Dramatic increase of space debris (SD) peak spatial density since 2006 seen at ESR

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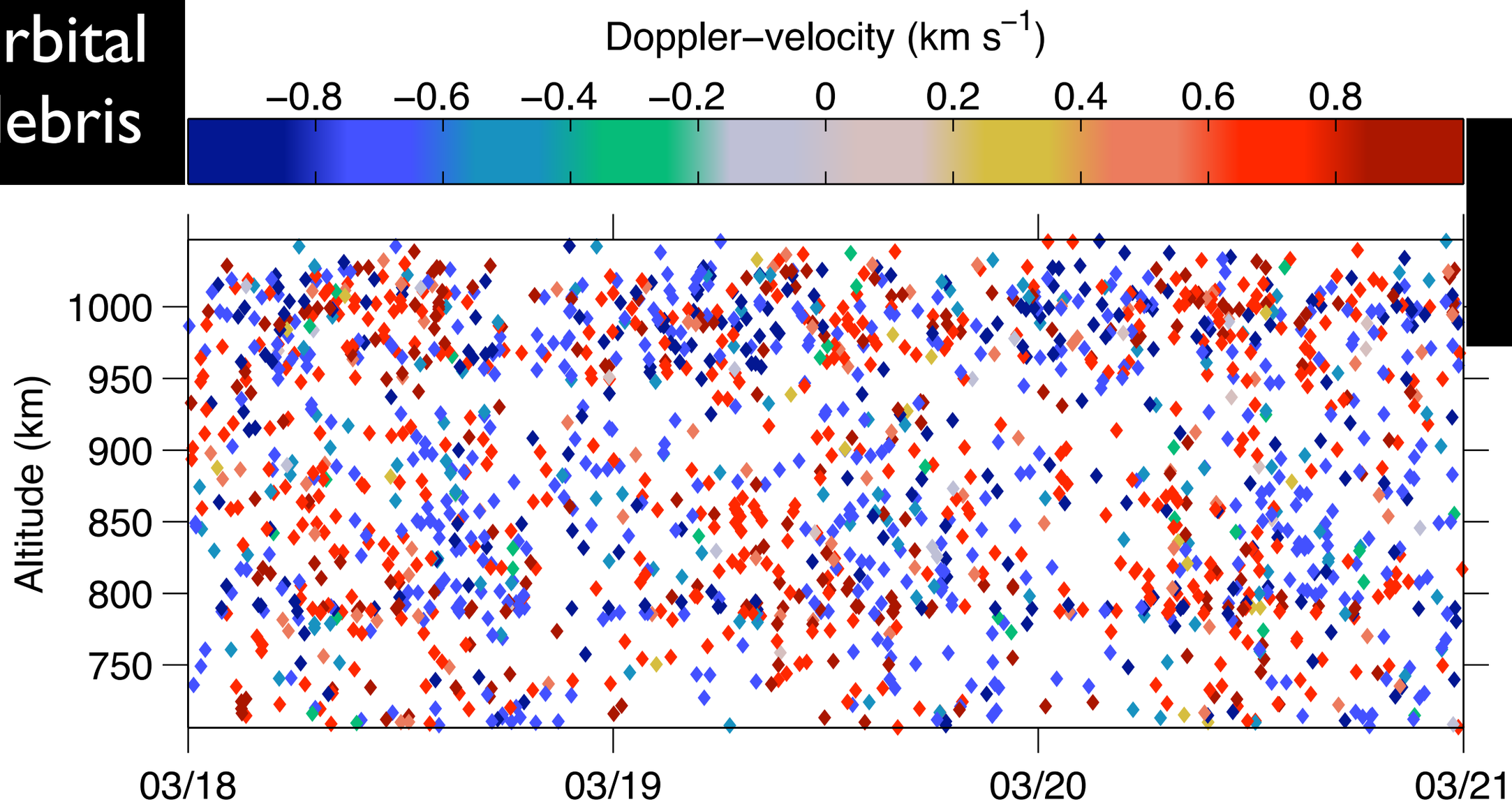
- Justify the claim
  - Why has the density increased ?
    - Spreading of the new debris cloud
      - EISCAT IPY SD campaign

Presented 6 August 2007 at the 13th EISCAT International Workshop in Mariehamn, Åland.

- Increase of orbital debris spatial density

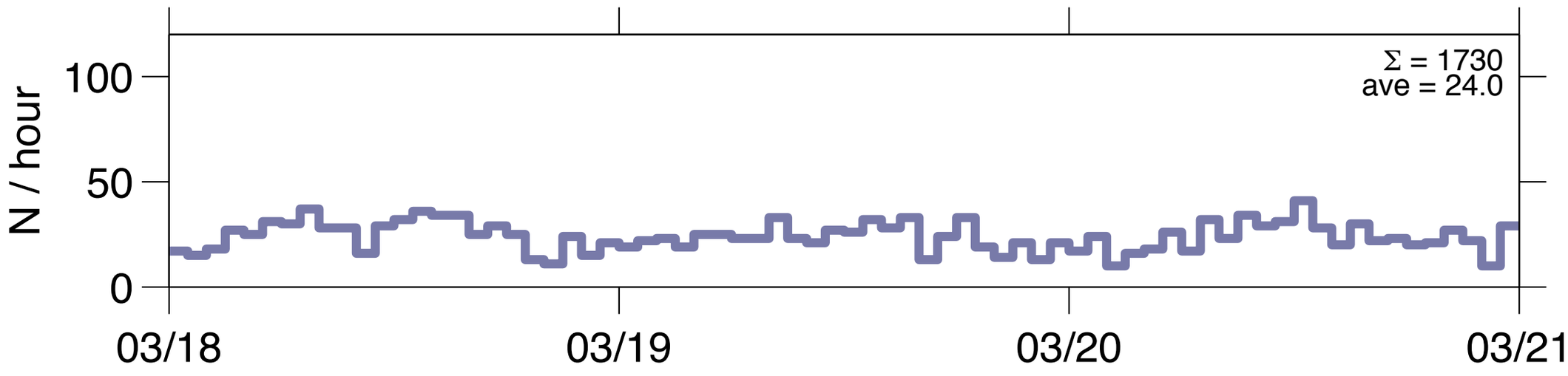
Debris event rate has increased
by at least a factor of 5 in
certain altitude zone.

