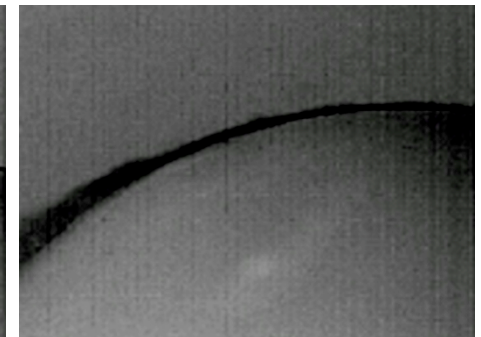
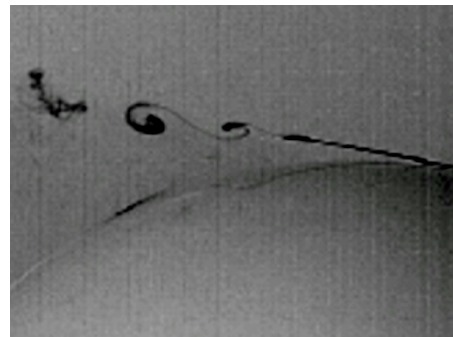
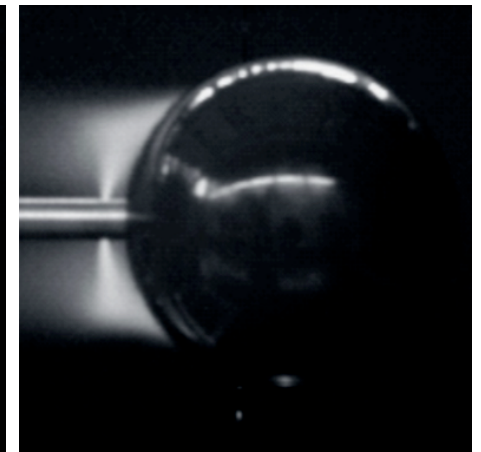
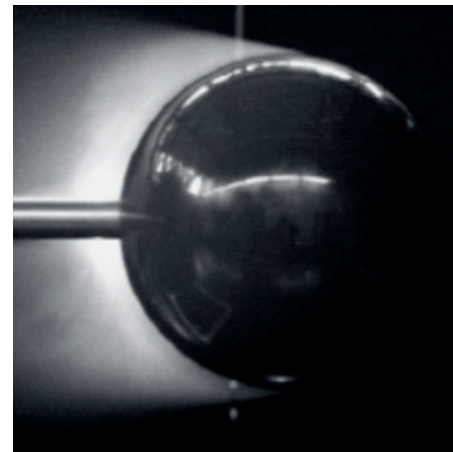




