DARK FLIGHT CALCULATIONS
How accurate can they be?

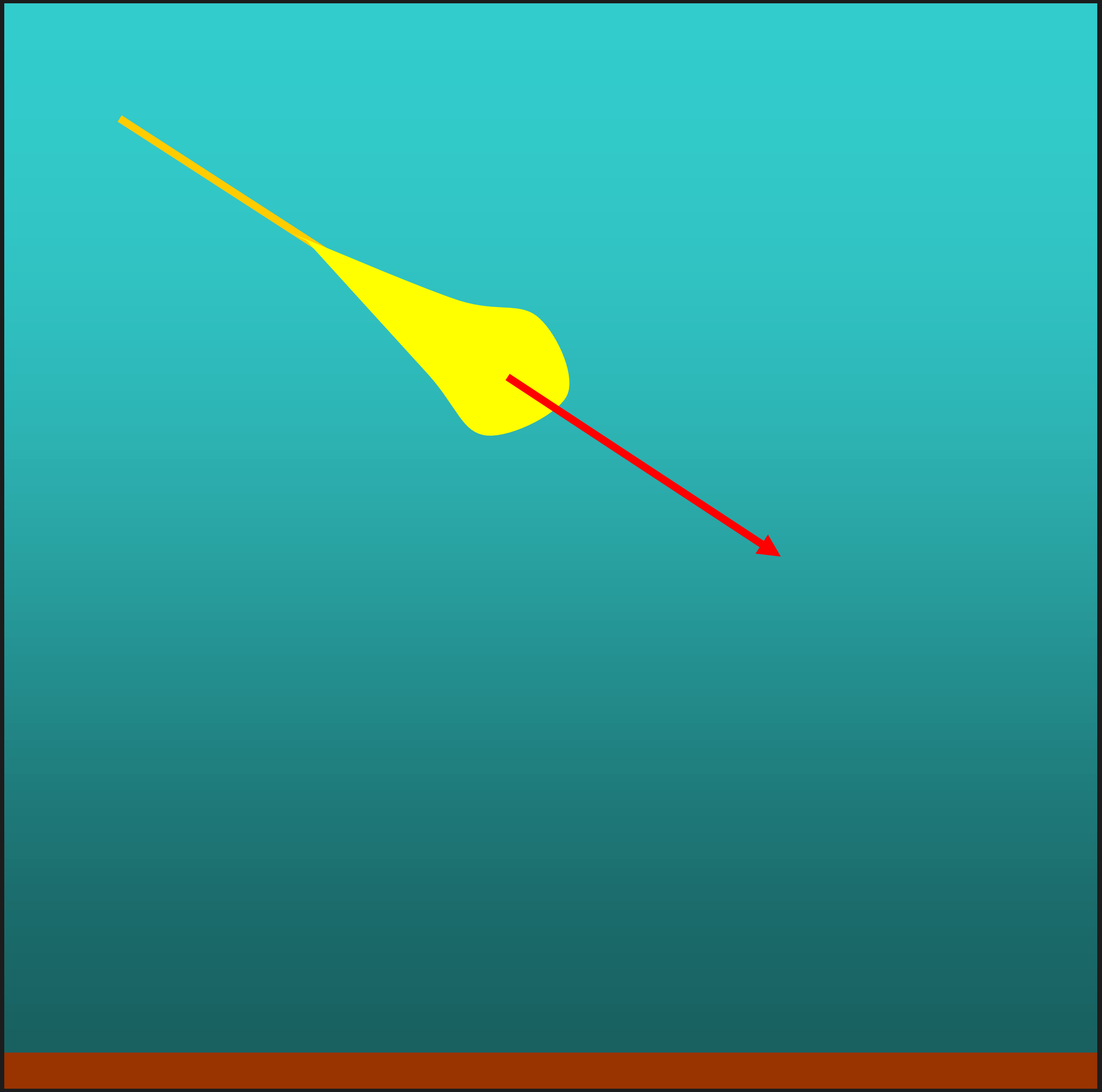
Željko Andreić

Faculty of Mining, Geology and Petroleeum Engineering,
University of Zagreb, Croatia

Croatian Meteor Network - Višnjan Science and Education Center
zandreic@rgn.hr   http://www.astro.hr/hmm/index.html

