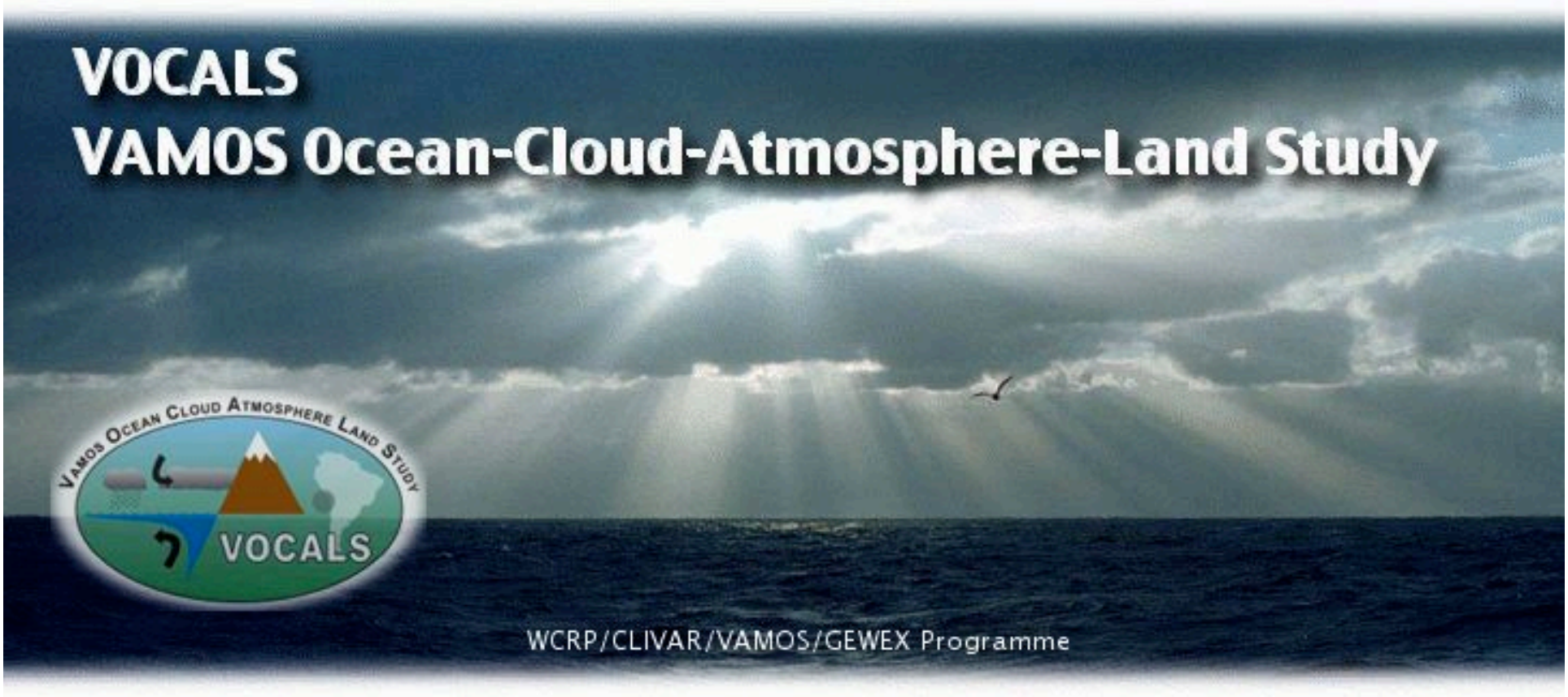
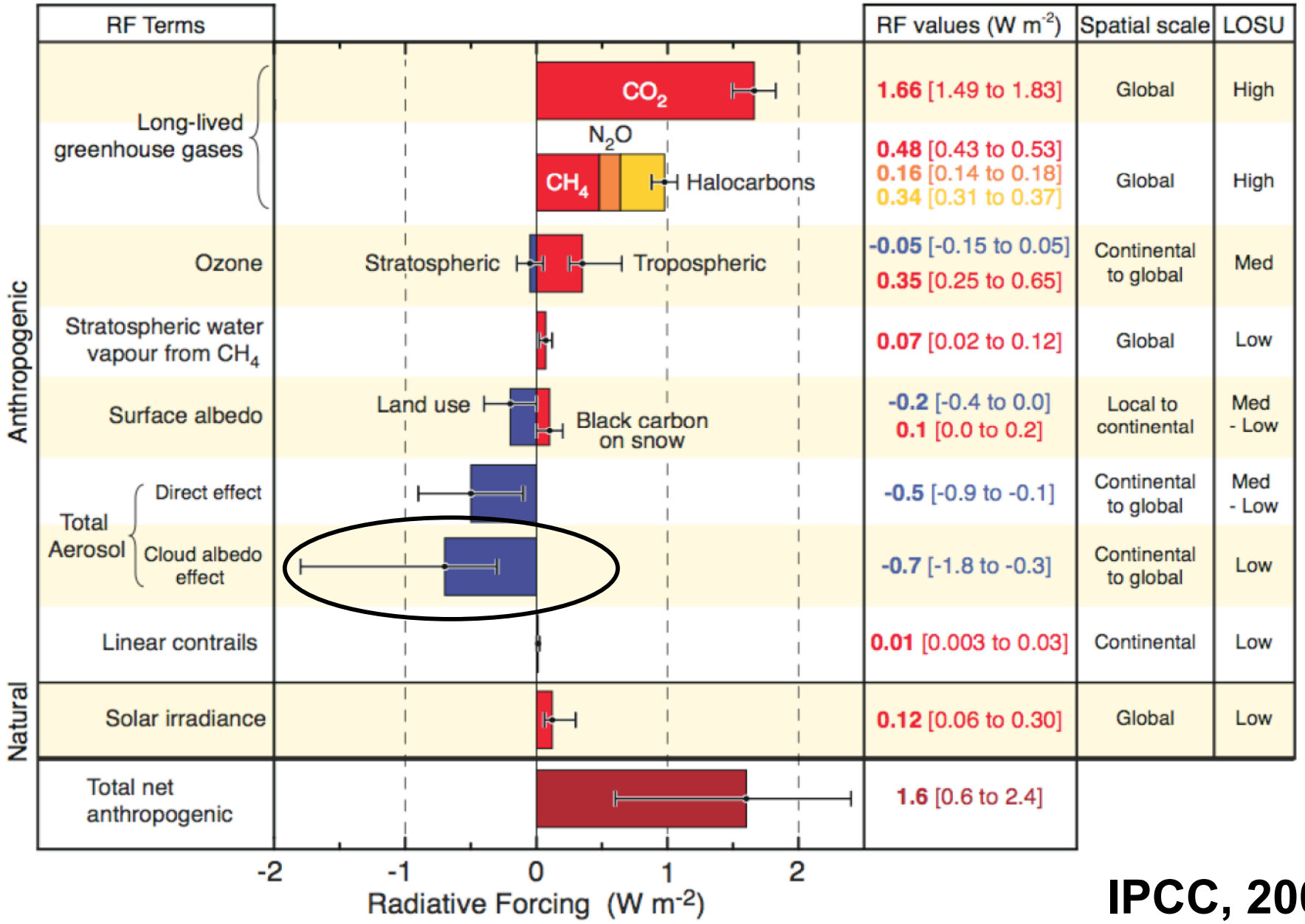
VOCALS Cloud-Drizzle-Aerosol Hypotheses



