

DO CAM3 SIMULATIONS CONVERGE WITH INCREASING HORIZONTAL RESOLUTION?

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Do simulations from AGCMs converge with increasing resolution?

Should simulations converge?

Are there reasons to believe them if they do not converge?

How should convergence be defined?

Should the smaller scales be believed?

Aqua-planet Simulations

Neale, R.B. and B.J.Hoskins, 2000a: A standard test for AGCMs including their physical parameterizations. I: The proposal. Atmos. Sci. Lett, Vol.1, No.2, pp. 101-107.

http://www.met.reading.ac.uk/~mike/APE/ape_home.html

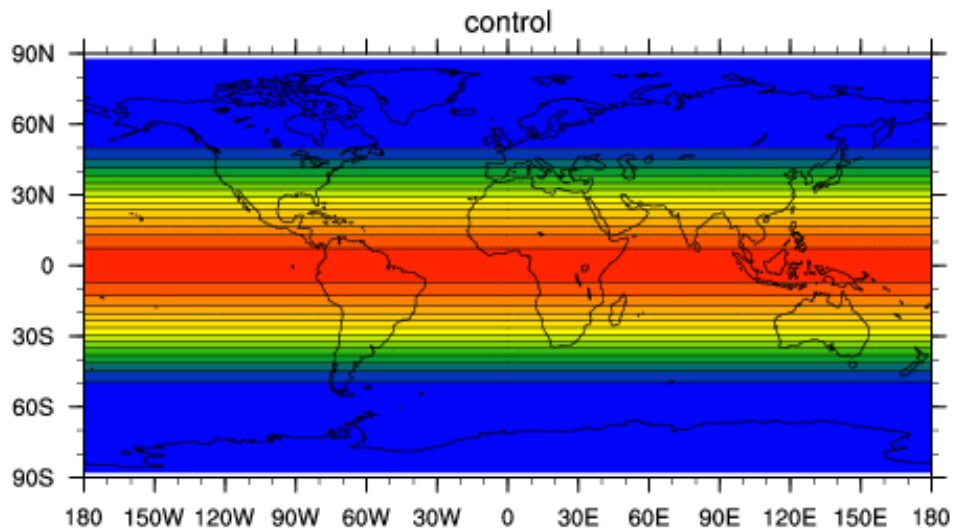
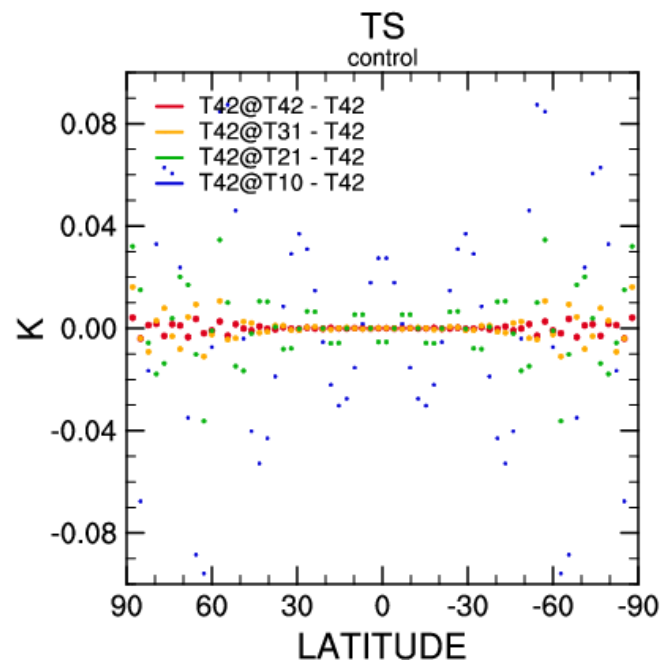
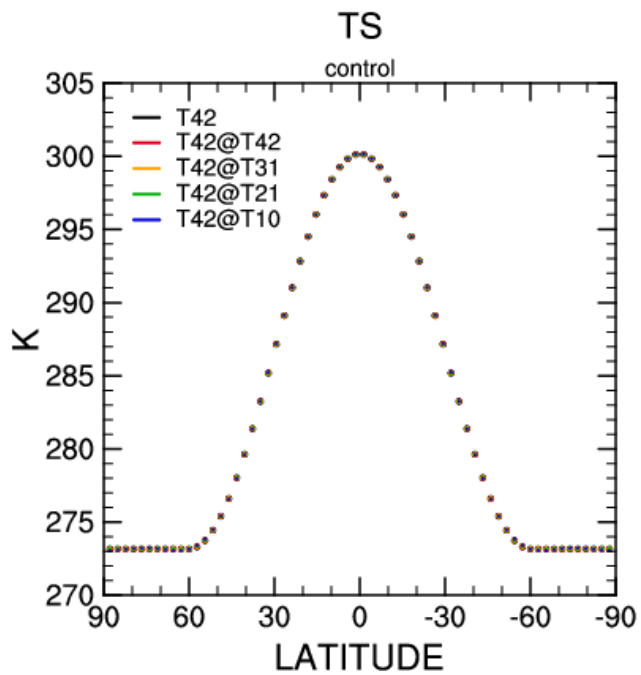
Atmospheric model with complete parameterization suite

Idealized surface

no land (or mountains), no sea ice

specified global sea surface temperatures everywhere

simple geometry



Community Atmosphere Model (CAM3)

Eulerian Spectral Transform

Finite Volume

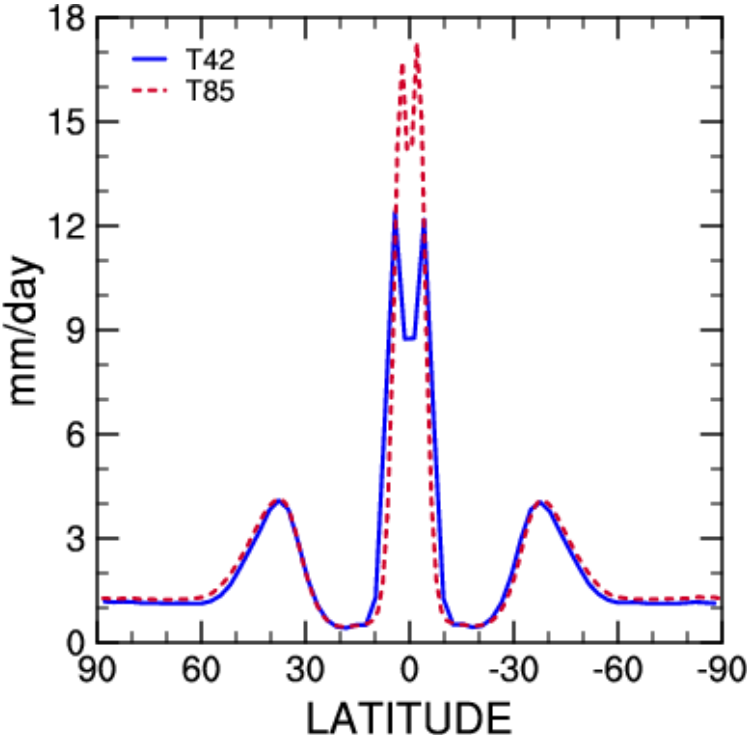
Semi-Lagrangian Spectral Transform

2 degree Finite Volume is equivalent to T42 Spectral Transform

1 degree Finite Volume is equivalent to T85 Spectral Transform

STANDARD EULERIAN SPECTRAL CAM3

PRECIPITATION



“JUST CHANGED RESOLUTION”

TIME STEP

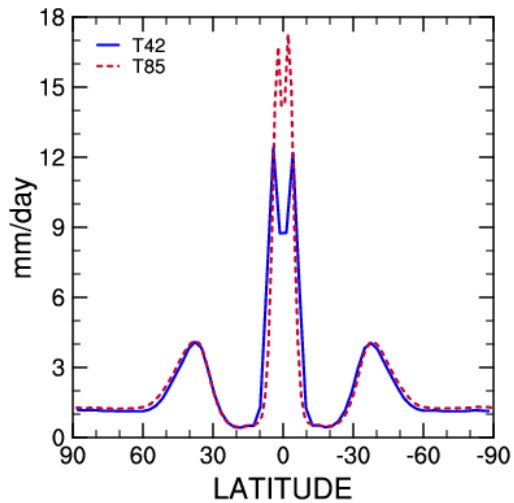
GRID

SPECTRAL TRUNCATION

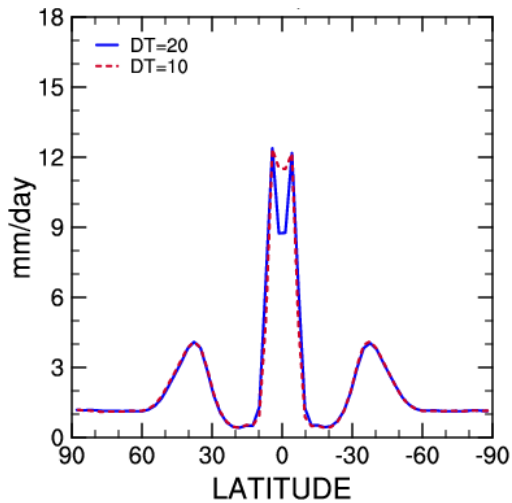
DIFFUSION

PARAMETERS

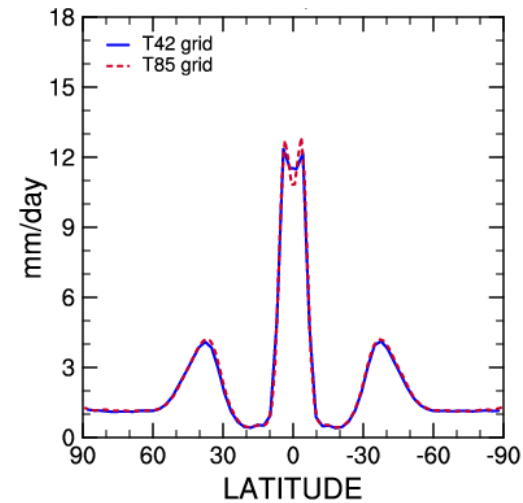
STANDARD CAM3



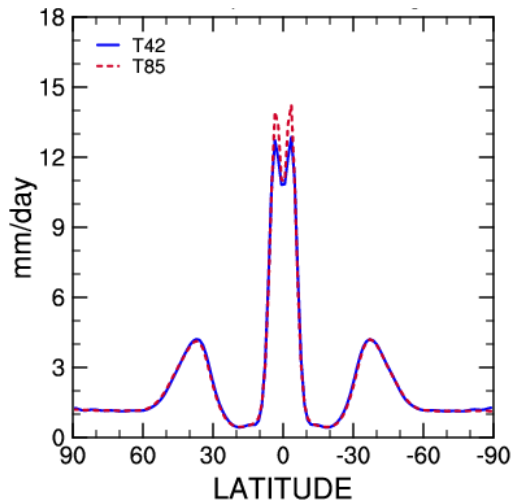
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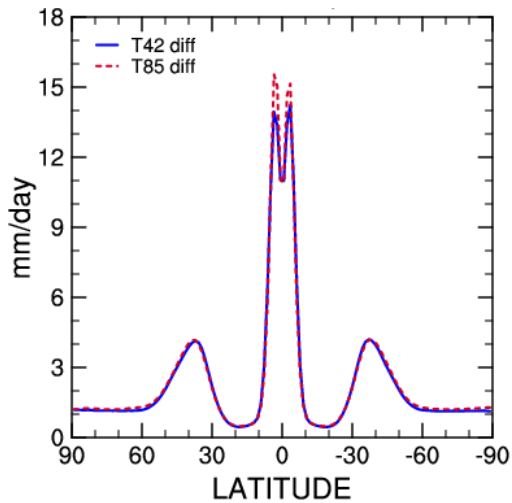
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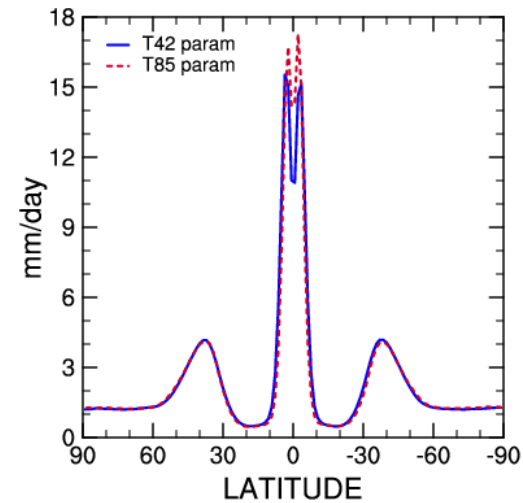
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DIFFUSION

