



**Figure 1**

Key historical MHWs. (a) SST anomalies on the day of peak MHW intensity. MHW intensity was defined based on the time series of SST averaged over the regions indicated by the black boxes. Light gray indicates areas of sea ice influence. (b) MHW properties for key historical events. The MHW intensity (*y* axis), MHW duration (*x* axis), and category (*color*; see Hobday et al. 2018a) were determined from the spatially averaged time series, as in panel *a*. The MHW area (*circle size*) is the total contiguous area reaching at least category 2 (strong). All events shown in panel *b* are referenced in Section 2. Abbreviations: AL, Gulf of Alaska and Bering Sea; Beng., Benguela; ECS, East China Sea; Med., Mediterranean; NA, northern Australia; MHW, marine heatwave; NEP, northeast Pacific; NWA, northwest Atlantic; SST, sea surface temperature; Tas., Tasman Sea; WA, Western Australia; WSA, western South Atlantic. Panel *a* inspired by a schematic from Frölicher & Laufkötter (2018).

Record-breaking MHWs have been documented where the atmospheric state played a central role in their development and maintenance. Examples of such events include those in the Mediterranean Sea during the summers of 2003 (Olita et al. 2007) and 2006 (Bensoussan et al. 2010), off the northeast coast of the United States in 2012 (Chen et al. 2014, 2015), from the southeast tropical Indian Ocean to the Coral Sea in 2015–2016 (Benthuyssen et al. 2018), in the East China Sea in