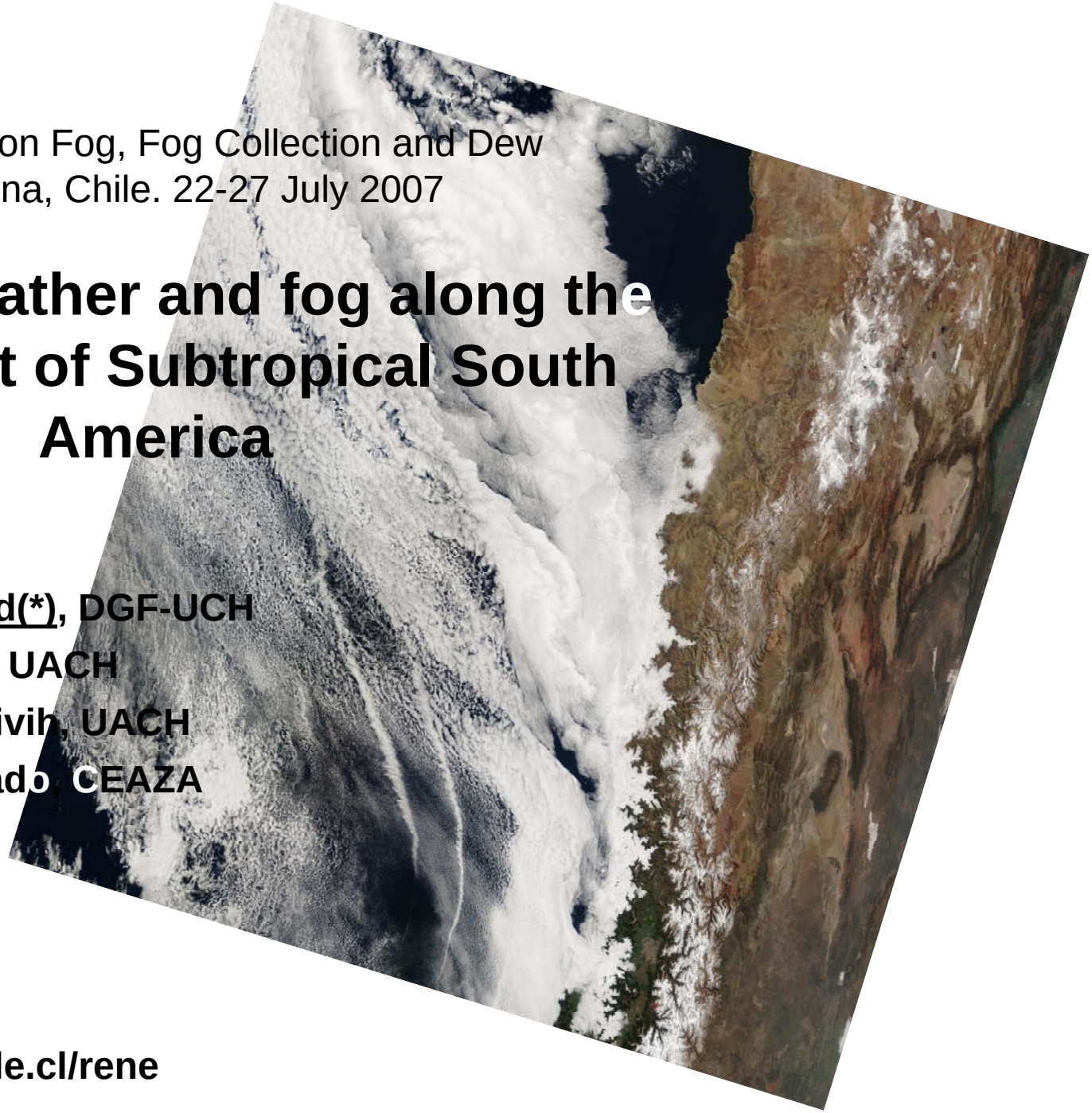
4th Int. Conf. on Fog, Fog Collection and Dew
La Serena, Chile. 22-27 July 2007

Climate, Weather and fog along the West Coast of Subtropical South America



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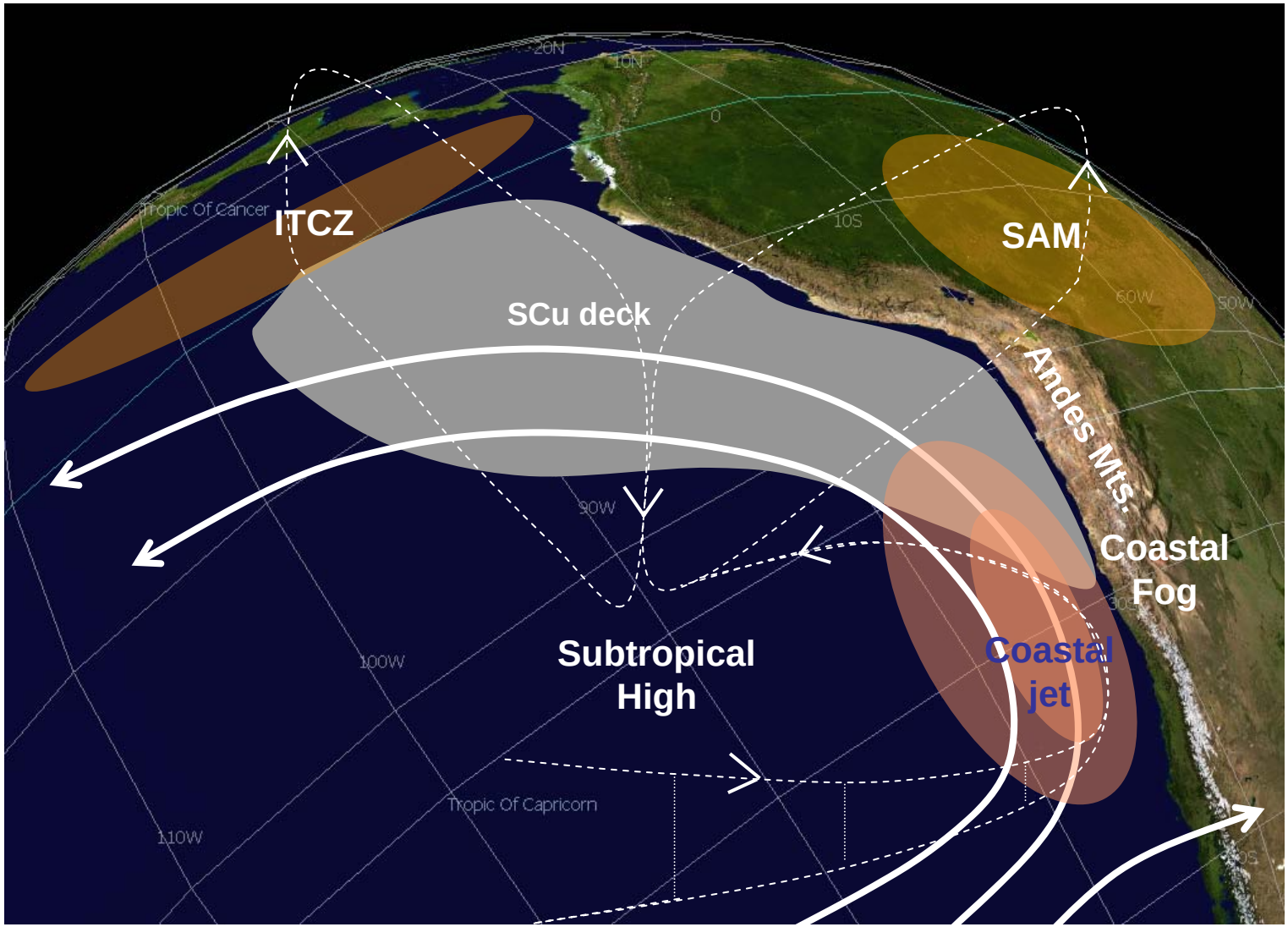
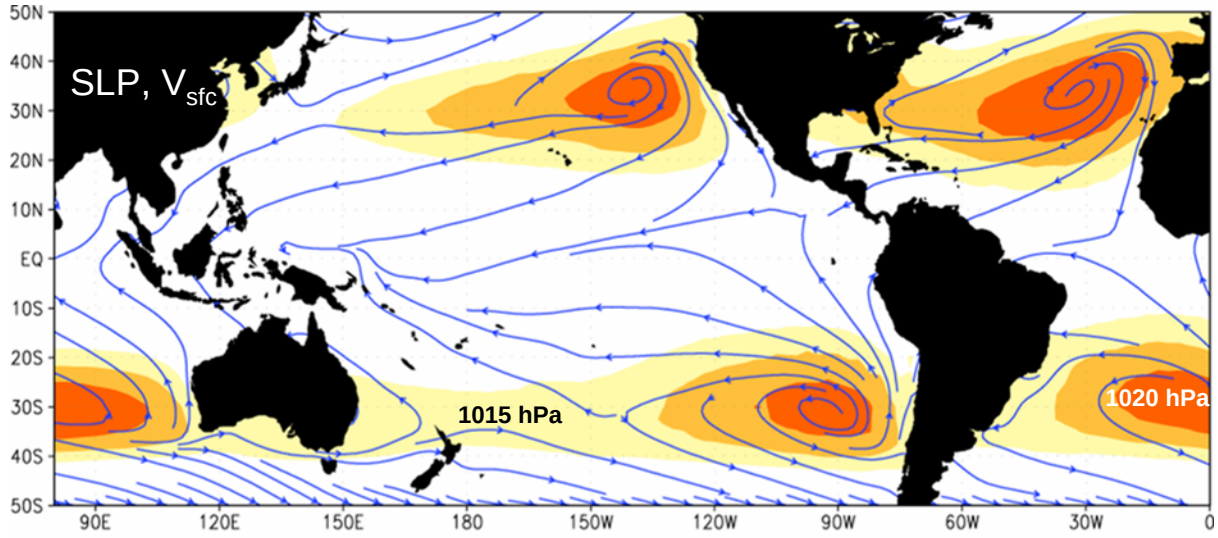
Outline