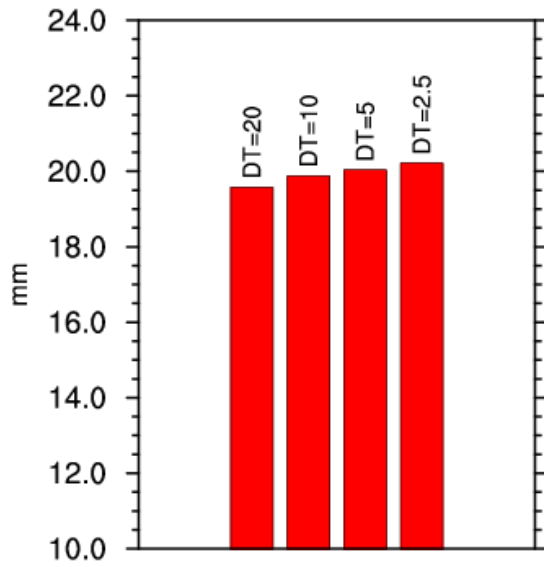


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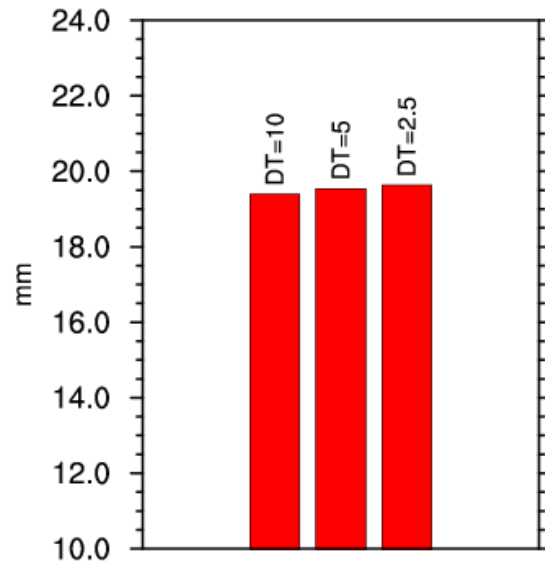


PRECIPITABLE WATER

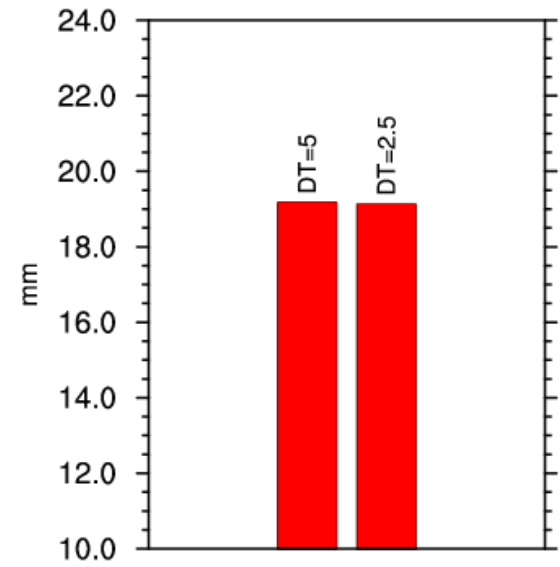
T42



T85

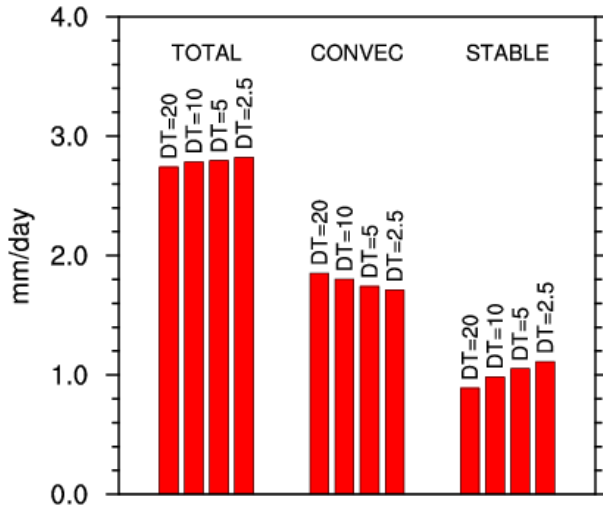


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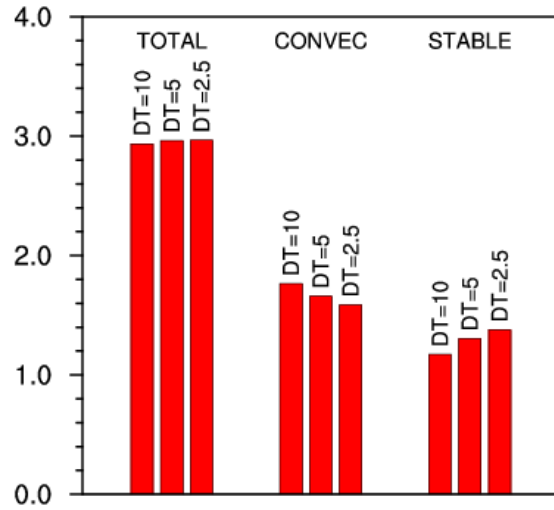


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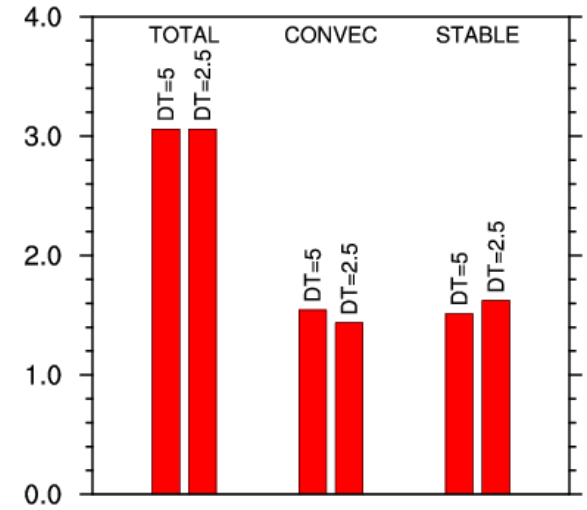
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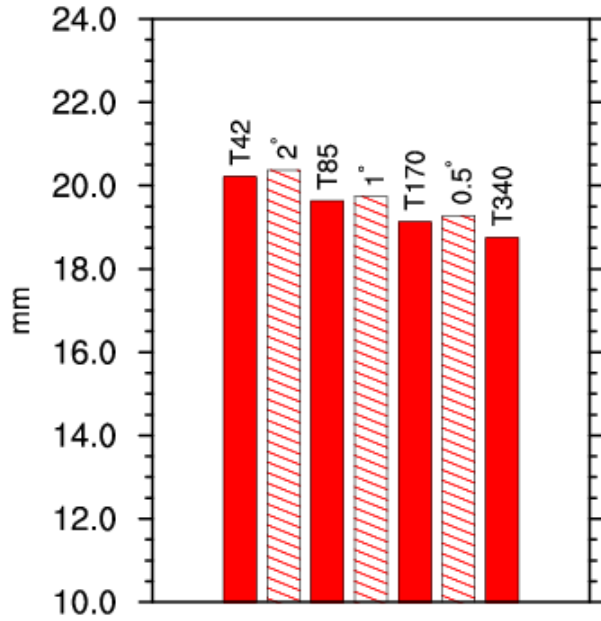


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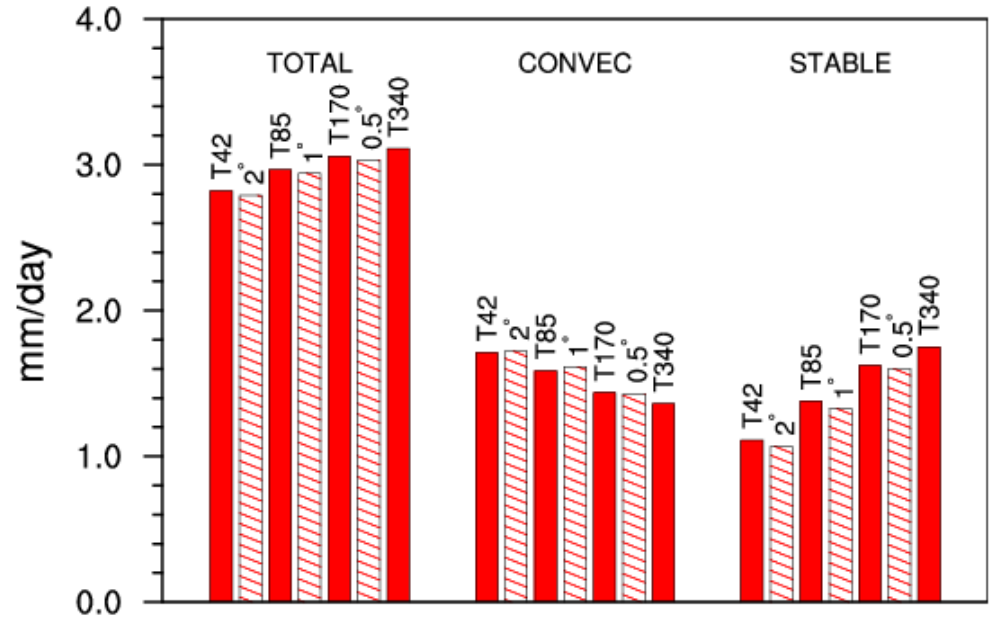


