Predictive equations budgets

The budget terms are decomposed into four main categories: advection, buoyancy, pressure, and dissipation. Each term is also labeled individually: ma (mean advection), ta (turbulence advection), tp (turbulence production), ac (accumulation), bp (buoyancy production), pr*n* (pressure term *n*), dp*n* (dissipation term *n*), and cl (clipping).

$$\begin{aligned}\frac{\partial \overline{w'^2}}{\partial t} = & \underbrace{-\bar{w}\frac{\partial \overline{w'^2}}{\partial z}}_{ma} \underbrace{-\frac{\partial \overline{w'^3}}{\partial z}}_{ta} \underbrace{-2\overline{w'^2}\frac{\partial \bar{w}}{\partial z}}_{ac} \underbrace{+\frac{2g}{\theta_0}\overline{w'\theta_v'}}_{bp} \\ & \underbrace{-\frac{C_4}{\tau_1}\left(\overline{w'^2}-\frac{2}{3}\bar{e}\right)}_{pr1} \underbrace{-C_5\left(-2\overline{w'^2}\frac{\partial \bar{w}}{\partial z}+\frac{2g}{\theta_0}\overline{w'\theta_v'}\right)}_{pr2} \underbrace{+\frac{2}{3}C_5\left(\frac{g}{\theta_0}\overline{w'\theta_v'}-\overline{u'w'}\frac{\partial \bar{u}}{\partial z}-\overline{v'w'}\frac{\partial \bar{v}}{\partial z}\right)}_{pr3} \\ & \underbrace{-\frac{C_1}{\tau_1}\overline{w'^2}}_{dp1} \underbrace{+\nu_1\nabla_z^2\overline{w'^2}}_{dp2} \underbrace{+\left.\frac{\partial \overline{w'^2}}{\partial t}\right|_{clip}}_{cl}\end{aligned} \tag{1}$$

$$\begin{aligned}\frac{\partial \overline{w'^3}}{\partial t} = & \underbrace{-\bar{w}\frac{\partial \overline{w'^3}}{\partial z}}_{ma} \underbrace{-\frac{\partial \overline{w'^4}}{\partial z}}_{ta} \underbrace{+3\overline{w'^2}\frac{\partial \overline{w'^2}}{\partial z}}_{tp} \underbrace{-3\overline{w'^3}\frac{\partial \bar{w}}{\partial z}}_{ac} \underbrace{+\frac{3g}{\theta_0}\overline{w'^2\theta_v'}}_{bp} \underbrace{-\frac{C_8}{\tau_{www}}\overline{w'^3}}_{pr1} \underbrace{-C_{11}\left(-3\overline{w'^3}\frac{\partial \bar{w}}{\partial z}+\frac{3g}{\theta_0}\overline{w'^2\theta_v'}\right)}_{pr2} \\ & \underbrace{+\left(K_w+\nu_8\right)\nabla_z^2\overline{w'^3}}_{dp1} \underbrace{+\left.\frac{\partial \overline{w'^3}}{\partial t}\right|_{clip}}_{cl}\end{aligned} \tag{2}$$

$$\frac{\partial \overline{w'q_t'}}{\partial t} = \underbrace{-\bar{w}\frac{\partial \overline{w'q_t'}}{\partial z}}_{ma} \underbrace{-\frac{\partial \overline{w'^2q_t'}}{\partial z}}_{ta} \underbrace{-\overline{w'^2}\frac{\partial \bar{q}_t}{\partial z}}_{tp} \underbrace{-\overline{w'q_t'}\frac{\partial \bar{w}}{\partial z}}_{ac} \underbrace{+\frac{g}{\theta_0}\overline{q_t'\theta_v'}}_{bp} \underbrace{-\frac{C_6}{\tau_2}\overline{w'q_t'}}_{pr1} \underbrace{+C_7\,\overline{w'q_t'}\frac{\partial \bar{w}}{\partial z}}_{pr2} \underbrace{-C_7\,\frac{g}{\theta_0}\overline{q_t'\theta_v'}}_{pr3} \underbrace{+\nu_6\nabla_z^2\overline{w'\,q_t'}}_{dp1} \tag{3}$$

$$\frac{\partial \overline{w'\theta_l'}}{\partial t} = \underbrace{-\bar{w}\frac{\partial \overline{w'\theta_l'}}{\partial z}}_{ma} \underbrace{-\frac{\partial \overline{w'^2\theta_l'}}{\partial z}}_{ta} \underbrace{-\overline{w'^2}\frac{\partial \bar{\theta}_l}{\partial z}}_{tp} \underbrace{-\overline{w'\theta_l'}\frac{\partial \bar{w}}{\partial z}}_{ac} \underbrace{+\frac{g}{\theta_0}\overline{\theta_l'\theta_v'}}_{bp} \underbrace{-\frac{C_6}{\tau_2}\overline{w'\theta_l'}}_{pr1} \underbrace{+C_7\,\overline{w'\theta_l'}\frac{\partial \bar{w}}{\partial z}}_{pr2} \underbrace{-C_7\,\frac{g}{\theta_0}\overline{\theta_l'\theta_v'}}_{pr3} \underbrace{+\nu_6\nabla_z^2\overline{w'\,\theta_l'}}_{dp1} \tag{4}$$

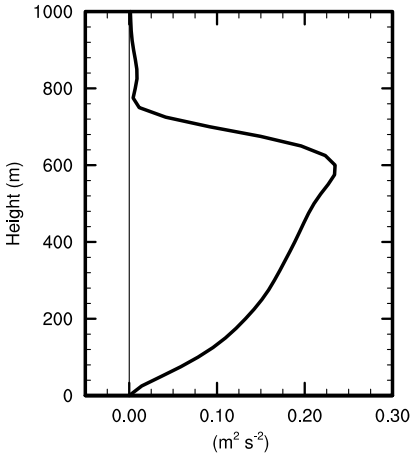
$$\frac{\partial \overline{q_t'^2}}{\partial t} = \underbrace{-\bar{w}\frac{\partial \overline{q_t'^2}}{\partial z}}_{ma} \underbrace{-\frac{\partial \overline{w' q_t'^2}}{\partial z}}_{ta} \underbrace{-2\overline{w' q_t'}\frac{\partial \bar{q}_t}{\partial z}}_{tp} \underbrace{-\frac{C_2}{\tau_1}\overline{q_t'^2}}_{dp1} \underbrace{+\nu_2 \nabla_z^2 \overline{q_t'^2}}_{dp2} \tag{5}$$

$$\frac{\partial \overline{\theta_l'^2}}{\partial t} = \underbrace{-\bar{w}\frac{\partial \overline{\theta_l'^2}}{\partial z}}_{ma} \underbrace{-\frac{\partial \overline{w' \theta_l'^2}}{\partial z}}_{ta} \underbrace{-2\overline{w' \theta_l'}\frac{\partial \bar{\theta}_l}{\partial z}}_{tp} \underbrace{-\frac{C_2}{\tau_1}\overline{\theta_l'^2}}_{dp1} \underbrace{+\nu_2 \nabla_z^2 \overline{\theta_l'^2}}_{dp2} \tag{6}$$

