

# Figures annex

## 1 RANS

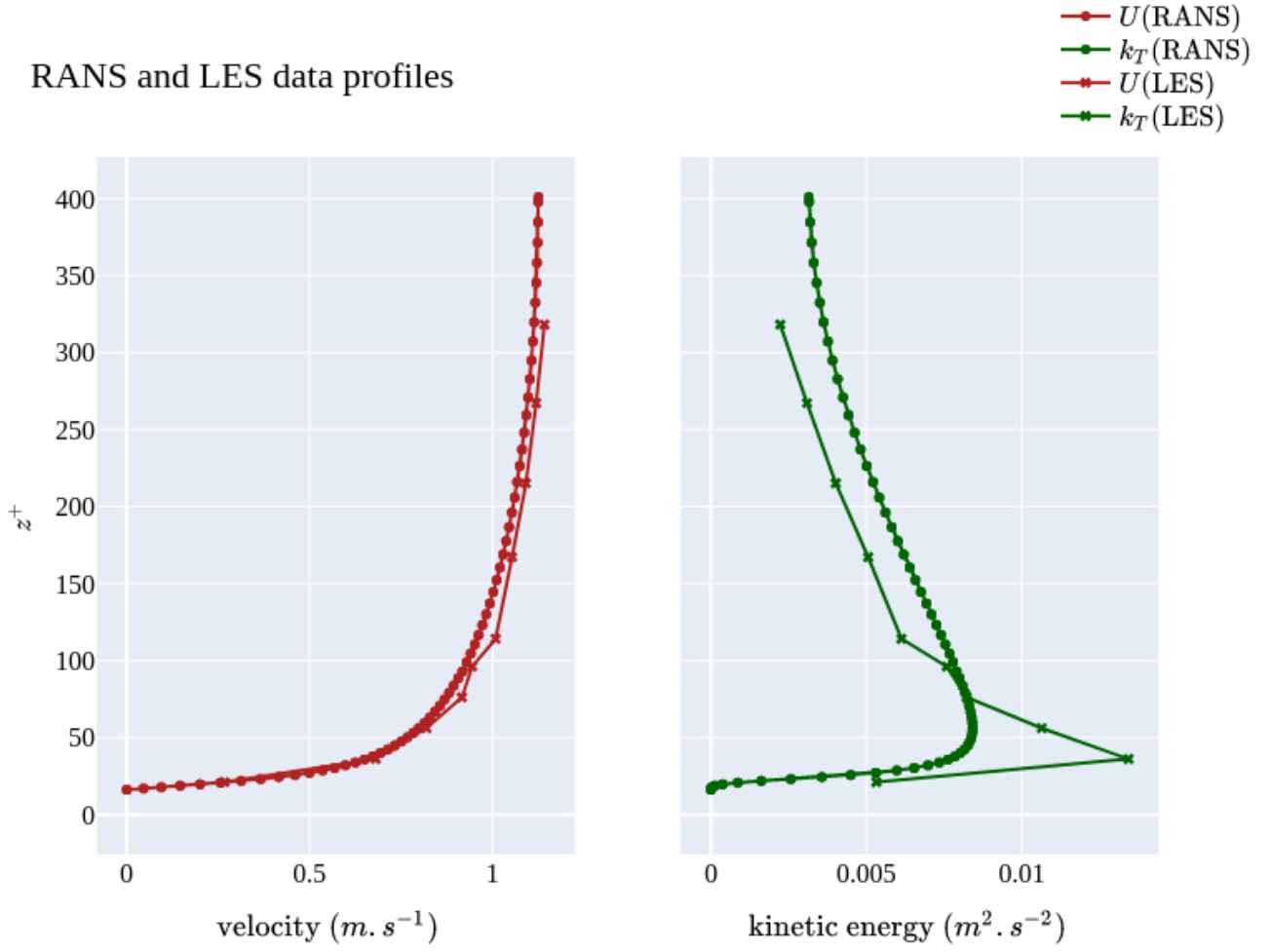


Figure 1: The comparison between RANS and LES data profiles of streamwise velocity (left figure) and kinetic energy (right) in function of  $z^+$

## 2 Velocity analyses

## 3 Frozen turbulence

We want to verify the frozen turbulence hypothesis which states that  $\phi_{ij}^{[1]}(k_1, x_2, x_3) = U_c \psi_{ij}(U_c k_1, x_2, x_3)$  with  $\omega = U_c k_1$ .  $U_c$  is the mean streamwise velocity,  $\phi_{ij}^{[1]}$  is the spatial spectra in the streamwise direction and  $\psi_{ij}$  is the time spectra.

