An assessment of the role of surface sensible heat flux

and the atmosphere inversion on the *breakup time* in a highly complex terrain

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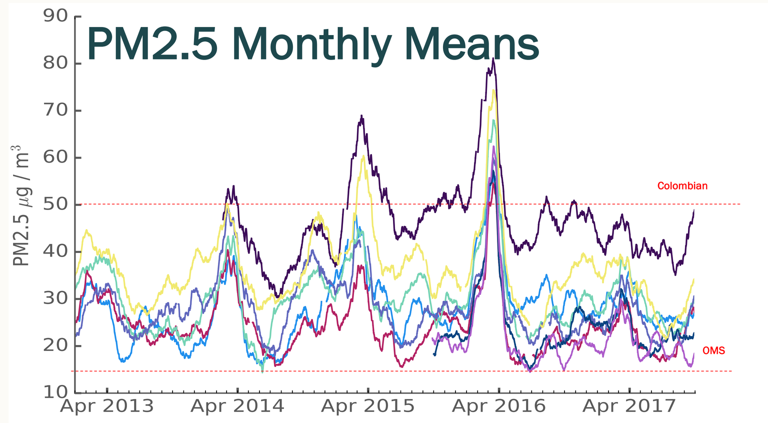
Introduction

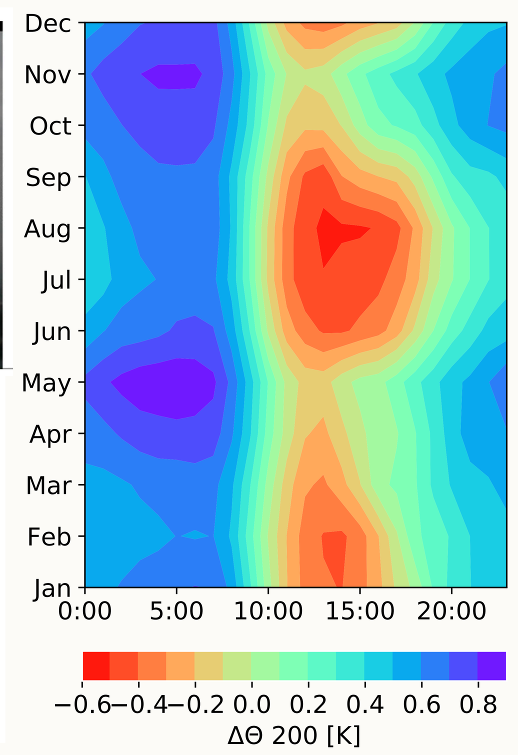
A low-latitude highly complex mountainous terrain located in the Andes ***mountain ranges***, home of about 3.5 million people over an extension of ***1152 km²***



1. 80% PM2.5
2. Complex Topography
3. Meteorology

The high levels of relative humidity, typical of the tropical atmospheres, increase the probability of ***low-level cloud*** formation. At the same time, the presence of those clouds modulates the rate of incoming solar radiation.

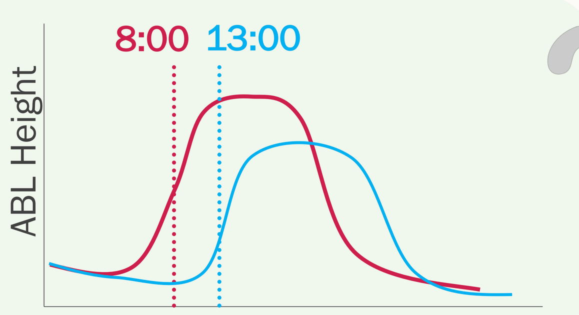
While these two types of days could happen any time of the year, there is a ***Seasonal clustering*** modulated by the migration of the ITCZ over the tropical region.



