Analysis of UHSAS Particle-by-Particle Data in BBOP: An Indicator of New Aerosol Formation in Forest Fire Plumes

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Aerosol Particle Spatial Distributions

1. Predominately a random Poisson distribution.
2. Measured by optical scattering probes (UHSAS and CAPS) by particle inter-arrival times (iat) which have a predominately exponential distribution.

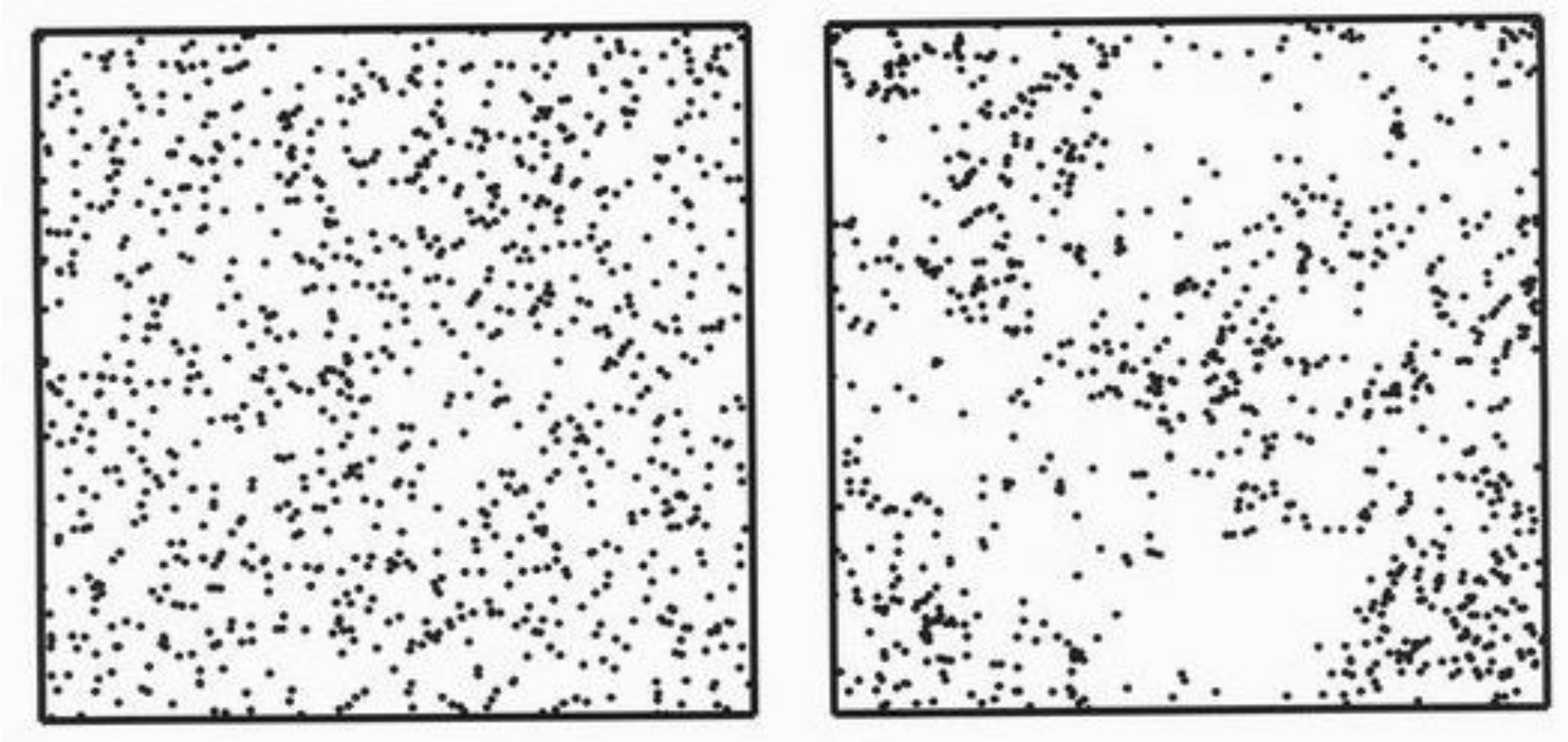
Parameterized by the Cluster Index, CI defined as:

$$\mathbf{CI = std(iat)/mean(iat)}$$

For every specified measurement period, 1 second in this study

If **CI =1**, then the aerosol spatial distribution is a random Poisson distribution
If **CI > 1**, then the aerosol spatial distribution is **"clustered"**

