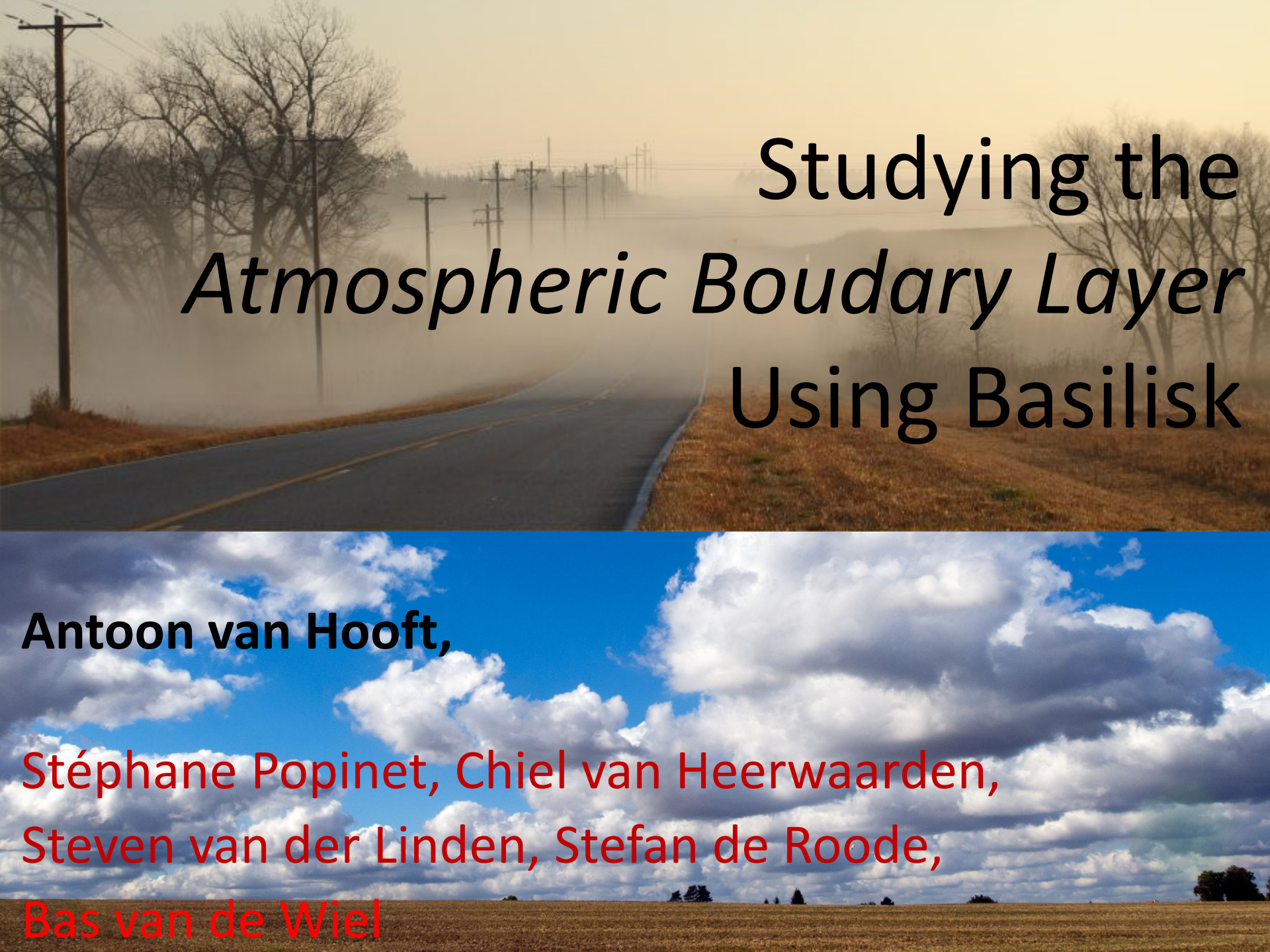
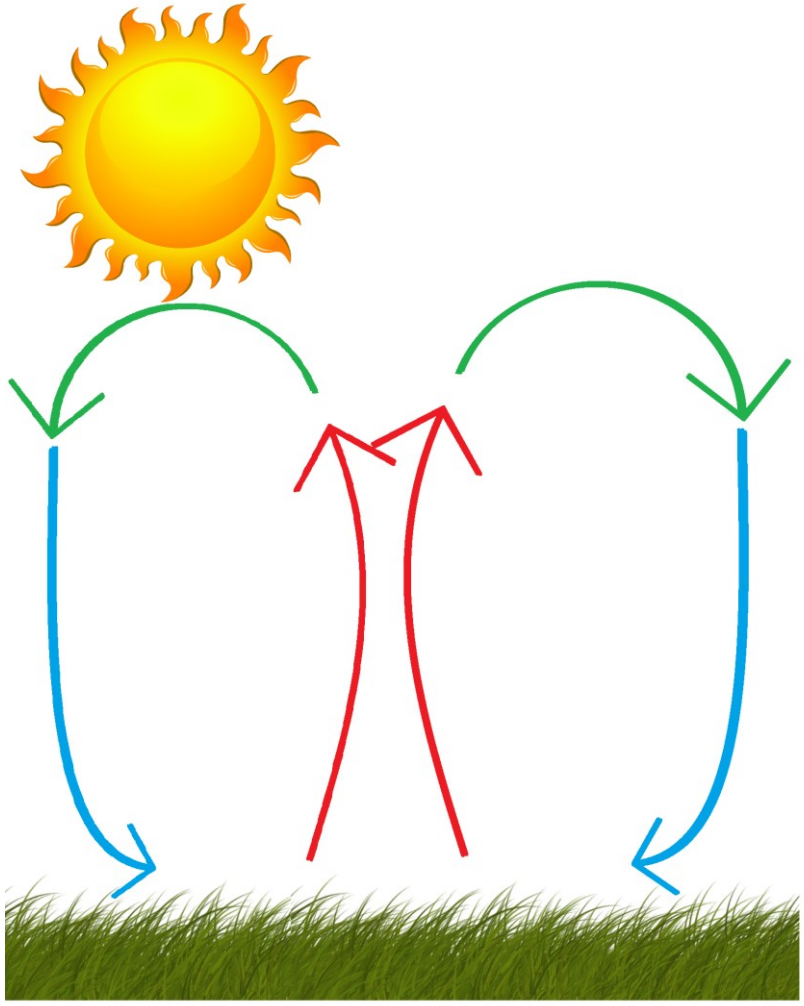


