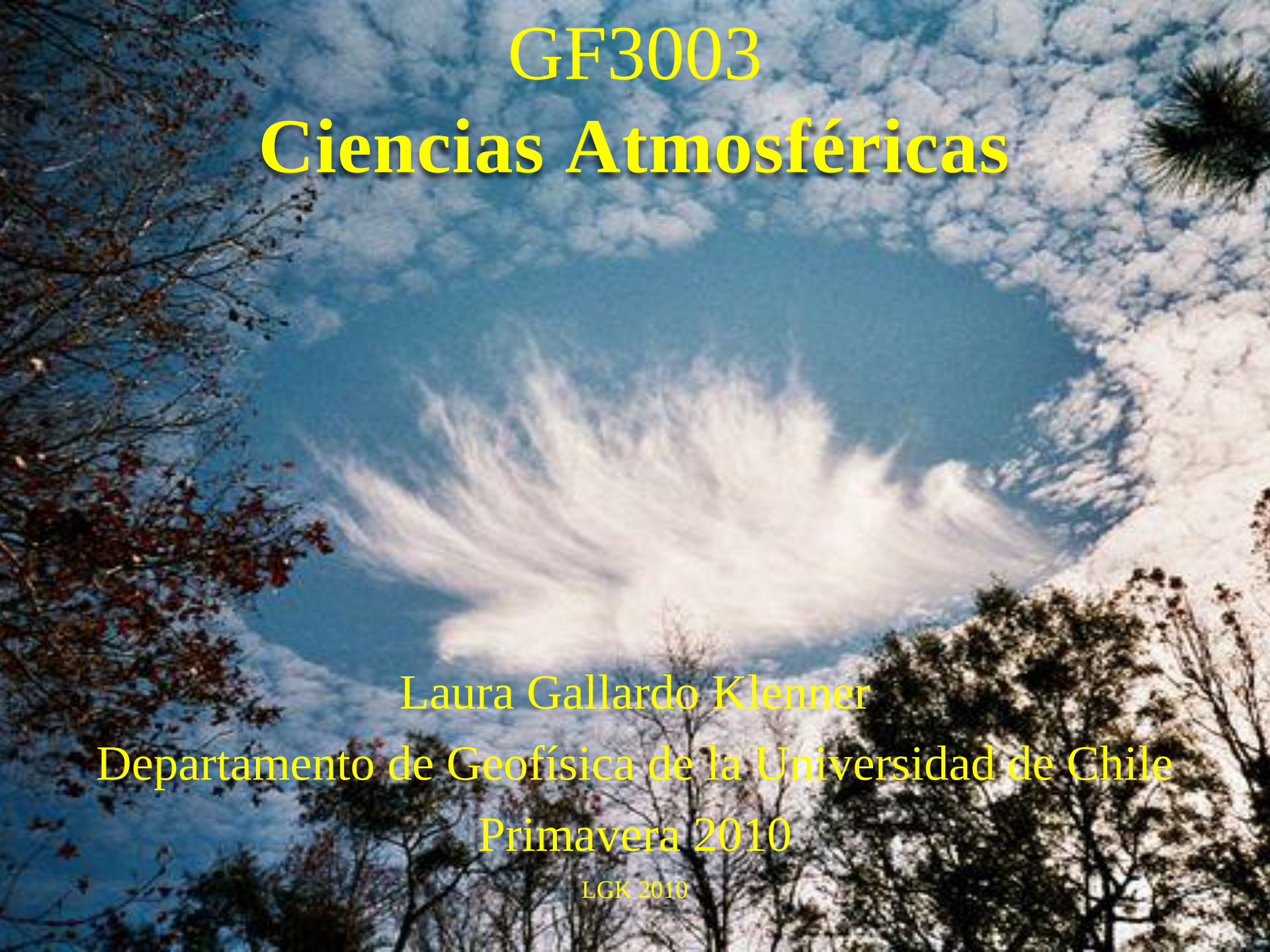


GF3003
Ciencias Atmosféricas

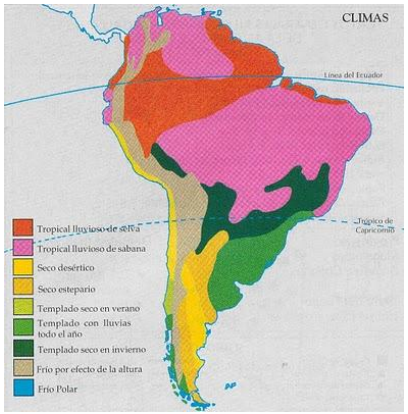
Laura Gallardo Klenner
Departamento de Geofísica de la Universidad de Chile

Primavera 2010

HOY:
Tiempo y clima de Chile
+algo de capa límite

- Capa límite
  - Flujos energéticos
  - Evolución
  - Observación

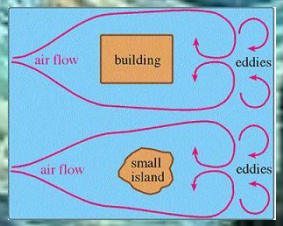
- Tiempo y clima de Chile
  - Norte
  - Centro
  - Sur
  - Patagonia

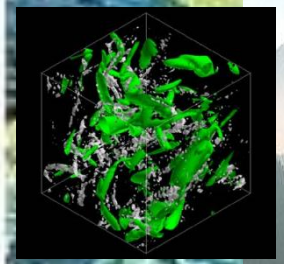


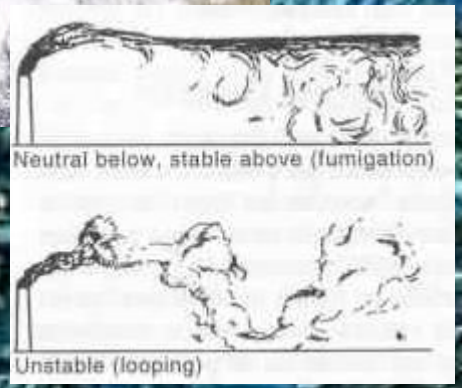
Más específicamente, el/la alumno/a será capaz de:

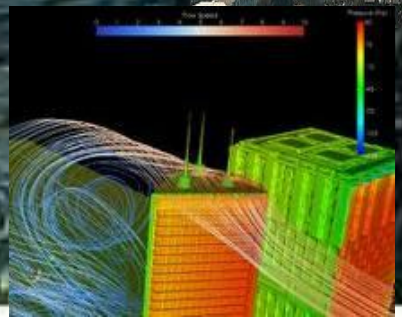
- Reconocer y describir físicamente los términos de la ecuación de balance de energía superficial y su evolución diurna
- Describir la evolución de la capa límite para condiciones simples
- Reconocer instrumentos de observación de la capa límite
- Aplicar elementos de circulación general y local para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

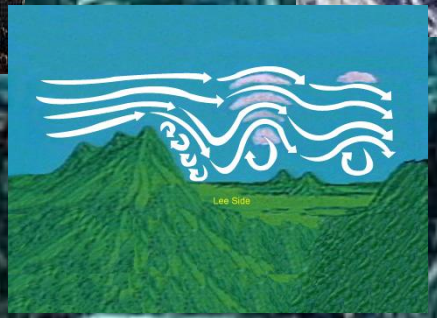
La atmósfera: un fluido turbulento



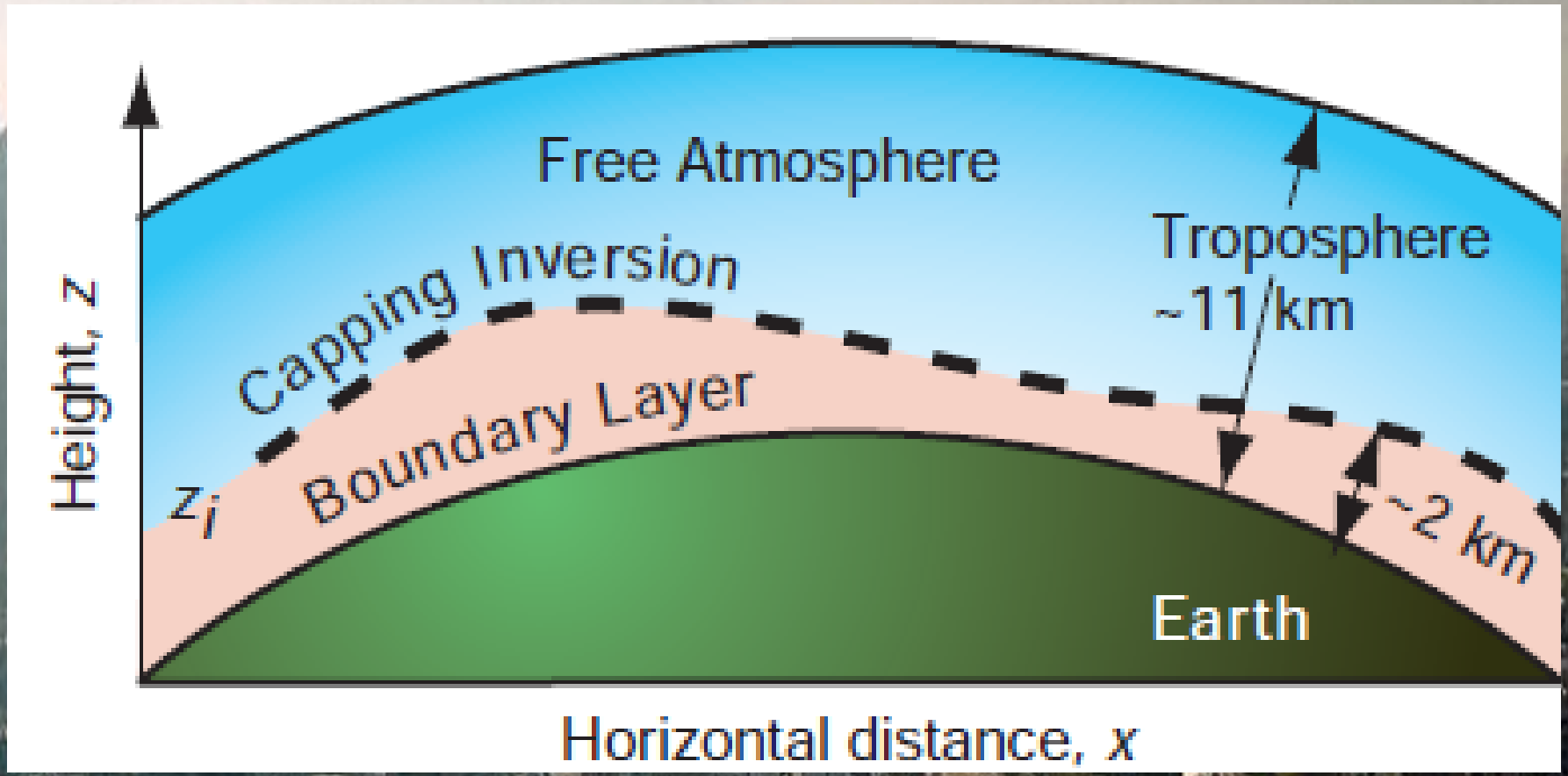




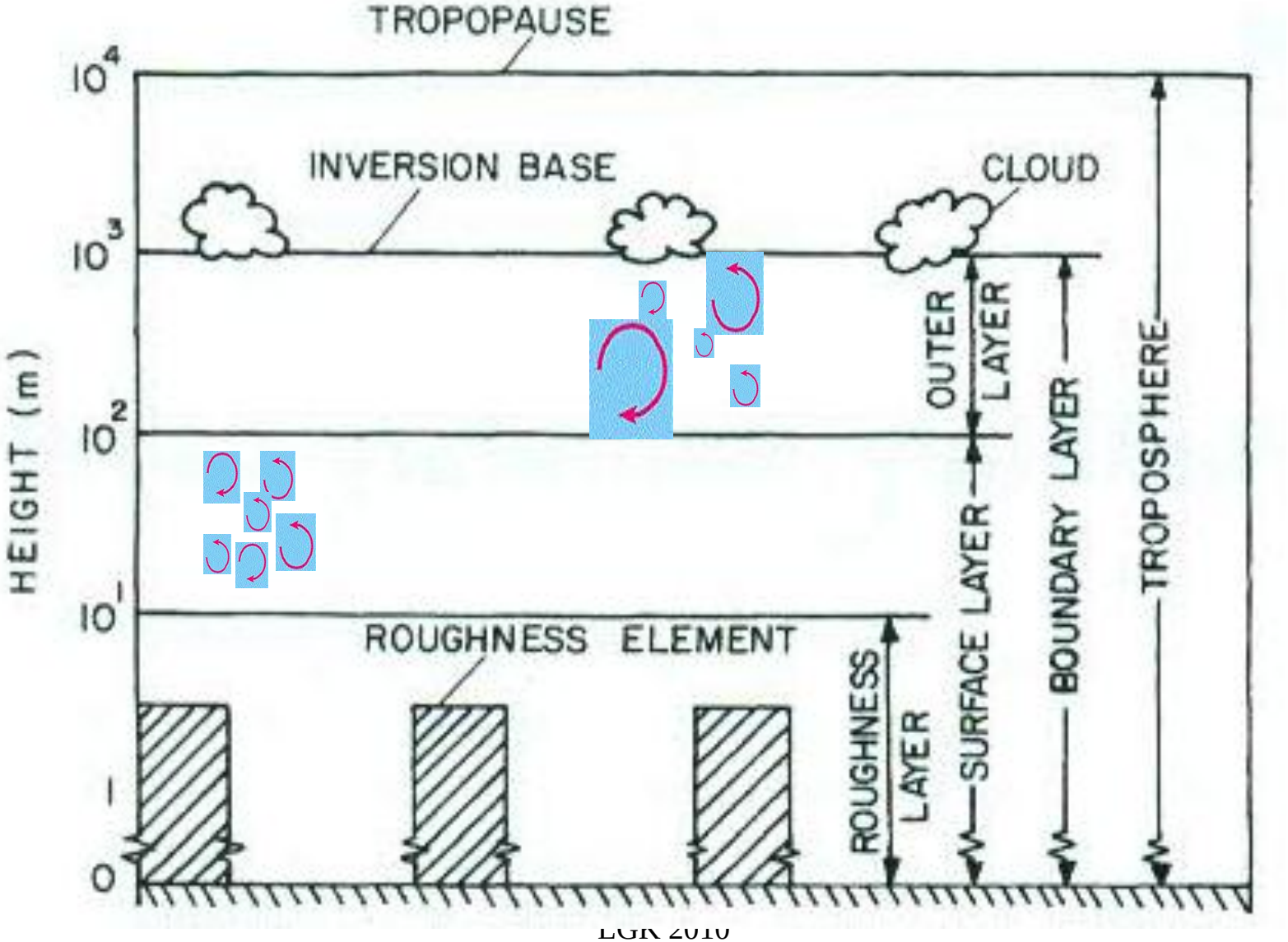




Turbulencia en la capa límite



Capas de la capa límite



Arya, 1999

Energía cinética turbulenta

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

Advección

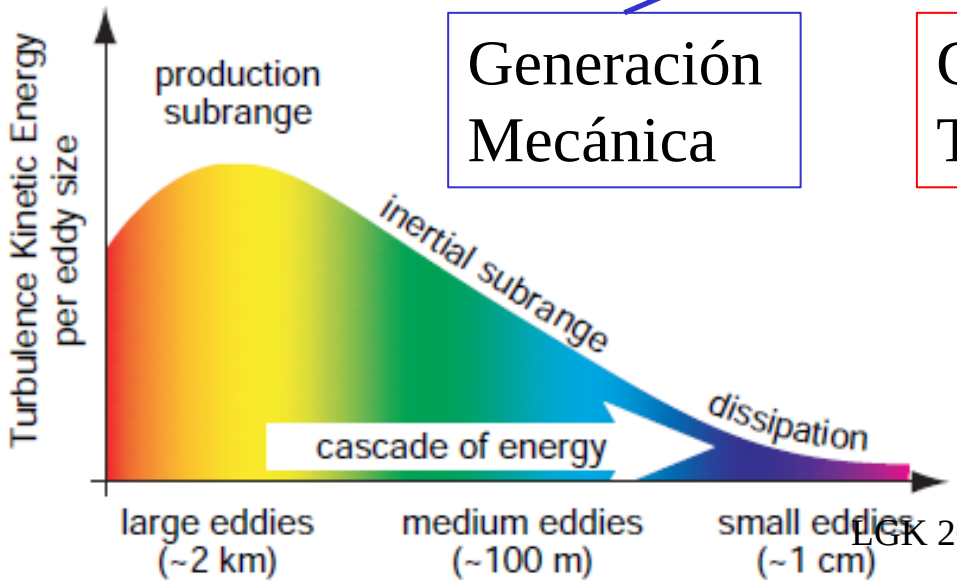
Transporte turbulento

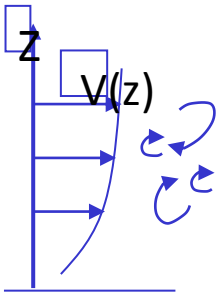
$$\frac{\partial(TKE/m)}{\partial t} = Ad + M + B + Tr - \varepsilon$$

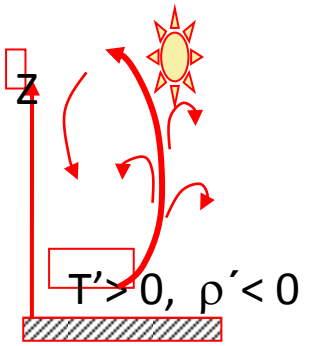
Generación Mecánica

Generación Térmica

Disipación







Aproximaciones a la capa límite

¿Cómo caracterizar las fluctuaciones?

Como si fuera difusión...

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

Análisis dimensional...

