

Figures annex

1 RANS and LES comparison

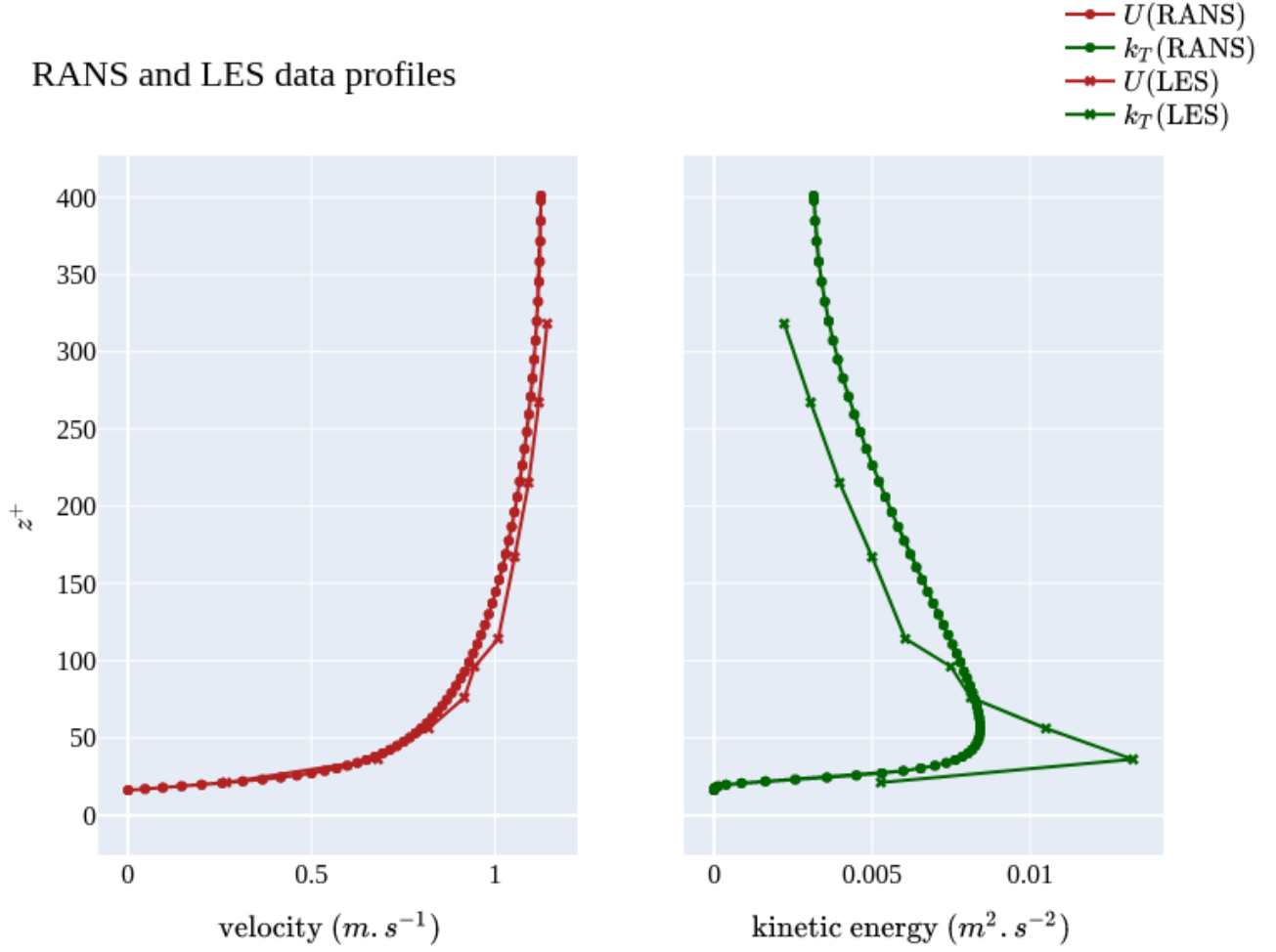


Figure 1: The comparison between RANS and LES data profiles of streamwise velocity (left figure) and kinetic energy (right) in function of z^+

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 ψ_{ij} is the time spectra.

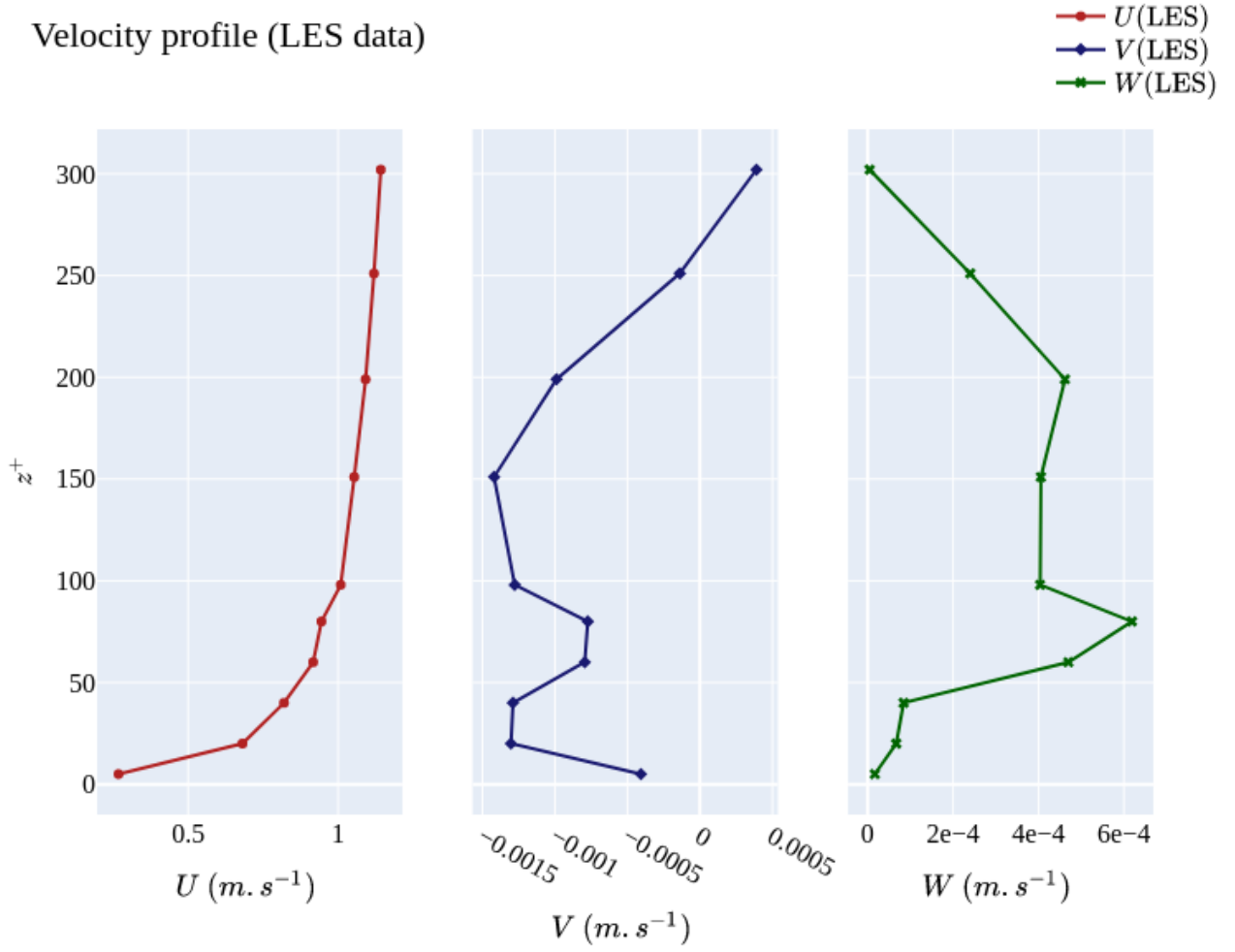


Figure 2: Three mean velocity profiles from LES datas extract from 10 streamwise plan. Left streamwise direction, center spanwise direction and right wall-normal direction.

3.1 2D correlation

3.2 Power spectras

4 Spatial correlations

5 Gamma coefficient determination

6 Wall-normal plan study

7 Von Karman

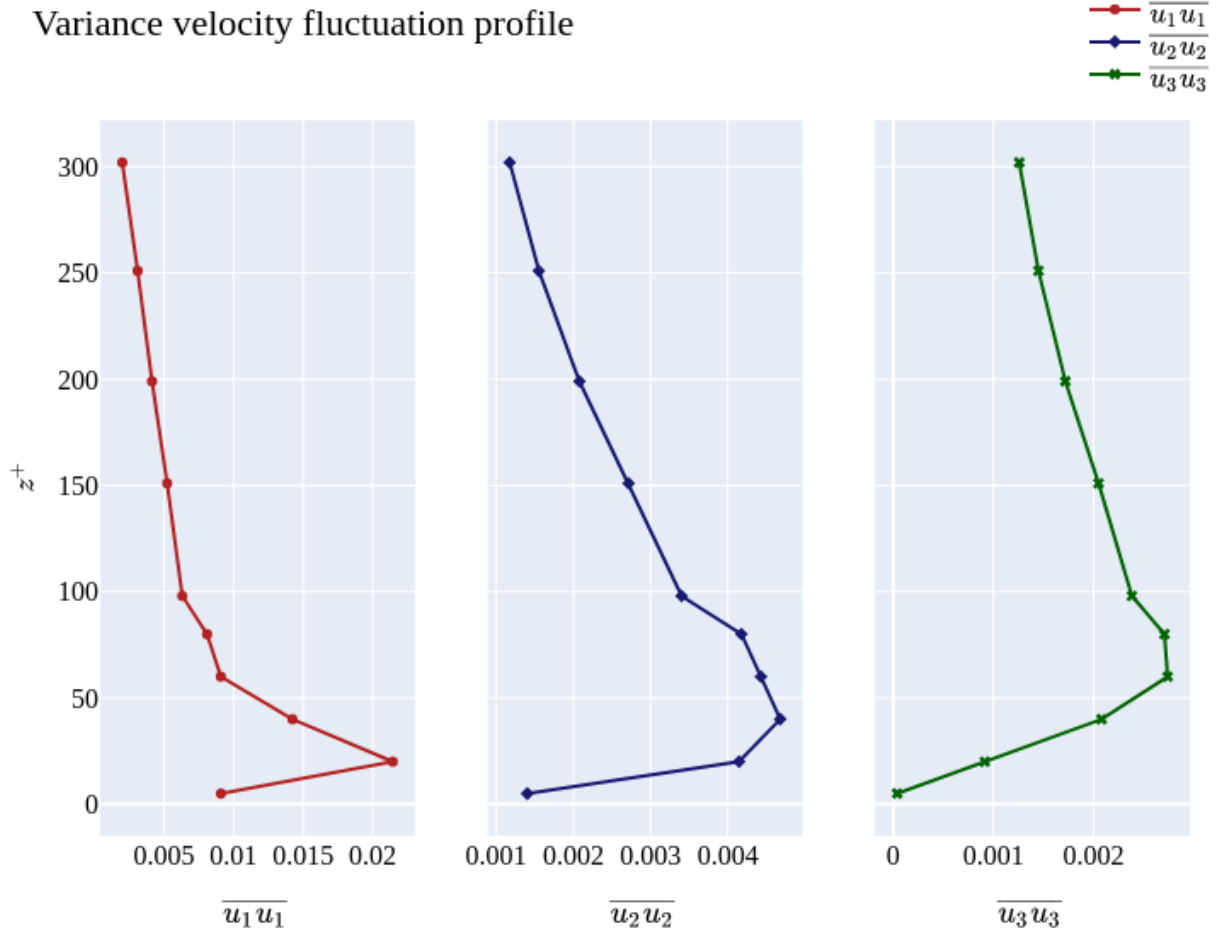


Figure 3: Three variance velocity fluctuation profiles from LES datas extract from 10 streamwise plan.

