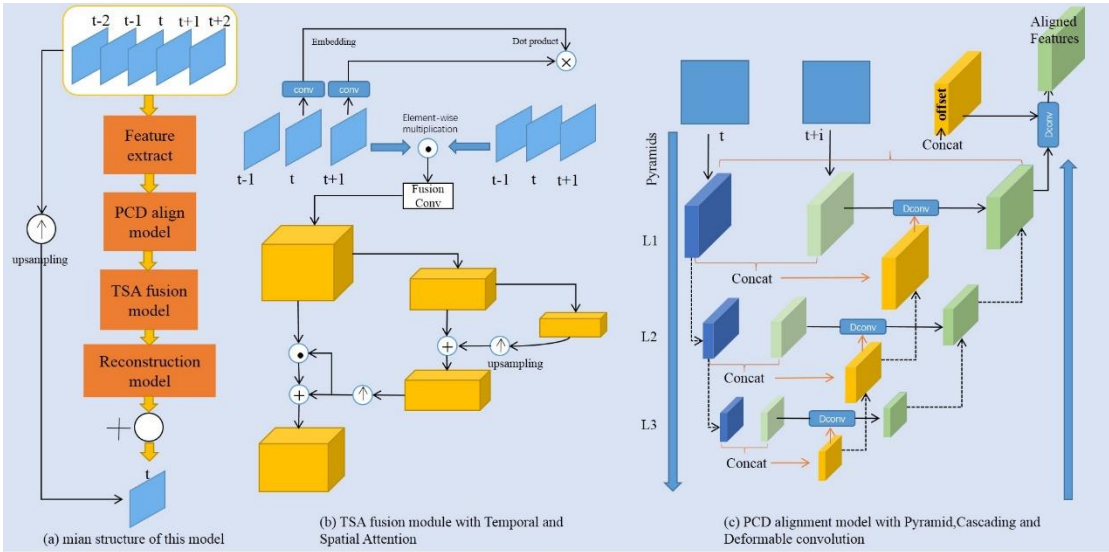
Figure S1 Innovative structure created in Deep-learning models. (a) Residual block proposed in EDSR (b) Residual dense block proposed in RDN (c)Residual Channel attention block proposed in RCAN