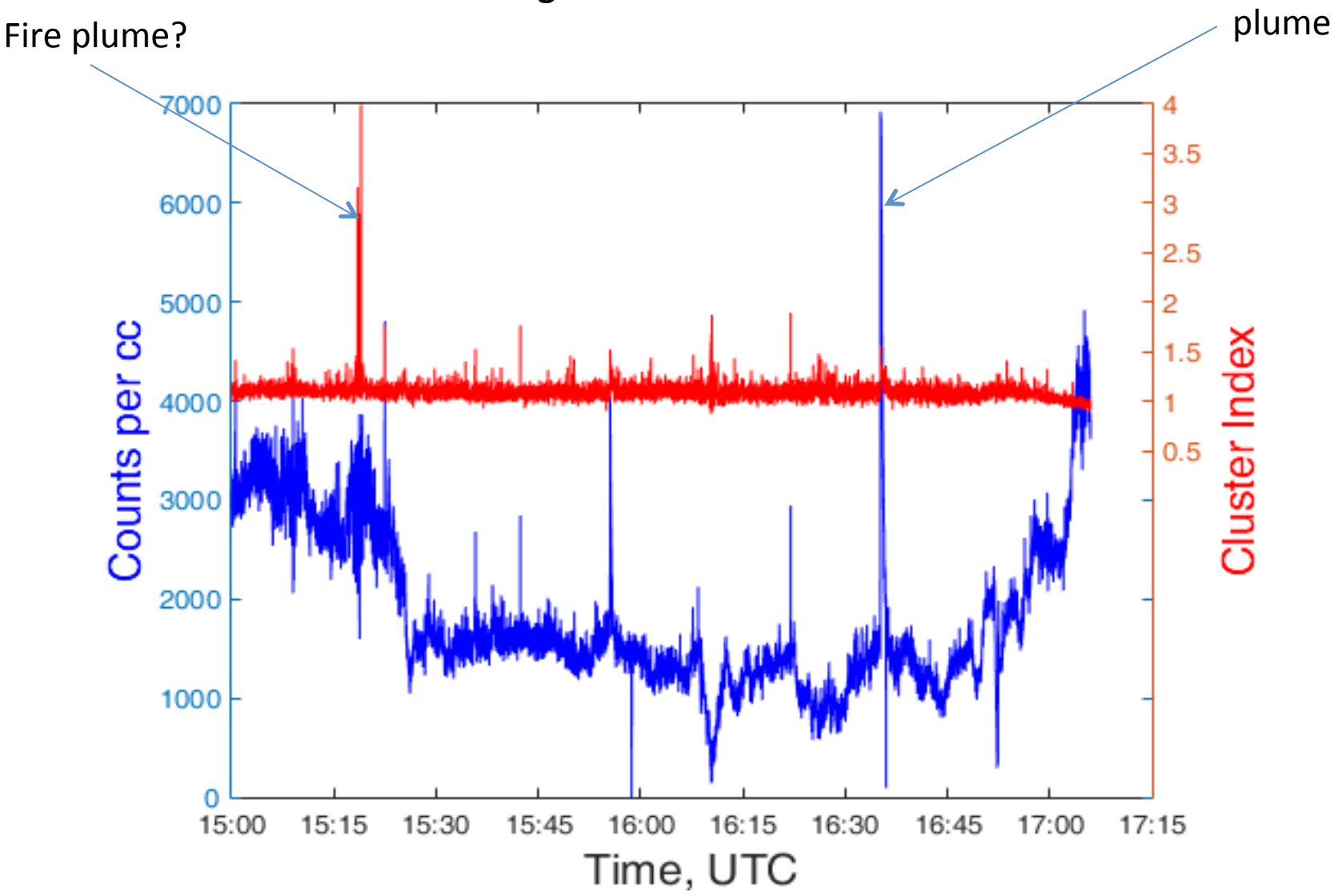
Examples of random and cluster distributions



