Data and metadata of the PRISMA database

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PRISMA Days, 25-26 Novembre 2022
Dipartimento di Fisica, UniTO

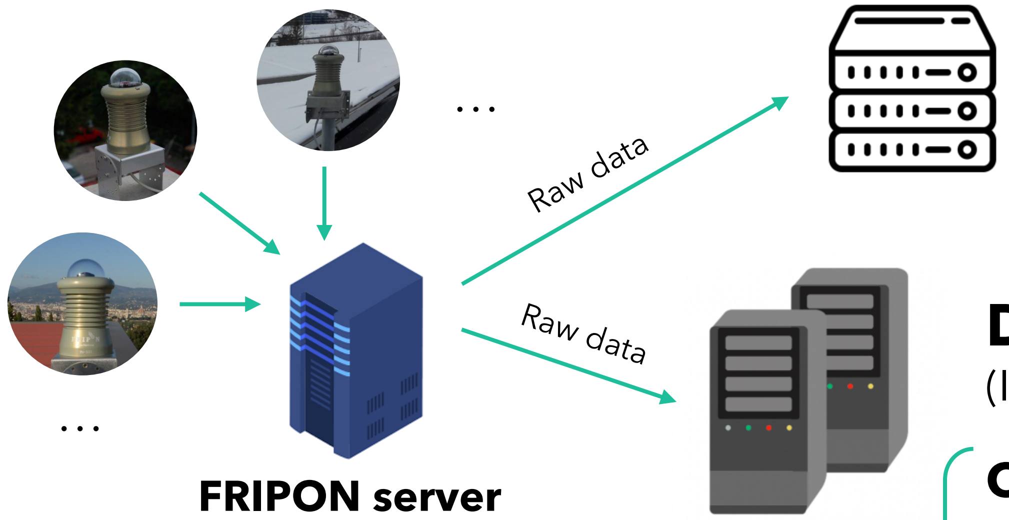
The PRISMA station

- All-sky camera **operated at 30 Hz** to capture meteors with a suitable sampling rate
- Meteor acquisition triggered by a dedicated software named **FreeTure** (https://github.com/cmarmo/freeture)
- A central server combine **detections of the same meteor** in events
- Every 10 minute the camera performs a 5 s exposure (**capture**) for calibration purposes

PRISMA dataset:

- **Captures**: ~140 / day (x 60 cameras, x 5 years)
- **Events**: ~2000 since 2016 (multiple events from ≥ 2 cameras)

The PRISMA dataflow



FRIPON server (LAM/OSU Pythéas)

Long-term data storage at INAF-IA2 (Italian Center for Astronomical Archives, OA Trieste)

Data processing pipeline

(INAF – OA Torino)

Calibration:

- Astrometry
- Photometry

Processed data

Events analysis:

- Video analysis (astrometry and photometry)
- Triangulation
- Dynamic model
- Orbit

Processed data

Next talks will address the work towards a fully Italian PRISMA network

Astrometry and photometry

- The data-set of captures are used for the astrometric and photometric calibration
- On each capture, **100 – 300 stars** can be identified
- Automatic procedure scans for positive sources on each image and **correlates them with catalogue sources** through a simplified projection
- Complete astrometric solution is computed on a daily and monthly basis:
  - High radial distortion
  - Optical axis ≠ zenith direction
  - Elliptic projection

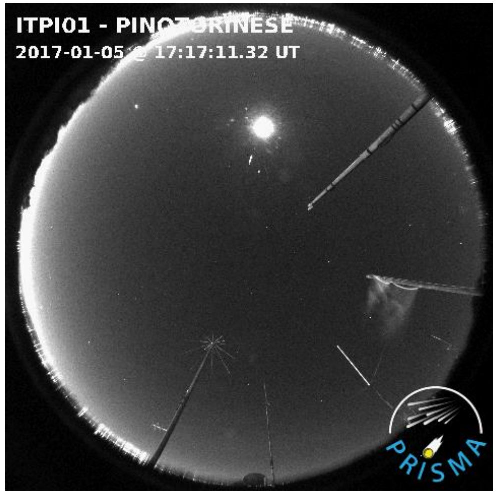
$$\begin{cases} b = a_0 - E + \operatorname{atan}\left(\dfrac{y - y_O}{x - x_O}\right) \\ u = Vr + S\left(e^{Dr} - 1\right) \end{cases} \qquad \begin{cases} a = E + \operatorname{atan}\left(\dfrac{\sin b \sin u}{\cos b \sin u \cos \epsilon + \cos u \sin \epsilon}\right) \\ z = \operatorname{acos}\left(\cos u \cos \epsilon - \cos b \sin u \sin \epsilon\right) \end{cases}$$

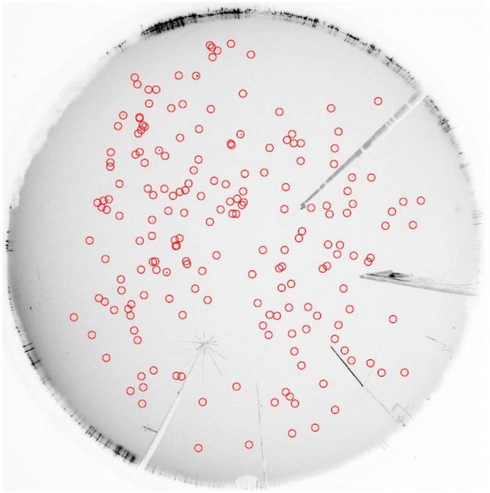
$$(x, y) \rightarrow (b, u) \rightarrow (a, z) \rightarrow (\alpha, \delta)$$

as a function of time for the meteor observation

For more details about the astrometric calibration of PRISMA cameras:

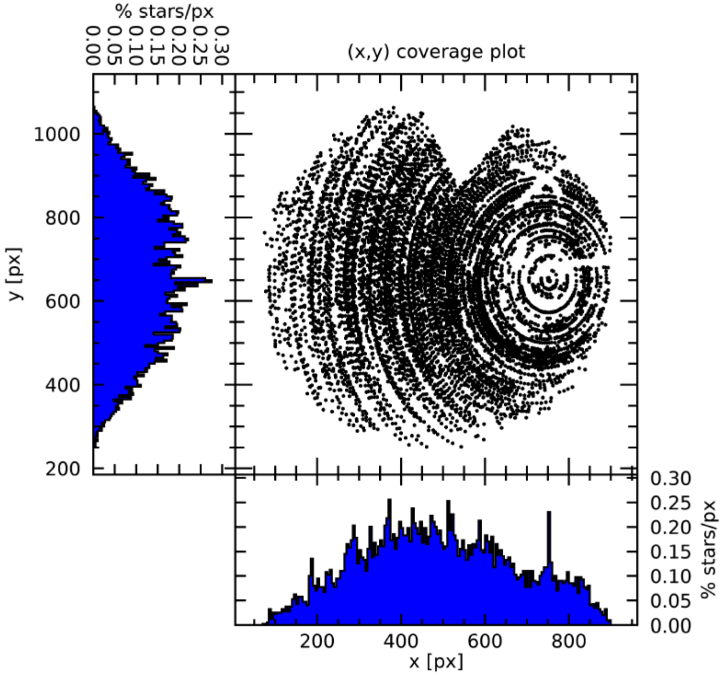
Barghini D. et al., “Astrometric calibration for all-sky cameras revisited”, *Astron. Astrophys.*, **2019**, 626, A105

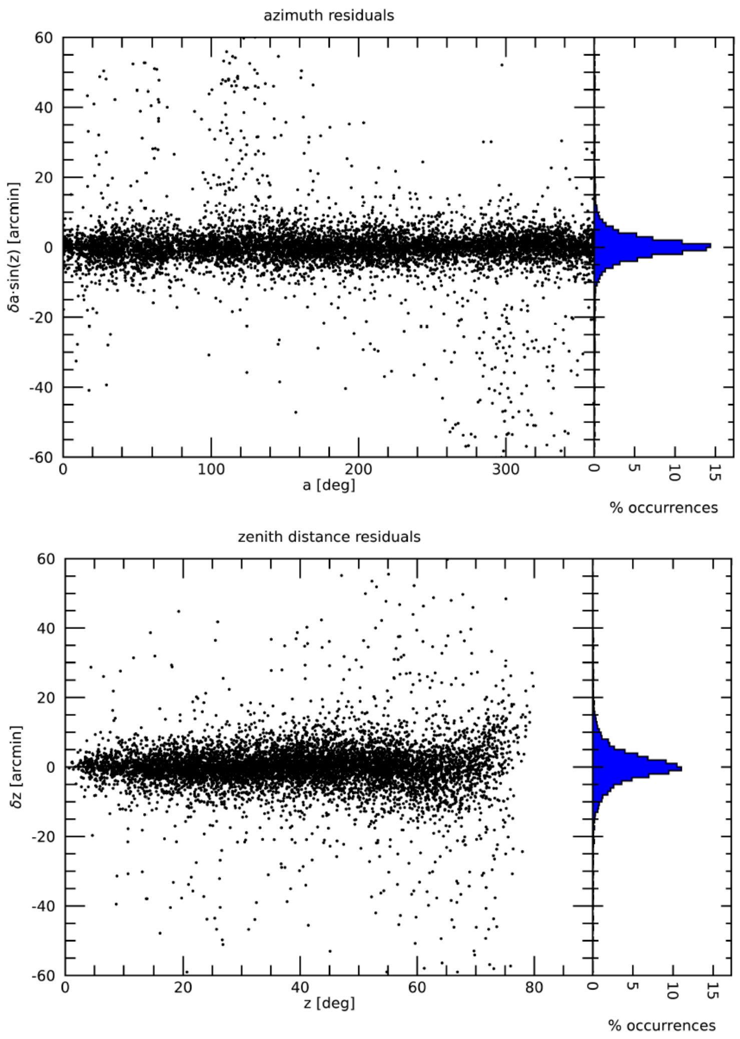


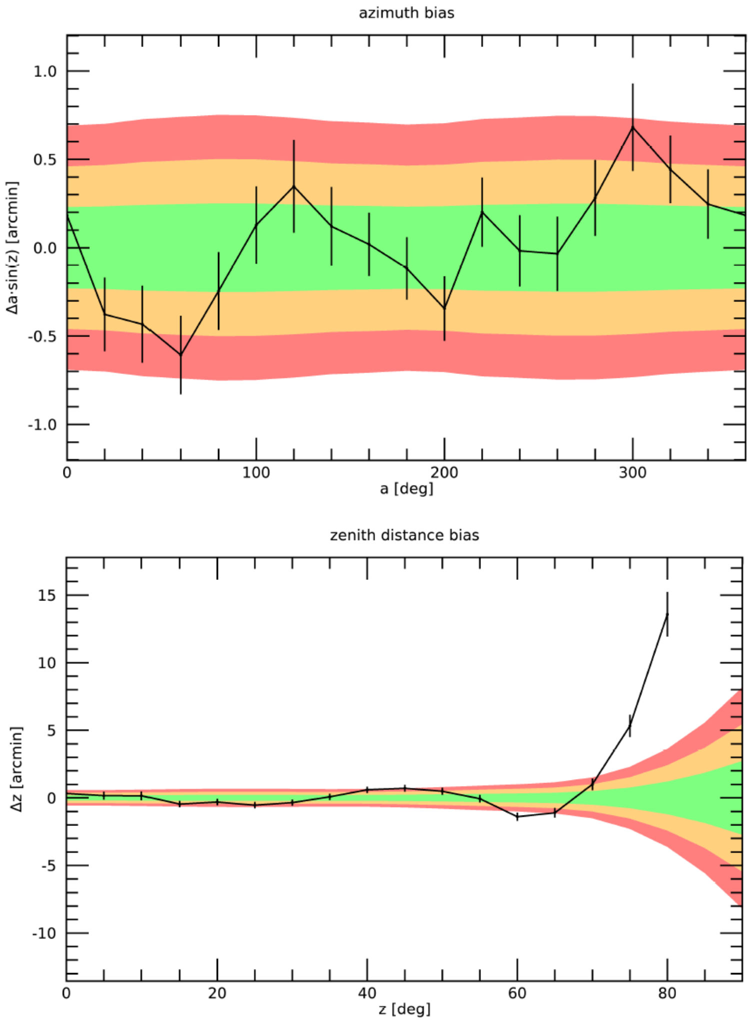


Astrometry results (1)

