EGU2022: Cosmic rays across scales and disciplines: the new frontier in environmental research

Space or climate? Disentangling cosmogenic and climatic drivers of present-day tritium (^3H_p) in global precipitation (EGU22-11230)

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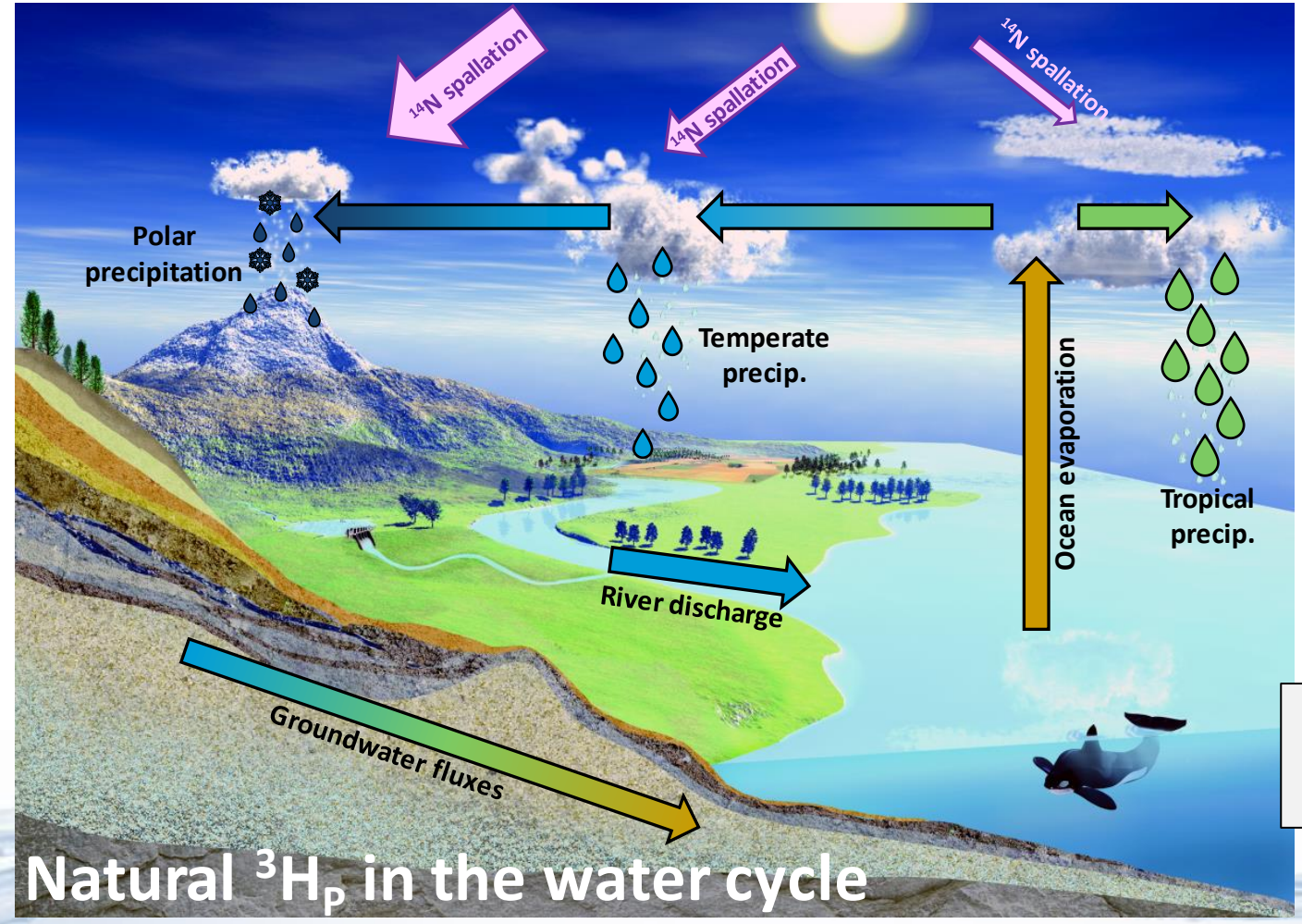
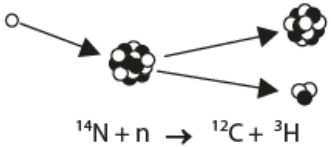
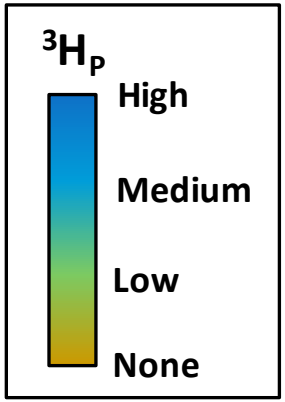
IAEA International Atomic Energy Agency



