UP 4: Ozeanographie, Hydro- und Kryosphäre

Time: Monday 11:30–13:00 Location: H48

Invited Talk UP 4.1 Mon 11:30 H48

Ocean mixing: why it's important and how it's measured by tracer release experiments — •Andrew Watson — School of Environmental Sciences, University of East Anglia, Norwich NR4 7TJ, UK

The ocean is a stratified medium nearly everywhere, with vertical mixing across density surfaces many orders of magnitude slower than horizontal mixing. Measuring the rate of mixing has proved difficult, because it is episodic, and varies by orders of magnitude depending on location. Yet the integrated effect of mixing is critical for our understanding of the global ocean circulation, determining in particular how the the deep ocean is ventilated – brought to the surface and returned to depth.

In the last dozen or so years a small number of large scale experiments using releases of sulphur hexafluoride, an inert tracer that can be detected at very low concentration in sea water, have provided accurate estimates of mixing rates integrated over large regions of the ocean the first time. These experiments have enabled us to construct a coherent picture of how the ocean mixes. This talk will review how these experiments have been done and their most important results.

UP 4.2 Mon 12:00 H48

Dispersion in North Atlantic Deep Water transfer between the northern source region and the South Atlantic — •Oliver Huhn and Wolfgang Roether — Institut für Umweltphysik, Universität Bremen

North Atlantic Deep Water (NADW) represents the Atlantic part of the deep, southward return arm of the oceanic "conveyor belt", which moderates Europe's climate and effects most of the water transfer from the ocean surface into the deep waters globally. The transfer starts from the NADW formation regions, which in the case of upper NADW (approx. 1500 - 2000 m depth) is the Labrador Sea (far NW Atlantic). NADW is found concentrated toward the continental slope of the Americas, but subject to meandering, and to recirculation into, and mixing with, the waters of the interior Atlantic. Individual water parcels thus follow a complex ensemble of trajectories. We have obtained characteristics of that ensemble by fitting the free parameters of a suitable function using extensive observations of the transient tracers CFC-11, CFC-12, CCl_4, and tritium. A tracer transfer function of ocean-surface concentrations to those in newly formed NADW was derived as a precursory step. In the upper NADW we obtain RMS transfer-time dispersions on the way from the Labrador Sea of 31 years at 6 °N rising to 53 years at 20 °S, compared to mean transfer times ranging 46 to 79 years (±20 %); furthermore, approximately 10 % to 40 % of the water is old, tracer-free water admixed on the way. Similar results have been obtained for lower NADW (approx. 2500 - 4000 m). The combination of tritium and CFC observations is particularly suited to constrain the dispersion, since it acts on the concentrations of these tracers in an opposite way. The tracer-adjusted transfer functions allow quantification of the NADW transport of pollutants and other compounds delivered to the NADW formation region. The results can furthermore check mean transfer times and large-scale dispersion of the NADW part of dynamic ocean circulation models.

UP 4.3 Mon 12:15 H48

Internal wave beams driven by internal seiching of a pit lake — •Bertram Boehrer[1], Craig Stevens[2], and Gregory Lawrence[3] — [1]Helmholtz-Zentrum für Umweltforschung, Brueckstraße 3a, D-39114 Magdeburg, Germany. (bertram.boehrer@ufz.de) — [2]New Zealand National Institute for Water and Atmospheric Research, PO Box 14-901, Kilbirnie, Wellington, New Zealand. (c.stevens@niwa.co.nz) — [3]Department of Civil Engineering, University of British Columbia, Vancouver, Canada V6T 1Z4. (lawrence@civil.ubc.ca)

Internal wave beams can be created by the internal seiche moving the stratified waters over the bench structure of the side walls of Island Copper mine pit lake. The first-mode seiche determines the frequency and its presence for several oscillation periods guarantees a sharp enough frequency band that interference patters can establish. The bench width, a residual feature of the mining, determines the horizontal wave length [1][2]. Both magnitudes, frequency and horizontal wavelength, fully define the path of the propagation of the wave beam, e.g. its angle against the vertical, through a given density stratification. Under the assumption, that the ray waves are reflected to a large portion at the sharp halocline, the resulting self-interference pattern can be evaluated.

