

# HAMP radar measurements and ICON forward simulations

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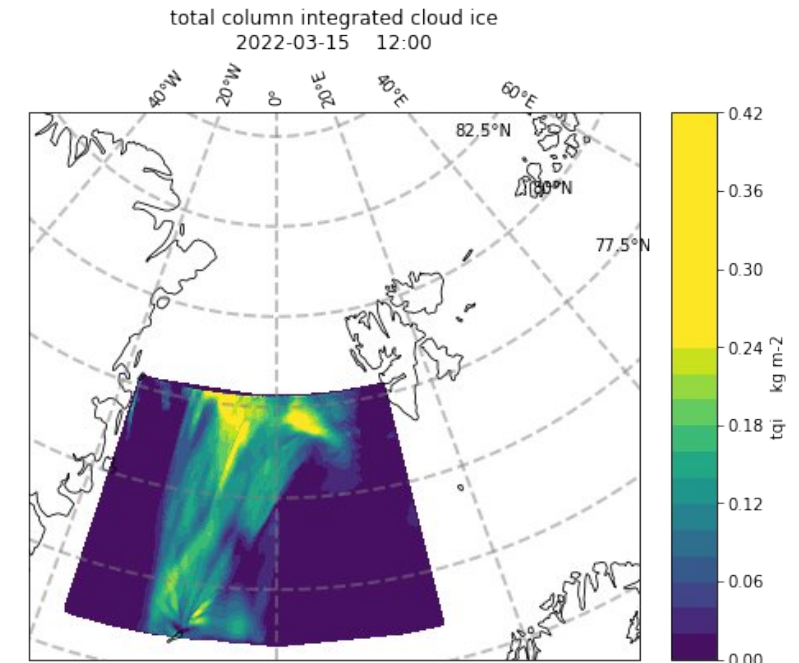
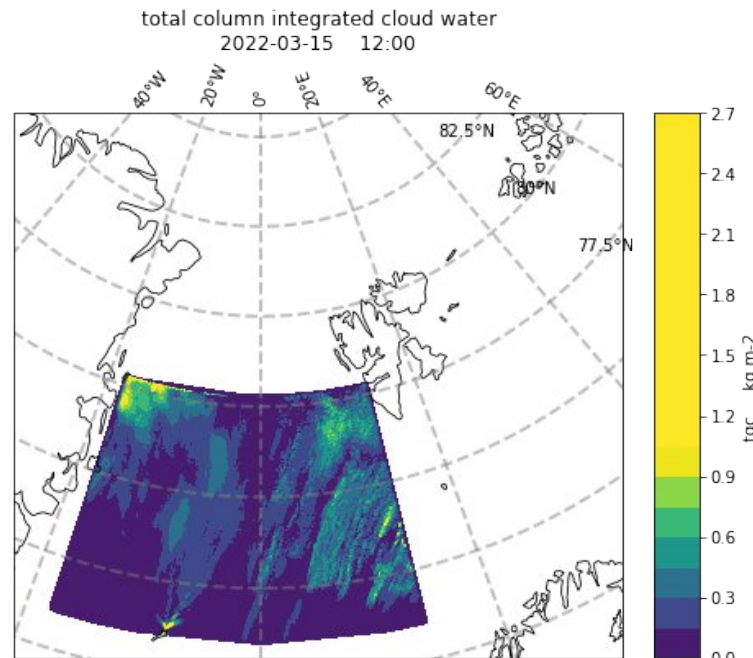
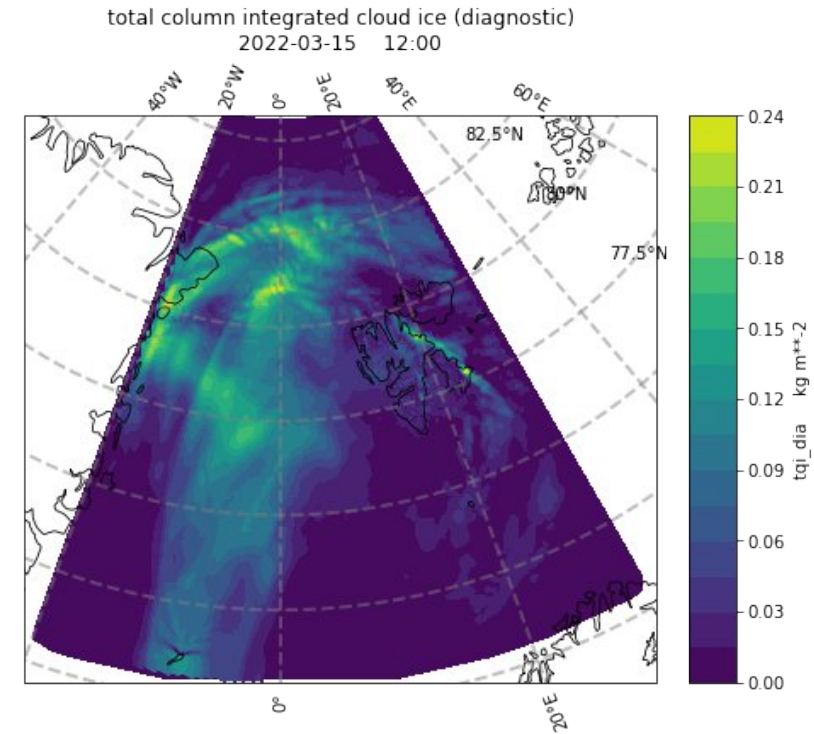
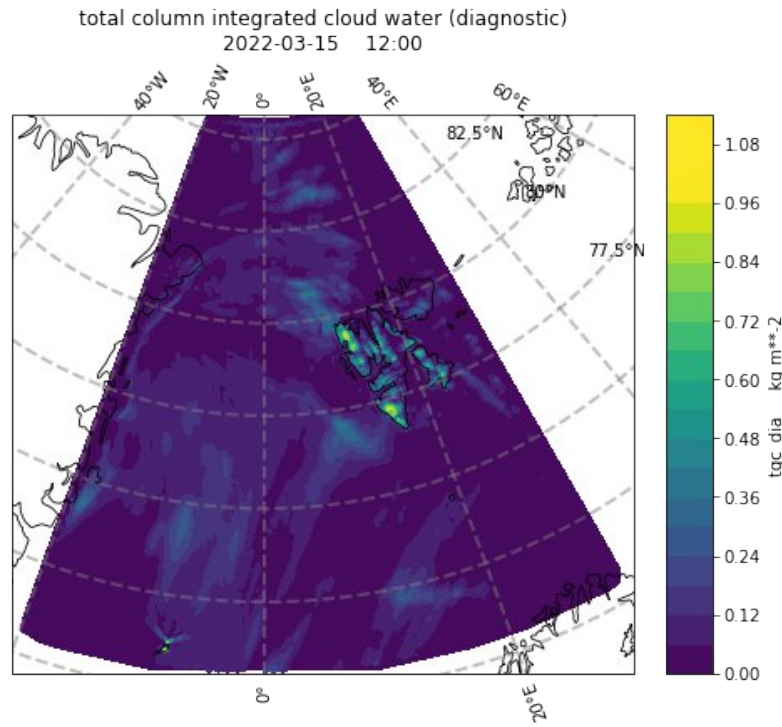
University of Cologne



