Convection Initiation and Moist Thermodynamic in the Planetary Boundary Layer: A Sounding Study of Tropical Storm Cindy by HAMS

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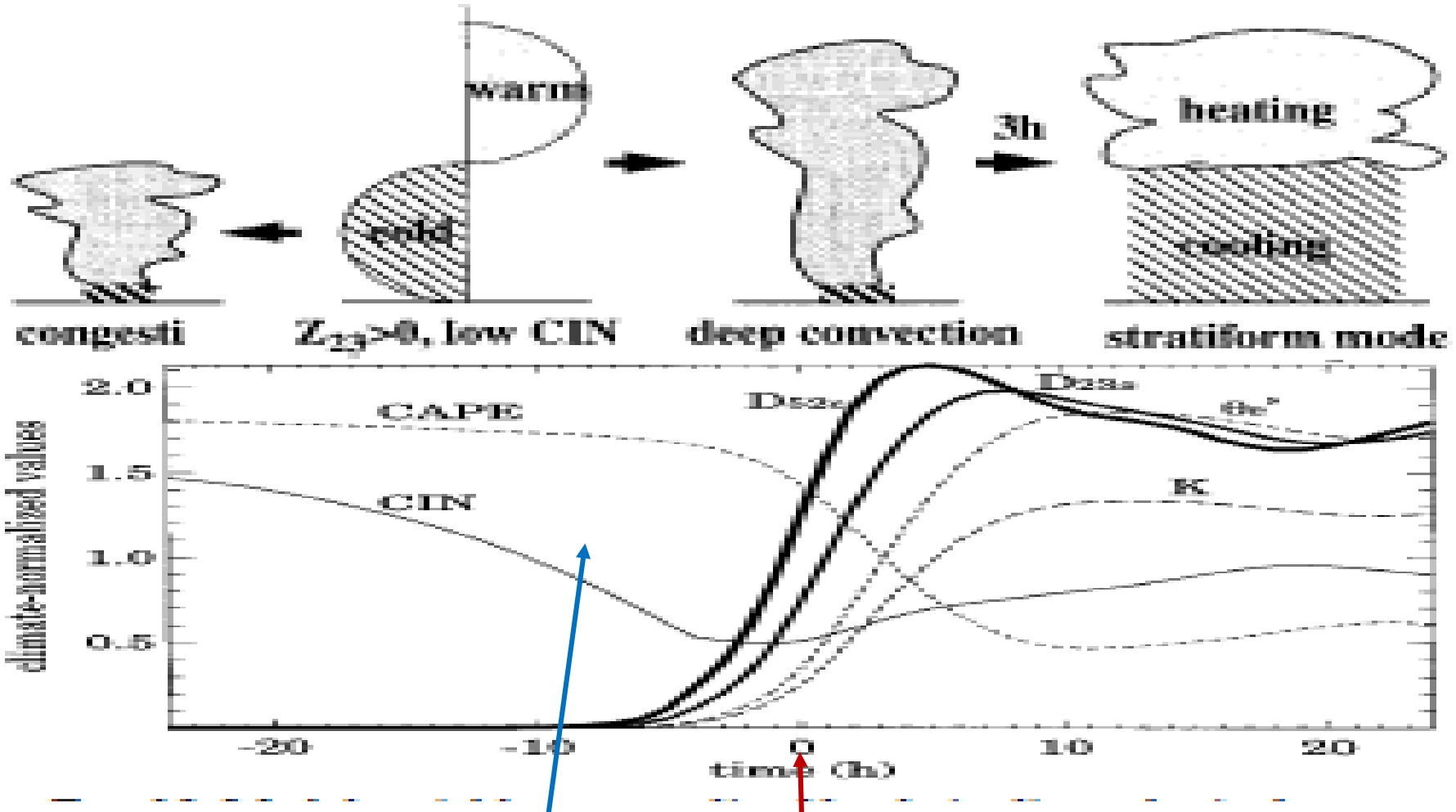
JPL/California Institute of Technology

Sounding Science Team Meeting (Maryland, 2018 October)

â 2018 California Institute of Technology
Government sponsorship acknowledged

CIN-Controlled Convection Initiation (Mapes JAS 2000)

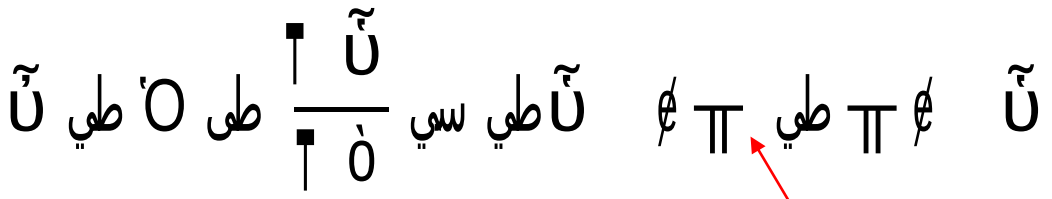


CIN reduced in preconditioning period

Deep Convection starts

- A wave propagates to a region
- Lower tropospheric T cooled, congestiform
- CIN reduced, triggerring deep convection

