Present-day precipitation sources for Northern Borneo: seasonal versus ENSO variability

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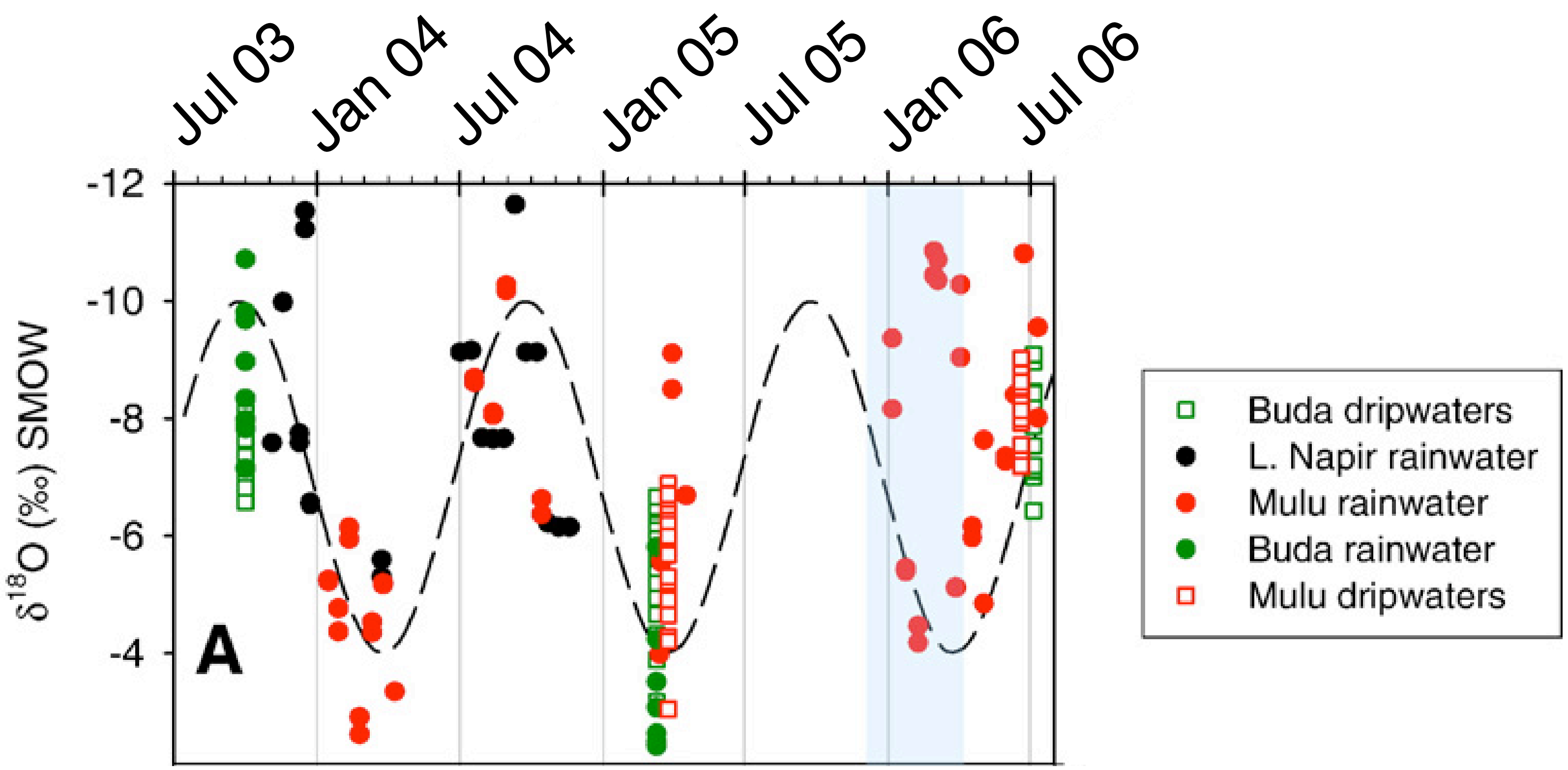
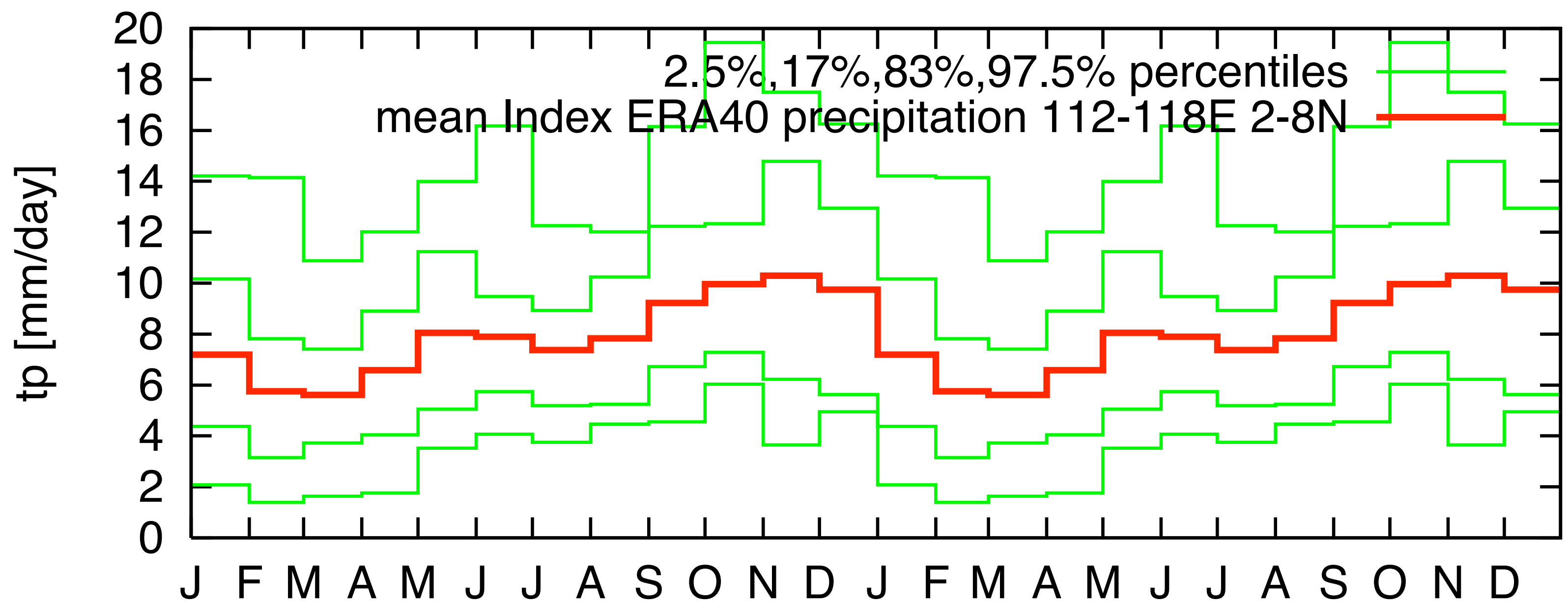
Image courtesy N. Meckler

Present-day precipitation and cave-water isotopes



Cobb et al., 2007



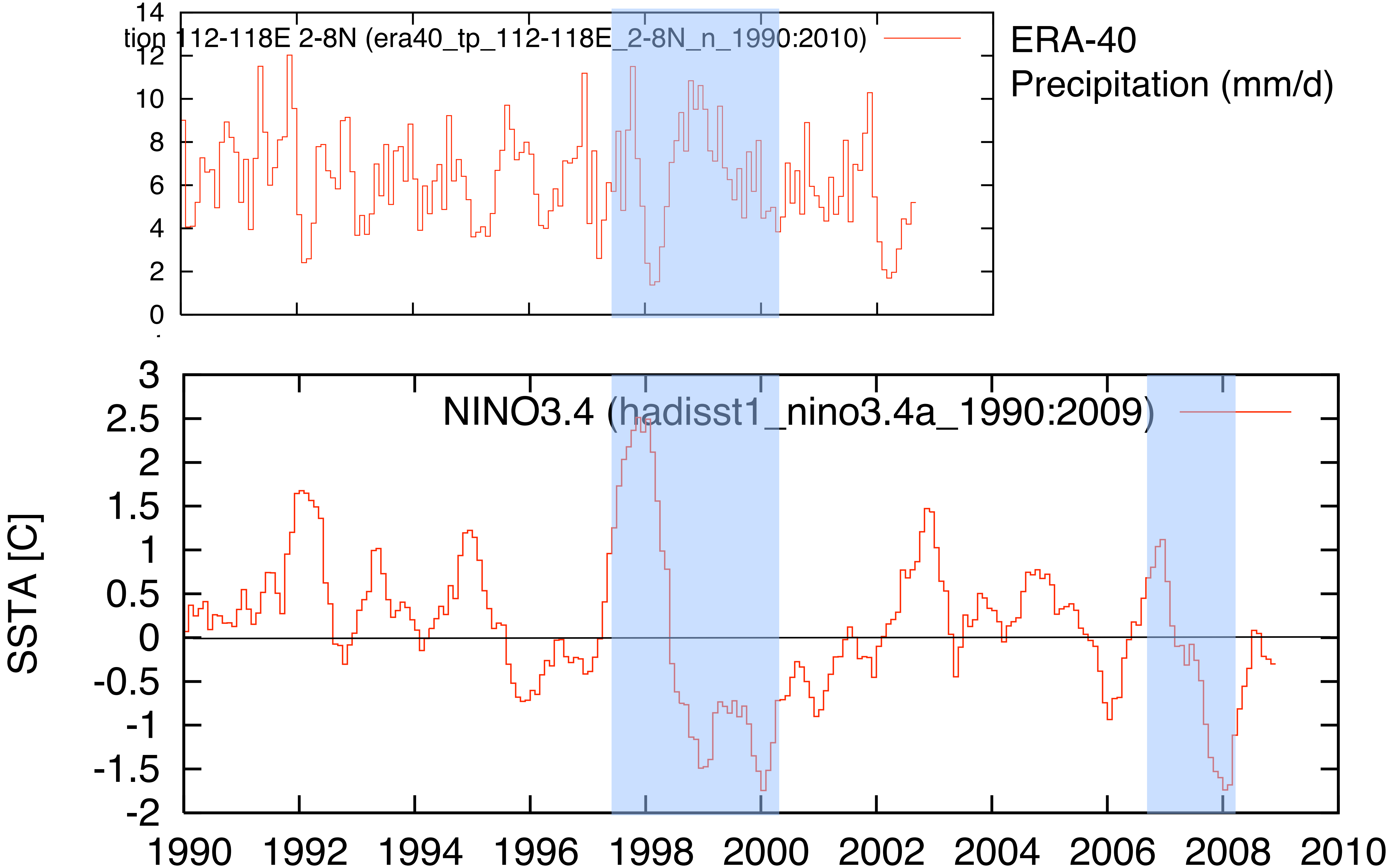
Isotope minimum: ~Oct (wet season)

Isotope maximum: ~Mar (dry season)

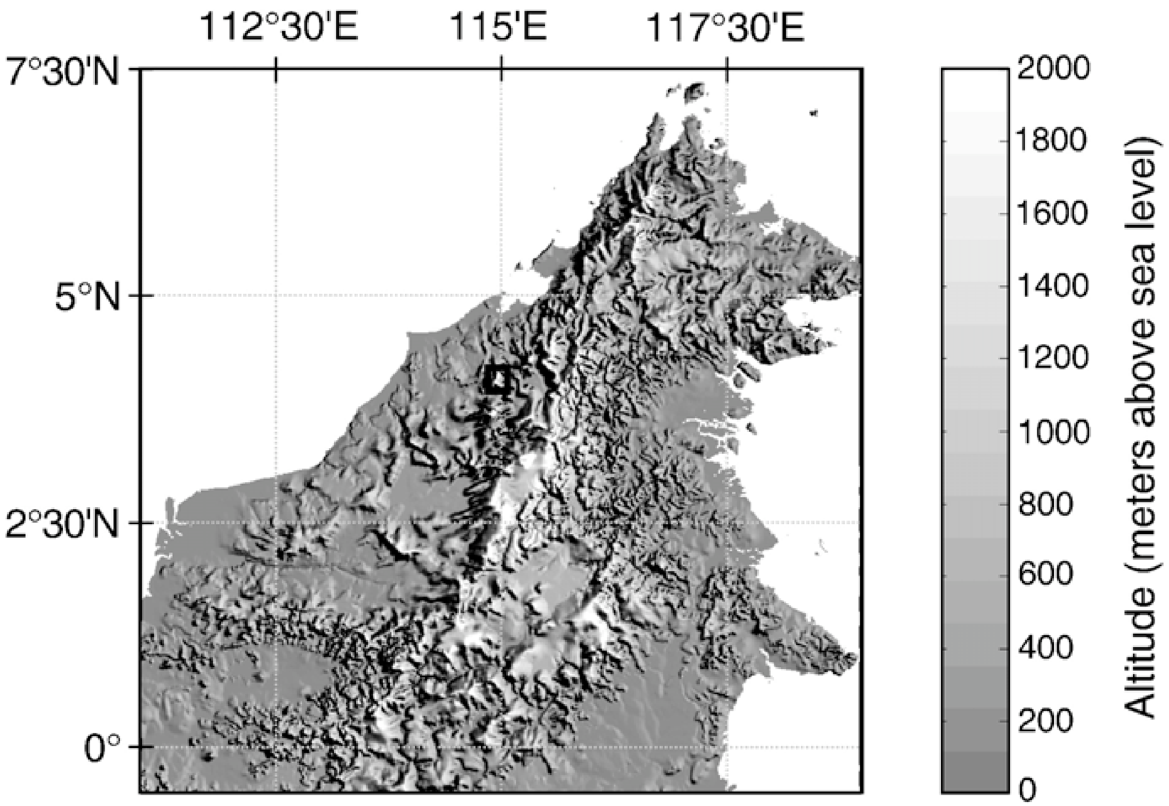
El Niño: extra-dry, less depleted?

