

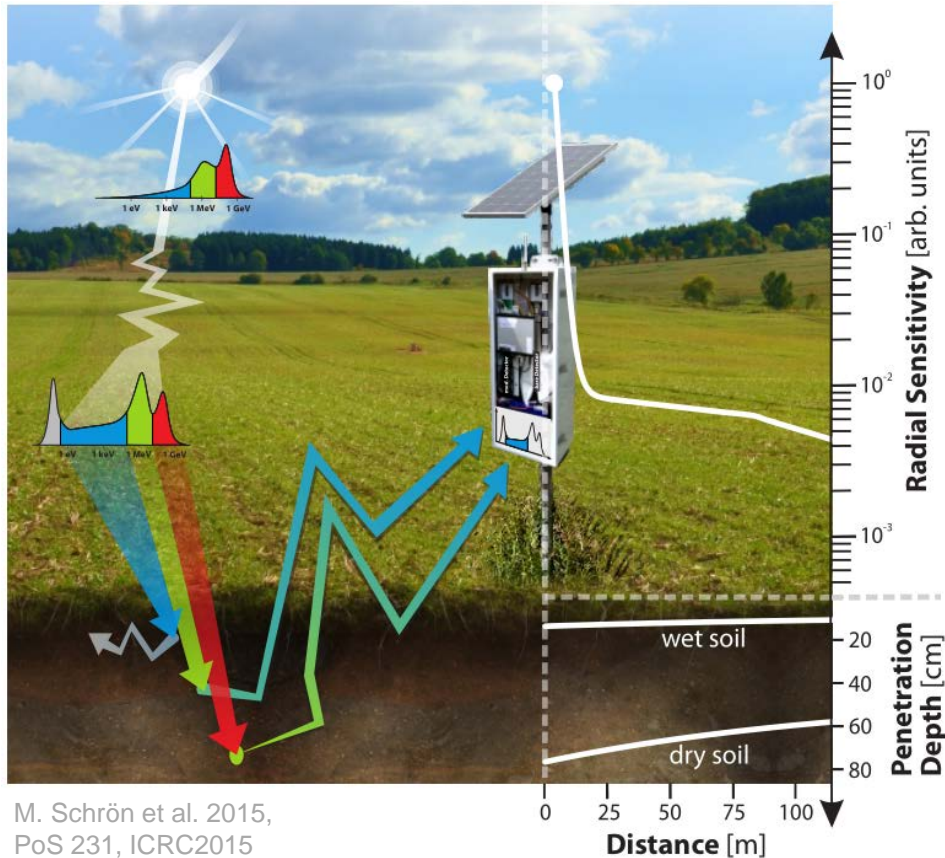


EGU Session HS1.1.3., April 2020

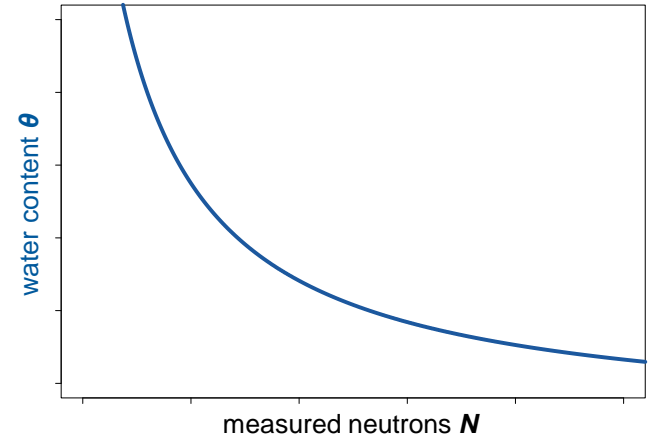
Martin Schrön,
Sascha E Oswald, Steffen Zacharias,
Peter Dietrich, Sabine Attinger

Monitoring and Mapping of Soil and Snow Water Across Scales with Cosmic-Ray Neutron Sensor Networks and Mobile Platforms

Cosmic-Ray Neutron Sensing (CRNS)



