Activity Report: Slovakia

- Institute and researchers

Researchers on JEM EUSO

- K. Kudela
- P. Bobik
- S. Pastircak
- J. Urbar (cooperating)

- Tatiana measurements analysis
- Huge background trigger simulations on KE PC cluster

Tatiana measurements archive
http://space.saske.sk/JEM/tatiana.html

To visualize Tatiana UV measurements and create reference frame for future use.

Ak http://space.saske.sk

- in internal JEM-EUSO part http://space.saske.sk/JEM.

User: jemeuso
Password: same as for RIKEN JEM-EUSO site

~7000 measurements of Universitetsky Tatiana satellite at ~25 000 figures (two types of figures)

Selection parameters
- Sun zenith angle
- Moon zenith angle
- length of one continuous measurement

Tatiana measurements archive

Visualisation of data from ultraviolet (UV) detector on board the Universitetsky-Tatiana satellite [1][2][3][4] measured in period from January 2005 to March 2007.

Archive of figures - lists (tables) of continuous measurements

Figures with maps

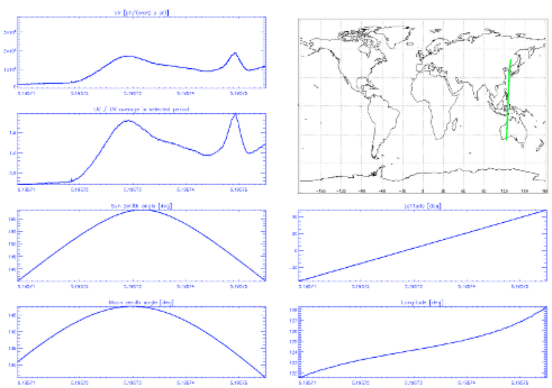
For Sun zenit angle > 108

For Sun zenit angle > 108, 20 minutes and longer measurements

For Sun zenit angle > 135 AND Moon zenith angle > 90

For Sun zenit angle > 135 And Moon zenith angle > 90, 20 minutes and longer measurements

Example:



click to enlarge

Figures without maps

For Sun zenit angle > 108

For Sun zenit angle > 108, 20 minutes and longer measurements

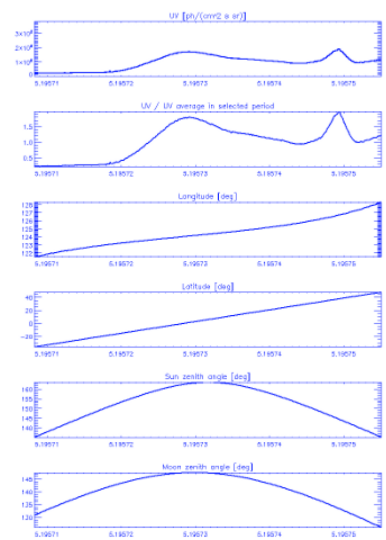
For Sun zenit angle > 135

For Sun zenit angle > 135, 20 minutes and longer measurements

For Sun zenit angle > 135 AND Moon zenith angle > 90

For Sun zenit angle > 135 And Moon zenith angle > 90, 20 minutes and longer measurements

Example:

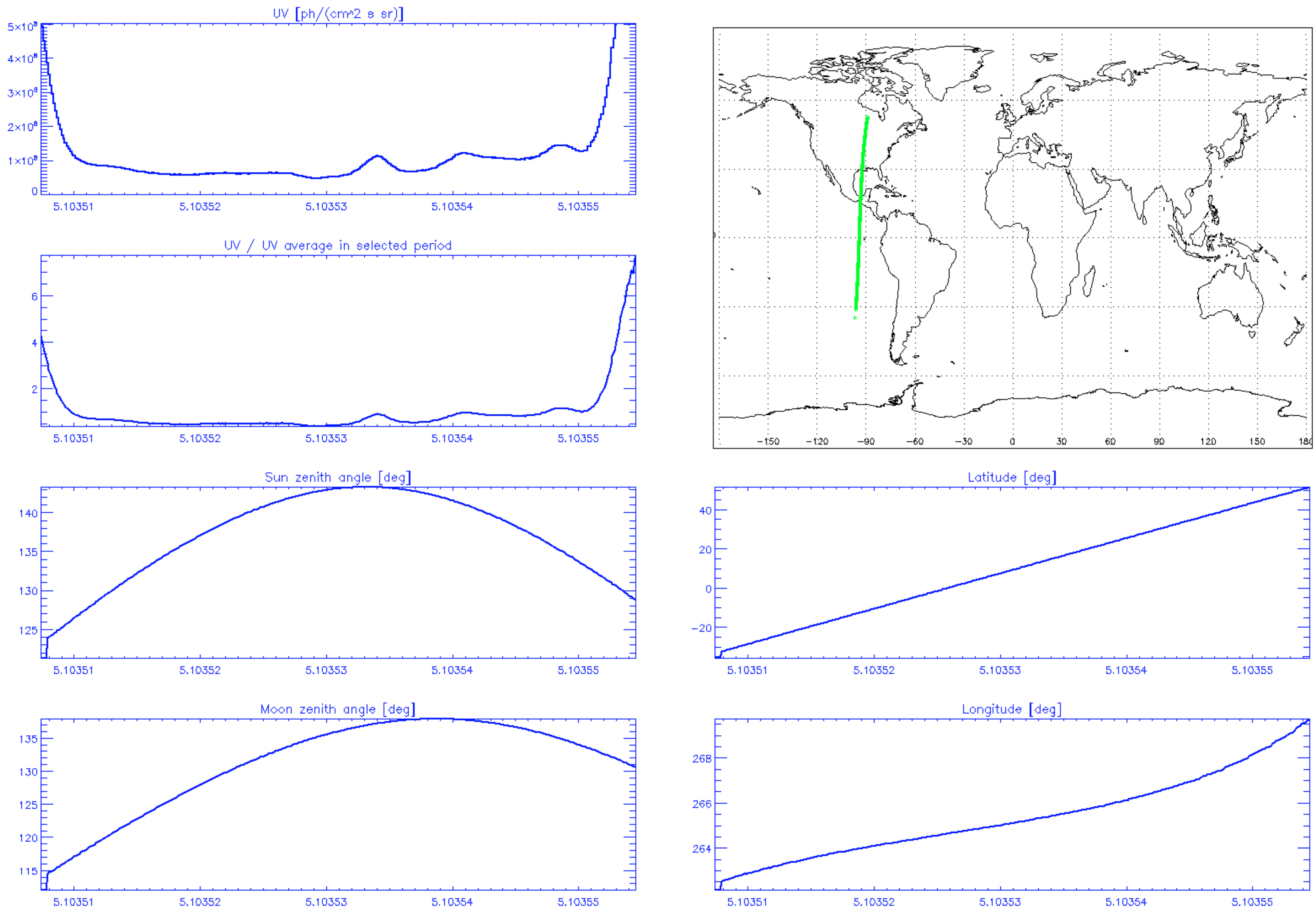


click to enlarge

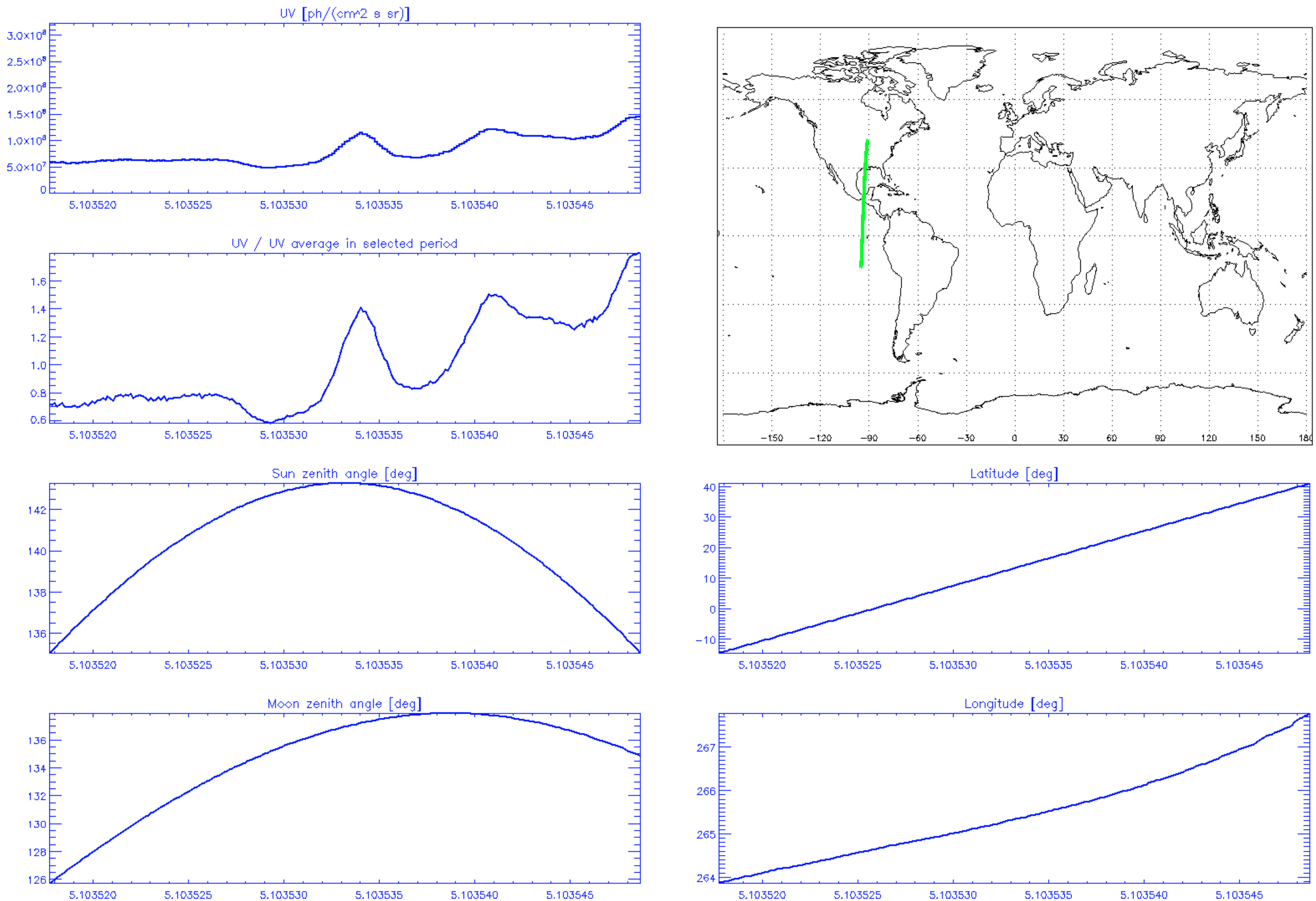
References

1. Garipov G. K., Khrenov B. A., Panasyuk M. I., Tulupov V. I., Shirokov A. V., Yashin I. V., Salazar H., UV radiation from the atmosphere: Results of the MSU Tatiana satellite measurements. Astroparticle Physics, Volume 24, Issue 4-5, p. 400-408, 2005
2. Garipov G. K., Panasyuk M. I., Tulupov V. I., Khrenov B. A., Shirokov A. V., Yashin I. V., Salazar H., Ultraviolet