CILBO – Lessons learned from the operation of a double-station meteor camera setup

D. Koschny, J. Mc Auliffe, E. Drolshagen, F. Bettonvil, J. Licandro, C. v. d. Luijt, T. Ott, H. Smit, H. Svedhem, O, Witasse, J. Zender

European Space Agency, Keplerlaan 1, Postbus 299
2200 AG Noordwijk, The Netherlands
Detlef.Koschny@esa.int

esa SCIENCE

CILBO

METEOR RESEARCH GROUP

CILBO =

Canary Island Long Baseline Observatory

A double station meteor observatory using image-intensified video cameras

(and: the whistling language with which the indegineous people were communicating)

Science goals

- Determine meteoroid physical properties (light curves)
- Find source regions of meteoroids in the solar system (orbits)
- chemical properties (spectroscopy)
- Constrain meteoroid models (determine flux, size distributions)

How do we do it? – see also IMC2013

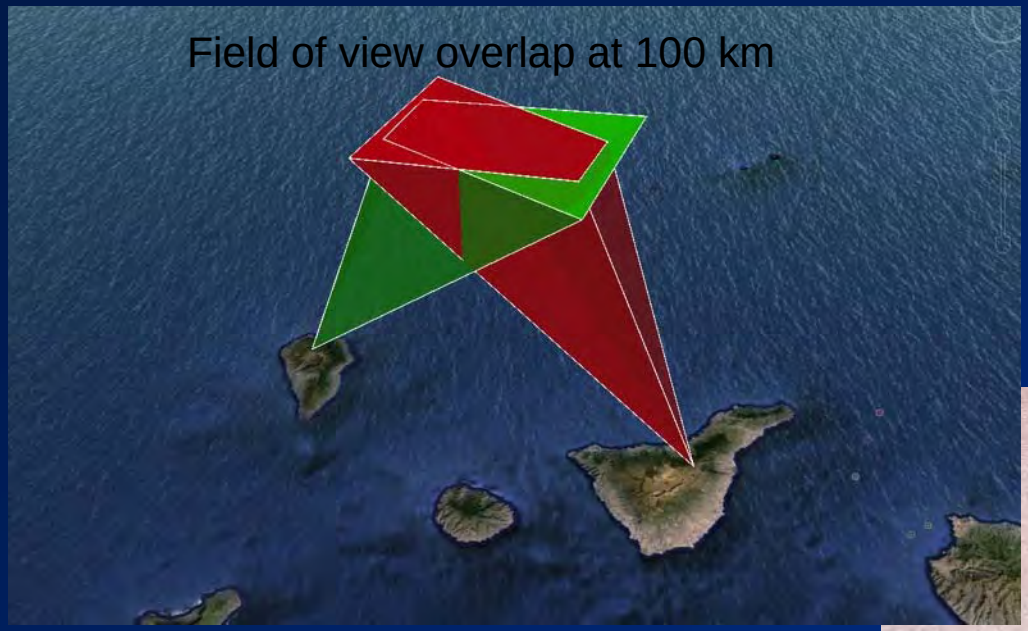
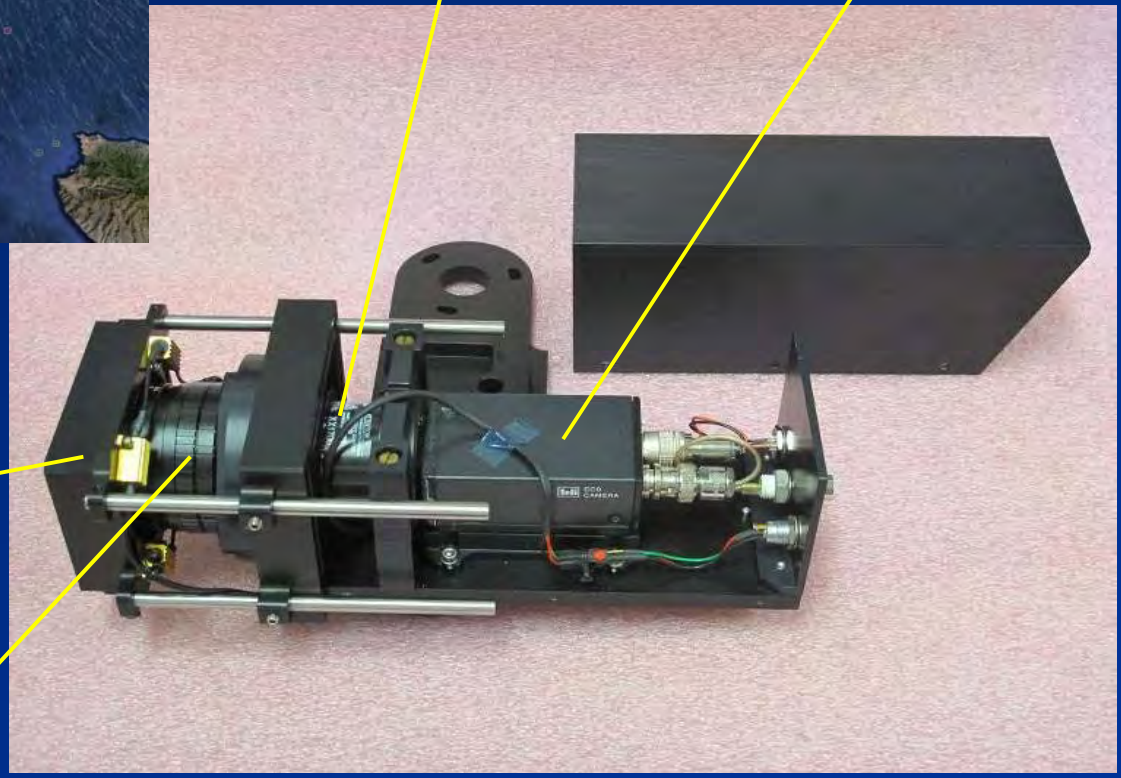
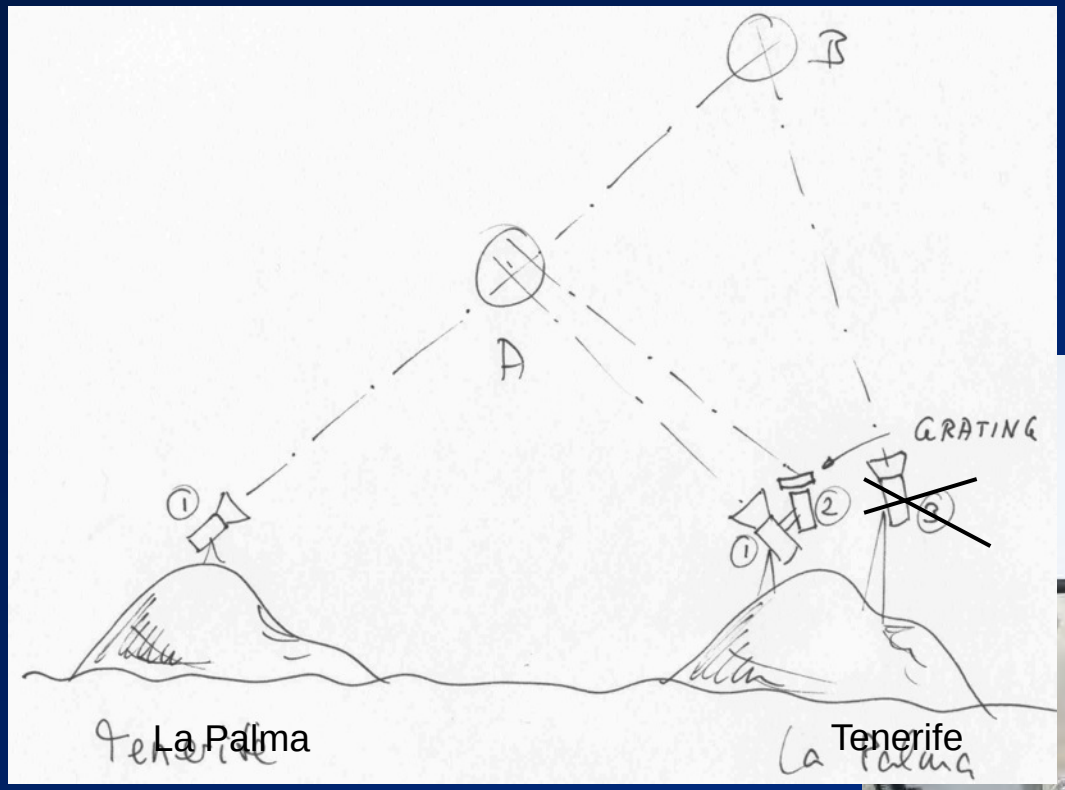