orbital debris

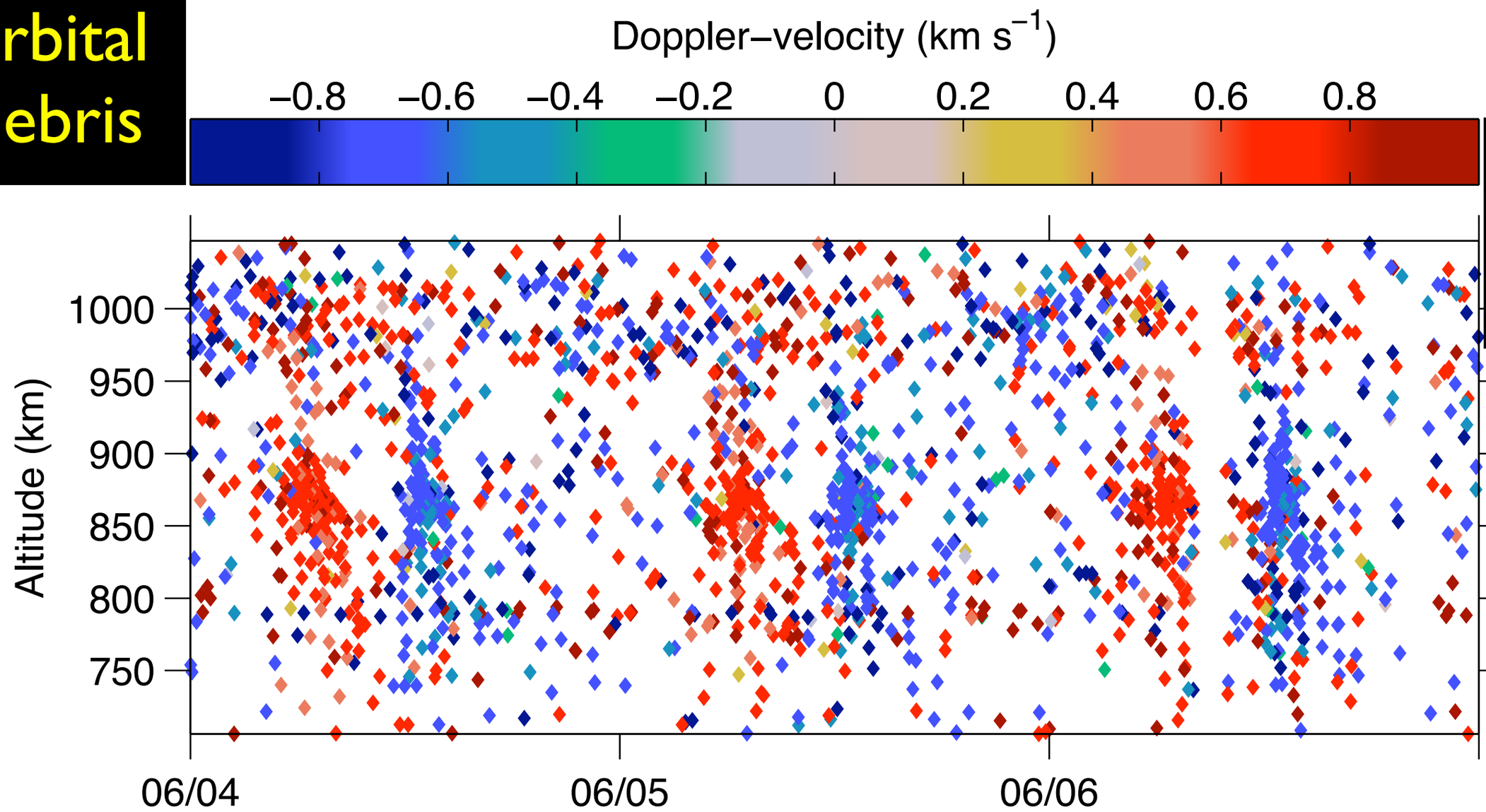


ESR experiment **steffe** @42m

18 - 20 March 2006

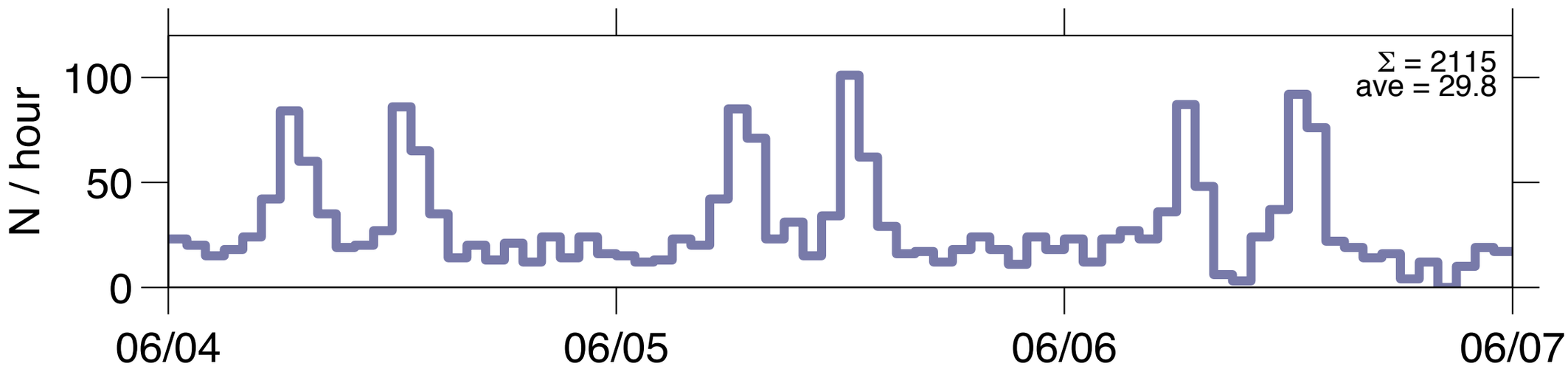


orbital debris

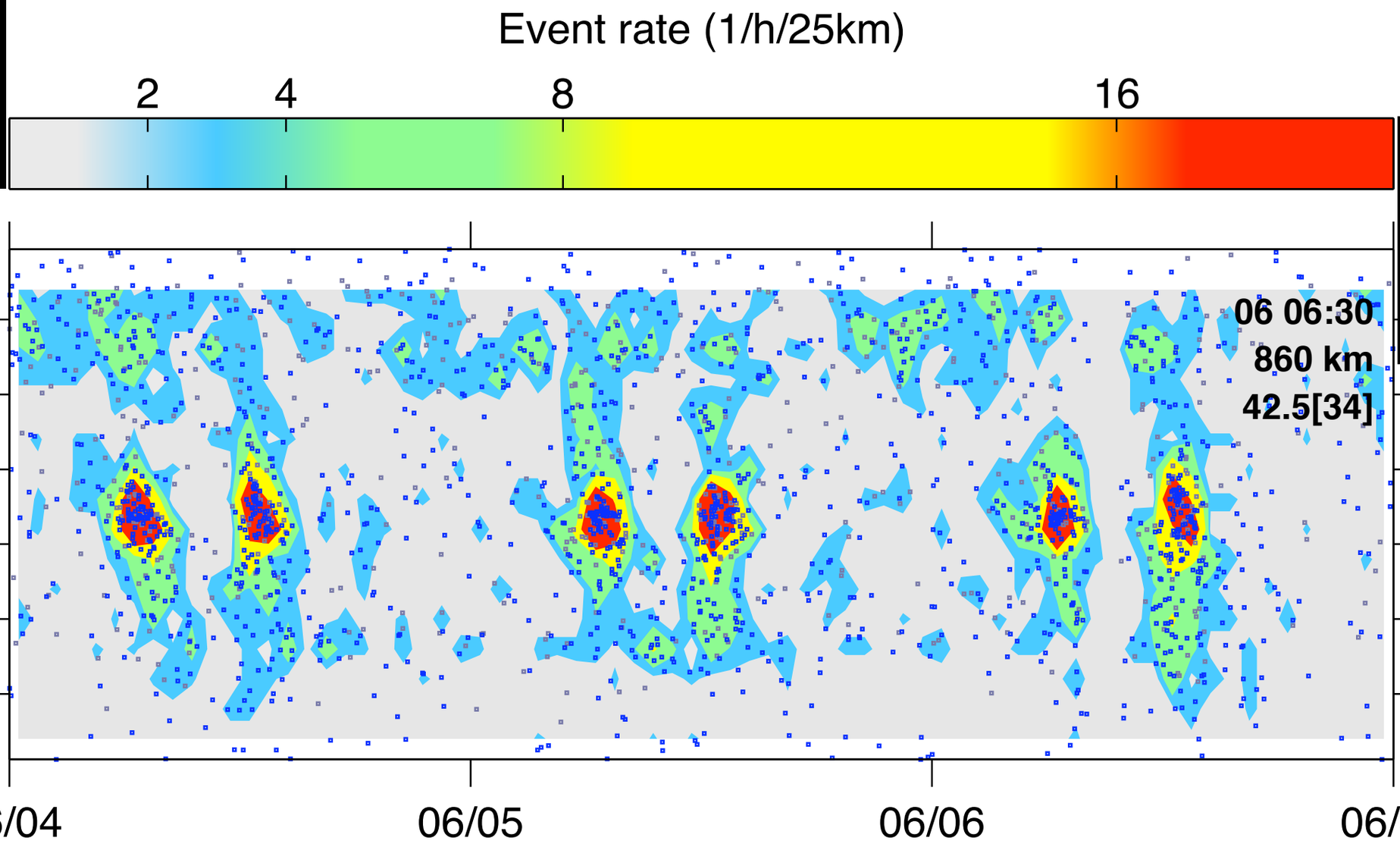


ESR experiment **ipy @42m32m**

4 - 6 June 2007

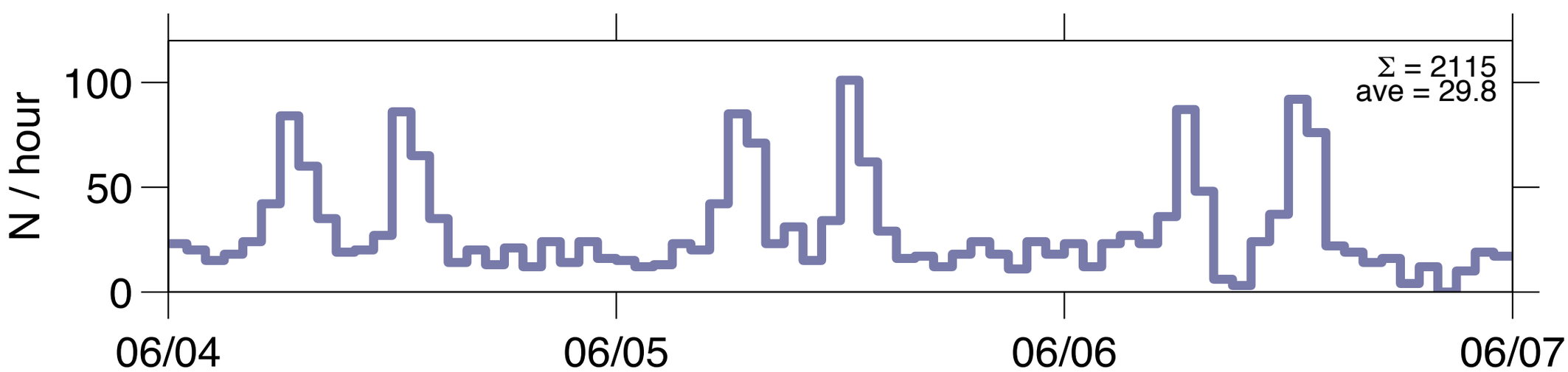


orbital debris



ESR experiment **ipy @42m32m**

4 - 6 June 2007

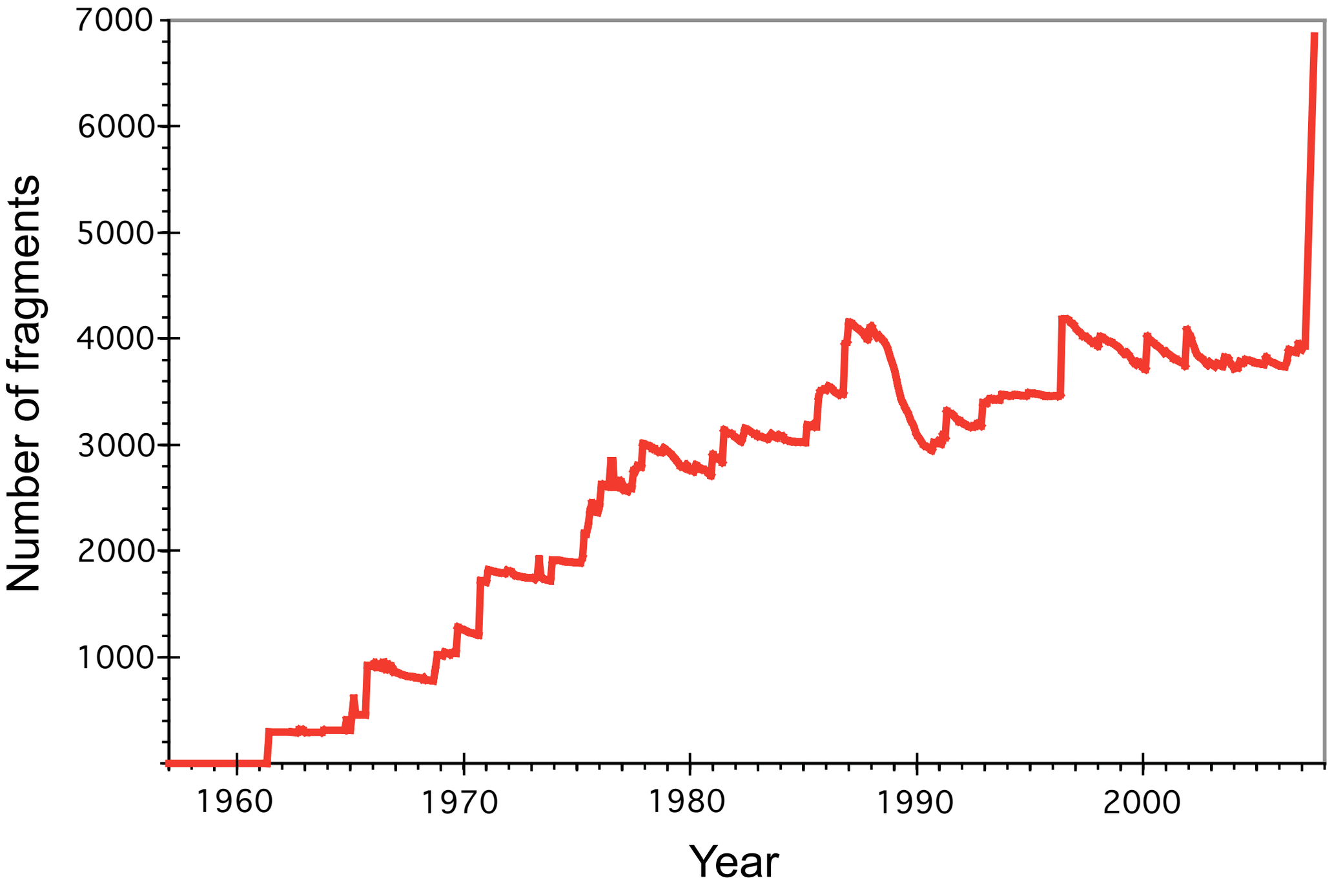


- Why has the density at ESR increased ?

On Jan 11, 2007, Chinese military destroyed by missile the polar-orbiting Fengyun 1C weather satellite, at an altitude of about 850 km.

