YOPPsiteMIP – The YOPP super-site Model Inter-comparison Project

Gunilla Svensson[1], Barbara Casati[2], Jonny Day[3], Taneil Uttal[4] and Øystein Godøy[5]

[1] Department of Meteorology, Stockholm University, Sweden. Contact: gunilla@misu.su.se
[2] Meteorological Research Division, Environment and Climate Change Canada, Canada.
[3] European Centre for Medium-Range Weather Forecasts, UK.
[4] NOAA Earth System Research Laboratory, Boulder Colorado, USA.
[5] Norwegian Meteorological Institute, Norway.

Requested model output

In order to permit process-based evaluation and verification of numerical weather prediction (NWP) and climate models with observations from key locations in the Arctic, Antarctic and Third Pole, we are calling for modeling centers to participate in this project. Engagement can be through archiving and providing high frequency output from forecasts produced during the Year of Polar Prediction (YOPP: 1st May 2017-30th June 2019, possibly extended for the MOSAiC period, summer 2019 – summer 2020) and answering research questions by analyzing the data.

The proposed set of locations is comprised of IASOA super-sites (https://www.esrl.noaa.gov/psd/iasoa), ECCC super-sites (ecpass.ca), selected Antarctic stations, and key locations covering the so–called "third pole" (Tibetan plateau).
In order to facilitate the study of ocean-cryosphere-atmosphere coupling processes, we suggest that data also be extracted at the (changing) locations of the research icebreaker Oden (expedition during YOPP-Second Special Observing Period (SOP2), summer 2018), and the MOSAIC drifting observatory (http://www.mosaicobservatory.org/, 2019-2010)[1]. A few fixed locations over the Arctic Ocean (e.g. the approximate location of the Sheba drifting observatory 165°W, 76°N) are also desirable. Table 1 shows the locations of the suggested sites. If possible, we suggest that data be provided for all sites. However, reporting a comprehensive set of parameters for fewer sites, which is necessary for regional models, is more useful than reporting a more limited set for many sites, since the aim is to facilitate process studies.

Table 1 Locations for site-specific model output

Super-site ***Filename***	**Latitude Longitude**	**Elevation**
	Arctic	
Barrow (Alaska) *barrow*	71.32°N, 156.62°W	8-20 m
Oliktok Point (Alaska) *oliktok*	70.50°N 149.89°W	2-6 m
White Horse (Canada) *whitehorse*	60.71°N, 135.07°W	682 m

[1] Locations can be found at http://www.polarprediction.net/yopp-activities/yopp-task-teams/verification/

Eureka (Canada) *eureka*	80.08°N 86.42°W	0-610 m
Iqaluit (Canada) *iqaluit*	63.74°N, 68.51°W	5-11 m
Alert (Canada) *alert*	82.49°N, 62.51°W	8-210 m
Summit (Greenland) *summit*	72.58°N, 38.48°W	3210-3250 m
Ny-Ålesund (Svalbard) (Zeppelin station) *nyalesund*	78.92°N, 11.53°E (78.9°N, 11.88°E)	0-30 m (473 m)
Sodankylä (Finland) (Pallas) *sodankyla*	67.37°N, 26.63°E (67.97°N, 24.12°E)	198 m (305 m)
Tiksi (Russia) *tiksi*	71.60°N, 128.89°E	1-30 m
Cherskii (Russia) *cherskii*	68.73°N, 161.38°E (68.51°N, 161.53°E)	8 m (16 m)
Ice Base Cape Baranova (Russia) *baranova*	79.3°N, 101.7°E	24 m

Antarctic

Alexander Tall Tower *alexander*	79.01°S, 170.72°E	55 m
Casey *casey*	66.28°S, 110.53°E	30 m
Davis *davis*	68.58°S, 77.97°E	
Dome C *domec*	75.08°S, 123.34°E	3233 m
Dumont d'Urville *dumont*	66.66°S, 140.01°E	0-50 m
Halley IV *halley*	75.58°S, 26.66° W	130 m
King Sejong (King George Island) *kingsejong*	62.22°S, 58.79° W	10 m
Georg von Neumayer *neumayer*	70.65°S, 8.25°W	42 m
Mawson *mawson*	67.60°S, 62.87°E	15 m
Syowa (Showa) *syowa*	69.00°S, 39.59°E	18-29 m

