Experimenting with SAM's CRM

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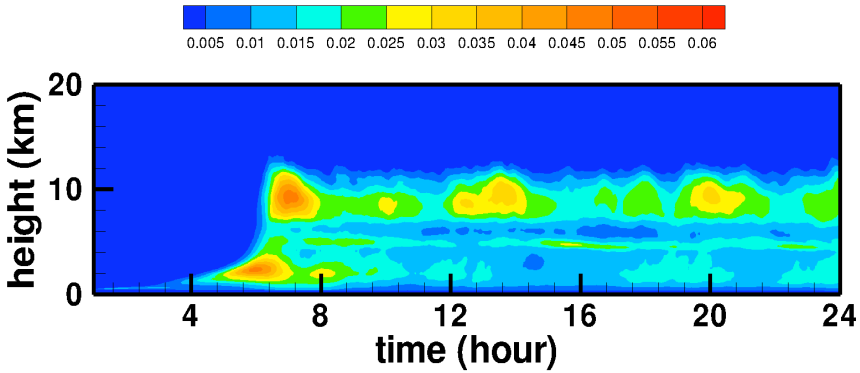
The CRM setup

1. SAM 6.8.2 version
2. Grid points: 128 x 128 x 64
3. Grid size: 1.6 km in horizontal, vary in vertical
4. GATE-IDEAL case (same as the Giga-LES)
5. Benchmark: Giga-LES solution

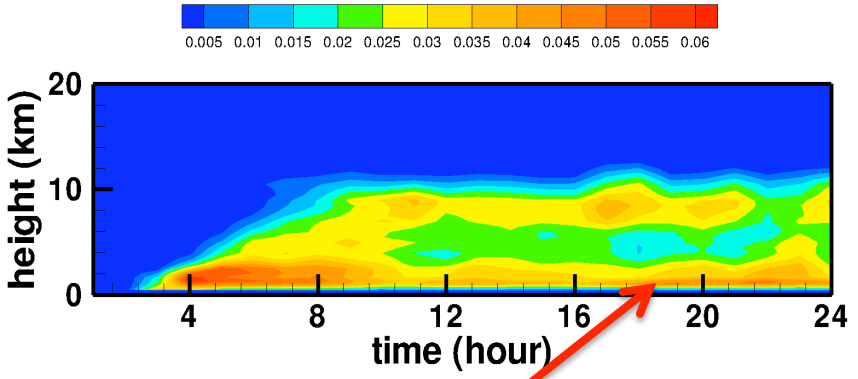
Comparison of cloud amounts

Giga-LES (benchmark)