Example:
ITPI01 – Pino Torinese
02/12/2018
~8k stars identified



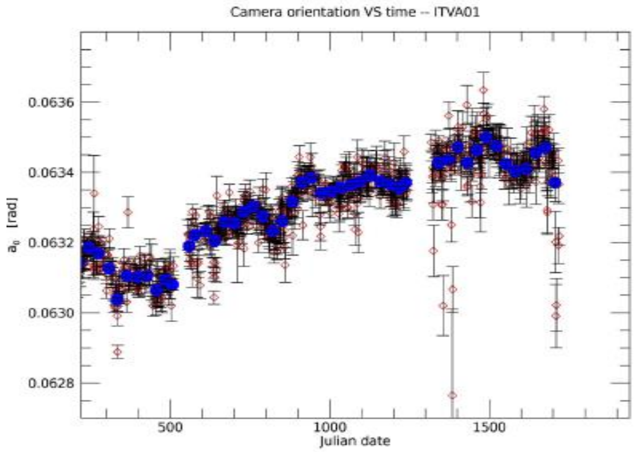


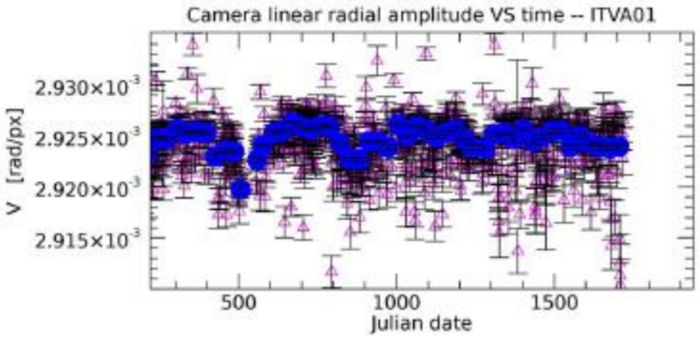


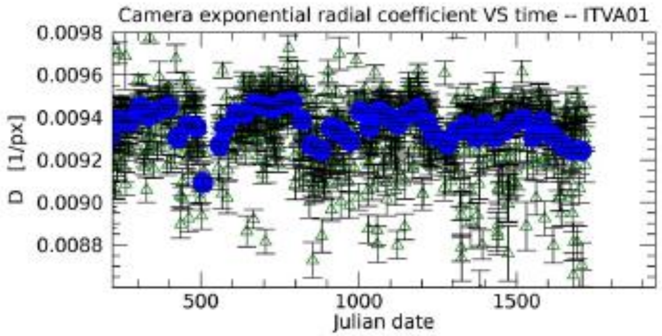
Astrometry results (2)

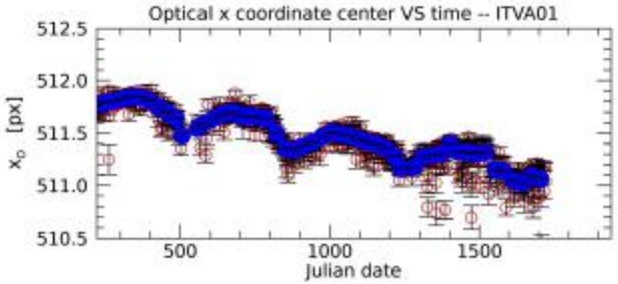
Example:
ITVA01 – Lignan
2017 – 2021 data

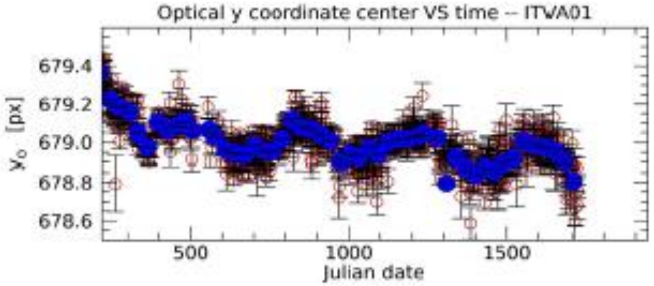
Trend +
seasonal variation

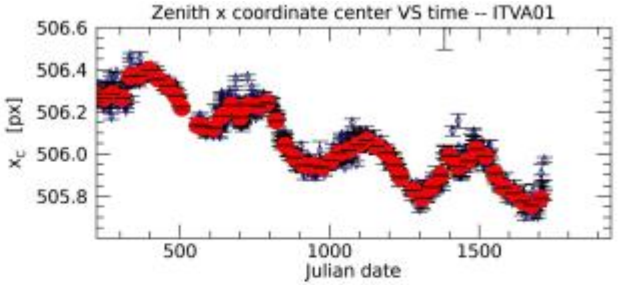


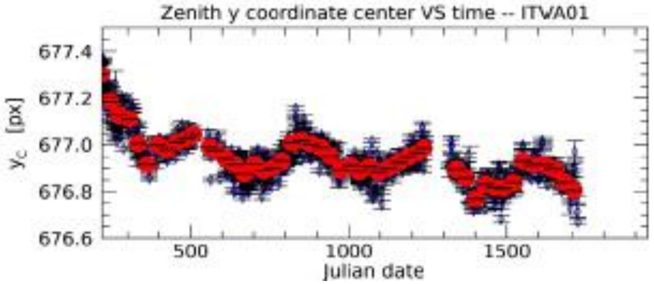


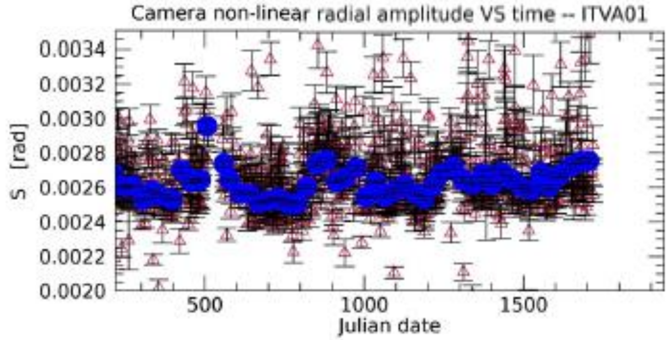








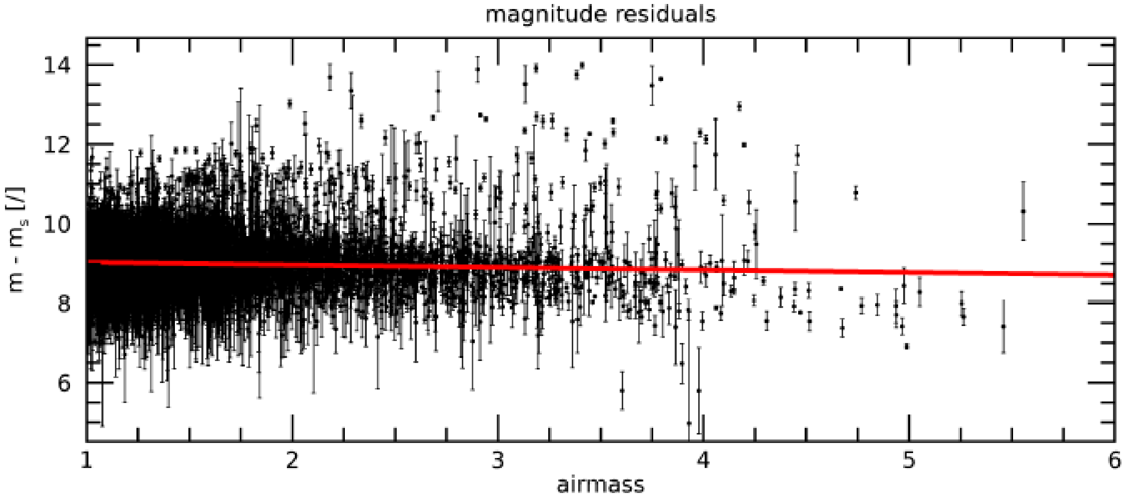


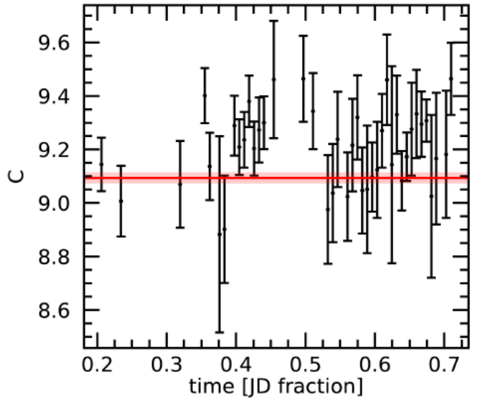


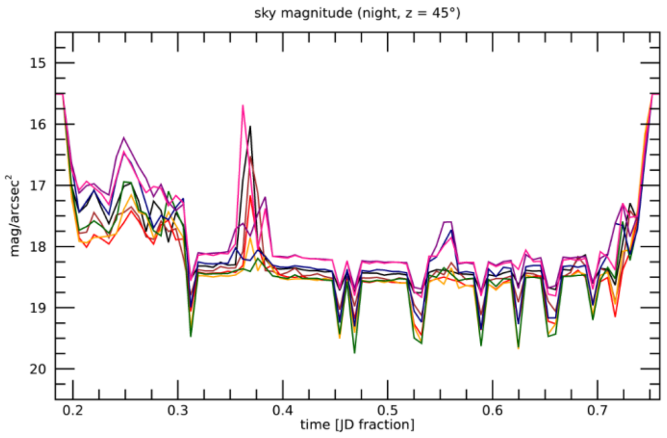
Photometry results (1)

