Bits & pieces
of

Practical hydrometry

Discharge measurements
Rating curve
Level measurements
Data transfer & management

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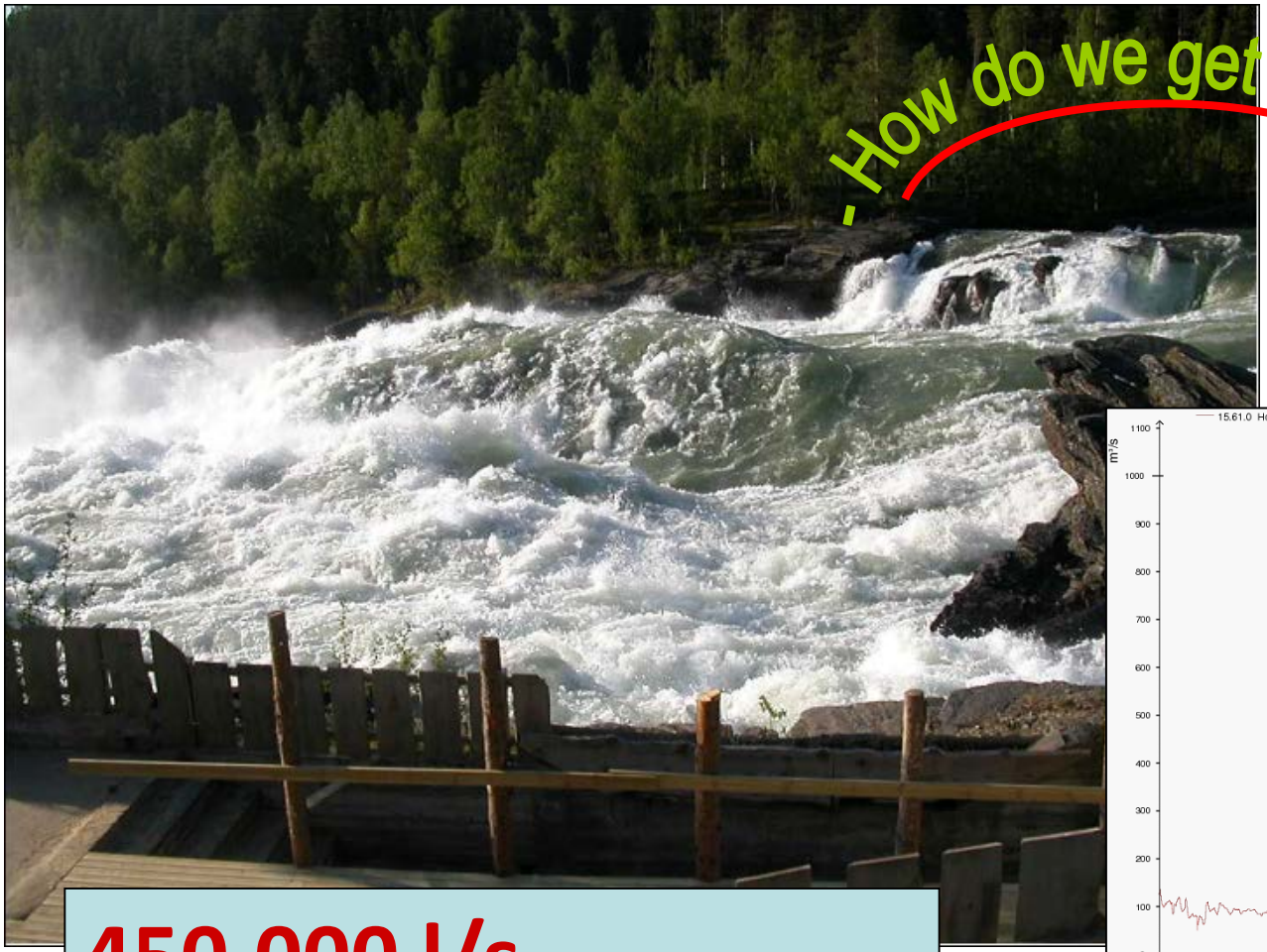
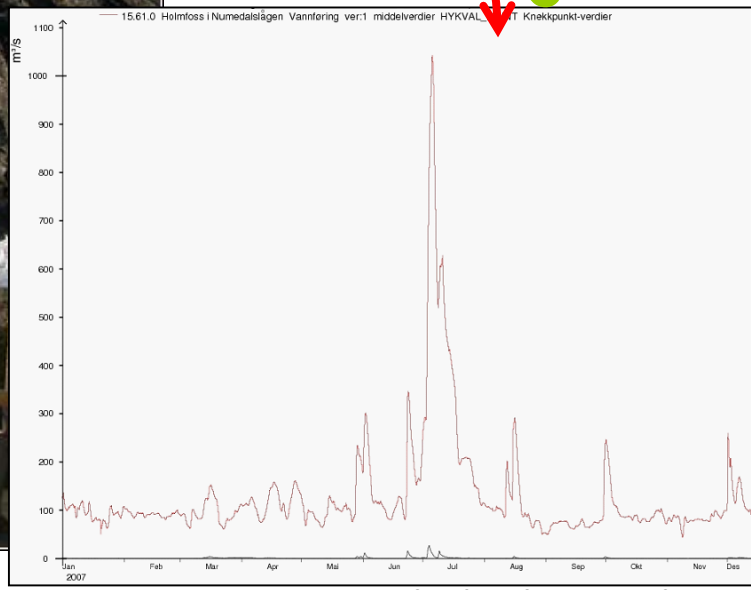
(programming, software, instrumentation, R&D, field work, trouble-shooting and stuff)

