A REFINED GRAVITY FIELD MODEL OF VENUS BASED ON TOPOGRAPHY: VGM2013. F. Li [1], W. F. Hao[2], L. Y. Xu[2], J. G. Yan[2], [1] Chinese Antarctic Center of Surveying and Mapping, Wuhan University, Wuhan 430079, China,fli@whu.edu.cn [2] Chinese Antarctic Center of Surveying and Mapping, Wuhan University, Wuhan 430079, China,haowf@whu.edu.cn.

Introduction: Models of the Venusian gravity field are mainly developed through the analyses of the spacecraft orbital tracking data. High frequency components of gravity will be drastically attenuated at higher spacecrafts altitude, which immensely limits the resolution of gravity field. The latest gravity field model MGNP180U (Konopliv et al.1999) has a spatial resolution around 100 km. The Venus topography model GTDR.3;2 from altimetry has a much higher resolution of around 5 km. As topography is recognized as a main contributor to the short-wavelength components of gravity field of the Earth, Moon, and other terrestrial planets (Wieczorek, 2007), it can be used to improve and refine the gravity with reasonable assumptions and modeling. One useful approach is residual terrain model (RTM), which is constructed by substructing a smooth surface from the topography. For example, Forsberg (1984) numerically integrated the topographic effect on the short-wavelength gravity, density anomaly and other geophysical parameters by dividing the terrain into rectangular prisms. Nagy et al. (2000) deduced the analytical expressions of gravitational potential and the first to second deviations of RTM. Hirt et al. (2010, 2012a, 2012b) adopted this method to refine the short-wavelength gravity field of Earth, Moon and Mars successfully. All of the above applications did not take the isostatic compensation into account, which can not be neglected for Venus even in short-wavelength (Kucinskas et al., 1996). Thus, we refined the Venusian gravity by RTM method in consideration of isostatic compensation correction.

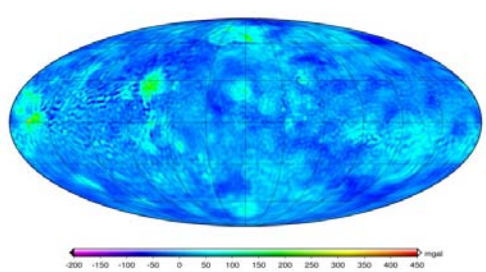
Data and method: The spheric harmonic model of topography is 719-degree VenusTopo719 from Wieczorek. This model is primarily based on the sinusoidally projected GTDR3.2 data set, with gaps filled by Pioneer Venus and Venera 15/16 data and interpolated using the GMT software (Wessel and Smith, 1998). GTDR 3;2 and VenusTopo719 are used here. The actual spatial resolution of MGNP180U varies dramatically on the surface because of the spatial constraint, with a resolution as high as degree 100 near the equator and as low as degree 40 elsewhere (Konopliv et al., 1999). VGM2013 is composed of three parts: 1) Venus surface normal gravity γ; 2) Gravity disturbances of medium to long wavelength using coefficients from degree 2 to degree 120 of the model MGNP180U, δg^{MGNP}; 3) Gravity disturbances of short wavelength obtained from RTM, δg^{VRTM} and isostatic compensation correction δg^{Airy} (Rummel et al., 1988).

Results and discussions: The three parts of VGM2013 and the total 3-dimensional Venusian surface gravity accelerations are displayed in Figure 1.

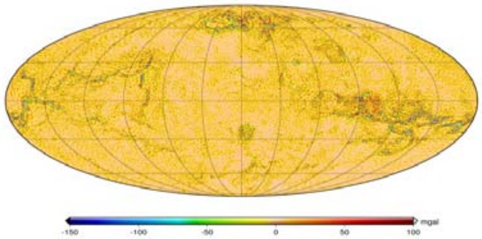
In Table 1 we can see that the VGM2013 model has a substantial effect on the amplitudes of almost all the major gravitational features on Venus compared with the model MGNP120PSAAP and MGNP180U. Sapas, Atalanta and Mead show minor differences, indicating that there are limited short wavelength structures. The maximum of the peaks is at Maat Mons of AtlaRegio, which is same for all the three models.

The gravity disturbances of Beta Regio from MGNP180U and VGM2013 are illustrated as example in Figure 2. The VGM2013 is consistent with MGNP180U in large scale, and shows much smallerscale of gravity details like rifts and ridges as well.

