UP 6: Additional Topics

Time: Wednesday 11:45–12:45 Location: H41

Invited Talk UP 6.1 Wed 11:45 H41

Estimating wind energy limits and atmospheric impacts at large scales from climate model simulations and first principles — Lee Miller and •Axel Kleidon — MPI Biogeochemie, Jena. Germany

Wind turbines generate electricity by removing kinetic energy from the atmosphere. When wind power is used at large scales, this removal results in reduced wind speeds that cannot be accounted for in large-scale wind power estimates derived from climatological wind speeds. Here we test how well wind power limits and this slowdown effect can be accounted for from first principles that are based on the momentum balance and the vertical downward flux of kinetic energy to the surface (VKE method). To do so, we apply VKE to the simulated control climate of a global climate model and compare the VKE estimates to the maximum wind power generation simulated by a set of sensitivity simulations ("GCM estimate"). On land, we find strong agreement between VKE and the GCM estimate, both with respect to generation rates (0.37 and 0.32 We m-2) as well as the reductions in wind speed by 42% and 44%. Over the ocean we find the GCM estimate to be about twice the VKE estimate (0.59 and 0.29 We m-2), yet wind speed reductions by 50% and 42% are comparable. We attribute this underestimation of generation rates to the common stable to neutral atmospheric conditions over the ocean. This offset between VKE and the GCM estimates over the ocean can be corrected for, so that VKE is a powerful approach to estimate more realistic wind power limits at large scales.

UP 6.2 Wed 12:15 H41

a drying and thermoelastic model for microwave ablation of concrete — •benjamin lepers[1] and guido link[2] — [1]KIT, hermann von helmholtz platz 1, 76344 eggenstein leopoldshafen, Germany — [2]KIT, hermann von helmholtz platz 1, 76344 eggenstein leopoldshafen, Germany

The use of high power microwaves to perform explosive spalling of concrete surfaces is a promising technique with applications in the area of concrete facilities decommissioning. The mechanism that creates explosive spalling is due to a combination of the thermal stress from high temperature gradients and the pore pressure generated from the water vaporization and water transport through a porous medium. In this paper a one dimensional model solving the heat and diffusion equations for liquid and vapor phase with the COMSOL Multiphysics finite element software is presented. The modelling of the drying process is based on the spatial reaction engineering approach (SREA). This paper discusses the influence of the relative activation energy parameter and effective diffusion coefficients on the temperature, water content and pore pressure in the case of fast microwave heating of concrete. This model is then used for a 3d geometry with a sealed insulated block of concrete and an conical waveguide antenna to compute the thermal stress, pore pressure and total stress

UP 6.3 Wed 12:30 H41

Applications of ^{39}Ar-ATTA in the environment: pilot studies for ocean- and ice-research — Stefan Beyersdorfer[1], •Florian Ritterbusch[1], Arne Kersting[1], Emeline Mathouchanh[1], Sven Ebser[2], Zhongyi Feng[2], Helene Hoffmann[1], Toste Tanhua[3], Werner Aeschbach[1], and Markus K. Oberthaler[2] — [1]Institute of Environmental Physics, Heidelberg University, Germany — [2]Kirchhoff-Institute for Physics, Heidelberg University, Germany — [3]GEOMAR Helmholtz-Zentrum für Ozeanforschung Kiel, Germany

Atom Trap Trace Analysis (ATTA) is a novel ultra-sensitive detection method for rare noble gas radioisotopes. In Heidelberg, an ATTA setup has been realized for ^{39}Ar (half-life 269 a) which is the only reliable dating isotope for water and ice in the range of 50-1000 a. After the successful demonstration of ^{39}Ar dating for large groundwater samples (1-2 m^3 of water) current developments aim at shorter measurement times and smaller sample sizes of 10-25 L of water or 4-10 kg of ice. An argon extraction system for such samples based on vacuum degassing and a Ti-Getter has been developed, achieving argon purities $> 98\%$ and recoveries $> 95\%$. The extraction system has been used for the preparation of samples from a pilot study for ^{39}Ar dating of ocean water masses in the oxygen minimum zone of the Eastern Tropical North Atlantic. Moreover, samples have been processed from a pilot study at the Gorner Glacier (Swiss Alps), which uses ^{39}Ar to provide an absolute age for different positions along the flowlines. The developed sample preparation methods are an important ingredient for the wide range of future applications that the advent of ^{39}Ar-ATTA opens up.