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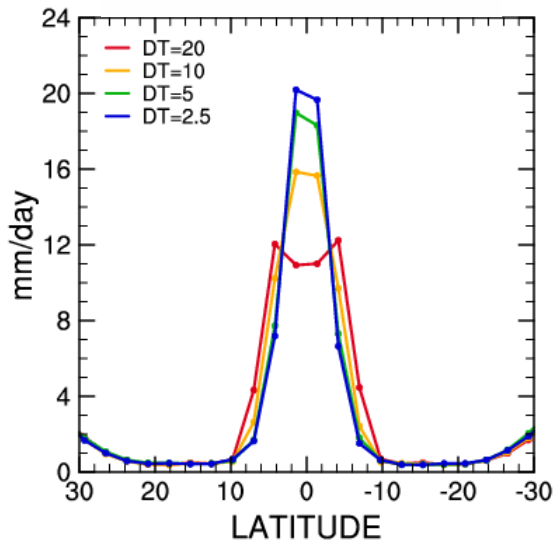
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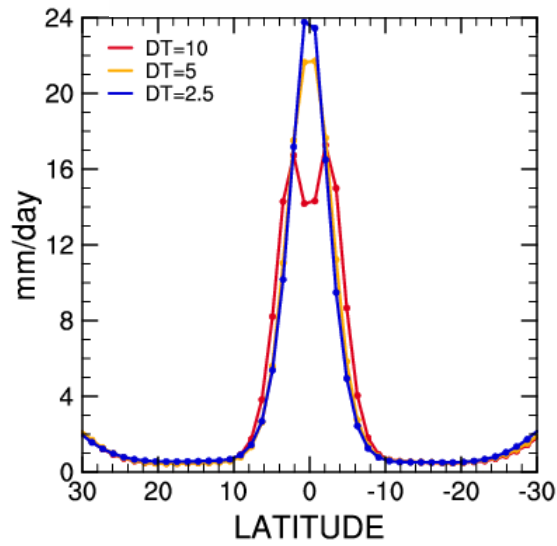
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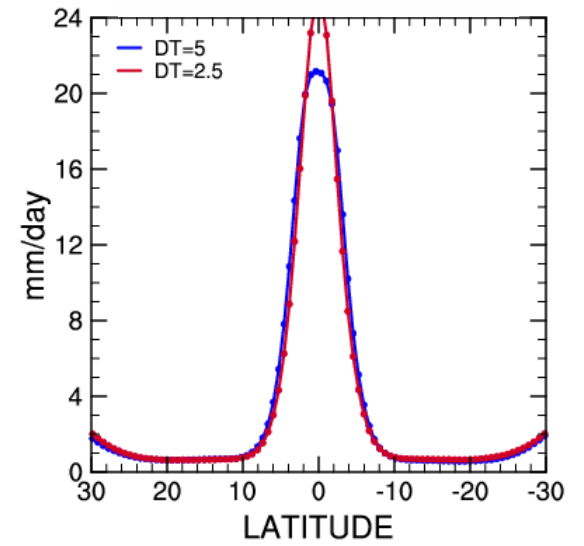
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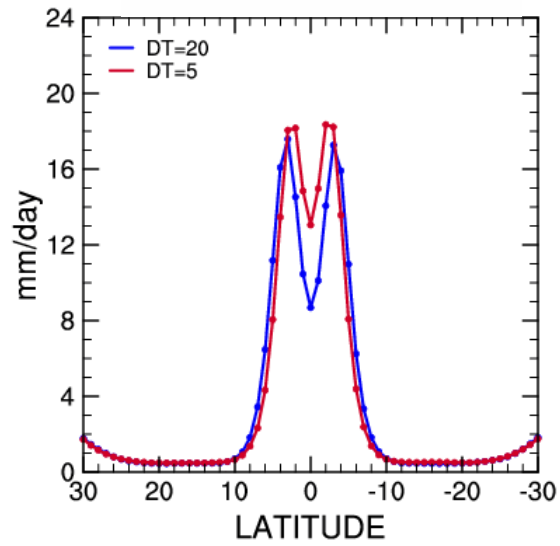
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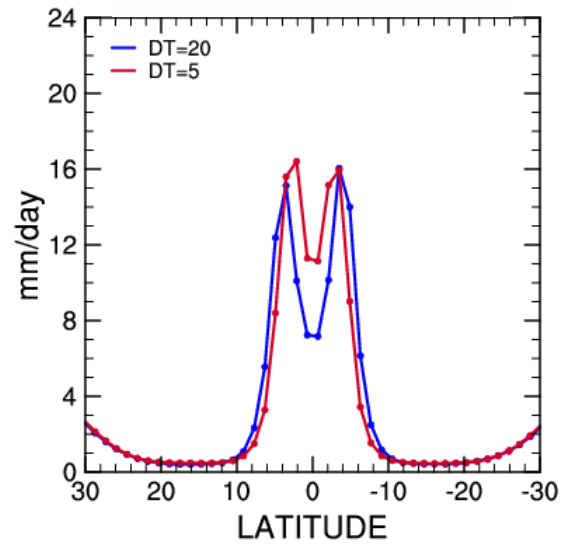
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1 x 1.25



TL127



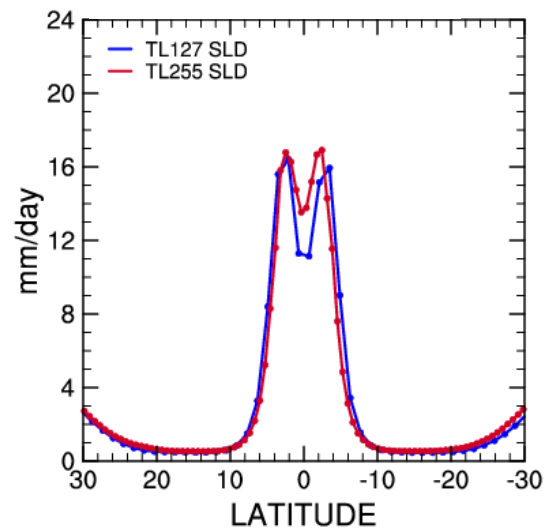
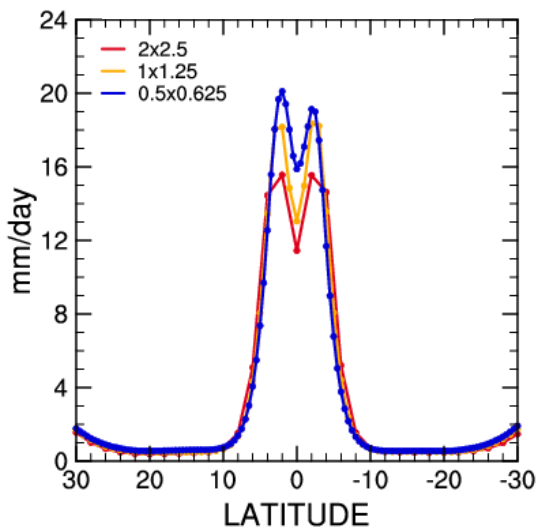
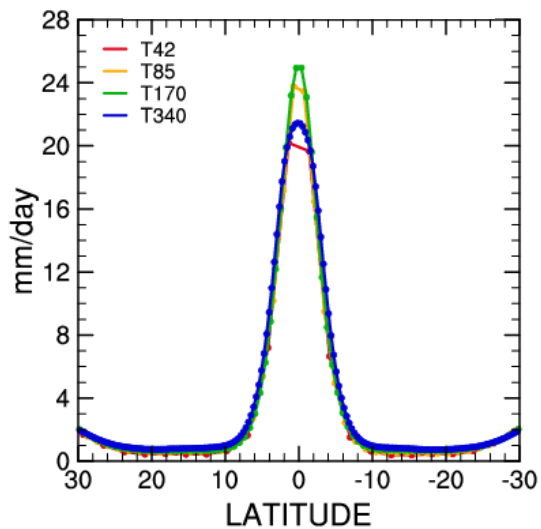
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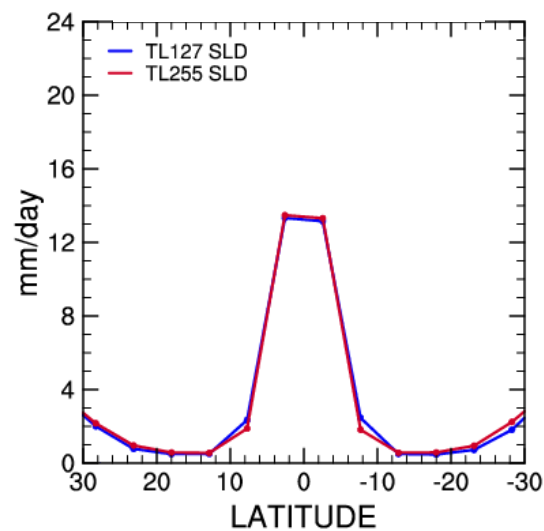
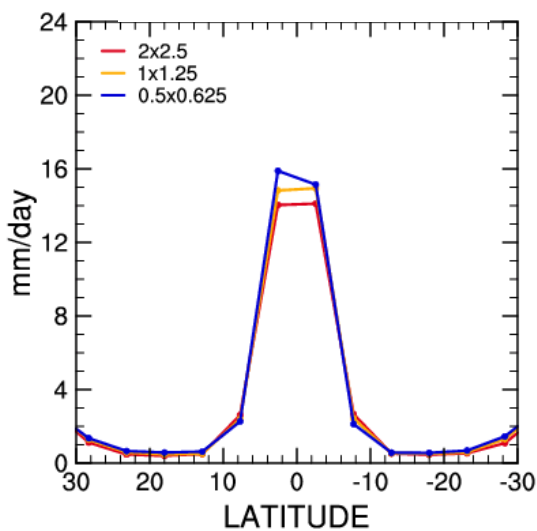
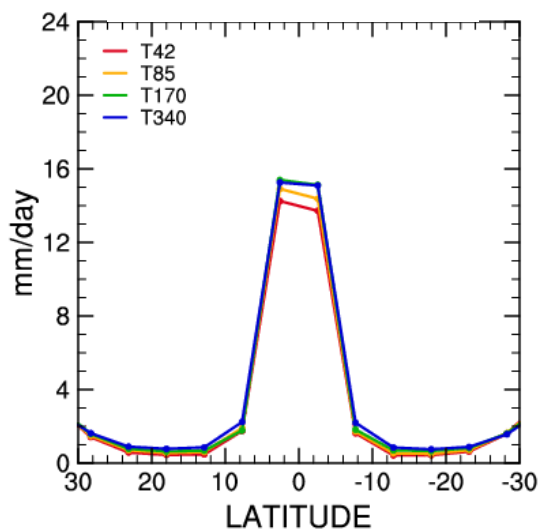
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SEMI-LAGRANGIAN

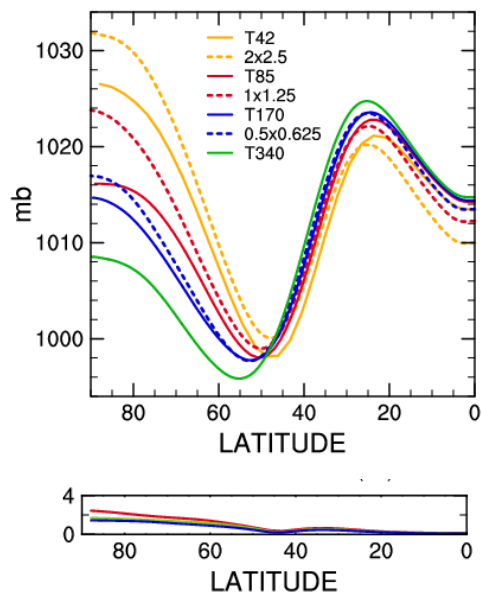
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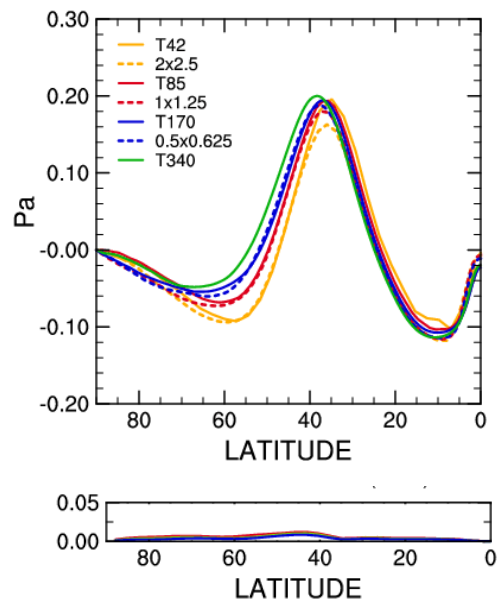
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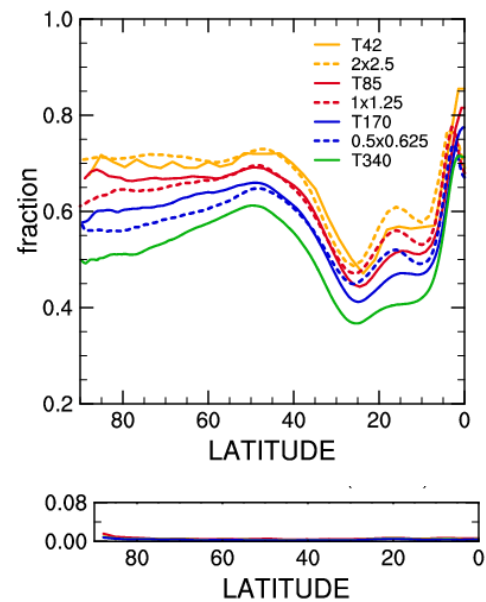
PS



