Mini-EUSO – meteors :
Cross-check with ground-based observations

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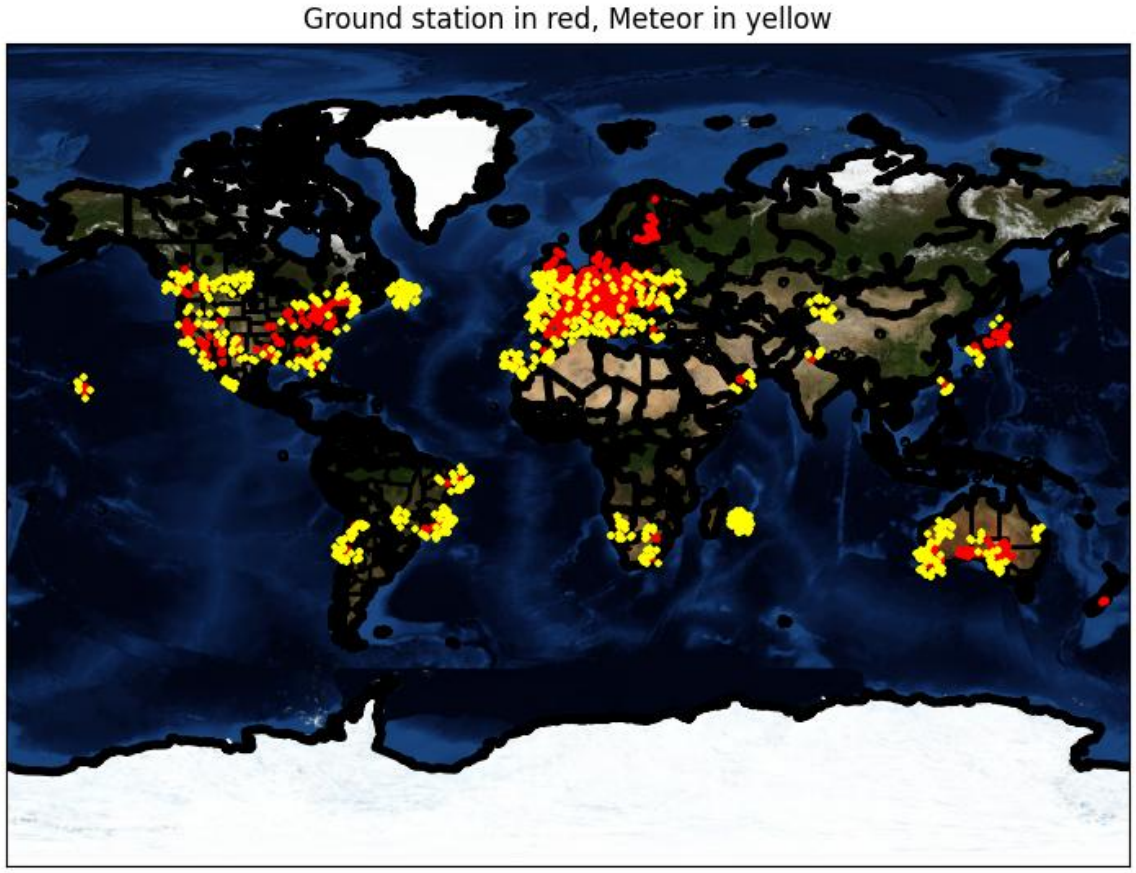
Introduction