flashes in the equatorial region of the Earth, Journal of Experimental and Theoretical Physics Letters, vol. 82, issue 4, pp. 185-187, 2005
3. Sadovnichy V. A. et. al., First results of investigating the space environment onboard the Universitetskii-Tatyana satellite, Cosmic Research, Volume 45, Issue 4, pp.273-286, 2007
4. Web http://cosmos.msu.ru

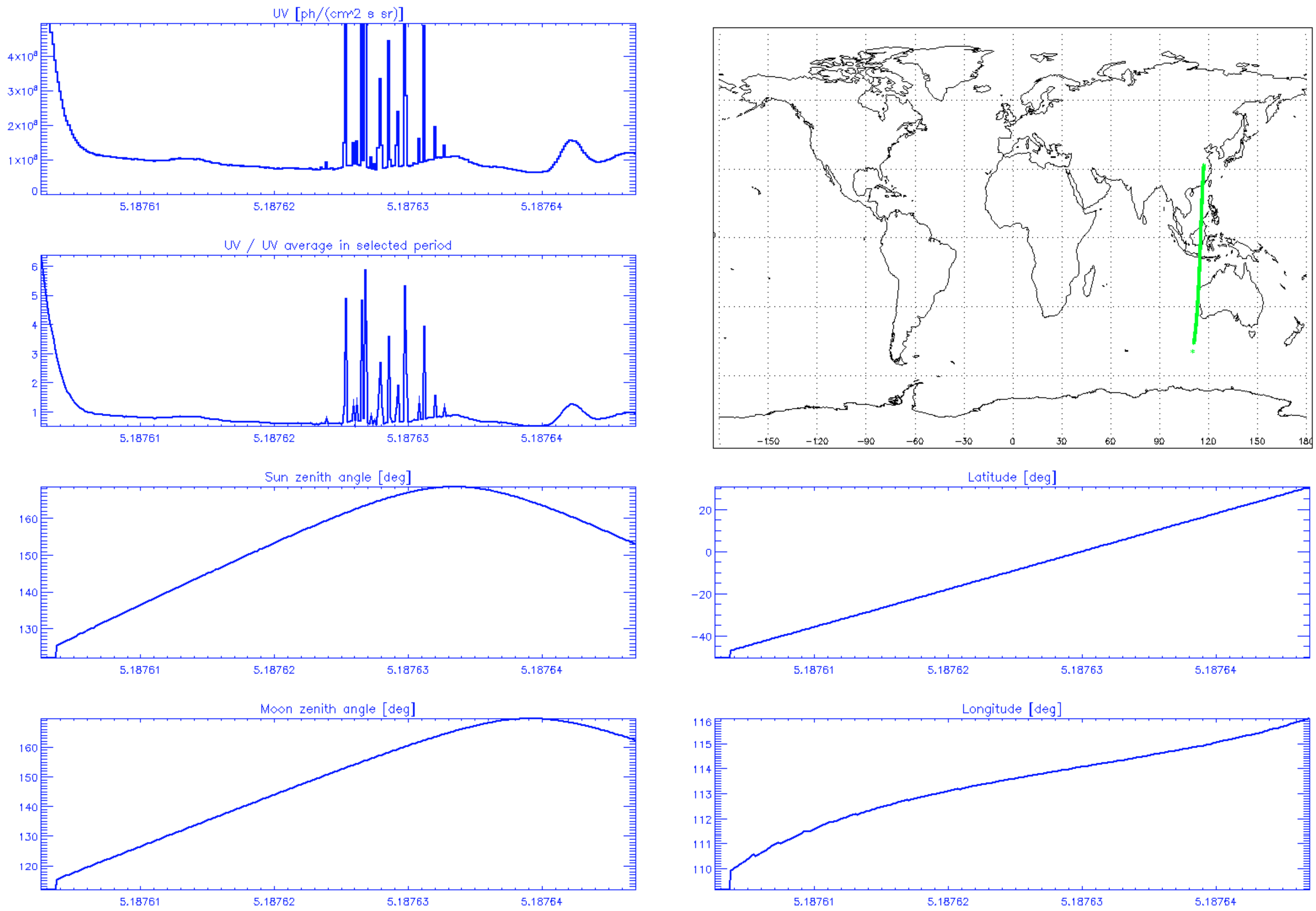
Tatiana measurements archive
ID:10, Sza > 108°, Date: 5 2 8 8 50 44 [y/m/d/h/min/sec]



