SeaLevel Newsletter

Issue 4 | January 2019

www.spp-sealevel.de

Welcome to the SPP-1889 SeaLevel Newsletter!

To start, we would like to wish you all a productive and stimulating 2019!
The year ahead promises a particularly interesting time for the SPP SeaLevel program, as the research projects in the 1st phase progressively merge their interdisciplinary knowledge obtained over the last ~3 years, but also as the program will enter its 2nd phase later in summer/autumn 2019, marking a new era of ideas, approaches and collaborations of the interdisciplinary and transdisciplinary sea level research performed within the SPP SeaLevel.

This issue presents: the most modern investigation of South America glacial areas, from the tropical Venezuela to the subpolar Tierra del Fuego by using satellites to estimate rates of ice mass loss and the contribution to sea level; a revised examination of Antarctica contribution to global sea level change based on a more realistic distribution of mass changes; and a household survey at the sea level threatened Bougainville Island, Papua New Guinea, and the social dimensions of coastal erosion there.

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Also, get informed about a past symposium and public photographic exhibition in Jakarta, with a focus on urban life, experienced aspects, policies and practices related to sea-level change in Jakarta, Manila, Singapore and other Southeast Asia areas; as well as read an overview of the recently held sea level and coastal impacts panel at the largest Earth and space science annual meeting.

We hope you enjoy reading the SPP SeaLevel Newsletter and thank you for your interest to our program and research activities!

SATELLITE: Constraining glacier elevation and mass changes in S. America

Matthias Braun, Philipp Malz, Christian Sommer; FAU Erlangen-Nürnberg

Most recently Nature Climate Change published results from the South America study of the SATELLITE project. Enjoy a part of the press release as a teaser or read the full article (links below).

'If you compare historical photos of glaciers with those taken more recently, you can see that where there was formerly ice, there is now very often nothing but rock. Geographers, however, are less interested in the area covered by a glacier, and more interested in its mass. Researchers from Friedrich-Alexander-Universität Erlangen-Nürnberg (FAU) have now investigated all glacial areas in South America in more detail than ever before, from the tropical

Fig 1: The Uppsala Glacier, the largest glacier in South America in Argentina, flows into Lago Argentino. When such outlet glaciers shrink, they first have to form a stable front again, which can stop the masses of ice flowing downstream.

areas of Venezuela to the subpolar regions of Tierra del Fuego. Their two major findings are that the highest rate of mass loss is in the Patagonian ice sheet, and that the glaciers in the tropics have lost considerably less mass than previously projected, although this is not the good news which it might appear at first sight.

(…)

One method for measuring all glaciers Geographers from FAU specialising in both climatology and remote sensing and spatial information, led by Prof. Dr. Matthias Braun and Dr. Tobias Sauter, also used satellite data for surveying South American glaciers, but they focused on calculating elevation levels instead of basing their results on gravimetric measurements. Two radar satellites from the German Aerospace Center (DLR) have been orbiting the Earth since 2010. The aim of the TanDEM-X-mission was to obtain a three-dimensional image of the Earth, which is not only of a consistent quality but also more accurate than anything that has gone before. Differences in elevation were recorded down to the last metre. The researchers from FAU used data collected between 2011 and 2015 and compared them with measurements from the Shuttle Radar Topography Mission of 2000. Using a complex method which involved making various corrections and calculating possible error margins, they compared the data to calculate the changes in elevation in the glacial regions of South America, thus obtaining an accurate picture of the changes in glacial mass. Their method was unusual in that they were able to use one uniform method to record all glacial areas in the region. In addition, the method even provided accurate data for individual glaciers. Comparing the measurements from both space missions allowed the researchers to gain detailed insights into the situation throughout South America. For the first time, researchers succeeded in analysing the large Patagonian ice fields separately from the surrounding, smaller glaciers. …'

Full press information here

nature climate change — LETTERS

Constraining glacier elevation and mass changes in South America

Matthias H. Braun, Philipp Malz, Christian Sommer, David Farías-Barahona, Tobias Sauter, Gino Casassa, Alvaro Soruco, Pedro Skvarca and Thorsten C. Seehaus

Excluding the large ice sheets of Greenland and Antarctica, glaciers in South America are large contributors to sea-level rise1. Their rates of mass loss, however, are poorly known. Here, using repeat bi-static synthetic aperture radar interferometry over the years 2000 to 2011/2015, we compute continent-wide, glacier-specific elevation and mass changes for 85% of the glacierized area of South America. Mass loss rate is calculated to be 19.43 ± 0.60 Gt a⁻¹ from elevation changes above ground, sea or lake level, with an additional 3.06 ± 1.24 Gt a⁻¹ from subaqueous ice mass loss not contributing to sea-level rise. The largest contributions come from the Patagonian icefields, where 83% mass loss occurs, largely from dynamic adjustments of large glaciers. These changes contribute 0.054 ± 0.002 mm a⁻¹ to sea-level rise. In comparison with previous studies2, tropical and out-tropical glaciers — as well as those in Tierra del Fuego — show considerably less ice loss. These results provide basic information to calibrate and validate glacier-climate models and also for decision-makers in water resource management.