Jang Bogo (Terra Nova Bay) *jangbogo*	74.62°S, 164.23°E	36 m
Amundsen-Scott South Pole *southpole*	90°S, 0°E	2835 m
Byrd *byrd*	80.01°S, 119.44°W	1539 m
Rothera *rothera*	67.57°S, 68.13° W	4 m
Vostok *vostok*	78.46°S, 106.84°E	3489 m
McMurdo (Scott base) *mcmurdo*	77.85°S, 166.67°E (77.85°S, 166.76°E)	10 m (10 m)
Troll *troll*	72.01°S, 2.54°E	1275 m
Third Pole		
Mera (Nepal) *mera*	27.7°N, 86.9°E	4570-4520 m
Tanggula (China) *tanggula*	32.58°N, 91.86°E	5100 m
Xidatan (China) *xidatan*	35.72°N, 94.13°E	4940-6420 m
Iaohugou (China) *iouhugou*	37.5°N, 96.5°E	4180 m
Ocean sites		
SHEBA location *sheba*	165°W, 76°N	Sea level
Arctic Ocean *ao1*	10°E, 85°N	Sea level
Arctic Ocean *ao2*	0°E, 90°N	Sea level
Arctic Ocean *ao3*	135°W, 81°N	Sea level

The motivation is to support detailed evaluation of the model representation of a range of physical processes, as described in the YOPP modelling plan (YOPP, 2017). The processes to be evaluated include the terms in the energy budget at the surface, momentum transfer, clouds and vertical profiles of a number of parameters, as well as other processes which are supported by the observations at the super-sites or of interest to compare between models.

Some key issues:

- **Output levels.** In order to permit detailed process studies, model parameters should be on the native model vertical levels.

- **Output frequency**. High frequency output, preferably every model time step, is desirable to support process studies. At least every 5 or 15 minutes is required, in order to align with the IASOA Amalgamated Observatory Data Files, which will include measurements with a frequency of 15 minutes. Since the output data is high frequency, averages and extremes during each output period are not required.
- **Output locations**. For coarser resolution models (10 km or coarser) we recommend archiving the four model grid-points nearest (surrounding) the super-site location. Ideally, model output should be provided for the set of model grid points within 20km of the observation site. Some of the super-site locations have two observational sites. Please provide data for the main location and make sure the other site is covered in the surrounding grid-points.

Output variables

Table 2 shows the site-specific output with variables in two tiers. Most variables in ***tier one*** are also included in the three-dimensional model output[2], however, no averaging is needed here and the output is on model levels.

Tier two model variables may not be observed at any site, but they allow for more process-based evaluation at some locations as well as for model inter-comparisons. Please use the variable names in Table 2; most are used in the CMIP experiments[3]. The ocean and sea-ice variables are also in this tier and variable names are updated to conform with SIMIP[4].

While the requested site-specific data primarily focus on atmospheric process studies at the observation supersites, additional sea ice and ocean output are also requested for some locations (Table 1). Please note that it is desirable to have the ocean and sea ice output on the atmospheric grid and the atmospheric model time-step frequency. In the presence of sea ice, the fluxes at surface should be partitioned over the sea ice and open ocean as done in the coupled model.

Please use the following convention for the naming of axes within the file. Please use 'lat', 'lon' (particularly if producing a cluster of points at each site) and 'time' as dimension names for each variable. For variables with a vertical dimension, use 'level' as the axis name in the atmosphere, 'olevel' for the ocean, 'snlevel' for snow and 'slevel' for soil (if snow or soil are multi-level). 'level' should contain integers with the highest number for the lowest model level (note that pressure and geopotential height should be provided as separate variables). 'olevel', 'slevel', and 'snlevel' should all be in meters.