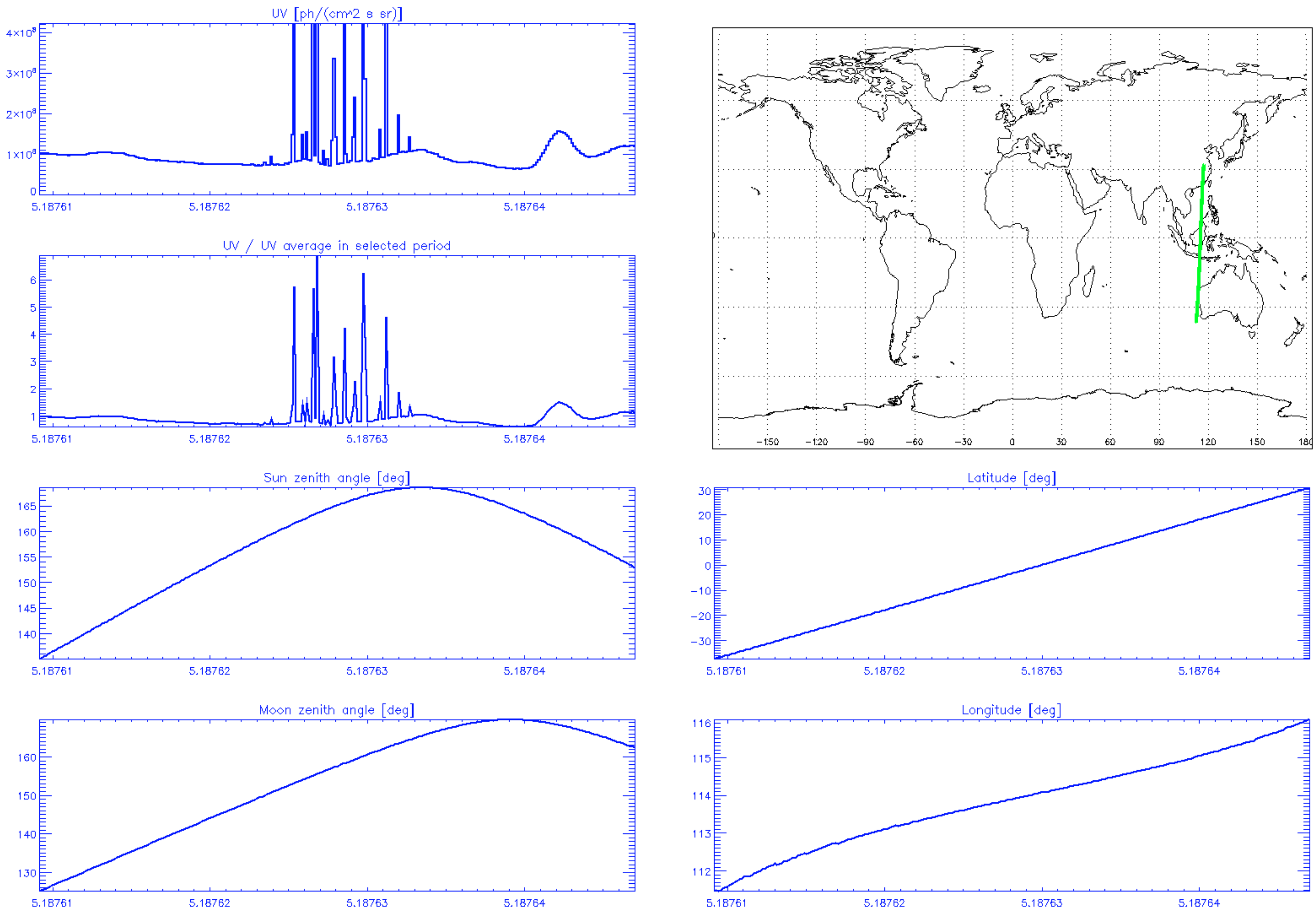
Tatiana measurements archive
ID:10, Sza > 135°, Mza > 90°, Date: 5 2 8 8 50 44



