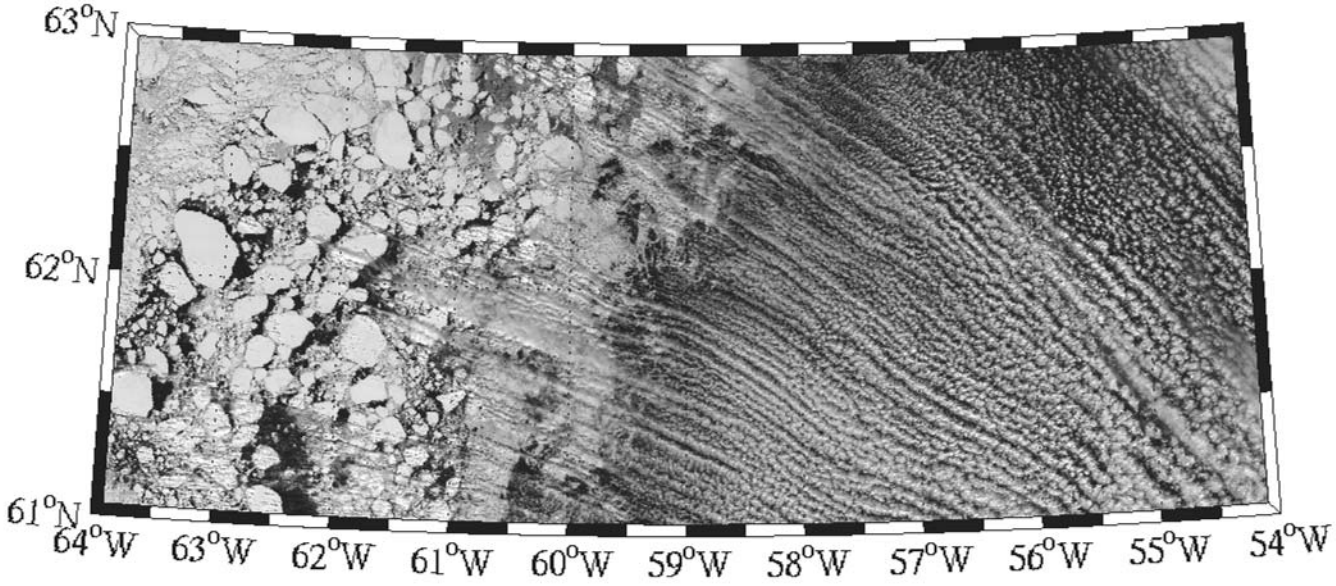


Figure 1 MODIS image on 12 April 2002 showing the organization of convection into two-dimensional roll clouds over and downstream of the marginal sea ice zone of the Labrador Sea.

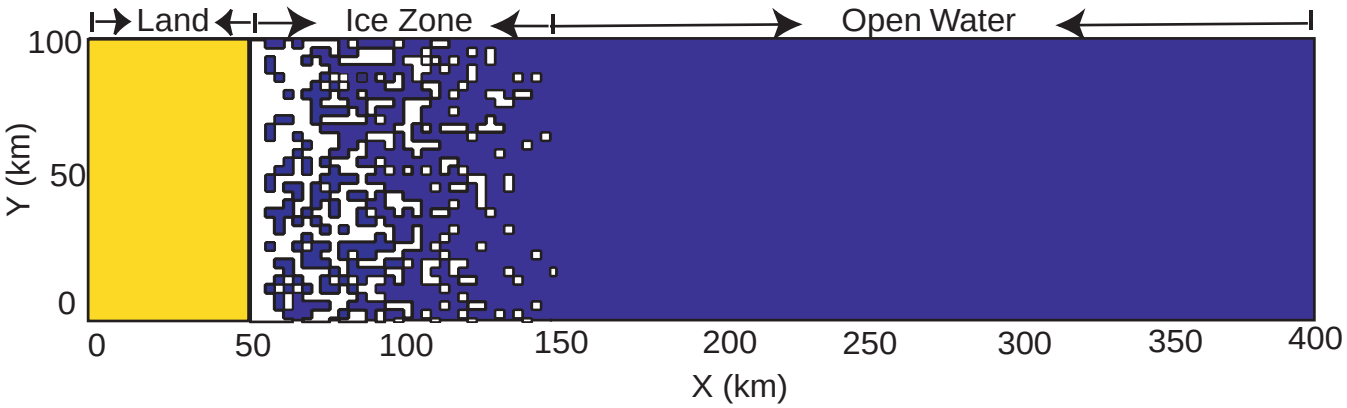


Figure 2 The platform of model domain used in boundary layer roll simulation. The grid points covered with yellow indicate land; the grid points covered with white indicate sea ice; the grid points covered with blue indicate open water.

