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Impact of horizontal resolution and model time step on European precipitation extremes in the OpenIFS 43r3 atmospheric model

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Supplementary Material

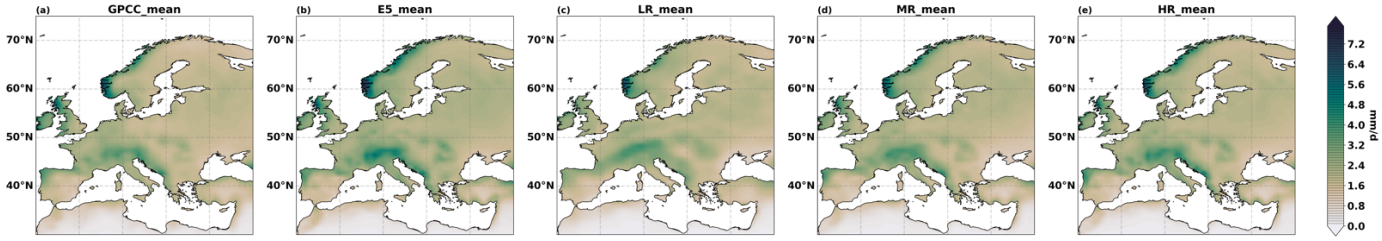

Fig. S1 Annual mean precipitation over Europe during 1982-2019 from (a) GPCC, (b) ERA5, (c) LR, (d) MR, (e) HR. Unit is mm/d.

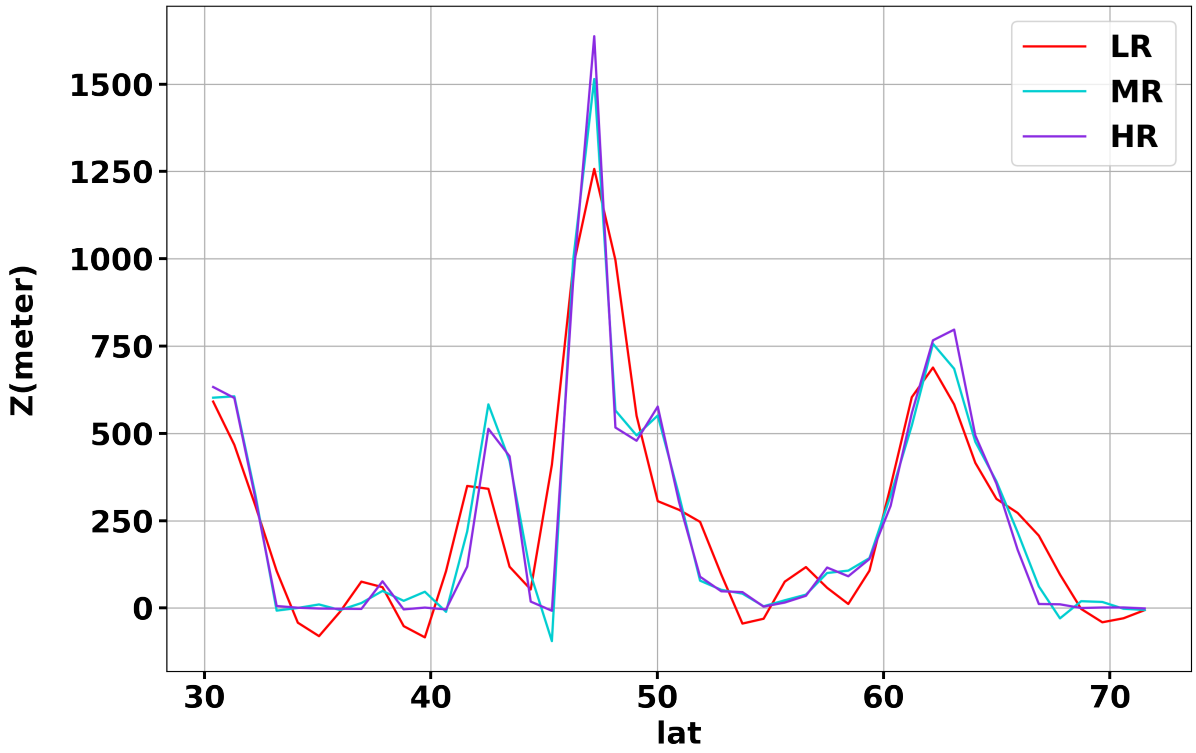

Fig. S2 The surface height (12.6° E, 30-72° N) in OpenIFS LR (red), MR (blue) and HR (purple). Unit is meter.