From nature to office



How do we get from this to that ?



Timeserie with discharge data

450.000 l/s

How do we know?

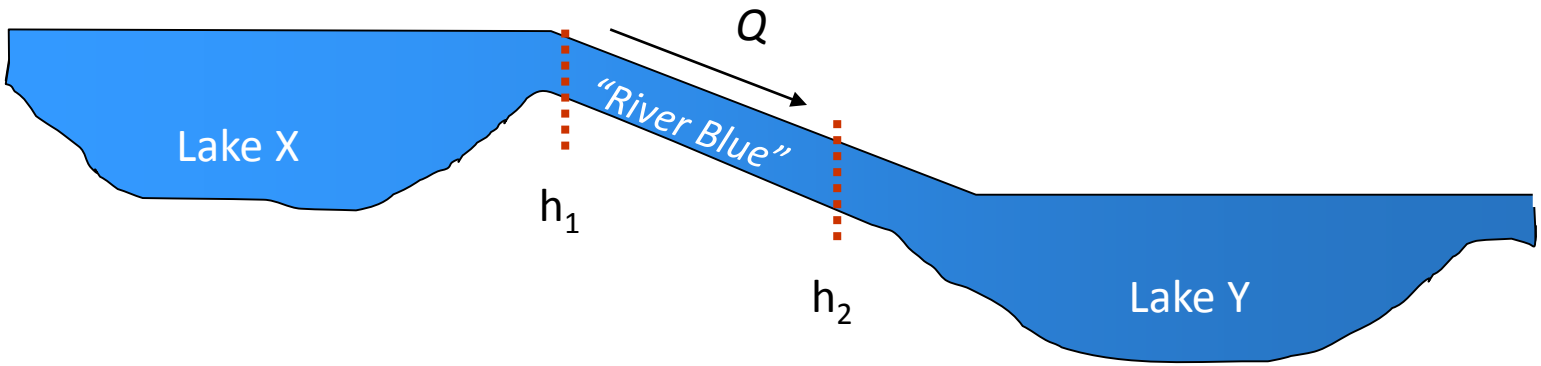
Water *discharge* vs. Water *level*

- To measure water **discharge** is difficult
  - To measure water **level** is piece of cake!
- **Continuous** discharge measurement is close to impossible!

