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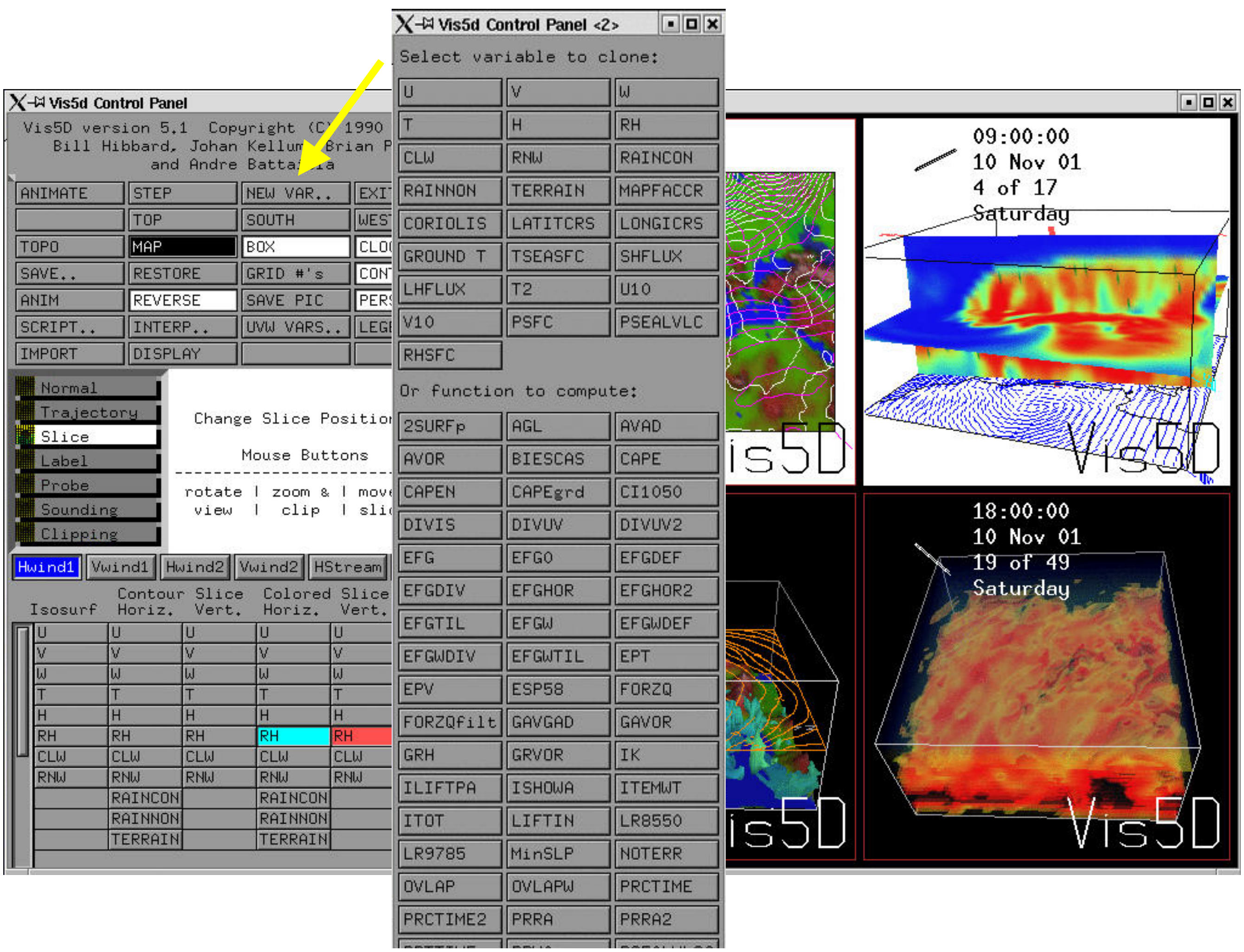
VIS5D EXTERNAL ANALYSIS FUNCTIONS FOR METEOROLOGICAL DIAGNOSIS OF MM5-v3 OUTPUT FIELDS

An external analysis function is a function written by you in FORTRAN which is called by Vis5D to produce a new variable as a function of the existing variables (NEW VAR button; see the example below). When you call your function from within vis5d, the function will be invoked once for each time step. The external function feature is intended for experienced Vis5D users who are also proficient FORTRAN programmers.



All external functions must be placed in a directory named "userfuncs" (this may be changed in the vis5d.h file) that is created when you install Vis5D on your computer system. This is relative to the current directory when you run vis5d. For example, suppose you always run vis5d while in "/usr/MM5user/superstorm_simulation", then your external analysis functions must be in "/usr/MM5user/superstorm_simulation/userfuncs". Also, this directory contains scripts "externf" and “externf_all” which are used to compile your functions.