Image: Google Earth/Drolshagen/Ott
KML files created with FoV3D (Barentsen, http://www.rssd.esa.int/index.php?project=METEOR&page=fov3d



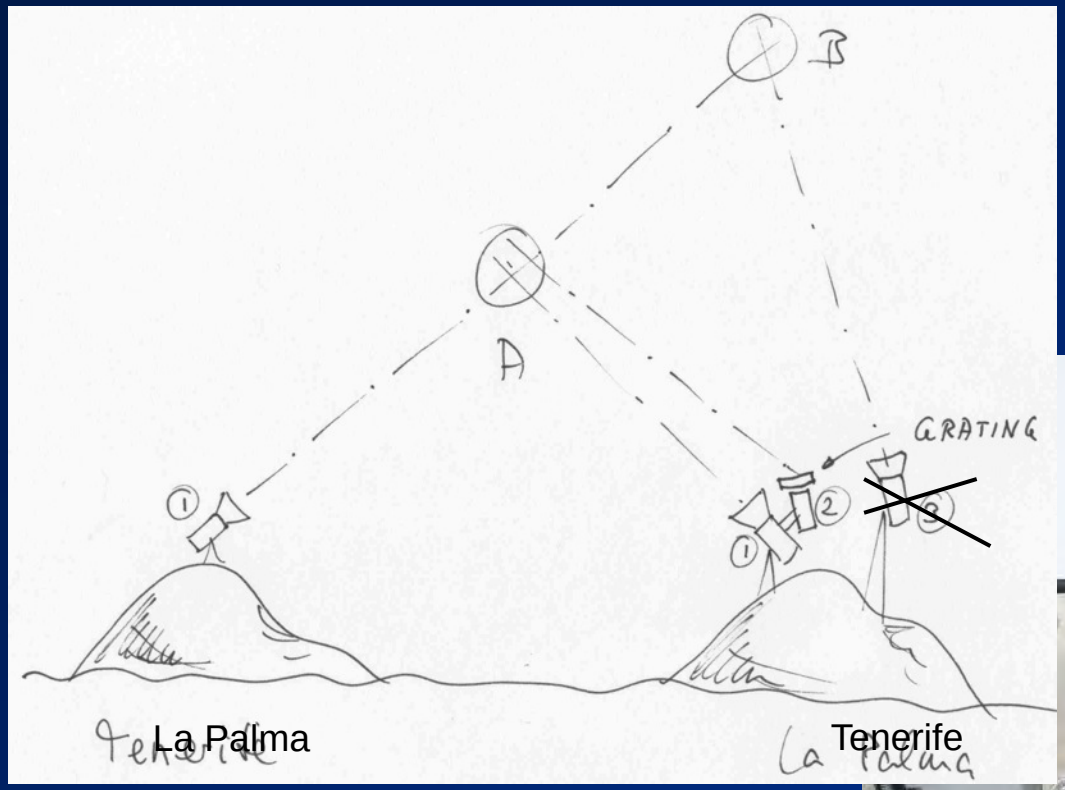
How do we do it?



First ideas: 2008!

First station ready: 2011!

How do we do it?



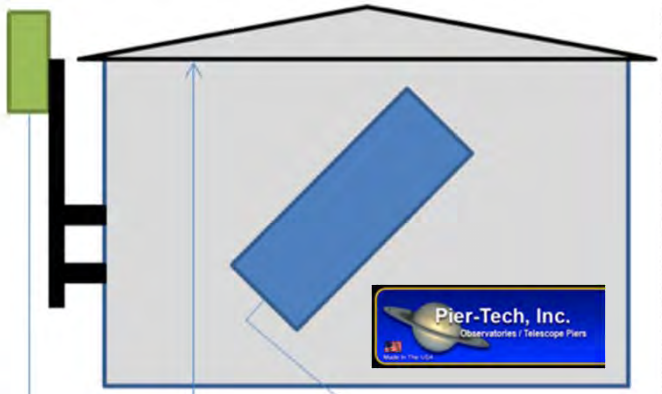
First ideas: 2008!

First station ready: 2011!

First science: 2014!

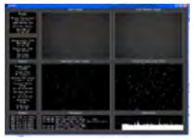
The setup

Boltwood



Weather sensor

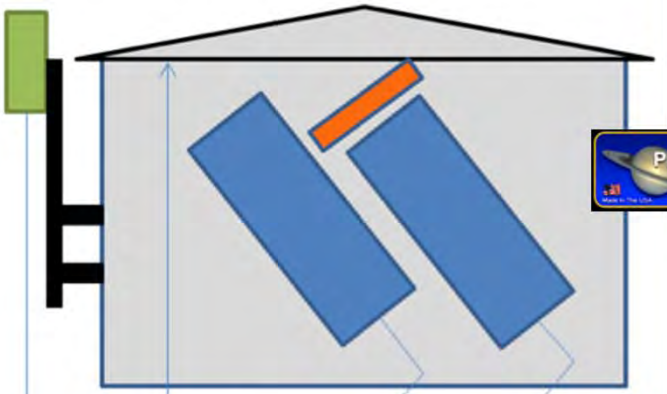
Dome control



MetRec

Archive s/w

MRG scheduler



Weather sensor

Dome control

MetRec

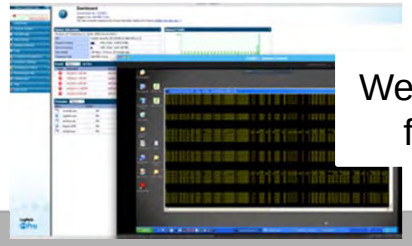
LPT:

SpcRec

Archive s/w

MRG scheduler

ftp server



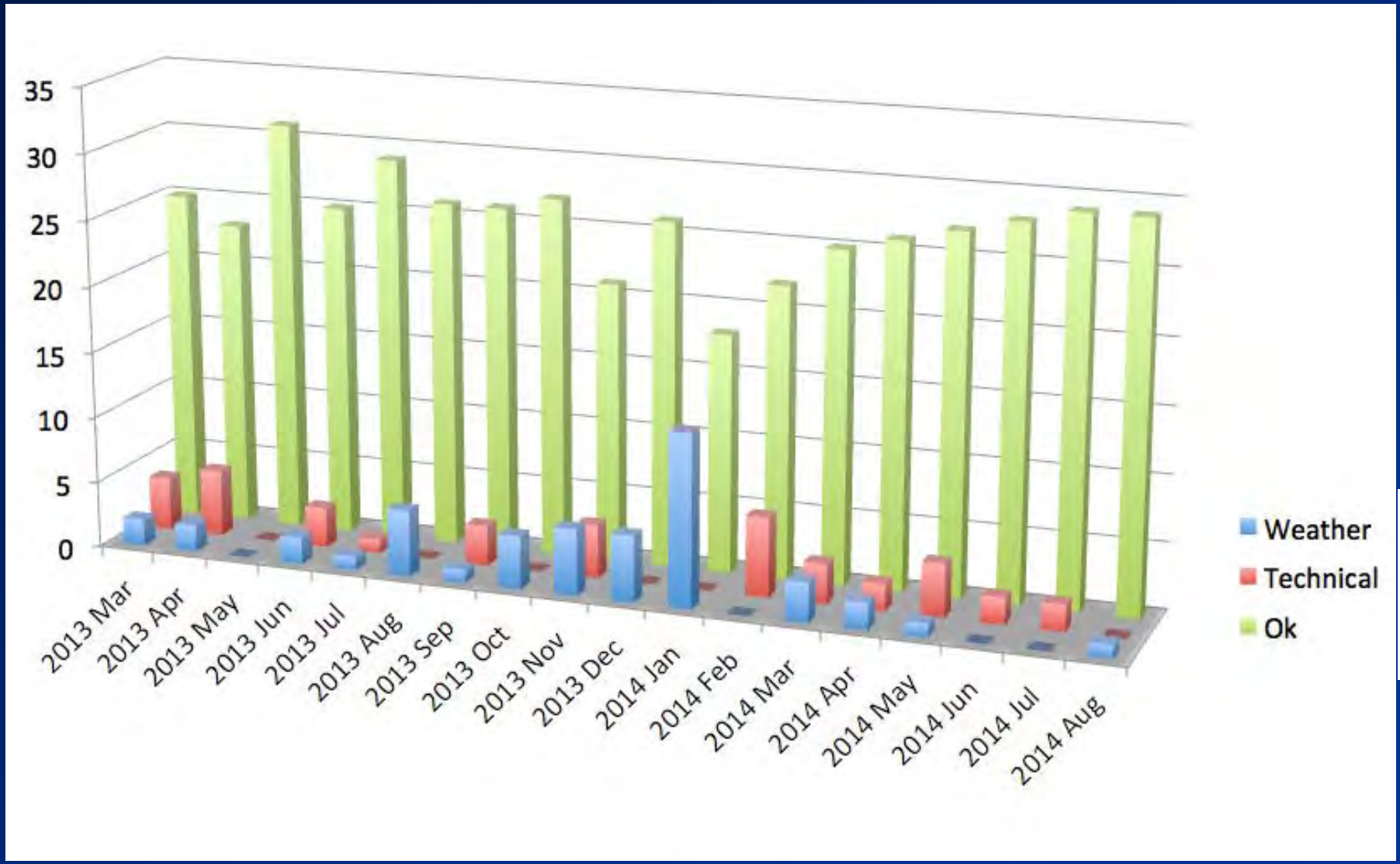
We use logmein.com for remote login

MRG = Meteor Research Group

Data flow

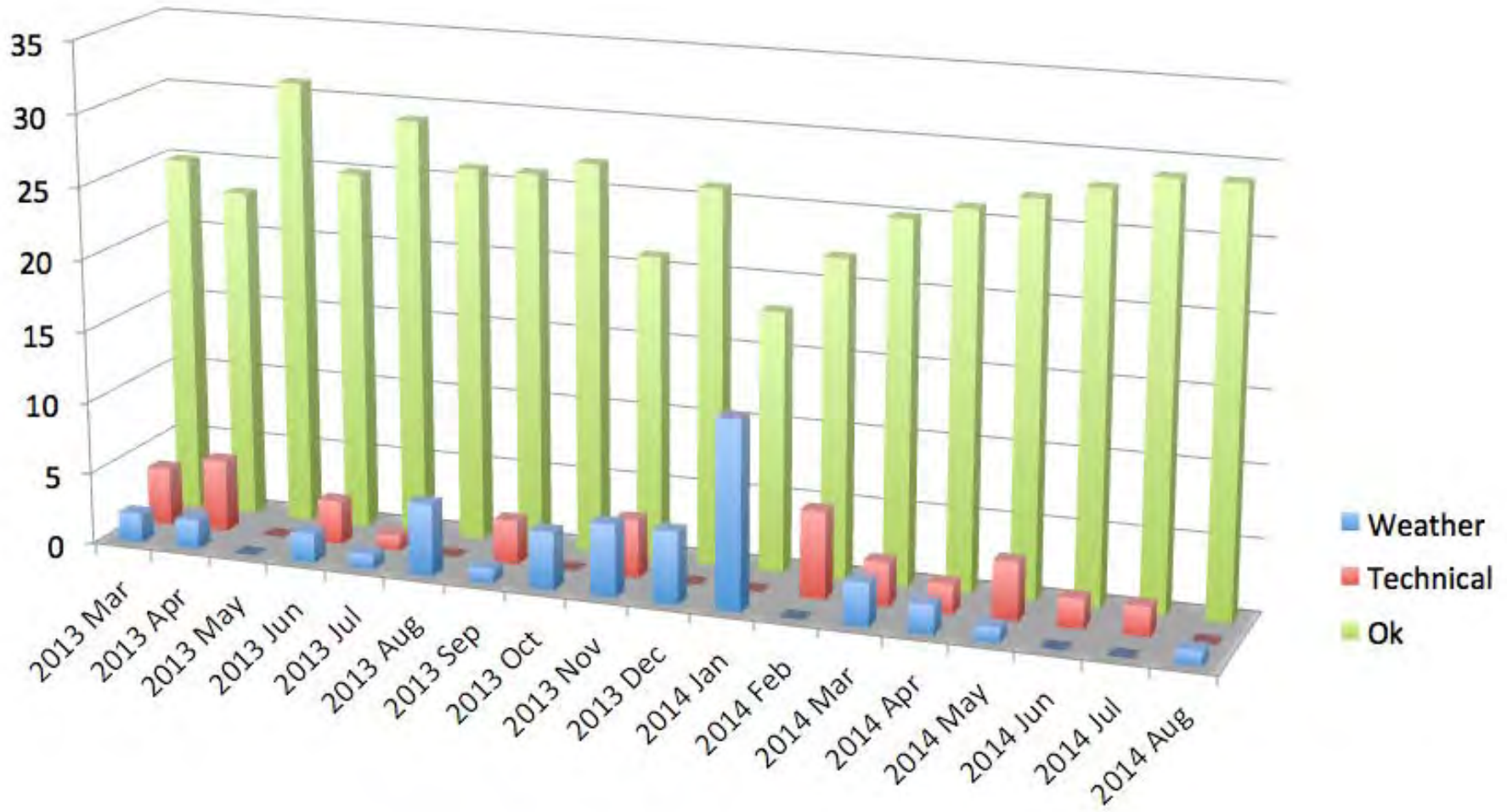
- Automatic compression and transfer at the end of the night to ESA/ESTEC ftp server
- Script to download/unpack to local machine
- Visual check of MetRec data at the end of the month, send to IMO video database team (Molau et al.)
- Trajectory/orbit computation: In Virtual Meteor Observatory (MOTS, Diaz del Rio + Koschny)
- Currently under development: Stand-alone version of trajectory (done) and orbit computation