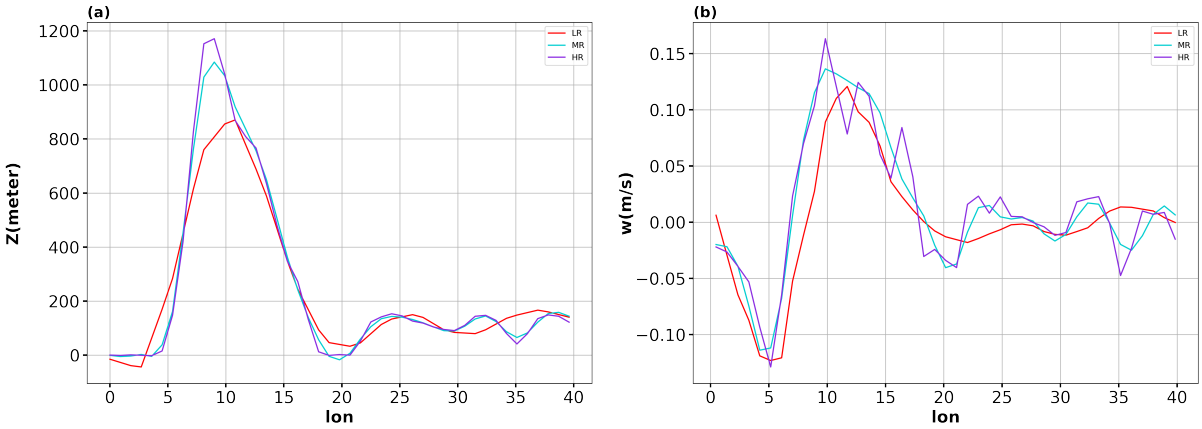

Fig. S3 The surface height (a) and annual mean vertical velocity (b) at 850 hPa over (0 – 40° E, 62° N) in OpenIFS LR (red), MR (blue) and HR (purple). Unit is m/s.

