Where does the fast solar wind comes from….exactly?

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1) Goal

To estimate the uncertainties in the back-mapping of the fast solar wind and provide a confidence area on the solar surface, which can be used for linkage analysis.

2) Methodology

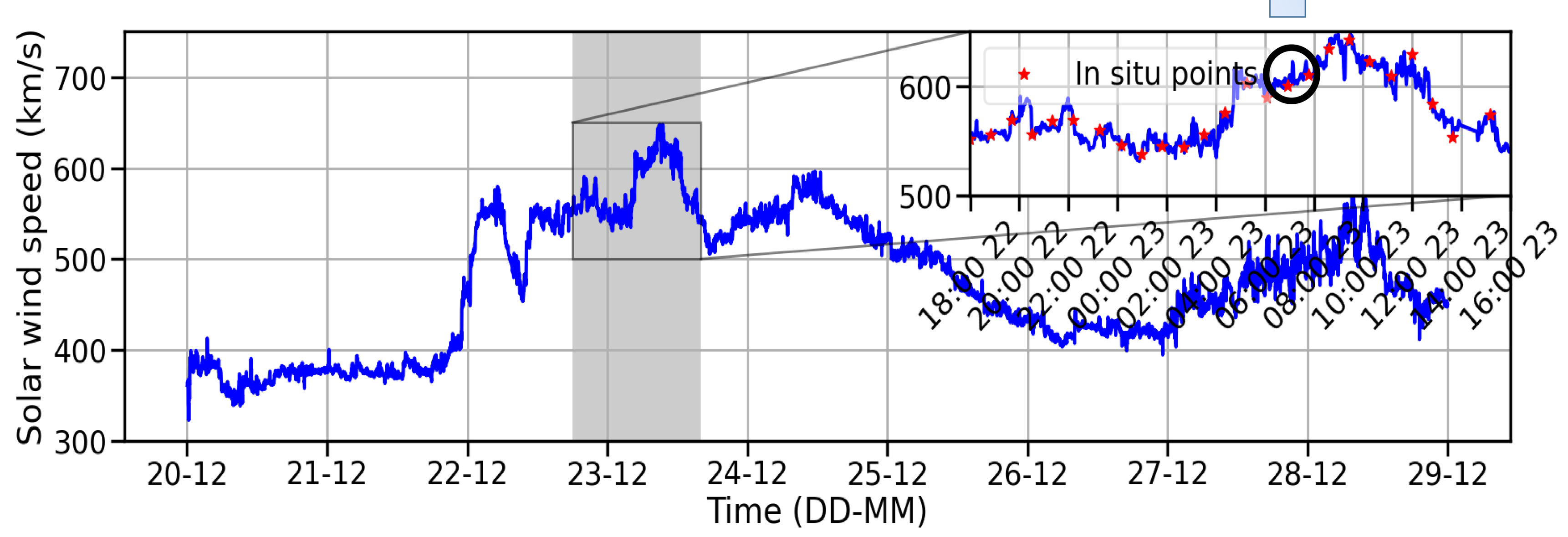
- Identify sources of uncertainty
- Perturb each source
- Compute and cluster (Gaussian Mixture Model) the back-mapped points on the solar surface