Measurement profile and rating curves

The trick is to find a place in the river where there is a *known relation between discharge (Q) and level (h)*

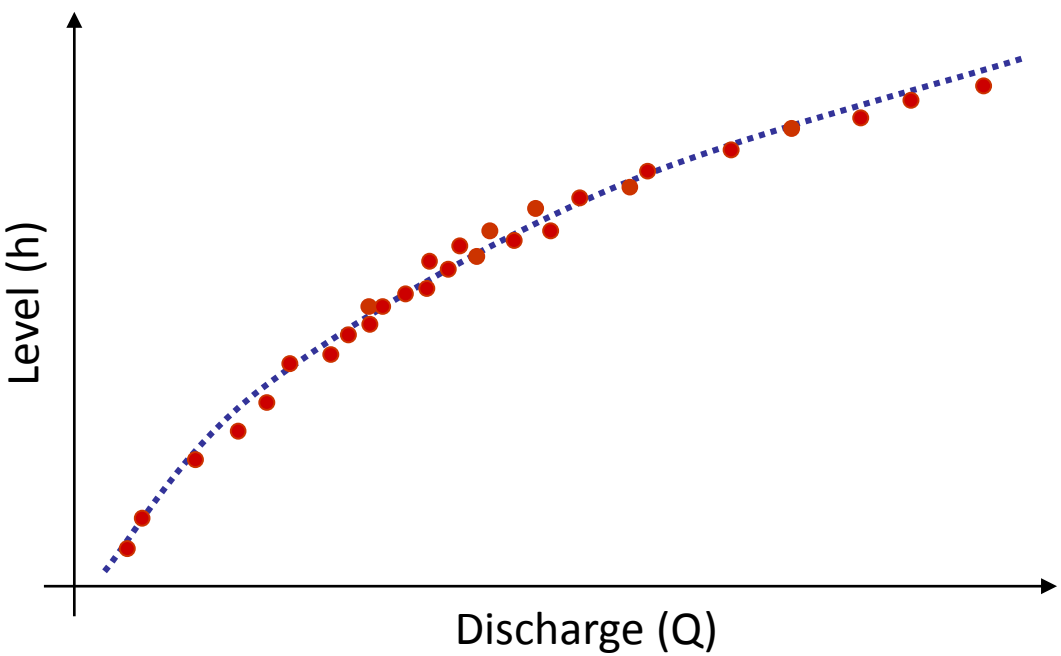
$$Q = f(h)$$

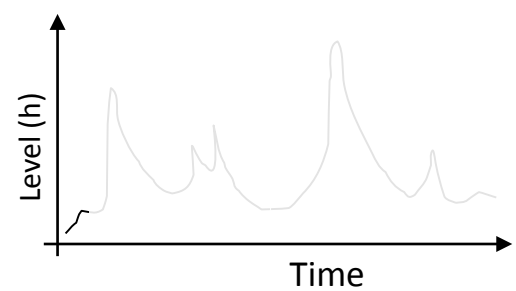


Finding the relationship

- known as the "fun part"!

- Do manual measurements of discharge at different water levels
- Use regression (or eyesight!) to find a mathematical relation, $Q=C(h-h_0)^n$ (Rating curve)





Manual discharge measurment

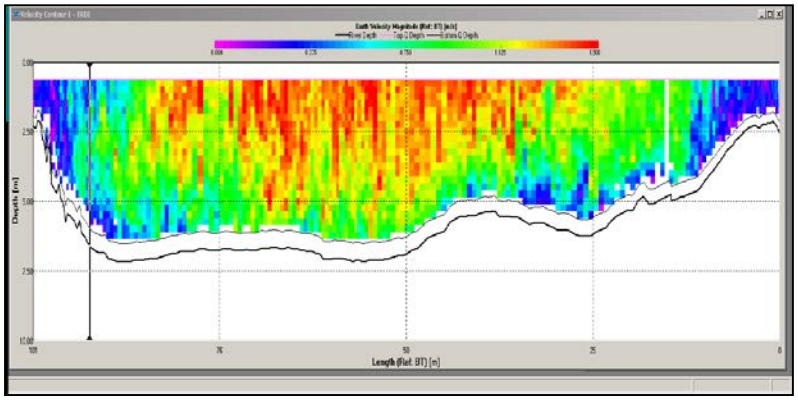
Propeller instrument (flygel)

