Evaluating processes controlling subtropical humidity using water vapor isotope measurements

Camille Risi

CIRES, Boulder

Thanks to: David Noone, Sandrine Bony,
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ground-based FTIR: Debra Wunsh, Matthias Schneider

TES meeting, 17 June 2010

Uncertainties in humidity changes

- subtropical relative humidity strongly impacts
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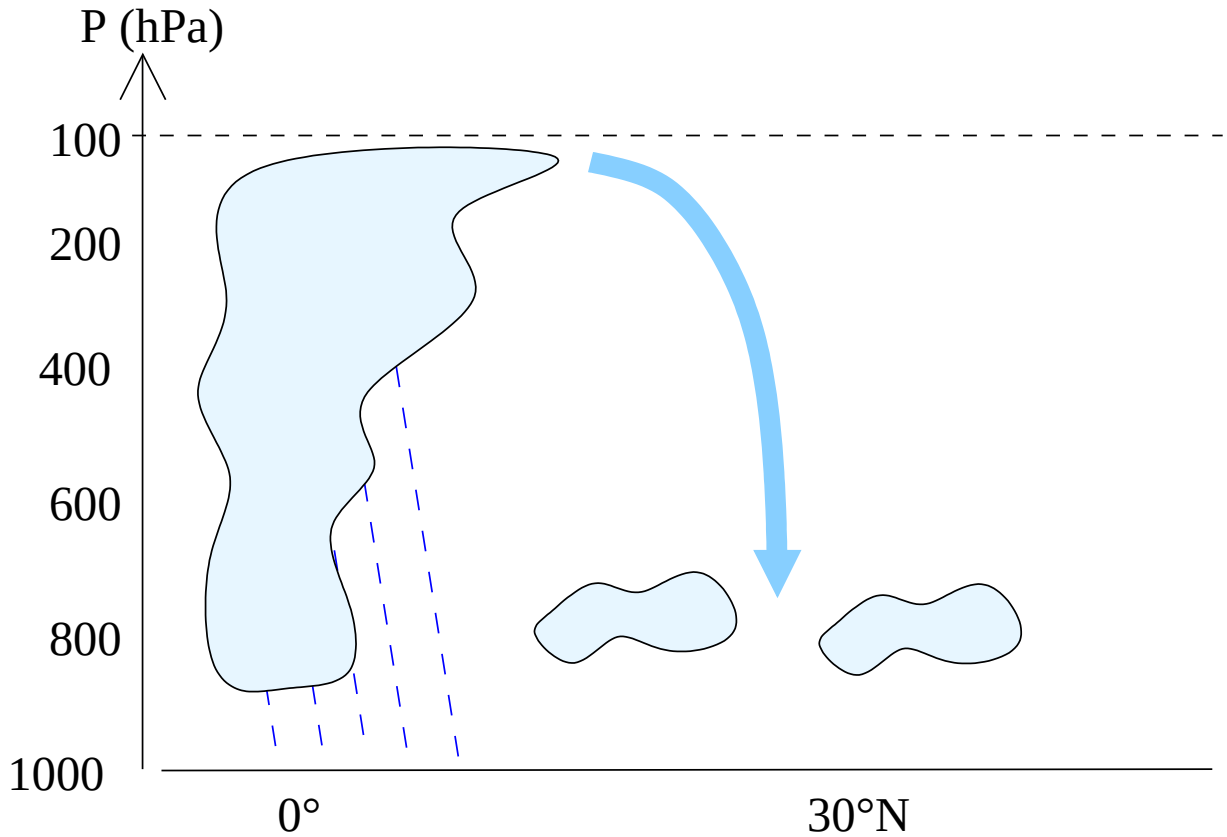
  - no link between mean state and projections (*Santer et al 2009*)
- How to evaluate the credibility of these projections?

Processes controlling relative humidity

- dispersion reflects complexity of humidity controls



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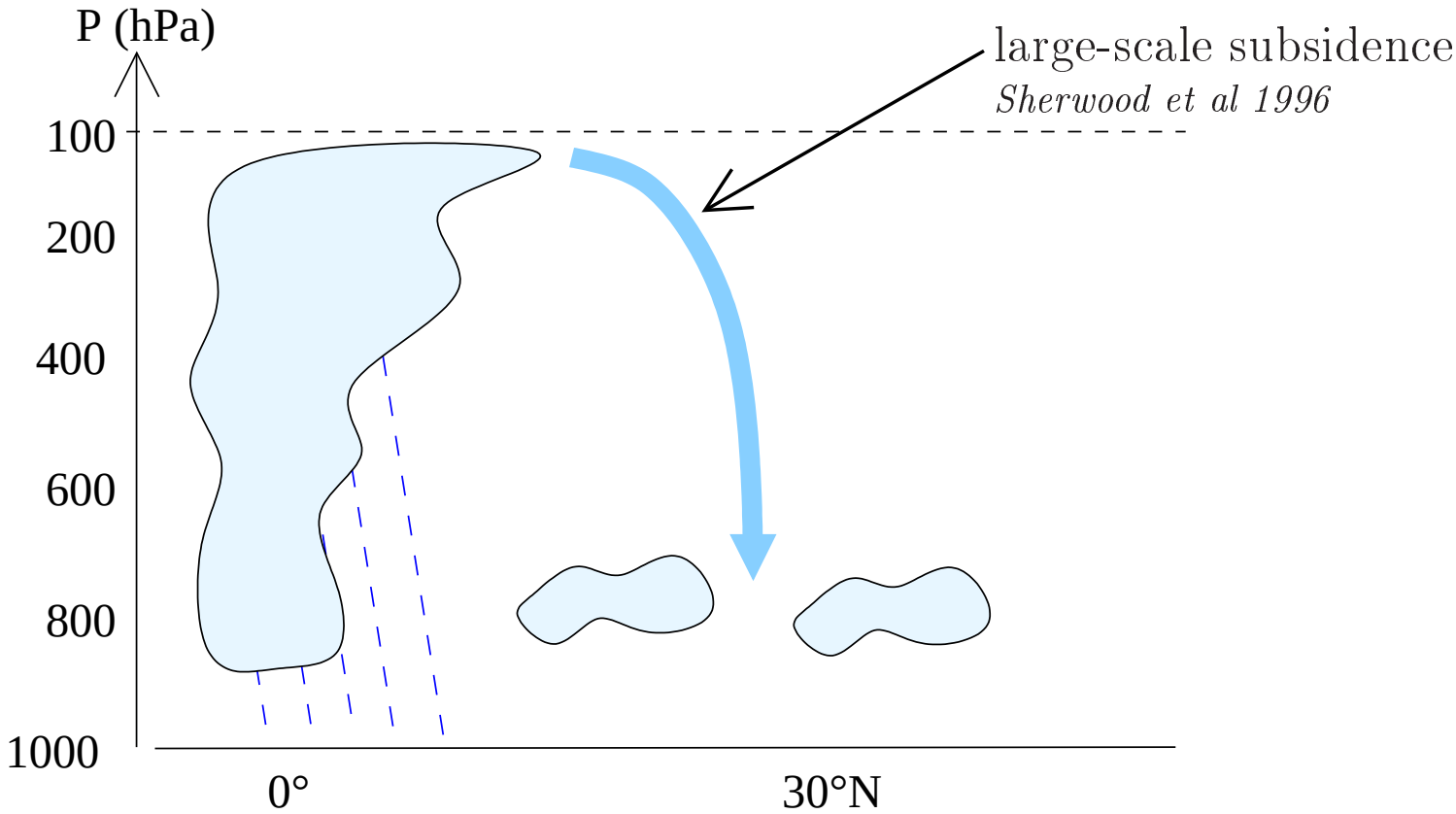

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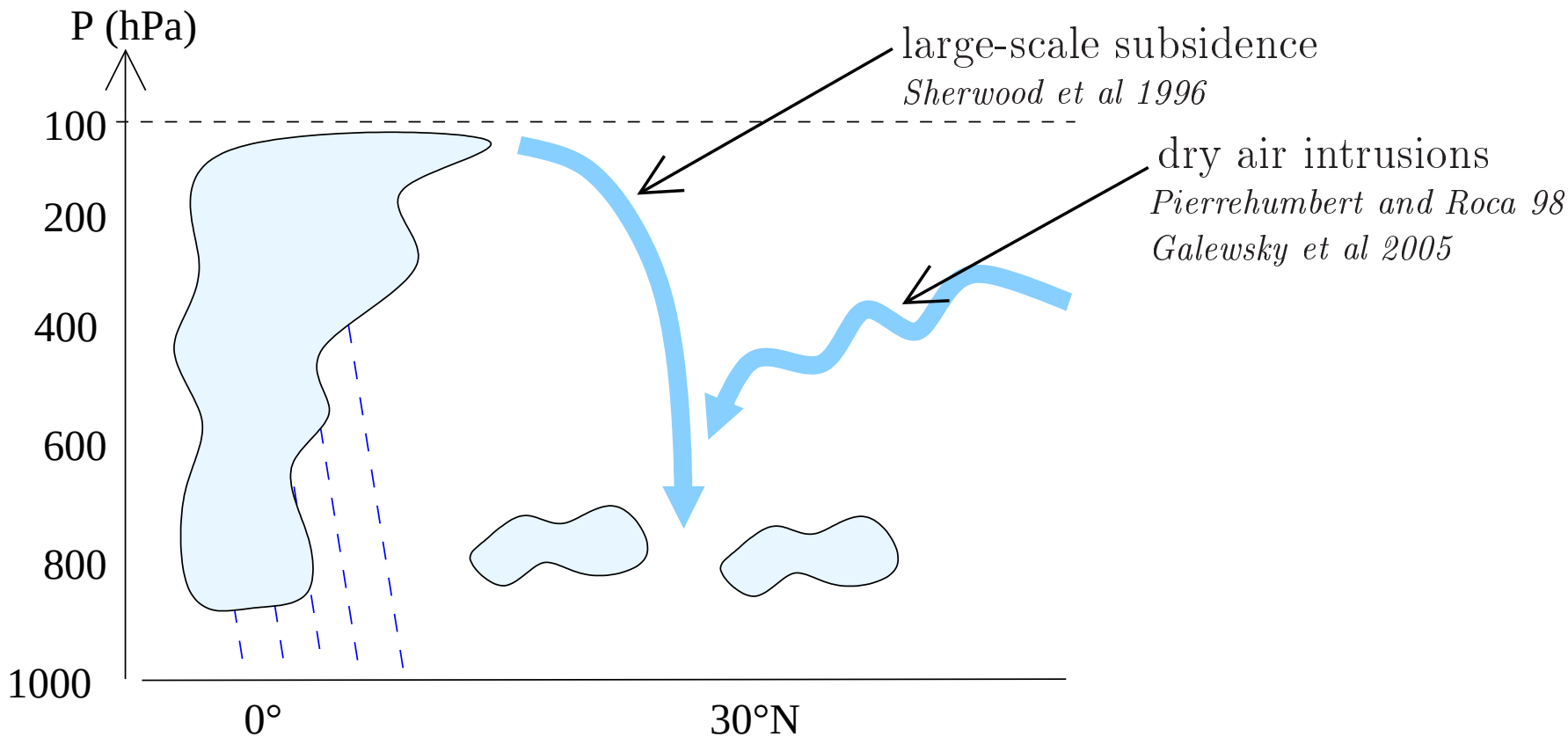

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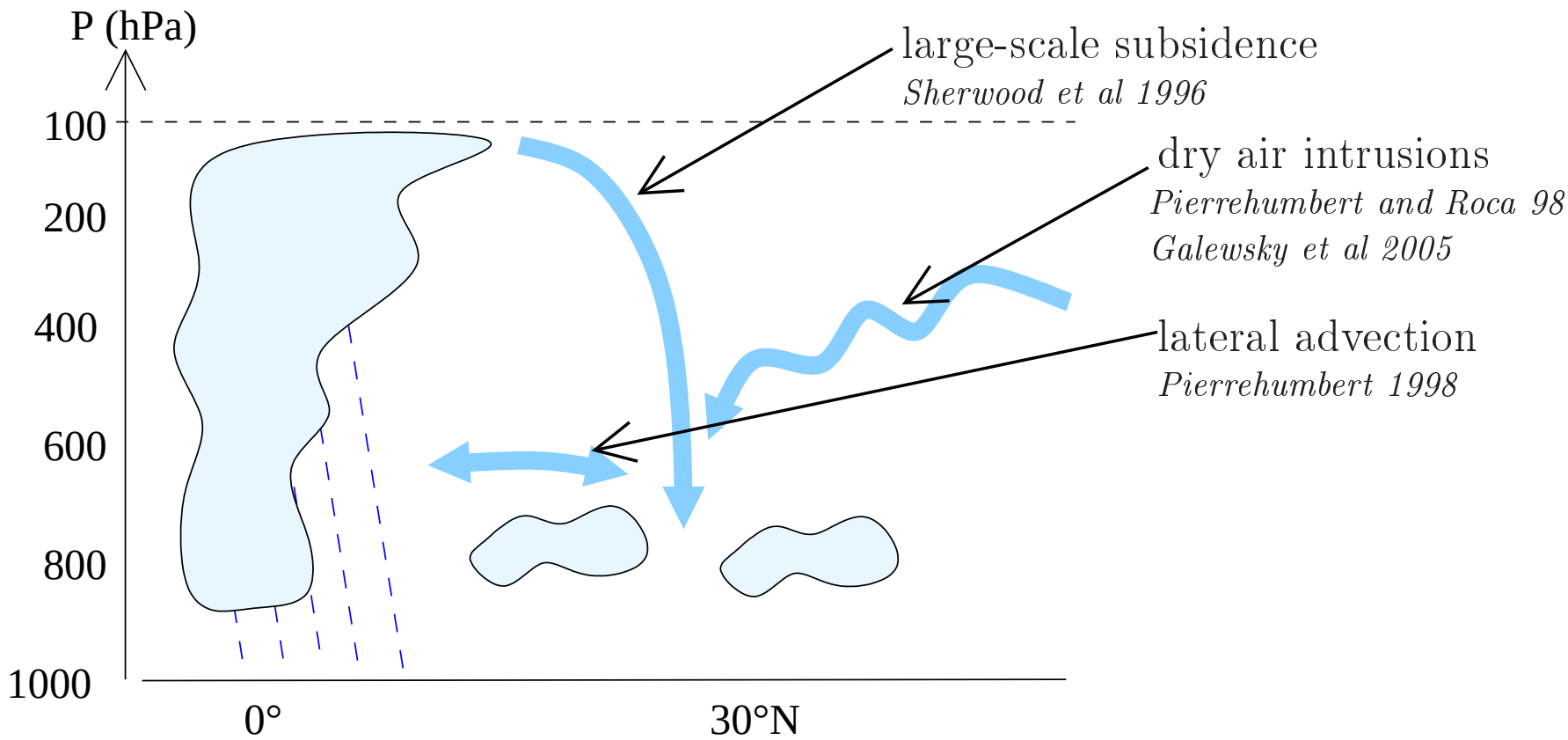

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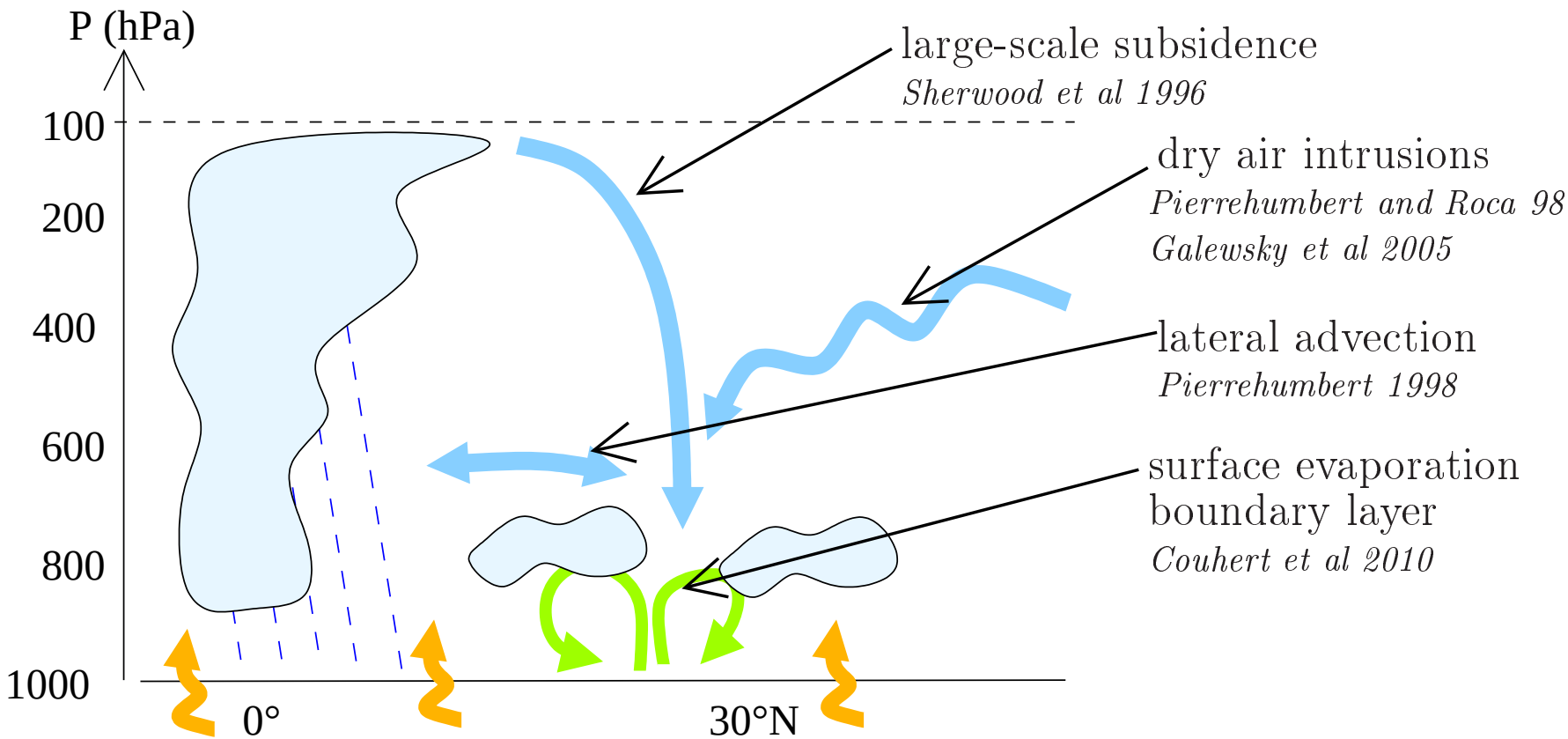

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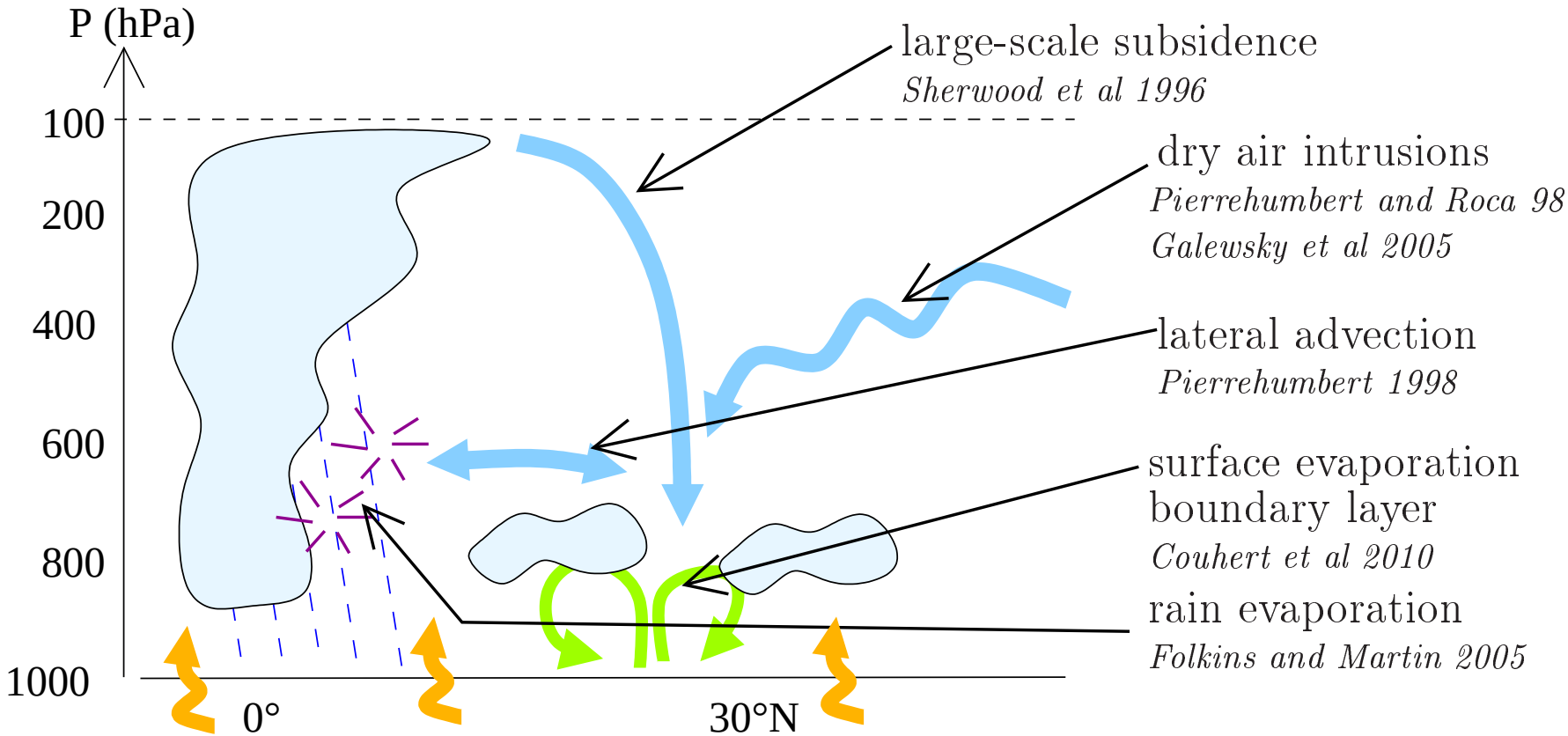

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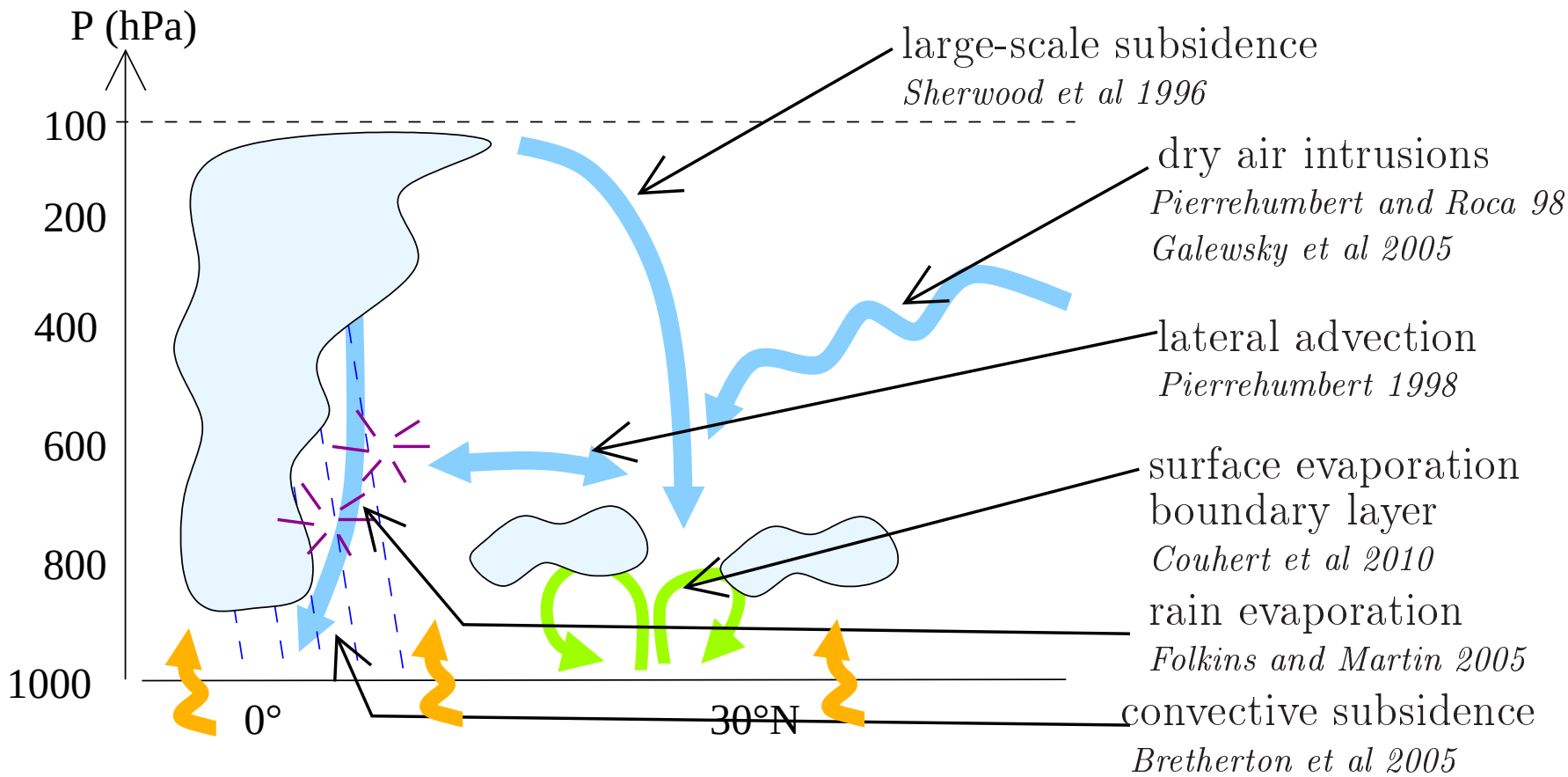

