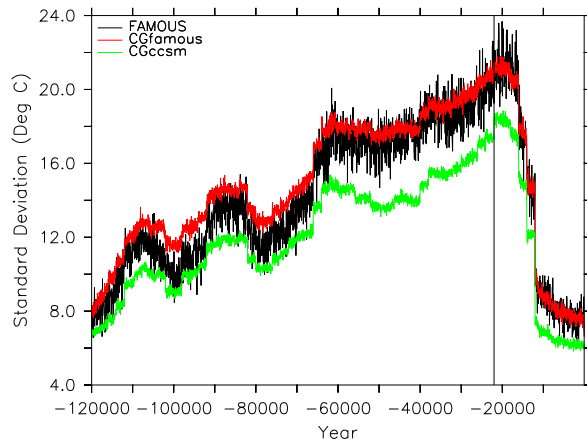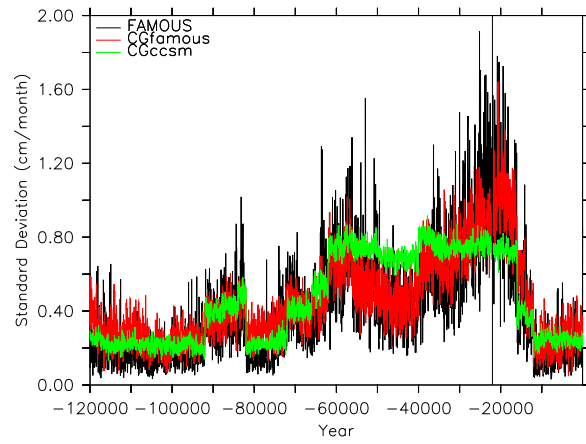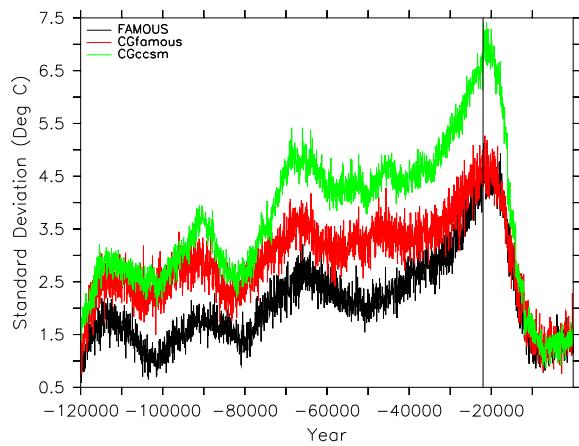**Supplement of Climate Generator**

This supplement contains time series, correlation maps and map plots comparison of CG (CGfamous and CGccsm) simulated fields with FAMOUS and EBM climate model outputs in different continents.
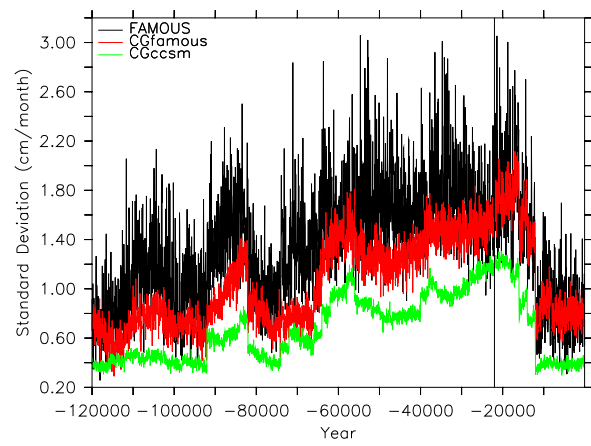
(a) February Temperature

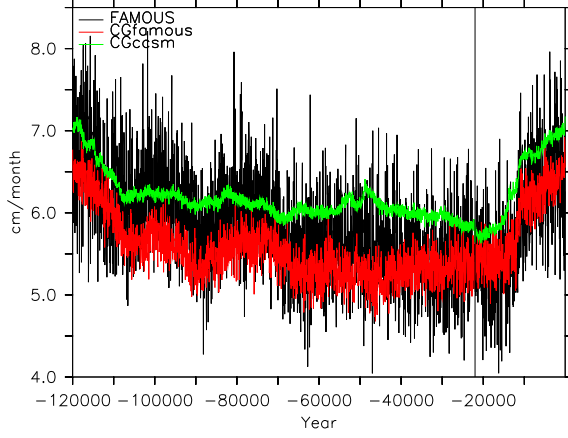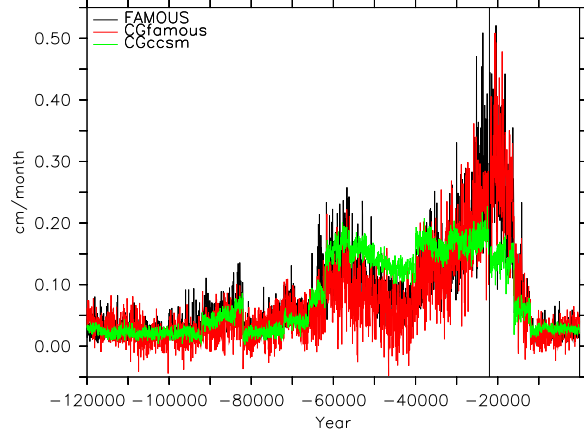(b) February Precipitation

(c) August Temperature
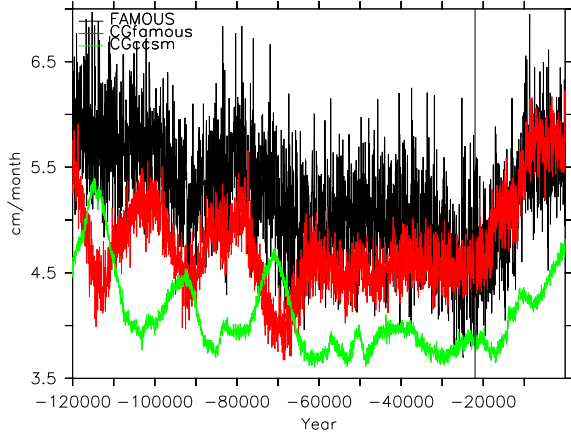
(d) August precipitation

Figure 1. Comparison of the spatial variance (standard deviation) on the ice region over north America. The black vertical line separates test (left) and training part (right).
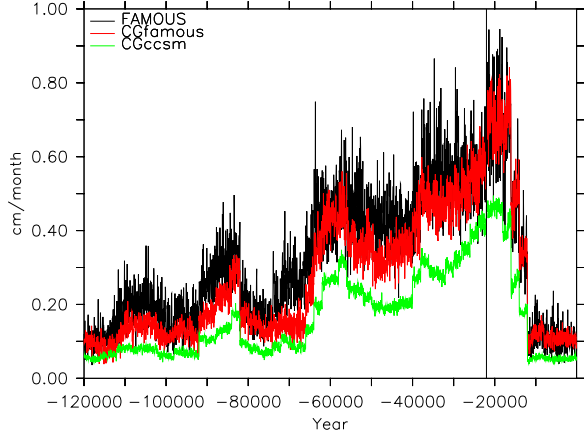
(a) February (Full grid area)

(b) February (Ice region)

(c) August (Full grid area)

(d) August (Ice region)

Figure 2. Comparison of the spatial mean (with latitudinal weighting over North America) precipitation time series. The black vertical line separates test (left) and training part (right).