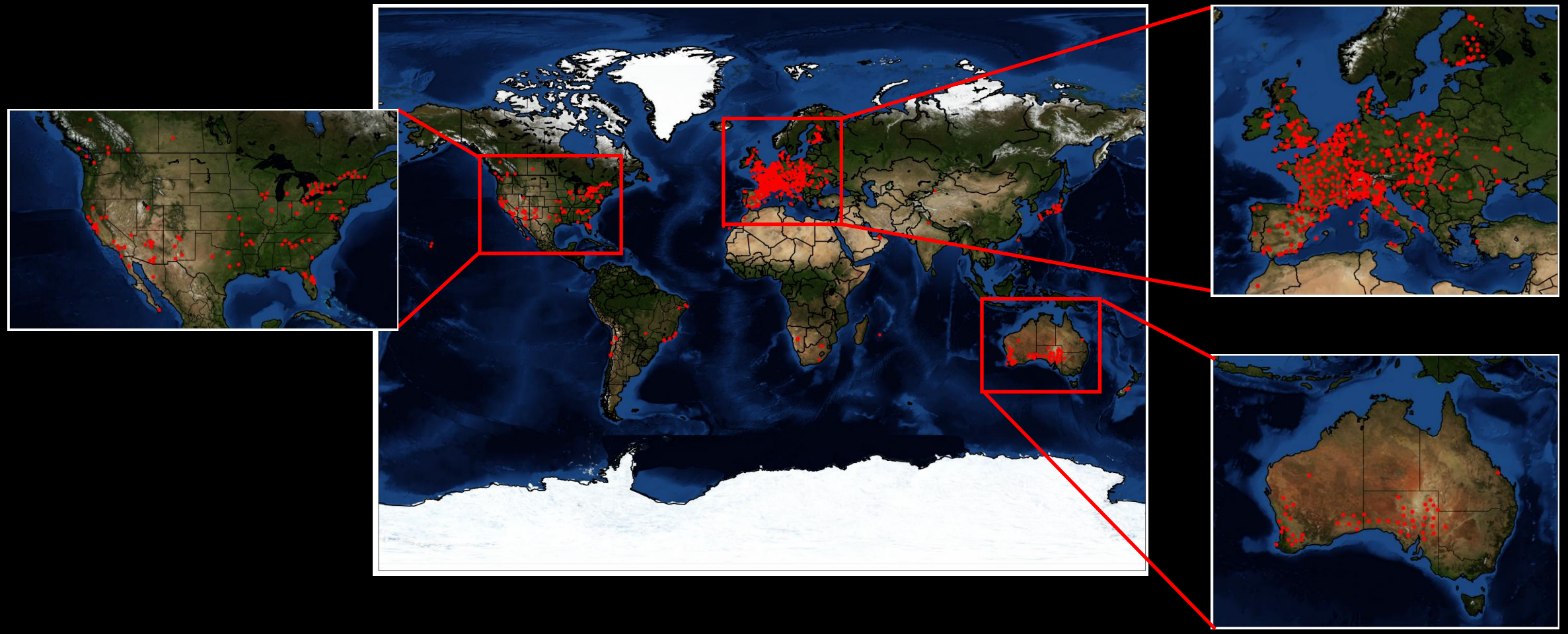
IDEA : check for possible double detections of meteors observed by Mini-EUSO and ground-based observations

We are using the actual latitude and longitude of the meteor trajectory from the pixel position computed by the meteor analysis pipeline from Mr. Matteo Battisti