Adaptive methods, stability and a posteriori error estimation

numfcl-2010

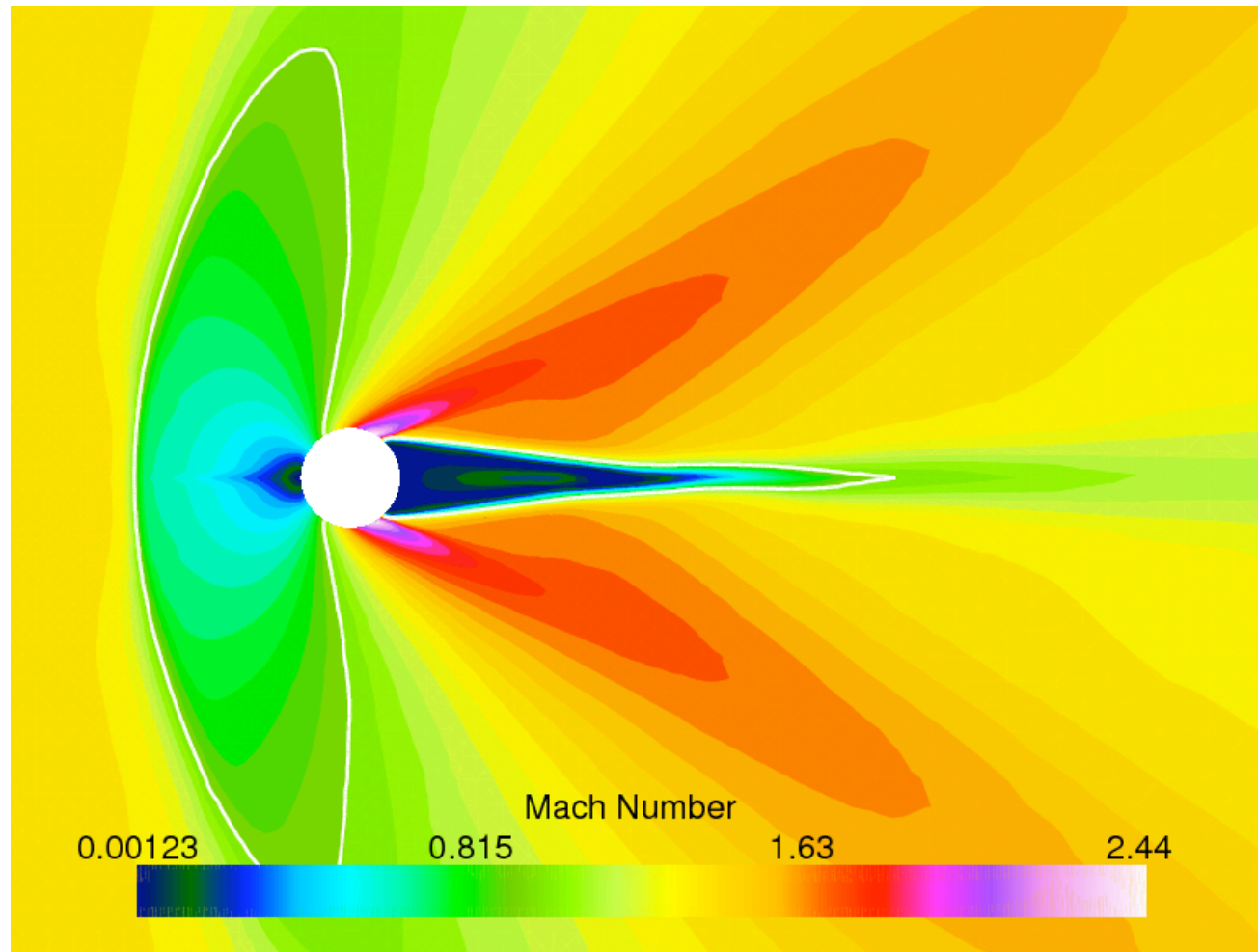
Turbulent flow



- Turbulence, boundary layers, shocks
- What can be computed?
- To what accuracy?
- To what cost?
- Exponential perturbation growth! (chaos)

