Convective Atmospheric Boundary Layer (ABL) forced by mesoscale surface heat flux variation

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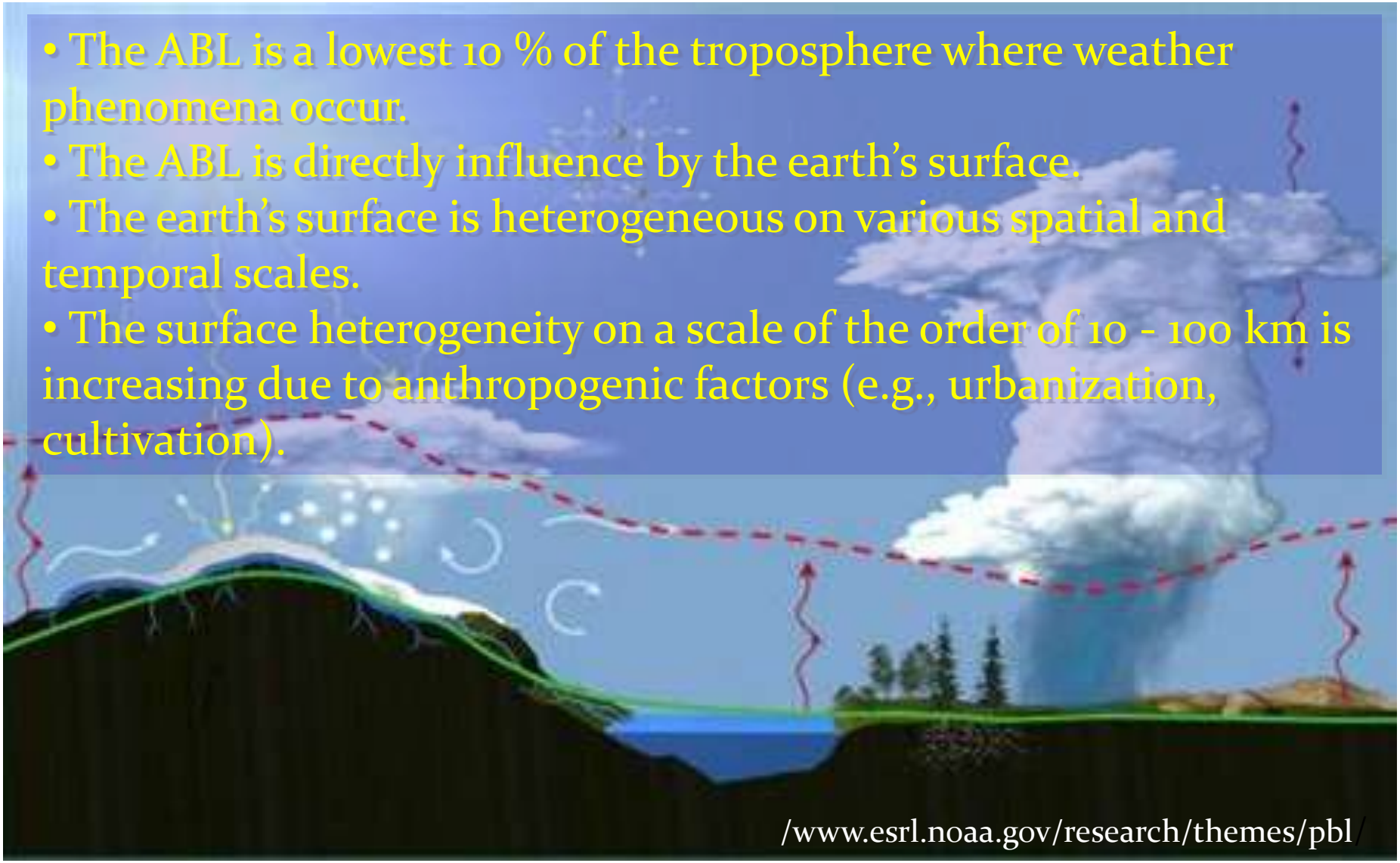
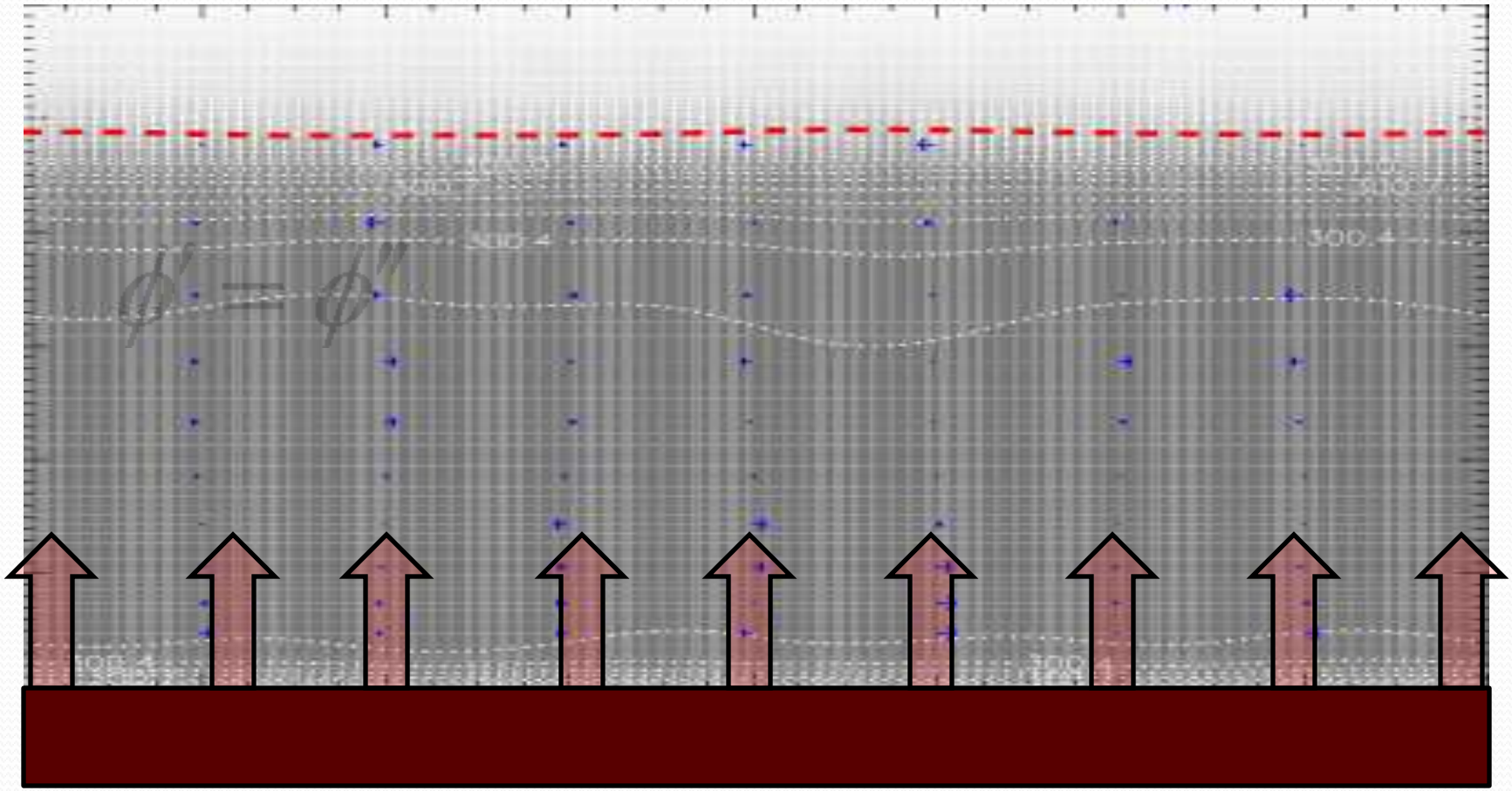
Atmospheric Boundary Layer (ABL)

