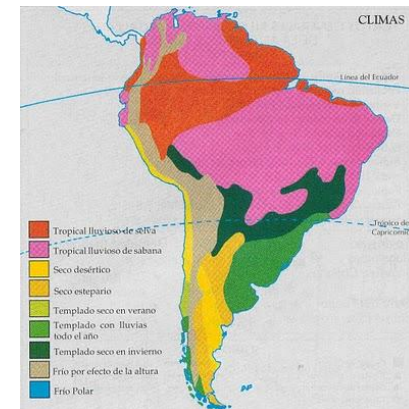
Primavera 2010

LGK 2010

HOY:

Tiempo y clima de Chile + algo de capa límite

- Capa límite
 - Flujos energéticos
 - Evolución
 - Observación
- Tiempo y clima de Chile
 - Norte
 - Centro
 - Sur
 - Patagonia

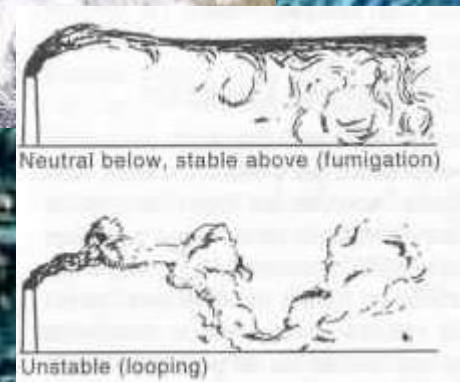
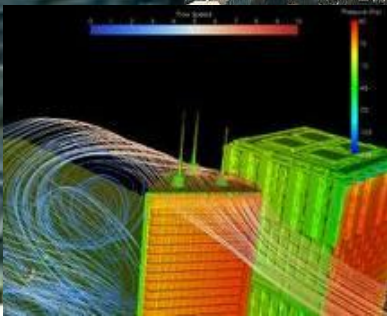
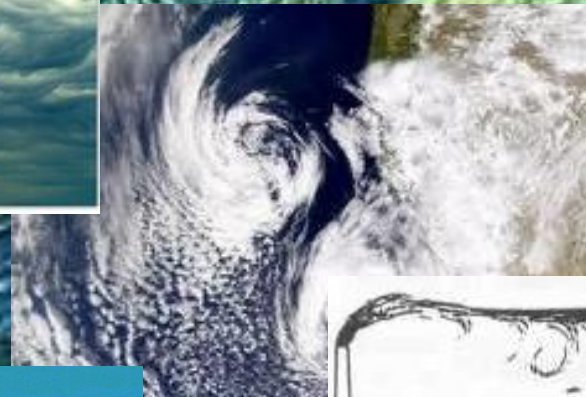
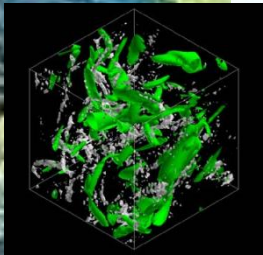
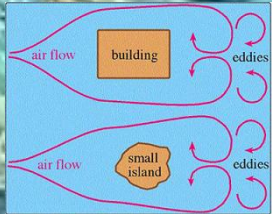


Más específicamente, el/la alumno/a será capaz de:

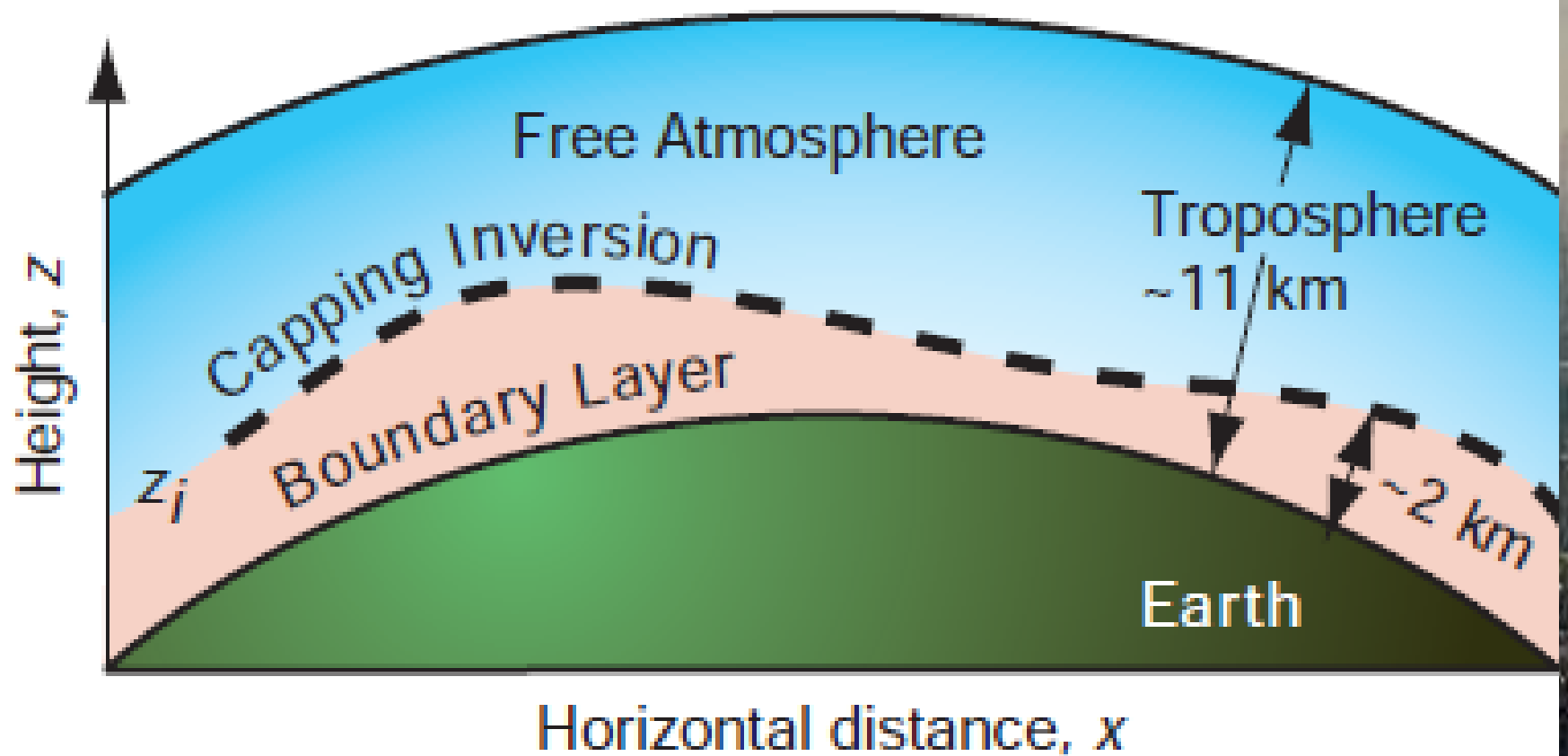
- Reconocer y describir físicamente los términos de la ecuación de balance de energía superficial y su evolución diurna
- Describir la evolución de la capa límite para condiciones simples
- Reconocer instrumentos de observación de la capa límite
- Aplicar elementos de circulación general y local para identificar patrones de precipitación, temperatura y vientos con énfasis en localidades de Chile



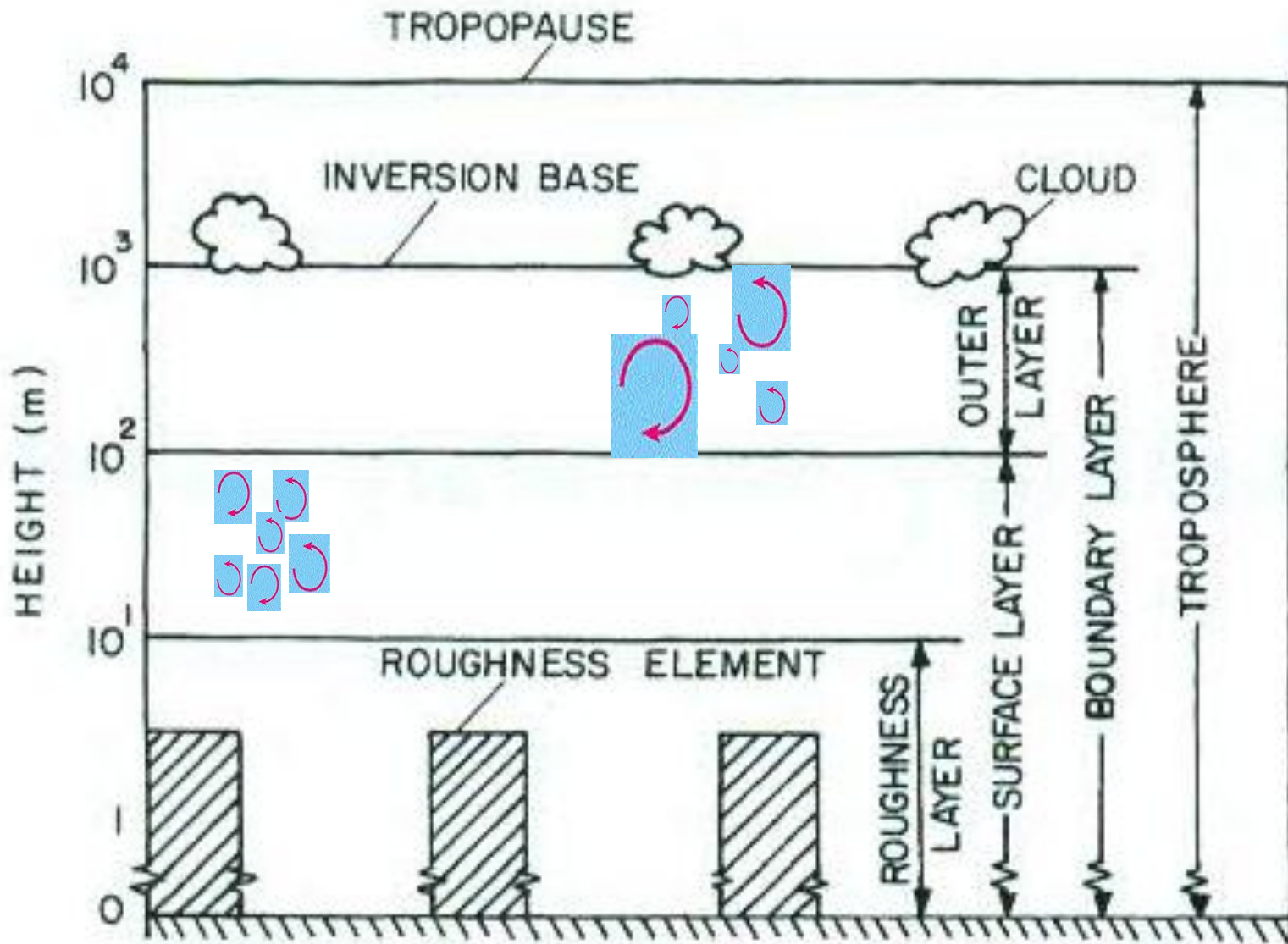
La atmósfera: un fluido turbulento



Turbulencia en la capa límite



Capas de la capa límite



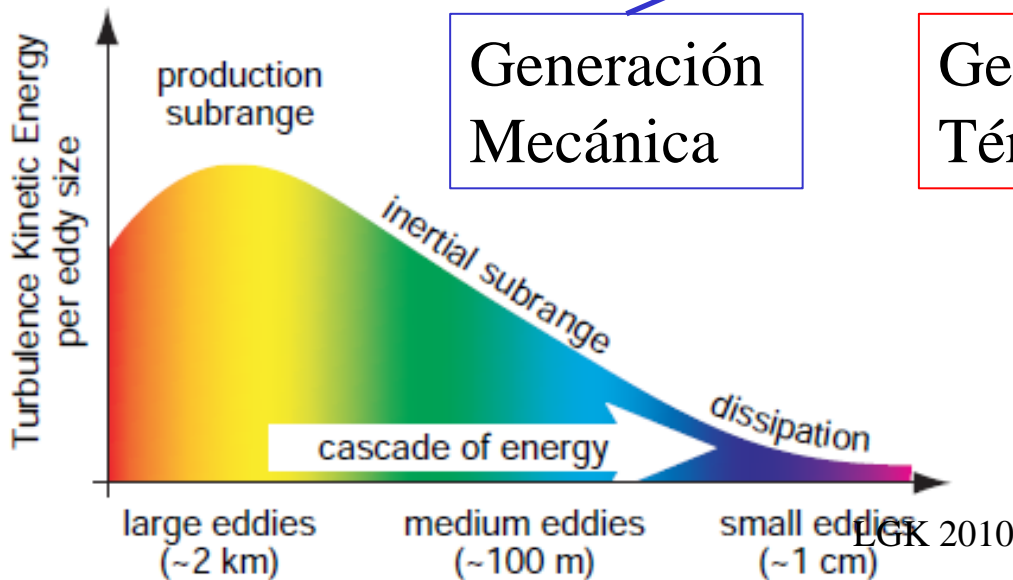
LUN 2010

Energía cinética turbulenta

$$\frac{TKE}{m} = \frac{1}{2} [\overline{u'^2} + \overline{v'^2} + \overline{w'^2}]$$

$$\frac{\partial(TKE/m)}{\partial t} = Ad + M + B + Tr - \varepsilon$$

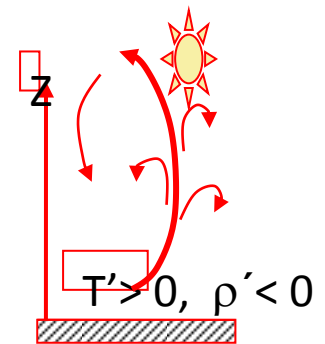
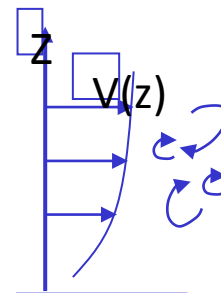
Advección
Transporte turbulento



Generación Mecánica

Generación Térmica

Disipación



Aproximaciones a la capa límite

¿Cómo caracterizar las fluctuaciones?

Como si fuera difusión...

$$F_H = \overline{w'\theta'} = -K \frac{\partial \overline{\theta}}{\partial z}$$

Ambas aproximaciones requieren parametrizar, esto es, relacionar la escala no resuelta con la resuelta a través de parámetros libres

Análisis dimensional...

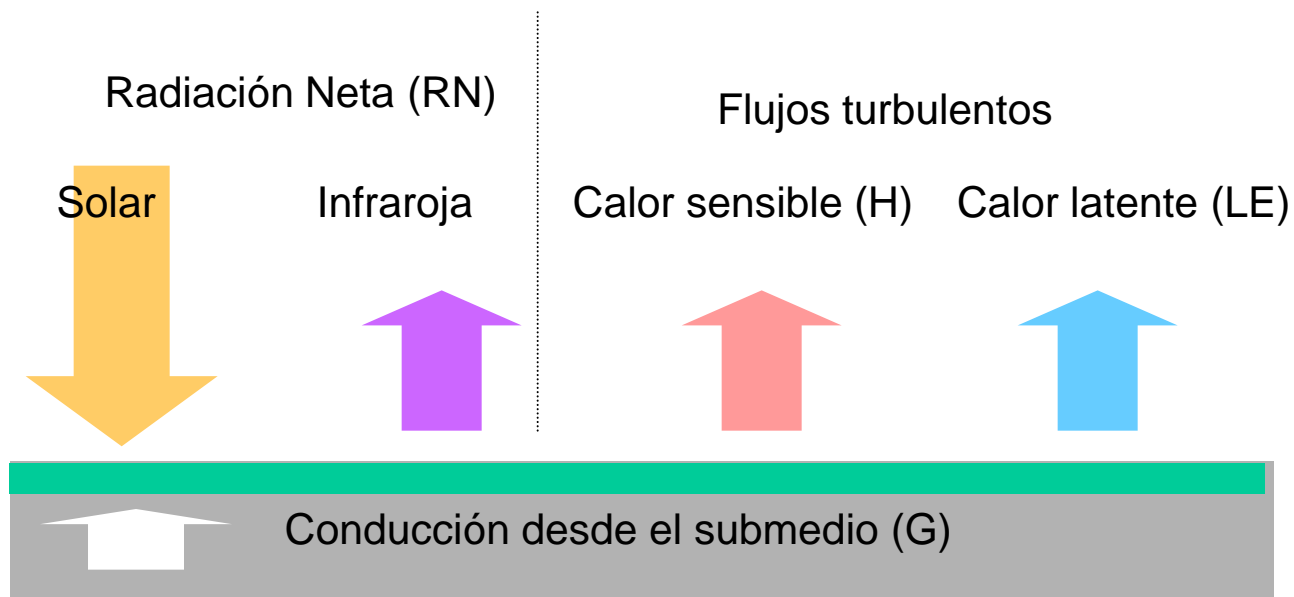
$$w_* = \left[\frac{g \cdot z_i}{T_v} \overline{w'\theta'_s} \right]^{1/3}$$

$$u_* = \left[\overline{u'w'}^2 + \overline{v'w'}^2 \right]^{1/4} = \left| \frac{\tau_s}{\rho} \right|^{1/2}$$

$$L \equiv \frac{-u_*^3}{k \cdot (g/T_v) \cdot (\overline{w'\theta'})_s}$$

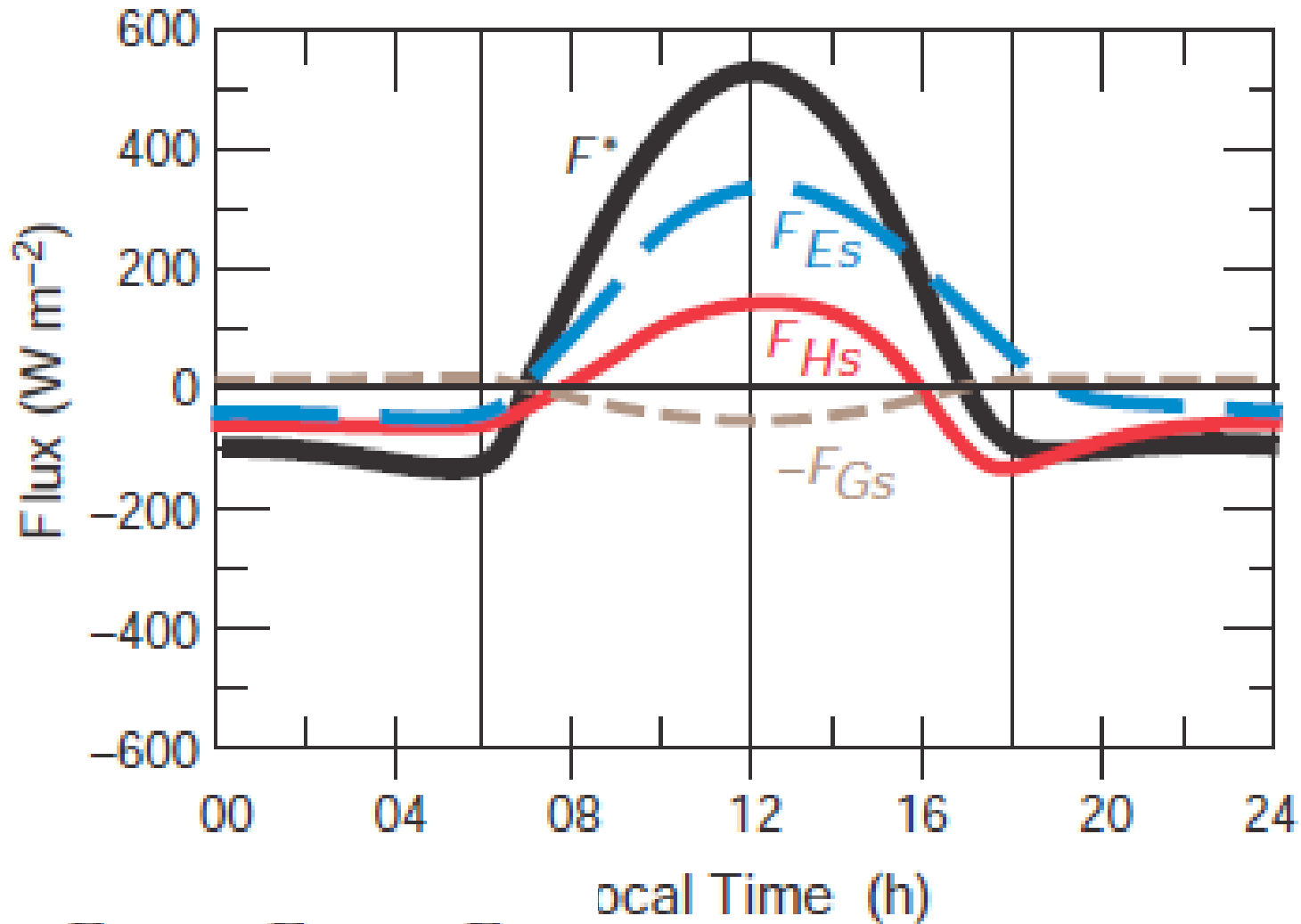
$$\frac{\overline{w'^2}}{w_*^2} = a \left(\frac{z}{z_i} \right)^b \left(1 - c \frac{z}{z_i} \right)^d$$