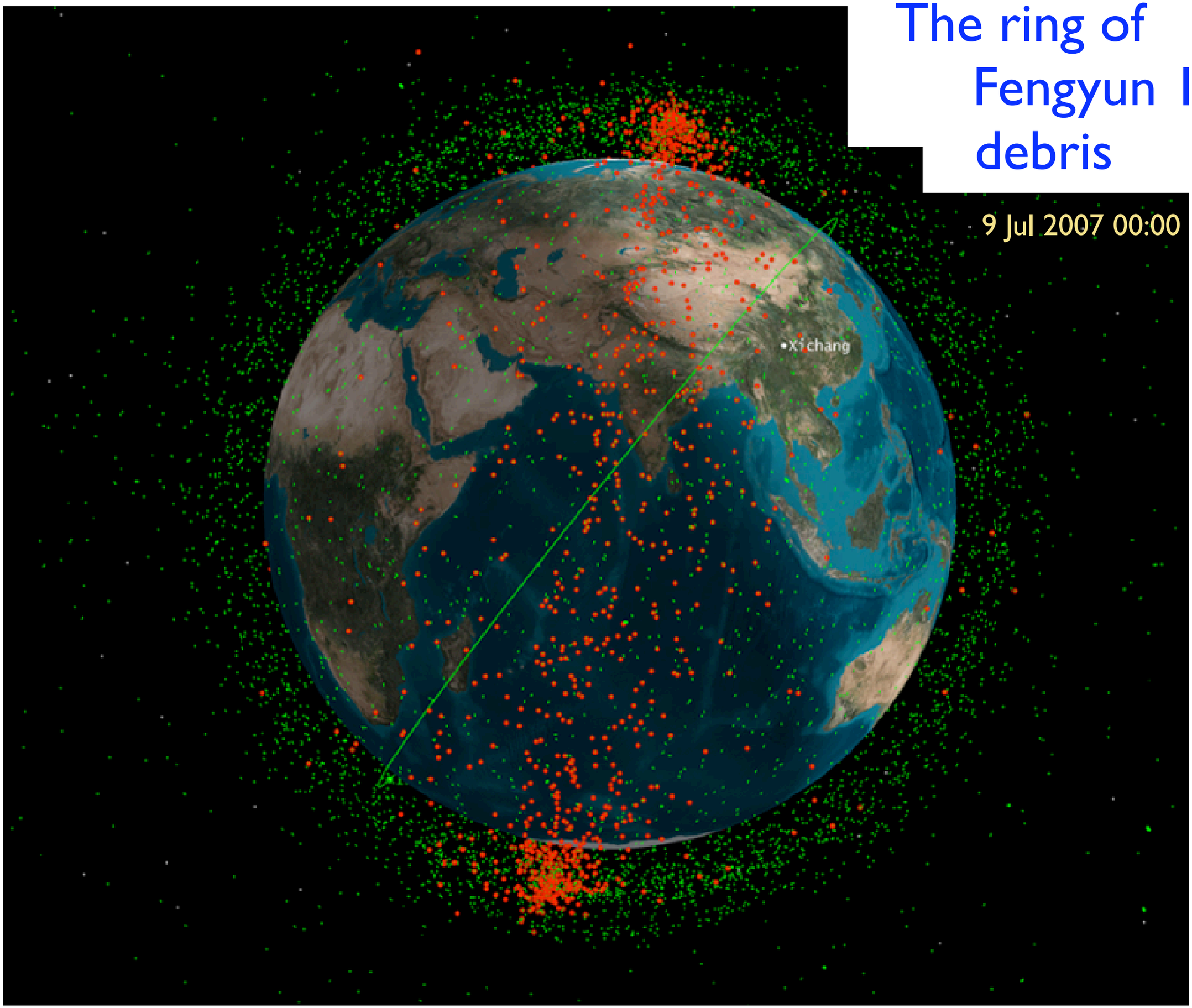
By July, USSTRATCOM had catalogued about 2000 pieces from that fragmentation.

Historical development of on-orbit catalogued fragmentation debris



Source: NASA's ODQN, July 2007 issue.

The ring of Fengyun 1C debris



Source: T.S. Kelso, AGI

- Spreading of the new debris cloud

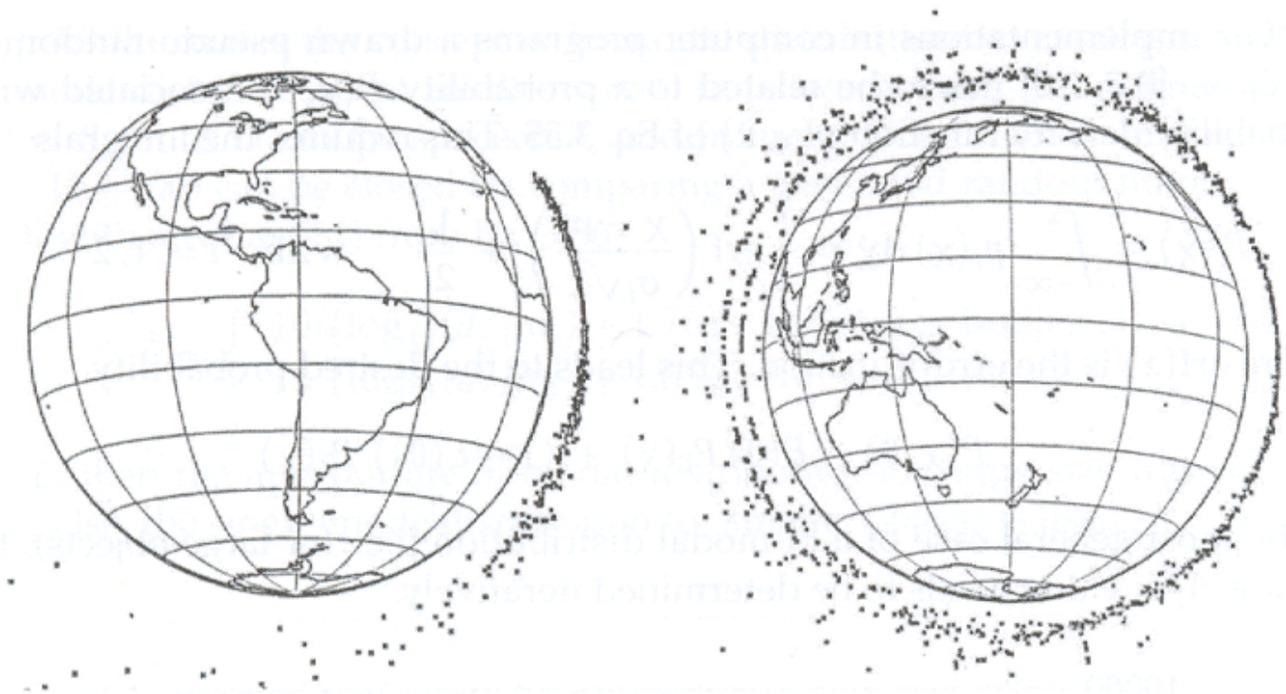
The debris orbits are expected the spread around the globe, due to orbit perturbation by the oblateness-term of Earth's gravity field.

Do we see any of this yet?

Spreading of debris after a breakup (model calc.)

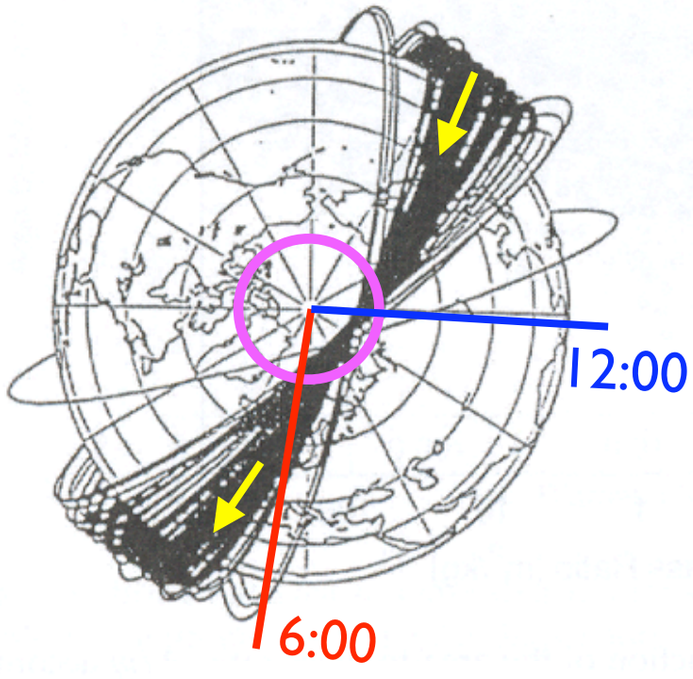
Spherically symmetric breakup on an 800 km, inclination 98.7° orbit.

Source: H. Klinkrad,
Space debris, Models and Risk Analysis, p. 72.

