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Construction of global maps of atmospheric and surface features of Venus based on new retrieval methods

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The exploration of Venus in the context of comparative planetology and solar system research is an important key to understand crucial aspects of planetary evolution, geology, and climate. Sufficient information can only be gained by applying a long-term remote sensing observation strategy. Early missions to Venus established some basic information about atmospheric and surface features, but only since ESA's Venus Express (VEX) mission is orbiting the planet, the first global database for systematic atmospheric and surface studies became available. It brings Venus back into the focus of exploration of the terrestrial planets after a period of more than 20 years.

The Visible and Infrared Thermal Imaging Spectrometer (VIRTIS) on Venus Express, after six years in a polar Venus orbit, provided an enormous amount of new data and a four-dimensional picture of the planet (2D imaging + spectral dimension + temporal variations). The spectral dimension permits a sounding at different levels of the atmosphere from the ground up to the thermosphere. The planned work focuses on the investigation of temperature fields, cloud composition and altitude distribution, and trace gas concentrations in the atmosphere of Venus. Studies will be mainly performed on the nightside of the planet where the narrow atmospheric window emissions are not obscured by the more intense solar radiation reflected by the clouds. The resulting multi-dimensional maps of atmospheric state parameters will be used to calculate atmospheric net fluxes, heating and cooling rates, and the radiative energy balance of the middle and lower atmosphere of Venus, and to produce required input data for global circulation models. The quantification and elimination of atmospheric impact factors on surface emissivity retrievals are additional important components of this work. The construction of emissivity maps and specification of local emissivity variations will allow of acquire clues on different soil compositions that enable statements about the geologic development of the planet.

Recently by the authors newly developed and verified radiative transfer models and special algorithms, which simultaneously use information from different atmospheric windows for each individual spectrum (multi-window application), can be improved to a large extent by adaptation of new multi-spectrum retrieval techniques (multi-spectrum application) and by the utilization of all available a priori information on surface and atmospheric parameters. In combination with new developments for sophisticated data calibration and pre-processing of VIRTIS-M-IR data this will seriously enhance the accuracy of retrieved atmospheric and surface parameters.

The paper will discuss the capability of the new multi-spectrum retrieval technique as well as the main scientific objectives of the planned work on global atmospheric and surface features of Venus.