Figure S1: Global (left panel) and Northern Hemisphere extratropic (NHET, right panel) mean net radiation at the top of the atmosphere in full-sky conditions. Solid lines and dashed lines are for tropical (a-b) and NH extratropical (c-d) eruptions, respectively. Different colors represent different ensemble member realizations. The black lines represent the ensemble member means of the baseline experiments. The gray shades represent two standard deviations of the control run. Note the different y-axes between the left and right panels.
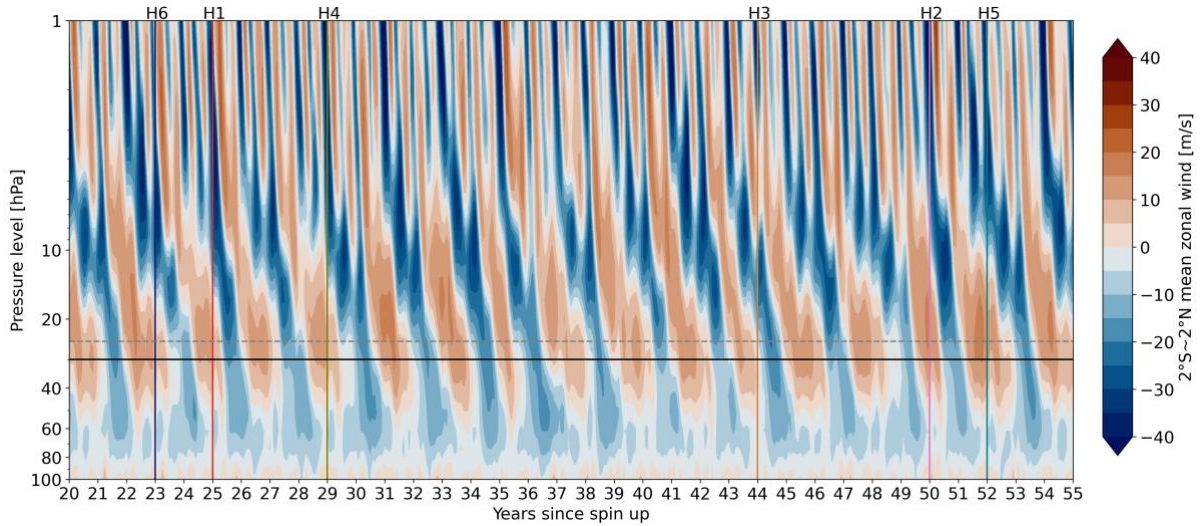
Figure S2: Initial QBO state indicated by the equatorial mean zonal wind at 30 hPa (black horizontal line), range from 2º S to 2º N. The grey horizontal line indicates the volcanic volatile injection altitude at 25 hPa. The vertical lines mark the selected initial QBO state in January for six members of the baseline experiment, corresponding colors are the same as that shown in figures 1 to 4.
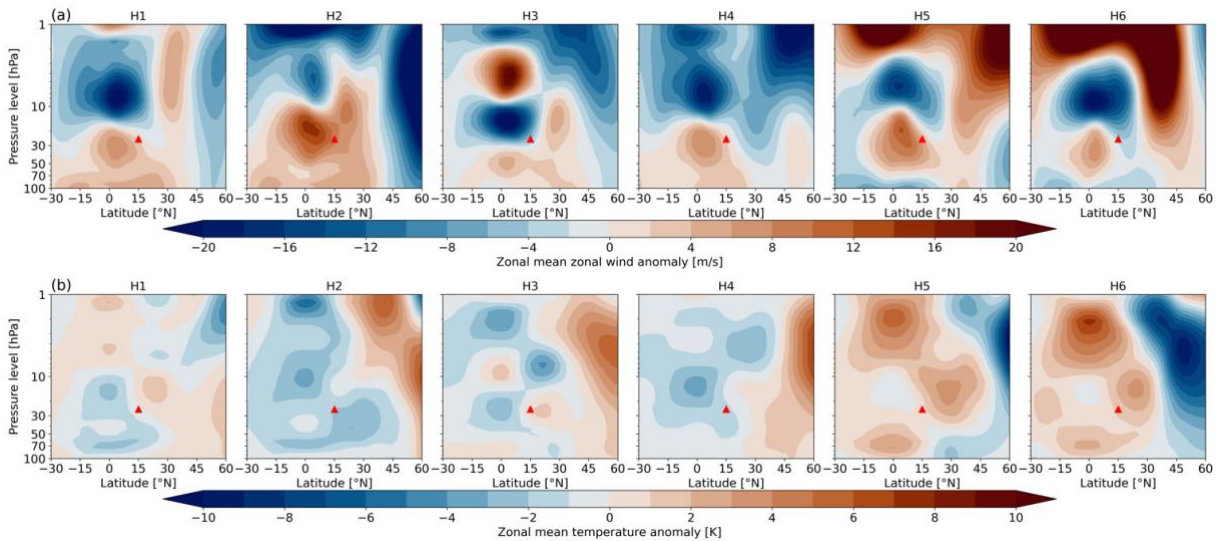
Figure S3: The first month latitudinal and vertical distribution of zonal mean zonal wind (a) and temperature (b) anomaly in six members of the baseline experiments. The red triangle indicates the level and latitude of the tropical volcanic injections.
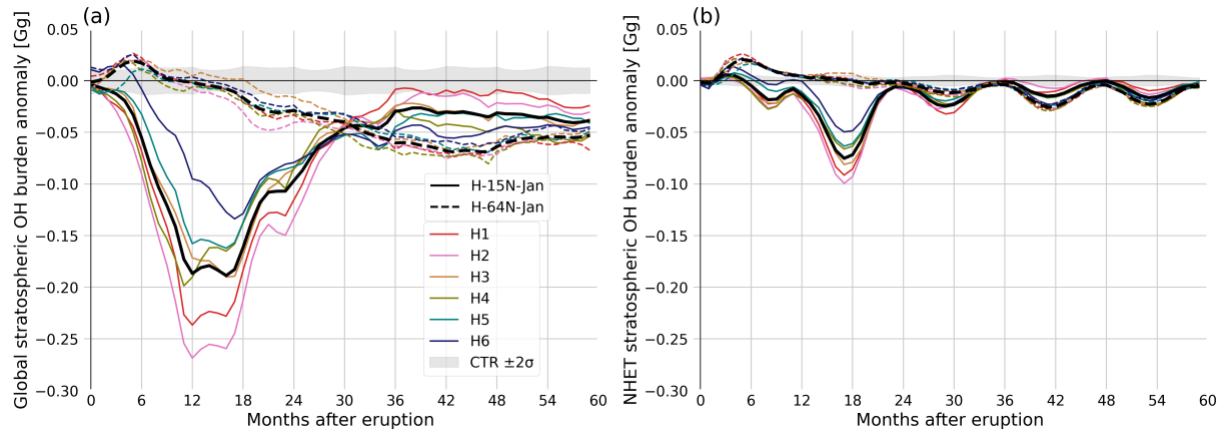
Figure S4: Global (a) and Northern Hemisphere extratropic (NHET, b) stratospheric OH burden anomaly. Solid lines and dashed lines are for tropical and extratropical eruptions, respectively. Different colors represent different ensemble member realizations. The black lines represent the ensemble member means of the baseline experiments.