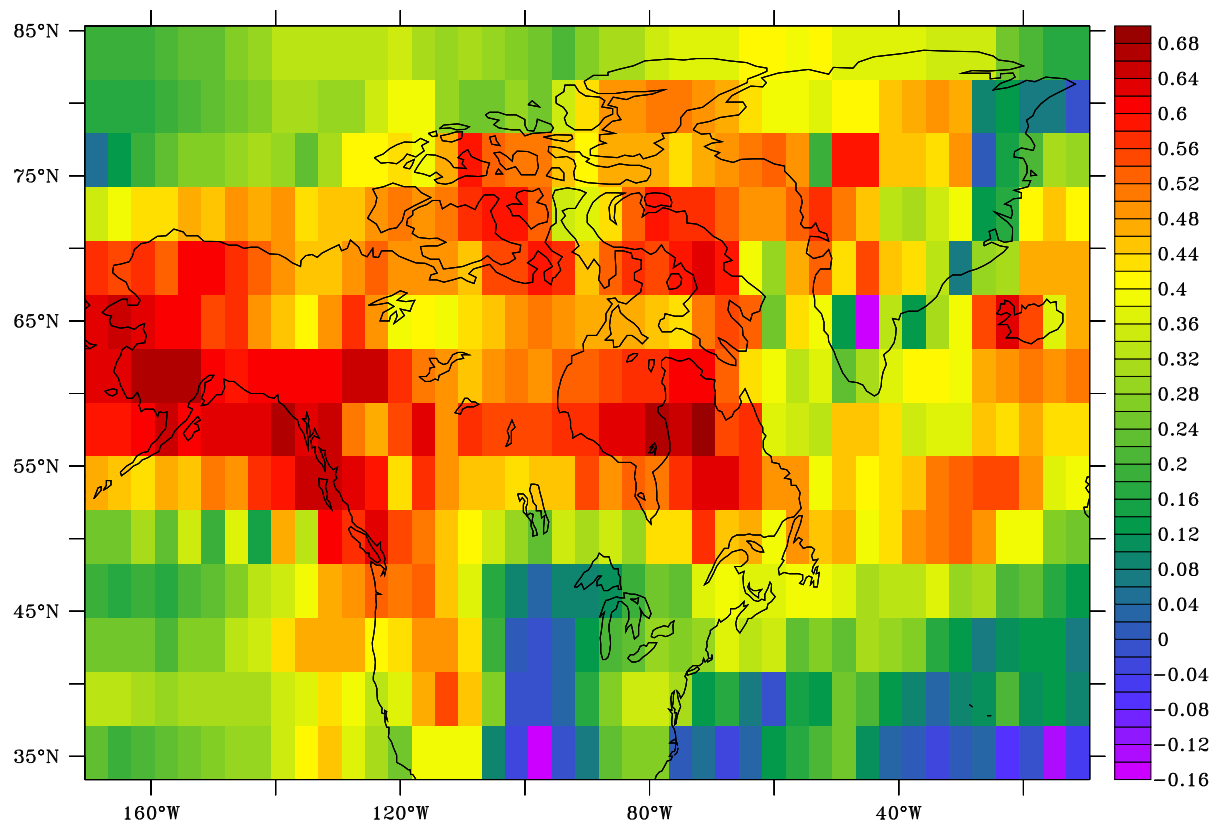
Figure 3. February correlation map between residual (i.e. CGfamous without noise - FAMOUS) Temperature and precipitation field over North America

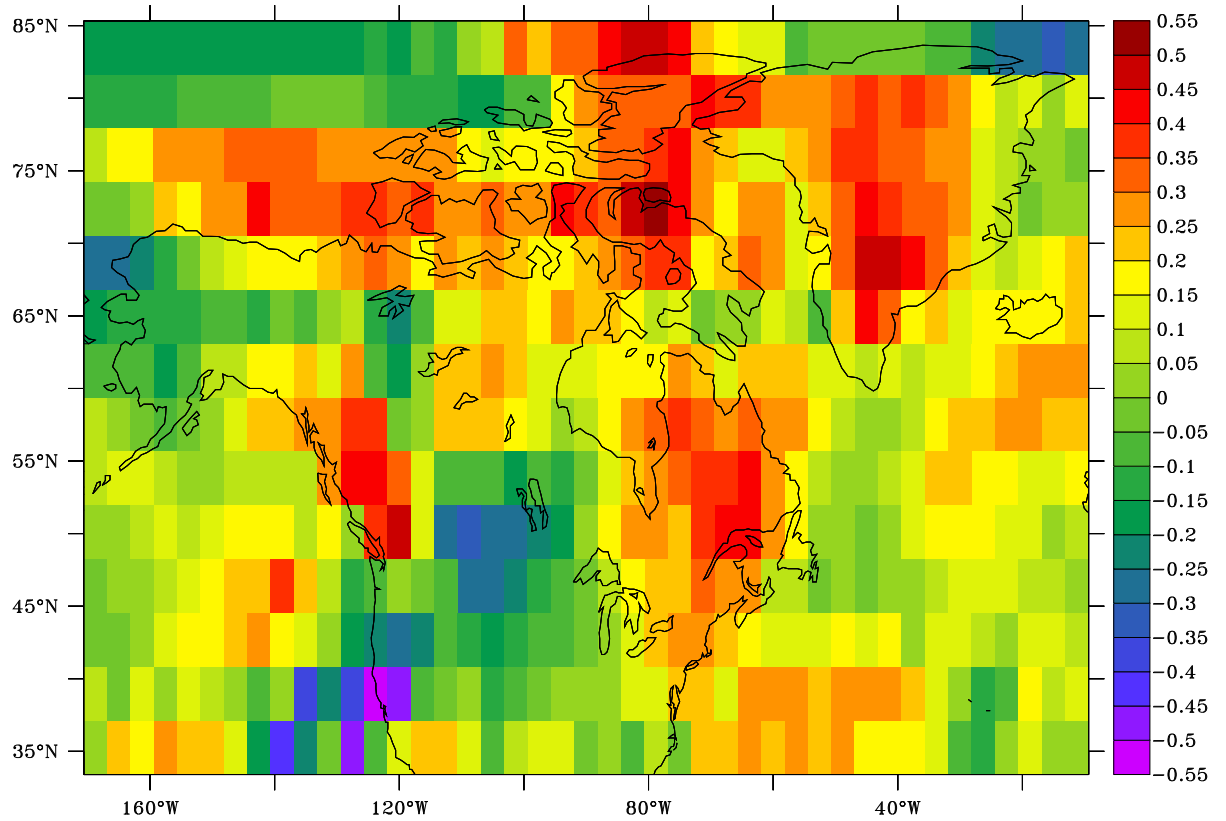**Figure 4.** August correlation map between residual (i.e. CGfamous without noise - FAMOUS) Temperature and precipitation field over North America
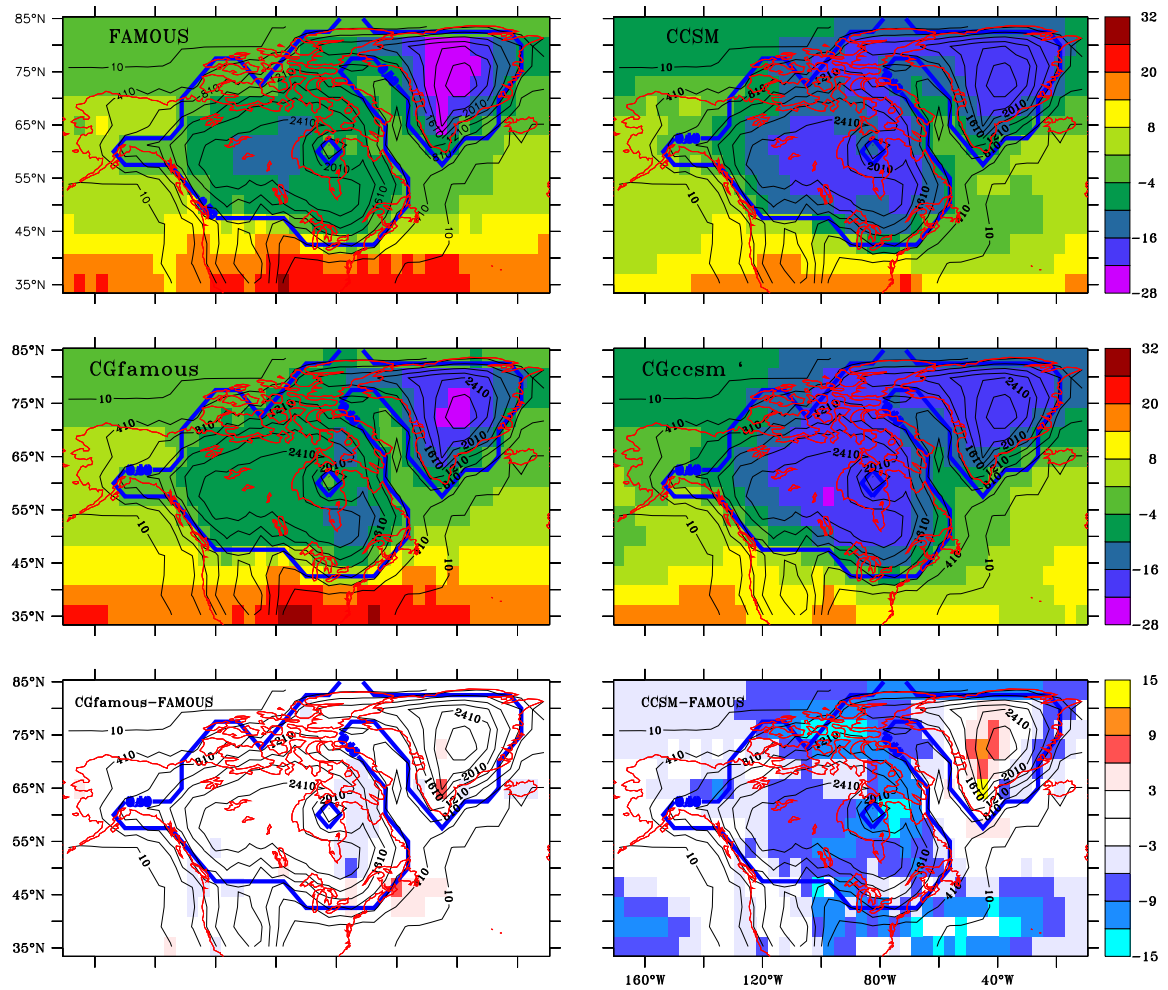
Figure 5. August temperature field (Deg C) over North America at 18 ka with the elevation and ice contour shown in black and blue. Difference between plots are shown in 3rd row. Model names and months are indicated in the top left corner in each box).