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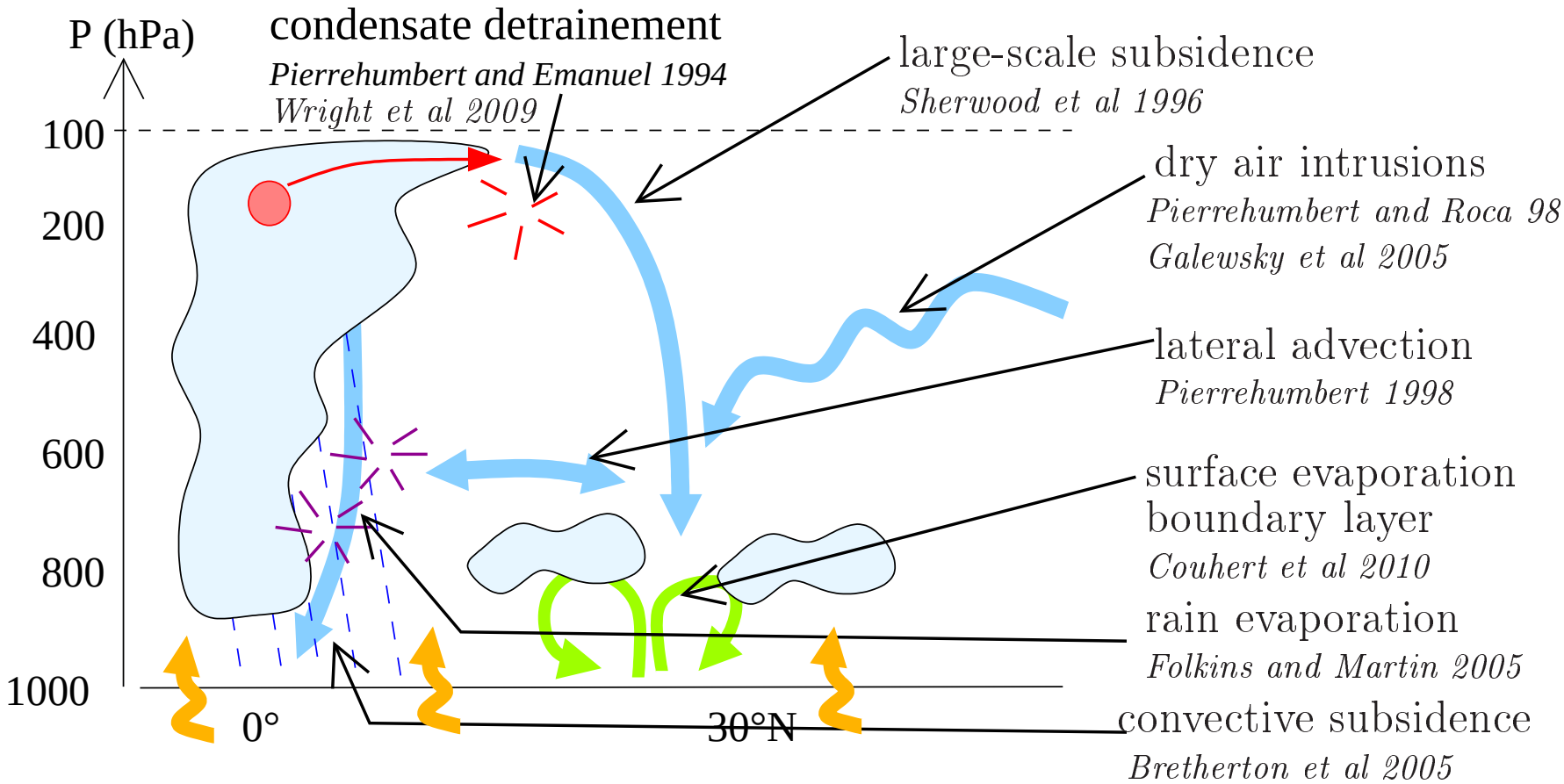

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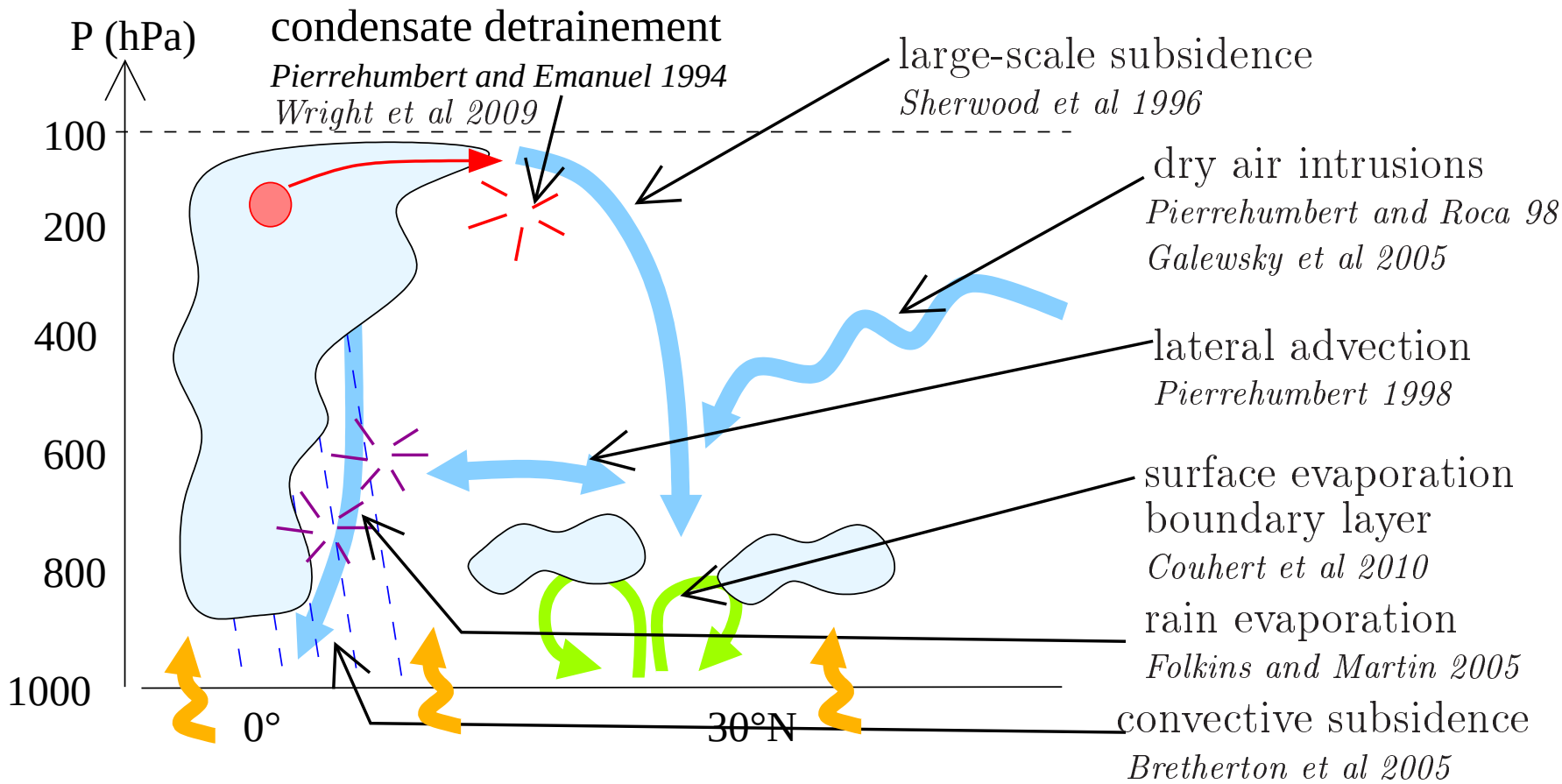
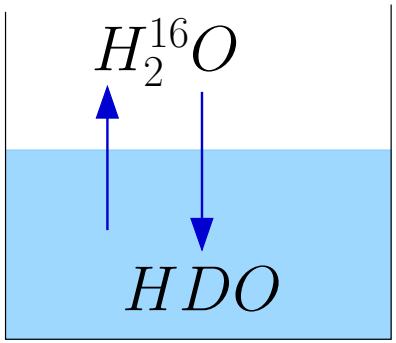


⇒need complementary evaluation tools

Water stable isotopes

- water isotopes: $H_2^{16}O$, $H_2^{18}O$,HDO
- fractionation



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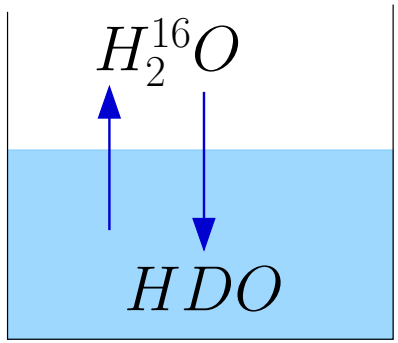

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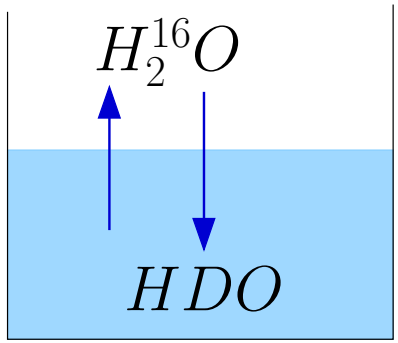

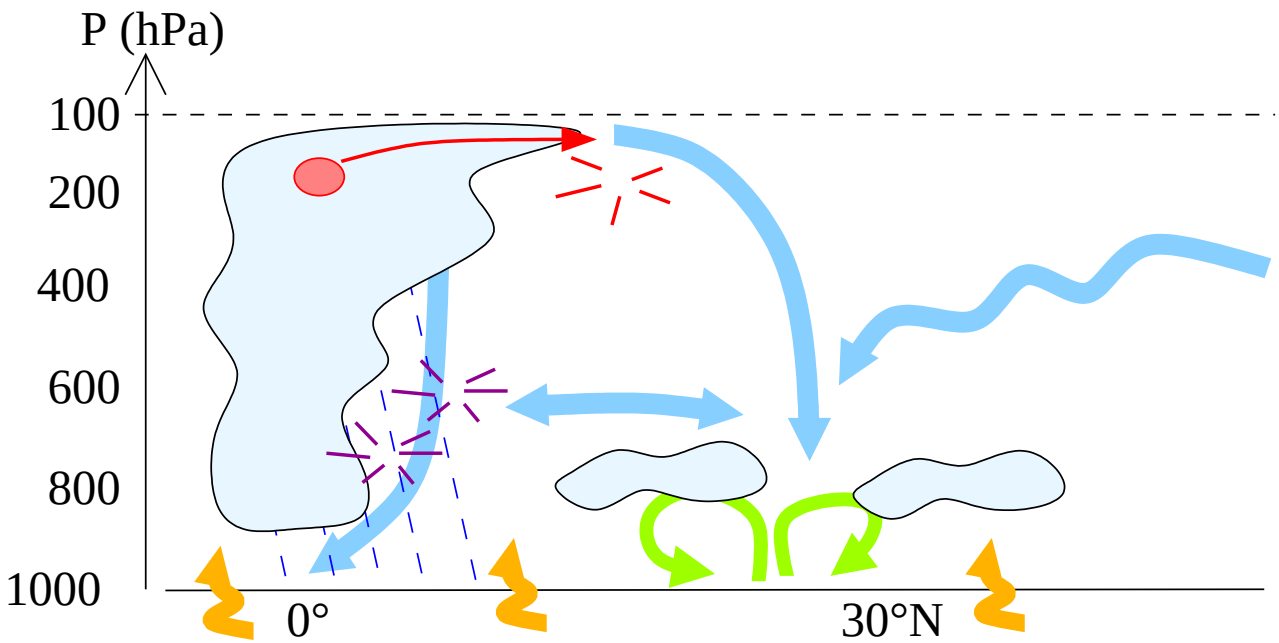

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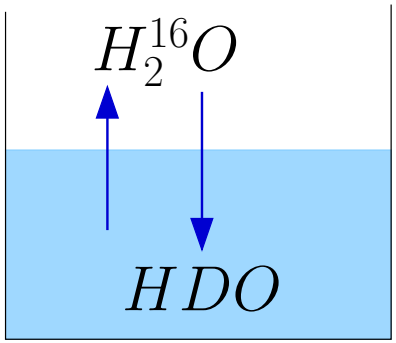

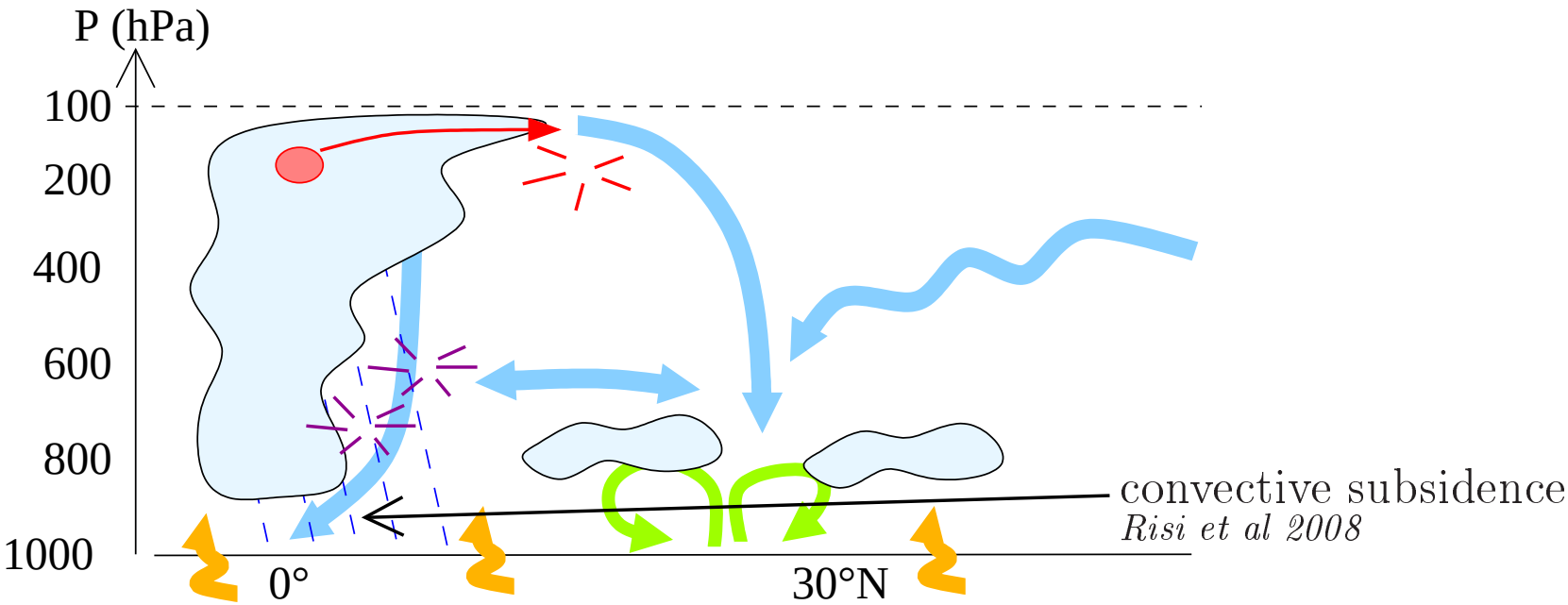

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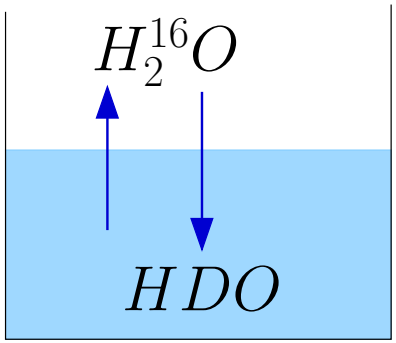

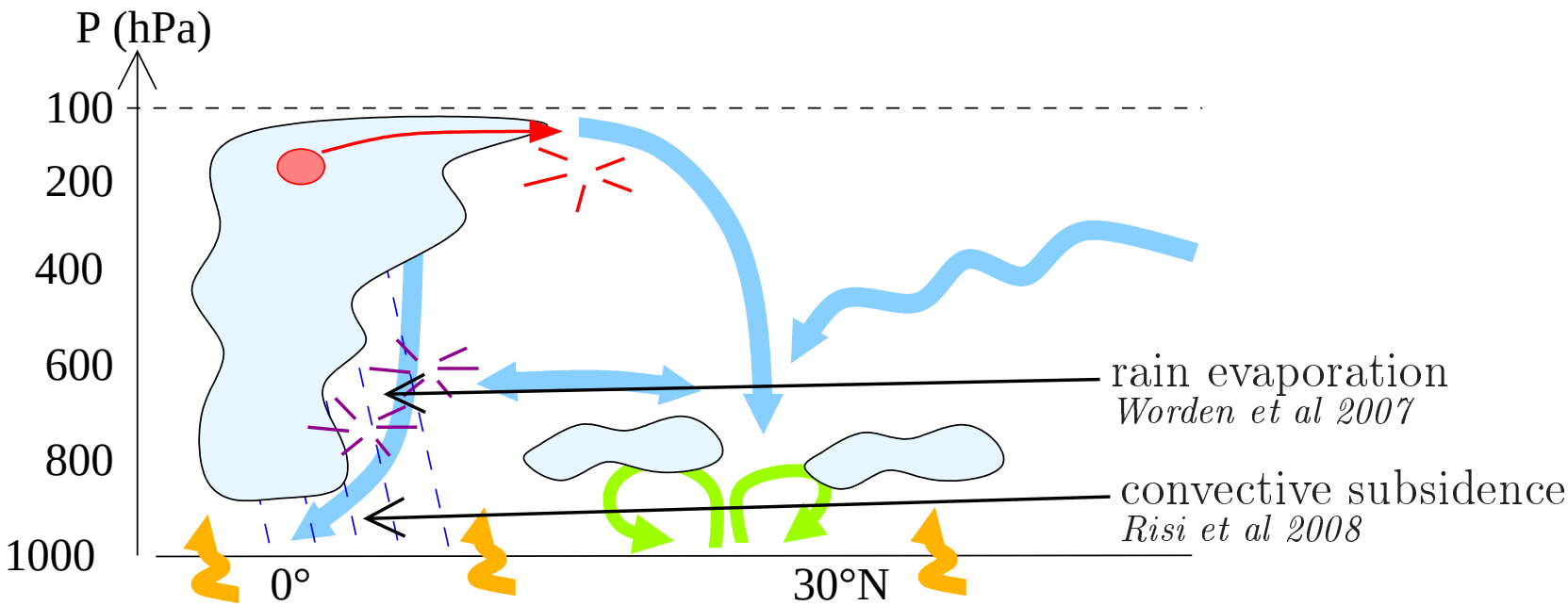

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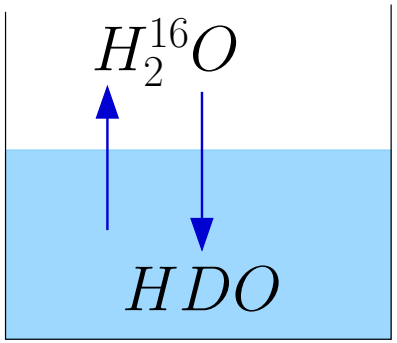

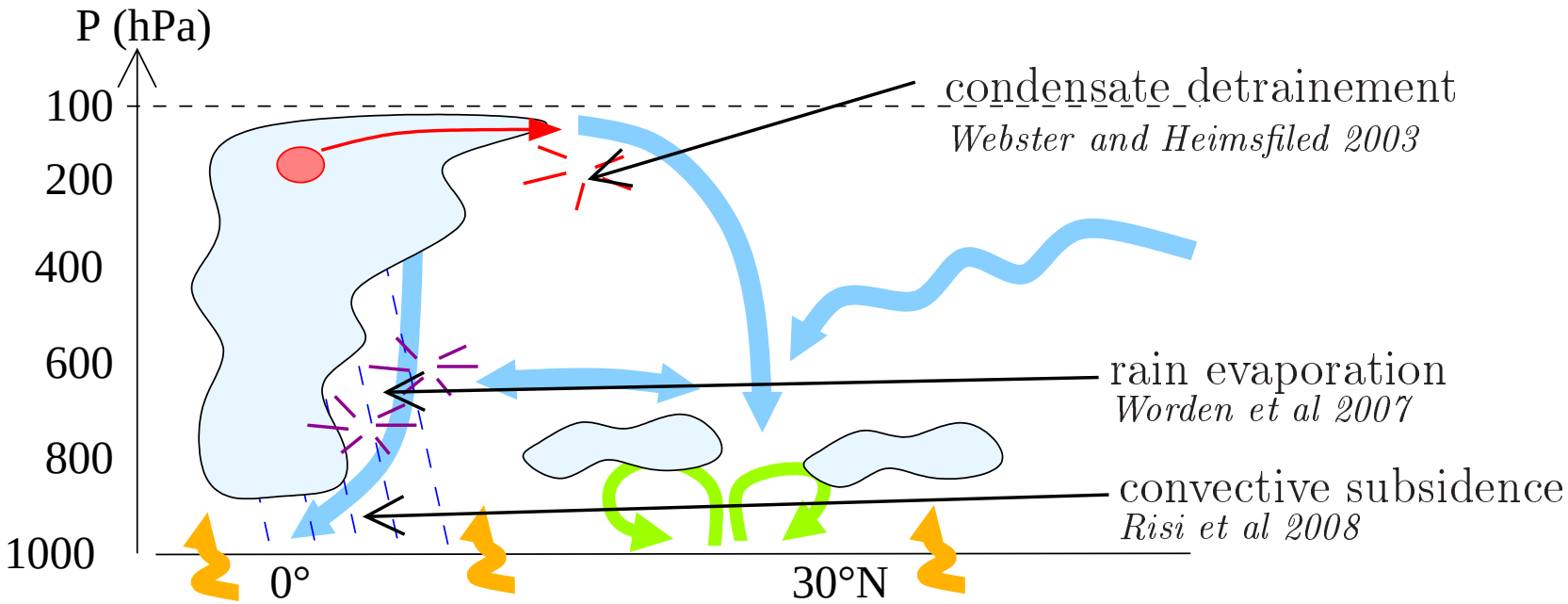

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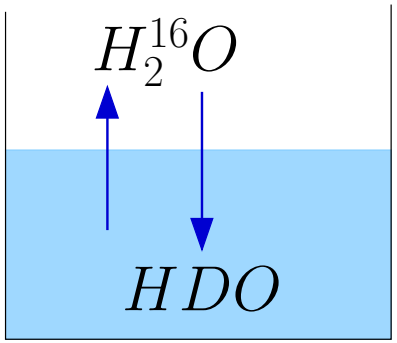

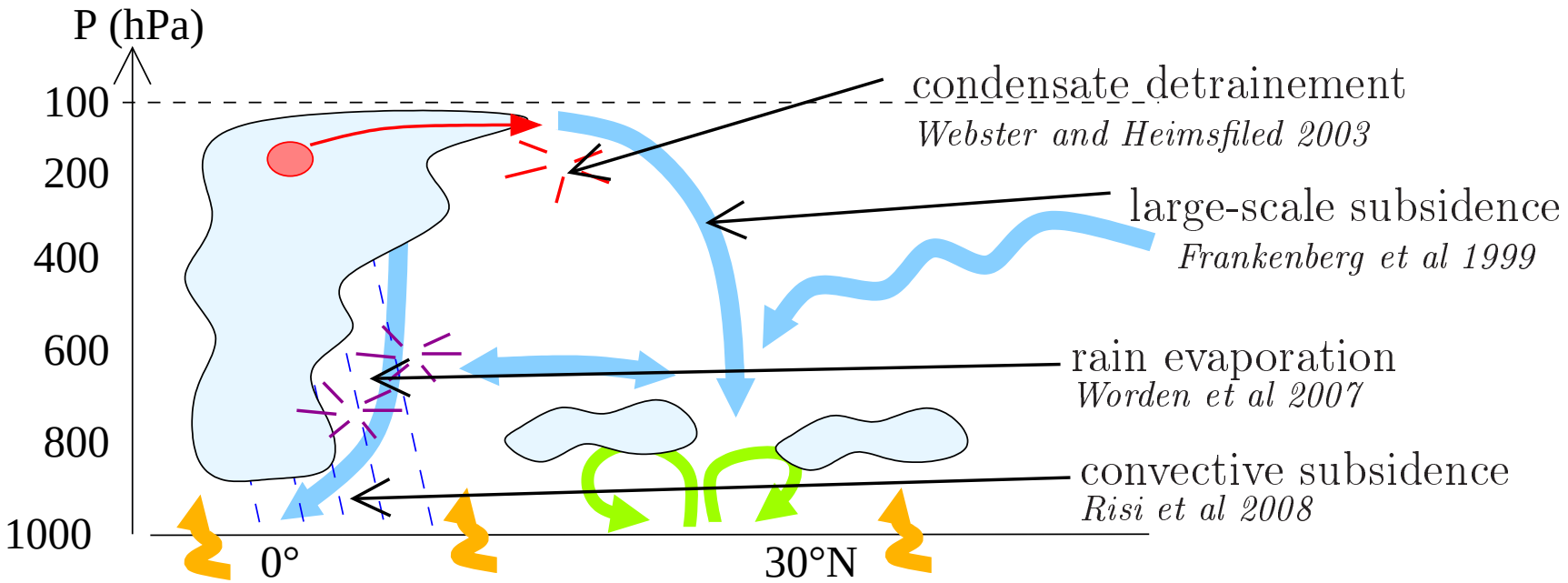

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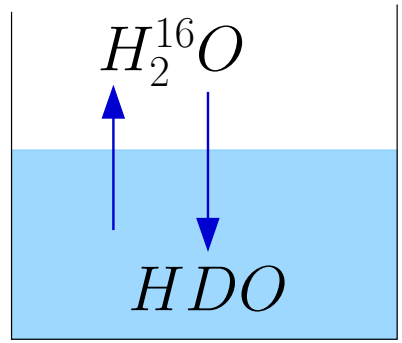

