



The role of convection over Indian subcontinent in trans-Himalayan moisture transport

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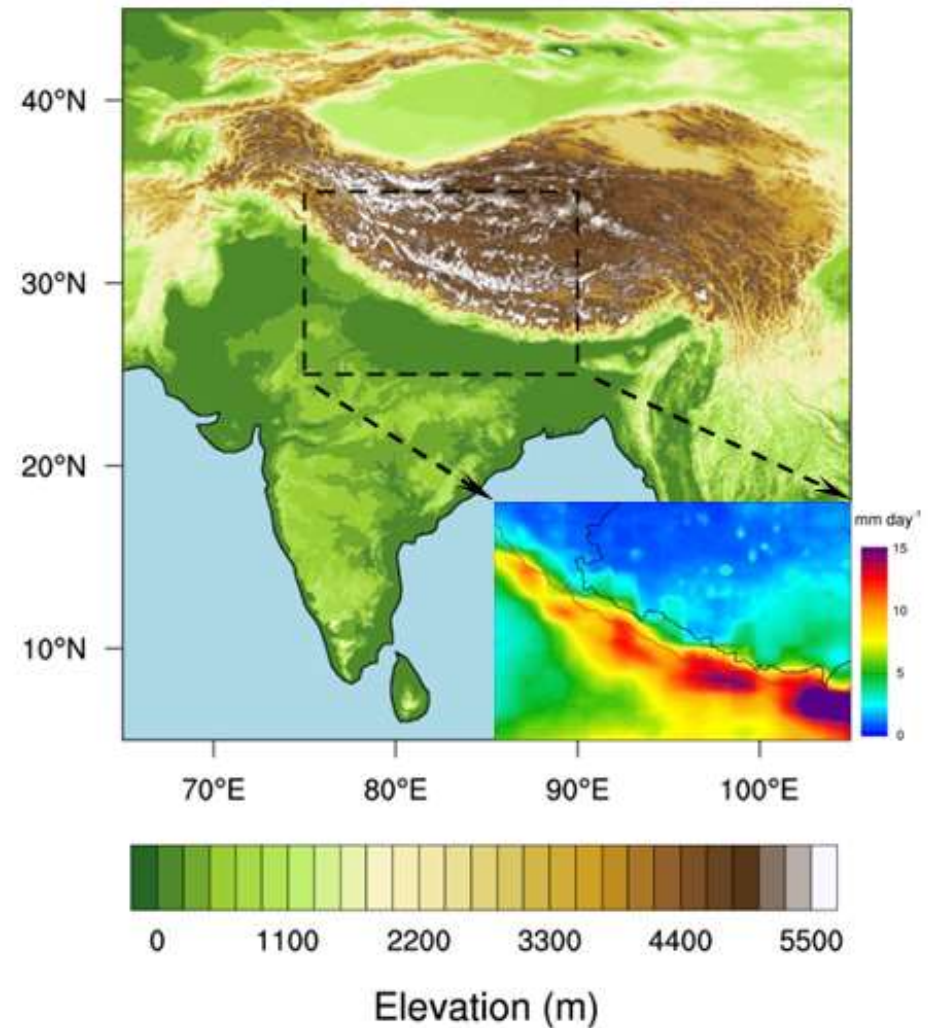
DISTRIBUTION OF DESERTS



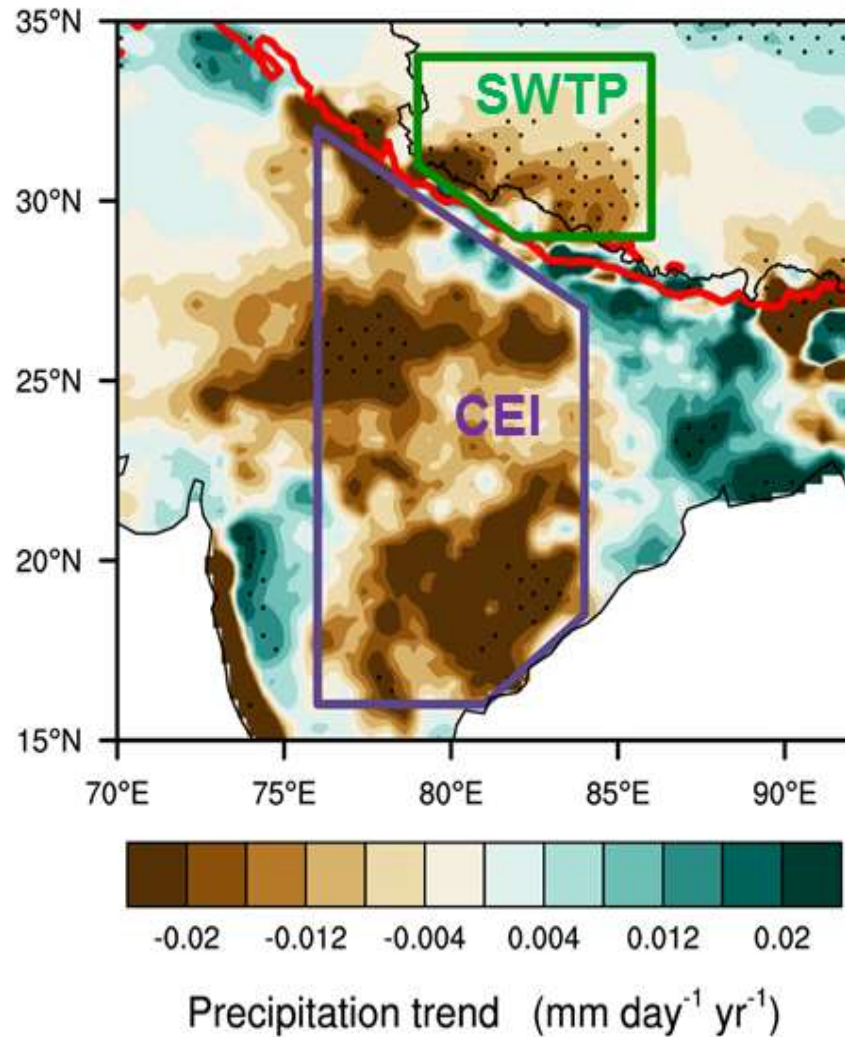
<http://www.slideshare.net/aland/desert-introduction>

The southwestern Tibetan Plateau (SWTP)

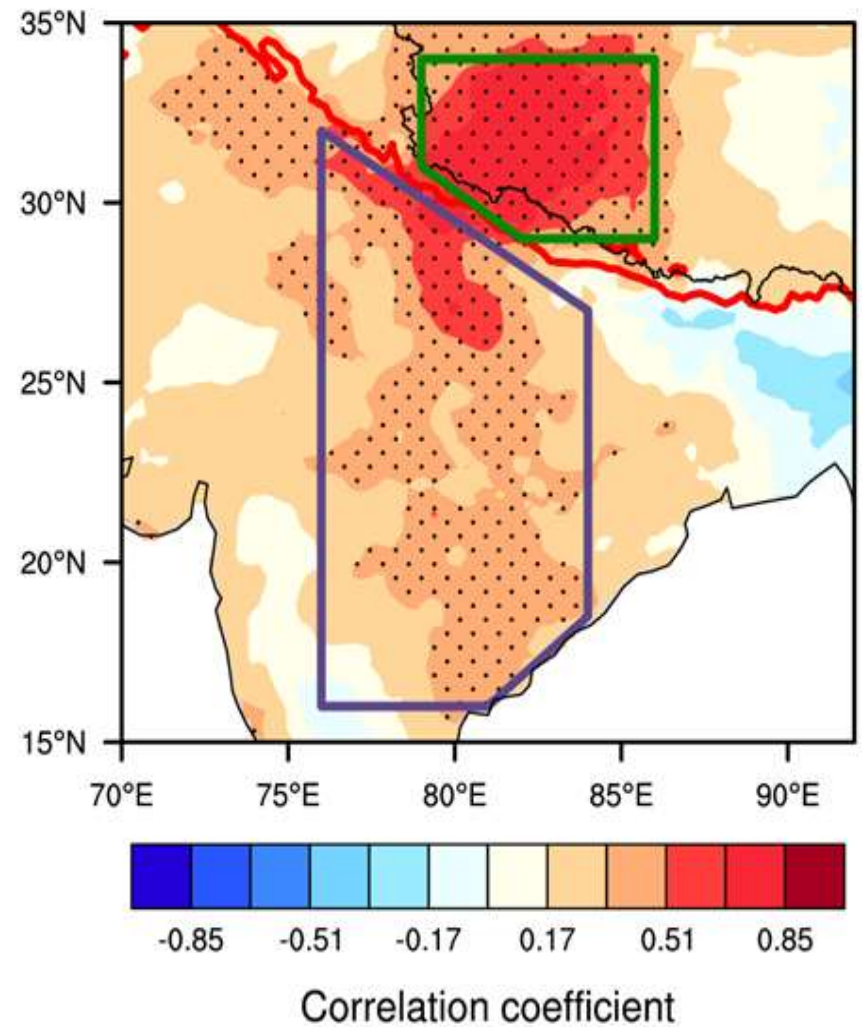
- A semiarid region with a vulnerable ecosystem, drier and more isolated than the more extensively studied eastern Tibetan Plateau
- Sharp decline in glacier extent over recent decades
- Precipitation events over the SWTP often serve as precursor for storm systems downstream, with some systems that develop over the SWTP later causing extreme rainfall and severe flooding in East Asia



