

Supplementary Material 4

Table SM4. Details of WRF outputs.

Variable	Description	Unit
Times	Time information of the model output.	
XLAT	Latitude values at the mass grid points.	degree_north
XLONG	Longitude values at the mass grid points.	degree_east
LU_INDEX	Land use category index.	
ZNU	Full sigma vertical coordinate values.	
ZNW	Half sigma vertical coordinate values.	
ZS	Surface heights.	m
DZS	Layer thickness at the interfaces.	m
VAR_SSO	VAR_SSO (used for coupled runs).	m2
U	Zonal wind component.	m s-1
V	Meridional wind component.	m s-1
W	Vertical wind component.	m s-1
PH	Perturbation geopotential.	m2 s-2
PHB	Base-state geopotential.	m2 s-2
T	Perturbation potential temperature.	K
THM	Moist potential temperature.	K
HFX_FORCE	Surface sensible heat flux forcing.	W m-2
LH_FORCE	Surface latent heat flux forcing.	W m-2
TSK_FORCE	Skin temperature forcing.	W m-2
HFX_FORCE_TEND	Tendency of surface sensible heat flux forcing.	W m-2 s-1
LH_FORCE_TEND	Tendency of surface latent heat flux forcing.	W m-2 s-1
TSK_FORCE_TEND	Tendency of skin temperature forcing.	W m-2 s-1
MU	Perturbation dry air mass.	Pa
MUB	Base-state dry air mass.	Pa
NEST_POS	Nest position.	-
P	Perturbation pressure.	Pa
PB	Base-state pressure.	Pa
FNM	Sigma coordinate vertical velocity.	
FNPN	Pressure coordinate vertical velocity.	
RDNW	Downward shortwave radiation flux.	
RDN	Net downward shortwave radiation flux.	
DNW	Downward longwave radiation flux.	
DN	Net downward longwave radiation flux.	
CFN	Convective precipitation flux.	
CFN1	Convective precipitation flux at model levels.	
THIS_IS_AN_IDEAL_RUN	Flag indicating if it's an idealized run.	-

P_HYD	Perturbation hydrostatic pressure.	Pa
Q2	Perturbation specific humidity at 2 meters.	kg kg-1
T2	Perturbation temperature at 2 meters.	K
TH2	Perturbation potential temperature at 2 meters.	K
PSFC	Surface pressure.	Pa
U10	Zonal wind component at 10 meters.	m s-1
V10	Meridional wind component at 10 meters.	m s-1
RDX	Grid spacing in the x-direction.	
RDY	Grid spacing in the y-direction.	
RESM	Grid spacing in meters.	
ZETATOP	Model topography height.	
CF1	Flag indicating convective precipitation at model levels.	
CF2	Flag indicating stratiform precipitation at model levels.	
CF3	Flag indicating grid-scale precipitation at model levels.	
ITIMESTEP	Current time step.	
XTIME	Simulation time in seconds.	minutes since 2019-03-23 18:00:00
QVAPOR	Water vapor mixing ratio.	kg kg-1
QCLOUD	Cloud water mixing ratio.	kg kg-1
QRAIN	Rainwater mixing ratio.	kg kg-1
QICE	Ice mixing ratio.	kg kg-1
QSNOW	Snow mixing ratio.	kg kg-1
QGRAUP	Graupel mixing ratio.	kg kg-1
QNICE	Non-precipitating ice mixing ratio.	kg-1
QNSNOW	Non-precipitating snow mixing ratio.	kg(-1)
QNRAIN	Non-precipitating rain mixing ratio.	kg(-1)
QNGRAUPEL	Non-precipitating graupel mixing ratio.	kg(-1)
SHDMAX	Maximum stomatal resistance.	
SHDMIN	Minimum stomatal resistance.	
SNOALB	Snow albedo.	
TSLB	Soil temperature.	K
SMOIS	Soil moisture content.	m3 m-3
SH2O	Liquid soil moisture content.	m3 m-3
SMCREL	Relative soil moisture content.	
SEAICE	Sea-ice fraction.	
XICEM	Sea-ice thickness.	
SFROFF	Surface runoff.	mm
UDROFF	Underground runoff.	mm
IVGTYP	Vegetation type.	
ISLTYP	Soil type.	
VEGFRA	Vegetation fraction.	