Balance de Energía Superficial



$$\rho c_p h \frac{\partial T}{\partial t} = RN + H + LE + G$$

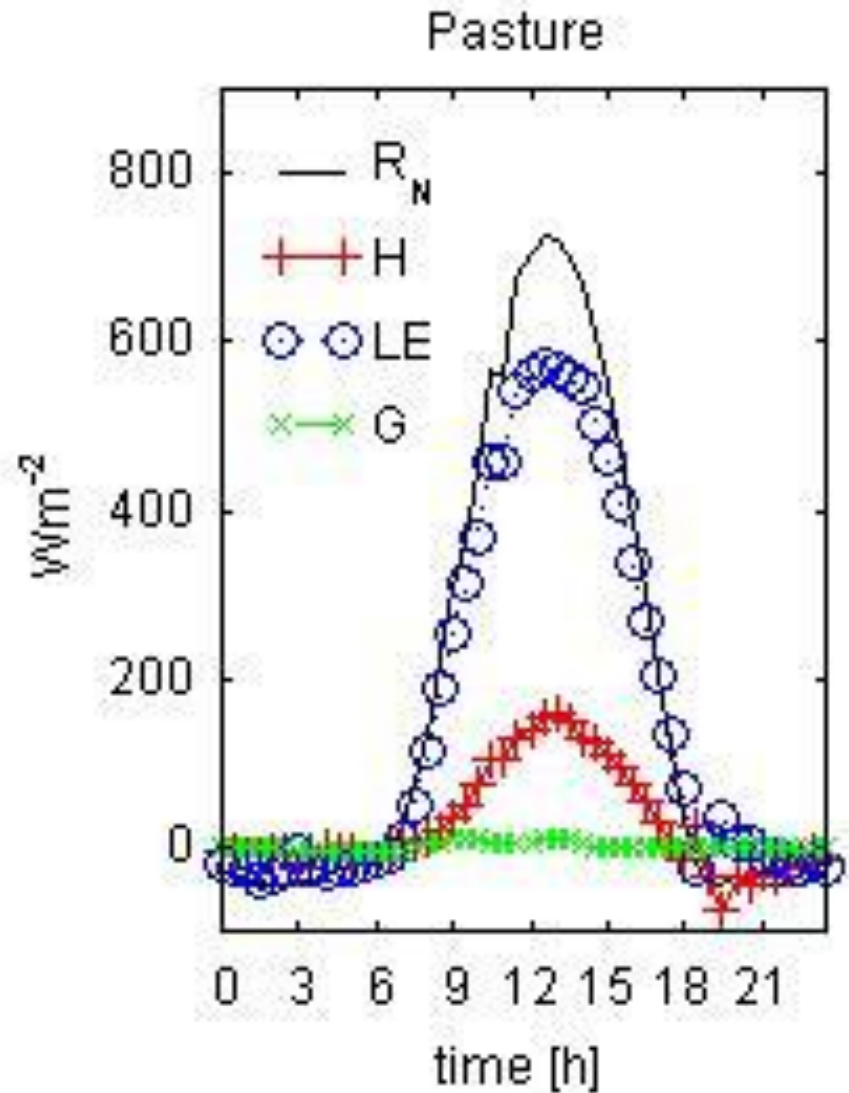
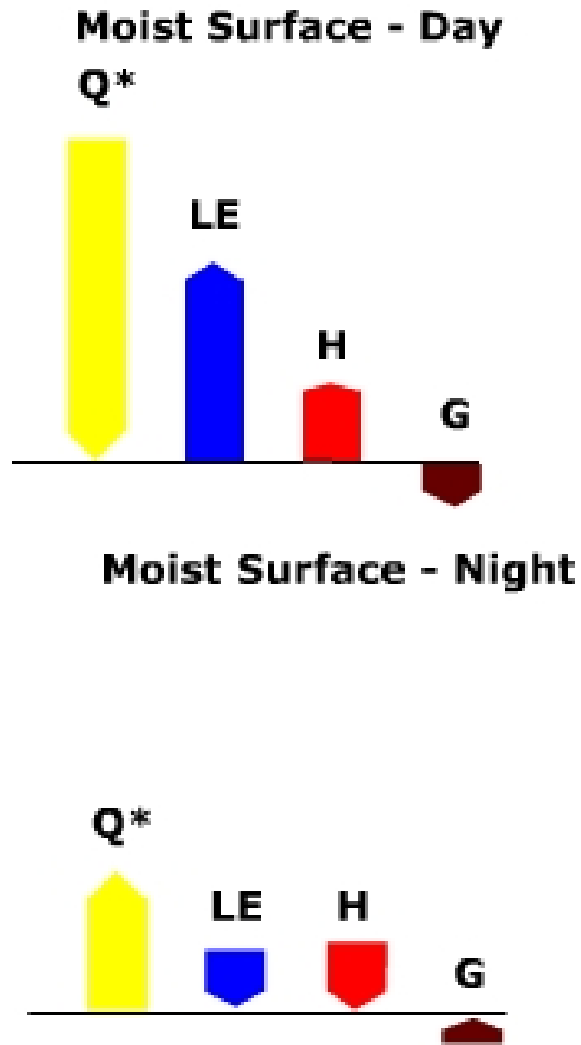
Balance energético en la capa límite



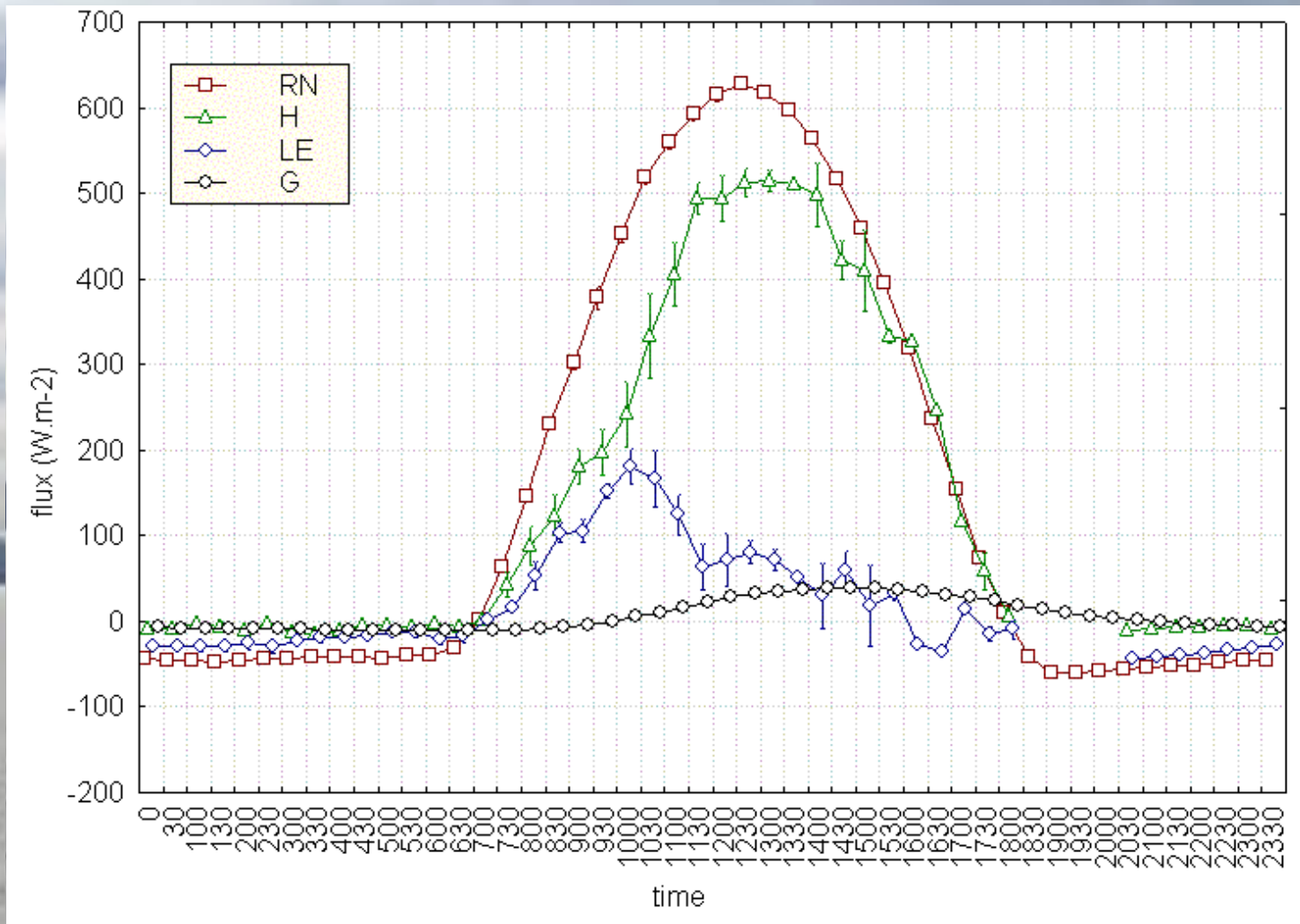
$$F^* = F_{Hs} + F_{Es} + F_{Gs}$$

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Los flujos cambian según la superficie y según la hora



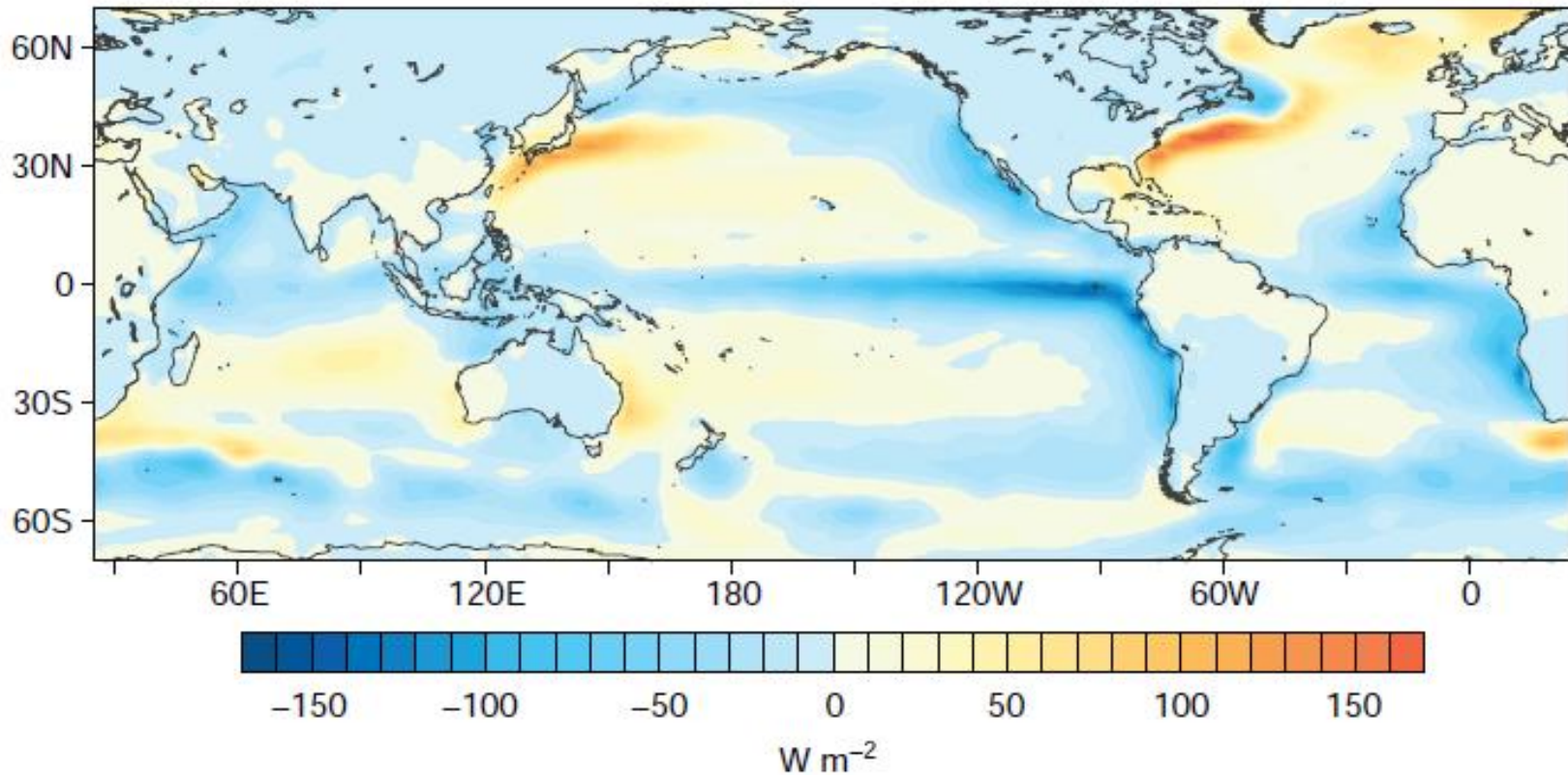
Balance de energía sobre un salar



$B=H/L$ Razón de Bowen...en este caso $B>1$

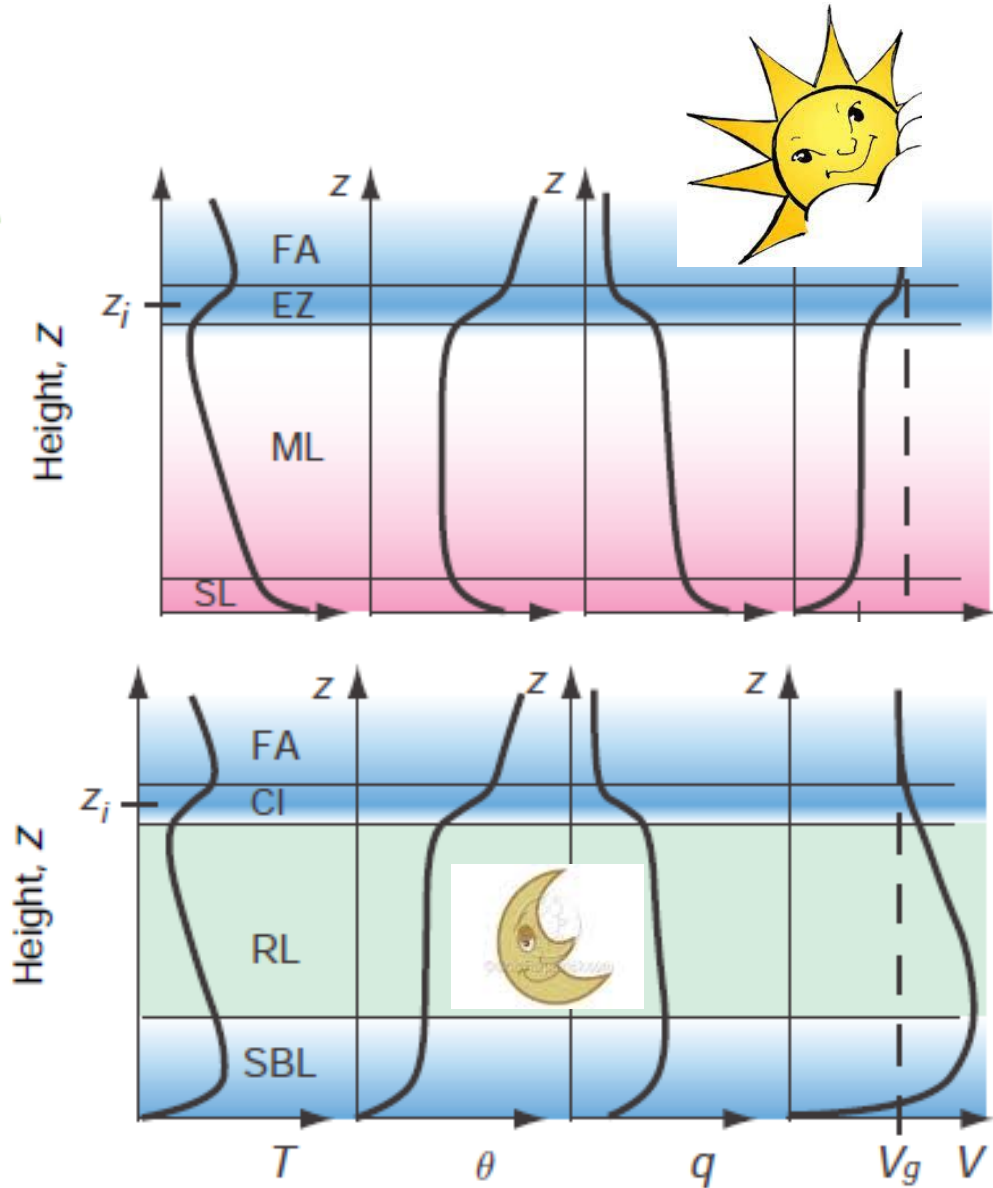
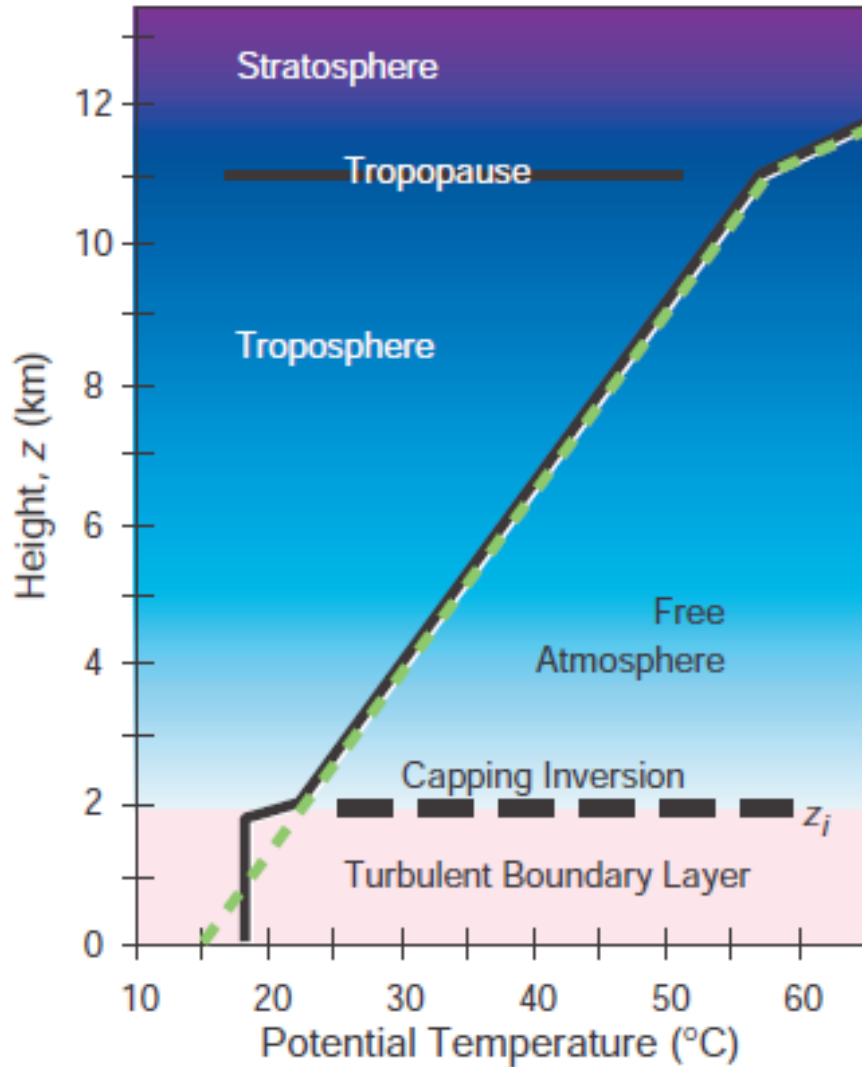
LGK 2010