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

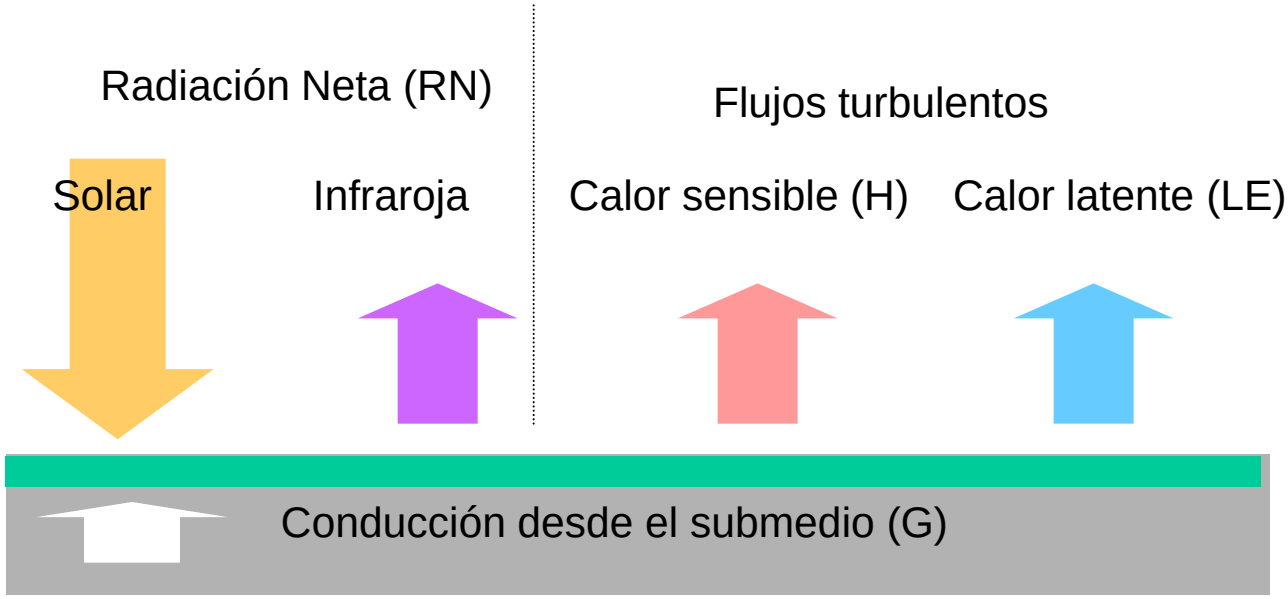
$$u_* = \left[\overline{u'w'}^2 + \overline{v'w'}^2\right]^{1/4} = \left|\frac{\tau_s}{\rho}\right|^{1/2}$$

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

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

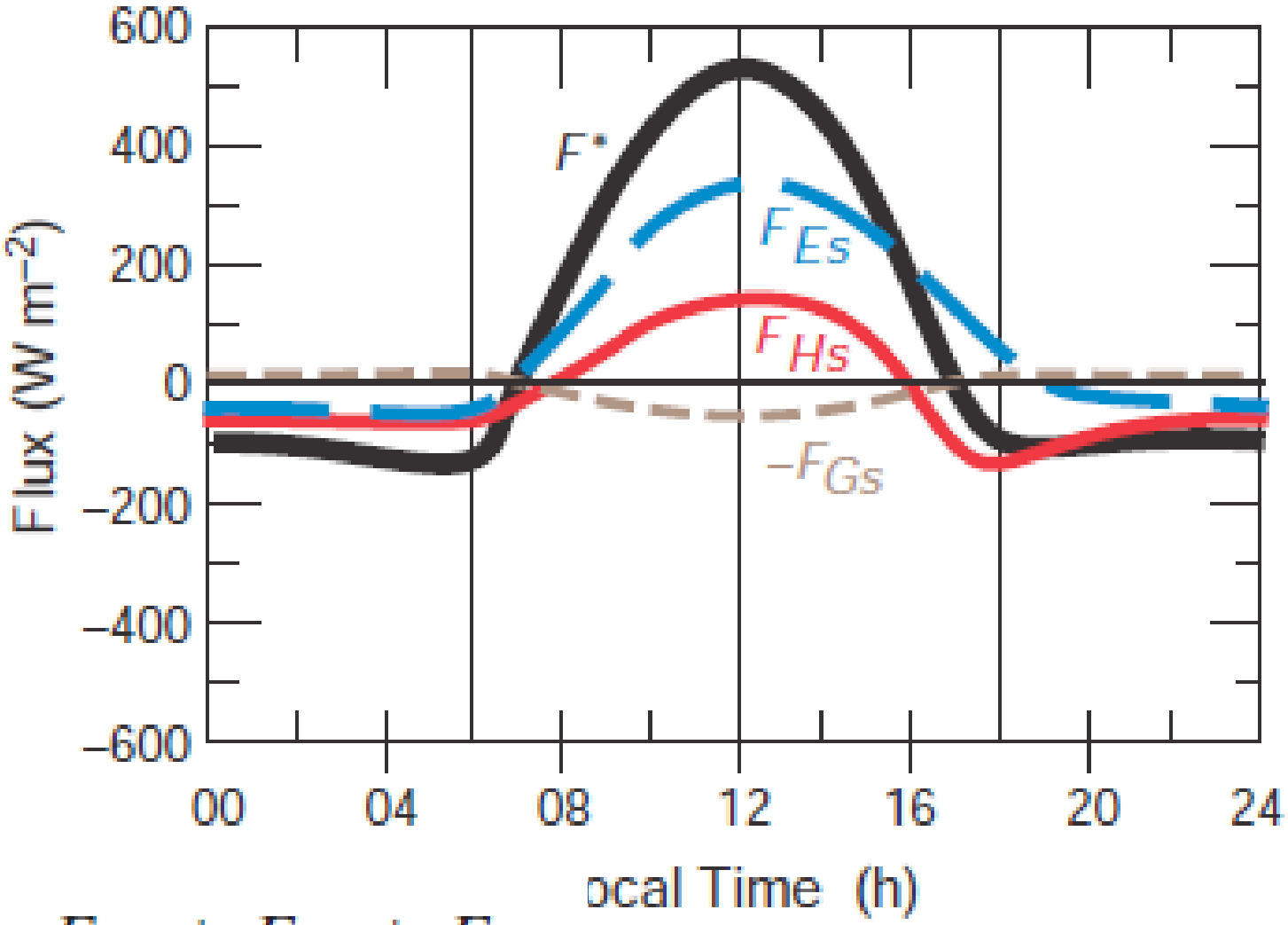
Ambas aproximaciones requieren parametrizar, esto es, relacionar la escala no resuelta con la resuelta a través de parámetros libres

Balance de Energía Superficial



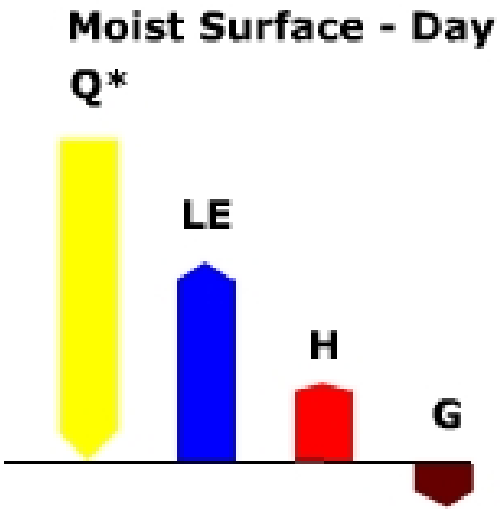
$$\rho c_p h \frac{\partial T}{\partial t} = RN + H + LE + G$$

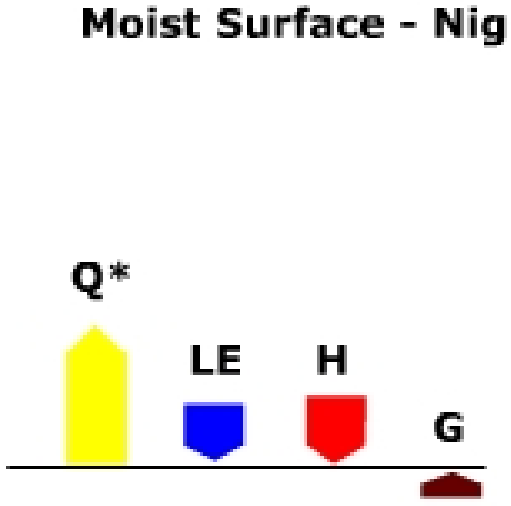
Balance energético en la capa límite

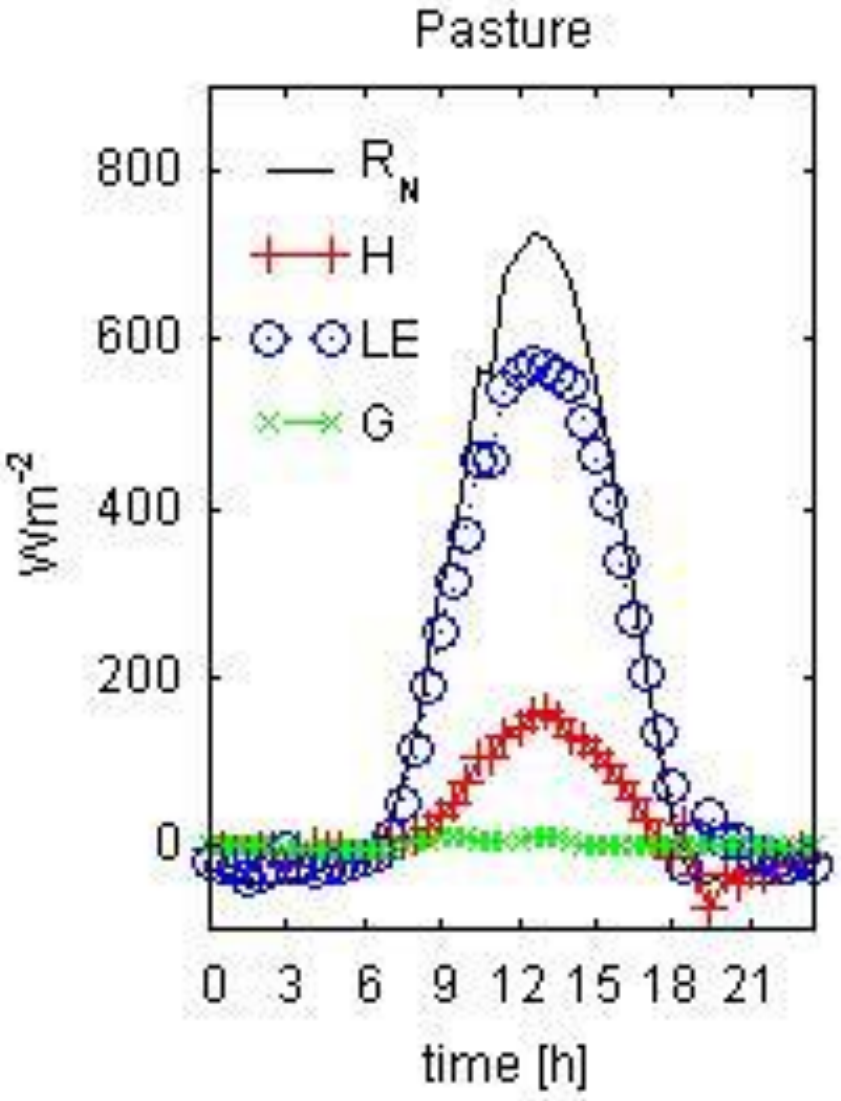


$$F^* = F_{Hs} + F_{Es} + F_{Gs}$$

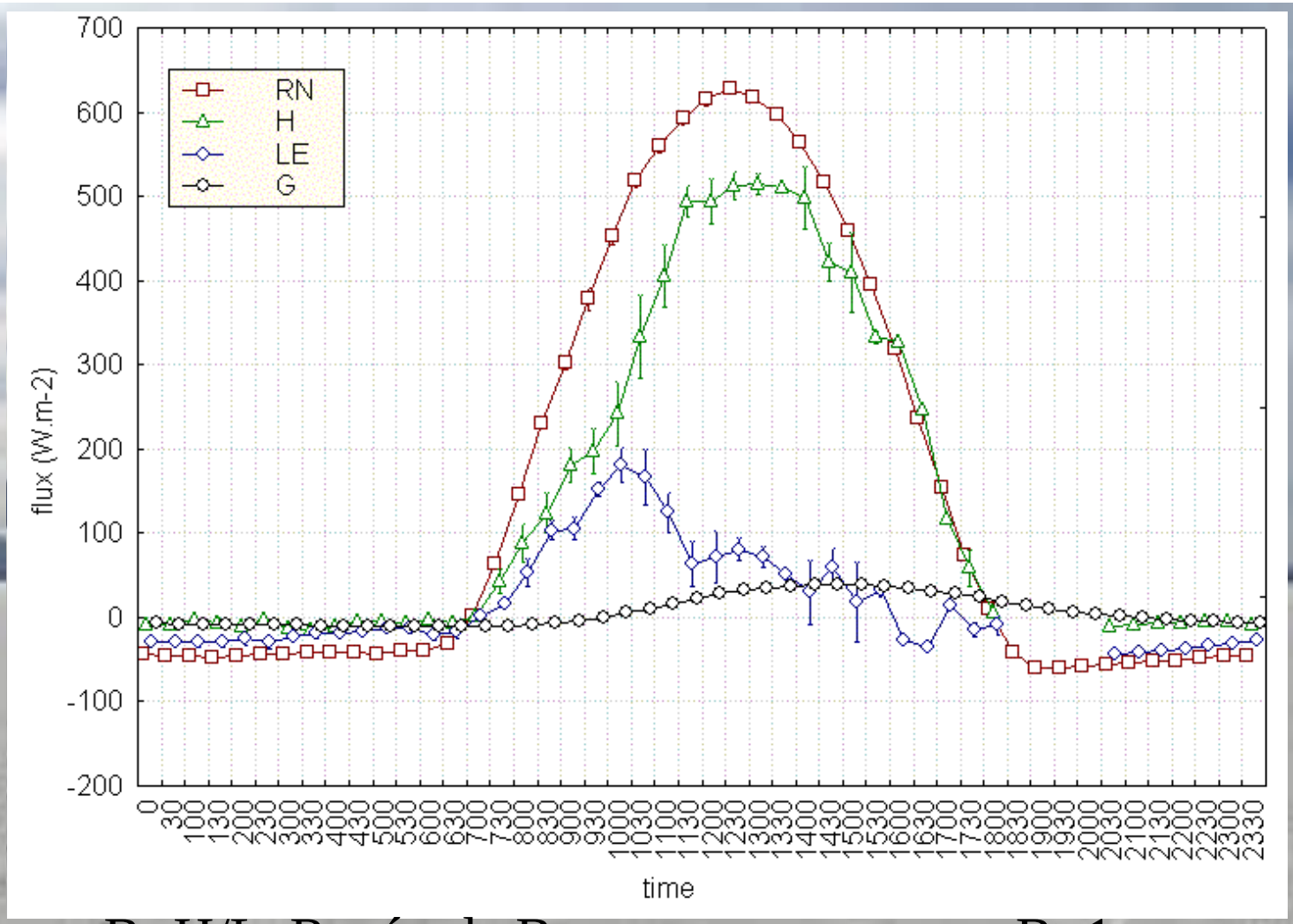
Los flujos cambian según la superficie y según la hora