Natural $^{3}H_{p}$ in the water cycle

IAEA Water Resources Programme



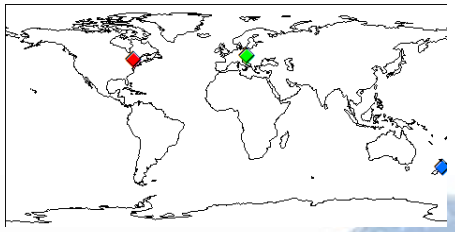


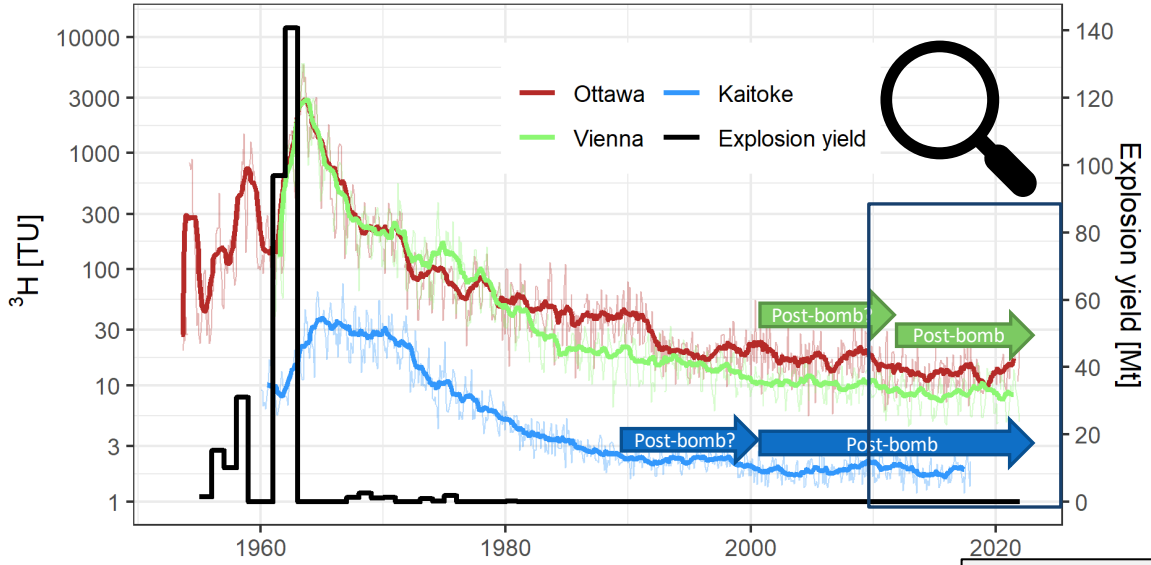
1 Tritium Unit (TU) = one $^{3}H^{1}HO$ per 10^{18} $^{1}H_{2}O$ = 0.111919 Bq kg^{-1}

27 May 2022

How we used to see ^3H_P for 50+ years

- Thermonuclear testing peak 1962
- Natural steady-state ca. 2000
- Anthropogenic ^3H_P not discussed today



