



Where micrometeorology went wrong more than a century ago

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Modern studies of turbulence in fluids began with the 19th century work of Osborne Reynolds. He put forth straightforward procedures, grounded in conservation law, to define the average fluid motion against which turbulence can be delineated. More than a century ago, however, the very first studies of atmospheric turbulence abandoned the definitions of Reynolds, and thereby the principle of linear momentum conservation. Thus, a long tradition was launched that simplified calculations - but introduced errors - by summing velocities rather than momenta. By the mid-20th century, leading micrometeorologists had lapsed into the common use of these erroneous procedures to calculate the mean motion, for which they furthermore arrogated the term “Reynolds averaging”. Here, we will examine differences between conservation-law-based averaging – as promoted by Reynolds – versus the adulterated “Reynolds averaging” that is now commonly applied in micrometeorology, and identify common misconceptions that have arisen in the discipline due to misrepresentation of Reynolds’s ideas. Chief in importance among these is the spurious concept of a net turbulent flux of air, a miscalculation that propagated for decades before coming to underlie the widely applied WPL “density correction” associated with the turbulent heat flux.