Required EUREC4A Large Eddy Model Output

March 15, 2024

Output data are required for the the whole $500 \times 300\,\mathrm{km}^2$ domain. Unless stated otherwise hourly data is required. Below you find the list of the data we would like to receive. If not all the data can be delivered, we would also welcome a subset of the required fields and fluxes.

Domain averaged profiles and scalars

Table 1 contains domain averaged profiles while Table 2 lists domain averaged surface, vertical integrated scalars and top of the atmosphere (TOA) fluxes and top of the model (TOM) fluxes. Top of the model (TOM) fluxes have been included because most Large Eddy Models have their highest model level still much lower than the top of the atmosphere.

Table 1: required Domain averaged hourly profiles (z,t) (60 min interval).

Variable Name	Description	Range	Notation	Units
ta_avg	air temperature profile	inst.	$\overline{T}$	K
ua_avg	eastward wind profile	inst.	$\overline{u}$	$\mathrm{m\,s^{-1}}$
va_avg	northward wind profile	inst.	$\overline{v}$	$\mathrm{m\,s^{-1}}$
hus_avg	specific humidity profile	inst.	$\overline{q}_{\mathrm{v}}$	$\mathrm{kg\,kg^{-1}}$
hur_avg	relative humidity profile	inst.	$\overline{RH}$	%
clw_avg	specific liquid water profile	inst.	$\overline{q}_{\mathrm{l}}$	$\mathrm{kg\,kg^{-1}}$
cli_avg	specific ice water profile	inst.	$\overline{q}_{\mathrm{i}}$	$\mathrm{kg\,kg^{-1}}$
plw_avg	rain water profile	inst.	$\overline{q}_{\mathrm{r,l}}$	$\mathrm{kg\,kg^{-1}}$
pli_avg	rain ice profile	inst.	$\overline{q}_{\mathrm{r,i}}$	$\mathrm{kg\,kg^{-1}}$
pres_avg	pressure	inst.	$\overline{P}$	hPa
tntrs_avg	shortwave radiative heating profile	inst.	$\overline{H}_{\mathrm{rad,sw}}$	$\mathrm{K\,s^{-1}}$
tntrl_avg	longwave radiative heating profile	inst.	$\overline{H}_{\mathrm{rad,lw}}$	$\mathrm{K\,s^{-1}}$
tntrscs_avg	shortwave radiative heating profile - clear sky	inst.	$\overline{H}_{\mathrm{rad,sw,cls}}$	$\mathrm{K\,s^{-1}}$
tntrlcs_avg	longwave radiative heating profile - clear sky	inst.	$\overline{H}_{\mathrm{rad,lw,cls}}$	$\mathrm{K\,s^{-1}}$
cldfrac_avg	global cloud fraction profile	inst.	$\overline{CF}$	%

Table 2: required 1D hourly domain averaged values (t) (5 min interval).