Please prepare a supporting text document providing information on model vertical grid, if half levels are used please provide information on which variables that are reported on which grid. Also, provide model documentation and basic information on how diagnostics, such as 2m temperature, visibility and boundary-layer height, are calculated. Explain if and how surrounding grid points are chosen as well as which sites that data are provided for. Information on static parameters used in the land model, such as vegetation type, soil type, etc. for the sites would be of great value. For ocean points, please provide information on if/how the coupling to sea ice and ocean is performed and how the model output should be interpreted. Include relevant model references and the person responsible for the data along with contact information in the document.

The model output should be netcdf format, with one file per forecast named with *model* name, *site* and startdate/time in hour UTC, combined as *site_model-institution_lYYYYMMDDTT* (example sodankyla_ifs-ecmwf_2018020100). Include all model output variables using the *variable* names from Table 2. The heading of a sample netcdf file (a dump of the file heading) is provided for reference as Attachment. Transfer the files to Met Norway, where the supersite model output is hosted (contact Øystein Godøy, o.godoy@met.no). In order to initiate the upload process, please use the contact form at the YOPP data portal, https://yopp.met.no/contact. An issue tracker, to facilitate the upload

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[2]http://www.polarprediction.net/fileadmin/user_upload/www.polarprediction.net/Home/Organization/Task_Teams/Modelling_Task_Team/YOPP_common_model_output_v13.pdf

[3] https://cmip.llnl.gov/cmip5/data_description.html

[4] Notz, D., Jahn, A., Holland, M., Hunke, E., Massonnet, F., Stroeve, J., Tremblay, B., and Vancoppenolle, M.: The CMIP6 Sea-Ice Model Intercomparison Project (SIMIP): understanding sea ice through climate-model simulations, Geosci. Model Dev., 9, 3427-3446, https://doi.org/10.5194/gmd-9-3427-2016, 2016.

process, will soon be available. Push or pull can be used for automated file submission. In the case of pull by the YOPP Data Portal, an end point offering SSH and scp or rsync is required. If push is preferred, the provider has to ask the YOPP Data Portal for the end point to use for scp. In order to allow push, the provider has to provide the YOPP Data Portal with the SSH key to use and the IP address(es) the upload process will be initiated from. Conformance checking prior to initiating a push is available at https://yopp.met.no/dataset_validation/form. Data will be served through OPeNDAP from the YOPP Data Portal. This allows aggregation of physical files into a dataset for each location. Data can be accessed directly from self-developed software, R, Python, Matlab etc.

Table 2 Model site-specific output. Tier 2 variables are shaded.

Variable name as in CMIP	***Longer name***	***Unit***	***Notes***
Single Level fixed variables			
Sftlf	Land area fraction	%	If applicable, provide information on tiles, and how they are populated for the main model output and the surrounding locations. For each tile provide information on what type of soil and vegetation
Orog	Surface altitude	M	Provide information for the main grid output as well as for the surrounding locations, using the WGS84 CRS.
Lat	Latitude	degrees East	
Lon	Longitude	degrees North	
Atmospheric variables on model levels			
Zg	Geopotential height	m	Provide for both full and half levels if applicable
pfull	Pressure on full levels	Pa	
phalf	Pressure on half levels	Pa	
ua	Eastward wind component	m s^{-1}	
va	Northward wind component	m s^{-1}	
wap	Vertical large-scale wind in pressure coordinates	Pa s^{-1}	Omega, positive downwards
ta	Temperature	K	
tdps	Dew-point temperature	K	
hus	Specific humidity	kg kg^{-1}	
tnt	Tendency of air temperature	K s^{-1}	
tnta	Tendency of air temperature due to advection	K s^{-1}	
tus	Tendency of specific humidity	s^{-1}	
tusa	Tendency of specific humidity due to advection	s^{-1}	
tnmmutot	Tendency of eastward wind	m s^{-2}	
tnmmvtot	Tendency of northward wind	m s^{-2}	
rlu	Upward short-wave radiation	W m^{-2}	