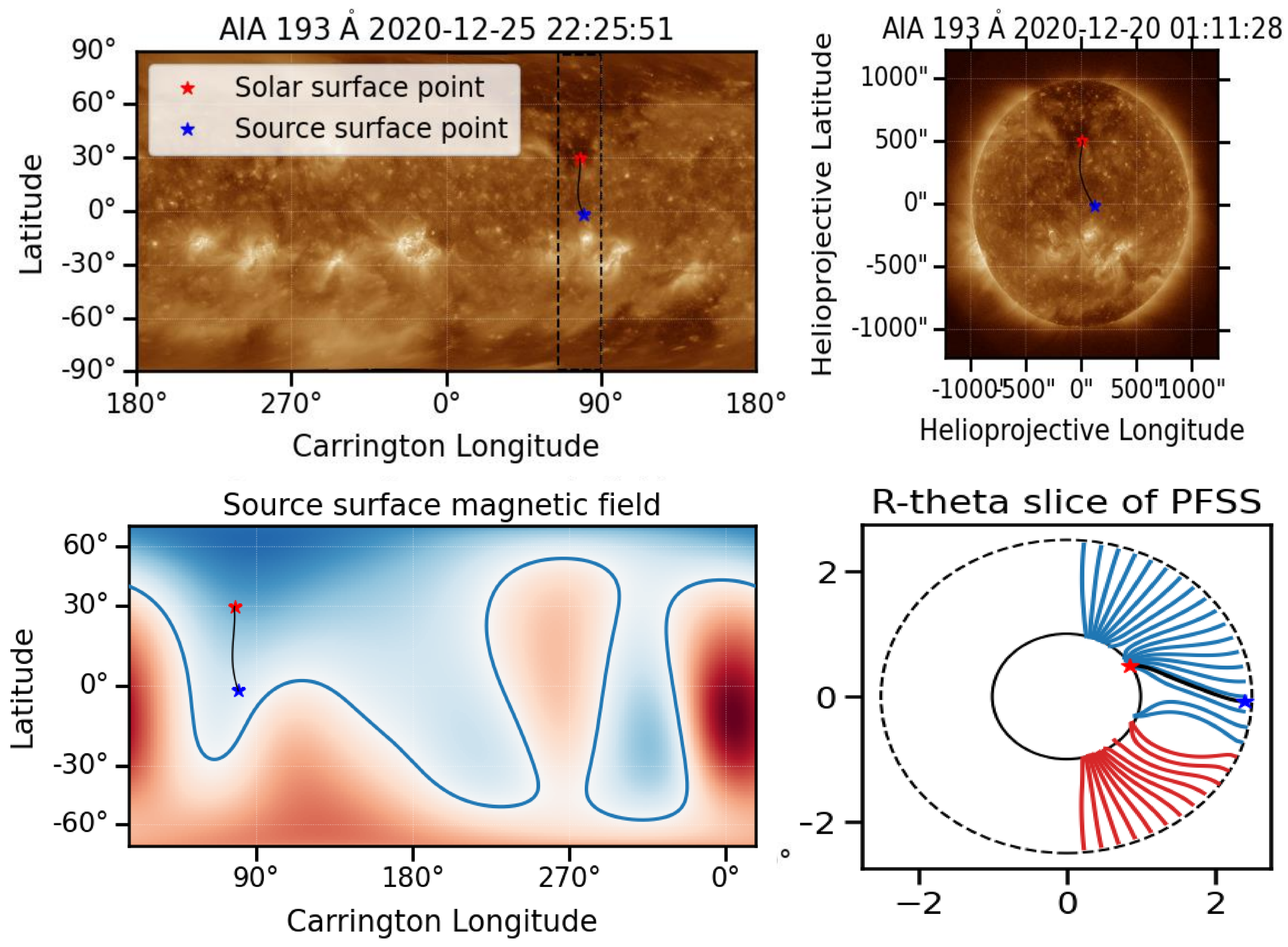
3) Sources

- **Velocity profiles in ballistic mapping**
- **Source surface height**
- **Magnetogram noise**
- Uncertainty in measured solar wind velocity
- Uncertainty in spacecraft position

4) Data

- Test case, high speed stream on 21-25/12/2020, WIND data.
- Sample the stream with a cadence of ~42 mins.
- These are the in situ points
- Back-map every in situ point perturbing each source of uncertainty independently



