

Indian summer monsoon onset forecast skill in the UK Met Office initialized coupled seasonal forecasting system (GloSea5-GC2)

Supplementary Figures

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Received: date / Accepted: date

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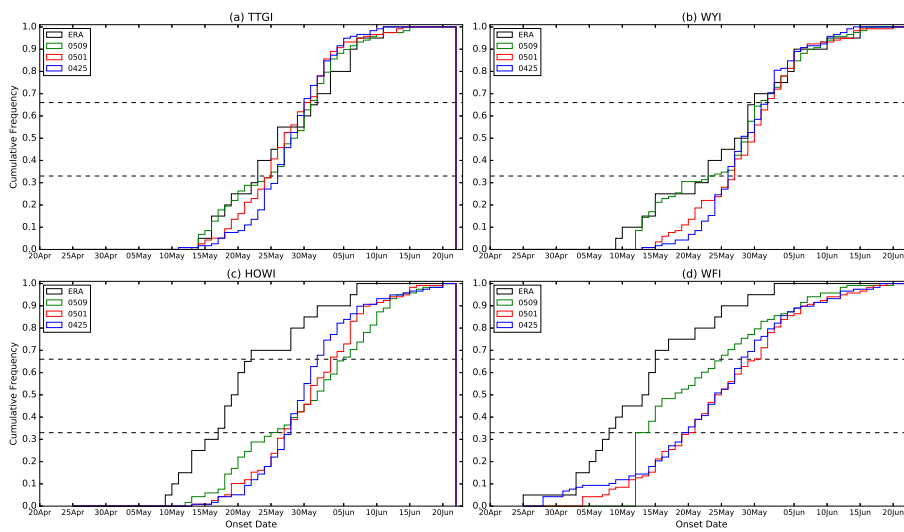


Fig. S1 Cumulative frequency of onset dates for the different model start date initializations and ERA-Interim as observations with (a) TTGI, (b) WYI, (c) HOWI and (d) WFI for time period of 1992-2011, with the upper and lower terciles values of any distribution (0.33 and 0.66 respectively) shown as black dashed lines.

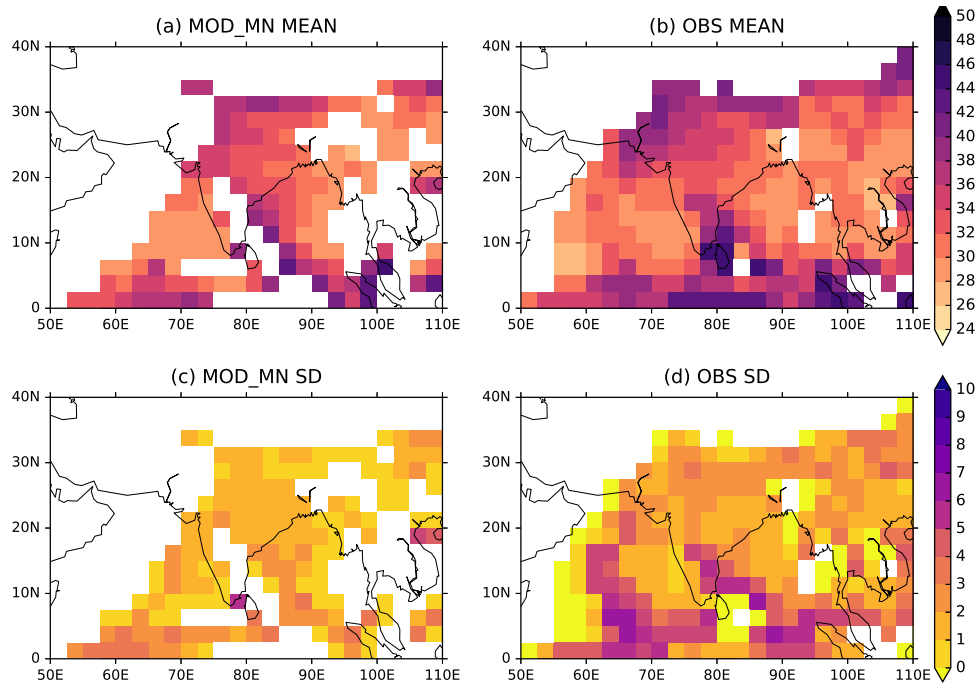


Fig. S2 Mean monsoon onset date with WLI for (a) MOD_MN and (b) OBS, and interannual standard deviation of monsoon onset dates with WLI for (c) MOD_MN and (d) OBS for time period of 1992-2011.

