



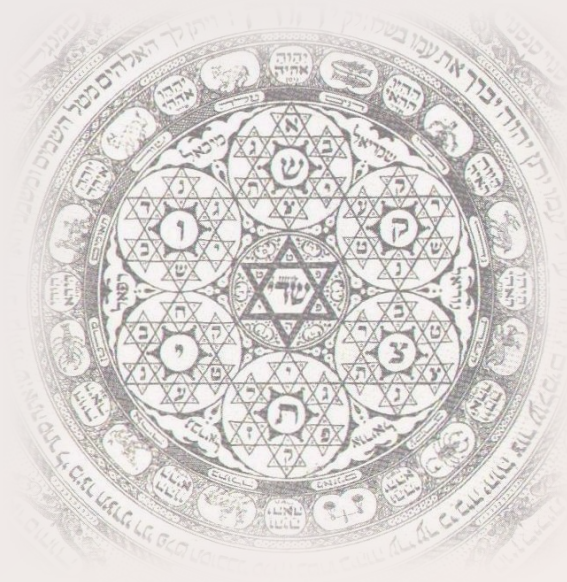
The Reasonable Effectiveness of Data in ATM

Massimiliano Zanin



Importance of Data in Science

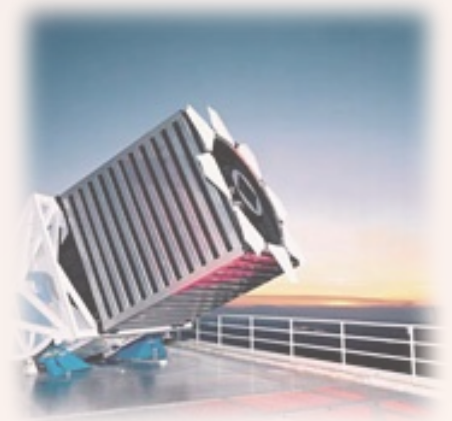
12th Century
Kabbalah



16th Century
Johannes Kepler



21st Century
Sloan Digital Sky Survey
CERN
Social sciences
...



And in ATM?

2 main problems

Diversity and heterogeneity
of data sources

Sensitive for safety and
security



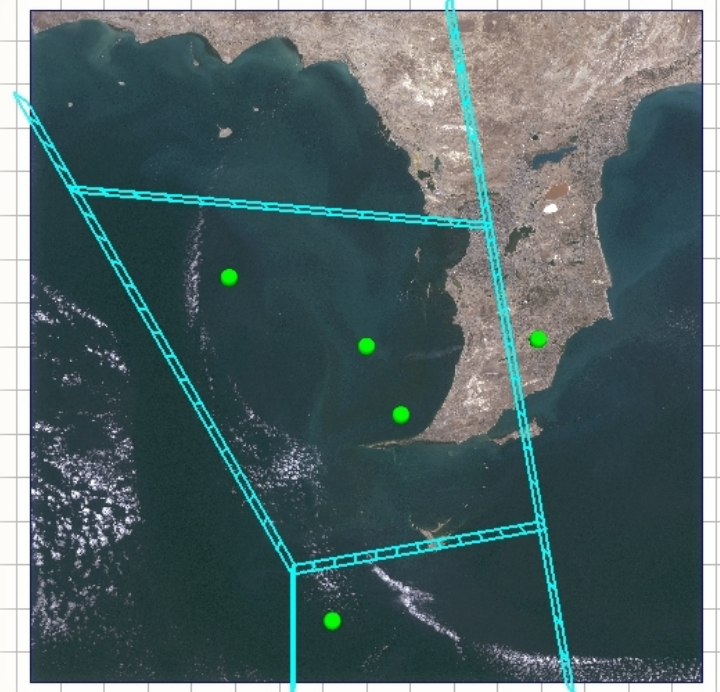
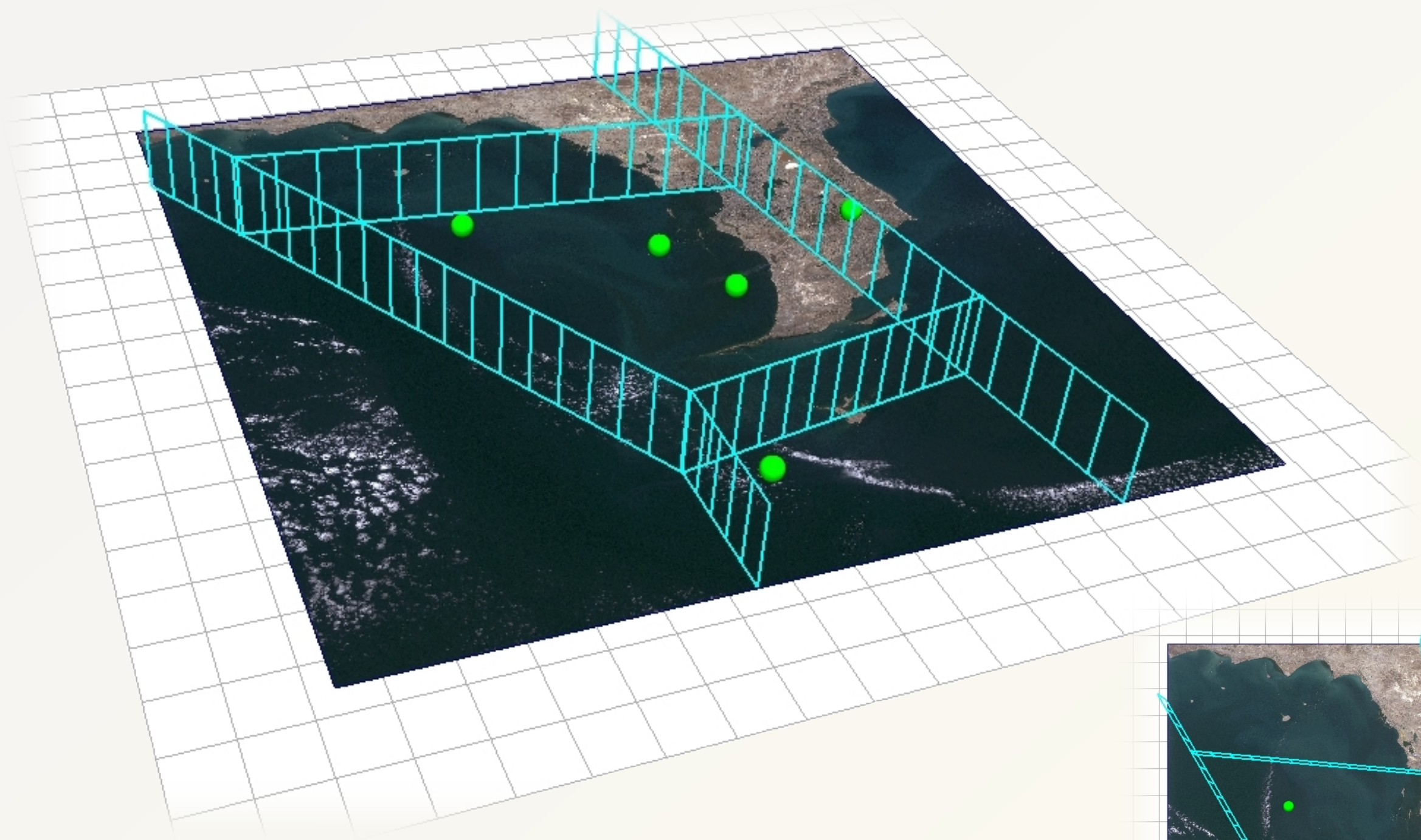
And in ATM?