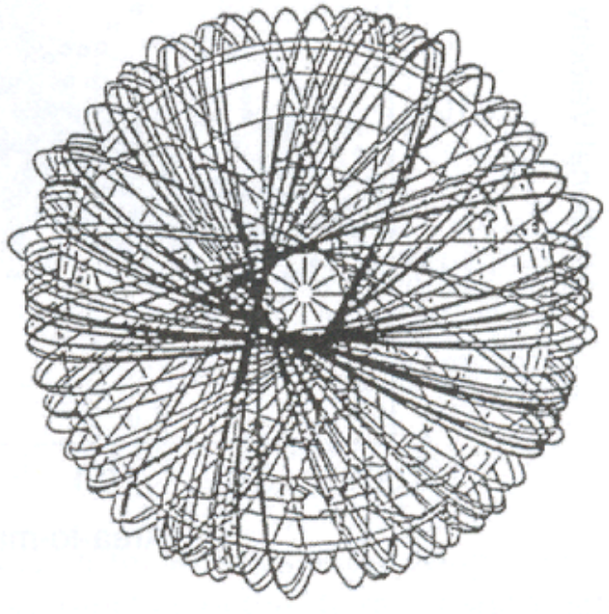


after 1 orbit

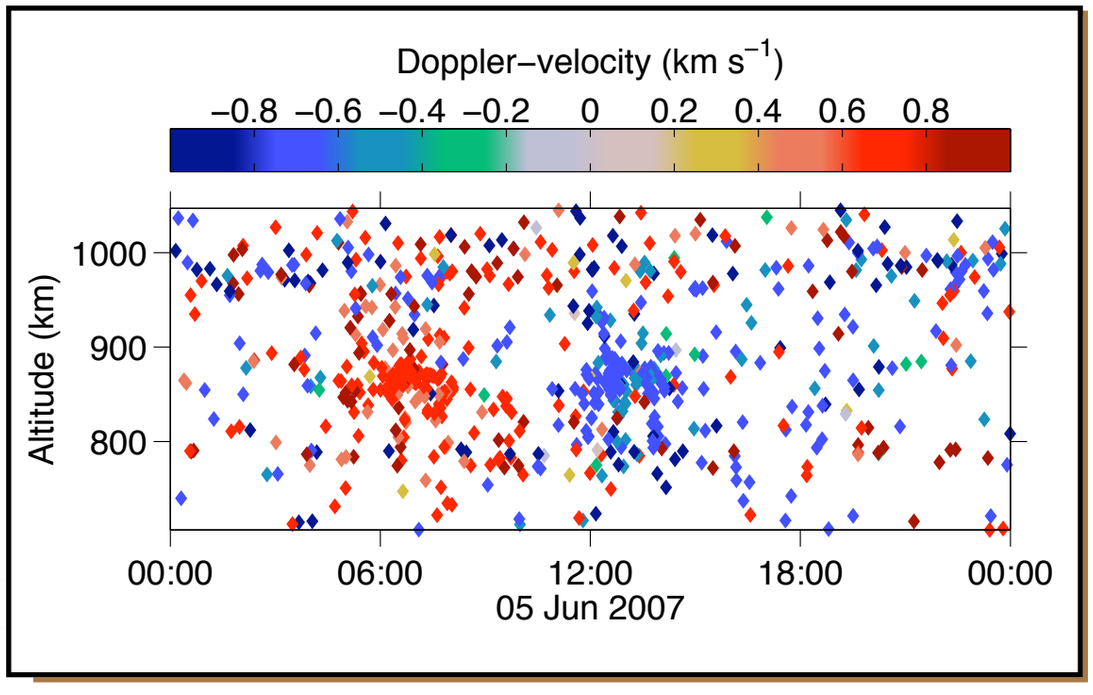
after 20 orbits



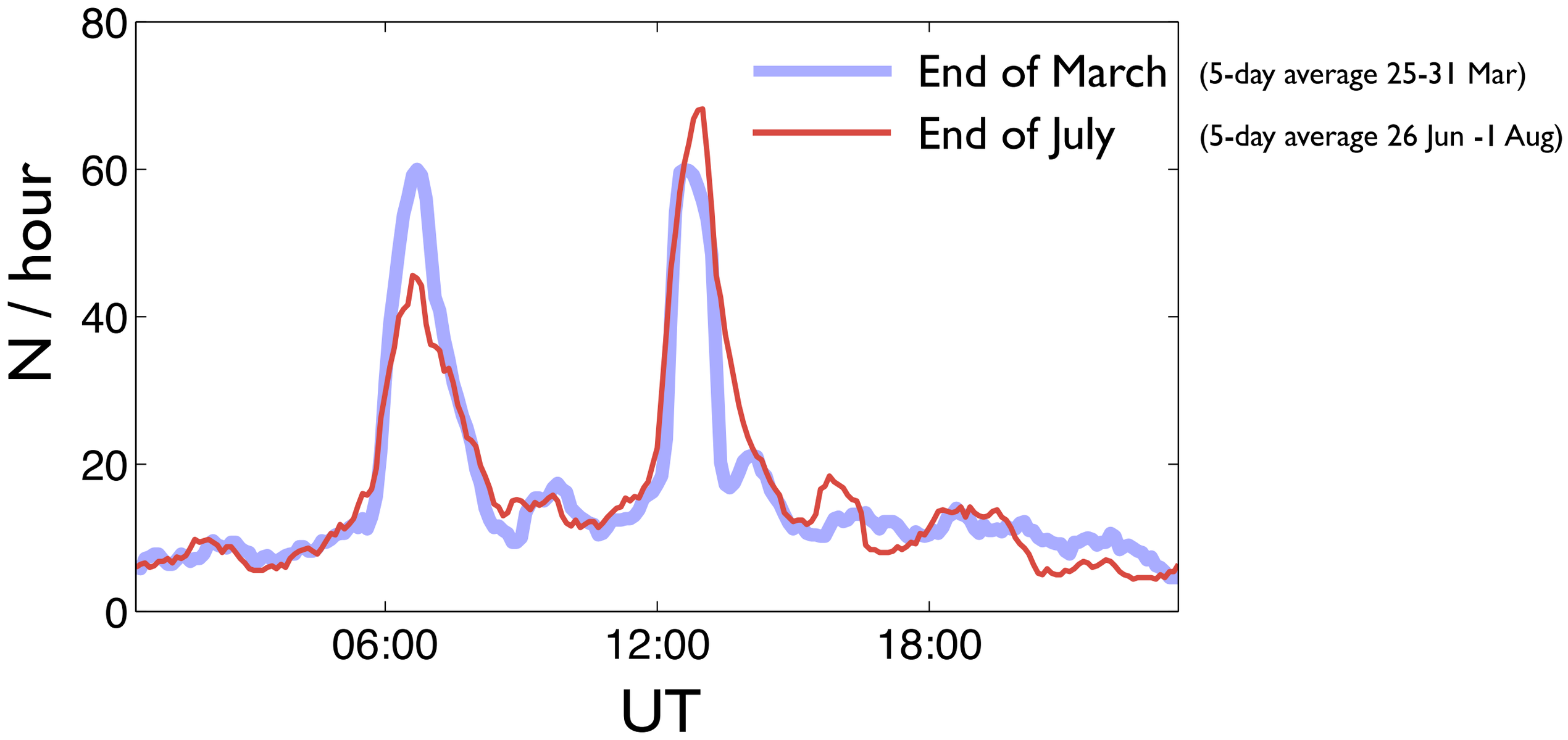
after 3 months



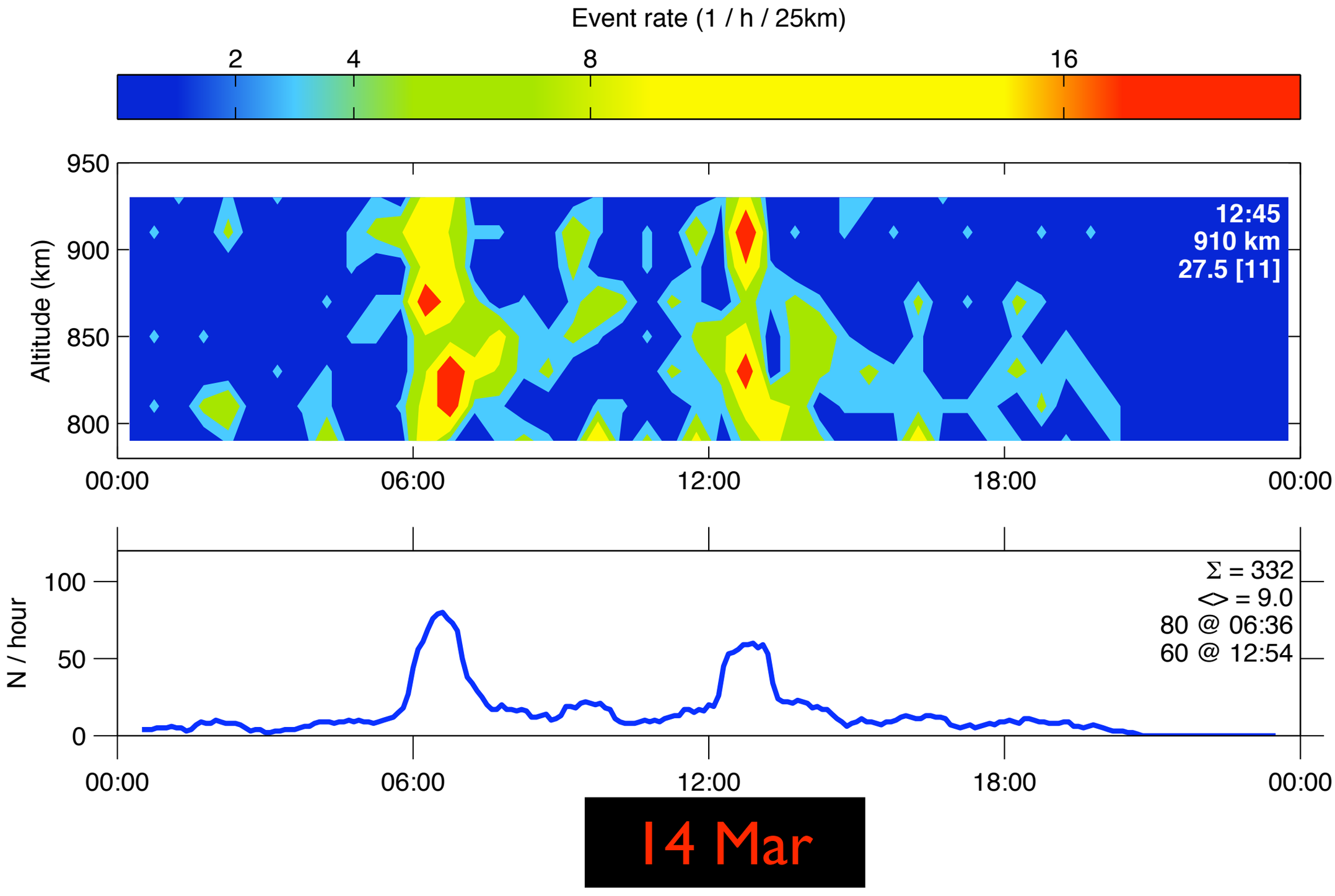
after 4 years



Daily event rate variation in altitude zone 780-950 km

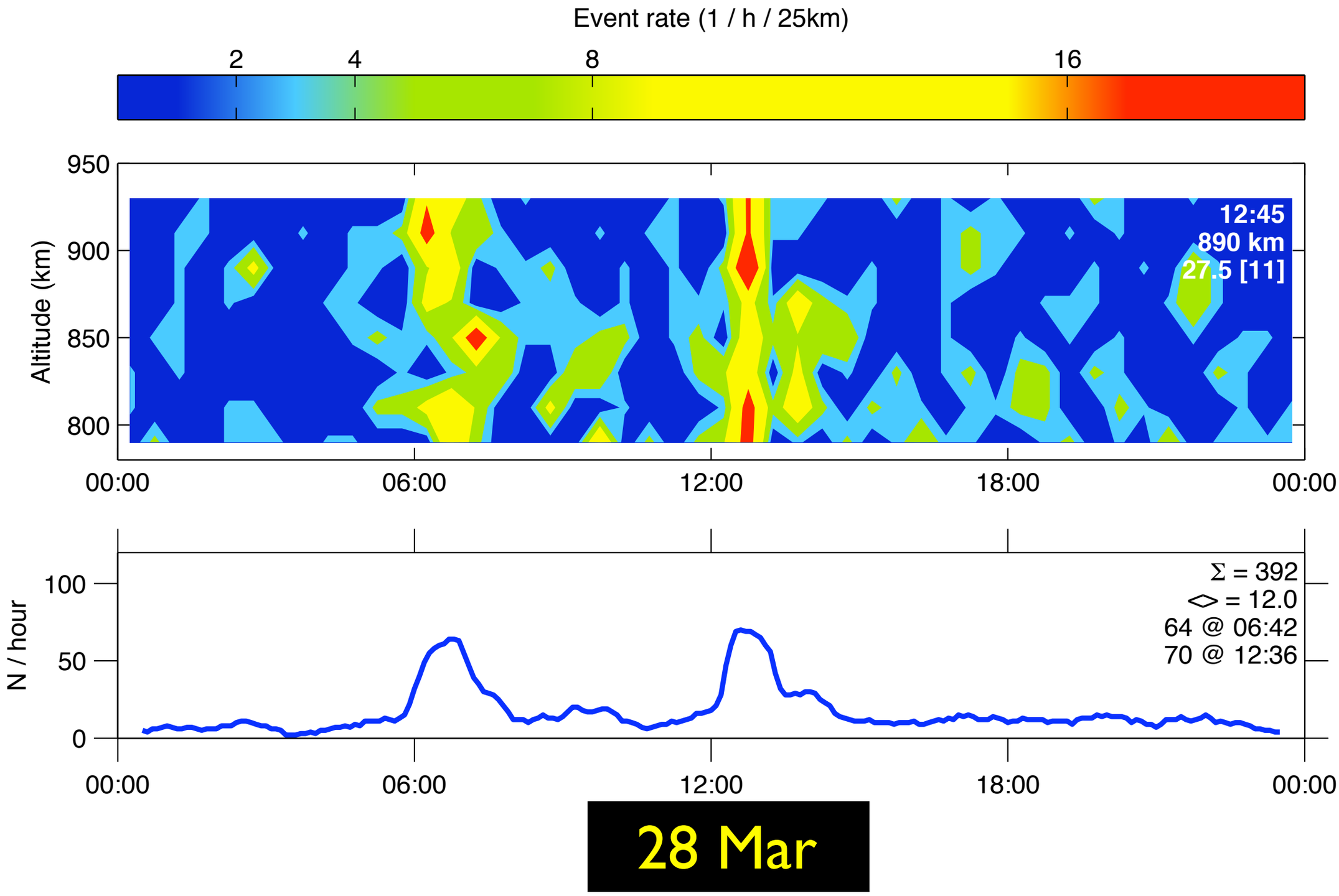


Hourly event rate