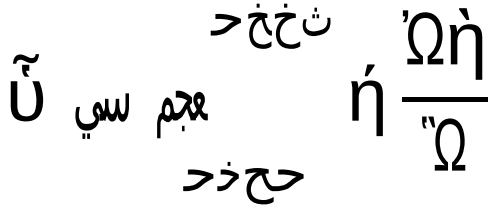
Description of Moisture Transport

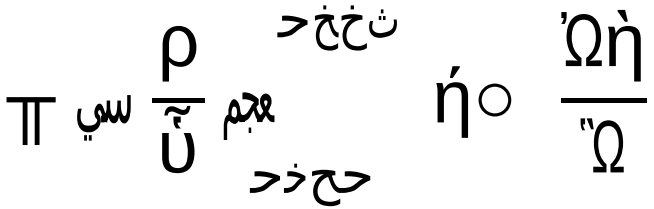


Where

QCNVG QADVT

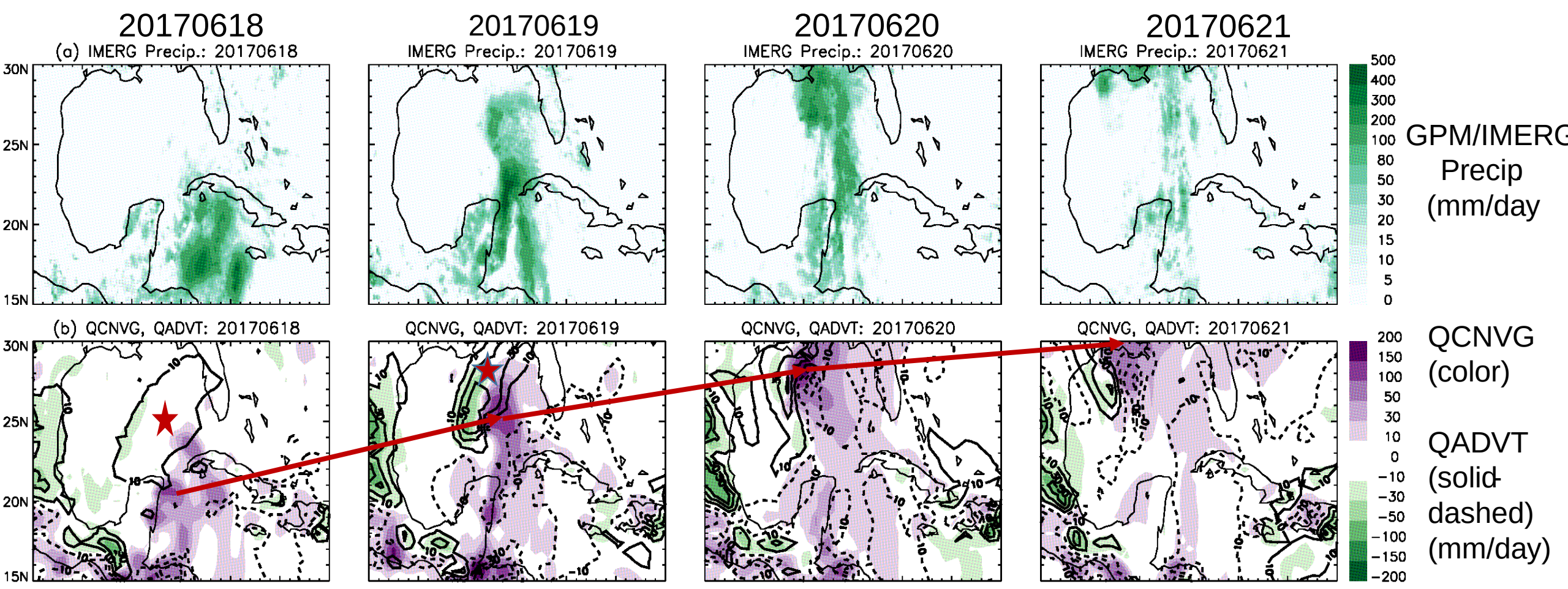
Use MERRA2 for the computation



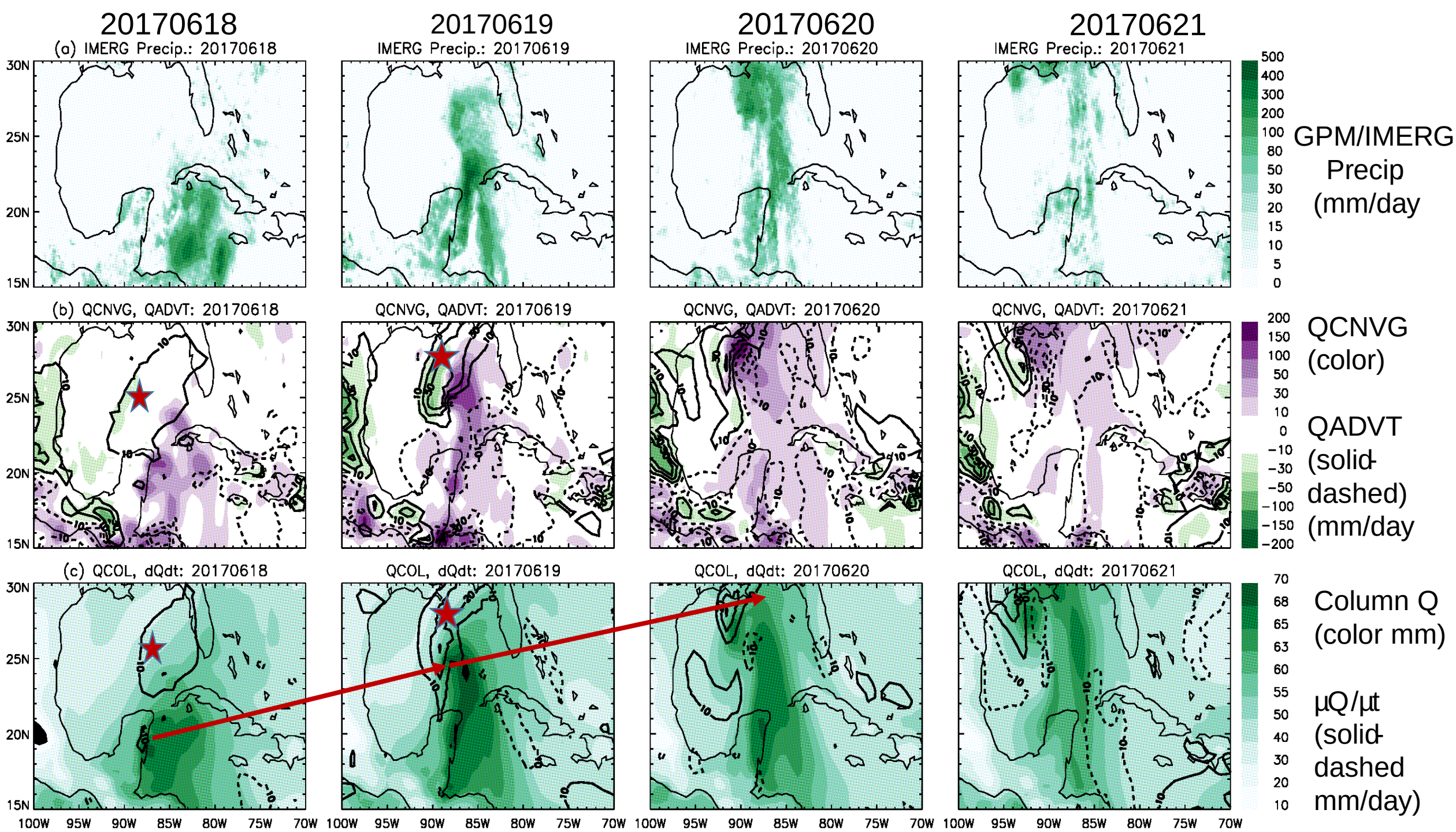


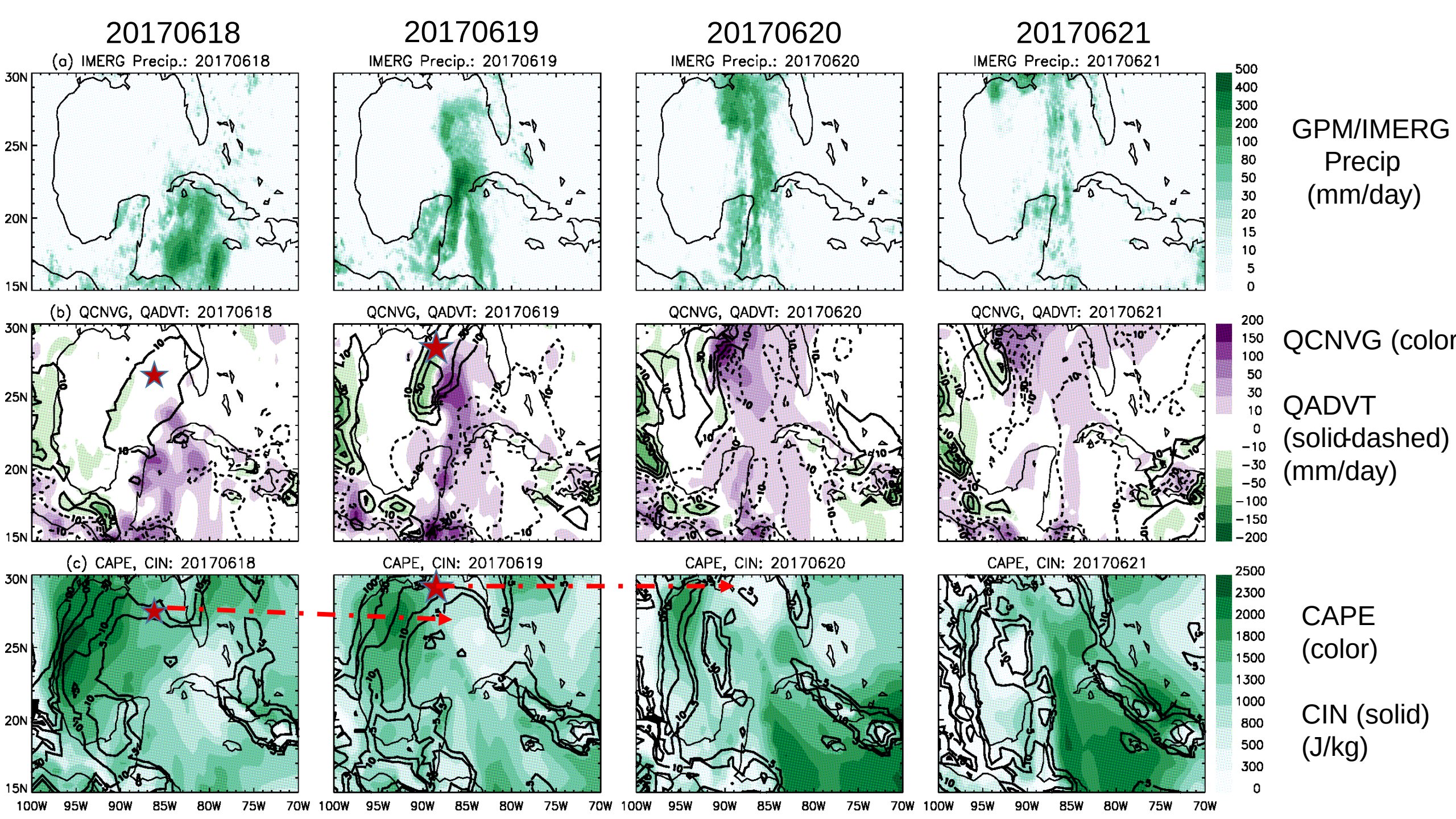
P: Precipitation
E: Evaporation
q: Specific humidity
p: Pressure altitude

(Wong et al. 2016 J. Climate)