La Niña: moist, depleted dry season

ENSO and precipitation time series

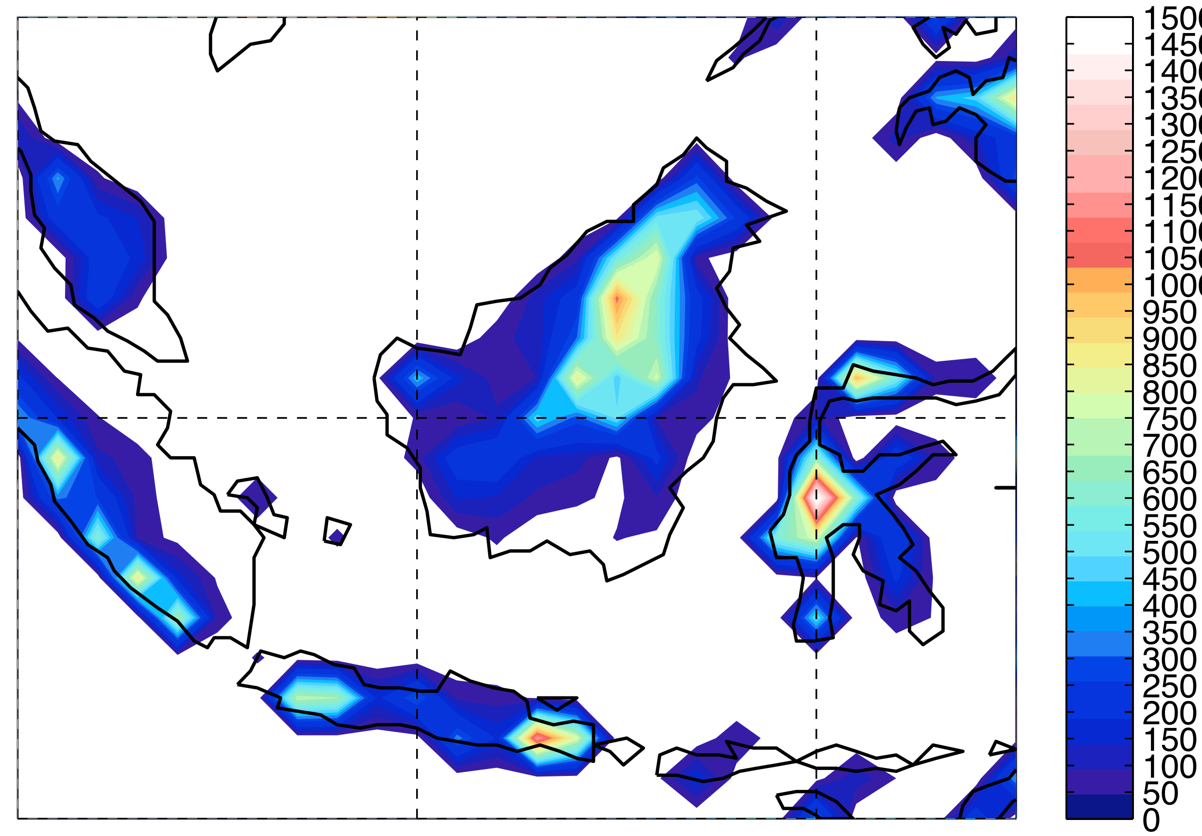


Study area Gunung Caves, Northern Borneo



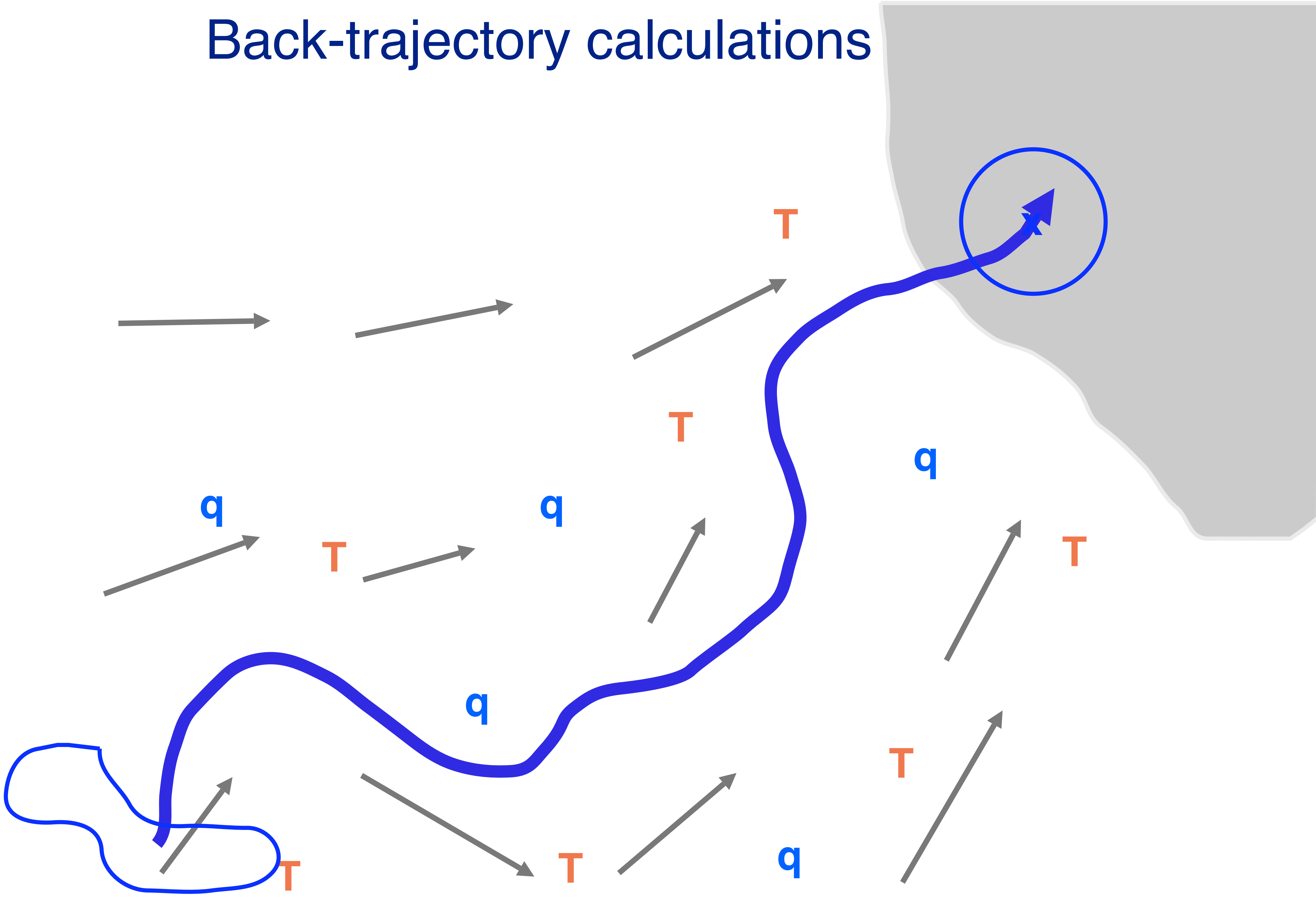
Cobb et al., 2007

high-resolution DEM



smoothed ECMWF
model orography (1°x1°)

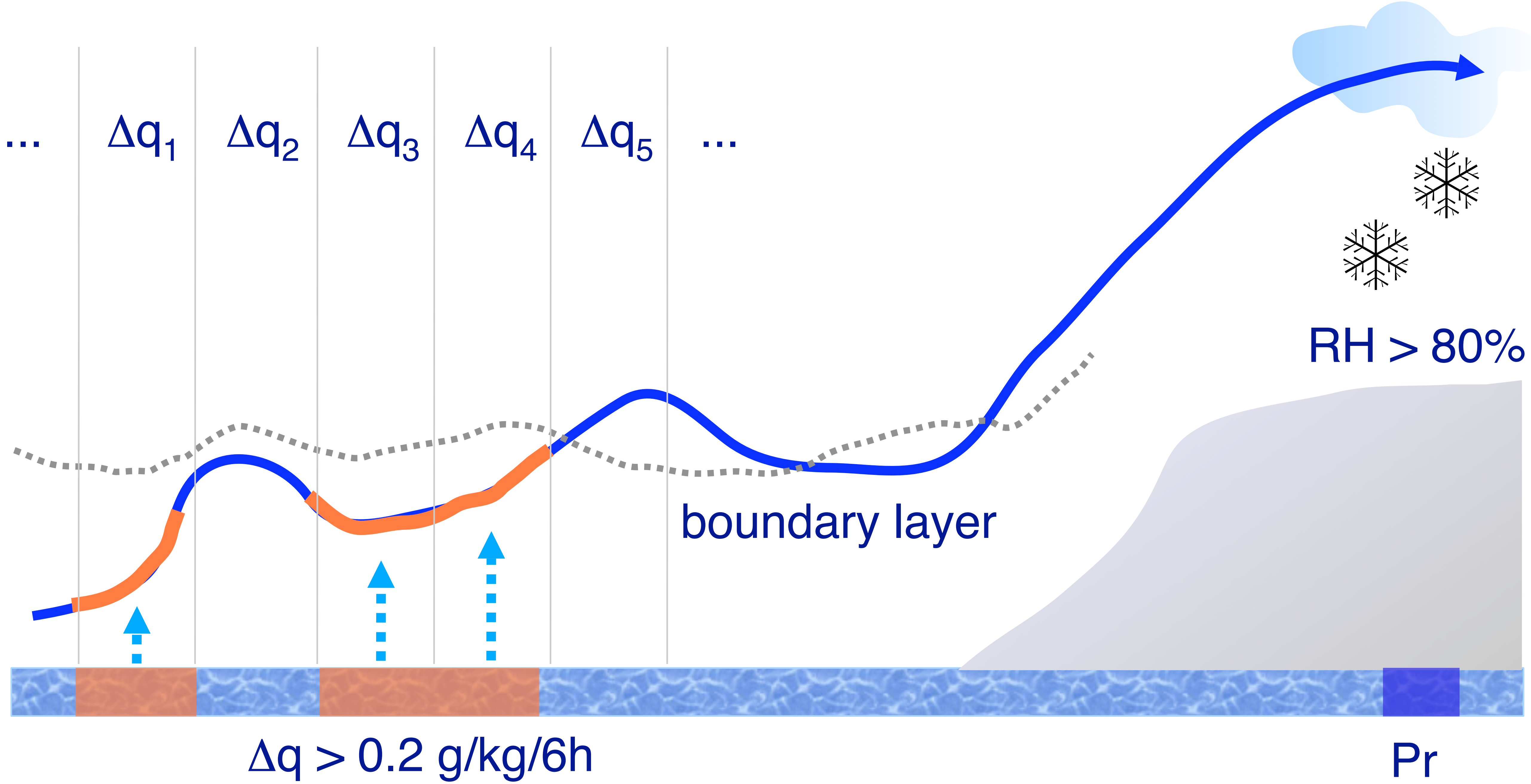
Back-trajectory calculations



t = -20 d

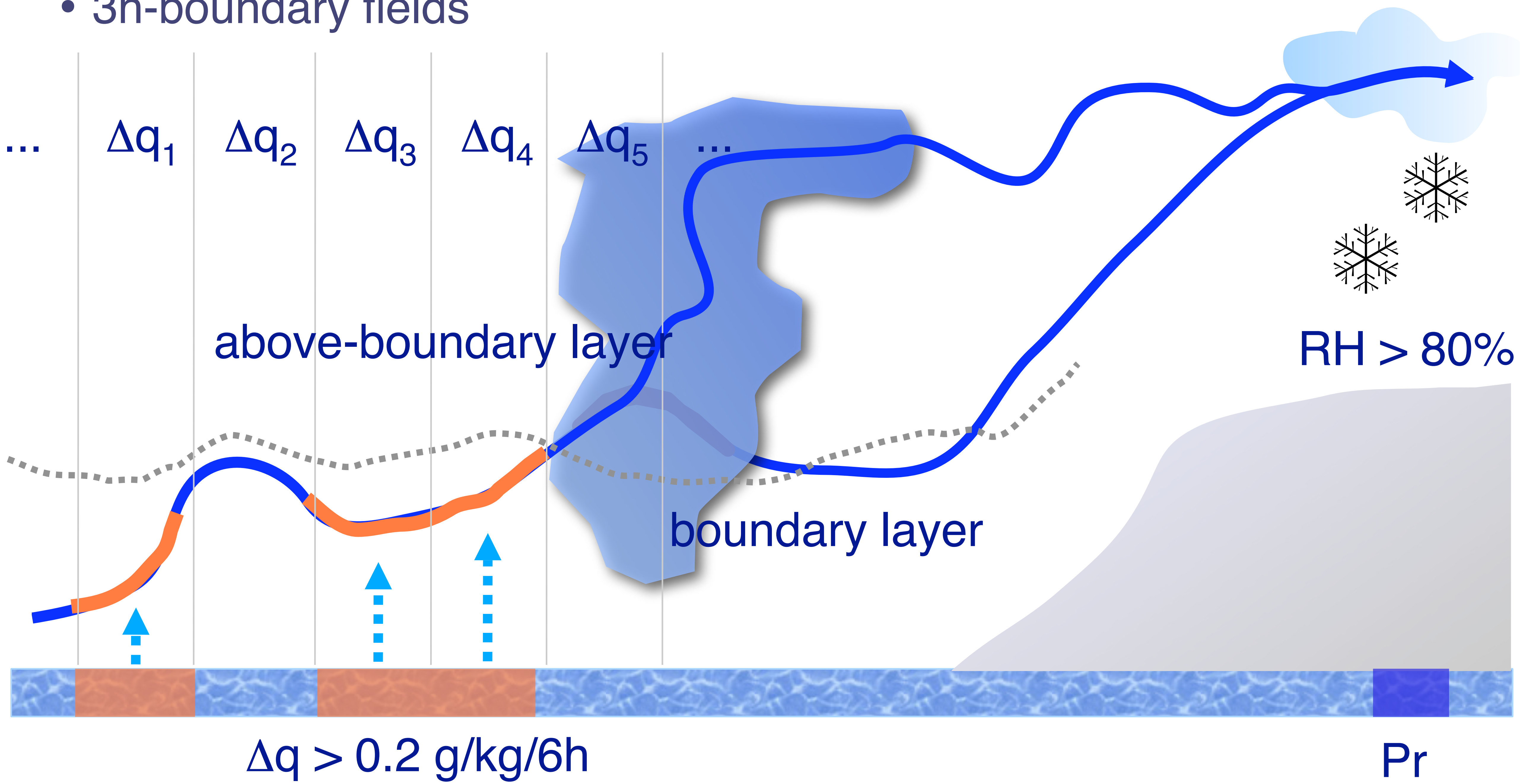
Identification of moisture sources

- Precipitation at arrival point over Greenland
- Within well-mixed marine boundary layer
- Moisture increase in an air parcel
- Account for uptake sequence