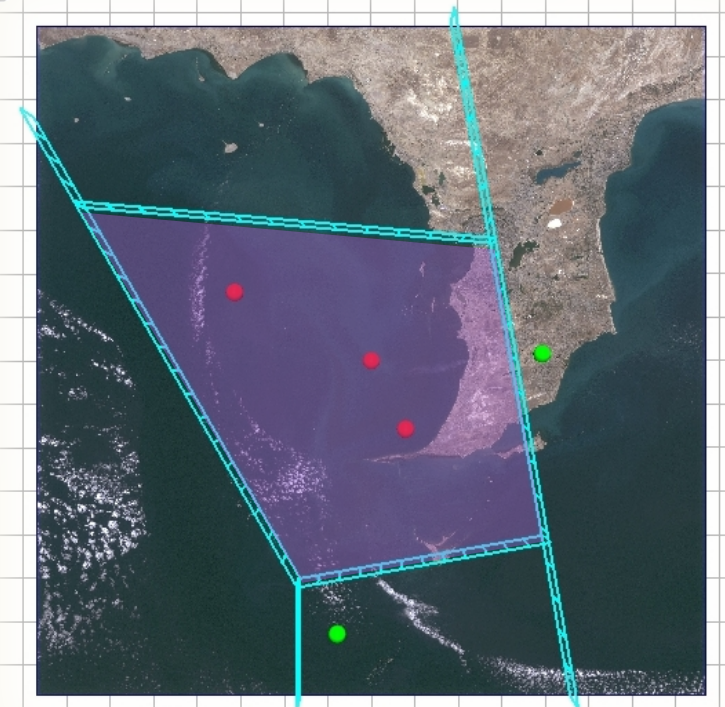
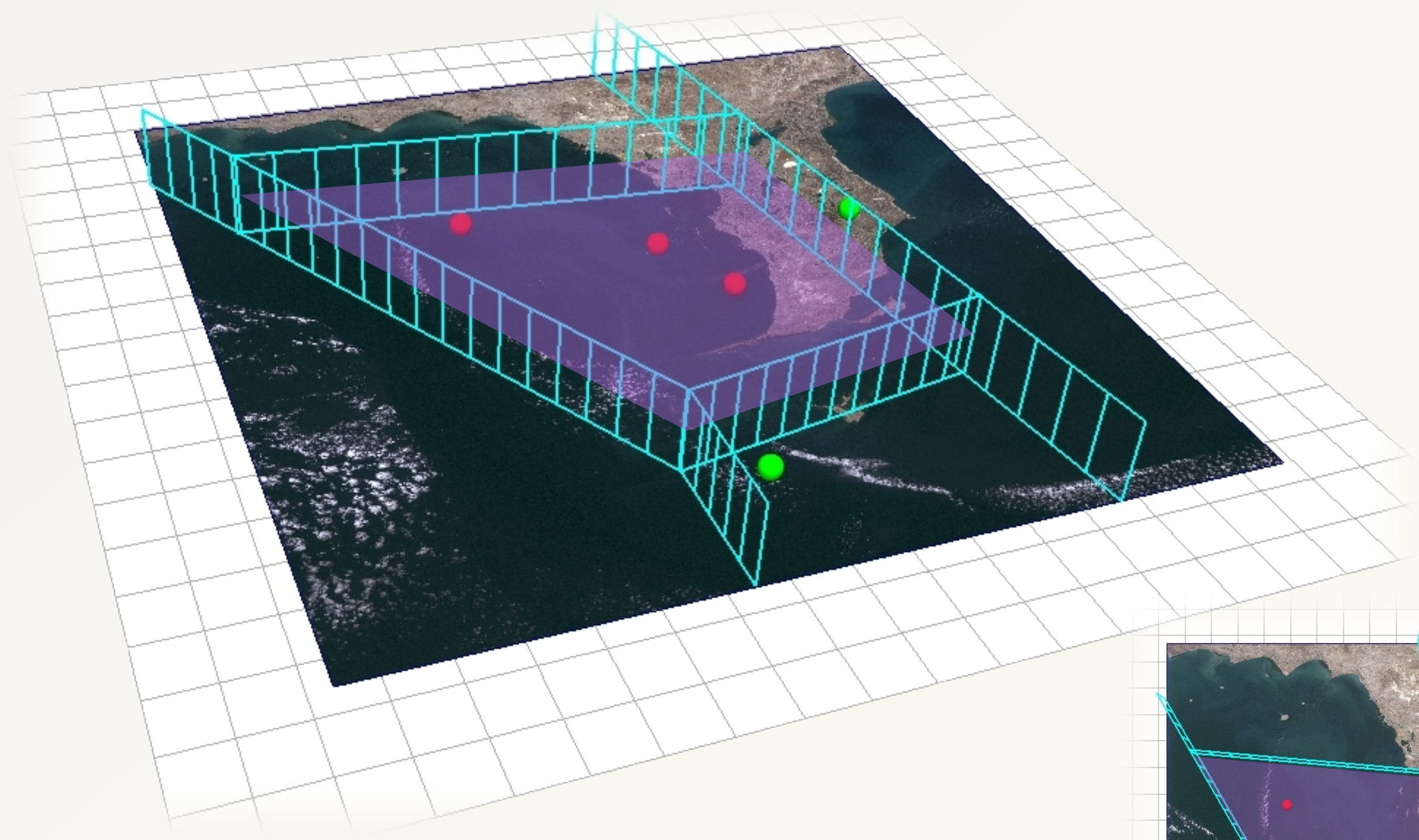
What about benefits?

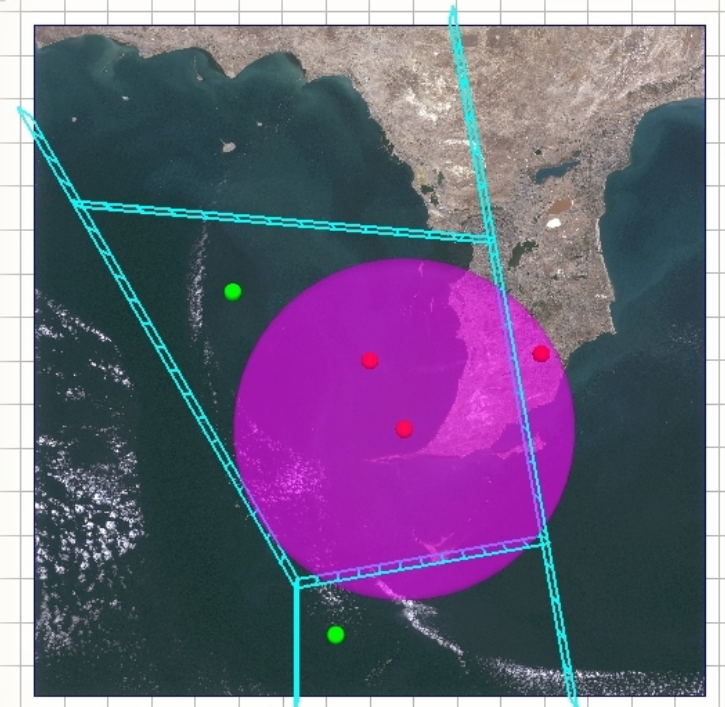
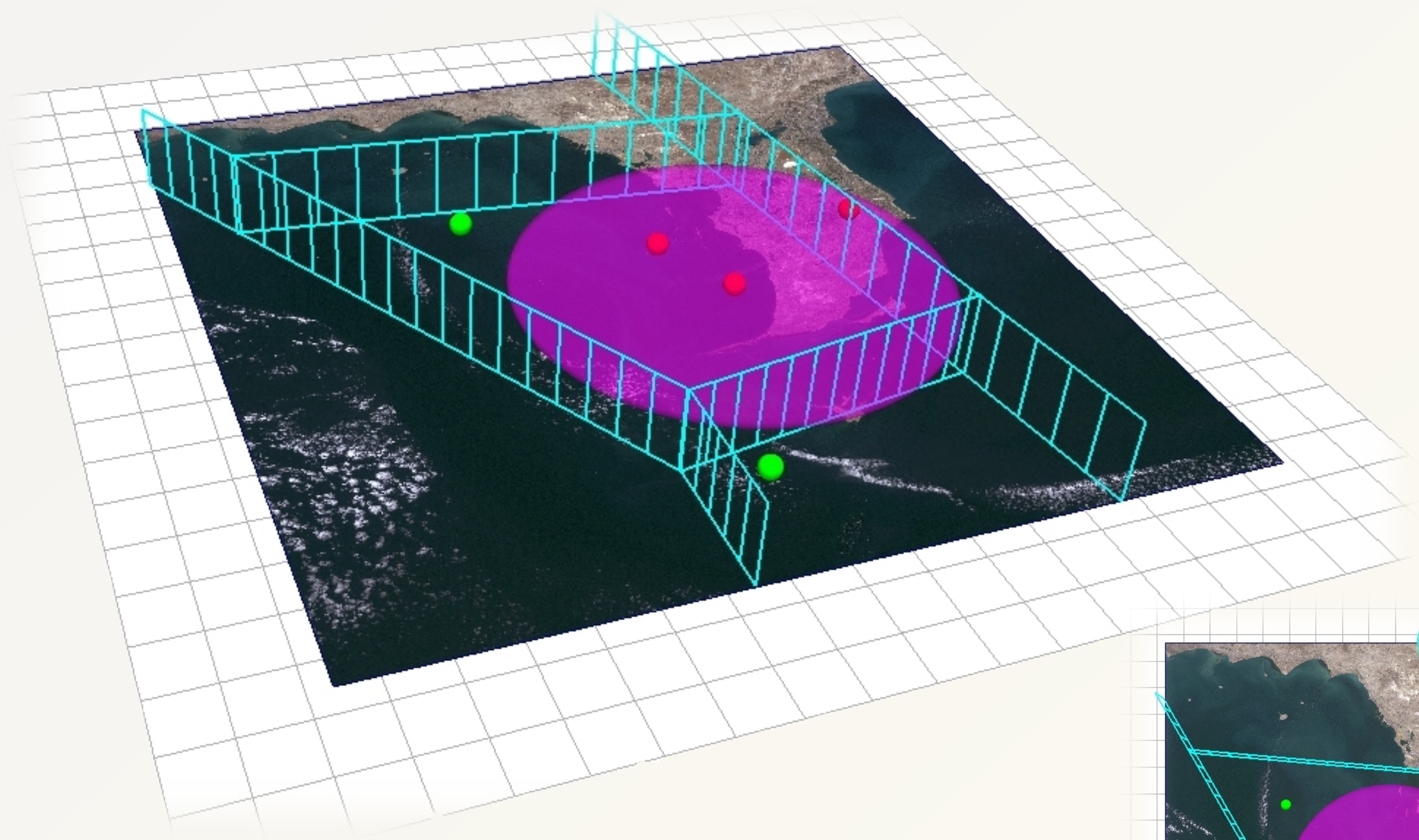
A simple test case



