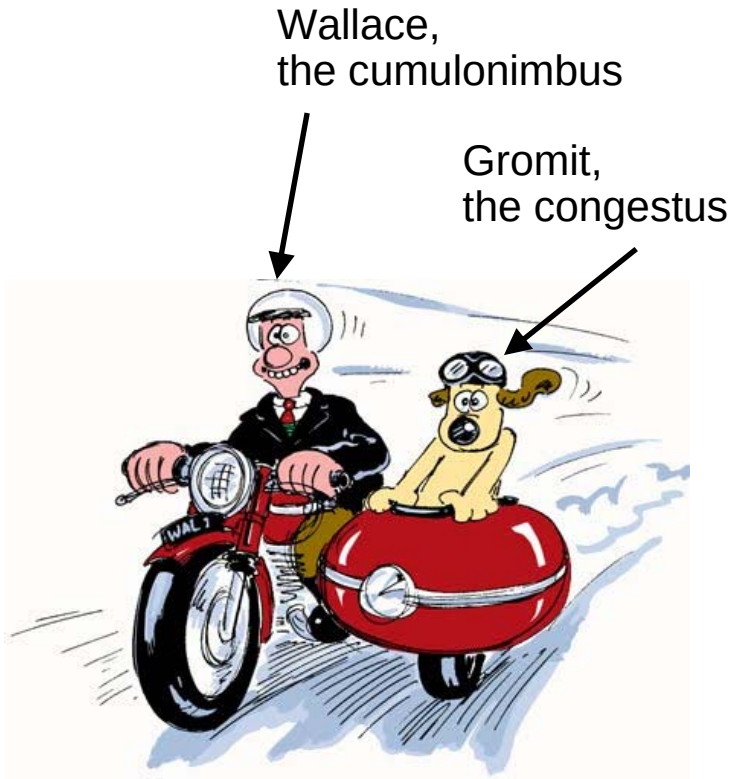
Cumulus congestus: Along for the ride?



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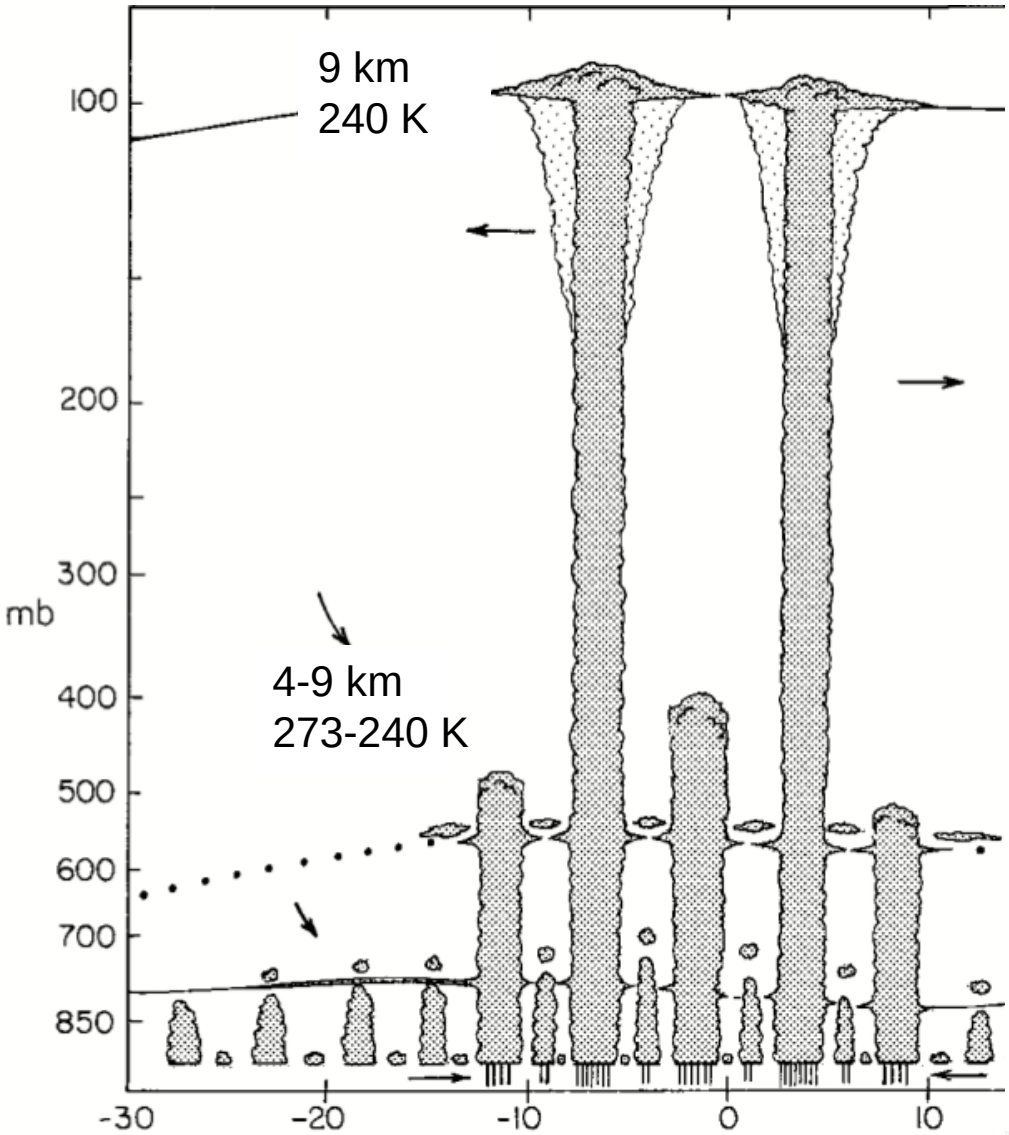
Preconditioning deep convection with cumulus congestus, 2013, *J. Atmos. Sci.*, **70**, 448-464