in altitude zone 780-950 km



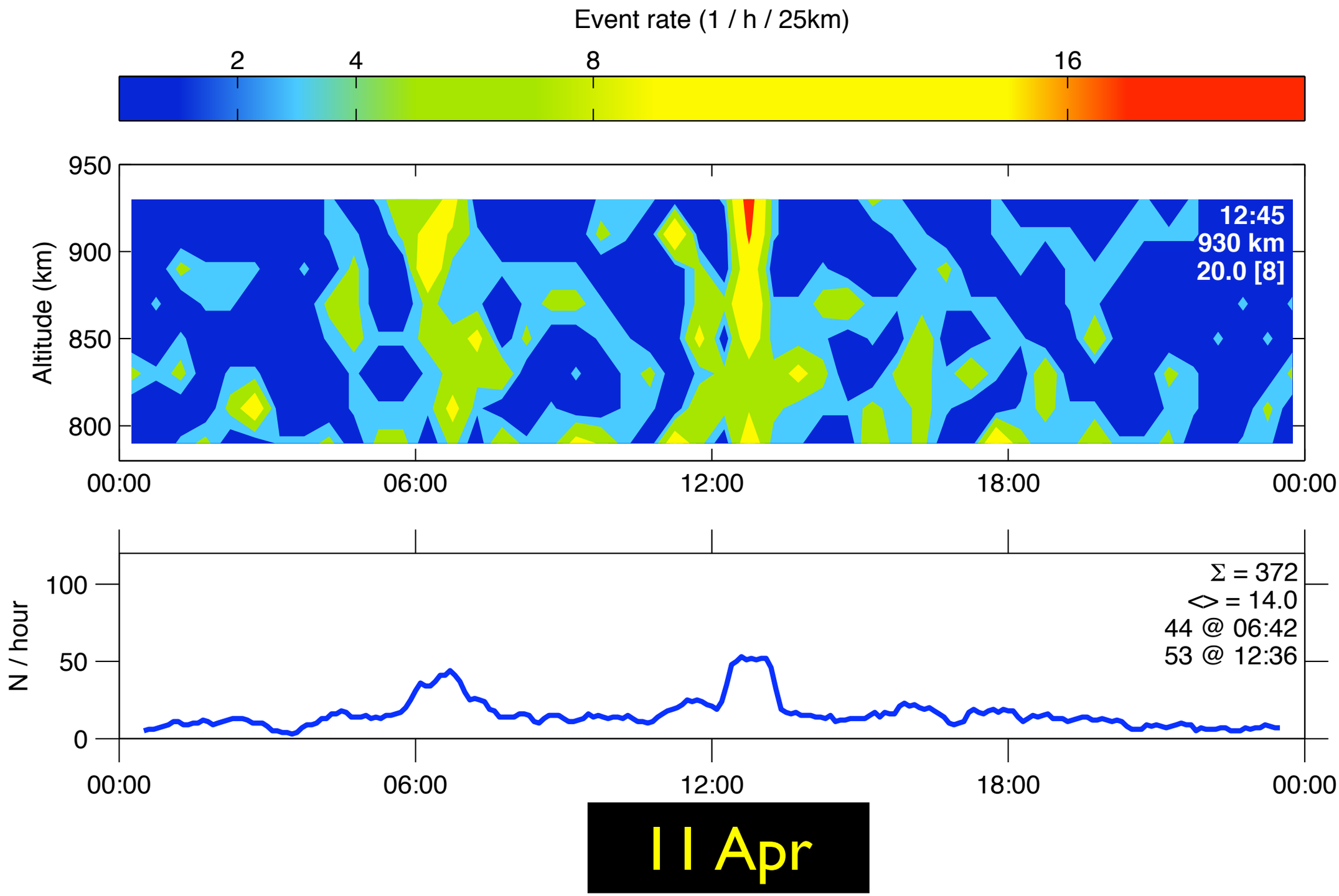
14 Mar

Hourly event rate
in altitude zone 780-950 km



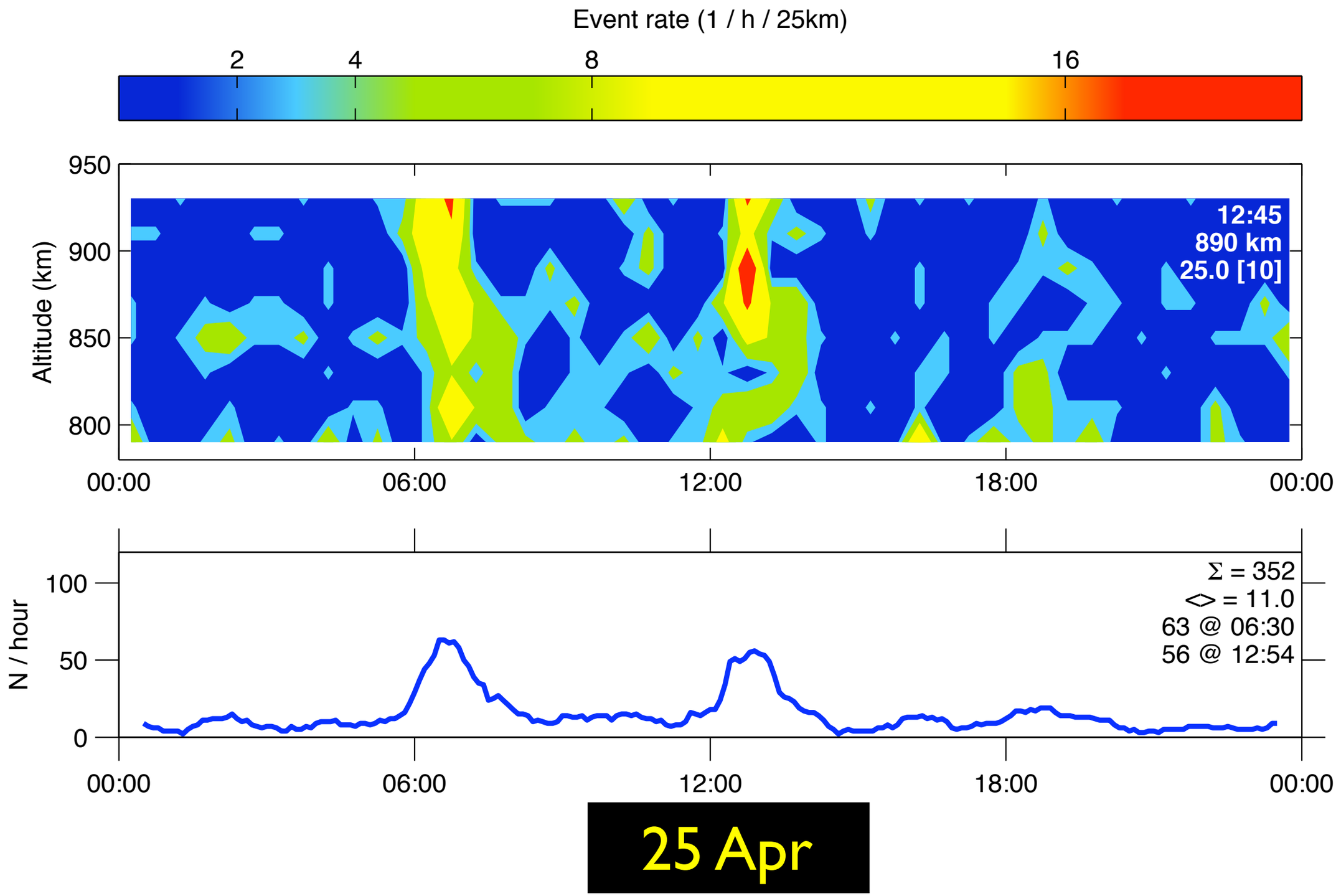
28 Mar

Hourly event rate
in altitude zone 780-950 km



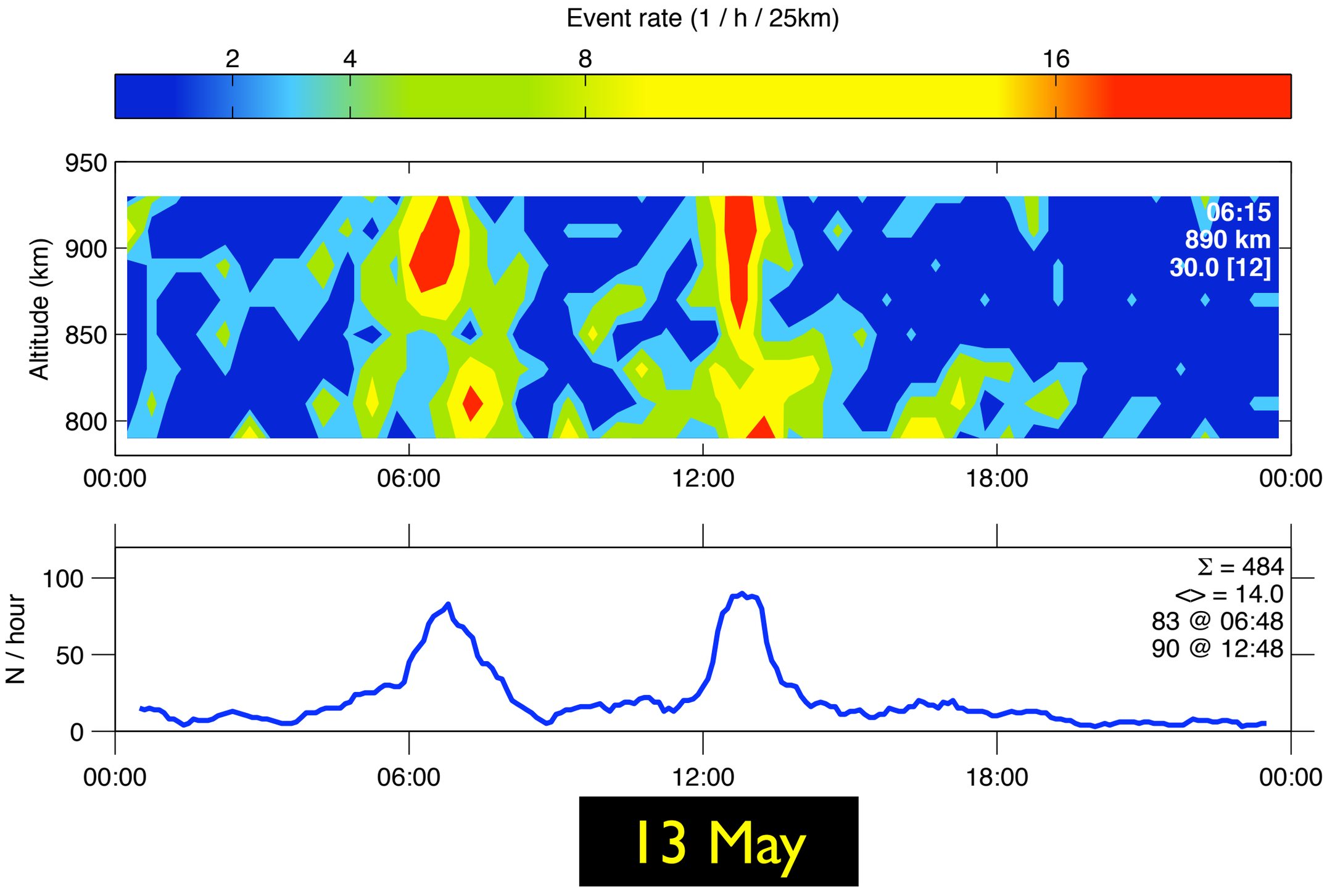
11 Apr

Hourly event rate
in altitude zone 780-950 km



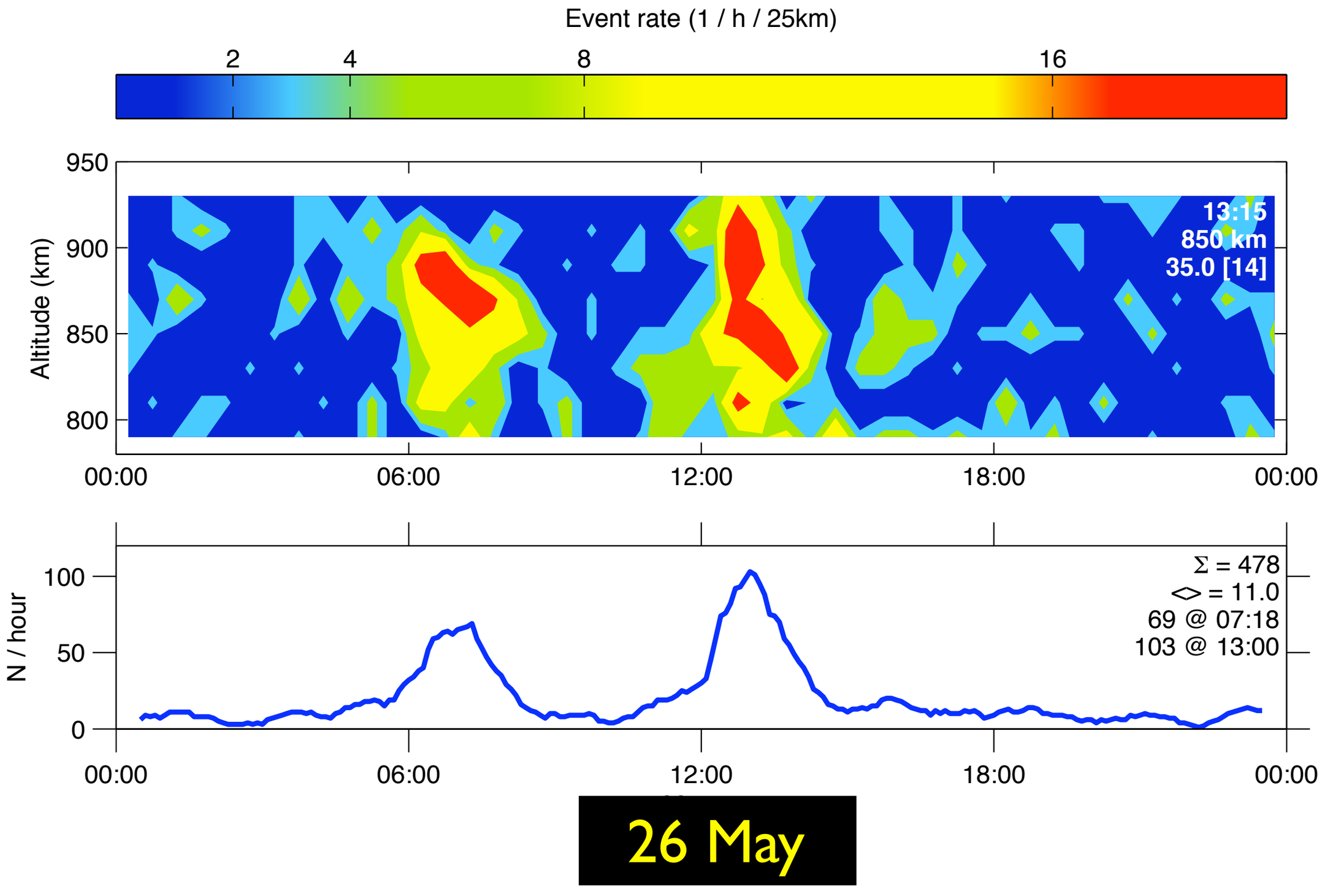