Globalmente



$$F_{net}^{\uparrow} = -F^* + F_{Hs} + F_{Es} \quad F^* = F_{Hs} + F_{Es} + F_{Gs}$$

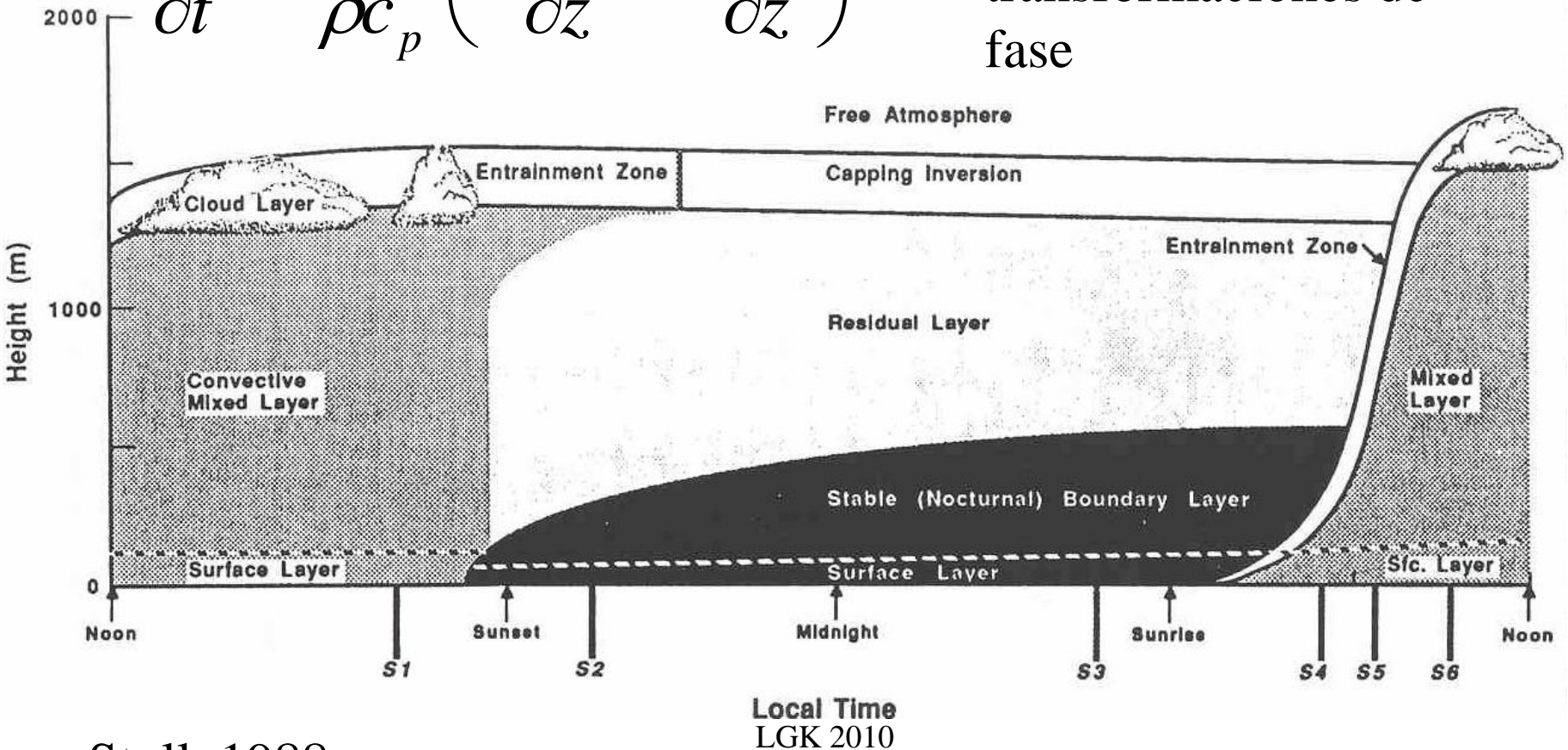
El efecto NO es sólo superficial



Evolución típica de la capa límite (día despejado, seco de verano)

$$\frac{\partial T}{\partial t} = \frac{1}{\rho c_p} \left(\frac{\partial RN}{\partial z} - \frac{\partial H}{\partial z} \right)$$

Si NO hay transformaciones de fase

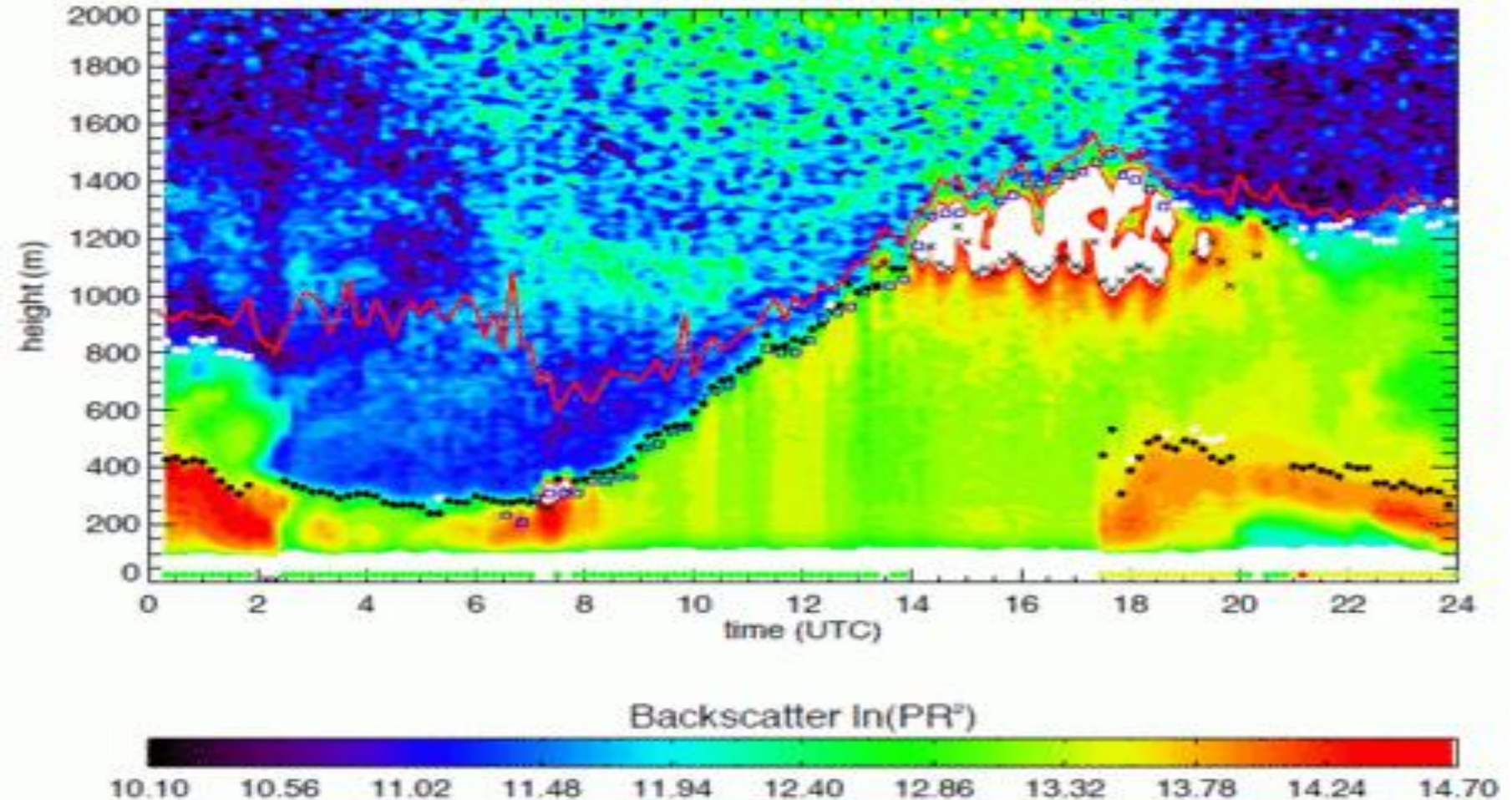


Stull, 1988

Local Time
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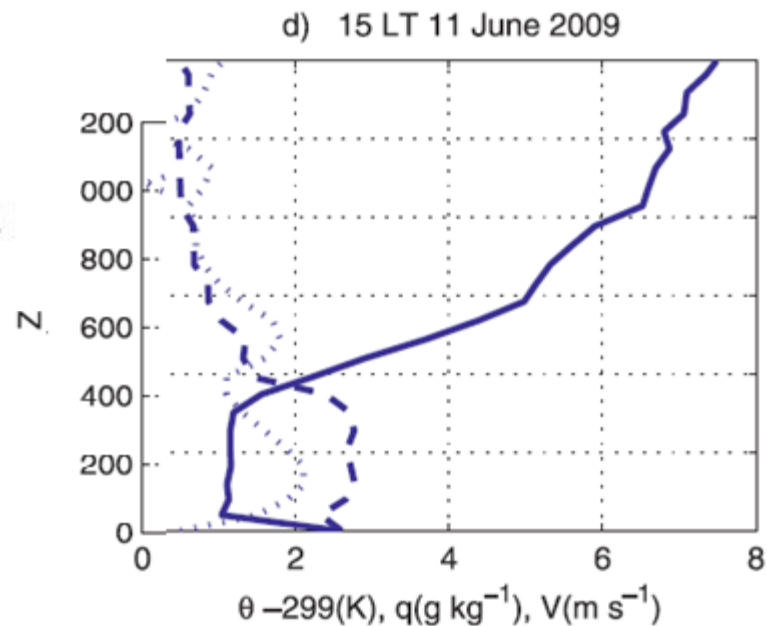
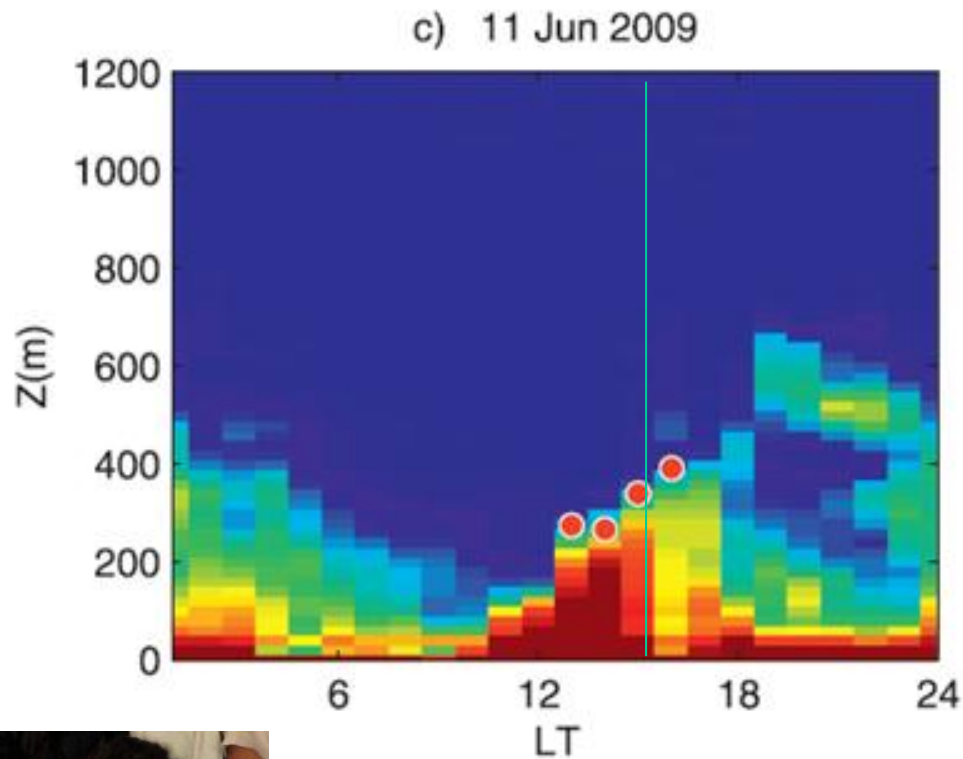
Y es verdad...

LD-40 backscatter Cabauw 27-07-2002



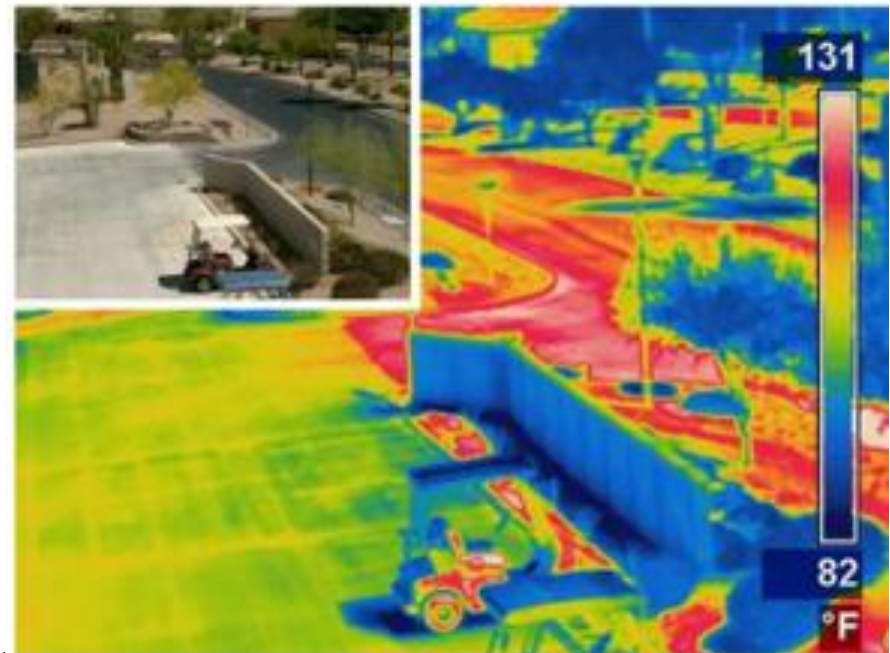
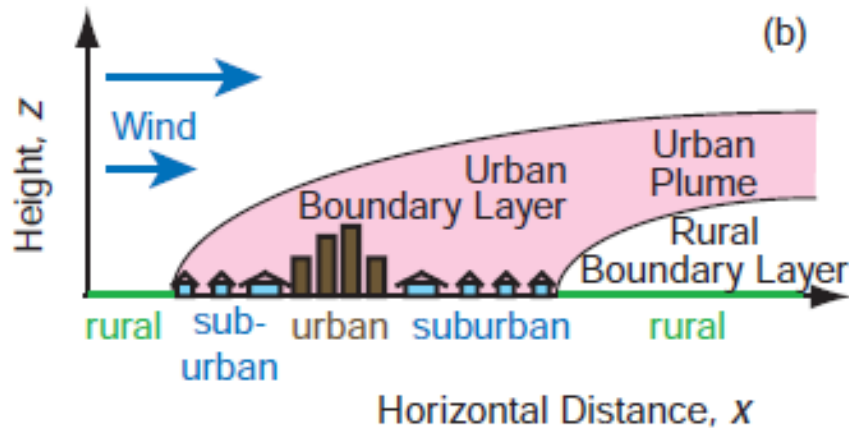
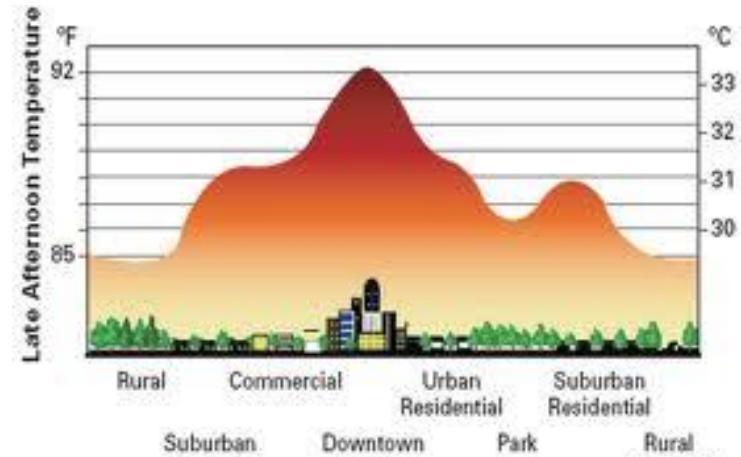
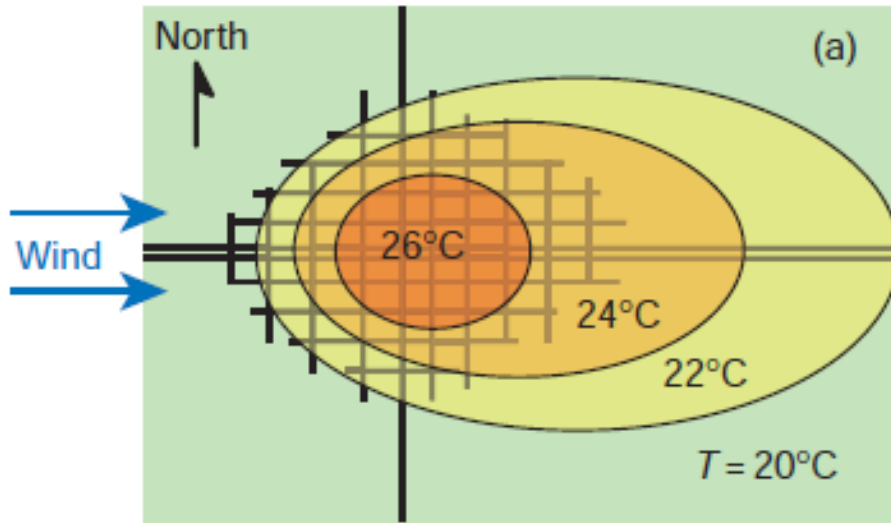
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Y también aquí...usando un nefobasímetro

