

**Supplemental Fig. 4** First three leading EOF patterns, as in Fig. 10, but of high-pass SSTA in the Southern Ocean for a selection of model simulations and observations. In addition to the observations, the CMIP3 and CMIP5 super models, the models with the largest (INMCM4) and smallest (CCSM4)  $RMSE_{EOF}$  value are shown.