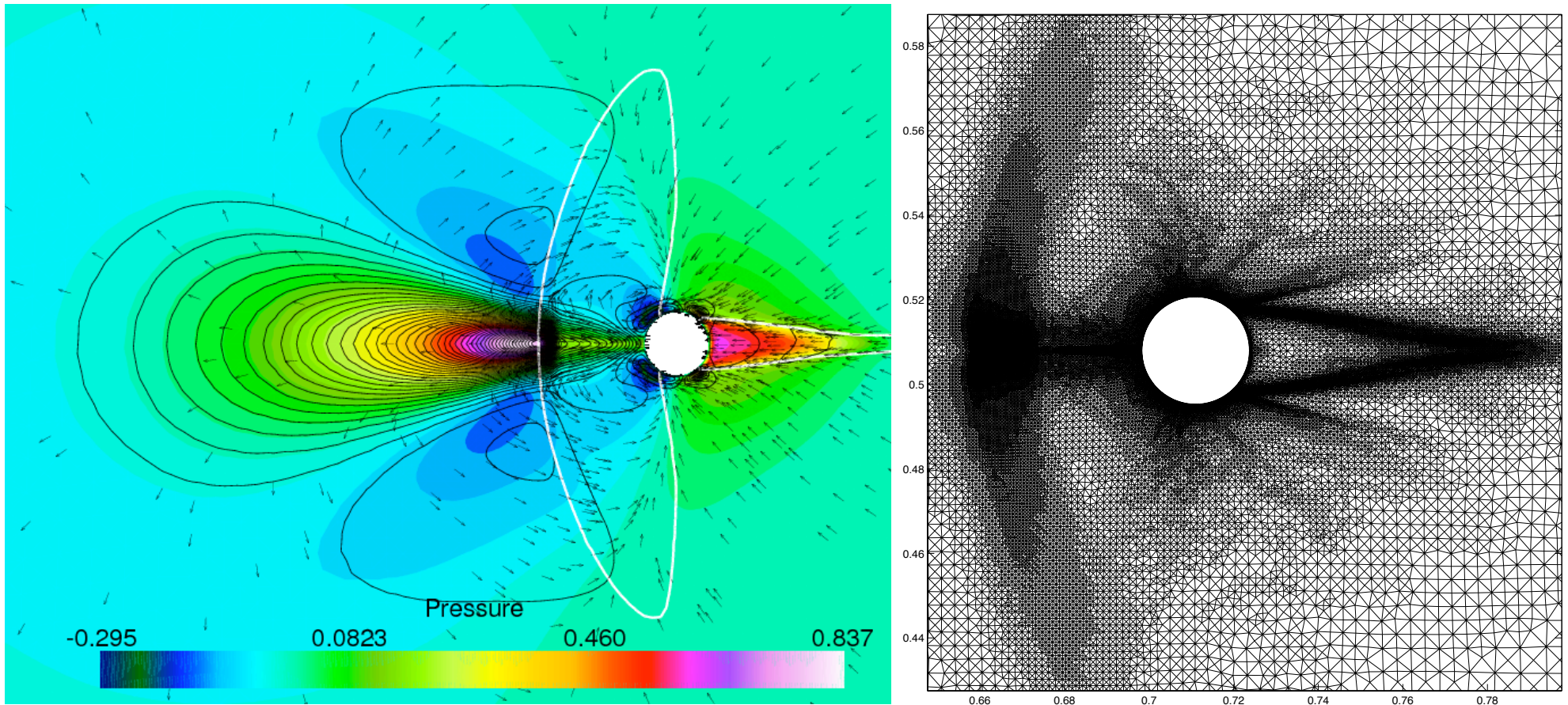


2D cylinder: Mach = 1.4



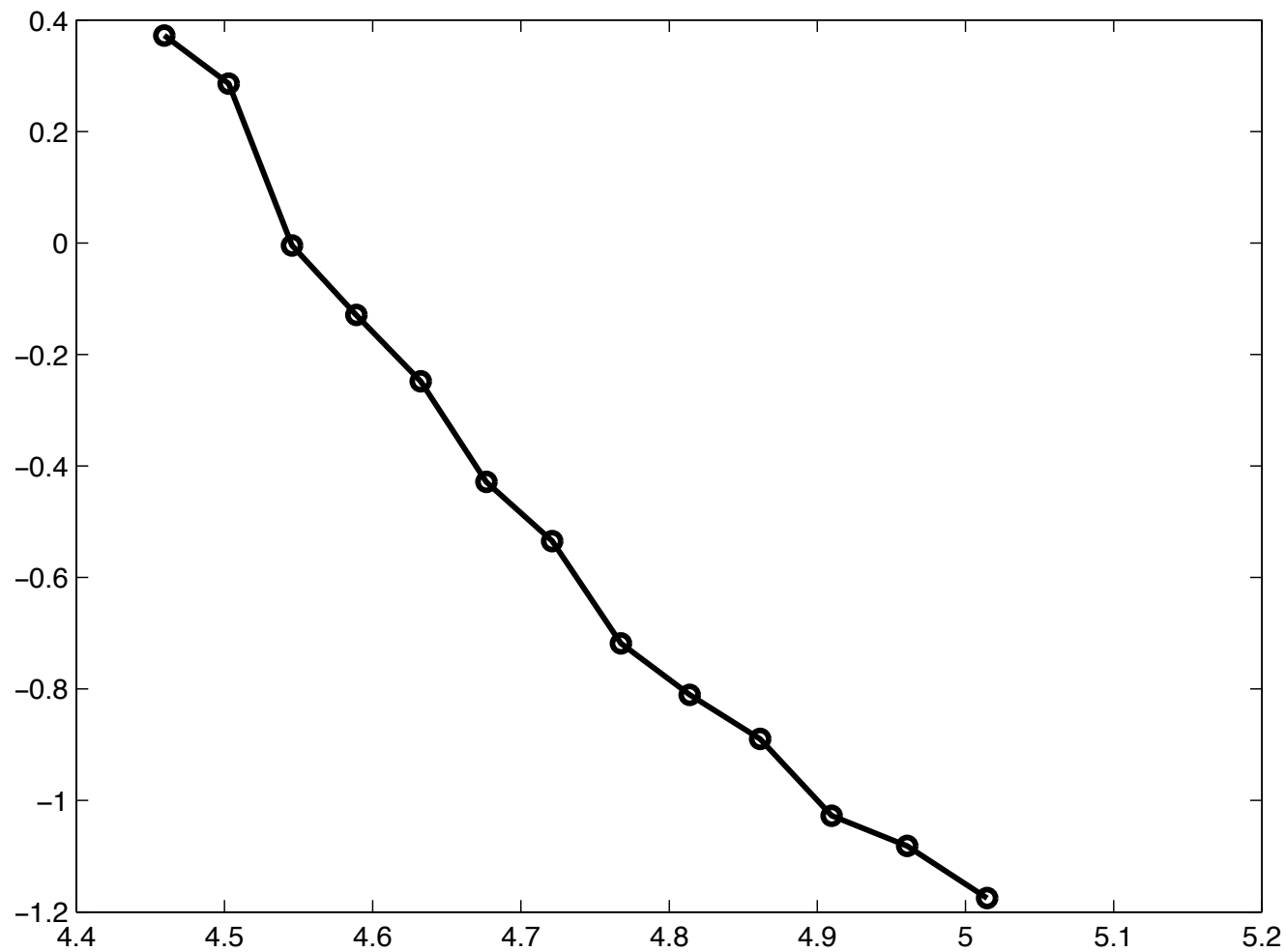
[M.Nazarov/J.Hoffman IJNMF 2010]