Drying trends

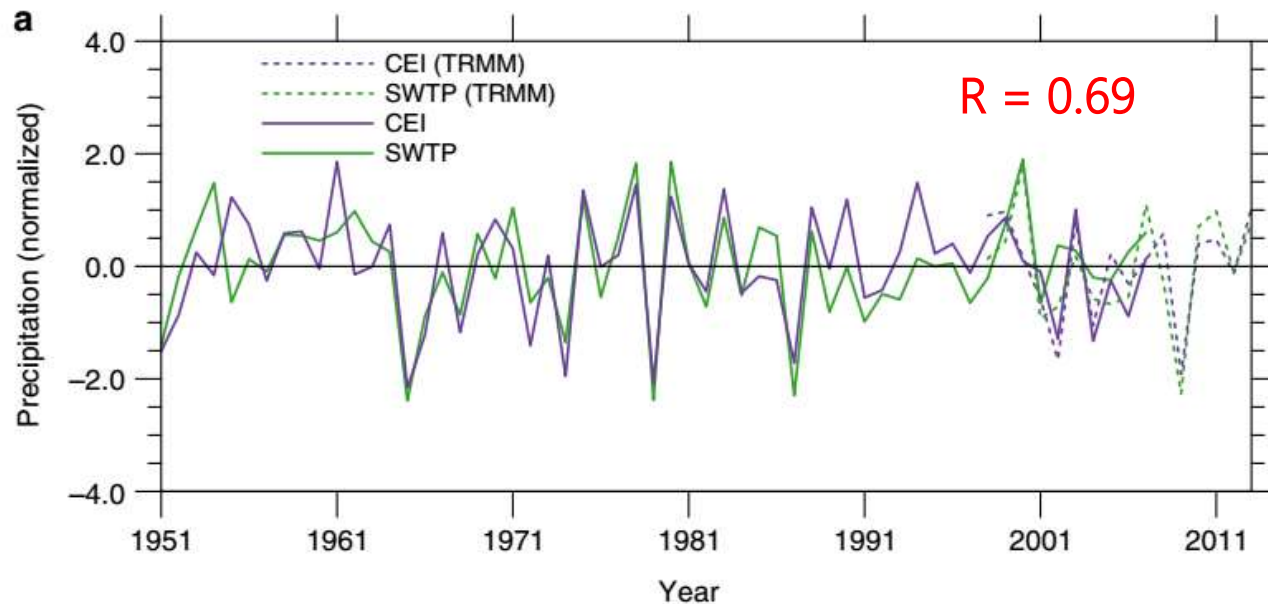


High correlations

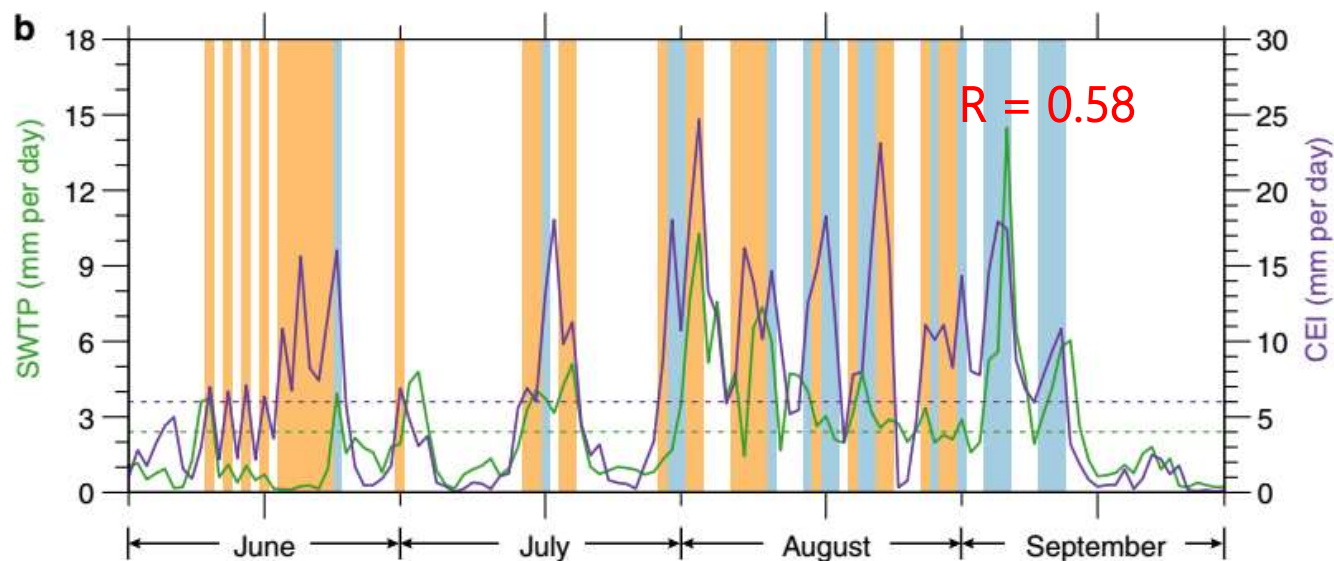


Consistent variations on different time scales

year-to-year

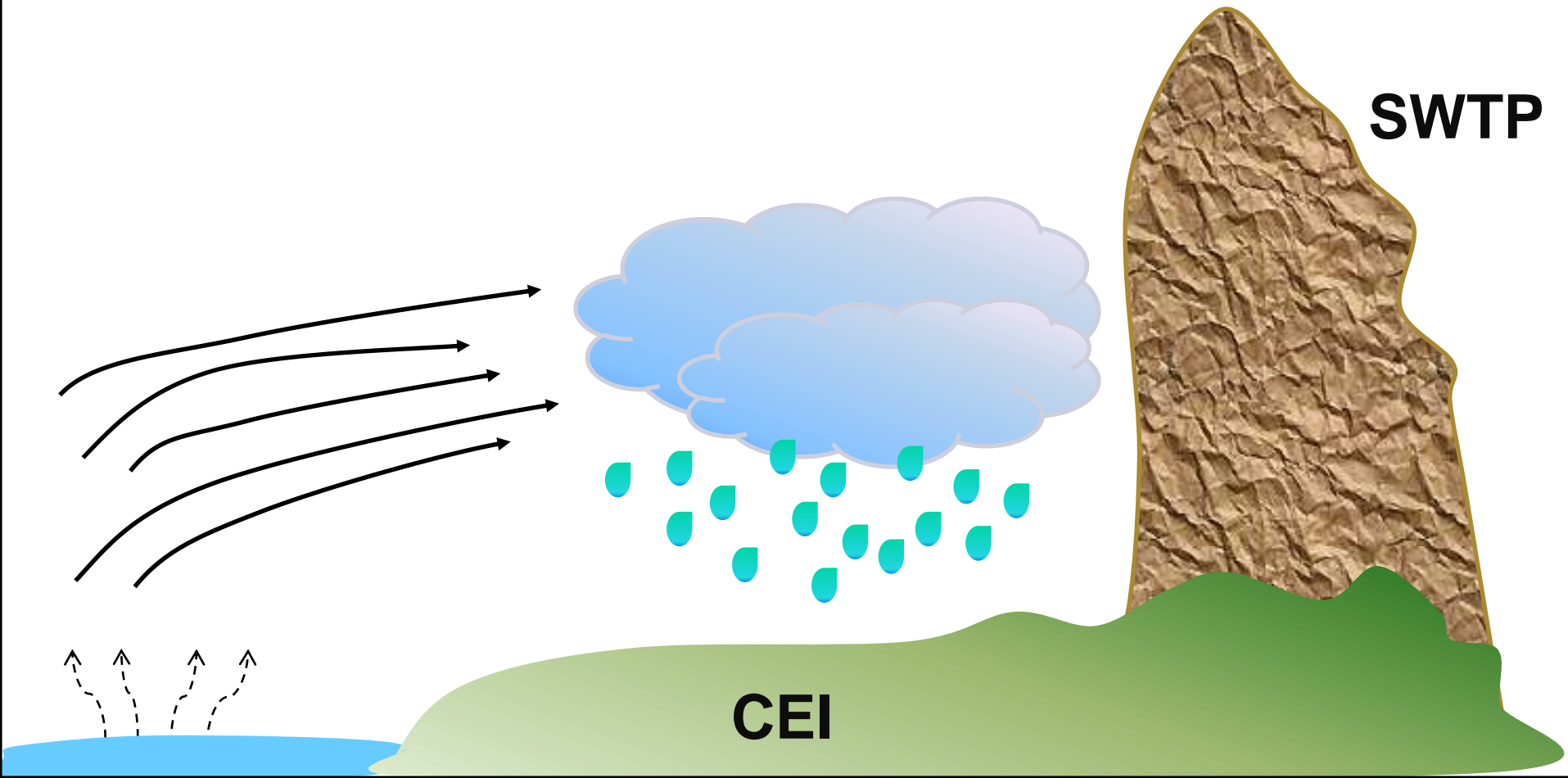


day-to-day

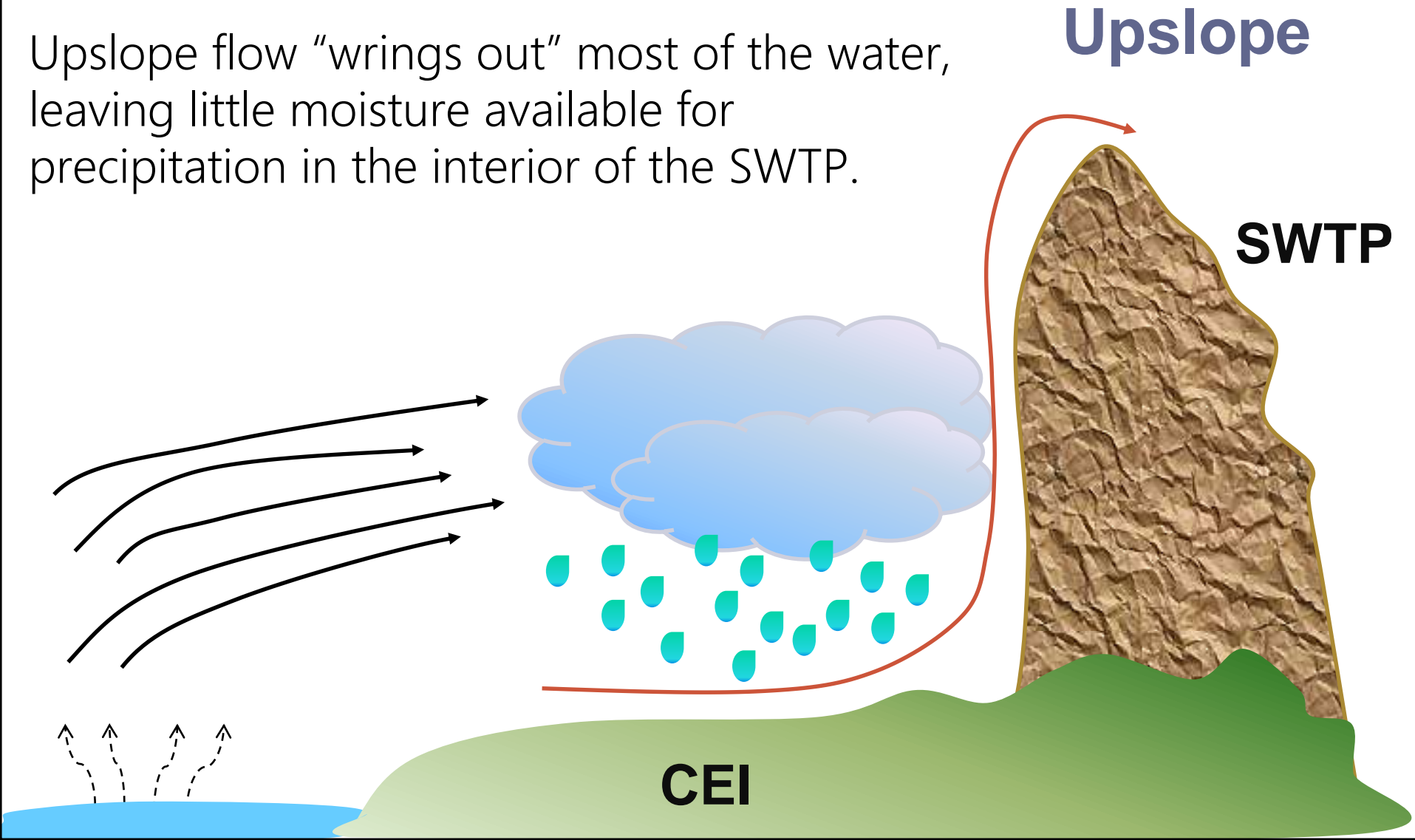


Key question:

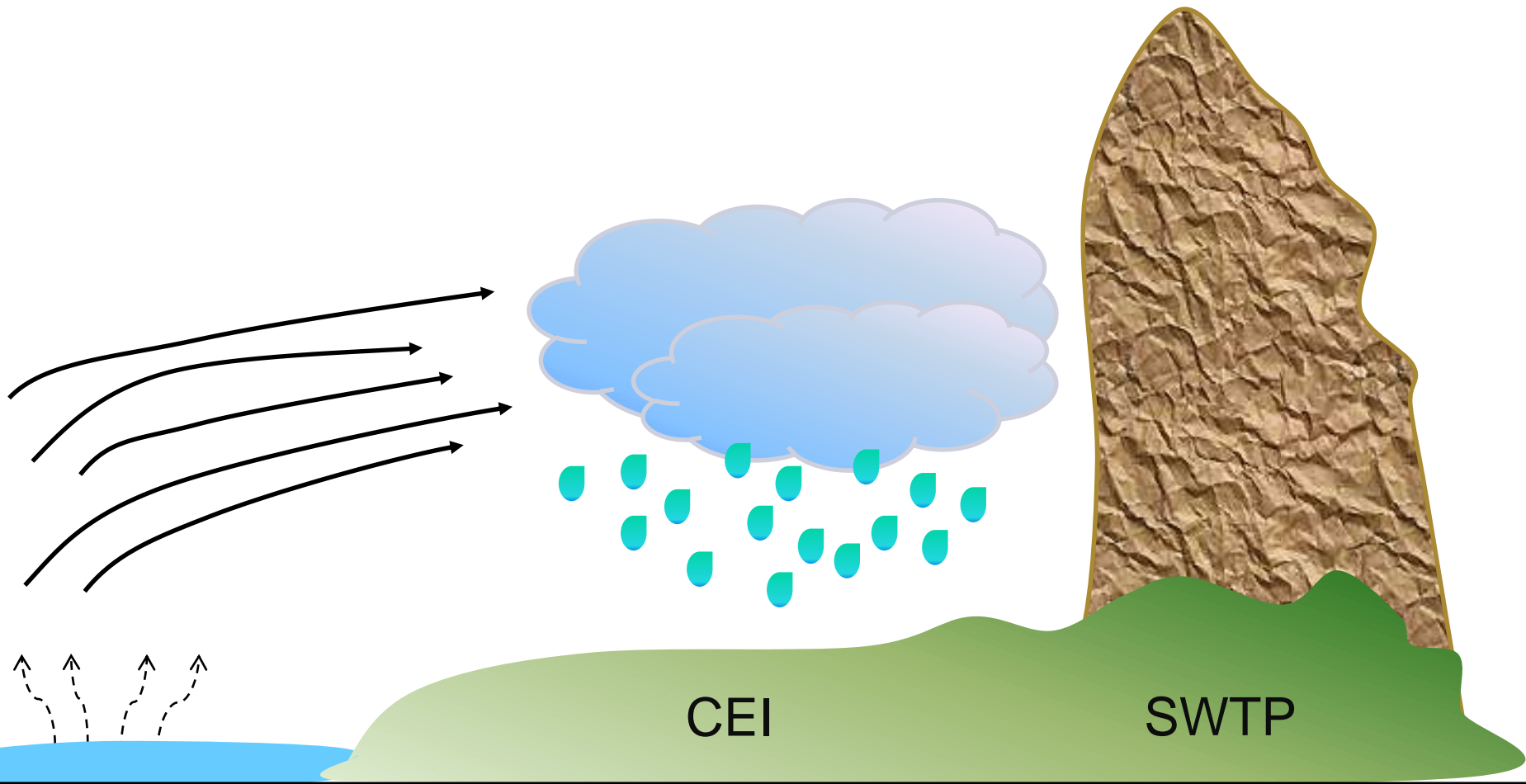
By what route(s) does this moisture arrive?



Upslope flow “wrings out” most of the water, leaving little moisture available for precipitation in the interior of the SWTP.



Another route other than upslope?



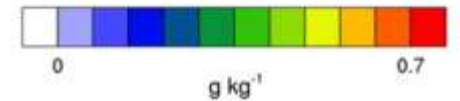
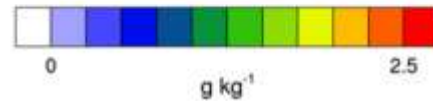
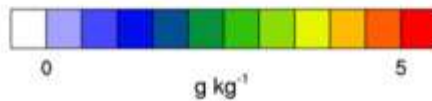
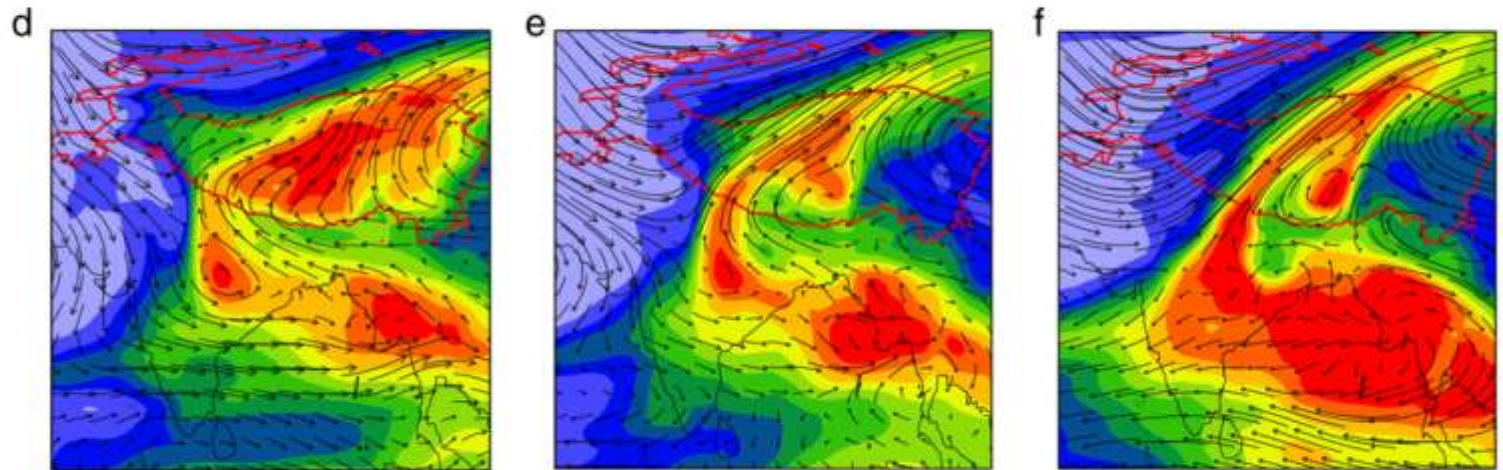
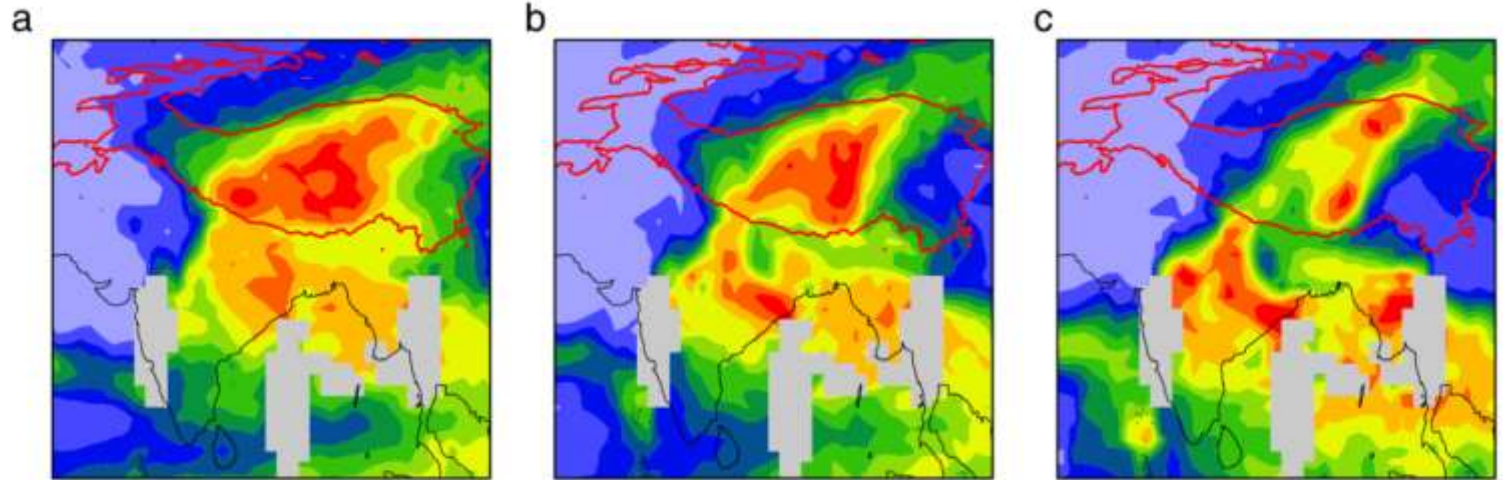
Case study: Moisture content