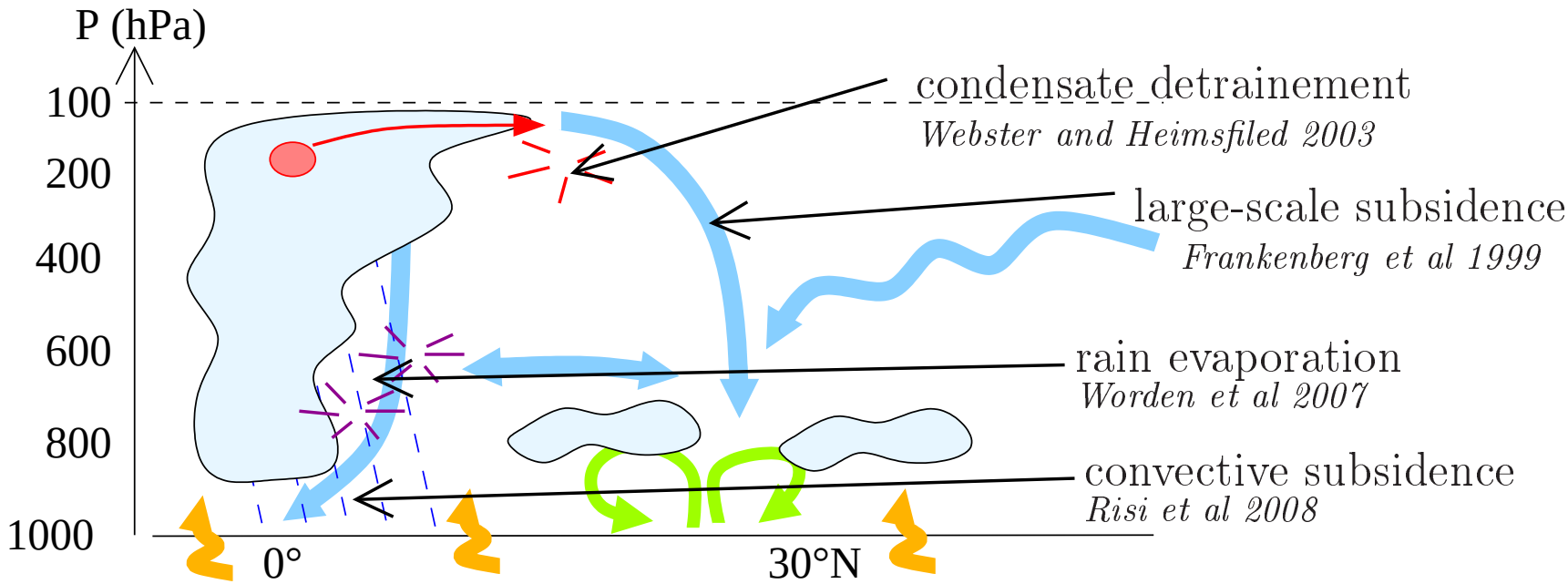

$\Rightarrow$ Goal: use water isotopes to evaluate processes controlling humidity in climate models

Isotope dispersion in climate models

- isotope-enabled GCMs intercomparison (SWING2)

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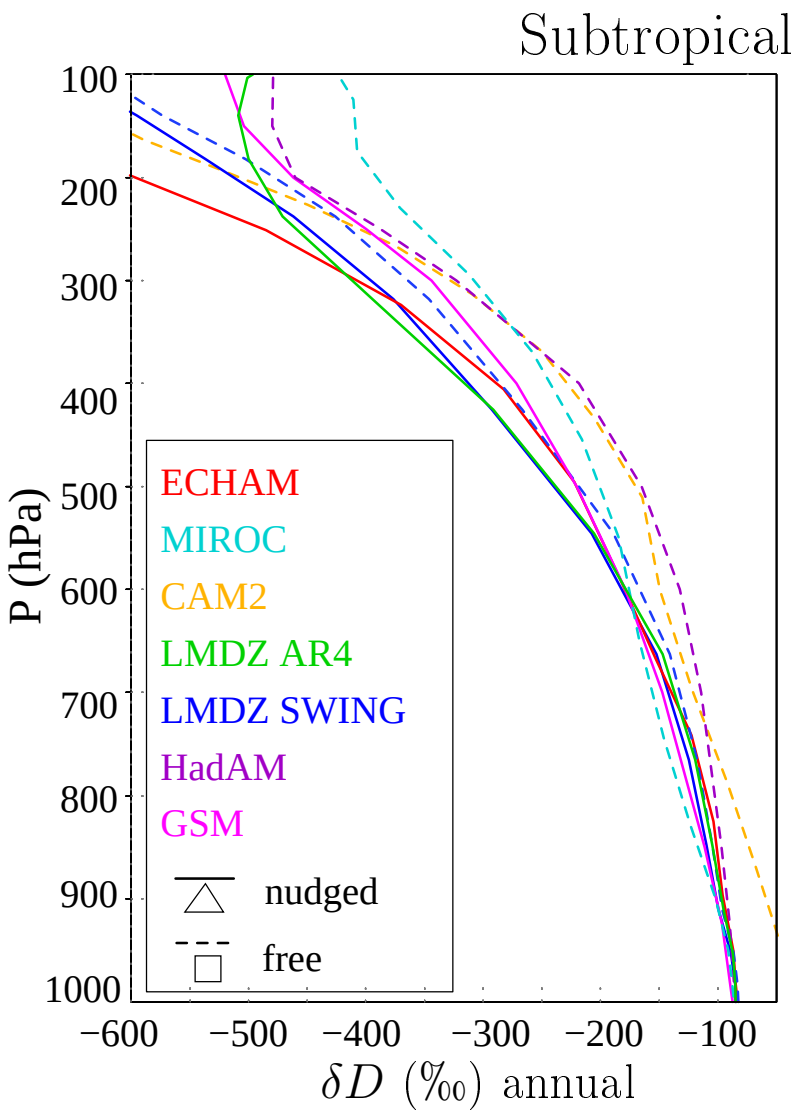

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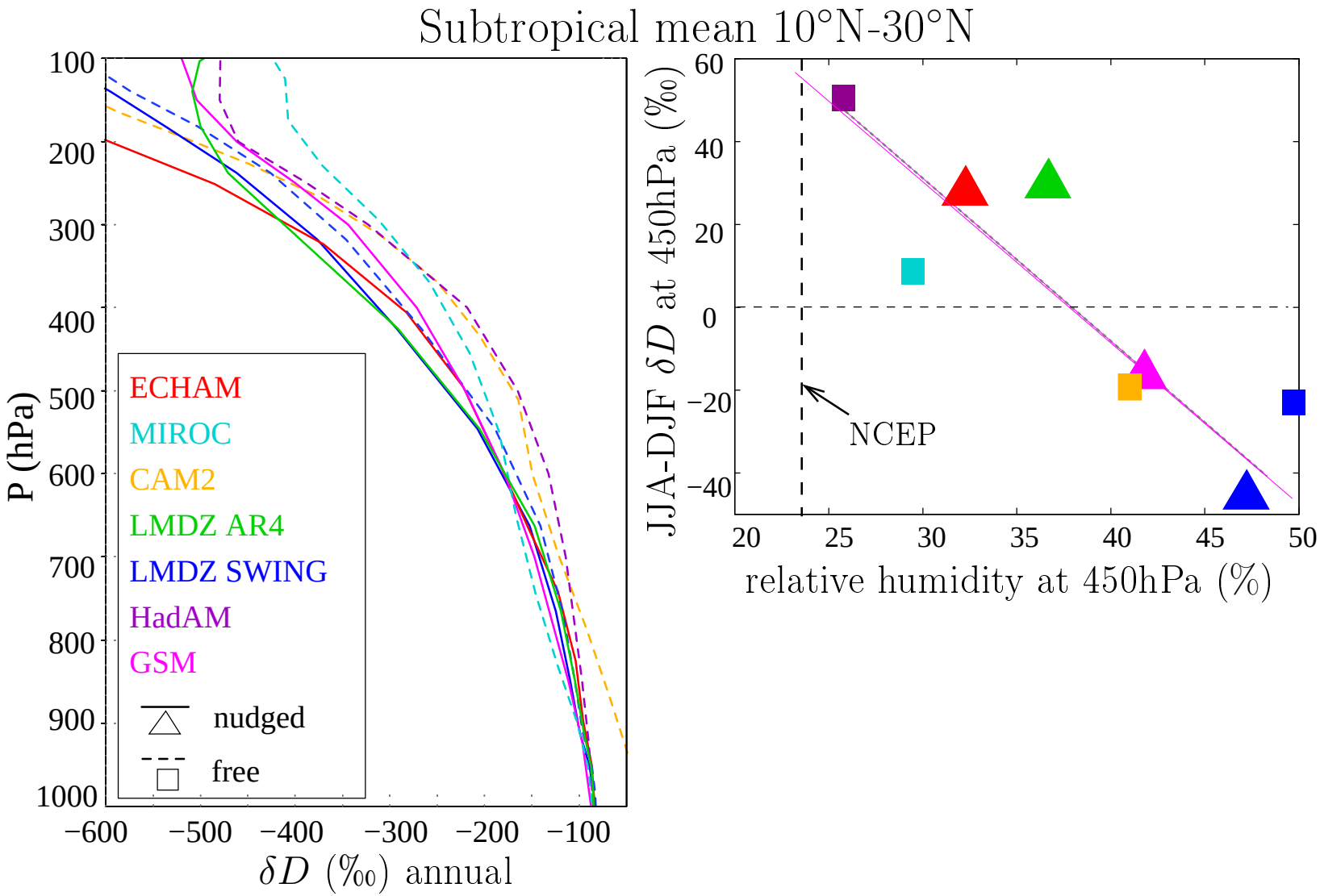

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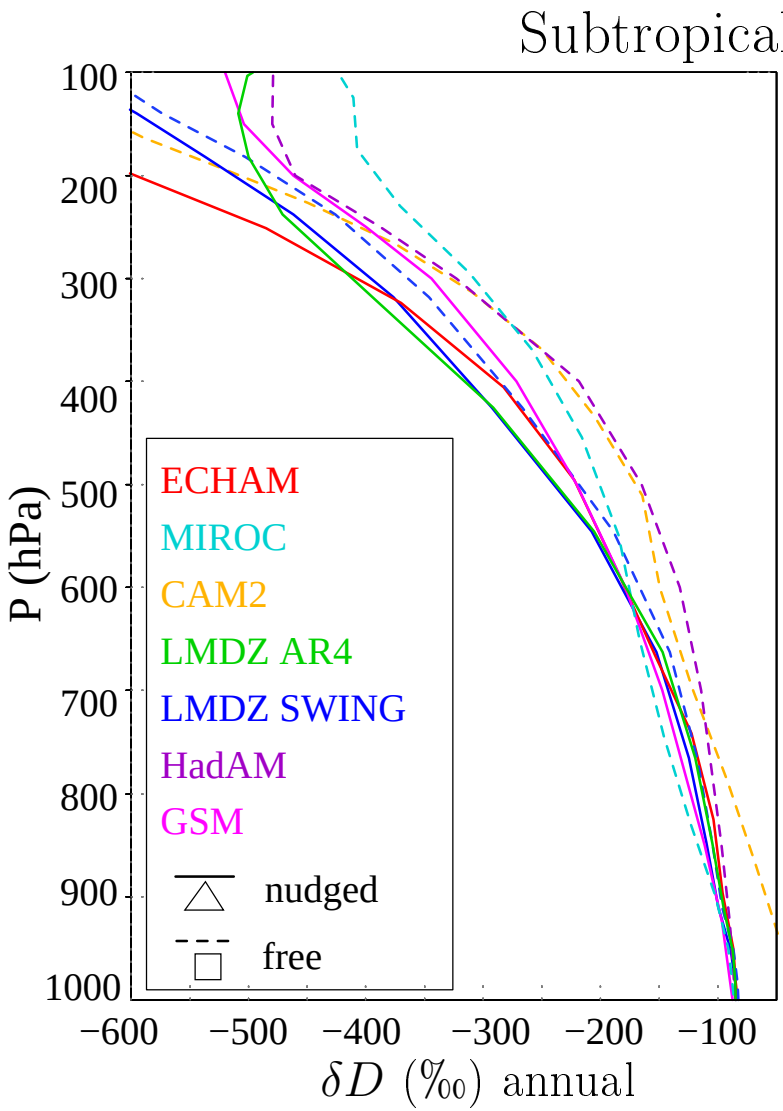

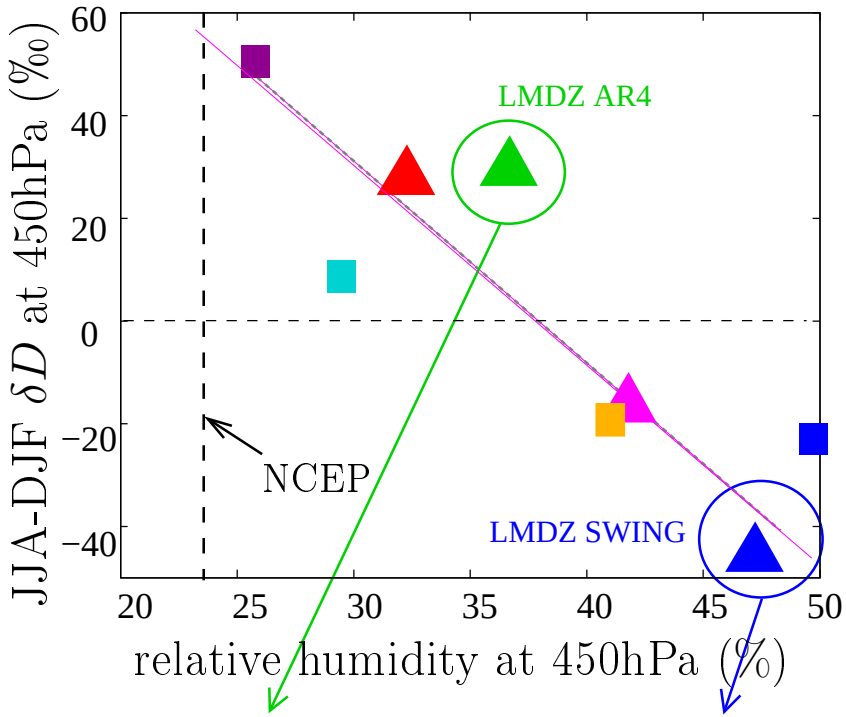

LMDZ-iso (Risi et al in press)

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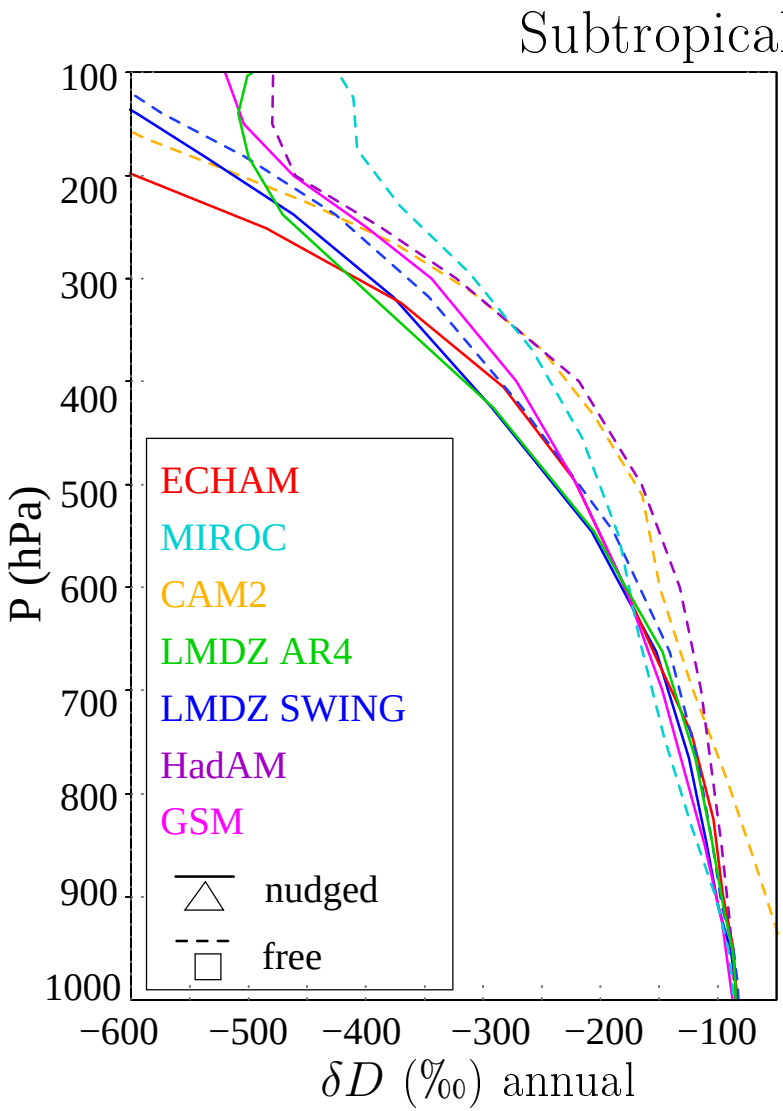

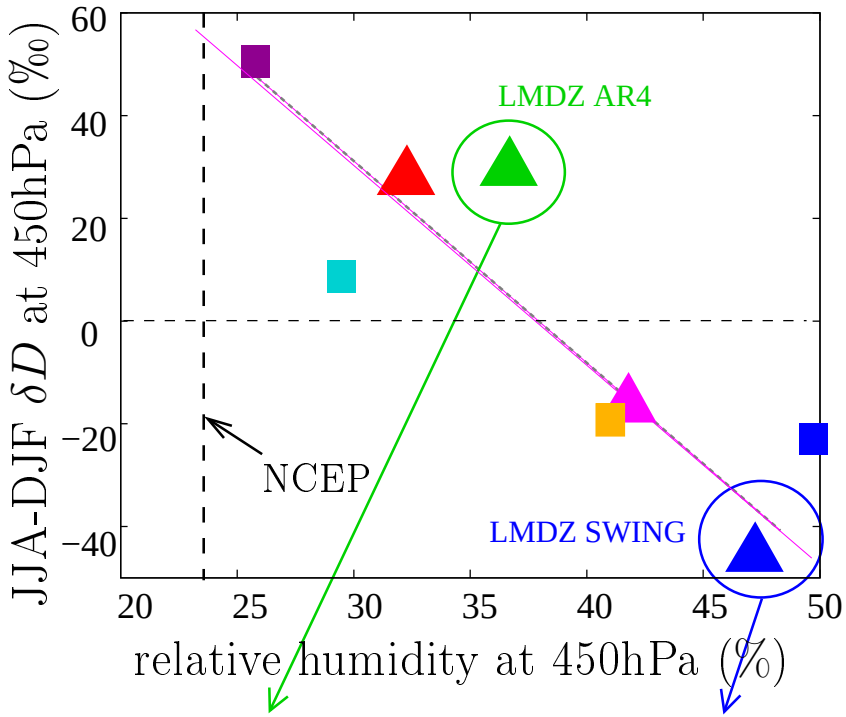

with
saturation limiter
(Codron and Sadourny 2002)
advect $\min(q,q_s)$

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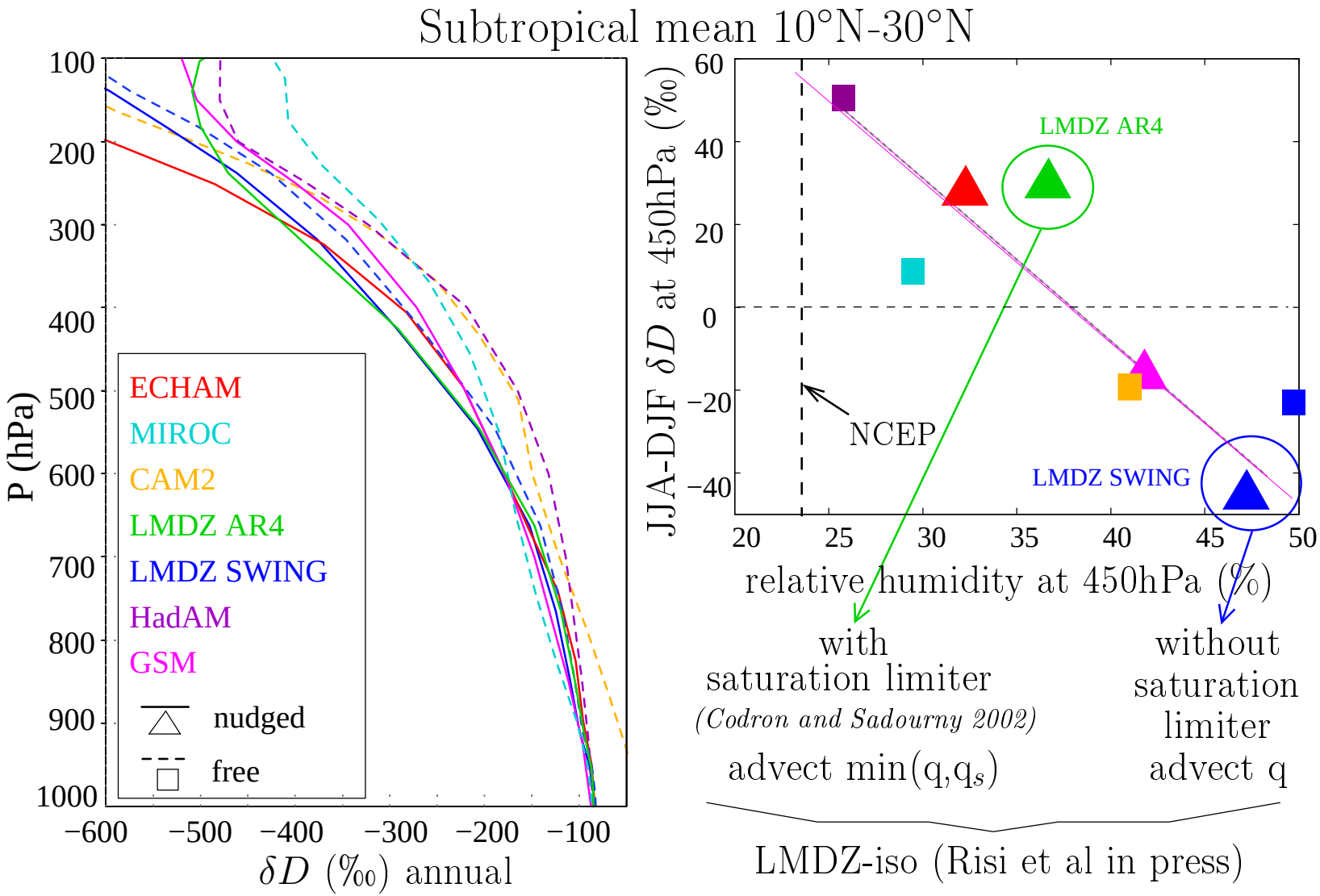

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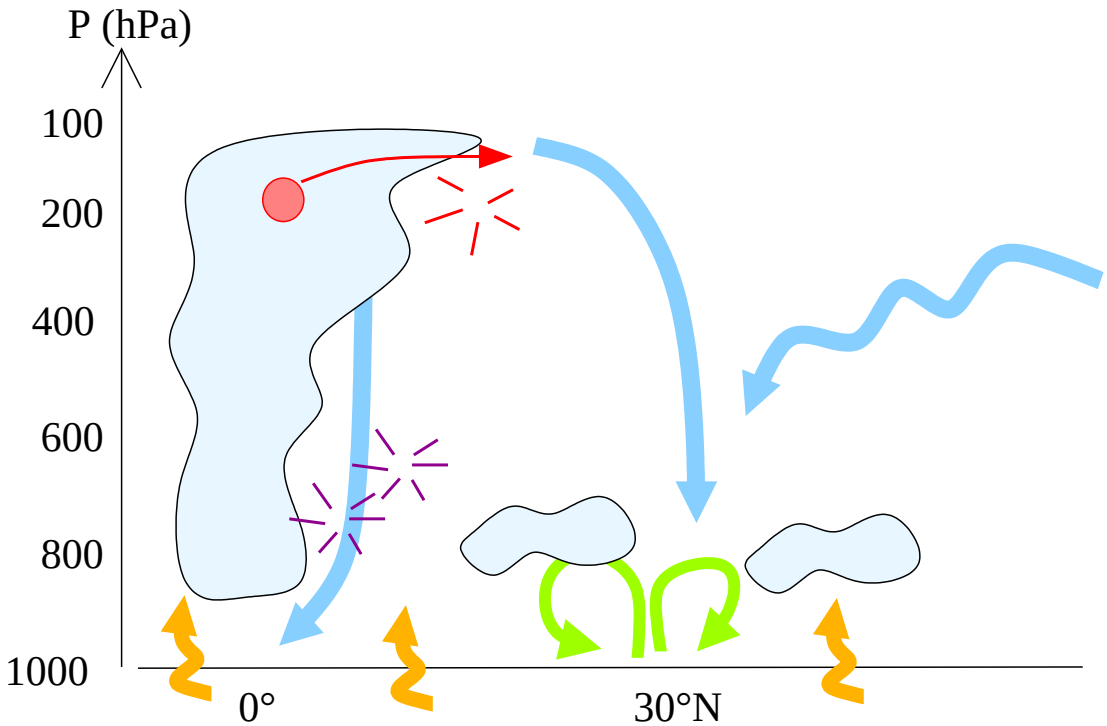