Contents

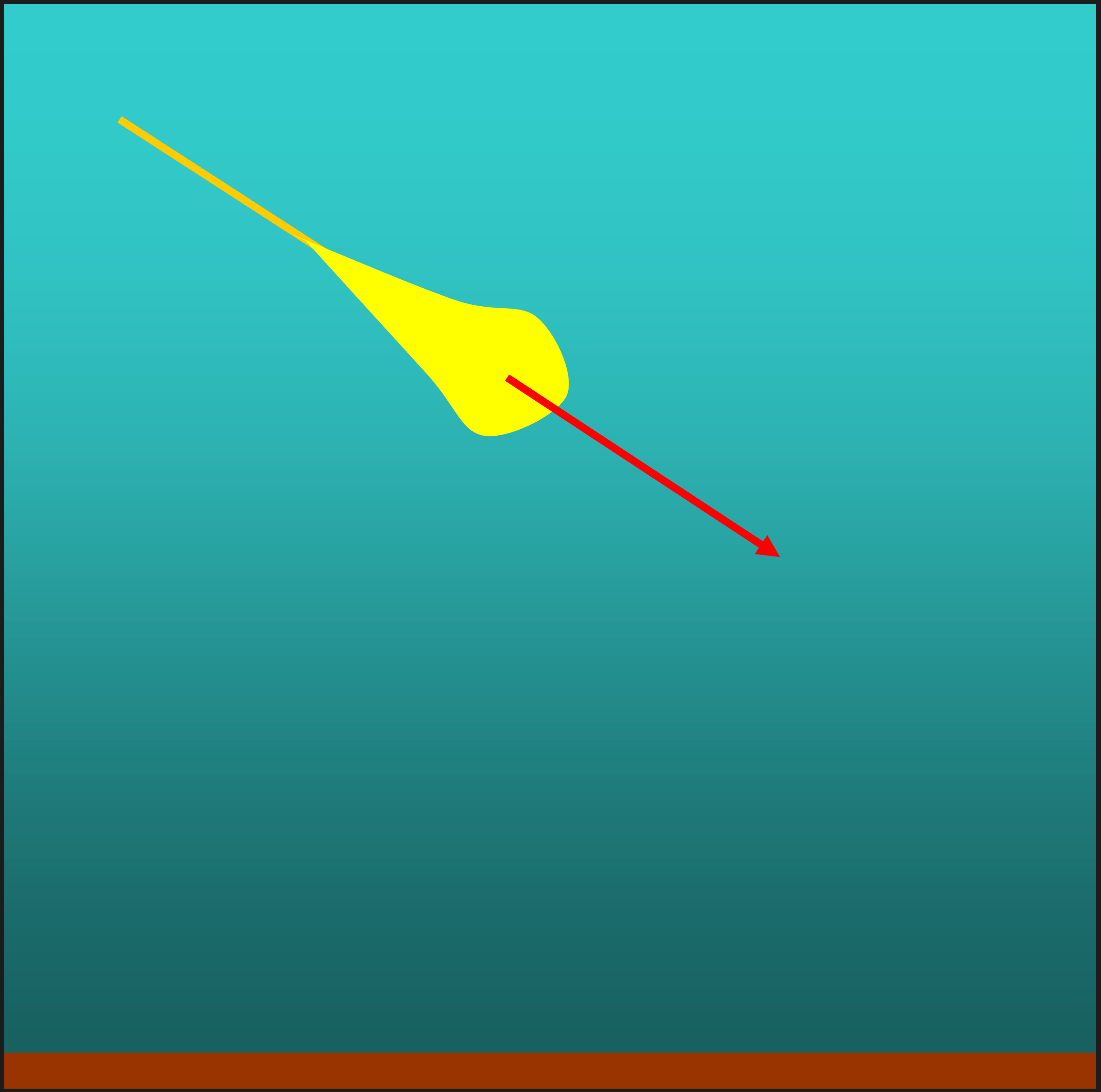
Introduction: a bright meteor is recorded!



Camera network provides data about a point near the trail end:

1. position
2. velocity
3. deceleration

Introduction: a bright meteor is recorded!



Physics provides equations of motion (so called drag equations).

we need to know:

1. size, shape and surface roughness of the body to get the corresponding drag coefficient

2. air density profile

3. wind profile

Input parameters all have measurement errors!