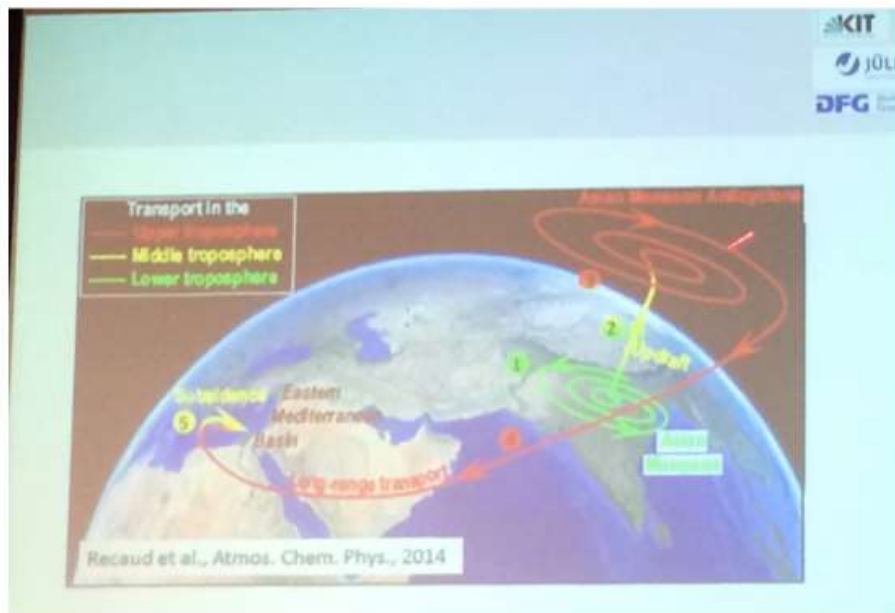
500hPa

300hPa

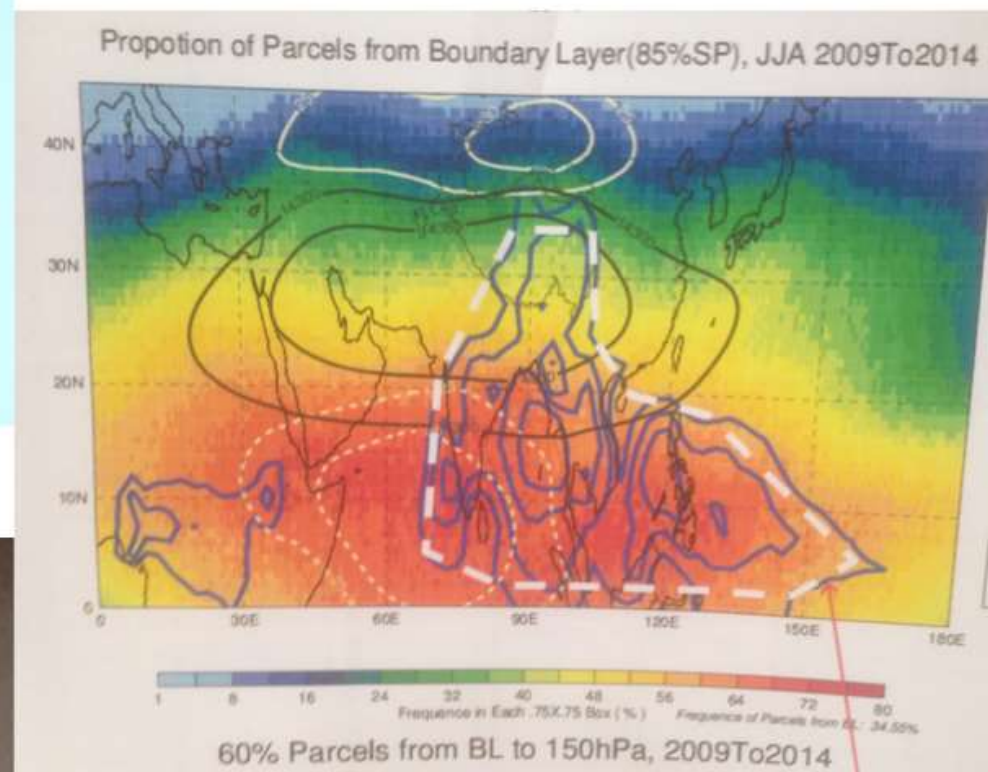
200hPa

AIRS

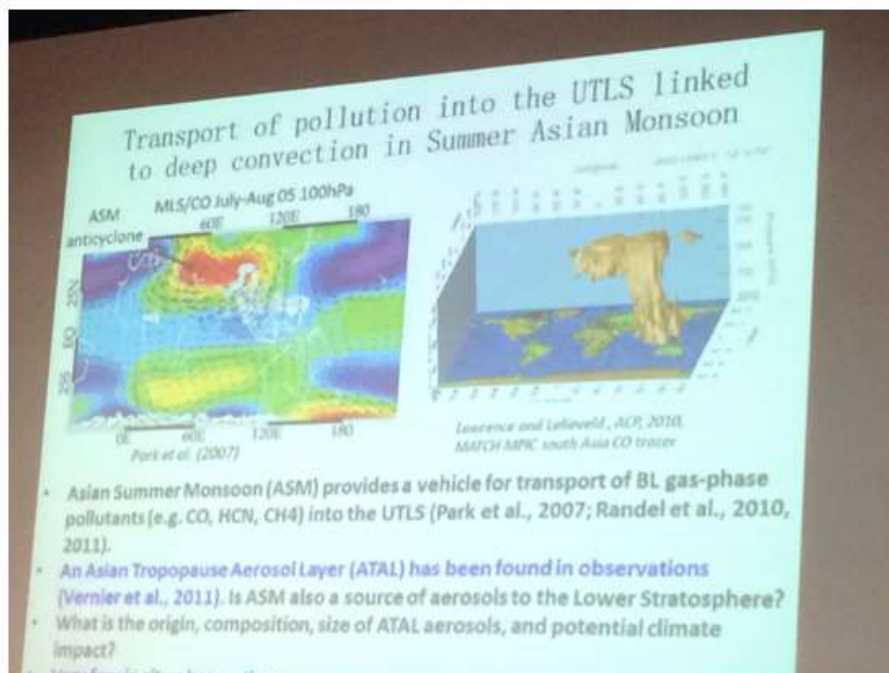




Harwig Harder 3rd ACAM workshop



Jianchun Bian 3rd ACAM workshop



T. Duncan Fairlie 3rd ACAM workshop

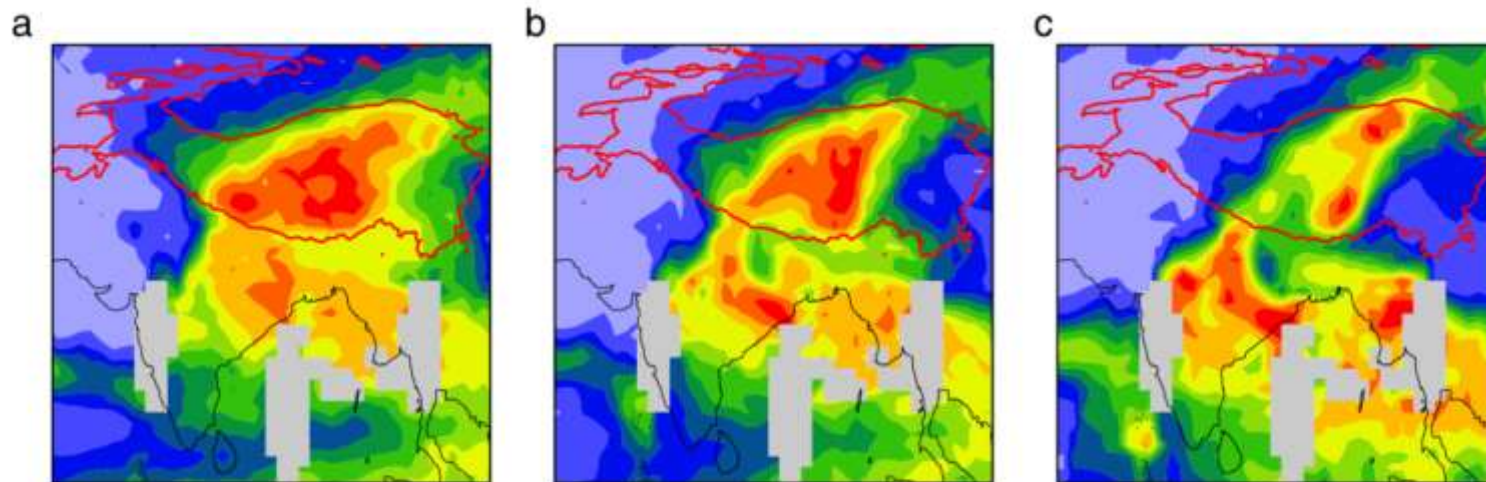
Case study: Moisture content

500hPa

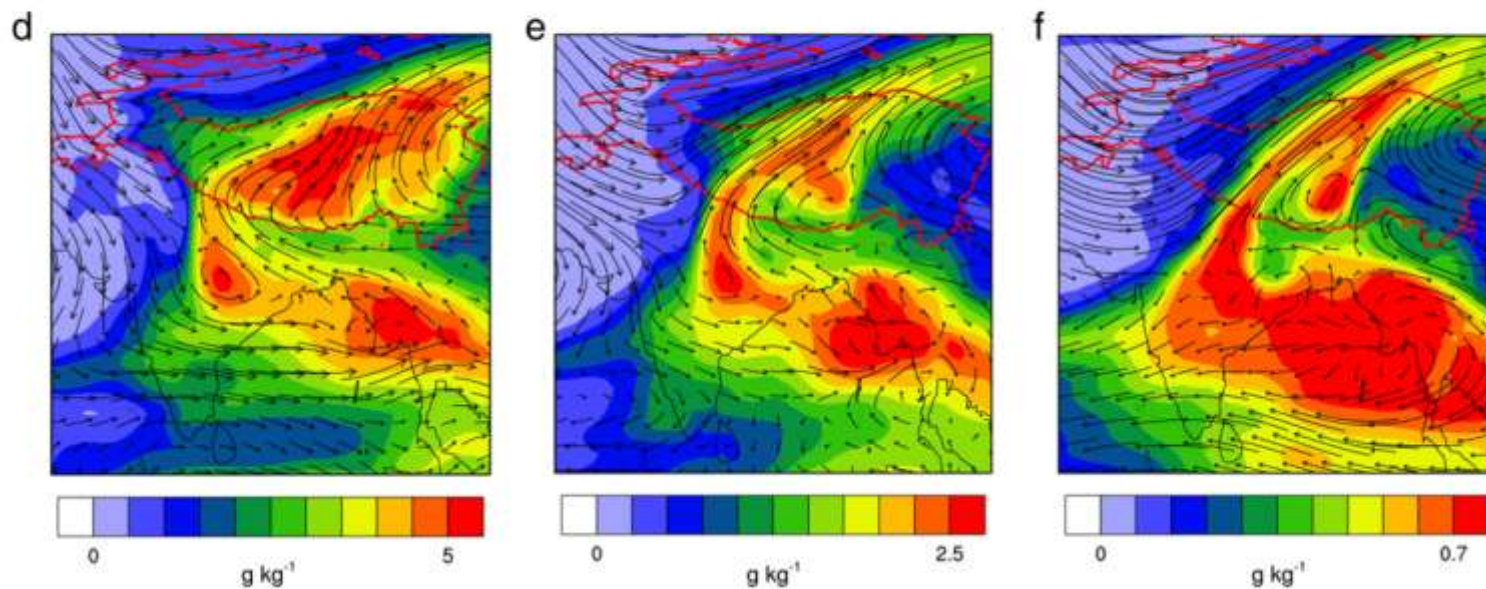
300hPa

200hPa

AIRS

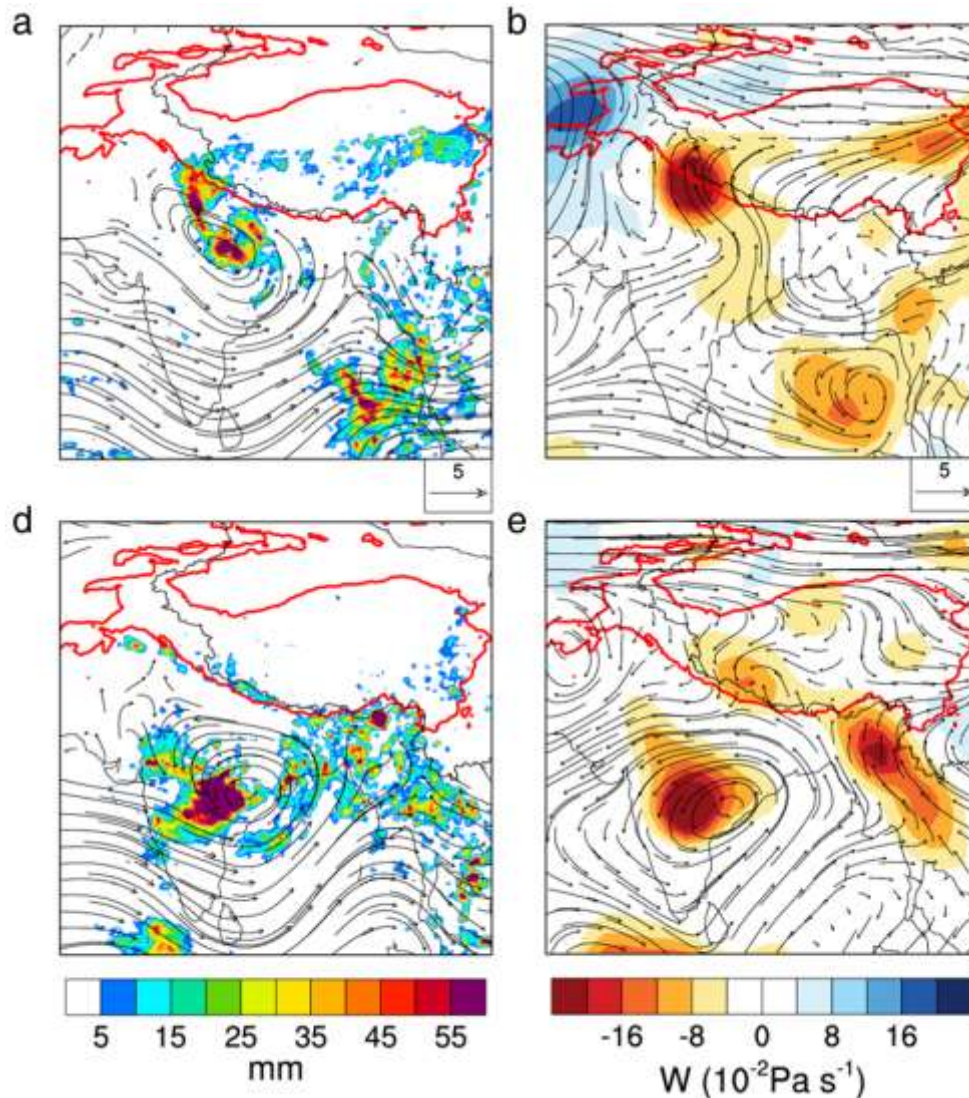


ERA-interim



Precipitation
&
850hPa wind field

Vertical velocity
&
500hPa wind field



Intrusive CS