- Understanding and modeling aerosol indirect effects
- Importance of drizzle to Sc climatology and climate feedbacks

Radiative Forcing Components



IPCC, 2007

AEROSOL-CLOUD-PRECIPITATION HYPOTHESES

#	Hypothesis	Obs	Models	Model Teams
1A	**Variability in the physicochemical properties of aerosols** has a measurable impact upon the formation of **drizzle** in stratocumulus clouds over the SEP.	C-130, RHB, Twin Otter, G-1,	LES WRF Chem GCMs	**Wood/Bretherton** **Feingold** **Cotton/Carrio** **PNNL**
1B	**Precipitation is a necessary condition** for the formation and maintenance of **pockets of open cells** (POCs) within stratocumulus clouds.	C-130, RHB	LES COAMPS	**Feingold** **Wood/Bretherton** **NRL, Wang**
1C	**The small effective radii** measured from space over the SEP are primarily controlled by **anthropogenic**, rather than **natural**, aerosol production, and entrainment of polluted air from the lower free-troposphere is an important source of cloud condensation nuclei.	C-130, RHB, G-1, Twin Otter, A-Train, Land site	WRF Chem CTMs Parcel Model GCMs	**Gallardo/Cordova** **Donner/Golaz** **Wood/Zaveri** **PNNL**
1D	**Depletion of aerosols by coalescence scavenging** is necessary for the maintenance of POCs.	C-130, A-Train	Parcel model LES GCMs	**Feingold** **PNNL** **Donner/Golaz**

Modeling challenges

- Does drizzle matter to current SEP cloud climatology?
- Does the second aerosol indirect (Albrecht) effect reinforce or cancel the Twomey effect in the SEP?

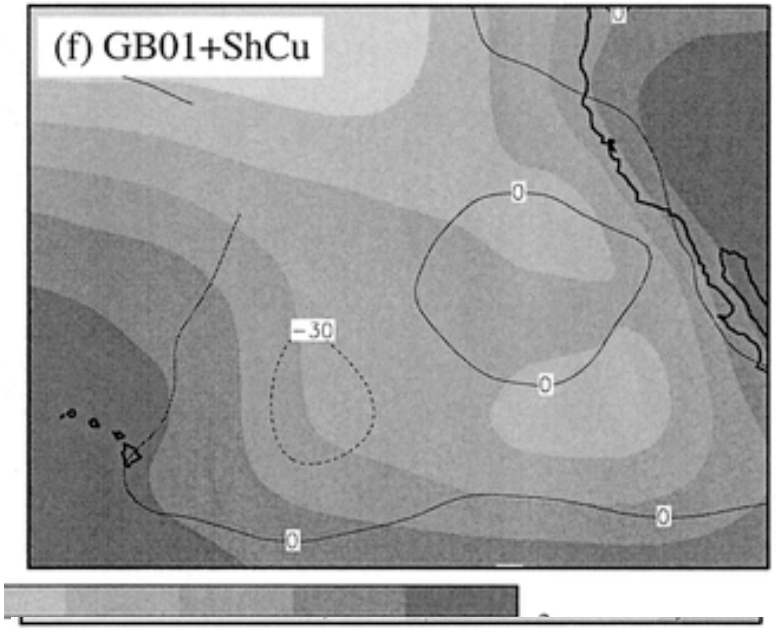
1A Can we reliably simulate sensitivity of Sc and drizzle to aerosol variations with LES? With meso./global models?

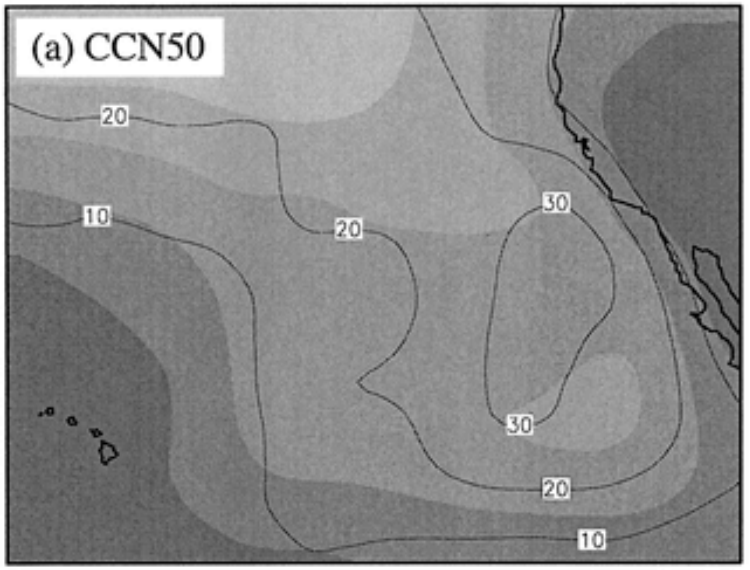
1B Do we have feasible modeling frameworks for simulating a POC lifecycle? Do they require simulating mesoscale coupling of the POC and its surroundings? How important is the diurnal cycle?

