

# The Lorenz energy cycle in simulated rotating annulus flows

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## Supplementary Material

### 2AV run at 4500s

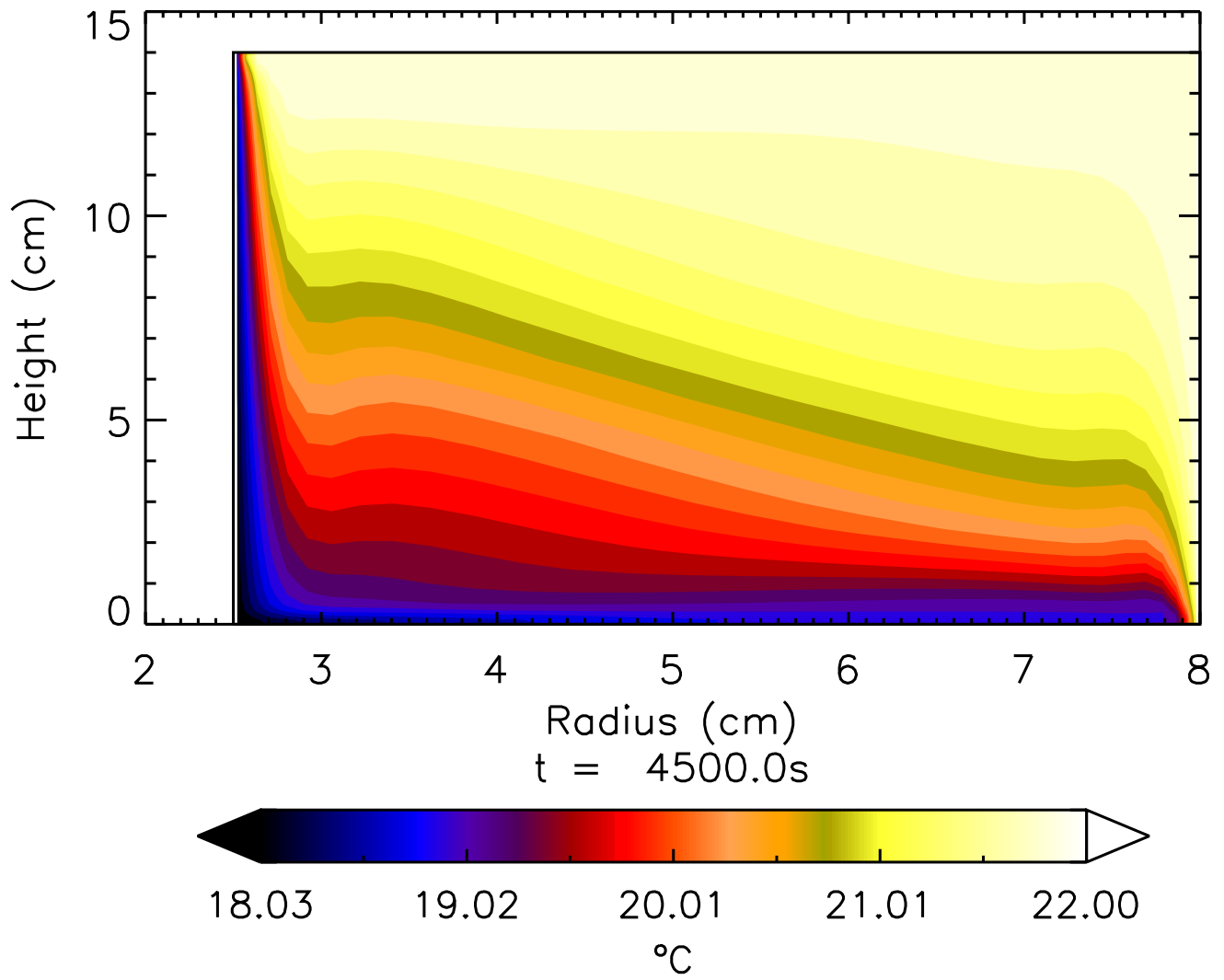
This file contains additional contour plots in the  $(R, z)$  plane, line plots showing horizontal means as a function of  $z$ , and time series.

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

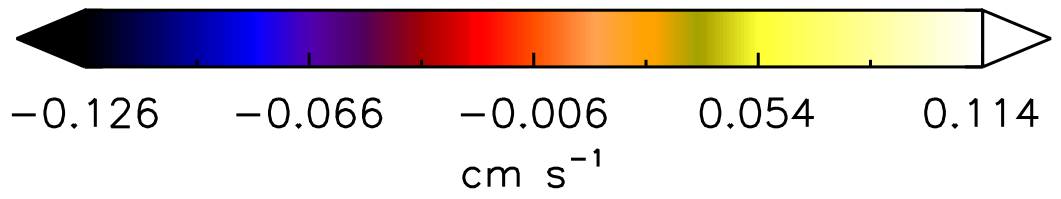
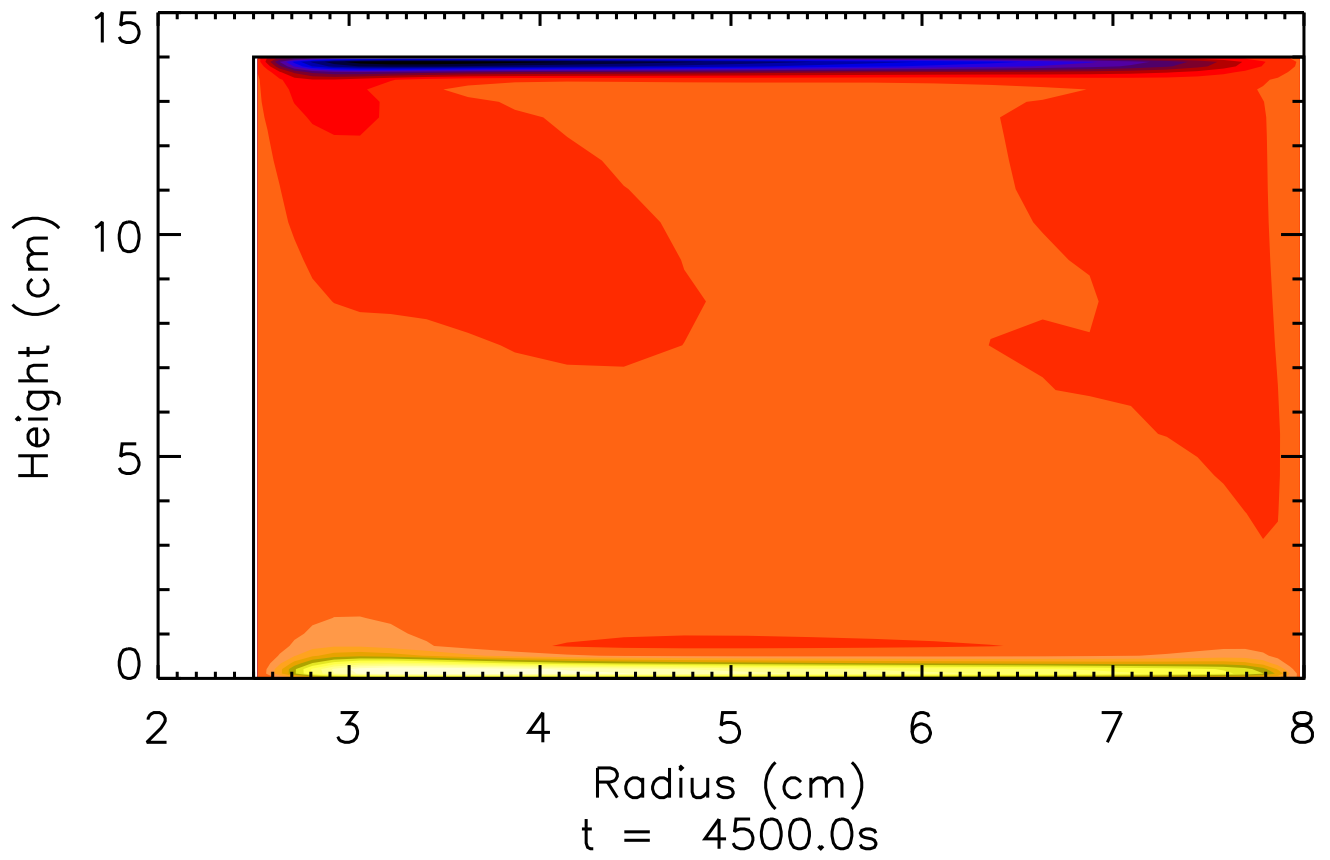
- A zonal or azimuthal mean is displayed as  $\langle x \rangle$   
( $\bar{x}$  in the main paper).
- A horizontal mean is displayed as  $|x|$   
( $\tilde{x}$  in the main paper).

Eddy fields use the same notation as the main paper.

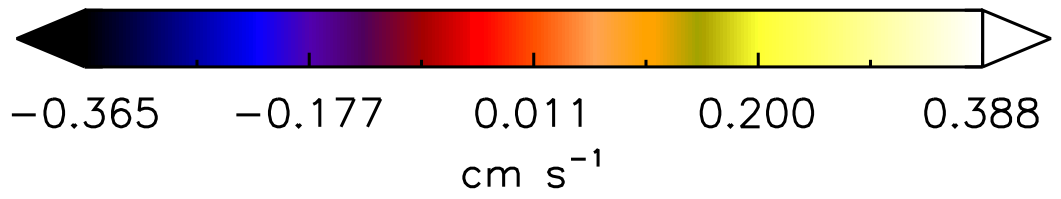
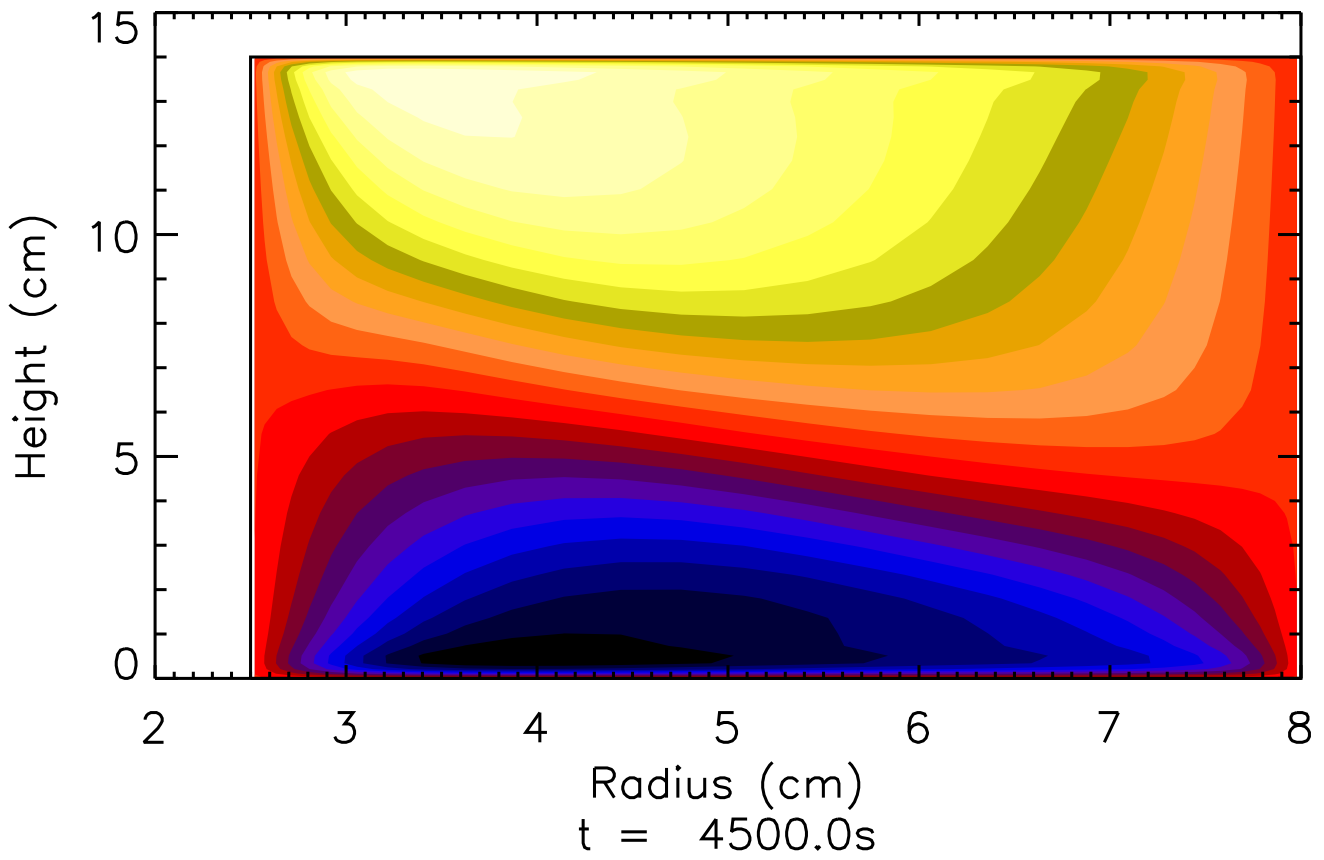
$\langle T \rangle$



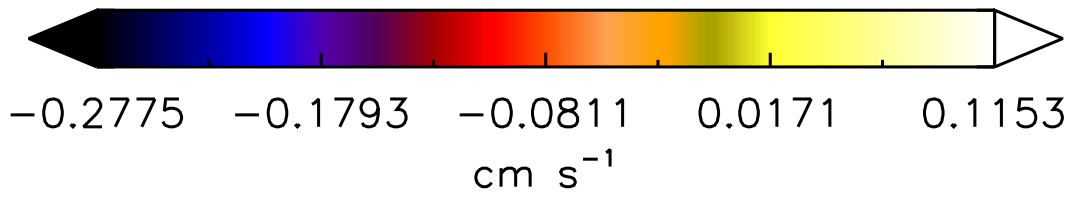
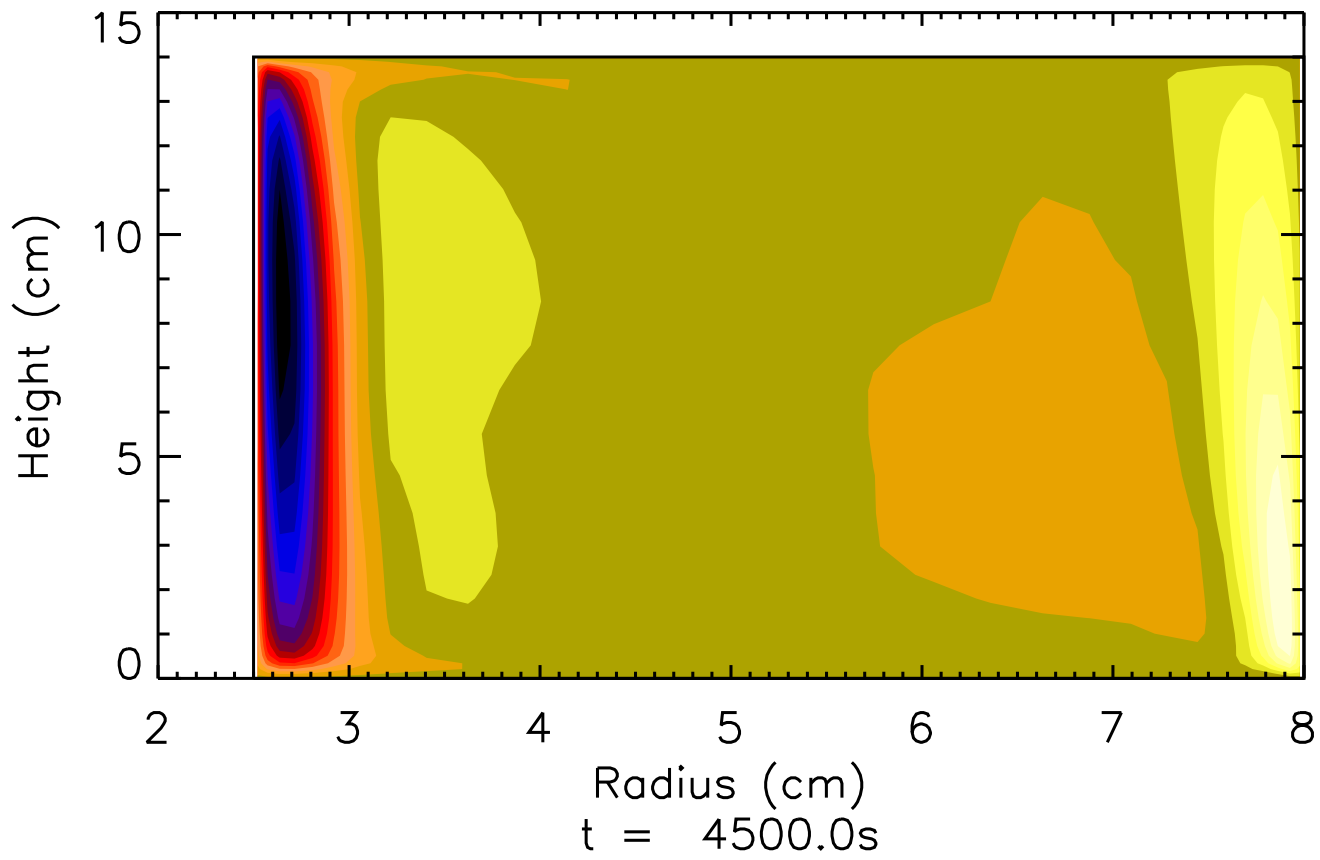
$\langle u \rangle$

