

Spatial Variability of the Entropy in the Boundary Layer

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A b s t r a c t

In this work, we explore the relationship between convection and the variability of entropy in the boundary layer inside the EPIC box, (91-97)W-(8-12)N, from Sep 1 to Oct 15 2001.

The entropy variability in the boundary layer is estimated from dropsondes released from the NOAA-WP3-43. Infrared temperatures from the GOES satellite are used as a surrogate for convection.

The analysis shows that for this region, a significant correlation exists between convection that took place about 10 hours before the measurements of entropy, and the variability in the boundary layer entropy.

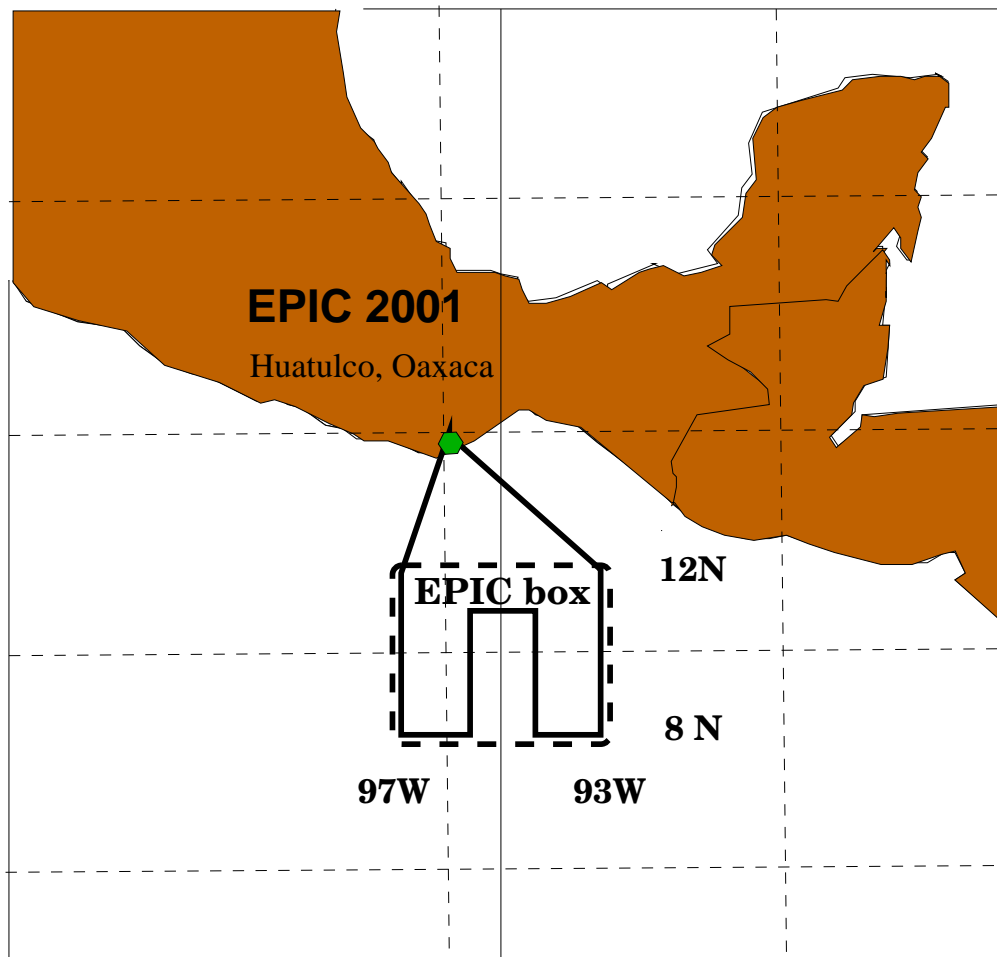


Figure 1. EPIC box. Thick-solid line represents the nominal WP3-43 track.

D a t a A n a l y s i s

Satellite A time series of the average infrared temperature is obtained from hourly images taken by the GOES satellite. For each image, data outside the EPIC box is discarded and the remaining infrared temperatures averaged. Gaps due to missing images are filled by linear interpolation before a three-hour smoothing filter is applied. The resulting series is shown in the upper panel of figure 4. An histogram of the infrared temperature averages is shown in figure 2.

