AMOS global meteor network
- update and status

AMOS

All-sky Meteor Orbit System

Juraj Tóth and AMOS team:

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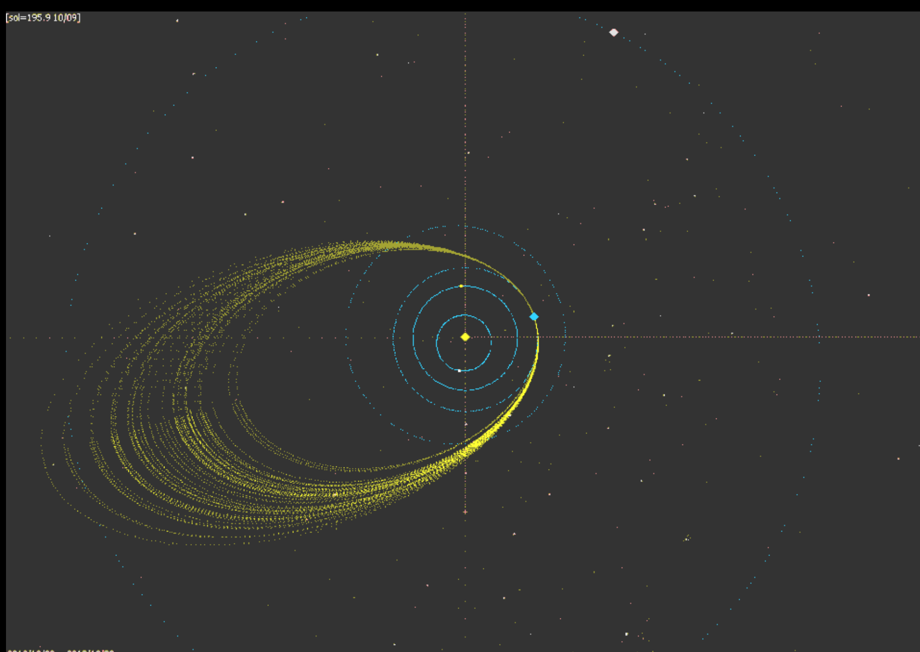
Comenius University in Bratislava, Slovakia

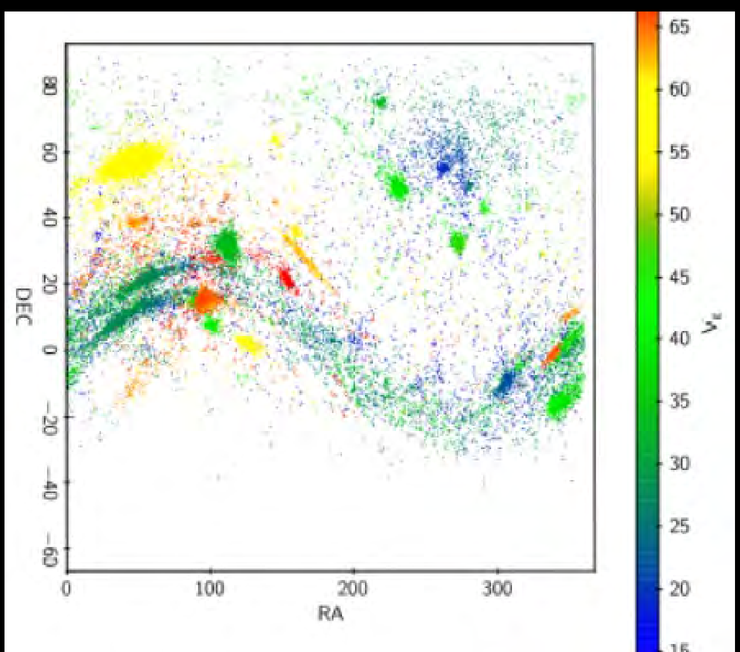
Outline of the talk:

- Motivation for the AMOS system and the network
- AMOS system description
- Network
- Sample of data and links to results

AMOS (All-Sky Meteor Orbit System) – WHY and WHAT FOR?

- dynamics of meteoroids, streams vs. parent comets/asteroids
- weak or asteroidal meteor showers/streams characterization
- meteoroid flux determination from sporadics/showers
- spectral study of meteors in the atmosphere
  - orbital distribution of primitive and evolved meteoroids
- byproduct: meteorites recoveries – e.g. Košice meteorite (15th case with the known orbit)