Dual solution and mesh (drag force)



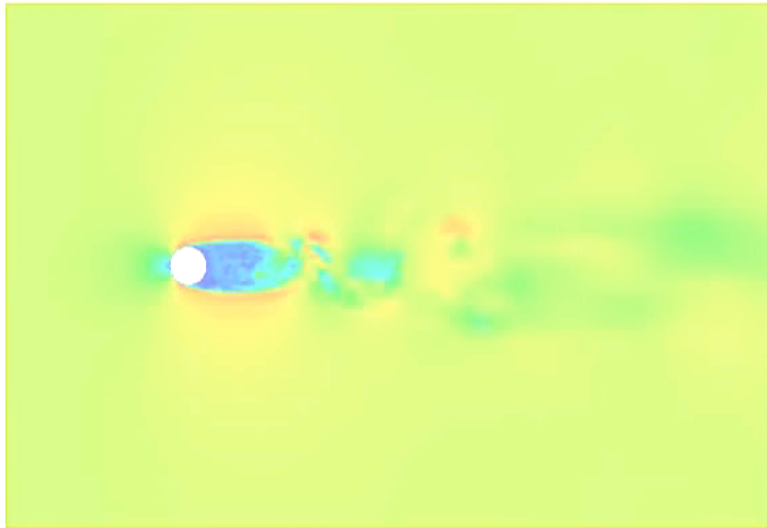
[M.Nazarov/J.Hoffman IJNMF 2010]