# ICON high-res

- **NWP:** 2.4 km resolution, 1-mom cloud microphysics, daily runs up to 3 days

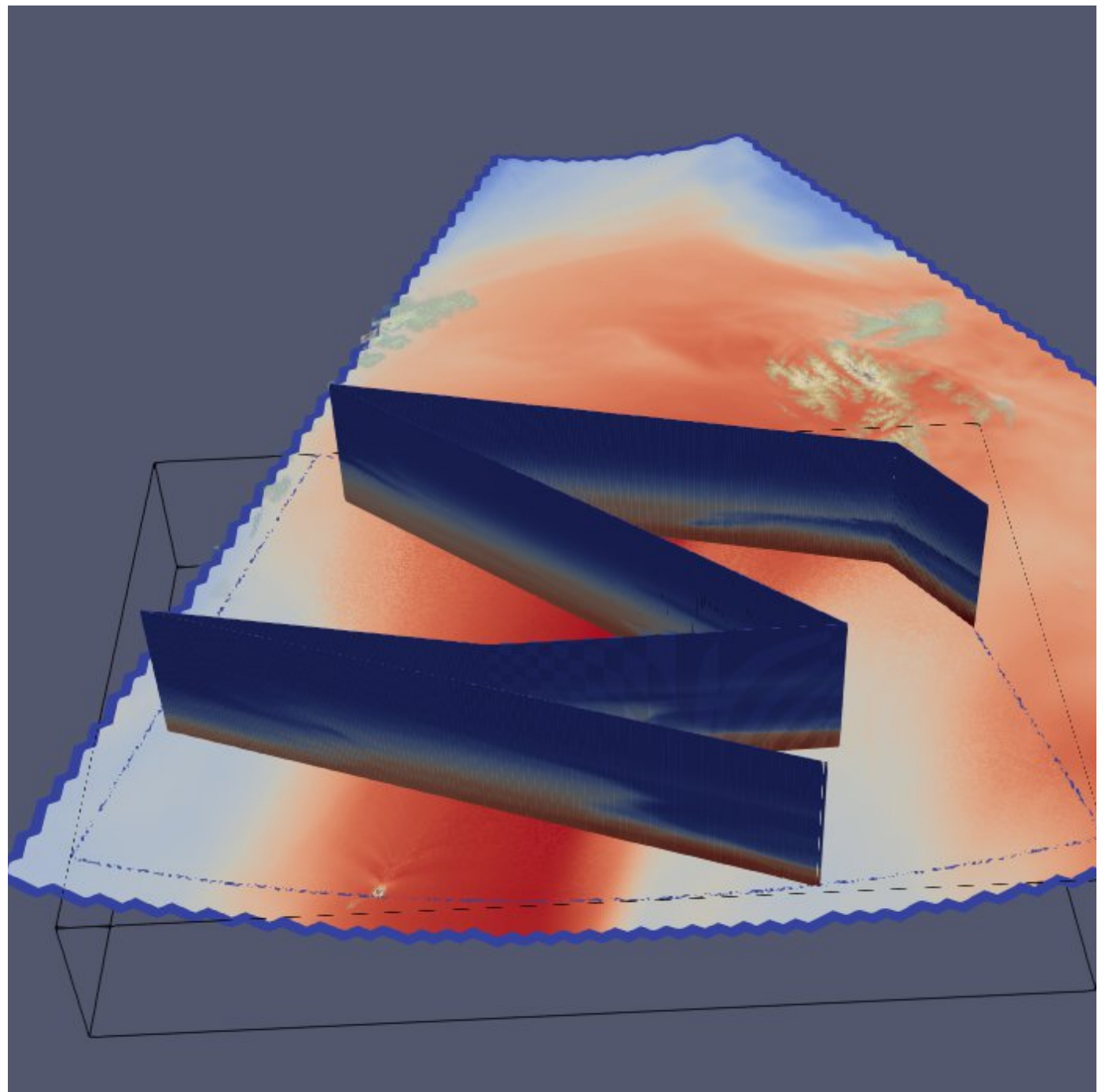
- **LES:** 0.6 km resolution, 2-mom cloud microphysics, on expected RF days