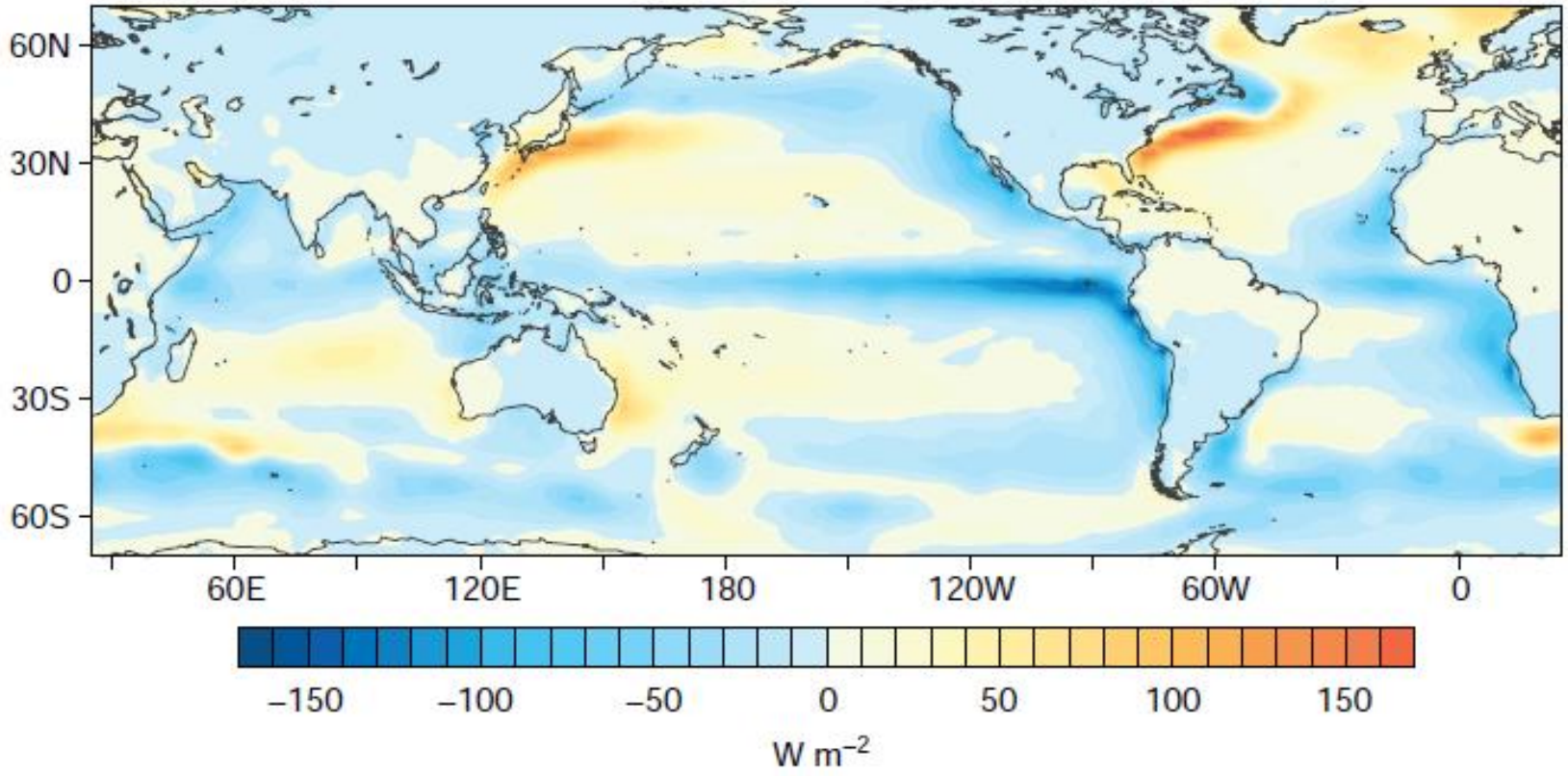
Balance de energía sobre un salar



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

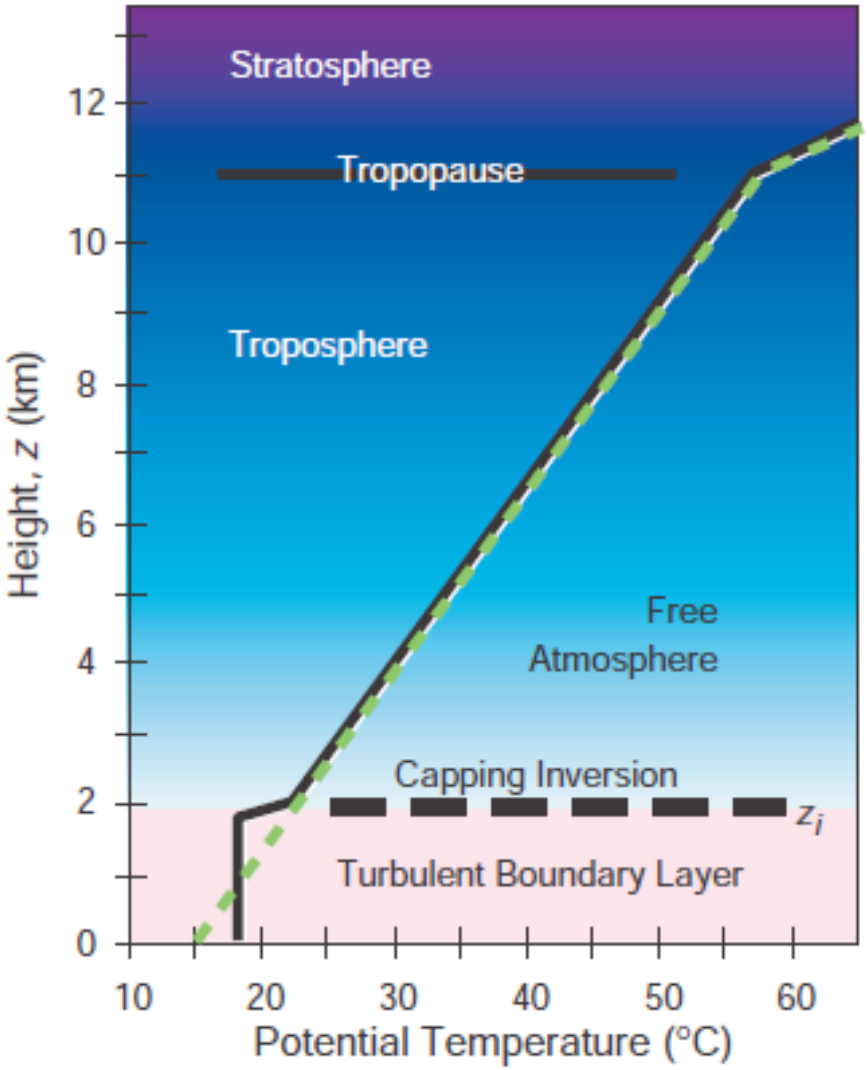
http://arts.monash.edu.au/ges/research/climate/glex/

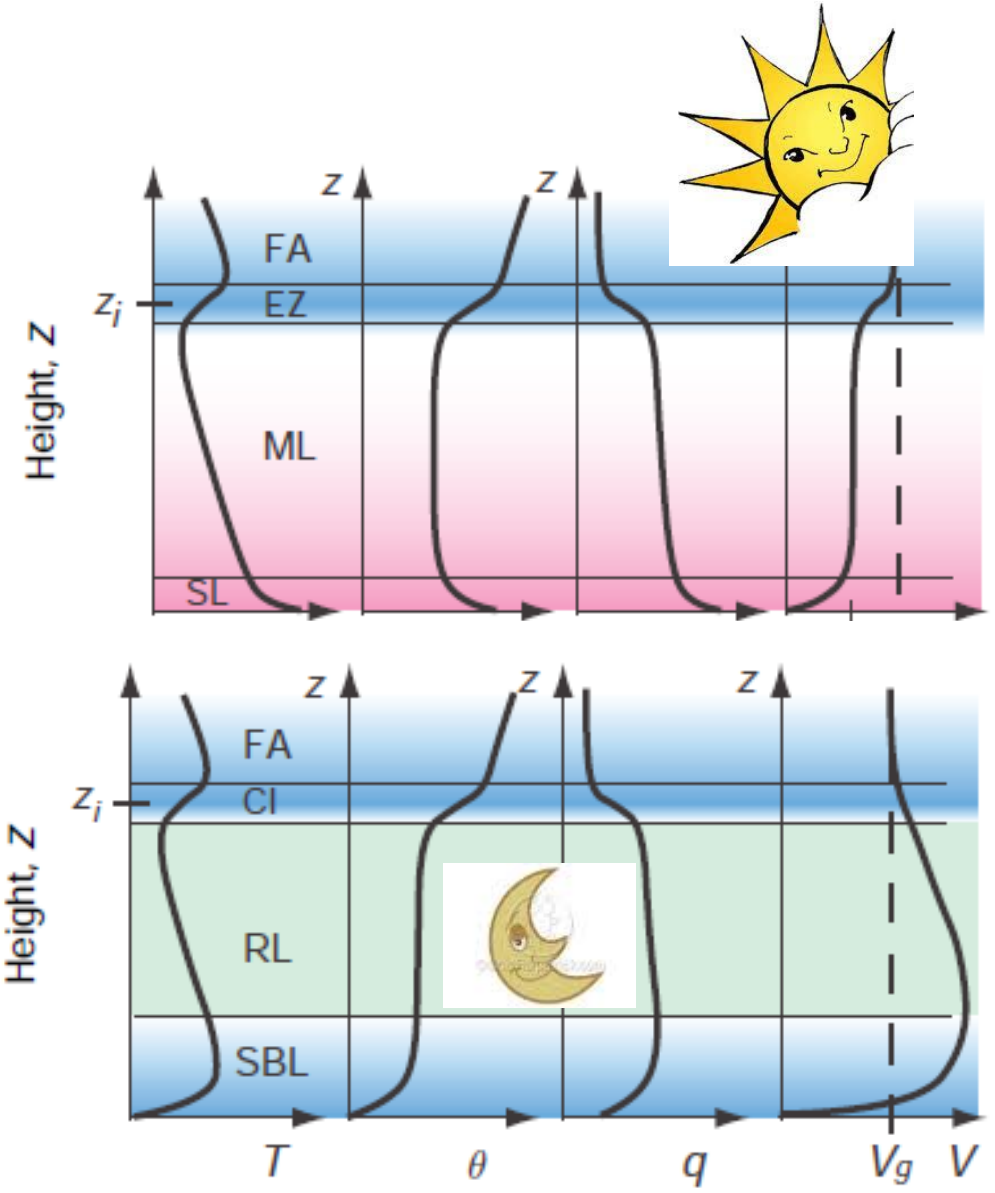
Globalmente



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

El efecto NO es sólo superficial

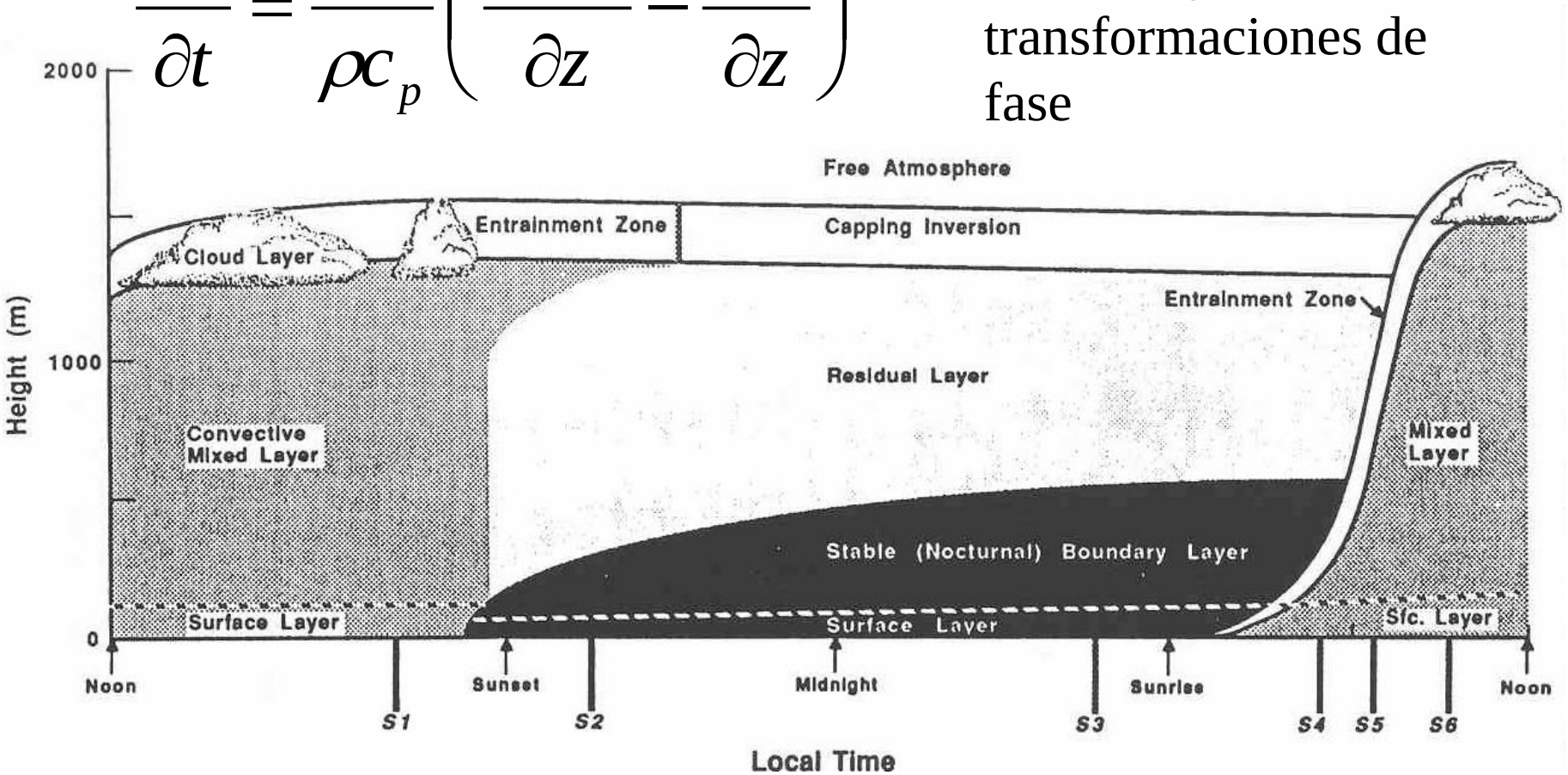




Evolución típica de la capa límite (día despejado, seco de verano)

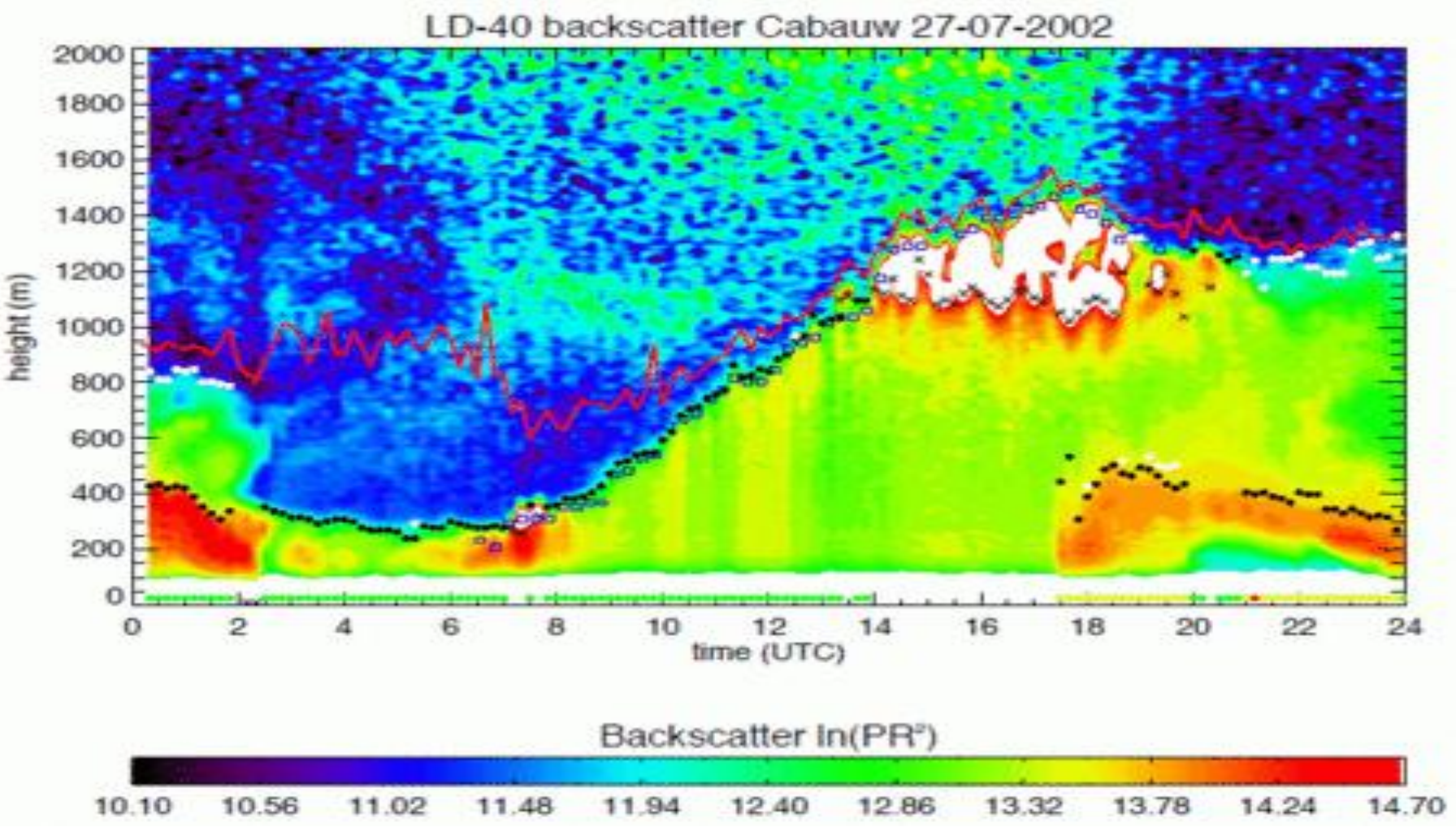
$$\frac{\partial T}{\partial t} = \frac{1}{\rho c_p}\left(\frac{\partial RN}{\partial z} - \frac{\partial H}{\partial z}\right)$$

Si NO hay transformaciones de fase



Stull, 1988

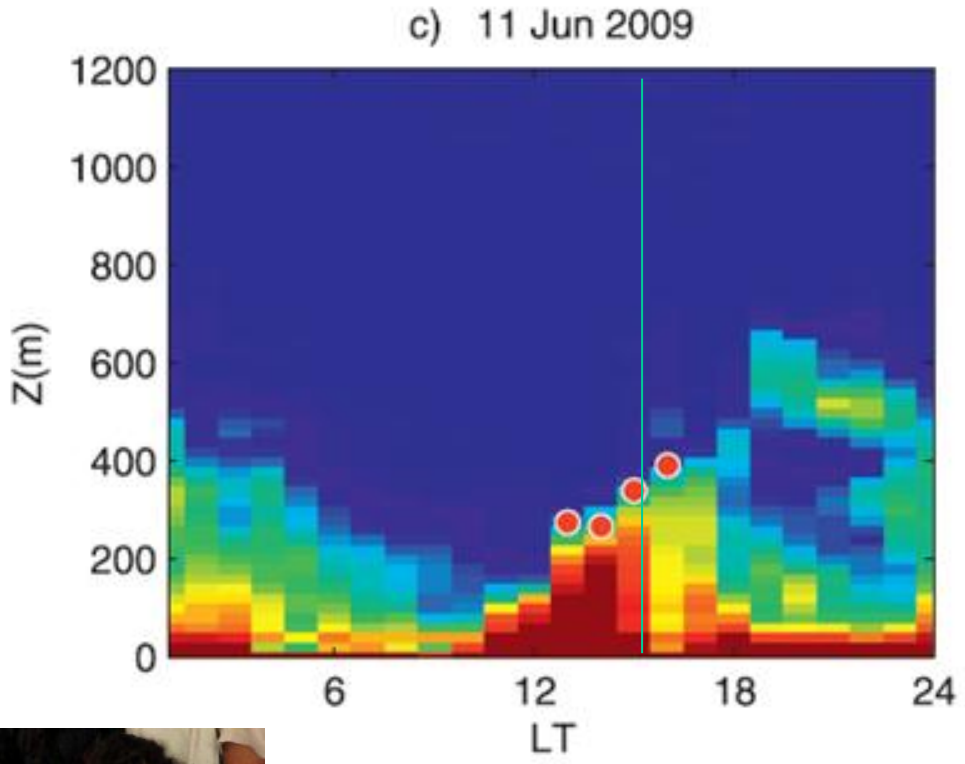
Y es verdad...

