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# Impact of Initialized Land Surface Temperature and Snowpack on Subseasonal to Seasonal Prediction Project, Phase I (LS4P-I): organization and experimental design

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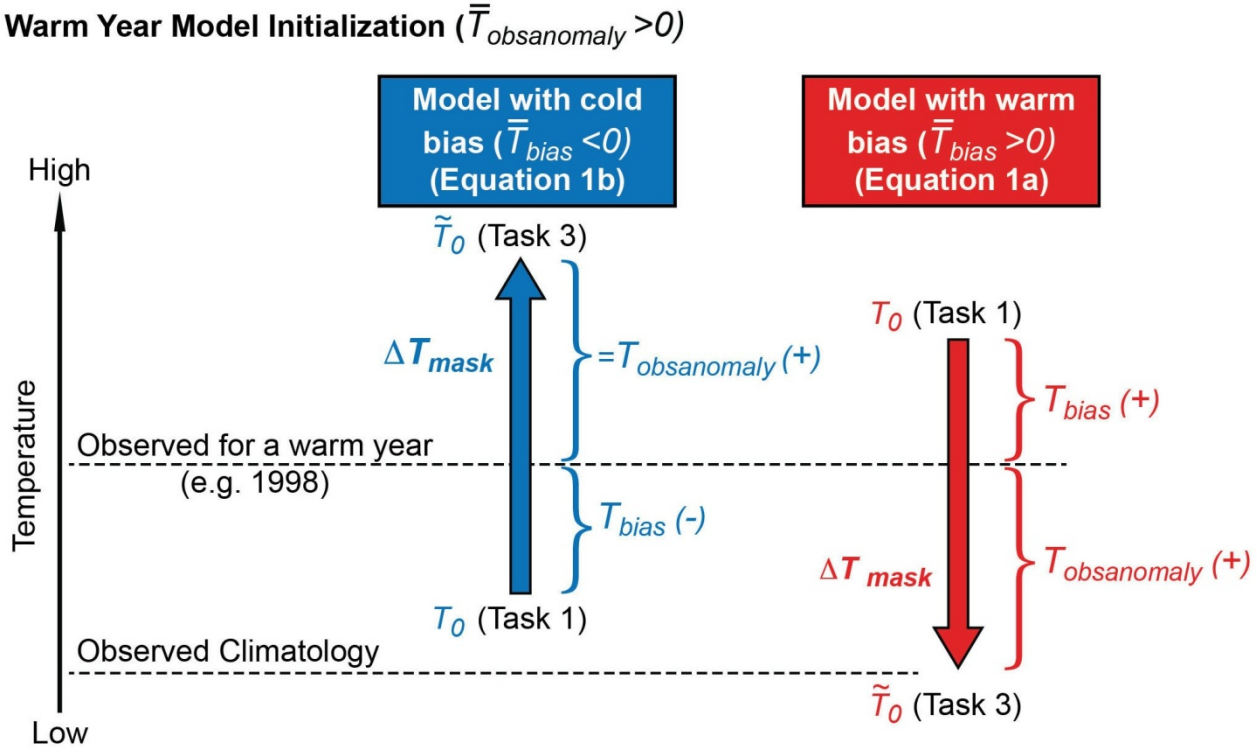


**Figure S1. Schematic Diagram for an Imposed Mask for Surface Temperature Initialization in Task 3 corresponding to a Warm Anomaly Year.**

Notes: **(1)** The part with blue/red color has bias and anomaly with same/different signs, respectively. **(2)** The +/- sign in the parentheses indicate that the value is positive/negative, respectively. The notation "= $T_{obsanomaly}$ (+)" indicates that it is the same value as the observed positive anomaly. **(3)** For simplicity, Figure S1 is only for the grid points which bias sign is the same as the sign of area averaged bias. **(4)**. $T_0$ is the initial condition for Task 1 and $\tilde{T}_0$ is the initial condition after imposing the mask for task 3.