Variance velocity ratio profile (LES data)

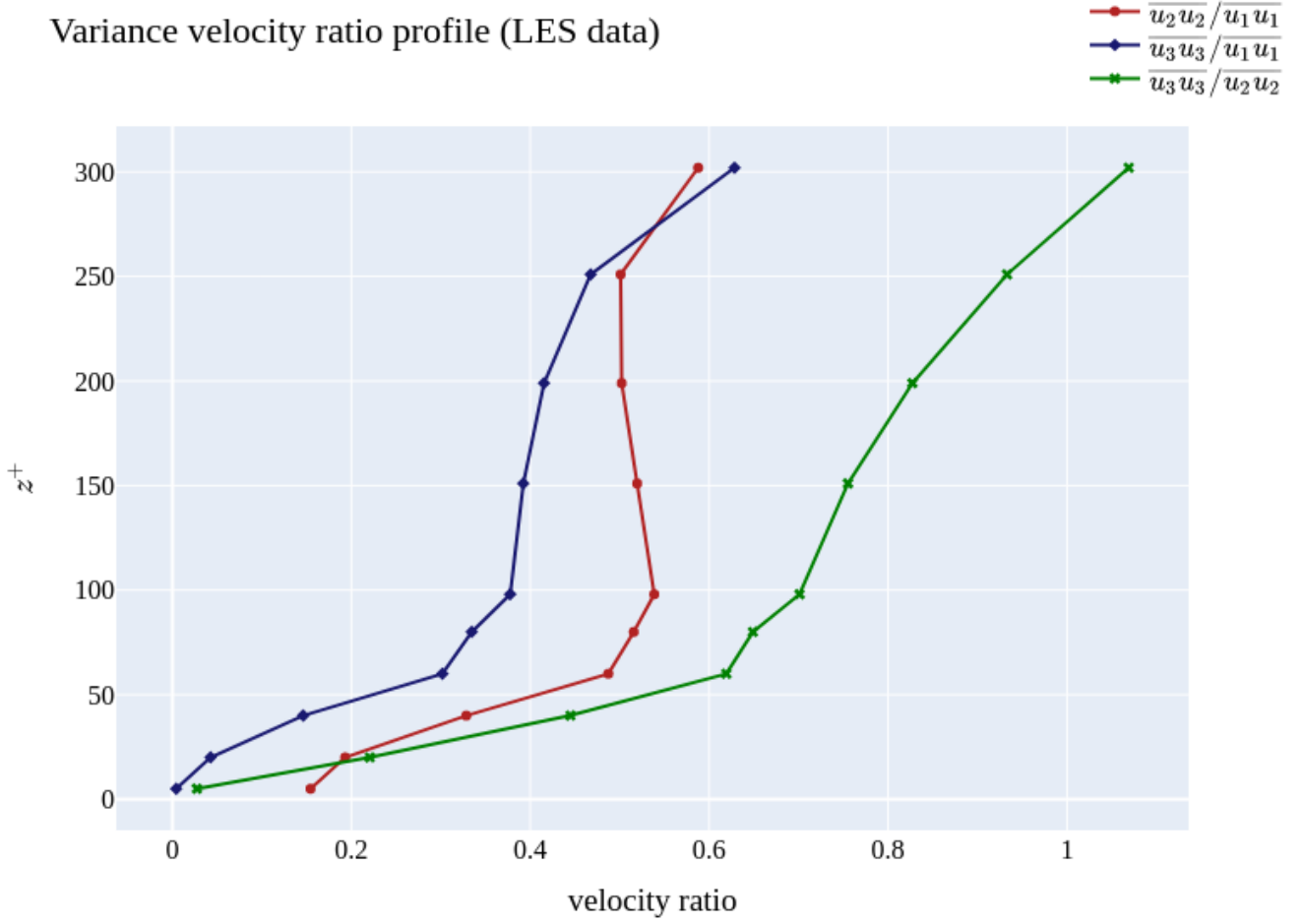
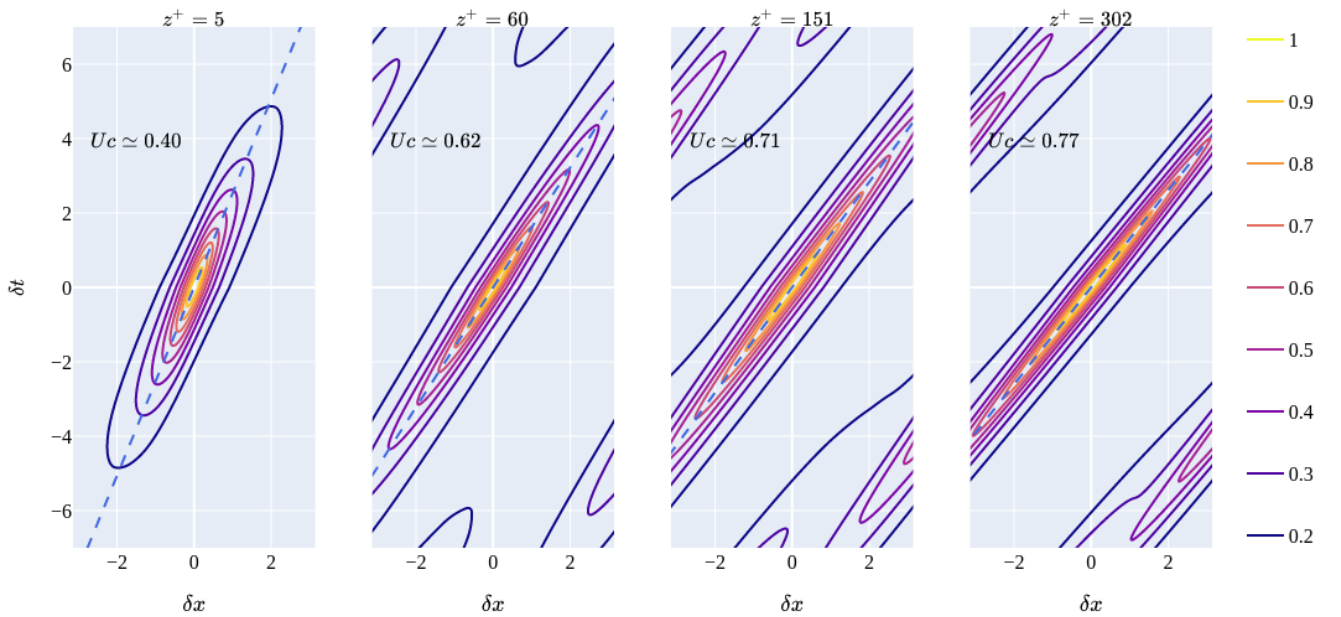
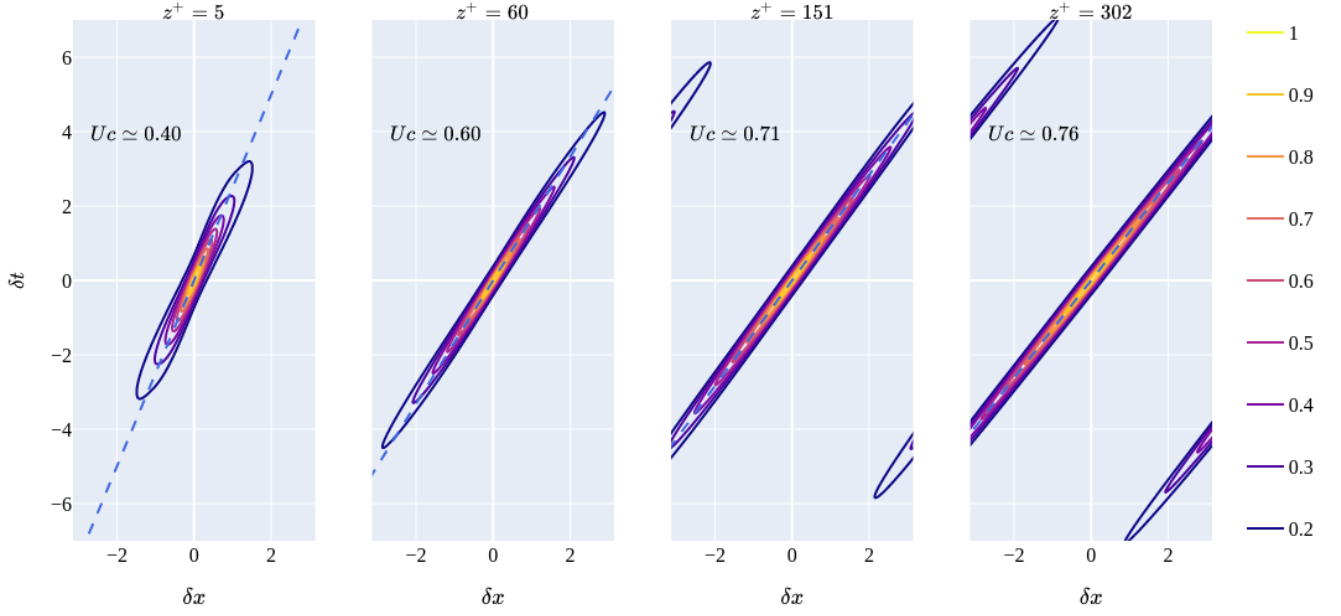


Figure 4: Square ratio of the spanwise on streamwise velocity (red) and the wall-normal on streamwise velocity (blue). They have been calculated taking the 10 streamwise plans. The streamwise velocity appears to be very dominant on both the spanwise and the wall-normal velocity.

Correlation 2D Streamwise u1



Correlation 2D Streamwise u2



Correlation 2D Streamwise u3

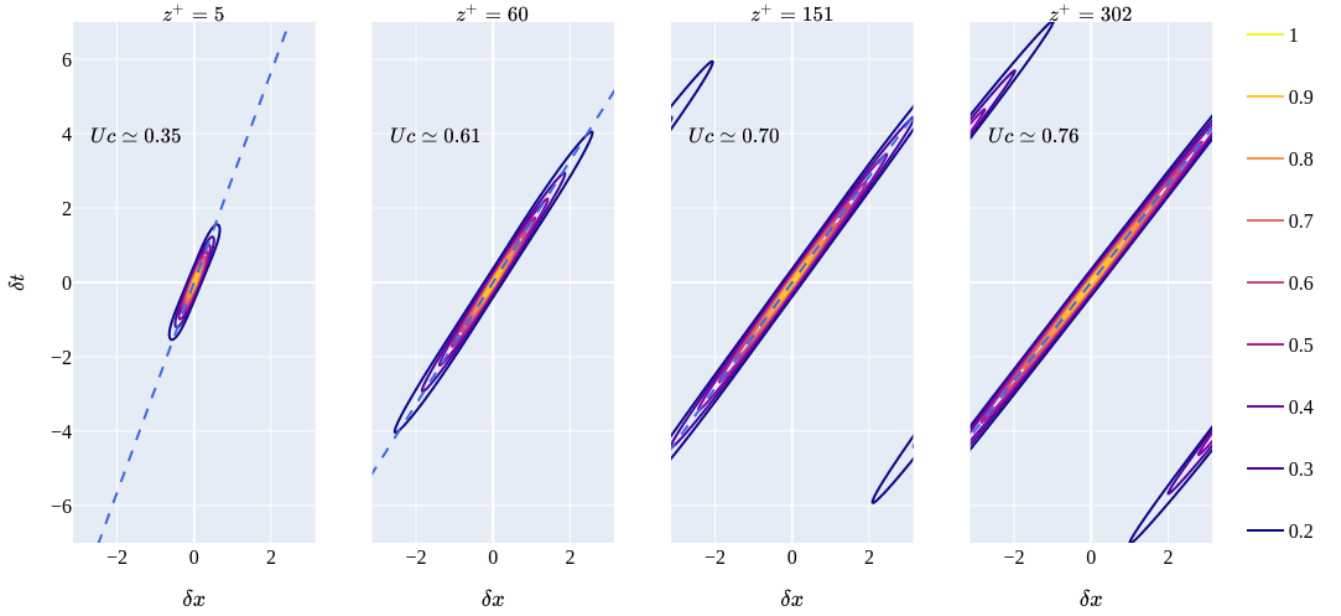


Figure 5: Contour plot of 2D correlation in four streamwise plans. (---) slop of the ellipses corresponding at $\frac{1}{U_c}$. To determine the slop we take the following values of the correlation function: (0.5, 0.6, 0.7, 0.8, 0.85, 0.9, 0.95)