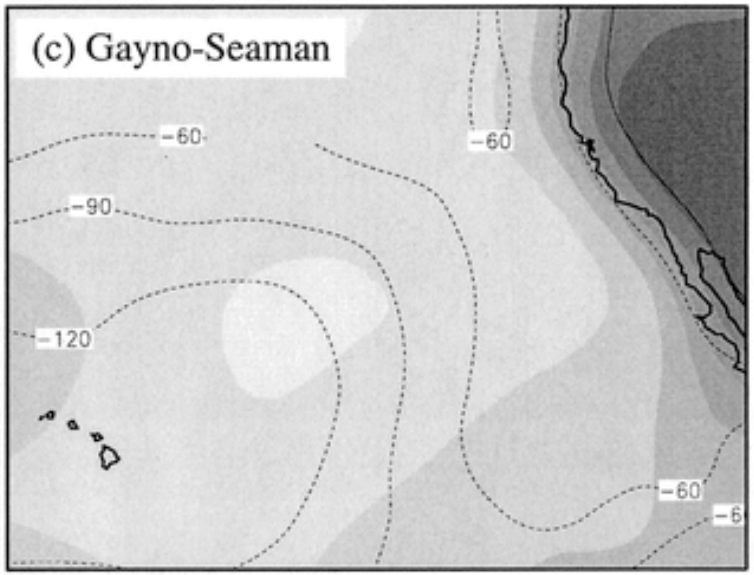
1C Can we simulate the day-to-day variability of aerosol concentration/composition above and in the SEP MBL? How about droplet effective radius in/out of broken cloud regimes? How about cloud fraction/LWP?

1D Can we simulate observed aerosol depletion inside a POC? Does this constrain local vs. remote aerosol sources?