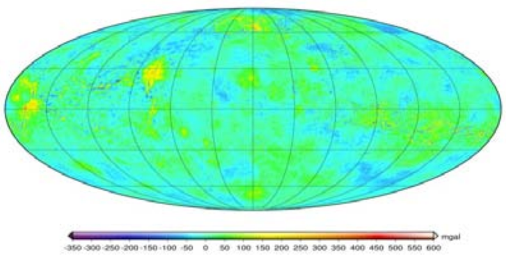
References: [1] Forsberg,R.,(1984). *Ohio Sate Univ Columubs Dept of Geodetic Science and Surveying*.[2] Hirt C., Featherstone W. E., (2012). *EPSL*, 329-330: 22-30.[3] Hirt C, et al., (2012). *PSS*, 67:147-154.[4] James P. B., et al (2013).*JGR* 118, 859–875. [5] Konopliv A. S., et al, (1999). *Icarus*, 139: 3-18.[6] Kucinskas A. B.and Turcotte D. L., (1996). *JGR*, 101: 4725-4736.[7] Nagy D.,and Papp G., Benedek J.,(2000). JoG, 74: 552-560. [8] Rummel R., et al., (1988). *Geod. Sci., Ohio State Univ., Columbus*.[9] Wessel, P., and Smith, W.H.F., (1998).*AGU*, 79,579. [10] Wieczorek, M. A., (2007). *Treatise on geophysics*, 10, 165-206.



(a)



(b)



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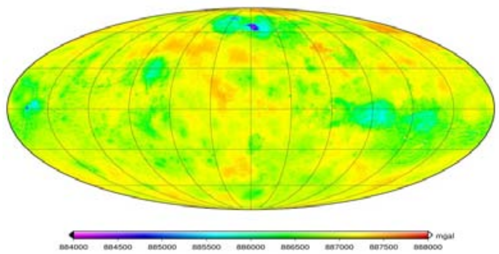
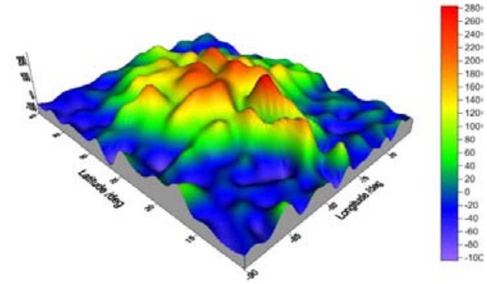
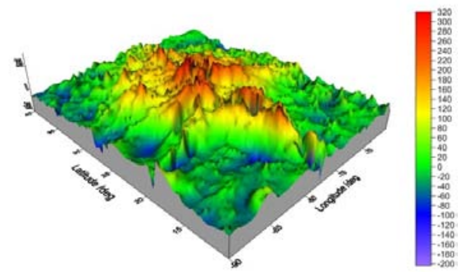


(d)

Figure 1 VGM2013 Output: (a) Gravity disturbances of medium-long wavelength. (b) Gravity disturbances of short wavelength. (c) VGM20013 surface gravity disturbances. (d) VGM20013 surface gravity acceleration. Mollweide projection with a central meridian of 0° longitude. Meridians and parallels are 30° apart.



(a) MGNP180U



(b) VGM2013

Fig. 2 Gravity disturbances at Beta Regio (in mgal)

Table 1 Gravity disturbance peaks at the surface of Venusian features of interest for three gravity models (in mgal)

Regions	LongitudeRange	LatitudeRange	MGNP120PSAAP	MGNP180U	VGM2013
Maxwell	50°W - 20°E	55 - 80°N	236.1	254.0	343.7
Akna	40-50°W	65 - 70°N	116.4	144.8	275.3
Freya	19-24°W	75 - 71°N	124.1	144.8	243.8
Bell	44-52°E	27 - 33°N	162.2	212.1	434.3
Beta	65-90°W	10 - 40°N	234.3	286.7	363.7
Gula	0-5°W	20 - 24°N	134.0	136.1	290.1
Maat	163-168°W	2°N - 1°S	379.3	486.3	615
Ozza	158-162°W	2-5°N	224.6	260.8	395.8
Nokomis	165-175°W	15-25°N	145.9	168.4	304.2
Sapas	170-175°W	8-10°N	170.3	202.9	280.7
Atalanta	150-170°E	60-70-°N	-85.0	-86.2	-107.1
Mead	56-60°E	10-15°N	-67.4	-105.1	-98.8