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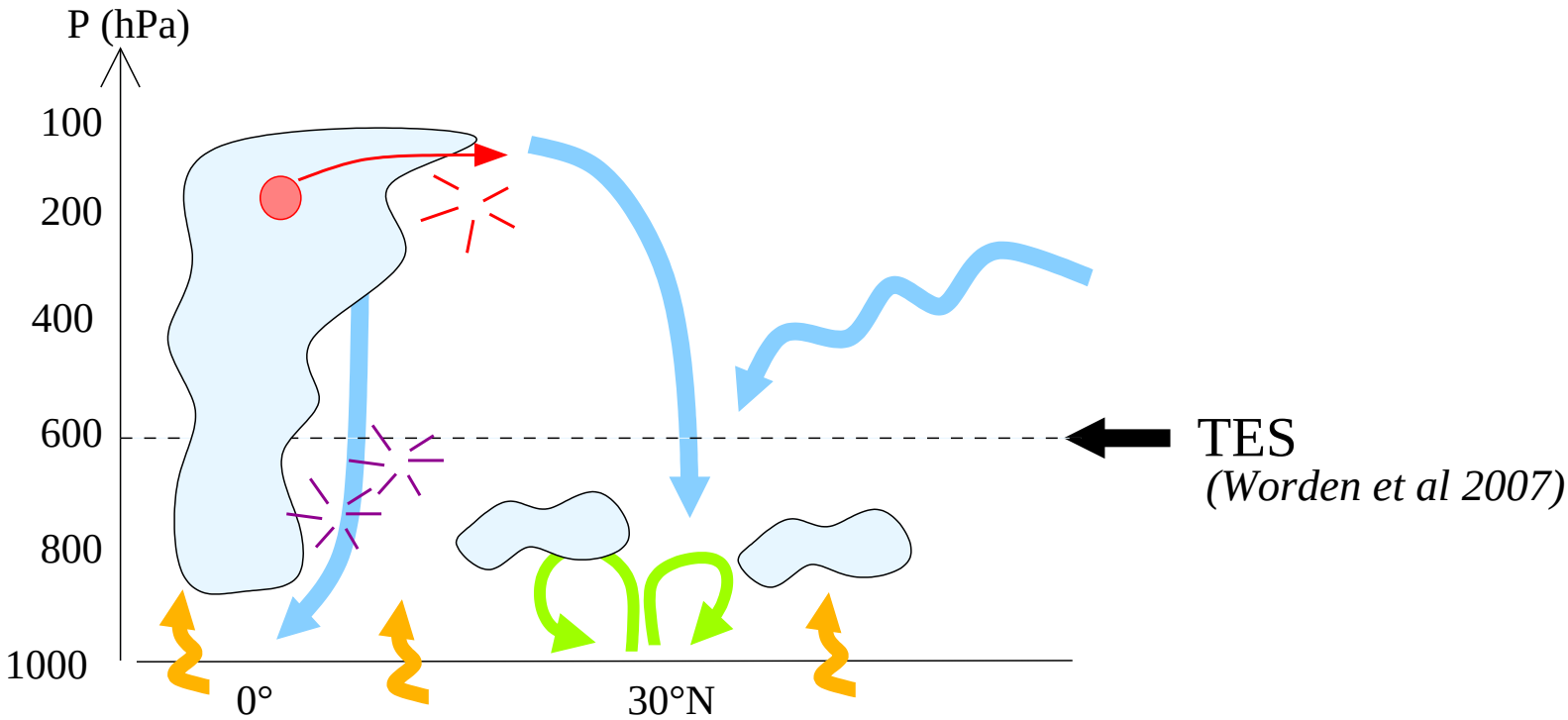

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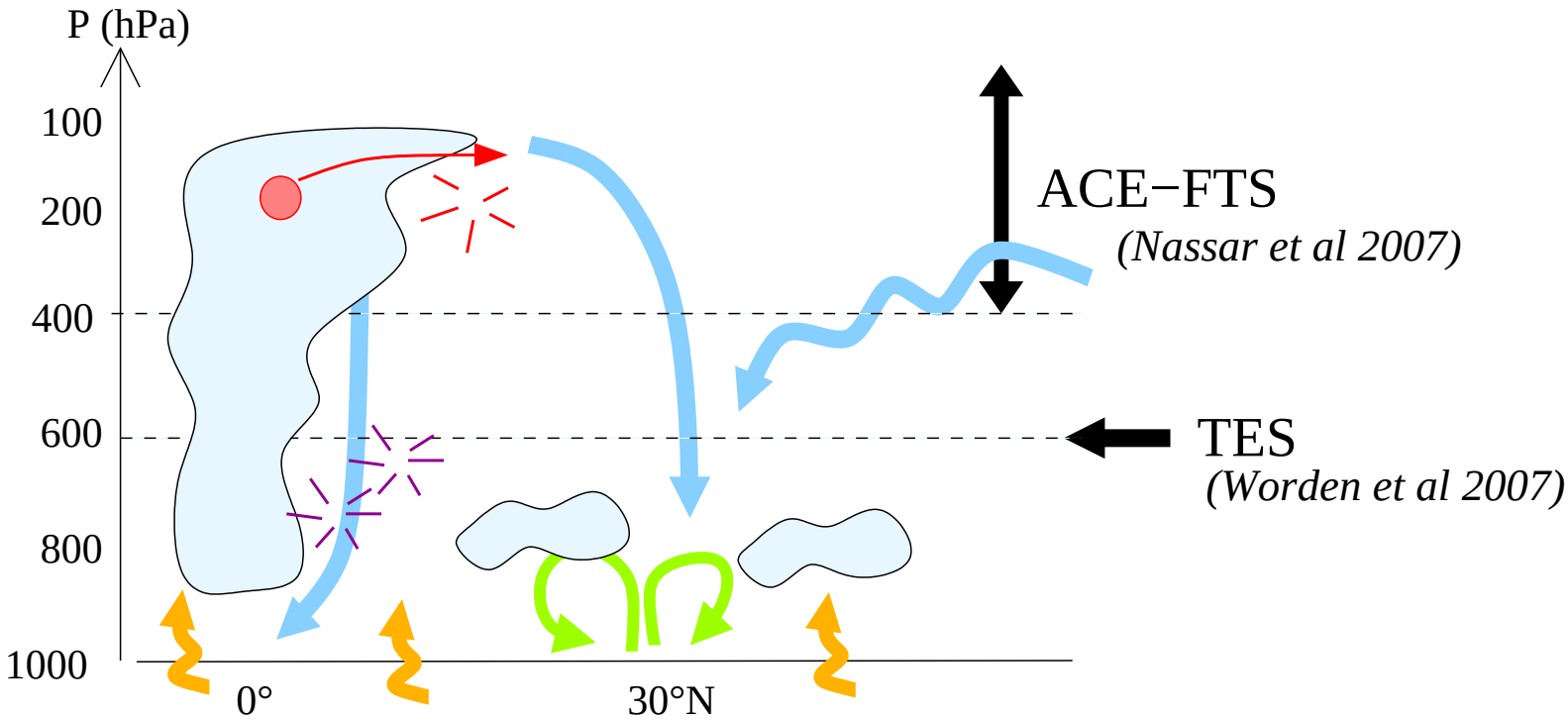

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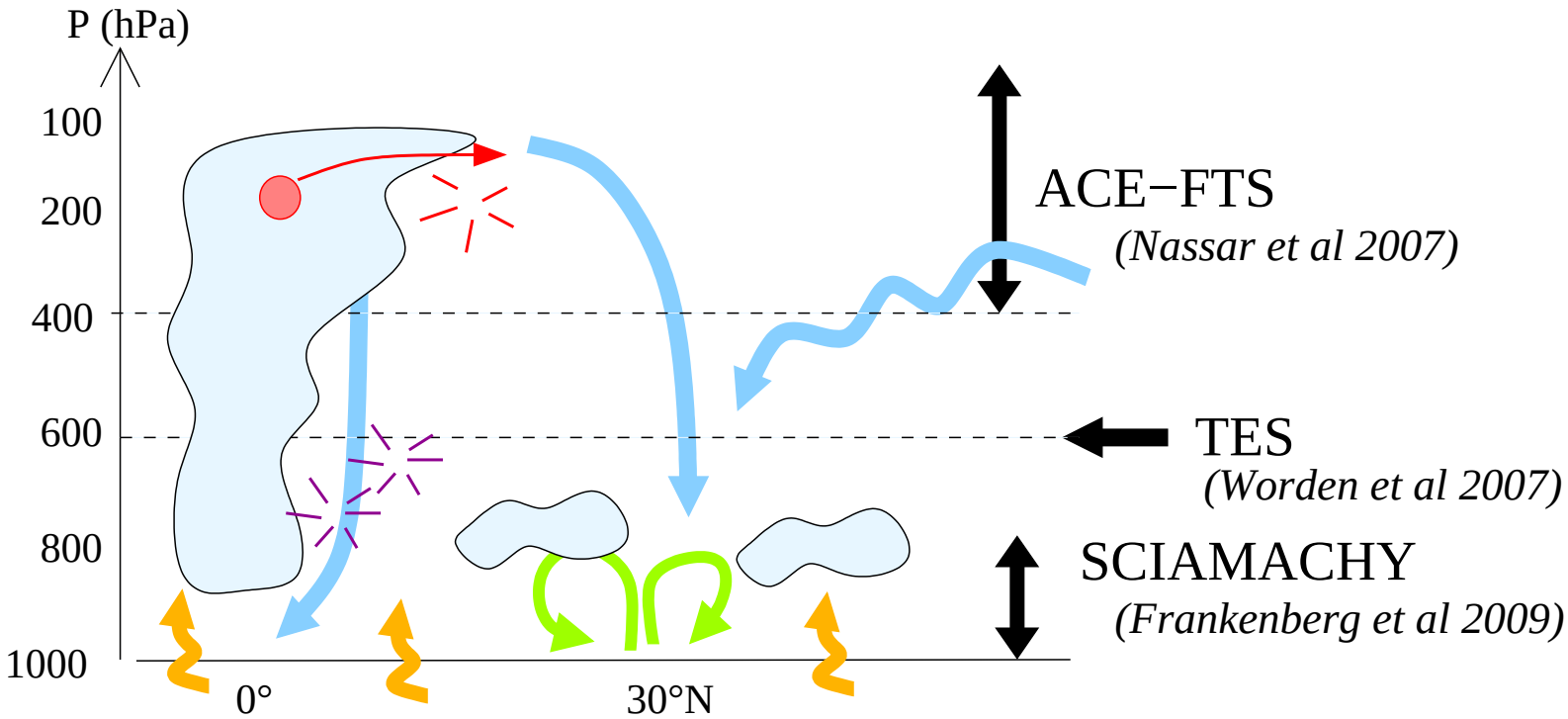

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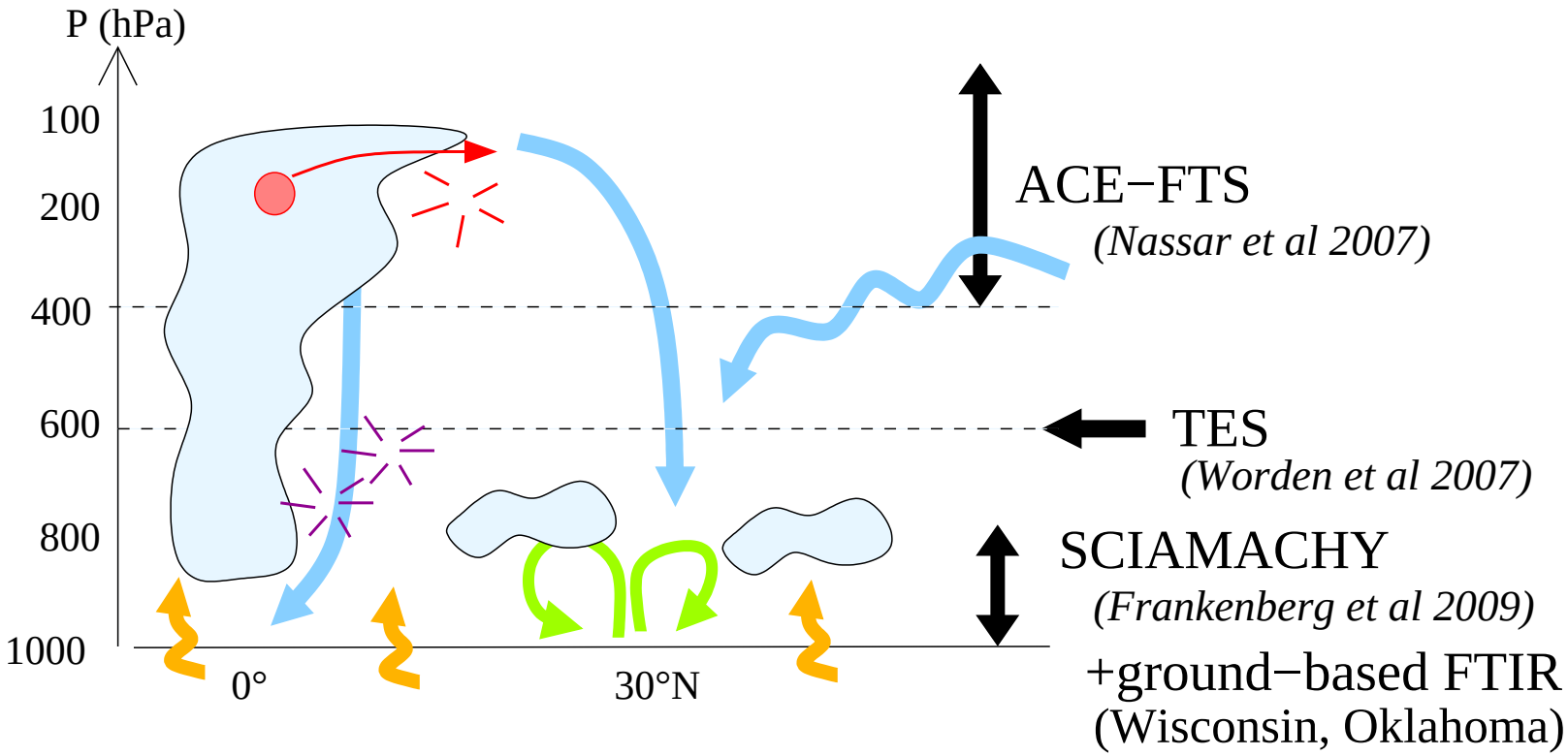

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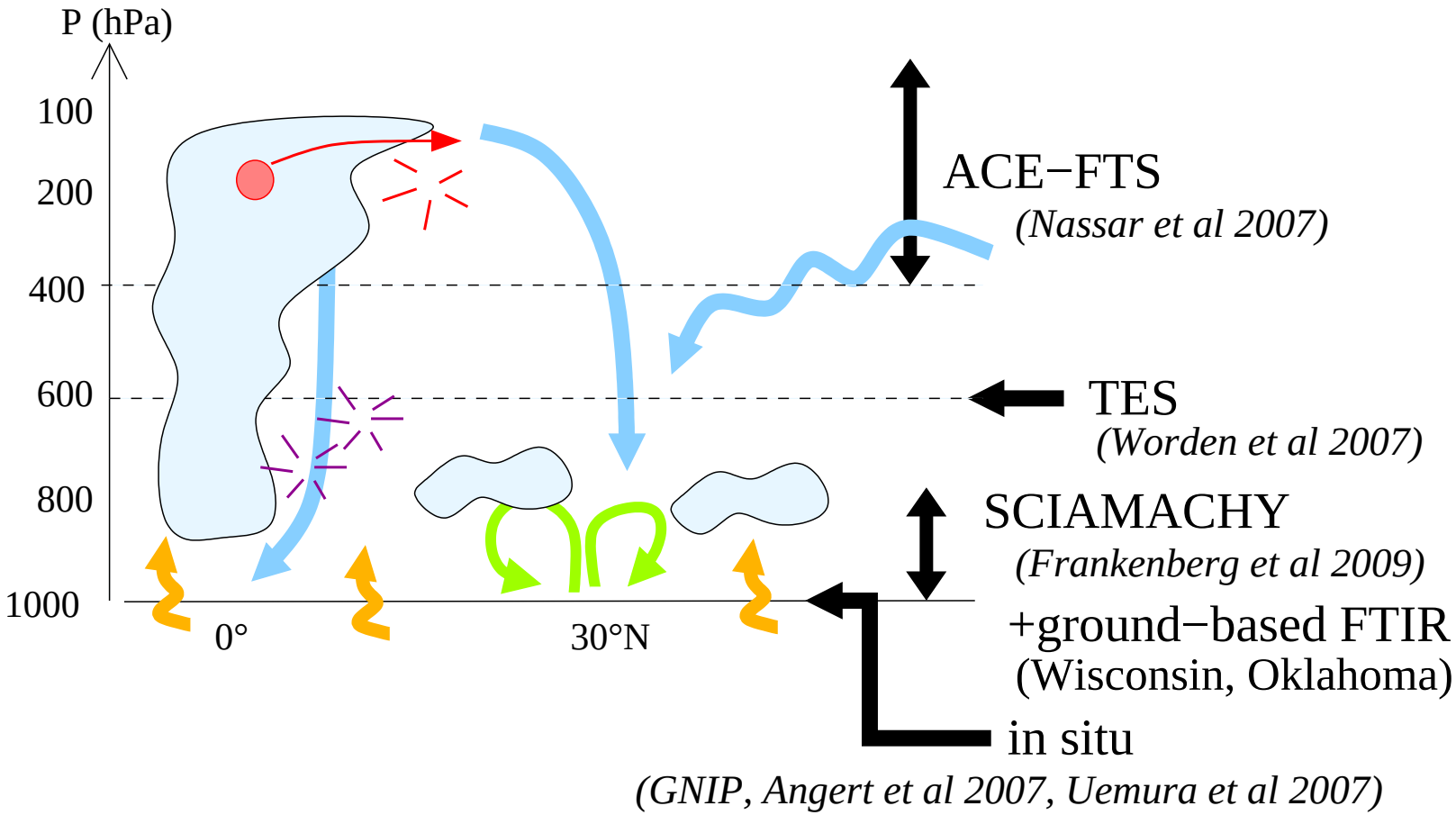

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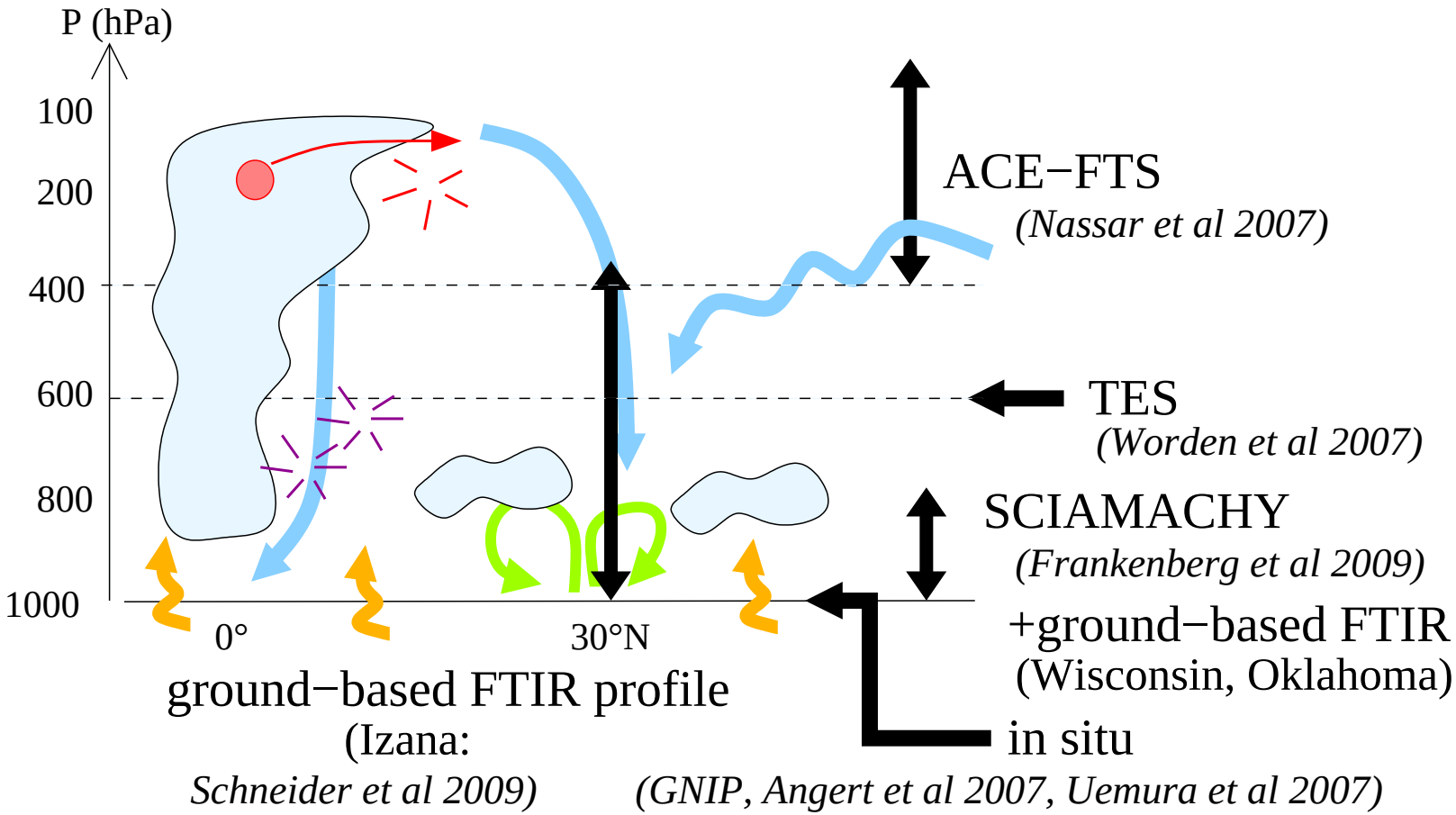

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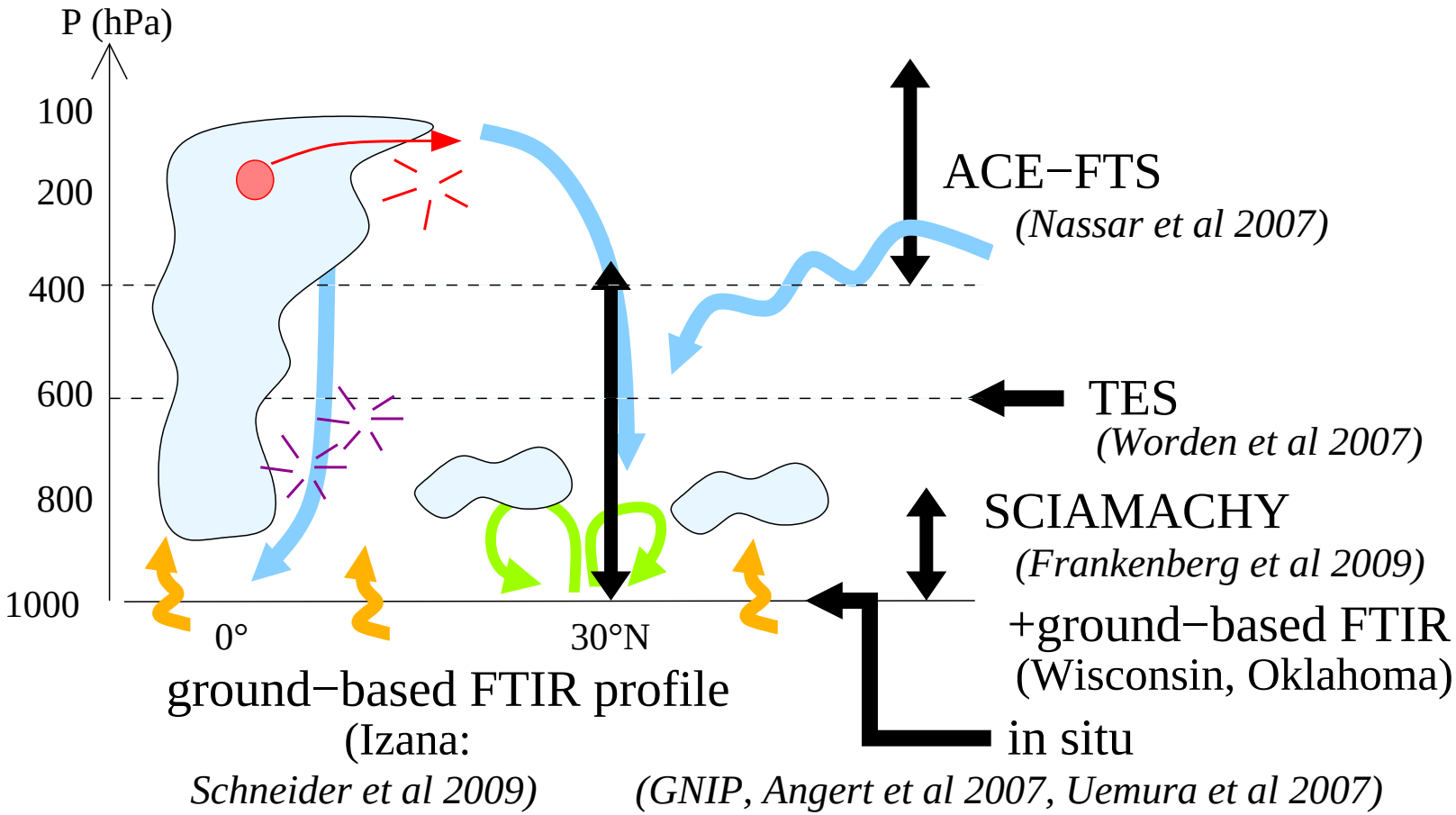

