
SWISS WATER
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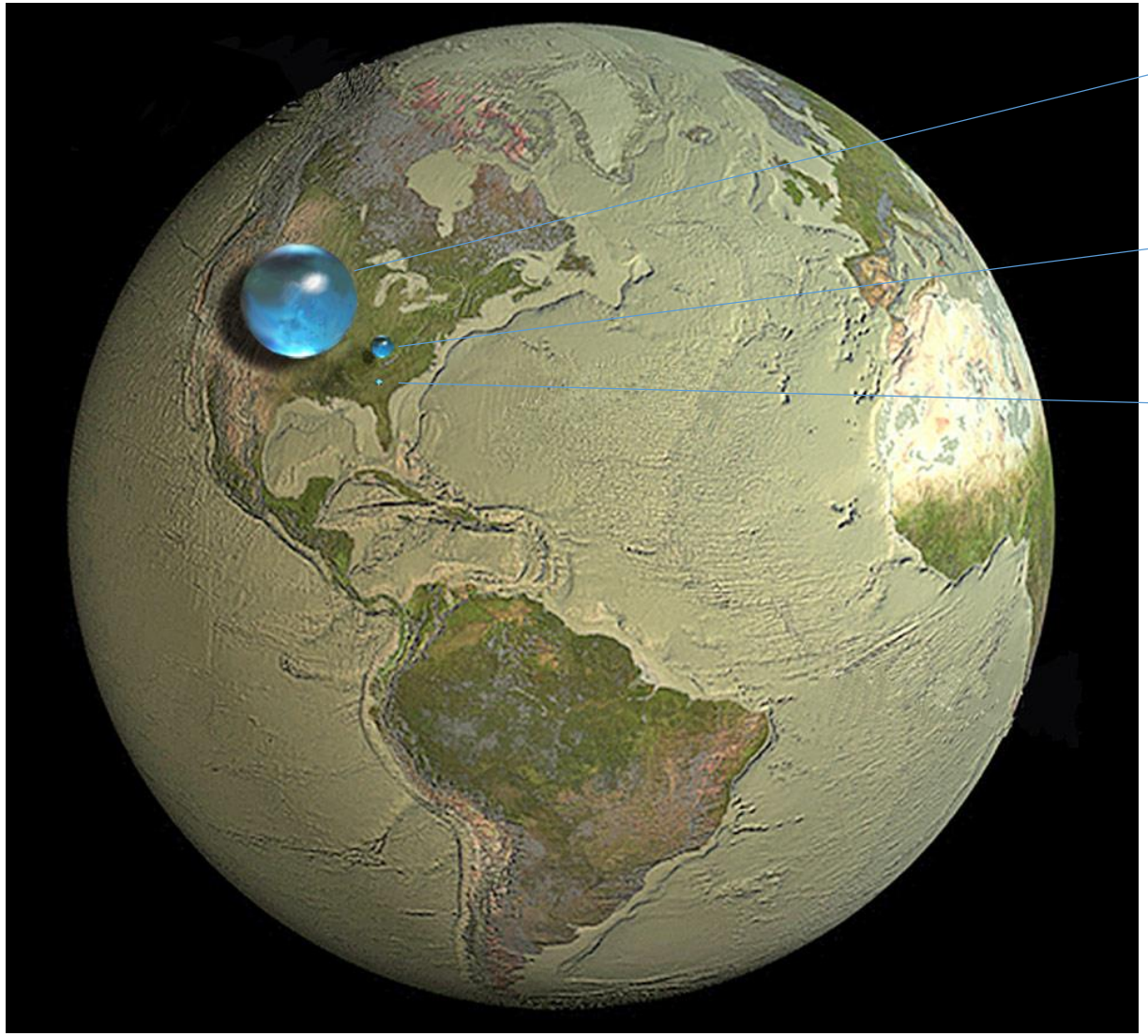
Groundwater paradox: a challenge for society

Groundwater: the most important freshwater resource

Global water resources



All of earth's water (oceans, groundwater, polar ice, rivers and lakes)