SATELLITE project: Braun, M.H., P. Malz, C. Sommer, D. Farías-Barahona, T. Sauter, G. Casassa, A. Socuro, P. Skvarca, and T.C. Seehaus (2019), Constraining glacier elevation and mass changes in S. America, Nature Climate Change, doi: 10.1038/s41558-018-0375-7.

Other Recent SPP SeaLevel Publications:

Labsea Melt project: Rhein, M., R. Steinfeldt, **O. Huhn**, J. Sültenfuß, and T. Breckenfelder (2018), Greenland submarine melt water observed in the Labrador and Irminger Sea: *Geophysical Research Letters*, 45, 10,570-10,578, doi:10.1029/2018GL079110.

SEASchange project: Rovere, A., P. Khanna, C.N. Bianchi, A.W. Droxler, C. Morri, and D.F. Naar (2018), Submerged reef terraces in the Maldivian Archipelago (Indian Ocean), *Geomorphology*, 317, 218-232, doi:10.1016/j.geomorph.2018/05.026.

Visit *www.spp-sealevel.de* → *"Resources"* → *"SPP Publications"* for a full list of SeaLevel publications

OMCG: Investigation of Antarctic contribution to global sea-level change

Willen, M.[1], Uebbing, B.[2], Kusche, J.[2], Horwath, M.[1], [1]TU Dresden, [2]University of Bonn

Temporal and spatial sea-level variations are measurable variables of climate change and can be quantified with satellite geodetic observations. The fingerprint inversion (Rietbroek et al., 2016) permits the estimation of the individual contributions of the sea-level change at both, global and regional level.

As part of the OMCG project, we extend the global fingerprint inversion to include observations of ice altimetry in order to extend the information on ice-mass variations and glacial isostatic adjustment (GIA). Previously, we assumed drainage basin wise homogeneous mass changes over Antarctica. In a first experiment, we utilized the spatial information from the ice altimetry trend map to replace the Antarctic fingerprints. This is done to achieve a more realistic distribution of mass changes over Antarctica. Fig. 2 shows the ice-altimetry trends and drainage basins (Zwally, et al., 2012). Table 1 summarizes the effect on components of the global sea-level budget.

Table 1: Relative sea level rates in mm yr^{-1} (2002-6–2016-05). Components of global sea-level budget compared of previous inversion run (base run) and with new Antarctic fingerprints (Antarctica repl.).

	Base run	Antarctica repl.
GLACIERS	0,418	0,399
ANTARCTICA	0,582	0,446
GREENLAND	0,740	0,742
HYDROLOGY	-0,034	0,096
MASS	1,707	1,681

While the sum of all mass components remained almost identical, we found that our previous result may have slightly overestimated the rates of the Antarctic contribution. The latter has been mostly compensated by an increased rate of the hydrological component. The effect on the contributions due to the mass change of the Greenland ice-sheet and land glaciers was negligible indicating that the estimation of these components is relatively stable with respect to changes in Antarctica. In terms of mass change the Antarctic contribution is ~210 (Base run) and ~160 Gt yr^{-1} (Antarctica repl.). We assume a significant influence due to a predefined GIA signal.

In the next step, we will prepare a time series of ice mass changes over Antarctica by combining ice-altimetry observation with modeled surface processes. These observations will serve as additional constraints within the inversion in order to improve the separation of ice mass changes from GIA signals. In the future, we will further extend the parameterization of the ice sheets within the fingerprint inversion based on additional prior information. This will aid our efforts to combine the simultaneous estimation of GIA, ice and firn processes from the combination of geodetic satellite observations.

References:

Rietbroek, R., Brunnabend, S. - E., Kusche, J., Schröter, J., & Dahle, C. (2016). Revisiting the contemporary sea-level budget on global and regional scales. PNAS.

Schröder, L., Horwath, M., Dietrich, R., Helm, V. (2018). Four decades of surface elevation change of the Antarctic Ice Sheet from multi-mission satellite altimetry, TCD.