Downtime ICC9



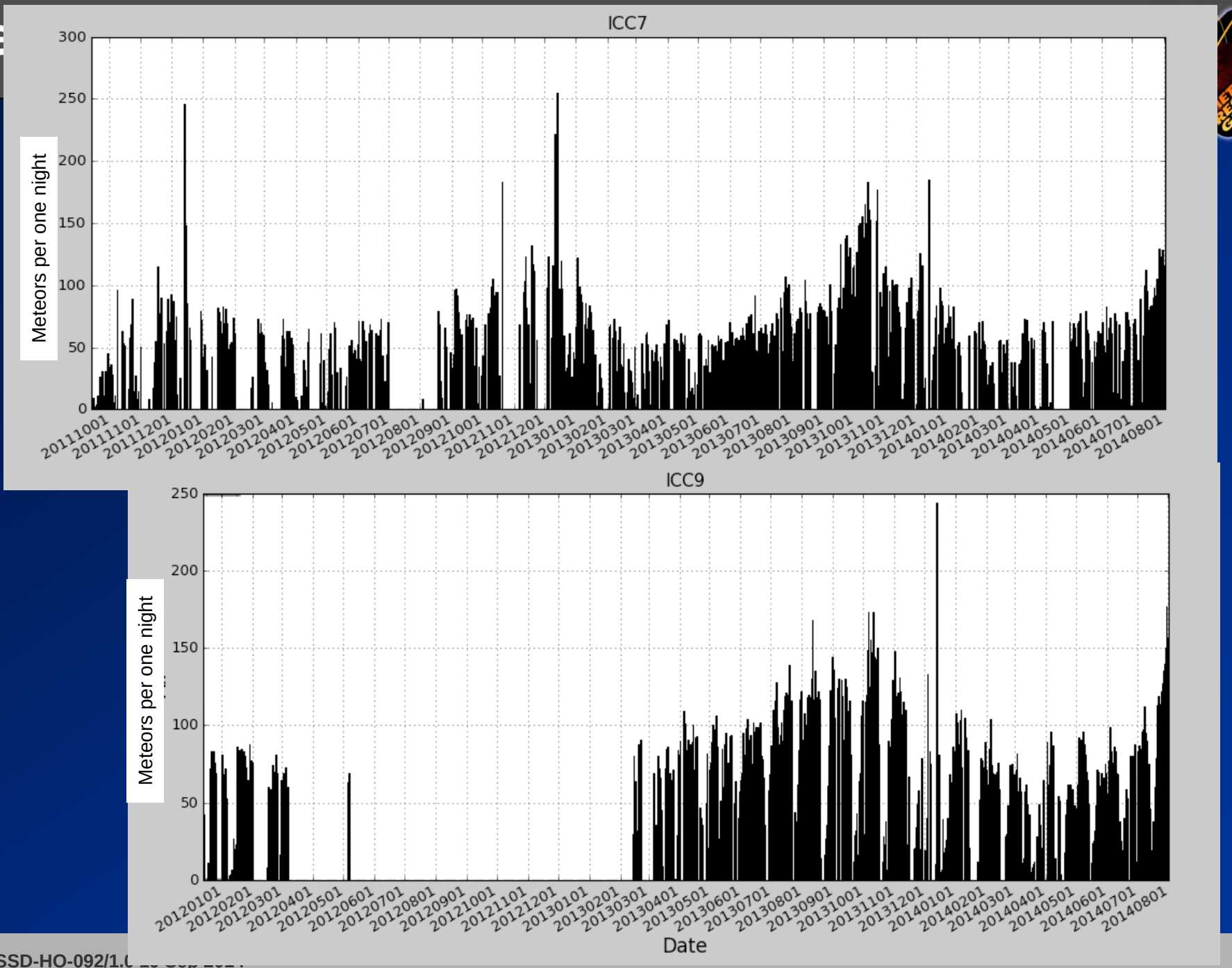
Weather	8.6 %
Technical	7.1 %
Ok	84.3 %

Downtime ICC9



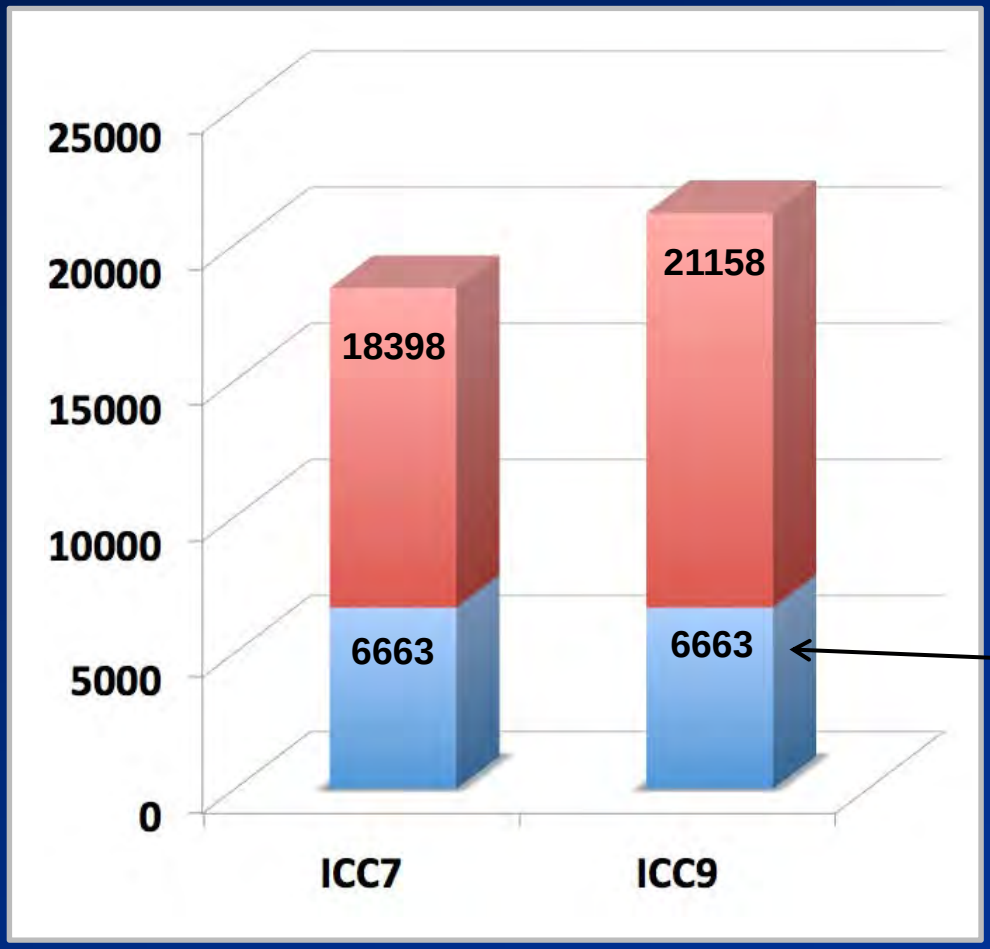
Weather	8.6 %
Technical	7.1 %
Ok	84.3 %

Complete system availability (ICC7 + ICC9) is 61.6 %


ICC7
Meteors per one night
0
50
100
150
200
250
300
20111001
20111101
20111201
20120101
20120201
20120301
20120401
20120501
20120601
20120701
20120801
20120901
20121001
20121101
20121201
20130101
20130201
20130301
20130401
20130501
20130601
20130701
20130801
20130901
20131001
20131101
20131201
20140101
20140201
20140301
20140401
20140501
20140601
20140701
20140801
ICC9
Meteors per one night
0
50
100
150
200
250
20120101
20120201
20120301
20120401
20120501
20120601
20120701
20120801
20120901
20121001
20121101
20121201
20130101
20130201
20130301
20130401
20130501
20130601
20130701
20130801
20130901
20131001
20131101
20131201
20140101
20140201
20140301
20140401
20140501
20140601
20140701
20140801
Date

Statistics
01 Jun 2013 – 31 May 2014(*)

- (*) This time frame was used in the analysis by Drolshagen and Ott



simultaneous

LESSONS LEARNED

Lessons learned

- Pier-Tech roof
  - Automation and electronics was upgraded by our technicians (e.g.: added a watchdog, add mechanical housing)
  - Works fine – but: Occasional shut-downs tracked to pressed emergency button
  - => Put fence around your station

Lessons learned

- Pier-Tech roof
  - Automation and electronics was upgraded by our technicians (e.g.: added a watchdog, add mechanical housing)