Suppose you want your function to be named "CAPE". Then the name of the FORTRAN program must be "CAPE.f". You would compile the function by typing "externf CAPE" (if you type “externf_all” all functions would be compiled). If there are no errors, an executable file "CAPE" will be written. Then in vis5d when you select NEW VAR, "CAPE" should appear in the list of functions in the pop-up window.

A number of **2D** and **3D** external analysis functions (FORTRAN programs) are here provided, which are designed for the dynamical and thermodynamical diagnosis of MM5-v3 output meteorological fields (see the scheme below). These analysis functions are described in the corresponding tables.

Of course, you can write your own external function. In such case, it's best to copy one of the supplied examples and then modify it.

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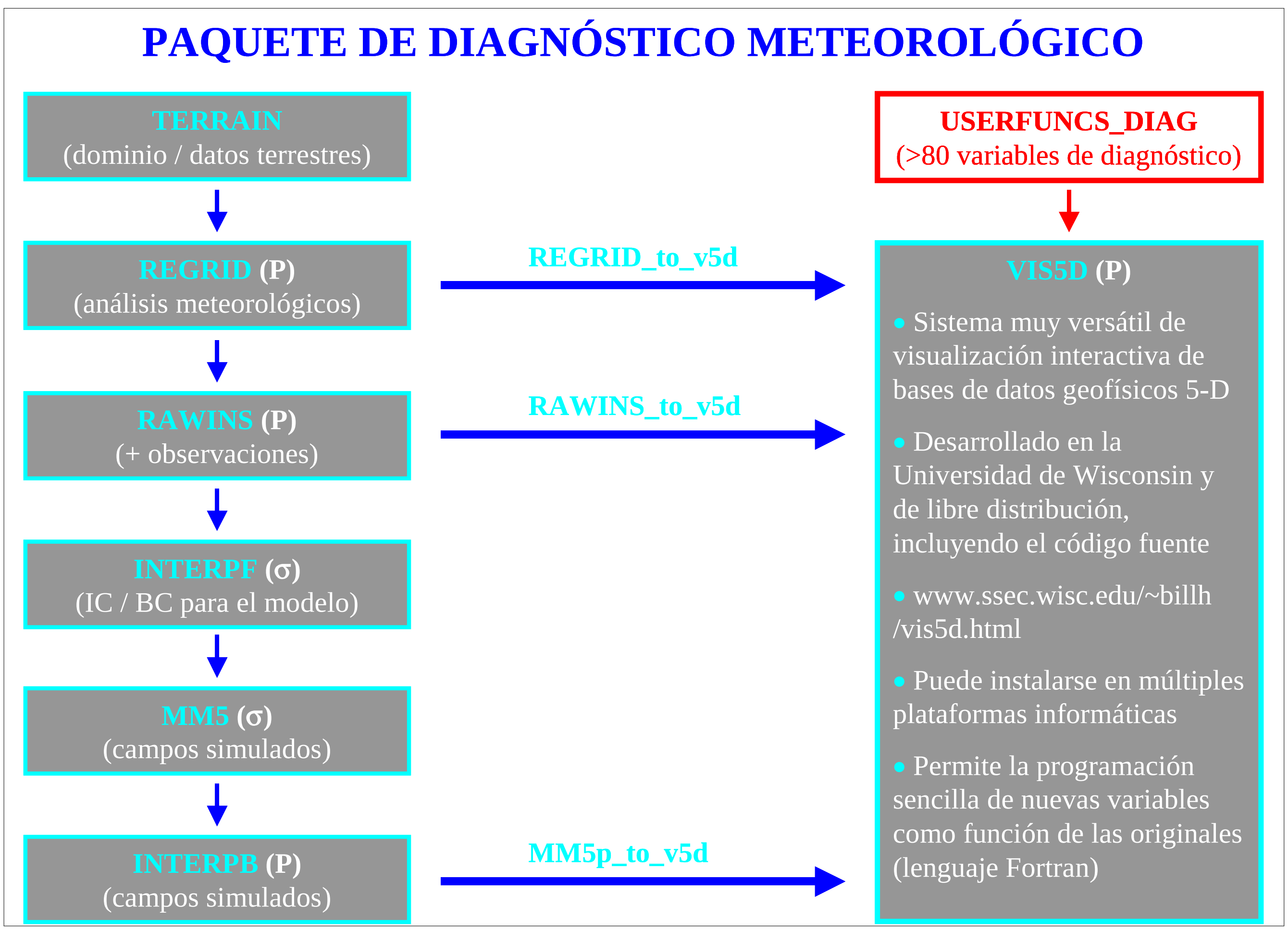

