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

- Subtropical High
- SCu deck
- ITCZ
- SAM
- Coastal jet
- Coastal Fog
- Andes Mts.
Climatological fields

![SLP, V_{sfc}, SST](image)
Surface winds

Coastal upwelling

Cold waters

WS (m/s) NANS<510 SONDJF PM 2000–2003 (309 cases)

Latitude

Longitude

SST 21/12/98
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 substantially reducing the amount of solar radiation that reaches the sea surface.

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 dissipate the cloud.
The rate of mid-tropospheric 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 ($Z_i$).
Example of too much subsidence...cloud clearing in connection with a coastal low in central Chile.
The rate of mid-tropospheric 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 condensation level (LCL)

![Cloud fraction vs Local SST graph]

- Too warm SST (>18°C)...
- ...too energetic eddies..
- ...increase entrainment thus warming, drying and thickening the MBL
- Transition from compact SCu to broken Cu

- Warmer SST...
- ...higher LCL...
- ...eventually LCL>Zi
Example of warming waters (and probably decreasing subsidence) producing a cloud transition over the SEP
Cross sections @ 27°S – CIMAR5

Garreau et al. 2001
Coastal Transect / Annual Mean

![Graph showing Coastal Topography, Inversion Base, Cloud base, LCL, SST, and Subsidence.](image)
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 Andean 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