Phase shifts between RVs and stellar variability indicators

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↑ Scan for my website

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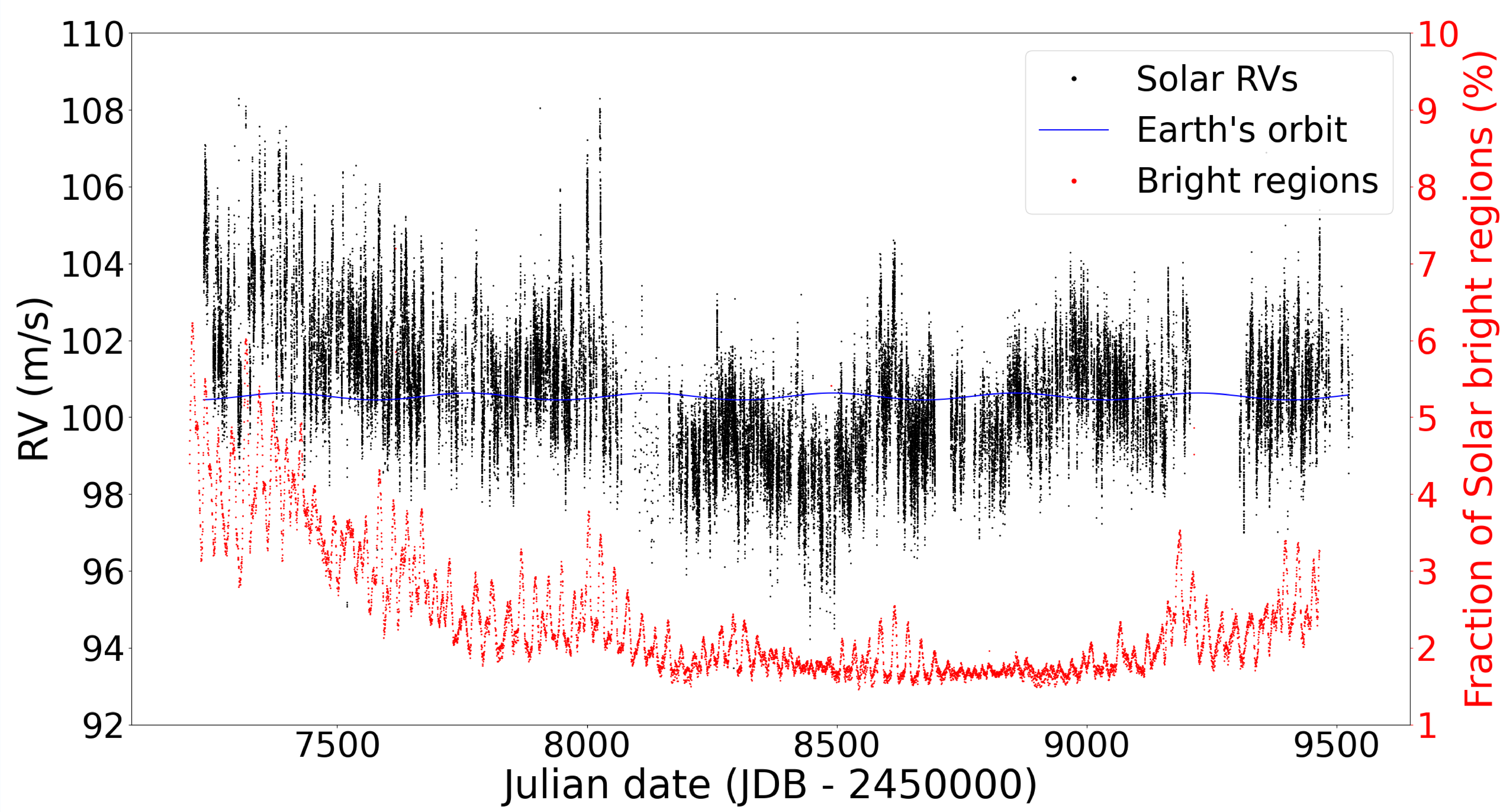
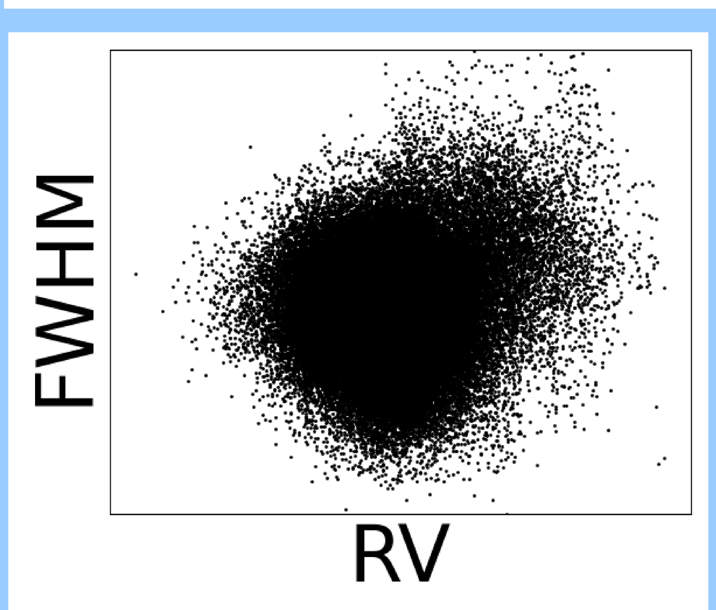
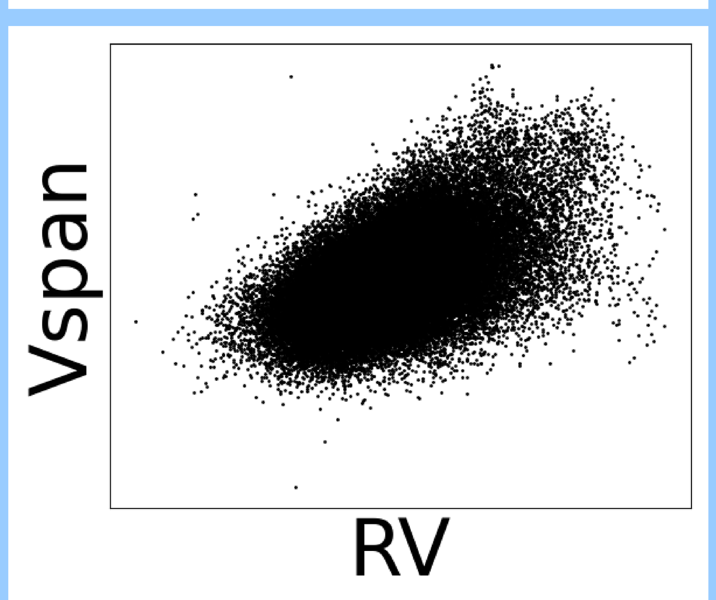


