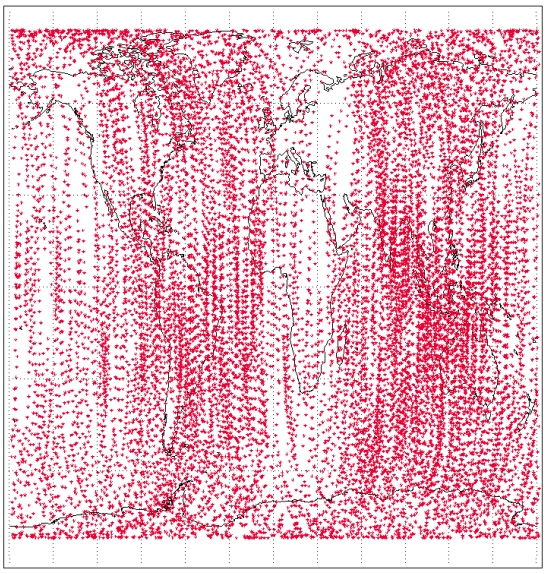
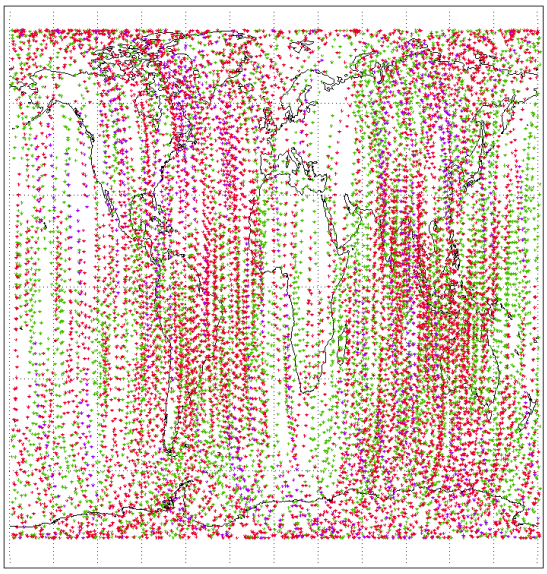
UV background

Tatiana data: web site of the MSU-250 project: *http://cosmos.msu.ru*

Measurements from January 2005 to March 2007
UV range: 300-400 nm
Acceptance cone of UV detector 14° - diameter of the observed area in the atmosphere 250 km
D3 data - see article: UV radiation from the atmosphere: Results of the MSU "Tatiana" satellite measurements, G.K. Garipov et al., Astroparticle Physics, Volume 24, Issues 4-5, 2005, Pages 400-408



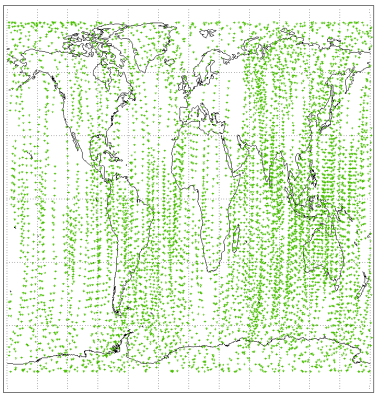
All Tatiana data - positions of measurements



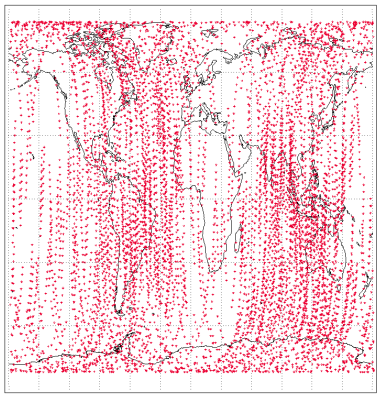
All Tatiana data, green for 2005, red for 2006 and magenta for 2007

Points of measurements year by year

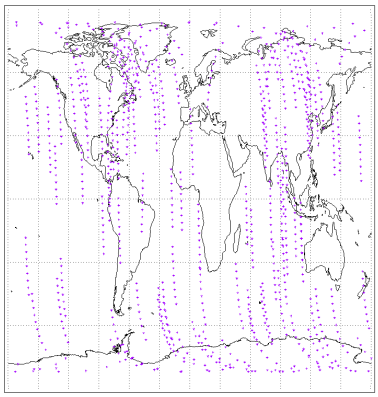
2005



2006



2007



Because JEM-ESUO will measure on the night side, we select from Tatiana data just those where Sun is 18° under local horizon i.e. Sun zenith angle (S_{ZA}) is more than 108°. Alternatively we use for selection S_{ZA} < 112.5° and 90° combined with Moon zenith angle (M_{ZA}) 90°.

Sun zenith angle > 108° , Tatiana trajectory reduced to latitude < 51.6°

- D3 data from region where geo. latitude < 51.6°

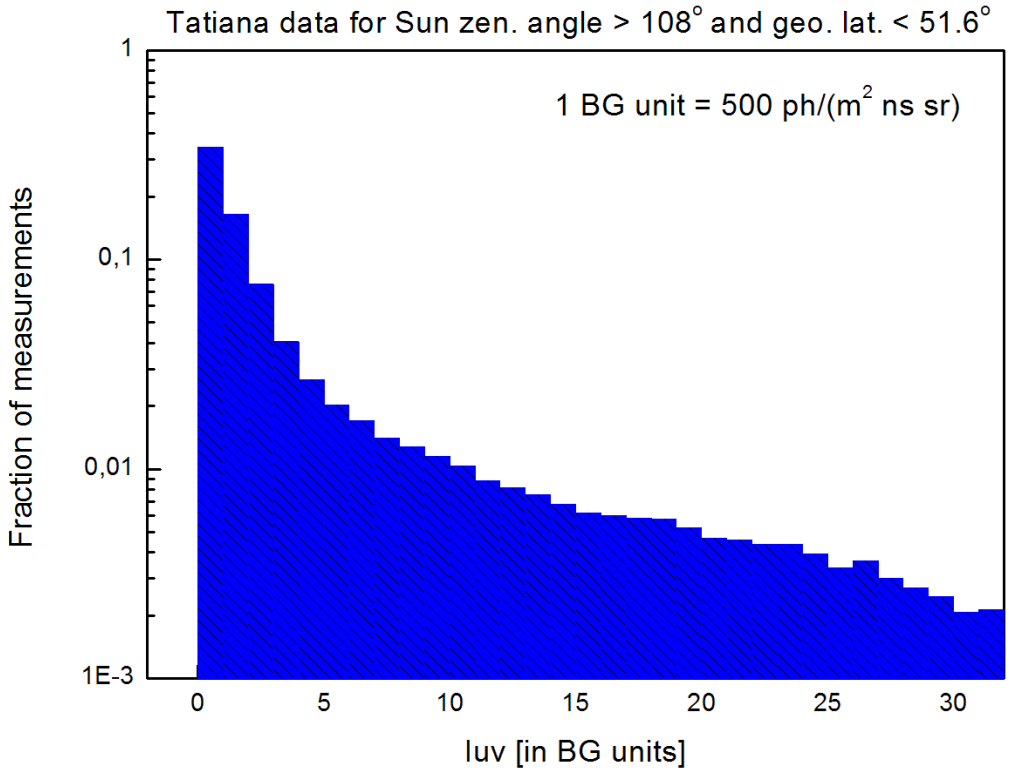


Table 1.