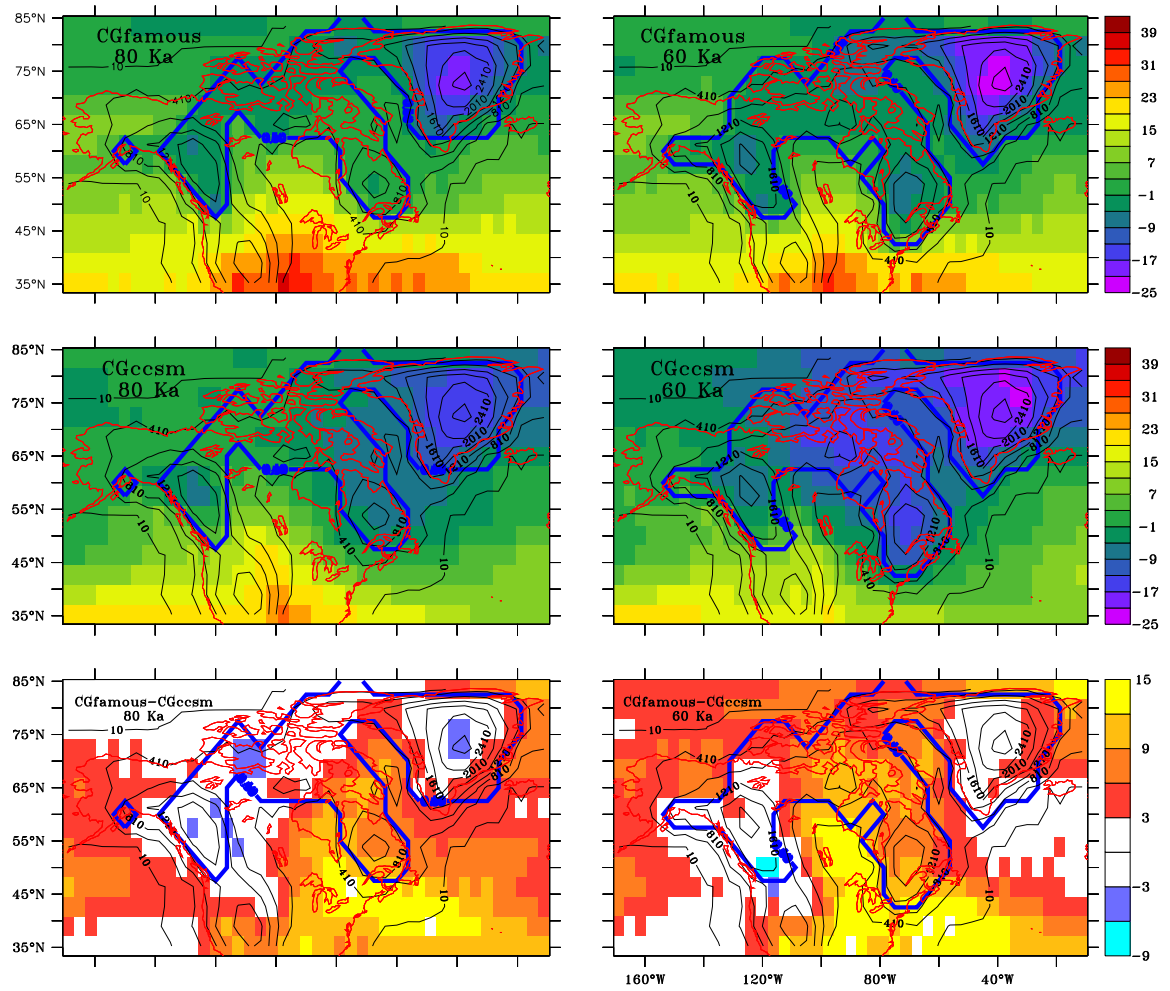
Figure 6. The August temperature field over North America (Deg C). (1st and 2nd row) with the elevation and ice contour shown in black and blue. Difference between plots are shown in 3rd row. Model names are indicated in the top left corner in each box).
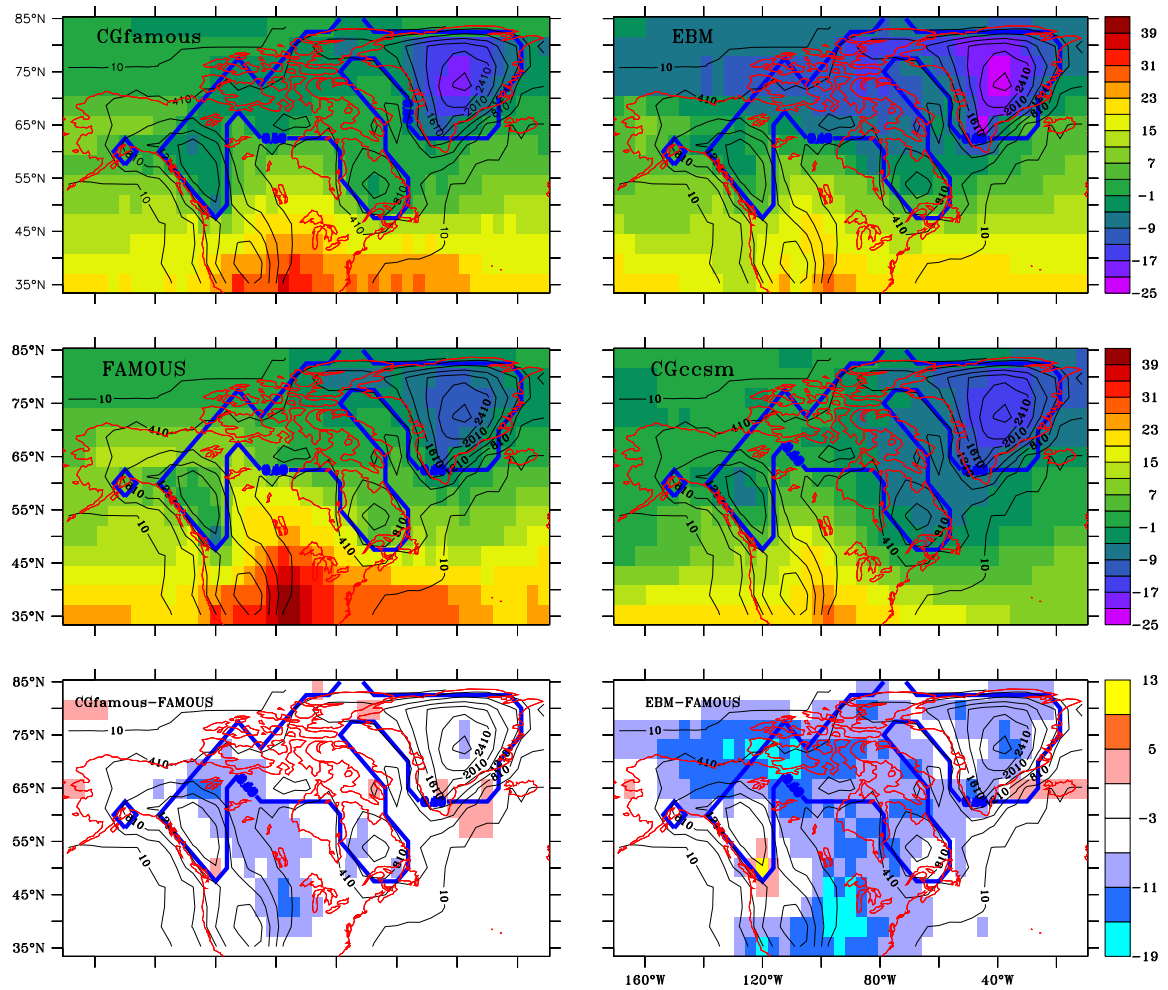
Figure 7. The August temperature field (Deg C) over North America at 80 ka (1st and 2nd row) with the elevation and ice contour shown in black and blue respectively. Difference between plots are shown in 3rd row. Model names are indicated in the top left corner in each box.