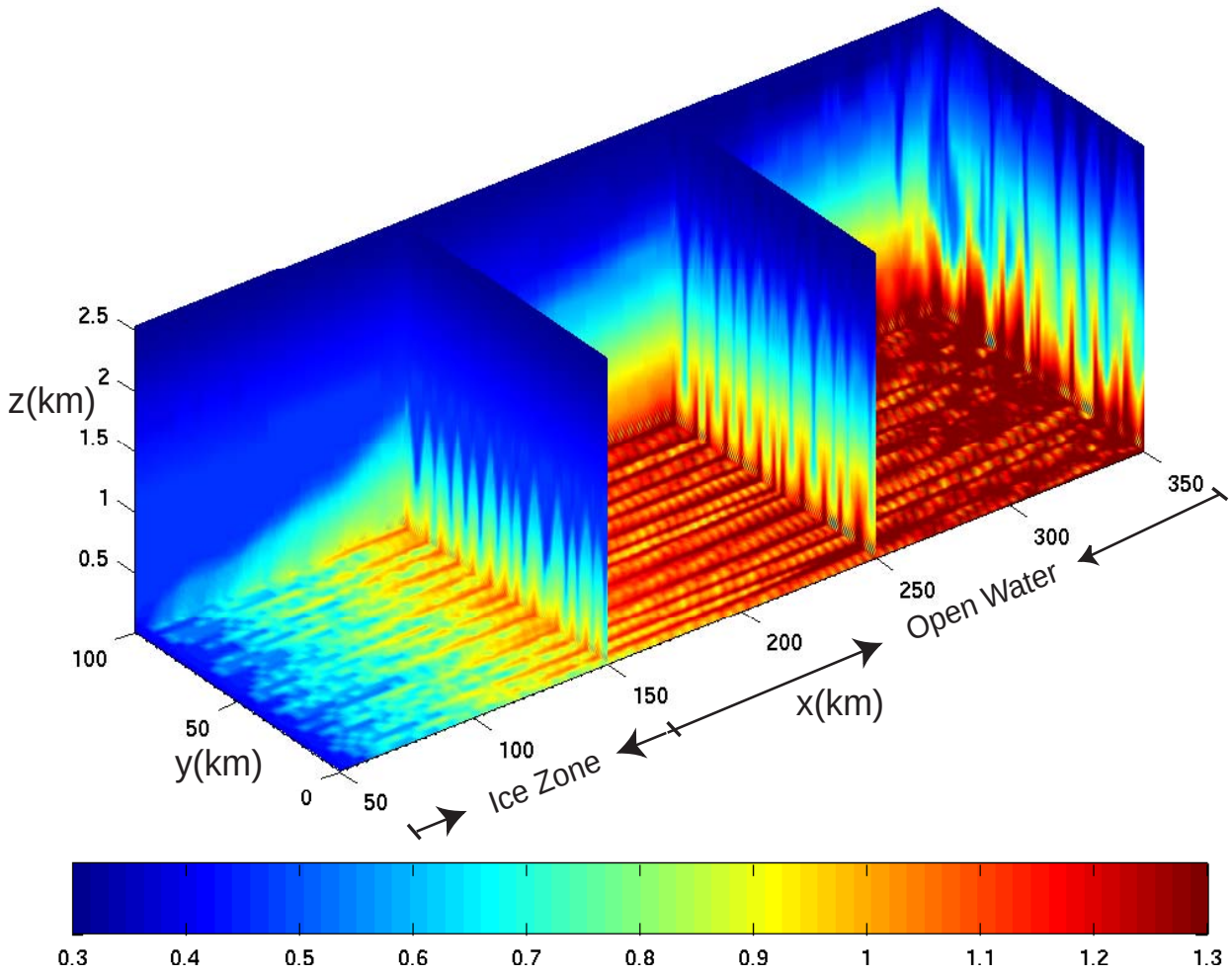


Figure 3 Three dimensional display of the specific humidity field (g kg^{-1}) from the simulation at 10 hours. The x-z plane is at y = 100 km; the x-y plane is at z = 25 m; three y-z planes are at x = 150 km, x = 250 km and x = 350 km separately.

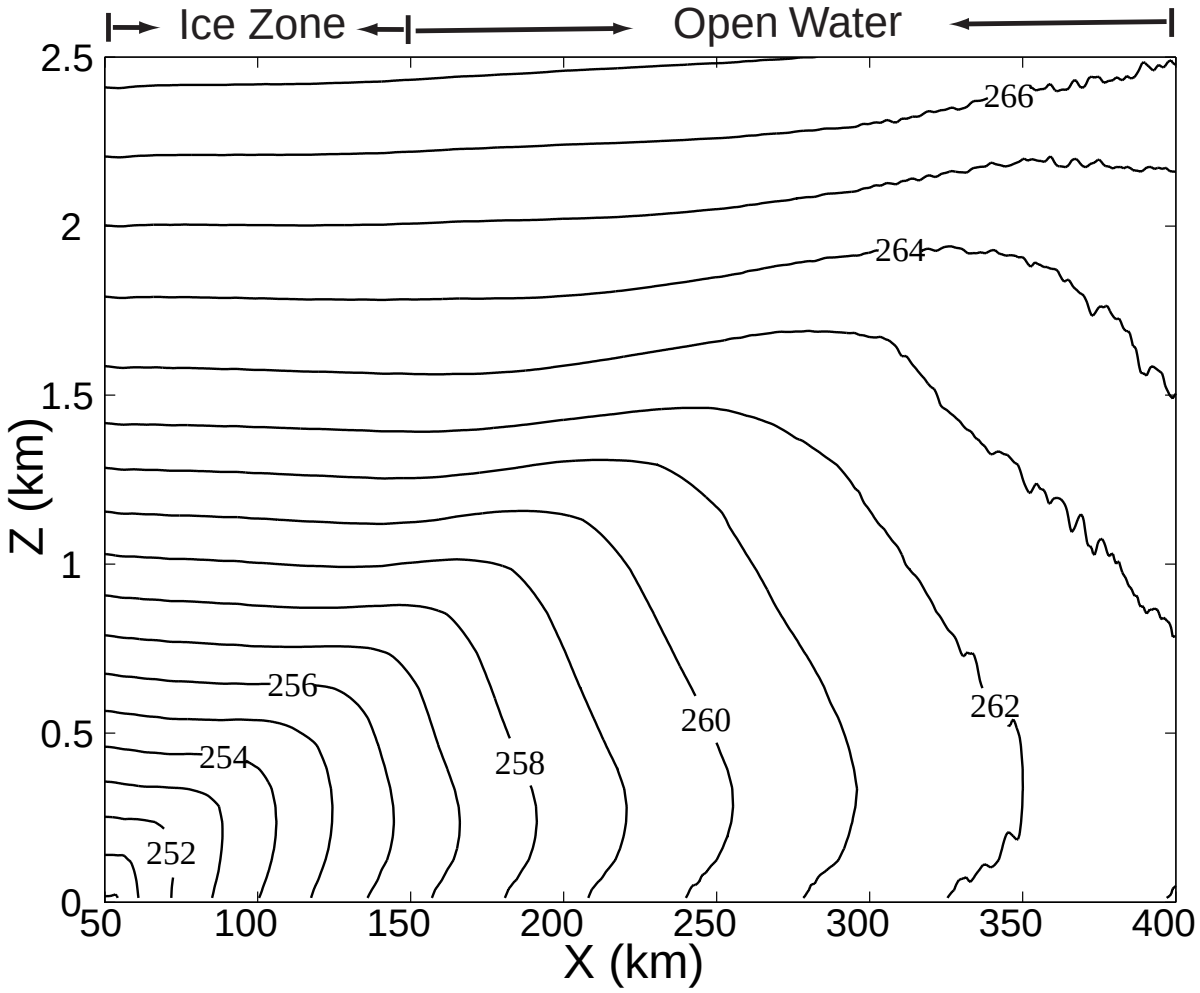


Figure 4. Vertical cross-section of potential temperature (K), averaged in the y direction, along mean wind direction at 10 hours.