Error bound for drag $|M(u) - M(U)|$

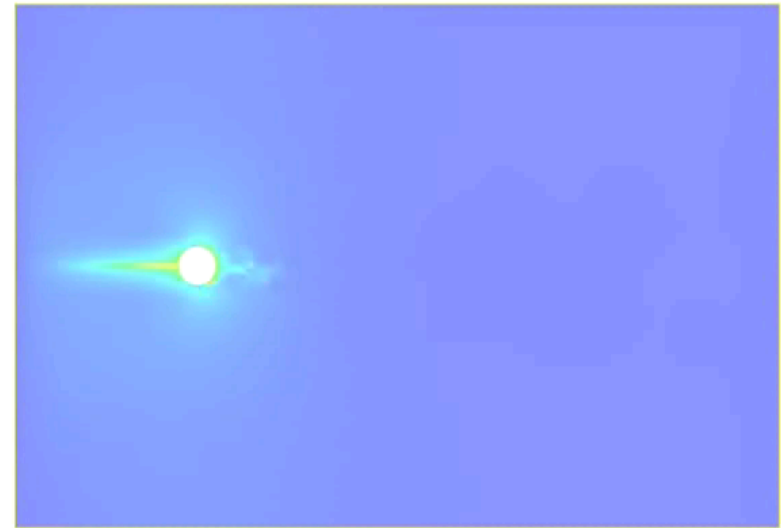
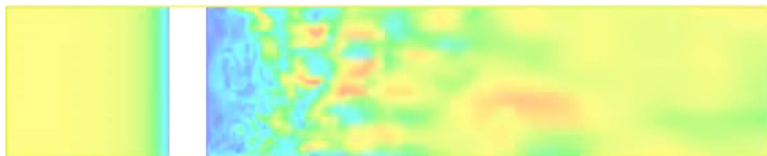


[M.Nazarov/J.Hoffman IJNMF 2010]

Ex: 3d circular cylinder $Re=3900$



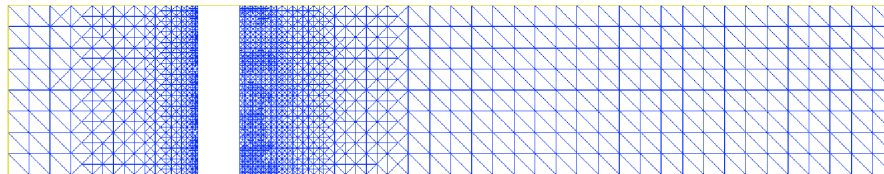
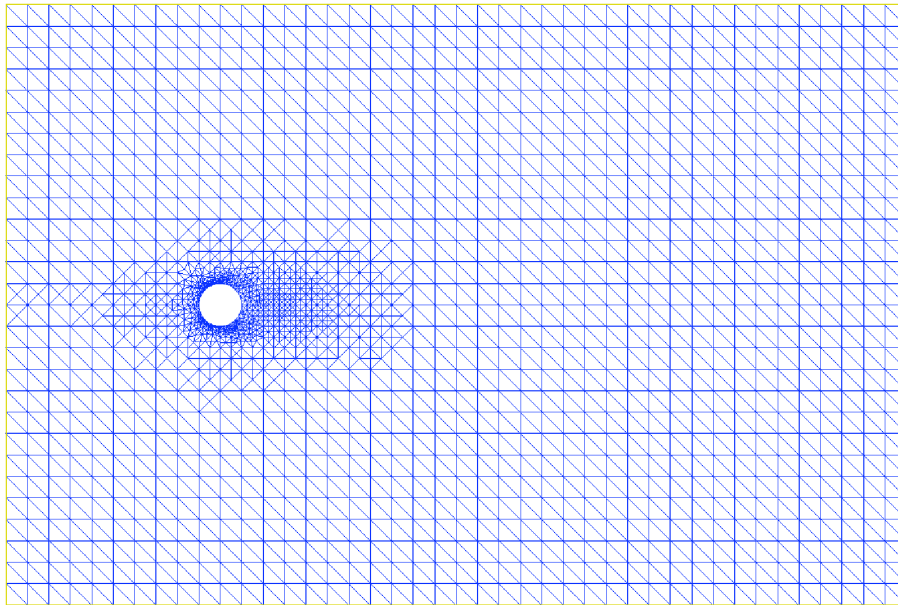
Primal solution