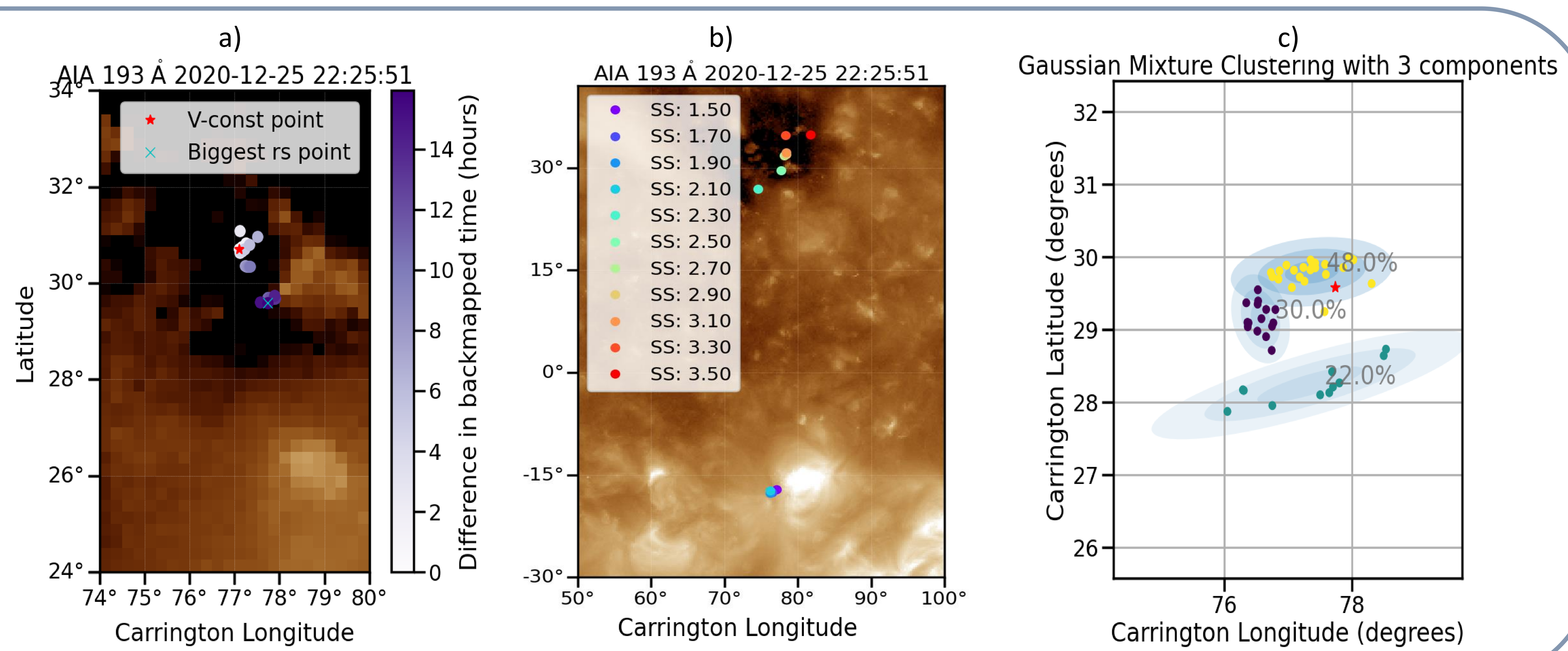


5) Analysis

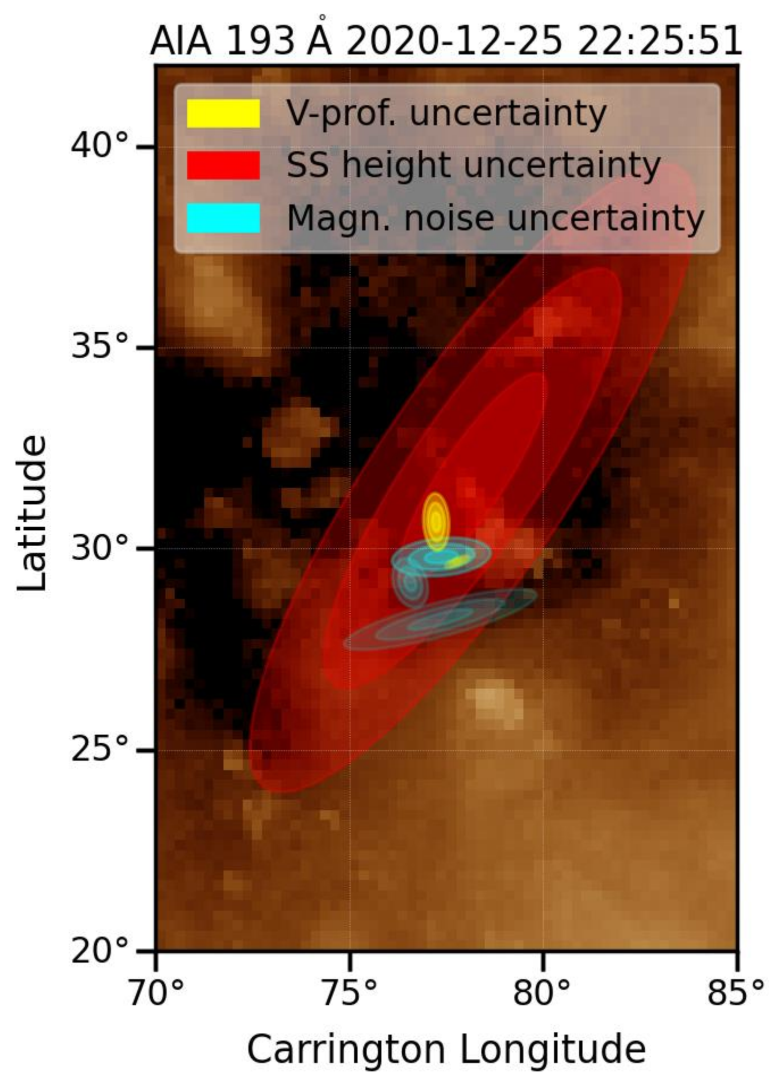
a) Velocity profiles ➡ Custom profiles based on the Parker approximations for large and small distances, constrained by observations (Doppler dimmings)

b) SS height ➡ Compute the back-mapping for a range of heights (1.5 – 3.5 solar radii)