Studying the *Atmospheric Boudary Layer* Using Basilisk

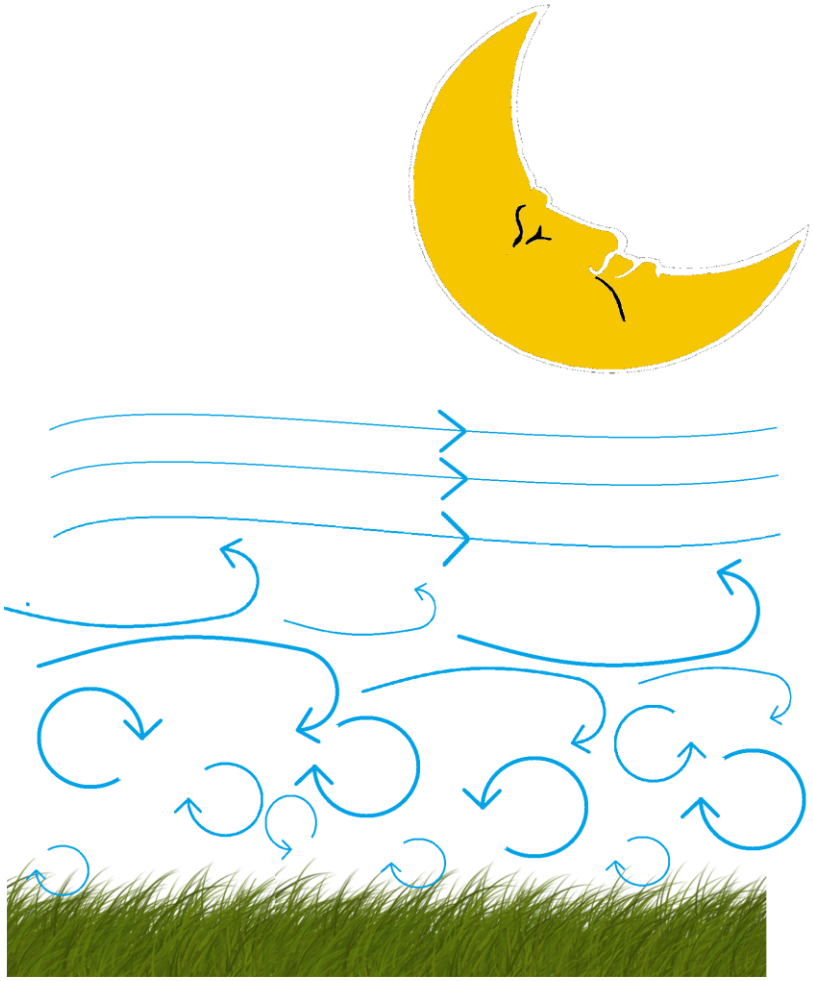
Antoon van Hooft,

Stéphane Popinet, Chiel van Heerwaarden,
Steven van der Linden, Stefan de Roode,
Bas van de Wiel

The Atmospheric Boundary Layer

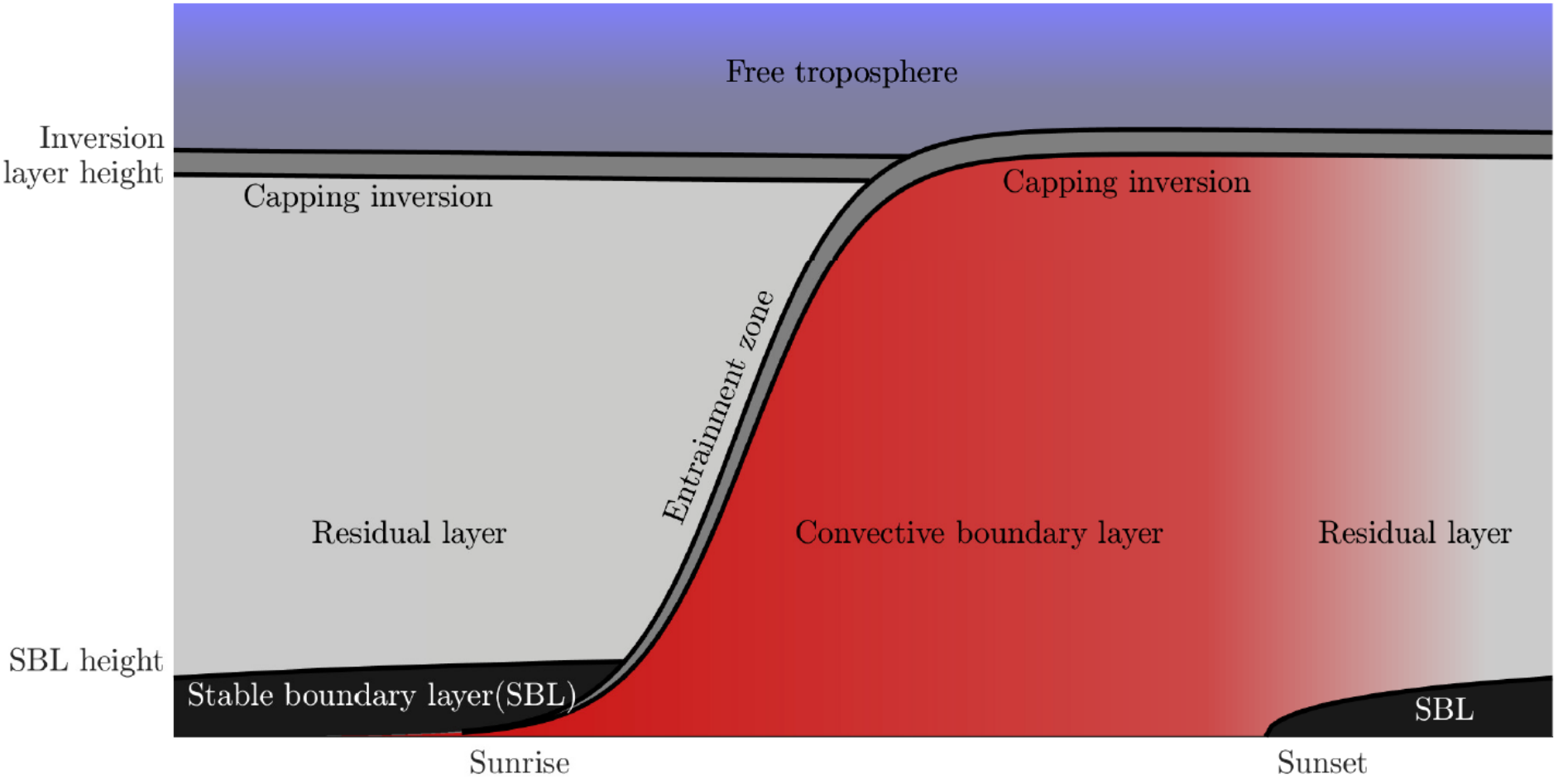


Daytime boundary layer



Nighttime boudary layer

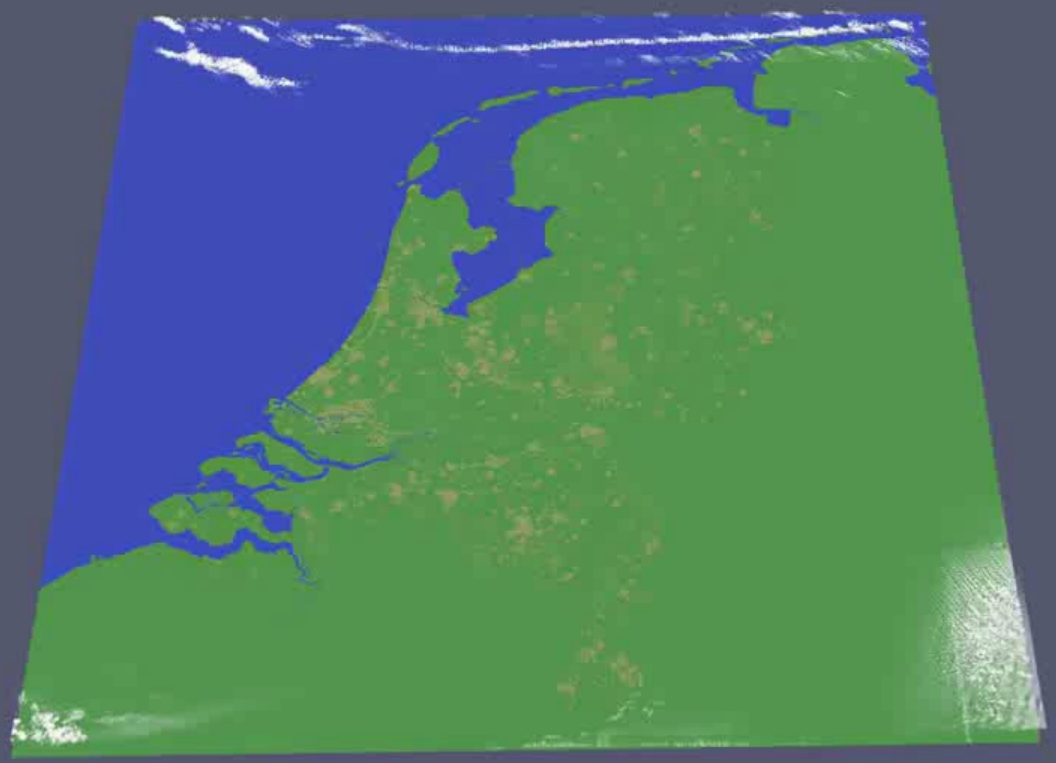
The Diurnal Cycle



Adapted from the book of stull (1988), as presented in Van Hooft et al. (2017)