### 3.1 Power spectras

### 3.2 2D correlation

## 4 Spatial correlations

## 5 Gamma coefficient determination

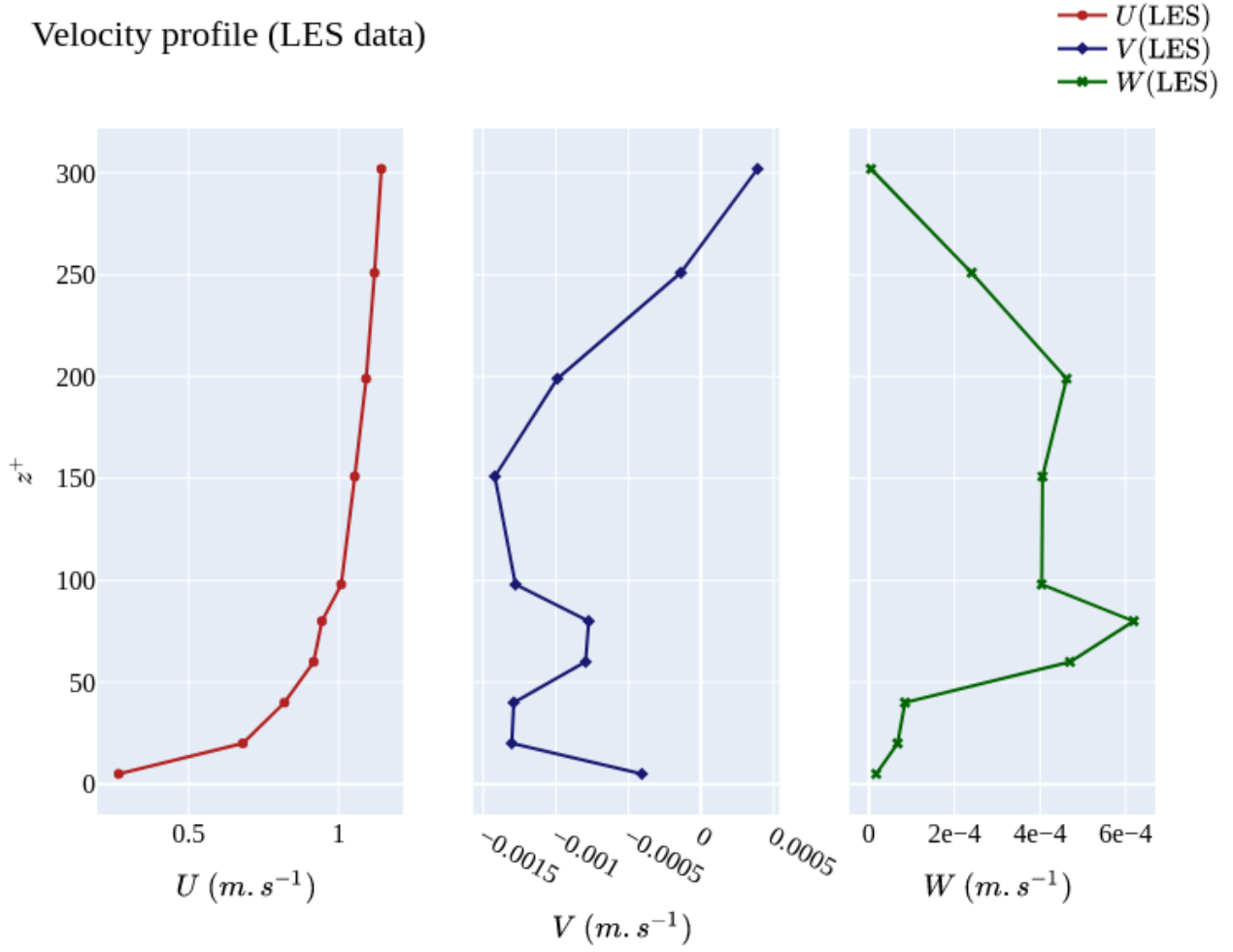


Figure 2: Three mean velocity profiles from LES datas extract from 10 streamwise plan. Left streamwise direction, center spanwise direction and right wall-normal direction.

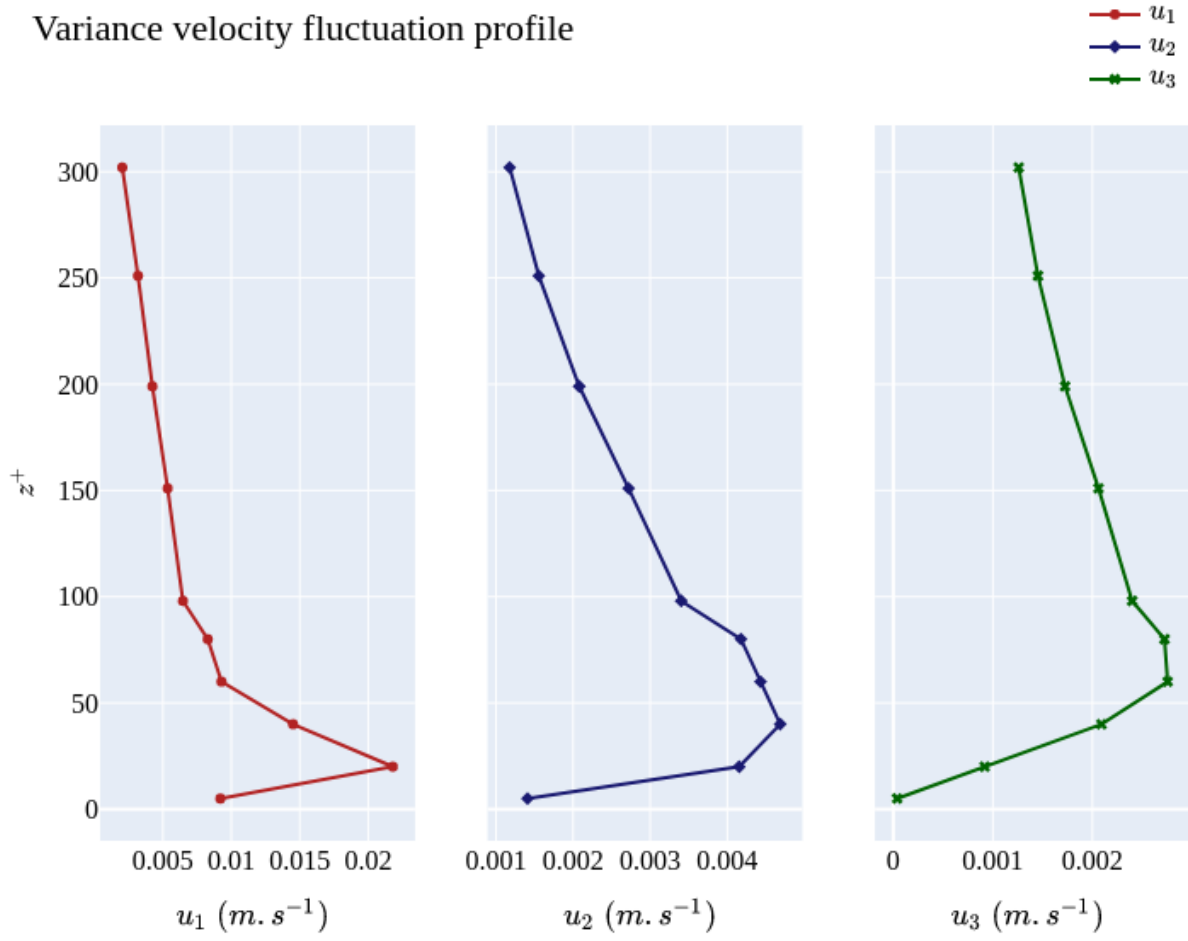


Figure 3: Three variance velocity fluctuation profiles from LES datas extract from 10 streamwise plan.

Variance velocity ratio profile (LES data)

