Preliminary AURIC & libRADtran background simulation for EUSO-Balloon flight

M. Putiš, P. Bobík, Š. Mackovjak
(IEP SAS)

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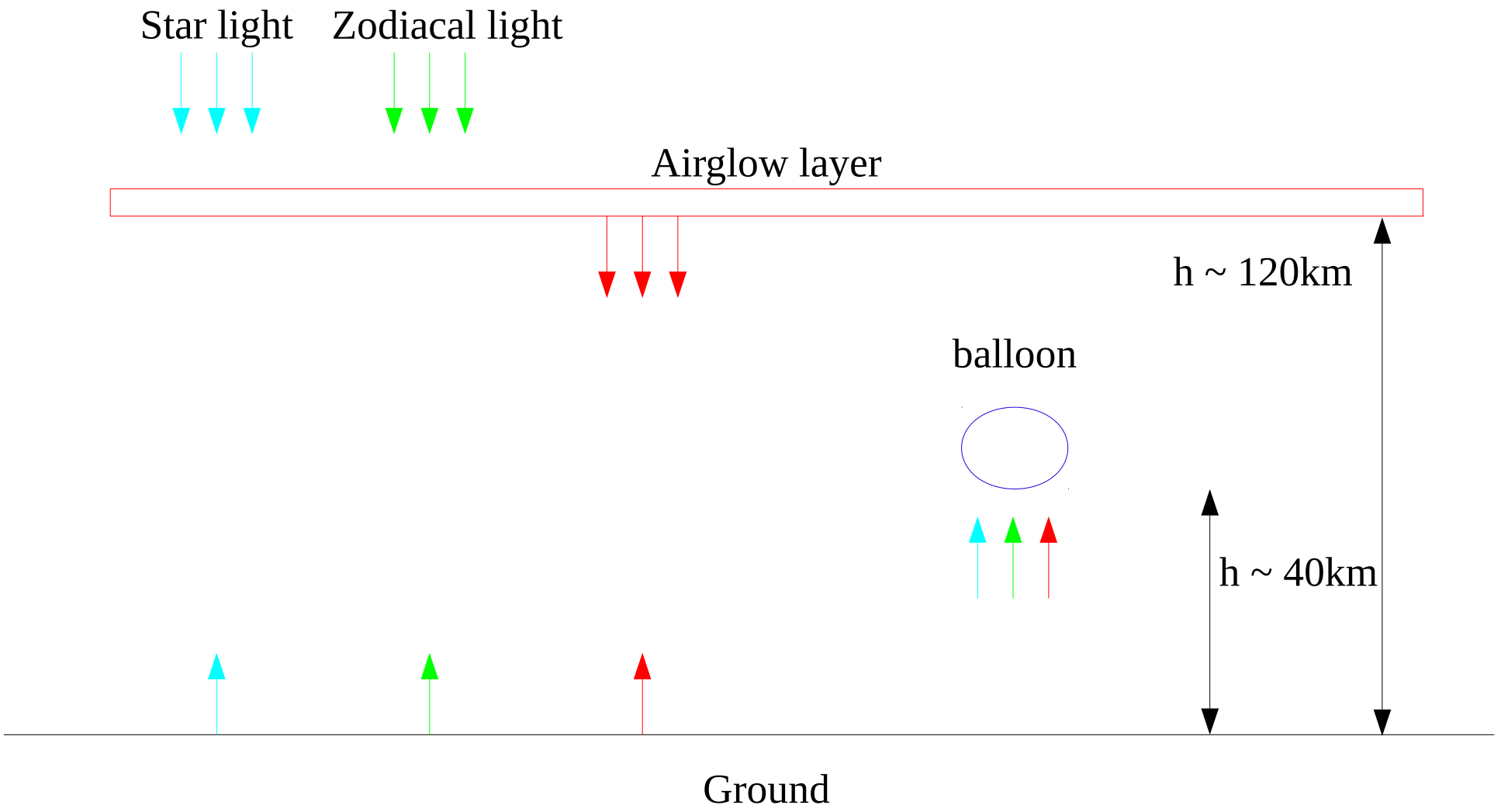
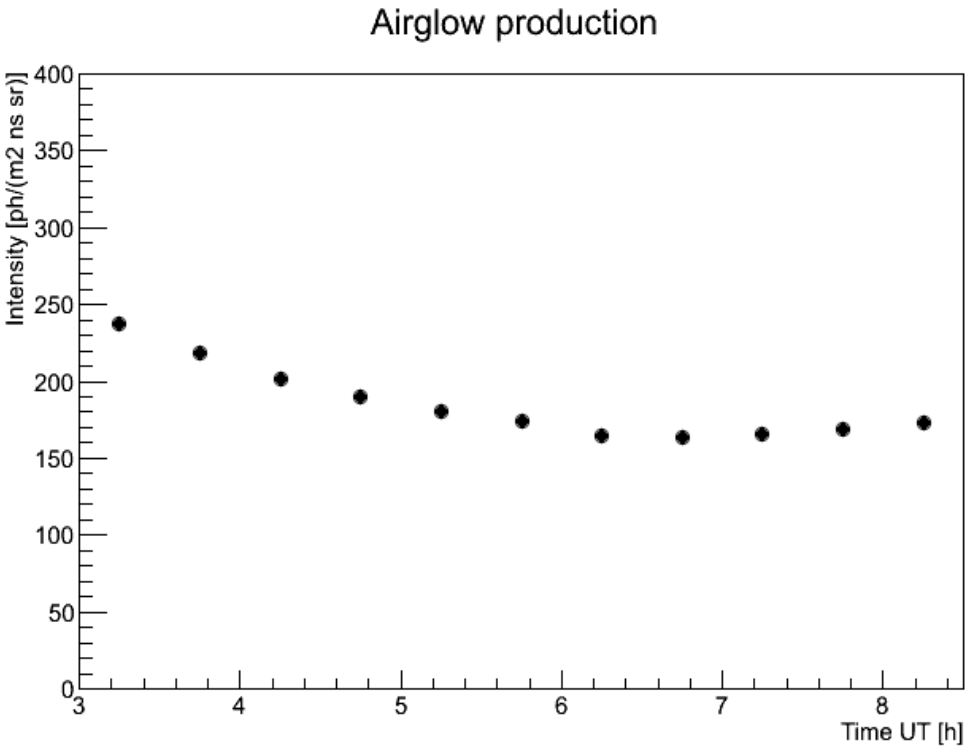
Sources of background for balloon