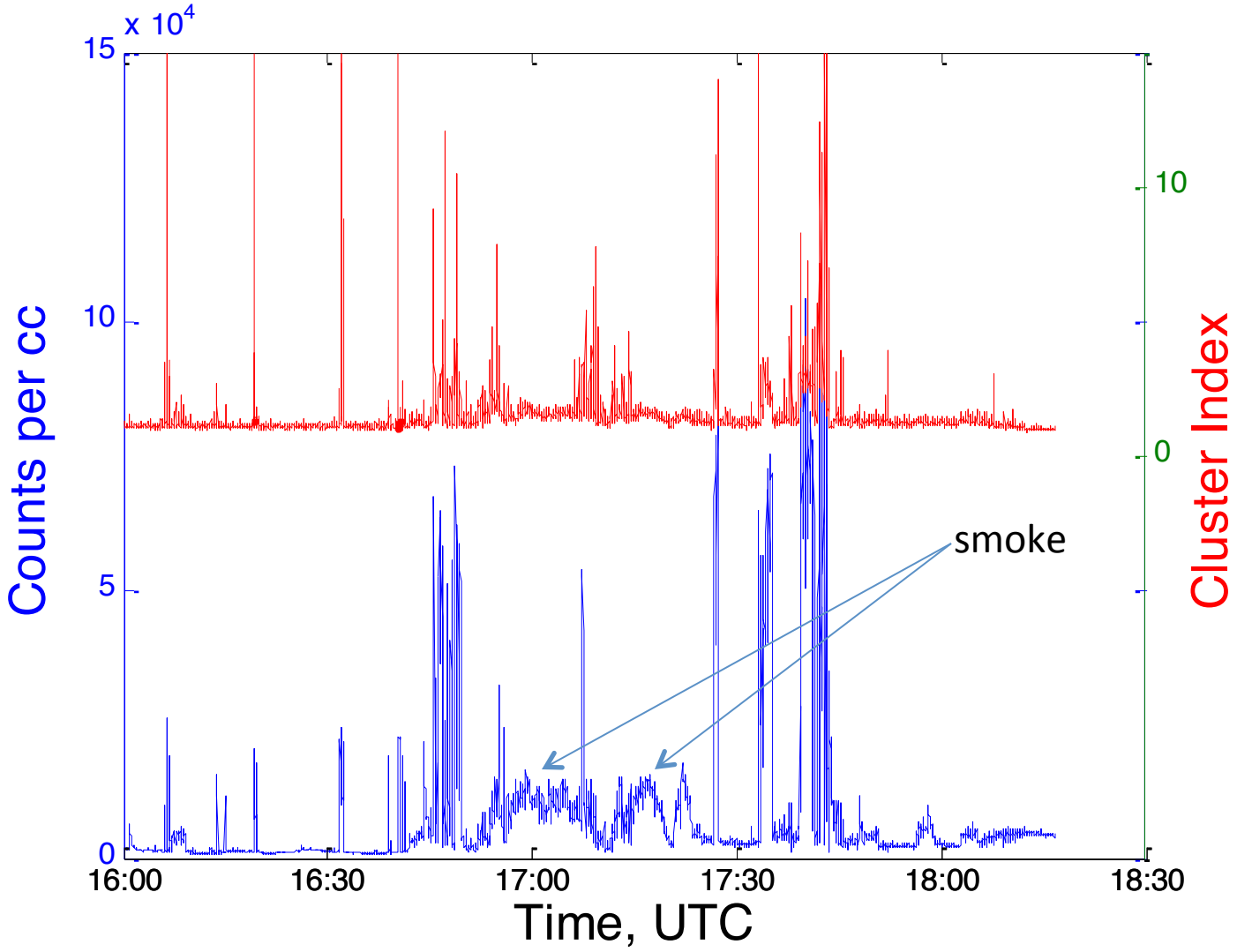
CI = 1

CI > 1

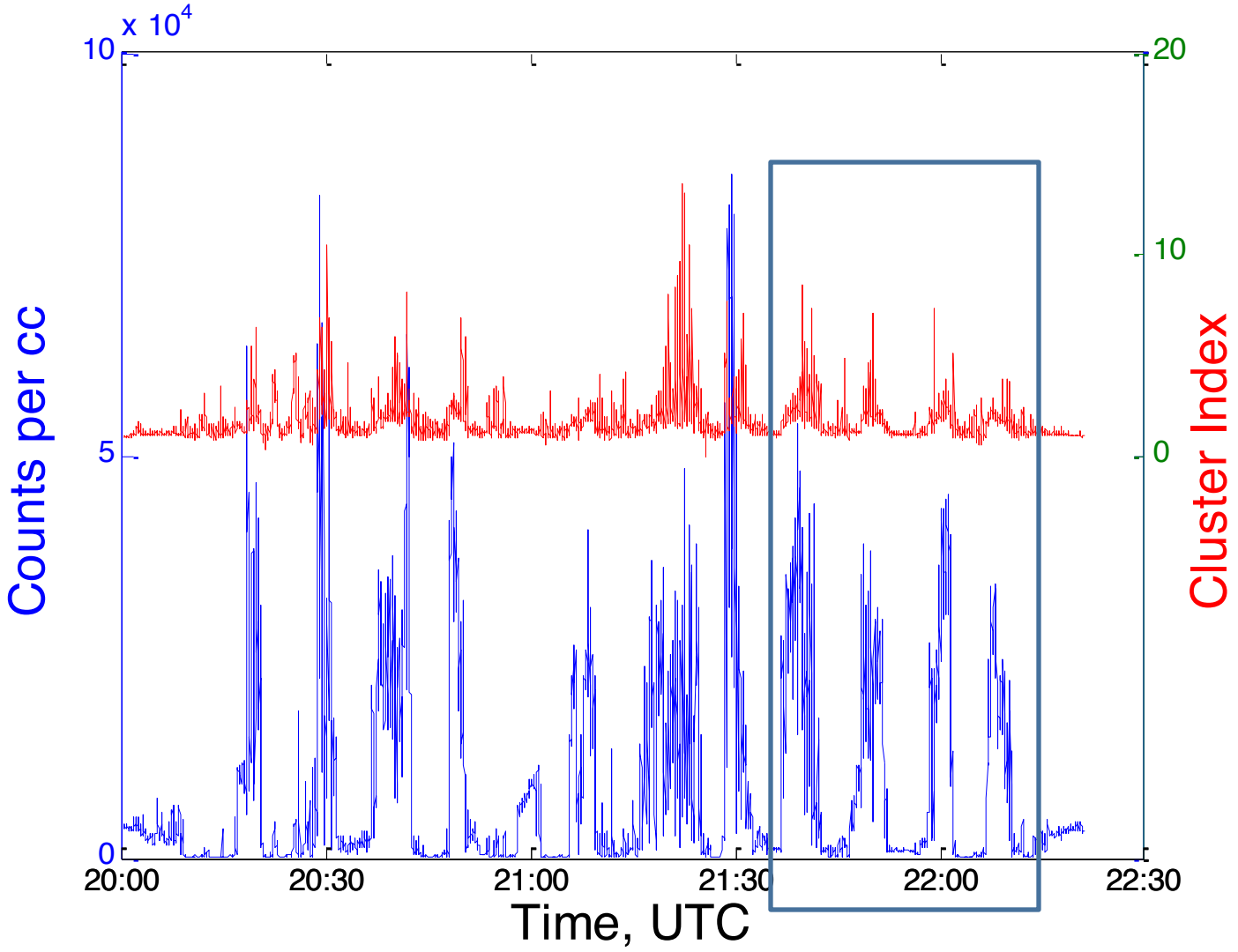
BBOP Flight without Forest Fires

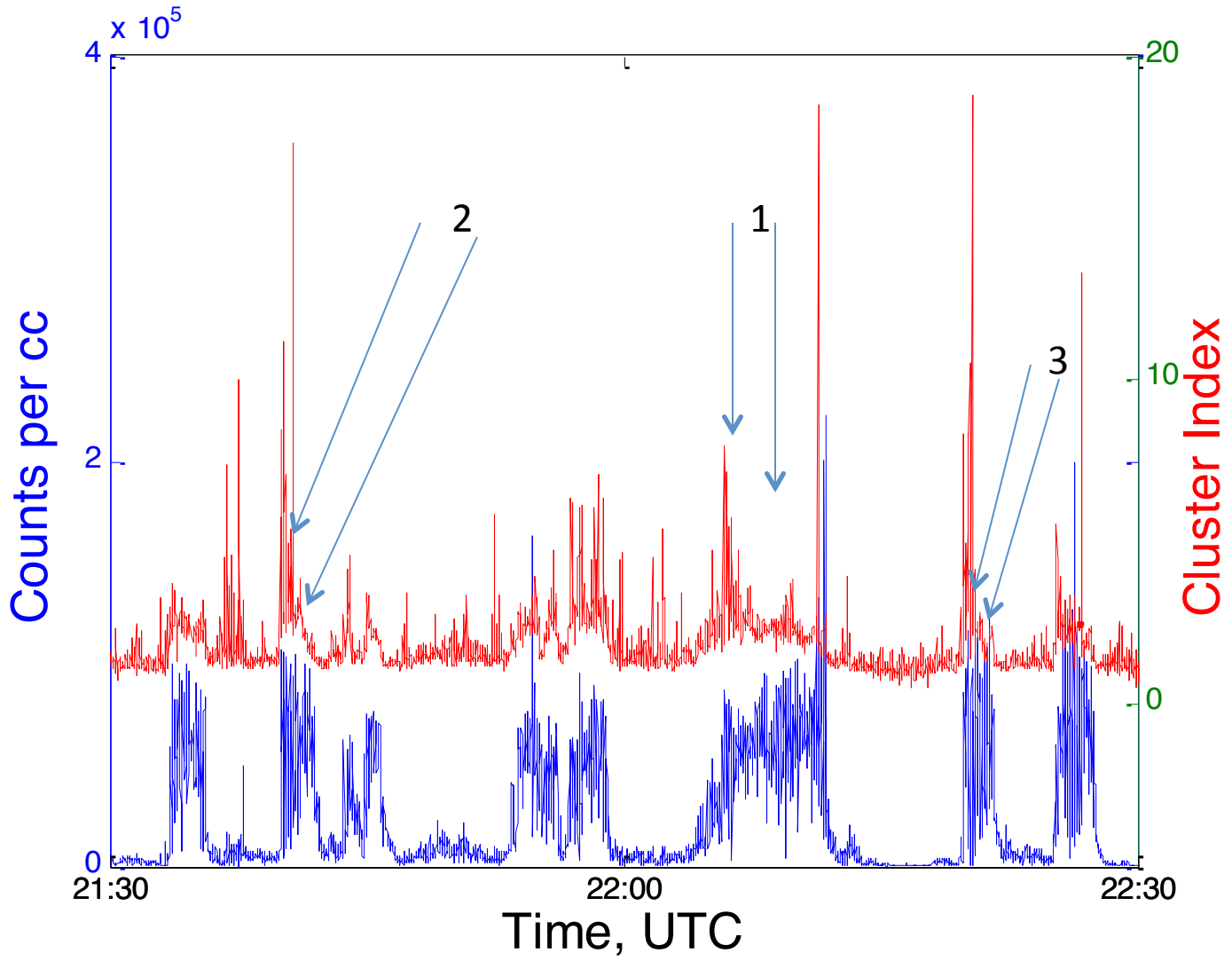


Smoke and Active Forest Fire



Lagrangian Transects away from an active Fire




Complex Active Fires
x 10^5
4
2
0
20
10
0
Counts per cc
Cluster Index
1
2
3
21:30
22:00
22:30
Time, UTC

Conclusions

The cluster index is a useful parameter to measure deviation from a random aerosol spatial distribution.

This cluster index calculated from UHSAs PbP data can be used to distinguish aged (CI=1) versus fresh (CI>1) fire produced aerosol plumes.

This can be helpful in the data analysis of the BBOP dataset.

This makes use of the underutilized PbP dataset produced by the UHSAS