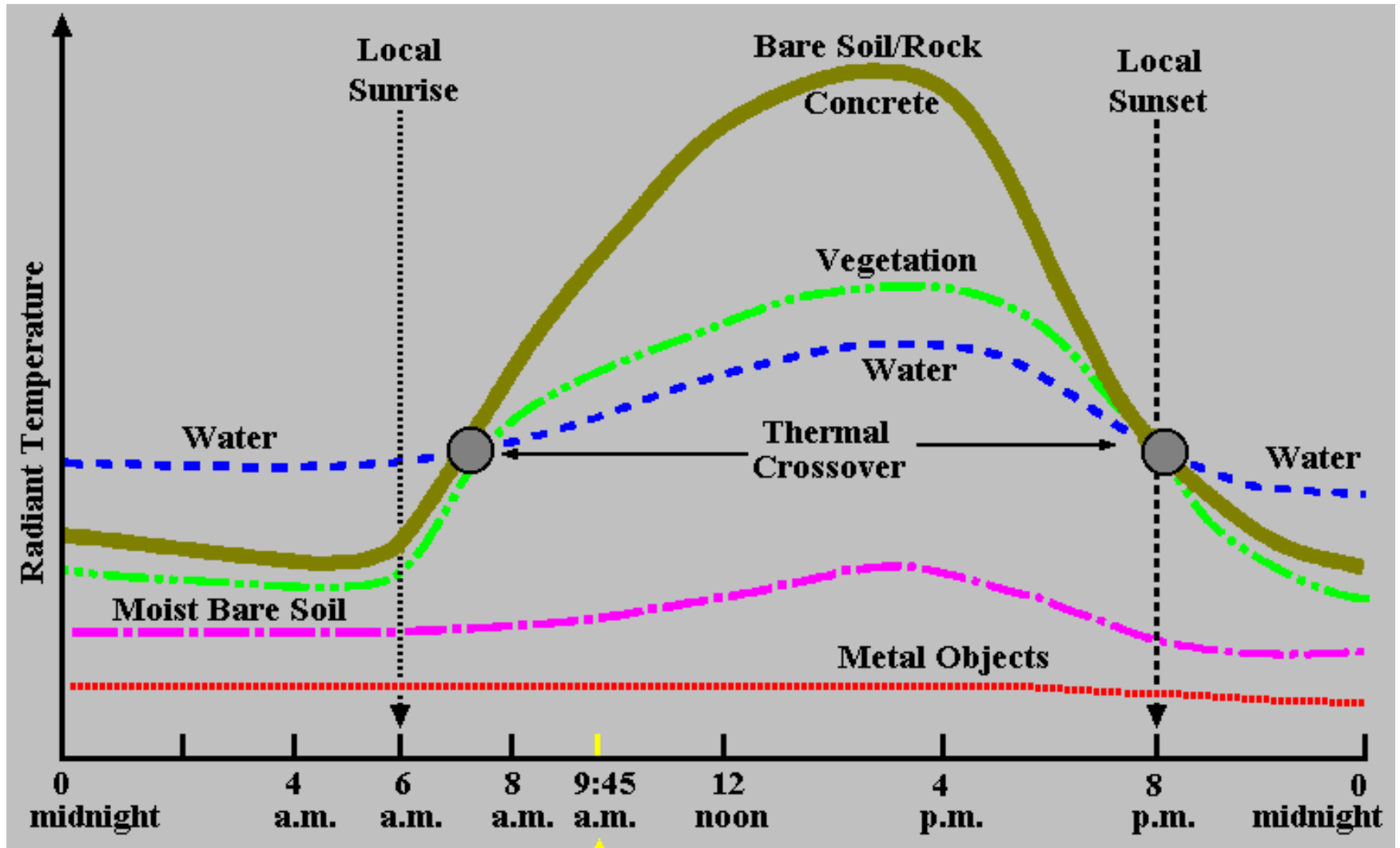


LGK 201

Efectos urbanos: isla calórica

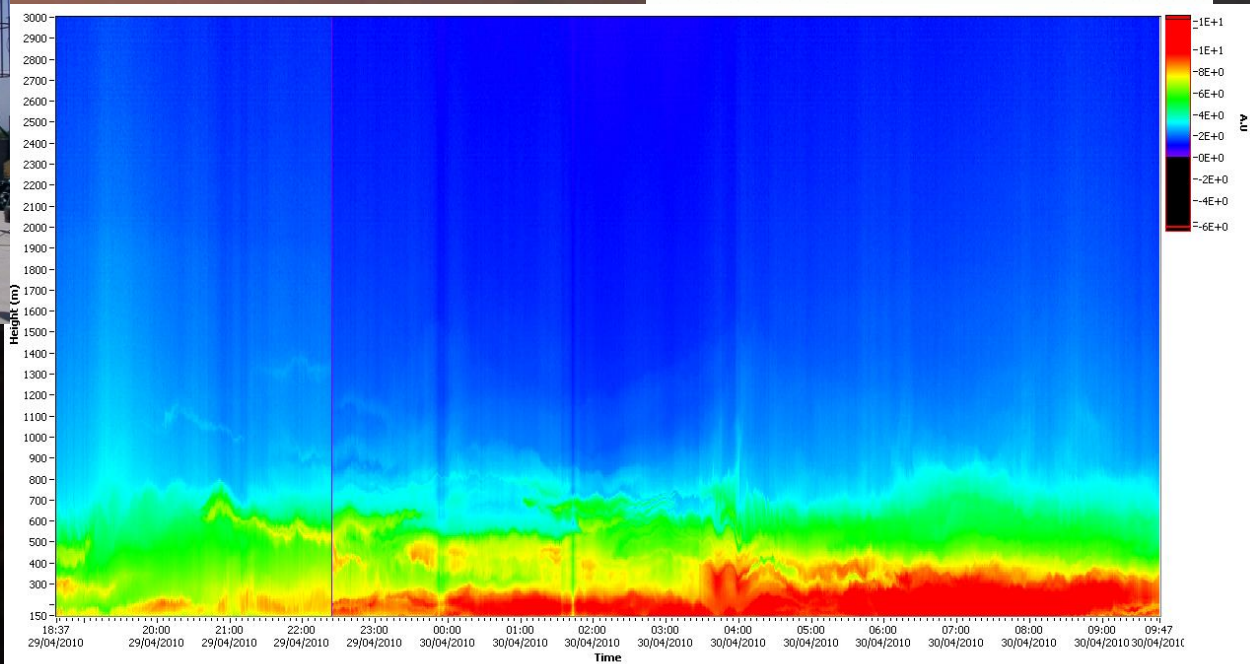
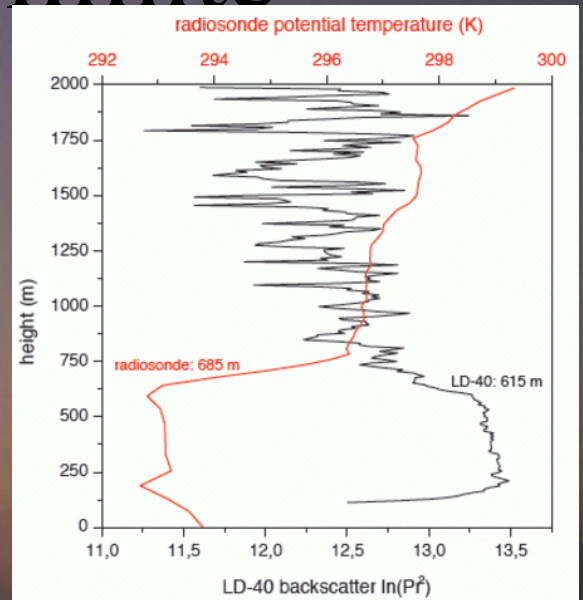


Hay que construir con cuidado...



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Observando la capa límite



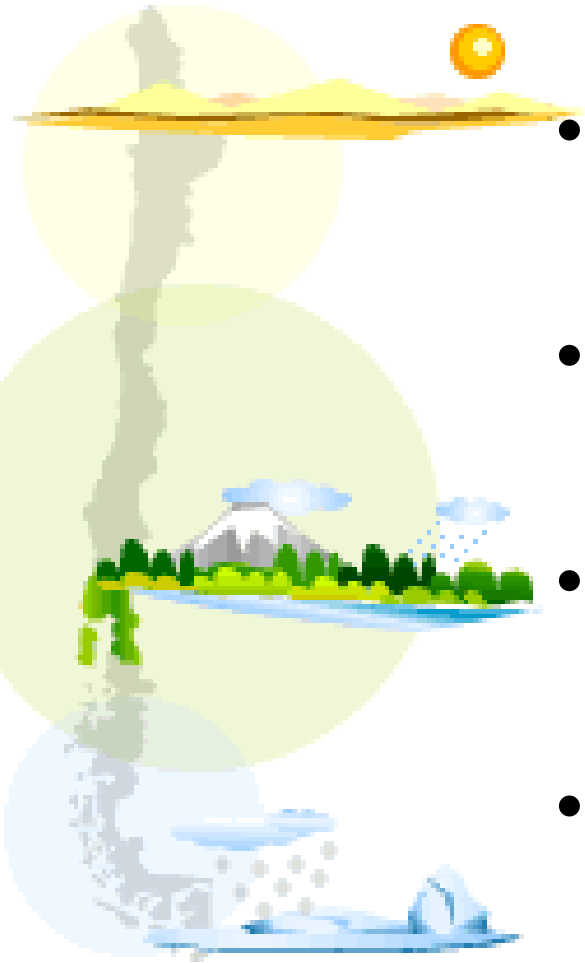
Turbulencia más allá de la capa límite



Pausa in situ (5 minutos)



Tiempo y clima de Chile



- Grupo 1: Norte de Chile - Antofagasta
- Grupo 2: Macrozona central- Santiago
- Grupo 3: Macrozona sur - Puerto Montt
- Grupo 4: Patagonia-Punta Arenas

- Caracteriza tu región en términos de:
 - Balance de energía superficial y características de la capa límite
 - Patrón de temperatura, precipitación y vientos superficiales a lo largo del año (Asócialos a los patrones de circulación de gran escala y locales relevantes)
 - Ciclo diario de T, vientos y capa de mezcla
- A partir de la situación de ayer, haz un pronóstico para hoy y verifícalo
- ¿Qué nubosidad se ha observado estos días? ¿A qué altura?



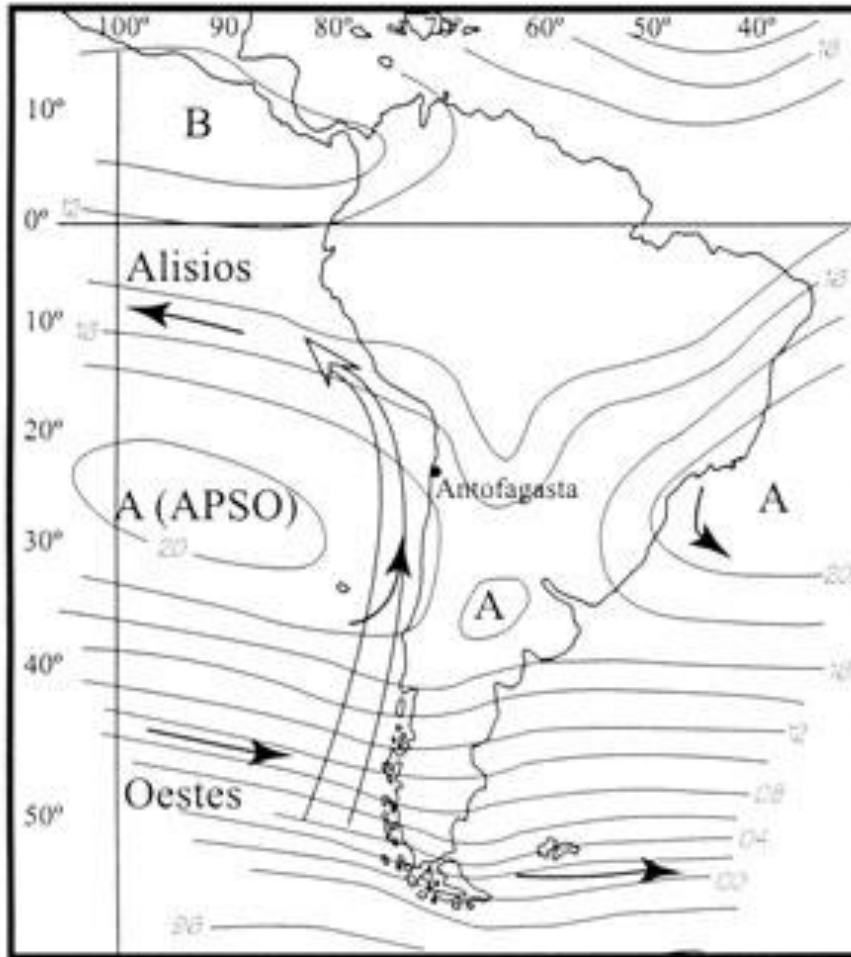
Completar en un texto de a lo más 200 palabras

-(Lugar)...está ubicado en ...(dónde)...donde se encuentra en ...(época)..bajo la influencia de ...(circulación general)...Además, ...(característica local)...influye sobre la circulación local a través de ...()
- Estas condiciones explican que se tenga...(patrón estacional de precipitación, temperatura y vientos)...
- El ciclo diario es....(ciclo diario de T, P y vientos)...

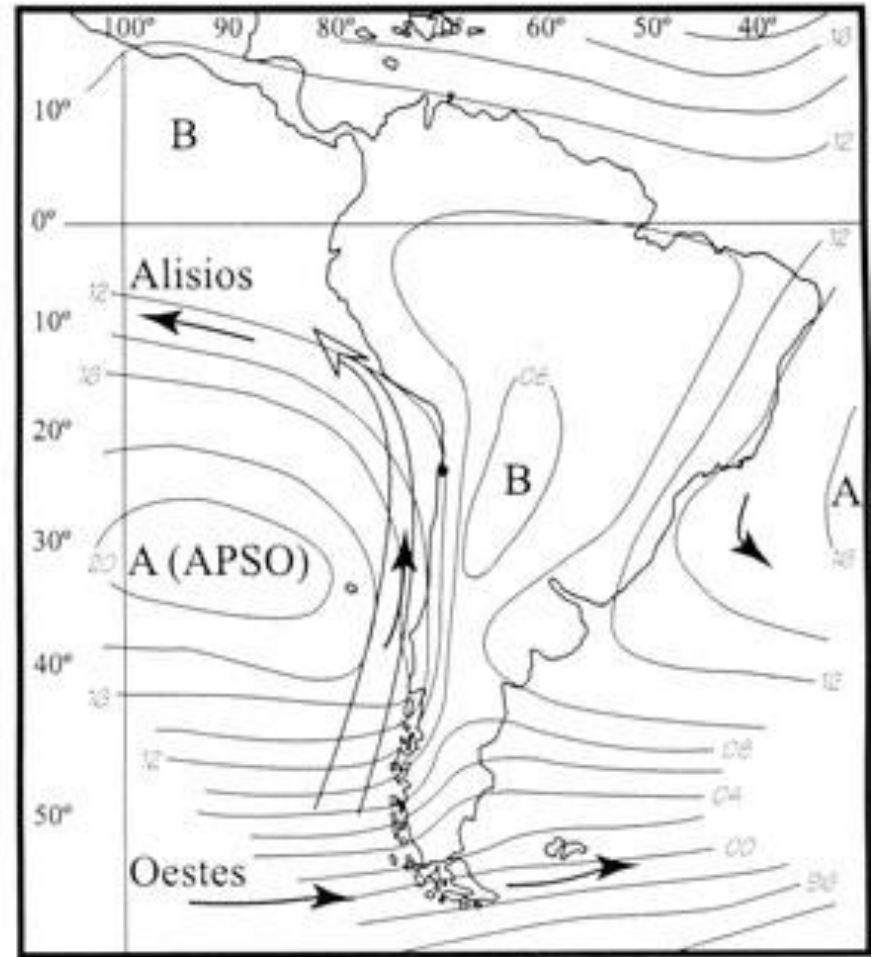


Análogo para las demás preguntas...

