

# The Lorenz energy cycle in simulated rotating annulus flows

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## Supplementary Material

### 3SV run at 4500s

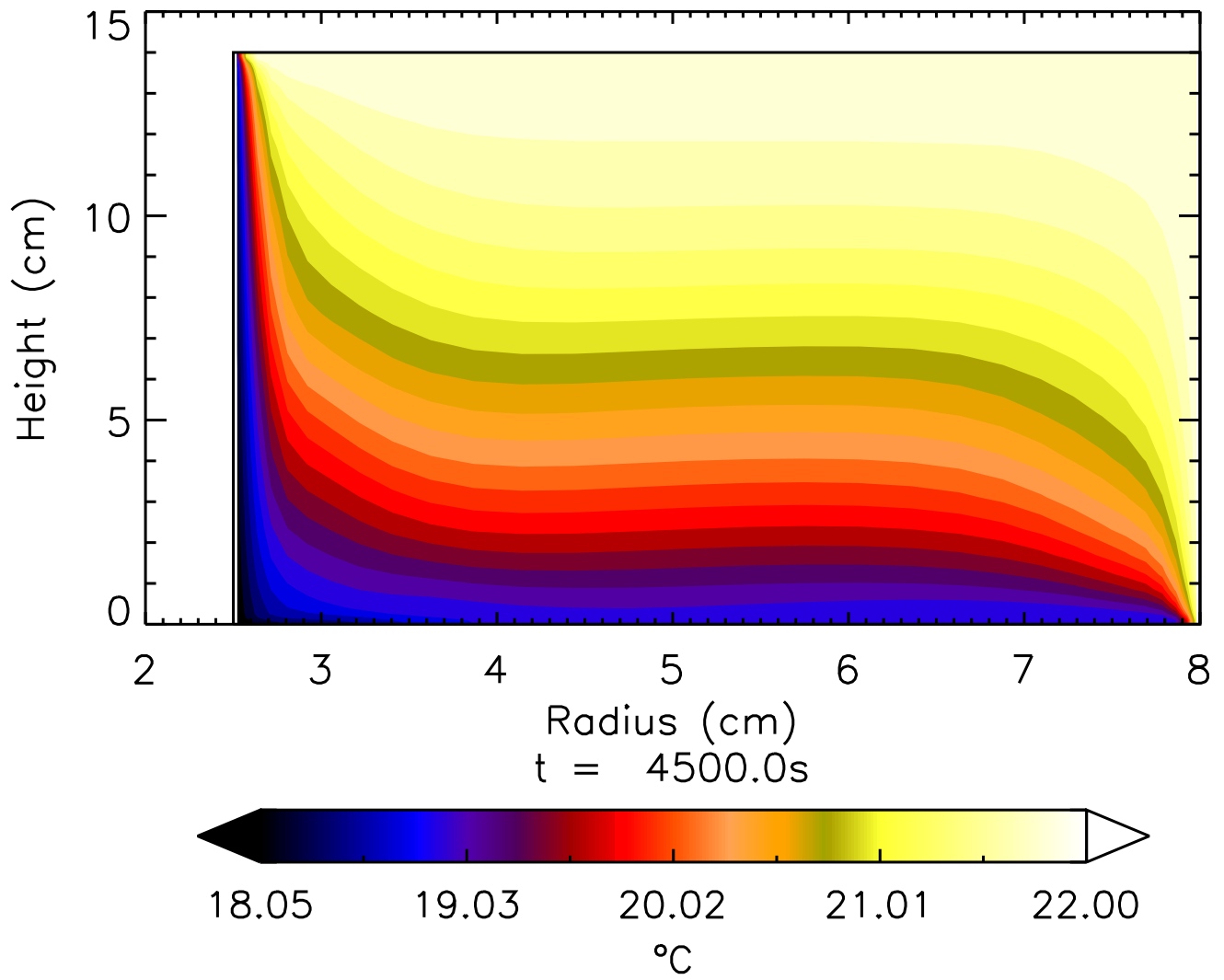
This file contains additional contour plots in the  $(R, z)$  plane, line plots showing horizontal means as a function of  $z$ , and time series.

Because of limitations in the plotting language, the notation for means is different in this document compared with the main paper:

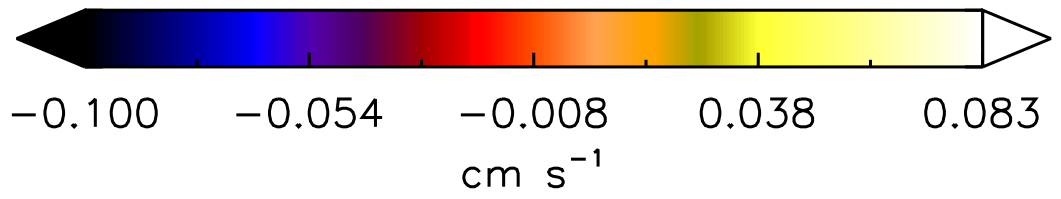
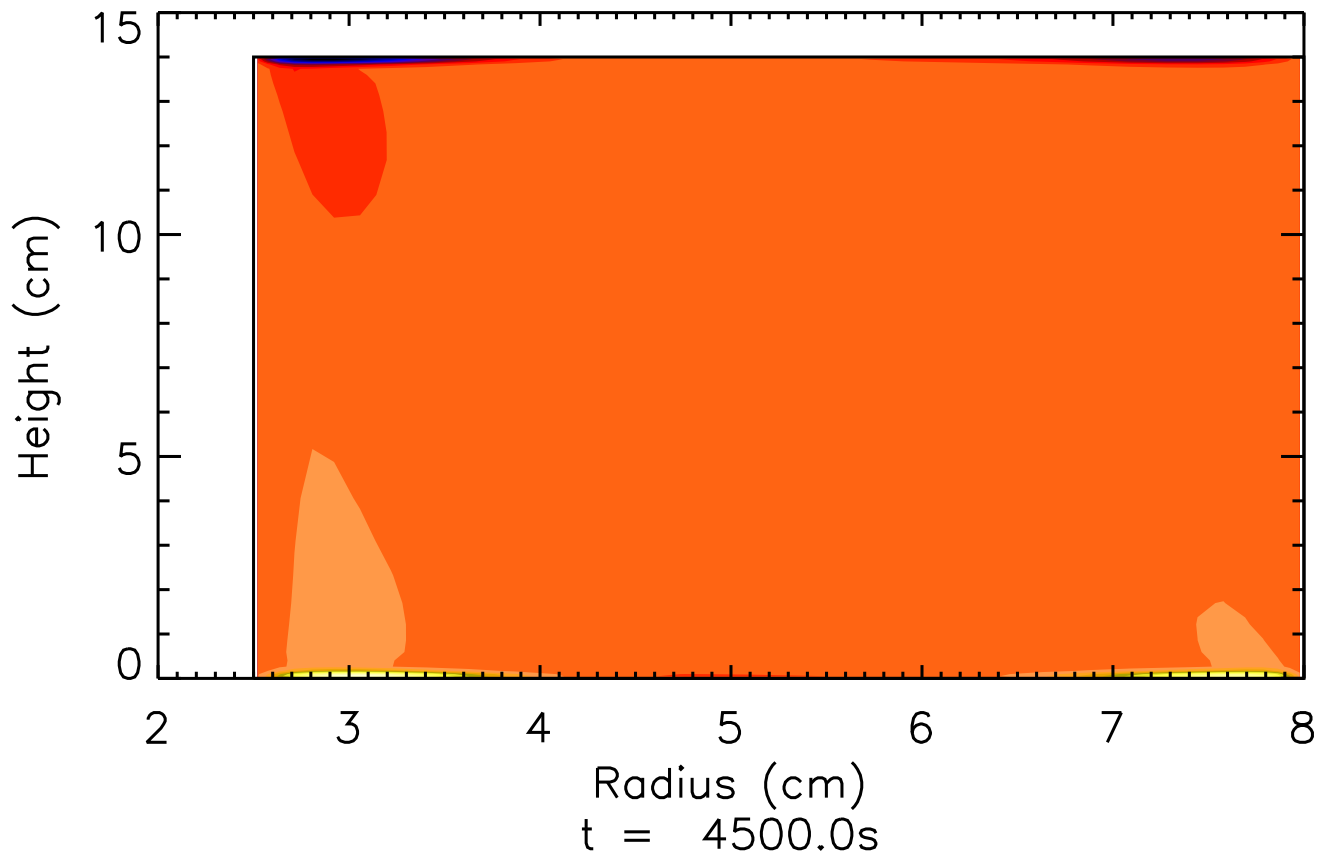
- A zonal or azimuthal mean is displayed as  $\langle x \rangle$  ( $\bar{x}$  in the main paper).
- A horizontal mean is displayed as  $|x|$  ( $\tilde{x}$  in the main paper).

Eddy fields use the same notation as the main paper.

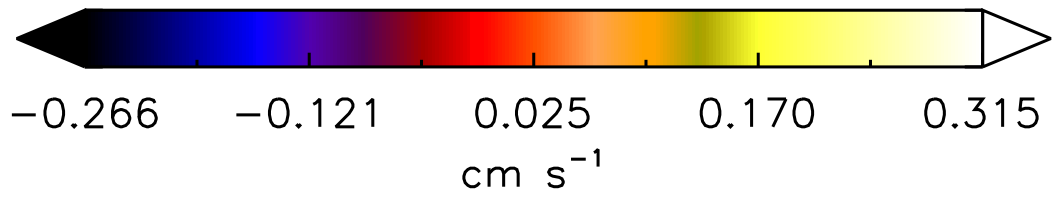
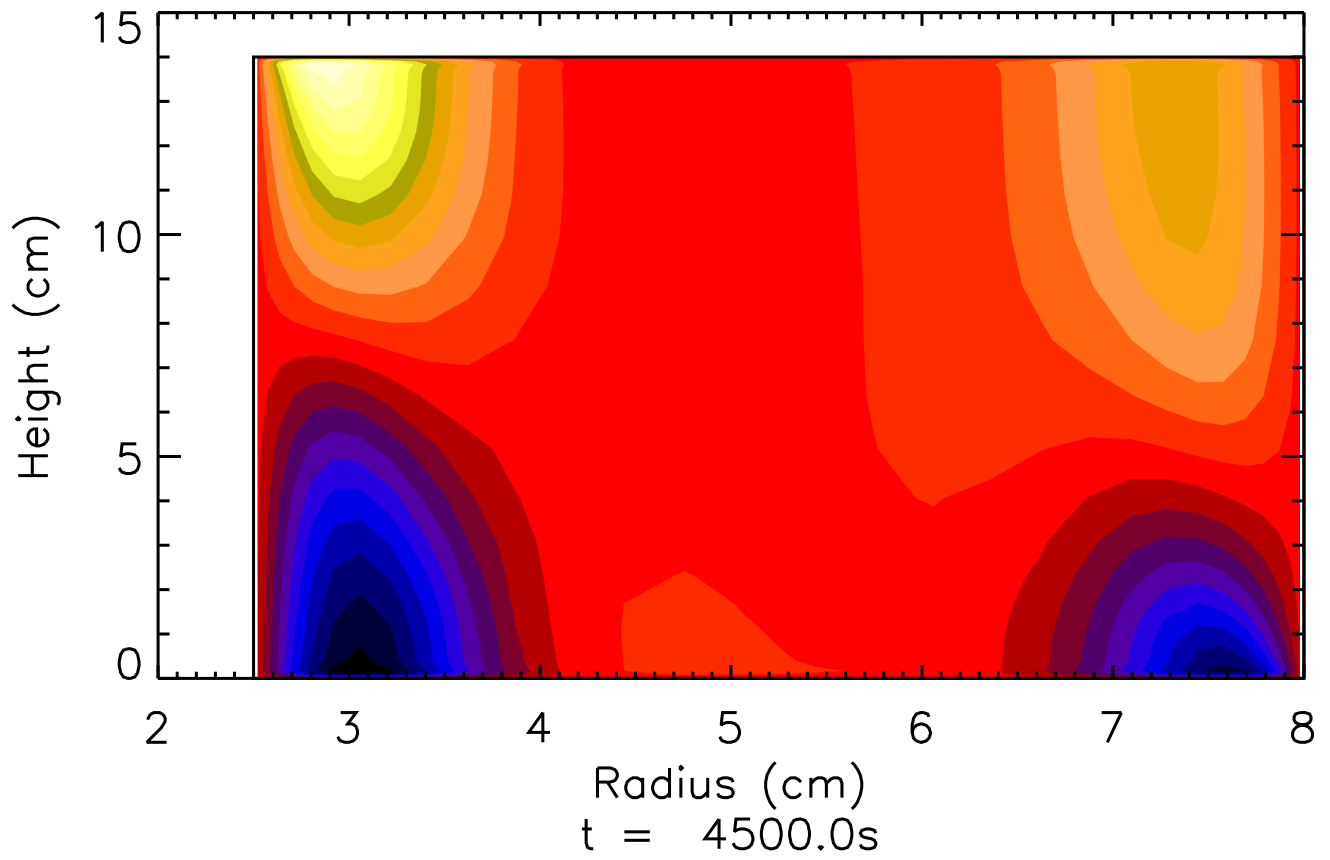
$\langle T \rangle$