  - Works fine – but: Occasional shut-downs tracked to pressed emergency button
  - => Put fence around your station

Lessons learned

- Boltwood cloud sensor
  - Fine – but fell off once…
  - => Make sure all mechanical fixations can withstand wind, weather, UV radiation…

Lessons learned

- Our scheduling software
  - Fine – many issues discovered during 6 month of testing in Detlef's back yard!
  - Unexplained damage of ICC9 by Moon coming into field of view
  - => Test, test, test! If you think it's ok: Test some more. Don't forget the complete system test.

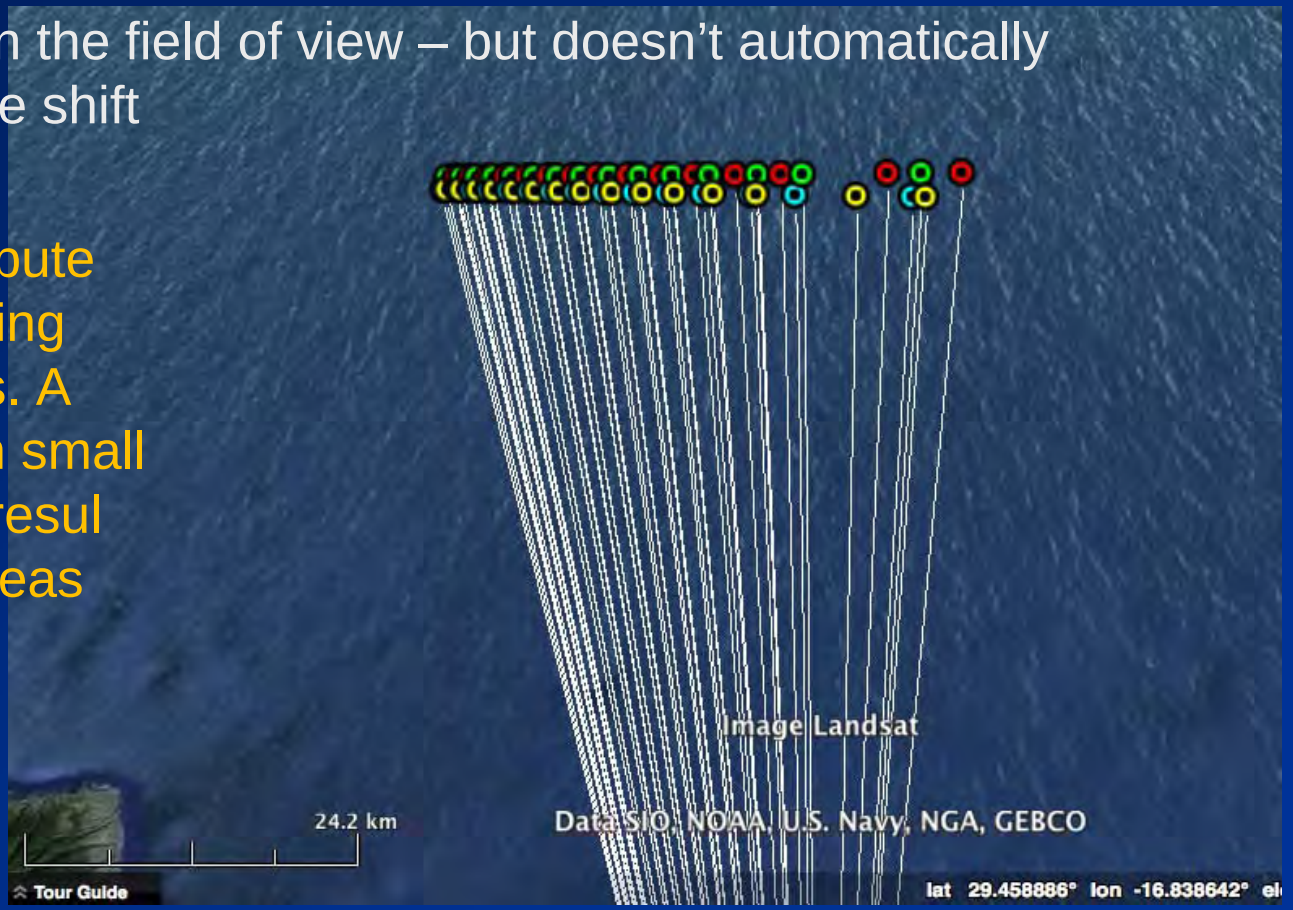
Lessons learned

- Time syncronisation
  - We use TimeMemo.exe
  - Works well – but sometimes wasn't running
  - => Check regularly whether your time syncronization works!
  - (corrected by interpolation)

- Time syncronisation
  - We use TimeMemo.exe
  - Works well – but sometimes wasn't running
  - => Check regularly whether your time syncronization works!
  - (corrected by interpolation)

Lessons learned

- Pointing direction changes
  - Happen (thermal changes?) – affect astrometric quality (shift visible in MetRec, i.e. >1 pixel) – not good for high-quality orbits
  - MetRec follows stars in the field of view – but doesn't automatically correct positions for the shift
  - Errors ~200 m
  - => MetRec could compute RA/Dec of meteors using detected star positions. A least for cameras with small field-of-views this will resul in a measureable increas in accuracy.