All of earth's liquid fresh water (groundwater, rivers and lakes)

All of earth's liquid surface fresh water (rivers and lakes)

Global water on earth : 1.4 Billion km^3

Distribution of freshwater

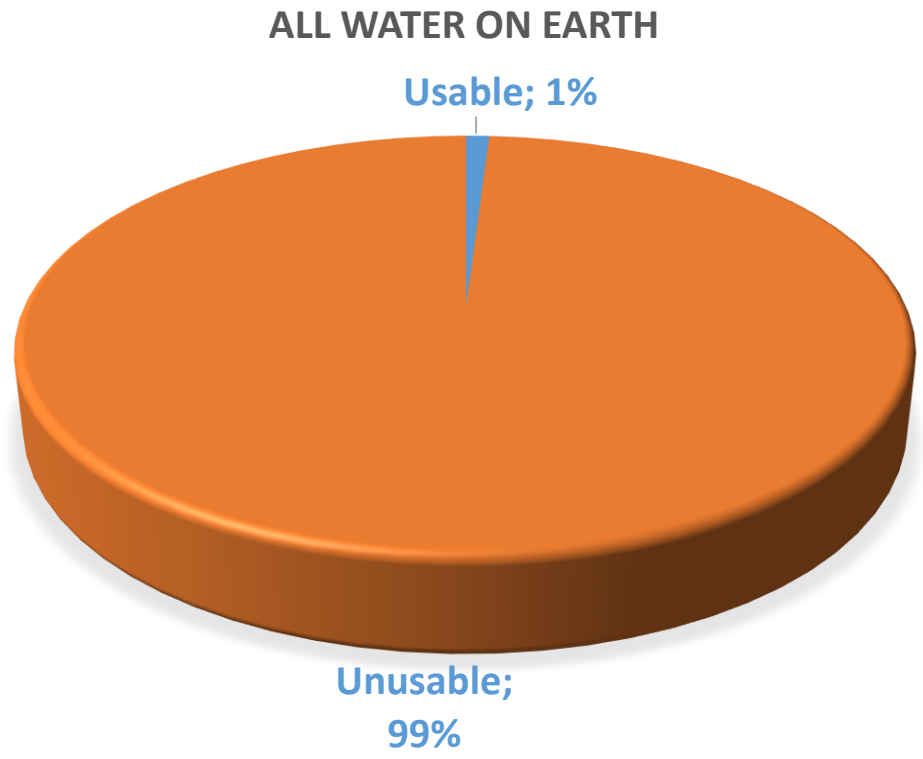
1% Surface water

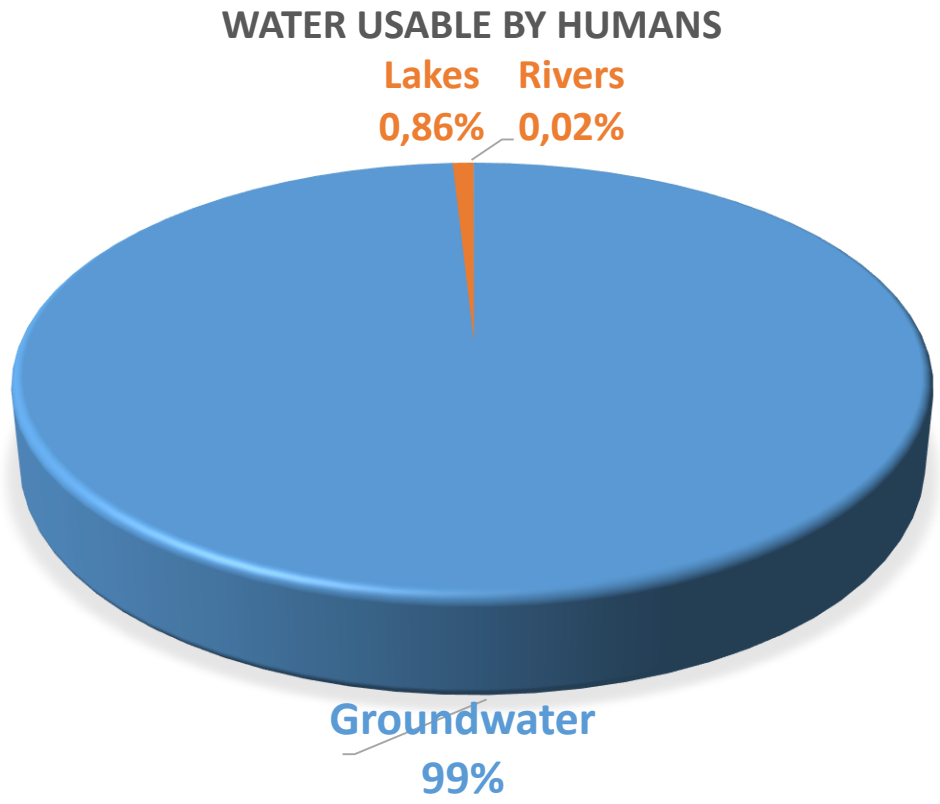
30% Groundwater