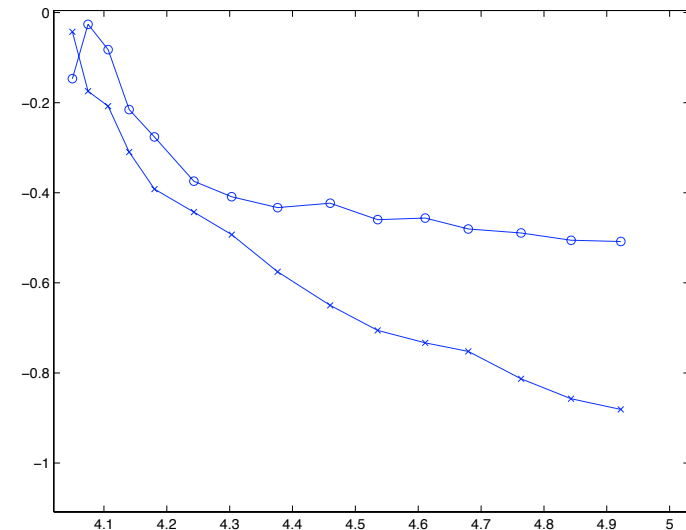
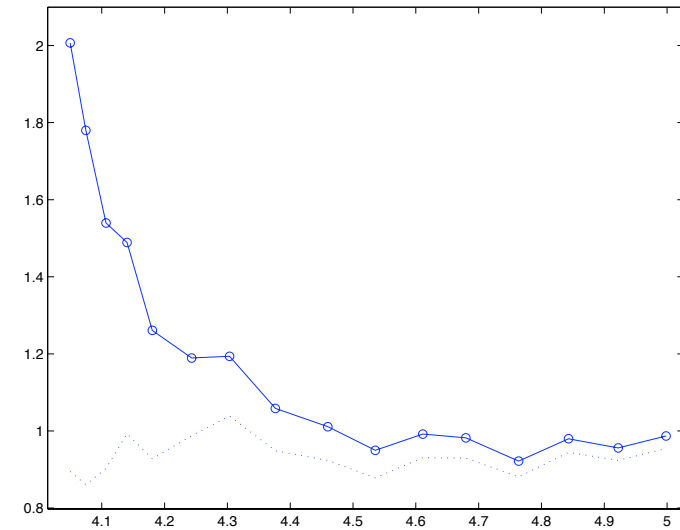
Dual solution for drag



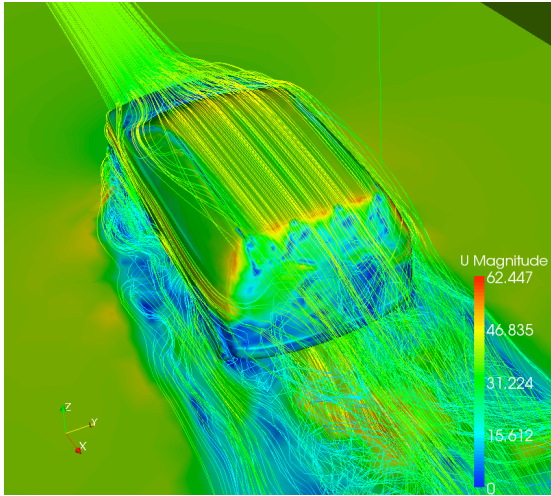
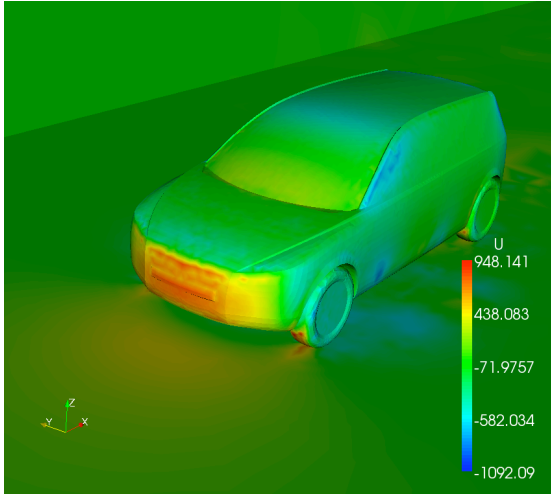
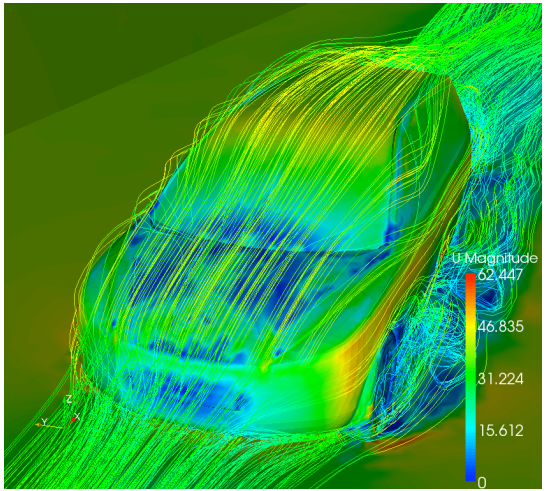
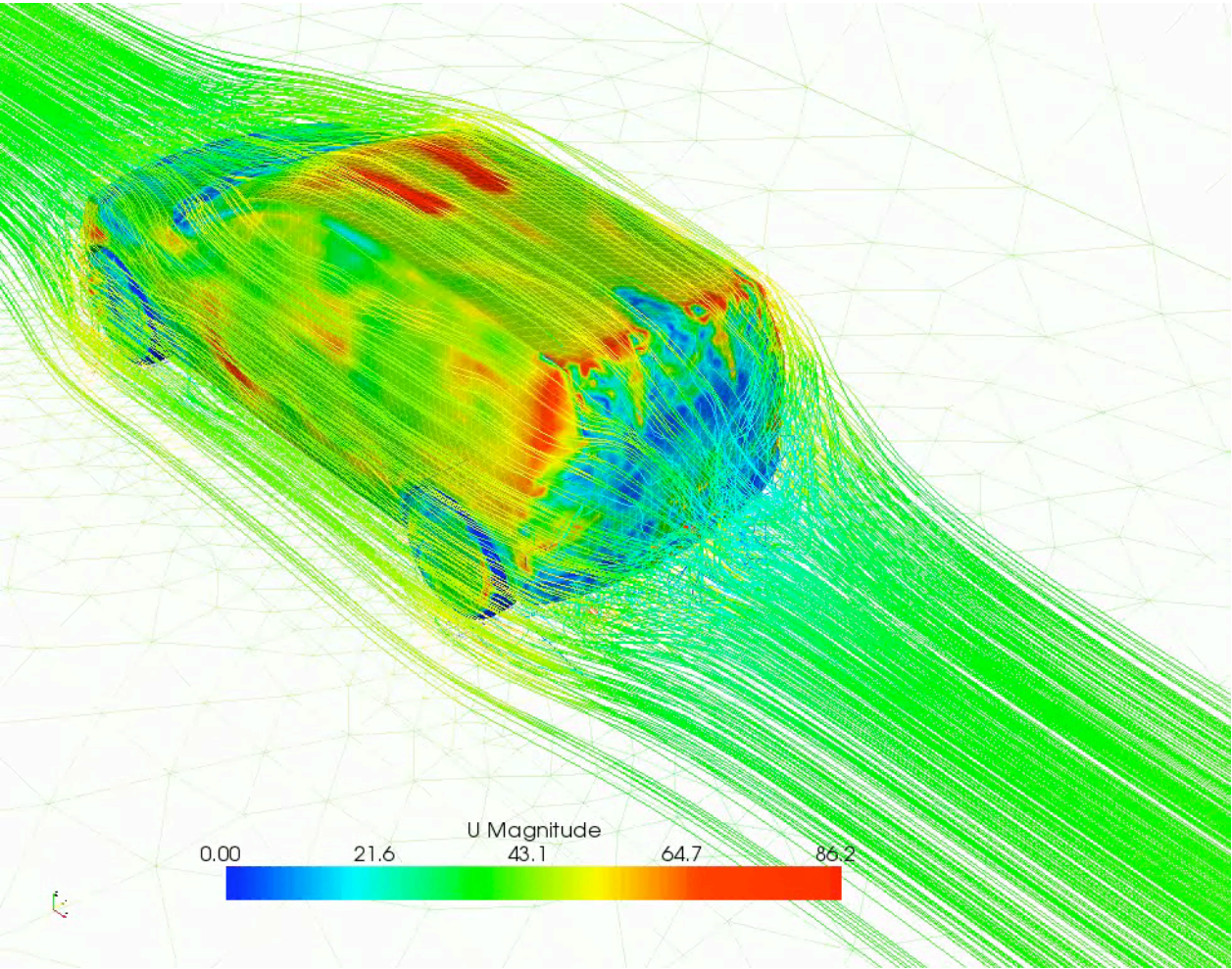
Convergence in drag: $< 10^5$ nodes