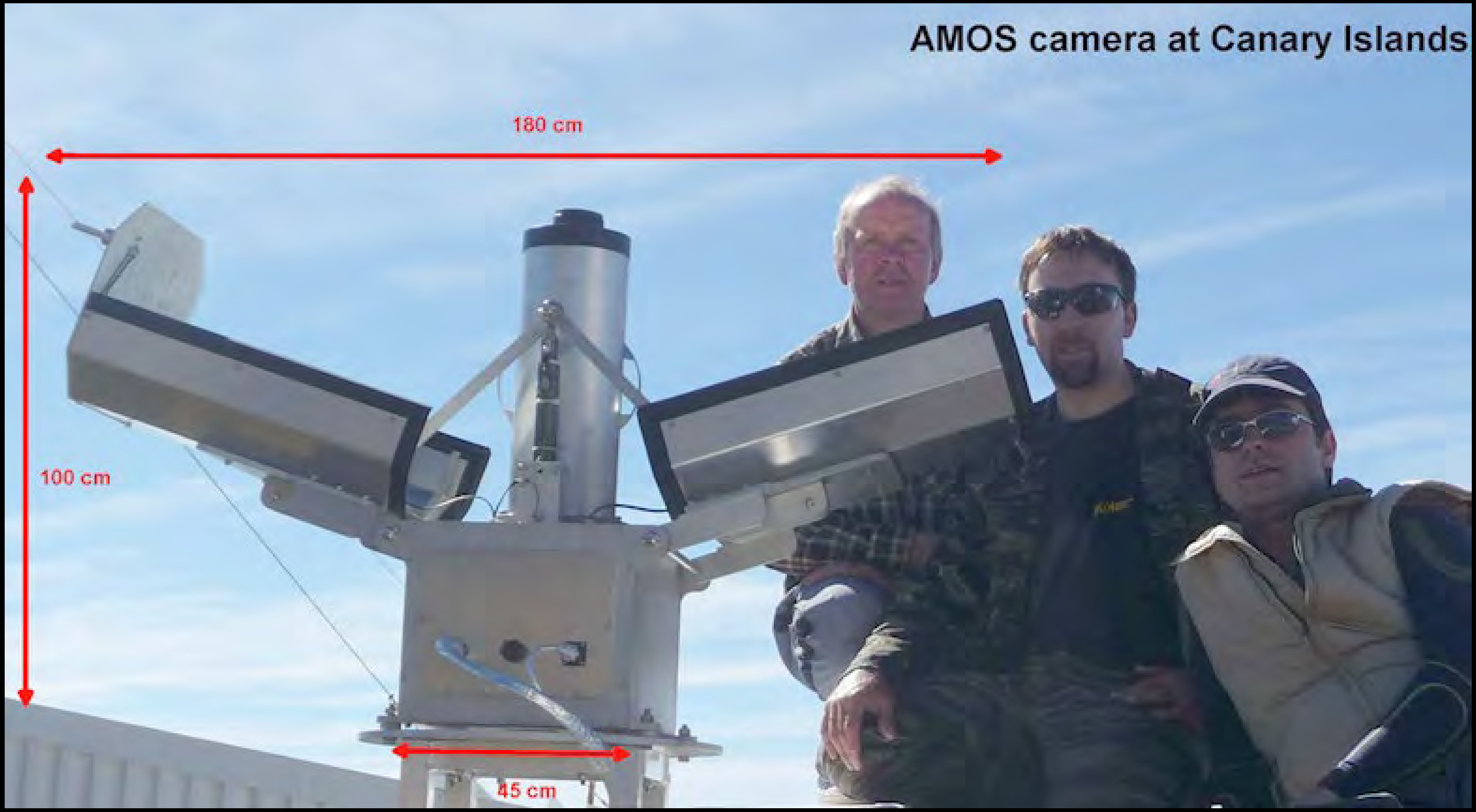


AMOS (All-Sky Meteor Orbit System)

- our own developed and patented system

AMOS instrumentation:

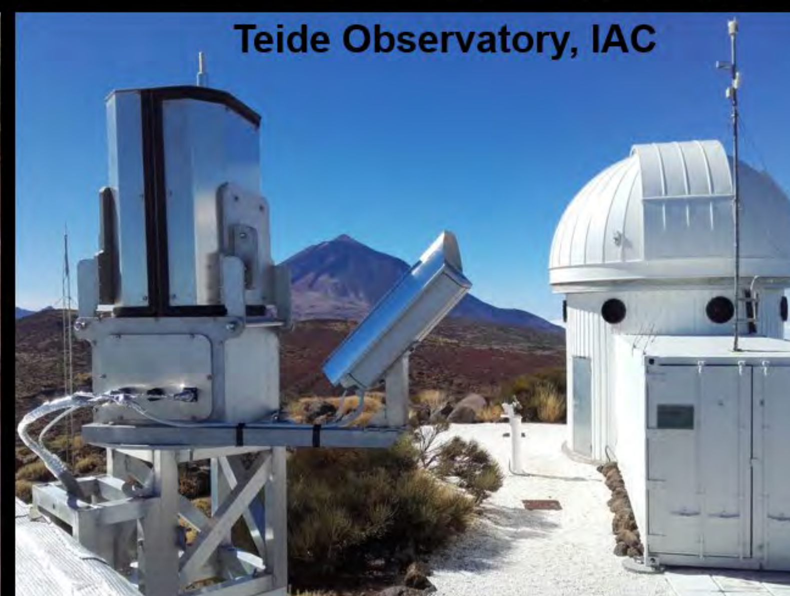
- Autonomous intensified optical video system
- Field of view 180 x 140 deg
- Resolution 1600 x 1200, 20 fps
- Stellar limiting magnitude + 5.0



One thousand Geminids above Tenerife Dec.13/14, 2017

AMOS, Teide, IAC
Tóth et al., 2017

AMOS (All-Sky Meteor Orbit System) network



… spectral hardware including PhD. student

AMOS Spectral Instrumentation

AMOS-Spec

Camera:	1600x1200, 12 fps
Grating:	1000 grooves/mm
Resolution:	1.5 nm/px
FOV:	100 deg circular
Lim. mag.:	-2.0

AGO Modra (Slovakia) - since 11/2013

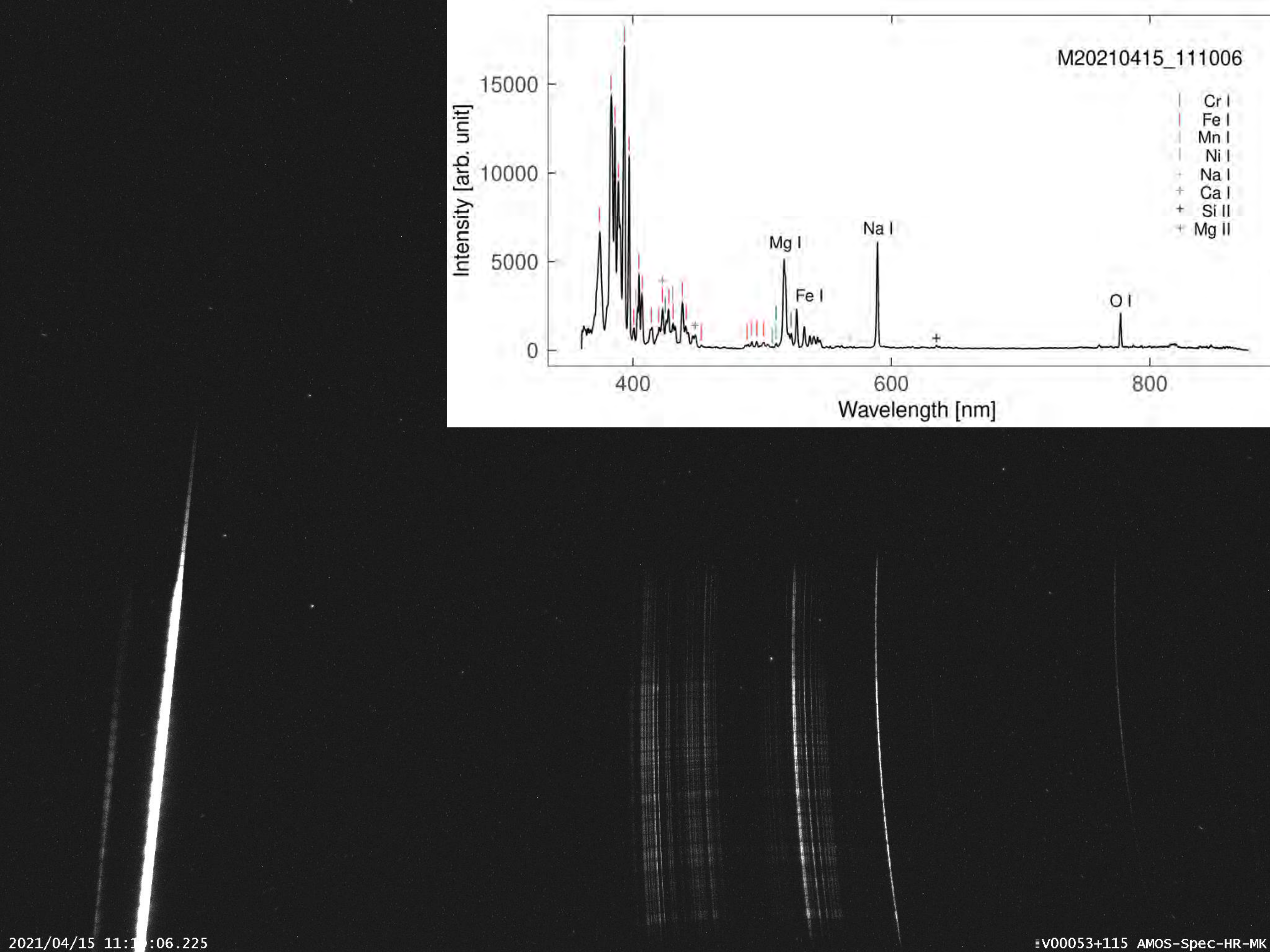
Supplemented by 5 AMOS stations (Slovak Video Meteor Network)