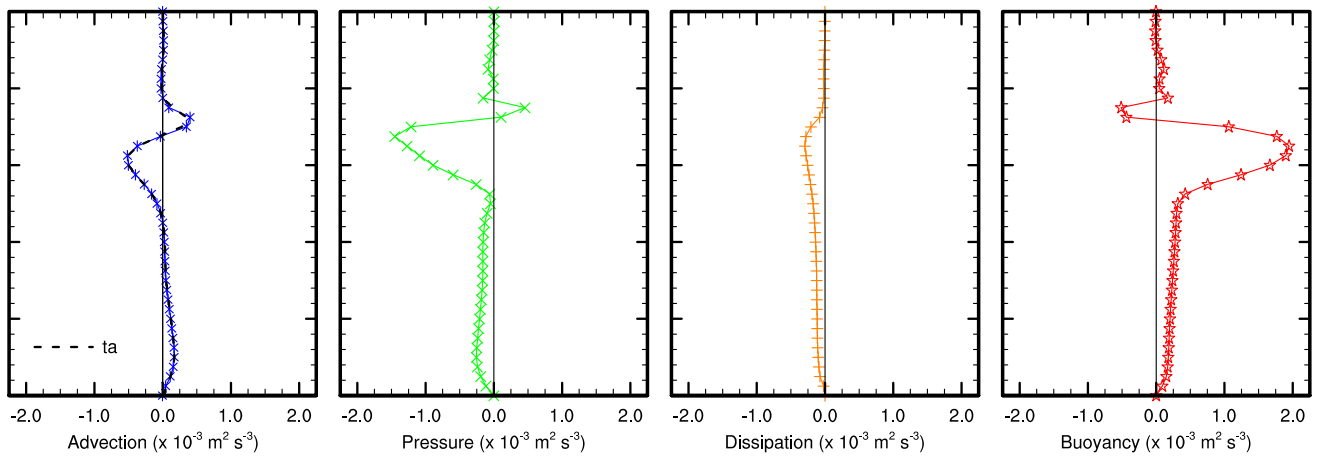
$$\frac{\partial \overline{q_t' \theta_l'}}{\partial t} = \underbrace{-\bar{w}\frac{\partial \overline{q_t' \theta_l'}}{\partial z}}_{ma} \underbrace{-\frac{\partial \overline{w' q_t' \theta_l'}}{\partial z}}_{ta} \underbrace{-\overline{w' q_t'}\frac{\partial \bar{\theta}_l}{\partial z}}_{tp1} \underbrace{-\overline{w' \theta_l'}\frac{\partial \bar{q}_t}{\partial z}}_{tp2} \underbrace{-\frac{C_2}{\tau_1}\overline{q_t' \theta_l'}}_{dp1} \underbrace{+\nu_2 \nabla_z^2 \overline{q_t' \theta_l'}}_{dp2} \tag{7}$$