# Table S1: Output List required for the LS4P-I

## S1.1 Monthly mean 3D profile variables [over the entire globe for ESMs] (Levels: [1000-100 hPa] standard output)

| Variable name | Abbreviation | Unit | Frequency |
|---|---|---|---|
| Geopotential height | gh | gpm | Monthly averaged |
| Meridional velocity | va | m/s | Monthly averaged |
| Specific humidity | hus | g/kg | Monthly averaged |
| Temperature | ta | K | Monthly averaged |
| Vertical velocity (Omega) | w | Pa/s | Monthly averaged |
| Zonal velocity | ua | m/s | Monthly averaged |
| Potential vorticity* | pv | $K\ m^2\ kg^{-1}\ s^{-1}$ | Monthly averaged |
| Relative humidity* | hur | % | Monthly averaged |
| Total diabatic heating* | tdh | K/day | Monthly averaged |

***These variables are optional.**

## S1.2 Monthly mean 2D variables [over the entire globe for ESMs]

| Variable name | Abbreviation | Unit | Frequency |
|---|---|---|---|
| Albedo | alb | % | Monthly averaged |
| Boundary layer height | blh | m | Monthly averaged |
| Mean sea level pressure | mslp | Pa | Monthly averaged |
| Surface pressure | sp | Pa | Monthly averaged |
| Orography | orog | m | Monthly averaged |
| Land sea mask | lsm | proportion | Monthly averaged |
| Sea ice cover | sic | proportion | Monthly averaged |
| 2m temperature | t2m | K | Monthly averaged |
| Minimum 2m temperature | t2min | K | Monthly averaged |
| Maximum 2m temperature | t2max | K | Monthly averaged |
| Sea surface (skin; SST + Land) temperature | sst (skt) | K | Monthly averaged |
| Soil temperature for the top 5 layers | td | K | Monthly averaged |
| 2m specific humidity | huss | g/kg | Monthly averaged |
| 10m u-velocity | u10m | m/s | Monthly averaged |
| 10m v-velocity | v10m | m/s | Monthly averaged |
| Total precipitation | pr | mm/day | Monthly averaged |
| Convective precipitation | conpre | mm/day | Monthly averaged |
| Total soil water content | tsw | m | Monthly averaged |
| Soil moisture for the top five layers | sm | $kg\ m^{-3}$ | Monthly averaged |
| Soil wetness at the rooting zone | swr | $m^3/m^3$ | Monthly averaged |
| Convective available potential energy | cape | $J\ kg^{-1}$ | Monthly averaged |
| Total cloud cover fraction | tcc | % | Monthly averaged |
| Surface latent heat flux | hlfs | $W/m^2$ | Monthly averaged |
| Surface sensible heat flux | hfss | $W/m^2$ | Monthly averaged |
| Surface ground heat flux | hfgs | $W/m^2$ | Monthly averaged |
| Surface downwelling LW radiation | rlds | $W/m^2$ | Monthly averaged |
| Surface upwelling LW radiation | rlus | $W/m^2$ | Monthly averaged |
| Surface downwelling SW radiation | rsds | $W/m^2$ | Monthly averaged |
| Surface upwelling SW radiation | rsus | $W/m^2$ | Monthly averaged |
| SW upwelling radiative flux at TOA | rsut | $W/m^2$ | Monthly averaged |
| SW downwelling radiative flux at TOA | rsdt | $W/m^2$ | Monthly averaged |
| Outgoing Longwave Radiation at top of Atm | olr | $W/m^2$ | Monthly averaged |
| Net surface radiation (LWup –Lwdow + Swup – Swdown) | netrad | $W/m^2$ | Monthly averaged |

| | | | |
|---|---|---|---|
| Snow cover | snc | % | Monthly averaged |
| Snow water equivalent | swe | $kg/m^2$ | Monthly averaged |
| Surface snow depth | snd | m | Monthly averaged |
| Runoff | roff | mm/s | Monthly averaged |