Å QADVT indicates region of preconditioning for development of deep convection


20170618
20170619
20170620
20170621
(a) IMERG Precip.: 20170618
IMERG Precip.: 20170619
IMERG Precip.: 20170620
IMERG Precip.: 20170621
(b) QCNVG, QADVT: 20170618
QCNVG, QADVT: 20170619
QCNVG, QADVT: 20170620
QCNVG, QADVT: 20170621
(c) QCOL, dQdt: 20170618
QCOL, dQdt: 20170619
QCOL, dQdt: 20170620
QCOL, dQdt: 20170621
30N
25N
20N
15N
100W 95W 90W 85W 80W 75W 70W
500 400 300 200 100 80 50 30 20 15 10 5 0
GPM/IMERG Precip (mm/day
200 150 100 50 30 10 0 −10 −30 −50 −100 −150 −200
QCNVG (color)
QADVT (solid-dashed) (mm/day
70 68 65 63 60 55 50 40 30 20 10
Column Q (color mm)
μQ/μt (solid-dashed mm/day)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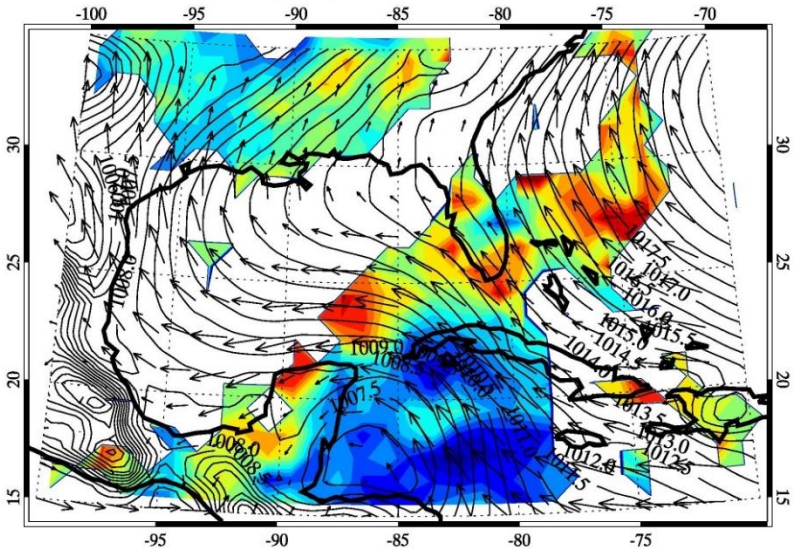
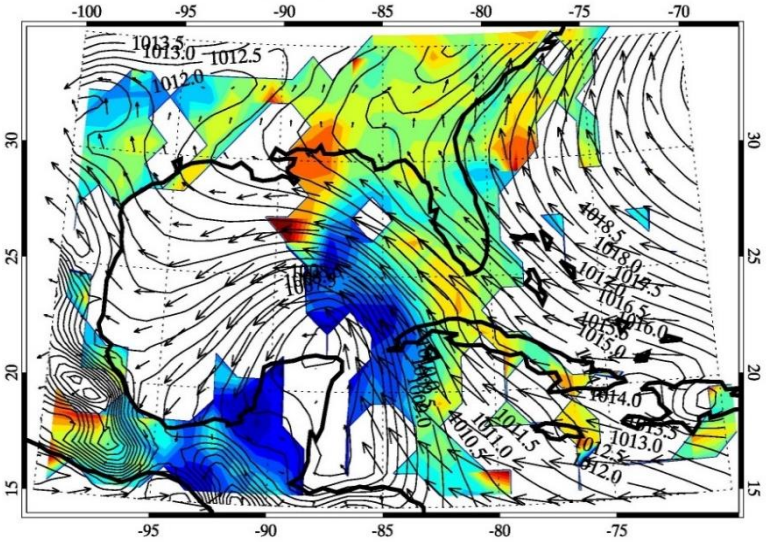
30N
25N
20N
15N
100W 95W 90W 85W 80W 75W 70W
500 400 300 200 100 80 50 30 20 15 10 5 0
200 150 100 50 30 10 0 −10 −30 −50 −100 −150 −200
2500 2300 2000 1800 1500 1300 1000 800 500 300 0
GPM/IMERG Precip (mm/day)
QCNVG (color
QADVT (solid-dashed) (mm/day)
CAPE (color)
CIN (solid) (J/kg)

MODIS Anvil Cloud Top Temperatures with ECMWF Sea-Level Pressure
(Courtesy of Terry Kubar)