69% Glaciers, ice on poles

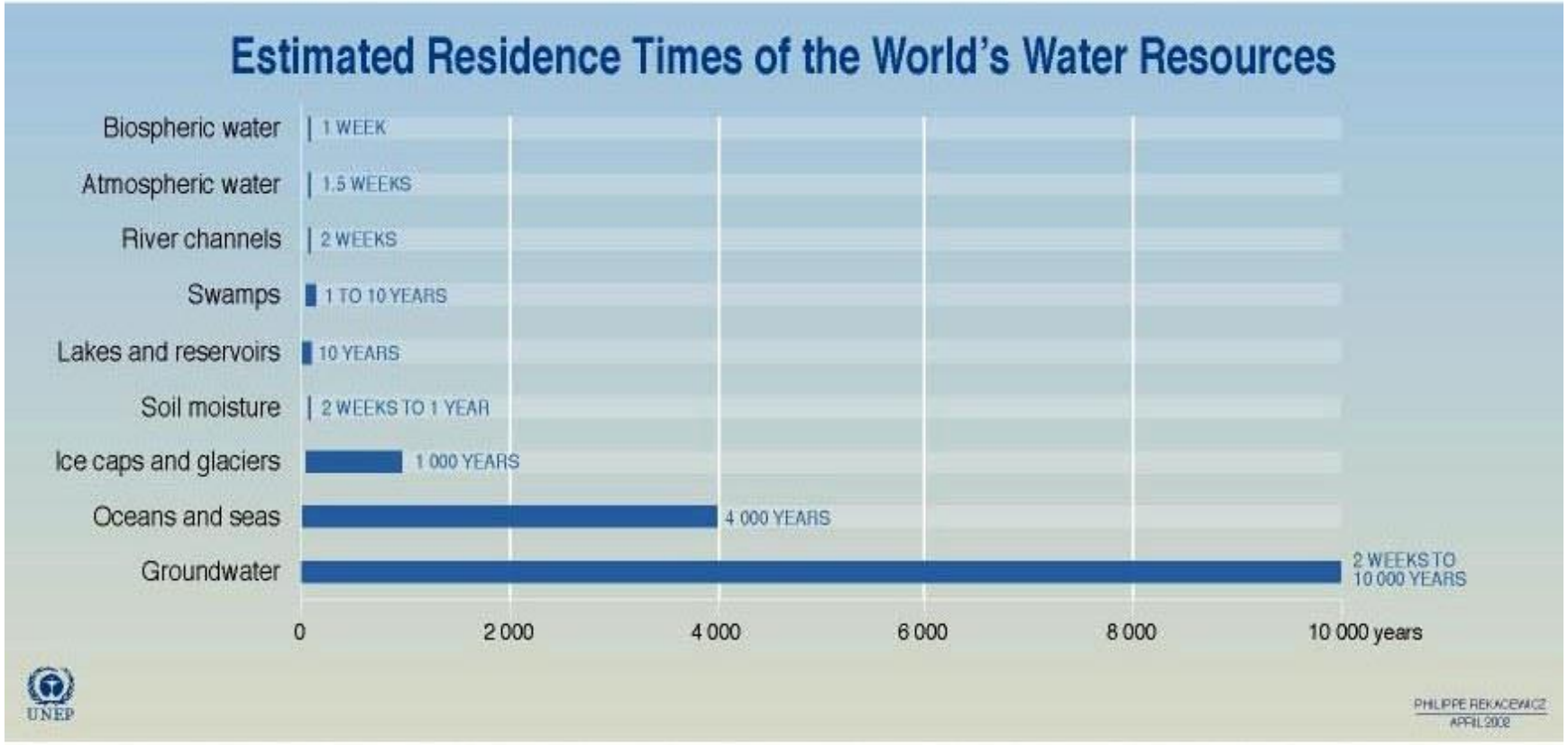
Water usable by humans

The paradox : Freshwater is an essential need and groundwater constitutes the main part of it but most of the time we have a poor knowledge of aquifers and insufficient data to exploit them in a sustainable way.