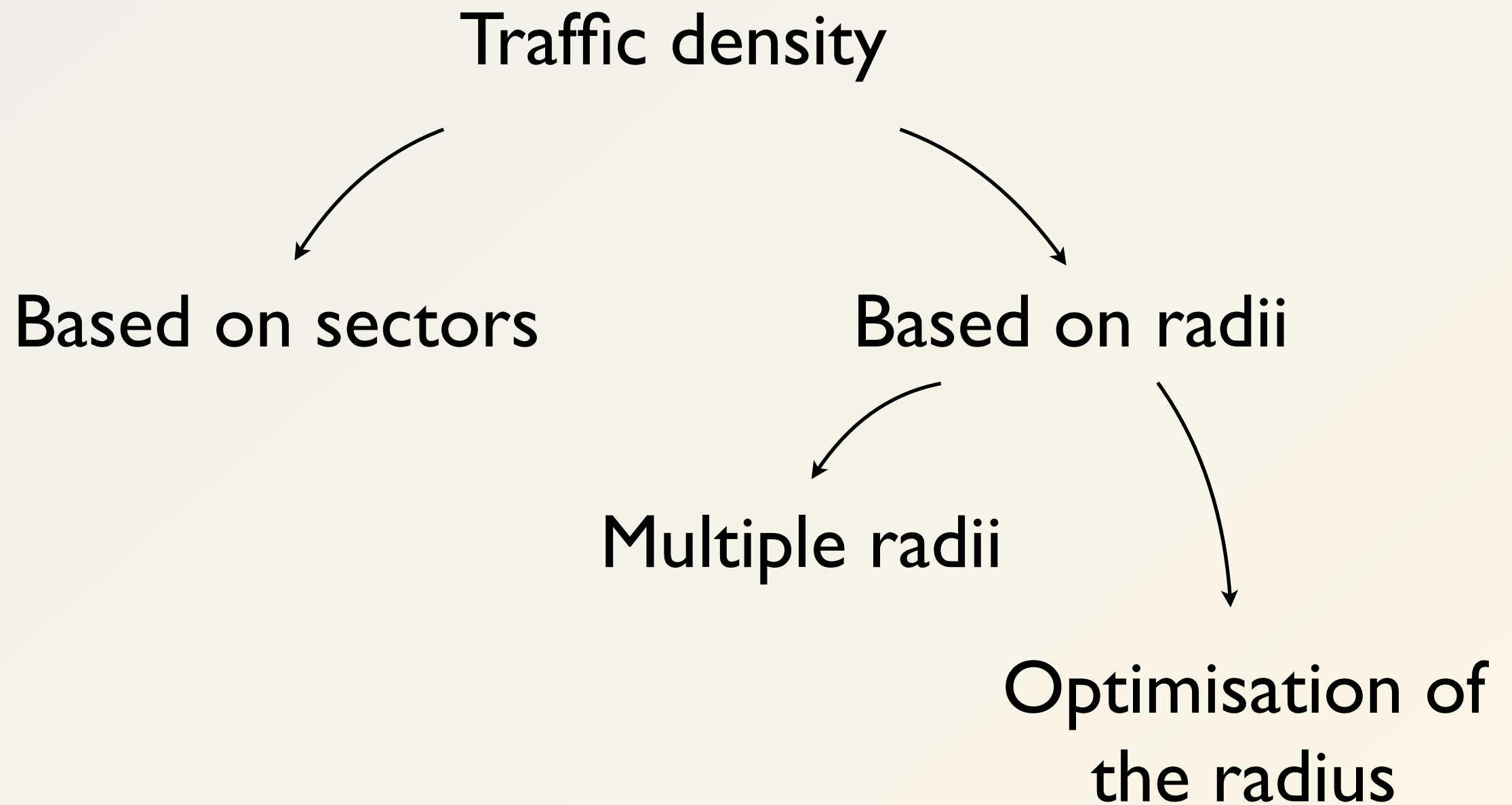
Sector traffic density







Lot of possibilities ...



How to choose?

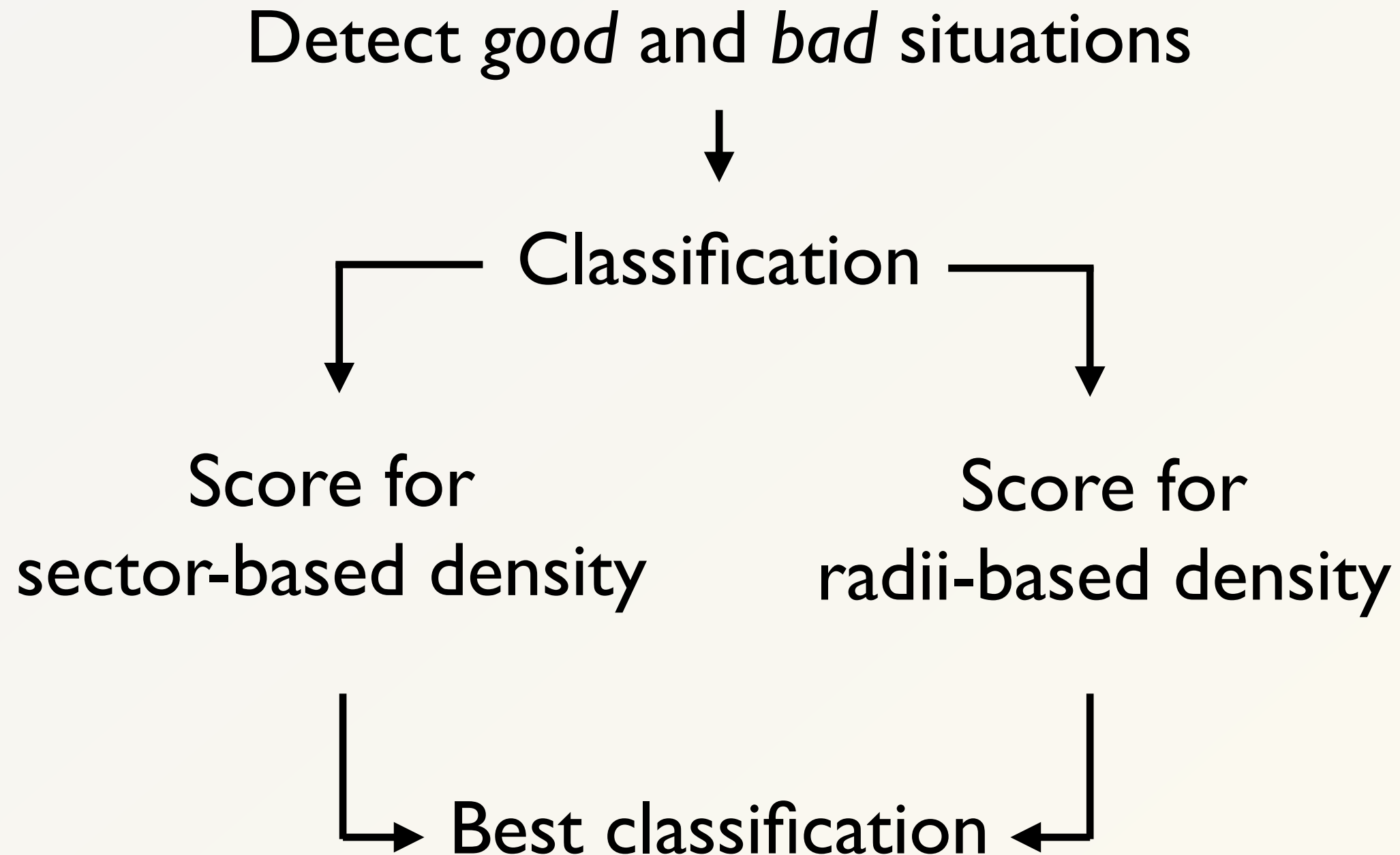
Data Science for obtaining an optimal result

Score in a classification task

=

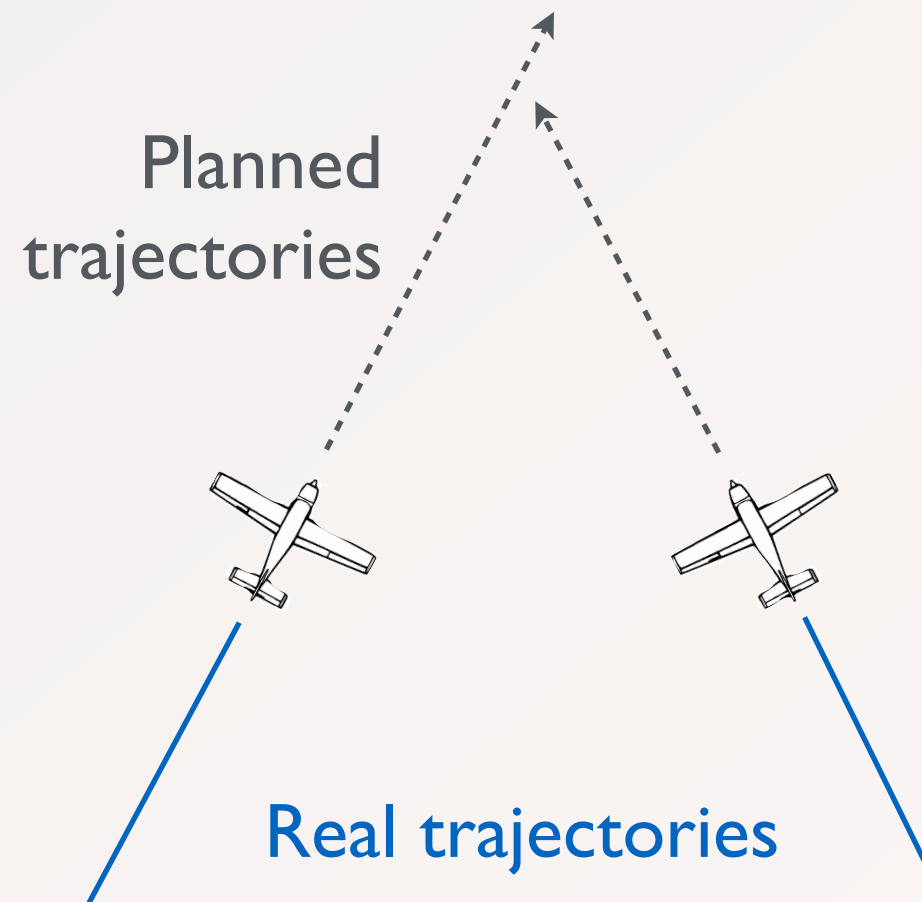
Relevance of the measure

How to choose?