Figure 8. The February temperature field (Deg C) over North America at 80 ka (1st and 2nd row) with the elevation and ice contour shown in black and blue respectively. Difference between plots are shown in 3rd row. Model names are indicated in the top left corner in each box.

Figure 9. The August temperature field at 60 ka over North America (Deg C) (1st and 2nd row) with the elevation and ice contour shown in black and blue respectively. Difference between plots are shown in 3rd row. Model names are indicated in the top left corner in each box.
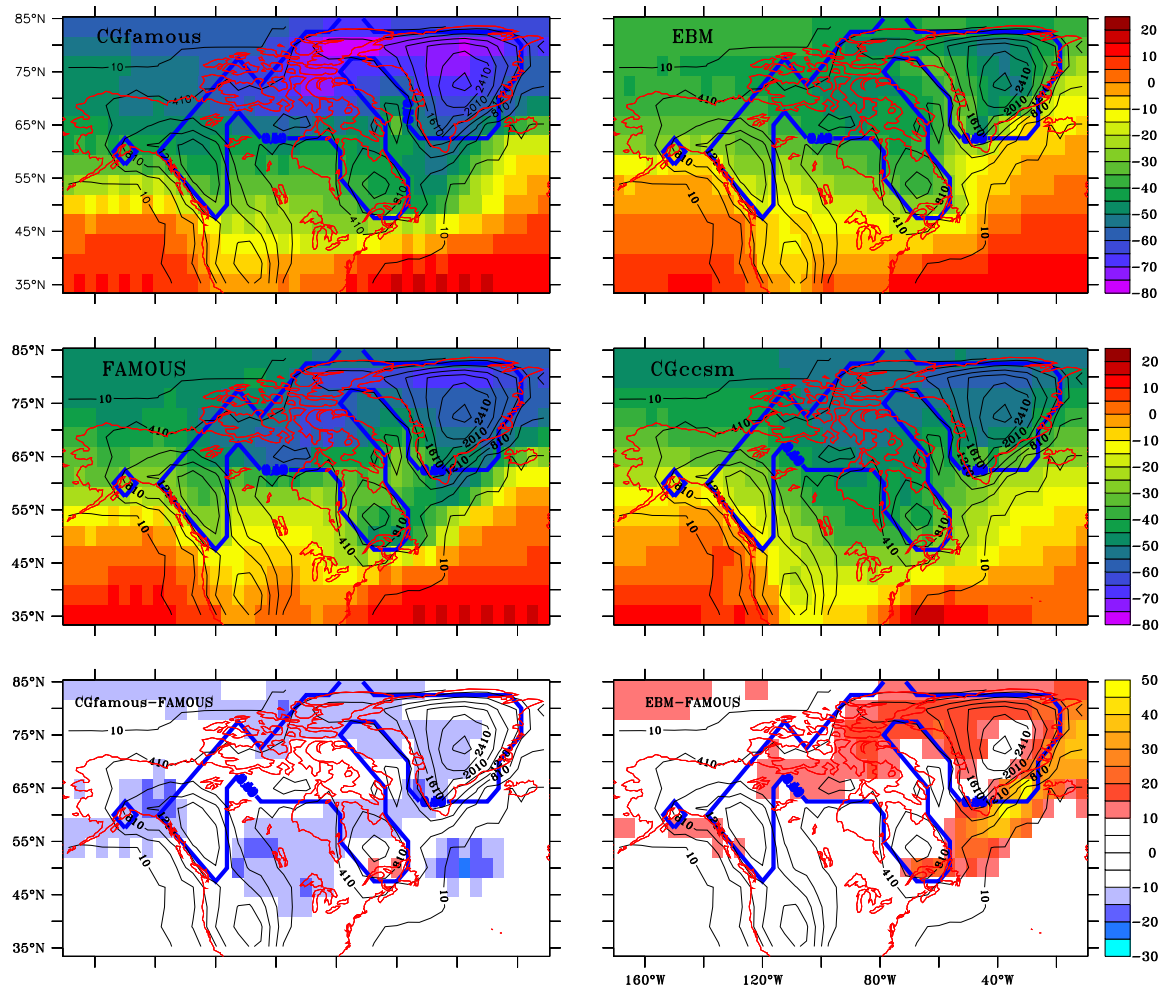
Figure 10. The February temperature field (Deg C) over North America at 60 ka (1st and 2nd row) with the elevation and ice contour shown in black and blue respectively. Difference between plots are shown in 3rd row. Model names are indicated in the top left corner in each box.
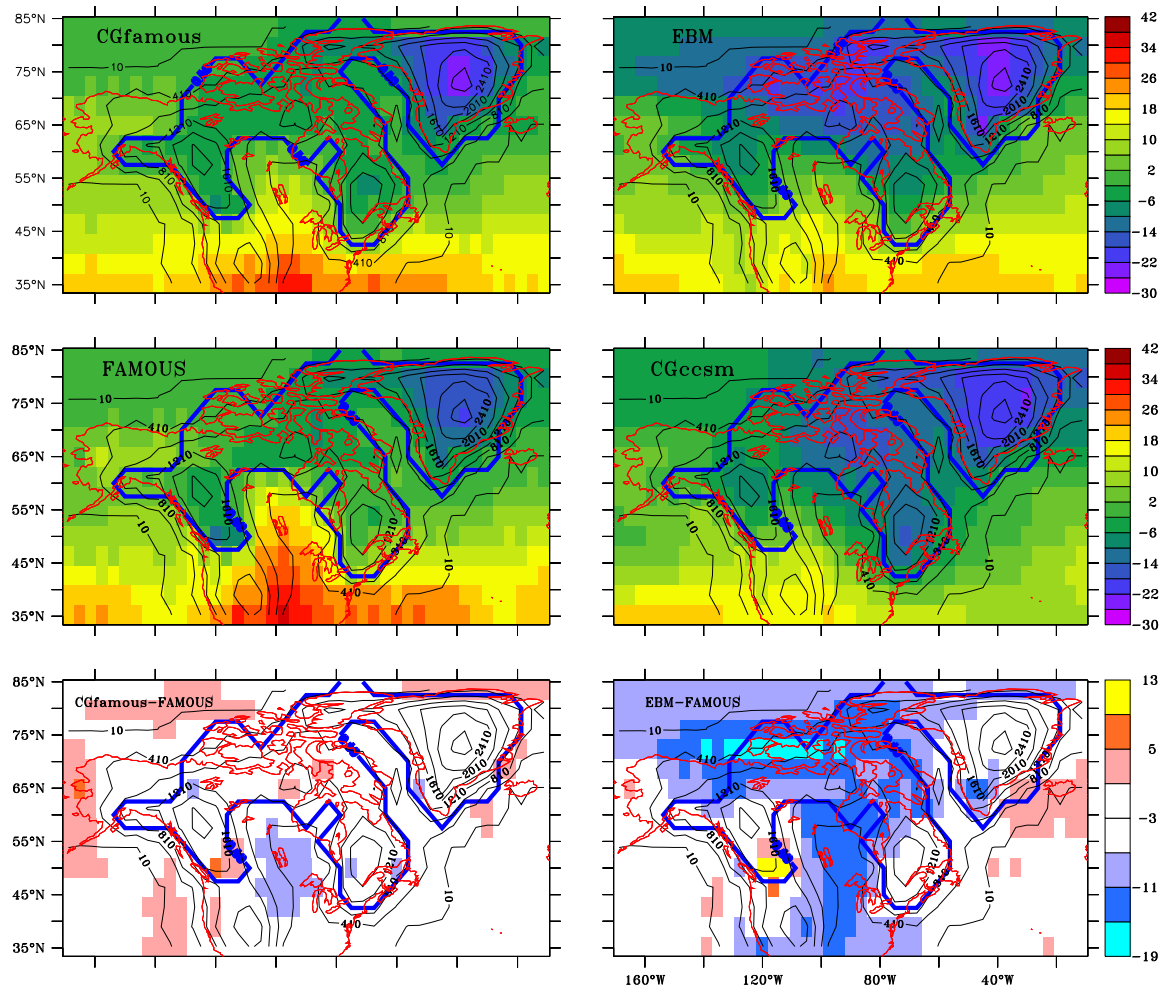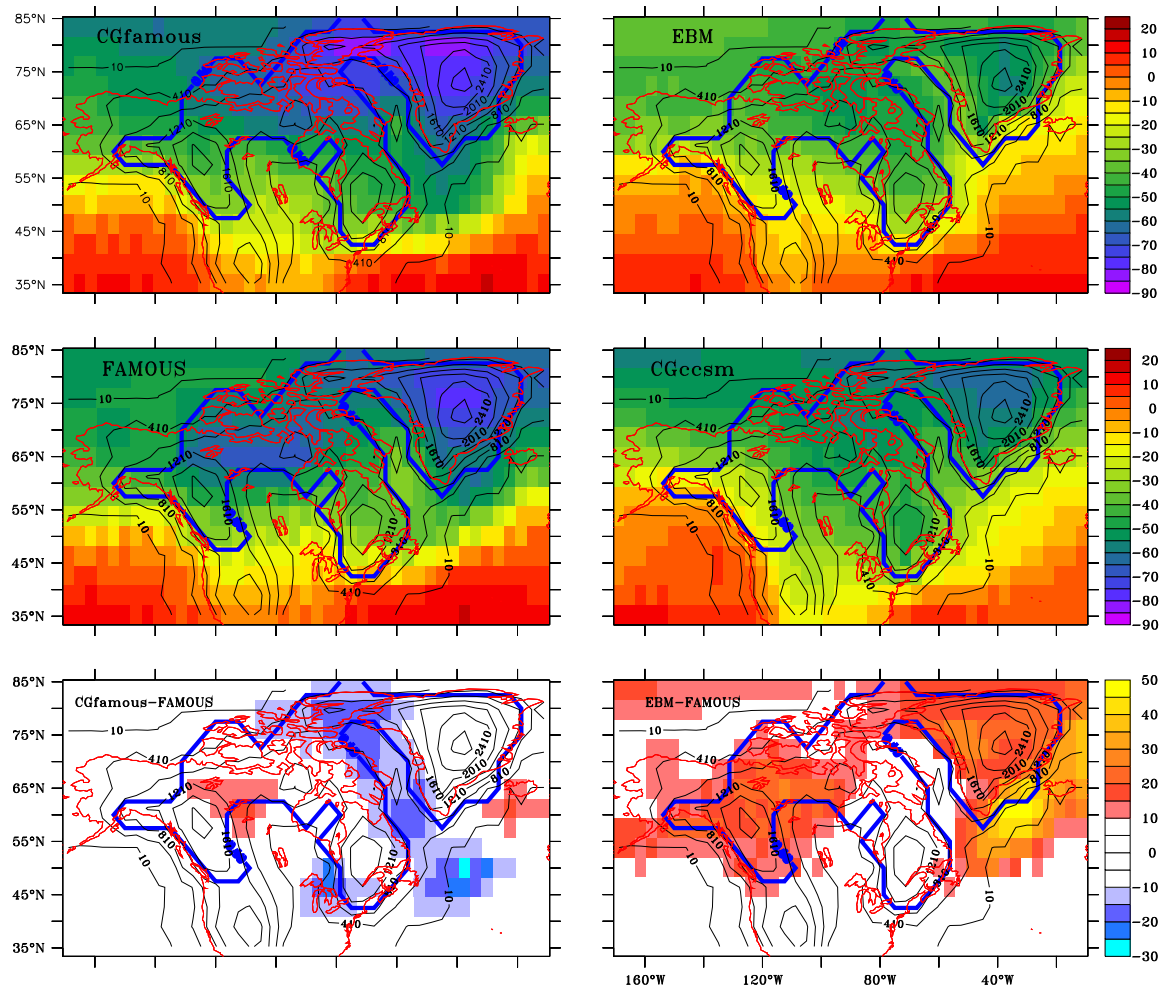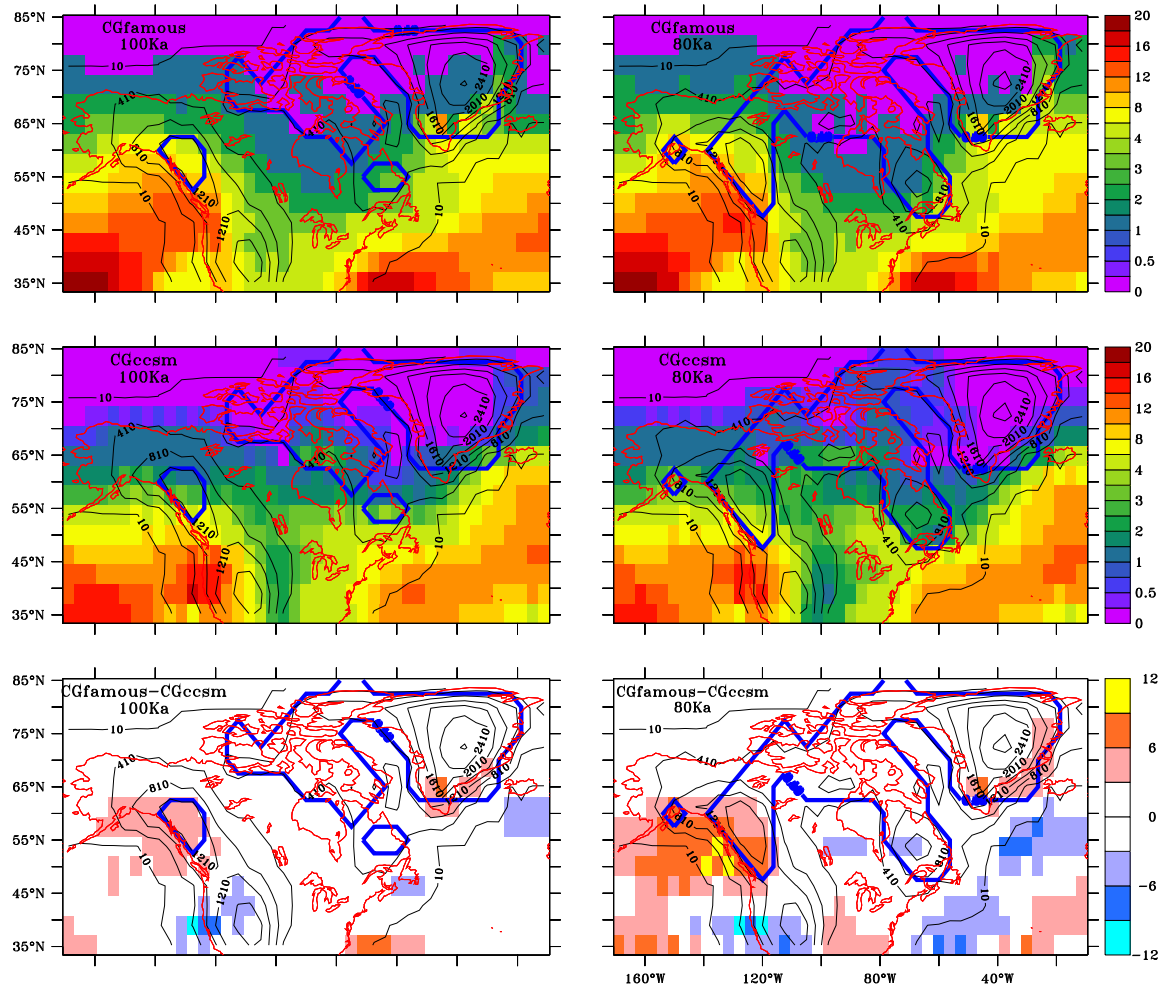
Figure 11. February precipitation field (cm/month) over North America. Models name and times indicated in the top left corner in each box.