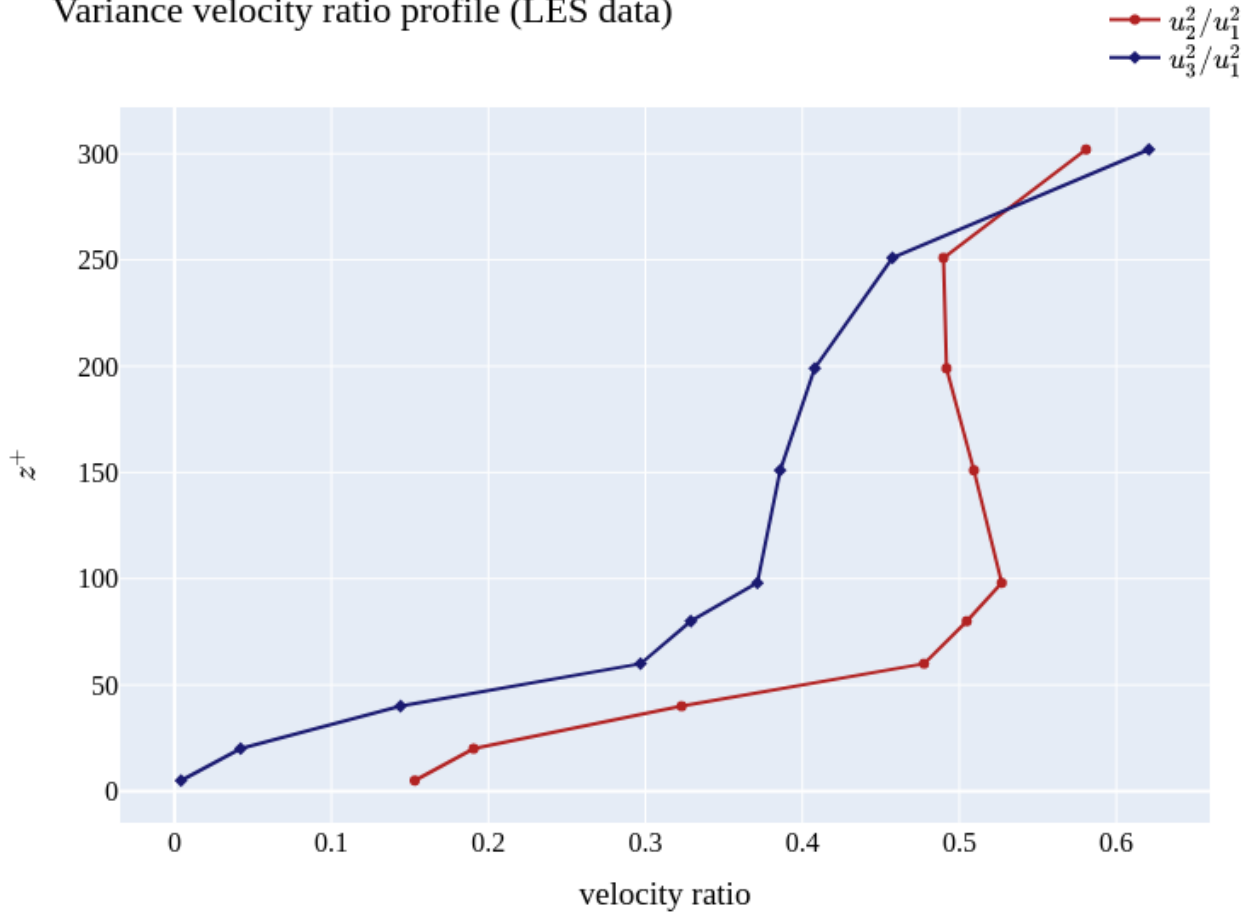
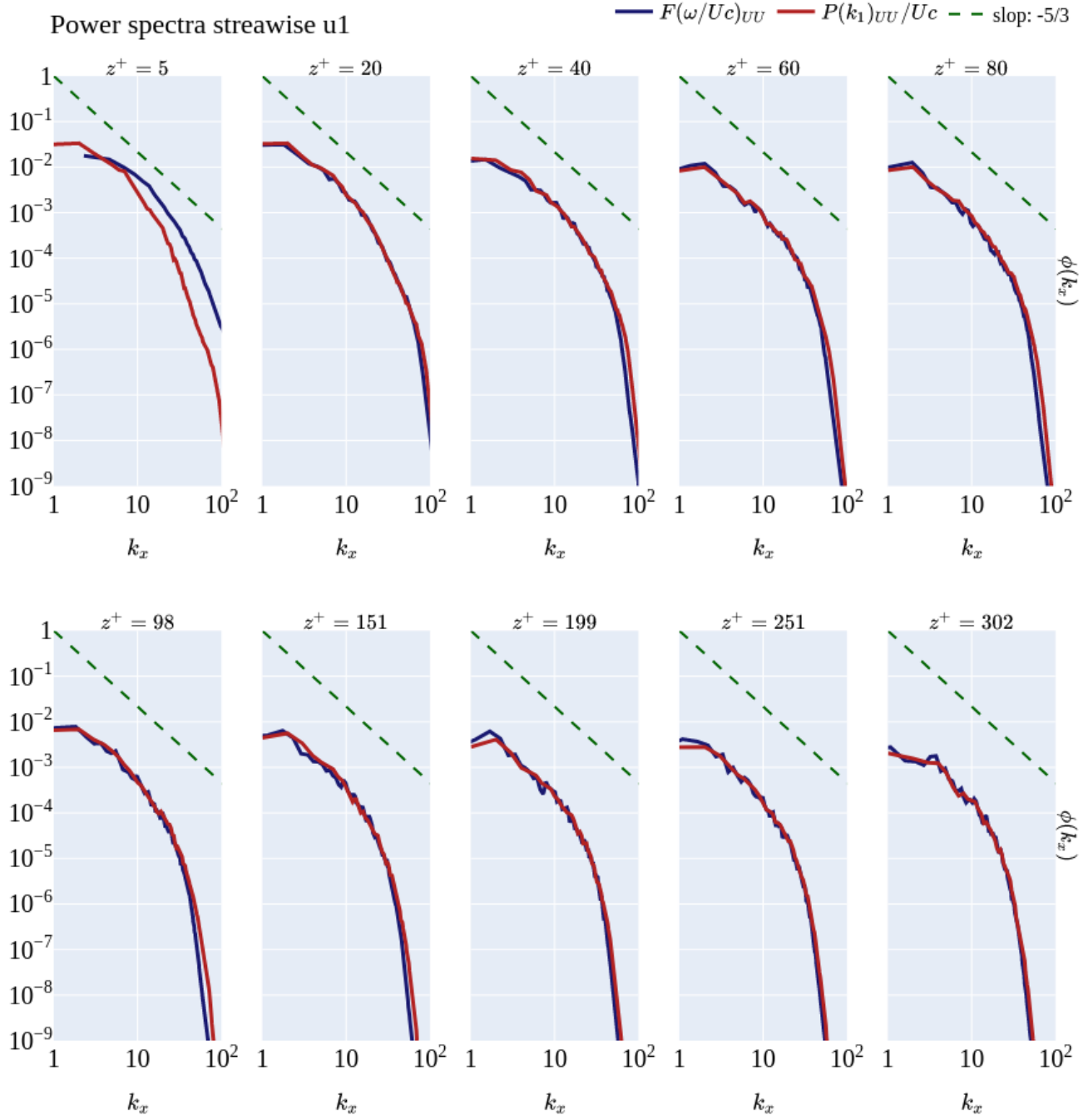
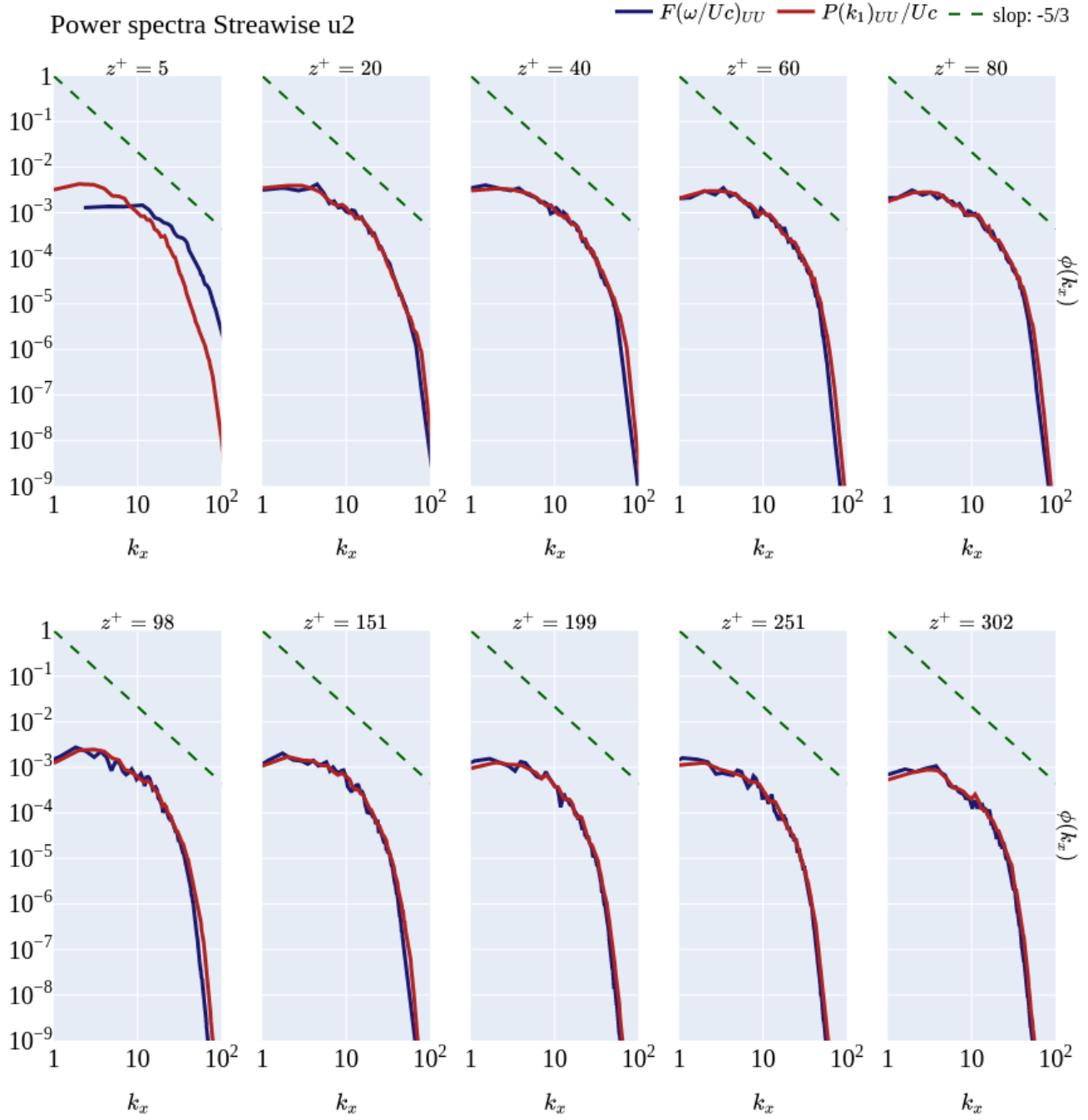


