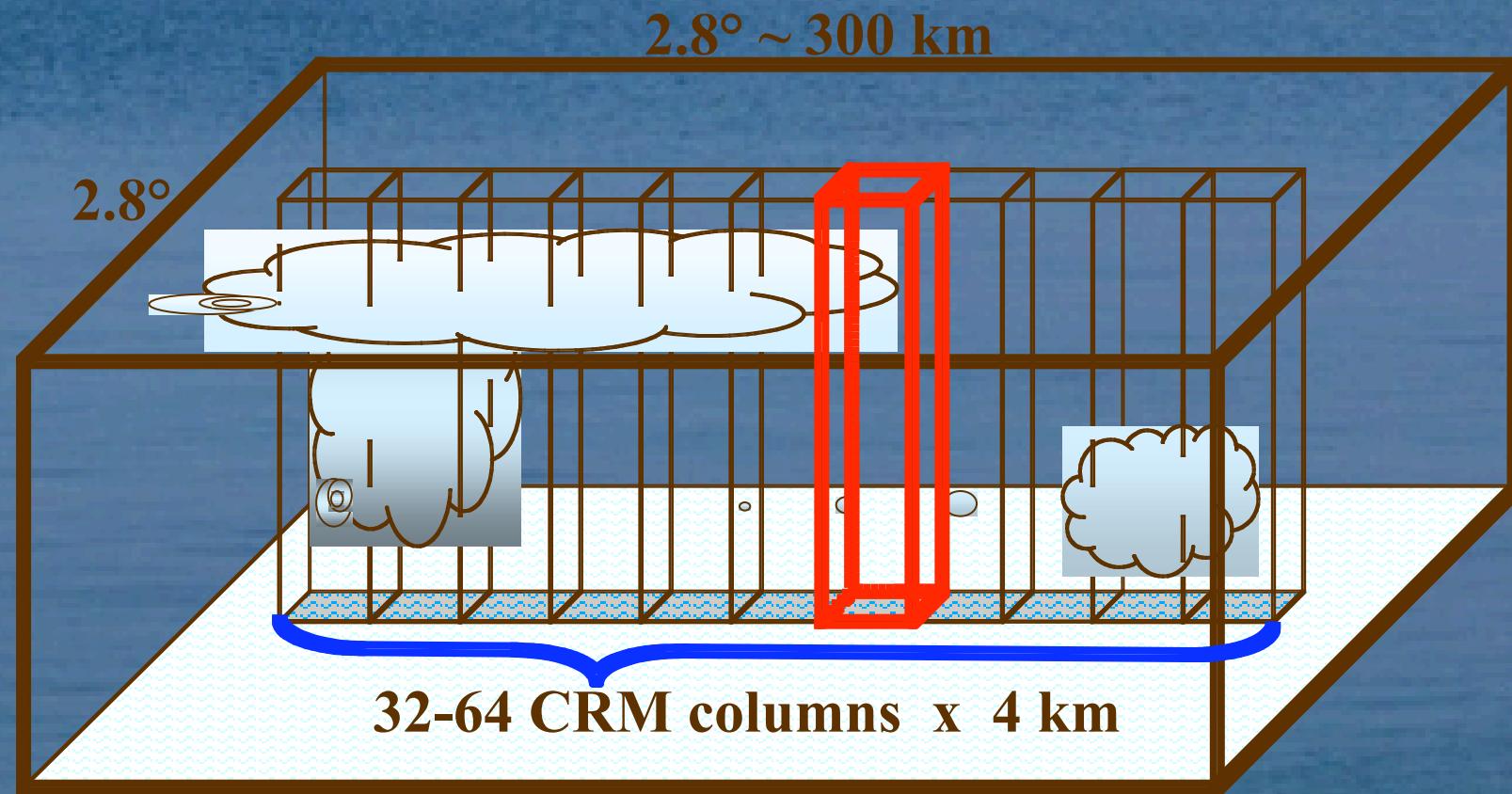


# **Minimal super-parameterization configurations for RICO**

**Marat Khairoutdinov**

**Center for Multi-Scale Modeling of Atmospheric Processes (CMMAP)**  
**Colorado State University**

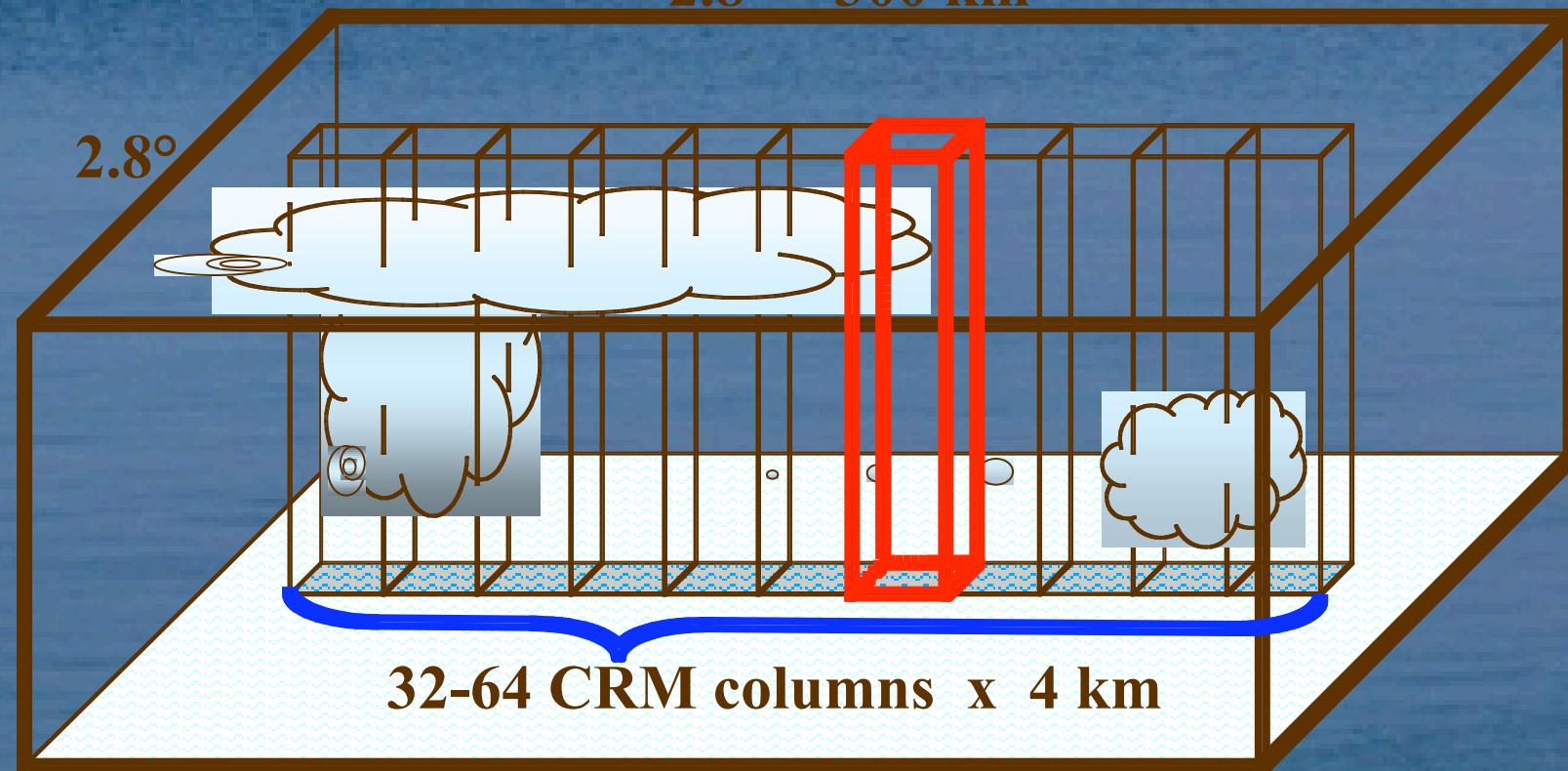
# Prototype MMF Approach:



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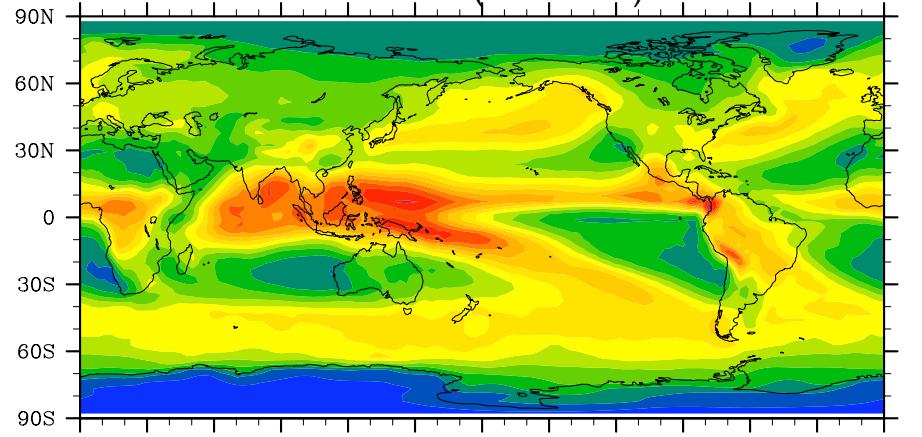
\$64K Q: Is such a crude CRM still better than an entraining plume model?

$2.8^\circ \sim 300 \text{ km}$



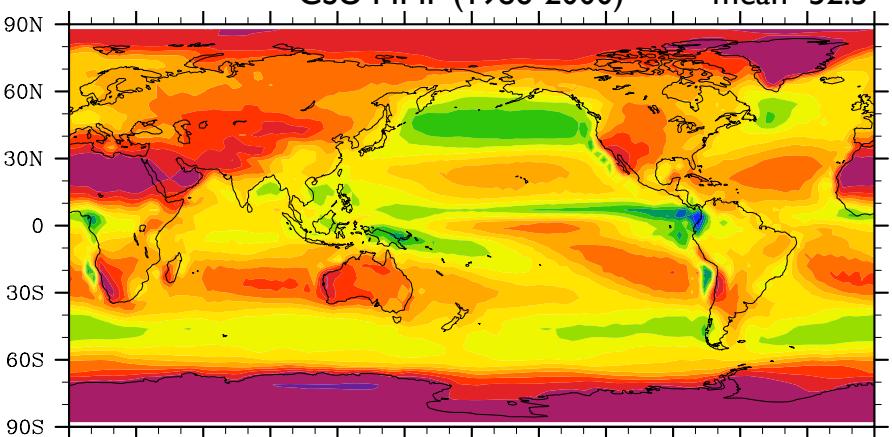
### Annual Longwave Cloud Effect (W/m<sup>2</sup>)