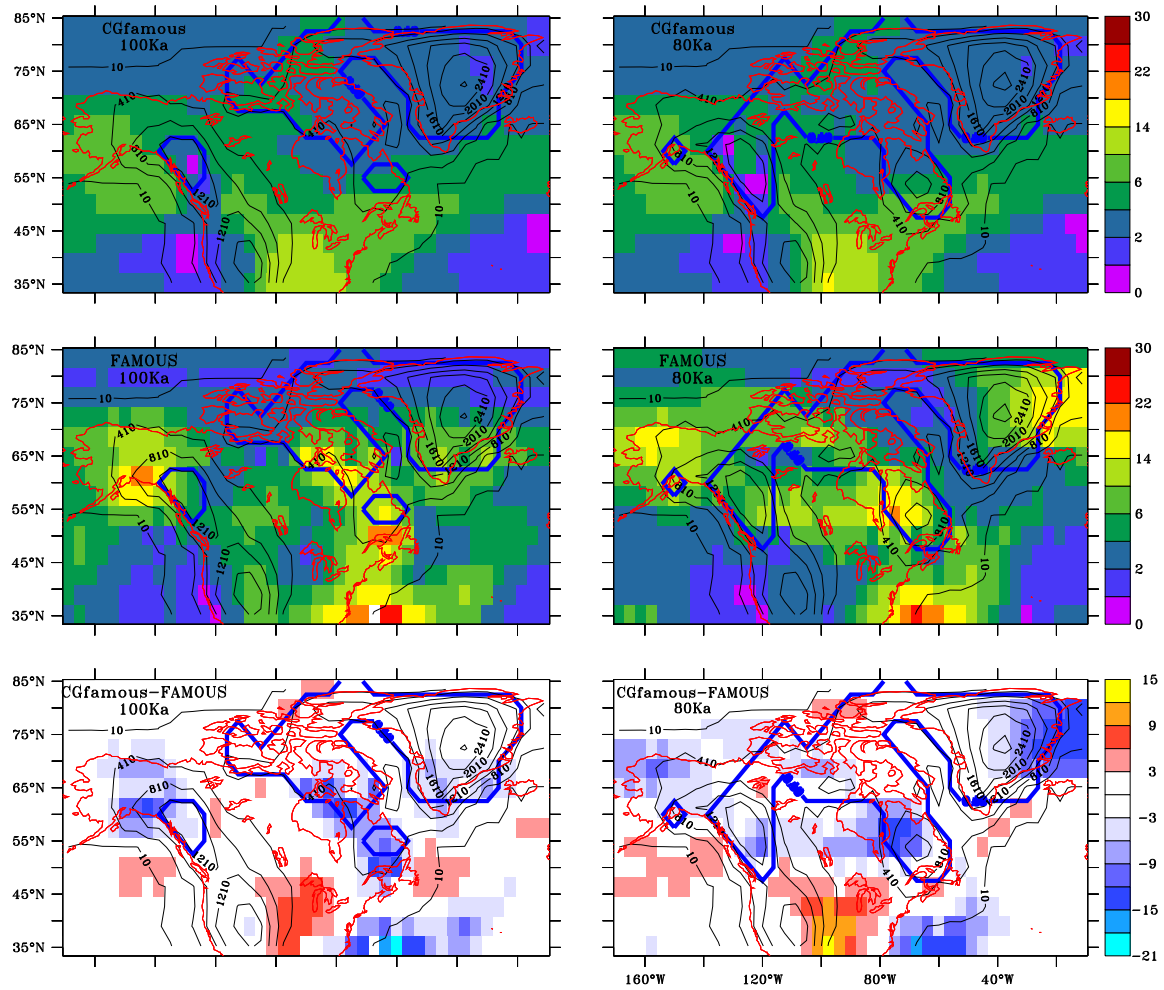
Figure 12. August precipitation field (cm/month) over North America (1st and 2nd row). Difference between plots are shown in 3rd row. Model names and times are indicated in the top left corner in each box.
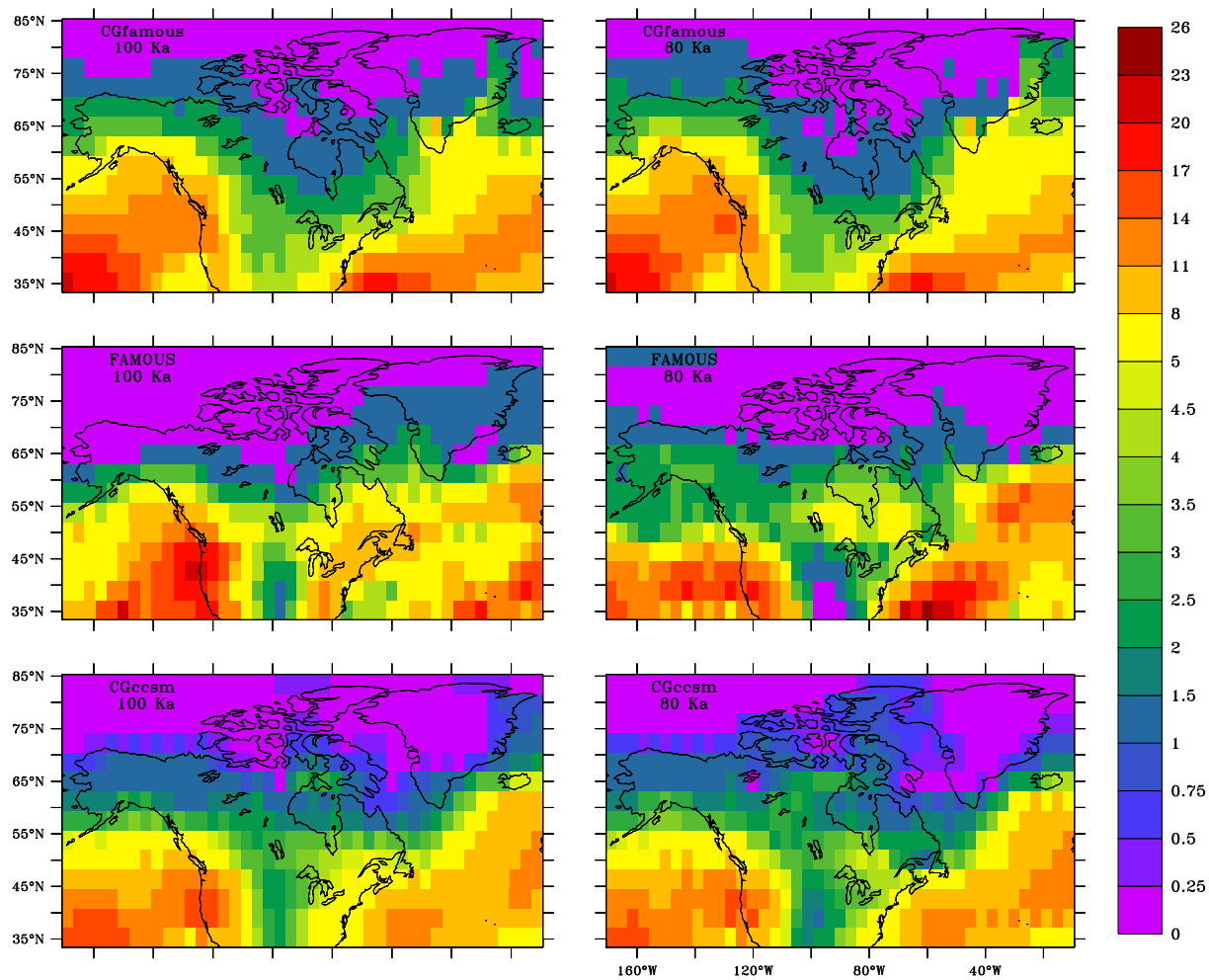
Figure 13. The February precipitation field (cm/month). Model names and times are indicated in the top left corner in each box.
