An efficient approach for estimating streamflow forecast skill elasticity

Article

Supplemental Material

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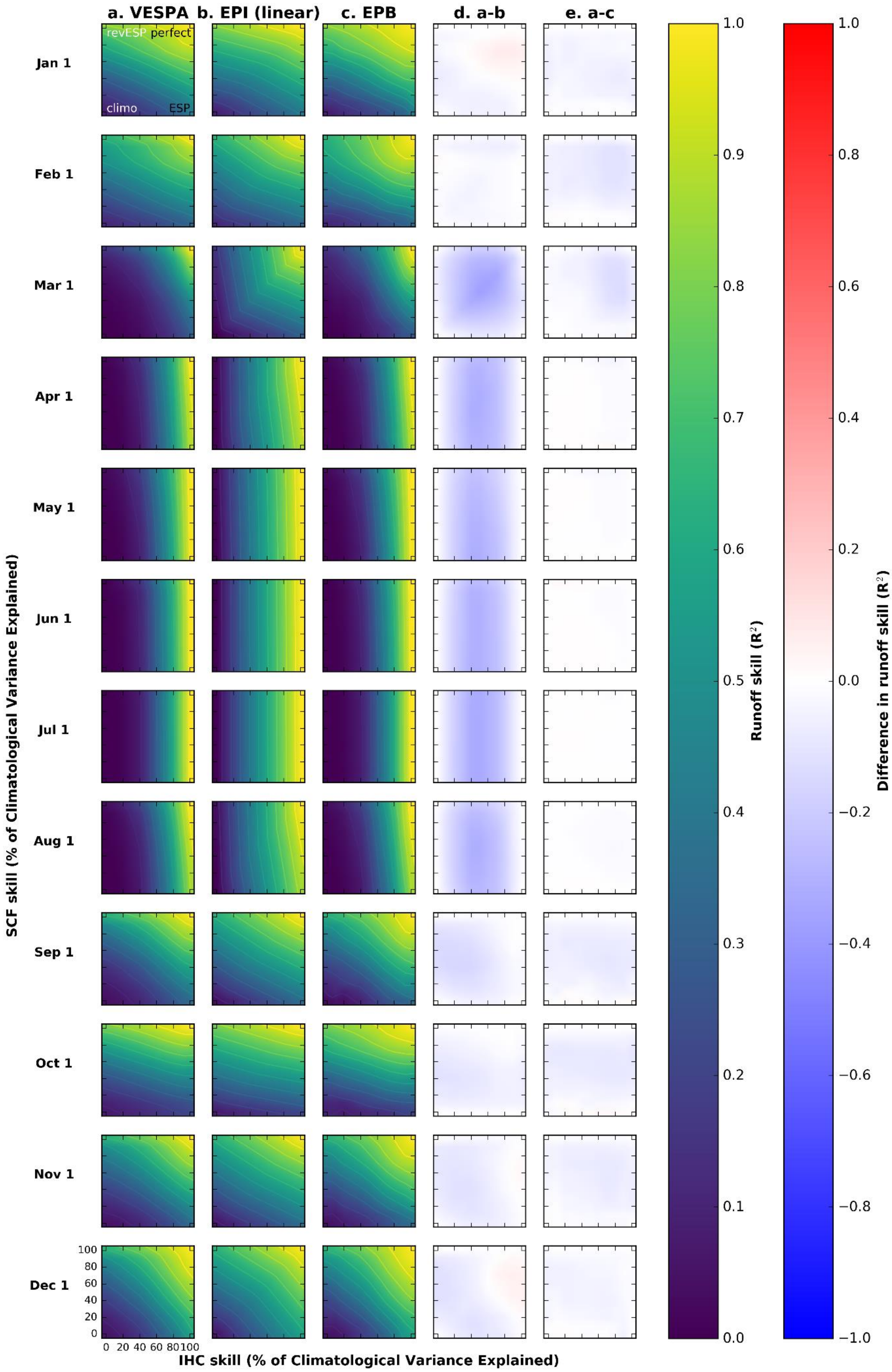
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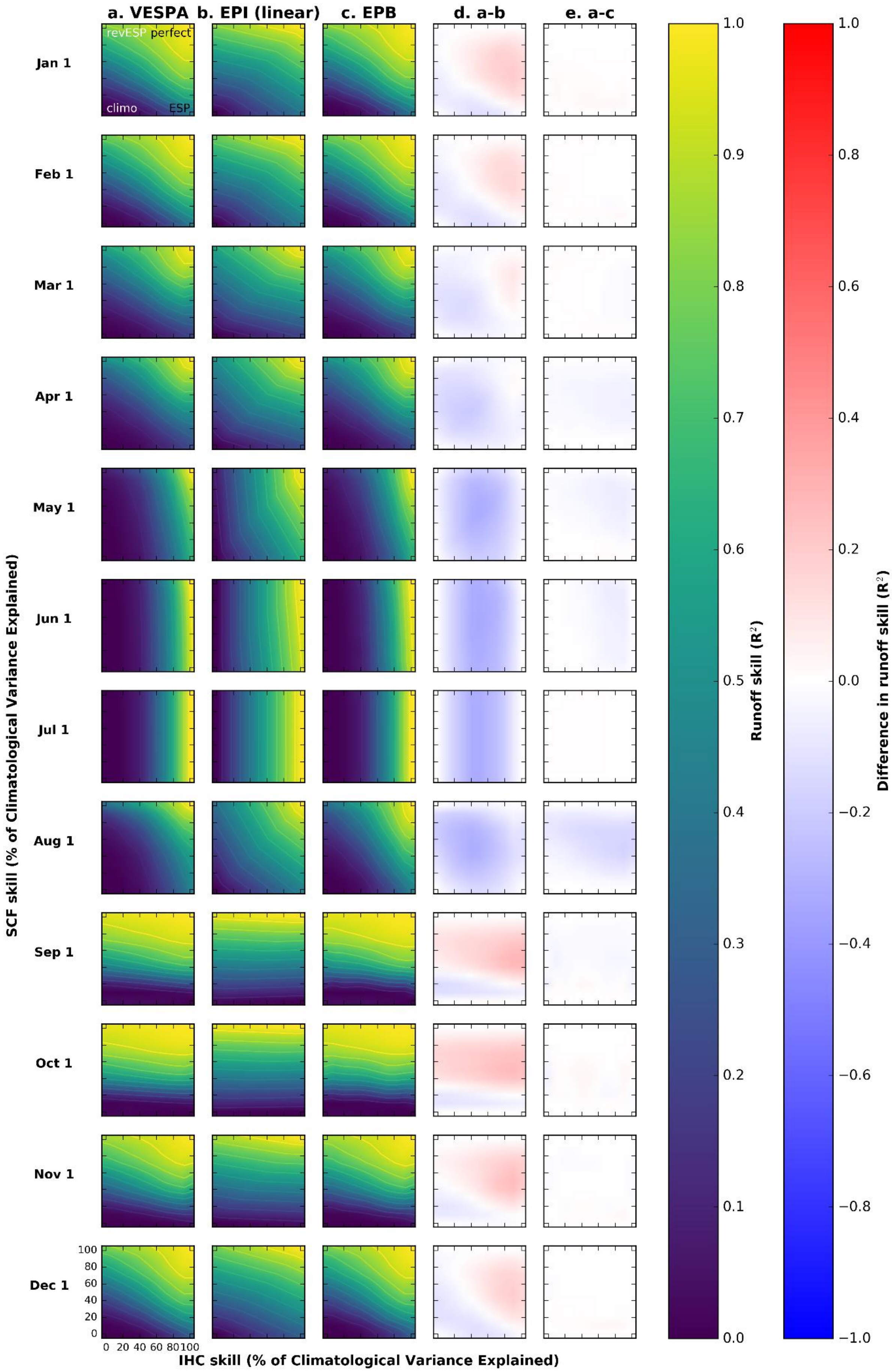
SCF skill (% of Climatological Variance Explained)
IHC skill (% of Climatological Variance Explained)
0 20 40 60 80 100
Runoff skill (R^2)
Difference in runoff skill (R^2)
1.0 0.9 0.8 0.7 0.6 0.5 0.4 0.3 0.2 0.1 0.0
1.0 0.8 0.6 0.4 0.2 0.0 −0.2 −0.4 −0.6 −0.8 −1.0

Supplementary Figure 1 Skill surface plots obtained for a. the VESPA, b. the linear EPI and c. the EPB methods. The skill is calculated from the R^2 of the 3-month streamflow forecast ensemble means against the 'perfect' forecasts, for hindcasts produced from 1981-2010 for the Merced River (CA; USGS gauge 011266500), with forecast initialisations on the first day of each month. Differences between the skill surface plots obtained for the d. VESPA and linear EPI methods and the e. VESPA and EPB methods are also shown.



