Supplementary Information to "Uncertainty and detectability of climate surface response to large volcanic eruptions"

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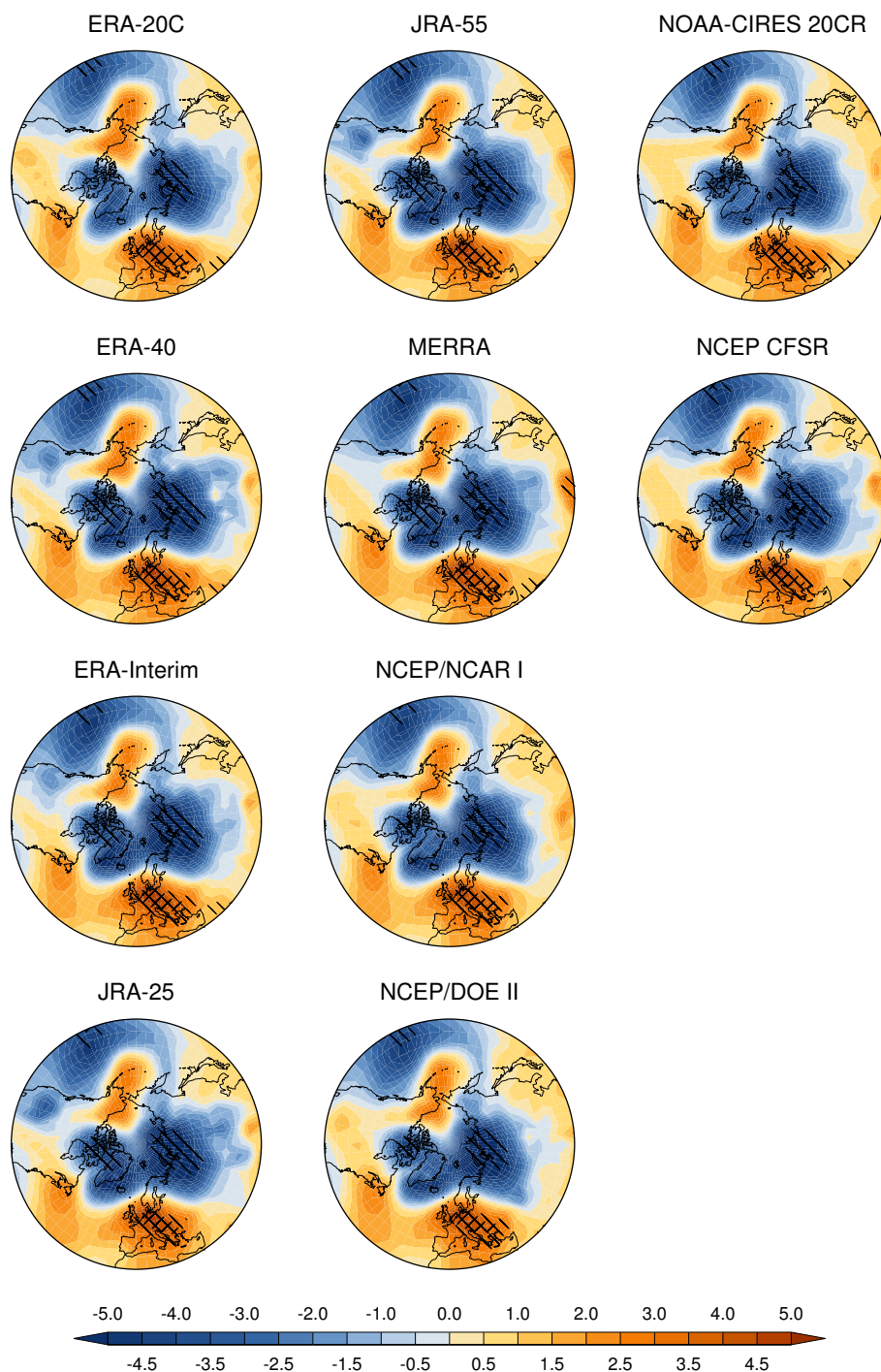
Figure S1. SLP anomalies (hPa) in the Northern Hemisphere in the first post volcanic winters (DJF) averaged over the two volcanic eruptions of Mt. Pinatubo (1991) and El Chichón (1982) for all 10 reanalysis datasets. Anomalies are calculated with respect to the mean for the years 1979-2012, excluding the following two years after the eruptions. Single diagonal lines correspond to the 90% and double diagonal lines to the 95% confidence level obtained with a Monte Carlo test of two independent samples.