rld	Downward short-wave radiation	W m^{-2}	
rsu	Upward long-wave radiation	W m^{-2}	
rsd	Downward long-wave radiation	W m^{-2}	
evu	Vertical eddy diffusivity coefficient for momentum due to parameterized turbulence	m^2 s^{-1}	
edt	Vertical eddy diffusion coefficient for temperature due to parameterized turbulence	m^2 s^{-1}	
wthv	Turbulent sensible heat flux based on virtual potential temperature	W m^{-2}	GCSS variable name
wqv	Turbulent moisture flux based on vapor content	W m^{-2}	GCSS variable name
uw	Eastward turbulent momentum flux	kg m^{-1} s^{-2}	GCSS variable name
vw	Northward turbulent momentum flux	kg m^{-1} s^{-2}	GCSS variable name
tke	Turbulent kinetic energy	m^2 s^{-2}	GCSS variable name
cl	Percentage cloud cover, including both large-scale and convective cloud	%	
clw	Mass fraction of cloud liquid water	kg kg^{-1}	
cli	Mass fraction of cloud ice	kg kg^{-1}	
Single Level atmospheric variables			
z0m	Surface roughness for momentum	m	No CMIP name
z0h	Surface roughness for heat	m	No CMIP name If a different value is used for moisture, please provide that as z0q
psl	Mean sea level pressure	Pa	
ps	Surface pressure	Pa	
uas	10 m eastward wind	m s^{-1}	
vas	10 m northward wind	m s^{-1}	
zmla	Height of Boundary Layer	m	Provide description on how it is calculated
tas	2m temperature	K	

tdps	2m dew point temperature	K	
huss	2m specific humidity	kg kg^{-1}	
pr	Total precipitation	kg m^{-2} s^{-1}	At surface, both liquid and rain
prsn	Snowfall flux	kg m^{-2} s^{-1}	At surface, all precipitation in solid phase
clt	Total cloud cover	%	
cod	Cloud optical thickness		
prw	Total column water vapour	kg m^{-2}	
clwvi	Total column liquid water	kg m^{-2}	
clivi	Total column icewater	kg m^{-2}	
vias	Horizontal visibility	m	No CMIP name, CF long name visibility_in_air
Surface and TOA variables			
snd	Surface snow thickness	m	
snc	Surface snow area fraction	%	
snw	Snow water equivalent	kg m^{-2}	
ts	Skin temperature	K	
tsns	Snow surface skin temperature	K	
tsnl	Snow temperature	K	Provide vertical grid if more than one layer (as snowlevel)
rhos	Snow density	kg m^{-3}	No CMIP name. Provide vertical grid if more than one layer
cnc	canopy area fraction	0-1	
tgs	Surface ground skin temperature	K	
tsl	Soil temperature profile	K	Provide vertical grid if more than one layer (as soillevel)
mrlsl	Soil moisture profile	kg m^{-2}	Provide vertical grid if more than one layer
rlut	Top-of-atmosphere outgoing long wave radiation	W m^{-2}	Follow the CF/CMIP convention that outgoing fluxes are positive upward
rsdt	Top-of-atmosphere incoming short-wave radiation	W m^{-2}	
rsut	Top-of-atmosphere outgoing short-wave radiation	W m^{-2}	
rsus	Upward surface short-wave radiation	W m^{-2}	Follow the CF/CMIP convention that outgoing fluxes are positive upward