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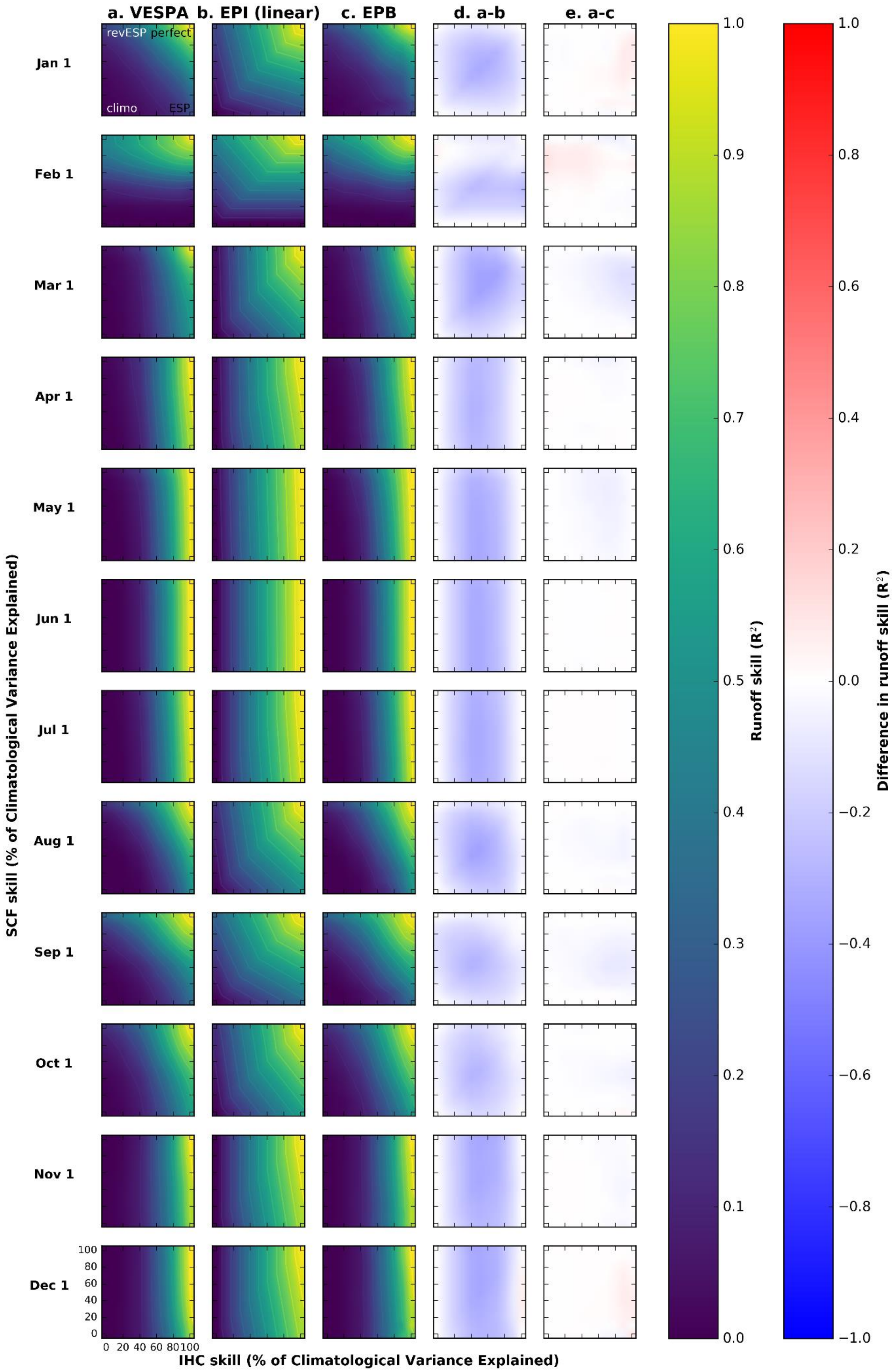
SCF skill (% of Climatological Variance Explained)
IHC skill (% of Climatological Variance Explained)
0 20 40 60 80 100
100 80 60 40 20 0
Runoff skill (R^2)
0.0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0
Difference in runoff skill (R^2)
−1.0 −0.8 −0.6 −0.4 −0.2 0.0 0.2 0.4 0.6 0.8 1.0

Supplementary Figure 2 Skill surface plots obtained for a. the VESPA, b. the linear EPI and c. the EPB methods. The skill is calculated from the R^2 *of the 3-month streamflow forecast ensemble means against the 'perfect' forecasts, for hindcasts produced from 1981-2010 for the Long Tom River (OR; USGS gauge 014166500), with forecast initialisations on the first day of each month. Differences between the skill surface plots obtained for the d. VESPA and linear EPI methods and the e. VESPA and EPB methods are also shown.*



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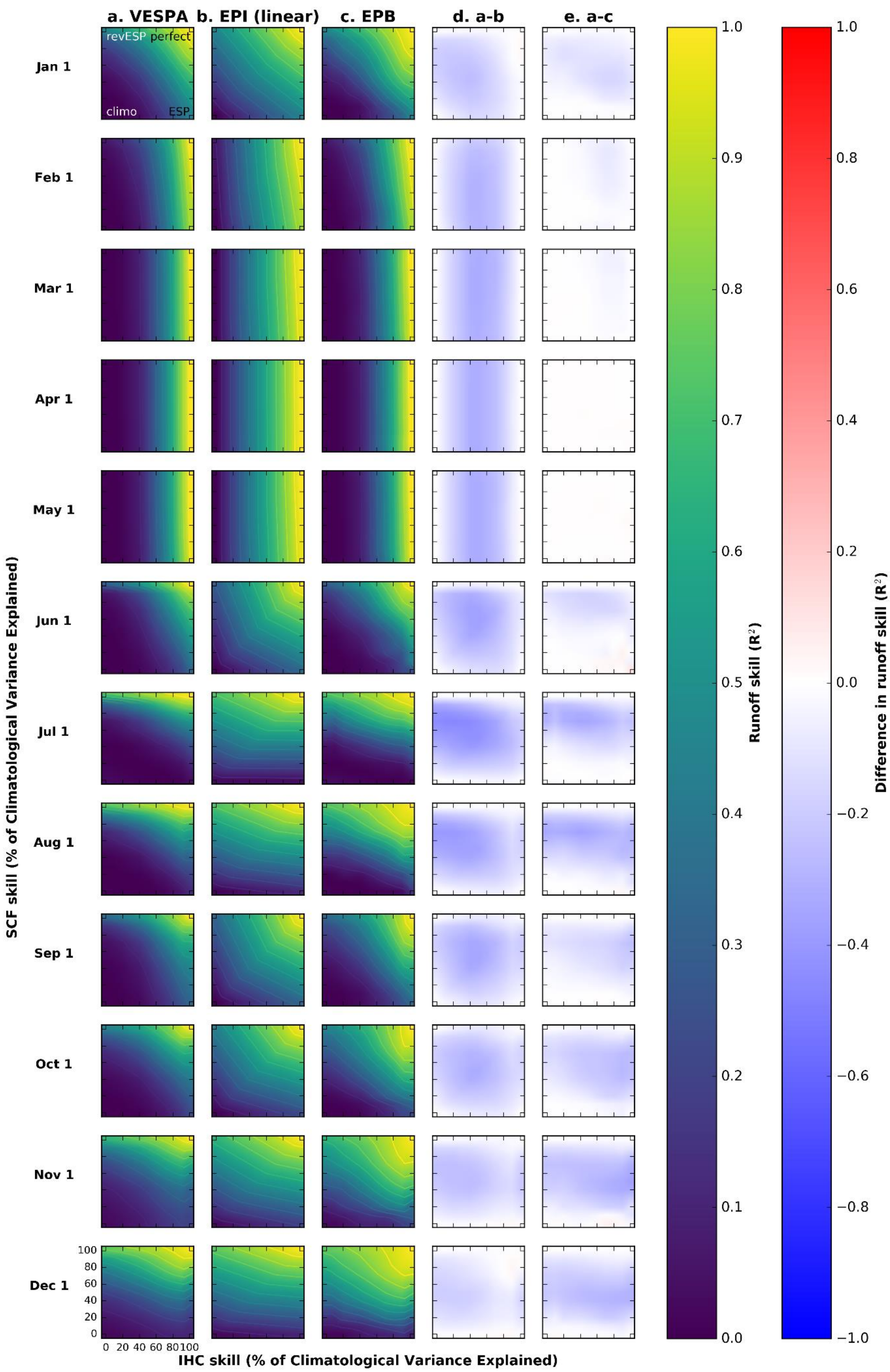
SCF skill (% of Climatological Variance Explained)
IHC skill (% of Climatological Variance Explained)
0 20 40 60 80 100
Runoff skill (R^2)
Difference in runoff skill (R^2)

Supplementary Figure 3 Skill surface plots obtained for a. the VESPA, b. the linear EPI and c. the EPB methods. The skill is calculated from the R^2 *of the 3-month streamflow forecast ensemble means against the 'perfect' forecasts, for hindcasts produced from 1981-2010 for the Beaver River (UT; USGS gauge 010234500), with forecast initialisations on the first day of each month. Differences between the skill surface plots obtained for the d. VESPA and linear EPI methods and the e. VESPA and EPB methods are also shown.*



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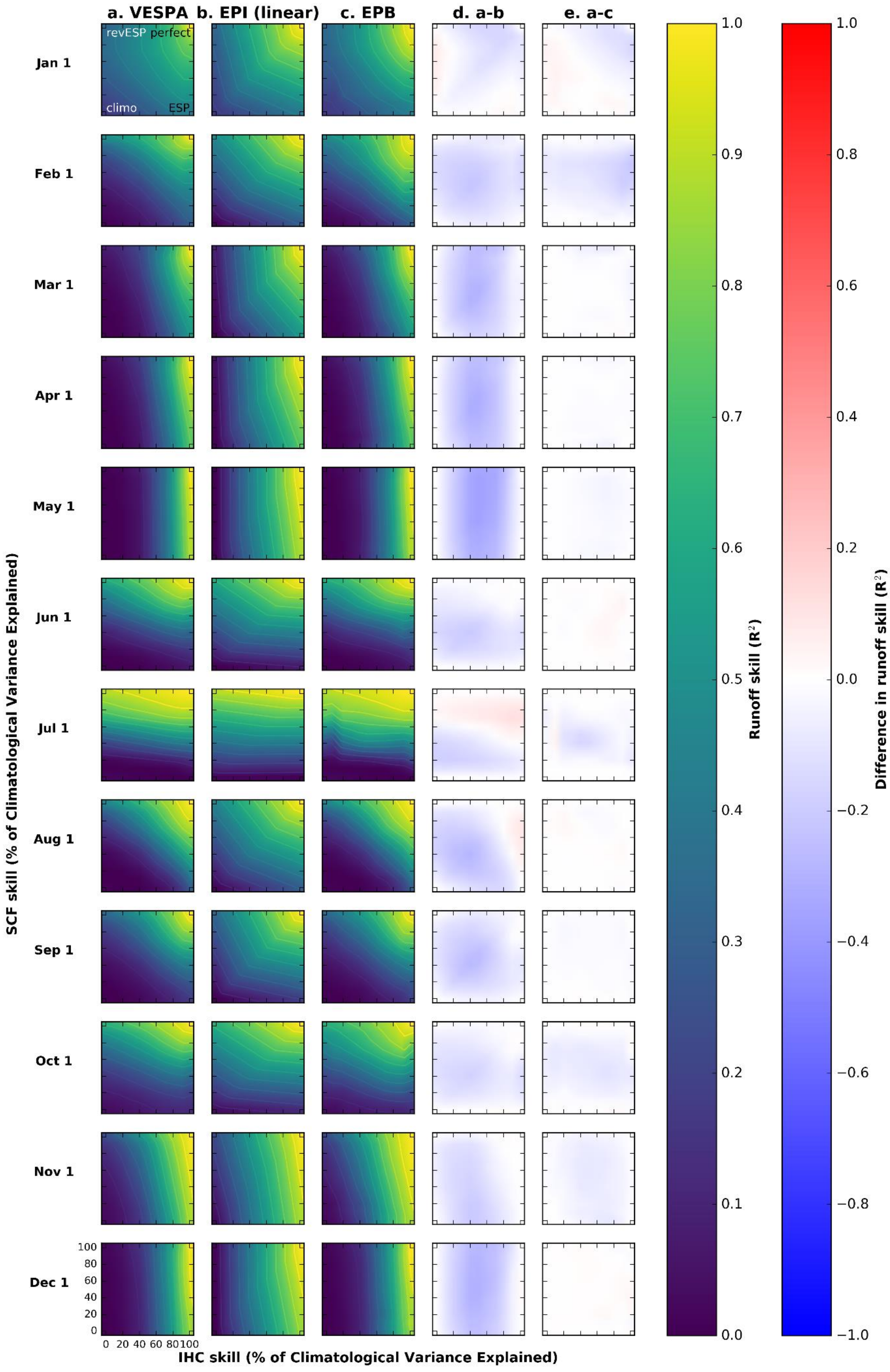
SCF skill (% of Climatological Variance Explained)
IHC skill (% of Climatological Variance Explained)
0 20 40 60 80 100
Runoff skill (R^2)
Difference in runoff skill (R^2)

