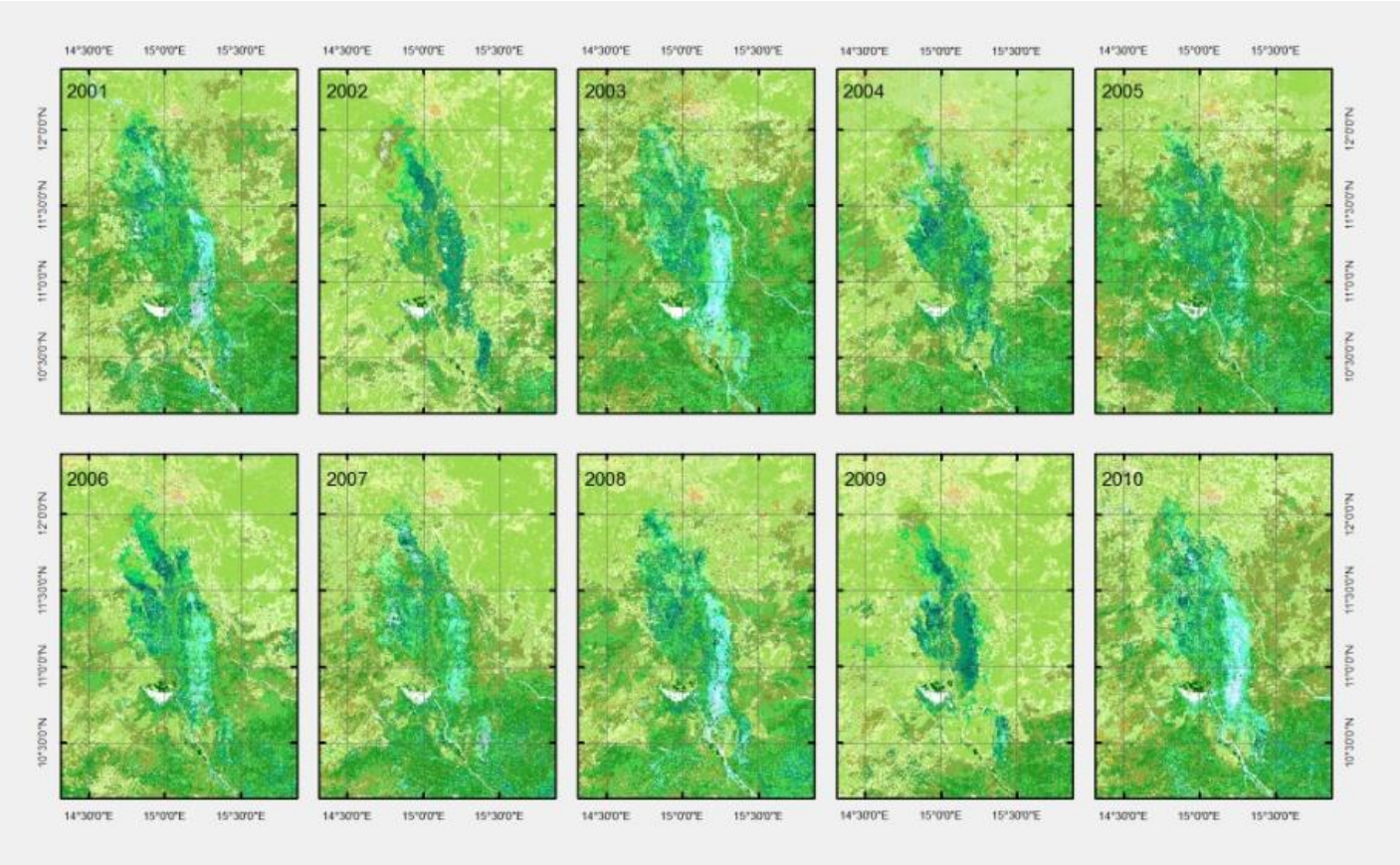
Better Understanding of Surface – Groundwater – Interaction: Role of swamp areas for groundwater recharge - Example of Massénya, Tchad Basin



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S.Vassolo, M.Bila, A.Hamit , N'Djaména, 2010

Surface water catchments

2 hydrogeological sub-basins:

