Optimizing the ALADIN cloudiness parameterization

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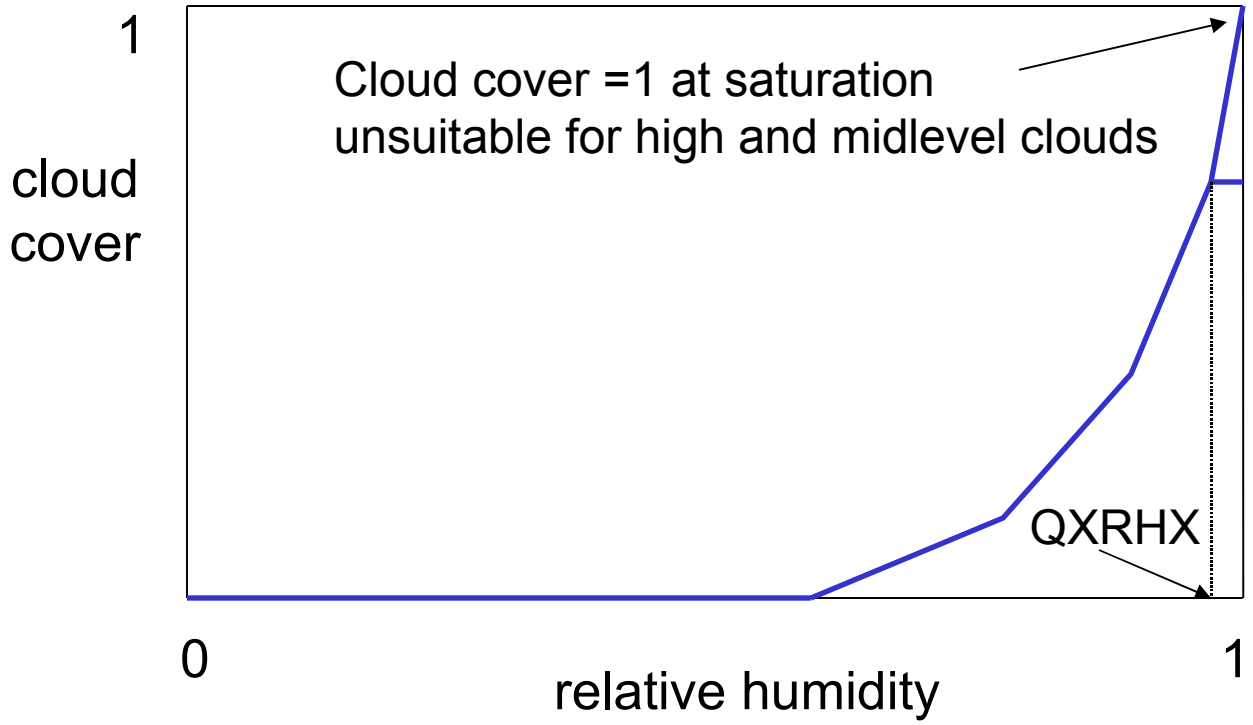
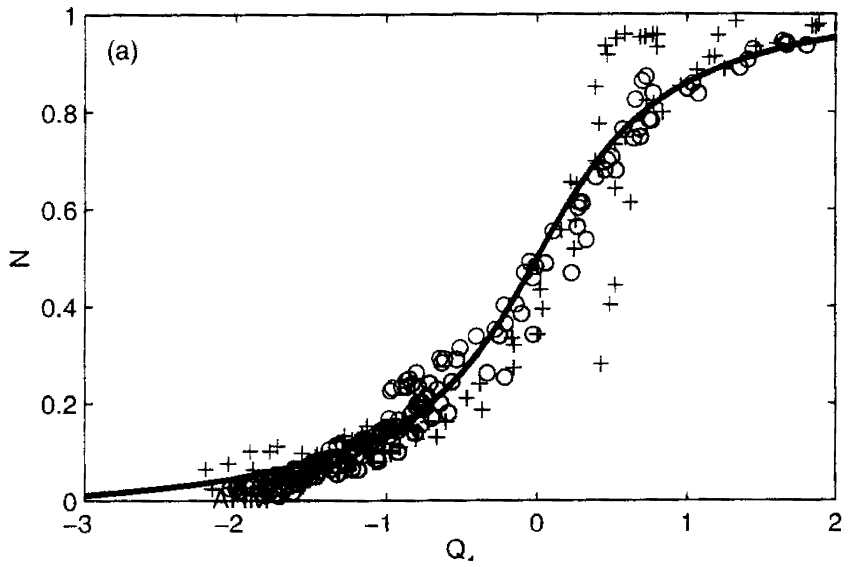
- The problem with Xu-Randall
- Critical relative humidity
- Use of raob and synop observations
- Optimization of namelist settings

