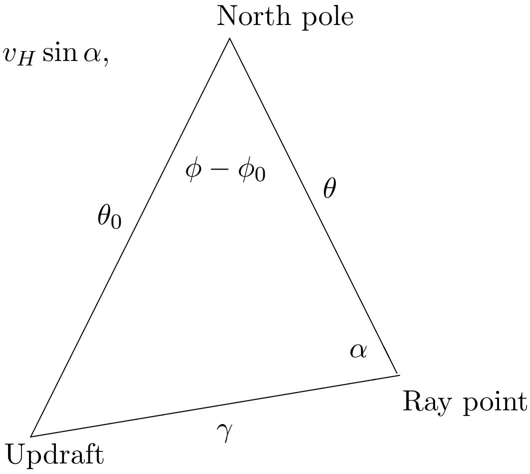
FORM TO SPECIFY INPUT DATA FOR WIND/CURRENT PERTURBATION MODEL VDRAFT3



$v_r = v_{r0} + \frac{1}{r\sin\gamma}\frac{\partial \psi \sin\gamma}{\partial\gamma}$, $v_\theta = v_{\theta 0} + v_H \cos\alpha$, $v_\phi = v_{\phi 0} + v_H \sin\alpha$,
$v_H = -\frac{1}{r}\frac{\partial r\psi}{\partial r}$, where v_{r0}, $v_{\theta 0}$, and $v_{\phi 0}$
are given by a background wind model,
$\psi = \sum_{i=1}^{2} \psi_{Ai}(h)\psi_{Bi}(\gamma)\psi_{Ci}(h) + \psi_{Di}(\gamma)\psi_{Ei}(h)$,
$\psi_{Ai}(h) = \frac{h^2}{h_i^2+h^2}$, $\psi_{Bi}(\gamma)\sin\gamma = r_e w_i \sin^2\gamma_i (1-e^{-\beta_i})/2$,
$\psi_{Ci}(h) = (1-\tanh((h-z_i)/\delta_i))/2$,
$\psi_{Di}(\gamma) = \frac{w_{vi} r_i^2}{6\delta_{vi}} e^{-\left(\frac{r_i}{\delta_{vi}}\right)^2 (\gamma-\gamma_i-\delta\gamma_i)^2} \sin^2\gamma$,
$\psi_{Ei}(h) = e^{-\left(\frac{h-z_i-\delta z_i}{\delta_{vi}}\right)^2}$, $r_i = r_e + z_i + \delta z_i$,
$\beta_i = \frac{\sin^2\gamma}{\sin^2\gamma_i}$, $h = r - r_e$,
$\cos\gamma = \sin\lambda_0\cos\theta + \cos\lambda_0\sin\theta\cos(\phi-\phi_0)$,
$\cos\alpha = [\sin\theta\cos\theta_0 - \sin\theta_0\cos\theta\cos(\phi-\phi_0)]/\sin\gamma$,
$\sin\alpha = \sin\theta_0\sin(\phi-\phi_0)/\sin\gamma$,
$\theta_0 = \pi/2 - \lambda_0$

This model represents the wind/current velocity of an updraft plus a downdraft with a ring vortex at the top of the updraft and at the top of the downdraft. Because this model is based on a stream function, it has zero divergence in three dimensions.

Specify–
the model check for VDRAFT3 = ____________ 4.0 ____________ (w125)
the input data-format code = ________________________ (w126)
an input data-set identification number = ________________________ (w127)
an 80-character description of the model with parameters:

____

and the model values:
λ_0 latitude of the updraft/downdraft ________________ rad, deg, km (w128)
ϕ_0 longitude of the updraft/downdraft ________________ rad, deg, km (w129)
w_1 maximum speed of the updraft ________________ km/s, m/s (w130)
γ_1 half width of the updraft ________________ rad, deg, km (w131)
h_1 depth of the inflow ________________ km, m (w132)
w_2 maximum speed of the downdraft ________________ km/s, m/s (w133)
γ_2 half width of the downdraft ________________ rad, deg, km (w134)
h_2 depth of the outflow ________________ km, m (w135)
z_1 height of the return outflow at the top ________________ km, m (w136)
δ_1 width of the return outflow at the top ________________ km, m (w137)
z_2 height of the return inflow at the top ________________ km, m (w138)
δ_2 width of the return inflow at the top ________________ km, m (w139)
w_{v1}/w_1 relative strength of the updraft ring vortex = ________________ (w140)
δ_{v1}/δ_1 relative thickness of the updraft ring vortex = ________________ (w141)
δz_1 relative height of the updraft ring vortex ________________ km, m (w142)
$\delta\gamma_1$ relative radius of the updraft ring vortex ________________ rad, deg, km (w143)
w_{v2}/w_2 relative strength of the downdraft ring vortex = ________________ (w144)
δ_{v2}/δ_2 relative thickness of the downdraft ring vortex = ________________ (w145)
δz_2 relative height of the downdraft ring vortex ________________ km, m (w146)
$\delta\gamma_2$ relative radius of the downdraft ring vortex ________________ rad, deg, km (w147)

OTHER MODELS REQUIRED: Any background wind/current velocity model.