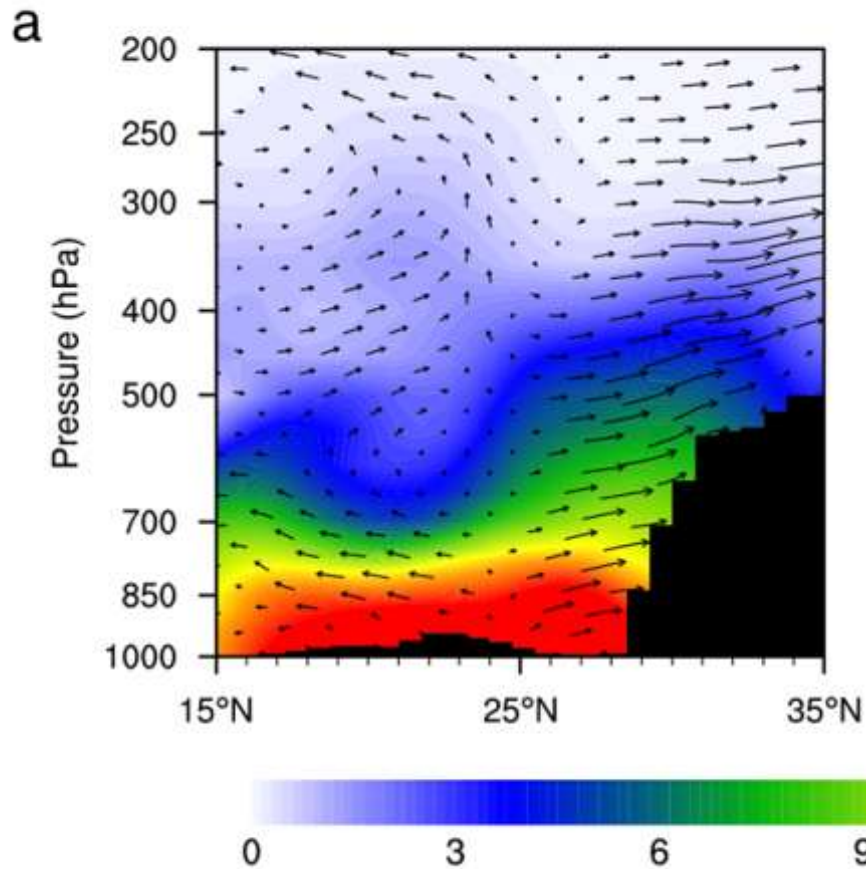
Rainfall can be transported
from Indian subcontinent into
SWTP

Non-intrusive CS

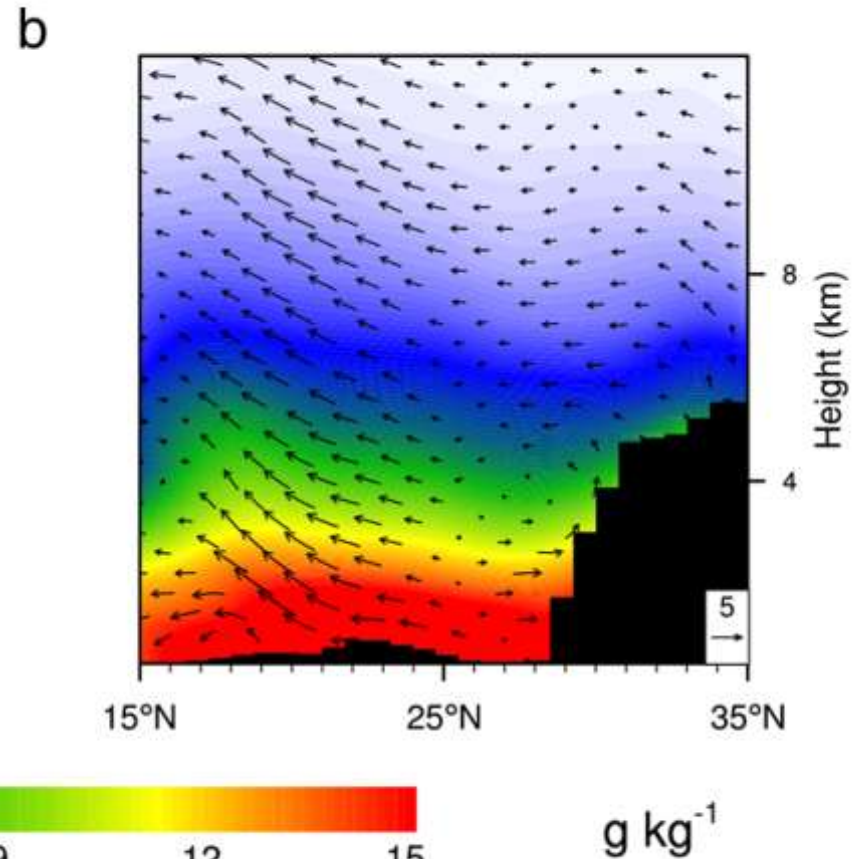
Rainfall is mainly confined
within Indian subcontinent

Cross profile of moisture content and meridional wind along 80°E

Intrusive CS



Non-intrusive CS

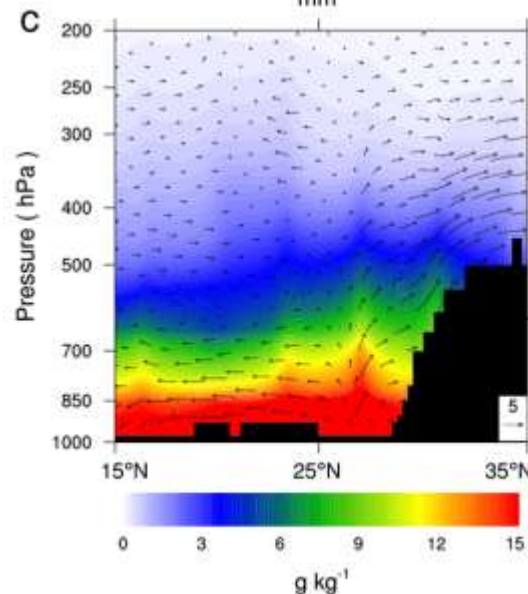
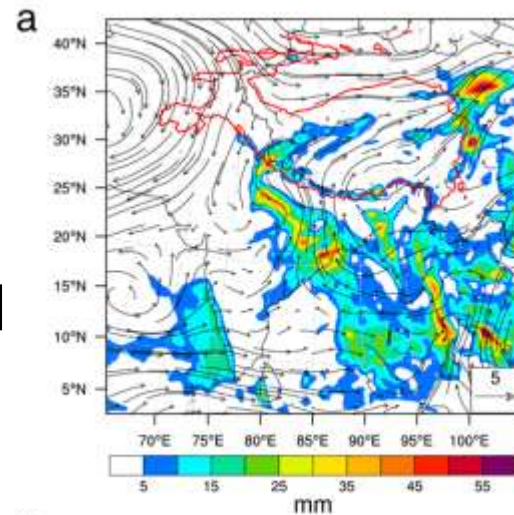


Model results :HAR data (Maussion *et al.*, 2014)

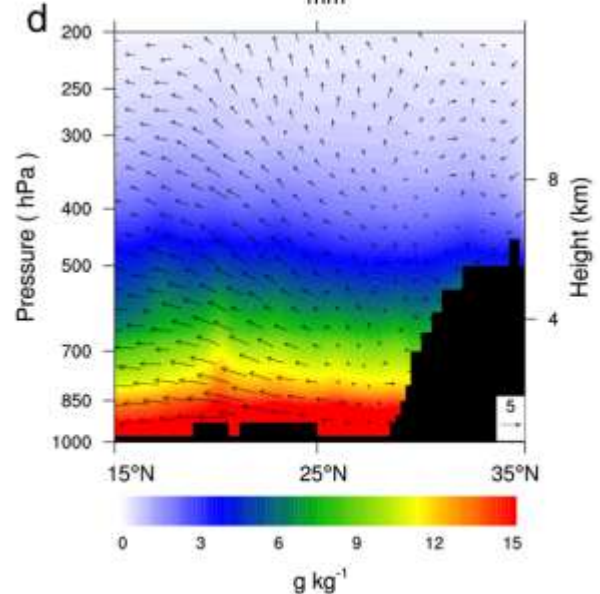
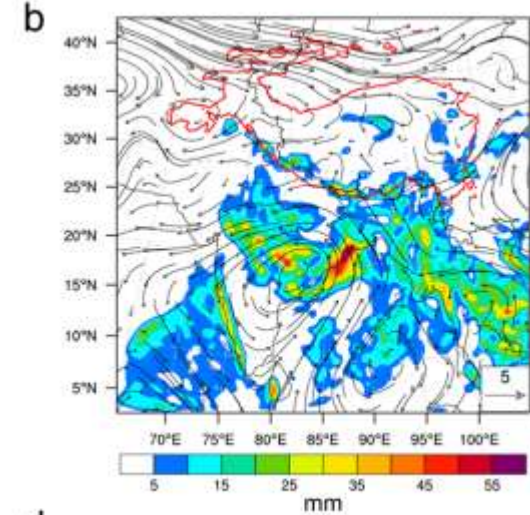
Precipitation
&
500hPa wind field