CSU MMF (1986-2000) mean 24.5

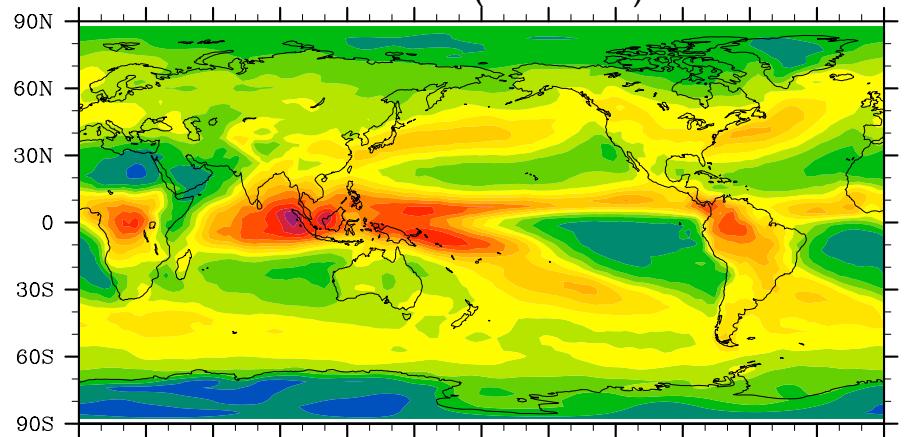


### Annual Shortwave Cloud Effect (W/m<sup>2</sup>)

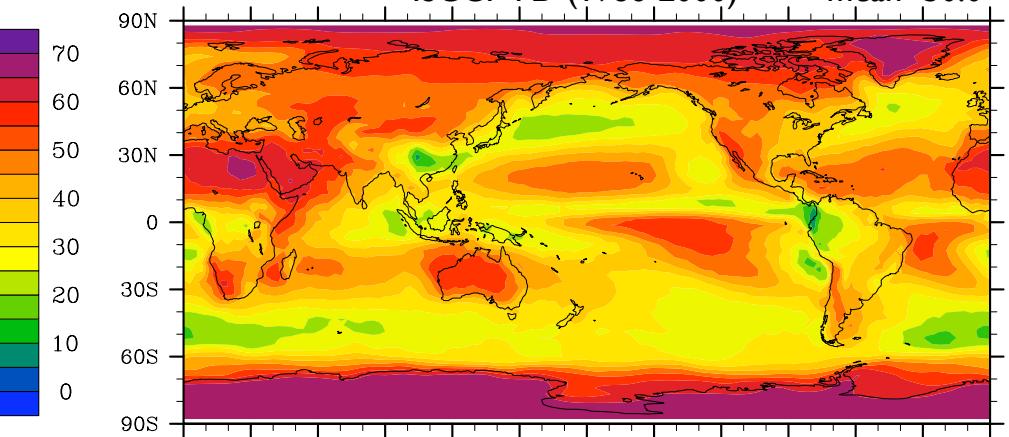
CSU MMF (1986-2000) mean -52.5



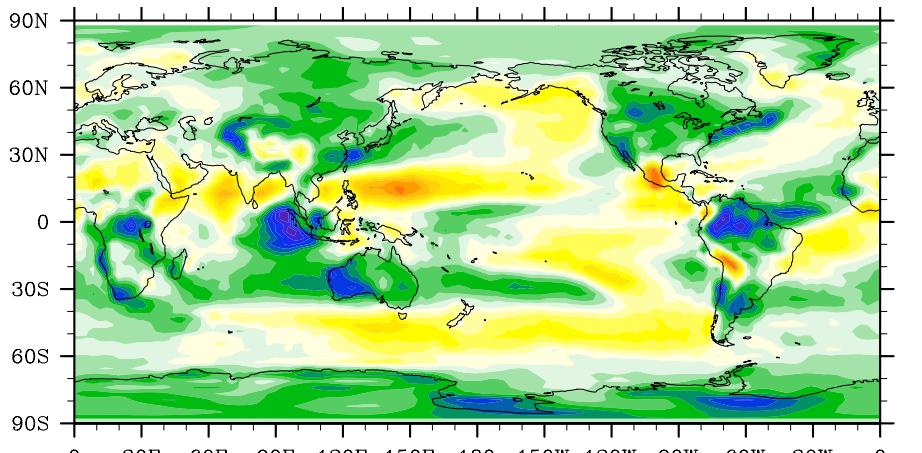
ISCCP-FD (1986-2000) mean 25.6



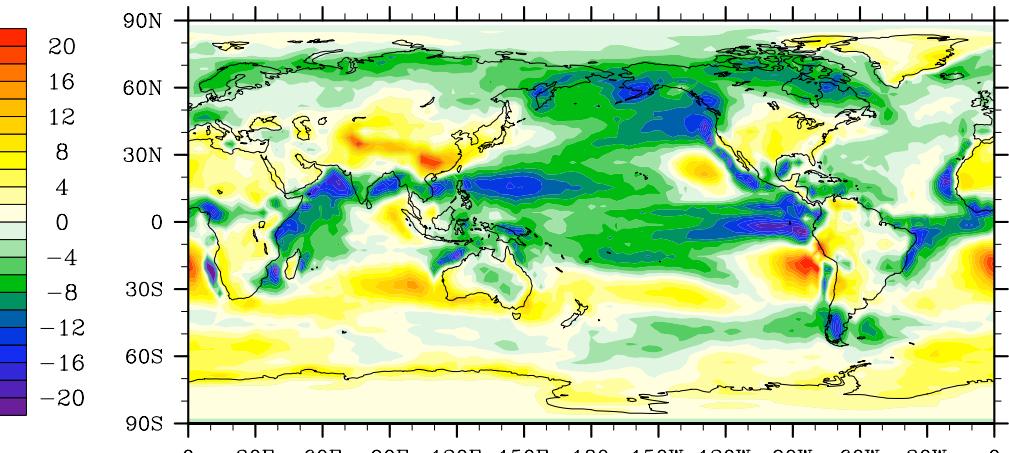
ISCCP-FD (1986-2000) mean -50.0



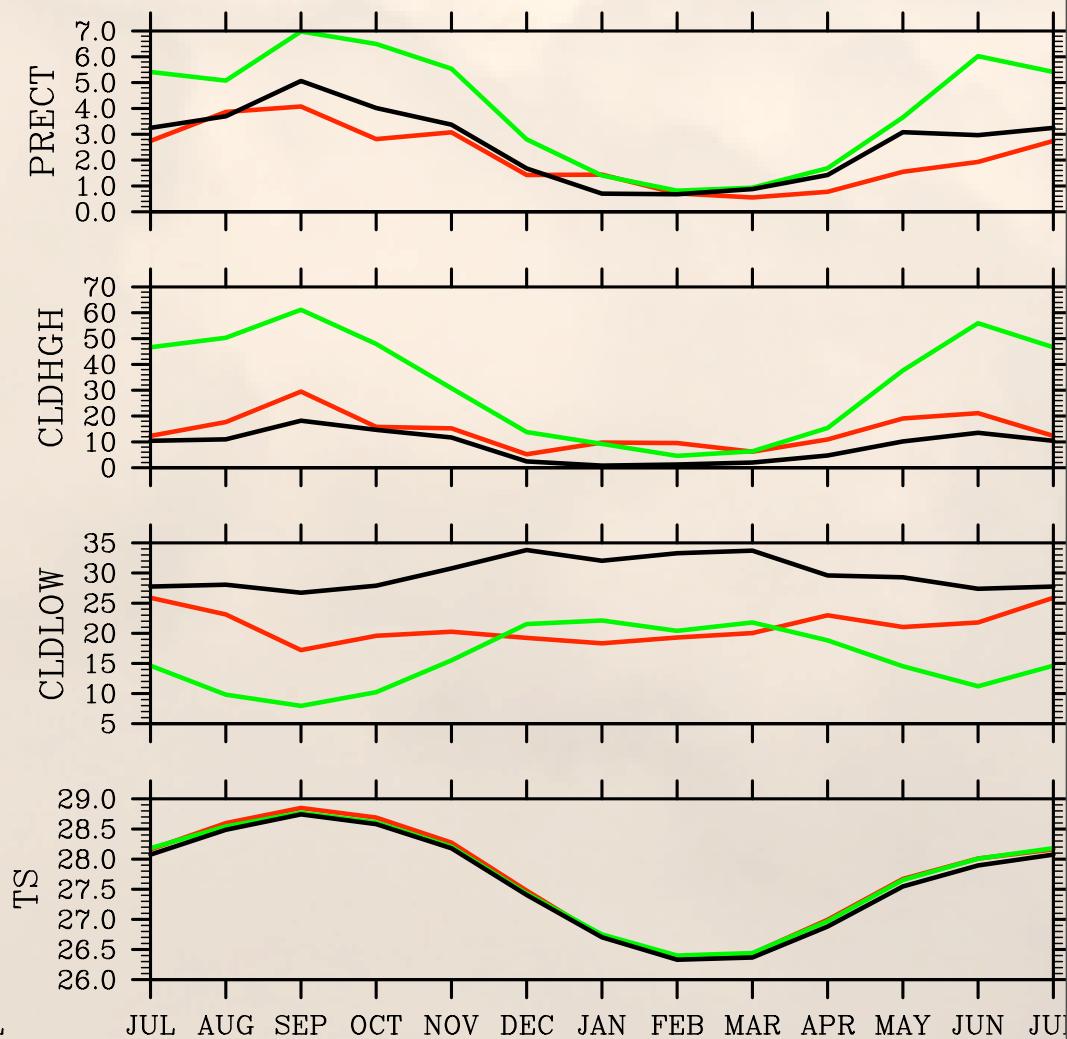
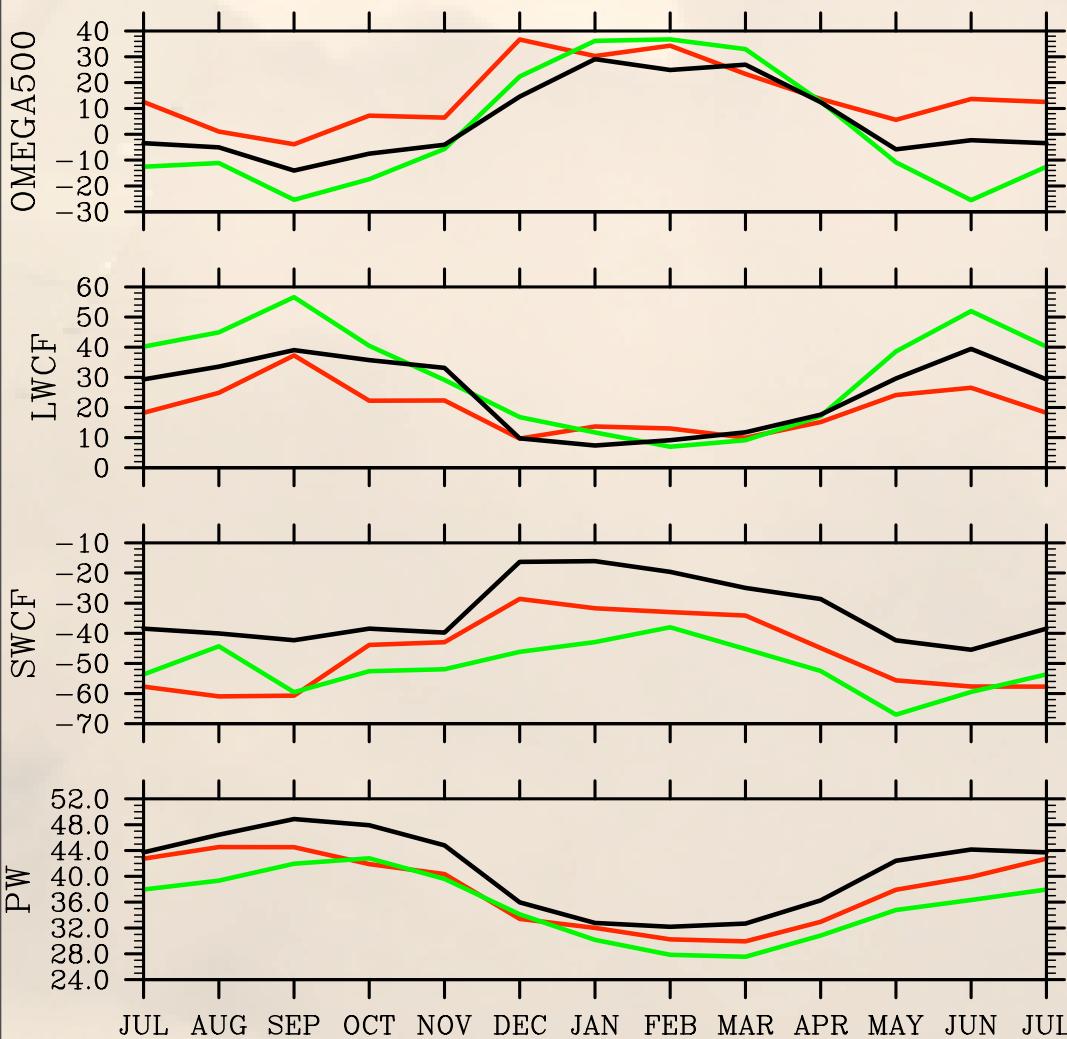
MMF minus ISCCP-FD mean -1.1