TAUX

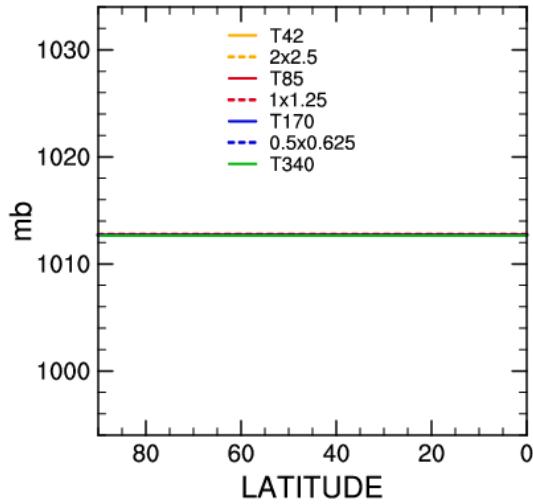


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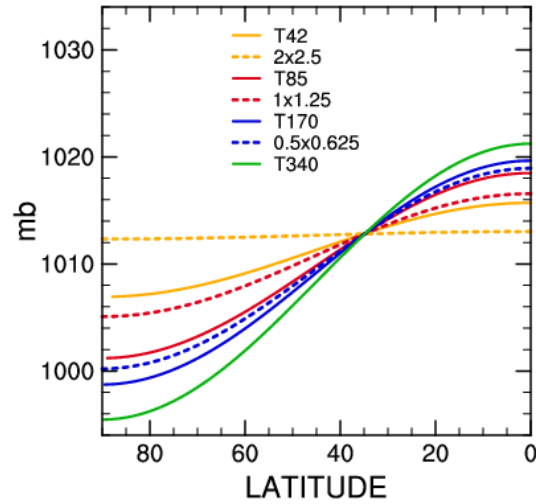


SURFACE PRESSURE

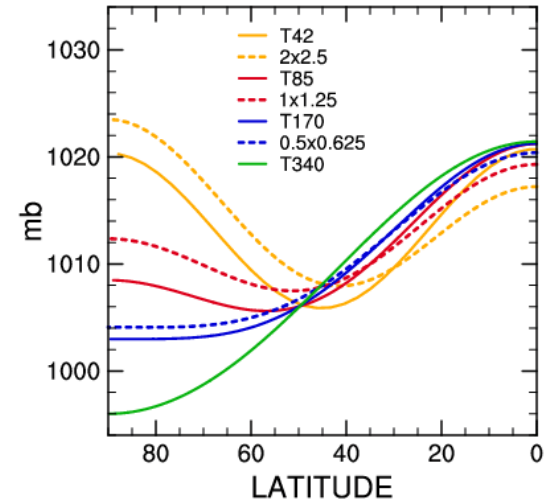
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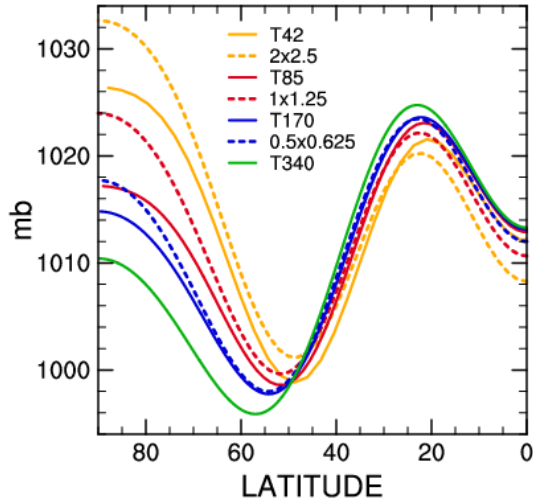
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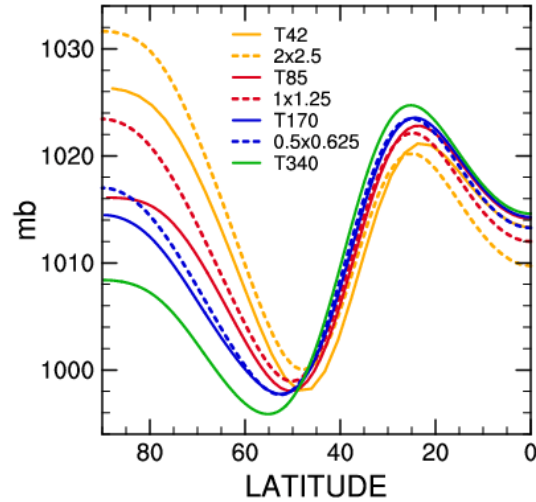
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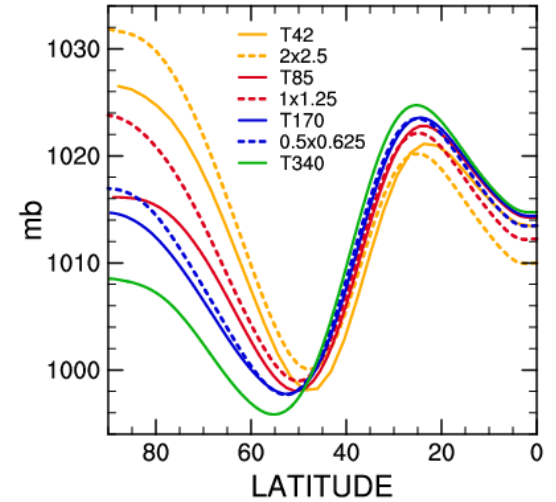
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T15

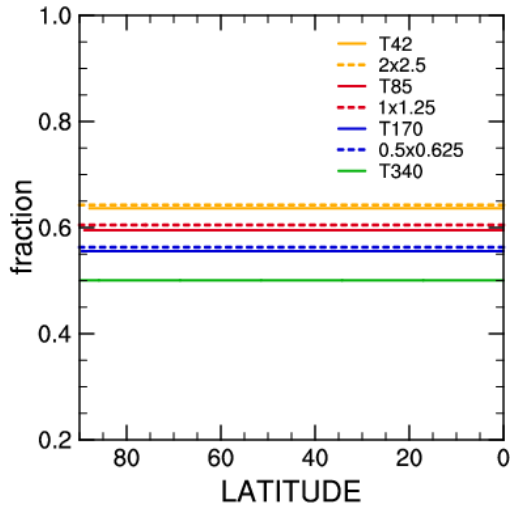


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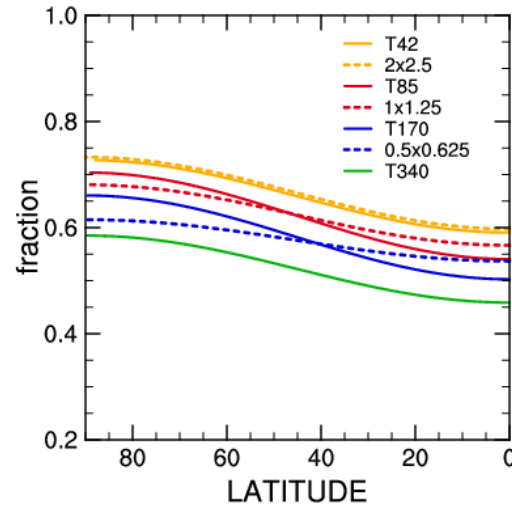