## Water vapour distribution

2D surface -> integrated water vapour

transect -> vertical distribution along the track



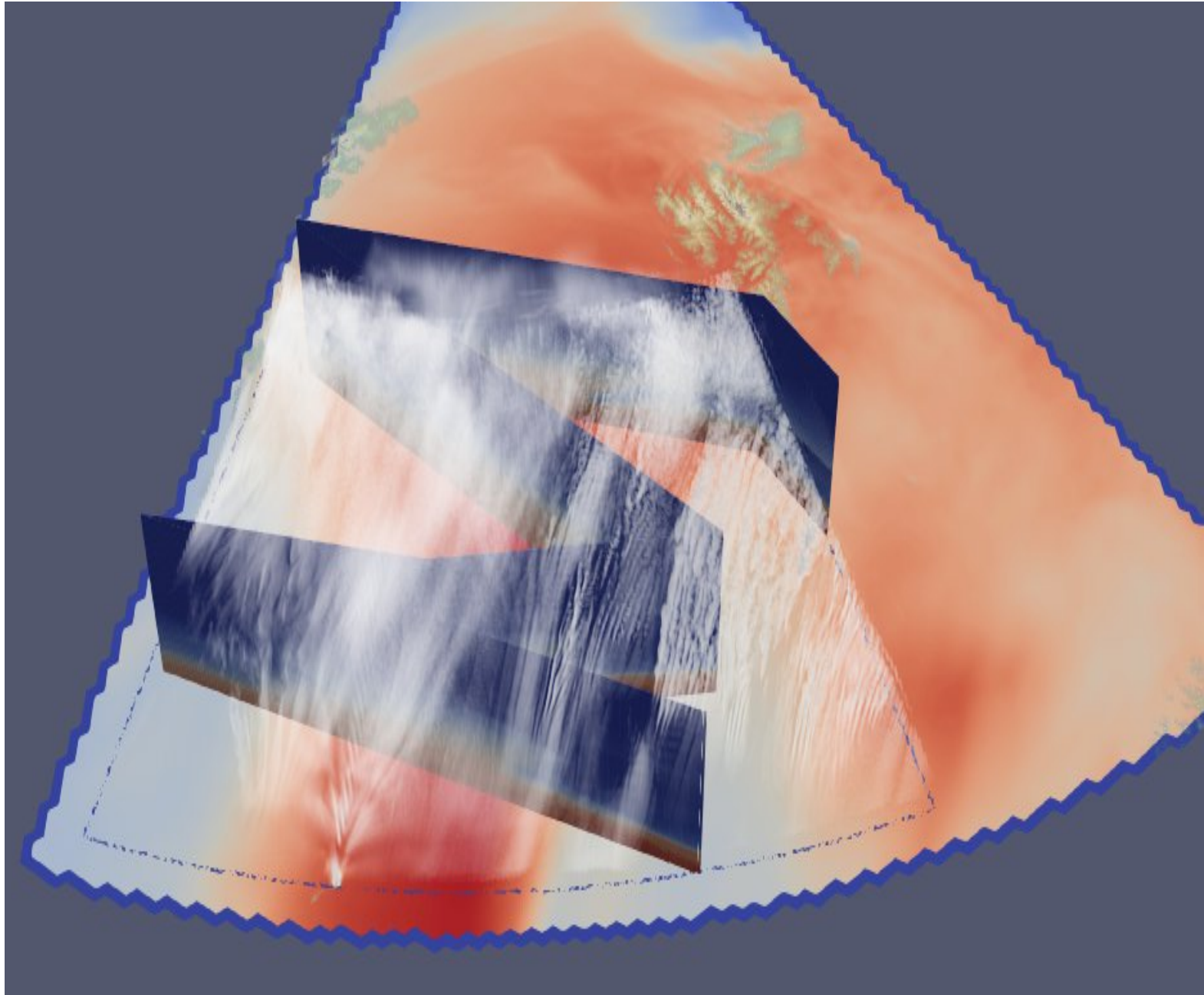


## Water vapour distribution

2D surface -> integrated water vapour

transect -> vertical distribution along the track

Add a “realistic” cloud rendering  
(map transparency on hydrometeor  
mixing ratio)

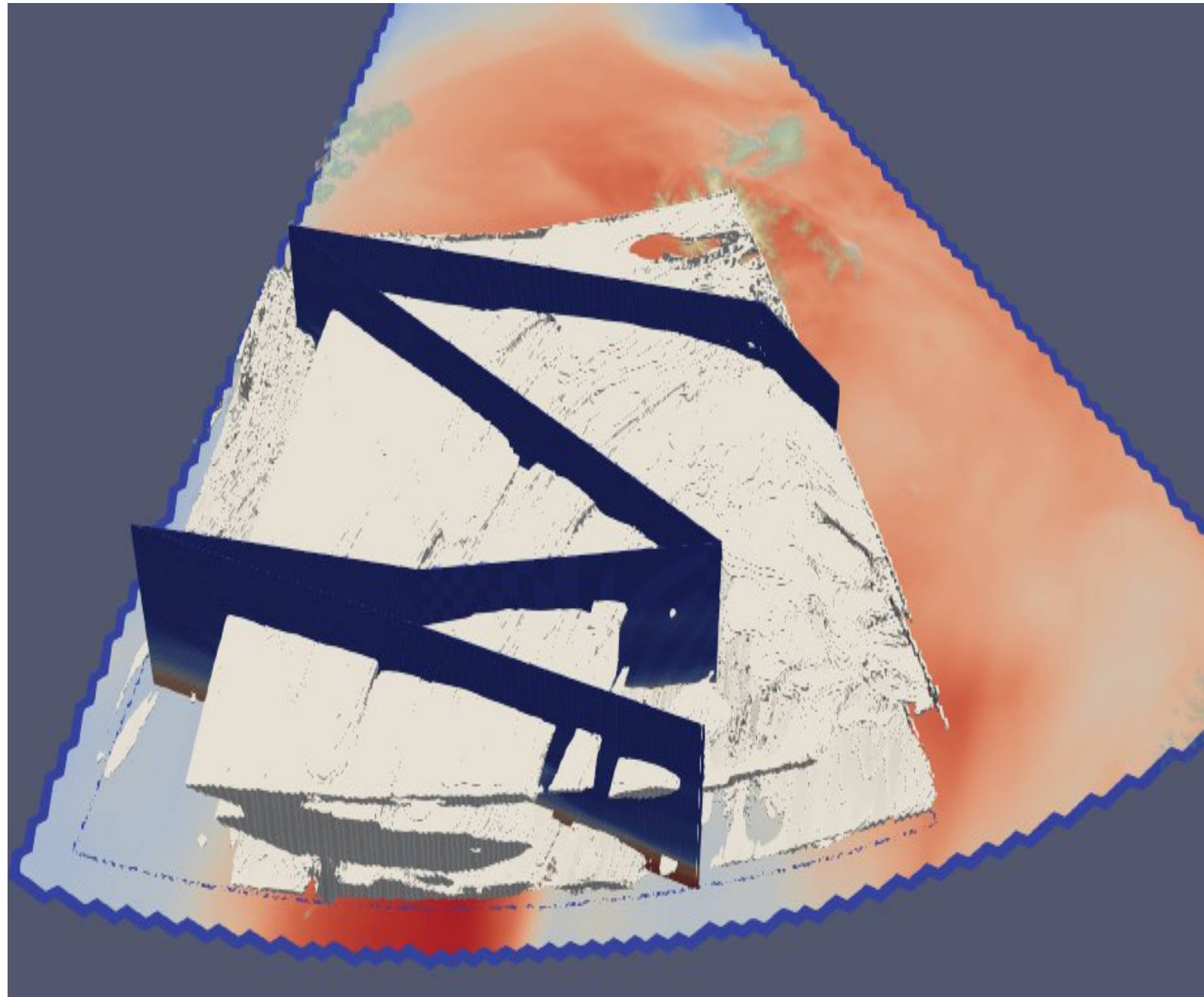


## Water vapour distribution

2D surface -> integrated water vapour

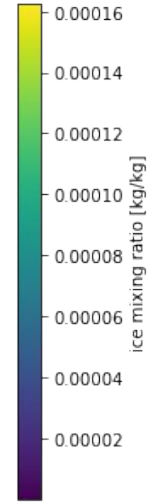
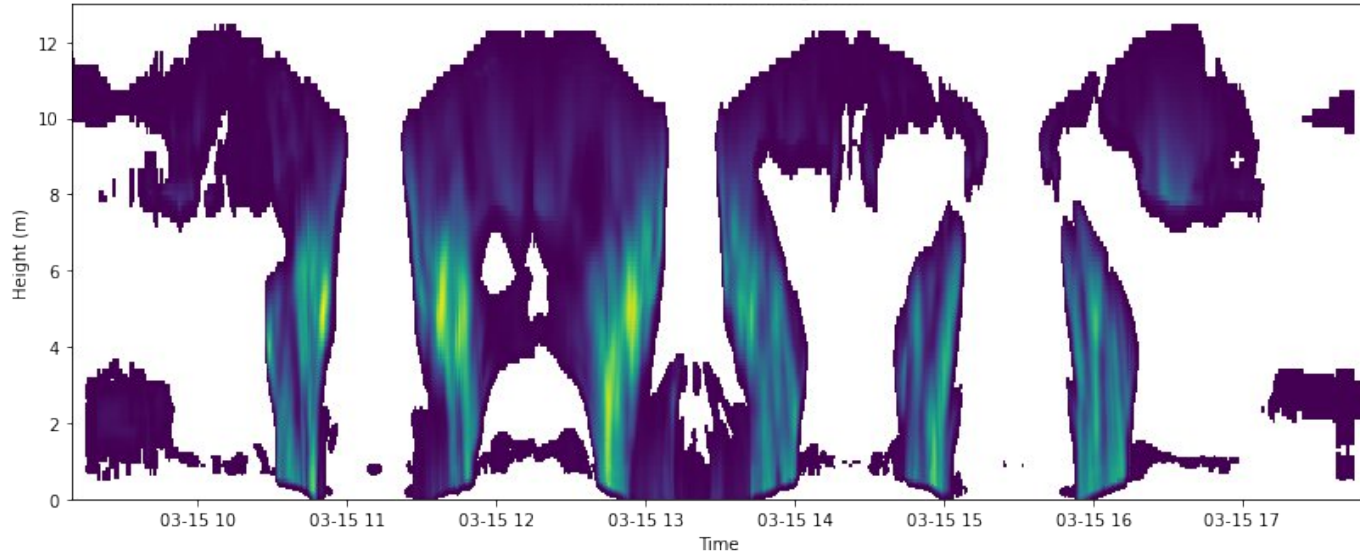
transect -> vertical distribution along the track