In the subroutine, v_r, v_θ, v_ϕ, and v_H are used for the perturbation.
$v_r = \sum_{i=1}^{2} -\psi_{Ai}(h)\frac{1}{r}\frac{d\psi_{Bi}(\gamma)\sin\gamma}{d\cos\gamma}\psi_{Ci}(h) - \frac{1}{r}\frac{d\psi_{Di}(\gamma)\sin\gamma}{d\cos\gamma}\psi_{Ei}(h)$,
$\frac{\partial v_r}{\partial r} = \sum_{i=1}^{2} -\psi'_{Ai}(h)\frac{1}{r}\frac{d\psi_{Bi}(\gamma)\sin\gamma}{d\cos\gamma}\psi_{Ci}(h) + \psi_{Ai}(h)\frac{1}{r^2}\frac{d\psi_{Bi}(\gamma)\sin\gamma}{d\cos\gamma}\psi_{Ci}(h) - \psi_{Ai}(h)\frac{1}{r}\frac{d\psi_{Bi}(\gamma)\sin\gamma}{d\cos\gamma}\psi'_{Ci}(h)$
$+ \frac{1}{r^2}\frac{d\psi_{Di}(\gamma)\sin\gamma}{d\cos\gamma}\psi_{Ei}(h) - \frac{1}{r}\frac{d\psi_{Di}(\gamma)\sin\gamma}{d\cos\gamma}\psi'_{Ei}(h)$,
$\frac{\partial v_r}{\partial \theta} = \sum_{i=1}^{2} -\left(\sin\gamma\frac{\partial\gamma}{\partial\theta}\right)\psi_{Ai}(h)\frac{1}{r}\frac{d}{d\cos\gamma}\left(\frac{d\psi_{Bi}(\gamma)\sin\gamma}{d\cos\gamma}\right)\psi_{Ci}(h) - \frac{1}{r}\frac{d}{d\gamma}\left(\frac{d\psi_{Di}(\gamma)\sin\gamma}{d\cos\gamma}\right)\psi_{Ei}(h)$,
$\frac{\partial v_r}{\partial \phi} = \sum_{i=1}^{2} -\left(\sin\gamma\frac{\partial\gamma}{\partial\phi}\right)\psi_{Ai}(h)\frac{1}{r}\frac{d}{d\cos\gamma}\left(\frac{d\psi_{Bi}(\gamma)\sin\gamma}{d\cos\gamma}\right)\psi_{Ci}(h) - \frac{1}{r}\frac{d}{d\gamma}\left(\frac{d\psi_{Di}(\gamma)\sin\gamma}{d\cos\gamma}\right)\psi_{Ei}(h)$,
$v_H = \sum_{i=1}^{2} -\psi'_{Ai}(h)\psi_{Bi}(\gamma)\psi_{Ci}(h) - \psi_{Ai}(h)\psi_{Bi}(\gamma)\psi'_{Ci}(h) - \frac{1}{r}\psi_{Ai}(h)\psi_{Bi}(\gamma)\psi_{Ci}(h)$
$- \psi_{Di}(\gamma)\psi'_{Ei}(h) - \frac{1}{r}\psi_{Di}(\gamma)\psi_{Ei}(h)$,
$\frac{\partial v_H}{\partial r} = \sum_{i=1}^{2} -\psi''_{Ai}(h)\psi_{Bi}(\gamma)\psi_{Ci}(h) - 2\psi'_{Ai}(h)\psi_{Bi}(\gamma)\psi'_{Ci}(h) - \psi_{Ai}(h)\psi_{Bi}(\gamma)\psi''_{Ci}(h) - \frac{1}{r}\psi'_{Ai}(h)\psi_{Bi}(\gamma)\psi_{Ci}(h)$
$-\frac{1}{r}\psi_{Ai}(h)\psi_{Bi}(\gamma)\psi'_{Ci}(h) + \frac{1}{r^2}\psi_{Ai}(h)\psi_{Bi}(\gamma)\psi_{Ci}(h) - \psi_{Di}(\gamma)\psi''_{Ei}(h) - \frac{1}{r}\psi_{Di}(\gamma)\psi'_{Ei}(h) + \frac{1}{r^2}\psi_{Di}(\gamma)\psi_{Ei}(h)$,
$\frac{\partial v_H}{\partial\cos\gamma} = \sum_{i=1}^{2} -\psi'_{Ai}(h)\frac{d}{d\cos\gamma}(\psi_{Bi}(\gamma))\psi_{Ci}(h) - \psi_{Ai}(h)\frac{d}{d\cos\gamma}(\psi_{Bi}(\gamma))\psi'_{Ci}(h)$
$- \frac{1}{r}\psi_{Ai}(h)\frac{d}{d\cos\gamma}(\psi_{Bi}(\gamma))\psi_{Ci}(h) - \frac{d}{d\cos\gamma}(\psi_{Di}(\gamma))\psi'_{Ei}(h) - \frac{1}{r}\frac{d}{d\cos\gamma}(\psi_{Di}(\gamma))\psi_{Ei}(h)$,
$\frac{d\psi_{Bi}}{d\cos\gamma} = \psi_{Bi}\frac{\cos\gamma}{\sin^2\gamma} + \frac{1}{\sin\gamma}\frac{d\psi_{Bi}\sin\gamma}{d\cos\gamma}$,
$\frac{d\psi_{Di}}{d\cos\gamma} = \psi_{Di}\frac{\cos\gamma}{\sin^2\gamma} + \frac{1}{\sin\gamma}\frac{d\psi_{Di}\sin\gamma}{d\cos\gamma}$,
$v_\theta = v_H\cos\alpha$,
$\frac{\partial v_\theta}{\partial r} = \frac{\partial v_H}{\partial r}\cos\alpha$,
$\frac{\partial v_\theta}{\partial \theta} = \frac{\partial v_H}{\partial\cos\gamma}\frac{\partial\cos\gamma}{\partial\theta}\cos\alpha + v_H\frac{\partial\cos\alpha}{\partial\theta}$,
$\frac{\partial v_\theta}{\partial \phi} = \frac{\partial v_H}{\partial\cos\gamma}\frac{\partial\cos\gamma}{\partial\phi}\cos\alpha + v_H\frac{\partial\cos\alpha}{\partial\phi}$,
$v_\phi = v_H\sin\alpha$,
$\frac{\partial v_\phi}{\partial r} = \frac{\partial v_H}{\partial r}\sin\alpha$,
$\frac{\partial v_\phi}{\partial \theta} = \frac{\partial v_H}{\partial\cos\gamma}\frac{\partial\cos\gamma}{\partial\theta}\sin\alpha + v_H\frac{\partial\sin\alpha}{\partial\theta}$,
$\frac{\partial v_\phi}{\partial \phi} = \frac{\partial v_H}{\partial\cos\gamma}\frac{\partial\cos\gamma}{\partial\phi}\sin\alpha + v_H\frac{\partial\sin\alpha}{\partial\phi}$,
$\sin\gamma\frac{\partial\gamma}{\partial\theta} = \sin\gamma\cos\alpha = \cos\theta_0\sin\theta - \sin\theta_0\cos\theta\cos(\phi-\phi_0)$,
$\sin\gamma\frac{\partial\gamma}{\partial\phi} = \sin\theta_0\sin\theta\sin(\phi-\phi_0) = \sin\theta\sin\alpha\sin\gamma$,
If $\sin\gamma \neq 0$, we can calculate α from
$\sin\alpha = \sin\theta_0\sin(\phi-\phi_0)/\sin\gamma$, and
$\cos\alpha = [\cos\theta_0\sin\theta - \sin\theta_0\cos\theta\cos(\phi-\phi_0)]/\sin\gamma$,
On the other hand, when $\sin\gamma = 0$, the above formulas are indeterminant. In that case, we need to determine α from the ray direction. This gives
$\cos\alpha = \frac{d\theta/dt\ \mathrm{sign}(d\phi/dt)}{\sqrt{(d\theta/dt)^2+(d\phi/dt)^2\sin^2\theta}}$ and
$\sin\alpha = \frac{\sin\theta d\phi/dt\ \mathrm{sign}(d\theta/dt)}{\sqrt{(d\theta/dt)^2+(d\phi/dt)^2\sin^2\theta}}$.
We define the following function, which is calculated in a separate subroutine.
$\psi_{Ai}(h_i,h) = \frac{h^2}{h_i^2+h^2}$, with the following derivatives
$\psi'_{Ai}(h_i,h) = \frac{2h_i^2 h}{(h_i^2+h^2)^2}$,
$\psi''_{Ai}(h_i,h) = \frac{2h_i^2(h_i^2-3h^2)}{(h_i^2+h^2)^3}$,
We define the following function, which is calculated in a separate subroutine.
$\psi_{Bi}(B,\sin^2\gamma_i,\Delta,\cos\gamma,\sin\gamma)\sin\gamma = B\sin^2\gamma_i(1-e^{-\beta_i})$, where $\beta_i = \frac{\sin^2\gamma}{\sin^2\gamma_i}$,with the following derivatives
$\frac{d}{d\cos\gamma}(\psi_{Bi}\sin\gamma) = -2B\cos\gamma e^{-\beta_i}$,
$\frac{d}{d\cos\gamma}\frac{d}{d\cos\gamma}(\psi_{Bi}\sin\gamma) = -2B\left(1-2\frac{\cos^2\gamma}{\sin^2\gamma_i^2}\right)e^{-\beta_i}$,
We define the following function, which is calculated in a separate subroutine.
$\psi_{Ci}(z_i,\delta_i,h) = \frac{1}{2}\left(1-\tanh\left(\frac{h-z_i}{\delta_i}\right)\right)$, with the following derivatives