MMF minus ISCCP-FD mean -2.5



( 15N - 15N , 61.5W - 61.5W )



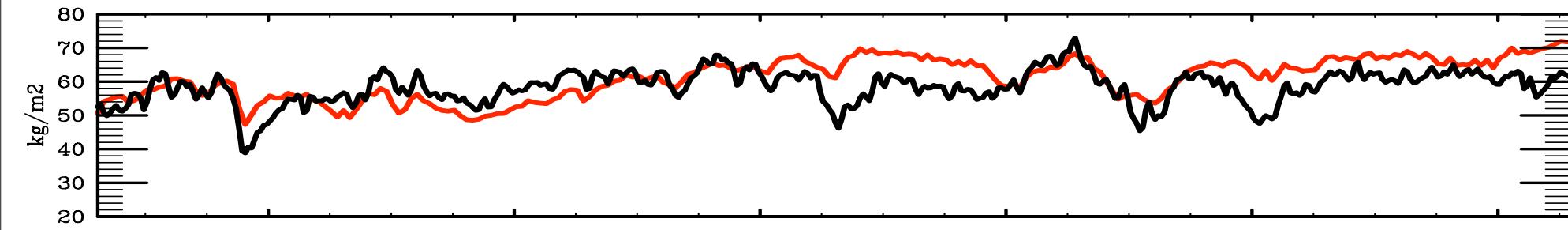
# CAM-SP-30 vertical grid

63.  
202.  
364.  
552.   
766.  
1006.  
1271.  
1662.  
2274.   
3097.  
4119.  
5310.  
6555.  
7763.  
8931.  
10048.  
11116.  
12141.  
13138.  
14115.  
15063.  
15984.  
16897.  
18052.  
19710.  
21910.  
24721.  
28235.