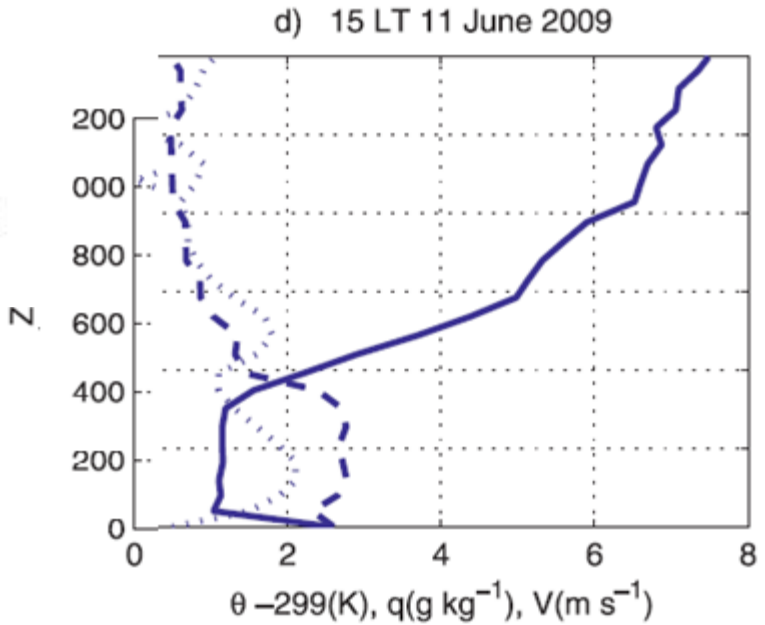


LGK 2010

http://www.knmi.nl/cms/content/84629/determination_of_the_mixing_layer_height_from_ceilometer_backscatter_profiles

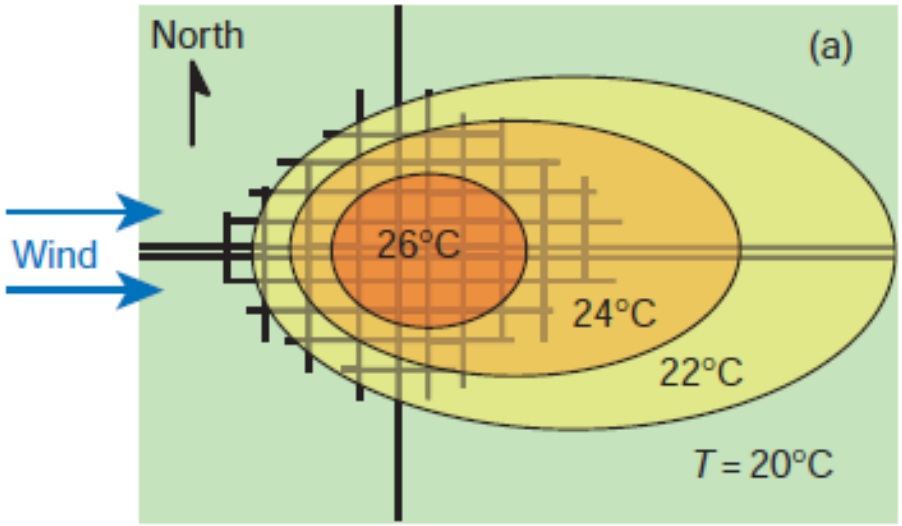
Y también aquí...usando un nefobasímetro

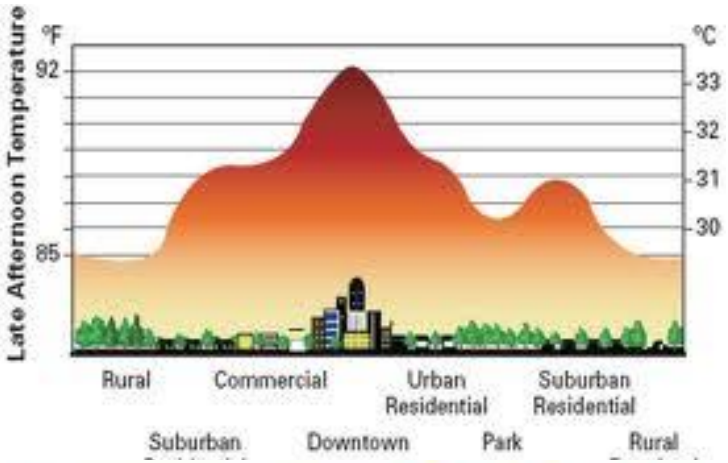


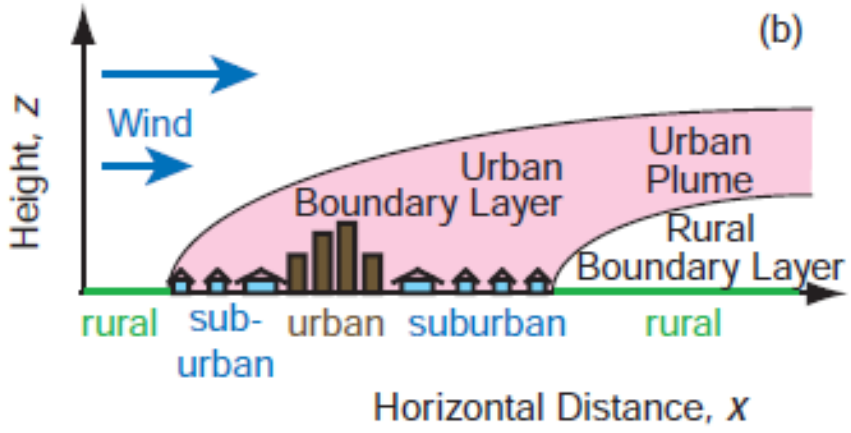


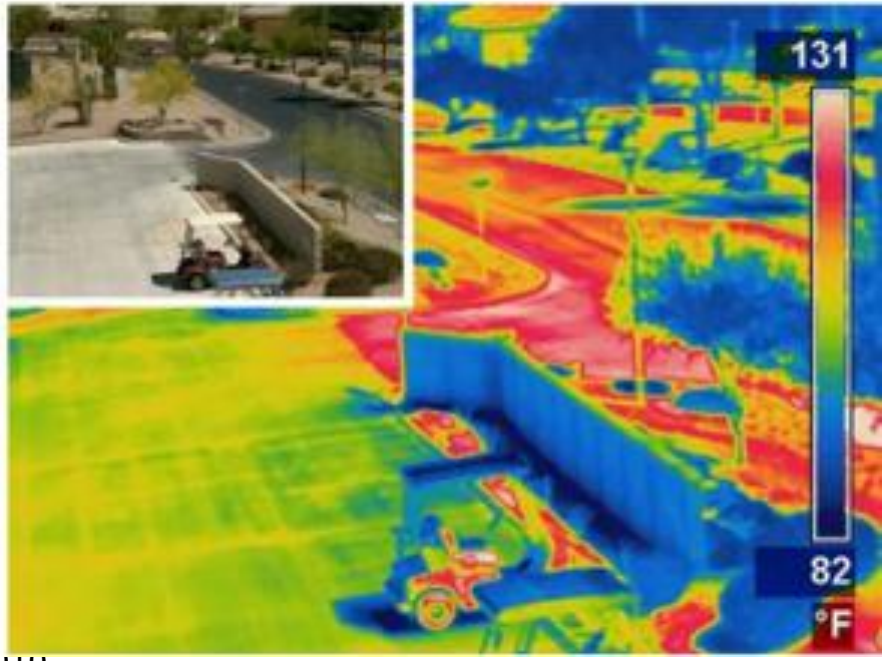
Muñoz & Undurraga, 2010 (JAM)

Efectos urbanos: isla calórica

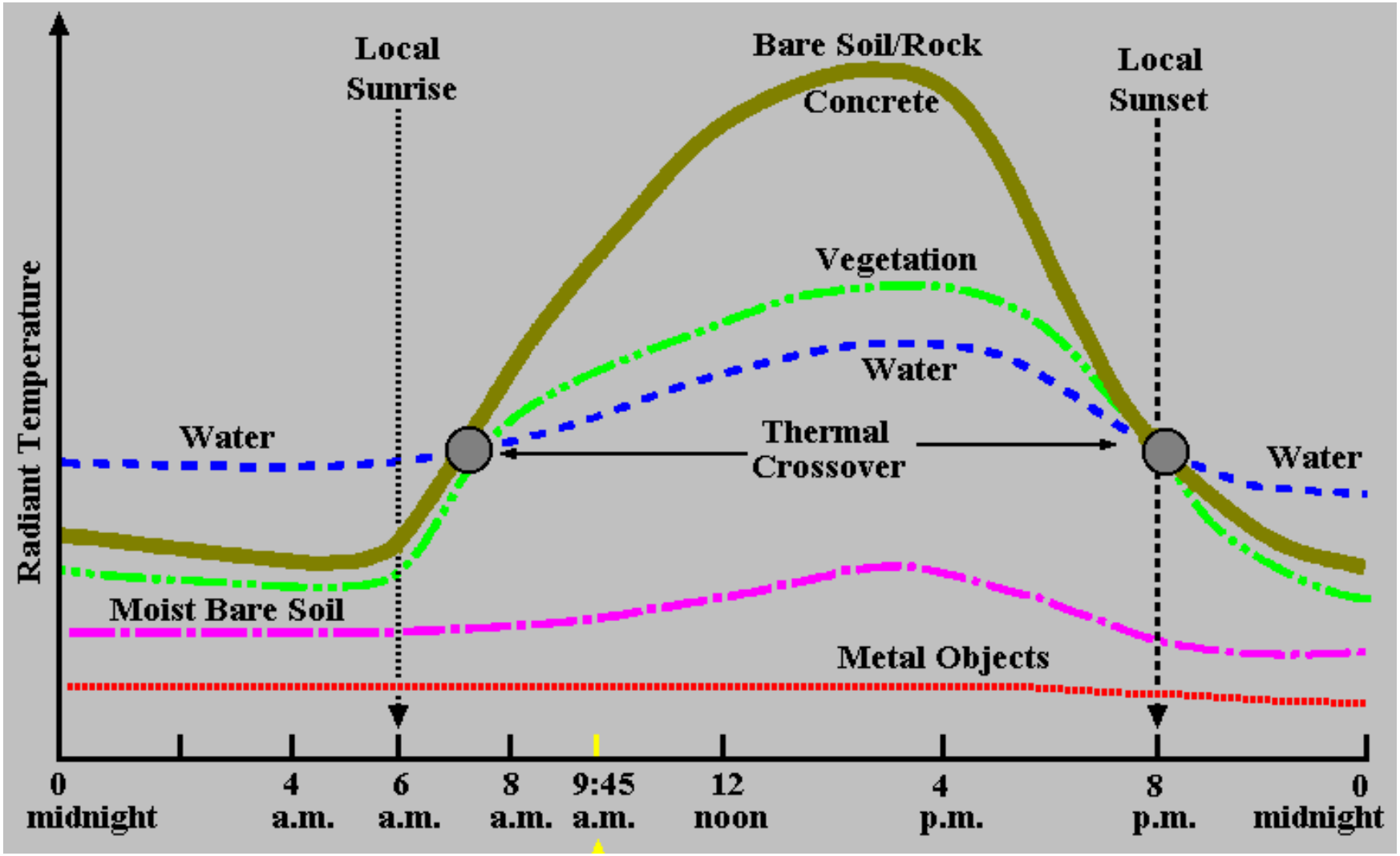








Hay que construir con cuidado...



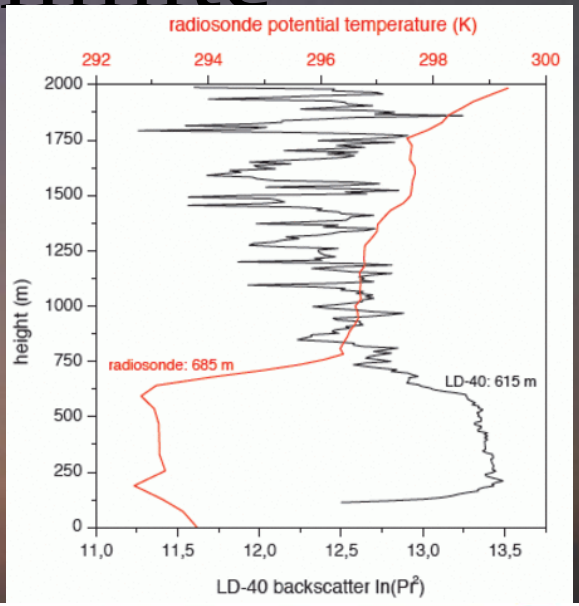
LGK 2010

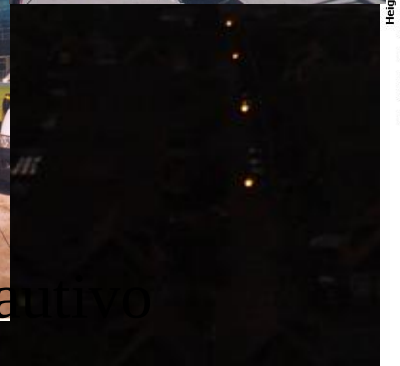
http://employees.oneonta.edu/baumanpr/geosat2/Urban_Heat_Island/Urban_Heat_Island_Part_I.htm

Observando la capa límite

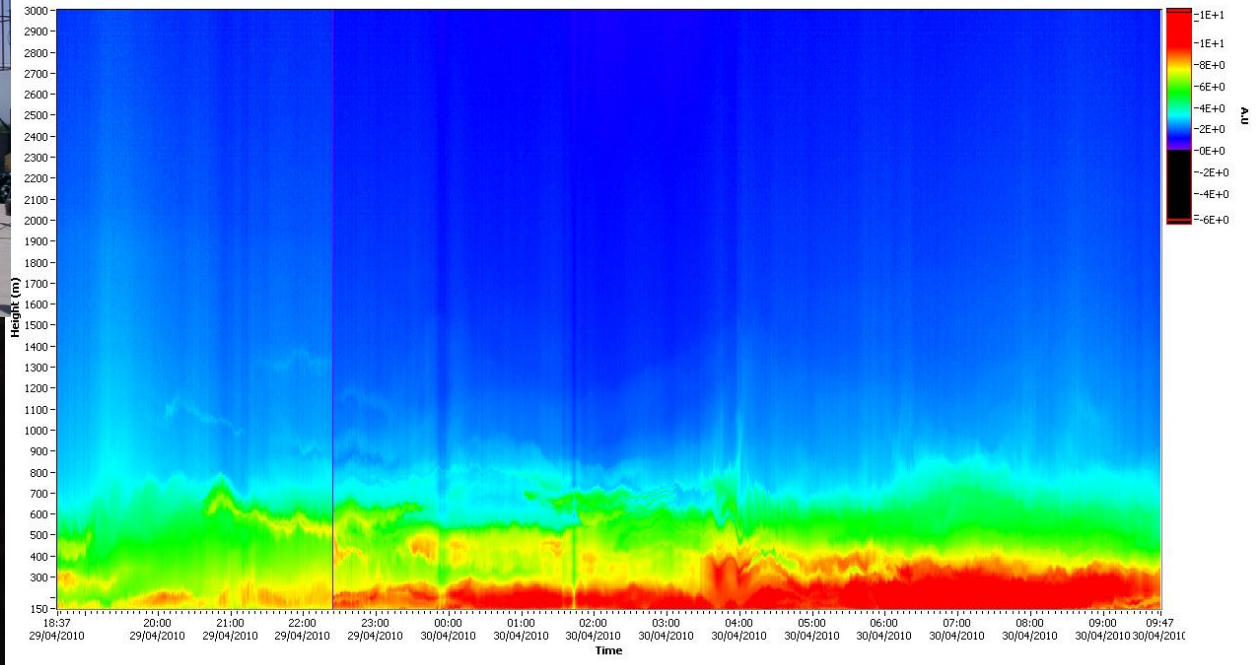
SODAR

Globo





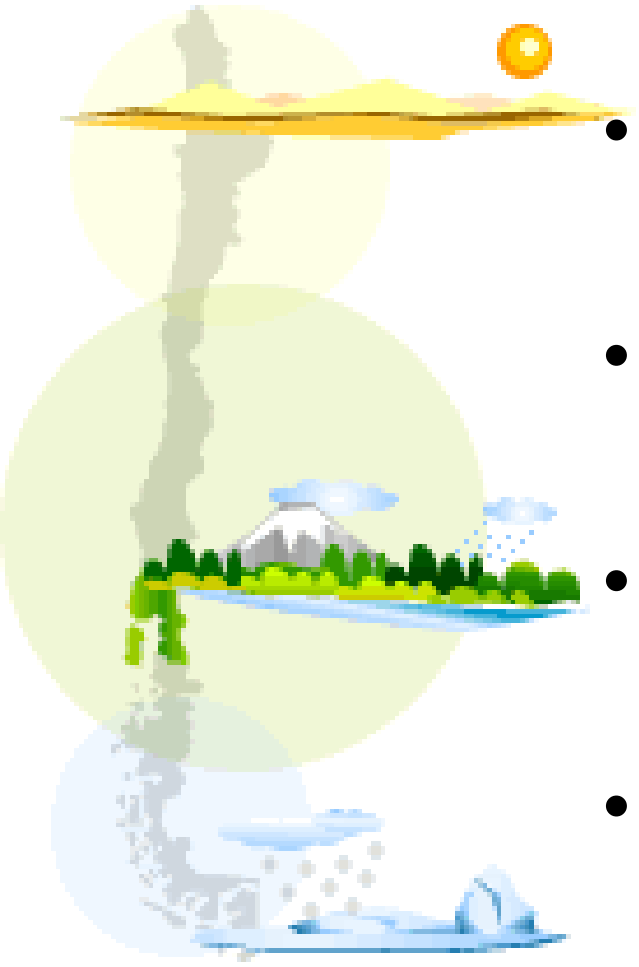
Globo cautivo



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?