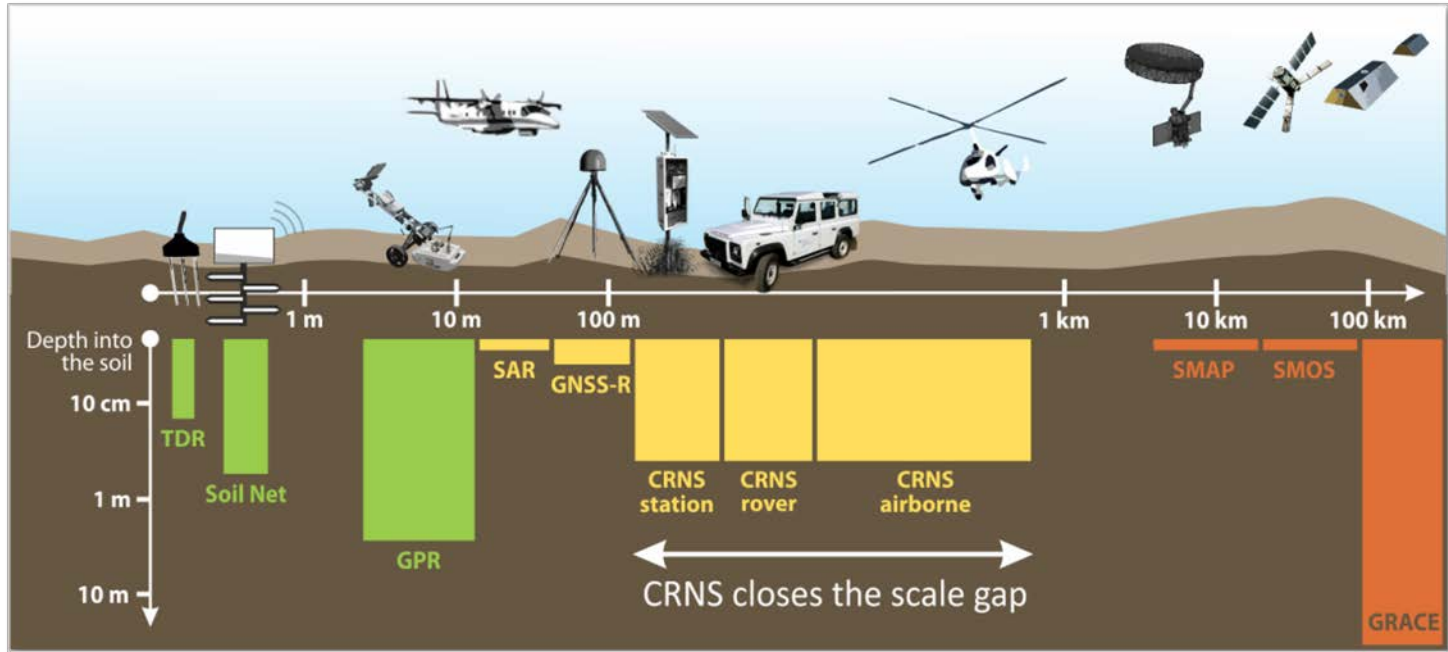
M. Schrön et al. 2015,
PoS 231, ICRC2015