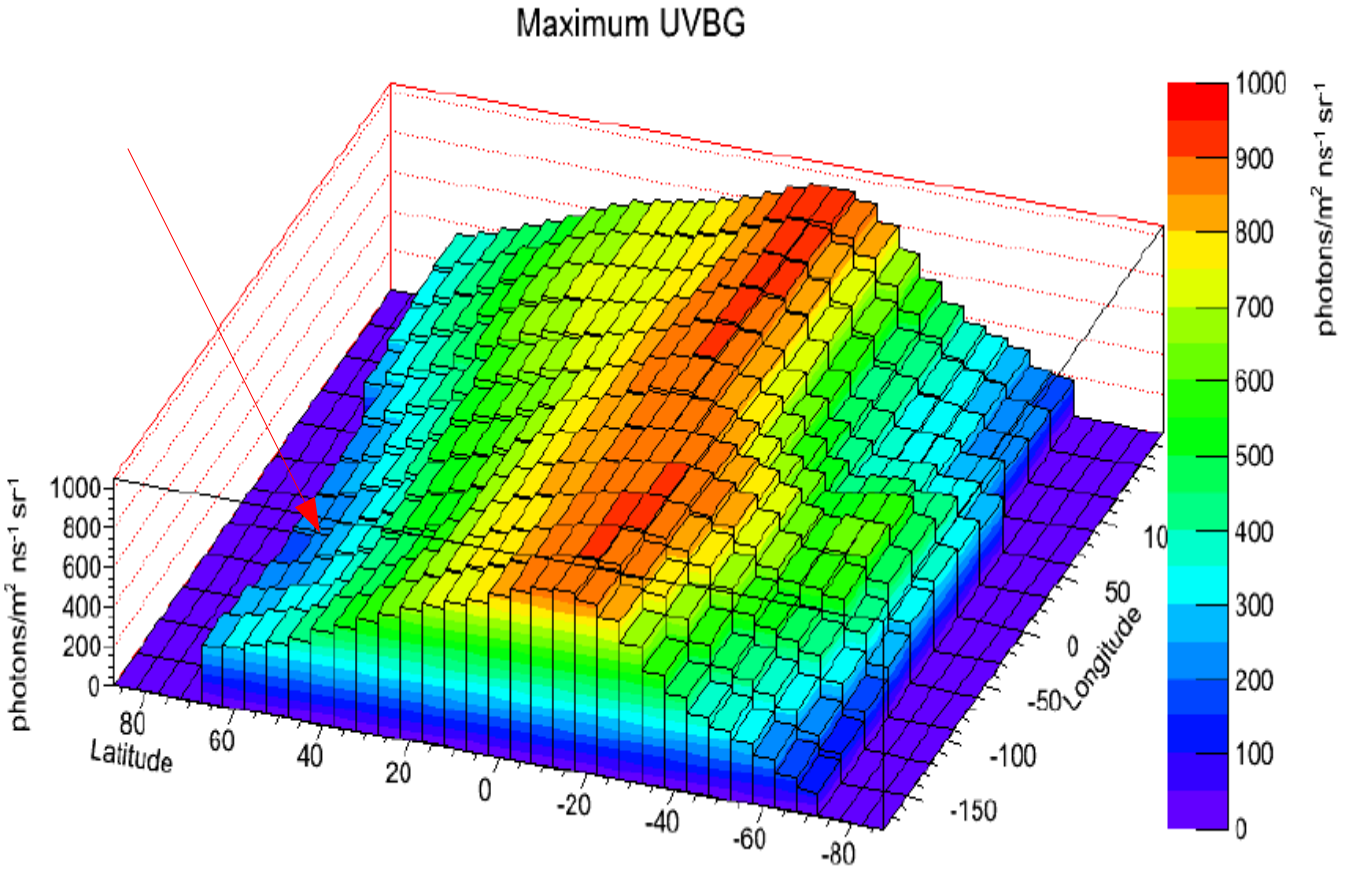
Sources of background for balloon

- Zodiacal light ~ 240 ph/(m2 ns sr) [1]
- Star light ~240 ph/(m2 ns sr) [1]
- Airglow production – AURIC model [2] for 25 august 2014, Timmins positions – see picture
- No moon, city lights, aurora
- Intensity ~ 200 ph/(m2 ns sr)
- Remember that situation is different for other positions – background could by higher – see next slide.

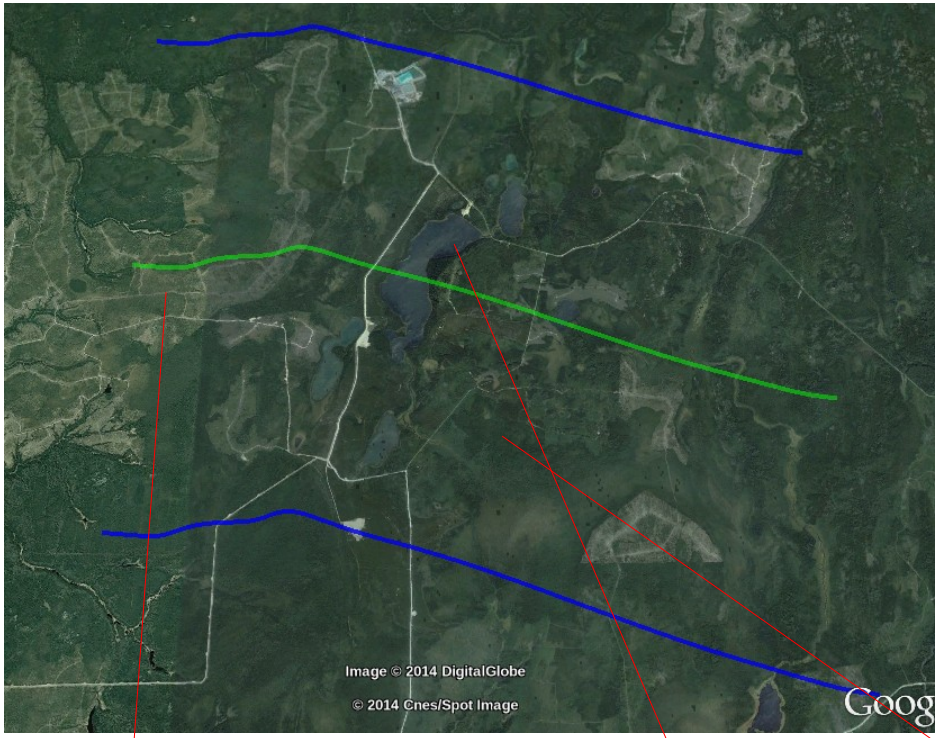


- [1] Louis M. Barbier et al, Astroparticle Physics 22 (2005) 439–449
- [2] D. J. Strickland et al, J. Quant. Spect. Rad. Transfer, 62, 689, 1999.

- Map of maximal values of background for night from 20-21 March, 1994 (Tenerfie meeting presentation)
- Timmins area at 20-21 March, 1994 ~ 300 ph/(m2 ns sr)
- Not same situation for other positions – background could by higher



Surface albedo



Balloon view 5:16 – 5:47 - distance approximately 10km

- ~ 48 deg 36' 55"

  ~ -82 deg 00' 15"

- ~ 48 deg 38' 08"

  ~ -82 deg 08' 57"