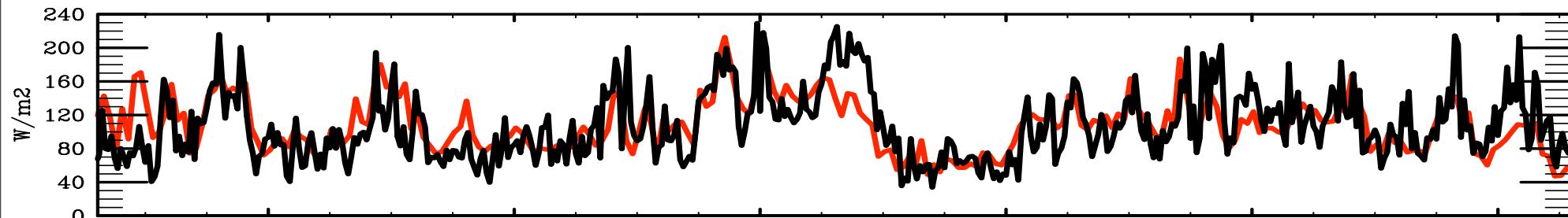
RICO  
cloud boundaries

## Precipitable Water

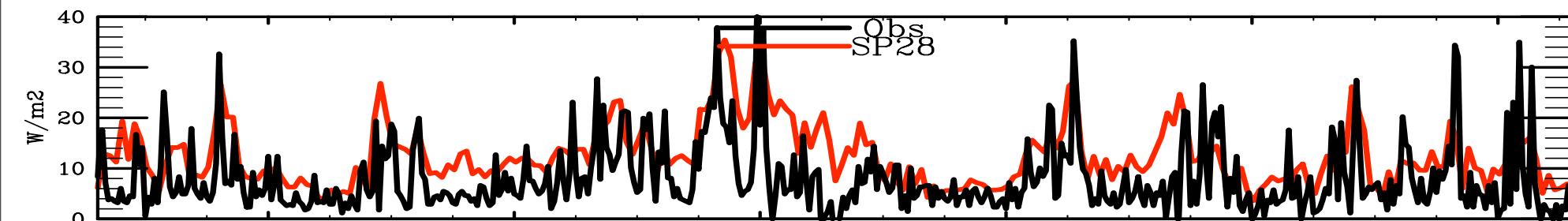
TOGA COARE



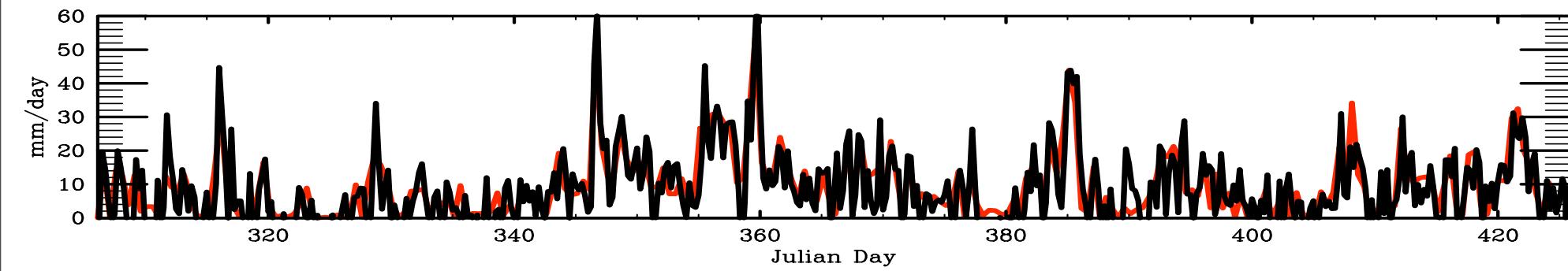
## Surface Latent Heat Flux



## Surface Sensible Heat Flux



## Precipitation Rate



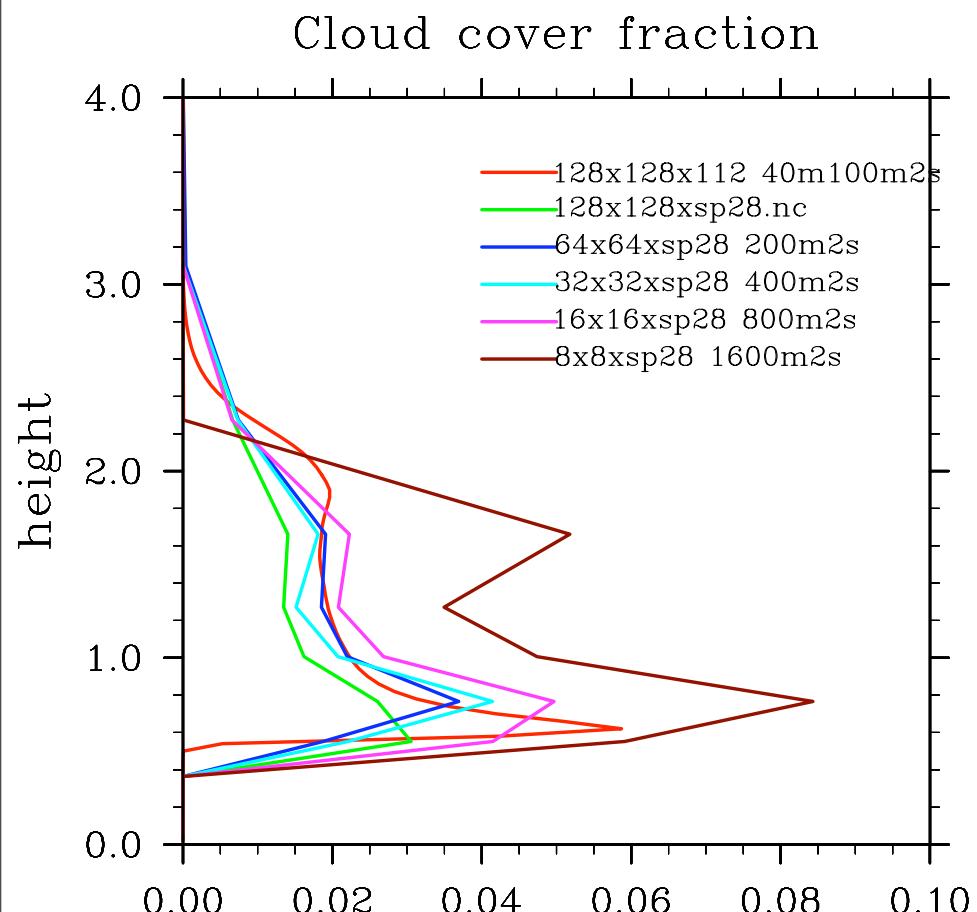
Julian Day

## **SAM sensitivity to resolution/dimensionality: RICO**

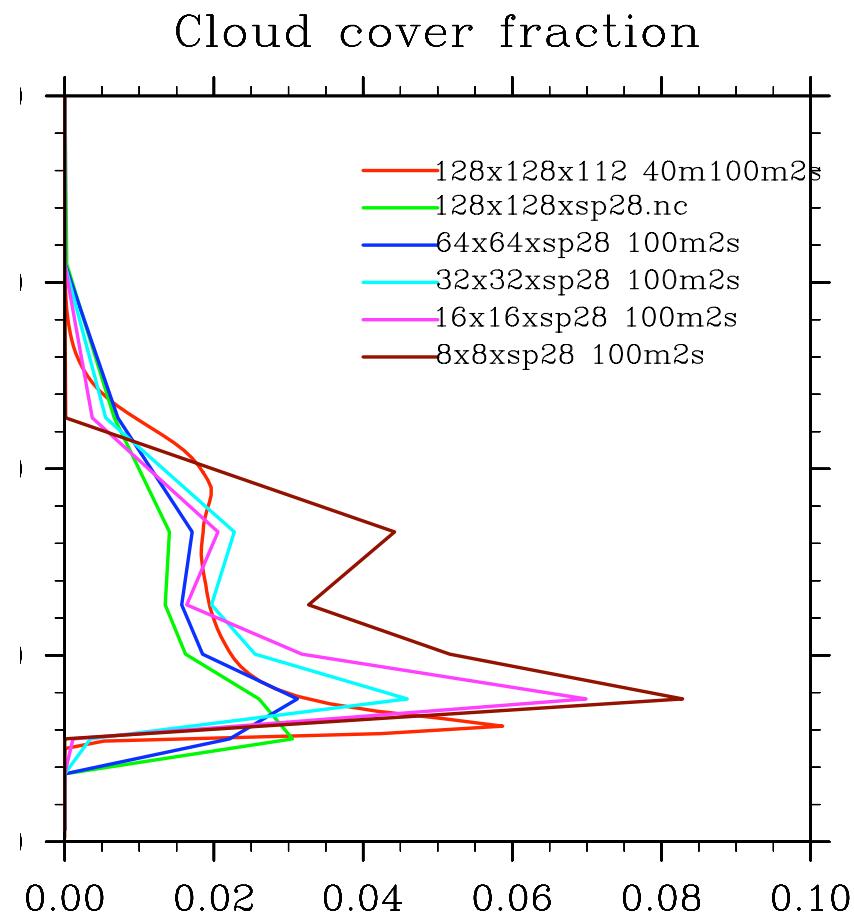
- 1. Keep domain size/#grid cells the same, degrade resolution.**
  
- 2. Keep #grid cells and resolution the same, reduce domain size.**

**Both sets use the SP vertical grid (28 levels)**

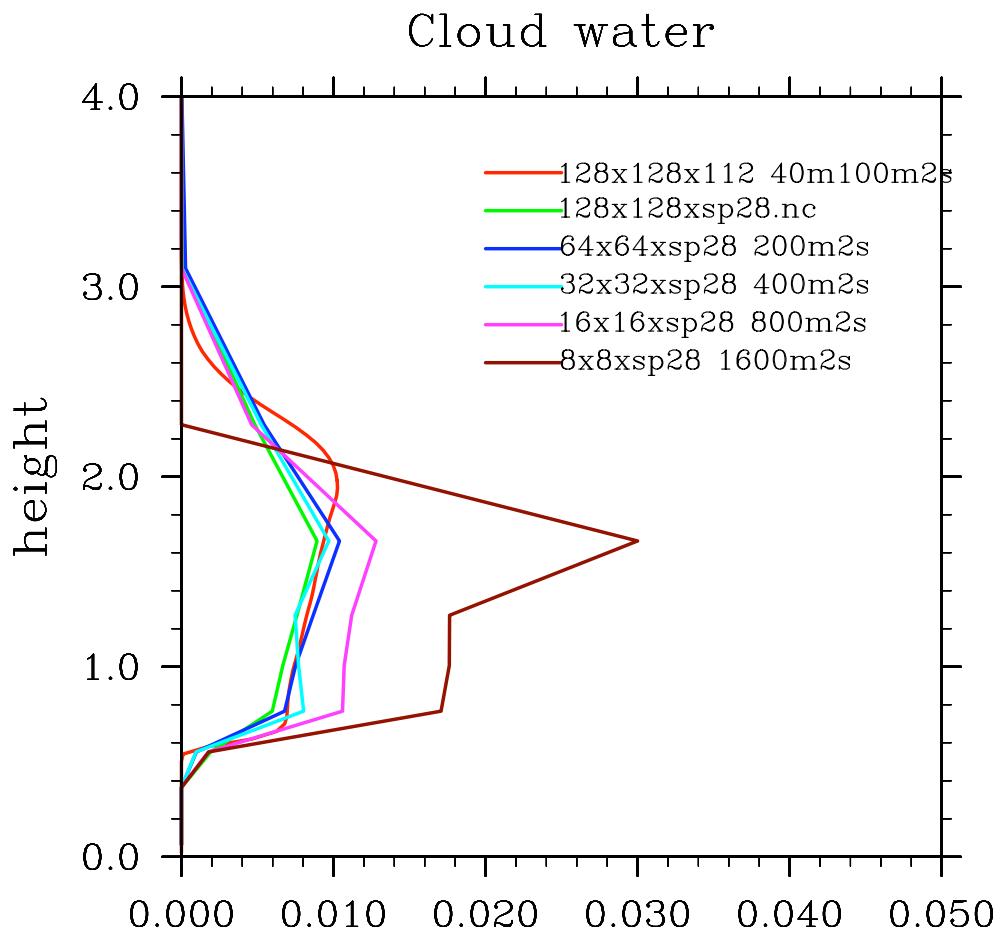
Domain size the same



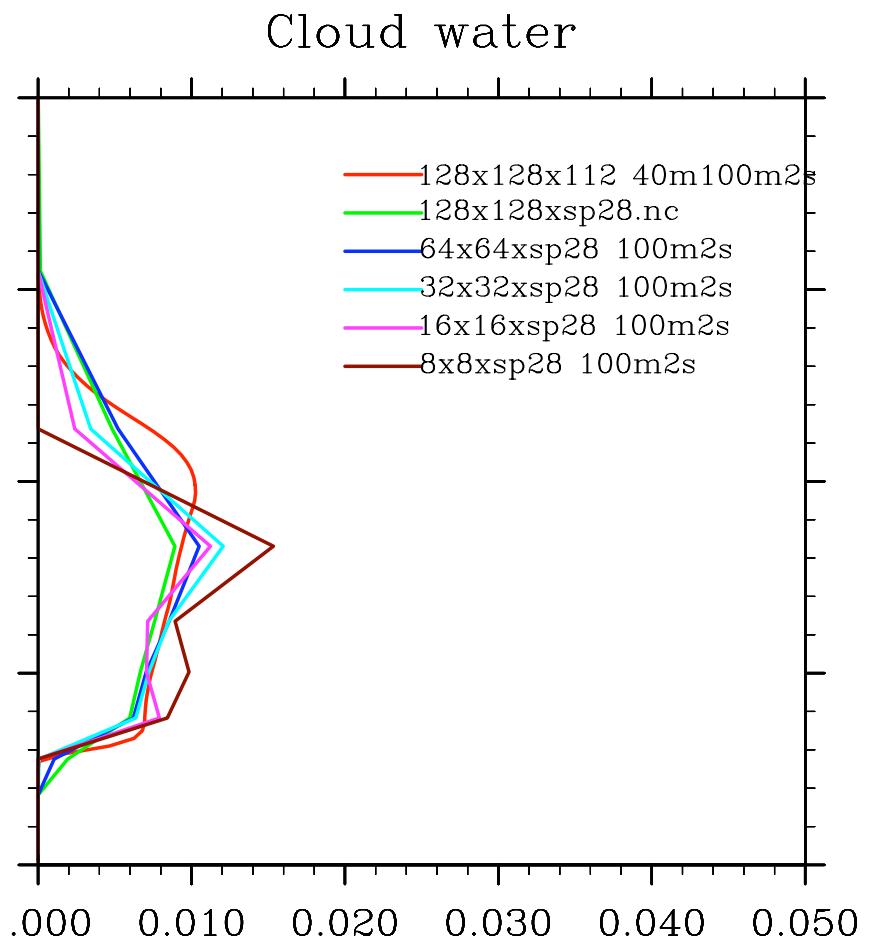
Resolution the same ( $dx=100m$ )



Domain size the same



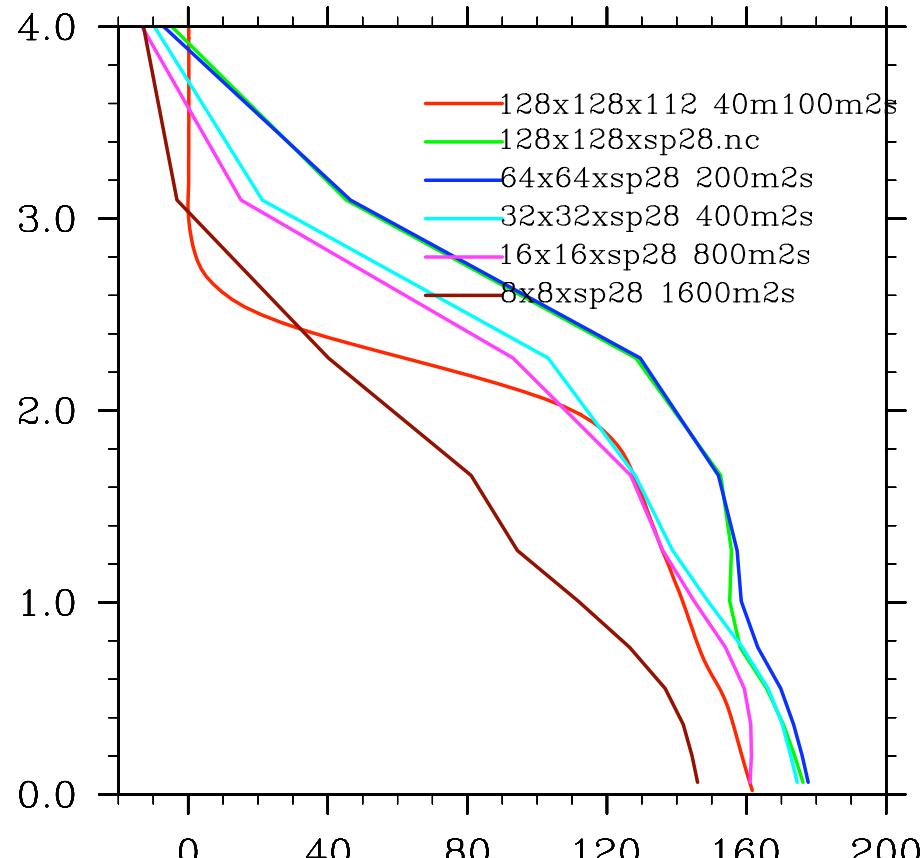
Resolution the same ( $dx=100m$ )