5   Figure S2 The main structure of the EDVR model

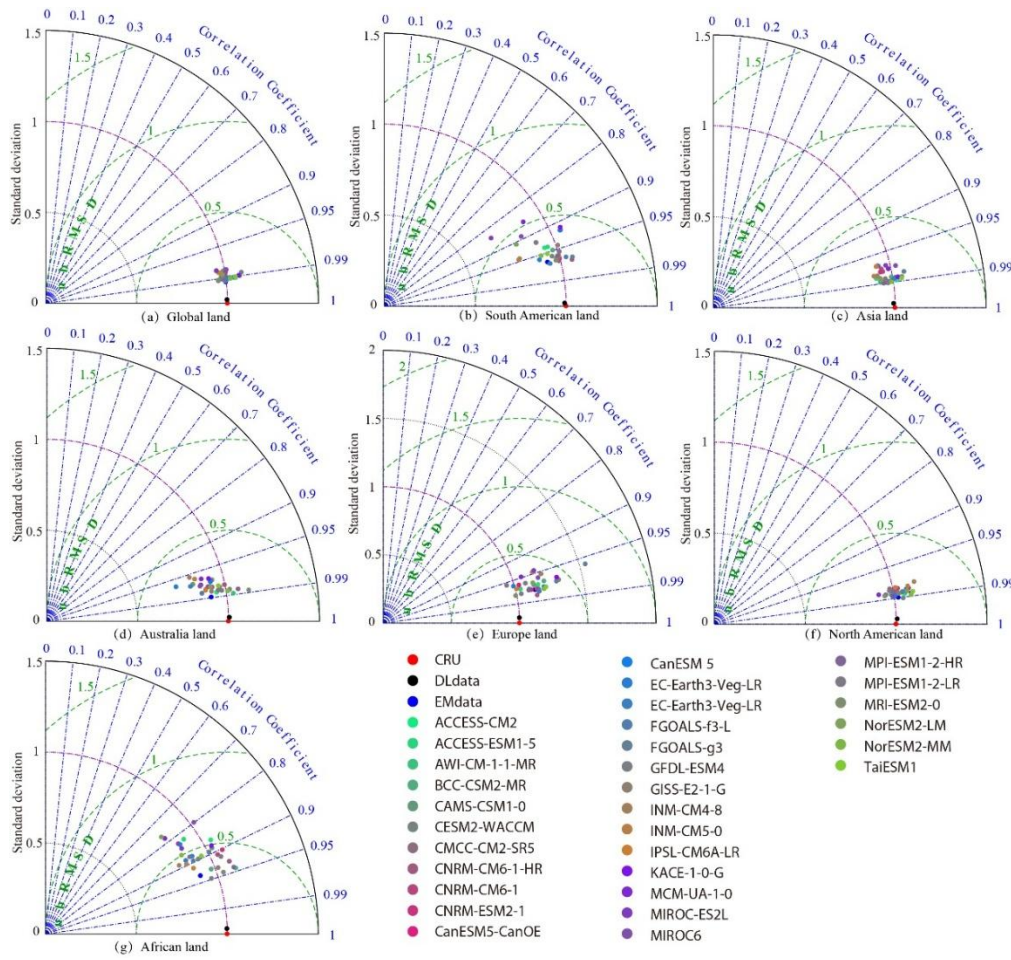



Figure S3 The climatological annual temperature of the Global and region areas was used for Taylor diagrams to compare each of the ESMs, the observation, DL merged-data, EM data for the period 1901–2014. The vertical coordinate is the standard deviation. Green concentric circles of dashed lines are ubRMSD. The angular coordinate is used to show the R.

10

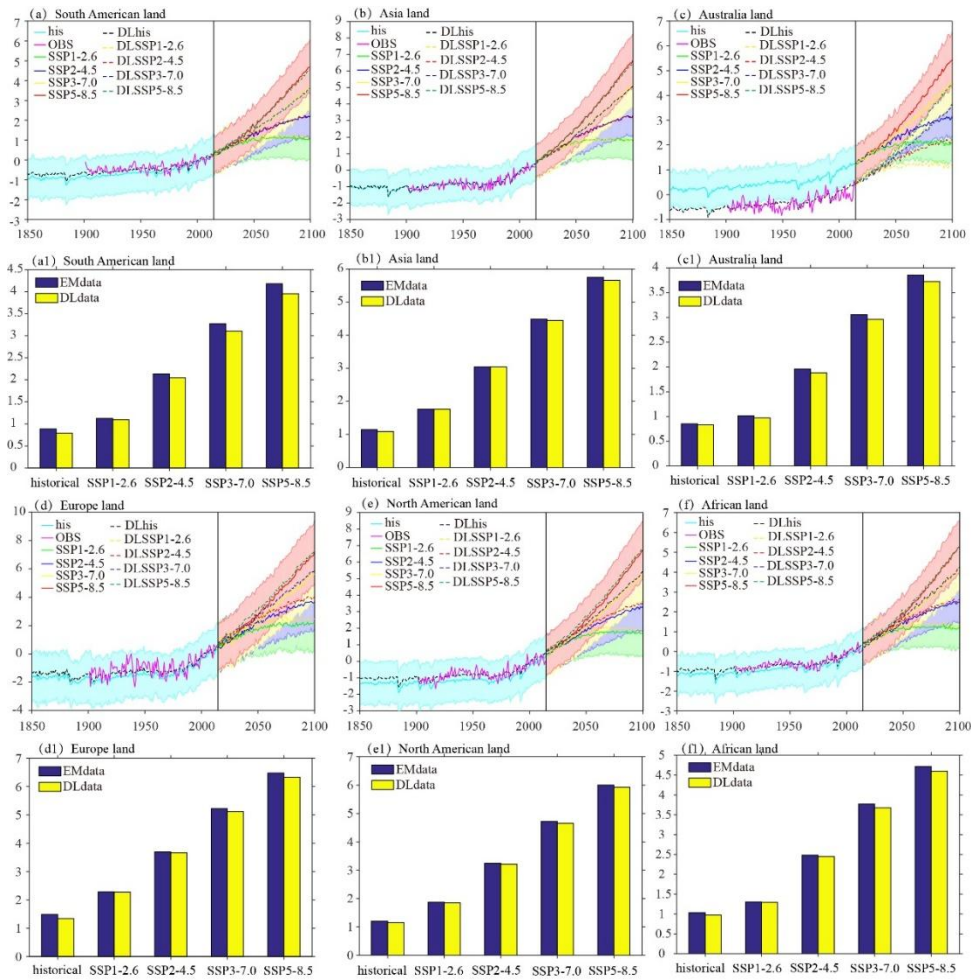



Figure S4 Regional time series of Global annual mean temperature anomalies of EM data, DL data and observation data over the global land surface and temperature change in historical and different scenarios based on EM data and DL data.