Velocity comparison

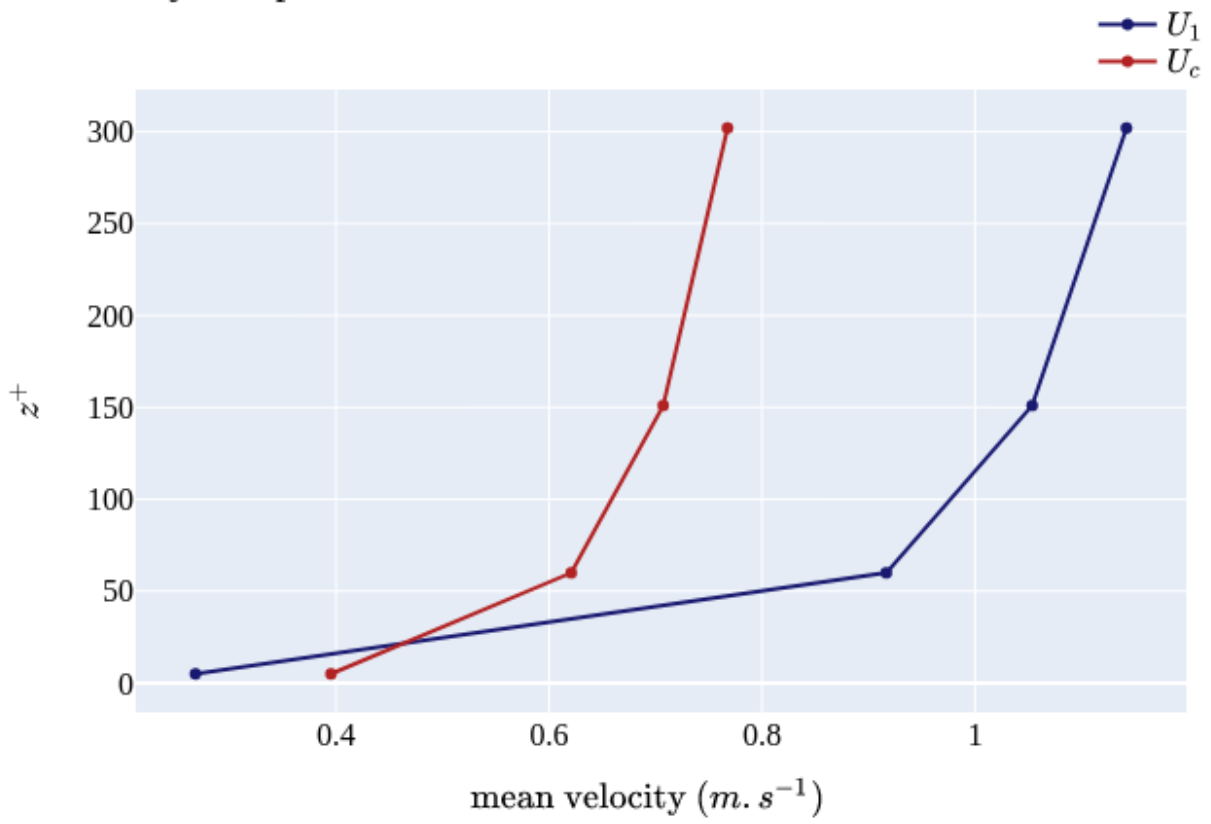


Figure 6: Comparison of slope determined velocity (U_c) and streamwise mean velocity (U_1) in function of z^+

Velocity ratio

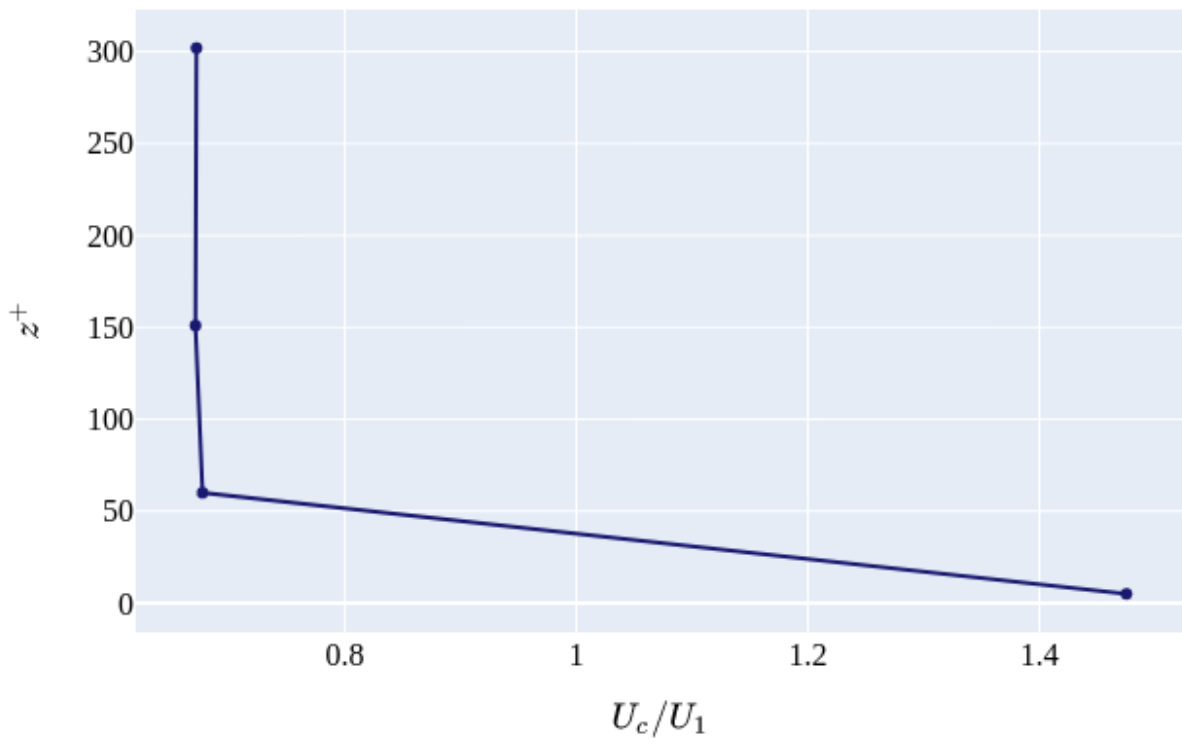
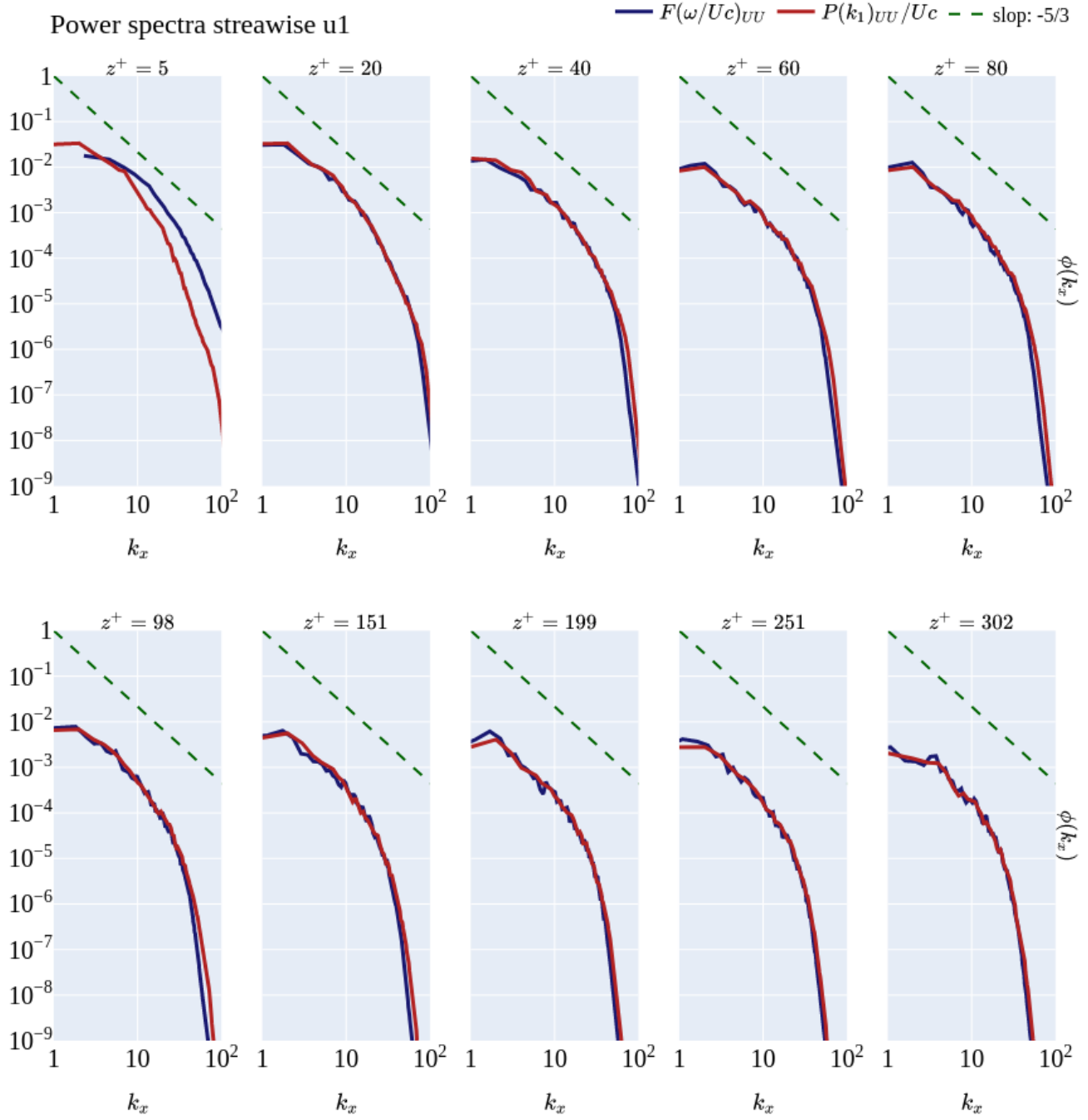
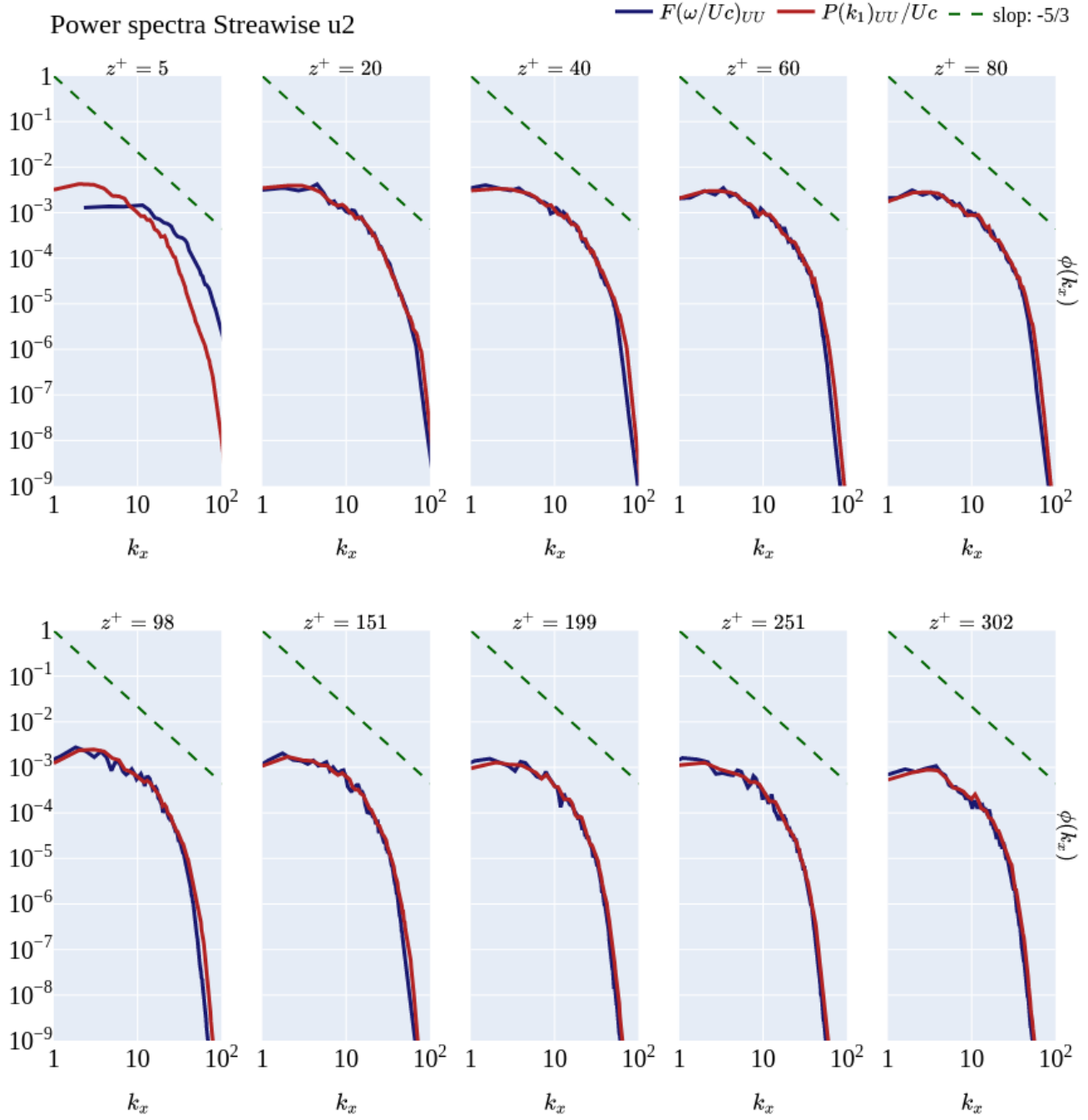