$\psi'_{Ci}(z_i, \delta_i, h) = -\frac{1}{2\delta_i}\mathrm{sech}^2\left(\frac{h-z_i}{\delta_i}\right)$,
$\psi''_{Ci}(z_i, \delta_i, h) = \frac{1}{\delta_i^2}\mathrm{sech}\left(\frac{h-z_i}{\delta_i}\right)\tanh\left(\frac{h-z_i}{\delta_i}\right)$,
We define the following function, which is calculated in a separate subroutine.
$\psi_{Di}(D, \Gamma, \Delta, \gamma, \cos\gamma, \sin\gamma)\sin\gamma = \frac{D}{\Delta}e^{-\left(\frac{\gamma-\Gamma}{\Delta}\right)^2}\sin^3\gamma$, with the following derivatives
$\frac{d\psi_{Di}\sin\gamma}{d\cos\gamma} = -\frac{D}{\Delta}e^{-\left(\frac{\gamma-\Gamma}{\Delta}\right)^2}\left(-2\frac{\gamma-\Gamma}{\Delta^2}\sin^2\gamma + 3\cos\gamma\sin\gamma\right)$ and
$\frac{d}{d\gamma}\left(\frac{d\psi_{Di}\sin\gamma}{d\cos\gamma}\right) = -\frac{D}{\Delta}e^{-\left(\frac{\gamma-\Gamma}{\Delta}\right)^2}\left[4\frac{(\gamma-\Gamma)^2}{\Delta^4}\sin^2\gamma - 10\frac{\gamma-\Gamma}{\Delta^2}\cos\gamma\sin\gamma - \frac{2}{\Delta^2}\sin^2\gamma + 3\cos^2\gamma - 3\sin^2\gamma\right]$.
We define the following function, which is calculated in a separate subroutine. In the following three formulas only, $h_i \equiv z_i + \delta z_i$.
$\psi_{Ei}(h_i, \delta_{vi}, h) = e^{-\left(\frac{h-h_i}{\delta_{vi}}\right)^2}$, with the following derivatives
$\psi'_{Ei}(h_i, \delta_{vi}, h) = -2\frac{h-h_i}{\delta_{vi}^2}e^{-\left(\frac{h-h_i}{\delta_{vi}}\right)^2}$,
$\psi''_{Ei}(h_i, \delta_{vi}, h) = -\frac{2}{\delta_{vi}^2}\left[1 - 2\left(\frac{h-h_i}{\delta_{vi}}\right)^2\right]e^{-\left(\frac{h-h_i}{\delta_{vi}}\right)^2}$,