- The ABL is a lowest 10 % of the troposphere where weather phenomena occur.
- The ABL is directly influence by the earth's surface.
- The earth's surface is heterogeneous on various spatial and temporal scales.
- The surface heterogeneity on a scale of the order of 10 - 100 km is increasing due to anthropogenic factors (e.g., urbanization, cultivation).

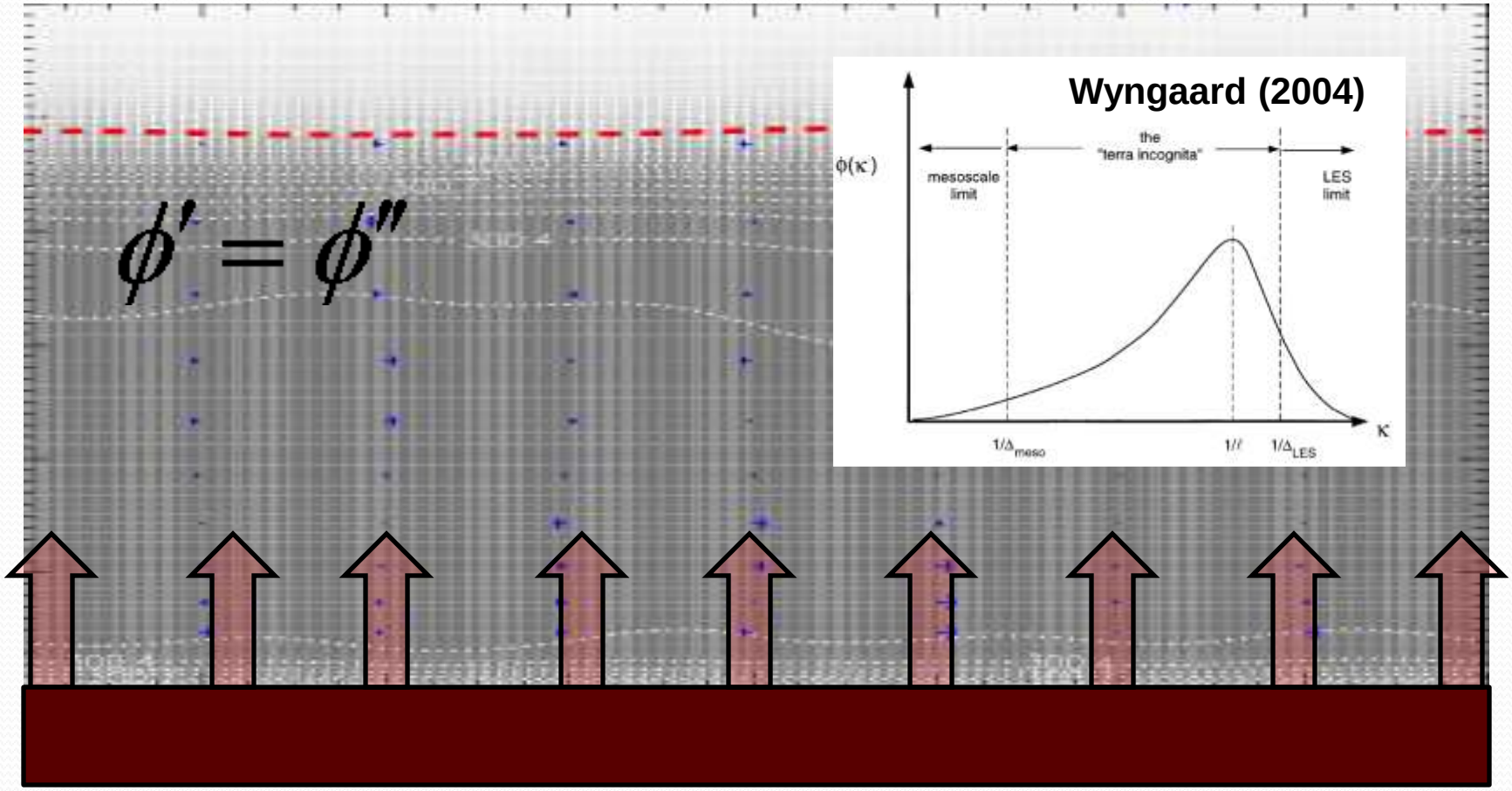


/www.esrl.noaa.gov/research/themes/pbl/

Horizontally homogeneous CBL

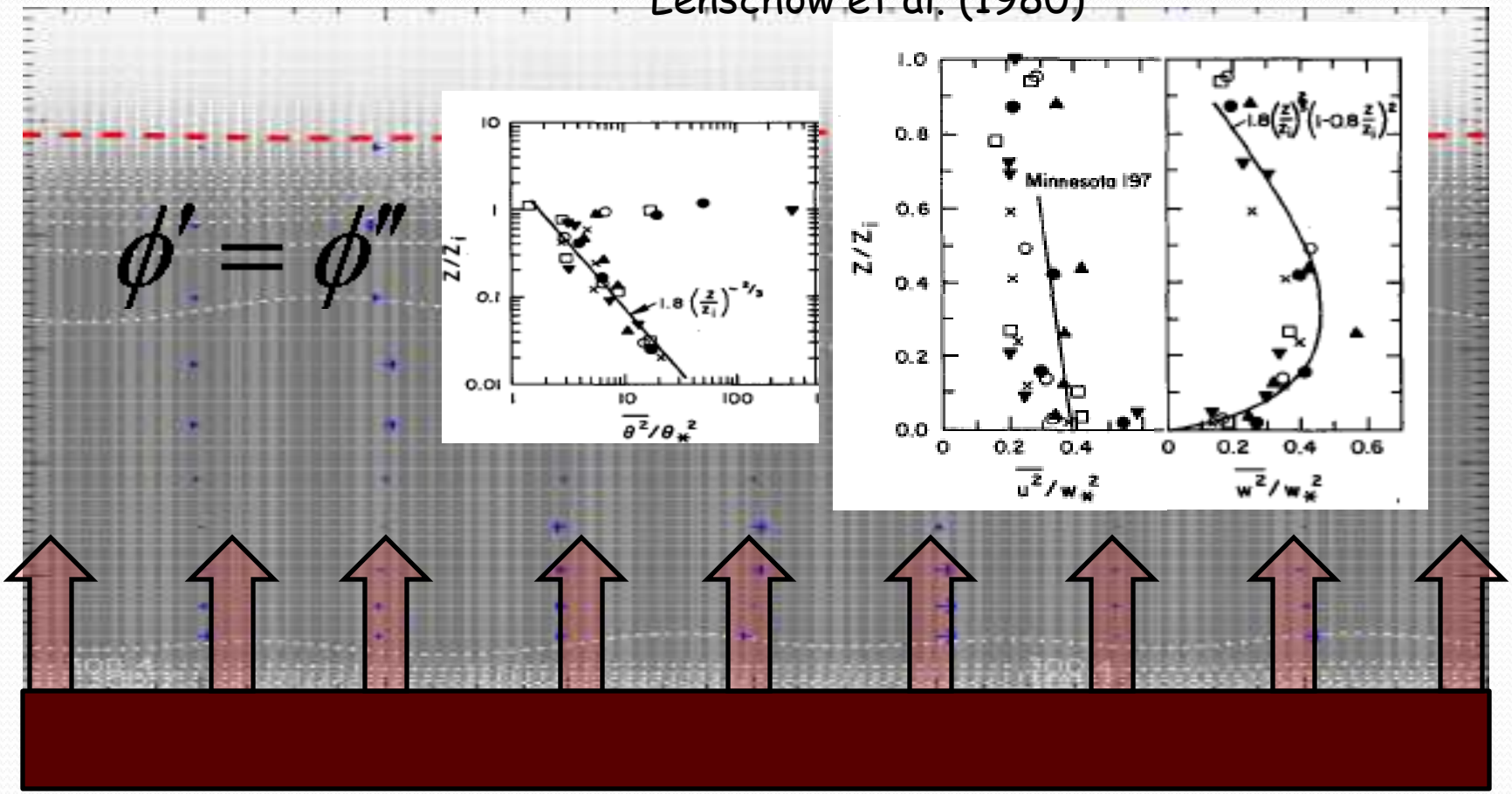


Horizontally homogeneous CBL



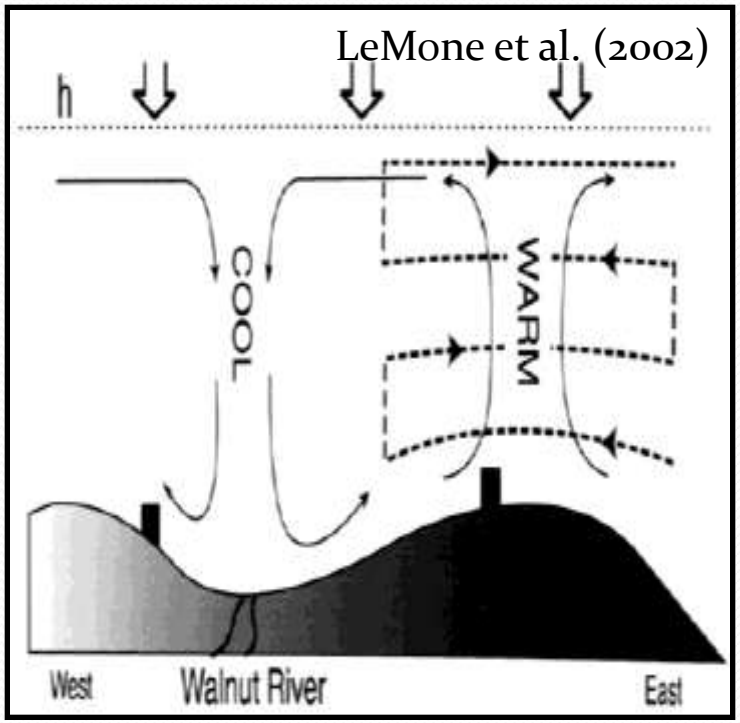
Horizontally homogeneous CBL

Lenschow et al. (1980)