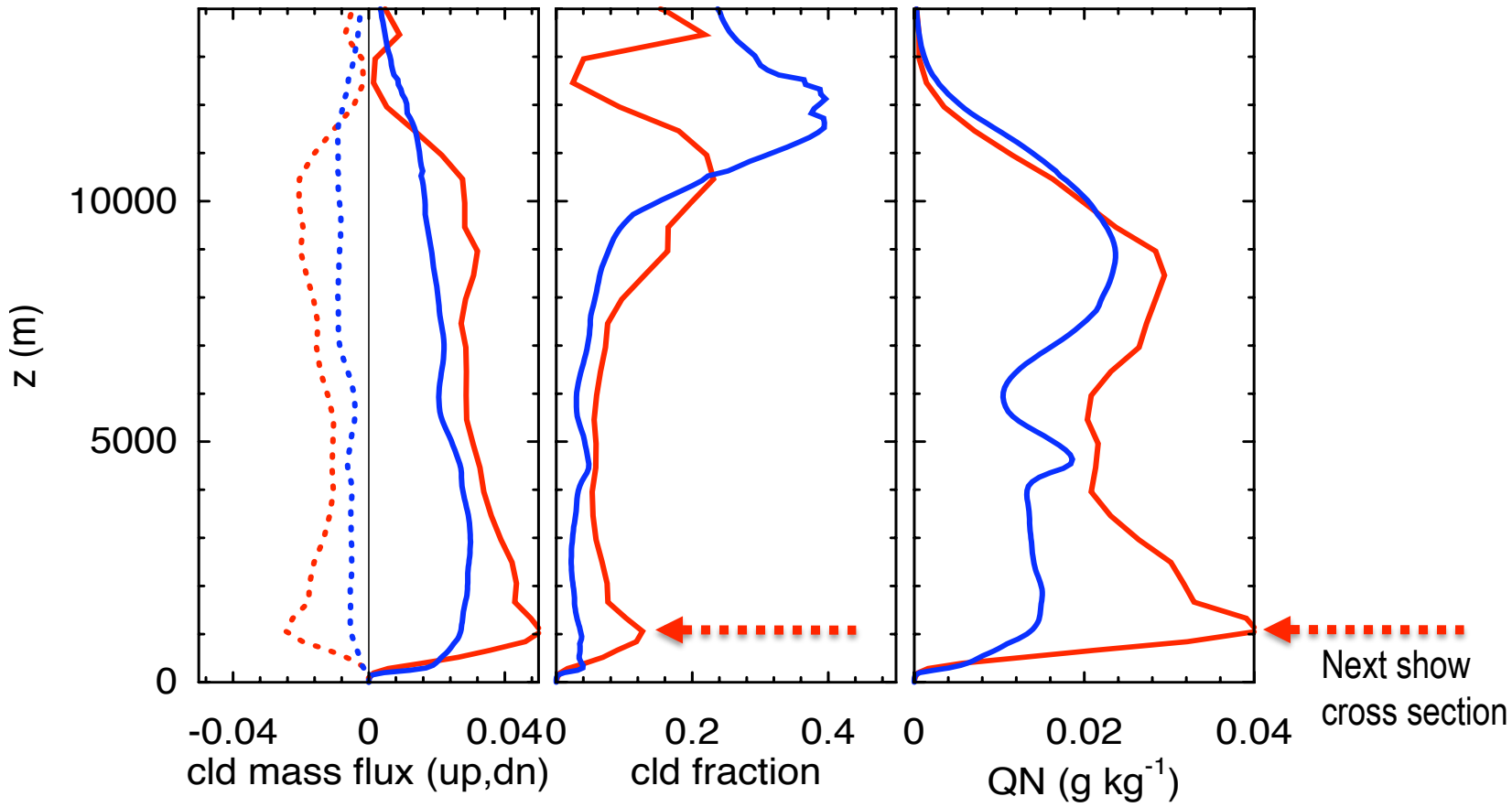
CRM run using SAM6.8.2

128 x 128 x 64 over 204.8 km x 204.8 km x 27 km



too much low cloud amount

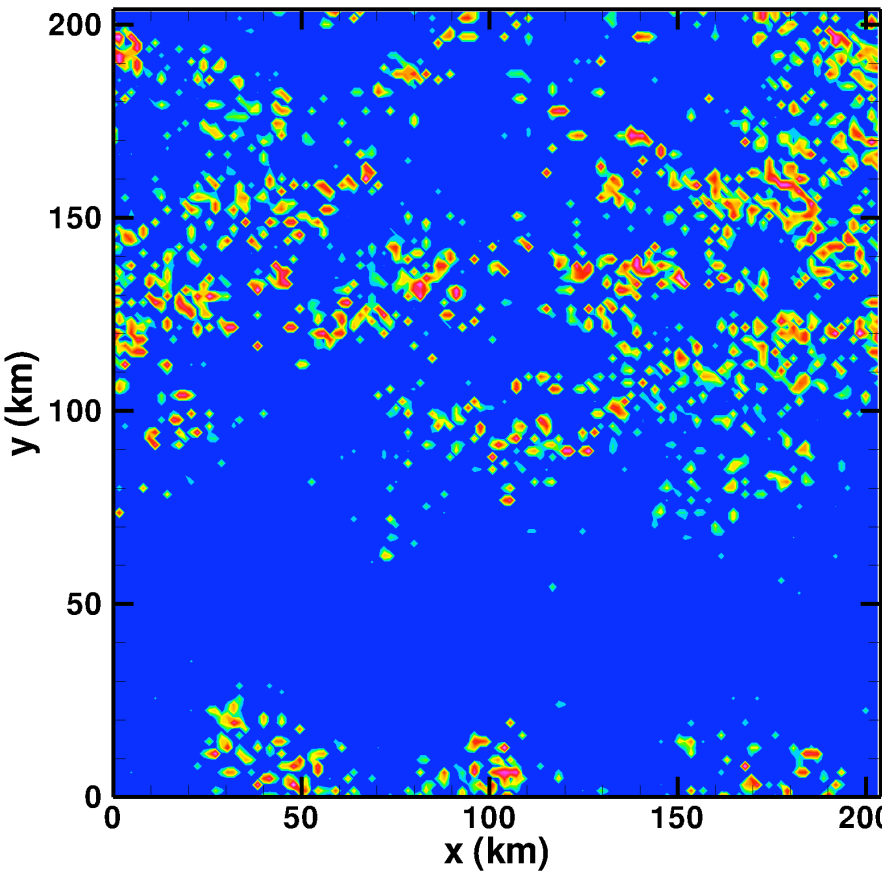
Horizontally-averaged cloud properties between Giga-LES (blue) and CRM (red)



