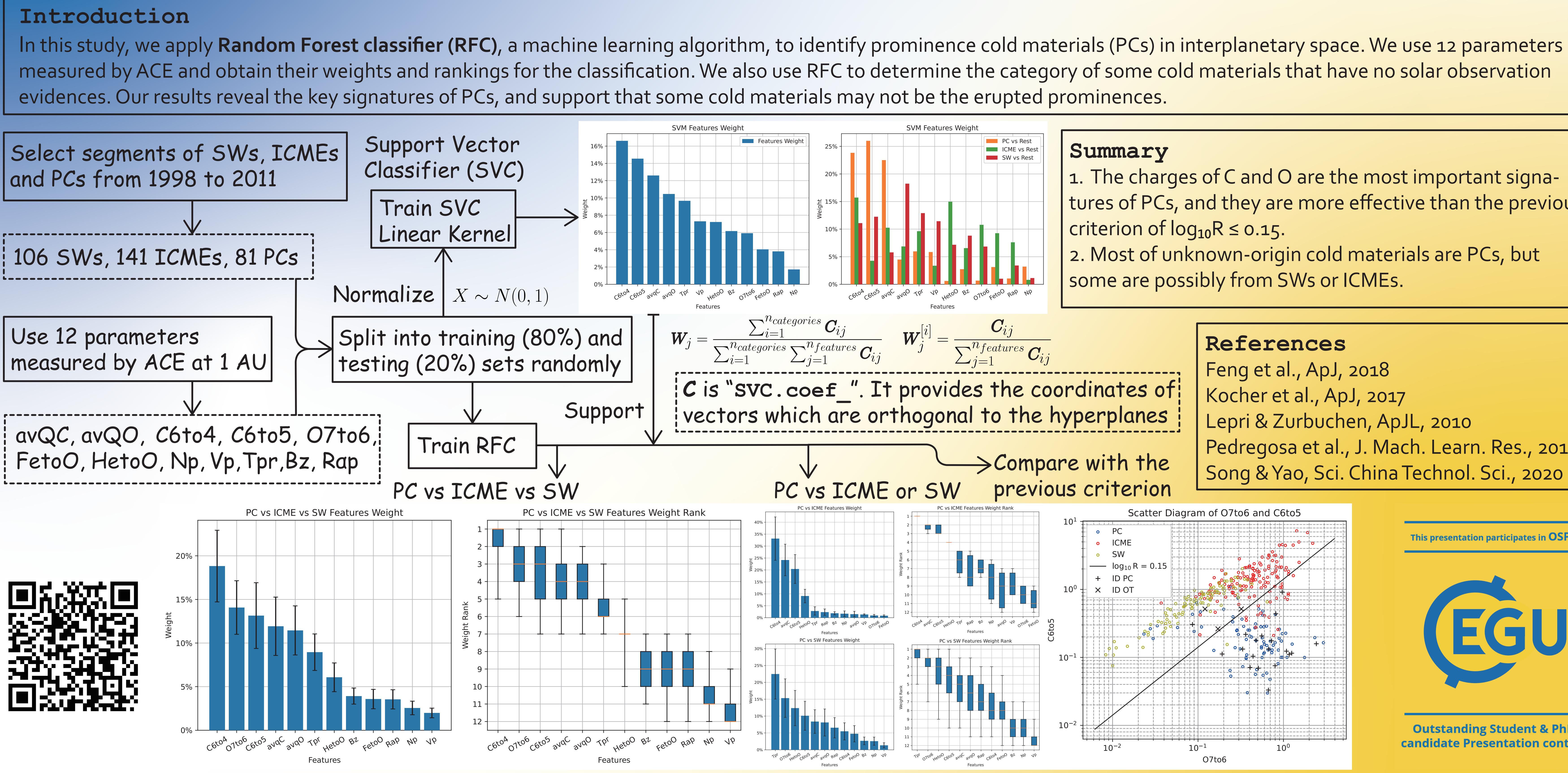# Key Signatures of Prominence Materials and Category of Carbon-Cold Materials identified by Random Forest Classifier

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Introduction

In this study, we apply **Random Forest classifier (RFC)**, a machine learning algorithm, to identify prominence cold materials (PCs) in interplanetary space. We use 12 parameters measured by ACE and obtain their weights and rankings for the classification. We also use RFC to determine the category of some cold materials that have no solar observation evidences. Our results reveal the key signatures of PCs, and support that some cold materials may not be the erupted prominences.

Select segments of SWs, ICMEs and PCs from 1998 to 2011

106 SWs, 141 ICMEs, 81 PCs

Use 12 parameters measured by ACE at 1 AU

avQC, avQO, C6to4, C6to5, O7to6, FetoO, HetoO, Np, Vp, Tpr, Bz, Rap

Support Vector Classifier (SVC)

Train SVC Linear Kernel

Normalize $X \sim N(0,1)$

Split into training (80%) and testing (20%) sets randomly

$$W_j = \frac{\sum_{i=1}^{n_{categories}} C_{ij}}{\sum_{i=1}^{n_{categories}} \sum_{j=1}^{n_{features}} C_{ij}} \qquad W_j^{[i]} = \frac{C_{ij}}{\sum_{j=1}^{n_{features}} C_{ij}}$$

C is "SVC.coef_". It provides the coordinates of vectors which are orthogonal to the hyperplanes

Train RFC

Support

PC vs ICME vs SW

PC vs ICME or SW

Compare with the previous criterion

Summary

1. The charges of C and O are the most important signatures of PCs, and they are more effective than the previous criterion of $\log_{10}R \leq 0.15$.

2. Most of unknown-origin cold materials are PCs, but some are possibly from SWs or ICMEs.

References

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