Surface rendering of clouds to show the stratification

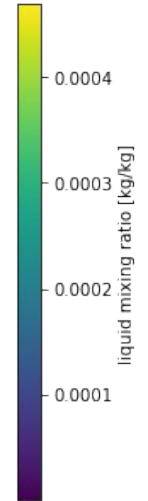
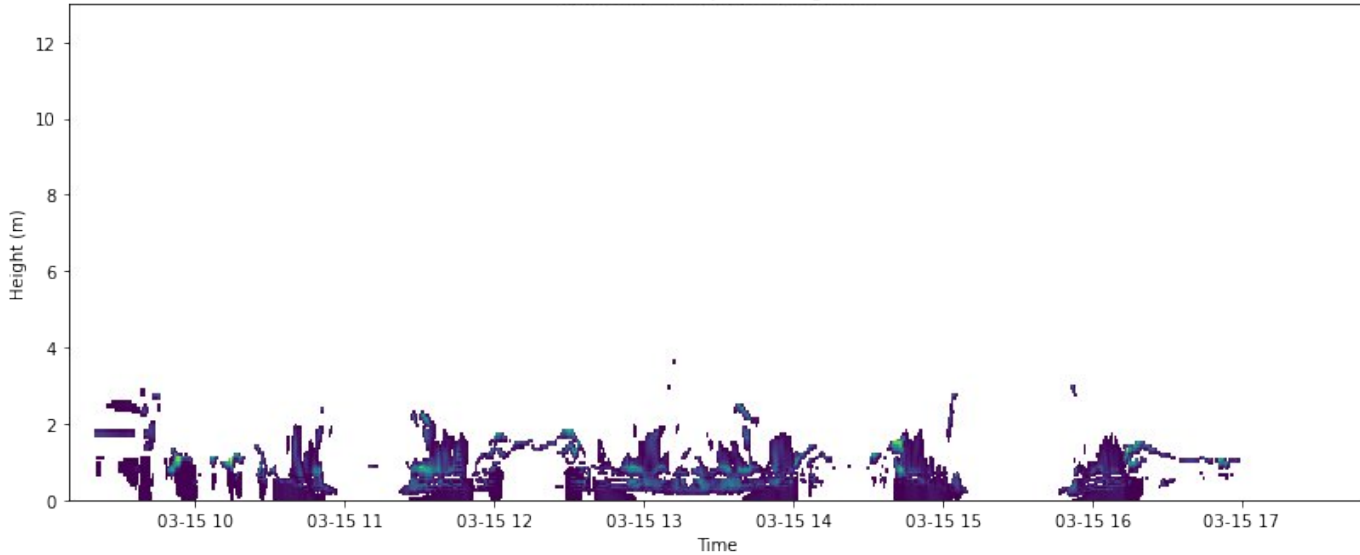