2D field	Physical meaning	Units	Necessary fields
CAPE	Convective available potential energy	J kg^{-1}	T, RH, H
CAPEN	Convection inhibition energy	J kg^{-1}	T, RH, H
CI1050	Convective instability in the layer 1000-500 hPa (- instability, + stability)	°C	T, RH
FQ1070	Vertical average of FORZQfil in the lower troposphere (1000-700 hPa)	10^{-18} m kg^{-1} s^{-1}	FORZQfil
FQ7020	Vertical average of FORZQfil in the mid-upper troposphere (700-200 hPa)	10^{-18} m kg^{-1} s^{-1}	FORZQfil
ErPV_Is	Ertel potential vorticity (interpolated to an isentropic surface defined in subroutine)	PV units	T, ErPV
ESP58	Thickness 500-850 hPa	m	H
GRH	Ground relative helicity	m^2 s^{-2}	U,V
IK	K index	°C	T, RH
ILIFTPA	Lifted parcel index	°C	T, RH
ISHOWA	Showalter index	°C	T, RH
ITEMWT	Wet bulb potential temperature index	°C	T, RH
ITOT	Total totals index	°C	T, RH
LIFTIN	Lifted index	°C	T, RH, H
LR8550	Temperature lapse rate between 850 and 500 hPa	K km^{-1}	H, T
LR9785	Temperature lapse rate between 975 and 850 hPa	K km^{-1}	H, T
OVLAP	Favourable area for convection development, where FORZQ(850)>0, CI1050<0 and WVFD85<0 overlap (- unfavourable, + favourable)	No units	FORZQ, CI1050, WVFD85
OVLAPW	Favourable area for convection development, where W(700)>0, CI1050<0 and WVFD85<0 overlap (- unfavourable, + favourable)	No units	W, CI1050, WVFD85
PRWA	Precipitable water	mm	T, RH
QWSLOPE	Upslope vertical moisture flux (- downslope, + upslope)	10^{-2} g m^{-2} s^{-1}	U, V, TERRAIN, T, RH, MAPFACCR

SRH	Storm relative helicity (storm motion specified in subroutine)	m^2 s^2	U, V
SRH700	Storm relative helicity (storm motion as wind at 700 hPa)	m^2 s^2	U, V
SRHvme	Storm relative helicity (storm motion estimated by 75R30 rule of 1000-500 hPa mean wind)	m^2 s^2	U, V
TH1050	Thickness 1000-500 hPa	m	H
WSLOPE	Upslope vertical flow (- downslope, + upslope)	cm s^{-1}	U, V, TERRAIN, MAPFACCR
WVFD70	Water vapor flux divergence averaged in the layer 1000-700 hPa (- convergence, + divergence)	10^{-3} g m^{-2} s^{-1}	T, RH, U, V, MAPFACCR
WVFD85	Water vapor flux divergence averaged in the layer 1000-850 hPa (- convergence, + divergence)	10^{-3} g m^{-2} s^{-1}	T, RH, U, V, MAPFACCR

3D field	Physical meaning	Units	Necessary fields
AGL	Above ground height	m	TERRAIN, H
AVAD	Absolute vorticity advection	10^{-9} s^{-2}	U, V, LATITCRS, MAPFACCR
AVOR	Absolute vorticity	10^{-5} s^{-1}	U, V, LATITCRS, MAPFACCR
DIVIS	Divergence of isallobaric wind (- convergence, + divergence)	10^{-5} s^{-1}	UISAL, VISAL, MAPFACCR
DIVUV	Divergence of horizontal wind (- convergence, + divergence)	10^{-5} s^{-1}	U, V, MAPFACCR
EFG	Escalar frontogenesis (- frontolysis, + frontogenesis)	10^{-9} K s^{-1} m^{-1}	U, V, W, T, MAPFACCR
EFGDEF	Escalar frontogenesis (deformation term) (- frontolysis, + frontogenesis)	10^{-9} K s^{-1} m^{-1}	U, V, W, T, MAPFACCR
EFGDIV	Escalar frontogenesis (divergence term) (- frontolysis, + frontogenesis)	10^{-9} K s^{-1} m^{-1}	U, V, W, T, MAPFACCR
EFGTIL	Escalar frontogenesis (tilting term) (- frontolysis, + frontogenesis)	10^{-9} K s^{-1} m^{-1}	U, V, W, T, MAPFACCR
EFGW	Escalar frontogenesis using wet-bulb potential temperature (- frontolysis, + frontogenesis)	10^{-9} K s^{-1} m^{-1}	U, V, W, T, RH, MAPFACCR
EFGWDEF	Escalar frontogenesis using wet-bulb potential temperature (deformation term) (- frontolysis, + frontogenesis)	10^{-9} K s^{-1} m^{-1}	U, V, W, T, RH, MAPFACCR
EFGWDIV	Escalar frontogenesis using wet-bulb potential temperature (divergence term) (- frontolysis, + frontogenesis)	10^{-9} K s^{-1} m^{-1}	U, V, W, T, RH, MAPFACCR
EFGWTIL	Escalar frontogenesis using wet-bulb potential temperature (tilting term) (- frontolysis, + frontogenesis)	10^{-9} K s^{-1} m^{-1}	U, V, W, T, RH, MAPFACCR
EPT	Equivalent potential temperature	^{o}C	T, RH
EPV	Equivalent potential vorticity	PV units	U, V, T, RH, LATITCRS, MAPFACCR
ErPV	Ertel potential vorticity	PV units	U, V, H, T, CORIOLIS, MAPFACCR