fire $\overline{w'^2}$ budget

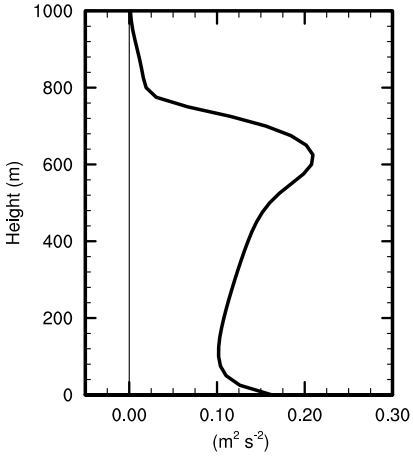
LES: $\overline{w'^2}$



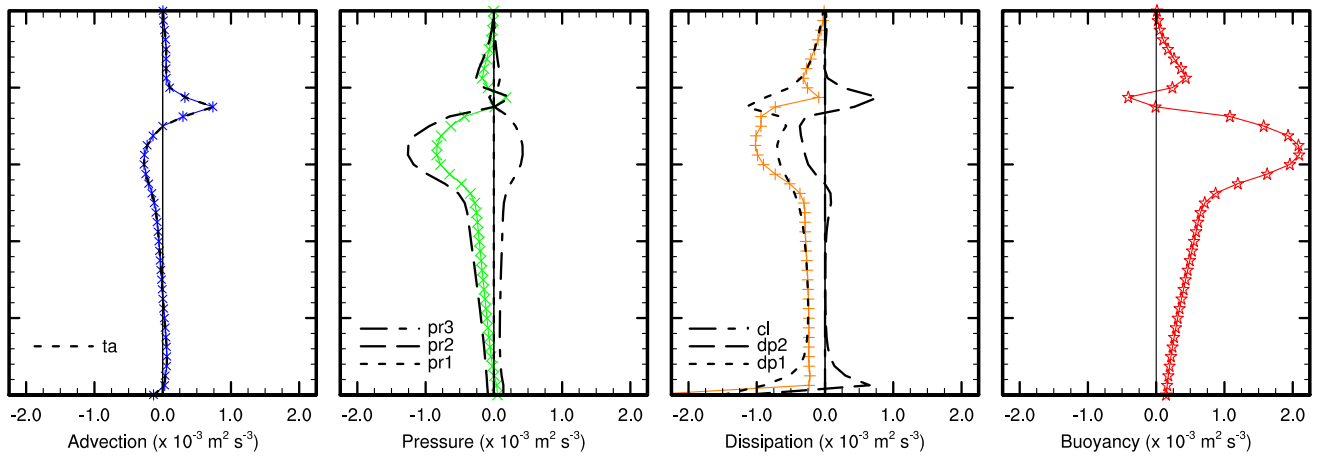
LES: budget terms



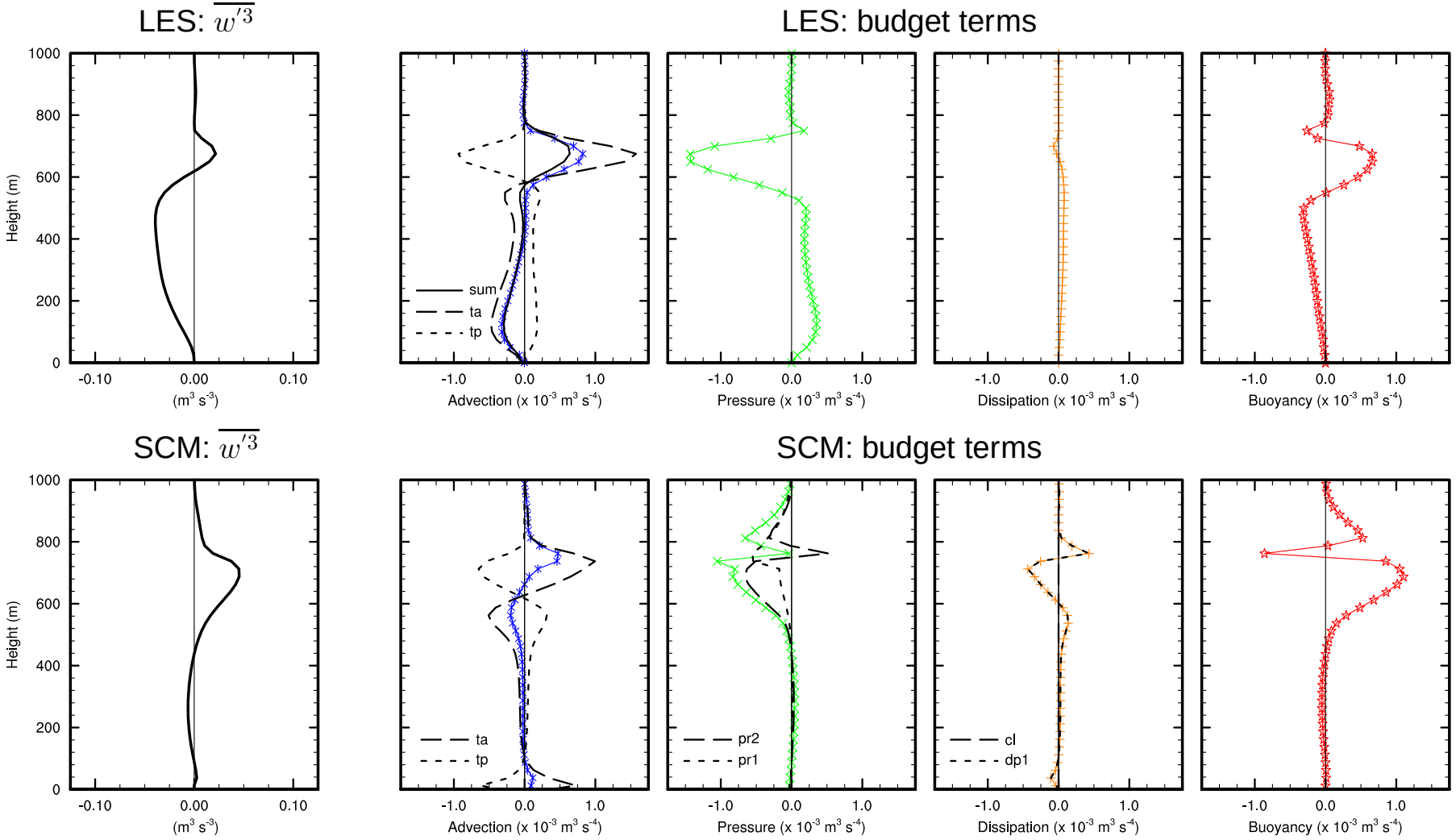
SCM: $\overline{w'^2}$



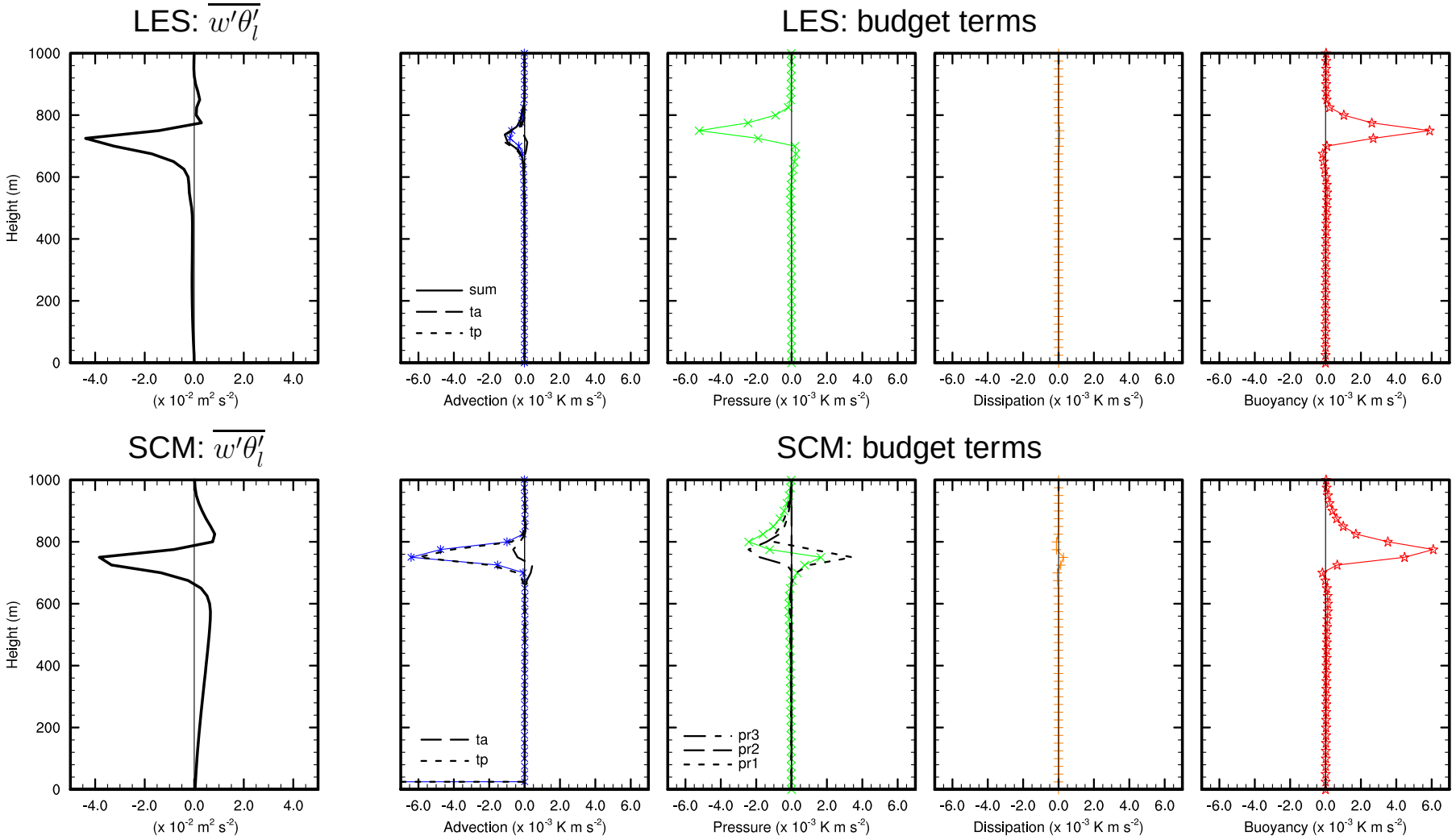
SCM: budget terms