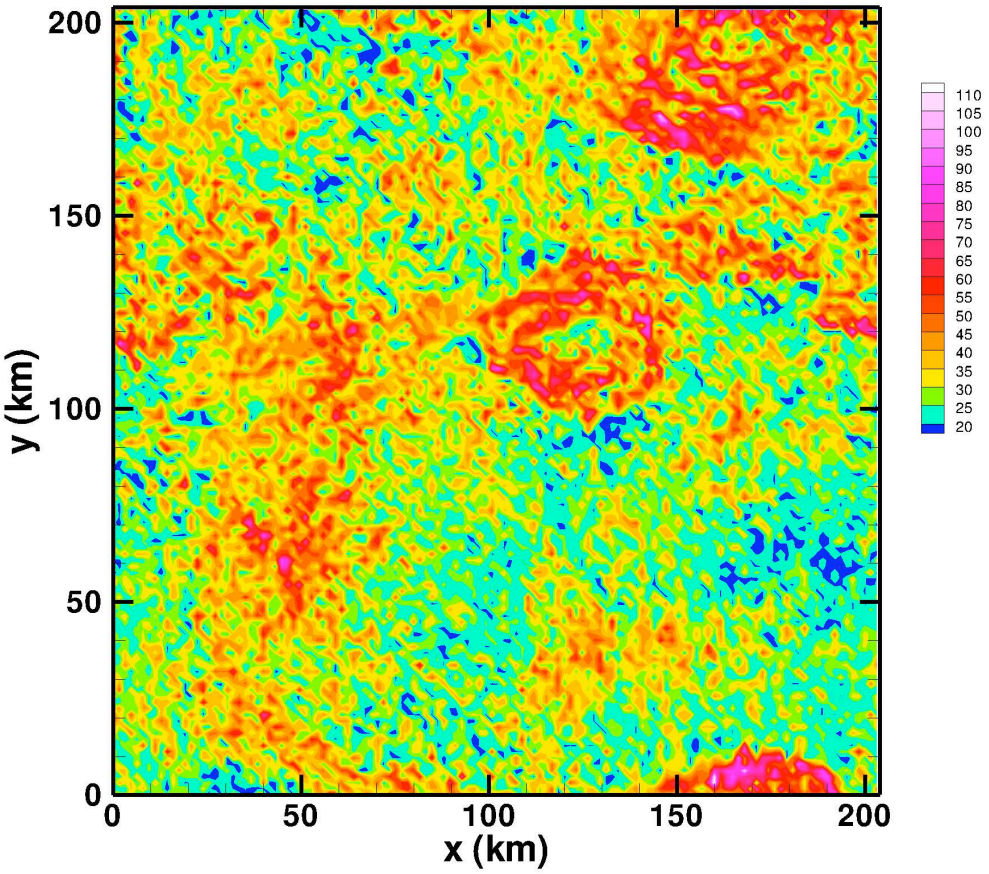
Problem #1: too much low cloud.