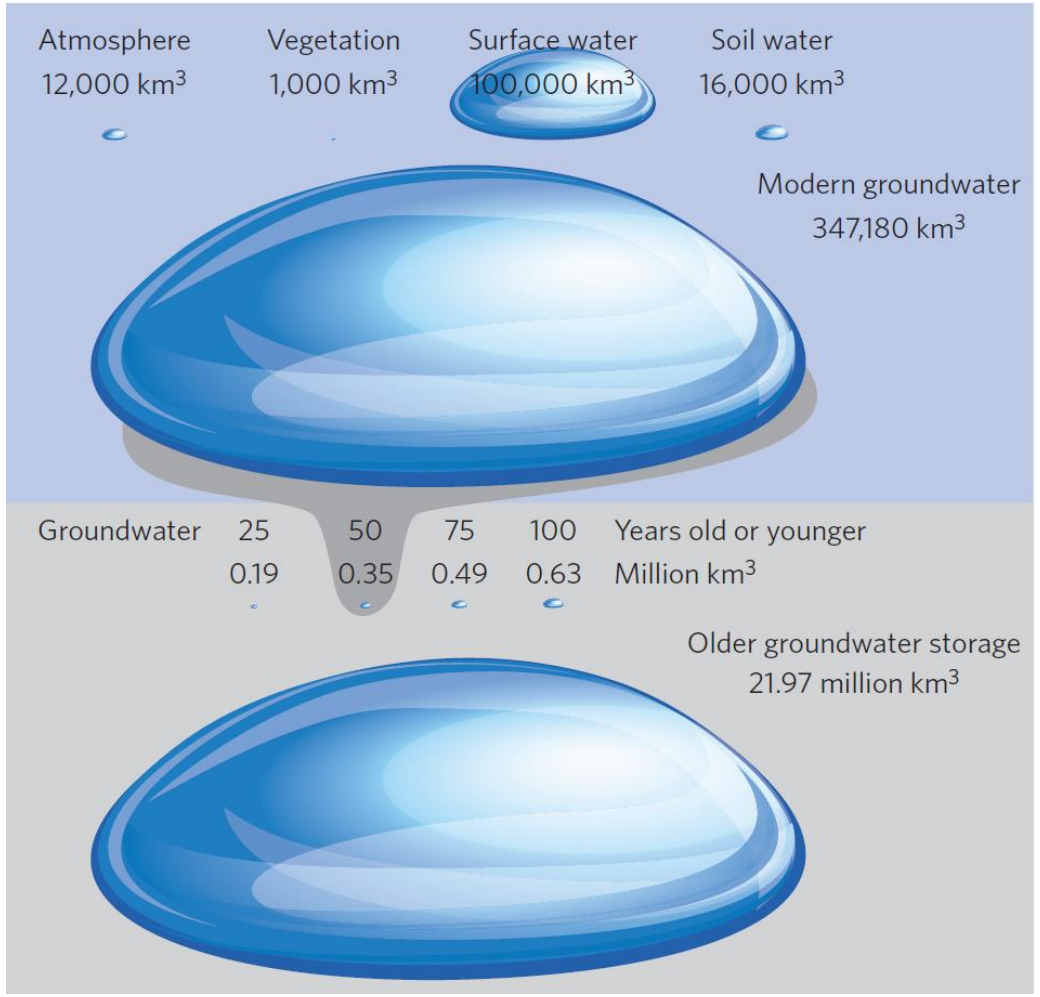


One resource but very different time scales



Source: Igor A. Shiklomanov, State Hydrological Institute (SHI, St. Petersburg) and United Nations Educational, Scientific and Cultural Organisation (UNESCO, Paris), 1999; Max Planck, Institute for Meteorology, Hamburg, 1994; Freeze, Allen, John, Cherry, *Groundwater*, Prentice-Hall: Engle wood Cliffs NJ, 1979.

Groundwater volume and distribution (upper 2 km)