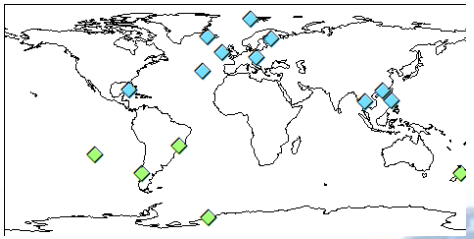


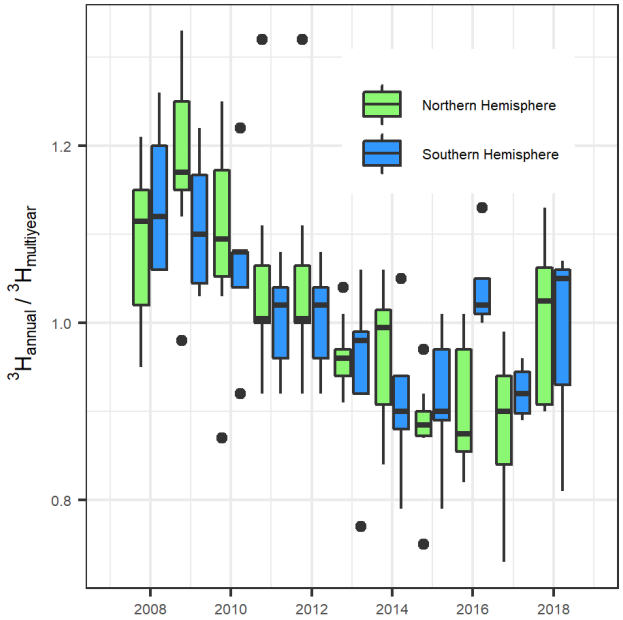
(IAEA/GNIP – https://nucleus.iaea.org/wiser
Plot modified after Rozanski et al. 1991 and Morgenstern & Taylor 2009)

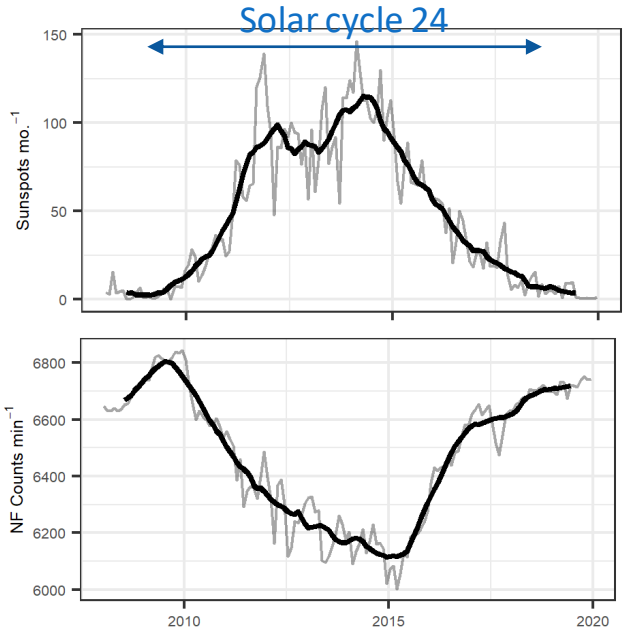
1 TU ~ 0.11 Bq kg^{-1}
1 Bq kg^{-1} ~ 8.9 TU

“Post-bomb” period and solar cycle

- Solar cycle imposes ~11a cyclicity.
- Solar cycle 24 shown (±1a)