AMOS-HS

Camera:	2048x1536, 15 fps
Grating:	1000 grooves/mm
Resolution:	0.5 nm/px
FOV:	60 x 45 deg
Lim. mag.:	-1.5

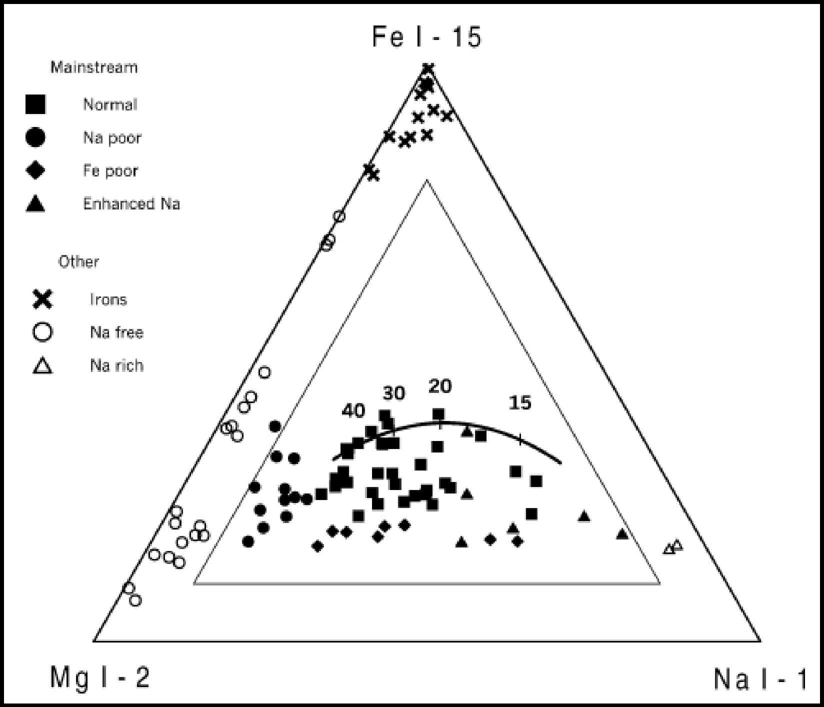
Canary Islands and Chile - since 12/2016

Supplemented by 2 AMOS stations on Canary Islands, Chile and Hawaii

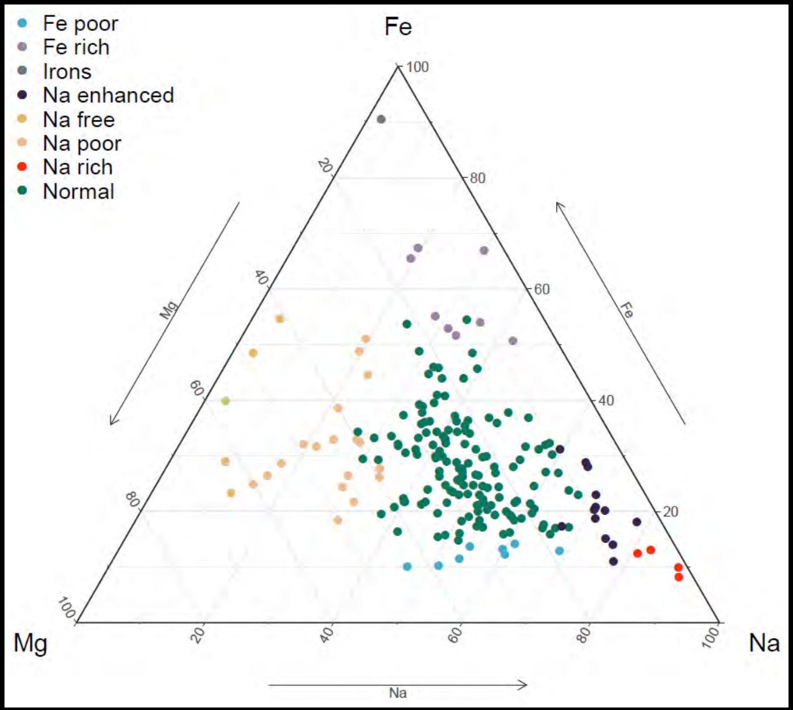

M20210415_111006
Intensity [arb. unit]
15000
10000
5000
0
400
600
800
Wavelength [nm]
Cr I
Fe I
Mn I
Ni I
Na I
Ca I
Si II
Mg II
Mg I
Fe I
Na I
O I
2021/04/15 11:1
:06.225
V00053+115 AMOS-Spec-HR-MK

AMOS – spectral observations, open issues

- higher Na/Mg ratio for larger meteoroids
- low number of pure iron meteoroids for cm – dm sizes
- new population of Fe rich meteoroids
- Na rich meteor spectra on Apollo orbits