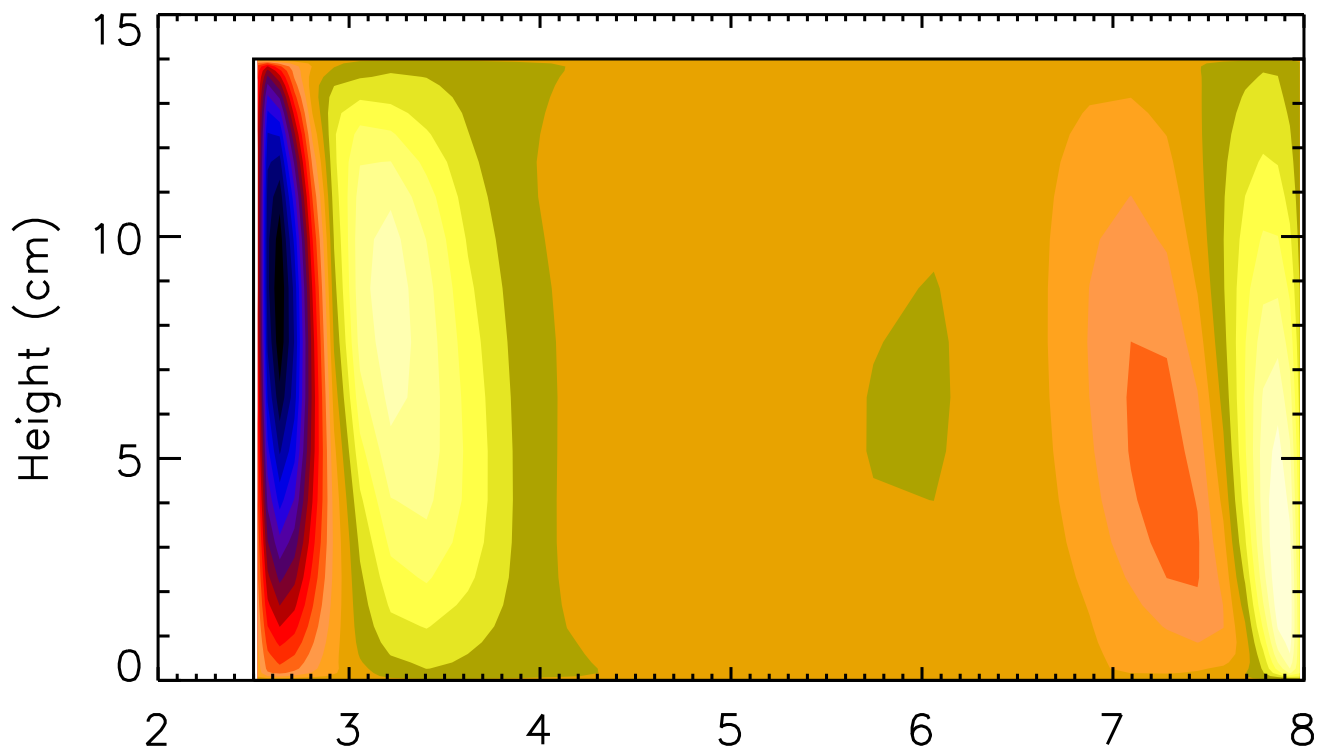
$\langle u \rangle$



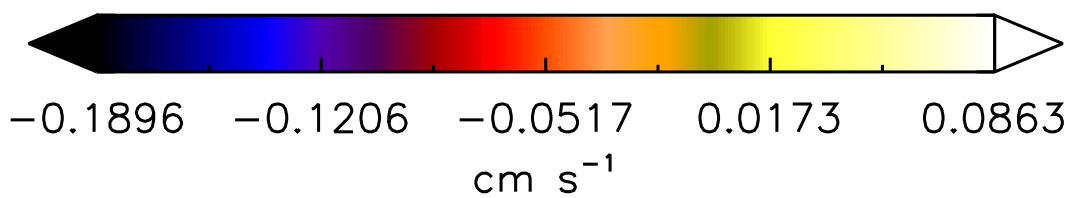
$\langle v \rangle$

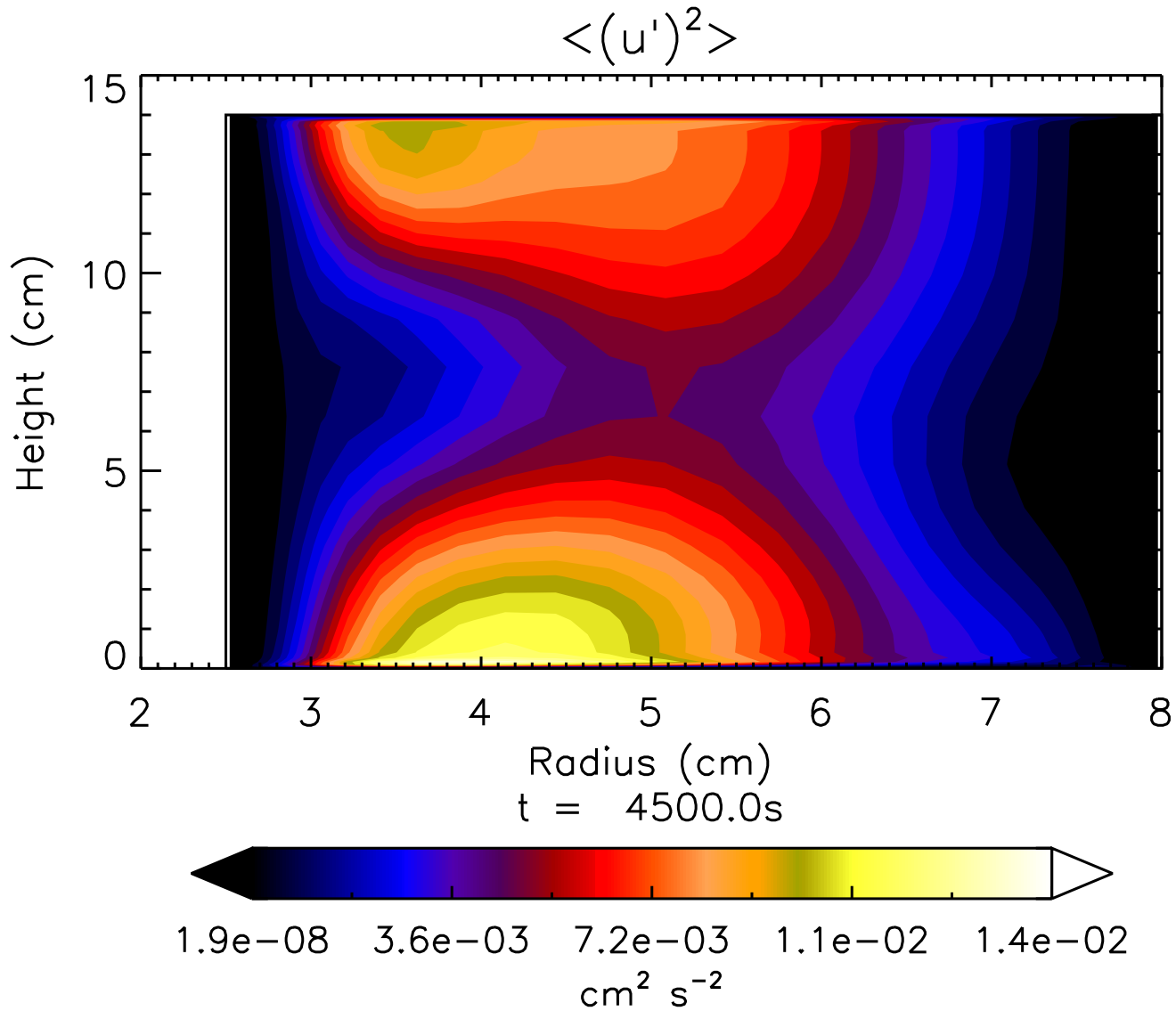


$\langle w \rangle$

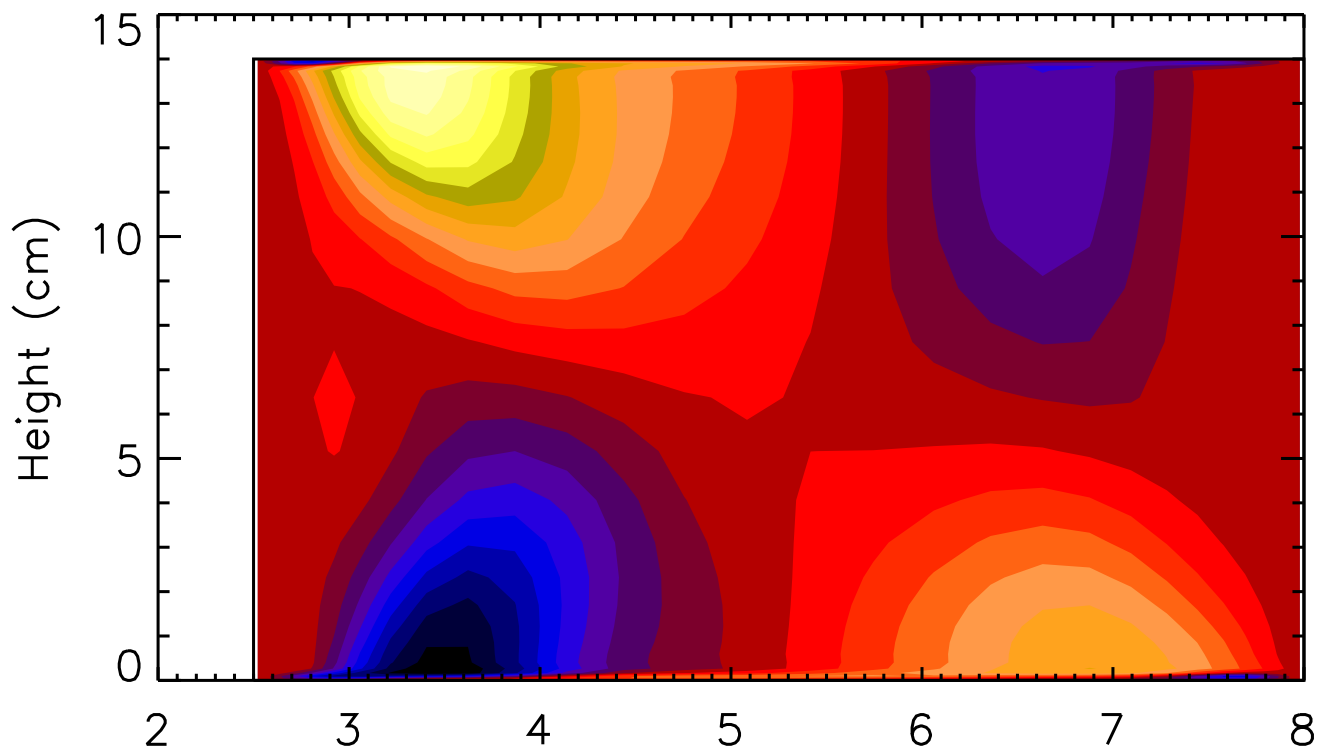


Radius (cm)  
 $t = 4500.0s$

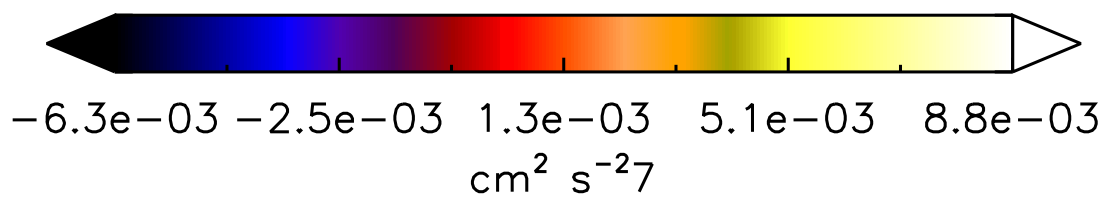




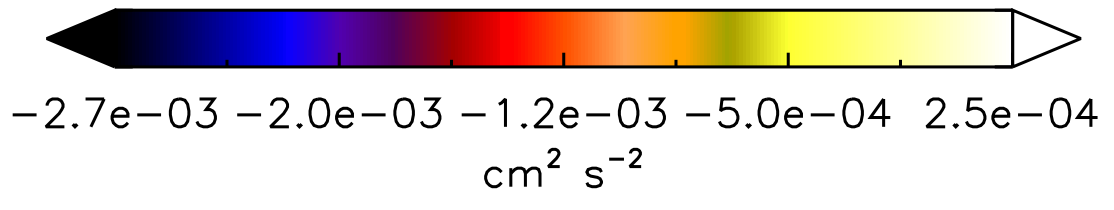
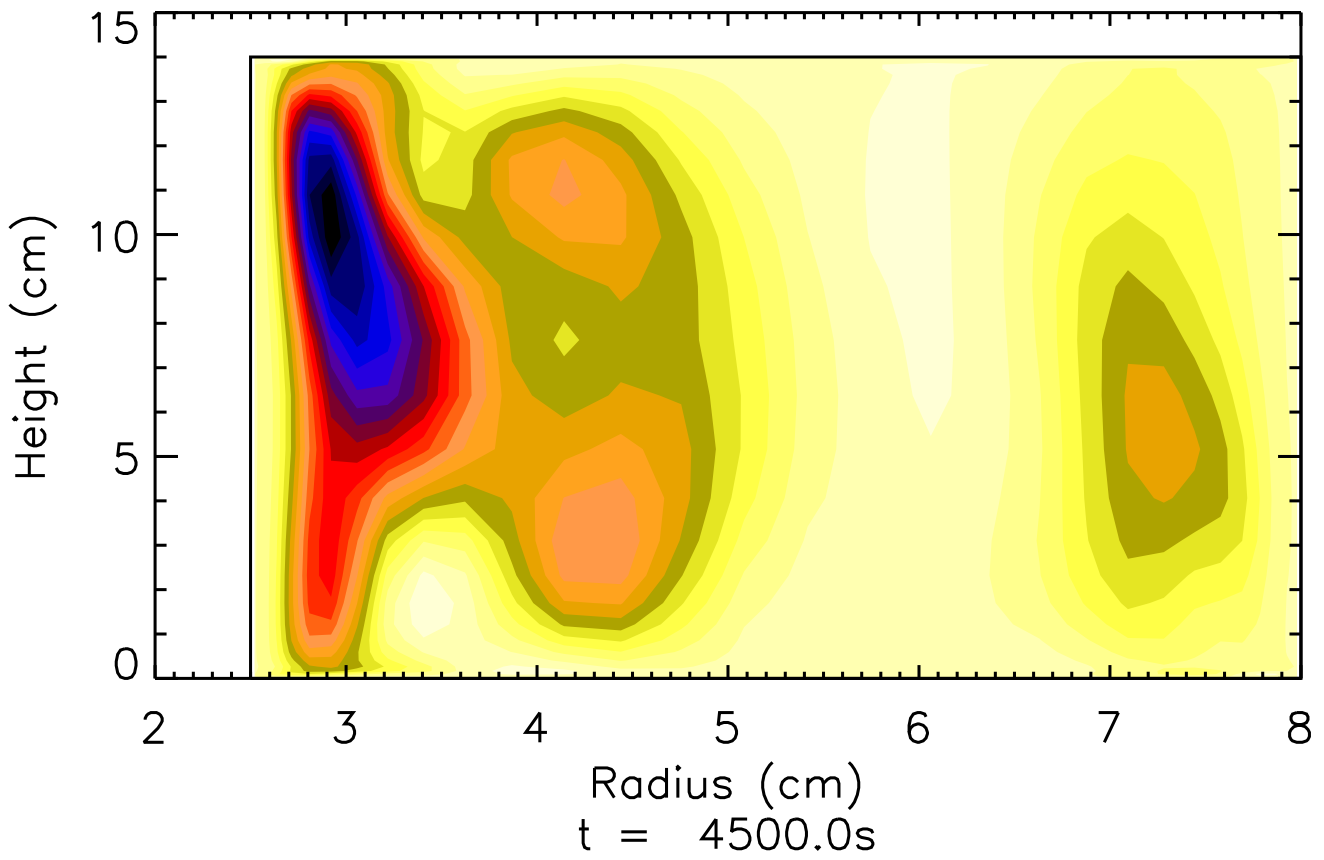
$\langle u'v' \rangle$



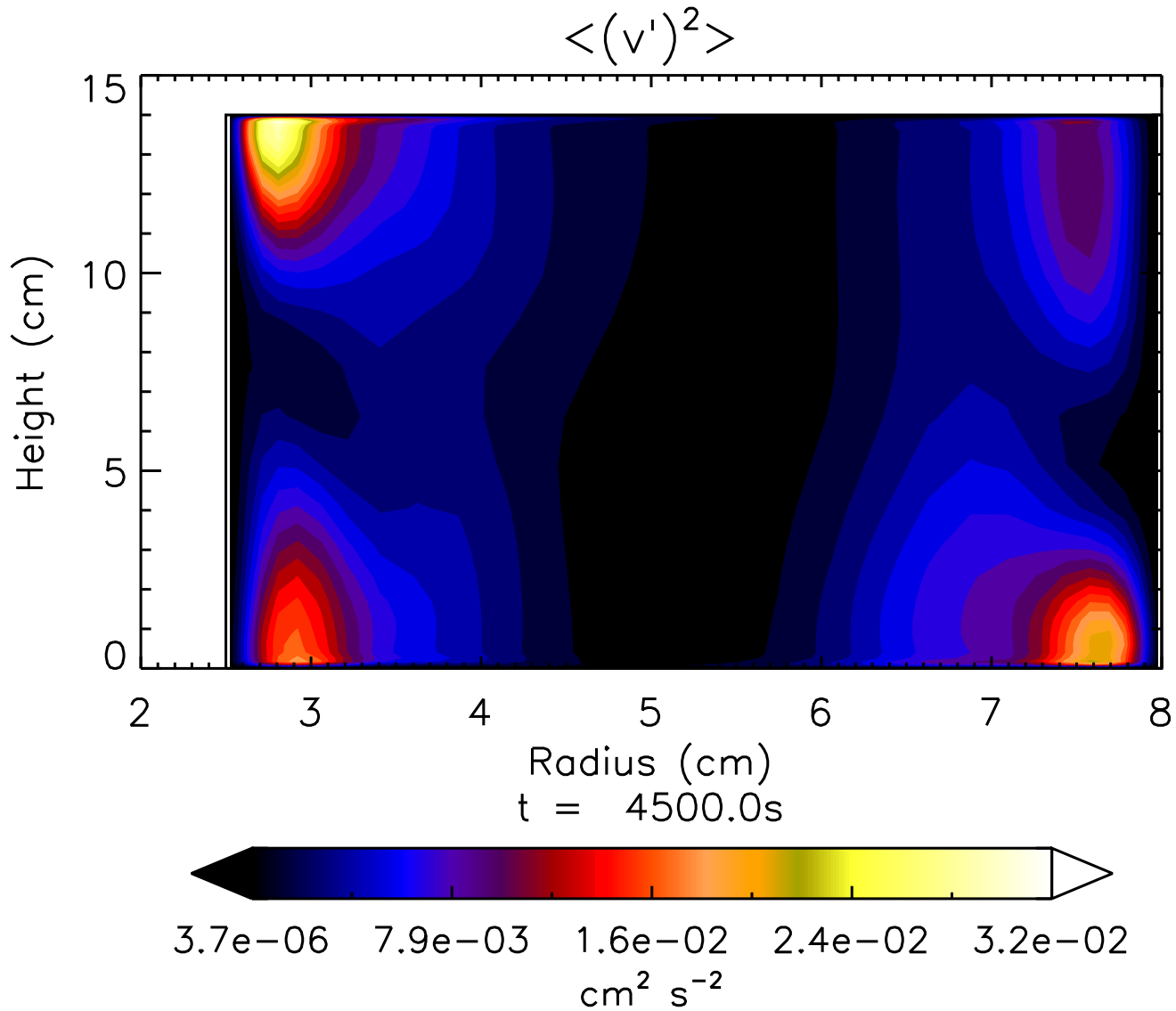
Radius (cm)  
 $t = 4500.0\text{s}$



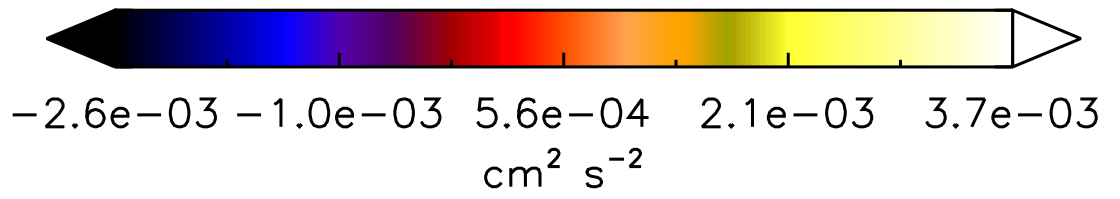
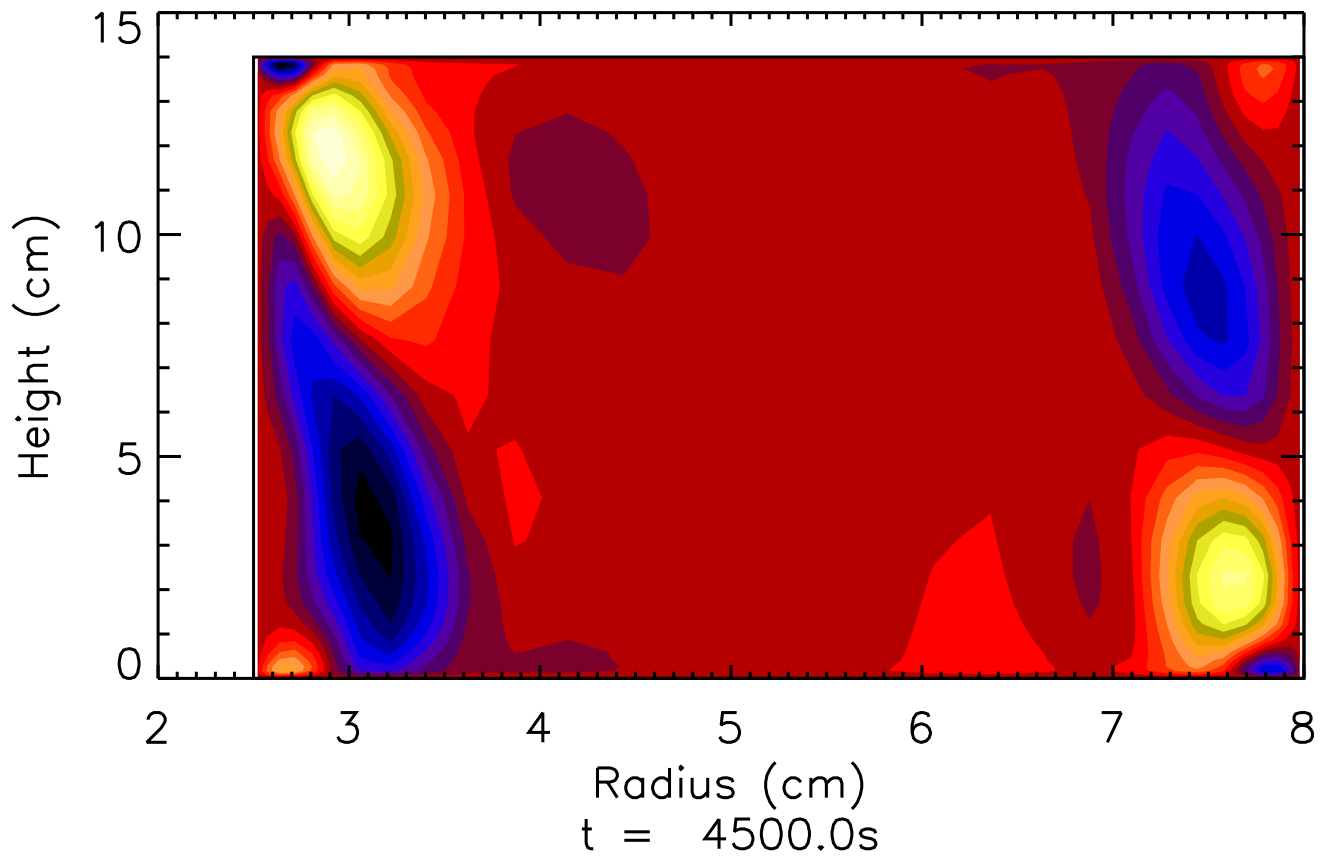
$\langle u'w' \rangle$

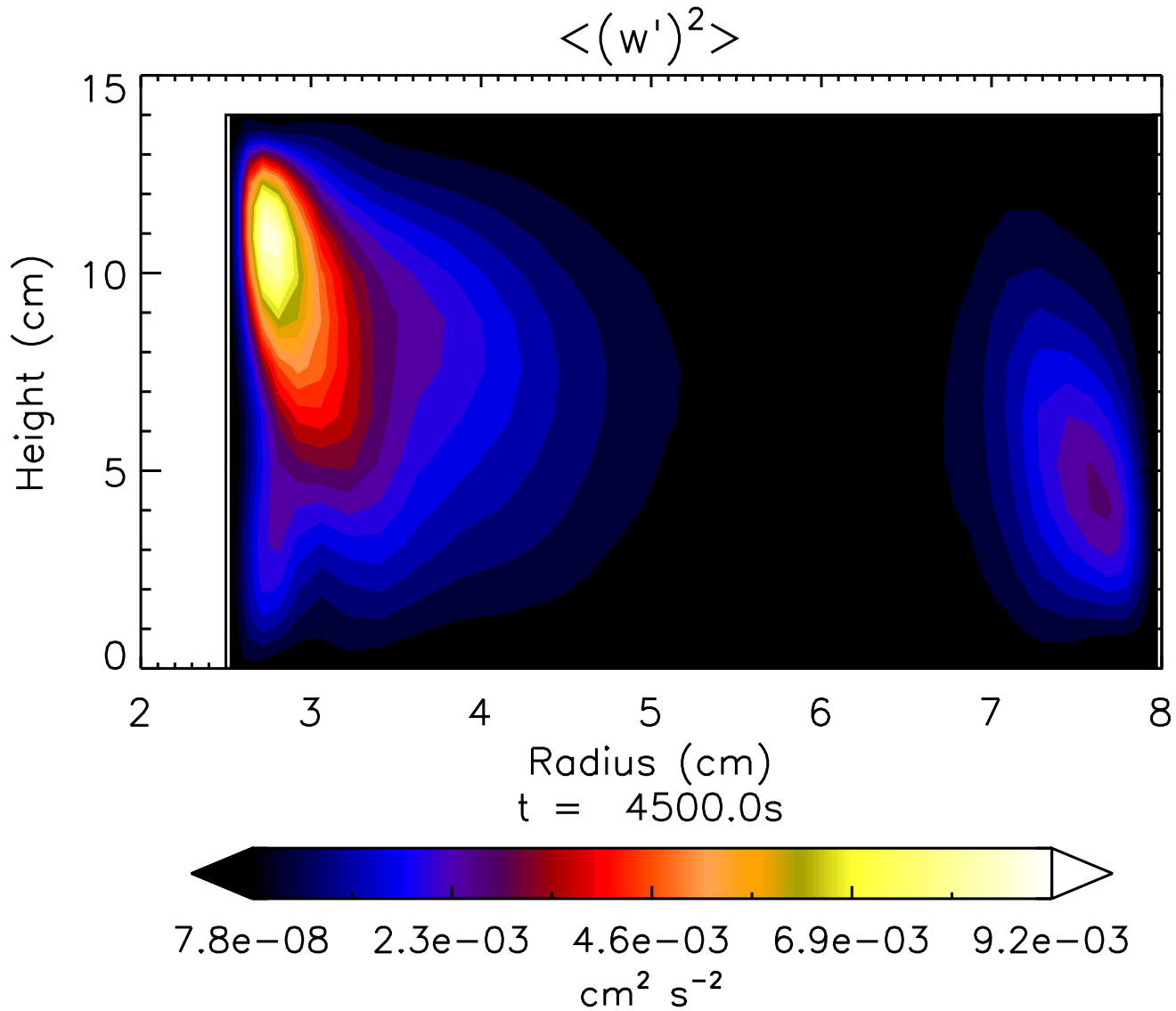




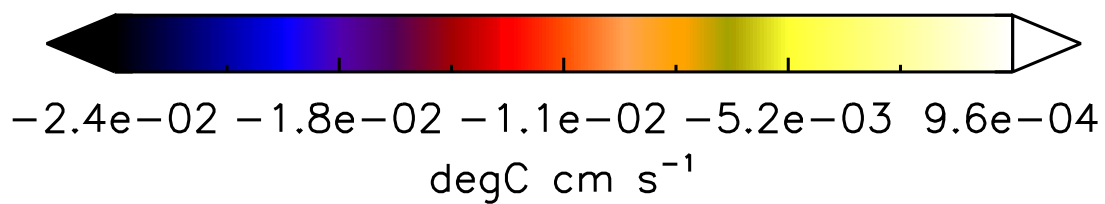
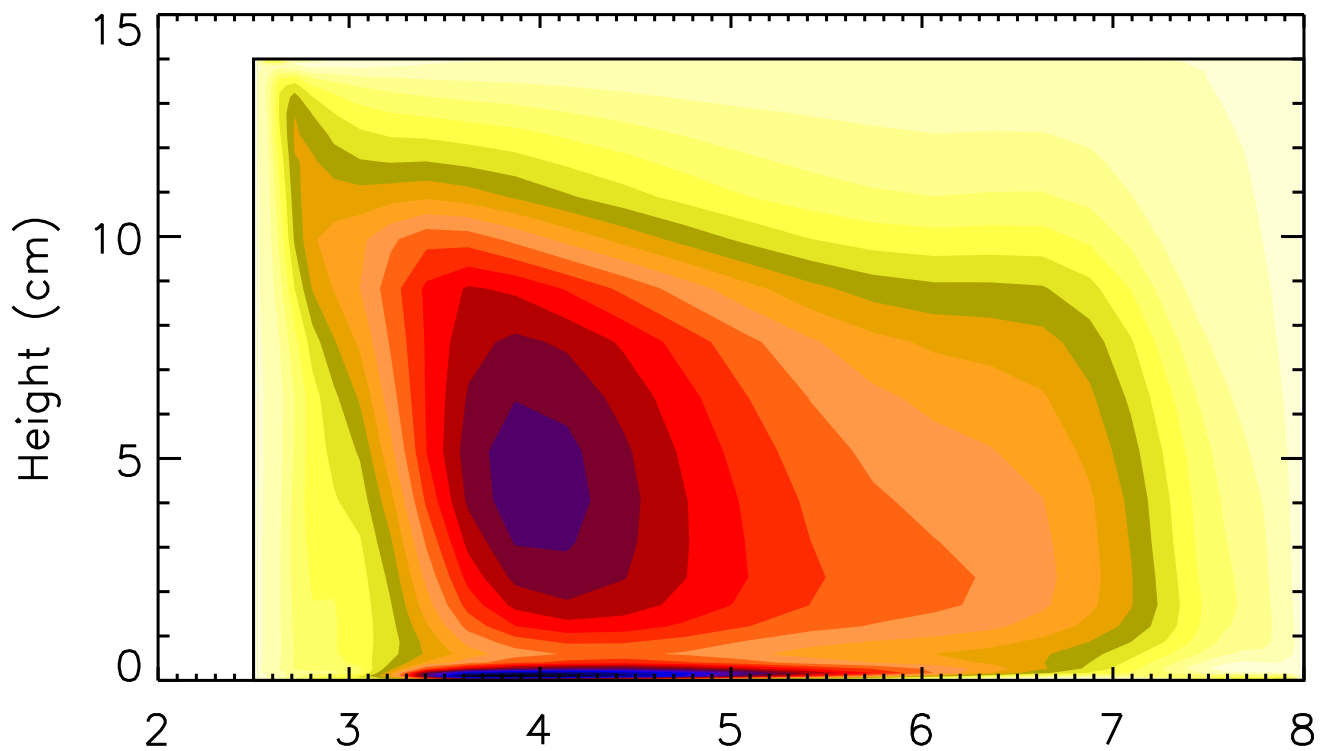


