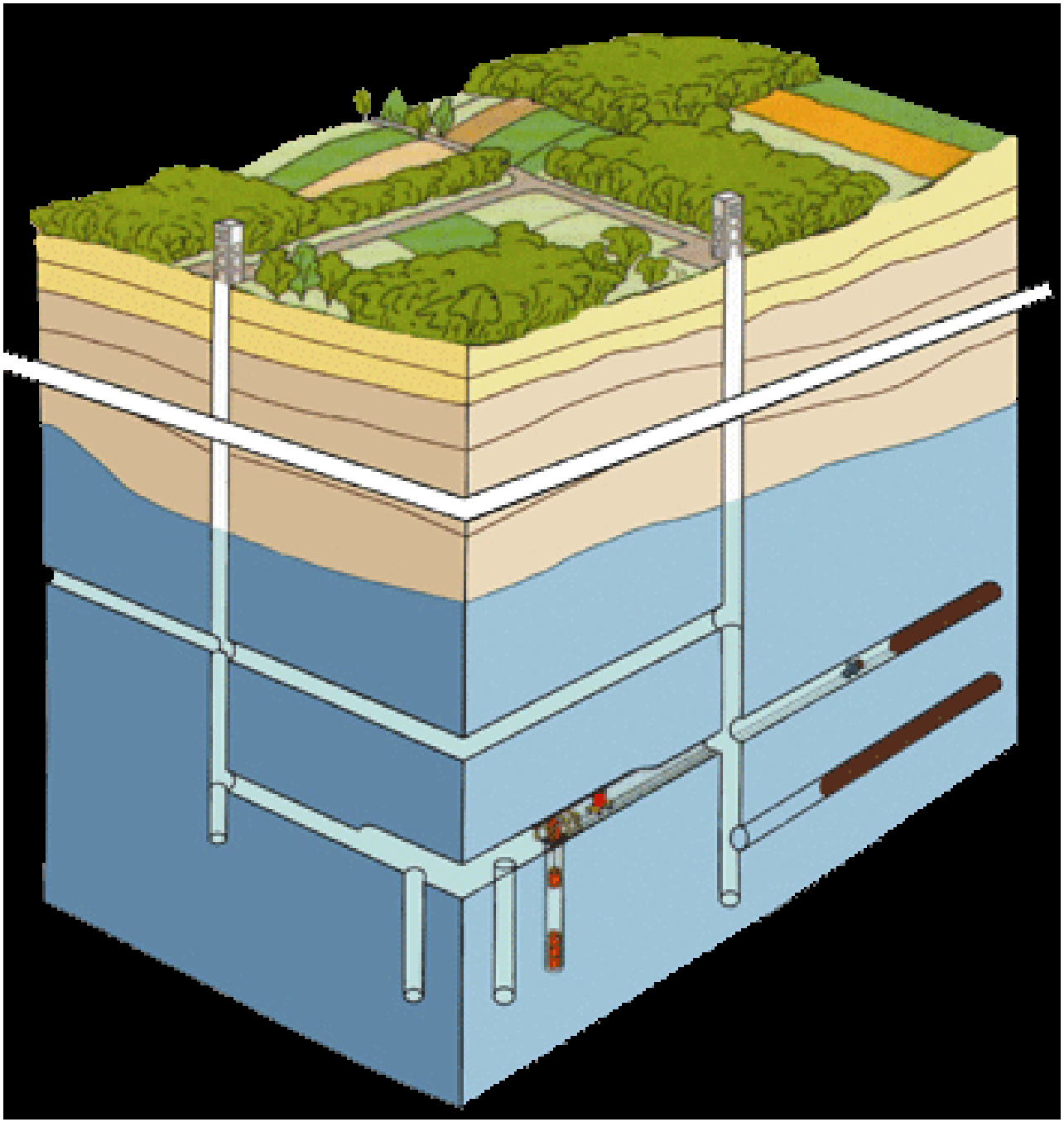
Radioactive waste in Germany

- provenience
    - NPP
    - Research and medical applications
- Amount and Storage locations
    - Weak and medium active waste
        - Collection points of federal states (Länder)
        - 4500 m^3/a (yearly average: 1984-2006)