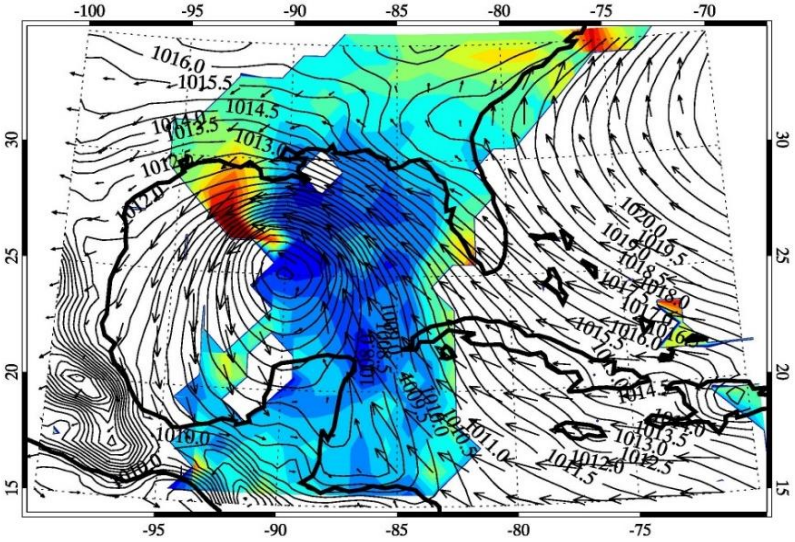
June 18
CTTs

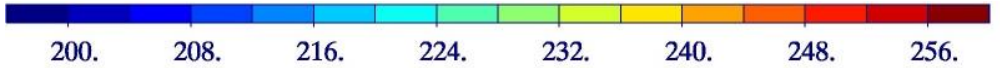


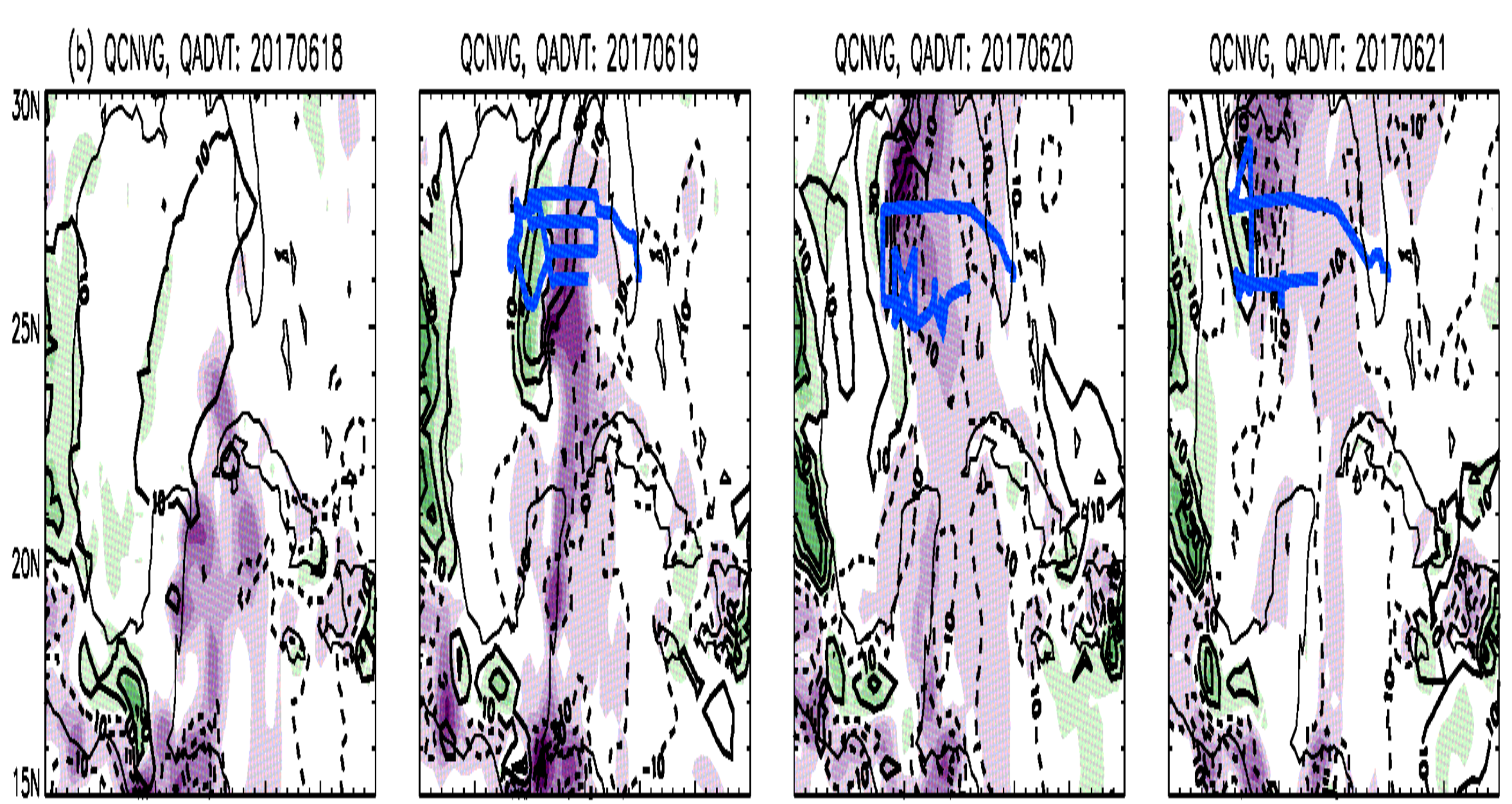
June19
CTTs



June20
CTTs