cutted trees (glade) and new young trees

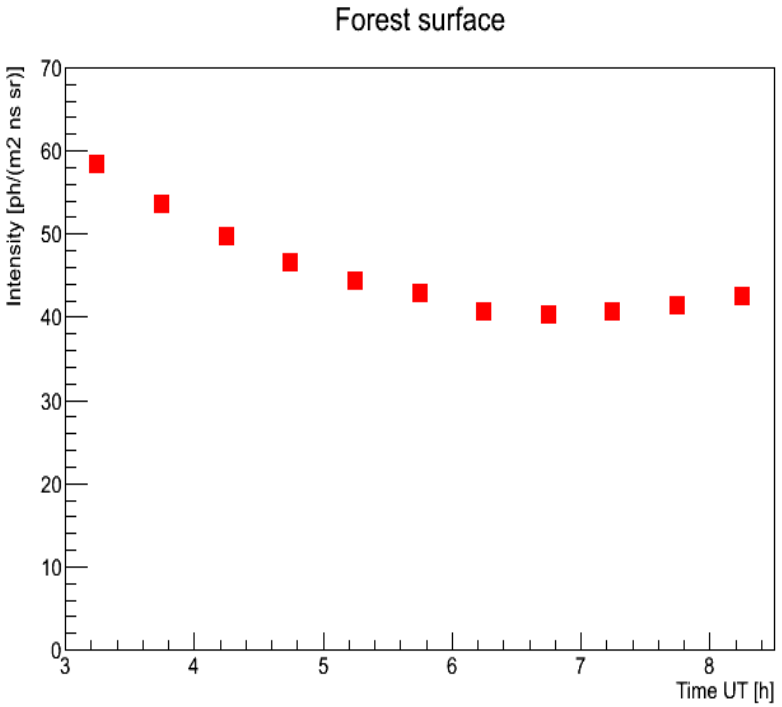
water

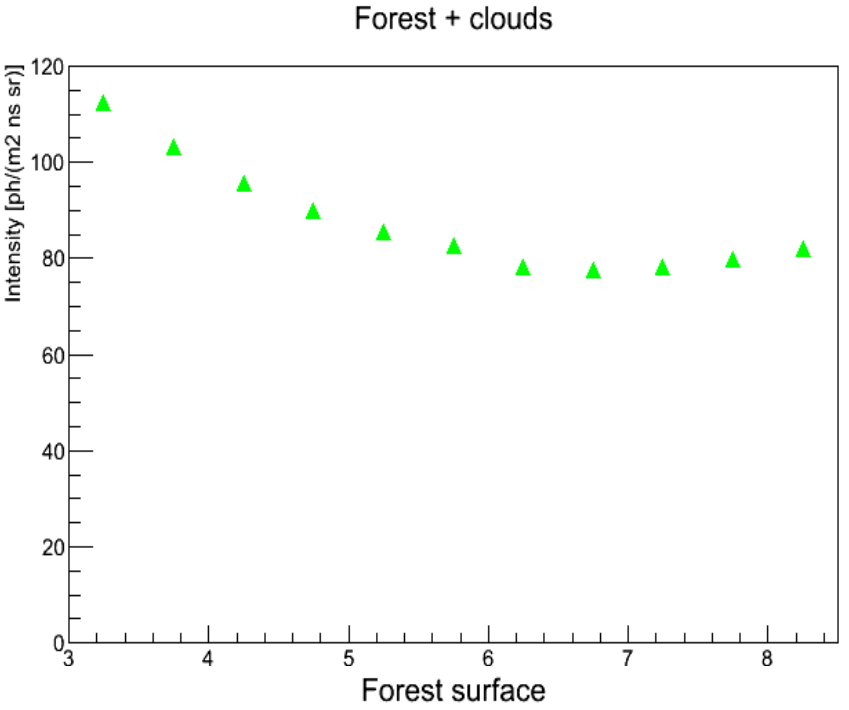
forest

libRadtran albedo map

- libRadtran albedo map – resolution 10' ~ 12 km (latitude 48) [3]
- We need more detail map
- Weighted average albedo (298 – 437 nm):
  - Water 0.0677
  - Forest:
    - Deciduous broad forest 0.0266
    - Deciduous needle forest 0.0258
    - Evergreen needle forest 0.0249
    - Mixed forest 0.028 – libRadtran for balloon
    - It doesn't matter which forest it is – albedos are too close
  - Cutted forest – we use mixed forest albedo
  - [3] B. Mayer and A. Kylling, Technical note: The libRadtran software package for radiative transfer calculations - description and examples of use, doi:10.5194/acp-5-1855-2005

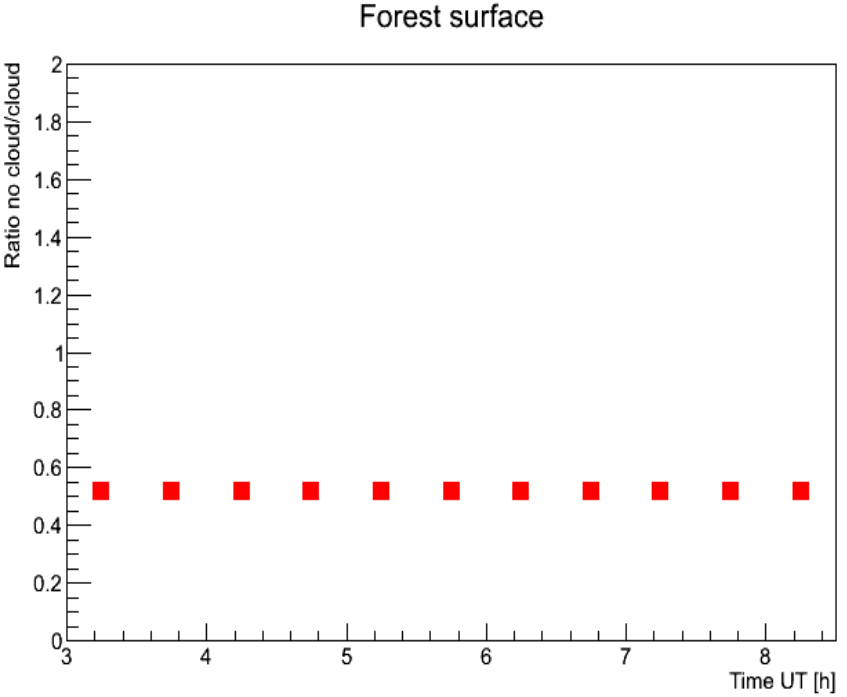
Reflected airglow intensity at 40km - forest surface