CRM's low cloud field vs. surface flux

Non-precipitating cloud amount at z ~ 1 km



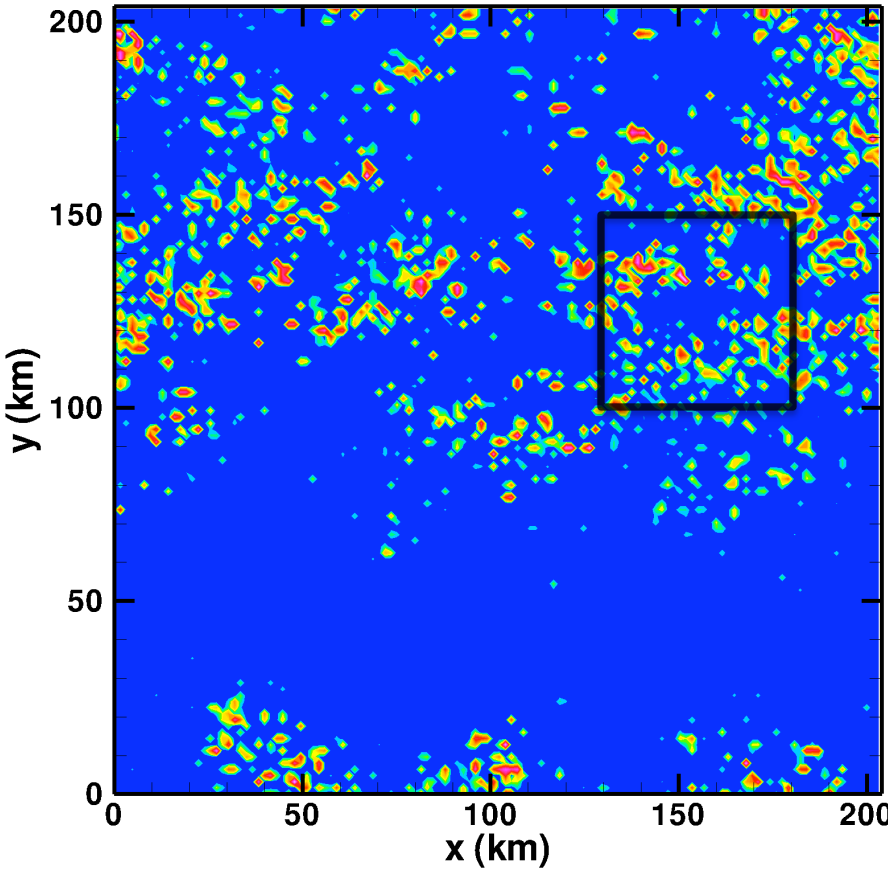
Surface latent heat flux



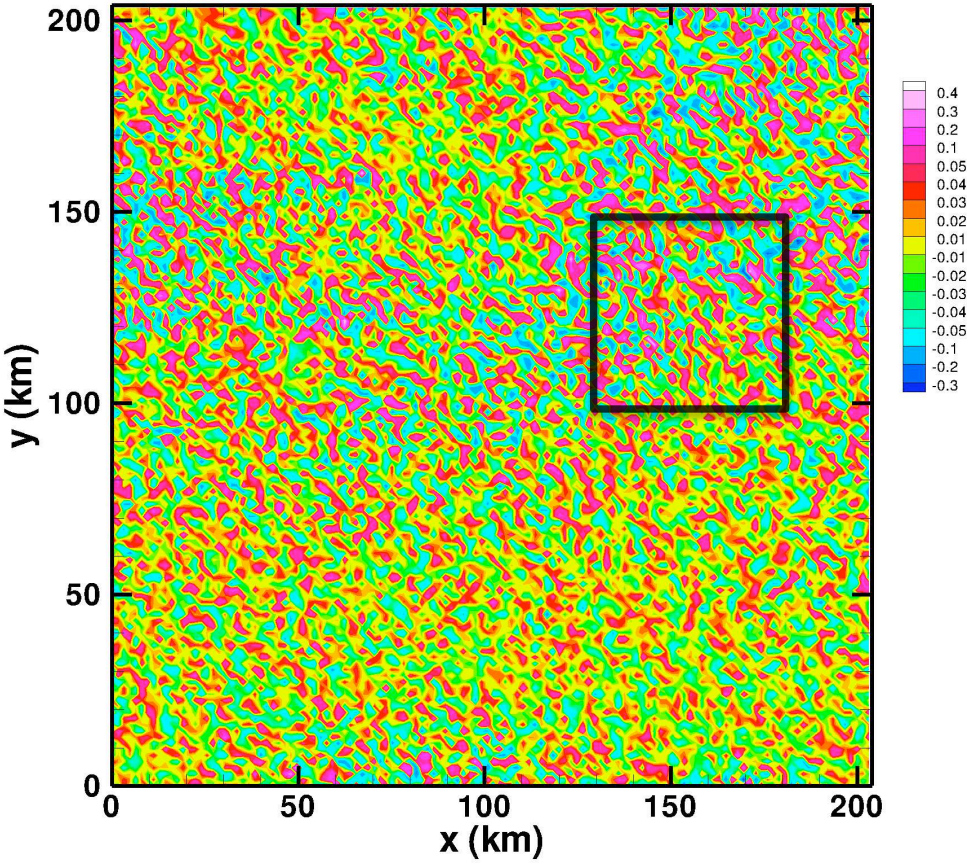
The large low-cld amount *may not* be a PBL problem??!