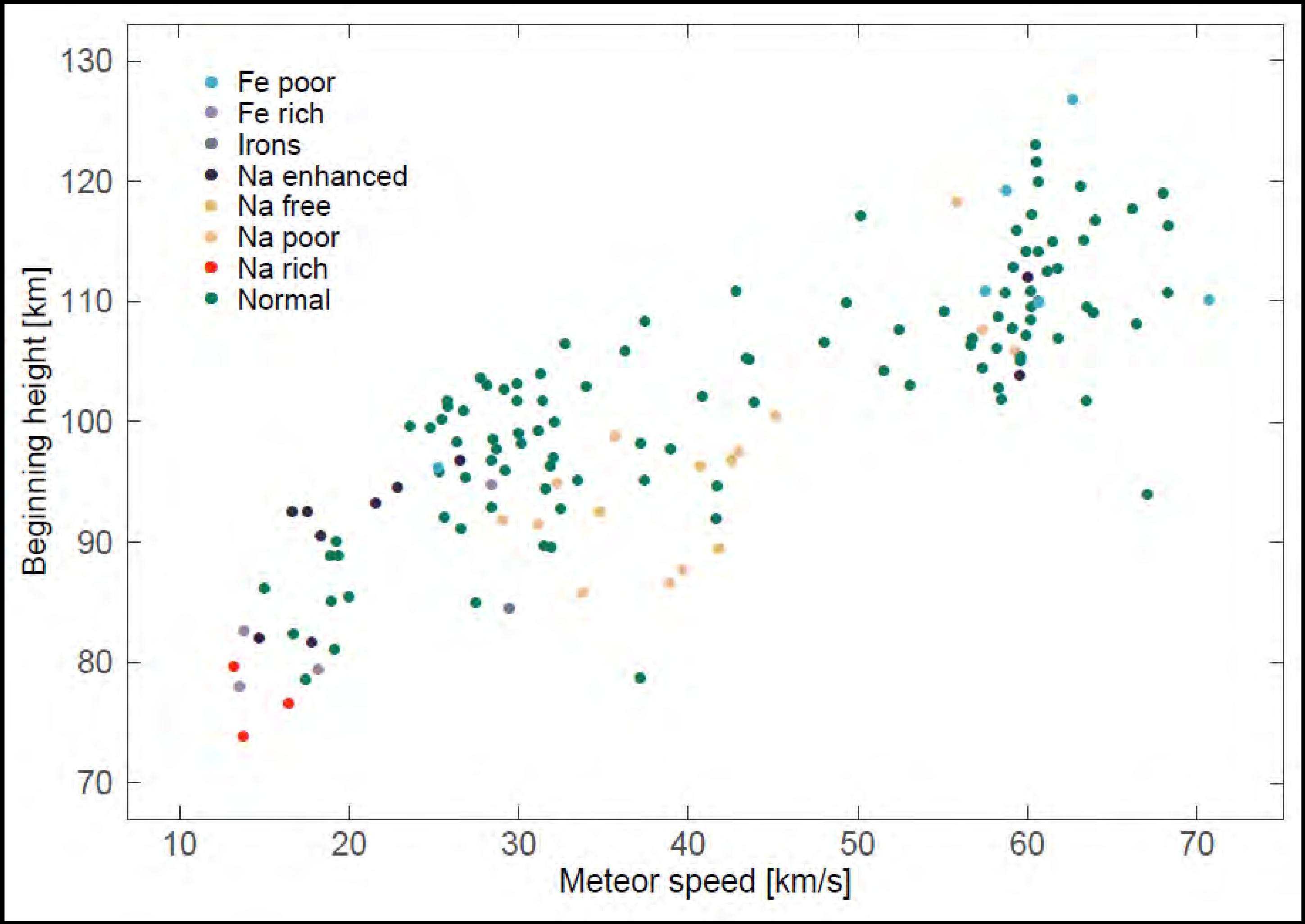


(Borovička et al., 2005)

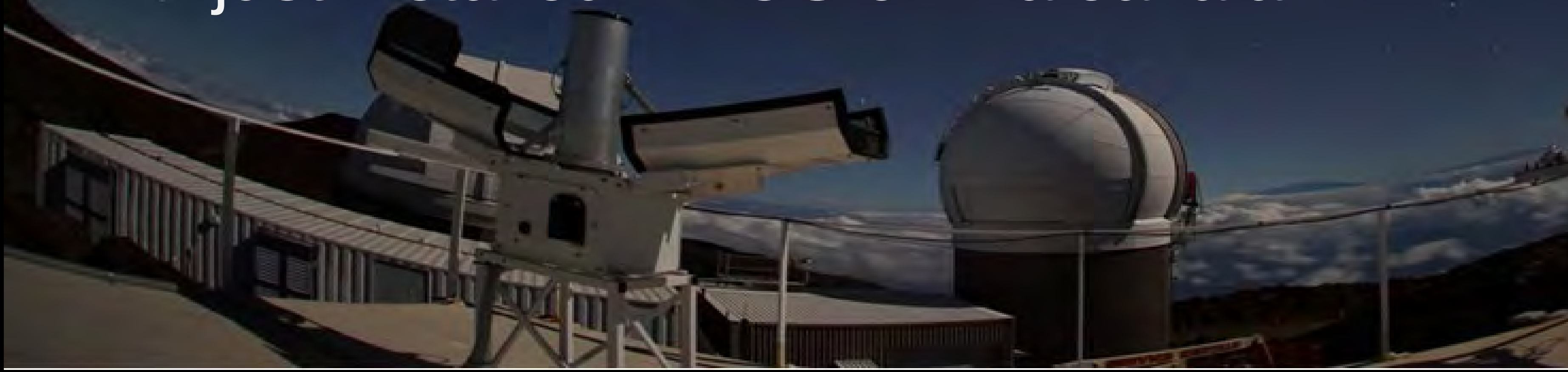


(Matlovič et al., 2019)

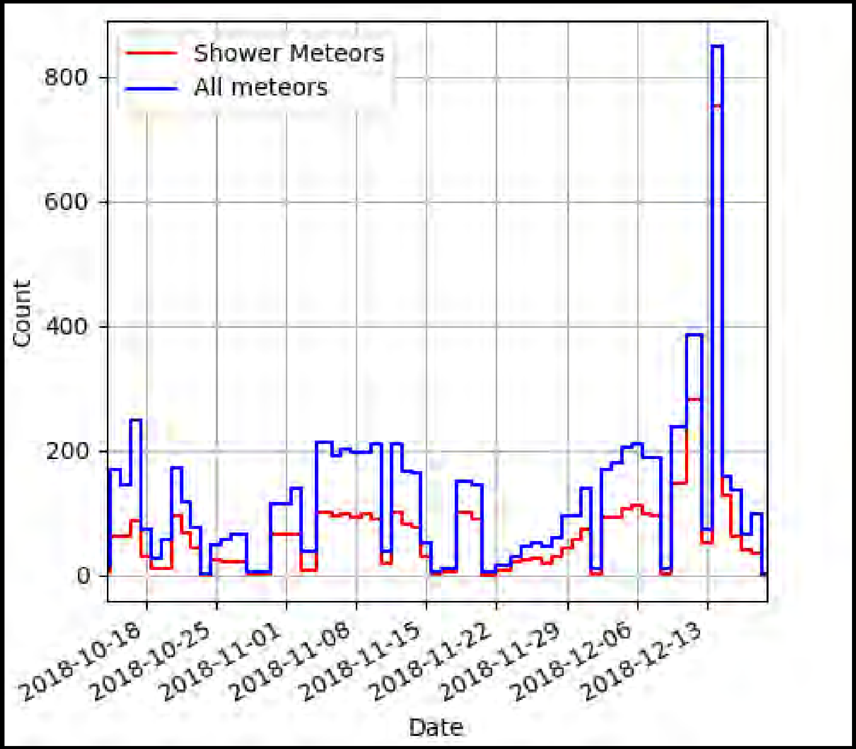
AMOS – brightest meteors from SVMN, sample data