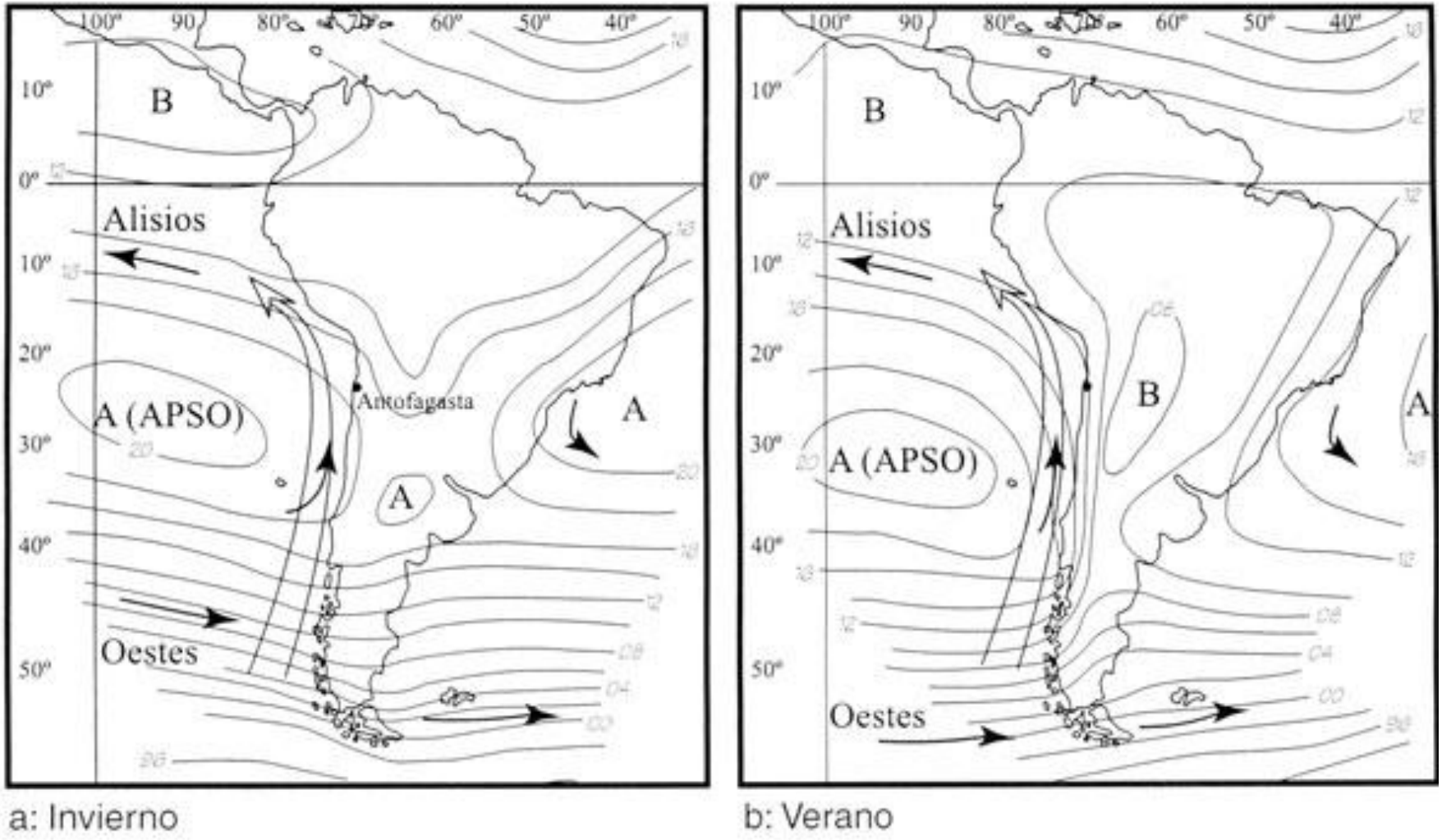



Completar en un texto de a lo más 200 palabras

- ....(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)...

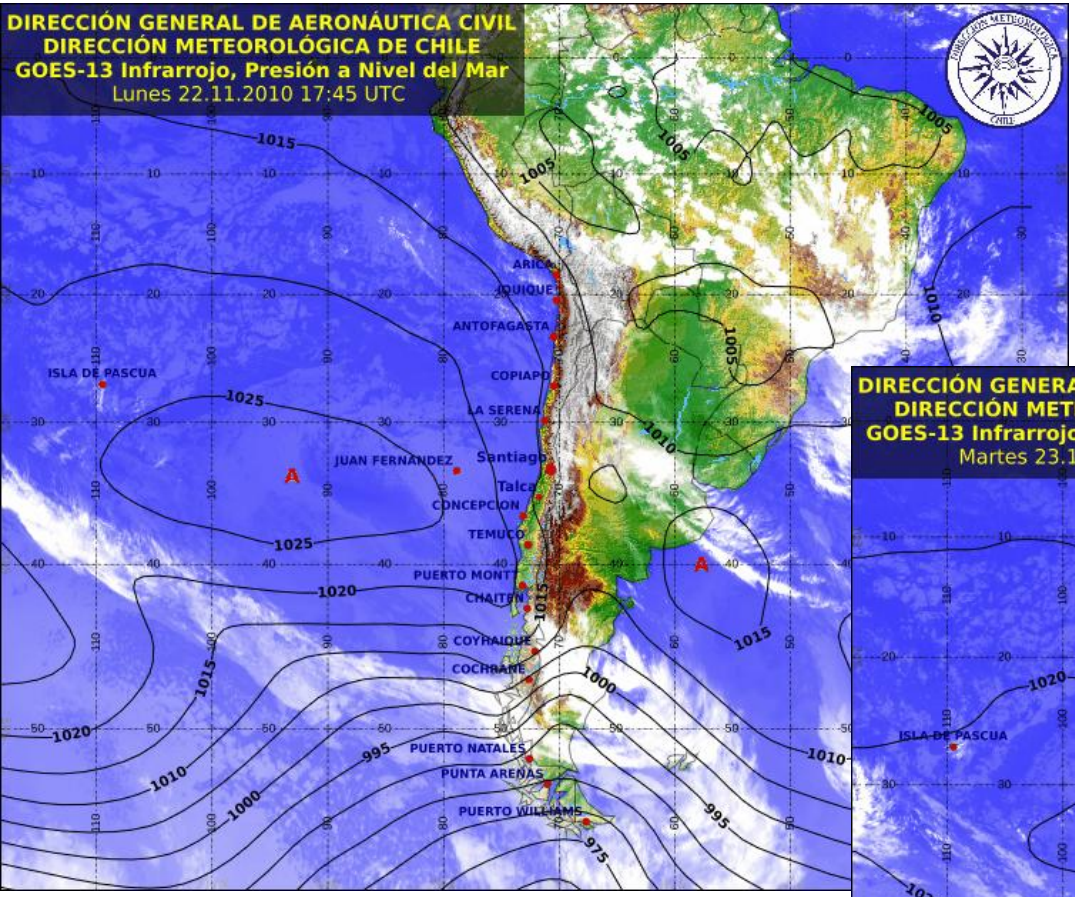
Análogo para las demás preguntas...

Condición característica



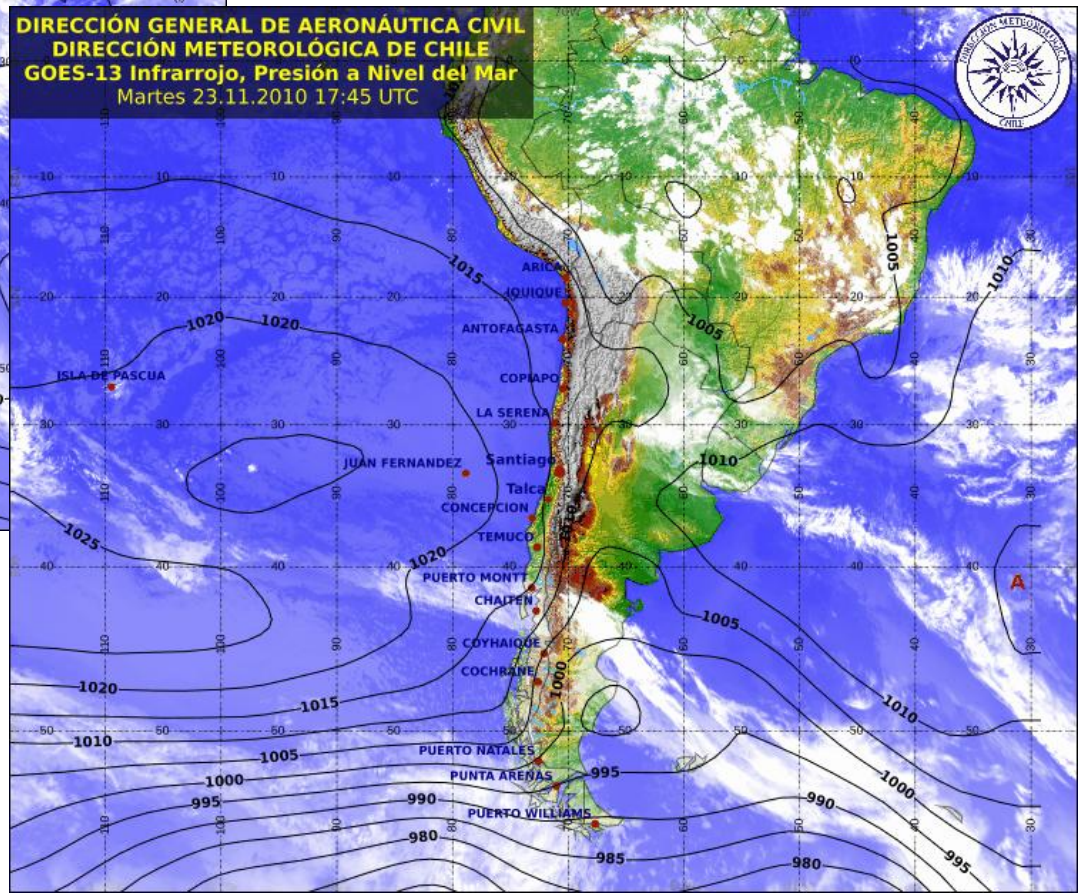
http://www.scielo.cl/scielo.php?pid=S0716-02082000000200002&script=sci_arttext

Carta sinóptica de superficie y nubosidad

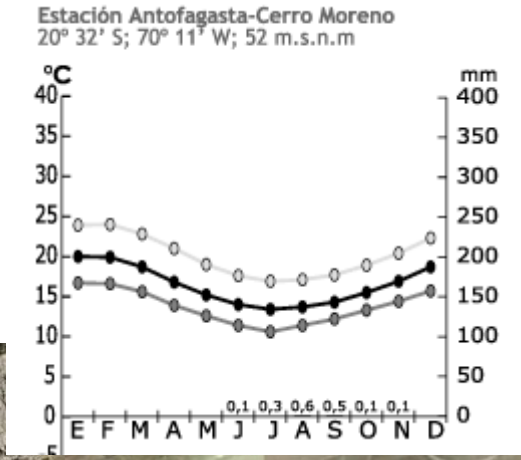


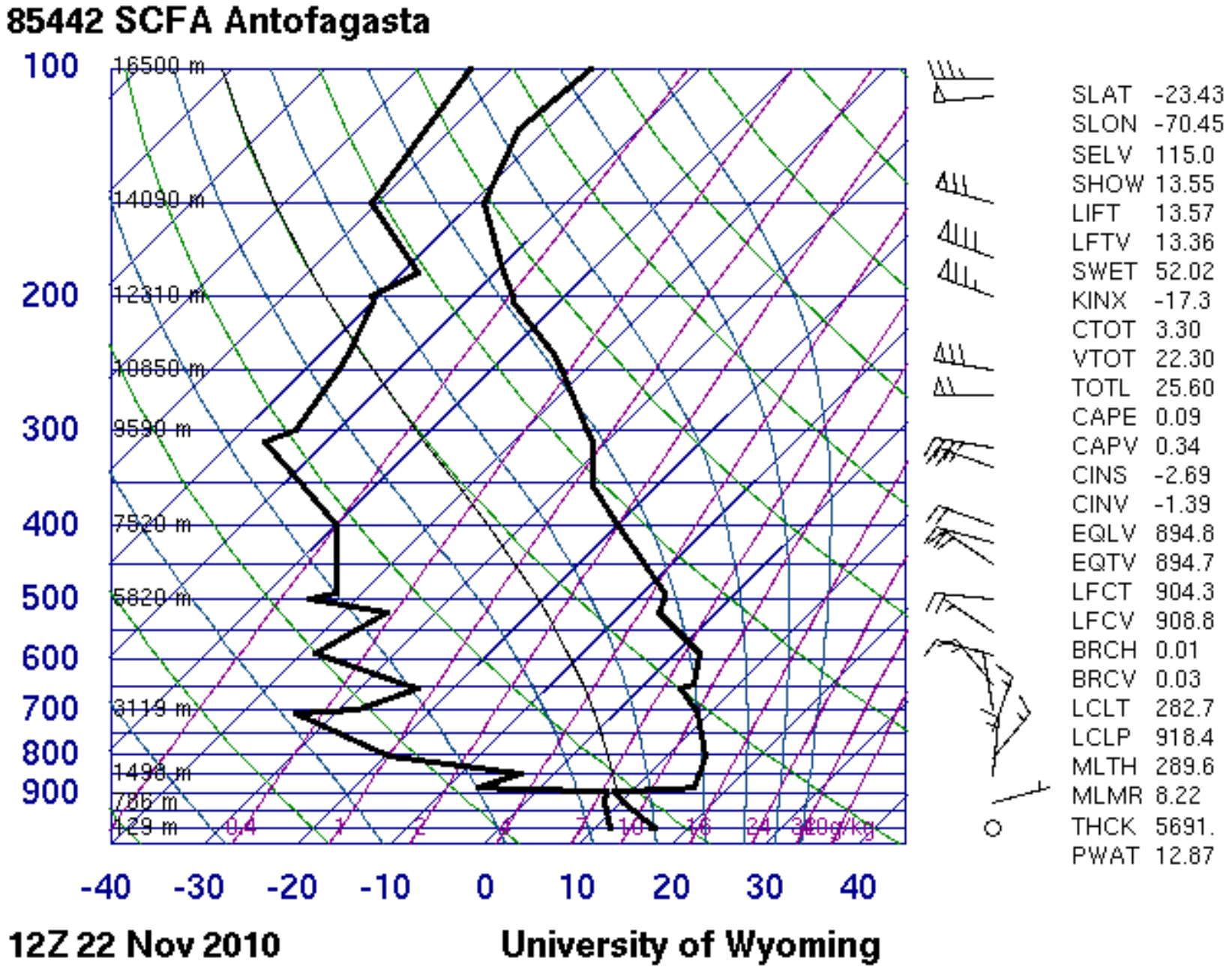
22/11 17:45 UTC

23/11 17:45 UTC



Antofagasta





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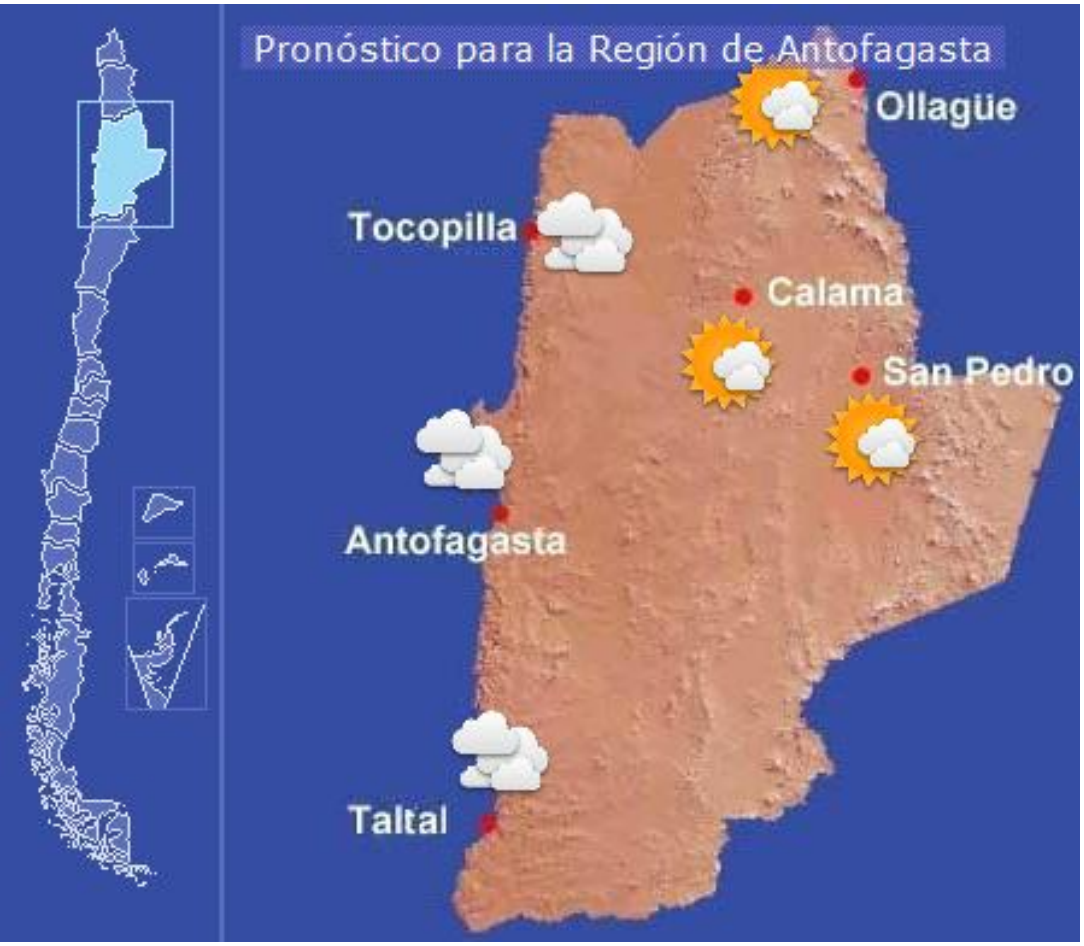
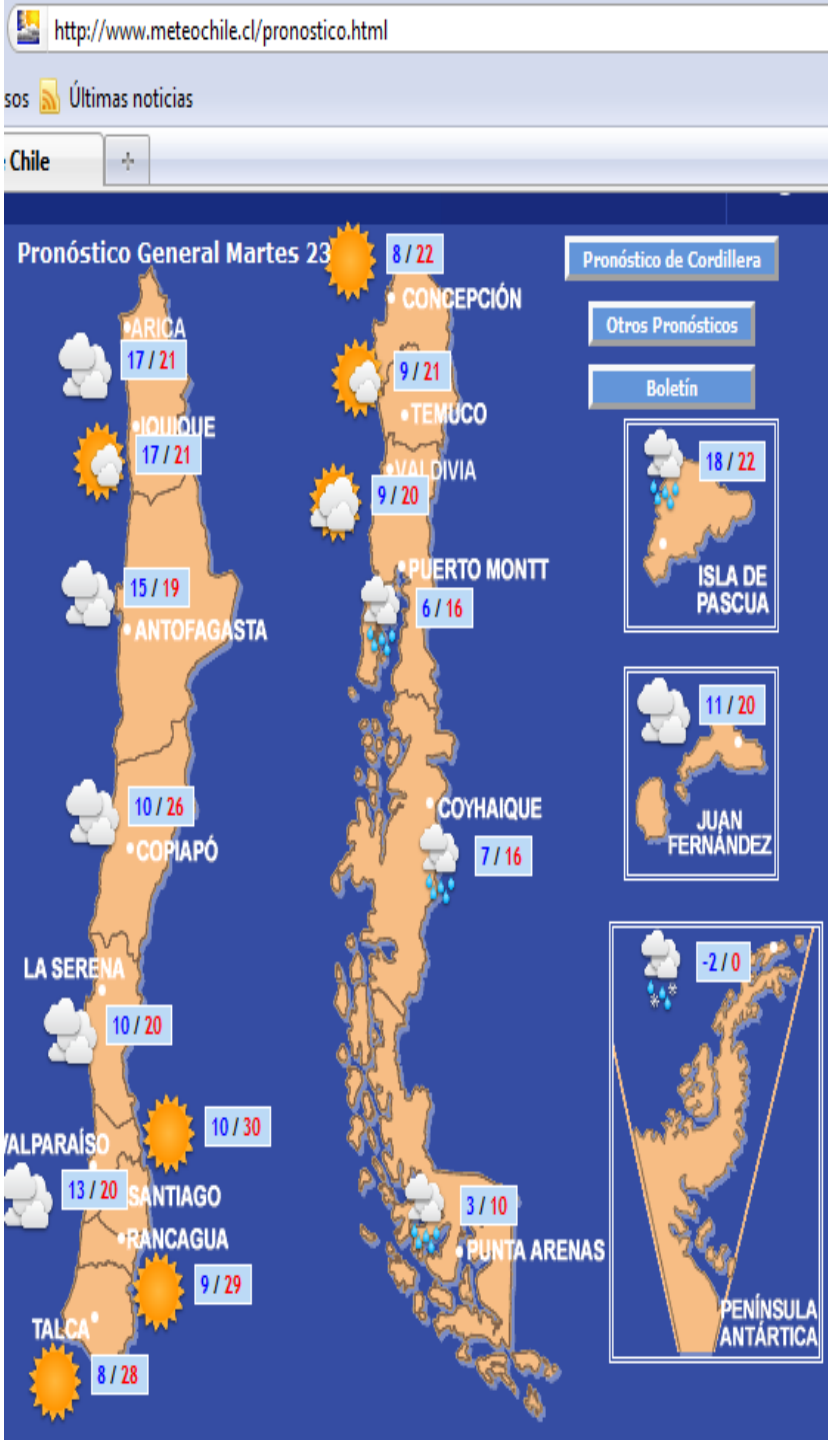
http://weather.uwyo.edu/upperair/sounding.html