$\langle v'w' \rangle$

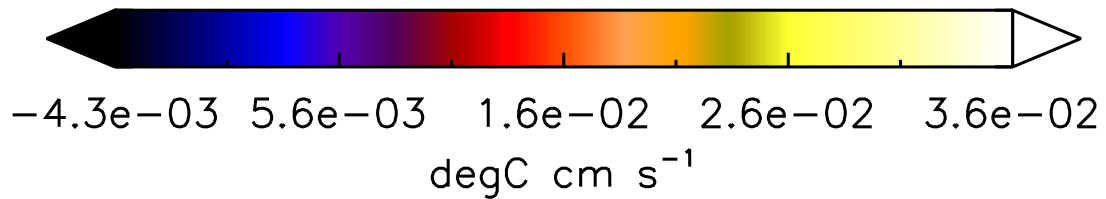
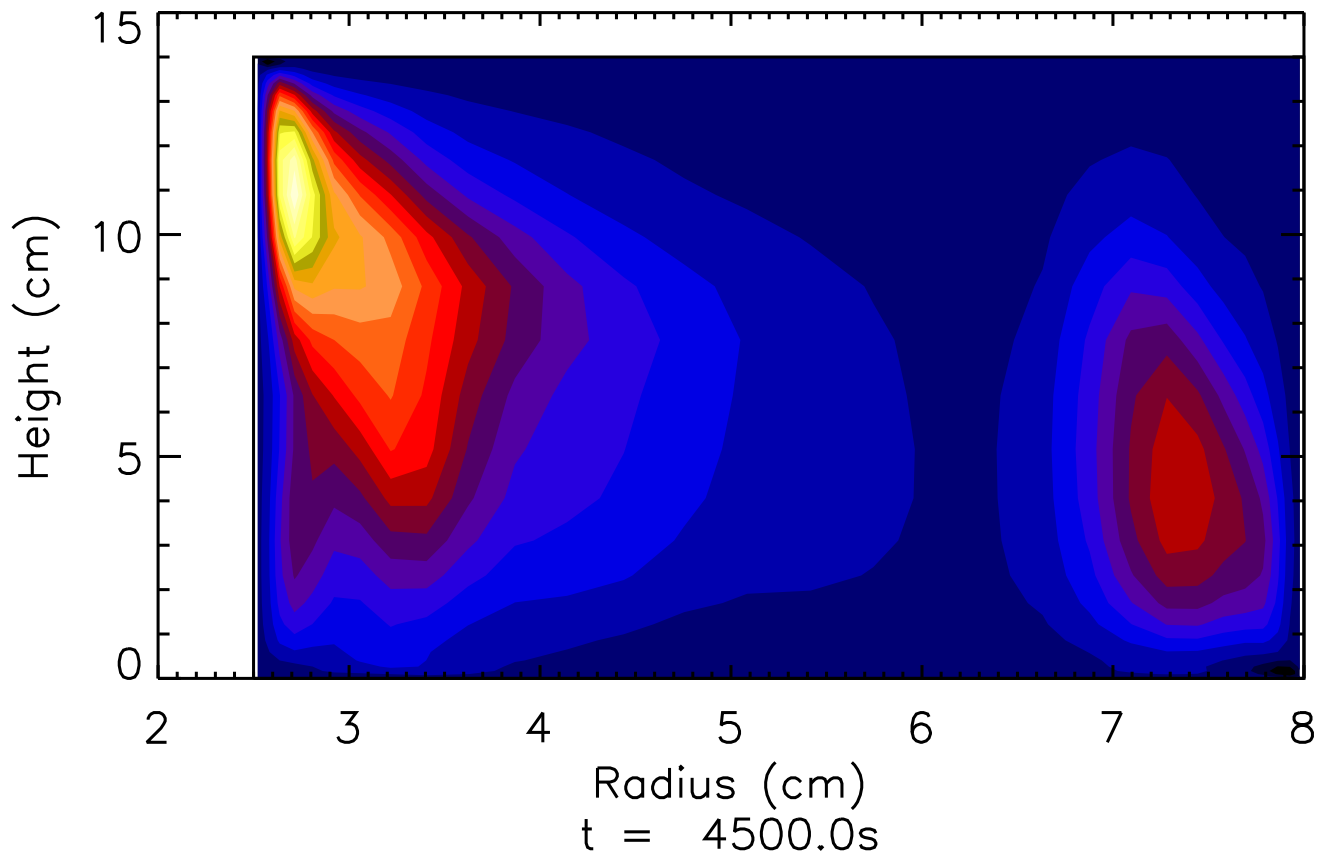




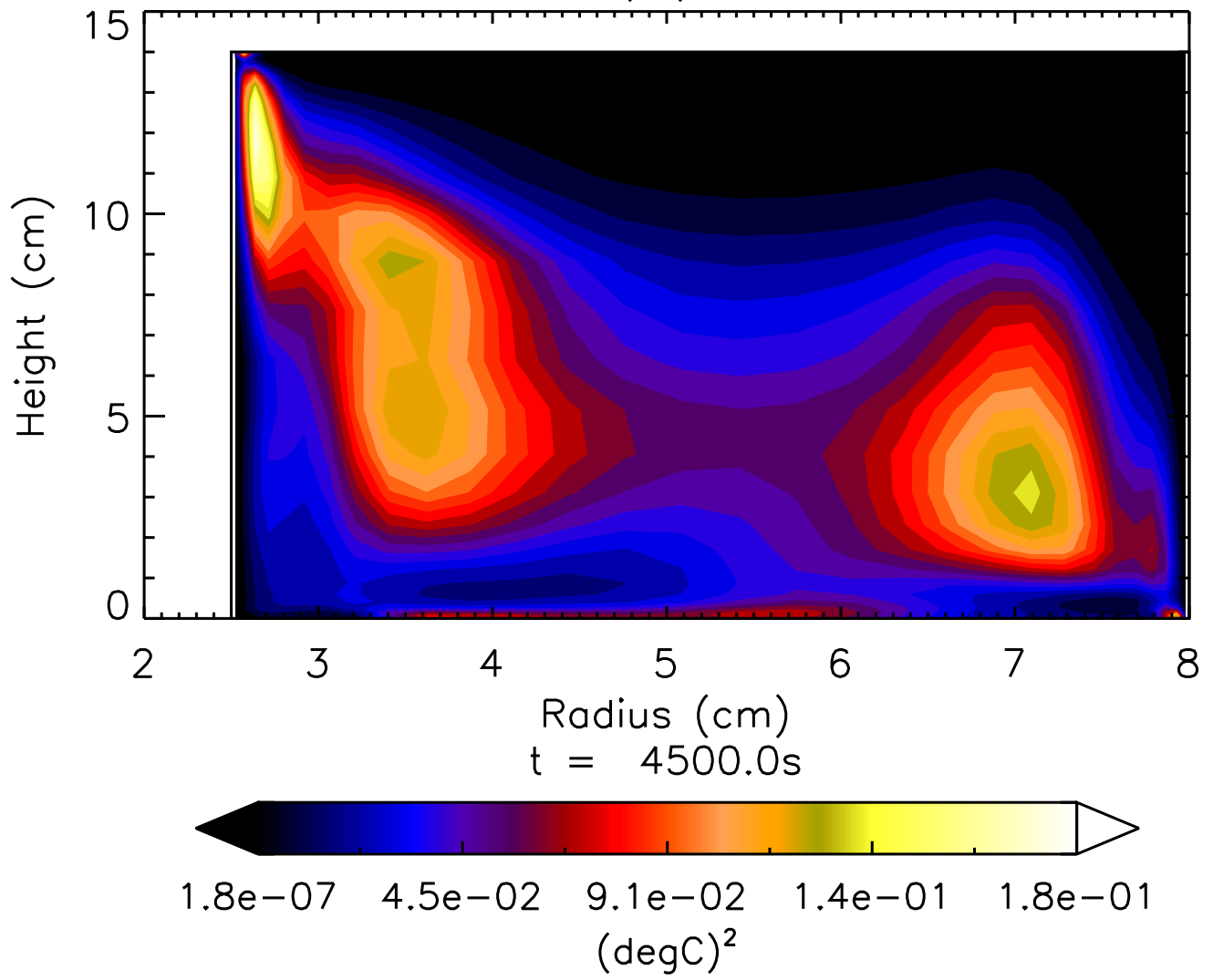
$\langle u'T' \rangle$



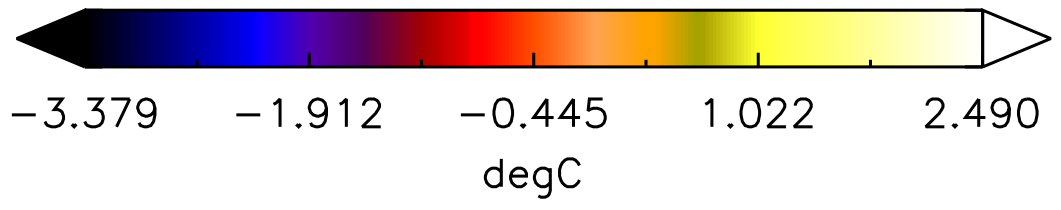
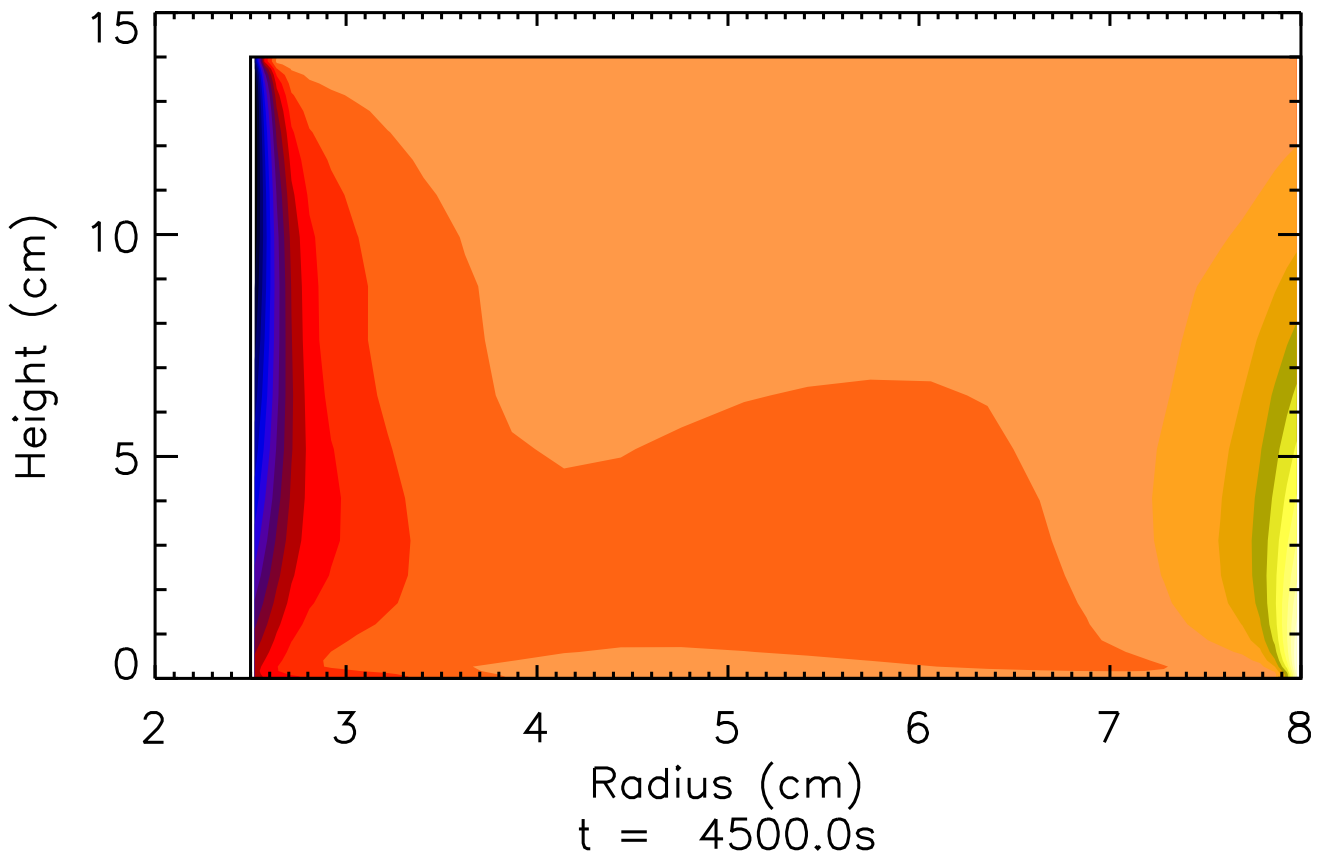
$\langle w'T' \rangle$



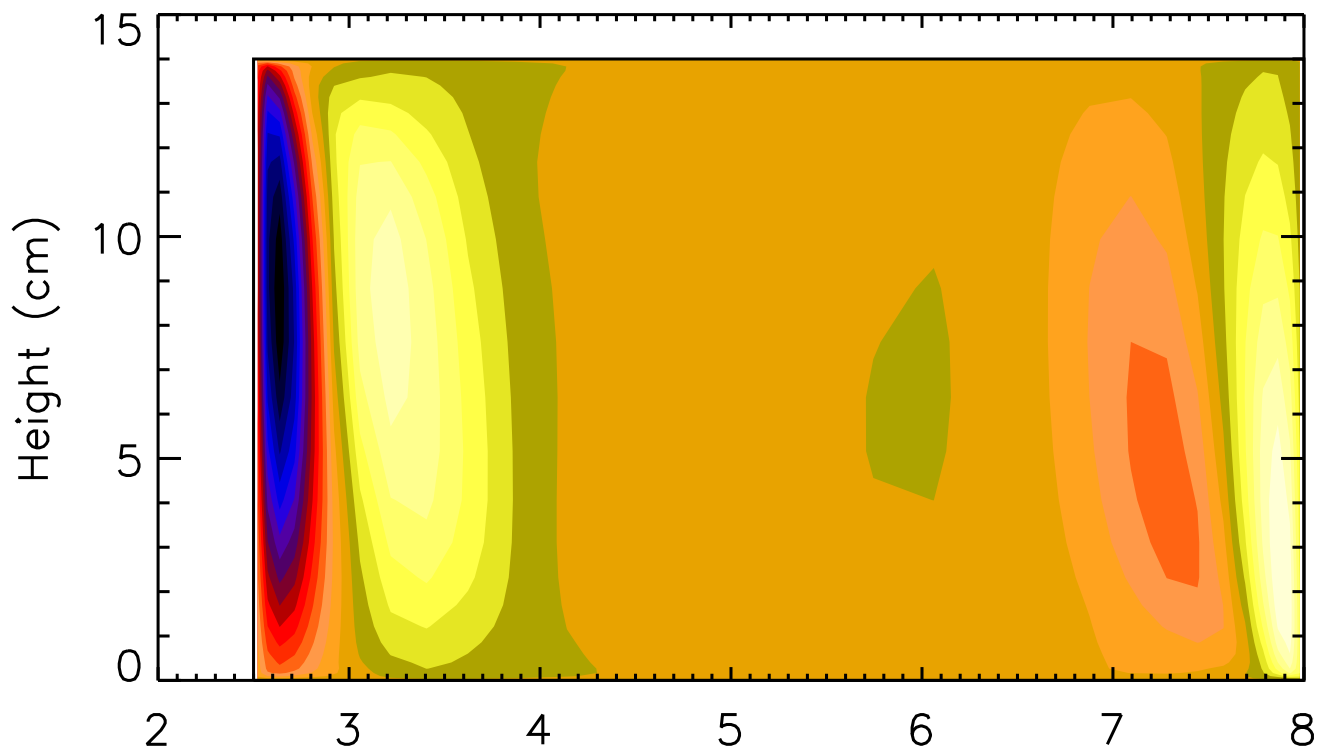
$$\langle (T')^2 \rangle$$



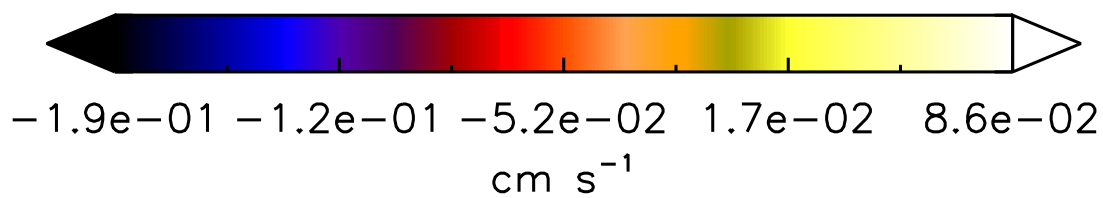
$\langle T'' \rangle$



$\langle w'' \rangle$

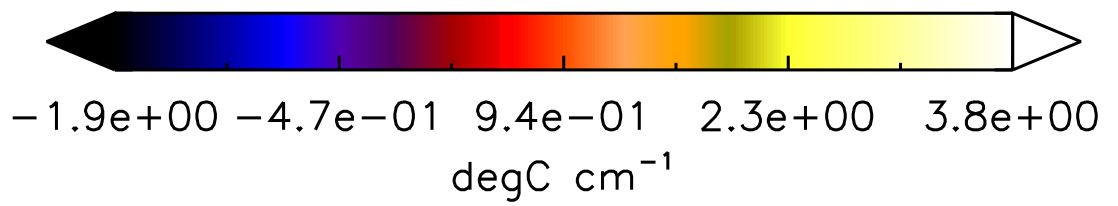
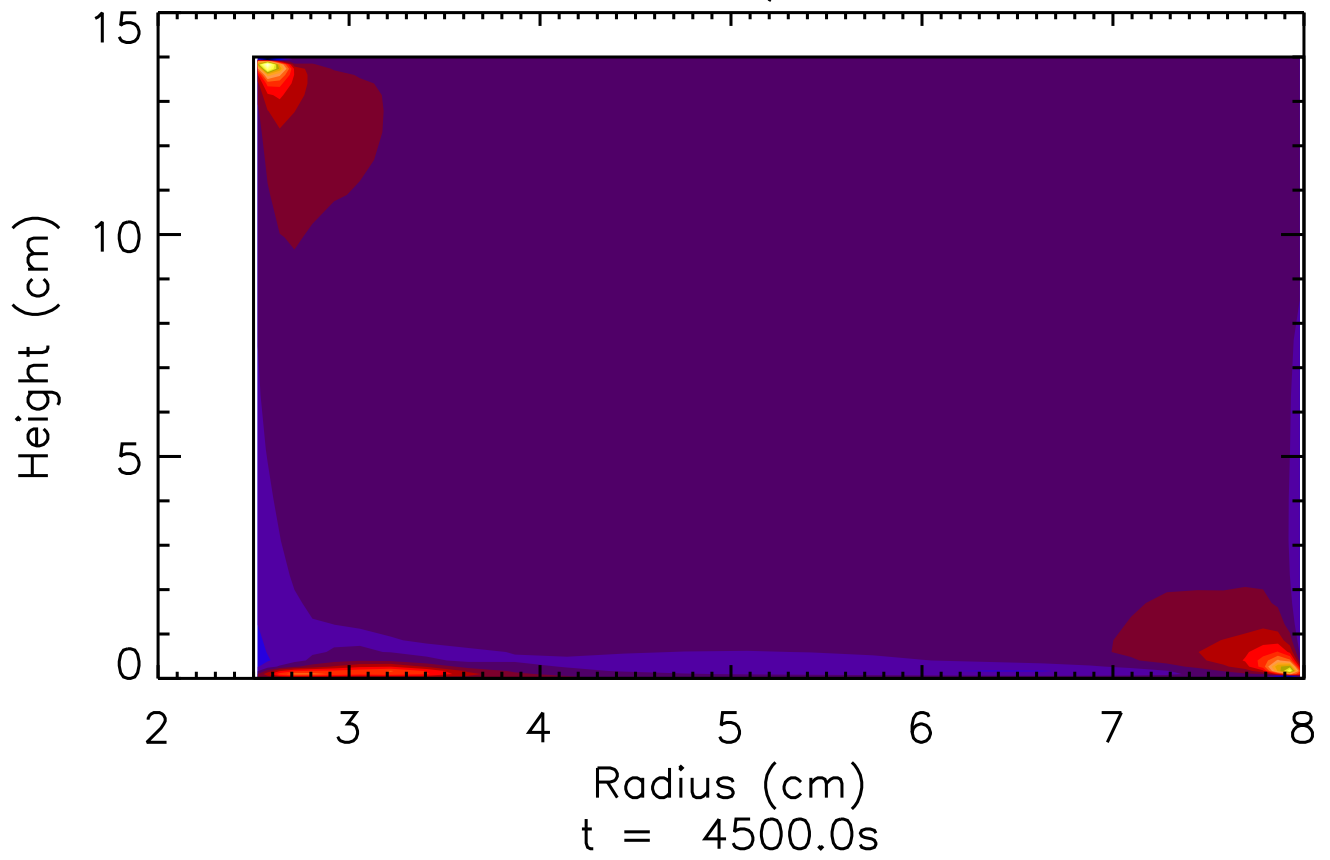


