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Regional Variability of the 20th century sea level rise from Ocean-Atmosphere Coupled Climate Models

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Over the 20th century, tide gauge records indicate a rise in global mean sea level of 1.7 mm.y-1 (Church and White 2011). This rise is essentially due to the warming of the ocean (which made the ocean water expand and sea level rise by ∼0.6 mm.yr-1) and the melt of mountain glaciers (which added more water to the ocean and made sea level rise by ∼,0.6 mm.yr-1 Gregory et al. 2013). Land water changes and Greenland surface mass balance changes also played a role but of lesser importance (∼0.1 mm.yr-1 for the land water storage and ∼0.2 mm.yr-1 for the Greenland mass balance since 1900, Gregory et al. 2013). Each of these different contributors to the 20th century global mean sea level rise had also an impact on the regional sea level changes. This regional signal, which must be added to the global sea level rise to compute the total sea level signal, is essential when we want to assess the impacts of the 20th century sea level rise on coastal areas and low lying islands.
In this study we aim to estimate this 20th century regional sea level changes. We use historical runs of the CMIP5 (Coupled Model Intercomparison Project Phase 5) coupled climate models, which cover the period 1850-2006, to estimate the different contributors to the regional sea level changes since 1900. The ocean warming contribution is directly computed from the Temperature and Salinity outputs of the CMIP5 models while the mountain glaciers and the Greenland contributions are computed from offline models using the surface temperature output of CMIP5 models. Concerning the landwater storage contribution, it is actually mainly of anthropogenic origin over the 20th century (Ngoduc et al. 2005, Meyssignac et Cazenave 2012) so it is not modeled in CMIP5 models. Consequently, we use here estimates of the landwater storage contribution based on 20th century observations from Konikow et al. 2011 and Wada et al. 2012. As a results we present the different contributions to regional sea level changes over the last century. We also show the sum of this contributions and we compare it with sea level observations from tide gauge records and satellite altimetry. This comparison enables to select the models that reproduce best the regional variability in sea level observed over the past decades. The next step is to use these selected models to compute improved sea level projections for 2100.