

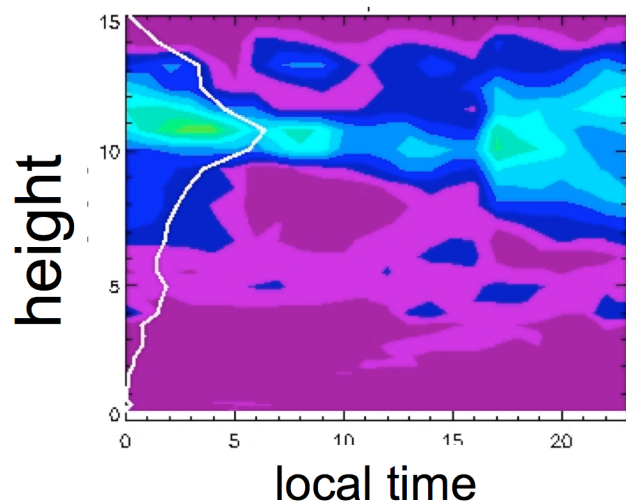
Model evaluation with CMBE and CloudNet products: Low clouds and drizzle.

Maike Ahlgrimm, Richard Forbes

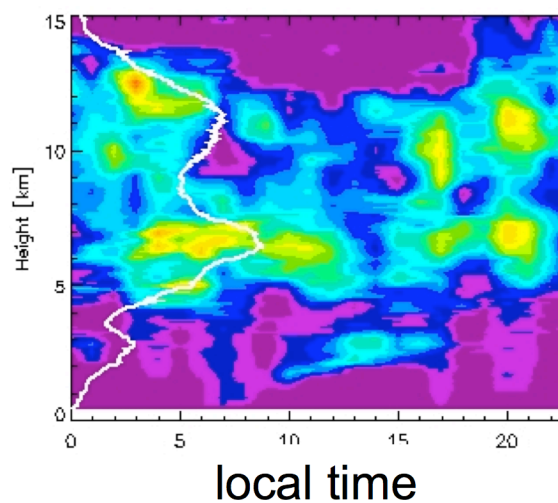
Bit of history: SW bias over land

- Too much SW reaching the ground over summertime continents
- Long standing bias
- Persists despite much work on shallow convection

oper (26r1)



CMBE/ARSCL



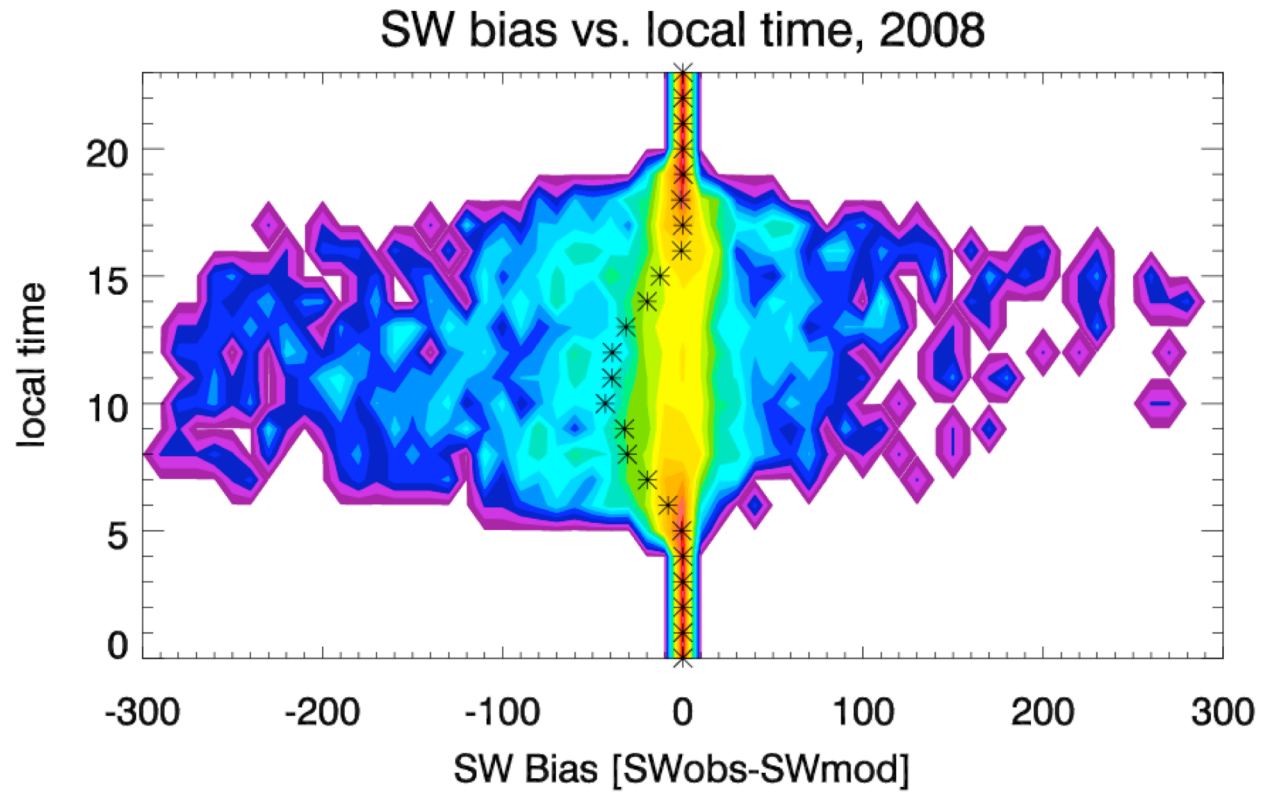
SGP July 2003
S. Cheinet

0

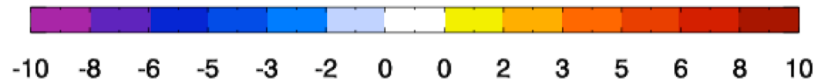
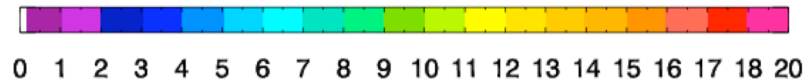
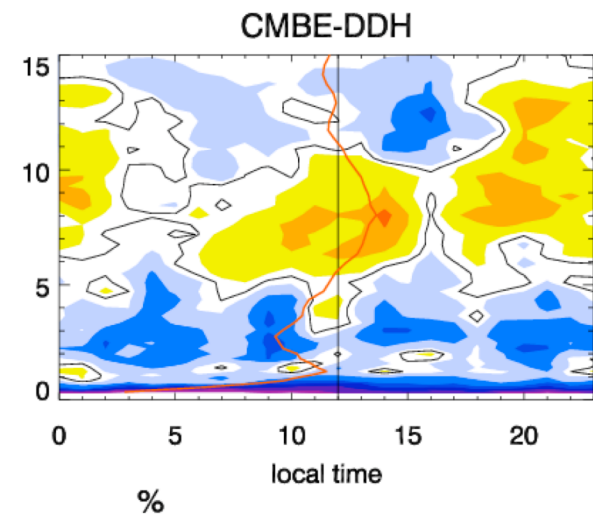
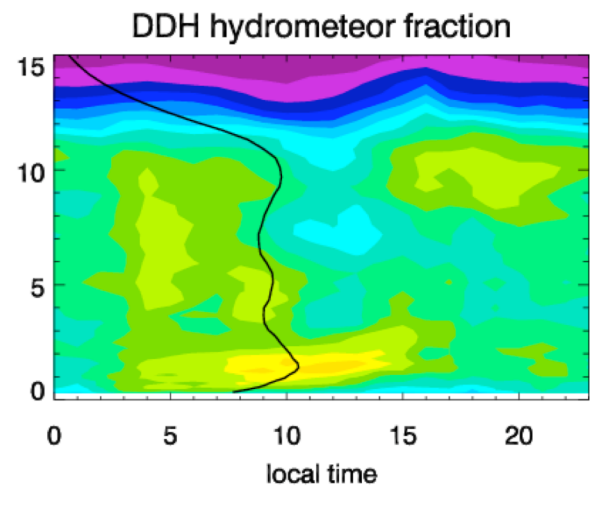
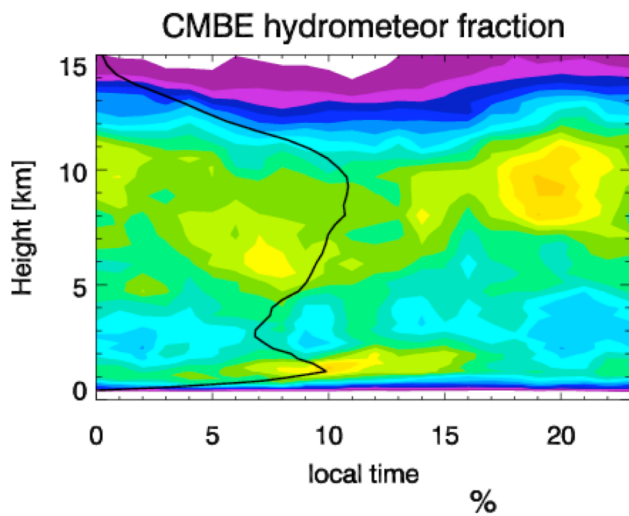
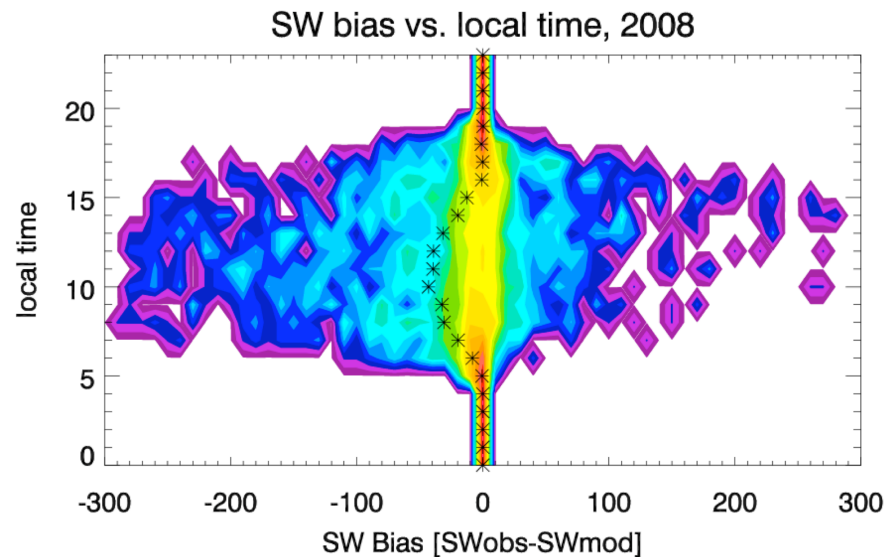