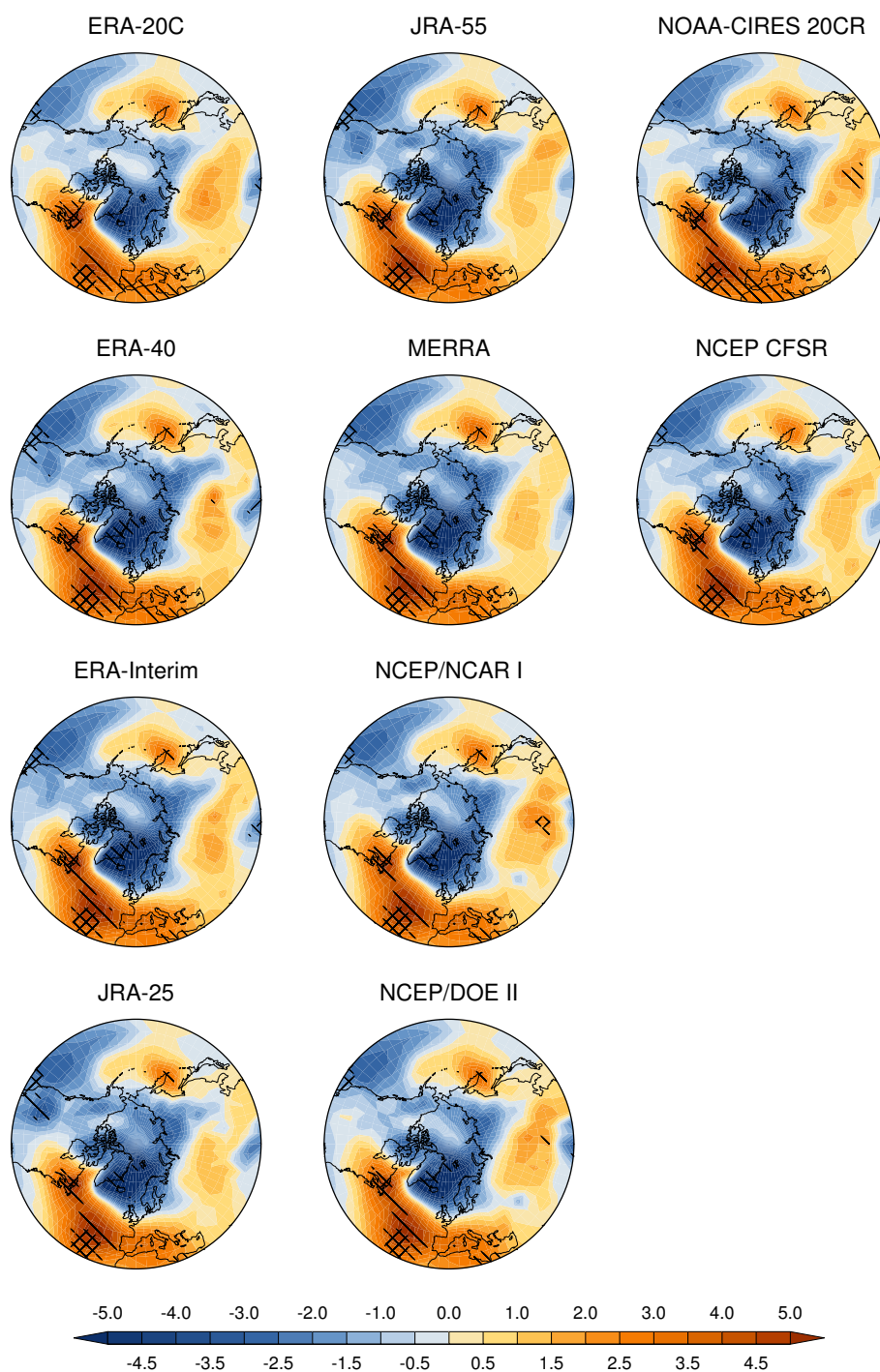
Figure S2. As Figure 1, but for the second post volcanic winter.