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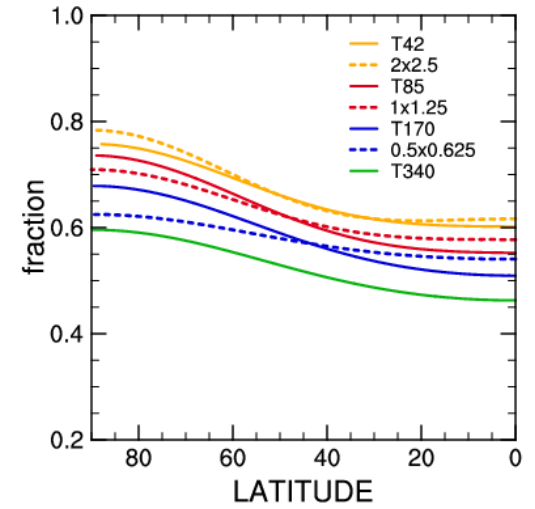
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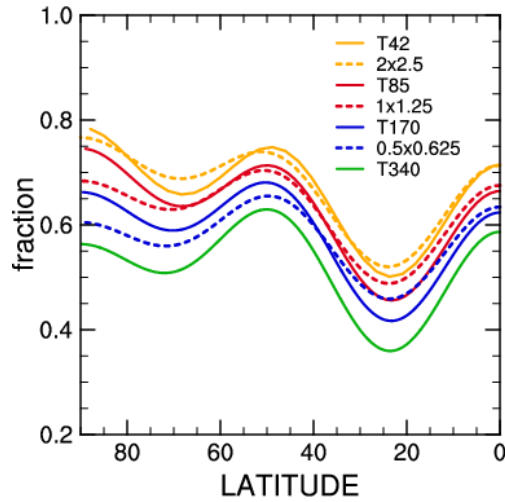
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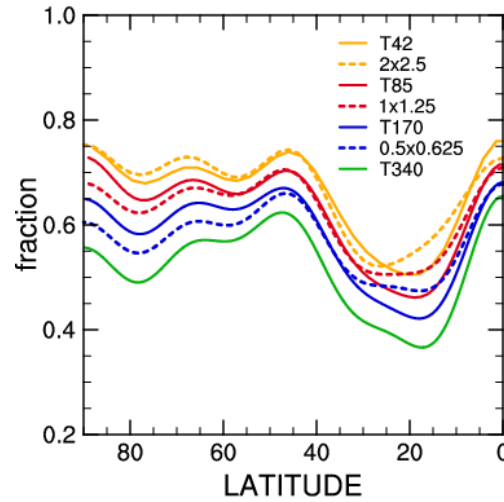
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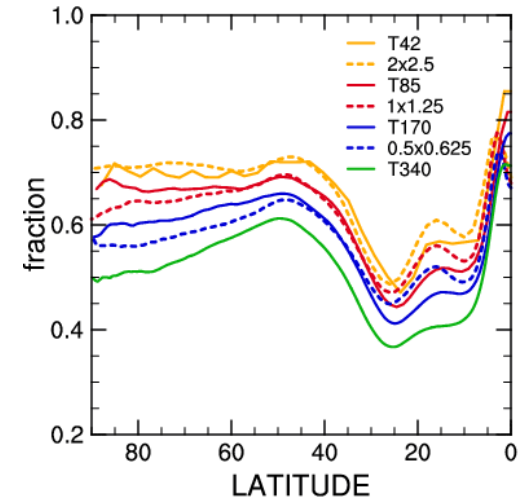
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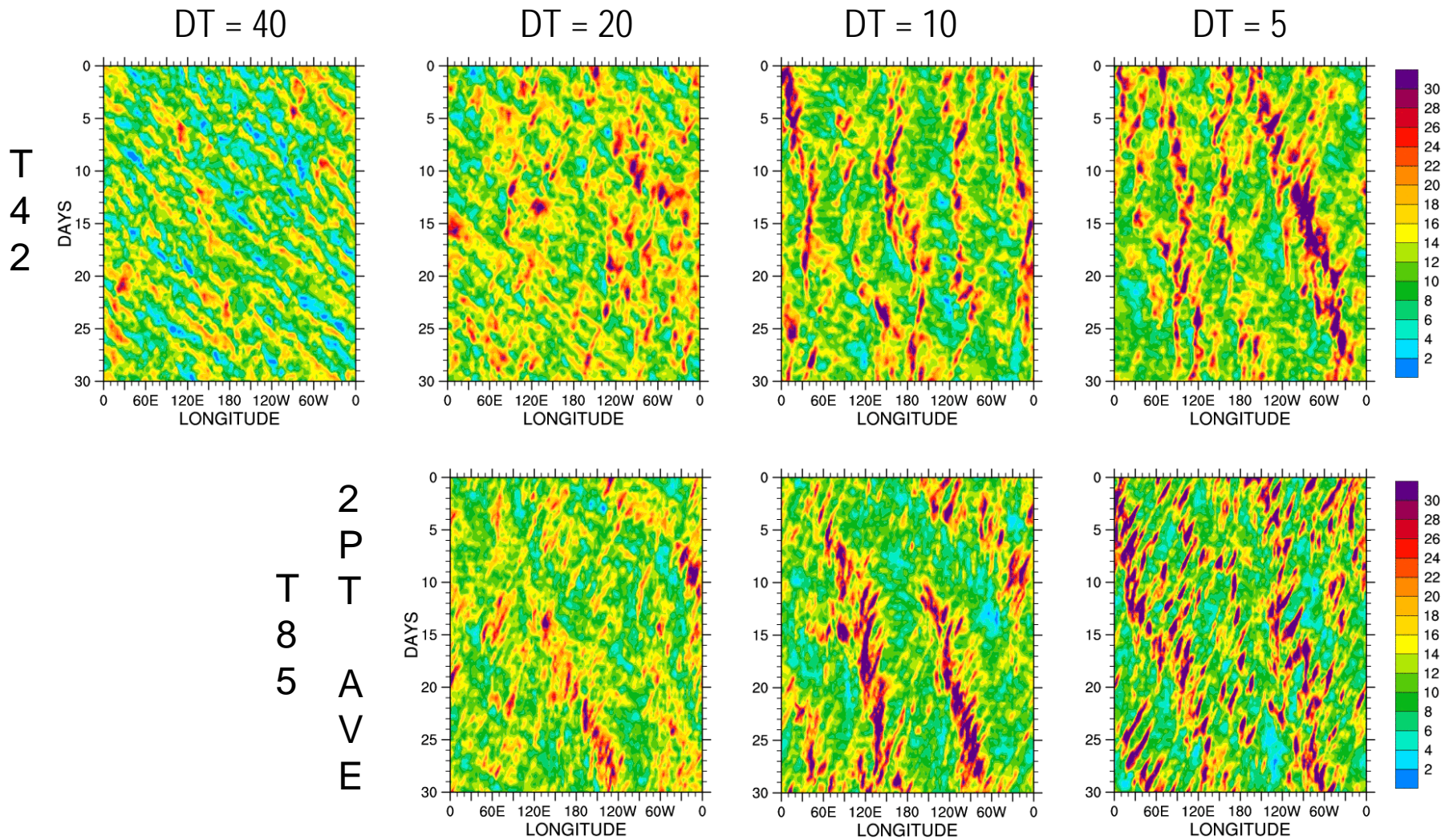


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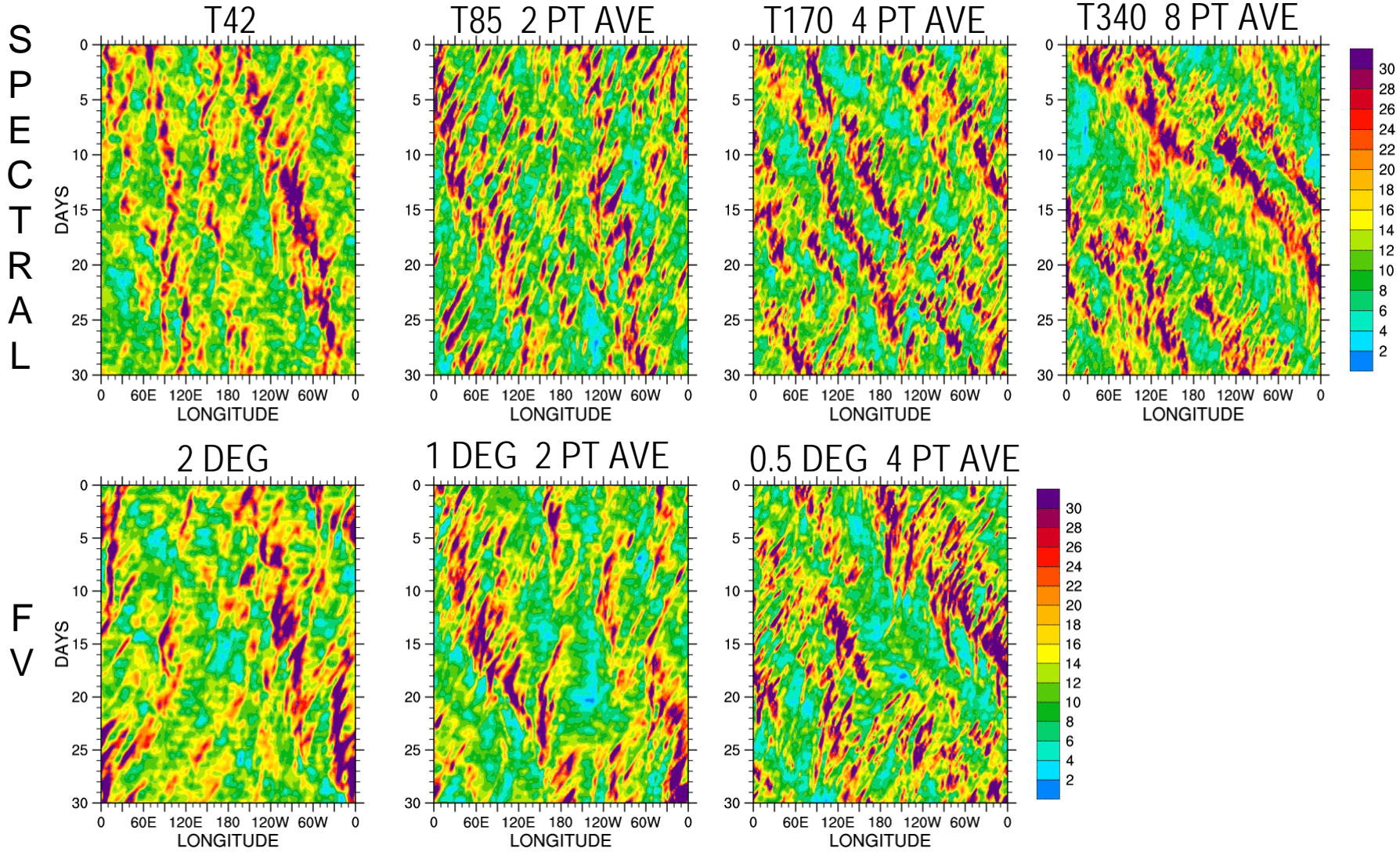


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PARAMETERIZATION DT = 5



SYMMETRIC

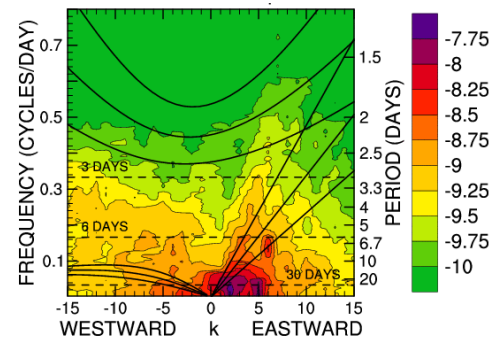
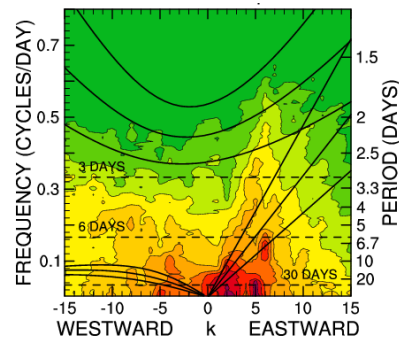
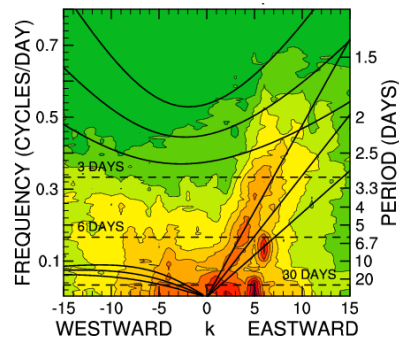
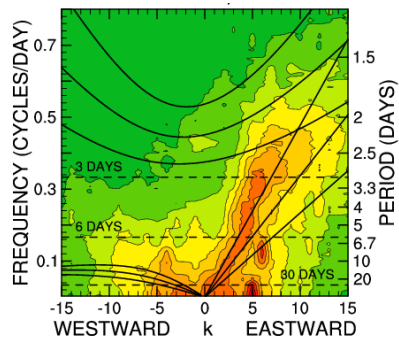
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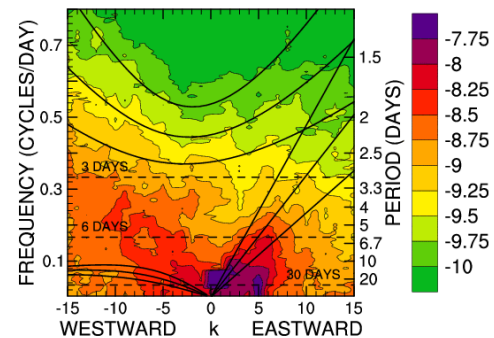
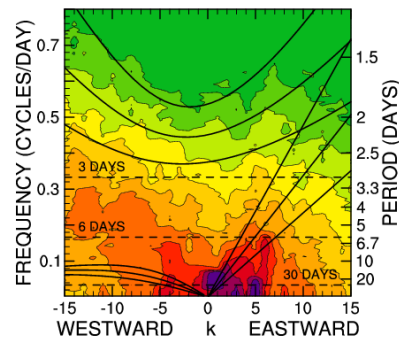
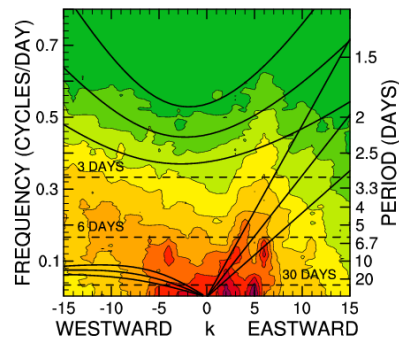
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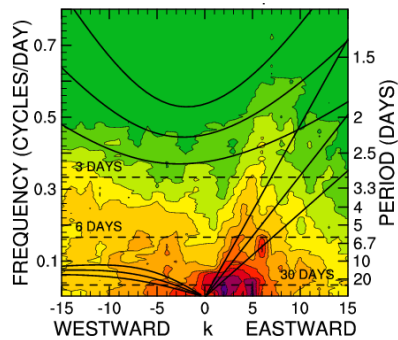