CRM's low cloud vs. vertical velocity

Non-precipitating cloud field at z ~ 1 km

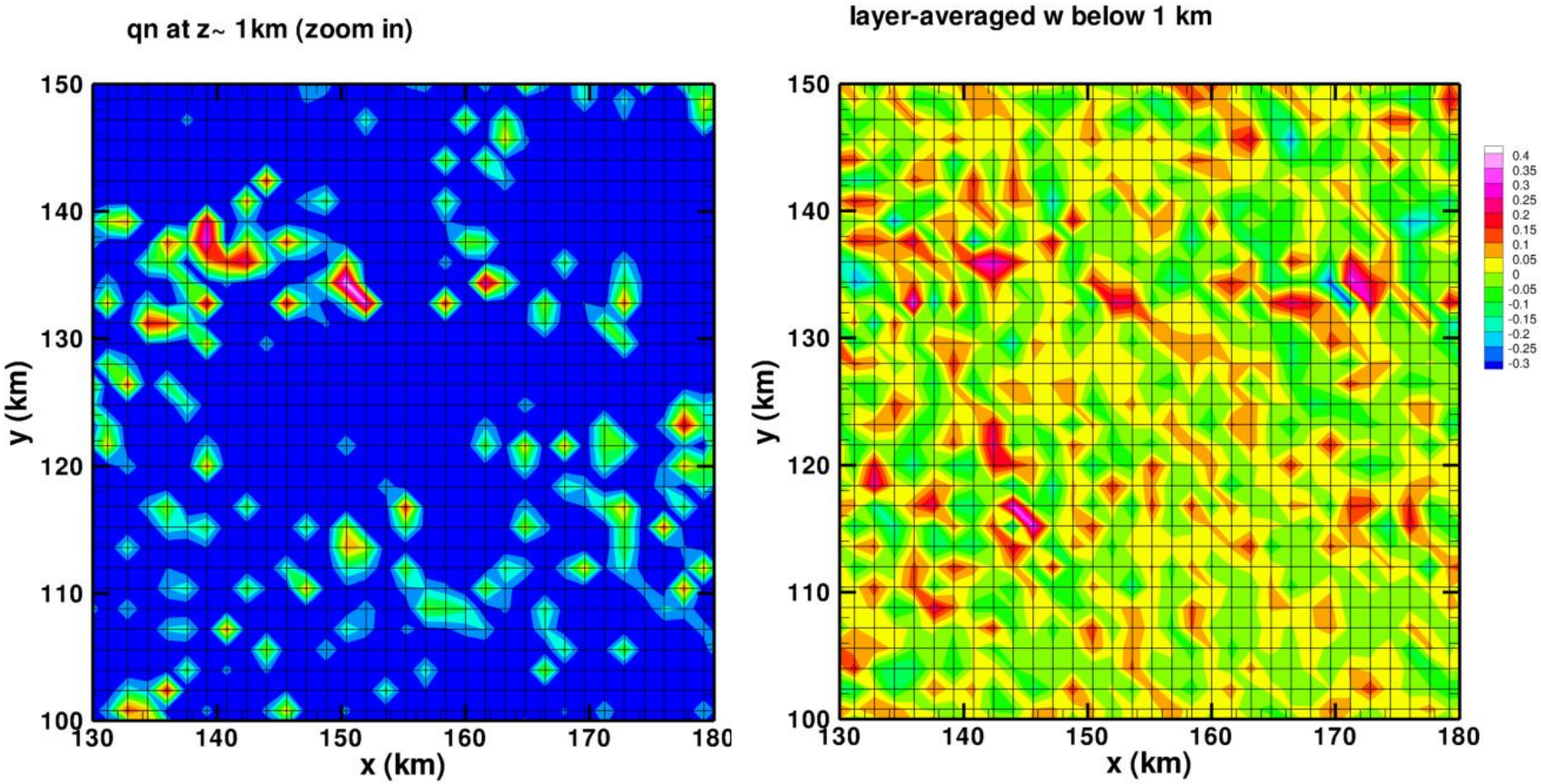