- quality screening

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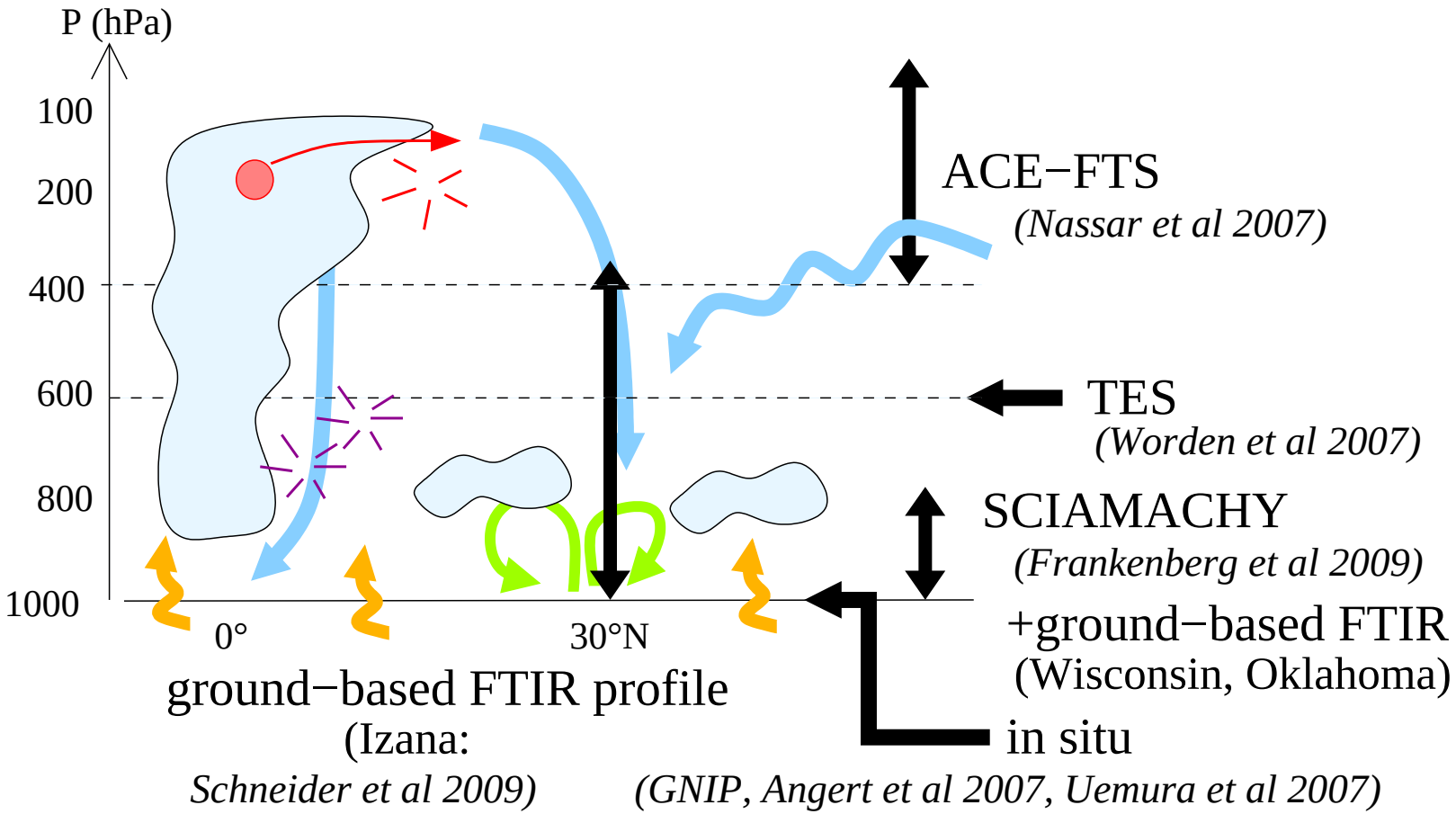
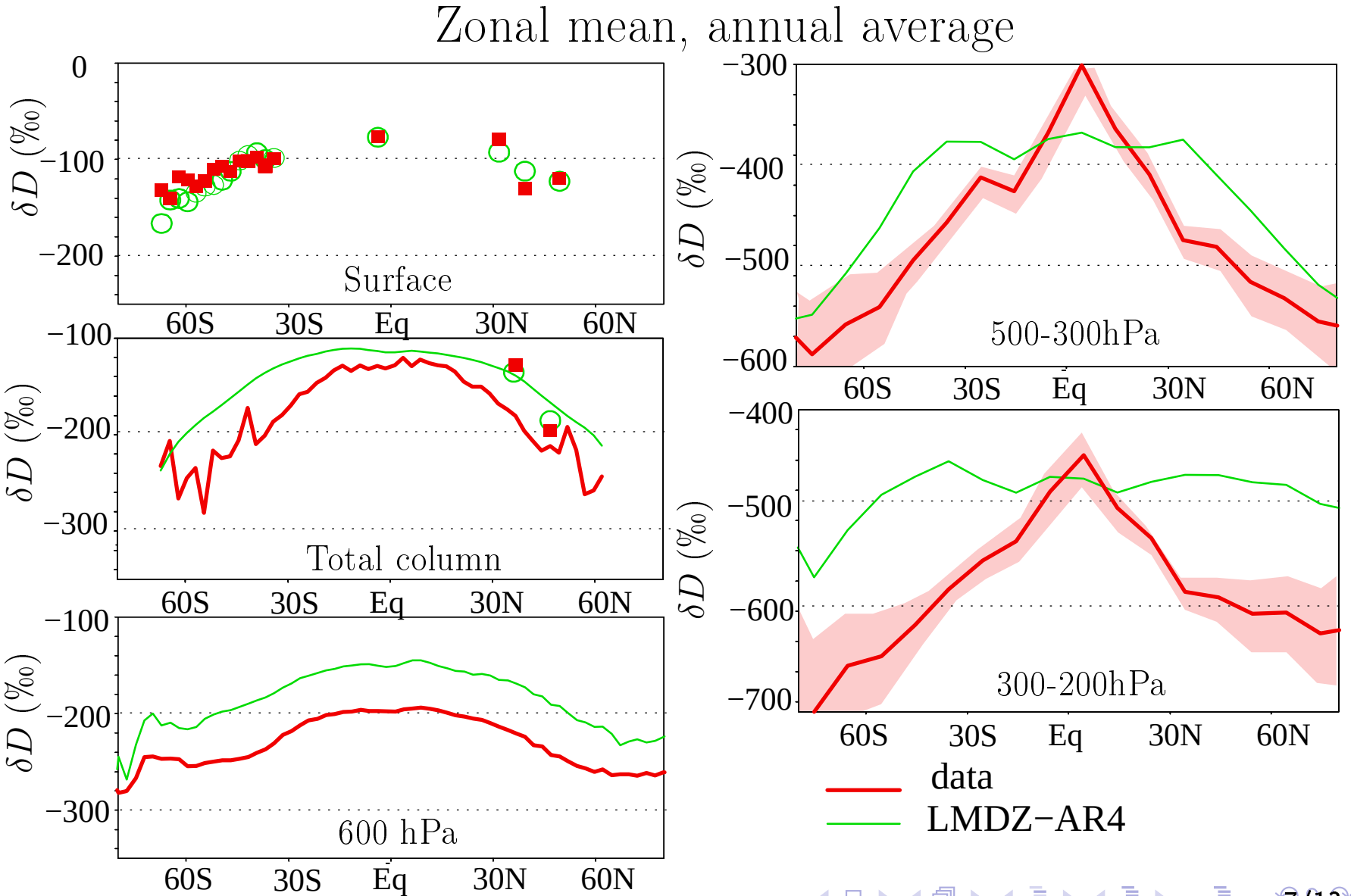


- quality screening
- GCM-data comparison: collocated with simulation nudged by ECMWF; averaging kernels

Multidataset evaluation: annual mean



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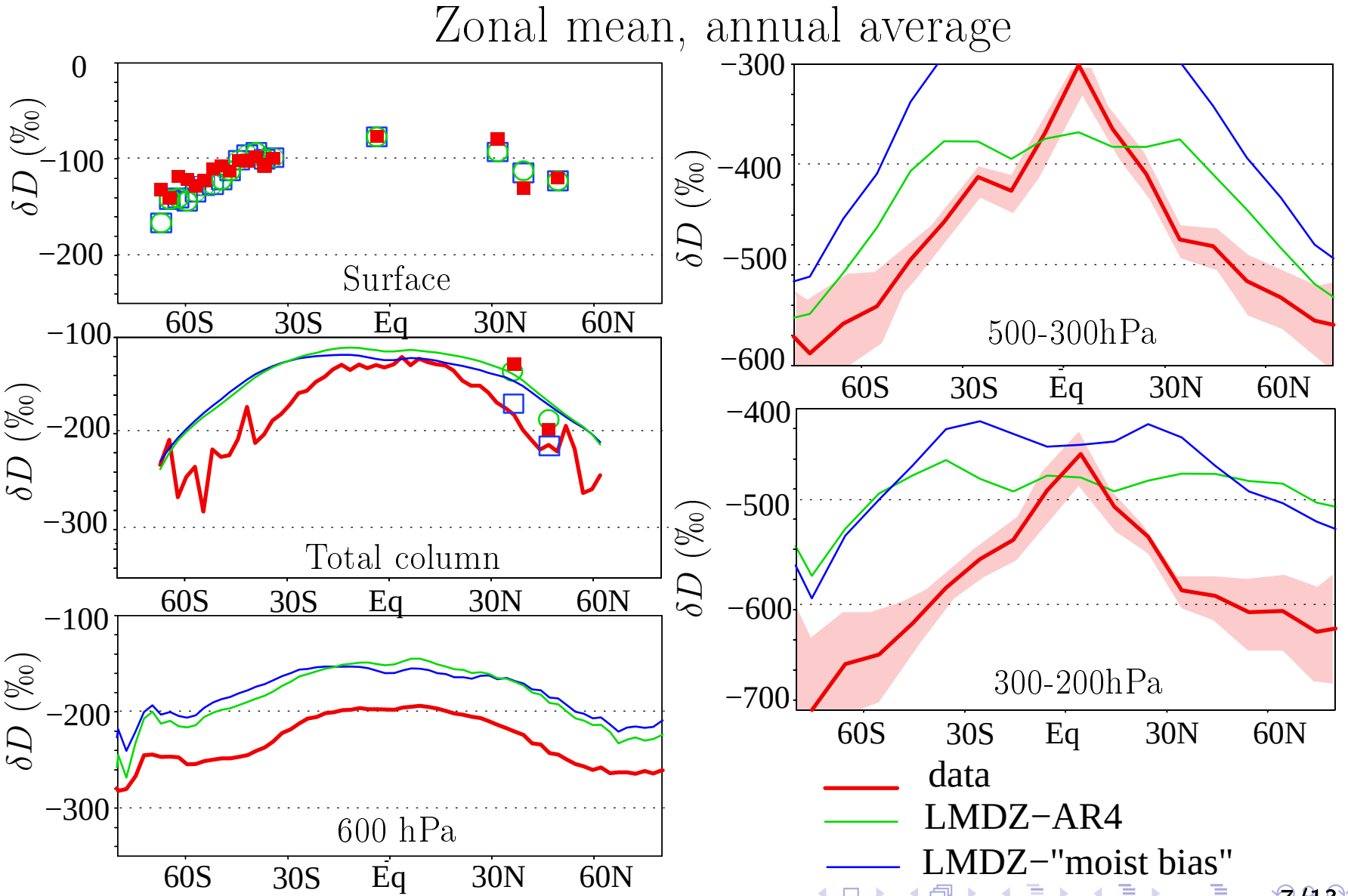
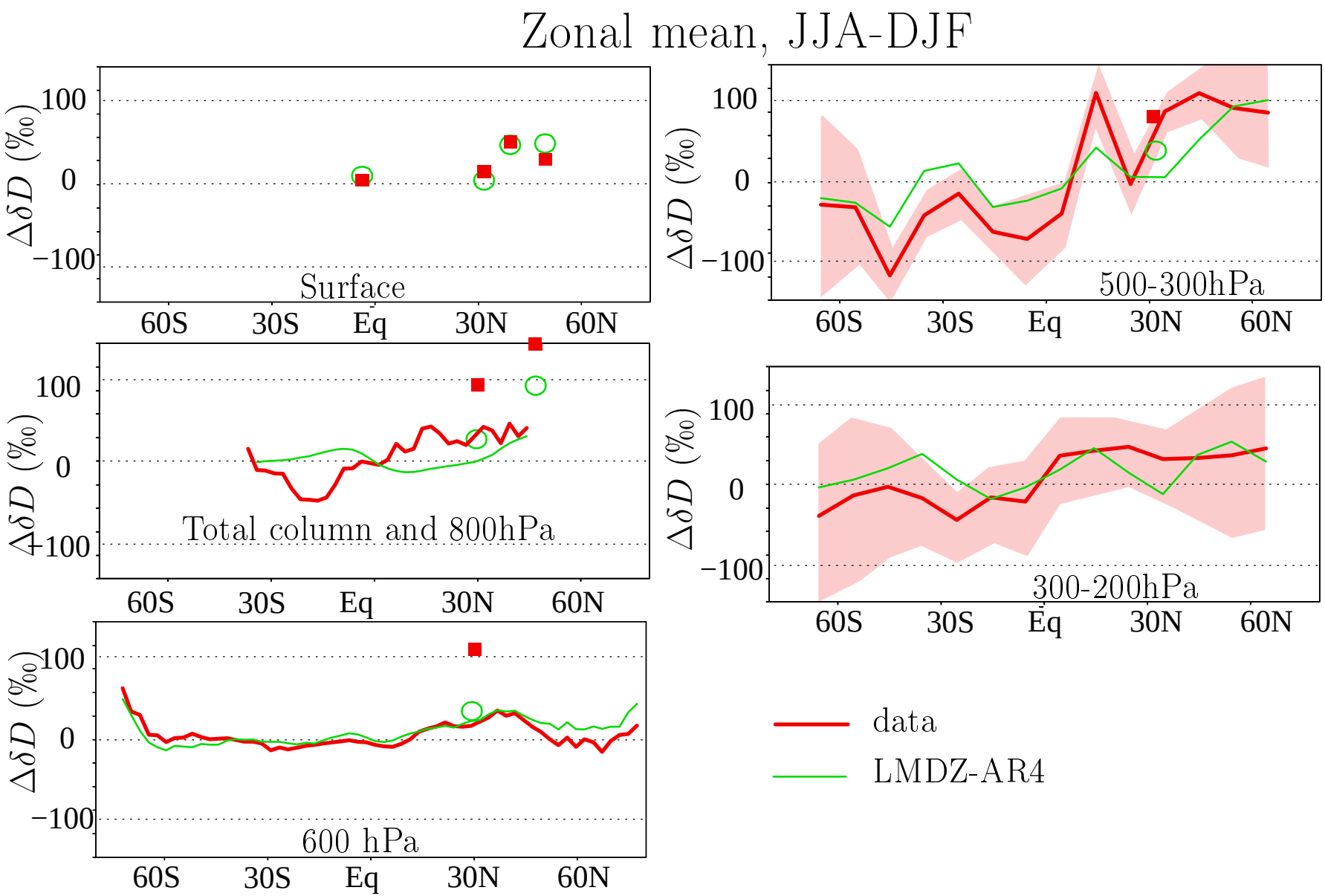


Multidataset evaluation: seasonal



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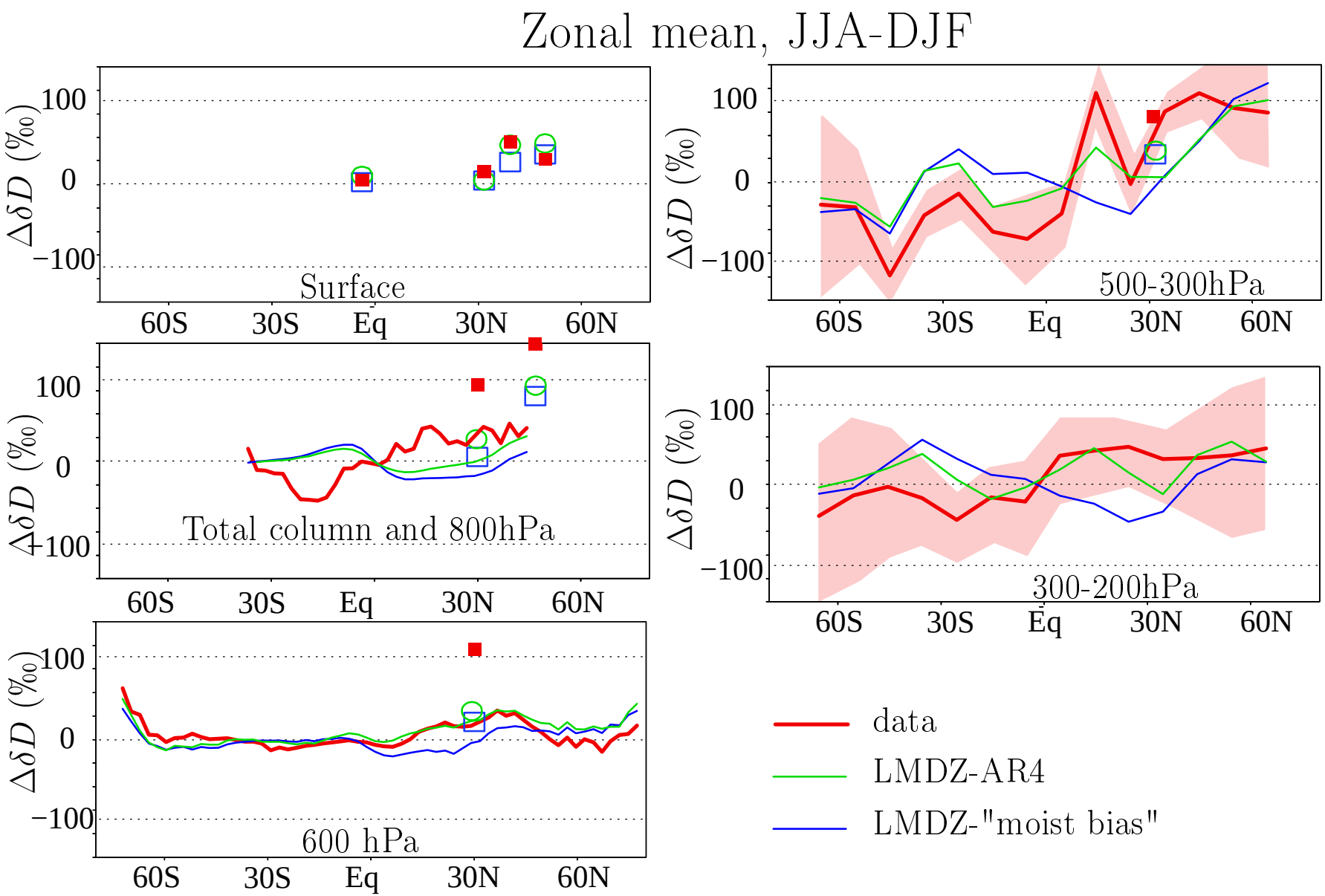
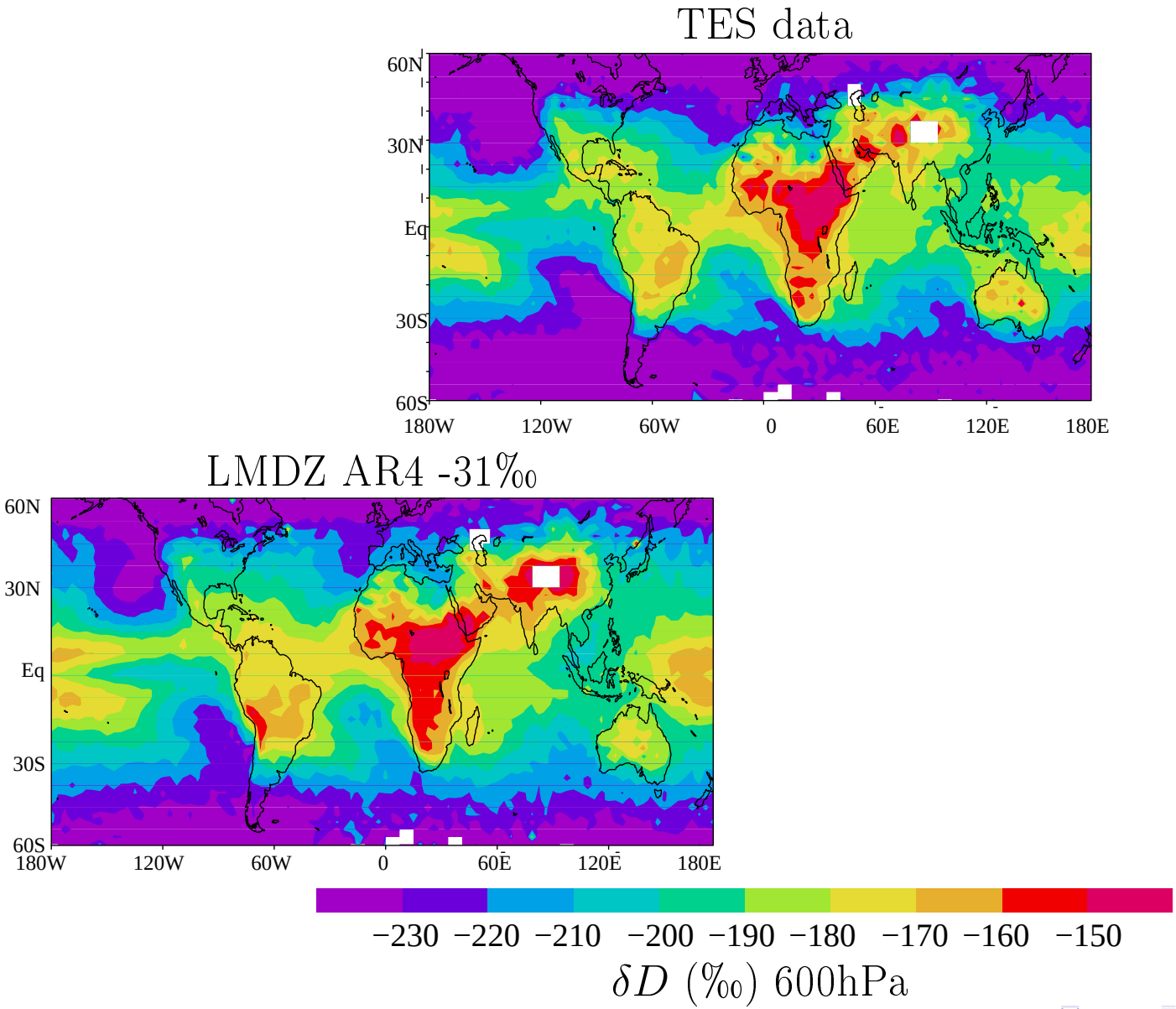


Annual mean in TES



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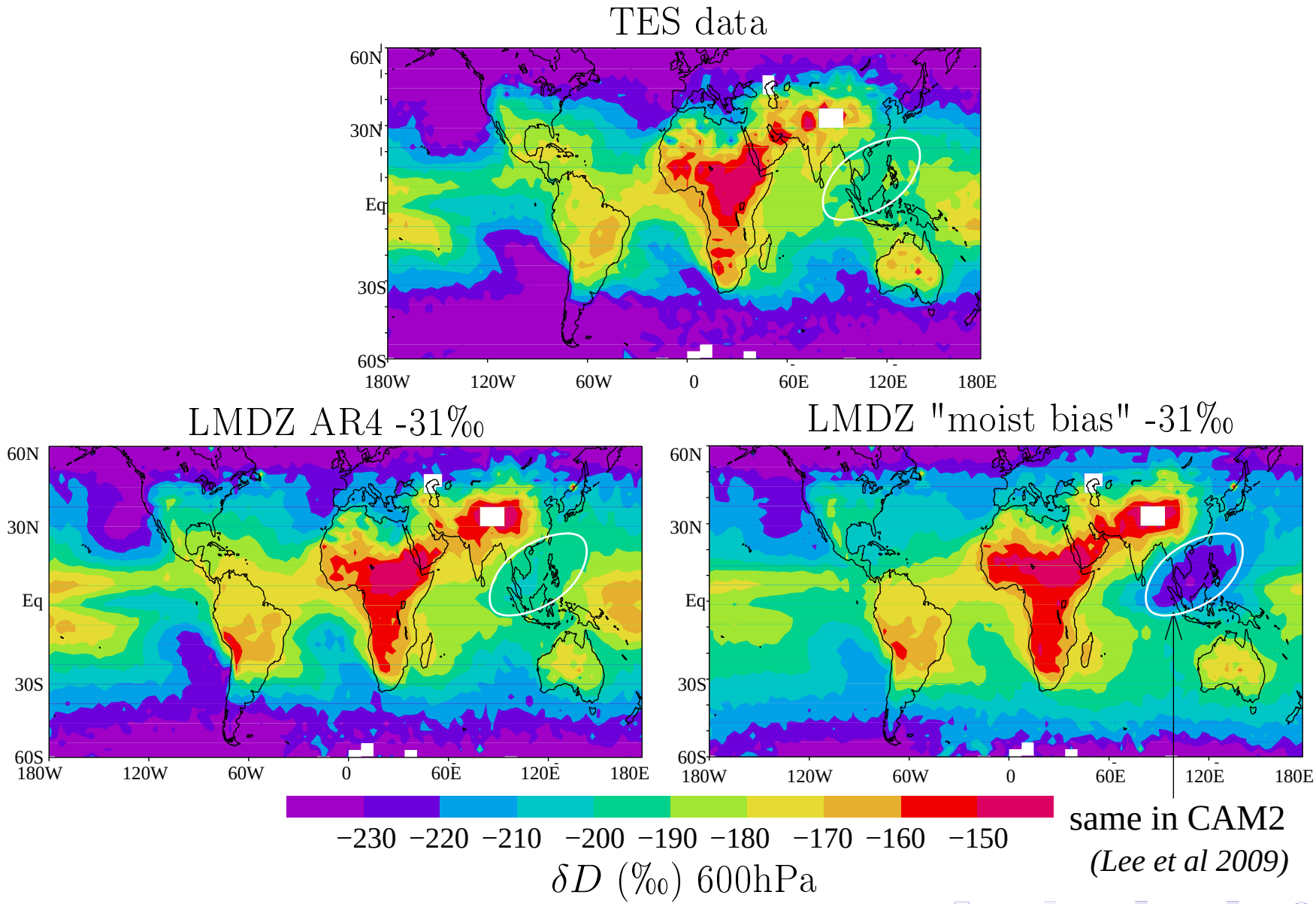