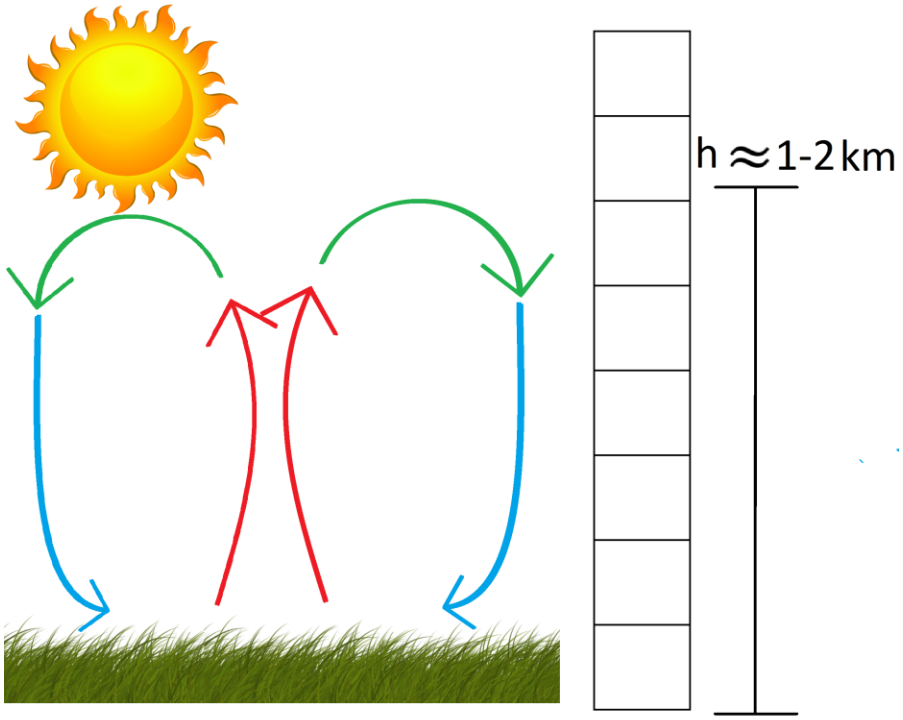
Turbulence resolving models

https://www.youtube.com/watch?v=0vorZ2_Jr1g

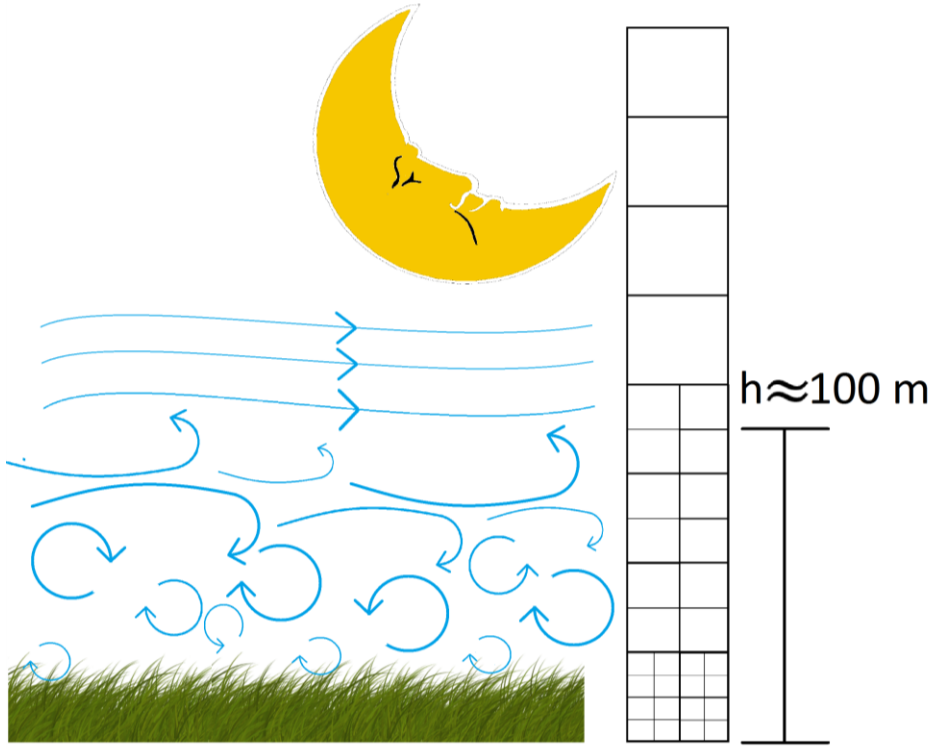


Video courtesy of Jerome Schalkwijk

Resolving the turbulent processes



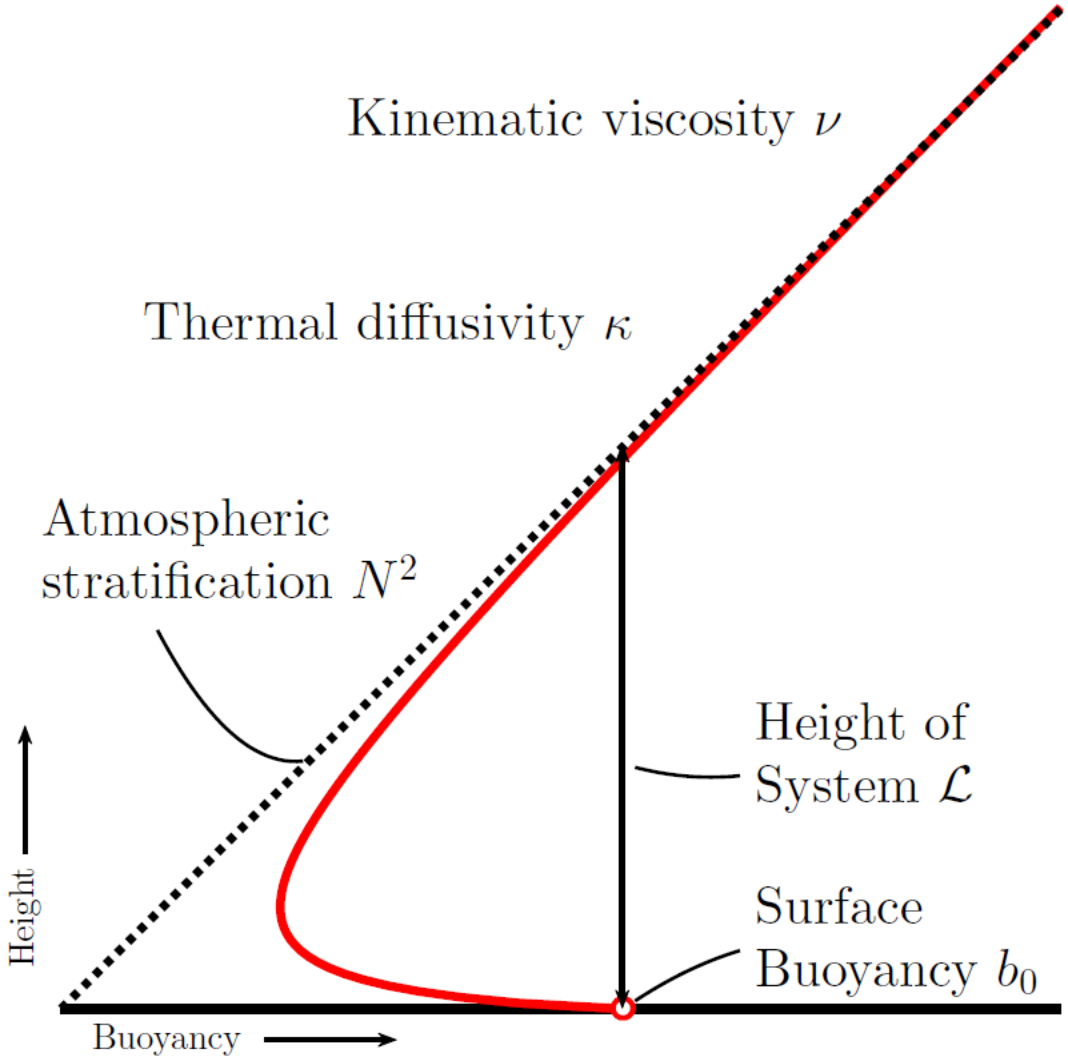