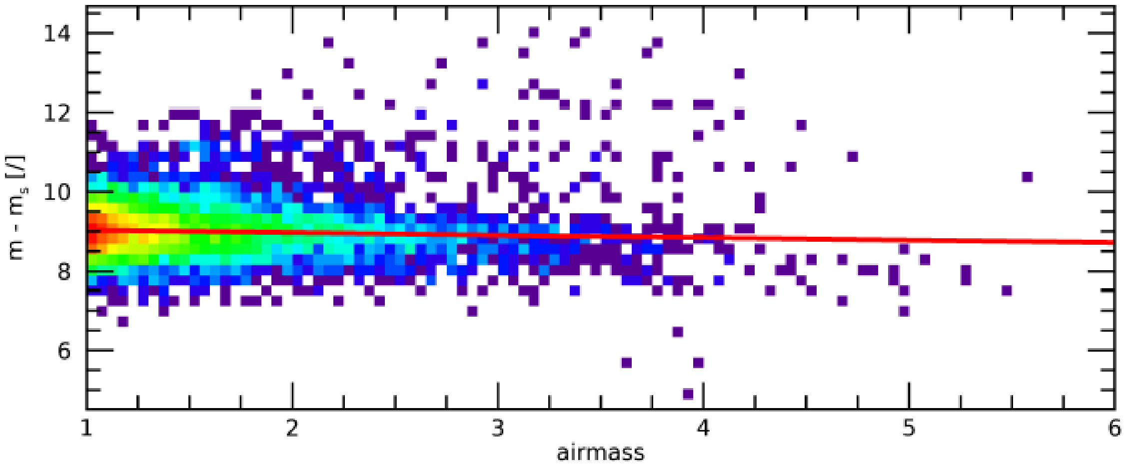
Example:
ITPI01 – Pino Torinese
02/12/2018
~8k stars identified

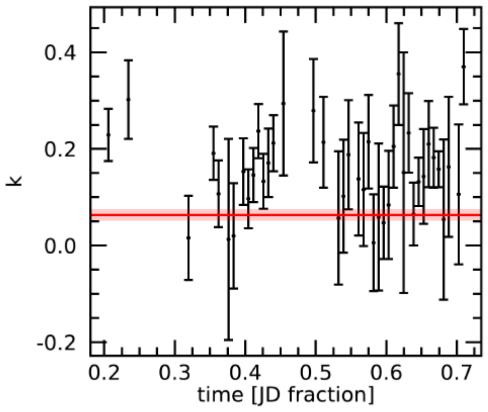
Not a photometric night!







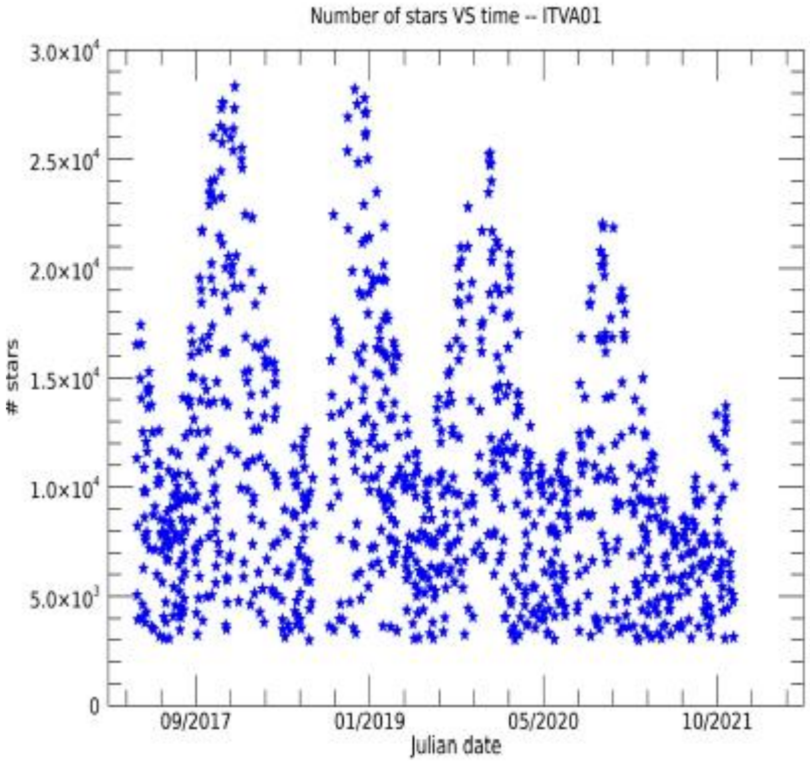


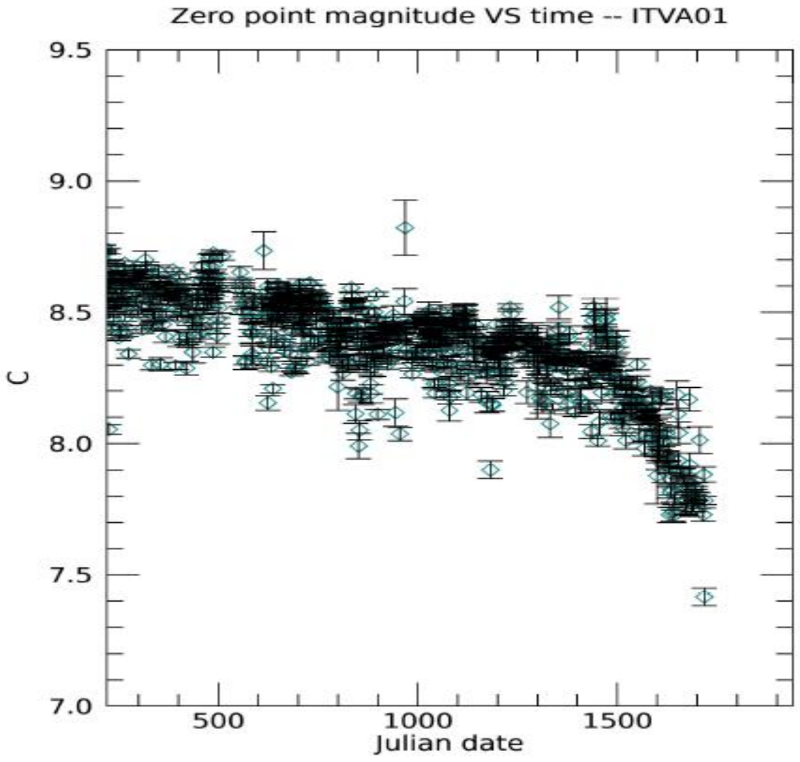


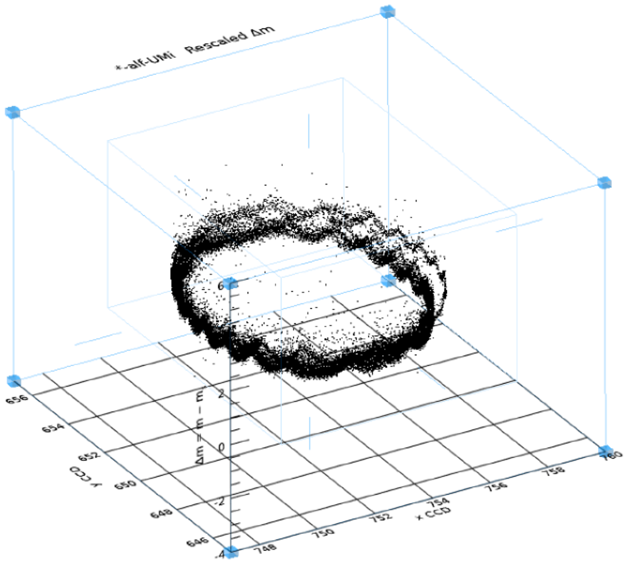
Photometry results (2)

Example:
ITVA01 – Lignan
2017 – 2021 data

Degradation of the performance (most probably related to dome transparency)







+ sub-pixel effects…

Output data from calibration pipeline

Monthly result files

ITPI01_201812_astro_covar.txt	17/11/2022 15:20	File TXT	3 KB
ITPI01_201812_astro_error.txt	17/11/2022 15:20	File TXT	5 KB
ITPI01_201812_astro_param.txt	17/11/2022 15:20	File TXT	2 KB
ITPI01_201812_astro_report.pdf	17/11/2022 15:20	Documento A...	3.976 KB
ITPI01_201812_astro_sigma.txt	17/11/2022 15:20	File TXT	2 KB
ITPI01_201812_astro_solution.txt	17/11/2022 15:20	File TXT	1 KB
ITPI01_201812_photo_param.txt	17/11/2022 15:19	File TXT	2 KB
ITPI01_201812_photo_sigma.txt	17/11/2022 15:19	File TXT	2 KB

Daily result files

ITPI01_20181202_assoc.txt	17/11/2022 15:19	File TXT	1.505 KB
ITPI01_20181202_astro_covar.txt	17/11/2022 15:20	File TXT	3 KB
ITPI01_20181202_astro_error.txt	17/11/2022 15:20	File TXT	5 KB
ITPI01_20181202_astro_param.txt	17/11/2022 15:19	File TXT	10 KB
ITPI01_20181202_astro_report.pdf	17/11/2022 15:20	Documento A...	4.011 KB
ITPI01_20181202_astro_sigma.txt	17/11/2022 15:19	File TXT	10 KB
ITPI01_20181202_astro_solution.txt	17/11/2022 15:20	File TXT	1 KB
ITPI01_20181202_photo_param.txt	17/11/2022 15:19	File TXT	57 KB
ITPI01_20181202_photo_report.pdf	17/11/2022 15:20	Documento A...	2.635 KB
ITPI01_20181202_photo_sigma.txt	17/11/2022 15:19	File TXT	57 KB
ITPI01_20181202_photo_solution.txt	17/11/2022 15:19	File TXT	1 KB

...