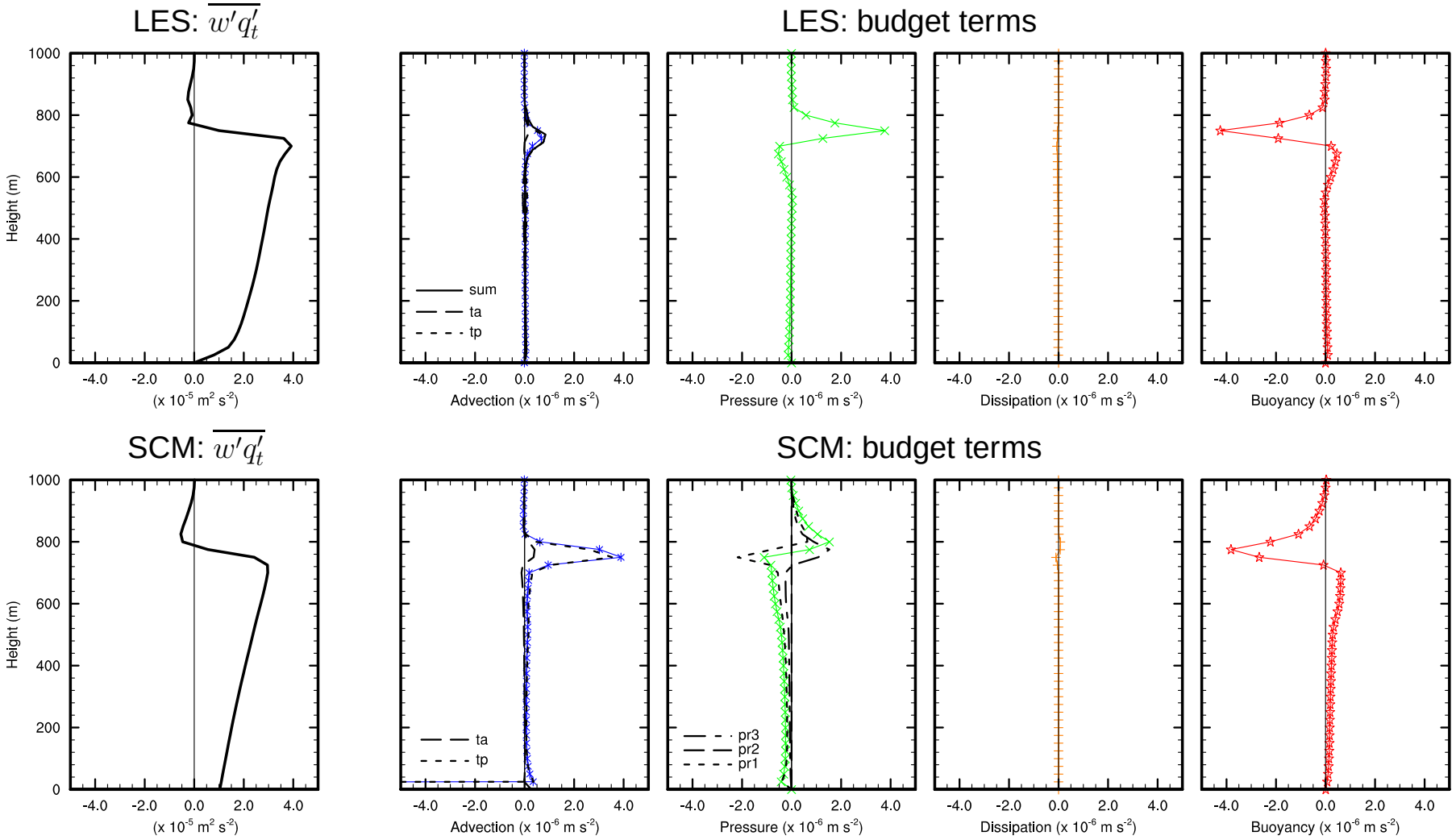
fire $\overline{w'^3}$ budget



fire $\overline{w'\theta_l'}$ budget

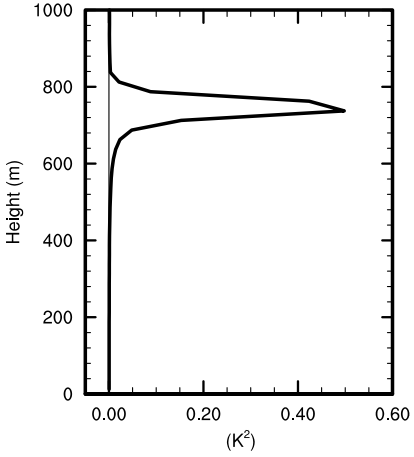


fire $\overline{w'q_t'}$ budget

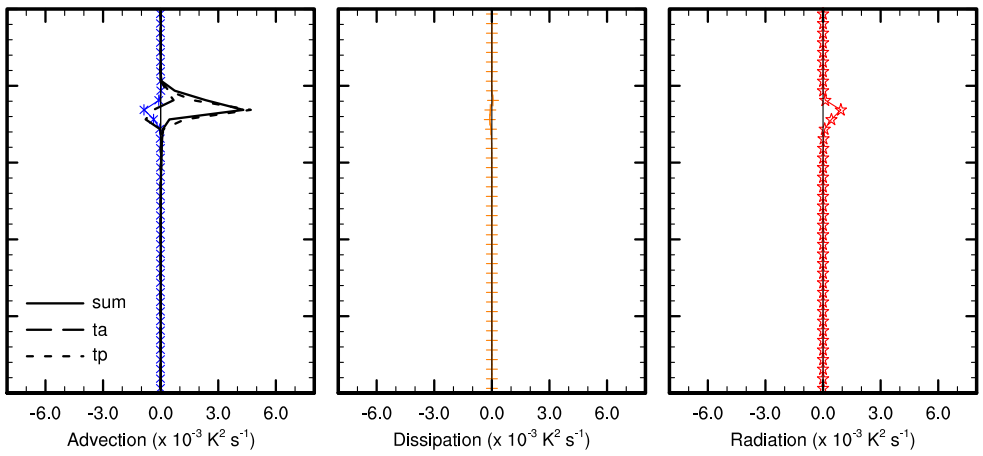


fire $\overline{\theta_l'^2}$ budget

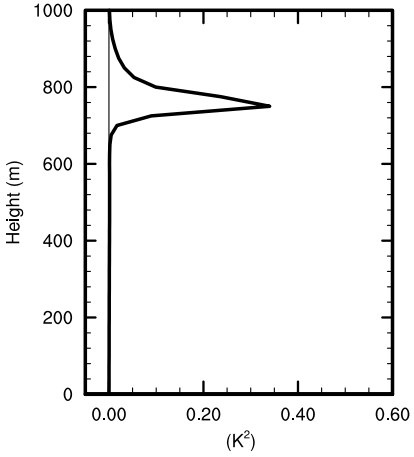