Daytime boundary layer



Nighttime boudary layer

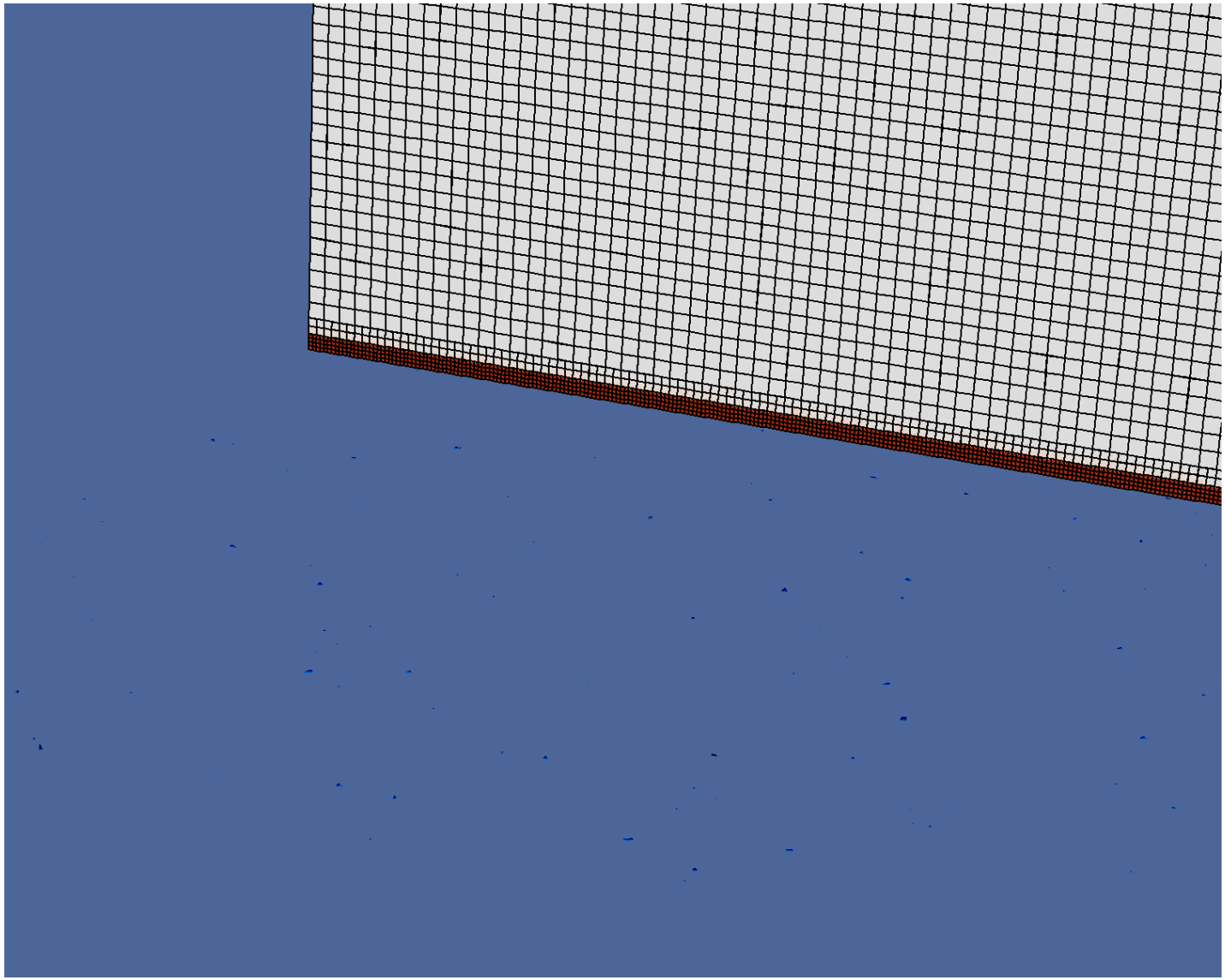
Adaptive Grids to the Rescue!

Introduce the method with a test case

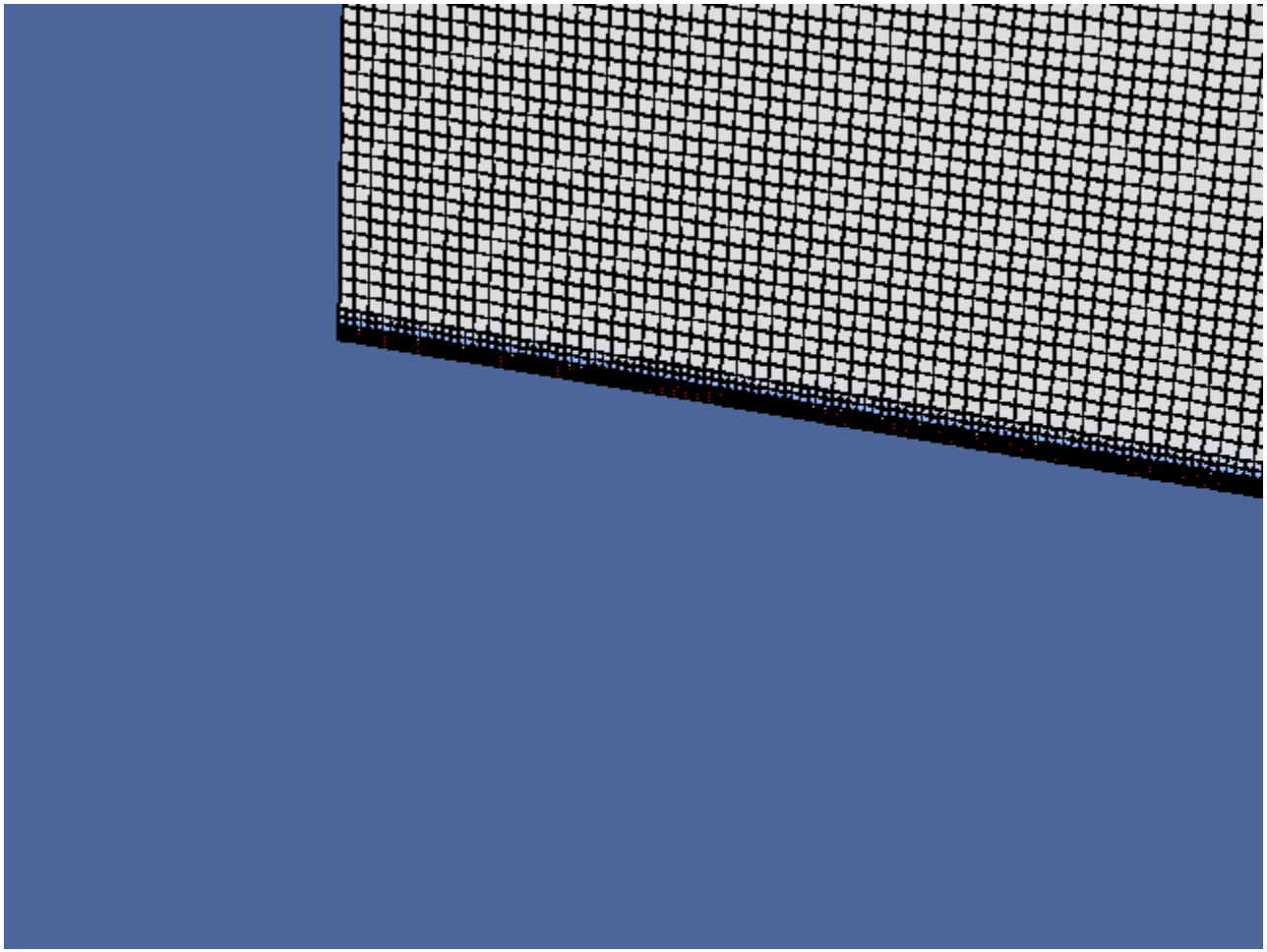


Adapted from Van Heerwaarden and Mellado, (2016), as presented in Van Hooft et al. (2017)