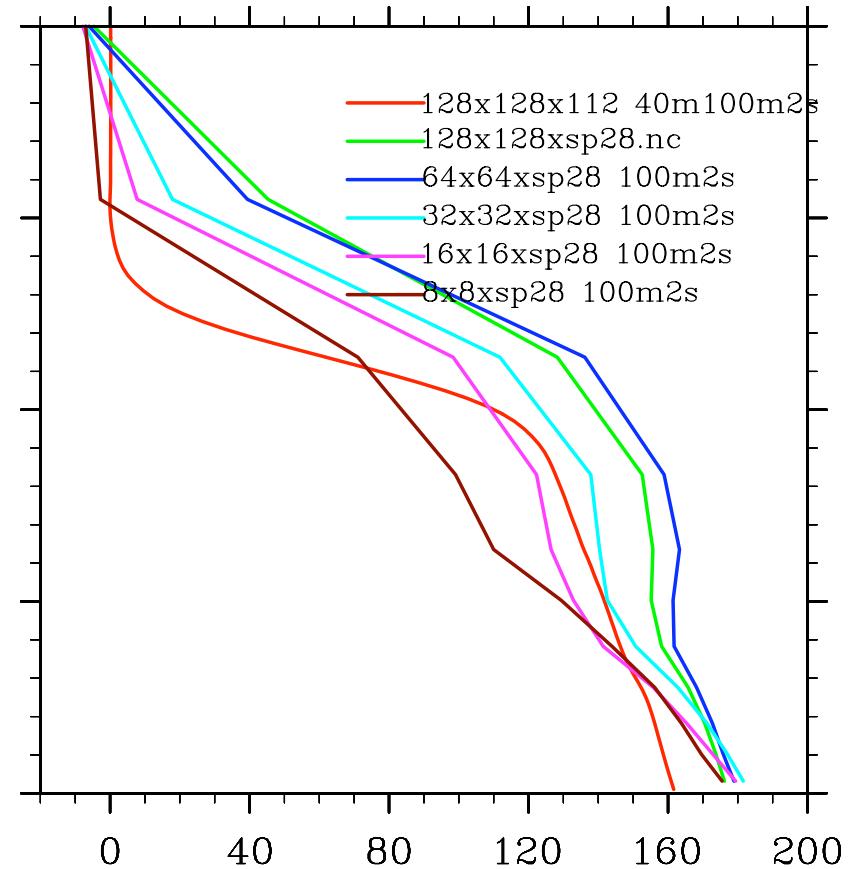
Domain size the same

Resolution the same ( $\Delta x=100m$ )

Total water flux (Total)

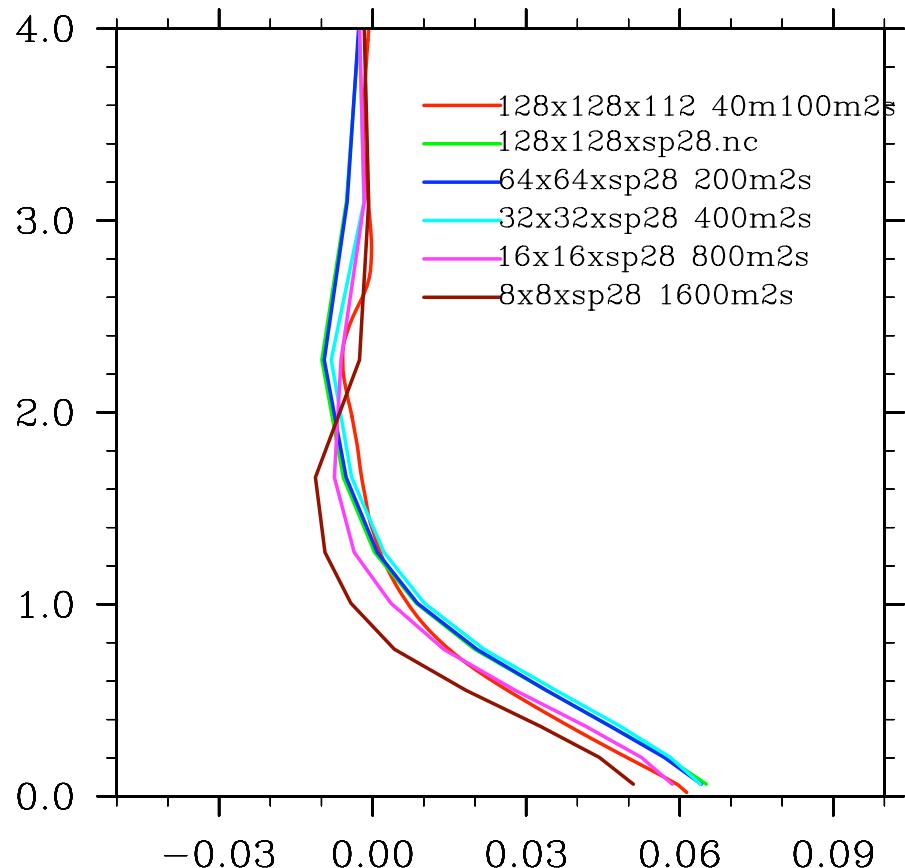


Total water flux (Total)



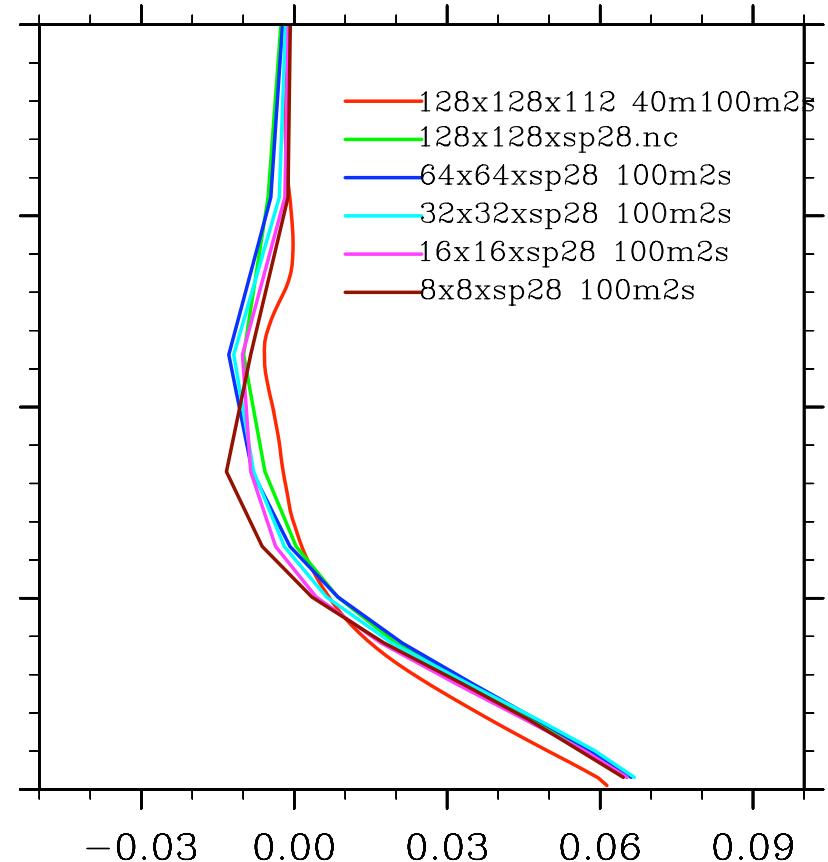
Domain size the same

x-momentum flux (Total)

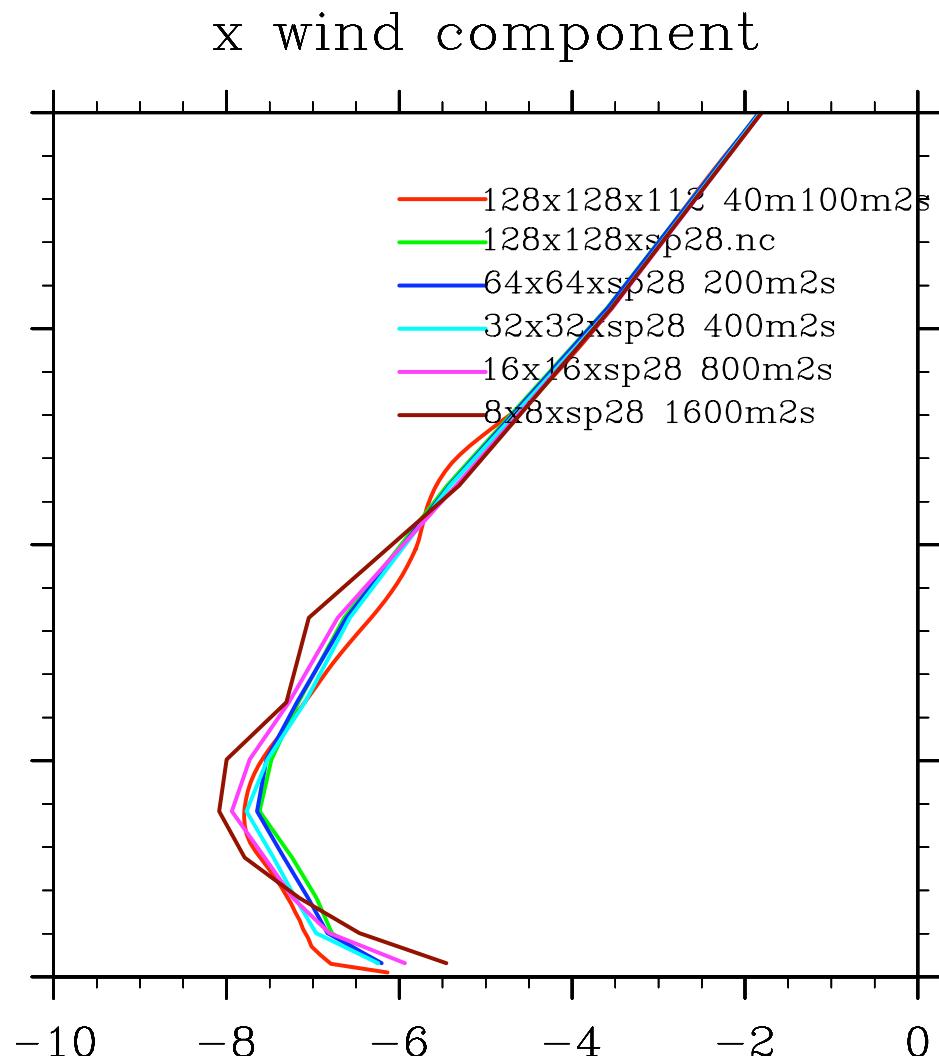


Resolution the same ( $\Delta x = 100\text{m}$ )