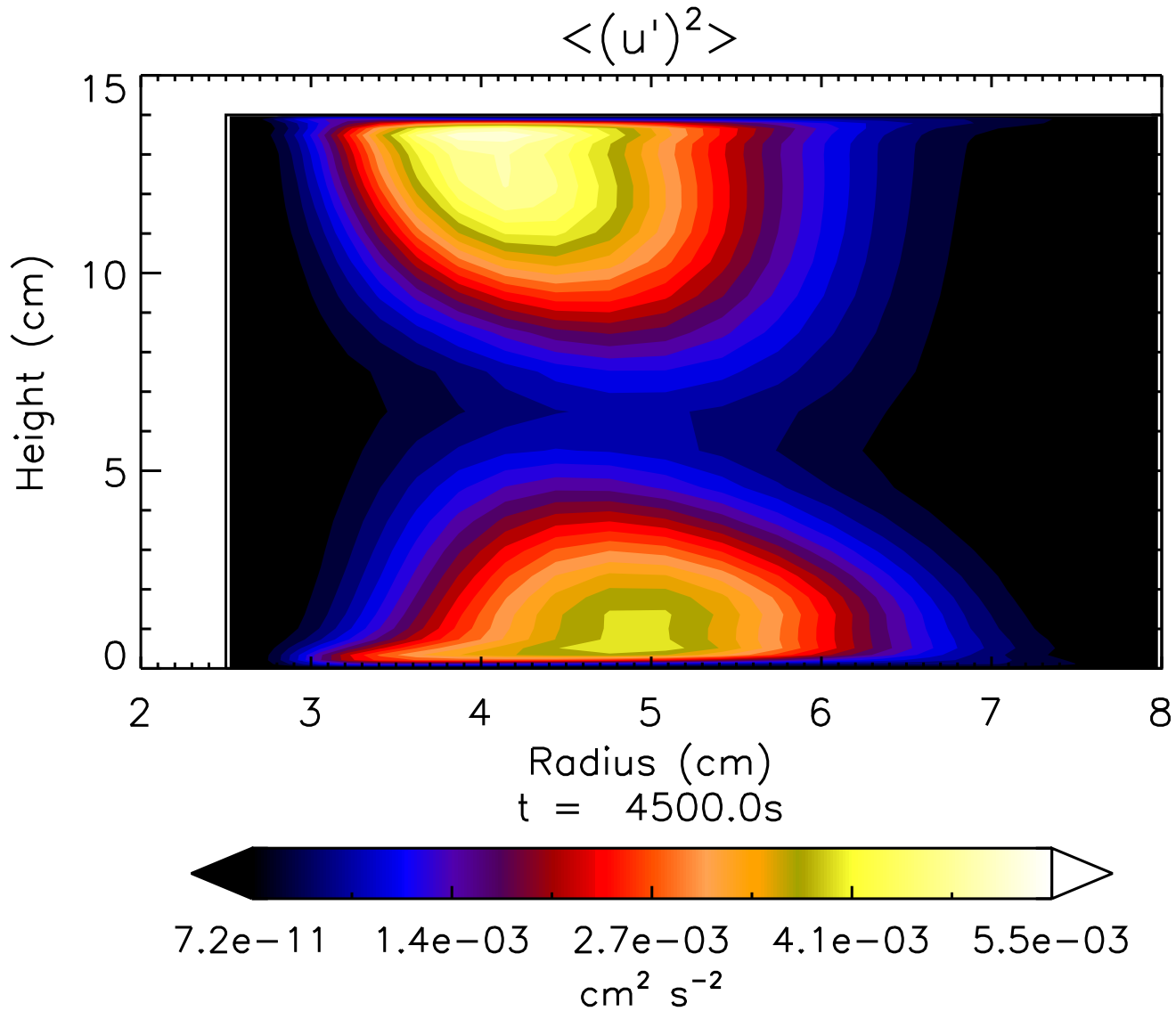


$\langle v \rangle$

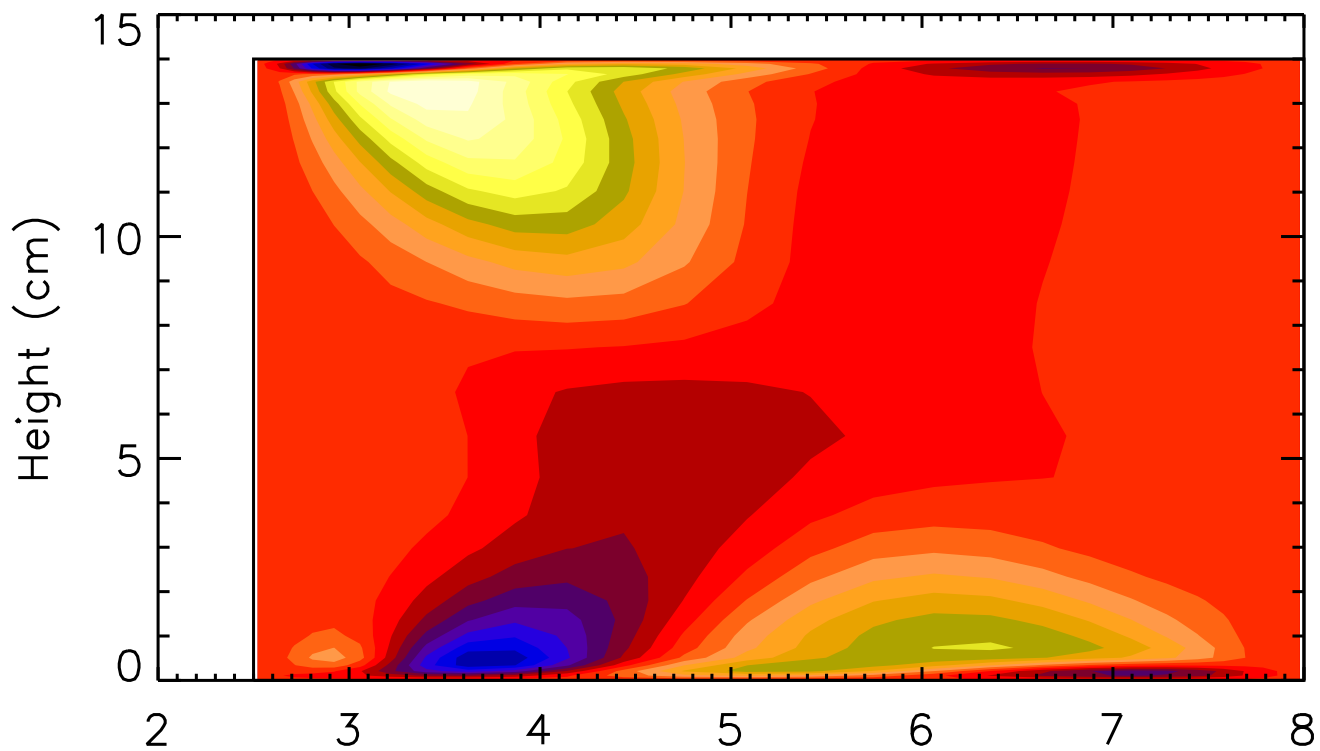


$\langle w \rangle$

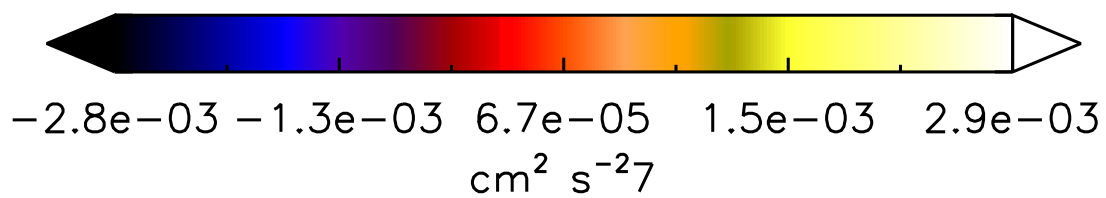


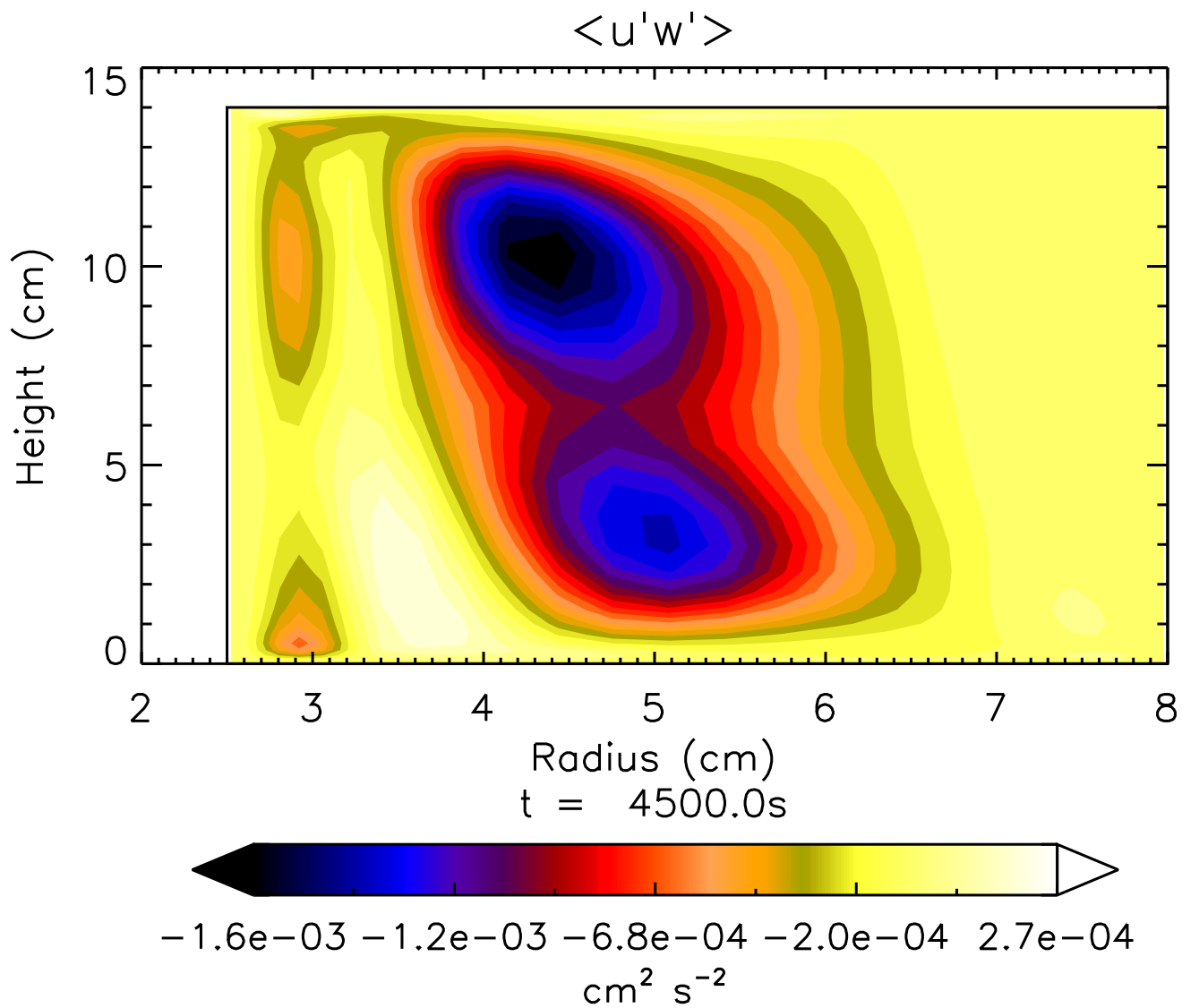


$\langle u'v' \rangle$

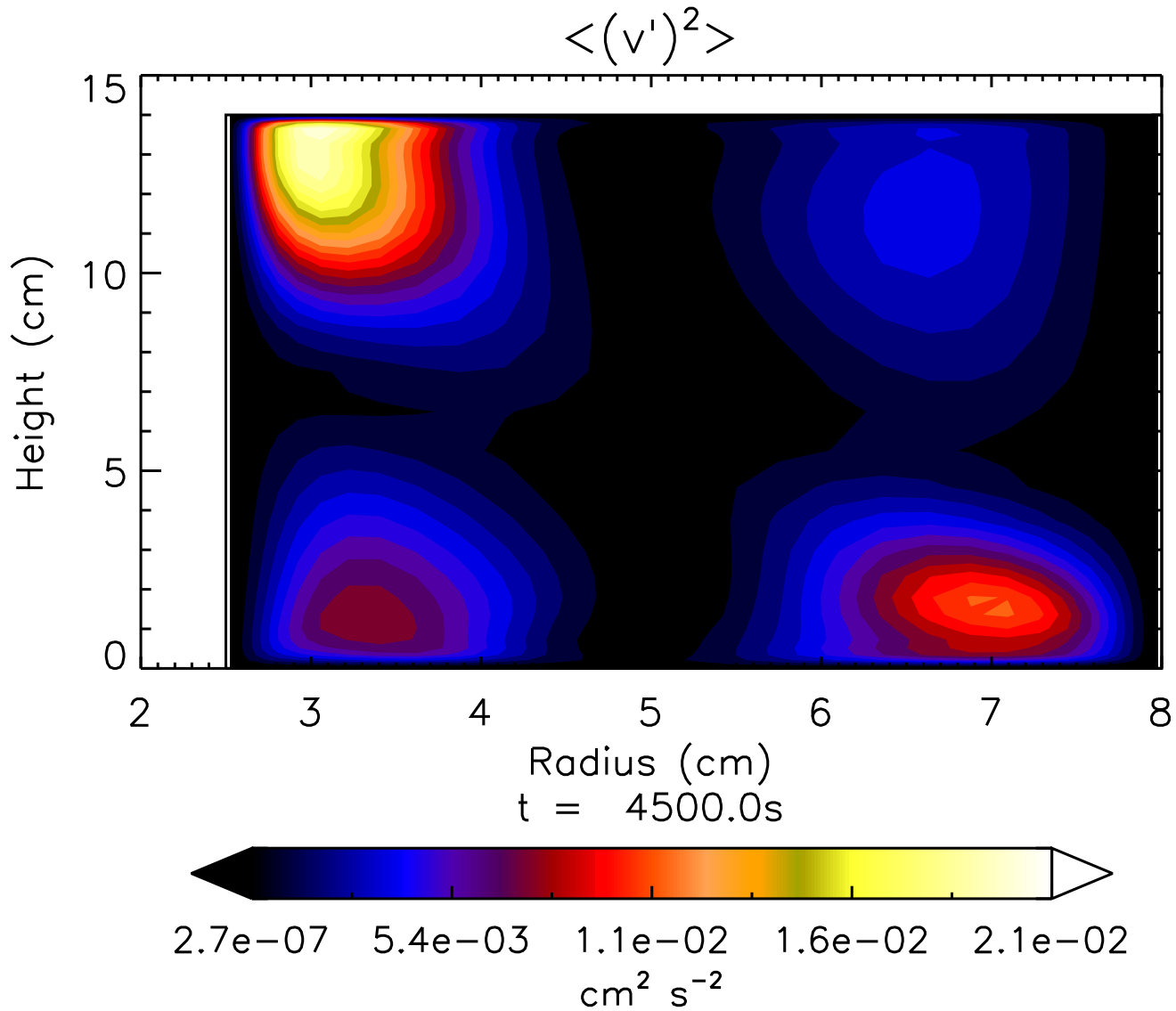


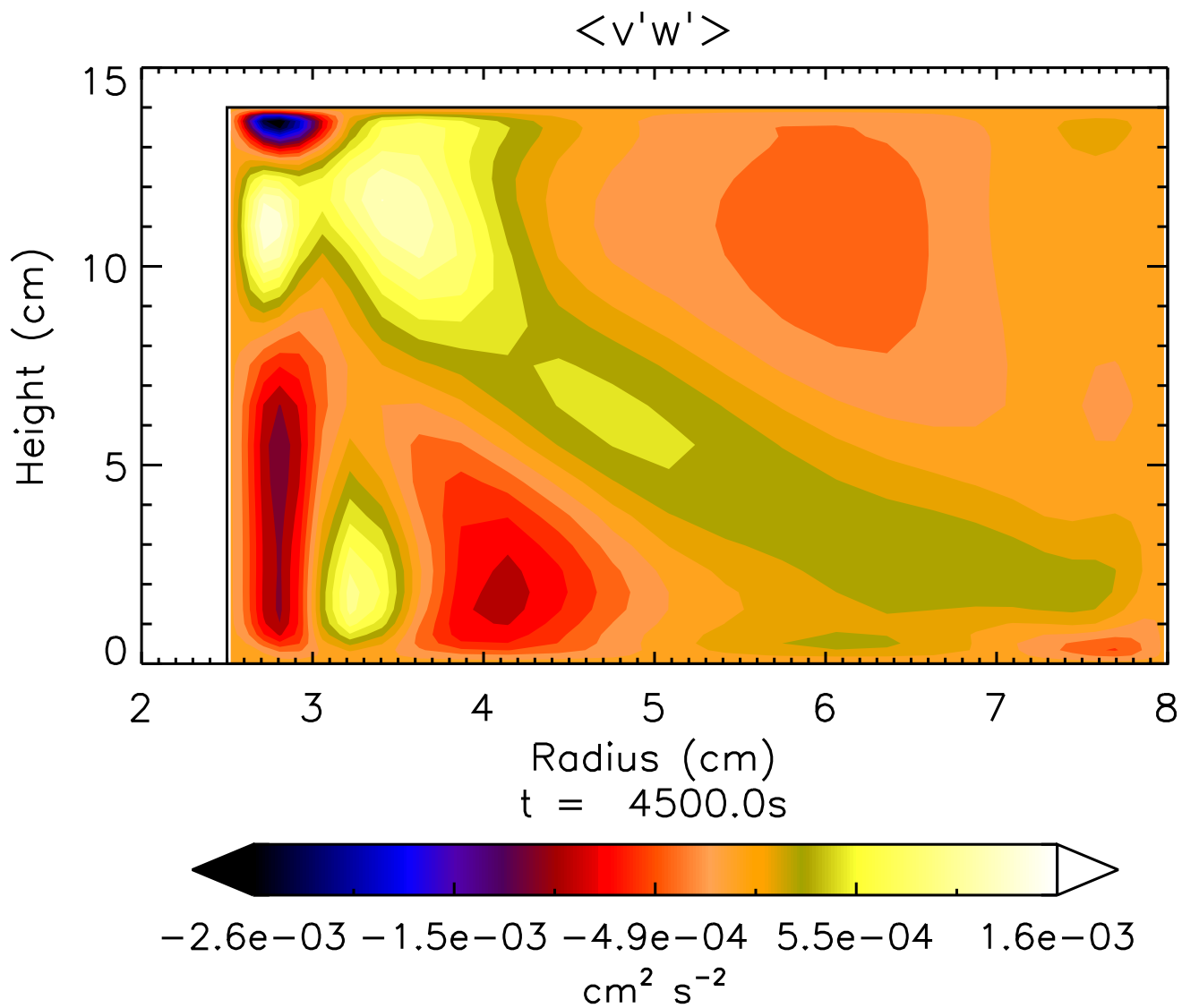
Radius (cm)  
 $t = 4500.0\text{s}$

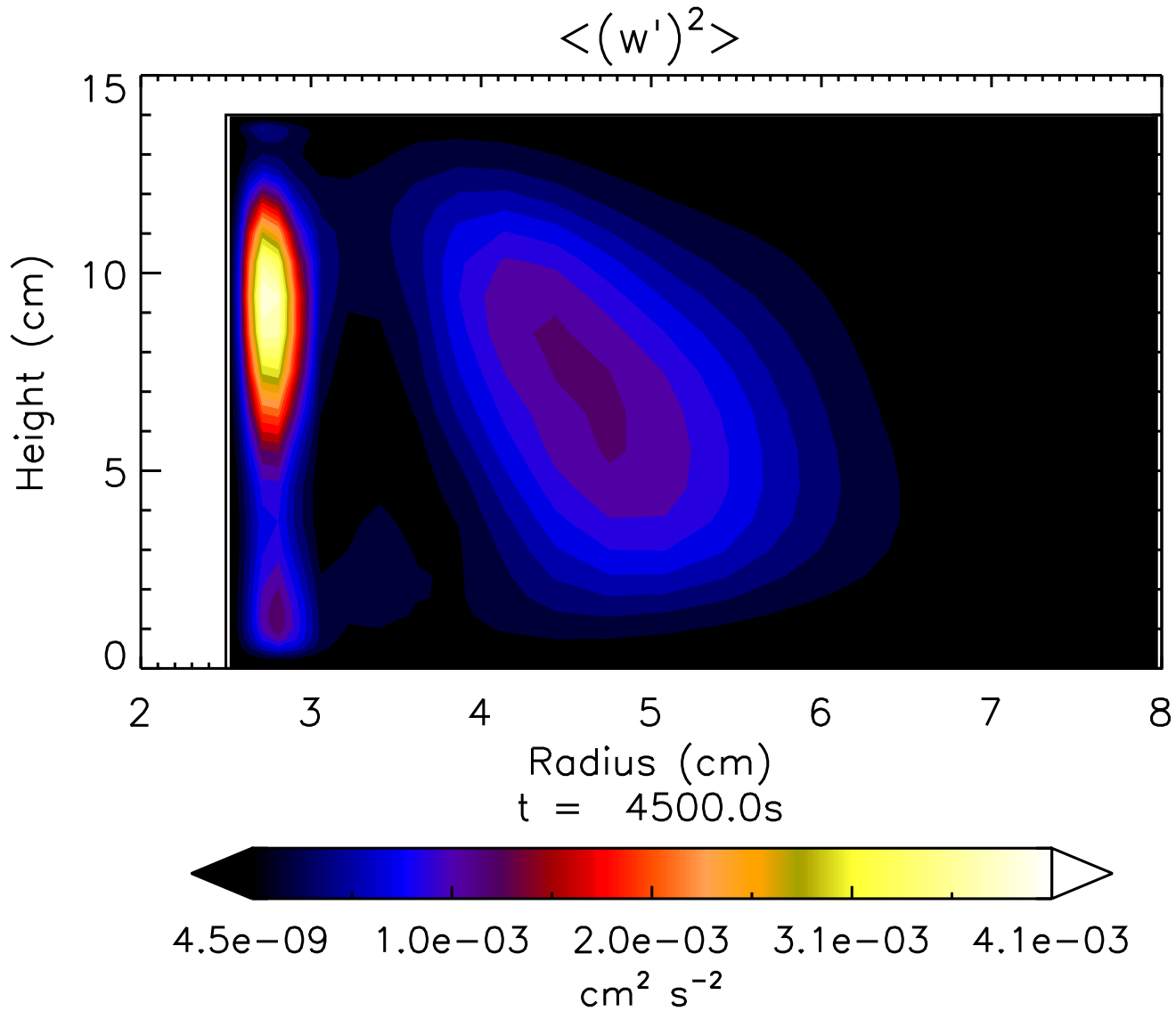




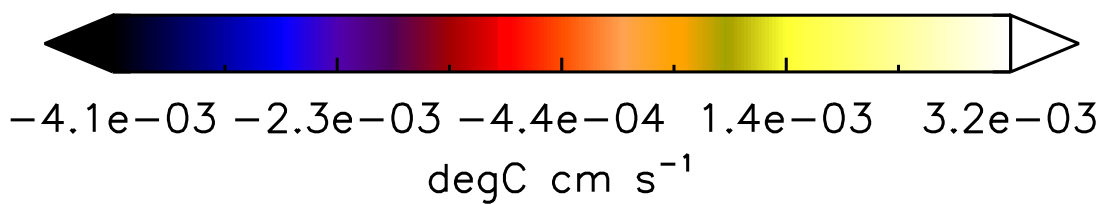
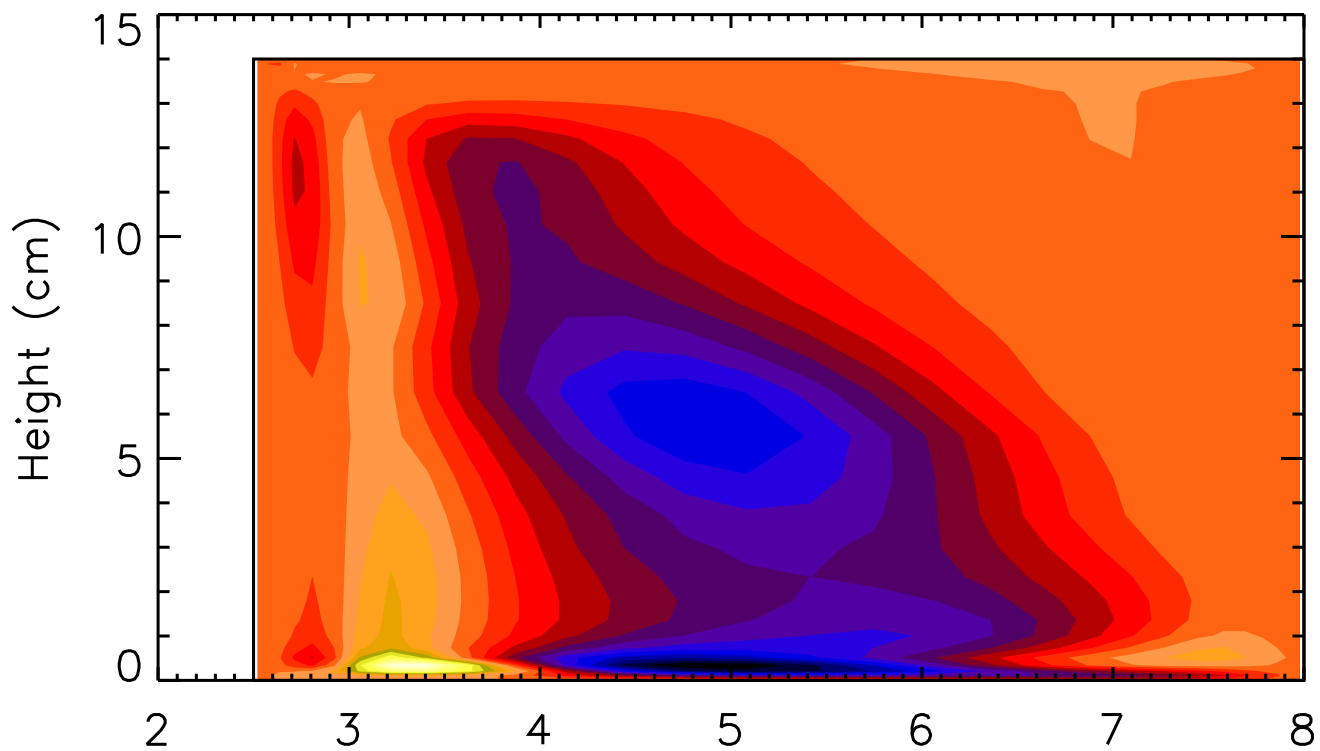