Variable Name	Description	Range	Notation	Units
pr_avg	surface precipitation rate	av.	$\overline{R}$	$\mathrm{kg\,m^{-2}\,s^{-1}}$
hfls_avg	surface upward latent heat flux	av	$\rho L_v \overline{w'q'_{\mathrm{v}}}_{\mathrm{srf}}$	$\mathrm{W\,m^{-2}}$
hfss_avg	surface upward sensible heat flux	av	$\rho c_p \overline{w'T'}_{\mathrm{srf}}$	$\mathrm{W\,m^{-2}}$
prw_avg	water vapor path	inst.	$\int q_{\mathrm{v}} \rho dz$	$\mathrm{kg\,m^{-2}}$
clwvi_avg	condensed water path	inst.	$\int q_{\mathrm{c}} \rho dz$	$\mathrm{kg\,m^{-2}}$
clivi_avg	ice water path	inst.	$\int q_{\mathrm{i}} \rho dz$	$\mathrm{kg\,m^{-2}}$
spwr_avg	saturated water vapor path	inst.	$\int q_{\mathrm{s}} \rho dz$	$\mathrm{kg\,m^{-2}}$
rlds_avg	surface downwelling longwave flux	av	$F_{\mathrm{rad,s,lw,dwn}}$	$\mathrm{W\,m^{-2}}$
rlus_avg	surface upwelling longwave flux	av	$F_{\mathrm{rad,s,lw,up}}$	$\mathrm{W\,m^{-2}}$
rsds_avg	surface downwelling shortwave flux	av	$F_{\mathrm{rad,s,sw,dwn}}$	$\mathrm{W\,m^{-2}}$
rsus_avg	surface upwelling shortwave flux	av	$F_{\mathrm{rad,s,sw,up}}$	$\mathrm{W\,m^{-2}}$
rsdscs_avg	surface downwelling shortwave flux - clear sky	av	$F_{\mathrm{rad,s,sw,dwn,cls}}$	$\mathrm{W\,m^{-2}}$
rsuscs_avg	surface upwelling shortwave flux - clear sky	av	$F_{\mathrm{rad,s,sw,up,cls}}$	$\mathrm{W\,m^{-2}}$
rldscs_avg	surface downwelling longwave flux - clear sky	av	$F_{\mathrm{rad,s,lw,dwn,cls}}$	$\mathrm{W\,m^{-2}}$
rluscs_avg	surface upwelling longwave flux - clear sky	av	$F_{\mathrm{rad,s,lw,up,cls}}$	$\mathrm{W\,m^{-2}}$
rsdt_avg	TOA incoming shortwave flux	av	$F_{\mathrm{rad,toa,sw,in}}$	$\mathrm{W\,m^{-2}}$
rsut_avg	TOA outgoing shortwave flux	av	$F_{\mathrm{rad,toa,sw,out}}$	$\mathrm{W\,m^{-2}}$
rlut_avg	TOA outgoing longwave flux	av	$F_{\mathrm{rad,toa,lw,out}}$	$\mathrm{W\,m^{-2}}$
rsutcs_avg	TOA outgoing shortwave flux -clear sky	av	$F_{\mathrm{rad,toa,sw,out.cls}}$	$\mathrm{W\,m^{-2}}$
rlutcs_avg	TOA outgoing longwave flux -clear sky	av	$F_{\mathrm{rad,toa,lw,out.cls}}$	$\mathrm{W\,m^{-2}}$
rsdtm_avg	TOM incoming shortwave flux	av	$F_{\mathrm{rad,tom,sw,in}}$	$\mathrm{W\,m^{-2}}$
rsutm_avg	TOM outgoing shortwave flux	av	$F_{\mathrm{rad,tom,sw,out}}$	$\mathrm{W\,m^{-2}}$
rlutm_avg	TOM outgoing longwave flux	av	$F_{\mathrm{rad,tom,lw,out}}$	$\mathrm{W\,m^{-2}}$
rsutmcs_avg	TOM outgoing shortwave flux -clear sky	av	$F_{\mathrm{rad,tom,sw,out.cls}}$	$\mathrm{W\,m^{-2}}$
rlutmcs_avg	TOM outgoing longwave flux -clear sky	av	$F_{\mathrm{rad,tom,lw,out.cls}}$	$\mathrm{W\,m^{-2}}$

2D Fields

Table 3 contains the 2D Surface and TOA fields. These are largely the same fields as required in Table 2, but this time for each horizontal gridpoint so that the horizontal variability of all these variables can be assessed at a hourly basis. As a rule of thumb it is preferred that instantaneous values for the fields are sufficient while hourly averaged values for the fluxes are preferred as these show significantly variability at subhourly timescales (see Table 3). If averaged values are not possible, then please provide instantanous values but please do indicate that you have done so.

Table 3: required 2D Surface, TOM and TOA Output Variables (60 min interval).