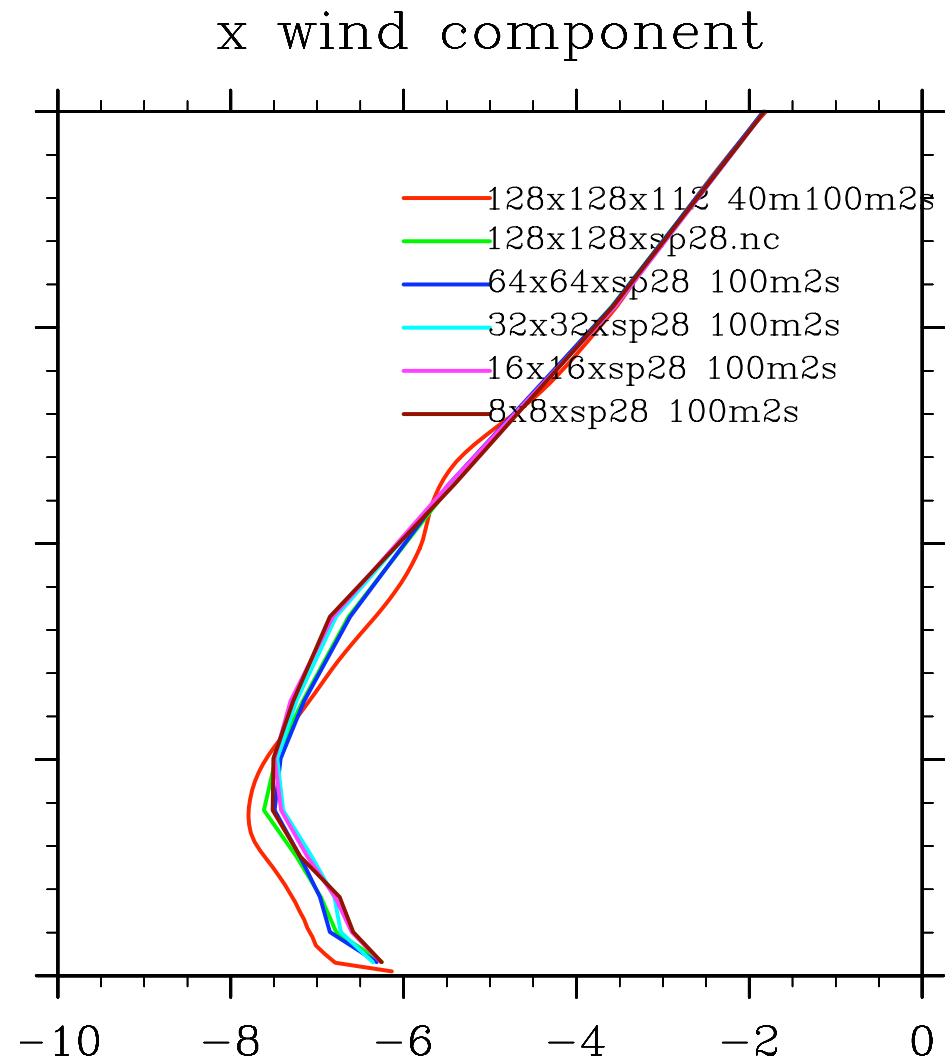
x-momentum flux (Total)



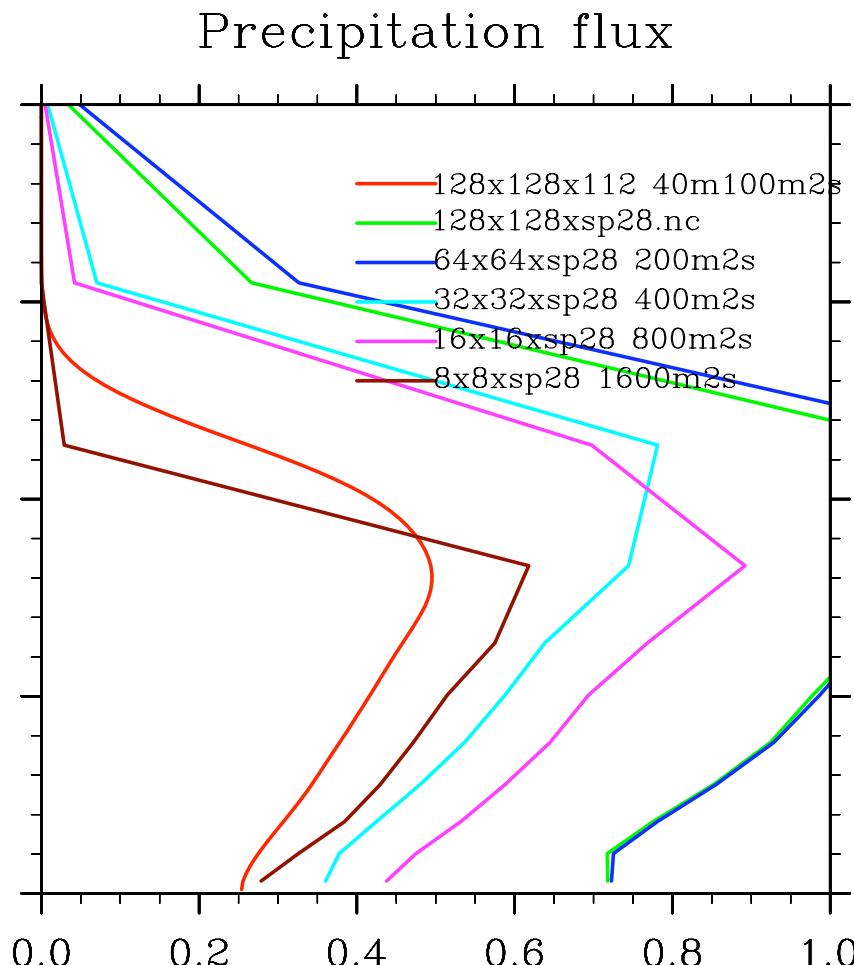
Domain size the same



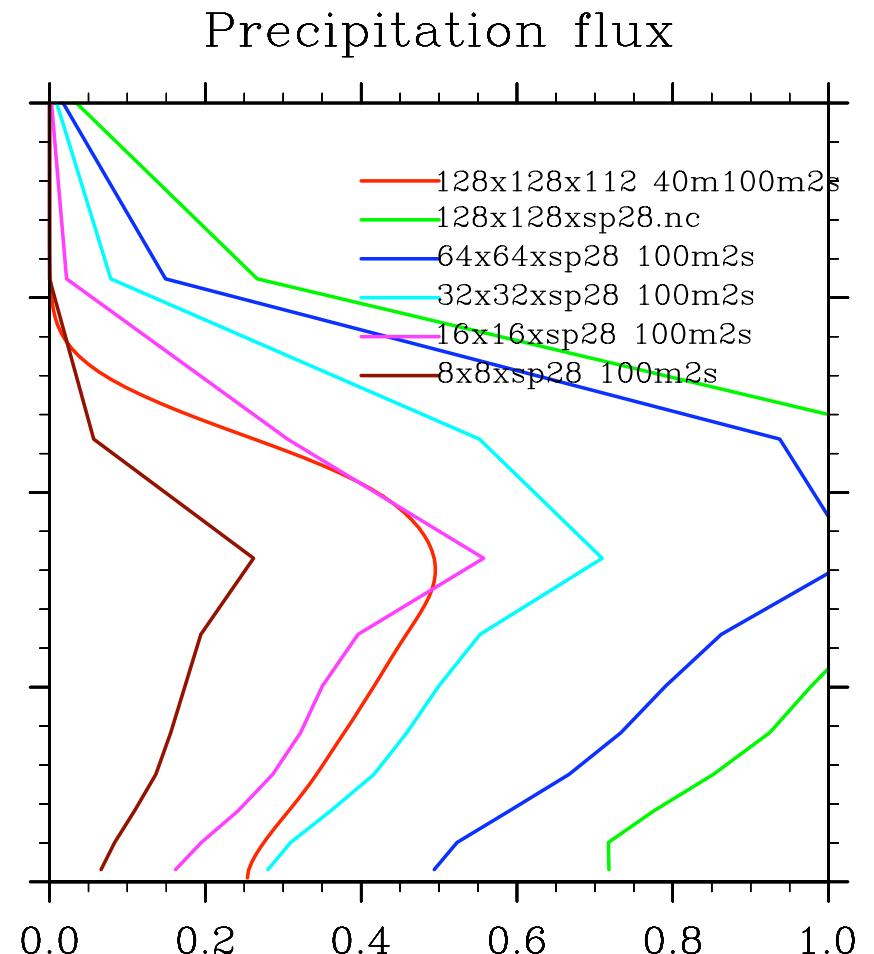
Resolution the same ( $\Delta x=100m$ )



Domain size the same



Resolution the same ( $dx=100m$ )