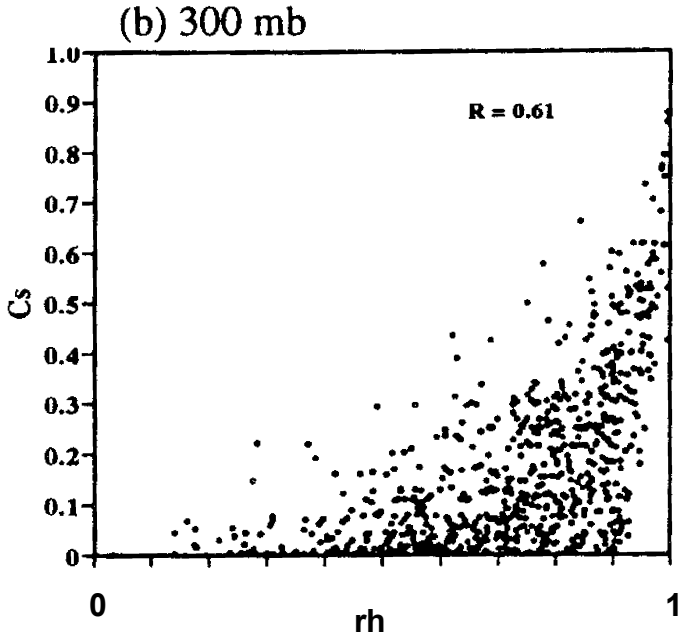
The problem with Xu-Randall



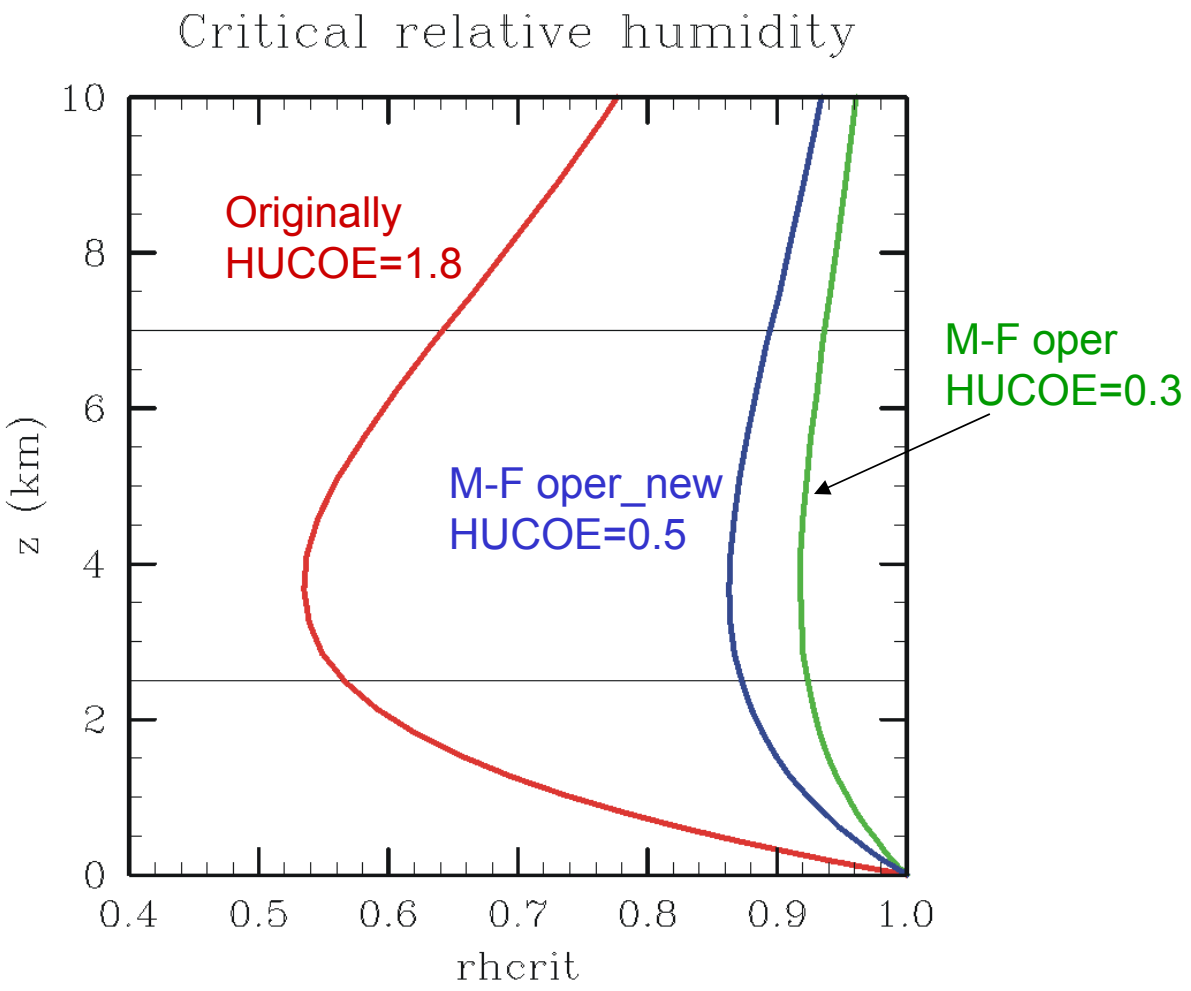
CRM data: cloudiness <1 at rh=100%



Chaboreau and Bechtold (2002)