$$N(\theta) = N_0 \left(\frac{0.0808}{\theta + 0.115} + 0.372 \right)$$

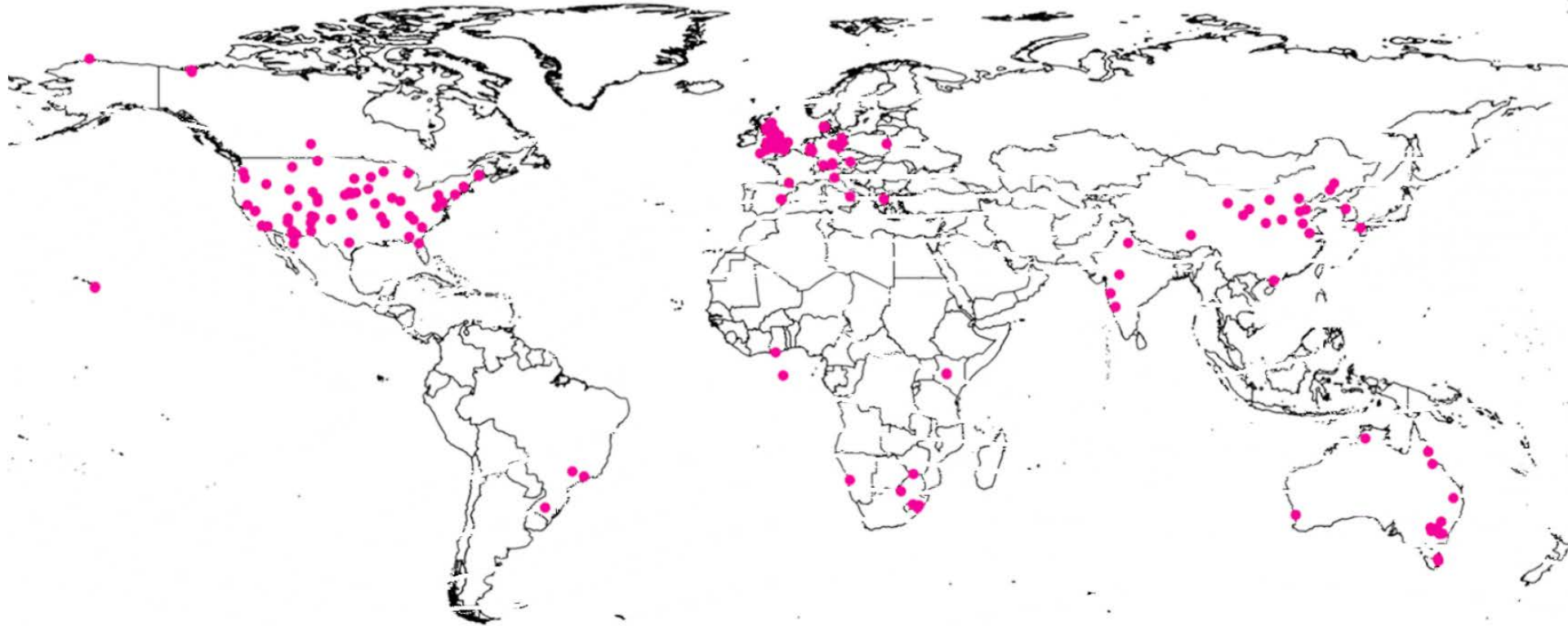
Desilets et al. 2010, WRR

CRNS closes the gap in soil moisture measurements



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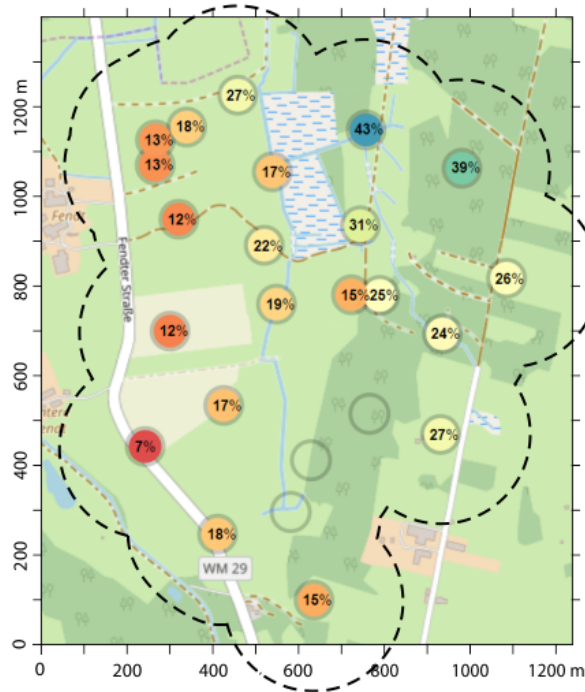
Stationary CRNS Networks (distributed)



Stationary CRNS Networks (dense)

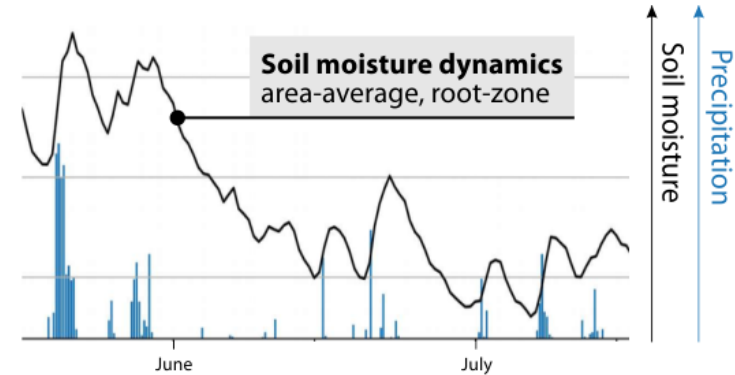
Stationary CRNS Networks

- full coverage of 1x1 km
- root-zone soil moisture
- hourly data



Total spatial coverage
(combined footprints)