Condición característica

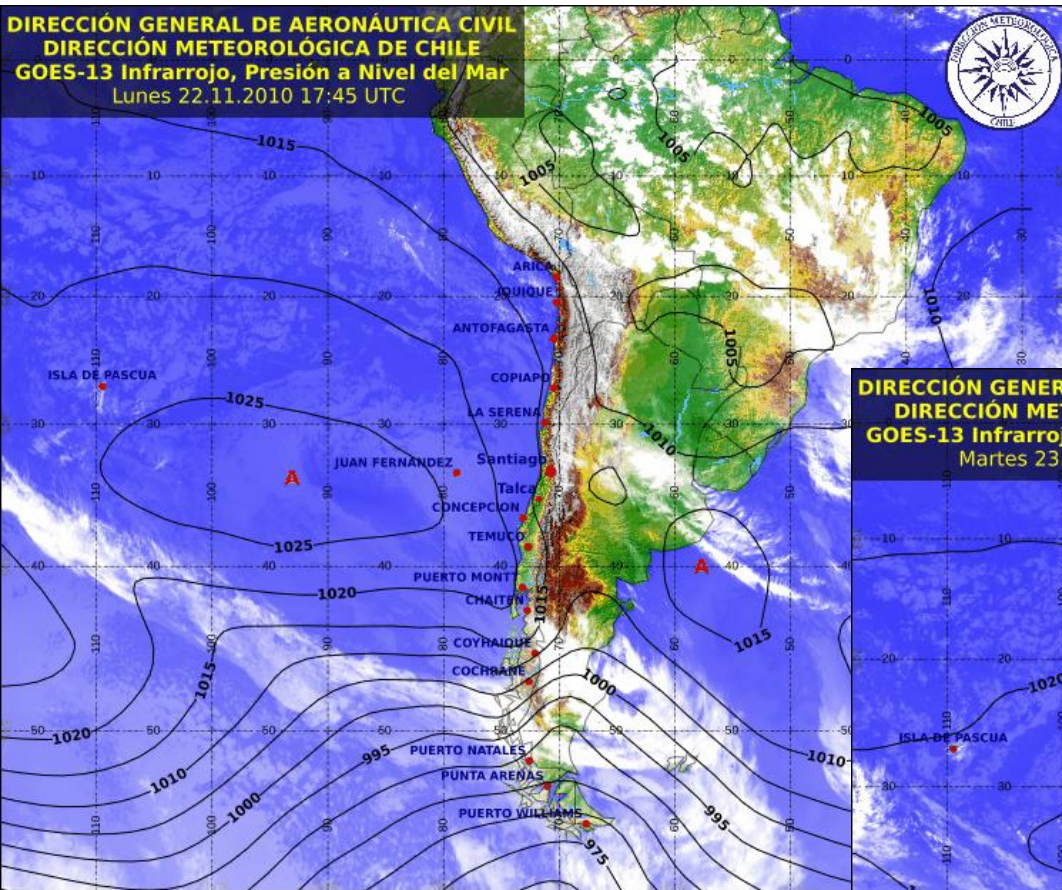


a: Invierno



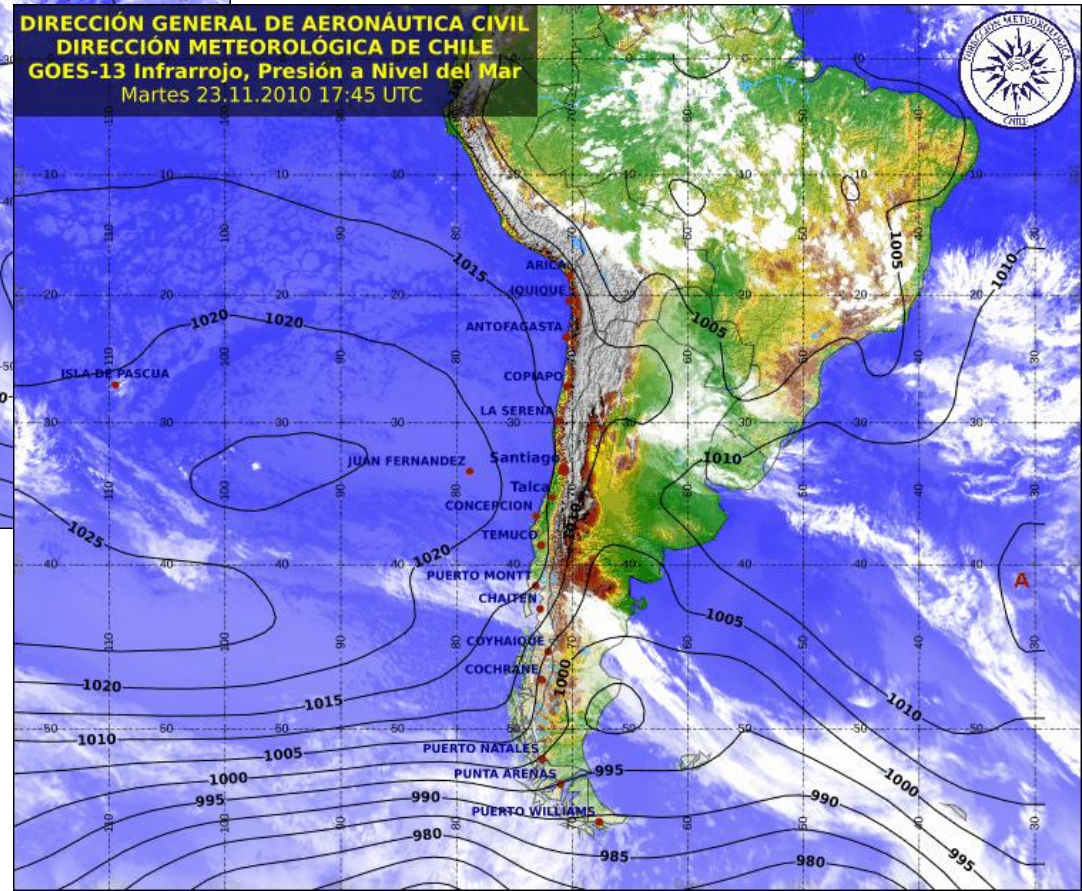
b: Verano

Carta sinóptica de superficie y nubosidad



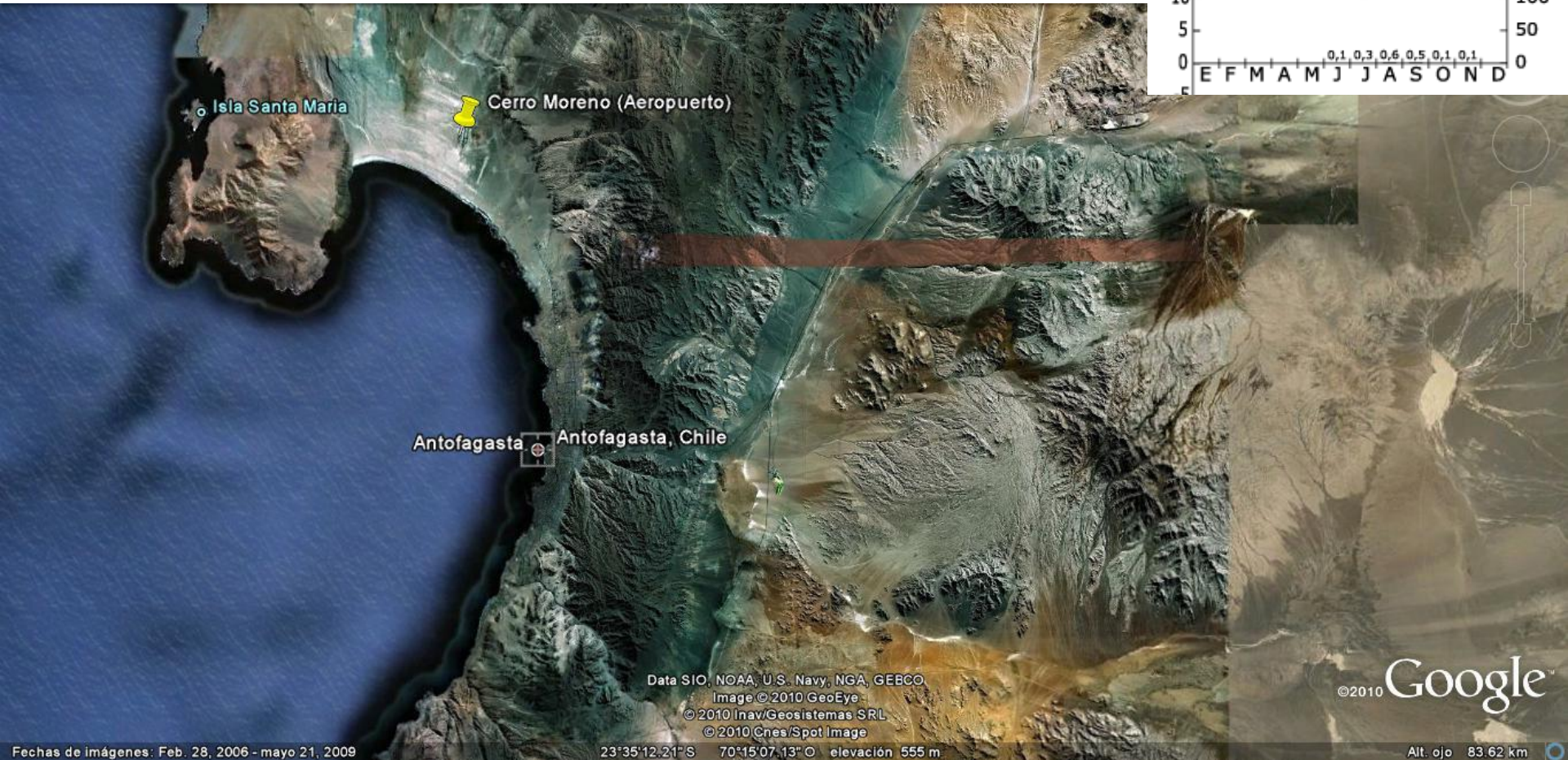
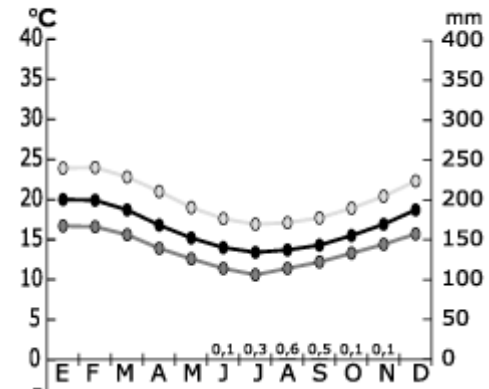
22/11 17:45 UTC

23/11 17:45 UTC

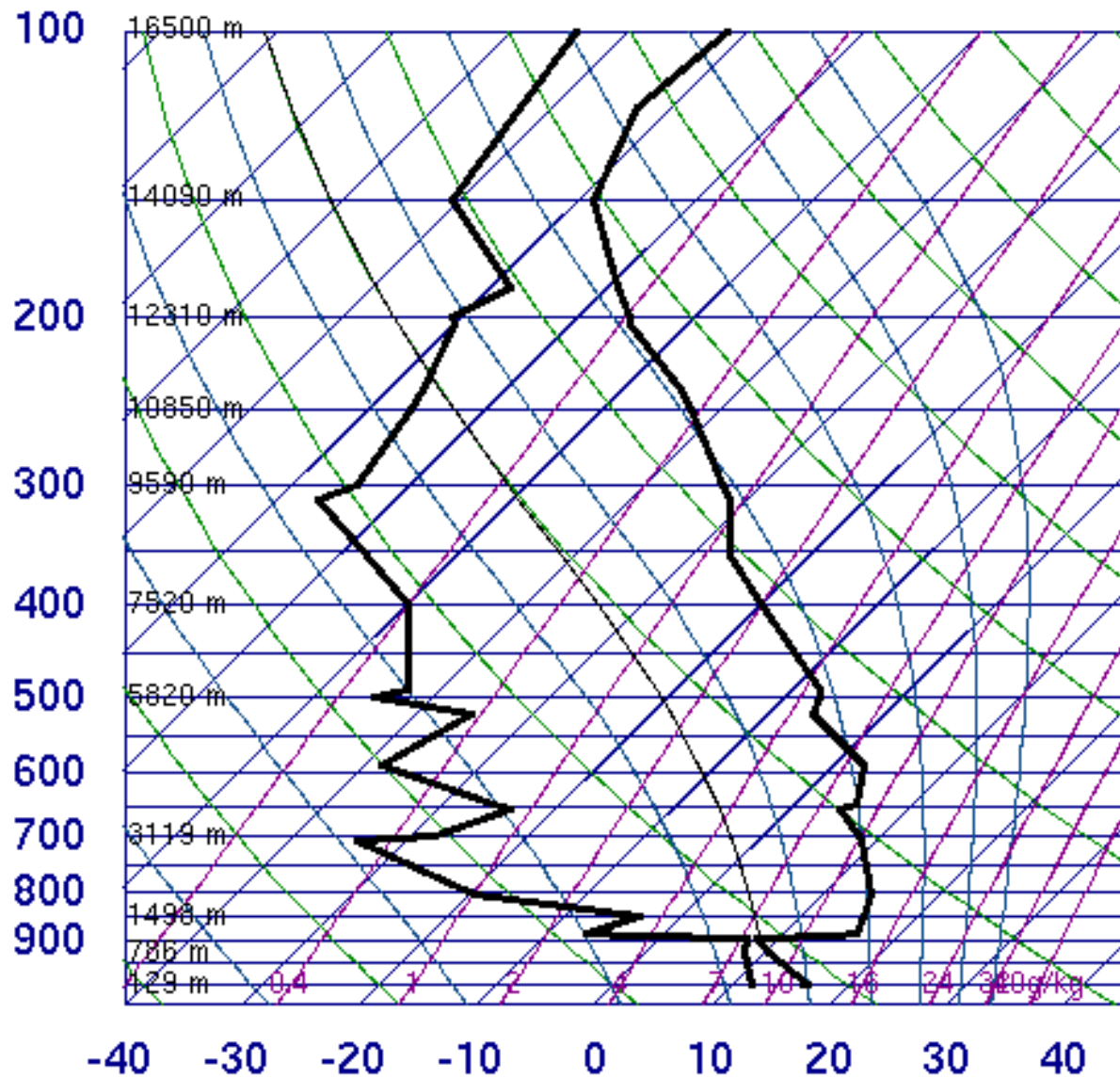


Antofagasta

Estación Antofagasta-Cerro Moreno
20° 32' S; 70° 11' W; 52 m.s.n.m



85442 SCFA Antofagasta



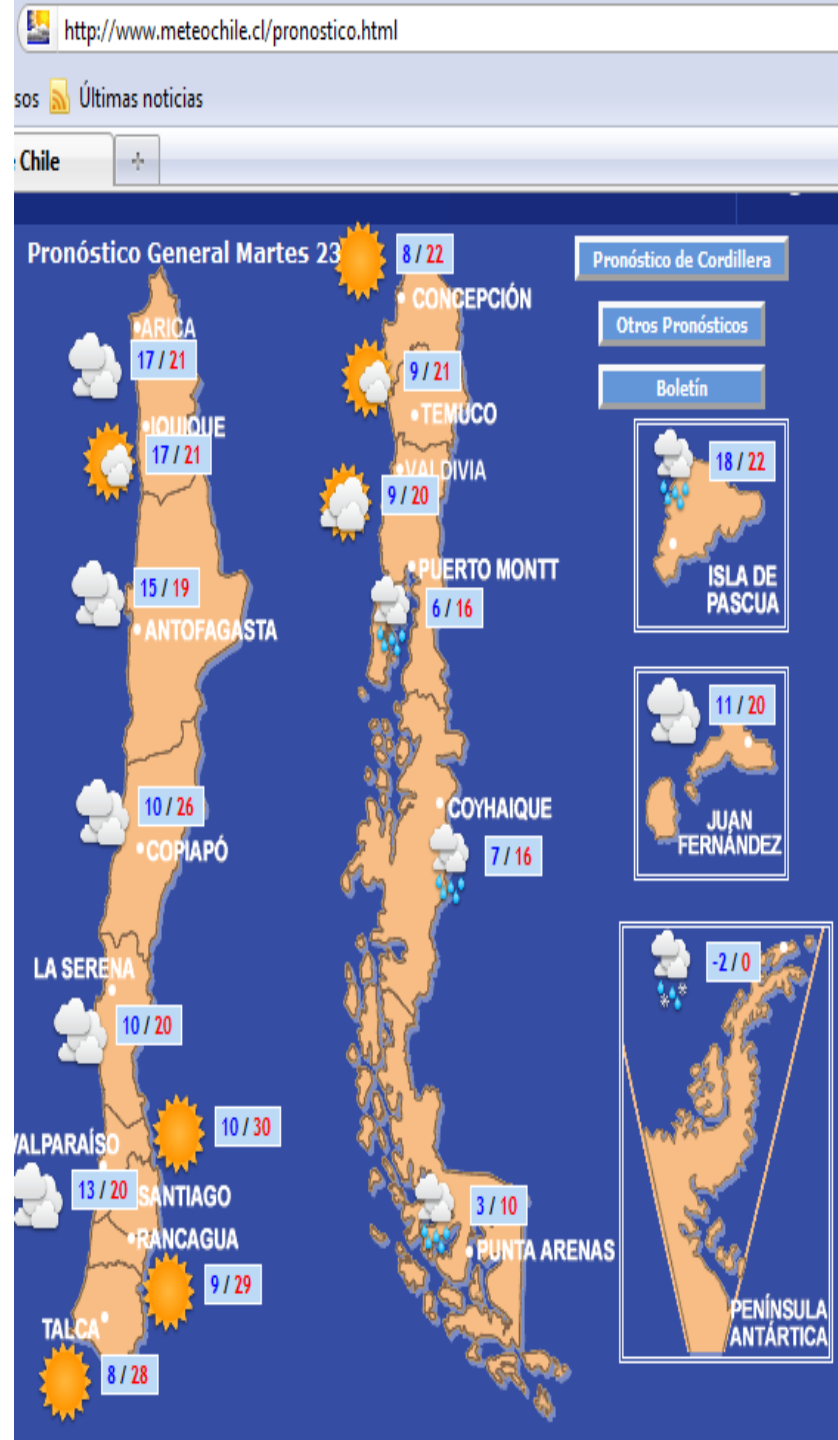
SLAT	-23.43
SLON	-70.45
SELV	115.0
SHOW	13.55
LIFT	13.57
LFTV	13.36
SWET	52.02
KINX	-17.3
CTOT	3.30
VTOT	22.30
TOTL	25.60
CAPE	0.09
CAPV	0.34
CINS	-2.69
CINV	-1.39
EQLV	894.8
EQTV	894.7
LFCT	904.3
LFCV	908.8
BRCH	0.01
BRCV	0.03
LCLT	282.7
LCLP	918.4
MLTH	289.6
MLMR	8.22
THCK	5691.
PWAT	12.87