SYMMETRIC

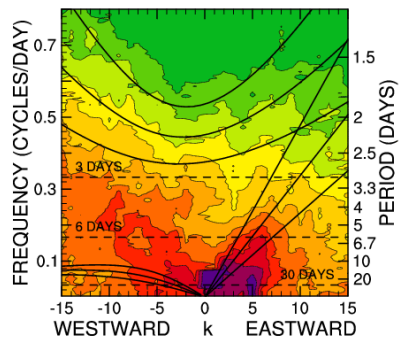
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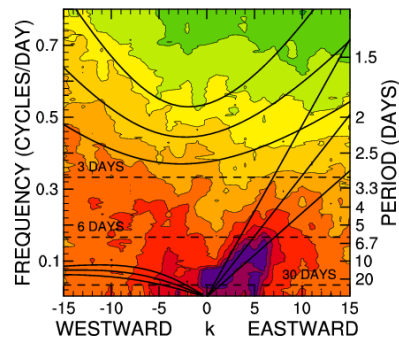
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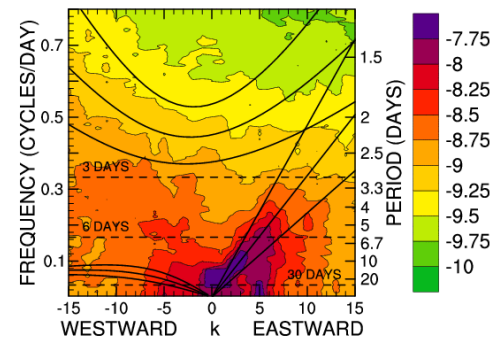
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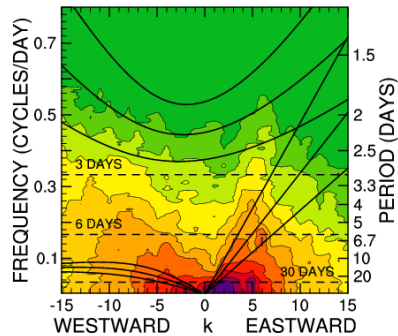


T340

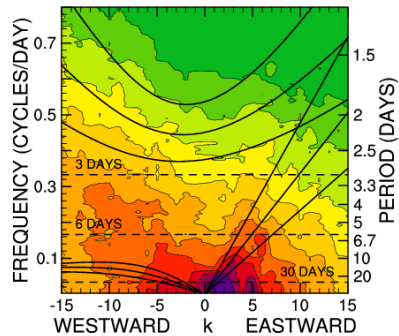


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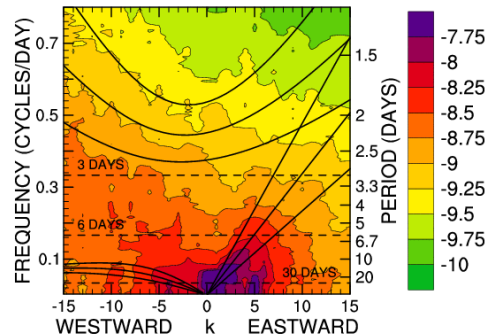
2 DEG



1 DEG



0.5 DEG

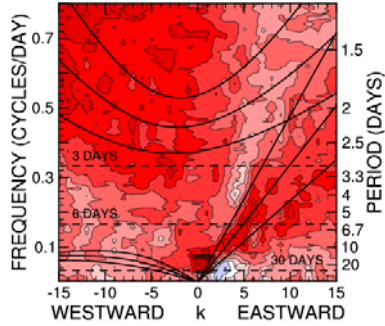


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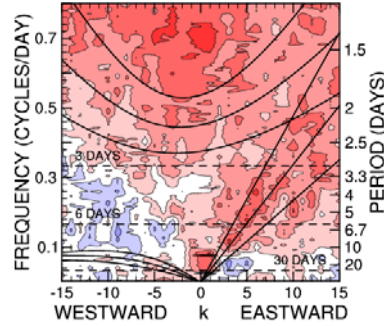
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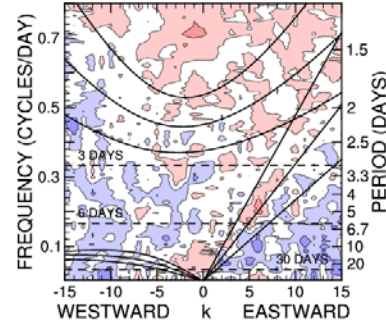
T340 / T42



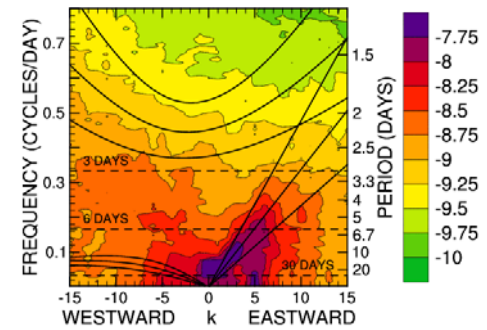
T340 / T85



T340 / T170

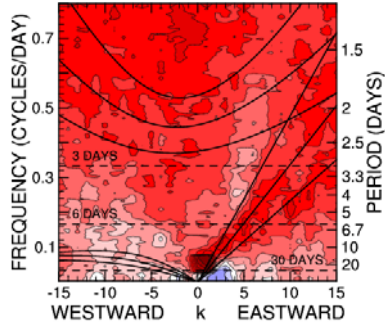


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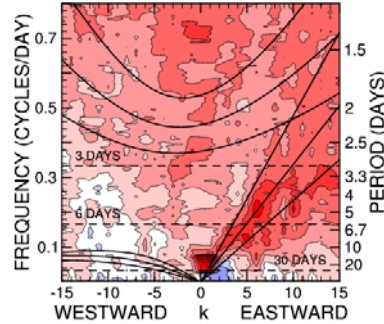


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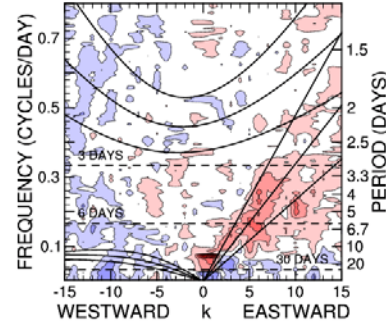
T340 / 2 DEG



T340 / 1 DEG

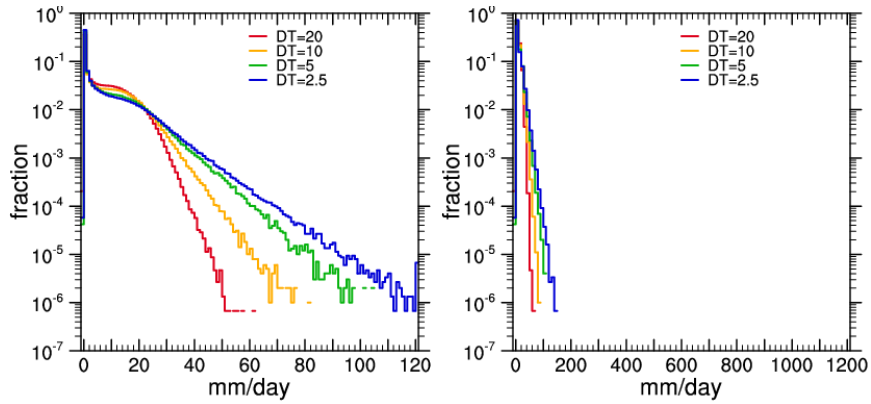


T340 / 0.5 DEG

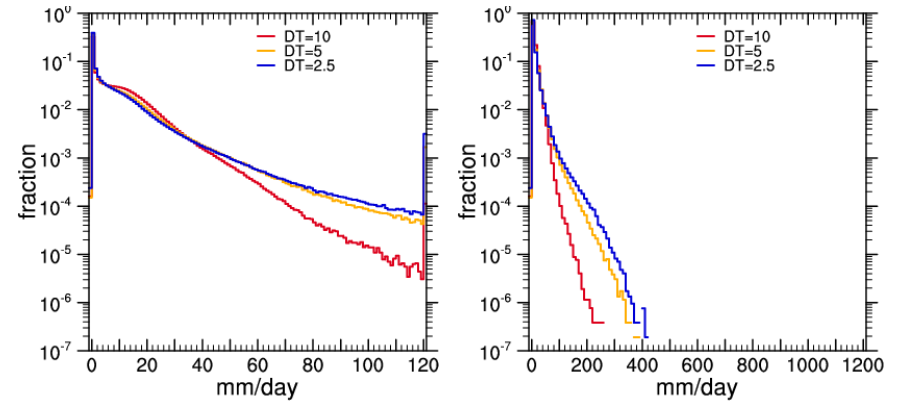


TROPICAL PRECIPITATION PDF

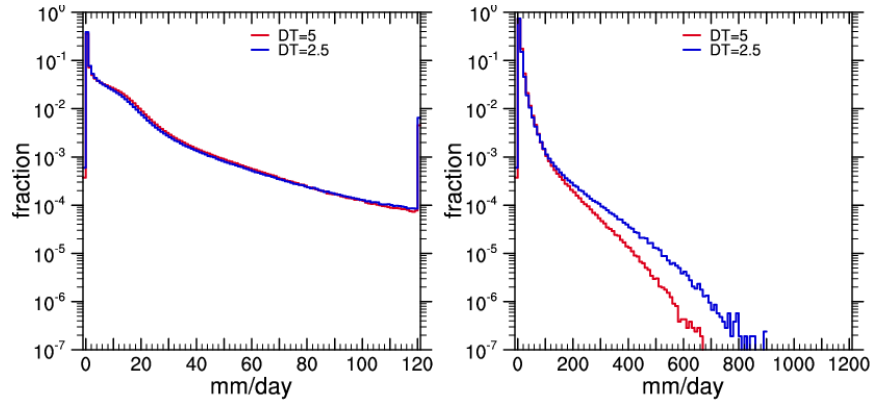
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T85