Regional model sensitivity of SWCF to N_d in NEP Sc





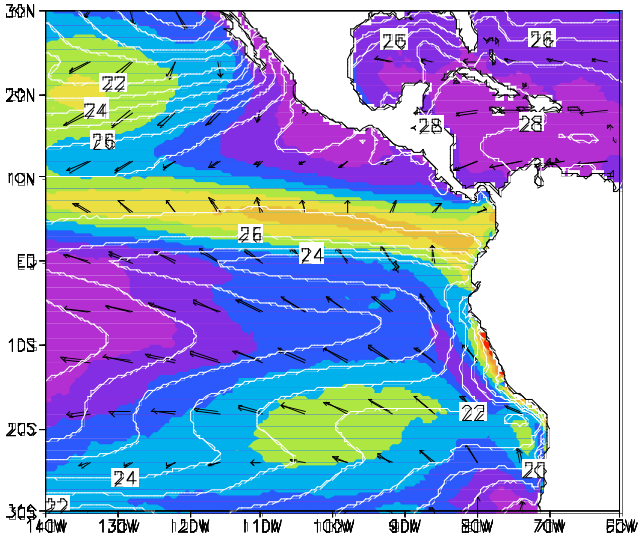


McCaa and Bretherton 2004

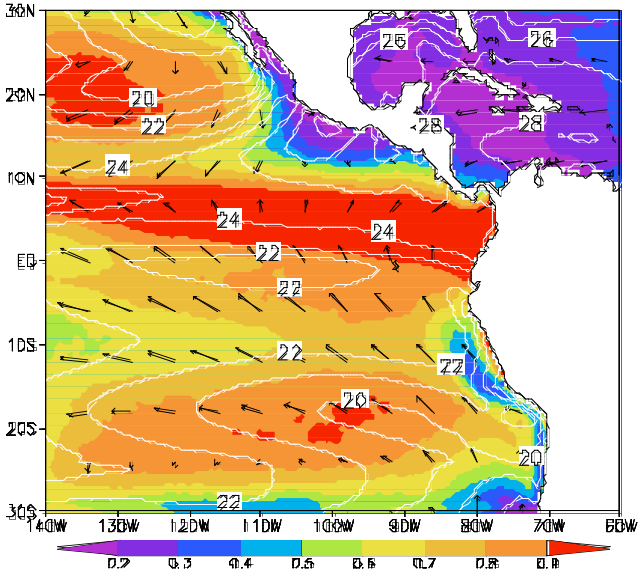
IROAM Suppressed drizzle experiment (no Drizzle) -deSzoeke