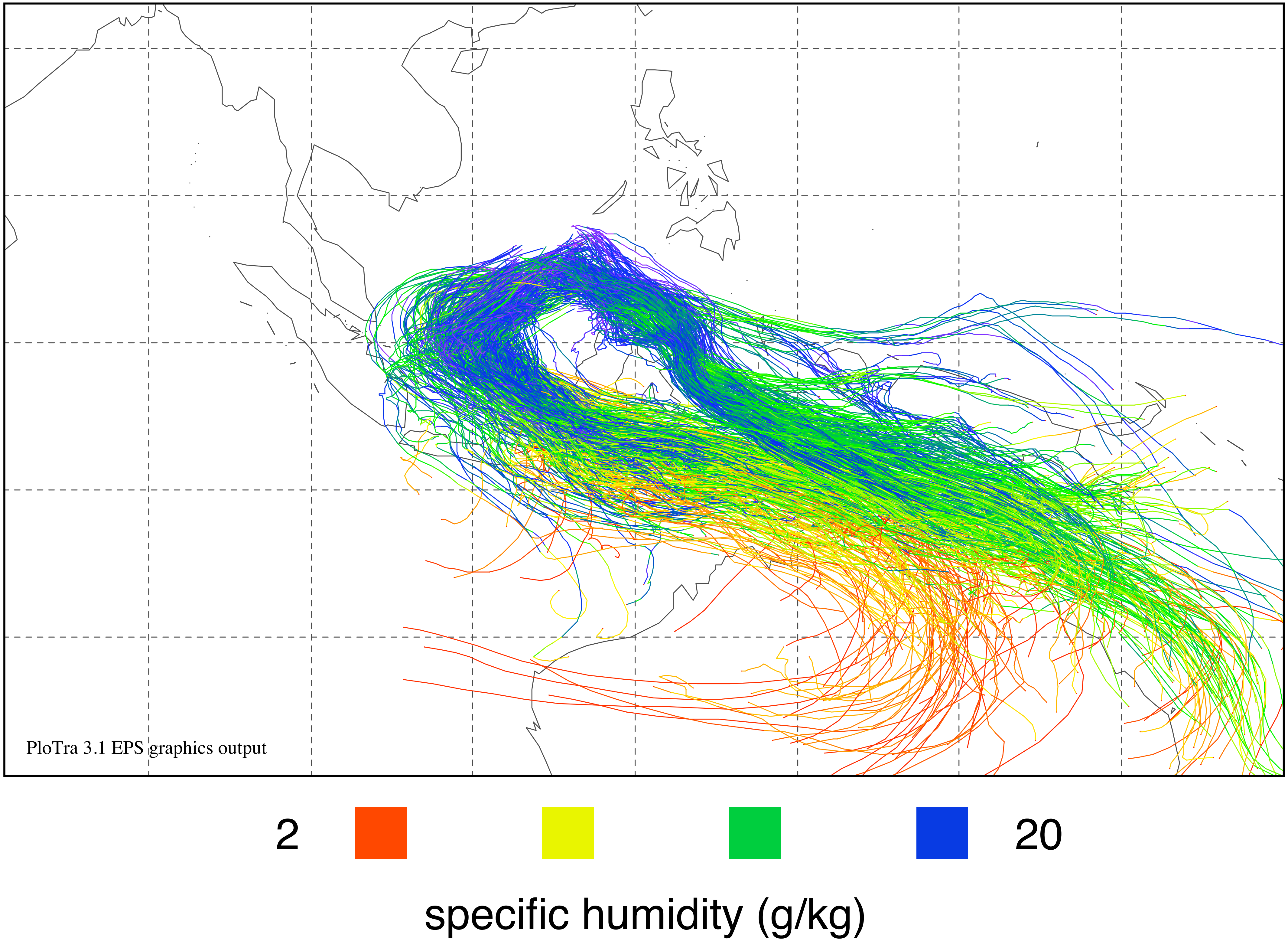


Improved water source diagnostic for convective regions

- Particle transport model FLEXPART
  - Mass-flux convection parameterisation (Emanuel and Živković-Rothman, 1999)
  - Boundary-layer turbulence
  - 3h-boundary fields