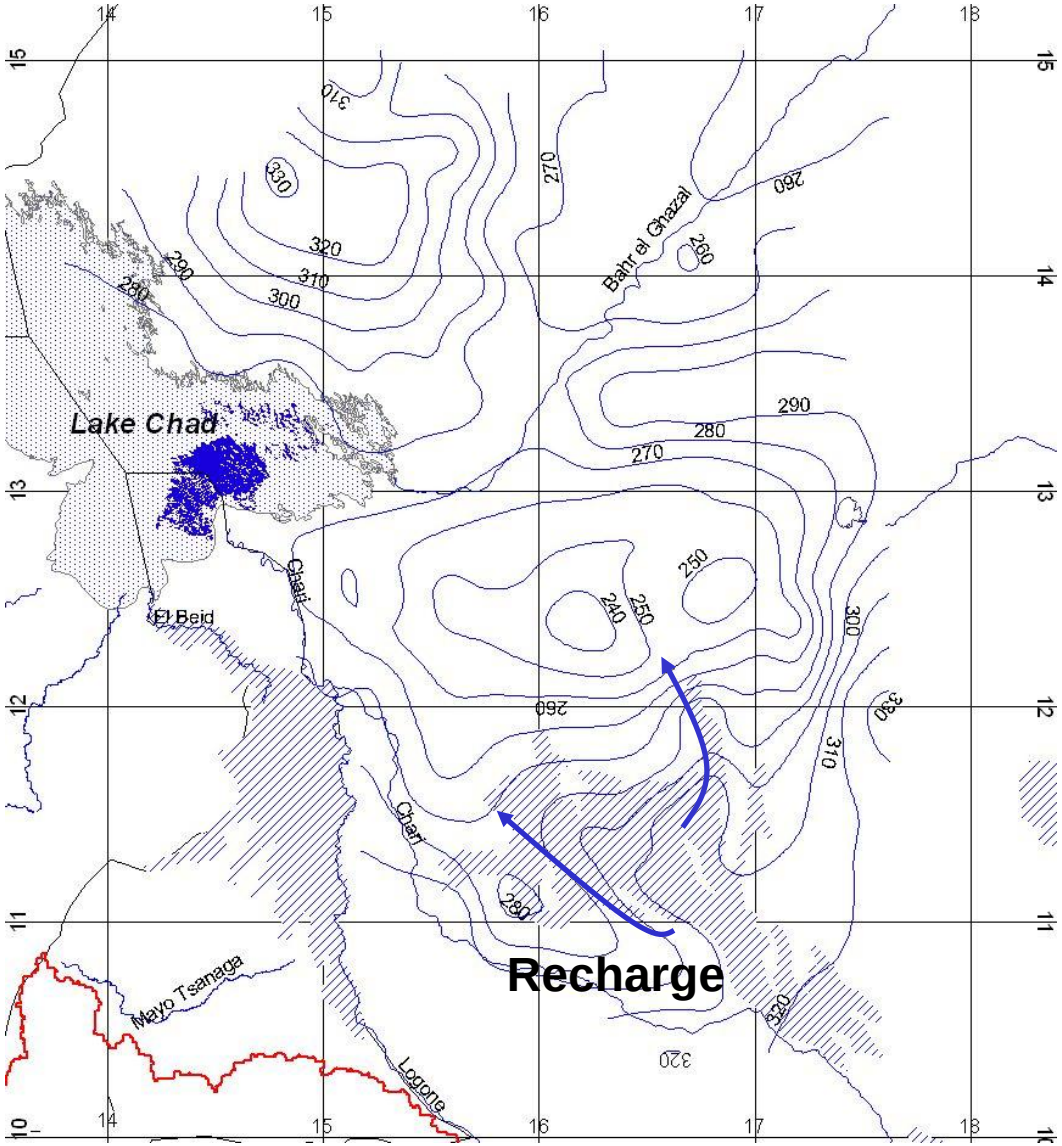
- Chari-Logone (95% input)
- Komadougou-Yobe (some 3%)

Rainfall (some 2%)

Swamp areas:

- Yaéré
- Lac Tchad
- Lac Fitri
- Massénya
- Salamat
- Komadugu-Yobe

Groundwater Contour Lines



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Comprehensive Isotopes Sampling on regional Scale