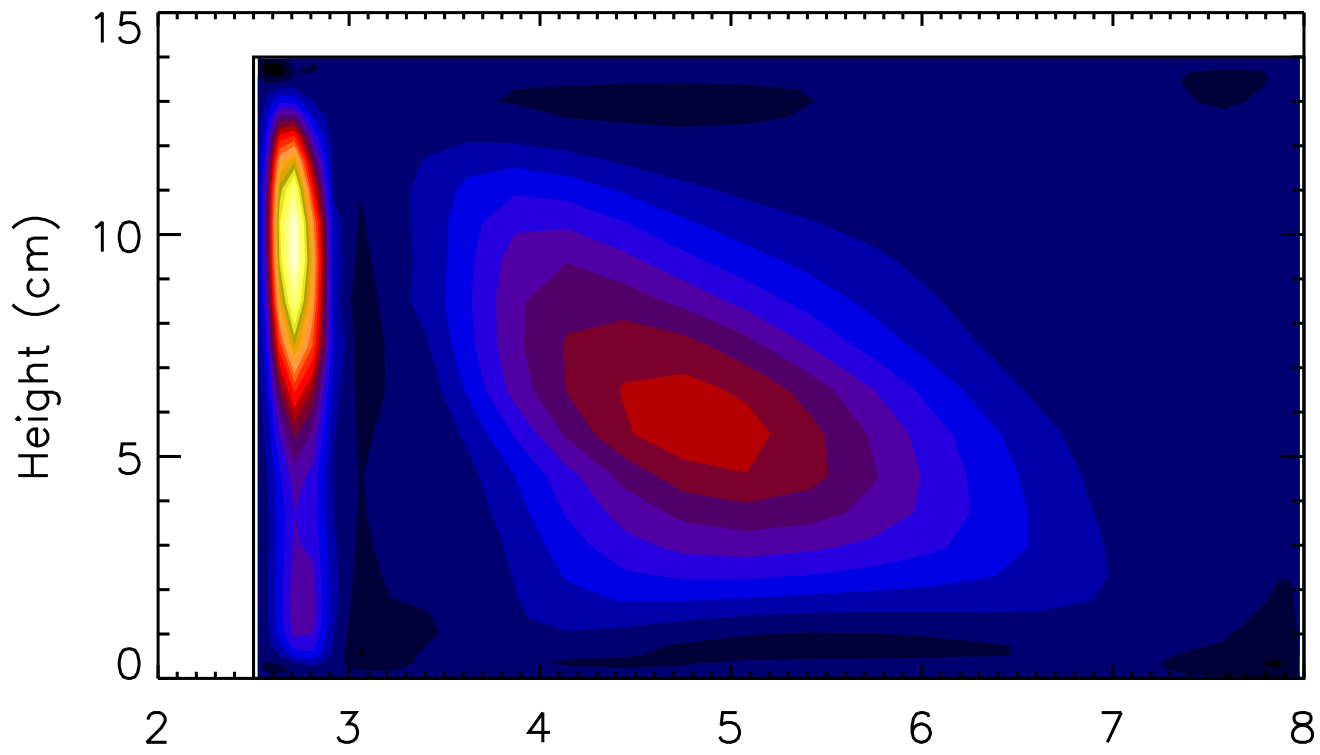




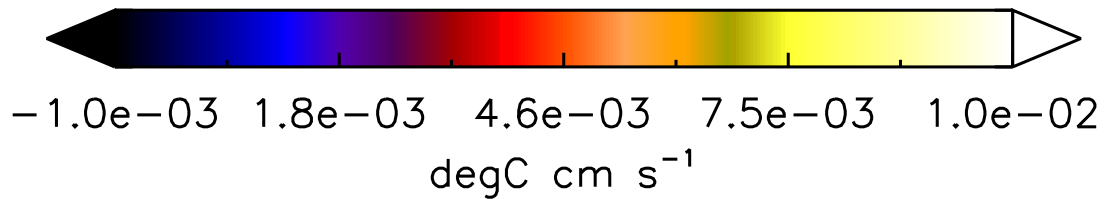
$\langle u'T' \rangle$



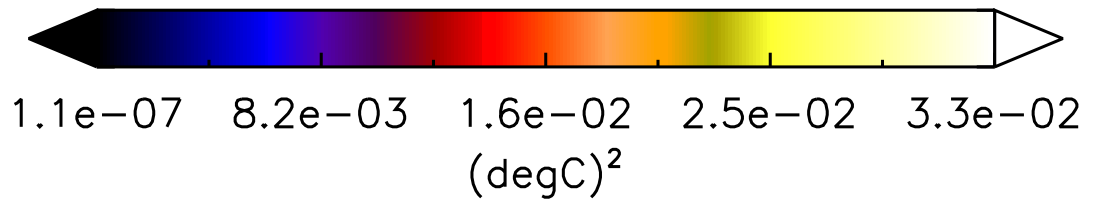
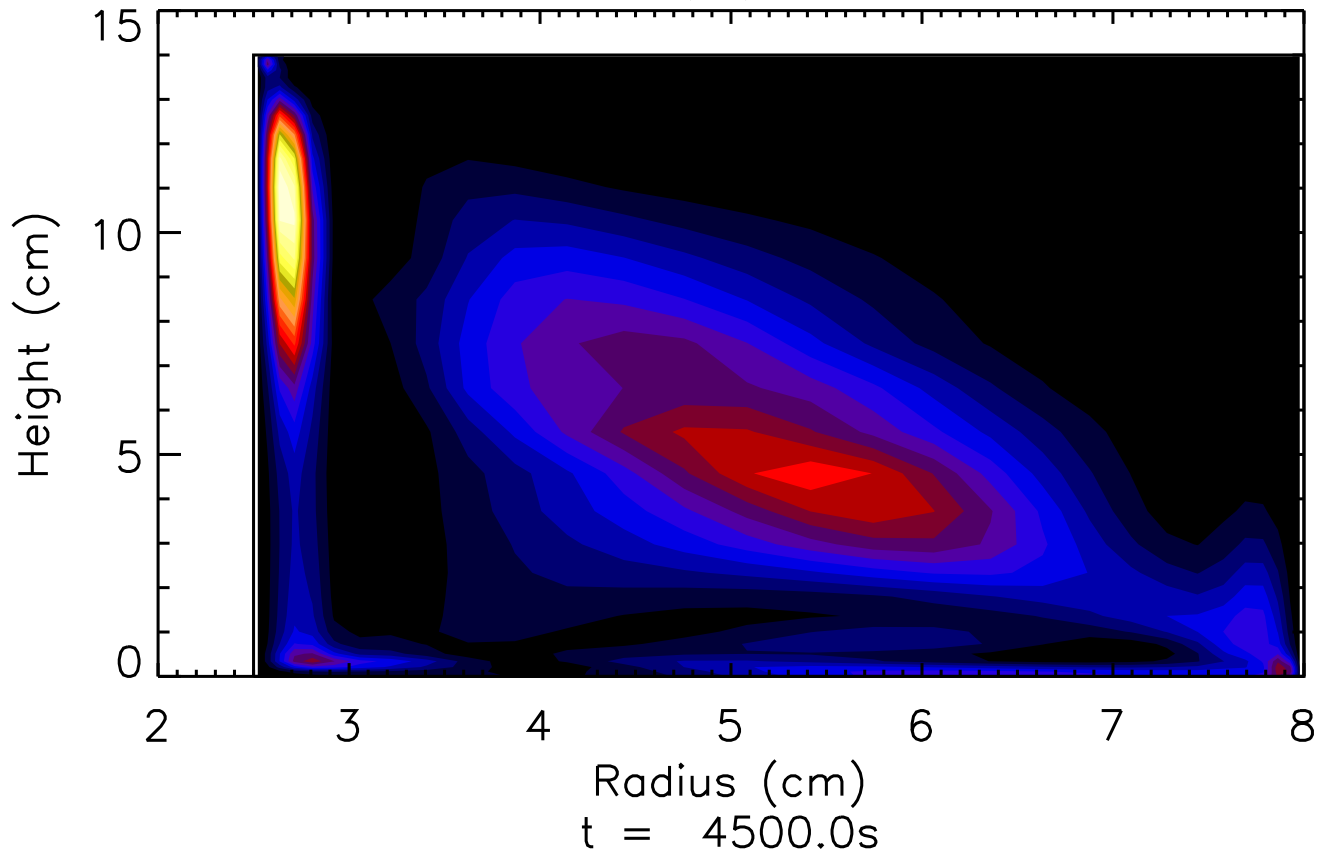
$\langle w'T' \rangle$



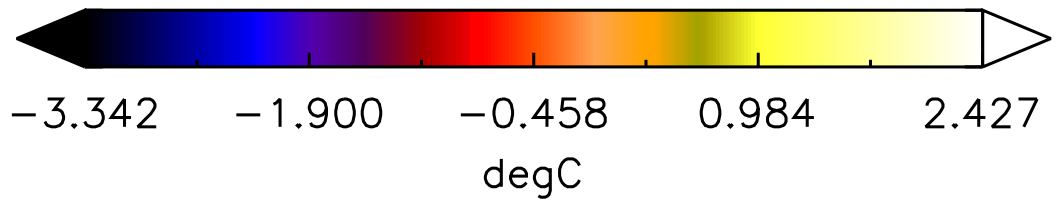
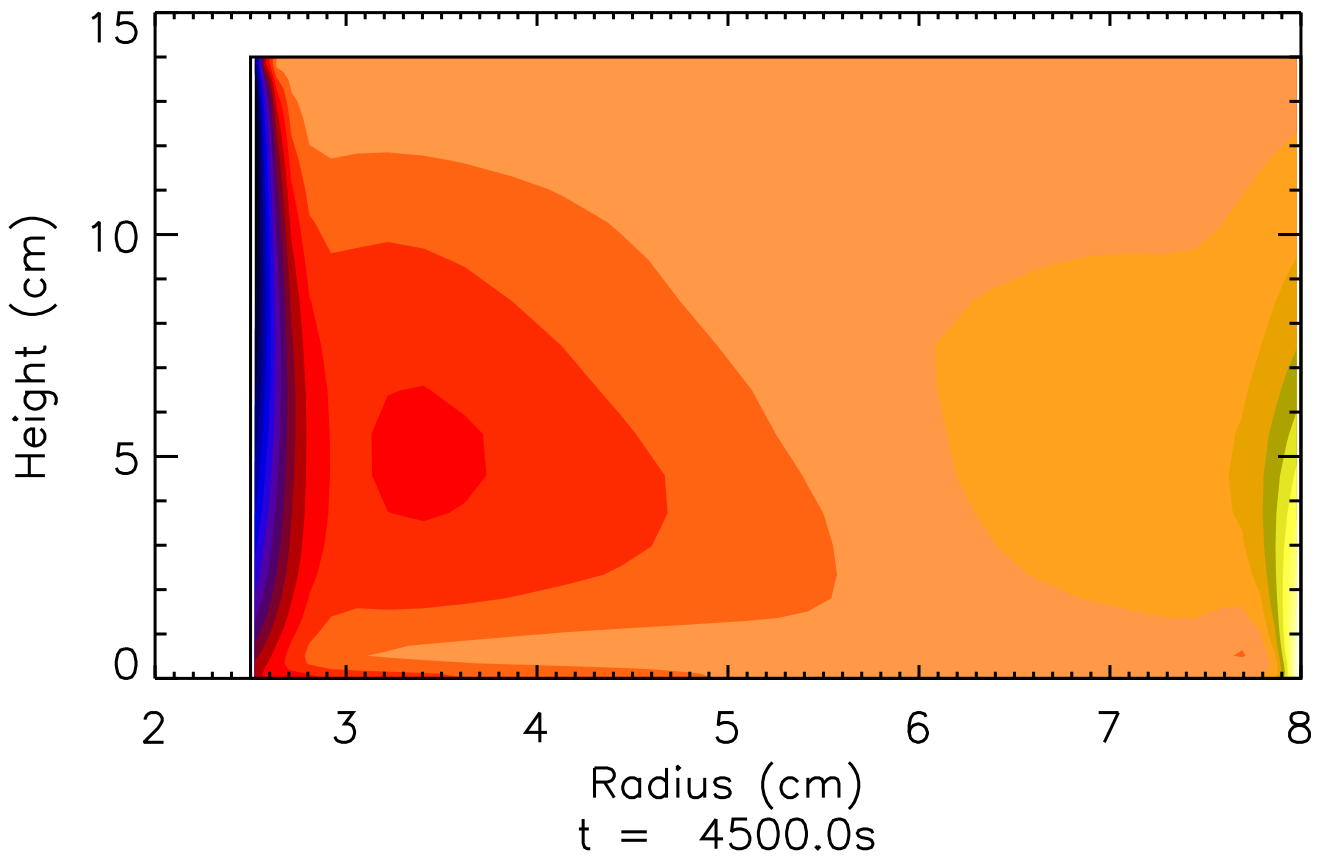
Radius (cm)  
 $t = 4500.0$ s



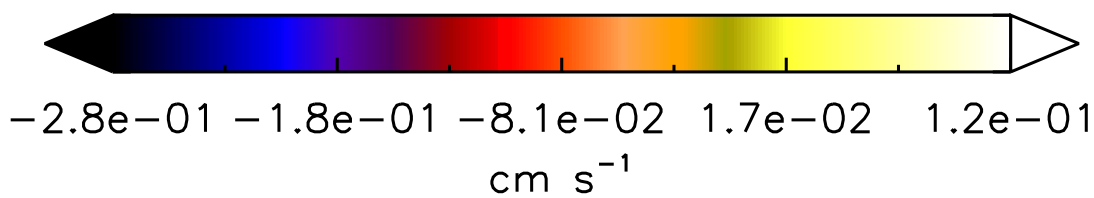
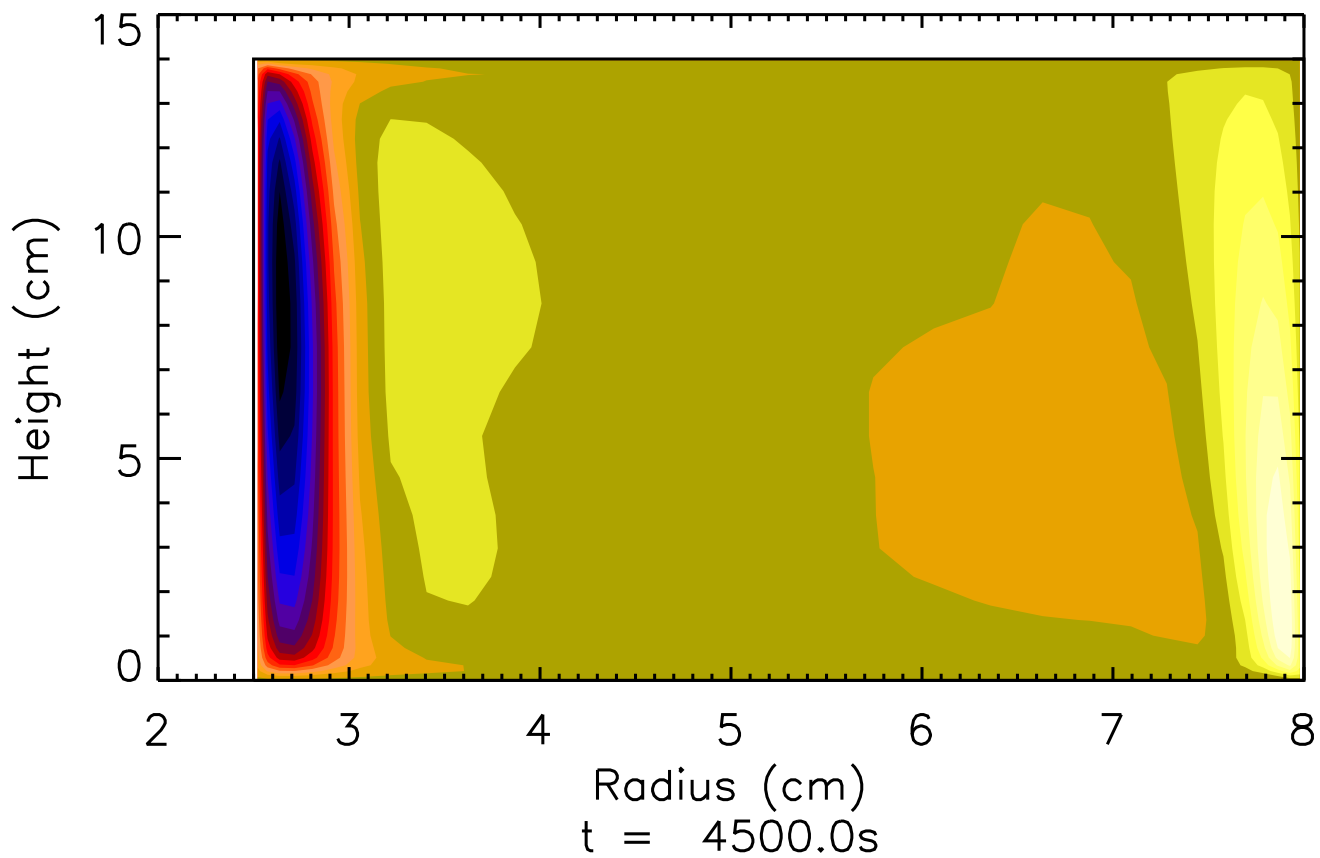
$$\langle (T')^2 \rangle$$