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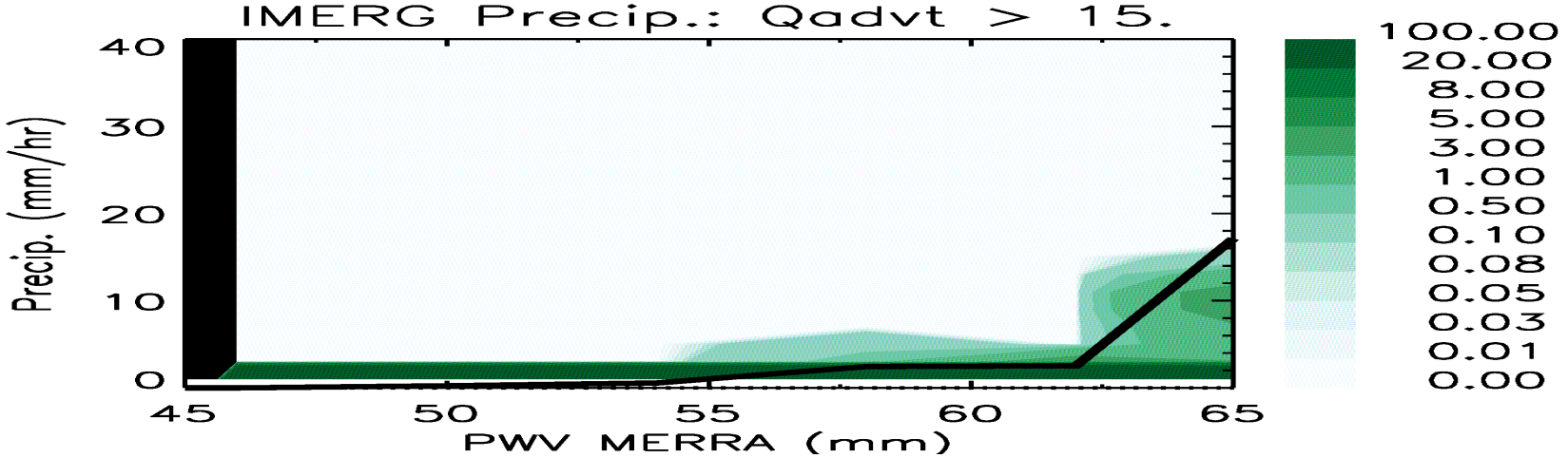
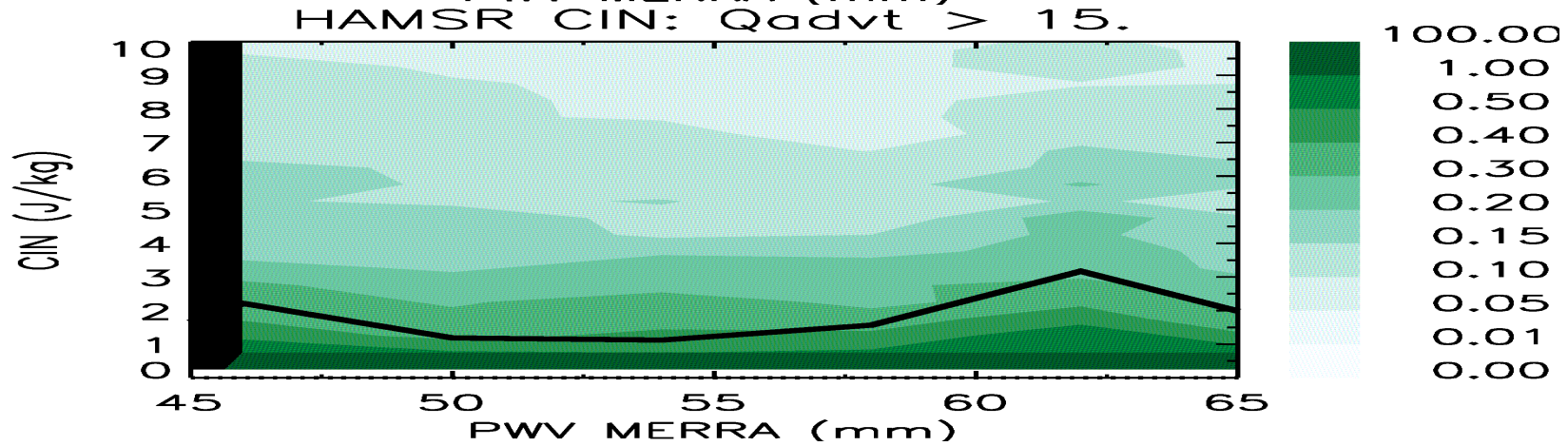
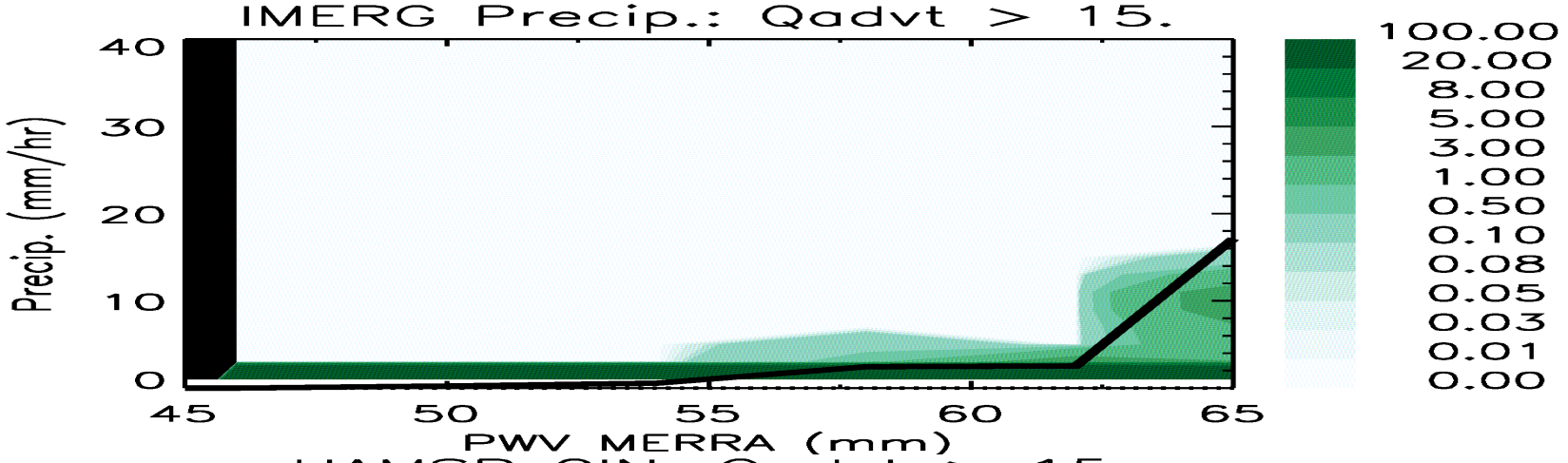