Sampling was performed for isotopes

^{1}H, ^{2}H and ^{3}H

^{16}O and ^{18}O

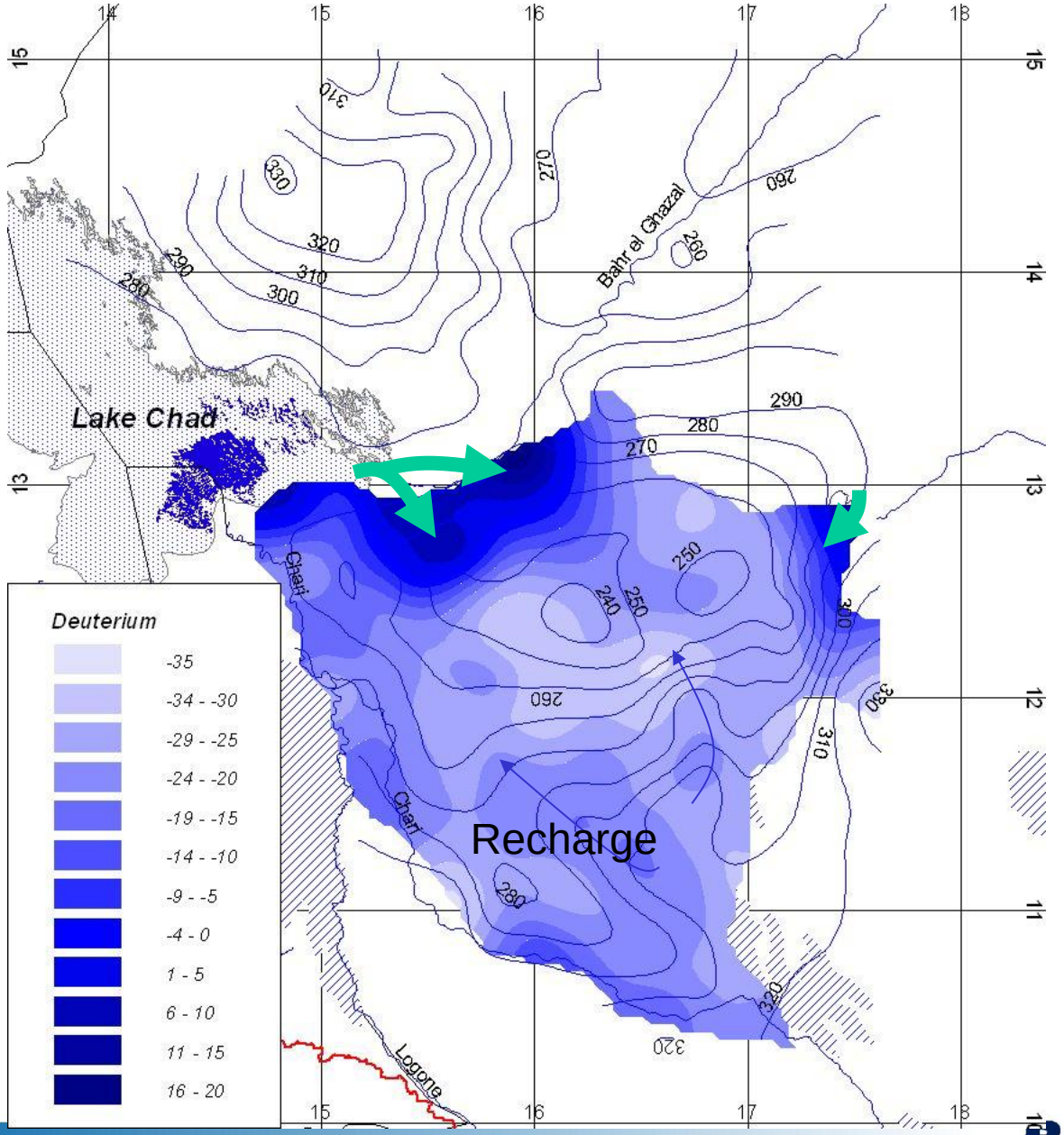
Everybody knows:

- It tends to rain first the „heavy isotopes“
- It tends to evaporate first the „light isotopes“

Isotopes

- Because evaporation involves light isotopes, surface water tends to become „heavy“

- $\Rightarrow$ „heavy” isotopes should be found preferably at zones recharged by surface water (swamps, lakes, rivers…)


Lake Chad
Bahr el Ghazal
Chari
Chari
Logone
Recharge
Deuterium
-35
-34 - -30
-29 - -25
-24 - -20
-19 - -15
-14 - -10
-9 - -5
-4 - 0
1 - 5
6 - 10
11 - 15
16 - 20

