UP 8: Carbon Cycle & Climate Change

Time: Thursday 14:00–15:15 Location: MOL/0213

Invited Talk UP 8.1 Thu 14:00 MOL/0213

Destabilization of carbon in tropical peatlands by enhanced weathering — •Alexandra Klemme[1], Tim Rixen[2], Moritz Müller[3], Justus Notholt[1], and Thorsten Warneke[1] — [1]Institute of Environmental Physics, University of Bremen — [2]Leibniz Center for Tropical Marine Research, Bremen — [3]Faculty of Engineering, Computing, and Science, Swinburne University of Technology Sarawak Campus

Southeast Asian peatlands represent a globally significant carbon store. Recent land use changes destabilize the peat, causing increased leaching of peat carbon into rivers. Despite resulting high river organic carbon concentrations, field data suggests only moderate carbon dioxide (CO2) emissions from rivers. We offer an explanation for this phenomenon by showing that carbon decomposition is hampered by the low pH in peat-draining rivers, and we find that enhanced input of carbonate minerals increases CO2 emissions by counteracting this pH limitation. One potential source of carbonate minerals to rivers is the application of enhanced weathering, a CO2 removal strategy that accelerates weathering-induced CO2 uptake from the atmosphere via the dispersion of rock powder. The effect of enhanced weathering on peatland carbon stocks is poorly understood. We present estimates for the response of CO2 emissions from tropical peat soils, rivers and coastal waters to enhanced weathering induced changes in soil acidity. The potential carbon uptake associated with enhanced weathering is reduced by $18-60\,\%$ by land-based re-emission of CO2 and is potentially offset completely by emissions from coastal waters.

Invited Talk UP 8.2 Thu 14:30 MOL/0213

Widespread forest decline in central Europe following three extreme summers in 2018-2020 — •Ana Bastos — Max Planck Institute for Biogeochemistry, Hans Knöll Str 10, 07745 Jena

Among the ten hottest summers in Europe since 1880, only two happened before 2010 (2003 and 2006). In Europe and other temperate regions, summers like 2003 and 2010 were extremely rare in the past, but are projected to happen every few years in the coming decades. Since they are stochastic to some extent, this means such extreme events do not necessarily happen at regular intervals, and they may cluster in time and/or space.

Together with that of 2003, the summers of 2018, and 2019 were exceptionally hot and dry in central Europe. In 2020, drought conditions persisted over a large region. Such a sequence of three exceptionally hot and dry summers is unprecedented in the observation-based record since 1950 and triggered a series of cascading effects that resulted in large-scale forest decline and tree mortality.

It is unclear to which extent this large-scale tree mortality event, driven by three consecutive extreme summers, reveals an anthropogenic fingerprint or whether these could have happened due to natural climate variability and disturbance interactions. This talk will discuss the conceptual and practical challenges of answering this question. Then, recent work addressing different aspects of this question from both data-driven and process-based modeling perspectives will be presented.

UP 8.3 Thu 15:00 MOL/0213

STEPSEC: Update und erste Ergebnisse — •Stefanie Falk für die STEPSEC-Kollaboration — Ludwig-Maximilians-Universität München (LMU)

Um sowohl nationale als auch internationale Klimaschutzziele einhalten zu können und den globalen Temperaturanstieg zu begrenzen, sind massive Reduktionen des CO_2-Ausstoßes notwendig. Da die bisherigen Maßnahmen zur Emissionsreduktion weltweit nicht ausreichend sind, müssen Wege gefunden werden, mehr Treibhausgase zu binden, als ausgestoßen werden. Wir führen eine robuste und vergleichende Bewertung der Potenziale der gängigsten Methoden landgebundener Kohlenstoffdioxidabscheidung (CDR_L) und ihrer Auswirkungen auf das Erdsystem unter der Annahme sozio-ökologischer Randbedingungen durch.

Unter Verwendung von drei dynamischen globalen Vegetationsmodellen (DGVMs) vergleichen wir Aufforstung, Waldbewirtschaftung und Bioenergie mit Kohlenstoffabscheidung und -speicherung. Dies erlaubt es das CDR_L-Potenzial mit hohem ökologischen Realismus zu untersuchen. Da gesellschaftliche Zwänge wichtige Hindernisse für die Umsetzung von CDR_L darstellen können, werden auch sozio-ökonomische Gesichtspunkte, basierend auf sozio-ökonomischen Pfaden und agentenbasierten Modellen, für die Landnutzungsentscheidungen Eingang finden.

Diese umfassende und interdisziplinäre Untersuchung von CDR_L Methoden wird eine fundierte Entscheidungsfindung ermöglichen.