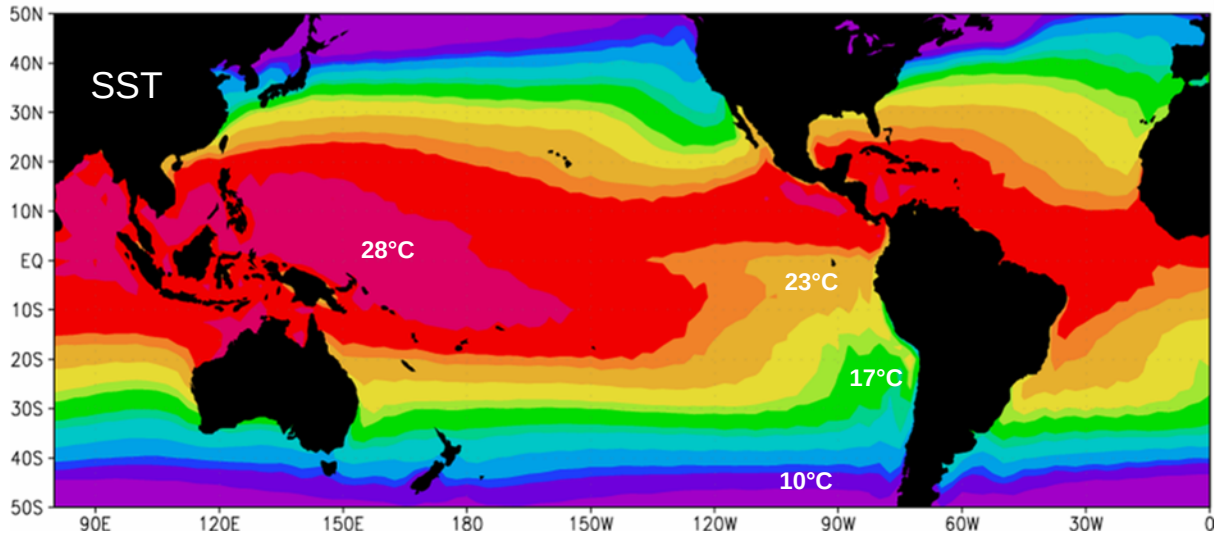
- Large-scale circulation
- Basic low-cloud dynamics
- Coastal cloud climatology
- Interannual variability

