Online turbulent diagnostics

MNH-V6-0-0 version
with
SURFEX 9.0+
PHYEX 0.7.0

December 11, 2025

Contents

1 Notations

α'	subgrid fluctuation of α	
$\overline{\alpha}$	mean value of α in the grid: resolved quantity	3D
$< \alpha >$	horizontal mean value of α	1D
$\tilde{\alpha} = \overline{\alpha} - < \alpha >$	resolved fluctuation to the mean profile	3D
$< \alpha >_{up}$	horizontal mean value of α in updrafts; only point with $\overline{w}$ greater than $< w >$ are considered	1D
$< \alpha >_{down}$	horizontal mean value of α in downdrafts; only point with $\overline{w}$ smaller than $< w >$ are considered	1D

Examples:

$\alpha'\beta'$		subgrid flux or (co)variance $\alpha'\beta'$	3D
$\overline{\alpha}$		mean value of α in each grid mesh	3D
$\overline{\alpha'}$	$= 0$	mean value of the turbulent fluctuation in each grid mesh	3D
$\overline{\alpha'\beta'}$		mean value in each grid mesh of subgrid flux or (co)variance	3D
$\tilde{\alpha}\tilde{\beta}$		resolved flux or (co)variance in each grid mesh	3D
$< \alpha >$		horizontal mean value of α	1D
$< \alpha' >$	$= 0$	horizontal mean value of a subgrid fluctuation	1D
$< \overline{\alpha} >$	$=< \alpha >$	horizontal mean value of a resolved field	1D
$< \tilde{\alpha} >$	$= 0$	horizontal mean value of a resolved fluctuation	1D
$< \overline{\alpha'\beta'} >$		horizontal mean value of subgrid flux or (co)variance	1D
$< \tilde{\alpha}\tilde{\beta} >$		horizontal mean value of resolved flux or (co)variance	1D

2 What is available

The computed fields have usually at least two dimensions: z and t, that is they are temporal evolutions of vertical profiles. They are always written in the diachronic file. Each field has its own fieldname, say 'NAME'.

When time averaging is asked for, the fields are temporally averaged (and so lose their temporal dimension).

When normalization is asked for, this operation is made independently on each vertical profile, for all times.

When both normalization and time averaging are asked for, normalization is made first, and then time averaging.

3 LES averaged fields (LLES_MEAN=TRUE)

Field	Notation in the diachronic file	Dims	If	Comments
$< u >$	MEAN_U	z,t,p		Mean U

Field	Notation in the diachronic file	Dims	If	Comments
$< v >$	MEAN_V	z,t,p		Mean V
$< w >$	MEAN_W	z,t,p		Mean W
$< p >$	MEAN_PRE	z,t,p		Mean pressure
$< dp >$	MEAN_DP	z,t,p		Mean Dyn production TKE
$< tp >$	MEAN_TP	z,t,p		Mean Thermal production TKE
$< tr >$	MEAN_TR	z,t,p		Mean transport production TKE
$< diss >$	MEAN_DISS	z,t,p		Mean Dissipation TKE
$< lm >$	MEAN_LM	z,t,p		Mean mixing length
$< \rho >$	MEAN_RHO	z,t,p		Mean density
$< \theta >$	MEAN_TH	z,t,p		Mean potential temperature
$< Mf >$	MEAN_MF	z,t,p		Mass-flux
$< \theta_l >$	MEAN_THL	z,t,p	r_c	Mean liquid potential temperature
$< \theta_v >$	MEAN_THV	z,t,p	r_v	Mean virtual potential temperature
$< Rt >$	MEAN_RT	z,t,p	r_v	Mean Rt (total water)
$< RH >$	MEAN_REHU	z,t,p	r_v	Mean Rh
$< Qs >$	MEAN_QS	z,t,p	r_v	Mean Qs
$< Kh\ for\ \theta >$	MEAN_KHT	z,t,p	r_c	Eddy-diffusivity (temperature)
$< Kh\ for\ qr >$	MEAN_KHR	z,t,p	r_c	Eddy-diffusivity (vapor)
$< r_v >$	MEAN_RV	z,t,p	r_v	Mean Rv
$< r_c >$	MEAN_RC	z,t,p	r_c	Mean Rc
$< r_r >$	MEAN_RR	z,t,p	r_r	Mean Rr
$< r_i >$	MEAN_RI	z,t,p	r_i	Mean Ri
$< r_s >$	MEAN_RS	z,t,p	r_s	Mean Rs
$< r_g >$	MEAN_RG	z,t,p	r_g	Mean Rg
$< r_h >$	MEAN_RH	z,t,p	r_h	Mean Rh
$< CLDFR >$	MEAN_CF	z,t,p	r_c	Mean Cf Profile
$< INDCf >$	MEAN_INDCF	z,t,p	r_c	Mean Cf>1-6 Profile (0 or 1)

Field	Notation in the diachronic file	Dims	If	Comments
$< INDCf2 >$	MEAN_INDCF2	z,t,p	r_c	Mean Cf>1-5 Profile (0 or 1)
$< RAINFR >$	MEAN_RF	z,t,p	r_r	Mean RF
$< s_v >$	MEAN_SV	z,t,p,n	s_v	Mean Sv
$< \sqrt{\overline{u}^2 + \overline{v}^2} >$	MEANWIND	z,t,p		Mean Modulus of Wind (different from $\sqrt{< \overline{u} >^2 + < \overline{v} >^2}$)
$< \overline{\rho} \max(\overline{w}, < w >) >$	MEANMSFX	z,t,p		Total updraft mass flux

Notes: dimension p is equal to the number of masks. When this dimension is not present, the computation is made only on the cartesian mask. Dimension n corresponds to the number of scalar variables.

4 LES pdf (LLES_PDF=TRUE)

Field	Notation in the diachronic file	Dims	If	Comments
PDF_θ	PDF_TH	z,t,p,n		Pdf potential temperature
PDF_W	PDF_W	z,t,p,n		Pdf vertical velocity
PDF_θ_v	PDF_THV	z,t,p,n		Pdf virtual potential temperature
PDF_R_v	PDF_RV	z,t,p,n		Pdf Rv
PDF_R_c	PDF_RC	z,t,p,n		Pdf Rc
PDF_R_t	PDF_RT	z,t,p,n		Pdf Rt
PDF_θ_l	PDF_THL	z,t,p,n		Pdf Thl
PDF_R_r	PDF_RR	z,t,p,n		Pdf Rr
PDF_R_i	PDF_RI	z,t,p,n		Pdf Ri
PDF_R_s	PDF_RS	z,t,p,n		Pdf Rs
PDF_R_g	PDF_RG	z,t,p,n		Pdf Rg

Notes: dimension p is equal to the number of masks. When this dimension is not present, the computation is made only on the cartesian mask. Dimension n corresponds to the number of PDF intervals.

5 LES averaged fields (LLES_RESOLVED=TRUE)

Field	Notation in the diachronic file	Dims	If	Comments
$< \tilde{u}^2 >$	RES_U2	z,t,p		Resolved <u2> variance
$< \tilde{v}^2 >$	RES_V2	z,t,p		Resolved <v2> variance
$< \tilde{w}^2 >$	RES_W2	z,t,p		Resolved <w2> variance
$< \tilde{u}\, \tilde{v} >$	RES_UV	z,t,p		Resolved <uv> Flux
$< \tilde{w}\, \tilde{u} >$	RES_WU	z,t,p		Resolved <wu> Flux
$< \tilde{w}\, \tilde{v} >$	RES_WV	z,t,p		Resolved <wv> Flux
$< \frac{1}{2}(\tilde{u}^2 + \tilde{v}^2 + \tilde{w}^2) >$	RES_KE	z,t,p		Resolved TKE Profile
$< \tilde{p}^2 >$	RES_P2	z,t,p		Resolved pressure variance
$< \tilde{u}\frac{\partial \tilde{p}}{\partial z} >$	RES_UPZ	z,t,p		Resolved <up> horizontal Flux
$< \tilde{v}\frac{\partial \tilde{p}}{\partial z} >$	RES_VPZ	z,t,p		Resolved <vp> horizontal Flux
$< \tilde{w}\frac{\partial \tilde{p}}{\partial z} >$	RES_WPZ	z,t,p		Resolved <wp> vertical Flux
$< \tilde{\theta}\, \tilde{\theta}_v >$	RES_THTV	z,t,p	r_v	Resolved potential temperature - virtual potential temperature covariance
$< \tilde{\theta}_l\, \tilde{\theta}_v >$	RES_TLTV	z,t,p	r_c	Resolved liquid potential temperature - virtual potential temperature covariance
$< \tilde{\theta}^2 >$	RES_TH2	z,t,p		Resolved potential temperature variance
$< \tilde{\theta_l}^2 >$	RES_THL2	z,t,p	r_c	Resolved liquid potential temperature variance
$< \tilde{u}\tilde{\theta} >$	RES_UTH	z,t,p		Resolved <uth> horizontal Flux
$< \tilde{v}\tilde{\theta} >$	RES_VTH	z,t,p		Resolved <vth> horizontal Flux
$< \tilde{w}\tilde{\theta} >$	RES_WTH	z,t,p		Resolved <wth> vertical Flux
$< \tilde{u}\tilde{\theta}_l >$	RES_UTHL	z,t,p	r_c	Resolved <uthl> horizontal Flux
$< \tilde{v}\tilde{\theta}_l >$	RES_VTHL	z,t,p	r_c	Resolved <vthl> horizontal Flux
Warning: contains both turbulent and gravity wave fields				

Field	Notation in the diachronic file	Dims	If	Comments
$< \tilde{w}\tilde{\theta}_l >$	RES_WTHL	z,t,p	r_c	Resolved <wthl> vertical Flux
$< \tilde{r_t}^2 >$	RES_RT2	z,t,p	r_c	Resolved total water variance
$< \tilde{w}\tilde{r}_t >$	RES_WRT	z,t,p	r_c	Resolved <wrt> vertical Flux
$< \tilde{u}\tilde{\theta}_v >$	RES_UTHV	z,t,p	r_v	Resolved <uthv> horizontal Flux
$< \tilde{v}\tilde{\theta}_v >$	RES_VTHV	z,t,p	r_v	Resolved <vthv> horizontal Flux
$< \tilde{w}\tilde{\theta}_v >$	RES_WTHV	z,t,p	r_v	Resolved <wthv> vertical Flux
$< \tilde{r_v}^2 >$	RES_RV2	z,t,p	r_v	Resolved water vapor variance
$< \tilde{\theta}\tilde{r}_v >$	RES_THRV	z,t,p	r_v	Resolved <thrv> covariance
$< \tilde{\theta}_l\tilde{r}_v >$	RES_TLRV	z,t,p	r_v, r_c	Resolved <thlrv> covariance
$< \tilde{\theta}_v\tilde{r}_v >$	RES_TVRV	z,t,p	r_v	Resolved <thvrv> covariance
$< \tilde{u}\tilde{r}_v >$	RES_URV	z,t,p	r_v	Resolved <urv> horizontal flux
$< \tilde{v}\tilde{r}_v >$	RES_VRV	z,t,p	r_v	Resolved <vrv> horizontal flux
$< \tilde{w}\tilde{r}_v >$	RES_WRV	z,t,p	r_v	Resolved <wrv> vertical flux
$< \tilde{r_c}^2 >$	RES_RC2	z,t,p	r_c	Resolved cloud water variance
$< \tilde{\theta}\tilde{r}_c >$	RES_THRC	z,t,p	r_c	Resolved <thrc> covariance
$< \tilde{\theta}_l\tilde{r}_c >$	RES_TLRC	z,t,p	r_c	Resolved <thlrc> covariance
$< \tilde{\theta}_v\tilde{r}_c >$	RES_TVRC	z,t,p	r_c	Resolved <thvrc> covariance
$< \tilde{u}\tilde{r}_c >$	RES_URC	z,t,p	r_c	Resolved <urc> horizontal flux
$< \tilde{v}\tilde{r}_c >$	RES_VRC	z,t,p	r_c	Resolved <vrc> horizontal flux
$< \tilde{w}\tilde{r}_c >$	RES_WRC	z,t,p	r_c	Resolved <wrc> vertical flux
$< \tilde{r_i}^2 >$	RES_RI2	z,t,p	r_i	Resolved cloud ice variance
$< \tilde{\theta}\tilde{r}_i >$	RES_THRI	z,t,p	r_i	Resolved <thri> covariance
$< \tilde{\theta}_l\tilde{r}_i >$	RES_TLRI	z,t,p	r_i	Resolved <thlri> covariance
$< \tilde{\theta}_v\tilde{r}_i >$	RES_TVRI	z,t,p	r_i	Resolved <thvri> covariance
$< \tilde{u}\tilde{r}_i >$	RES_URI	z,t,p	r_i	Resolved <uri> horizontal flux
$< \tilde{v}\tilde{r}_i >$	RES_VRI	z,t,p	r_i	Resolved <vri> horizontal flux
Warning: contains both turbulent and gravity wave fields				

