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Tower-based and airborne sampler for disjunct eddy covariance measurements of biogenic VOC

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The biogenic volatile organic compounds (VOCs), emitted by vegetation, are known to play a significant role in atmospheric chemistry (e.g. in photo-oxidant pollution). With increasing concern about air quality, we need to quantify these emissions to understand the processes controlling the chemical composition of our atmosphere. Developing a powerful algorithm to build the emission inventory would require flux measurements at a scale comparable to that of the emission database.
While Eddy Covariance (EC) is the most direct technique for ecosystem-scale trace gases flux measurement, its use requires fast (< 0.1 s) and highly sensitive (ppt) sensors which are not currently available for most of VOC concentration measurements. An interesting alternative is the Disjunct Eddy Covariance (DEC) technique, which allows longer integration times (1 s - 10 s) for a small (and therefore acceptable) reduction of flux estimate accuracy. DEC relies on the same assumptions as EC but sub-samples the time series. As a result, it gives more time for concentration measurements between quickly grabbed samples. A disjunct eddy sampler has been developed for trace gases flux measurements at the Laboratoire d'Aérologie in Toulouse, France. This prototype named MEDEE was tested during a first field campaign in summer 2010 and will be deployed on several tower based and airborne field campaigns in the next coming years. It is composed of an air sampler and a transfer system to an on-line analyzer. A micro controller chip plus a computer coordinate and control the whole system. MEDEE's sampler is designed for rapid capture with inert materials of air samples. It comprises two mechanical syringes with 1.2 L stainless steel reservoirs. Three solenoid valves on each reservoir inlet guide the air for sampling, transfer to the analyzer and emptying. Each syringe piston is moved by an electric actuator and allows for pressure regulation during sample transfer to the analyzer. We present the design of the instrument, as well as illustrations of isoprene fluxes measured during the first field campaign above a downy oak forest located in south-east of France.