ANALYSIS OF MAGELLAN AND VENUS EXPRESS TRACKING DATA FOR VENUS GRAVITY FIELD DETERMINATION. Sander Goossens[1,2], Frank G. Lemoine[2], Pascal Rosenblatt[3], Sébastien Lebonnois[4], Erwan Mazarico[2]. [1]Center for Research and Exploration in Space Science and Technology, University of Maryland Baltimore County, 1000 Hilltop Circle, Baltimore MD 21250 U.S.A. (email: sander.j.goossens@nasa.gov), [2]NASA GSFC, 8800 Greenbelt Road, Greenbelt MD 20771 U.S.A., [3]Royal Observatory of Belgium, Av. Circulaire 3, B-1180 Uccle, Belgium, [4]Laboratoire de Météorologie Dynamique, CNRS/UPMC, Place Jussieu, Box 99, 75252 Paris Cedex 05, France.

Introduction: The gravitational field of a planet depends on its internal density distribution, and in combination with topography it can provide a powerful method to probe the interior structure of a planet [1]. Models of planetary gravity fields are determined from satellite tracking data. For Venus, data from the Pioneer Venus Orbiter (1978-1980) and Magellan (1990-1994) spacecraft have been used, and the most recent gravity field model is an expansion in spherical harmonics of degree and order 180, called MGNP180U [2]. Due to computational constraints, the potential coefficients of this model were estimated in successive batches, resulting in artificial discontinuities in the solutions and their error estimates. This hampers the application in geophysical analysis of the models over their whole range, but especially at higher resolutions. We present results of a reanalysis of the Magellan tracking data. We augment this data set with tracking data from the European Space Agency's Venus Express mission (VEX) [3].

Methods: We use our NASA Goddard Space Flight Center (GSFC) GEODYN II Orbit Determination and Geodetic Parameter Estimation package [4] to process the Venus tracking data. We use tracking data from cycles 4, 5 and 6 from Magellan since those were dedicated to radio tracking for the gravity experiment [2]. We also add VEX data. We process the tracking data in continuous spans of data called arcs. We account for the effects of angular momentum desaturation (AMD) events by estimating a constant acceleration in three directions (in the radial, along, and cross-track component). We pay specific attention to the mismodeling of atmospheric effects by employing an atmosphere model [5] in our modeling of the drag force on the satellite, and by estimating scale coefficients on this drag force, once every orbit with time-correlation, in a similar fashion as we estimated empirical accelerations on the Gravity Recovery and Interior Laboratory (GRAIL) data [6]. We also pay close attention to the effects of the atmosphere on the estimated low-degree gravity field coefficients, by forward modeling pressure fields from a General Circulation Model [7], following a technique developed for Earth [8] that has also been applied at Mars [9].

Results: Preliminary efforts have focused on the processing of the Magellan data. We use data with a 2 second count interval with the goal to extract high-resolution information from the data. Our efforts will focus on the determination of a gravity model of degree and order 220 at maximum. Despite indications that the remaining dependence of data noise on altitude is related to ionospheric influences rather than unmodeled gravity [2], we aim for a larger expansion because of our use of 2 s data. We will also leverage the computational tools that we developed for the analysis of the GRAIL gravity data [*e.g.,*6]. Data from VEX will mostly be used to increase resolution in certain areas where VEX collected gravity passes [3], and to extend our temporal baseline for the estimation of time-varying gravity effects such as those described by potential degree 2 Love numbers and the spin-rate secular variations. Effects of atmosphere modeling on these parameters will also be investigated.

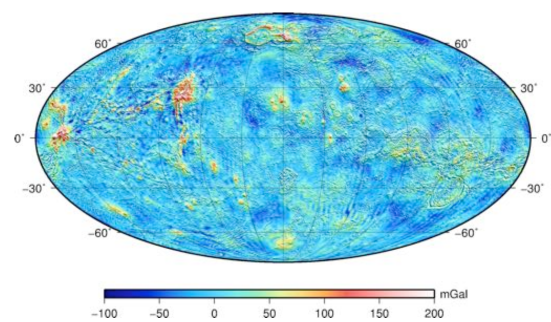

Figure 1 Preliminary gravity field model from Magellan data, shown up to degree and order 140, shaded by topography.

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