- All results from the pipeline are usually output to ASCII files (**TXT**) and **PDF** reports (printable format)
- In the database, they will be organized in **daily and monthly tar archives**

Most important ones (for calibration):

- **_assoc.txt**: list of recognized stars used for astro/photometry
- **_astro/photo_report.pdf**: summary of the calibration process
- **_astro/photo_solution.txt**: astrometry and photometry solution parameters

Example of ASCII table

ITPI01_20181202
config = ITPI01_20171010.ini
model = proj_asin1

image	julian_date	x	s_x	y	s_y	mags	s_mags	eff	sat	star_id	az	zd
[/]	[/]	[px]	[px]	[px]	[px]	[/]	[/]	[/]	[/]	[/]	[rad]	[rad]
ITPI01_20181202T165629_UT-0	2458455.20589579	484.908	0.300	682.051	0.300	-5.016	0.365	0.997	0.	*-6-Lac	2.060380	0.064144
ITPI01_20181202T165629_UT-0	2458455.20589579	517.996	0.300	747.285	0.300	-5.122	0.379	0.966	0.	*-lam-And	1.335697	0.259072
ITPI01_20181202T165629_UT-0	2458455.20589579	573.932	0.300	886.510	0.300	-6.350	0.148	0.849	0.	*-gam01-And	1.262628	0.715616
ITPI01_20181202T165629_UT-0	2458455.20589579	611.090	0.300	942.696	0.300	-5.925	0.225	0.793	0.	*-rho-Per	1.205454	0.923037
ITPI01_20181202T165629_UT-0	2458455.20589579	492.717	0.300	590.782	0.300	-5.414	0.304	0.975	0.	*-ksi-Cyg	4.732041	0.211491
ITPI01_20181202T165629_UT-0	2458455.20589579	528.354	0.300	678.764	0.300	-4.345	0.704	0.992	0.	*-alf-Lac	0.499677	0.107949
ITPI01_20181202T165629_UT-0	2458455.20589579	622.427	0.300	932.832	0.300	-6.440	0.150	0.795	0.	*-bet-Per	1.159197	0.912409
ITPI01_20181202T165629_UT-0	2458455.20589579	482.476	0.300	540.764	0.300	-6.197	0.156	0.942	0.	*-gam-Cyg	4.654042	0.362190
ITPI01_20181202T165629_UT-0	2458455.20589579	506.026	0.300	568.128	0.300	-7.468	0.052	0.961	0.	*-alf-Cyg	4.873919	0.280143
ITPI01_20181202T165629_UT-0	2458455.20589579	584.198	0.300	738.680	0.300	-4.618	0.589	0.945	0.	*-rho-Cas	0.735788	0.350210
ITPI01_20181202T165629_UT-0	2458455.20589579	596.117	0.300	773.994	0.300	-6.625	0.095	0.921	0.	*-alf-Cas	0.869601	0.448109
ITPI01_20181202T165629_UT-0	2458455.20589579	605.897	0.300	776.275	0.300	-5.290	0.354	0.914	0.	*-eta-Cas	0.829150	0.472351
ITPI01_20181202T165629_UT-0	2458455.20589579	573.301	0.300	657.369	0.300	-5.370	0.285	0.971	0.	*-zet-Cep	6.263410	0.231391
ITPI01_20181202T165629_UT-0	2458455.20589579	574.909	0.300	672.710	0.300	-4.675	0.553	0.970	0.	*-del-Cep	0.158145	0.239136
ITPI01_20181202T165629_UT-0	2458455.20589579	599.001	0.300	744.958	0.300	-6.546	0.105	0.934	0.	*-bet-Cas	0.707335	0.393454
ITPI01_20181202T165629_UT-0	2458455.20589579	623.775	0.300	770.090	0.300	-6.642	0.115	0.907	0.	*-gam-Cas	0.731614	0.500193
ITPI01_20181202T165629_UT-0	2458455.20589579	576.494	0.300	636.940	0.300	-6.017	0.163	0.967	0.	*-mu.-Cep	6.016405	0.253574
ITPI01_20181202T165629_UT-0	2458455.20589579	633.984	0.300	788.264	0.300	-5.915	0.180	0.891	0.	*-del-Cas	0.770271	0.560190
ITPI01_20181202T165629_UT-0	2458455.20589579	666.490	0.300	867.003	0.300	-5.839	0.263	0.824	0.	*-gam-Per	0.904302	0.807907
ITPI01_20181202T165629_UT-0	2458455.20589579	669.774	0.300	893.125	0.300	-6.918	0.100	0.804	0.	*-alf-Per	0.954191	0.881627
ITPI01_20181202T165629_UT-0	2458455.20589579	678.627	0.300	910.074	0.300	-5.626	0.347	0.786	0.	*-del-Per	0.962561	0.945762
ITPI01_20181202T165629_UT-0	2458455.20589579	523.226	0.300	513.654	0.300	-5.116	0.468	0.920	0.	*-del-Cyg	4.950237	0.451410
ITPI01_20181202T165629_UT-0	2458455.20589579	621.407	0.300	679.376	0.300	-4.748	0.592	0.937	0.	*-iot-Cep	0.173995	0.381004
ITPI01_20181202T165629_UT-0	2458455.20589579	601.124	0.300	620.771	0.300	-6.024	0.169	0.948	0.	*-alf-Cep	5.949632	0.336408
ITPI01_20181202T165629_UT-0	2458455.20589579	599.640	0.300	597.446	0.300	-5.323	0.358	0.940	0.	*-eta-Cep	5.772705	0.368527
ITPI01_20181202T165629_UT-0	2458455.20589579	646.197	0.300	633.775	0.300	-5.618	0.294	0.918	0.	*-bet-Cep	6.137469	0.456919
ITPI01_20181202T165629_UT-0	2458455.20589579	691.115	0.300	682.162	0.300	-5.924	0.191	0.883	0.	*-gam-Cep	0.141412	0.589886
ITPI01_20181202T165629_UT-0	2458455.20589579	764.442	0.300	925.508	0.300	-8.293	0.032	0.719	0.	*-alf-Aur	0.802084	1.188287
ITPI01_20181202T165629_UT-0	2458455.20589579	654.839	0.300	559.739	0.300	-5.401	0.362	0.889	0.	*-del-Dra	5.757663	0.566893
ITPI01_20181202T165629_UT-0	2458455.20589579	692.577	0.300	562.733	0.300	-5.376	0.427	0.863	0.	*-chi-Dra	5.862960	0.666011
ITPI01_20181202T165629_UT-0	2458455.20589579	752.149	0.300	655.557	0.300	-6.563	0.133	0.832	0.	*-alf-UMi	0.015362	0.780726

ITPI01_20181202_assoc.txt

Metadata description

- Important parameters (e.g., number of identified stars, latitude, longitude…) are saved as metadata that will be imported on database
- They are saved as **FITS header**

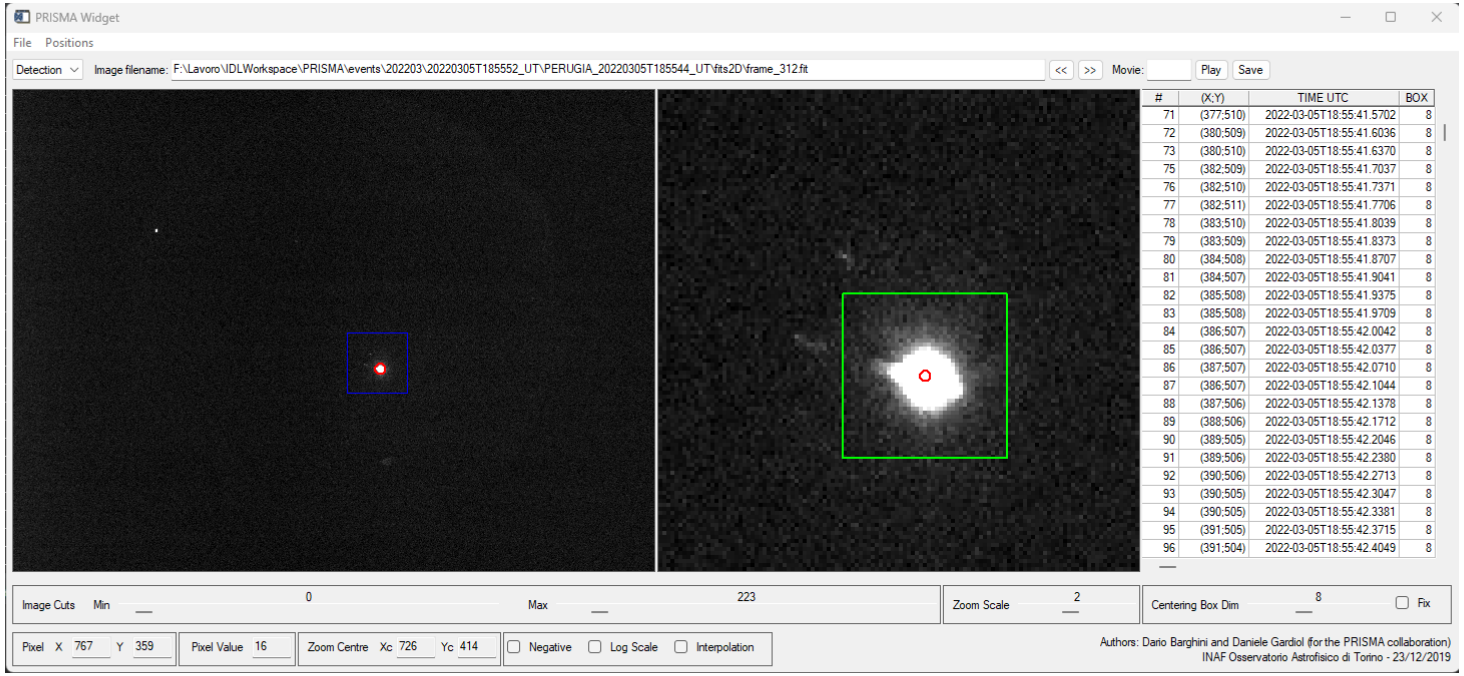
PRISMA_ITPI01_2018-12-04_calibration.fits

```
SIMPLE  =                    T / Written by IDL:  Thu Nov 17 15:17:38 2022
BITPIX  =                   16 / number of bits per data pixel
NAXIS   =                    0 / number of data axes
EXTEND  =                    T / FITS dataset may contain extensions
IF_DATA =                    1 / 1 if there are data, 0 otherwise
N       =                  136 / number of captures
NAME    = 'PINOTORINESE'       / PRISMA camera name
DATE    = '2018-12-04'         / acquisition night
JD      =              2458457 / julian date
LAT     =            45.041230 / station latitude [deg]
LON     =             7.764930 / station longitude [deg]
HGT     =                615.0 / station elevation [m]
IF_ASTR =                    1 / 1 if astrometric calibrated, 0 otherwise
IF_PHOT =                    1 / 1 if photometric calibrated, 0 otherwise
NSTARS  =                11584 / number of identified stars
MOON_PH =                0.059 / moon phase
MOON_ZD =                3.380 / max moon zd [deg]
SCALE   =               0.1675 / linear pixel scale [deg/px]
MAGZ    =                9.724 / mean sky mag at zd = 0° [mag/as^2]
S_MAGZ  =                0.162 / err on mean sky mag at zd = 0° [mag/as^2]
MAGM    =                9.262 / mean sky mag at zd = 45° [mag/as^2]
S_MAGM  =                0.214 / err on mean sky mag at zd = 45° [mag/as^2]
MAGL    =                8.775 / mean sky mag at zd = 70° [mag/as^2]
S_MAGL  =                0.464 / mean sky mag at zd = 70° [mag/as^2]
MODEL_P = 'airmass '           / photometric model
C       =                9.113 / zero-point magnitude [mag]
```

```
S_C     =                0.017 / err on zero-point magnitude [mag]
K       =                0.042 / atm extinction coeff [mag/am]
S_K     =                0.010 / err on atm extinction coeff [mag/am]
MODEL_A = 'proj_rotz_exp1_asym' / astrometric model
A0      =            0.0394656 / dir of the north [rad]
S_A0    =          2.77897E-05 / err on dir of the north [rad]
XO      =              483.772 / x of the opt center [px]
S_XO    =            0.0437275 / err on x of the opt center [px]
YO      =              660.416 / y of the opt center [px]
S_YO    =            0.0369387 / err on y of the opt center [px]
XZ      =              494.785 / x of the zenith dir [px]
S_XZ    =            0.0129780 / err on x of the zenith dir [px]
YZ      =              662.492 / y of the zenith dir [px]
S_YZ    =            0.0126970 / err on y of the zenith dir [px]
V       =           0.00291309 / linear plate scale [rad/px]
S_V     =          8.07752E-07 / err on linear plate scale [rad/px]
S       =           0.00268649 / exponential scale [rad]
S_S     =          5.56005E-05 / err on exponential scale [rad]
D       =           0.00921680 / exponential radial factor [1/px]
S_D     =          4.43313E-05 / err on exponential radial factor [1/px]
J       =          0.000409793 / amplitude of opt plate misalign [rad]
S_J     =          5.39453E-05 / err on amplitude of opt plate misalign [rad]
PHI     =              2.47119 / phase of opt plate misalign [rad]
S_PHI   =             0.129302 / err on phase of opt plate misalign [rad]
FPREV   = 'PRISMA_ITPI01_2018-12-04_calibration.png' / preview filename
END
```