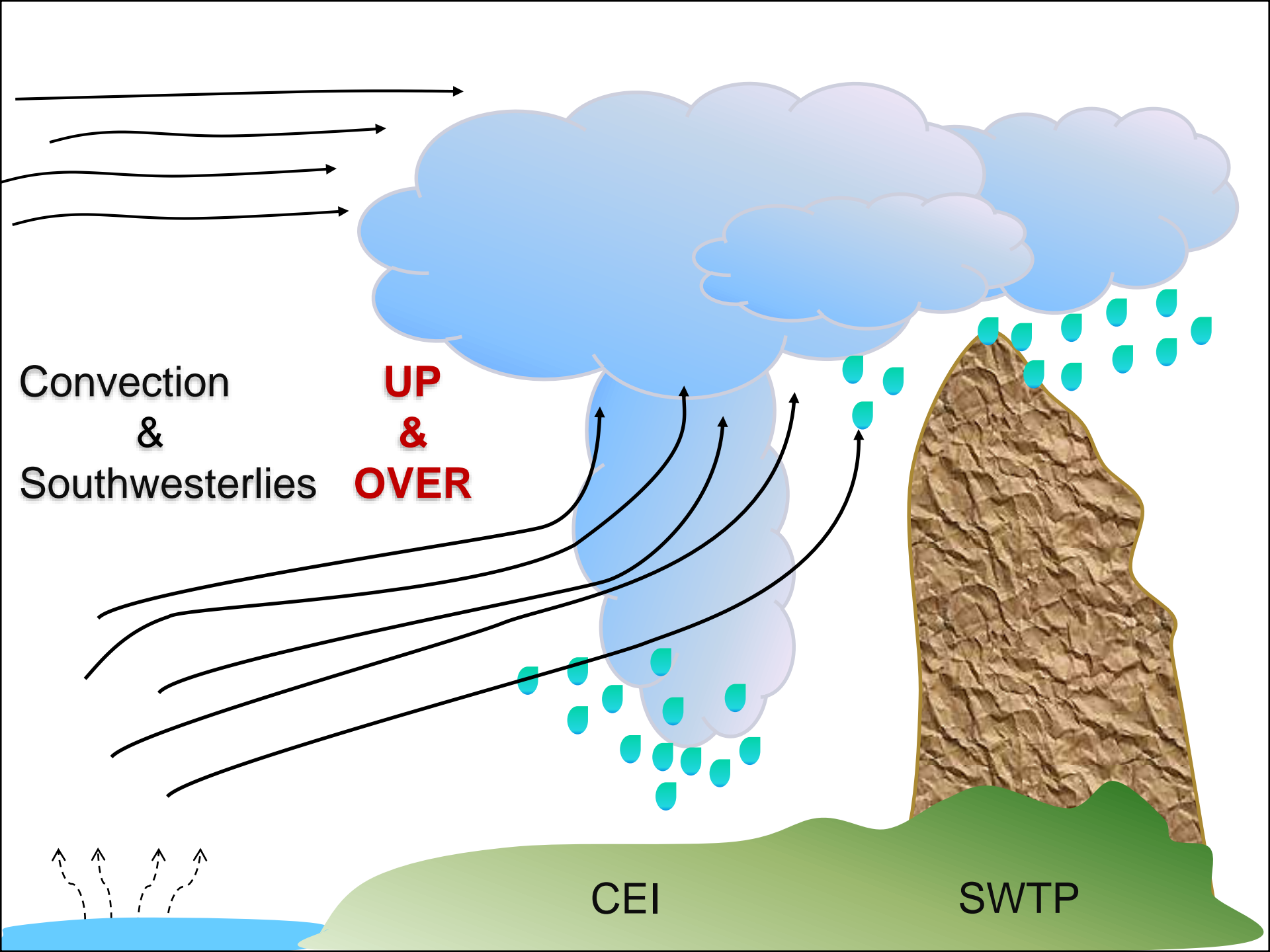
moisture
&
wind field profile

Intrusive CS

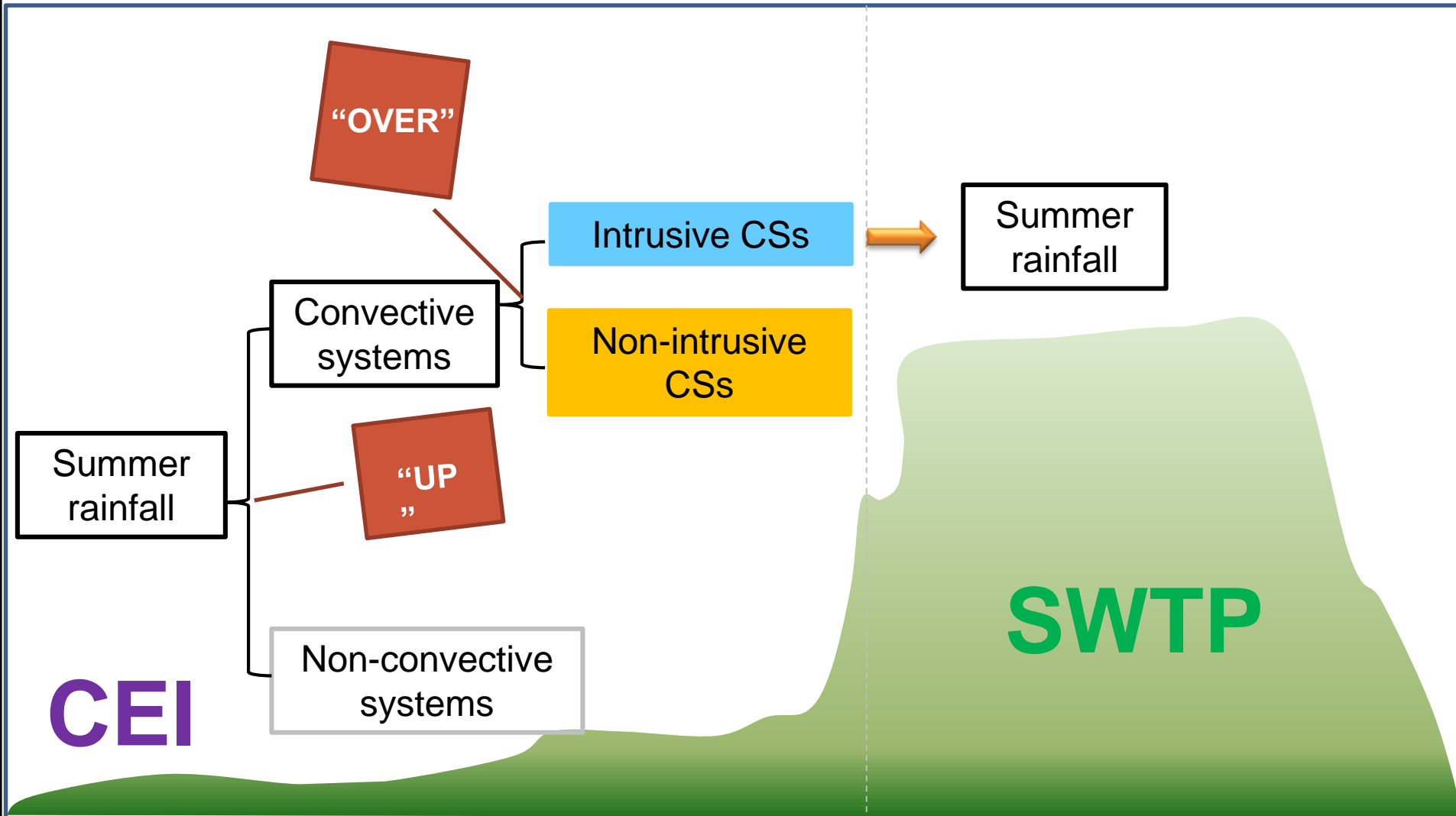


Non-intrusive CS





Hypothesis of up-and-over route

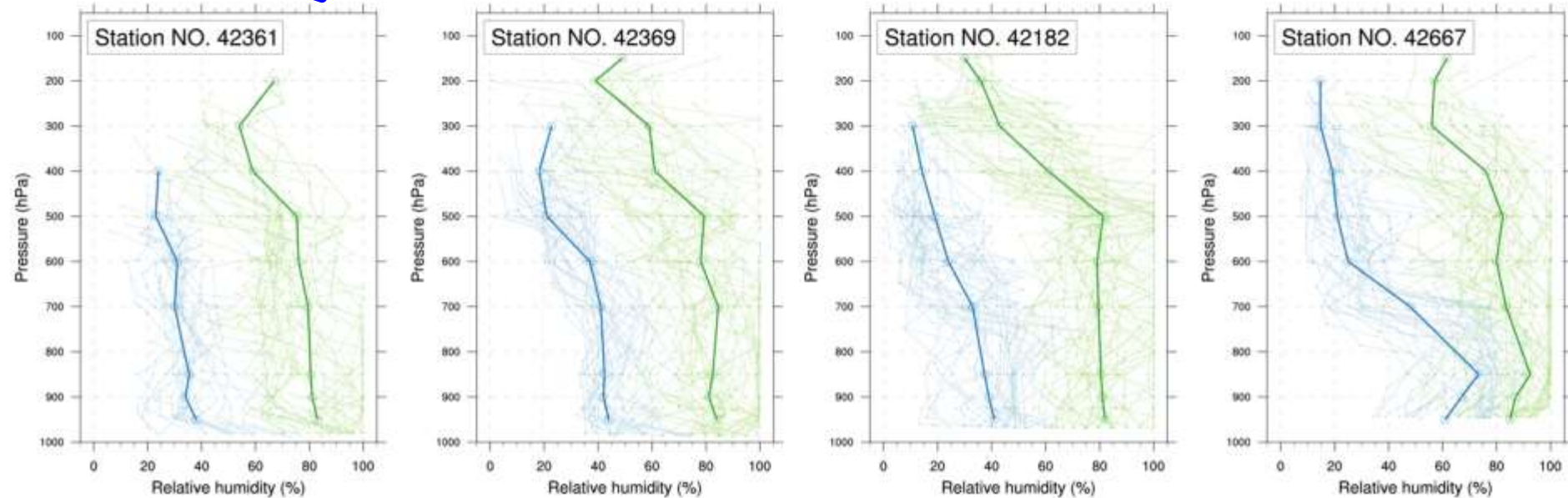
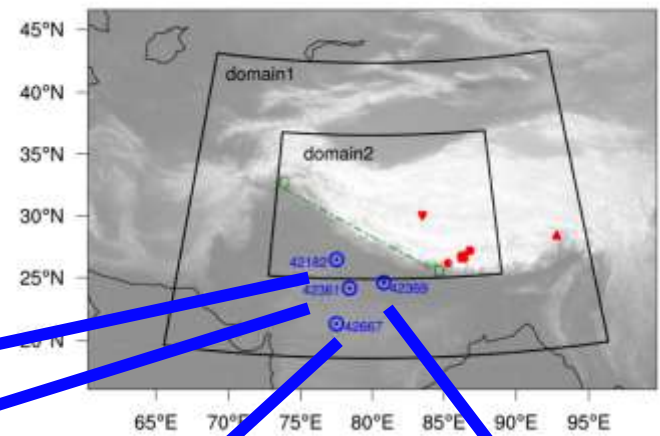


