becomes fully turbulent. The amplitudes at $f_m$ therefore differs depending on how far upstream the meandering started to build up. Also, it again shows that the meandering and subsequent transition occurs earlier in the CLBM cases. Additionally, the signature of the blade passage is still visible in the lower-resolution CLBM cases. This is not the case for the NS reference, despite the smaller meandering at this downstream position. In line with the observations made earlier, this aspect might relate to a higher numerical dissipation of the NS scheme.

Further downstream at $x = 24D$ the wake is fully turbulent in all CLBM cases, characterised by a sub-intertial range with a typical $-5/3$-slope. This is also the case for the NS solution with $\Delta x = D/32$. Here, however, the meandering is still more visible due to the later start of the transition of the wake. Also, when comparing both approaches at the highest spatial resolution (bottom right in Fig. 7) it shows that the sub-inertial range of the CLBM approach reaches to higher frequencies. In accordance with that, it appears that the CLBM does indeed resolve smaller turbulent structures, as shown in the contour plot of the Q-criterion (Fig. 11).

![Rendering of the instantaneous contours of the Q-criterion ($Q = 0.0005$) in the far-wake with the CLBM and NS with $\Delta x = D/32$.](image)

**Figure 11.** Rendering of the instantaneous contours of the Q-criterion ($Q = 0.0005$) in the far-wake with the CLBM and NS with $\Delta x = D/32$.

## 5 Code-to-code Comparison in Turbulent Inflow

Laminar inflow cases allow for a good comparison of fundamental numerical aspects as discussed in Sect. 4. Nevertheless, the case itself remains rather academic as atmospheric inflows are mostly turbulent. Furthermore, Sect. 4 has shown that a direct comparison of the far-wake can be difficult due to the different downstream positions of the laminar-to-turbulent transition of the wake. A turbulent inflow generally accelerates the transition while reducing the dependency of the point of transition on the numerical diffusivity of the scheme. A complementing comparison in turbulent inflow will therefore be presented in the following. For the sake of brevity we limit the discussion to cases with the highest spatial resolution $\Delta x = D/32$. Apart from the introduction of turbulence at the inlet both numerical set-ups remain unchanged. Also note, that the mean resulting blade loads exhibit no notable difference towards the laminar inflow case. Additional discussion beyond Sect. 4.1 is therefore omitted.