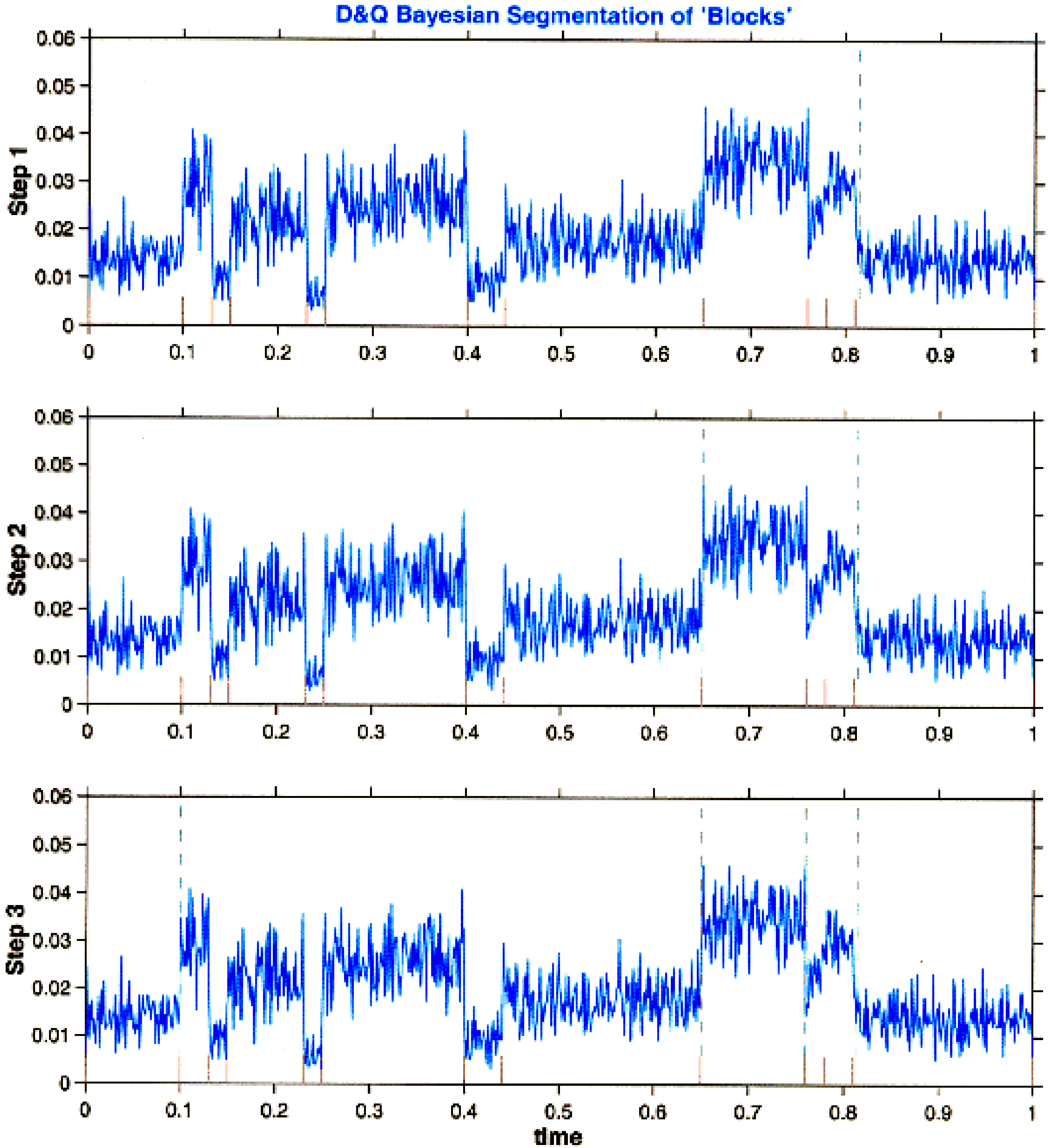
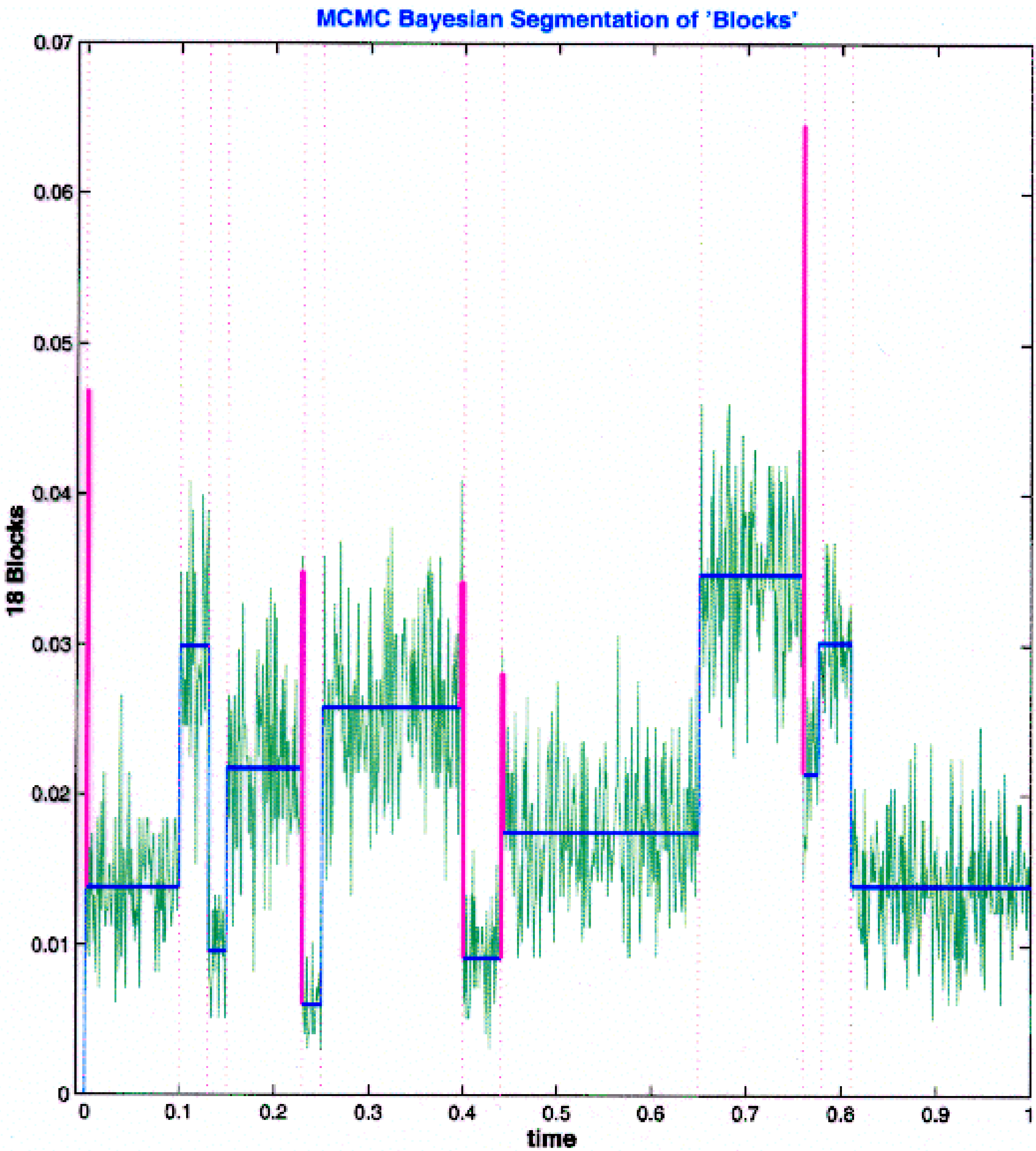