Variable Name	Description	Units	Range	Height	Notation
psl	sea level pressure	Pa	inst.	0 m	P_{s}
sst	Sea Surface Temperature	K	inst.	0 m	T_{s}
hfss	Surface Sensible Heat flux	$\mathrm{W\,m^{-2}}$	av	0 m	$\rho c_p \overline{w'T'}_{\mathrm{s}}$
hfls	Surface Latent Heat flux	$\mathrm{W\,m^{-2}}$	av	0 m	$\rho L_v \overline{w'q'_v}_{\mathrm{s}}$
ewss	Eastward surface stress	$\mathrm{kg\,m^{-1}\,s^{-2}}$	av	0 m	$\rho\overline{u'w'}_{\mathrm{s}}$
nsss	Northward surface stress	$\mathrm{kg\,m^{-1}\,s^{-2}}$	av	0 m	$\rho\overline{v'w'}_{\mathrm{s}}$
rlds	Surface downwelling longwave flux	$\mathrm{W\,m^{-2}}$	av	0 m	$F_{\mathrm{rad,s,lw,dwn}}$
rlus	Surface upwelling longwave flux	$\mathrm{W\,m^{-2}}$	av	0 m	$F_{\mathrm{rad,s,lw,up}}$
rsds	Surface downwelling shortwave flux	$\mathrm{W\,m^{-2}}$	av	0 m	$F_{\mathrm{rad,s,sw,dwn}}$
rsus	Surface upwelling shortwave flux	$\mathrm{W\,m^{-2}}$	av	0 m	$F_{\mathrm{rad,s,sw,up}}$
rsdscs	Surface downwelling shortwave flux - clear sky	$\mathrm{W\,m^{-2}}$	av	0 m	$F_{\mathrm{rad,s,sw,dwn,cls}}$
rsuscs	Surface upwelling shortwave flux - clear sky	$\mathrm{W\,m^{-2}}$	av	0 m	$F_{\mathrm{rad,s,sw,up,cls}}$
rldscs	Surface downwelling longwave flux - clear sky	$\mathrm{W\,m^{-2}}$	av	0 m	$F_{\mathrm{rad,s,lw,dwn,cls}}$
rluscs	Surface upwelling longwave flux - clear sky	$\mathrm{W\,m^{-2}}$	av	0 m	$F_{\mathrm{rad,s,lw,up,cls}}$
rsdt	TOA incoming shortwave flux	$\mathrm{W\,m^{-2}}$	av	TOA	$F_{\mathrm{rad,toa,sw,in,}}$
rsut	TOA outgoing shortwave flux	$\mathrm{W\,m^{-2}}$	av	TOA	$F_{\mathrm{rad,toa,sw,out,}}$
rlut	TOA outgoing longwave flux	$\mathrm{W\,m^{-2}}$	av	TOA	$F_{\mathrm{rad,toa,lw,out,}}$
rsutcs	TOA outgoing shortwave flux - clear sky	$\mathrm{W\,m^{-2}}$	av	TOA	$F_{\mathrm{rad,toa,sw,out,cls}}$
rlutcs	TOA outgoing longwave flux - clear sky	$\mathrm{W\,m^{-2}}$	av	TOA	$F_{\mathrm{rad,toa,lw,out,cls}}$
rsdtm	TOM incoming shortwave flux	$\mathrm{W\,m^{-2}}$	av	TOM	$F_{\mathrm{rad,tom,sw,in,}}$
rsutm	TOM outgoing shortwave flux	$\mathrm{W\,m^{-2}}$	av	TOM	$F_{\mathrm{rad,tom,sw,out,}}$
rlutm	TOM outgoing longwave flux	$\mathrm{W\,m^{-2}}$	av	TOM	$F_{\mathrm{rad,tom,lw,out,}}$
rsutmcs	TOM outgoing shortwave flux - clear sky	$\mathrm{W\,m^{-2}}$	av	TOM	$F_{\mathrm{rad,tom,sw,out,cls}}$
rlutmcs	TOM outgoing longwave flux - clear sky	$\mathrm{W\,m^{-2}}$	av	TOM	$F_{\mathrm{rad,tom,lw,out,cls}}$

Table 4 contains vertical integrated values of cloud and humidity related properties and some near surface fields. Since we are interested in the spatio-temporal development of these variables these 2D fields are requested every 5 minutes. To determine low cloud fraction use all levels below 3km, for midlevel cloud fraction all leveles between 3 and 5 km, and for high cloud fraction all model levels beyond 5 km.

Table 4: required 2D high temporal resolution output Variables (5 min interval).