Source: Tom Gleeson, et al., The global volume and distribution of modern groundwater, Nature Geoscience, nov. 2015

< 6% of the groundwater is less than 50 years old. Most recently recharged and more vulnerable to global change.

> 94% of the groundwater is older than 50 years, sometimes fossil (non renewable), more resilient to global change.

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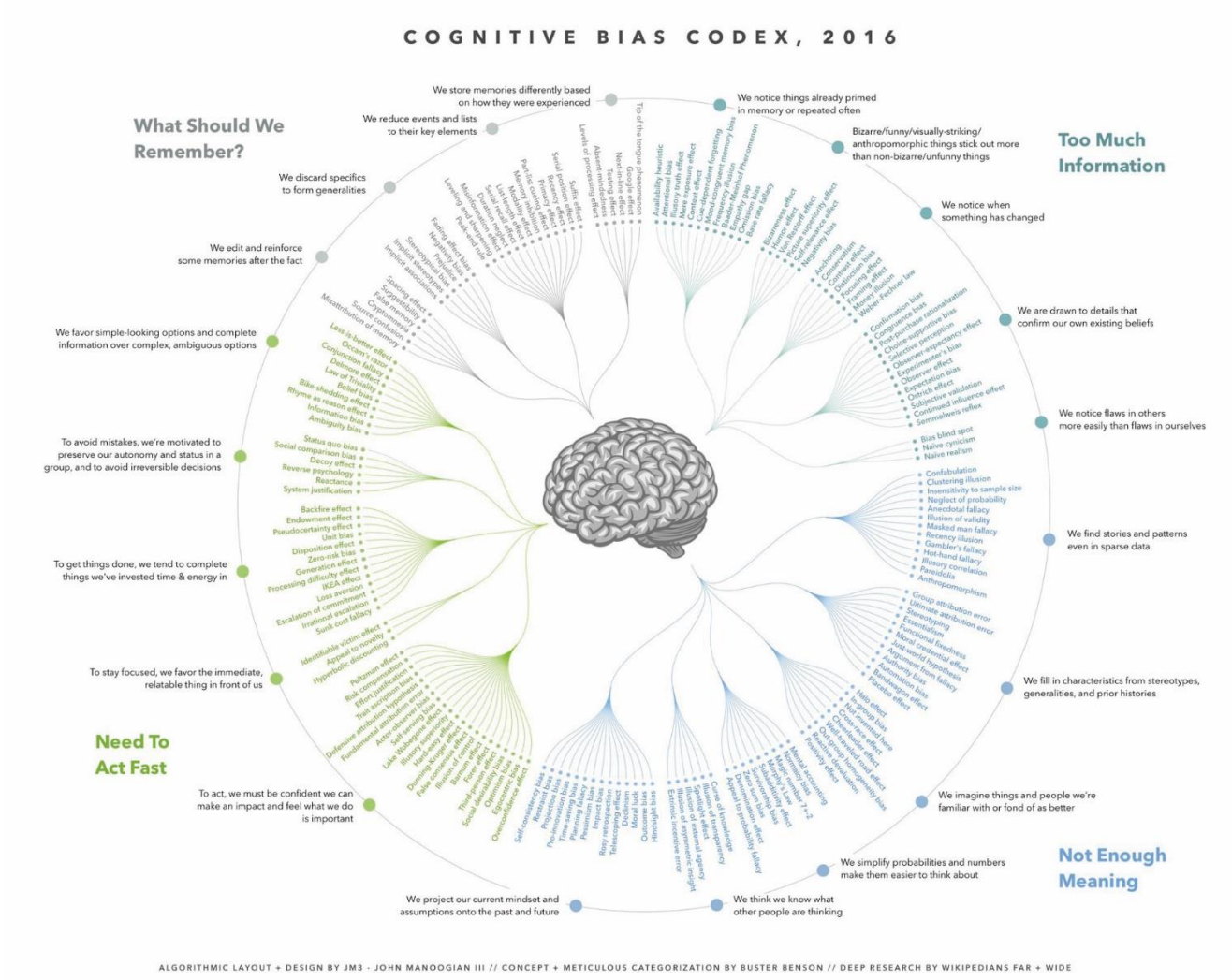
Groundwater: the unknown resource. WHY ?