25 Apr

Hourly event rate
in altitude zone 780-950 km



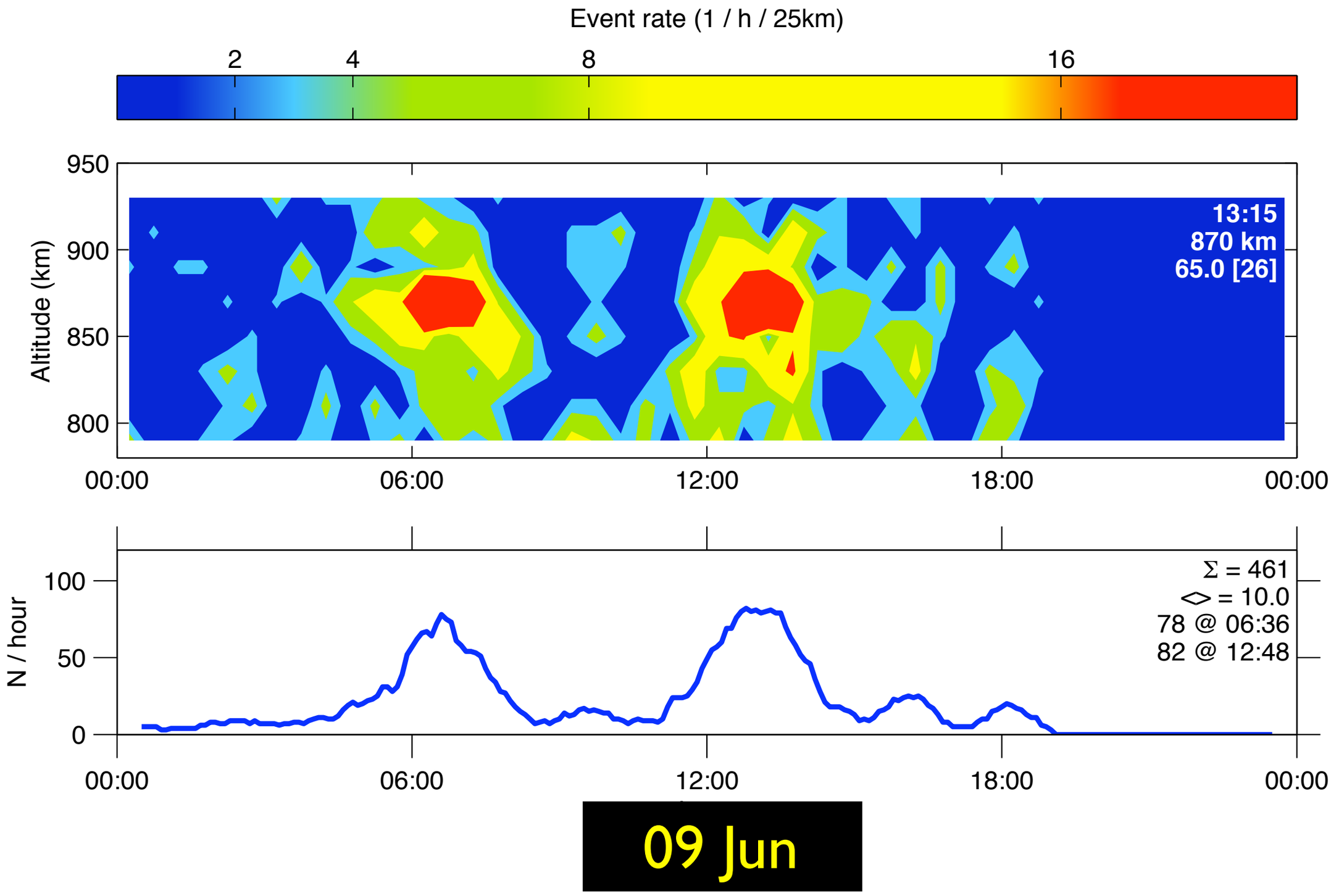
13 May

Hourly event rate
in altitude zone 780-950 km



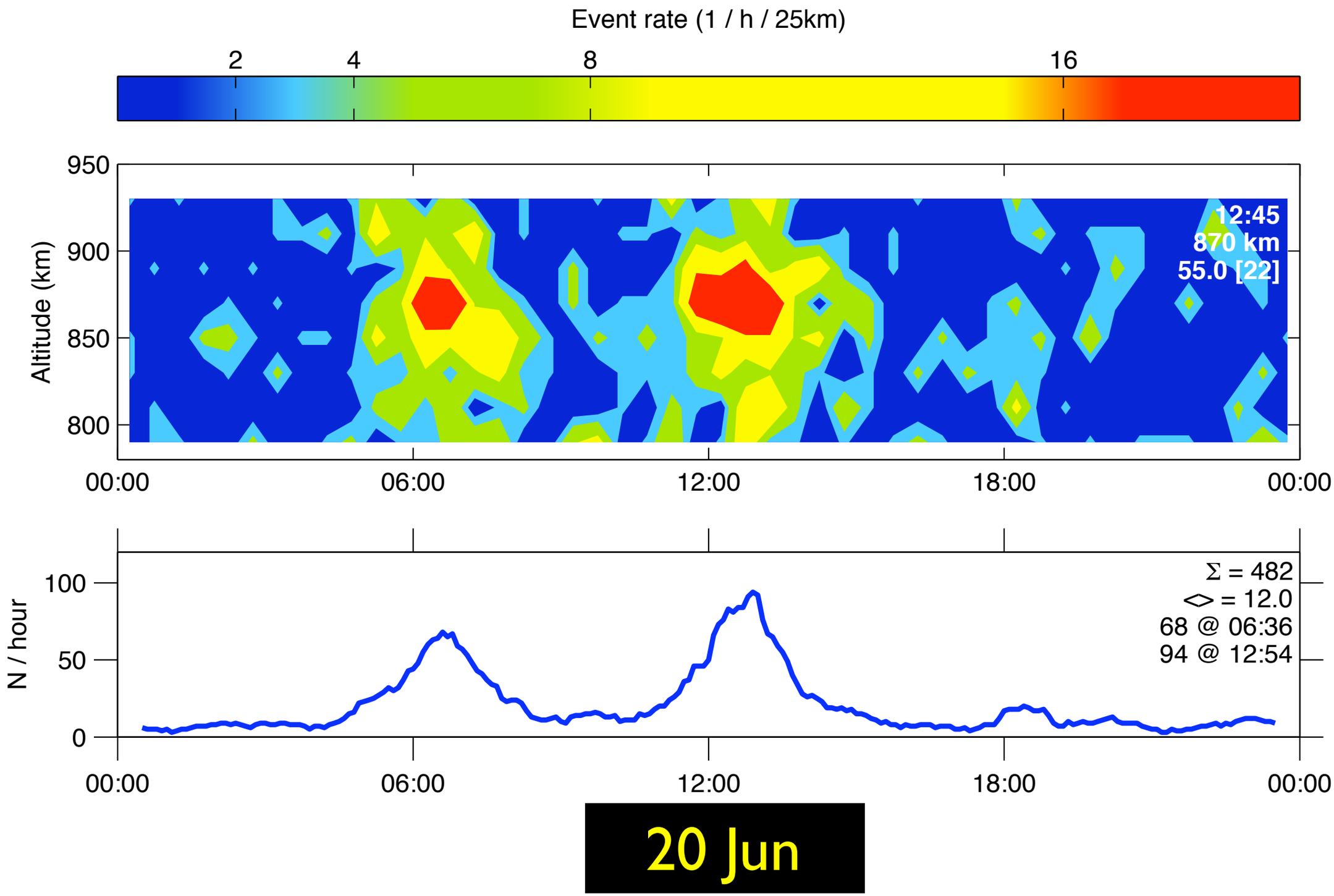
26 May

Hourly event rate
in altitude zone 780-950 km



09 Jun

Hourly event rate
in altitude zone 780-950 km



20 Jun

Hourly event rate