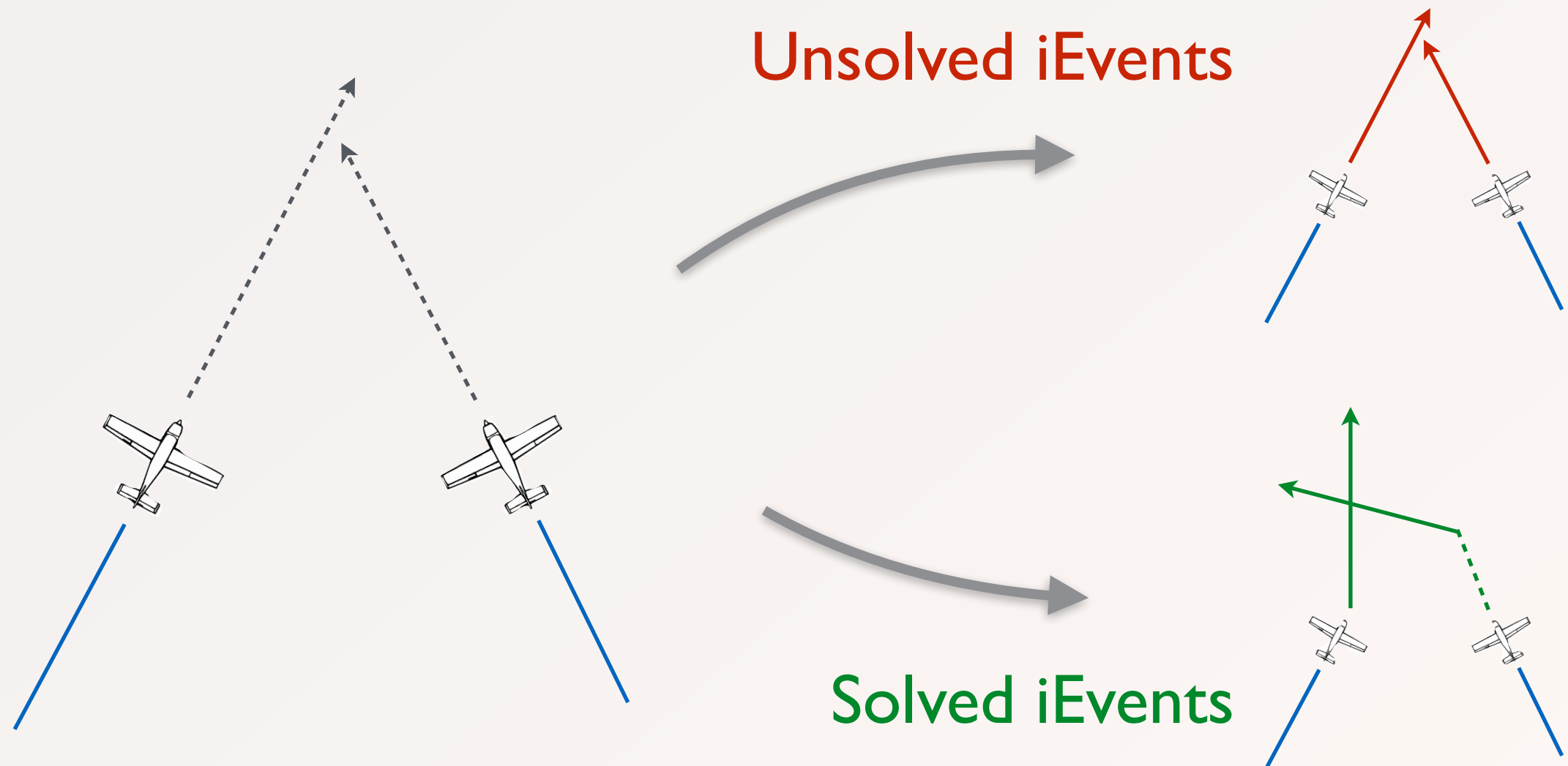
Identifying iEvents

Events in which two aircraft are expected to get involved in a LoS event

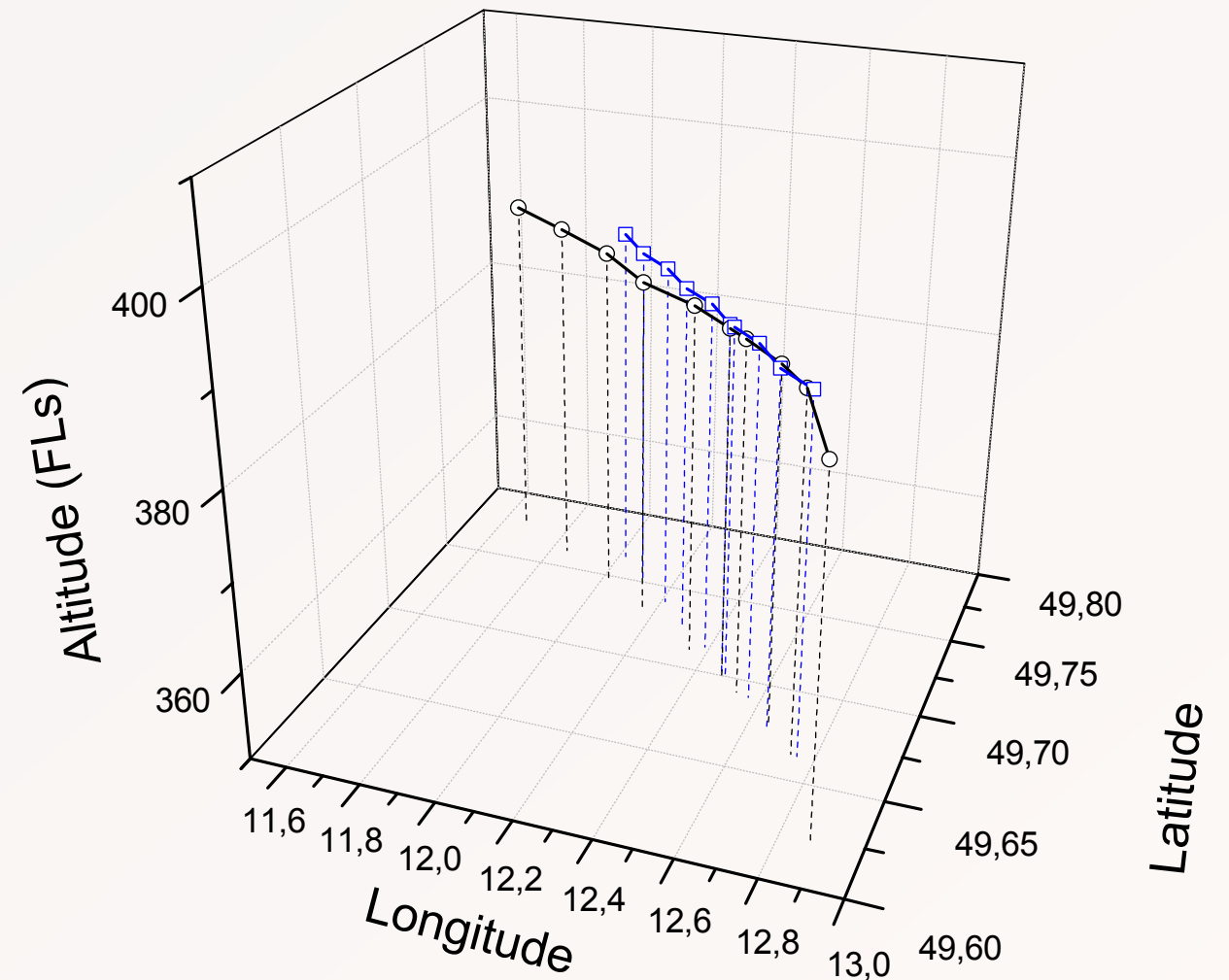
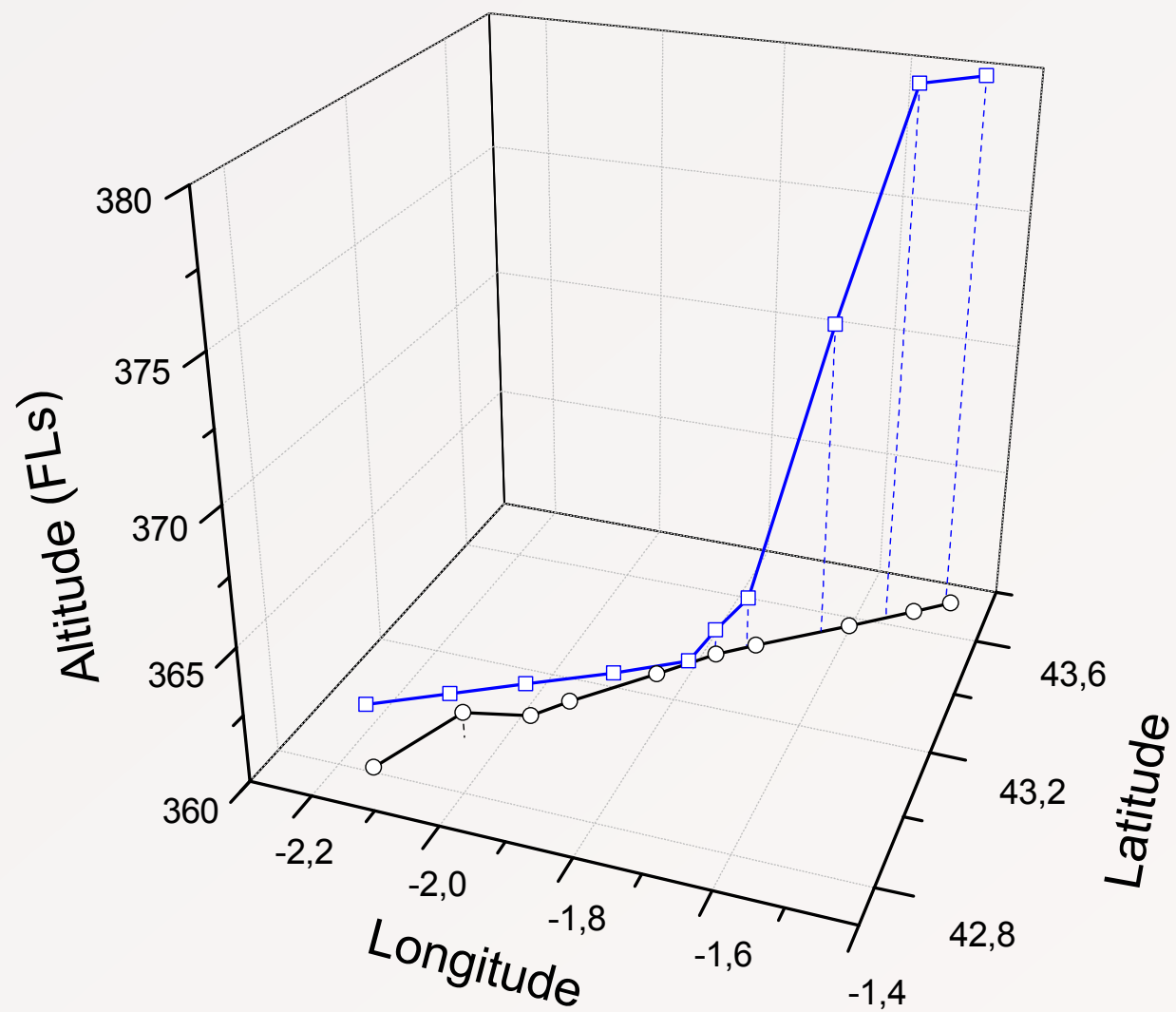


