In this thesis we study the properties of exoplanetary atmospheres. The first part describes methods for searching exoplanets, statistics of discovered exoplanets and the sampling factors. The second part describes the properties of chosen planets and moons in the Solar system (Venus, Mars and Titan) and also possible properties of the exoplanetary atmospheres that are only briefly understood. The third part describes the atmospheric models which incorporate a full 3D model of the atmosphere, and a shallow-water model. We also show the results of exoplanetary atmospheric models published in the scientific journals. This part also describes the icosahedral geodetic grid that is advantageous for the global climatic models, and also discretisation on sphere and the application of the operators (gradient, divergence, vorticity) on geodetic grid. The last part is about creating program for global shallow water model in divergence-vorticity variables with forcing system with using icosahedral geodetic grid – we describe technical properties connected with model creating, parameters which the model uses during time integration, geographic system for results display and we show results for various kinds of extrasolar planets and planets in the Solar system. We used several numerical tests for testing model quality. The results are discussed in the conclusion.