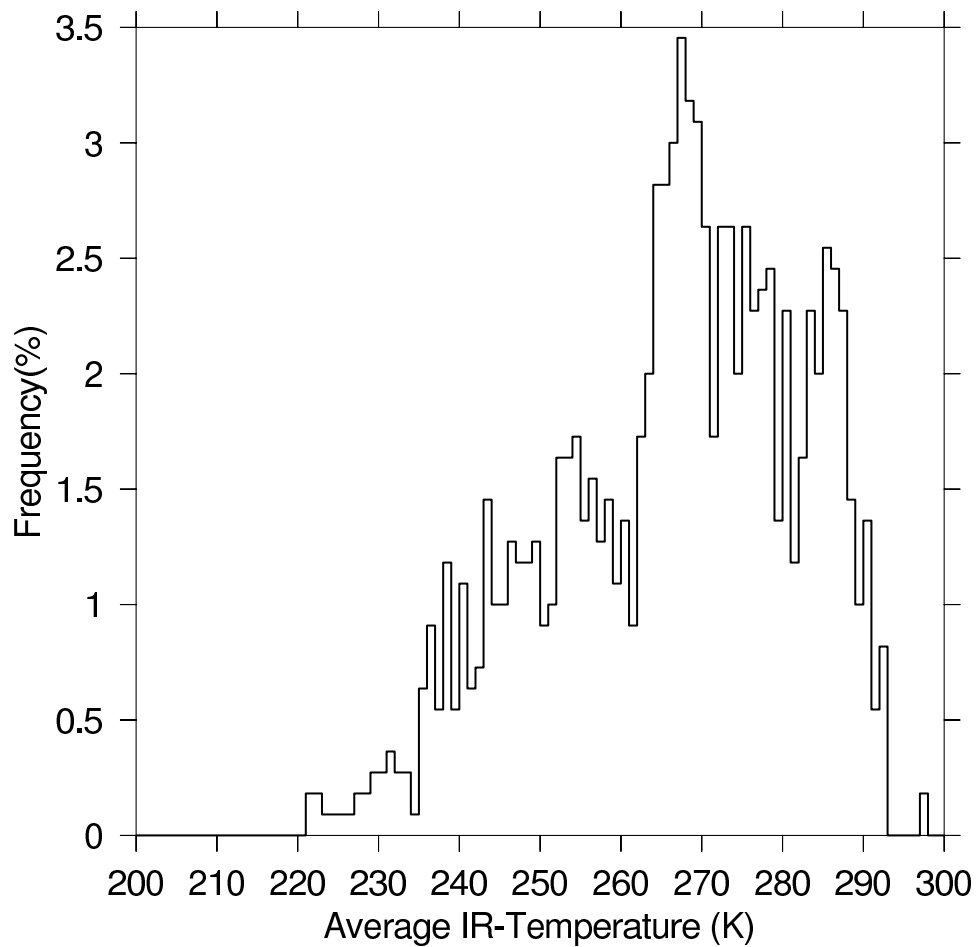


Figure 2. Histogram of average infrared temperatures over the EPIC box observed from Sep 1 to Oct 15 2001.

