

An integrated, interdisciplinary approach between natural & social sciences is needed to better understand & address regional sea level change (RSLC) & its impacts on societies. The German Research Foundation (DFG) Priority Program (SPP) 'Regional Sea Level Change and Society (SeaLevel)' performs a comprehensive, interdisciplinary analysis to advance our knowledge on RSLC, while accounting for human-environment interactions & socio-economic developments in the coastal zone. SeaLevel consists of 20 projects, bringing together over 80 scientists from 23 German research institutions & a wide range of disciplines, such as phys. oceanography, geophysics, geodesy, hydrology, marine geology, coastal engineering, geography, sociology, economics & environmental management. The program focuses on: i) the North & Baltic Seas with potential impacts on Germany, and ii) the South-East Asia/Indonesia region, encompassing coastal megacities, low-lying islands & deltas. These regions contrast developed & developing countries, & thus differ fundamentally in their socio-politico-economic & cultural contexts, adaptation & response strategies towards SLC. By combining observations with models, natural & social scientists within the SeaLevel work together with the aim to create a scientific base for quantitative, integrated coastal zone management (ICZM), applicable to many endangered places globally. Below we present some recent results from the different SPP SeaLevel projects.

Contributions to global & regional sea level changes

PARSL-Glac: Contemporary glacier mass (GM) is in disequilibrium with current climate. 36 \pm 8% GM loss is already committed to past greenhouse gas emissions (~15 kg of ice /1kg of CO² emission). Thus, mitigating future emissions will have limited influence on GM change in 21st century. No difference between 1.5 & 2 deg. significant detectable in SL contribution of scenarios is glaciers, but in the long-term, mitigation will exert strong control, highlighting the need for ambitious measures for long-term preservation of glaciers (*Marzeion et al., 2018*).





OMCG

investigates differences in approaches to improve mass/steric SL[®] **budget**, by extending the inverse method (2016).

Including ice-altimetry is expected to further improve ocean mass change (OMC) estimates & decrease GIA-related uncertainty in inversion-based OMC.

Regional Impacts in North Europe

MOREWACC: Projections of SLR impact on the morphological development of Wadden Sea (North Sea) in 2010-2100 indicate a transition from tidal-flat-dominated system toward lagoon-like system, with large part of Sylt-Rømø Bight permanently covered by water potentially dramatic and thus, implications for Wadden Sea' ecosystem (Becherer et al., 2018).



Recent SPP SeaLevel publications: Becherer, J., J. Hofstede, U. Gräwe, K. Purkiani, E. Schulz & H. Burchard (2018), The Wadden Sea in transition - consequences of sea level rise: Ocean Dyn., 68, 131-151. Bott, L.M., J. Illigner, M.A. Marfai, T. Schöne, & B. Braun (2018), Meeresspiegelanstieg & Überschwemmungen an der Nordküste Zentraljavas-Physische Ursachen & soziale Anpassungsmaßnahmen. Geographische Rundschau 70(4), 4-8. Esselborn, S., S. Rudenko, & T. Schöne (2018), Orbit-related sea level errors for TOPEX altimetry at seasonal to decadal timescales, Ocean Sci., 14, 205-223. Karegar, M.A., T.H. Dixon, R. Malservisi, J. Kusche, & S.E. Engelhart (2017), Nuisance Flooding and Relative Sea-Level Rise: the Importance of Present-Day Land Motion, Nature Scientific Reports, 7(11197). Marzeion, B., G. Kaser, F. Maussion, & N. Champollion (2018), Limited Influence of climate change mitigation on short-term glacier mass loss: Nature Climate Change. Rudenko S., K.-H. Neumayer, D. Dettmering, S. Esselborn, T. Schöne, J.-C. Raimondo (2017), Improvements in precise orbits of altimetry satellites and their impact on mean sea level monitoring, IEEE Trans. Geosc. Rem. Sens., 55(6) Schaffer, J., W.-J. von Appen, P.A. Dodd, C. Hofstede, C. Mayer, L. de Steur, & T. Kanzow (2017), Warm water pathways toward Nioghalvfjerdsfjorden Glacier, Northeast Greenland, J. Geophys. Res. Oceans, 122, 4004-4020.



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DECVAR: Projected RSLC from 100 MPI-ESM ensemble are subject to considerable uncertainty under RCP 4.5 & historical scenarios. The spread in future SL trend in coastal cities indicating reaches up to 10 cm, significant challenges in mitigating potential impacts on society.





Decision making and governance

TRANSOCAP: Coastal floods, their causes & consequences can be understood as coupled **socio-ecological systems**. Indonesia's RSLR is highly divergent: -5 to >10 cm yr⁻¹. In Semarang (Central Java), GNSS-corrected tide gauge data show 10 cm yr⁻¹ local SLR, caused by land subsidence due to e.g. excessive groundwater extraction & surface load, which leads to frequent tidal & river floods



Ice sheet-Ocean Interactions

OGreen79: Greenland Ice Sheet is losing mass at an accelerating rate. Analysis of historic & recent bathymetric, hydrographic, & velocity observations to understand Atlantic waters (AW) supply in the cavity beneath the floating Nioghalvfjerdsfjorden Glacier (79NG), i.e. the largest glacier in N.E. Greenland, indicates boundary current transport of warm >1°C AW via Norske Trough toward 79NG (Schaffer et al., 2017).

Regional Impacts in S.E. Asia/ Indonesia

CoRSEA: Using state-of-theart geodetic sensors (tide gauges, GNSS, altimetry, GRACE, InSAR) to identify SLC & patterns, extreme SL & coastal flooding under local subsidence in Java/Indonesia megacities, e.g. Jacarta, Semarang & Surabaya, & combine results with socio-economic studies.



• Winiversity of Stuttgart

So far, locals have been able to cope through mutual, collective action & social capital.



Outmigration is very limited. But with future SLR, how long will it be socio-economically feasible? (*Bott et al*., 2018).

sampling & measuring fossil microatolls as indicators of past & today SLC (**SEASchange**); maintaining tide gauge network in Indonesia (CoRSEA)

hydrographic cruises in **Greenland** to study **basal melt** water (*Labsea Melt*); ethnographic research on adaptation policies & sociotechnological practices for risk governance in S.E. Asia megacities of Jakarta, Manila & Singapore (EMERSA);





SPP SeaLevel Fieldwork includes....

engineering approaches to coastal hazards, perception & governance in Maldives (**DICES**), & many more.



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Rhein et al., 2018, GRL

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