Supplementary Figure 4 Skill surface plots obtained for a. the VESPA, b. the linear EPI and c. the EPB methods. The skill is calculated from the R^2 *of the 3-month streamflow forecast ensemble means against the 'perfect' forecasts, for hindcasts produced from 1981-2010 for the Gila River (NM; USGS gauge 009430500), with forecast initialisations on the first day of each month. Differences between the skill surface plots obtained for the d. VESPA and linear EPI methods and the e. VESPA and EPB methods are also shown.*



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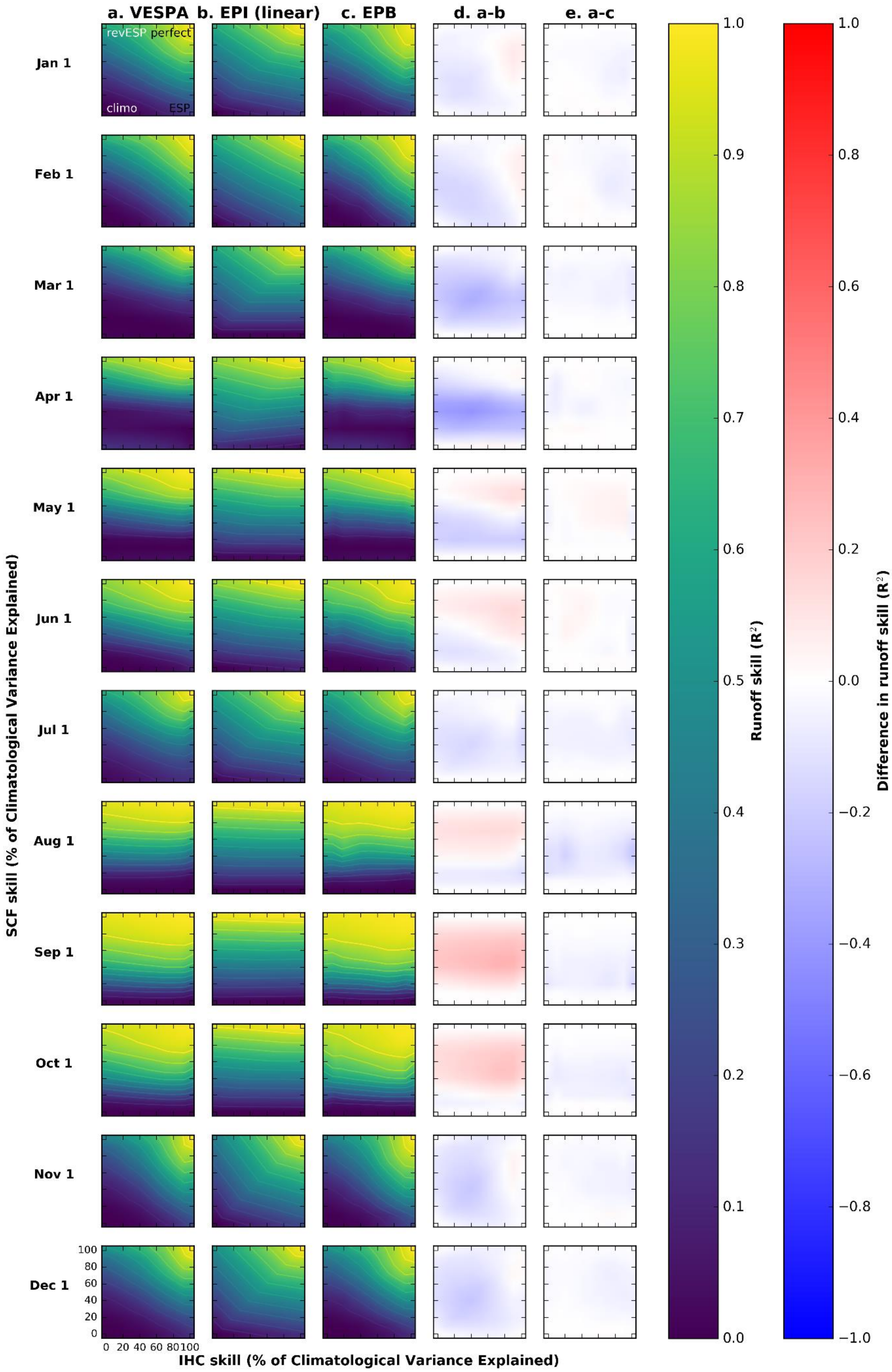
SCF skill (% of Climatological Variance Explained)
IHC skill (% of Climatological Variance Explained)
0 20 40 60 80 100
Runoff skill (R^2)
Difference in runoff skill (R^2)

Supplementary Figure 5 Skill surface plots obtained for a. the VESPA, b. the linear EPI and c. the EPB methods. The skill is calculated from the R^2 of the 3-month streamflow forecast ensemble means against the 'perfect' forecasts, for hindcasts produced from 1981-2010 for the Gallinas Creek (NM; USGS gauge 008380500), with forecast initialisations on the first day of each month. Differences between the skill surface plots obtained for the d. VESPA and linear EPI methods and the e. VESPA and EPB methods are also shown.



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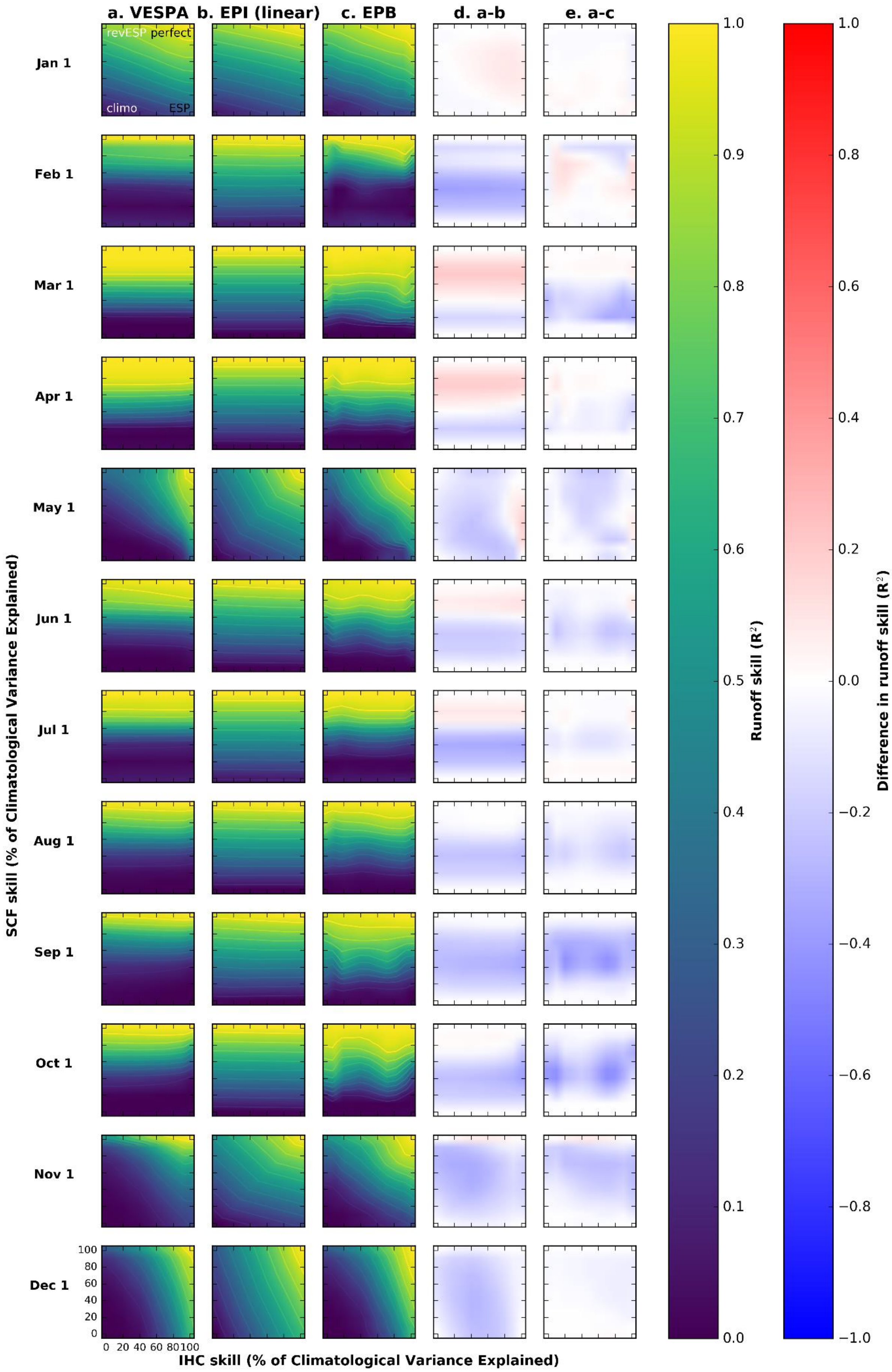
SCF skill (% of Climatological Variance Explained)
IHC skill (% of Climatological Variance Explained)
0 20 40 60 80 100
Runoff skill (R^2)
Difference in runoff skill (R^2)

Supplementary Figure 6 Skill surface plots obtained for a. the VESPA, b. the linear EPI and c. the EPB methods. The skill is calculated from the R^2 of the 3-month streamflow forecast ensemble means against the 'perfect' forecasts, for hindcasts produced from 1981-2010 for the E Fk San Jacinto River (TX; USGS gauge 008070200), with forecast initialisations on the first day of each month. Differences between the skill surface plots obtained for the d. VESPA and linear EPI methods and the e. VESPA and EPB methods are also shown.