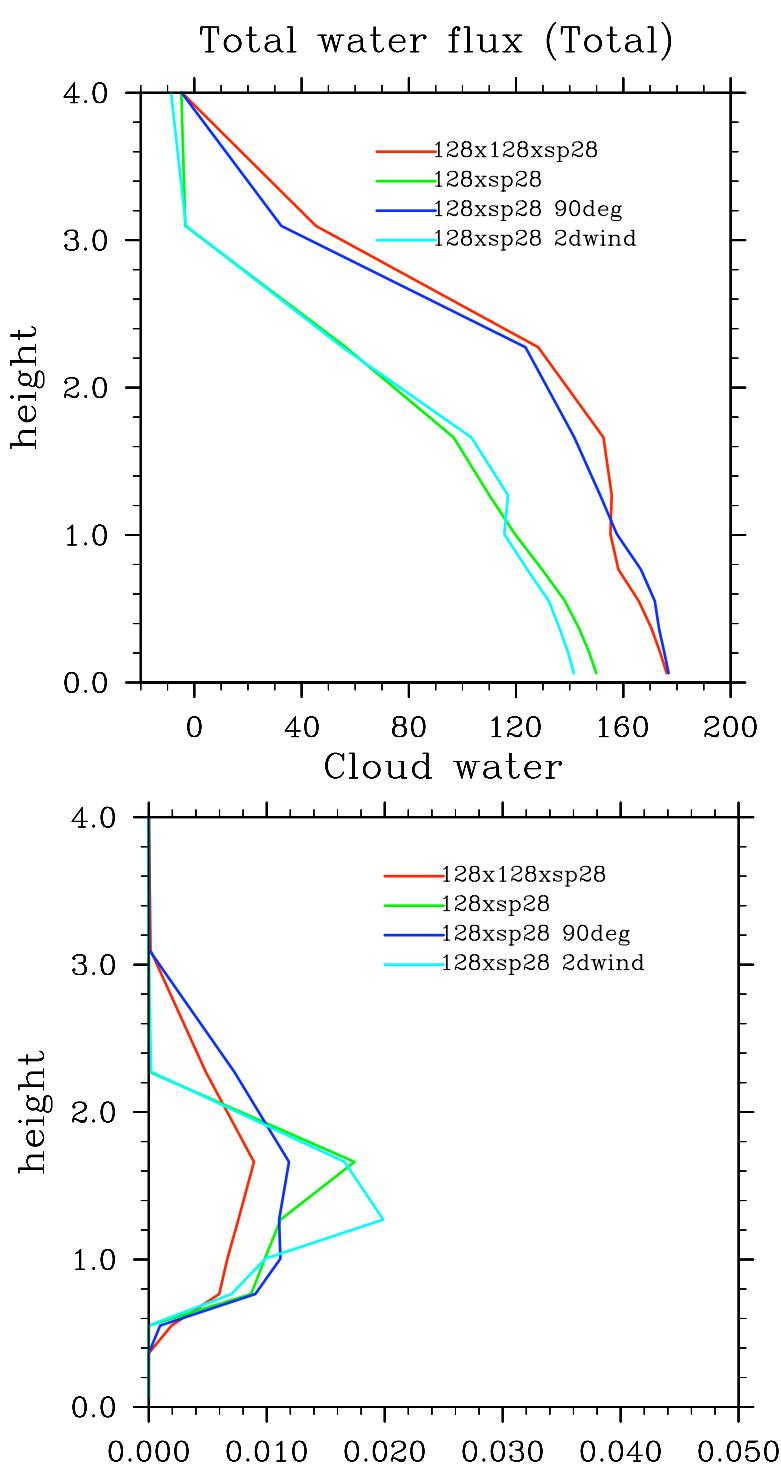
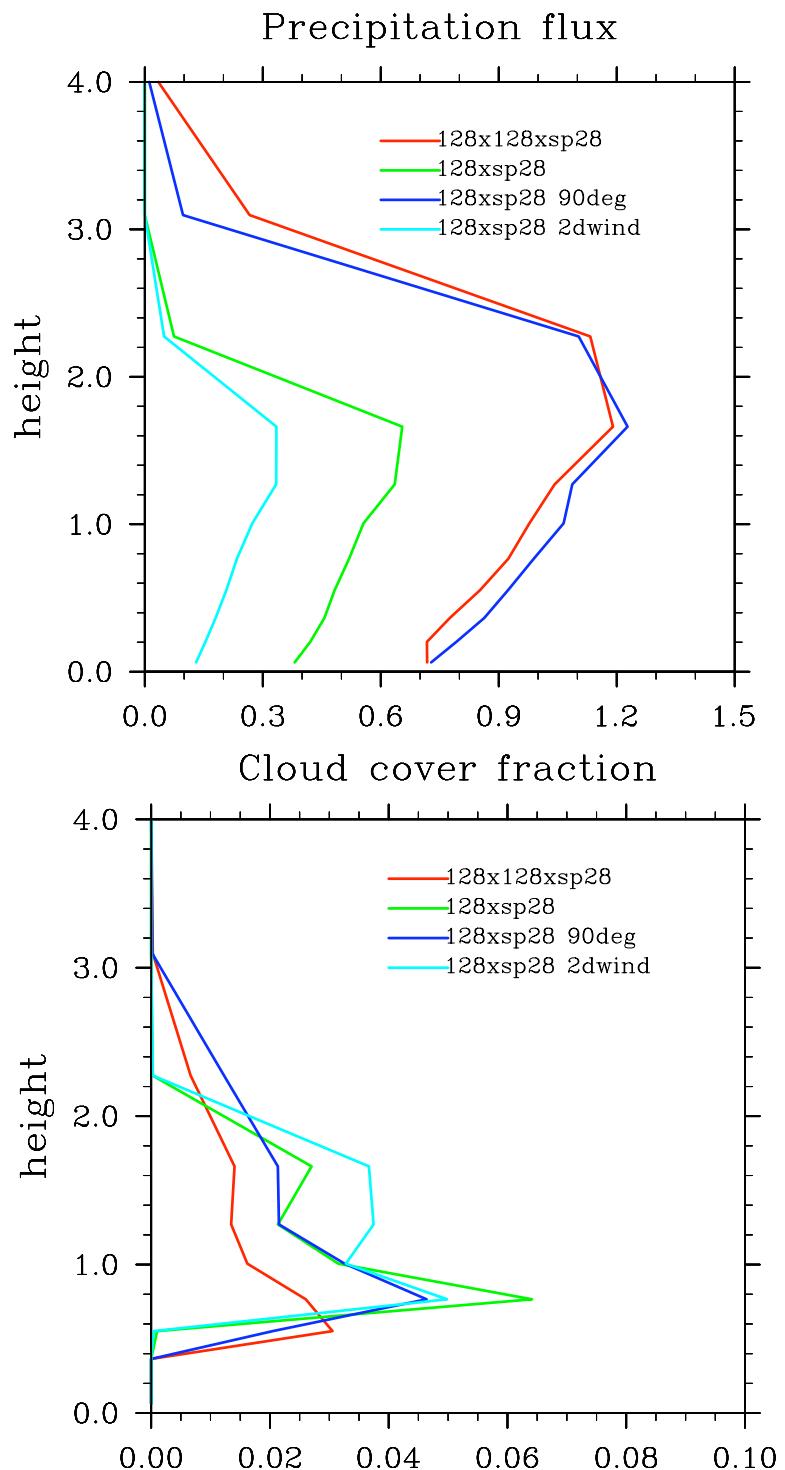
# **SAM offline sensitivity to 2D: RICO**

**1. x-wind component**

**2. y-wind component**

**3. Total wind speed (all in one direction)**

**2D domain 128 x sp28 (dx=100m)**

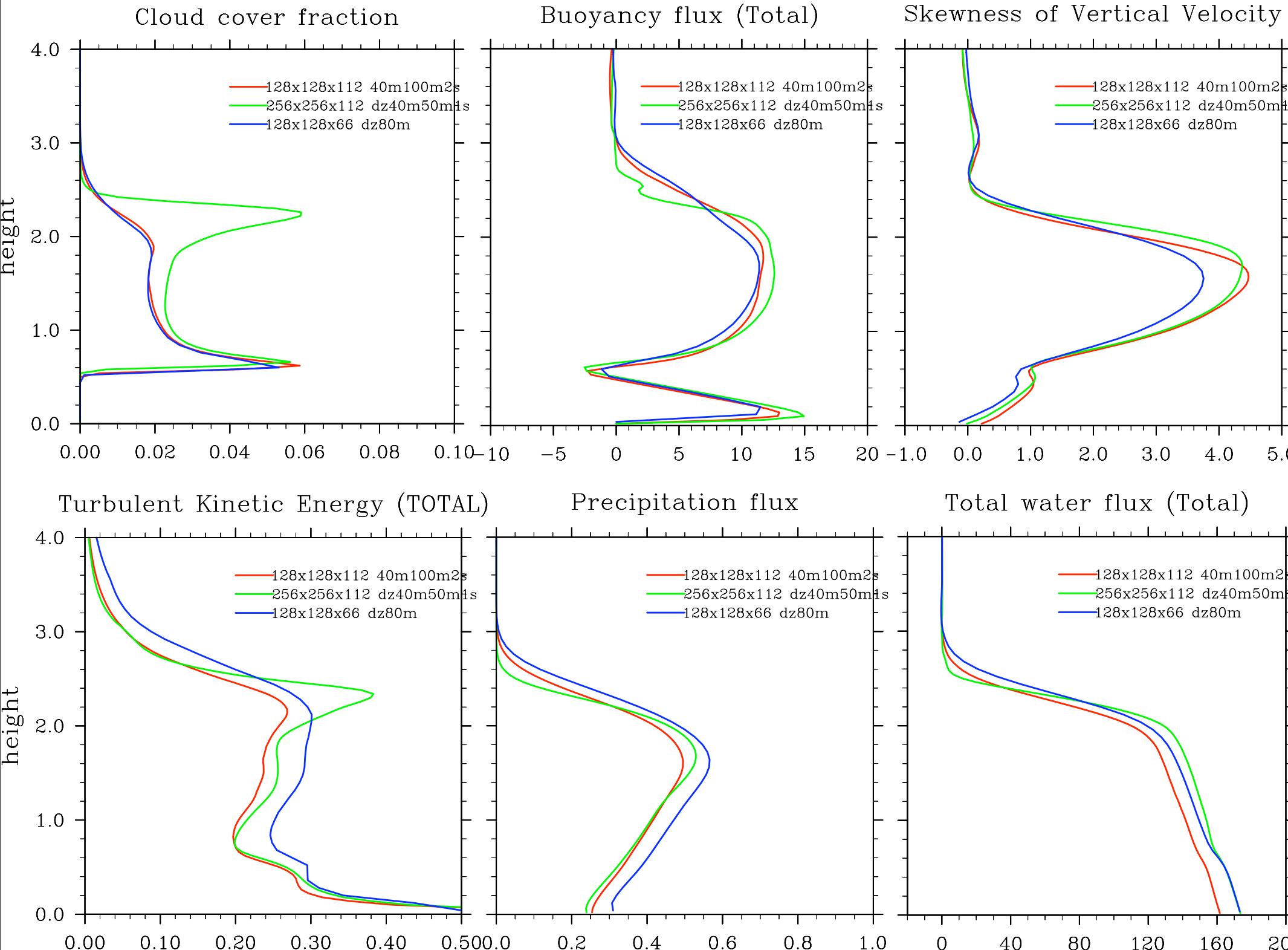


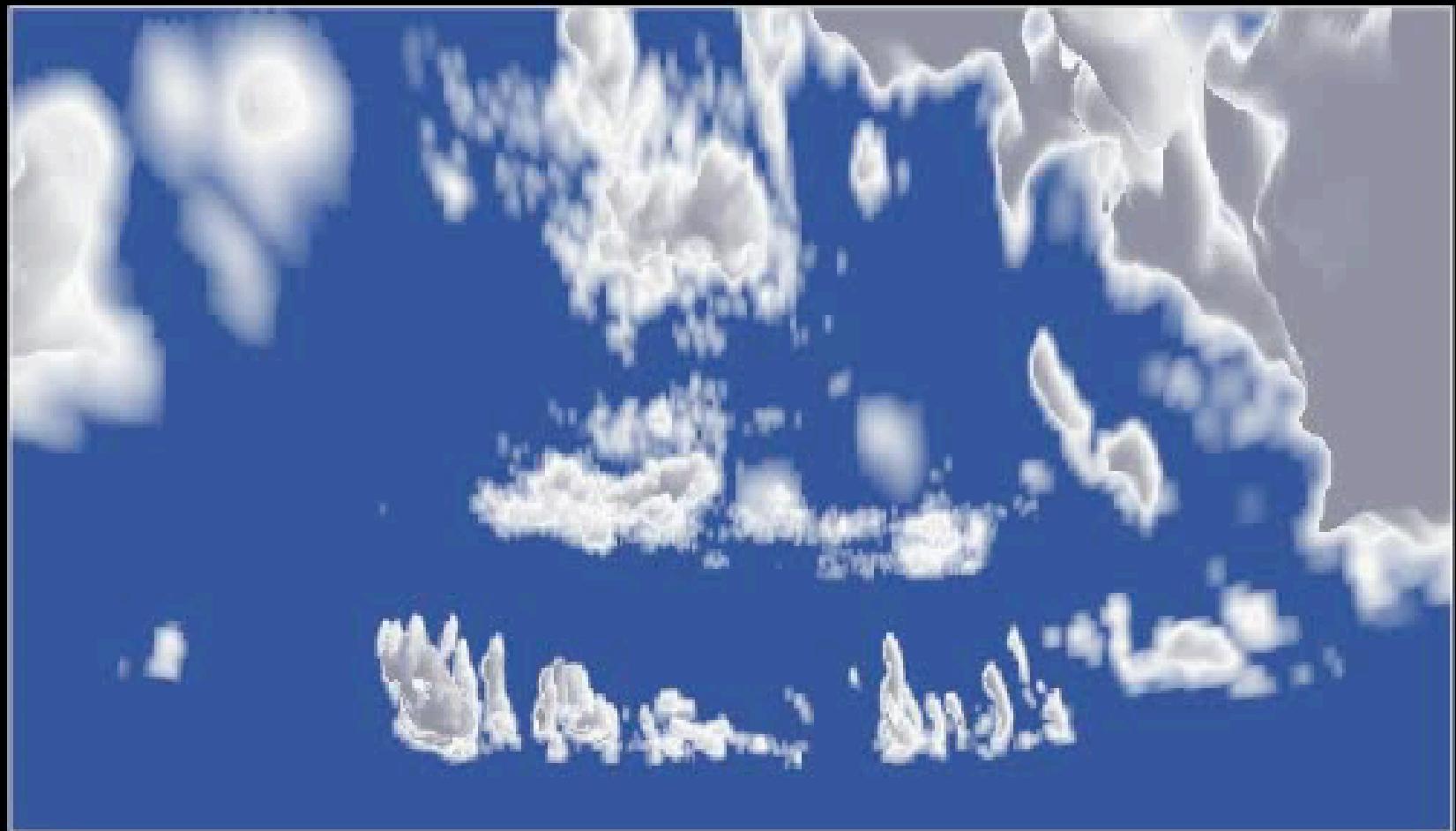
## SAM offline sensitivity to resolution: RICO

