We are thankful to the Reviewers for carefully reading our manuscript and their useful comments and suggestions that allowed us to improve the manuscript. In the following the comments of the Reviewers are given in black and our responses in blue.
Christian Gruber (on behalf of the co-authors)

Reviewer 1
The paper represents a possible approach of the combination of different observations for determination of the "surface mass transport". In my opinion the work is interesting in itself, but requires a revision in several place before the publication. Major remarks are reported in the following.

1. The paper basically refers to numerical results, which are quite valuable for such regions as Greenland and Antarctic areas. Despite numerous illustrations, it is written rather in a compact way but may not be understood by the reader. For that reason this paper may be considered as a good paper, if authors will introduce a special section with the theory of determination of mass transport including all adopted assumptions (Probably authors supposed that surface masses are concentrated in a thin layer at the surface of the spherical Earth). If so, the following basic reference is missing:

Wahr, J., M. Molenaar, and F. Bryan (1998), Time variability of the Earth's gravity field: Hydrological and oceanic effects and their possible detection using GRACE, J. Geophys. Res., 103, 30,205– 30,229.
We have added this citation.

line 62: used to solve for the gravity variations on surface grid tiles.
changed to:
used to solve for the surface mass equivalents that are concentrated in a thin layer at the surface of the spherical Earth (cf. Wahr et al. 1998).

2. According to the title of manuscript, the authors should note that the determination of the mass redistribution at the Earth's surface from the given external potential is traditionally treated as special boundary case of improperly posed inverse problem of the gravitational potential. From this viewpoint accuracy estimates of the mass redistribution at the Earth's surface (Greenland, Antarctic) given in this work need to be explained in details.
Added, line 71: It should be noted that this improperly posed inverse problem is constrained in two aspects.
Added before "Despite the regularized processing methodology,"
The formal accuracy estimates are found in the updated Kalman covariances that are epoch-wise co-estimated with the states. This results in the equivalent accuracy as

obtained from a regularized solution and is based on error propagation during the time update and a least-squares prediction error. For further details, the reader is referred to (Gruber et al., GJI in review).

The authors can find the rigorous accuracy estimation for the case
of such properly posed inverse problem in the following paper:
?? properly posed
Marchenko A. N. (2009) On the Global Density Distribution Based on the Earth's Mechanical Parameters and Piecewise Reference Model. In: "Mission and Passion: Science" A volume dedicated to Milan Burša on the occasion of his 80th birthday , (Ed. P.Holota), Czech National Committee of Geodesy and Geophysics, Prague, 2009, pp. 169-179.
We have added this citation.

3. The reviewer has a certain doubts concerning the next remark (lines 12-14) of the authors: "In addition, non-conventional methods based on radial basis functions (RBF) and mascons will give the ability to compute models in regional and global representation as well".
This is, in fact, what we show in our paper. We have deleted the word "will" in this sentence.

Such sentence could lead to a violation of understanding of the so-
called RBF or radial multipole potentials (as harmonic functions) introduced by Maxwell (1881) and Lunar mascons (as singular objects) approximated by the potential of point masses, disks, etc.

Yes, the Reviewer is right, we are only modeling the external potential of the Earth, condensed to the thin layer. Poisson's Equation is employed in exterior space. No misinterpretation can be expected here.

On the other hand this sentence has direct relation rather to the
modeling of the external potential then to the Earth's surface mass transport. Because of the Lauricella's theorem the direct modeling of second one is impossible without special study: any density distribution can be represented as simple sum of harmonic density and density of zero potential. See the basic reference:
Moritz, H. (1990) The Figure of the Earth. Theoretical Geodesy and Earth's Interior, Wichmann, Karlsruhe, 1990.
with the application of the Lauricella's theorem to the Earth's density
Marchenko A.N., Abrikosov O.V. A note on the standard parameterization of the Earth's dynamical figure and Darwin's density distribution. Bollettino di Geodesia et Scienze Affini, Anno LIX, (4), pp. 335-348

We believe, that this reference is of no relevancy as we have considered a thin layer of constant density, only. The main contributor to Earth density variations is removed as a static background model.

Summarizing, the reviewer recommends the publication of this manuscript in the Earth Surface Dynamics after improvements, including the Summary, according to given before suggestions.

Reviewer 2

The authors discuss a novel method based on (regularized) radial basis functions for recovery of the global Earth's gravity field from GRACE inter-satellite range-rate data. To test its performance, they authors use four independent datasets and using various metrics they compare results of the new method with respect to three global geopotential models derived from GRACE data. Obtained numerical results demonstrate that the new method can be used for global gravity field modelling as an alternative to classical spherical (spheroidal) harmonic models.

In my opinion, the article contains interesting new results. Thus, I support the publication of the article in ESD, maybe after the authors consider my remarks:

1- Both the abstract and discussion should explicitly state that the RBF modelling technique can be used for processing GRACE data yielding global gravity field models which fit independent reference values at the same level as commonly accepted global geopotential models based on spherical harmonics. Advantages (and potentially also weaknesses) of the new technique (implementation complexity, computational cost, temporal and spatial resolvability etc.) could be mentioned in the text.

Thank you for this suggestion. We have added the following sentence in the abstract and in the discussion: "We show that the RBF modelling technique can be used for processing GRACE data yielding global gravity field models which fit independent reference values at the same level as commonly accepted global geopotential models based on spherical harmonics."

We added (after "hydro-geophysical signals"):
Some key advantages of the method are summarized as follows:
  • enhanced temporal resolution,
  • regional solutions and refinements if local covariance information available,
  • no post filtering required (user- friendly),
  • spatial constraining (e.g. land/ocean de- coupling),
  • linear equations and low computational costs,

- reduced artefacts through spatial localization compared to global coefficient estimation,
- combination with other space gravimetric techniques such as satellite laser ranging, gradiometry, and sea surface topography from altimetry.

2- The RBF-based modelling technique is described in Section 1 using the standard text with some references. I would like to see at least fundamental equations of the mathematical model to make the article self-contained for its readers.
The basic equations require several pages, and as they are given in (Gruber et al., reviewed in GJI) and (Novak, 2007) this would result in a third repetition.

3- The alternative global geopotential models are referenced in Section 1 but for the same reason given above, few words about each model could be added (maximum resolution, processing technique, estimation of low-degree coefficients etc.).

We have added at the end of manuscript:
For details about the maximum resolution, error estimates and low-degree harmonic coefficients the reader is refered to the corresponding file ftp://gfzop.gfz-potsdam.de/EGSIEM/readme.