BG in 500 ph/(m^2 s sr)	Coverage [%]	Sum [%]	Rest of hist. [%]
BG x 1	34.4205	34.4205	65.5795
BG x 2	16.5006	50.9211	49.0789
BG x 3	7.6335	58.5546	41.4454
BG x 4	4.0558	62.6104	37.3896
BG x 5	2.6692	65.2797	34.7203
BG x 6	2.0302	67.3099	32.6901
BG x 7	1.7067	69.0166	30.9834
BG x 8	1.3996	70.4161	29.5839
BG x 9	1.2782	71.6943	28.3057
BG x10	1.1520	72.8463	27.1537
BG x11	1.0358	73.8821	26.1179
BG x12	0.8807	74.7629	25.2371
BG x13	0.8142	75.5771	24.4229
BG x14	0.7536	76.3307	23.6693
BG x15	0.6790	77.0097	22.9903
BG x16	0.6153	77.6250	22.3750
BG x17	0.5997	78.2247	21.7753
BG x18	0.5822	78.8069	21.1931
BG x19	0.5760	79.3829	20.6171
BG x20	0.5252	79.9081	20.0919

Average $_{<3xBG}$ = 521.2650 ph/(m^2 s sr)

1. column - UV intensity in BG units, 1 BG = 500 ph/(m^2 s sr)
2. column - fraction of measurements with selected BG level in %
3. column - sum of fractions for BG with UV intensity less than selected BG (= value from 1. column)
4. column - 100% minus value in 3. column

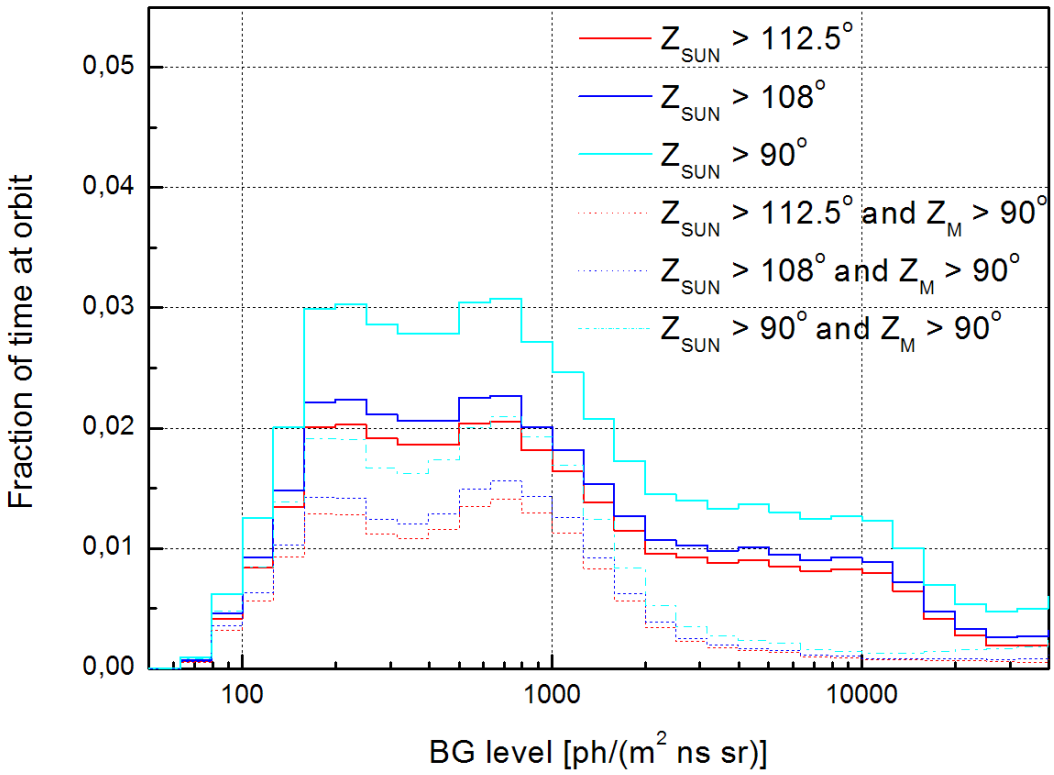


Fig. 1. Fraction of time at orbit (D3 data) for set of S_{ZA} (Z_{SUN} on figure) and Moon zenith angle 90°.