$\langle T'' \rangle$

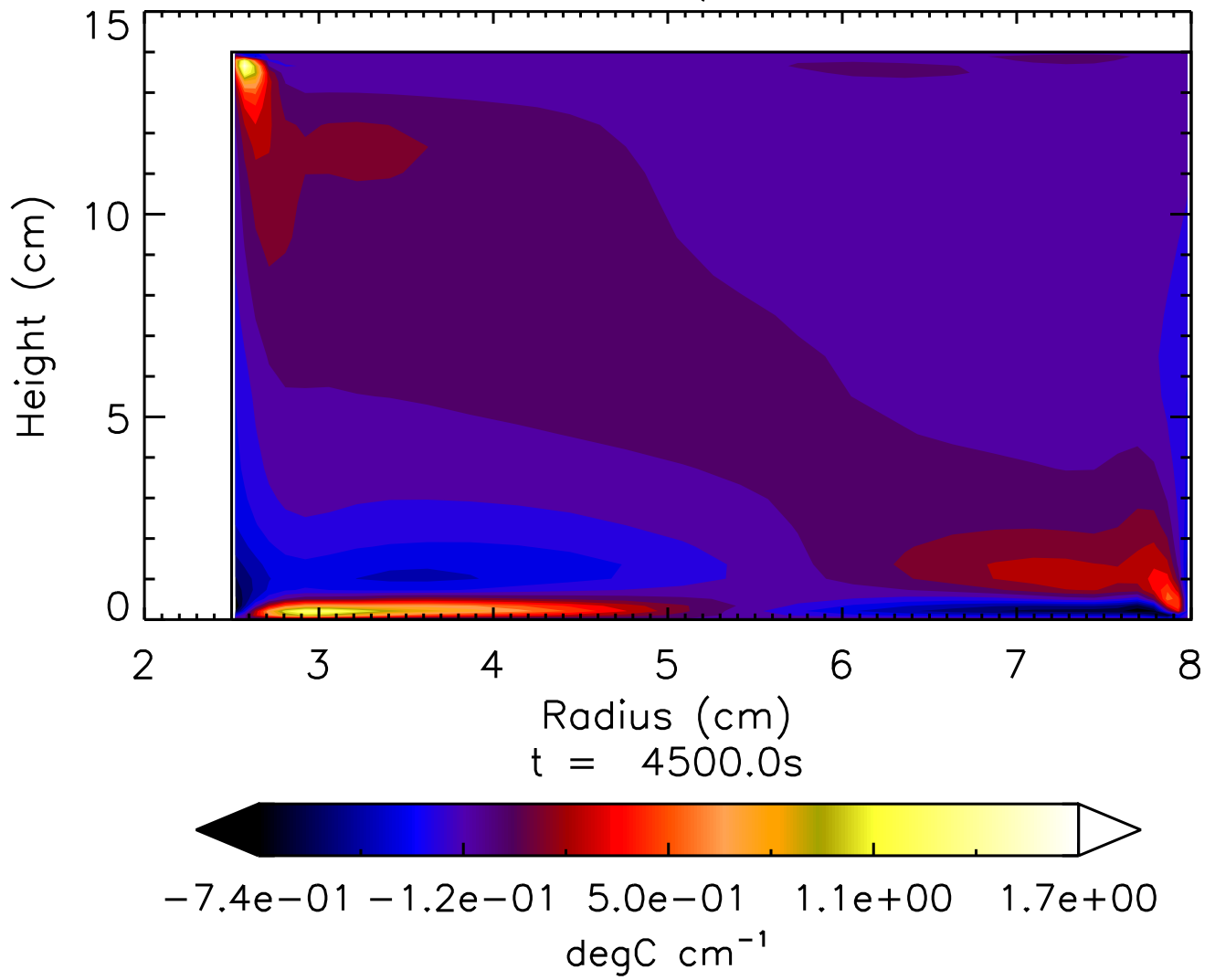


$\langle w'' \rangle$

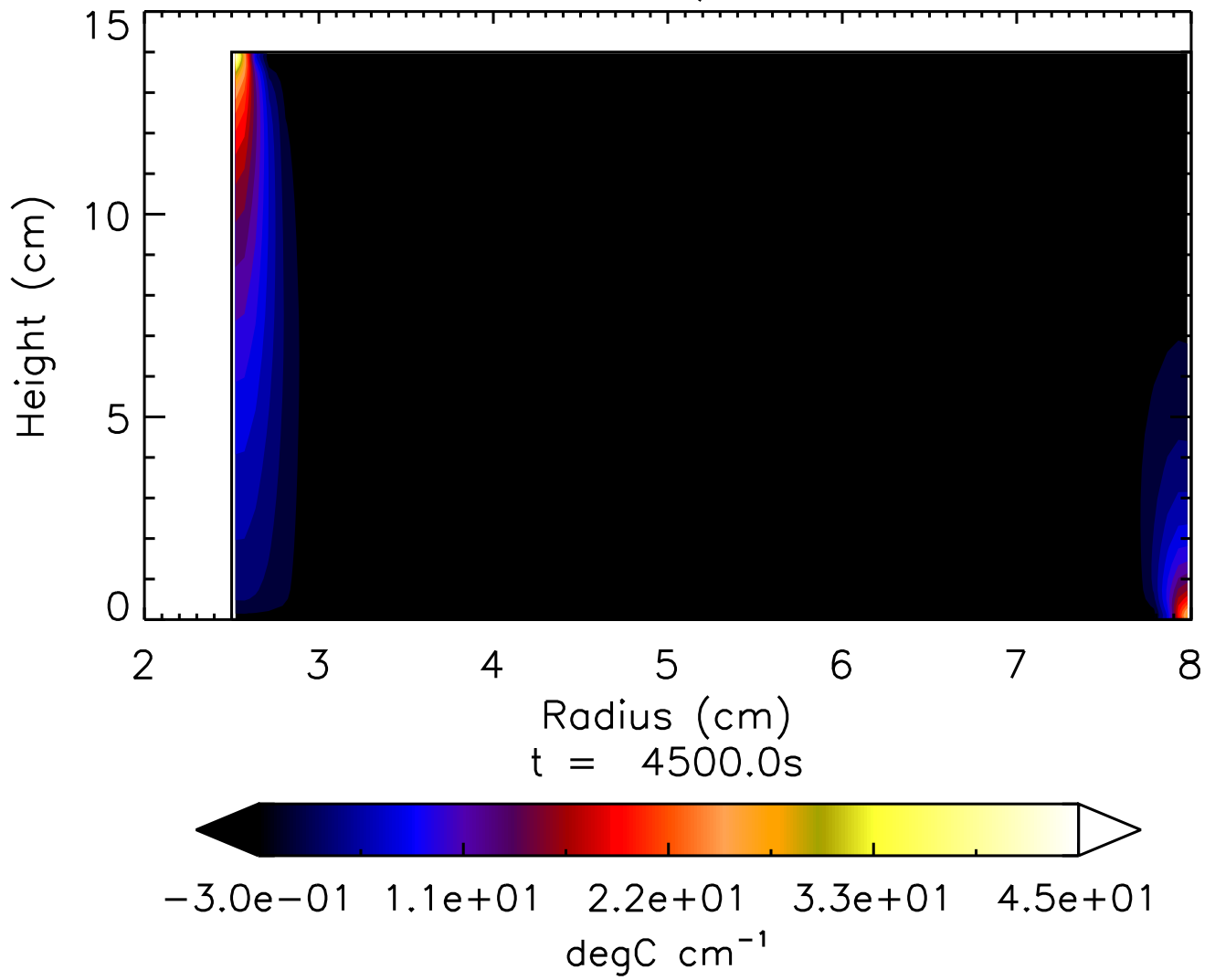




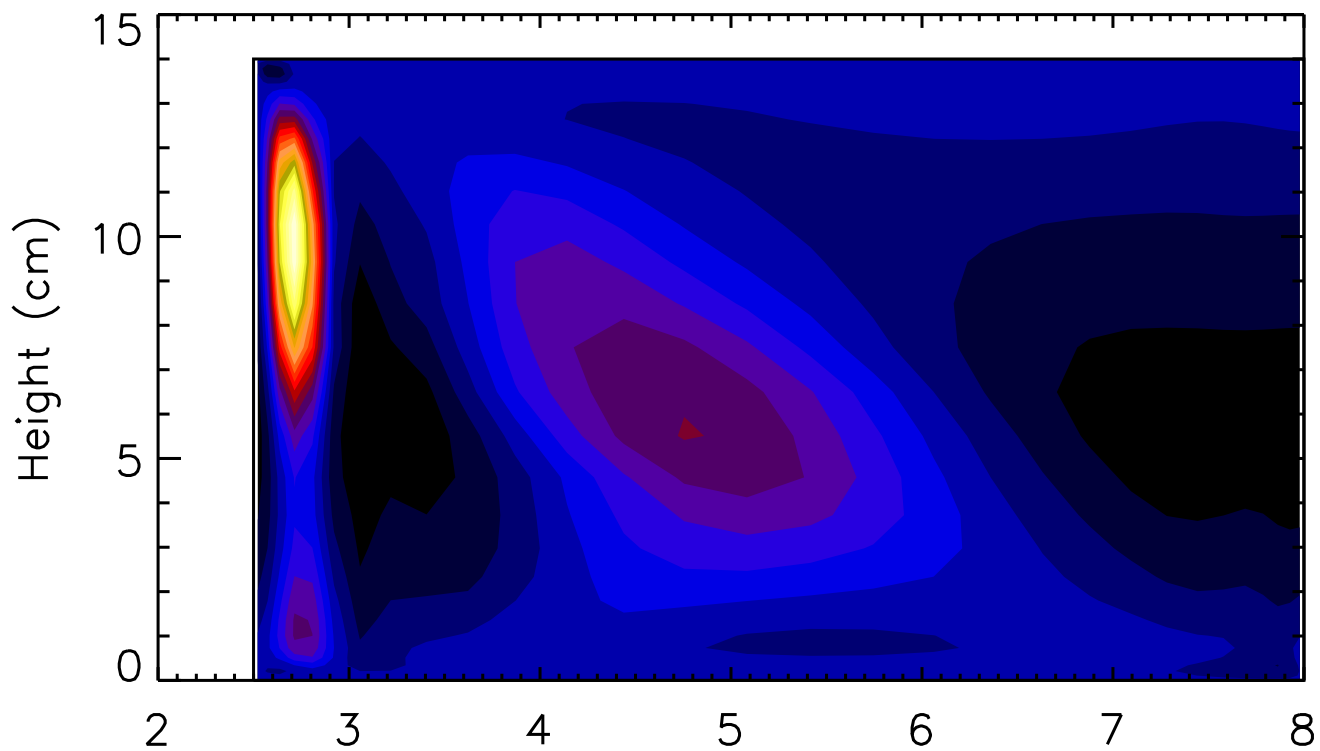
$$\partial \langle T'' \rangle / \partial z$$



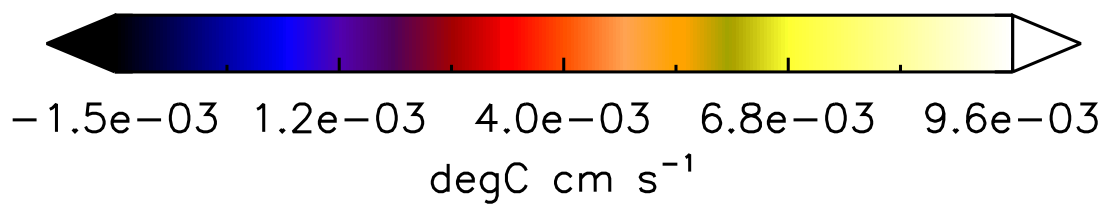
$$\partial \langle T'' \rangle / \partial R$$



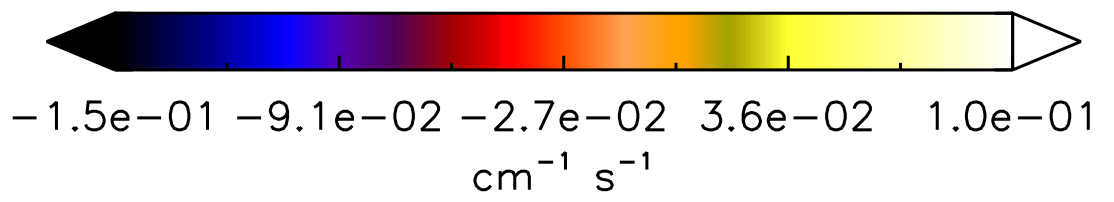
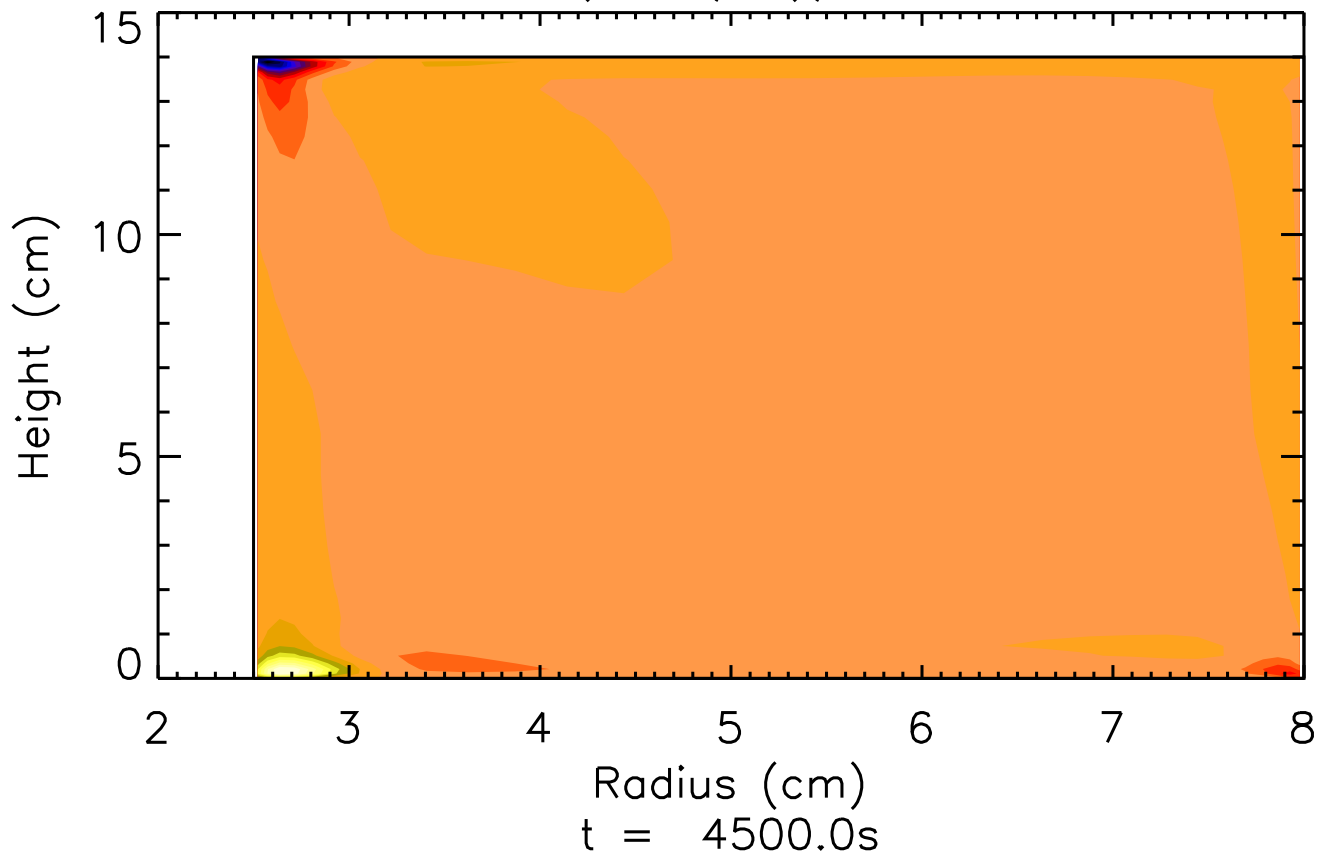
$\langle w'T' \rangle''$



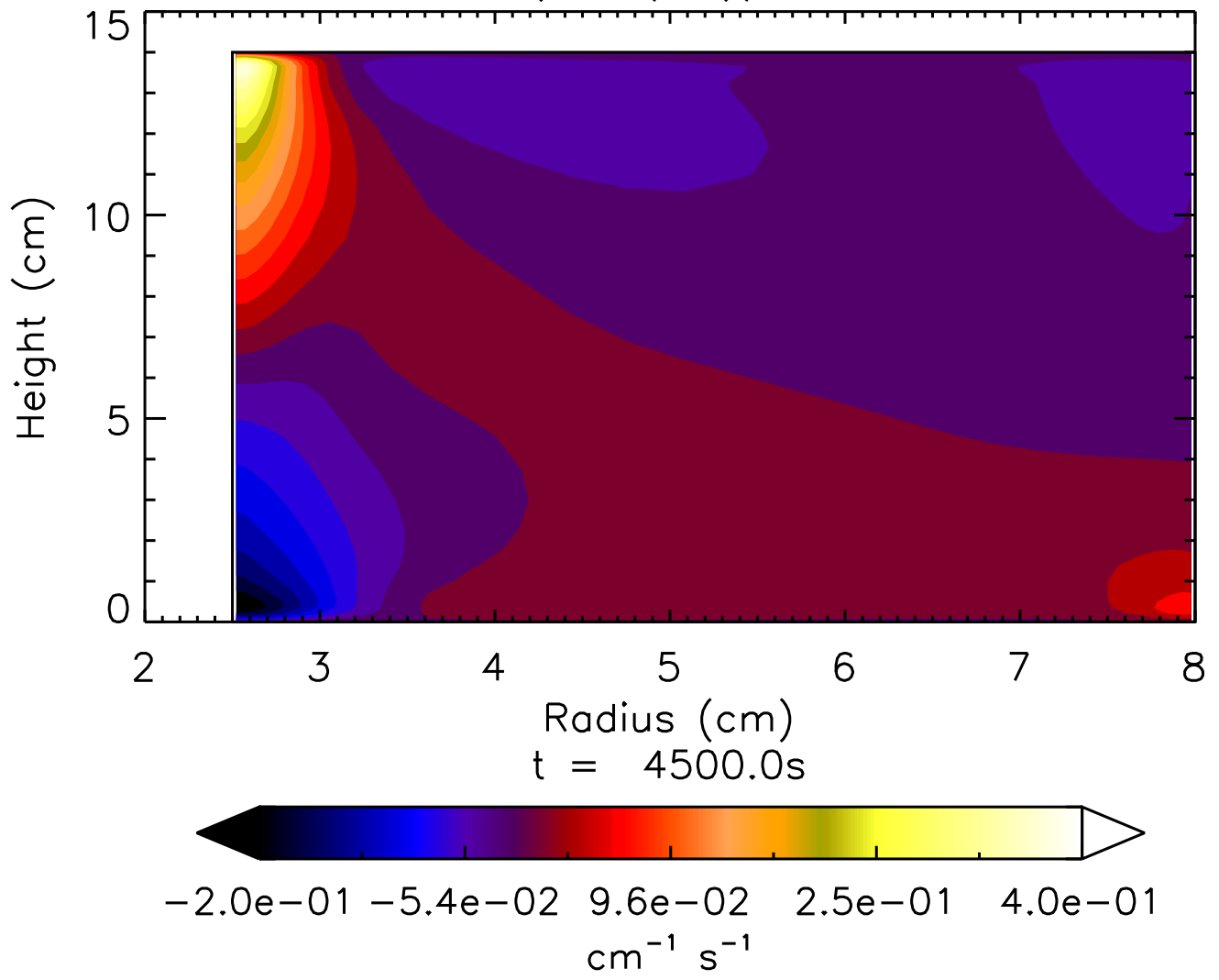
Radius (cm)  
 $t = 4500.0\text{s}$



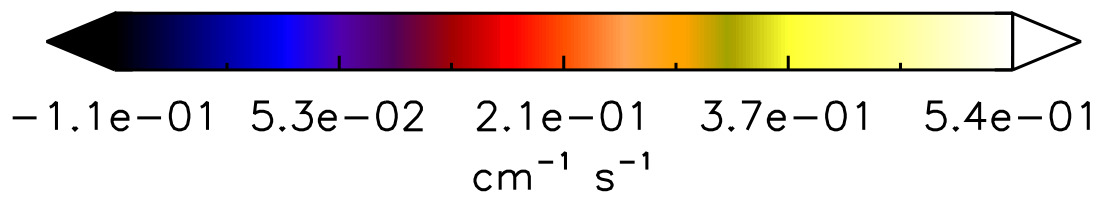
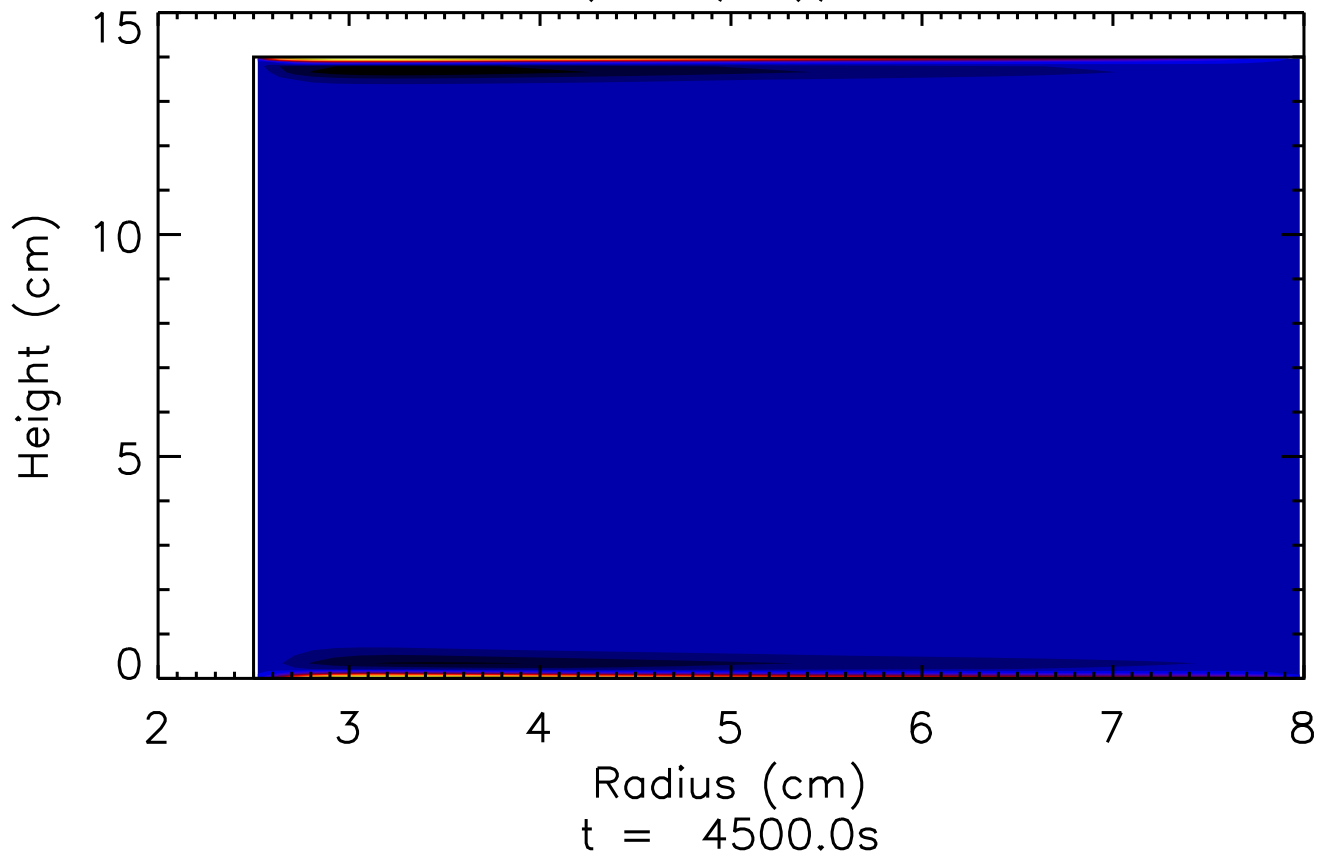
$$\partial(\langle u \rangle / R) / \partial R$$



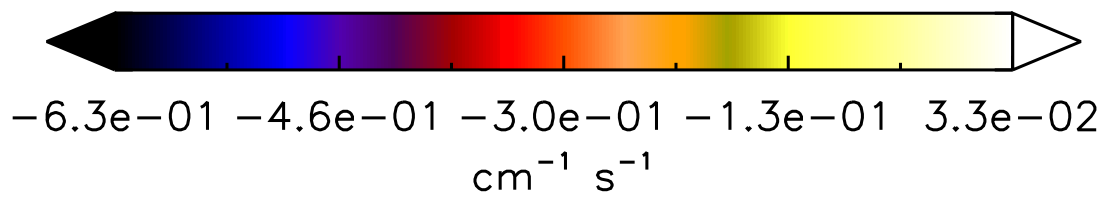
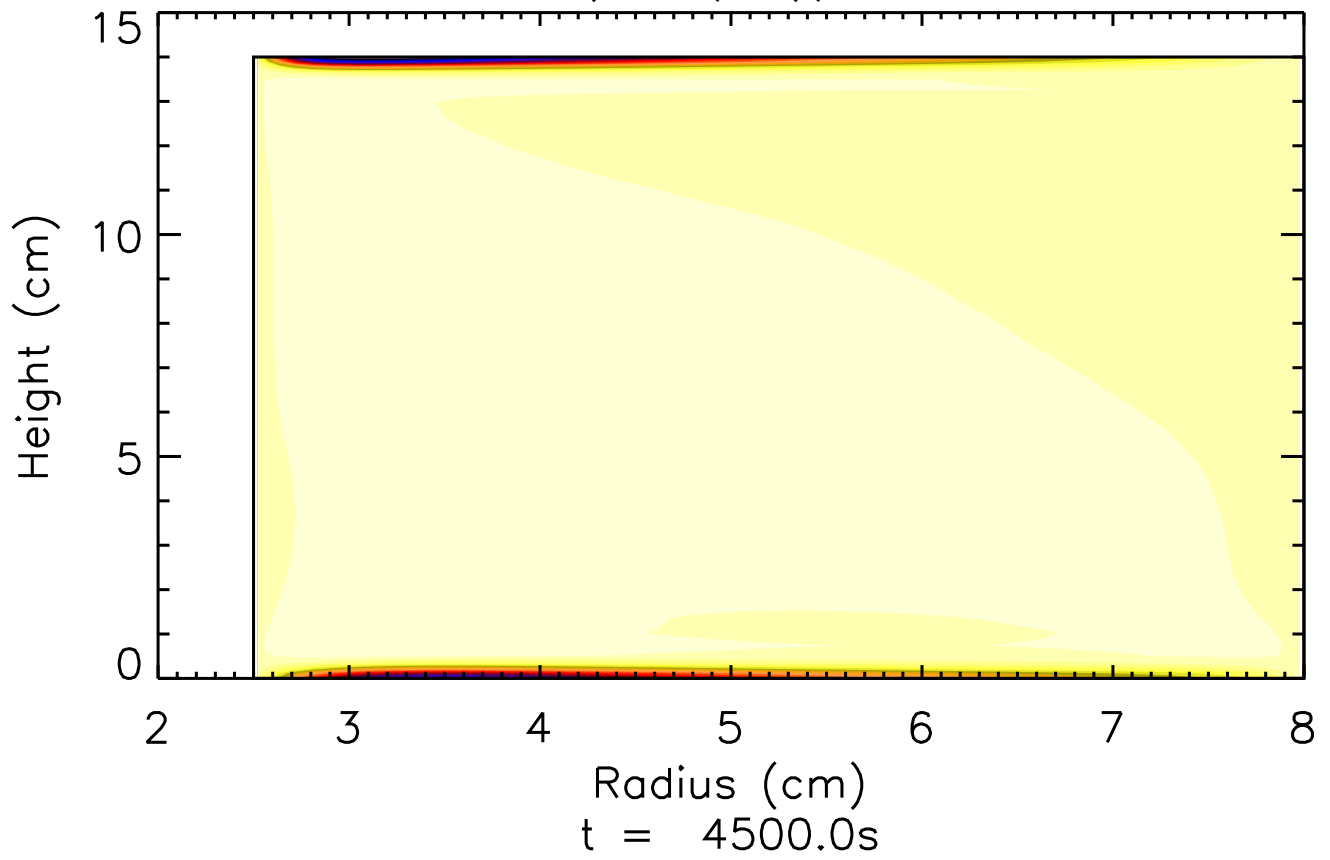
$$\partial(\langle v \rangle / R) / \partial R$$