CMN, a good triangulation (3 or more stations):

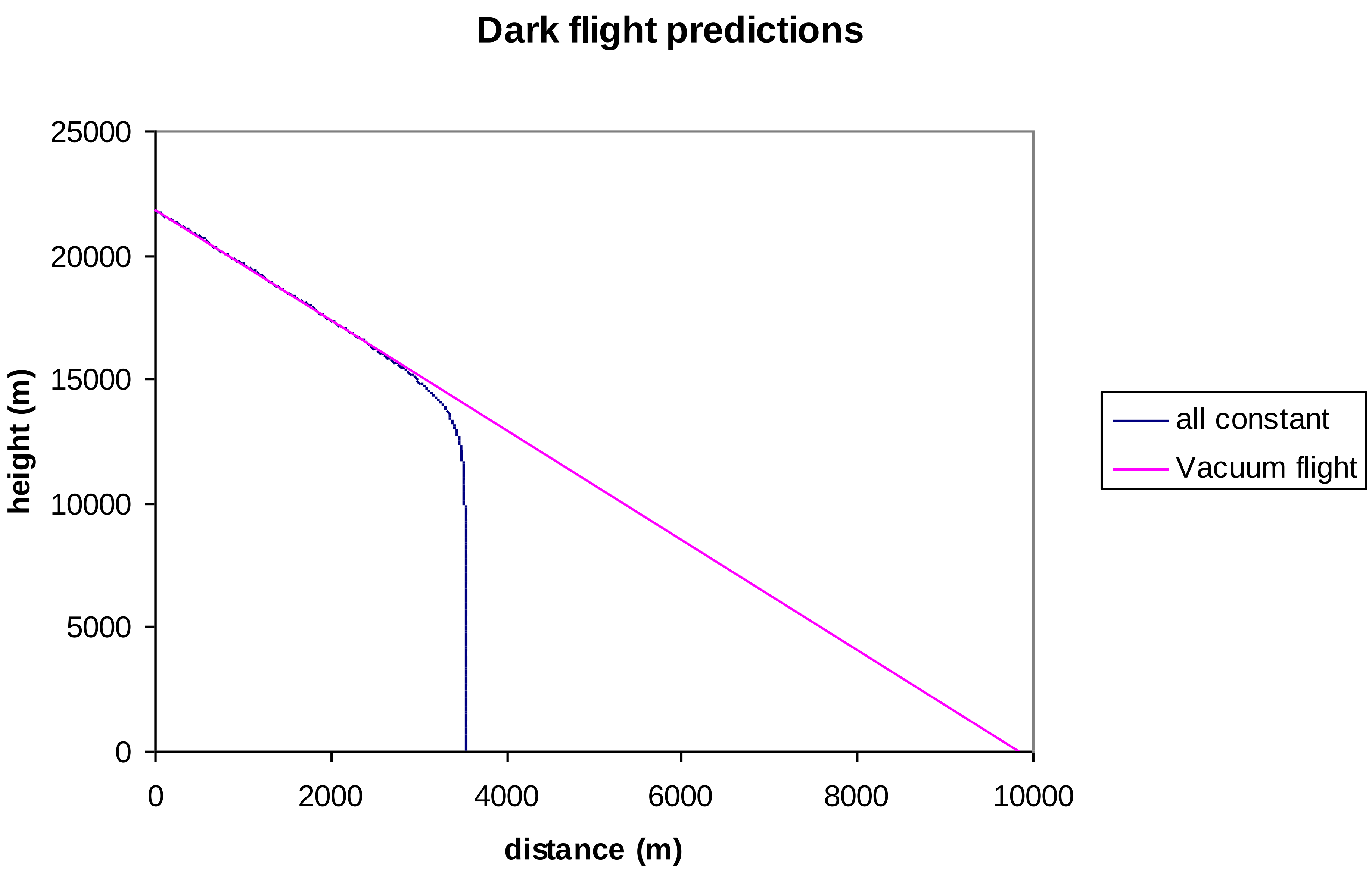
position:	+- 100 m
speed:	+- 500 m/s
deceleration:	+- 50%
direction:	+- 0.5º
enterance angle:	+- 0.5º

