A few slides for discussions in John's group

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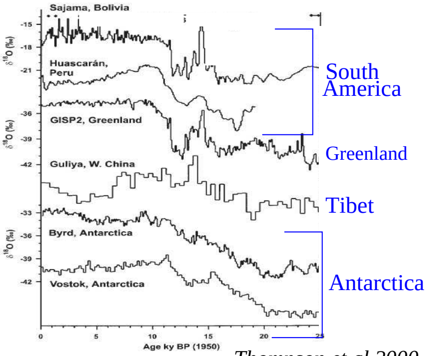
Outline

- Paleo
- Consraining convective processes
  - Latent heating
  - Rain reevaporation
  - Combining with chemical measurements?

What does $\delta^{18}O_p$ records?

- Thompson et al 2000 $\rightarrow$ temperature proxy



Thompson et al 2000

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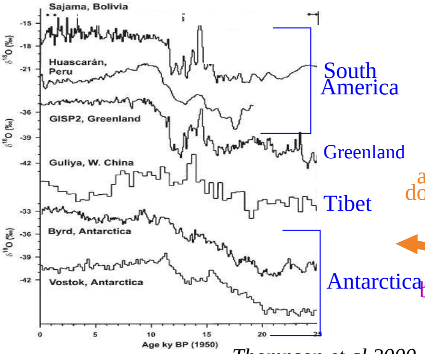
- Vuille et al 2005, Pausata et al 2011 $\longrightarrow$ precipitation proxy



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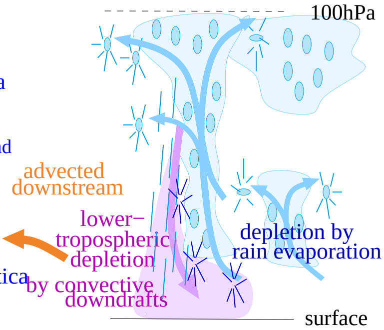

Risi et al 2008

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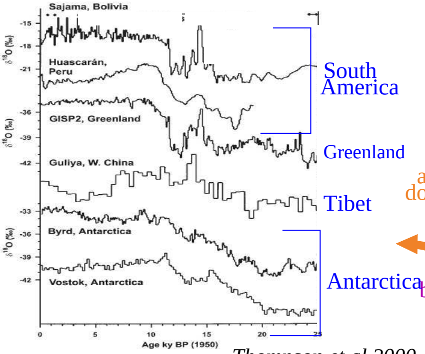

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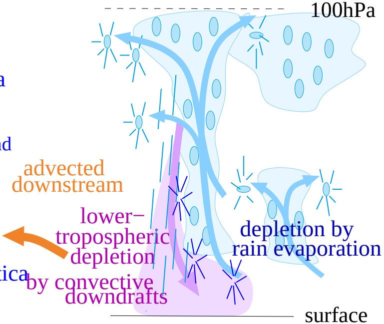
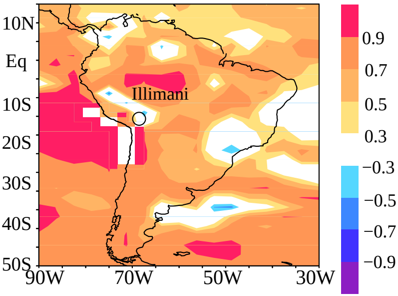


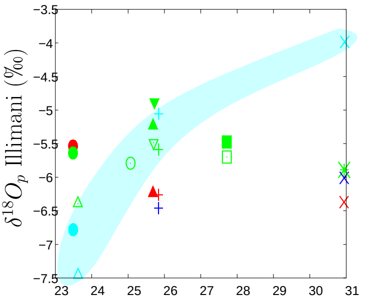
Risi et al 2008

$\Longrightarrow$ Use LMDZ GCM with isotopes (*Risi et al 2010*):
11 different climates (e.g. LGM, MH); 4 different model physics

Is $\delta^{18}O_p$ a proxy for temperature?