ErPV_ad	Horizontal advection of Ertel potential vorticity (wind components specified in subroutine)	PVU in 12 h	Wind comp., ErPV, MAPFACCR
FORZQ	Q-vector dynamical forcing for vertical motion (- downward, + upward)	10^{-18} m kg^{-1} s^{-1}	T, H, LATITCRS, MAPFACCR
FORZQfil	Q-vector dynamical forcing for vertical motion(smoothed) (- downward, + upward)	10^{-18} m kg^{-1} s^{-1}	T, H, LATITCRS, MAPFACCR
GAVGAD	Geostrophic absolute vorticity advection	10^{-9} s^{-2}	H, LATITCRS, MAPFACCR
GAVOR	Geostrophic absolute vorticity	10^{-5} s^{-1}	H, LATITCRS, MAPFACCR
GRVOR	Geostrophic relative vorticity	10^{-5} s^{-1}	H, LATITCRS, MAPFACCR
PT	Potential temperature	^{o}C	T
PV	Potential vorticity	PV units	U, V, T, LATITCRS, MAPFACCR
PVAD	Potential vorticity advection	10^{-5} PVU s^{-1}	U, V, T, LATITCRS, MAPFACCR
QV	Water vapor mixing ratio	g kg^{-1}	T, RH
RFG	Rotational frontogenesis (- cyclonic, + anticyclonic)	10^{-9} K s^{-1} m^{-1}	U, V, W, T, MAPFACCR
RFGDEF	Rotational frontogenesis (deformation term) (- cyclonic, + anticyclonic)	10^{-9} K s^{-1} m^{-1}	U, V, W, T, MAPFACCR
RFGTIL	Rotational frontogenesis (tilting term) (- cyclonic, + anticyclonic)	10^{-9} K s^{-1} m^{-1}	U, V, W, T, MAPFACCR
RFGVOR	Rotational frontogenesis (relative vorticity term) (- cyclonic, + anticyclonic)	10^{-9} K s^{-1} m^{-1}	U, V, W, T, MAPFACCR
RVOR	Relative vorticity	10^{-5} s^{-1}	U, V, LATITCRS, MAPFACCR
SPDAG	Ageostrophic wind speed	m s^{-1}	UAG, VAG
SPDIS	Isallobaric wind speed	m s^{-1}	UISAL, VISAL
SPDUV	Horizontal wind speed	m s^{-1}	U, V
TD	Dew point temperature	^{o}C	T, RH

TEMAD	Temperature advection	$^{o}C\ s^{-1}$	T, U, V, MAPFACCR
TFPPT	Thermal frontal parameter, based on potential temperature	$10^{-4}\ ^{o}C\ m^{-2}$	T, MAPFACCR
TFPWPT	Thermal frontal parameter, based on wet bulb potential temperature	$10^{-4}\ ^{o}C\ m^{-2}$	T, RH, MAPFACCR
UAG **VAG**	Ageostrophic wind	$m\ s^{-1}$	H, U, V, LATITCRS, MAPFACCR
UAGIR **VAGIR**	Ageostrophic wind (irrotational part)	$m\ s^{-1}$	H, U, V, LATITCRS, MAPFACCR
UAGND **VAGND**	Ageostrophic wind (non divergent part)	$m\ s^{-1}$	H, U, V, LATITCRS, MAPFACCR
UG **VG**	Geostrophic wind	$m\ s^{-1}$	H, LATITCRS, MAPFACCR
UISAL **VISAL**	Isallobaric wind	$m\ s^{-1}$	UG, VG, UAG, VAG, LATITCRS, MAPFACCR
UQ **VQ**	Q vector	$10^{-10}\ m^{2}\ kg^{-1}\ s^{-1}$	T, H, LATITCRS, MAPFACCR
WPT	Wet bulb potential temperature	^{o}C	T, RH