Soil moisture dynamics
area-average, root-zone

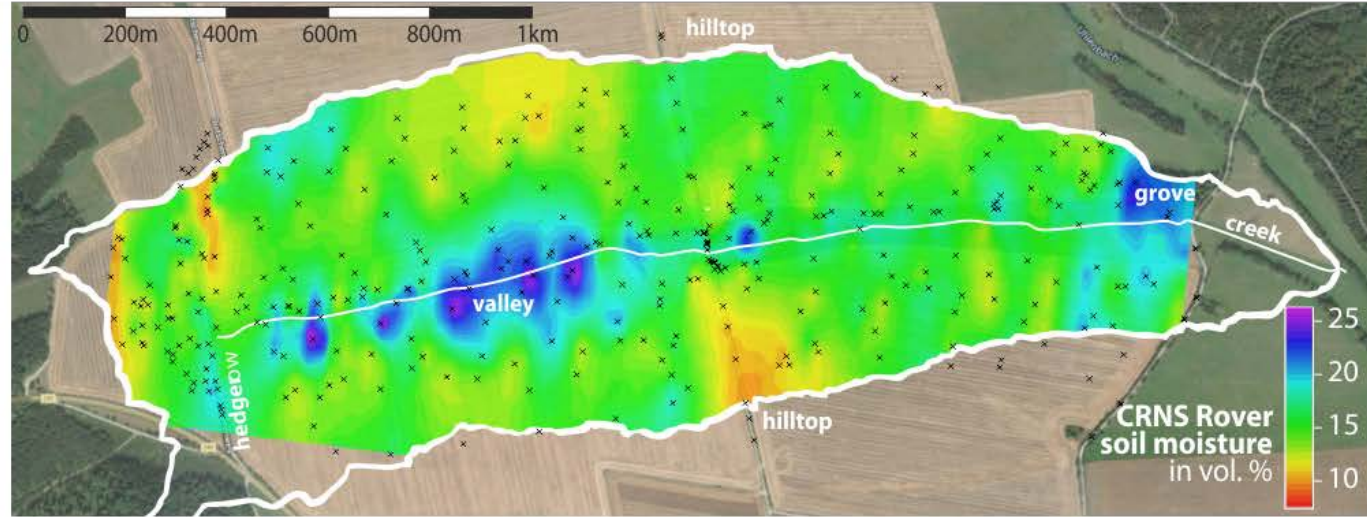


Modified from
Fersch et al. 2020,
Earth Syst. Sci. Data Discuss.

Mobile CRNS (by car, field scale)