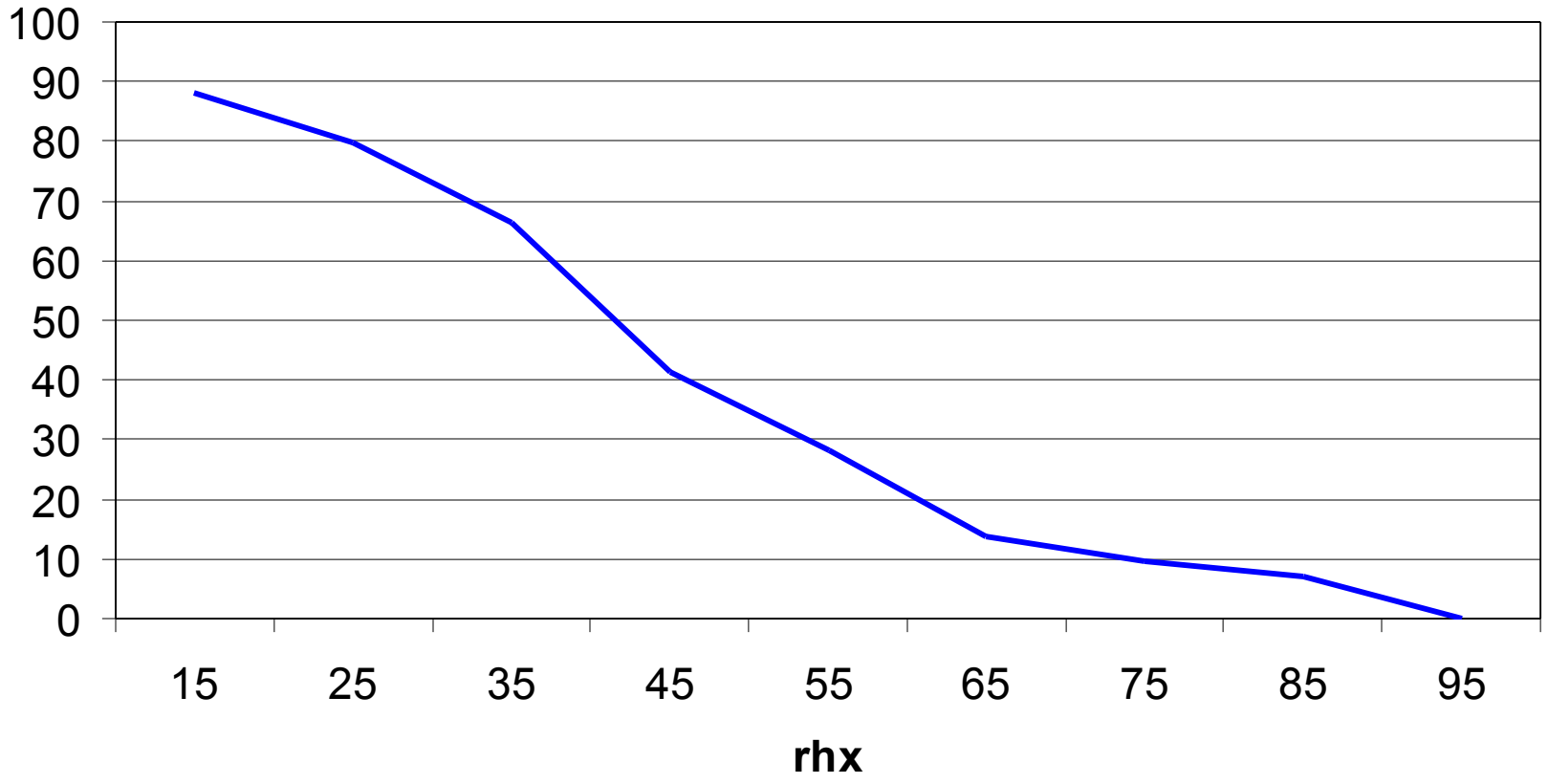


Xu and Randall (1996)