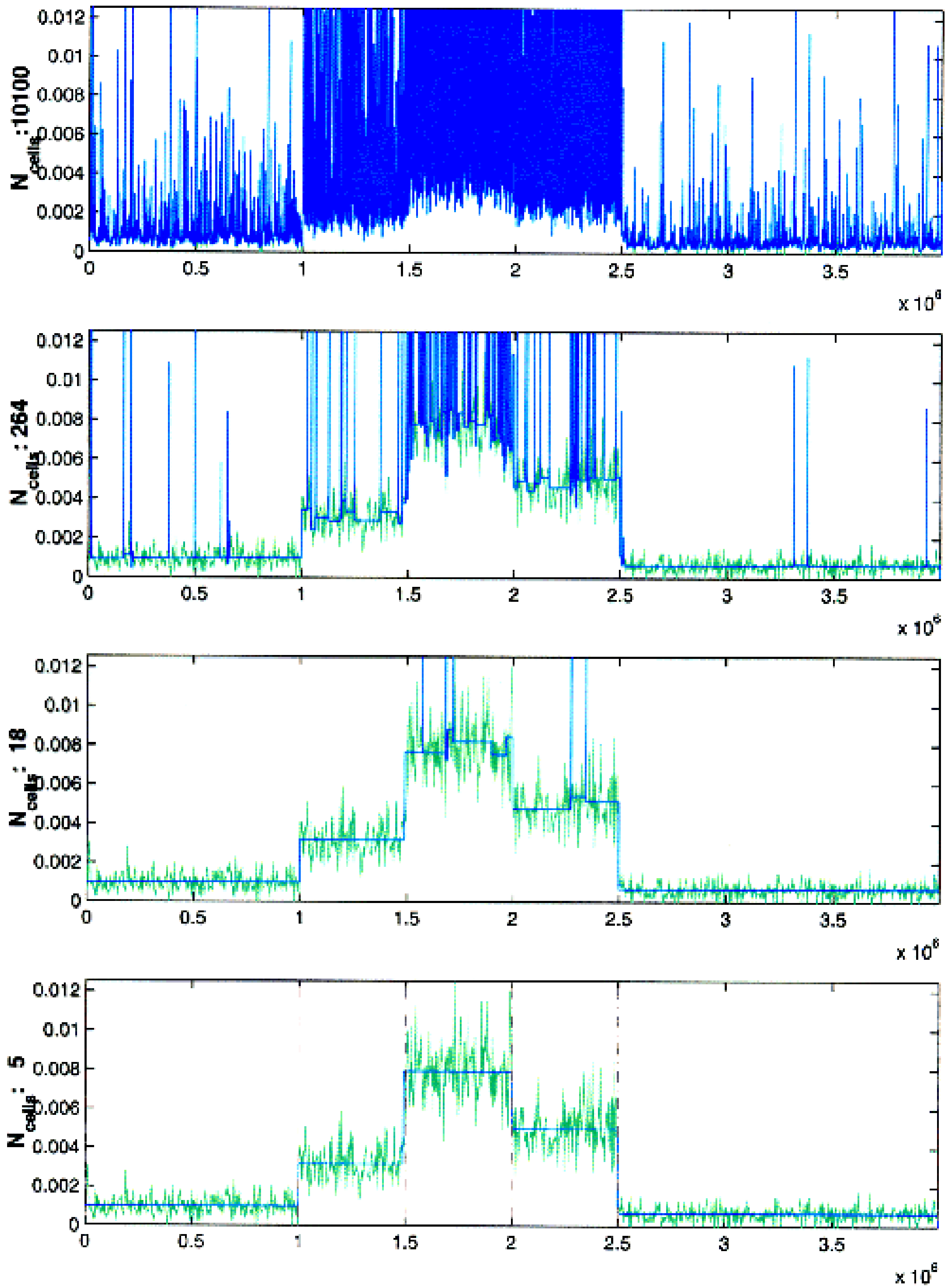