Figure 4: Square ratio of the spanwise on streamwise velocity (red) and the wall-normal on streamwise velocity (blue). They have been calculated taking the 10 streamwise plans. The streamwise velocity appears to be very dominant on both the spanwise and the wall-normal velocity.





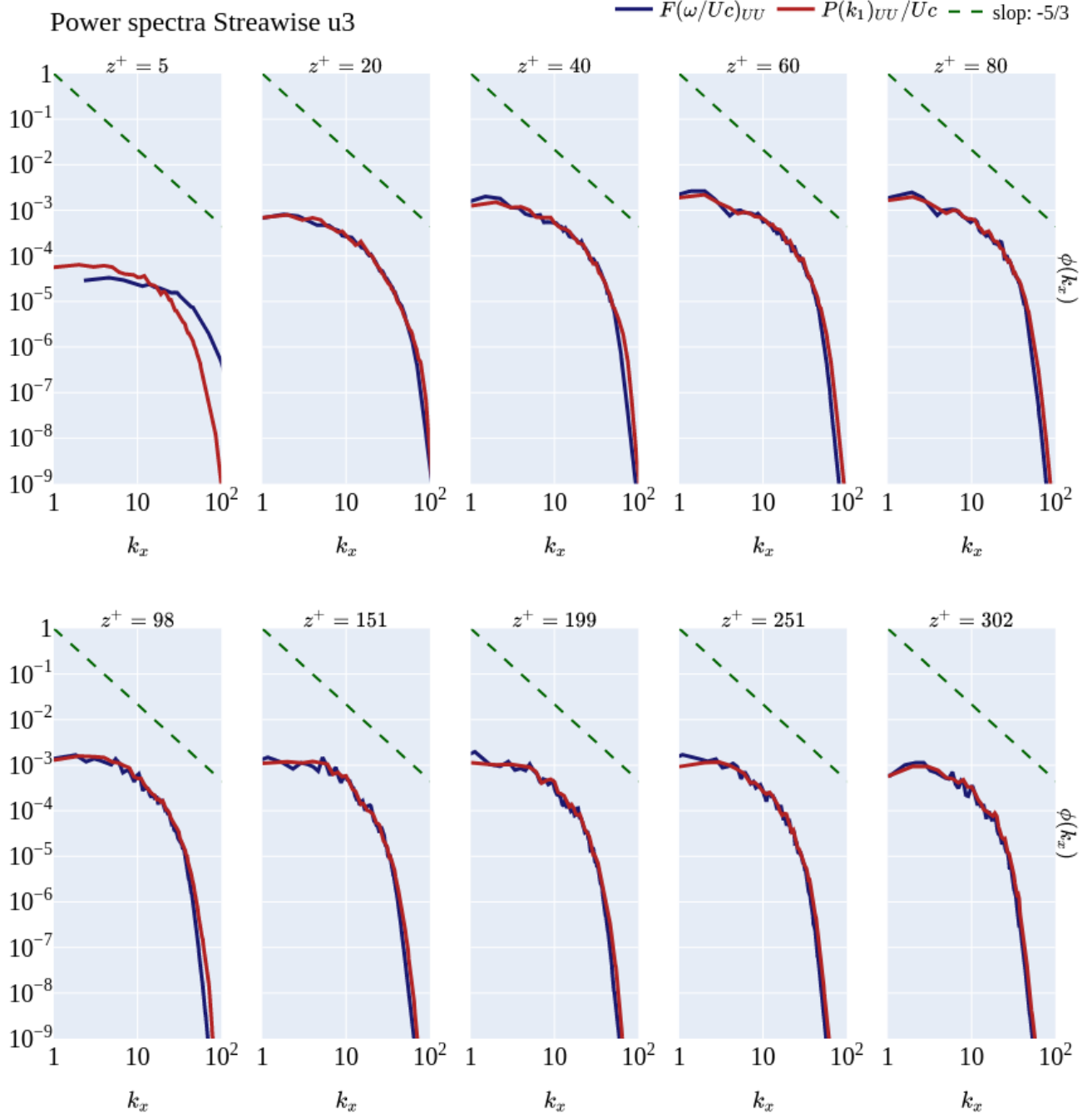
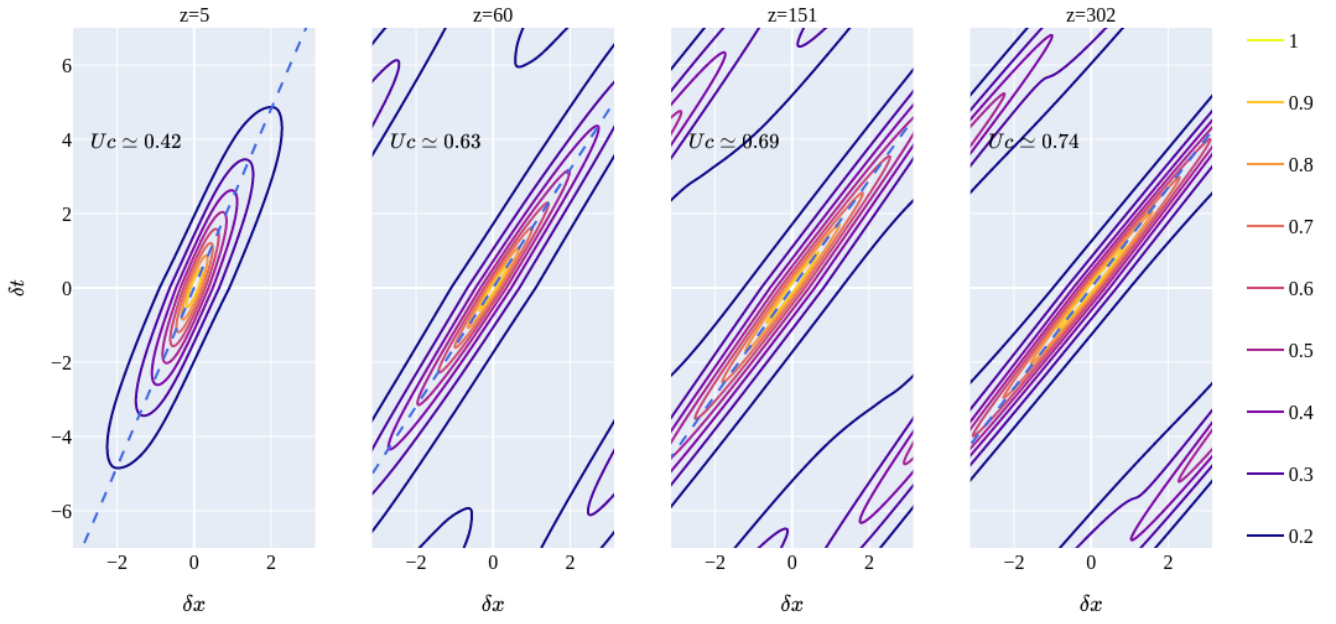
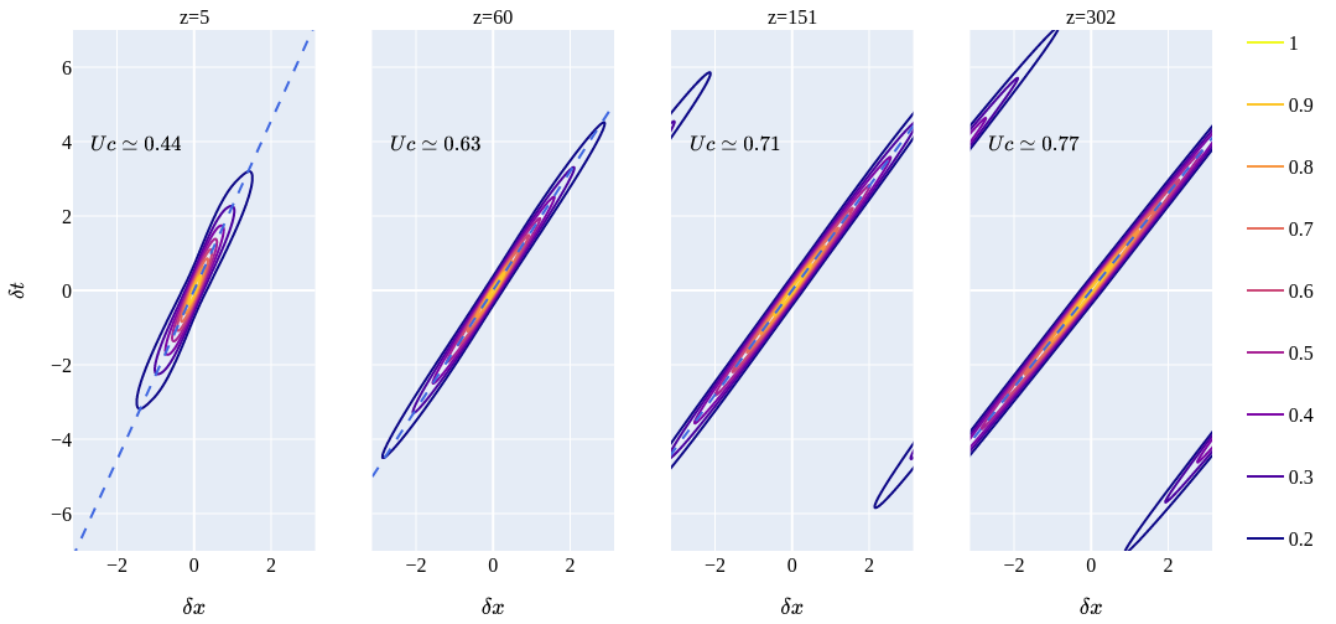