Identifying iEvents

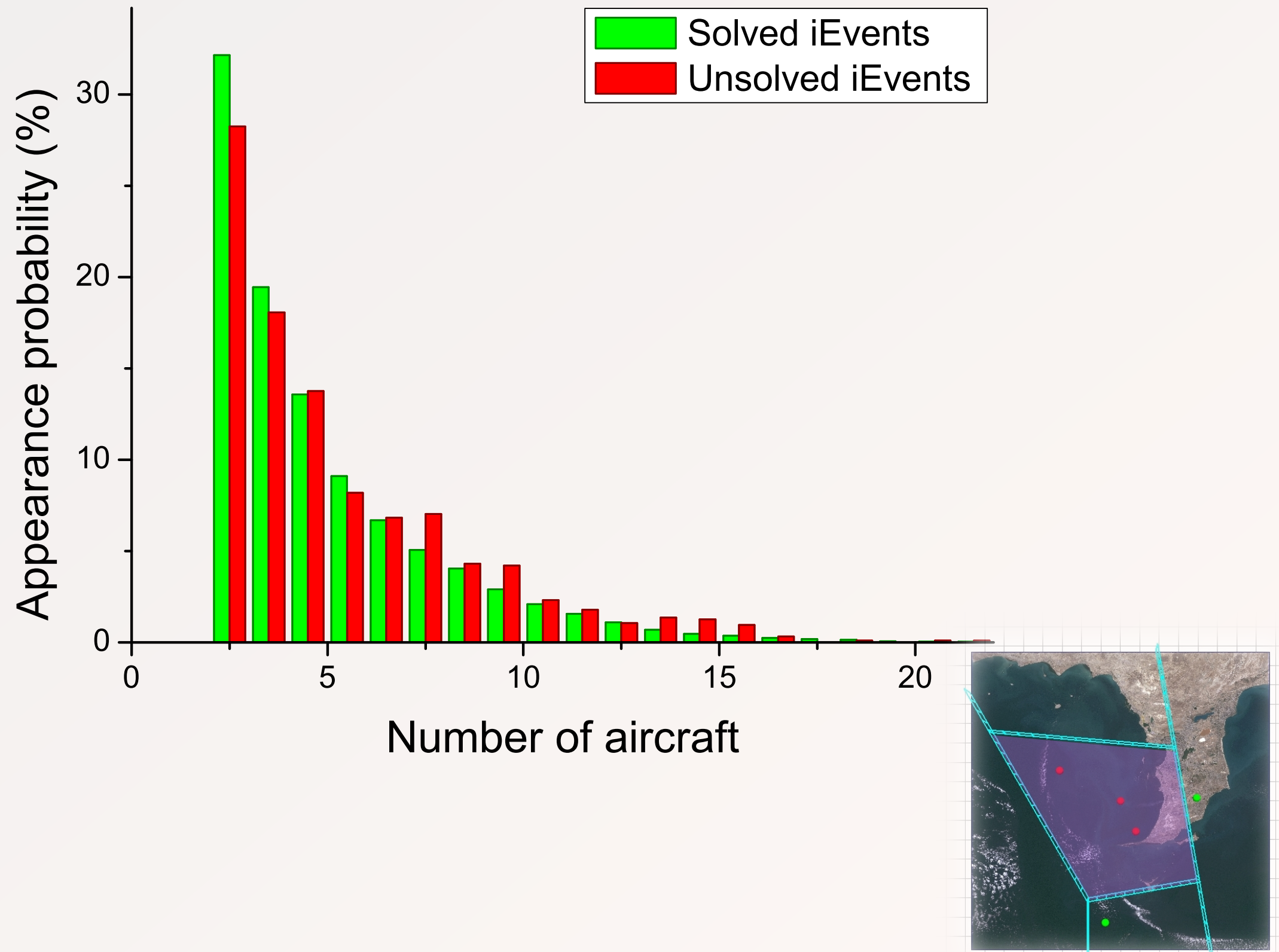
Events in which two aircraft are expected to get involved in a LoS event