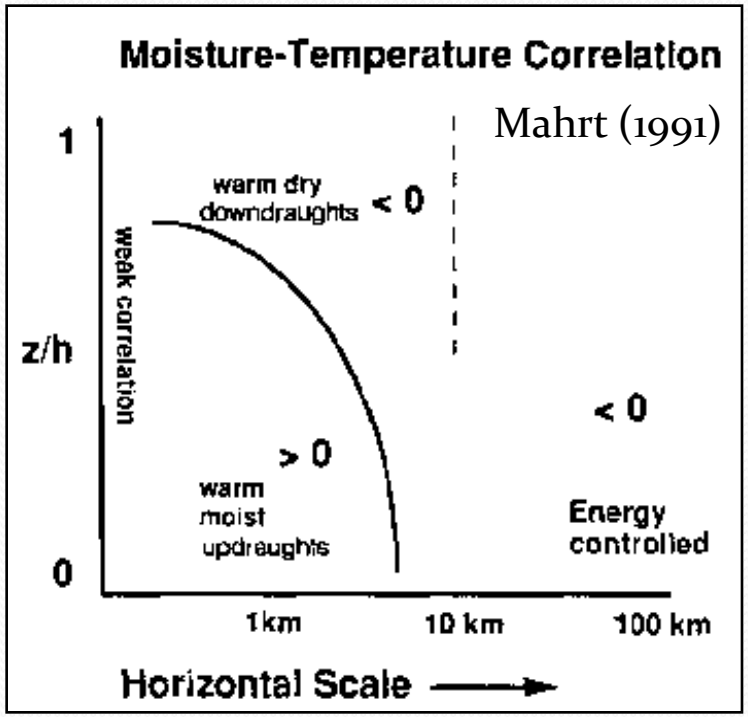


ABL variability
on a scale of tens of kilometers

Inland Breeze Circulation



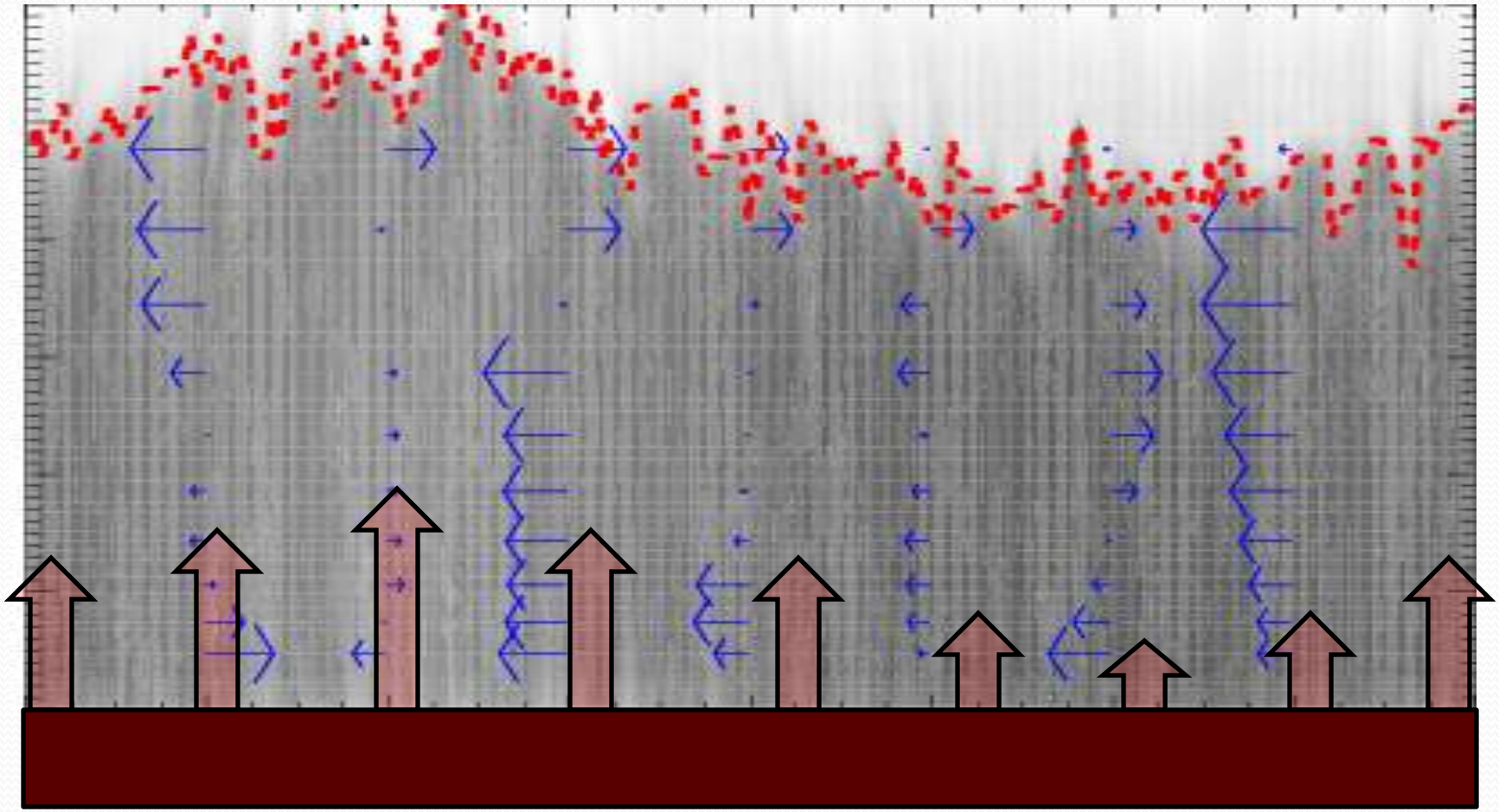
Surface Energy Budget (SEB) constraint



Rnet-G=SH+LE