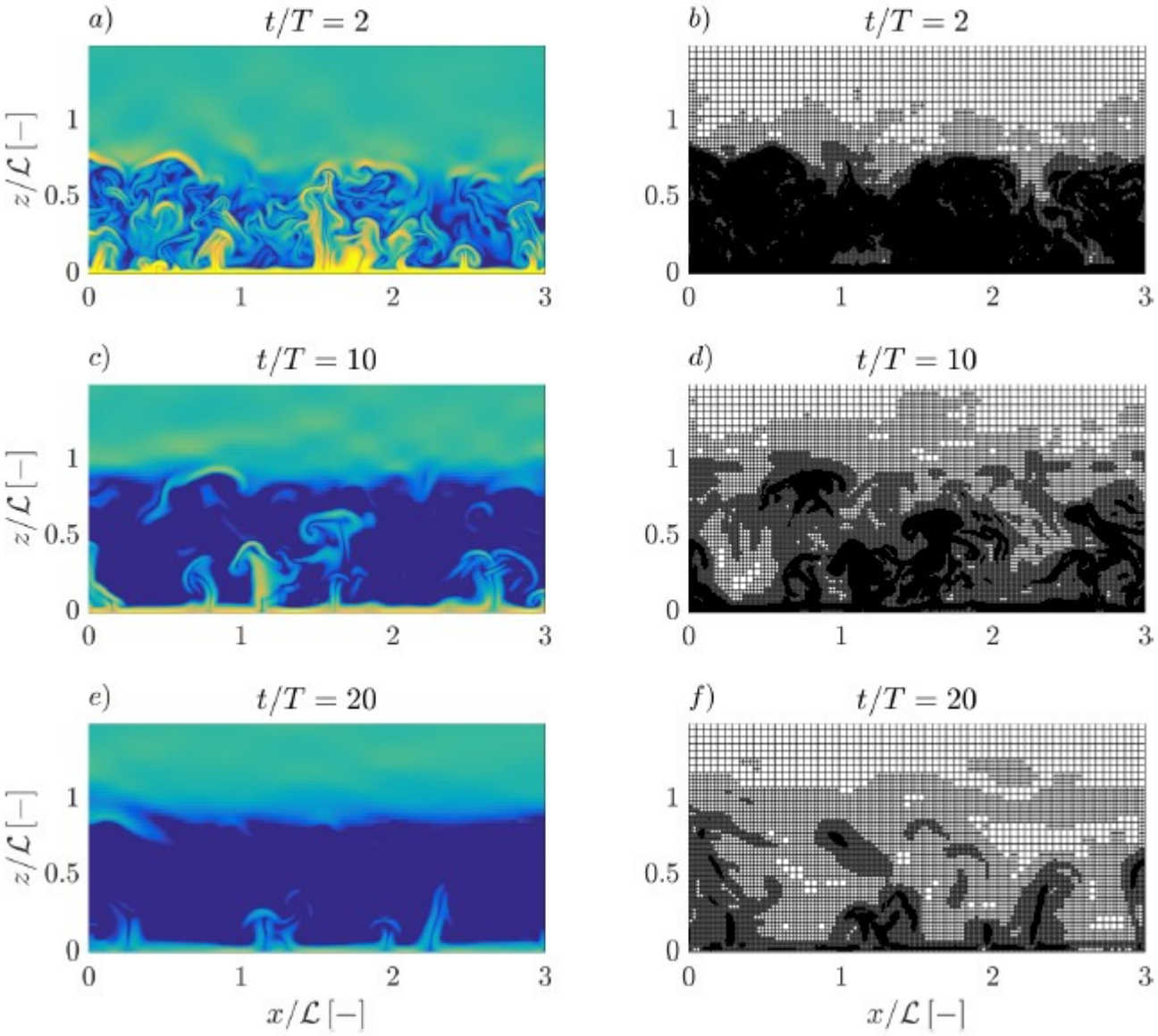
Initial convective instability



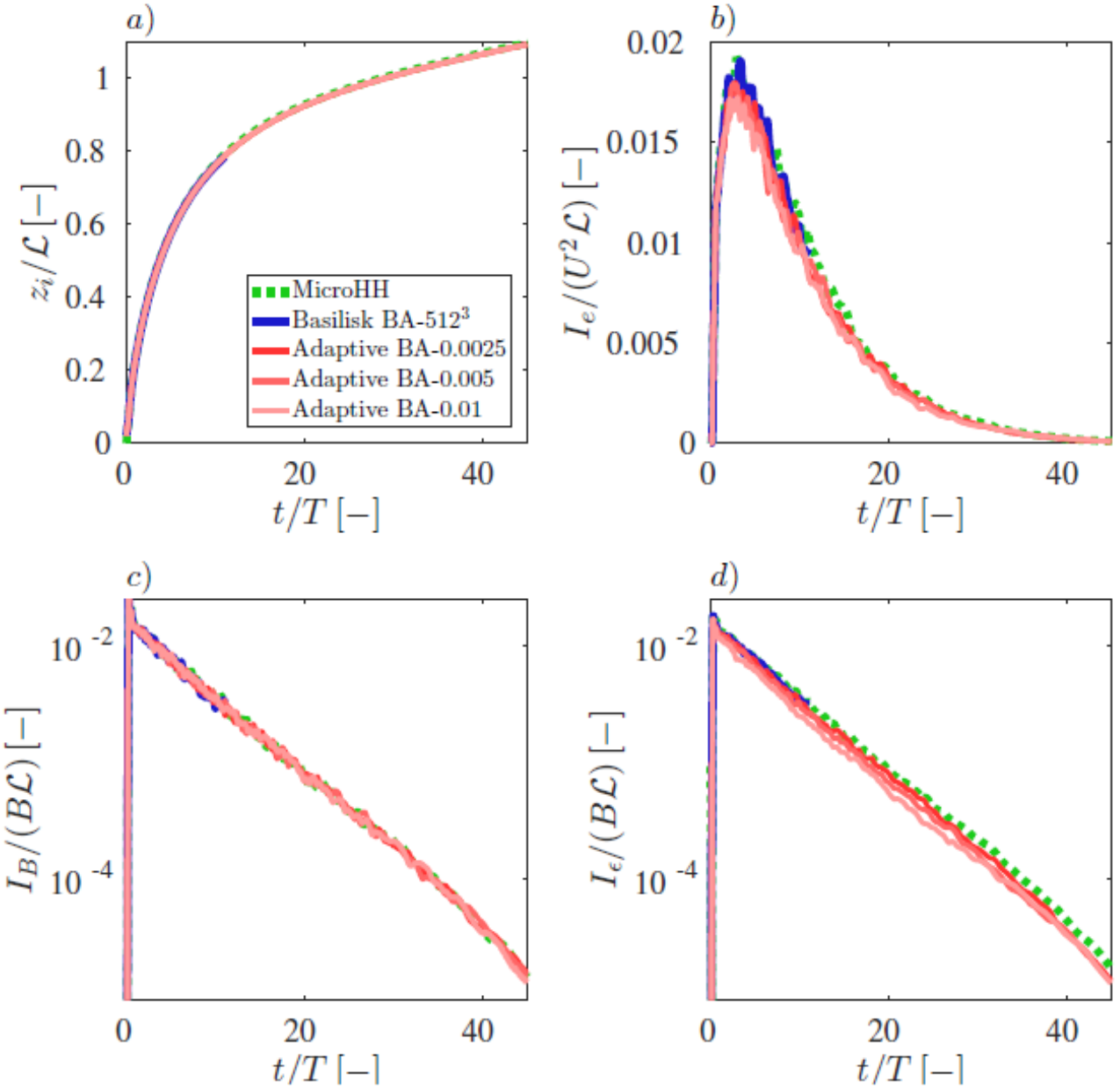
Growth of the boundary layer



Subsequent decay



Results



Interested?