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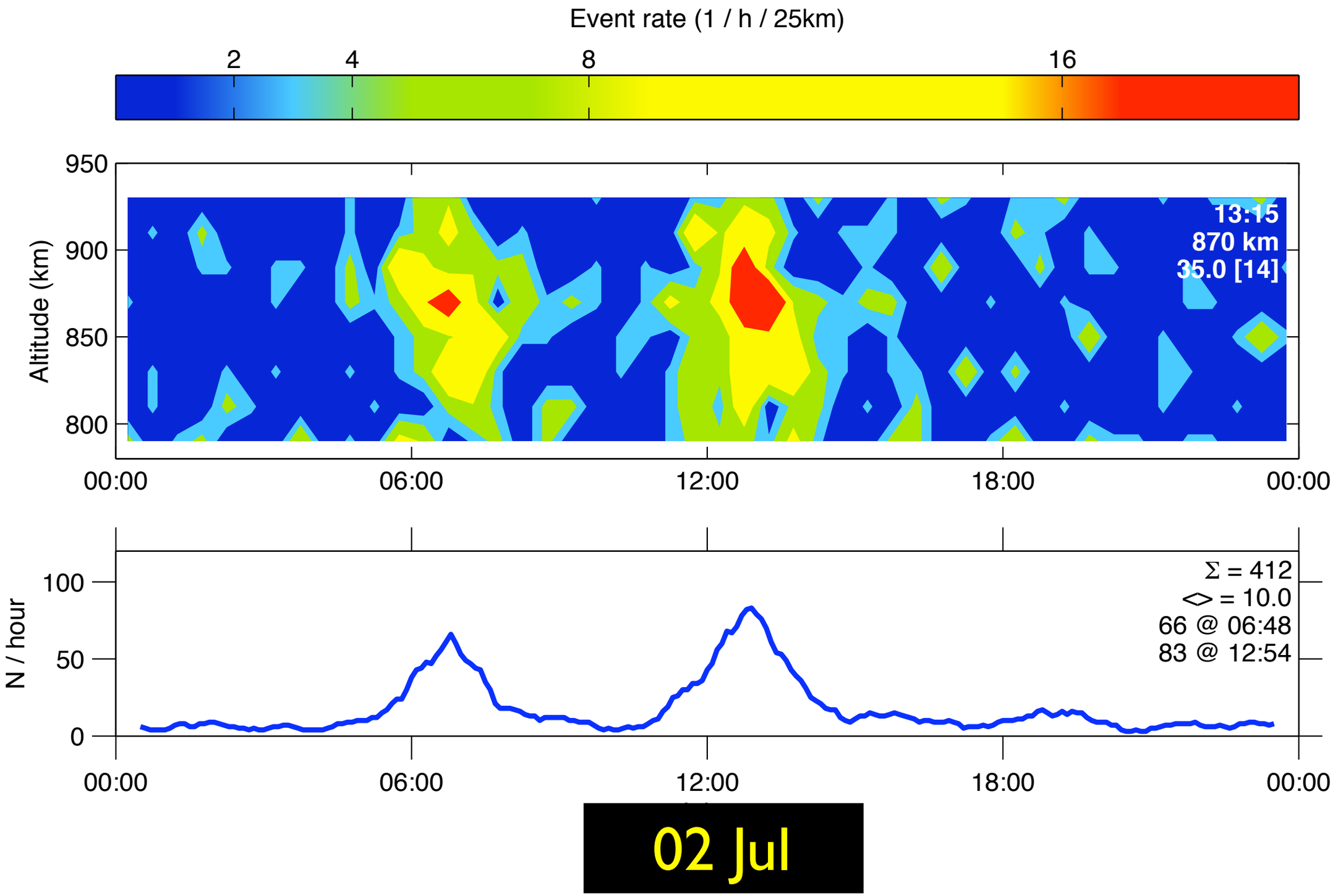
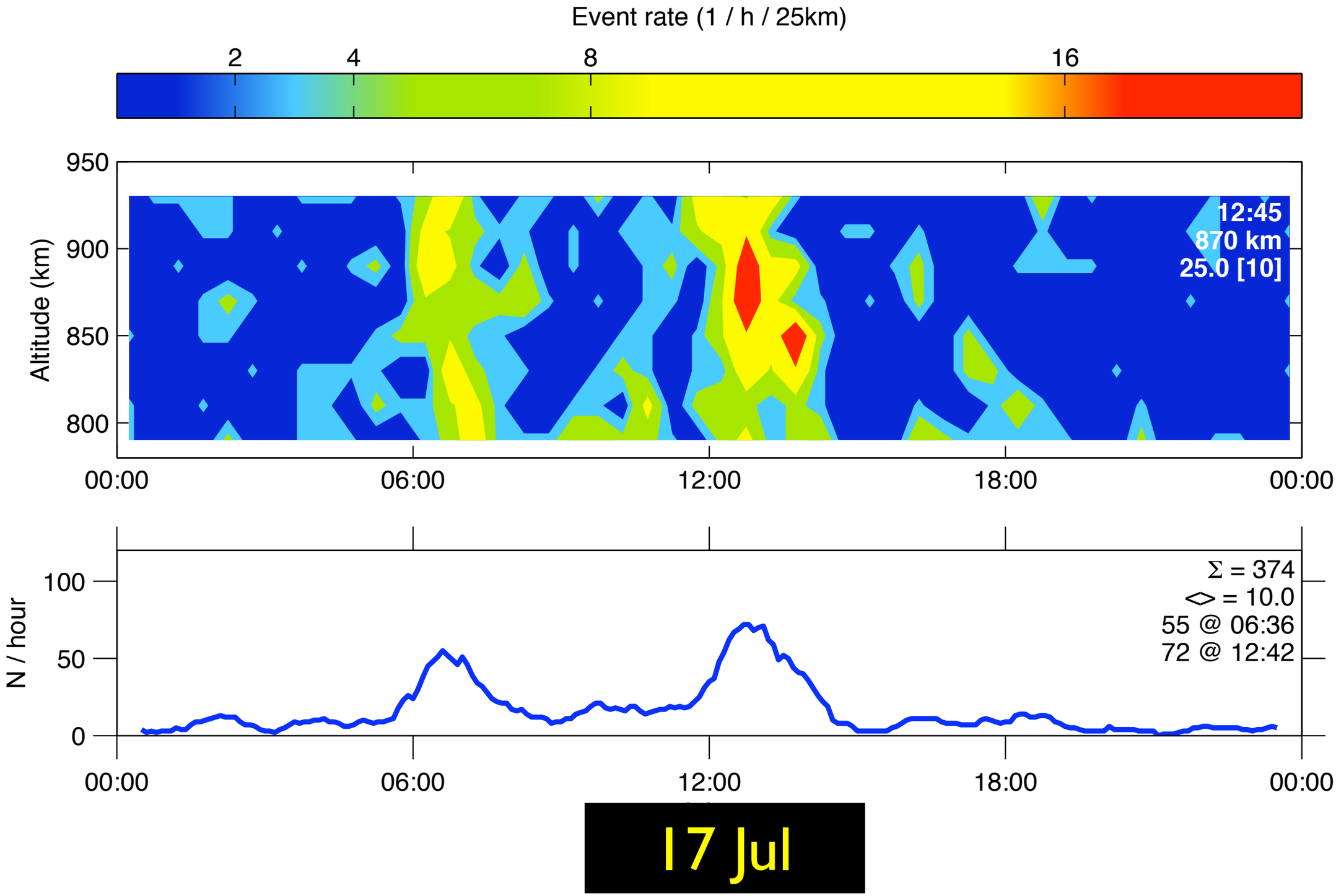


02 Jul

Hourly event rate
in altitude zone 780-950 km



17 Jul

Hourly event rate
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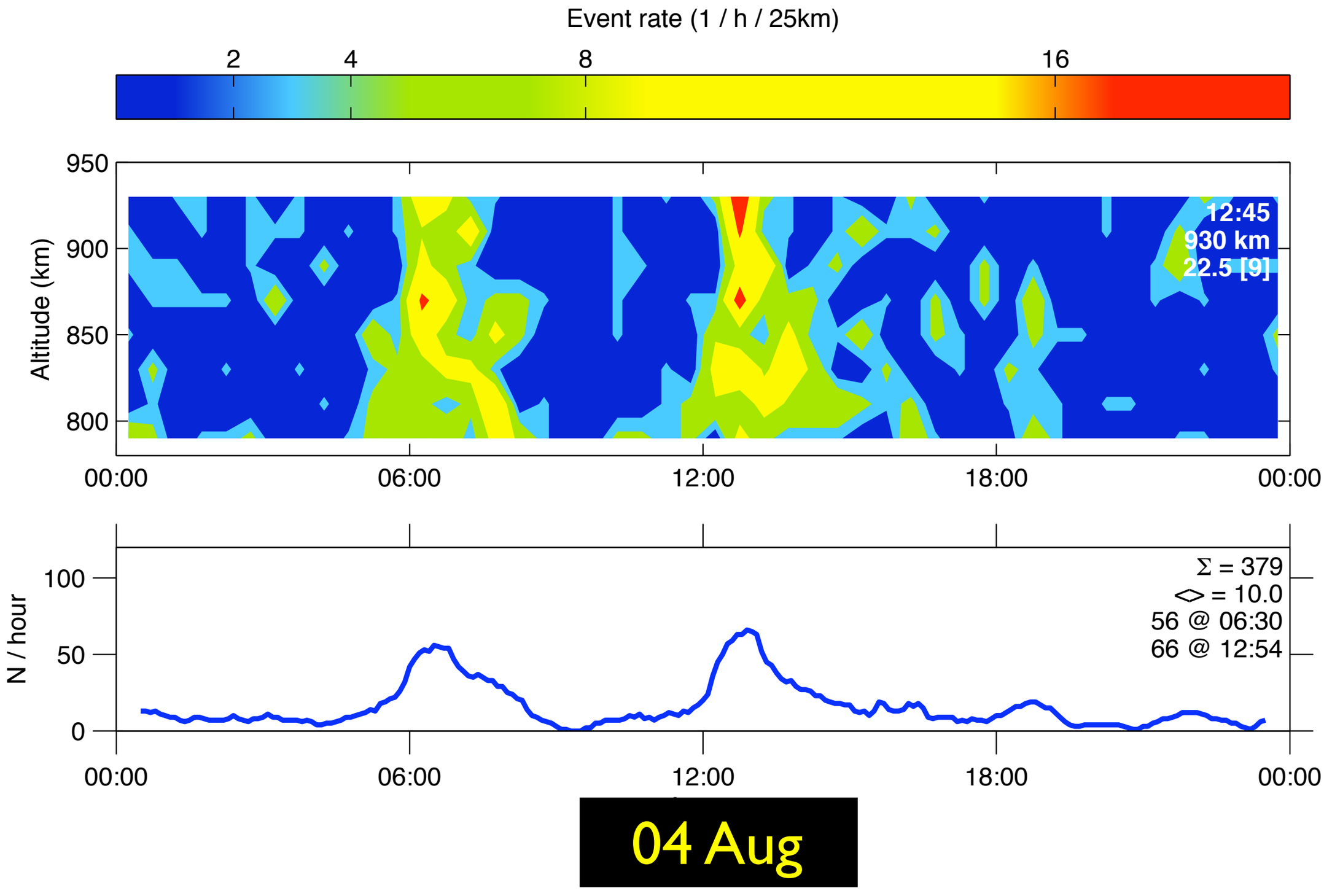
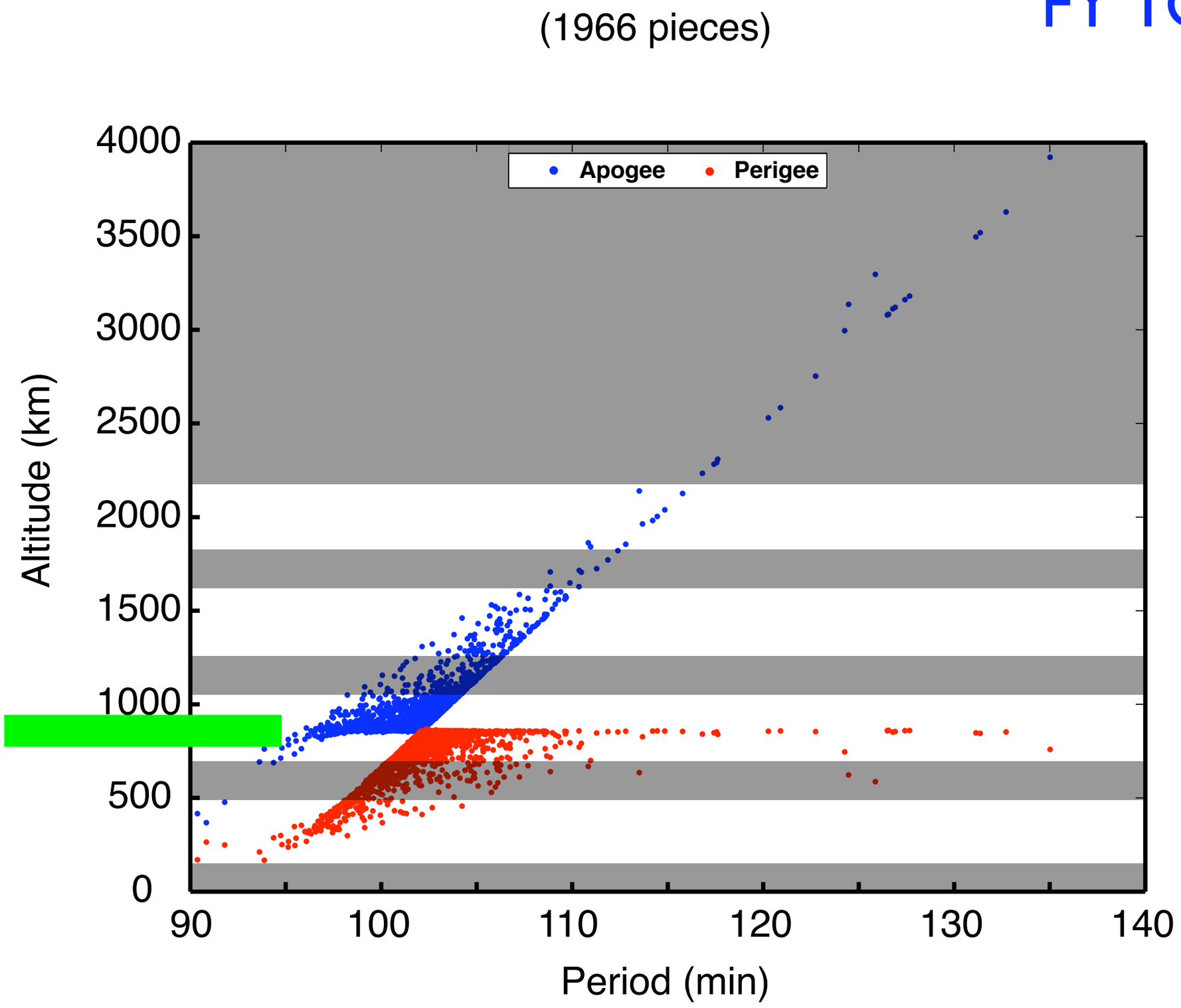