Cumulus congestus

- 3rd dominant cloud population
- Precipitate
- Moisten
- Generate circulation

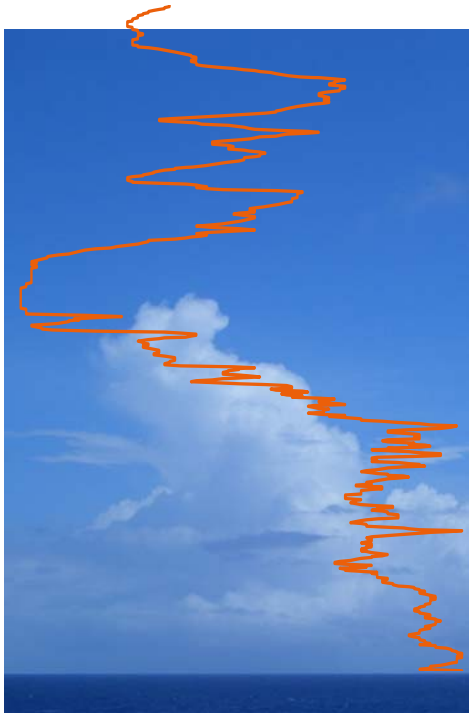


(Johnson et al. 1999)

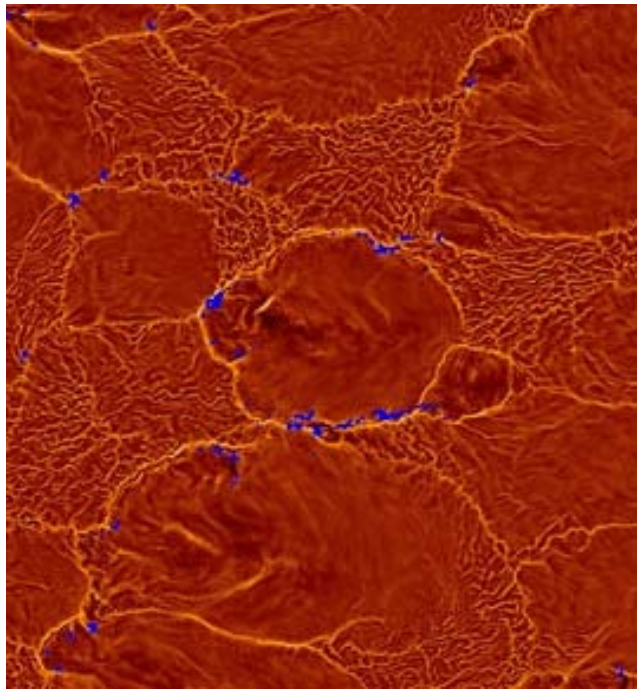
Preconditioning idea

- Congestus moistening promotes deep convection

~7 km



- Convergence (from congestus) promotes deep convection



(Linda Schlemmer)