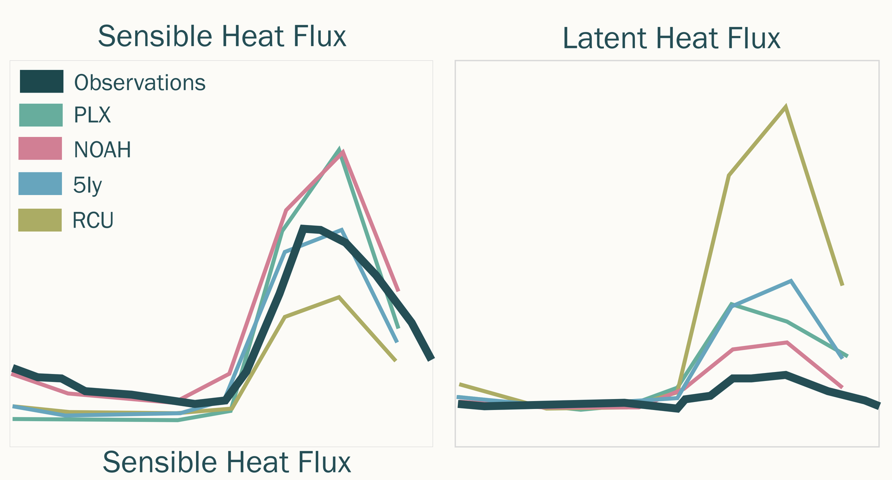
What are the practical implications of a late breakup?

What processes condition it?

What does it depend on?

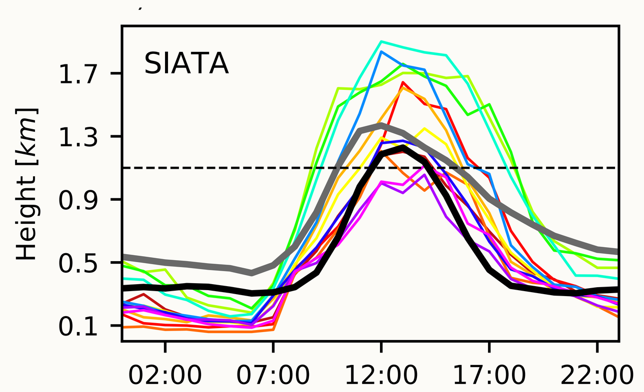


Data vs. Modeling Approach

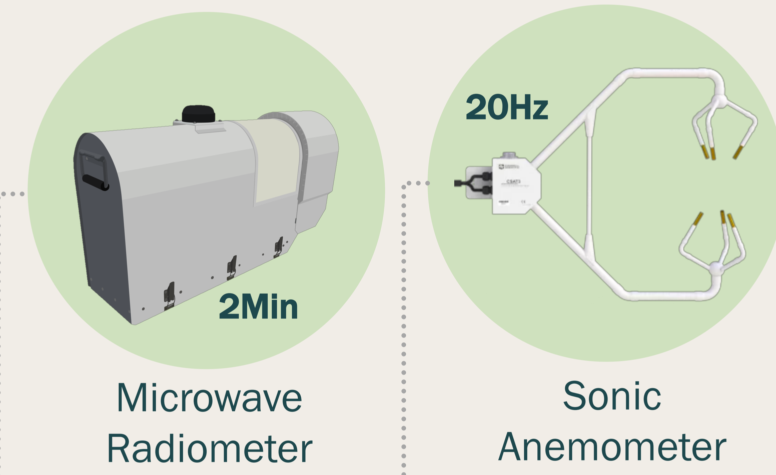


WRF has problems reproducing the turbulent heat fluxes

The WRF captures the diurnal cycle, but the transition to an unstable atmosphere happens very soon, this could bias the results of this study.



Data



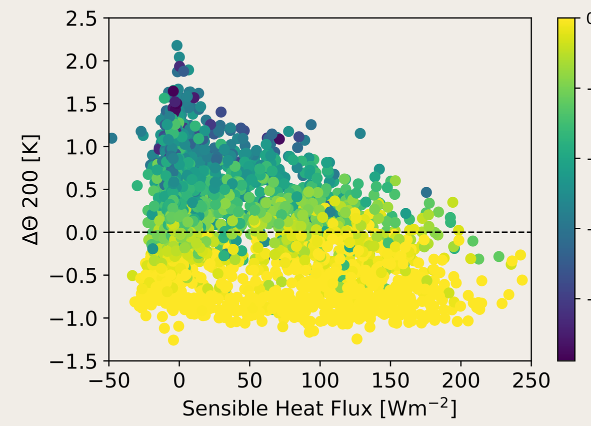
$Q_{required}$

- CIN
- CIN1500
- CIN1200
- $\triangle\theta v_{800}$
- $\triangle\theta v_{200}$

$Q_{provided}$

Sensible Heat Flux

Even though the nature of the measurements is different, the coherence presented in the diagram suggests that both datasets can be used to asses the ***breakup*** problem.