correlation between tropical mean SST and $\delta^{18}O_p$



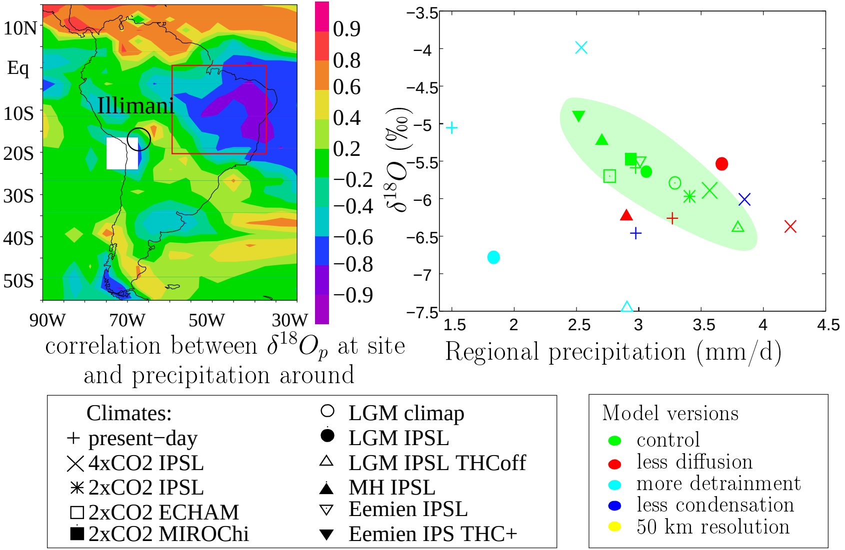
tropical-mean (30°S-30°N) SST (°C)

Climates:
+ present−day
× 4xCO2 IPSL
✳ 2xCO2 IPSL
□ 2xCO2 ECHAM
■ 2xCO2 MIROChi
○ LGM climap
● LGM IPSL
△ LGM IPSL THCoff
▲ MH IPSL
▽ Eemien IPSL
▼ Eemien IPS THC+

Model versions
- control
- less diffusion
- more detrainment
- less condensation
- 50 km resolution

- temperature = significant control at paleo time scales
- but sensitive to model physics

Is $\delta^{18}O_p$ a proxy for precipitation?



- $\delta^{18}O_p$ influenced by past regional precipitation changes
- but sensitive to model physics

Summary on the interpretation of paleo isotopic records

- At paleo time-scales and especially during LGM, temperature is a major control in LMDZ
- Also relationship with upstream precip
- But sensitive to the model physics

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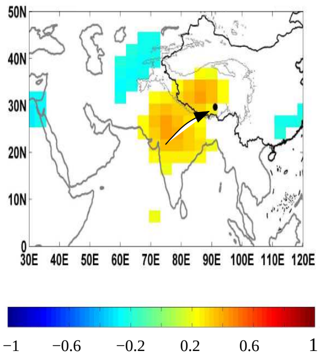
$\Longrightarrow$ Which physics is the most realistic?

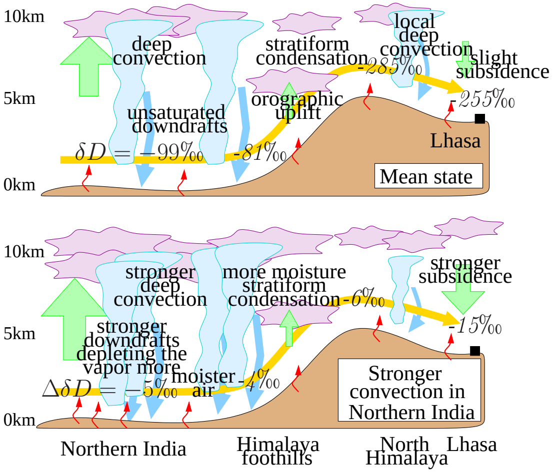
$\Longrightarrow$ use present day measurements to better test climate-$\delta^{18}O$ relationships?

Case study: what controls $\delta^{18}O_p$ in Lhasa?