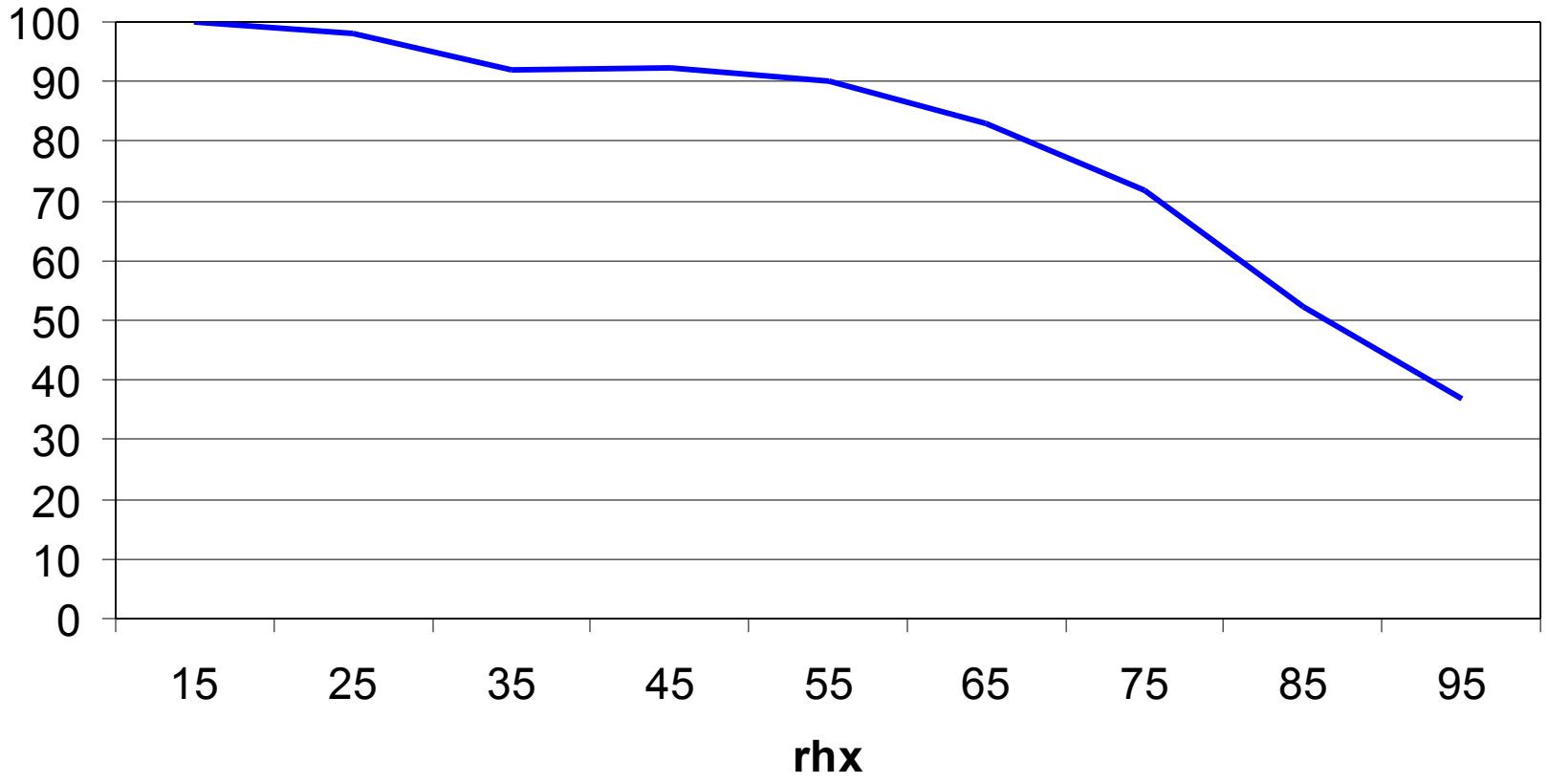
Very wide tuning range for rhcrit → what do observations show?