Field	Notation in the diachronic file	Dims	If	Comments
$< \tilde{w}\tilde{r_i} >$	RES_WRI	z,t,p	r_i	Resolved <wri> vertical flux
$< \tilde{w}\tilde{r_r} >$	RES_WRR	z,t,p	r_r	Resolved <wrr> vertical flux
Precipitation flux	INPRR3D	z,t,p	r_r	Precipitation flux
Max Precipitation flux	MAXINPRR3D	z,t,p	r_r	Max Precip flux
Evaporation flux	EVAP3D	z,t,p	r_r	Evaporation profile
$< \tilde{s_v}^2 >$	RES_SV2	z,t,p,n	s_v	Resolved scalar variables variances
$< \tilde{\theta}\tilde{s_v} >$	RES_THSV	z,t,p,n	s_v	Resolved <ThSv> variance
$< \tilde{\theta_l}\tilde{s_v} >$	RES_TLSV	z,t,p,n	s_v, r_c	Resolved <ThlSv> variance
$< \tilde{\theta_v}\tilde{s_v} >$	RES_TVSV	z,t,p,n	s_v, r_v	Resolved <ThvSv> variance
$< \tilde{u}\tilde{s_v} >$	RES_USV	z,t,p,n	s_v	Resolved <uSv> horizontal flux
$< \tilde{v}\tilde{s_v} >$	RES_VSV	z,t,p,n	s_v	Resolved <vSv> horizontal flux
$< \tilde{w}\tilde{s_v} >$	RES_WSV	z,t,p,n	s_v	Resolved <wSv> vertical flux
$< \tilde{u}^3 >$	RES_U3	z,t,p		Resolved <u3>
$< \tilde{v}^3 >$	RES_V3	z,t,p		Resolved <v3>
$< \tilde{w}^3 >$	RES_W3	z,t,p		Resolved <w3>
$< \tilde{u}^4 >$	RES_U4	z,t,p		Resolved <u4>
$< \tilde{v}^4 >$	RES_V4	z,t,p		Resolved <v4>
$< \tilde{w}^4 >$	RES_W4	z,t,p		Resolved <w4>
$< \tilde{w}\ \tilde{\theta_l}^2 >$	RES_WTL2	z,t,p		Resolved <wThl2>
$< \tilde{w}^2\ \tilde{\theta_l} >$	RES_W2TL	z,t,p		Resolved <w2Thl>
$< \tilde{w}\ \tilde{r_v}^2 >$	RES_WRV2	z,t,p	r_v	Resolved <wRv2>
$< \tilde{w}^2\ \tilde{r_v} >$	RES_W2RV	z,t,p	r_v	Resolved <w2Rv>
$< \tilde{w}\ \tilde{r_t}^2 >$	RES_WRT2	z,t,p	r_v	Resolved <wRt2>
$< \tilde{w}^2\ \tilde{r_t} >$	RES_W2RT	z,t,p	r_v	Resolved <w2Rt>
$< \tilde{w}\ \tilde{\theta_l}\tilde{r_v} >$	RES_WTLRV	z,t,p	r_v	Resolved <wThlRv> (if r_v and no r_c, replaced by $< \tilde{w}\ \tilde{\theta}\tilde{r_v} >$)
$< \tilde{w}\ \tilde{\theta_l}; \tilde{r_t} >$	RES_WTLRT	z,t,p	r_v	Resolved <wThlRt>
Warning: contains both turbulent and gravity wave fields				

Field	Notation in the diachronic file	Dims	If	Comments
$< \tilde{w}\ \tilde{r_c}^2 >$	RES_WRC2	z,t,p	r_c	Resolved <wRc2>
$< \tilde{w}^2\ \tilde{r_c} >$	RES_W2RC	z,t,p	r_c	Resolved <w2Rc>
$< \tilde{w}\ \tilde{\theta_l}\tilde{r_c} >$	RE_WTLRC	z,t,p	r_c	Resolved <wThlRc>
$< \tilde{w}\ \tilde{r_v}\tilde{r_c} >$	RE_WRVRC	z,t,p	r_c	Resolved <wRvRc>
$< \tilde{w}\ \tilde{r_i}^2 >$	RES_WRI2	z,t,p	r_i	Resolved <wRi2>'
$< \tilde{w}^2\ \tilde{r_i} >$	RES_W2RI	z,t,p	r_i	Resolved <w2Ri>'
$< \tilde{w}\ \tilde{\theta_l}\tilde{r_i} >$	RE_WTLRI	z,t,p	r_i	Resolved <wThlRi>
$< \tilde{w}\ \tilde{r_v}\tilde{r_i} >$	RE_WRVRI	z,t,p	r_i	Resolved <wRvRi>
$< \tilde{w}\ \tilde{s_v}^2 >$	RES_WSV2	z,t,p,n	s_v	Resolved <wSv2>
$< \tilde{w}^2\ \tilde{s_v} >$	RES_W2SV	z,t,p,n	s_v	Resolved <w2Sv>
$< \tilde{w}\ \tilde{\theta_l}\tilde{s_v} >$	RE_WTLSV	z,t,p,n	s_v	Resolved <wThlSv> (if no r_c, replaced by $< \tilde{w}\ \tilde{\theta}\tilde{s_v} >$)
$< \tilde{w}\ \tilde{r_v}\tilde{s_v} >$	RE_WRVSV	z,t,p,n	r_v, s_v	Resolved <wRvSv>
$< \tilde{\theta_l}\frac{\partial \tilde{p}}{\partial z} >$	RES_TLPZ	z,t,p		Resolved <Thldp/dz> (if no r_c, replaced by $< \tilde{\theta}\frac{\partial}{\partial z,t,p}\tilde{p} >$)
$< \tilde{\theta_l}\frac{\partial \tilde{p}}{\partial z} >$	RES_TLPZ	z,t,p		Resolved <Thldp/dz>
$< \tilde{r_t}\frac{\partial \tilde{p}}{\partial z} >$	RES_RTPZ	z,t,p	r_c	Resolved <Rtdp/dz>
$< \tilde{r_v}\frac{\partial \tilde{p}}{\partial z} >$	RES_RVPZ	z,t,p	r_v	Resolved <Rvdp/dz>
$< \tilde{r_c}\frac{\partial \tilde{p}}{\partial z} >$	RES_RCPZ	z,t,p	r_c	Resolved <Rcdp/dz>
$< \tilde{r_i}\frac{\partial \tilde{p}}{\partial z} >$	RES_RIPZ	z,t,p	r_i	Resolved <Ridp/dz>
$< \tilde{s_v}\frac{\partial \tilde{p}}{\partial z} >$	RES_SVPZ	z,t,p,n	s_v	Resolved <Svdp/dz>
$< \tilde{u}\ \left[\frac{1}{2}(\tilde{u}^2+\tilde{v}^2+\tilde{w}^2)\right] >$	RES_UKE	z,t,p		Resolved flux of resolved kinetic energy
$< \tilde{v}\ \left[\frac{1}{2}(\tilde{u}^2+\tilde{v}^2+\tilde{w}^2)\right] >$	RES_VKE	z,t,p		Resolved flux of resolved kinetic energy
$< \tilde{w}\ \left[\frac{1}{2}(\tilde{u}^2+\tilde{v}^2+\tilde{w}^2)\right] >$	RES_WKE	z,t,p		Resolved flux of resolved kinetic energy
Warning: contains both turbulent and gravity wave fields				

Notes: dimension p is equal to the number of masks. When this dimension is not present, the computation is made only on the cartesian mask. Dimension n corresponds to the number of scalar variables. r_t is total water $(r_v + r_c + r_r + r_i + r_s + r_g + r_h)$.

6 LES averaged fields (LLES_SUBGRID=TRUE)

Field	Notation in the diachronic file	Dims	If	Comments
$< \frac{1}{2}(\overline{u'^2} + \overline{v'^2} + \overline{w'^2}) >$	SBG_TKE	z,t,p		Subgrid TKE
$< \overline{u'^2} >$	SBG_U2	z,t,p		Subgrid <u2> variance
$< \overline{v'^2} >$	SBG_V2	z,t,p		Subgrid <v2> variance
$< \overline{w'^2} >$	SBG_W2	z,t,p		Subgrid <w2> variance
$< \overline{u'v'} >$	SBG_UV	z,t,p		Subgrid <uv> flux
$< \overline{w'u'} >$	SBG_WU	z,t,p		Subgrid <wu> flux
$< \overline{w'v'} >$	SBG_WV	z,t,p		Subgrid <wv> flux
$< \overline{\theta_l'^2} >$	SBG_THL2	z,t,p		Subgrid liquid potential temperature variance (if no r_c, replaced by $< \overline{\theta'^2} >$)
$< \overline{u'\theta_l'} >$	SBG_UTHL	z,t,p		Subgrid horizontal flux of liquid potential temperature (if no r_c, replaced by $< \overline{u'\theta'} >$)
$< \overline{v'\theta_l'} >$	SBG_VTHL	z,t,p		Subgrid horizontal flux of liquid potential temperature (if no r_c, replaced by $< \overline{v'\theta'} >$)
$< \overline{w'\theta_l'} >$	SBG_WTHL	z,t,p		Subgrid vertical flux of liquid potential temperature (if no r_c, replaced by $< \overline{w'\theta'} >$)
$< \overline{w'p'} >$	SBG_WP	z,t,p		Subgrid <wp> vertical flux
$< \overline{\phi 3'} >$	SBG_PHI3	z,t,p		Subgrid Phi3 function
$< \overline{LM'} >$	SBG_LMIX	z,t,p		Subgrid Mixing Length
$< \overline{LD'} >$	SBG_LDIS	z,t,p		Subgrid Dissipation Length
$< \overline{Km'} >$	SBG_KM	z,t,p		Eddy diffusivity for momentum
$< \overline{Kh'} >$	SBG_KH	z,t,p		Eddy diffusivity for heat
$< \overline{w'\theta_v'} >$	SBG_WTHV	z,t,p	r_v	Subgrid vertical flux of liquid potential temperature
$< \overline{r_t'^2} >$	SBG_RT2	z,t,p	r_v	Subgrid total water variance

Field	Notation in the diachronic file	Dims	If	Comments
$< \overline{\theta_l' r_t'} >$	SBG_TLRT	z,t,p	r_v	Subgrid <thlrt> covariance (if no r_c, replaced by $< \overline{\theta' r_v'} >$)
$< \overline{u' r_t'} >$	SBG_URT	z,t,p	r_v	Subgrid total water horizontal flux
$< \overline{v' r_t'} >$	SBG_VRT	z,t,p	r_v	Subgrid total water horizontal flux
$< \overline{w' r_t'} >$	SBG_WRT	z,t,p	r_v	Subgrid total water vertical flux
$< \overline{\psi 3'} >$	SBG_PSI3	z,t,p	r_v	Subgrid Psi3 function
$< \overline{r_c'^2} >$	SBG_RC2	z,t,p	r_c	Subgrid cloud water variance
$< \overline{u' r_c'} >$	SBG_URC	z,t,p	r_c	Subgrid cloud water horizontal flux
$< \overline{v' r_c'} >$	SBG_VRC	z,t,p	r_c	Subgrid cloud water horizontal flux
$< \overline{w' r_c'} >$	SBG_WRC	z,t,p	r_c	Subgrid cloud water vertical flux
$< \overline{u' s_v'} >$	SBG_USV	z,t,p,n	s_v	Subgrid <uSv> horizontal flux
$< \overline{v' s_v'} >$	SBG_VSV	z,t,p,n	s_v	Subgrid <vSv> horizontal flux
$< \overline{w' s_v'} >$	SBG_WSV	z,t,p,n	s_v	Subgrid <wSv> vertical flux
$< \overline{u'} \left[\frac{1}{2} (\overline{u'^2} + \overline{v'^2} + \overline{w'^2}) \right] >$	SBG_UTKE	z,t,p		Subgrid flux of subgrid kinetic energy
$< \overline{v'} \left[\frac{1}{2} (\overline{u'^2} + \overline{v'^2} + \overline{w'^2}) \right] >$	SBG_VTKE	z,t,p		Subgrid flux of subgrid kinetic energy
$< \overline{w'} \left[\frac{1}{2} (\overline{u'^2} + \overline{v'^2} + \overline{w'^2}) \right] >$	SBG_WTKE	z,t,p		Subgrid flux of subgrid kinetic energy
$< \overline{w'^2 \theta_l'} >$	SBG_W2TL	z,t,p		Subgrid flux of subgrid kinetic energy
$< \overline{w' \theta_l'^2} >$	SBG_WTL2	z,t,p		Subgrid flux of subgrid kinetic energy
$< \overline{\theta}_{lUpdraftMassFlux} >$	THLUP_MF	z,t,p	r_i	Subgrid <thl> of updraft
$< \overline{r}_{tUpdraftMassFlux} >$	RTUP_MF	z,t,p	r_v	Subgrid <rt> of updraft

Field	Notation in the diachronic file	Dims	If	Comments
$<\overline{r}_{vUpdraftMassFlux}>$	RVUP_MF	z,t,p	r_v	Subgrid <rv> of updraft
$<\overline{r}_{cUpdraftMassFlux}>$	RCUP_MF	z,t,p	r_c	Subgrid <rc> of updraft
$<\overline{r}_{iUpdraftMassFlux}>$	RIUP_MF	z,t,p	r_i	Subgrid <ri> of updraft
$<\overline{W}_{UpdraftMassFlux}>$	WUP_MF	z,t,p		Subgrid <w> of updraft
$<\overline{MassFlux}_{UpdraftMassFlux}>$	MAFLX_MF	z,t,p		Subgrid <MF> of updraft
$<\overline{Detr}_{UpdraftMassFlux}>$	DETR_MF	z,t,p		Subgrid <detr> of updraft
$<\overline{Entr}_{UpdraftMassFlux}>$	ENTR_MF	z,t,p		Subgrid <entr> of updraft
$<\overline{Frac}_{UpdraftMassFlux}>$	FRCUP_MF	z,t,p		Subgrid <FracUp> of updraft
$<\overline{\theta}_{vUpdraftMassFlux}>$	THVUP_MF	z,t,p		Subgrid <thv> of updraft
$<\overline{w'\theta'_l}_{MassFlux}>$	WTHL_MF	z,t,p		Subgrid <wthl> of mass flux convection scheme
$<\overline{w'r'_t}_{MassFlux}>$	WRT_MF	z,t,p		Subgrid <wrt> of mass flux convection scheme
$<\overline{w'\theta'_v}_{MassFlux}>$	WTHV_MF	z,t,p		Subgrid <wthv> of mass flux convection scheme
$<\overline{w'u'}_{MassFlux}>$	WU_MF	z,t,p		Subgrid <wu> of mass flux convection scheme
$<\overline{w'v'}_{MassFlux}>$	WV_MF	z,t,p		Subgrid <wv> of mass flux convection scheme

Notes: dimension p is equal to the number of masks. When this dimension is not present, the computation is made only on the cartesian mask. Dimension n corresponds to the number of scalar variables. r_t is total water $(r_v + r_c + r_r + r_i + r_s + r_g + r_h)$.