# Properties along the track

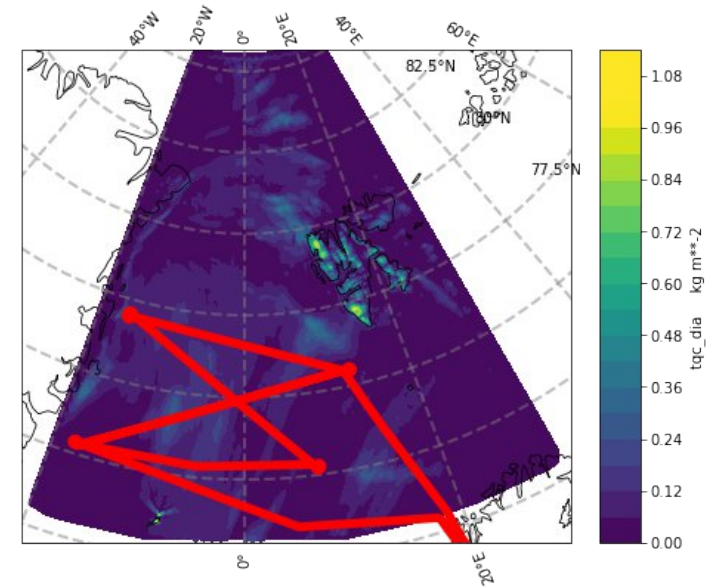
Model data - ice mixing ratio



Model data - liquid mixing ratio



total column integrated cloud water (diagnostic)  
2022-03-15 12:00

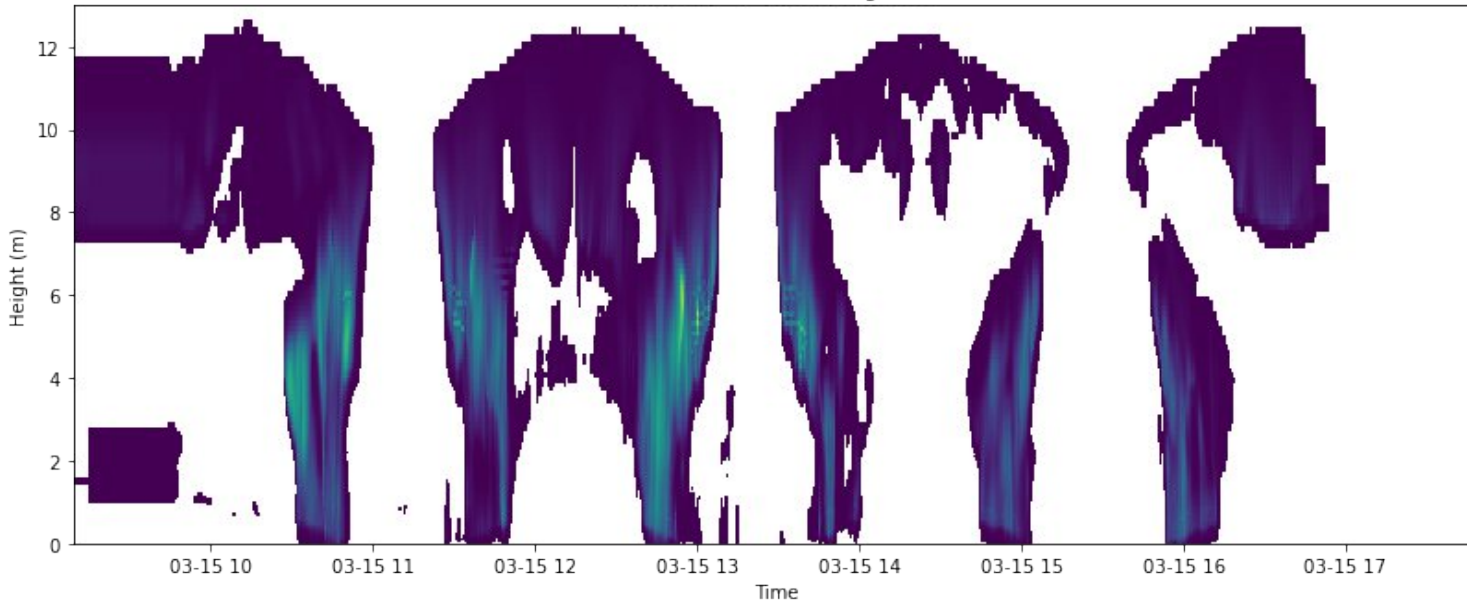


**NWP simulations**

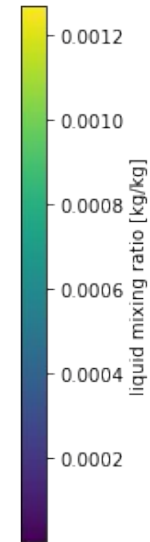
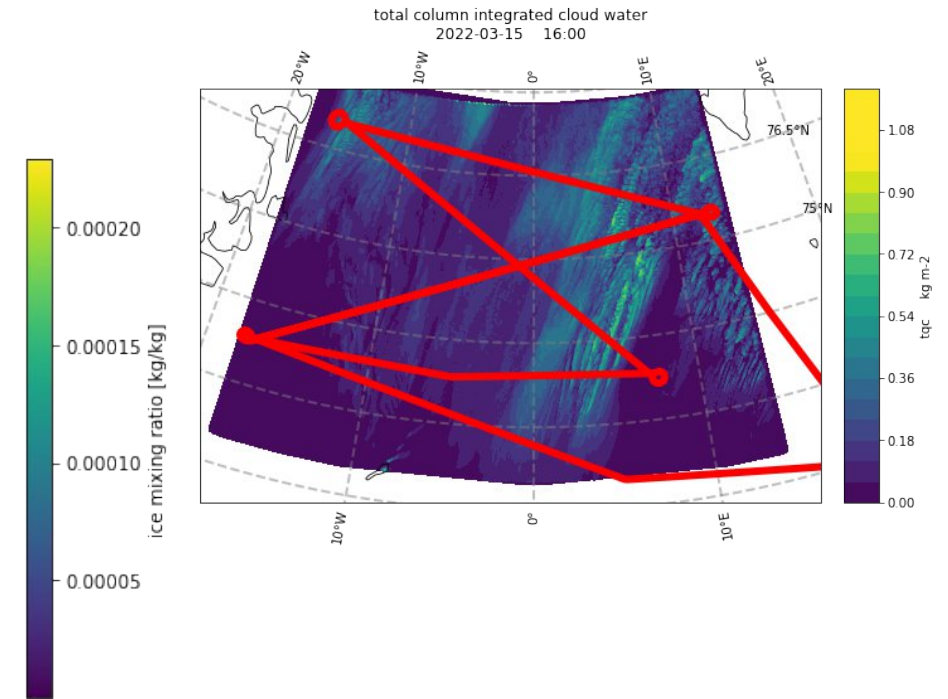
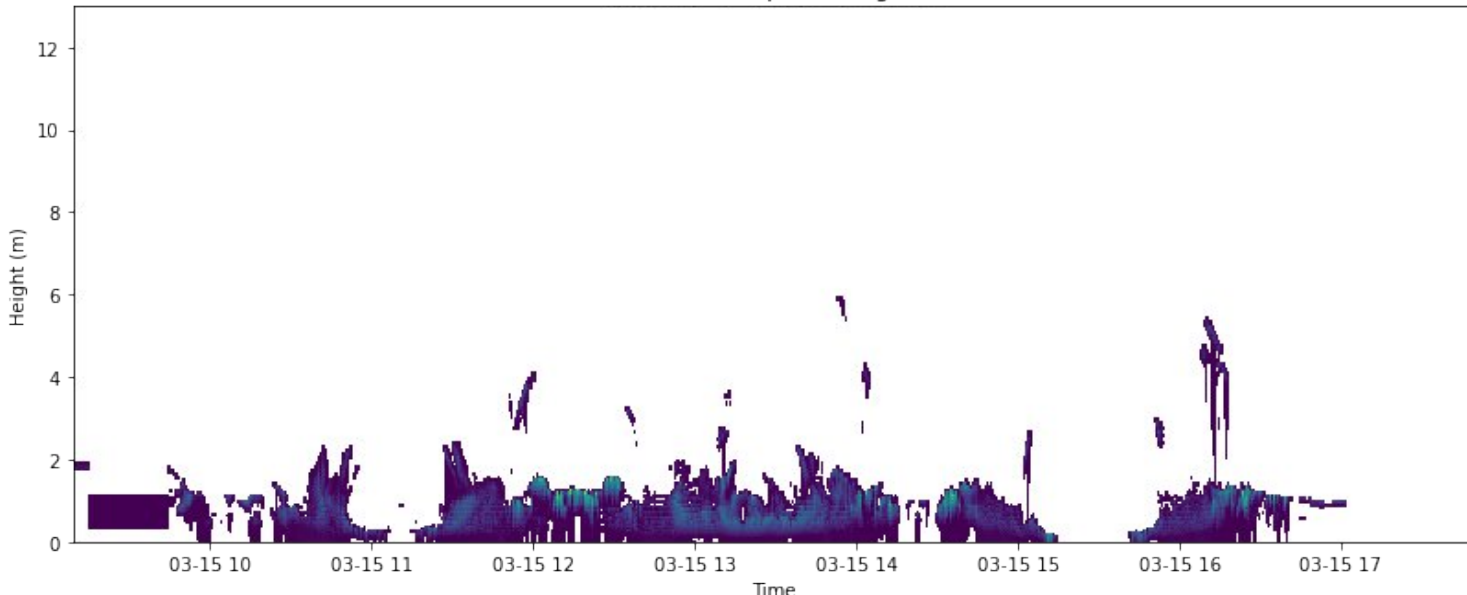