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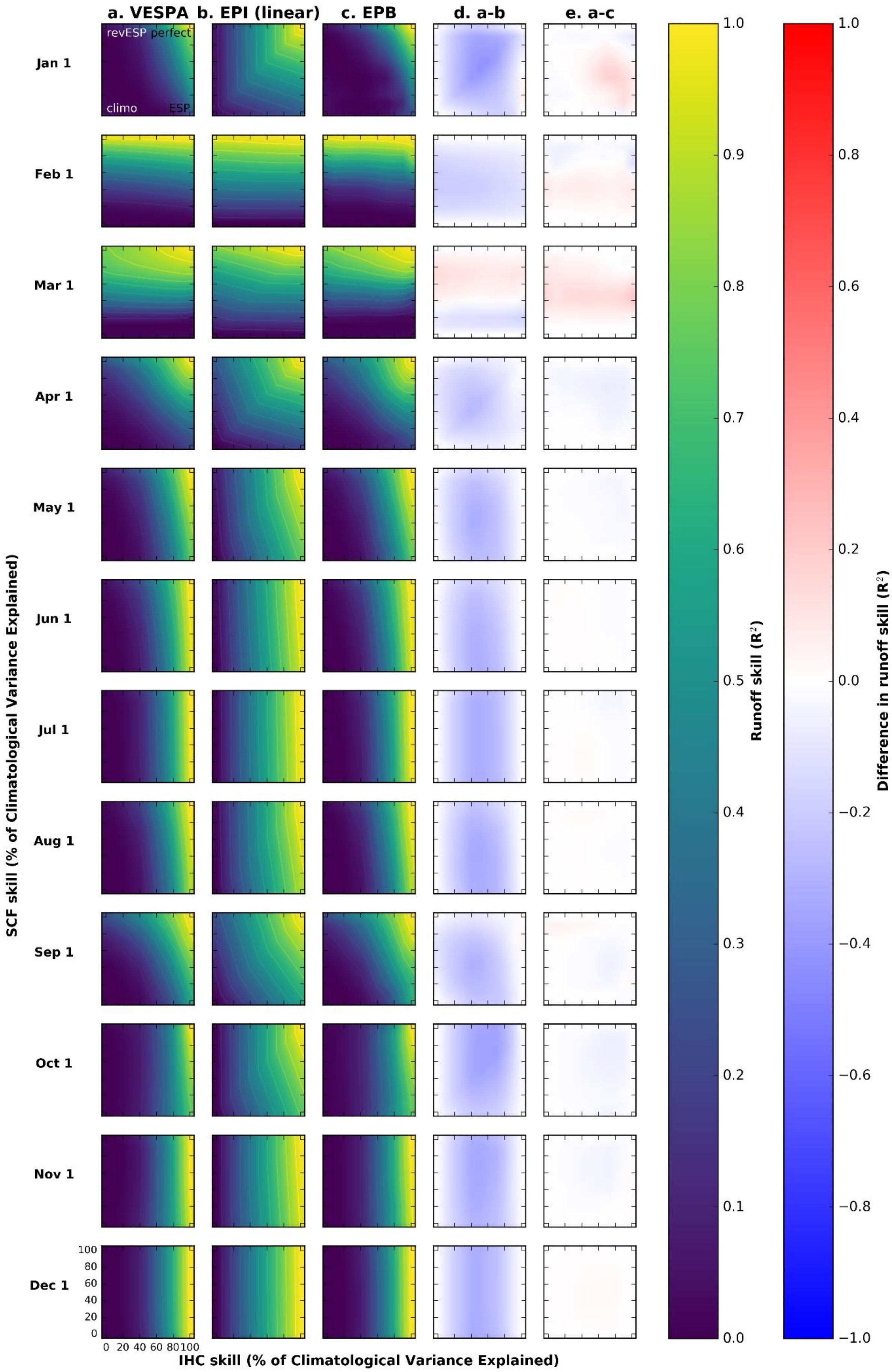
SCF skill (% of Climatological Variance Explained)
IHC skill (% of Climatological Variance Explained)
0 20 40 60 80 100
Runoff skill (R^2)
Difference in runoff skill (R^2)

Supplementary Figure 7 Skill surface plots obtained for a. the VESPA, b. the linear EPI and c. the EPB methods. The skill is calculated from the R^2 *of the 3-month streamflow forecast ensemble means against the 'perfect' forecasts, for hindcasts produced from 1981-2010 for the UTE Creek (NM; USGS gauge 007226500), with forecast initialisations on the first day of each month. Differences between the skill surface plots obtained for the d. VESPA and linear EPI methods and the e. VESPA and EPB methods are also shown.*



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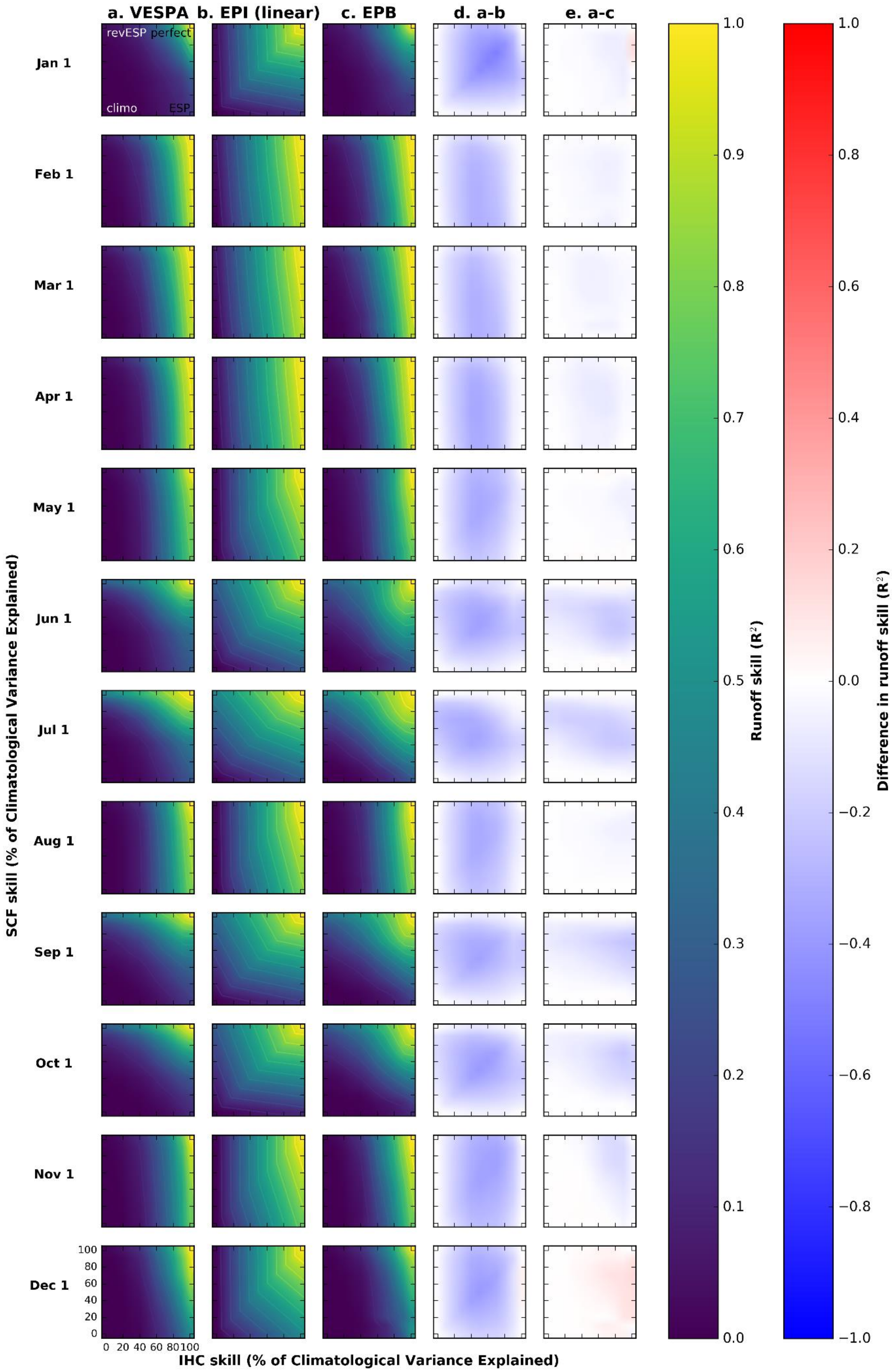
SCF skill (% of Climatological Variance Explained)
IHC skill (% of Climatological Variance Explained)
0 20 40 60 80 100
Runoff skill (R^2)
Difference in runoff skill (R^2)

Supplementary Figure 8 Skill surface plots obtained for a. the VESPA, b. the linear EPI and c. the EPB methods. The skill is calculated from the R^2 of the 3-month streamflow forecast ensemble means against the 'perfect' forecasts, for hindcasts produced from 1981-2010 for the Bull Lake Creek (WY; USGS gauge 006224000), with forecast initialisations on the first day of each month. Differences between the skill surface plots obtained for the d. VESPA and linear EPI methods and the e. VESPA and EPB methods are also shown.