Radius (cm)  
 $t = 4500.0s$

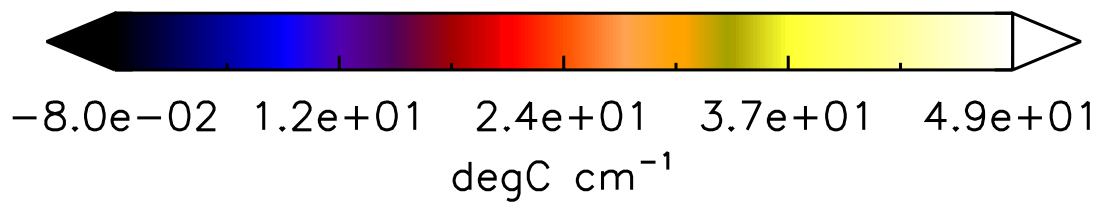
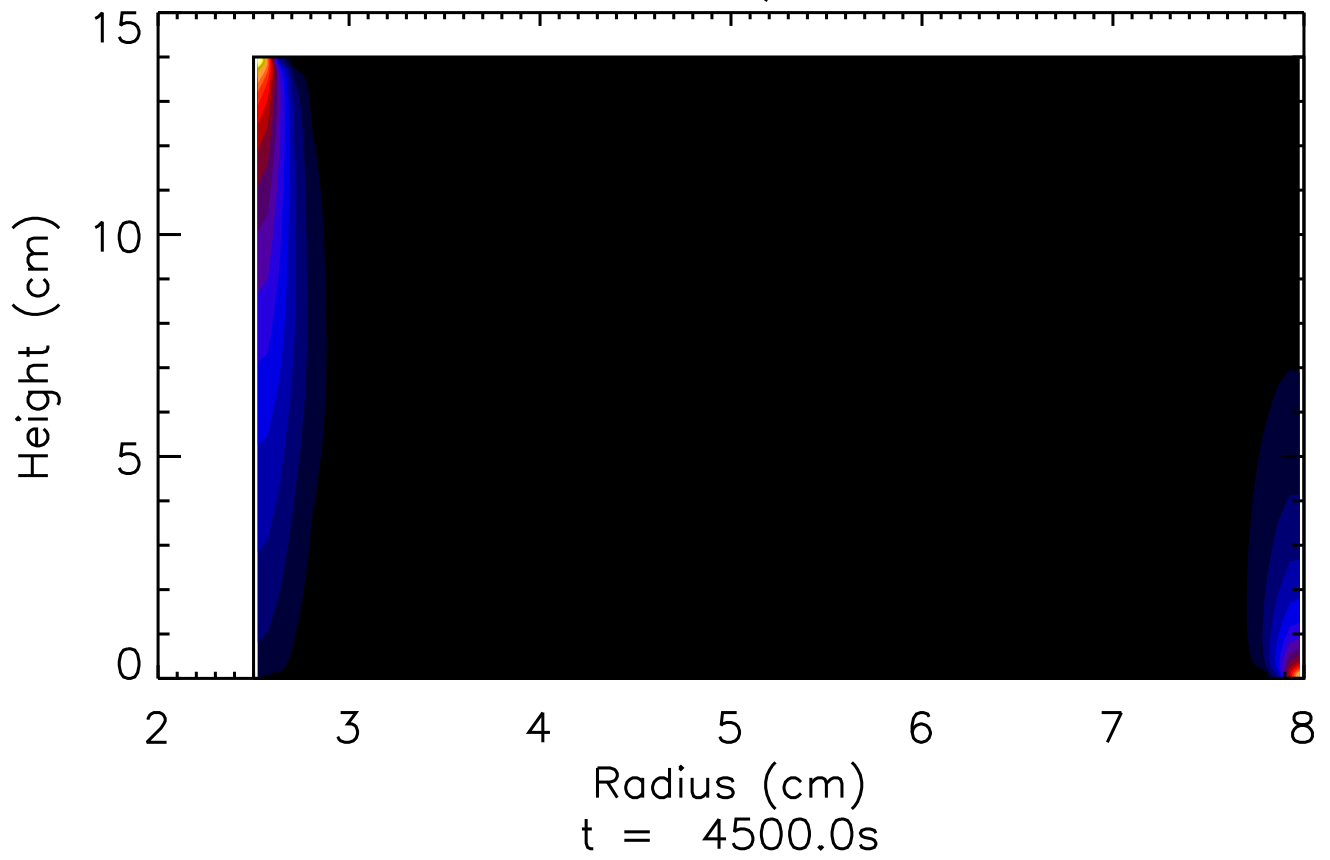




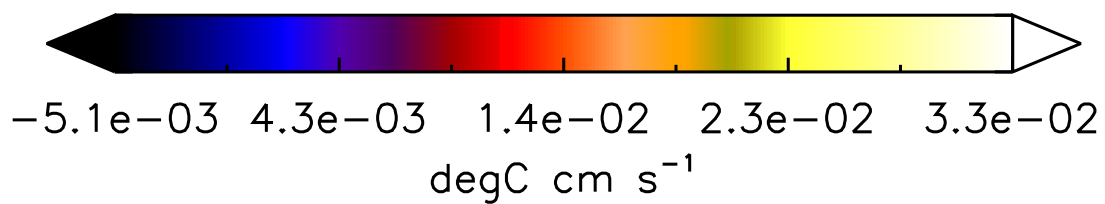
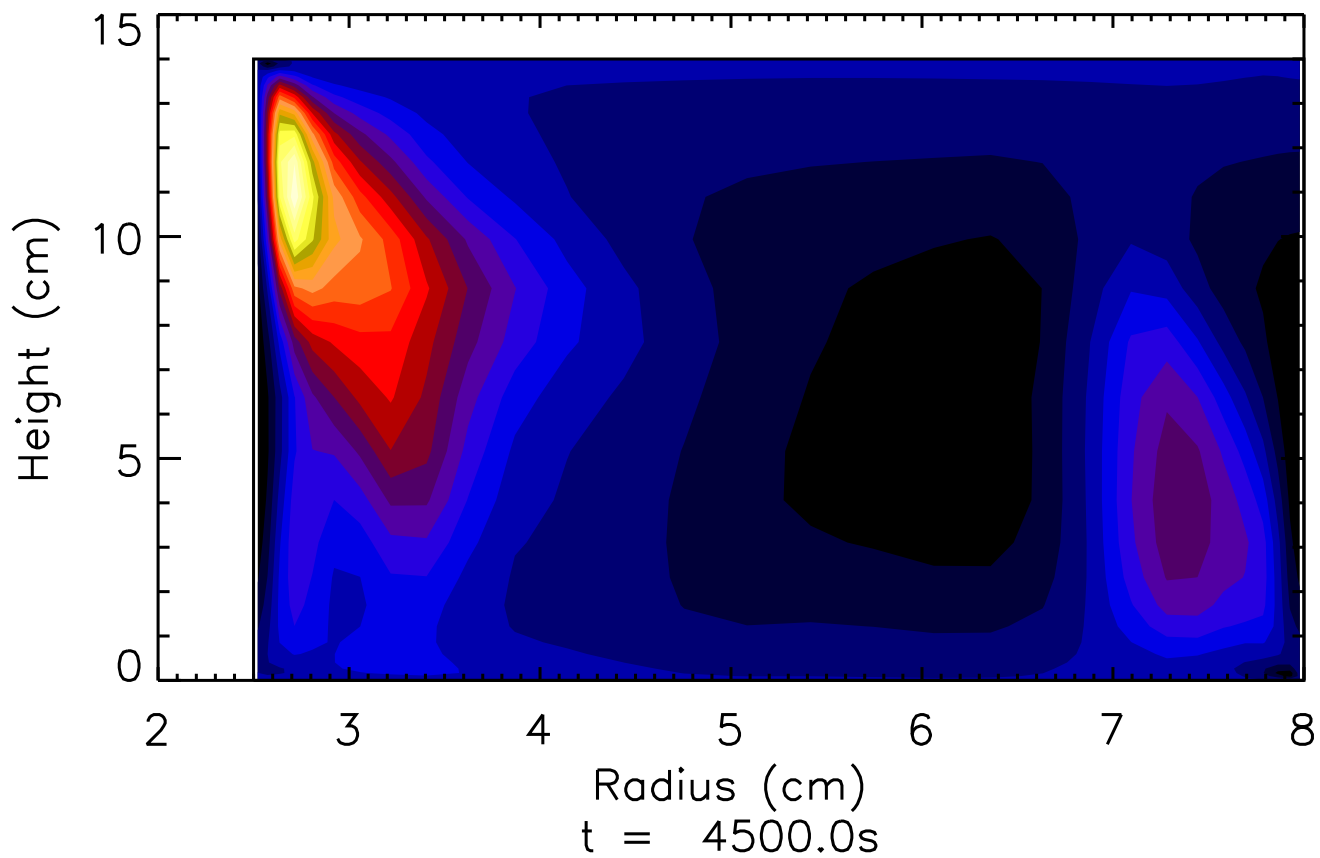
$$\partial \langle T'' \rangle / \partial z$$



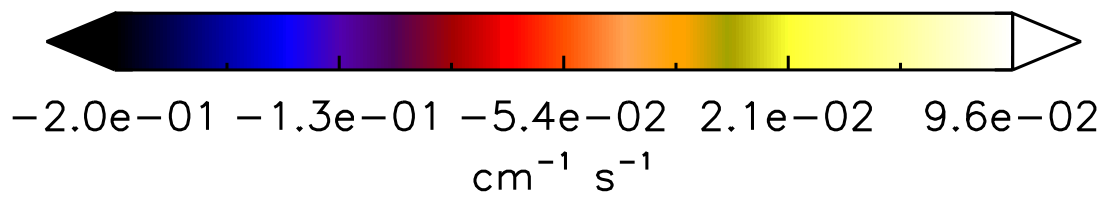
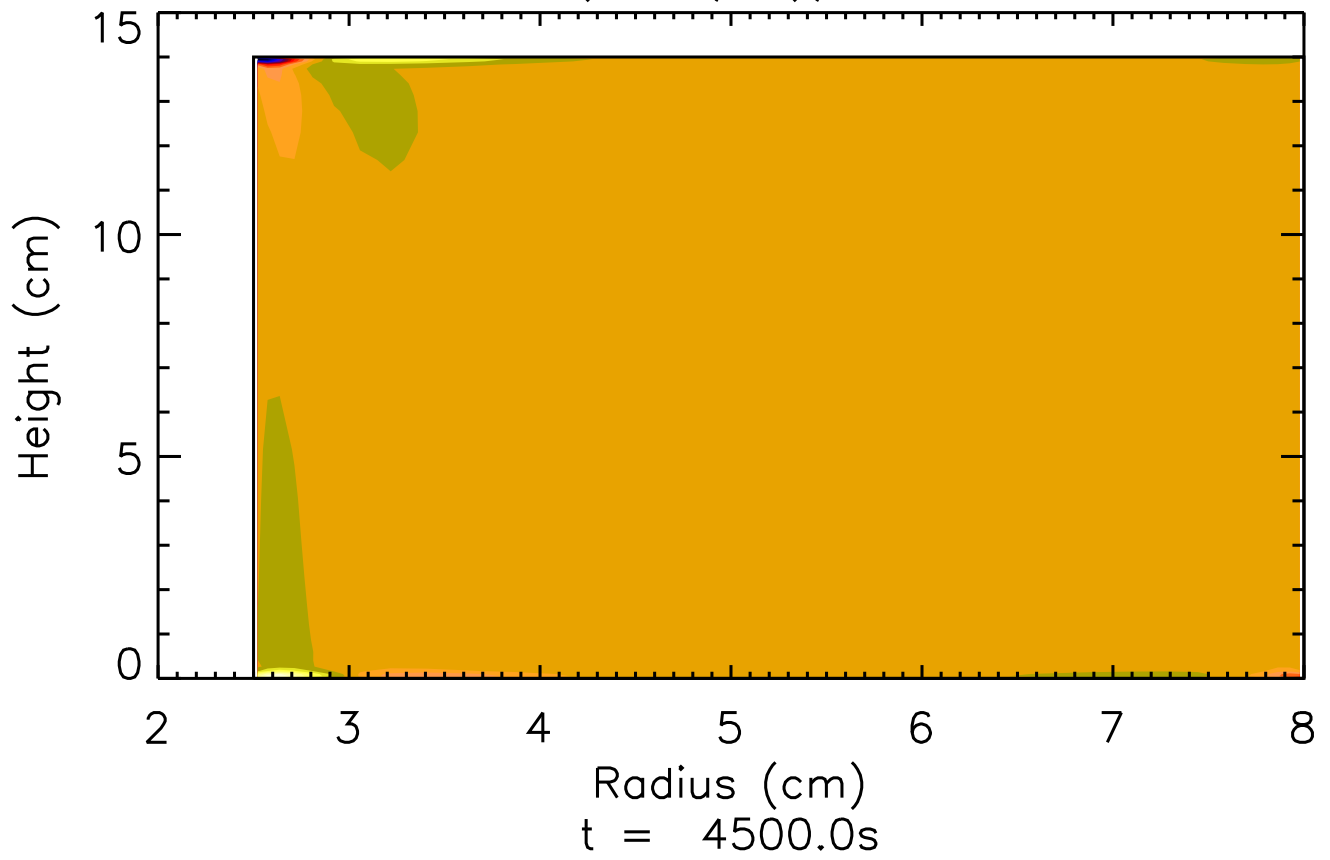
$$\partial \langle T'' \rangle / \partial R$$



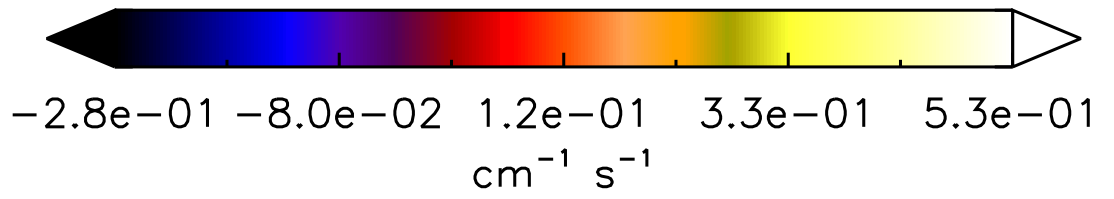
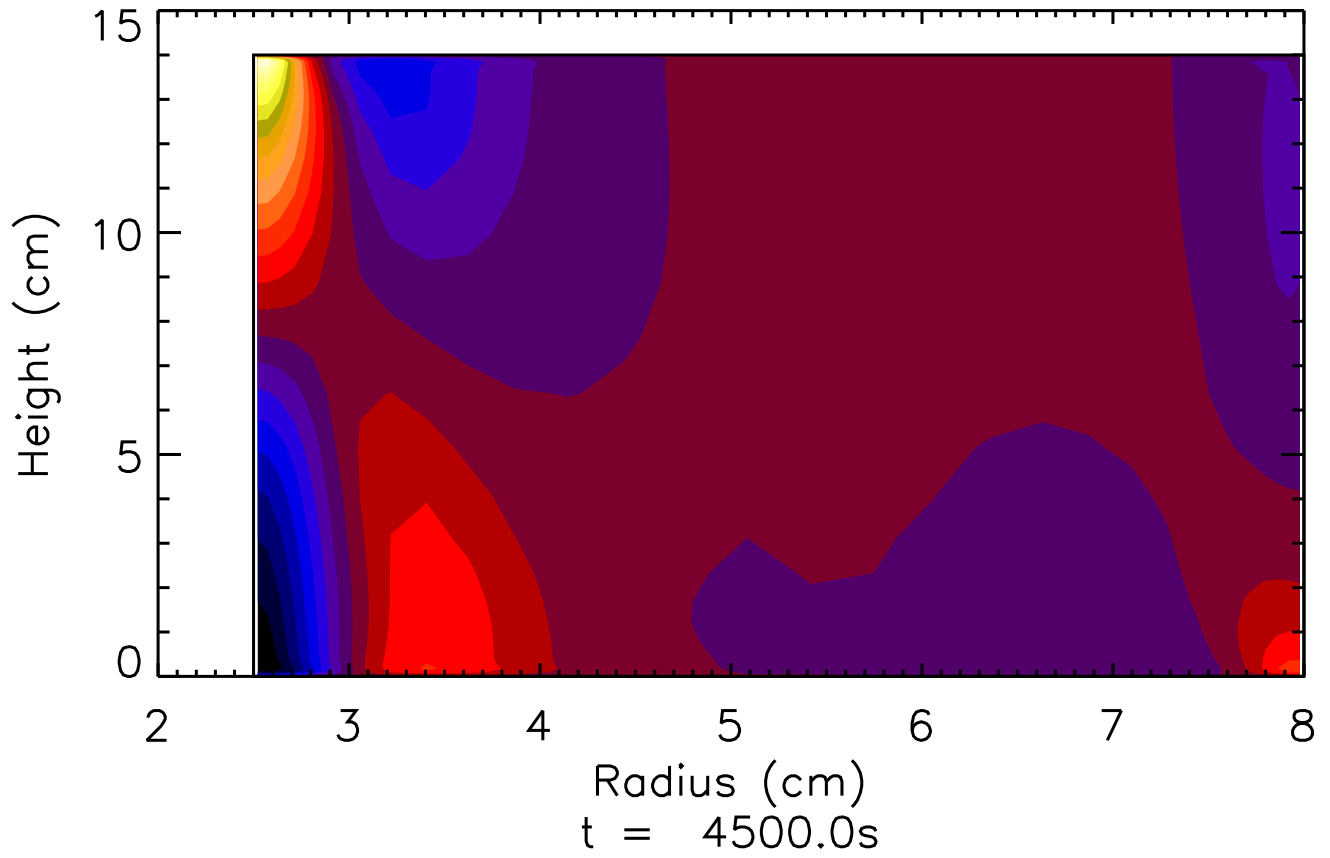
$\langle w'T' \rangle''$



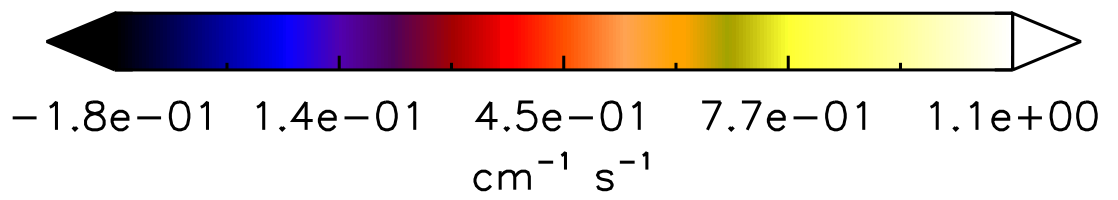
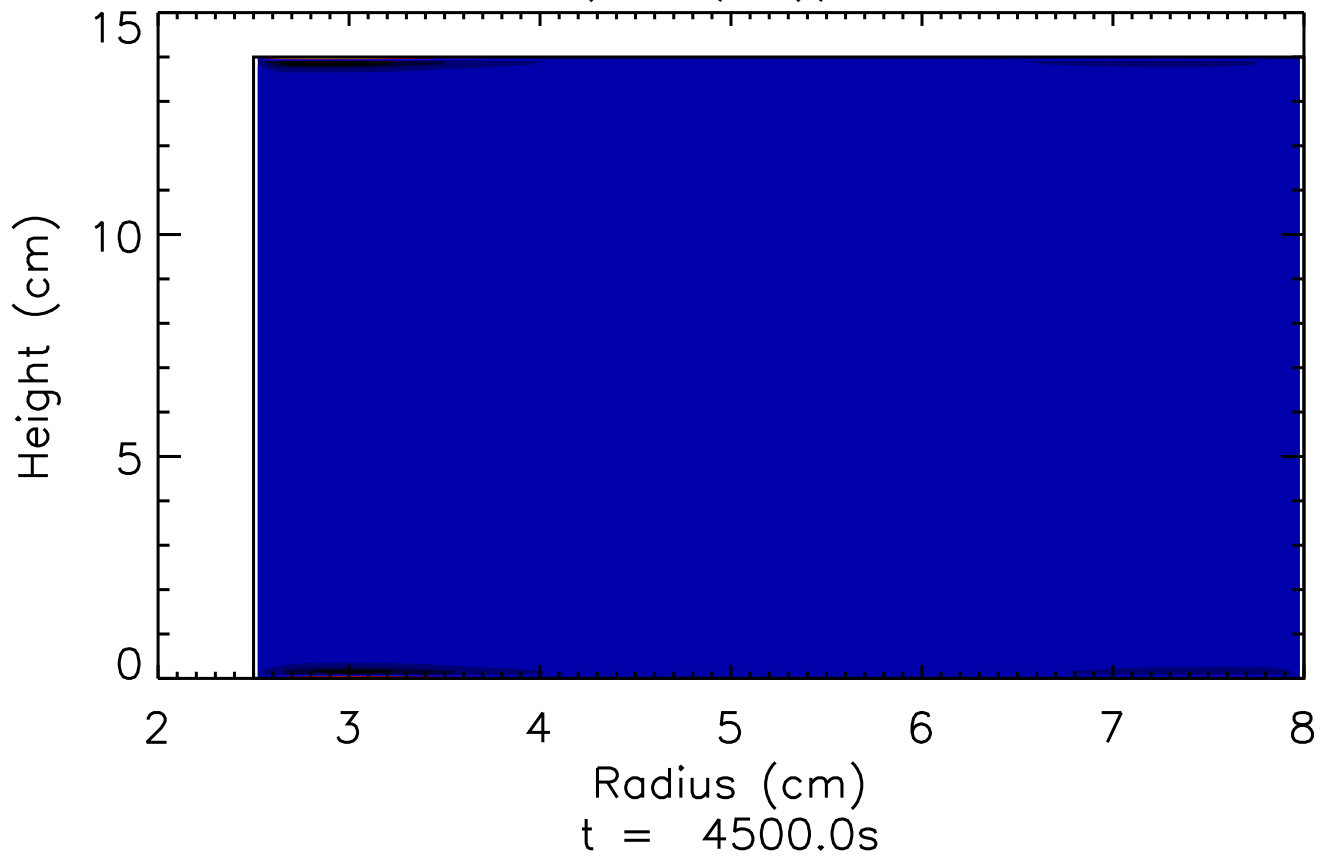
$$\partial(\langle u \rangle / R) / \partial R$$