Definitions:

FORTRAN variable	Variable name	Definition
LAMBDA0	λ_0	Latitude of updraft/downdraft
PHI0	ϕ_0	Longitude of updraft/downdraft
W1	w_1	Maximum speed of updraft
W2	w_2	Maximum speed of downdraft
GAMMA1	γ_1	Half width of updraft
GAMMA2	γ_2	Half width of downdraft
H1	h_1	Depth of inflow
H2	h_2	Depth of outflow
z1	z_1	Height of the return outflow at the top
z2	z_2	Height of the return inflow at the top
delta1	δ_1	Width of the return outflow at the top
delta2	δ_2	Width of the return inflow at the top
stren1	w_{v1}/w_1	Relative strength of the updraft ring vortex, W(140)
thick1	δ_{v1}/δ_1	Relative thickness of the updraft ring vortex, W(141)
deltaz1	δz_1	Relative height of the updraft ring vortex, W(142)
deltag1	$\delta\gamma_1$	Relative radius of the updraft ring vortex, W(143)
stren2	w_{v2}/w_2	Relative strength of the downdraft ring vortex, W(144)
thick2	δ_{v2}/δ_2	Relative thickness of the downdraft ring vortex, W(145)
deltaz2	δz_2	Relative height of the downdraft ring vortex, W(146)
deltag2	$\delta\gamma_2$	Relative radius of the downdraft ring vortex, W(147)
EARTHR	r_e	Radius of the Earth
EARSQ	r_e^2	
SING1SQ	$\sin^2\gamma_1$	
SING2SQ	$\sin^2\gamma_2$	
SINLAM0	$\sin\lambda_0$	
	θ_0	Co-latitude of updraft/downdraft
COSTH0	$\cos\theta_0$	
COSLAM0	$\cos\lambda_0$	
SINTH0	$\sin\theta_0$	
H1SQ	h_1^2	