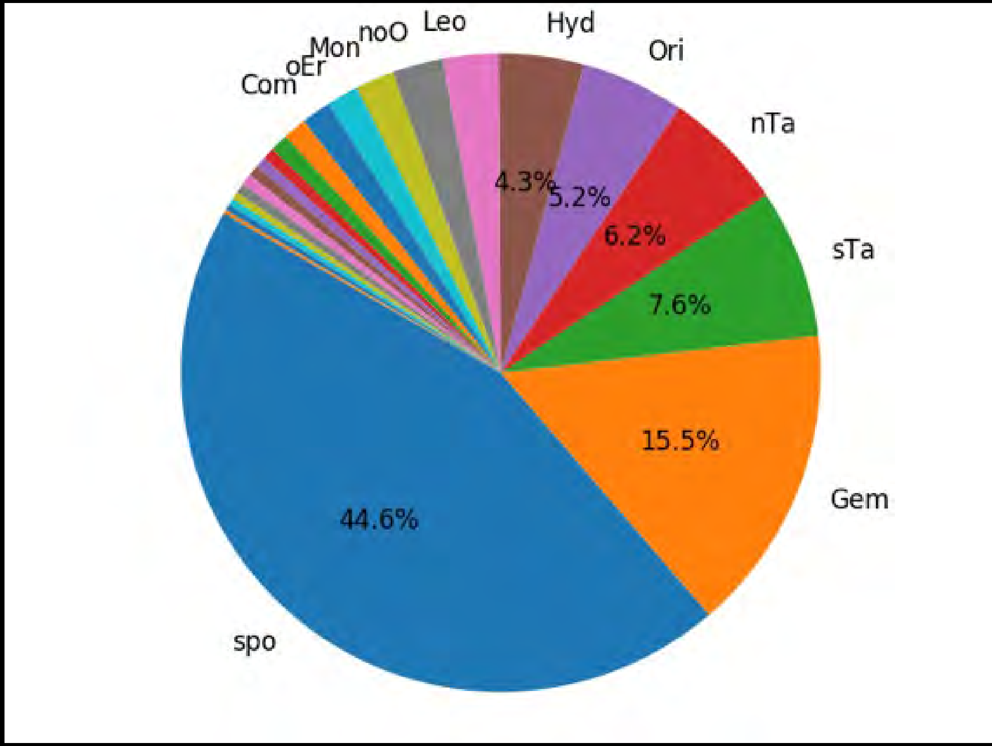


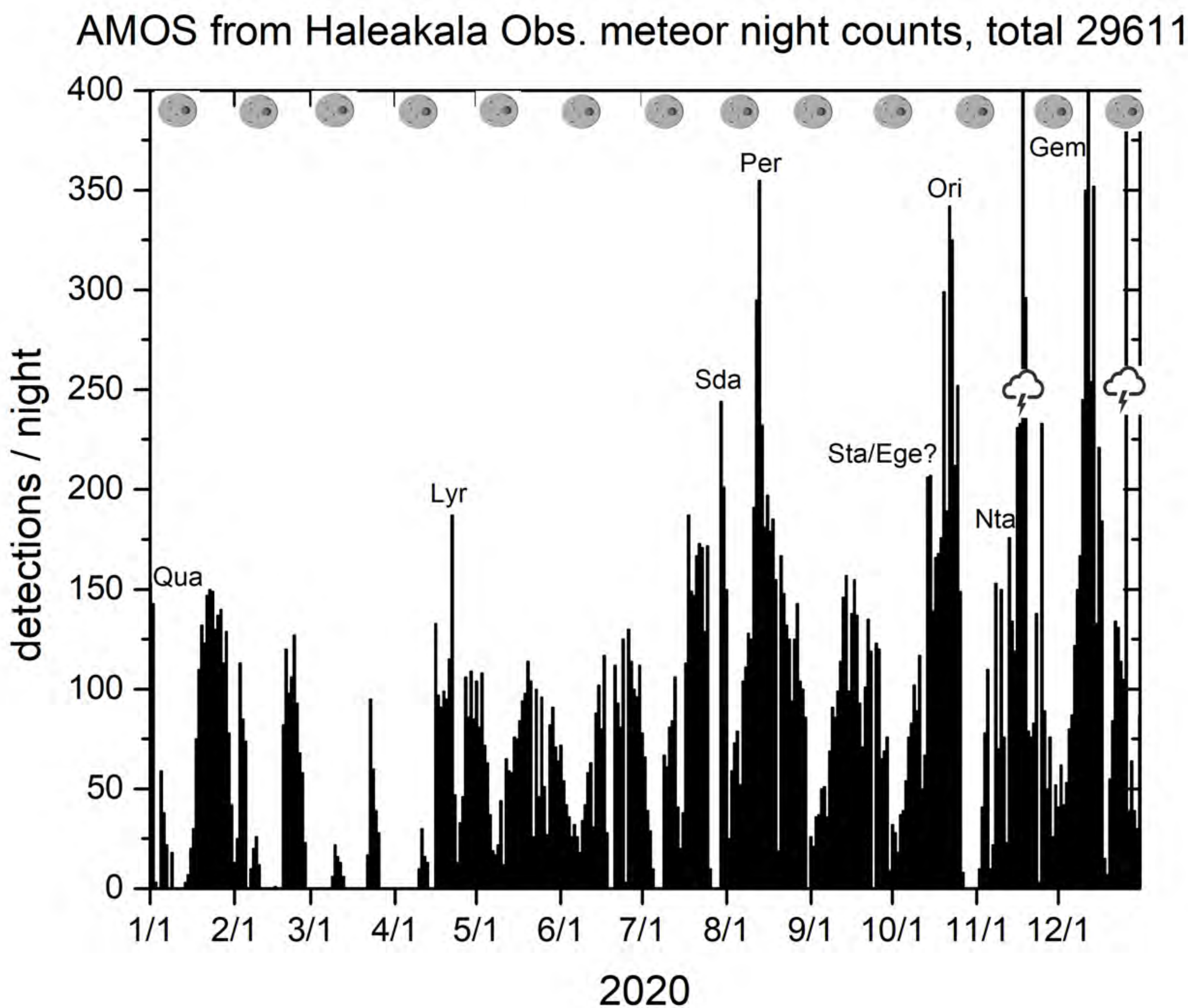
… just installed AMOS on Haleakala



Oct. 14 – Dec. 19, 2018 AMOS-HK detected 6,047 single-station video meteors.