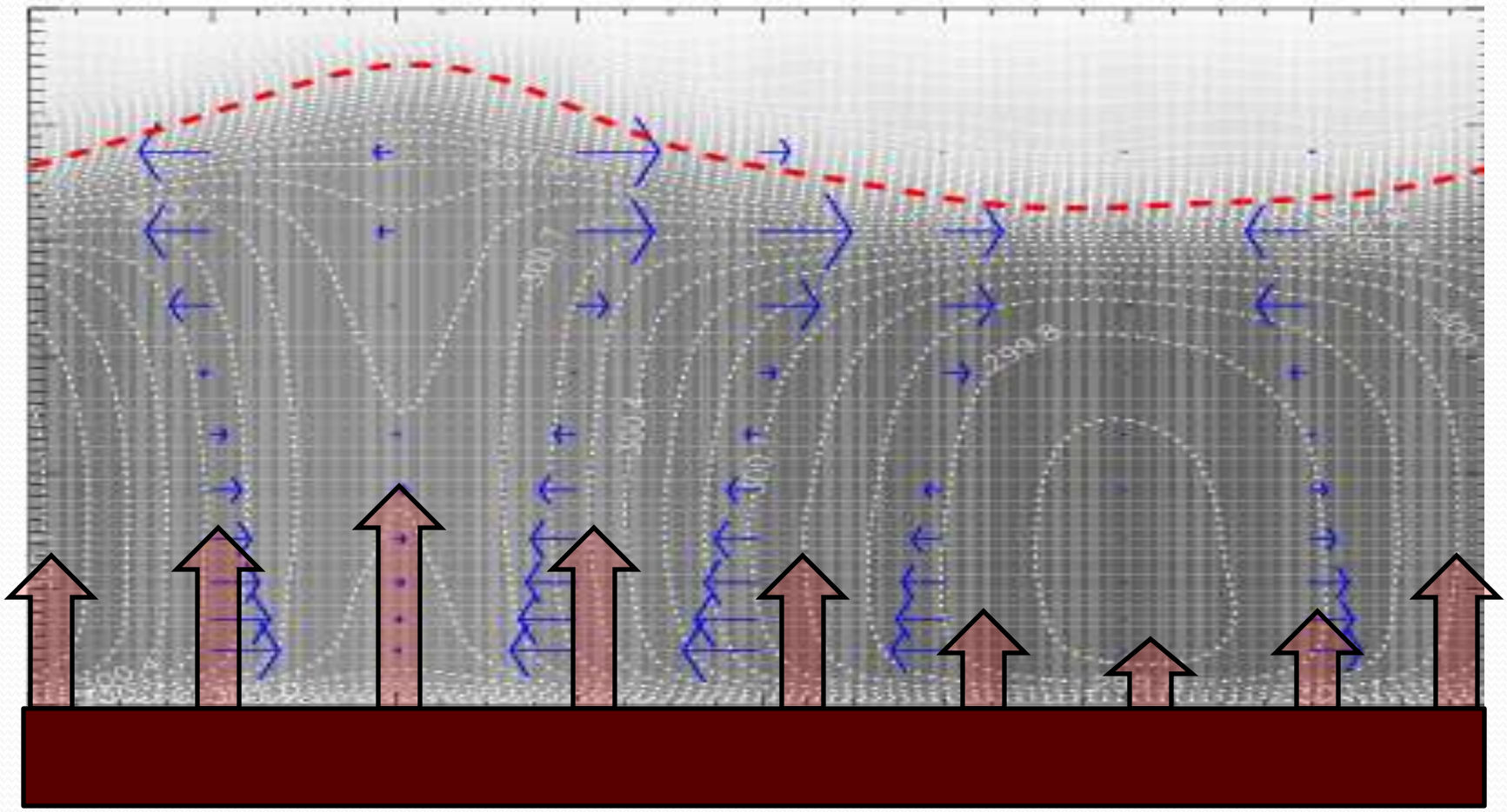
Horizontally heterogeneous CBL

$$\phi' = \phi^M + \phi''$$



Horizontally heterogeneous CBL

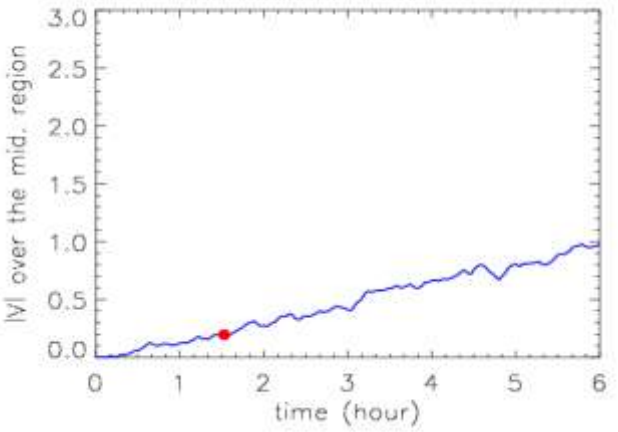
ϕ^M



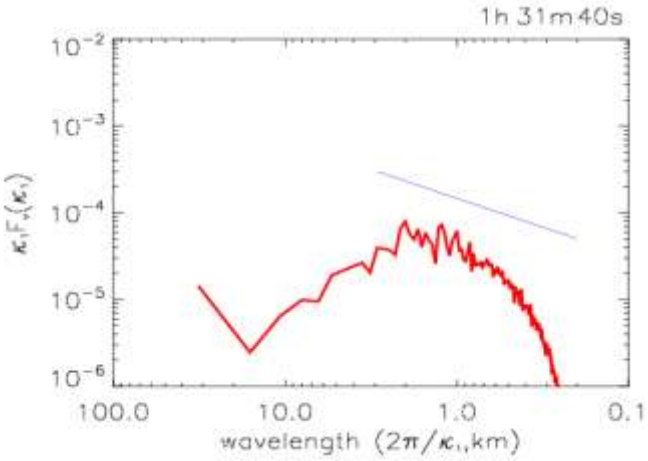
Downscale Energy Cascade

A050L32