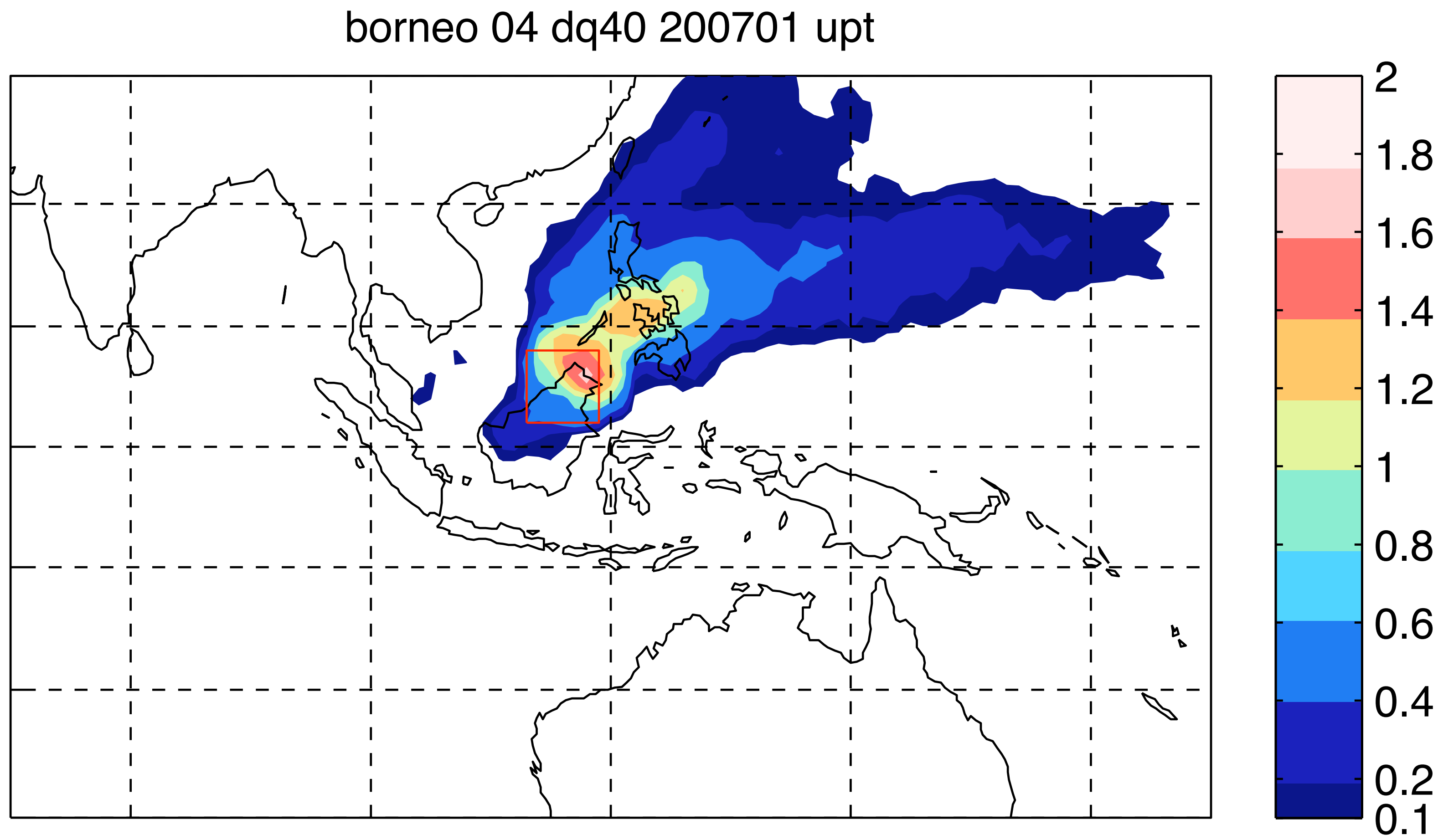


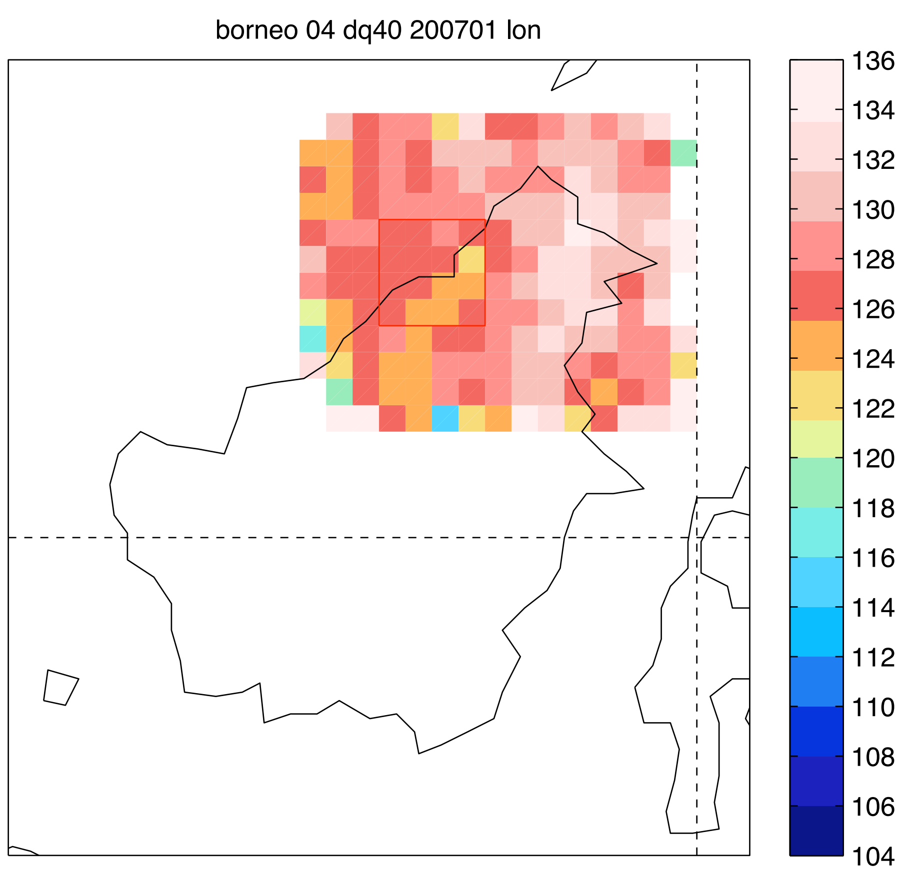
2007 09

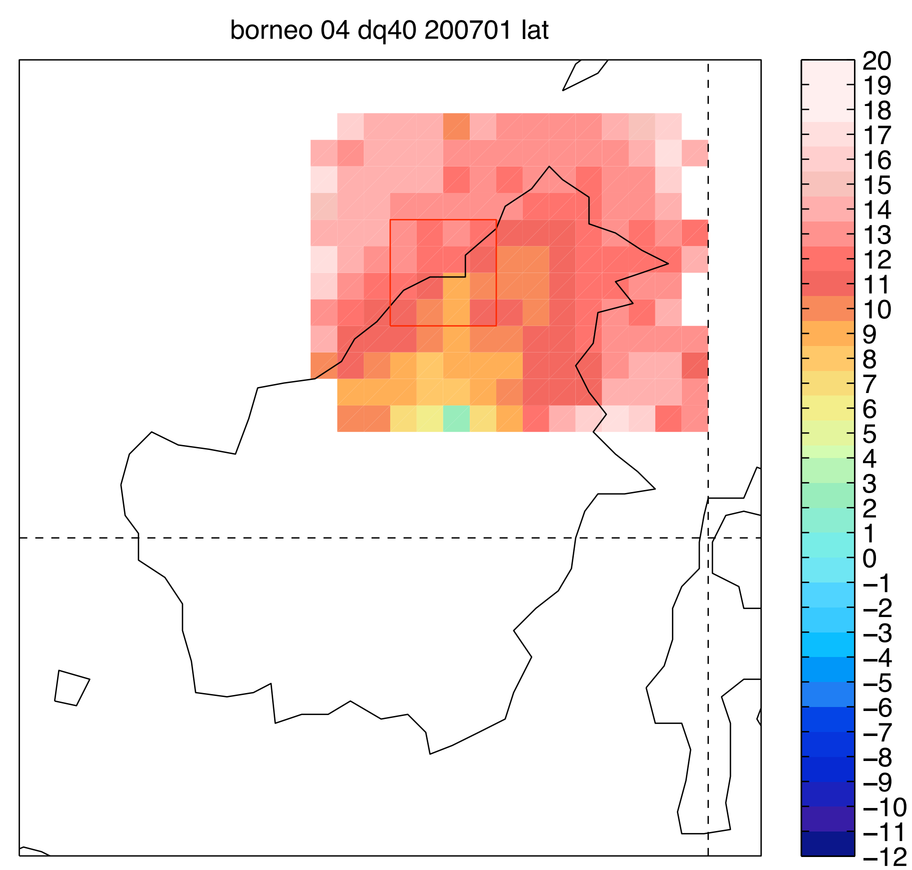


Niño 3.4:
0.64

2007 01

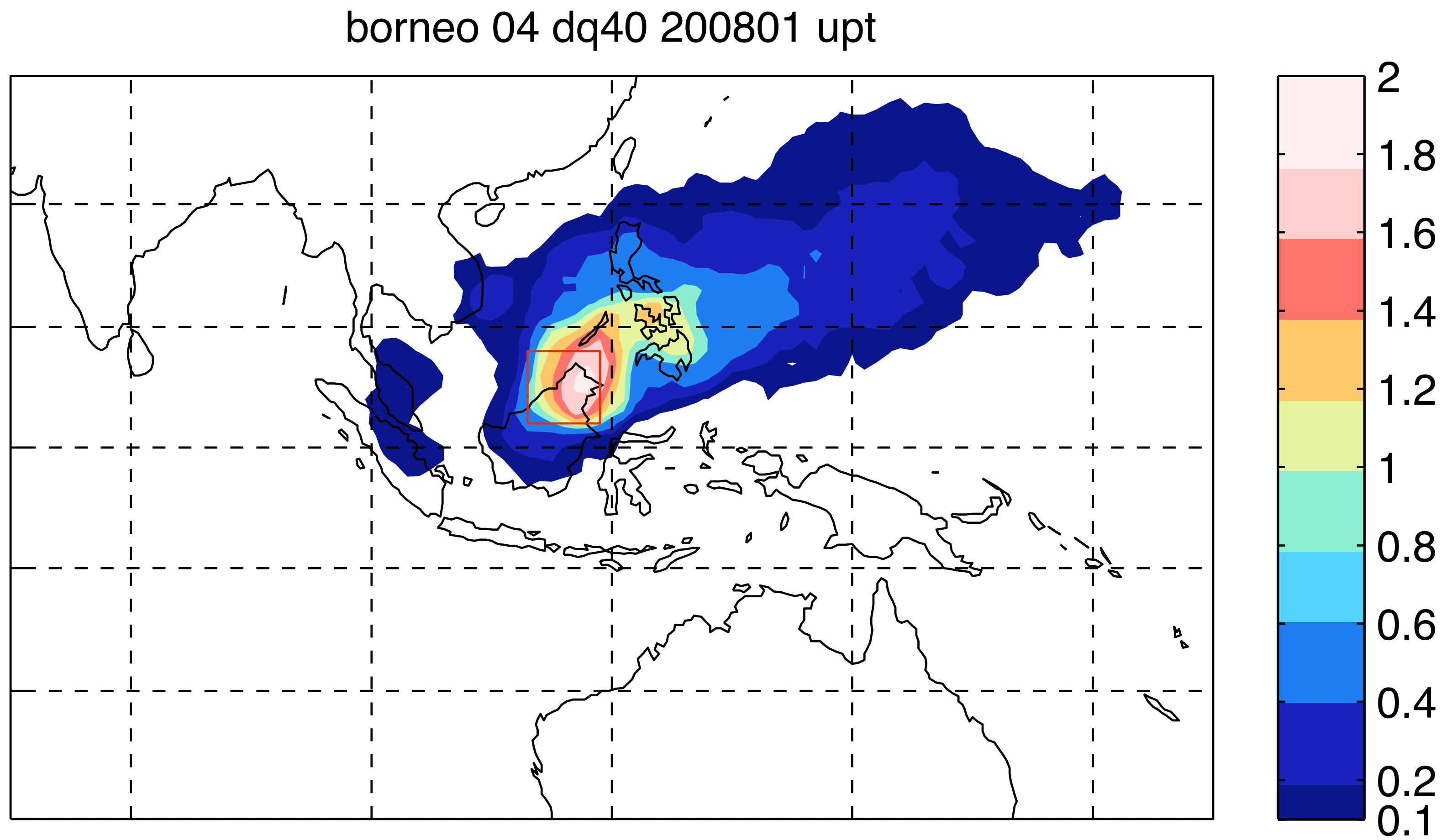


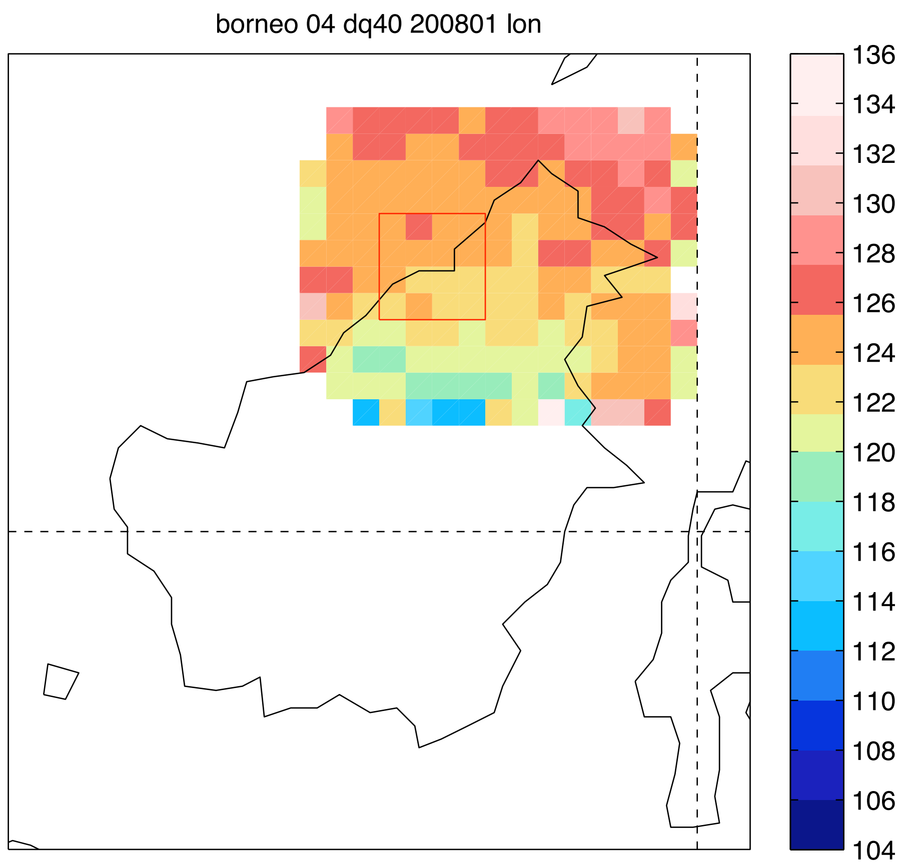


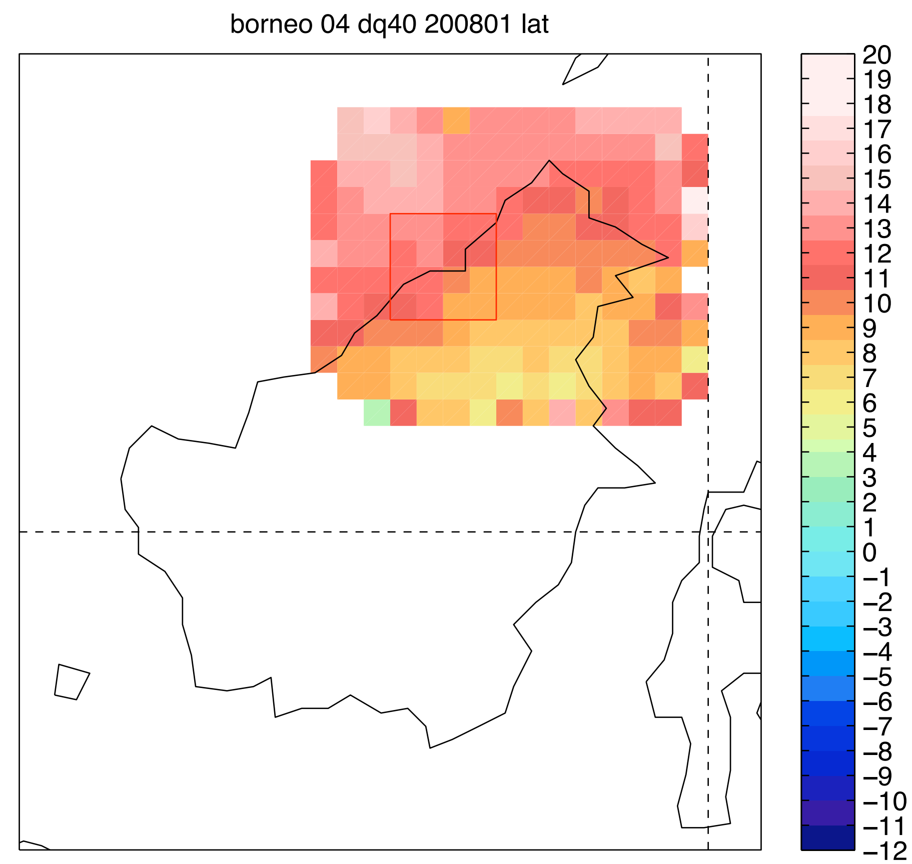


Niño 3.4:
-1.73

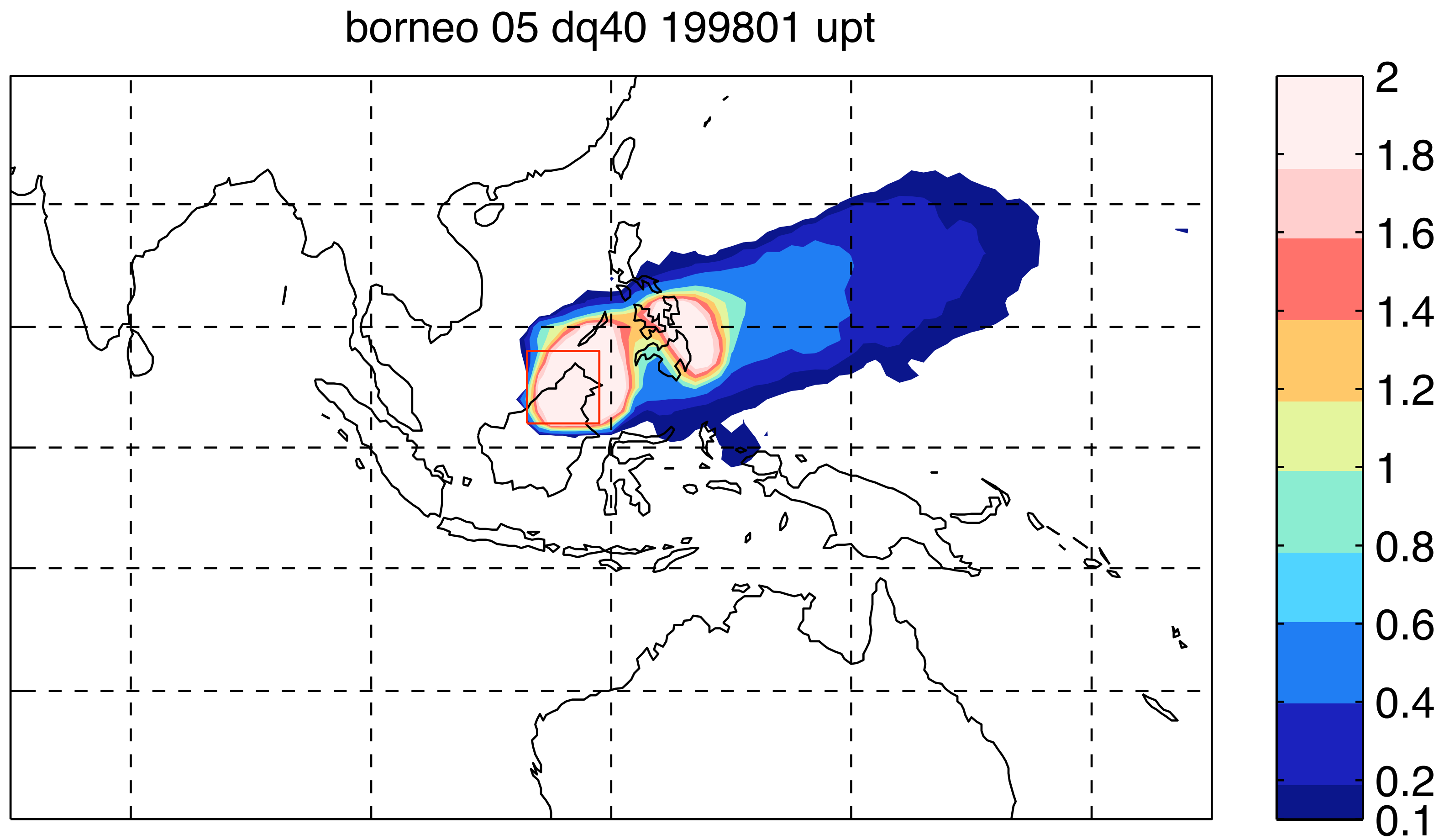
2008 01