Figure 5: Power spectra in space (red) and time (blue) for the streamwise velocity (top), spanwise velocity (middle) and wall-normal velocity (bottom) at 10 different heights. The  $Uc$  took is the mean velocity along the streamwise axis

Correlation 2D Streamwise u1



Correlation 2D Streamwise u2





### Correlation 2D Streamwise u3

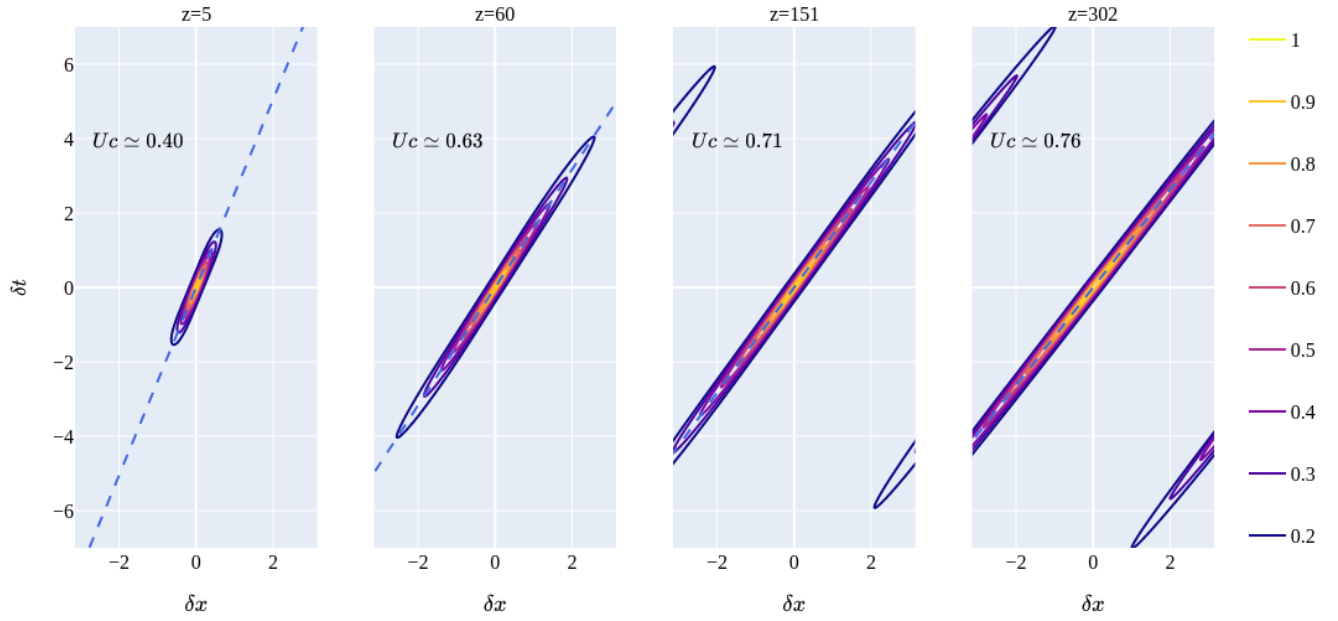


Figure 6: Contour plot of 2D correlation in four streamwise plans. (---) slope of the ellipses corresponding at  $\frac{1}{U_c}$ . To determine the slope we take the following values of the correlation function: (0.5, 0.6, 0.7, 0.8, 0.85, 0.9, 0.95)