20

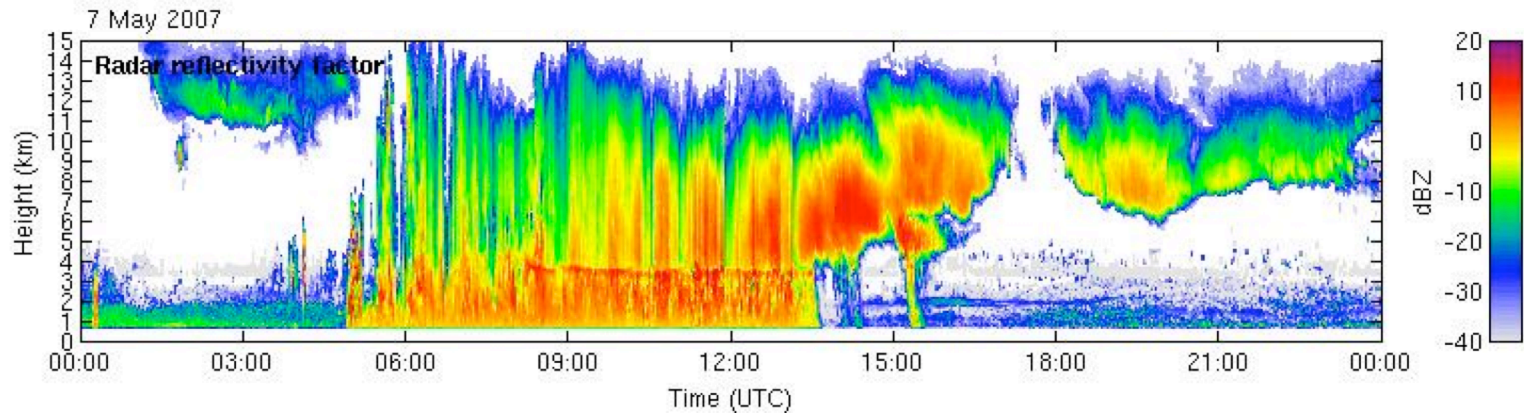
SW bias at SGP



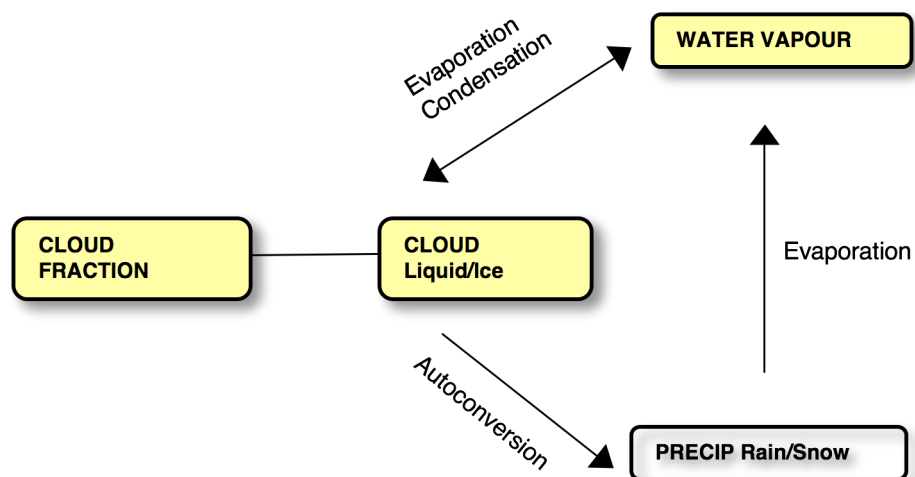
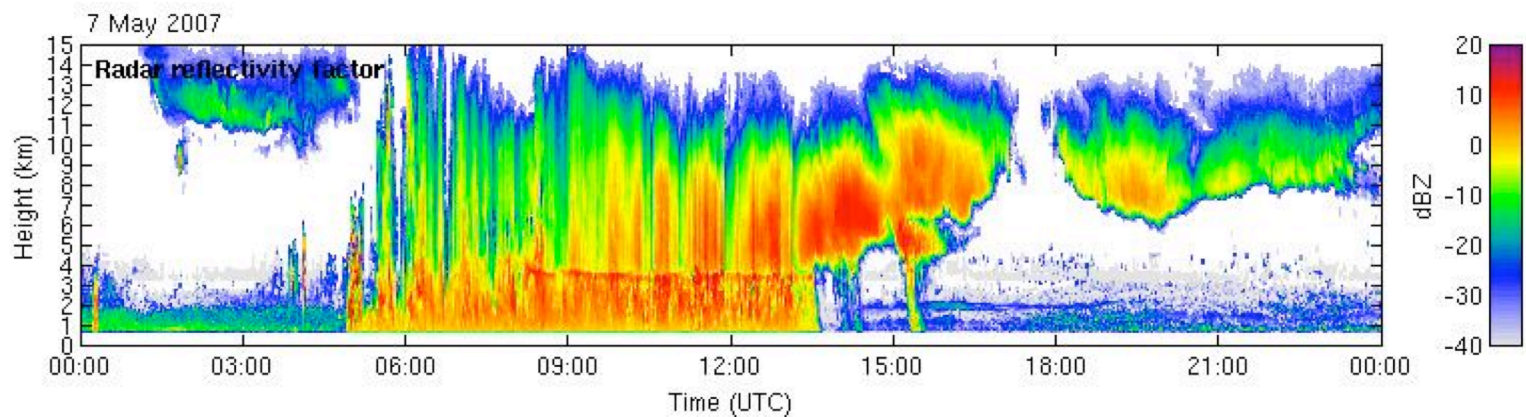
SW bias at SGP



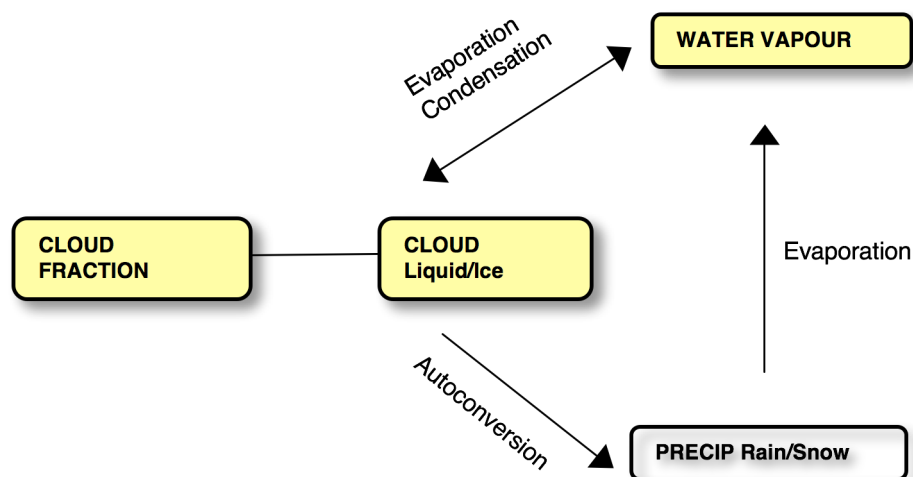
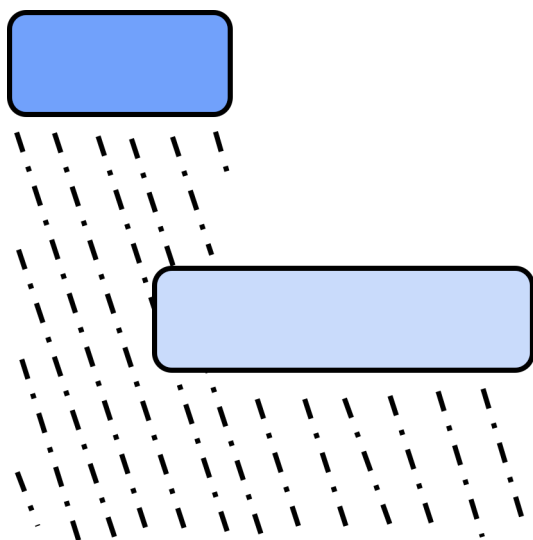
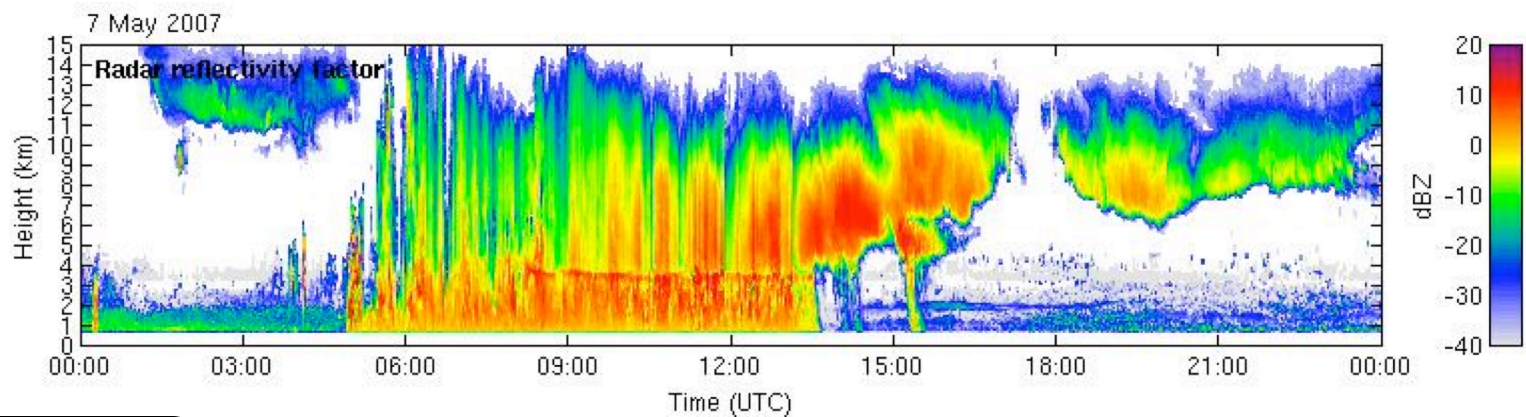
Hydrometeor fraction: cloud, rain, snow