Final Dataset

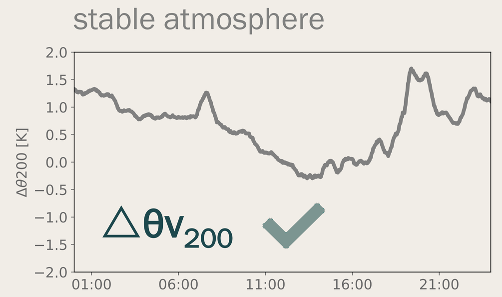
Time resolution: 2min

From 2018-02-01 to 2018-11-20

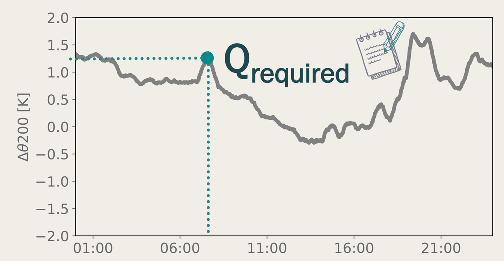
Methodology

1. Choose Index

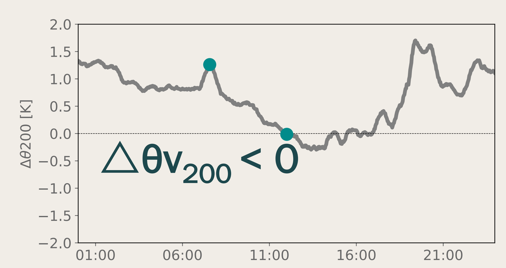
Indicates the strength of the stable atmosphere



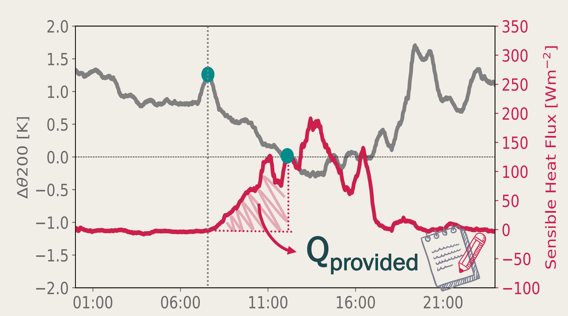
2. Max. Stable point after 6am.

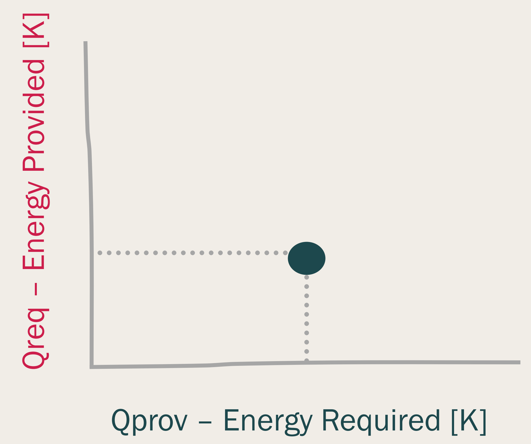


3. Set the Instability Threshold



4. Area under the forcing curve



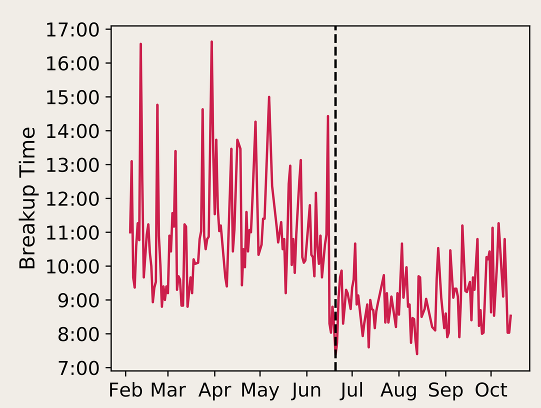


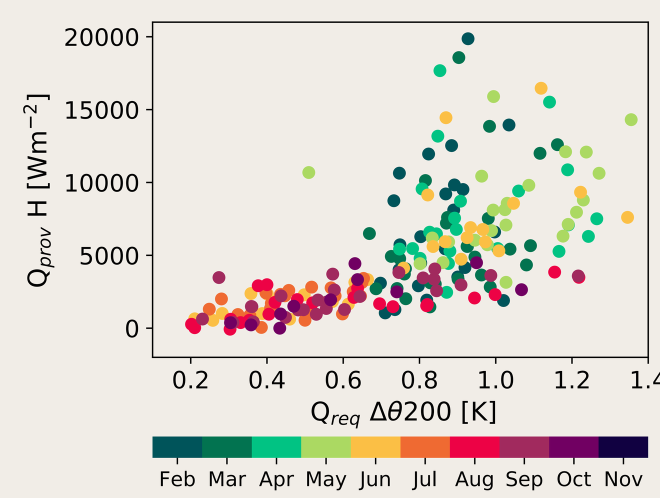
Results

The Qreq-Qprov relationship clusters according to the time of the year.