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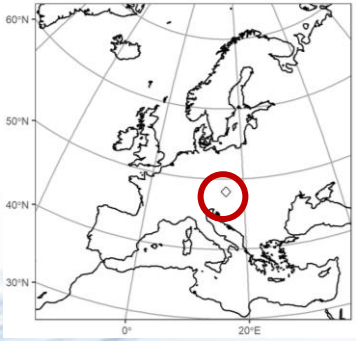
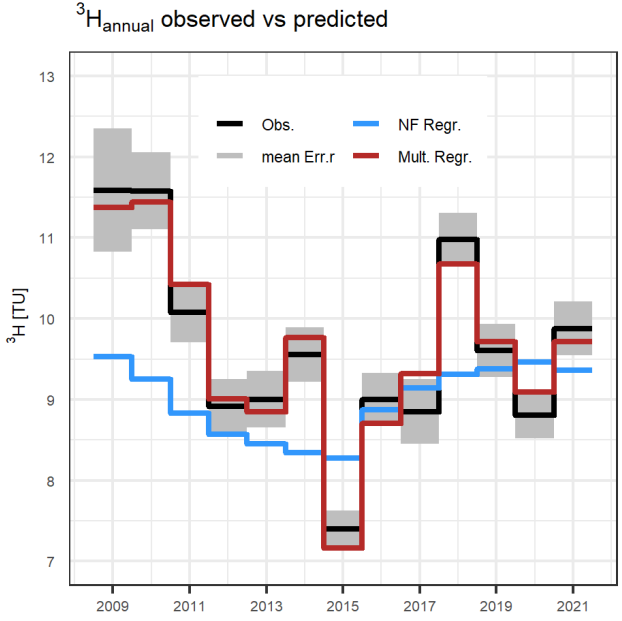
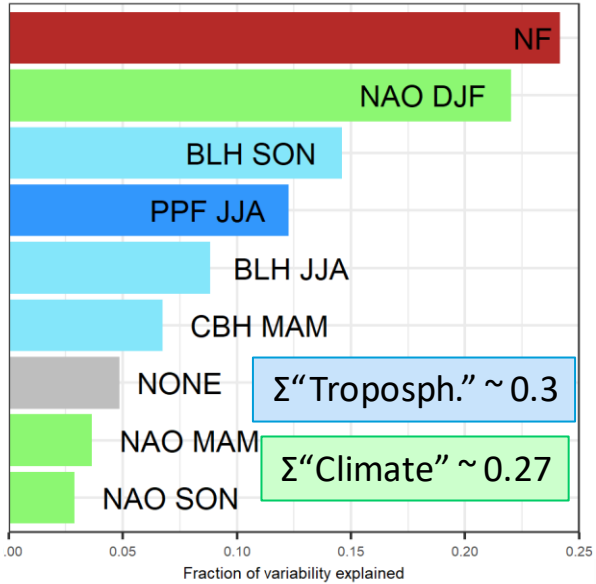
(Sources: IAEA/GNIP; WDC-SILSO, Royal Observatory of Belgium, Brussels); cosmicrays.oulu.fi/Sodankylä Obs.

How much “stratosphere” vs. “troposphere”?

- Vienna: Neutron flux alone explains 35% of variability
- Multiple regression of NF, NAO, boundary layer ht., summer precipitation,… explains 96% of variability







(Sources: IAEA/GNIP; cosmicrays.oulu.fi/Sodankylä Obs.; ERA-5)

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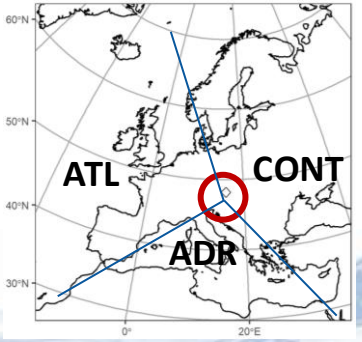
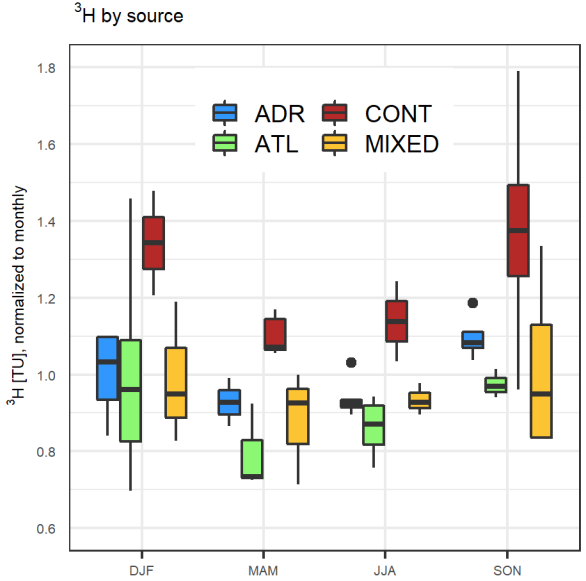
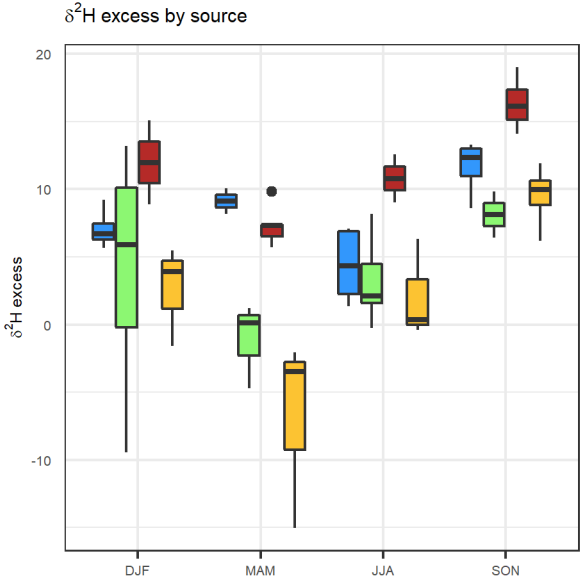
Work in progress: Source regions for daily ^3H_P