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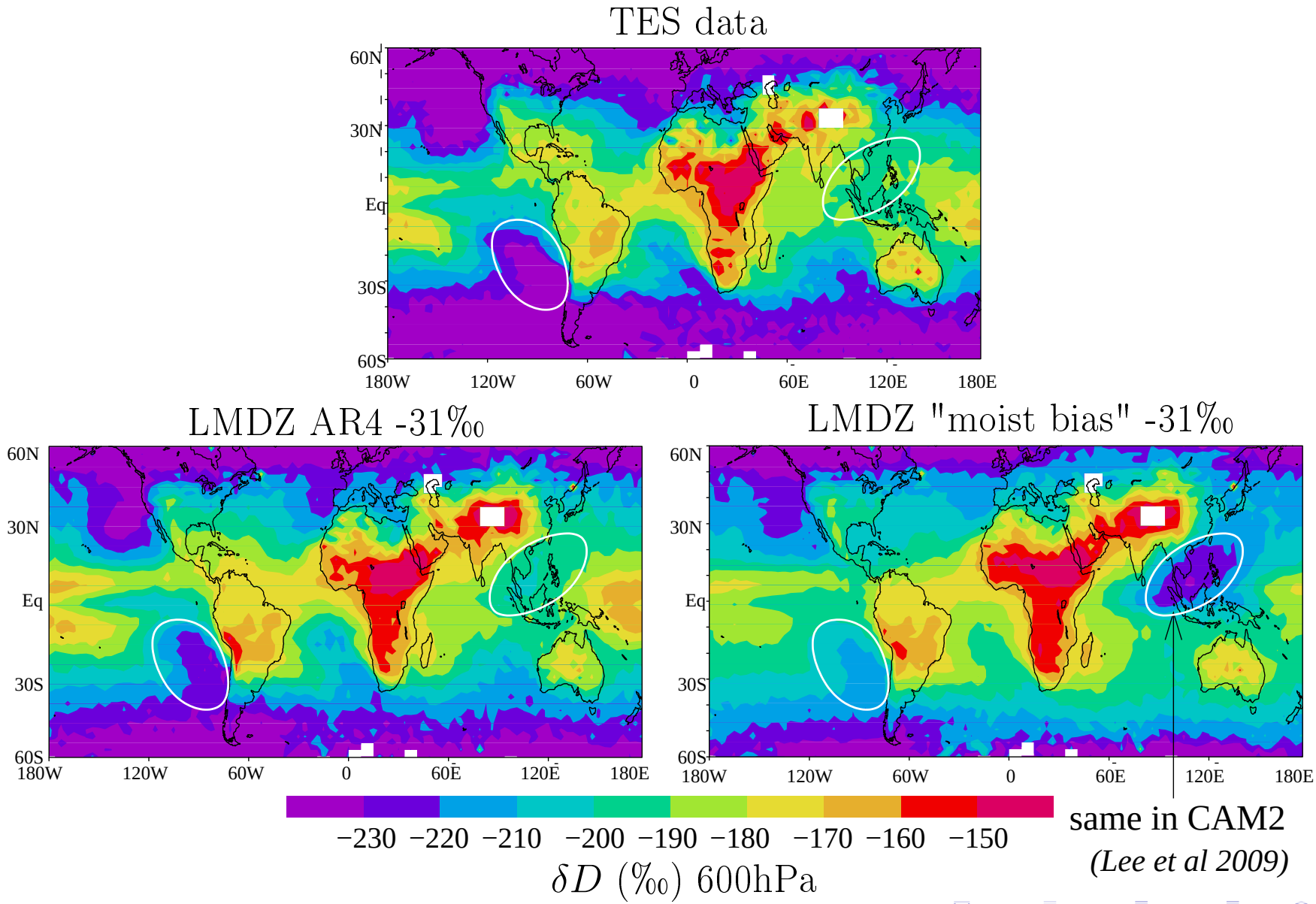
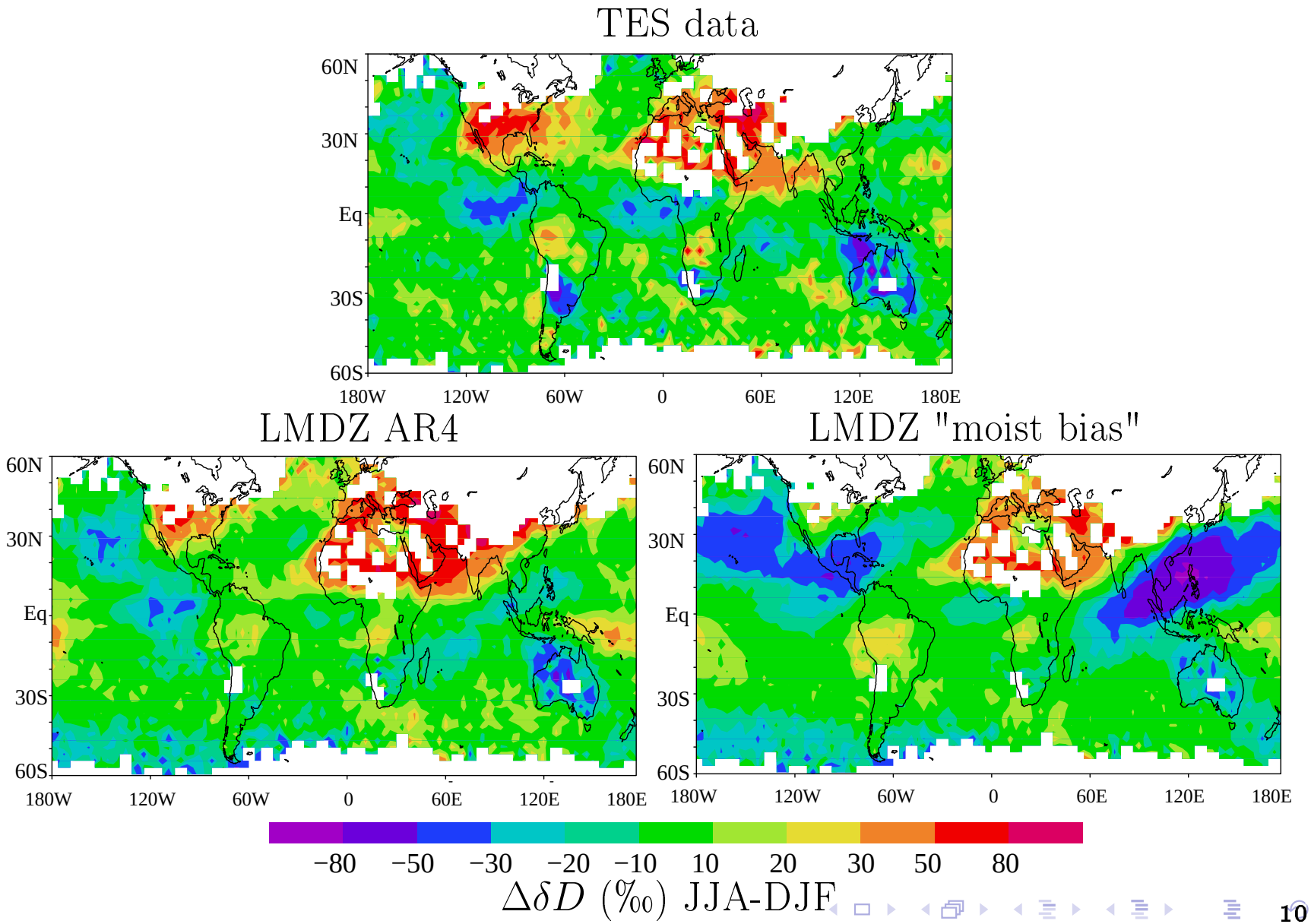
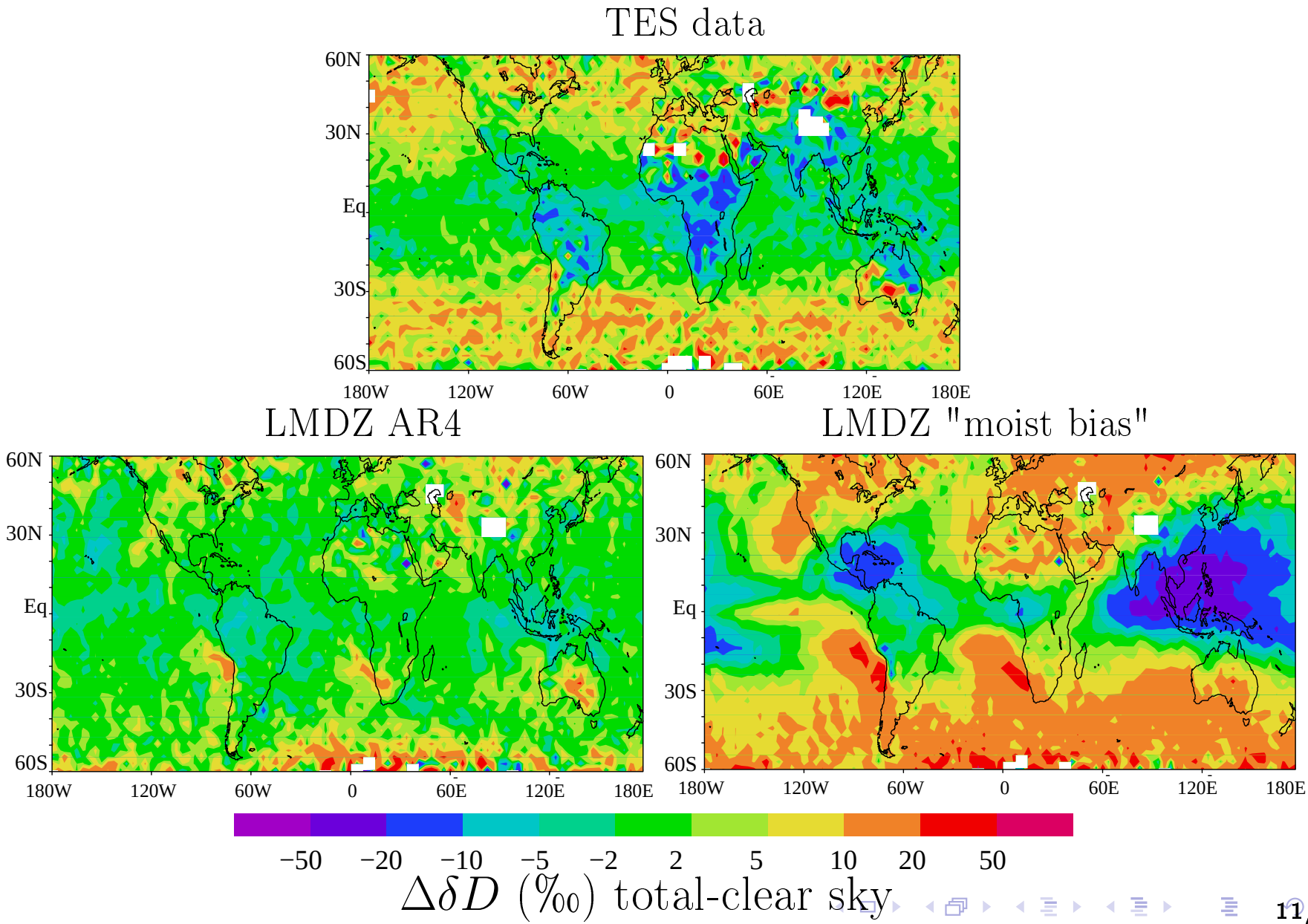


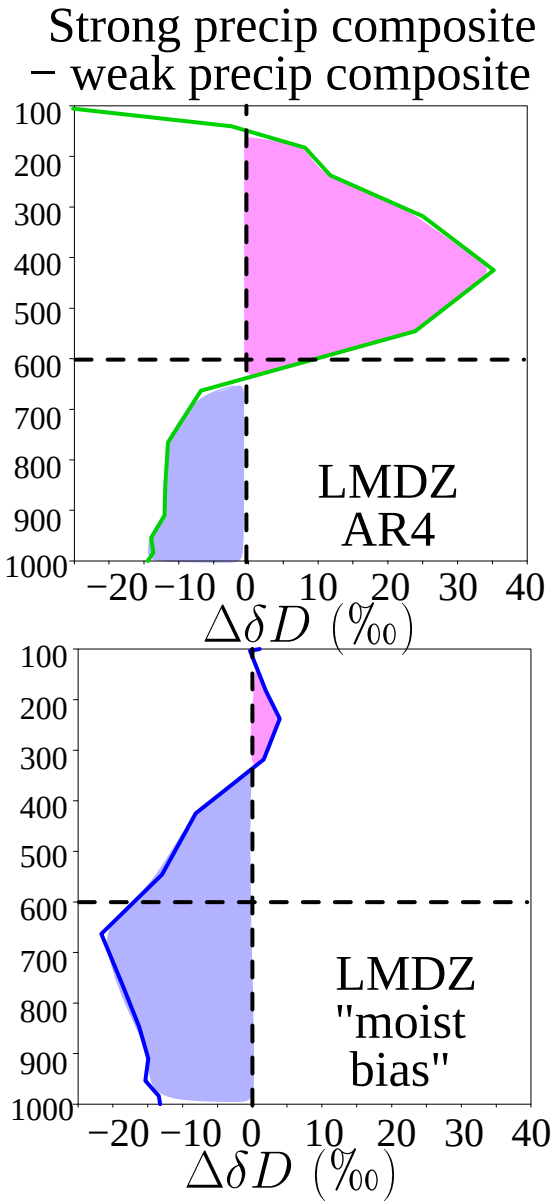
Seasonal variations in TES



Cloud effect in TES



Isotopes reveal dehydration pathways



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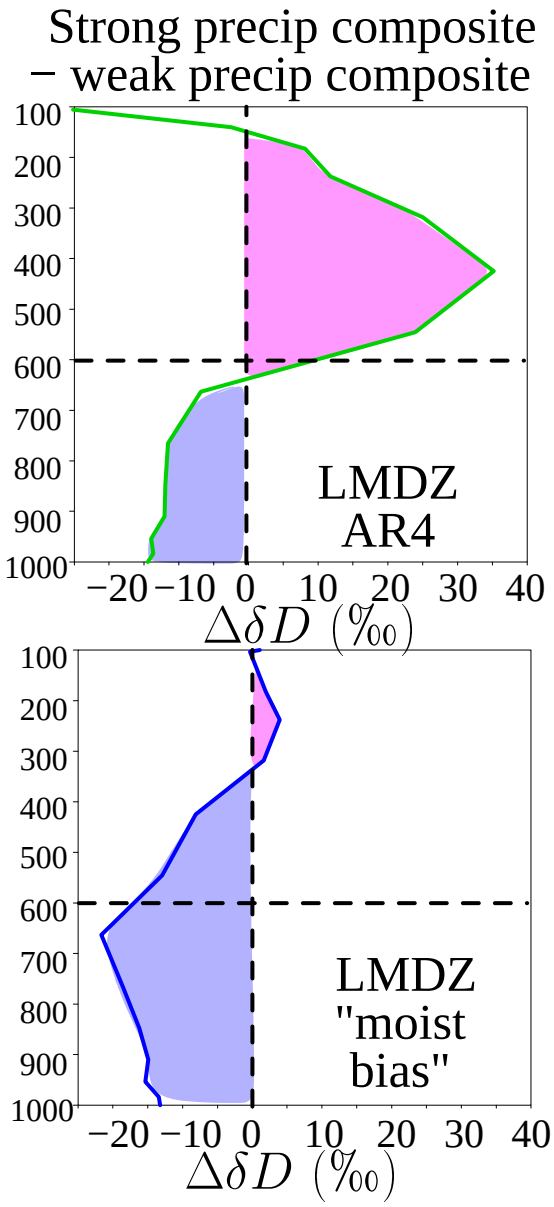

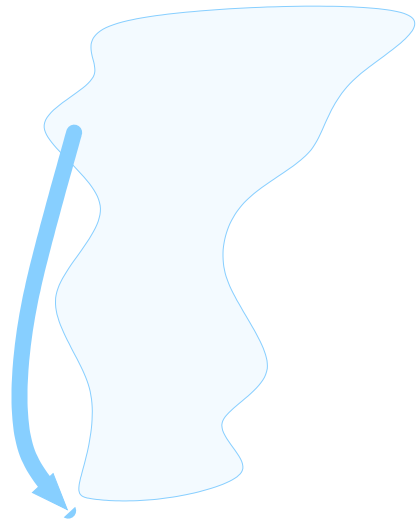

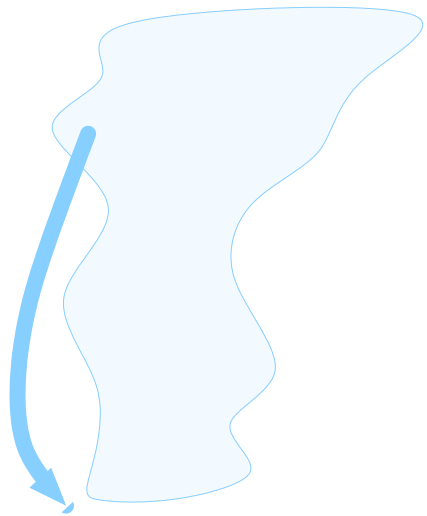

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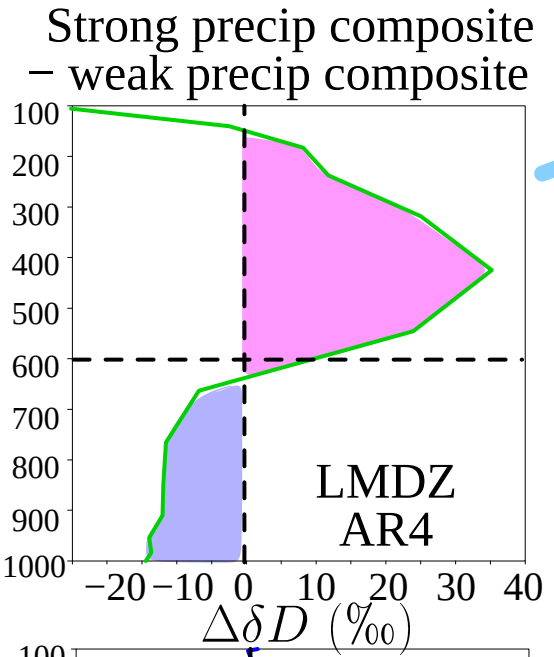

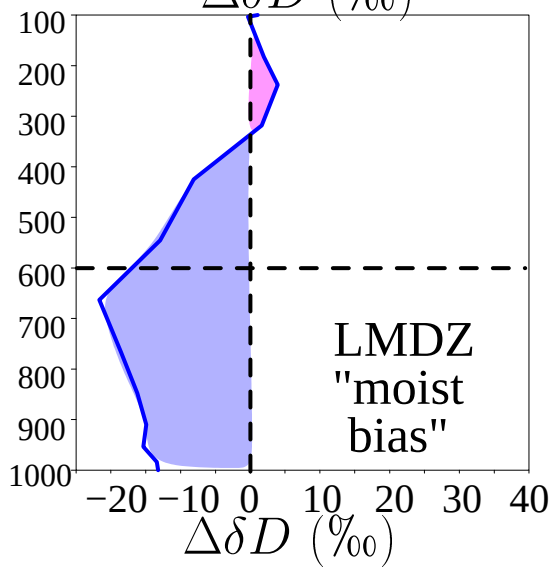

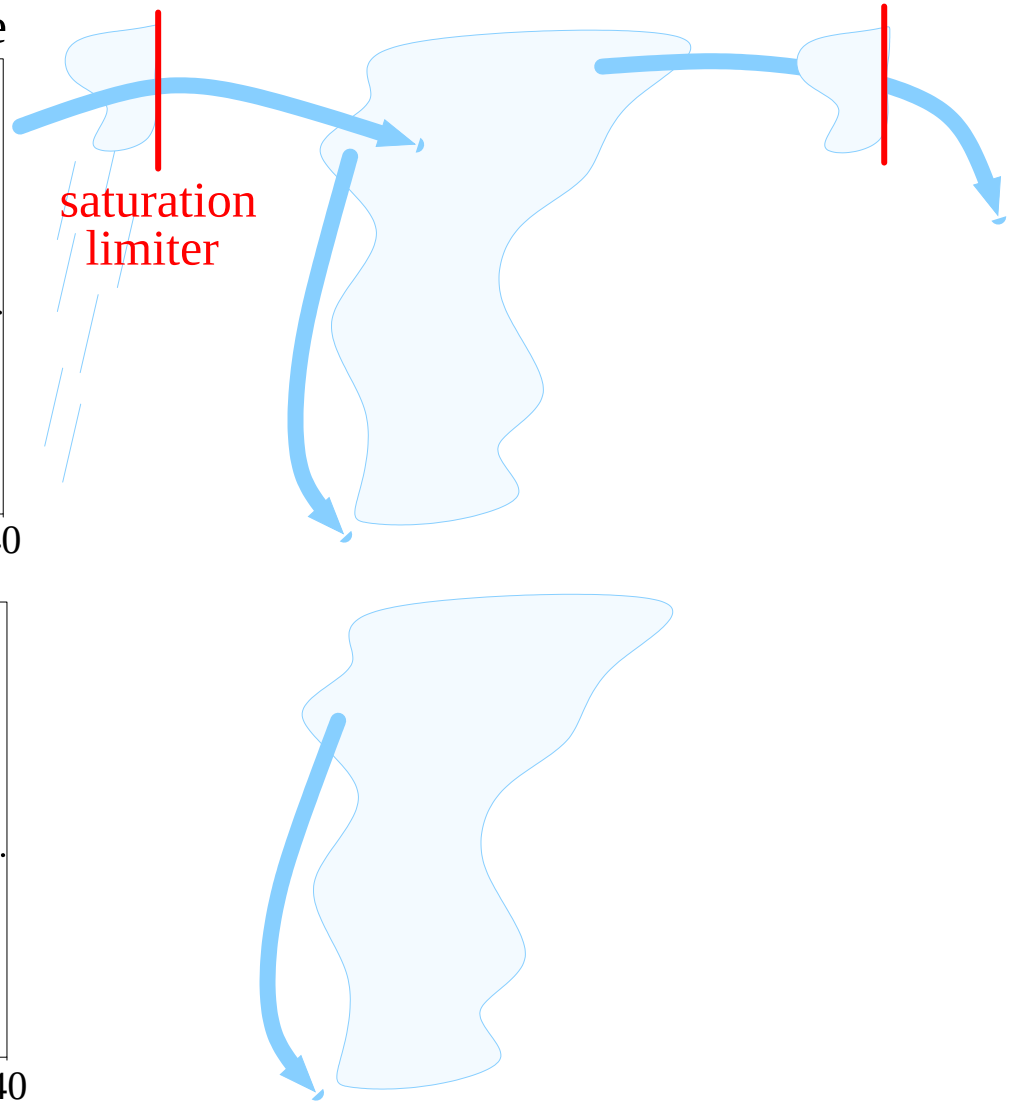

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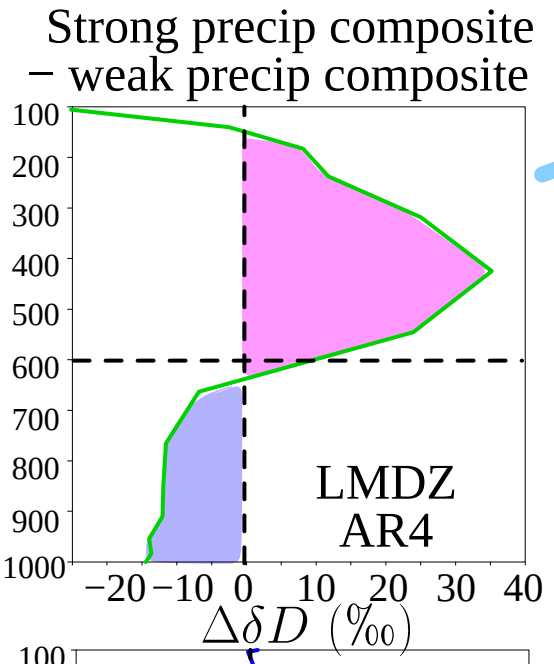

