STELLAR PARAMETERS VIA SPECTRUM SYNTHESIS OF APOGEE DR 16 H-BAND SPECTRA OF M DWARF STARS

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We present a method to derive stellar parameters for M dwarfs using high-resolution H-band spectra via spectrum synthesis using iSpec, Turbospectrum, MARCS models atmospheres, and a custom-made line list including over 1000000 water lines (Sarmento et al. 2021). The method was developed to provide reliable spectroscopic parameters from the spectra of current and future NIR high-resolution spectrographs. We derived the spectroscopic parameters (T_{eff}, $[M/H]$, $log\ g$) for a sample of 313 M dwarfs in the APOGEE DR16 and compared them to the ones obtained by ASPCAP and previous values derived from NIR and optical data.

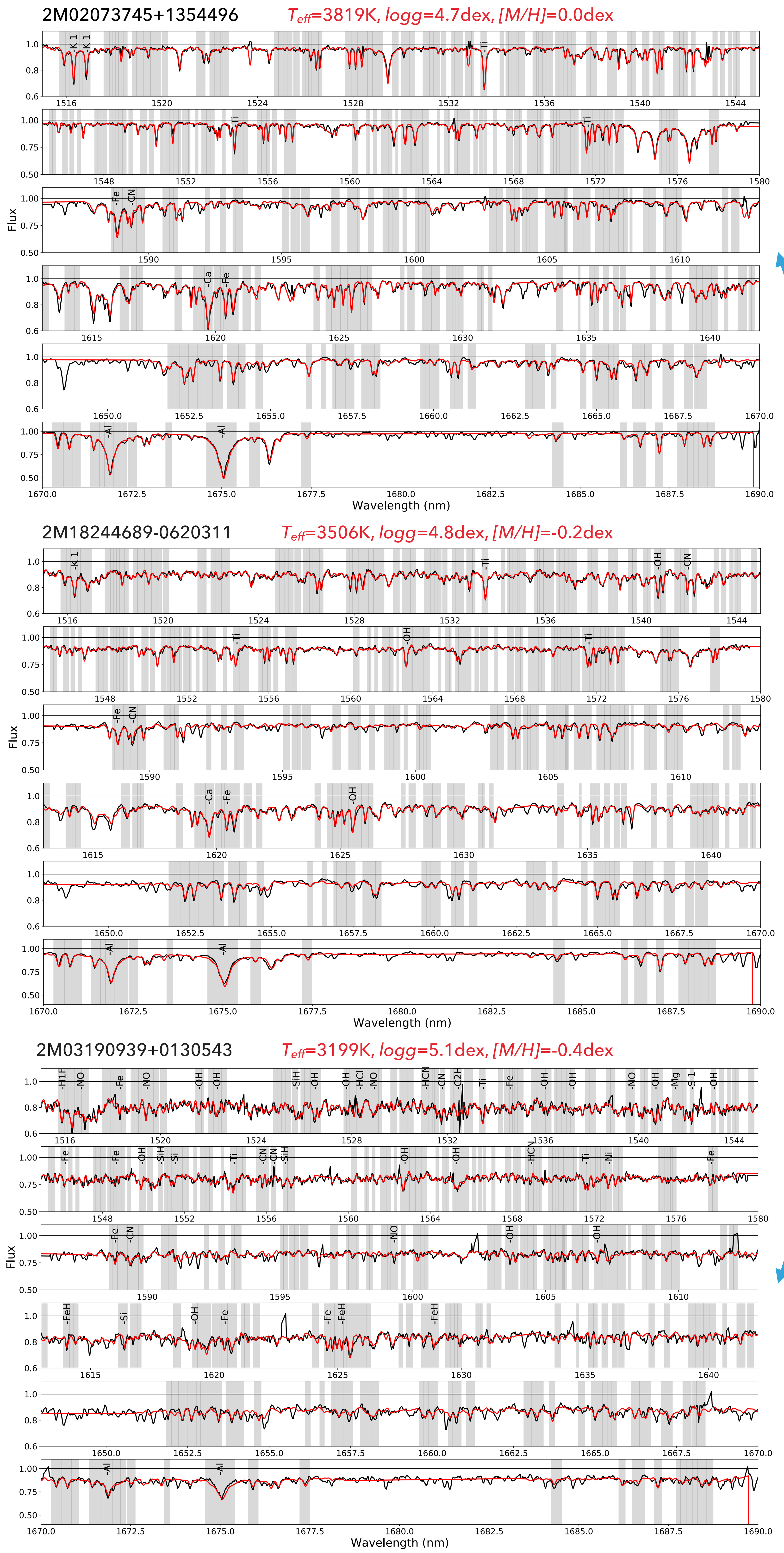

Figure 1: APOGEE spectra of 3 stars analyzed in Sarmento et al. 2021 normalized by the template method described in the paper. The best-fitting synthetic spectrum for each star is over-plotted in red. The areas used for the chi-squared minimization of the pipeline are shown in grey. As the effective temperature decreases, the stellar continuum is affected by molecular absorption (e.g., water vapor: a 600 K difference in T_{eff} can result in a ~0.2 difference in the "continuum" flux for a star. For the colder objects, the synthesis procedure becomes challenging.