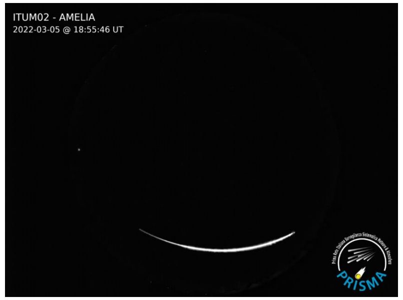
Detection analysis

- Analysis of the video data from each station (**detection**) of the **event**
- Determination of **position** (x,y) and **flux** of the meteor as a function of the time through barycentre / aperture photometry and PSF fitting
- Estimation of **PSF saturation** (important for meteorite-droppers!)
- Astro/photometric solution to get celestial coordinates and apparent magnitude
- Production of the **detection image and video**



Detection results

Example:
20220305T185552_UT
10 cameras



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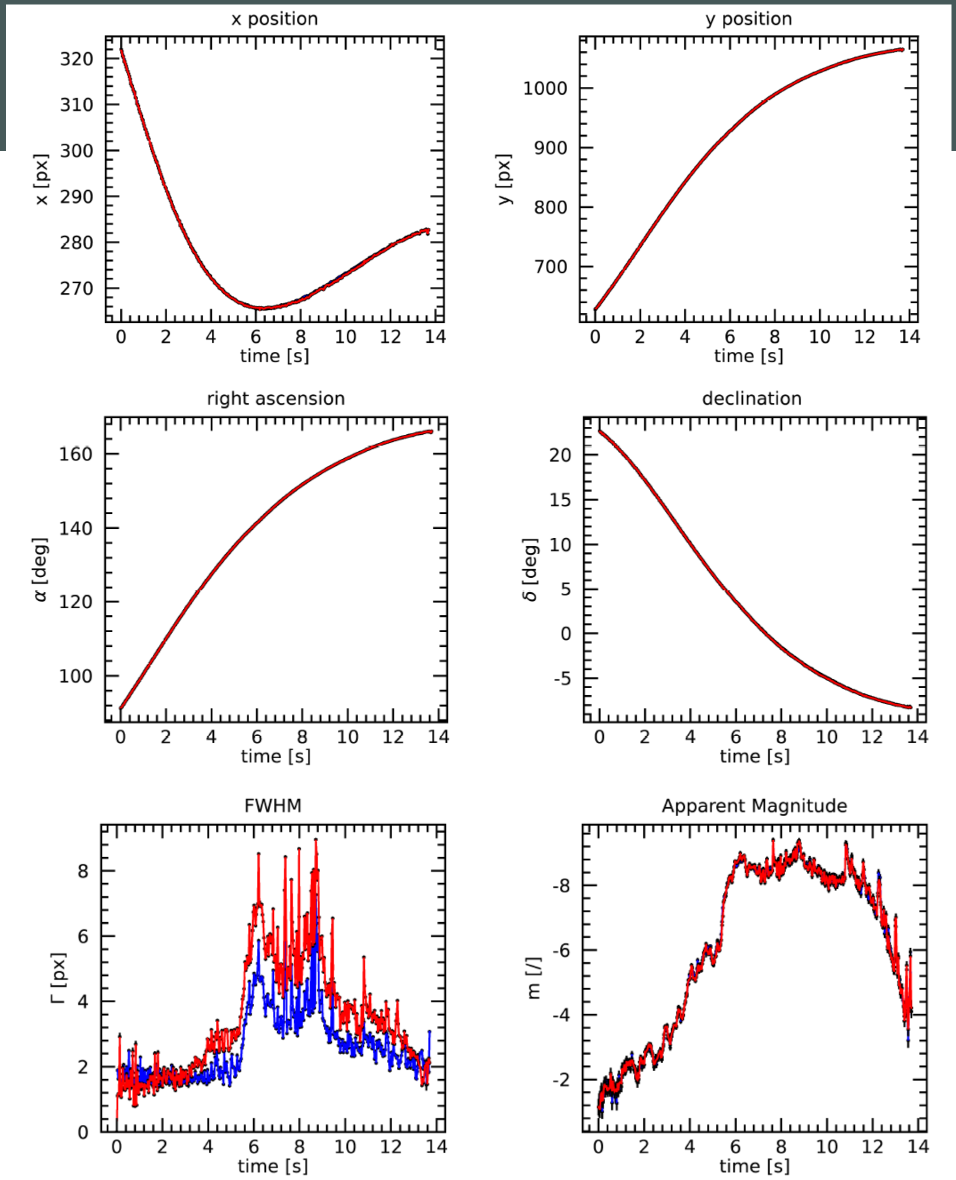
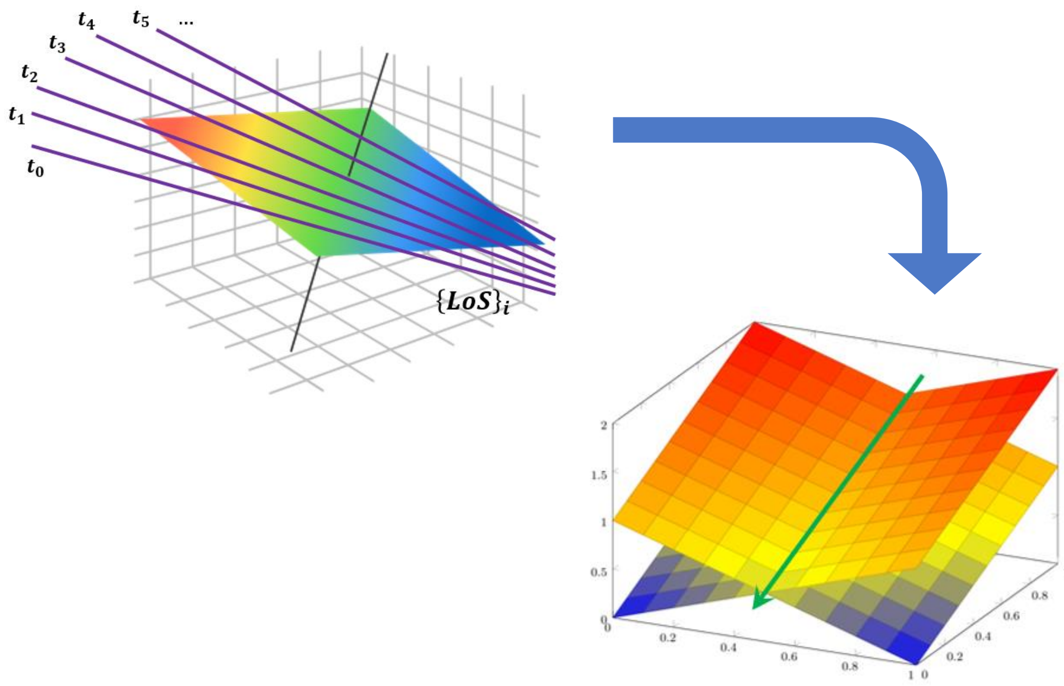


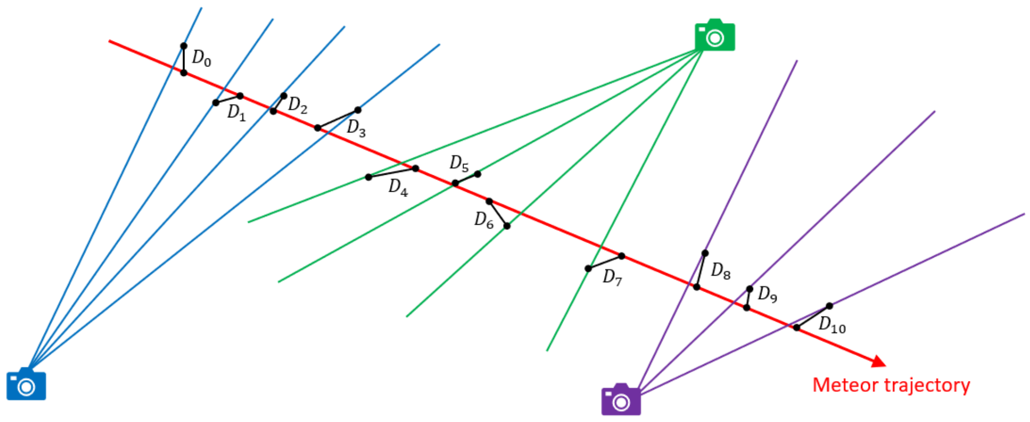
Triangulation

Two main approach to reconstruct the 3D meteor path in the atmosphere, both assuming a **straight-line trajectory**

Plane intersection between couples of cameras (Ceplecha, 1987)