- A propeller measures the water speed, just like a wind speed sensor
- Many measurements at different depths across the river makes an average velocity.
- Together with the cross-section area, the discharge can be calculated

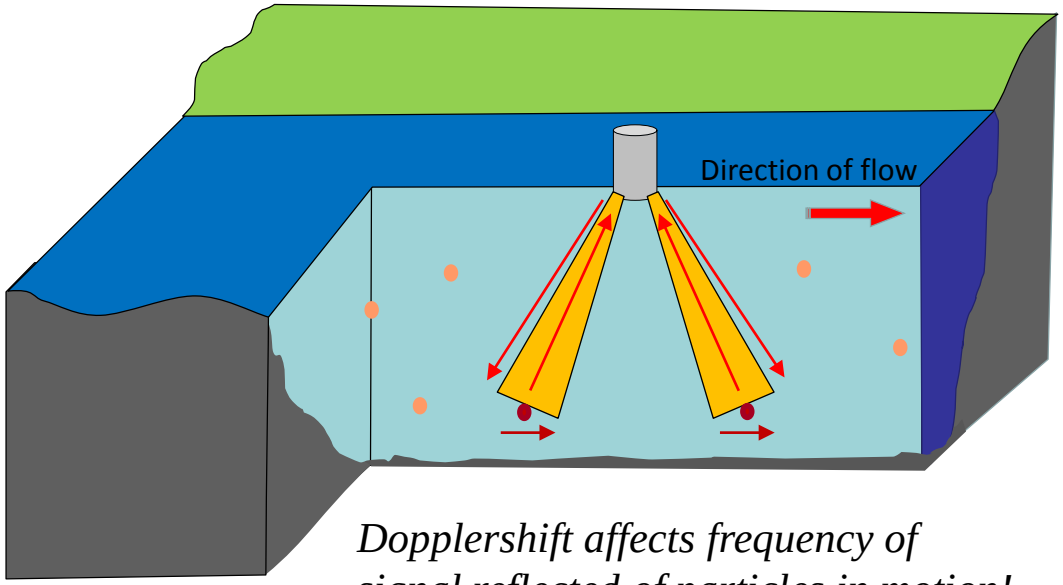
  $Q\ [m^3/s] = v\ [m/s] * a\ [m^2]$

Manual discharge measurment

Acoustic (doppler shift) instruments



- Sound pulses sent down in the water, and reflect of particles.
- Doppler effect makes it possible to measure the water velocities at different depths.
- Gives detailed “maps” of velocity in profile. Quick and easy; also on big rivers!



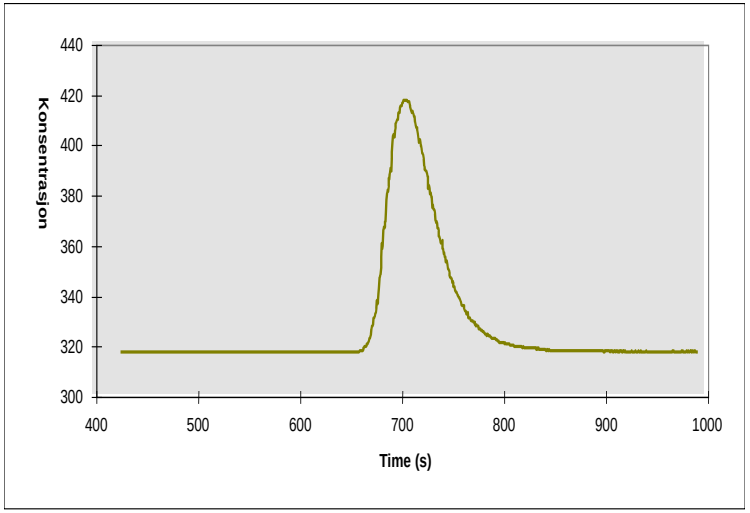
Dopplershift affects frequency of signal reflected of particles in motion!