Pronóstico DMC





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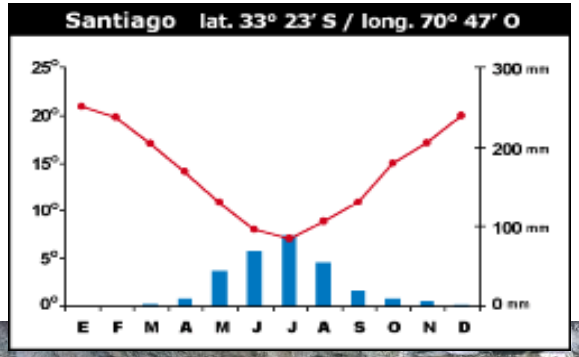
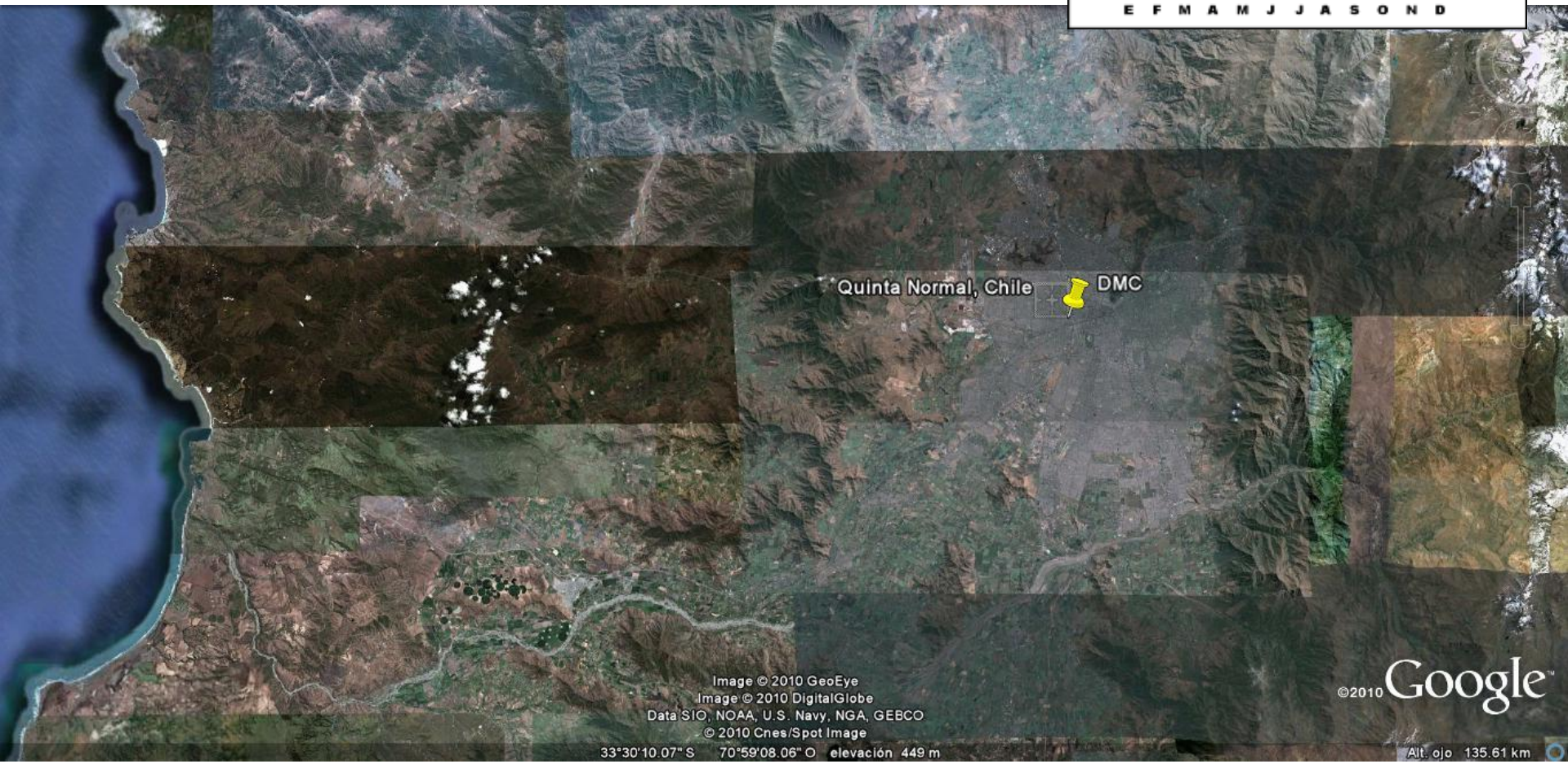
http://www.meteochile.cl/pronostico.html

Santiago





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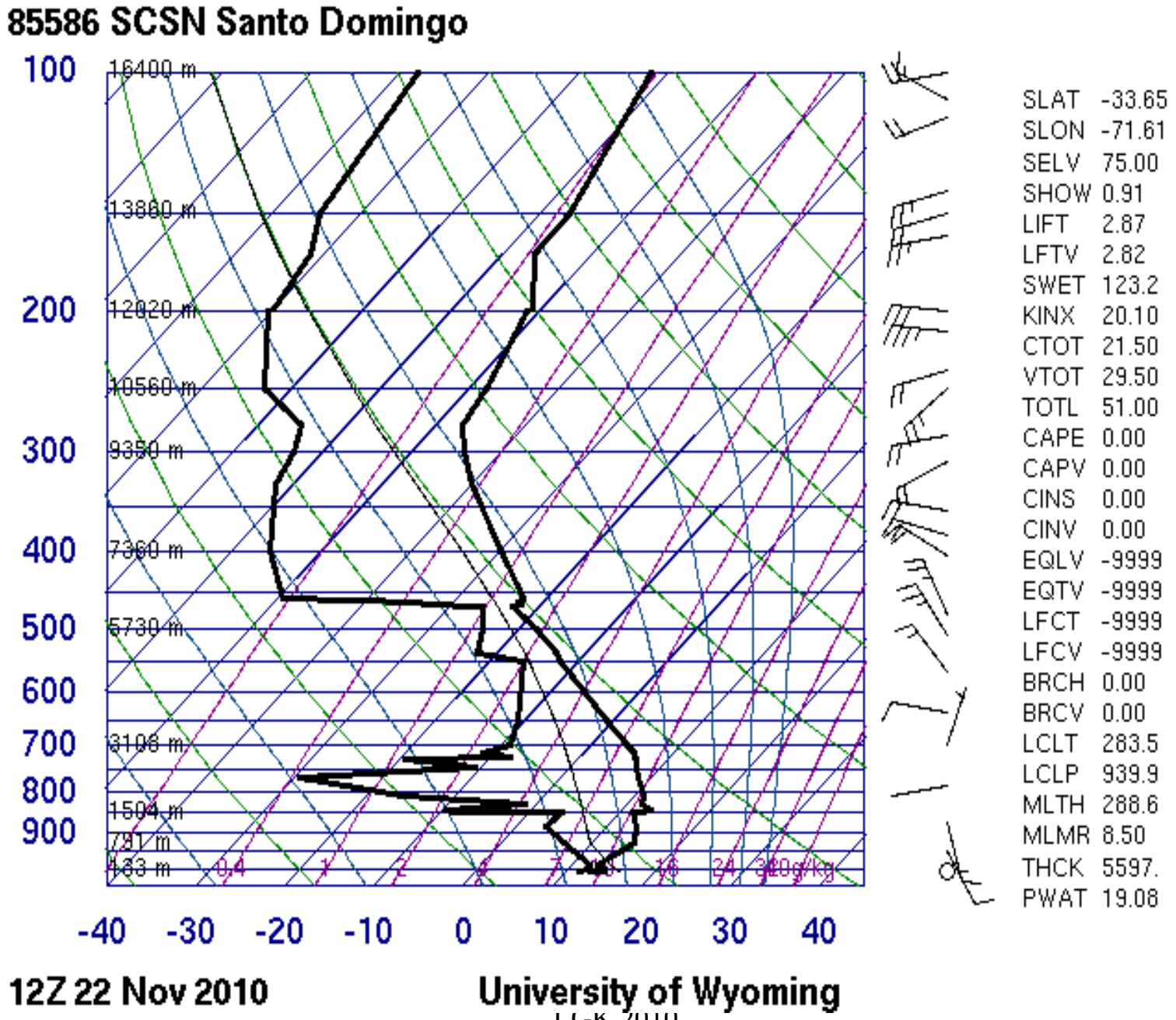
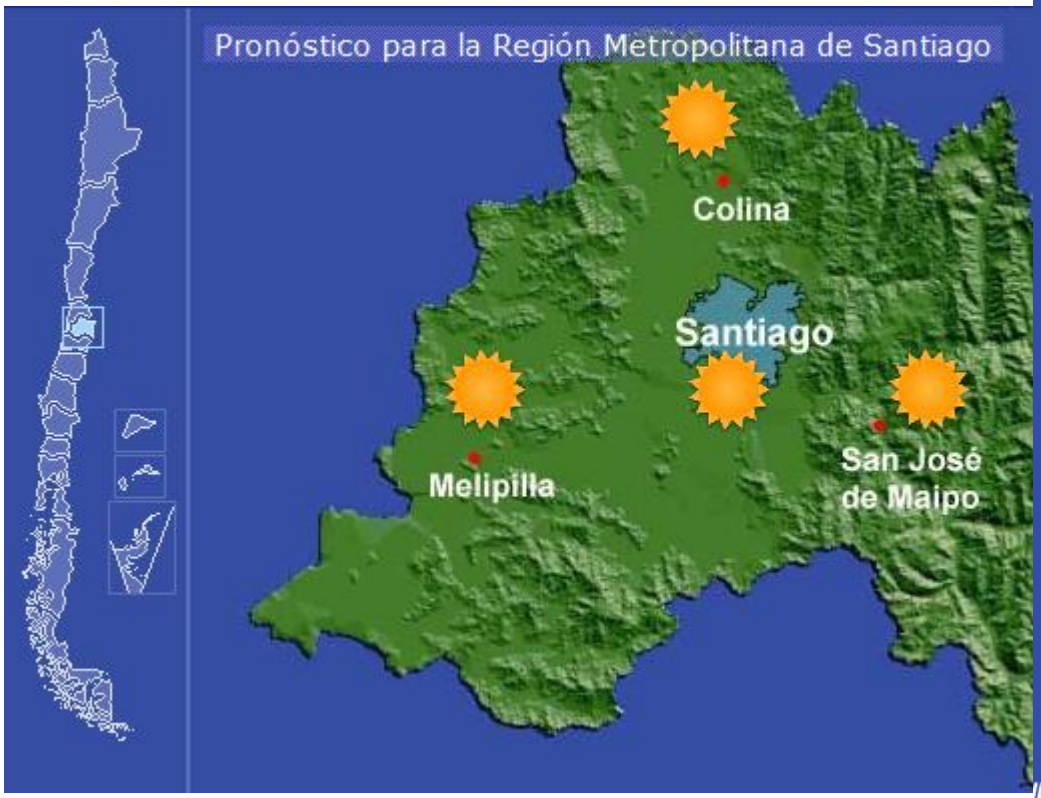
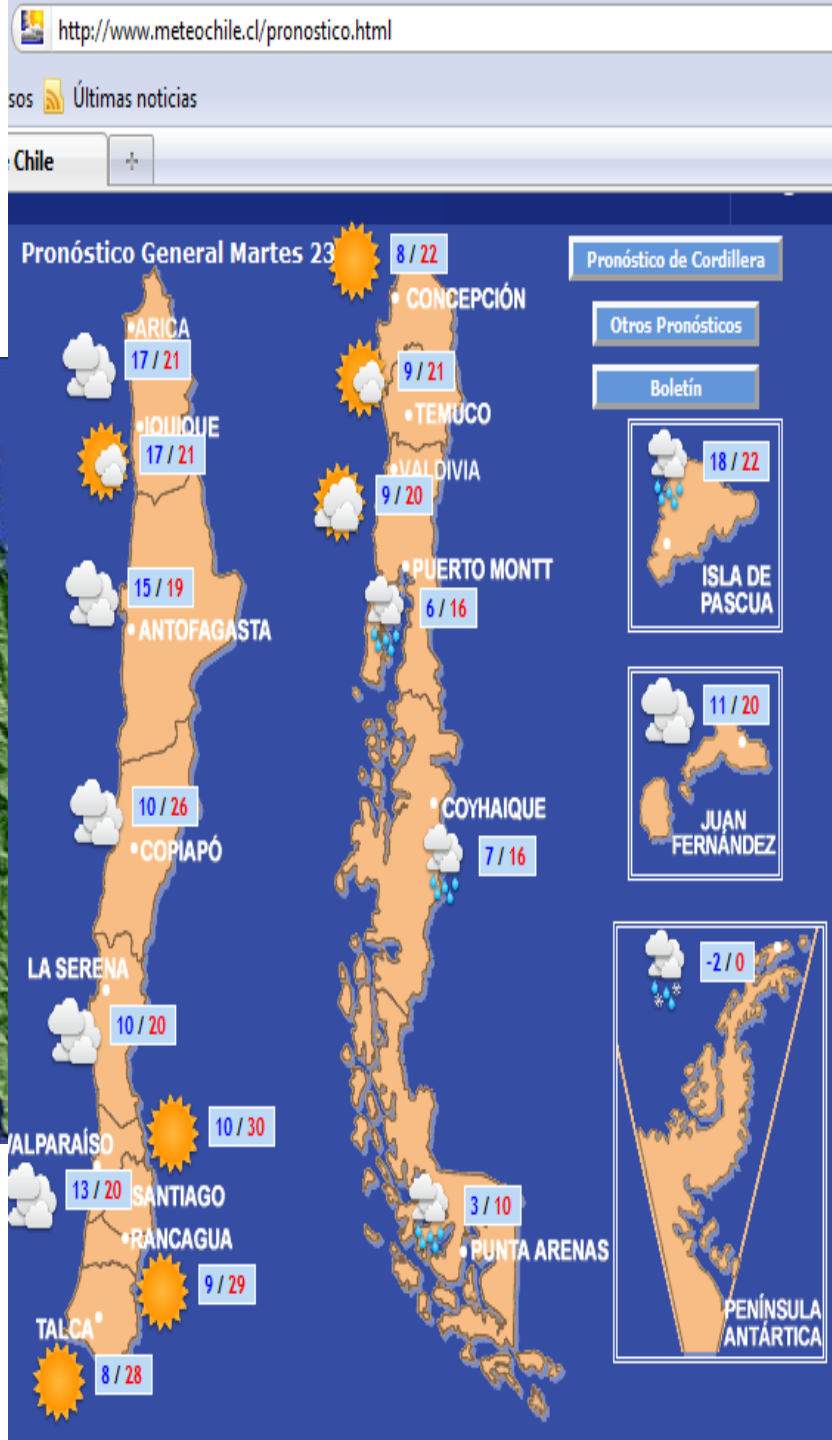
http://www.atmosfera.cl/HTML/climatologia/climadechile/tempyprec.htm