rsds	Downward surface short-wave radiation	W m^{-2}	
rlus	Upward surface long-wave radiation	W m^{-2}	Follow the CF/CMIP convention that outgoing fluxes are positive upward
rlds	Downward surface long-wave radiation	W m^{-2}	
hfls	Surface turbulence latent heat flux	W m^{-2}	
hfss	Surface turbulence sensible heat flux	Wm^{-2}	
hfds	Surface downward heat flux	Wm^{-2}	Ground heat flux
hfdsn	Surface downward heat flux in snow	Wm^{-2}	
hfdsnb	Downward heat flux at snow botton	Wm^{-2}	
albs	Surface albedo	0-1	
albsn	snow and ice albedo	0-1	Albedo over snowcovered portion of gridcell
tauv	Time-average northward turbulence surface stress	N m^{-2}	
tauu	Time-average eastward turbulence surface stress	N m^{-2}	
For ocean locations only, reported on atmospheric grid			
Fixed ocean variables			
thkcello	Ocean model cell thickness	m	
Ocean variables on model levels			
to	Ocean temperature	K	
so	Sea water salinity		The units of salinity are dimensionless and the units attribute should normally be given as 1e-3 or 0.001 i.e. parts per thousand.
uo	Ocean u-velocity	m s^{-1}	
vo	Ocean v-velocity	m s^{-1}	
wo	Ocean w-velocity	m s^{-1}	
Ocean single level variables			
tos	Sea surface temperature	K	
mlotst	Ocean mixed-layer depth	m	Defined by sigma T
hfsso	Atmosphere-ocean sensible heat flux	W m^{-2}	
hflso	Atmosphere-ocean latent heat flux	W m^{-2}	

rsntds	Net downward shortwave radiation at sea water surface	W m^{-2}	
rlntds	Net downward longwave radiation at sea water surface	W m^{-2}	
wfo	Fresh water flux into sea water	kg m^{-2} s^{-1}	
fsitherm	Water flux into sea water due to sea ice thermodynamic	kg m^{-2} s^{-1}	
tauuo	Ocean surface x-stress	N m^{-2}	Surface downward x Stress
tauvo	Ocean surface y-stress	N m^{-2}	Surface downward y Stress
sigwave	Significant wave height	m	No CMIP name
Sea ice variables, report on atmospheric grid Quantities refer to the ice-covered fraction portion of the grid-cell only			
siconc	Sea ice concentration (area fraction)	%	Only report variables if siconc > 0
siitdconc	Sea-ice concentration (area fraction) in categories	0-1	
sithick	Sea ice thickness	m	
siitdthick	Sea-ice thickness in thickness categories		
sisnthick	Snow thickness on sea-ice	m	
siage	Sea-ice age	s	
siu	Sea ice u-velocity	m s^{-1}	
siv	Sea ice v-velocity	m s^{-1}	
sisali	Sea ice salinity	g kg^{-1}	
sistressave	Sea ice normal stress (pressure)	Pa	
sicompstren	Compressive sea ice strength	Pa m	
sitemptop	Surface temperature (temperature at atmosphere-cryosphere interface)	K	
sitempsnic	Temperature at snow-ice interface	K	
sitempbot	Temperature at ice-ocean interface	K	
sialb	Sea-ice / snow albedo	%	
siflsensupbot	Ocean-ice net sensible heat flux	W m^{-2}	

siflsenstop	Net upward sensible heat flux over sea ice	W m^{-2}	
sifllatstop	Net upward latent heat flux over sea ice	W m^{-2}	
siflswdtop	Downwelling shortwave flux over sea ice	W m^{-2}	
siflswutop	Upwelling shortwave flux over sea ice	W m^{-2}	
sifllwdtop	Downwelling longwave flux over sea ice	W m^{-2}	
sifllwutop	Upwelling longwave flux over sea ice	W m^{-2}	
siflcondtop	Net conductive heat flux in ice at the surface	W m^{-2}	
sipr	Rainfall rate over sea ice	kg m^{-2} s^{-1}	
ficonc	Fast ice concentration (area fraction)	0-1	Not in CMIP or CF
fithick	Fast ice thickness	m	Not in CMIP or CF
riconc	Ridged ice concentration (area fraction)	0-1	Not in CMIP or CF
rithick	Ridged ice thickness	m	Not in CMIP or CF

