

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	rhus	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 data for the above variables are also welcome, when available.**

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