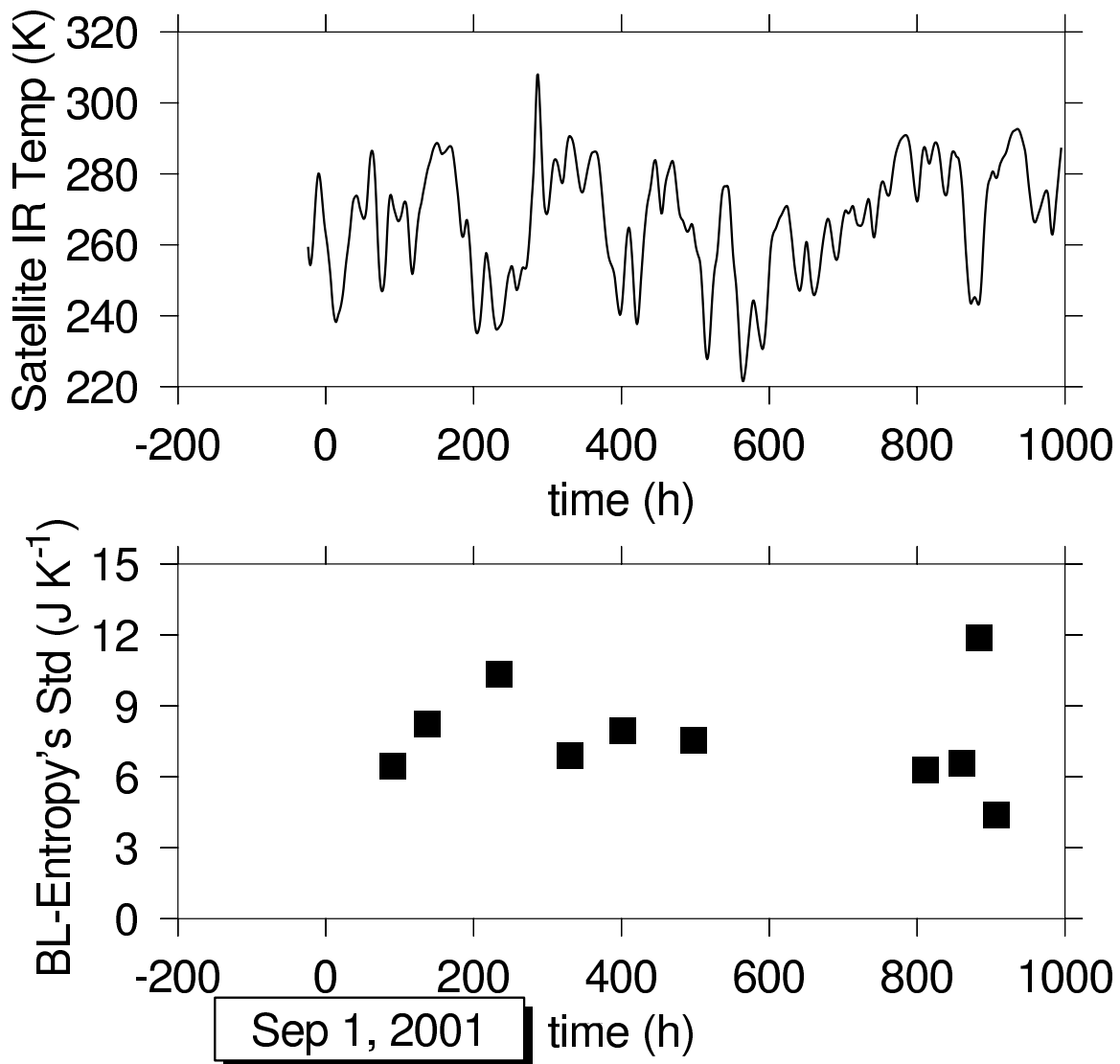
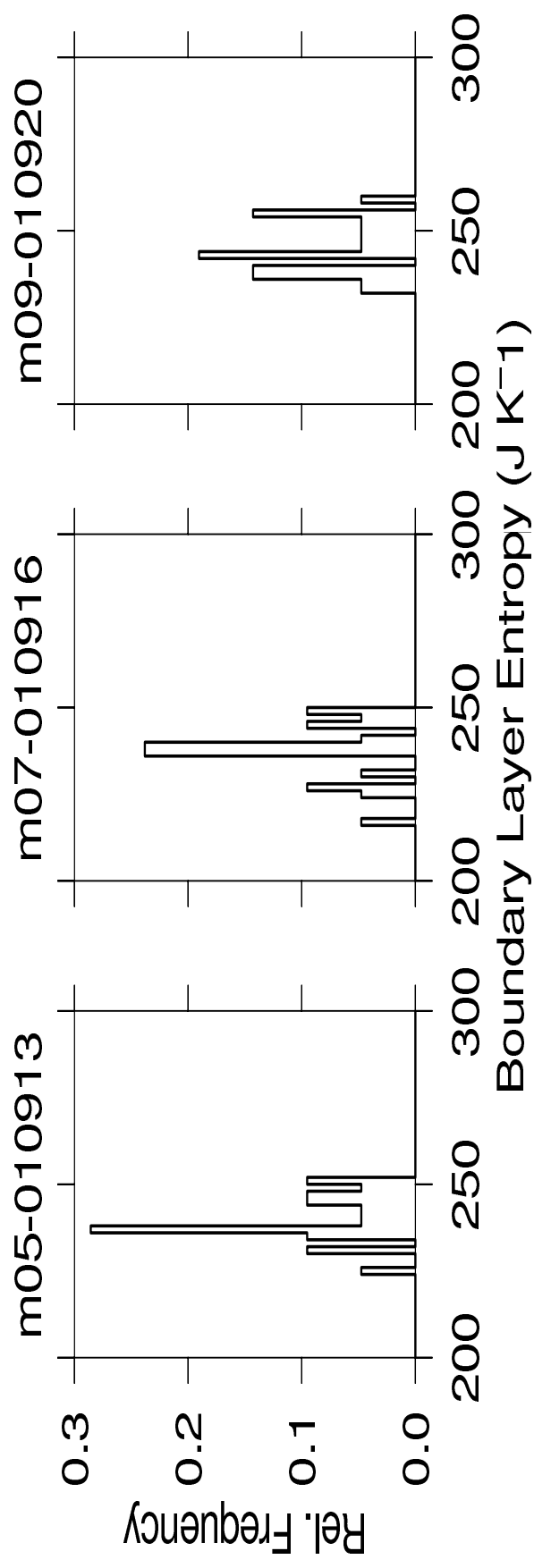