probability of no high cloudiness

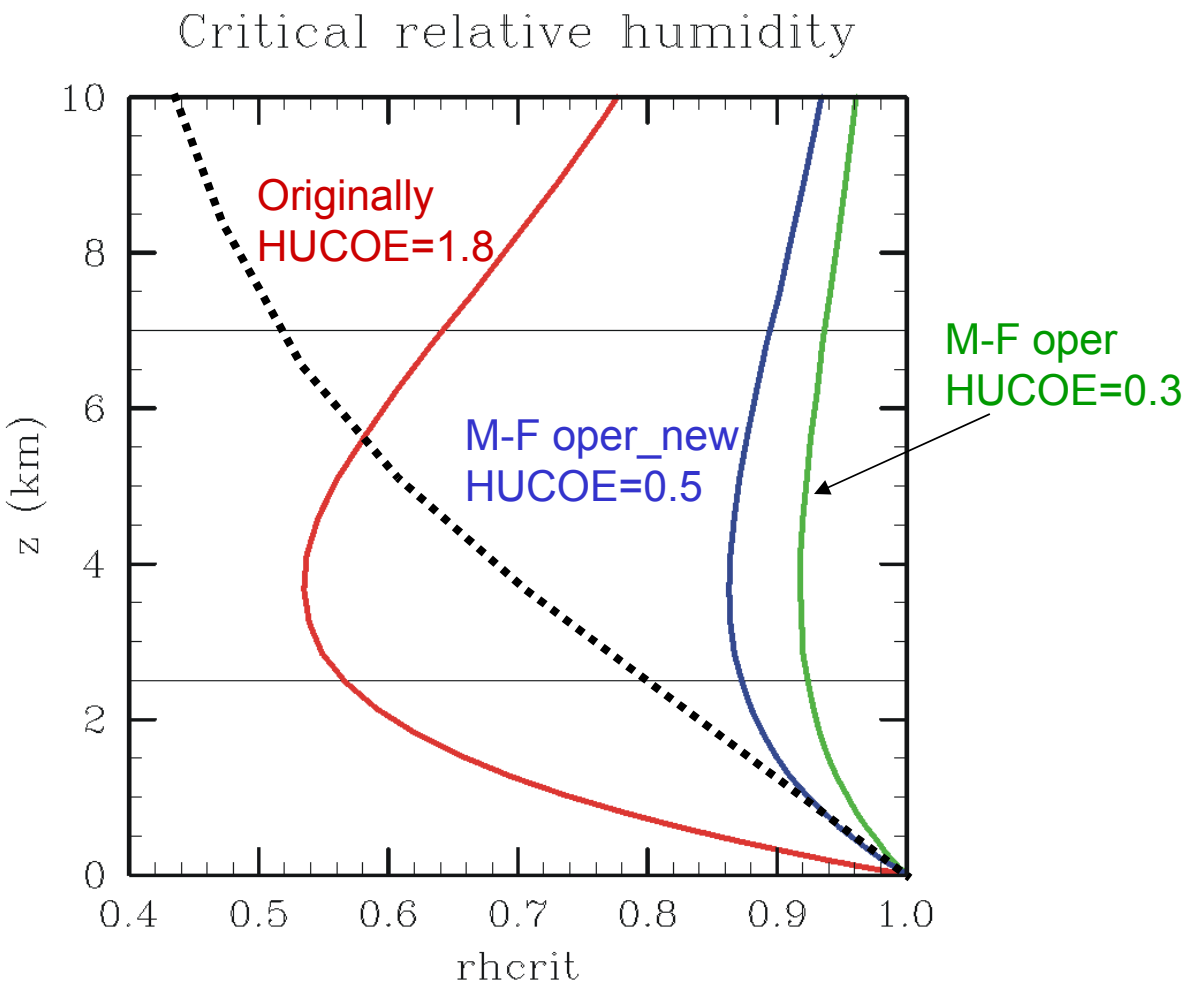


Based on SYNOP and RAOB observations Vienna, 12Z (1999-2004): most rapid drop between 35% and 65% relative humidity

probability of no mid-level cloudiness



Based on SYNOP and RAOB observations Vienna, 12Z (1999-2004): significant drop begins around 65% relative humidity