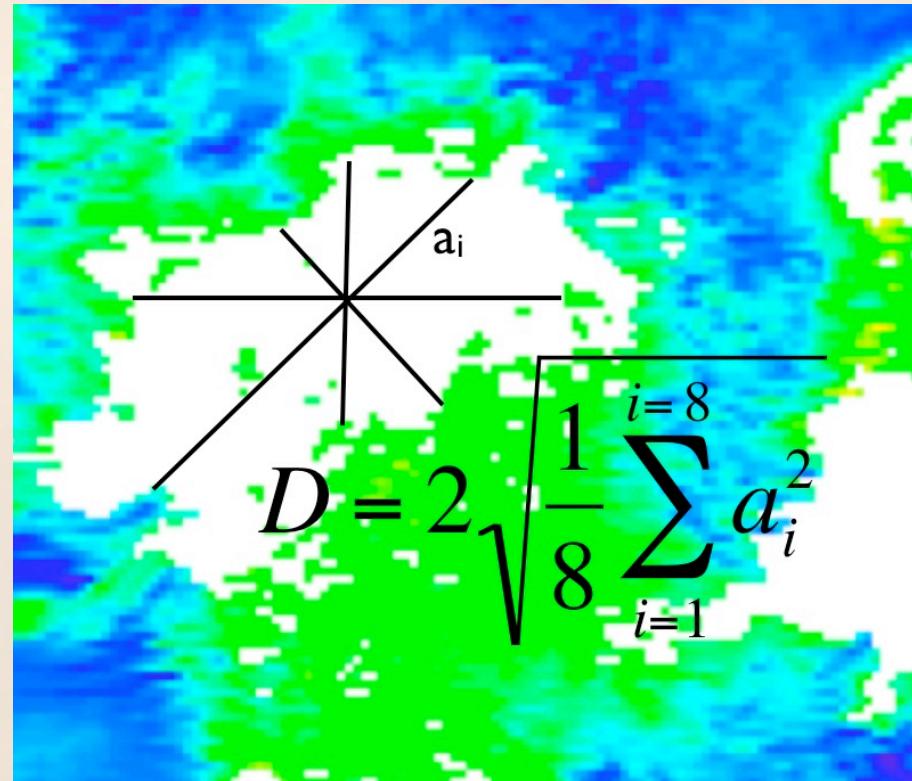
1.  $dx = 100m, dz = 80m$

2.  $dx = 50m, dz=40m$

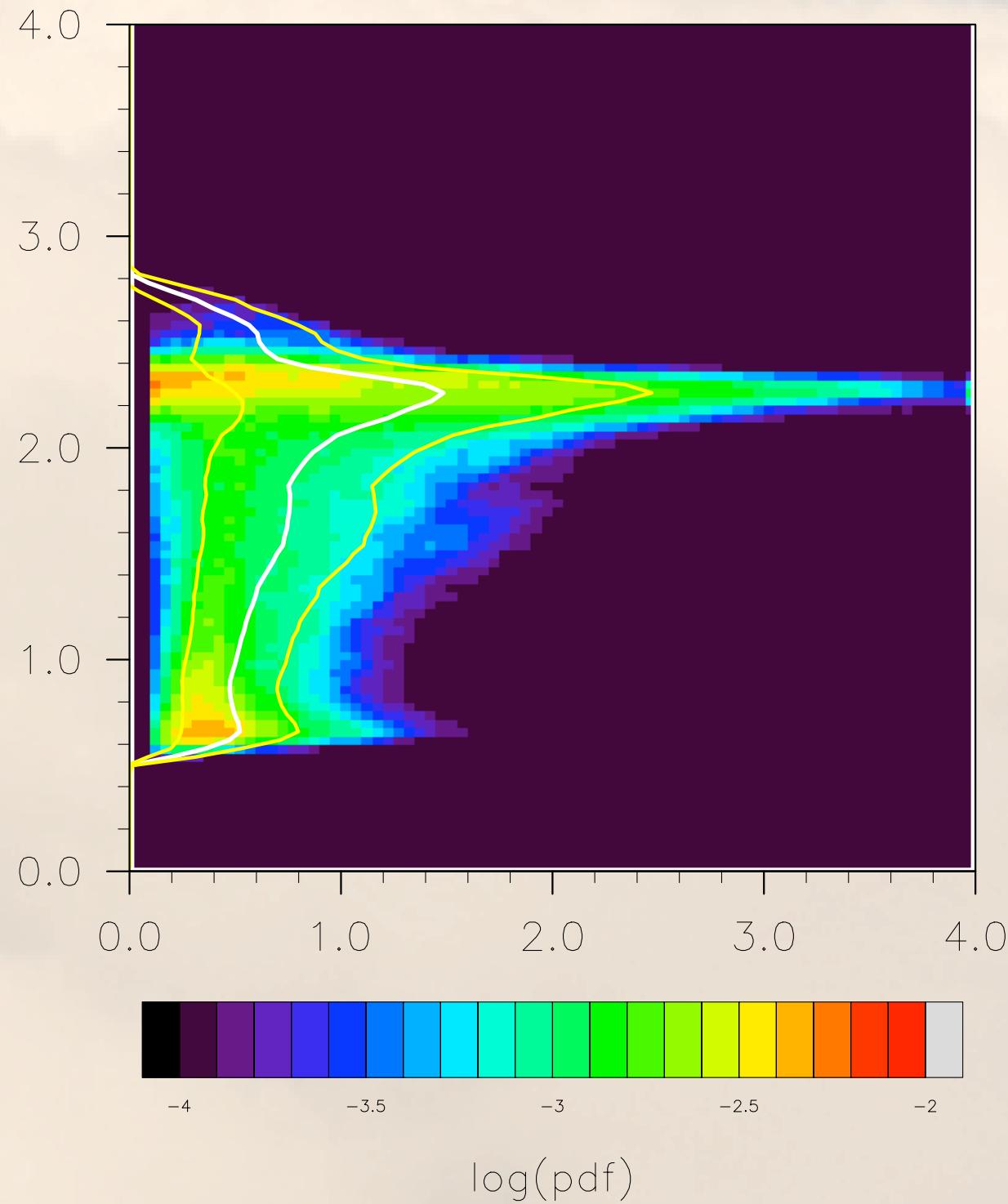
All 3D



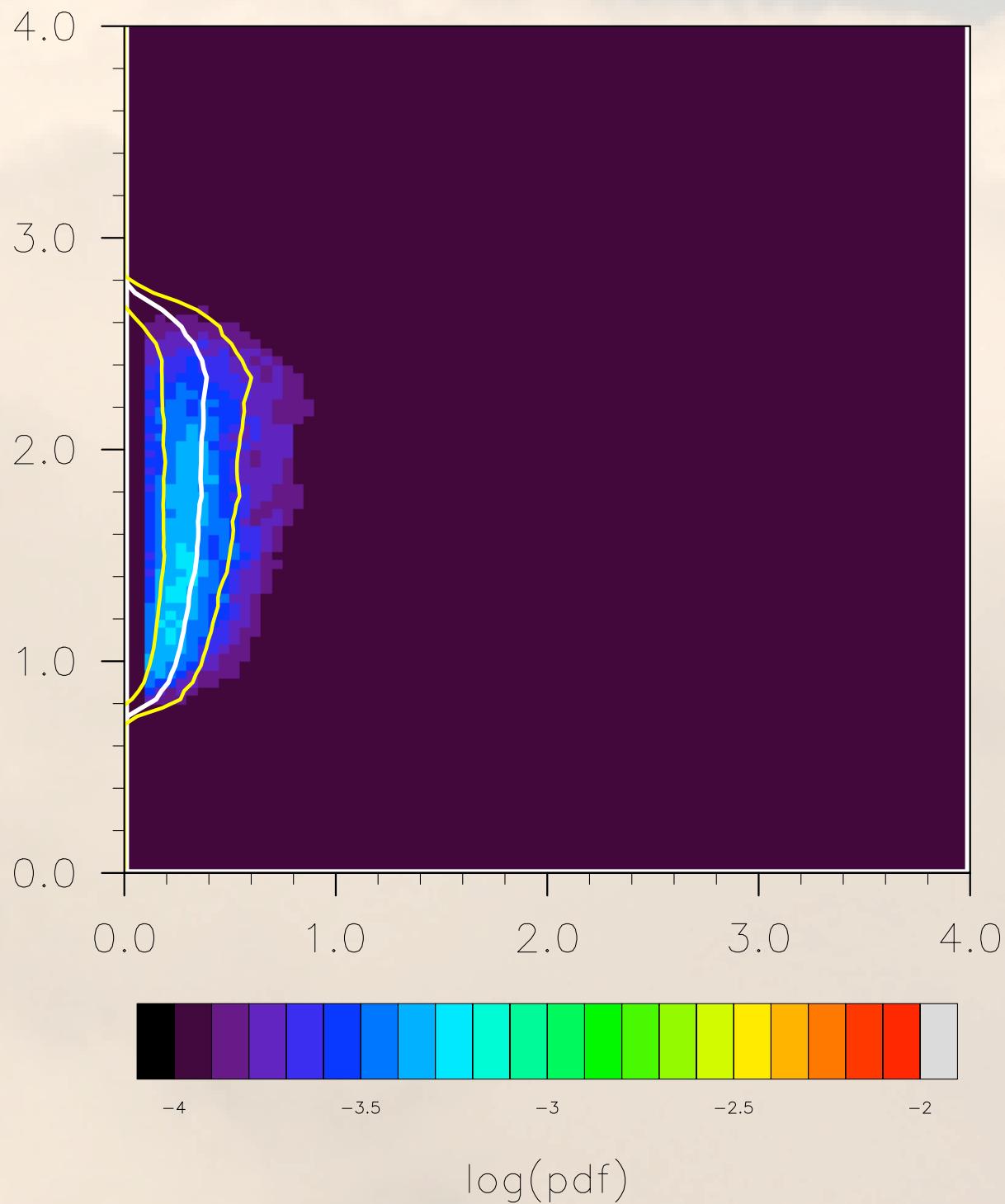




PDF Cloud Size, km 23h55 UTC



PDF Cloud Core Size, km 23h55 UTC



## **(Preliminary) Conclusions:**

**Both, low resolution & small domain 3D SAM is able to model RICO case**

**2D SAM shows great sensitivity to orientation of the domain relative to wind**

**3D (normal grid) SAM is not sensitive to at least halving of the vertical resolution**

**SAM results don't seem to converge when horizontal resolution is doubled (50m)**