Manual discharge measurement

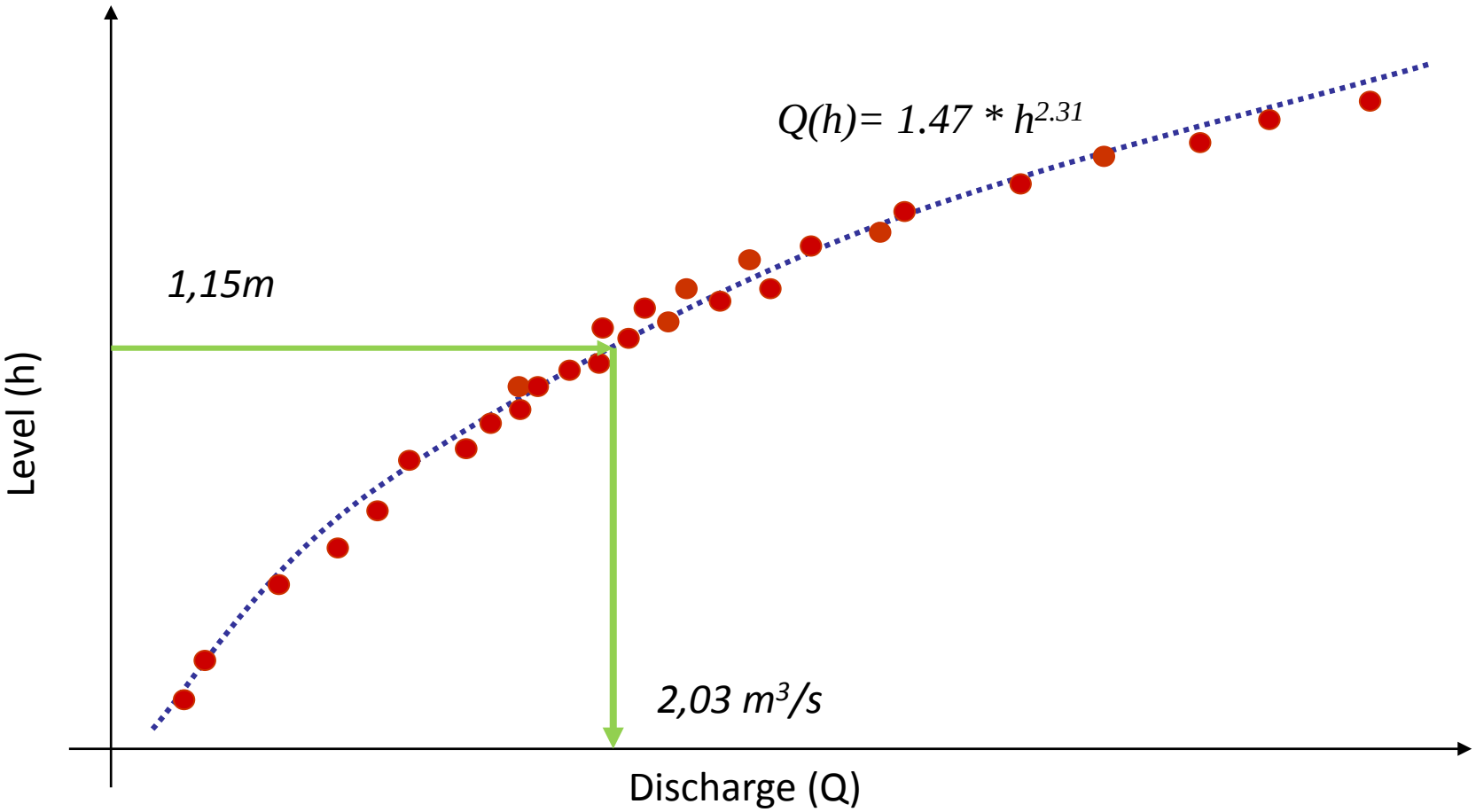
Tracer dilution (salt, NaCl)