"UP" process

Relative humidity: 4 radiosonde stations

Convection days

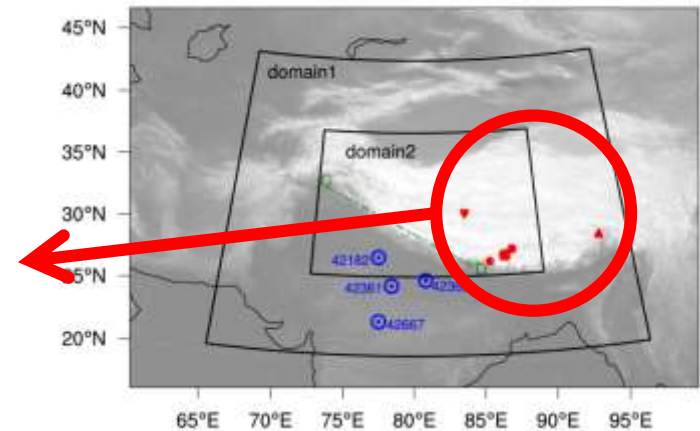
Non-convection days



The RH is nearly twice wetter in convective days than in non-convective days through 1000 hPa-300 hPa.

"OVER" process

O¹⁸ Isotope in 98 precipitation events



- ◆ Evaporation-condensation process will **remove** the isotopes in the rainfall particles (Yao *et al.*, 2013)
- ◆ Larger rainfall, **larger** isotopic depletion (Tian *et al.*, 2006)

Upslope/local recycling: Larger isotopic depletion

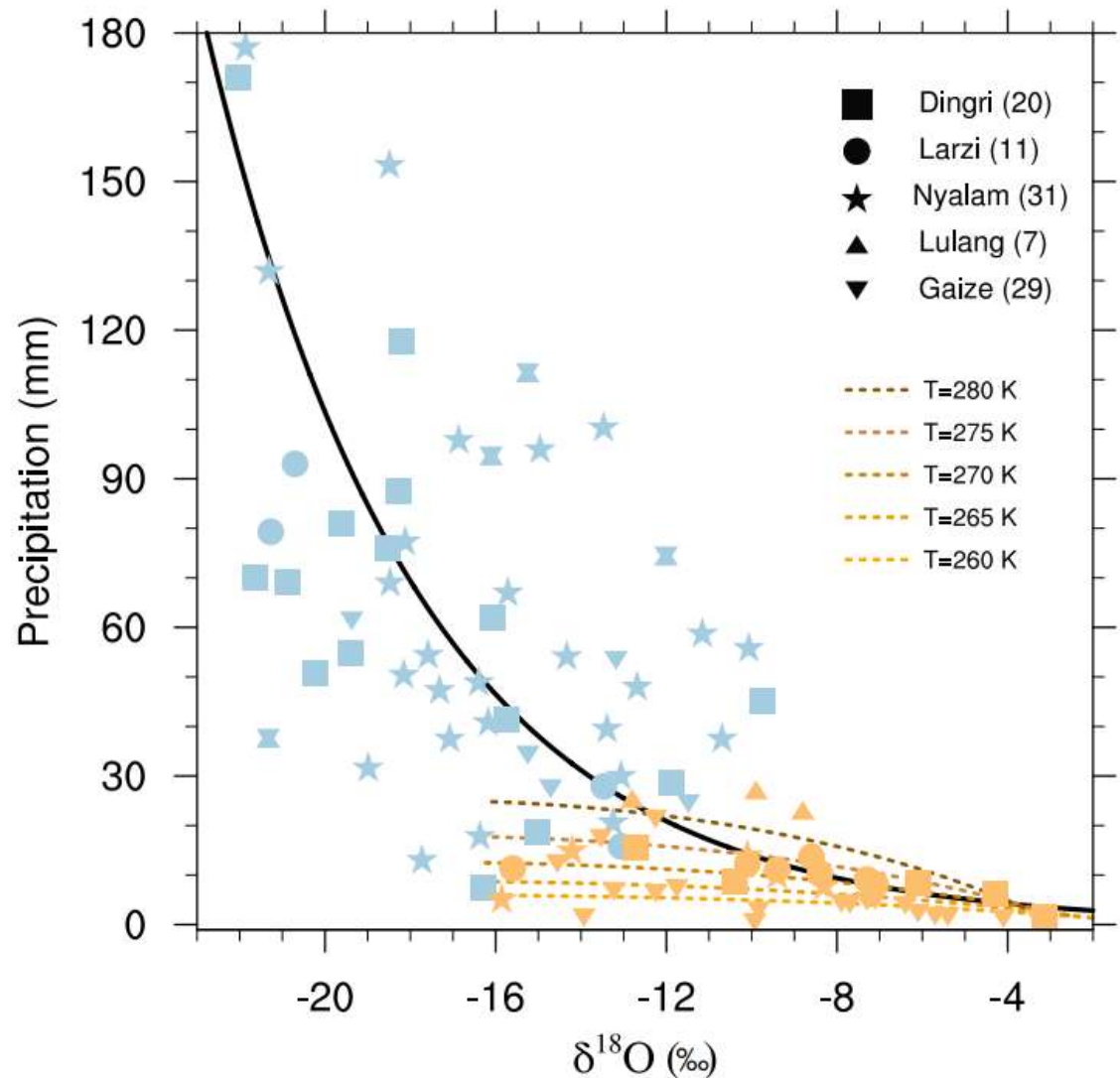
Up-and-over: Smaller isotopic depletion

"OVER" process

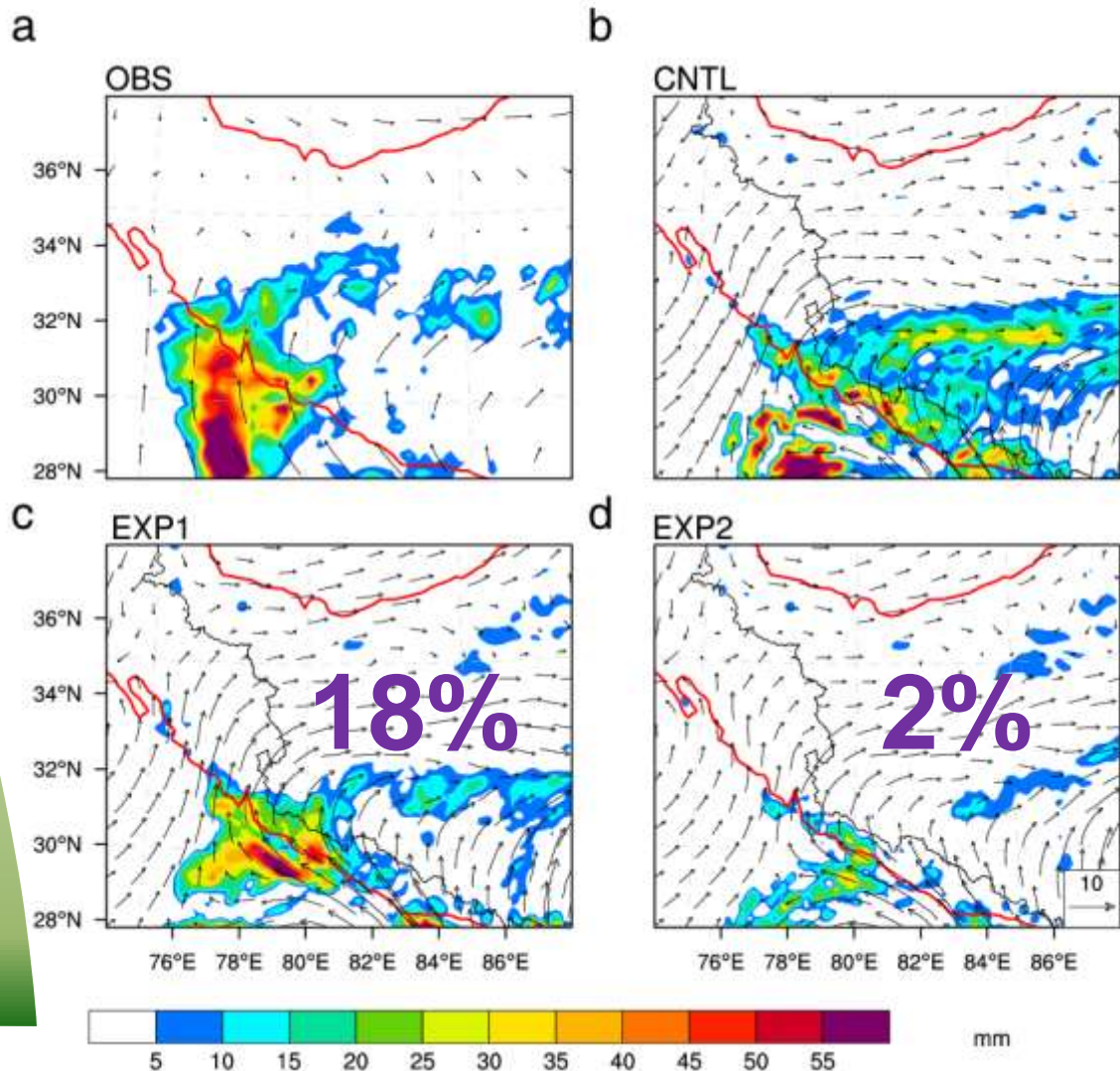
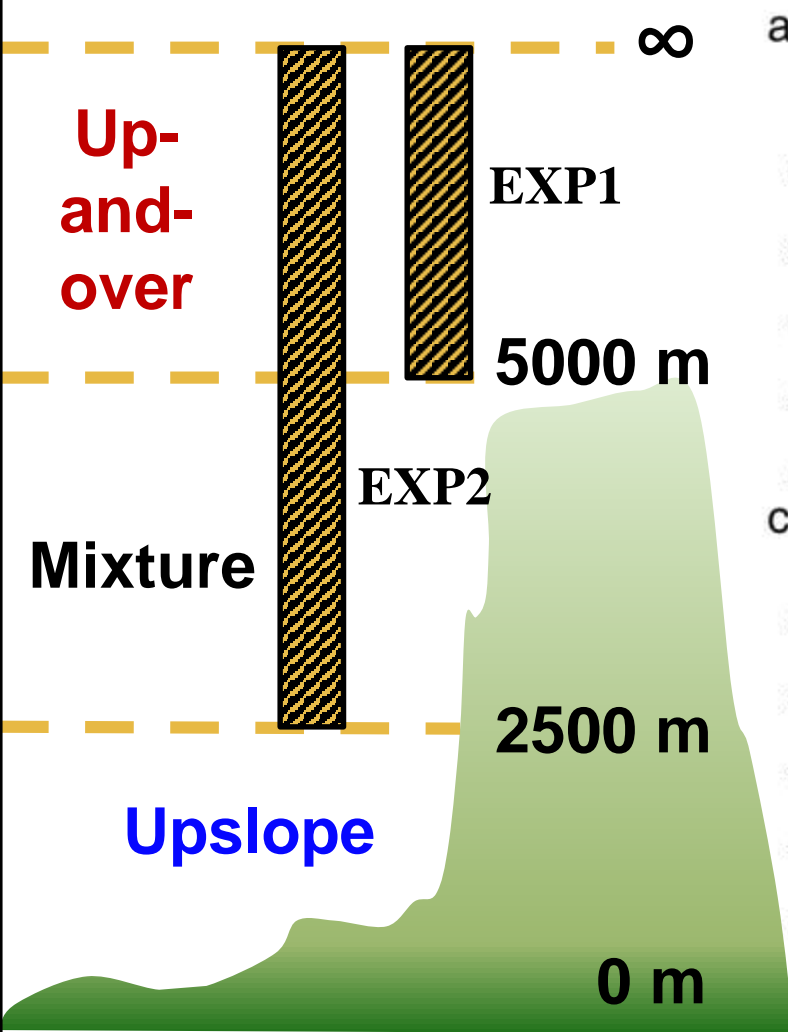
(Provided by *Institute of Tibetan Plateau Research, CAS*)

