Density modelling of the lithosphere is of interest for various geophysical applications, e.g., for the description of subduction zones or exploration. In the past, terrestrial gravity data was used for these models. The increase of spatial resolution and good availability of satellite gravity data eases the set up of large scale density models. Although the resolution has been improved in the past decade (e.g., GOCE provides a spatial resolution of 90 km compared to 500 km of CHAMP in 2002), it is still insufficient for detailed density modelling. Therefore, combined models containing terrestrial and satellite data are used for modelling on a local scale (e.g., EGM 2008 provides a spatial resolution of 10 km). In general, combined models provide high accuracy gravity data. However, in areas without surface data and regions of high topography, these models contain large errors that significantly vary from the standard deviation. In our study, we analyze these errors from a geophysical perspective on a local scale. Furthermore, we set up accurate algorithms for exact topographic reduction and spherical Bouguer reduction to reduce processing errors. Data from the Andes, Costa Rica, and Argentina are examined from different global gravity models and compared to terrestrial data. Finally, we identify a) the spatial resolution that is sufficient for density modelling, b) areas containing large errors, c) solutions for such regions, and d) applicability of reduction techniques on satellite gravity data.