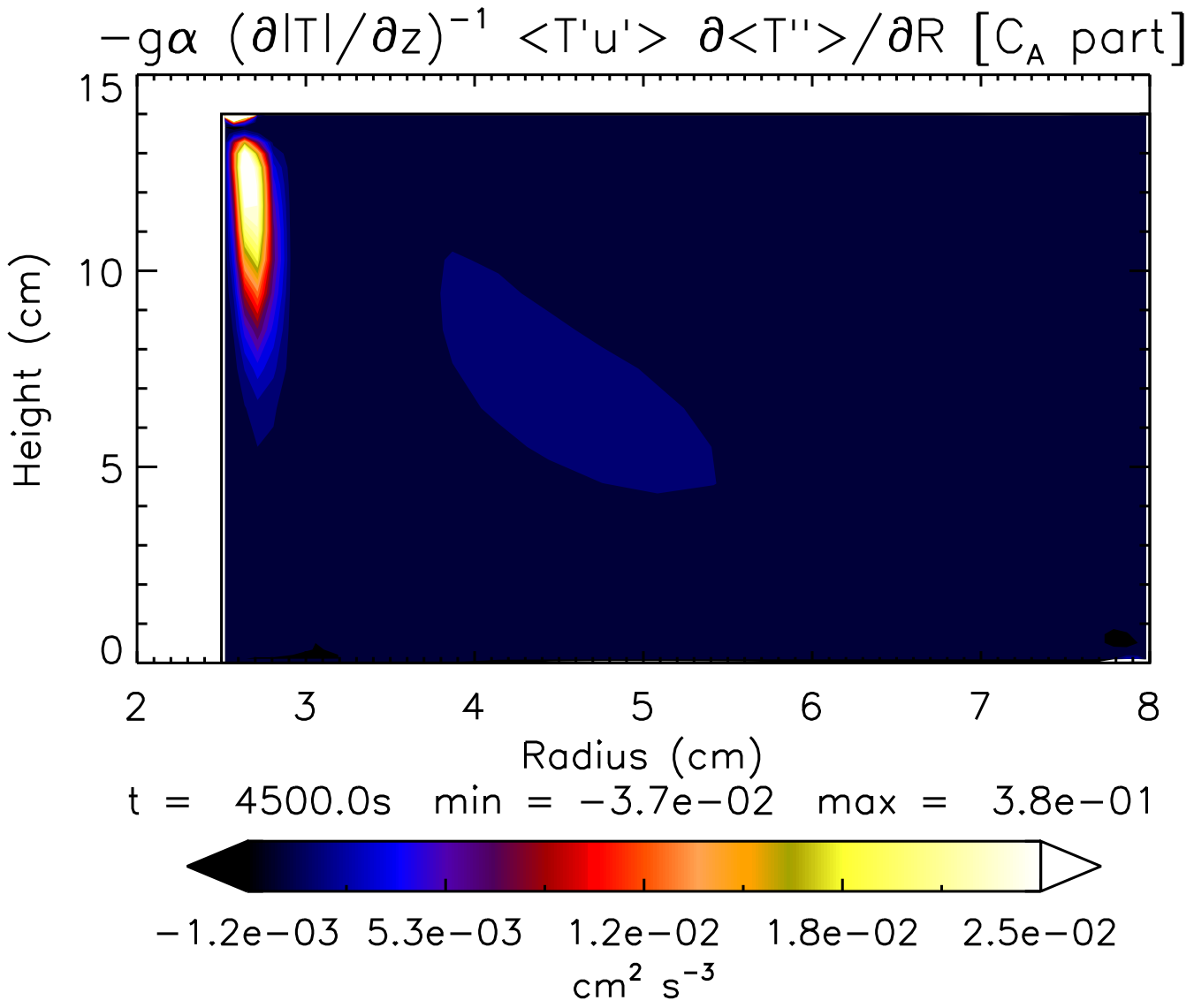


$$\partial(\langle u \rangle / R) / \partial z$$



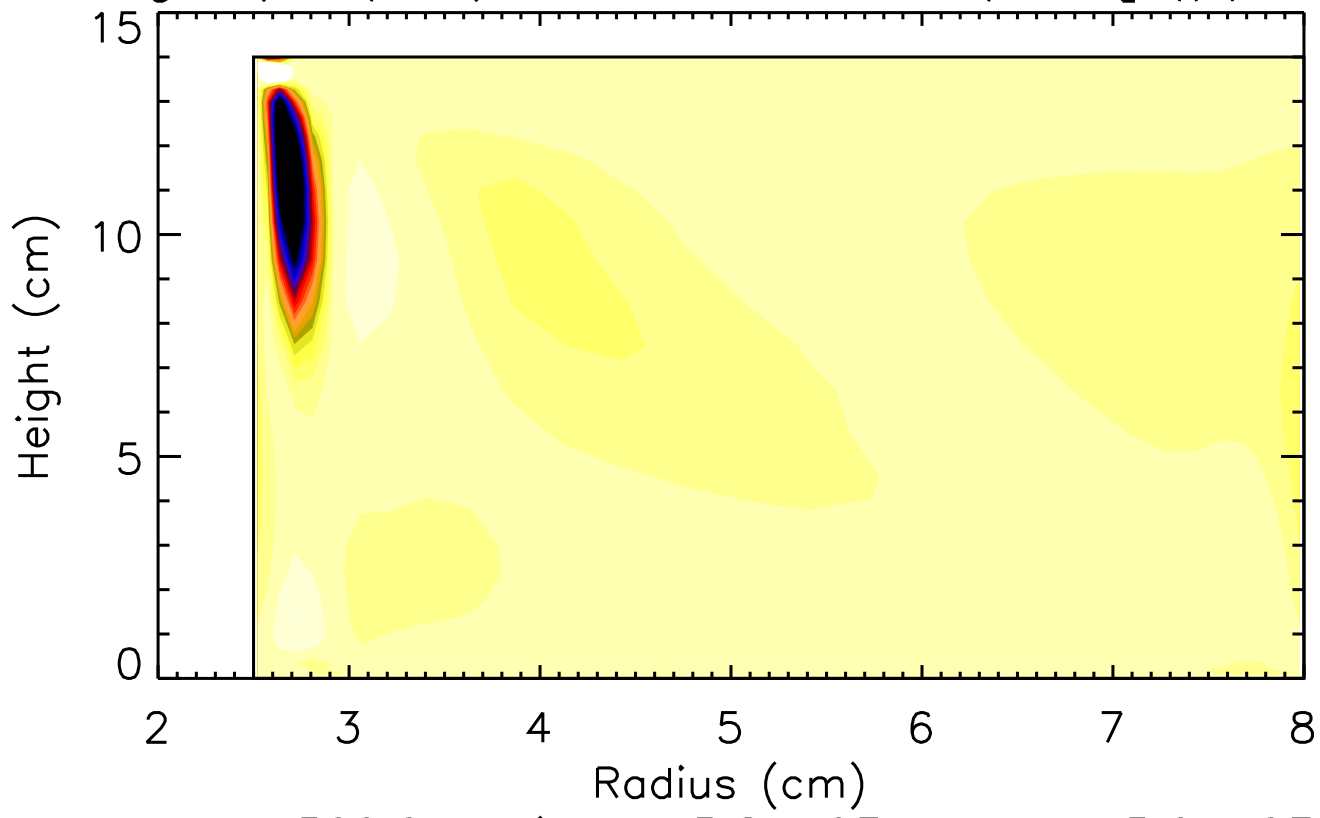
$$\partial(\langle v \rangle / R) / \partial z$$



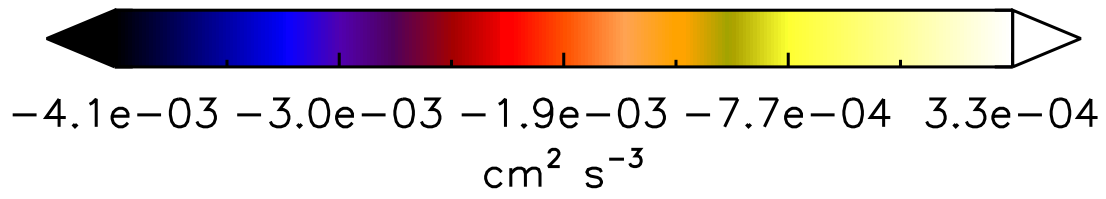




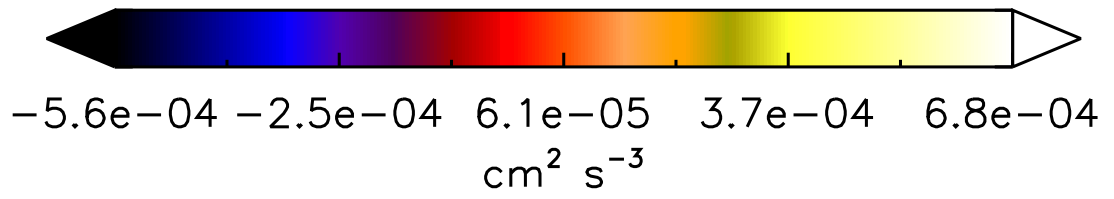
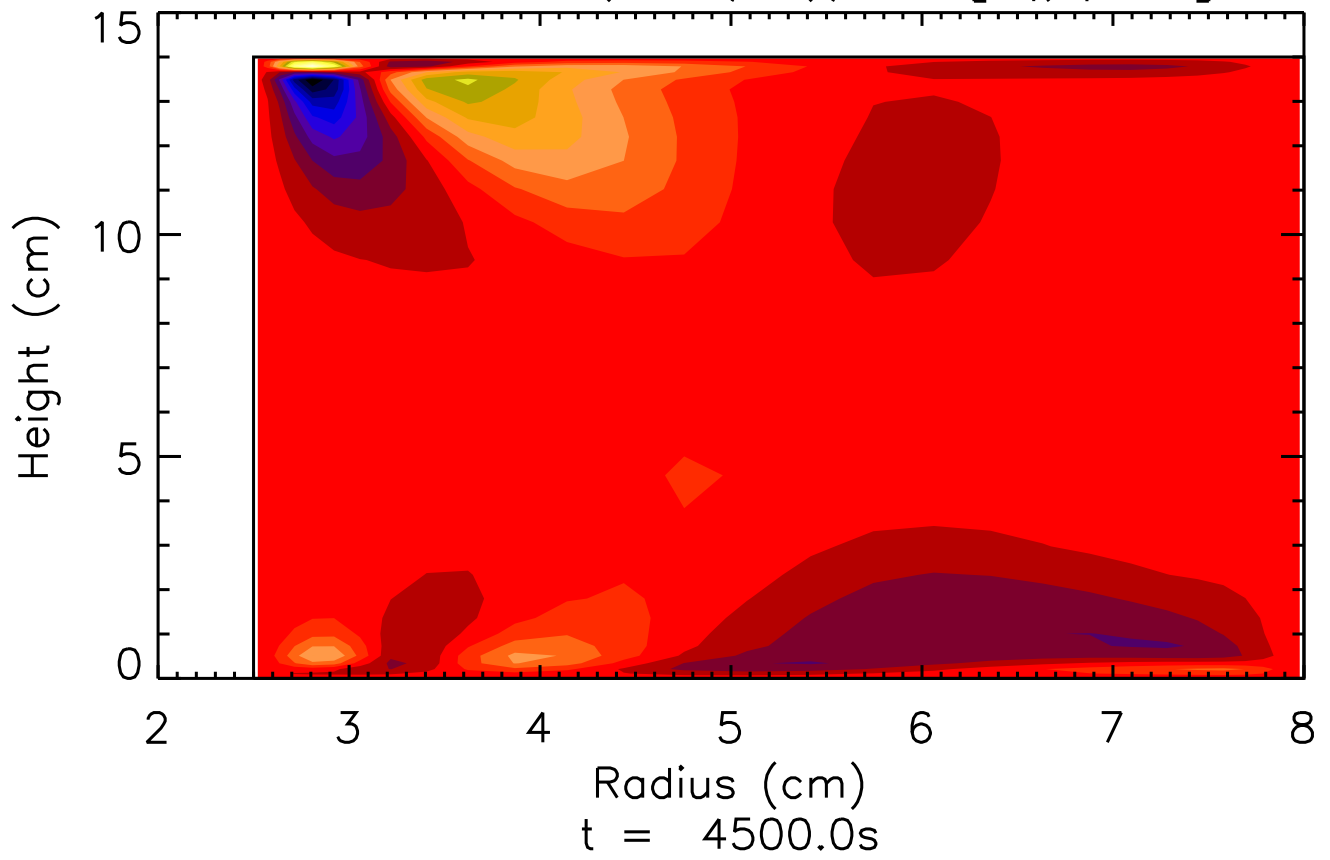
$$-g\alpha (\partial|T|/\partial z)^{-1} \langle T'w' \rangle'' \partial \langle T'' \rangle / \partial z \quad [C_A \text{ part}]$$



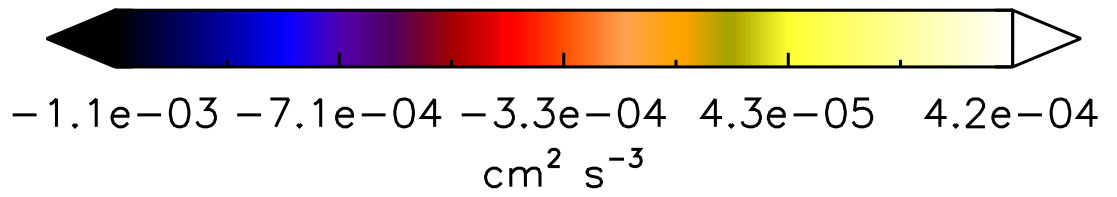
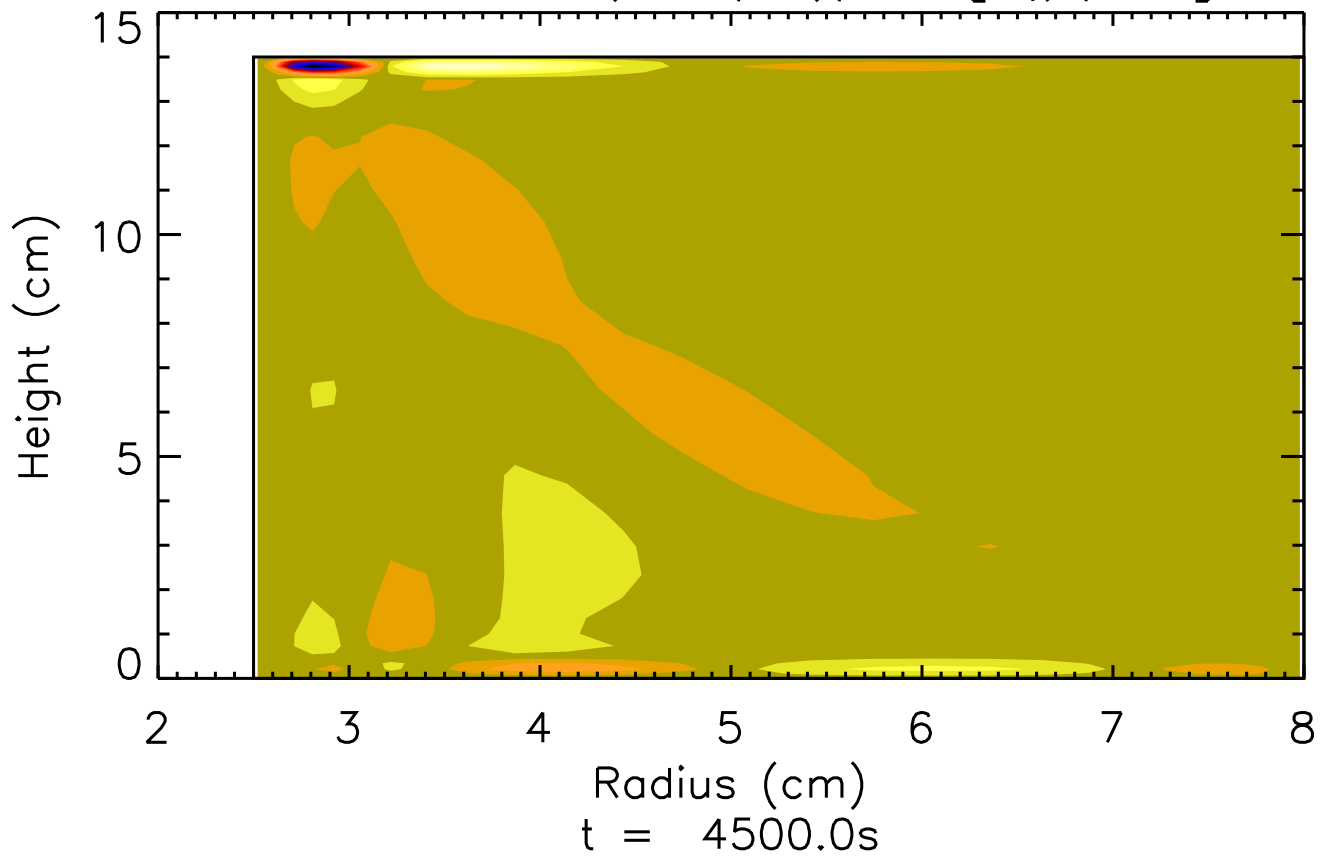
t = 4500.0s min =  $-5.8e-03$  max =  $5.0e-03$



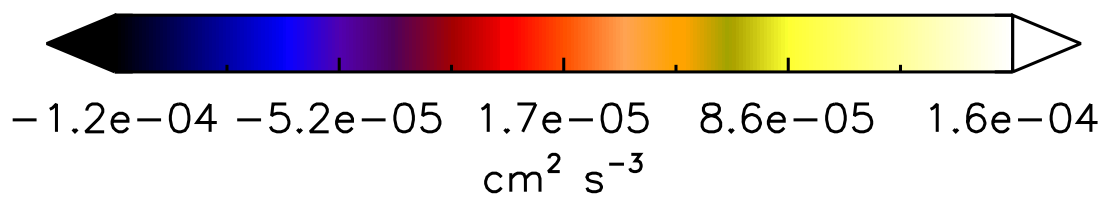
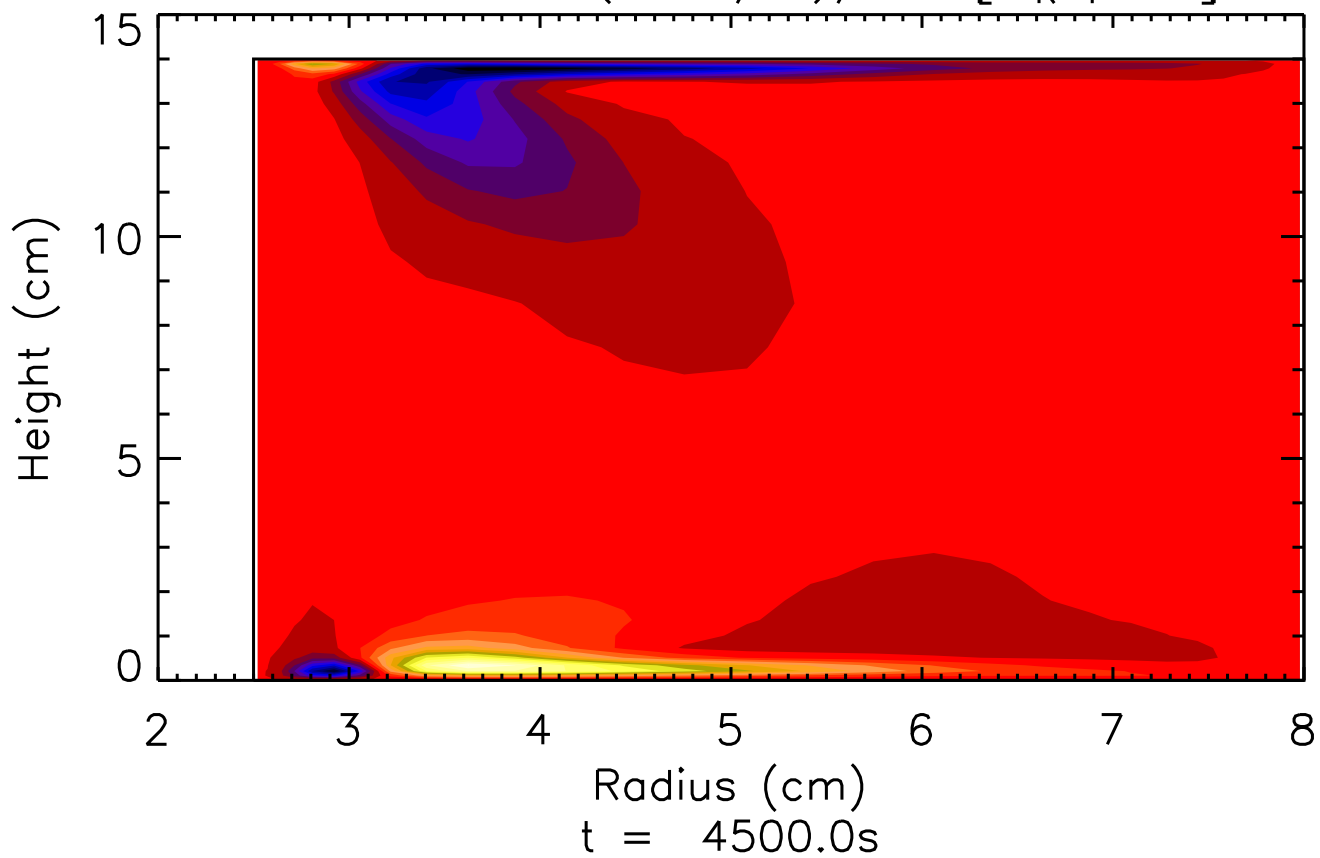
$$-R \langle u'v' \rangle \frac{\partial(\langle v \rangle / R)}{\partial R} [C_k \text{ part}]$$