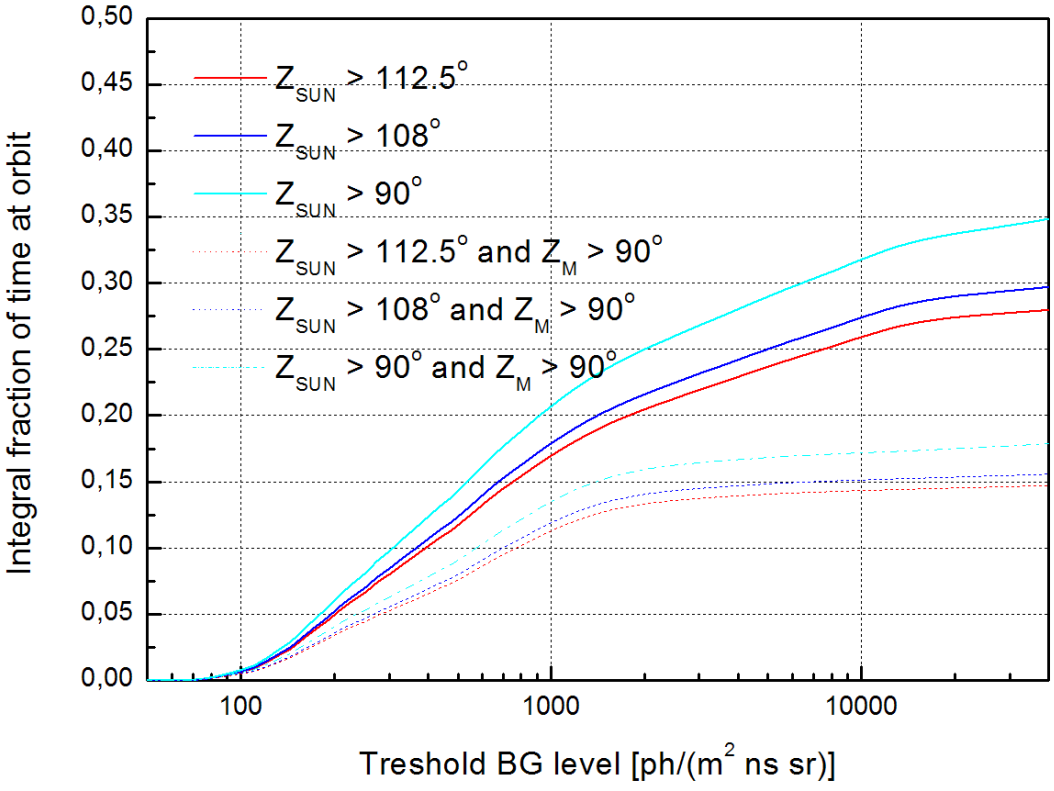


Fig. 2. Integral fraction of time at orbit (D3 data) for set of S_{ZA} (Z_{SUN} on figure) and Moon zenith angle 90° as function of BG treshold.

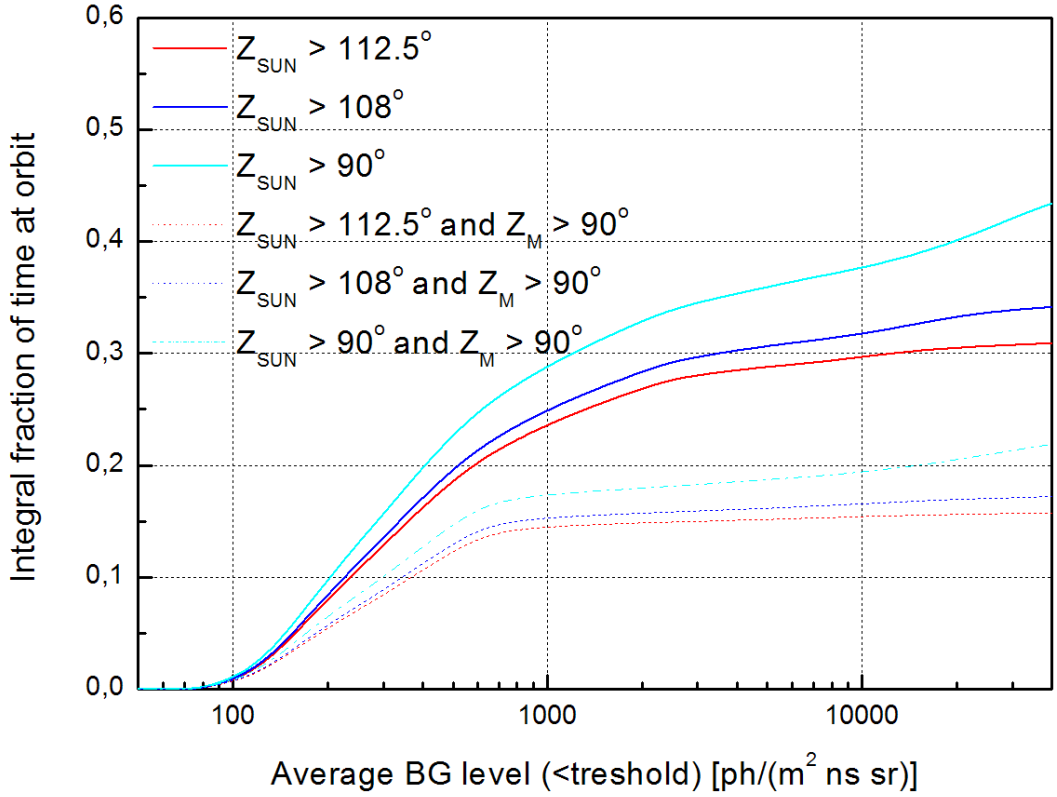


Fig. 3. Integral fraction of time at orbit (D3 data) for set of S_{ZA} (Z_{SUN} on figure) and Moon zenith angle 90o as function average BG level.

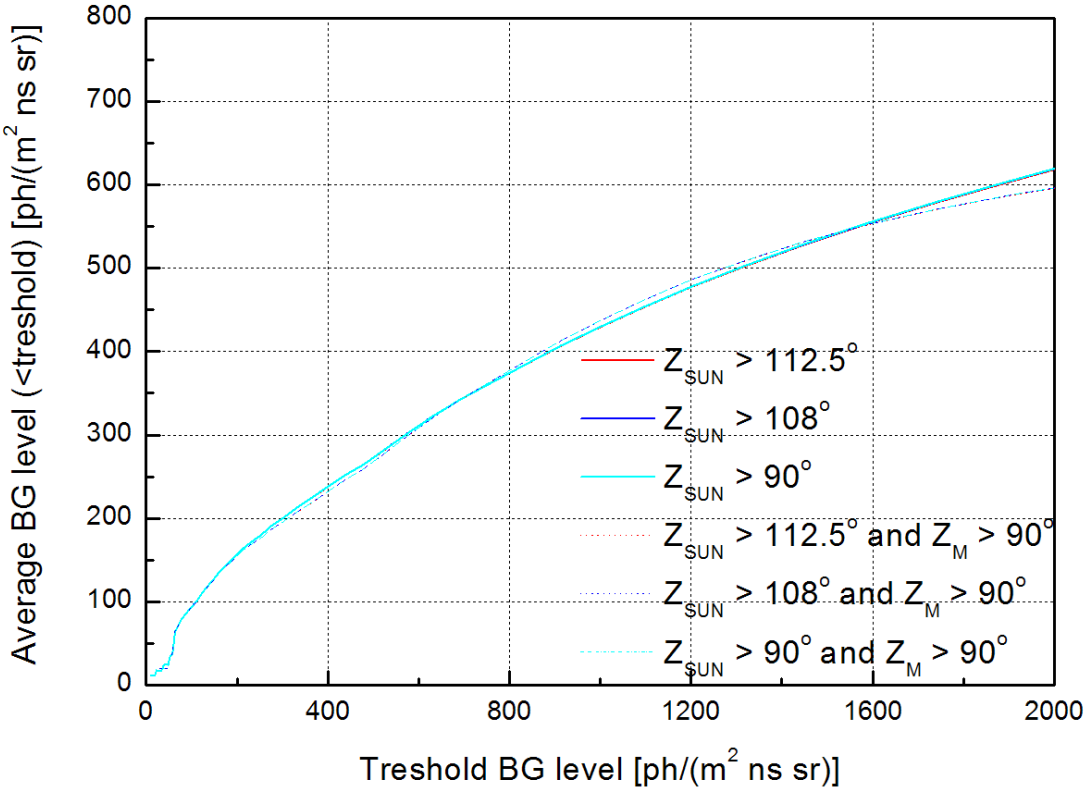


Fig. 4. Average BG level (D3 data) for set of S_{ZA} (Z_{SUN} on figure) and Moon zenith angle 90° as function of treshold BG level.