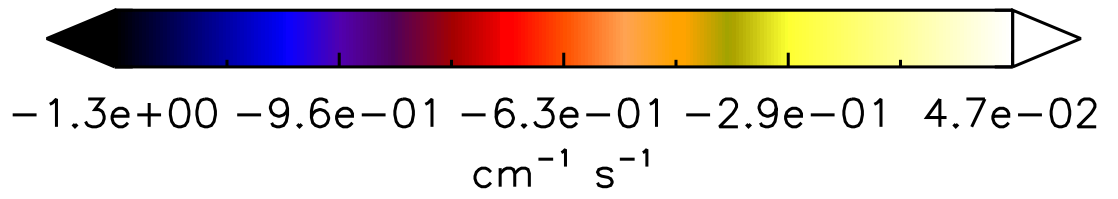
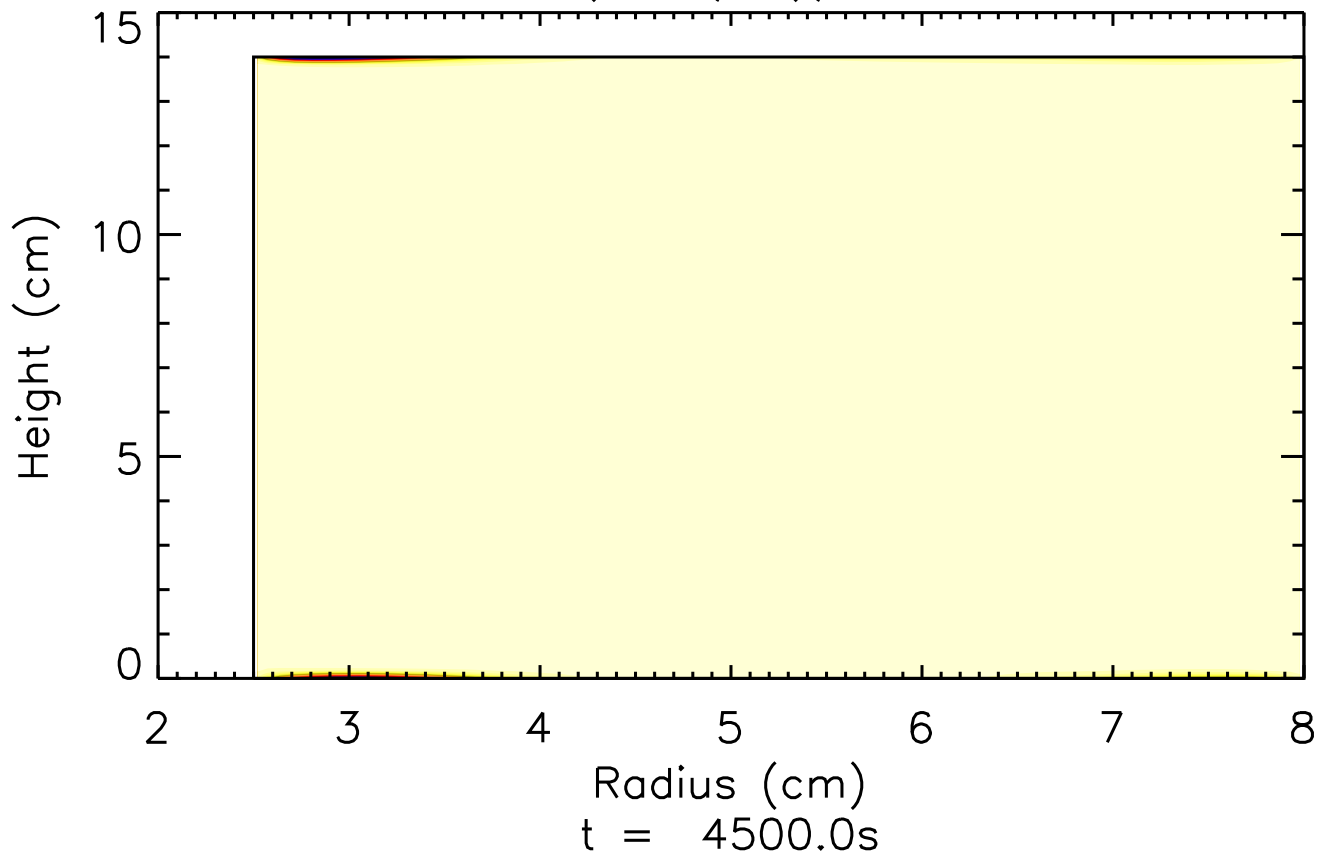
$$\partial(\langle v \rangle / R) / \partial R$$

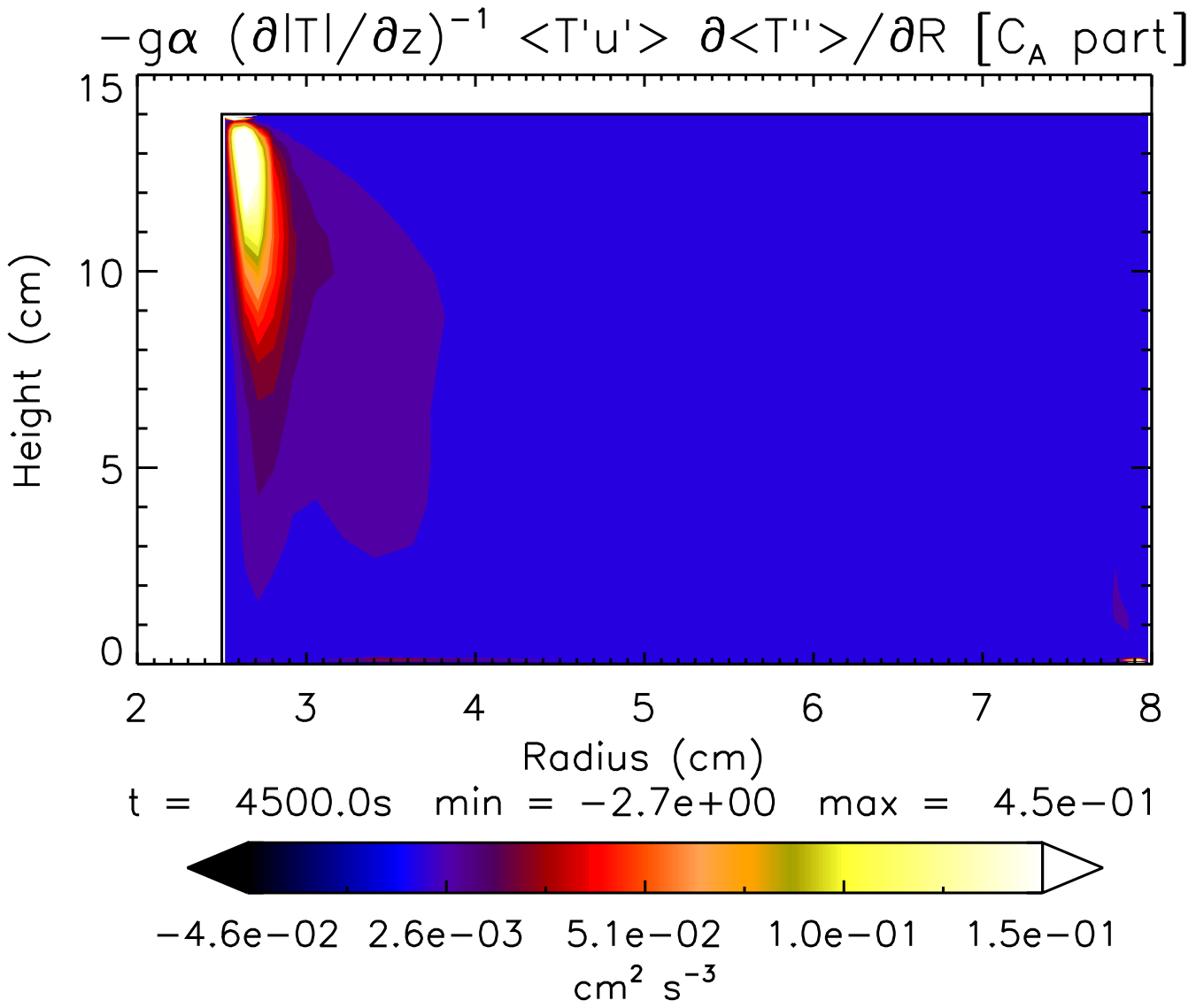


$$\partial(\langle u \rangle / R) / \partial z$$



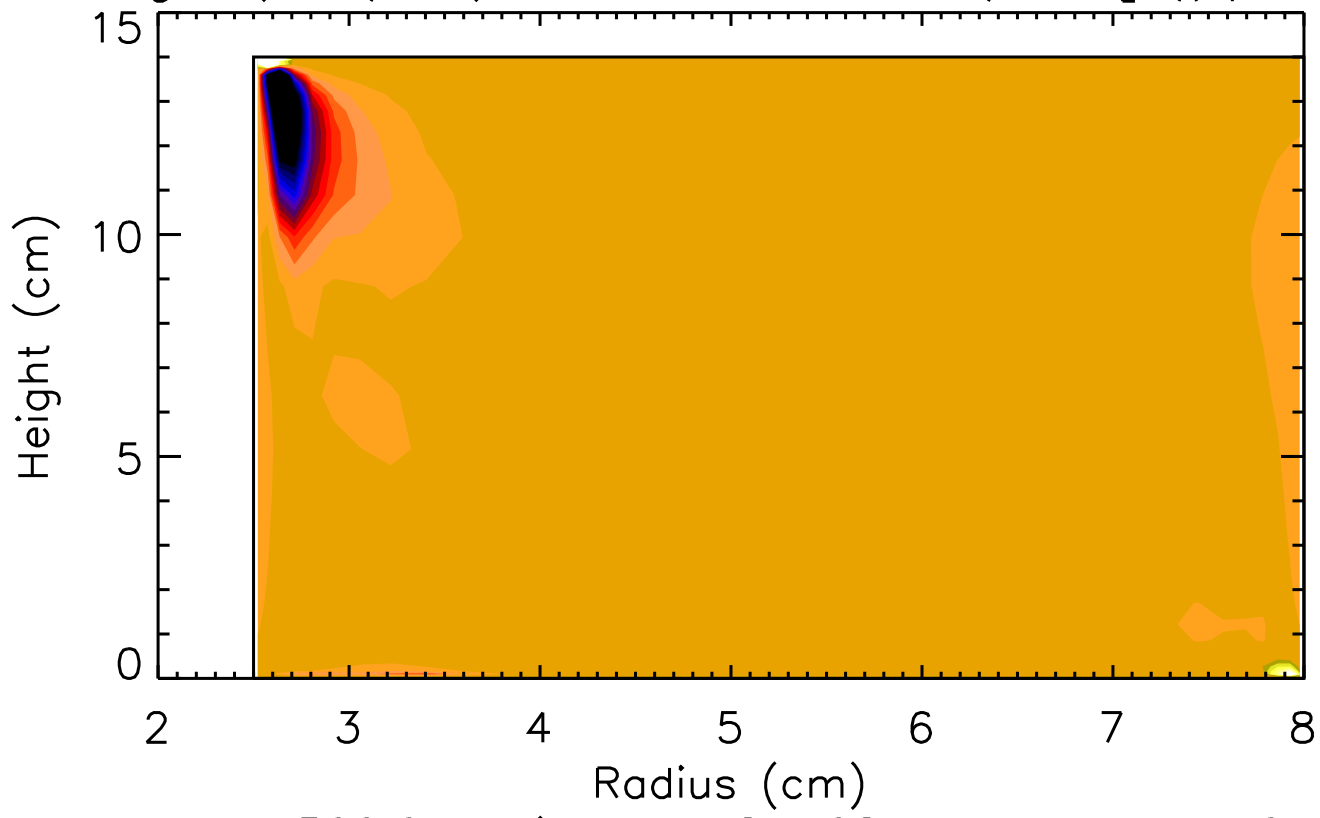
$$\partial(\langle v \rangle / R) / \partial z$$



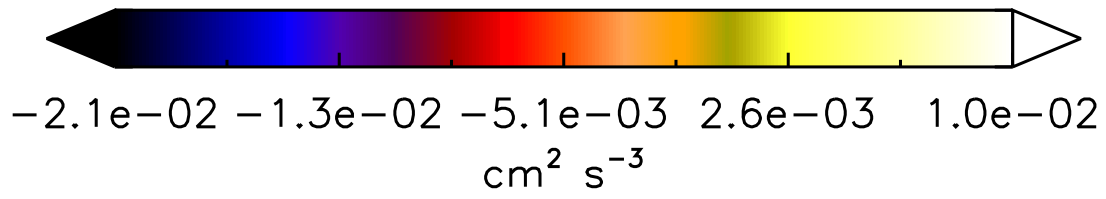




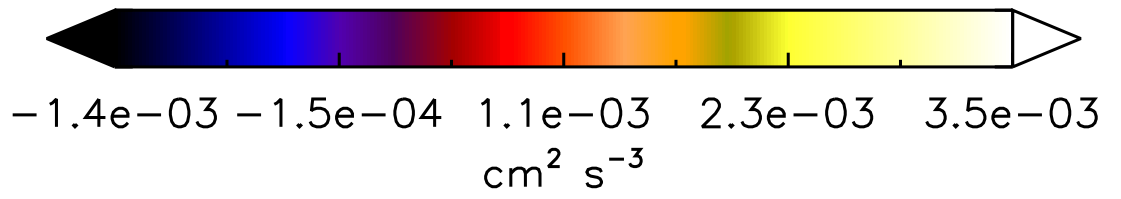
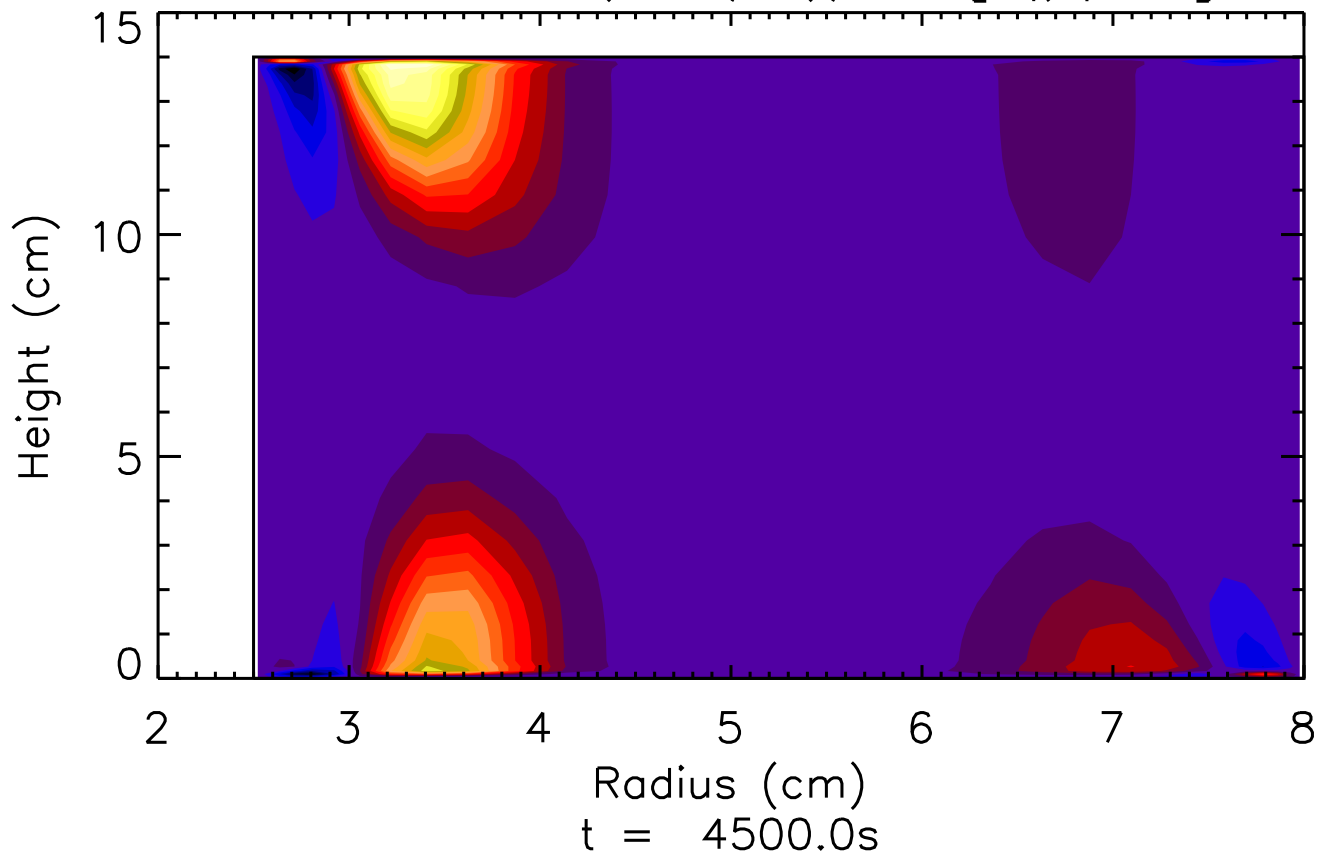
$$-g\alpha (\partial|T|/\partial z)^{-1} \langle T'w' \rangle'' \partial \langle T'' \rangle / \partial z \quad [C_A \text{ part}]$$



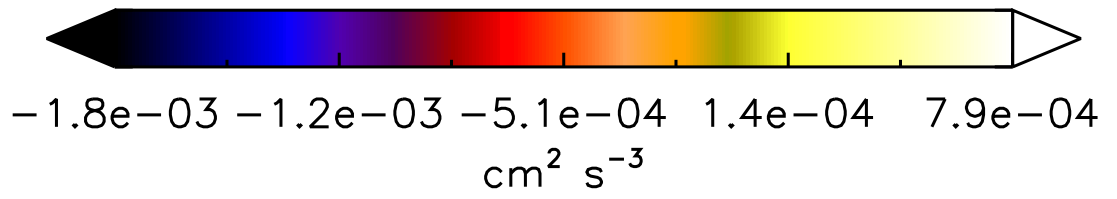
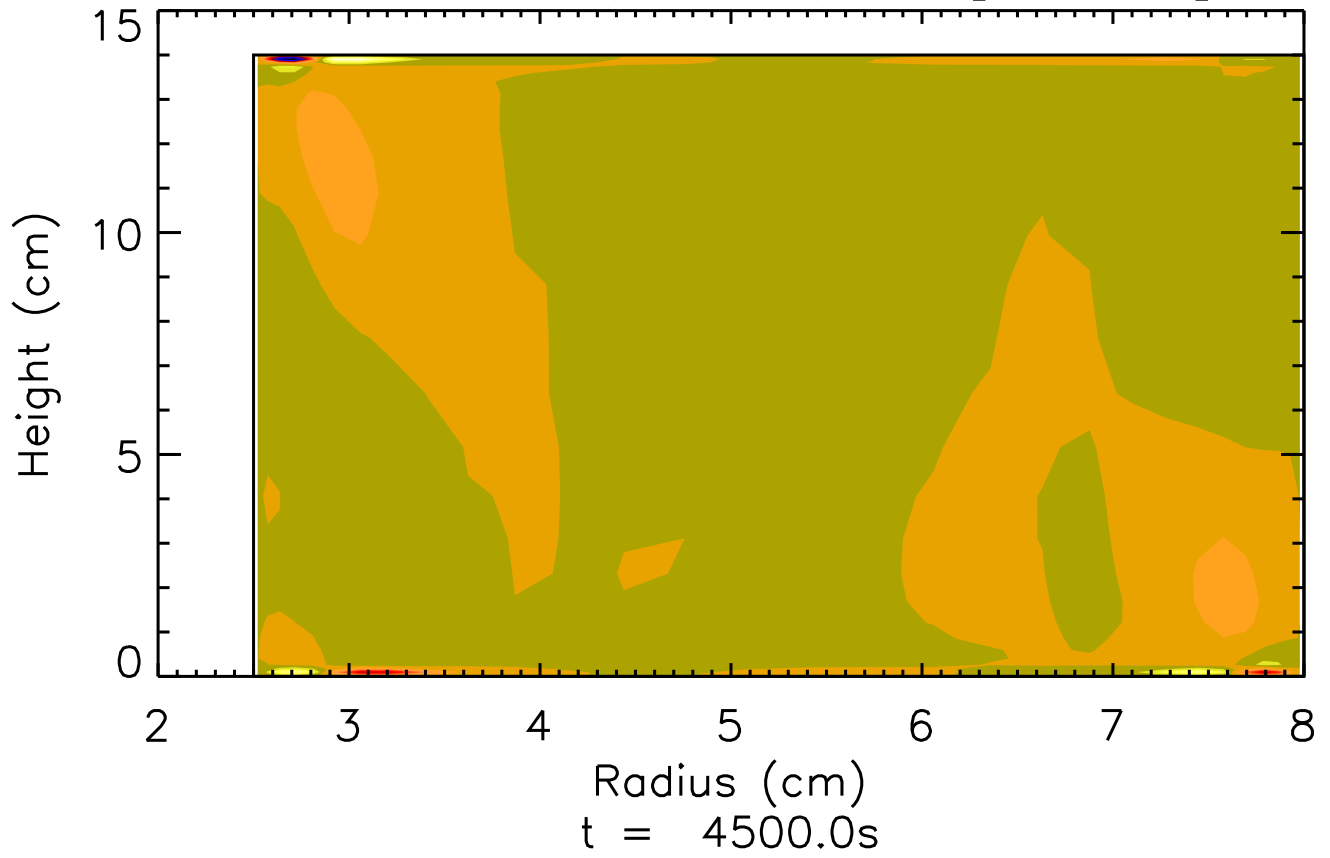
t = 4500.0s min = -4.2e-02 max = 1.1e-01