12Z 22 Nov 2010

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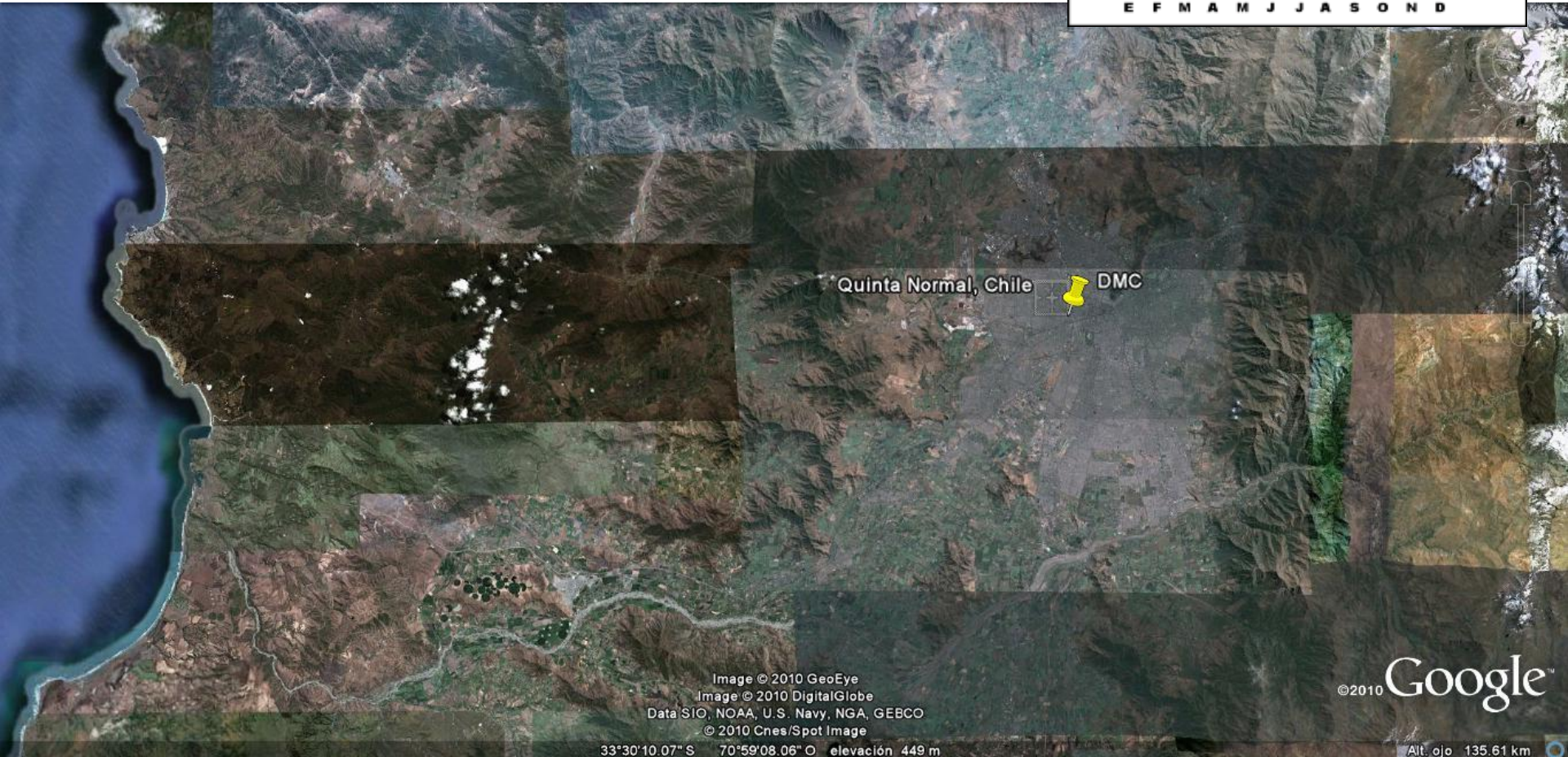
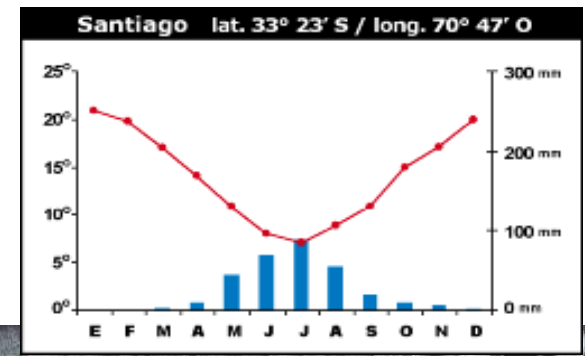
Pronóstico DMC



LGK 2010

<http://www.meteochile.cl/pronostico.html>

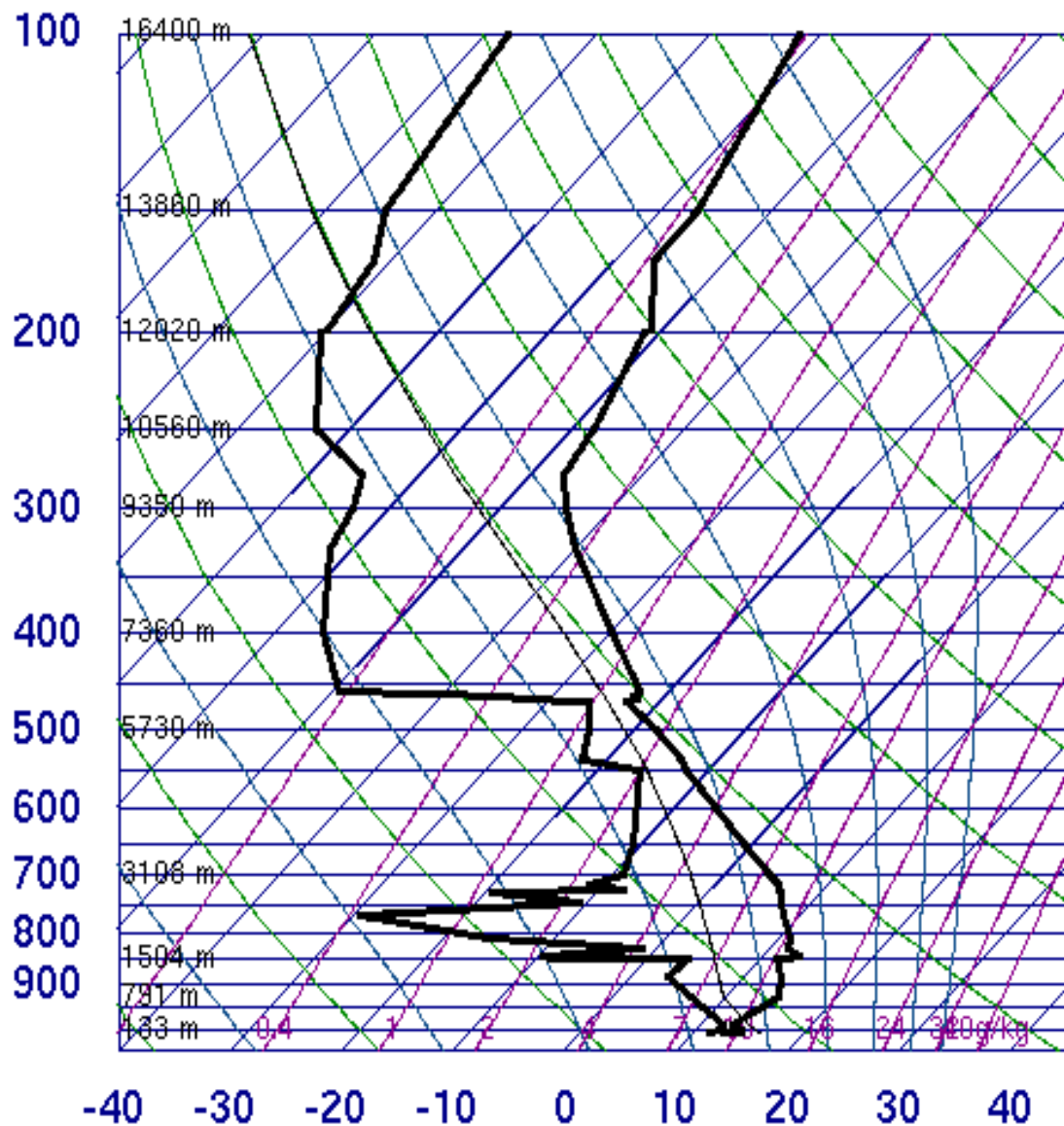
Santiago



LGK 2010

<http://www.atmosfera.cl/HTML/climatologia/climadechile/tempyprec.htm>

85586 SCSN Santo Domingo

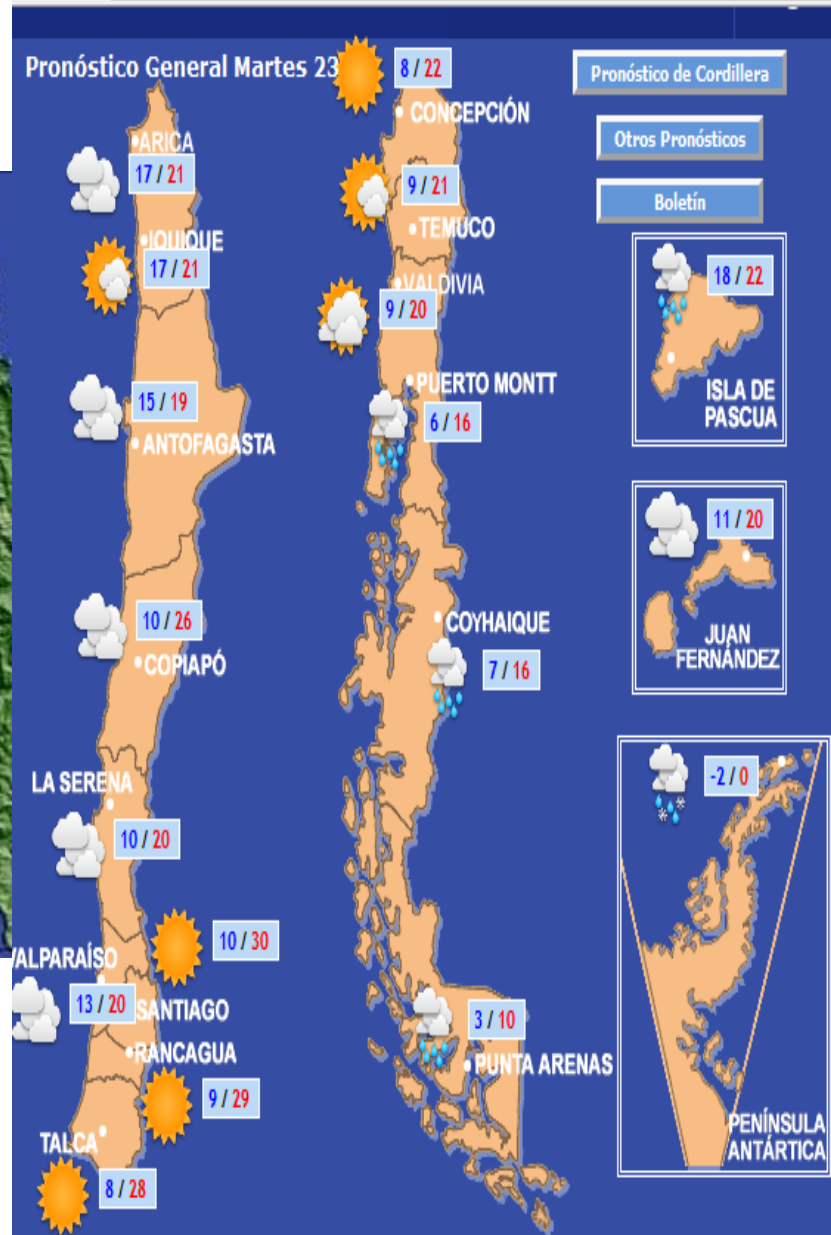
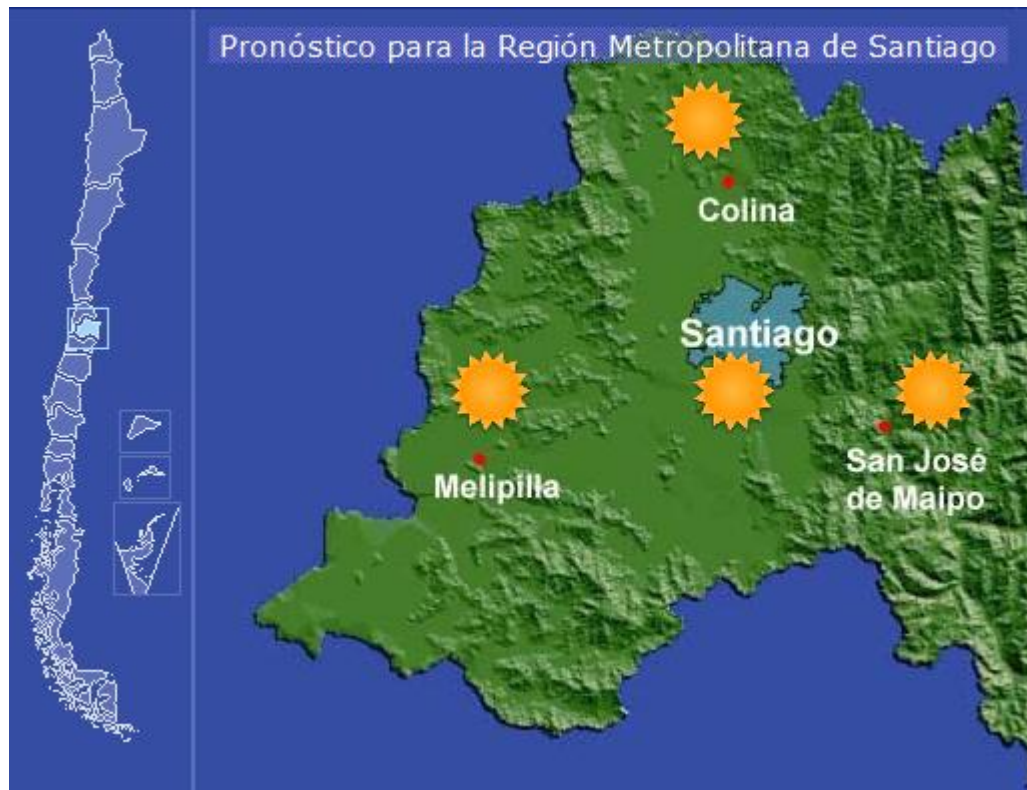


SLAT	-33.65
SLON	-71.61
SELV	75.00
SHOW	0.91
LIFT	2.87
LFTV	2.82
SWET	123.2
KINX	20.10
CTOT	21.50
VTOT	29.50
TOTL	51.00
CAPE	0.00
CAPV	0.00
CINS	0.00
CINV	0.00
EQLV	-9999
EQTV	-9999
LFCT	-9999
LFCV	-9999
BRCH	0.00
BRCV	0.00
LCLT	283.5
LCLP	939.9
MLTH	288.6
MLMR	8.50
THCK	5597.
PWAT	19.08

12Z 22 Nov 2010

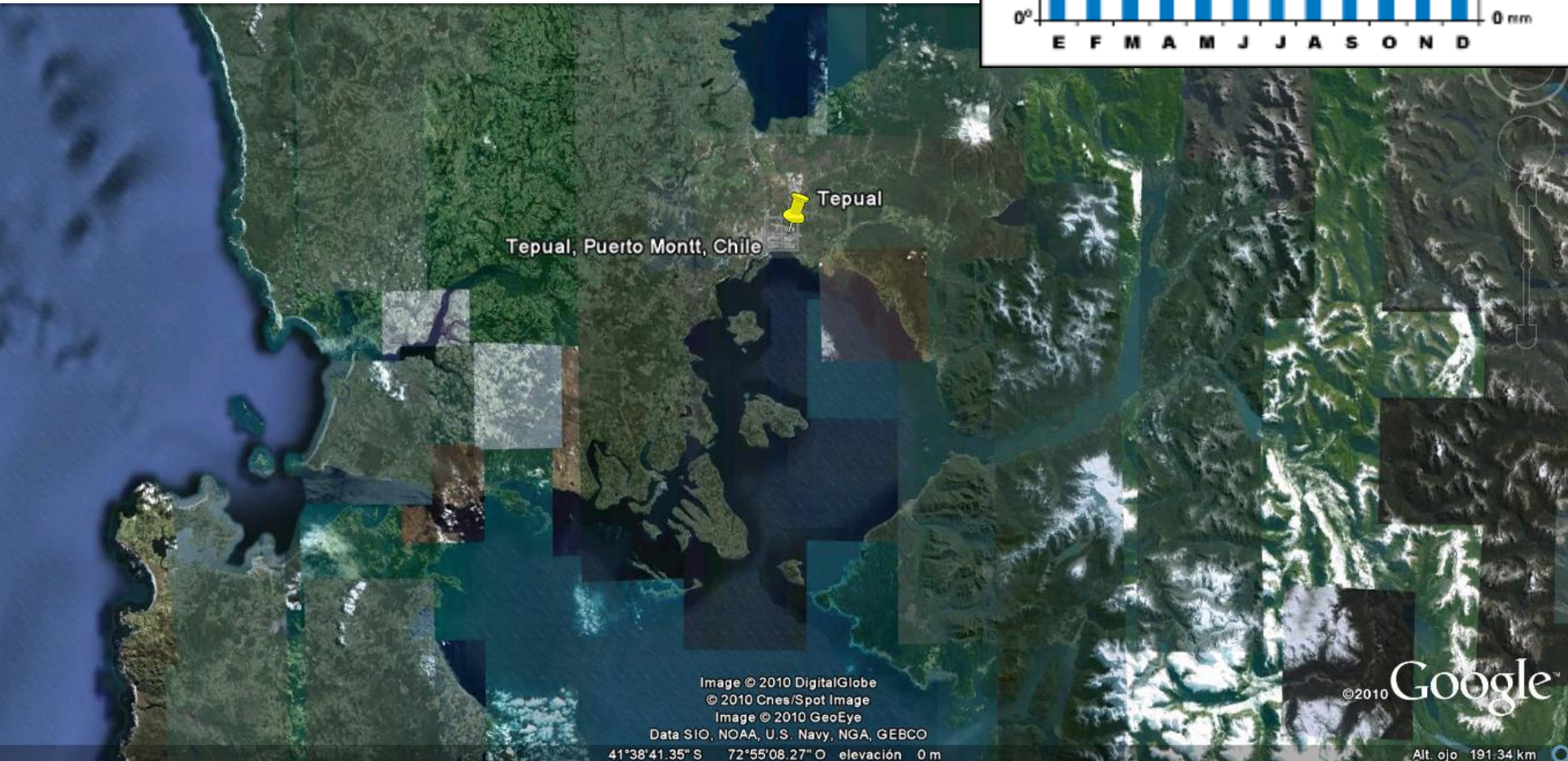
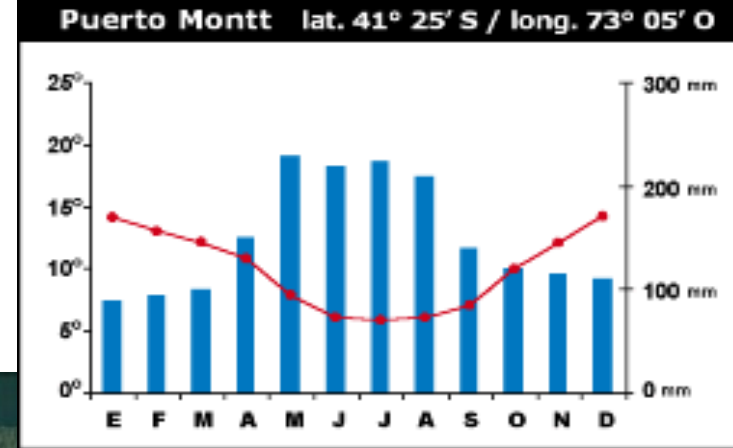
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Pronóstico DMC