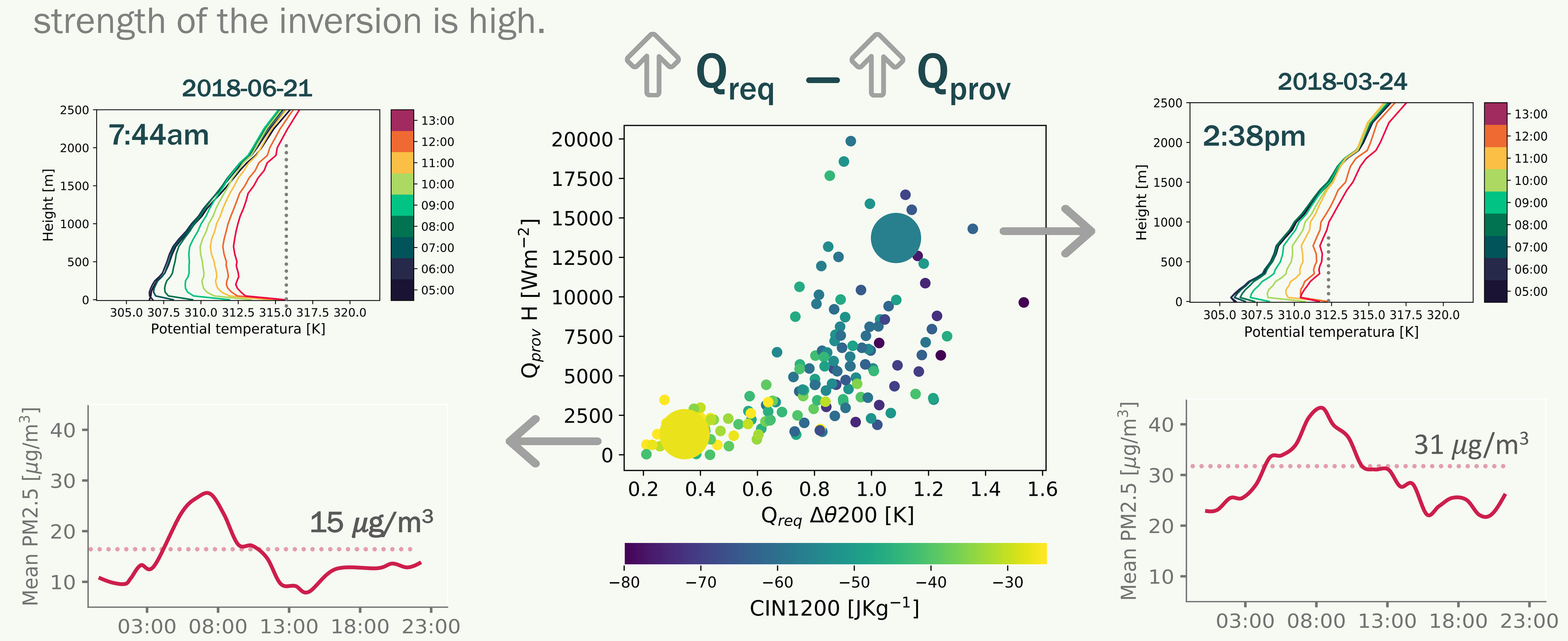
In different seasons the amount of energy changes drastically. As a consequence, the breakup time also changes.