Example: a simulated fall of a bright bollide

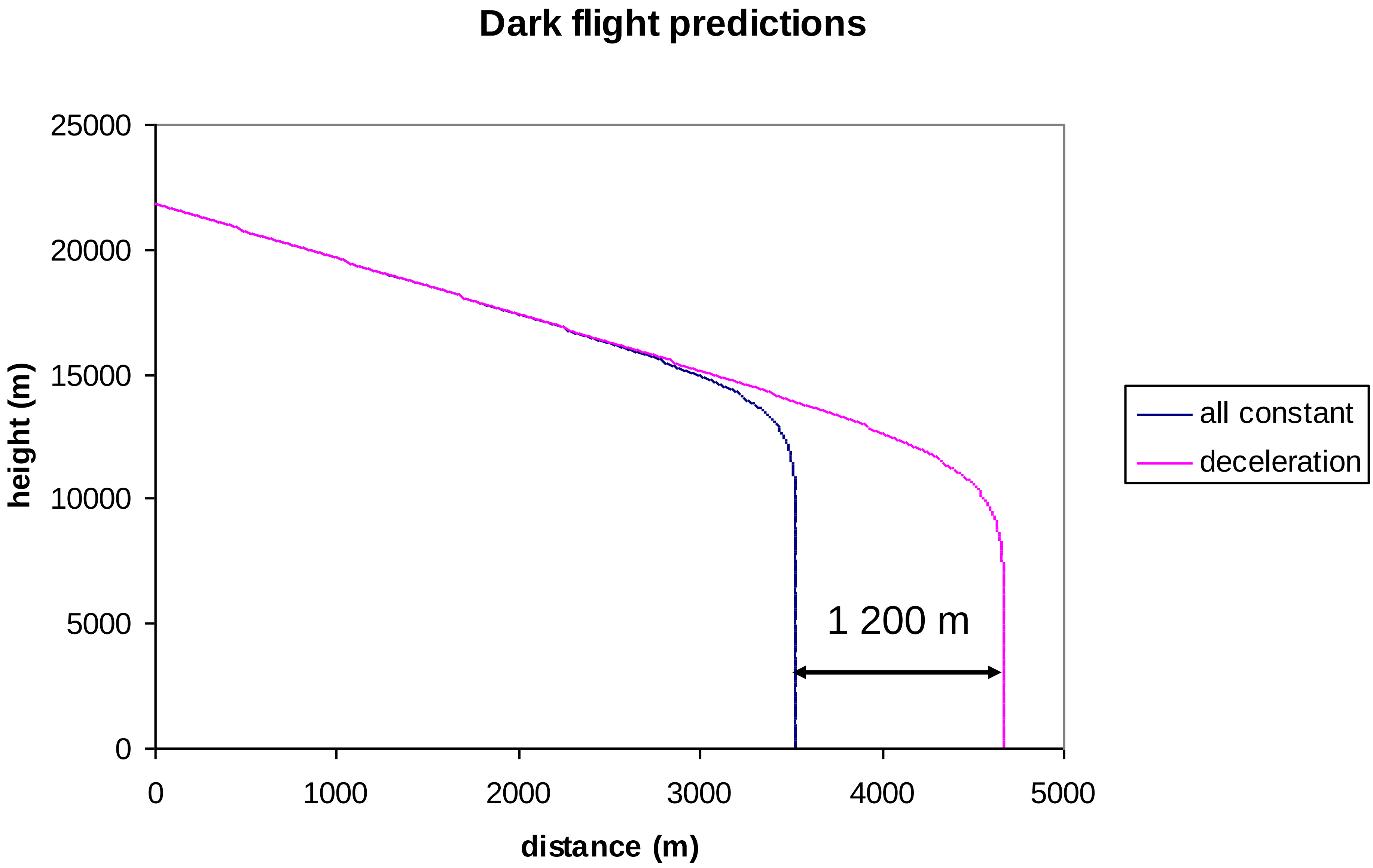
Initial point:

height: 22 000 m
velocity: 5 000 m/s
deceleration: 5 000 m/s^2
enterance angle: 67^o

Ideal fall (no wind, everything known)



Deceleration uncertainity



Everything together:

input uncertainty		shift on ground
position:	+- 100 m	+- 100 m
velocity:	+- 500 m/s	+- 500 m
deceleration:	+- 50%	+- 800 m
direction:	+- 0.5°	+- 300 m
impact angle:	+- 0.5°	+- 100 m

deceleration is the biggest problem!

combined, expected error is about 2 000 m

Drag coefficient:

- Shape, surface and velocity dependent!
- shape unknown, we assume a very rough sphere!

high velocities:

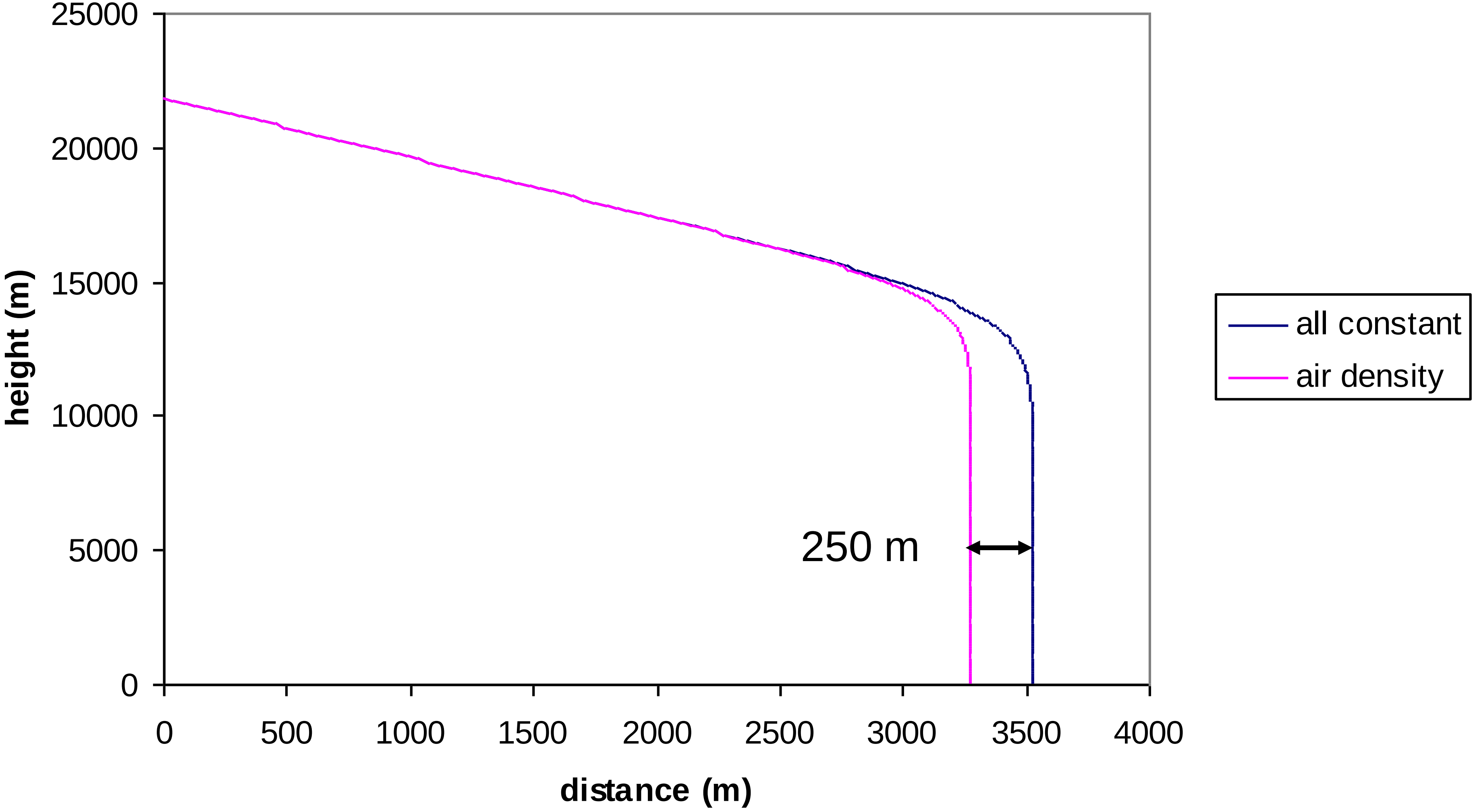
smooth sphere:	0.8
rough sphere:	~1.6
very rough sphere:	~1.2