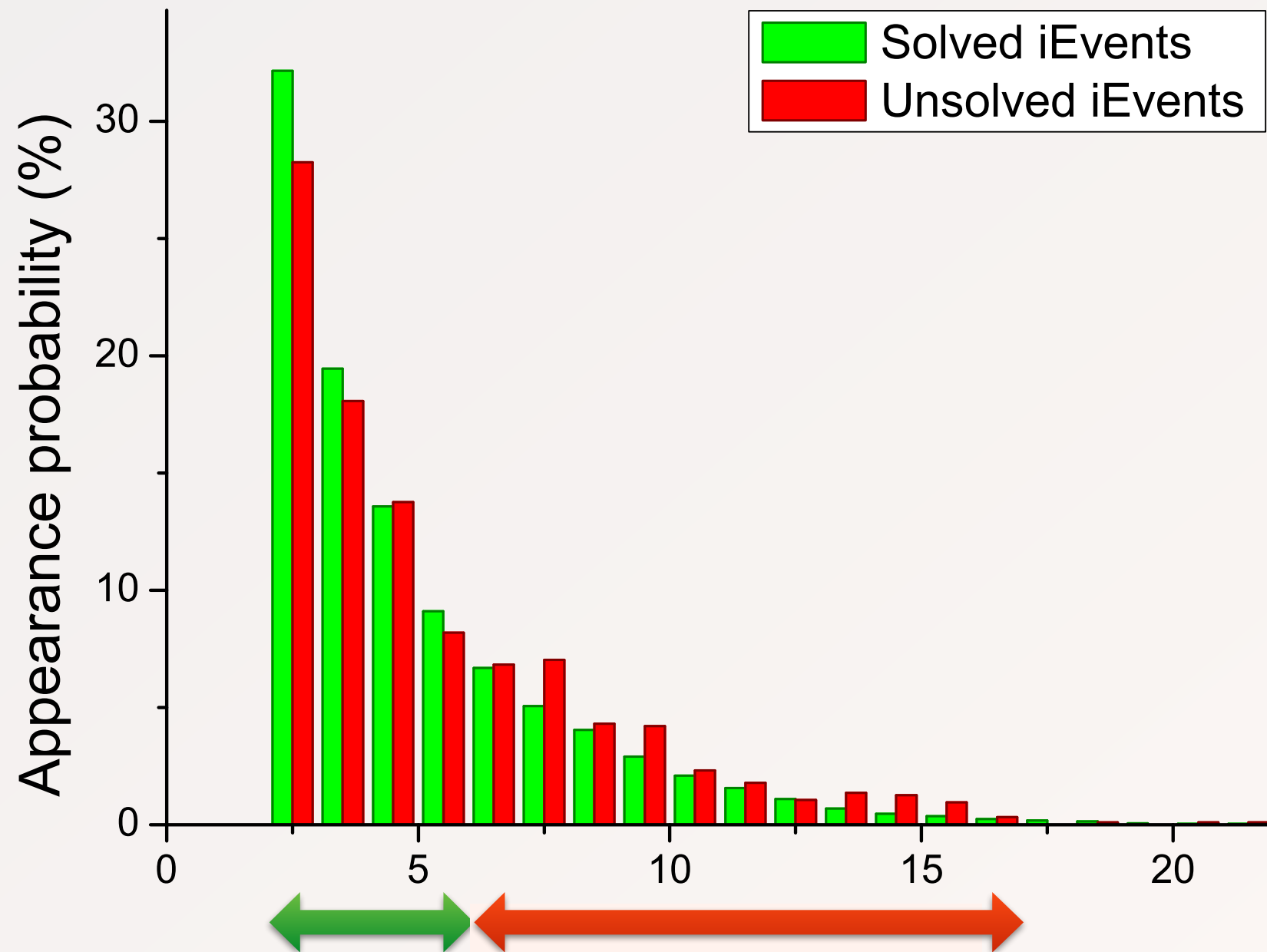
Identifying iEvents



Sector-based density

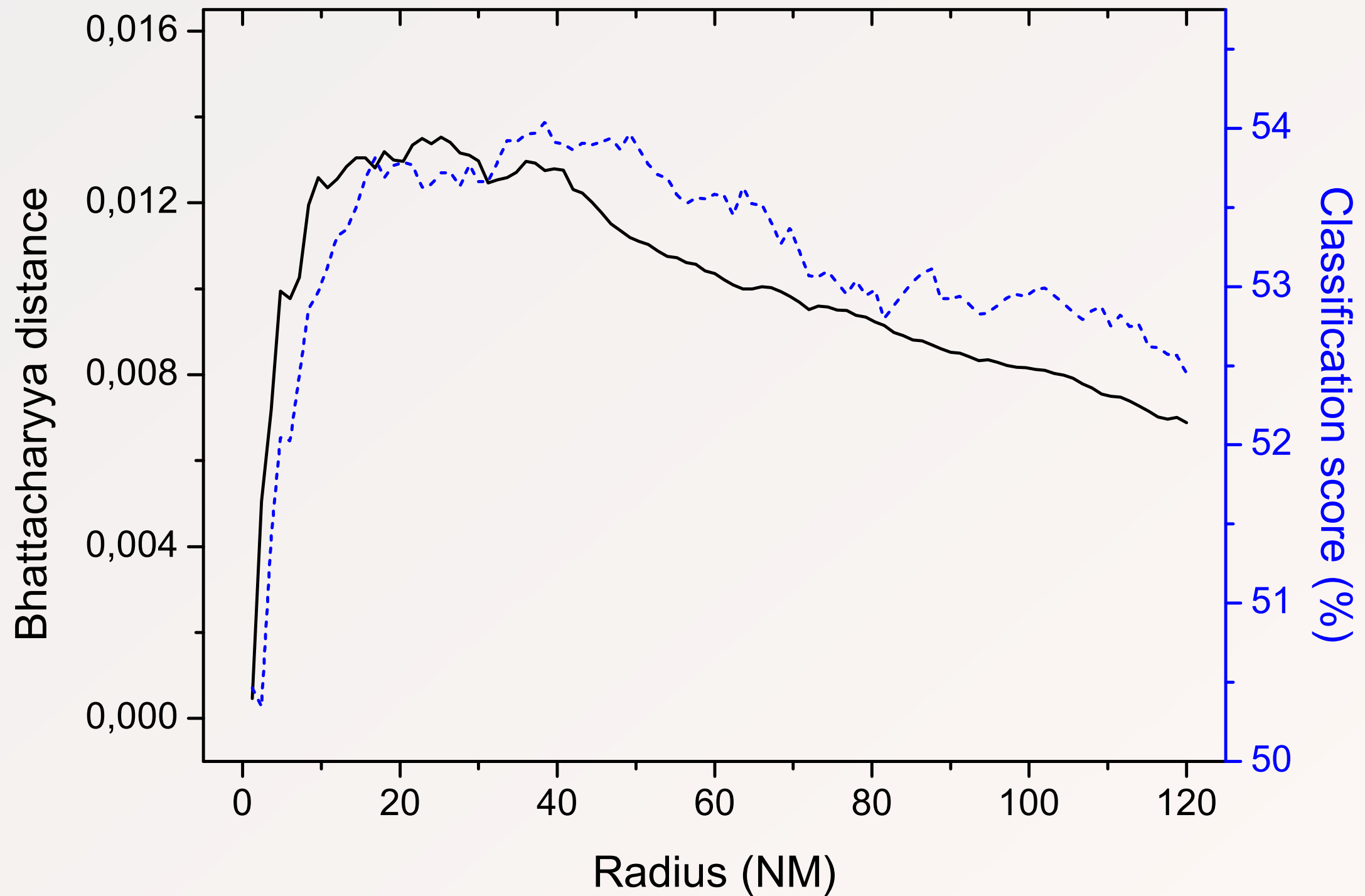


Sector-based density



Classification score: **51.101%**

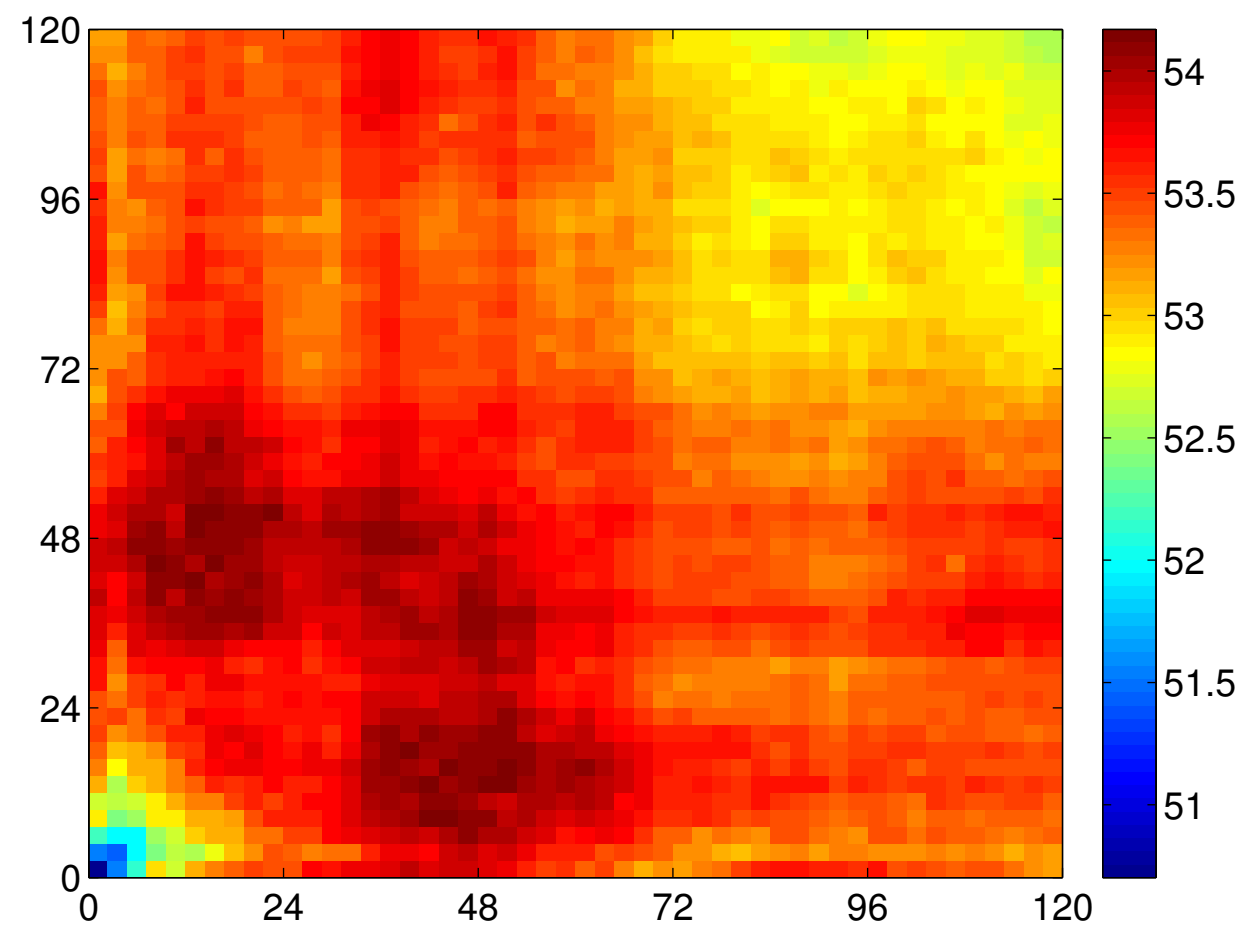
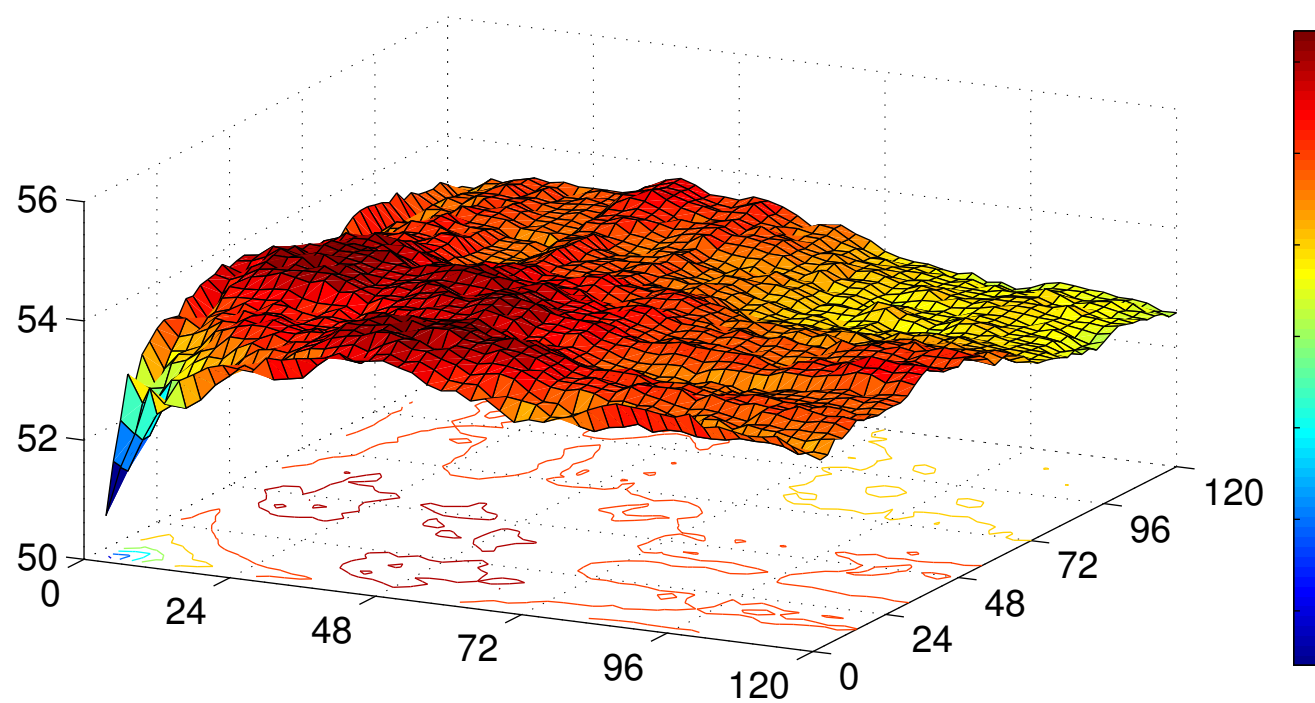
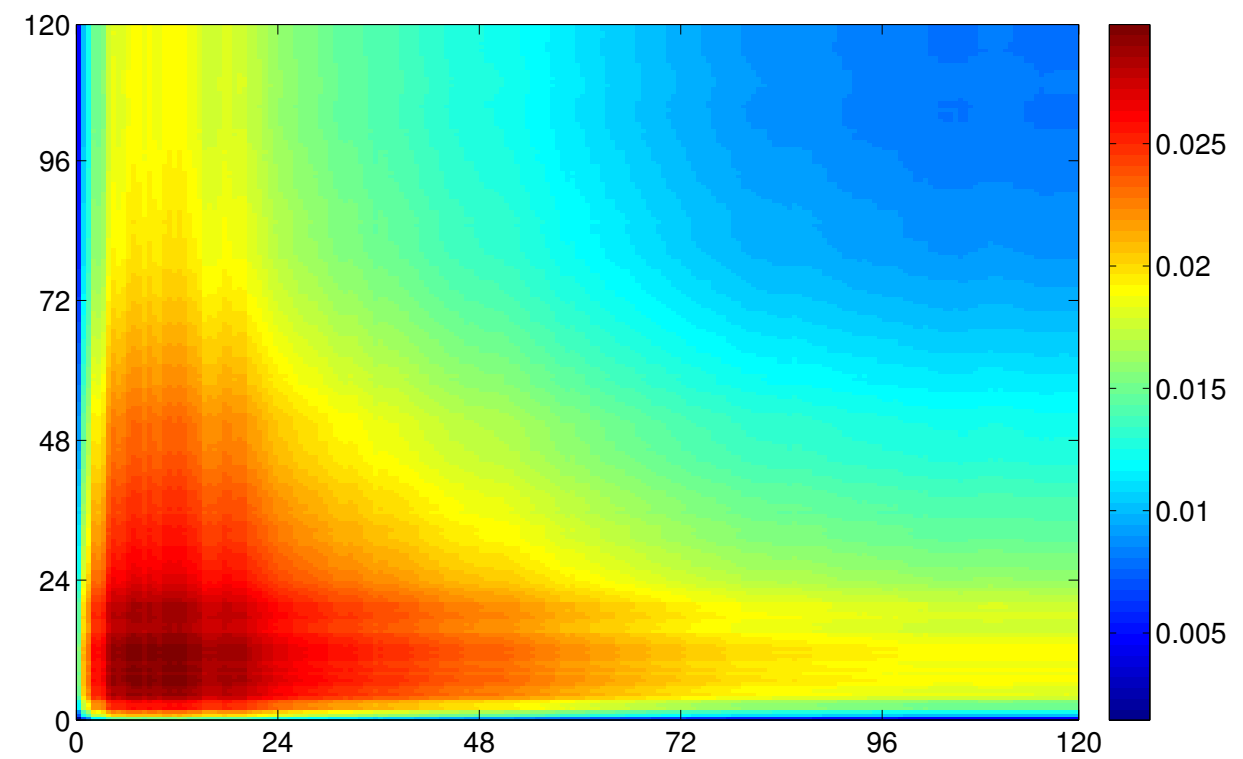
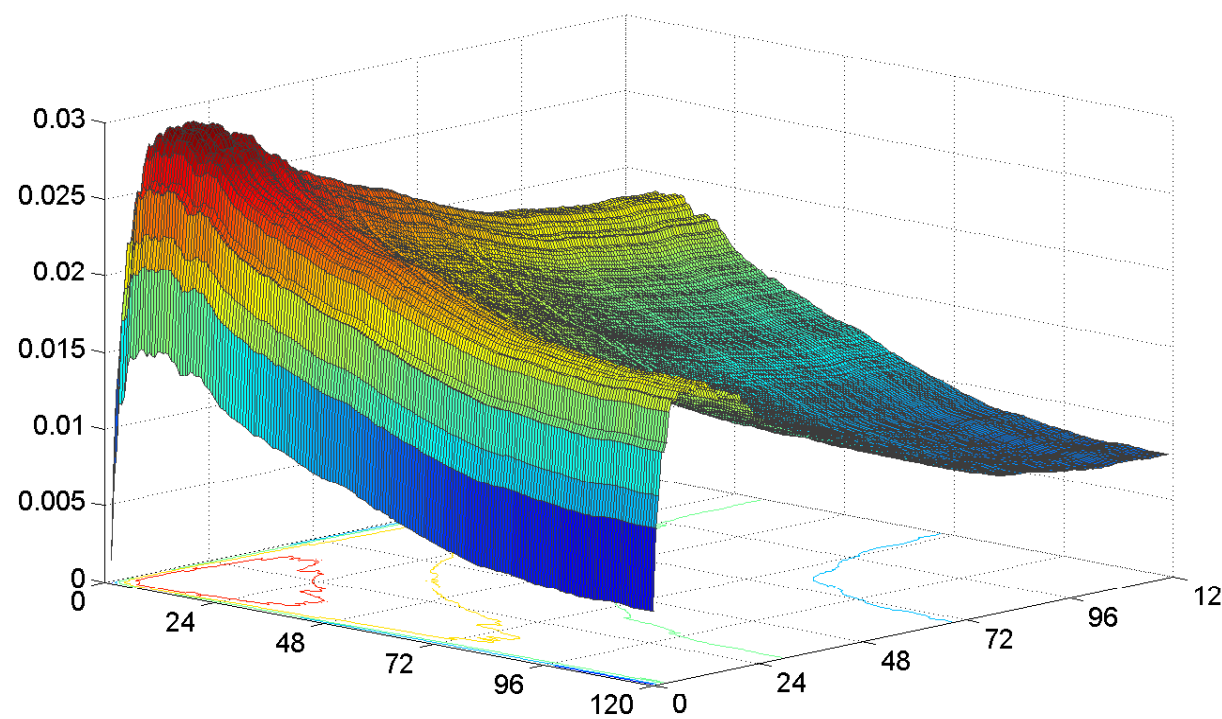
Radii-based density