clouds

control

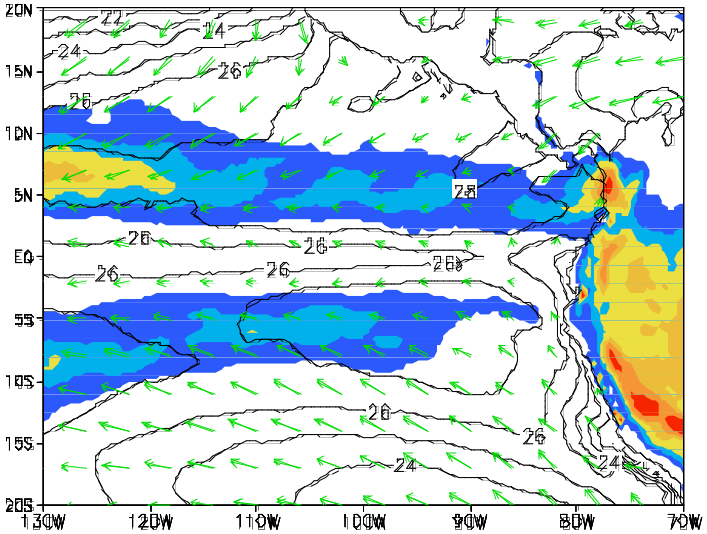


no Drizzle clouds



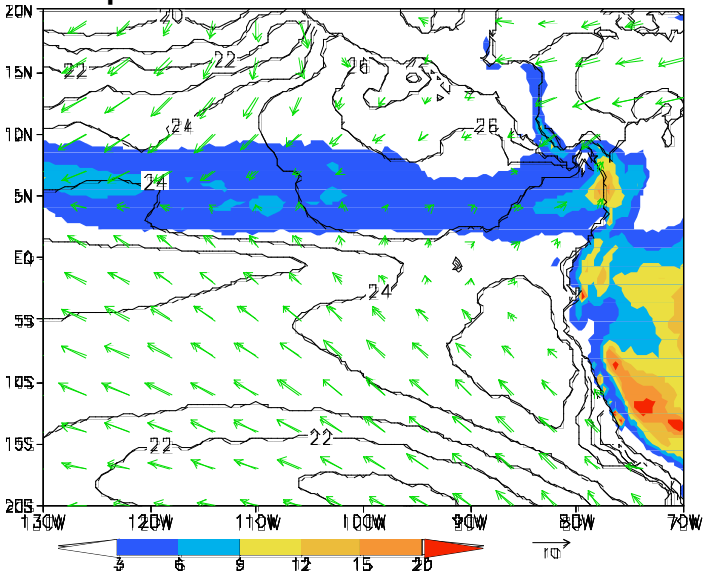
April rain

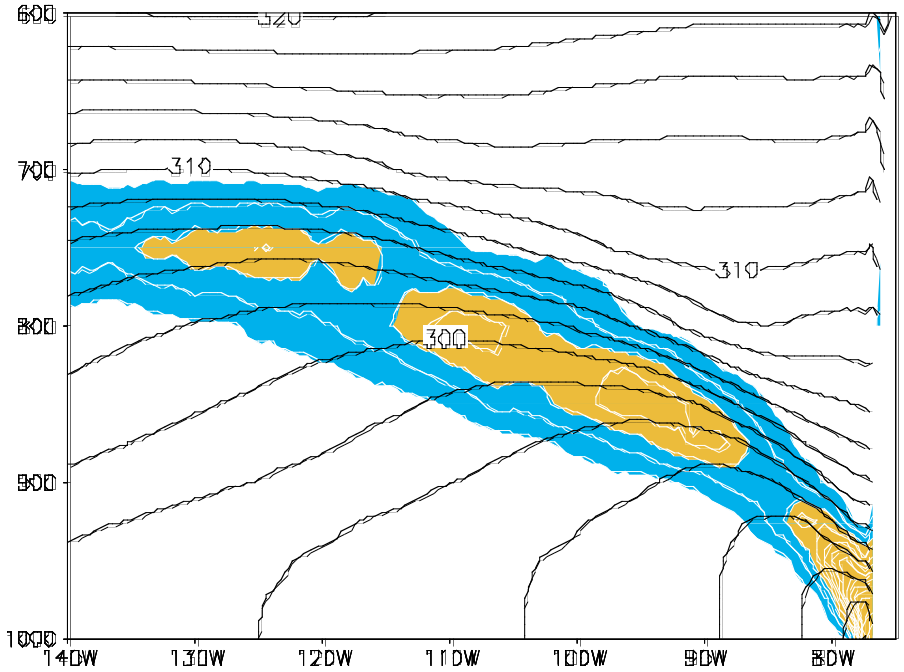
control



April no Drizzle rain

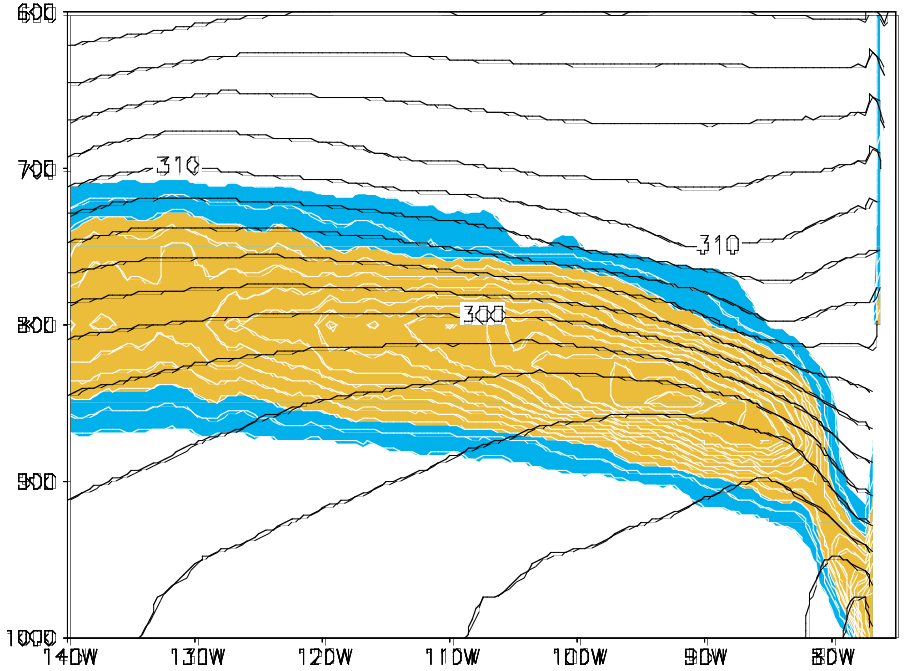
no Drizzle





15˚S zonal-vertical section:
cloud and potential temperature

control



no Drizzle