- Pure magic
  - Alternatively: A little physics and mathematics
- Dump a known amount of salt into the river
- Make sure the river mixes the salt well, vertically and laterally
- Measure concentration downstream
- **$Q = M / (\int (C - C0)\, dt)$**

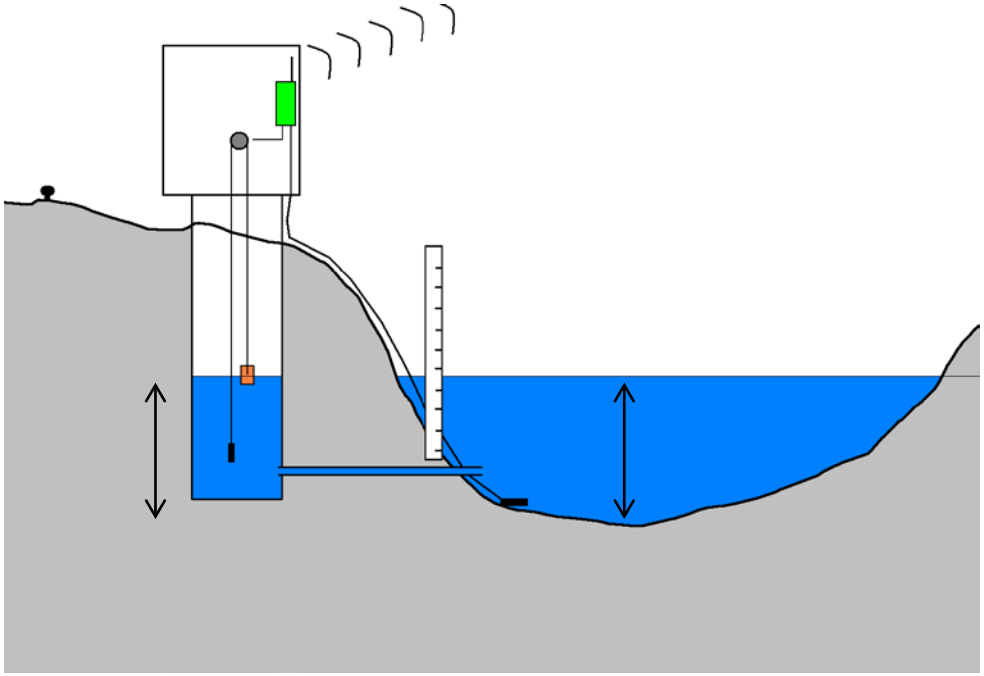
Q - discharge in l /s
M - injected quantity in mg
C - tracer concentration in mg/l
C0 - tracer concentration equivalent to the background conductivity
t - period of time of the tracer passage in sec