Attachment

```
netcdf sodankyla_ecmwf_ifs_2017050100 {
dimensions:
	time = UNLIMITED ; // (576 currently)
	lon = 1 ;
	lat = 1 ;
	level = 137 ;
	half_level = 138 ;
	soillevel = 4 ;
	tiles = 9 ;
variables:
	double lat(lat) ;
		lat:long_name = "latitude" ;
		lat:units = "degrees_north" ;
	double lon(lon) ;
		lon:long_name = "longitude" ;
		lon:units = "degrees_east" ;
	float time(time) ;
		time:long_name = "verification time" ;
		time:calendar = "standard" ;
		time:units = "hours since 2017-05-01 00:00:00" ;
	double soillevel(soillevel) ;
		soillevel:_FillValue = 9.96920996838687e+36 ;
	double zg(time, lat, lon, level) ;
		zg:long_name = "Geopotential height" ;
		zg:units = "m" ;
		zg:_FillValue = 9.96920996838687e+36 ;
	double pfull(time, lat, lon, level) ;
		pfull:long_name = "Pressure on full levels" ;
		pfull:units = "Pa" ;
		pfull:_FillValue = 9.96920996838687e+36 ;
	double ta(time, lat, lon, level) ;
		ta:long_name = "Temperature" ;
		ta:units = "K" ;
		ta:_FillValue = 9.96920996838687e+36 ;
	double ua(time, lat, lon, level) ;
		ua:long_name = "Eastward wind component" ;
		ua:units = "m/s" ;
		ua:_FillValue = 9.96920996838687e+36 ;
	double va(time, lat, lon, level) ;
		va:long_name = "Northward wind component" ;
		va:units = "m/s" ;
		va:_FillValue = 9.96920996838687e+36 ;
	double hus(time, lat, lon, level) ;
		hus:long_name = "Specific humidity" ;
		hus:units = "Kg/Kg" ;
		hus:_FillValue = 9.96920996838687e+36 ;
	double hur(time, lat, lon, level) ;
		hur:long_name = "Relative humidity" ;
		hur:units = "%" ;
		hur:_FillValue = 9.96920996838687e+36 ;
	double cl(time, lat, lon, level) ;
		cl:long_name = "Percentage cloud cover including both 
large-scale and convective cloud" ;
		cl:units = "%" ;
		cl:_FillValue = 9.96920996838687e+36 ;
	double clw(time, lat, lon, level) ;
		clw:long_name = "Mass fraction of cloud liquid water" ;
		clw:units = "kg/kg" ;
		clw:_FillValue = 9.96920996838687e+36 ;
	double cli(time, lat, lon, level) ;
		cli:long_name = "Mass fraction of cloud ice" ;
		cli:units = "kg/kg" ;
		cli:_FillValue = 9.96920996838687e+36 ;
	double rain(time, lat, lon, level) ;
		rain:_FillValue = 9.96920996838687e+36 ;
	double snow(time, lat, lon, level) ;
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```
            snow:_FillValue = 9.96920996838687e+36 ;
      double wap(time, lat, lon, level) ;
            wap:long_name = "Vertical large scale wind in pressure
coordinates" ;
            wap:units = "Pa/s" ;
            wap:_FillValue = 9.96920996838687e+36 ;
      double tnt(time, lat, lon, level) ;
            tnt:long_name = "Tendency of air temperature" ;
            tnt:units = "K/s" ;
            tnt:_FillValue = 9.96920996838687e+36 ;
      double tnhus(time, lat, lon, level) ;
            tnhus:long_name = "Tendency of specific humidity" ;
            tnhus:units = "s-1" ;
            tnhus:_FillValue = 9.96920996838687e+36 ;
      double tnmmutot(time, lat, lon, level) ;
            tnmmutot:long_name = "Tendency of eastward wind" ;
            tnmmutot:units = "m/s2" ;
            tnmmutot:_FillValue = 9.96920996838687e+36 ;
      double tnmmvtot(time, lat, lon, level) ;
            tnmmvtot:long_name = "Tendency of northward wind" ;