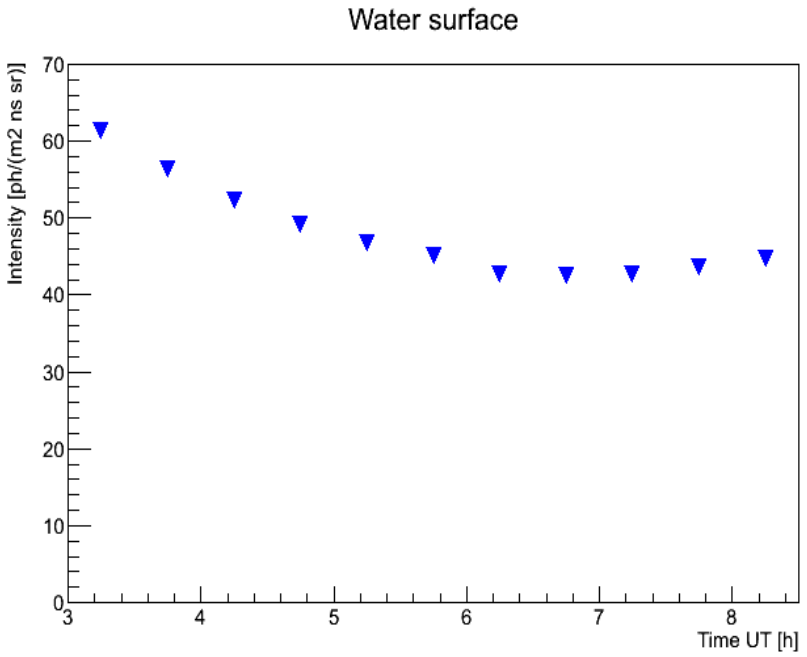


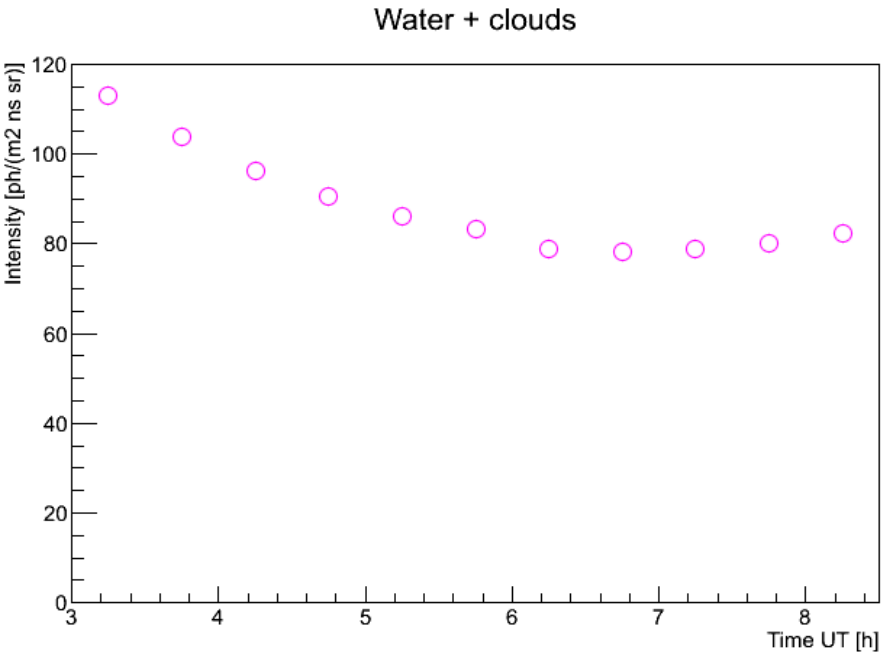
- LibRadtran cloud **example (not real cloud)**:
  - Optical depth 15
  - altitude (km) water content (g/m3) effective droplet radius (um)
  - 5.000 0 0
  - 4.000 0.2 12.0
  - 3.000 0.1 10.0
  - 2.000 0.1 8.0