Figure 7: Ratio of slope determined velocity (U_c) and streamwise mean velocity (U_1) in function of z^+





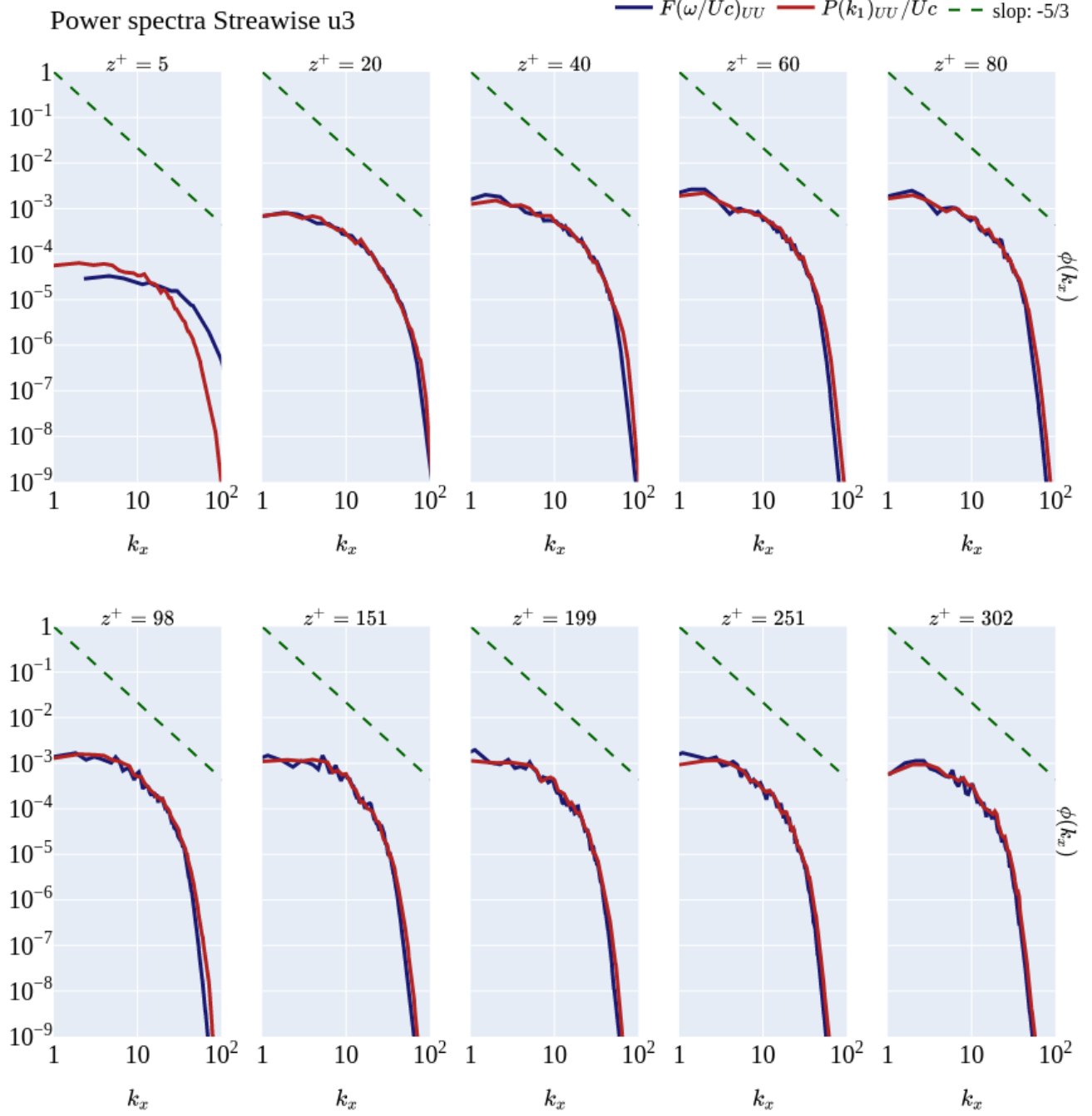


Figure 8: Power spectra in space (red) and time (blue) for the streamwise velocity (top), spanwise velocity (middle) and wall-normal velocity (bottom) at 10 different heights. The Uc took is the mean velocity along the streamwise axis