        - 270 000 m^3 (until 2040)
    - Highly active waste (spent nuclear fuels)
        - Interim respositories Gorleben and Ahaus
        - Near-site interim storage
        - 29 000 m^3 (until 2040)
    - Disposal
    - Storage in a final repository

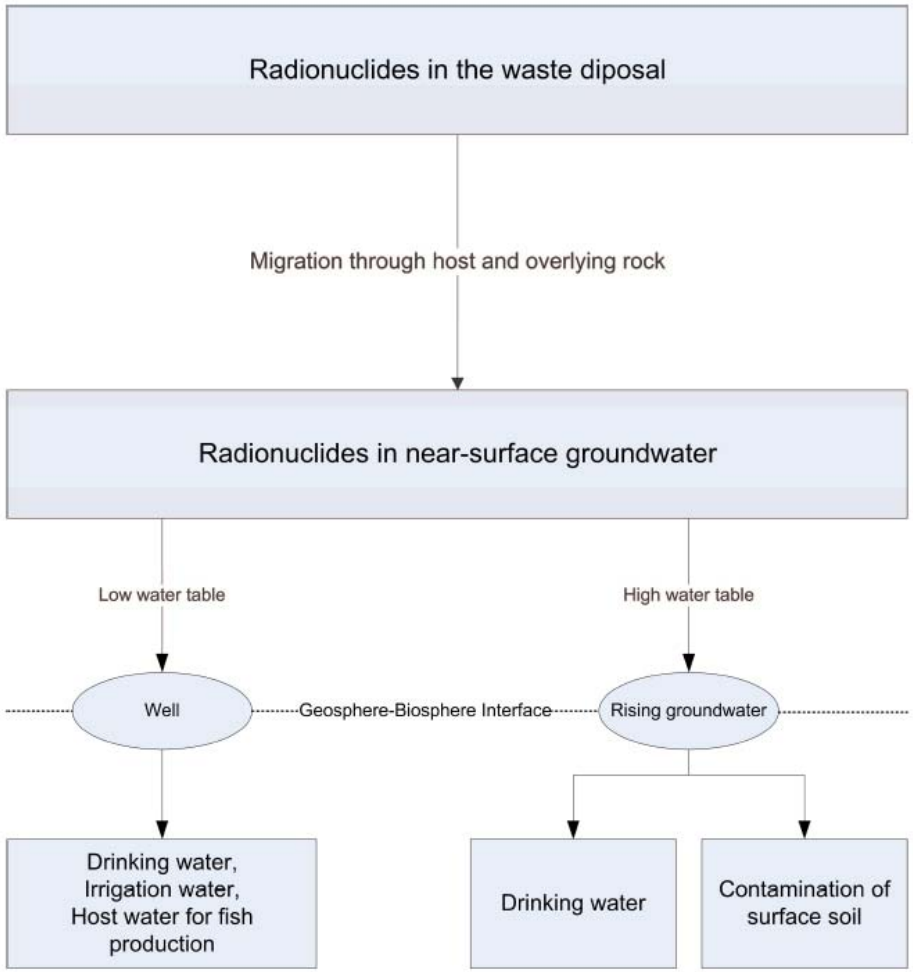
Schematic sketch of a waste repository