This talk

1. Is congestus moistening fast enough to promote deep convection ?

   - **Observed transition time T_{obs}**
     Actual transition time, from congestus to deep

   - **Congestus moistening transition time T_{cmoist}**
     Transition time if the only acting process would be moistening by congestus

   - **Convergence-induced transition time T_{w}**
     Transition time if the transition was forced through convergence

1. Is the convergence induced by congestus clouds strong enough to promote deep convection?

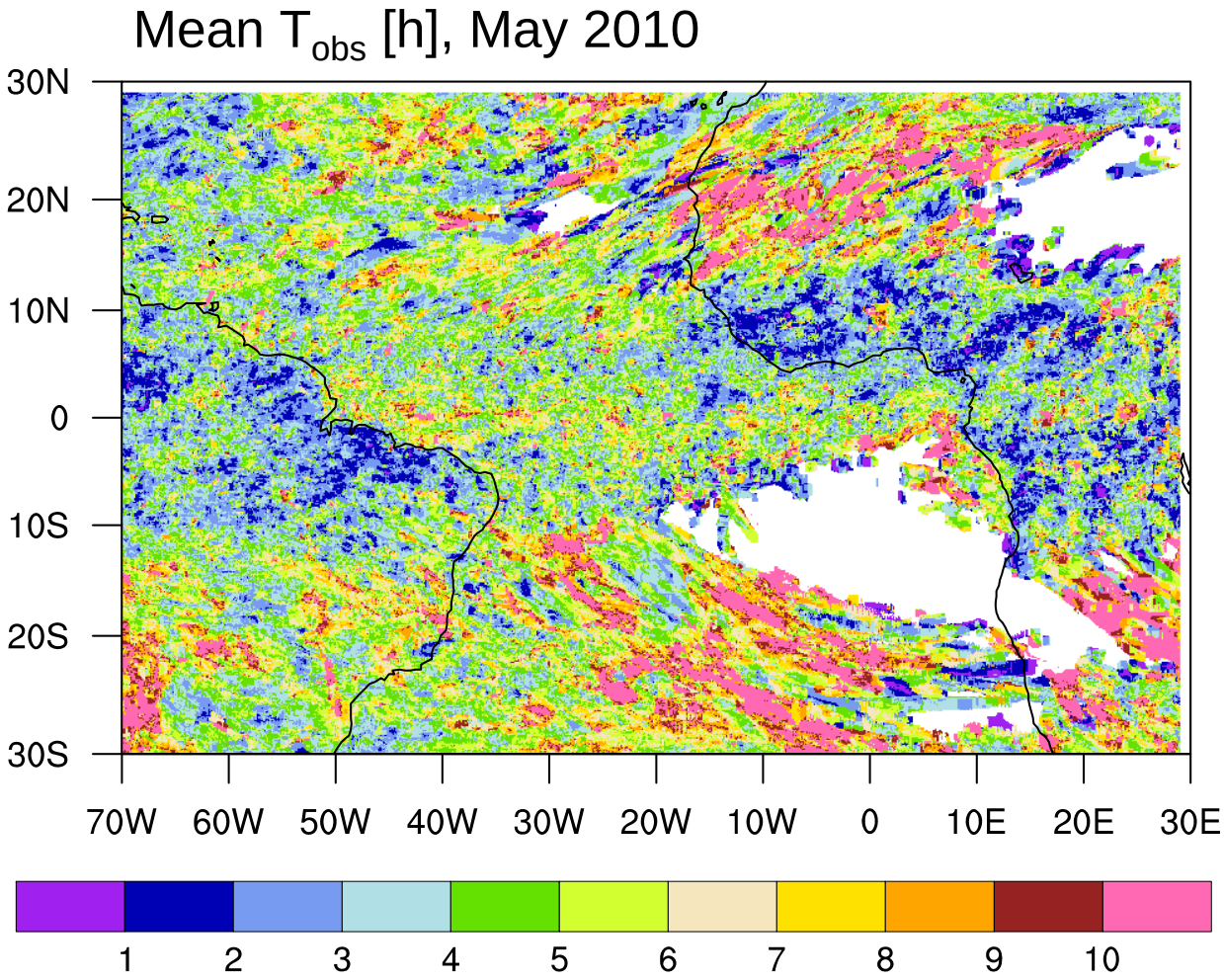
Observed transition time T_{obs}

Over ocean:

T_{obs} ≈ 4 hours

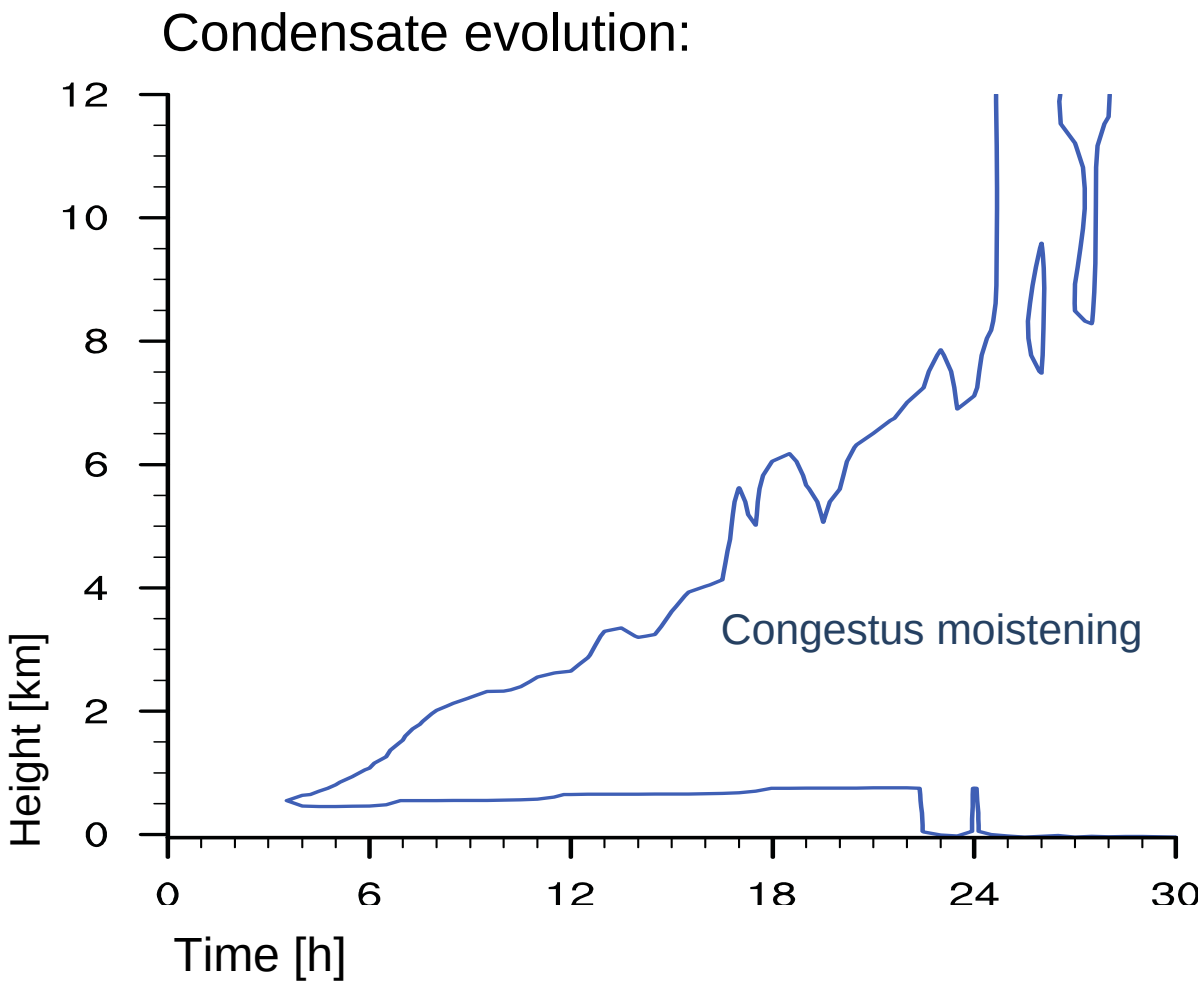
Over land:

T_{obs} ≈ 2 hours



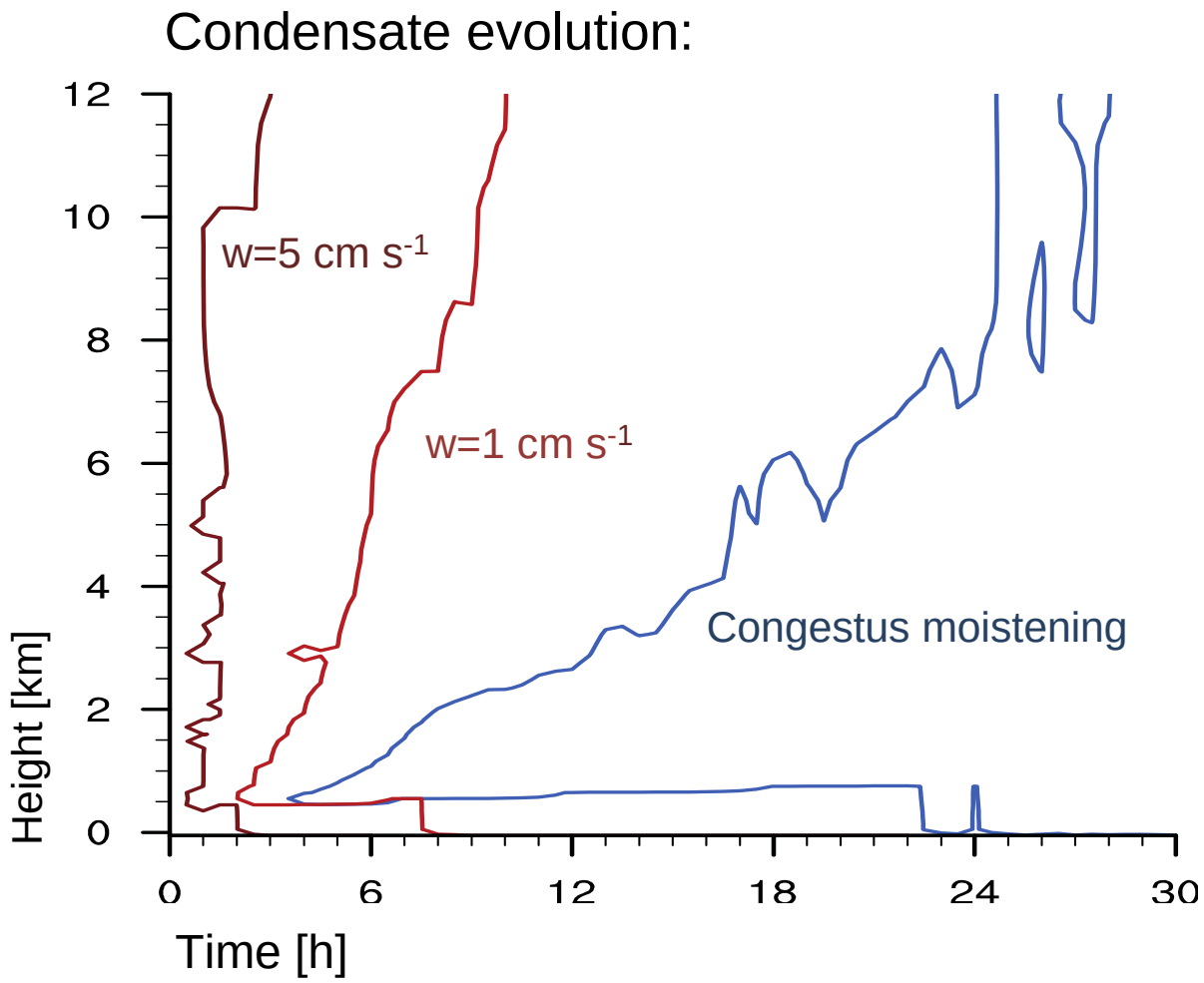
Congestus moistening transition time T_{cmoist}