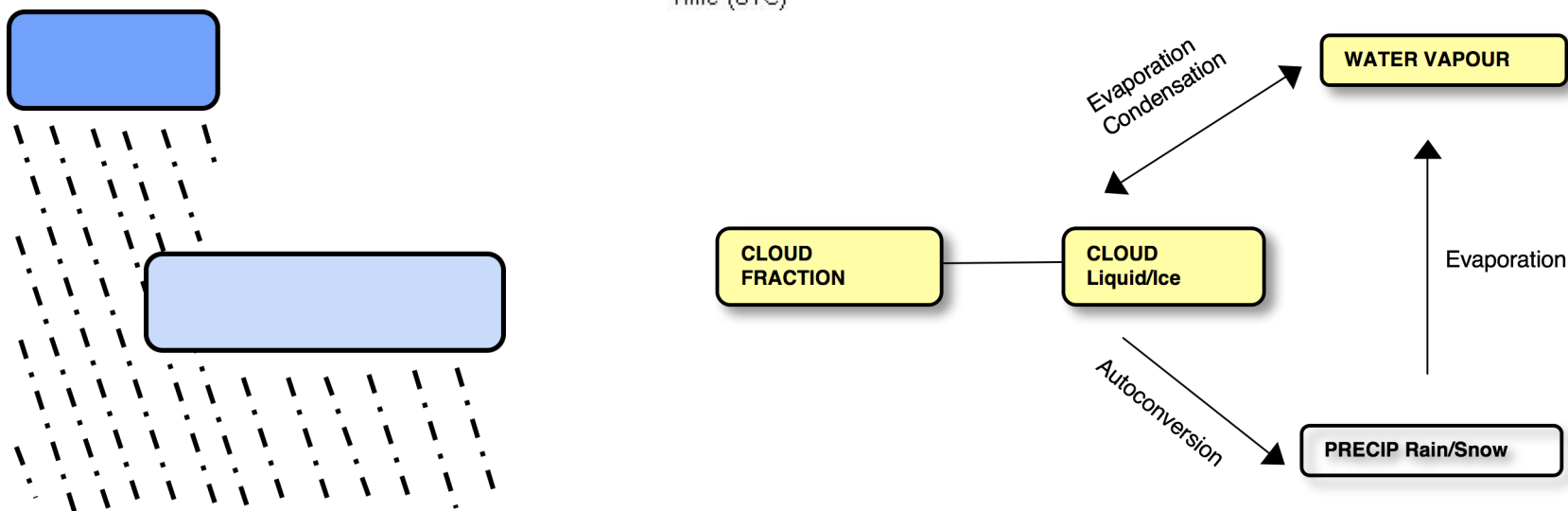
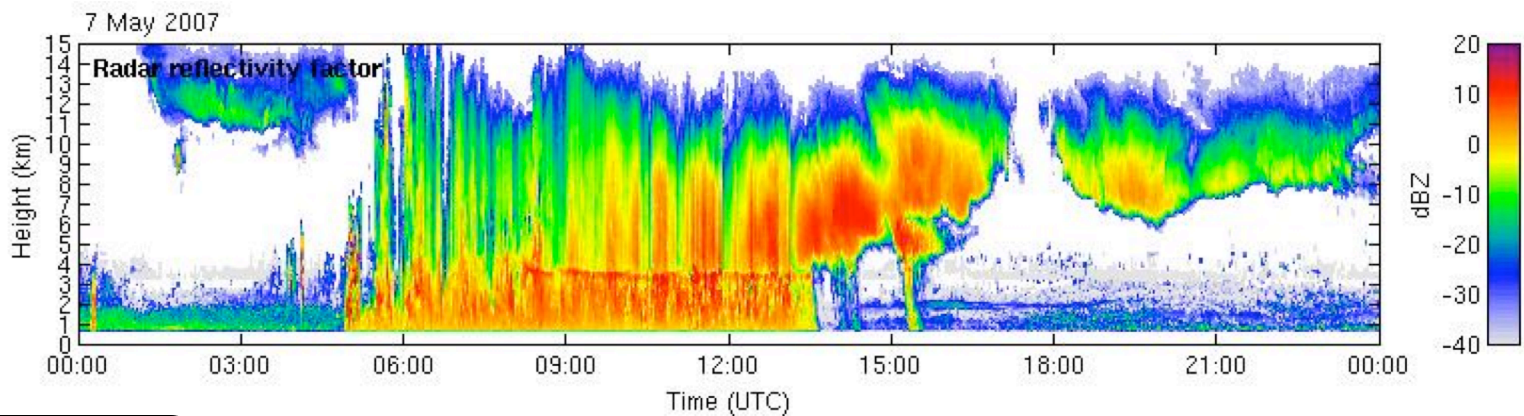
Hydrometeor fraction: cloud, rain, snow



Hydrometeor fraction: cloud, rain, snow



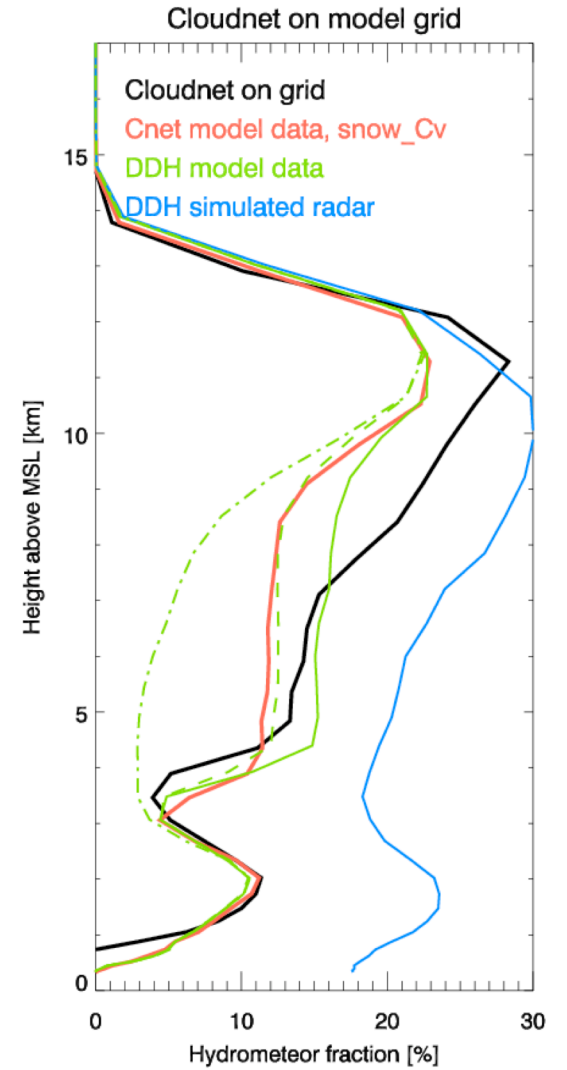
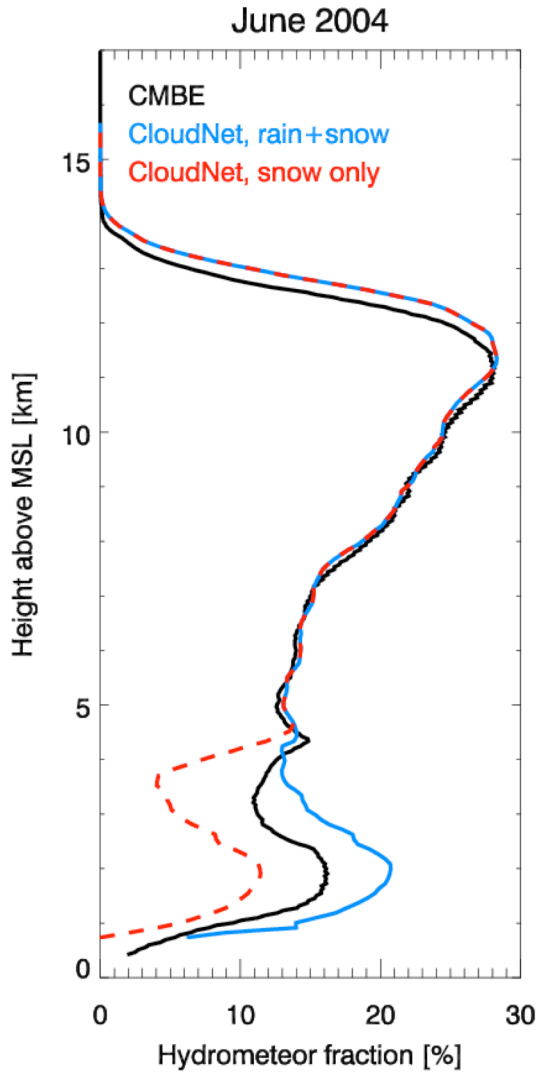
Hydrometeor fraction: cloud, rain, snow



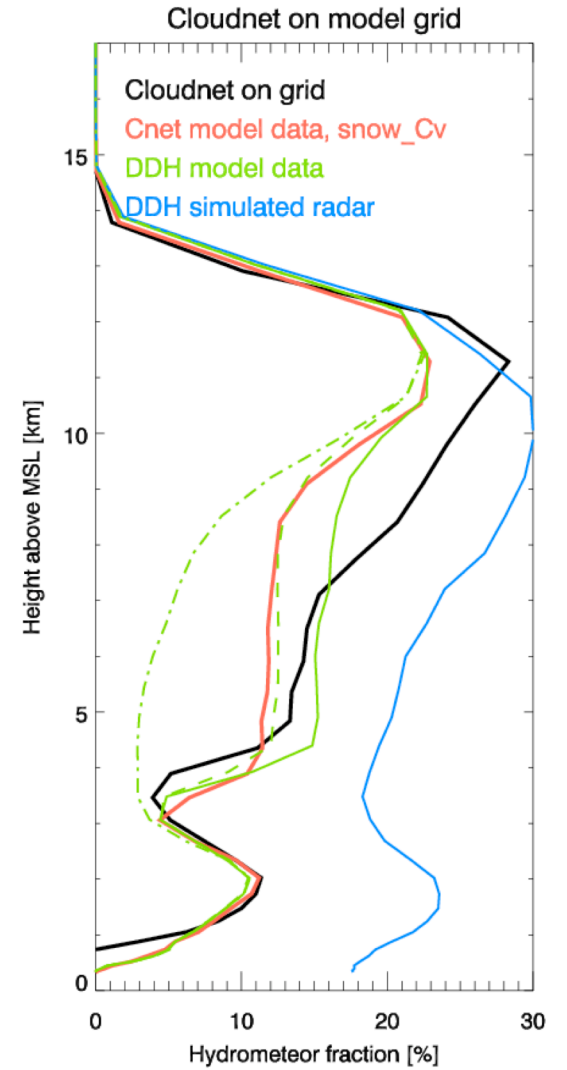
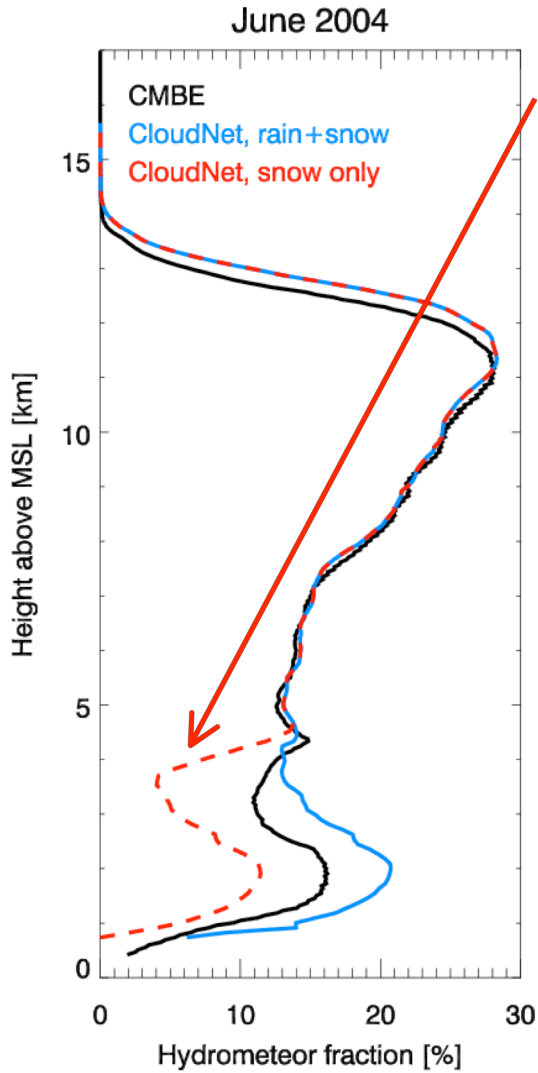
overlap → precip flux → precip density → radar simulator