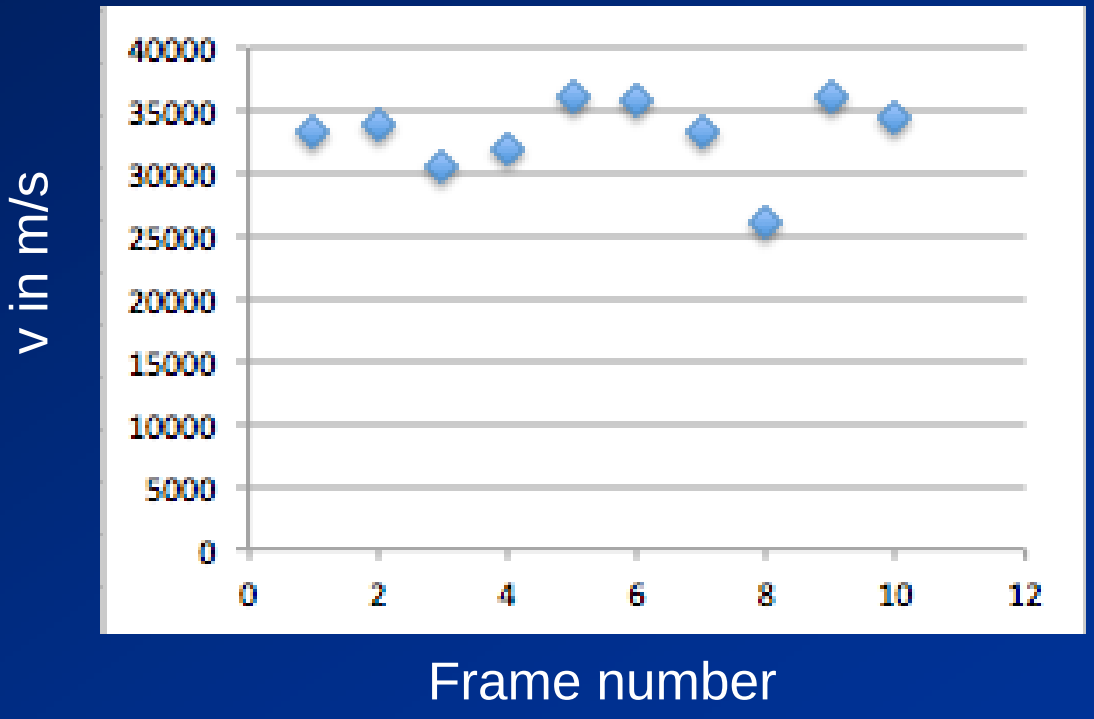


Lessons learned

- Timeliness of data checking
  - Time syncronisation stopped for whatever reason
  - We only found out 6 weeks afterwards
  - => Data should be checked in a timely manner
    - Weather ok?
    - Meteor data available?
    - All files there as expected?
    - Time synchronization working?
    - More????