smooth elipsoid:	~1.0
hemisphere:	~1.6
flat disk:	~5

Expected errors are about 300 - 500 m

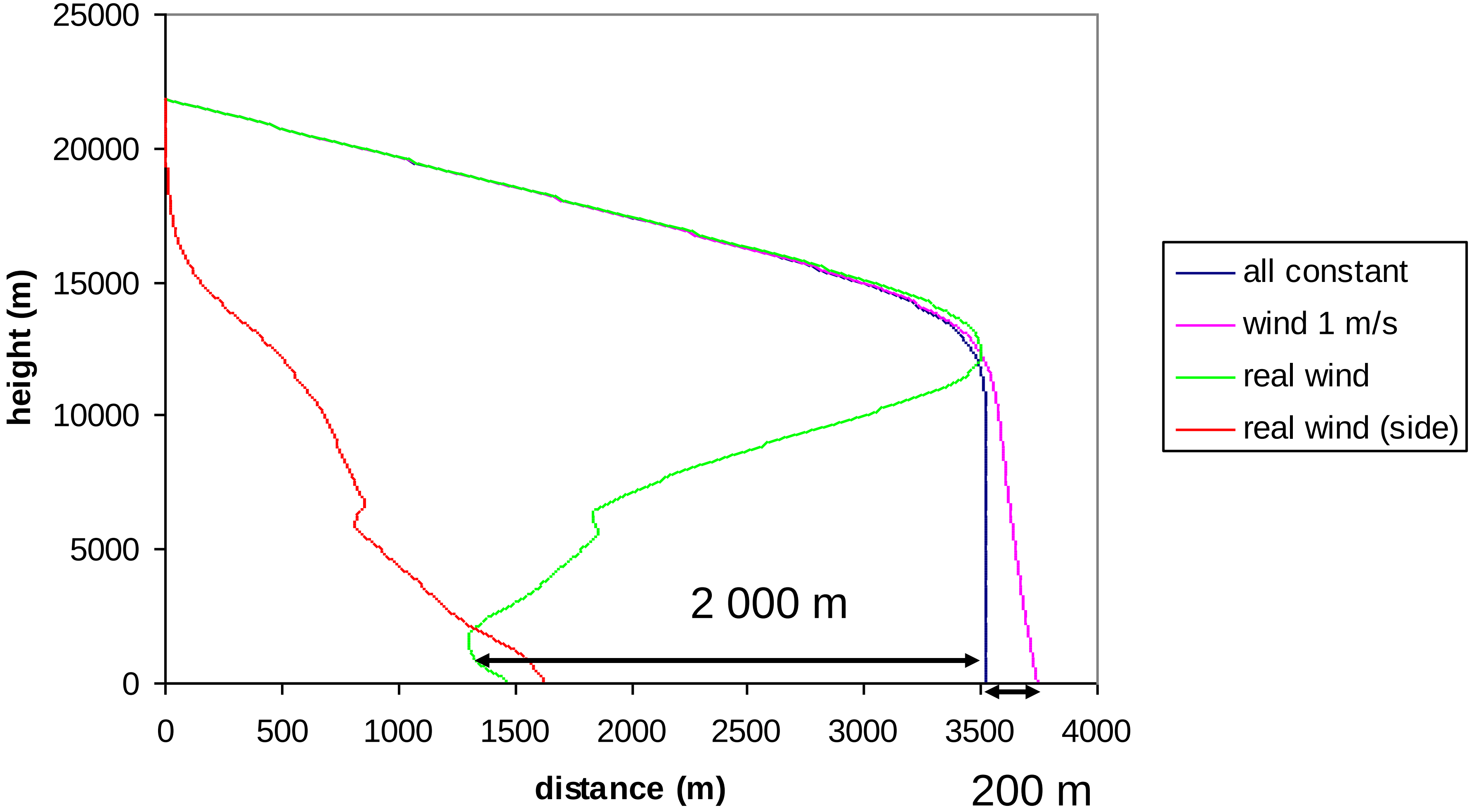
Atmospheric density:

Data from meteorology or from meterological models (the standard atmosphere).