            tnmmvtot:units = "m/s2" ;
            tnmmvtot:_FillValue = 9.96920996838687e+36 ;
      double phalf(time, lat, lon, half_level) ;
            phalf:long_name = "Pressure on half levels" ;
            phalf:units = "Pa" ;
            phalf:_FillValue = 9.96920996838687e+36 ;
      double zghalf(time, lat, lon, half_level) ;
            zghalf:long_name = "Geopotential height on half
levels" ;
            zghalf:units = "m" ;
            zghalf:_FillValue = 9.96920996838687e+36 ;
      double uw(time, lat, lon, half_level) ;
            uw:long_name = "Eastward turbulent momentum flux" ;
            uw:units = "kg m-1 s-2" ;
            uw:_FillValue = 9.96920996838687e+36 ;
      double vw(time, lat, lon, half_level) ;
            vw:long_name = "Northward turbulent momentum flux" ;
            vw:units = "kg m-1 s-2" ;
            vw:_FillValue = 9.96920996838687e+36 ;
      double tsl(time, lat, lon, soillevel) ;
            tsl:long_name = "Soil temperature profile" ;
            tsl:units = "K" ;
            tsl:_FillValue = 9.96920996838687e+36 ;
      double mrlsl(time, lat, lon, soillevel) ;
            mrlsl:long_name = "Soil moisture profile" ;
            mrlsl:units = "kg m-2" ;
            mrlsl:_FillValue = 9.96920996838687e+36 ;
      double tile_frac(time, lat, lon, tiles) ;
            tile_frac:long_name = "Surface tile fraction" ;
            tile_frac:units =  ;
            tile_frac:_FillValue = 9.96920996838687e+36 ;
      double tile_ts(time, lat, lon, tiles) ;
            tile_ts:long_name = "Skin temperature per tile" ;
            tile_ts:units = "K" ;
            tile_ts:_FillValue = 9.96920996838687e+36 ;
      double tile_albs(time, lat, lon, tiles) ;
            tile_albs:long_name = "Surface albedo on tiles" ;
            tile_albs:units =  ;
            tile_albs:_FillValue = 9.96920996838687e+36 ;
      double rsds(time, lat, lon) ;
            rsds:long_name = "Downward surface short-wave
radiation" ;
            rsds:units = "Wm-2" ;
            rsds:_FillValue = 9.96920996838687e+36 ;
      double rlds(time, lat, lon) ;
            rlds:long_name = "Downward surface long-wave
radiation" ;
            rlds:units = "Wm-2" ;
            rlds:_FillValue = 9.96920996838687e+36 ;
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```
	double rsus(time, lat, lon) ;
		rsus:long_name = "Upward surface short-wave radiation" ;
		rsus:units = "Wm-2" ;
		rsus:_FillValue = 9.96920996838687e+36 ;
	double rlus(time, lat, lon) ;
		rlus:long_name = "Upward surface long-wave radiation" ;
		rlus:units = "Wm-2" ;
		rlus:_FillValue = 9.96920996838687e+36 ;
	double hfls(time, lat, lon) ;
		hfls:long_name = "Surface turbulence latent heat flux" ;
		hfls:units = "Wm-2" ;
		hfls:_FillValue = 9.96920996838687e+36 ;
	double hfss(time, lat, lon) ;
		hfss:long_name = "Surface turbulent sensible heat
flux" ;
		hfss:units = "Wm-2" ;
		hfss:_FillValue = 9.96920996838687e+36 ;
	double rlut(time, lat, lon) ;
		rlut:long_name = "Top of atmosphere outgoing long-wave
radiation" ;
		rlut:units = "Wm-2" ;
		rlut:_FillValue = 9.96920996838687e+36 ;
	double rsdt(time, lat, lon) ;
		rsdt:long_name = "Top of atmosphere incoming short-wave