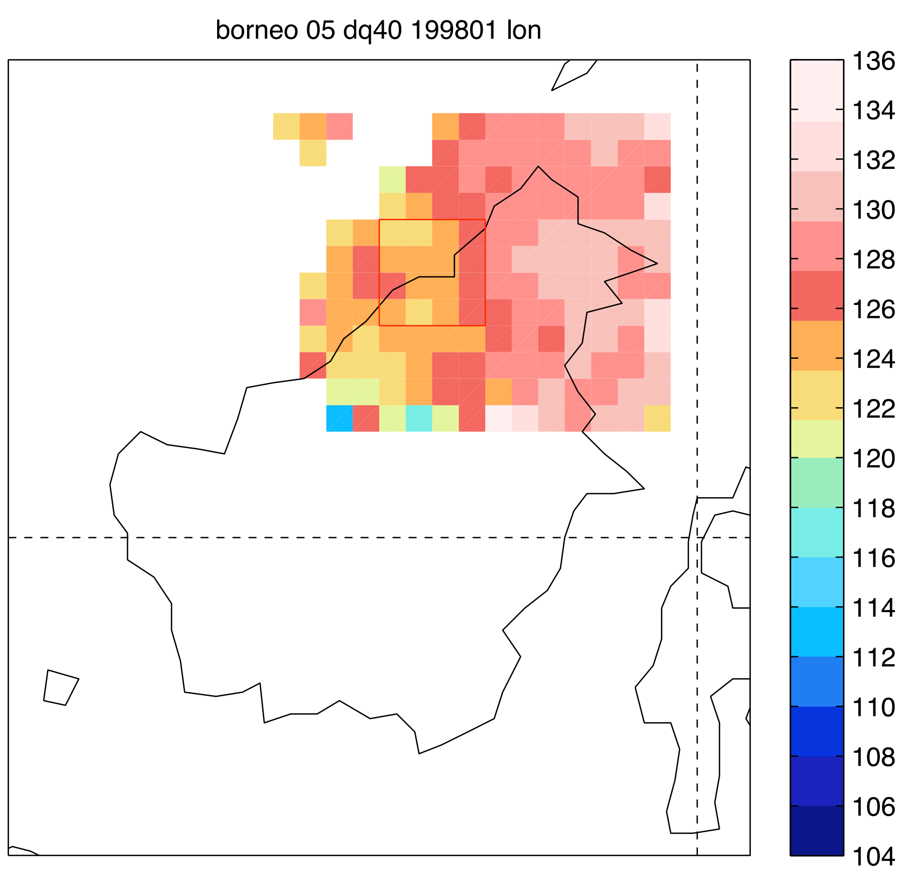


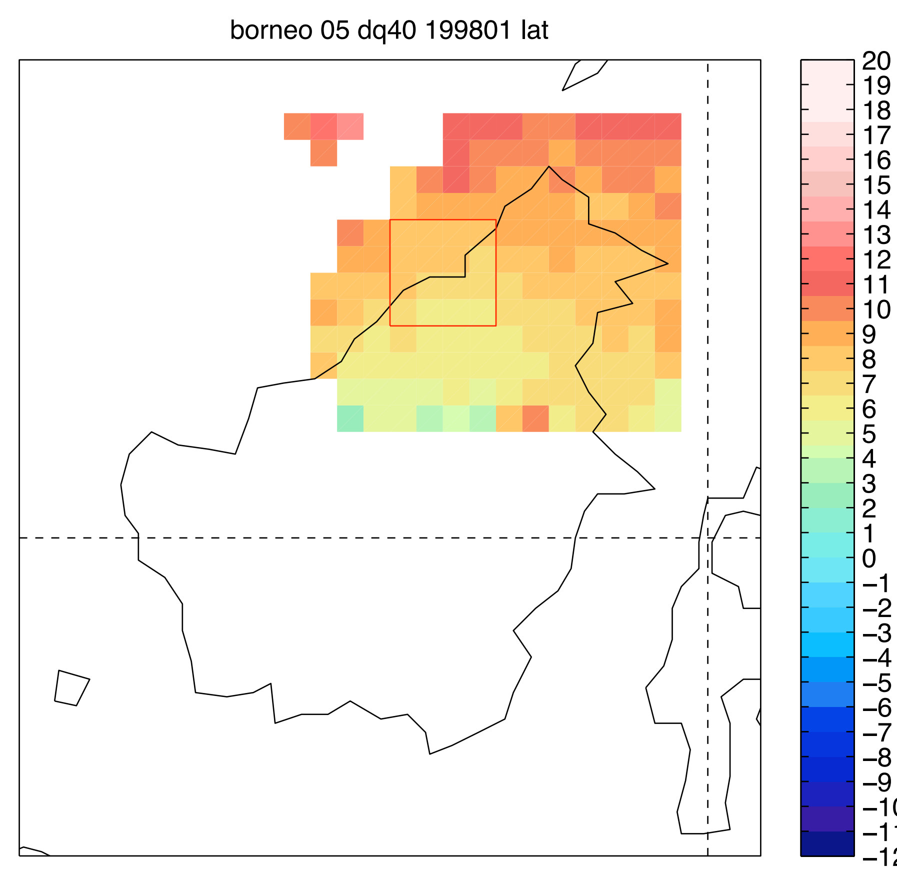


Niño 3.4:
2.54

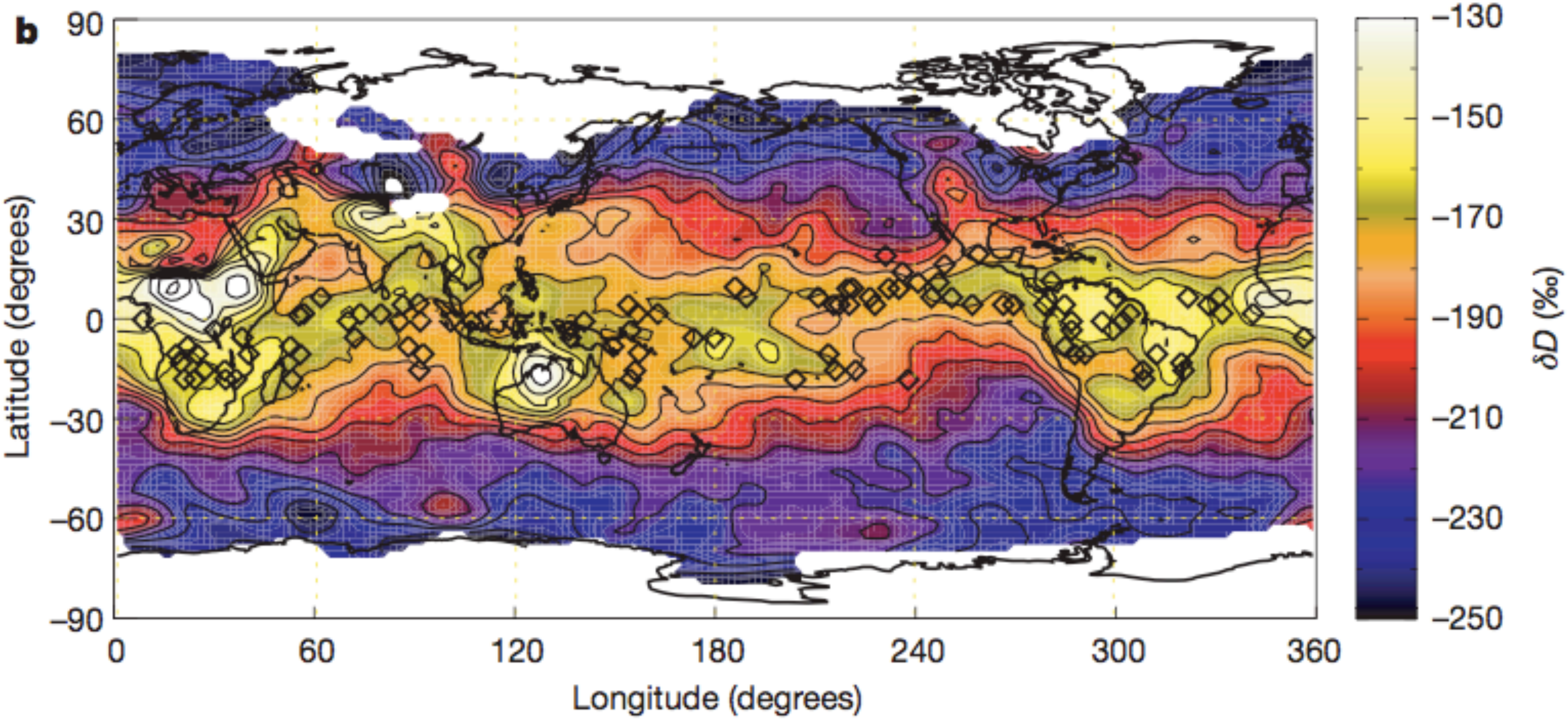


1998 01



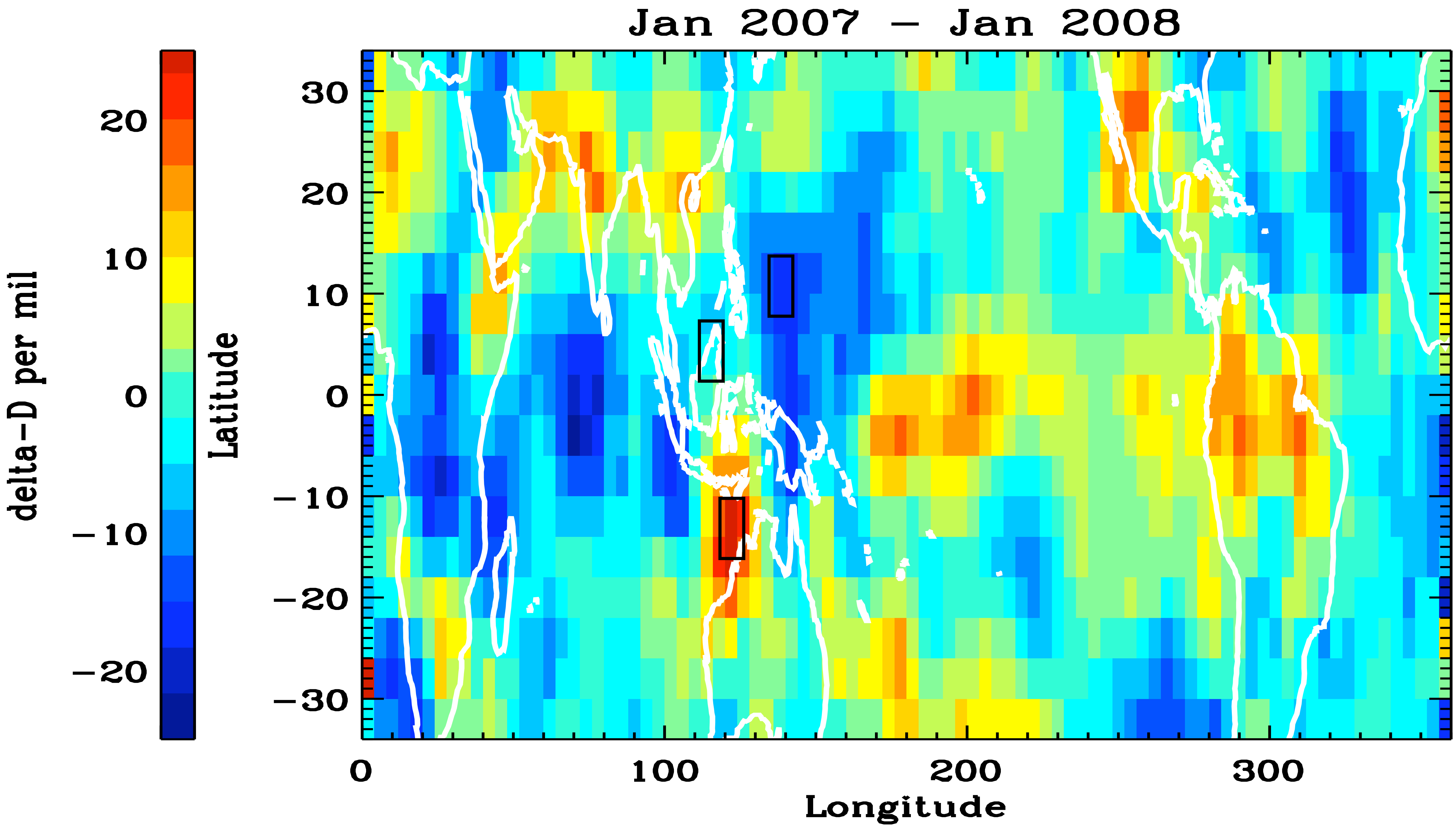


TES stable isotopes of the water vapour (850-500 hPa)

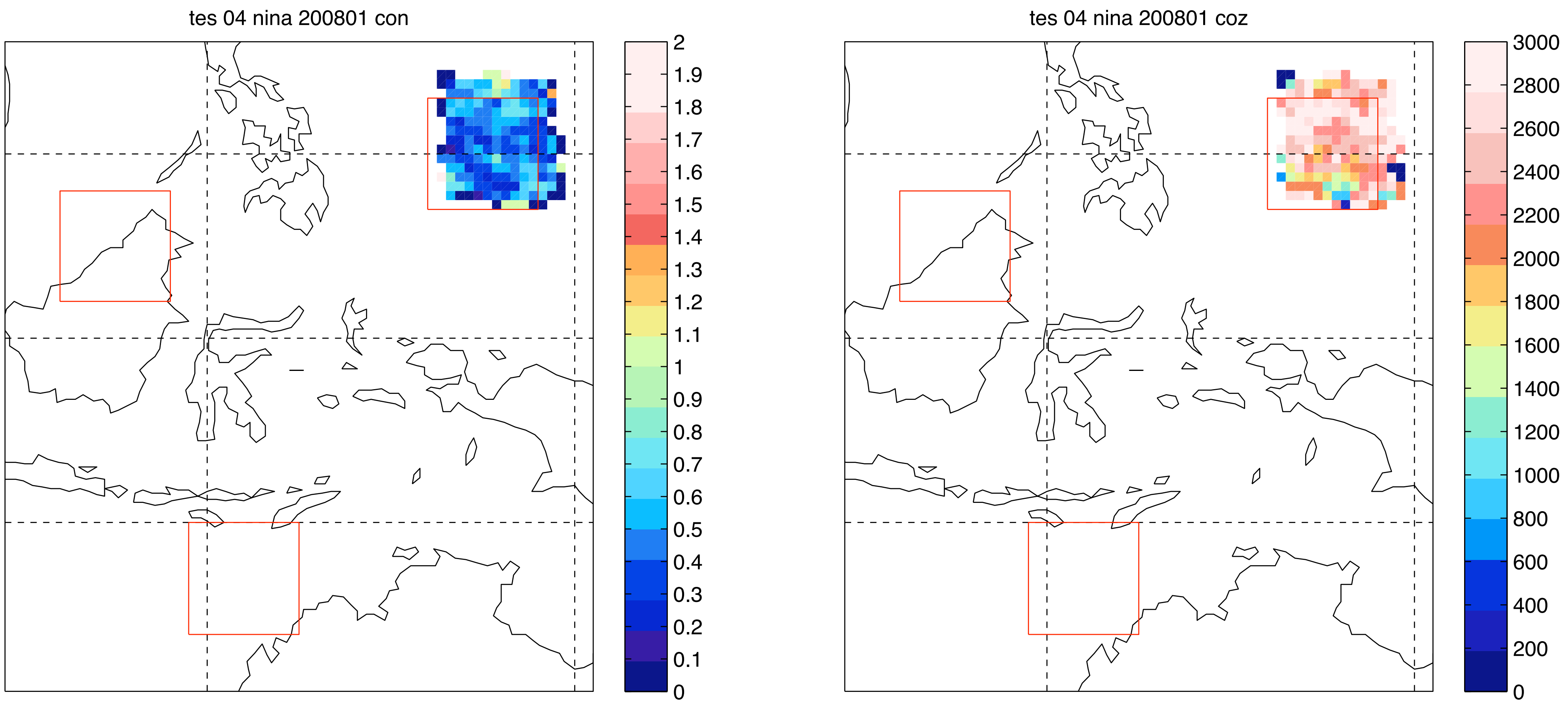


Worden et al., 2007

TES stable isotope ratio of the water vapour (850-500 hPa)