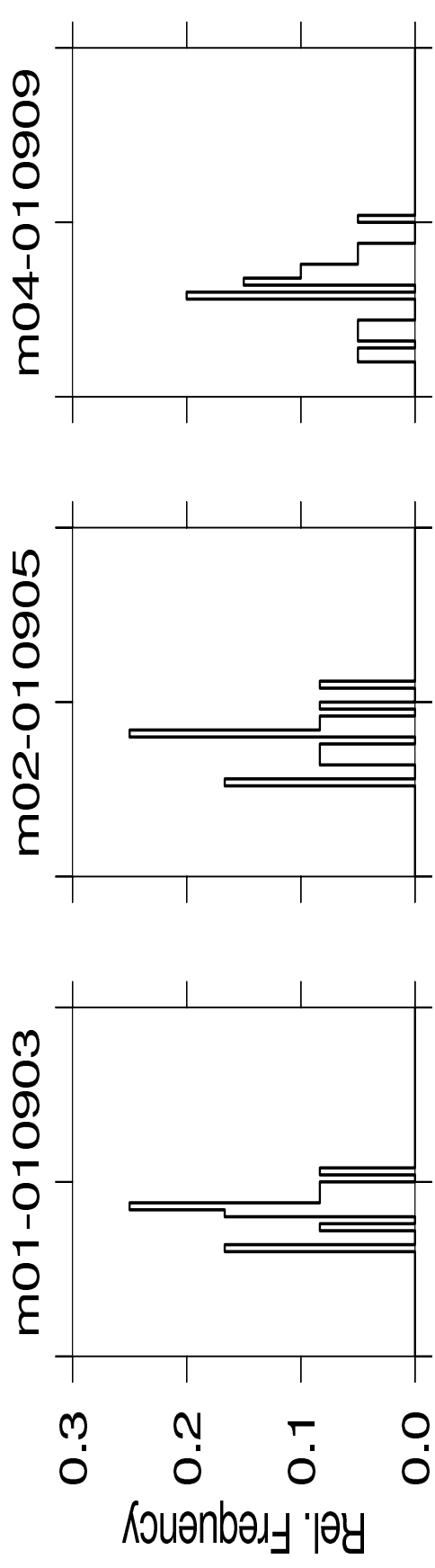