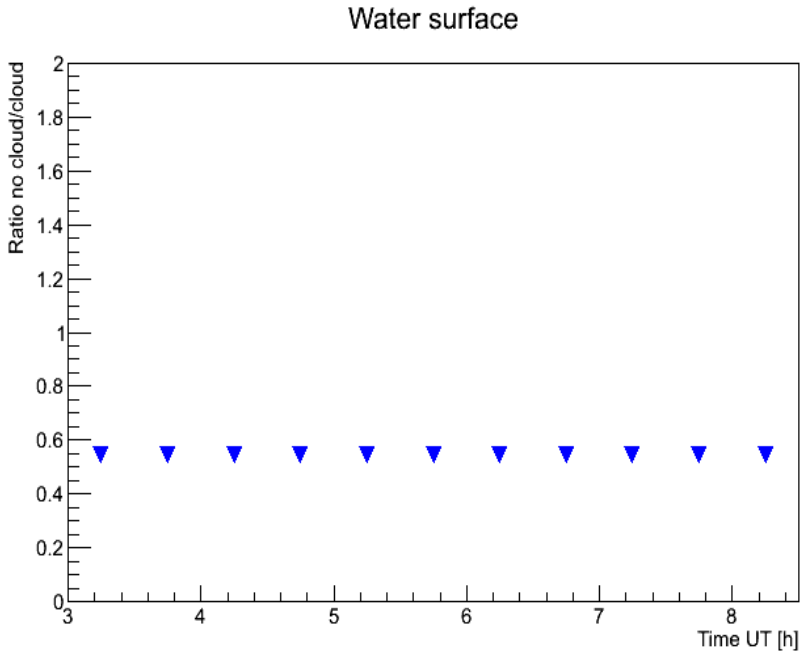
- Cloud increase reflected radiation by factor ~2



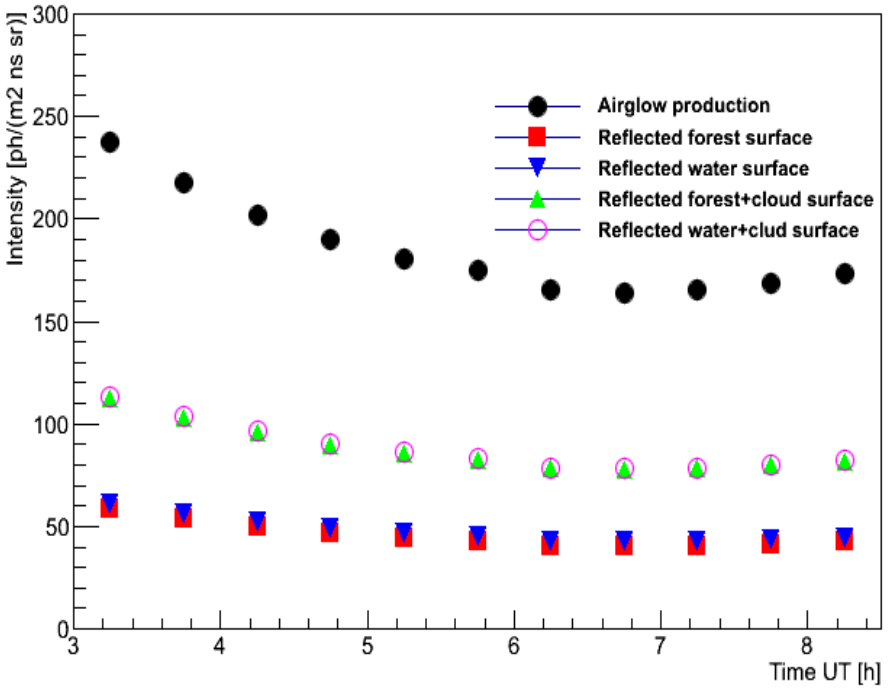
Reflected airglow intensity at 40km - water surface