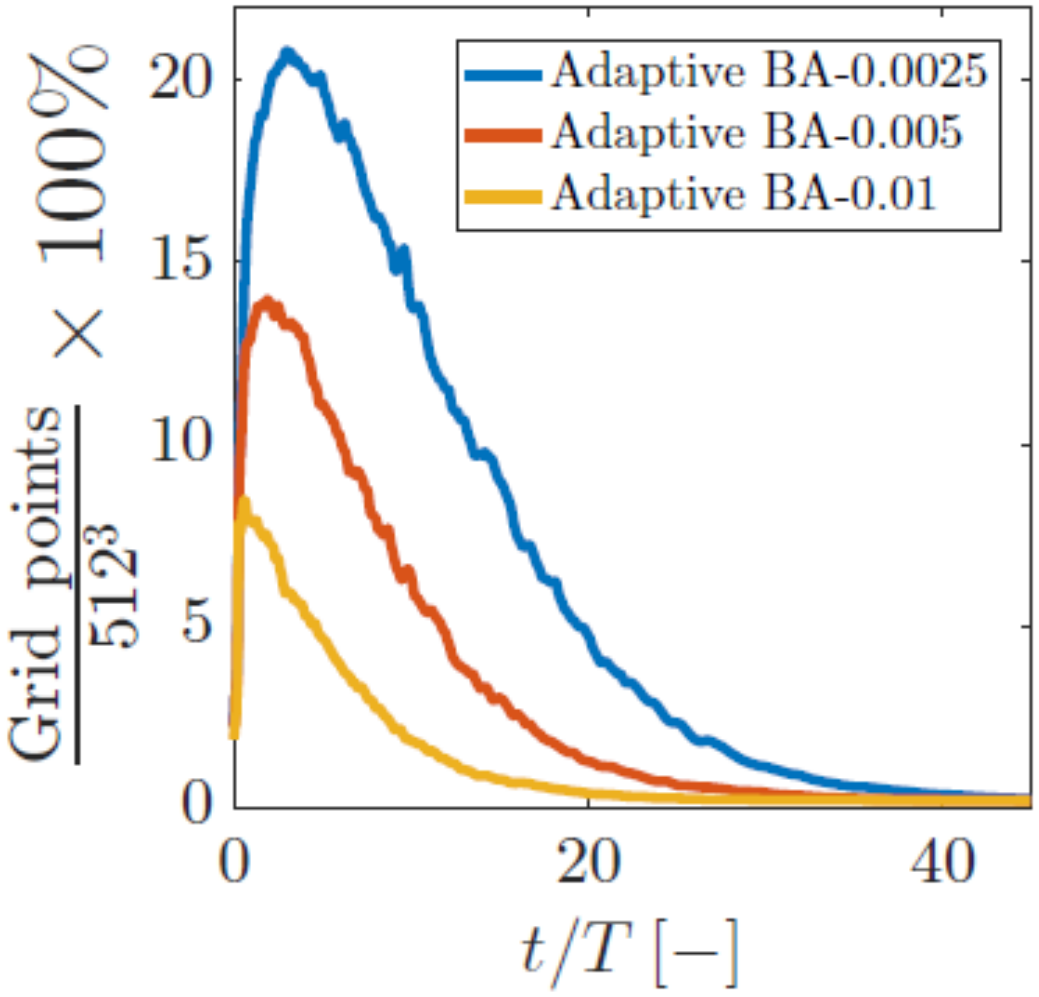
Van Hooft et al.