Figure 4. The upper panel shows the time series of the satellite infrared temperature averaged over the EPIC box. The lower panel shows the time series for the entropy's standard deviation in the boundary layer derived from dropsondes released by the WP3-43. The time is given in hours from 0 UTC, Sep 1, 2001.

WP3 Dropsondes The boundary layer entropy at each dropsonde site is calculated as the average of the entropies below 500 m. The standard deviation of those averages during each flight is used as a measure of the entropy variability in the boundary layer. The resulting time series is shown in the lower panel of figure 4. Histograms of the boundary layer entropy, for each flight, are shown in figure 3.



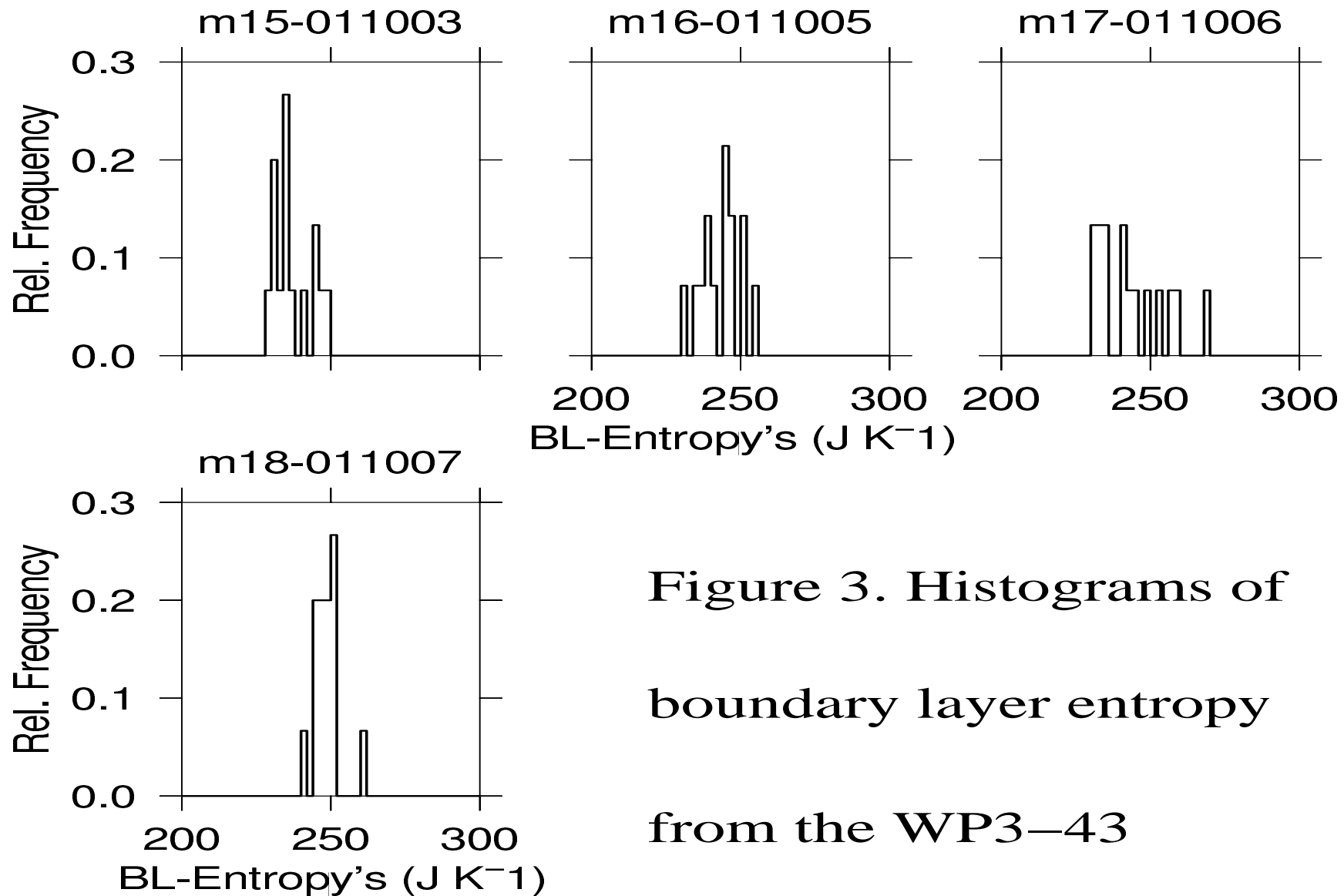


Figure 3. Histograms of
boundary layer entropy
from the WP3–43

Correlation coefficient First the linear trends are eliminated from the temperature and entropy time series. For each lag a group of detrended infrared temperatures is selected and correlated with the entropy's standard deviation time series. The groups are composed by those temperatures whose time value, when shifted by the given amount of lag, corresponds to a time in the entropy's time series – see figure 5. The Sperman's rank correlation coefficient is used to quantify the relation between the variables. The results with 95% confidence level are shown in figure 6.