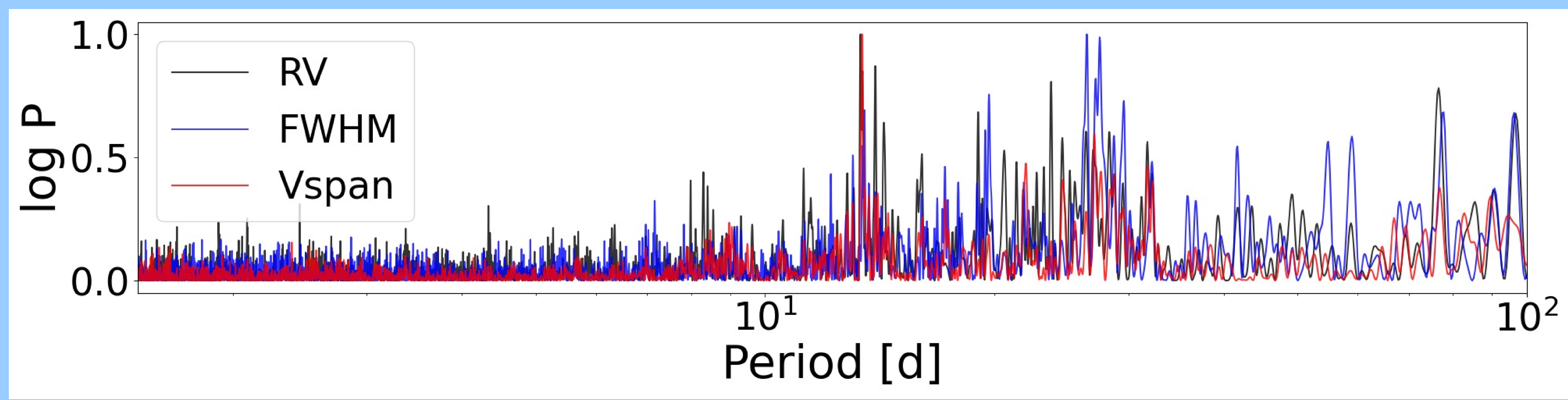
The HARPS-N Collaboration started **observing the Sun-as-a-star** in July 2015. We correct the Solar RVs for any effects of Solar System bodies and atmospheric extinction. This dataset thus provides a unique test case to understand the behaviour of stellar variability in RVs. The downwards slope represents the long-term variability of the Sun's magnetic field as tracked by the fraction of bright regions on the Sun. The (blue) RV signal of our Earth is an order of magnitude below the stellar variability scatter.