Towards adaptive grids for Atmospheric boundary layer simulations

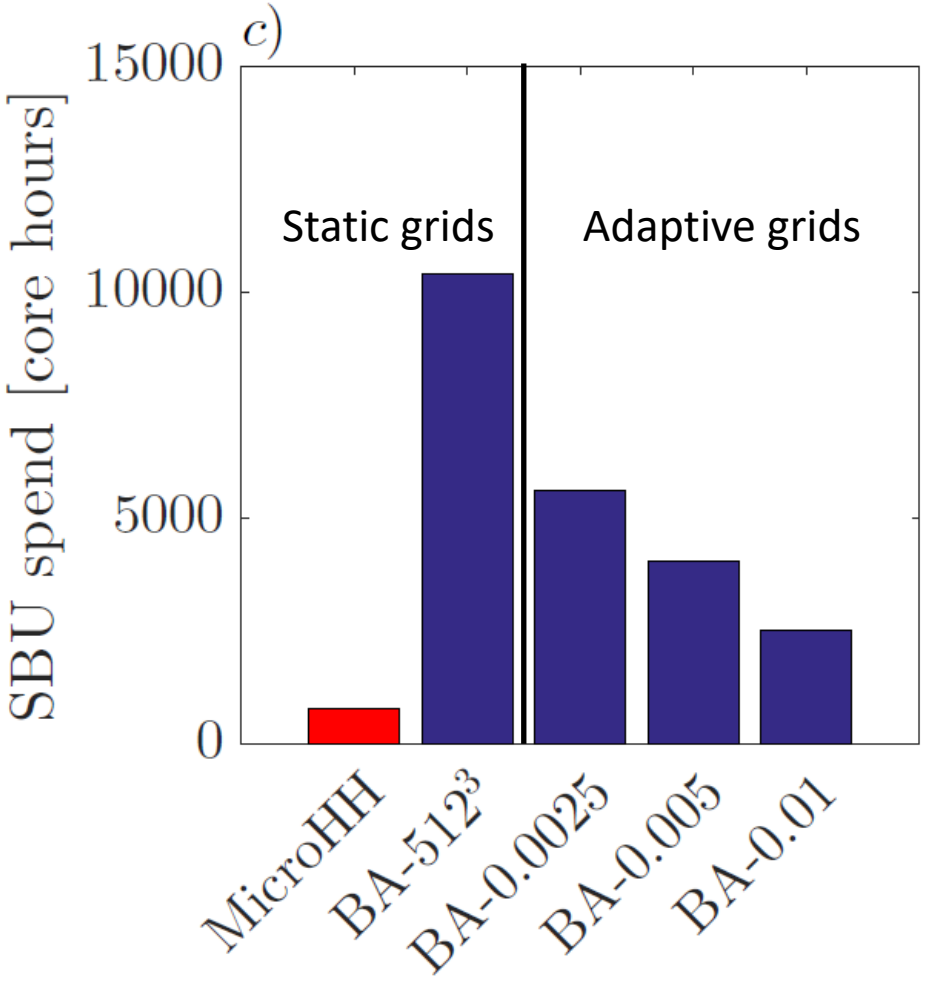
Boundary Layer Meterology

Provisionally accepted

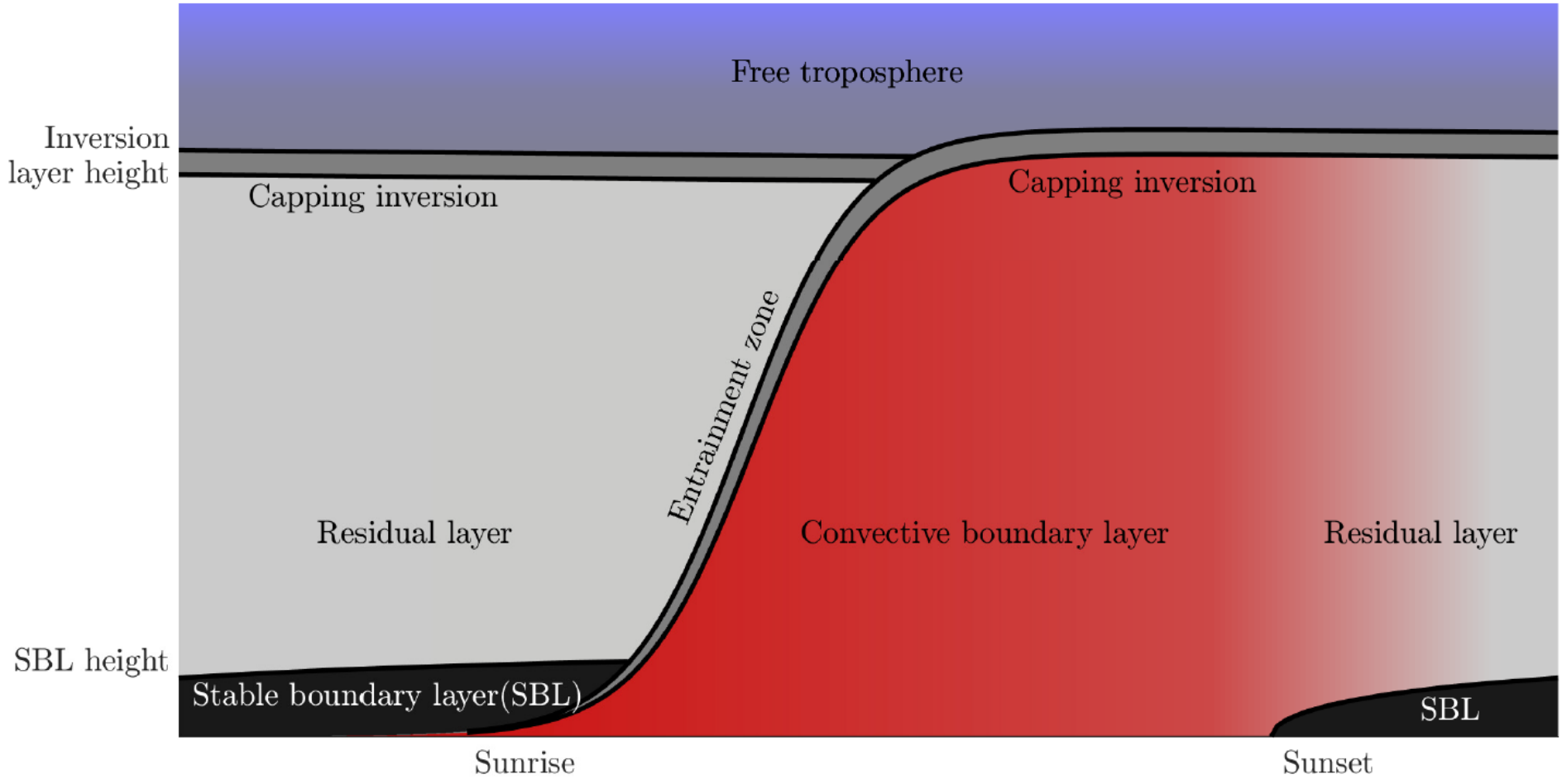
Adaptivity


Adaptive BA-0.0025
Adaptive BA-0.005
Adaptive BA-0.01
$\frac{\text{Grid points}}{512^3} \times 100\%$
0
5
10
15
20
0
20
40
t/T [−]

Performance



To be Continued



Current / future work

- Large Eddy Simulations
  - Vreman sub-grid-scale model implemented
  - Testing is in progress
- Analysis of the scale separation in the atmosphere
- Baslisk for Global Circulation Models (GCM)
  - A few slides

Single Collumn Models as building blocks for GCMs

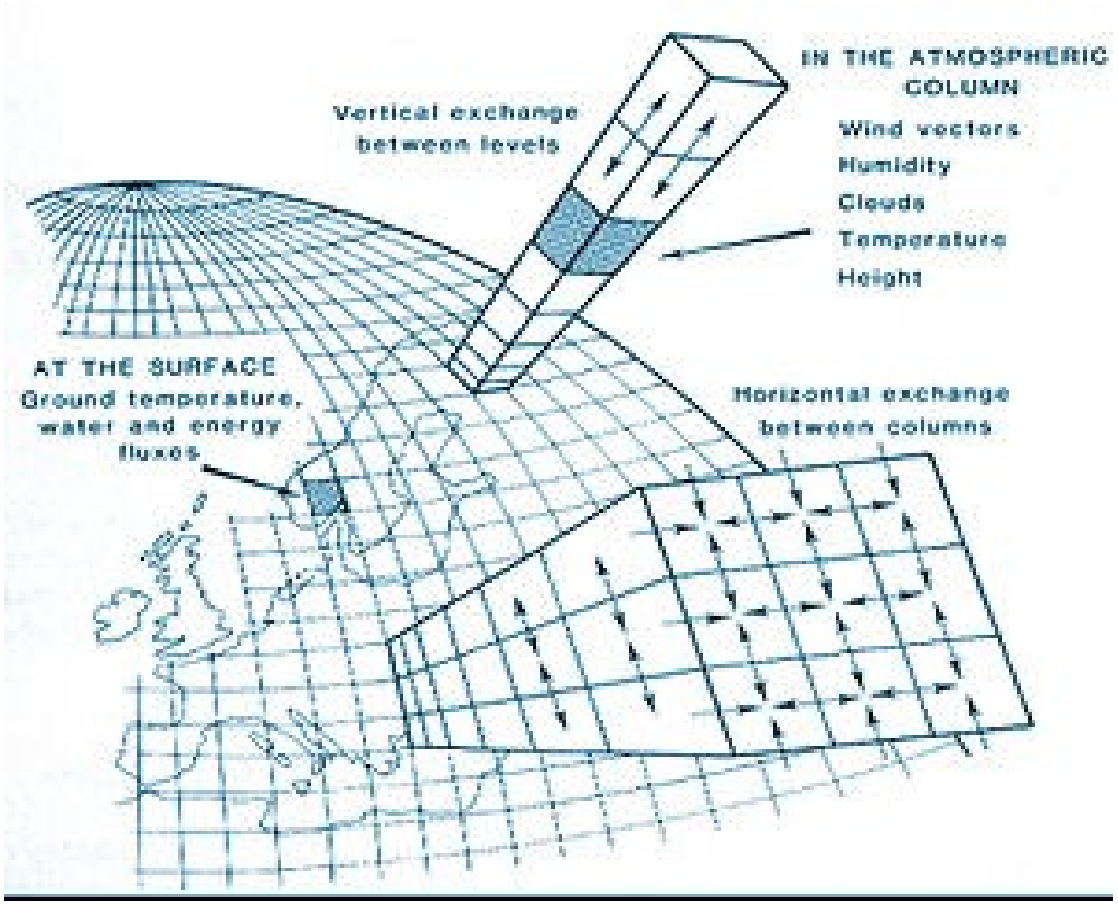
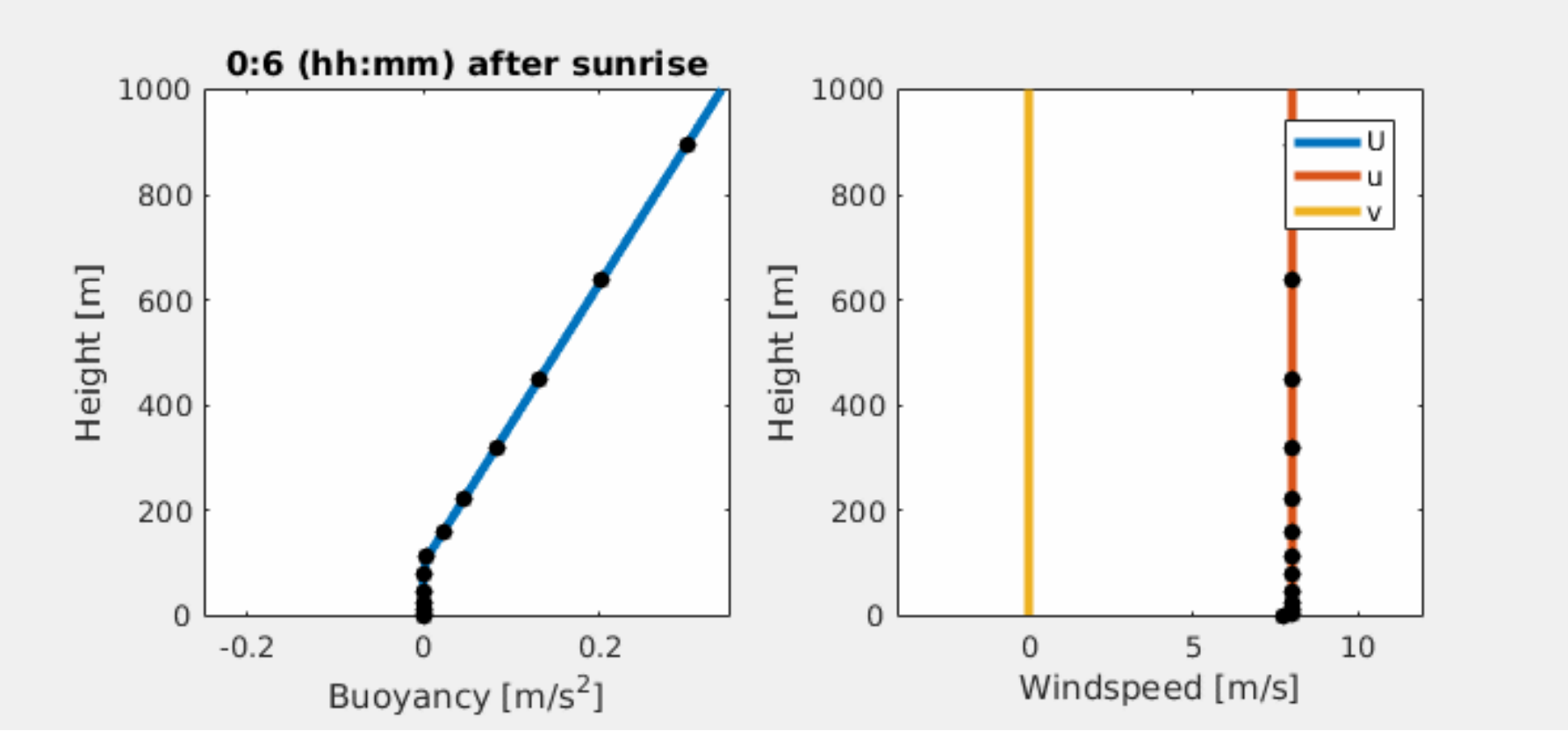