### Velocity comparison

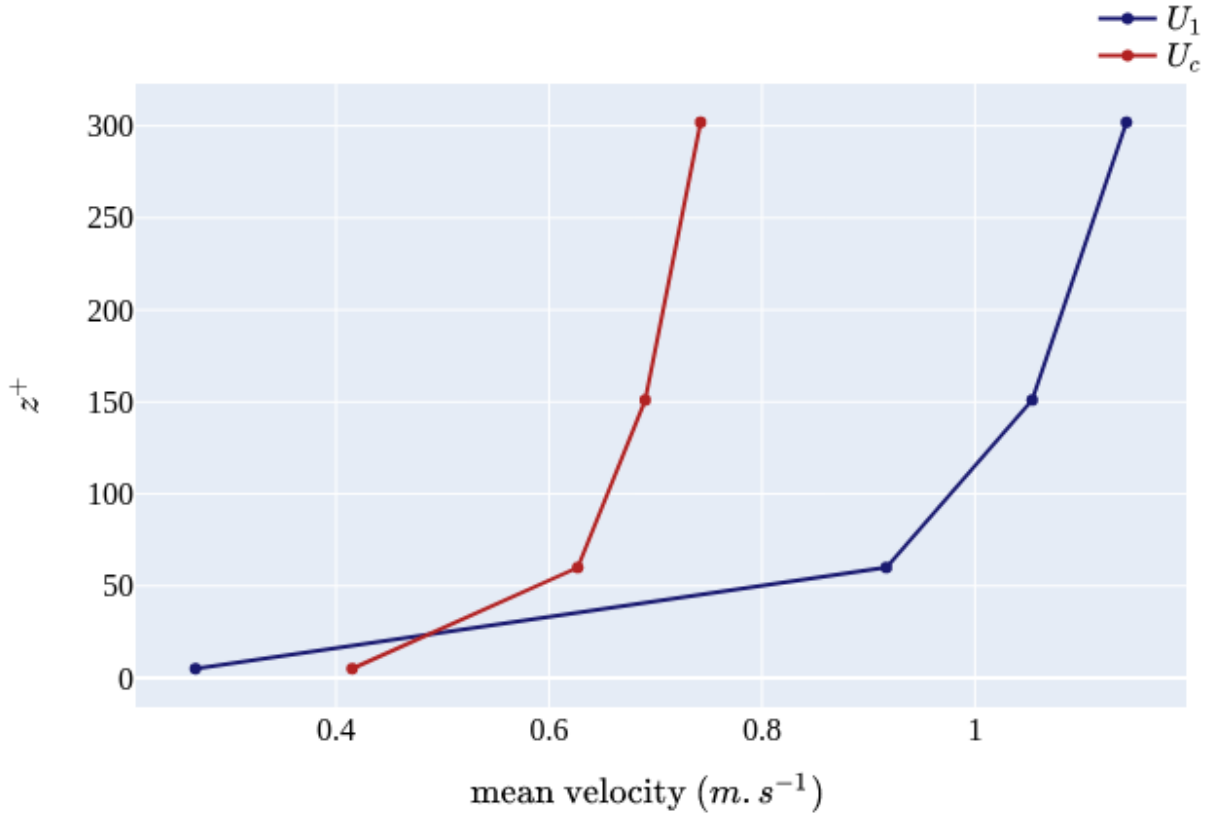


Figure 7: Comparison of slope determined velocity ( $U_c$ ) and streamwise mean velocity ( $U_1$ ) in function of  $z^+$

## Velocity ratio

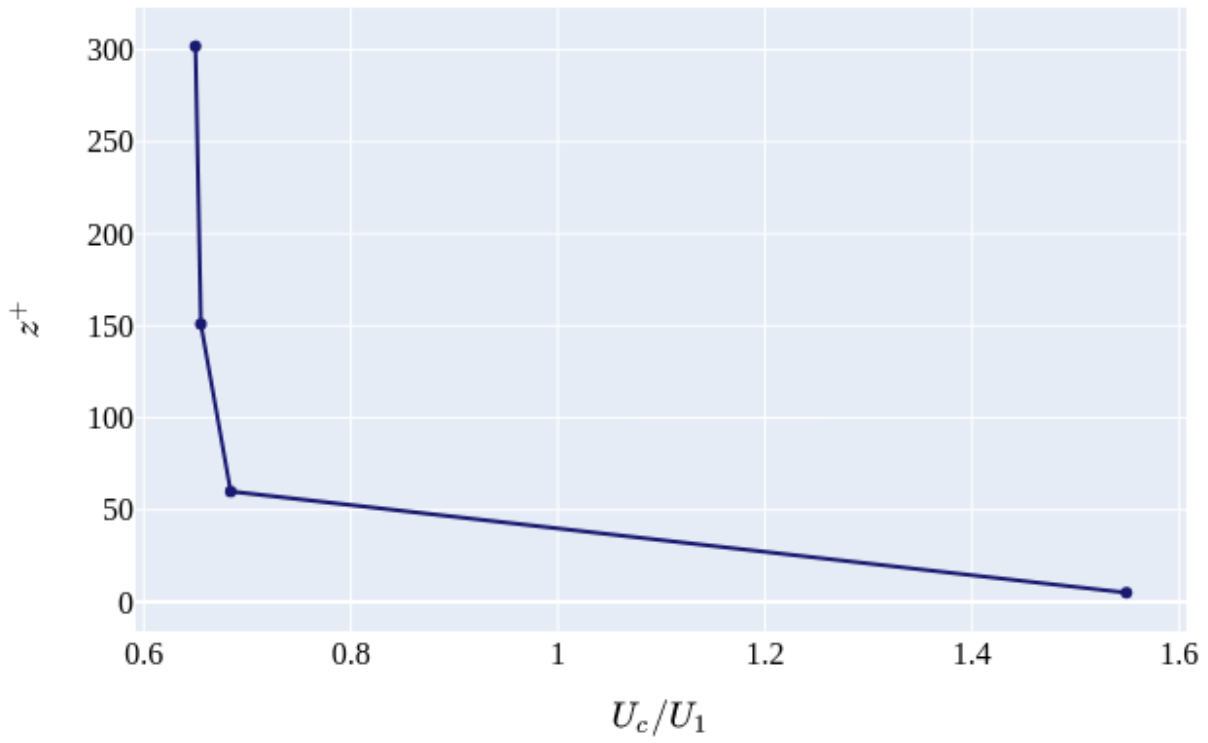
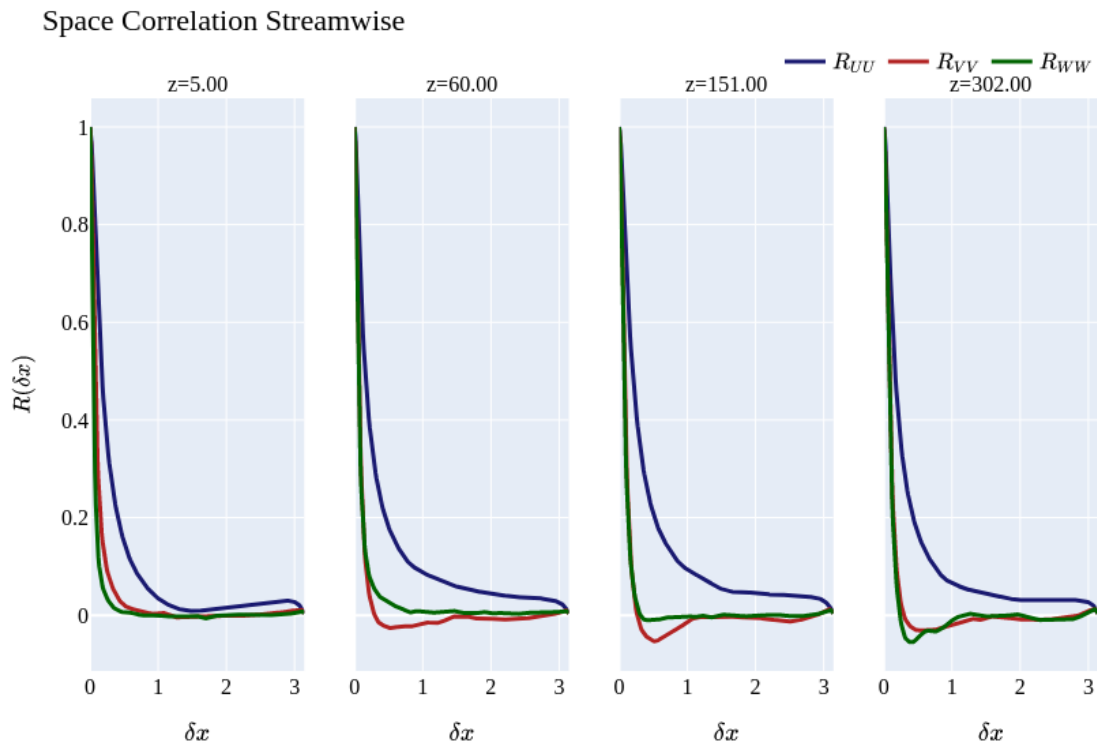


