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Satellite orbit estimation using DORIS data: comparison of reduced-dynamic and dynamic orbit modeling and discussion of modeling aspects

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Reduced-dynamic orbit modeling is currently used to compute the routine solutions of the GOP analysis center, which are of similar accuracy as solutions from the other centers utilizing a precise non-conservative force modeling. GOP works with a modified version of the Bernese GPS Software that has not supported non-conservative orbit modeling but utilized empirical and pseudo-stochastic orbit modeling. This limitation is now overcome by new scientific modification of the software, which opens the unique possibility to compare both approaches using the same software platform. The precise dynamic LEO orbit modeling includes the attitude models and the nominal satellite macro-models, with modeling of non-conservative acceleration, i.e. Sun radiation pressure, Earth radiation pressure and atmospheric drag. Both dynamic and reduced-dynamic approaches are used by different analysis centers providing DORIS solutions. The focus of this study is the analysis of the differences between these two approaches for LEO satellite orbit estimation and the verification of the nominal satellite attitude model quality, checked through the necessity of employing 1-per revolution empirical parameters. In addition, the impact of indirect and direct Earth radiation pressure models are assessed, including an analytical model as well as a latitude dependent and a latitude-longitude dependent model. All the presented studies are based on the comparison of estimated DORIS orbits with the multi-technique orbits estimated by other groups as well as on internal arc overlaps and orbit validation using SLR data. Not only orbits estimated with fixed network are analyzed but also the impact of the orbital models on the free-network solutions is investigated.