LES: $\overline{\theta_l'^2}$



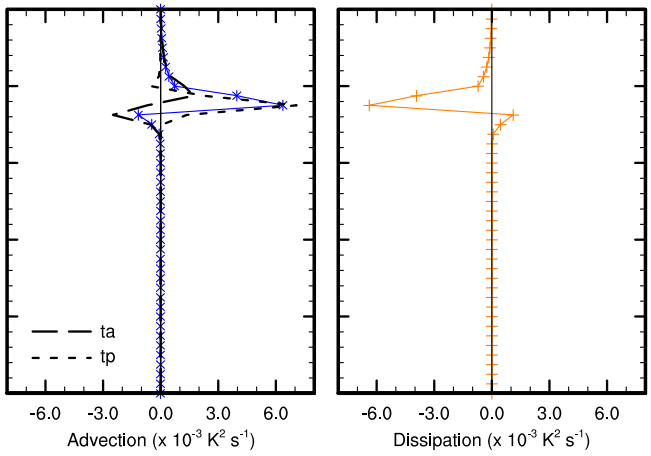
LES: budget terms



SCM: $\overline{\theta_l'^2}$

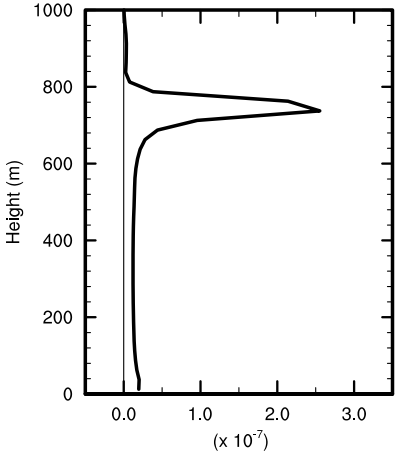


SCM: budget terms

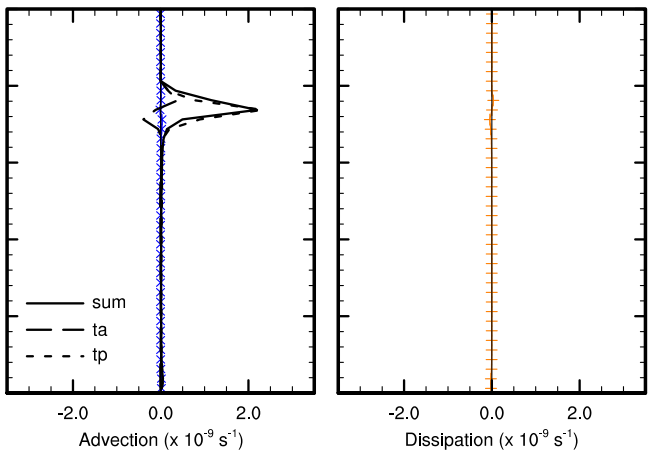


fire $\overline{q_t'^2}$ budget