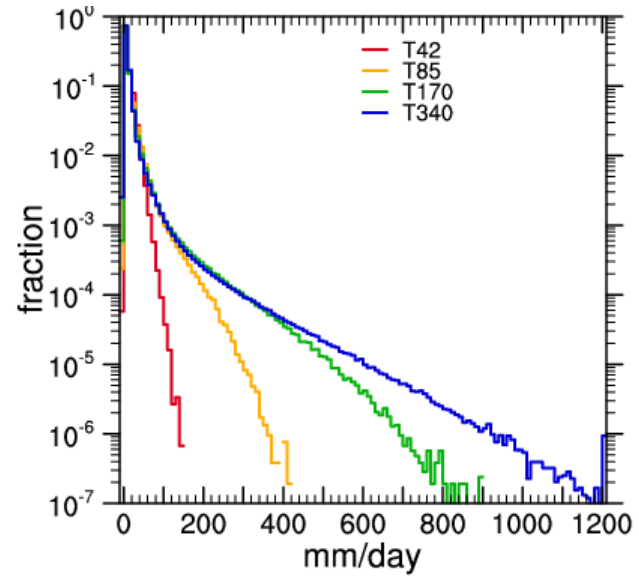
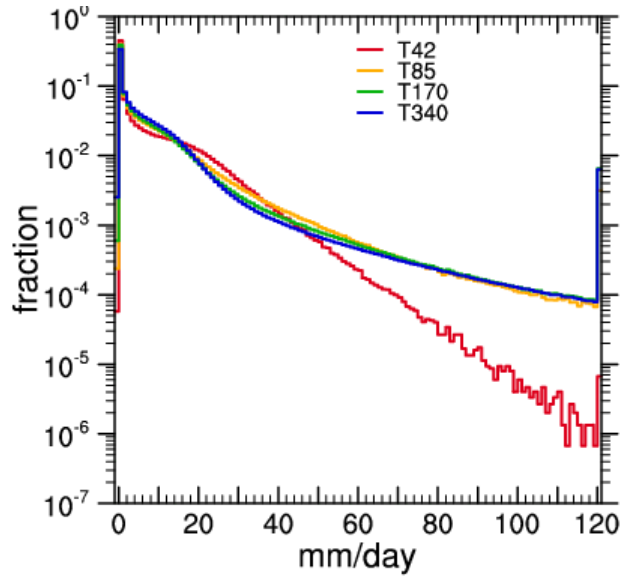


T170



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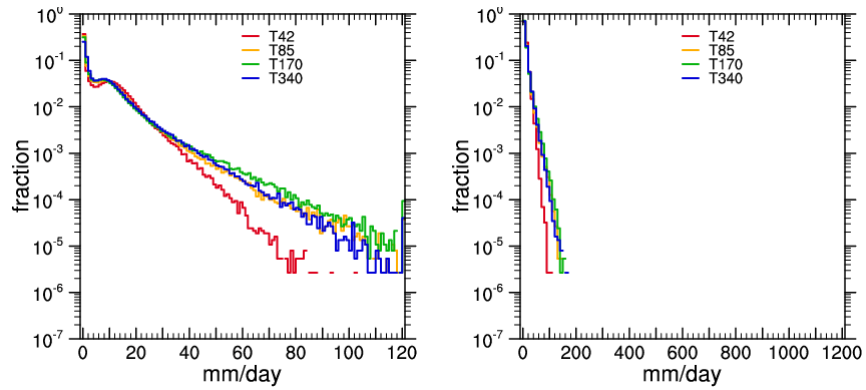
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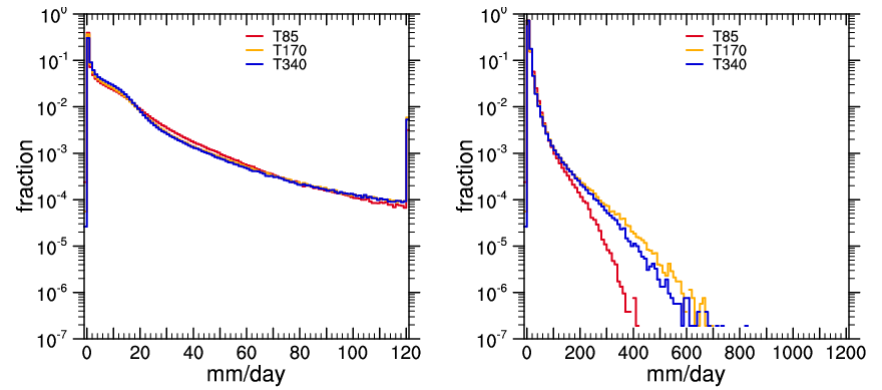
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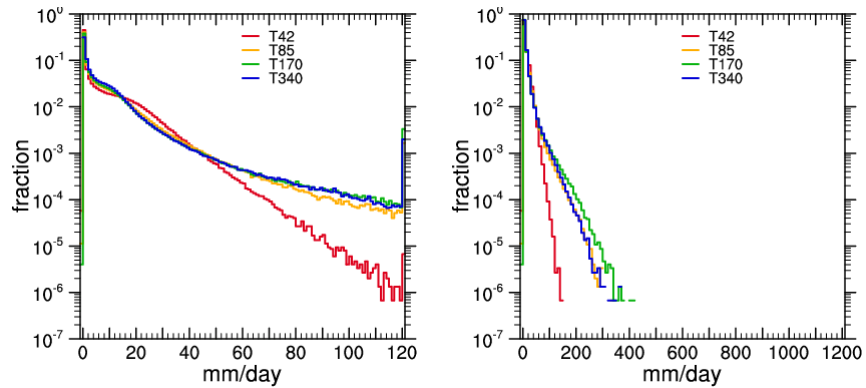
T21 SCALES



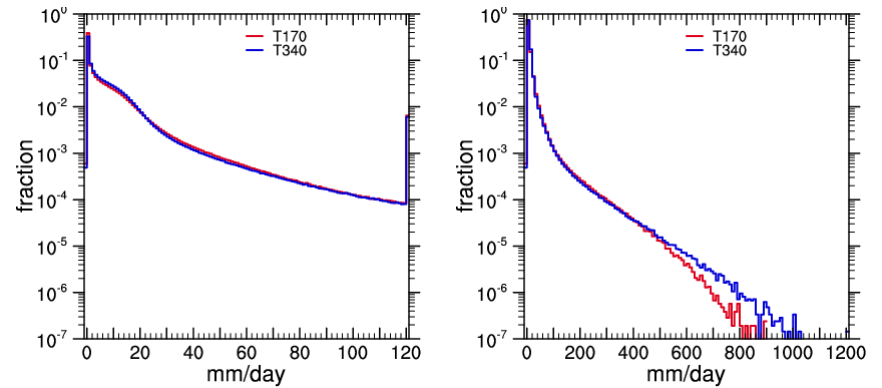
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T42 SCALES

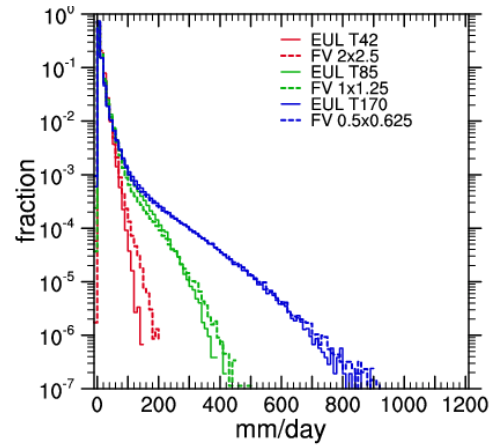
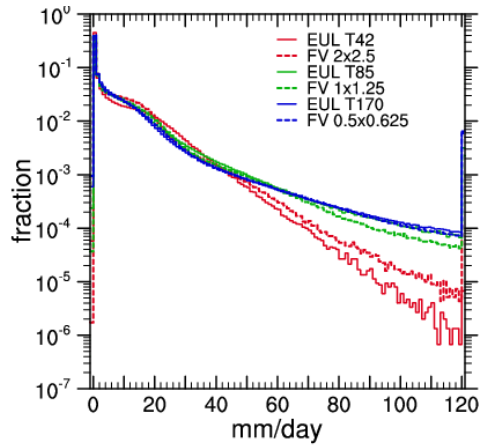


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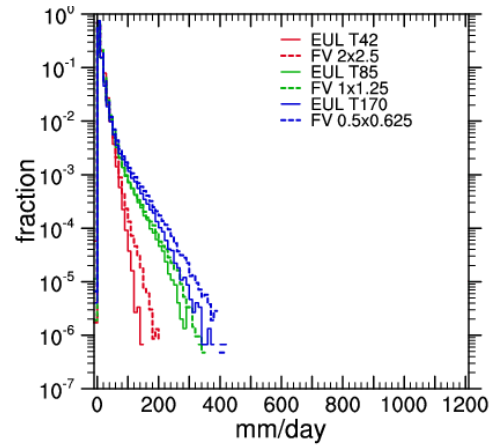
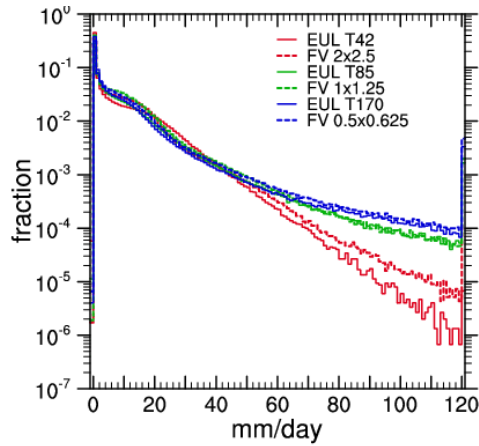


TROPICAL PRECIPITATION PDF

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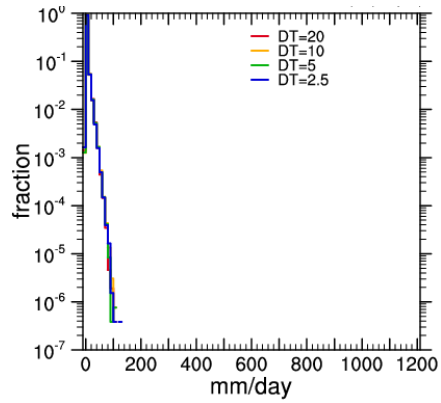
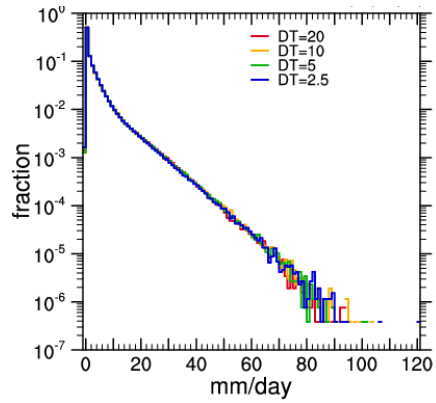


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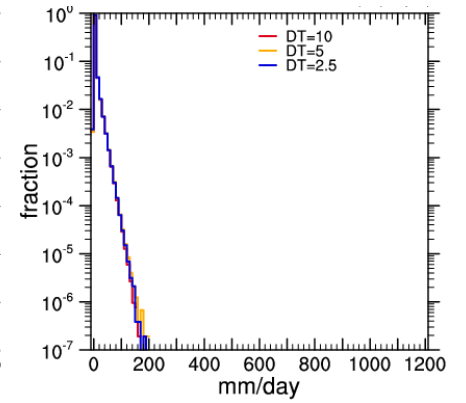
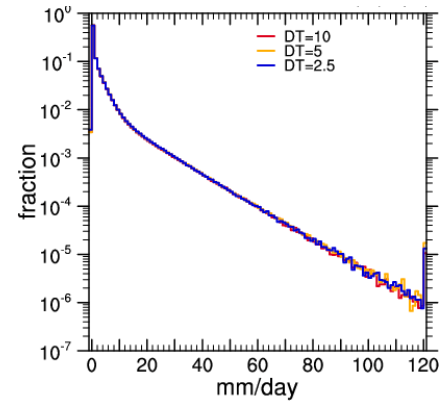