Long term safety assessment

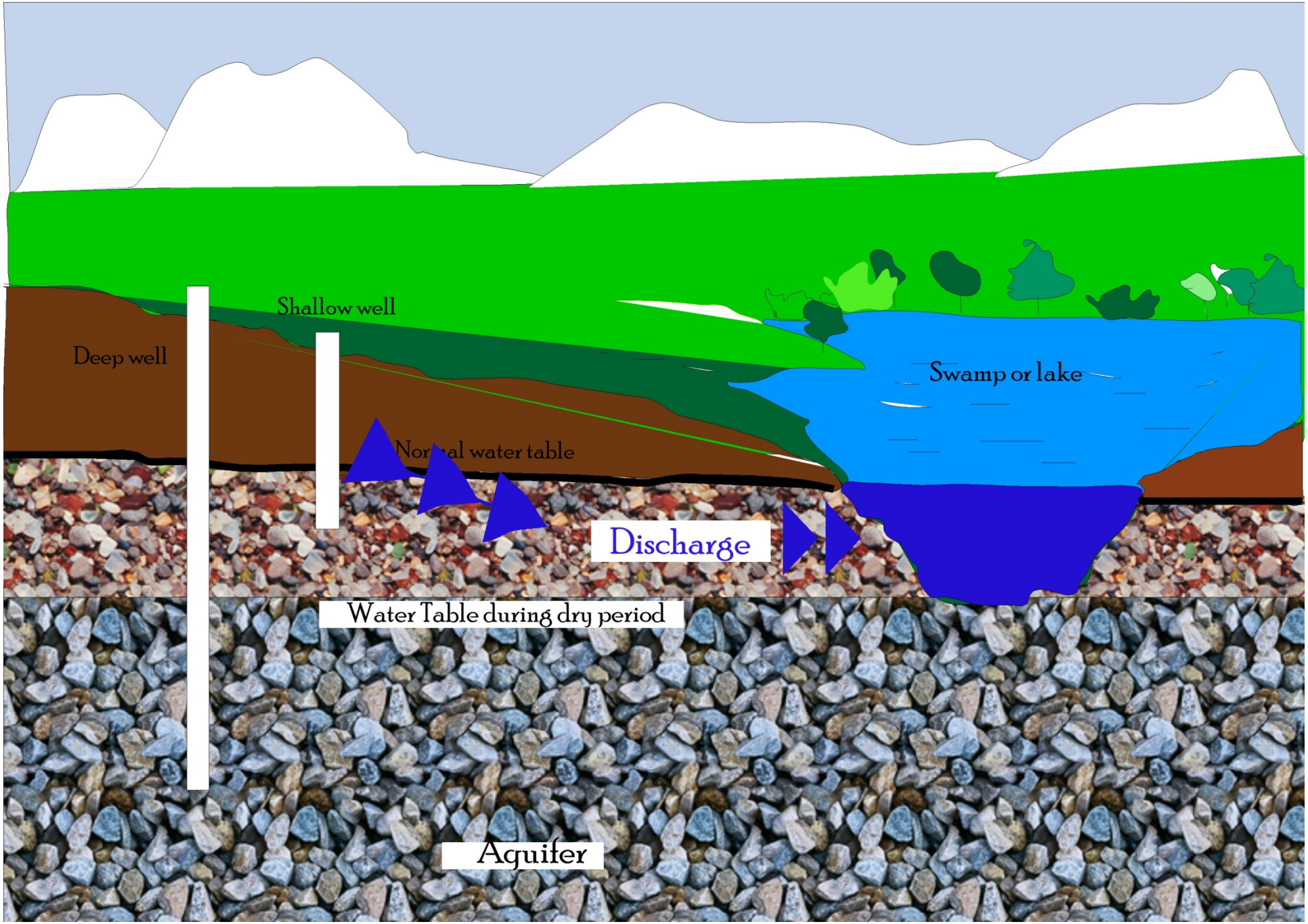
- Retention of radio-nuclides
  - Waste matrix
  - Filling material and technical barriers
  - Host rock
  - overburden
- Transport in ground water
  - **Interfaces with the biosphere**
    - **Rise of contaminated water**