- T_{obs} = 2-4 h
- T_{cmoist} = 10 h



Convergence-induced transition time T_w

- T_{obs} = 2-4 h
- T_{cmoist} = 10 h
- T_w = 1-4 h



This talk

1. Is congestus moistening fast enough to promote deep convection ?
   - For the spatial and temporal scales of systems considered, no
   - Congestus are along for the ride…

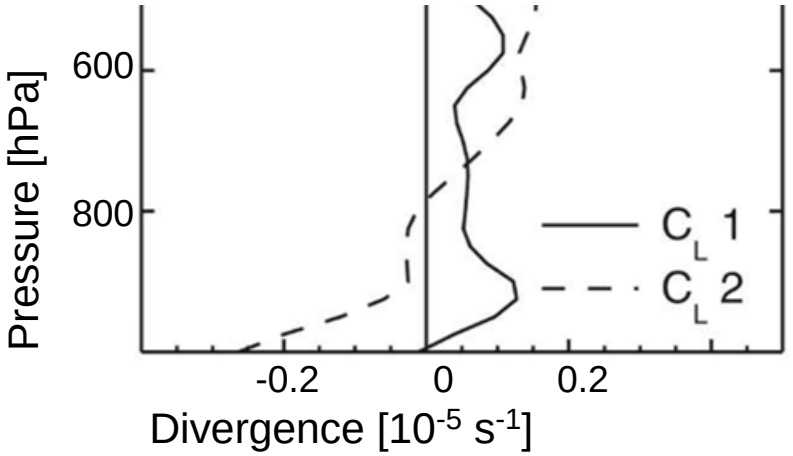
1. Is the convergence induced by congestus clouds strong enough to explain observed transition times?
   - w ~ 1 cm s^{-1}, T ~ 4 h
   - w ~ 2 cm s^{-1}, T ~ 2 h

Circulation induced by congestus clouds

- Divergence deduced from congestus (C_L 2) during KWAJEX would give:

  $w \sim 0.2 \text{ cm s}^{-1} << 1 \text{ cm s}^{-1}$

Schumacher et al. (2008)



Convergence induced by congestus

Do we find regions of enhanced convergence due to the congestus?

10 km

$w > 1$ cm s^{-1}, $T > 4h$

$w > 2$ cm s^{-1}, $T > 2h$

Convergence induced by congestus

Do we find regions of enhanced convergence due to the congestus?