Key atmospheric features over the SEP

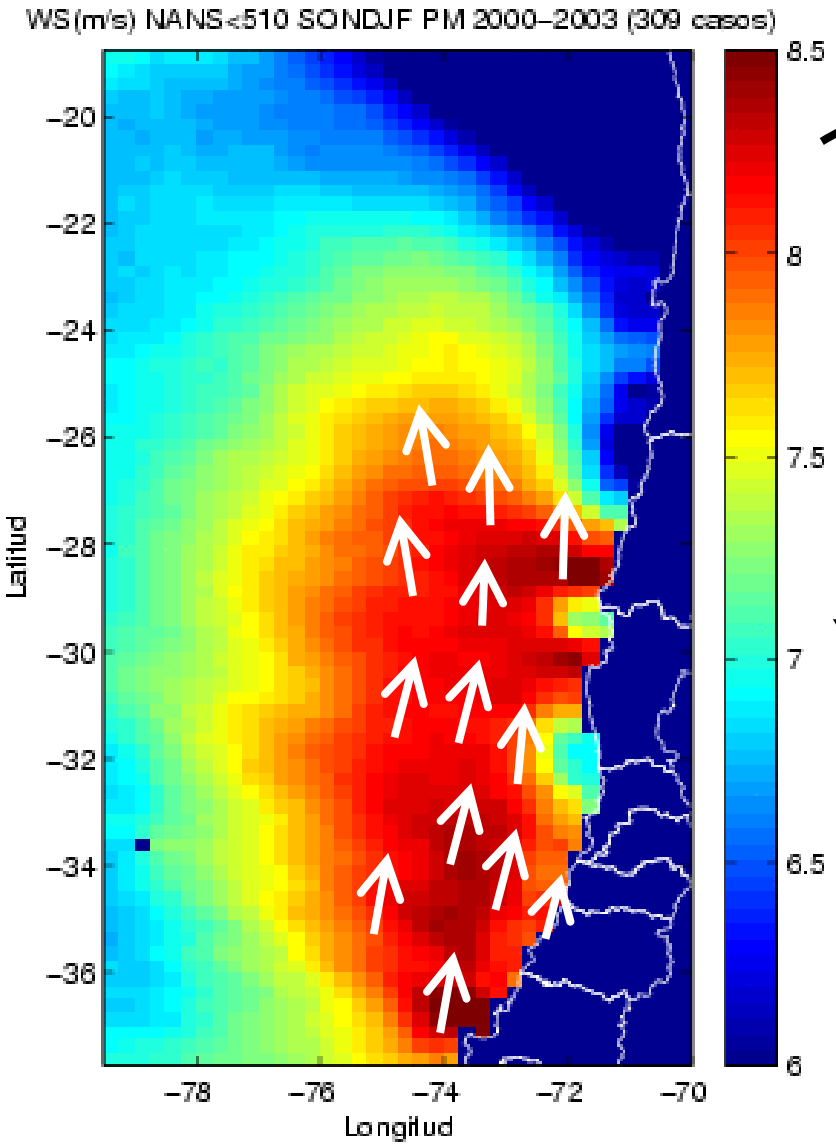


Climatological fields

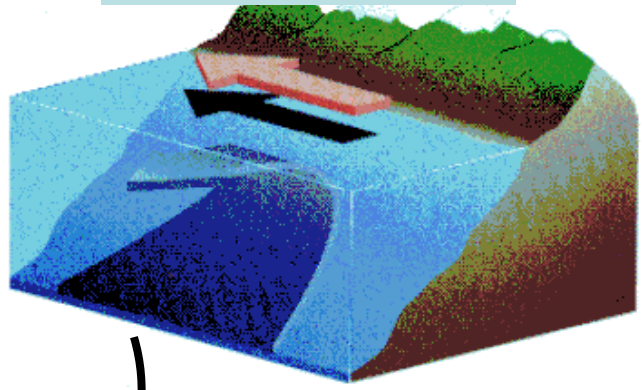




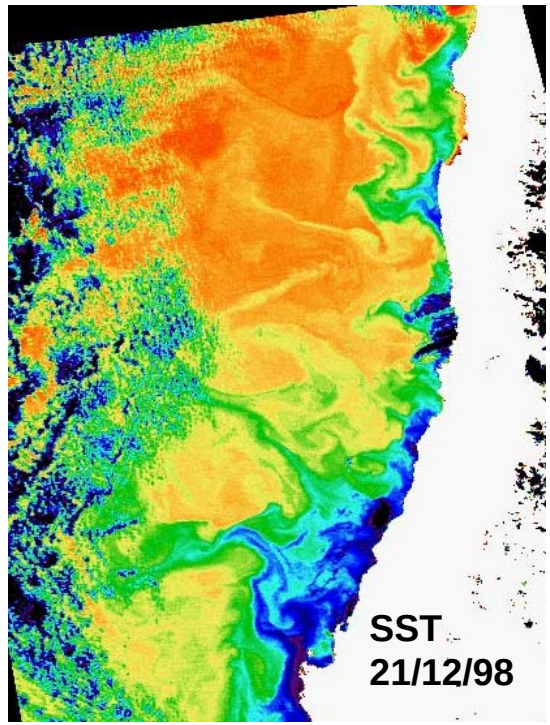
Surface winds



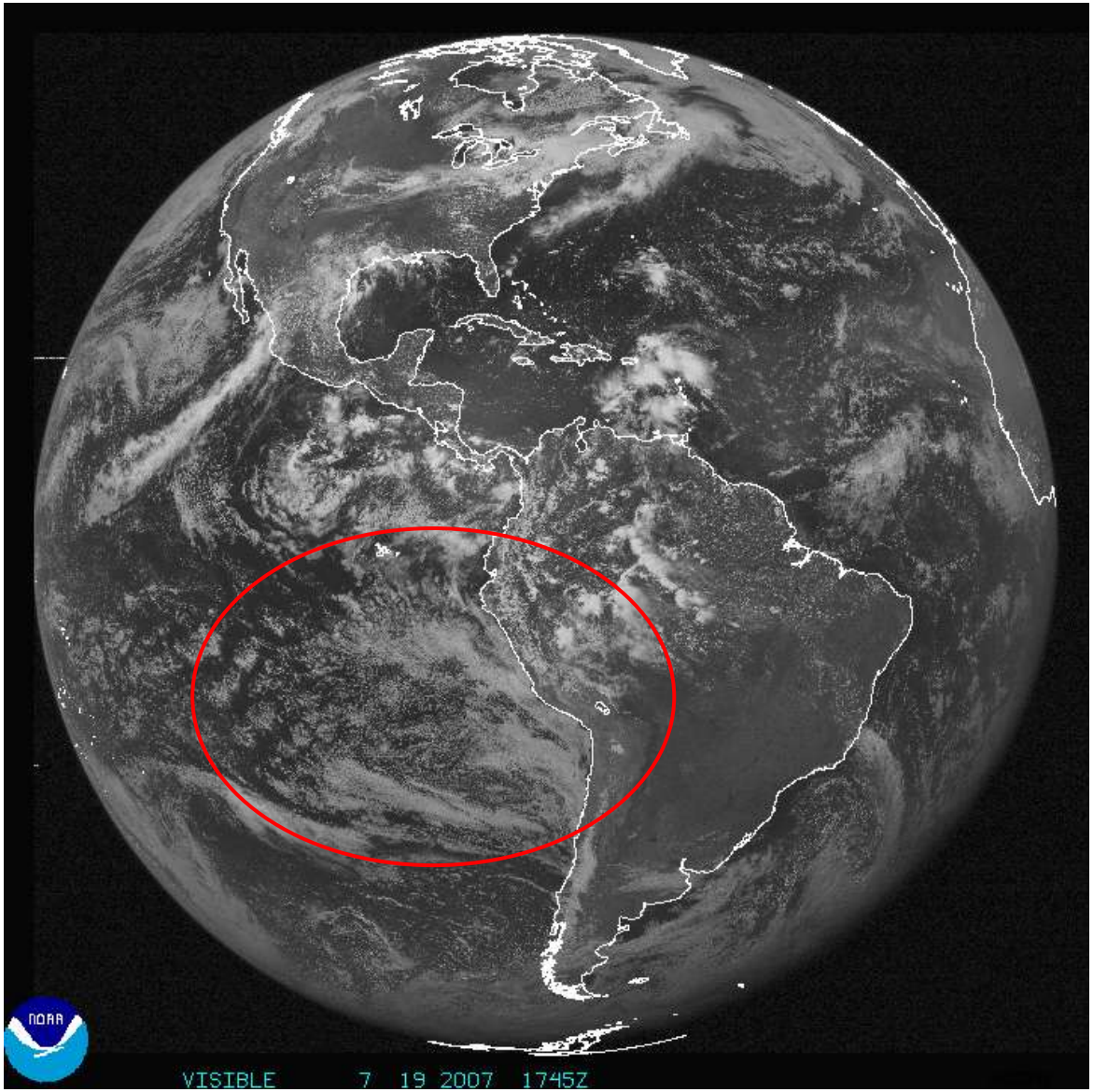
Coastal upwelling

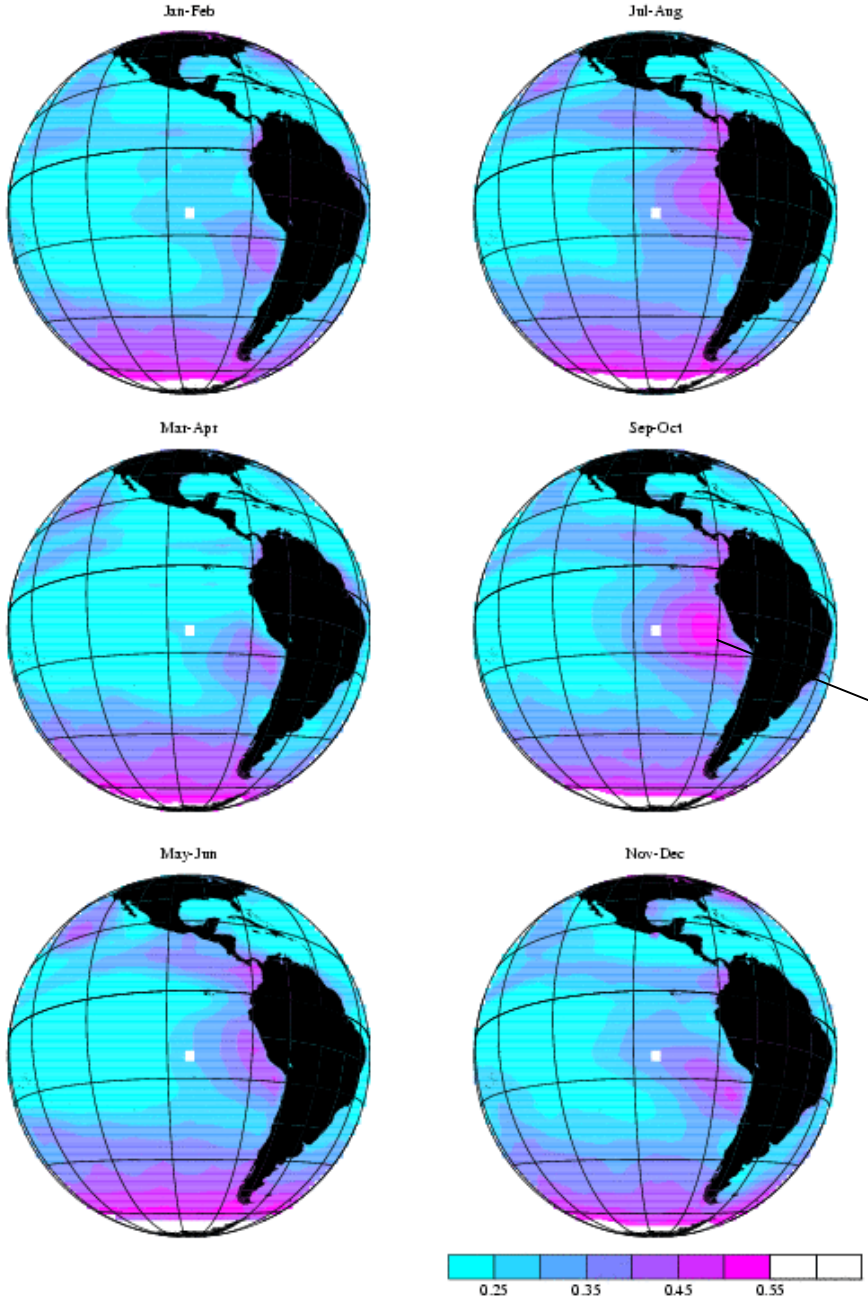


Cold waters



Another climatological feature of the SEP is its Stratocumulus (SCu) cloud deck





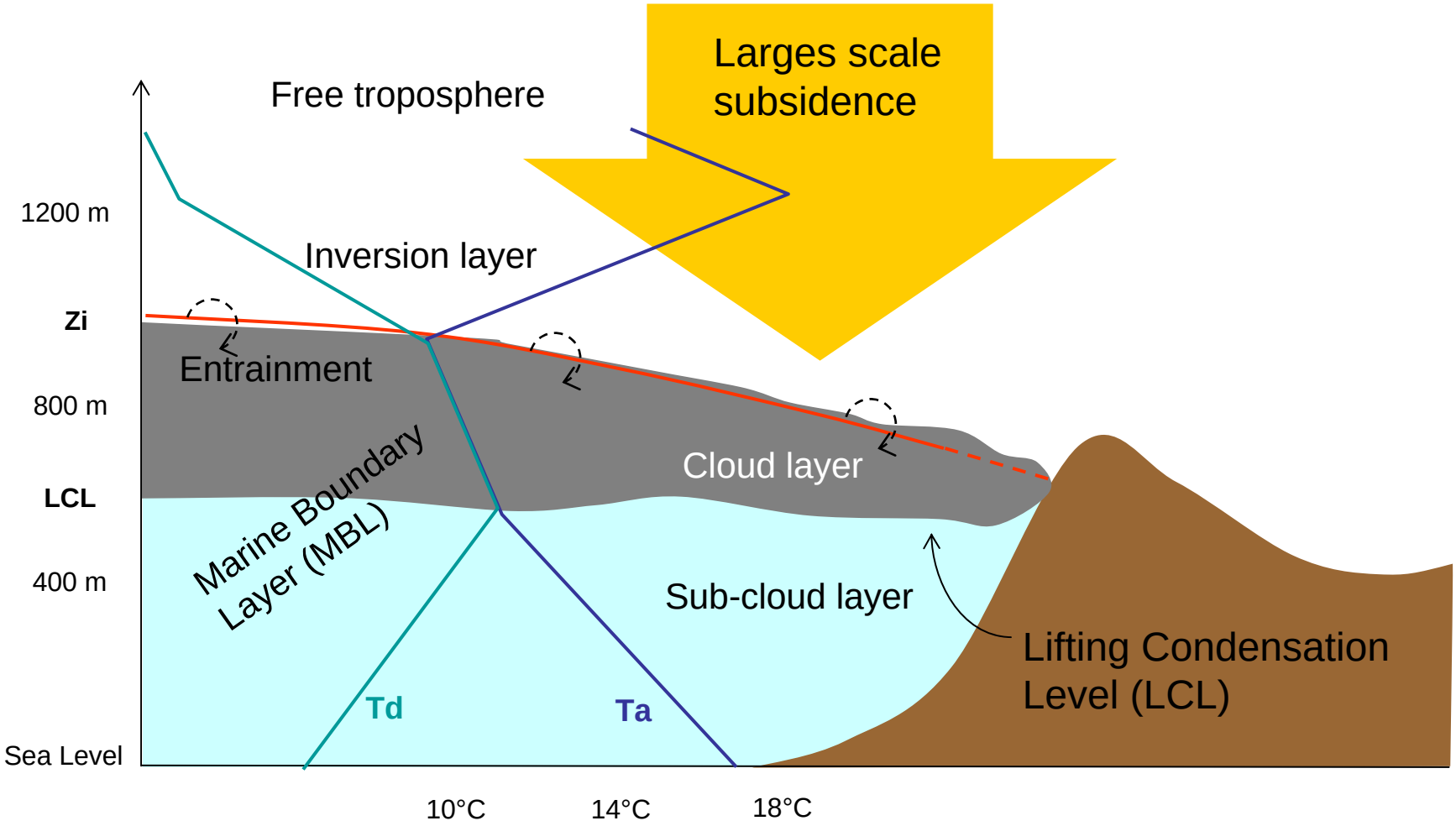
The extensive and persistent deck of SCu over the SSEP plays an important role in the regional and global climate by substancially reducing the ammount of solar radiation that reaches the sea surface

60-80%
temp. freq.