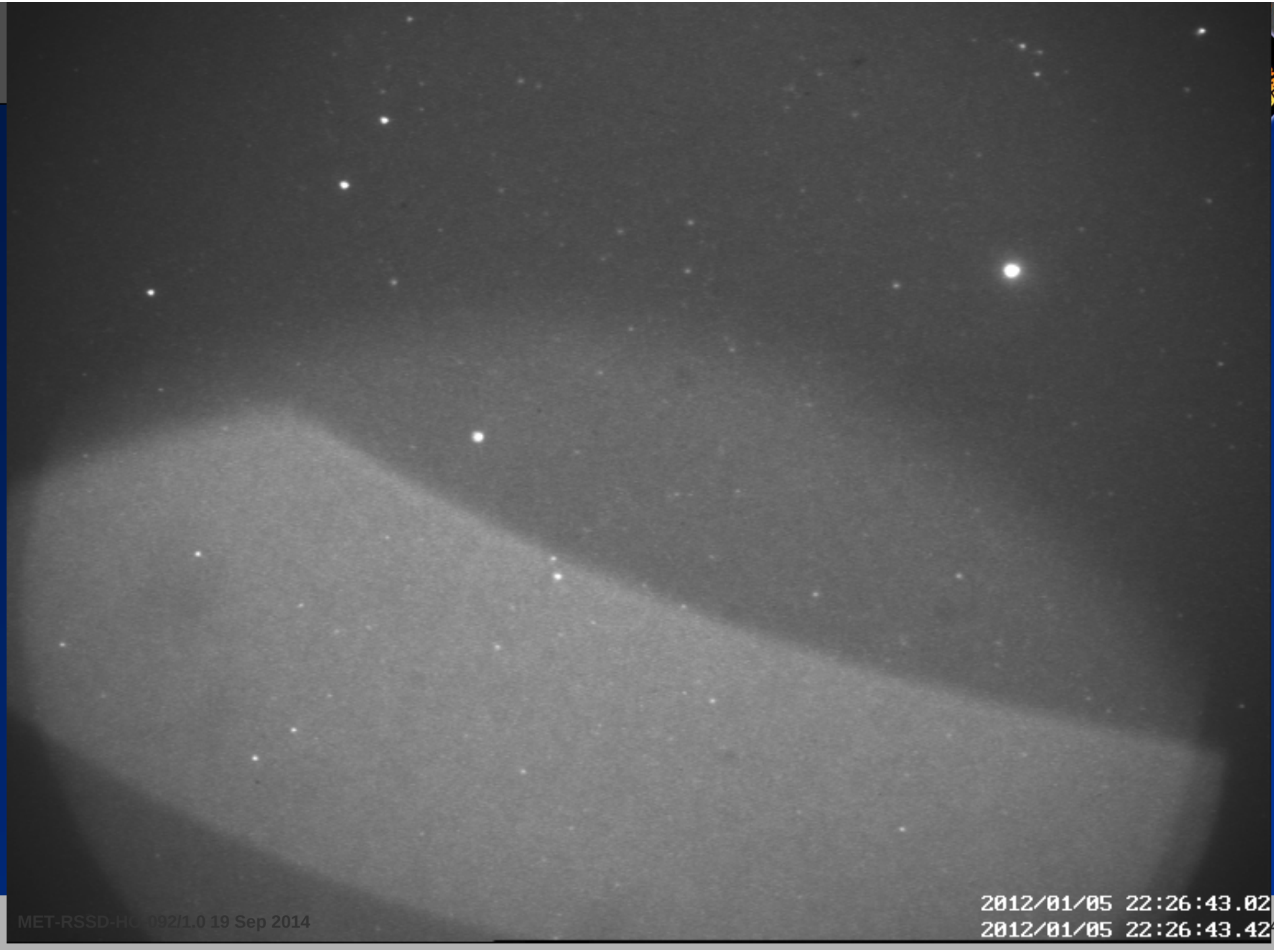
Lessons learned

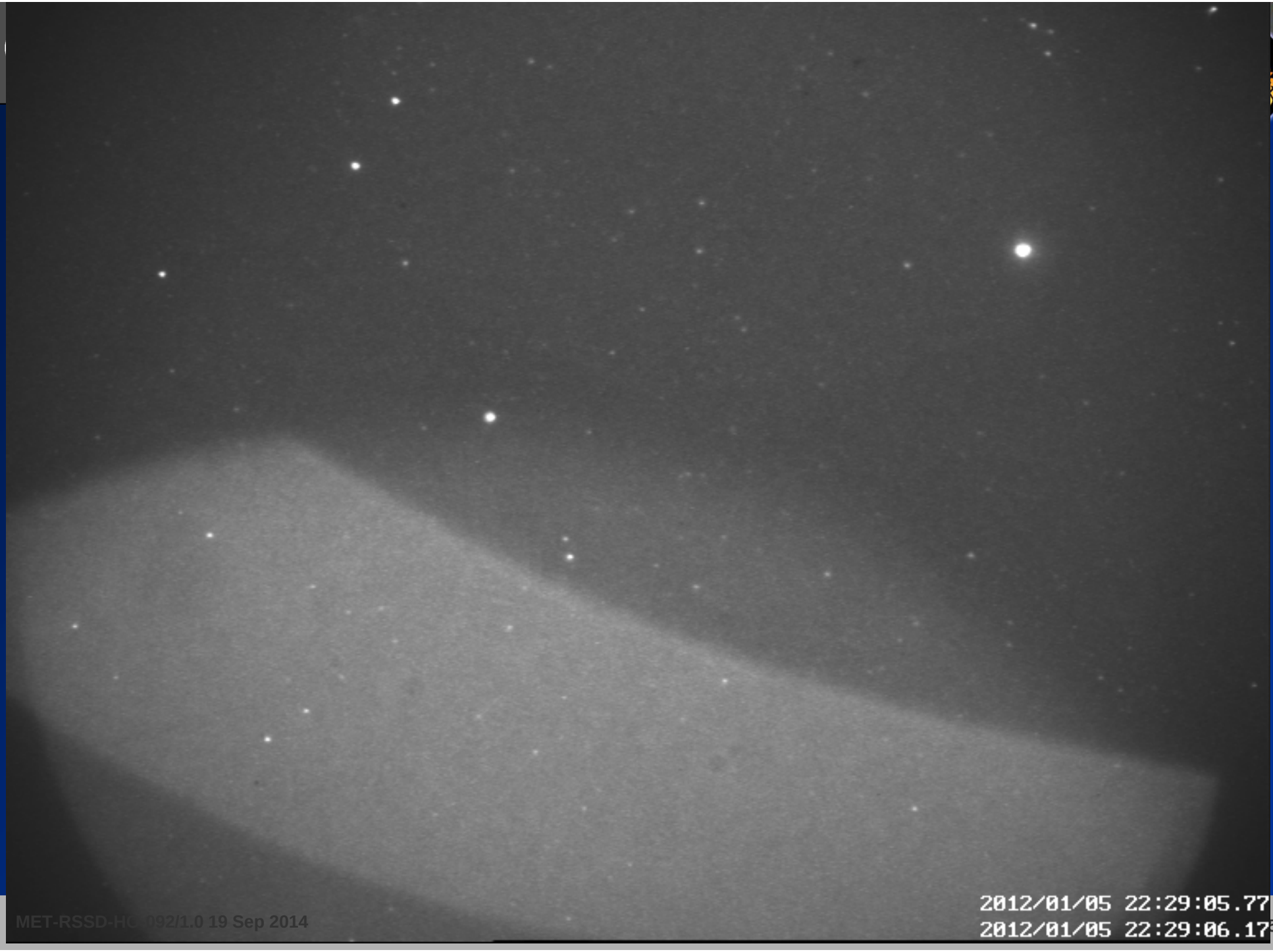
- Velocity has large errors
  - MetRec uses photometric centroid
  - Changes as meteors leave trails
  - => Improve astrometry by using ‘front end’ of meteor