7 LES averaged fields (LLES_UPDRAFT=TRUE)

Field	Notation in the diachronic file	Dims	If	Comments
$< f_{up} >$	UP_FRAC	z,t		Updraft fraction
$< w >_{up}$	UP_W	z,t		Updraft W mean value

Field	Notation in the diachronic file	Dims	If	Comments
$< \theta >_{up}$	UP_TH	z,t		Updraft potential temperature mean value
$< \theta_l >_{up}$	UP_THL	z,t	r_c	Updraft liquid potential temperature mean value
$< \theta_v >_{up}$	UP_THV	z,t	r_v	Updraft virtual potential temperature mean value
$< \frac{1}{2}(\tilde{u}^2 + \tilde{v}^2 + \tilde{w}^2) >_{up}$	UP_KE	z,t		Updraft resolved TKE mean value
$< \frac{1}{2}(\tilde{u'^2} + \tilde{v'^2} + \tilde{w'^2}) >_{up}$	UP_TKE	z,t		Updraft subgrid TKE mean value
$< r_v >_{up}$	UP_RV	z,t	r_v	Updraft water vapor mean value
$< r_c >_{up}$	UP_RC	z,t	r_c	Updraft cloud water mean value
$< r_r >_{up}$	UP_RR	z,t	r_r	Updraft rain mean value
$< r_i >_{up}$	UP_RI	z,t	r_i	Updraft ice mean value
$< r_s >_{up}$	UP_RS	z,t	r_s	Updraft snow mean value
$< r_g >_{up}$	UP_RG	z,t	r_g	Updraft graupel mean value
$< r_h >_{up}$	UP_RH	z,t	r_h	Updraft hail mean value
$< s_v >_{up}$	UP_SV	z,t,n	s_v	Updraft scalar variables mean values
$< \tilde{\theta}^2 >_{up}$	UP_TH2	z,t		Updraft resolved Theta variance
$< \tilde{\theta_l}^2 >_{up}$	UP_THL2	z,t	r_c	Updraft resolved Theta_l variance
$< \tilde{\theta}\, \tilde{\theta_v} >_{up}$	UP_THTV	z,t	r_v	Updraft resolved Theta Theta_v covariance
$< \tilde{\theta_l}\, \tilde{\theta_v} >_{up}$	UP_TLTV	z,t	r_c	Updraft resolved Theta_l Theta_v covariance
$< \tilde{w}\, \tilde{\theta} >_{up}$	UP_WTH	z,t		Updraft resolved WTh flux
$< \tilde{w}\, \tilde{\theta_l} >_{up}$	UP_WTHL	z,t	r_c	Updraft resolved WThl flux
$< \tilde{w}\, \tilde{\theta_v} >_{up}$	UP_WTHV	z,t	r_v	Updraft resolved WThv flux
$< \tilde{r_v}^2 >_{up}$	UP_RV2	z,t	r_v	Updraft resolved water vapor variance
$< \tilde{\theta}\, \tilde{r_v} >_{up}$	UP_THRV	z,t	r_v	Updraft resolved <thrv> covariance
$< \tilde{\theta_l}\, \tilde{r_v} >_{up}$	UP_THLRV	z,t	r_v, r_c	Updraft resolved <thlrv> covariance

Field	Notation in the diachronic file	Dims	If	Comments
$< \tilde{\theta_v} \, \tilde{r_v} >_{up}$	UP_THVRV	z,t	r_v	Updraft resolved <thvrv> covariance
$< \tilde{w} \, \tilde{r_v} >_{up}$	UP_WRV	z,t	r_v	Updraft resolved <wrv> vertical flux
$< \tilde{r_c}^2 >_{up}$	UP_RC2	z,t	r_c	Updraft resolved cloud water variance
$< \tilde{\theta} \, \tilde{r_c} >_{up}$	UP_THRC	z,t	r_c	Updraft resolved <thrc> covariance
$< \tilde{\theta_l} \, \tilde{r_c} >_{up}$	UP_THLRC	z,t	r_c	Updraft resolved <thlrc> covariance
$< \tilde{\theta_v} \, \tilde{r_c} >_{up}$	UP_THVRC	z,t	r_c	Updraft resolved <thvrc> covariance
$< \tilde{w} \, \tilde{r_c} >_{up}$	UP_WRC	z,t	r_c	Updraft resolved <wrc> vertical flux
$< \tilde{r_i}^2 >_{up}$	UP_RI2	z,t	r_i	Updraft resolved cloud ice variance
$< \tilde{\theta} \, \tilde{r_i} >_{up}$	UP_THRI	z,t	r_i	Updraft resolved <thri> covariance
$< \tilde{\theta_l} \, \tilde{r_i} >_{up}$	UP_THLRI	z,t	r_i	Updraft resolved <thlri> covariance
$< \tilde{\theta_v} \, \tilde{r_i} >_{up}$	UP_THVRI	z,t	r_i	Updraft resolved <thvri> covariance
$< \tilde{w} \, \tilde{r_i} >_{up}$	UP_WRI	z,t	r_i	Updraft resolved <wri> vertical flux
$< \tilde{s_v}^2 >_{up}$	UP_SV2	z,t,n	s_v	Updraft resolved scalar variables variances
$< \tilde{\theta} \, \tilde{s_v} >_{up}$	UP_THSV	z,t,n	s_v	Updraft resolved <ThSv> variance
$< \tilde{\theta_l} \, \tilde{s_v} >_{up}$	UP_THLSV	z,t,n	s_v, r_c	Updraft resolved <ThlSv> variance
$< \tilde{\theta_v} \, \tilde{s_v} >_{up}$	UP_THVSV	z,t,n	s_v, r_v	Updraft resolved <ThvSv> variance
$< \tilde{w} \, \tilde{s_v} >_{up}$	UP_WSV	z,t,n	s_v	Updraft resolved <wSv> vertical flux

Note: all computations are made only on the cartesian mask. Dimension n corresponds to the number of scalar variables.

8 LES averaged fields (LLES_DOWNDRAFT=TRUE)

Field	Notation in the diachronic file	Dims	If	Comments
$< f_{dw} >$	DW_FRAC	z,t		Downdraft fraction
$< w >_{dw}$	DW_W	z,t		Downdraft W mean value
$< \theta >_{dw}$	DW_TH	z,t		Downdraft potential temperature mean value
$< \theta_l >_{dw}$	DW_THL	z,t	r_c	Downdraft liquid potential temperature mean value
$< \theta_v >_{dw}$	DW_THV	z,t	r_v	Downdraft virtual potential temperature mean value
$< \frac{1}{2}(\tilde{u}^2 + \tilde{v}^2 + \tilde{w}^2) >_{dw}$	DW_KE	z,t		Downdraft resolved TKE mean value
$< \frac{1}{2}(\tilde{u'^2}+\tilde{v'^2}+\tilde{w'^2}) >_{dw}$	DW_TKE	z,t		Downdraft subgrid TKE mean value
$< r_v >_{dw}$	DW_RV	z,t	r_v	Downdraft water vapor mean value
$< r_c >_{dw}$	DW_RC	z,t	r_c	Downdraft cloud water mean value
$< r_r >_{dw}$	DW_RR	z,t	r_r	Downdraft rain mean value
$< r_i >_{dw}$	DW_RI	z,t	r_i	Downdraft ice mean value
$< r_s >_{dw}$	DW_RS	z,t	r_s	Downdraft snow mean value
$< r_g >_{dw}$	DW_RG	z,t	r_g	Downdraft graupel mean value
$< r_h >_{dw}$	DW_RH	z,t	r_h	Downdraft hail mean value
$< s_v >_{dw}$	DW_SV	z,t,n	s_v	Downdraft scalar variables mean values
$< \tilde{\theta}^2 >_{dw}$	DW_TH2	z,t		Downdraft resolved Theta variance
$< \tilde{\theta_l}^2 >_{dw}$	DW_THL2	z,t	r_c	Downdraft resolved Theta_l variance
$< \tilde{\theta}\, \tilde{\theta_v} >_{dw}$	DW_THTV	z,t	r_v	Downdraft resolved Theta Theta_v covariance
$< \tilde{\theta_l}\, \tilde{\theta_v} >_{dw}$	DW_TLTV	z,t	r_c	Downdraft resolved Theta_l Theta_v covariance
$< \tilde{w}\, \tilde{\theta} >_{dw}$	DW_WTH	z,t		Downdraft resolved WTh flux
$< \tilde{w}\, \tilde{\theta_l} >_{dw}$	DW_WTHL	z,t	r_c	Downdraft resolved WThl flux

Field	Notation in the diachronic file	Dims	If	Comments
$< \tilde{w}\ \tilde{\theta_v} >_{dw}$	DW_WTHV	z,t	r_v	Downdraft resolved WThv flux
$< \tilde{r_v}^2 >_{dw}$	DW_RV2	z,t	r_v	Downdraft resolved water vapor variance
$< \tilde{\theta}\ \tilde{r_v} >_{dw}$	DW_THRV	z,t	r_v	Downdraft resolved <thrv> covariance
$< \tilde{\theta_l}\ \tilde{r_v} >_{dw}$	DW_THLRV	z,t	r_v, r_c	Downdraft resolved <thlrv> covariance
$< \tilde{\theta_v}\ \tilde{r_v} >_{dw}$	DW_THVRV	z,t	r_v	Downdraft resolved <thvrv> covariance
$< \tilde{w}\ \tilde{r_v} >_{dw}$	DW_WRV	z,t	r_v	Downdraft resolved <wrv> vertical flux
$< \tilde{r_c}^2 >_{dw}$	DW_RC2	z,t	r_c	Downdraft resolved cloud water variance
$< \tilde{\theta}\ \tilde{r_c} >_{dw}$	DW_THRC	z,t	r_c	Downdraft resolved <thrc> covariance
$< \tilde{\theta_l}\ \tilde{r_c} >_{dw}$	DW_THLRC	z,t	r_c	Downdraft resolved <thlrc> covariance
$< \tilde{\theta_v}\ \tilde{r_c} >_{dw}$	DW_THVRC	z,t	r_c	Downdraft resolved <thvrc> covariance
$< \tilde{w}\ \tilde{r_c} >_{dw}$	DW_WRC	z,t	r_c	Downdraft resolved <wrc> vertical flux
$< \tilde{r_i}^2 >_{dw}$	DW_RI2	z,t	r_i	Downdraft resolved cloud ice variance
$< \tilde{\theta}\ \tilde{r_i} >_{dw}$	DW_THRI	z,t	r_i	Downdraft resolved <thri> covariance
$< \tilde{\theta_l}\ \tilde{r_i} >_{dw}$	DW_THLRI	z,t	r_i	Downdraft resolved <thlri> covariance
$< \tilde{\theta_v}\ \tilde{r_i} >_{dw}$	DW_THVRI	z,t	r_i	Downdraft resolved <thvri> covariance
$< \tilde{w}\ \tilde{r_i} >_{dw}$	DW_WRI	z,t	r_i	Downdraft resolved <wri> vertical flux
$< \tilde{s_v}^2 >_{dw}$	DW_SV2	z,t,n	s_v	Downdraft resolved scalar variables variances

Field	Notation in the diachronic file	Dims	If	Comments
$< \tilde{\theta}\ \tilde{s_v} >_{dw}$	DW_THSV	z,t,n	s_v	Downdraft resolved <ThSv> variance
$< \tilde{\theta_l}\ \tilde{s_v} >_{dw}$	DW_THLSV	z,t,n	s_v, r_c	Downdraft resolved <ThlSv> variance
$< \tilde{\theta_v}\ \tilde{s_v} >_{dw}$	DW_THVSV	z,t,n	s_v, r_v	Downdraft resolved <ThvSv> variance
$< \tilde{w}\ \tilde{s_v} >_{dw}$	DW_WSV	z,t,n	s_v	Downdraft resolved <wSv> vertical flux

Note: all computations are made only on the cartesian mask. Dimension n corresponds to the number of scalar variables.

9 LES averaged surface fields

Field	Notation in the diachronic file	Dims	If	Comments
$< \overline{w'\theta'}_{surf} >$	Q0	t		Sensible heat flux at the surface
$< \overline{w'r'_v}_{surf} >$	E0	t	r_v	Latent heat flux at the surface
$< \overline{w's'_v}_{surf} >$	SV0	t,n	s_v	Scalar variable fluxes at the surface
$u_* = \left\{ < \overline{u'w'}_{surf} >^2 + < \overline{v'w'}_{surf} >^2 \right\}^{\frac{1}{4}}$	Ustar	t		Friction velocity
$w_* = \left\{ < \frac{g}{\theta} >< \overline{w'\theta'_v}_{surf} >< h > \right\}^{\frac{1}{3}}$	Wstar	t		Convective velocity if positive surface buoyancy flux
$< L_{MO} >$	L_MO	t		Monin-Obukhov length
$PRECFR$	PREC_FRAC	t	r_r	Fraction of columns where rain at surface
$INPRR$	INST_PREC	t	r_r	Instantaneous precipitation rate
$INPRC$	INST_SEDIM	t	r_c	Instantaneous cloud precipitation rate

Field	Notation in the diachronic file	Dims	If	Comments
$INDEP$	INST_DEPOS	t	r_c	Instantaneous cloud deposition rate (if LDEPOSC=T or LDEPOC=T)
$RAIN\_INPRR$	RAIN_PREC	t	r_r	Instantaneous precipitation rate over rainy grid cells
$ACPRR$	ACCU_PREC	t	r_r	Accumulated precipitation rate

Note: dimension n corresponds to the number of scalar variables.