Trend in data

Hypothesis:
1. BG/duty cycle is time dependent.
2. With 11/22 year periodicity?

We take 6 month and 1 year periods and evaluate duty cycle and average background UV intensity for threshold 1500 ph/(m^2 ns sr) :
6 months periods i.e. (2005.0 - 2005.5), (2005.1 - 2005.6), (2005.2 - 2005.7) etc.
1 year periods i.e. (2005.0 - 2006.0), (2005.1 - 2006.1), (2005.2 - 2006.2) etc.

Results are presented at Fig. 5 (for D3 data).

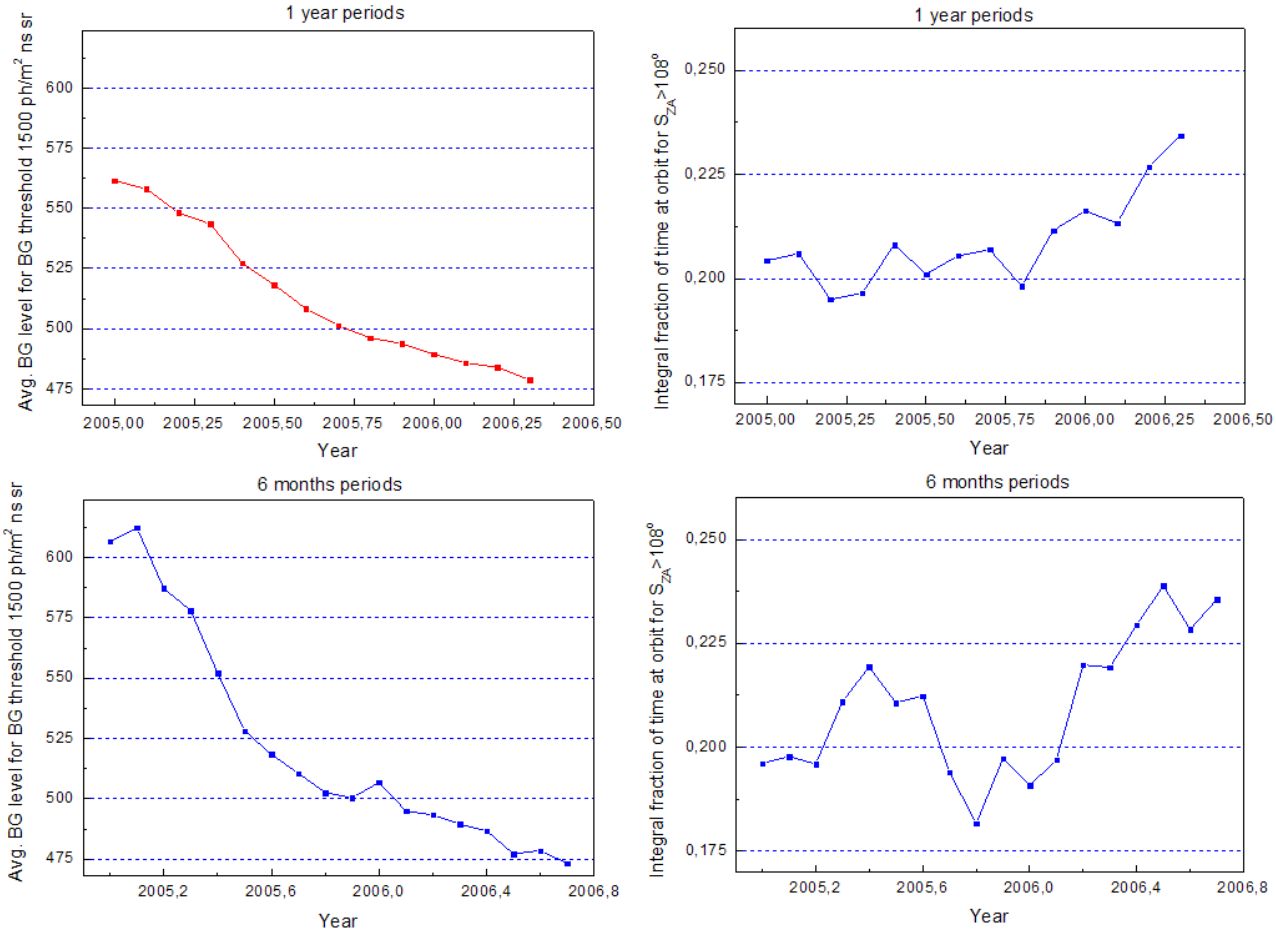


Fig. 5. Average background UV intensities and duty cycle evolution for treshold 1500 ph/(m^2 ns sr). D3 data, S_{ZA} > 108°, lat.<51.6°

I another words we evaluating average BG intensity of UV light for all measurements with intensity below treshold 1500 ph/(m^2 ns sr) in selected periods. Decreasing of avg. intensities with time from 2005 till almost end the year 2006 is consistent with decreasing Sun activity (coming solar minimum in 2008 and 2009).

As is presented on Fig. 6. moon light has no change to this decreasing trend.

Situation for different tresholds is presented on Fig. 7. Threshold are in BG unit (1 BG unit = 500 ph/(m^2 ns sr)). We can see that for lower tresholds we have decreasing trend while higher tresholds show oposite trend. More clear it can be seen from Table 2. where we compare average UV light intensities in first and last of checked half year periods (i.e. periods (2005.0 - 2005.5) and (2006.7 - 2007.2)) for different BG tresholds.

As authors of data explain trend in data appear in connection with increasing difficulties in keeping detector in nadir direction.