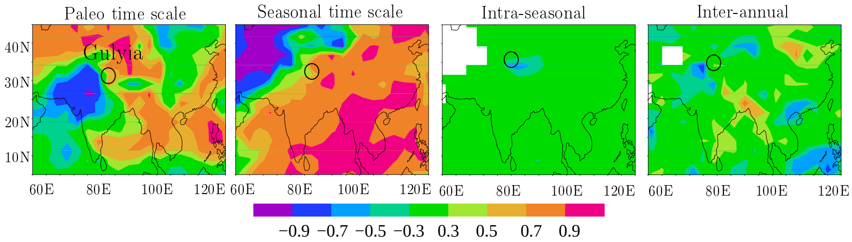
- Work by You He: weekly, JJAS, Lhasa, TES+LMDZ
- precip $\delta^{18}O$ varies follows vapor δD $\Rightarrow$focus on vapor



Correlation between δD
at Lhasa at 500 hPa
observed by TES
and OLR 2 days before



Does this apply to paleo scales?



correlation between $\delta^{18}O_p$ at Gulyia and precipitation around

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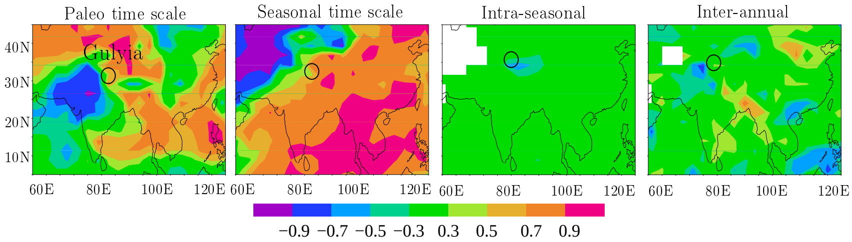


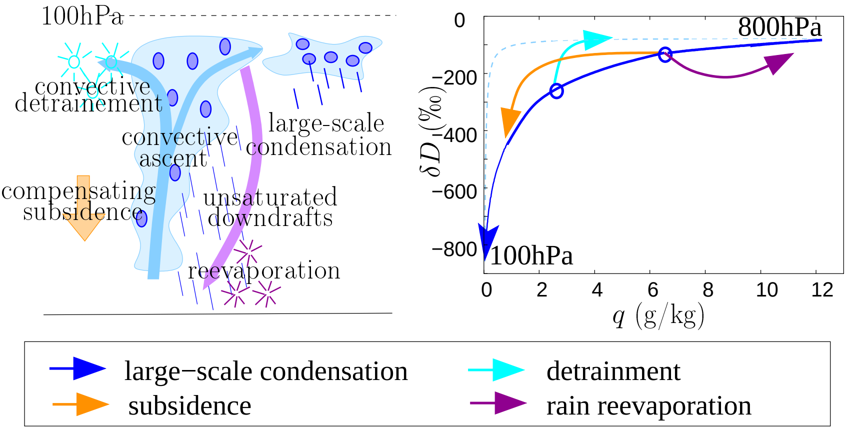
correlation between $\delta^{18}O_p$ at Gulyia and precipitation around

$\Longrightarrow$Understanding daily controls not enough for paleo controls

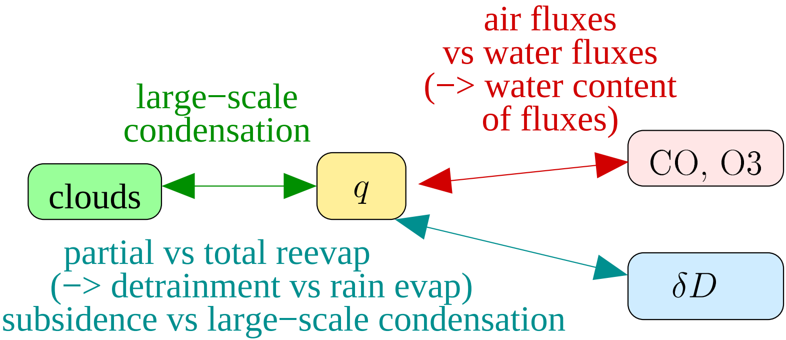
- work in progress: are some sensitivity tests more realistic at daily time scales?
  Do we expect them to be more realistic for paleo time scales?

Theoretical framework: q-δD

- Moistening and dehydrating processes *(Worden et al 2007)*



Combine with chemical measurements?