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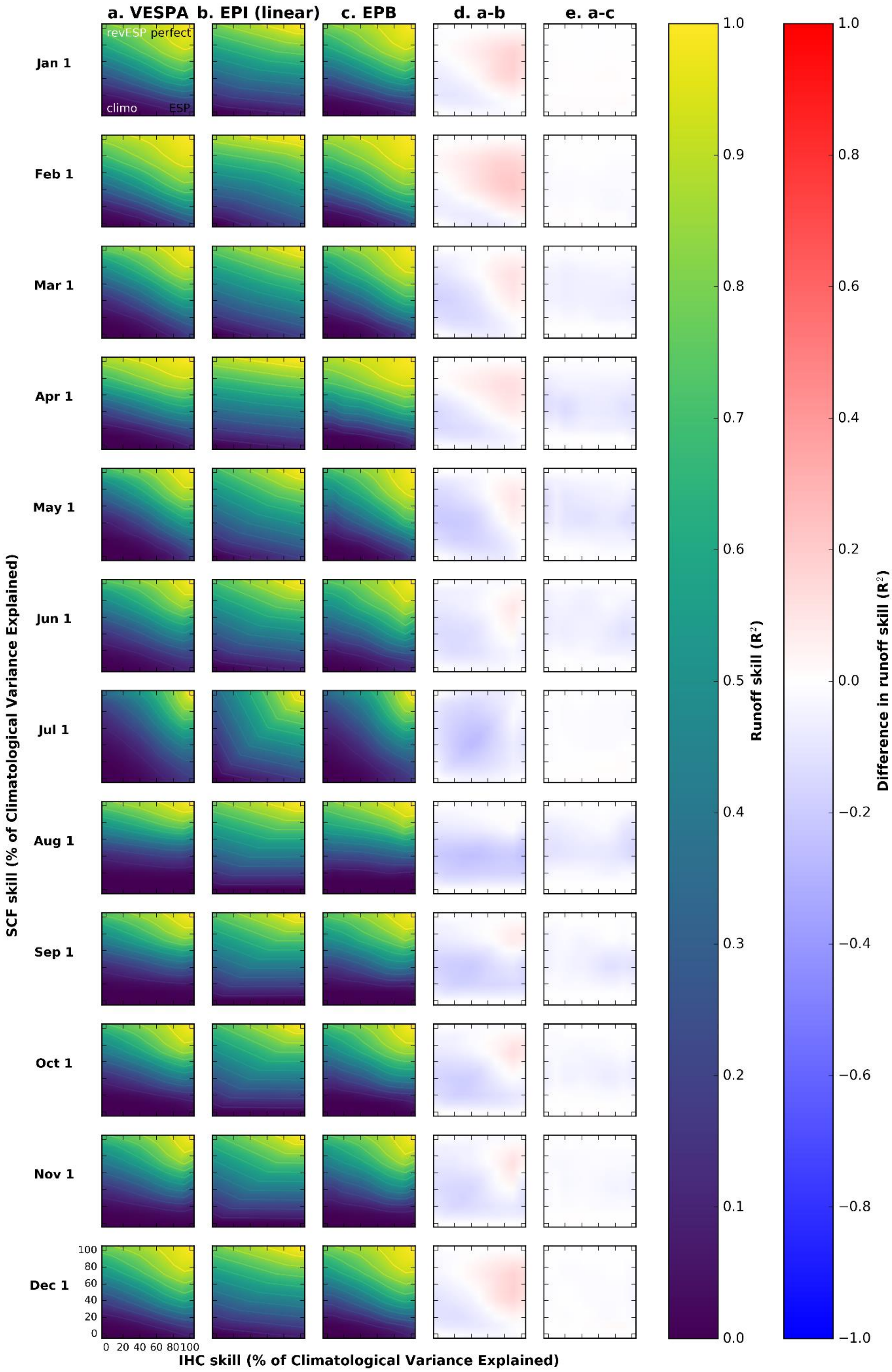
SCF skill (% of Climatological Variance Explained)
IHC skill (% of Climatological Variance Explained)
0 20 40 60 80 100
0 20 40 60 80 100
Runoff skill (R^2)
0.0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0
Difference in runoff skill (R^2)
−1.0 −0.8 −0.6 −0.4 −0.2 0.0 0.2 0.4 0.6 0.8 1.0

Supplementary Figure 9 Skill surface plots obtained for a. the VESPA, b. the linear EPI and c. the EPB methods. The skill is calculated from the R^2 of the 3-month streamflow forecast ensemble means against the 'perfect' forecasts, for hindcasts produced from 1981-2010 for the Sheyenne River (ND; USGS gauge 005057000), with forecast initialisations on the first day of each month. Differences between the skill surface plots obtained for the d. VESPA and linear EPI methods and the e. VESPA and EPB methods are also shown.



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SCF skill (% of Climatological Variance Explained)
IHC skill (% of Climatological Variance Explained)
0 20 40 60 80 100
Runoff skill (R^2)
Difference in runoff skill (R^2)
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−0.4
−0.2
0.2
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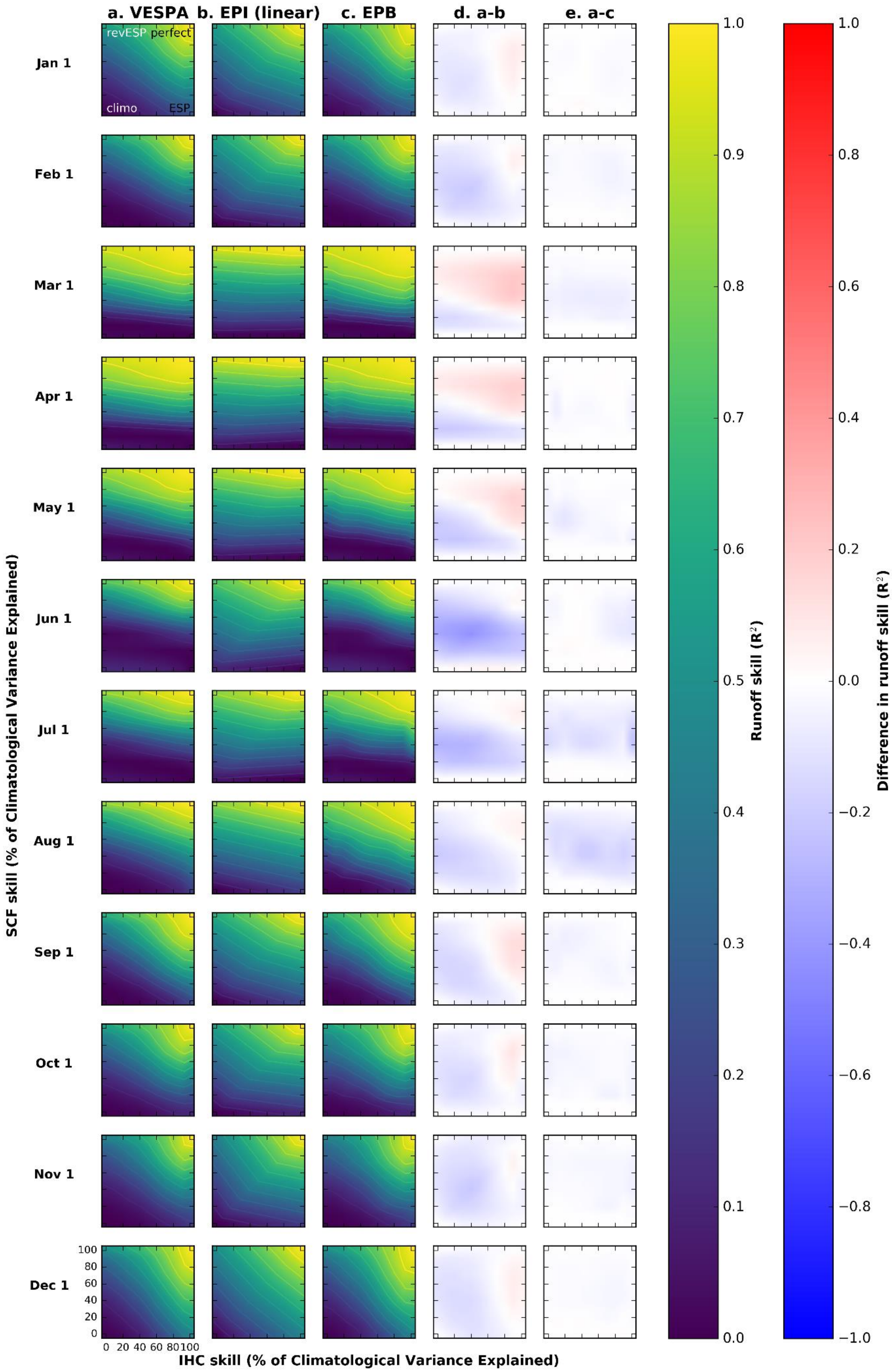
Supplementary Figure 10 Skill surface plots obtained for a. the VESPA, b. the linear EPI and c. the EPB methods. The skill is calculated from the R^2 of the 3-month streamflow forecast ensemble means against the 'perfect' forecasts, for hindcasts produced from 1981-2010 for the Tickfaw River (LA; USGS gauge 007376000), with forecast initialisations on the first day of each month. Differences between the skill surface plots obtained for the d. VESPA and linear EPI methods and the e. VESPA and EPB methods are also shown.