- 2018 daily ^3H_P sampling campaign (n=70 samples)
- Backtrajectory analysis
- Distinct season/source signals in ^3H_P







(Sources: IAEA unpublished data; NOAA/HYSPLIT [Stein et al. 2015])

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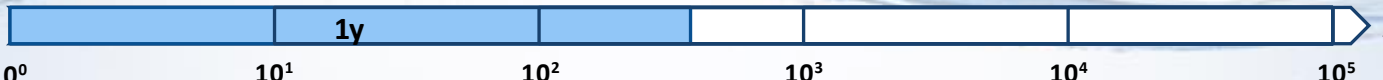
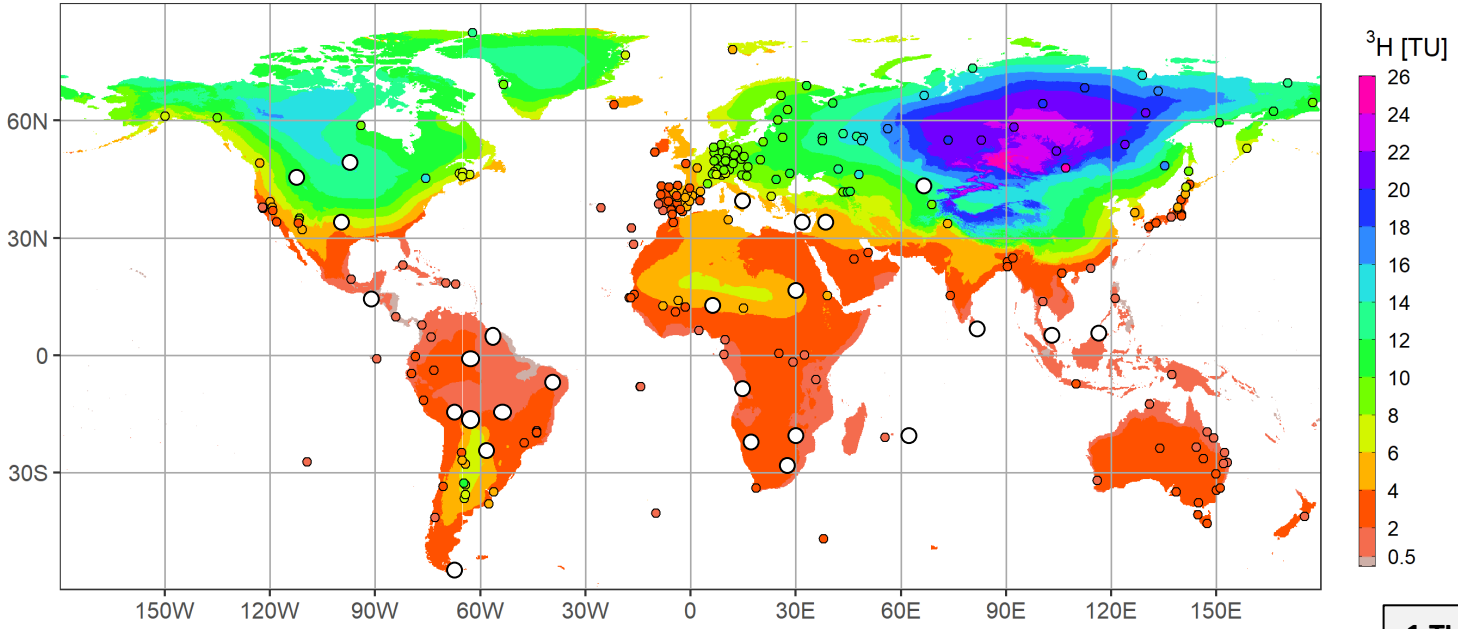


Thanks! GNIP always likes volunteers!



(Terzer-Wassmuth et al. 2022, under review – white dots represent new sites since 2021/22)

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