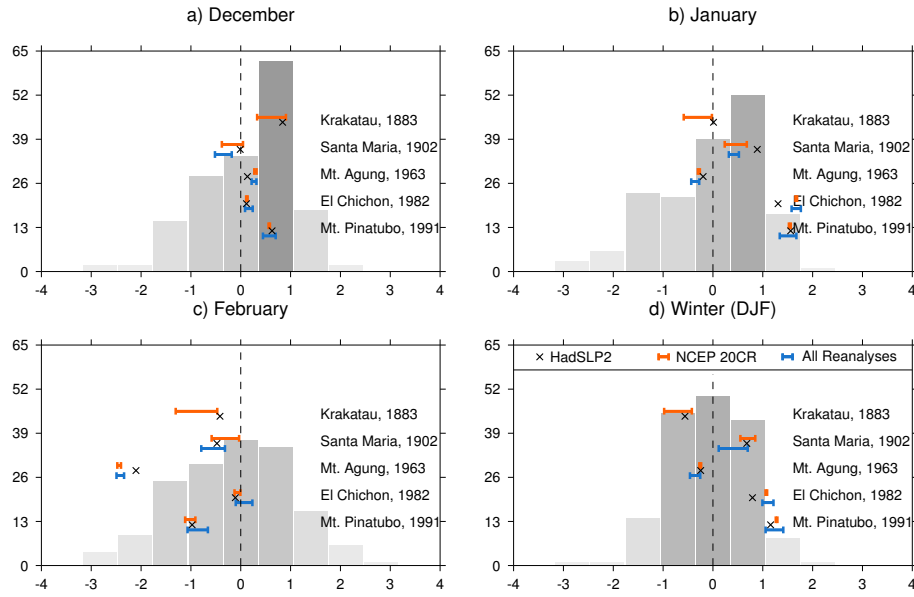
Figure S3. Monthly North Atlantic Oscillation (NAO) index of the second winter after 5 volcanic eruptions (a-c) and the winter mean (d), calculated with HadSLP2 observation data and reanalysis data. All data is calculated with respect to the mean for the years 1979-2012, excluding the following two years after the two eruption. The EOF is calculated over the period 1979-2012 for every product separately. The histogram shows the NAO index of the 163 years of observation data (1850-2012). The blue lines show the reanalysis data spread of the NAO index for the winter after Mt. Pinatubo and El Chichón. The orange lines show the 90% ensemble spread of the NAO after all 5 volcanic eruptions calculated with the NCEP-20CR dataset.
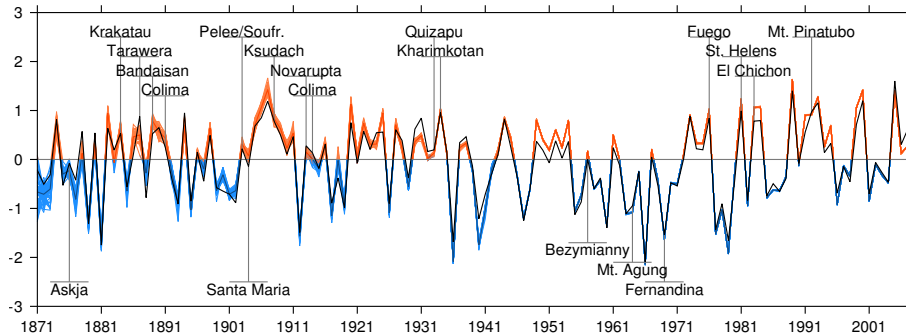
Figure S4. Winter mean NAO index from 1871 until present, calculated with HadSLP2 observation data and NCEP-20CR ensemble data. All data is calculated with respect to the mean for the years 1979-2012, excluding the following two years after the two eruption. The EOF is calculated over the period 1979-2012. Every single thin coloured line represents one ensemble of the NCEP-20CR reanalysis. Thick coloured line shows the NCEP-20CR ensemble mean and black line shows HadSLP2 data. All volcanoes from Figure 2 are indicated by a grey line at the first winter after the eruption or at the second winter after the eruptions in the case of Fuego and Santa María. All volcano names which are above the zero line were followed by a positive NAO in the first (or second) winter after the eruption according to the HadSLP2 data and all volcano names which are below the zero line were followed by a negative NAO.