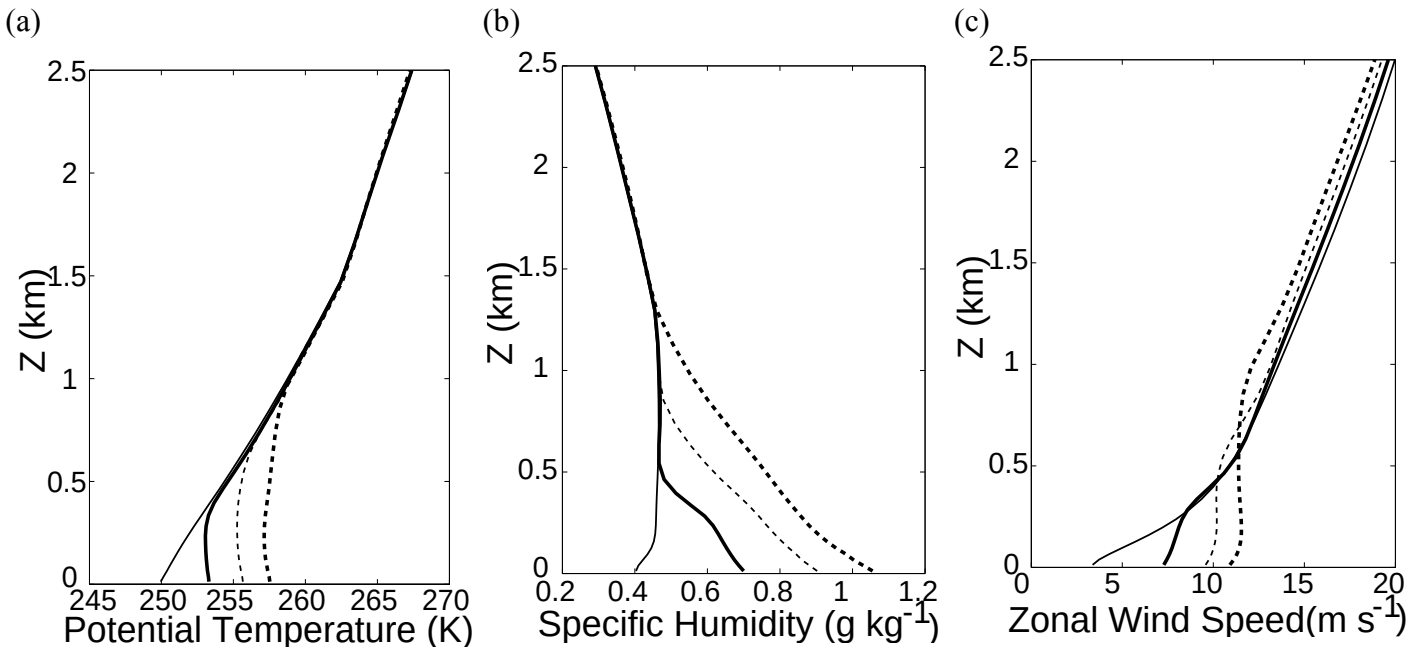


Figure 5. The evolution of vertical profiles of (a) potential temperature (K), (b) specific humidity (g kg^{-1}) and (c) zonal wind (m s^{-1}) at the x = 0 km (thin solid), 90 km (thick solid), 130 km (thin dashed) and 170 km (thick dashed) separately after 10 hours of model simulation. All profiles are averaged in the y direction.

