Toward a universal model for planetary climate

Nicolas Iro

With the discovery of an increasing number of planets outside our Solar System (over 800 so far), we are becoming familiar with physical conditions and atmospheric compositions that span a much wider range that what covered by the planets of our solar system. Non-exhaustive examples are equilibrium temperatures ranging from 50K (Neptune) to over 3000K (WASP-12b, WASP18b) ; orbital eccentricity, ranging from 0-0.1 for solar system planets (except Mercury) and circularized close-in hot Jupiters to HD80606b (e = 0.93). Other parameters relevant for atmospheric dynamical features are also quite diverse : the Rhines length and Rossby length are, e.g., much smaller than the planet radii for Solar system planets, while they are comparable to the planetary radii for hot Jupiters and Neptunes, meaning that in the latter case typical circulation features are global. Such a large variety of atmospheric conditions will be spanned by the EChO mission as its design will allow for time-varying phenomena in exoplanets atmospheres.

We will present VIPER, the Versatile Interactive PlanetSimulator for Extrasolar Research. This project, under development, aims at developing the Planet Simulator, an already flexible climate model to a new level of modularity. In the next phase of the implementation, we will remove all parameterization pertaining to Earth, allowing for instance to study any planetary rotation rate and add a simple yet precise radiative scheme based on the k-distribution coefficients. This will allow us to model the climate on a variety of planetary conditions from early Mars to Super-Earths.