

Satellite Altimetry in the Czech Republic: Status 2007

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Abstract: The aim of this presentation is to inform about works in satellite altimetry in the Czech republic during the last 15 years and to provide an outline of the results. The results come from two groups, one is from CEDR (Center for Earth Dynamics Research) and the second is from Military Geographic and Hydrometeorologic Office. We also cooperated with NOAA and NIMA. We worked out-and used repeatedly-a method based on long-term averaged crossover altimetry data (from missions ERS 1, 2, Envisat and Geosat). With these (generated from orbits using tested geopotential models) we computed Latitude Lumped Coefficient (LLC) discrepancies, compared them to the LLC errors projected from the covariance matrices of these models and from the comparison assessed the accuracy of the gravity models. We used single and dual satellite crossover data (SSC and DSC) to refine gravity field models. We also utilized the DSC between low and higher altimetry orbits to detect possible offsets among the terrestrial reference frames of the altimetry missions involved. The potential of geoid W_0 has been derived by means of combining altimetry, levelling, GPS height and gravity data and in turn, an offset between different world height systems has been estimated. We also studied the theory of bistatic satellite altimetry, namely the distribution of reflecting points and the accuracy of their determined surface heights and most recently the determination of the specular reflecting points on the Earth represented not only by a sphere but also an oblate ellipsoid.

Key words: Satellite altimetry, accuracy of the earth gravity field models, single- and dual-satellite crossovers, world height systems, bistatic satellite altimetry

INTRODUCTION

Accuracy assessment of gravity field models by means of crossover altimetry data: It is one thing is to compute an Earth gravity field model-a set of harmonic geopotential coefficients C_{lm} , S_{lm} (also known as Stokes parameters), of degree l and order m . Just as demanding is to estimate their actual accuracy (not only internal precision from the covariance matrix); this becomes more and more difficult as their apparent errors decrease (Klokočník *et al.*, 2004; Novák *et al.*, 2006). Various methods are in use (Lerch, 1991, Lemoine *et al.*, 1998). We have developed and used a method based on crossover satellite altimetry data, very often independent of the global solutions and sufficiently accurate, at least in the pre-GRACE era.

The radial direction is crucial for altimetry. The formulae for the radial, static gravity field induced error as a time series, are well known (Colombo, 1984; Wagner, 1989). But the time series of error does not provide any

useful insight into its source on the orbit or in altimeter corrections because direct altimetry is dominated by the much larger uncertainty of the detailed geoid at the surface. That is revealed in differences of altimeter heights at crossovers (eliminating the influence of the geoid error) and (in comparison) displaying the geographical distribution of the radial error due to the geopotential in latitude and longitude. This last is accomplished using (Rosborough's, 1986) transformation (Rosborough and Tapley, 1987) by projecting the variance-covariance matrices of the tested gravity models to yield expected orbit geopotential errors of SSCs (single-satellite crossovers) geo-graphically. But such information, while useful as an overview and used many times, says nothing about the spectral quality of the geopotential errors. Following the natural formulation of spherical harmonics, this 'Rosborough spectrum' is most readily displayed by order in terms of so-called Latitude Lumped Coefficients (LLC). They were defined (for SSC)