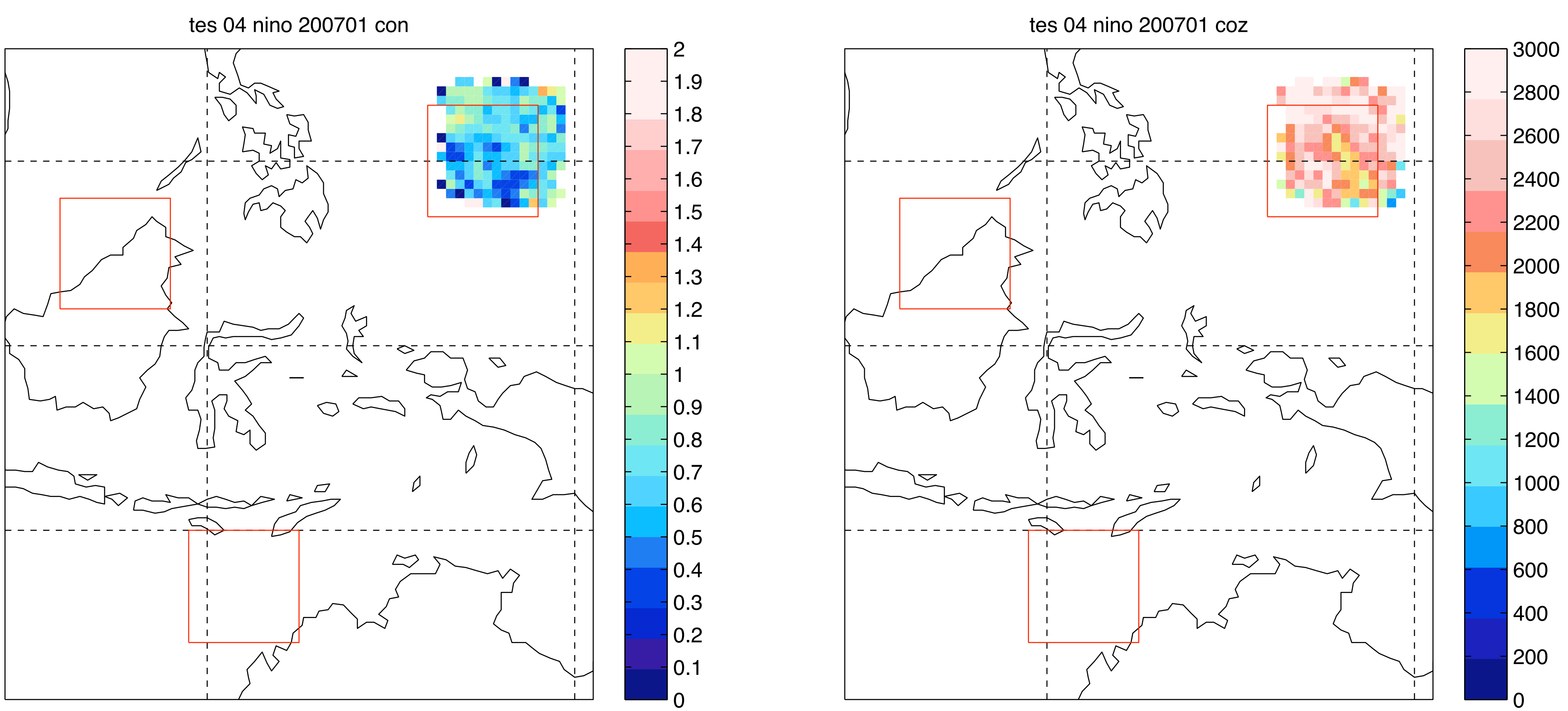
red: more depletion during El Niño, blue: more depletion during La Niña