In a quasi-stationary state



No significant energy cascade



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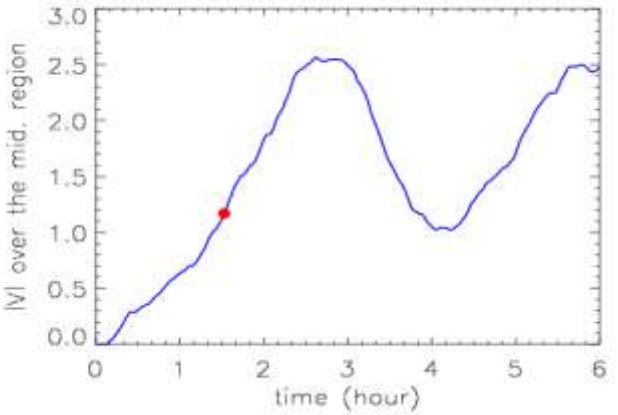
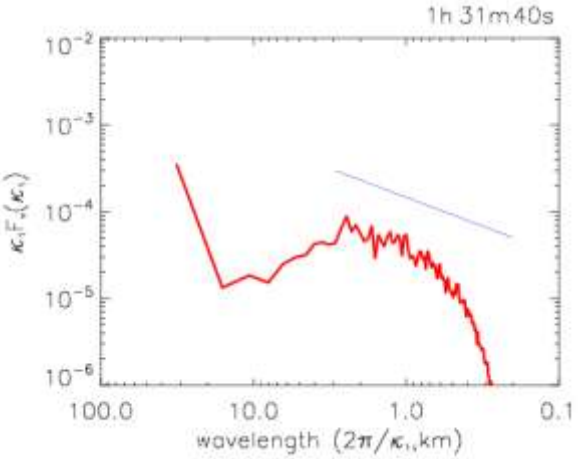
Not in a quasi-stationary state