threshold ← precip flux

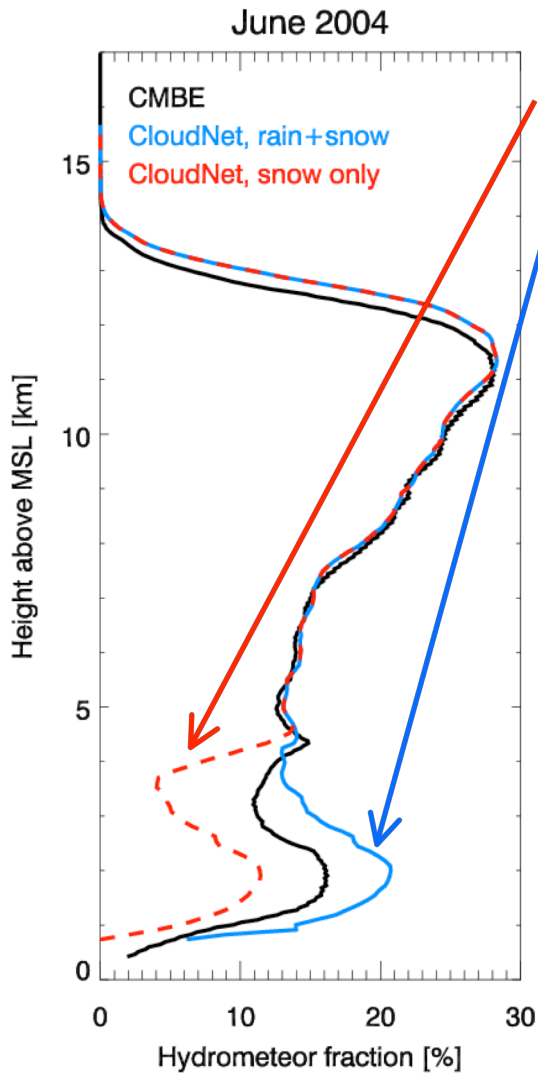
How do CloudNet/CMBE compare to model?



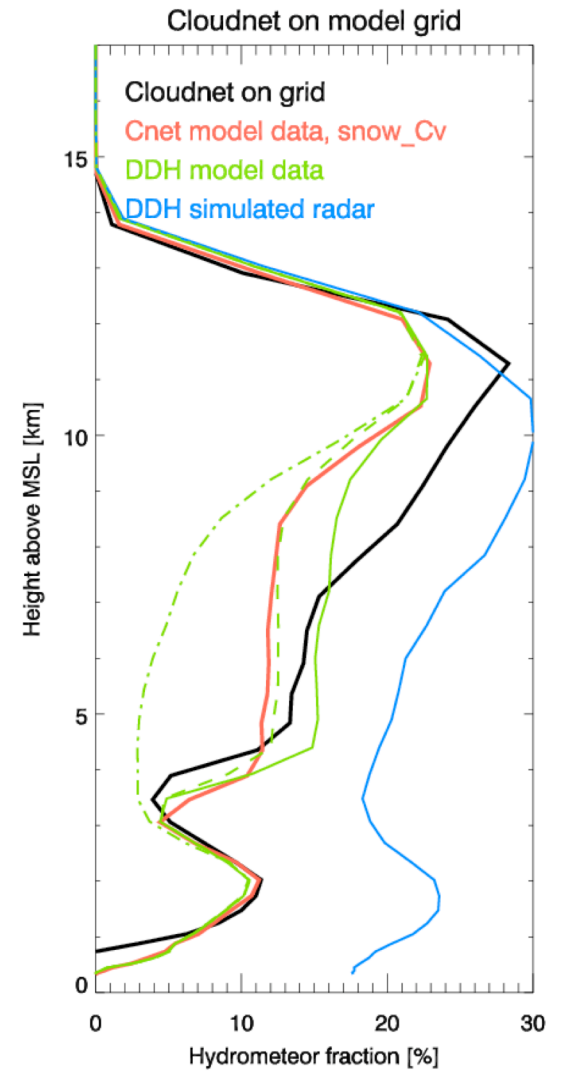
How do CloudNet/CMBE compare to model?



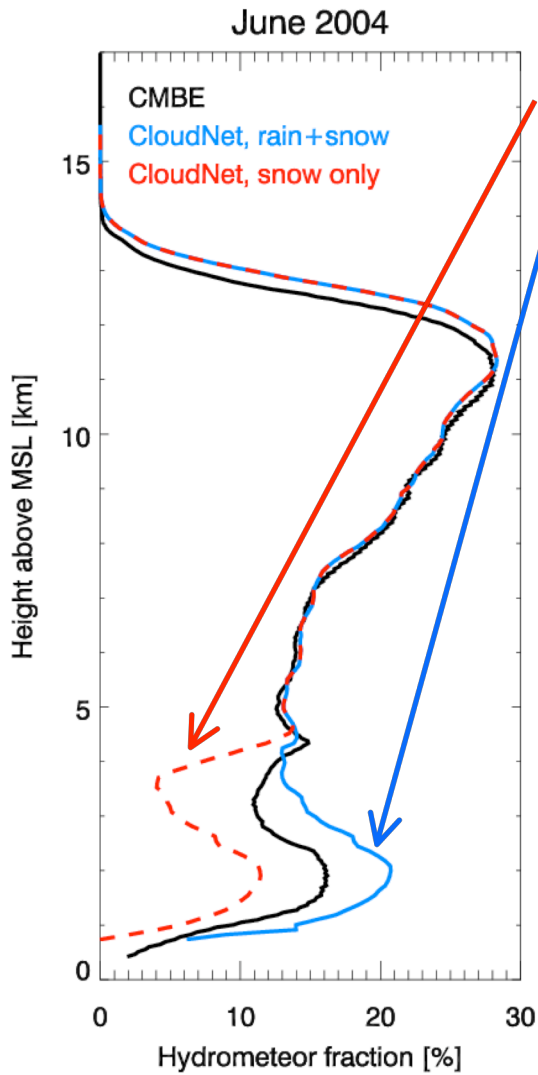
How do CloudNet/CMBE compare to model?



no rain
differences in rain treatment?

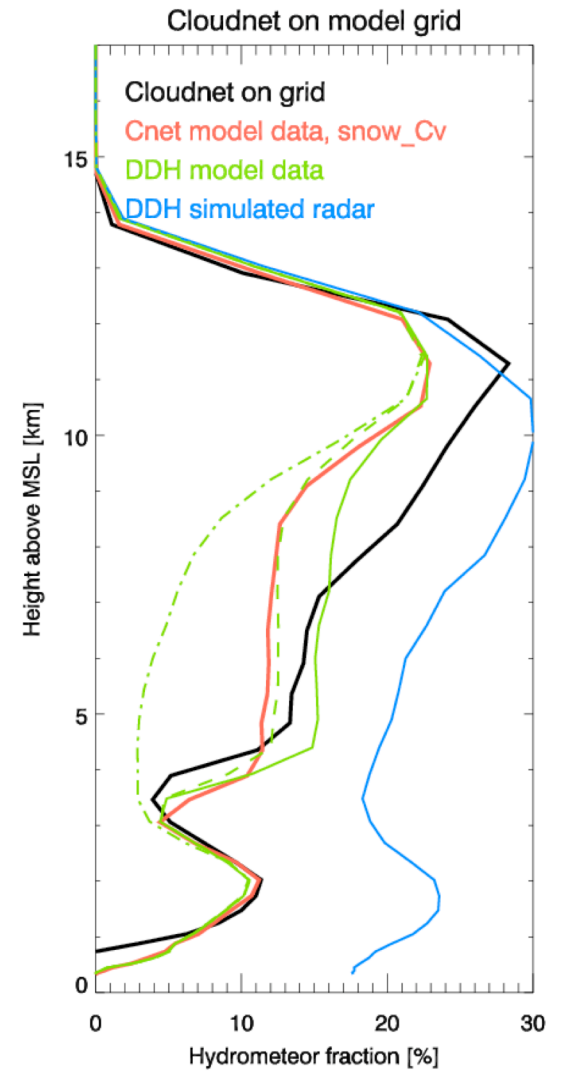


How do CloudNet/CMBE compare to model?

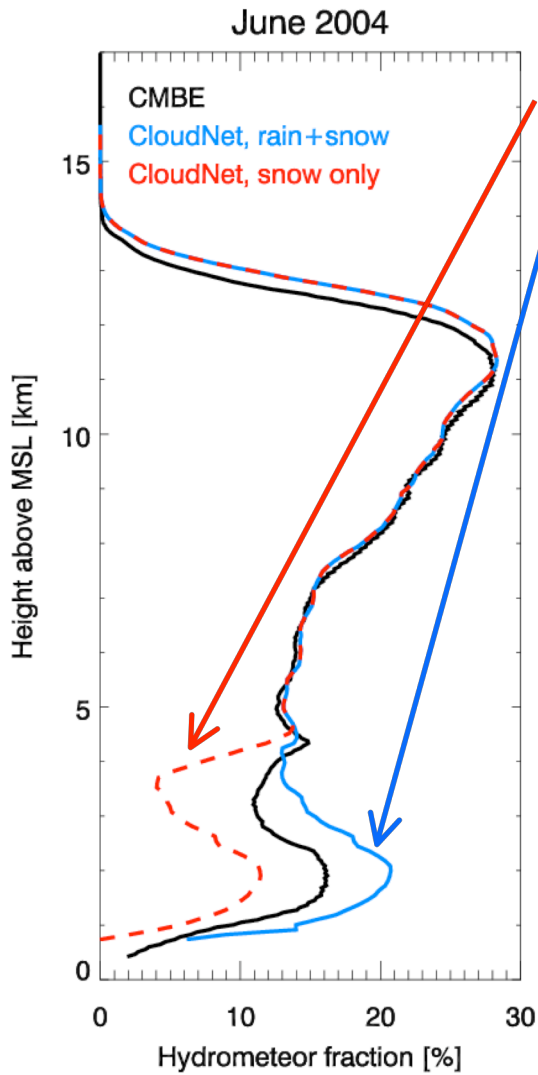


no rain

differences in rain treatment?
screening out rain also
screens out some low clouds



How do CloudNet/CMBE compare to model?