Recharge through Massénya

- Some 10 mm/year
- Assuming an area of 10,000 km²
- ⇒ Recharge = 0.1 km³/yr

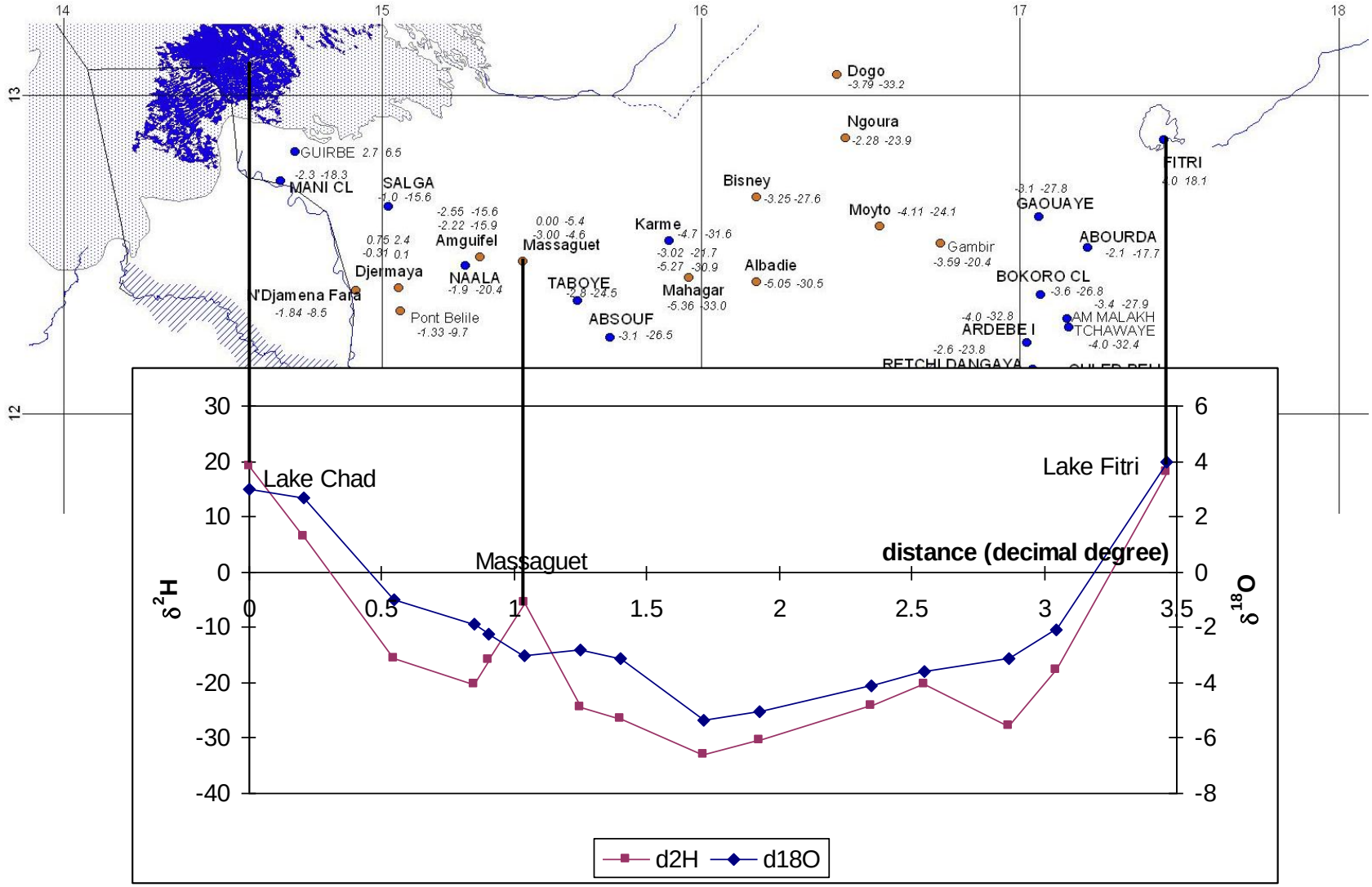
⇒ **Swamp areas controle quantity and quality of infiltrated surface water**