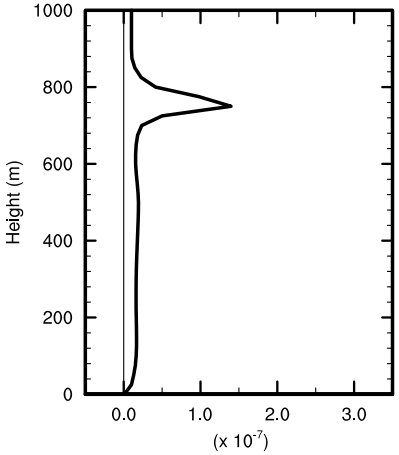
LES: $\overline{q_t'^2}$



LES: budget terms



SCM: $\overline{q_t'^2}$



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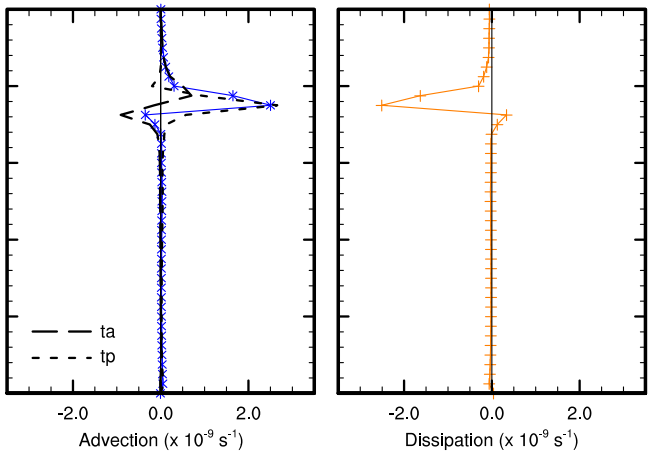
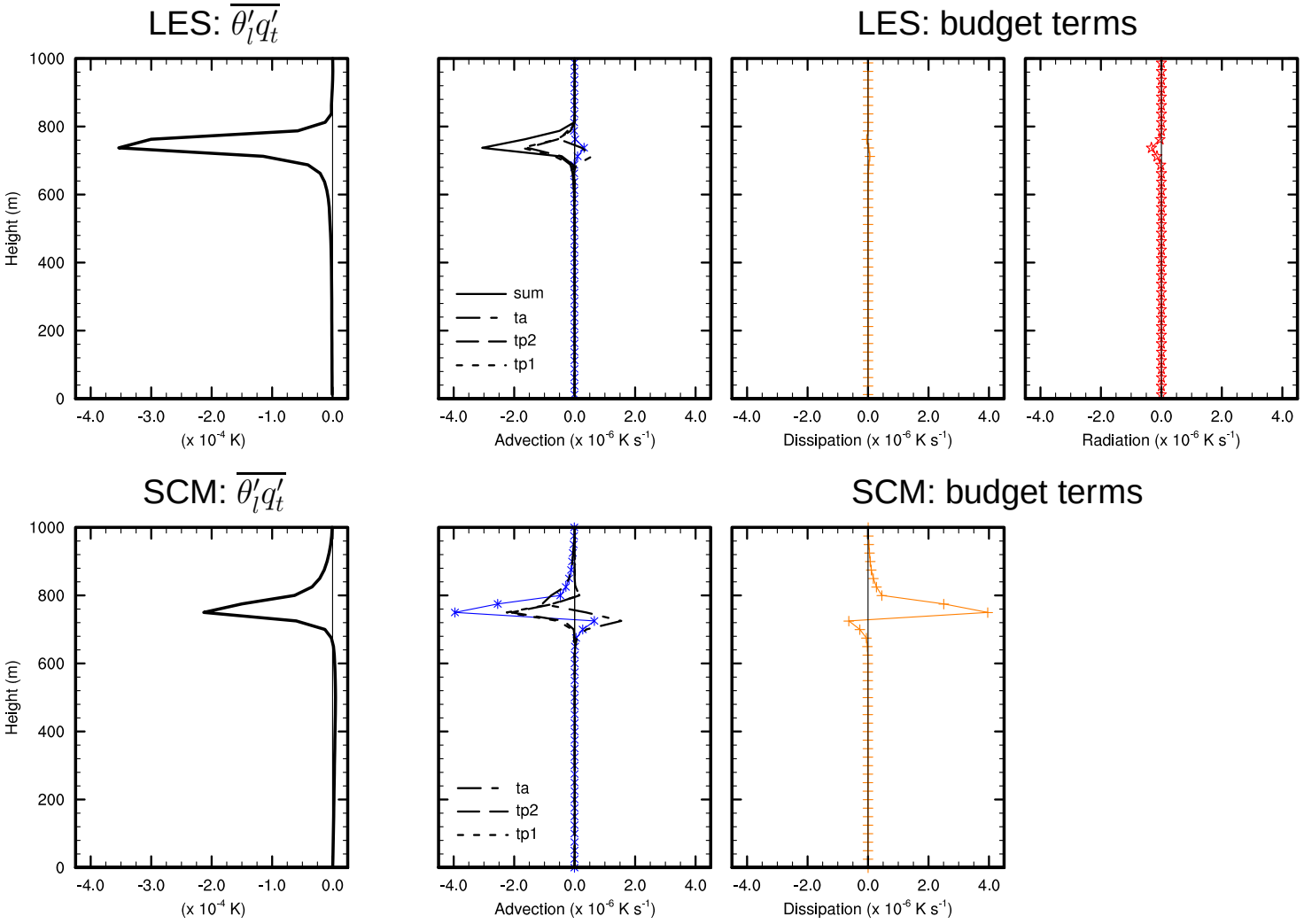
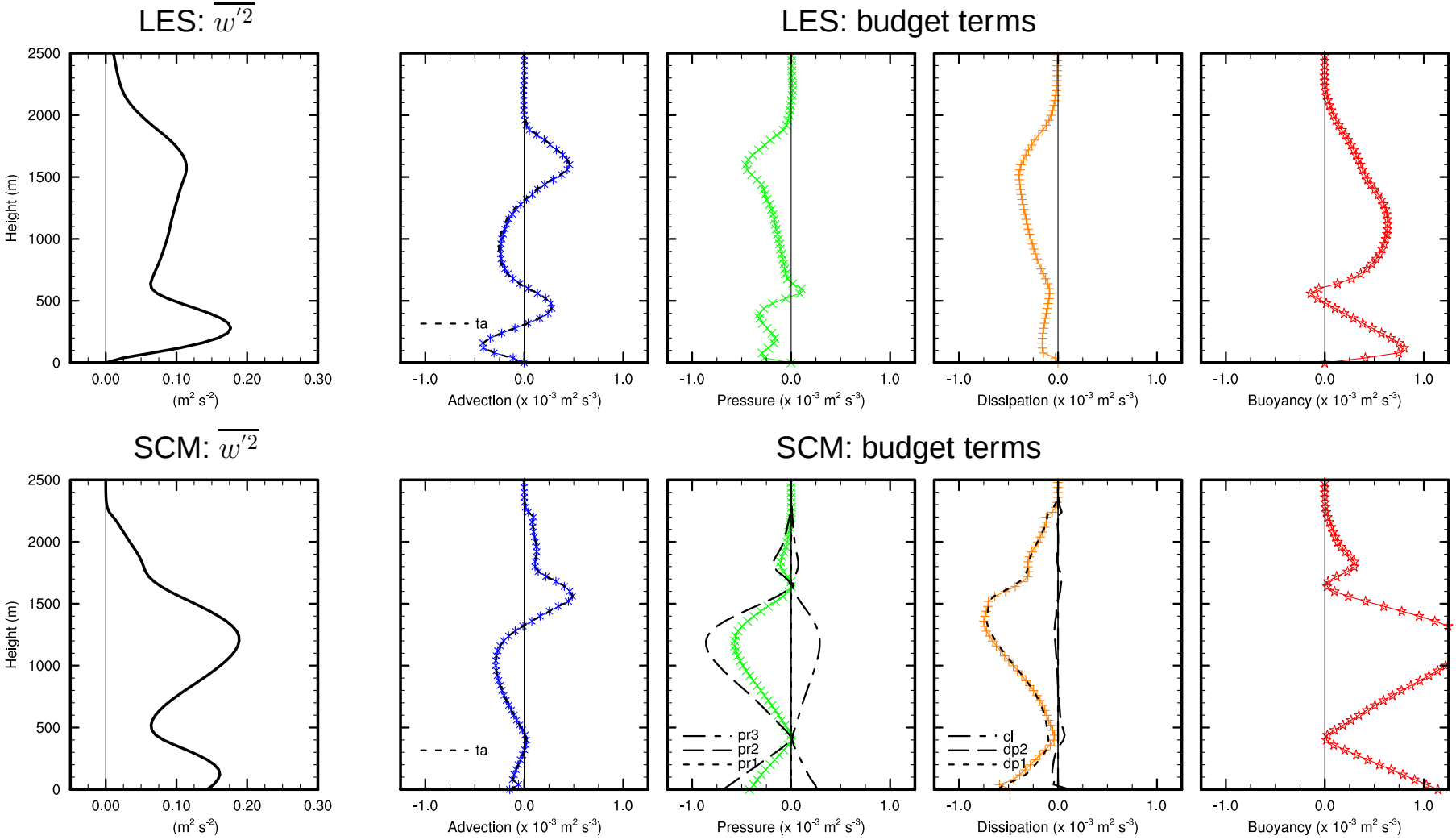