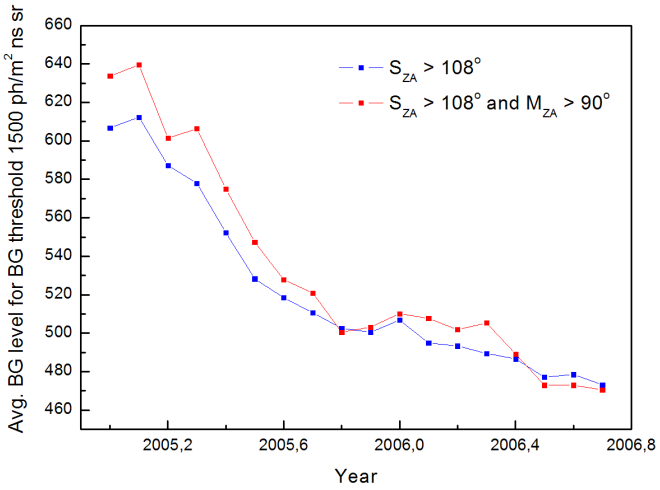


Fig 6. Moon influence to average background UV intensities for treshold 1500 ph/(m^2 ns sr). D3 data, S_{ZA} > 108°, lat.<51.6° (blue) and S_{ZA} > 108°, M_{ZA} >90°, lat.<51.6° (red)

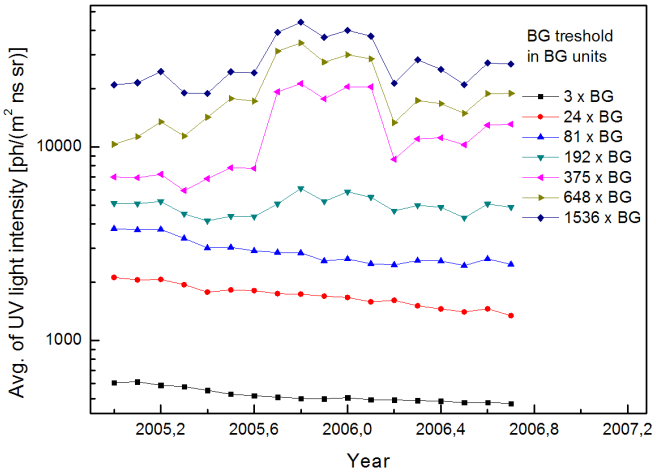
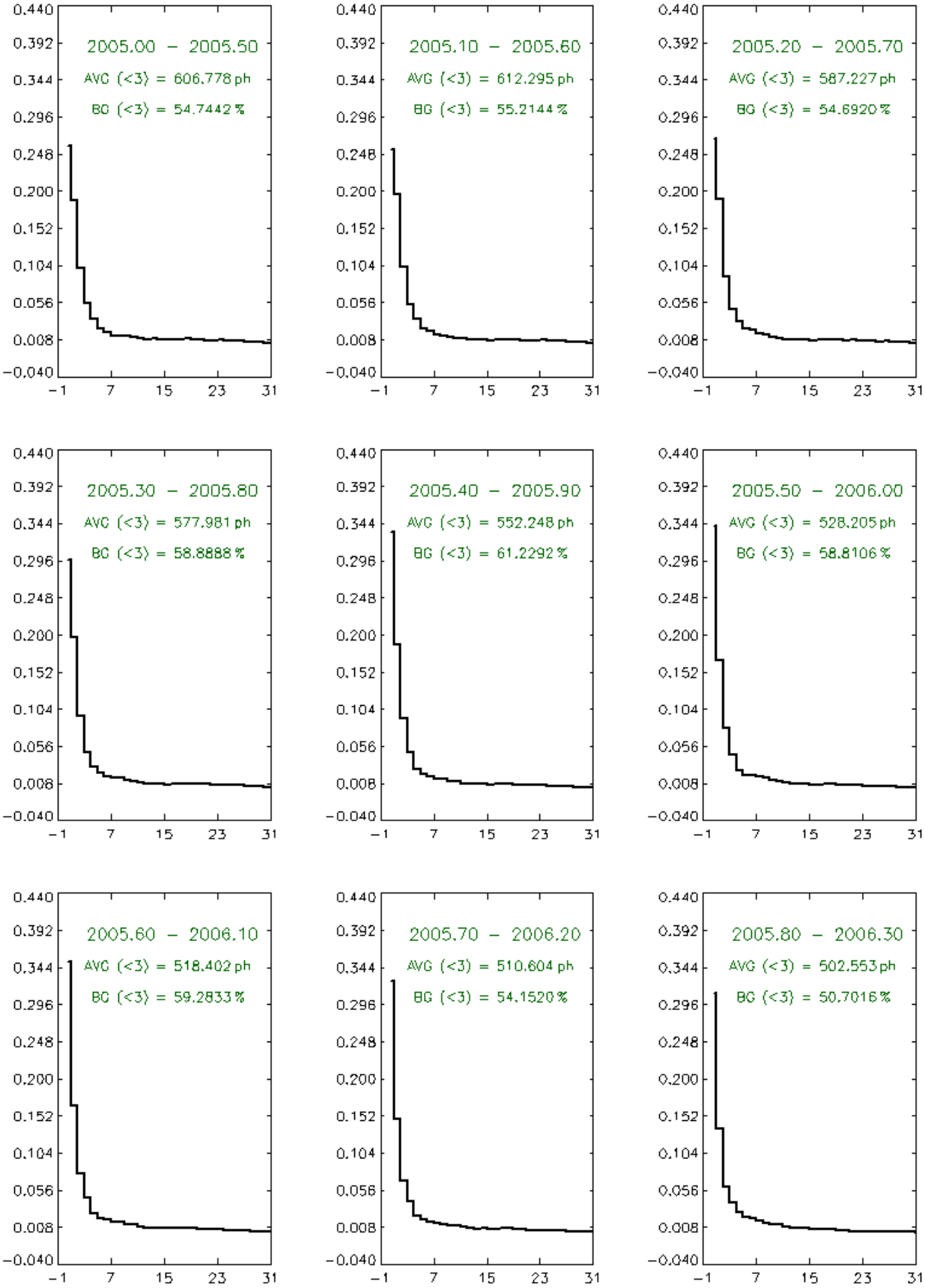


Fig. 7. Average background UV intensities for set of differen tresholds.