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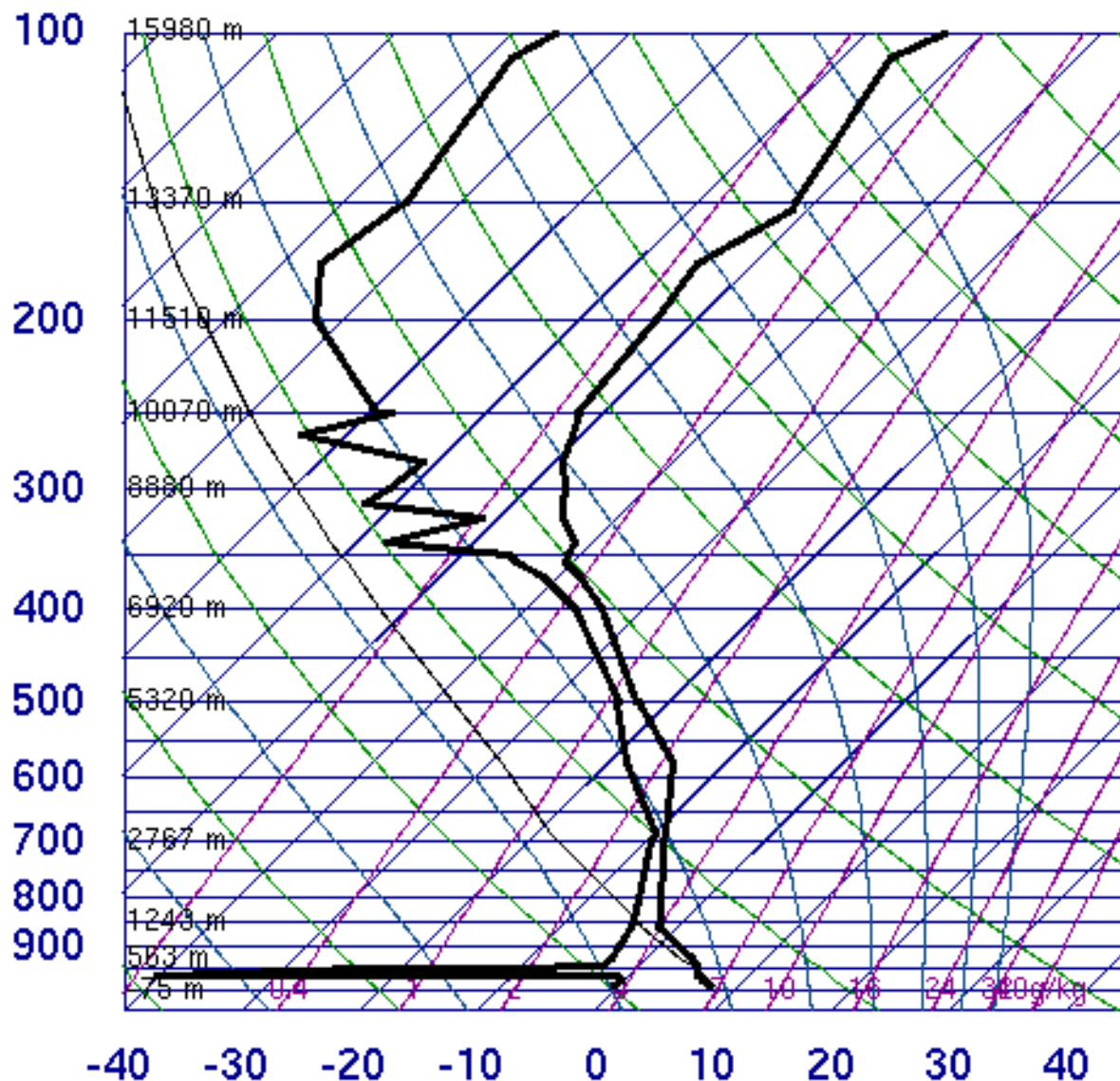
Puerto Montt



LGK 2010

<http://www.atmosfera.cl/HTML/climatologia/climadechile/tempyprec.htm>

85934 SCCL Punta Arenas



SLAT	-53.00
SLON	-70.85
SELV	33.00
SHOW	10.94
LIFT	15.78
LFTV	15.90
SWET	135.9
KINX	15.30
CTOT	18.30
VTOT	20.60
TOTL	38.90
CAPE	0.00
CAPV	0.00
CINS	0.00
CINV	0.00
EQLV	-9999
EQTV	-9999
LFCT	-9999
LFCV	-9999
BRCH	0.00
BRCV	0.00
LCLT	258.7
LCLP	738.5
MLTH	282.1
MLMR	2.47
THCK	5395.
PWAT	13.32

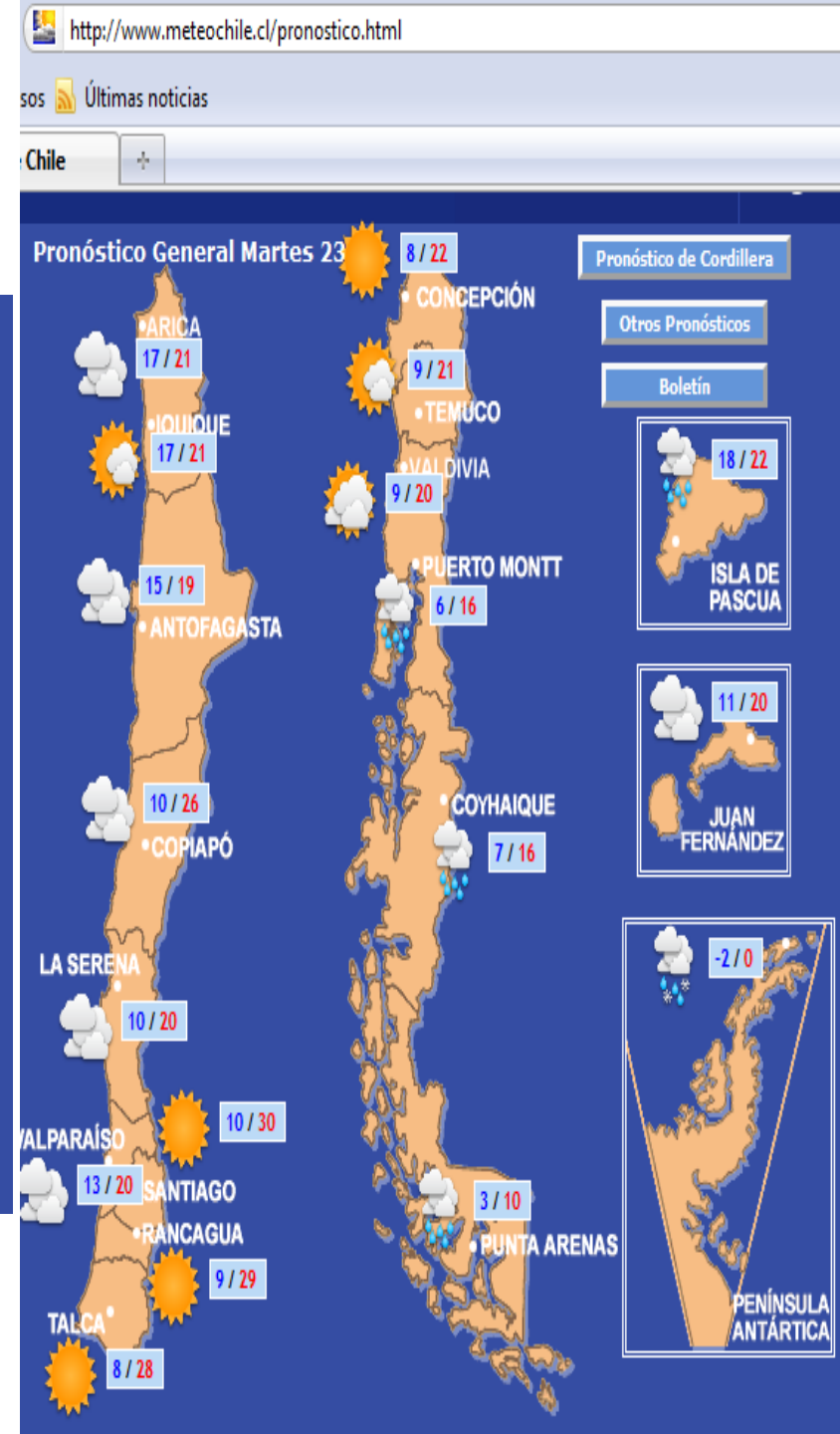
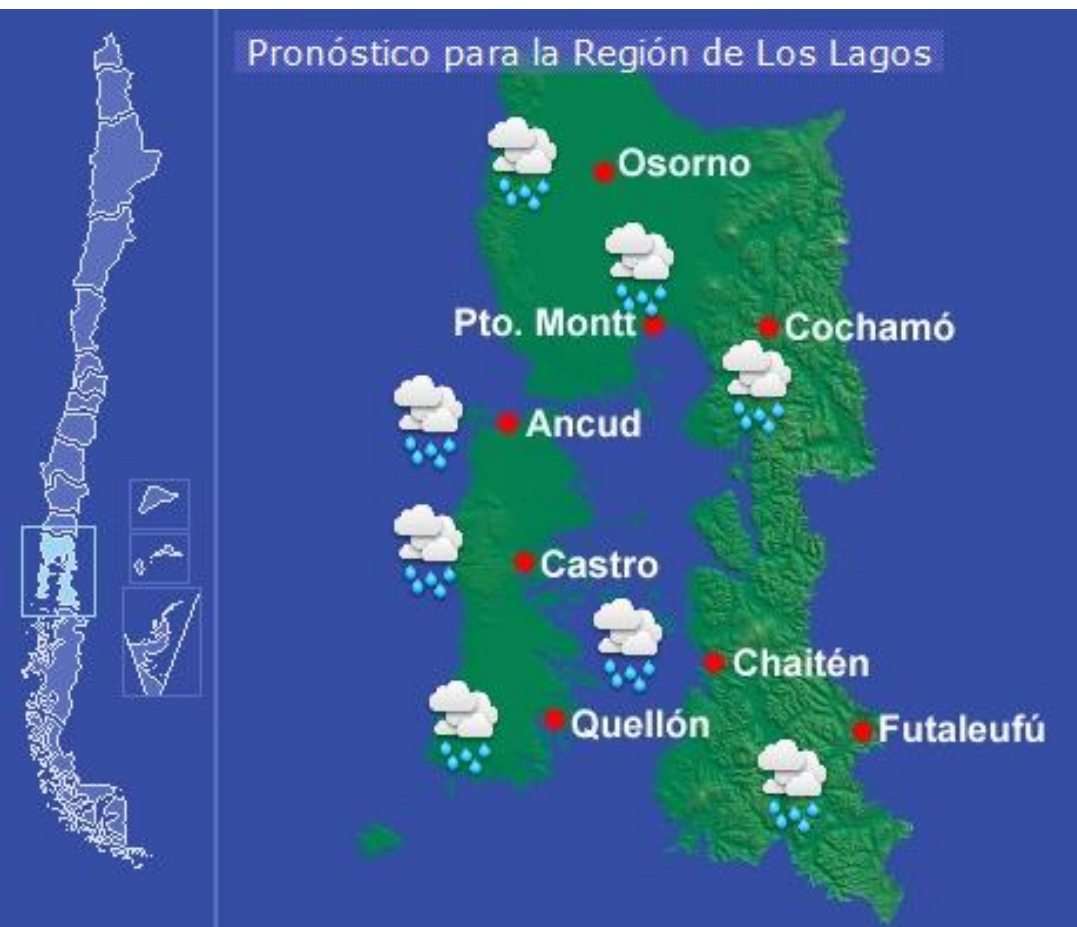
12Z 22 Nov 2010

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<http://weather.uwyo.edu/upperair/sounding.html>

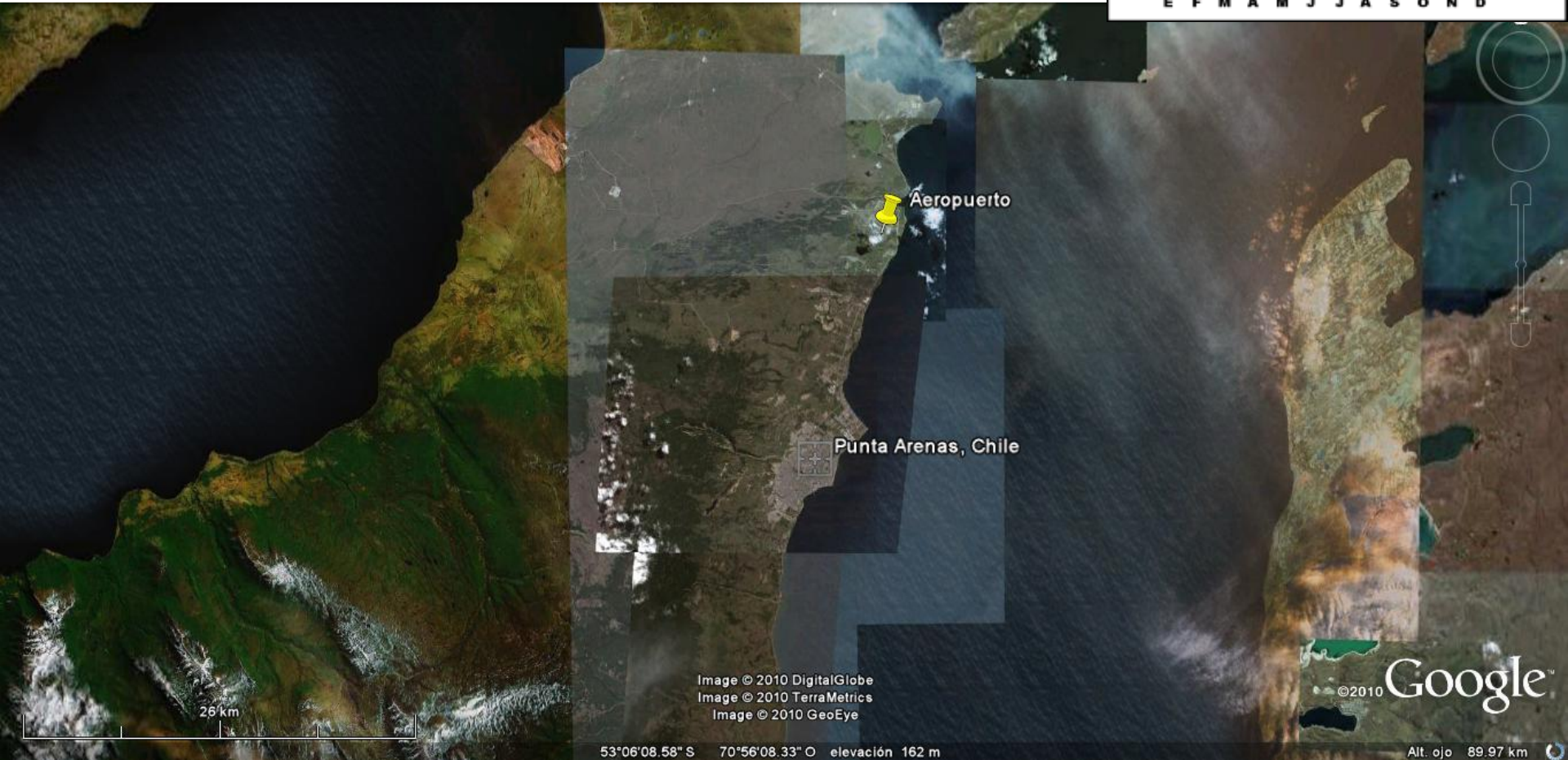
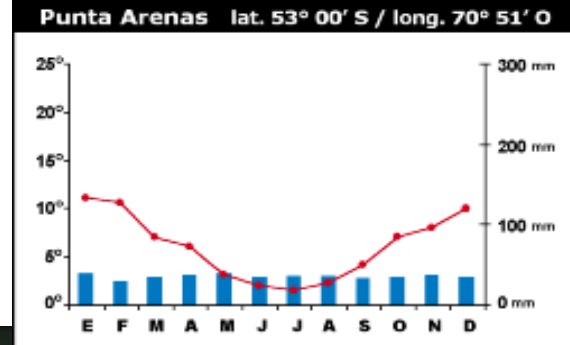
Pronóstico DMC



