# J-PLUS: Discovery and characterisation of ultracool dwarfs using Virtual Observatory tools
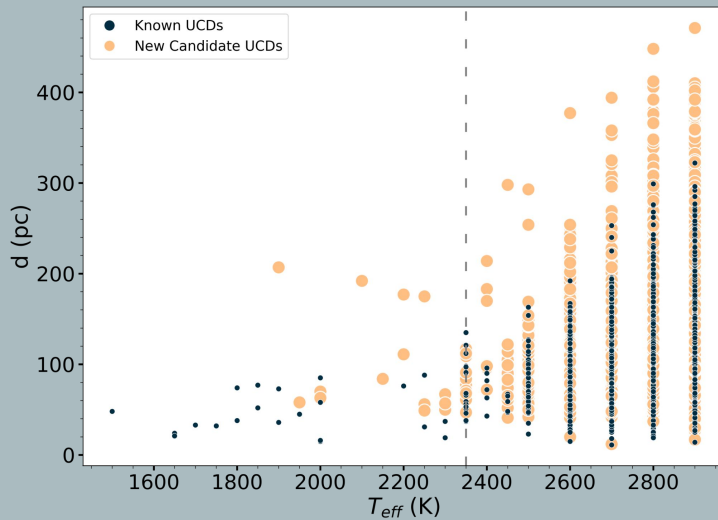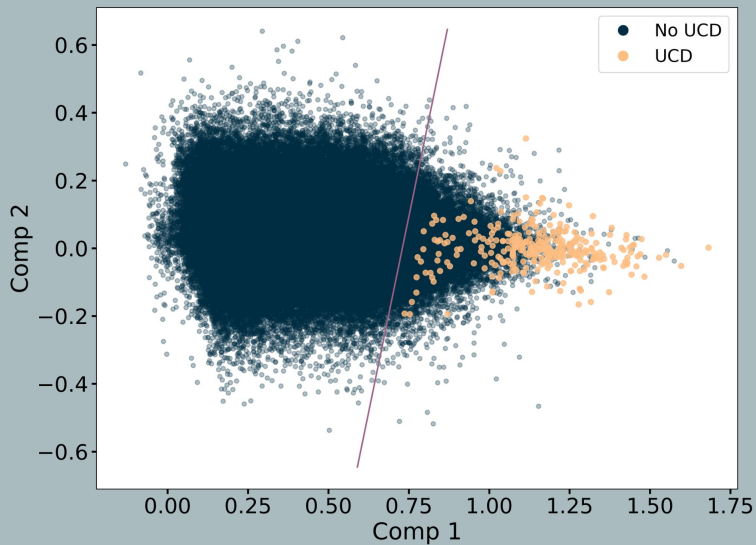## II. Second data release and machine learning methodology

Distance vs. effective temperature diagram for previously reported (blue) and new (yellow) candidate UCDs with good parallax conditions. The vertical dashed line indicates the lower limit of effective temperature for M-type dwarfs (2359 K) according to Pecaut & Mamajek (2013).



Projection of the sample used in the machine learning methodology onto the hyperplane defined by the first two principal components. Points are colour-coded according to their class, UCD (yellow) or non-UCD (dark blue). The purple line represents the decision threshold used to make a first cut at identifying UCDs.

Ultracool dwarfs (UCDs) comprise the lowest mass members of the stellar population and brown dwarfs, from M7 V to cooler objects with L, T, and Y spectral types. Most of them have been discovered using wide-field imaging surveys, for which the Virtual Observatory (VO) has proven to be of great utility.

In this paper we present the search for UCDs performed across the entire Javalambre Photometric Local Universe Survey (J-PLUS) second data release, following a VO methodology based on both photometric and astrometric data and using the Virtual Observatory Sed Analyzer (VOSA) to estimate the effective temperatures. We also developed a two-step machine learning method, based on principal component analysis and support vector machine algorithms, to reproduce this search using only J-PLUS photometry.

We identified a total of 7827 new candidate UCDs, which represents an increase of about 135% in the number of UCDs reported in the sky coverage of the J-PLUS second data release. Among these candidates, we found 122 possible unresolved binary systems, 78 wide multiple systems, and 48 objects with a high Bayesian probability of belonging to a young association. With the machine learning approach, we obtained a recall score of 92% and 91% in the 20×20 deg$^2$ regions used for testing and blind testing, respectively.

The consolidated methodology used in this paper will be used in deeper and larger upcoming surveys such as J-PAS and Euclid.