⇒ **hence, play an essential for groundwater bodies**

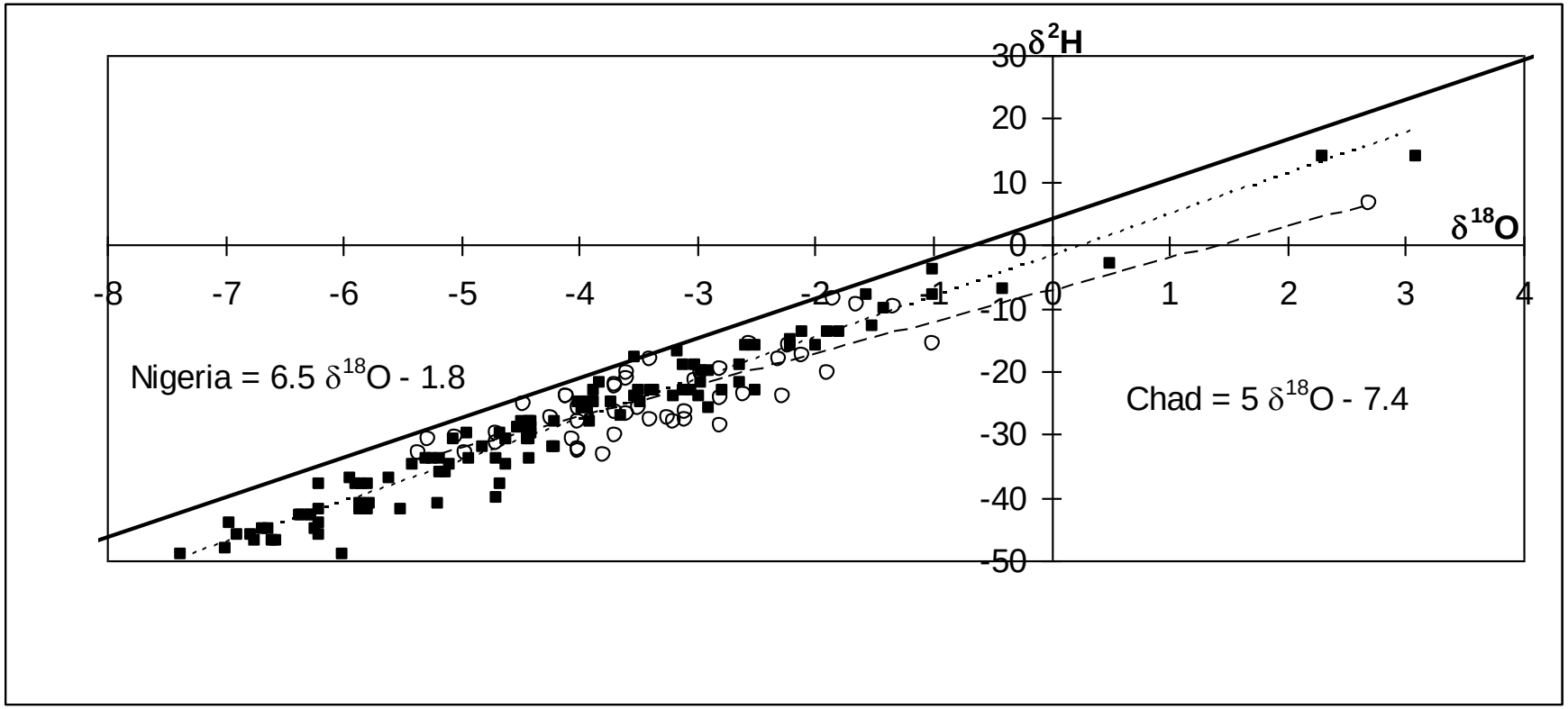
Results from Isotope Samples taken from wells and surface water bodies

- There is recharge from the Lake Chad as well as from the Lake Fitri into de aquifer
- Clear decline of $\delta^{18}O$ and $\delta^{2}H$ with increasing distance to the lakes
- Sudden increase of isotope values at Massaguet is an indication of recharge by surface water, probably a palaeo-channel from the River Chari (Djoret 2000)