LTM bi-monthly albedo

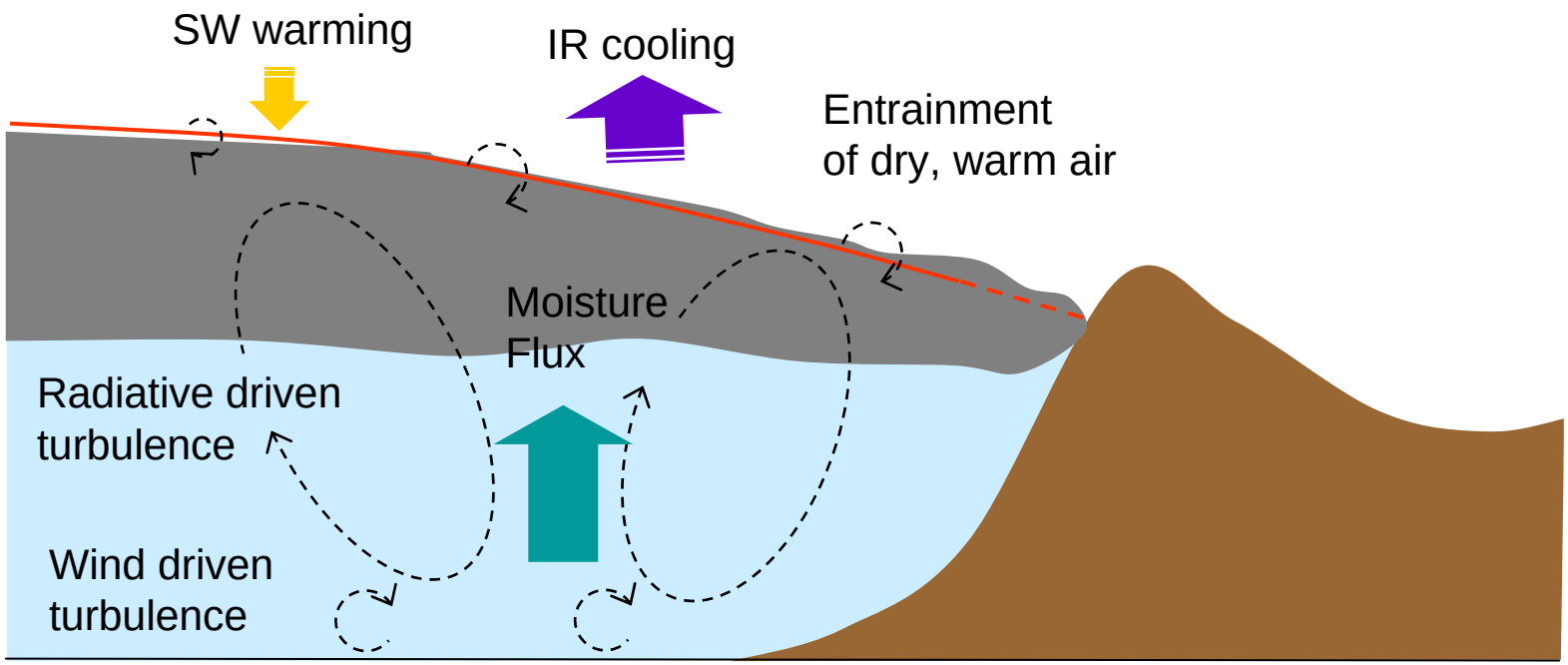
Albedo (cloudiness)

The inversion layer is maintained by the large-scale subsidence. It caps a cool, moist, often well mixed marine boundary layer in contact with the cold waters of the SE Pacific.



The turbulence within the MBL is largely driven by longwave cooling at the top of the cloud deck. Large eddies transport moist air upward, eventually reaching the LCL and forming the cloud. Note the feedback between cloud and turbulence.

Eddies can also overshoot the MBL thus entraining dry, warm air that tend to disipate the cloud.

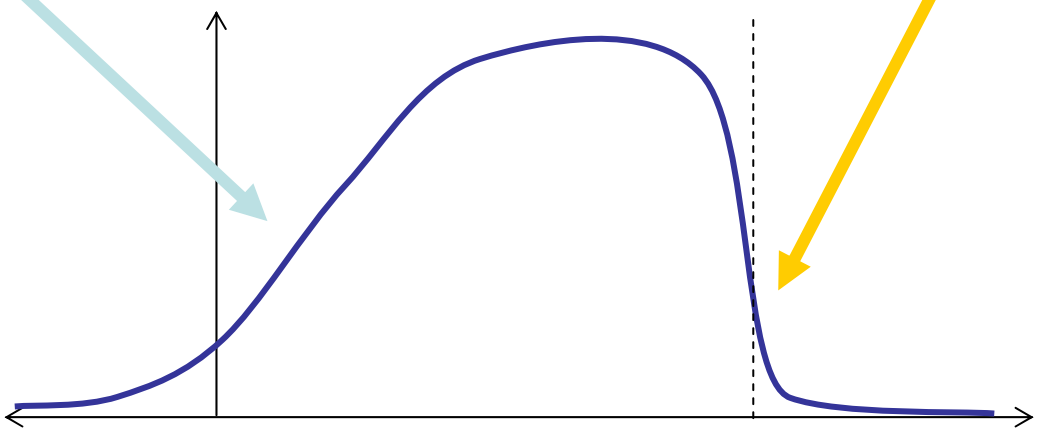


The rate of mid-troposheric subsidence (w) and the sea surface temperature (SST) are the key large-scale variables that control the existence of SCu on a large range of time and spatial scales.

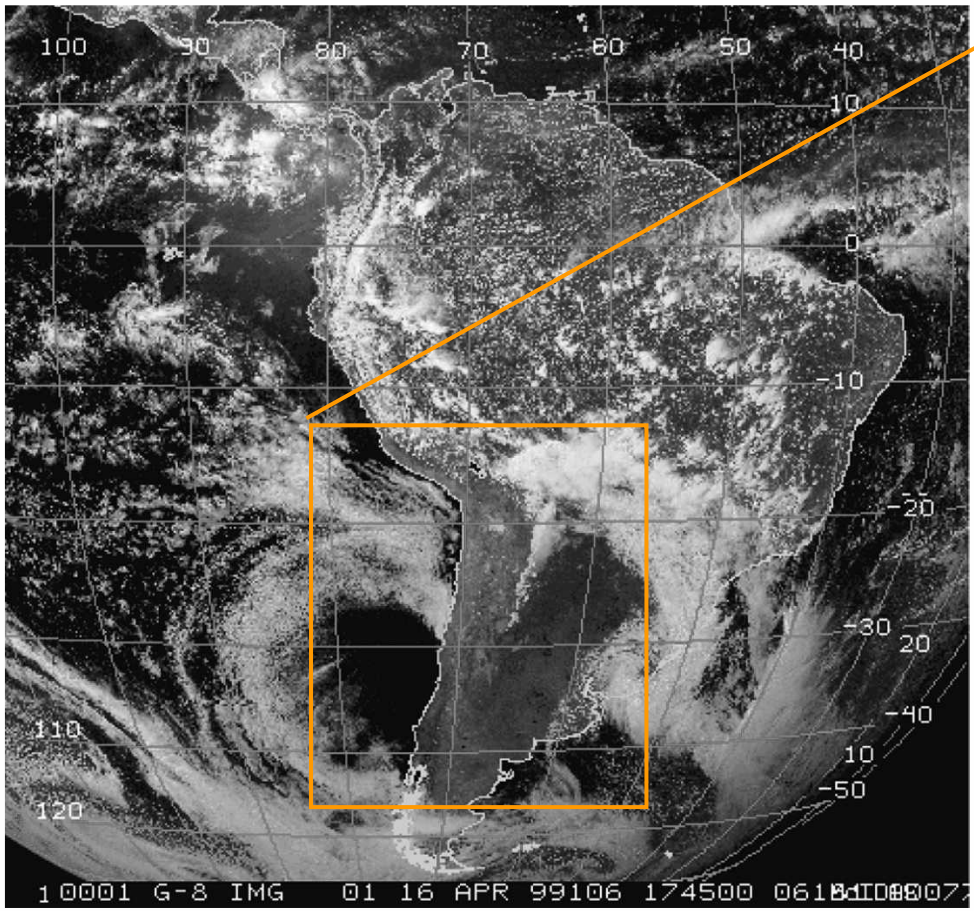
In particular, w largely controls the MBL depth (Zi)