10 LES averaged fields: radiative terms

Field	Notation in the diachronic file	Dims	If	Comments
sw_{up}	SWU	z,t,p		SW upward radiative flux
sw_{down}	SWD	z,t,p		SW downward radiative flux
lw_{up}	LWU	z,t,p		LW upward radiative flux
lw_{down}	LWD	z,t,p		LW downward radiative flux
$dthrad_{sw}$	DTHRADSW	z,t,p		SW radiative temperature tendency
$dthrad_{lw}$	DTHRADLW	z,t,p		LW radiative temperature tendency
Mean Effective Radius	RADEFF	z,t,p		Mean effective radius

11 Miscellaneous LES averaged fields

Field	Notation in the diachronic file	Dims	If	Comments
$< h >$	BL_H	t		Boundary Layer Height
$\int TKEdz$	INT_TKE	t		Vertical integrated TKE
ZCB	ZCB	t	r_c	Cloud base height
CF	ZCFTOT	t	r_c	Total cloud cover ($r_c > 1.e - 6$)

Field	Notation in the diachronic file	Dims	If	Comments
$CF2$	ZCF2TOT	t	r_c	Total cloud cover ($r_c > 1.e-5$)
$\int \rho(r_c + r_r)$	LWP	t	r_c	Liquid water path
VAR_LWP	LWPVAR	t	r_c	Liquid Water path variance
$\int \rho r_r$	RWP	t	r_r	Rain Water path
$\int \rho r_i$	IWP	t	r_i	Ice Water path
$\int \rho r_s$	SWP	t	r_s	Snow Water path
$\int \rho r_g$	GWP	t	r_g	Graupel Water path
$\int \rho r_h$	HWP	t	r_h	hail Water path
H_CFmax	ZMAXCF	t	r_c	Height of cloud fraction maximum (rc>1e-6)
H_CFmax2	ZMAXCF2	t	r_c	Height of cloud fraction maximum (rc>1e-5)

12 LES 2 points correlations

Field	Notation in the diachronic file	Dims	If	Comments
$< \tilde{u}(x,y)\ \tilde{u}(x+l_x,y) >$	CI_UU	l_x,z,t		
$< \tilde{u}(x,y)\ \tilde{u}(x,y+l_y) >$	CJ_UU	l_y,z,t		
$< \tilde{v}(x,y)\ \tilde{v}(x+l_x,y) >$	CI_VV	l_x,z,t		
$< \tilde{v}(x,y)\ \tilde{v}(x,y+l_y) >$	CJ_VV	l_y,z,t		
$< \tilde{w}(x,y)\ \tilde{w}(x+l_x,y) >$	CI_WW	l_x,z,t		
$< \tilde{w}(x,y)\ \tilde{w}(x,y+l_y) >$	CJ_WW	l_y,z,t		
$< \tilde{u}(x,y)\ \tilde{v}(x+l_x,y) >$	CI_UV	l_x,z,t		
$< \tilde{u}(x,y)\ \tilde{v}(x,y+l_y) >$	CJ_UV	l_y,z,t		
$< \tilde{w}(x,y)\ \tilde{u}(x+l_x,y) >$	CI_WU	l_x,z,t		
$< \tilde{w}(x,y)\ \tilde{u}(x,y+l_y) >$	CJ_WU	l_y,z,t		
$< \tilde{w}(x,y)\ \tilde{u}(x+l_x,y) >$	CI_WV	l_x,z,t		
$< \tilde{w}(x,y)\ \tilde{u}(x,y+l_y) >$	CJ_WV	l_y,z,t		

Field	Notation in the diachronic file	Dims	If	Comments
$< \tilde{\theta}(x,y)\ \tilde{\theta}(x+l_x,y) >$	CI_THTH	l_x,z,t		
$< \tilde{\theta}(x,y)\ \tilde{\theta}(x,y+l_y) >$	CJ_THTH	l_y,z,t		
$< \tilde{\theta_l}(x,y)\ \tilde{\theta_l}(x+l_x,y) >$	CI_TLTL	l_x,z,t	r_c	
$< \tilde{\theta_l}(x,y)\ \tilde{\theta_l}(x,y+l_y) >$	CJ_TLTL	l_y,z,t	r_c	
$< \tilde{w}(x,y)\ \tilde{\theta}(x+l_x,y) >$	CI_WTH	l_x,z,t		
$< \tilde{w}(x,y)\ \tilde{\theta}(x,y+l_y) >$	CJ_WTH	l_y,z,t		
$< \tilde{w}(x,y)\ \tilde{\theta_l}(x+l_x,y) >$	CI_WTHL	l_x,z,t	r_c	
$< \tilde{w}(x,y)\ \tilde{\theta_l}(x,y+l_y) >$	CJ_WTHL	l_y,z,t	r_c	
$< \tilde{r_v}(x,y)\ \tilde{r_v}(x+l_x,y) >$	CI_RVRV	l_x,z,t	r_v	
$< \tilde{r_v}(x,y)\ \tilde{r_v}(x,y+l_y) >$	CJ_RVRV	l_y,z,t	r_v	
$< \tilde{\theta}(x,y)\ \tilde{r_v}(x+l_x,y) >$	CI_THRV	l_x,z,t	r_v	
$< \tilde{\theta}(x,y)\ \tilde{r_v}(x,y+l_y) >$	CJ_THRV	l_y,z,t	r_v	
$< \tilde{\theta_l}(x,y)\ \tilde{r_v}(x+l_x,y) >$	CI_TLRV	l_x,z,t	r_v,r_c	
$< \tilde{\theta_l}(x,y)\ \tilde{r_v}(x,y+l_y) >$	CJ_TLRV	l_y,z,t	r_v,r_c	
$< \tilde{w}(x,y)\ \tilde{r_v}(x+l_x,y) >$	CI_WRV	l_x,z,t	r_v	
$< \tilde{w}(x,y)\ \tilde{r_v}(x,y+l_y) >$	CJ_WRV	l_y,z,t	r_v	
$< \tilde{r_c}(x,y)\ \tilde{r_c}(x+l_x,y) >$	CI_RCRC	l_x,z,t	r_c	
$< \tilde{r_c}(x,y)\ \tilde{r_c}(x,y+l_y) >$	CJ_RCRC	l_y,z,t	r_c	
$< \tilde{\theta}(x,y)\ \tilde{r_c}(x+l_x,y) >$	CI_THRC	l_x,z,t	r_c	
$< \tilde{\theta}(x,y)\ \tilde{r_c}(x,y+l_y) >$	CJ_THRC	l_y,z,t	r_c	
$< \tilde{\theta_l}(x,y)\ \tilde{r_c}(x+l_x,y) >$	CI_TLRC	l_x,z,t	r_c	
$< \tilde{\theta_l}(x,y)\ \tilde{r_c}(x,y+l_y) >$	CJ_TLRC	l_y,z,t	r_c	
$< \tilde{w}(x,y)\ \tilde{r_c}(x+l_x,y) >$	CI_WRC	l_x,z,t	r_c	
$< \tilde{w}(x,y)\ \tilde{r_c}(x,y+l_y) >$	CJ_WRC	l_y,z,t	r_c	
$< \tilde{r_i}(x,y)\ \tilde{r_i}(x+l_x,y) >$	CI_RIRI	l_x,z,t	r_i	
$< \tilde{r_i}(x,y)\ \tilde{r_i}(x,y+l_y) >$	CJ_RIRI	l_y,z,t	r_i	
$< \tilde{\theta}(x,y)\ \tilde{r_i}(x+l_x,y) >$	CI_THRI	l_x,z,t	r_i	
$< \tilde{\theta}(x,y)\ \tilde{r_i}(x,y+l_y) >$	CJ_THRI	l_y,z,t	r_i	
$< \tilde{\theta_l}(x,y)\ \tilde{r_i}(x+l_x,y) >$	CI_TLRI	l_x,z,t	r_i	

Field	Notation in the diachronic file	Dims	If	Comments
$< \tilde{\theta}_l(x,y)\ \tilde{r}_i(x,y+l_y) >$	CJ_TLRI	l_y,z,t	r_i	
$< \tilde{w}(x,y)\ \tilde{r}_i(x+l_x,y) >$	CI_WRI	l_x,z,t	r_i	
$< \tilde{w}(x,y)\ \tilde{r}_i(x,y+l_y) >$	CJ_WRI	l_y,z,t	r_i	
$< \tilde{s_v}(x,y)\ \tilde{s_v}(x+l_x,y) >$	CI_SSjsv	l_x,z,t	s_v	
$< \tilde{s_v}(x,y)\ \tilde{s_v}(x,y+l_y) >$	CJ_SSjsv	l_y,z,t	s_v	
$< \tilde{w}(x,y)\ \tilde{s_v}(x+l_x,y) >$	CI_WSjsv	l_x,z,t	s_v	
$< \tilde{w}(x,y)\ \tilde{s_v}(x,y+l_y) >$	CJ_WSjsv	l_y,z,t	s_v	

Note: jsv stands for the number of the scalar variable (written with 3 characters, for example 025).

13 LES spectra

Field	Notation in the diachronic file	Dims	If	Comments
$\frac{1}{2\pi L}\int_L < \tilde{u}(x,y)\ \tilde{u}(x+l_x,y) >\ e^{-ik_xl_x}dl_x$	SI_UU	k_x,z,t,2		
$\frac{1}{2\pi L}\int_L < \tilde{u}(x,y)\ \tilde{u}(x,y+l_y) >\ e^{-ik_yl_y}dl_y$	SJ_UU	k_y,z,t,2		
$\frac{1}{2\pi L}\int_L < \tilde{v}(x,y)\ \tilde{v}(x+l_x,y) >\ e^{-ik_xl_x}dl_x$	SI_VV	k_x,z,t,2		
$\frac{1}{2\pi L}\int_L < \tilde{v}(x,y)\ \tilde{v}(x,y+l_y) >\ e^{-ik_yl_y}dl_y$	SJ_VV	k_y,z,t,2		
$\frac{1}{2\pi L}\int_L < \tilde{w}(x,y)\ \tilde{w}(x+l_x,y) >\ e^{-ik_xl_x}dl_x$	SI_WW	k_x,z,t,2		
$\frac{1}{2\pi L}\int_L < \tilde{w}(x,y)\ \tilde{w}(x,y+l_y) >\ e^{-ik_yl_y}dl_y$	SJ_WW	k_y,z,t,2		
$\frac{1}{2\pi L}\int_L < \tilde{u}(x,y)\ \tilde{v}(x+l_x,y) >\ e^{-ik_xl_x}dl_x$	SI_UV	k_x,z,t,2		
$\frac{1}{2\pi L}\int_L < \tilde{u}(x,y)\ \tilde{v}(x,y+l_y) >\ e^{-ik_yl_y}dl_y$	SJ_UV	k_y,z,t,2		
$\frac{1}{2\pi L}\int_L < \tilde{w}(x,y)\ \tilde{u}(x+l_x,y) >\ e^{-ik_xl_x}dl_x$	SI_WU	k_x,z,t,2		
$\frac{1}{2\pi L}\int_L < \tilde{w}(x,y)\ \tilde{u}(x,y+l_y) >\ e^{-ik_yl_y}dl_y$	SJ_WV	k_y,z,t,2		
$\frac{1}{2\pi L}\int_L < \tilde{\theta}(x,y)\ \tilde{\theta}(x+l_x,y) >\ e^{-ik_xl_x}dl_x$	SI_THTH	k_x,z,t,2		
$\frac{1}{2\pi L}\int_L < \tilde{\theta}(x,y)\ \tilde{\theta}(x,y+l_y) >\ e^{-ik_yl_y}dl_y$	SJ_THTH	k_y,z,t,2		
$\frac{1}{2\pi L}\int_L < \tilde{\theta}_l(x,y)\ \tilde{\theta}_l(x+l_x,y) >\ e^{-ik_xl_x}dl_x$	SI_TLTL	k_x,z,t,2	r_c	
$\frac{1}{2\pi L}\int_L < \tilde{\theta}_l(x,y)\ \tilde{\theta}_l(x,y+l_y) >\ e^{-ik_yl_y}dl_y$	SJ_TLTL	k_y,z,t,2	r_c	