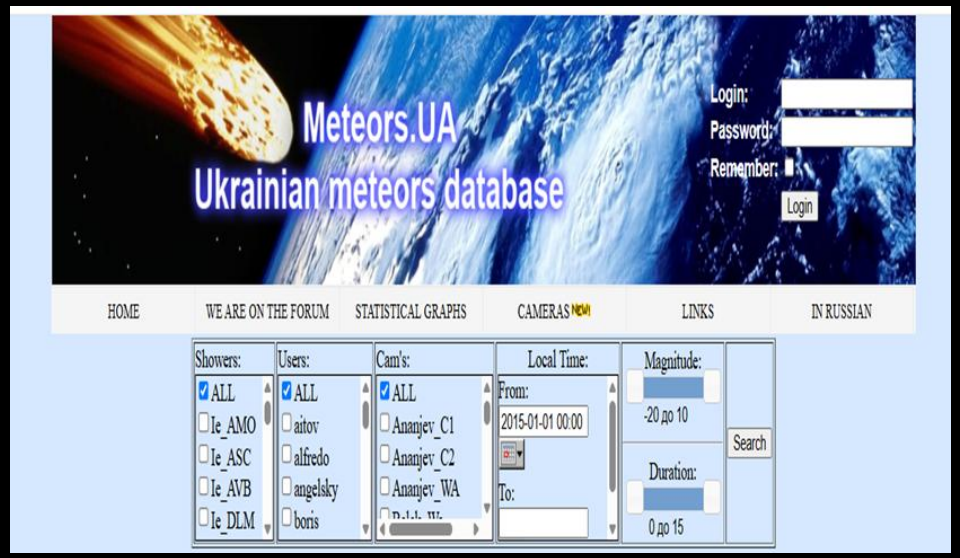
770 meteor events

Meteor and fireball network listing



Comparing with several ground-based observations

Fireball Recovery and InterPlanetary Observation Network



MeteorNews

Comparing with several ground-based data

Mini-EUSO	EDMOND
rootfile 2019_12_31__03_56_47 with M = 0.69	with M = -0.89298

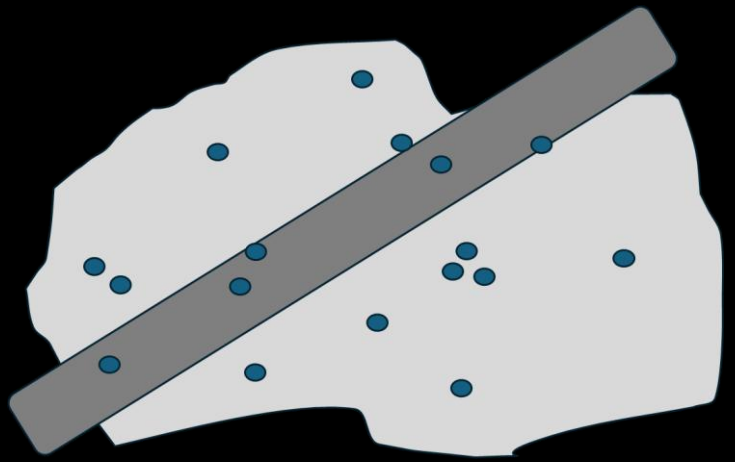
Mini-EUSO	Meteors UA Ukrainian Meteor data
rootfile 2020_09_14__21_25_53 with M = 2.8, 5.58, 2.46	with M = 0.6 from Camera Khmelnitsk_M4 with M = 0.9 from Camera Vishnevoe_WE
rootfile 2020_09_14__23_03_17 with M = 2.67, 5.25, 3.84, 4.5	with M = 1 from Camera Vishnevoe_WE with M = -0.2 from Camera Vishnevoe_WE

Mini-EUSO	SonotaCo Newtork Japan data
rootfile 2021_01_15__19_03_20 with M = 3.79, 3.82, 4.61	with M = 0.4

Detection rate comparing with EDMOND data base

In 3 years (2019, 2020, 2021), EDMOND detected 68,000 meteor events

- Using rough assumption, EDMOND detected 62 event/ day, 8 event/ minute, 0.13 event/ minute
- Using total time when Mini-EUSO near EDMOND stations (7072 seconds), maximum number of meteor detect by Mini-EUSO is 15.32 event/minute
- Considering the total observation area of EDMOND stations, the number of meteor detected by Mini-EUSO is 0.65 event