La Niña

0.46
2425m

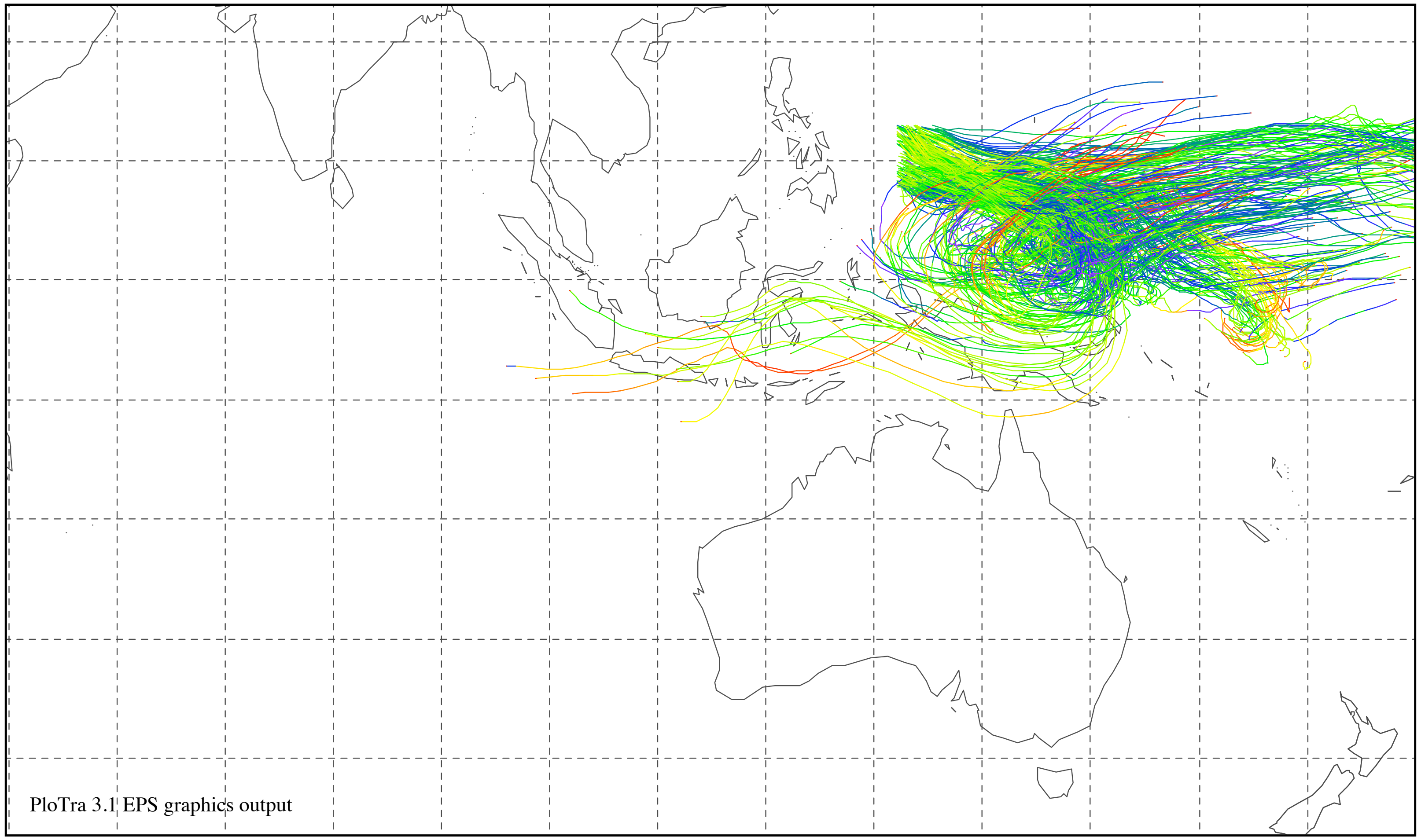
TES: less depletion during La Niña



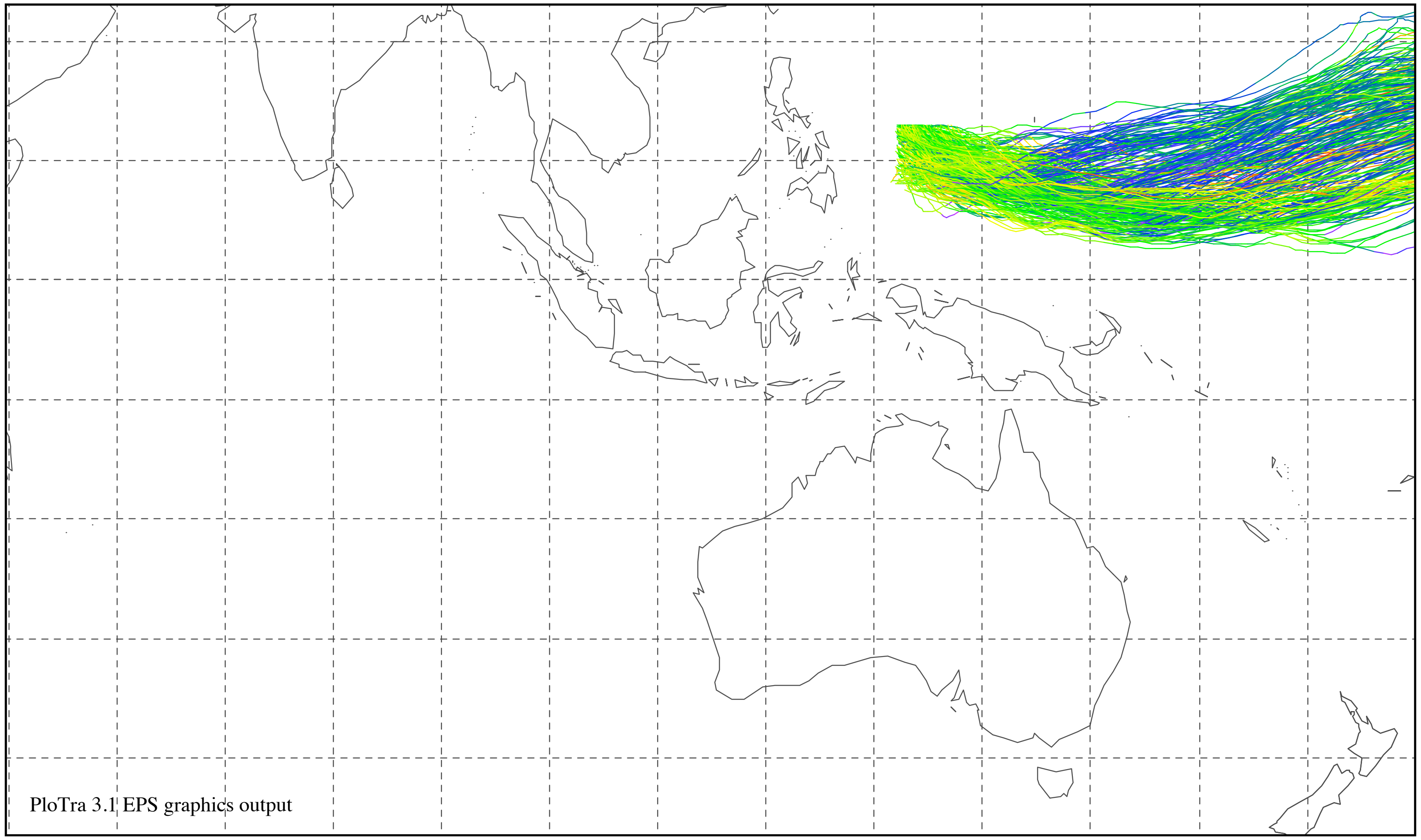
El Niño

0.70
2447

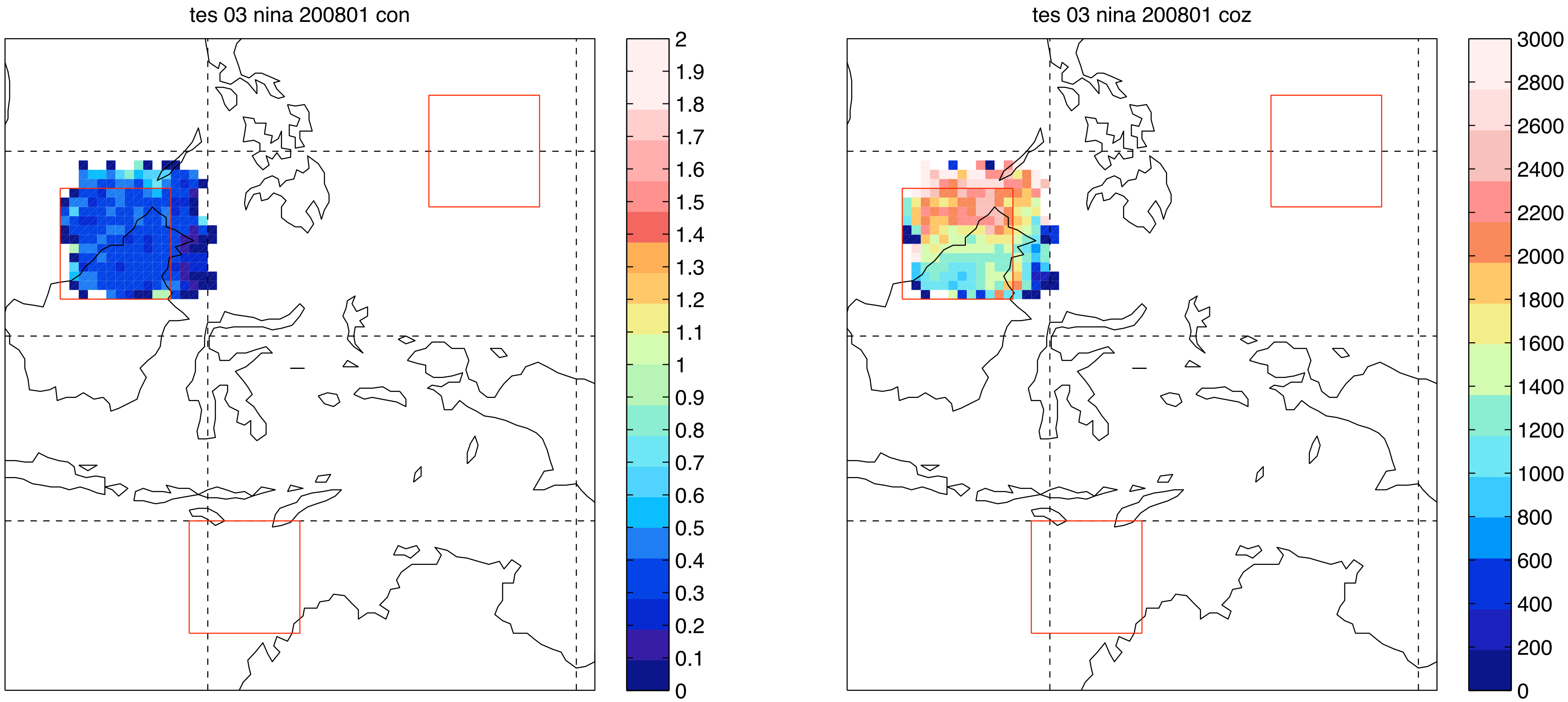
La Niña



El Niño



La Niña

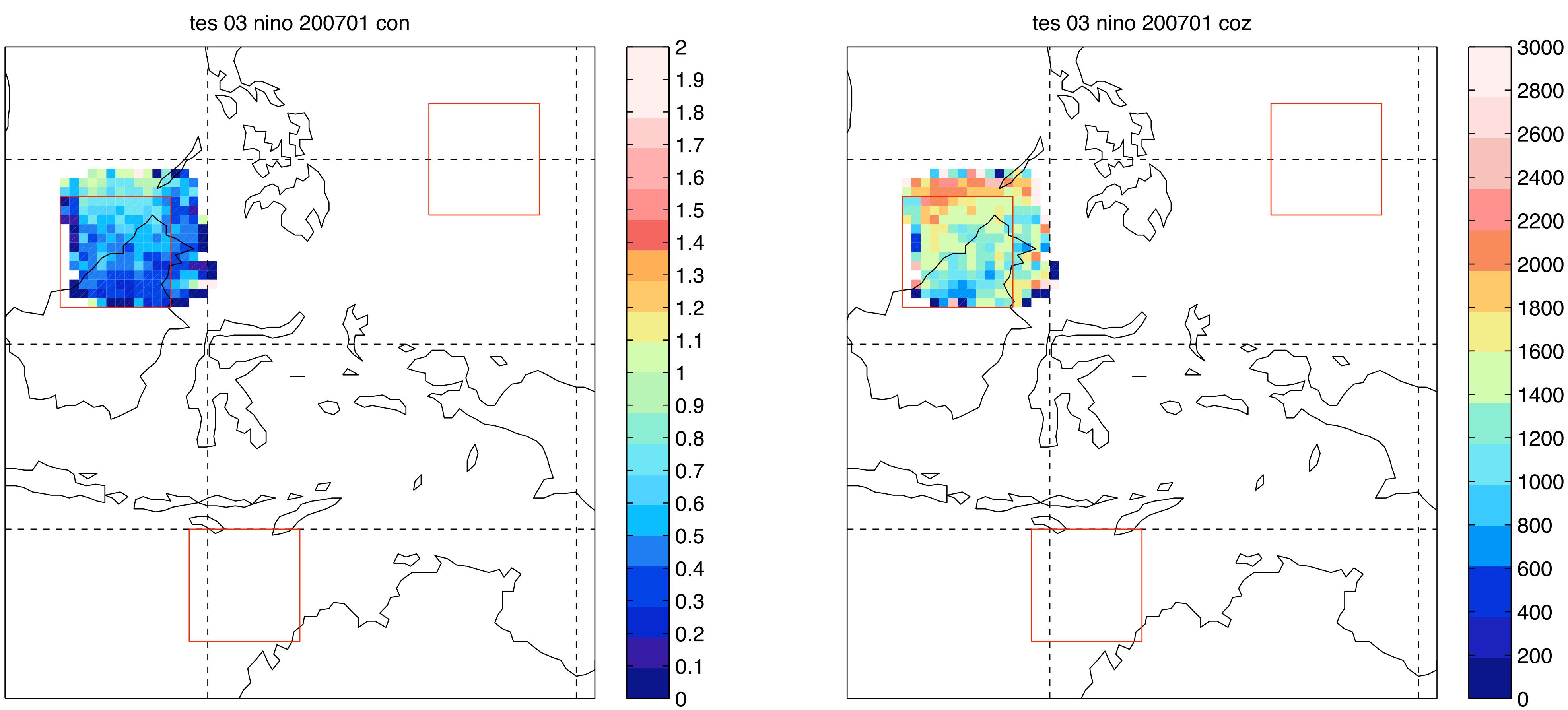


0.50

1481m

TES: slightly less depletion during La Niña

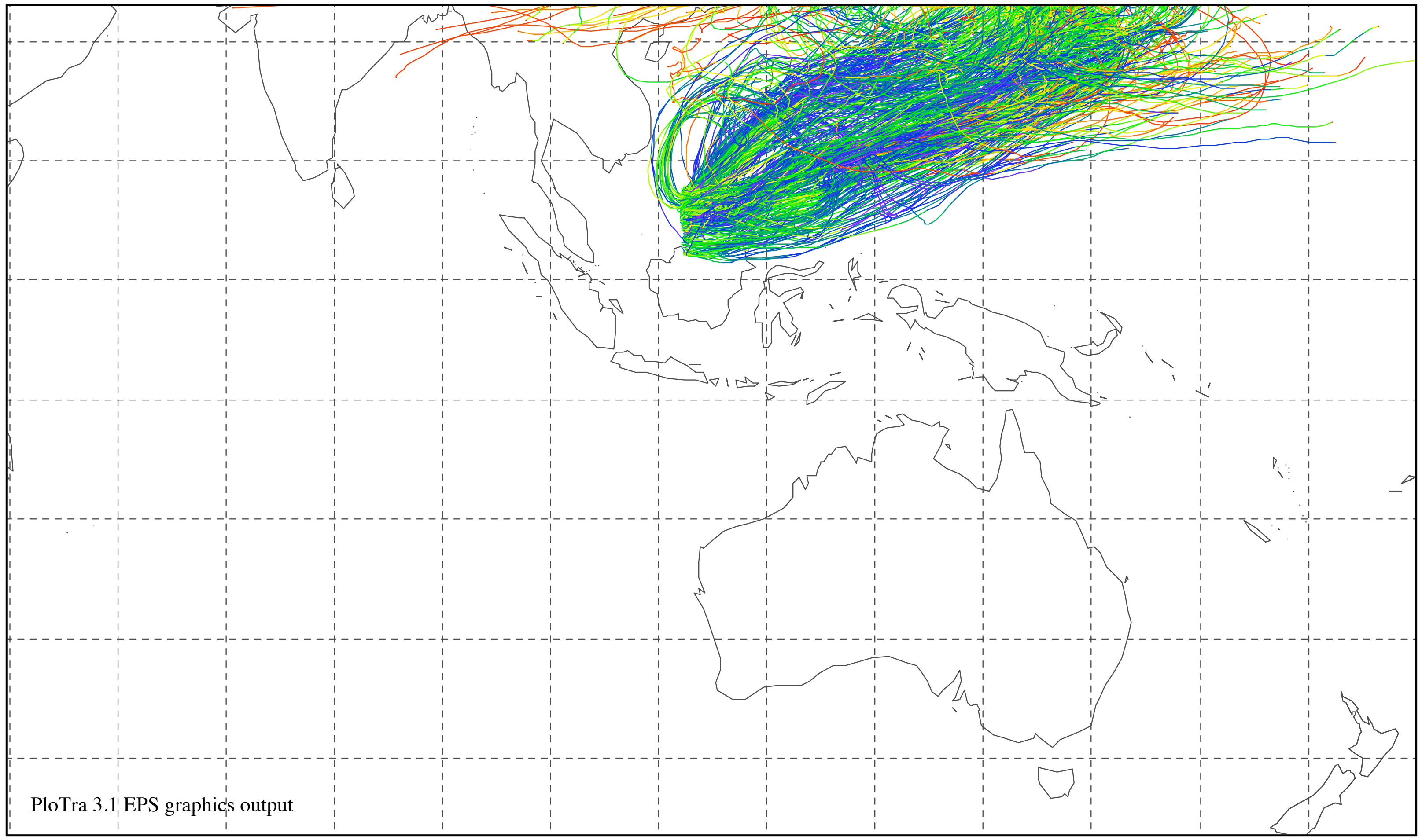
El Niño



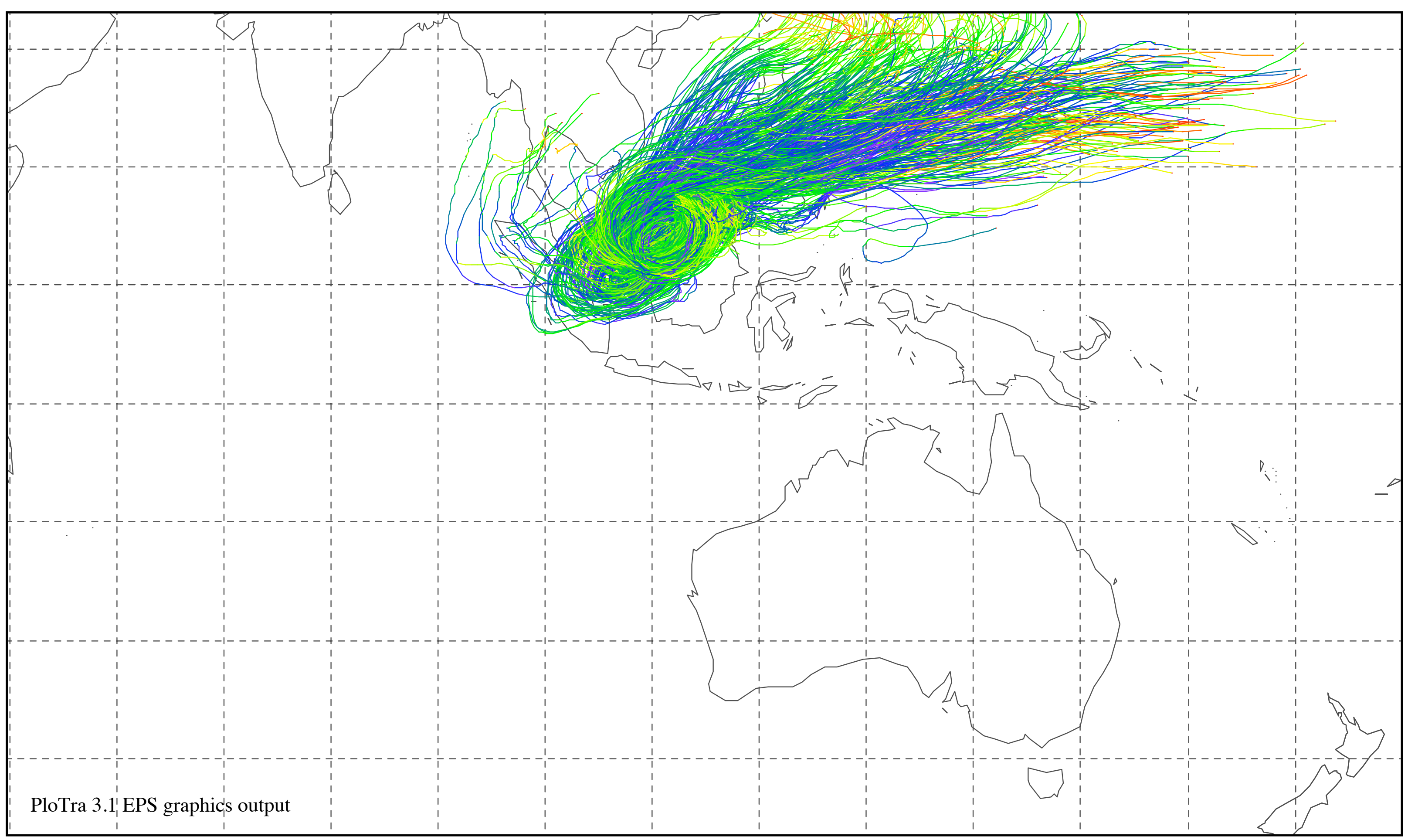
0.32

1677m

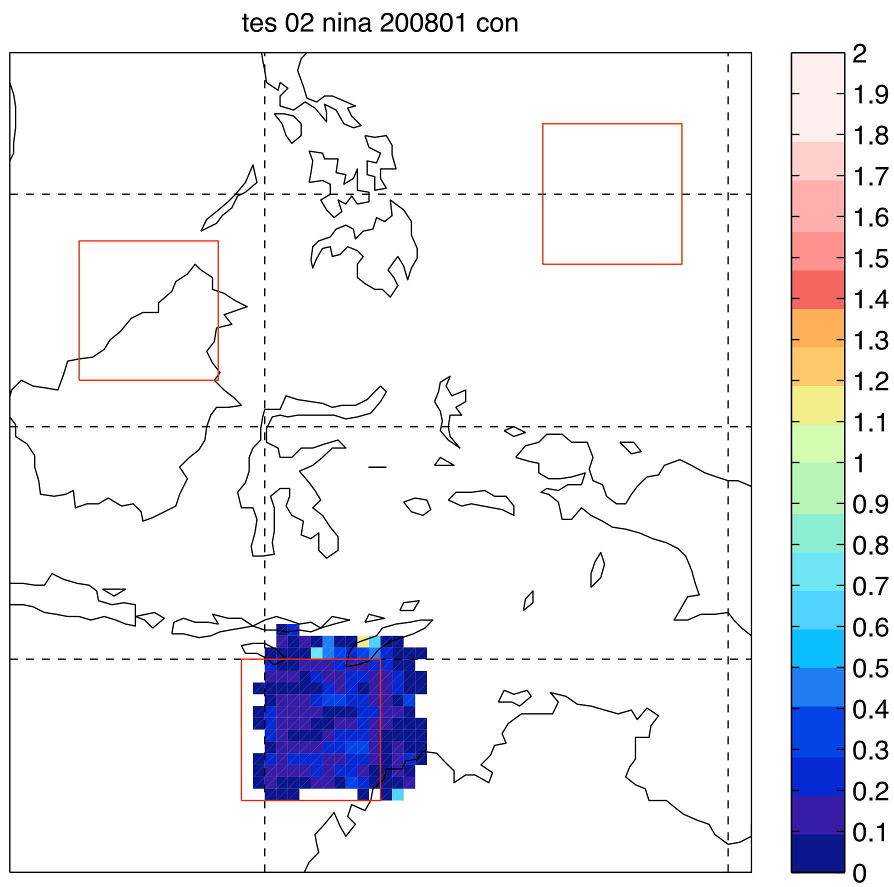
La Niña

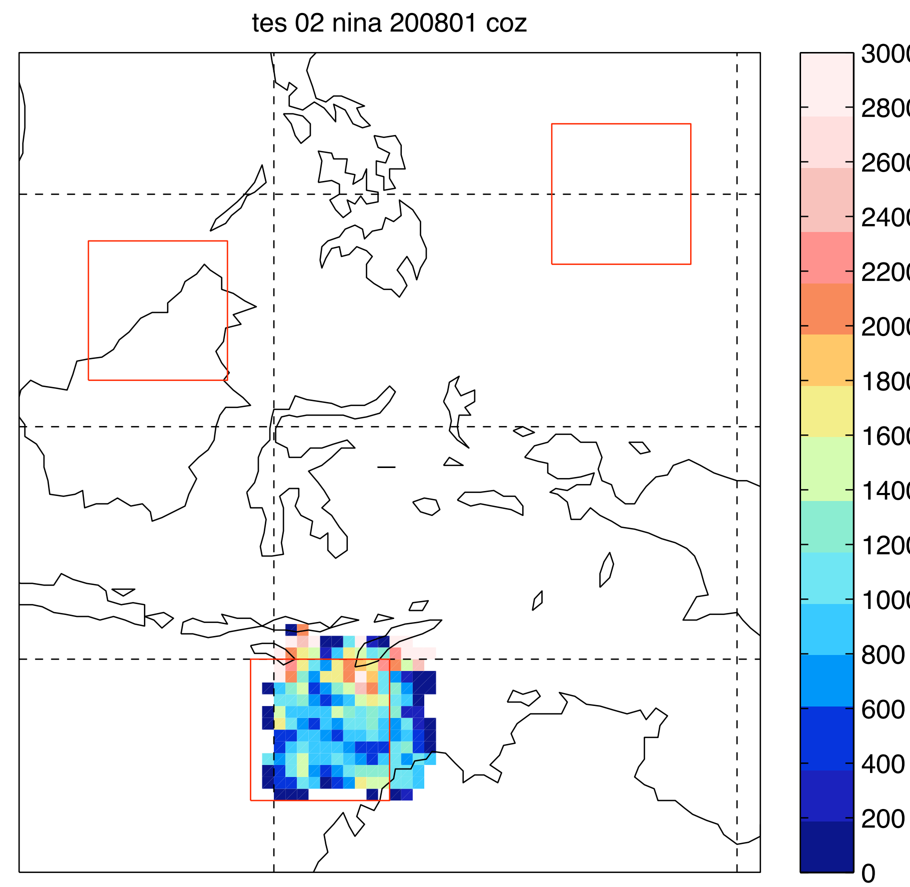


El Niño



La Niña

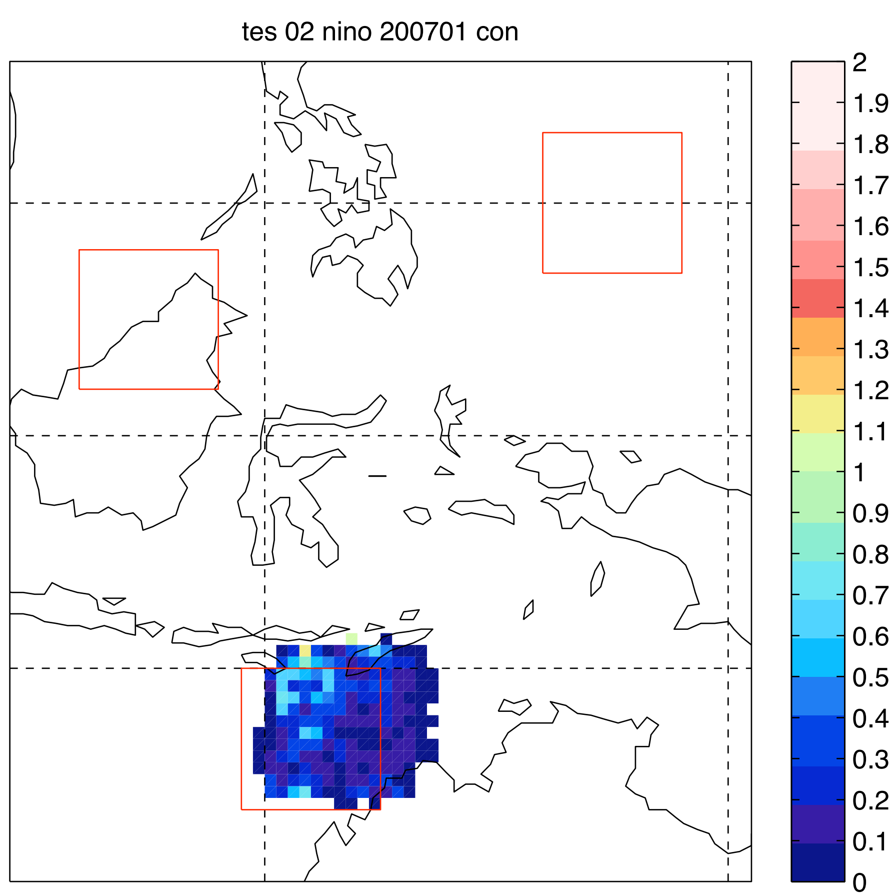


