

We also identify the development stages of the TIMPS lifecycle. These stages are found in the gmd variable which gives what we refer to as the growth, mature, and decay stages. This variable is a time-series with values of 0, 1, 2, and 3 - 1 indicates a growth stage, 2 a mature stage, 3 a decaying stage, and 0 is unidentifiable as one of the previous three stages. These stages are calculated by using the time-series of area and volumetric rain rate (VRR). The gmd variable is shown in shades in Figures 4a and 4b for two sample TIMPS respectively. Area and VRR are filtered using a moving average with a window 20% the length of the TIMPS time-series (Figures 4c and 4d) and the gradient of the filtered time-series is calculated using a centered difference (Figures 4e and 4f). From the filtered time-series, maxima are identified and those maxima that are twice that of the surrounding local minima are identified as peaks of mature periods. All consecutive times with area and VRR greater than 75% of the mature period's maxima are then designated as mature periods (e.g., Figures 4c and 4d). Periods before and after are then examined for consecutive periods of positive gradient in filtered area and VRR (e.g., Figures 4e and 4f). Further, these growth periods must last at least 3 time-steps to ensure sustained growth rather than sudden mergers of two large MCSs.

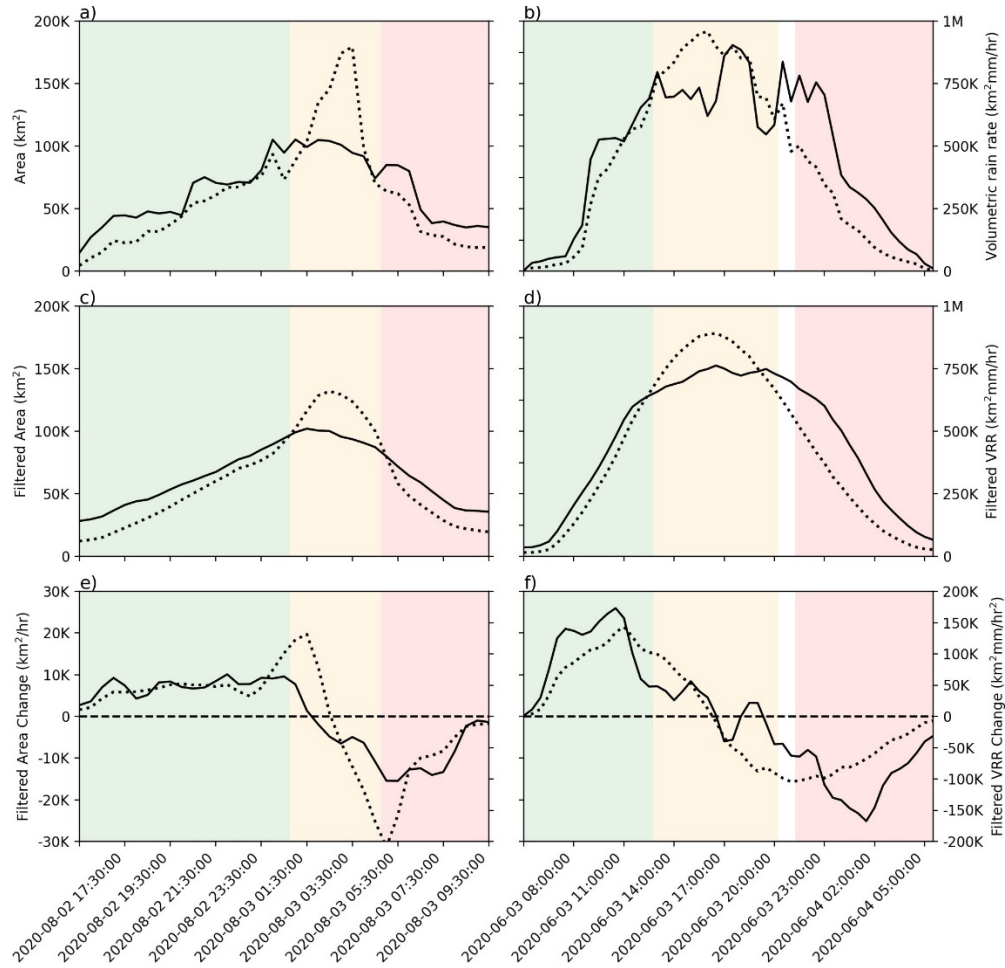


Figure 4: Depiction of the growth, mature, and decay stages of a,c,e) TIMPS 20201327436 (shown in Figure 2d) and b,d,f) TIMPS 20200978282 (shown in pink in Figure 3d). Colored shades show the growth (green), mature (yellow), and red (decay stages). Time-series shown are a,b) area (solid) and volumetric rain rate (dotted), c,d) filtered area (solid) and filtered volumetric rain rate (dotted), and e,f) area change (solid) and volumetric rain rate change (dotted).