Check out Collier Cameron, Mortier et al. 2019 and Dumusque et al. 2021 for more information on our data processing and correction procedures.

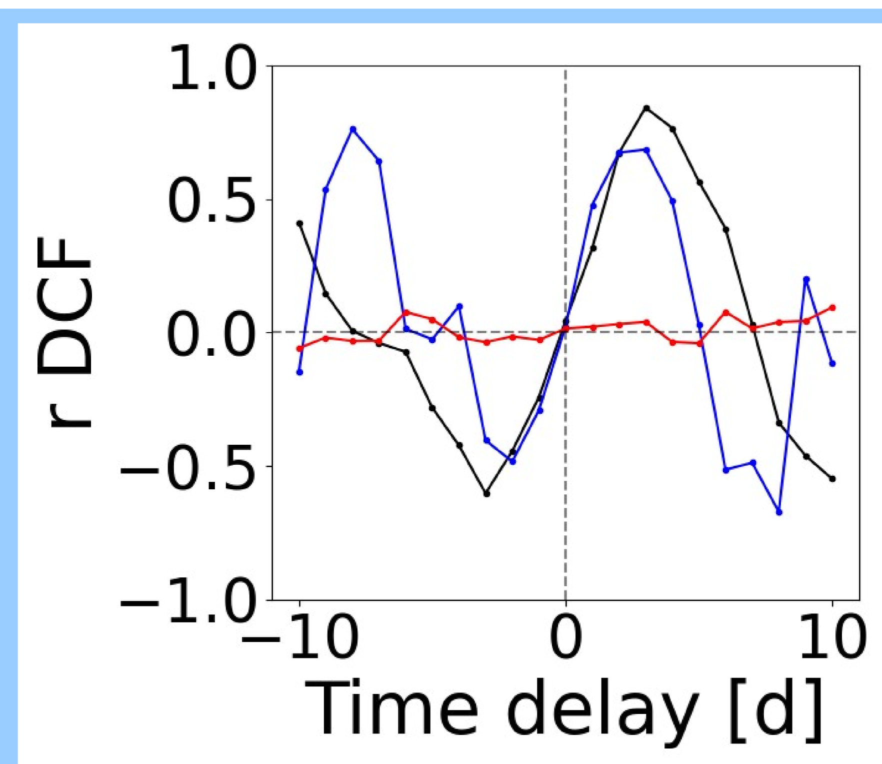




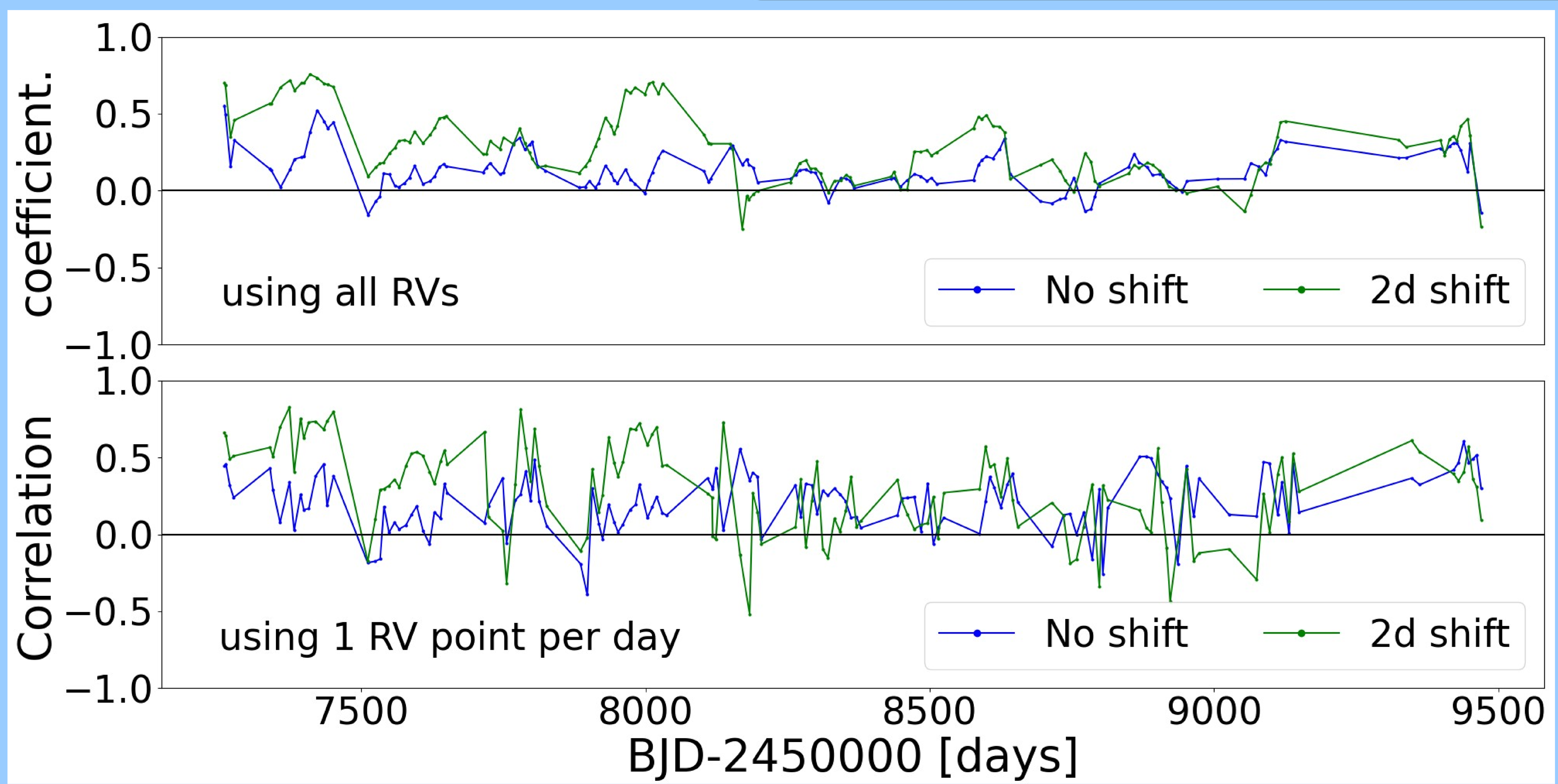
- Calculate a variety of line profile indicators tracking width (FWHM), depth and asymmetry (eg Vspan – Boisse et al. 2011) of the cross correlation function (CCF).
- Periodic behaviour of RV and indicators found to be very similar with Solar rotation period and first harmonic clearly detectable (see the right BGLS periodogram).
- Correlation between RV and indicators is present but not strong (as seen in the left figures).
- Same behaviour for all indicators.



- Get discrete correlation function coefficient
- Blue during highest activity, red during lowest activity, black in between. →
- When a strong correlation is present, the shift is between 2 and 3 days, corresponding to 30 to 45 degrees in longitude on the Solar surface (see also Boisse et al. 2011).



- Split the data in overlapping chunks of 60 days, with the next data chunk starting roughly 10 days later.
- Get DCF between RV and indicator for each chunk to study long-term behaviour.
- Repeat by taking one random time per day – mimics real stellar observations.



Conclusions

- HARPS-N Solar data shows that line profile indicators track the behaviour of RVs well, but fall behind by 2-3 days.
- Dense sampling is crucial to track this.
- During low surface activity, RV scatter is not mimicked in these indicators.
- Mortier et al. in prep.