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SCF skill (% of Climatological Variance Explained)
IHC skill (% of Climatological Variance Explained)
0 20 40 60 80 100
Runoff skill (R^2)
Difference in runoff skill (R^2)
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0.0
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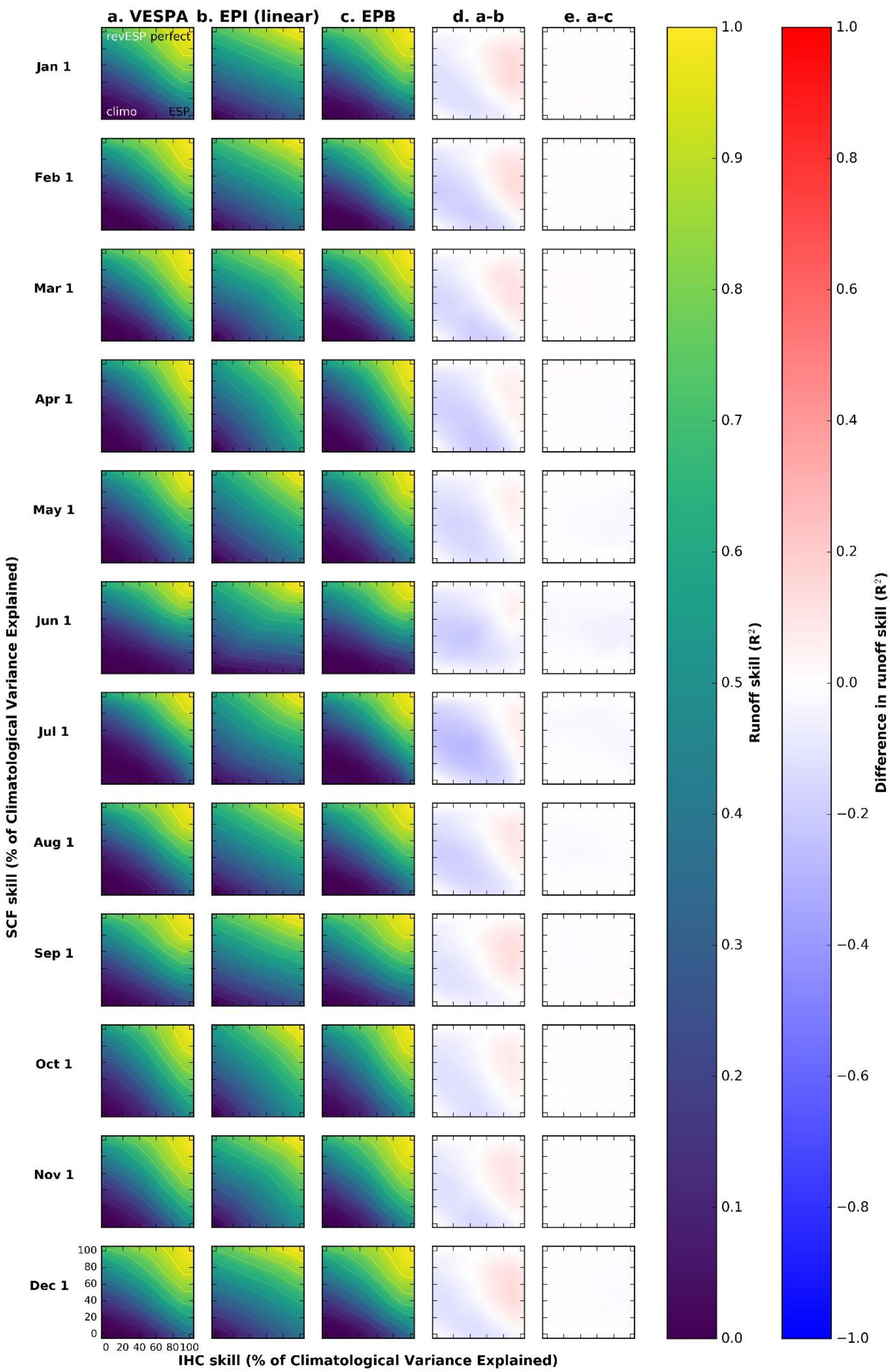
−0.2
−0.4
−0.6
−0.8
−1.0

Supplementary Figure 11 Skill surface plots obtained for a. the VESPA, b. the linear EPI and c. the EPB methods. The skill is calculated from the R^2 of the 3-month streamflow forecast ensemble means against the 'perfect' forecasts, for hindcasts produced from 1981-2010 for the East Fork Shoal Creek (IL; USGS gauge 005593900), with forecast initialisations on the first day of each month. Differences between the skill surface plots obtained for the d. VESPA and linear EPI methods and the e. VESPA and EPB methods are also shown.



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SCF skill (% of Climatological Variance Explained)
IHC skill (% of Climatological Variance Explained)
0 20 40 60 80 100
Runoff skill (R^2)
Difference in runoff skill (R^2)
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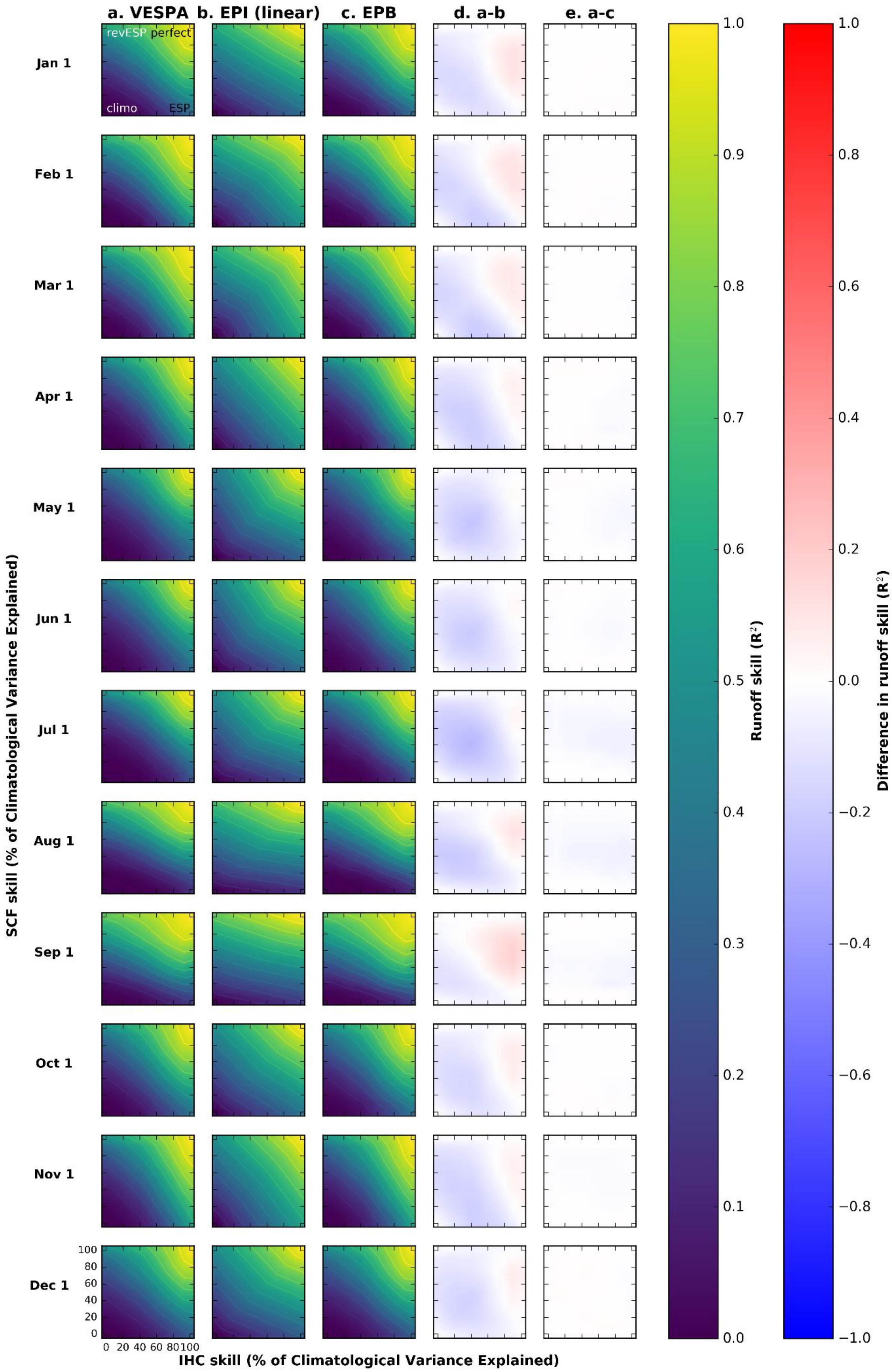
−1.0

Supplementary Figure 12 Skill surface plots obtained for a. the VESPA, b. the linear EPI and c. the EPB methods. The skill is calculated from the R^2 of the 3-month streamflow forecast ensemble means against the 'perfect' forecasts, for hindcasts produced from 1981-2010 for the Nantahala River (NC; USGS gauge 003504000), with forecast initialisations on the first day of each month. Differences between the skill surface plots obtained for the d. VESPA and linear EPI methods and the e. VESPA and EPB methods are also shown.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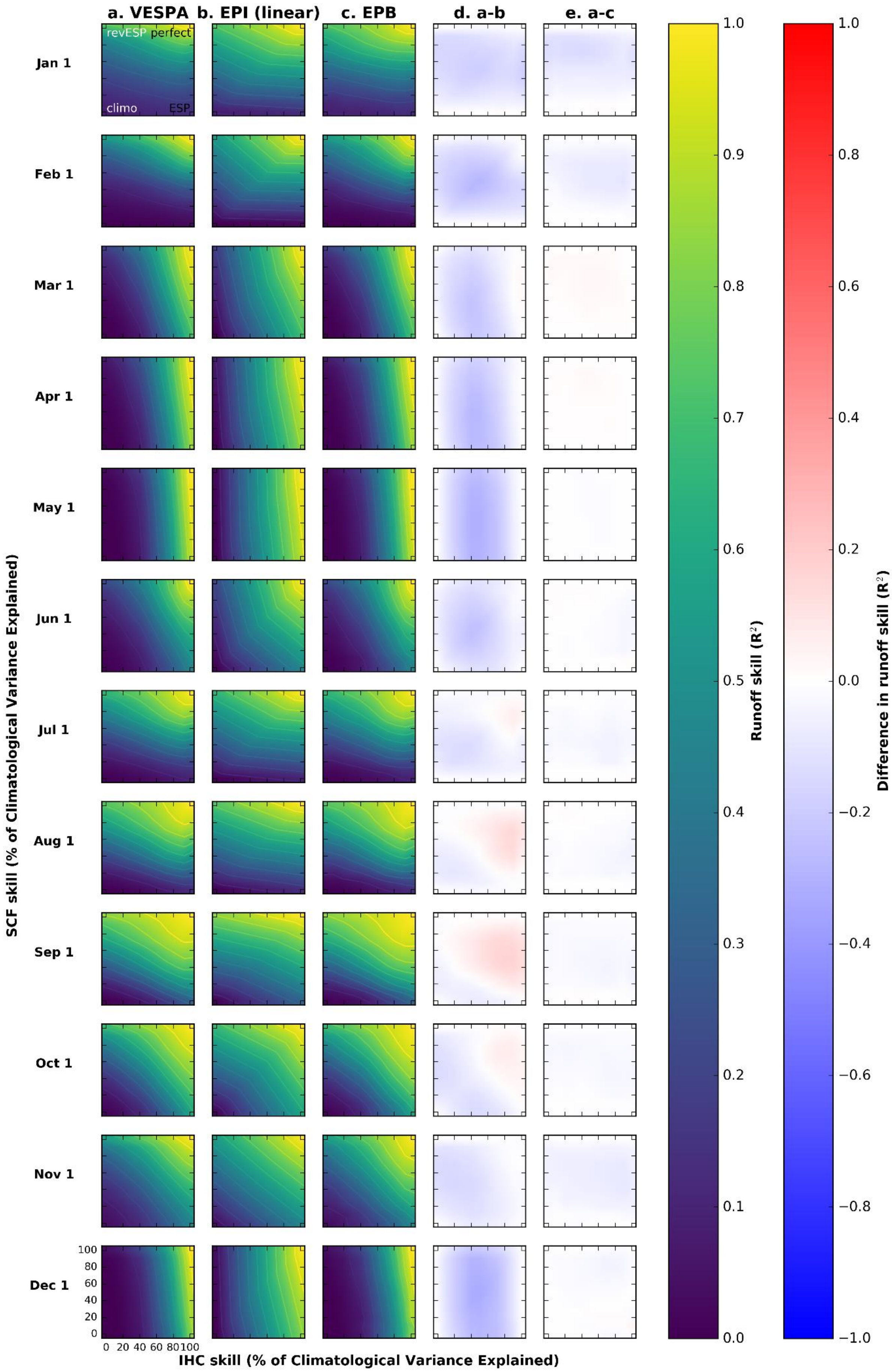
SCF skill (% of Climatological Variance Explained)
IHC skill (% of Climatological Variance Explained)
Runoff skill (R^2)
Difference in runoff skill (R^2)