MID-LATITUDE PRECIPITATION PDF

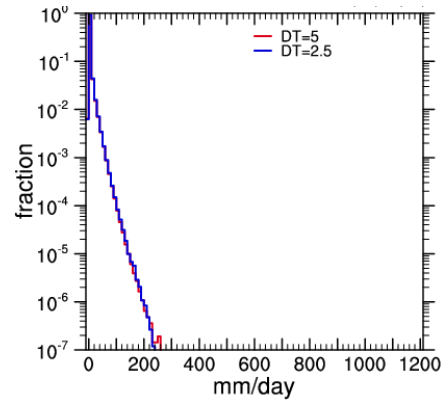
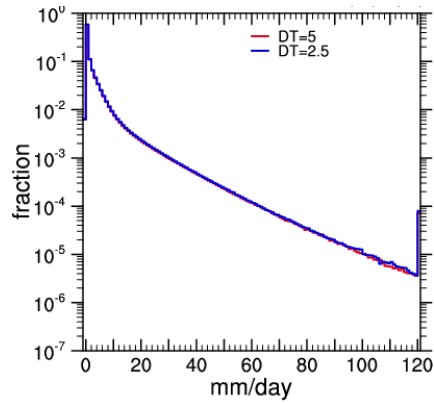
T42



T85

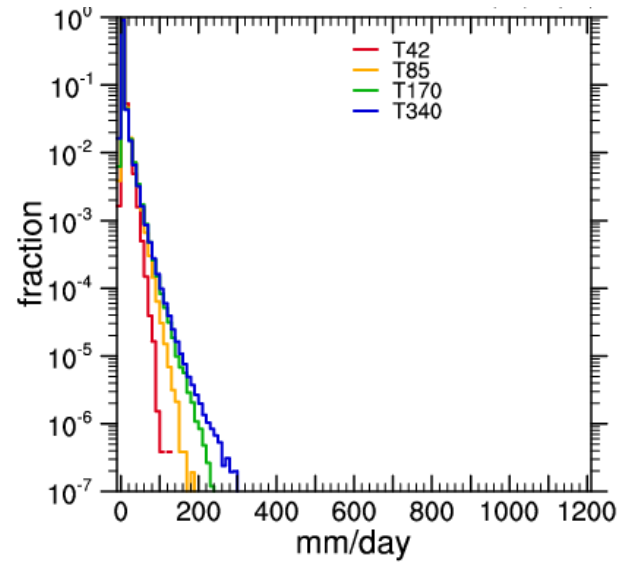
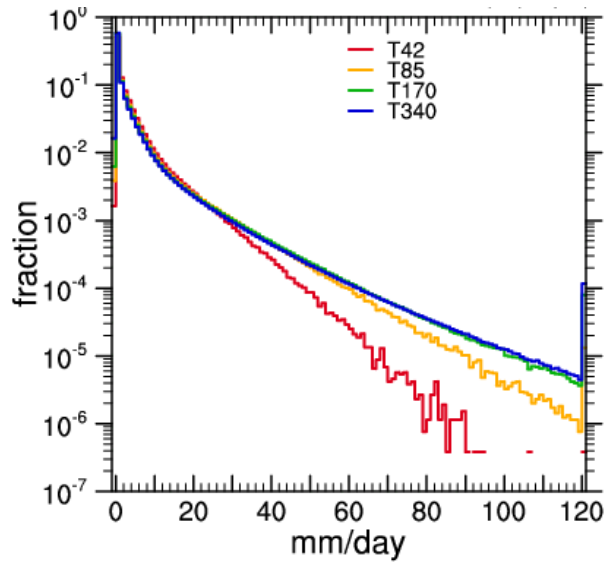


T170



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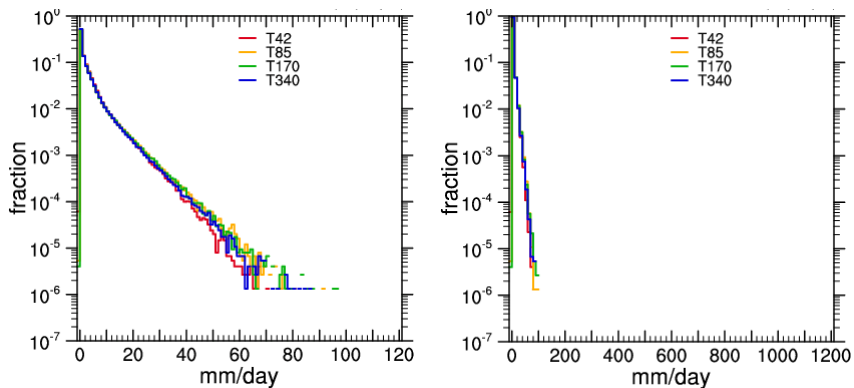
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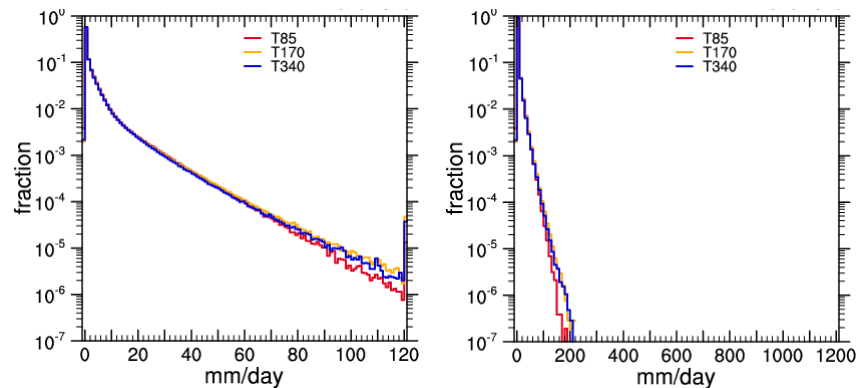
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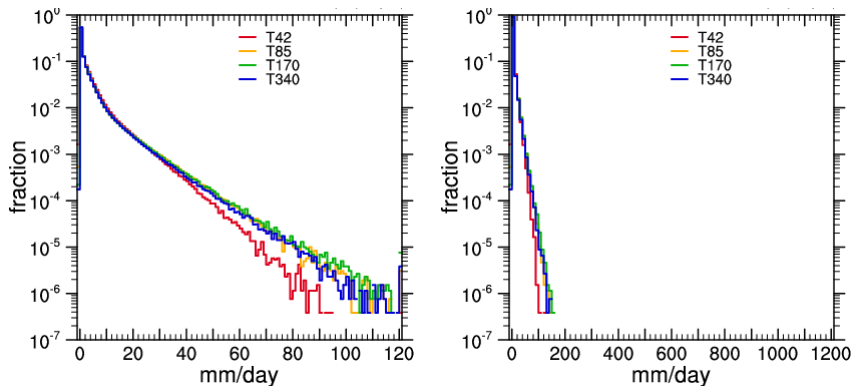
T21 SCALES



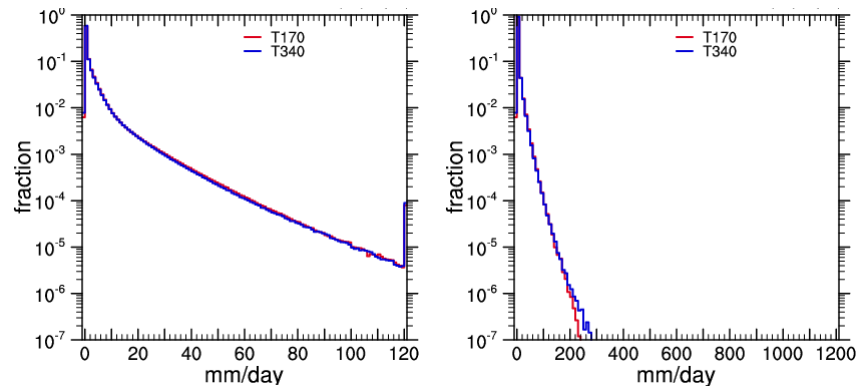
T85 SCALES



T42 SCALES

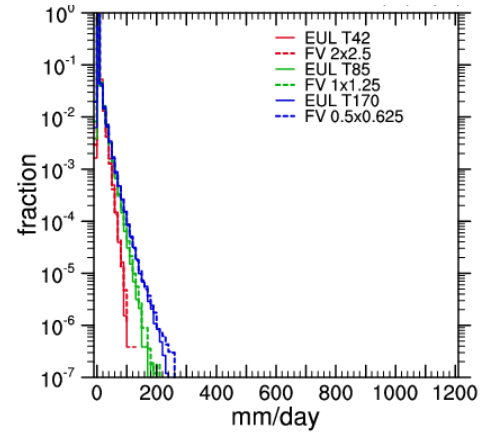
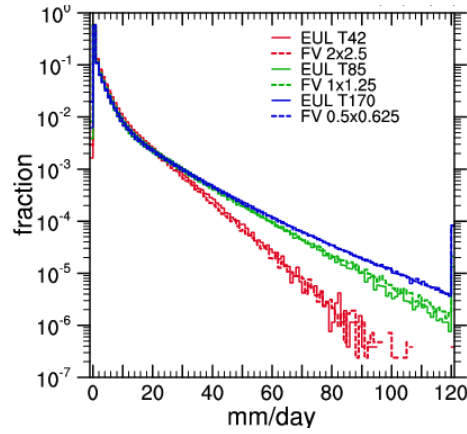


T170 SCALES

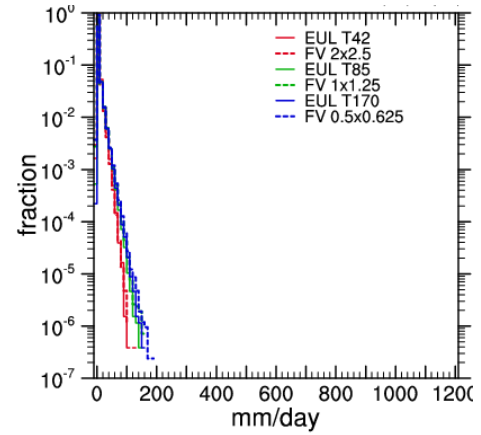
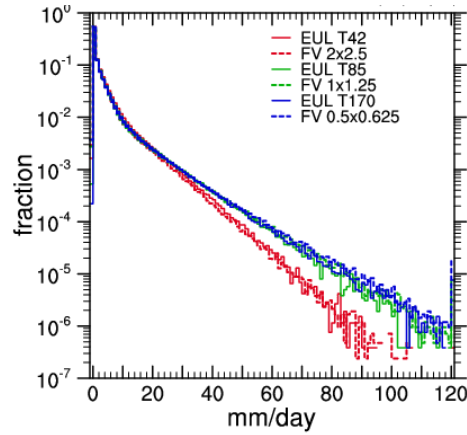


MID-LATITUDE PRECIPITATION PDF

PARAMETERIZATION DT = 5



T42 SCALES



Develop parameterizations independent of time step
(or apply them in a range where independent)

(Removing the parameterization DT dependency)

Large scales do not converge for all fields

Is this due to parameterizations?

Should parameterizations be tuned to give convergent solutions?

TROPICAL WAVES

Converge at relatively high resolution

VARIABILITY

Larger scales converge

Need at least T85 or 1 degree resolution

Discard smallest half of scales