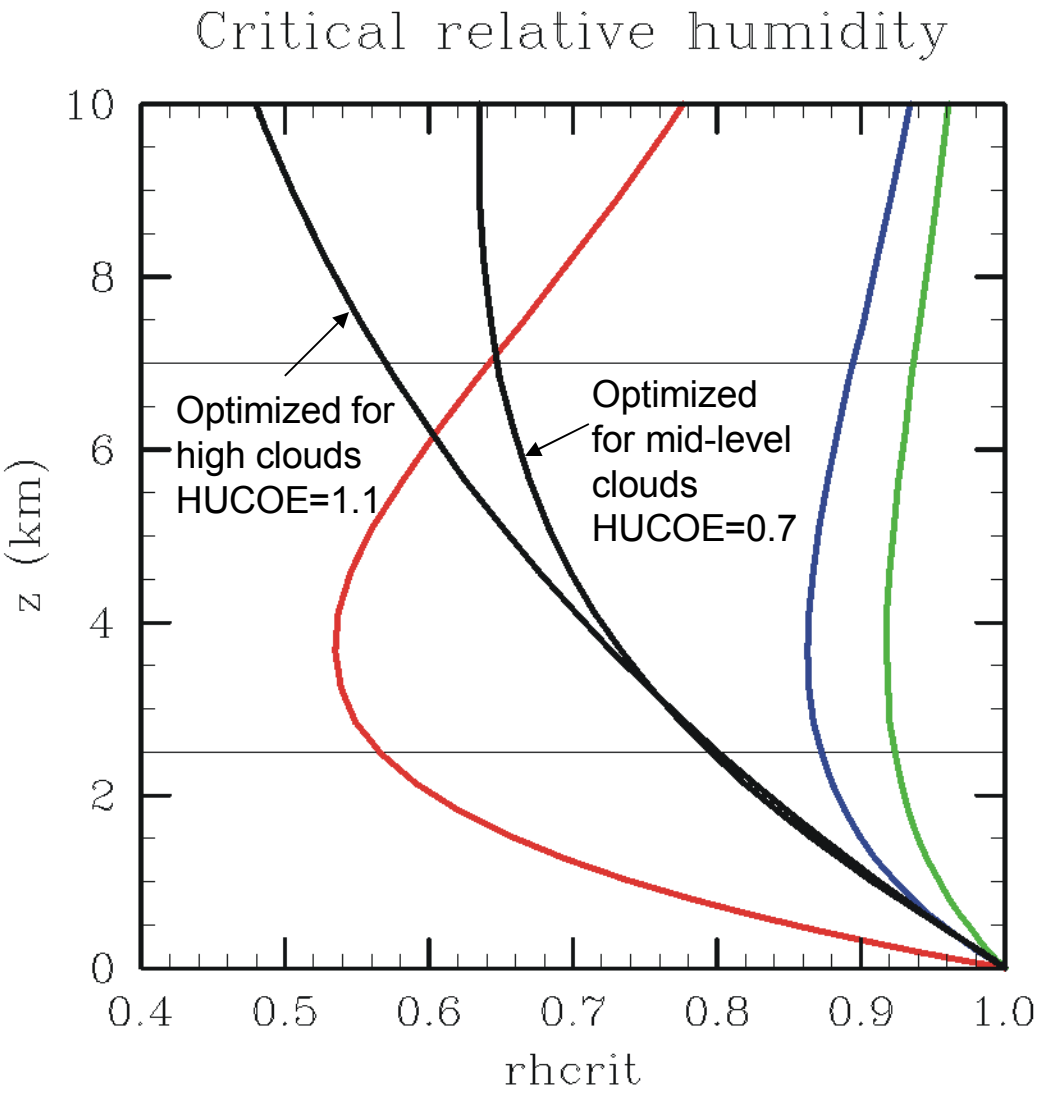
→ different profile shape suggested by observations

Functional form of rhcrit

$$rhcrit = 1 - HUCOE\,\eta^{NPCLO1}(1-\eta)^{NPCLO2}[1+\sqrt{HUTIL}\,(\eta-0.5)]$$

Can the inactive exponents NPCLO1, NPCLO2 be used to obtain the suggested shape of rhcrit?