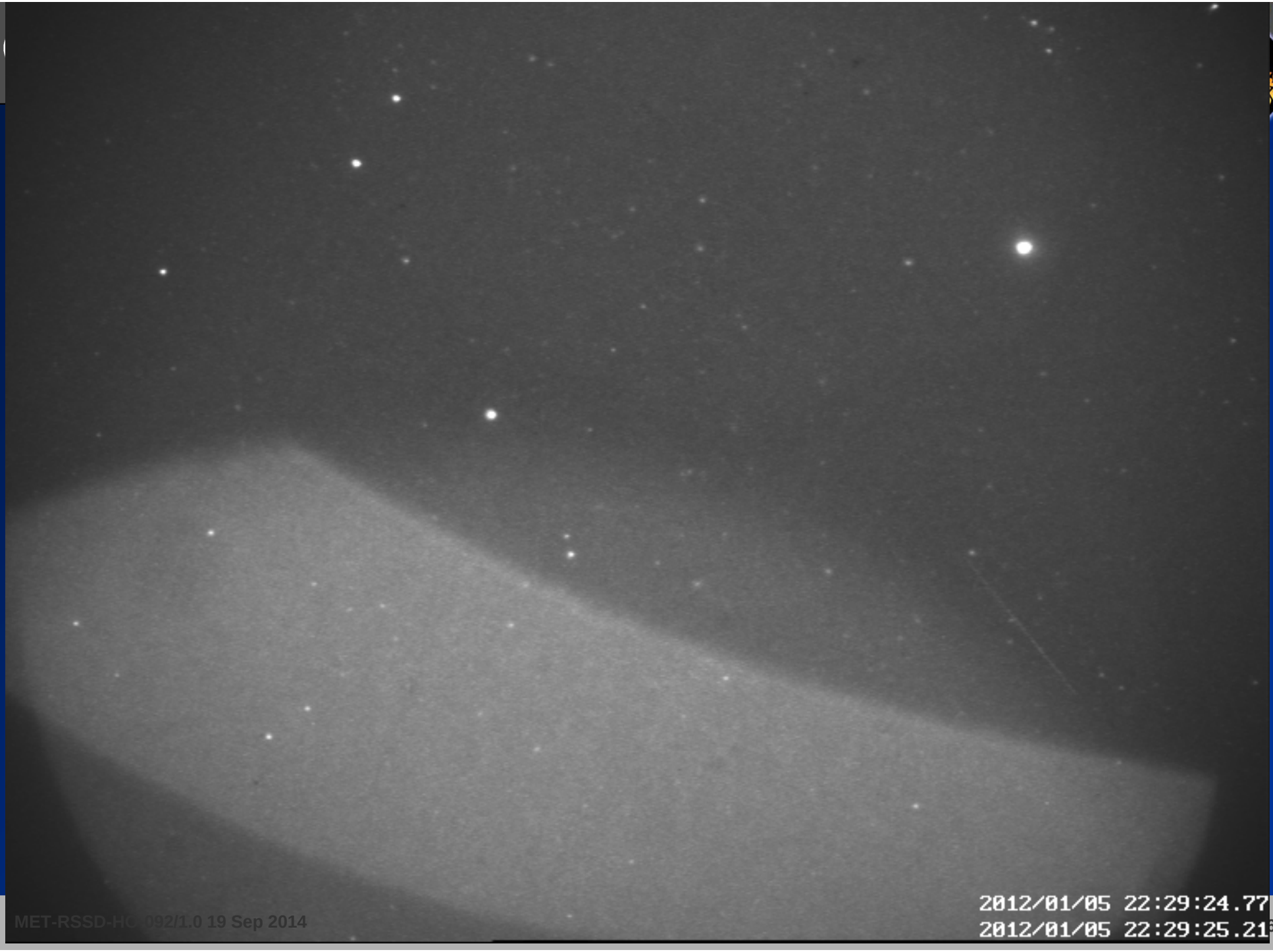


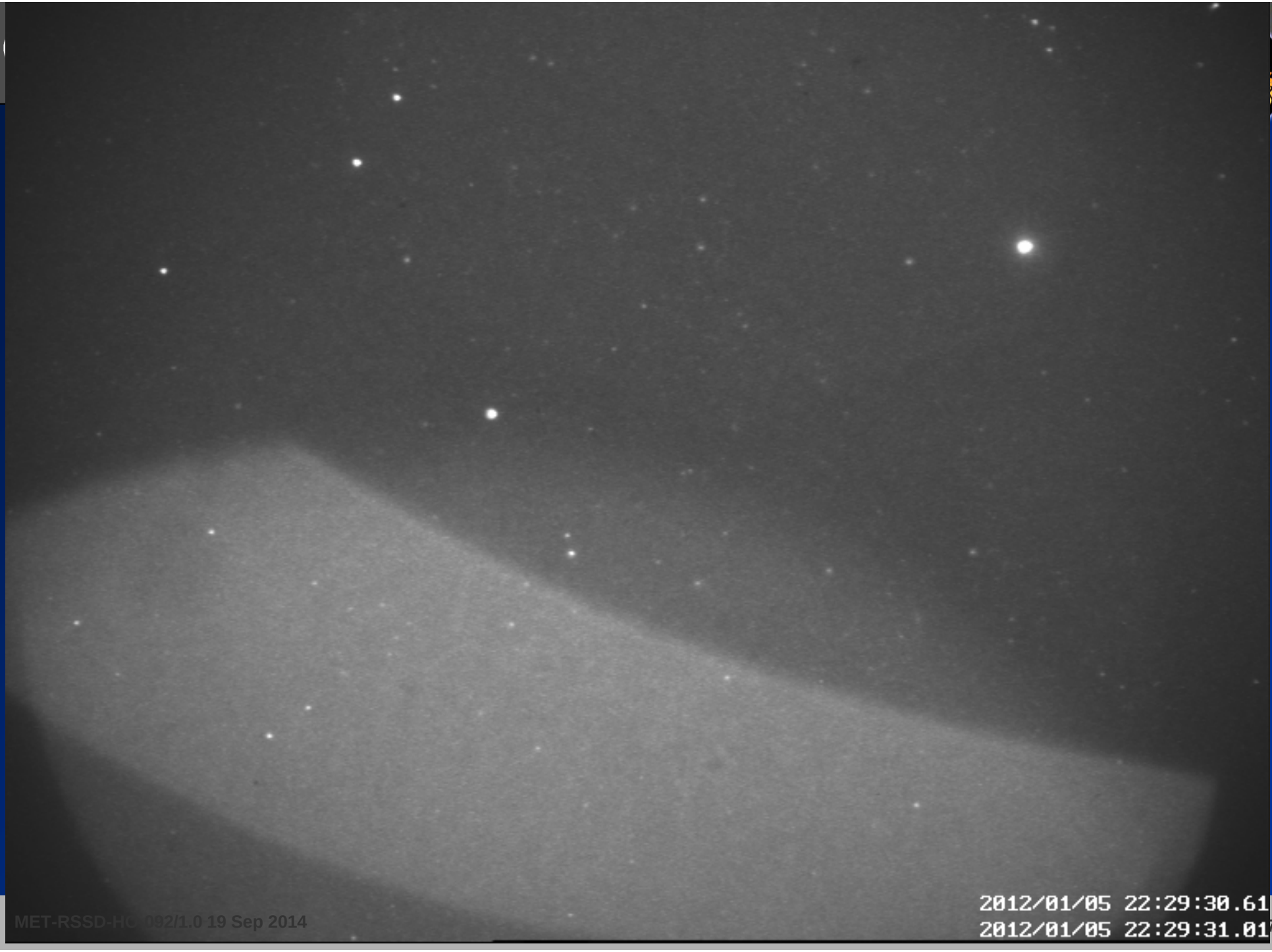
Lessons learned

- The Moon
  - Is bad
  - Paint the Moon black.
  - Use as target for an asteroid deflection mission demonstration.


2012/01/05 22:26:43.02
2012/01/05 22:26:43.42


2012/01/05 22:29:05.77
2012/01/05 22:29:06.17

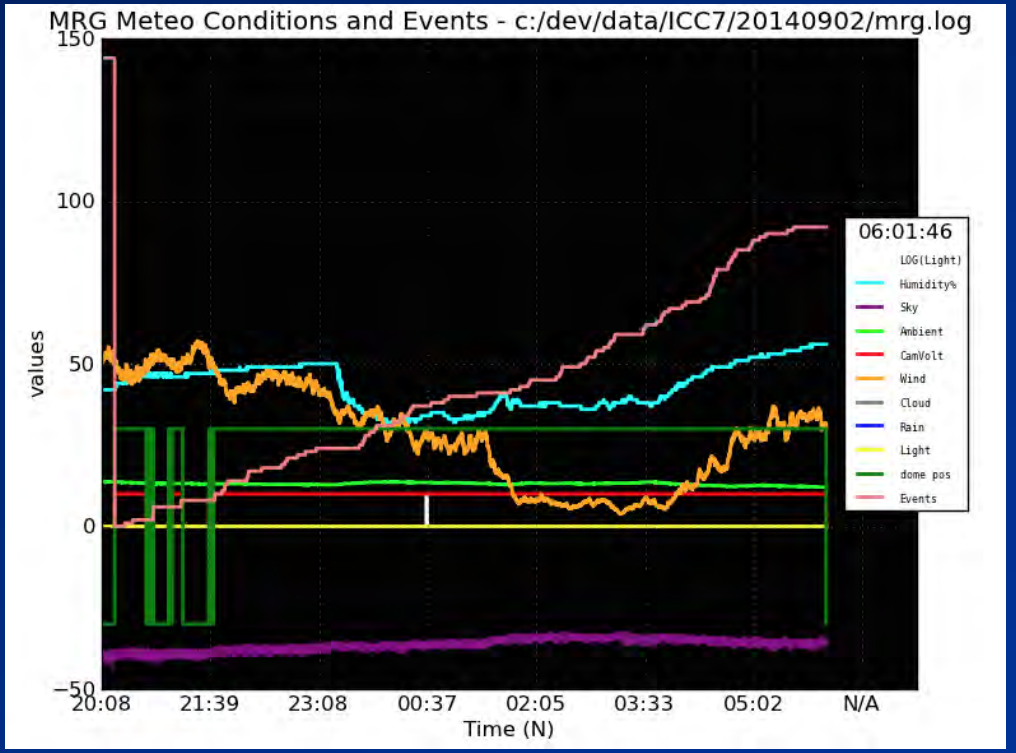

2012/01/05 22:29:24.77
2012/01/05 22:29:25.21


2012/01/05 22:29:30.61
2012/01/05 22:29:31.01


2012/01/05 22:35:04.09
2012/01/05 22:35:05.12

Lessons learned

- Log files are important!
  - We write log files for a lot of stuff
  - Good!
  - Plot information graphically
  - => Produce log files for everything you can think of.



Conclusions

- CILBO works
- An automated setup needs good preparation – lessons learned were given in this talk
- Science: See presentations by E. Drolshagen and T. Ott

- Extra slides

Statistics

	ICC7	ICC9	Simultaneous
Total number of meteors until 31 Jul 2014	42232	33403	7955
01 Jun 2013 – 31 May 2014 (*)	18398	21158	6663

When both cameras were on simultaneously	ICC7	ICC9	Simultaneous
Total number of meteors until 31 Jul 2014	18807	23547	7955
01 Jun 2013 – 31 May 2014 (*)	12491	15913	6663

- (*) This time frame was used in the analysis by Drolshagen and Ott