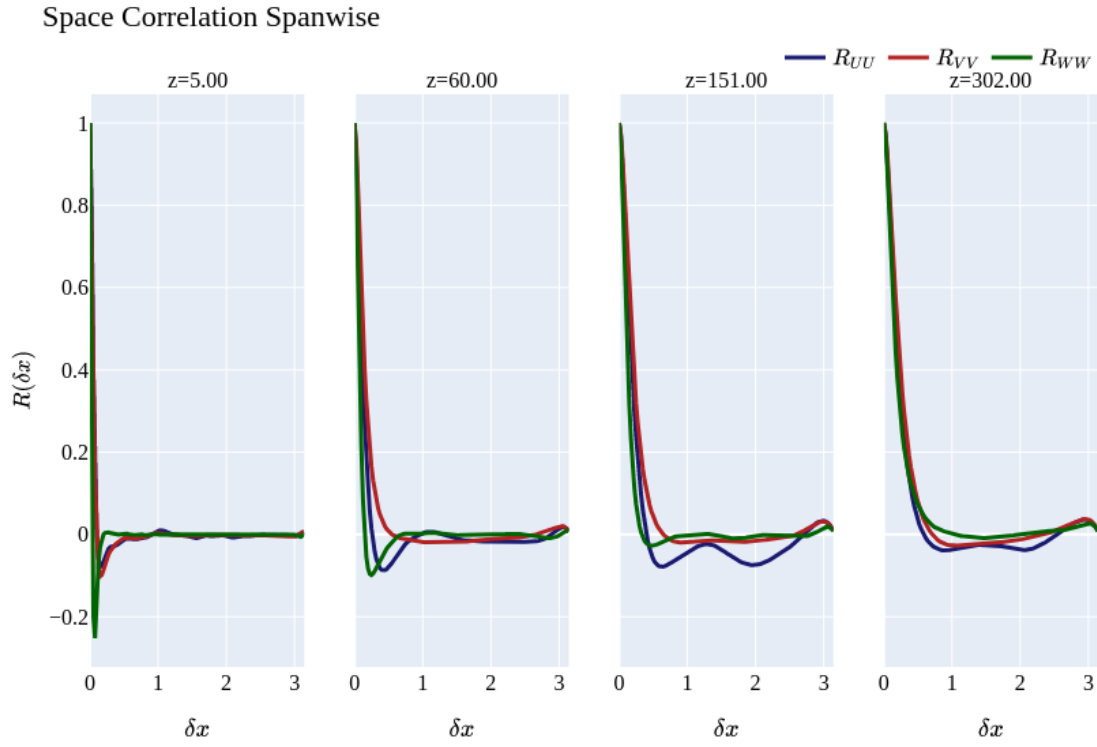
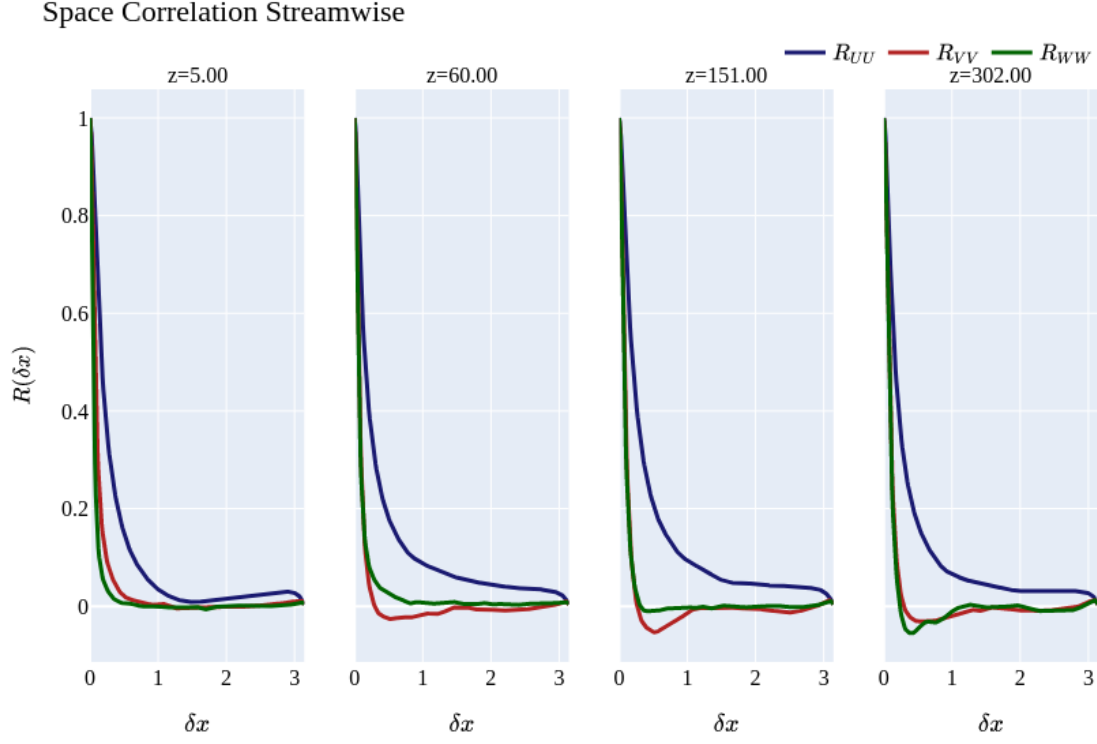
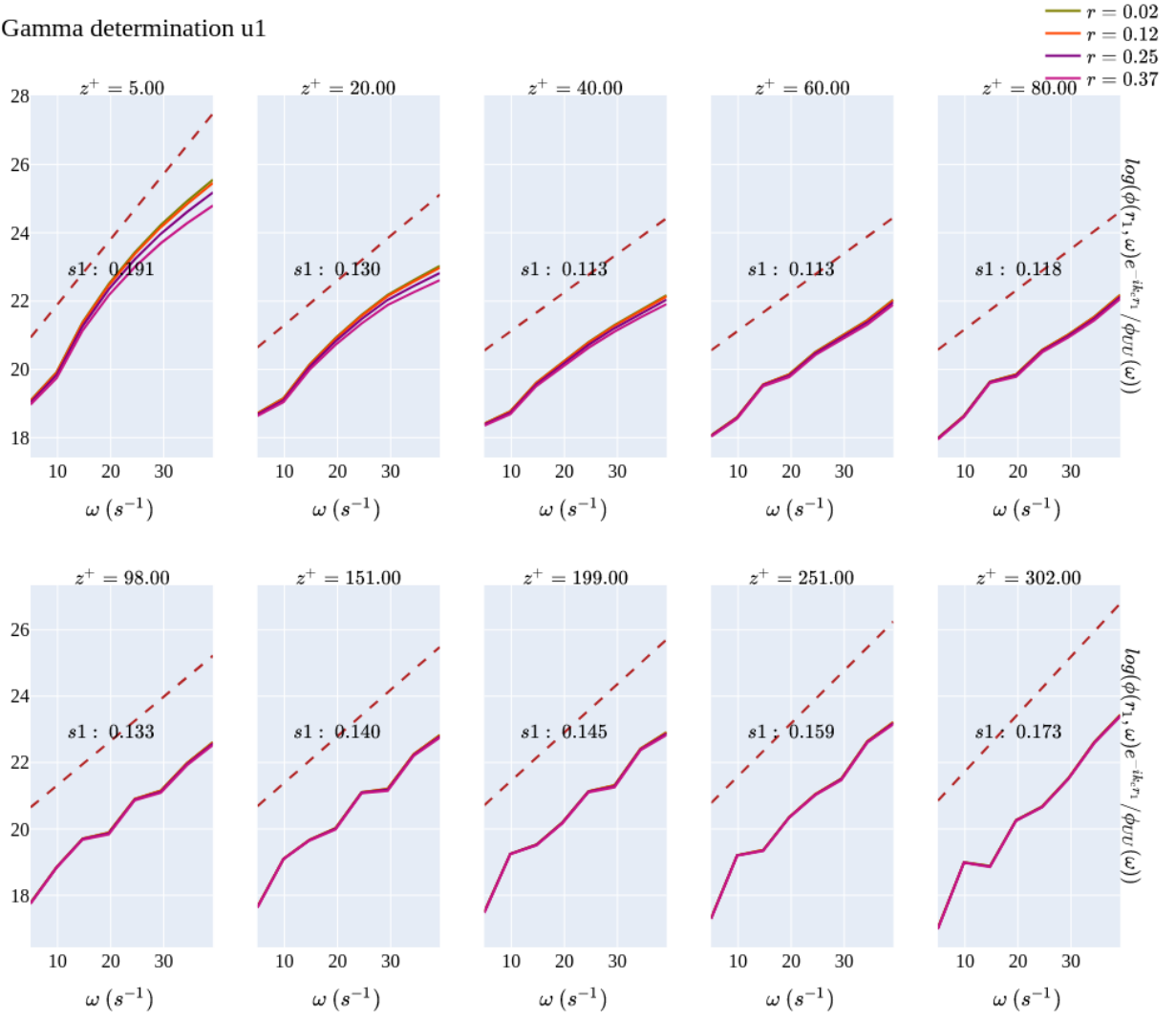
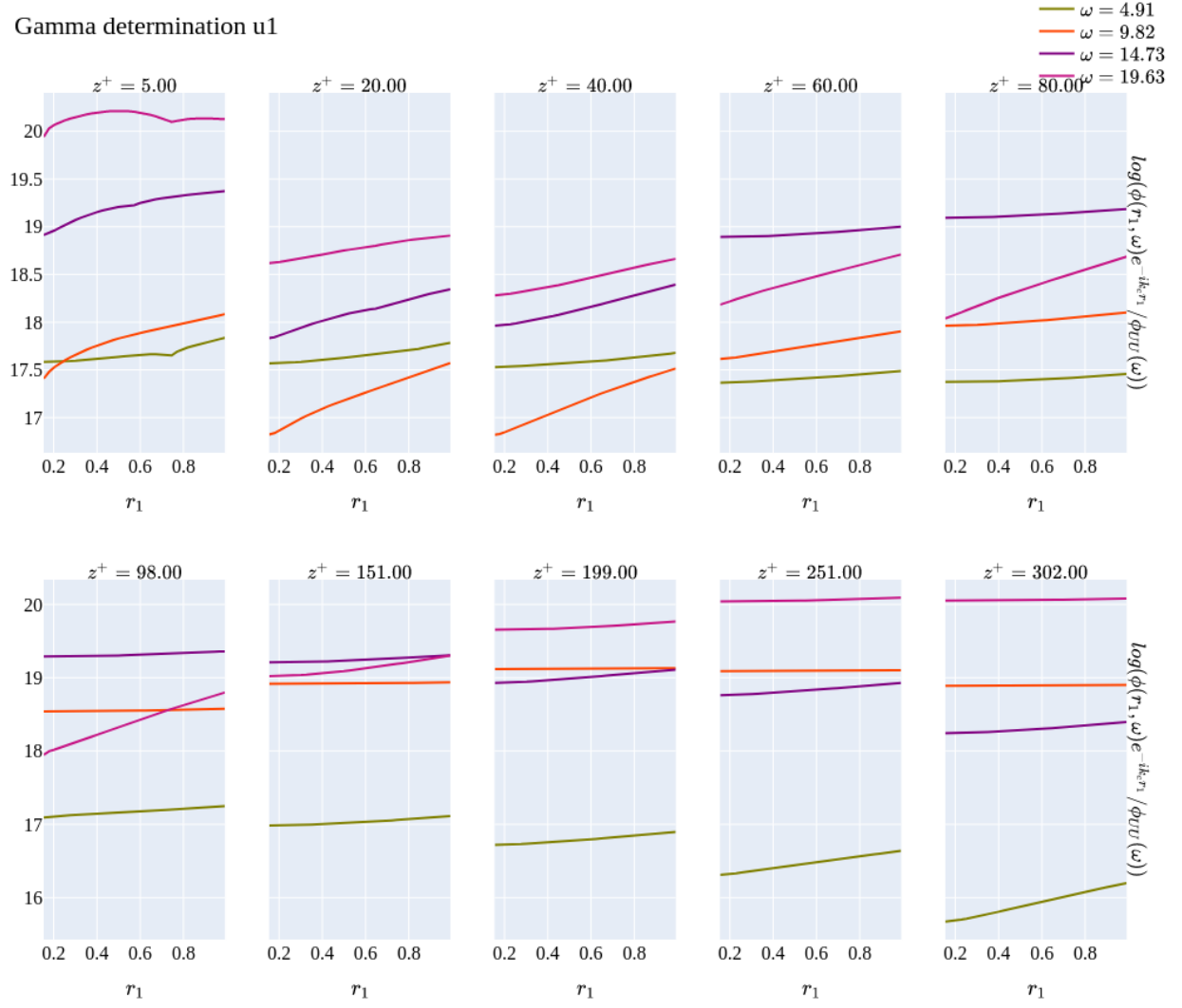


Figure 9: Spatial correlation in a streamwise plan (top figure) and in a spanwise plan (bottom figure). U is the streamwise, V the spanwise and W the wall-normal velocities