SonotaCo DATA

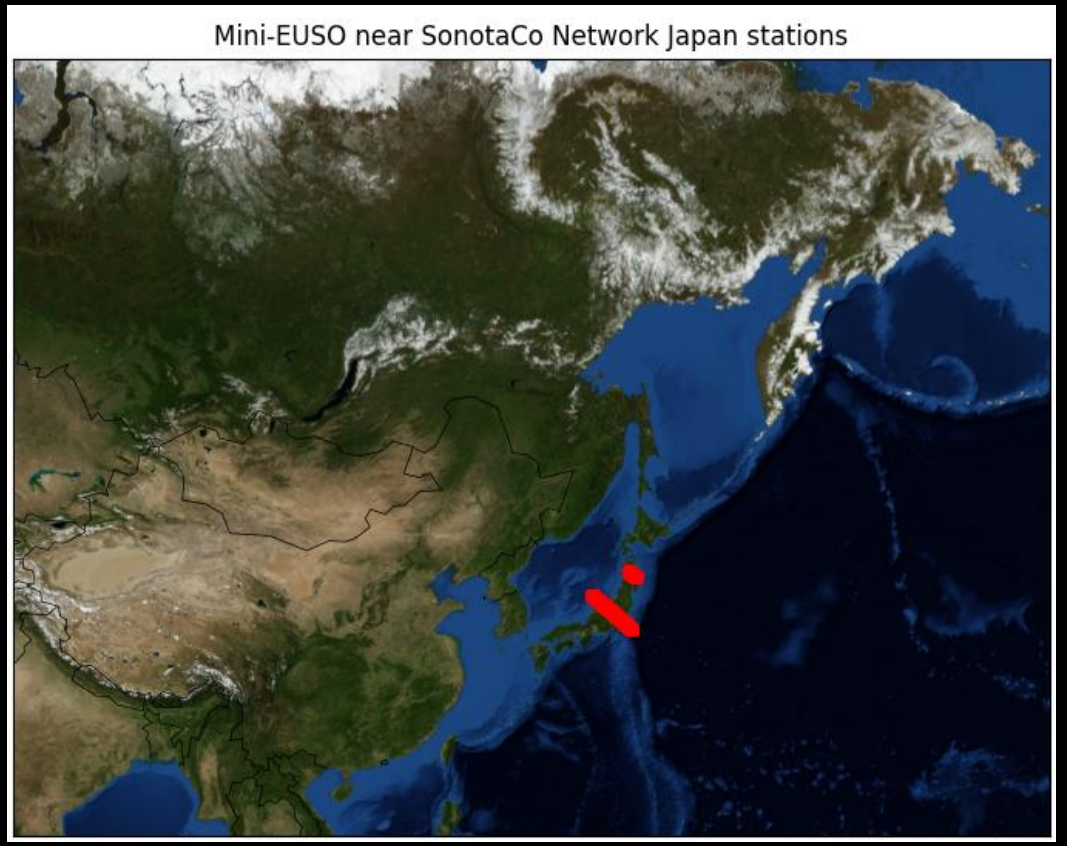
$$TOTAL\ SonotaCo\ DATA = SonotaCo\ 2019 + SonotaCo\ 2020 + SonotaCo\ 2021$$
$$TOTAL\ SonotaCo\ DATA = 28{,}587 + 33{,}446 + 41{,}177$$
$$TOTAL\ SonotaCo\ DATA = 103{,}210\ events$$

$$SonotaCo\ RATE = \frac{TOTAL\ SonotaCo\ DATA}{NUMBER\ OF\ MINUTES\ IN\ 3\ YEARS}$$

$$SonotaCo\ RATE = \frac{103{,}210\ event}{1095\ day} \approx \frac{94.26\ event}{day} \approx \frac{94.26\ event}{8h/day} \approx \frac{11.78\ event}{hour} \approx \frac{0.20\ event}{minute}$$

$$SonotaCo\ RATE = \frac{103{,}210\ event}{1095\ day} \approx \frac{94.26\ event}{day} \approx \frac{94.26\ event}{3.6h/\ day} \approx \frac{26.18\ event}{hour} \approx \frac{0.44\ event}{minute}$$

- Using total time when Mini-EUSO near SonotaCo Japan stations (89 seconds), maximum number of meteor detect by Mini-EUSO is 0.3 event/minute



$$Maximum\ Number = SonotaCo\ RATE \times TOTAL\ MINUTES\ Mini-EUSO\ near\ \text{SonotaCo}\ stations$$

$$Maximum\ Number = 0.20 \frac{ev}{minute} \times \frac{89\ s}{\frac{60\ s}{minute}} \approx 0.3\ event$$

$$Maximum\ Number = 0.44 \frac{ev}{minute} \times \frac{89\ s}{\frac{60\ s}{minute}} \approx 0.65\ event$$

Considering the total observation area of SonotaCo stations, the number of meteor detected by Mini-EUSO is 0.06 event

$$Number\ by\ Mini-EUSO = Maximum\ Number \times \frac{Area\ Mini-EUSO}{Area\ SonotaCo}$$

$$Number\ by\ Mini-EUSO = 0.3\ event \times \frac{2304\ \ pixel \times 6\ km \times 6\ km}{435{,}563\ km^2}$$

$$Number\ by\ Mini-EUSO\ \approx 0.06\ event \quad \textit{(0.124 event)}$$

FRIPON DATA – multiple events (Europe Stations)