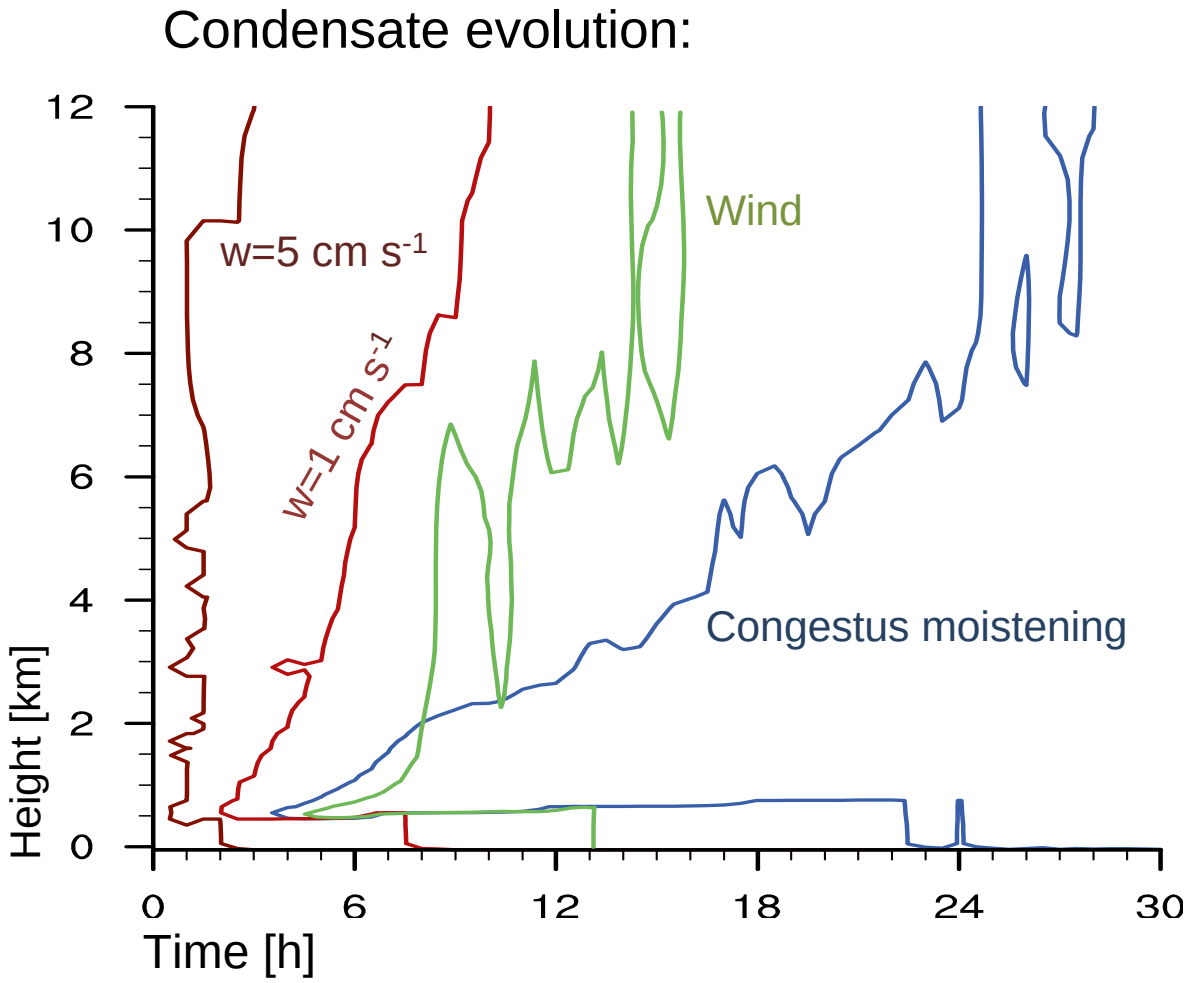
10 km

$w > 1$ cm s^{-1}, $T > 4$h NO

$w > 2$ cm s^{-1}, $T > 2$h YES

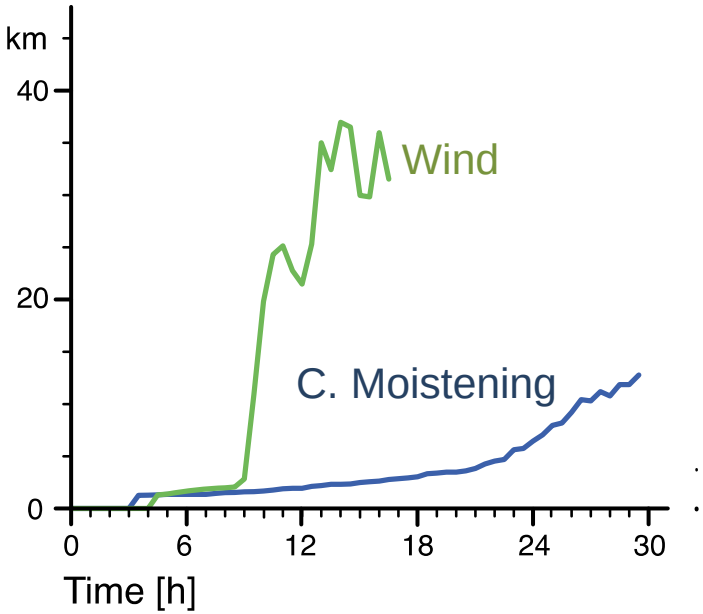
Enhancing convergence?