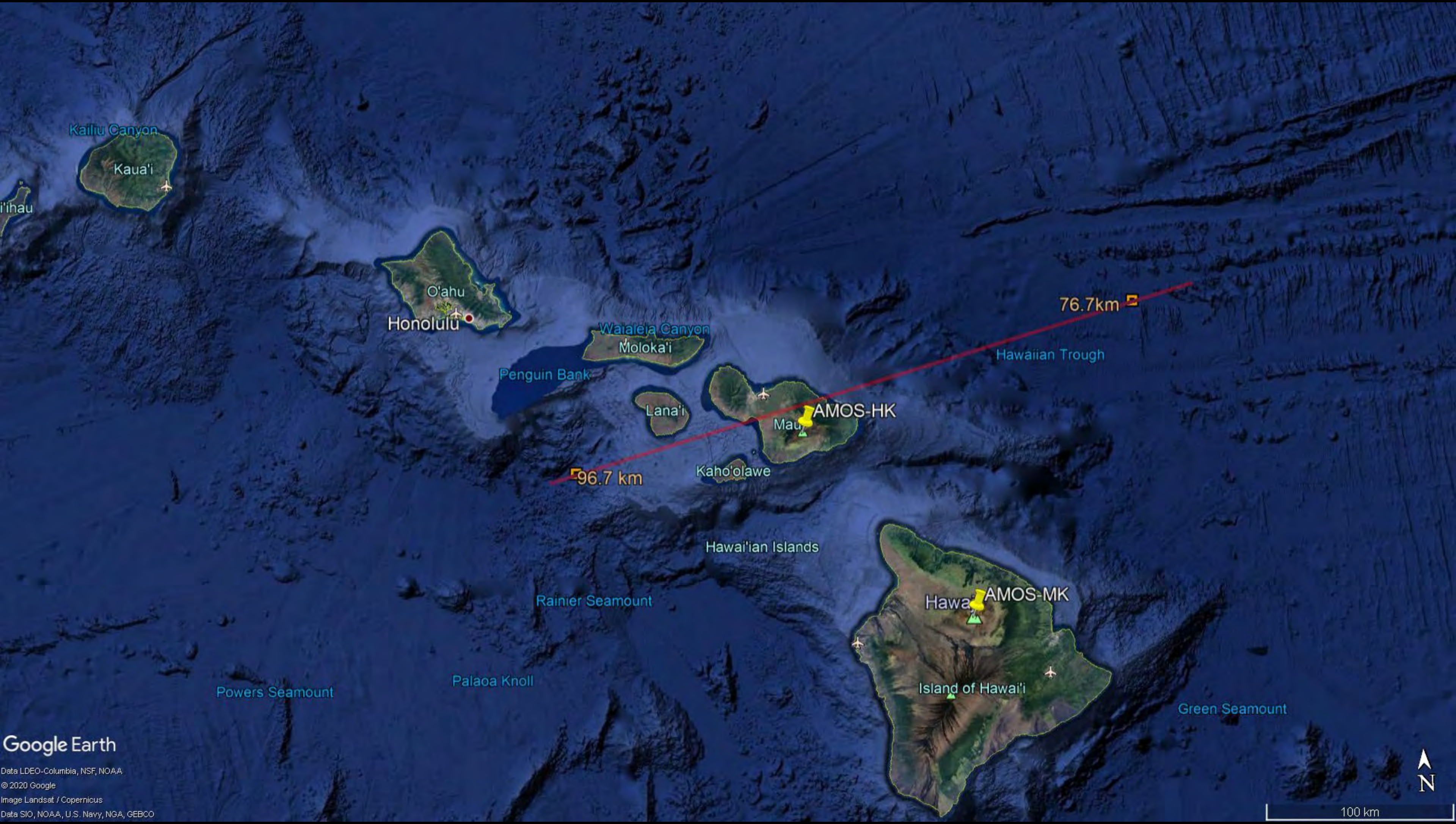






AMOS from Haleakala Obs. meteor night counts, total 29611
detections / night
0
50
100
150
200
250
300
350
400
1/1
2/1
3/1
4/1
5/1
6/1
7/1
8/1
9/1
10/1
11/1
12/1
2020
Qua
Lyr
Sda
Per
Sta/Ege?
Ori
Nta
Gem