Significant energy cascade



Normalized θ, v, and w turbulence variances

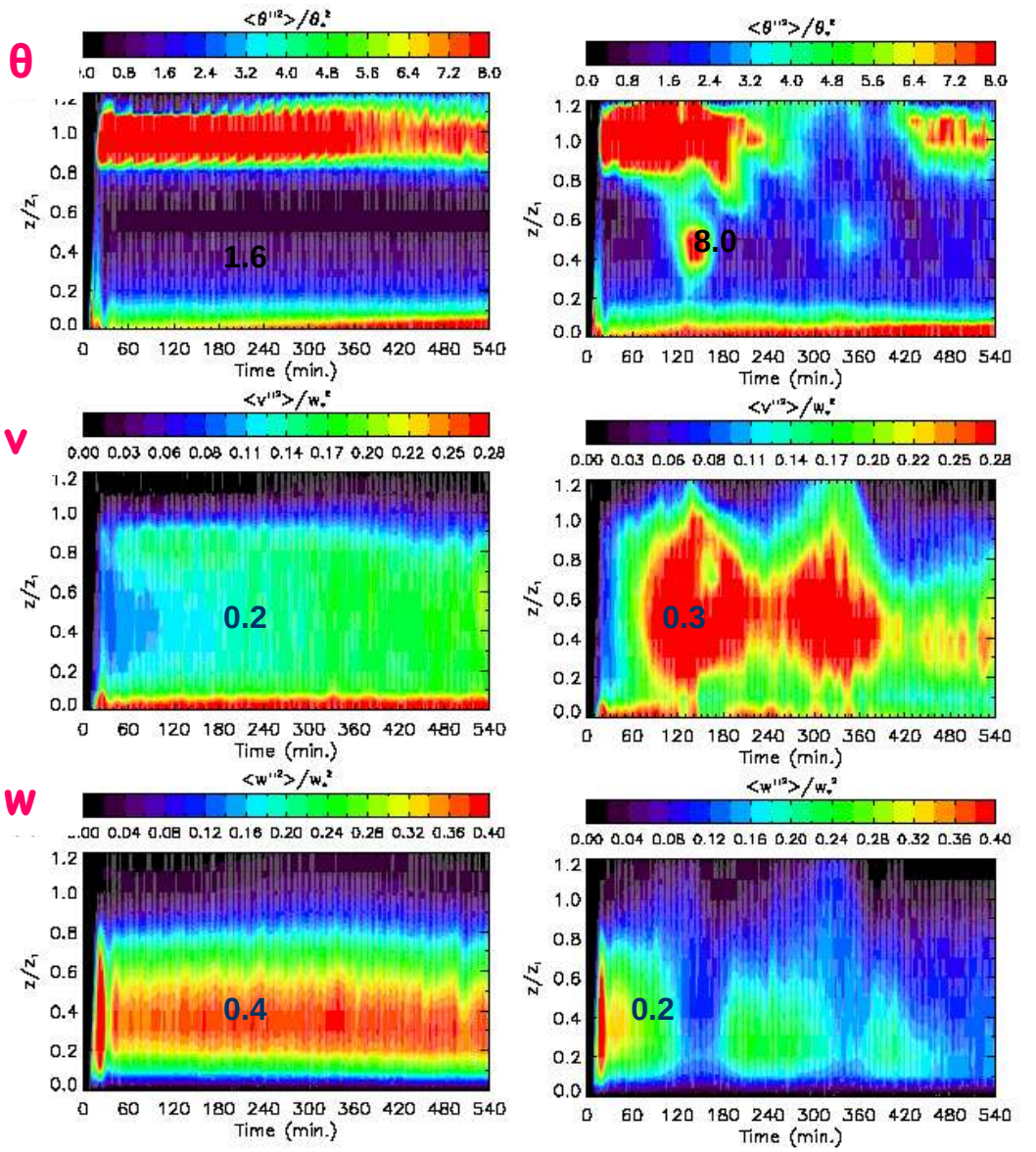
No significant energy cascade

Significant energy cascade

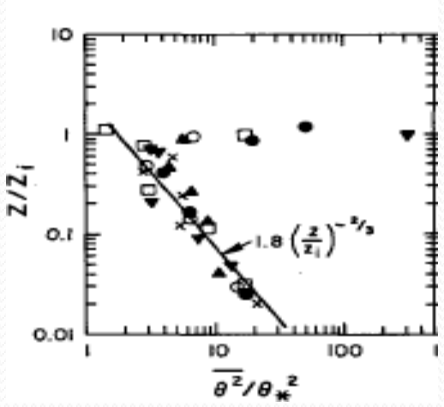
θ

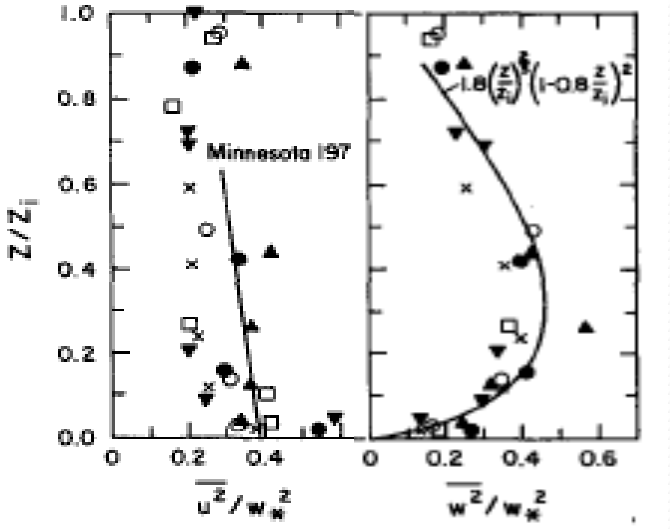
v

w



Does the mixed-layer similarity work ?





Lenschow et al. (1980)

Ongoing and future works

- More large eddy simulations (LES) with more realistic surface forcing and atmosphere conditions (e.g., diurnal change of surface fluxes, multiple scale surface forcing, heterogeneous background weather conditions)
- Mesoscale model(MM)simulations with the same conditions

➢ To know the regime where mesoscale modeling fails

➢ To suggest a better strategy to deal with the ABL turbulence in a mesoscale model