Results (1/2)

	Score
<i>Baseline</i>	50.000%
Sector-based density	51.101%
1-radius density	54.040%

Radii-based density



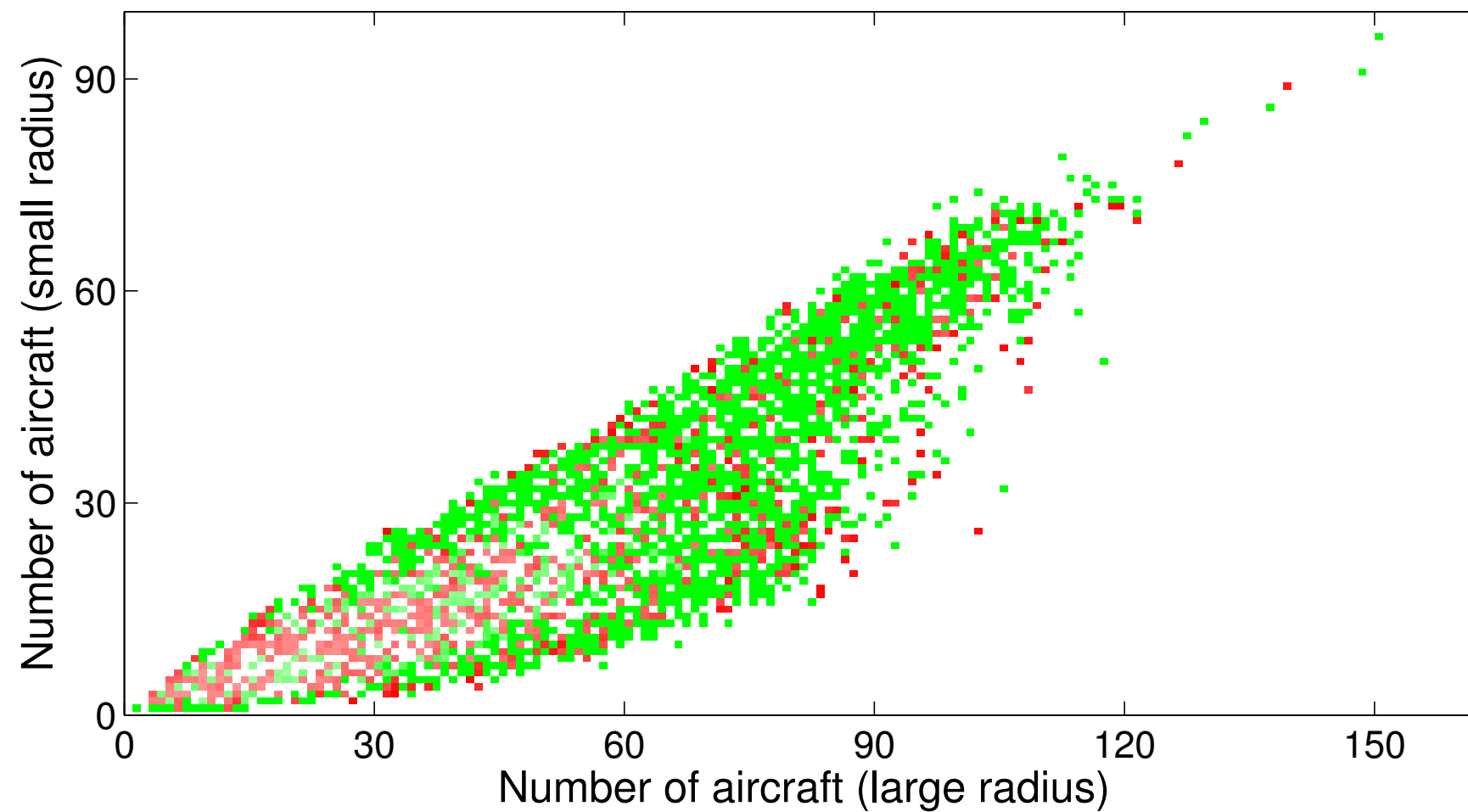
Results (2/2)

	Score
<i>Baseline</i>	50.000%
Sector-based density	51.101%
1-radius density	54.040%
2-radii density	54.130%

