THERMAL INERTIA VARIATIONS ON THE SURFACE OF VESTA FROM THE DAWN DATA. M.T. Capria[1], F. Tosi[1], F. Capaccioni[1] , M.C. De Sanctis[1], E. Palomba[1], E. Ammannito[1], T.N. Titus[2] , J.-P. Combe[3], M. Toplis[4], J. Sunshine[5], C.T. Russell[6], C.A. Raymond[7] , and the Dawn team. [1]INAF-IAPS, Via del Fosso del Cavaliere 100, I-00133 Rome, Italy, mariateresa.capria@iasf-roma.inaf.it. [2]Astrogeology Science Center, U.S. Geological Survey, 2255 North Gemini Drive, Flagstaff, AZ 86001, USA. [3]Bear Fight Institute, 22, Fiddler's Road, P.O. Box 667, Winthrop, WA, 98862, USA. [4]Institut de Recherche en Astrophysique et Planétologie (UMR 5277), Observatoire Midi-Pyrénées, 31400, Toulouse, France. [5]Department of Astronomy, University of Maryland at College Park, MD 20742-2421, USA. [6]Institute of Geophysics and Planetary Physics, University of California at Los Angeles, 3845 Slichter Hall, 603 Charles E. Young Drive, East, Los Angeles, CA 90095-1567, USA. [7]NASA/Jet Propulsion Laboratory and California Institute of Technology, 4800 Oak Grove Drive, Pasadena, CA 91109, USA.

Introduction: Deriving the physical properties of Vesta's regolith is part of the integrated analysis performed by the Dawn mission. Surface thermal properties, such as thermal inertia, can give a clue on the status of the regolith, because they are very sensitive to this status. Temperature information has been obtained from the Dawn/VIR (Visible InfraRed imaging spectrometer) spectra acquired during the Vesta campaign [1, 2, 3]. When combined with a thermophysical model, these temperatures can be used to derive surface thermal properties. Thermal properties are sensitive to several physical characteristics of the surface that are not all spatially resolved. In particular, thermal conductivity is sensitive to particle size, rock abundance, bedrock exposure, soil porosity and regolith thickness. Thus, the derivation of surface temperatures and thermal inertia can lead to the characterization of surface and subsurface properties of Vesta and the determination of regolith properties.

Methods: The model we are using solves the heat conduction equation and provide the temperature as a function of thermal conductivity, albedo, emissivity, density and specific heat,. Self-heating from small-scale (sub-pixel) surface roughness is also taken into account. A layered terrain, with regolith on the surface and density increasing towards the interior, is assumed. The model is applied to the actual shape of Vesta: for any given location, characterized by a well-defined illumination condition and a given UTC time to compute the thermal inertia that results in model temperatures providing a best-fit to surface temperatures as retrieved by VIR.

The model has been already applied to the first Vesta full-disk data to derive the global average thermal inertia of Vesta. The values obtained range between 25 and 35 J m^{-2} K^{-1} $s^{-1/2}$. These values are typical of fine-grained, unconsolidated materials (i.e. dust) and suggest a surface in which a dust layer is widespread on coarser regolith. The model is now being applied on small regions of the surface of Vesta. Specific regions are selected because they are interesting for some reason or appear different from the surroundings, such as, for example, dark and bright spots and other peculiar features.

Small-scale surface roughness is described using a formalism [4, 5] that allows to infer the degree of roughness of the surface layer. Given a location, the thermophysical code is applied until the obtained temperatures are matching (best-fit techniques are used) the temperatures derived from the VIR spectra. The thermal inertia, thermal conductivity, albedo and roughness values are then assumed to be characterizing the location under analysis.

It is often difficult to disentangle the effects of varying thermal inertia (i.e. thermal conductivity) values from the effects of varying the values of the parameters that describe small-scale roughness. The results of the model must be carefully checked and interpreted by taking into account the context (from high-resolution images acquired by the framing camera) and in general all the available information. Particularly important is, to this end, the "local time" information. A given spot on Vesta's surface has been typically observed more than once, at different local solar angles and scales. This can greatly improve the reliability of the results.

Initial results: To date, the code is being applied to an initial list of small regions with bright or dark materials, corresponding to areas with higher or lower temperatures compared to the surrounding average temperatures. This initial analysis is already highlighting local differences, (with respect to the average value) in the value of the thermal inertia. This is a clear indication of differences in the local physical properties of the surface layer, namely a different thermal conductivity due to different levels of soil roughness and compactness.

Future analyses will lead to a classification of the surface of Vesta in terms of albedo and thermal inertia, and qualitative indications of the local roughness (or smoothness) of the surface. This information, coupled with he mineralogical information, will help to characterize the materials of the surface of Vesta and will complement analyses of the regolith properties from high-resolution images [6].

Acknowledgements: The authors acknowledge the support of the Dawn Science, Instrument and Operations Teams. This work was supported by the Italian Space Agency (ASI), ASI-INAF Contract I/026/05/0.

References: [1] De Sanctis et al. (2010) *Space Sci. Rev.*, doi: 10.1007/s11214-010-9668-5

[2] Tosi et al., 2011, AGU

[3] Tosi et al. 2012, in preparation

4] Mueller and Lagerros (1998) *Astronomy and Astrophysics*, 338, 340

[5] Davidsson et al. (2009) *Icarus*, 201, 335

[6] Denevi et al., 2012, LPSC 43rd