LGK 2010

<http://www.meteochile.cl/pronostico.html>

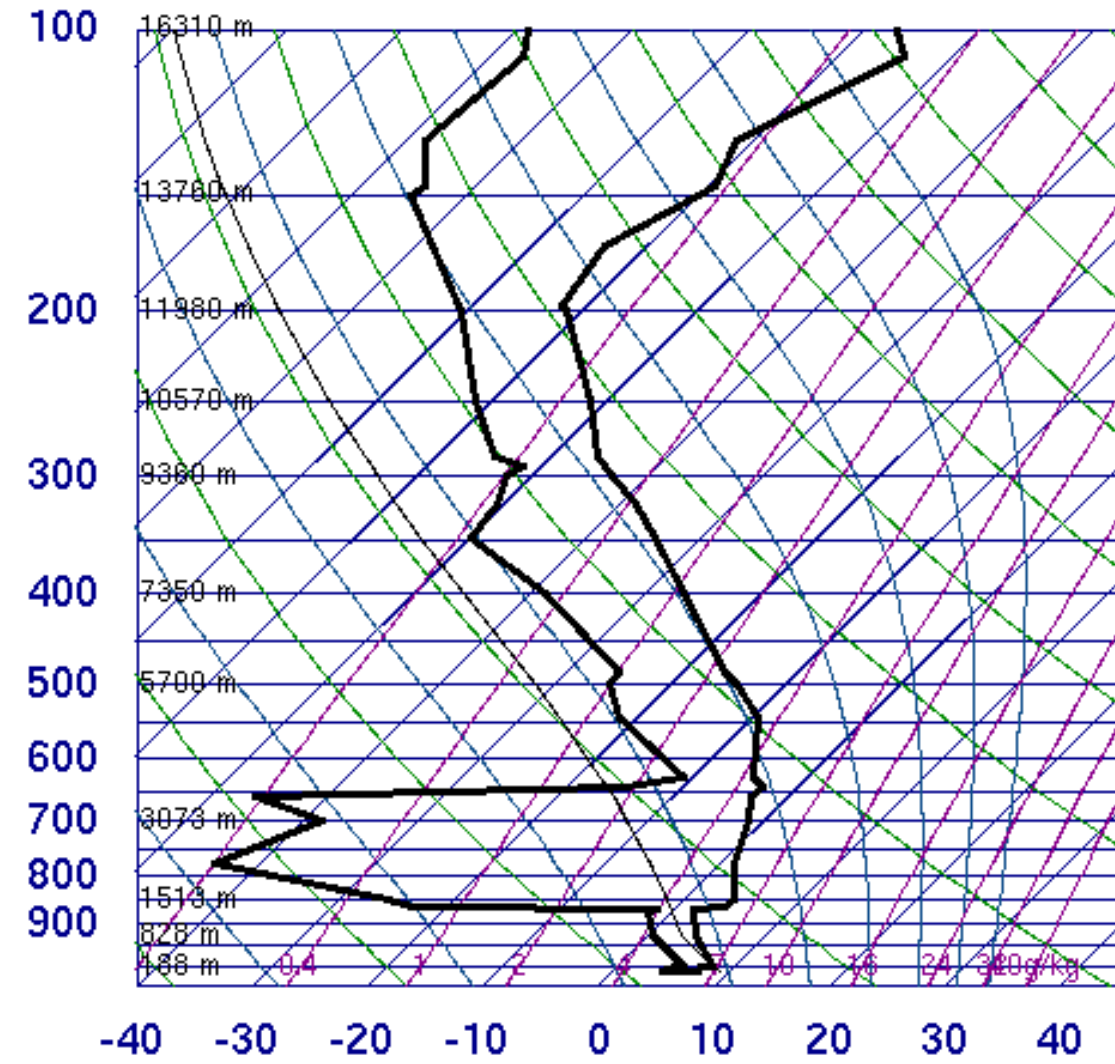
Punta Arenas



LGK 2010

<http://www.atmosfera.cl/HTML/climatologia/climadechile/tempyprec.htm>

85799 SCTE Puerto Montt



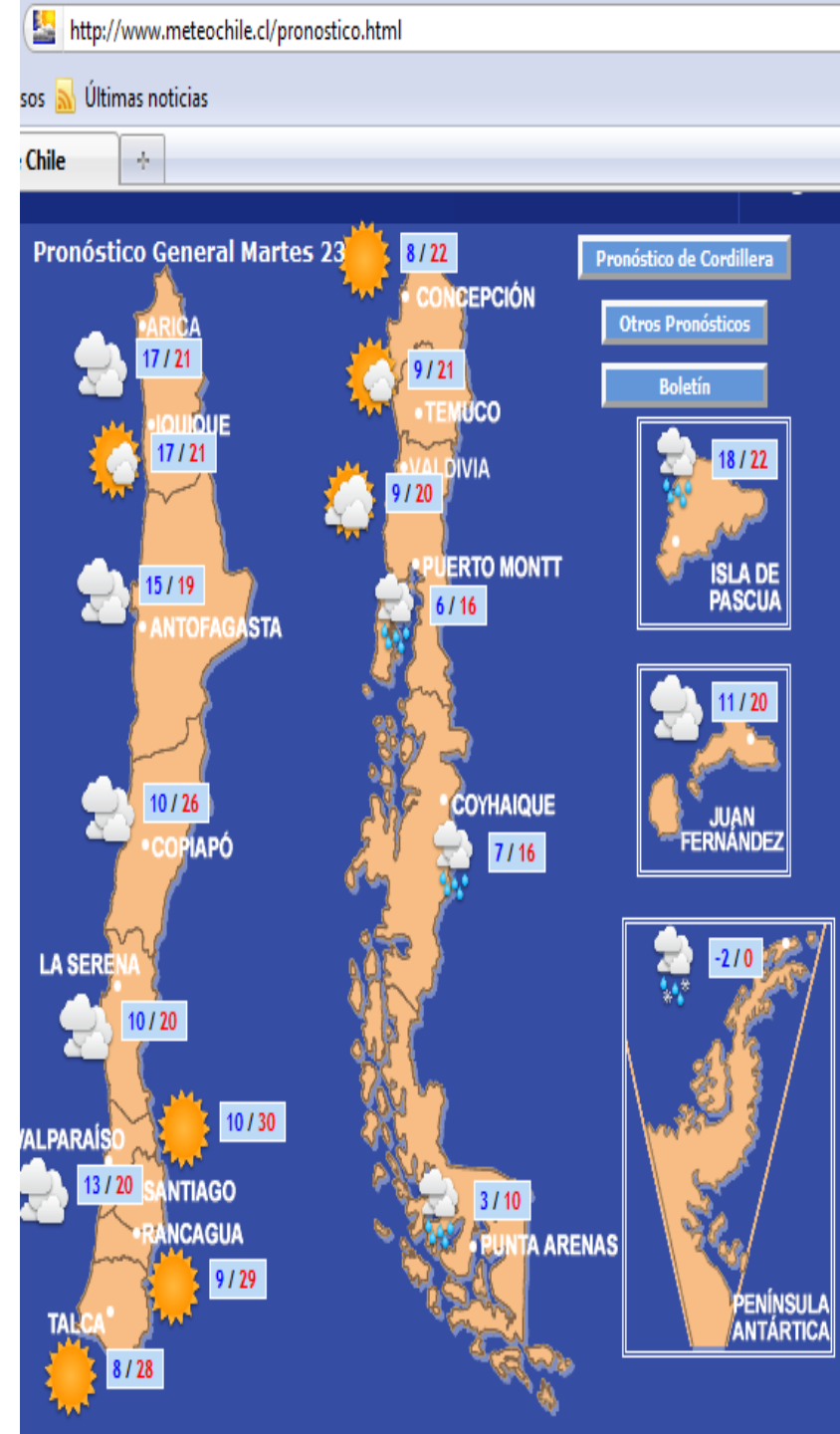
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SLON	-73.10
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SHOW	20.15
LIFT	17.41
LFTV	17.48
SWET	42.02
KINX	-44.3
CTOT	-11.5
VTOT	18.50
TOTL	7.00
CAPE	0.00
CAPV	0.00
CINS	0.00
CINV	0.00
EQLV	-9999
EQTV	-9999
LFCT	-9999
LFCV	-9999
BRCH	0.00
BRCV	0.00
LCLT	276.6
LCLP	941.4
MLTH	281.4
MLMR	5.26
THCK	5512.
PWAT	10.93

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Pronóstico DMC



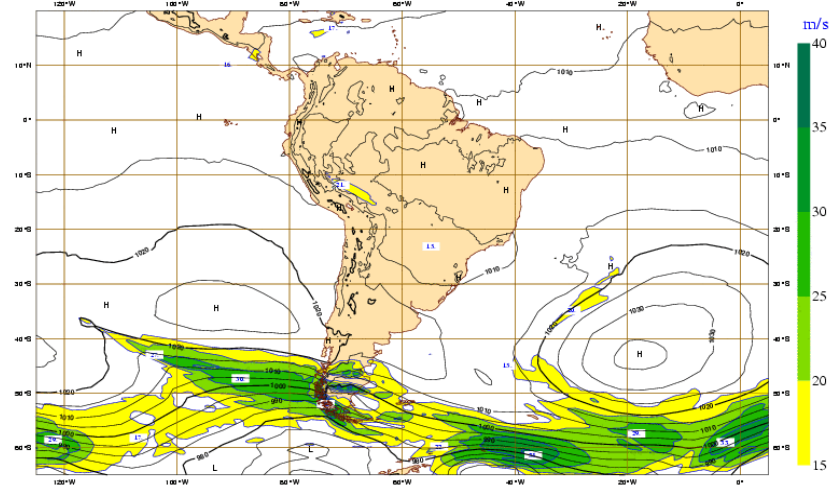
LGK 2010

<http://www.meteochile.cl/pronostico.html>

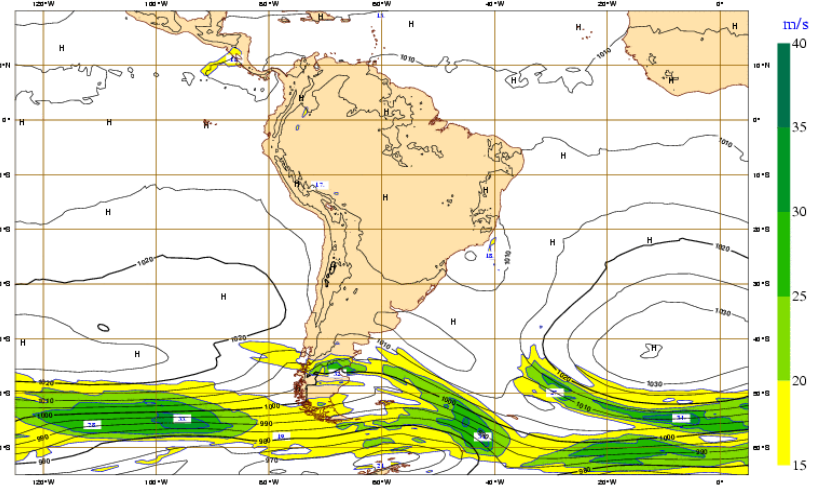
Análisis ECMWF (22/11)

<http://www.ecmwf.int/products/forecasts/d/charts>

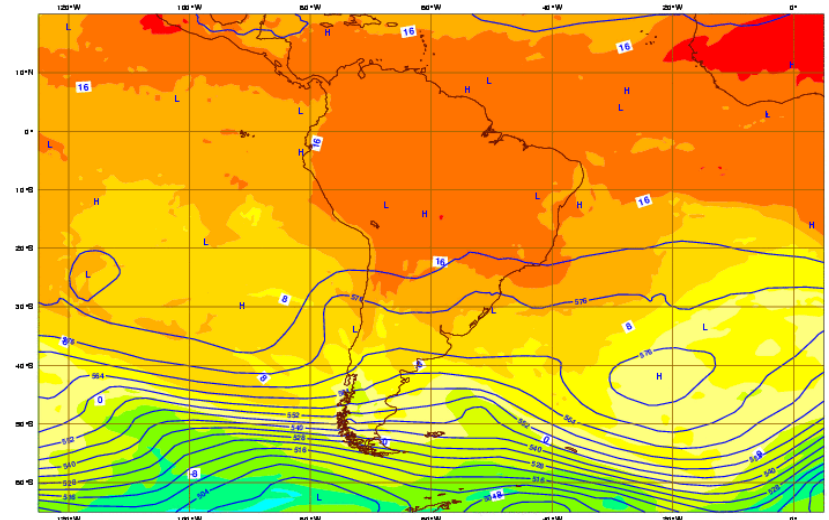
Monday 22 November 2010 12UTC ©ECMWF Analysis t+000 VT: Monday 22 November 2010 12UTC
Surface: Mean sea level pressure / 850-hPa wind speed



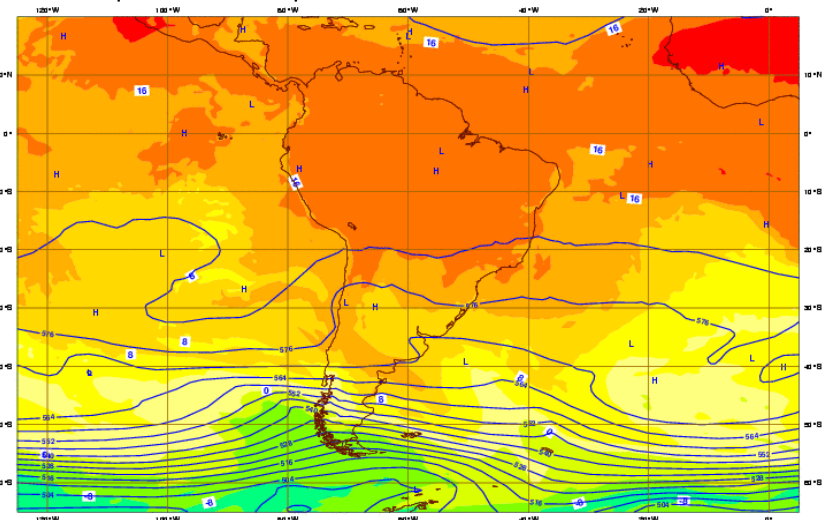
Monday 22 November 2010 12UTC ©ECMWF Forecast t+024 VT: Tuesday 23 November 2010 12UTC
Surface: Mean sea level pressure / 850-hPa wind speed



Monday 22 November 2010 12UTC ©ECMWF Analysis t+000 VT: Monday 22 November 2010 12UTC
850 hPa Temperature / 500 hPa Geopotential



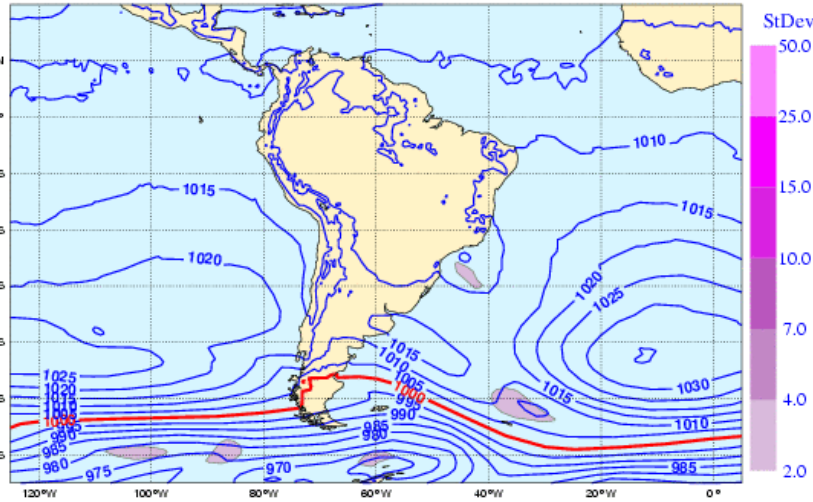
Monday 22 November 2010 12UTC ©ECMWF Forecast t+024 VT: Tuesday 23 November 2010 12UTC
850 hPa Temperature / 500 hPa Geopotential



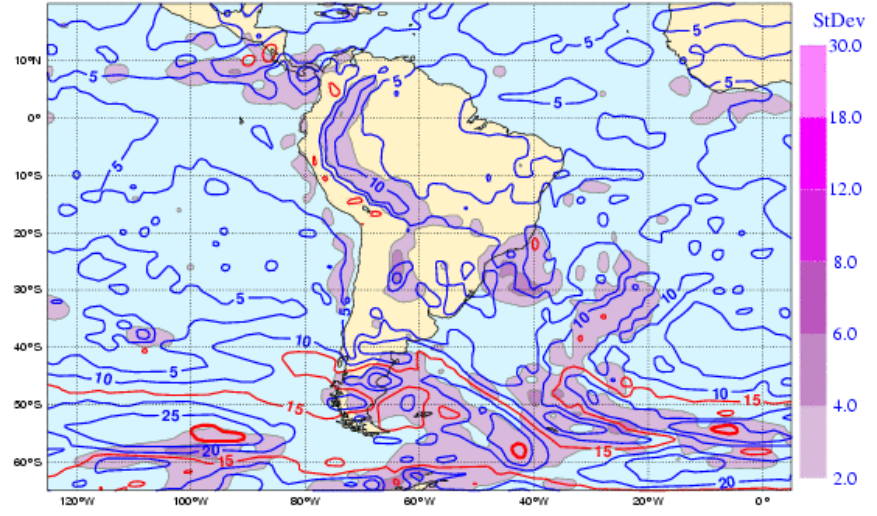
Pronóstico ECMWF

<http://www.ecmwf.int/products/forecasts/d/charts>

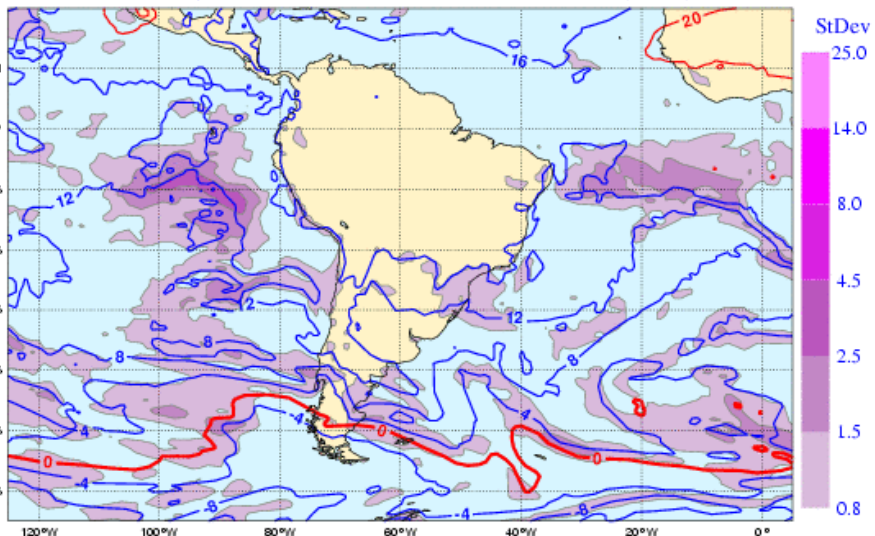
Monday 22 November 2010 12UTC ECMWF Forecast t+24 VT: Tuesday 23 November 2010 12UTC
Mean sea level pressure (MSLP) Deterministic Forecast and Standard Deviation (shaded)



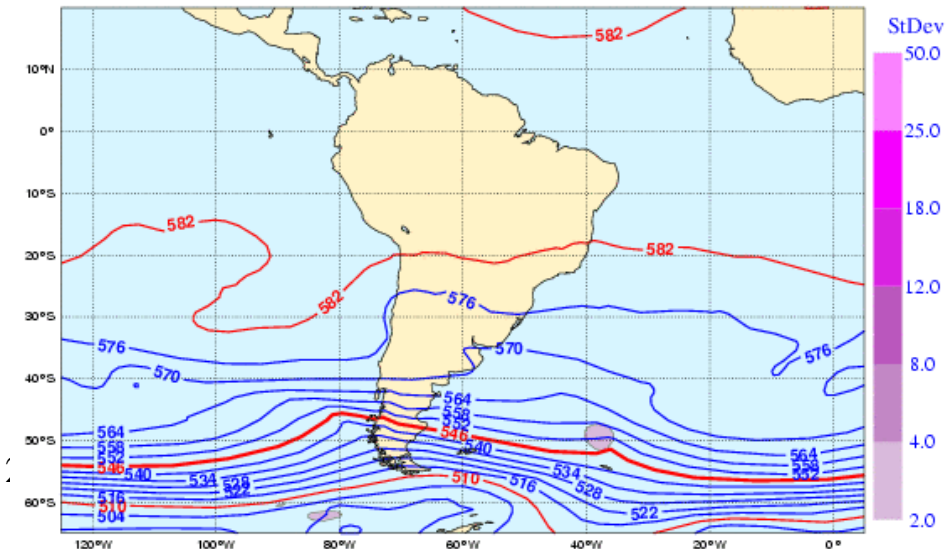
Monday 22 November 2010 12UTC ECMWF Forecast t+24 VT: Tuesday 23 November 2010 12UTC
850hPa Wind speed Deterministic Forecast and Standard Deviation (shaded)



Monday 22 November 2010 12UTC ECMWF Forecast t+24 VT: Tuesday 23 November 2010 12UTC
850hPa Temperature Deterministic Forecast and Standard Deviation (shaded)



Monday 22 November 2010 12UTC ECMWF Forecast t+24 VT: Tuesday 23 November 2010 12UTC
500hPa Geopotential Deterministic Forecast and Standard Deviation (shaded)



That's all Folks!



LGK 2010

Lecturas de hoy

- Obligatoria
 - Wallace and Hobbs, Atmospheric Science (Ch. ~9)
- Complementaria
 - **Van Gogh painted perfect turbulence**
 - <http://www.nature.com/news/2006/060703/full/news060703-17.html>

