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Detecting seamounts in the satellite-derived vertical gravity gradient field by nonlinear inversion

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Seamounts draw diverse interests because of their practical and scientific importance. The spatial distribution, volumes, and summit depths of seamounts are informative to researchers managing fisheries, investigating biodiversity of marine habitats, improving ocean circulation and tsunami prediction models, and understanding underwater volcanism through time and space. The constructing of this global database is limited by the incomplete coverage of existing shipboard depth measurements. In this study, we utilize the newly released version 16.1 of the satellite-derived vertical gravity gradient (VGG) data that reveal more details of the seafloor than previous releases. The perturbations of the VGG due to seamounts result from their density contrast with the surrounding water. By assuming that the shapes of such signals can be adequately approximated as the sums of individual, partially over-lapping, elliptical Gaussian features, we can form a nonlinear inverse problem that will fit the elliptical Gaussian model to the VGG data. The model parameters describing the shape and location of an individual elliptical Gaussian are the VGG amplitude, longitudinal and latitudinal coordinates of the peak, major and minor axes of the elliptical base, and the azimuth of the major axis. The logarithmic barrier method is applied to ensure the positivity of all the recovered amplitudes. Given estimates of data noise, we use various model selection criteria (e.g., F-test and Akaike Information Criterion) to evaluate the significance of the detected seamounts and to prevent the model from being overfitted. With the enhanced VGG data resolution and our new searching method, we aim to detect and characterize seamounts rising more than 1 km above the surrounding seafloor. The inversion approach is applied to the Pacific plate first and then globally. Once the

seamounts have been well characterized in terms of their VGG expressions we will process these parameters further so as to ultimately obtain reliable estimates of their approximate physical dimensions.