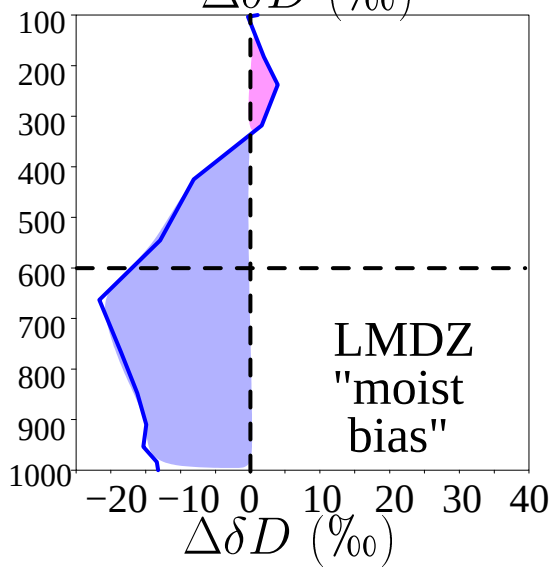

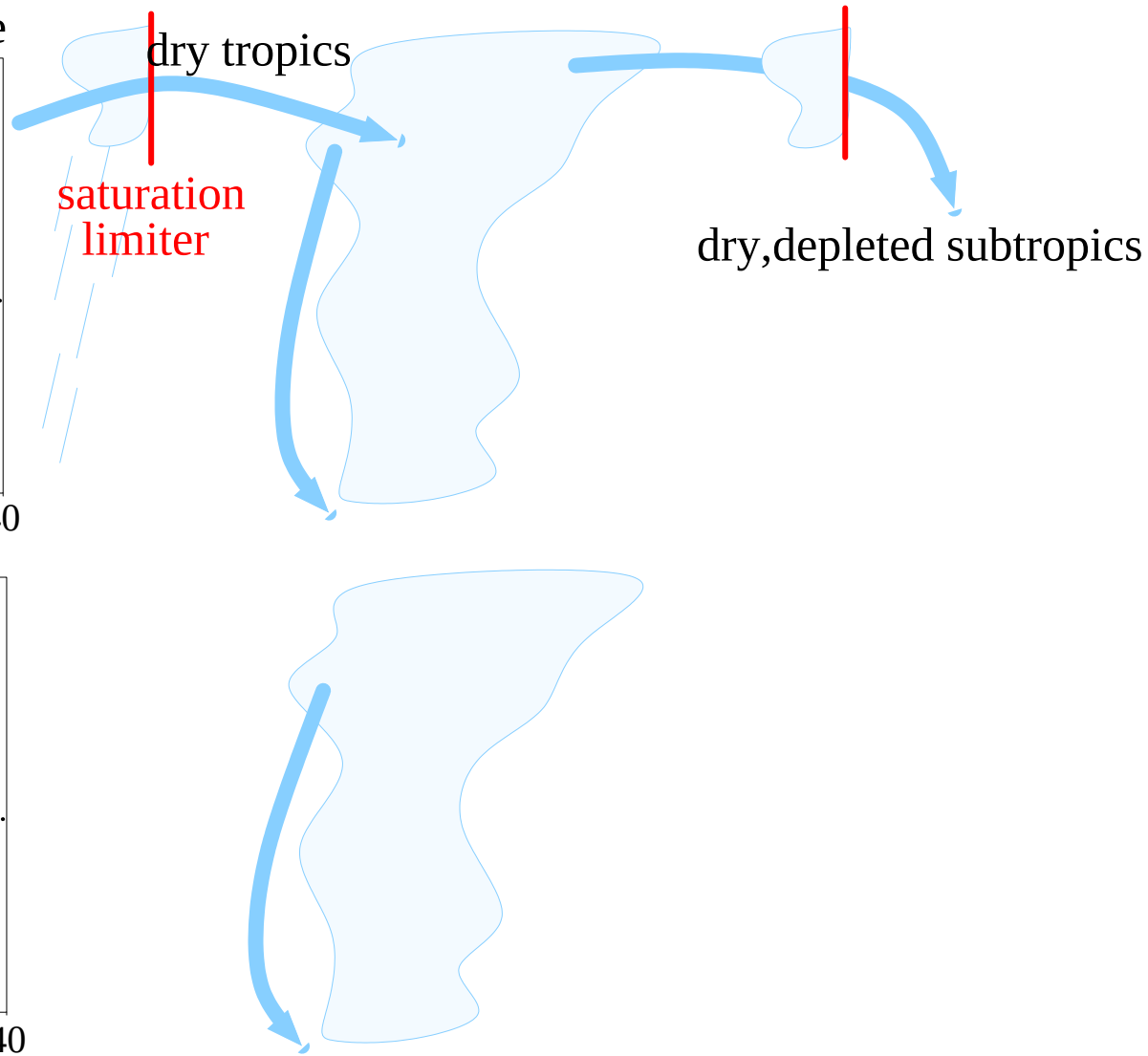

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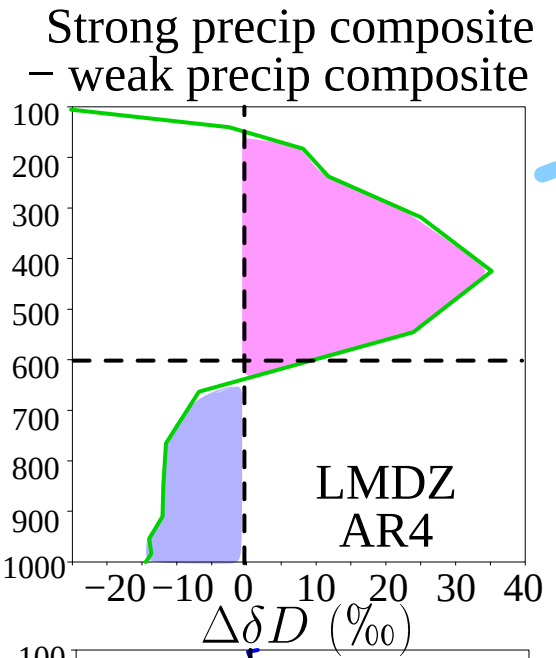

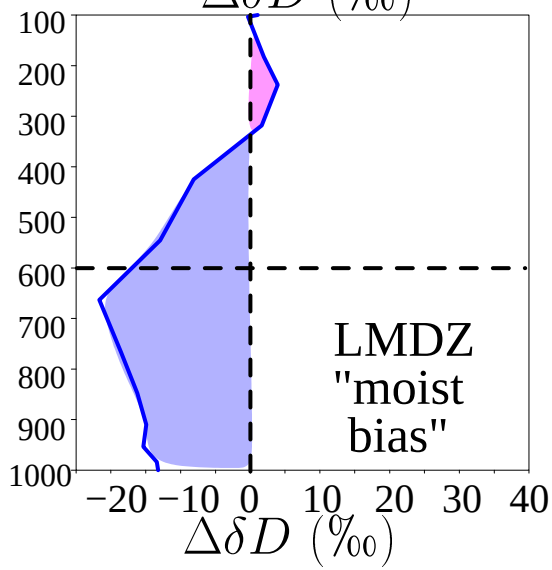

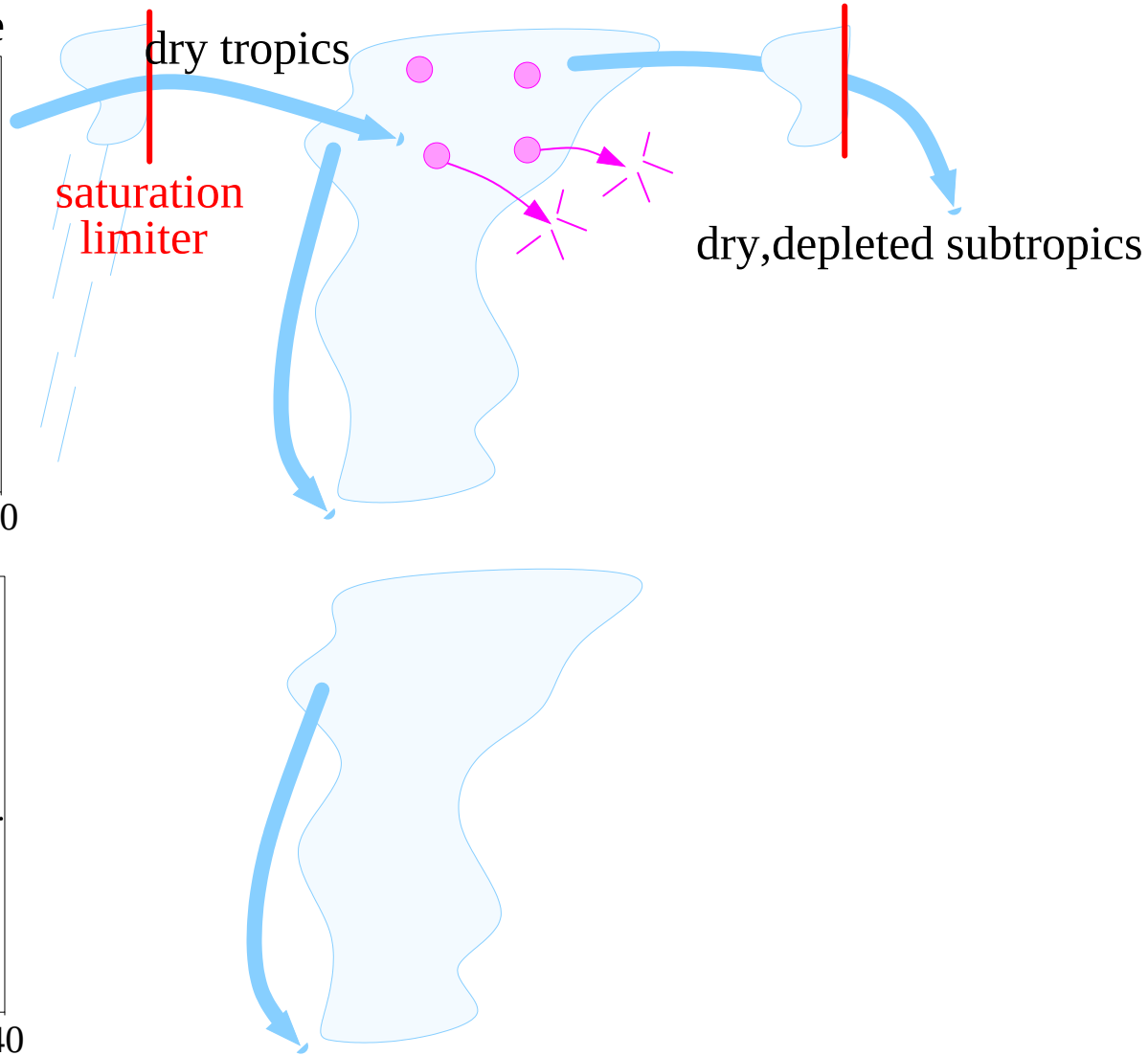

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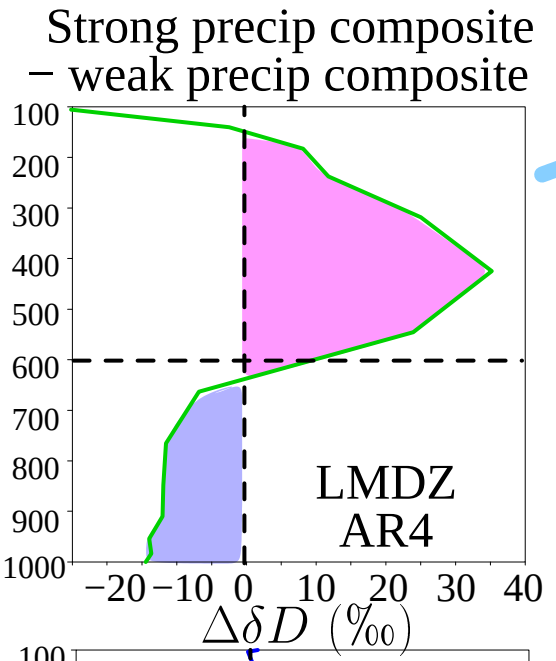

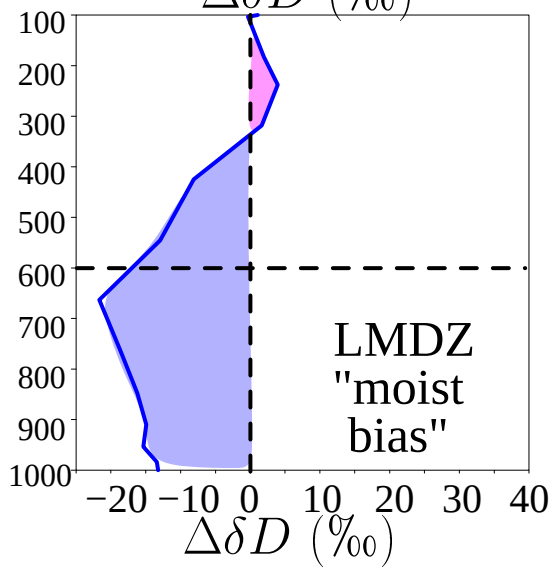

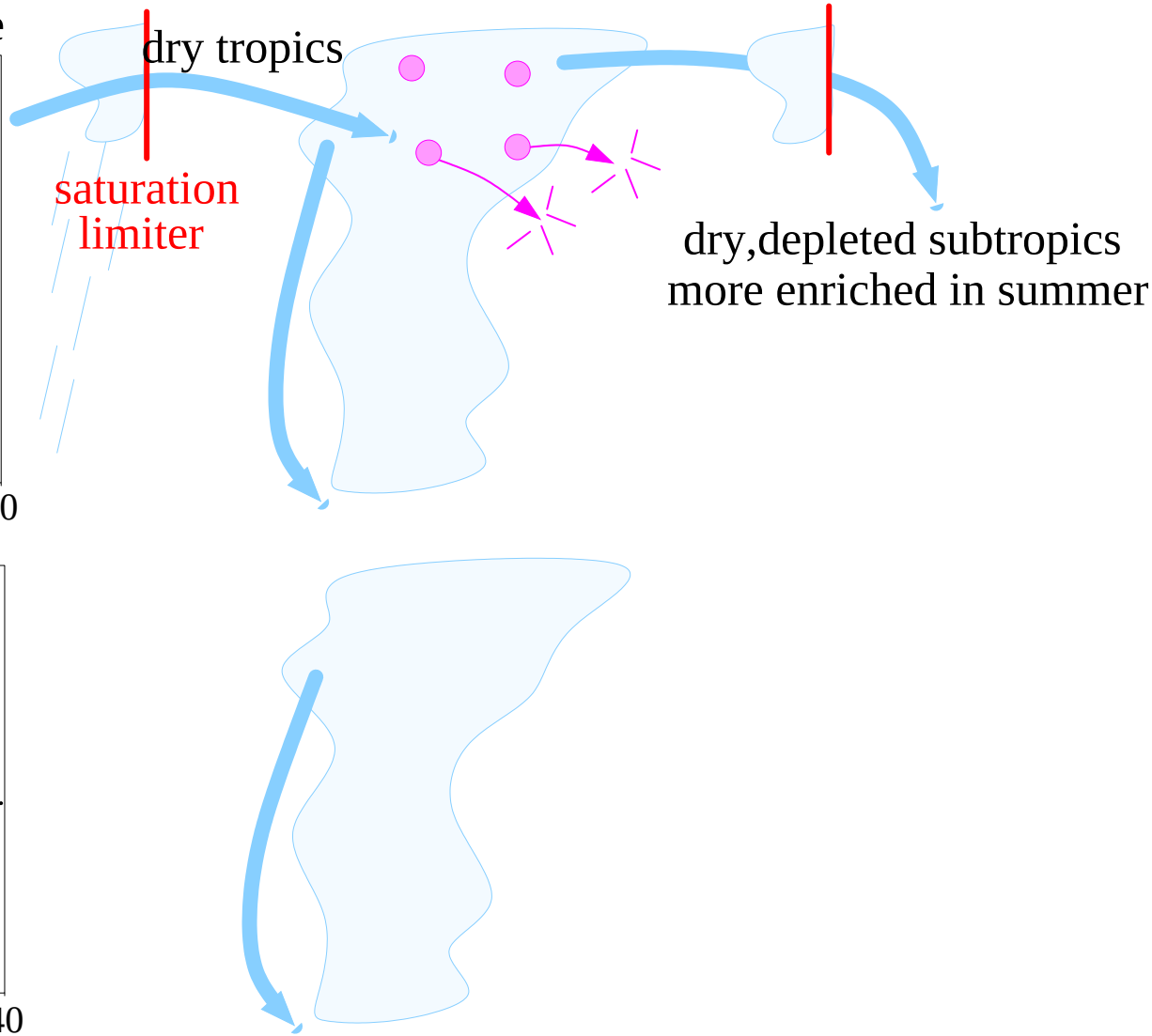

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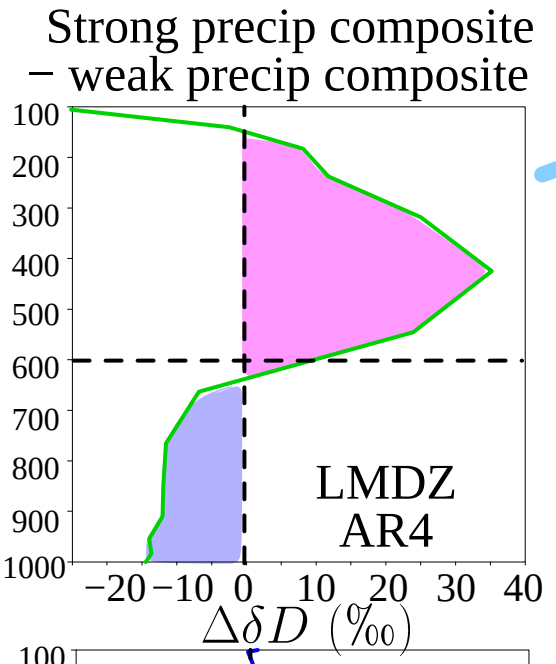

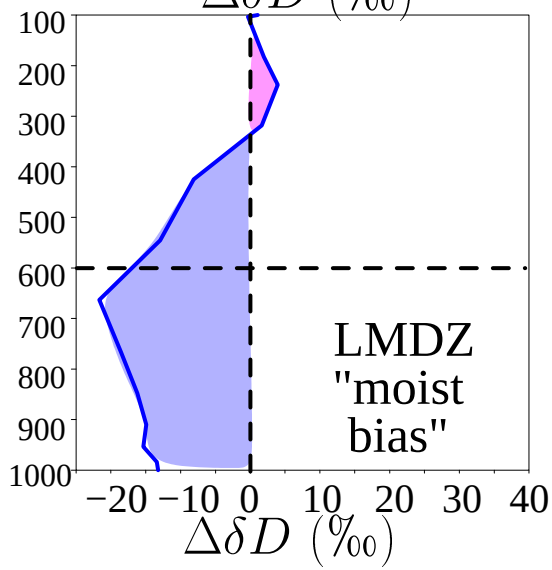

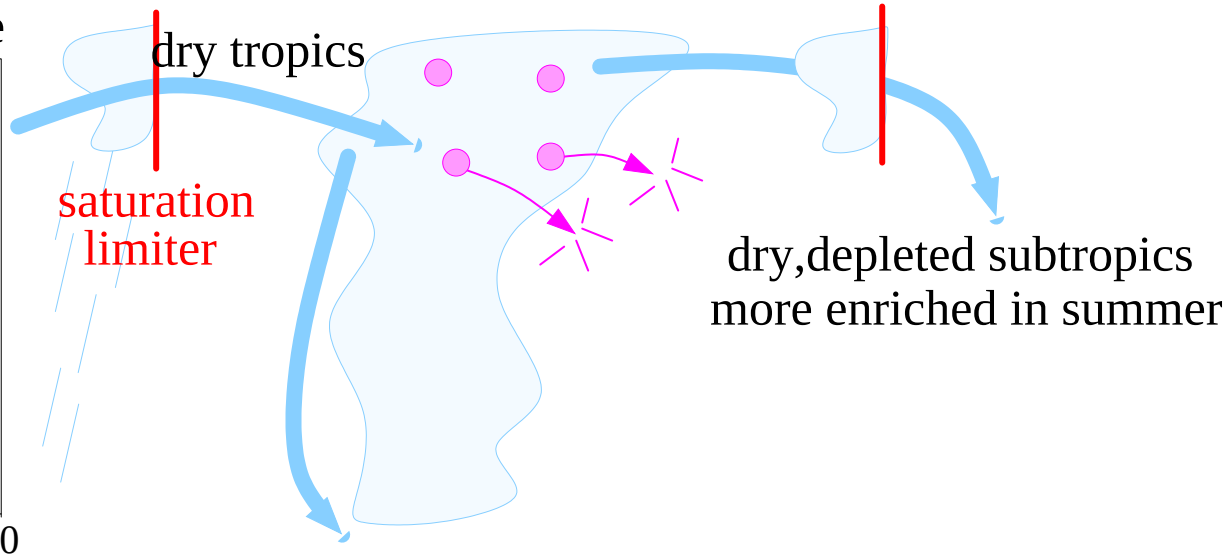

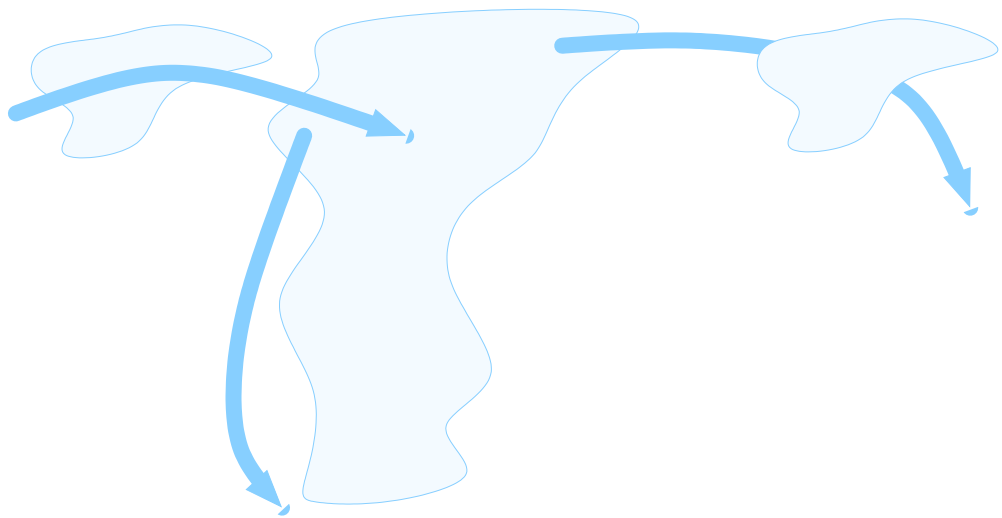

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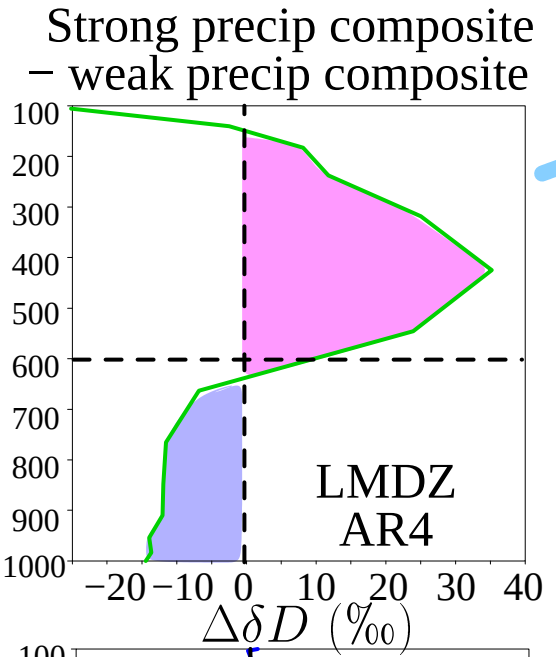

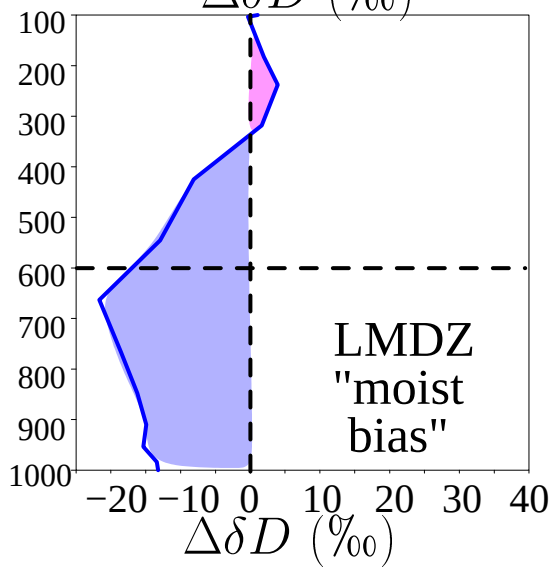

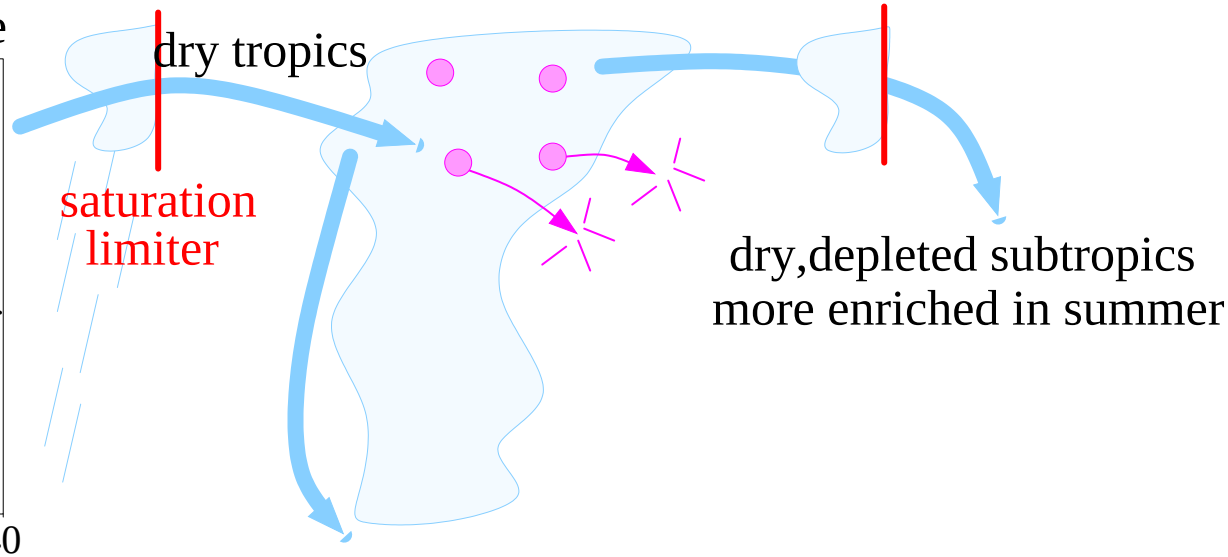

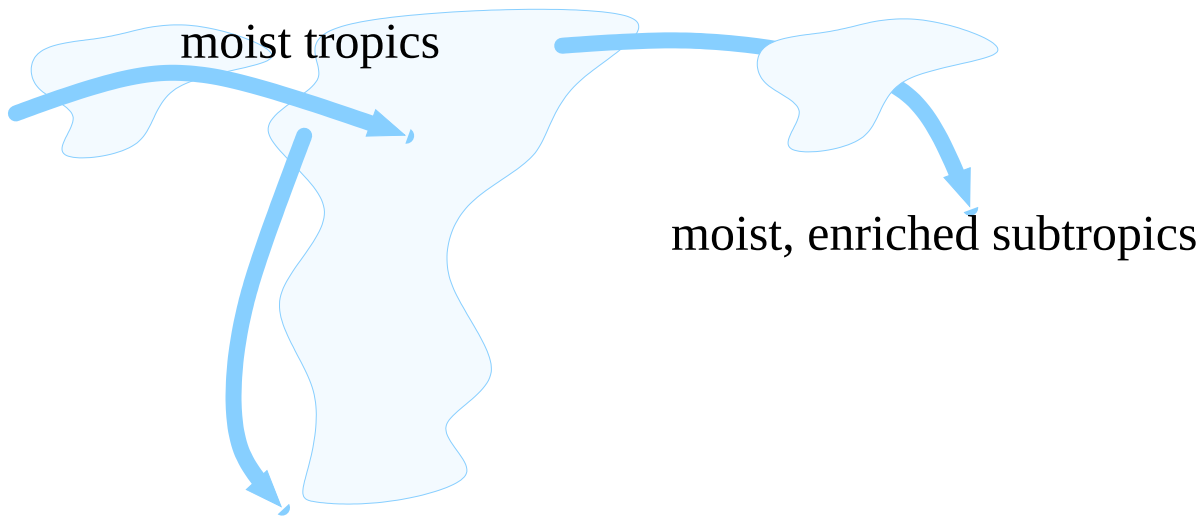

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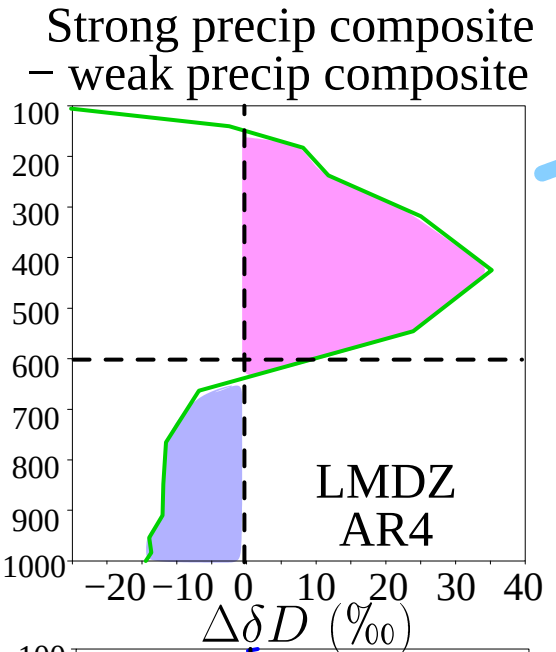