# Properties along the track

Model data - ice mixing ratio



Model data - liquid mixing ratio



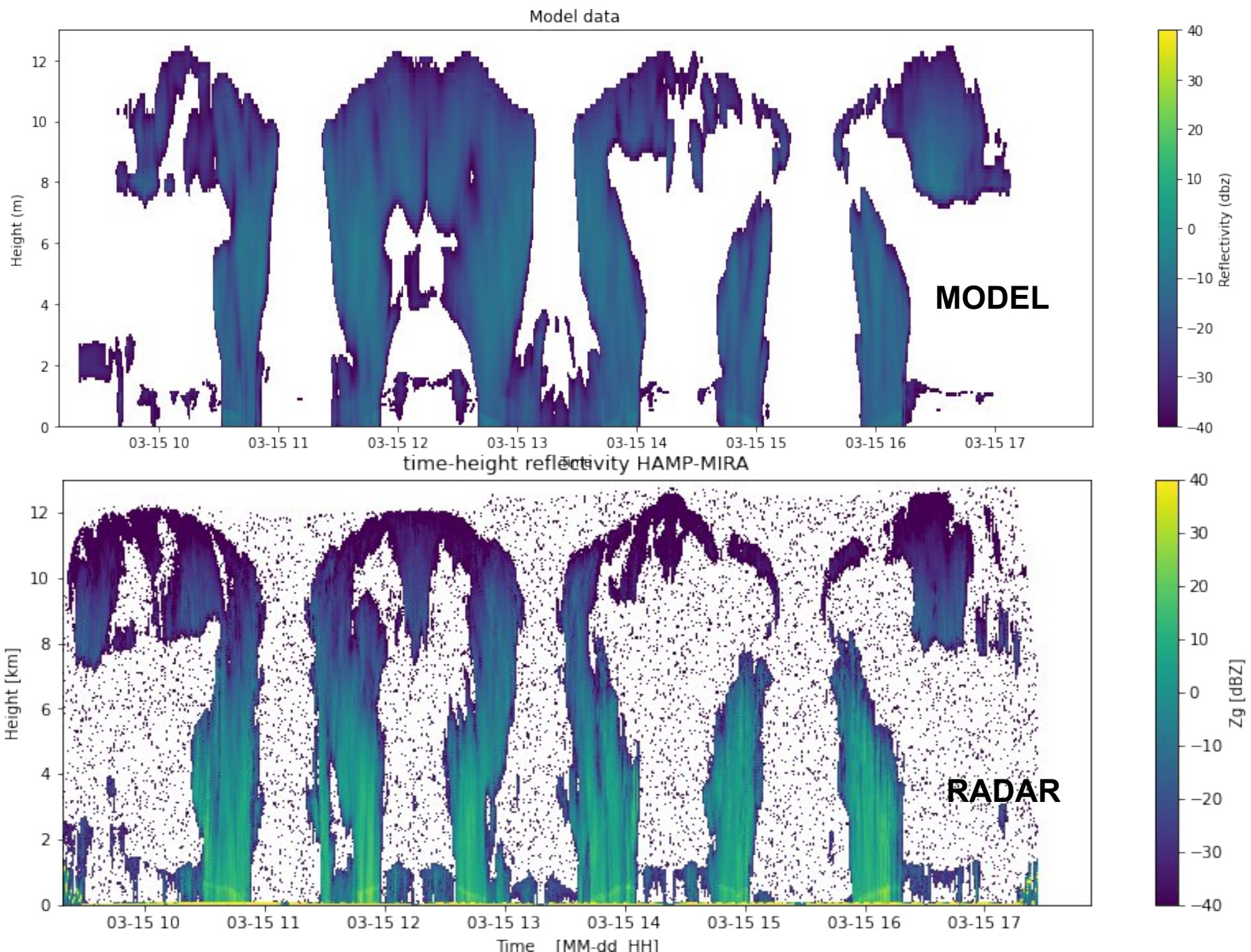
**LES simulations**

# Forward Simulations NWP

NWP does not resolve clouds

yet position and cloud height are well modeled

Model data roughly 10dB less than observations  
-> unresolved clouds?