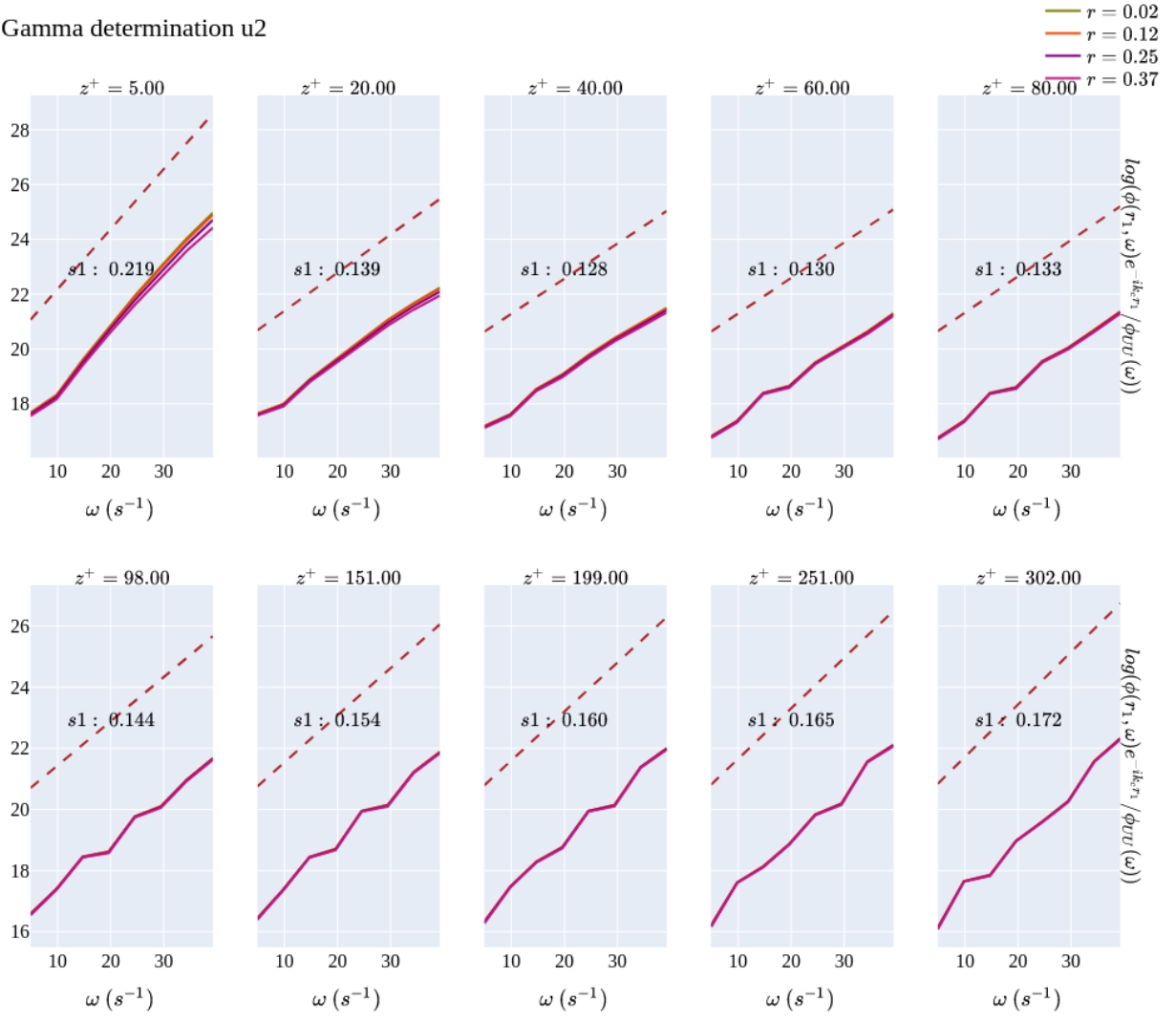
Gamma determination u1



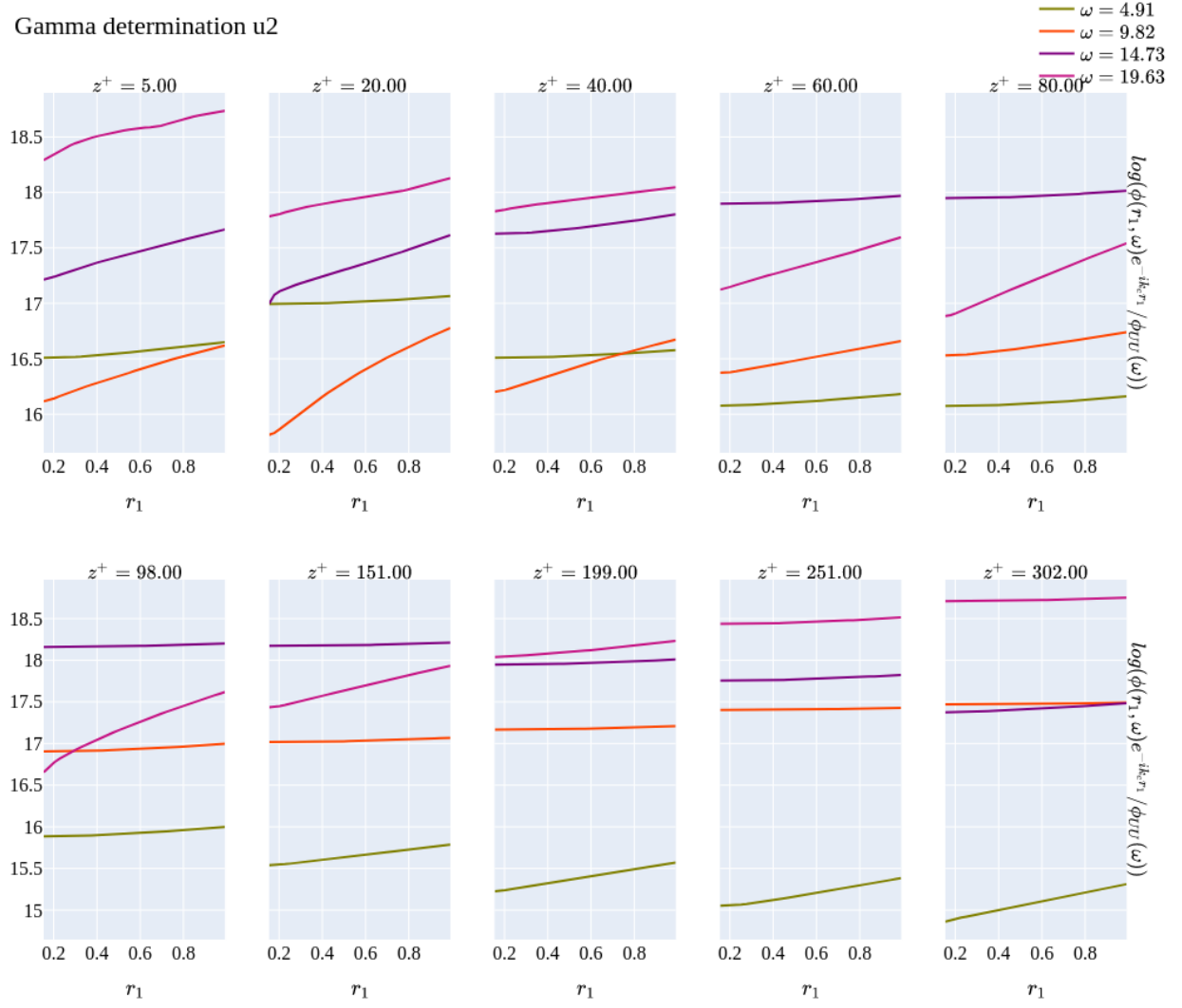
Gamma determination u1



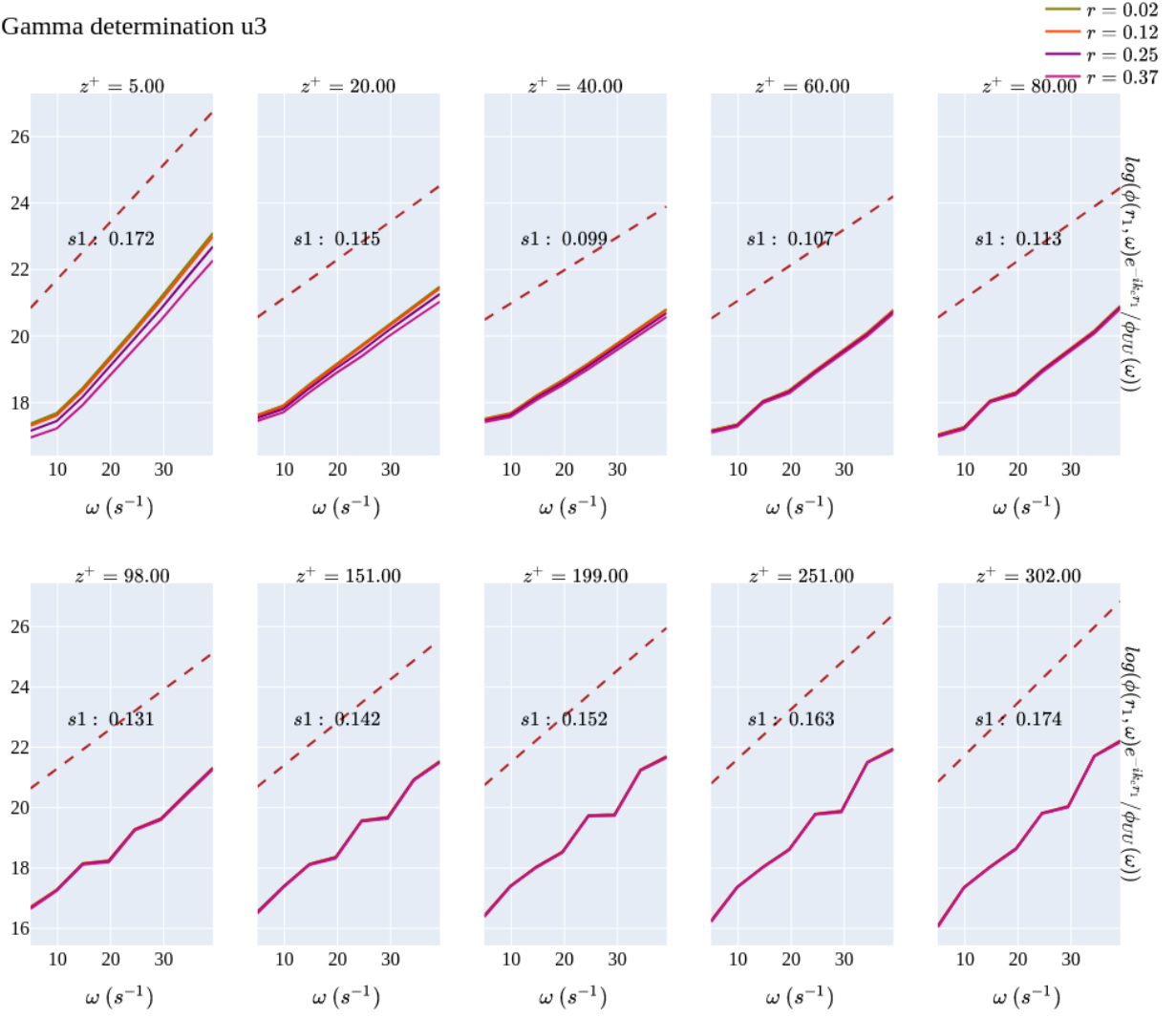
Gamma determination u2



Gamma determination u2



Gamma determination u3



Gamma determination u3

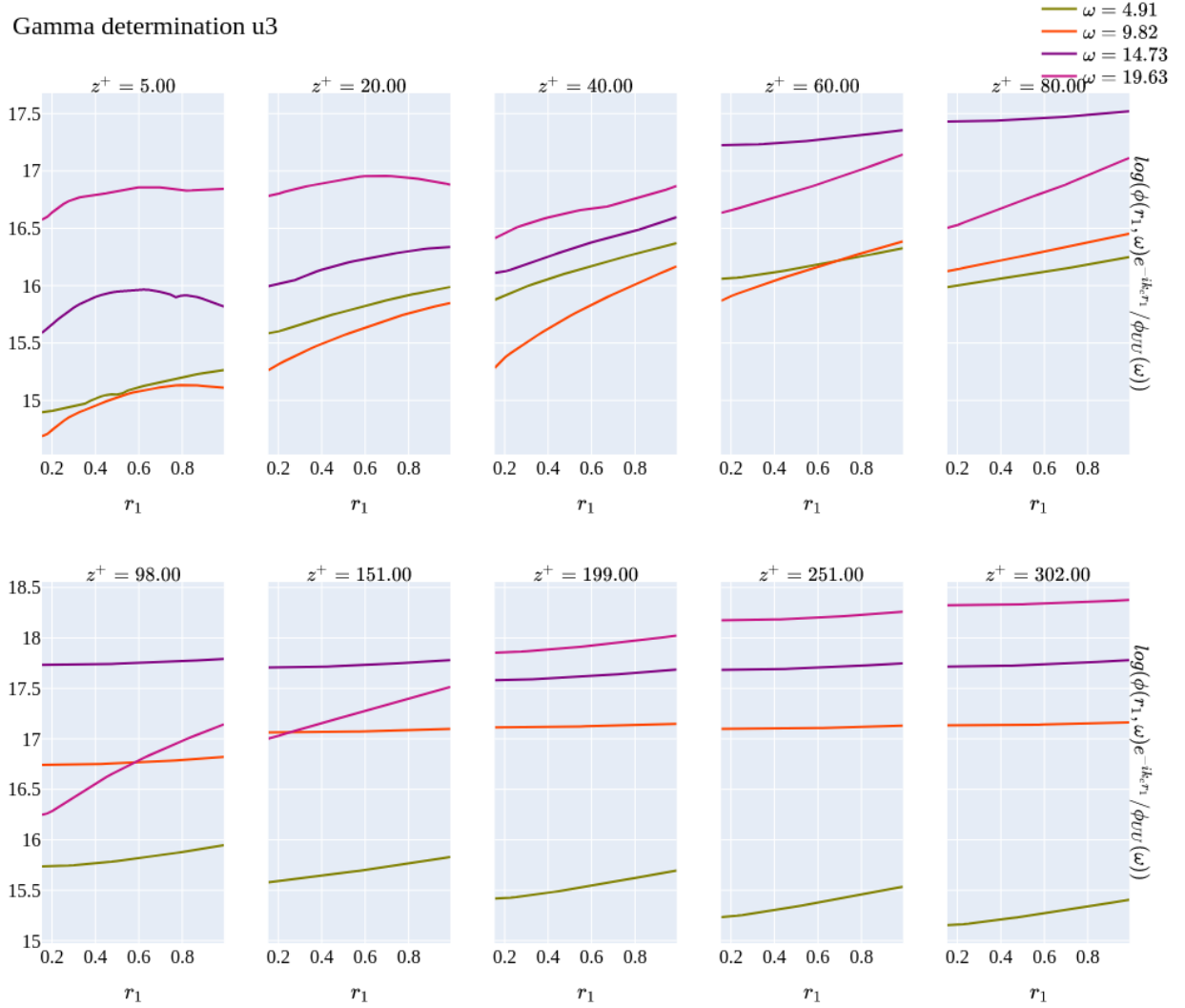


Figure 10: Determination of γ coefficient as $e^{-\gamma k_c r_1} = \frac{\phi(r_1, \omega)}{\phi_{ii}(\omega)} e^{-i k_c r_1}$ plotted in function of ω or r . All these spectra are computed with streamwise plan with streamwise velocity (top figure), spanwise velocity (middle figure) and wall-normal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