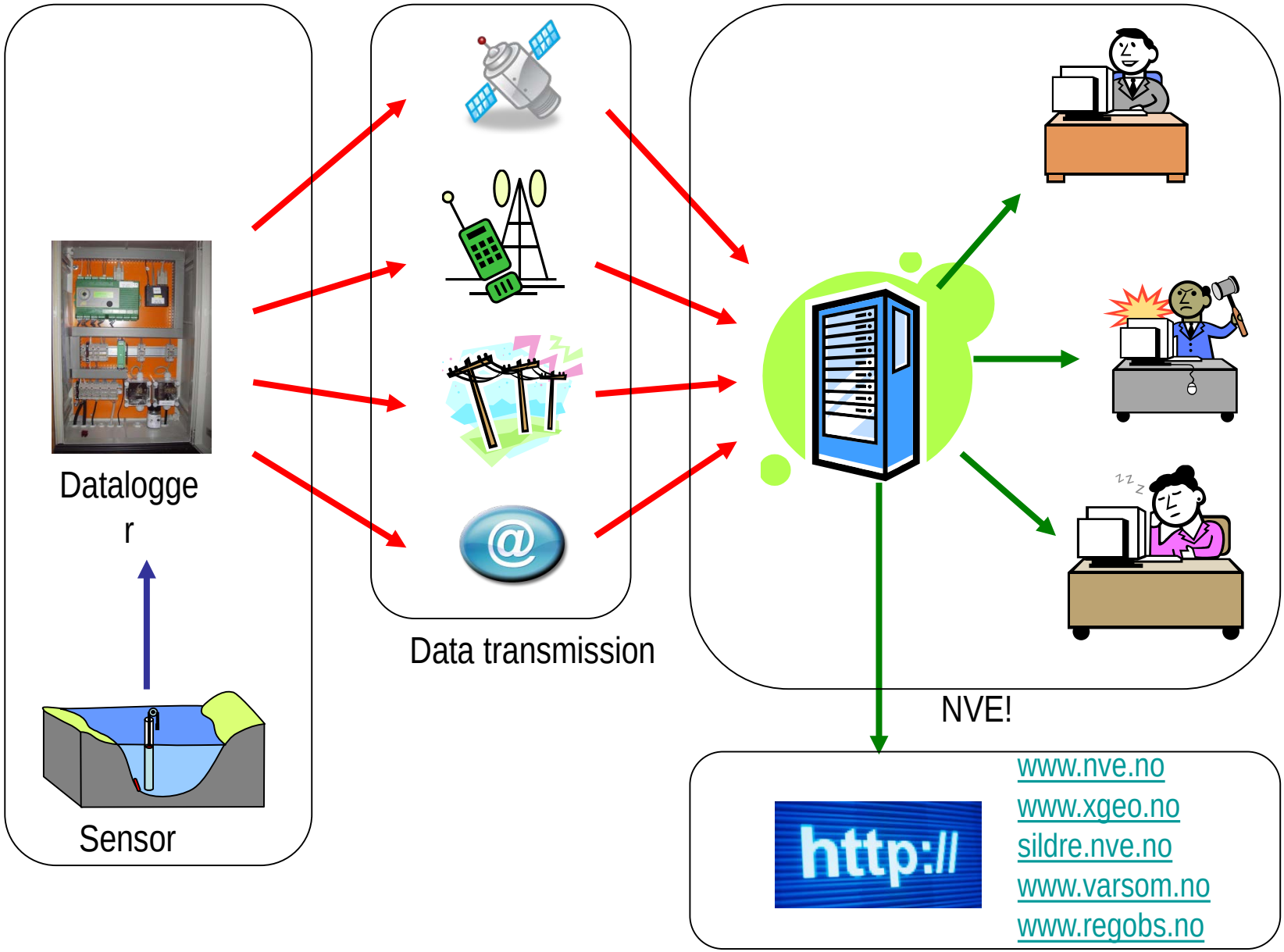
Rating curve: Check!