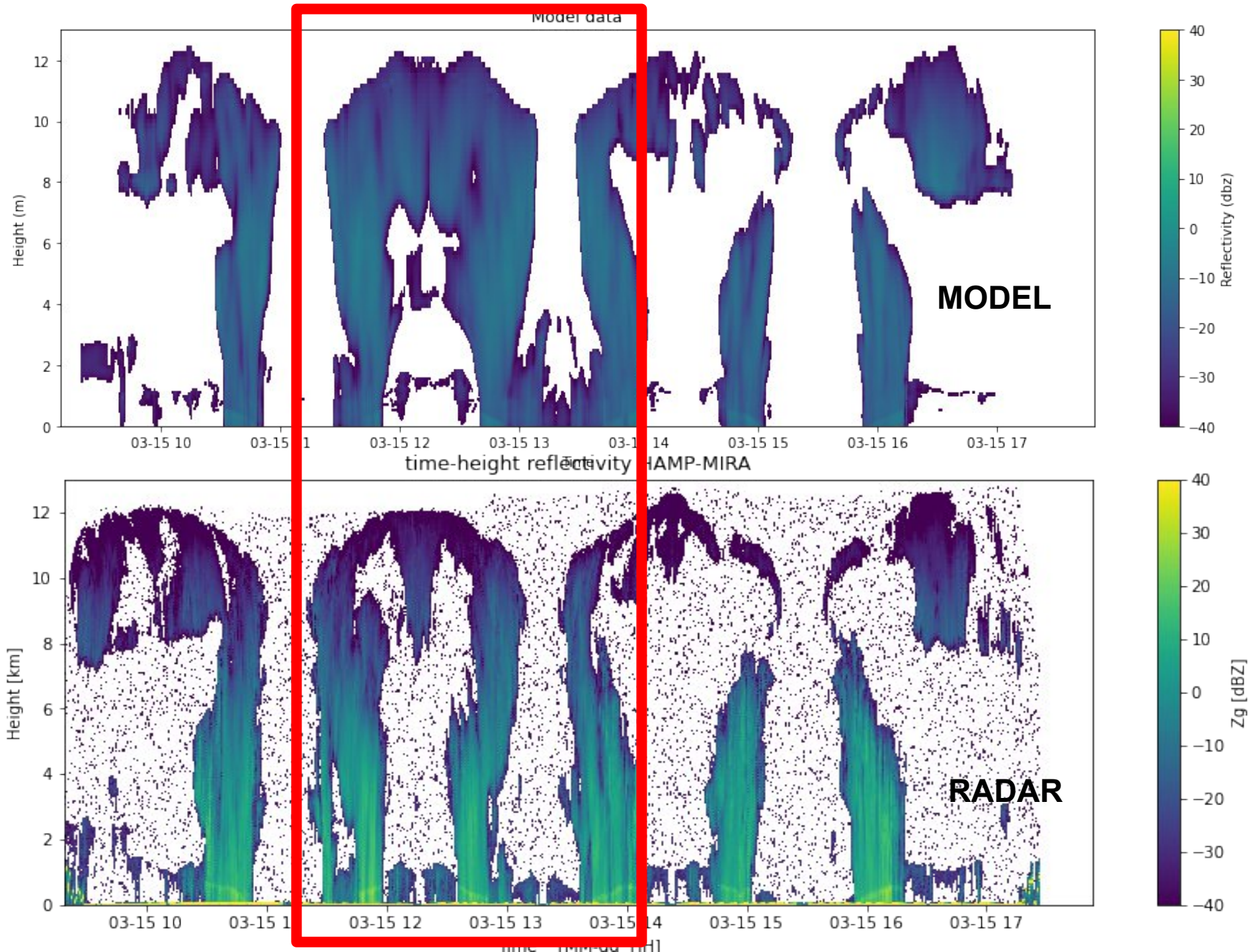




# Forward Simulations LES ....

Zoom-in few hours to  
reduce data-load

PS:background plot is  
still NWP



# Forward Simulations LES

Zoom-in few hours to  
reduce data-load

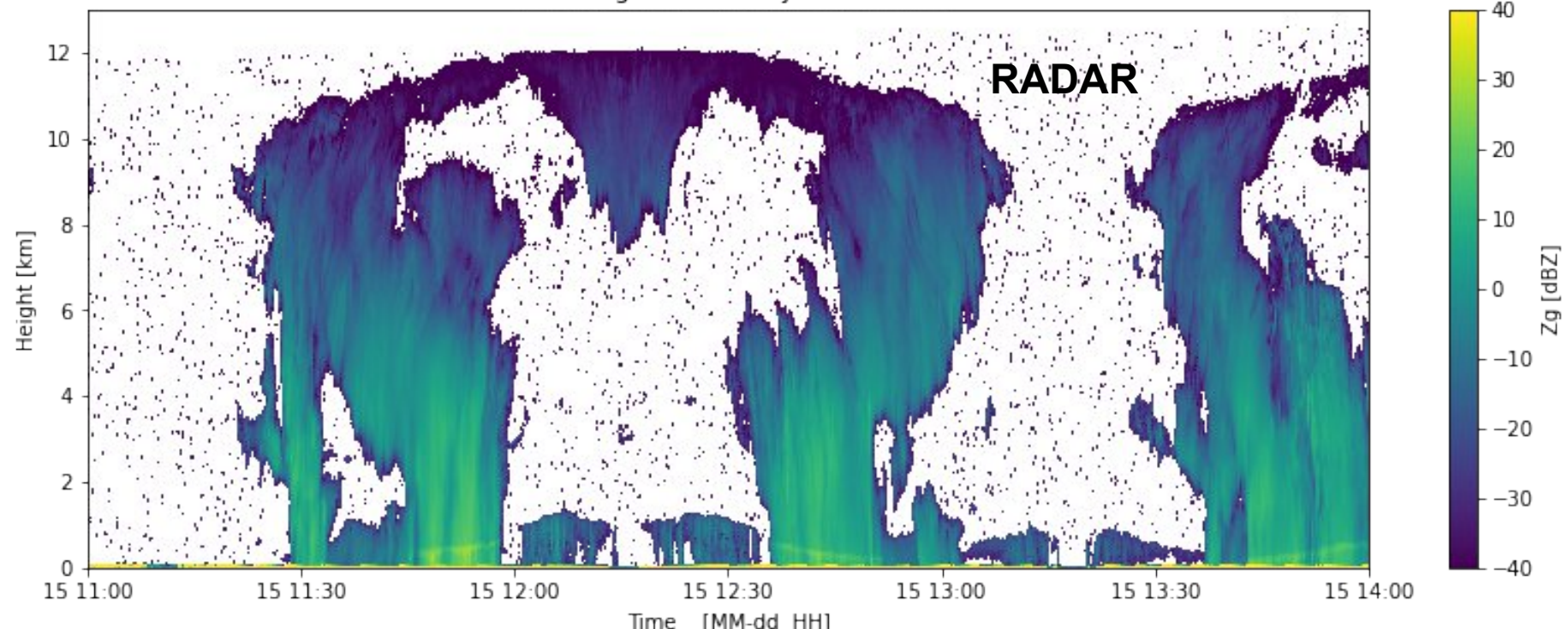
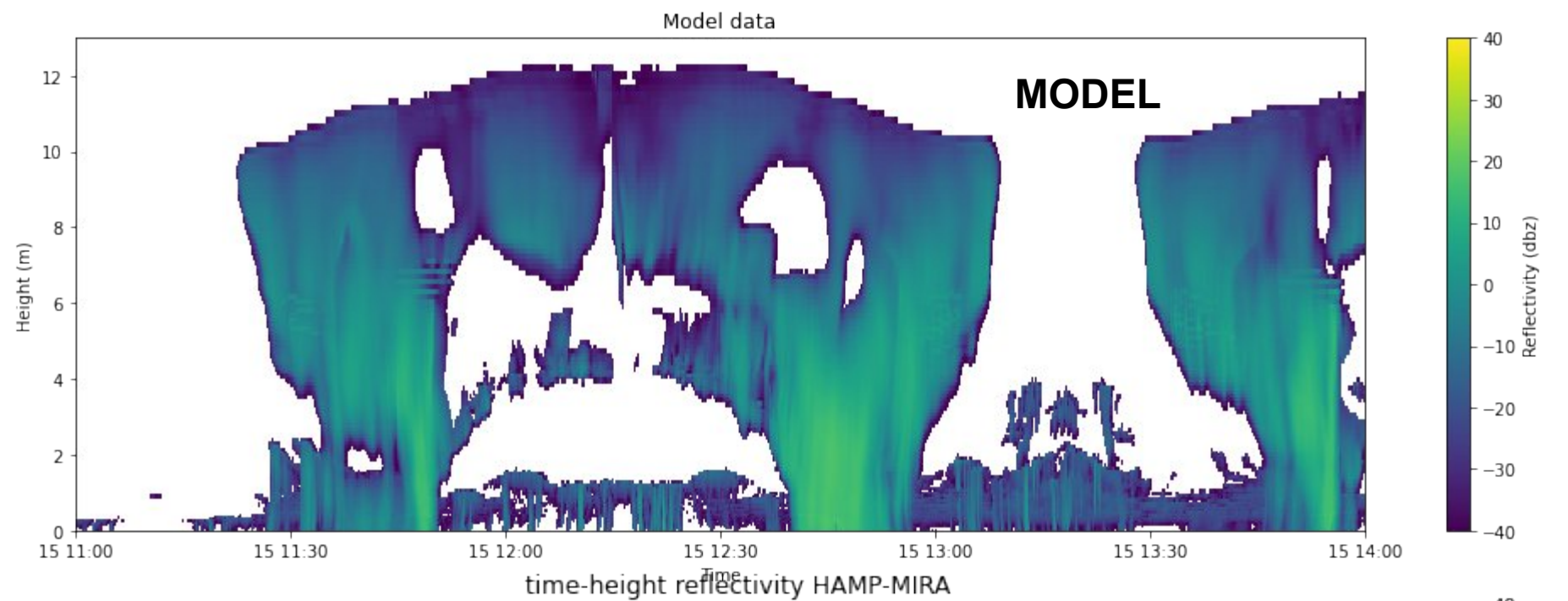
LES does resolve clouds