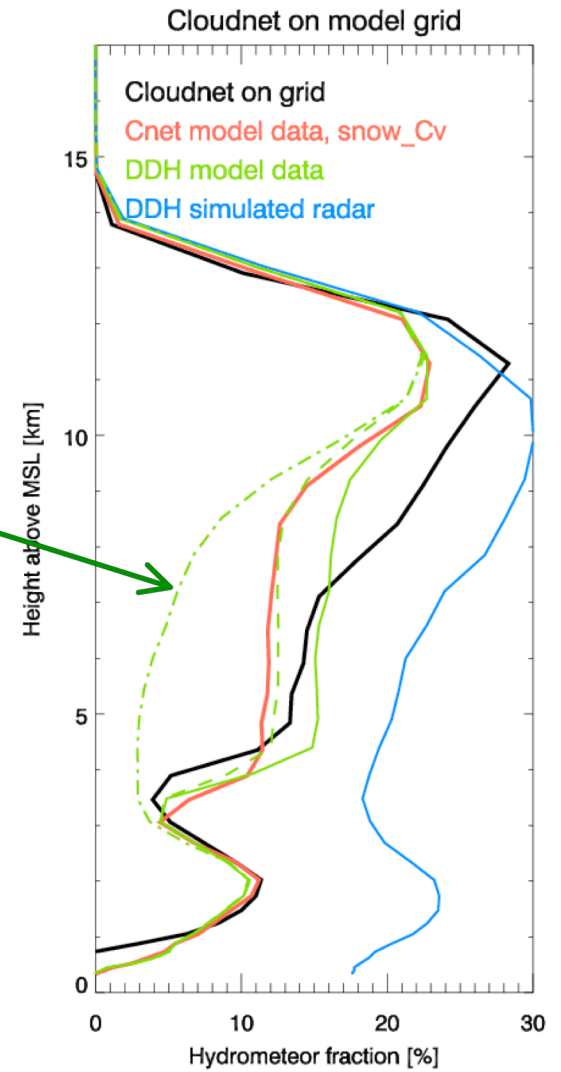


no rain

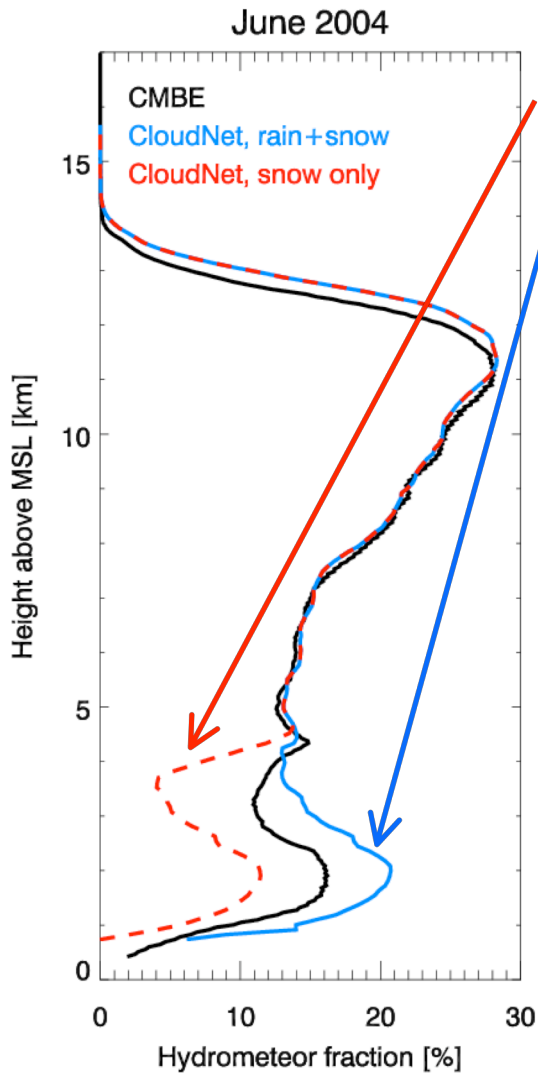
differences in rain treatment?

screening out rain also screens out some low clouds

model fraction with various snow flux thresholds



How do CloudNet/CMBE compare to model?



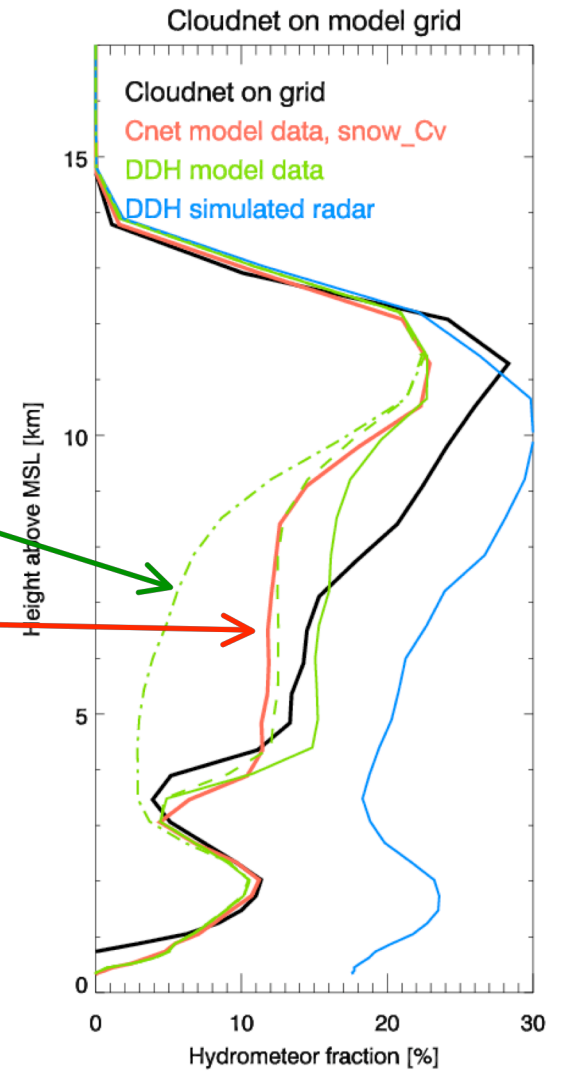
no rain

differences in rain treatment?

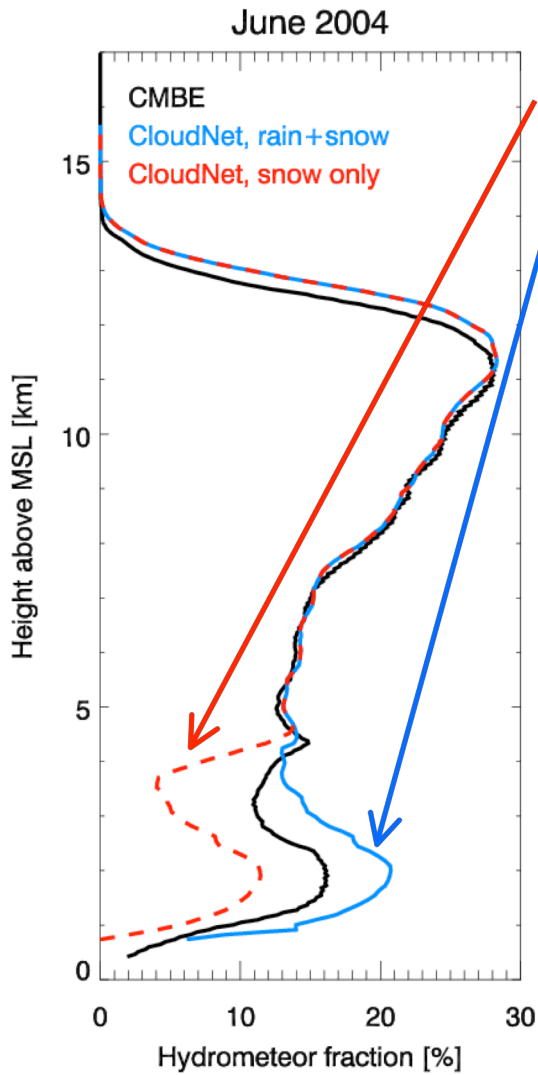
screening out rain also screens out some low clouds

model fraction with various snow flux thresholds

CloudNet's estimate of model fraction incl. snow



How do CloudNet/CMBE compare to model?



no rain

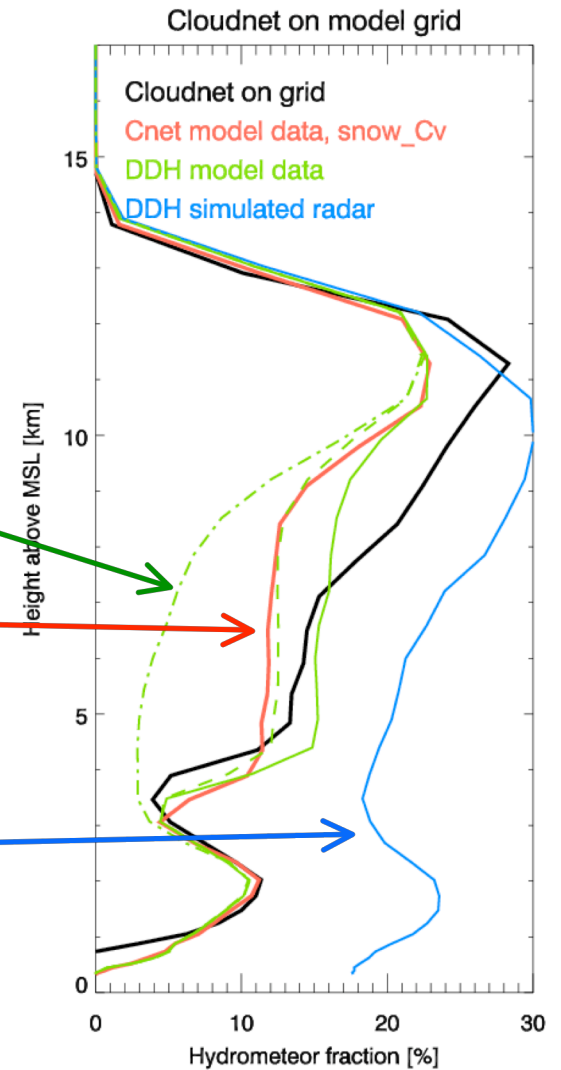
differences in rain treatment?