Computational mesh after 15 refinements:
convergence to experiment in c_D , c_L , c_p , St, \dots

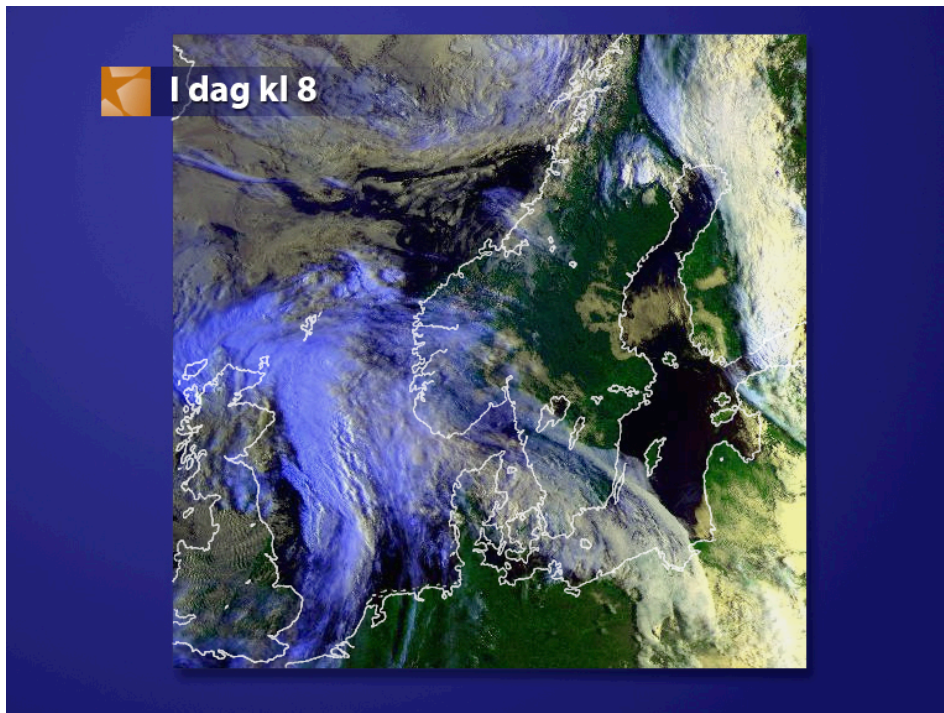


Computation of drag: geometry by Volvo Cars

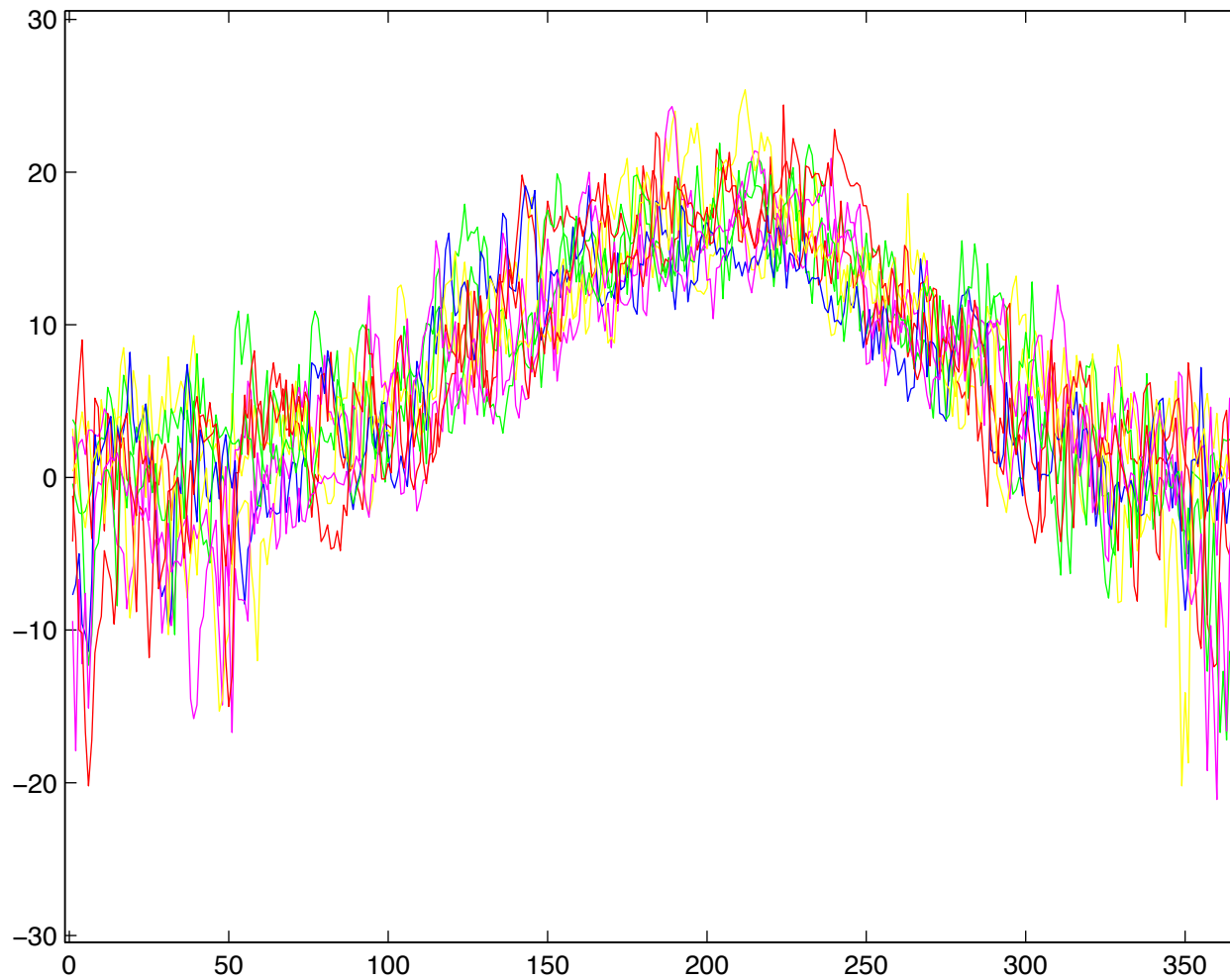


Varför inte 10-dygnsprognos?

