

Stability Index for Marine Low Cloud Cover over the Mid-latitudes

*Hideaki Kawai¹, Tsuyoshi Koshiro¹

1. Meteorological Research Institute

The estimated inversion strength (EIS; Wood & Bretherton 2006) is a well-known index that highly correlates with marine low-cloud cover and has been used in many studies. The index estimates strength of inversion at the top of the atmospheric mixed layer based on the potential temperature at 700 hPa and near the sea surface. However, marine low-cloud cover over the mid-latitudes, which is rather large, is slightly underestimated by EIS. On the other hand, the estimated cloud-top entrainment index (ECTEI; Kawai et al. 2017), which is developed from EIS, corresponds better to large low-cloud cover over the mid-latitudes than EIS (Fig. 1).

The reason can be explained as follows. The EIS takes into account only the temperature profile and does not include information on water vapor. On the other hand, the ECTEI, which is deduced from a criterion of cloud top entrainment that can destroy low-clouds, includes information on the vertical profile of water vapor (specific humidity at 700 hPa and near the sea surface) as well as that of temperature. Even though the EIS has similar values over the subtropics and the mid-latitudes, marine low-clouds over the mid-latitudes are less easily destroyed because of lower sea surface temperature and larger relative humidity around 700 hPa. The ECTEI can simply explain that these two factors contribute to large marine low-cloud cover over the mid-latitudes.

In addition, it is briefly introduced that climate model MRI-ESM2, which utilizes ECTEI in the cloud parameterization, reasonably reproduces marine low clouds over the mid-latitudes and the corresponding radiation bias is small.

Keywords: marine low cloud, mid-latitudes, cloud parameterization, climate model

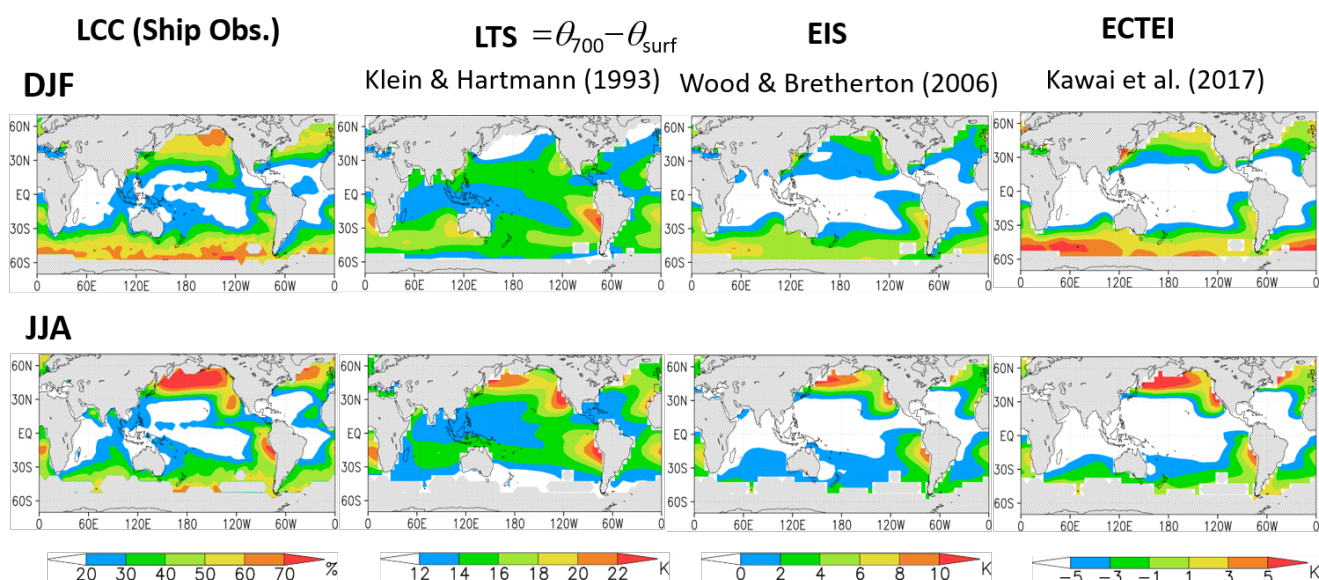


Figure 1: Climatologies of low stratiform cloud cover (%), LTS (K), EIS (K) and ECTEI (K) for December to February and June to August (modified after fig. 12 in Kawai et al. 2019, *GMD*). Cloud cover data were obtained from EECRA shipboard observations, and stability indexes were calculated using ERA-40 data (1957–2002).