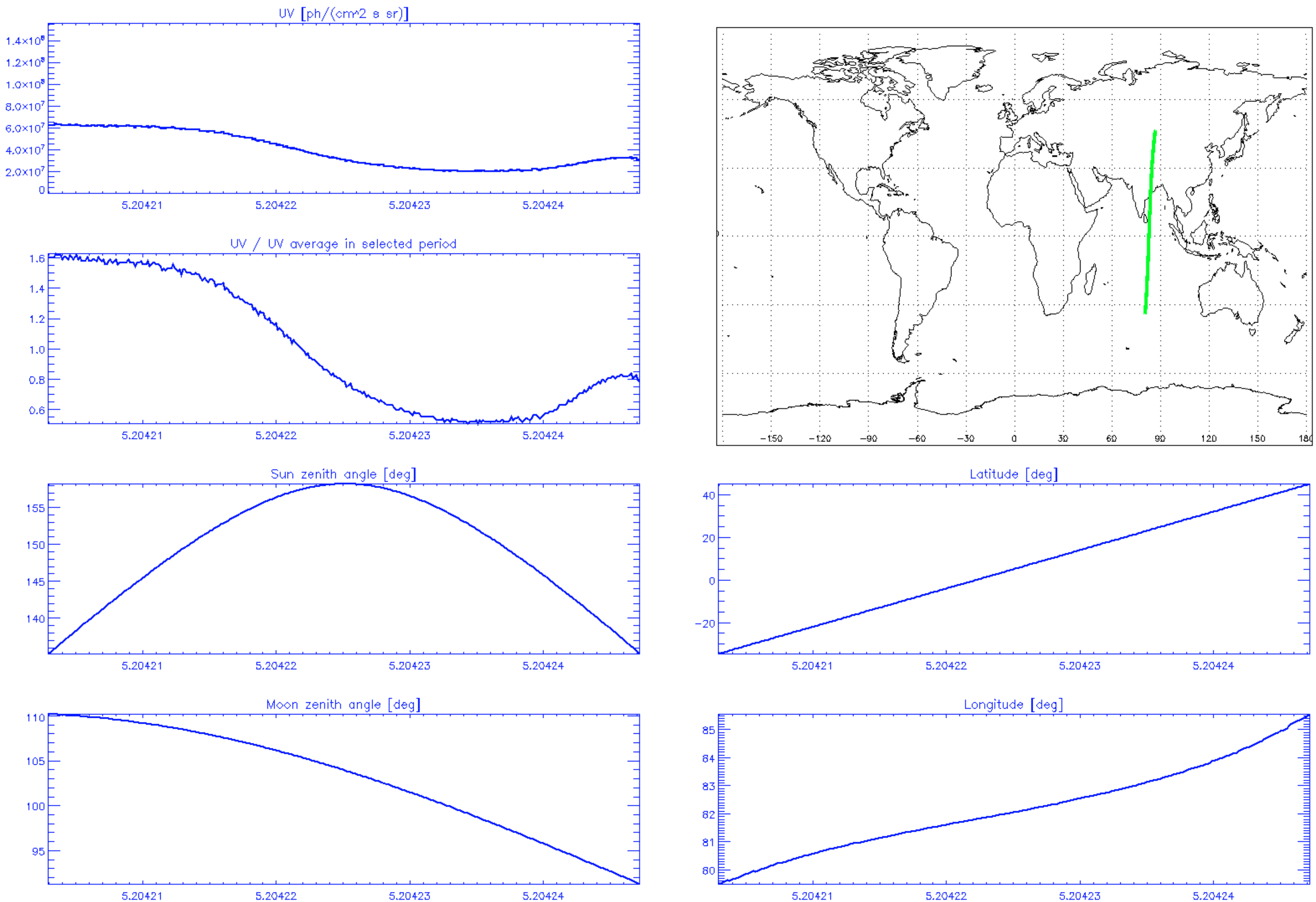
Tatiana measurements archive
ID:108, Sza > 108°, Date: 5 3 8 15 31 26



Tatiana measurements archive
ID:108, Sza > 135°, Mza > 90°, Date: 5 3 8 15 31 26



Tatiana measurements archive
ID:142, Sza > 135°, Mza > 90°, Date: 5 3 14 17 2 34



Stability coefficient

Stability of UV background clearly depend on Sun relative position to place of measurements i.e. on Sun zenith angle. It make sense then evaluate BG stability as function of Sun zenith angle threshold. To avoid moon light influence we select measurements where moon zenith angle Mza is higher than 90^o.

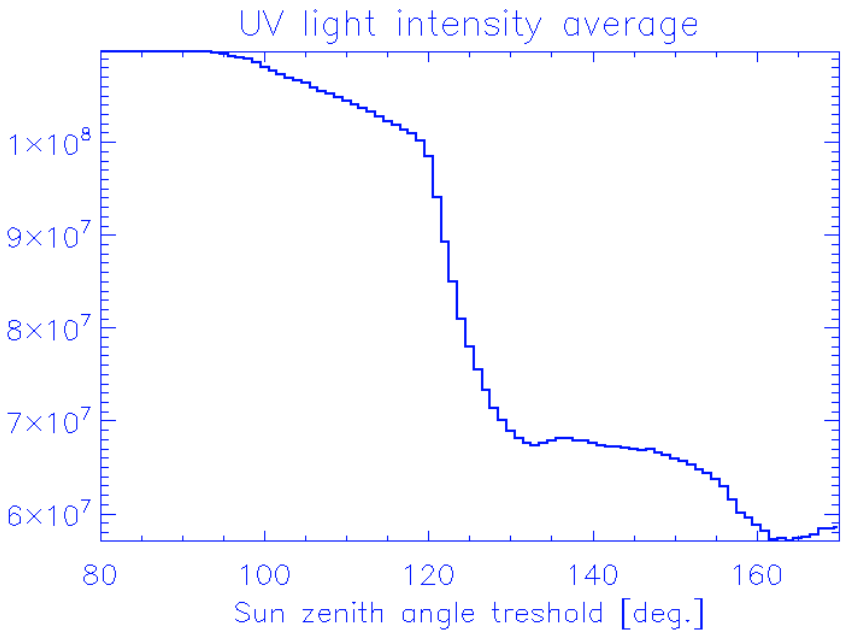
- four different stability coefficients was tested

- as upper estimation coefficient based on ratio between maximum and minimum UV intensity values of measured periods

- stability coefficient based on standard deviation of UV signal during measured periods

- stability coefficient based on on curve length of UV signal graph during measured periods

- stability coefficient based on average absolute deviation of measurements



For selected Sza treshold (Sza>x^o) we evaluate average absolute deviation AAD of UV intensity signal during all continuous measurements.

$$AAD_{i,Sza>x^o} = \frac{1}{T_i} \sum_{j=1}^{j=(N_i-1)} \left| I_{UV,i,j} - \overline{I_{UV,i}} \right|$$

where T_i is lenght (time) of *i-th* measurements. Then stability coefficient for Sza>x^o is