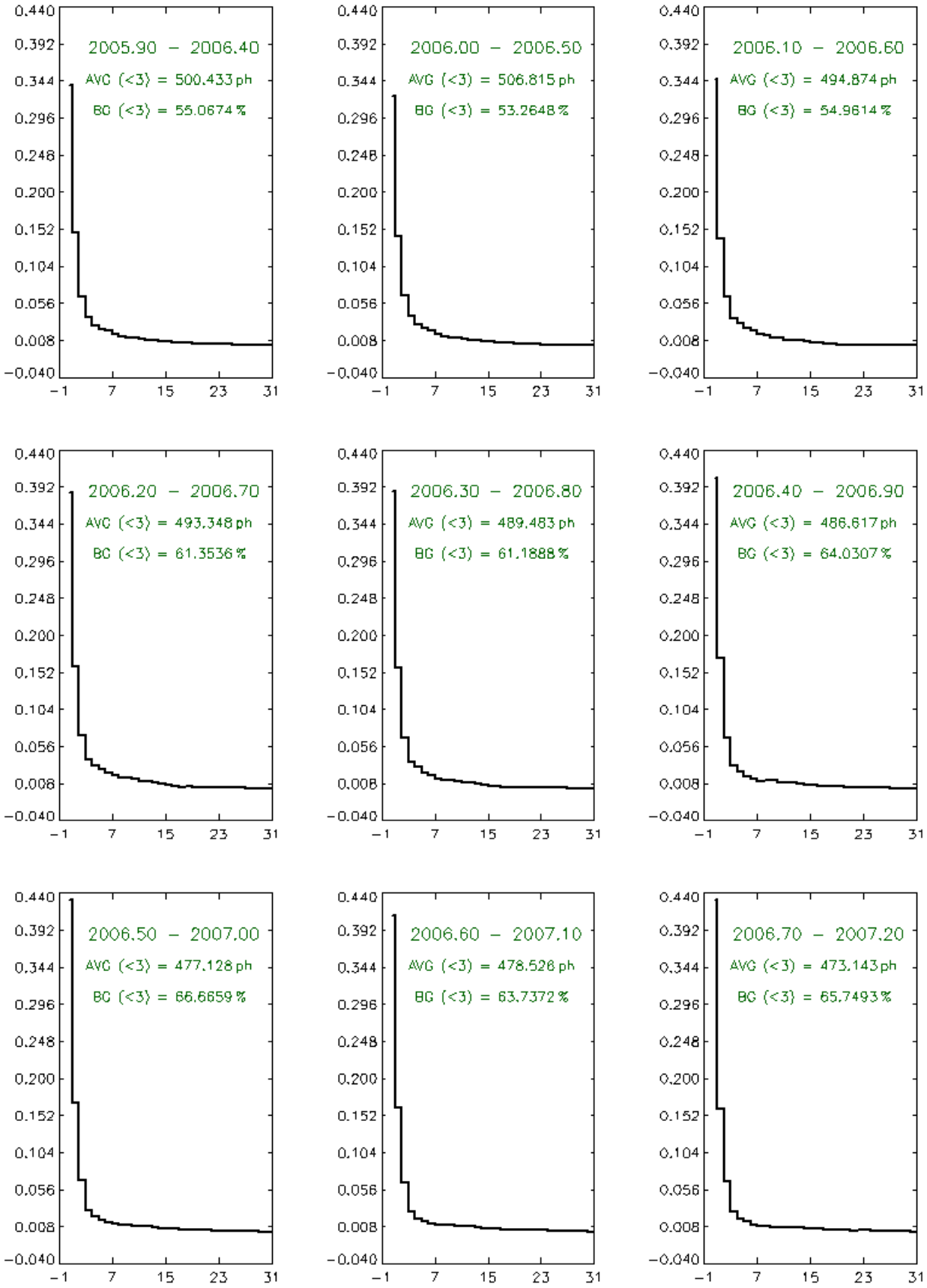
Table 2.

Treshold in BG units [1 BG = 500 ph/(m^2 ns sr)]	Ratio I_{UV} (2005.0) / I_{UV} (2006.7)
BG x 3	1.28
BG x 24	1.58
BG x 81	1.53
BG x 192	1.05
BG x 375	0.53
BG x 648	0.55
BG x 1029	0.78
BG x 1536	0.78
BG x 2187	0.80

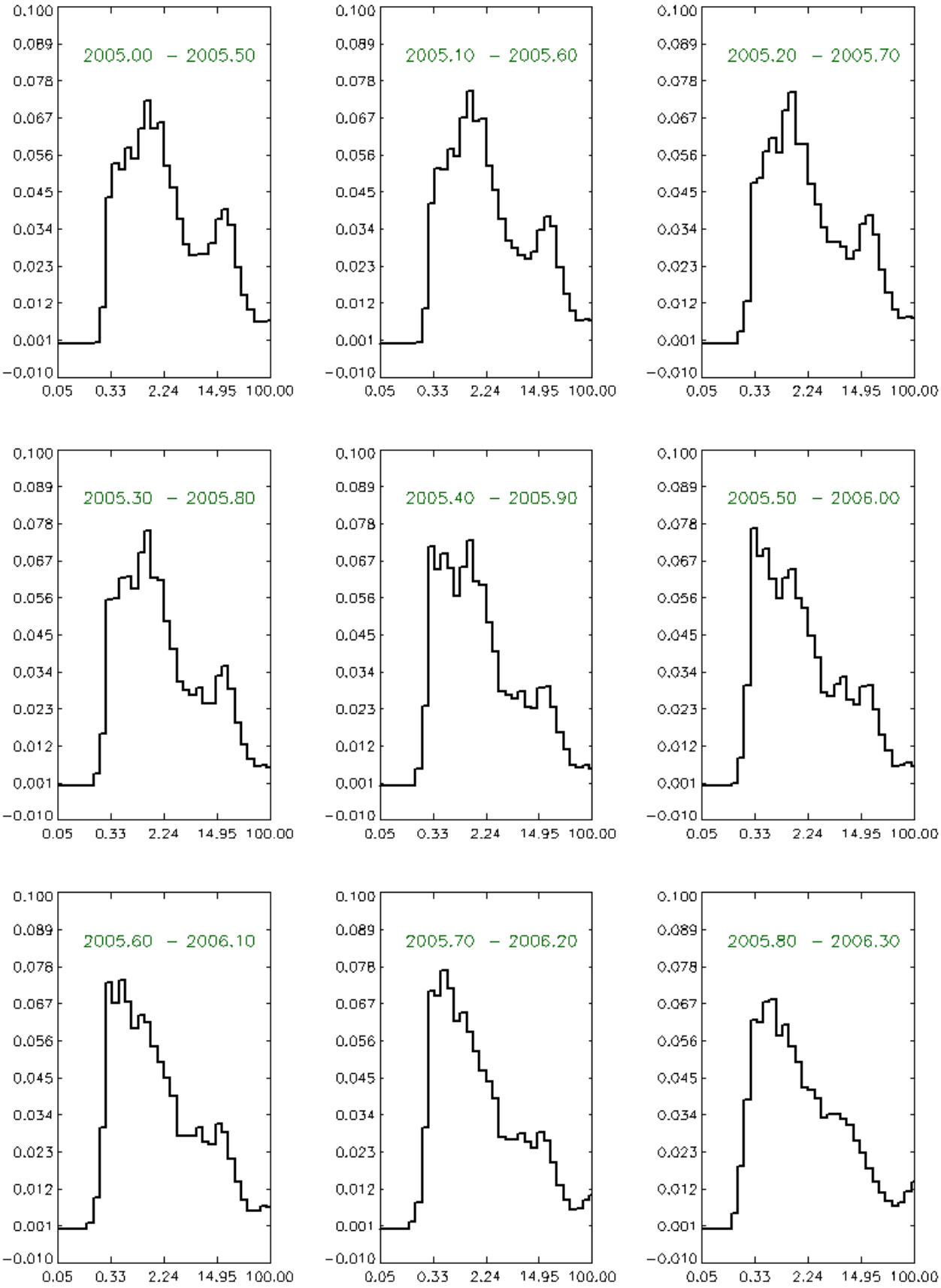
Figures on the next 6 pages show evolution of fraction of time on orbit during night (when S_{ZA} > 108°) histograms during Tatiana measurements.