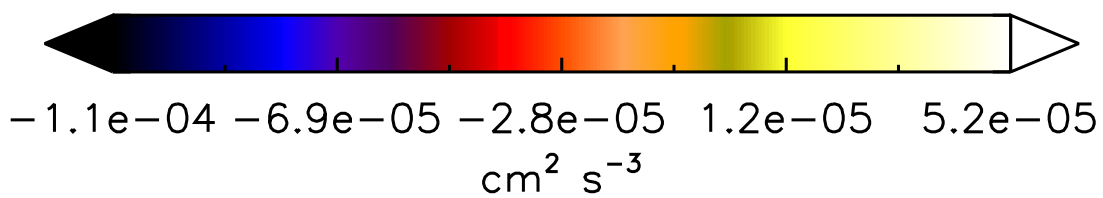
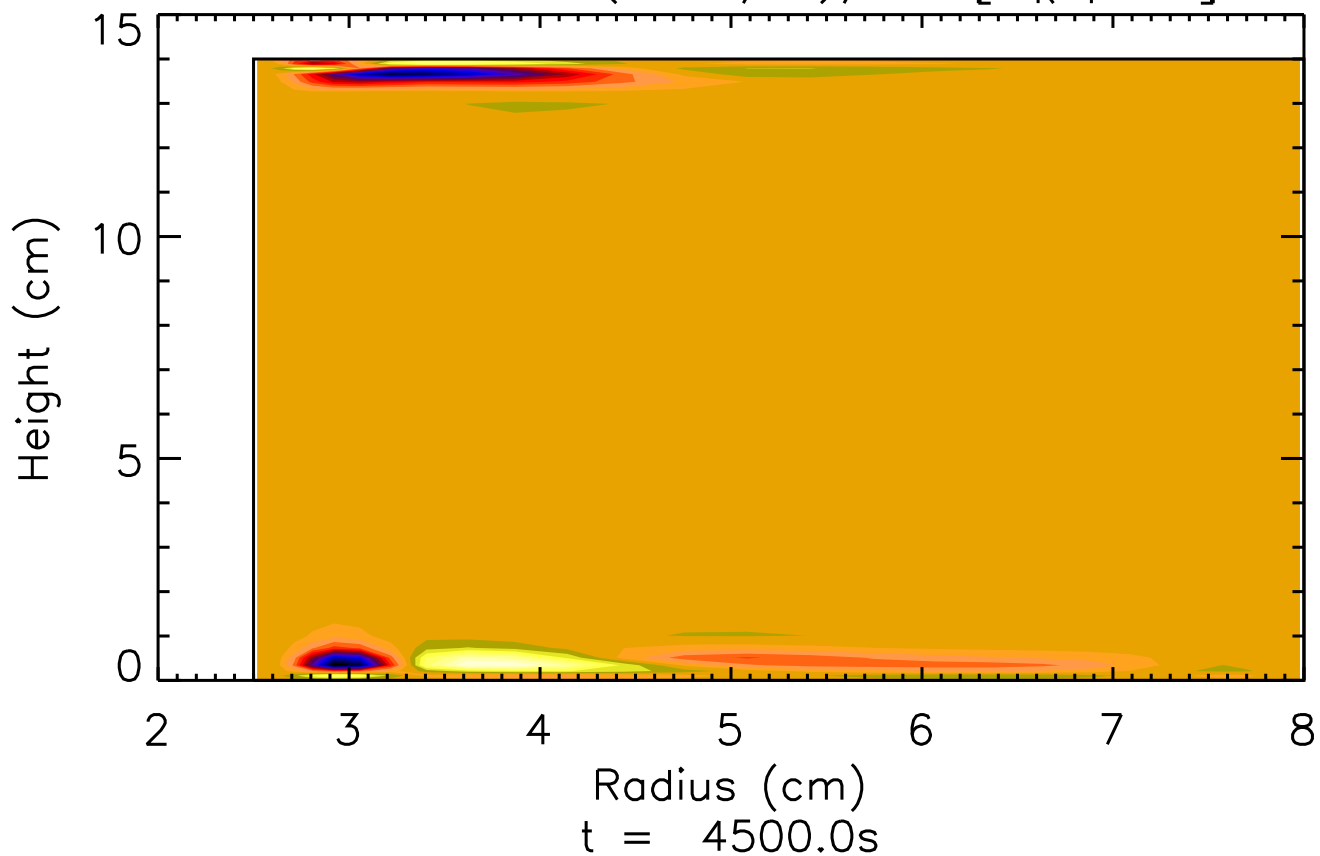
$$-R \langle v'w' \rangle \frac{\partial \langle v \rangle / R}{\partial z} [C_k \text{ part}]$$

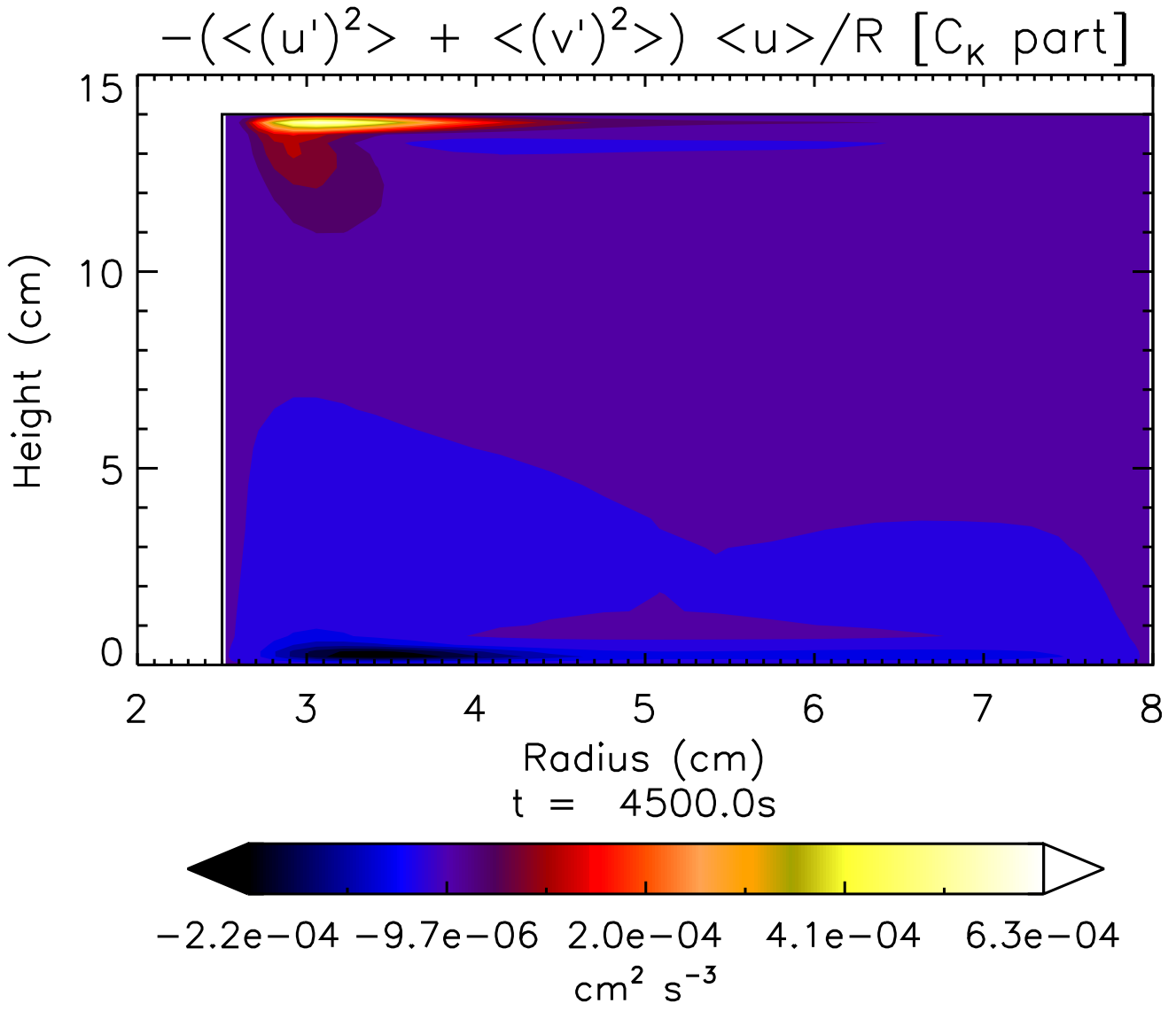


$-R \langle u'u' \rangle \partial(\langle u \rangle / R) / \partial R$  [ $C_k$  part]

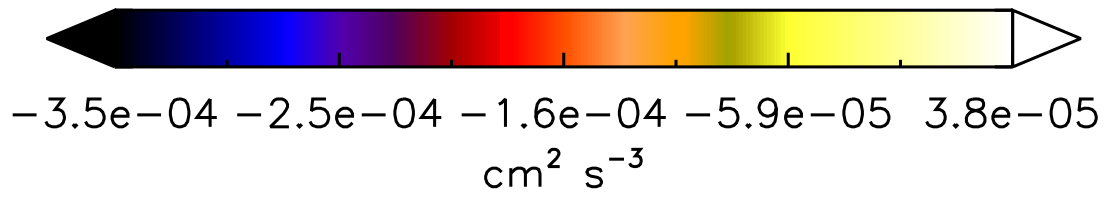
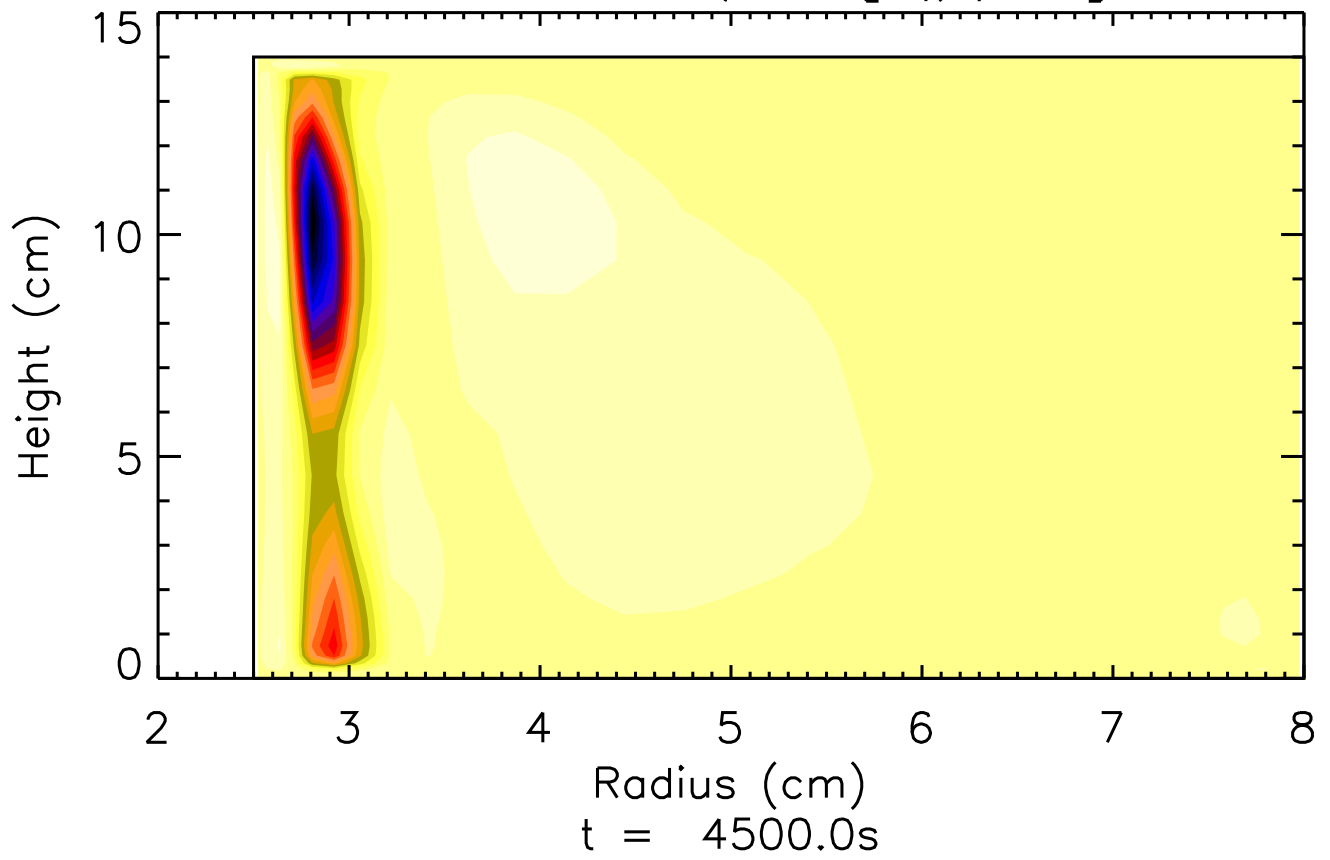


$-R \langle u'w' \rangle \partial(\langle u \rangle / R) / \partial z$  [ $C_k$  part]

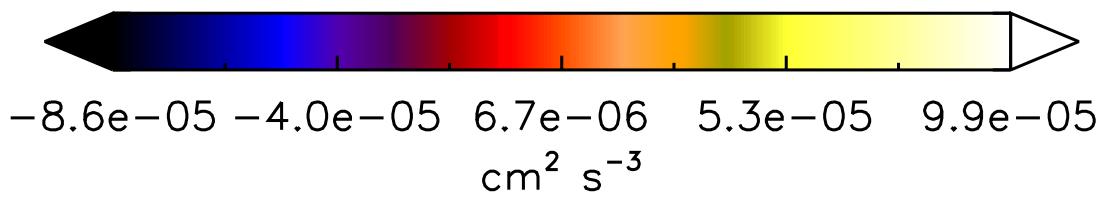
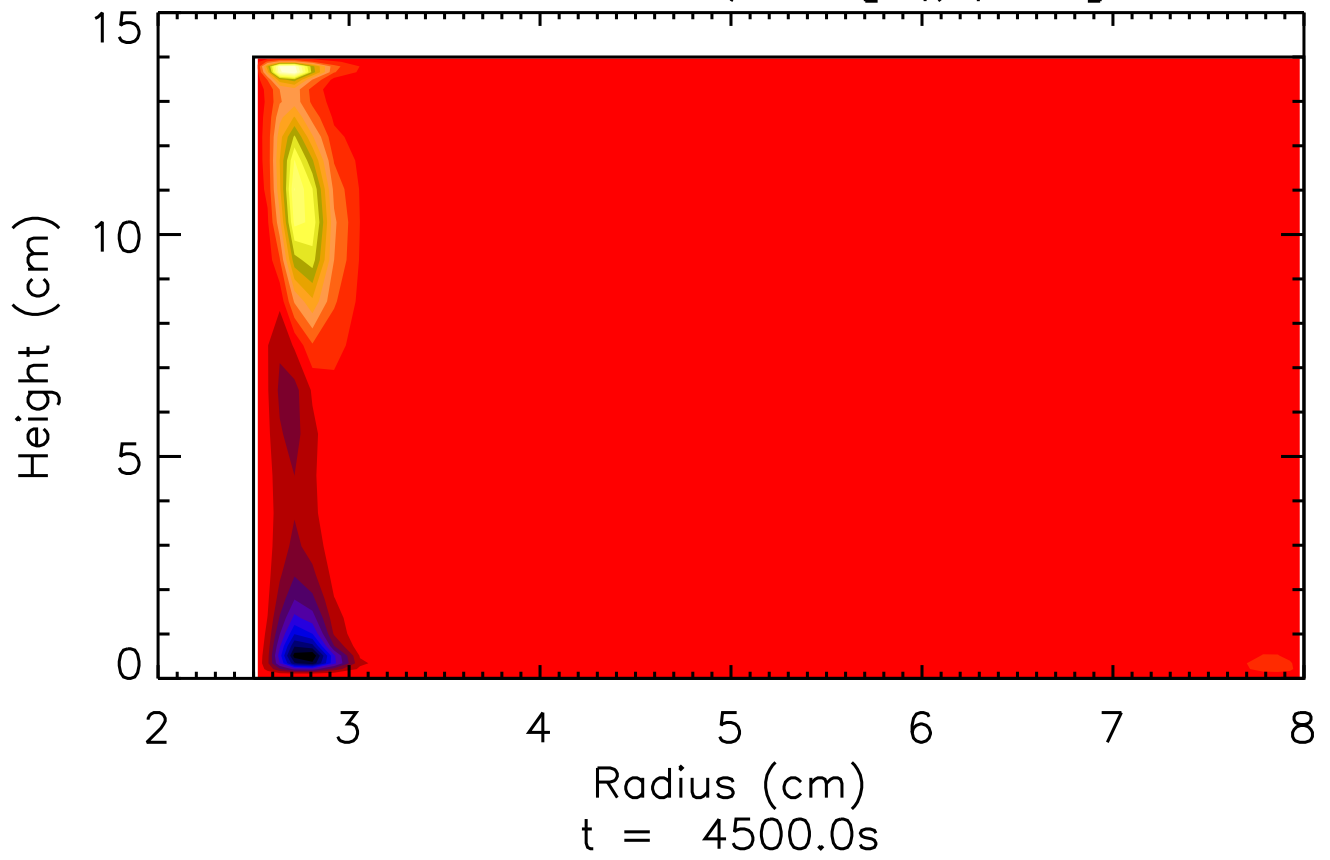




$\langle u'w' \rangle \partial \langle w \rangle / \partial R$  [ $C_k$  part]

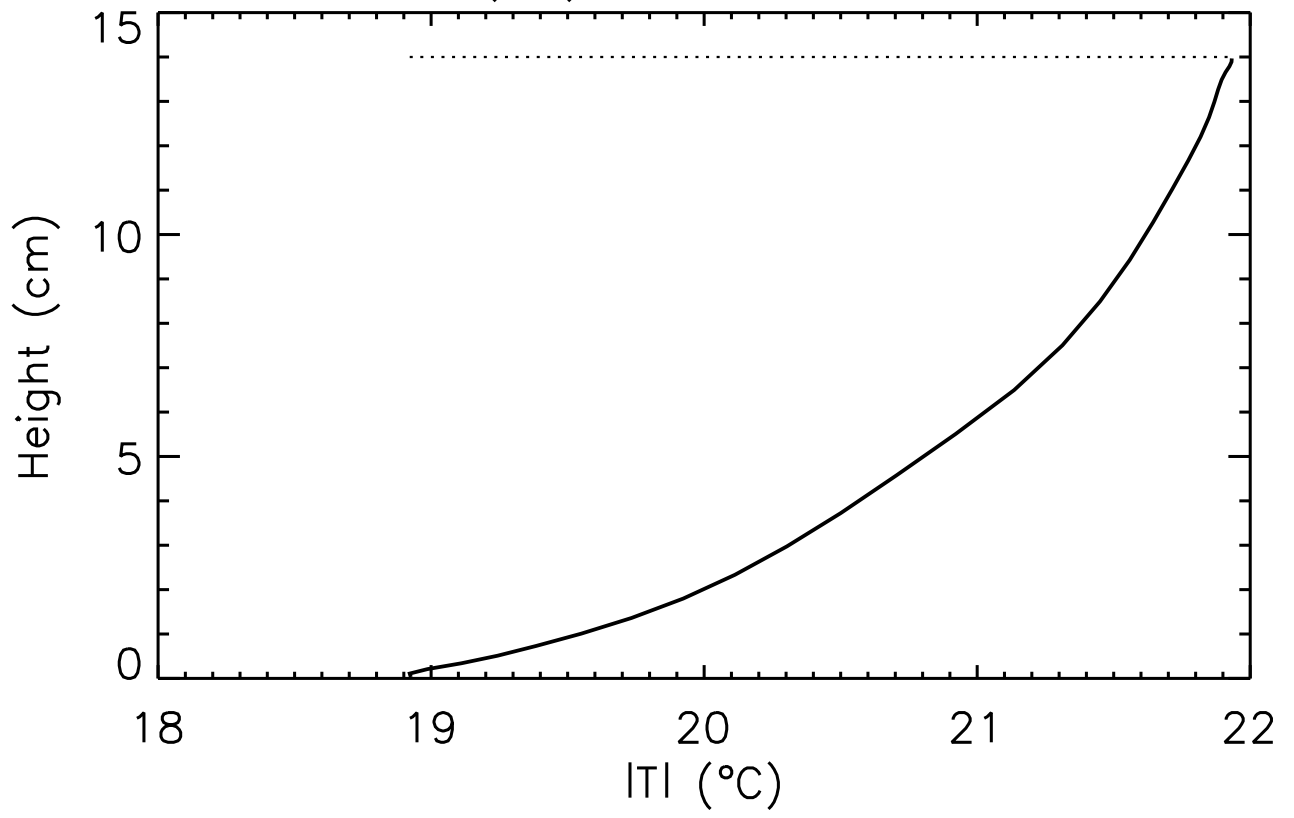


$\langle w'w' \rangle \partial \langle w \rangle / \partial z$  [ $C_K$  part]