[1] Boehrer, B., and C. Stevens (2005), Ray waves in a pit lake, Geophys. Res. Lett., 32, L24608 [2] Stevens, C., T.S.R. Fisher, and G.A. Lawrence (2005), Turbulent layering beneath the pycnocline in an strongly stratified pit lake, Limnol. Oceanogr., 50, 197* 206.

UP 4.4 Mon 12:30 H48

Edelgase in Klimaarchiven: Neue Resultate und Entwicklungen — •Werner Aeschbach-Hertig — Institut für Umweltphysik, Universität Heidelberg

Anwendungen von Edelgasen in Klimaarchiven zur Datierung oder als Temperaturproxy beschränken sich bisher auf das Grundwasser. Dort hat sich das Edelgas-Paläothermometer bewährt, ausserdem kann radiogenes He als qualitativer Altersindikator dienen. Aktuelle Edelgasresultate aus zwei Studien in China ergeben auch für Asien eine eiszeitliche Abkühlung von ca. 5 °C, zeigen jedoch eine ungewöhnliche Variabilität bei jungen Proben. Die Korrelation der Edelgastemperaturen mit stabilen Isotopen liefert eine Eichung des Isotopenthermometers, die für andere Archive von Bedeutung ist.

Bei der Interpretation der Edelgasdaten aus Grundwasser wurden große Fortschritte gemacht. Diese ermöglichen eine zuverläßige Temperaturbestimmung auch im Beisein von Luftüberschüssen und sogar im Falle von Entgasung. Dennoch ist die Methode durch die Schwierigkeit der Grundwasserdatierung in ihrer Aussagekraft eingeschränkt. Deshalb arbeiten wir zur Zeit am Transfer des Edelgasthermometers auf Fluideinschlüsse in Speläothemen, die ein vielversprechendes Archiv darstellen. Erste Resultate lassen die Erreichung dieses Zieles als möglich aber schwierig erscheinen. Neue Perspektiven bieten sich auch für die Anwendung von Edelgasen im Klimaarchiv Eis, insbesondere zur Kalibration von Altersmodellen mit Hilfe von radiogenem He. Interessante neue Ansätze bestehen zudem für die Messung von Edelgas-Radioisotopen zur Datierung in Grundwasser, Eis, und Ozean.

UP 4.5 Mon 12:45 H48

Water harvest enhanced by radiation exchange — •Dieter Ihrig[1], Michael Licht[1], Ulrich Brunert[1], Jens Eggemann[1], Andreas Vach[1], and Rainer Mauersberger[2] — [1]FH Suedwestfalen, Interdis. Zentr. f. Lebenswissenschaften, Frauenstuhlweg 31, 58644 Iserlohn — [2]Instituto de RadioAstronomia Milimétrica, E 18012 Granada, Espana

According to the United Nations, lack of drinking water is killing more people than war. Our approach to this urgent problem is to harvest atmospheric water (dew) by using polymer films (LDPE/LLDPE) that are transparent to the atmospheric window at 8 to 13 micron. This allows cooling down a device just by looking through that window into the cold upper atmosphere. To avoid the formation of stable, thermally insulating droplets, patterns of hydrophobic and hydrophilic regions (like those found on the wings of the desert beetle Stenocara) in future have to be etched onto the films. Here we present our device to make use of radiation exchange with the upper atmosphere in order to harvest atmospheric water, including model calculations and show first results of field tests of our device made in Summer 2006 at the IRAM Pico Veleta Observatory (altitude 2900m). This project is funded by the German Federal Ministry of Education and Research (FKZ 02WD0458)