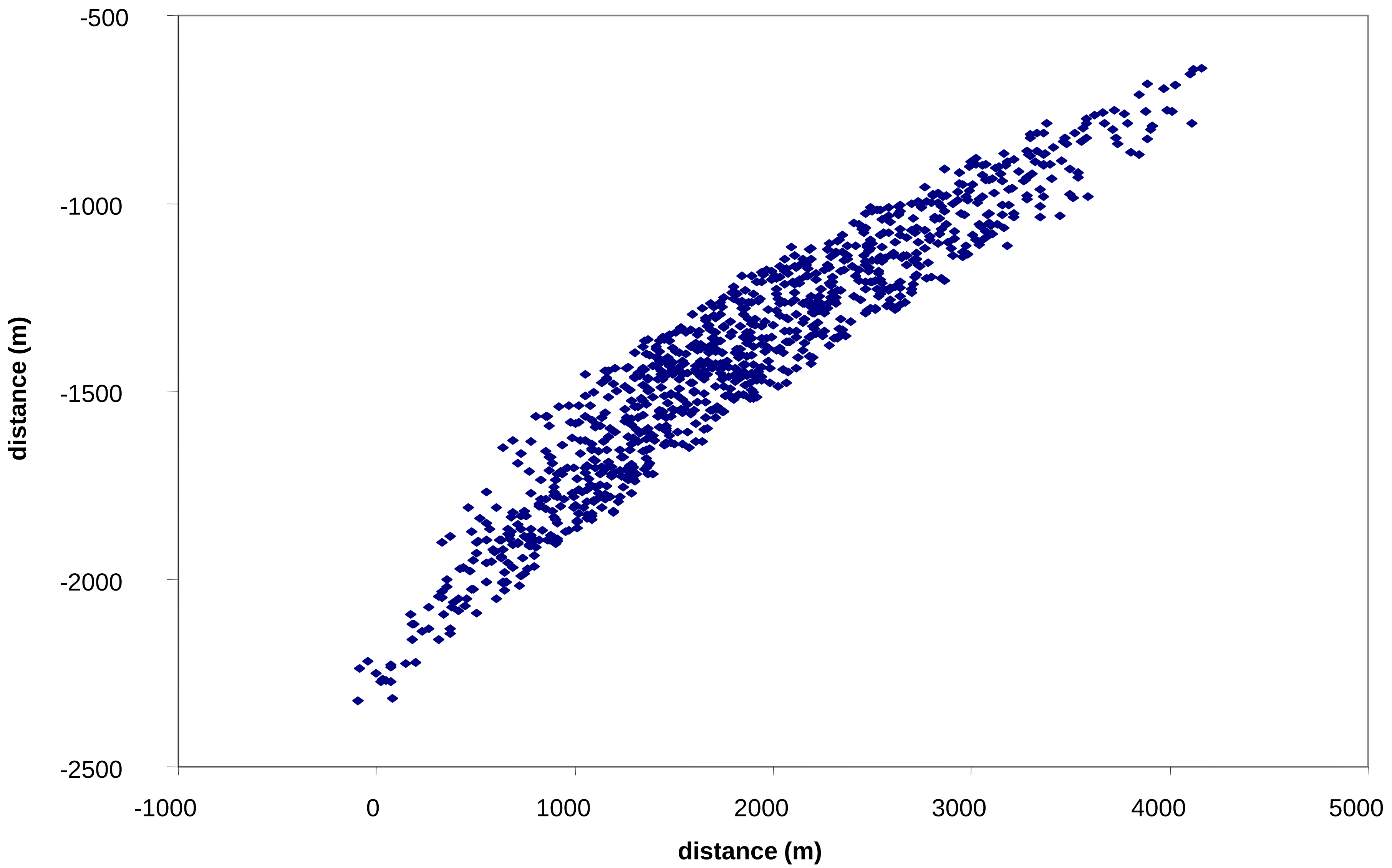


Wind speed and direction:

Data from meteorology (atmospheric soundings)



All uncertainties together, 1000 virtual meteorites:



What else:

- we still do not know how to determine/model:

- body rotation
- disintegration
- non-constant winds (bura for example)

A real strewn field:

Gold basin (USA) strewn field of a large meteorite is 4x11 km in size. Thousands of small meteorites were found in it.

But, carefull: this was a very big meteoroid!

184 Field Guide to Meteors and Meteorites

Figure 10.1. Gold Basin strewn field, the best documented strewn field on Earth. Thousands of L4 meteorites have been found following the discovery of two meteorites by Jim Kriegh in 1995. Each black dot on this map represents a single or a cluster of meteorites. The strewn field ellipse shown here will likely change shape and size as discoveries are made in the surrounding difficult, irregular, and steep terrain. The direction of the incoming meteoroid remains unknown. Typically, larger meteorites are found at the far end of a strewn field. No such size distribution has been found at Gold Basin. Data courtesy of Jim Kriegh.

Acknowledgements to:

All CMN members for their devoted work and persistence.

Dr. Dunja Plačko-Vršnak of the Meteorological and Hydrological Service of the Republic of Croatia.

Ministry of Science, Education and Sports of the Republic of Croatia.

Višnjan Science and Education Center, Croatia.

Thank you for your attention. Questions?