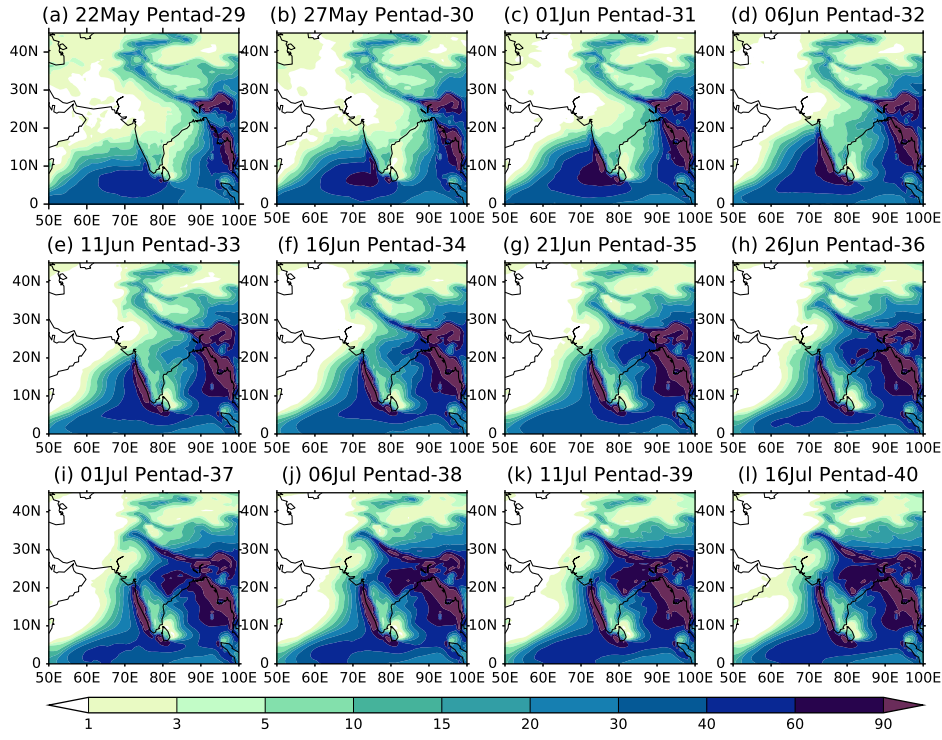


Fig. S3 Pentad sum precipitation climatology (mm) for 1992-2011, starting from (a) 22nd of May (Pentad-29) to (l) 16th of July (Pentad-40) for MOD_MN.

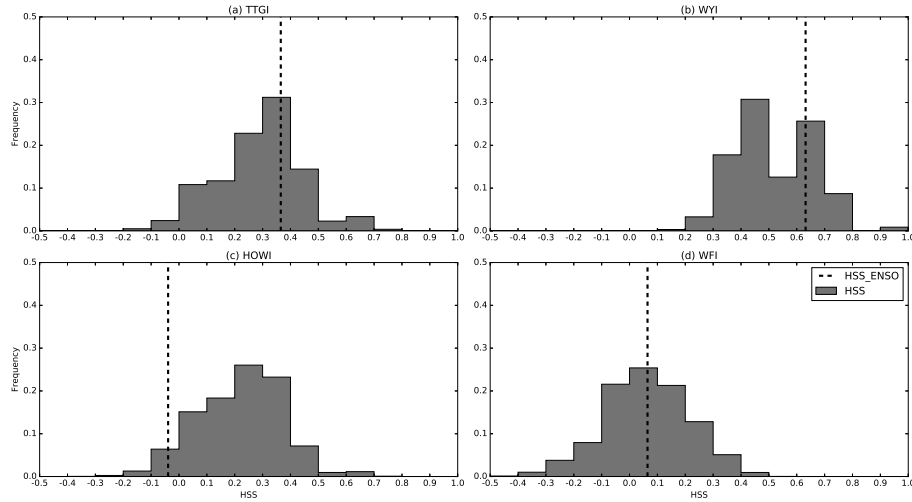


Fig. S4 Frequency distribution of skill-score measure (HSS) for 10,000 random samples of 11 years from the 20-year period of 1992-2011 (RANDOM11) with the four monsoon onset indices, (a) TTGI, (b) WYI, (c) HOWI and (d) WFI for MOD_MN. The vertical dashed lines represent the skill-score measure (HSS) for the 11 ENSO years (ENSO11) derived from MOD_MN for the respective monsoon onset index.

Table S1 Details of Met Office Global Seasonal Forecast System 5 (GloSea5) in Global Coupled configuration 2 (GC2) with differences between operational and hindcast modes.

Component	Model	Resolution		Hindcast Initialization	Operational Forecast Initialization	Coupling	
Global Atmosphere 6.0 (GA6.0; Walters et al., 2017)	MetUM (Met Office Unified Model)	N216 resolution (0.833° × 0.556°)	85 vertical levels	ERA-Interim Reanalysis (Dee et al., 2011)	Met Office operational numerical weather prediction 4D-Var data assimilation system analysis (Rawlins et al., 2007)	GA6.0 and GL6.0 models integrate on the same grid as the same model executable	GA6.0 and GL6.0 are coupled with GO5.0 and GSI6.0 using OASIS3 coupler (Valcke, 2013) at coupling period of 3 hours
Global Land 6.0 (GL6.0; Best et al., 2011; Walters et al., 2017)	JULES (Joint UK Land Environment Simulator) model	N216 resolution (0.833° × 0.556°)	4 soil levels (9 surface tile types representing surface heterogeneity)	ERA-Interim Reanalysis (Dee et al., 2011) for snow amount and soil temperature; and JULES reanalysis with Integrated Project Water and Global Change (WATCH) forcing data applied to ERA-Interim data (Weedon et al., 2011) for soil moisture	Met Office analysis (Rawlins et al., 2007) for snow amount and soil temperature; and JULES reanalysis with Integrated Project Water and Global Change (WATCH) forcing data applied to ERA-Interim data (Weedon et al., 2011) for soil moisture		
Global Ocean 5.0 (GO5.0; Megann et al., 2014)	NEMO (Nucleus for European Modelling of the Ocean) model	ORCA 0.25° tripolar grid	75 vertical levels (with a 1m top level)	GloSea5 Ocean analysis using the GloSea5 global ocean 3.0 system driven by ERA-Interim reanalysis (1989-2011) and incorporated using NEMOVAR assimilation scheme	Forecast Ocean Assimilation Model (FOAM) Ocean Analysis (Blockley et al., 2013) and incorporated using NEMOVAR assimilation scheme	GO5.0 and GSI6.0 models integrate on the same grid as the same model executable with the difference of CICE using Arakawa B grid and NEMO C grid	
Global Sea Ice 6.0 (GSI6.0; Rae et al., 2015)	CICE (Los Alamos Sea Ice) model	ORCA 0.25° tripolar grid	5 sea-ice thickness categories				