15

TabelS1 Temperature changes of DL data and EM data in different periods and different regions (Not bold is EM data and the bold is DL data)

	Historical	SSP1-2.6	SSP2-4.5	SSP3-7.0	SSP5-8.5
Global	1.09/**1.01**	1.54/**1.51**	2.76/**2.70**	4.11/**4.00**	5.22/**5.08**
SA	0.88/**0.78**	1.12/**1.09**	2.13/**2.04**	3.27/**3.10**	4.18/**3.95**
Asia	1.14/**1.08**	1.76/**1.75**	3.04/**3.05**	4.48/**4.44**	5.75/**5.66**
Australia	0.85/**0.82**	1.01/**0.97**	1.95/**1.88**	3.05/**2.95**	3.85/**3.72**
Europe	1.48/**1.33**	2.28/**2.26**	3.69/**3.66**	5.21/**5.11**	6.48/**6.33**
NA	1.20/**1.15**	1.88/**1.84**	3.24/**3.21**	4.71/**4.65**	6.00/**5.92**

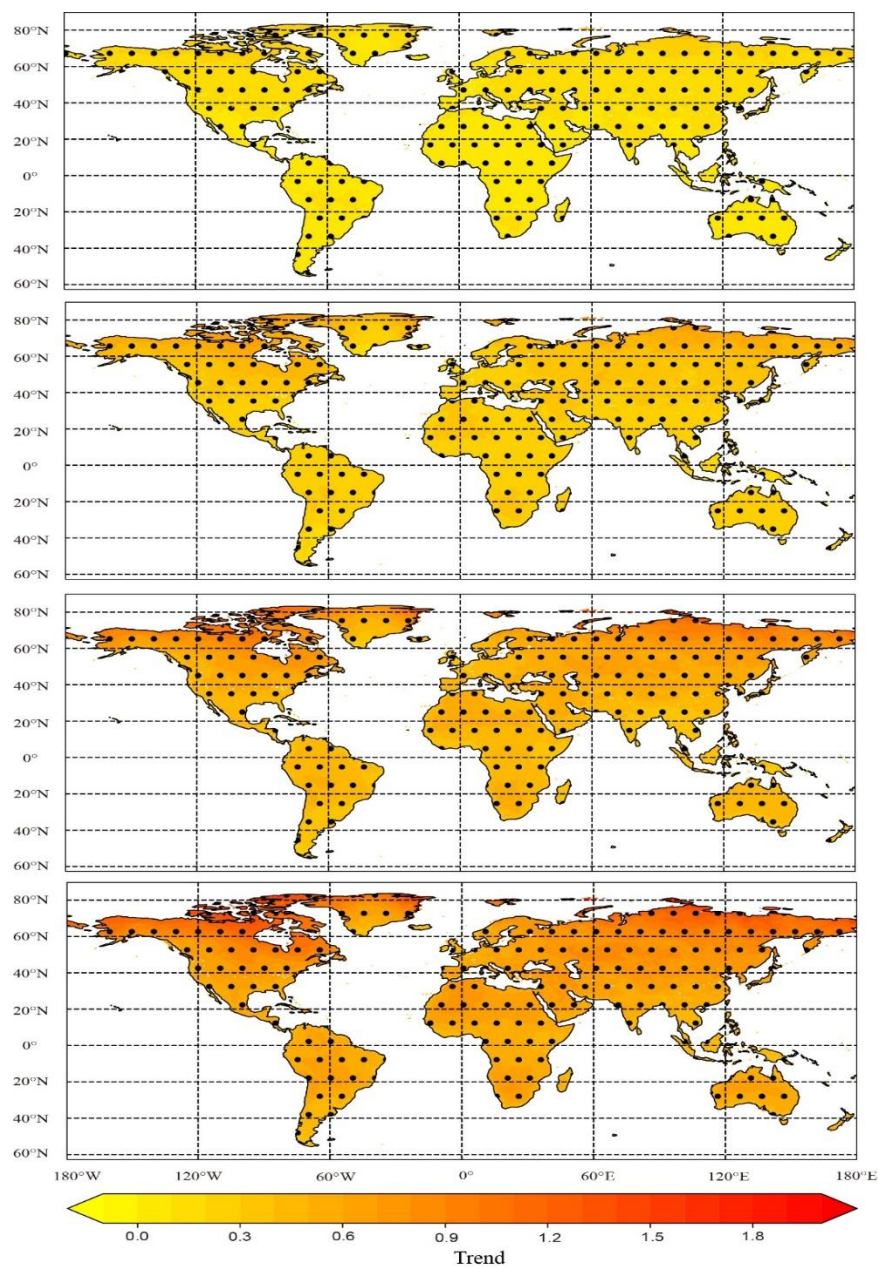
| African | 1.03/**0.96** | 1.31/**1.29** | 2.48/**2.44** | 3.77/**3.67** | 4.72/**4.60** |

20

Figure S5 Spatial distribution of future annual temperature trends per decade in SSP1-2.6, SSP2-4.5, SSP3-7.0 and SSP5-8.5 scenarios. Doted regions meet the 95% significant test.