Gamma evolution

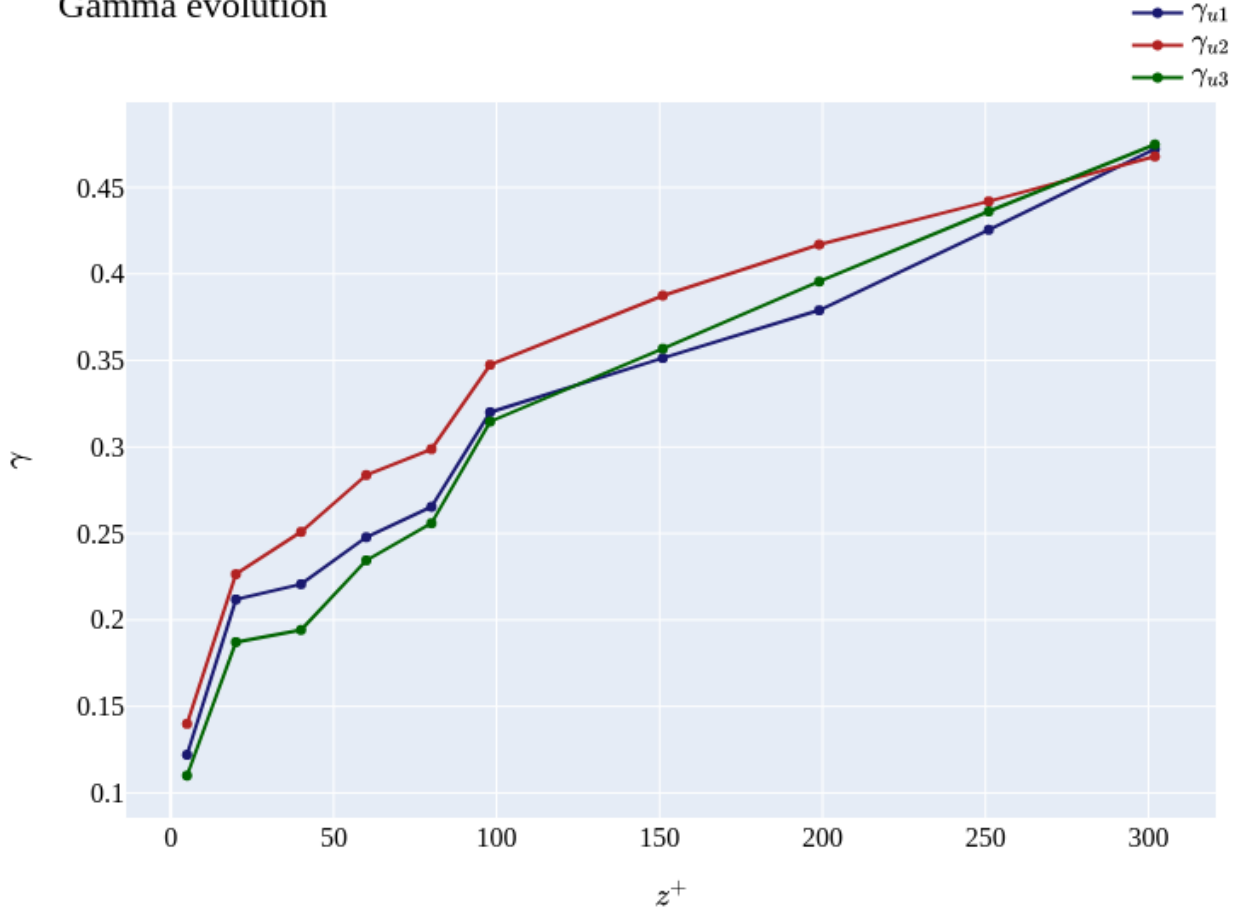


Figure 11: Figure representing the evolution of γ coefficient in function of z^+ for the ω dependency, determined by the precedent figures.

Gamma evolution

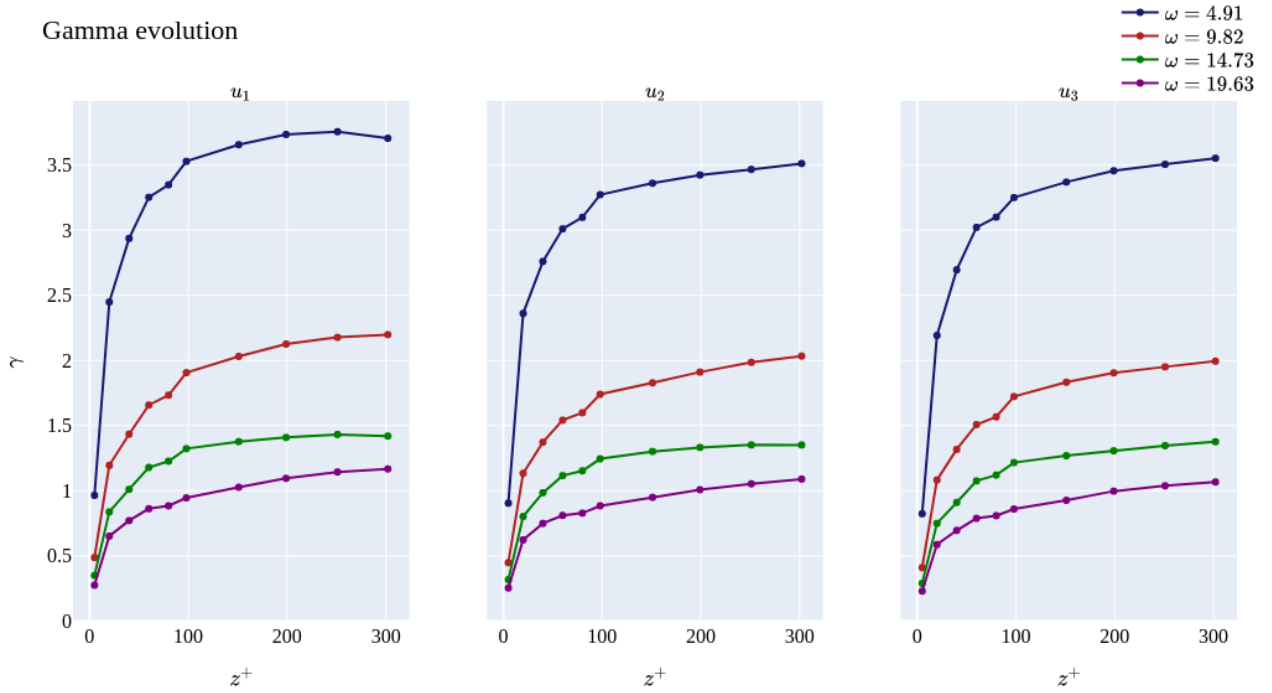


Figure 12: Figure representing the evolution of γ coefficient in function of z^+ for the r dependency determined by the precedent figures.

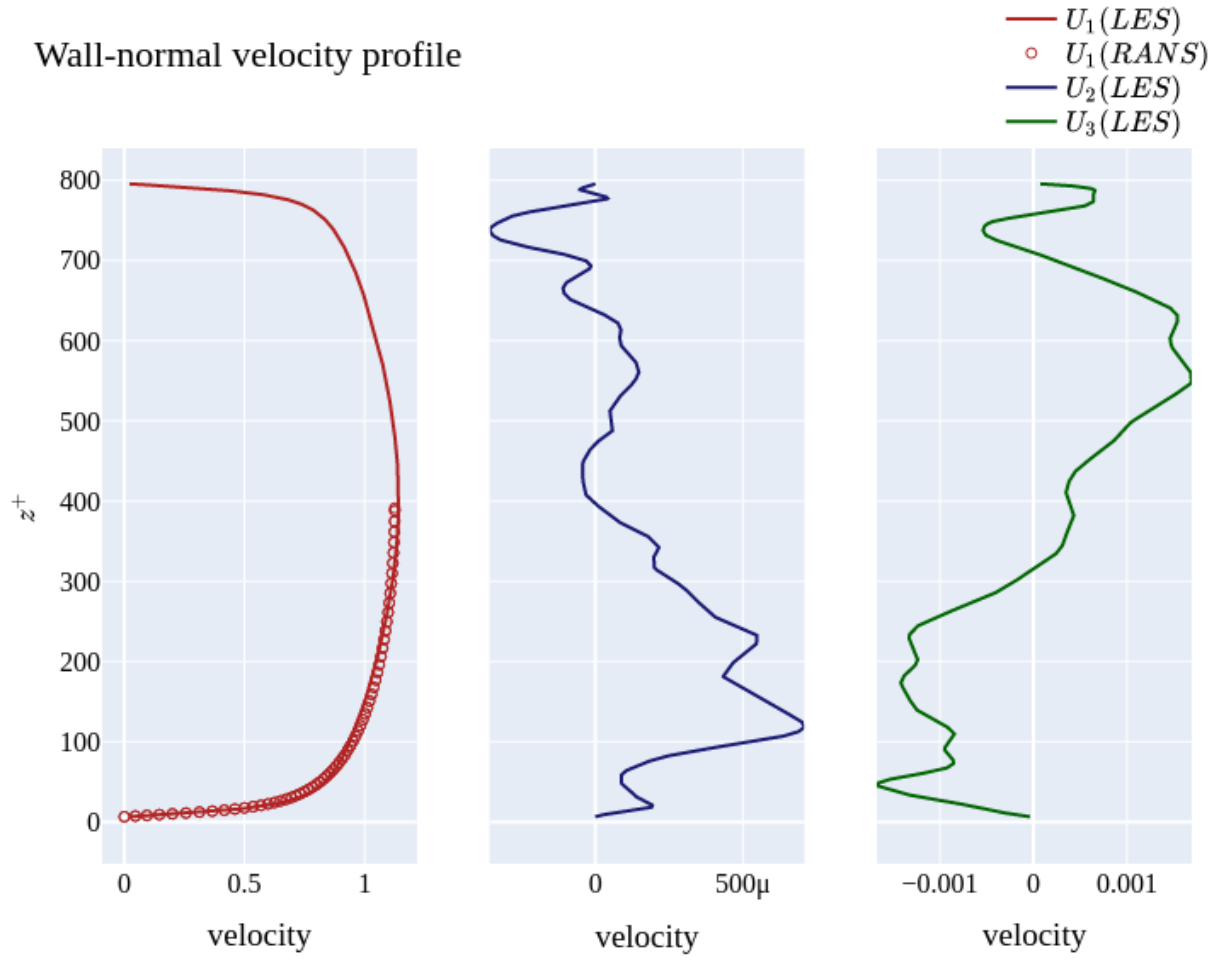


Figure 13: Mean velocity profile for a normal plan taken at the middle of the channel with 10 wall-normal lines having 1936 points each.