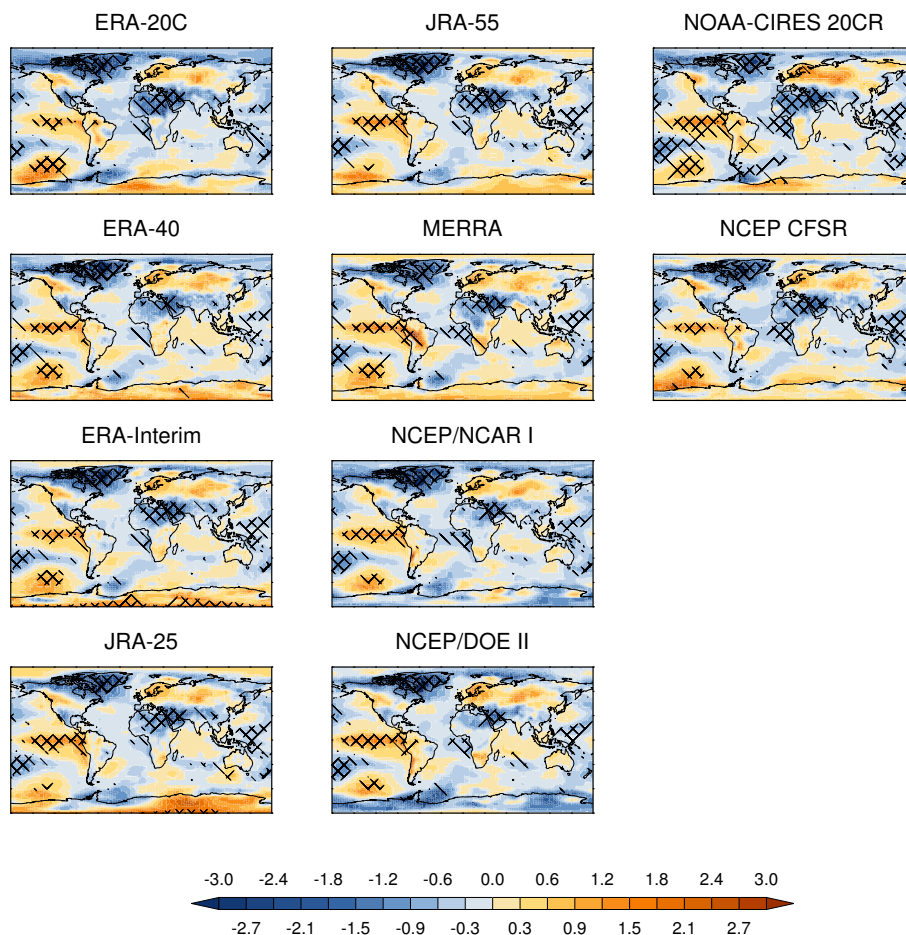
Figure S5. TAS anomalies (K) averaged over the first year after the eruption and over the two volcanic eruptions Mt. Pinatubo (1991) and El Chichón (1982) for all 10 reanalysis products. Anomalies are calculated with respect to the average over the years 1979-2012. Single diagonal lines correspond to the 90% and double diagonal lines to the 95% confidence level obtained with a Monte Carlo test of two independent samples
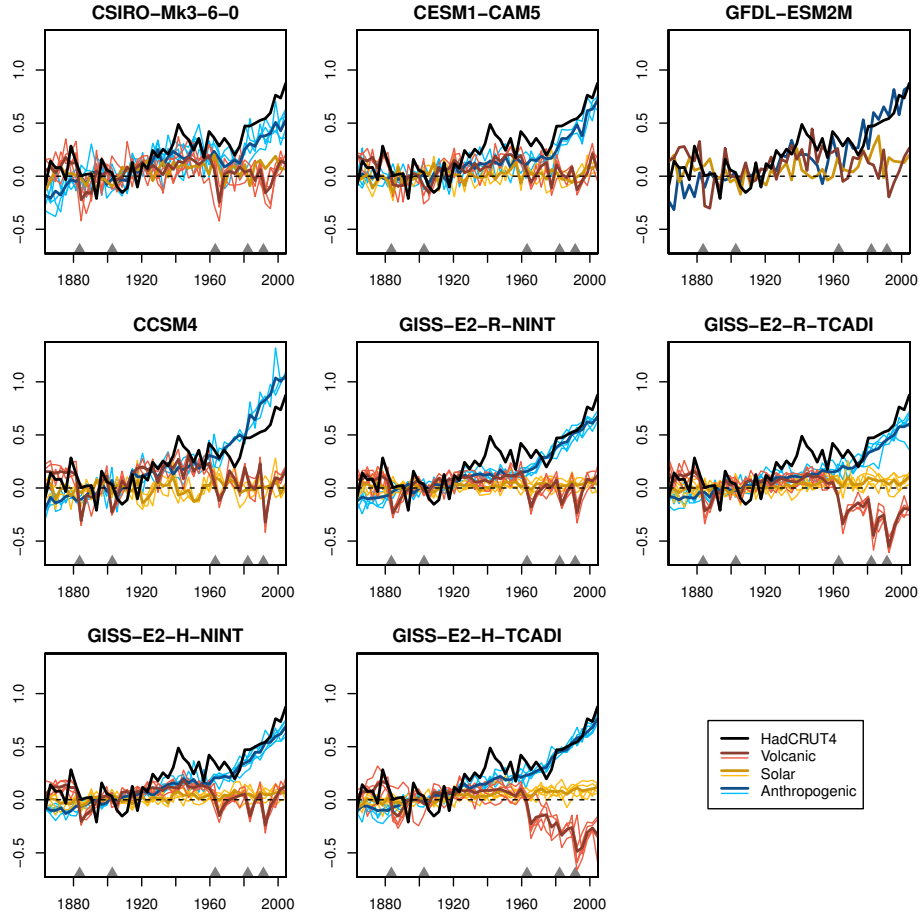
Figure S6. Tropical 3 year mean TAS variations in K (1862-2005) with respect to 1880-1919 for the CMIP5 historicalMisc experiments with just volcanic forcing in brown , just solar forcing in yellow and just anthropogenic forcing in blue of every model. The