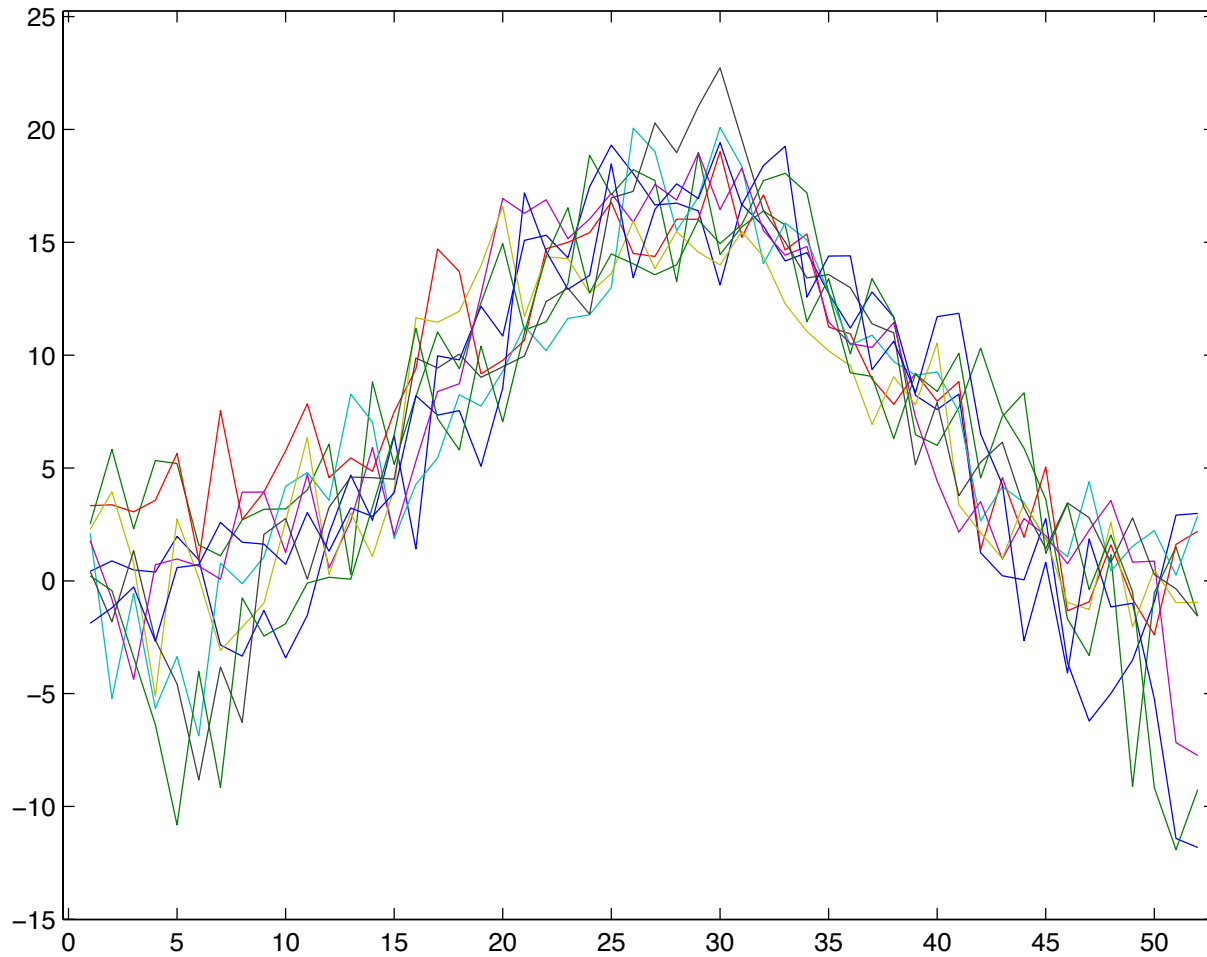
- Samla in data från väderstationer: fel i initialdata $u(0)-U(0)$
- Simulera vädret med Eulers ekvationer diskretiseringsfel – residual $R(U)$
- Stabilitet: stabilitetsfaktorer S_c, S_d



Temperatur in Målilla: dygnsmedel

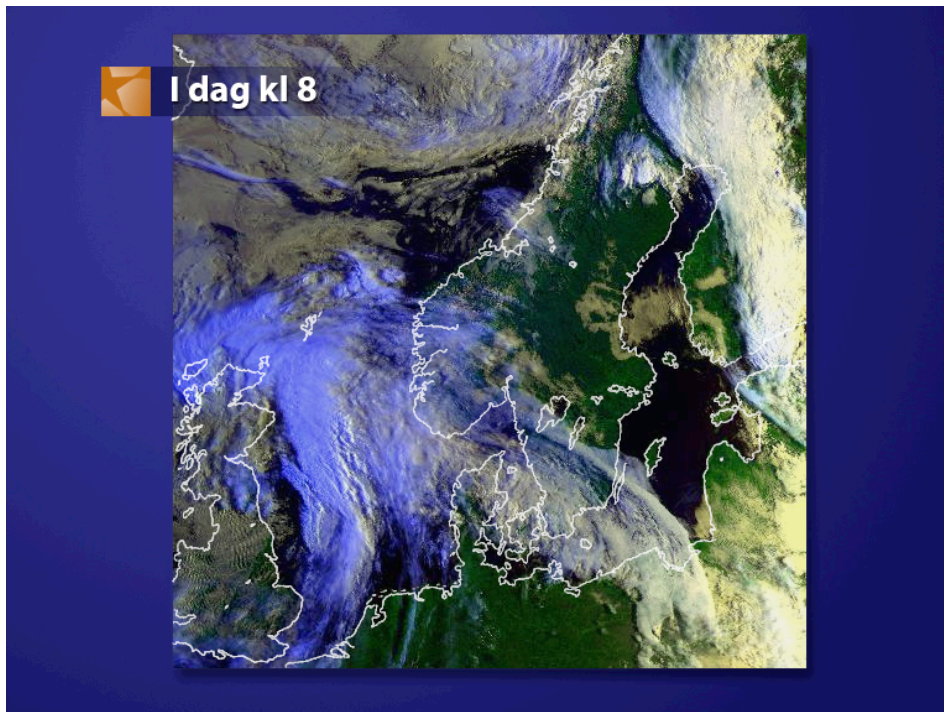


Temperatur in Målilla: veckomedel



Varför inte 10-dygnsprognos?

- Stabilitet: stabilitetsfaktorer S_c , S_d
- Stabilitet beror på vad som ska beräknas: medelvärden stabilare än punktvärden!
- Månadsmedeltemperatur predikterbar, men inte dagstemperatur längre än ca. 5 dygn!



Kursregistrering

- Alla studenter som följer DN1240, Numeriska metoder for F/CL, måste anmäla sig som aktiva på KTH's Rapp-system:
- <http://rapp.nada.kth.se/rapp/>
- senast på fredag 12 november!!