Benefits from complex 2-  
mom microphyscs

Matching is quite good

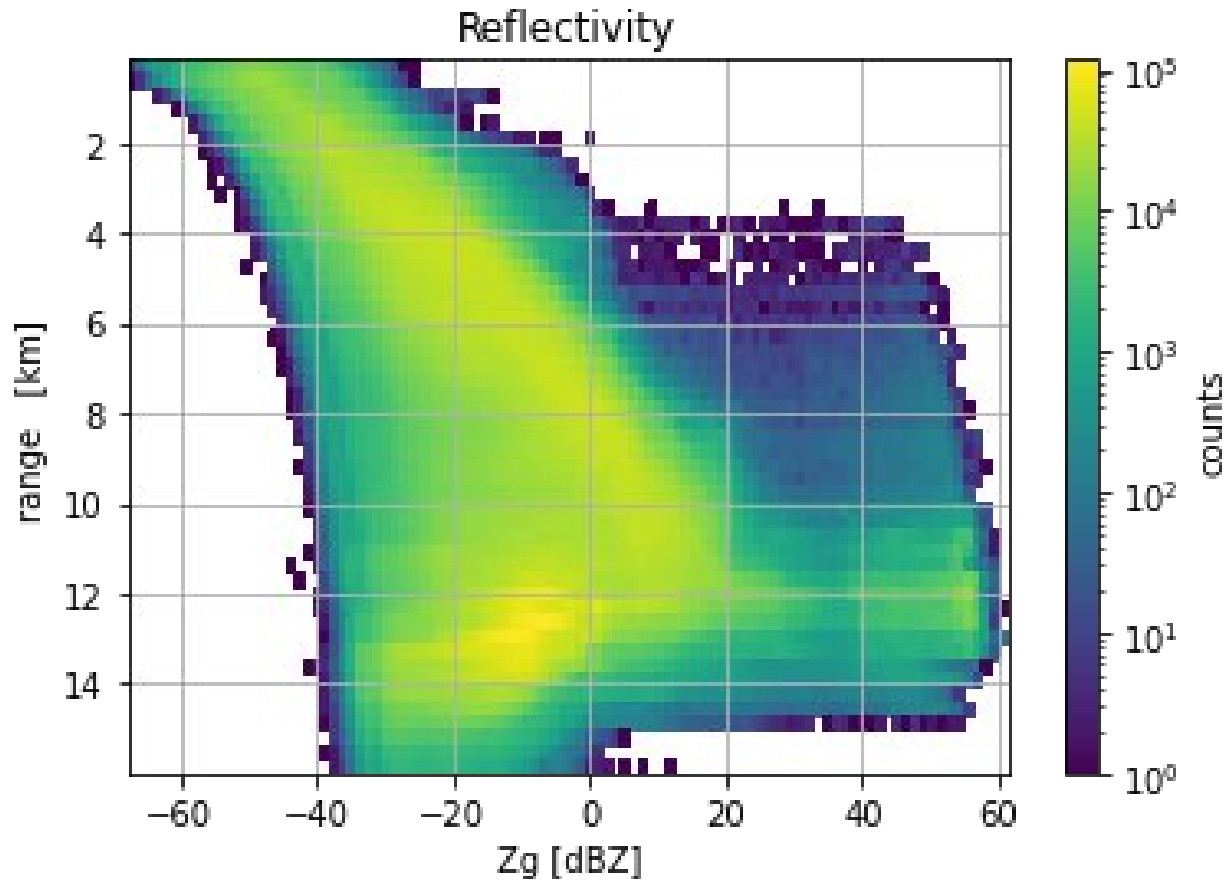
Better resolved low-level  
clouds

Low level clouds less  
present in the radar data  
-> model bias?  
-> radar sensitivity?





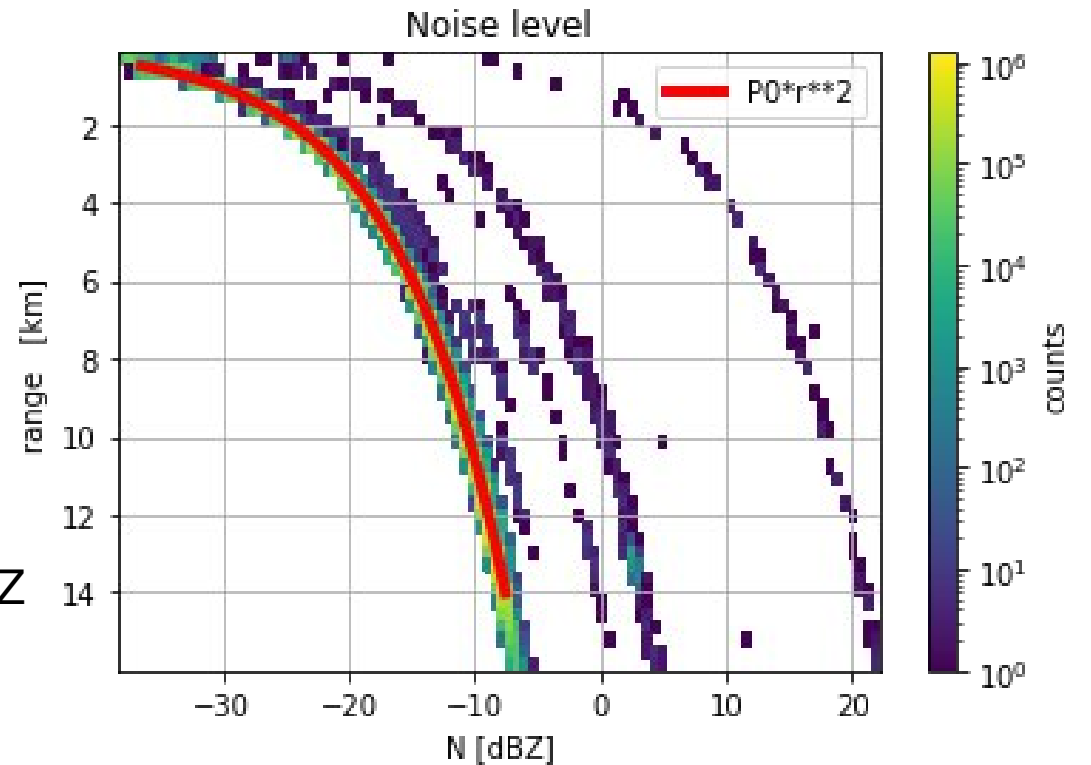
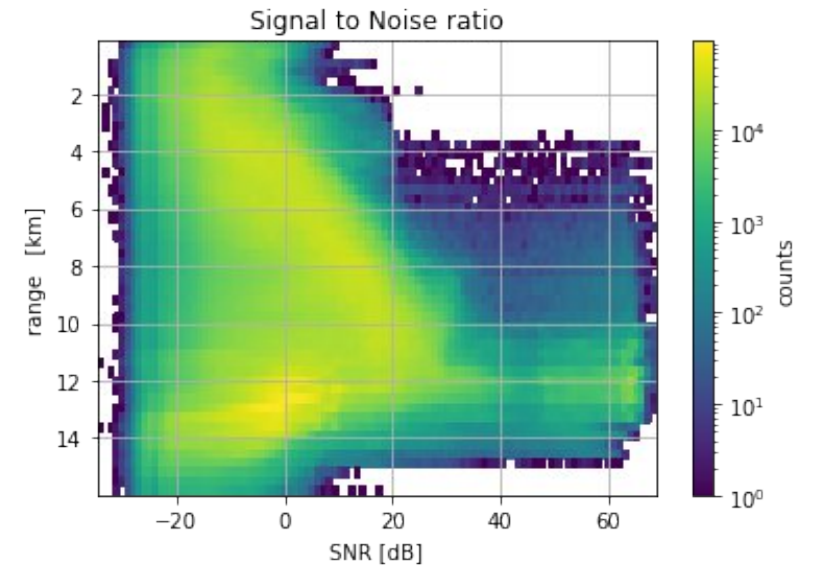
# Instrument characterization



$N(1\text{km}) = -30\text{dBZ}$

$N(3\text{km}) = -20\text{dBZ}$

$N(10\text{km}) = -10\text{dBZ}$





# Summary

- High resolution modeling captures cloud properties
  - 2km resolution seems sufficient for general structure
  - 600m resolution needed for small-scale low-level clouds
- Model evaluation with forward simulation of radar (and other instruments?)
- Instrument response function to be fully characterized and included in the forward simulations
- MIRA sensitivity to low-level clouds could be improved by flying lower altitudes