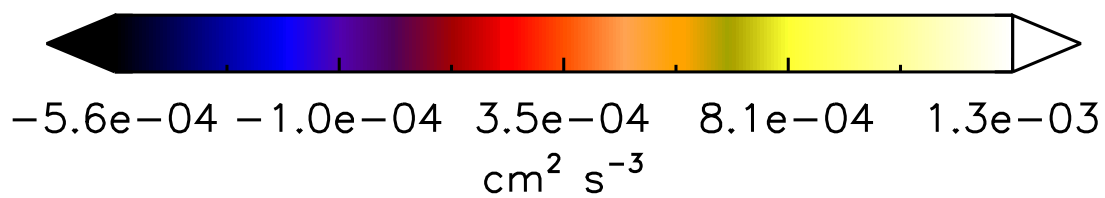
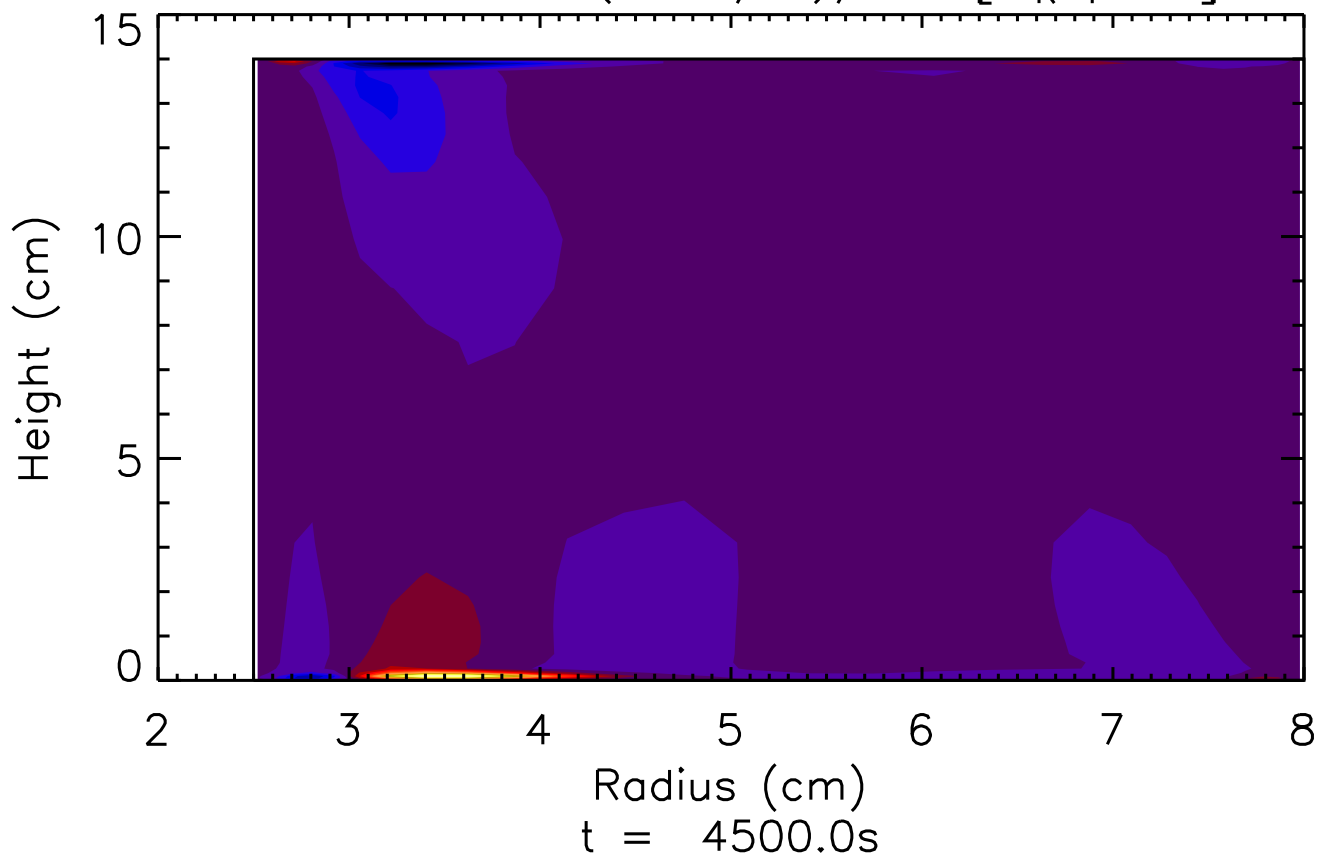
$$-R \langle u'v' \rangle \frac{\partial(\langle v \rangle / R)}{\partial R} [C_k \text{ part}]$$



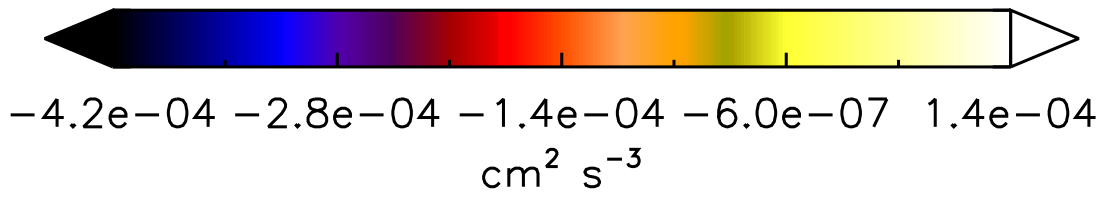
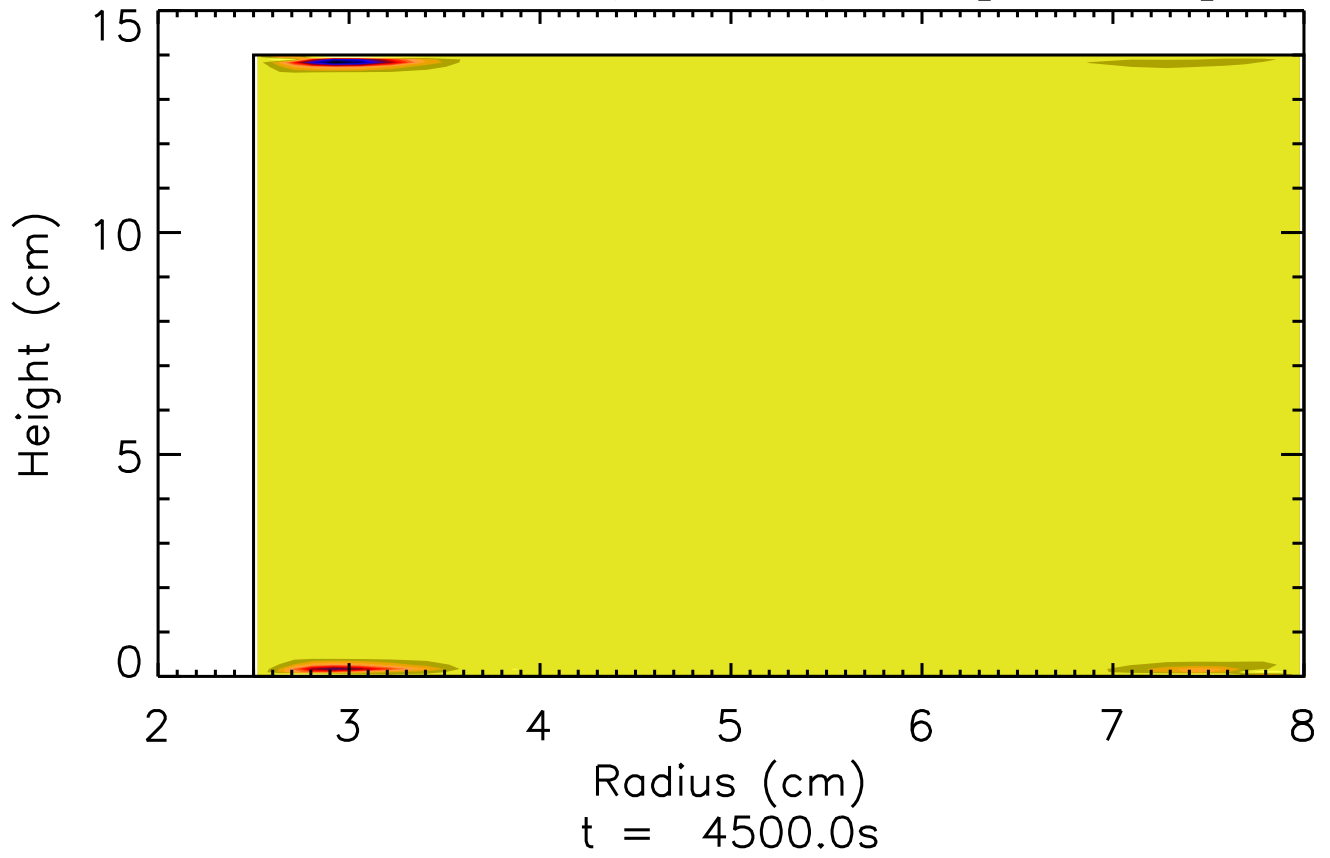
$$-R \langle v'w' \rangle \frac{\partial \langle v \rangle / R}{\partial z} [C_k \text{ part}]$$

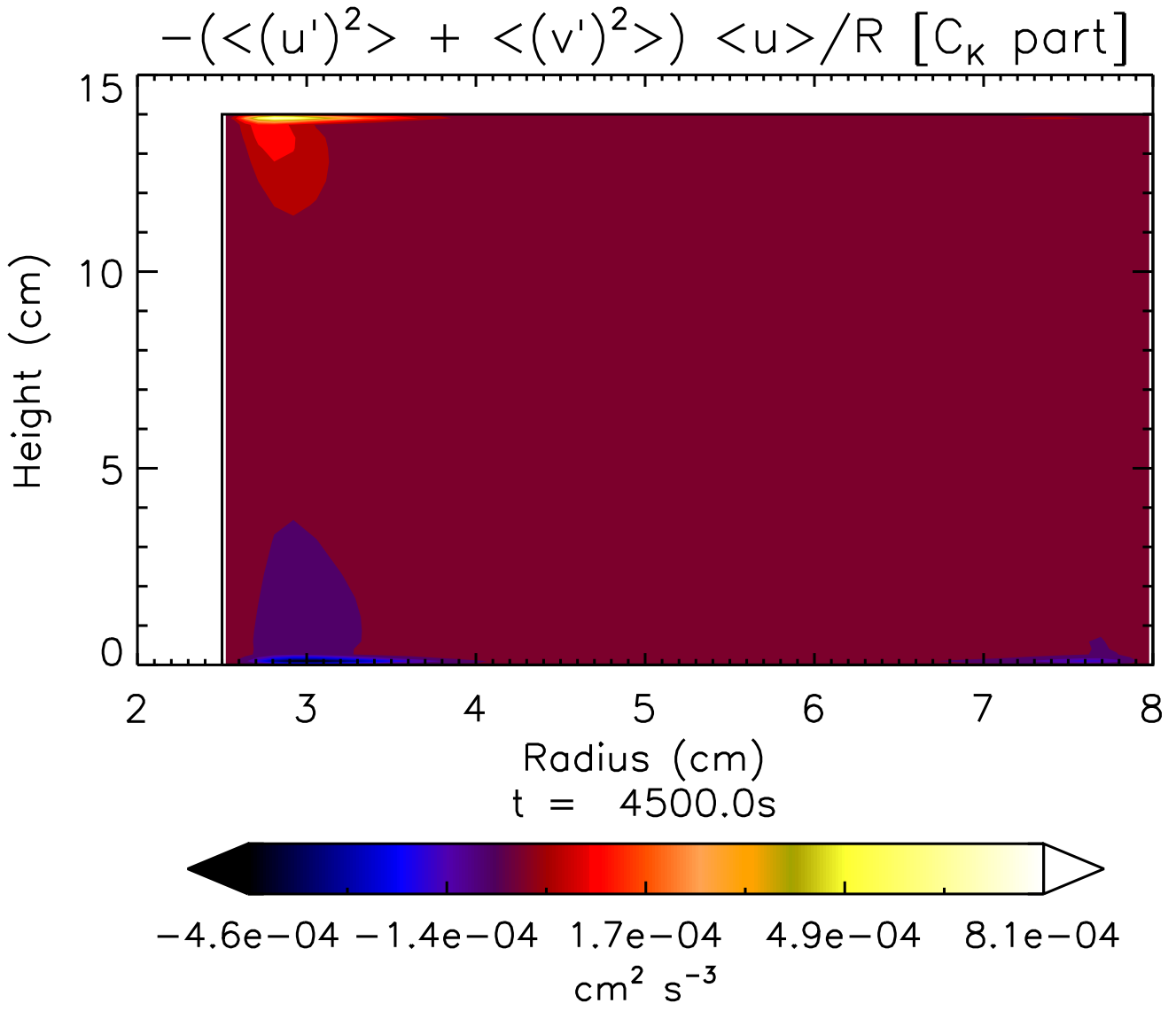


$$-R \langle u'u' \rangle \frac{\partial(\langle u \rangle / R)}{\partial R} [C_k \text{ part}]$$

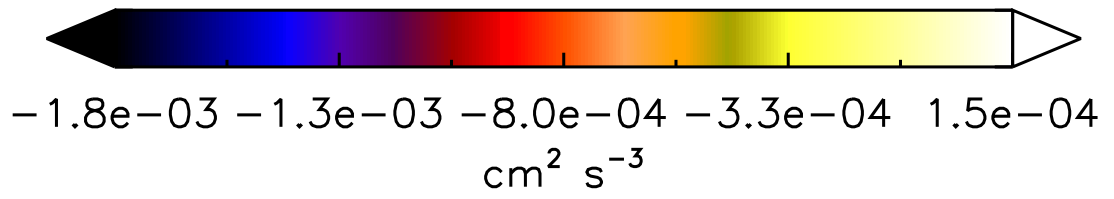
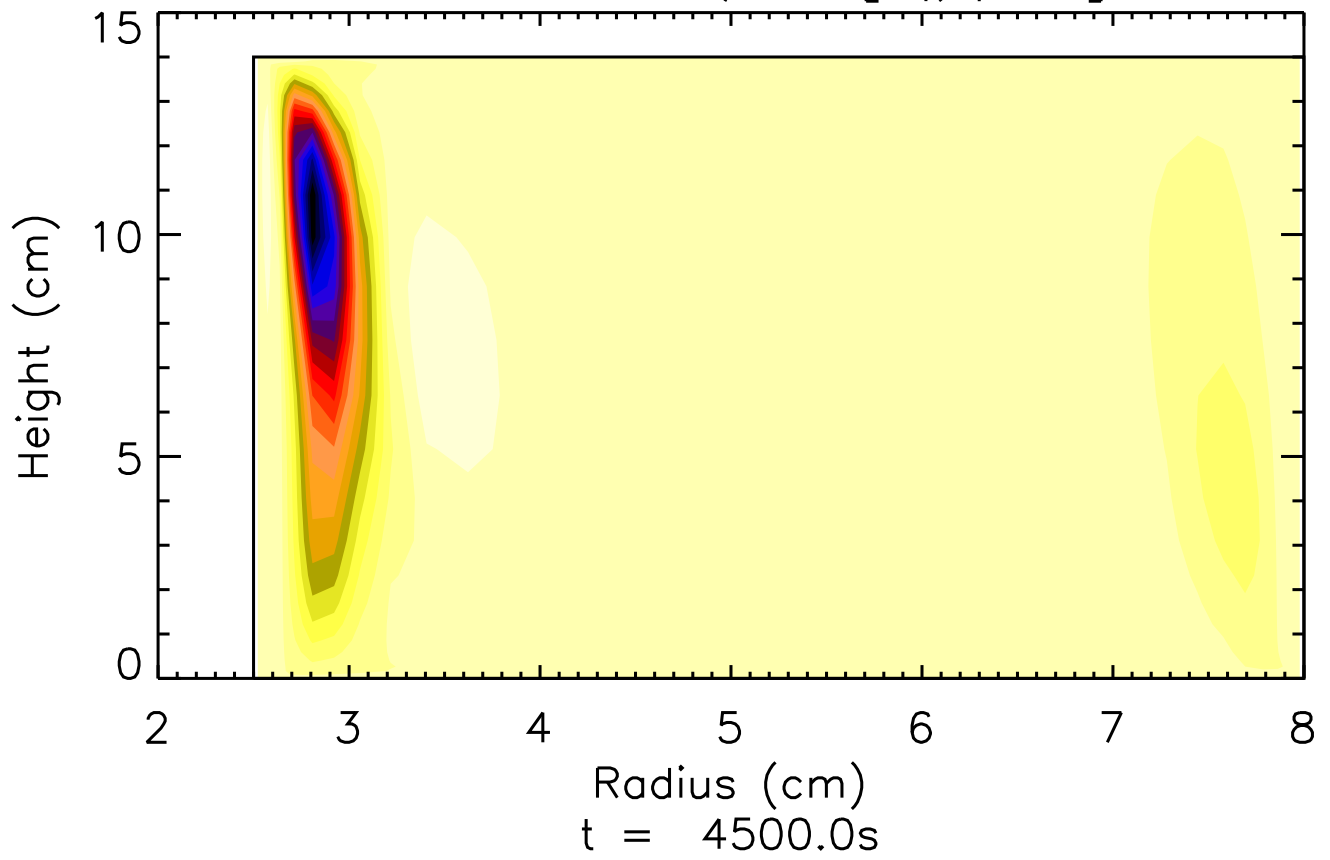


$$-R \langle u'w' \rangle \frac{\partial \langle u \rangle / R}{\partial z} [C_k \text{ part}]$$

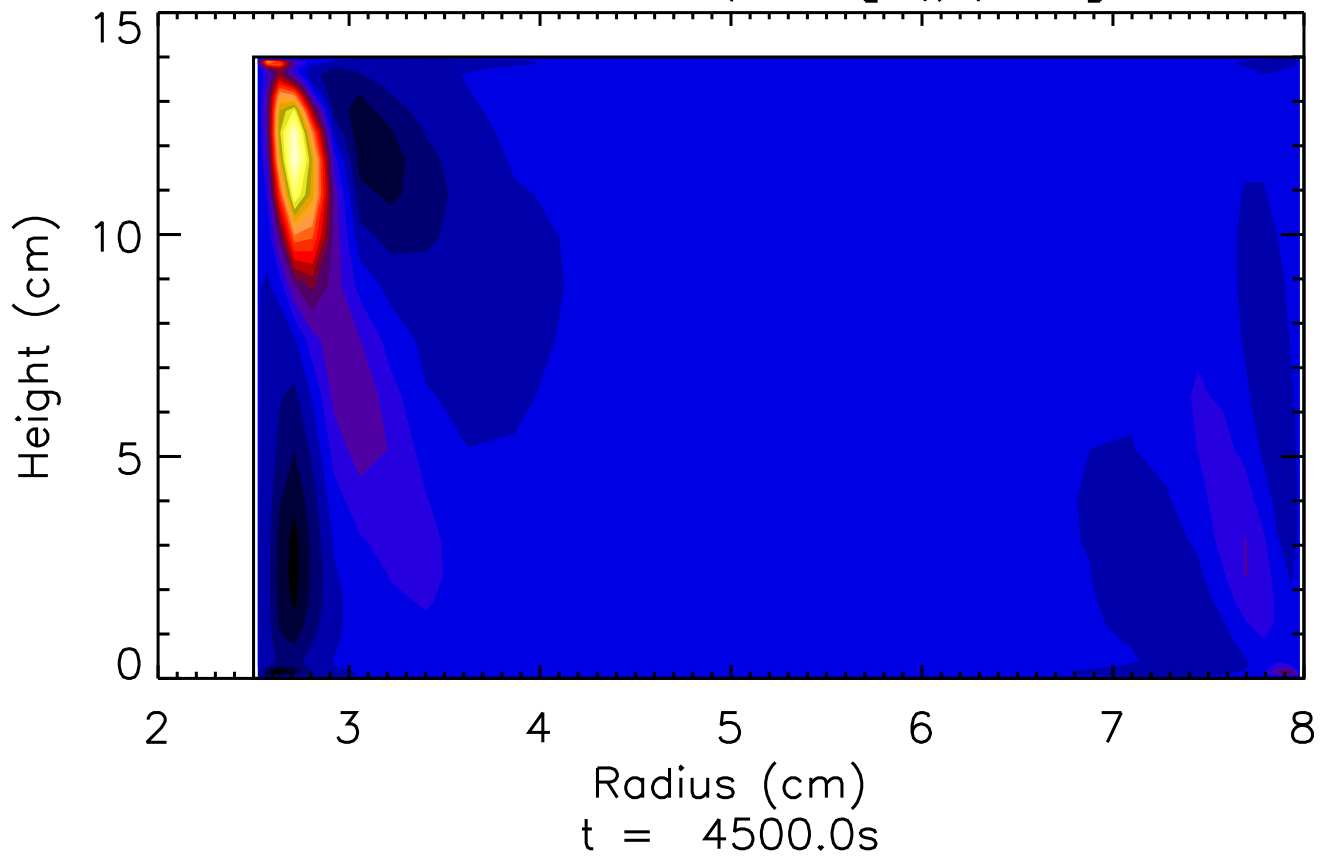




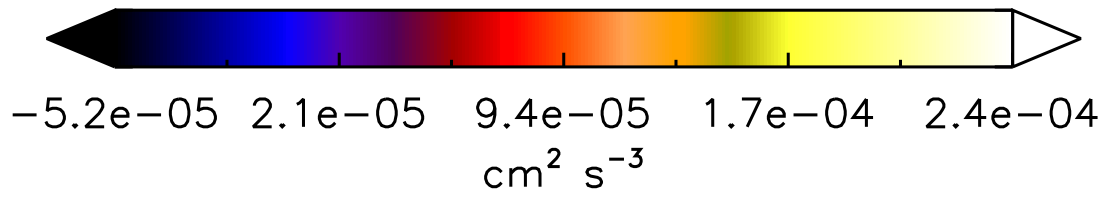
$\langle u'w' \rangle \partial \langle w \rangle / \partial R$  [ $C_k$  part]



$\langle w'w' \rangle \partial \langle w \rangle / \partial z$  [ $C_K$  part]