Field	Notation in the diachronic file	Dims	If	Comments
$\frac{1}{2\pi L}\int_L < \tilde{w}(x,y)\,\tilde{\theta}(x+l_x,y) > \ e^{-ik_xl_x}dl_x$	SI_WTH	k_x,z,t,2		
$\frac{1}{2\pi L}\int_L < \tilde{w}(x,y)\,\tilde{\theta}(x,y+l_y) > \ e^{-ik_yl_y}dl_y$	SJ_WTH	k_y,z,t,2		
$\frac{1}{2\pi L}\int_L < \tilde{w}(x,y)\,\tilde{\theta}_l(x+l_x,y) > \ e^{-ik_xl_x}dl_x$	SI_WTHL	k_x,z,t,2	r_c	
$\frac{1}{2\pi L}\int_L < \tilde{w}(x,y)\,\tilde{\theta}_l(x,y+l_y) > \ e^{-ik_yl_y}dl_y$	SJ_WTHL	k_y,z,t,2	r_c	
$\frac{1}{2\pi L}\int_L < \tilde{r_v}(x,y)\,\tilde{r_v}(x+l_x,y) > \ e^{-ik_xl_x}dl_x$	SI_RVRV	k_x,z,t,2	r_v	
$\frac{1}{2\pi L}\int_L < \tilde{r_v}(x,y)\,\tilde{r_v}(x,y+l_y) > \ e^{-ik_yl_y}dl_y$	SJ_RVRV	k_y,z,t,2	r_v	
$\frac{1}{2\pi L}\int_L < \tilde{\theta}(x,y)\,\tilde{r_v}(x+l_x,y) > \ e^{-ik_xl_x}dl_x$	SI_THRV	k_x,z,t,2	r_v	
$\frac{1}{2\pi L}\int_L < \tilde{\theta}(x,y)\,\tilde{r_v}(x,y+l_y) > \ e^{-ik_yl_y}dl_y$	SJ_THRV	k_y,z,t,2	r_v	
$\frac{1}{2\pi L}\int_L < \tilde{\theta}_l(x,y)\,\tilde{r_v}(x+l_x,y) > \ e^{-ik_xl_x}dl_x$	SI_TLRV	k_x,z,t,2	r_v,r_c	
$\frac{1}{2\pi L}\int_L < \tilde{\theta}_l(x,y)\,\tilde{r_v}(x,y+l_y) > \ e^{-ik_yl_y}dl_y$	SJ_TLRV	k_y,z,t,2	r_v,r_c	
$\frac{1}{2\pi L}\int_L < \tilde{w}(x,y)\,\tilde{r_v}(x+l_x,y) > \ e^{-ik_xl_x}dl_x$	SI_WRV	k_x,z,t,2	r_v	
$\frac{1}{2\pi L}\int_L < \tilde{w}(x,y)\,\tilde{r_v}(x,y+l_y) > \ e^{-ik_yl_y}dl_y$	SJ_WRV	k_y,z,t,2	r_v	
$\frac{1}{2\pi L}\int_L < \tilde{r_c}(x,y)\,\tilde{r_c}(x+l_x,y) > \ e^{-ik_xl_x}dl_x$	SI_RCRC	k_x,z,t,2	r_c	
$\frac{1}{2\pi L}\int_L < \tilde{r_c}(x,y)\,\tilde{r_c}(x,y+l_y) > \ e^{-ik_yl_y}dl_y$	SJ_RCRC	k_y,z,t,2	r_c	
$\frac{1}{2\pi L}\int_L < \tilde{\theta}(x,y)\,\tilde{r_c}(x+l_x,y) > \ e^{-ik_xl_x}dl_x$	SI_THRC	k_x,z,t,2	r_c	
$\frac{1}{2\pi L}\int_L < \tilde{\theta}(x,y)\,\tilde{r_c}(x,y+l_y) > \ e^{-ik_yl_y}dl_y$	SJ_THRC	k_y,z,t,2	r_c	
$\frac{1}{2\pi L}\int_L < \tilde{\theta}_l(x,y)\,\tilde{r_c}(x+l_x,y) > \ e^{-ik_xl_x}dl_x$	SI_TLRC	k_x,z,t,2	r_c	
$\frac{1}{2\pi L}\int_L < \tilde{\theta}_l(x,y)\,\tilde{r_c}(x,y+l_y) > \ e^{-ik_yl_y}dl_y$	SJ_TLRC	k_y,z,t,2	r_c	
$\frac{1}{2\pi L}\int_L < \tilde{w}(x,y)\,\tilde{r_c}(x+l_x,y) > \ e^{-ik_xl_x}dl_x$	SI_WRC	k_x,z,t,2	r_c	
$\frac{1}{2\pi L}\int_L < \tilde{w}(x,y)\,\tilde{r_c}(x,y+l_y) > \ e^{-ik_yl_y}dl_y$	SJ_WRC	k_y,z,t,2	r_c	
$\frac{1}{2\pi L}\int_L < \tilde{r_i}(x,y)\,\tilde{r_i}(x+l_x,y) > \ e^{-ik_xl_x}dl_x$	SI_RIRI	k_x,z,t,2	r_i	
$\frac{1}{2\pi L}\int_L < \tilde{r_i}(x,y)\,\tilde{r_i}(x,y+l_y) > \ e^{-ik_yl_y}dl_y$	SJ_RIRI	k_y,z,t,2	r_i	
$\frac{1}{2\pi L}\int_L < \tilde{\theta}(x,y)\,\tilde{r_i}(x+l_x,y) > \ e^{-ik_xl_x}dl_x$	SI_THRI	k_x,z,t,2	r_i	
$\frac{1}{2\pi L}\int_L < \tilde{\theta}(x,y)\,\tilde{r_i}(x,y+l_y) > \ e^{-ik_yl_y}dl_y$	SJ_THRI	k_y,z,t,2	r_i	
$\frac{1}{2\pi L}\int_L < \tilde{\theta}_l(x,y)\,\tilde{r_i}(x+l_x,y) > \ e^{-ik_xl_x}dl_x$	SI_TLRI	k_x,z,t,2	r_i	
$\frac{1}{2\pi L}\int_L < \tilde{\theta}_l(x,y)\,\tilde{r_i}(x,y+l_y) > \ e^{-ik_yl_y}dl_y$	SJ_TLRI	k_y,z,t,2	r_i	
$\frac{1}{2\pi L}\int_L < \tilde{w}(x,y)\,\tilde{r_i}(x+l_x,y) > \ e^{-ik_xl_x}dl_x$	SI_WRI	k_x,z,t,2	r_i	
$\frac{1}{2\pi L}\int_L < \tilde{w}(x,y)\,\tilde{r_i}(x,y+l_y) > \ e^{-ik_yl_y}dl_y$	SJ_WRI	k_y,z,t,2	r_i	
$\frac{1}{2\pi L}\int_L < \tilde{s_v}(x,y)\,\tilde{s_v}(x+l_x,y) > \ e^{-ik_xl_x}dl_x$	SI_SSjsv	k_x,z,t,2	s_v	

Field	Notation in the diachronic file	Dims	If	Comments
$\frac{1}{2\pi L}\int_L < \tilde{s_v}(x,y)\ \tilde{s_v}(x,y+l_y) >\ e^{-ik_y l_y} dl_y$	SJ_SSjsv	k_y,z,t,2	s_v	
$\frac{1}{2\pi L}\int_L < \tilde{w}(x,y)\ \tilde{s_v}(x+l_x,y) >\ e^{-ik_x l_x} dl_x$	SI_WSjsv	k_x,z,t,2	s_v	
$\frac{1}{2\pi L}\int_L < \tilde{w}(x,y)\ \tilde{s_v}(x,y+l_y) >\ e^{-ik_y l_y} dl_y$	SJ_WSjsv	k_y,z,t,2	s_v	

Notes: dimension 2 is for real and imaginary parts. jsv stands for the number of the scalar variable (written with 3 characters, for example 025).

14 Budget of (resolved + subgrid) turbulent quantities

14.1 Budget of total turbulent kinetic energy

All terms of the equation of $\frac{\partial}{\partial t}(E+e)$ are computed and stored in the diachronic group BU_KE. Here, e and E denote the subgrid and resolved Tke respectively:

$$< e >=< \frac{1}{2}(\overline{u'^2}+\overline{v'^2}+\overline{w'^2}) > \qquad\qquad < E >=< \frac{1}{2}(\tilde{u}^2+\tilde{v}^2+\tilde{w}^2) >$$

Here are **main terms** of the equations for the horizontal mean of subgrid Tke and resolved Tke, in the frame of Boussinesq approximation. Note that the computations of the budgets terms are done with the complete equation set and discretization of MESONH. The equations here are simplified only for the sake of easier understanding. Other terms can arise from the parametrizations of MESONH, and will also be taken into account in the budget.

$$\begin{aligned}\frac{\partial}{\partial t} < e >= \ & \overbrace{- < u_\alpha > \frac{\partial}{\partial x_\alpha} < e >}^{ADVM} \ \overbrace{- < \tilde{u_\alpha}\frac{\partial}{\partial x_\alpha} e >}^{ADVR} \ \overbrace{- \frac{1}{< \rho >} < \overline{u'_\alpha \frac{\partial p'}{\partial x_\alpha}} >}^{PRES} \ \overbrace{- < \frac{\partial}{\partial x_\alpha}\overline{u'_\alpha e} >}^{TR} \\ & \underbrace{- < \overline{u'_\alpha u'_\beta} > \frac{\partial < u_\beta >}{\partial x_\alpha}}_{DPM} \ \underbrace{- < \overline{u'_\alpha u'_\beta}\frac{\partial \tilde{u_\beta}}{\partial x_\alpha} >}_{DPR} \ + \underbrace{< \beta \overline{w'\theta'_v} >}_{TP} \ \underbrace{- < \epsilon >}_{DISS}\end{aligned}$$

$$\begin{aligned}\frac{\partial}{\partial t} < E >= \ & \overbrace{- < u_\alpha > \frac{\partial}{\partial x_\alpha} < E >}^{ADV} \ \overbrace{- \frac{1}{< \rho >} < \tilde{u_\alpha}\frac{\partial \tilde{p}}{\partial x_\alpha} >}^{PRES} \ \overbrace{- < \tilde{u_\alpha}\tilde{u_\beta} > \frac{\partial < u_\beta >}{\partial x_\alpha}}^{DP} \\ & + \underbrace{< \beta \tilde{w}\tilde{\theta_v} >}_{TP} \ \underbrace{- \frac{\partial}{\partial x_\alpha} < \tilde{u_\alpha} E >}_{TR} \ \underbrace{- < \tilde{u_\alpha}\frac{\partial}{\partial x_\beta}\overline{u'_\alpha u'_\beta} >}_{SBGT} \quad + \ldots\end{aligned}$$

The terms of (spectral) transport from resolved to subgrid motions is SBTG in the equation of $< E >$ (sink), and ADVR and DPR in the equation of $< e >$ (sources). One should note that:

$$\text{ADVR} + \text{DPR} = -\text{SGBT}$$

Note in case of gridnesting

In case of 2way gridnesting, the subgrid scheme is not alone to influence the resolved motions due to subgrid scale. Part of the job is done by the averaged of the smaller-scale models. The terms of (spectral) transport from resolved to subgrid motions are then both SBTG and NEST in the equation of $< E >$ (sinks). Therefore

$$\text{ADVR} + \text{D}\hat{\text{P}}\text{R} = -(\text{SGBT} + \text{NEST})$$

Where $\text{D}\hat{\text{P}}\text{R}$ is the dynamical production that should produce the subgrid-scale model to equilibrate the sink at resolved scale.

Field	Process name	Dims	Comments
$-\frac{\partial}{\partial t} < e >$	SBG_TEND	z,t	subgrid (opposite of) tendency of $< e >$
$- < \overline{u'w'} > \frac{\partial}{\partial z} < u > - < \overline{v'w'} > \frac{\partial}{\partial z} < v >$	SBG_DP_M	z,t	subgrid dynamic production by mean gradient
$< -\overline{u'_\alpha u'_\beta} \frac{\partial}{\partial x_\beta} \tilde{u_\alpha} >$	SBG_DP_R	z,t	subgrid dynamic production by resolved fluctuations
$- < w > \frac{\partial}{\partial z} < e >$	SBG_ADVM	z,t	subgrid advection by mean flow
$-W_{forc} \frac{\partial}{\partial z} < e >$	SBG_FORC	z,t	subgrid advection by large-scale W forcing
$- < \frac{\partial}{\partial z} \overline{w'e} >$	SBG_TR	z,t	subgrid turbulent transport
$- < \tilde{u_\alpha} \frac{\partial}{\partial x_\alpha} e >$	SBG_ADVR	z,t	subgrid advection by resolved flow
$-\frac{1}{<\rho>} < \overline{u'_\alpha \frac{\partial p'}{\partial x_\alpha}} >$	SBG_PRES	z,t	subgrid pressure-correlation
$< \beta \overline{w'\theta'_v} >$	SBG_TP	z,t	subgrid thermal production
$- < \epsilon >$	SBG_DISS	z,t	subgrid dissipation
numerical diffusion of $< e >$	SBG_NUMD	z,t	subgrid numerical diffusion against $2\Delta x$
relaxation of $< e >$	SBG_RELA	z,t	subgrid sponge layer relaxation
2way nesting of $< e >$	SBG_NEST	z,t	subgrid average from smaller nested models
Remark: all these processes are written in the BU_KE group of the diachronic file			

Field	Process name	Dims	Comments
miscellaneous	SBG_MISC	z,t	subgrid: other effects
residual of budget of $< e >$	SBG_RESI	z,t	residual of subgrid budget (should be zero)
$-\frac{\partial}{\partial t} < E >$	RES_TEND	z,t	resolved (opposite of) tendency of $< E >$
$- < w > \frac{\partial}{\partial z} < E >$	RES_ADV	z,t	resolved advection by mean flow
$-W_{forc} \frac{\partial}{\partial z} < E >$	RES_FORC	z,t	resolved advection by large-scale W forcing
$- < \tilde{u}\tilde{w} > \frac{\partial}{\partial z} < u > - < \tilde{v}\tilde{w} > \frac{\partial}{\partial z} < v >$	RES_DP	z,t	resolved dynamic production by mean gradient
$-\frac{\partial}{\partial x_\alpha} < \tilde{u_\alpha} E >$	RES_TR	z,t	turbulent transport of resolved flux by itself
$-\frac{1}{<\rho>} < \tilde{u_\alpha} \frac{\partial \tilde{p}}{\partial x_\alpha} >$	RES_PRES_	z,t	resolved pressure-correlation
$< \beta \tilde{w} \tilde{\theta_v} >$	RES_TP	z,t	resolved thermal production
$- < \tilde{u_\alpha} \frac{\partial}{\partial x_\beta} \overline{u'_\alpha u'_\beta} >$	RES_SBGT	z,t	resolved sink due to subgrid turbulence
Coriolis terms	RES_CORI	z,t	resolved Coriolis effect (should be zero for $< E >$)
numerical diffusion of $< E >$	RES_NUMD	z,t	resolved numerical diffusion against $2\Delta x$
relaxation of $< E >$	RES_RELA	z,t	resolved sponge layer relaxation
2way nesting of $< E >$	RES_NEST	z,t	resolved average from smaller nested models
miscellaneous	RES_MISC	z,t	resolved: other effects (curvature terms...)
residual of budget of $< E >$	RES_RESI	z,t	residual of resolved budget (should be zero)
Remark: all these processes are written in the BU_KE group of the diachronic file			

Note that if a term is zero because the process accounting for it is not activated in the model, the term is not listed in the diachronic file. In order to know which terms have been computed and stored, use the command 'print BU_KE proc' in diaprog.