Figure 8: Ratio of slop determined velocity ( $U_c$ ) and streamwise mean velocity ( $U_1$ ) in function of  $z^+$



### Space Correlation Spanwise

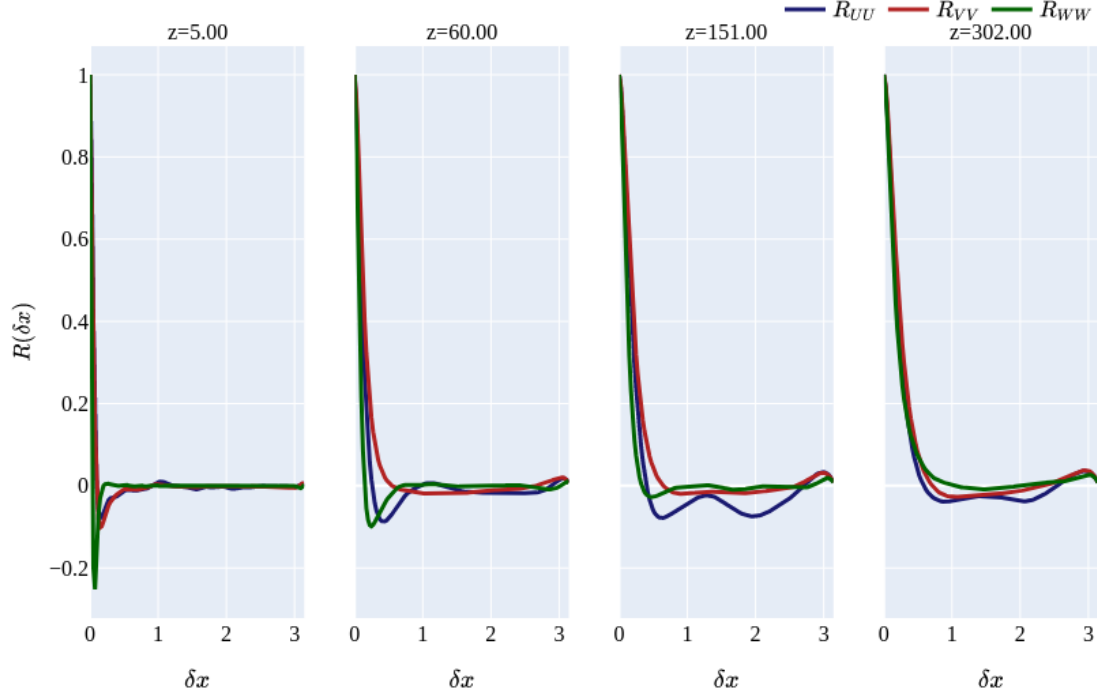
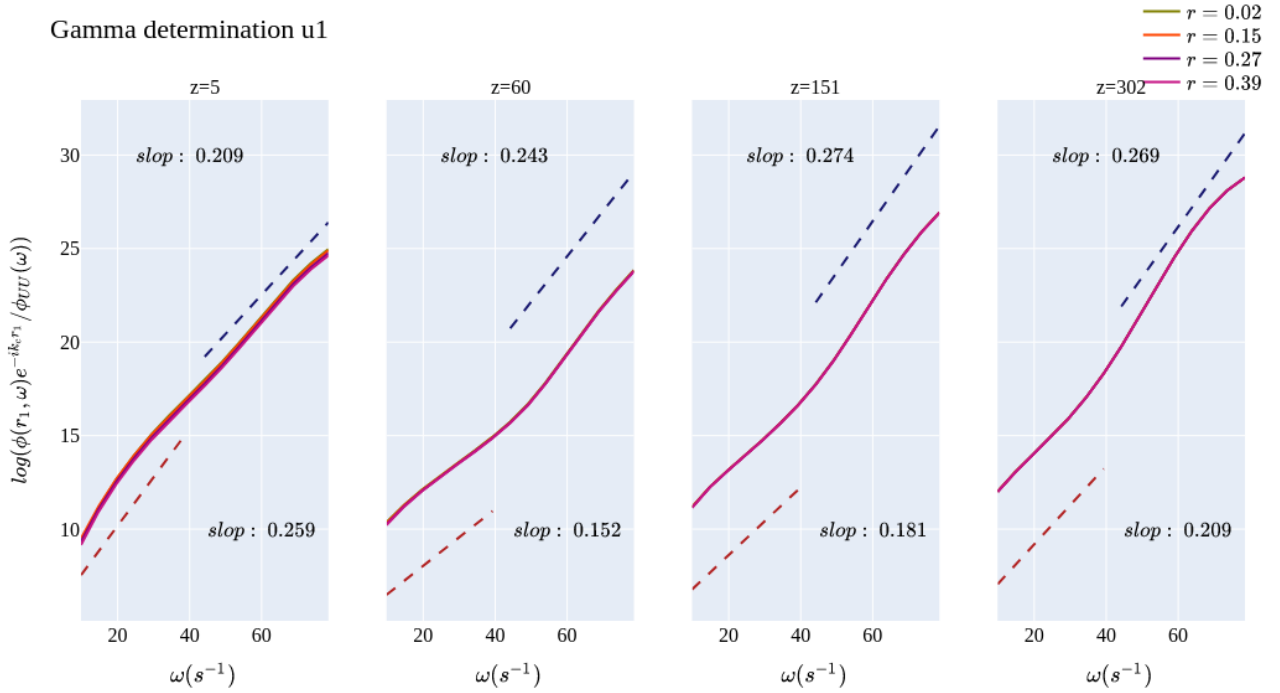


Figure 9: Spatial correlation in a streamwise plan (top figure) and in a spanwise plan (bottom figure).  $U$  is the streamwise,  $V$  the spanwise and  $W$  the wall-normal velocities