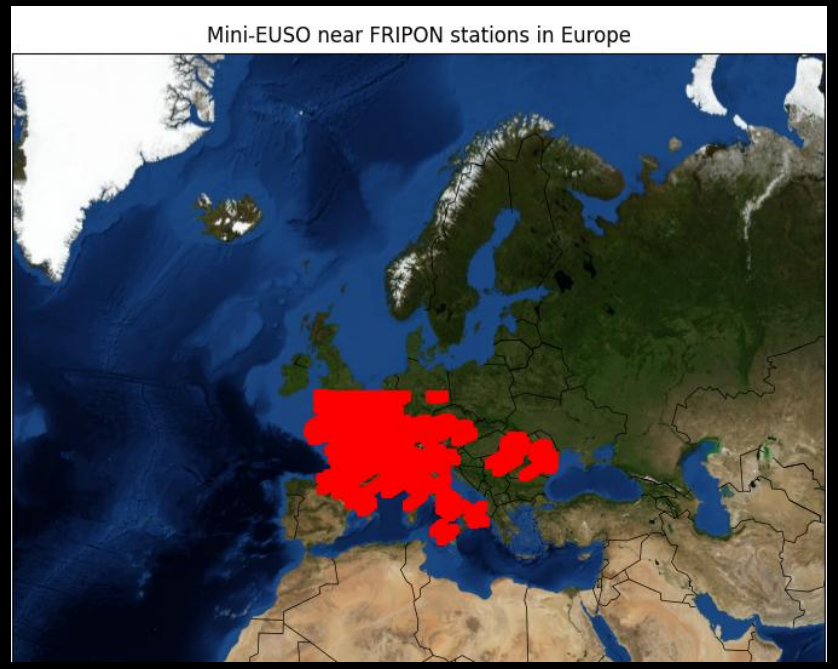
$$TOTAL\ FRIPON\ DATA = FRIPON\ 2019 + FRIPON\ 2020 + FRIPON\ 2021$$
$$TOTAL\ FRIPON\ DATA = 1{,}123 + 1{,}042 + 1{,}088$$
$$TOTAL\ FRIPON\ DATA = 3{,}253\ events$$

$$\text{FRIPON}\ RATE = \frac{TOTAL\ FRIPON\ DATA}{NUMBER\ OF\ MINUTES\ IN\ 3\ YEARS}$$

$$FRIPON\ RATE = \frac{3{,}253\ event}{1095\ day} \approx \frac{2.97\ event}{day} \approx \frac{2.97\ event}{8h/day} \approx \frac{0.37\ event}{hour} \approx \frac{0.006\ event}{minute}$$

$$FRIPON\ RATE = \frac{3{,}253\ event}{1095\ day} \approx \frac{2.97\ event}{day} \approx \frac{2.97\ event}{3.6h/\ day} \approx \frac{0.825\ event}{hour} \approx \frac{0.014\ event}{minute}$$

FRIPON DATA – multiple event



$$Maximum\ Number = FRIPON\ RATE\ \times TOTAL\ MINUTES\ Mini-EUSO\ near\ FRIPON\ EU\ stations$$

$$Maximum\ Number = 0.006 \frac{ev}{minute} \times \frac{6{,}693\ s}{\frac{60\ s}{minute}} \approx 0.67\ event$$

$$Maximum\ Number = 0.014 \frac{ev}{minute} \times \frac{6{,}693\ s}{\frac{60\ s}{minute}} \approx 1.56\ event$$

FRIPON DATA – multiple event

$$Number\ by\ Mini-EUSO = Maximum\ Number \times \frac{Area\ Mini-EUSO}{Area\ FRIPON\ in\ Europe}$$

$$Number\ by\ Mini-EUSO = 0.67\ event \times \frac{2304\ \ pixel \times 6\ km \times 6\ km}{2{,}377{,}492\ km^2}$$

$$Number\ by\ Mini-EUSO\ \approx 0.02\ event\ \ (0.054\ event)$$

UKRAINE DATA

$$TOTAL\ UKRAINE\ DATA = UKRAINE\ 2019 + UKRAINE\ 2020 + UKRAINE\ 2021$$
$$TOTAL\ UKRAINE\ DATA = 34{,}737 + 29{,}317 + 21{,}173$$
$$TOTAL\ UKRAINE\ DATA = 85{,}227\ events$$

$$UKRAINE\ RATE = \frac{TOTAL\ UKRAINE\ DATA}{NUMBER\ OF\ MINUTES\ IN\ 3\ YEARS}$$

$$UKRAINE\ RATE = \frac{85{,}227\ event}{1095\ day} \approx \frac{77.833\ event}{day} \approx \frac{77.833\ event}{8h/\ day} \approx \frac{9.73\ event}{hour} \approx \frac{0.16\ event}{minute}$$