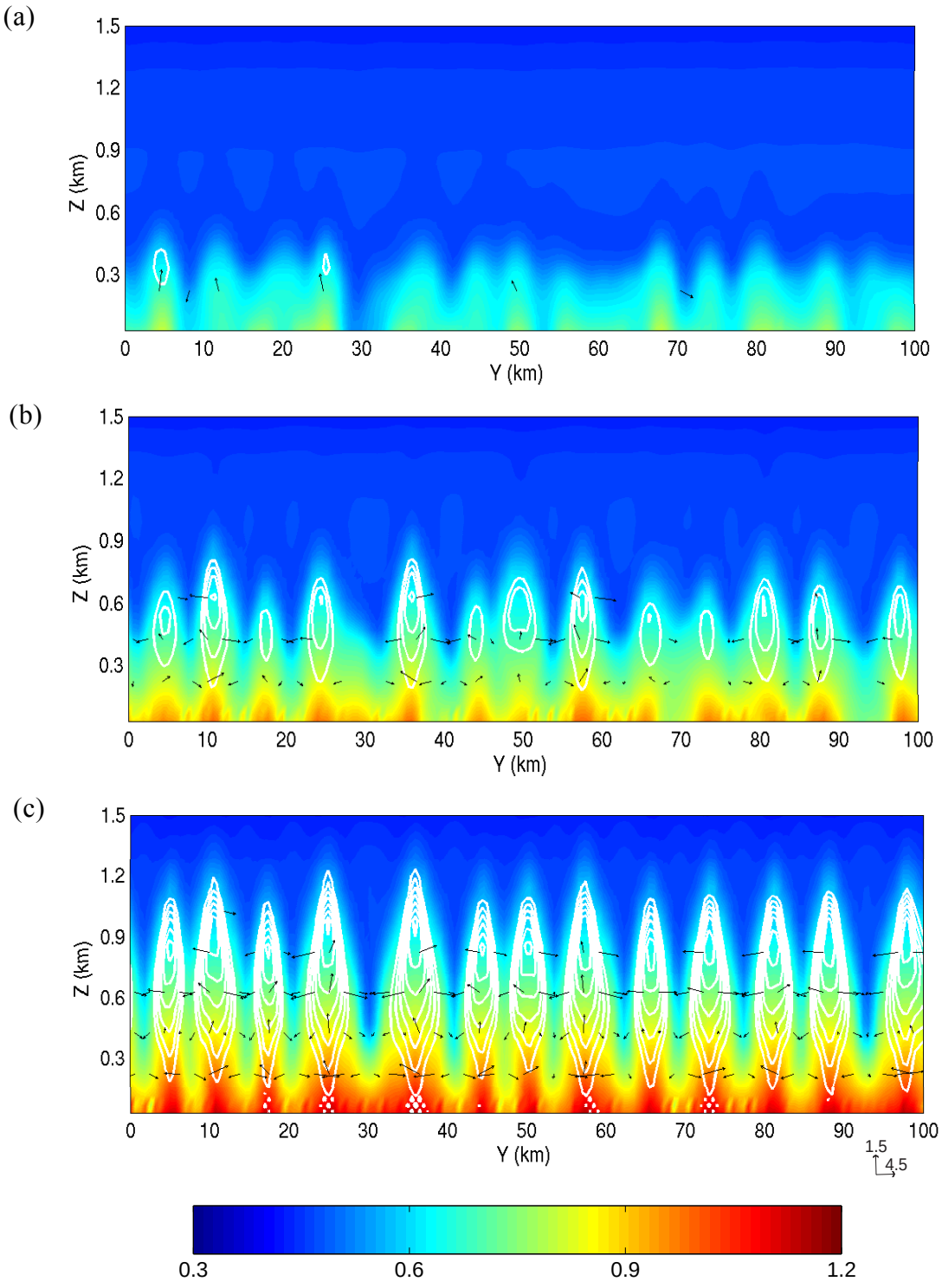
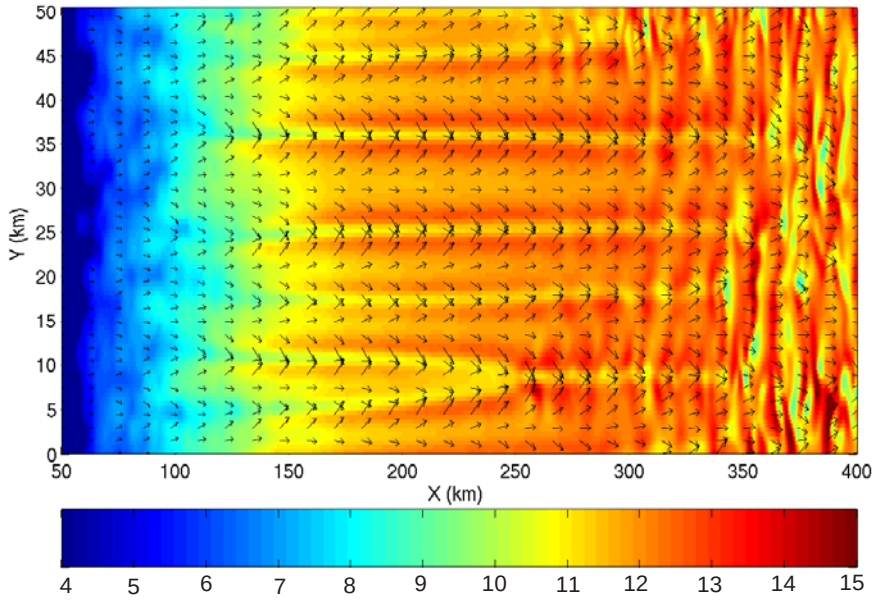


Figure 6. Secondary flow development at 10 hours over the sea-ice zone at (a) x = 90 km (45 % sea ice), (b) x = 130 km (18 % sea ice) and (c) x = 170 km (open water). The specific humidity field (g kg^{-1}) is shaded, the cloud liquid water mixing ratio (g kg^{-1}) is contoured with contour interval 0.05g kg^{-1} and the velocity in the y-z plane is indicated by the vectors (only plotted every 4th grid in y direction and every 3rd grid in z direction with abs (w) > 0.1 m s^{-1}).

(a)



(b)

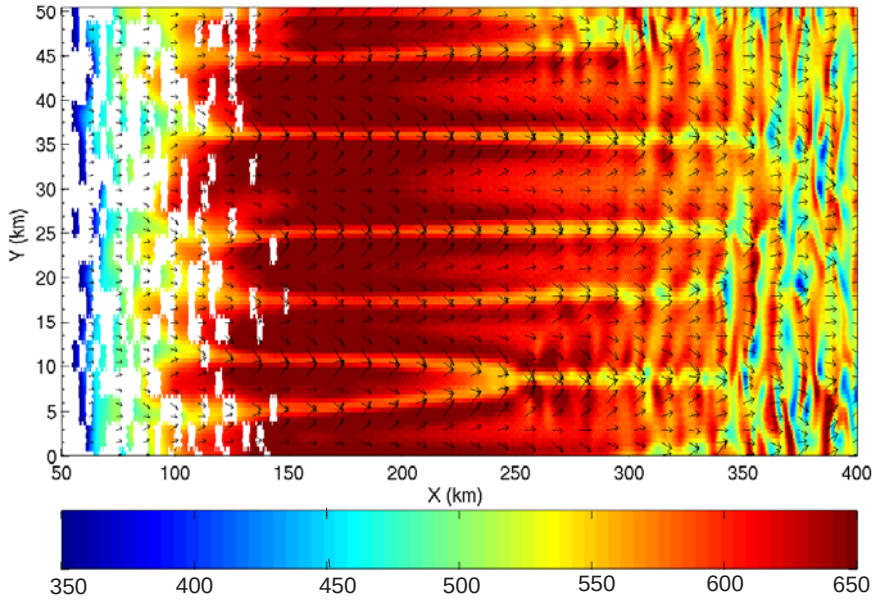


Figure 7. Horizontal cross-section of (a) horizontal wind at 10m (m $s^{-1)}$ and (b) surface total turbulent heat flux (W m^{-2}) at 10 hours. The velocity in the x-y plane is indicated by the vectors and only plotted every 24th grid in the x direction and every 3rd grid in the y direction.