Too little subsidence…
…MBL becomes too deep…
…eddies can't span the whole MBL…
…cloud layer decouples from sfc. layer

Too much subsidence…
…MBL becomes too shallow…
…moist air doesn't reach saturation
(Zi < LCL)



Example of too much subsidence…cloud clearing in connection with a coastal low in central Chile



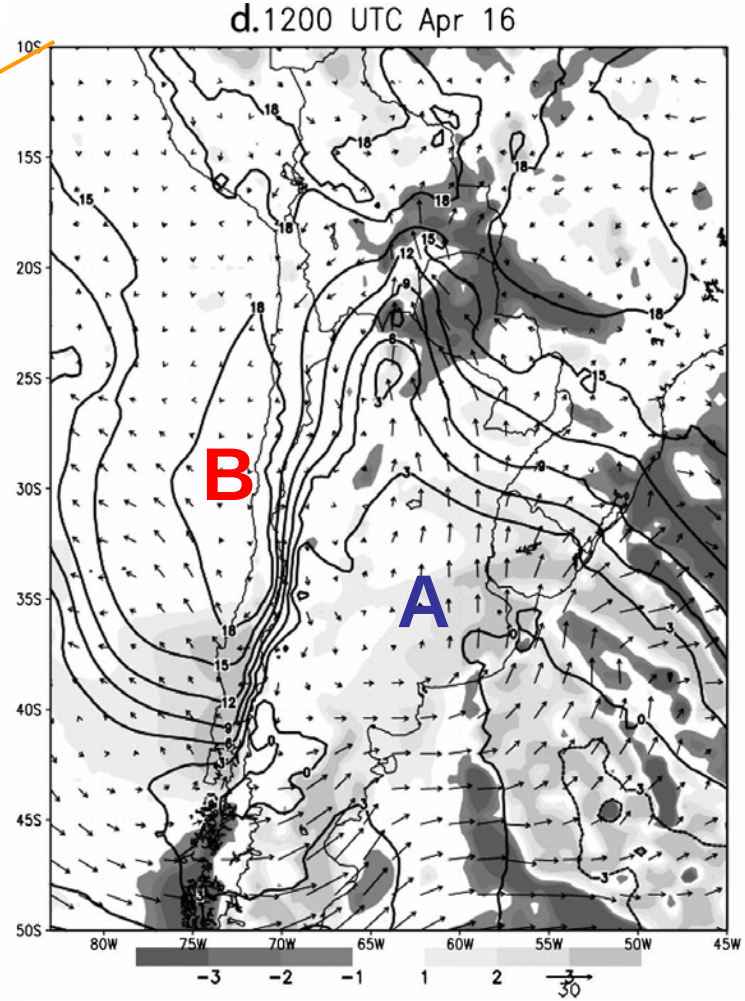
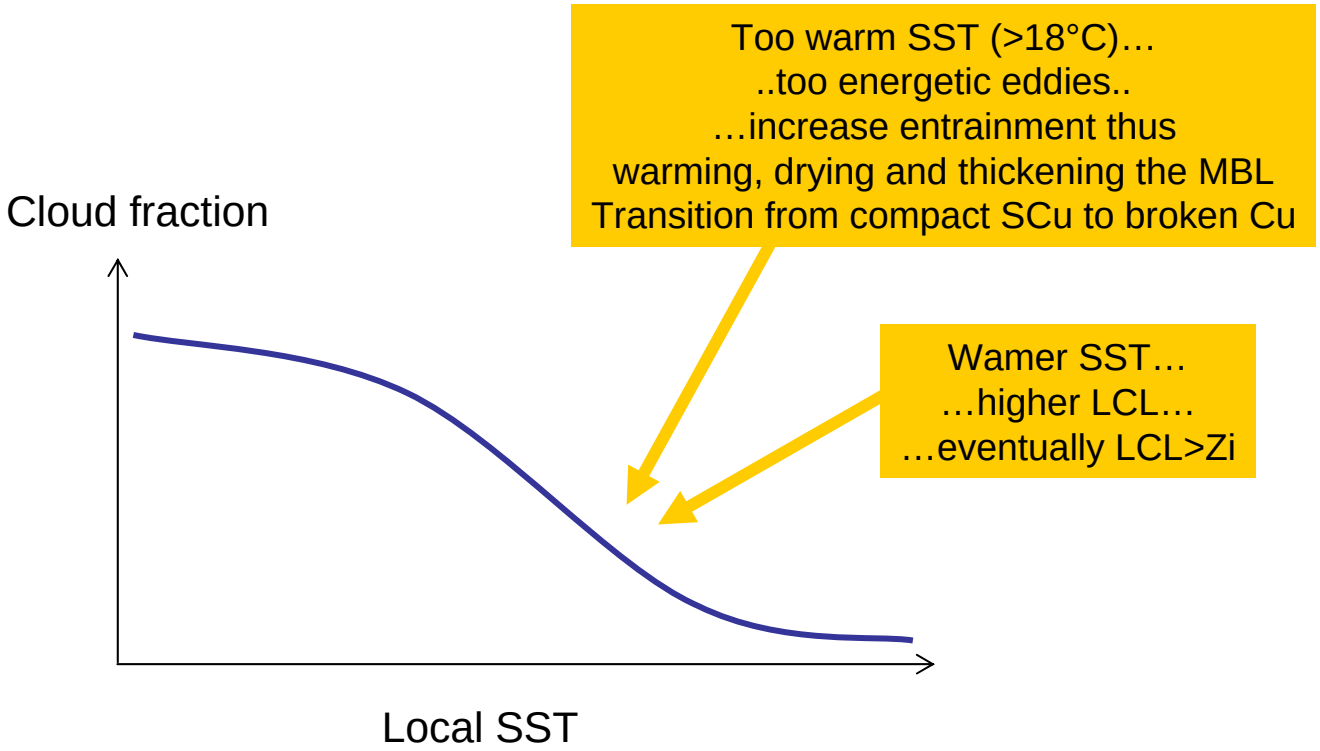


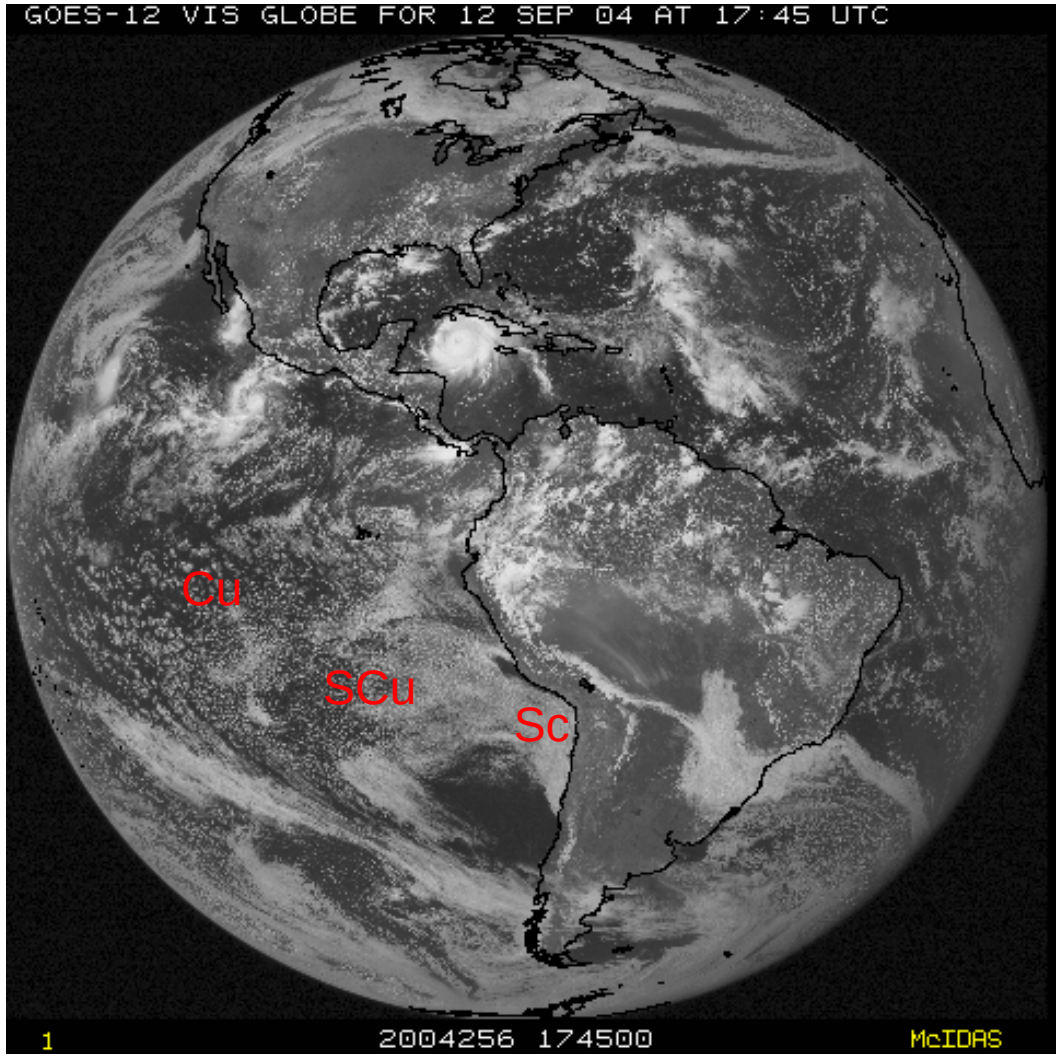
FIG. 4. *GOES-8* visible (channel 1) satellite image at 1745 UTC 16 Apr 1999.