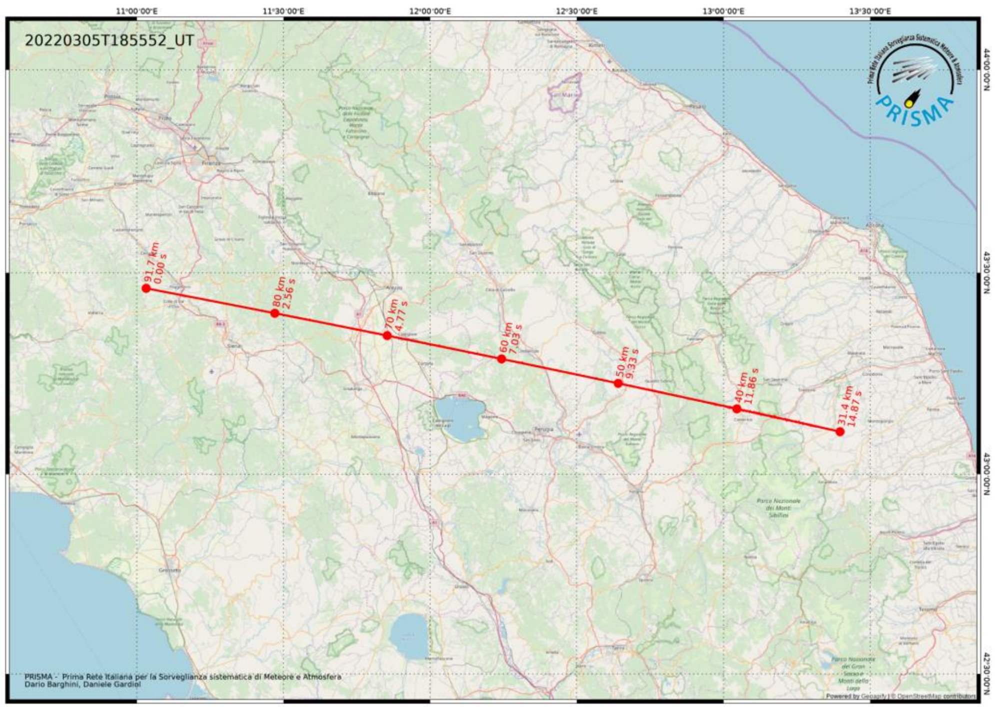


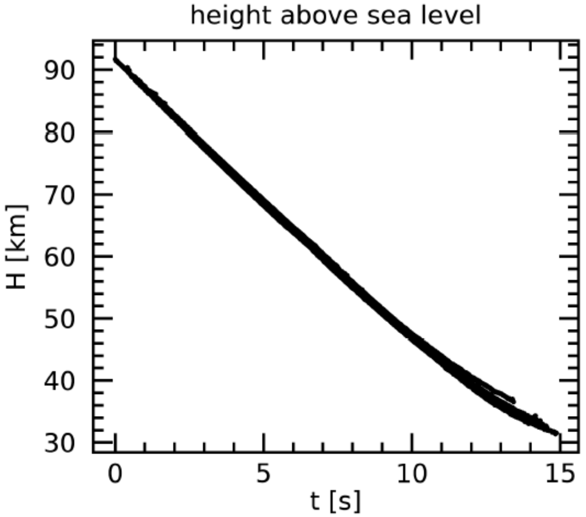
Minimizing distances of lines of sight between N cameras (Borovicka, 1990)

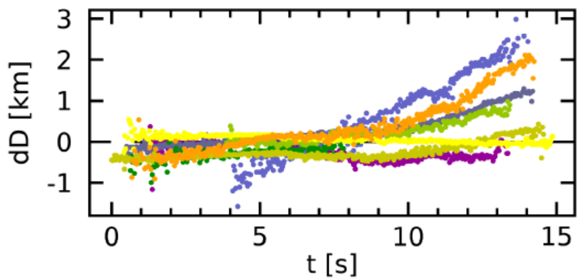


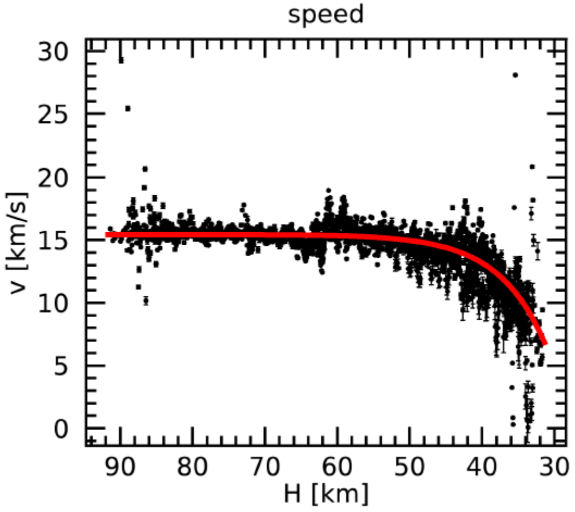
Triangulation results

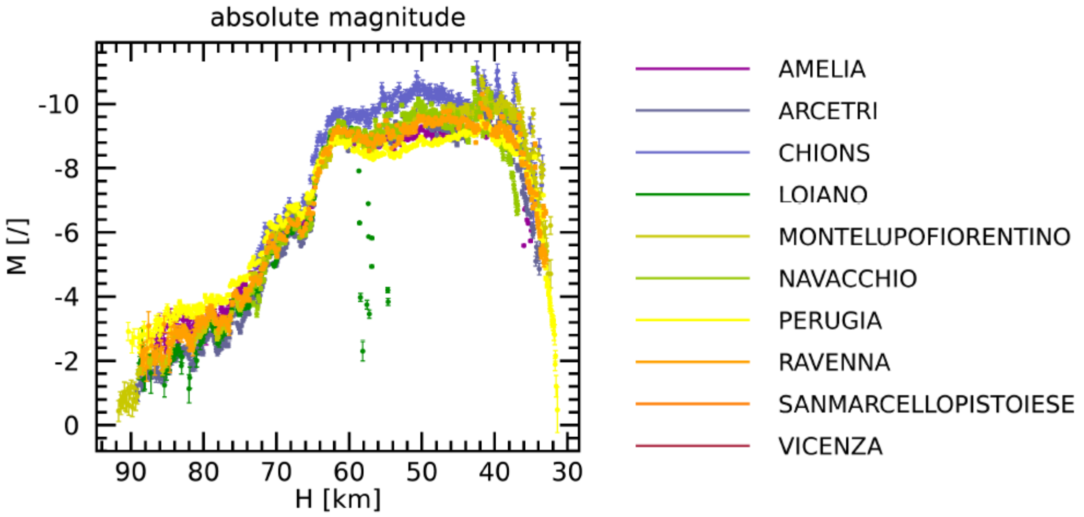
Example:
20220305T185552_UT
10 cameras

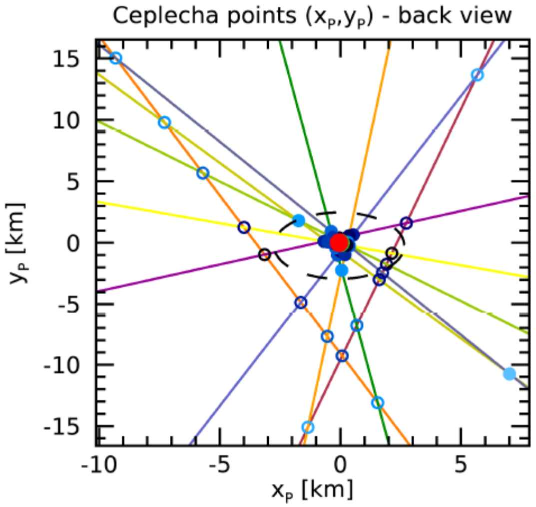












Dynamic model

The output from triangulation $(t, h, v, \mathcal{M})$ is the input for the evaluation of the dynamical model

$$
\begin{cases}
\dfrac{dh}{dt} = -v \sin\gamma \\
M \dfrac{dv}{dt} = -\Gamma S \rho v^2 \\
\dfrac{dM}{dt} = -\dfrac{\Lambda}{2Q} S \rho v^3 \\
I = -\tau \dfrac{d}{dt}\left(\dfrac{1}{2} M v^2\right)
\end{cases}
$$

Two approachs:

- **Analytical solution** (Gritsevich, 2009 & 2011) – with some assumptions
- **Numerical solution** (Ceplecha 1987, Kalenichenko 2006)

Both are evaluated, in 4 total versions:

- **dynamical** Grit09 / Kale06
- **photo-dynamical** Grit09 / Kale06 (deceleration + intensity modelling)

The main outputs of the dynamical model evaluation are the mass, section, equivalent radius of the meteoroid as a function of the time. In any case, there are **a lot of assumptions** involved (which are therefore reflected in a **relatively high uncertainty** in the estimation of these values)