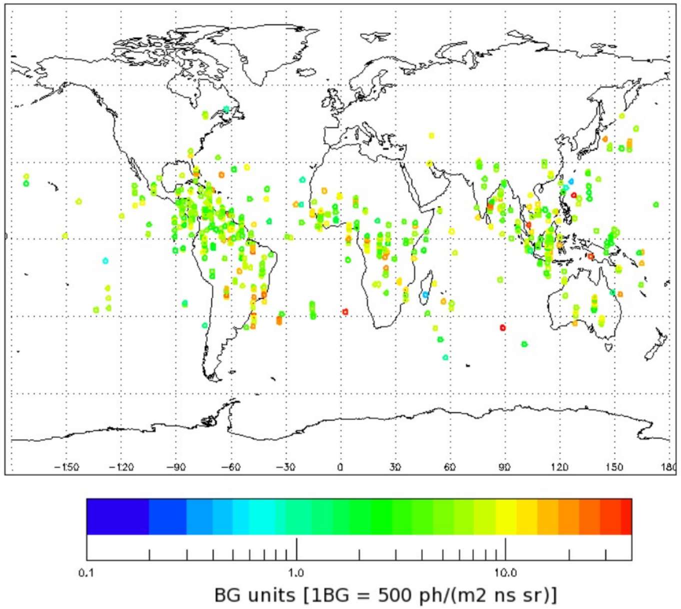
$$SC(Sza>x^o) = \frac{1}{T} \sum_{i=1}^{i=m} AAD_{i,Sza>x^o} N_i \quad \text{where} \quad T = \sum_{i=1}^{i=m} N_i$$

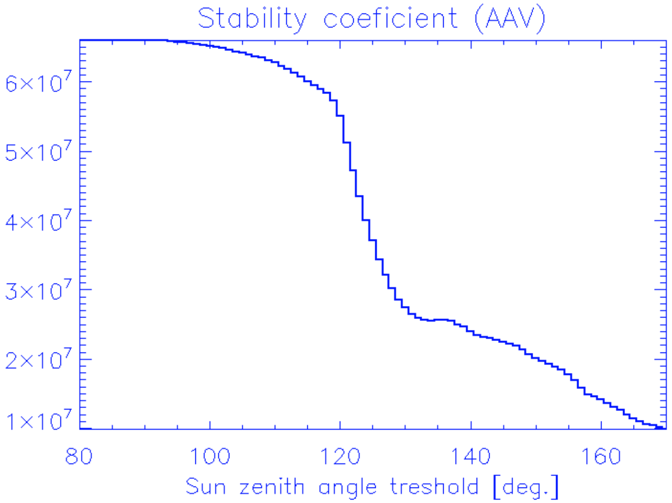
Stability coefficient

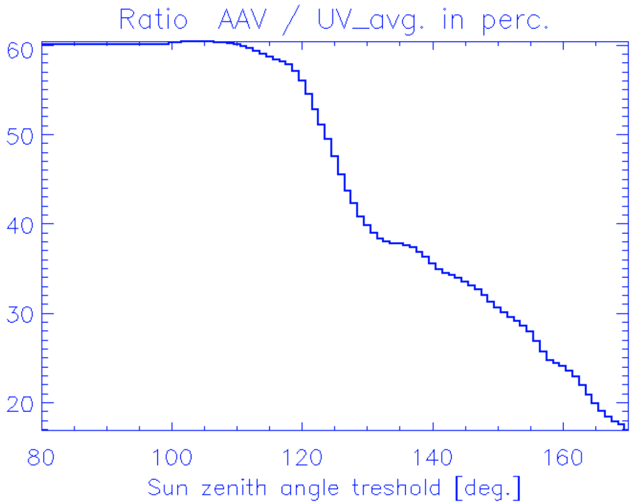
Different stability coefficient evaluate how UV light change during measurements on Earth orbit. From all coefficients we can see that stability of signal depend on Sun zenith angle, and change relatively fast till Sza reach 132°. This lead us to change (redefinition) of night definition for Tatiana orbit. Now we redefine night for orbit ~940 km as time when satellite local Sza>132°.

- Stability coefficient based on average absolute deviation show that stability of signal on the night side, when moon is under horizon is in order of 10ths percents from average value of UV intensity during measurement in previous/surrounding moments/orbit (flashes and TLE events are exception from this conclusion).

