5.2 Contributions to the TKE Budget

5.2.1 Term 1: Storage

Fig 2.10 shows that there can be substantial variation in the magnitude of TKE with time at any one height. Fig 5.1 shows a simulation of TKE over a two day period, where a dramatic increase and decrease of TKE occurs within each diurnal cycle. An increase in TKE from a small early morning value to a larger early afternoon value represents a net storage of TKE in the air.   In particular, nonturbulent FA air just above the ML top must be *spun up* (i.e., its turbulence intensity must increase from near zero to the current ML value) as entrainment incorporates it into the ML.

Over a land surface experiencing a strong diurnal cycle, typical order of magnitudes for this term range from about 5×10^{-5} m^2 s^{-3} for surface-layer air over a 6 h interval, to about 5×10^{-3} m^2 s^{-3} for FA air that is spun up over 15 min (i.e., over a time interval corresponding to t_*).   Fig 5.2 shows sample observations of TKE made in the surface layer, where TKE varies by about two orders of magnitude.

During the later afternoon and evening, a corresponding *spin down* (i.e., decrease of TKE with time) occurs where dissipation and other losses exceed the production of turbulence. The storage term is thus negative during this transition phase.

Fig. 5.1   Modeled time and space variation of $\bar{e}$ (turbulence kinetic energy, units $m^2 s^{-2}$), for Wangara. From Yamada and Mellor (1975).