The rate of mid-troposheric subsidence (w) and the sea surface temperature (SST) are the key large-scale variables that control the existence of SCu on a large range of time and spatial scales.

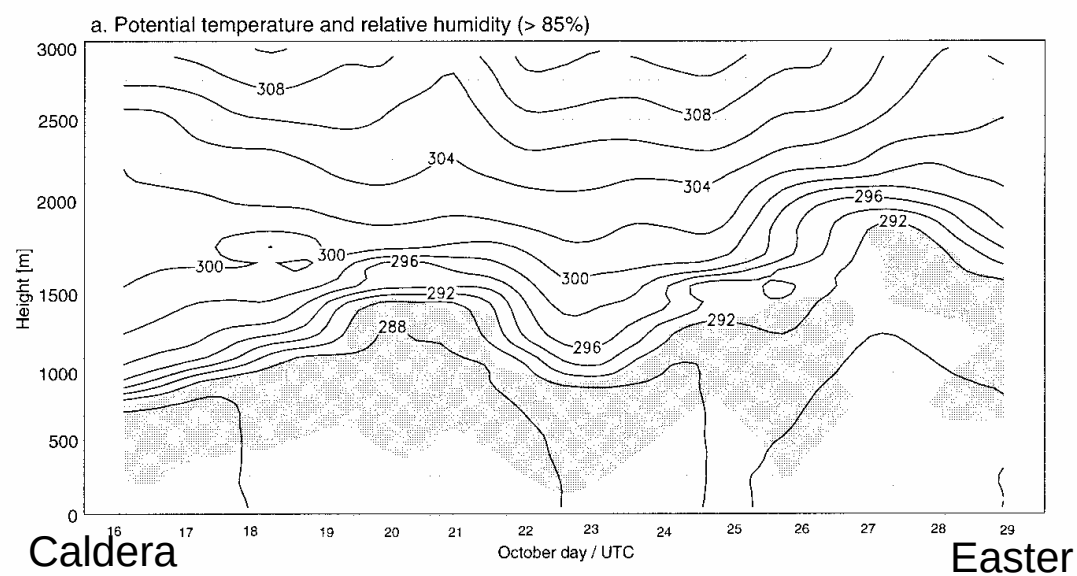
In particular, SST largely determines the lifting condesation level (LCL)



Example of warming waters (and probably decreasing subsidence) producing a cloud transition over the SEP

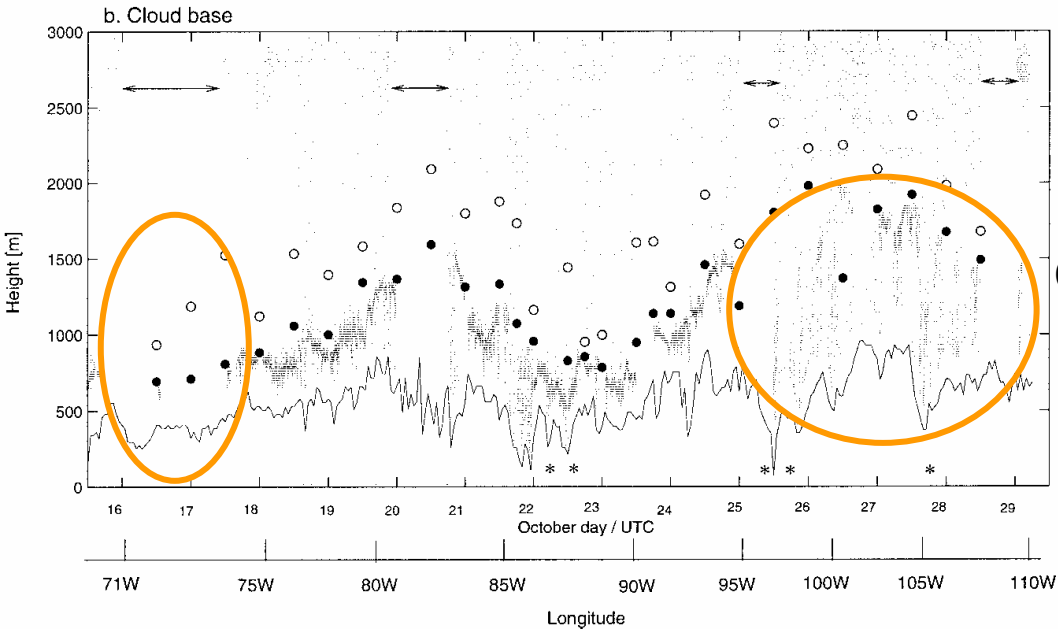


Cross sections @ 27°S – CIMAR5



Caldera

Easter Is.