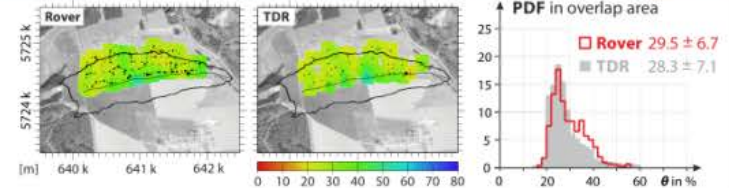
Agricultural field mapping Mobile CRNS

- catchment-scale mapping
- root-zone soil moisture
- small-scale resolution



Schrön et al. 2018, WRR

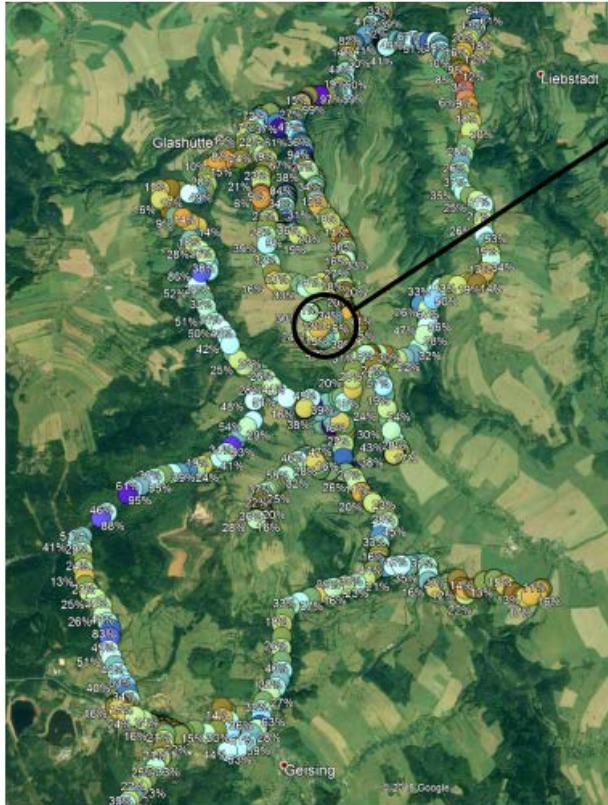
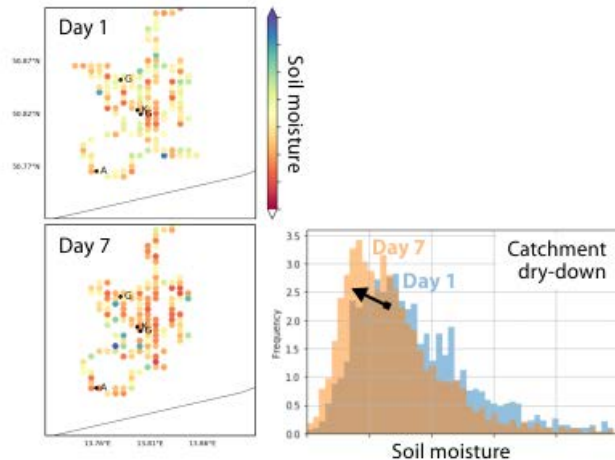
Validation with
100 in-situ TDR
measurements



Mobile CRNS (by car, catchment scale)

Multi-day mapping with **Mobile CRNS**

- catchment-scale roving on roads
- root-zone soil moisture
- multiple days per month



Credits: DigitalEarth campaign Müglitztal 2019, (in prep.)

© 2019 M. Schrön (UFZ), and DigitalEarth (UFZ), Map: Google Earth

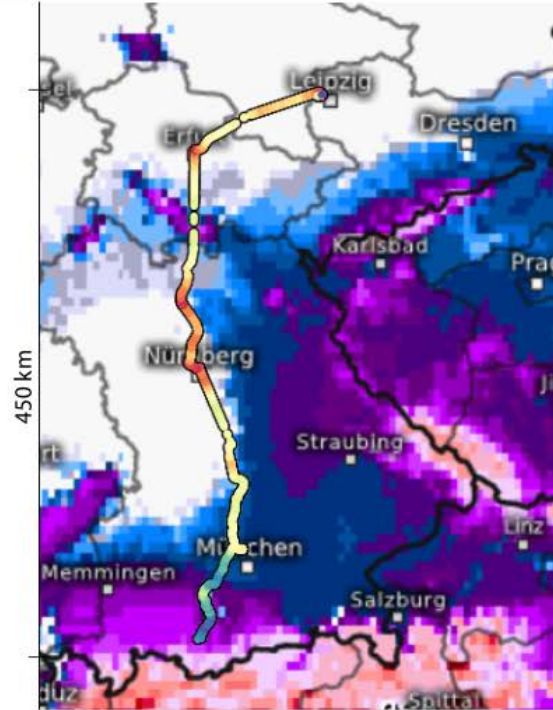
Mobile CRNS (by train, country scale)

Large-Scale Transects with CRNS on Rails

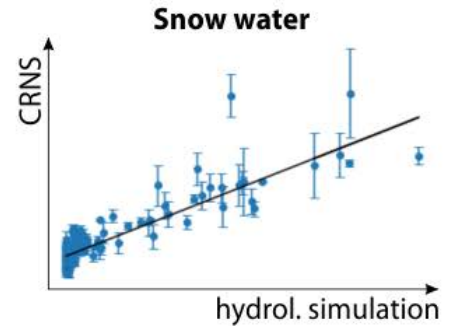
- country-wide transects
- root-zone soil/snow water
- regular coverage by public transport



Photo: Wikipedia



Satellite map by kachelmannwetter.com



Credits: Martin Schrön, campaigns 2019, (in prep.)