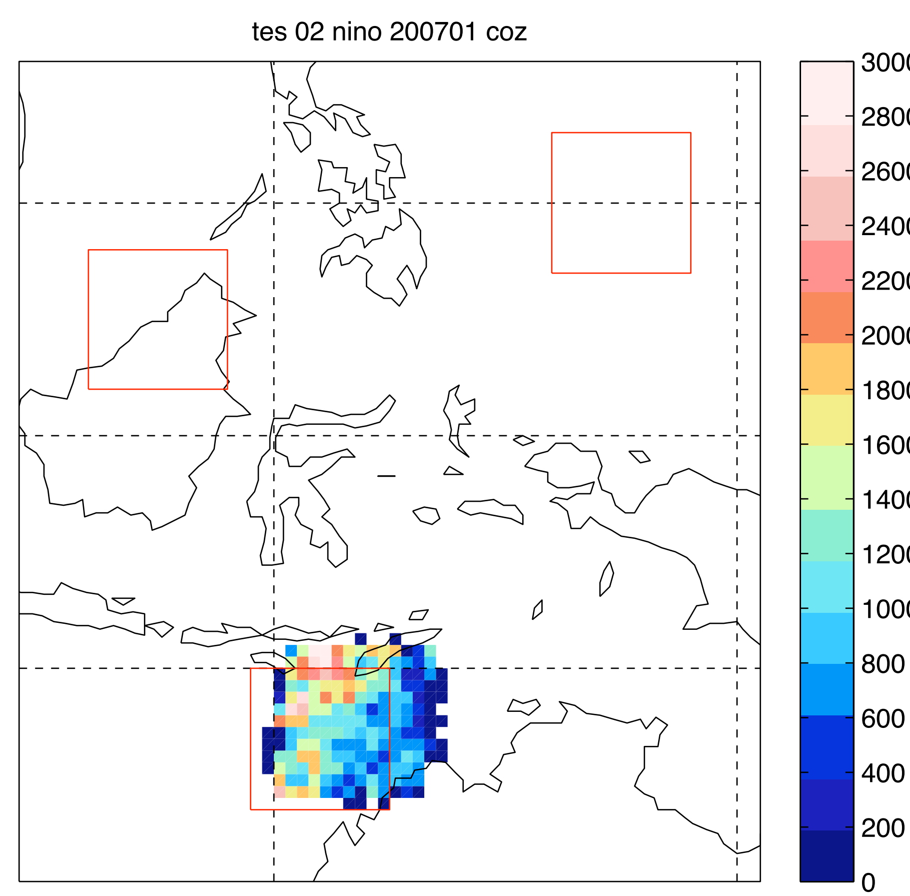


0.14
1109m

TES: much more depletion during La Niña

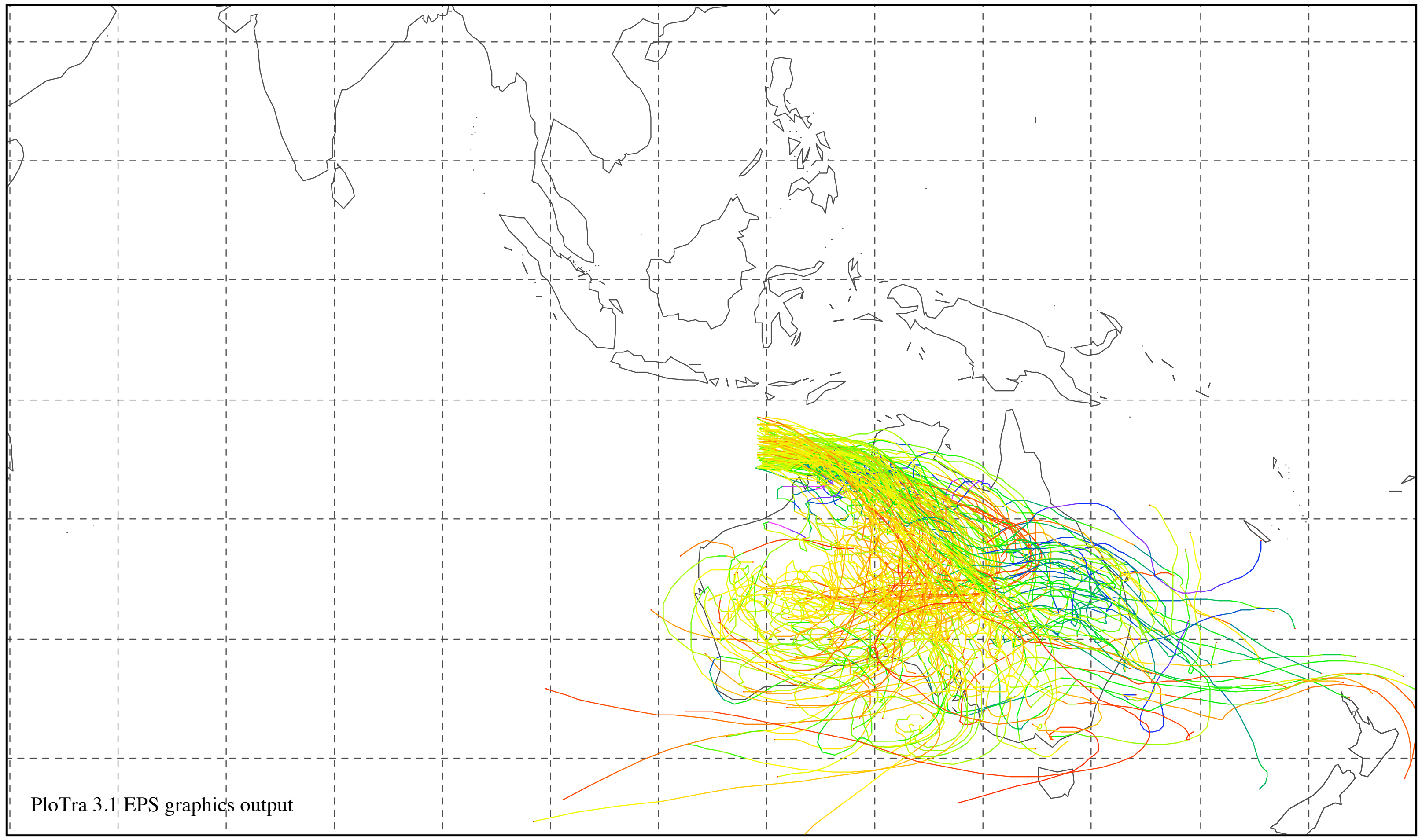
El Niño



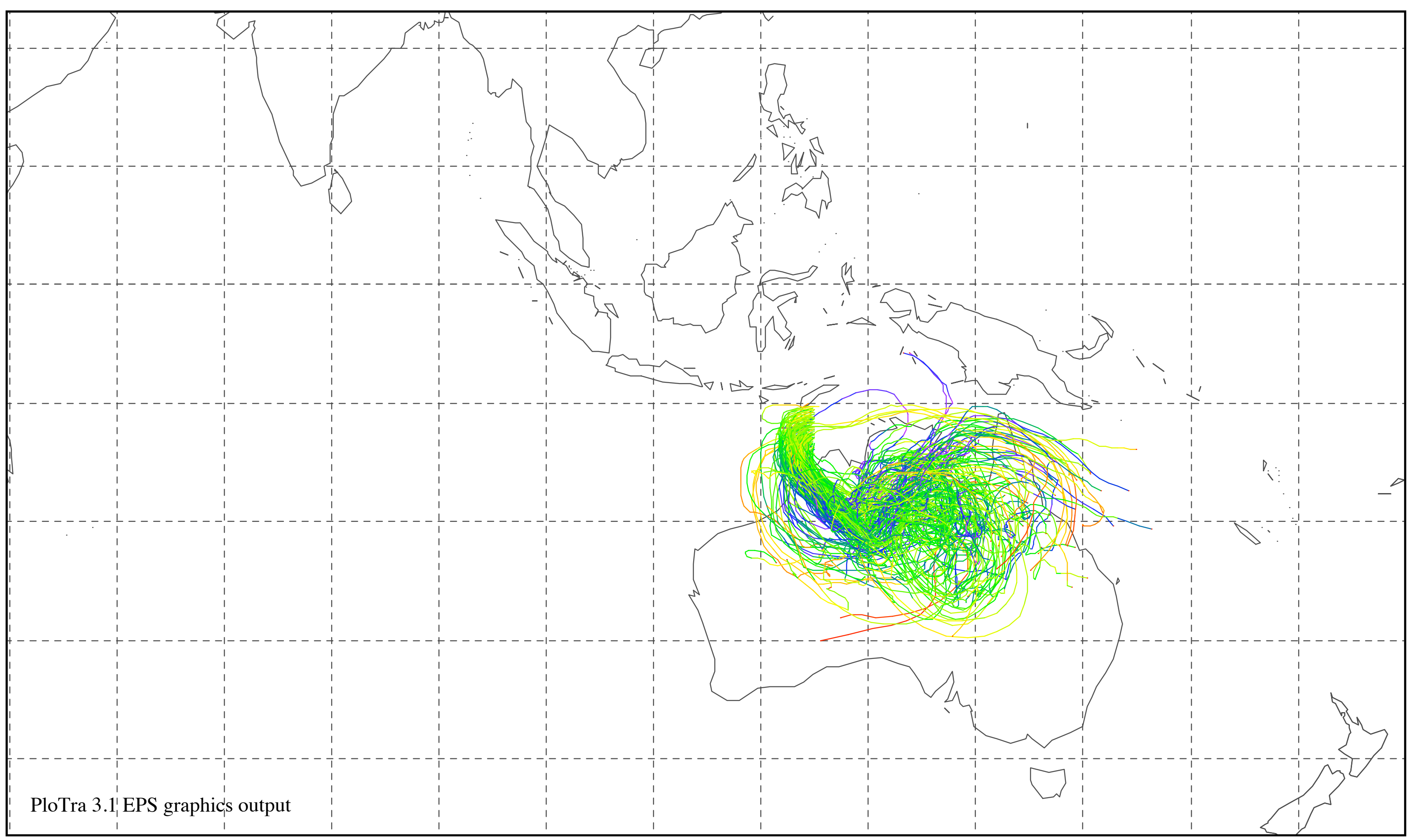


0.21
1032m

La Niña



El Niño



Summary and Questions

- What fraction of the water that TES sees causes what fraction of the precipitation?
- Convection frequency and intensity partly agree with TES observations
- Other processes, such as advection of depleted vapour seem to be important
- What is the best way forward in tying TES isotopes to surface precipitation isotopes?