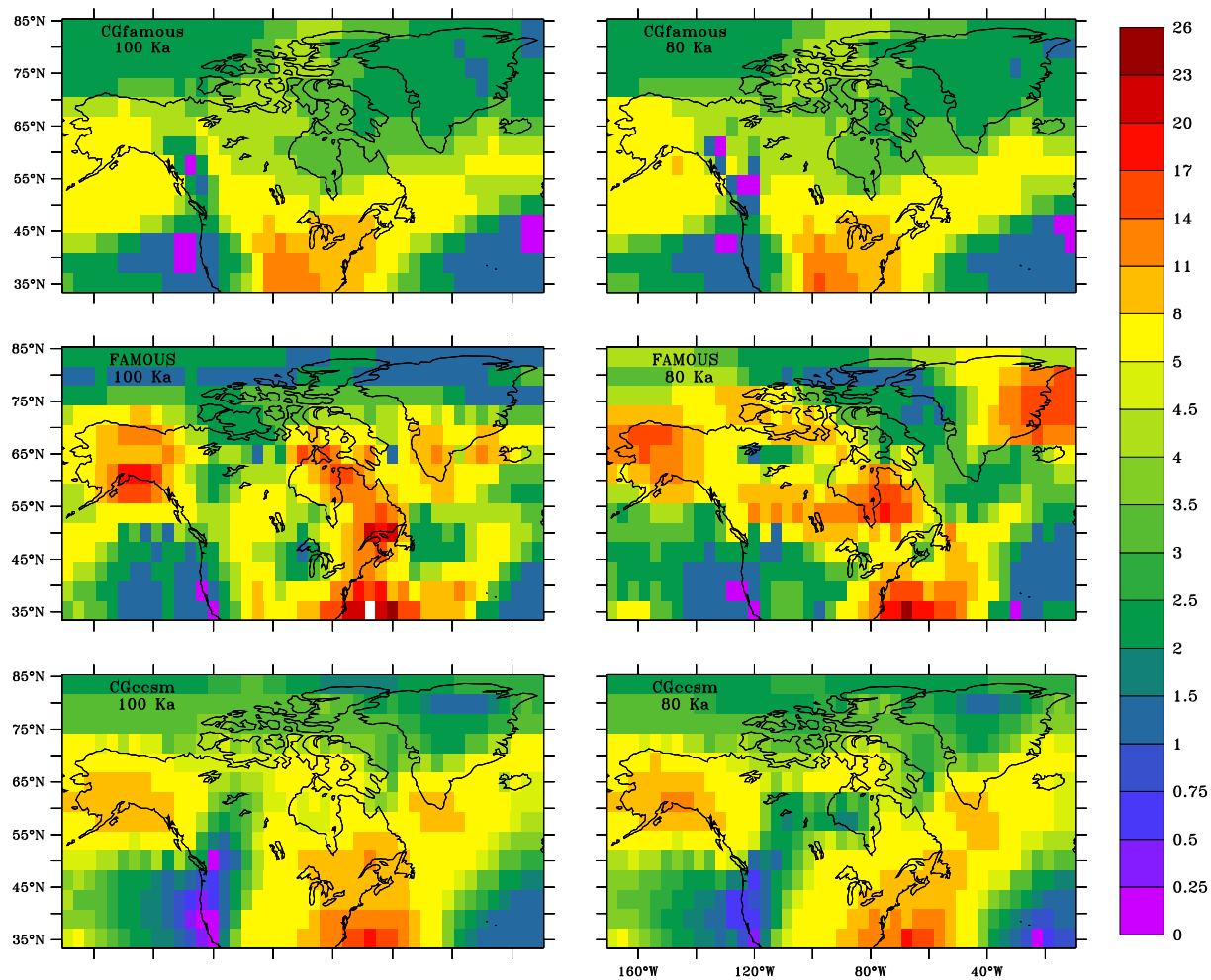
Figure 14. The August precipitation field (cm/month) over North America. Model names and times are indicated in the top left corner in each box.

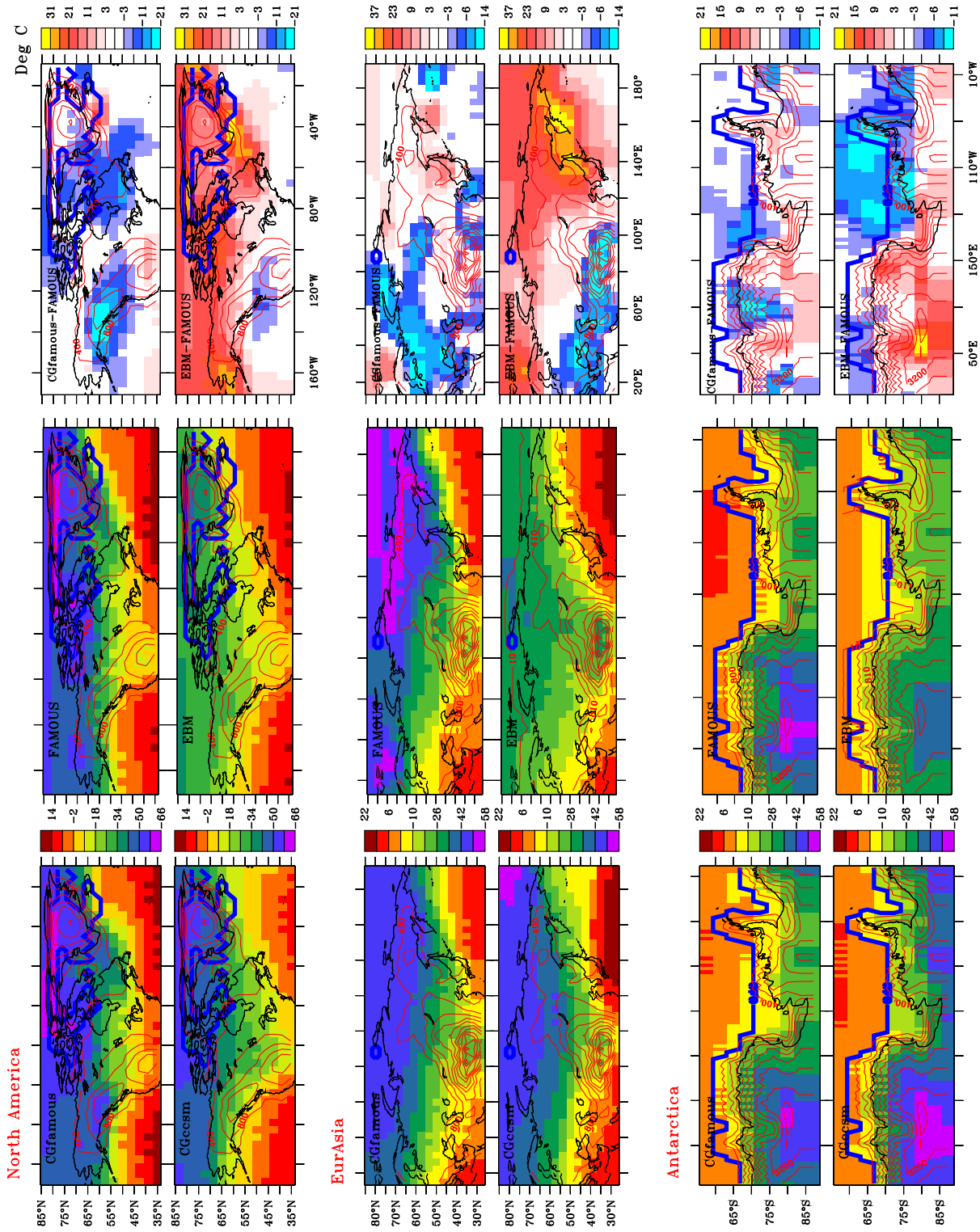**Figure 15.** February temperature field (Deg C) at 100 ka with the elevation and ice contour shown in red. Difference between plots are shown in 3rd row. Model names and months are indicated in the top left corner in each box).

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Figure 16. August precipitatin field (Deg C) with the elevation and ice contour shown in red and blue. Difference between plots are shown in 3rd row. Model names and months are indicated in the top left corner in each box).
