Examination of methane ebullition in a Swiss hydropower reservoir

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Motivation

• Methane emissions from inland waters, including man-made reservoirs, are often neglected in global budgets. 
• As hydropower reservoirs often act as sediment and carbon traps, they can be methane hot spots thereby potentially reducing the ‘greenness’ of this energy source.
• Ebullition is the most efficient pathway in shallow waters, but is consistently understudied.
• The spatiotemporal variability of ebullition also hinders systematic monitoring of atmospheric emissions.

Field Site

• Lake Wohlen near Bern, Switzerland is a run-off reservoir that has some of the highest ebullition emissions recorded in a temperate system, which are sensitive to temperature changes.

Methods

• Seven detailed surveys were conducted in summer 2008 in the most active ebullition region (see map)
• A 120 kHz echosounder (Simrad EK60) was used to locate and quantify ebullition flux (see Poster 10539 at BG86 for details)
• Drifting chamber surveys were conducted simultaneously and an eddy covariance system continuously recorded fluxes.

Small-scale spatial heterogeneity of ebullition

• Between 400 and 1600 m² of the active ebullition region was surveyed via hydroacoustics
• With the bubble sizes known, ebullition flux from the sediments can be estimated (Poster 10539)
• Fluxes ranged from 0 to ~10⁻¹ mg CH₄ m⁻² d⁻¹ with the majority between 10⁻² and 10⁻¹ mg CH₄ m⁻² d⁻¹
• CH₄ bubble flux from the sediment into the water column was contoured to illustrate any spatial trends in flux (Fig. 3)
• The highest fluxes were observed on July 23 and occurred in the center of the survey region
• Low flux zones were found along the southern and northern banks of the survey region

Implications

• Average hydroacoustic derived surface emissions for all surveys indicate a high flux zone (blue-green area, Fig. 6) along the center of a sloping lake bed
• Low fluxes are generally found in the deepest part (old river channel) and along the southern shallow shelf, although the variability is high there and fewer measurements were made (Fig. 6 bottom)
• Hydroacoustic methods provide higher spatial resolution of fluxes than chambers and gives a more accurate location of where ebullition occurs compared to ECA data
• Spatial variability of ebullition can then be explored in more detail once the ebullition regions have been identified