Intrusive CS
Less depleted
"Up-and-over"

Non-intrusive CS
Depleted
**Local recycling/
Upslope**



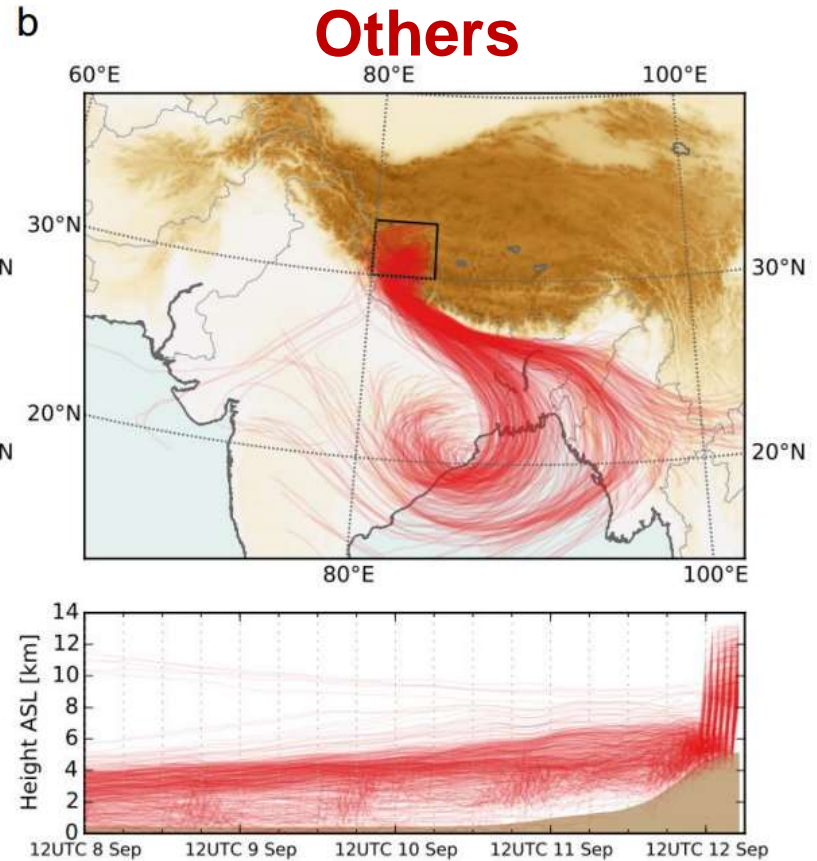
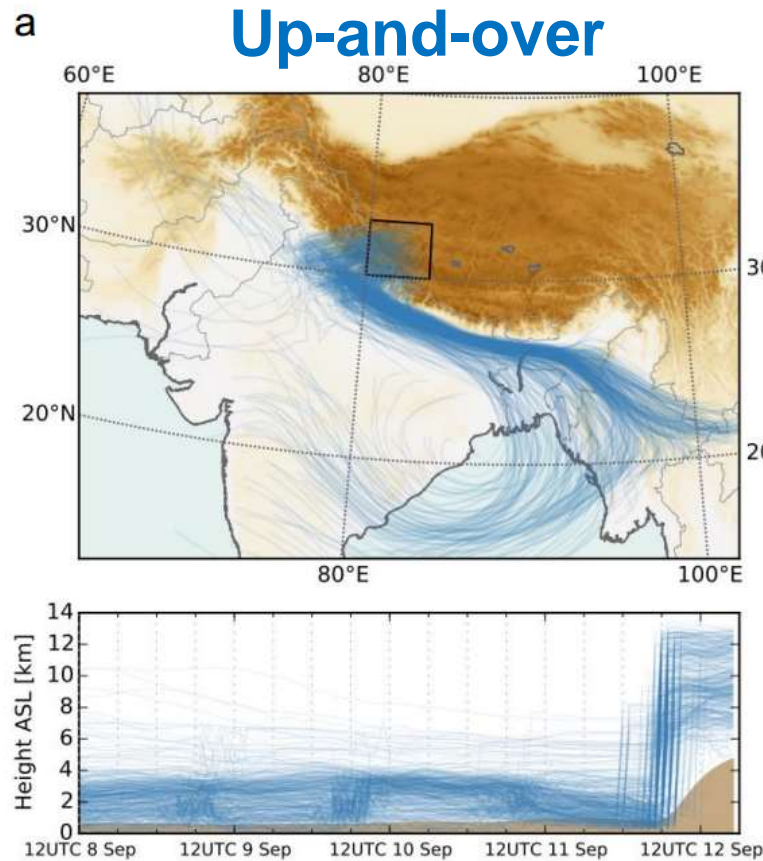
Model test-WRF model



EXP1: halving the RH in the upper layer——Cutoff the up-and-over route
EXP2: halving the RH in the upper two layers——Retain the upslope route

Model test-FLEXPART model

(Conducted by Jonathon S. Wright)



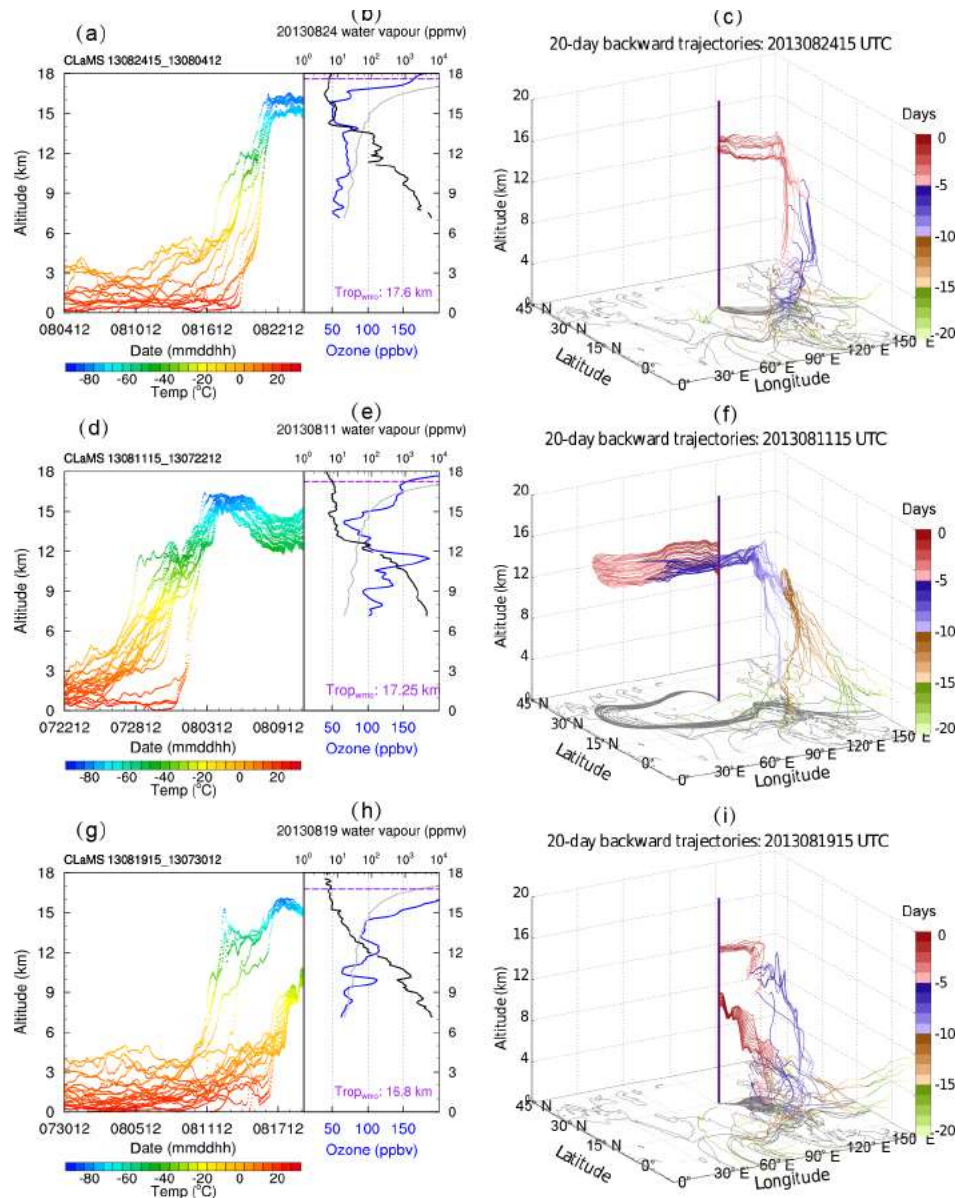
**Percentage
of rainfall
particles:**

50-75%

25-50%

3rd ACAM workshop

(Personal communication with Dan Li Poster #16)



A relatively close position between the ASM and typhoon Trami led to the parcels arriving at the Lhasa site in a short period of time... ..

Li et al., ACP, 2017

Conclusion:

Up-and-over route for moisture transport

More details can be found here



ARTICLE

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OPEN

Summer rainfall over the southwestern Tibetan Plateau controlled by deep convection over the Indian subcontinent

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Another key question:

Can up-and-over route still account for trans-Himalayans pollutant transport?

Thanks for your
attention & listening!