radiation" ;
		rsdt:units = "Wm-2" ;
		rsdt:_FillValue = 9.96920996838687e+36 ;
	double rsut(time, lat, lon) ;
		rsut:long_name = "Top of atmosphere outgoing short-wave
radiation" ;
		rsut:units = "Wm-2" ;
		rsut:_FillValue = 9.96920996838687e+36 ;
	double pr(time, lat, lon) ;
		pr:long_name = "Total precipitation" ;
		pr:units = "kg m-2 s-1" ;
		pr:_FillValue = 9.96920996838687e+36 ;
	double prsn(time, lat, lon) ;
		prsn:long_name = "Snowfall flux" ;
		prsn:units = "kg m-2 s-1" ;
		prsn:_FillValue = 9.96920996838687e+36 ;
	double clt(time, lat, lon) ;
		clt:long_name = "Total cloud Cover" ;
		clt:units = "%" ;
		clt:_FillValue = 9.96920996838687e+36 ;
	double zmla(time, lat, lon) ;
		zmla:long_name = "Height of boundary layer" ;
		zmla:units = "m" ;
		zmla:_FillValue = 9.96920996838687e+36 ;
	double tas(time, lat, lon) ;
		tas:long_name = "2m temperature" ;
		tas:units = "K" ;
		tas:_FillValue = 9.96920996838687e+36 ;
	double ts(time, lat, lon) ;
		ts:long_name = "Skin temperature" ;
		ts:units = "K" ;
		ts:_FillValue = 9.96920996838687e+36 ;
	double huss(time, lat, lon) ;
		huss:long_name = "2m specific humidity" ;
		huss:units = "kg kg-1" ;
		huss:_FillValue = 9.96920996838687e+36 ;
	double uas(time, lat, lon) ;
		uas:long_name = "10m eastward wind" ;
		uas:units = "m s-1" ;
		uas:_FillValue = 9.96920996838687e+36 ;
	double vas(time, lat, lon) ;
		vas:long_name = "10m northward wind" ;
		vas:units = "m s-1" ;
		vas:_FillValue = 9.96920996838687e+36 ;
	double tauu(time, lat, lon) ;
```

```
		tauu:long_name = "Time-averaged eastward turbulence surface stress" ;
		tauu:units = "N m-1" ;
		tauu:_FillValue = 9.96920996838687e+36 ;
	double tauv(time, lat, lon) ;
		tauv:long_name = "Time-averaged northward turbulence surface stress" ;
		tauv:units = "N m-1" ;
		tauv:_FillValue = 9.96920996838687e+36 ;
	double orog(time, lat, lon) ;
		orog:long_name = "Surface altitude" ;
		orog:units = "m" ;
		orog:_FillValue = 9.96920996838687e+36 ;
	double ps(time, lat, lon) ;
		ps:long_name = "Surface Pressure" ;
		ps:units = "Pa" ;
		ps:_FillValue = 9.96920996838687e+36 ;
	double tsn(time, lat, lon) ;
		tsn:long_name = "Snow temperature profile" ;
		tsn:units = "K" ;
		tsn:_FillValue = 9.96920996838687e+36 ;
	double snd(time, lat, lon) ;
		snd:long_name = "Surface snow thickness" ;
		snd:units = "m" ;
		snd:_FillValue = 9.96920996838687e+36 ;
	double rhos(time, lat, lon) ;
		rhos:long_name = "Snow density" ;
		rhos:units = "kg m-3" ;
		rhos:_FillValue = 9.96920996838687e+36 ;
	double albsn(time, lat, lon) ;
		albsn:long_name = "Snow and ice albedo" ;
		albsn:units =  ;
		albsn:_FillValue = 9.96920996838687e+36 ;
	double snw(time, lat, lon) ;
		snw:long_name = "Snow water equivalent" ;
		snw:units = "kg m-2" ;
		snw:_FillValue = 9.96920996838687e+36 ;
	double hfdsnb(time, lat, lon) ;
		hfdsnb:long_name = "Downward heat flux at snow bottom" ;
		hfdsnb:units = "W m-2" ;
		hfdsnb:_FillValue = 9.96920996838687e+36 ;
	double snc(time, lat, lon) ;
		snc:long_name = "Surface snow area fraction" ;
		snc:units = "%" ;
		snc:_FillValue = 9.96920996838687e+36 ;

// global attributes:
		:creation_date = "Thu  5 Jul 12:07:29 BST 2018" ;
}
```