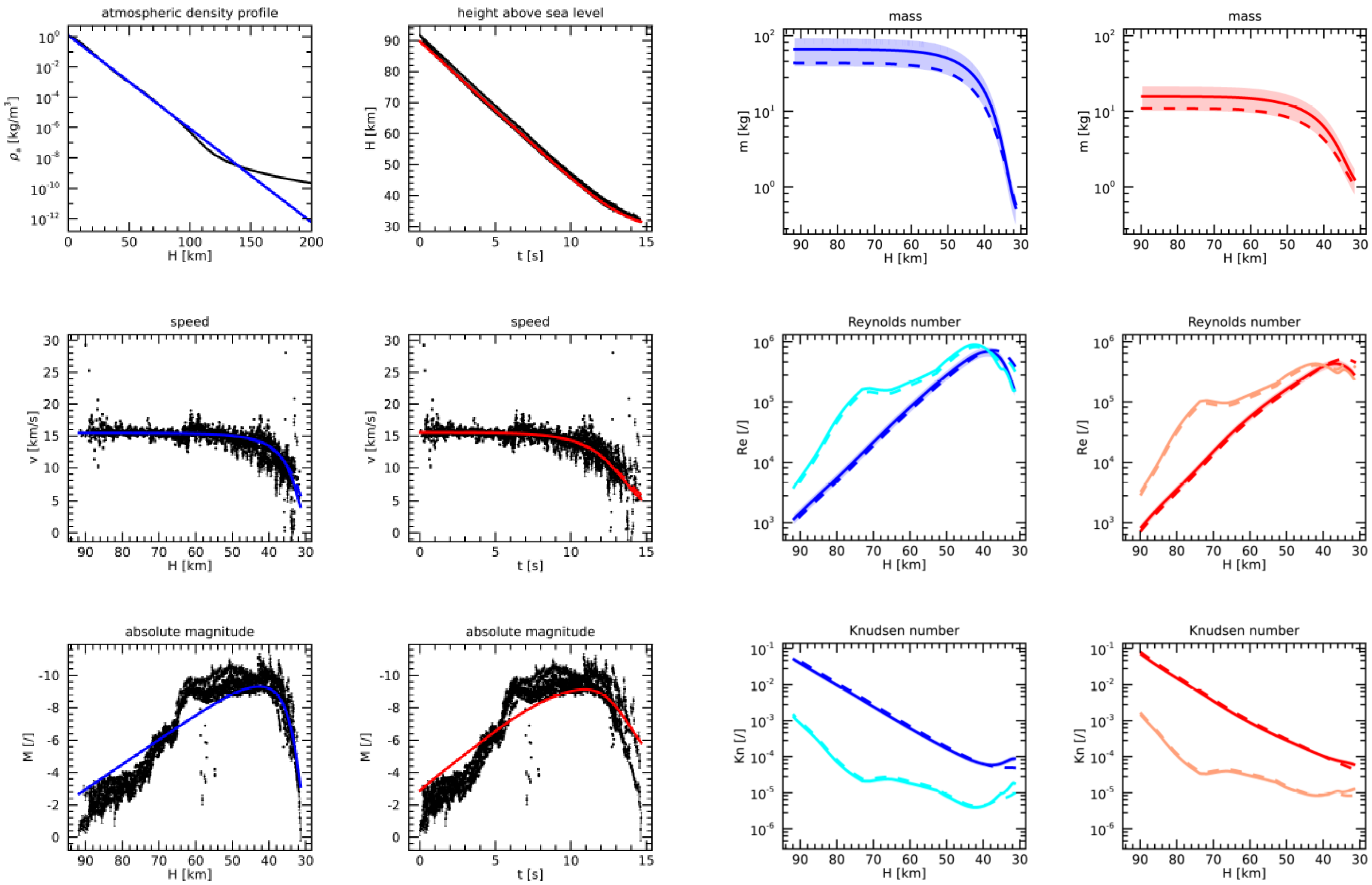
Dynamic model results

Example:
20220305T185552_UT
10 cameras

$\boldsymbol{\gamma = 16.5 \pm 0.5\ \mathrm{deg}}$

$\boldsymbol{v_\infty = 15.5 \pm 0.1\ \mathrm{km/s}}$
$\boldsymbol{M_\infty = 10\ - 90\ \mathrm{kg}}$
$\boldsymbol{d_\infty = 15\ - 35\ \mathrm{cm}}$

$\boldsymbol{v_{fin} \sim 5\ \mathrm{km/s}}$
$\boldsymbol{M_{fin} = 0.5\ - 1.5\ \mathrm{kg}}$
$\boldsymbol{d_{fin} = 3\ - 9\ \mathrm{cm}}$



Orbit

The output from triangulation and dynamical model:

$(v_\infty, \alpha, \delta) \rightarrow (v_{\infty x}, v_{\infty y}, v_{\infty z})$ **= observed radiant**

- correction for Earth's rotation speed
- Correction for Earth's gravitational attraction
  → $(v_G, \alpha_G, \delta_G)$ **= geocentric radiant**
- Correction for Earth revolution speed
  → $(v_H, \alpha_H, \delta_H)$ **= heliocentric radiant**
- **ORBITAL ELEMENTS**

$$v = (v_{Hx}, v_{Hy}, v_{Hz})$$
$$\vec{h} = \vec{r} \times \vec{v}$$

$$\vec{e} = \frac{1}{GM}\left(\left(v^2 - \frac{GM}{r}\right)\vec{r} - (\vec{r}\cdot\vec{v})\vec{v}\right)$$

$$\cos(\Omega) = \frac{h_y}{\sqrt{{h_x}^2 + {h_y}^2}}$$

$$\cos(i) = \frac{h_z}{h}$$

$$\cos(\omega) = \frac{-h_y e_x + h_x e_y}{e\sqrt{{h_x}^2 + {h_y}^2}}$$

$$\cos(\Omega) = \frac{h_y}{\sqrt{{h_x}^2 + {h_y}^2}}$$

$$a = \frac{1}{\frac{2}{r} - \frac{v^2}{GM}}$$

Orbit results

WORK IN PROGRESS

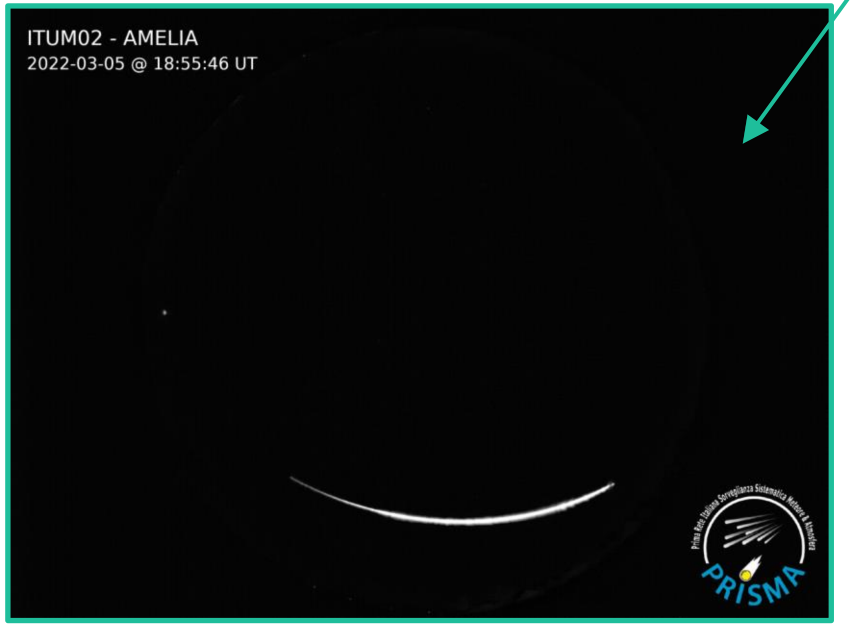
Output data from event pipeline

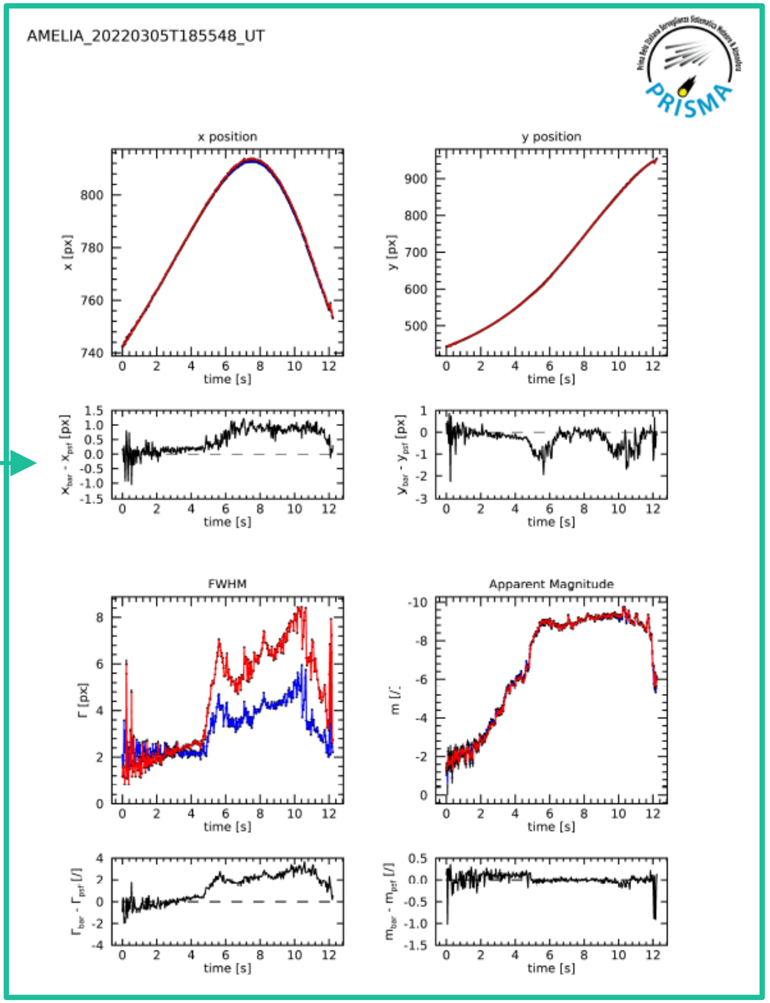
- astrometry
- dynamic
- triangulation

- AMELIA_20220305T185548_UT
- ARCETRI_20220305T185546_UT
- CHIONS_20220305T185552_UT
- LOIANO_20220305T185548_UT

...

- AMELIA_20220305T185548_UT_bar.txt
- AMELIA_20220305T185548_UT_bar_param.txt
- AMELIA_20220305T185548_UT_bar_sigma.txt
- AMELIA_20220305T185548_UT_image.png
- AMELIA_20220305T185548_UT_psf.txt
- AMELIA_20220305T185548_UT_psf_param.txt
- AMELIA_20220305T185548_UT_psf_sigma.txt
- AMELIA_20220305T185548_UT_report.pdf
- AMELIA_20220305T185548_UT_thumb.png
- AMELIA_20220305T185548_UT_video.avi
- newpositions.txt

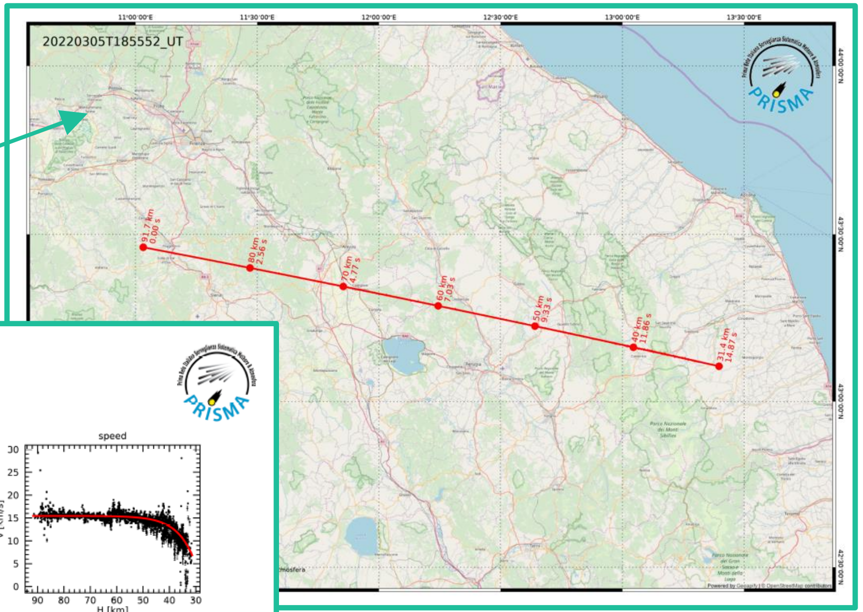


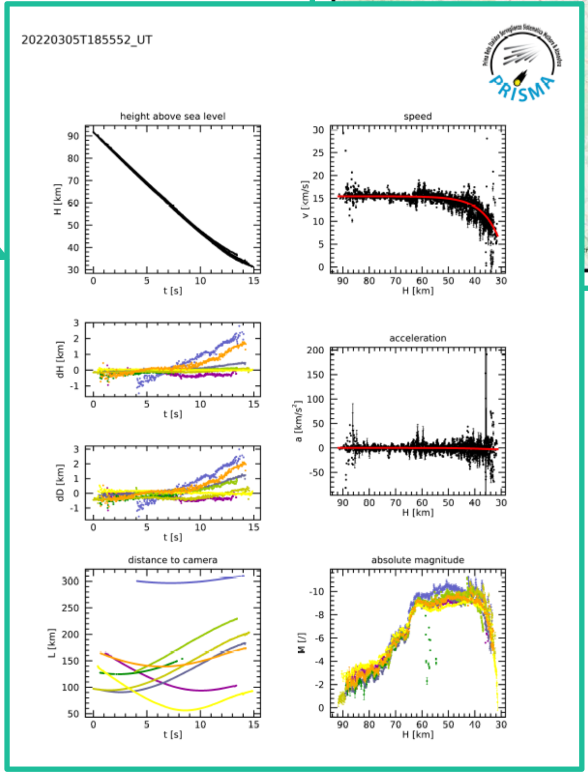


Output data from event pipeline

- astrometry
- dynamic
- triangulation

- 20220305T185552_UT_triang_flight.kml
- 20220305T185552_UT_triang_ground.kml
- 20220305T185552_UT_triang_lines.kml
- 20220305T185552_UT_triang_LoS.txt
- 20220305T185552_UT_triang_map.png
- 20220305T185552_UT_triang_report.pdf
- 20220305T185552_UT_triang_results.txt
- 20220305T185552_UT_triang_stations.kml
- 20220305T185552_UT_triang_summary.txt
- 20220305T185552_UT_triang_traj.txt
- 20220305T185552_UT_triang_trajectory.kml