2020/10/25 08:01:39.043 0013
V00009+127 AMOS-HK

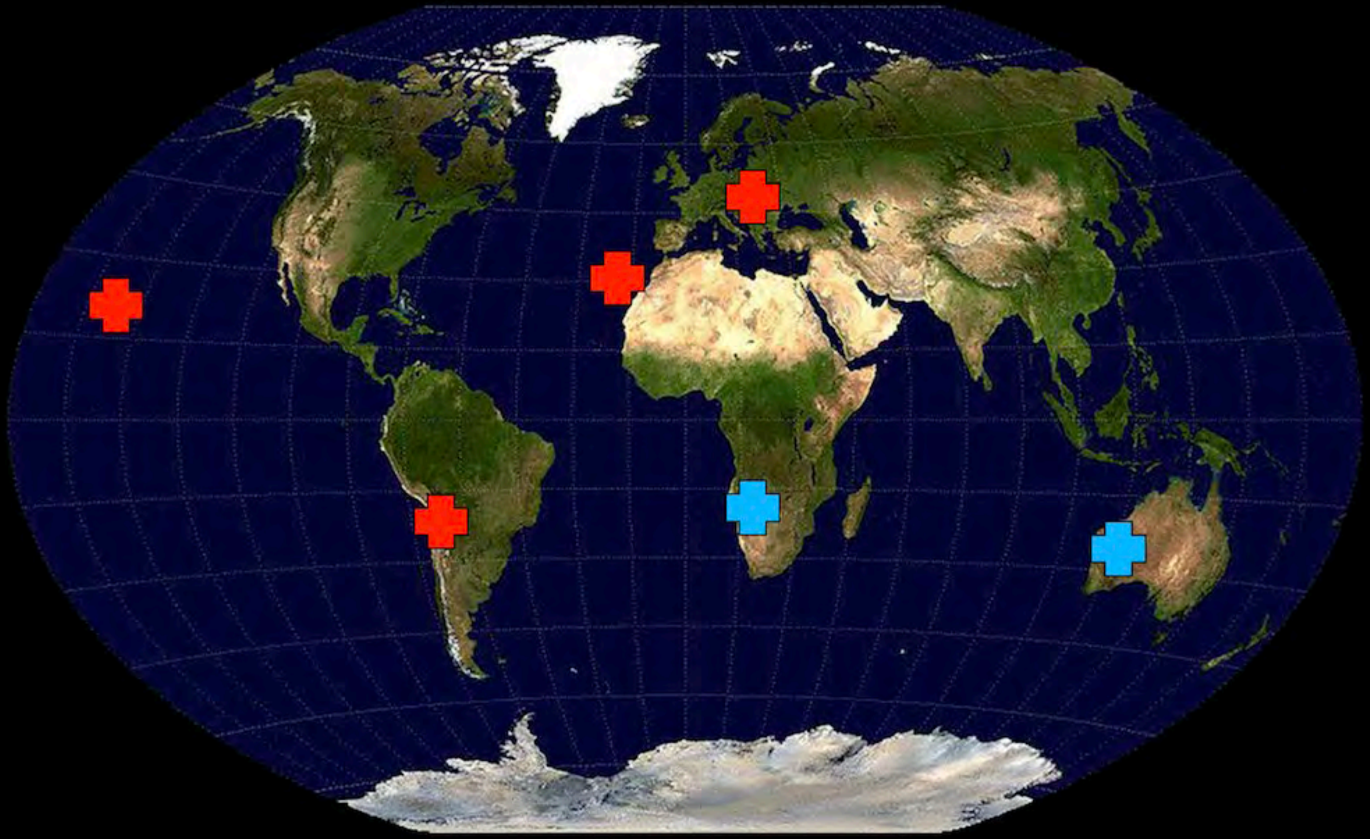

Kailiu Canyon
Kaua'i
i'ihau
O'ahu
Honolulu
Waialeia Canyon
Moloka'i
Penguin Bank
Lana'i
Maui
AMOS-HK
76.7km
Hawaiian Trough
96.7 km
Kaho'olawe
Hawai'ian Islands
Rainier Seamount
Hawai
AMOS-MK
Powers Seamount
Palaoa Knoll
Island of Hawai'i
Green Seamount
Google Earth
Data LDEO-Columbia, NSF, NOAA
© 2020 Google
Image Landsat / Copernicus
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
N
100 km

Perseids above Haleakala, Hawaii
Aug.14, 2021

… iced AMOS on Haleakala

AMOS global network – 10 stations on 4 locations

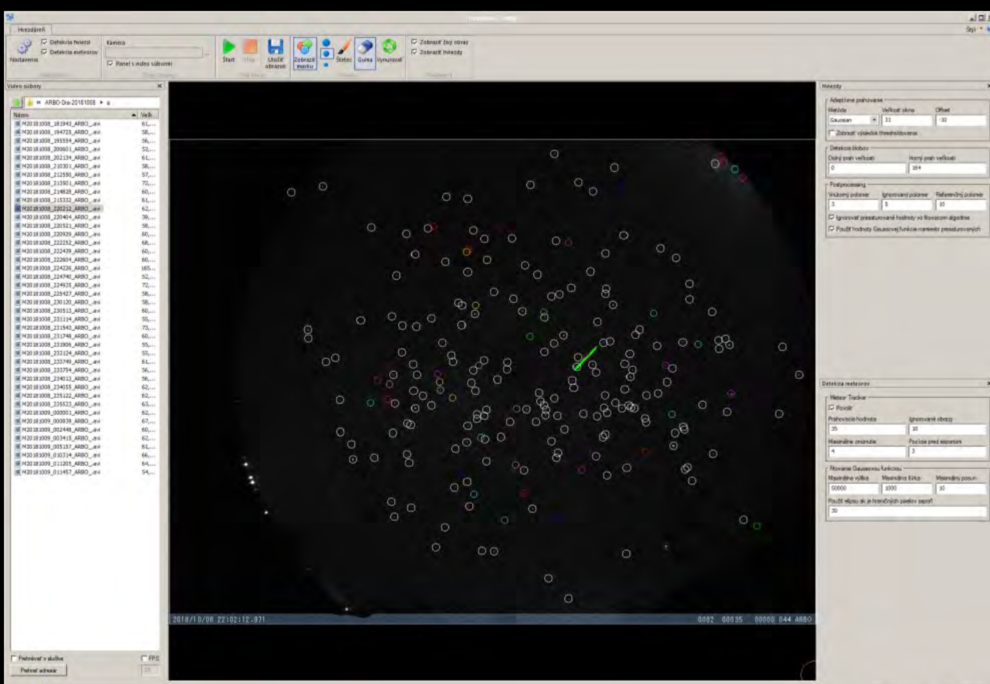
- Slovak Video Meteor Network 2009
- Canary Islands 2015
- Chile, Atacama 2016
- Hawaii, 2018

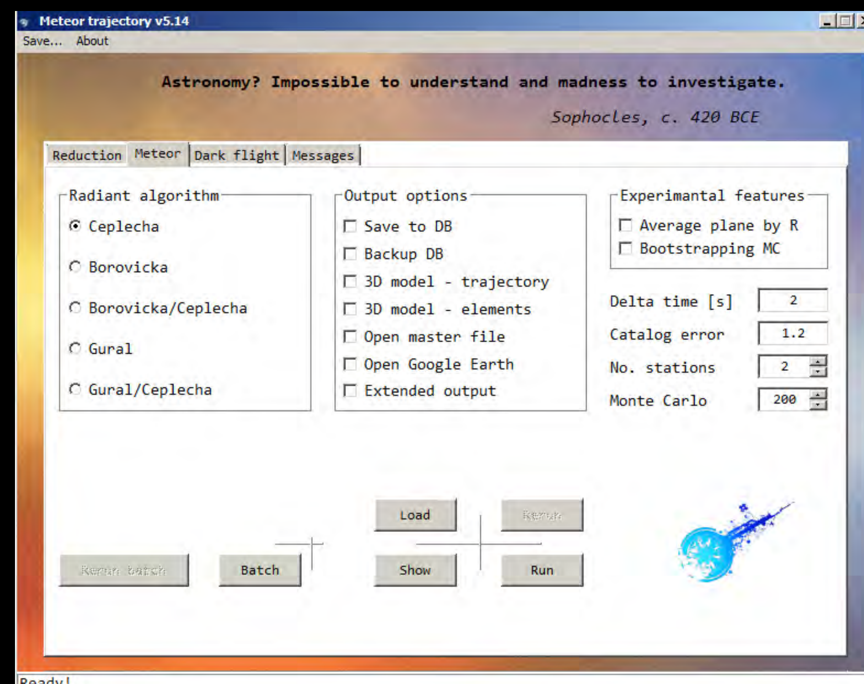


AMOS – ready for Australia

AMOS – software and analytical tool development

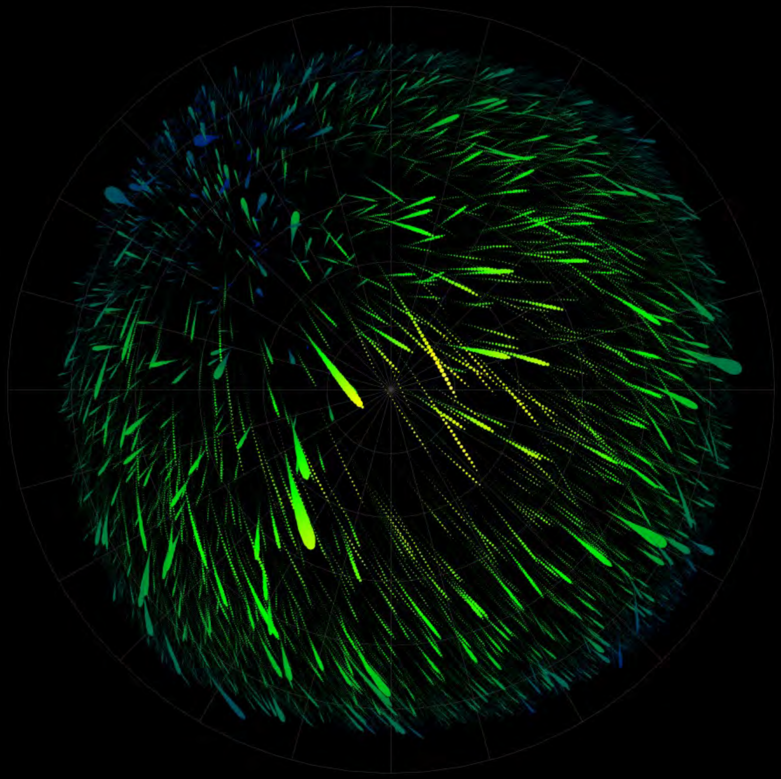
- own detection software AMOS (with cooper. KVANT)
- own all-sky reduction tool RedSky (Borovička et al., 1995)
- own trajectory and orbit solver MT 5.46
- planned open database