Fraction of time at orbit for $S_{ZA} > 108^{o}$
D3 data, $S_{ZA} > 108^{o}$, lat.<51.6°, in BG units [1 BG = 500 ph/(m^2 ns sr)]

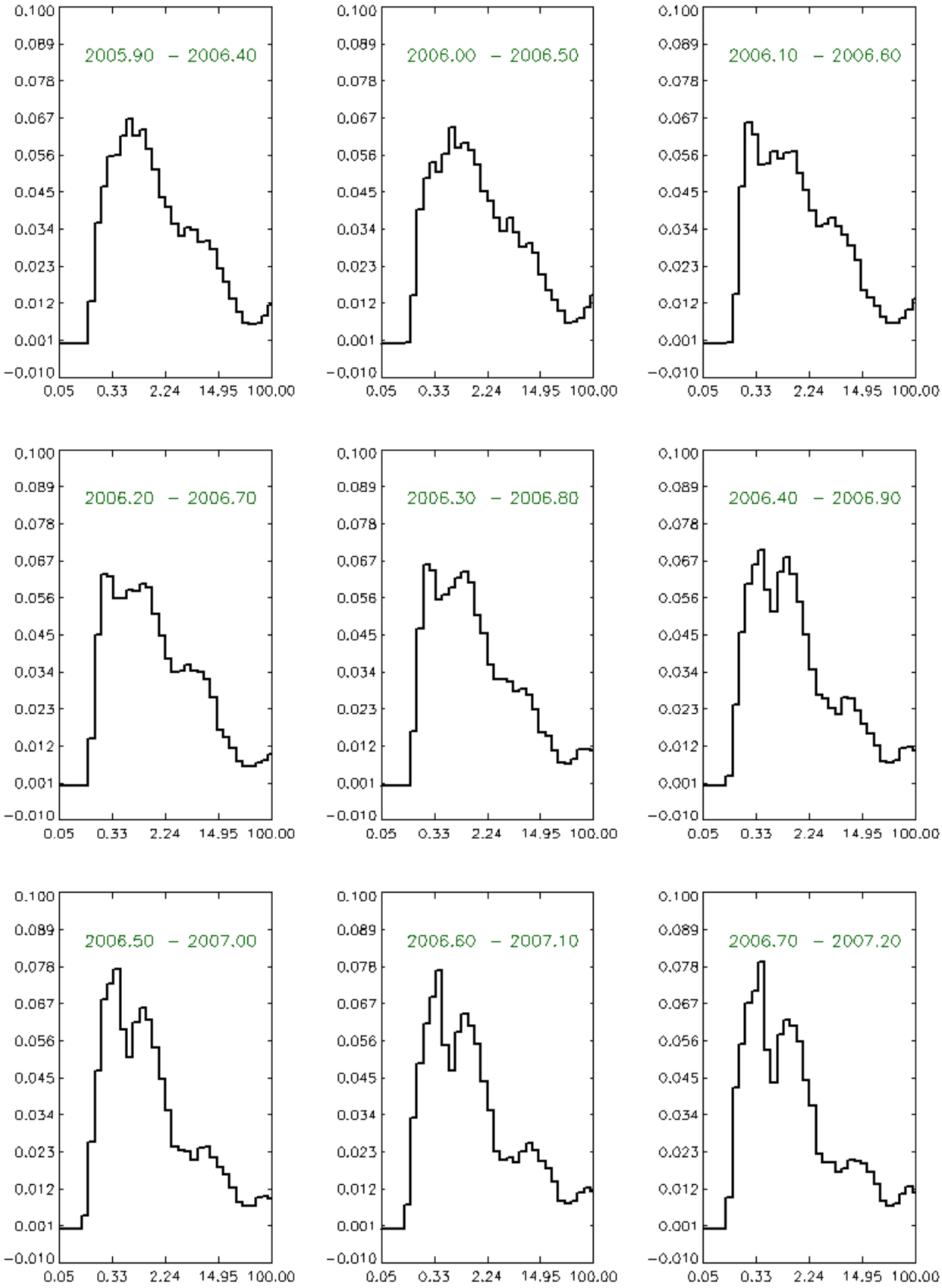


Fraction of time at orbit for $S_{ZA} > 108°$
D3 data, $S_{ZA} > 108°$, lat.<51.6°, in BG units [1 BG = 500 ph/(m^2 ns sr)]



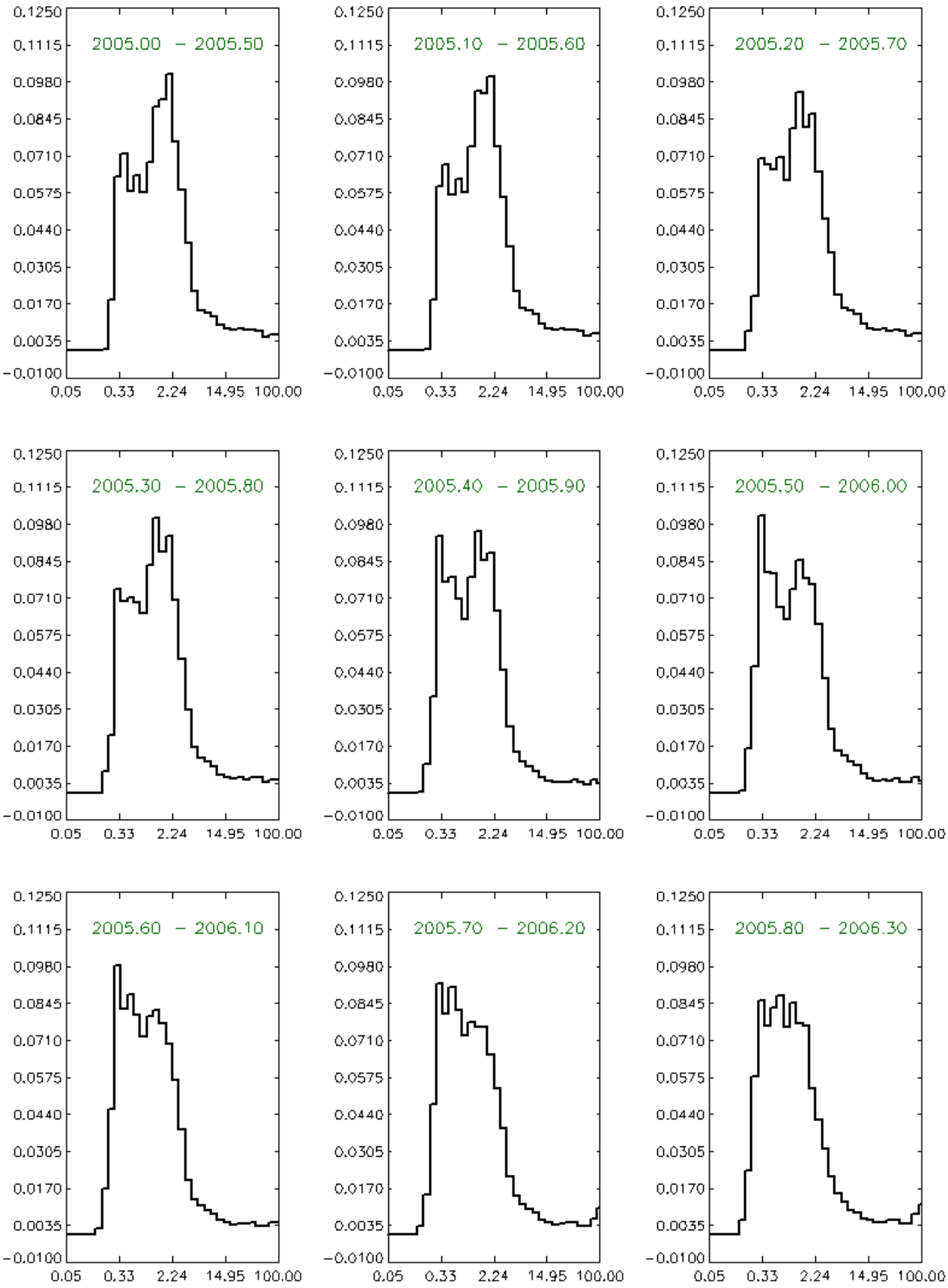
Fraction of time at orbit for $S_{ZA} > 108^{o}$