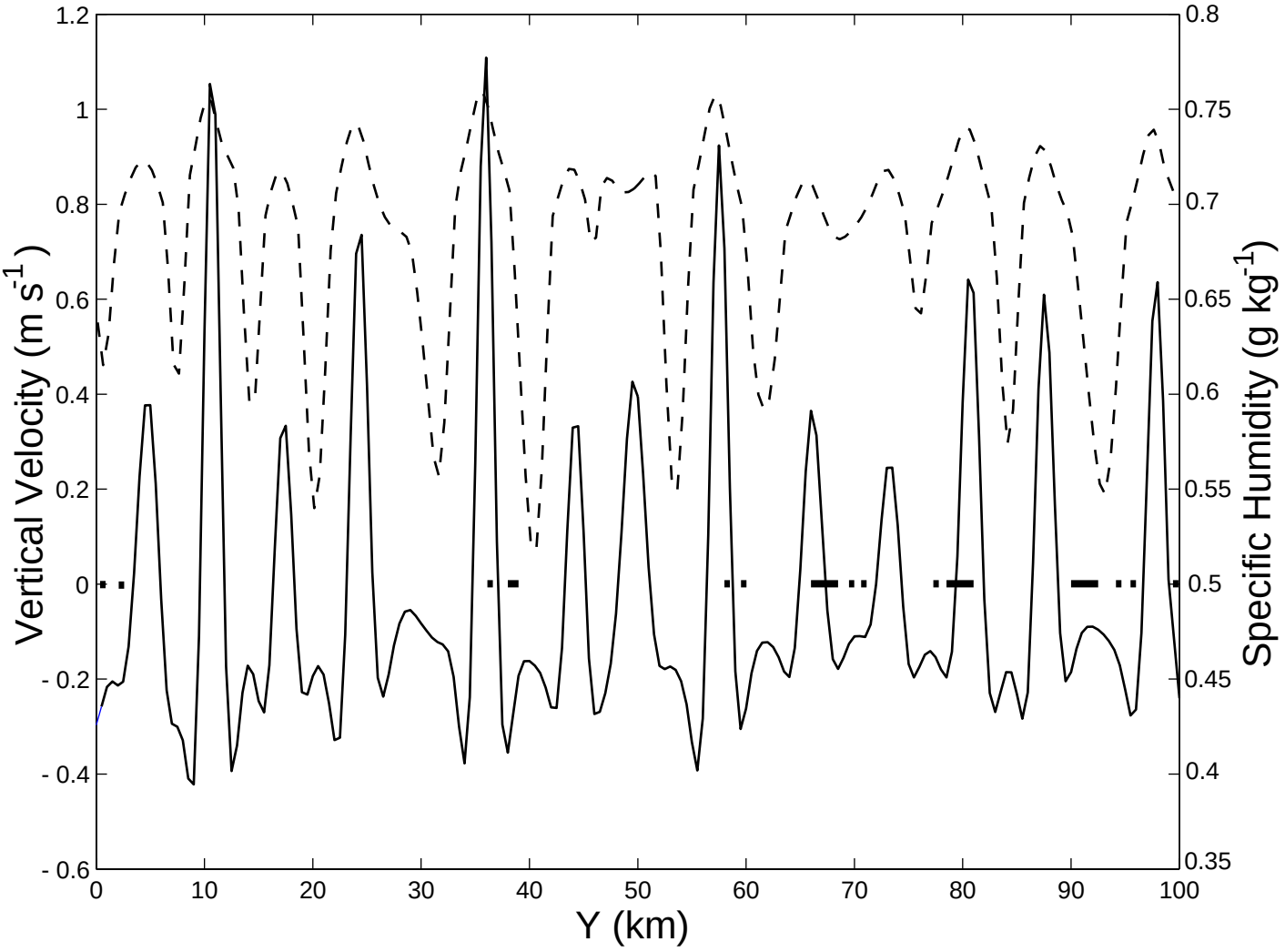


Figure 8 Cross-roll structure in vertical velocity (solid line) and specific humidity (dashed line) fields at x=130 km, z = 0.5 km. The thick solid line indicates surface ice cover.