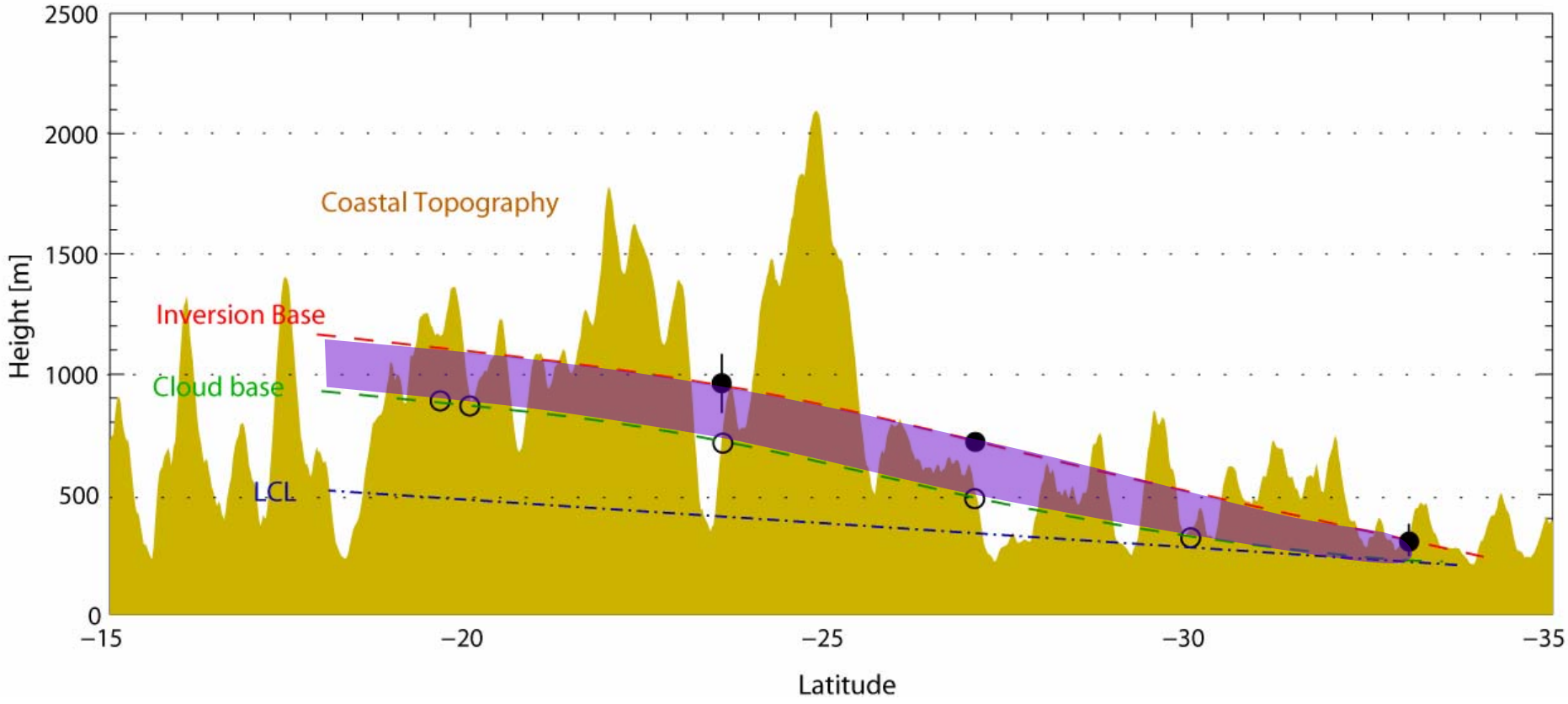


Ceilo data

LCL

Garreaud et al. 2001

Coastal Transect / Annual Mean

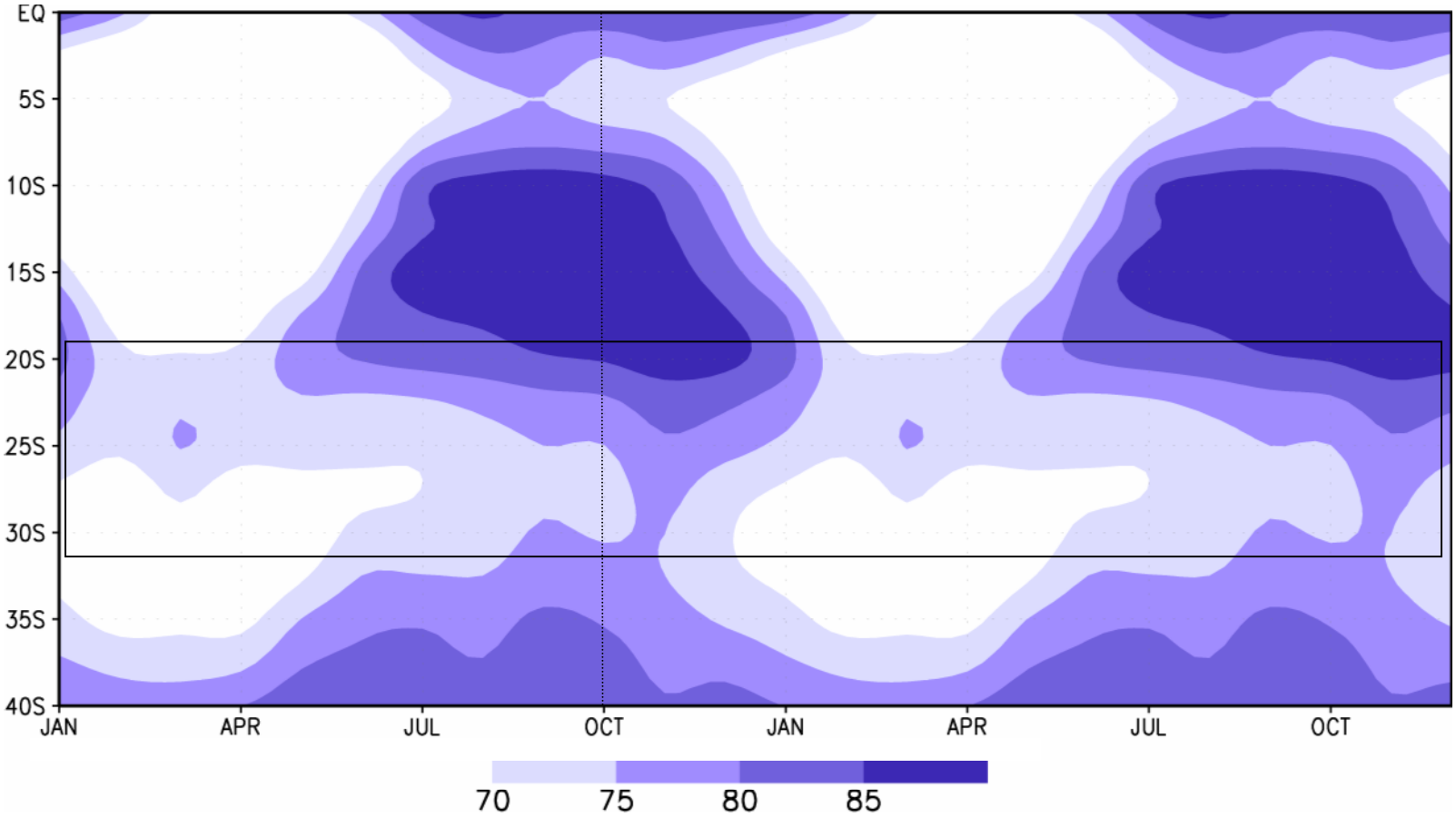


SST

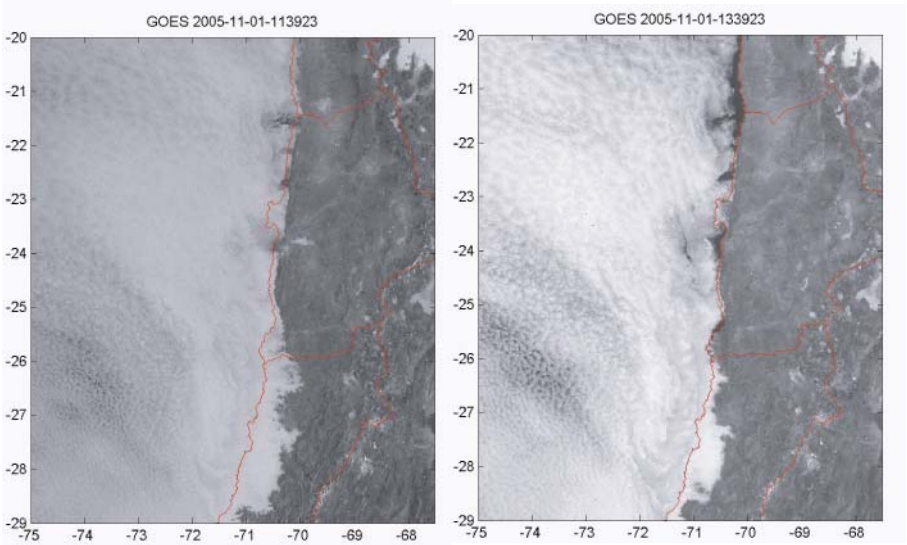
Subisdence

Coastal Transect / Mean Seasonal Cycle of Cloudiness

Caution: These are *near coastal clouds*, derived from the ISCCP C2 Database (2.5°×2.5° lat-lon), and **NOT** coastal fog.



Key feature of diurnal cycle:
Diurnal Coastal clearing, most marked during spring-summer



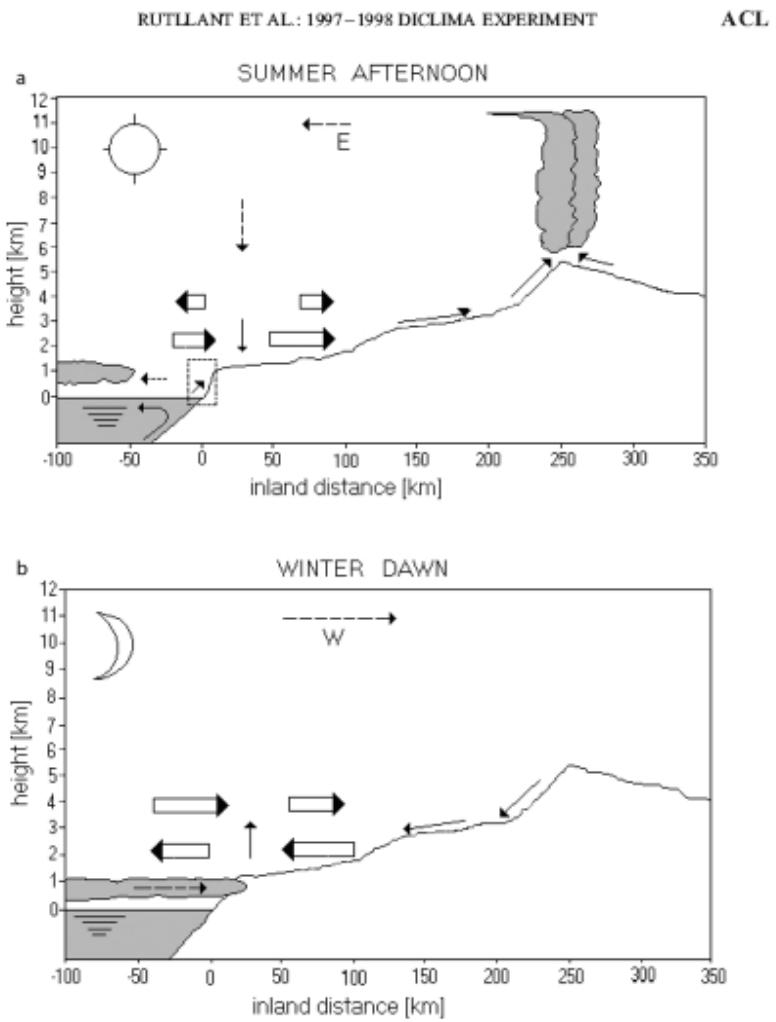
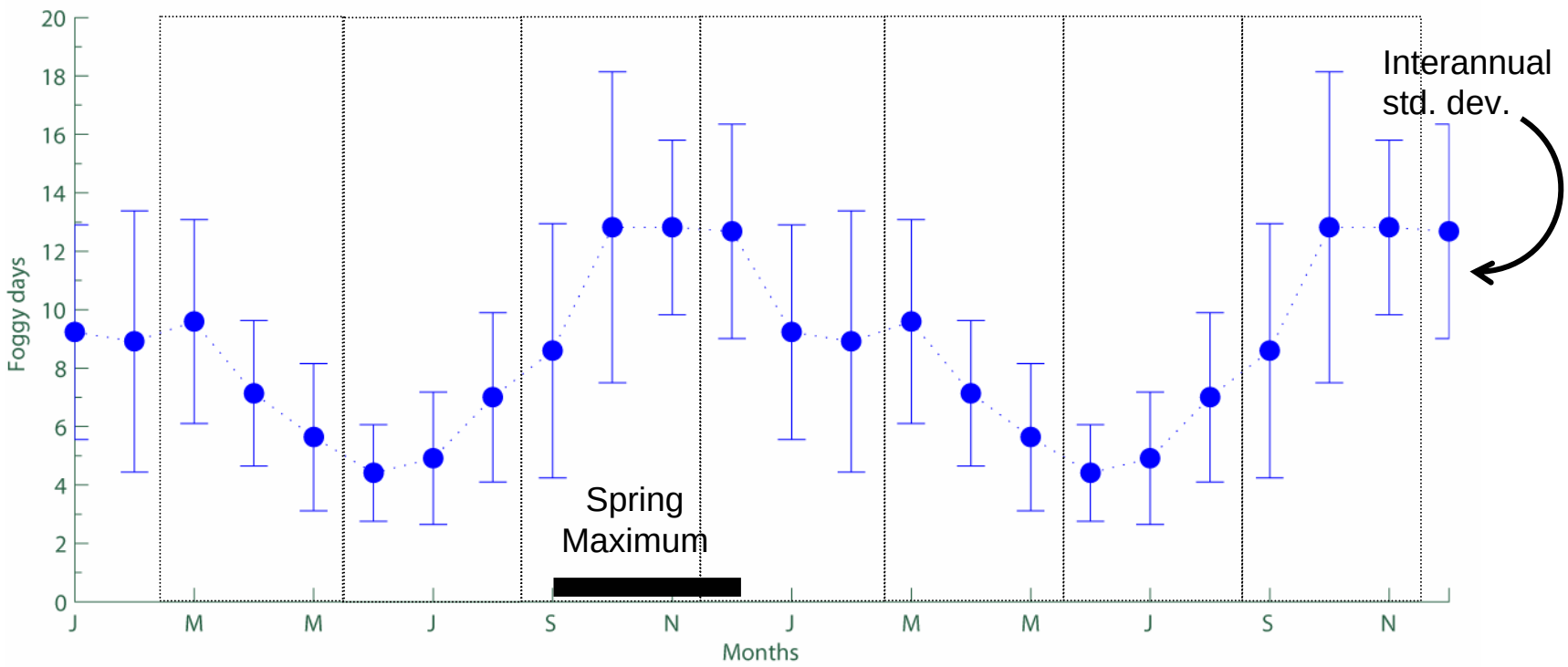