D&Q Bayesian Segmentation of 'Blocks'
Step 1
Step 2
Step 3
time
0.06
0.05
0.04
0.03
0.02
0.01
0
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1



MCMC Bayesian Segmentation of 'Blocks'
18 Blocks
time
0
0.01
0.02
0.03
0.04
0.05
0.06
0.07
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1



N_cells:10100
N_cells: 264
N_cells: 18
N_cells: 5
0.012
0.01
0.008
0.006
0.004
0.002
0
0.5
1
1.5
2
2.5
3
3.5
x 10^6

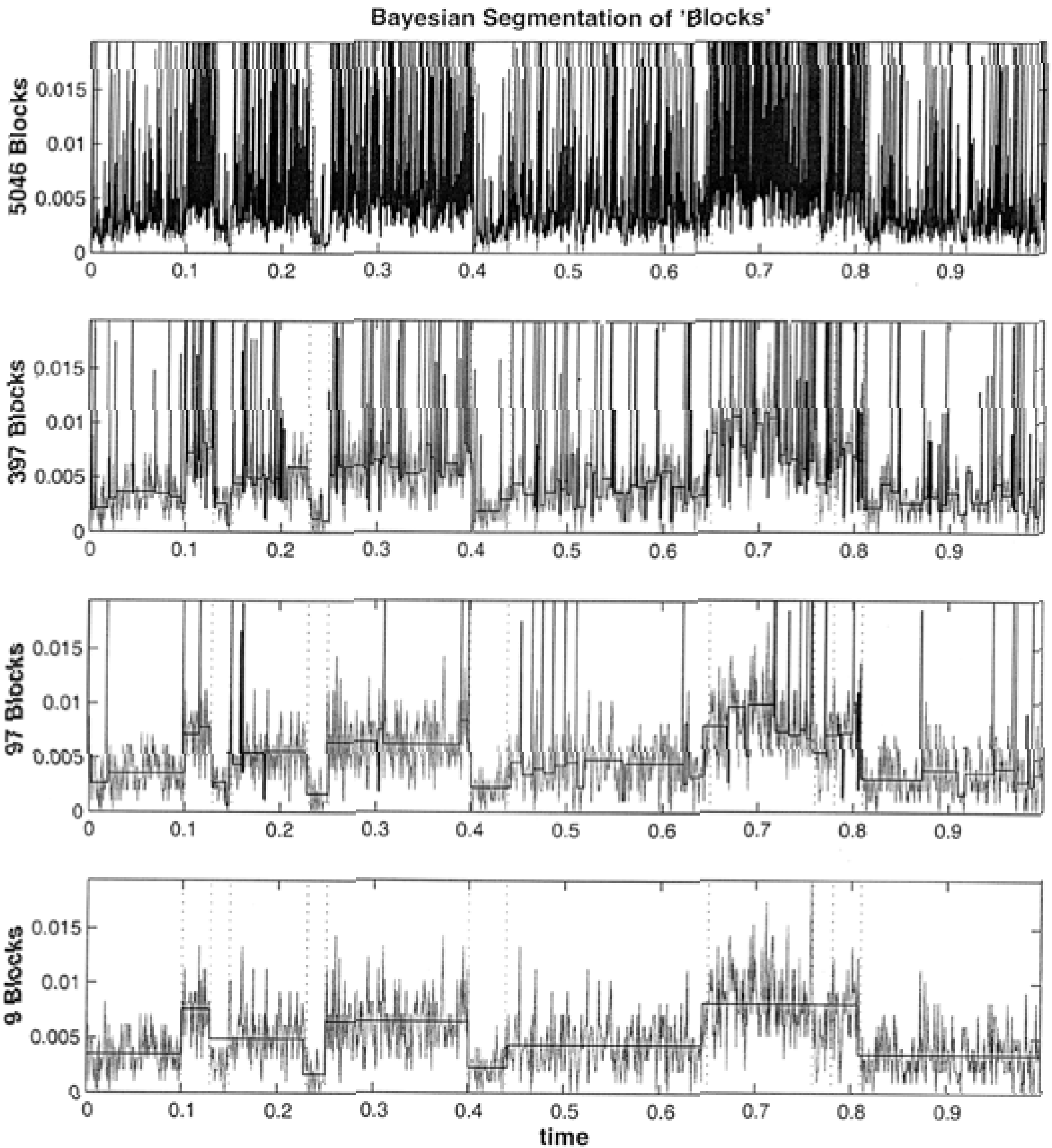
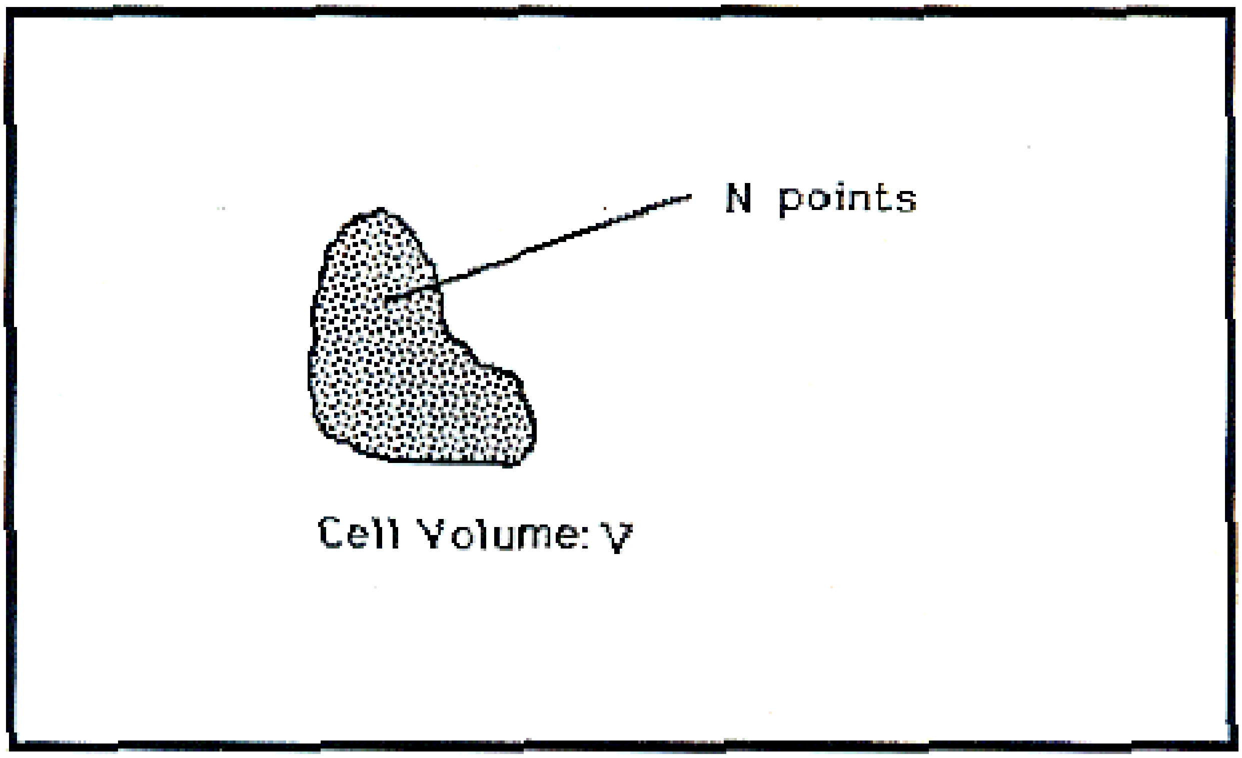
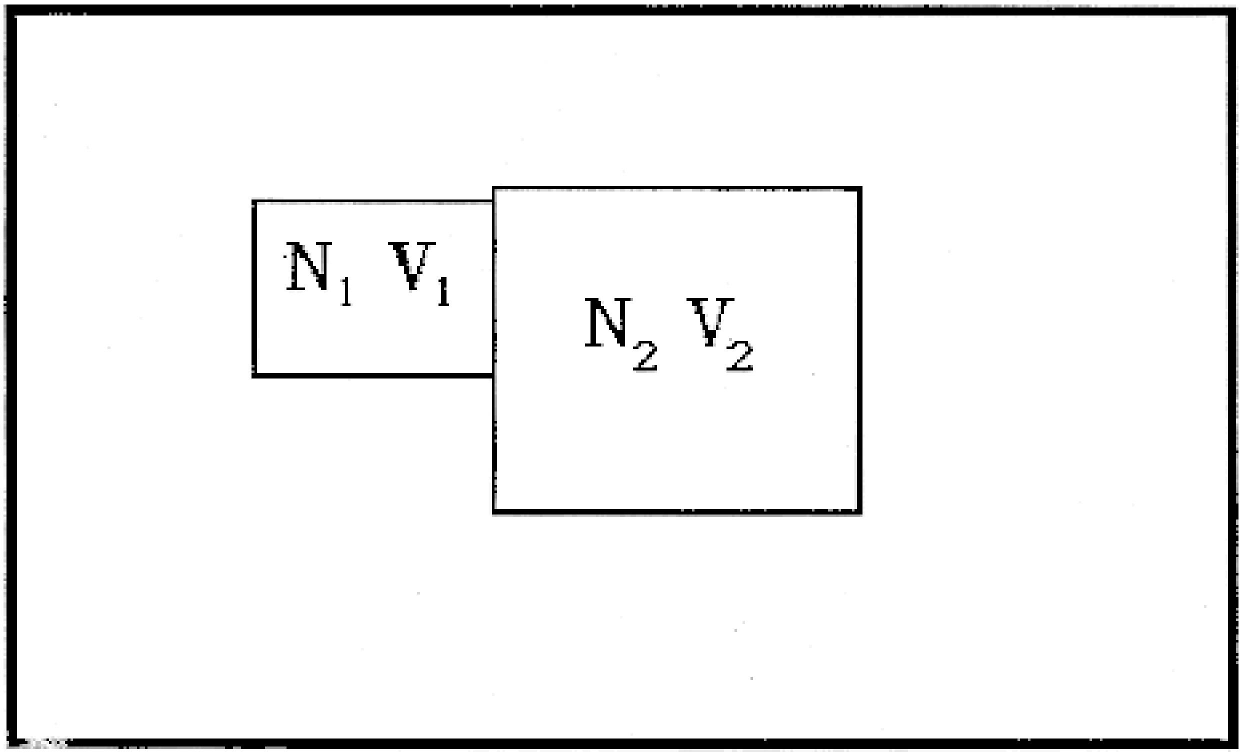