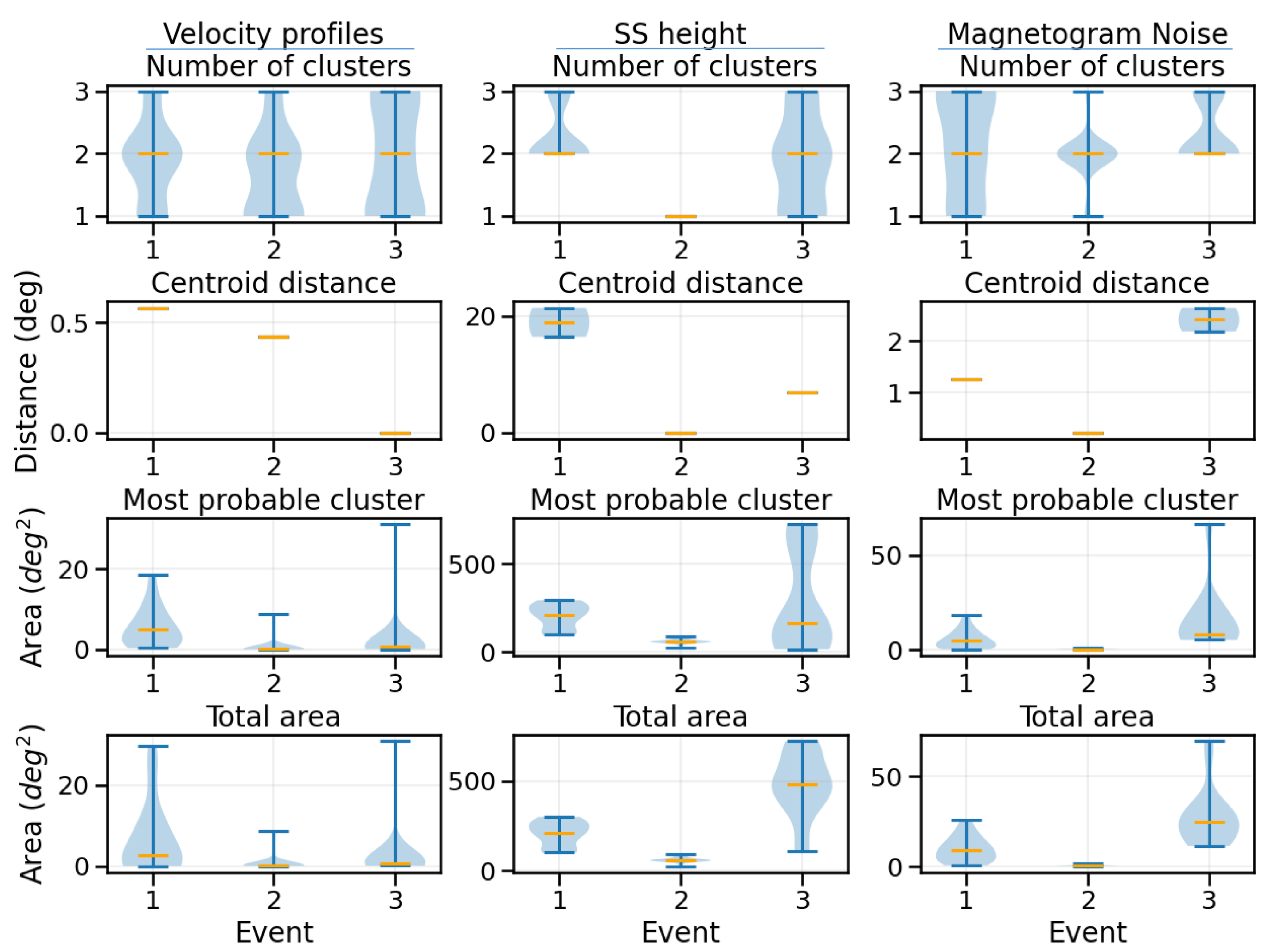
c) Magnetogram noise ➡ Add noise and perform a Monte Carlo simulation, repeating the back-mapping for every noise realization



6) Uncertainties aggregation



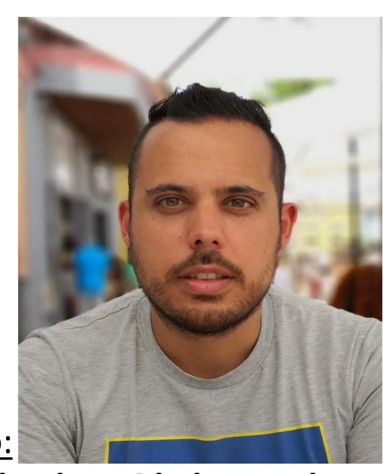
7) Statistics



8) Conclusions

- A solar wind back-mapping framework that takes into account almost all possible sources of uncertainty
- Ordering in the significance of each uncertainty source (persists from a single in situ point to multi-event analysis)
  SS height > Magnetogram noise > v-profiles
- 4 metrics to evaluate the back-mapping performance and pave the way for a statistical study

Scan me ↑
For more details.



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