- Rain (IMERG) histograms for QADVT > 15 mm/day show smaller rain
- A transition is still seen between 55-60 mm



- Countours for probability for high CIN (HAMSR) decrease between 50-55 mm



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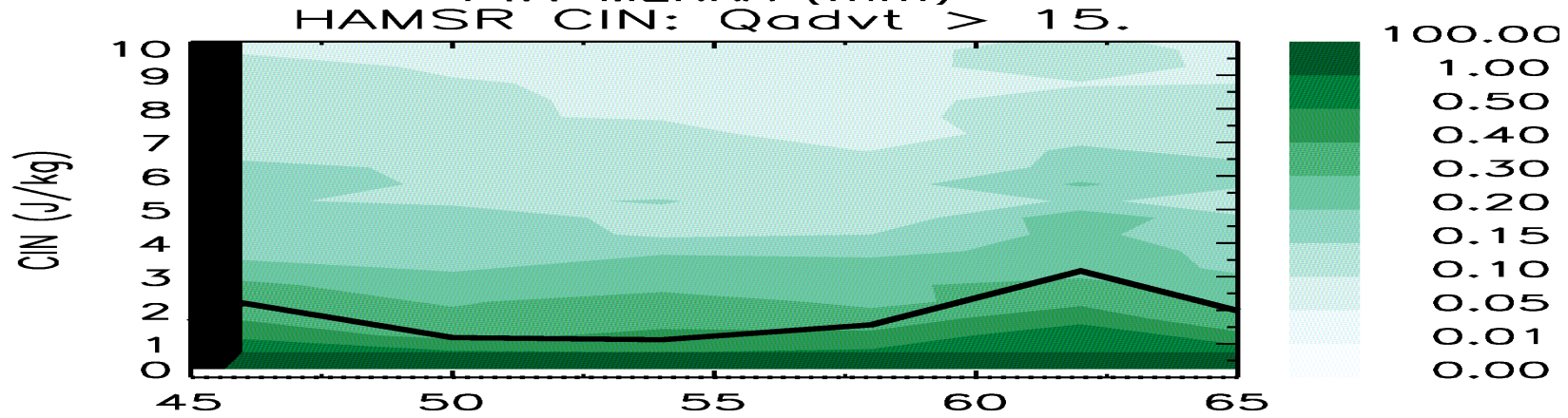