screens out some low clouds

model fraction with various snow flux thresholds

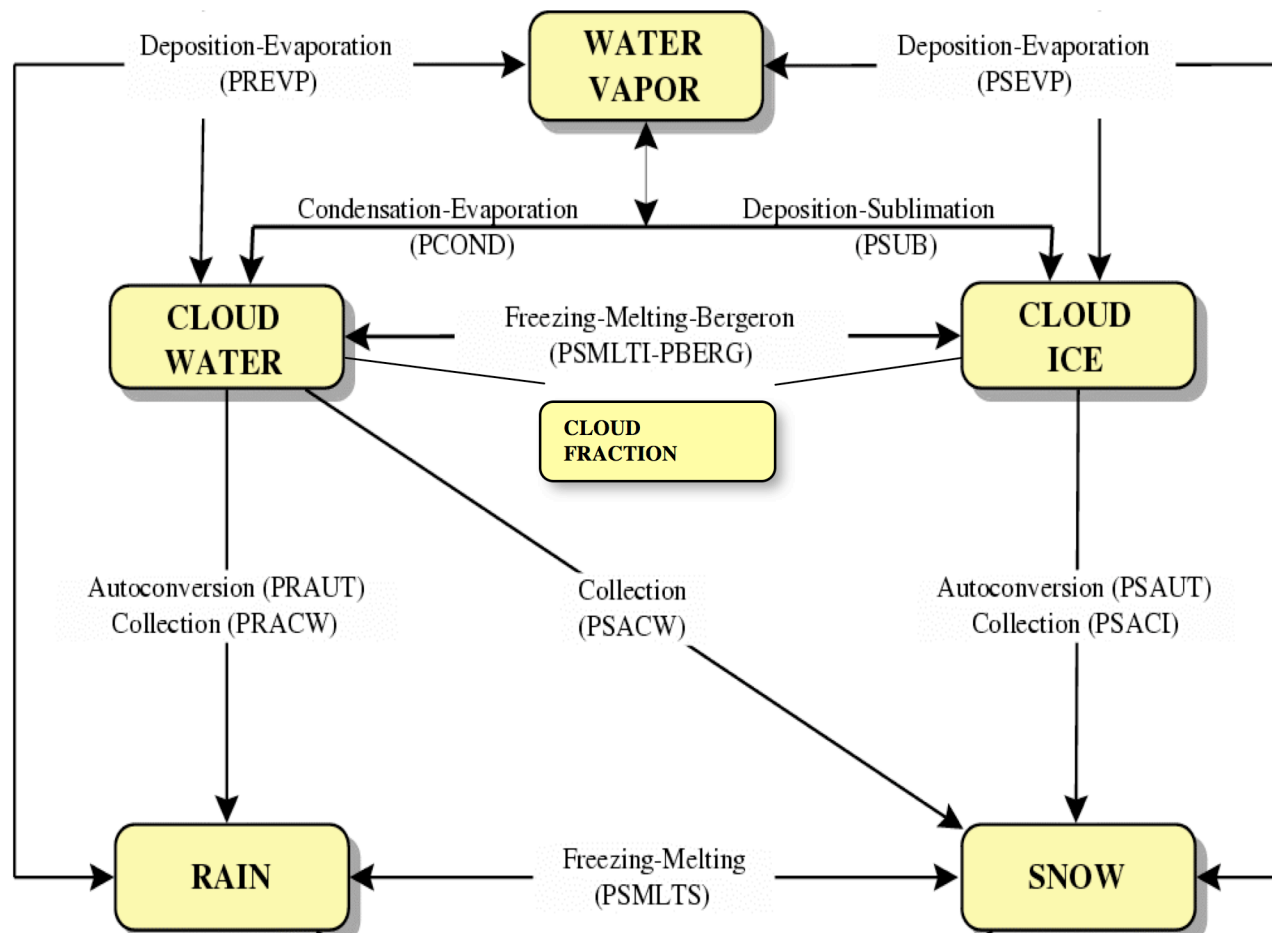
CloudNet's estimate of model fraction incl. snow

The "correct" way: fraction based on simulated radar reflectivity



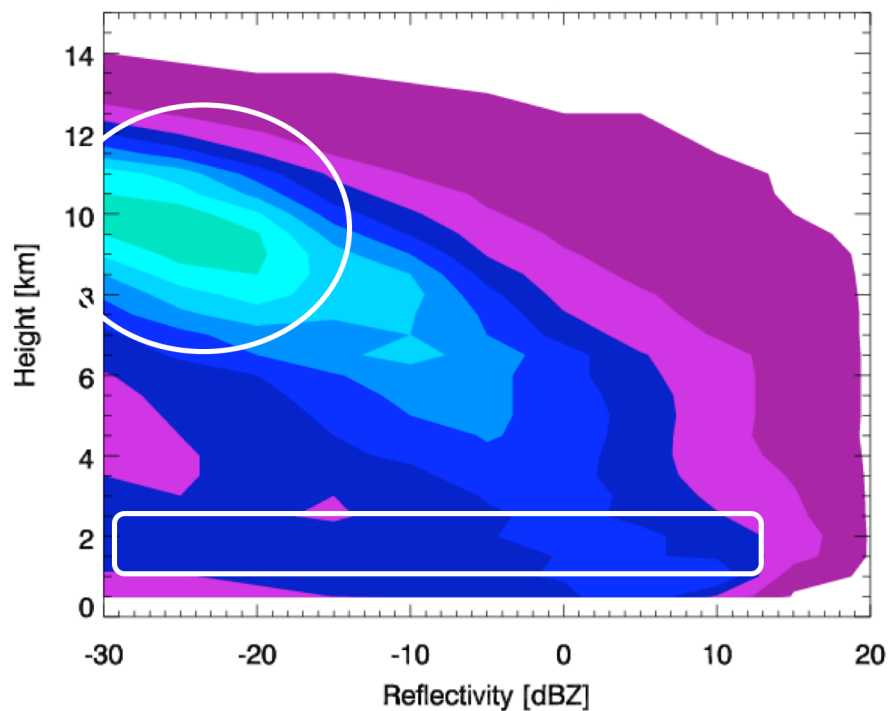
New prognostic cloud scheme

Revisit conversion processes

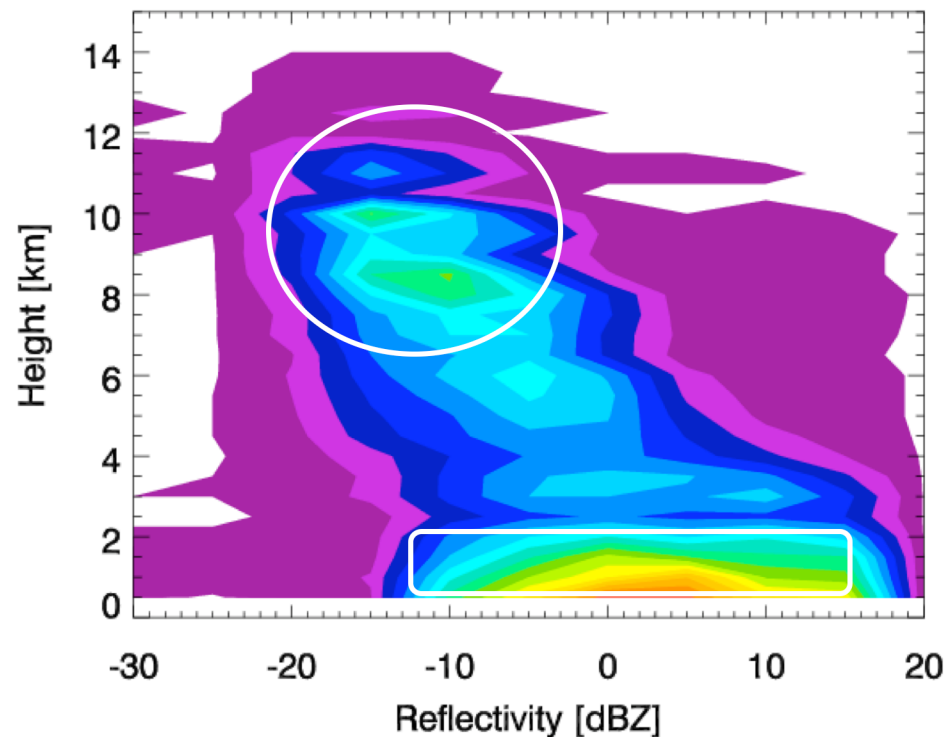


Reflectivity at SGP

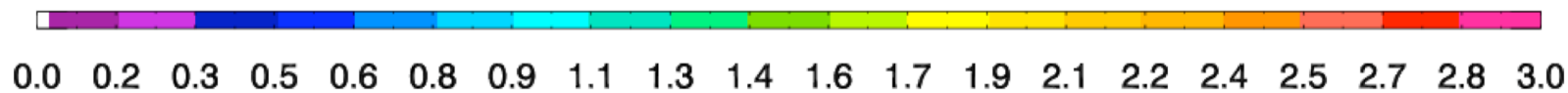
MMCR at SGP, 2004



Simulated reflectivity model, 2004



Frequency [%]