Supplementary Figure 13 Skill surface plots obtained for a. the VESPA, b. the linear EPI and c. the EPB methods. The skill is calculated from the R^2 *of the 3-month streamflow forecast ensemble means against the 'perfect' forecasts, for hindcasts produced from 1981-2010 for the New River (VA; USGS gauge 003164000), with forecast initialisations on the first day of each month. Differences between the skill surface plots obtained for the d. VESPA and linear EPI methods and the e. VESPA and EPB methods are also shown.*



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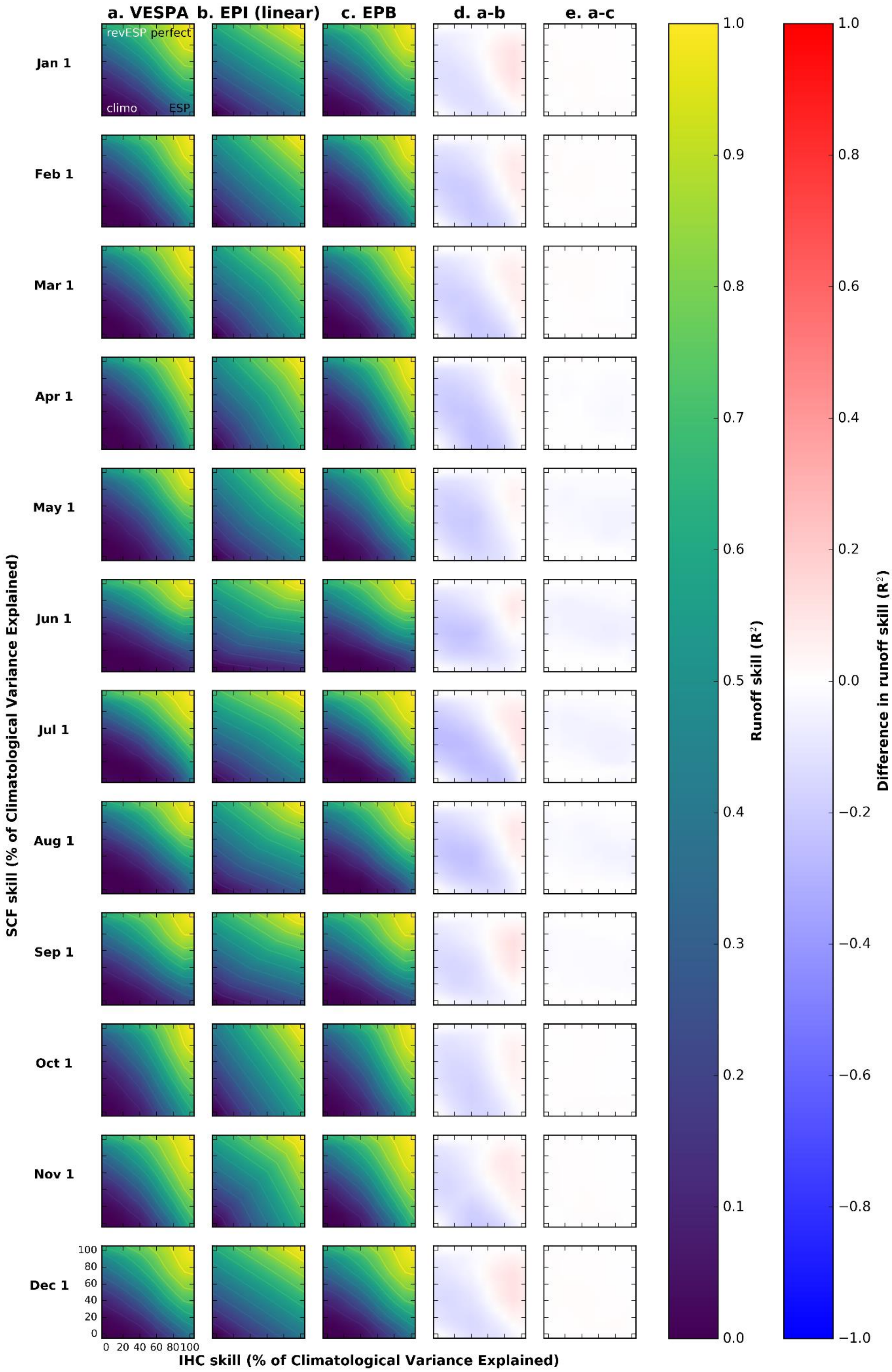
SCF skill (% of Climatological Variance Explained)
IHC skill (% of Climatological Variance Explained)
0 20 40 60 80 100
Runoff skill (R^2)
Difference in runoff skill (R^2)

Supplementary Figure 14 Skill surface plots obtained for a. the VESPA, b. the linear EPI and c. the EPB methods. The skill is calculated from the R^2 of the 3-month streamflow forecast ensemble means against the 'perfect' forecasts, for hindcasts produced from 1981-2010 for the Middle Branch Escanaba River (MI; USGS gauge 004057800), with forecast initialisations on the first day of each month. Differences between the skill surface plots obtained for the d. VESPA and linear EPI methods and the e. VESPA and EPB methods are also shown.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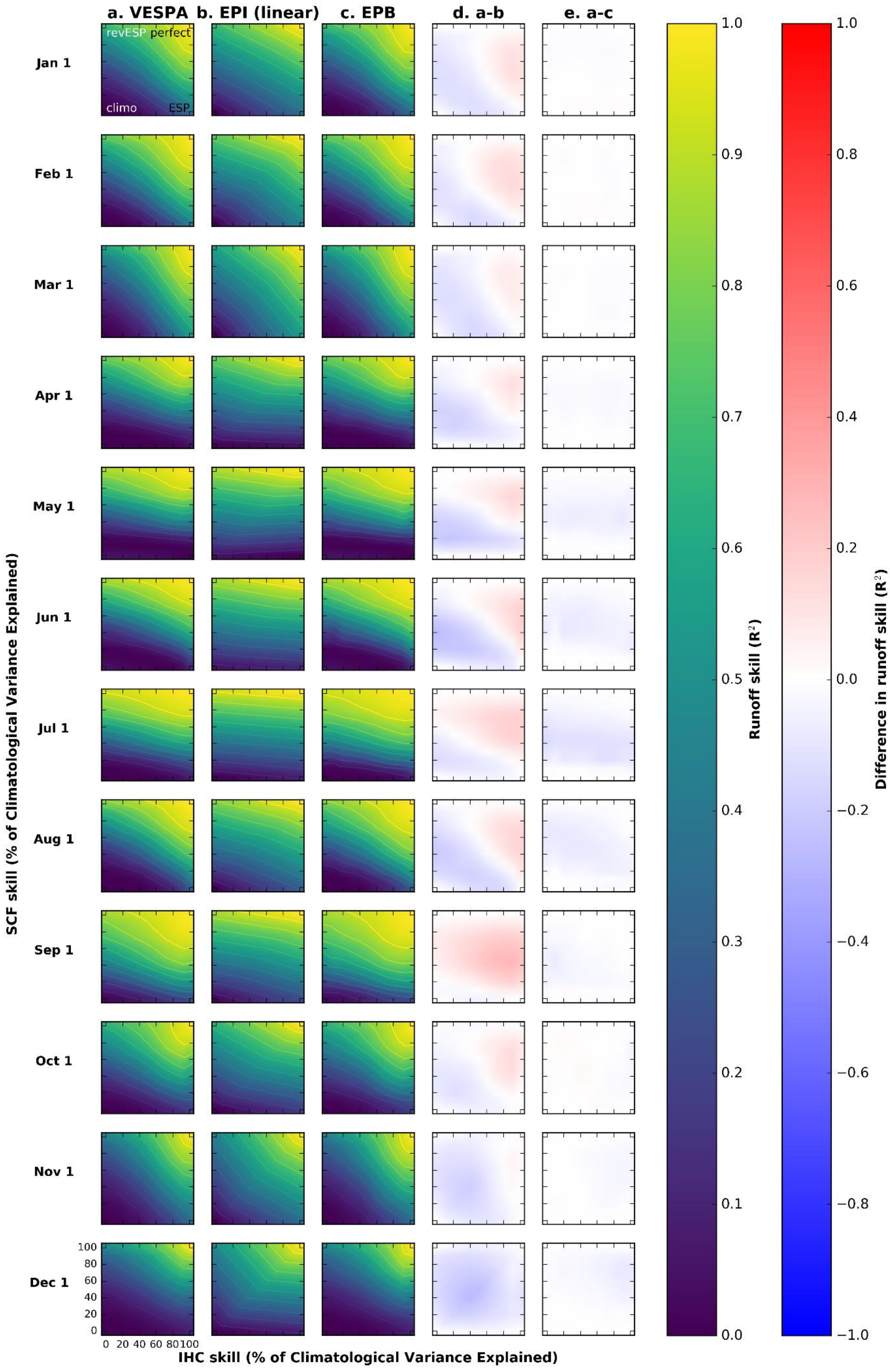
SCF skill (% of Climatological Variance Explained)
IHC skill (% of Climatological Variance Explained)
0 20 40 60 80 100
Runoff skill (R^2)
Difference in runoff skill (R^2)