04 Aug

- EISCAT IPY orbital debris campaign

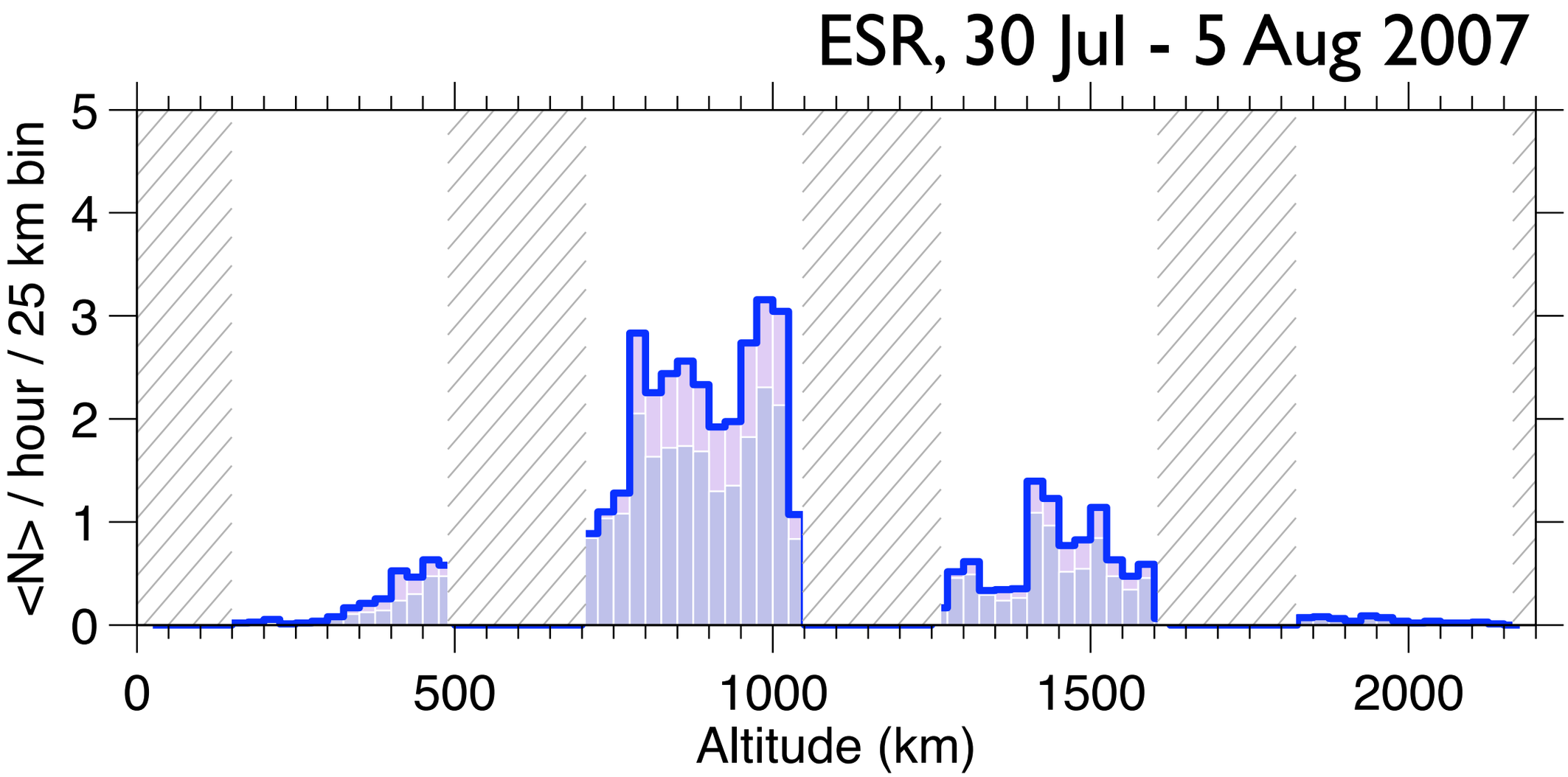
Altitude coverage, etc.

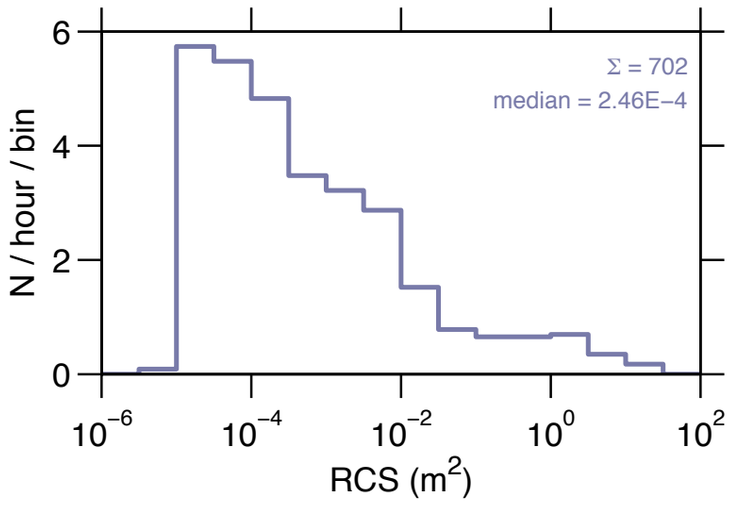
Gabbard plot of FY 1C debris



Source: CelesTrak/CSSI
(http://celestrak.com/events/FY1C-Gabbard.pdf)

Mean event rate as function of altitude





EISCAT orbital debris measurements during the IPY

- "23/6" measurement at ESR since March 12, in parallel with the standard IPY measurement, using the SD receiver.

- About 1000 event per day.
- Altitude coverage 4 x 340 km between 150 and 2160 km.
- Detection limit RCS ~ 10 mm^2 at 800 km.

- Only analysis results, ~20 MB per day, are saved. This is rather bad, for the analysis has serious problems.

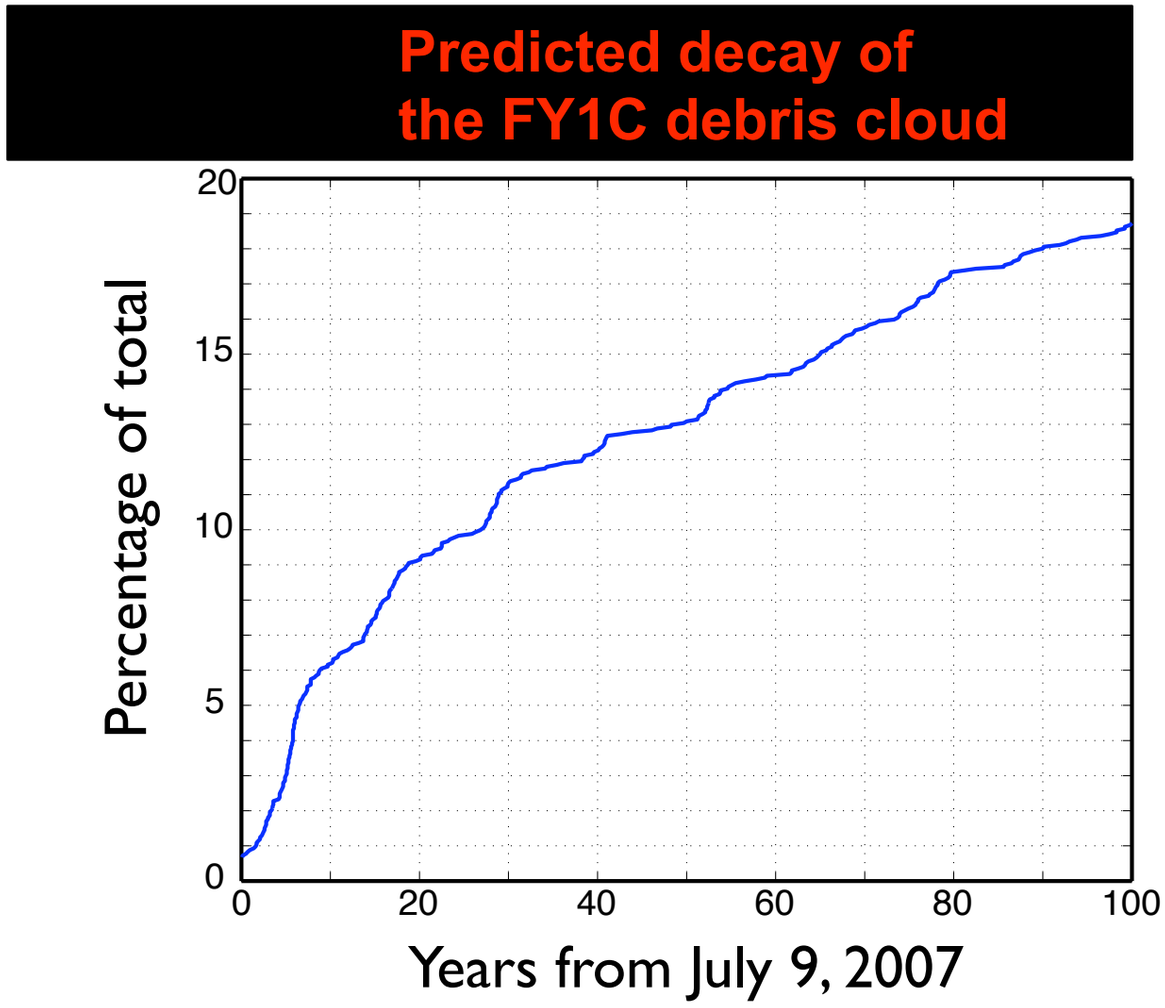
- Daily and weekly result summaries (~0.3 MB/day) are available via EISCAT IPY page https://e7.eiscat.se/groups/IPY

Killing the FY 1C by a ground-launched missile was a brilliant technical achievement, and a first.

The FY 1C debris will stay on orbit several hundred years.

There for sure are more to come

◆ **END** ◆



Source: CelesTrak/CSSI (http://celestrak.com/events/FY1C-Lifetime.pdf)