14.2 Budget of total (liquid) temperature flux

All terms of the equation of $\frac{\partial}{\partial t}(< \tilde{w}\tilde{\theta}_l > + < \overline{w'\theta'_l} >)$ are computed and stored in the diachronic group BU_WTHL. All comments made for the total Tke equation are valid here.

$$
\begin{aligned}
\frac{\partial}{\partial t} < \overline{w'\theta'_l} >= \; & \overbrace{- < u_\alpha > \frac{\partial}{\partial x_\alpha} < \overline{w'\theta'_l} >}^{ADVM} \; \overbrace{- < \tilde{u_\alpha} \frac{\partial}{\partial x_\alpha} \overline{w'\theta'_l} >}^{ADVR} \quad \overbrace{- < \overline{u'_\alpha w'} > \frac{\partial < \theta_l >}{\partial x_\alpha} - < \overline{u'_\alpha \theta'_l} > \frac{\partial < w >}{\partial x_\alpha}}^{DPM} \\
& \underbrace{- < \overline{u'_\alpha w'} \frac{\partial \tilde{\theta}_l}{\partial x_\alpha} > - < \overline{u'_\alpha \theta'_l} \frac{\partial \tilde{w}}{\partial x_\alpha} >}_{DPR} + \underbrace{< \beta \overline{\theta'_l \theta'_v} >}_{TP} \quad \underbrace{- \frac{1}{< \rho >} < \overline{\theta'_l \frac{\partial p'}{\partial z}} >}_{PRES} \quad \underbrace{- < \frac{\partial}{\partial x_\alpha} \overline{u'_\alpha w' \theta'_l} >}_{TR}
\end{aligned}
$$

$$
\begin{aligned}
\frac{\partial}{\partial t} < \tilde{w}\tilde{\theta}_l >= \; & \overbrace{- < u_\alpha > \frac{\partial}{\partial x_\alpha} < \tilde{w}\tilde{\theta}_l >}^{ADV} \; \overbrace{- \frac{1}{< \rho >} < \tilde{\theta}_l \frac{\partial \tilde{p}}{\partial x_\alpha} >}^{PRES} \quad \overbrace{- < \tilde{u_\alpha}\tilde{w} > \frac{\partial < \theta_l >}{\partial x_\alpha} - < \tilde{u_\alpha}\tilde{\theta}_l > \frac{\partial < w >}{\partial x_\alpha}}^{DP} \\
& + \underbrace{< \beta \tilde{\theta}_l \tilde{\theta}_v >}_{TP} \quad \underbrace{- \frac{\partial}{\partial x_\alpha} < \tilde{u_\alpha}\tilde{w}\tilde{\theta}_l >}_{TR} \quad \underbrace{- < \tilde{w} \frac{\partial}{\partial x_\alpha} \overline{u'_\alpha \theta'_l} > - < \tilde{\theta}_l \frac{\partial}{\partial x_\alpha} \overline{u'_\alpha w'} >}_{SBGT} + \ldots
\end{aligned}
$$

Field	Process name	Dims	Comments
$- < \overline{w'^2} > \frac{\partial}{\partial z} < \theta_l >$	SBG_DP_M	z,t	subgrid dynamic production by mean gradient
$< -\overline{w'^2} \frac{\partial}{\partial z} \tilde{\theta}_l >$	SBG_DP_R	z,t	subgrid dynamic production by resolved fluctuations
$- < \frac{\partial}{\partial z} \overline{w'^2 \theta'_l} >$	SBG_TR	z,t	subgrid turbulent transport
$-\frac{1}{<\rho>} < \overline{\theta'_l \frac{\partial p'}{\partial z}} >$	SBG_PRES	z,t	subgrid pressure-correlation
$< \beta \overline{\theta'_l \theta'_v} >$	SBG_TP	z,t	subgrid thermal production
residual of budget of $< \overline{w'\theta'_l} >$	SBG_RESI	z,t	residual of subgrid budget (must be small)
$-\frac{\partial}{\partial t} < \tilde{w}\tilde{\theta}_l >$	RES_TEND	z,t	resolved (opposite of) tendency of $< \tilde{w}\tilde{\theta}_l >$
$- < w > \frac{\partial}{\partial z} < \tilde{w}\tilde{\theta}_l >$	RES_ADV	z,t	resolved advection by mean flow
$-W_{forc} \frac{\partial}{\partial z} < \tilde{w}\tilde{\theta}_l >$	RES_FORC	z,t	resolved advection by large-scale W forcing
$- < \tilde{w}^2 > \frac{\partial}{\partial z} < \theta_l > - < \tilde{w}\tilde{\theta}_l > \frac{\partial}{\partial z} < w >$	RES_DP	z,t	resolved dynamic production by mean gradient
$-\frac{\partial}{\partial x_\alpha} < \tilde{u_\alpha}\tilde{w}\tilde{\theta}_l >$	RES_TR	z,t	turbulent transport of resolved flux by itself
Remark: all these processes are written in the BU_WTHL group of the diachronic file			

Field	Process name	Dims	Comments
$-\frac{1}{<\rho>} < \tilde{\theta}_l \frac{\partial \tilde{p}}{\partial z} >$	RES_PRES	z,t	resolved pressure-correlation
$< \beta \tilde{\theta}_l \tilde{\theta}_v >$	RES_TP	z,t	resolved thermal production
$- < \tilde{w} \frac{\partial}{\partial x_\alpha} \overline{u'_\alpha \theta'_l} - < \tilde{\theta}_l \frac{\partial}{\partial x_\alpha} \overline{u'_\alpha w'} >$	RES_SBGT	z,t	resolved sink due to subgrid turbulence
Coriolis terms	RES_CORI	z,t	resolved Coriolis effect
numerical diffusion of $< \tilde{w} \tilde{\theta}_l >$	RES_NUMD	z,t	resolved numerical diffusion against $2\Delta x$
relaxation of $< \tilde{w} \tilde{\theta}_l >$	RES_RELA	z,t	resolved sponge layer relaxation
2way nesting of $< \tilde{w} \tilde{\theta}_l >$	RES_NEST	z,t	resolved average from smaller nested models
miscellaneous	RES_MISC	z,t	resolved: other effects (ref. pressure term, curvature term, microphysics, radiation...)
residual of budget of $< \tilde{w} \tilde{\theta}_l >$	RES_RESI	z,t	residual of resolved budget (should be zero)
$-\frac{\partial}{\partial t} < \overline{w'\theta'_l} >$ (neglected in turb. scheme	NSG_TEND	z,t	neglected opposite of tendency of $< \overline{w'\theta'_l} >$
$- < w > \frac{\partial}{\partial z} < \overline{w'\theta'_l} >$	NSG_ADVM	z,t	neglected advection by mean flow
$- < \tilde{u_\alpha} \frac{\partial}{\partial x_\alpha} \overline{w'\theta'_l} >$	NSG_ADVR	z,t	neglected advection by resolved flow
terms due to $\overline{w}$ gradients	NSG_DPGW	z,t	neglected production by gradient of vertical velocity for subgrid quantity
terms due to hor. $\overline{\theta_l}$ gradients	NSG_DPGT	z,t	neglected production by horizontal gradient of Thl for subgrid quantity
Remark: all these processes are written in the BU_WTHL group of the diachronic file			

14.3 Budget of total (liquid) temperature variance

All terms of the equation of $\frac{\partial}{\partial t}(< \tilde{\theta}_l^{\,2} > + < \overline{\theta_l'^2} >)$ are computed and stored in the diachronic group BU_THL2. All comments made for the total Tke equation are valid here.

$$\frac{\partial}{\partial t} < \overline{\theta_l'^2} >= \underbrace{\overbrace{- < u_\alpha > \frac{\partial}{\partial x_\alpha} < \overline{\theta_l'^2} >}^{ADVM} \quad -2 < \overline{u_\alpha'\theta_l'}\frac{\partial \tilde{\theta}_l}{\partial x_\alpha} >}_{DPR} \quad \underbrace{\overbrace{- < \tilde{u_\alpha}\frac{\partial}{\partial x_\alpha}\overline{\theta_l'^2} >}^{ADVR} \quad - < \frac{\partial}{\partial x_\alpha}\overline{u_\alpha'\theta_l'^2} >}_{TR} \quad \overbrace{-2 < \overline{u_\alpha'\theta_l'} > \frac{\partial < \theta_l >}{\partial x_\alpha}}^{DPM} \quad \underbrace{-\epsilon_\theta}_{DISS}$$

$$\frac{\partial}{\partial t} < \tilde{\theta_l}^2 >= \underbrace{\overbrace{- < u_\alpha > \frac{\partial}{\partial x_\alpha} < \tilde{\theta_l}^2 >}^{ADV} \quad -\frac{\partial}{\partial x_\alpha} < \tilde{u_\alpha}\tilde{\theta_l}^2 >}_{TR} \quad \underbrace{\overbrace{-2 < \tilde{u_\alpha}\tilde{\theta}_l > \frac{\partial < \theta_l >}{\partial x_\alpha}}^{DP} \quad -2 < \tilde{\theta}_l \frac{\partial}{\partial x_\alpha}\overline{u_\alpha'\theta_l'} >}_{SBGT} \quad + \dots$$

Field	Process name	Dims	Comments
$-2 < \overline{w'\theta_l'} > \frac{\partial}{\partial z} < \theta_l >$	SBG_DP_M	z,t	subgrid dynamic production by mean gradient
$< -2\overline{w'\theta_l'}\frac{\partial}{\partial z}\tilde{\theta}_l >$	SBG_DP_R	z,t	subgrid dynamic production by resolved fluctuations
$- < \frac{\partial}{\partial z}\overline{w'\theta_l'^2} >$	SBG_TR	z,t	subgrid turbulent transport
$- < \epsilon_\theta >$	SBG_DISS	z,t	subgrid dissipation
residual of budget of $< \overline{w'\theta_l'} >$	SBG_RESI	z,t	residual of subgrid budget (must be small)
$-\frac{\partial}{\partial t} < \tilde{\theta_l}^2 >$	RES_TEND	z,t	resolved (opposite of) tendency of $< \tilde{\theta_l}^2 >$
$- < w > \frac{\partial}{\partial z} < \tilde{\theta_l}^2 >$	RES_ADV	z,t	resolved advection by mean flow
$-W_{forc}\frac{\partial}{\partial z} < \tilde{\theta_l}^2 >$	RES_FORC	z,t	resolved advection by large-scale W forcing
$- < 2\tilde{w}\tilde{\theta}_l > \frac{\partial}{\partial z} < \theta_l >$	RES_DP	z,t	resolved dynamic production by mean gradient
$-\frac{\partial}{\partial x_\alpha} < \tilde{u_\alpha}\tilde{\theta_l}^2 >$	RES_TR	z,t	turbulent transport of resolved flux by itself
$- < 2\tilde{\theta}_l\frac{\partial}{\partial x_\alpha}\overline{u_\alpha'\theta_l'} >$	RES_SBGT	z,t	resolved sink due to subgrid turbulence
numerical diffusion of $< \tilde{\theta_l}^2 >$	RES_NUMD	z,t	resolved numerical diffusion against $2\Delta x$
relaxation of $< \tilde{\theta_l}^2 >$	RES_RELA	z,t	resolved sponge layer relaxation
Remark: all these processes are written in the BU_THL2 group of the diachronic file			

Field	Process name	Dims	Comments
2way nesting of $<\tilde{\theta_l}^2>$	RES_NEST	z,t	resolved average from smaller nested models
miscellaneous	RES_MISC	z,t	resolved: other effects (ref. pressure term, radiation, microphysics...)
residual of budget of $<\tilde{\theta_l}^2>$	RES_RESI	z,t	residual of resolved budget (should be zero)
$-\frac{\partial}{\partial t}<\overline{\theta_l'^2}>$ (neglected in turb. scheme)	NSG_TEND	z,t	neglected opposite of tendency of $<\overline{\theta_l'^2}>$
$-<w>\frac{\partial}{\partial z}<\overline{\theta_l'^2}>$	NSG_ADVM	z,t	neglected advection by mean flow
$-<\tilde{u_\alpha}\frac{\partial}{\partial x_\alpha}\overline{\theta_l'^2}>$	NSG_ADVR	z,t	neglected advection by resolved flow
Remark: all these processes are written in the BU_THL2 group of the diachronic file			

14.4 Budget of total water flux

All terms of the equation of $\frac{\partial}{\partial t}(<\tilde{w}\tilde{r_t}>+<\overline{w'r_t'}>)$ are computed and stored in the diachronic group BU_WRT. All comments made for the total Tke equation are valid here.

$$
\begin{aligned}
\frac{\partial}{\partial t}<\overline{w'r_t'}>= \; & \overbrace{-<u_\alpha>\frac{\partial}{\partial x_\alpha}<\overline{w'r_t'}>}^{ADVM}\;\overbrace{-<\tilde{u_\alpha}\frac{\partial}{\partial x_\alpha}\overline{w'r_t'}>}^{ADVR}\;\overbrace{-<\overline{u_\alpha'w'}>\frac{\partial<r_t>}{\partial x_\alpha}-<\overline{u_\alpha'r_t'}>\frac{\partial<w>}{\partial x_\alpha}}^{DPM} \\
& \underbrace{-<\overline{u_\alpha'w'}\frac{\partial\tilde{r_t}}{\partial x_\alpha}>-<\overline{u_\alpha'r_t'}\frac{\partial\tilde{w}}{\partial x_\alpha}>}_{DPR}+\underbrace{<\beta\overline{r_t'\theta_v'}>}_{TP}\;\underbrace{-\frac{1}{<\rho>}<\overline{r_t'\frac{\partial p'}{\partial z}}>}_{PRES}\;\underbrace{-<\frac{\partial}{\partial x_\alpha}\overline{u_\alpha'w'r_t'}>}_{TR}
\end{aligned}
$$

$$
\begin{aligned}
\frac{\partial}{\partial t}<\tilde{w}\tilde{r_t}>= \; & \overbrace{-<u_\alpha>\frac{\partial}{\partial x_\alpha}<\tilde{w}\tilde{r_t}>}^{ADV}\;\overbrace{-\frac{1}{<\rho>}<\tilde{r_t}\frac{\partial\tilde{p}}{\partial x_\alpha}>}^{PRES}\;\overbrace{-<\tilde{u_\alpha}\tilde{w}>\frac{\partial<r_t>}{\partial x_\alpha}-<\tilde{u_\alpha}\tilde{r_t}>\frac{\partial<w>}{\partial x_\alpha}}^{DP} \\
& +\underbrace{<\beta\tilde{r_t}\tilde{\theta_v}>}_{TP}\;\underbrace{-\frac{\partial}{\partial x_\alpha}<\tilde{u_\alpha}\tilde{w}\tilde{r_t}>}_{TR}\;\underbrace{-<\tilde{w}\frac{\partial}{\partial x_\alpha}\overline{u_\alpha'r_t'}>-<\tilde{r_t}\frac{\partial}{\partial x_\alpha}\overline{u_\alpha'w'}>+\ldots}_{SBGT}
\end{aligned}
$$