Supplementary Figure 15 Skill surface plots obtained for a. the VESPA, b. the linear EPI and c. the EPB methods. The skill is calculated from the R^2 of the 3-month streamflow forecast ensemble means against the 'perfect' forecasts, for hindcasts produced from 1981-2010 for the Chattooga River (GA; USGS gauge 002177000), with forecast initialisations on the first day of each month. Differences between the skill surface plots obtained for the d. VESPA and linear EPI methods and the e. VESPA and EPB methods are also shown.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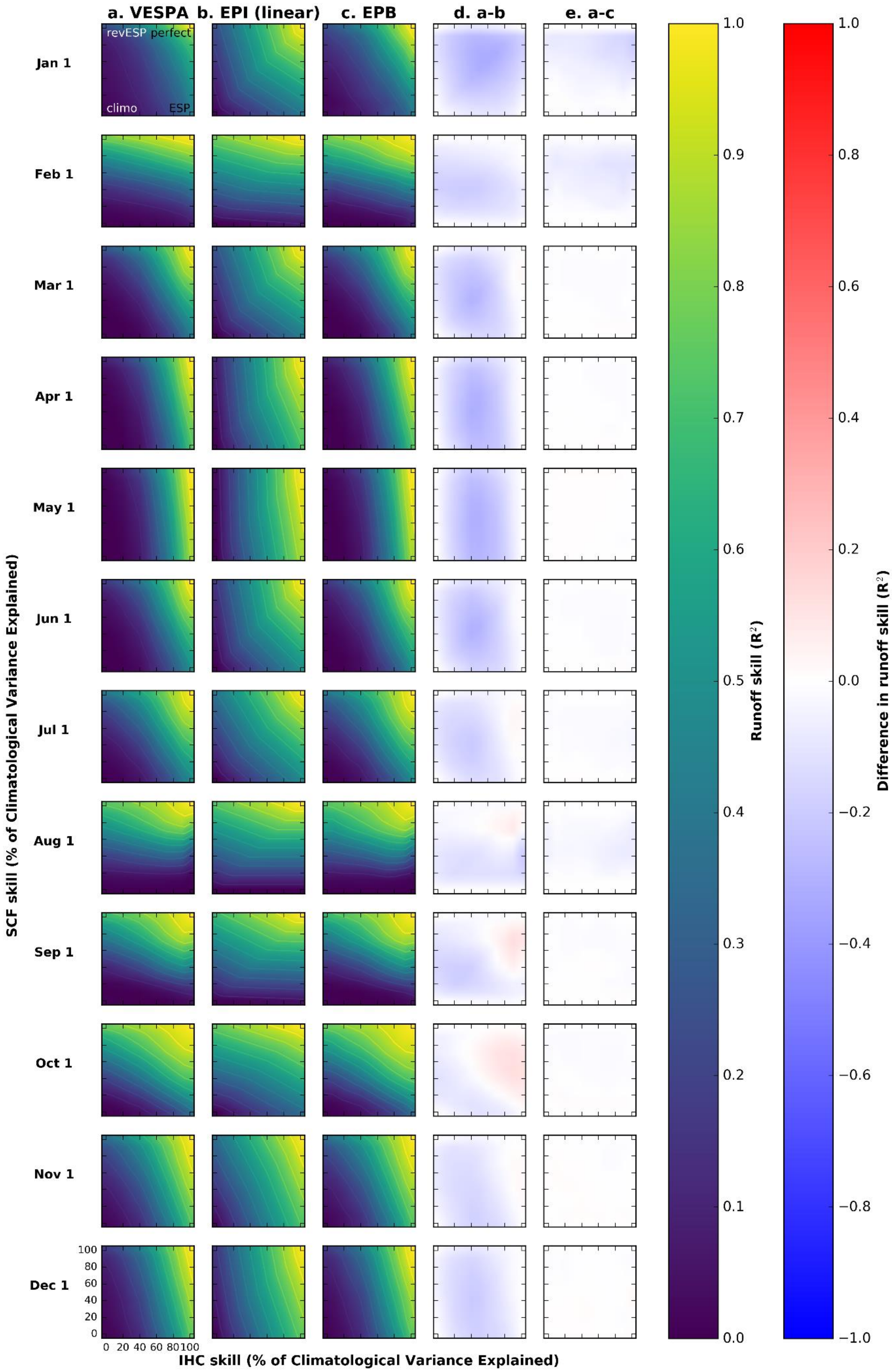
SCF skill (% of Climatological Variance Explained)
IHC skill (% of Climatological Variance Explained)
0 20 40 60 80 100
100 80 60 40 20 0
Runoff skill (R^2)
1.0 0.9 0.8 0.7 0.6 0.5 0.4 0.3 0.2 0.1 0.0
Difference in runoff skill (R^2)
1.0 0.8 0.6 0.4 0.2 0.0 −0.2 −0.4 −0.6 −0.8 −1.0

Supplementary Figure 16 Skill surface plots obtained for a. the VESPA, b. the linear EPI and c. the EPB methods. The skill is calculated from the R^2 *of the 3-month streamflow forecast ensemble means against the 'perfect' forecasts, for hindcasts produced from 1981-2010 for the SO. Branch Potomac River (WV; USGS gauge 001606500), with forecast initialisations on the first day of each month. Differences between the skill surface plots obtained for the d. VESPA and linear EPI methods and the e. VESPA and EPB methods are also shown.*



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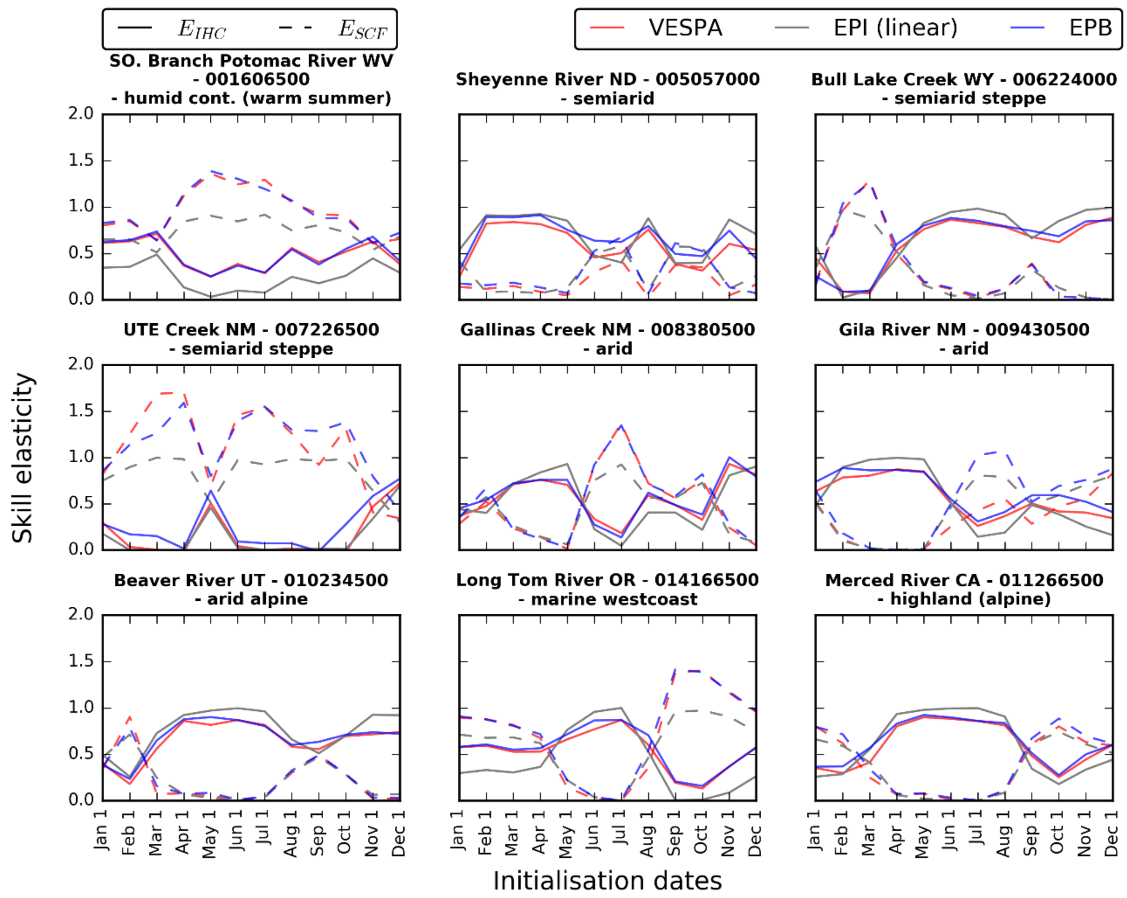
SCF skill (% of Climatological Variance Explained)
IHC skill (% of Climatological Variance Explained)
0 20 40 60 80 100
Runoff skill (R^2)
Difference in runoff skill (R^2)

Supplementary Figure 17 Skill surface plots obtained for a. the VESPA, b. the linear EPI and c. the EPB methods. The skill is calculated from the R^2 of the 3-month streamflow forecast ensemble means against the 'perfect' forecasts, for hindcasts produced from 1981-2010 for the Fish River (ME; USGS gauge 001013500), with forecast initialisations on the first day of each month. Differences between the skill surface plots obtained for the d. VESPA and linear EPI methods and the e. VESPA and EPB methods are also shown.



Supplementary Figure 18 Streamflow forecast skill elasticities for the IHCs (i.e., E_{IHC}, solid line) and the SCFs (i.e., E_{SCF}, dashed line), calculated across a quadrant situated within the 3-month streamflow forecast skill surface plots for the VESPA (in red), the linear EPI method (in grey) and the EPB method (in blue; using Eq. (4) and (5)*). Each plot shows the evolution of the IHC and SCF skill elasticities with the initialisation date for a given catchment. The climatological regions of the catchments are indicated in the plots' headings. The skill surface plots from which these skill elasticities were calculated are presented in Figure 4 and Supplementary Figures 1 to 17.*