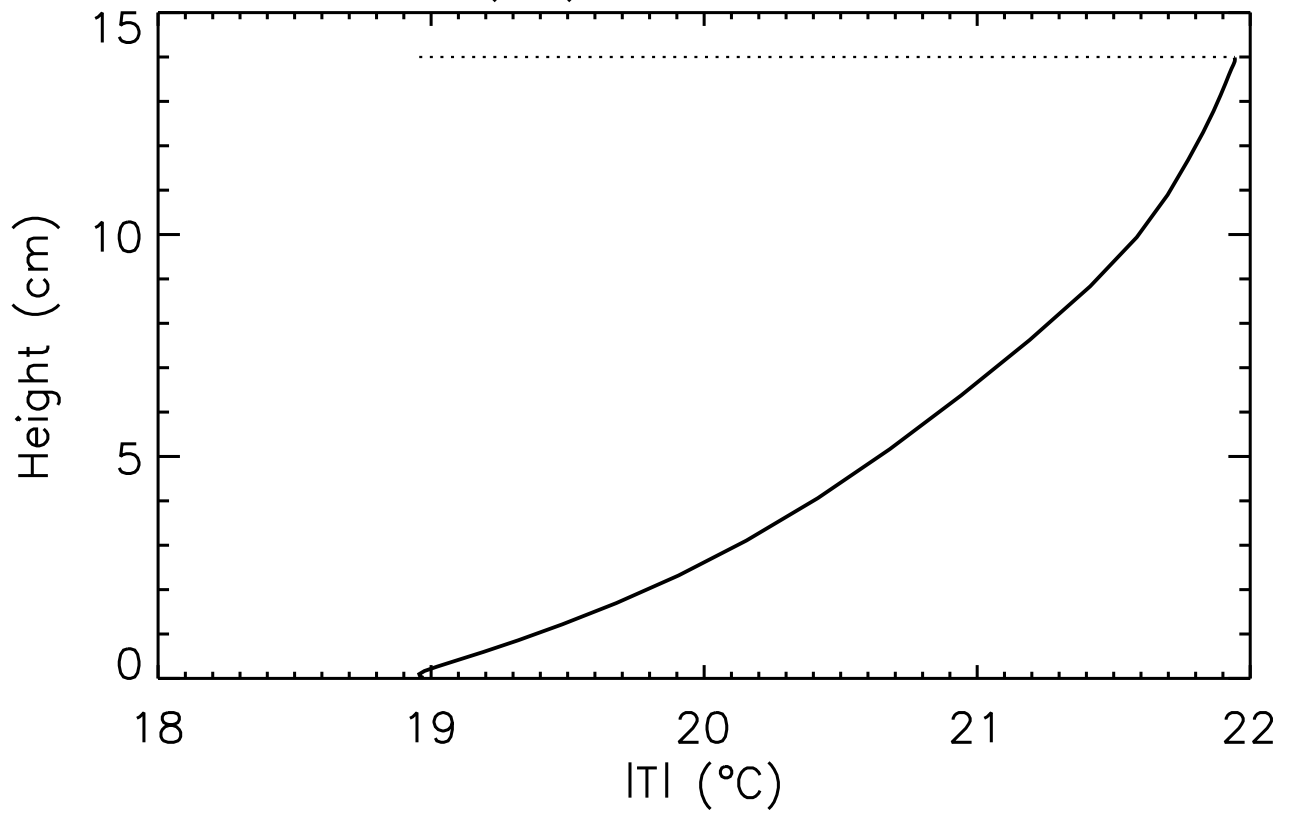


Radius (cm)  
 $t = 4500.0\text{s}$

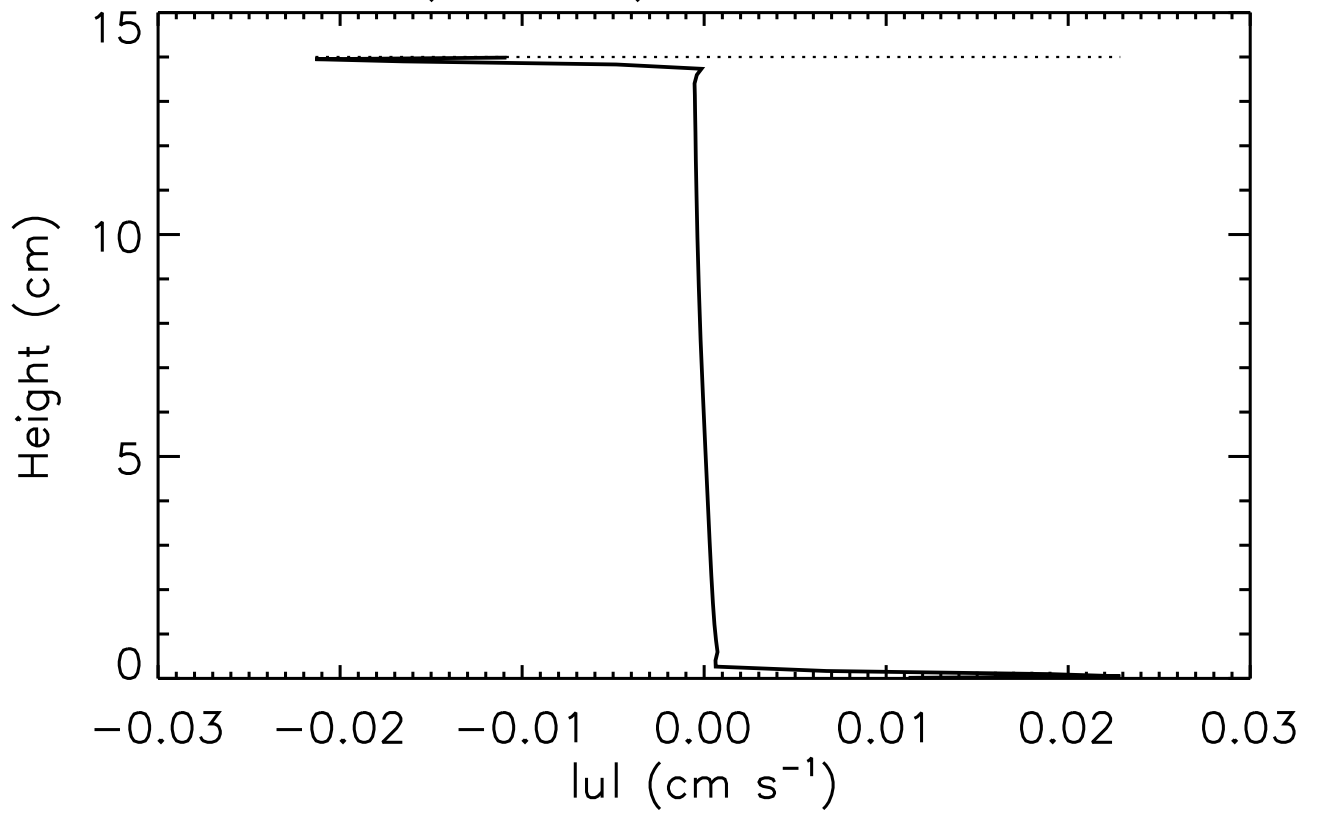




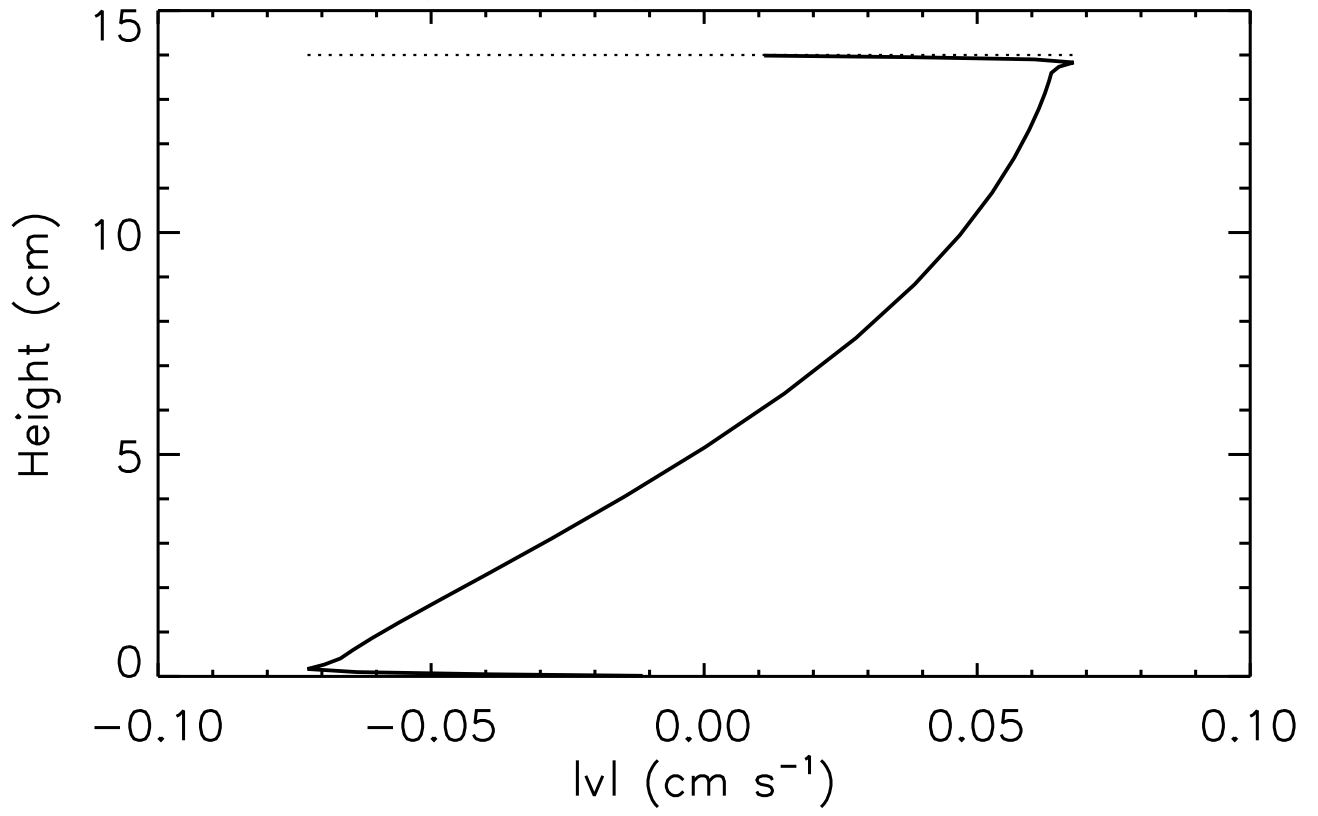
ITI (°C) t = 4500.0s



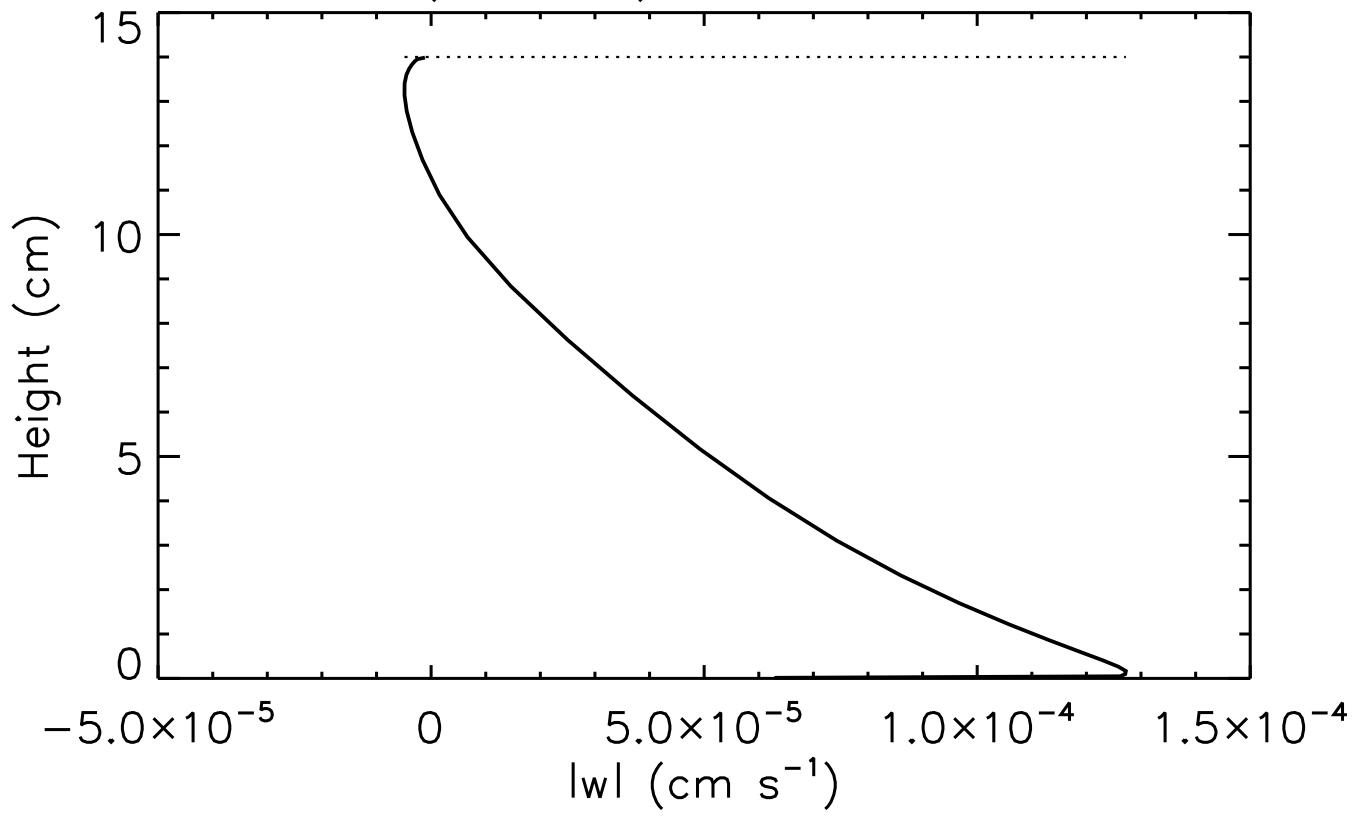
$lul$  ( $\text{cm s}^{-1}$ )  $t = 4500.0\text{s}$



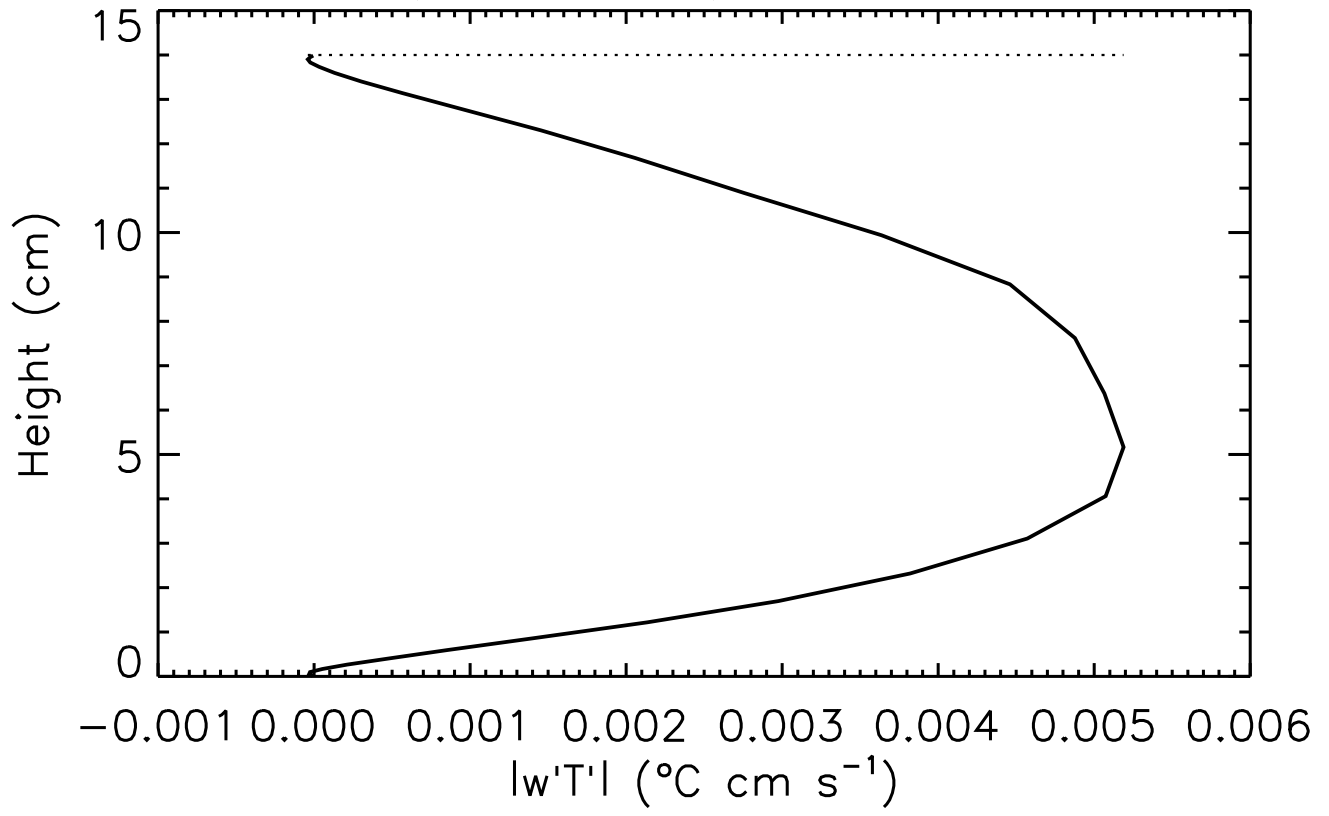
$|\text{v}|$  ( $\text{cm s}^{-1}$ )  $t = 4500.0\text{s}$



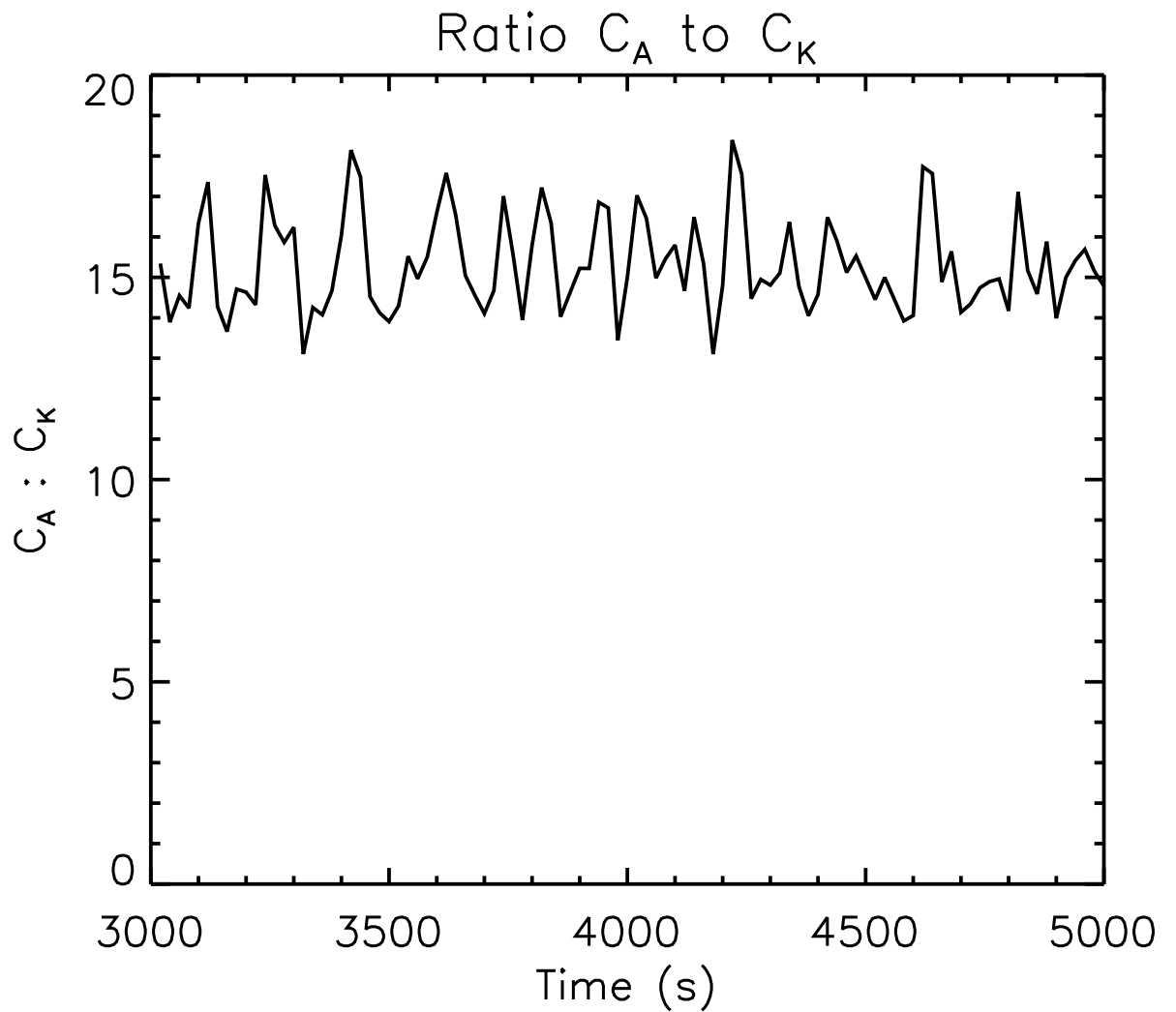
$lw$  ( $\text{cm s}^{-1}$ )  $t = 4500.0\text{s}$