Zwally, H. J., Giovinetto, M. B., Beckley, M. A., L. Saba, J. L. (2012) Antarctic and Greenland Drainage Systems, GSFC Cryospheric Sciences Laboratory

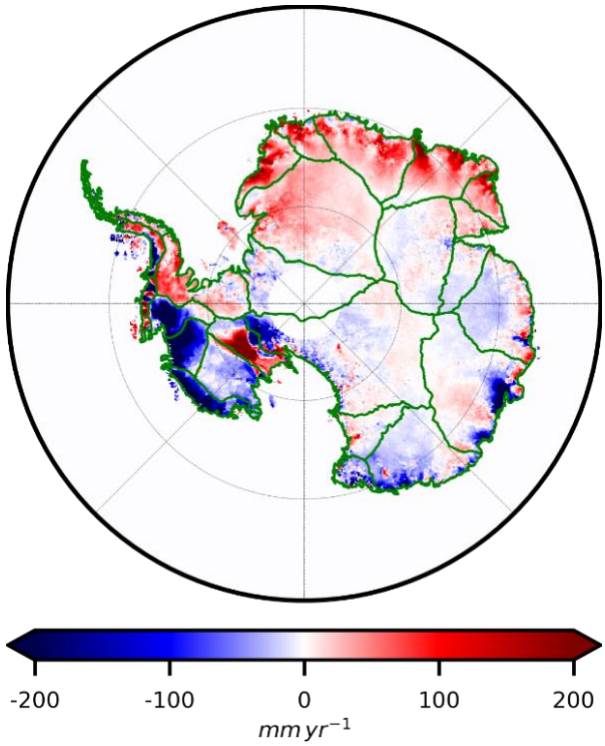


Fig. 2: Ice altimetry derived trends (Schröder et. al., 2018) and drainage basins (green, Zwally et al., 2012).

DICES: Social Dimensions of Coastal Erosion in Bougainville – Household Survey

Susann Adloff[1], Arne Hennig[2] ([1]Institute for Environmental, Resource and Spatial Economics, Kiel University, [2]Institute of Geography, University of Hamburg)

The DICES project (Dealing with Change in Small Island Developing States) has the objective to scrutinize societal action and political reaction in sea level change adaptation in small island developing states. Within this project, two case study islands are investigated. Bougainville, one of the two case study sites in DICES, is located about 900 km east of mainland Papua New Guinea and was the destination of a field trip in summer 2018.

Bougainville is recovering from a decade long civil war that ended in 2001, resulting in widespread poverty, strained relationships in the community and weak political institutions. Currently, discussions of political independence from mainland Papua New Guinea are dominating the political discourse in the country. Aside all that, Bougainville is located in a region with high rates of sea level rise.

The aim of our research trip was to get a better understanding of how the people of Bougainville perceive their environment, what challenges they have to deal with, and how they are involved in the decision-making processes regarding coastal protection measures. The main focus was on the conduct of a household survey that the DICES team previously did in the Maldives. Other used methods encompassed participatory observations and focused interviews with stakeholders.

We find that coastal erosion in Bougainville is a commonly experienced environmental problem, being most relevant on surrounding islands. In fact, some of these are already temporarily uninhabitable due to impacts of sea level rise. Yet, on average, interviewees perceive sea level rise and coastal erosion as less pressing issues when compared to social issues such as corruption, a lack of economic perspectives, crime and health problems. Interviewee's knowledge on climate change was lacking depth. However, personal experiences and the exchange of information with friends and family members living on affected islands has generated a mutual awareness of the risks of climate change for the people of Bougainville. As political institutions are still weak and mainly absent outside of the island's capital, Buka, coastal protection measures beyond the capital are – if at all – mostly implemented by individuals or communities on their own. This causes coastal protection measures to be improvised constructs. Furthermore, we found knowledge about coastal protection being mostly disseminated on an informal level.

The next step of DICES is to investigate people's preferences for coastal adaptation measures and the overall potential of ecosystem-based coastal protection measures on the two case study islands.

Fig 3: Interview with a woman living on the coastline in Bougainville.

The **Sea Level Documentation Database** is continuously expanded with up-to-date & older, natural & social science information & references related to sea level. Help us develop it further by forwarding us your publications!
www.spp-sealevel.de → "Resources"→ "SL Documentation Database"

EMERSA: "Translating Sea Level Change in Urban Life" – A Mid-term Symposium

Johannes Herbeck (artec, Universität Bremen) & Rapti Siriwardane-de Zoysa (Leibniz Centre for Tropical Marine Research)

The EMERSA project (led by Prof. Dr. A-K Hornidge and Prof. Dr. M. Flitner), and their core partners at Universitas Indonesia (UI) Dr. Hendricus A. Simarmata co-organized a mid-term symposium at the UI campus in Salemba, Jakarta between the 4th and 6th of September, 2018. The event brought together researchers from the social sciences, the humanities, the physical sciences and area studies working across a diverse range of themes relating to the lived and experiential aspects of (relative) sea-level change in Southeast Asia.