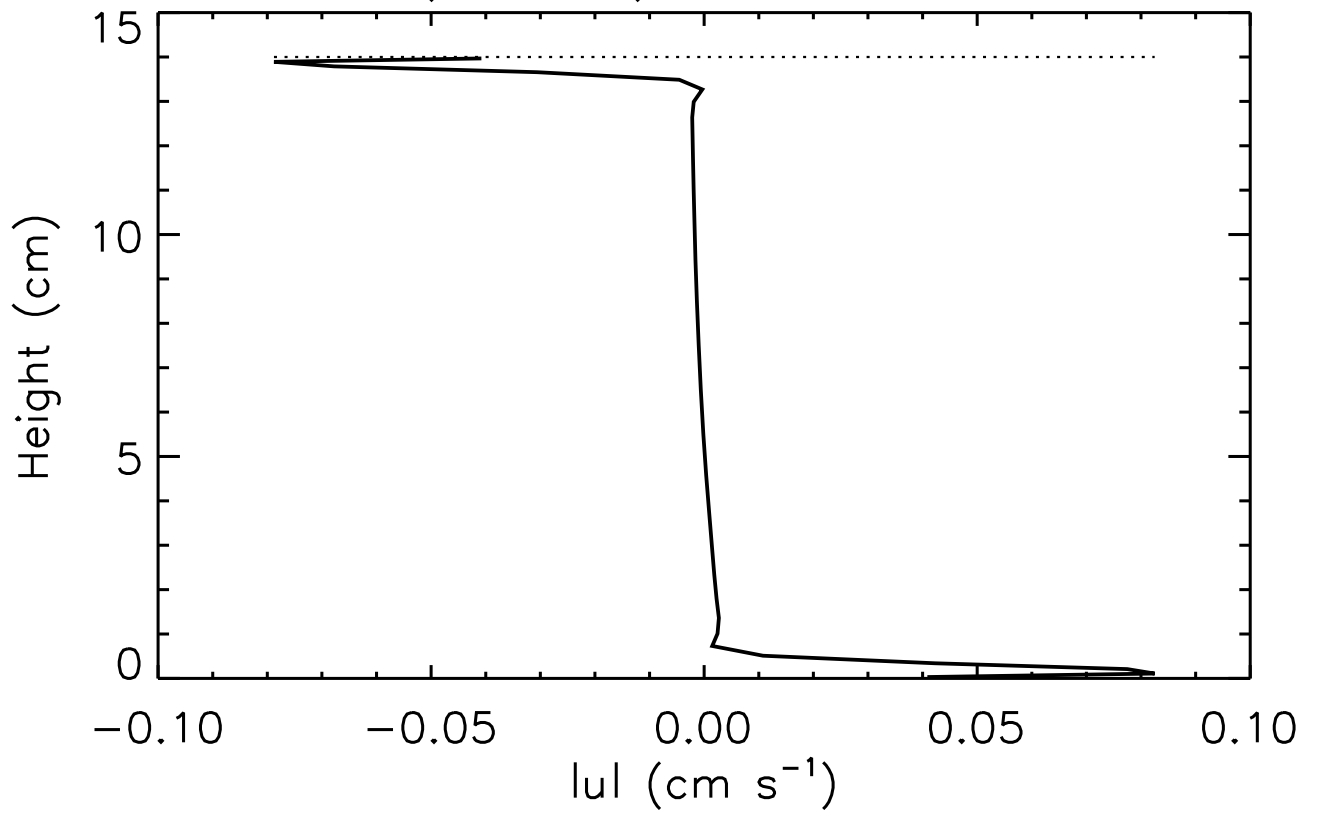




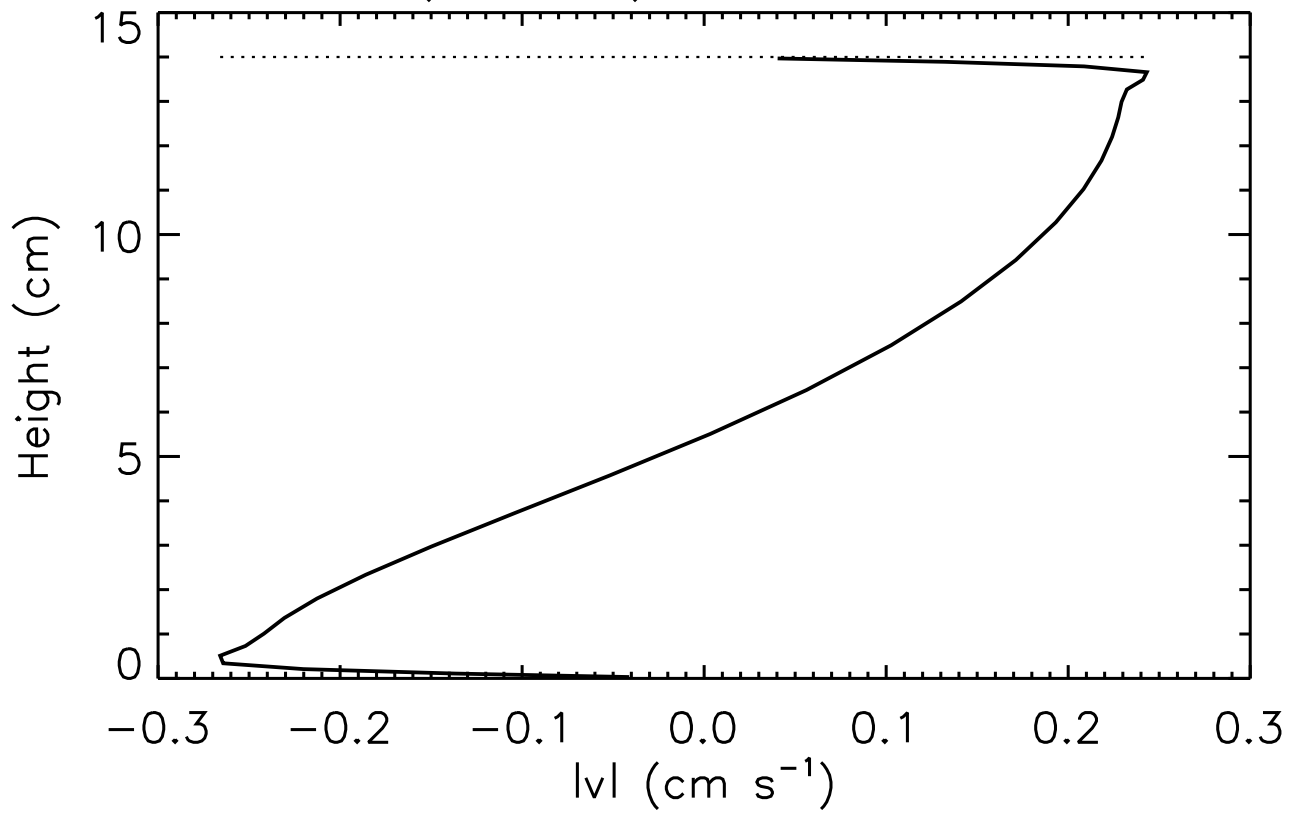
ITI (°C) t = 4500.0s



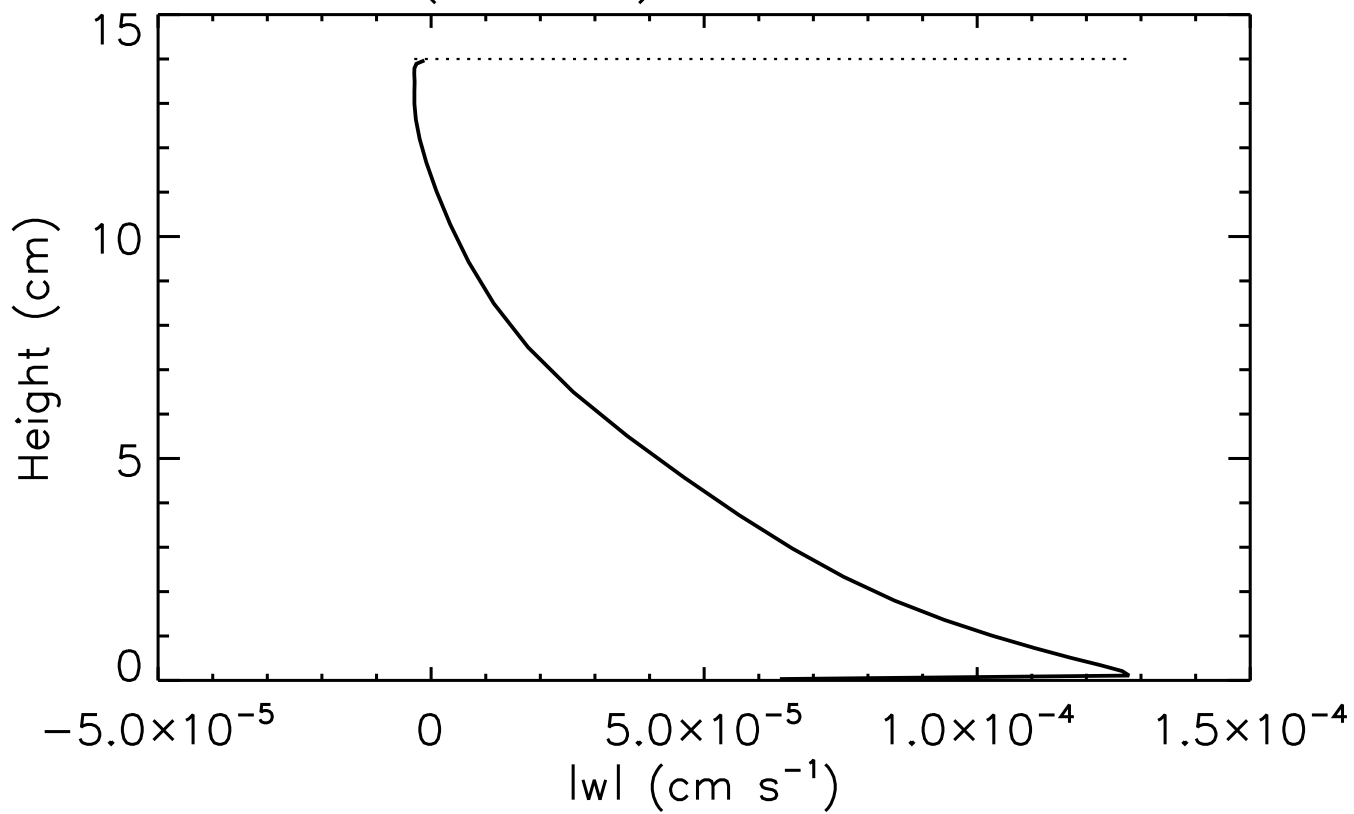
$lul$  ( $\text{cm s}^{-1}$ )  $t = 4500.0\text{s}$



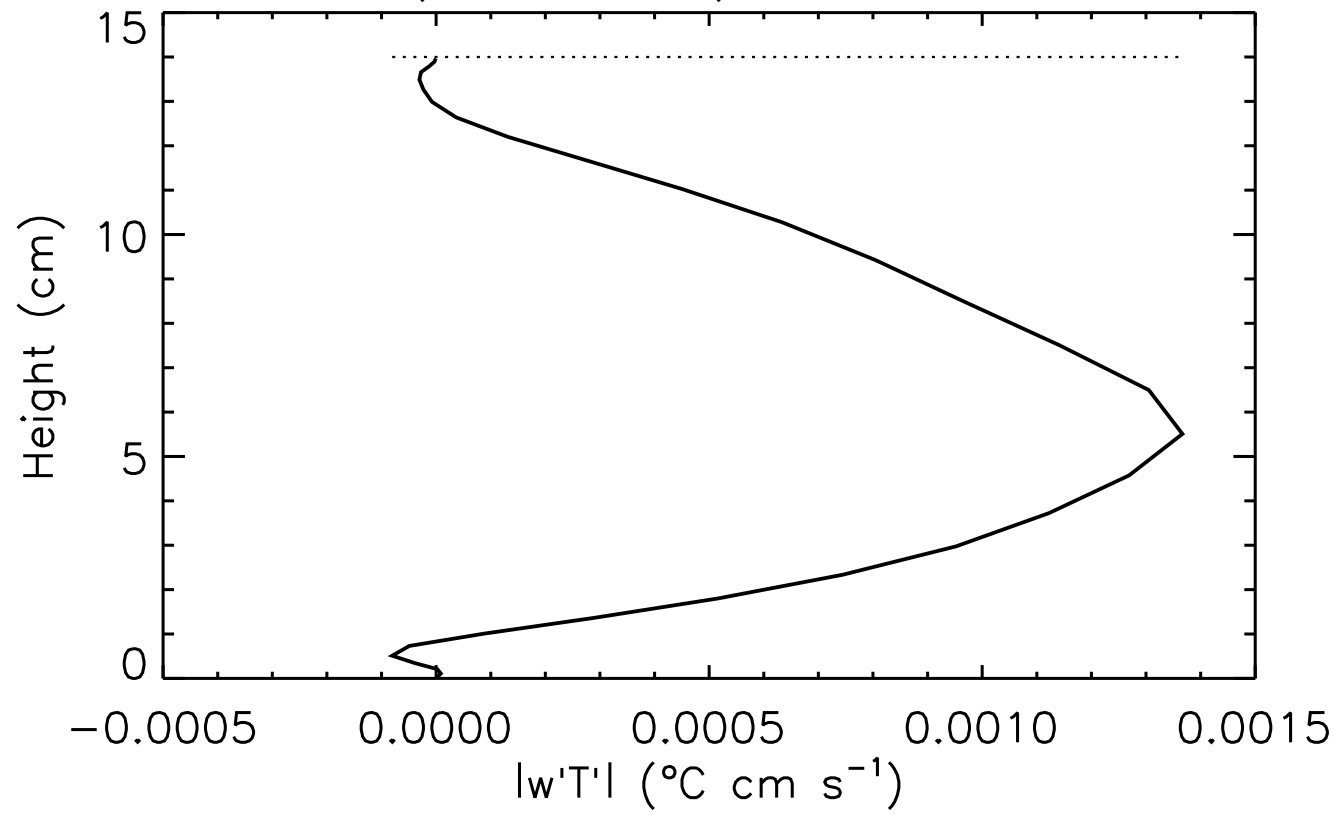
$lv_l$  ( $\text{cm s}^{-1}$ )  $t = 4500.0\text{s}$



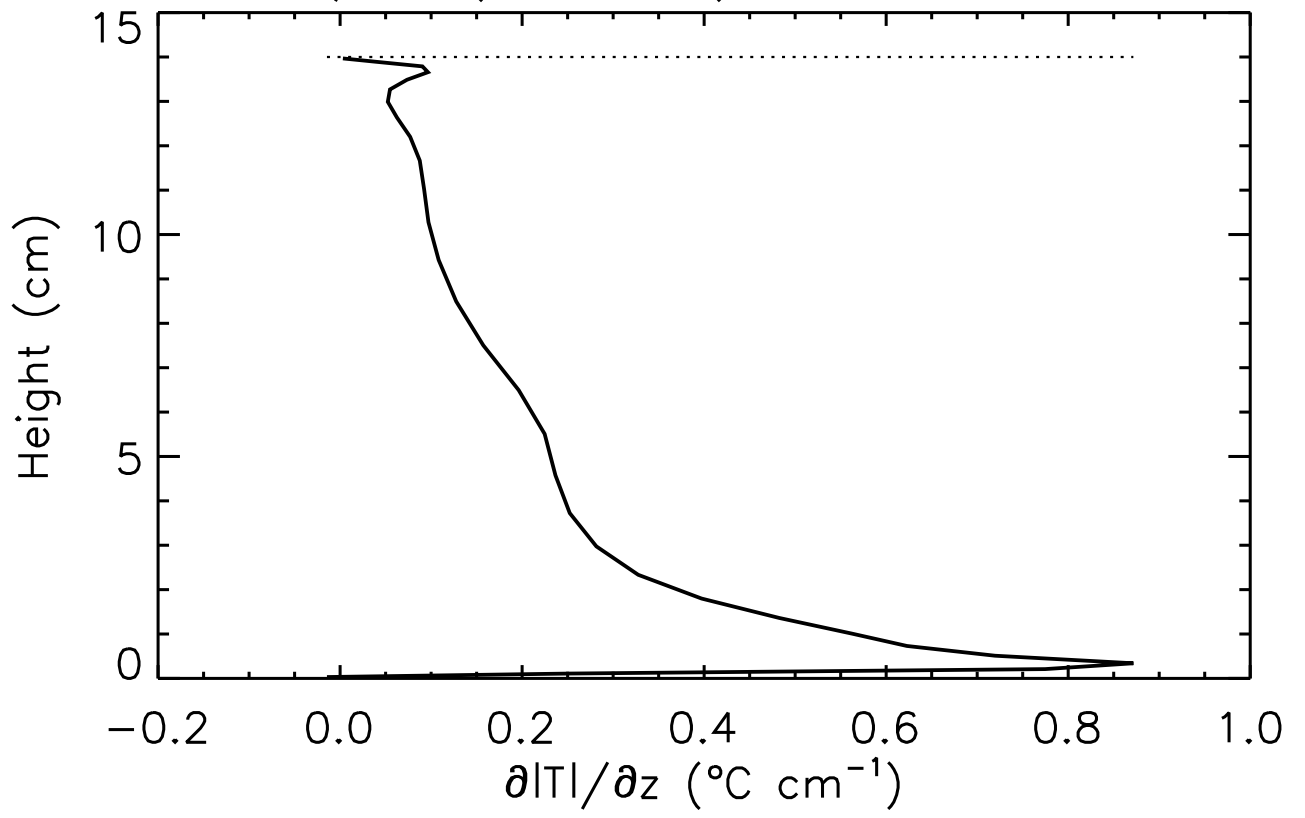
$lw$  ( $\text{cm s}^{-1}$ )  $t = 4500.0\text{s}$



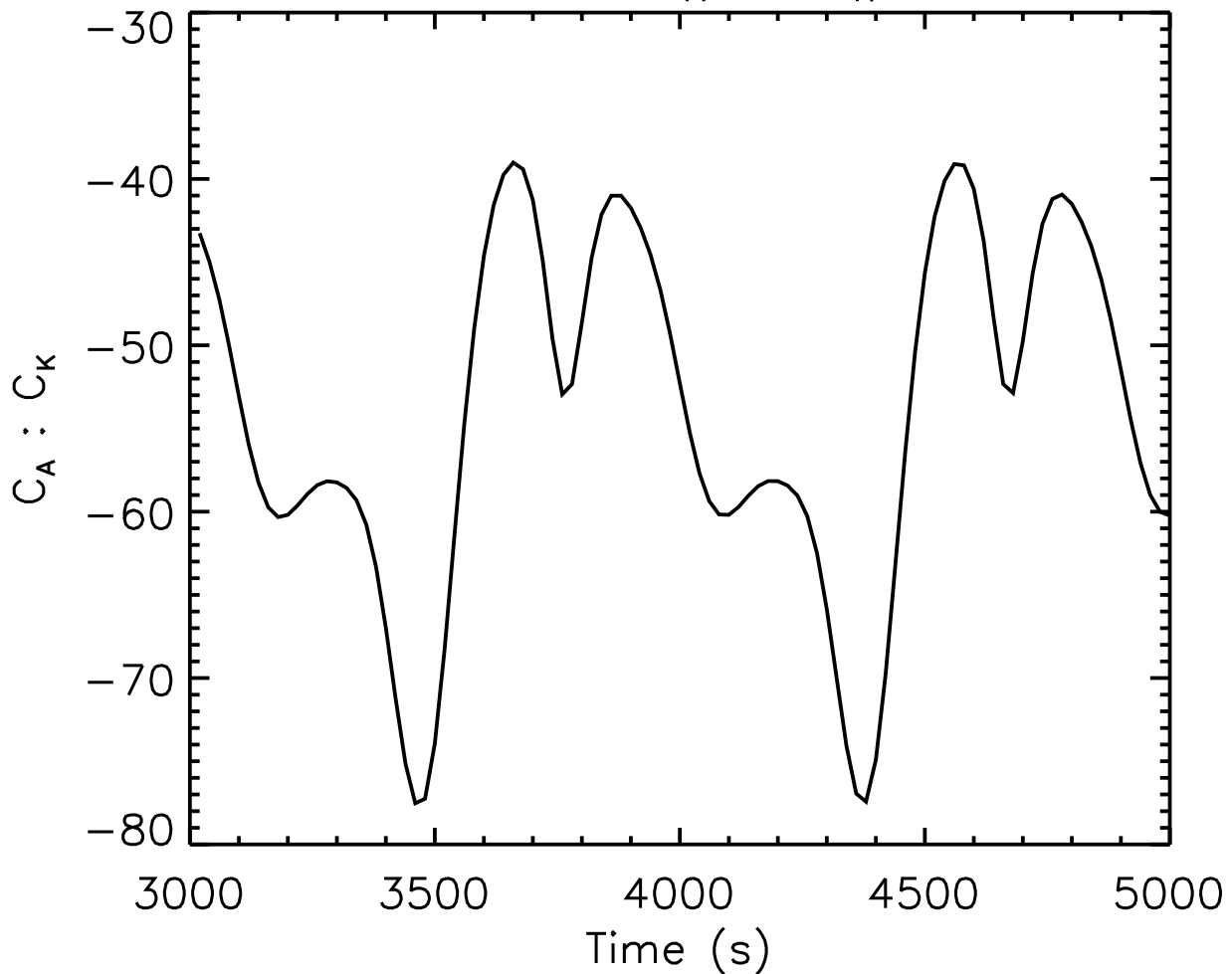
$|w'T'|$  ( $^{\circ}\text{C cm s}^{-1}$ )  $t = 4500.0\text{s}$