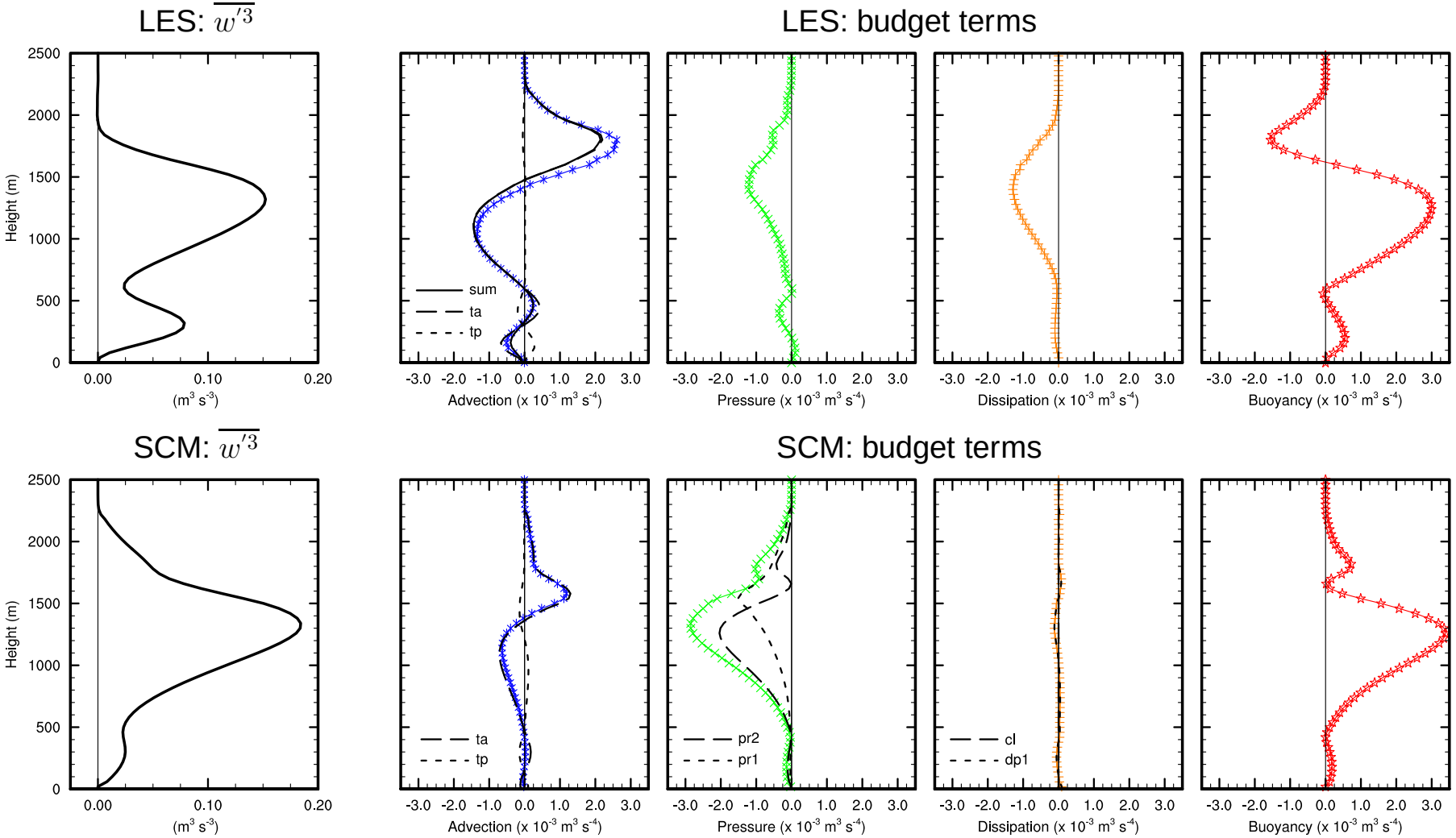
fire $\overline{\theta_l' q_t'}$ budget



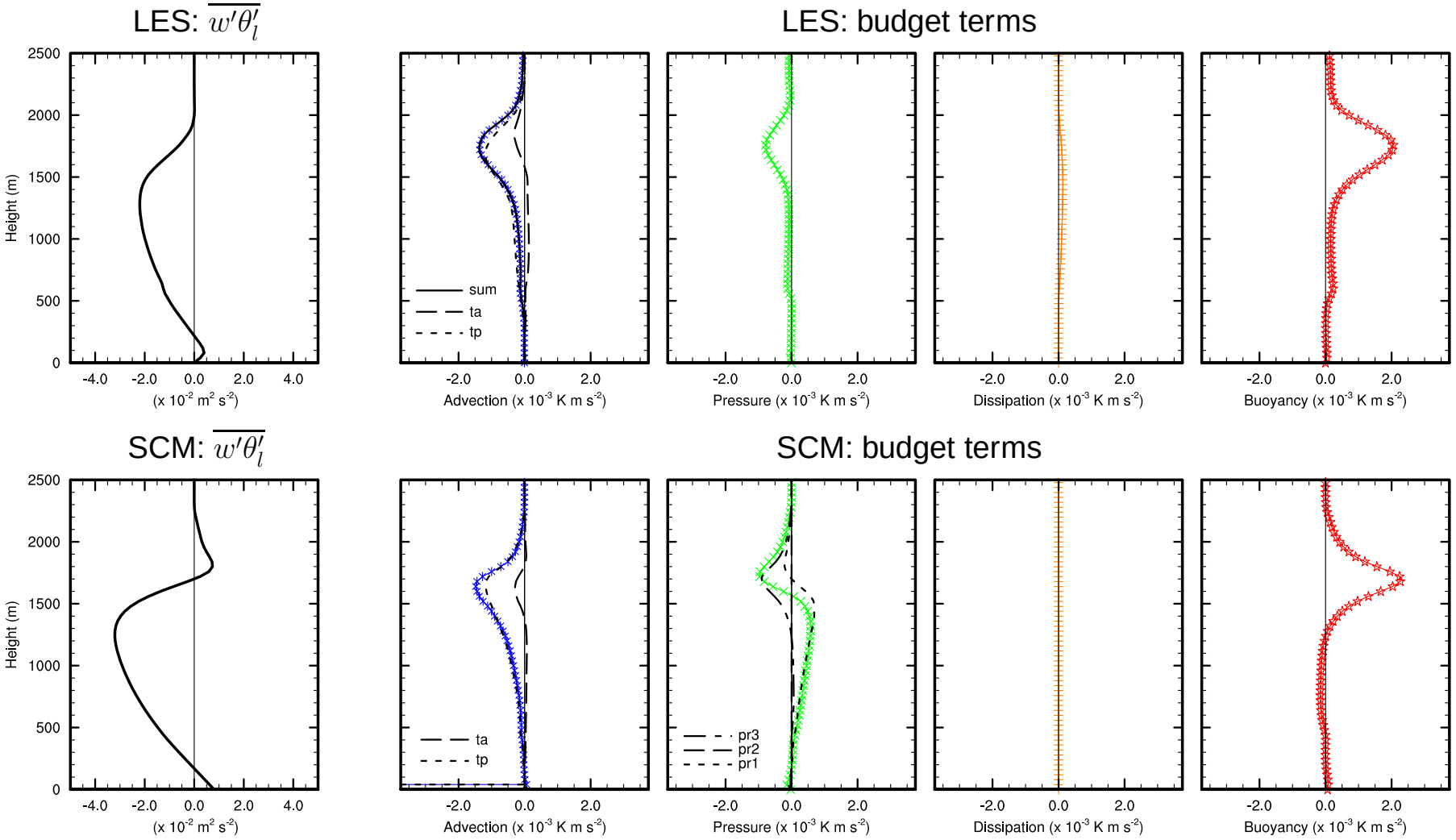
bomex $\overline{w'^2}$ budget



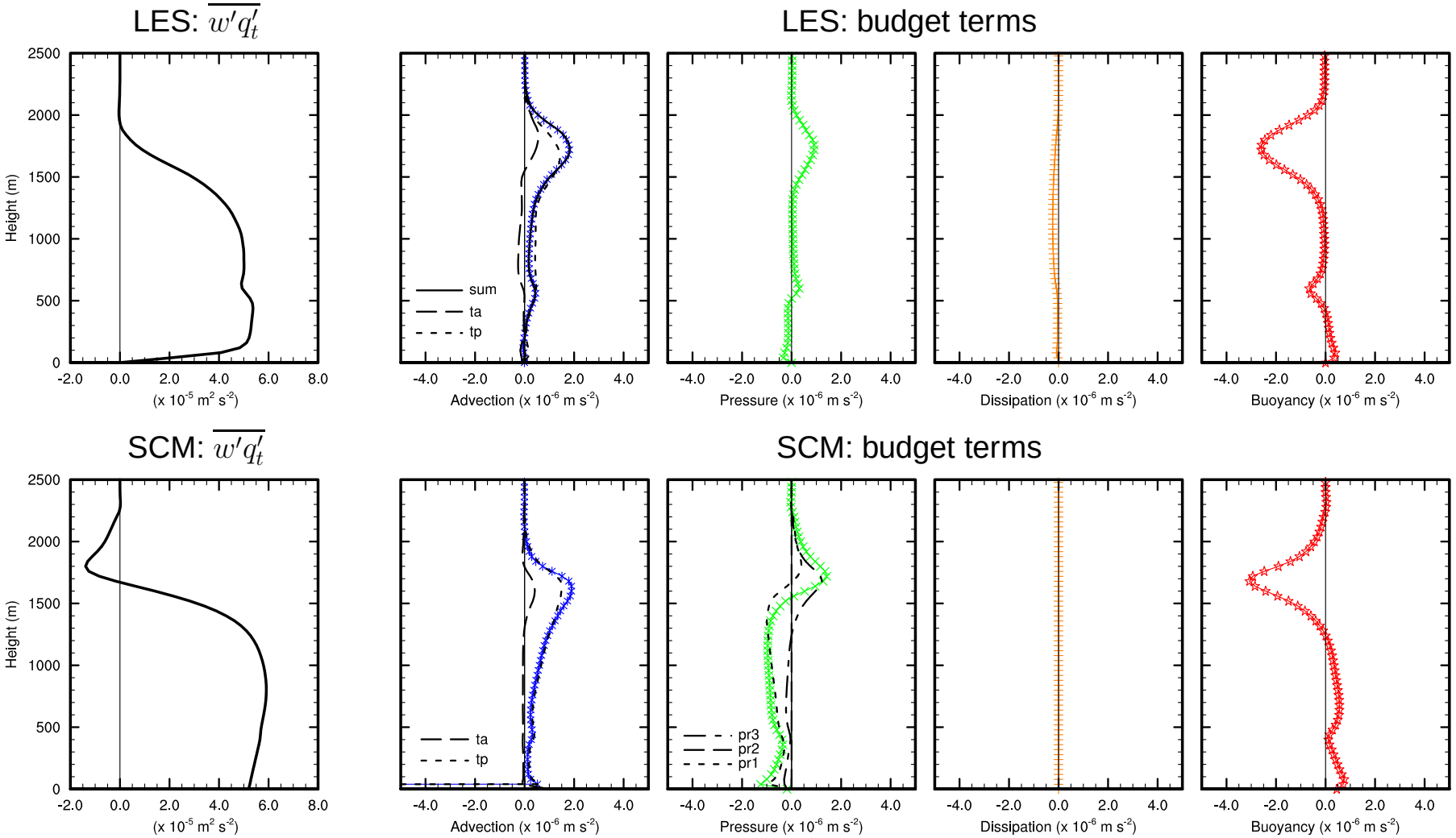
bomex $\overline{w'^3}$ budget



bomex $\overline{w'\theta_l'}$ budget

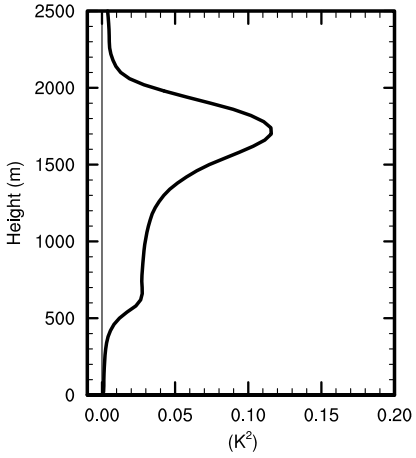


bomex $\overline{w'q_t'}$ budget

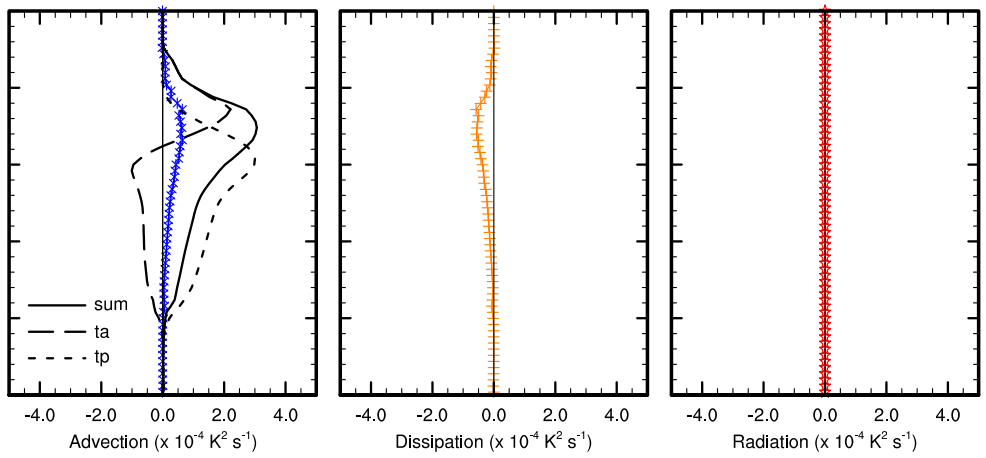


bomex $\overline{\theta_l'^2}$ budget

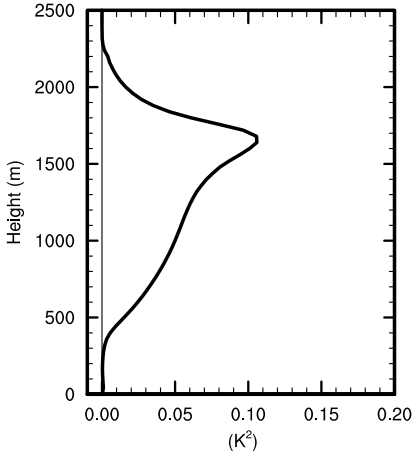