The event kicked off with a public photographic exhibition at the Ke:Kini Gallery in Menteng (central Jakarta), featuring 15 photographic frames contributed by symposium participants featuring varied aspects of their field work – from artificial islands in Singapore, sea walls in Jakarta, to *balagay* vessel expeditions in the South China Sea. The event served as an excellent opportunity to spark conversations on the diversity of field experiences and research approaches, both between the participants as well as with a wider, interested public. The exhibition ran for three consecutive evenings.

Fig 4 & 5: EMERSA public photo exhibition and symposium participants, together with the hosts and project partners at Universitas Indonesia (UI), Jakarta.

The following two workshop days were opened up by a keynote lecture delivered by Assistant Professor Dr. Matthew Schneider-Mayerson, NUS-Yale College, Singapore, entitled: "Feeling Sea Level Rise: Narrative, Perception, Action". The workshop saw engaged and intense discussions on the various papers that had been sent in prior to the event and were presented at the event. The sequence was divided into four thematics with 3-4 presentations that covered a wide range of topics featuring case-studies from Jakarta, Manila, Singapore, and New Caledonia. The core themes focused on everyday urban justice and livelihood contestations in coastal cities as a result of policy interventions such as in/voluntary relocation, everyday practices of living with floods and land subsidence, including imaginaries of 'futuring' urban coastscapes through practices such as amphibious lifestyles featuring floating homes and utopic-libertarian visions such as seasteading.

The second quarter of the workshop brought participants together in a shared roundtable dialogue on conceptual approaches to studying migration, mobility and movement, particularly with respect to traveling adaptive knowledges, policies and practices for living with sea level change – in the broadest sense.

EMERSA project members in Bremen and their partners are presently working on an edited volume (for Brill´s Asian Studies series), co-edited with Associate Professor Dr. Kelvin E.Y. Low and Senior Lecturer Dr. Noorman Abdullah (National University of Singapore).

The volume will bring together much of the original material that was presented at the workshop, together with a number of new collaboration partners.

"Sea Level Change, Coastal Impacts and Flooding" at AGU Fall Meeting, December 2018, Washington, D.C.USA

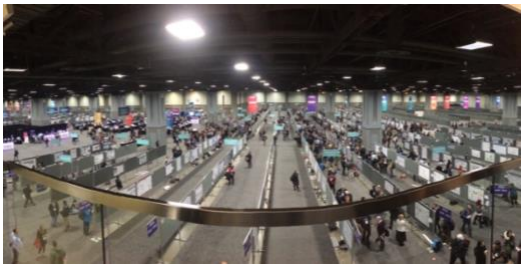
Changes in sea level are impacting communities across the globe on an almost daily basis through increased erosion and subsidence, greater saltwater intrusion, more frequent "nuisance" flooding, and higher storm surge. The Session "Sea Level Change and Coastal Impacts and Flooding" at the American Geophysical Union (AGU) Fall meeting, co-convened and co-chaired by the SPP SeaLevel Coordination representative Prof. D. Stammer, concerned the information needed for planning for, adapting to, and mitigating current and future sea level as well as to identify areas where improvements still need to be made.

The SPP SeaLevel was also at the AGU Fall Meeting, both at the sea level session and the Research in Germany booth at the Exhibition Hall, where visitors had the opportunity to meet with the SPP SeaLevel Coordination team and scientists and discover more about the program's research objectives, current state and goals and discuss the most recent findings.

Several SPP SeaLevel projects presented their most recent results at the conference: scientists from the OMCG project gave presentations on the "Ocean mass change from GRACE and Swarm missions" and "Non-linear evolution of vertical land motion as a key to improve sea-level estimates"; the DECVAR project on "Downscaling regional SLC in CMIP5 climate change projections in the North Atlantic" and on "Sensitivity Of Sea Level Response In FAFMIP Experiments To Model Resolution" and the SATELLITE project on "Glacier elevation and mass change of mountain glaciers outside the polar regions, derived from TanDEM-X InSAR data and SRTM C-Band between 2000 and 2011-15".