Figure 3. Block representations using the Cell Coalescence algorithm. The top panel shows the overly fine segmentation in the early stages of the iteration. In successive panels the process is converging toward a coarser representation. The bottom panel shows the first stage at which the Bayes factor contraindicates merging of all of the remaining blocks. The actual changepoints used to generate the data are shown as vertical dotted lines.



Marginal Likelihood = F(N, V)



Merge if likelihood for merged cell is greater than product of likelihoods of separate cells:

$$F(N_1 + N_2, V_1 + V_2) > F(N_1, V_1)\, F(N_2, V_2)$$

RANDOM LATTICE FIELD THEORY:
General formulation*

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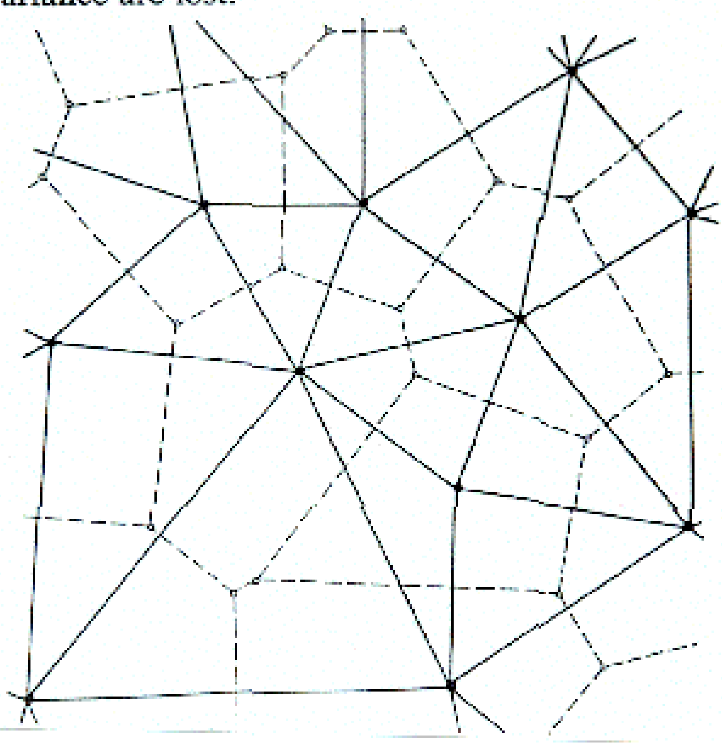
Received 4 February 1982

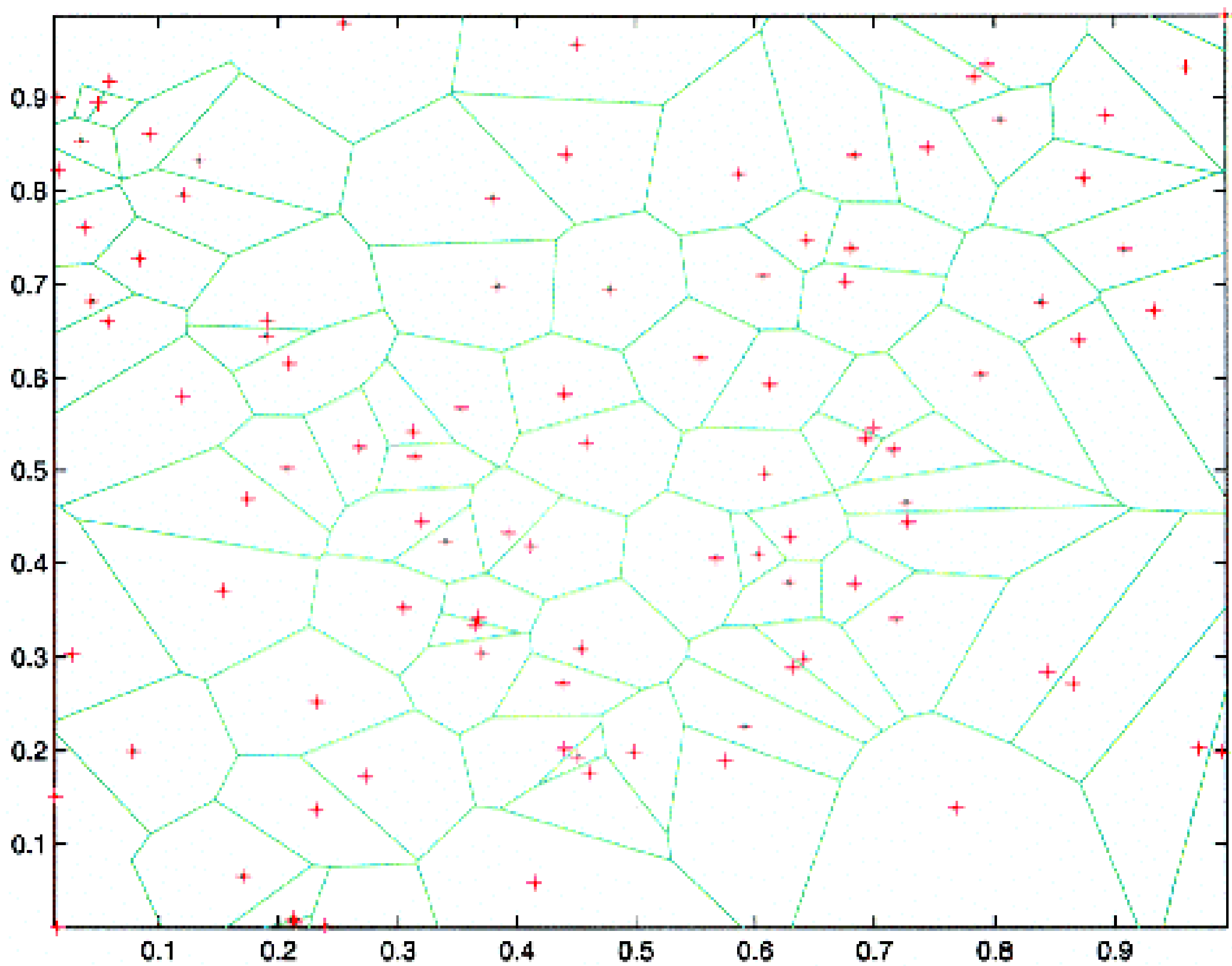
A new type of lattice field theory is formulated in which the sites are chosen randomly in space. An algorithm is given for linking nearby sites; these links form the edges of non-overlapping simplices which fill the entire volume. All physical quantities averaged over such a lattice can therefore be translationally and rotationally symmetric.