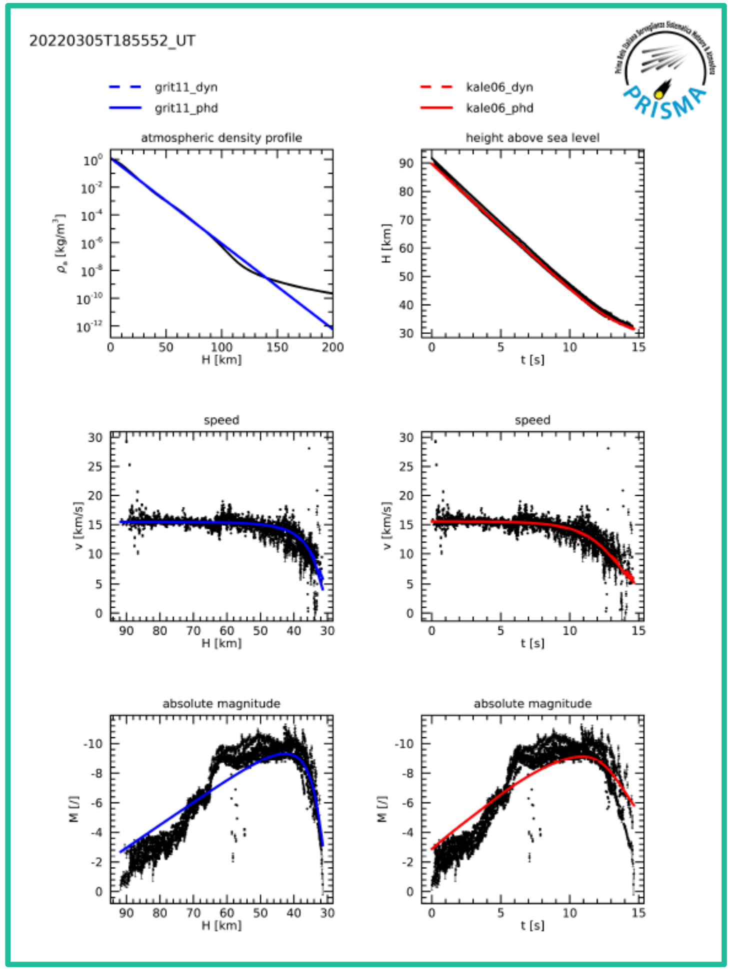
Output data from event pipeline

- astrometry
- dynamic
- triangulation

- 20220305T185552_UT_atmospheric_model.txt
- 20220305T185552_UT_dynamic_report.pdf
- 20220305T185552_UT_dynamic_summary.txt
- 20220305T185552_UT_grit11_dyn_param.txt
- 20220305T185552_UT_grit11_dyn_sigma.txt
- 20220305T185552_UT_grit11_phd_param.txt
- 20220305T185552_UT_grit11_phd_sigma.txt
- 20220305T185552_UT_kale06_dyn_param.txt
- 20220305T185552_UT_kale06_dyn_sigma.txt
- 20220305T185552_UT_kale06_phd_param.txt
- 20220305T185552_UT_kale06_phd_sigma.txt

20220305T185552_UT
Gamma = 0.750 ± 0.080
rho = 3300.0 ± 200.0 kg/m^3

		Grit11_dyn	Grit11_phd	Kale06_dyn	Kale06_phd
Time of Flight	[s]	15.06 ± 0.08	15.33 ± 0.09	14.65 ± 0.05	14.65 ± 0.05
Pre-atmospheric velocity	[km/s]	15.4663 ± 0.0214	15.4486 ± 0.0203	15.5532 ± 0.0550	15.5308 ± 0.0466
Trajectory inclination	[deg]	16.4933 ± 0.9102	16.4933 ± 0.9102	16.6813 ± 0.0603	16.6550 ± 0.0512
Pre-atmospheric MSR	[kg/m^2]	6.462e+02 ± 0.845e+02	7.415e+02 ± 0.943e+02	4.076e+02 ± 0.465e+02	4.602e+02 ± 0.512e+02
Pre-atmospheric mass	[kg]	4.379e+01 ± 1.798e+01	6.616e+01 ± 2.649e+01	1.099e+01 ± 0.399e+01	1.582e+01 ± 0.561e+01
Pre-atmospheric section	[m^2]	6.776e-02 ± 1.953e-02	8.922e-02 ± 2.514e-02	2.696e-02 ± 0.696e-02	3.437e-02 ± 0.870e-02
Pre-atmospheric size	[m]	2.937e-01 ± 0.423e-01	3.371e-01 ± 0.475e-01	1.853e-01 ± 0.239e-01	2.092e-01 ± 0.265e-01
Ablation coeff. (sigma)	[s^2/km^2]	4.210e-02 ± 0.393e-02	4.346e-02 ± 0.150e-02	2.309e-02 ± 0.425e-02	2.365e-02 ± 0.147e-02
Ballistic coeff. (alpha)	[/]	35.6253 ± 4.6578	31.0470 ± 3.9493	55.8656 ± 6.6429	49.5520 ± 5.7592
MSR-loss param. (beta)	[/]	1.6784 ± 0.1548	2.3169 ± 0.0904	0.9310 ± 0.1704	1.3895 ± 0.1267
Mass-loss param. (Omega)	[/]	5.0353 ± 0.4644	5.1866 ± 0.1749	2.7931 ± 0.5111	2.8525 ± 0.1747
Shape-change coeff. (mu)	[/]	0.6667 ± 0.0000	0.5533 ± 0.0169	0.6667 ± 0.0000	0.5129 ± 0.0447
Luminous eff. (tau)	[/]	NaN ± NaN	4.376e-03 ± 1.668e-03	NaN ± NaN	1.805e-02 ± 0.641e-02
Initial Height	[km]	91.7310 ± 0.0172	91.7310 ± 0.0172	89.7249 ± 0.0216	89.6610 ± 0.0192
Final Height	[km]	31.4183 ± 0.0137	31.4183 ± 0.0137	31.3771 ± 0.1151	31.5845 ± 0.0966
Initial Velocity	[km/s]	15.4651 ± 0.0214	15.4475 ± 0.0203	15.5506 ± 0.0552	15.5290 ± 0.0467
Final Velocity	[km/s]	5.9219 ± 0.3577	4.1143 ± 0.2689	5.9403 ± 0.2694	5.2776 ± 0.2191
Initial MSR	[kg/m^2]	6.460e+02 ± 0.845e+02	7.413e+02 ± 0.943e+02	4.075e+02 ± 0.466e+02	4.601e+02 ± 0.514e+02
Final MSR	[kg/m^2]	1.543e+02 ± 0.241e+02	8.615e+01 ± 1.189e+01	1.840e+02 ± 0.282e+02	1.346e+02 ± 0.184e+02
MSR @ v = 3 km/s	[kg/m^2]	1.285e+02 ± 0.215e+02	7.977e+01 ± 1.112e+01	1.663e+02 ± 0.277e+02	1.208e+02 ± 0.172e+02
Initial mass	[kg]	4.376e+01 ± 1.796e+01	6.611e+01 ± 2.647e+01	1.098e+01 ± 0.399e+01	1.581e+01 ± 0.562e+01
Final mass	[kg]	5.959e-01 ± 2.889e-01	5.344e-01 ± 2.191e-01	1.011e+00 ± 0.480e+00	1.269e+00 ± 0.470e+00
mass @ v = 3 km/s	[kg]	3.442e-01 ± 1.776e-01	4.498e-01 ± 1.852e-01	7.464e-01 ± 3.841e-01	1.015e+00 ± 0.381e+00
Initial section	[m^2]	6.773e-02 ± 1.952e-02	8.919e-02 ± 2.513e-02	2.694e-02 ± 0.979e-02	3.436e-02 ± 1.220e-02
Final section	[m^2]	3.863e-03 ± 1.296e-03	6.203e-03 ± 1.923e-03	5.495e-03 ± 2.141e-03	9.422e-03 ± 3.740e-03
section @ v = 3 km/s	[m^2]	2.679e-03 ± 0.953e-03	5.639e-03 ± 1.761e-03	4.488e-03 ± 1.832e-03	8.404e-03 ± 3.391e-03
Initial size	[m]	2.937e-01 ± 0.423e-01	3.369e-01 ± 0.475e-01	1.852e-01 ± 0.240e-01	2.091e-01 ± 0.266e-01
Final size	[m]	7.013e-02 ± 1.177e-02	3.916e-02 ± 0.590e-02	8.364e-02 ± 1.376e-02	6.120e-02 ± 0.913e-02
size @ v = 3 km/s	[m]	5.841e-02 ± 1.038e-02	3.626e-02 ± 0.551e-02	7.560e-02 ± 1.341e-02	5.491e-02 ± 0.851e-02



Conclusions

- Everything is (almost) **ready for a first data release**
- We are **deploying the pipeline** in the servers installed at INAF – OATo
- Most likely, the **processing of the data** collected up to 2022 will take place in the **next months**
- The database, including calibrations and events/results, will be hosted at INAF - IA2 (OATS) and will be accessible to the collaboration through an **user interface**
- Data will be provided in tar.gz archives and will include **FITS header tables with metadata** that will be searchable throught the database interface
- With the data release we will provide a document with a **detailed description of the content** of the database

THANK YOU FOR YOUR ATTENTION!