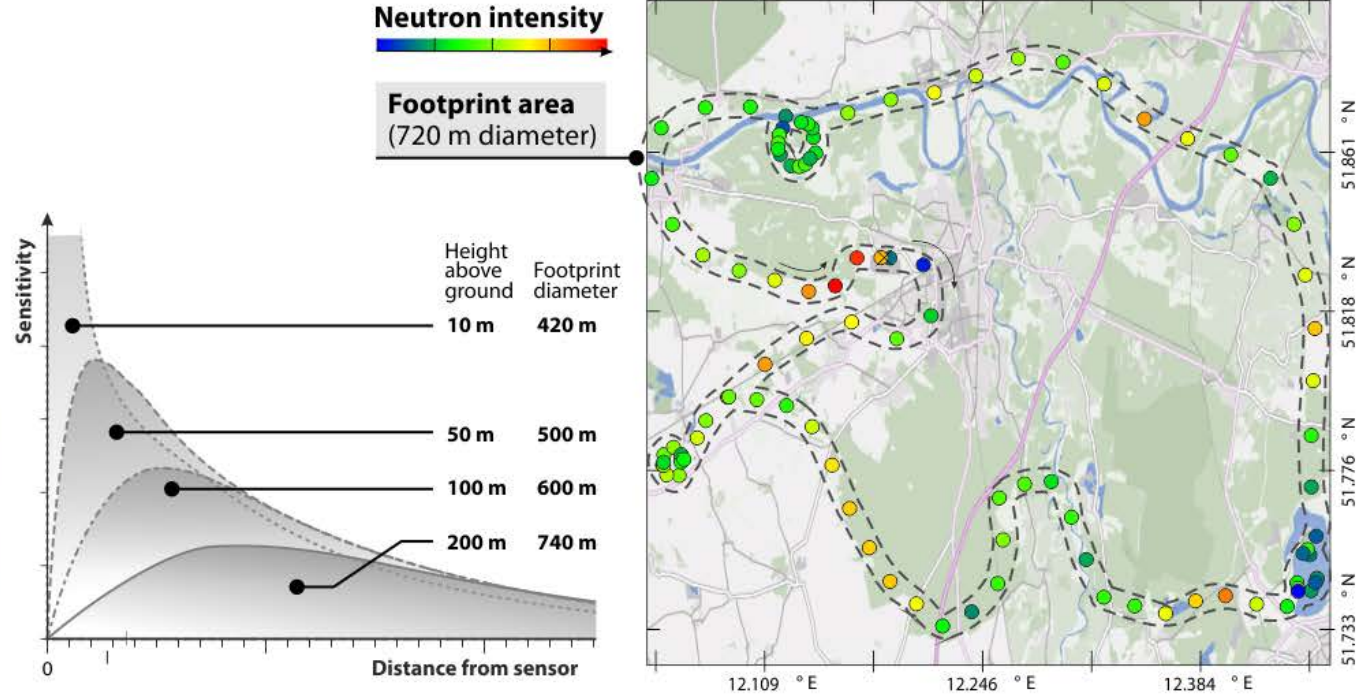
Air-borne CRNS (by gyrocopter, regional scale)

Airborne Neutron Sensing

- unhindered areal coverage
- larger footprint, no road effect
- root-zone soil/snow water



Schrön 2017, Dissertation (Uni Potsdam),
Lausch et al. 2019, Remote Sensing



Monitoring and Mapping of Soil and Snow Water Across Scales

with Cosmic-Ray Neutron Sensor Networks and Mobile Platforms

Cosmic-ray neutron albedo sensing (CRNS) is a modern technology that can be used to non-invasively measure the average water content in the environment (i.e., in soil, snow, or vegetation).

Single CRNS stations are continuously monitoring the local water dynamics at fixed field sites, mobile CRNS platforms are used for on-demand soil moisture mapping at the ...

- field to catchment scale (by car)
- regional scale (by car, gyrocopter)
- country scale (by train)

Future CRNS observations could provide a valuable contribution to the multi-sensor approach, e.g. to help tracking and characterizing surface water movement, to map regional-scale soil moisture patterns, or to calibrate and evaluate satellite data.