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

Pronóstico DMC

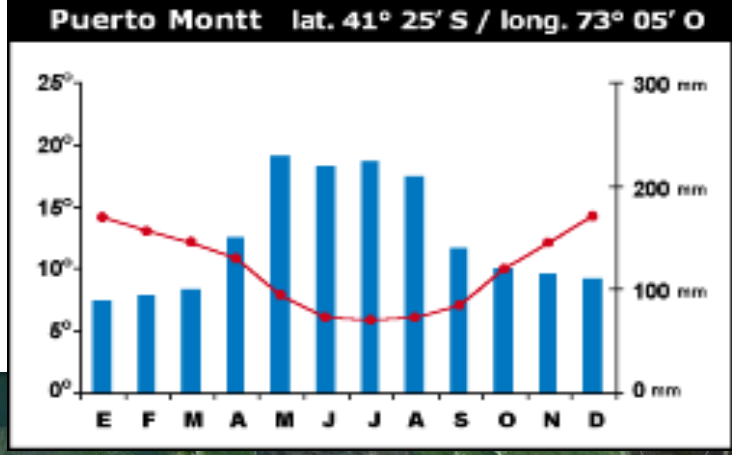


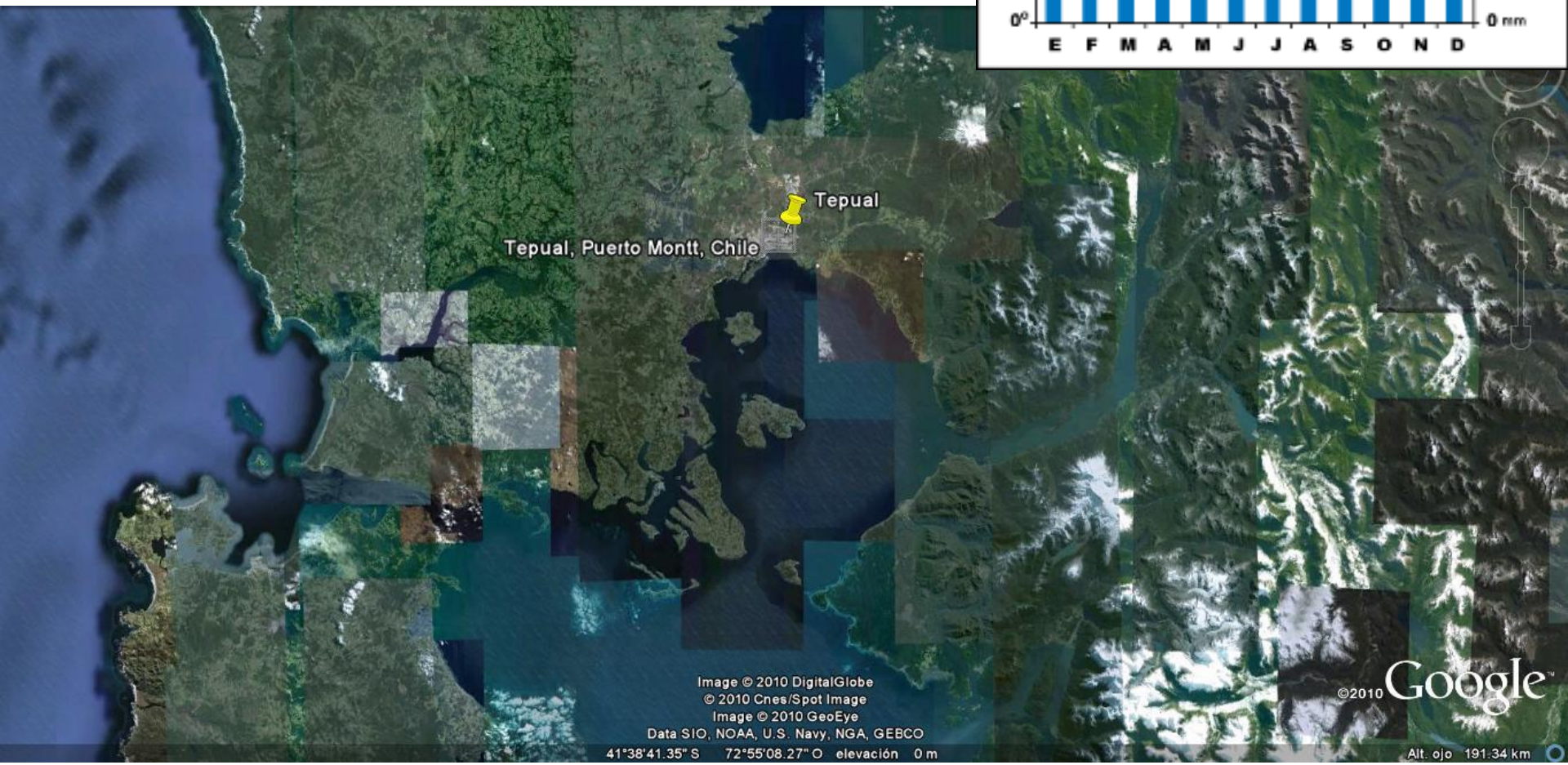


LGK 2010

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

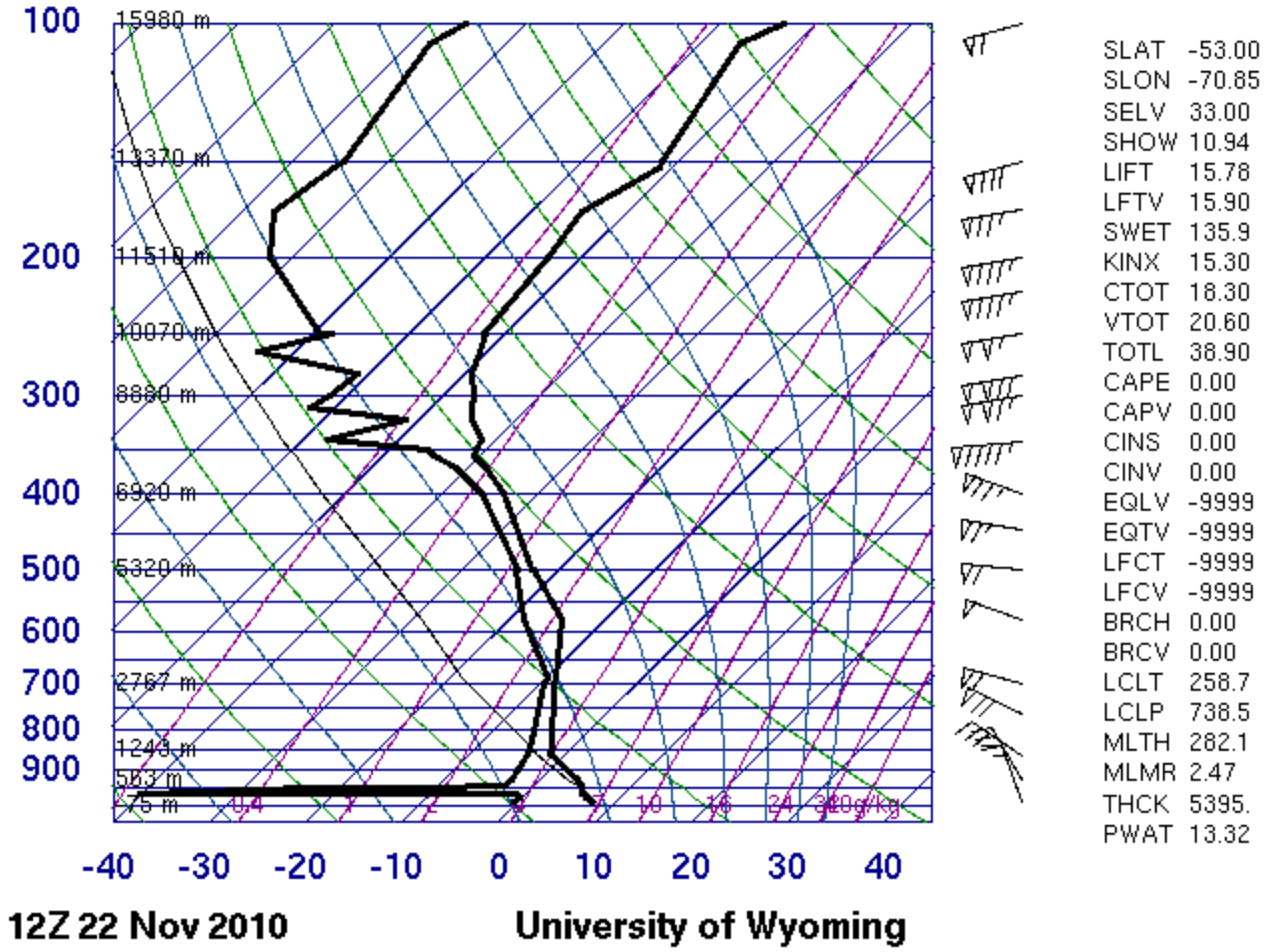
Puerto Montt





LGK 2010

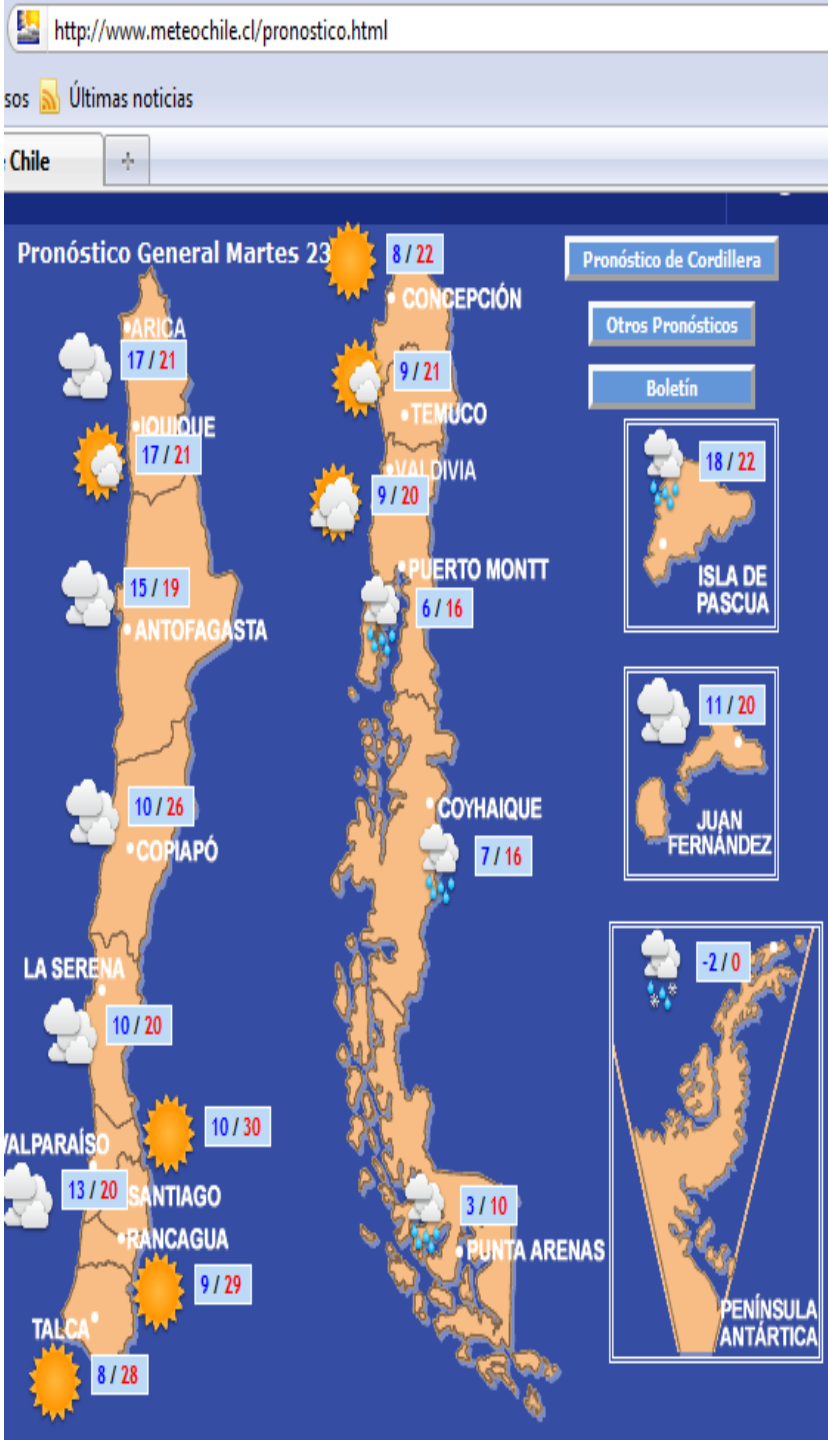
http://www.atmosfera.cl/HTML/climatologia/climadechile/tempyprec.htm