Stable Isotope Profiles at Regional Scale



Stable Isotope Profiles at Regional Scale



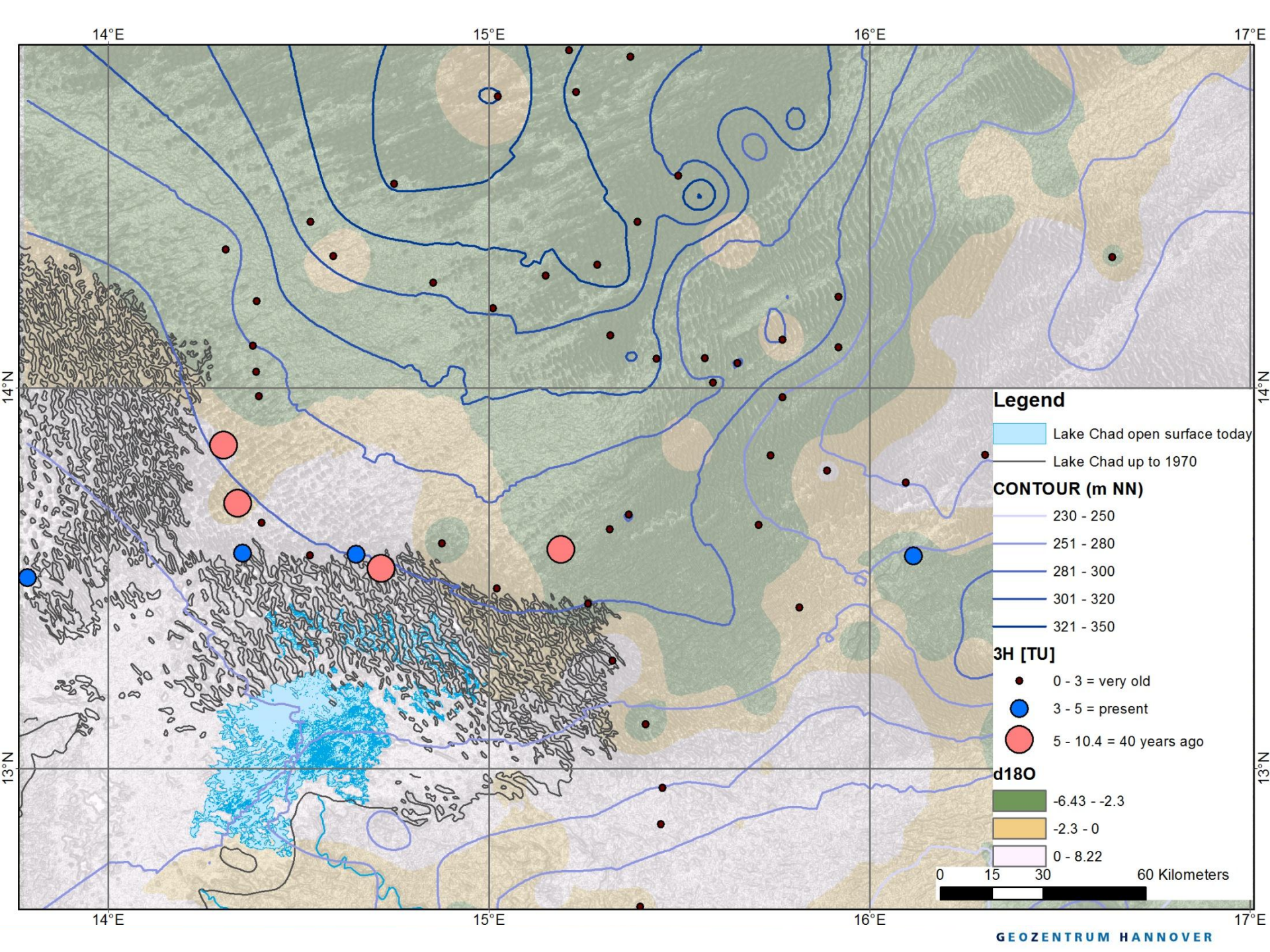
Comparison of Nigeria data from Goni (2006):

- black squares from Nigeria and open circles from chad basin
- data from Nigeria show a trend-line with a higher slope
  → indication of less evaporation in recharged water
- Further, the squares are farther to the left of the graph towards less enriched values, which means that recharge occurs under lower temperature

Tritium values in Kanem (Northern part of Lake Chad)

- Wells very close or in the northern basin show actual recharge
- Wells located more than 10 km from the lake shore recharge from the 70ies

  → lake had a much larger surface!
- All other wells show “old water” before the mid-50ies
- with slight mixture of “younger components” (?)


14°E
15°E
16°E
17°E
14°N
13°N
Legend
Lake Chad open surface today
Lake Chad up to 1970
CONTOUR (m NN)
230 - 250
251 - 280
281 - 300
301 - 320
321 - 350
3H [TU]
0 - 3 = very old
3 - 5 = present
5 - 10.4 = 40 years ago
d18O
-6.43 - -2.3
-2.3 - 0
0 - 8.22
0 15 30 60 Kilometers
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