### Gamma determination u1



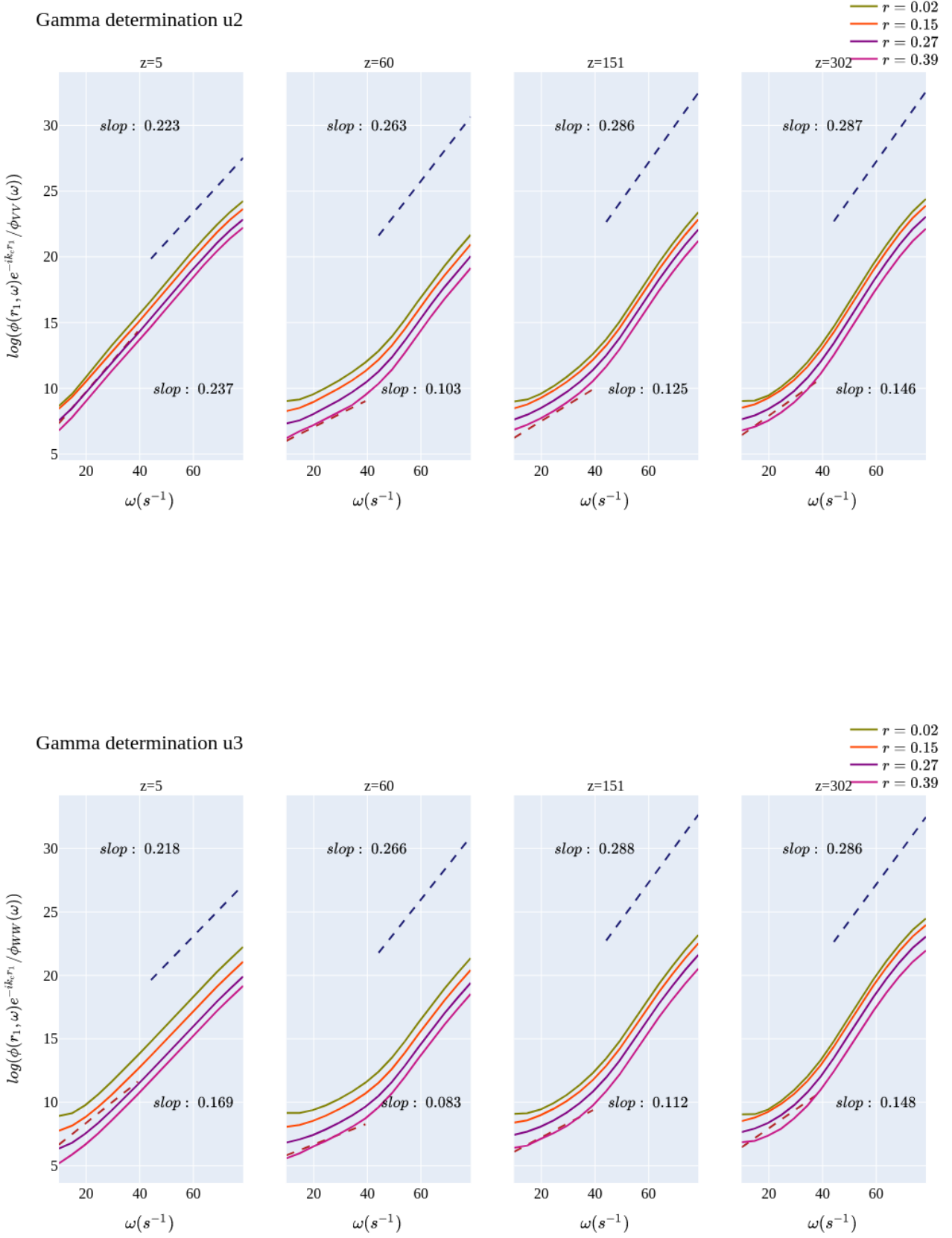


Figure 10: Determination of  $\gamma$  coefficient as  $e^{-\gamma k_c r_1} = \frac{\phi(r_1, \omega)}{\phi_{ii}(\omega)} e^{-ik_c r_1}$ . All these spectra are computed with streamwise plan with streamwise velocity (top figure), spanwise velocity (middle figure) and wall-normal velocity (bottom figure)

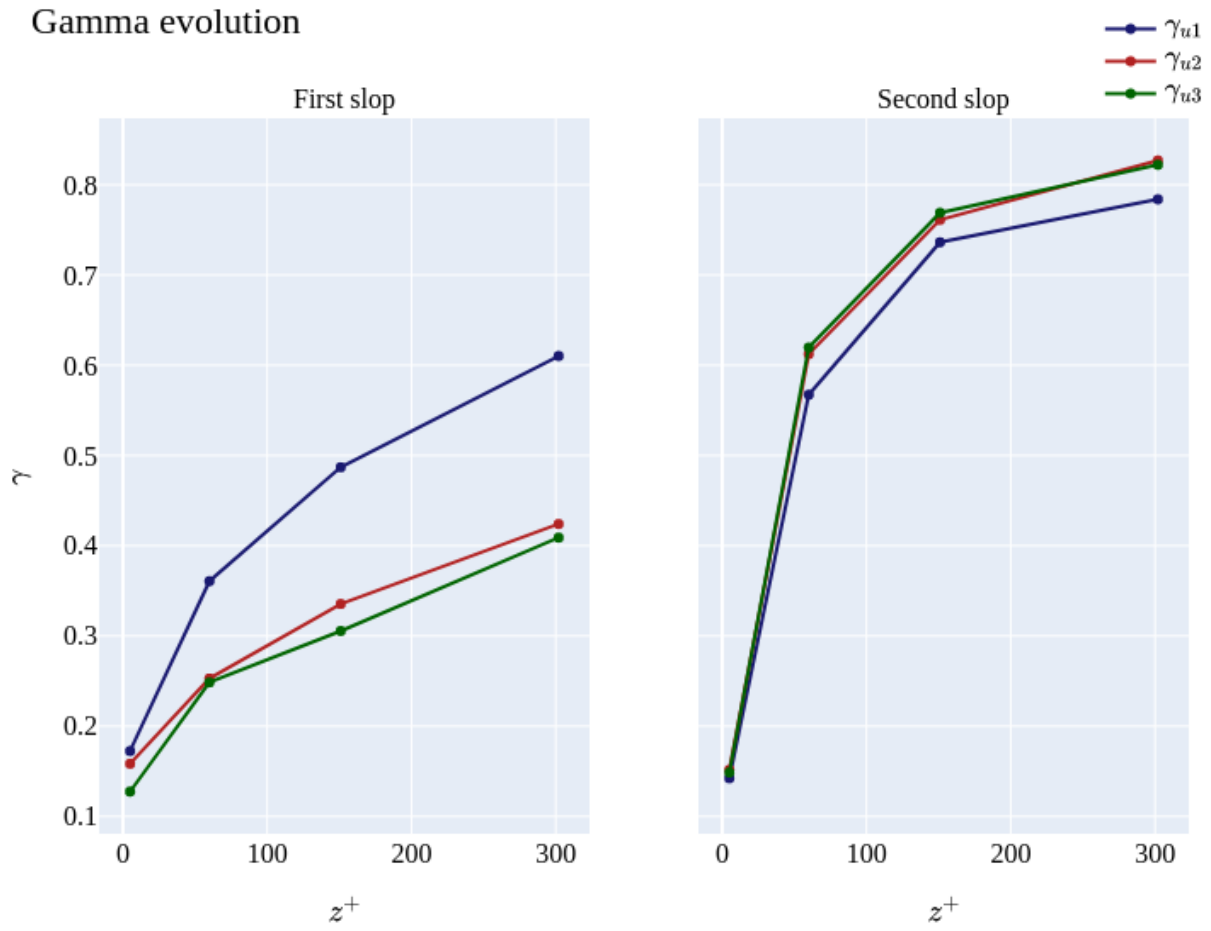


Figure 11: Figure representing the evolution of  $\gamma$  coefficient in function of  $z^+$  determined by the precedent figures.