$\partial|T|/\partial z$  ( $^{\circ}\text{C cm}^{-1}$ )  $t = 4500.0\text{s}$

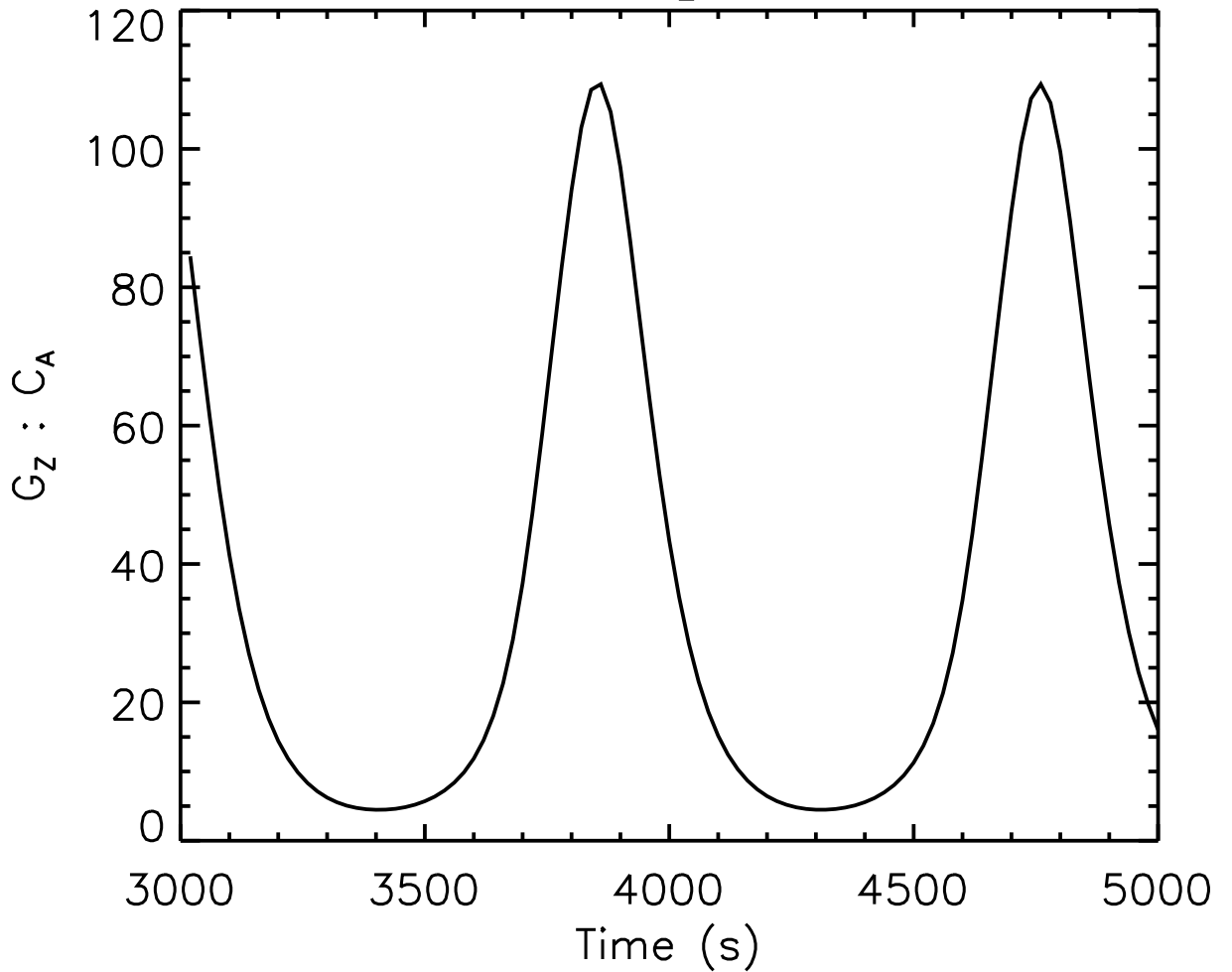


Ratio  $C_A$  to  $C_K$



Percentiles [25,50,75]=[ $-6.00e+01$ , $-5.44e+01$ , $-4.46e+01$ ]

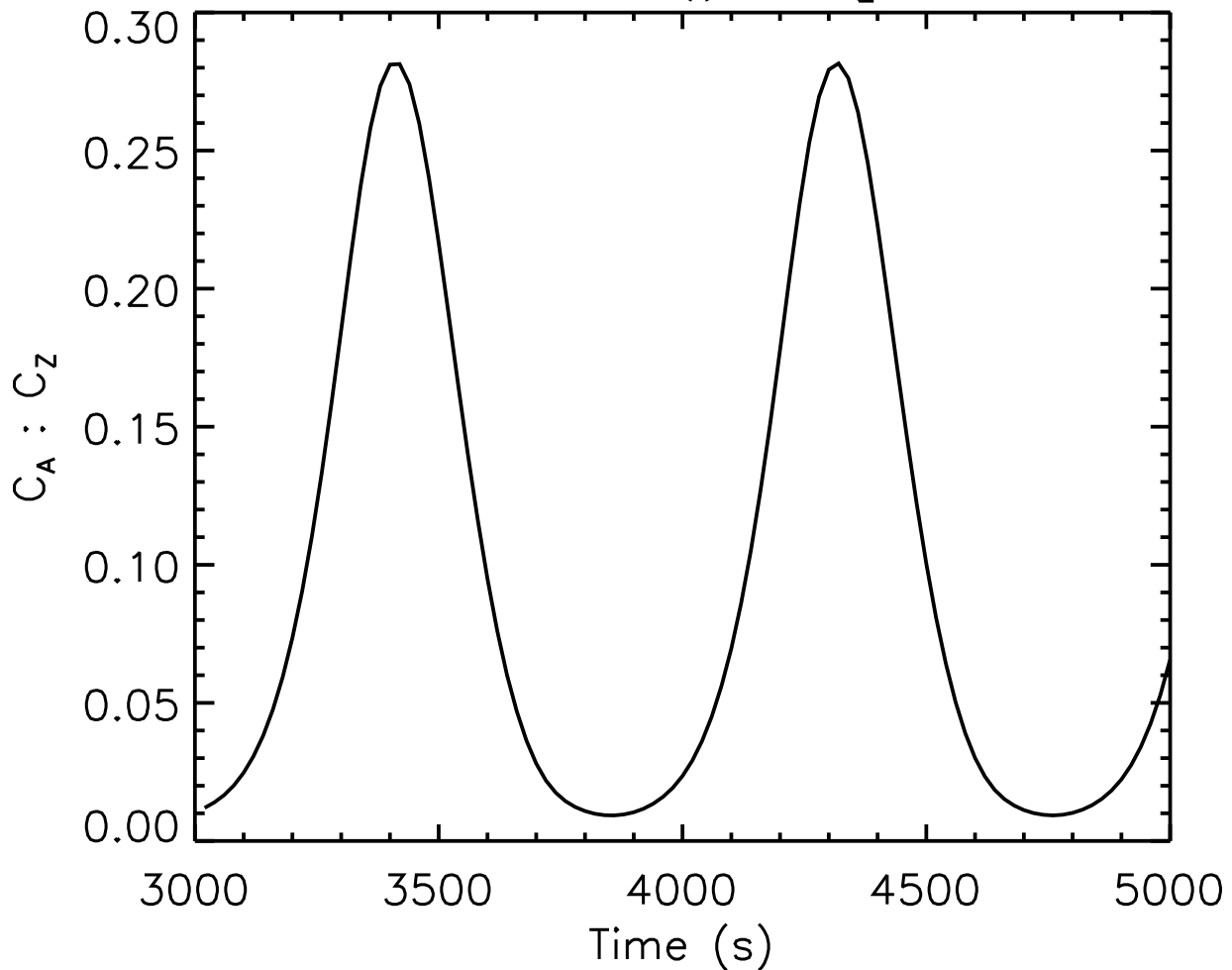
Ratio  $G_Z$  to  $C_A$



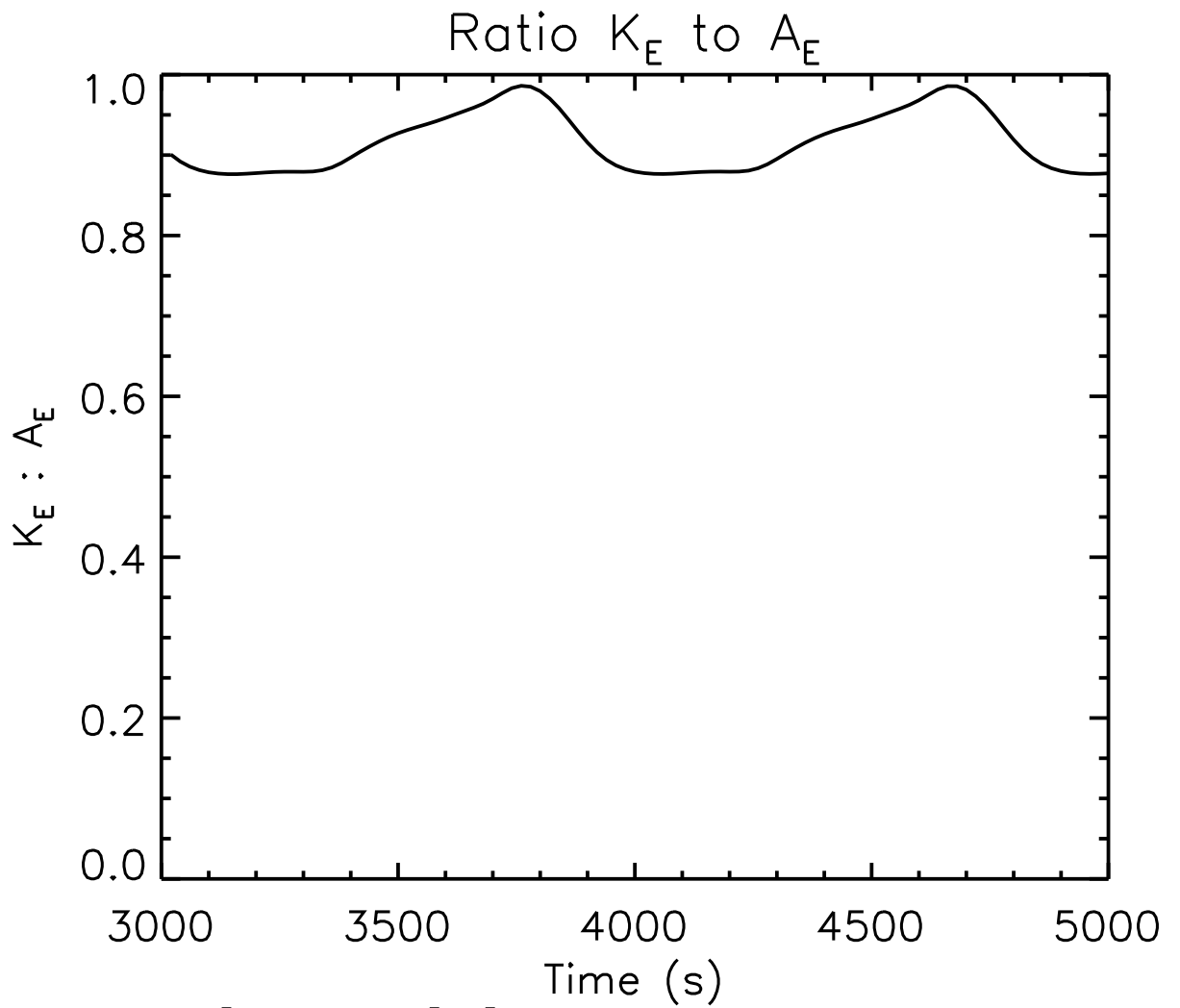
Percentiles [25,50,75]=[ 7.14e+00, 2.13e+01, 6.11e+01]



Ratio  $C_A$  to  $C_Z$

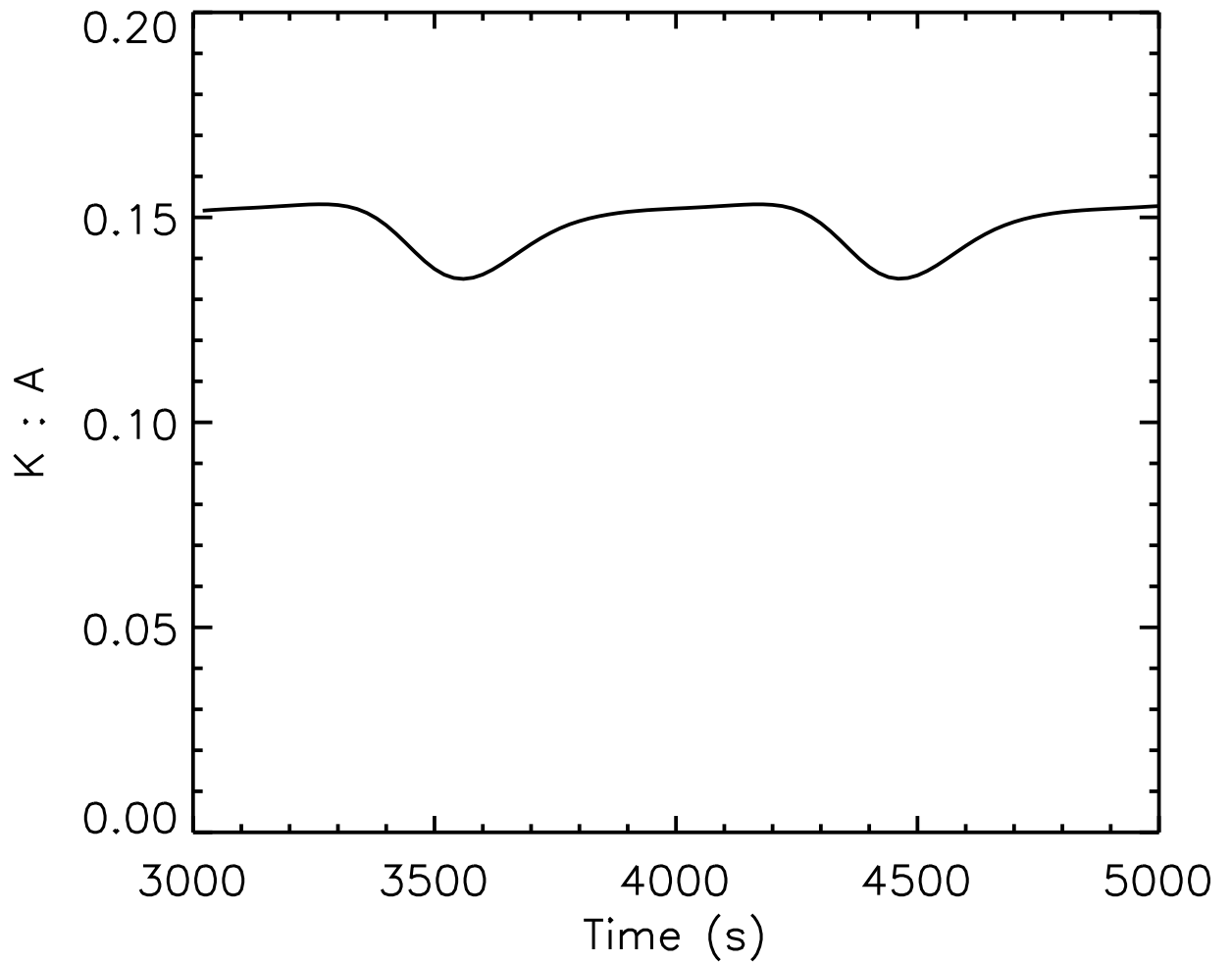


Percentiles [25,50,75]=[ 1.75e-02, 5.29e-02, 1.72e-01]



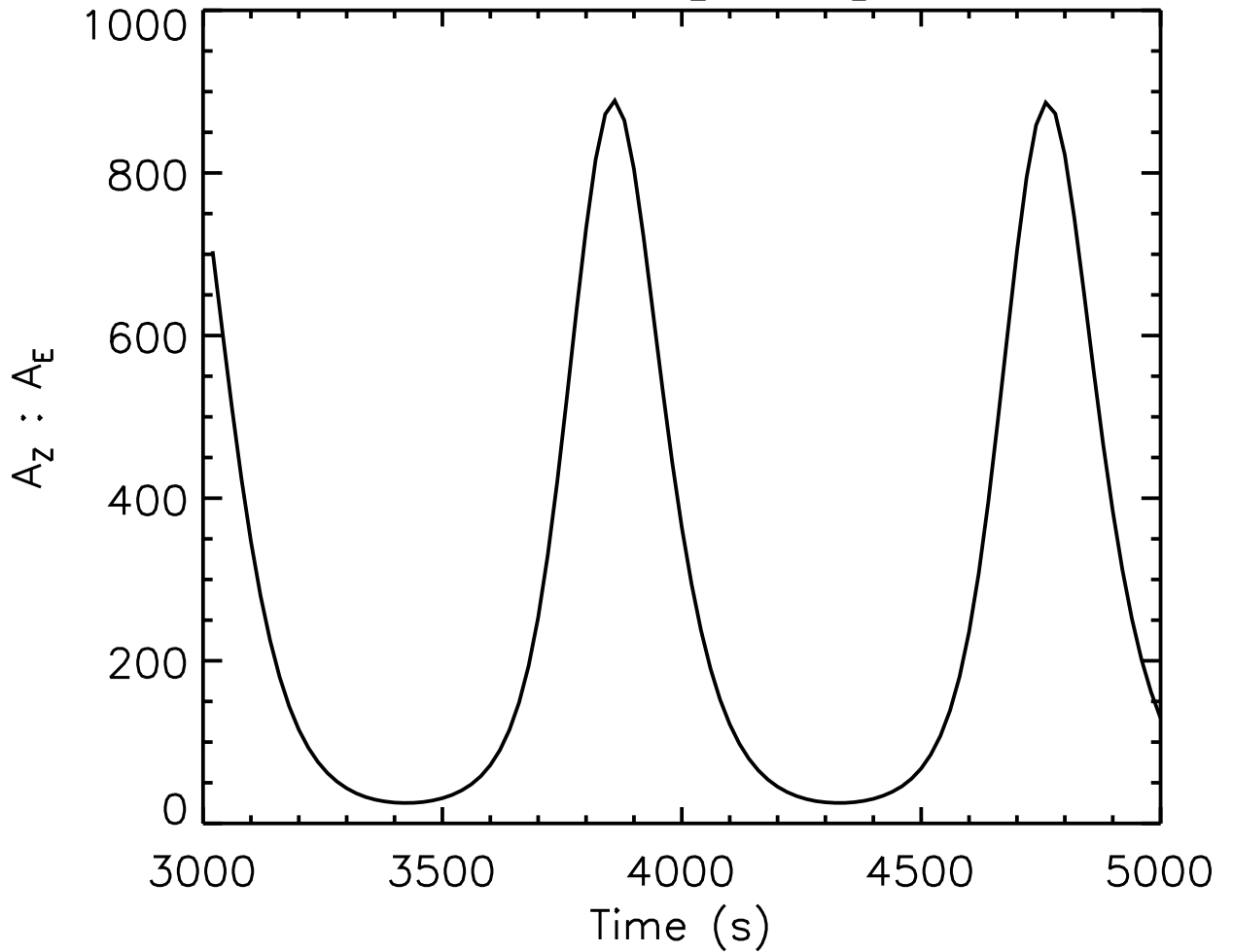
Percentiles [25,50,75]=[ 8.79e-01, 9.04e-01, 9.48e-01]

Ratio K to A



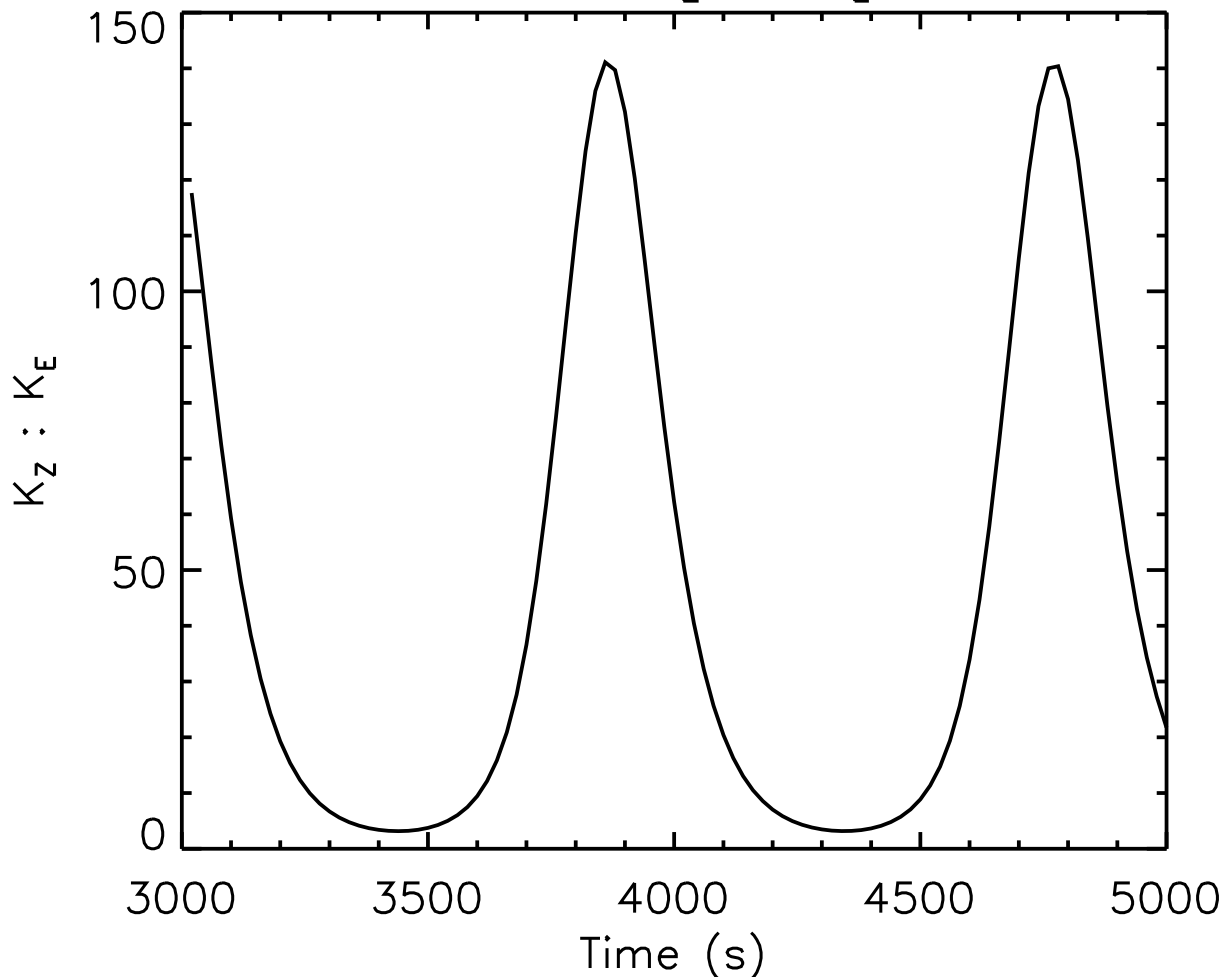
Percentiles [25,50,75]=[ 1.43e-01, 1.51e-01, 1.52e-01]

Ratio  $A_Z$  to  $A_E$



Percentiles [25,50,75]=[ 4.51e+01, 1.52e+02, 4.95e+02]

Ratio  $K_Z$  to  $K_E$



Percentiles [25,50,75]=[ 6.04e+00, 2.56e+01, 7.75e+01]

# Energy rates of change