Sarmento et al. 2021

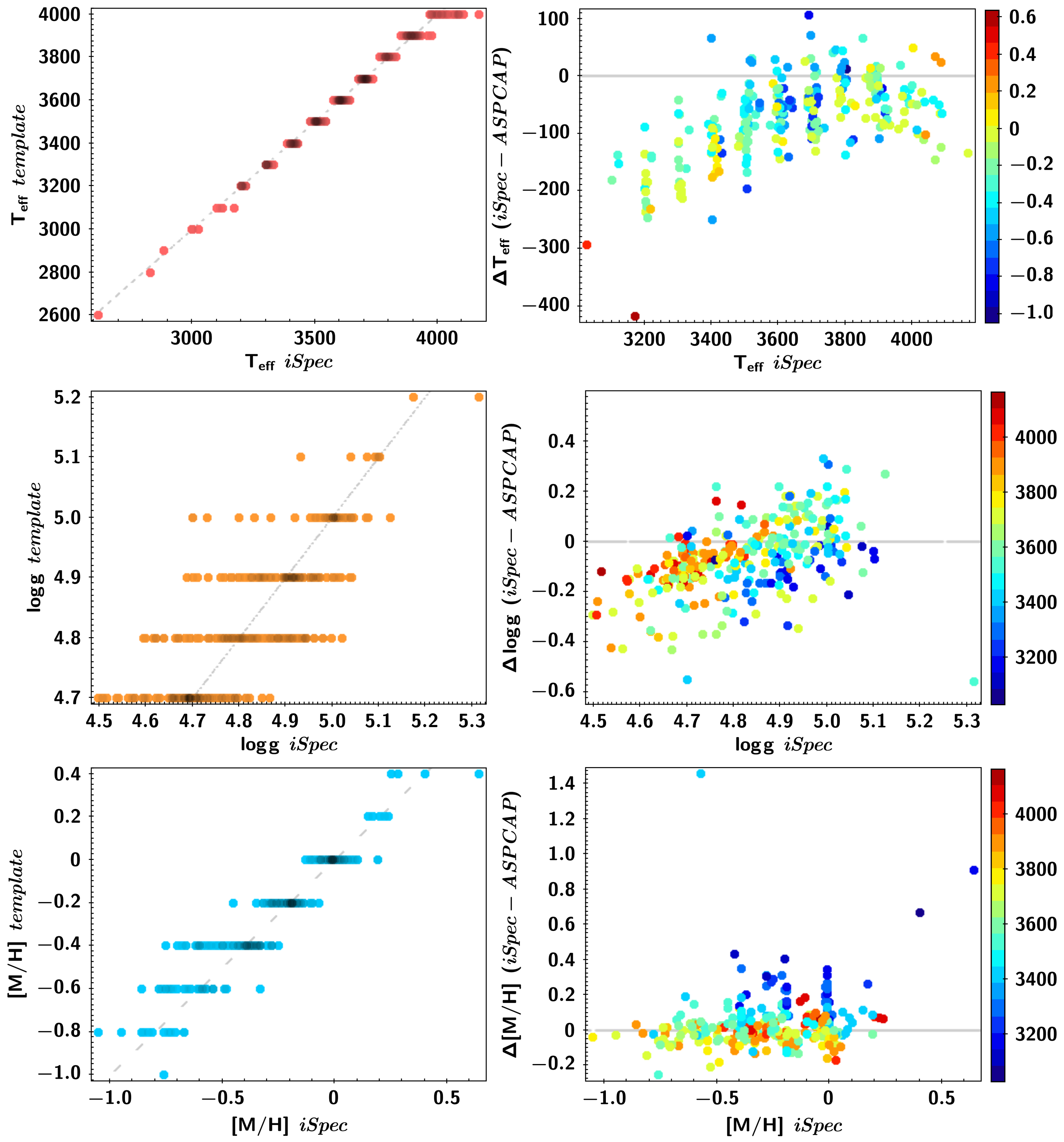

Figure 2: The normalization of the APOGEE spectra was done using templates. The standard approach used in hotter stars (FGK dwarfs) is not possible due to the high molecular absorption present in M dwarfs. The spectrum of each star was normalized using synthetic spectra obtained from 148 different combinations of T_{eff}, log g, and [M/H] values from PARSEC isochrones (Bressan et al. 2012). The template values against the predicted values by our pipeline are shown in plots on the left, where the resolution of the synthetic spectra sample becomes evident (100 K in T_{eff}, 0.1 dex in log g, 0.2 dex in [M/H]). The ASPCAP DR16 values from Jönsson et al. 2020 against our values are plotted on the right. Our T_{eff} values, on average, are lower than the ASPCAP values, and for the colder objects, our metallicity values are consistently higher.