1. Introduction

Among the more promising techniques currently being used to investigate the properties of quantum field theory is the replacement of the space-time continuum on which the theory is defined by a discrete lattice**. Such a lattice approximation to a continuum field theory makes finite the number of degrees of freedom per unit volume, allowing the application of numerical methods to the approximate theory. Furthermore, the ultraviolet divergences of the theory are regulated in a manner not requiring the use of perturbation theory. Applications of this method to date have used a lattice based on a regular, hypercubic array of points in space or space-time. Although such a regular lattice is the simplest choice, its introduction explicitly violates the Poincaré symmetry possessed by the original theory. Both the translation and Lorentz invariance are lost.



Nuclear Physics B202 (1982) 89–125



0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9

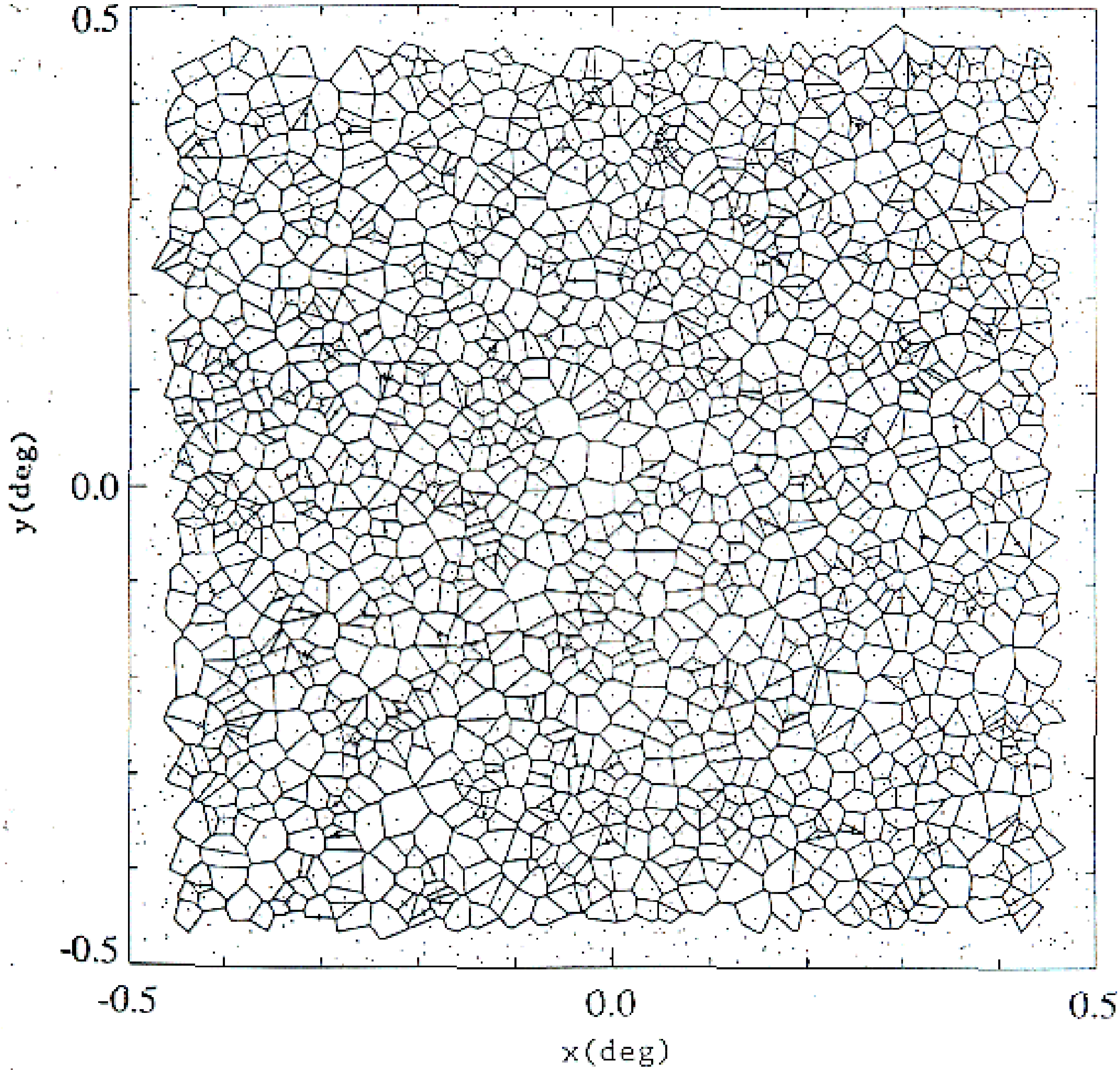
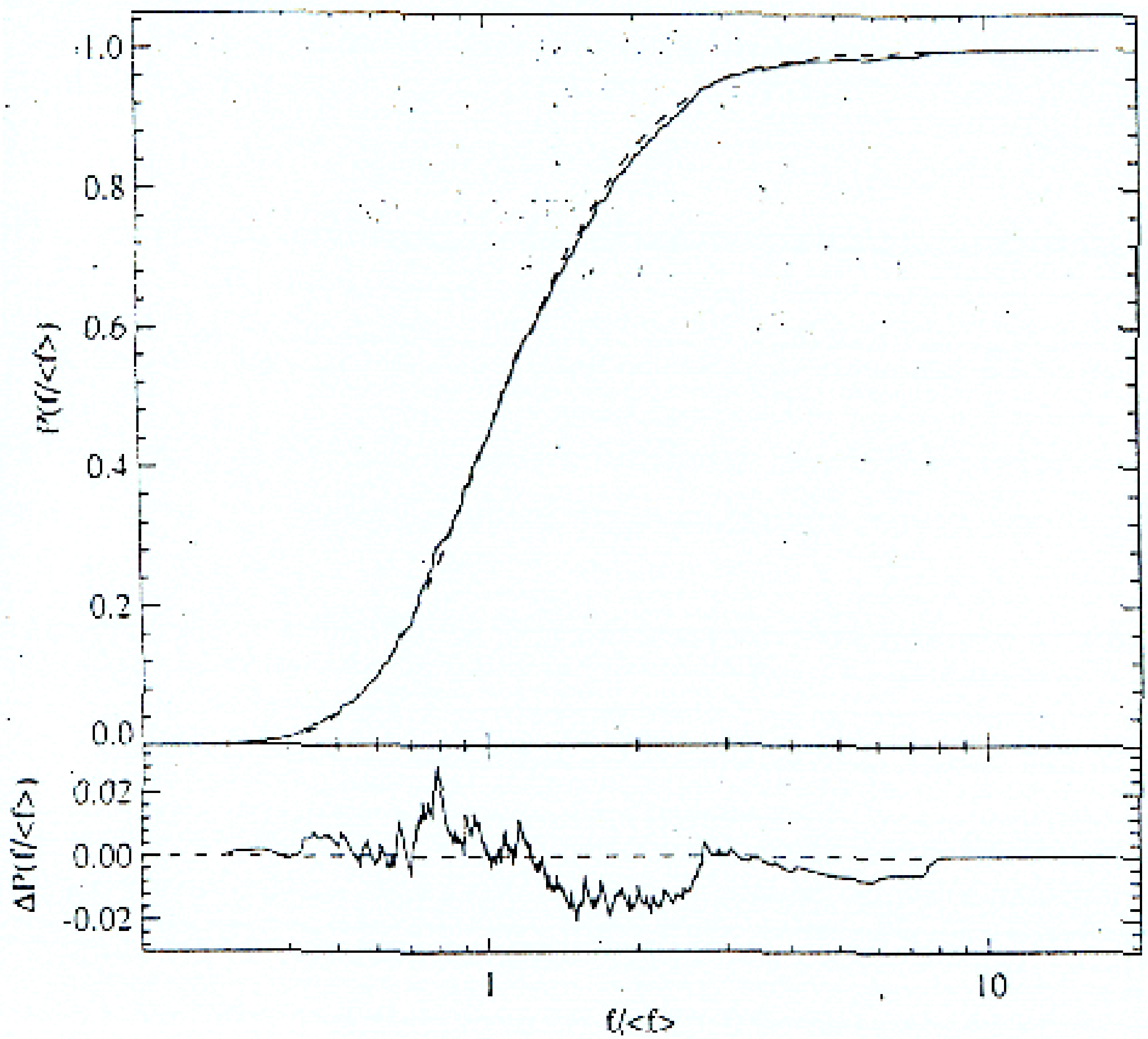
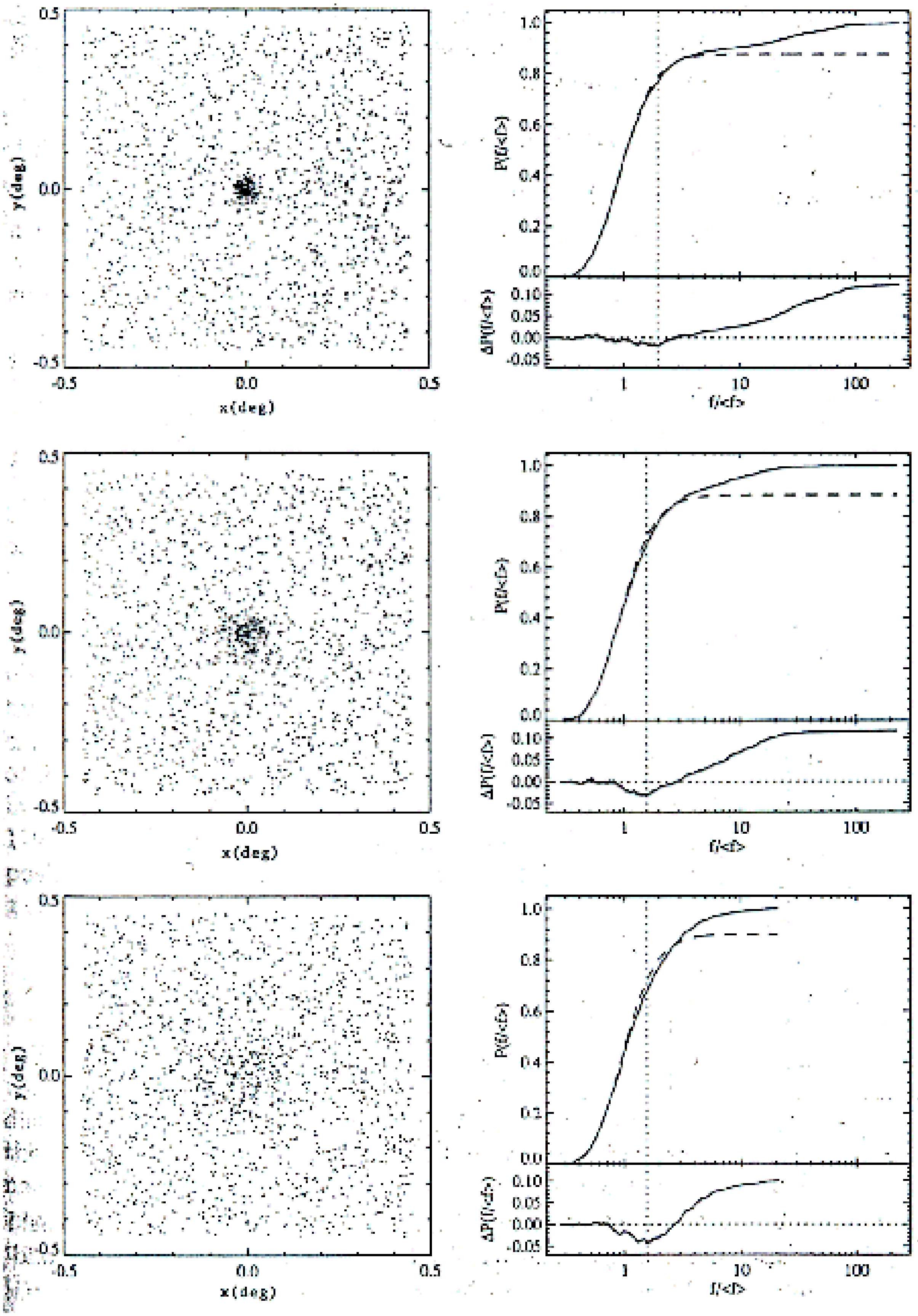


FIG. 1. Voronoi tessellation of a sample set of 2000 randomly positioned photons in a $1^\circ \times 1^\circ$ field.