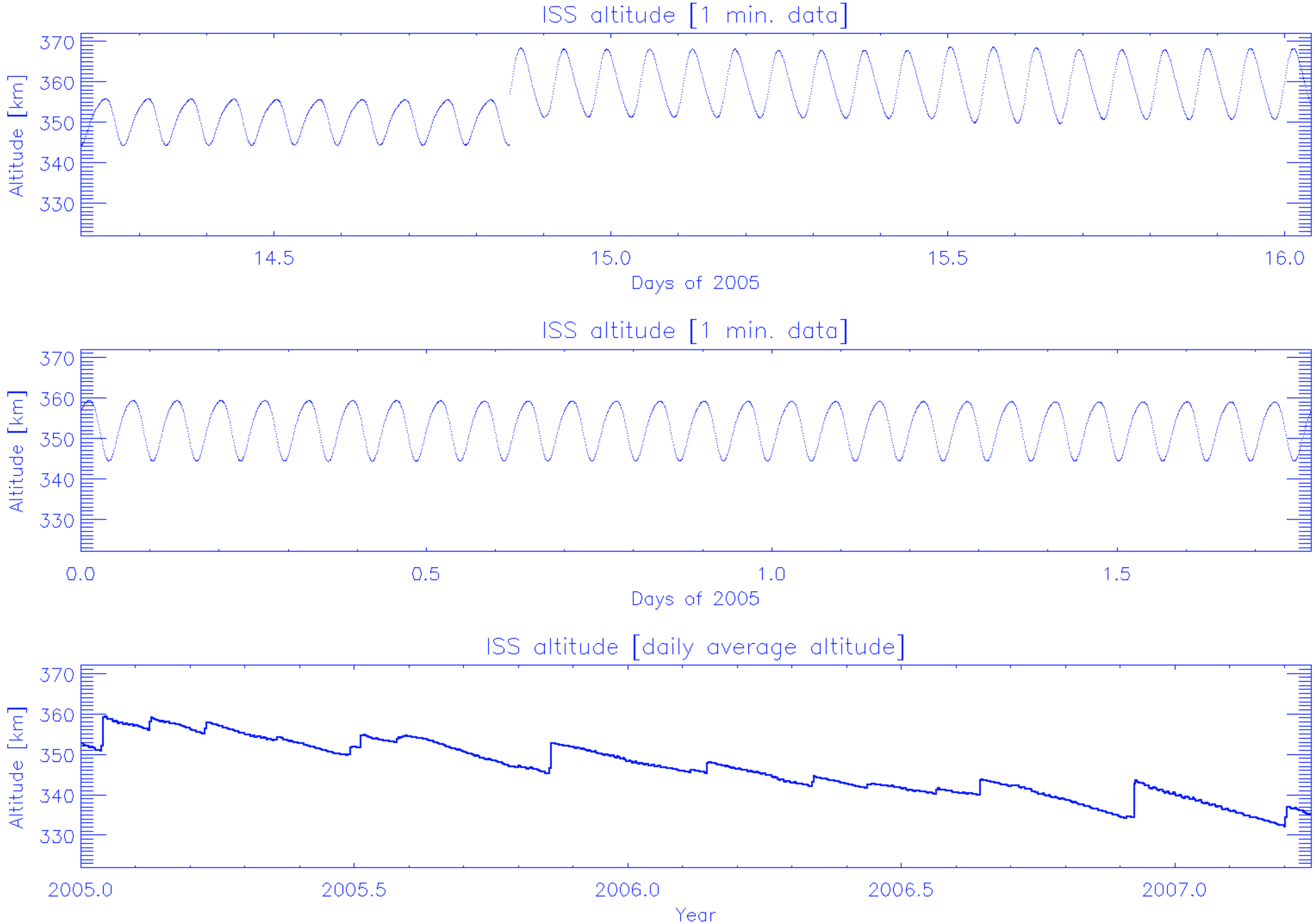
- Let us note that this results are evaluated from signal with flashes (TLE) events. Flashes was not cleaned from signal. If measurements with flashes will be cleaned out, stability increase.







JEM-EUSO duty cycle
2005 - 2007 from real ISS trajectory



JEM-EUSO duty cycle
2005 - 2007 from real ISS trajectory

We estimate a ISS duty cycle for UV background less than 1500 ph/(m^2 ns sr) from real ISS trajectory and moon light evaluation.

Estimation can be described in the following points:

1. We use ISS real trajectory data (one minute time positions-resolution) from 2005 till 2010 years [1].

2. For all ISS positions we eavaluate sun zenith angle (S_{ZA}), moon zenith angle (M_{ZA}) and moon phase (M_p) for time from 2005 till 2007 (same period as Tatiana observations was).

3. For every position, M_{ZA} and M_p UV light intensity I_{UV} in ph/(m^2 ns sr) was evaluated from next equation[2][3]:

$$I_{UV}=16000*\cos(M_{ZA})*10^{-0.4*(0.16M_p+5.5*1e\text{-}6*M_p^4)} \quad (1)$$

Note: equation (1) gives negative values for $M_{ZA}>90^o$ - it simply means that moon is under horizon, so no moon light is present

4. From all data we evaluate a duty cycle for different sun zenith angles tresholds:

S_{ZA} treshold [deg.]	Duty cycle [%]
90	31.2712
91	30.7674
92	30.2658
93	29.7663
94	29.2756
95	28.7827
96	28.2934
97	27.8049
98	27.3158
99	26.8283
100	26.3317
101	25.8452
102	25.3461
103	24.8433
104	24.3137
105	23.7518
106	23.1724
107	22.5994
108	22.0198
109	21.4447
110	20.8674
111	20.2907
112	19.7127
113	19.1333
114	18.5709
115	18.0170
116	17.4682
117	16.9216
118	16.3977
119	15.8720
120	15.3608
121	14.8700
122	14.3917
123	13.9231
124	13.4657
125	13.0105
126	12.5648
127	12.1099
128	11.6789
129	11.2452
130	10.8270

S_{ZA} treshold [deg.]	Duty cycle [%]
131	10.4016
132	9.9813
133	9.5706
134	9.1542
135	8.7378
136	8.3462
137	7.9544
138	7.5829
139	7.2075
140	6.8476
141	6.4949
142	6.1453
143	5.8096
144	5.4817
145	5.1692
146	4.8620
147	4.5451
148	4.2396
149	3.9317
150	3.6299
151	3.3272
152	3.0375
153	2.7868
154	2.5635
155	2.3600
156	2.1667
157	1.9819
158	1.8106
159	1.6473
160	1.4907
161	1.3449
162	1.2047
163	1.0748
164	0.9491
165	0.8325
166	0.7245
167	0.6219
168	0.5306
169	0.4441
170	0.3659