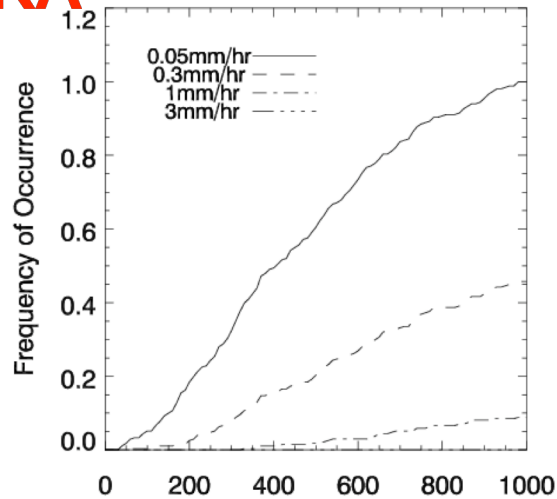


- Reflectivities from ice/snow too high
- Too much drizzle

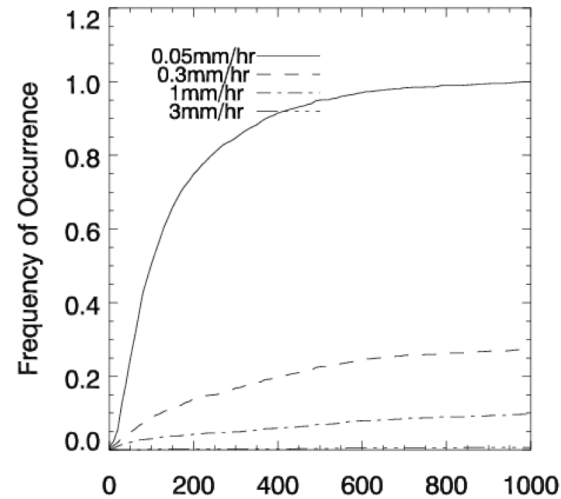
LWP and drizzle relationships

GRA

Graciosa 6/09-12/09

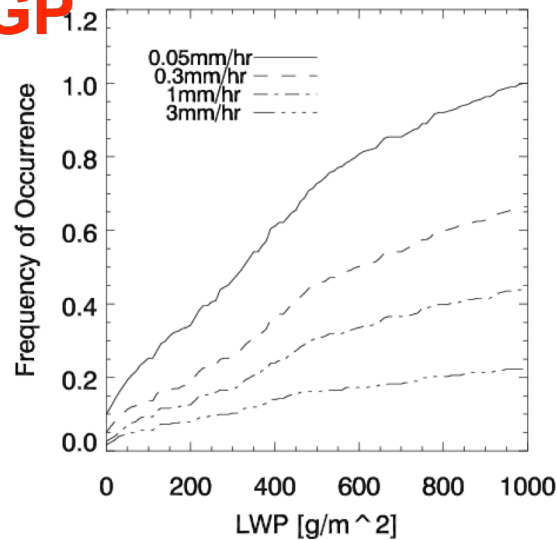


ECMWF model 6/09-12/09

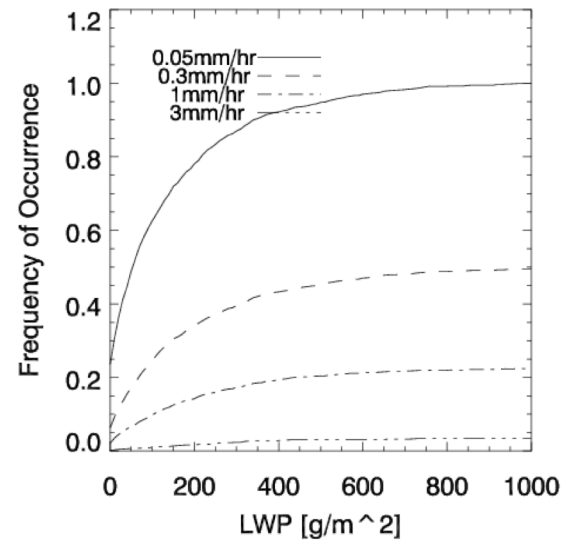


SGP

ORG SGP 2008



ECMWF model 2008

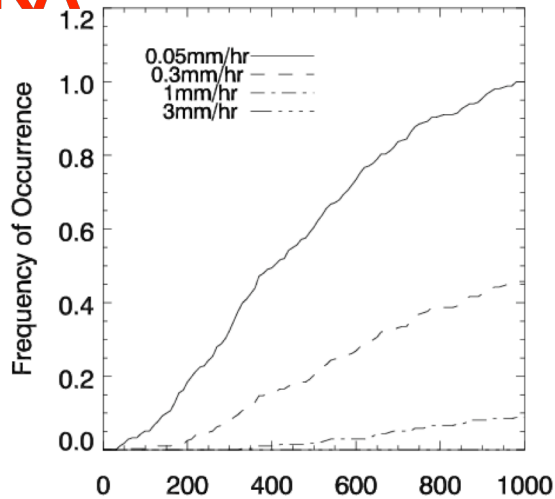


LWP and drizzle relationships

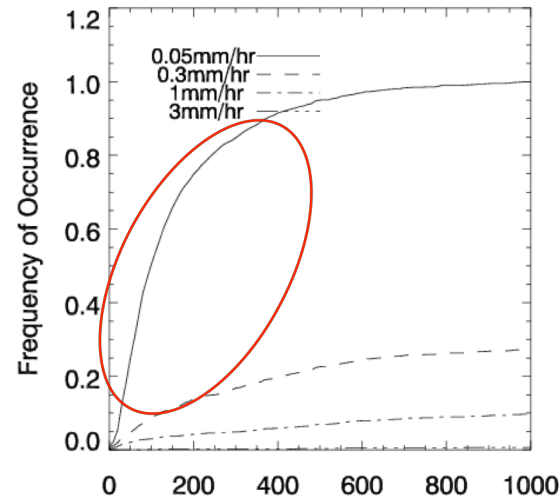
Model:

GRA

Graciosa 6/09-12/09



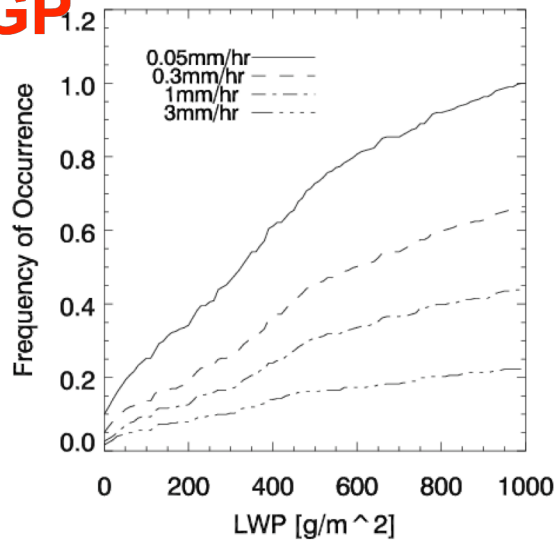
ECMWF model 6/09-12/09



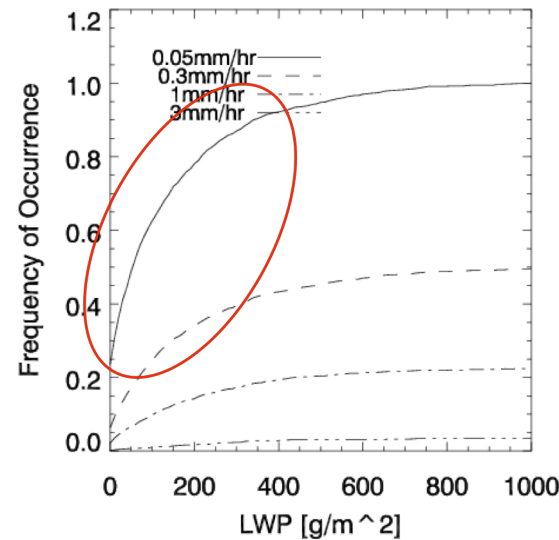
Rapid onset of light precip at low LWP at both sites

SGP

ORG SGP 2008



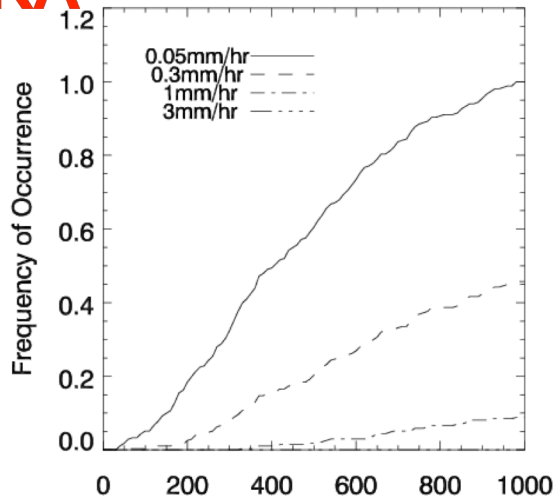
ECMWF model 2008



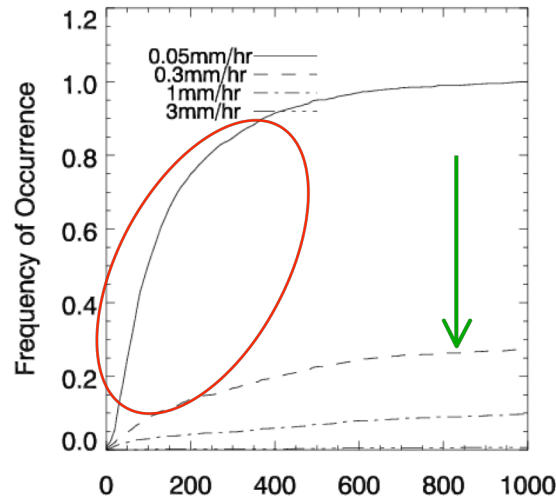
LWP and drizzle relationships

GRA

Graciosa 6/09-12/09



ECMWF model 6/09-12/09

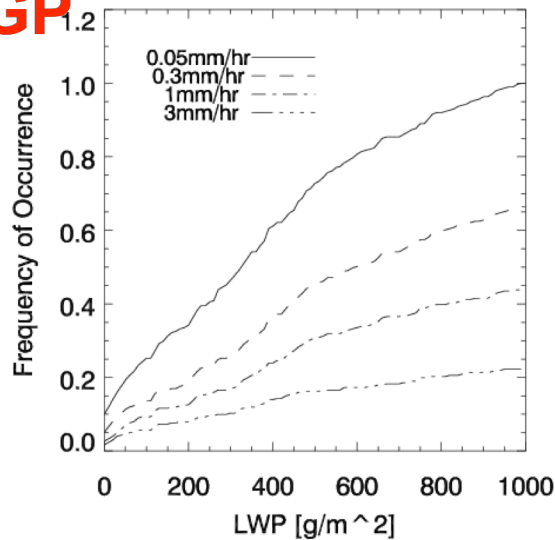


Model:

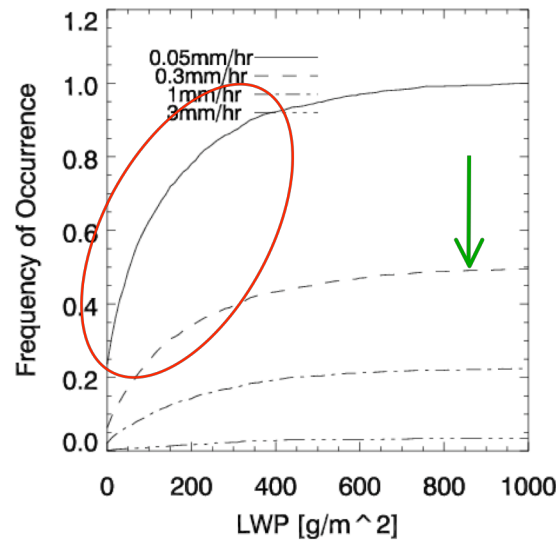
Rapid onset of light precip at low LWP at both sites