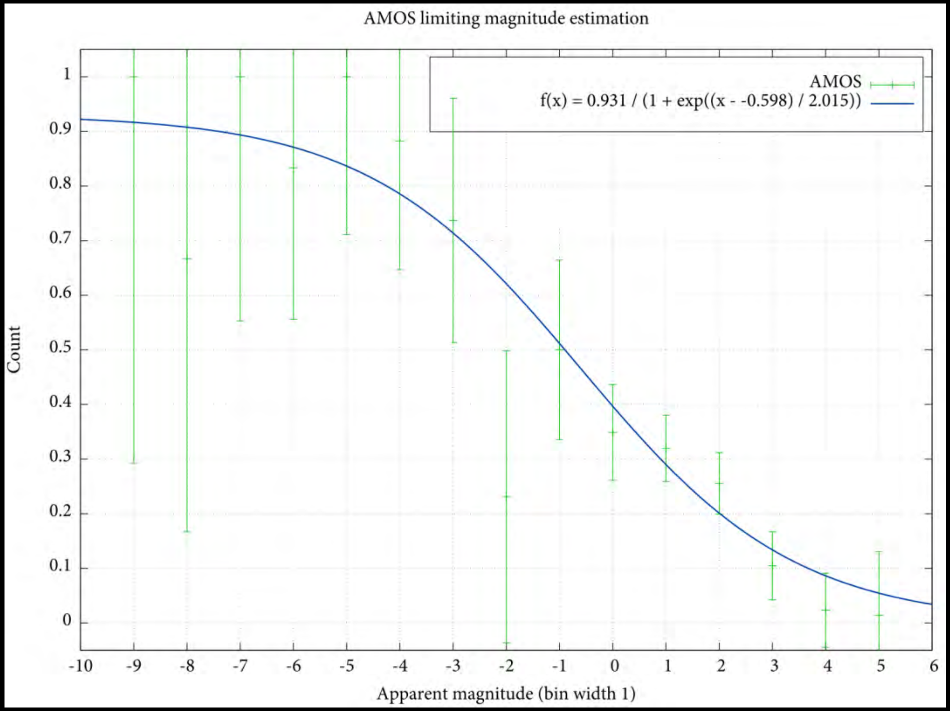




- Peter Vereš – AMOS team,
  Telescopic meteors from Haleakala - preliminary results from AMOS and ATLAS

- M. Baláž
  Determination of Meteoroid Flux from Meteor Data Debiased by Numerical Simulation





Simulations of meteoroid and micrometeoroid interactions with the Earth atmosphere

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- **The aim of work is to compare the dynamics of used spherical and real meteorite shapes and to confront them with the real meteorite impact point.**

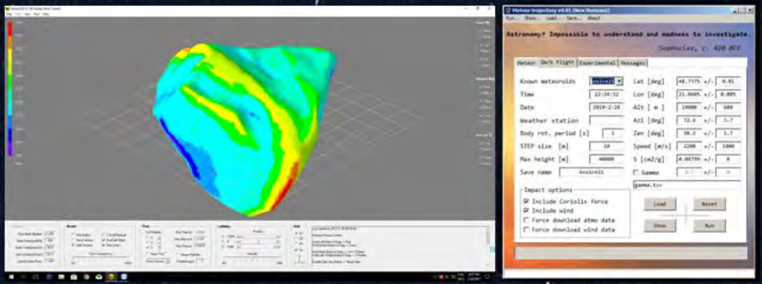

Figure 1. a) *On the left, the MicroCFD (Computing Fluid Dynamics) software interface, which simulates conditions on the body in wind tunnel,* ***b)*** *On the right, Meteor Trajectory software to model the dark phase of flight.*

Software and 3D models

•*MicroCFD* (Figure 1a), a virtual wind tunnel used to simulate gas interaction with 3D body models.

•Input files are 3D stereolithographic models in .stl format (standard CAD format). The surface of the models is formed by individual triangle areas.

•The output is the value of the drag coefficient *Γ(h)* in six rotations of each model. The assumption of high Reynolds number and turbulence.

•*Meteor Trajectory* (Figure 1b), interface for modeling meteorite trajectory during the dark phase of flight. The input value is the drag coefficient of the model.

•Simulated rotation of the body based on its random or gradual orientation [4].

•Two models of the fragments of meteorite Košice with catalog number 21 respectively 53 [5] and one micrometeorite model [6] from the Russian Novaya Zemlya Archipelago (Figure 2a,b).

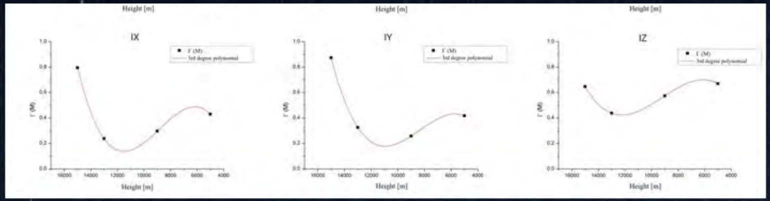

Figure 3. *Dependecne of drag coefficient on height change for fragment of meteorite Košice with catalog no. 21 (208 g). From the upper left corner, to rotate X, Y, Z and inverse IX, IY, IZ. The graph shows the apparent variability of the resistance coefficient Γ when changing the height.*

- **The shape of the trajectory and the impact area is dependent of the drag coefficient within the wind conditions (Figure 4).**
- **Utilizing the function to rotate at every step of the integration of the gradual REG and randomly RAND.**
- **Compared to the real point of impact (Figure 4, on the right no. 21), retain of the line with the individual modeled impacts with the expect direction of flight.**
- **Final result: shape of the meteorite matters, it can change the final position on the ground within tens - hundreds meters.**

	X	Y	Z	IX	IY	IZ	RAN	REG
Vzdialenosť [m]	2180	2260	1870	2060	2150	770	1830	1960

Meteorites material laboratory tests ...

High Enthalpy Flow Diagnostics Group – HEFDiG, IRS, Universität Stuttgart


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0035
V00013+058 AGO


Any questions?