1.0
0.8
0.6
0.4
0.2
0.0
P(f/<f>)
0.02
0.00
-0.02
ΔP(f/<f>)
1
10
f/<f>



0.5
0.0
-0.5
y (deg)
x (deg)
1.0
0.8
0.6
0.4
0.2
0.0
P(f/<f>)
0.10
0.05
0.00
-0.05
ΔP(f/<f>)
1
10
100
f/<f>

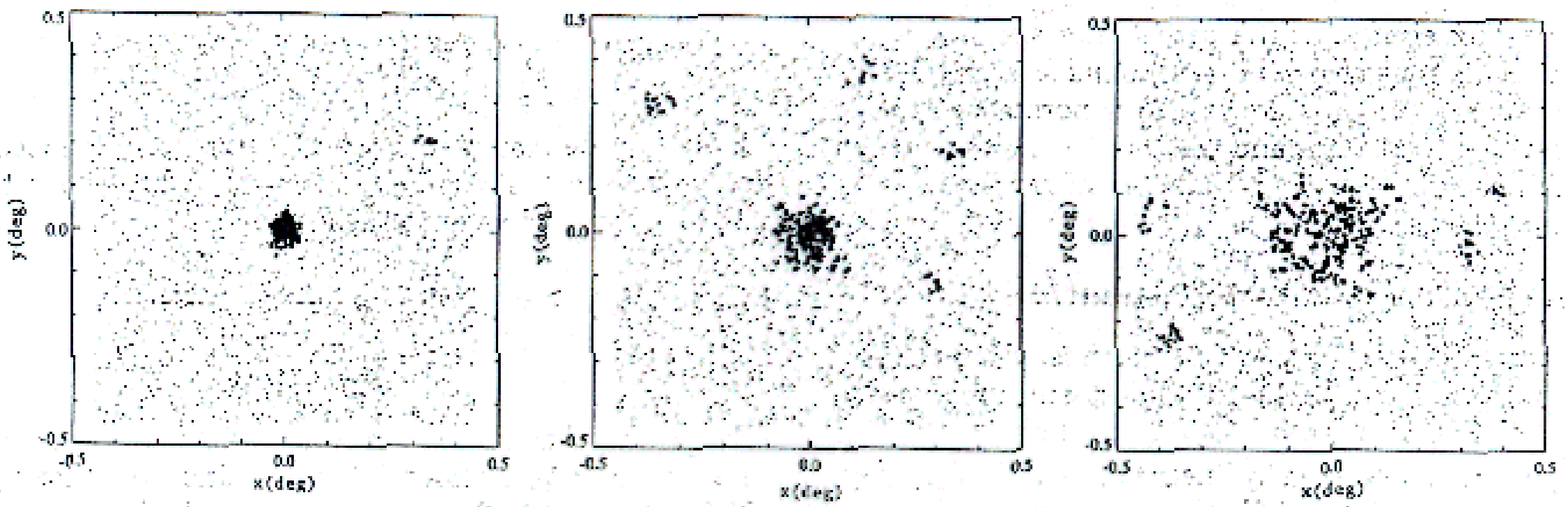


FIG. 4. Sources found in the simulated fields by our algorithm (left to right: $\sigma = 1', 2', 4'$).

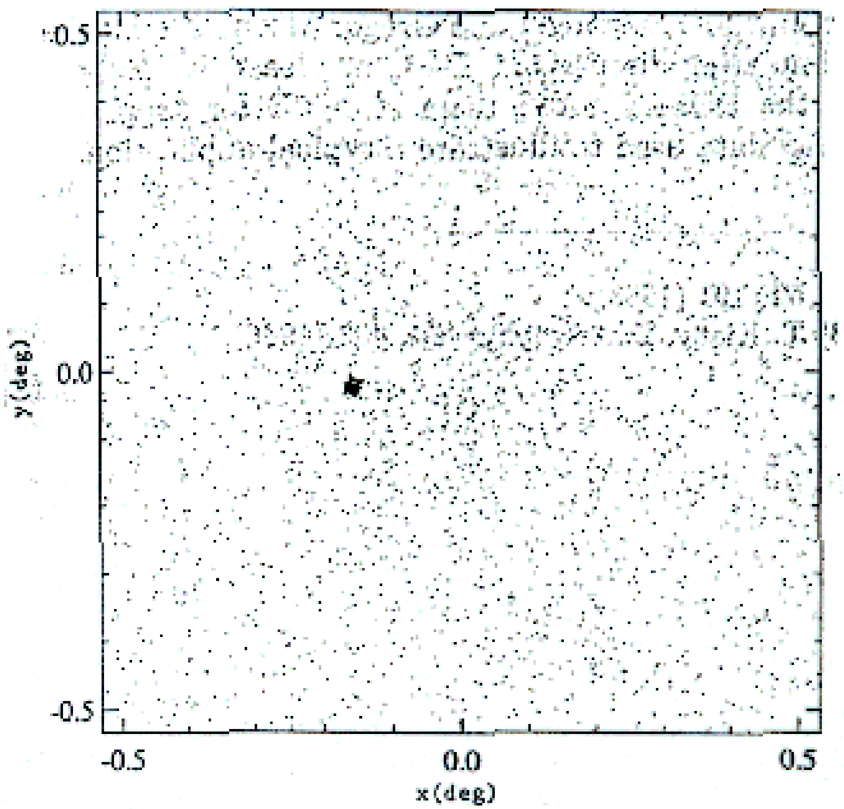


FIG. 6. Photon distribution in a field from the ROSAT all-sky survey.

