

IMAU	The atmospheric boundary layer:	
	Where the atmosphere meets the Earth	
	Outline	
	Definitions and description	
	Quantifying turbulent exchange:	
	Reynolds decomposition	
	Closure problem	
	Different ABL types	
	Neutral (Ekman / Friction) layer	
	Convective boundary layer	
	Stable boundary layer	
	Surface energy balance	
USPC 2016		2



















There is a dominant wavelength at which disturbance grow the fastest. This is characteristic of all pure shear instabilities. A disturbance with a small wavelength decays as a result of viscosity, while one that is too large requires too much shear to cause it to overturn. Hence only one wavelength dominates the flow after the instability sets in, and rather than being mixed effectively, only large scale stirring dominates the flow *Pc206*



IMAU Mixed instability

In the above two examples, either a convective instability or a shear instability stirs and mixes the two fluids of differing densities. In either case, with enough time, the fluids in each container would have been completely mixed. But in each case, large scale turbulence dominated the flow field just after the onset of the instabilities.

Small scale turbulence decayed quickly, and mixing occurred through molecular diffusion across relatively weak gradients within the flow field stirred by the large scale turbulence.

Small scale turbulence is what more effectively mixes out two fluids of differing densities, since it increases the gradients by which molecular diffusion acts. But if only small scale turbulence exists, it is quickly overtaken by viscosity.

Hence an ideal situation that maximizes the mixing efficiency is one in which large scales feed energy into small scales which efficiently accomplish the mixing. This occurs in a mixed instability, which arises when an unstable density gradient exists at a sheared interface between two fluids, creating a situation with a negative Richardson number (Ri < 0)

ISPC 2016













































































