EPSC Abstracts
Vol. 14, EPSC2020-1097, 2020
https://doi.org/10.5194/epsc2020-1097
Europlanet Science Congress 2020

Combining Kepler, TESS and ground based data for characterising exoplanets and stellar activity

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This work compares the information obtained from TESS and Kepler lightcurves, and integrates information obtained from ground based observatories. We apply Machine learning methods for modelling stellar and instrumental systematics in lightcurves because they can quickly identify patterns in data without prior knowledge of the functional form. We use a Gaussian Process to model the stellar activity, background granulation, and transit signals simultaneously because we expect that using a multi-component model can improve planetary characterisation. This work seeks to address the following questions:

RQ1: How accurately can we model the stellar activity and transit signals in TESS and Kepler lightcurves with machine learning?

RQ2: To what extent can we use these models to interpret the rotation periods and activity cycles of the stars?

RQ3: To what extent can we use these models to detrend the lightcurves and improve transit exoplanet characterization?

The model is initialized using information from Box Least Squares, LombScargle analysis, and Autocorrelation functions, and then Markov Chain Monte Carlo algorithms are run to fit rotational modulation parameters and planet parameters. We compare the results of this method across different missions (TESS and Kepler) and compare the results of this method with results obtained from ground based surveys. We illustrate the comparison and the astrophysical results in the case of WASP62 and Kepler 78 targets.