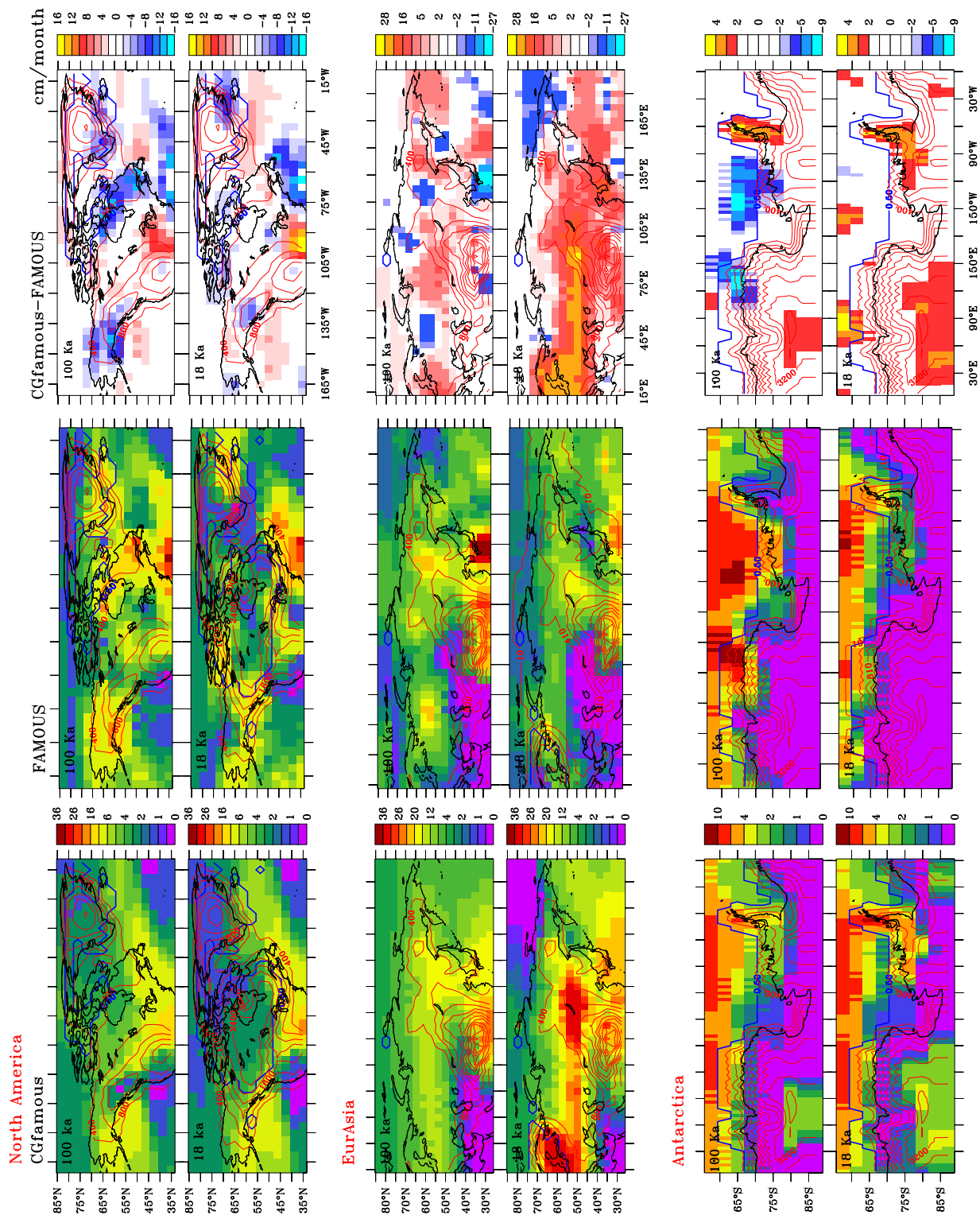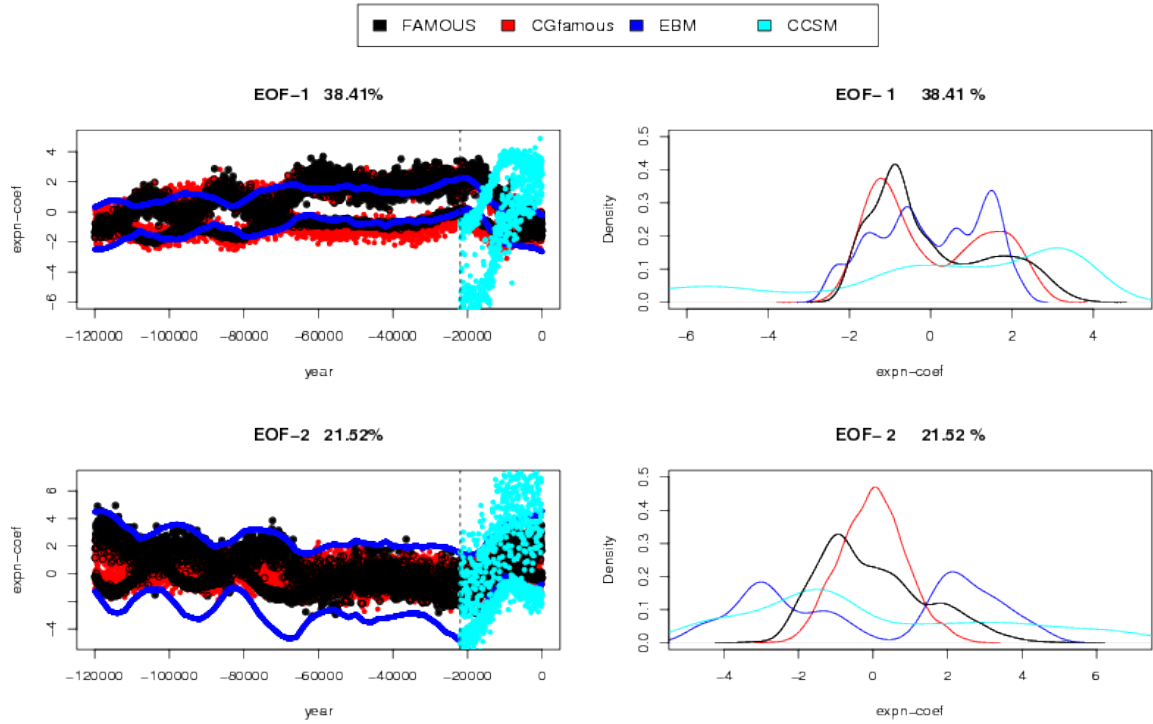
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Figure 17. Temperature field over EurAsia, left column: Distribution of the expansion coefficient over total time steps for the leading two EOFs of the FAMOUS Model data (black), and the distribution of the expansion coefficients over time obtained by an ensemble projection of CGfamous simulation (red), EBM temperature (blue) and CCSM (cyan) onto the same EOFs. Top time series represent the August EOFs and bottom time series are the February EOFs. Right column: Distribution of the expansion coefficients for the leading two FAMOU EOFs for the FAMOUS (black), CGfamous (red), EBM temperature (blue), and CCSM (cyan) datasets.

Figure 18. Temperature field over Antarctica, left column: Distribution of the expansion coefficient over total time steps for the leading two EOFs of the FAMOUS Model data (black), and the distribution of the expansion coefficients over time obtained by an ensemble projection of CGfamous simulation (red), EBM temperature (blue) and CCSM (cyan) onto the same EOFs. Top time series represent the August EOFs and bottom time series are the February EOFs. Right column: Distribution of the expansion coefficients for the leading two FAMOUS EOFs for the FAMOUS (black), CGfamous (red), EB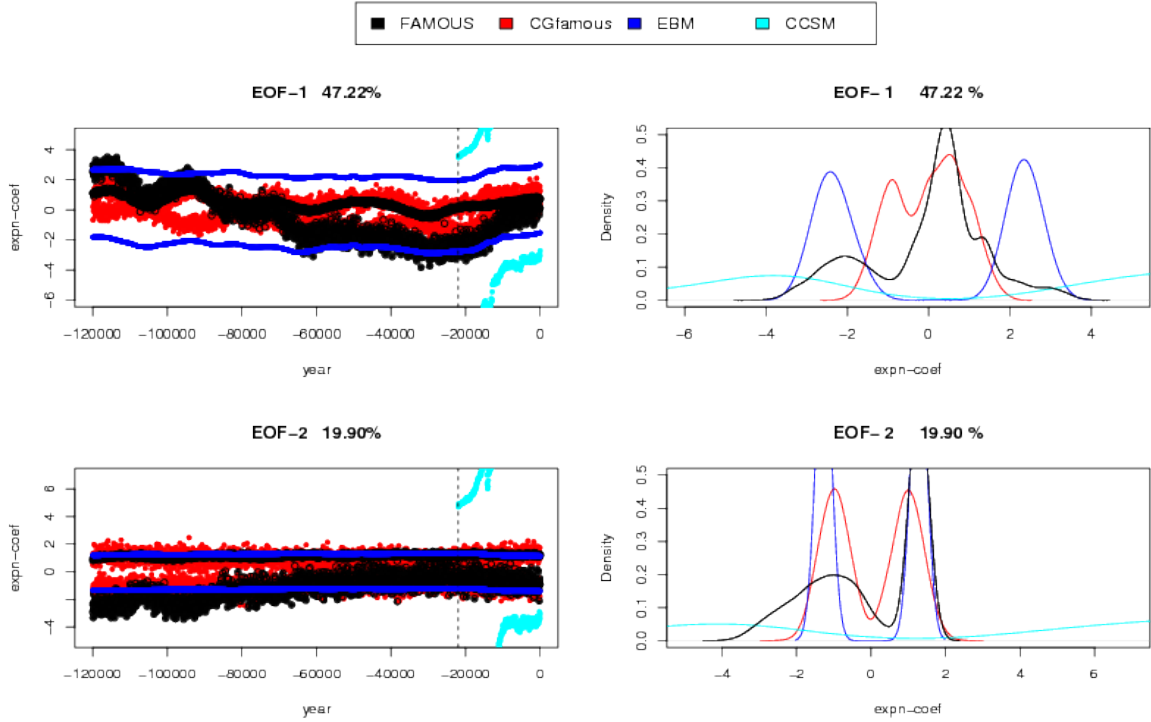M temperature (blue), and CCSM (cyan) datasets.