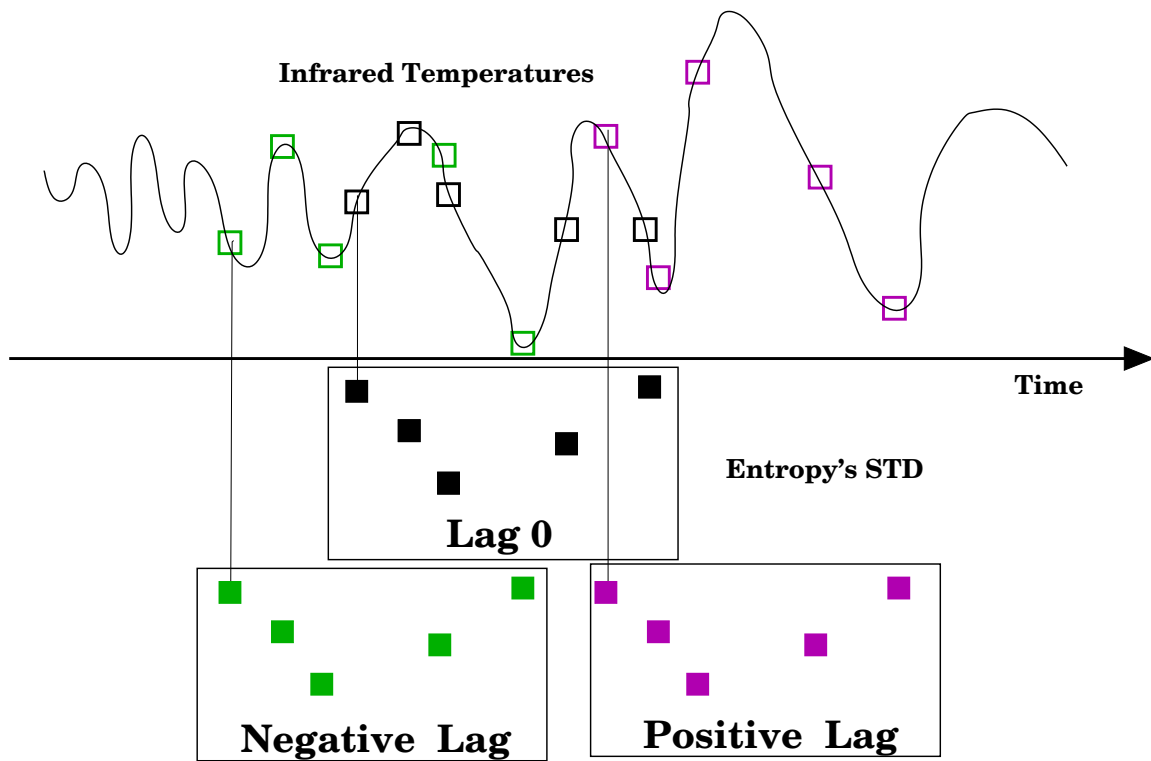


Figure 5. Schematic showing how groups of infrared temperature are selected for each lag. For a given lag, the Sperman's rank correlation coefficient is calculated between the entropy's standard deviation and the corresponding group of infrared temperatures.

R E S U L T S

It is found that convection leads the variability in the boundary layer entropy by about 10 hours, with deep convection broadening the entropy distribution.

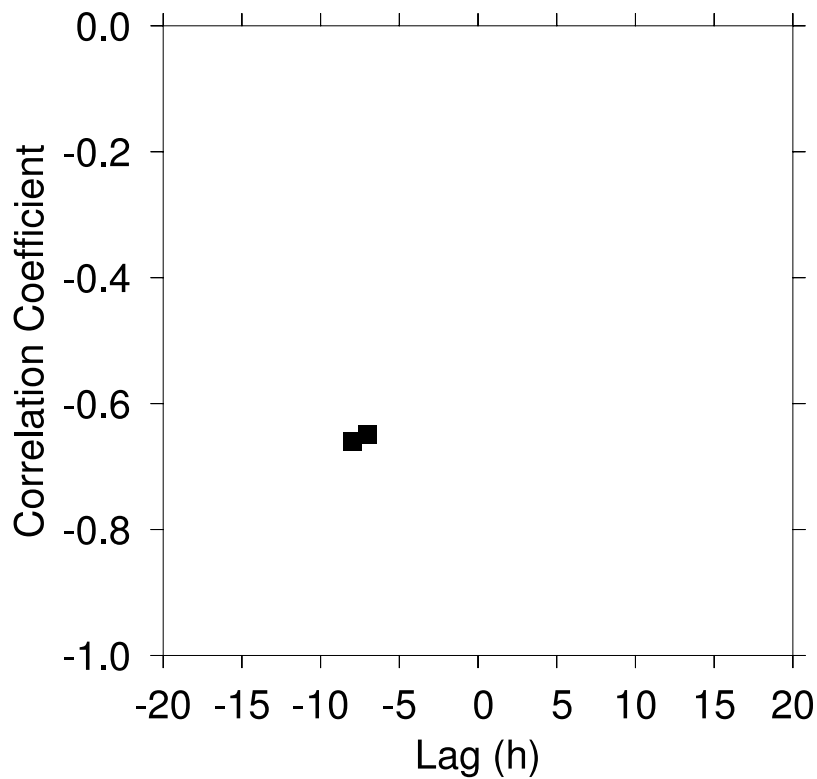


Figure 6. Spearman's correlation coefficient between average infrared temperature and entropy's standard deviation in the boundary layer as a function of lag. Negative lag indicates convection leading the entropy. The negative correlation shows deep convection (smaller values in the infrared temperature) broadening the entropy distribution in the boundary layer.