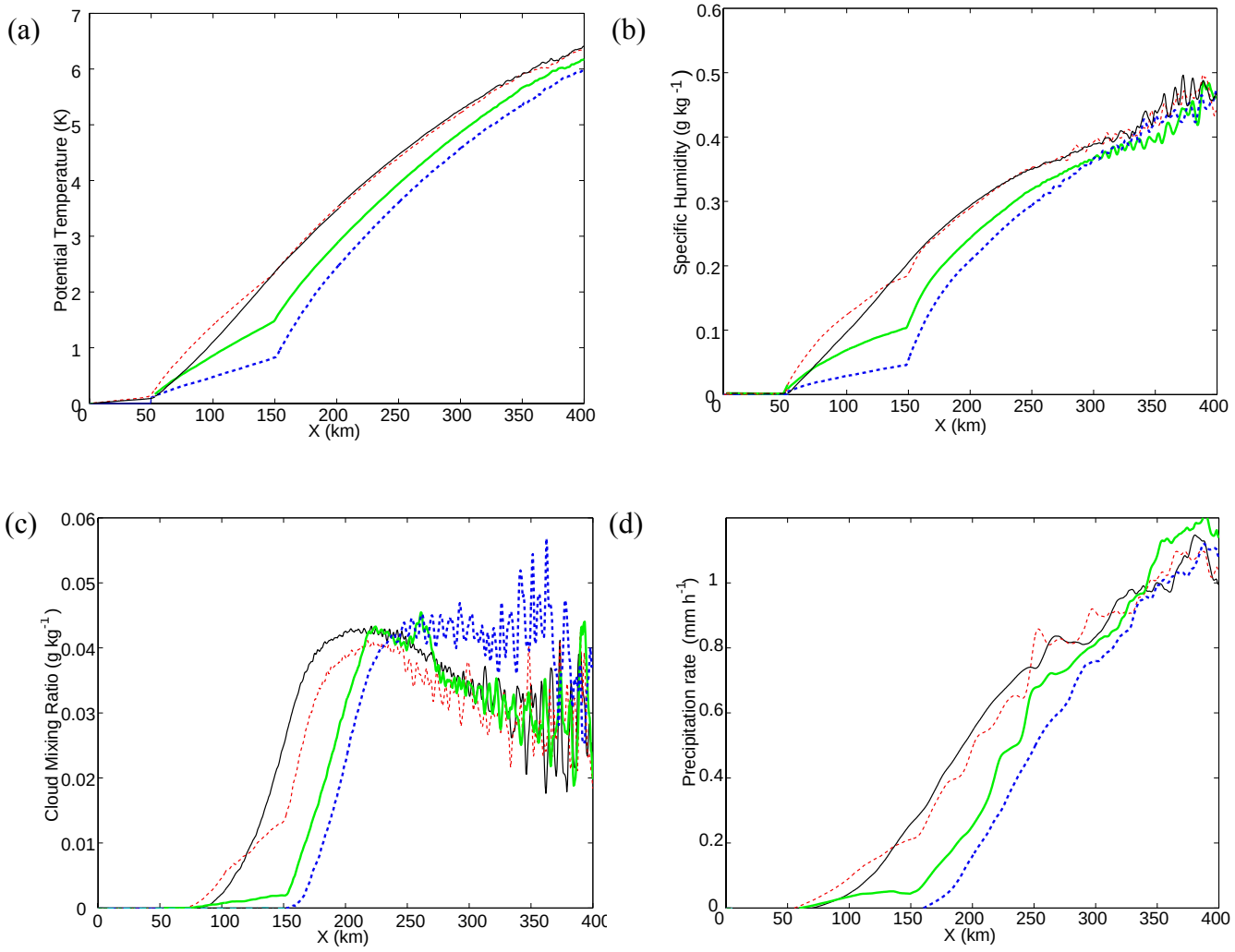


Figure 9. Variation of (a) potential temperature (K), (b) specific humidity (g kg^{-1}), (c) cloud mixing ratio (g kg^{-1}) and (d) precipitation rate (mm h^{-1}) as a function of distance downwind (x) at 10 hours for Exp1 (black), Exp2 (red), Exp3 (green) and Exp4 (Blue). All the variables represent anomalies from the upstream conditions and are averaged from surface to 2 km in the vertical then averaged along the y direction.

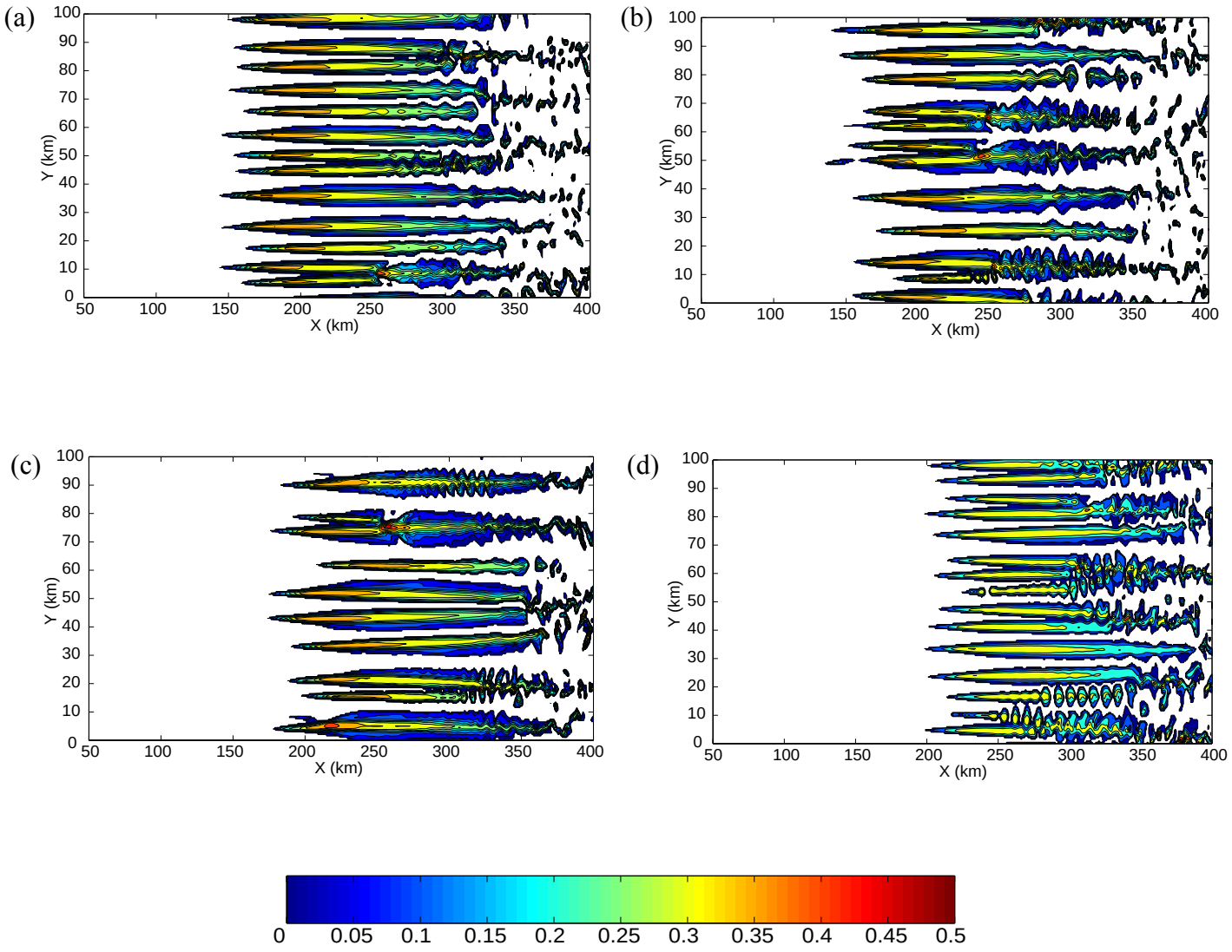
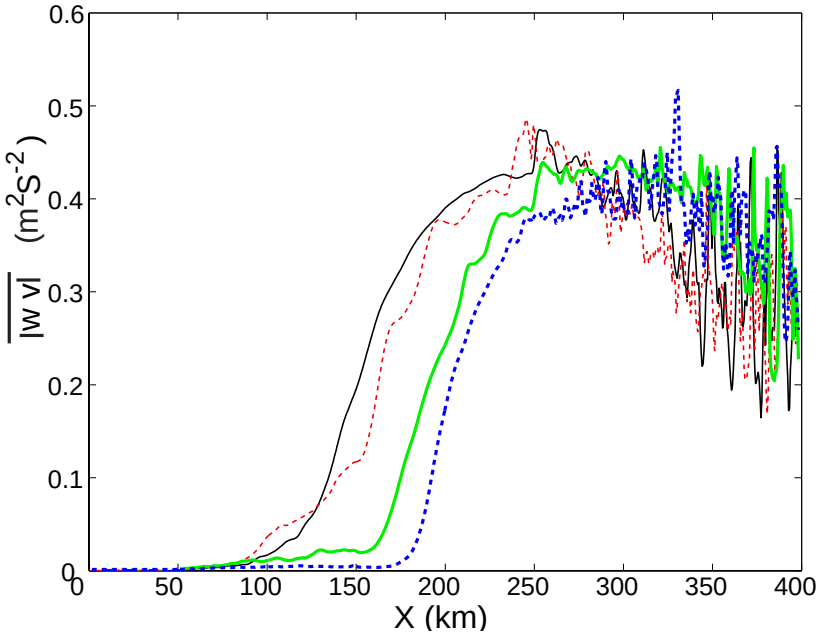