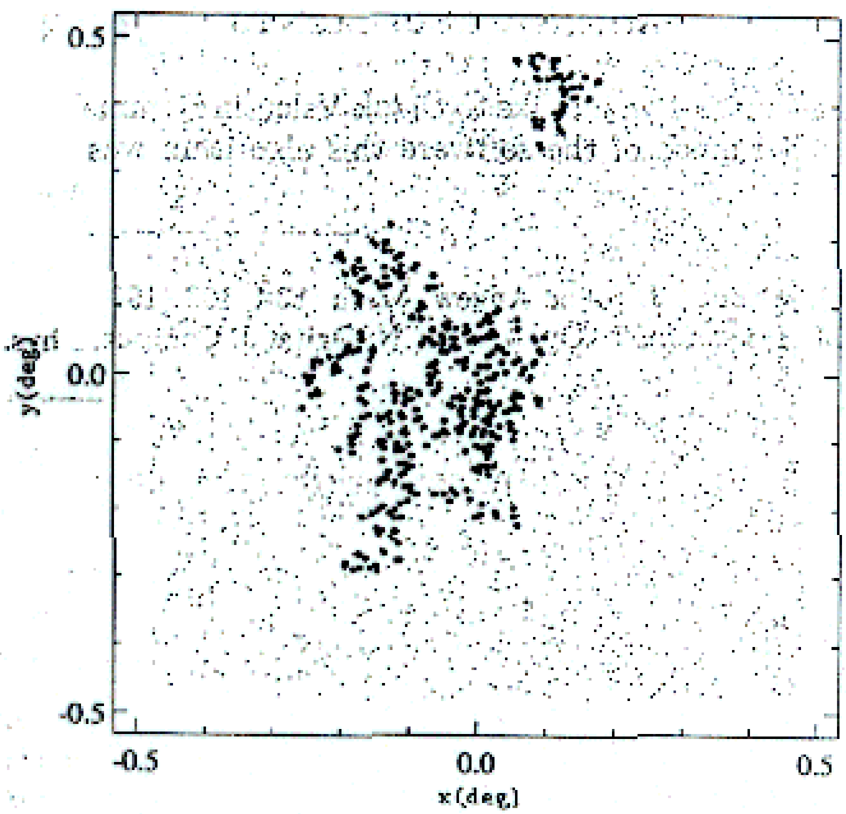
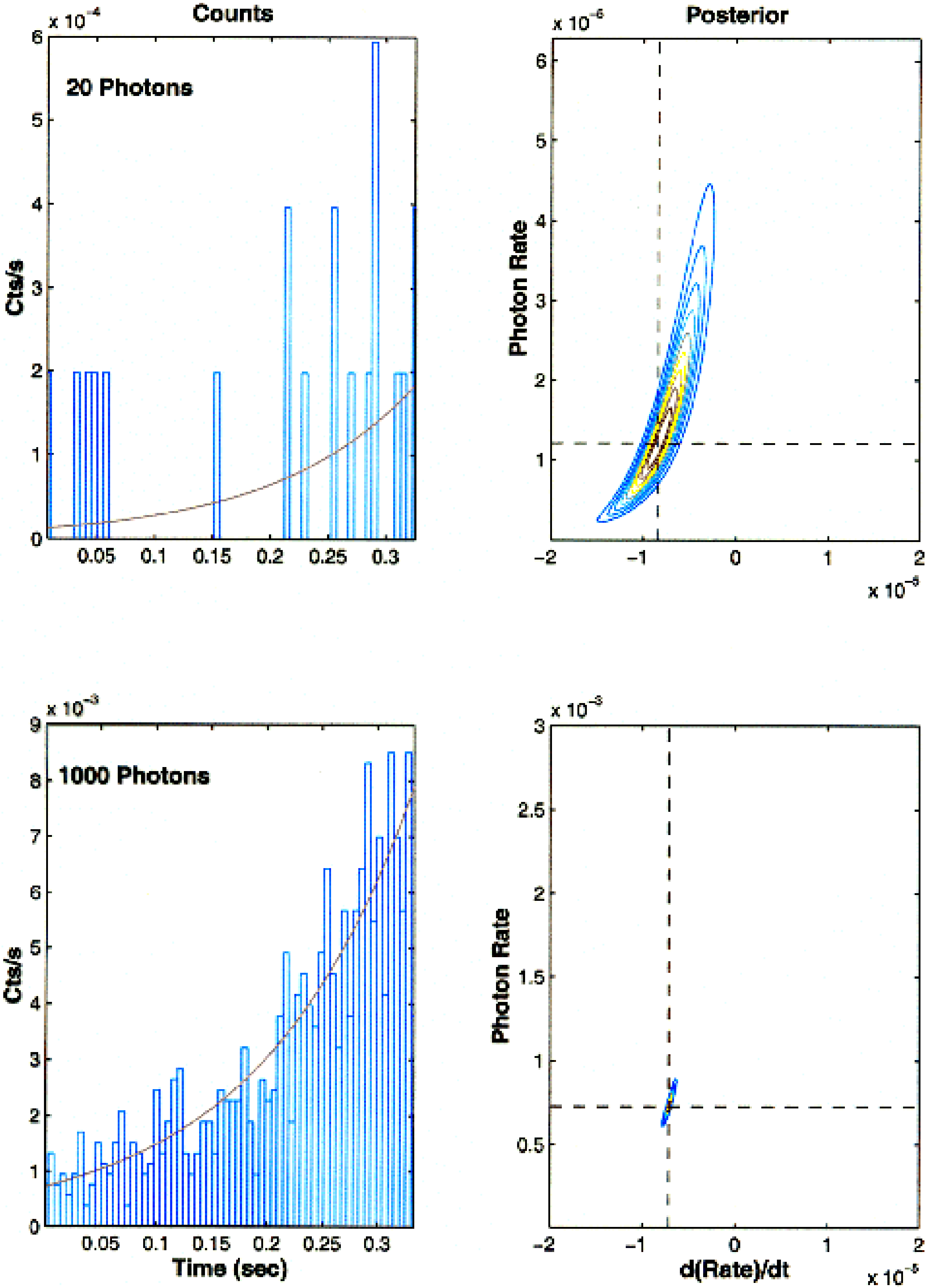


FIG. 7. Sources detected by the algorithm in the ROSAT field.



Counts
Posterior
20 Photons
1000 Photons
Cts/s
Photon Rate
Time (sec)
d(Rate)/dt

ADVANTAGES OF BAYESIAN BLOCKS

- DATA DETERMINES STRUCTURES
- NO BINS
  - NO DEPENDENCE ON BIN SIZE
  - NO DEPENDENCE ON BIN LOCATION
  - NO ARTIFICIAL LIMITS ON RESOLUTION
- NO SLIDING WINDOWS
- MULTIPLE INTENSITY LEVELS
- EXACT TREATMENT OF STATISTICS
- AUTOMATIC BACKGROUND DETERMINATION

TBD:

- TIME VARIABILITY (3D BLOCKS?)
- POINT SPREAD FUNCTION