Short Name	Long Name	Units	Range	Notation
tcc	Total Cloud Cover	$[0 \ldots 1]$	inst.	
lcc	Low Cloud Cover	$[0 \ldots 1]$	inst.	cloud cover below 680 hP
hcc	High Cloud Cover	$[0 \ldots 1]$	inst.	cloud cover above 680 hP
prw	water vapor path	$\mathrm{kg\,m^{-2}}$	inst.	$\int q_\mathrm{v}\rho\,\mathrm{d}z$
clwvi	condensed water path	$\mathrm{kg\,m^{-2}}$	inst.	$\int q_\mathrm{c}\rho\,\mathrm{d}z$
clivi	ice water path	$\mathrm{kg\,m^{-2}}$	inst.	$\int q_\mathrm{i}\rho\,\mathrm{d}z$
rwp	rain water path	$\mathrm{kg\,m^{-2}}$	inst.	$\int q_\mathrm{r}\rho\,\mathrm{d}z$
CAPE	Conditional Available Potential Energy	$\mathrm{m^2 s^{-2}}$	inst.	CAPE
u10m	10 m eastward wind	$\mathrm{m\,s^{-1}}$	inst.	u_10m
v10m	10 m northward wind	$\mathrm{m\,s^{-1}}$	inst.	v_10m
t10m	10 m temperature	K	inst.	T_10m
q10m	10 m specific humidity	$\mathrm{kg\,kg^{-1}}$	inst.	q_10m
zml	Mixed layer height	m	inst.	z_ML
pr	Surface precipitation	$\mathrm{kg\,m^{-2}\,s^{-1}}$	av	R_s

2D fields at designated heights

Table 5 contains a number of essential fields at designated heights: the middle of the subcloud layer, near cloud base height, near cloud top height, just above cloud top height and the middle of the troposphere.

Table 5: required 2D fields at specified levels (60 min interval)

Short Name	Long Name	Units	Range	Levels
u2d	zonal component wind	$\mathrm{m\,s^{-1}}$	inst.	400, 1000, 1500, 3000, 5000 m
v2d	meridional component wind	$\mathrm{m\,s^{-1}}$	inst.	400, 1000, 1500, 3000, 5000 m
t2d	temperature	K	inst.	400, 1000, 1500, 3000, 5000 m
q2d	specific humidity	$\mathrm{kg\,kg^{-1}}$	inst.	400, 1000, 1500, 3000, 5000 m
w2d	vertical velocity	m/per/second	inst.	400, 1000, 1500, 3000, 5000 m
ql2d	liquid water	$\mathrm{kg\,kg^{-1}}$	inst.	400, 1000, 1500 m
r2d ...	rain water	$\mathrm{kg\,kg^{-1}}$	inst.	400, 1000, 1500 m
rh2d ...	relative humidity	[...]	inst.	400, 1000, 1500 m

High resolution Profiles

For models that can flexibly write high-frequency grid-point output, we request vertical profiles at a 5-minute frequency of the variables listed in Table 6, within a square of 10 x 10 km2 around the centre of the EUREC4A circle (centre at 57.72 W ,13.30 N) .

Table 6: required high frequency profile output at the EUREC4A circle (5 min interval)

Short Name	Long Name	Units	Range
u	zonal component wind	$m\,s^{-1}$	inst.
v	meridional component wind	$m\,s^{-1}$	inst.
t	temperature	K	inst.
q	specific humidity	$kg\,kg^{-1}$	inst.
w	vertical velocity	$m\,s^{-1}$	inst.
clwc	liquid water	$kg\,kg^{-1}$	inst.

3D Output

Storage of some 3d fields is desirable but also requires enormous storage capacities and is not easy to handle. We therefore propose to output the 3d fields of the variables listed in table 7 for the operational horizontal domain at a 6 hourly output frequency

Table 7: Required 3d Output fields at a 6 hourly frequency

Short Name	Long Name	Units	Range
u3d	zonal component wind	$m\,s^{-1}$	inst.
v3d	meridional component wind	$m\,s^{-1}$	inst.
t3d	temperature	K	inst.
q3d	specific humidity	$kg\,kg^{-1}$	inst.
w3d	vertical velocity	$m\,s^{-1}$	inst.
clwc3d	liquid water	$kg\,kg^{-1}$	inst.