Quick regime shift associated with the transition to a dry season



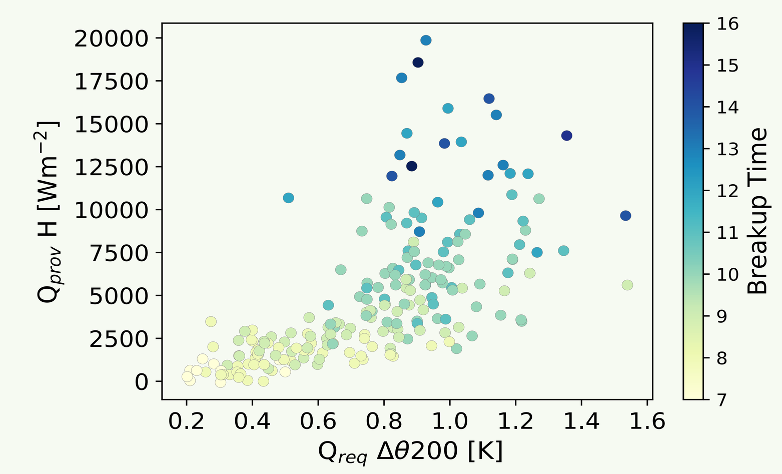


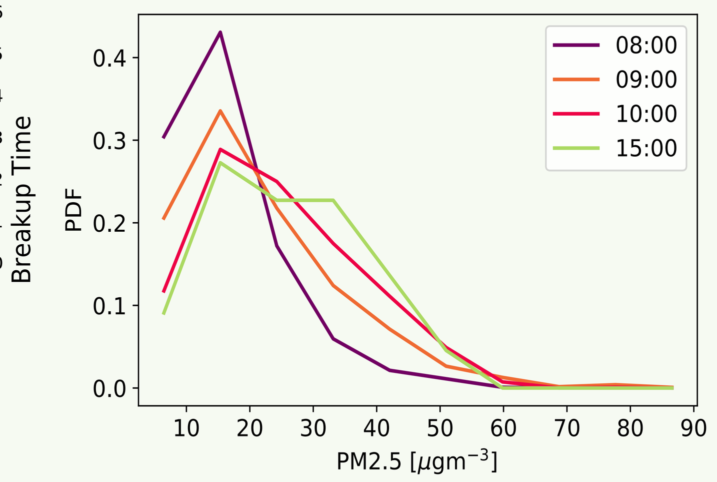
The data shows that the energy provided to reach the Breakup indeed is larger when the strength of the inversion is high.



Influence on Air Quality

From a practical point of view, the breakup time has an important influence in the PM2.5 concentration inside of the valley.

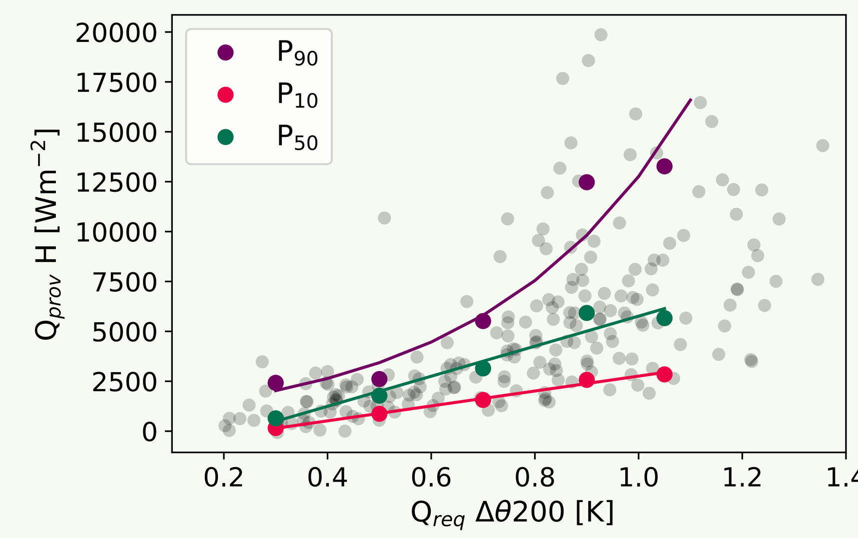




Heating Efficiency

Low heating efficiency: Not all the energy provided is used to heat the atmosphere within the Aburrá Valley.

There is energy exported outside of the Valley



Conclusions

There is a strong relationship between the ***features of the nighttime inversion and the energy needed*** to reach the breakup.

As a consequence of the topographic conditions, a late breakup could lead to an ***accumulation of pollutants*** inside of the Aburrá Valley.

There appears to be a variable heating ***efficiency rate,*** that depends on the magnitude of the required energy.

In spite of the different ***spatial representativeness*** of the sensors used, the approach suggest a link between valley-wide thermodynamics and local scale turbulence

Aknowledgements

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