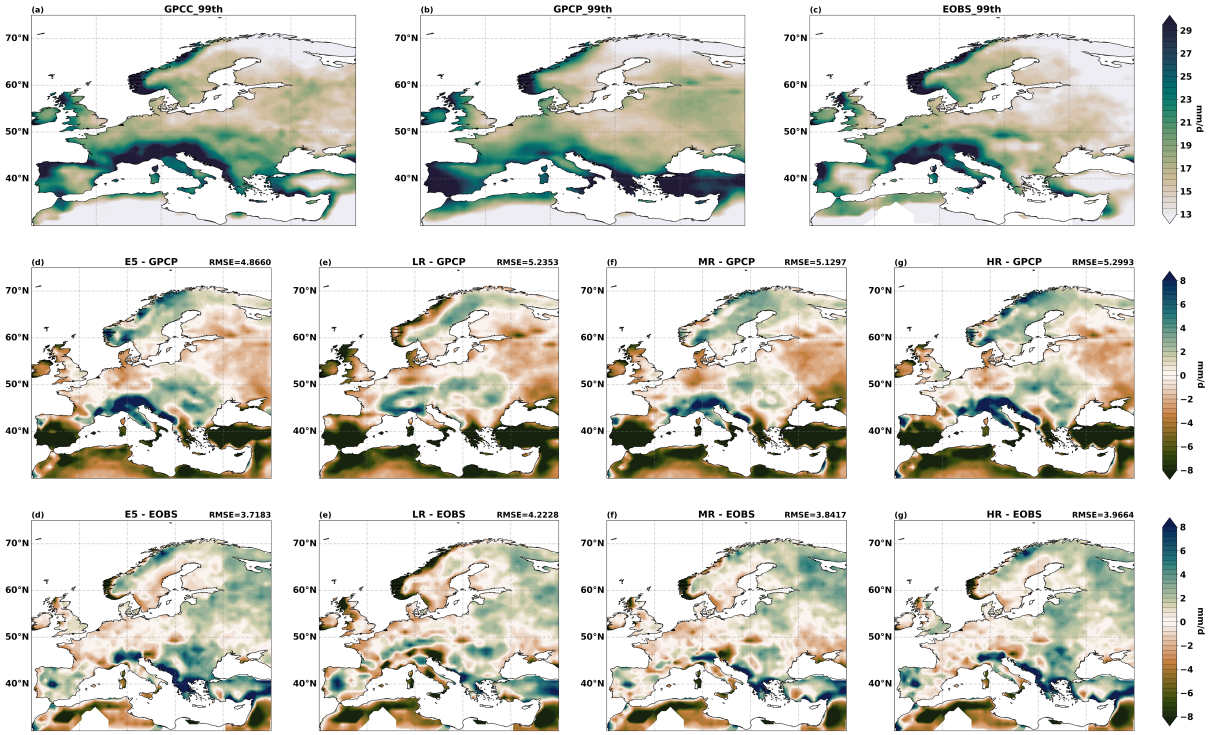

Fig. S4 The 99th percentile precipitation over Europe during 1982-2019 from (a) GPCC, (b) GPCP and (c) EOBS. Panels (d)-(g) are the biases between (d) ERA5, (e) HR, (f) MR, (g) HR and GPCP. Panels (h)-(k) are the same as panels (d)-(g) but for EOBS dataset.

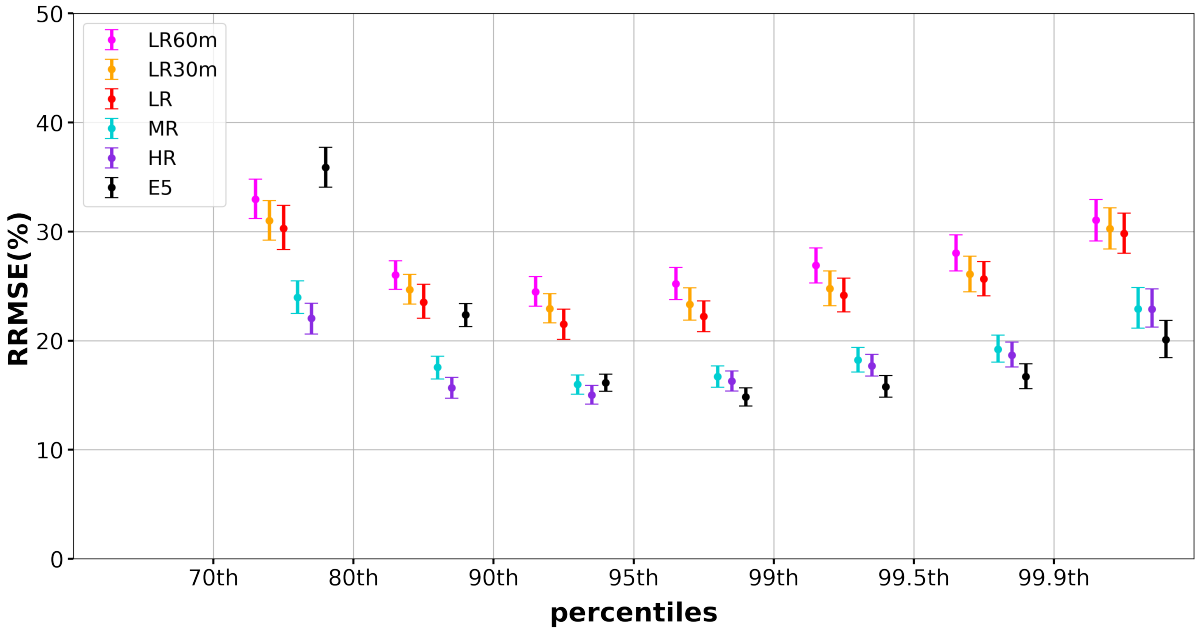

Fig. S5 Same as Fig. 5, but for relative RMSE (RRMSE).

