Project acronym: AOM-PEaT

# Project title: Anaerobic Oxidation of Methane: Potentials, Estimation and Transition

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Discipline: Earth Sciences & Environment

Station(s): Svartberget Research Station (Finland)

Anaerobic Oxidation of Methane (AOM) is a process of methane ($CH_4$) consumption under anoxic conditions driven by microorganisms, which oxidize $CH_4$ with various terminal electron acceptors other than oxygen, e.g. sulfate, nitrate, nitrite, some metals (Fe, Mn) or organic compounds. Despite the global significance, the exact mechanisms (potential electron acceptors, optimal biochemical conditions, etc.) and relevance of AOM in terrestrial ecosystems are almost unknown. The proposal is addressing the following objectives: (1) Assessment of the potential of AOM in a natural boreal peatland with the long-term application of alternative electron acceptors (AEAs). This will be achieved by means of innovative below-ground labeling approach. (2) Estimation of the mechanisms driving AOM, including the involvement of main AEAs - $Fe^{3+}$, $NO_3^-$/ $NO_2^-$, $SO_4^{2-}$ and humic compounds. (3) Transition of the results to other ecosystems, with the emphasis on (restored) temperate peatlands. The AOM will be estimated via application of $^{13}C$-enriched (labeled) $CH_4$ (10 AT%) and measurement of $^{13}C$-$CO_2$ as an end-product of oxidation. To prove $CH_4$ consumption to take place through AOM and not through a conventional oxidation at oxic conditions, the measurement will be conducted below water table level along a depth profile: 0.5-1.0-2.0 m. The monitoring of oxygen concentrations belowground will be conducted by $O_2$-sensors installed on the respective depths. To conduct the field experiment, the so-called “passive diffusion” chambers will be applied. The $CH_4$ labeling along with reference will provide data of both added and natural gases dynamics at the experimental site and within site – with depth. Simultaneously, analyzing the inorganic and organic electron acceptors ($NO_3^-$, $NO_2^-$, $SO_4^{2-}$, $Fe^{3+}$, DOC), $O_2$, temperature and other environmental parameters (pH, precipitation, etc.) will help to better understand site-dependent conditions and link them to estimated AOM. As an expected scientific impact and a breakthrough, we believe the obtained results may change the existing concept of $CH_4$ cycling in terrestrial ecosystems, including arctic regions, and will help to improve current process-based models of regional and global carbon balance.