Layer-averaged w below 1 km



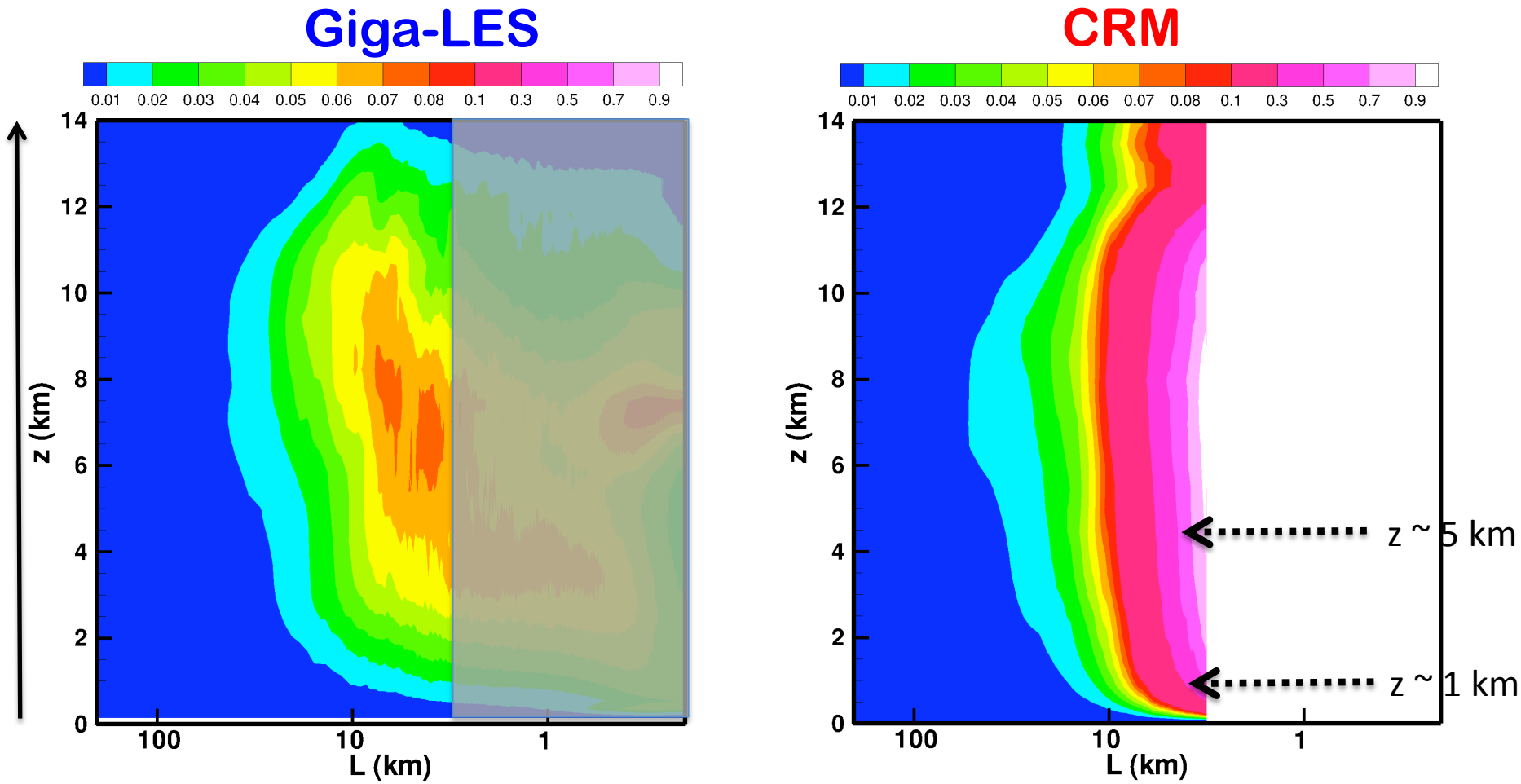
zoom in →

Lots of “grid-scale” low-cloud and w & they are somewhat related.