Field	Process name	Dims	Comments
$-<\overline{w'^2}>\frac{\partial}{\partial z}<r_t>$	SBG_DP_M	z,t	subgrid dynamic production by mean gradient
$<-\overline{w'^2}\frac{\partial}{\partial z}\tilde{r_t}>$	SBG_DP_R	z,t	subgrid dynamic production by resolved fluctuations
Remark: all these processes are written in the BU_WRT group of the diachronic file			

Field	Process name	Dims	Comments
$-<\frac{\partial}{\partial z}\overline{w'^2 r'_t}>$	SBG_TR	z,t	subgrid turbulent transport
$-\frac{1}{<\rho>}<\overline{r'_t\frac{\partial p'}{\partial z}}>$	SBG_PRES	z,t	subgrid pressure-correlation
$<\beta\overline{r'_t\theta'_v}>$	SBG_TP	z,t	subgrid thermal production
residual of budget of $<\overline{w'r'_t}>$	SBG_RESI	z,t	residual of subgrid budget (must be small)
$-\frac{\partial}{\partial t}<\tilde{w}\tilde{r}_t>$	RES_TEND	z,t	resolved (opposite of) tendency of $<\tilde{w}\tilde{r}_t>$
$-<w>\frac{\partial}{\partial z}<\tilde{w}\tilde{r}_t>$	RES_ADV	z,t	resolved advection by mean flow
$-W_{forc}\frac{\partial}{\partial z}<\tilde{w}\tilde{r}_t>$	RES_FORC	z,t	resolved advection by large-scale W forcing
$-<\tilde{w}^2>\frac{\partial}{\partial z}<r_t>-<\tilde{w}\tilde{r}_t>\frac{\partial}{\partial z}<w>$	RES_DP	z,t	resolved dynamic production by mean gradient
$-\frac{\partial}{\partial x_\alpha}<\tilde{u_\alpha}\tilde{w}\tilde{r}_t>$	RES_TR	z,t	turbulent transport of resolved flux by itself
$-\frac{1}{<\rho>}<\tilde{r}_t\frac{\partial\tilde{p}}{\partial z}>$	RES_PRES_	z,t	resolved pressure-correlation
$<\beta\tilde{r}_t\tilde{\theta}_v>$	RES_TP	z,t	resolved thermal production
$-<\tilde{w}\frac{\partial}{\partial x_\alpha}\overline{u'_\alpha r'_t}>-<\tilde{r}_t\frac{\partial}{\partial x_\alpha}\overline{u'_\alpha w'}>$	RES_SBGT	z,t	resolved sink due to subgrid turbulence
Coriolis terms	RES_CORI	z,t	resolved Coriolis effect
numerical diffusion of $<\tilde{w}\tilde{r}_t>$	RES_NUMD	z,t	resolved numerical diffusion against $2\Delta x$
relaxation of $<\tilde{w}\tilde{r}_t>$	RES_RELA	z,t	resolved sponge layer relaxation
2way nesting of $<\tilde{w}\tilde{r}_t>$	RES_NEST	z,t	resolved average from smaller nested models
miscellaneous	RES_MISC	z,t	resolved: other effects (ref. pressure term, curvature term, radiation, microphysics...)
residual of budget of $<\tilde{w}\tilde{r}_t>$	RES_RESI	z,t	residual of resolved budget (should be zero)
$-\frac{\partial}{\partial t}<\overline{w'r'_t}>$ (neglected in turb. scheme)	NSG_TEND	z,t	neglected opposite of tendency of $<\overline{w'r'_t}>$
$-<w>\frac{\partial}{\partial z}<\overline{w'r'_t}>$	NSG_ADVM	z,t	neglected advection by mean flow
$-<\tilde{u_\alpha}\frac{\partial}{\partial x_\alpha}\overline{w'r'_t}>$	NSG_ADVR	z,t	neglected advection by resolved flow
Remark: all these processes are written in the BU_WRT group of the diachronic file			

Field	Process name	Dims	Comments
terms due to $\overline{w}$ gradients	NSG_DPGW	z,t	neglected production by gradient of vertical velocity for subgrid quantity
terms due to hor. $\overline{r_t}$ gradients	NSG_DPGT	z,t	neglected production by horizontal gradient of Thl for subgrid quantity
Remark: all these processes are written in the BU_WRT group of the diachronic file			

14.5 Budget of liquid temperature - total water covariance

All terms of the equation of $\frac{\partial}{\partial t}(<\tilde{\theta}_l\tilde{r}_t> + <\overline{\theta_l' r_t'}>)$ are computed and stored in the diachronic group BU_THLR. All comments made for the total Tke equation are valid here.

$$\frac{\partial}{\partial t}<\overline{\theta_l' r_t'}>= \overbrace{-<u_\alpha>\frac{\partial}{\partial x_\alpha}<\overline{\theta_l' r_t'}>}^{ADVM} \overbrace{-<\tilde{u_\alpha}\frac{\partial}{\partial x_\alpha}\overline{\theta_l' r_t'}>}^{ADVR} \overbrace{-<\overline{u_\alpha'\theta_l'}>\frac{\partial<r_t>}{\partial x_\alpha}-<\overline{u_\alpha' r_t'}>\frac{\partial<\theta_l>}{\partial x_\alpha}}^{DPM}$$

$$\underbrace{-<\overline{u_\alpha'\theta_l'}\frac{\partial\tilde{r}_t}{\partial x_\alpha}>-<\overline{u_\alpha' r_t'}\frac{\partial\tilde{\theta}_l}{\partial x_\alpha}>}_{DPR} \underbrace{-<\frac{\partial}{\partial x_\alpha}\overline{u_\alpha'\theta_l' r_t'}>}_{TR} \underbrace{-\epsilon_{\theta r}}_{DISS}$$

$$\frac{\partial}{\partial t}<\tilde{\theta}_l\tilde{r}_t>= \overbrace{-<u_\alpha>\frac{\partial}{\partial x_\alpha}<\tilde{\theta}_l\tilde{r}_t>}^{ADV} \overbrace{-<\tilde{u_\alpha}\tilde{\theta}_l>\frac{\partial<r_t>}{\partial x_\alpha}-<\tilde{u_\alpha}\tilde{r}_t>\frac{\partial<\theta_l>}{\partial x_\alpha}}^{DP}$$

$$\underbrace{-\frac{\partial}{\partial x_\alpha}<\tilde{u_\alpha}\tilde{\theta}_l\tilde{r}_t>}_{TR} \underbrace{-<\tilde{\theta}_l\frac{\partial}{\partial x_\alpha}\overline{u_\alpha' r_t'}>-<\tilde{r}_t\frac{\partial}{\partial x_\alpha}\overline{u_\alpha'\theta_l'}>}_{SBGT} +$$

Field	Process name	Dims	Comments
$-<\overline{w'\theta_l'}>\frac{\partial}{\partial z}<r_t>-<\overline{w'r_t'}>\frac{\partial}{\partial z}<\theta_l>$	SBG_DP_M	z,t	subgrid dynamic production by mean gradient
$<-\overline{u_\alpha'\theta_l'}\frac{\partial}{\partial x_\alpha}\tilde{r}_t><-\overline{u_\alpha' r_t'}\frac{\partial}{\partial x_\alpha}\tilde{\theta}_l>$	SBG_DP_R	z,t	subgrid dynamic production by resolved fluctuations
$-<\frac{\partial}{\partial z}\overline{w'\theta_l' r_t'}>$	SBG_TR	z,t	subgrid turbulent transport
$-<\epsilon_{\theta r}>$	SBG_DISS	z,t	subgrid dissipation
residual of budget of $<\overline{w'\theta_l' r_t'}>$	SBG_RESI	z,t	residual of subgrid budget (must be small)
$-\frac{\partial}{\partial t}<\tilde{\theta}_l\tilde{r}_t>$	RES_TEND	z,t	resolved (opposite of) tendency of $<\tilde{\theta}_l\tilde{r}_t>$
Remark: all these processes are written in the BU_THLR group of the diachronic file			

Field	Process name	Dims	Comments
$- < w > \frac{\partial}{\partial z} < \tilde{\theta}_l \tilde{r}_t >$	RES_ADV	z,t	resolved advection by mean flow
$-W_{forc} \frac{\partial}{\partial z} < \tilde{\theta}_l \tilde{r}_t >$	RES_FORC	z,t	resolved advection by large-scale W forcing
$- < \tilde{w}\tilde{\theta}_l > \frac{\partial}{\partial z} < r_t > - < \tilde{w}\tilde{r}_t > \frac{\partial}{\partial z} < \theta_l >$	RES_DP	z,t	resolved dynamic production by mean gradient
$-\frac{\partial}{\partial x_\alpha} < \tilde{u_\alpha}\tilde{\theta}_l \tilde{r}_t >$	RES_TR	z,t	turbulent transport of resolved flux by itself
$- < \tilde{\theta}_l \frac{\partial}{\partial x_\alpha} \overline{u'_\alpha r'_t} > - < \tilde{r}_t \frac{\partial}{\partial x_\alpha} \overline{u'_\alpha \theta'_l} >$	RES_SBGT	z,t	resolved sink due to subgrid turbulence
numerical diffusion of $< \tilde{\theta}_l \tilde{r}_t >$	RES_NUMD	z,t	resolved numerical diffusion against $2\Delta x$
relaxation of $< \tilde{\theta}_l \tilde{r}_t >$	RES_RELA	z,t	resolved sponge layer relaxation
2way nesting of $< \tilde{\theta}_l \tilde{r}_t >$	RES_NEST	z,t	resolved average from smaller nested models
miscellaneous	RES_MISC	z,t	resolved: other effects (ref. pressure term, radiation, microphysics...)
residual of budget of $< \tilde{\theta}_l \tilde{r}_t >$	RES_RESI	z,t	residual of resolved budget (should be zero)
$-\frac{\partial}{\partial t} < \overline{\theta'_l r'_t} >$ (neglected in turb. scheme)	NSG_TEND	z,t	neglected opposite of tendency of $< \overline{w' r'_t} >$
$- < w > \frac{\partial}{\partial z} < \overline{\theta'_l r'_t} >$	NSG_ADVM	z,t	neglected advection by mean flow
$- < \tilde{u_\alpha} \frac{\partial}{\partial x_\alpha} \overline{\theta'_l r'_t} >$	NSG_ADVR	z,t	neglected advection by resolved flow
Remark: all these processes are written in the BU_THLR group of the diachronic file			

14.6 Budget of total water variance

All terms of the equation of $\frac{\partial}{\partial t}(< \tilde{r_t}^2 > + < \overline{r_t'^2} >)$ are computed and stored in the diachronic group BU_RT2. All comments made for the total Tke equation are valid here.

$$\frac{\partial}{\partial t} < \overline{r_t'^2} >= \overbrace{- < u_\alpha > \frac{\partial}{\partial x_\alpha} < \overline{r_t'^2} >}^{ADVM} \overbrace{- < \tilde{u_\alpha} \frac{\partial}{\partial x_\alpha} \overline{r_t'^2} >}^{ADVR} \overbrace{-2 < \overline{u_\alpha' r_t'} > \frac{\partial < r_t >}{\partial x_\alpha}}^{DPM}$$

$$\underbrace{-2 < \overline{u_\alpha' r_t'} \frac{\partial \tilde{r}_t}{\partial x_\alpha} >}_{DPR} \underbrace{- < \frac{\partial}{\partial x_\alpha} \overline{u_\alpha' r_t'^2} >}_{TR} \underbrace{- \epsilon_r}_{DISS}$$

$$\frac{\partial}{\partial t} < \tilde{r_t}^2 >= \overbrace{- < u_\alpha > \frac{\partial}{\partial x_\alpha} < \tilde{r_t}^2 >}^{ADV} \overbrace{-2 < \tilde{u_\alpha} \tilde{r_t} > \frac{\partial < r_t >}{\partial x_\alpha}}^{DP}$$

$$\underbrace{- \frac{\partial}{\partial x_\alpha} < \tilde{u_\alpha} \tilde{r_t}^2 >}_{TR} \underbrace{-2 < \tilde{r}_t \frac{\partial}{\partial x_\alpha} \overline{u_\alpha' r_t'} >}_{SBGT} + \dots$$