Figure 9. Schematic diagrams of the zonal mass flux (thick arrows) and zonal flow (thin arrows) across the arid northern coast of Chile: (a) austral summer afternoon conditions and (b) austral winter early morning conditions. The dashed rectangle in Figure 9a represents the cross section depicted in Figure 8.

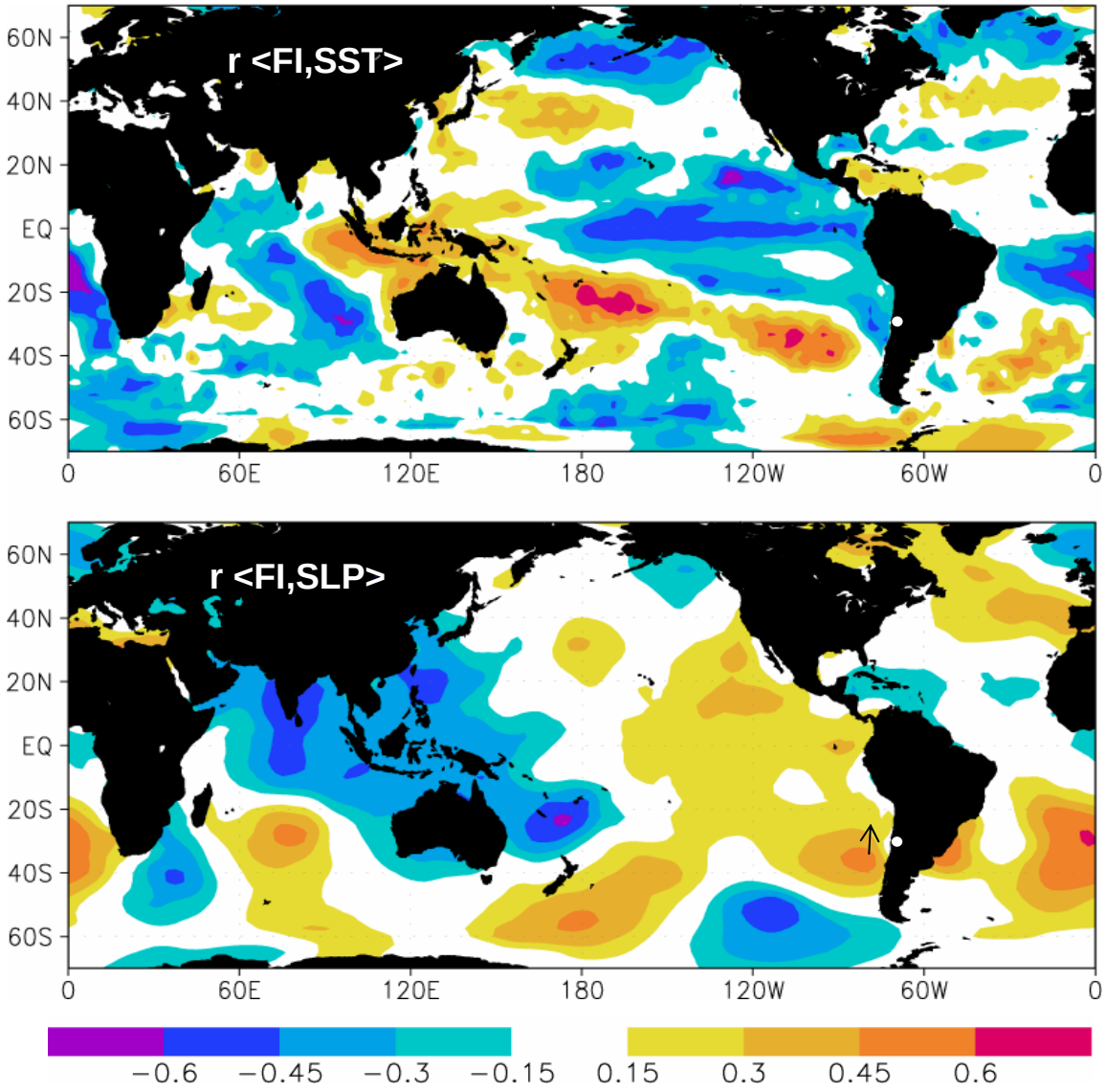
Fog Index at Fray Jorge

Number of days during SON with foggy conditions according to park rangers' visual observations



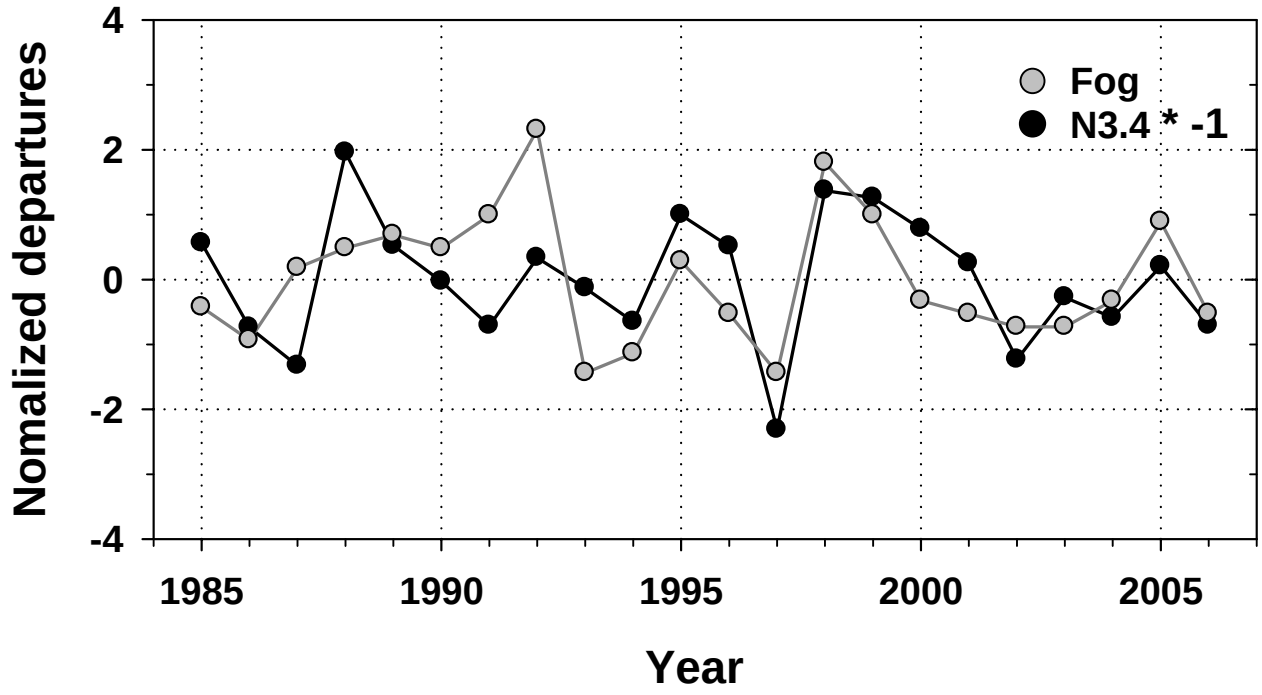
Interannual variability of the Fog Index at Fray Jorge

1Point Correlation maps between SON Fog Index and SST/SLP



This is a very much **La Niña** pattern

Interannual variability of the Fog Index at Fray Jorge



El Niño years – less foggy days at Fray Jorge
La Niña years – More foggy days at Fray Jorge