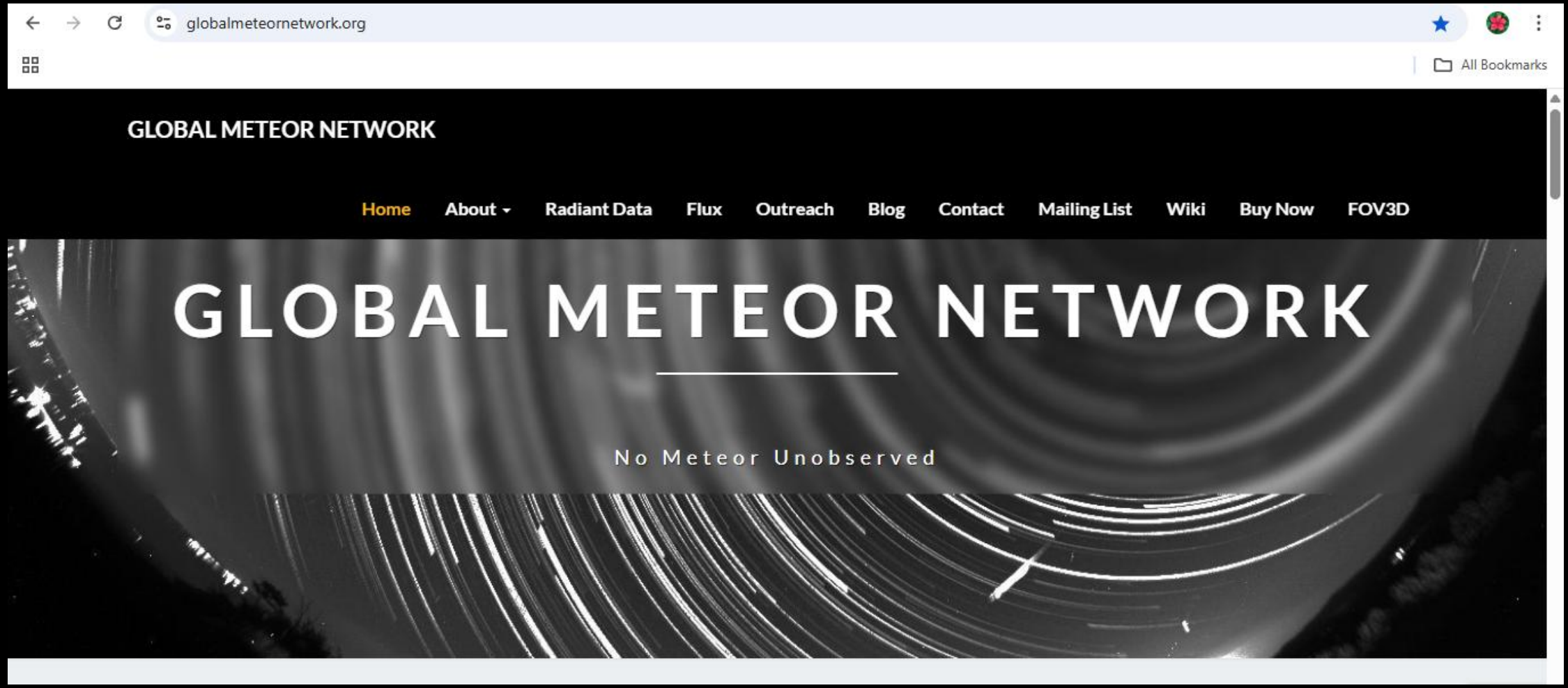
UKRAINE DATA

$$Maximum\ Number = UKRAINE\ RATE \times TOTAL\ MINUTES\ Mini-EUSO\ near\ UKRAINE\ stations$$