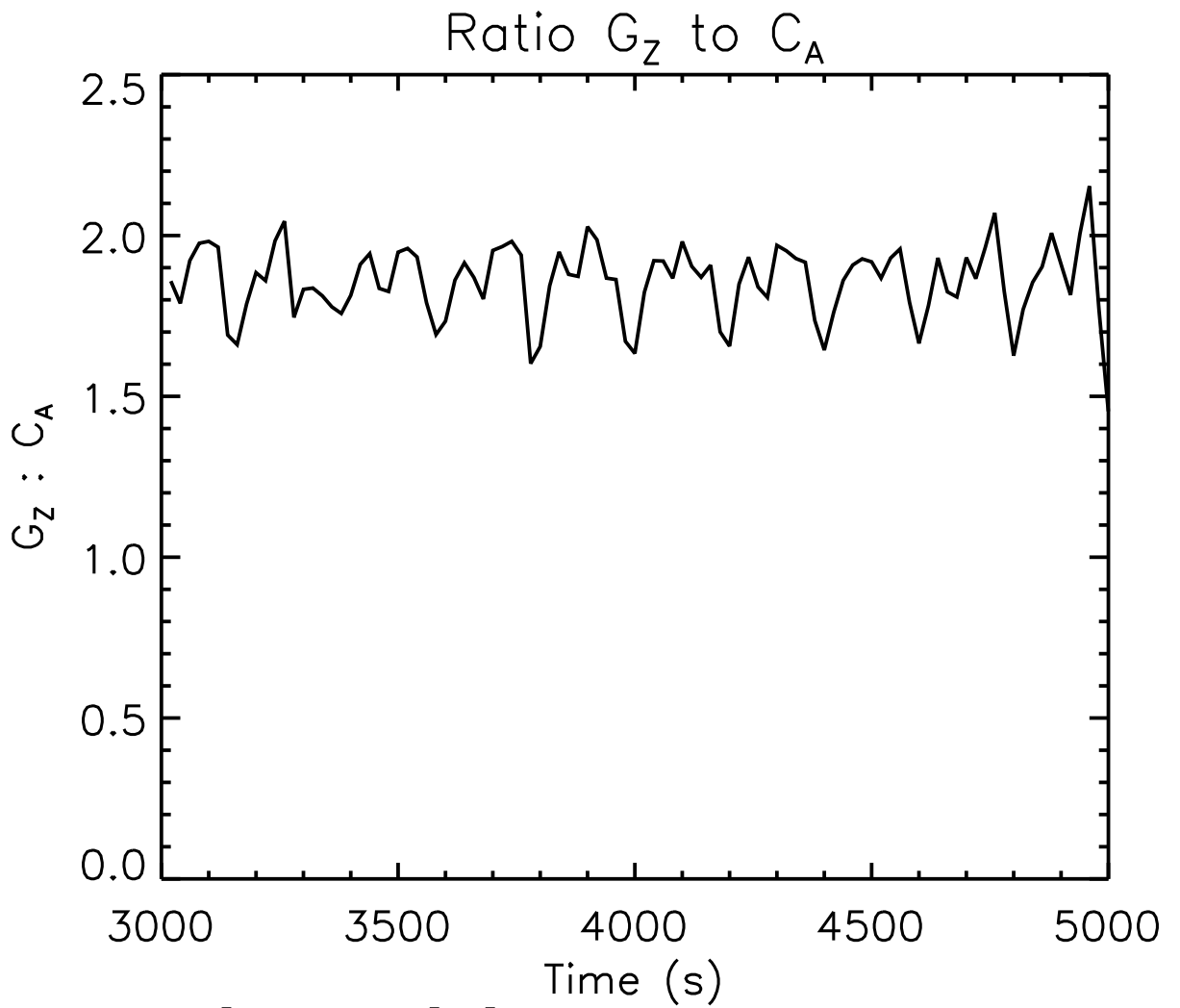
$|w'T'|$  ( $^{\circ}\text{C cm s}^{-1}$ )  $t = 4500.0\text{s}$





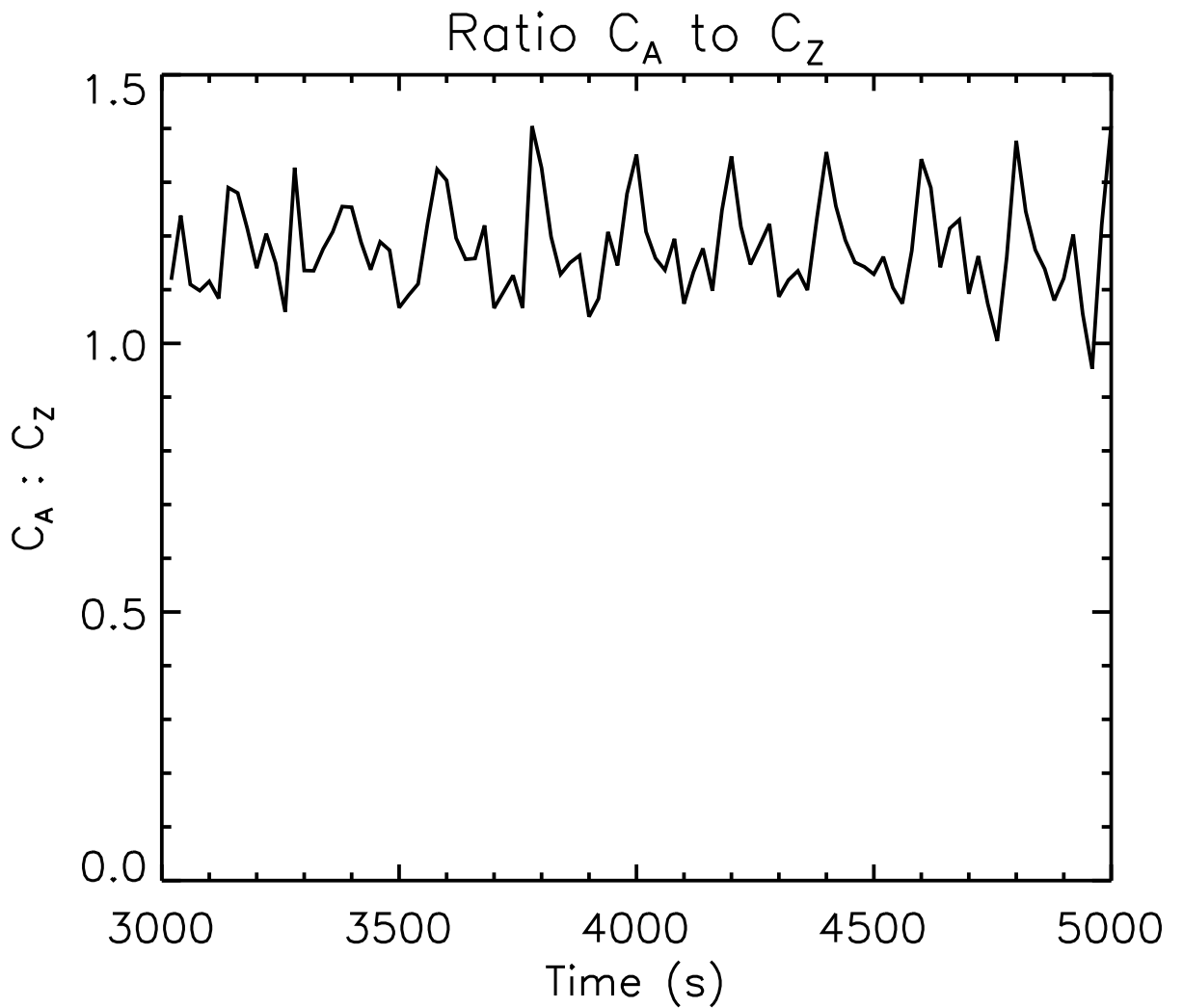


Percentiles [25,50,75]=[ 1.45e+01, 1.50e+01, 1.62e+01]



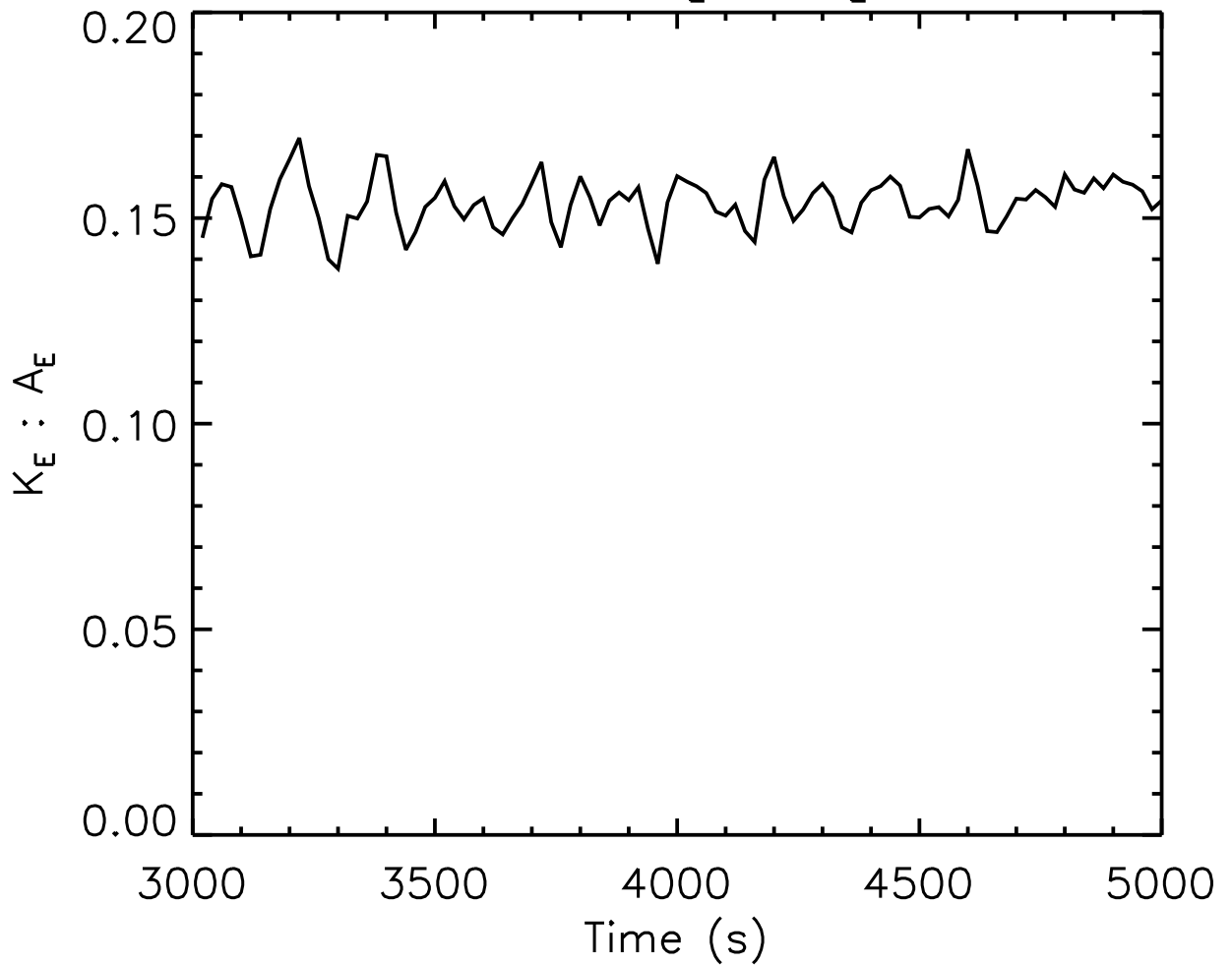
Percentiles [25,50,75]=[ 1.79e+00, 1.87e+00, 1.93e+00]





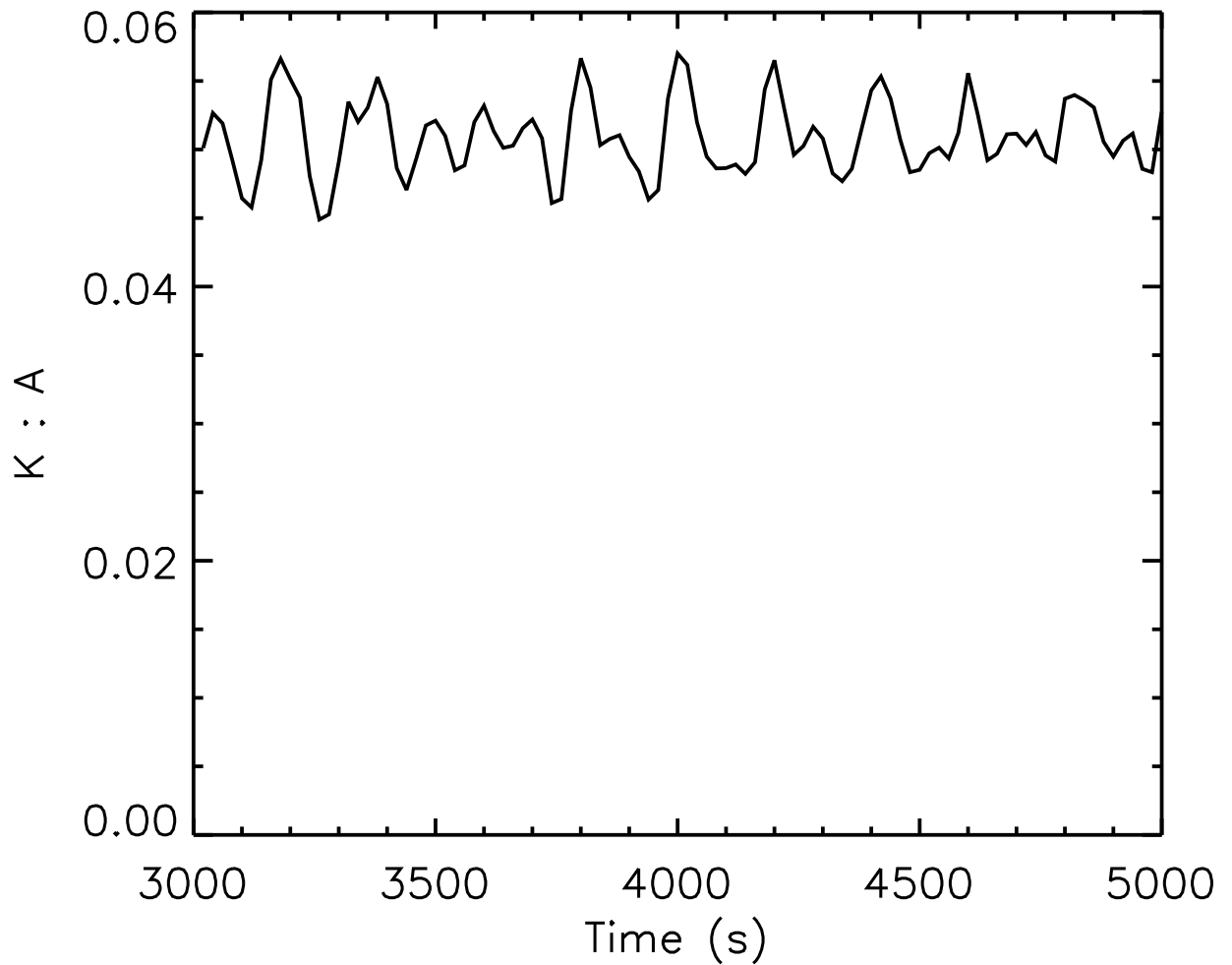
Percentiles [25,50,75]=[ 1.12e+00, 1.16e+00, 1.22e+00]

Ratio  $K_E$  to  $A_E$



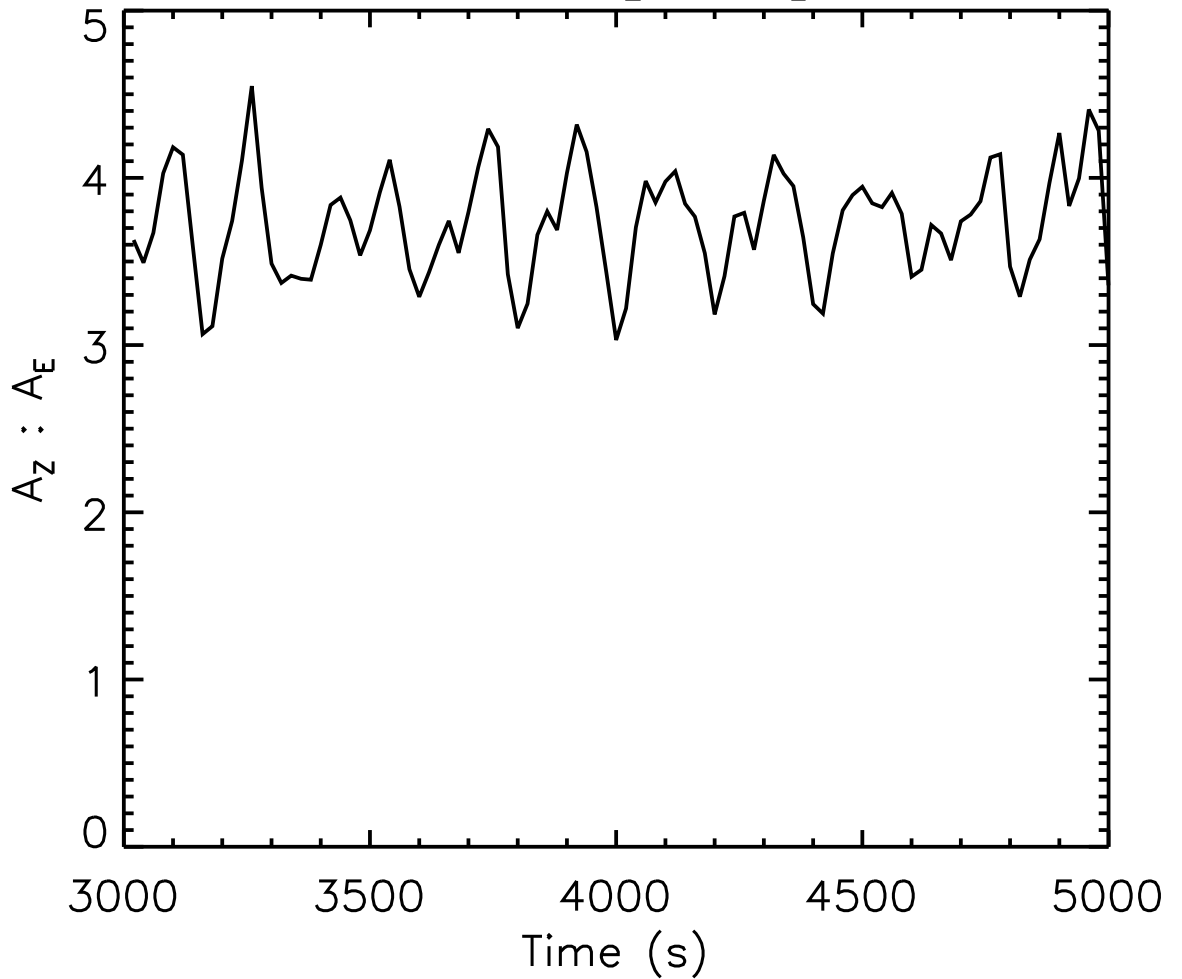
Percentiles [25,50,75]=[ 1.50e-01, 1.54e-01, 1.58e-01]

Ratio K to A



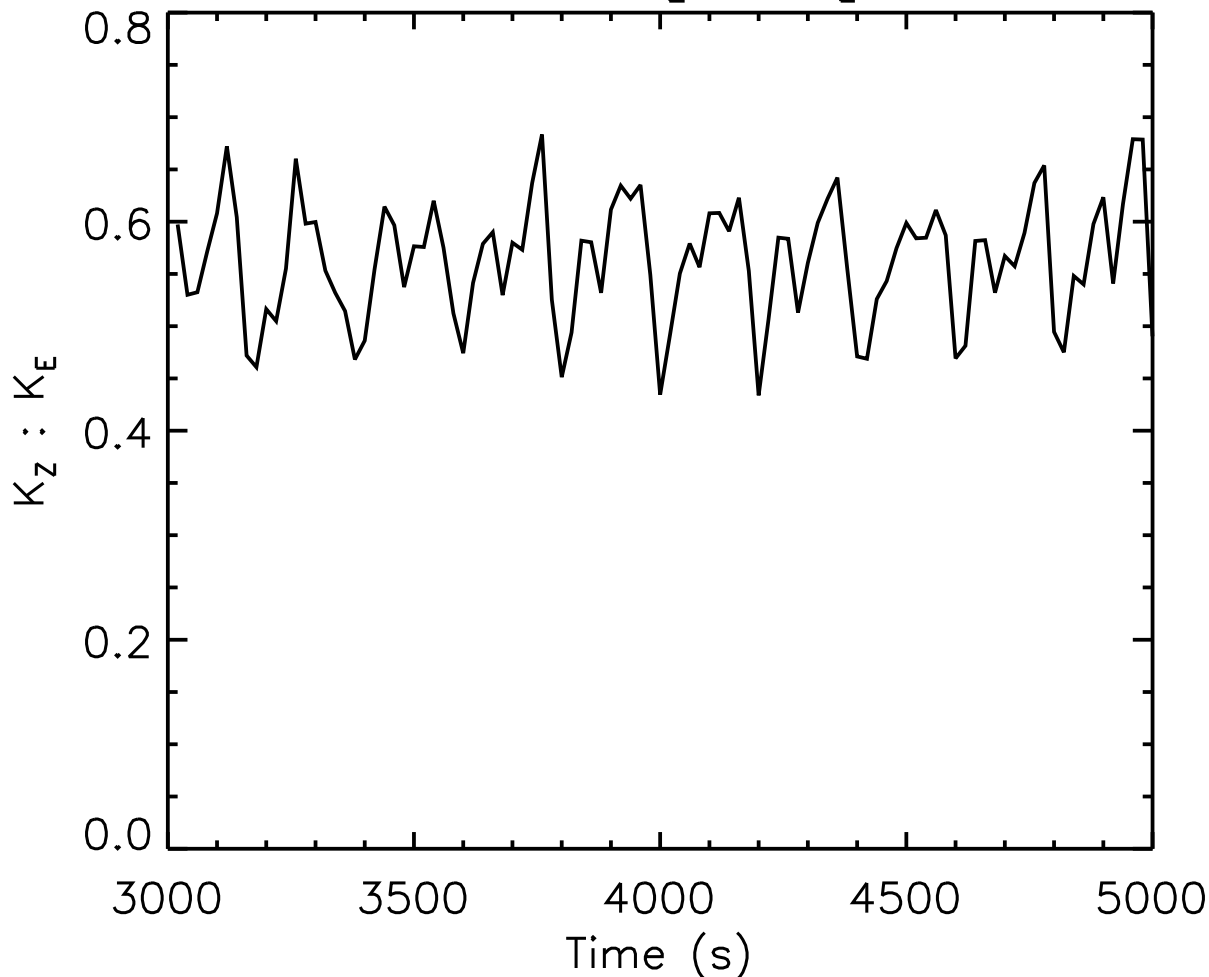
Percentiles [25,50,75]=[ 4.91e-02, 5.08e-02, 5.30e-02]

Ratio  $A_Z$  to  $A_E$



Percentiles [25,50,75]=[ 3.49e+00, 3.75e+00, 3.95e+00]

Ratio  $K_Z$  to  $K_E$



Percentiles [25,50,75]=[ 5.30e-01, 5.75e-01, 6.00e-01]

# Energy rates of change