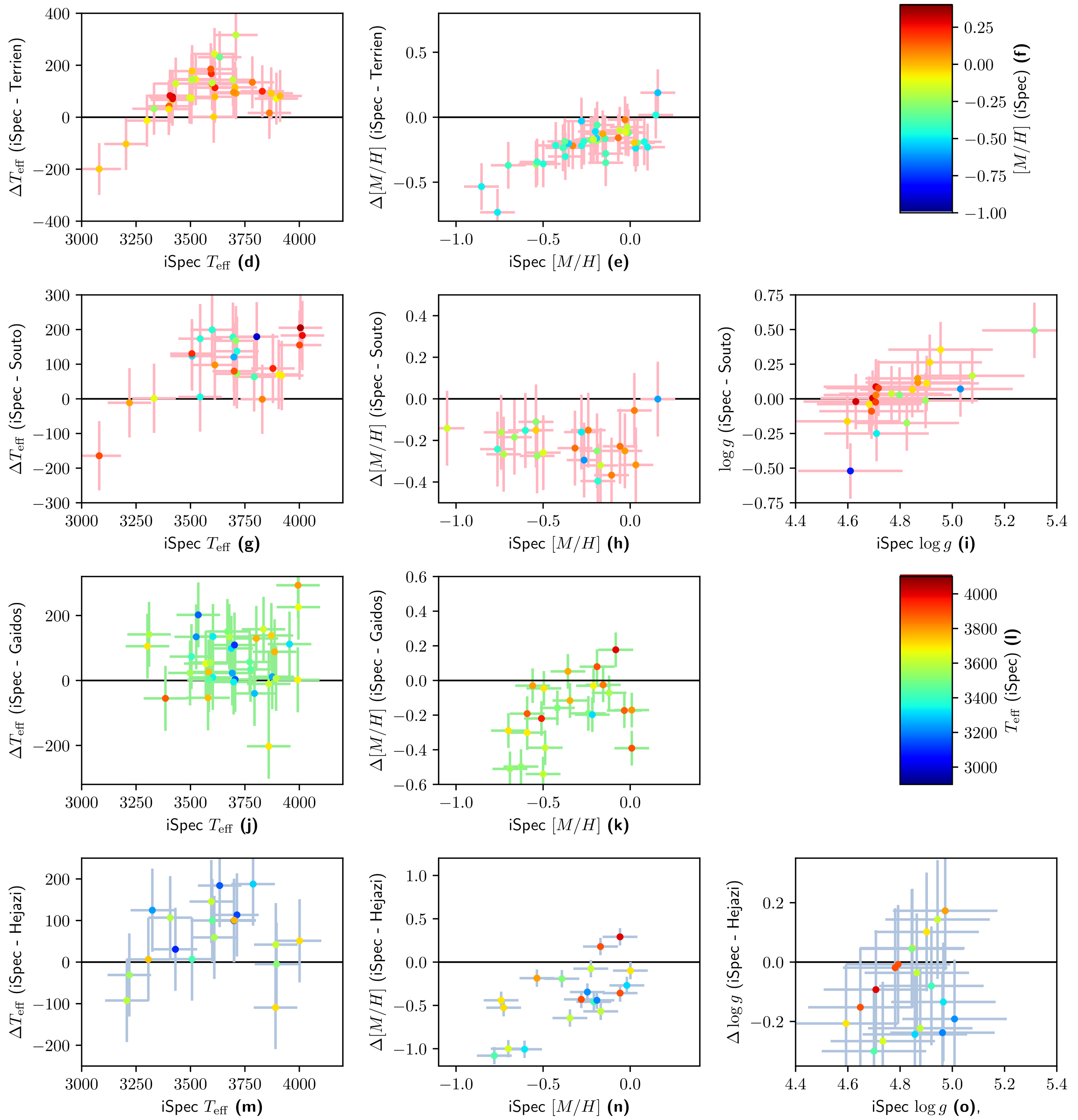

Figure 3: Positive ΔT_{eff} values are found across multiple literature comparisons (Terrien et al. 2015, Souto et al. 2020, Gaidos et al. 2014, and Hejazi et al. 2019), although usually within uncertainty levels. However, the presence of negative Δ[M/H] values in most of our literature comparisons suggest issues with the temperature and metallicity determination in our pipeline, as the effects of changes in these parameters in the M dwarf regime are not independent. We also note that our results are also dependent on the assumptions of the PARSEC evolutionary code. More analysis needs to be done on this subject.