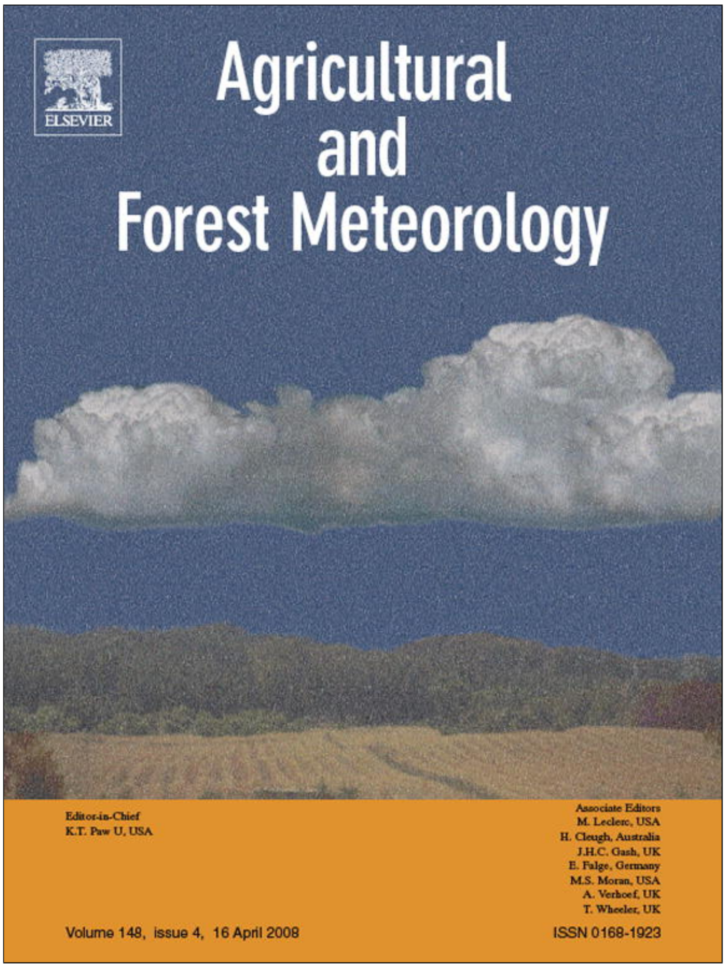
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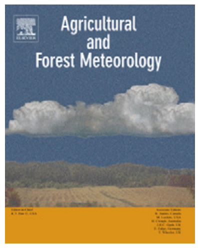

Short communication

Comment on "the storage term in eddy flux calculations"

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Finnigan (2006) purports to present a formal definition of the storage change term for FLUXNET research assessing surface-atmosphere exchange via eddy fluxes, but errs in the definition of the scalar being exchanged. Although referred to somewhat ambiguously as "scalar concentration", the scalar presented for analysis is in fact the gas density, as is clear both from previous work (Finnigan et al., 2003) and also in the context of the mass balance expression presented and integrated over a control volume. This scalar variable is inappropriate for expressing boundary-layer conservation principles in the context of the FLUXNET goal of estimating CO_2 sources or sinks at the surface (Baldocchi et al., 2001) because it has surface source terms not directly related to CO_2 exchange, as we shall now see.

The CO_2 density is defined as the ratio of conserved CO_2 mass to volume, a non-conservative variable for which thermal expansion represents a source in accordance with Charles's Law. The definition of the source term for CO_2 density, in conjunction with the convenient and traditional inclusion of molecular transport, must therefore include sensible heat exchange with the surface by molecular conduction. Similar micrometeorological examination of gas composition reveals that isothermal, isobaric humidification by molecular diffusion near an evaporating surface also represents a sink term for the density of any dry air gas constituent such as CO_2 (Kowalski and Serrano-Ortiz, 2007). In short, the "density effects" whose influences often exceed that of CO_2 exchange in determining fluctuations in CO_2 density (Webb et al., 1980) operate also at the molecular level, where they are absorbed into the definition of the source term for CO_2 density and make this non-conservative scalar inappropriate for the expression of conservation principles within a control volume.

In the context of estimating CO_2 surface exchange, for simplicity it is preferable to express boundary-layer budgets in terms of conservation of the mixing ratio (Kowalski and Serrano-Ortiz, 2007).

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