H2SQ	h_2^2	
CONST1	$r_e w_1/2$	
CONST2	$r_e w_2/2$	
VH	v_H	Horizontal component of wind velocity perturbation
	r	Distance from center of Earth to ray point
RSQ	r^2	
H	h	Height of ray point above sea level
HSQ	h^2	
HCUBE	h^3	
	θ	Co-latitude of ray point
COSTH	$\cos\theta$	
SINTH	$\sin\theta$	
PH	ϕ	Longitude of ray point
COSPH	$\cos(\phi-\phi_0)$	
SINPH	$\sin(\phi-\phi_0)$	
	γ	Great circle angle between updraft/downdraft and ray point
COSGAM	$\cos\gamma$	
SINGAM	$\sin\gamma$	
SINGSQ	$\sin^2\gamma$	
psi	$\psi=\psi_1+\psi_2$	Stream function
psisg	$\psi\sin\gamma=\psi_1\sin\gamma+\psi_2\sin\gamma$	
psi1	$\psi_1=\psi_{A1}\psi_{B1}\psi_{C1}$	
psi1sg	$\psi_1\sin\gamma=\psi_{A1}\psi_{B1}\sin\gamma\psi_{C1}$	
psi2	$\psi_2=\psi_{A2}\psi_{B2}\psi_{C2}$	
psi2sg	$\psi_2\sin\gamma=\psi_{A2}\psi_{B2}\sin\gamma\psi_{C2}$	
psiA1%value	ψ_{A1}	
psiA1%p	$\psi'_{A1}(h)$	
psiA1%pp	$\psi''_{A1}(h)$	
psiB1	ψ_{B1}	
psiB1sg%value	$\psi_{B1}\sin\gamma$	
psiB1sg%p	$\frac{d}{d\cos\gamma}(\psi_{B1}\sin\gamma)=-\frac{1}{\sin\gamma}\frac{d}{d\gamma}(\psi_{B1}\sin\gamma)$	
psiB1sg%pp	$\frac{d}{d\cos\gamma}\frac{d}{d\cos\gamma}(\psi_{B1}\sin\gamma)$	
psiC1%value	ψ_{C1}	
psiC1%p	$\psi'_{C1}(h)$	
psiC1%pp	$\psi''_{C1}(h)$	
psiD1sg%value	$\psi_{D1}\sin\gamma$	
psiD1sg%p	$\frac{d}{d\cos\gamma}(\psi_{D1}\sin\gamma)=-\frac{1}{\sin\gamma}\frac{d}{d\gamma}(\psi_{D1}\sin\gamma)$	
psiD1sg%pp	$\frac{d}{d\gamma}\frac{d}{d\cos\gamma}(\psi_{D1}\sin\gamma)$	
psiE1%value	ψ_{E1}	
psiE1%p	$\psi'_{E1}(h)$	
psiE1%pp	$\psi''_{E1}(h)$	
psiA2%value	ψ_{A2}	
psiA2%p	$\psi'_{A2}(h)$	
psiA2%pp	$\psi''_{A2}(h)$	
psiB2	ψ_{B2}	
psiB2sg	$\psi_{B2}\sin\gamma$	
psiB2sg%value	$\psi_{B2}\sin\gamma$	
psiB2sg%p	$\frac{d}{d\cos\gamma}(\psi_{B2}\sin\gamma)=-\frac{1}{\sin\gamma}\frac{d}{d\gamma}(\psi_{B2}\sin\gamma)$	
psiB2sg%pp	$\frac{d}{d\cos\gamma}\frac{d}{d\cos\gamma}(\psi_{B2}\sin\gamma)$	