Figure 10 Horizontal cross-section of cloud mixing ratio (g kg^{-1}) at z = 1000 m at 10 hours for (a) Exp1, (b) Exp2, (c) Exp3, and (d) Exp4.

(a)



(b)

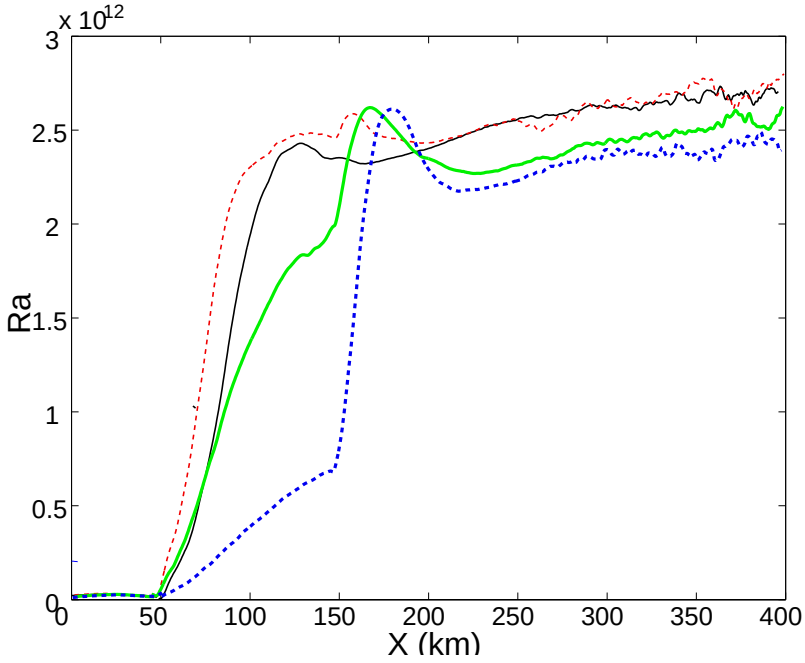


Figure 11. Averaged profiles as a function of along mean wind distance at 10 hours for (a) secondary flow moment (averaged from surface to 2 km in the vertical then averaged along the y direction) and (b) boundary layer Rayleigh number (averaged along the y direction). Exp1 (black), Exp2 (red), Exp3 (green) and Exp4 (Blue).