LGK 2010

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

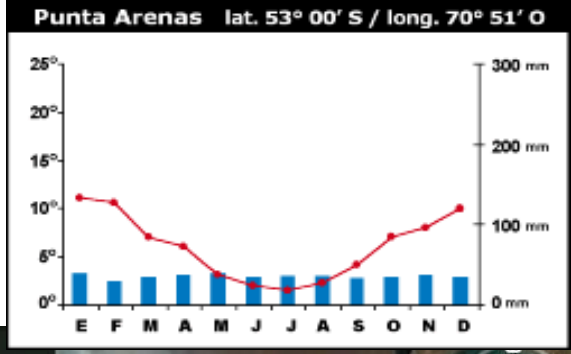
Pronóstico DMC

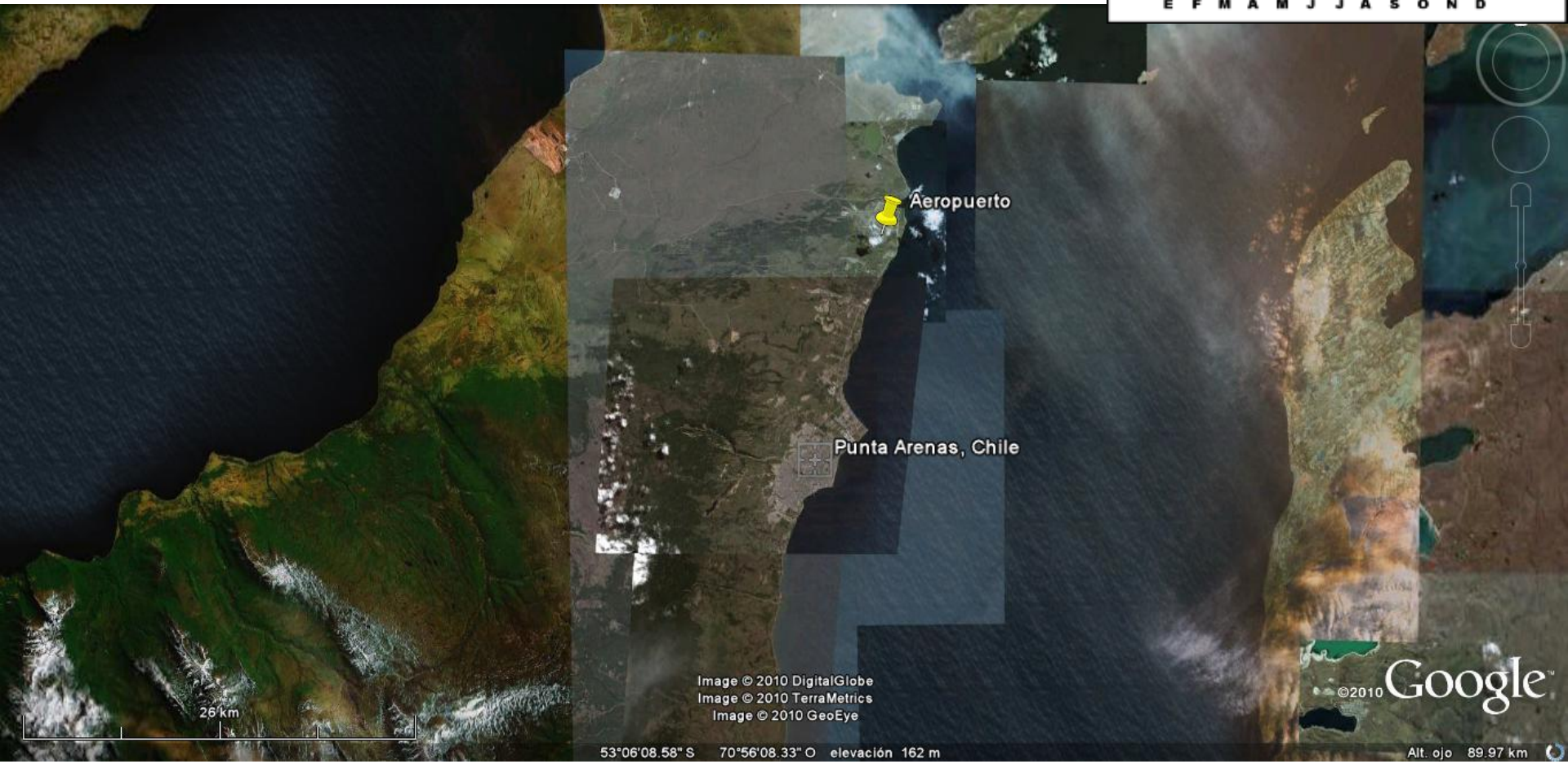


LGK 2010

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

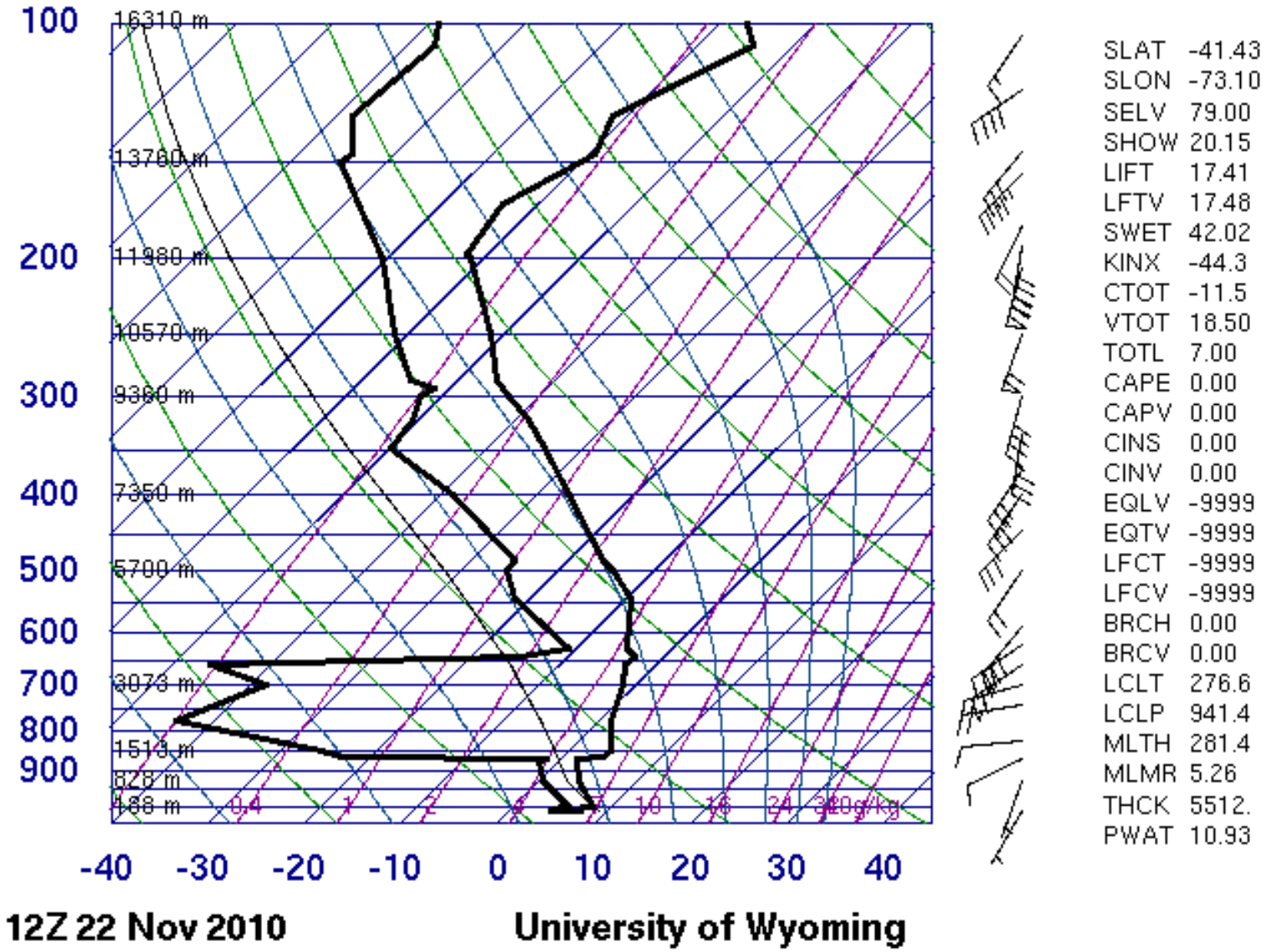
Punta Arenas





LGK 2010

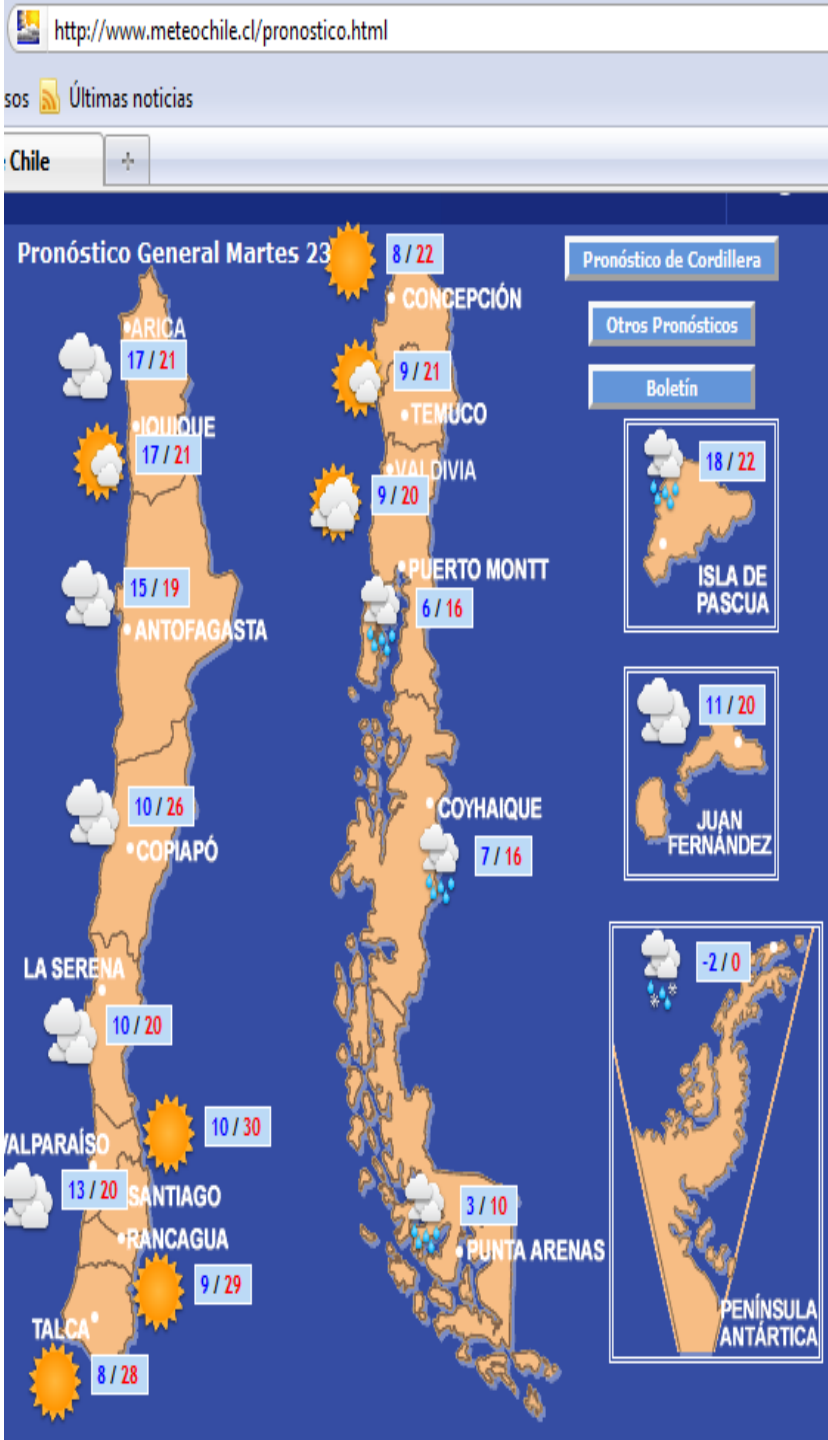
http://www.atmosfera.cl/HTML/climatologia/climadechile/tempyprec.htm



LGK 2010

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

Pronóstico DMC

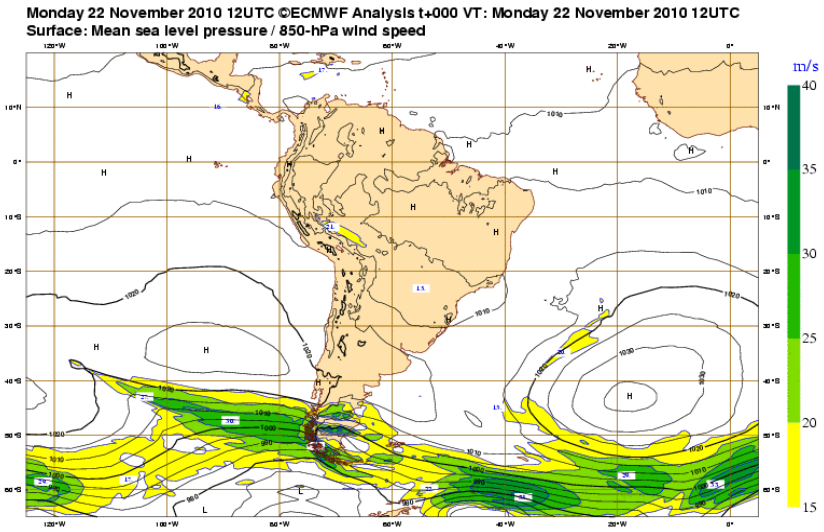


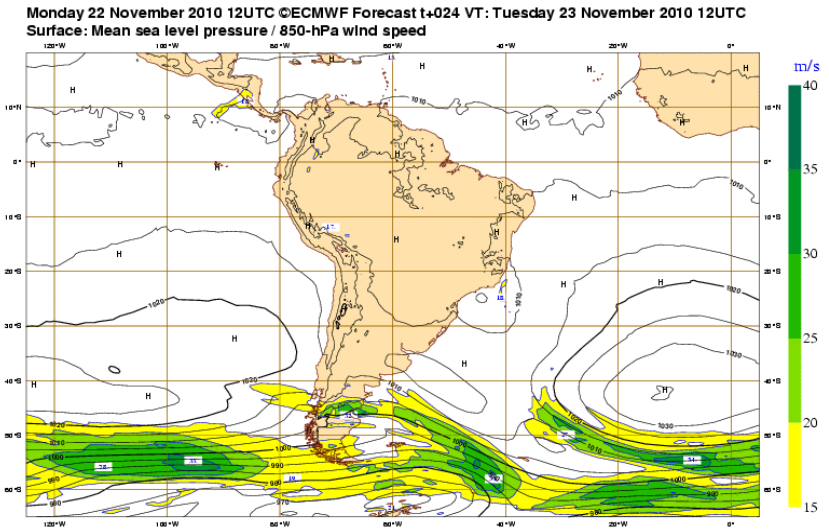
LGK 2010

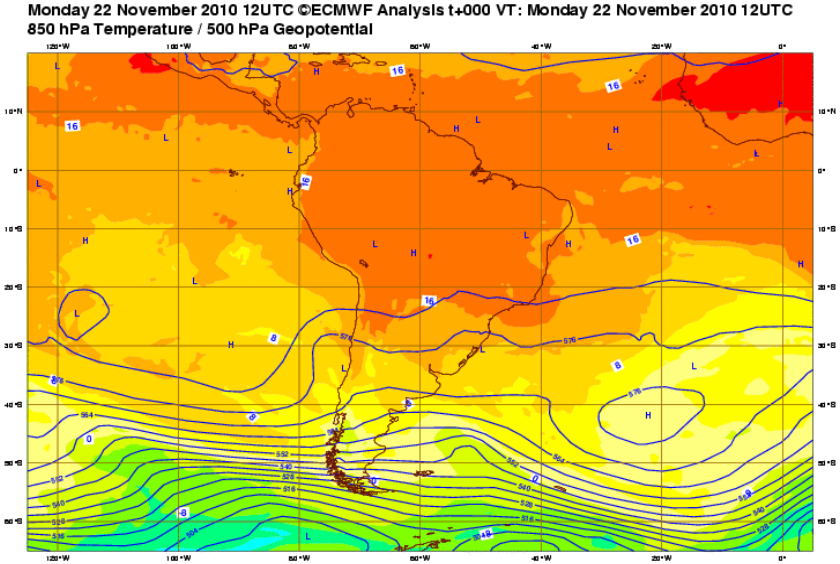
http://www.meteochile.cl/pronostico.html

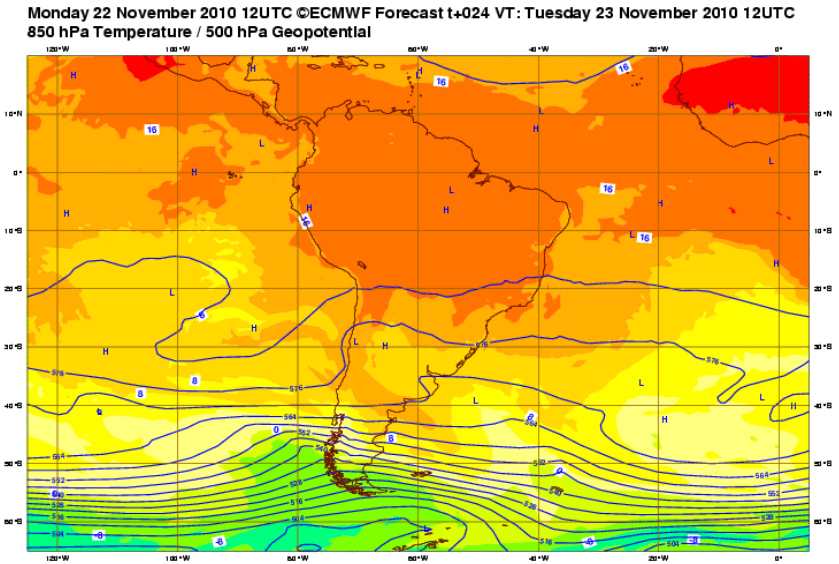
Análisis ECMWF (22/11)

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



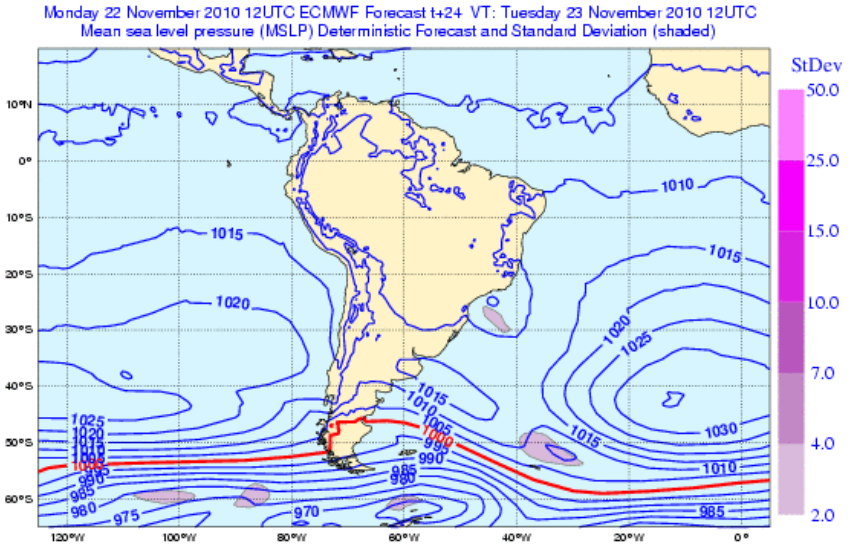


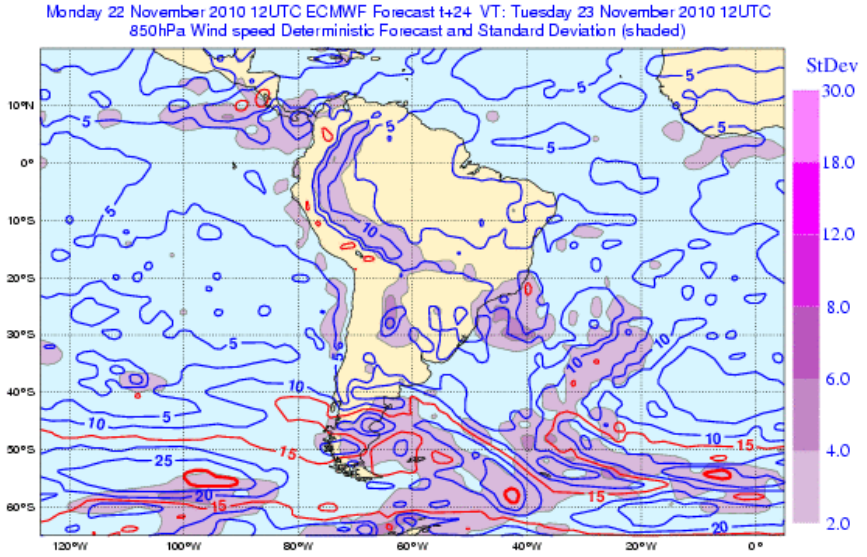


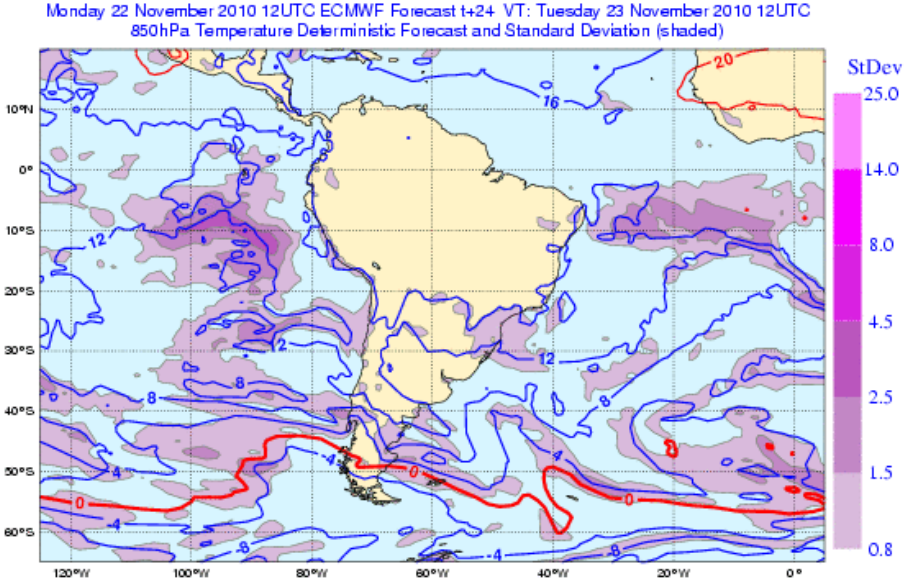


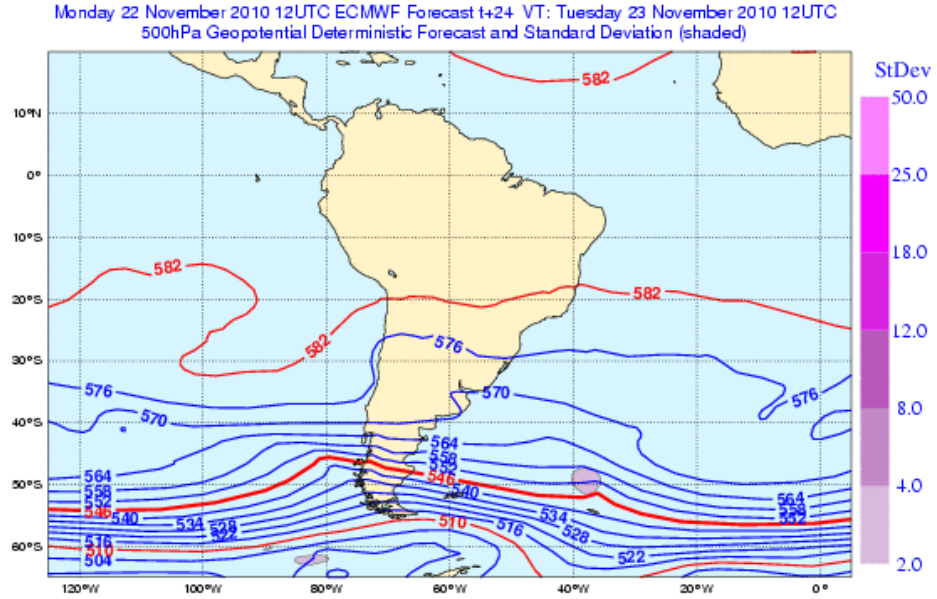
Pronóstico ECMWF

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










That's all Folks!

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