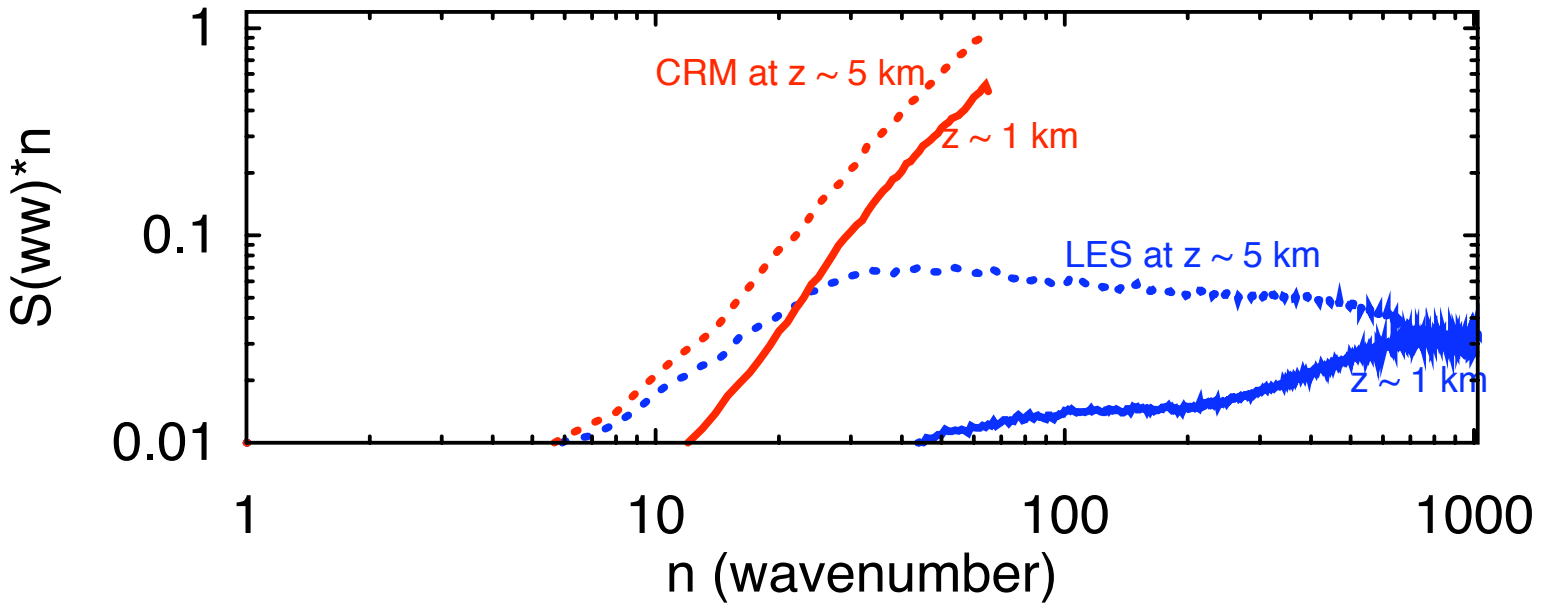


Is the “grid-scale” w field realistic?

Compare the w-spectra between Giga-LES and CRM



Power spectra of w at z ~ 1 km & 5km



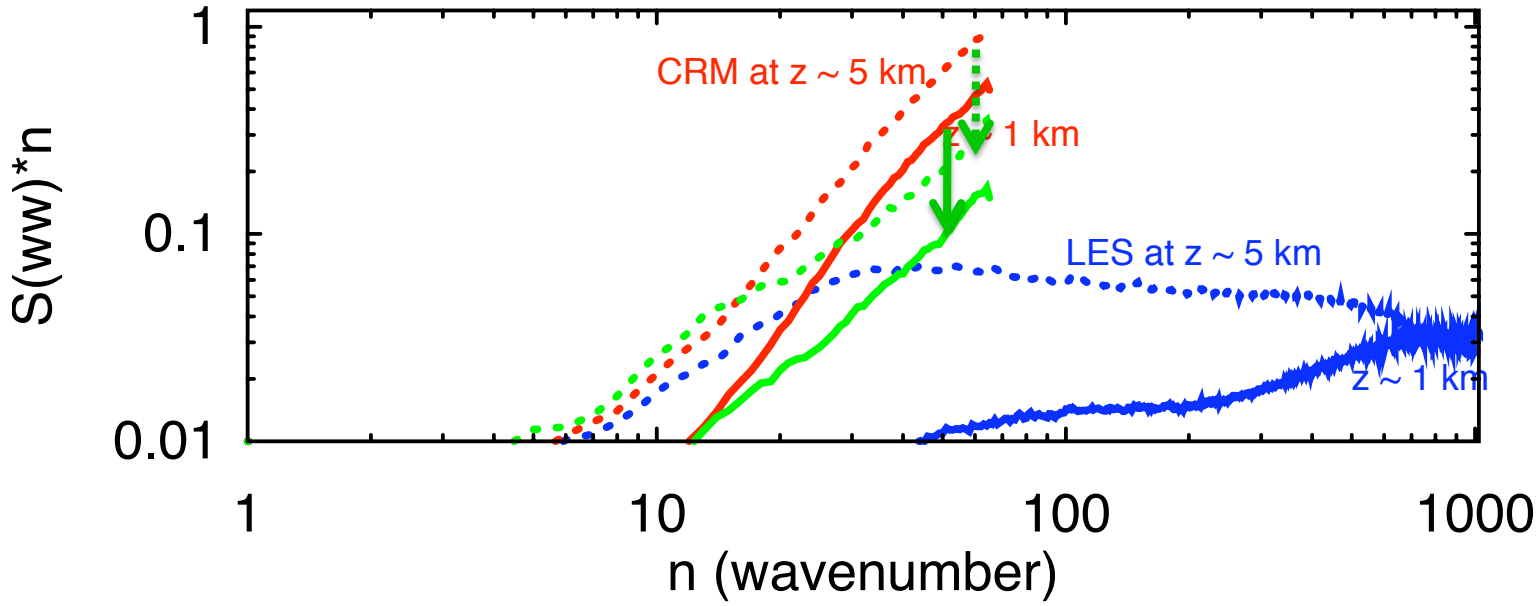
Problem #2: too much w-variance near the CRM grid cutoff

Why do I care about the unrealistic "grid-scale" vertical velocity and low-cloud amount in CRM?

