Using the Absence of Wind-Profiler Reflectivity to Study Stratocumulus-Topped Marine Boundary Layer Processes

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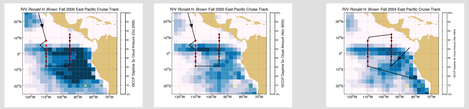
The Setting

Sc-topped MBLs are extensive, poorly modeled, and hard to observe from space

"We need information", i.e. *data*
"We need data", i.e. *numbers*
What if *no data* can give us *information*?

R/V *Ronald H. Brown* in the tropical east Pacific

Fall 2000 Fall 2004

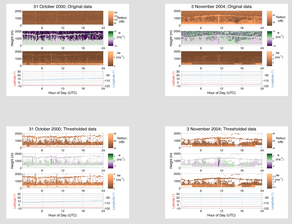


The Problem

No (atmospheric) numbers!

Original Data:

Rigorously Quality-Controlled Data:

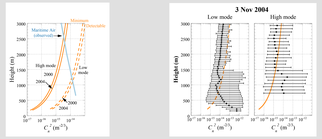


Can this tell us something about the atmosphere?

The Approach

The structure function parameter of the index of refraction, C_n^2

- Can be obtained from a calibrated profiler
- Reflectivity is related to Bragg scatter from index of refraction fluctuations caused by turbulence



Many C_n^2 values calculated from original data are below the detectable thresholds

Interpreting C_n^2 in this context

- Linear combination of C_θ^2 , C_q^2, and $C_{\theta q}^2$
  $\Longrightarrow$ gaps from weakening top-down processes?
- $\left(\text{Turbulent Intensity}\right)\times\dfrac{d\left(\text{Potential Refractive Index}\right)}{dz}$
  $\Longrightarrow$ gaps from reduced turbulent intensity?

i.e. decoupling of the Sc-topped MBL

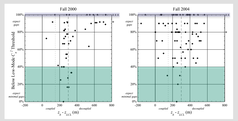
The Confirming Evidence

Cloud base height z_b vs. LCL height z_{LCL}

- Large $\Delta z = z_b - z_{LCL}$ indicates decoupling

Is high mode's min(C_n^2) < low mode's C_n^2 threshold?

- If larger percent "yes", expect more extensive gaps



100% C_n^2 minima are undetectable when $\Delta z \geq$ (varies)
$\leq$ 40% C_n^2 minima are undetectable when $\Delta z <$ 350m

The Implications

The absence of signal is a robust measurement

- Key: thoughtfully removing theoretically and physically unrealistic values

A more sensitive profiler could yield a C_n^2 decoupling threshold

- Key: NOAA must nurture and support the in-house instruments and expertise it has and will need

Allows NOAA to leverage its prior investments in data collection and storage

- Field programs; remote locations; long deployments