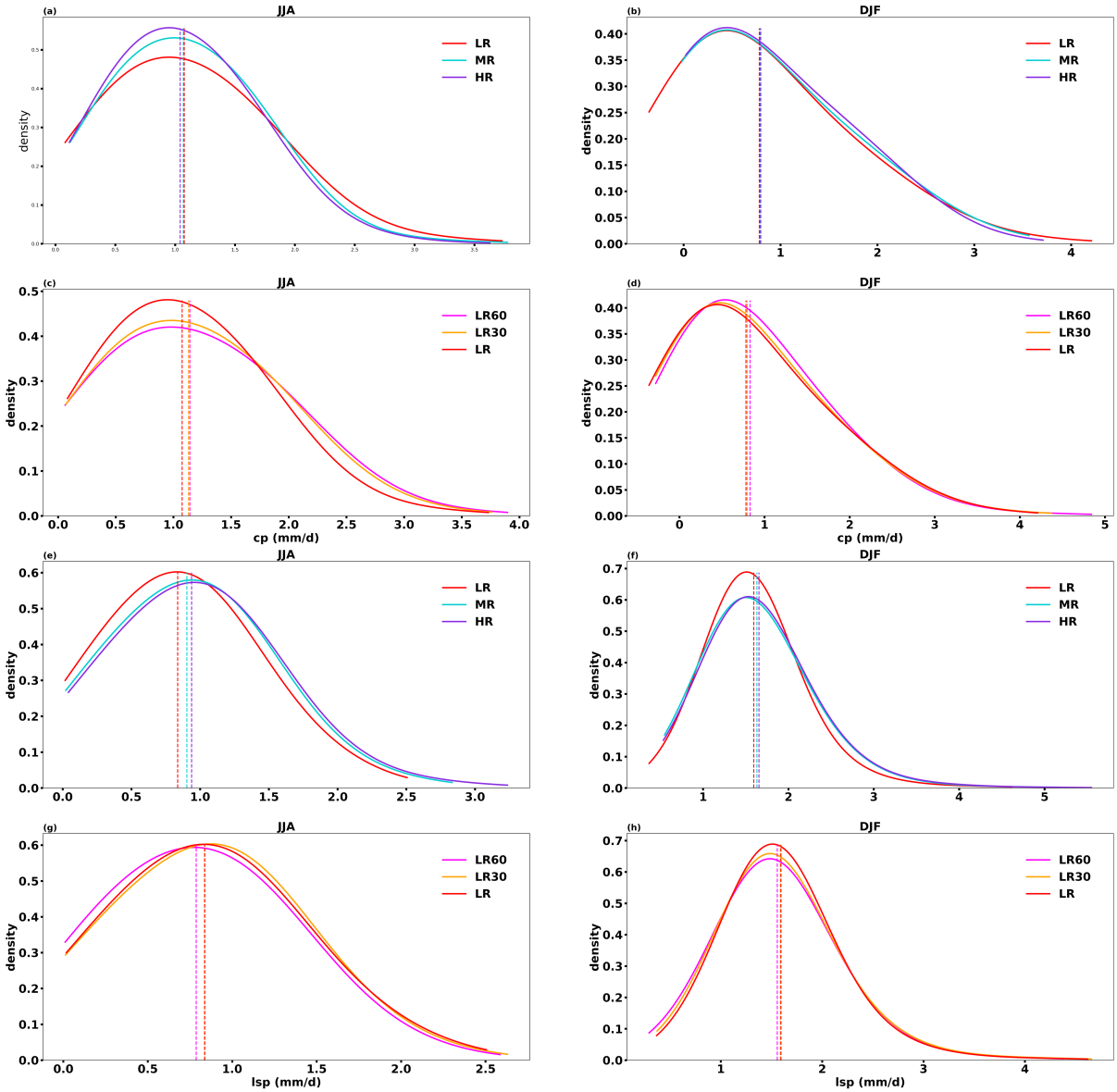

Fig. S6 European convective (a-d) and large-scale precipitation (e-h) distribution across different horizontal resolutions (a, b, e and f) and model time steps (c, d, g and h) in mean state in JJA and DJF (LR60m: magenta, LR30m: orange, LR: red, MR: blue, HR: purple). The time period is 1982-2019. The dash lines are the mean values of each distribution.