psiC2%value	ψ_{C2}	
psiC2%p	$\psi'_{C2}(h)$	
psiC2%pp	$\psi''_{C2}(h)$	
psiD2sg%value	$\psi_{D2}\sin\gamma$	
psiD2sg%p	$\frac{d}{d\cos\gamma}(\psi_{D2}\sin\gamma) = -\frac{1}{\sin\gamma}\frac{d}{d\gamma}(\psi_{D2}\sin\gamma)$	
psiD2sg%pp	$\frac{d}{d\gamma}\frac{d}{d\cos\gamma}(\psi_{D2}\sin\gamma)$	
psiE2%value	ψ_{E2}	
psiE2%p	$\psi'_{E2}(h)$	
psiE2%pp	$\psi''_{E2}(h)$	
BETA	$\beta = \sin^2\gamma/\sin^2\gamma_1$ or $\sin^2\gamma/\sin^2\gamma_2$	
EXBET	$e^{-\beta}$	
SUM	$h_1^2 + h^2$ or $h_2^2 + h^2$	
SUMSQ	$(h_1^2 + h^2)^2$ or $(h_2^2 + h^2)^2$	
VR	$v_r = -\frac{1}{r^2}\frac{\partial\psi}{\partial\cos\gamma}$	Vertical component of wind velocity perturbation
PVRR	$\partial v_r/\partial r = -(\partial^2\psi/\partial h\partial\cos\gamma)/r^2 + 2(\partial\psi/\partial\cos\gamma)/r^3$	
SGPGTH	$-\partial\cos\gamma/\partial\theta = \sin\gamma\partial\gamma/\partial\theta$	
SGPGPH	$-\partial\cos\gamma/\partial\phi = \sin\gamma\partial\gamma/\partial\phi$	
PGTH	$\partial\gamma/\partial\theta$	
PGPH	$\partial\gamma/\partial\phi$	
PVRTH	$\partial v_r/\partial\theta$	
PVRPH	$\partial v_r/\partial\phi$	
VH	$v_H = -\frac{\partial\psi/\partial h}{r\sin\gamma}$	horizontal component of wind velocity perturbation
VHDSG	$v_H/\sin\gamma = -\frac{\partial\psi/\partial h}{r\sin^2\gamma}$	
	α	azimuth angle of updraft counter-clockwise from North as viewed from ray point
SINALP	$\sin\alpha$	
SINALPSQ	$\sin^2\alpha$	
COSALP	$\cos\alpha$	
COSALPSQ	$\cos^2\alpha$	
COS2ALP	$\cos 2\alpha$	
DEN	$\sqrt{(d\theta/dt)^2 + (d\phi/dt)^2\sin^2\theta}$	
VTH	v_θ	Southward component of wind velocity perturbation
VPH	v_ϕ	Eastward component of wind velocity perturbation
PVHR	$\partial v_H/\partial r$	
PVTHR	$\partial v_\theta/\partial r$	
PSINALPTH	$\partial\sin\alpha/\partial\theta$	
PSINALPPH	$\partial\sin\alpha/\partial\phi$	
PCOSALPTH	$\partial\cos\alpha/\partial\theta$	
PCOSALPPH	$\partial\cos\alpha/\partial\phi$	
PVHPG	$\partial v_H/\partial\cos\gamma = -1/\sin\gamma\partial v_H/\partial\gamma$	
SGPVHPG	$-\partial v_H/\partial\gamma$	
PVHTH	$\partial v_H/\partial\theta$	
PVHPH	$\partial v_H/\partial\phi$	
PVTHTH	$\partial v_\theta/\partial\theta$	
PVTHPH	$\partial v_\theta/\partial\phi$	
PVPHR	$\partial v_\phi/\partial r$	
PVPHTH	$\partial v_\phi/\partial\theta$	
PVPHPH	$\partial v_\phi/\partial\phi$	
VSQ	$\lvert v\rvert^2$	

V	$\|v\|$
PVTH	$\partial\|v\|/\partial\theta$
PVPH	$\partial\|v\|/\partial\phi$
PVR	$\partial\|v\|/\partial r$