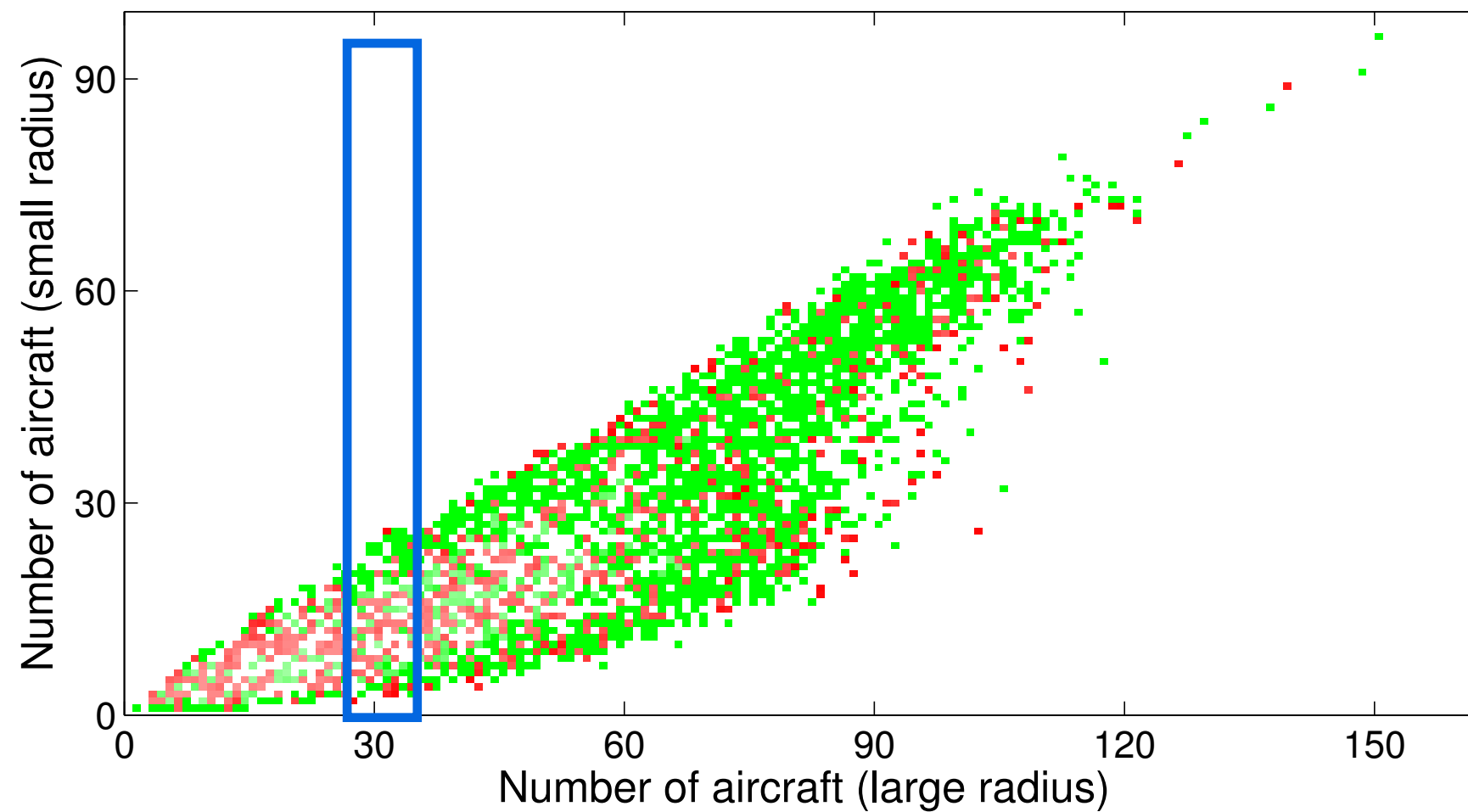
Best measure of traffic density:

2 radii, 12 and 48 NM

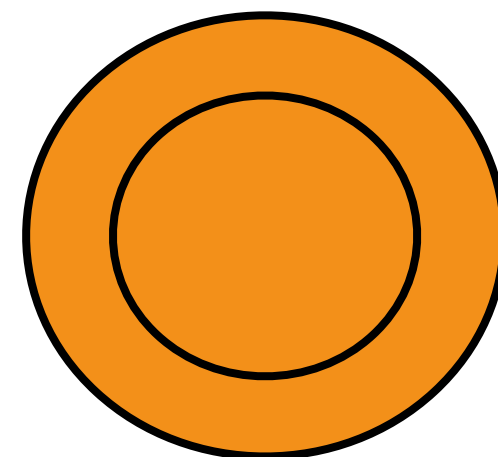
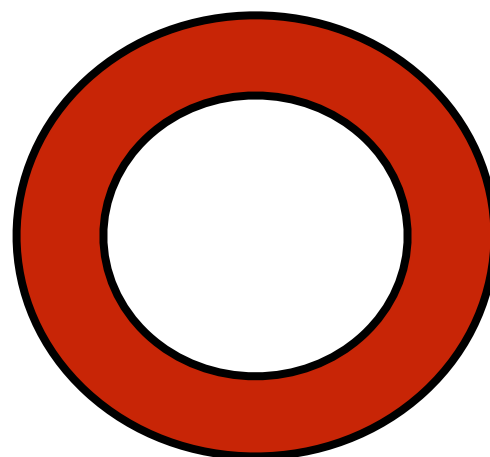
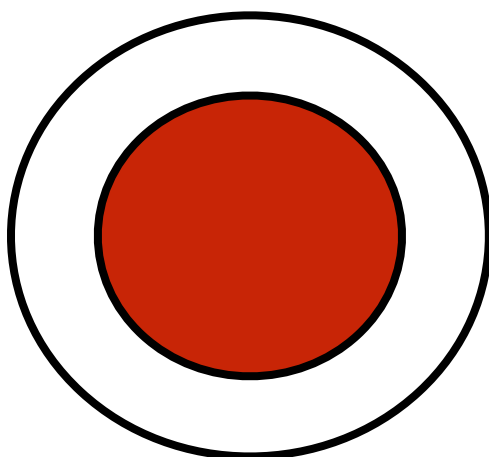
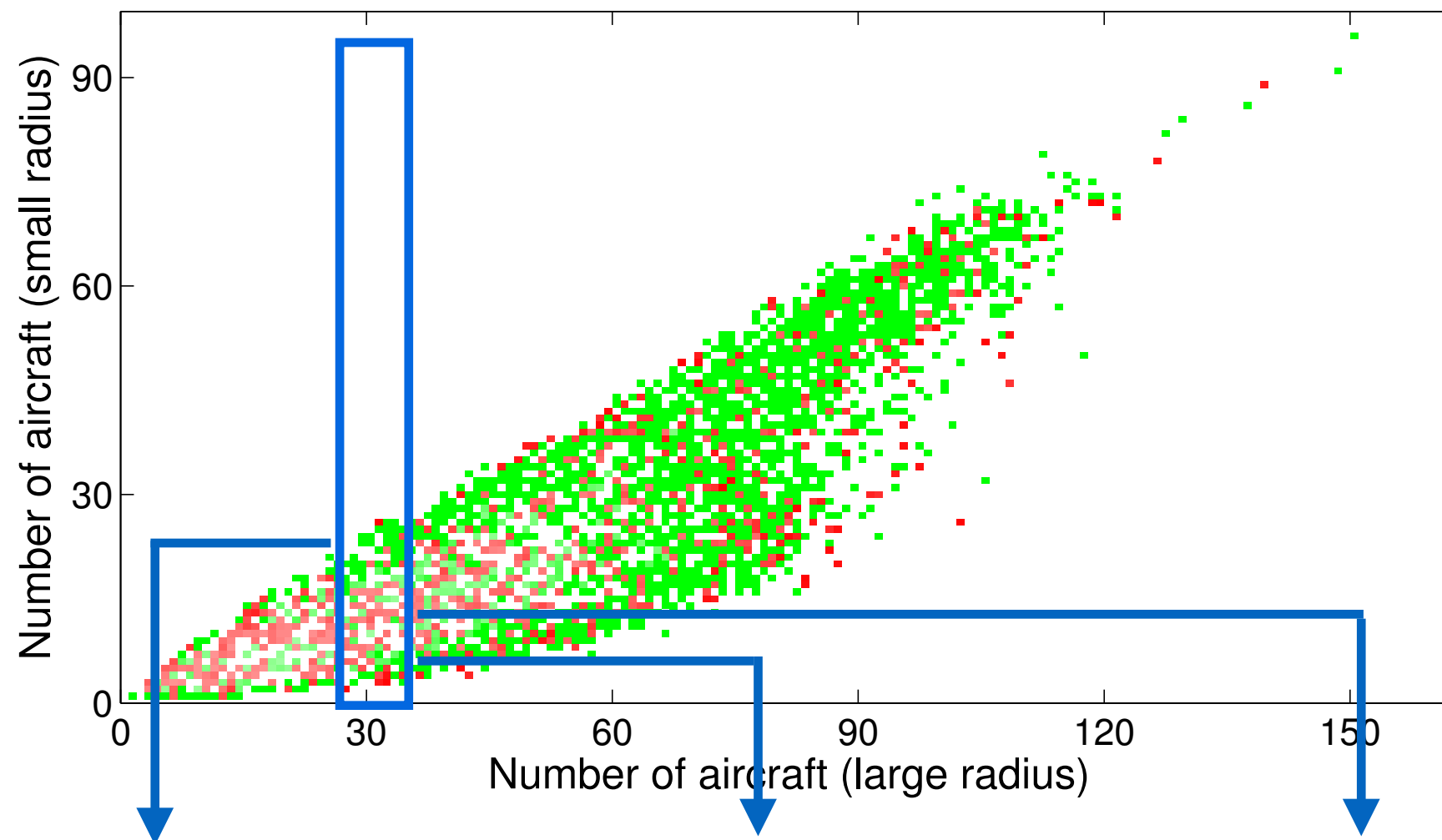
More knowledge?



More knowledge?



More knowledge?



So, what?

Data Science as a way of better
understand the ATM system



Listen to the data

There's a pattern, there's a pattern,
there's a pattern there to follow,
A pattern, there's a pattern,
there's a pattern there to follow.

Thank you
mz@innaxis.org

Band of skulls

M. Zanin

Synchronization Likelihood in Aircraft Trajectories.
10th USA/Europe ATM Seminar, Chicago, 2013.

M. Zanin

Network analysis reveals patterns behind air safety events.
Physica A - submitted.

M. Zanin, P. Sousa, D. Papo, et al.

Optimizing functional network representation of multivariate time series.
Scientific reports, 2, 2012.