SGP

ORG SGP 2008

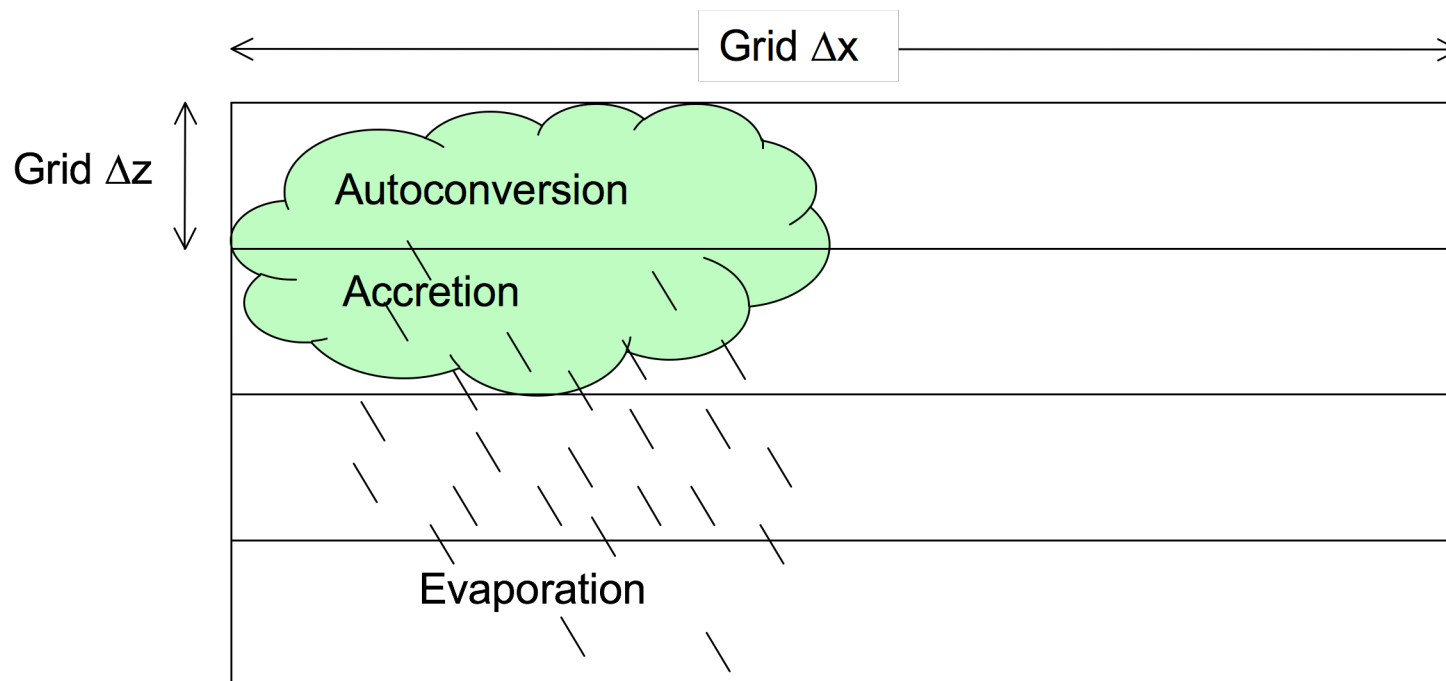


ECMWF model 2008

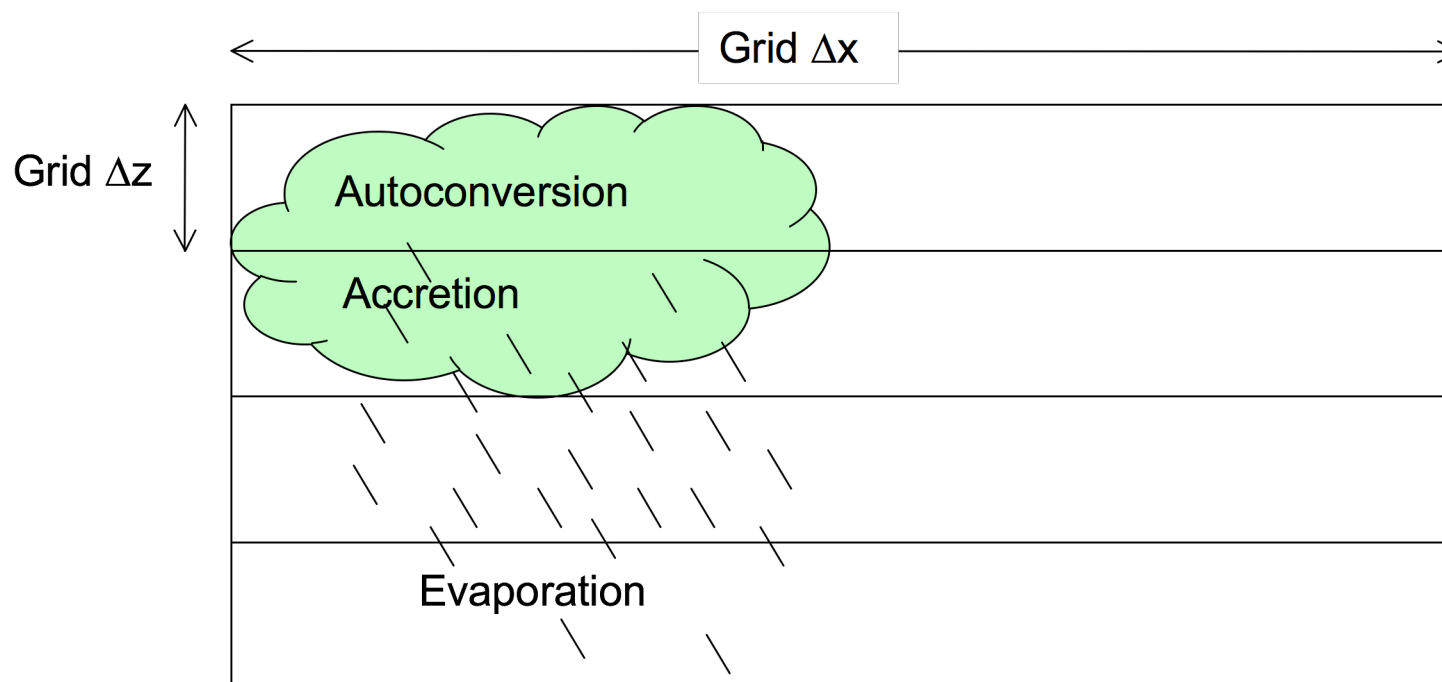


Gets land-ocean contrast right: more intense precip events over land

Precipitation - warm rain processes



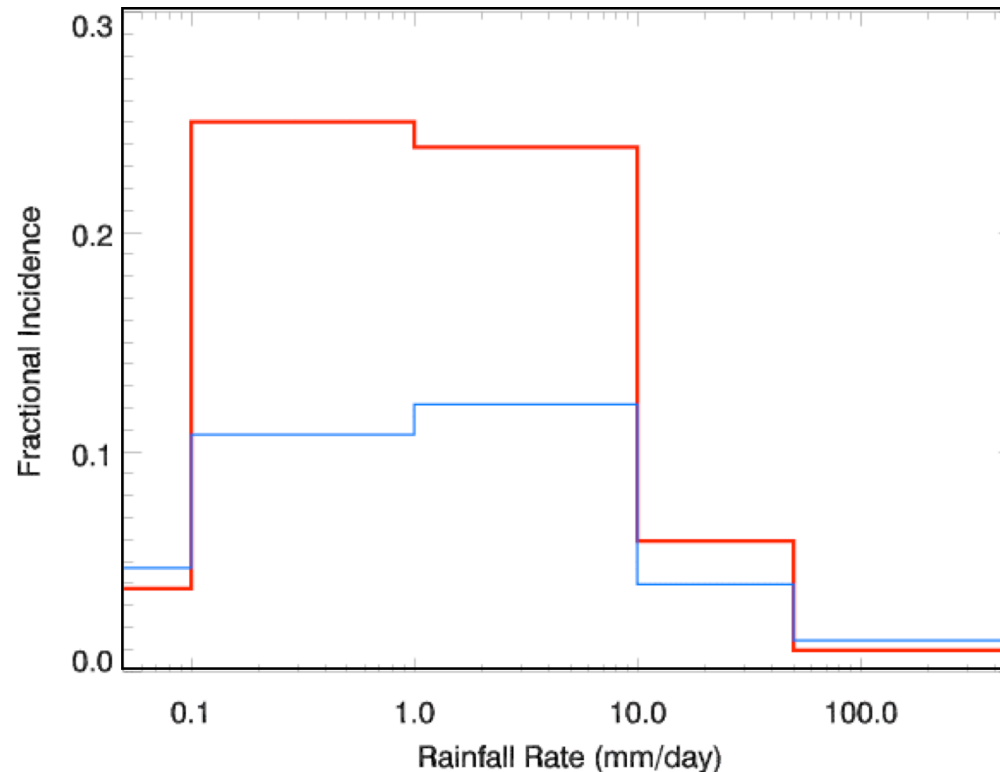
Precipitation - warm rain processes



- Is the light rain problem due to:
 - Autoconversion of unrealistically low liquid water content cloud ?
 - Insufficient enhancement due to inadequate accretion ?
 - Incorrect evaporation rates for drizzle ?
 - Sub-grid heterogeneity issues ?
 - Numerical issues (implicit formulation, resolution, long timesteps) ?

Overprediction of light precipitation occurrence

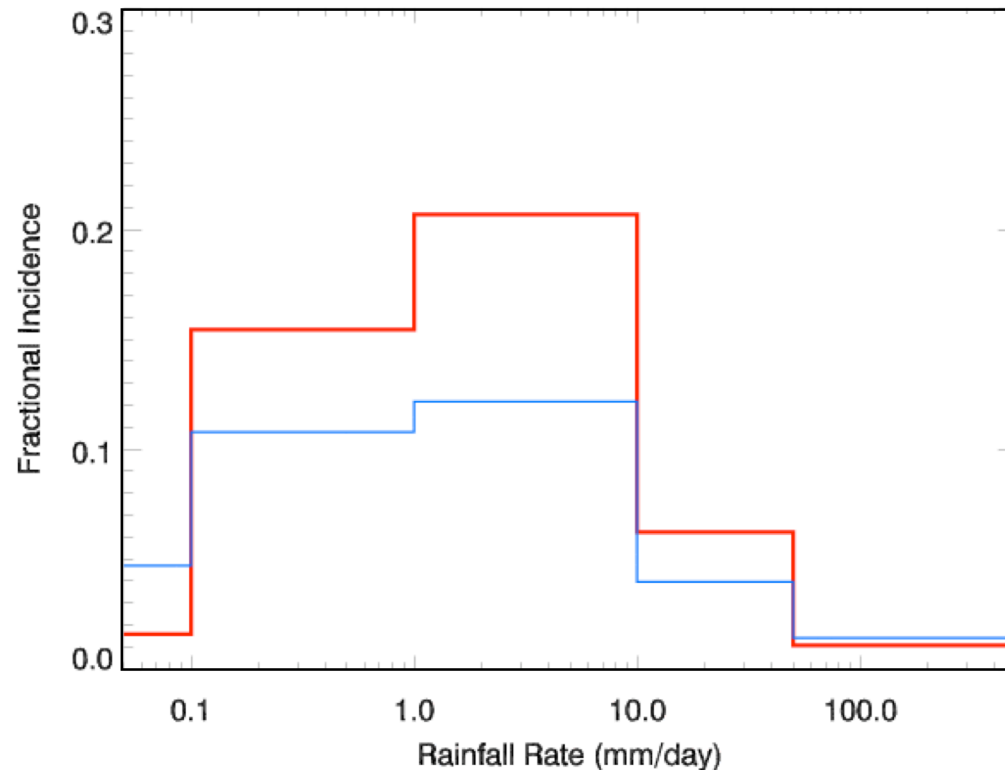
Frequency of occurrence of rainfall as a function of rainfall rate over ocean (60°S to 60°N) derived from CloudSat (33%) and the IFS model (60%).



- The model overestimates rainfall occurrence by a factor of two
- Improved with changes to evaporation formulation/sub-grid numerics

Overprediction of light precipitation occurrence

Frequency of occurrence of rainfall as a function of rainfall rate over ocean (60°S to 60°N) derived from CloudSat (33%) and the IFS model (60%).



- The model overestimates rainfall occurrence by a factor of two
- Improved with changes to evaporation formulation/sub-grid numerics

Summary and outlook

- **Treatment of model precip very important for interpretation of evaluation results involving “cloud” amount**
- **Two distinct particle sizes for ice and snow lead to overestimate of reflectivity from snow**
- **Drizzle sensitive to re-evaporation formulation**
- **Next steps: revisit conversion processes, test in SCM**