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Abteilung Kommunikation und Öffentlichkeitsarbeit
Referat Medien- und Öffentlichkeitsarbeit
Tel. 040-428 38 29 68
Fax 040-428 38 24 49
E-Mail: medien@uni-hamburg.de

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Rivers and streams release more CO2 than previously believed

Running waters release significantly more carbon dioxide into our atmosphere than assumed, as researchers at Yale University's School of Forestry & Environmental Studies, the University of Hamburg's Center for Earth System Research and Sustainability (CEN, part of the KlimaCampus) and further partner institutions recently discovered. The study was published in the latest issue of the magazine "Nature."

According to the study, the largest amounts of CO2 are released in tropical "hotspots" like Southeast Asia, the Amazon and Middle America. "In fact, about 70 percent of the carbon flux from inland waters occurs in just over 20 percent of the planet's land surface", said Peter A. Raymond, a professor of ecosystem ecology at F&ES and lead author of the study.

The research group's calculations show that running waters release some 1.8 billion tons of carbon into the atmosphere every year. Lakes and water reservoirs, e.g. at dams, account for an additional 0.32 billion tons, meaning that taken together, inland waters release a total of ca. 2.1 billion tons of carbon annually. For comparison: That equates to roughly one-fifth of the emissions caused by humans.

Earlier studies had indicated that the CO2 emissions of inland waters and their role in the carbon cycle might have been underestimated, which sparked the international research project launched in 2010: As a first step, the researchers had to create a map featuring the morphological characteristics, e.g. the depth and breadth, of all bodies of water on the Earth. "We thought, 'OK, someone must have done this before,'" explains Raymond, "but then we started looking and said, 'Oh, we have to do this.'" Using newly available datasets, particularly from satellite-based technologies, the research team calculated that rivers and streams cover about 625,000 square kilometers of the planet's surface, compared with about three million square kilometers for lakes and reservoirs.

Based on the latest research from Prof. Jens Hartmann at the University of Hamburg's CEN, a map of the CO2 concentrations of running waters was also created. In order to produce the map, Hartmann and his team collected and analyzed the data from 6,708 recording stations located near rivers and streams around the world. "Data from individual rivers like the Rhine or the Amazon couldn't tell us anything about the global distribution. But we needed a highly accurate representation of the CO2 concentrations in these waters," recalls Hartmann. "Our database, which my team and I have established over the last ten years, delivers that. As the data is based on the work of hundreds of

researchers, whose findings we have standardized and systematically collated, we've now made the leap from qualitative observation of waters as a source of CO2 to quantitative research."

For the study, scientists also calculated the different speeds of gas exchange between inland waters and the atmosphere. The stronger the turbulences at the water's surface, the more CO2 is released into the atmosphere. The combination of maps and data revealed that, while the CO2 emissions from lakes and reservoirs are lower than assumed, those from rivers and streams are three times as high as previously believed. The contribution from smaller running waters like streams is disproportionately high. "Inland waters are biogeochemical hotspots," states Raymond. These waters will need to be more precisely mapped if we want to better understand their influence on the global carbon balance.

The study was coordinated by Prof. Peter A. Raymond of Yale University. The other chief authors were Prof. Dr. Jens Hartmann, CEN, University of Hamburg; Dr. Ronny Lauerwald, Université Libre de Bruxelles; and Dr. Sebastian Sobek, Uppsala University.

The "Nature" article:

http://www.nature.com/nature/journal/v503/n7476/full/nature12760.html

Information on the Working Group "Chemistry of Natural Aqueous Solutions," led by Prof. Jens Hartmann:

http://www.ifbm.zmaw.de/Chemie-natuerlicher-Waesser.6395.0.html

Any questions?

Prof. Dr. Jens Hartmann
Center for Earth System Research and Sustainability (CEN), University of Hamburg
Member Institute of the KlimaCampus
Tel.: 040 42838-6686
E-Mail: jens.hartmann@zmaw.de