Groundwater : out of sight….out of rational consideration?



Confirmation bias: seek confirmation of our beliefs, allows quick decisions while minimizing efforts. It is not a successful strategy for managing new situations.

«Visible is credible» bias : the invisible requires a greater effort of belief, or education, and consequently often ends up unrepresented in our mental models

Groundwater: the tragedy of the commons?

	Excludable	Nonexcludable
Rival	**Private Goods** Food and clothing Car House	**Commons Goods** Fish in open sea Atmosphere Public waterways
Nonrival	**Low-congestion Goods** Cable television Satellite radio Online WSJ	**Public Goods** Tax-based: Nuclear umbrella The law Indirect private funding: Search engine On the air TV

The Prisoners' Dilemma

Pareto optimality

		Prisoner A Choices: *Stay Silent*	Prisoner A Choices: *Confess and Betray*
Prisoner B Choices	*Stay Silent*	Each serves one month in jail	Prisoner A goes free Prisoner B serves full year in jail
Prisoner B Choices	*Confess and Betray*	Prisoner A serves full year in jail Prisoner B goes free	Each serves three months in jail

Nash equilibrium

Non cooperation and individual choices lead to a **Nash equilibrium**: every person in a group makes the best decision for herself, based on what she thinks the others will do. Individually rational economic actions work to the detriment of all by destroying resources held in common. For example, individual pumping of too much groundwater can result in the depletion of the resource.

Pareto efficiency or **Pareto optimality** is a state of allocation of resources from which it is impossible to reallocate so as to make any one individual or preference criterion better off without making at least one individual or preference criterion worse off.

Groundwater: approach from resources to water needs

Sectoral approach	Multisectoral approach
Resources are considered independantly	Resources are considered in an holistic manner
Constraint based	Interactions based
Development based on opportunities	Planified development
Project scale	Functional scale
Disciplinary competences	Transdisciplinary competences
Analytical thinking	Systemic thinking

Groundwater: solutions for a sustainable use? – 5 market places

1. Understanding social patterns of groundwater uses and poverty impacts in an urban context (case study Ghana): hosted by Jenny Gronwall from UPGro;
2. Making groundwater more visible with an approach to monitor and protect groundwater (North Korea case study): Marc-André Bünzli from SDC/HA;
3. Exploring the sector thinking silo with the example of monitoring and protection of groundwater in Switzerland: hosted by Michael Sinreich from Swiss federal Office for the Environment and IAH/Swiss Chapter;
4. Solution-oriented stand about innovations and groundwater: hosted by Bob Walter and Jake Longenecker, from the Department of Earth and Environment Franklin and Marshall College;
5. Out-of-the-box thinking with the shaping of the new RWSN strategy to support change in mind-set: hosted by Sean Furey from RWSN;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Thank you!!!