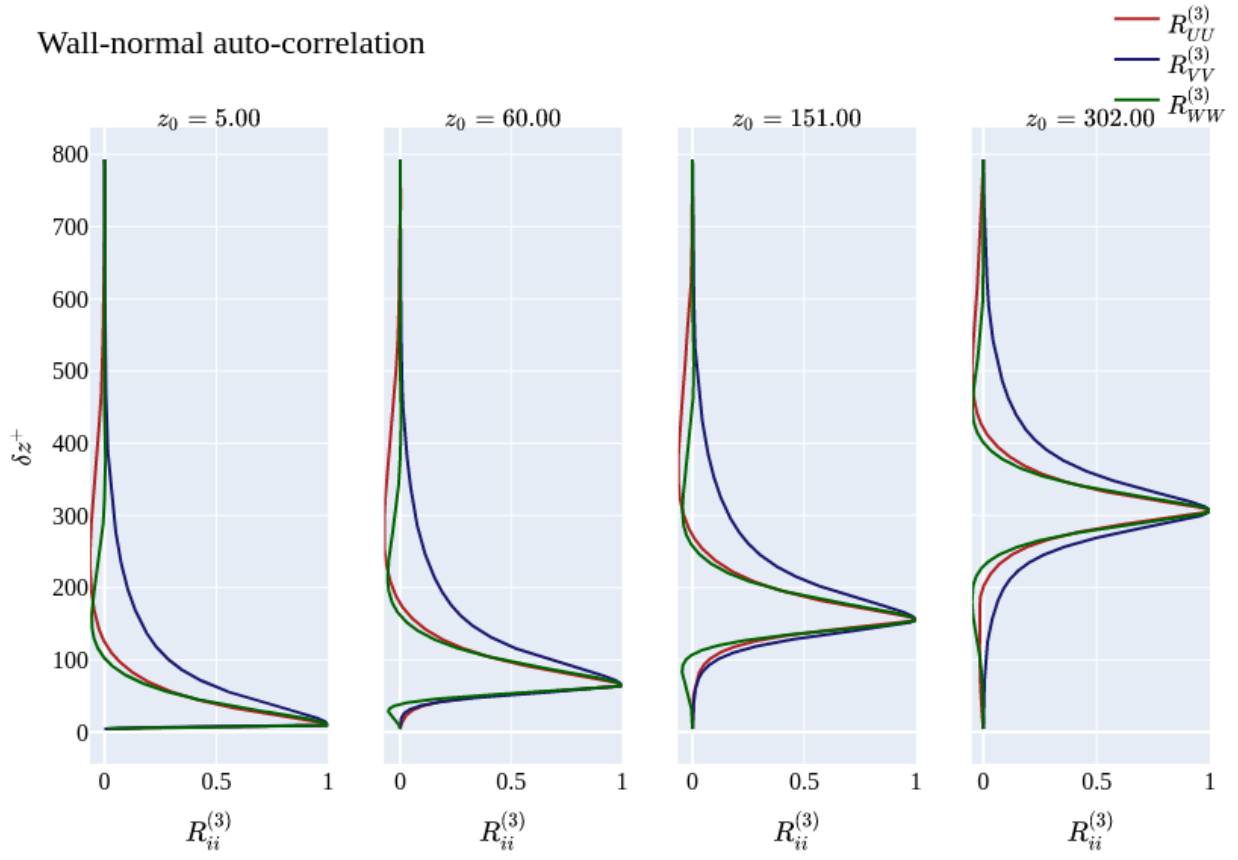
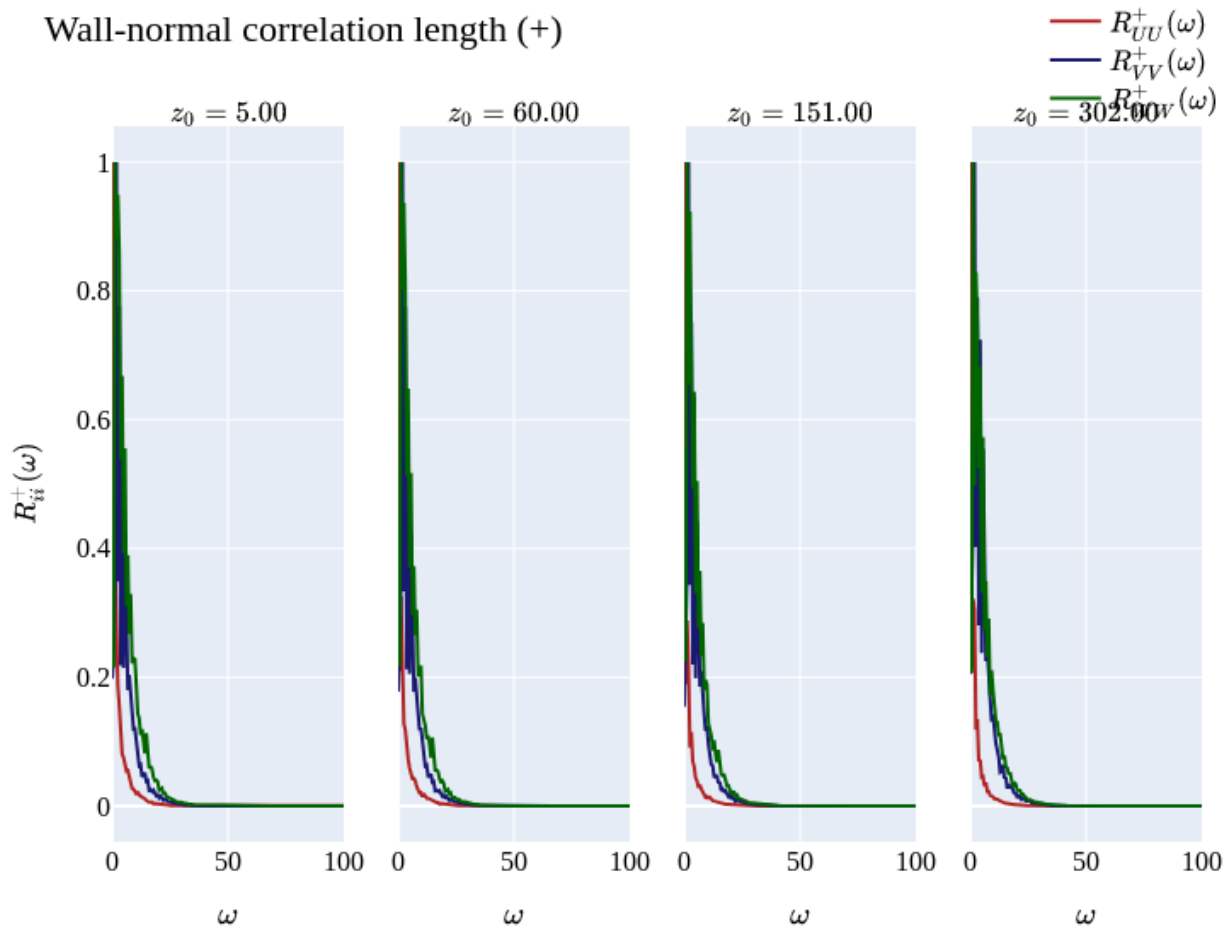


Figure 14: Autocorrelation at different height references (z_0) for the wall-normal plan.

Wall-normal correlation length (+)



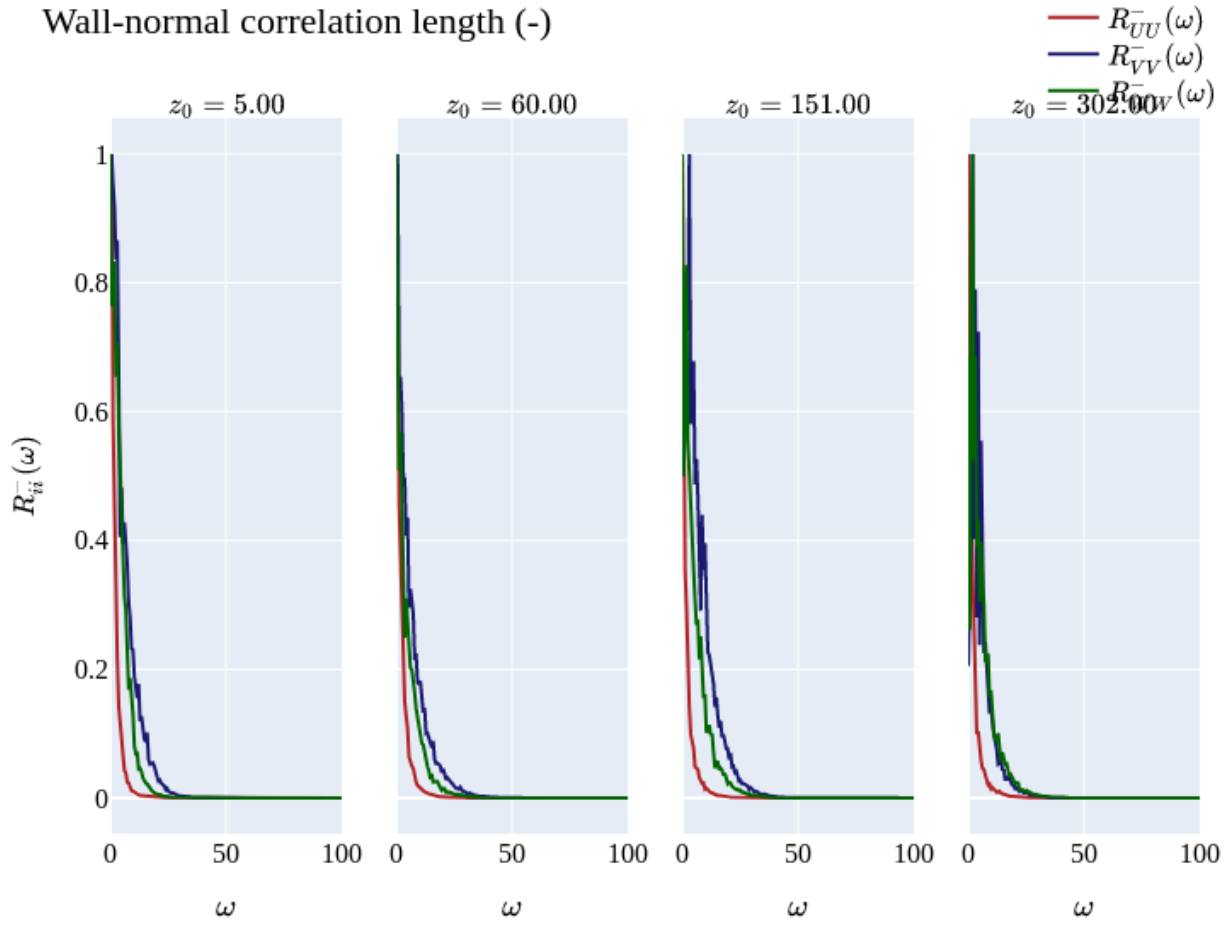
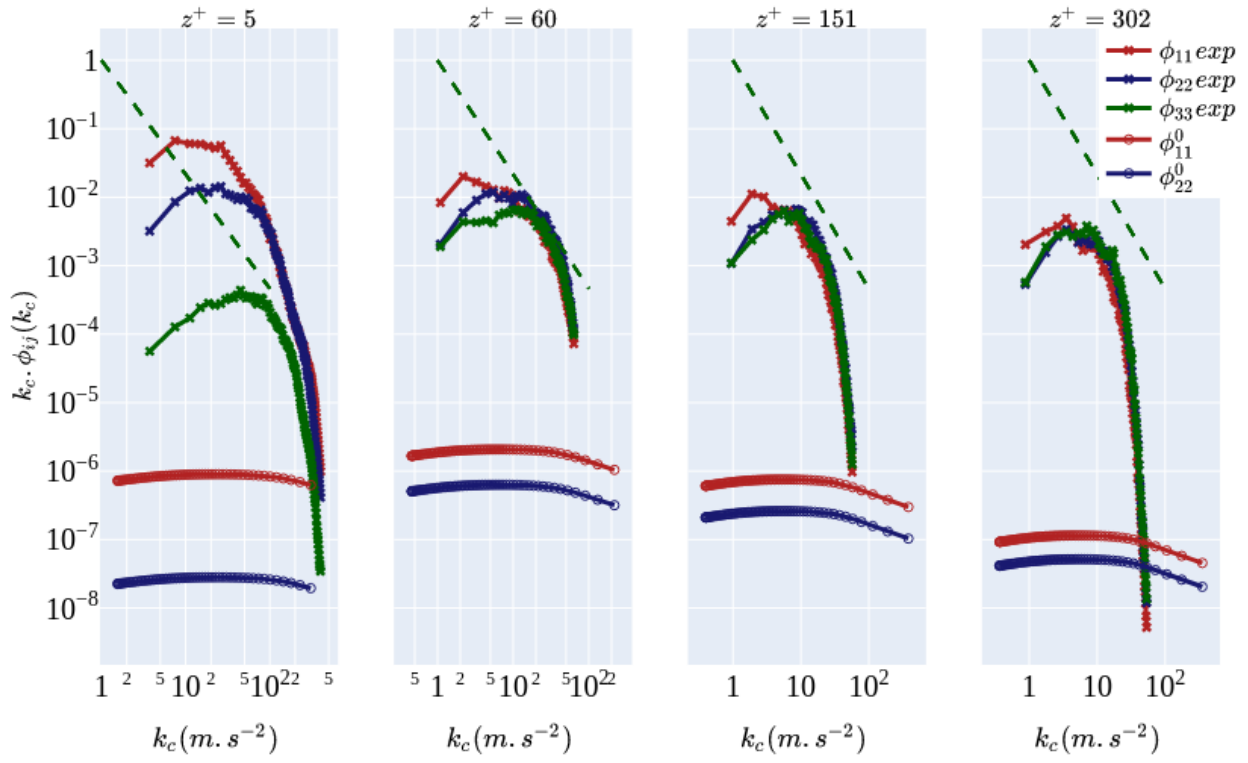


Figure 15: Representing the function $R_{ii}^{+/-}(z, \omega) = \int_{\delta z} \langle u_i(z, \omega) u_i^*(z + \delta z, \omega) \rangle d\delta z$ summed on z and plotted in function of ω

Von Karman Spectra



Von Karman Spectra