Citations

1. http://sscweb.gsfc.nasa.gov/cgi-bin/sscweb/Locator.cgi
2. Montanet: EUSO-SIM-REP-009-1.2 (2004);
3. Krisiunas & Schaefer, Astrom. Soc. of the Pactifc, 103, (1993) 1033. Krisciunas

Cloudiness influence on UV signal atmosph. propagation

- Study of influence of actual cloud situation (cloud fraction and pool of 202 parameters) on the UV light Universitetsky Tatiana-1 orbital nightside measurements using International Satel. Cloud Climatology Project (ISCCP) datahttp://isccp.giss.nasa.gov
- Gridded Cloud Product - Revised algorithm (D1) Resolution: 280km equal-area grid, 3hour, global, Spatial averages of DX quantities and statistical summaries, including properties of cloud types. Satellites are merged into a global grid. Atmosphere and surface properties from TOVS are appended.

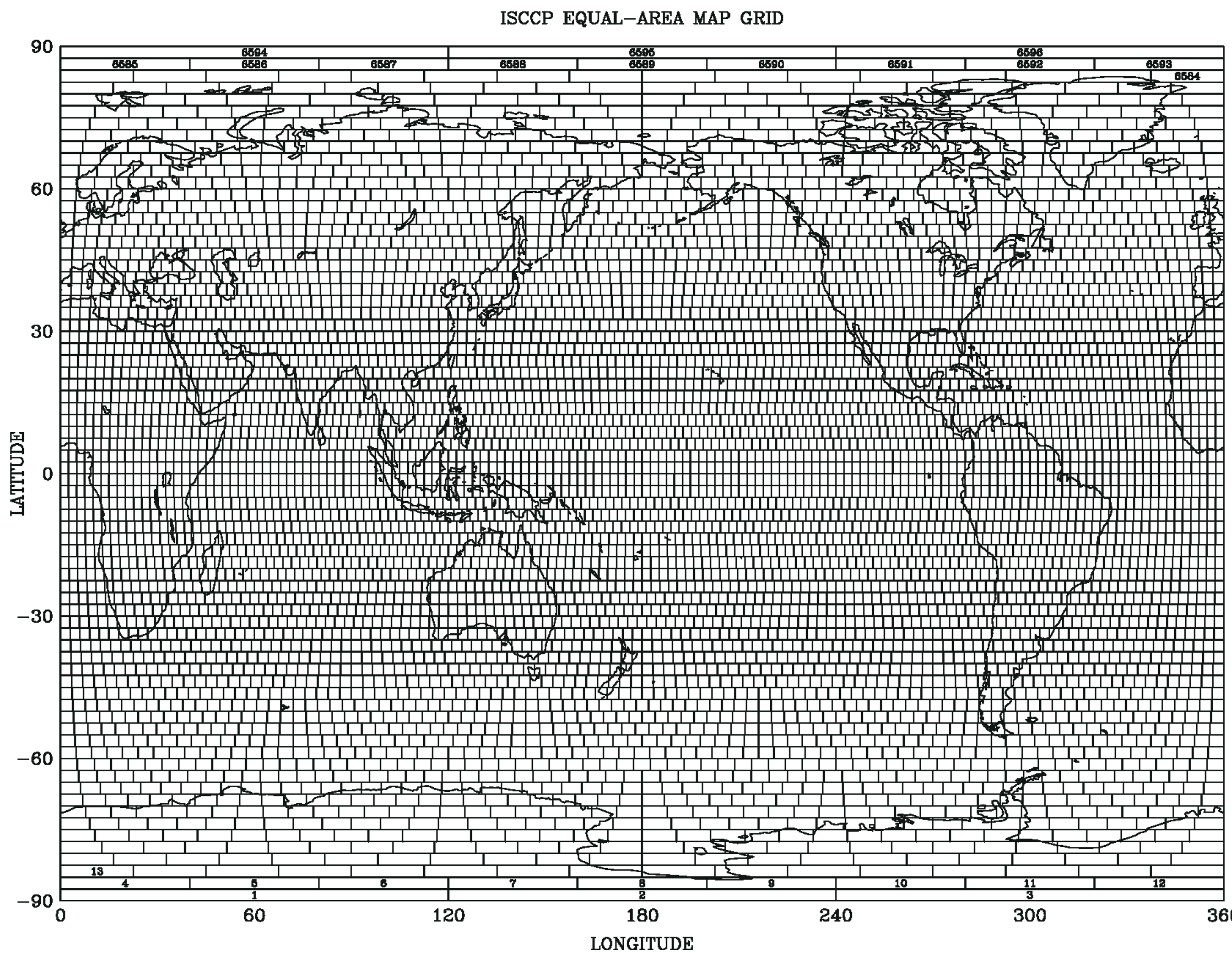


Figure 3.1. Equal-area map grid used for ISCCP data. The first and last thirteen cells are numbered for illustration.

Visualization of generated 3hour-global 280km grid cloud map (ISCCP) with UV measurements (Universitetsky Tatiana)