Field	Process name	Dims	Comments
$-2 < \overline{w' r_t'} > \frac{\partial}{\partial z} < r_t >$	SBG_DP_M	z,t	subgrid dynamic production by mean gradient
$< -2 \overline{w' r_t'} \frac{\partial}{\partial z} \tilde{r}_t >$	SBG_DP_R	z,t	subgrid dynamic production by resolved fluctuations
$- < \frac{\partial}{\partial z} \overline{w' r_t'^2} >$	SBG_TR	z,t	subgrid turbulent transport
$- < \epsilon_r >$	SBG_DISS	z,t	subgrid dissipation
residual of budget	SBG_RESI	z,t	residual of subgrid budget (should be zero)
$- \frac{\partial}{\partial t} < \tilde{r_t}^2 >$	RES_TEND	z,t	resolved (opposite of) tendency of $< \tilde{r_t}^2 >$
$- < w > \frac{\partial}{\partial z} < \tilde{r_t}^2 >$	RES_ADV	z,t	resolved advection by mean flow
$-W_{forc} \frac{\partial}{\partial z} < \tilde{r_t}^2 >$	RES_FORC	z,t	resolved advection by large-scale W forcing
$- < 2 \tilde{w} \tilde{\theta_l} > \frac{\partial}{\partial z} < r_t >$	RES_DP	z,t	resolved dynamic production by mean gradient
$- \frac{\partial}{\partial x_\alpha} < \tilde{u_\alpha} \tilde{r_t}^2 >$	RES_TR	z,t	turbulent transport of resolved flux by itself
$- < 2 \tilde{r}_t \frac{\partial}{\partial x_\alpha} \overline{u_\alpha' r_t'} >$	RES_SBGT	z,t	resolved sink due to subgrid turbulence
numerical diffusion of $< \tilde{r_t}^2 >$	RES_NUMD	z,t	nresolved umerical diffusion against $2\Delta x$
relaxation of $< \tilde{r_t}^2 >$	RES_RELA	z,t	resolved sponge layer relaxation
Remark: all these processes are written in the BU_RT2 group of the diachronic file			

Field	Process name	Dims	Comments
2way nesting of $<\tilde{r_t}^2>$	RES_NEST	z,t	resolved average from smaller nested models
miscellaneous	RES_MISC	z,t	resolved: other effects (ref. pressure term, radiation, microphysics...)
residual of budget of $<\tilde{r_t}^2>$	RES_RESI	z,t	residual of resolved budget (should be zero)
$-\frac{\partial}{\partial t} < \overline{r_t'^2} >$ (neglected in turb. scheme)	NSG_TEND	z,t	neglected opposite of tendency of $<\overline{r_t'^2}>$
$-<w>\frac{\partial}{\partial z}<\overline{r_t'^2}>$	NSG_ADVM	z,t	neglected advection by mean flow
$-<\tilde{u_\alpha}\frac{\partial}{\partial x_\alpha}\overline{r_t'^2}>$	NSG_ADVR	z,t	neglected advection by resolved flow
Remark: all these processes are written in the BU_RT2 group of the diachronic file			

14.7 Budget of total scalar flux

All terms of the equation of $\frac{\partial}{\partial t}(<\tilde{w}\tilde{s_v}>+<\overline{w's_v'}>)$ are computed and stored in the diachronic group BU_WSV. All comments made for the total Tke equation are valid here.

$$\begin{aligned}
\frac{\partial}{\partial t}<\overline{w's_v'}>= & \overbrace{-<u_\alpha>\frac{\partial}{\partial x_\alpha}<\overline{w's_v'}>}^{ADVM}\ \overbrace{-<\tilde{u_\alpha}\frac{\partial}{\partial x_\alpha}\overline{w's_v'}>}^{ADVR}\ \overbrace{-<\overline{u_\alpha'w'}\frac{\partial\tilde{s_v}}{\partial x_\alpha}>-<\overline{u_\alpha's_v'}\frac{\partial\tilde{w}}{\partial x_\alpha}>}^{DPR} \\
& \underbrace{-<\overline{u_\alpha'w'}>\frac{\partial<s_v>}{\partial x_\alpha}-<\overline{u_\alpha's_v'}>\frac{\partial<w>}{\partial x_\alpha}}_{DPM}\ +\underbrace{<\beta\overline{s_v'\theta_v'}>}_{TP}\ \underbrace{-\frac{1}{<\rho>}<\overline{s_v'\frac{\partial p'}{\partial z}}>}_{PRES} \\
& \underbrace{-<\frac{\partial}{\partial x_\alpha}\overline{u_\alpha'w's_v'}>}_{TR}
\end{aligned}$$

$$\begin{aligned}
\frac{\partial}{\partial t}<\tilde{w}\tilde{s_v}>= & \overbrace{-<u_\alpha>\frac{\partial}{\partial x_\alpha}<\tilde{w}\tilde{s_v}>}^{ADV}\ \overbrace{-\frac{1}{<\rho>}<\tilde{s_v}\frac{\partial\tilde{p}}{\partial x_\alpha}>}^{PRES}\ +\overbrace{<\beta\tilde{s_v}\tilde{\theta_v}>}^{TP} \\
& \underbrace{-<\tilde{w}\frac{\partial}{\partial x_\alpha}\overline{u_\alpha's_v'}>-<\tilde{s_v}\frac{\partial}{\partial x_\alpha}\overline{u_\alpha'w'}>}_{SBGT}\ \underbrace{-\frac{\partial}{\partial x_\alpha}<\tilde{u_\alpha}\tilde{w}\tilde{s_v}>}_{TR} \\
& \underbrace{-<\tilde{u_\alpha}\tilde{w}>\frac{\partial<s_v>}{\partial x_\alpha}-<\tilde{u_\alpha}\tilde{s_v}>\frac{\partial<w>}{\partial x_\alpha}}_{DP}\ +\dots
\end{aligned}$$

Field	Process name	Dims	Comments
$-<\overline{w'^2}>\frac{\partial}{\partial z}<s_v>$	SBG_DP_M	z,t,n	subgrid dynamic production by mean gradient
$<-\overline{w'^2}\frac{\partial}{\partial z}\tilde{s_v}>$	SBG_DP_R	z,t,n	subgrid dynamic production by resolved fluctuations
$-<\frac{\partial}{\partial z}\overline{w'^2 s_v'}>$	SBG_TR	z,t,n	subgrid turbulent transport
$-\frac{1}{<\rho>}<\overline{s_v'\frac{\partial p'}{\partial z}}>$	SBG_PRES	z,t,n	subgrid pressure-correlation
$<\beta\overline{s_v'\theta_v'}>$	SBG_TP	z,t,n	subgrid thermal production
residual of budget of $<\overline{w's_v'}>$	SBG_RESI	z,t,n	residual of subgrid budget (must be small)
$-\frac{\partial}{\partial t}<\tilde{w}\tilde{s_v}>$	RES_TEND	z,t,n	resolved (opposite of) tendency of $<\tilde{w}\tilde{s_v}>$
$-<w>\frac{\partial}{\partial z}<\tilde{w}\tilde{s_v}>$	RES_ADV	z,t,n	resolved advection by mean flow
$-W_{forc}\frac{\partial}{\partial z}<\tilde{w}\tilde{s_v}>$	RES_FORC	z,t,n	resolved advection by large-scale W forcing
$-<\tilde{w}^2>\frac{\partial}{\partial z}<s_v>-<\tilde{w}\tilde{s_v}>\frac{\partial}{\partial z}<w>$	RES_DP	z,t,n	resolved dynamic production by mean gradient
$-\frac{\partial}{\partial x_\alpha}<\tilde{u_\alpha}\tilde{w}\tilde{s_v}>$	RES_TR	z,t,n	turbulent transport of resolved flux by itself
$-\frac{1}{<\rho>}<\tilde{s_v}\frac{\partial\tilde{p}}{\partial z}>$	RES_PRES	z,t,n	resolved pressure-correlation
$<\beta\tilde{s_v}\tilde{\theta_v}>$	RES_TP	z,t,n	resolved thermal production
$-<\tilde{w}\frac{\partial}{\partial x_\alpha}\overline{u_\alpha' s_v'}>-<\tilde{s_v}\frac{\partial}{\partial x_\alpha}\overline{u_\alpha' w'}>$	RES_SBGT	z,t,n	resolved sink due to subgrid turbulence
Coriolis terms	RES_CORI	z,t,n	resolved Coriolis effect
numerical diffusion of $<\tilde{w}\tilde{s_v}>$	RES_NUMD	z,t,n	resolved numerical diffusion against $2\Delta x$
relaxation of $<\tilde{w}\tilde{s_v}>$	RES_RELA	z,t,n	resolved sponge layer relaxation
2way nesting of $<\tilde{w}\tilde{s_v}>$	RES_NEST	z,t,n	resolved average from smaller nested models
miscellaneous	RES_MISC	z,t,n	resolved: other effects (curvature term, chemistry…)
residual of budget of $<\tilde{w}\tilde{s_v}>$	RES_RESI	z,t,n	residual of resolved budget (should be zero)
Remark: all these processes are written in the BU_WSV group of the diachronic file			

Field	Process name	Dims	Comments
$-\frac{\partial}{\partial t} < \overline{w's_v'} >$ (neglected in turb. scheme)	NSG_TEND	z,t,n	neglected opposite of tendency of $< \overline{w's_v'} >$
$- < w > \frac{\partial}{\partial z} < \overline{w's_v'} >$	NSG_ADVM	z,t,n	neglected advection by mean flow
$- < \tilde{u_\alpha} \frac{\partial}{\partial x_\alpha} \overline{w's_v'} >$	NSG_ADVR	z,t,n	neglected advection by resolved flow
terms due to $\overline{w}$ gradients	NSG_DPGW	z,t,n	neglected production by gradient of vertical velocity for subgrid quantity
terms due to hor. $\overline{s_v}$ gradients	NSG_DPGT	z,t,n	neglected production by horizontal gradient of Thl for subgrid quantity
Remark: all these processes are written in the BU_WSV group of the diachronic file			

14.8 Budget of total scalar variance

All terms of the equation of $\frac{\partial}{\partial t}(< \tilde{s_v}^2 > + < \overline{s_v'^2} >)$ are computed and stored in the diachronic group BU_SV2. All comments made for the total Tke equation are valid here.

$$\frac{\partial}{\partial t} < \overline{s_v'^2} > = \overbrace{- < u_\alpha > \frac{\partial}{\partial x_\alpha} < \overline{s_v'^2} >}^{ADVM} \overbrace{- < \tilde{u_\alpha} \frac{\partial}{\partial x_\alpha} \overline{s_v'^2} >}^{ADVR} \overbrace{-2 < \overline{u_\alpha' s_v'} > \frac{\partial < s_v >}{\partial x_\alpha}}^{DPM}$$
$$\underbrace{-2 < \overline{u_\alpha' s_v'} \frac{\partial \tilde{s_v}}{\partial x_\alpha} >}_{DPR} \underbrace{- < \frac{\partial}{\partial x_\alpha} \overline{u_\alpha' s_v'^2} >}_{TR} \underbrace{- \epsilon_{s_v}}_{DISS}$$

$$\frac{\partial}{\partial t} < \tilde{s_v}^2 > = \overbrace{- < u_\alpha > \frac{\partial}{\partial x_\alpha} < \tilde{s_v}^2 >}^{ADV} \overbrace{-2 < \tilde{u_\alpha} \tilde{s_v} > \frac{\partial < s_v >}{\partial x_\alpha}}^{DP}$$
$$\underbrace{- \frac{\partial}{\partial x_\alpha} < \tilde{u_\alpha} \tilde{s_v}^2 >}_{TR} \underbrace{-2 < \tilde{s_v} \frac{\partial}{\partial x_\alpha} \overline{u_\alpha' s_v'} >}_{SBGT} + \dots$$

Field	Process name	Dims	Comments
$-2 < \overline{w's_v'} > \frac{\partial}{\partial z} < s_v >$	SBG_DP_M	z,t,n	subgrid dynamic production by mean gradient
$< -2\overline{w's_v'} \frac{\partial}{\partial z} \tilde{s_v} >$	SBG_DP_R	z,t,n	subgrid dynamic production by resolved fluctuations
$- < \frac{\partial}{\partial z} \overline{w's_v'^2} >$	SBG_TR	z,t,n	subgrid turbulent transport
$- < \epsilon_{s_v} >$	SBG_DISS	z,t,n	subgrid dissipation
Remark: all these processes are written in the BU_SV2 group of the diachronic file			

Field	Process name	Dims	Comments
residual of budget of $<\overline{w's'_v}>$	SBG_RESI	z,t,n	residual of subgrid budget (must be small)
$-\frac{\partial}{\partial t}<\tilde{s_v}^2>$	RES_TEND	z,t,n	resolved (opposite of) tendency of $<\tilde{s_v}^2>$
$-<w>\frac{\partial}{\partial z}<\tilde{s_v}^2>$	RES_ADV	z,t,n	resolved advection by mean flow
$-W_{forc}\frac{\partial}{\partial z}<\tilde{s_v}^2>$	RES_FORC	z,t,n	resolved advection by large-scale W forcing
$-<2\tilde{w}\tilde{\theta_l}>\frac{\partial}{\partial z}<s_v>$	RES_DP	z,t,n	resolved dynamic production by mean gradient
$-\frac{\partial}{\partial x_\alpha}<\tilde{u_\alpha}\tilde{s_v}^2>$	RES_TR	z,t,n	turbulent transport of resolved flux by itself
$-<2\tilde{s_v}\frac{\partial}{\partial x_\alpha}\overline{u'_\alpha s'_v}>$	RES_SBGT	z,t,n	resolved sink due to subgrid turbulence
numerical diffusion of $<\tilde{s_v}^2>$	RES_NUMD	z,t,n	resolved numerical diffusion against $2\Delta x$
relaxation of $<\tilde{s_v}^2>$	RES_RELA	z,t,n	resolved sponge layer relaxation
2way nesting of $<\tilde{s_v}^2>$	RES_NEST	z,t,n	resolved average from smaller nested models
miscellaneous	RES_MISC	z,t,n	resolved: other effects (chemistry. . .)
residual of budget of $<\tilde{s_v}^2>$	RES_RESI	z,t,n	residual of resolved budget (should be zero)
$-\frac{\partial}{\partial t}<\overline{s_v'^2}>$ (neglected in turb. scheme)	NSG_TEND	z,t,n	neglected opposite of tendency of $<\overline{s_v'^2}>$
$-<w>\frac{\partial}{\partial z}<\overline{s_v'^2}>$	NSG_ADVM	z,t,n	neglected advection by mean flow
$-<\tilde{u_\alpha}\frac{\partial}{\partial x_\alpha}\overline{s_v'^2}>$	NSG_ADVR	z,t,n	neglected advection by resolved flow
Remark: all these processes are written in the BU_SV2 group of the diachronic file			