### S1.3 Daily mean 2D variables [over the entire globe for ESMs]

| **Variable name** | **Abbreviation** | **Unit** | **Frequency** |
|---|---|---|---|
| Boundary layer height | blh | m | Daily averaged |
| Mean sea level pressure | mslp | Pa | Daily averaged |
| Surface pressure | sp | Pa | Daily averaged |
| 2m temperature | t2m | K | Daily averaged |
| 2m dew point temperature | 2d | K | Daily averaged |
| Sea surface (skin; SST + Land) temperature/ | sst (skt) | K | Daily averaged |
| Soil temperature for the top five layers | td | K | Daily averaged |
| Soil moisture for the top five layers | sm | $kg\ m^{-3}$ | Daily averaged |
| Total precipitation | pr | mm/day | Daily averaged |
| Convective precipitation | conpre | mm/day | Daily averaged |
| Convective available potential energy | cape | $J\ kg^{-1}$ | Daily averaged |
| Total cloud cover fraction | tcc | % | Daily averaged |
| Surface latent heat flux | hlfs | $W/m^2$ | Daily averaged |
| Surface sensible heat flux | hfss | $W/m^2$ | Daily averaged |
| Surface ground heat flux | hfgs | $W/m^2$ | Daily averaged |
| Surface zonal momentum flux | suflx | $N\ m^{-2}$ | Daily averaged |
| Surface meridional momentum flux | svflx | $N\ m^{-2}$ | Daily averaged |
| SW upwelling radiative flux at the surface | rsus | $W/m^2$ | Daily averaged |
| SW downwelling radiative flux at the surface | rsds | $W/m^2$ | Daily averaged |
| LW upwelling radiative flux at the surface | rlus | $W/m^2$ | Daily averaged |
| LW downwelling radiative flux at the surface | rlds | $W/m^2$ | Daily averaged |
| Outgoing Longwave radiation at top of Atm | olr | $W/m^2$ | Daily averaged |
| Net surface radiation (LWup –Lwdow + Swup – Swdown) | netrad | $W/m^2$ | Daily averaged |
| Snow cover | snc | % | Daily averaged |
| Surface snow depth | snd | m | Daily averaged |
| Snow water equivalent | swe | $kg/m^2$ | Daily averaged |

### S1.4 Daily atmospheric (mean 3D) pressure level field [over the entire globe for ESMs] provided at 925, 850, 700, 600, 500, 300, 200, and 100 hPa

| Variable name | Abbreviation | Unit | Frequency |
|---|---|---|---|
| Geopotential height | gh | gpm | Daily averaged |
| Meridional velocity | va | m/s | Daily averaged |
| Specific humidity | hus | g/kg | Daily averaged |
| Temperature | ta | K | Daily averaged |
| Vertical velocity (Omega) | w | Pa/s | Daily averaged |
| Zonal velocity | ua | m/s | Daily averaged |

### S1.5 2D variables with diurnal variation (6 hourly outputs) [over the entire globe from ESMs]

| Variable name | Abbreviation | Unit | Frequency |
|---|---|---|---|
| Boundary layer height | blh | m | 6 hourly |
| 2m temperature | t2m | K | 6 hourly |
| Soil temperature for the top three layers | td | K | 6 hourly |
| Total precipitation | pr | mm/s | 6 hourly |
| Convective precipitation | conpre | mm/s | 6 hourly |
| Total cloud cover fraction | tcc | % | 6 hourly |
| Surface latent heat flux | hlfs | $W/m^2$ | 6 hourly |
| Surface sensible heat flux | hfss | $W/m^2$ | 6 hourly |
| Surface ground heat flux | hfgs | $W/m^2$ | 6 hourly |
| SW upwelling radiative flux at the surface | rsus | $W/m^2$ | 6 hourly |
| SW downwelling radiative flux at the surface | rsds | $W/m^2$ | 6 hourly |
| LW upwelling radiative flux at the surface | rlus | $W/m^2$ | 6 hourly |
| LW downwelling radiative flux at the surface | rlds | $W/m^2$ | 6 hourly |

***3 hourly and 1 hourly data for the above variables are also welcome, when available.**

Note: The outputs should be in NetCDF format and in regular lat/lon grids