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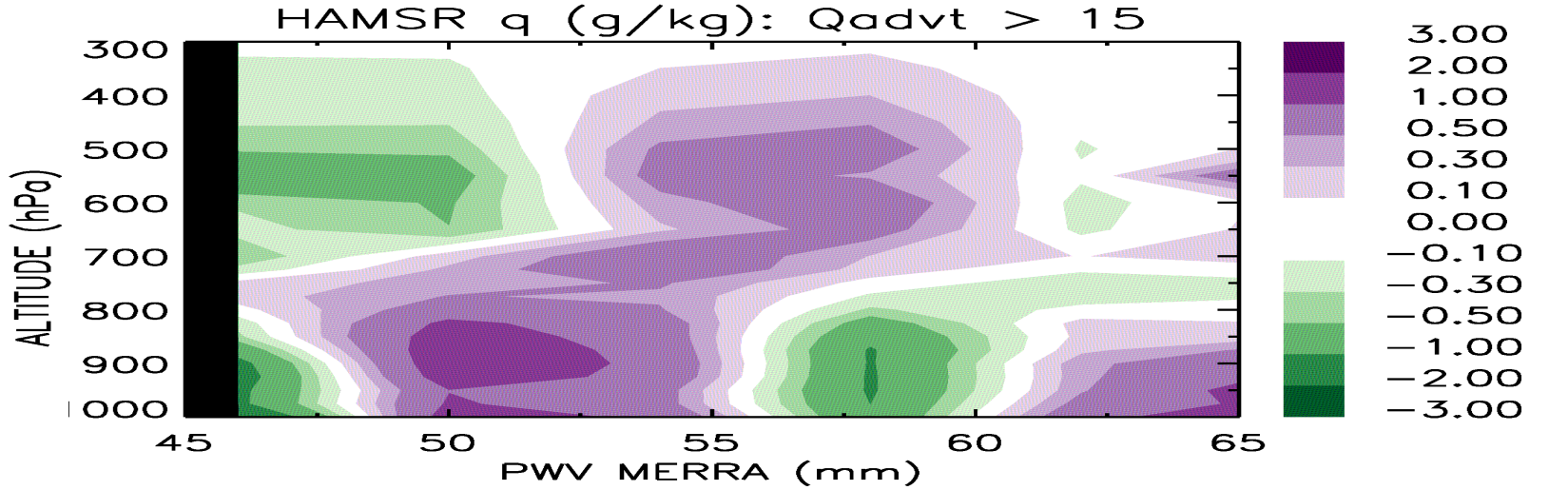
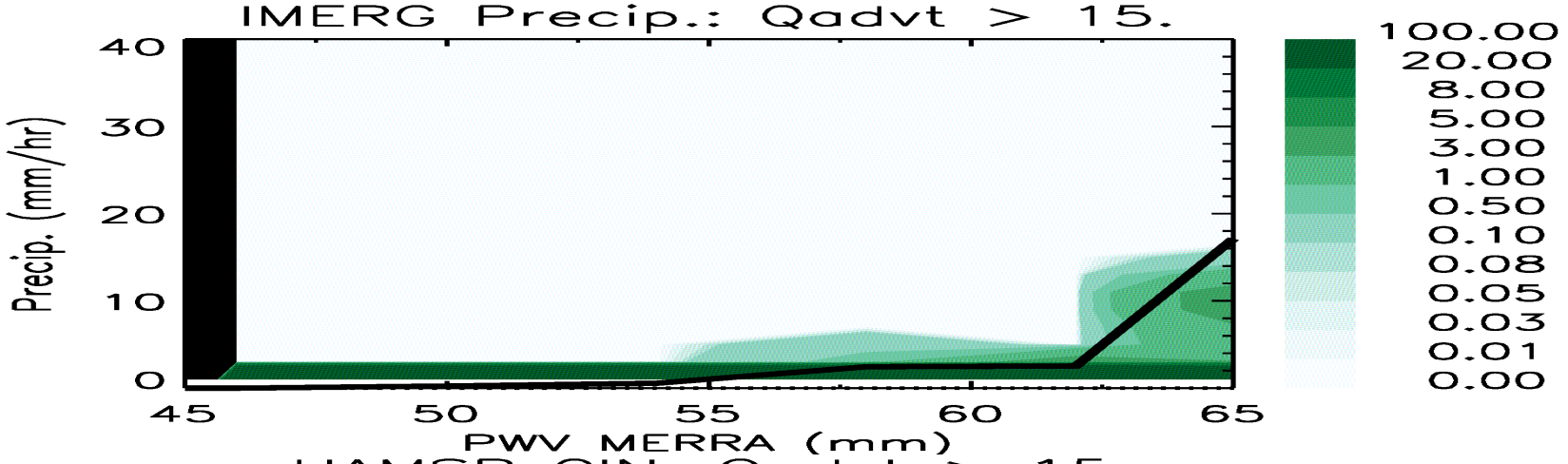


- Mid-tropospheric moistening begins around 50-55 mm and reaches a peak at 55-60 mm



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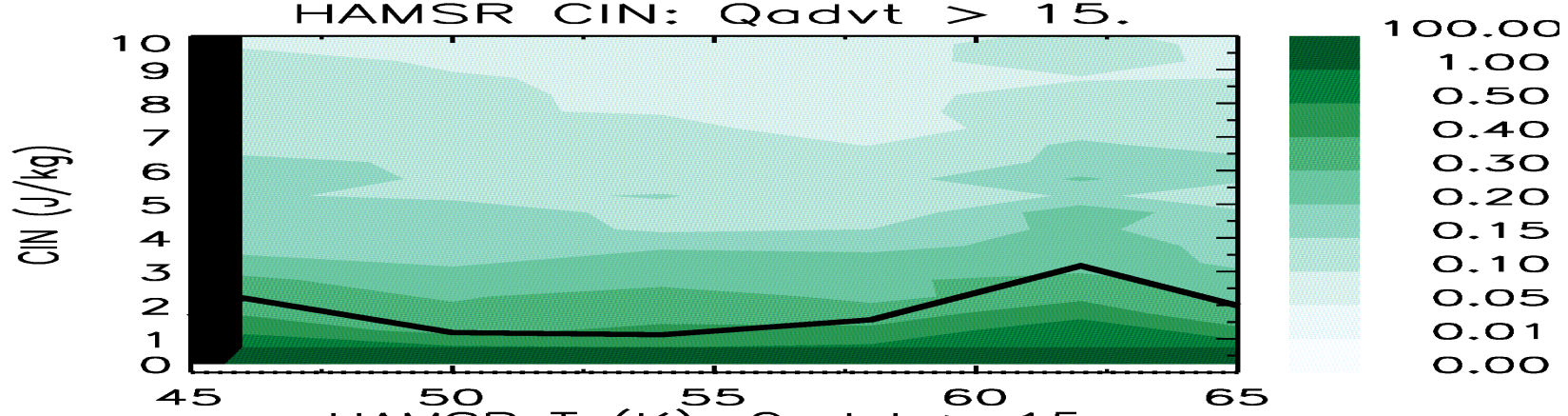