black solid line shows HadCRUT4 observation data. Light color lines are ensemble members of the model and solid lines show the ensemble mean. Gray triangles indicate large tropical volcanic eruptions.
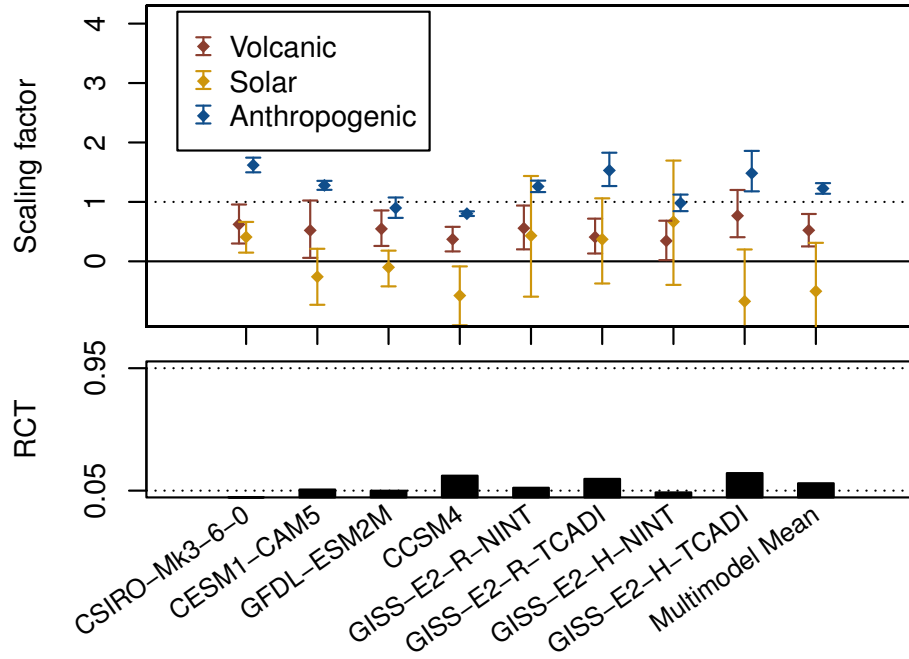
Figure S7. Similar to figure 10 but with golbal data and including the solar signal. Scaling factors best-estimates (diamond) and condicence intercal of global TAS (1862-2005) for all different CMIP5-models (Table 2) and multimodel mean calculated using the ROF method. The p values of the confidence interval, produced with a RCT, is shown in the lower panel. To include the solar forcing, the surface temperatures anomalies are enhanced by a factor of three and the resulting scaling factor is divided by the same factor.