GRDFLX	Ground heat flux.	W m-2
ACGRDFLX	Accumulated ground heat flux.	J m-2
ACSNOM	Accumulated snow melt.	kg m-2
SNOW	Snowfall.	kg m-2
SNOWH	Snow depth.	m
CANWAT	Canopy water.	kg m-2
SSTSK	Sea surface skin temperature.	K
COSZEN	Cosine of solar zenith angle.	dimensionless
LAI	Leaf area index.	m-2/m-2
VAR	Auxiliary variable for nudging.	
MAPFAC_M	Map scale factor for mass grid.	
MAPFAC_U	Map scale factor for u-grid.	
MAPFAC_V	Map scale factor for v-grid.	
MAPFAC_MX	Map scale factor on mass grid in x-direction.	
MAPFAC_MY	Map scale factor on mass grid in y-direction.	
MAPFAC_UX	Map scale factor on u-grid in x-direction.	
MAPFAC_UY	Map scale factor on u-grid in y-direction.	
MAPFAC_VX	Map scale factor on v-grid in x-direction.	
MF_VX_INV	Inverse of map factor on v-grid in x-direction.	
MAPFAC_VY	Map scale factor on v-grid in y-direction.	
F	Coriolis parameter.	s-1
E	Vertical coordinate stretching factor.	s-1
SINALPHA	Sine of grid rotation angle.	
COSALPHA	Cosine of grid rotation angle.	
HGT	Terrain height.	m
TSK	Surface skin temperature.	K
P_TOP	Model top pressure.	Pa
T00	Reference temperature.	K
P00	Reference pressure.	Pa
TLP	Terrain-following hydrostatic pressure.	
TISO	Isobaric temperature.	K
TLP_STRAT	Terrain-following hydrostatic pressure for stratiform.	K
P_STRAT	Perturbation pressure for stratiform.	Pa
MAX_MSTFX	Maximum mixing ratio of surface exchange for momentum in x-direction.	
MAX_MSTFY	Maximum mixing ratio of surface exchange for momentum in y-direction.	
RAINC	Accumulated convective precipitation.	mm
RAINSH	Accumulated shallow convective precipitation.	mm
RAINNC	Accumulated non-convective precipitation.	mm
SNOWNC	Accumulated snowfall (non-convective).	mm
GRAUPELNC	Accumulated graupel (non-convective).	mm

HAILNC	Accumulated hail (non-convective).	mm
CLDFRA	Cloud fraction.	
SWDOWN	Downward shortwave radiation flux at the surface.	W m-2
GLW	Downward longwave radiation flux at the surface.	W m-2
SWNORM	Normalized downward shortwave radiation flux at the surface.	W m-2
OLR	Outgoing longwave radiation flux at the top of the atmosphere.	W m-2
XLAT_U	Latitude values at u-grid points.	degree_north
XLONG_U	Longitude values at u-grid points.	degree_east
XLAT_V	Latitude values at v-grid points.	degree_north
XLONG_V	Longitude values at v-grid points.	degree_east
ALBEDO	Surface albedo.	-
CLAT	Cosine of latitude.	degree_north
ALBBCK	Background albedo.	
EMISS	Surface emissivity.	
NOAHRES	NOAH model restart flag.	W m{-2}
TMN	Minimum temperature at the surface.	K
XLAND	Land fraction.	
UST	Surface friction velocity.	m s-1
PBLH	Planetary boundary layer height.	m
HFX	Surface sensible heat flux.	W m-2
QFX	Surface latent heat flux.	kg m-2 s-1
LH	Surface latent heat flux.	W m-2
ACHFX	Accumulated surface sensible heat flux.	J m-2
ACLHF	Accumulated surface latent heat flux.	J m-2
SNOWC	Snow cover.	
SR	Soil moisture rating.	-
SAVE_TOPO_FROM_REAL	Flag indicating if topography is saved from the real data.	flag
ISEEDARR_SPPT	Random seed array for SPPT (Shallow Cumulus Scheme).	
ISEEDARR_SKEBS	Random seed array for SKEBS (Stochastic Kinetic Energy Backscatter).	
ISEEDARR_RAND_PERTURB	Random seed array for random perturbations.	
ISEEDARRAY_SPP_CONV	Random seed array for convective perturbations.	
ISEEDARRAY_SPP_PBL	Random seed array for PBL perturbations.	
ISEEDARRAY_SPP_LSM	Random seed array for LSM perturbations.	
C1H	Land-use category parameter 1 for heat.	Dimensionless
C2H	Land-use category parameter 2 for heat.	Pa
C1F	Land-use category parameter 1 for moisture.	Dimensionless
C2F	Land-use category parameter 2 for moisture.	Pa
C3H	Land-use category parameter 3 for heat.	Dimensionless
C4H	Land-use category parameter 4 for heat.	Pa

C3F	Land-use category parameter 3 for moisture.	Dimensionless
C4F	Land-use category parameter 4 for moisture.	Pa
PCB	Perturbation cloud base pressure.	Pa
PC	Perturbation cloud top pressure.	Pa
LANDMASK	Land-sea mask.	
LAKEMASK	Lake mask.	
SST	Sea surface temperature.	K
SST_INPUT	Input sea surface temperature.	K