1978). In a number of bays along the U.S. coastlines, for example, the tidal range in the bay is greater than that outside (O'Brien and Clark, 1974). Amplification becomes most pronounced when the forced and natural frequencies are equal. If therefore an increase in water depth due to sea level rise were such as to shift bay response away from resonance, the tidal range relative to that at the mouth could, as illustrated previously, decrease in spite of the opposing trend caused by decreasing bottom friction and increasing tidal admittance with increasing water depth. In a great many inlet/bay systems, however, bottom friction in the inlet channel controls the bay tide; hence in these cases sea level rise will increase the bay range, as will be illustrated later.

4.3.2 Superelevation Effect

In most bays, the tidal mean water level is usually different, often higher than mean sea level. The difference, referred to as bay superelevation, results from a number of physical factors. Mehta and Philip (1986) reviewed these factors, and the physical mechanisms by which they generate superelevation. Representative maximum superelevation corresponding to each cause, as might be found from measurements, were suggested; Table 4.1 gives a summary of the findings. Among the listed causes, sea level rise will directly or indirectly influence inlet/bay geometry, sea tide, salinity, wave penetration and some other factors. Since these in turn influence the mean bay level, in the evaluation, for instance, of the change in tidal range due to sea level change, the associated change in superelevation must be additionally considered in calculating the net water change.

Mann (1987) examined the superelevation effect resulting from inlet/bay response to tidal forcing. Tide-averaged hydrodynamic equations were developed and it was shown that bottom friction in the inlet channel is the primary cause of superelevation. Stokes drift, tidal current asymmetry and river runoff were identified (in the absence of such effects as those arising from salinity, wind waves, etc.) as the major governing physical processes. Mann considered the case of a small, deep bay connected to the sea via a long inlet channel. The combined effects of tide and superelevation resulting from sea level rise were evaluated, as will be noted in the next section.