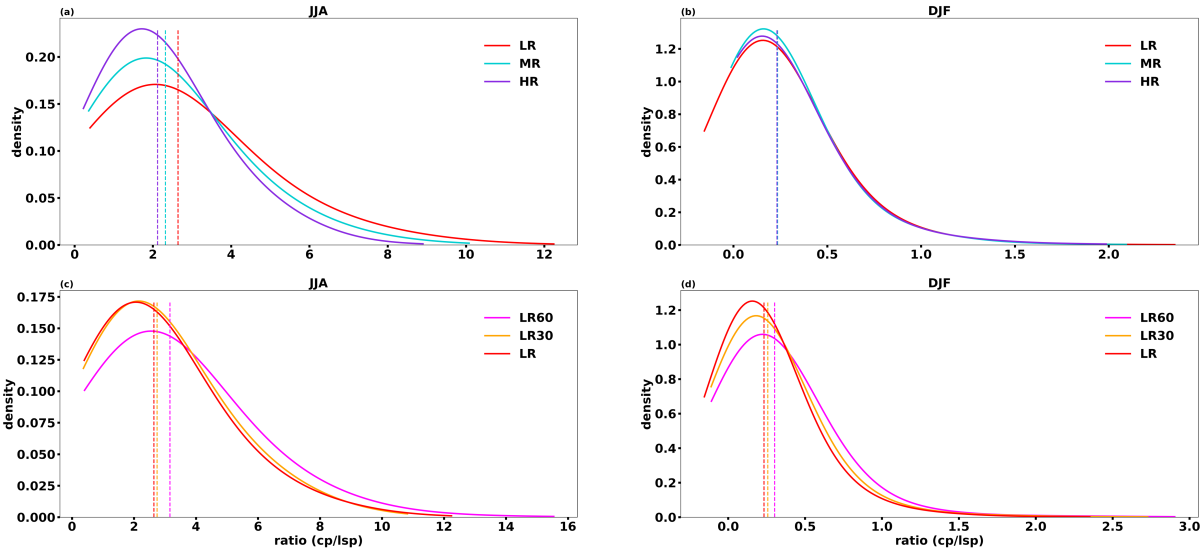

Fig. S7 The ratio between European convective and large-scale precipitation in mean state across different horizontal resolutions (a & b) and model time steps (c & d) in JJA and DJF (LR60m: magenta, LR30m: orange, LR: red, MR: blue, HR: purple). The dash lines are the mean values of each distribution.

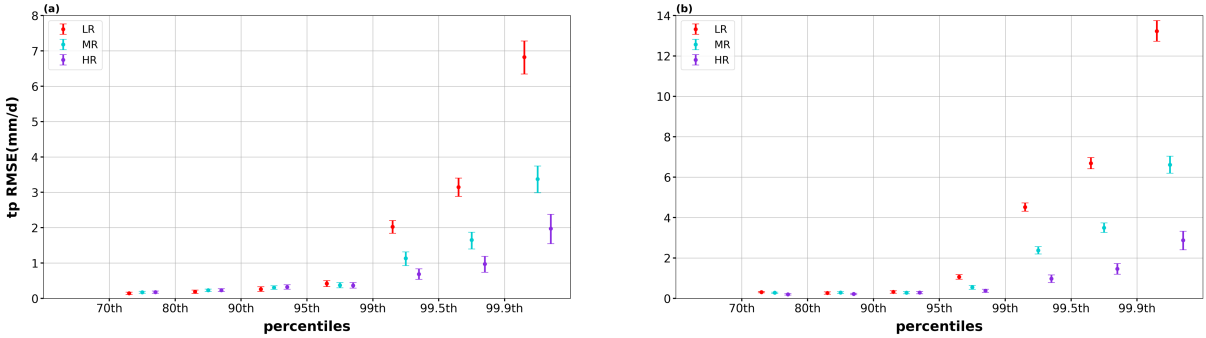

Fig. S8 RMSEs (referenced to GPCC) for annual Europe-averaged total precipitation at different percentile ranges (70^{th} – 80^{th}, 80^{th} – 90^{th}, 90^{th} – 95^{th}, 95^{th} – 99^{th}, 99^{th} – 99.5^{th}, 99.5^{th} – 99.9^{th} and >99.9^{th} percentile) in OpenIFS simulations (LR: red, MR: blue, HR: purple) on (a) regridded and (b) native resolution. Dots are the RMSE values, and error bars are the 95 % CI.