IDEALIZED MESOSCALE SIMULATIONS OF SURFACE-HETEROGENEITY DRIVEN CIRCULATIONS

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Introduction

Heterogeneity in surface characteristics (soil moisture, vegetation cover, etc.) can result in heterogeneity in surface heating and thus in the overlying air temperature. This air temperature difference results in a pressure gradient and flow from the warmer region to the cooler region. The resulting circulation is known by various names including "inland breeze."

The conditions under which inland breezes form is investigated in this study. This may lead to parameterizations to account for the effect of unresolved inland breezes.

The formation of a heterogeneity-caused circulation strong enough to overcome the background wind and reverse the flow did not occur until ND1 was much larger than the expected critical value (> 2 compared to the expected 0.86). Similarly configured LES indicate a critical value of ~1.2 (Tyndall and Davis 2008). It is important to note that there are features in these simulations which are not currently understood but are believed to be numerical. Therefore, definite conclusions must await the resolution of these issues.

Experiment Name | A | B | C | D | E | F | G
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<tbody>
<tr>
<td>( \Delta u_{syn} )</td>
<td>0.010</td>
<td>0.025</td>
<td>0.049</td>
<td>0.085</td>
<td>0.135</td>
<td>0.201</td>
<td>0.286</td>
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<tr>
<td>( SBF )</td>
<td>0.80</td>
<td>1.08</td>
<td>1.34</td>
<td>1.60</td>
<td>1.84</td>
<td>2.09</td>
<td>2.45</td>
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Preliminary Results

The u-component wind (along the heterogeneity; ms⁻¹) is shown below at 4.5 h, averaged in the homogeneous direction. Negative values indicate flow to the left on the figures. The solid line without symbols is the zero contour of u-component wind.

Summary and Conclusions

Idealized simulation using WRF V3.0
- 128 km x 128 km with 4 km spacing
- 95 vertical levels with 33 levels in lowest 1000 m
- Doubly periodic boundary conditions
- Surface sensible heat flux specified for two patches
- Initial temperature profile based on 18 UTC 25 May 2002 sounding over Homestead, TX
- Default MYJ TKE scheme diagnoses PBL top too high so MMS Eta TKE method for output PBL top is used
- Artificial geostrophic wind used to impose synoptic wind and pressure gradient
- Initial wind adjusted near the surface using radix theory

Research funded by DTRA through W911NF-06-1-0439
Constant flux modifications based on code provided by Mariusz Pagowski (NOAA/ESRL).

References