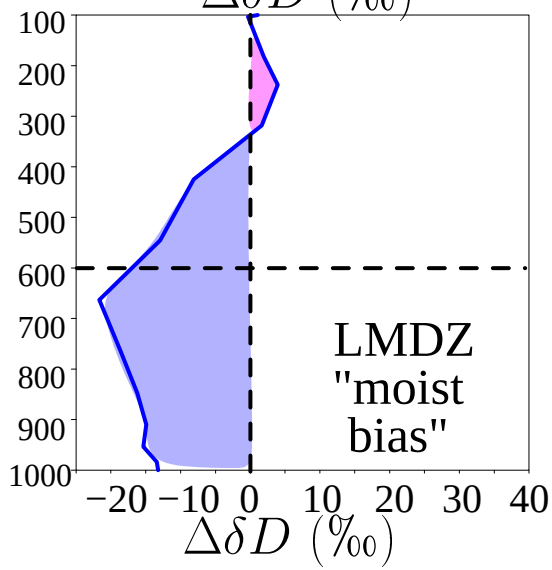

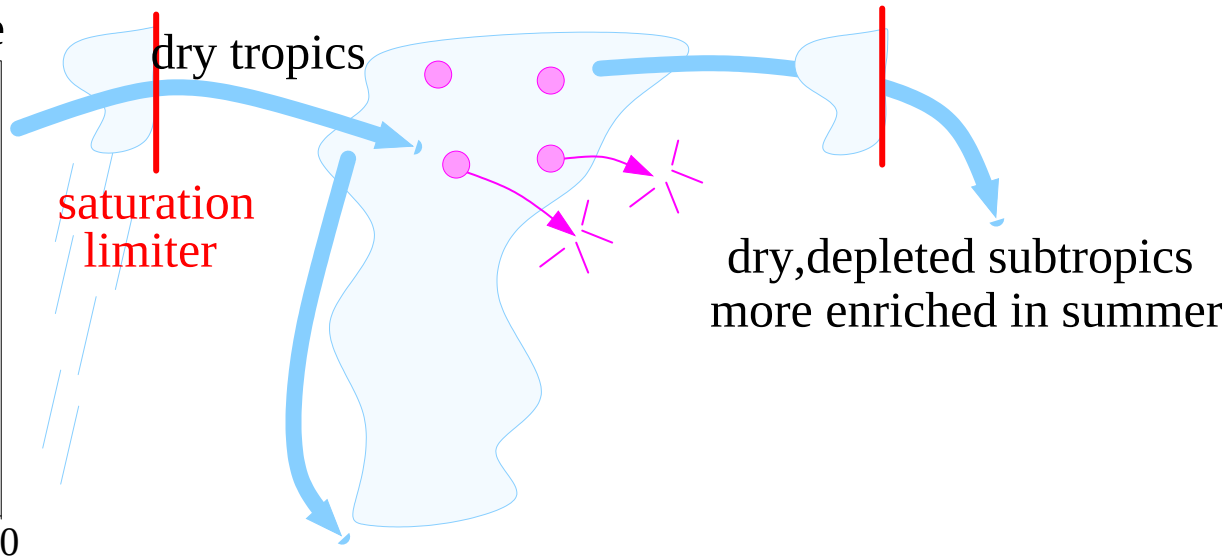

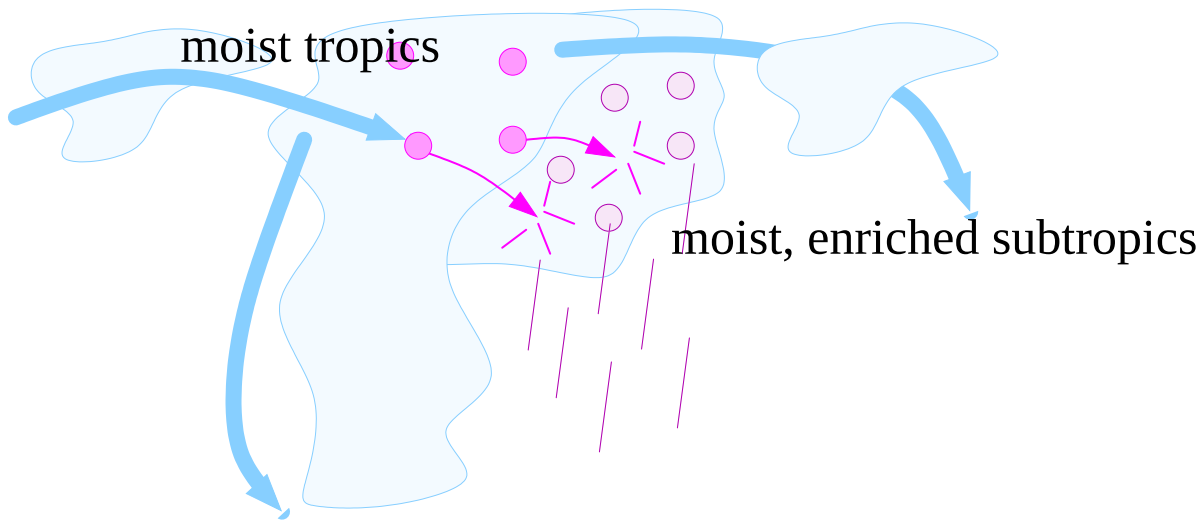

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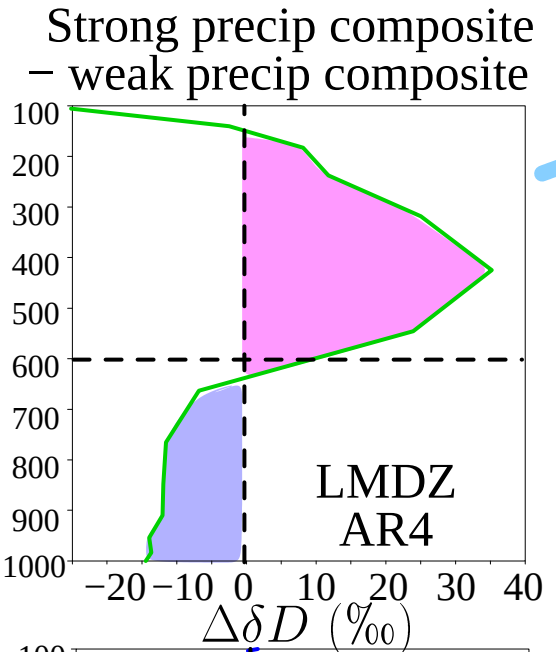

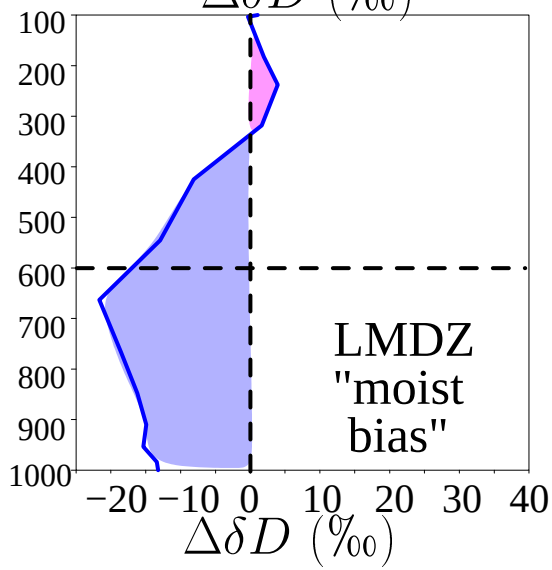

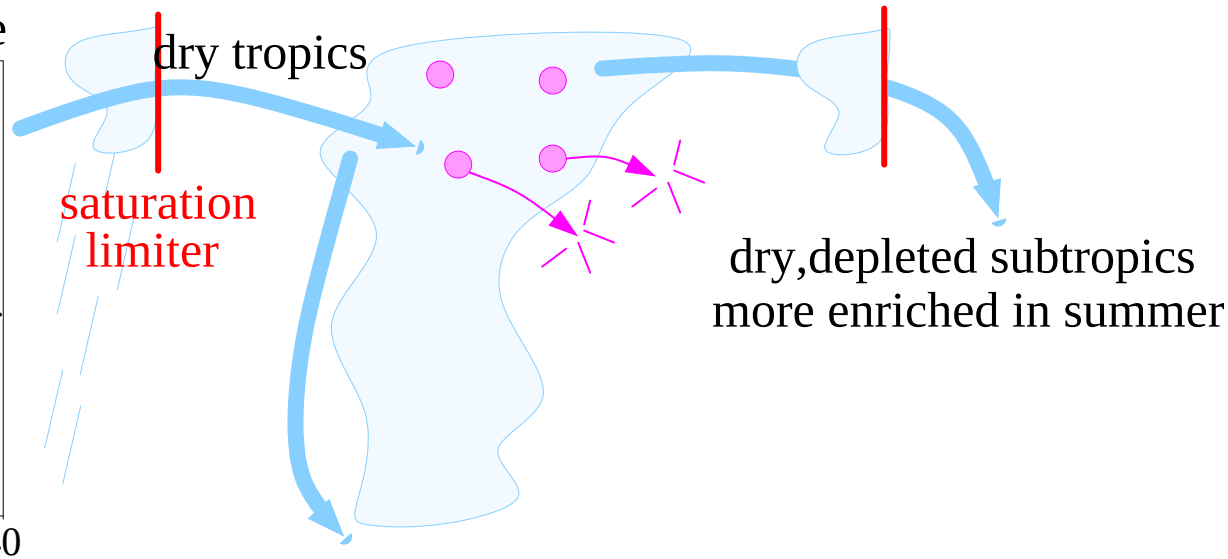

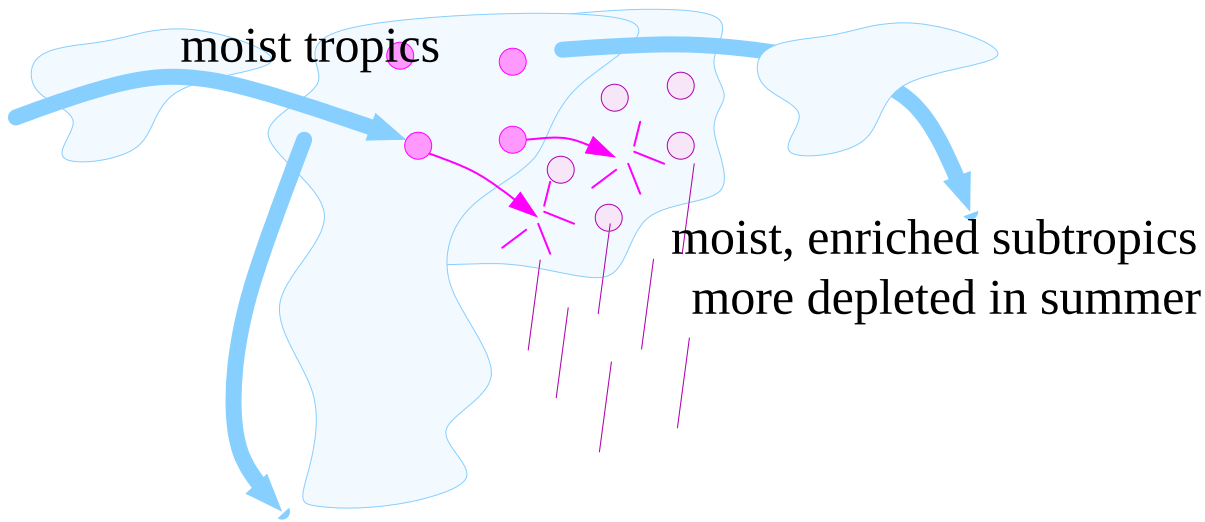

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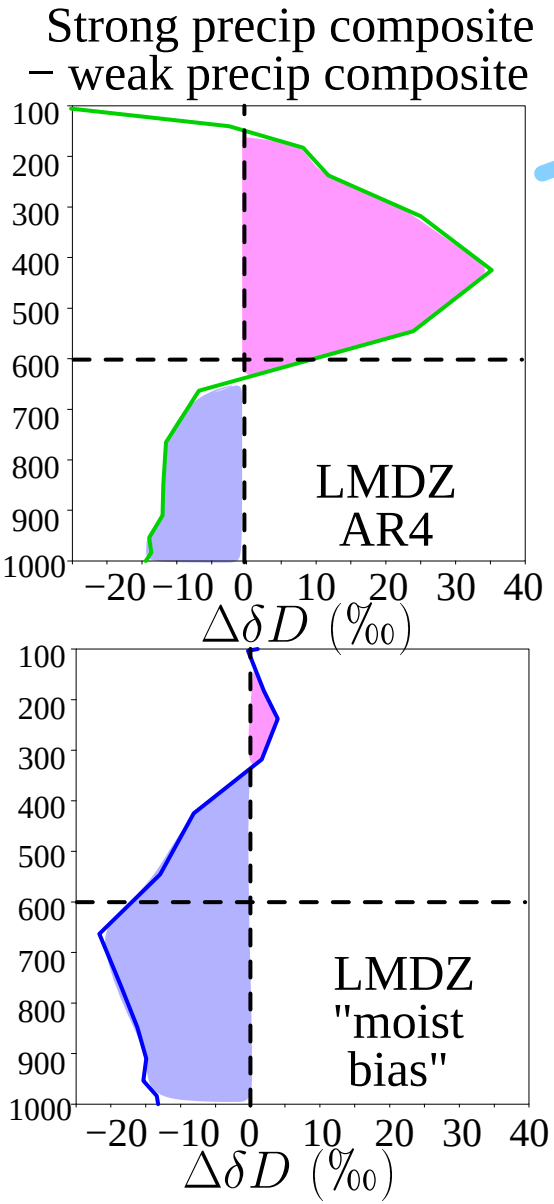

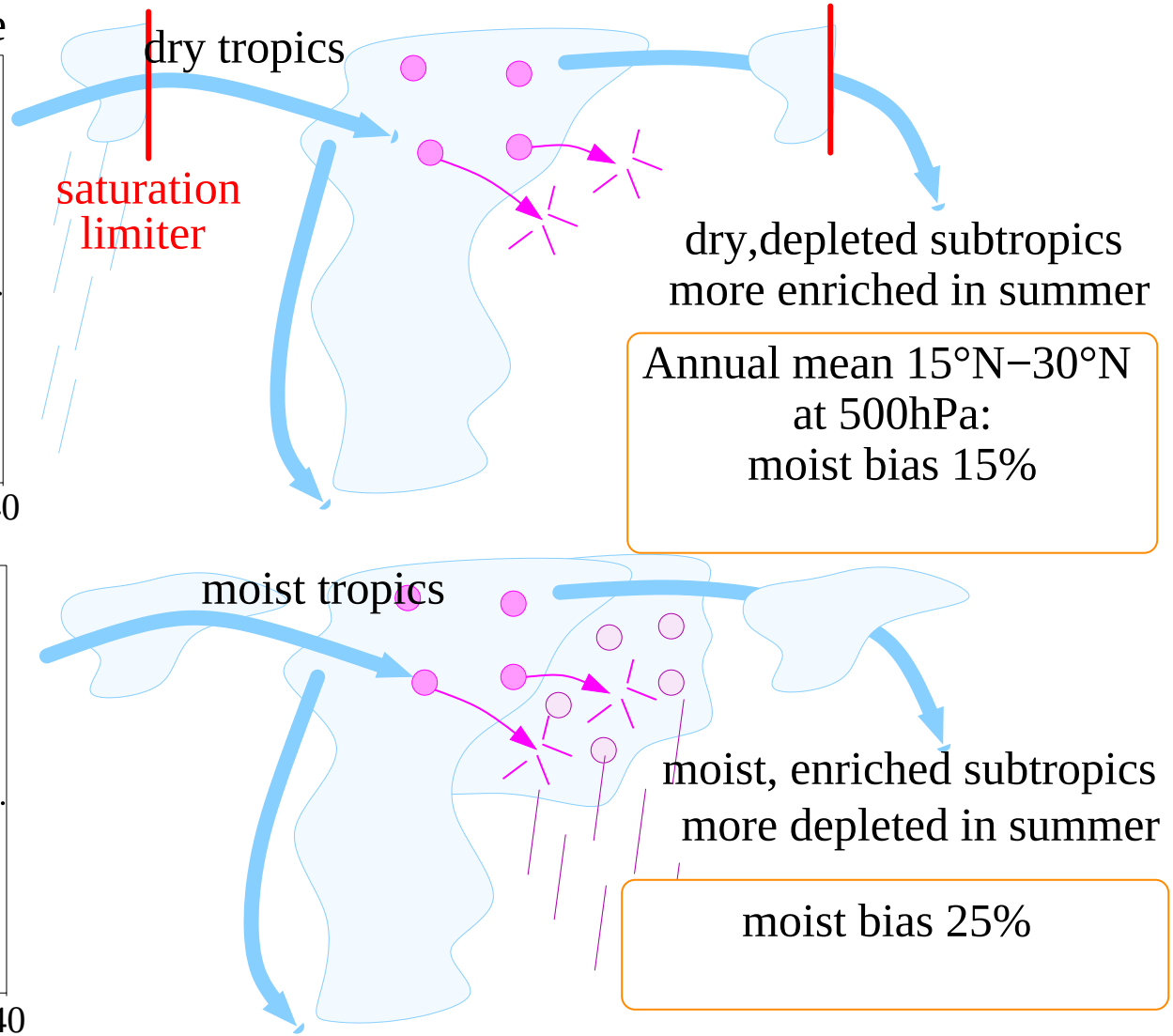

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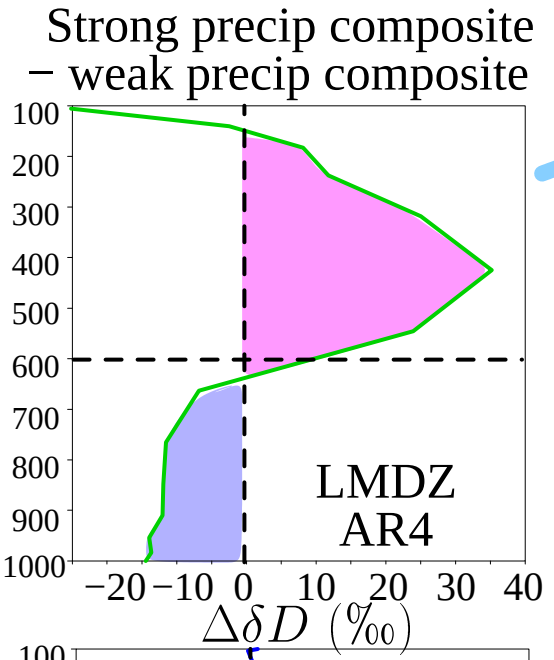

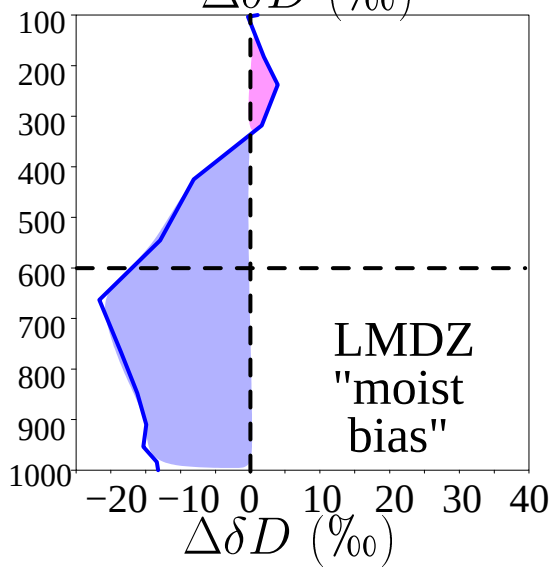

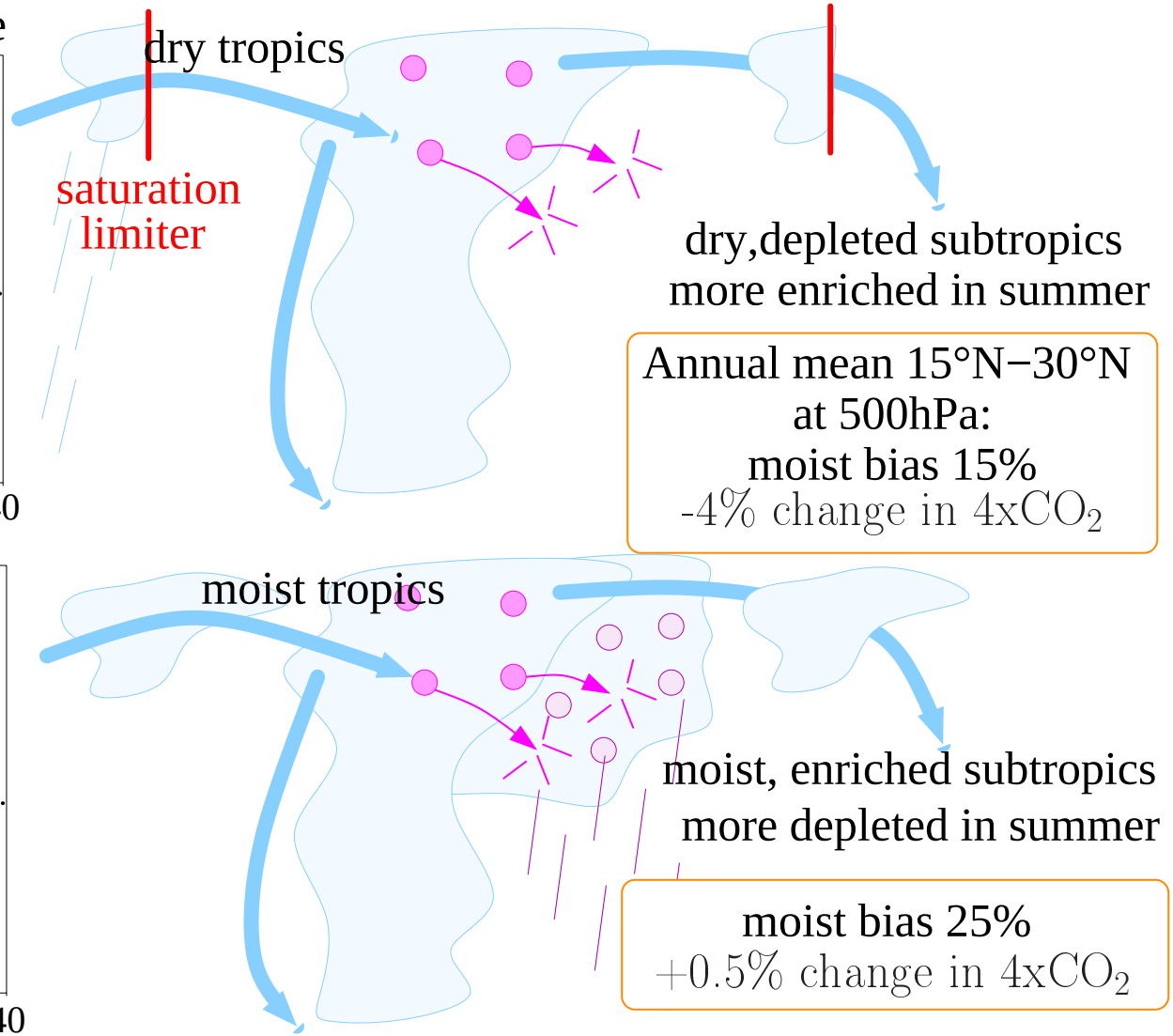

Conclusion/perspectives

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