D3 data, $S_{ZA} > 108^{o}$, lat.<51.6°, in BG units [1 BG = 500 ph/(m^2 ns sr)]



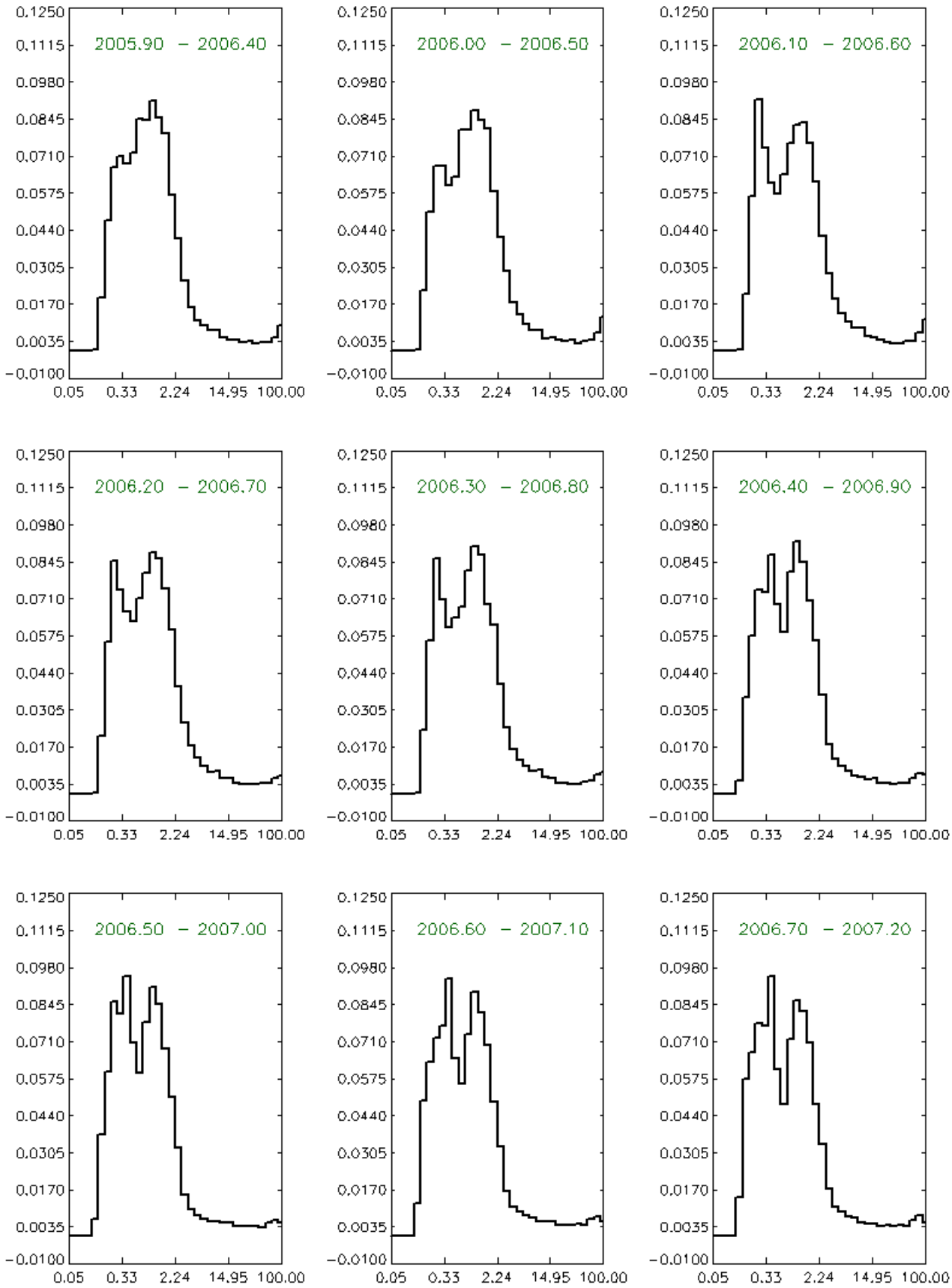
Fraction of time at orbit for $S_{ZA} > 108^{\circ}$

D3 data, $S_{ZA} > 108^{\circ}$, lat.< 51.6°, in BG units [1 BG = 500 ph/(m^2 ns sr)]



Fraction of time at orbit for $S_{ZA} > 108^{o}$, Mza>90°

D3 data, $S_{ZA} > 108^{o}$, $M_{ZA}>90^{o}$, lat.<51.6°, in BG units [1 BG = 500 ph/(m^2 ns sr)]



Fraction of time at orbit for S_{ZA} > 108°, M_{ZA}>90°

D3 data, S_{ZA} > 108°, M_{ZA}>90°, lat.<51.6°, in BG units [1 BG = 500 ph/(m^2 ns sr)]