Level measurement & gauging stations

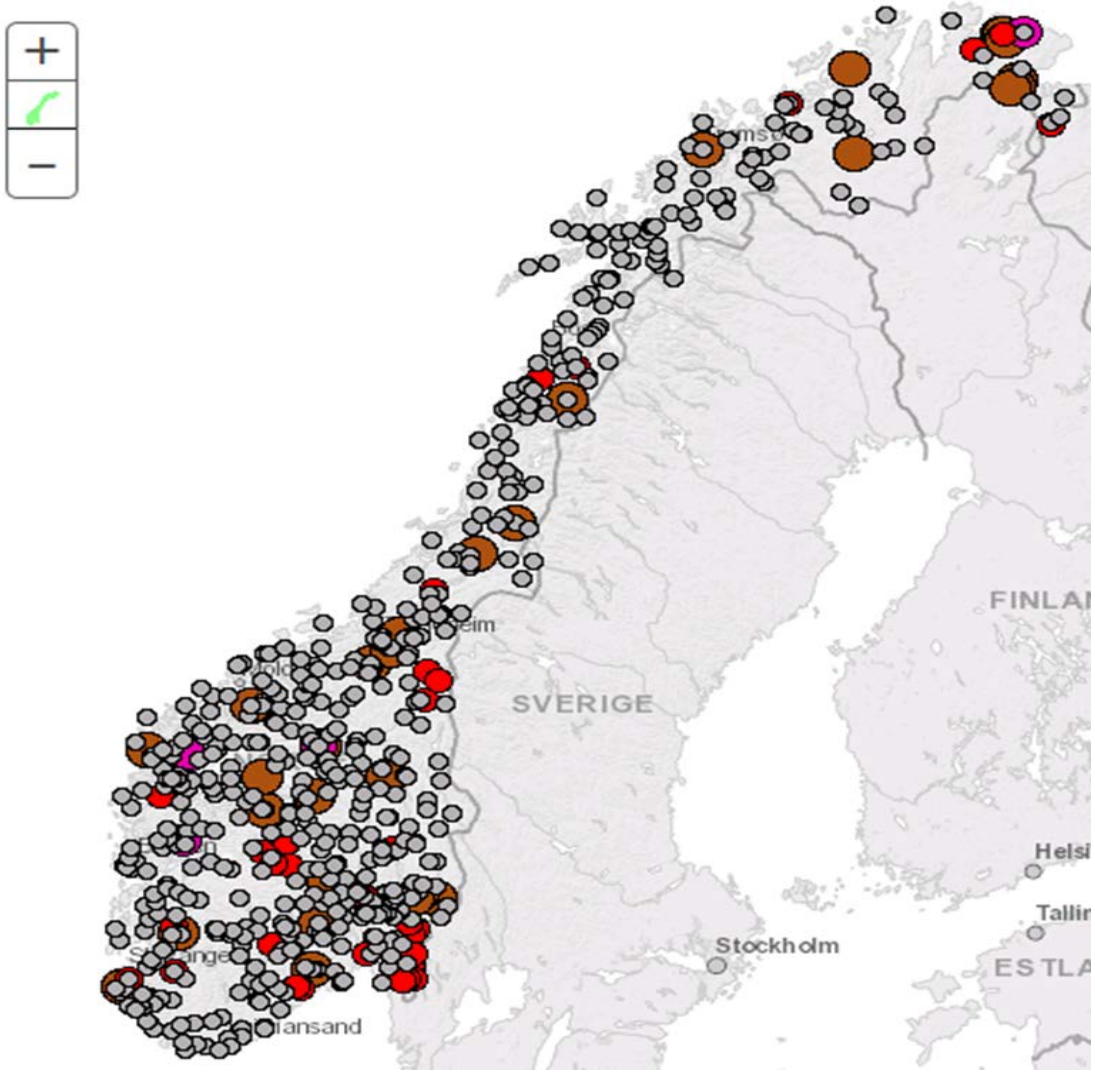


Data transfer & management



Automatic transferred measuring sites

Antall stasjoner som vises i kartet: **615** Vis som liste



Hydrology in action!

- *Theoretical skills*
  - Hydrology, fluid mechanics, computer science, maths.
- *Practical skills*
  - Know how to use a hammer
  - Boat, car & trailer
  - Swimming!
  - Electronics
  - Outdoor life
- *Social skills*
  - You spend a lot of time with your field-partner

NVE