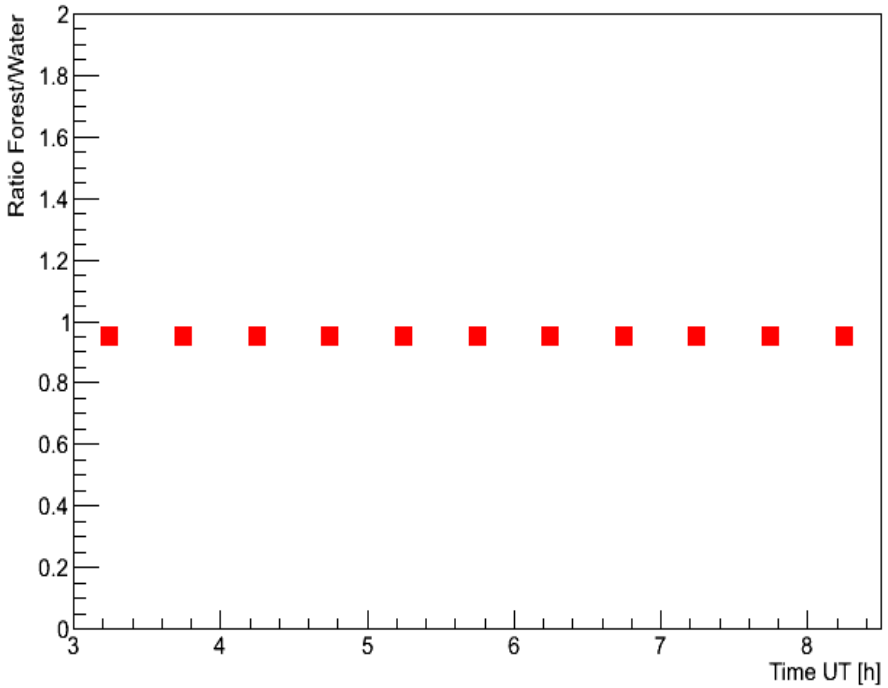


- Same situation like for forest

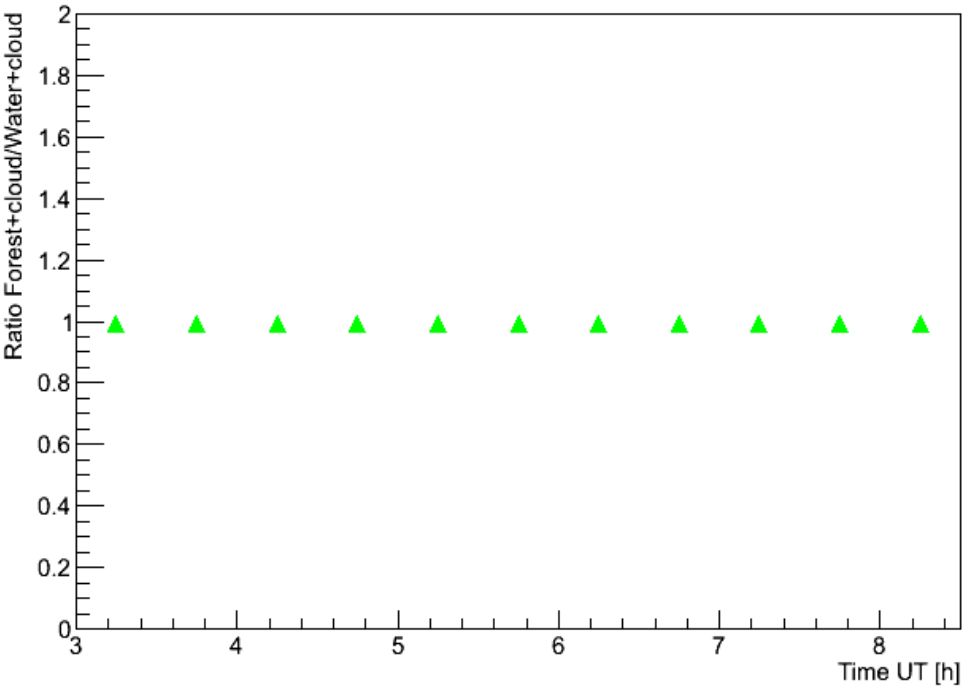


- Minimal difference of reflected intensity for forest and water surface

No cloud



Cloud



Summary

- Sources of balloon background:
  - Airglow (relatively low direct airglow production for EUSO-balloon doesn't mean same situation for all places in world.)
  - Zodiacal light
  - Star light
- Albedo for balloon area:
  - Water – 0.068
  - Forest (doesn't matter which one) – 0.028
  - Minimal difference between reflected light from water and forest
- Clouds (our example of cloud) increase reflected light by factor ~2 for forest and water surface

Preliminary comparison of measured and simulated background at 5:30 UT for EUSO-balloon