Would they significantly affect (or interact with) microphysics and radiation over long simulations?

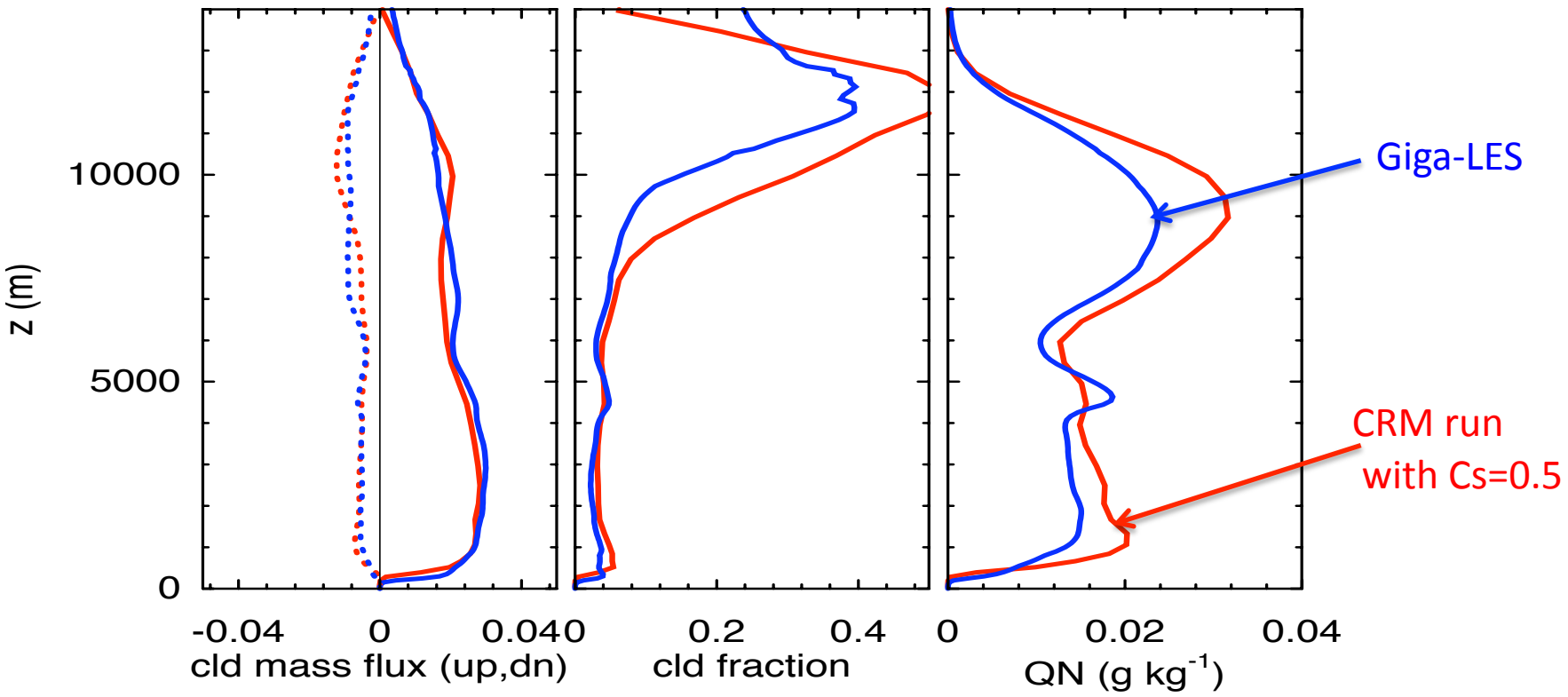
A quick fix: set Cs=0.5 (from 0.15)

(green curves)



Increasing SGS constant Cs (or Ck/Ce) drains more w-energy out…

Increasing Cs also reduces the low-cloud amount



The horizontally-averaged cloud field agrees better with Giga-LES, but there are issues to consider…..

Issues related to the unrealistic w and low-cloud amount:

- **2nd-order centered FF adv scheme for momentum**

  ➡ numerical overshoot in w?

- **SGS length scale = Δz for vertical K, but**

  = Δh for horizontal K

  ➡ physically justified?

- **Does the "PBL" matter? How to represent it?**