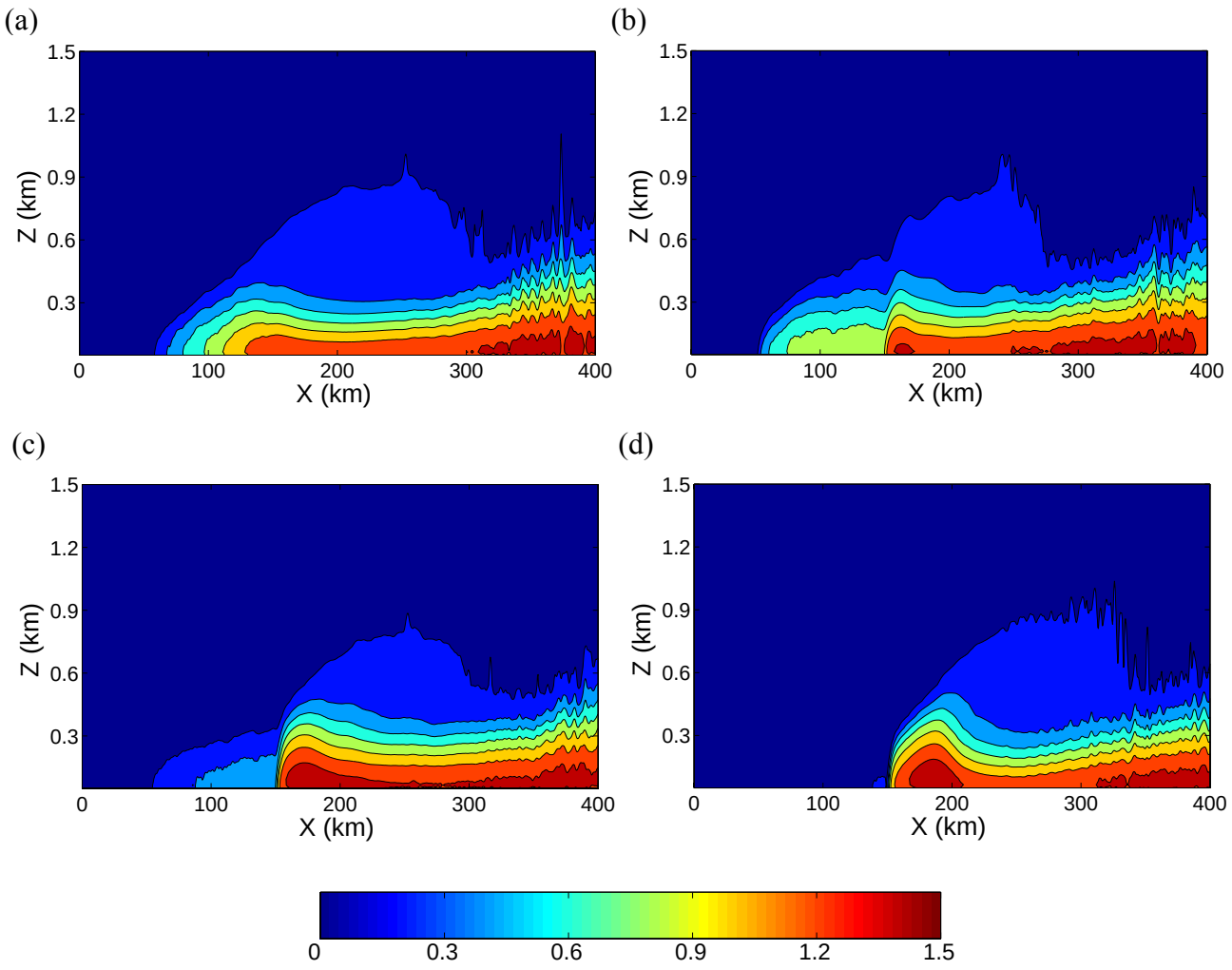


Figure 12. Vertical Cross-sections of subgrid turbulent kinetic energy ($m^2 s^{-2}$) at 10 hours for (a) Exp1, (b) Exp2, (c) Exp3 and (d) Exp4. Averaged along the y direction.

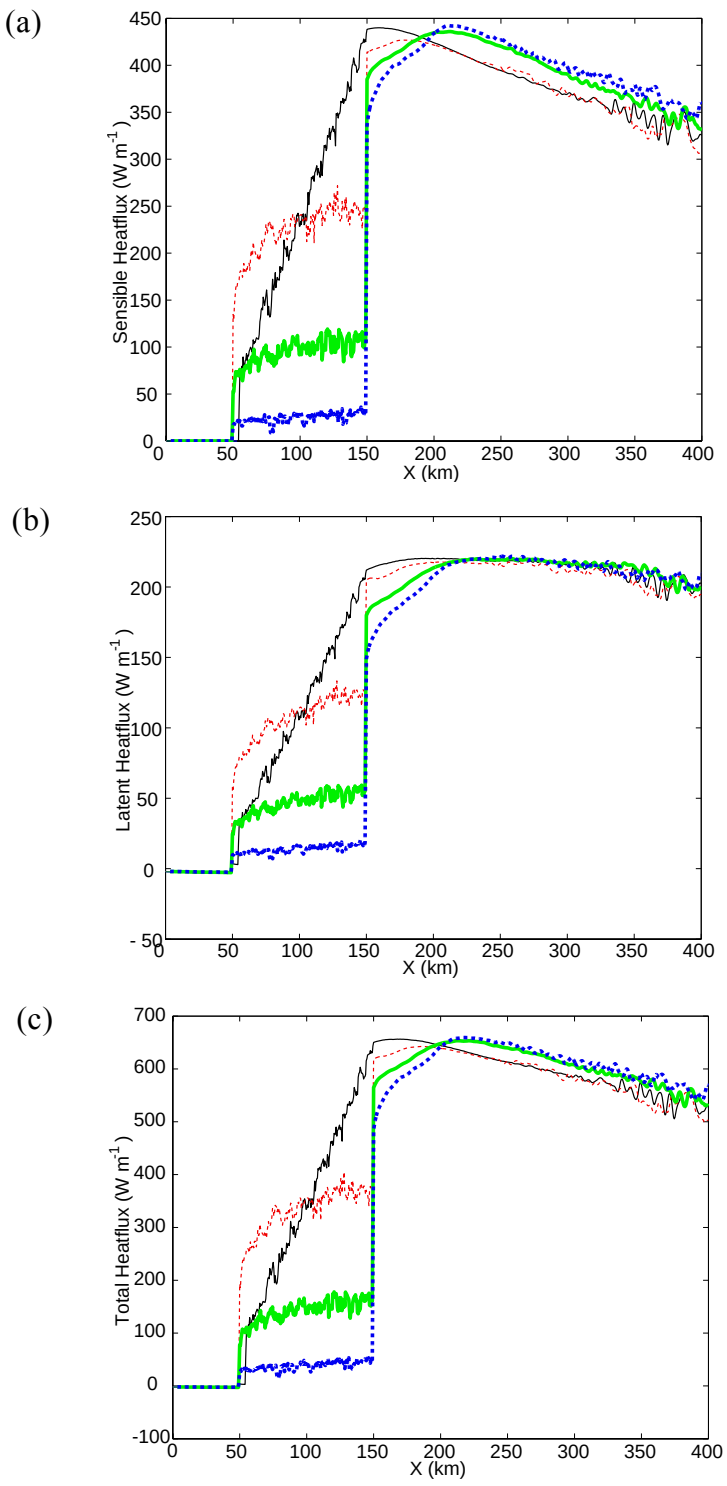


Figure 13. Evolution of (a) sensible heat flux (W m^{-2}), (b) latent heat flux (W m^{-2}), and (c) total heat flux (W m^{-2}) as a function of distance downwind (x) at 10 hours for Exp1 (black), Exp2 (red), Exp3 (green) and Exp4 (Blue). All the variables are averaged along the y direction.