- T_{obs} = 2-4 h
- T_{cmoist} = 10 h
- T_w = 1-4 h
- T = 4 h

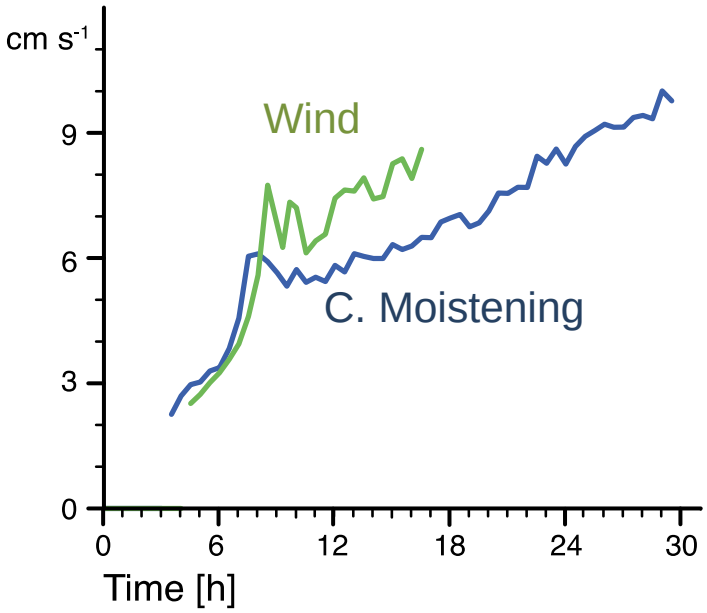


Enhancing convergence?

Size of area with w > 2 cm s^{-1}



Mean w



Moistening

1 g kg^{-1}

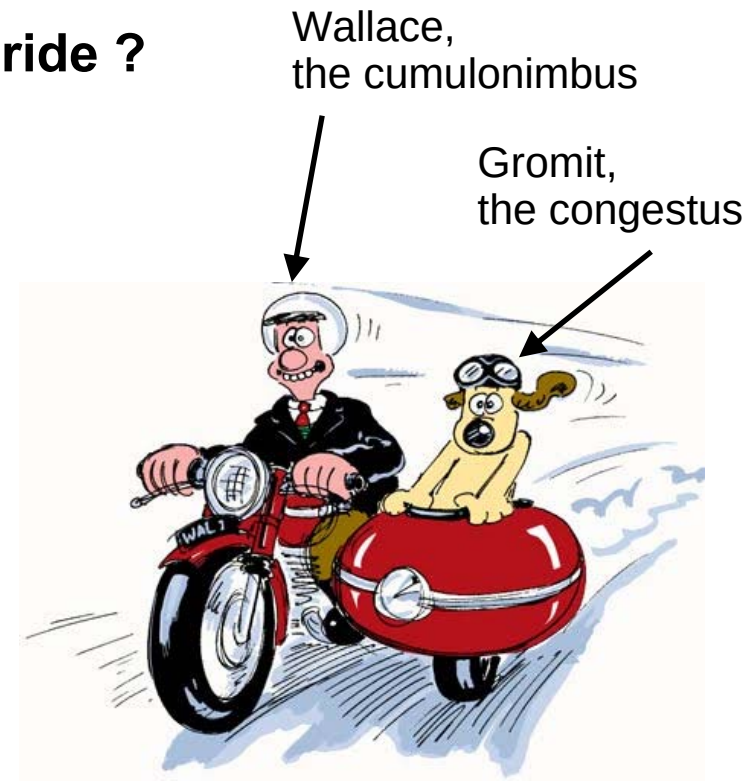
0.5 g kg^{-1}

Khairoutdinov and Randall (2006), Rio et al. (2009), Boing et al. (2012)

Conclusions

Are cumulus congestus just along for the ride ?

- Moistening of the troposphere
  Along for the ride
- Inducing circulation through heating
  Along for the ride
- Cold pools
  Not for the ride



For the range of spatial and temporal scales considered here.