The well-attended, dedicated to sea level session invited contributions on understanding and projecting regional coastal sea level changes (SLC), accounting for changes in extreme events, assessing the role of land motion in future coastal flooding, changes and their relation to open ocean processes and the ability to forecast them under climate change conditions. A variety of topics were discussed, ranging from the river-recharge effects on sea level, hurricane impacts, frequency and consequences of coastal flooding events, comprehensive assessments of coastal hazards and wave contribution to coastal sea level rise (SLR), uncertainties in historical reconstructions in steric SLC, vertical land movement and coastal groundwater response to future SLR, the endangered Small Pacific and Indian Ocean Islands, as well as concepts such as "Why mitigate, when we can adapt", including others.

The AGUFall meeting, the largest Earth and space science gathering in the world, took place in Washington D.C. on 10-14 December 2018, marking also the beginning of AGU's Centennial in 2019, a time to reflect on the meaning of a century of discovery and its contribution to inform policy decisions, spark innovation, and protect health and welfare of people globally.



Figs 6-8: The AGUFall Meeting took place in Washington D.C. in December 2018, bringing together over 40000 scientists from the Earth and space sciences.

TRANSOCAP: Invitation to conference:

Invitation to the 37th Annual Conference

of the Working Group of Coastal and Maritime Geography

Cologne, 9th – 11th of May 2019

www.amk2019.uni-koeln.de

Location	University of Cologne, Institute of Geography, Otto-Fischer-Str. 4, 50674 Cologne
Organisation	Prof. Dr. Boris Braun, Prof. Dr. Helmut Brücker, Lisa-Michéle Bott, Sebastian Frank, Dr. Daniel Kelterbaum, Dr. Hannes Laermanns, Juliane Scheder, Susanne Weber
Program	Thursday evening, 9th of May 2019: Icebreaker Event Friday and Saturday, 10th – 11th of May 2019: Presentations & Poster Session Friday afternoon: Members meeting of the AMK followed by the conference dinner
Registration deadline	**15th of March 2019** Please register for an oral presentation or poster by submitting an abstract in English with 400 words maximum.
Topics	A wide range of physical- and anthropogeographic topics, including:

- Coastal geology and morph dynamics
- Historical/long-term coastal development
- Evidence and impacts of extreme wave events
- Climate change, sea level rise, and subsidence
- Ecosystem services and indicators
- Environmental pollution, marine litter, and water quality
- Marine resource use and aquaculture
- Coastal spatial planning and risk management
- Social vulnerability and adaptation to coastal hazards
- Risk perception and coastal livelihood

Conference languages are English and German.

Coming Events related to sea-level research:

Scenarios Forum 2019: Forum on Scenarios for Climate and Societal Futures, 11-13 March, Denver, Colorado, USA

Geoscience and Society Summit, 18-21 March, Stockholm, Sweden

European Geophysical Union (EGU) General Assembly 2019, 7-12 April, Vienna, Austria

US CLIVAR Workshop "Sea Level Hotspots from Florida to Maine: Drivers, Impacts and Adaptation, 23-25 April, Norfolk, Virginia, USA

37th Annual Conference of the Working Group on Coastal and Maritime Geography, 9-11 May, Cologne, Germany

European Space Agency (ESA) Living Planet Symposium 2019, 13-19 May, Milan, Italy

Japan Geoscience Union (JpGU) Meeting 2019, 26-30 May, Chiba, Japan

At What Point Managed Retreat? Resilience Building in the Coastal Zone, 19-21 June, New York, USA

27th International Union of Geodesy and Geophysics (IUGG) General Assembly, 8-18 July, Montréal, Québec, Canada

Saline Futures and Food Security Conference, 10-13 September, Leeuwarden, the Netherlands

3rd International Conference on Coastal Cities and their Sustainable Future, 11-13 September, Rome, Italy

Coastal Changes and Evolution (CoCHE) Training School for early-career coastal researchers, 15-18 September, Sardinia, Italy

"*Globalizing coastal adaptation? Policy mobilities and imaginaries of coastal futures in times of sea level change" panel session at the Deutsche Kongress für Geographie*, 25-30 September, Kiel, Germany

The SPP SeaLevel Members

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Main content edited by
Dr. Eleni Tzortzi
Other authors are credited respectively

Coordination team
Prof. D. Stammer & Dr. Eleni Tzortzi

Center for Earth System Research & Sustainability (CEN)/
Institute of Oceanography,
University of Hamburg
Bundesstraße 53, 20146,
Hamburg, Germany

Email:
eleni.tzortzi@uni-hamburg.de

Phone:
+49 (0) 40 42838 2987

@spp_sealevel