What are the optimal values for HUCOE, HUTIL, NPCLO1, NPCLO2?



High:
HUCOE=1.1
HUTIL=1.3
NPCLO1=0.0
NPCLO2=1.1

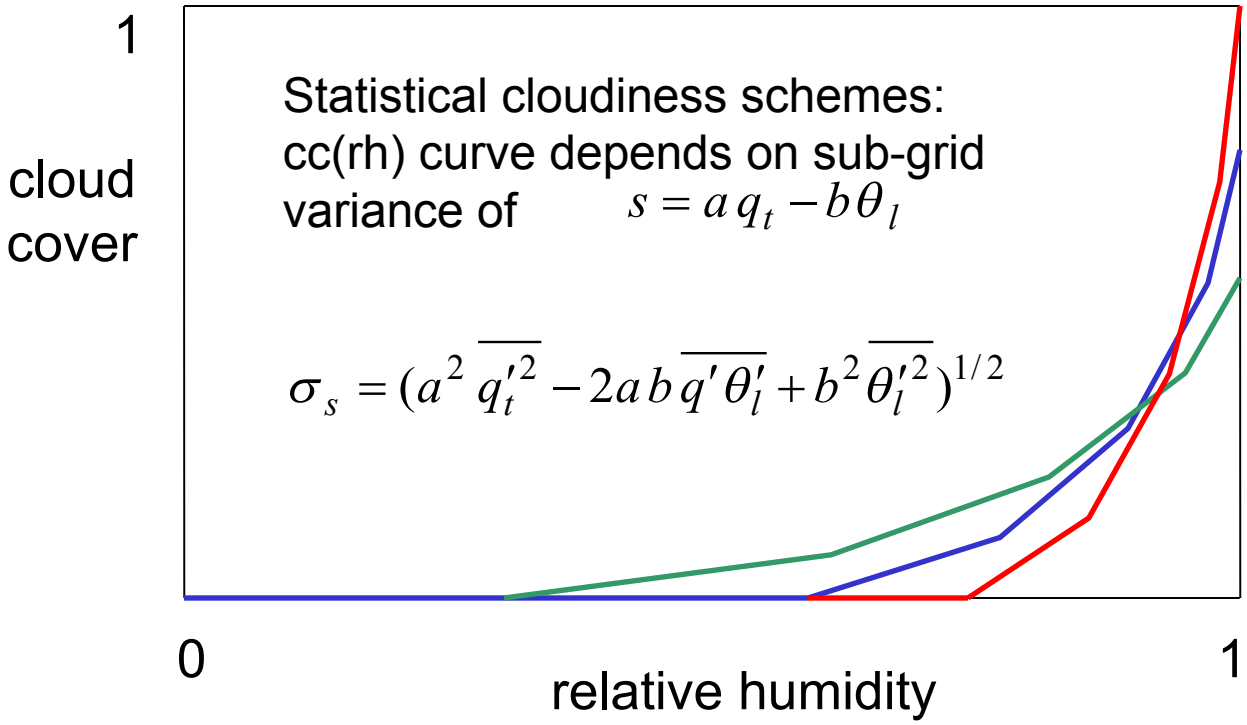
Mid-level:
HUCOE=0.7
HUTIL=1.3
NPCLO1=0.0
NPCLO2=1.1

Validation results for mid-level clouds

	ACNEBN version	rhcrit profile	MAE (%)	BIAS (%)
MF oper	Xu-Randall	classical	11.3	-2.6
MF oper new	Xu-Randall + LRNUMX	classical	10.3	-0.7
ZAMG exp	classical	new shape	7.7	-0.4
MF exp	Xu-Randall + LRNUMX (different tuning!)	new shape	8.1	-0.6

QSSC (shallow convection): the smaller the better, but 200-400 ok

Further possible improvements



In model with 1st-order closure: parameterize σ_s via vertical gradients of q_t, θ_l

Conclusions based on Vienna data

- Use modified critical relative humidity profile
- Xu-Randall no real advantage for med+hi clouds
- Off-line tuning useful for exploring parameter space

Next steps

- Test results on other raob stations (June 2004)
- Test optimized tuning in parallel suite (July 2004)
- Put into operations (Aug 2004?)
- Test if statistical scheme improves cloud diagnostic