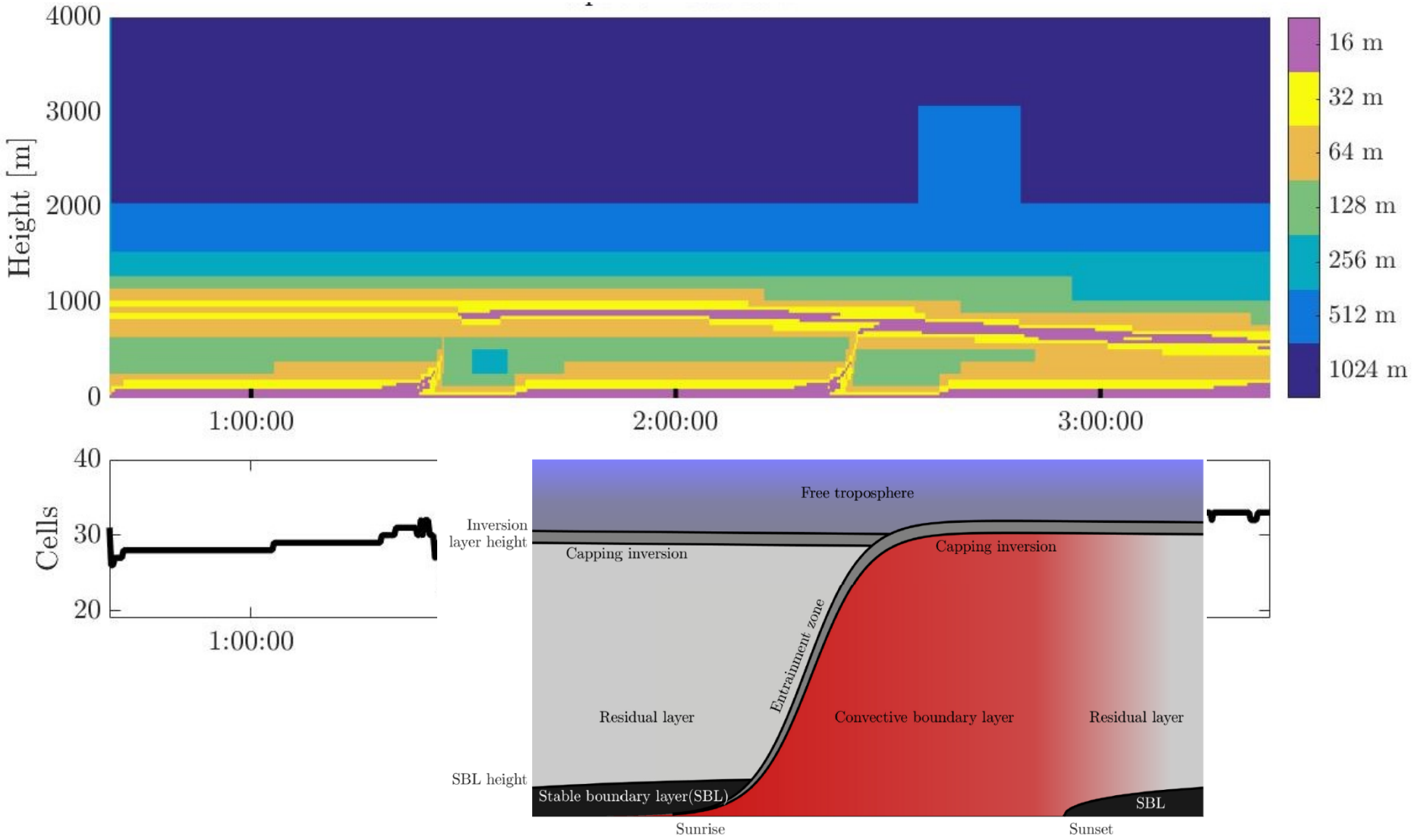
Image Couresy of Tom Morris

Results



Van Hooft et al. (in prep.)

Resolution


4000
3000
2000
1000
0
Height [m]
1:00:00
2:00:00
3:00:00
16 m
32 m
64 m
128 m
256 m
512 m
1024 m
40
30
20
Cells
1:00:00
Free troposphere
Inversion layer height
Capping inversion
Capping inversion
Entrainment zone
Residual layer
Convective boundary layer
Residual layer
SBL height
Stable boundary layer(SBL)
SBL
Sunrise
Sunset

Conclusion

The usage of adaptive grids opens new possibilites for atmospheric boundary layer research