LES: $\overline{\theta_l'^2}$



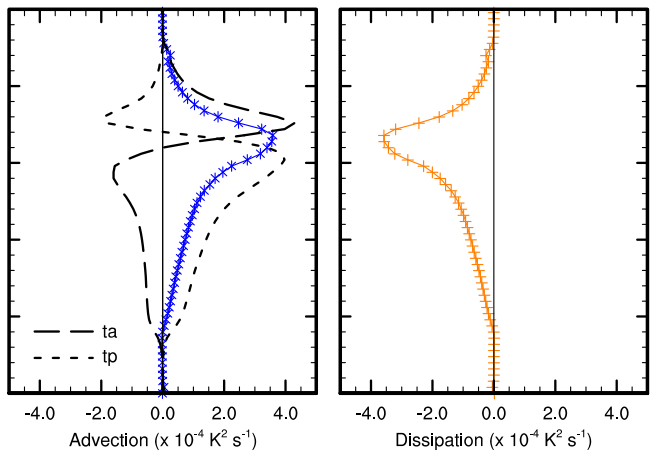
LES: budget terms



SCM: $\overline{\theta_l'^2}$

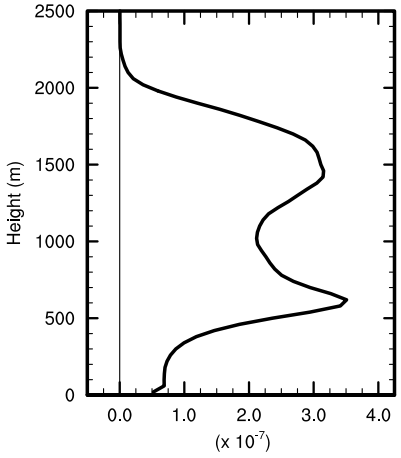


SCM: budget terms

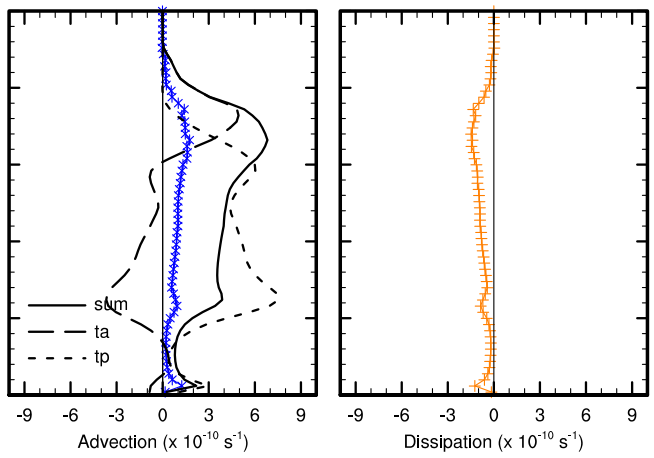


bomex $\overline{q_t'^2}$ budget

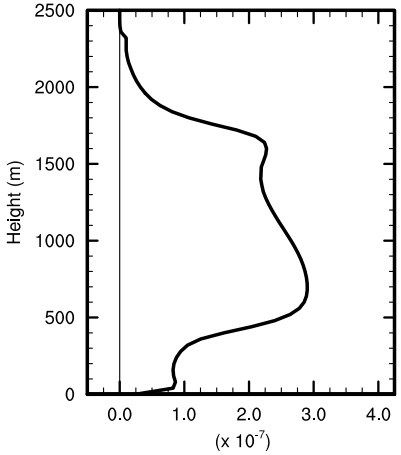
LES: $\overline{q_t'^2}$



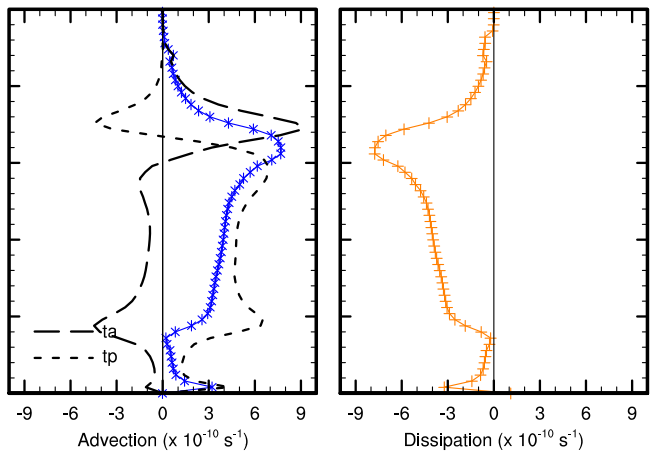
LES: budget terms



SCM: $\overline{q_t'^2}$



SCM: budget terms



bomex $\overline{\theta_l' q_t'}$ budget