Two Methods to Improve Turbulence Estimates Above a Forest in a CFD Model

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In this investigation, we make two modifications to the forest model of the WindSim CFD software, evaluate their impact on wind speed and turbulence intensity (TI) estimates by using wind tunnel data, and test the findings against data from a forested site. The first method is a variable profile of leaf area index (LAI) to represent the physical shape of the forest more accurately; and the second is modification to the closure coefficients in the turbulence transport equations. The modifications focus on the work of Lopes et al. (2011), who used a LES model to show that the turbulence production terms originally proposed by Green (1992), expanded upon by Sanz (2003), and widely used in the industry may be unnecessary.

Introduction

In this investigation, we make two modifications to the forest model of the WindSim CFD software, evaluate their impact on wind speed and turbulence intensity (TI) estimates by using wind tunnel data, and test the findings against data from a forested site. The first method is a variable profile of leaf area index (LAI) to represent the physical shape of the forest more accurately; and the second is modification to the closure coefficients in the turbulence transport equations. The modifications focus on the work of Lopes et al. (2011), who used a LES model to show that the turbulence production terms originally proposed by Green (1992), expanded upon by Sanz (2003), and widely used in the industry may be unnecessary.

Method I: Variable leaf area index

- Retracted wind tunnel from Meroney experiment (1968)
- Selected for its use of zero-pressure-gradient ceiling and the inlet wind speed and TI profile which is the same as the WindSim standard
- Wind speed and turbulence intensity data was collected at many locations downstream the forest edge
- Wind tunnel dimensions 2x2x26 m

Method II: Closure coefficient modification

Table 1: Closure coefficient modifications.

<table>
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<tr>
<th>Source</th>
<th>(D_2)</th>
<th>(D_3)</th>
<th>(C_{14})</th>
<th>(C_{15})</th>
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<td>6.51</td>
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<td>Dalpe &amp; Masson</td>
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References


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