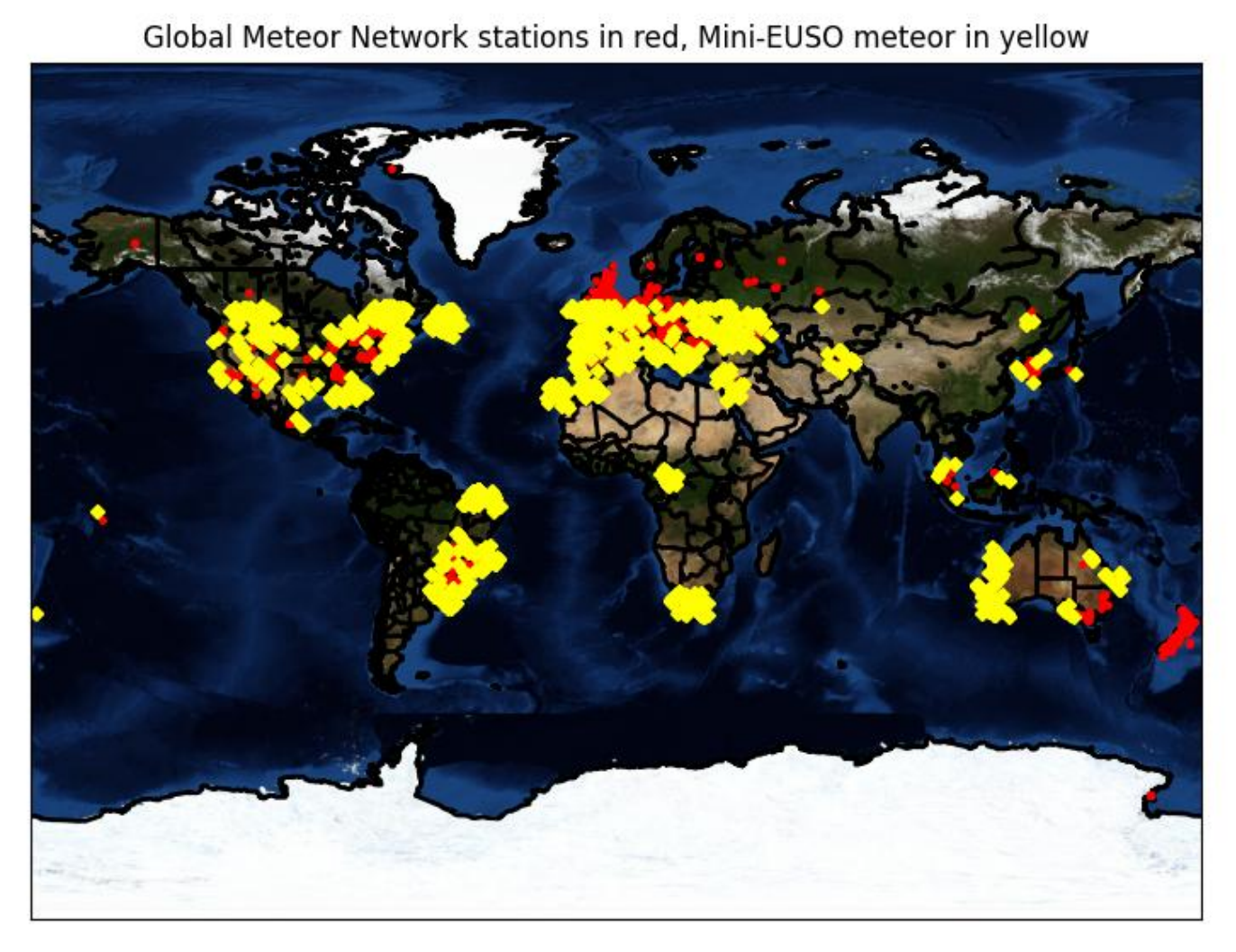
$$Maximum\ Number = 0.16 \frac{ev}{minute} \times \frac{1{,}004\ s}{\frac{60\ s}{minute}} \approx 2.68\ event$$

$$Number\ by\ Mini-EUSO \approx 0.24\ event$$

Global Meteor Network



Global Meteor Network



- Make a list of 1505 ground-observation stations for GMN
- Using ISS lat and ISS lon, we got 913 meteor events near GMN stations

Thank you