UP 7: Cryosphere, Hydrosphere and Oceanography

Time: Wednesday 15:00–17:15 Location: HFT-FT 131

Invited Talk UP 7.1 Wed 15:00 HFT-FT 131

Uncertainties of sea ice thickness estimates from SMOS radiometry and CryoSat-2 synthetic aperture radar altimetry — •Lars Kaleschke, Nina Maass, and Xiangshan Tian-Kunze — Institut für Meereskunde, KlimaCampus, Universität Hamburg

Sea ice plays an important role in the climate system. Firstly, it is considered as an early indicator of climate change because of the amplification of climatic variations in the polar regions. Secondly, sea ice is involved in the processes that drive the polar amplification and has a potential global impact on climate. The uncertainties of sea ice thickness estimates are of particular relevance for analysing the reliability of climate models.

Data from the recently launched ESA satellites CryoSat-2 and SMOS can be used to estimate sea ice thickness. Although both sensors take advantage of a synthetic aperture principle, they do provide complementary information. CryoSat-2 measures the elevation of the sea ice surface, the so-called freeboard, with an active radar system. The sea ice thickness can be inferred from the freeboard with several assumptions, e.g. about sea ice density and the backscatter horizon within the snow surface. SMOS measures the thermal radiation at a wavelength of 21 cm. Electromagnetic radiation with this long wavelength emerges from the ice-ocean interface and can be used to infer the sea ice thickness with assumptions about the ice temperature and salinity that affect the penetration depth and emissivity. In this presentation we will give an overview of the methods and the associated uncertainties for deriving sea ice thickness from SMOS and CryoSat-2.

UP 7.2 Wed 15:30 HFT-FT 131

Remote sensing of snow on sea ice — Christian Melsheimer and •Georg Heygster — Institut für Umweltphysik, Universität Bremen

Snow on sea ice significantly reduces the heat flow between the ocean and the atmosphere and thus influences the thickness growth and melting of sea ice. Furthermore, snow on sea ice considerably increases the friction of ice-going ships. Therefore, snow on sea ice is an important quantity for modeling and predicting sea ice, and because of the inaccessibility of most of the sea ice, remote sensing methods are necessary for investigating it. Here, we want to estimate the thickness of the snow layer on sea ice using satellite instruments, namely microwave radiometers, microwave scatterometers and optical sensors.

The base is an algorithm that uses the influence of the snow layer on the thermal microwave emission by the underlying sea ice at 19 and 37 GHz. This algorithm, however, is applicable to level first-year ice under non-melting conditions. To mask out areas where these conditions are not met, the radar backscatter at 5.3 GHz can be inspected as it is increased in melting conditions and for rough ice.

We present first results of implementing this algorithm in an operational processing chain for sea ice concentration and compare with some in-situ measurements.

Invited Talk UP 7.3 Wed 15:45 HFT-FT 131

Oceanographic measurements in Fram Strait – a gateway to the Arctic Ocean — •Florian Greil, Agnieszka Beszczynska-Möller, and Ursula Schauer — Alfred Wegener Institut (AWI) für Polar- und Meeresforschung, D-27515 Bremerhaven, Germany

The Fram Strait is a 500 km wide passage between Greenland and Svalbard. It is is the unique deep water connection between the Arctic Ocean and the North Atlantic. Arctic surface waters flow southward in the East Greenland Current and carry sea ice out of the Arctic. The West Spitsbergen Current (WSC) flows northward and brings relatively warm and saline waters into the Arctic. The WSC is the northern extension the Norwegian Atlantic Current which in turns originates in the Gulf Stream. They are the only oceanic source of heat for the Arctic Ocean and may thus affect the sea ice cover. Other possible mechanisms for the declining ice cover will also be presented.

The Alfred Wegener Institute maintains a an array of moored instruments at 78.8°N since the mid 1990s. The instruments acquire temperature and current data over the whole year. Our data reveals a warming (of approximately 1°C from 1997 to now) of the Atlantic water inflow. On monthly to decadal time scales, we also observe a great variability of the oceanic fluxes.

UP 7.4 Wed 16:15 HFT-FT 131

Plausibility and Stability of Models for Dissolved Noble Gases in Groundwater — •Werner Aeschbach-Hertig, Florian Freundt, Michael Jung, and Martin Wieser — Institut für Umweltphysik, Universität Heidelberg , 69120 Heidelberg

Several models describe dissolved noble gases in groundwater and the phenomena of excess air and degassing. The classical explanation for excess air is that air bubbles are entrapped during infiltration and subsequently completely dissolved. This "unfractionated air" (UA) model is hard to reconcile with the amount of entrapped air and the available pressures in soils. Models based on diffusive fractionation are in conflict with the absence of isotope fractionation. The "oxygen depletion" (OD) model postulates an increase of noble gas partial pressures in soil air as a result of oxygen consumption. Recent experiments have demonstrated this effect to be seasonally restricted and rather weak.

The "closed-system equilibration" (CE) model assumes that trapped air bubbles reach solubility equilibrium with groundwater at the local pressure. We find this model to provide the most physically realistic description of the gas - groundwater interaction. The flexible CE model includes both excess air and degassing and encompasses the UA model as well as a pressure effect similar to the OD model as limiting cases. The downside of this versatility is its tendency towards numerical instability. Occasionally solutions with clearly unrealistic parameter values occur, which produce a warm bias and large uncertainties of estimated temperatures. In some cases it appears possible to find corresponding well-behaved solutions of the model.

UP 7.5 Wed 16:30 HFT-FT 131

Seen als Quelle atmosphärischen Methans: Bedeutung von räumlich und zeitlichen Skalen für die Abschätzung der Emissionen — •Hilmar Hofmann — Arbeitsgruppe Umweltphysik, Limnologisches Institut, Universität Konstanz, Mainaustr. 252, 78464 Konstanz

Seen sind eine bedeutende Quelle atmosphärischen Methans, aber die seeinternen Frei- und Ausbreitungspfade sind unklar. In oxischen Wasserkörpern sind die Sedimente der Flachwasserzonen (Litoral) aufgrund der höheren Wasser- (Sediment) Temperaturen im Vergleich zu den Sedimenten des Profundals hochproduktiv. Zusätzlich sind die Sedimente des Litorals regelmäßig durch Oberflächenwellen gestört, die den Porenwasseraustausch befördern oder die Sedimentoberfläche durch Resuspension aufbrechen. Im oligotrophen Bodensee wurden verschiedene Messkampagnen zur Methanfreisetzung und -verteilung von gelöstem Methan zwischen dem Litoral und Pelagial (Freiwasser) durchgeführt. Diese Messungen zeigten die Bedeutung von Oberflächenwellen und der Wassertemperatur für die Dynamik und die Menge an freigesetztem, gelöstem Methan im flachen Litoral. Die gelösten Methankonzentrationen im flachen Litoral waren immer höher als die des Pelagials. Das Litoral stellt deswegen eine bedeutende Quelle für das seeweit gelöste Methan dar. Die seeweite Verteilung von gelöstem Methan ist mit der Wassertemperatur, der Strömung und der Seemorphometrie korreliert und zeigte große räumlich-zeitliche Heterogenitäten. Diese haben einen bedeutenden Einfluss auf die tatsächlichen, seeweiten Emissionen, sind aber in den bisherigen Bilanzen nicht berücksichtigt.

30 min coffee break