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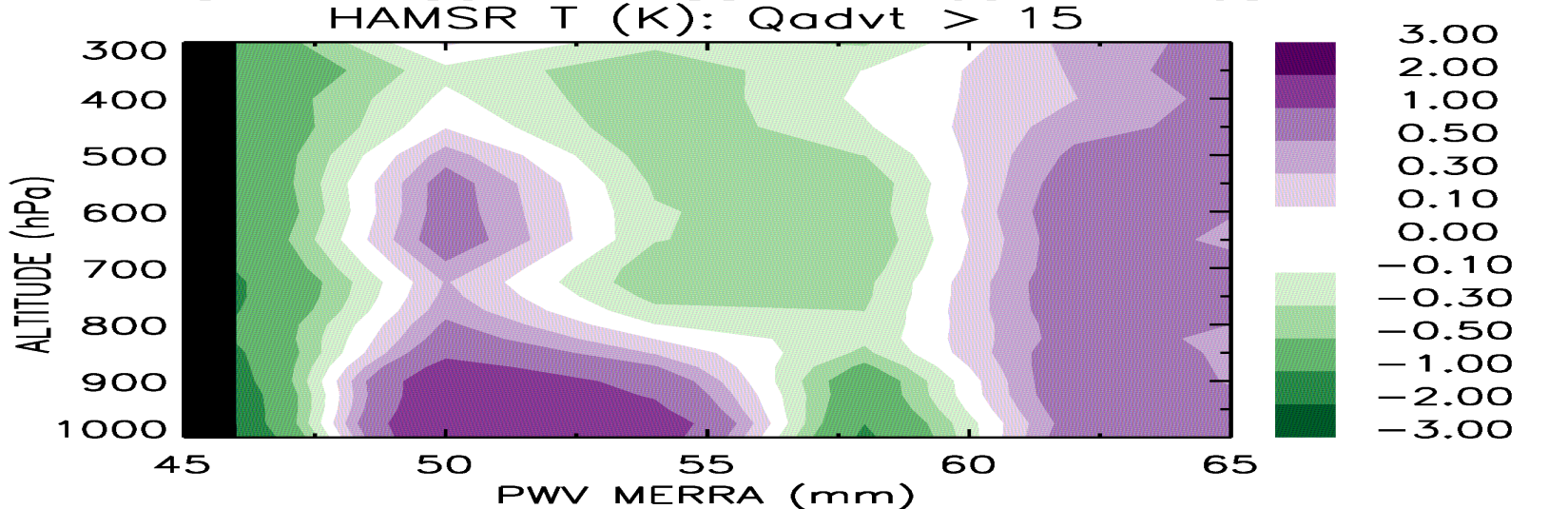
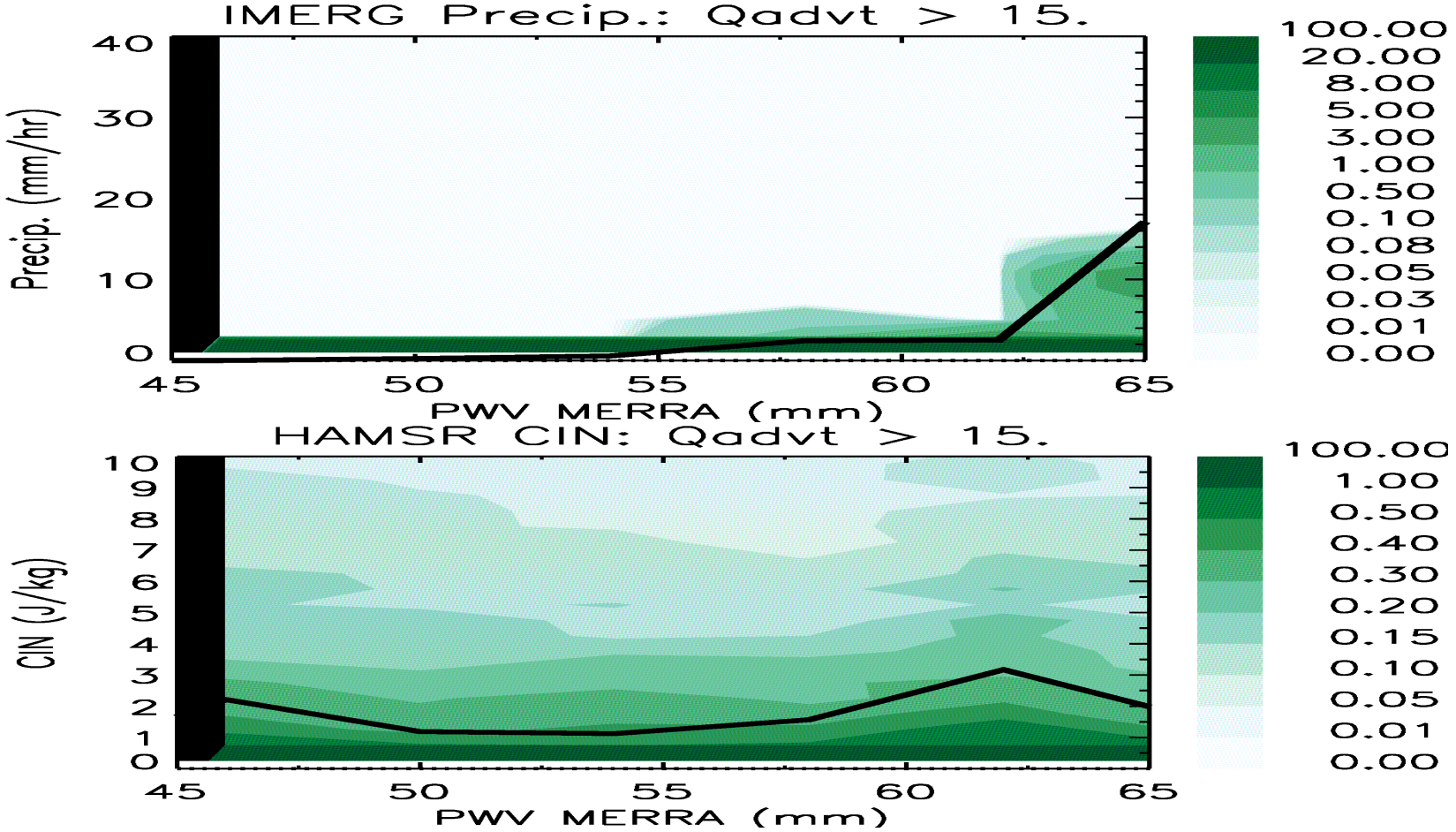


- Cooling at top of PBL begins around 50 mm and develops deeper into the PBL between 55-60 mm.



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- PDF of q_e in the PBL spreads when there begins to have rainfall.

q_e (K)