Global Sea-Level Budget and Ocean Mass Budget Assessment

Initial results from ESA’s CCI Sea Level Budget Closure (SLBC) project

Summary

Studies of the sea-level (SL) budget are a means of assessing and understanding how sea level is changing and what are the causes. Closure of the total sea-level budget implies that the observed changes of global mean sea level equal the sum of observed (or otherwise assessed) contributions, namely changes in ocean mass and ocean thermal expansion. Closure of the ocean mass budget implies that the observed ocean mass change (OMC) equals assessed changes in mass from glaciers, ice sheets, land water storage, snow pack and atmospheric water content. Misclosure of these balances indicates errors in some of the components or contributions from missing or unassessed elements in the budget.

SLBC_cci

ESA’s Climate Change Initiative (CCI) has conducted a number of projects related to sea level, namely the Sea Level CCI project, the Greenland and Antarctic Ice Sheet CCI projects, the Glaciers CCI project and the Sea Temperature CCI project.

The aim of the CCI Sea Level Budget Closure project, launched in April 2017, is to close the CCI sea-level budget, together with further ocean products provided by the project partners to reassess the sea-level budget and ocean mass budget.

Specifically, the project further develops and analyses products based on the CCI projects mentioned above in conjunction with data products from ocean profiles (e.g., Argo), GRACE-based ocean mass change assessments, and model-based data for glaciers and land hydrology. The project benefits from directly involving the expertise on the product generation for all the involved sea-level contributions.

Initial Results

Here, we report on the initial assessment of global sea-level budget and ocean mass budget closure. This initial assessment uses data products that were available by the beginning of the project. In this presentation, we focus on the 2003–2015 (GRACE / ARGO) period. We consider the budget of the long-term trends as well as the budget of the overall interannual variations.

A special focus is on the account for uncertainties of the individual contributions, building on the expertise of all project partners. We find that the budget is closed within uncertainties. Systematic uncertainties in the ocean mass change estimates appear to dominate the uncertainty budget.

References

A collection of survey papers is available in the Surveys of Geophysics 2017, 38(3), special issue “ESI Workshop on Integrative Studies of the Mean Sea Level and its Components.”


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Global Ocean Mass Budget

Table 1: Trends 2003–2015/16 of components that contribute to the sea-level budget with standard uncertainties.

Table 2: GMSL trend budget 2003–14/15; with standard uncertainties.

Table 3 & 4: Global Ocean Mass Change from GRACE solutions.

Table 5: Ocean mass change component from GRACE solutions.

Fig. 1: Global ocean mass change from several GRACE solutions, here, the seasonal signal is still included.

Fig. 2: Individual ocean mass component contributions. Note the strong seasonal signal of the land water component, in this figure, the seasonal signal has been removed.

Fig. 3: GMSL from GRACE ensemble means, dark blue, upper panel and the sum of the individual components (red). For this figure, the seasonal signal has been removed.