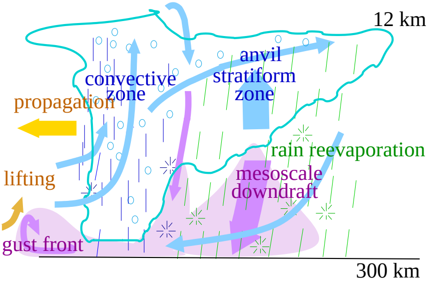


Constrain latent heating profiles?

- Use SCM simulations in WTG (weak temperature gradient) : temperature is prescribed, large-scale vertical velocity is diagnosed

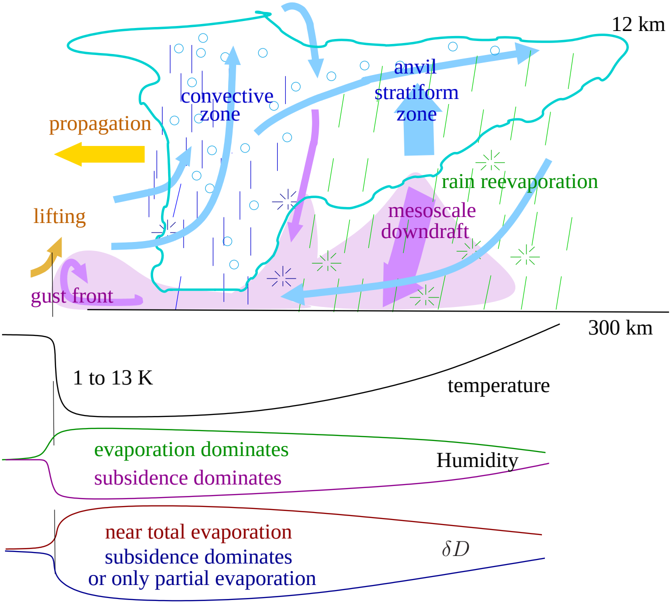
-> feedbacks between convection and large-scale circulation

Constrain rain reevaporation in squall lines?

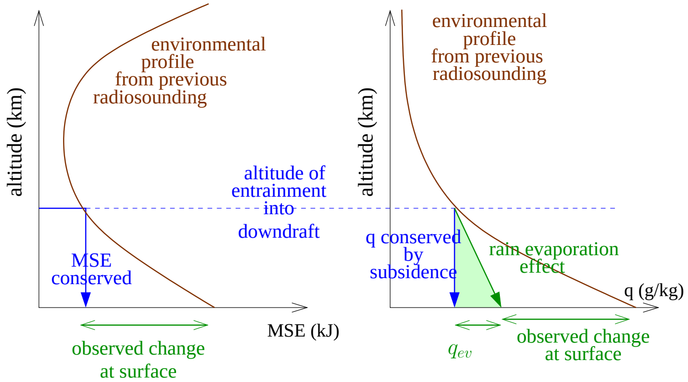


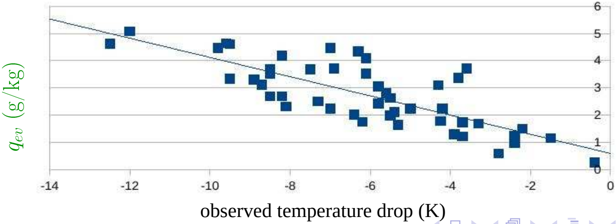
- Goals:
  - Relate rain reevaporation to LS conditions and cloud types
  - Use these relationships to evaluate cold pool scheme in LMDZ
- Datasets:
  - "pilot study": 3-year high-freq sfc vap δD in Niamey (picarro)
  - 2x daily radiosoundings -> environmental conditions
  - Meteosat -> Cloud classification every 15 minutes
  - future extension at larger scales: TES and IASI

Cold pools properties



Moist static energy budget





Plans on cold pools and rain reevaporation

- MSE budget -> estimate q_{ev} (rain reevaporation contribution)
- Large-scale controls on q_{ev}? Cloud type and organization?
- No link between q_{ev} and cold pool δD -> depends on evaporated drop fraction and drop size distribution? (*Risi et al 2010*)
- Use results to evaluate LMDZ cold pool scheme (*Grandpeix et al 2010*) and tune its parameters?
- At the larger scale, effect of rain reevaporation on intra-seasonal variability? e.g. source of moistening in African Easterly Waves? (*Poan et al 2014*)