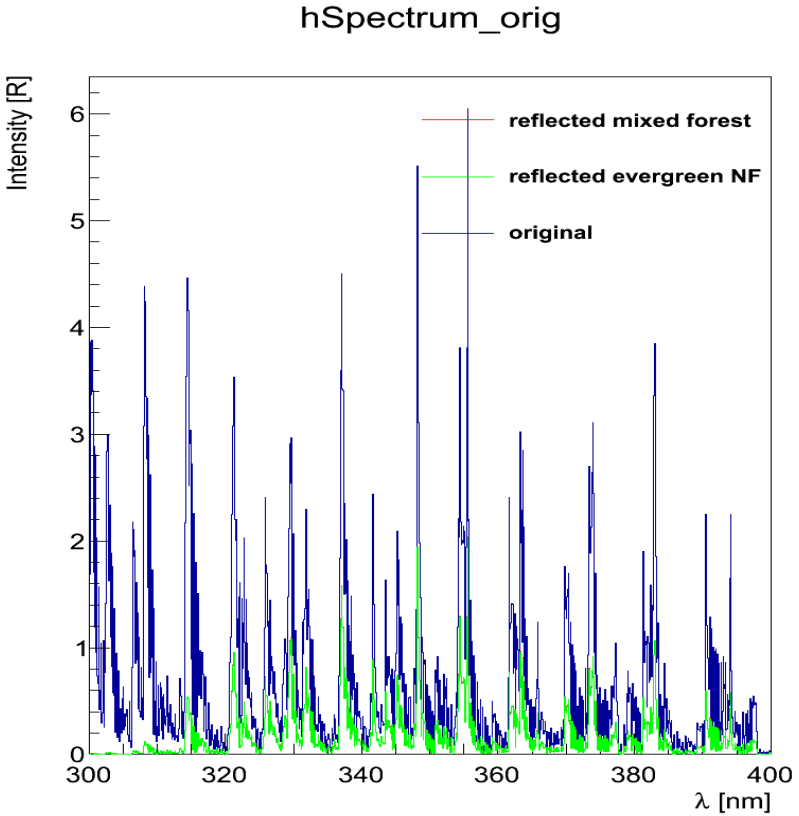
- **Fast estimation of balloon observed intensity (value from Simon Mackovjak presentation)**
  - One pixel see : 0.25o x 0.25o
  - PDM see 48px x 48px = 144 deg2
  - **Assumption 1** : front lens have 1 m2
  - Acceptance EUSO balloon 144 / 3282,81 = 0.043 m2 sr
  - **Assumption 2.a.** : Throughput x BG3 x QE = 0.1
  - **Assumption 2.b.** : Throughput x BG3 x QE = 0.05
  - **2.a.** then 100 ph /(m2 ns sr) = 0.47 pe/(px GTU)
  - **2.b.** then 100 ph /(m2 ns sr) = 0.94 pe/(px GTU)
  - **2.a.** If balloon observe 0.68 pe/(px GTU) we see 144.7 ph / (m2 ns sr)
  - **2.b.** If balloon observe 0.68 pe/(px GTU) we see 289.4 ph / (m2 ns sr)

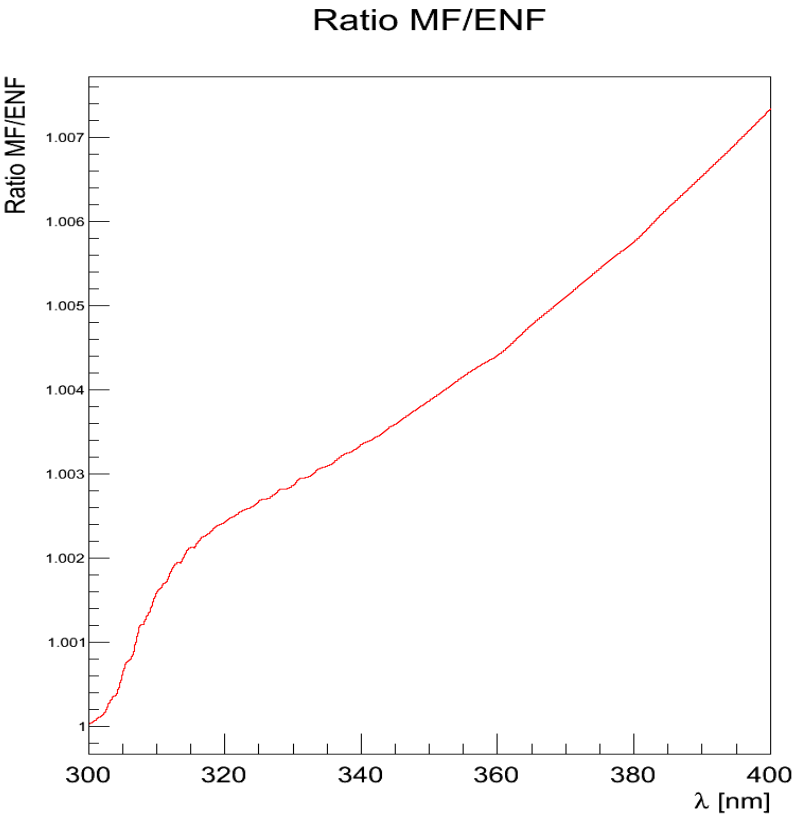
- Direct radiation (not seen by balloon)
  - Zodiacal light ~ 240 ph/(m^2 ns sr) [1]
  - Star light ~240 ph/(m2 ns sr) [1]
  - Airglow ~ 174 ph/(m2 ns sr)

- Reflected light no clouds:
  - Airglow ~ 42 ph/(m2 ns sr)
  - Zodiacal light ~ (42/174)*240=57 ph/(m2 ns sr)
  - Star light ~ (42/174)*240=57 ph/(m2 ns sr)
  - Sum ~ 156 ph/(m2 ns sr)
- Reflected light with clouds:
  - Airglow ~ 82 ph/(m2 ns sr)
  - Zodiacal light ~ (82/174)*240=114 ph/(m2 ns sr)
  - Star light ~ (82/174)*240=114 ph/(m2 ns sr)
  - Sum ~ 310 ph/(m2 ns sr)

backup

Spectrum for different forest





- Reflected spectrum for
  - Mixed forest
  - Evergreen needle forest