    - **Well**
    - **Flow into surface waters**
- **Use of contaminated resources**
  - **Soil**
  - **Water**
- **Assessment of potential radiation exposure occurring very late in time**
  - **Boundary conditions?**

Interfaces for Radio-nuclides to the biosphere

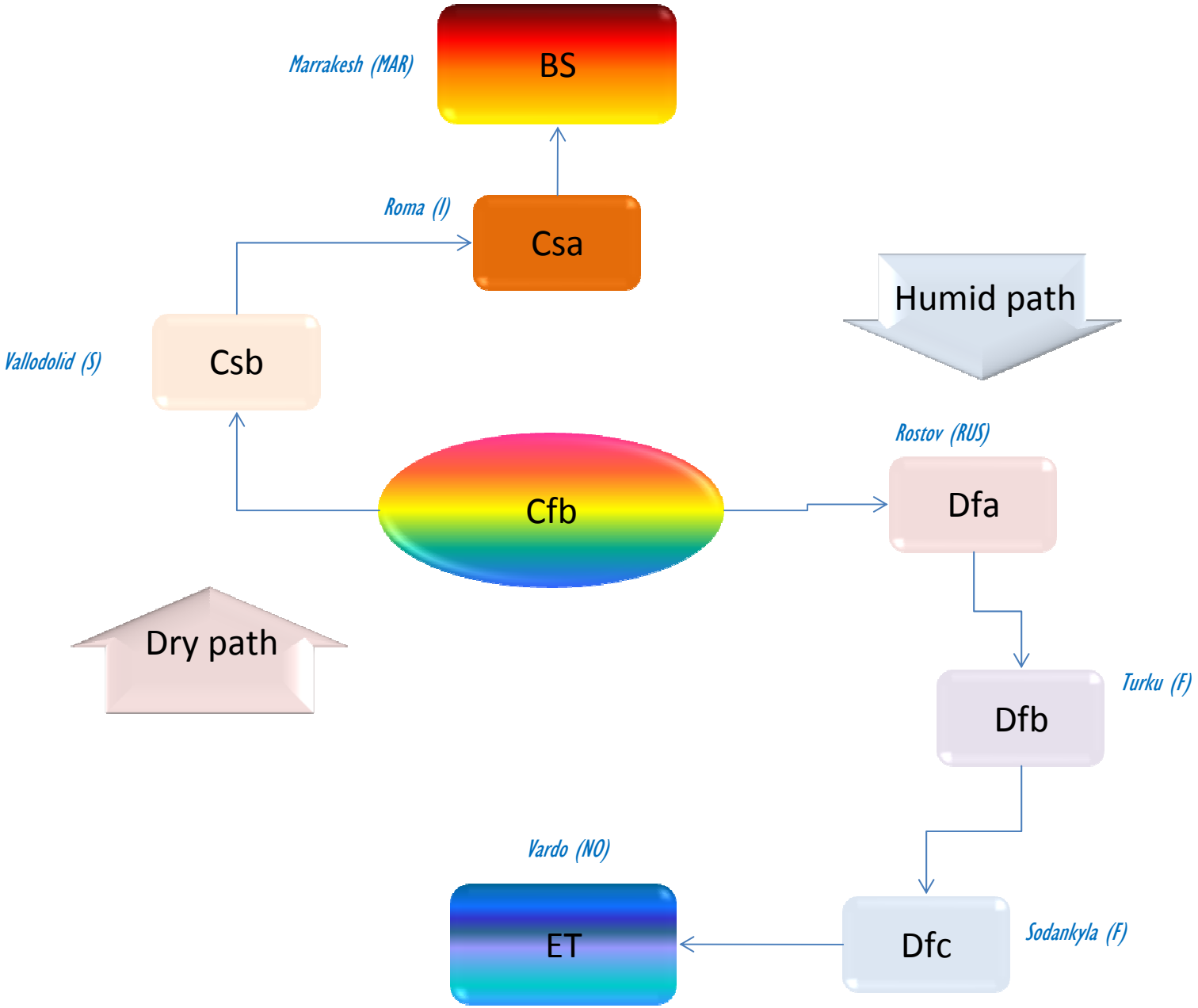


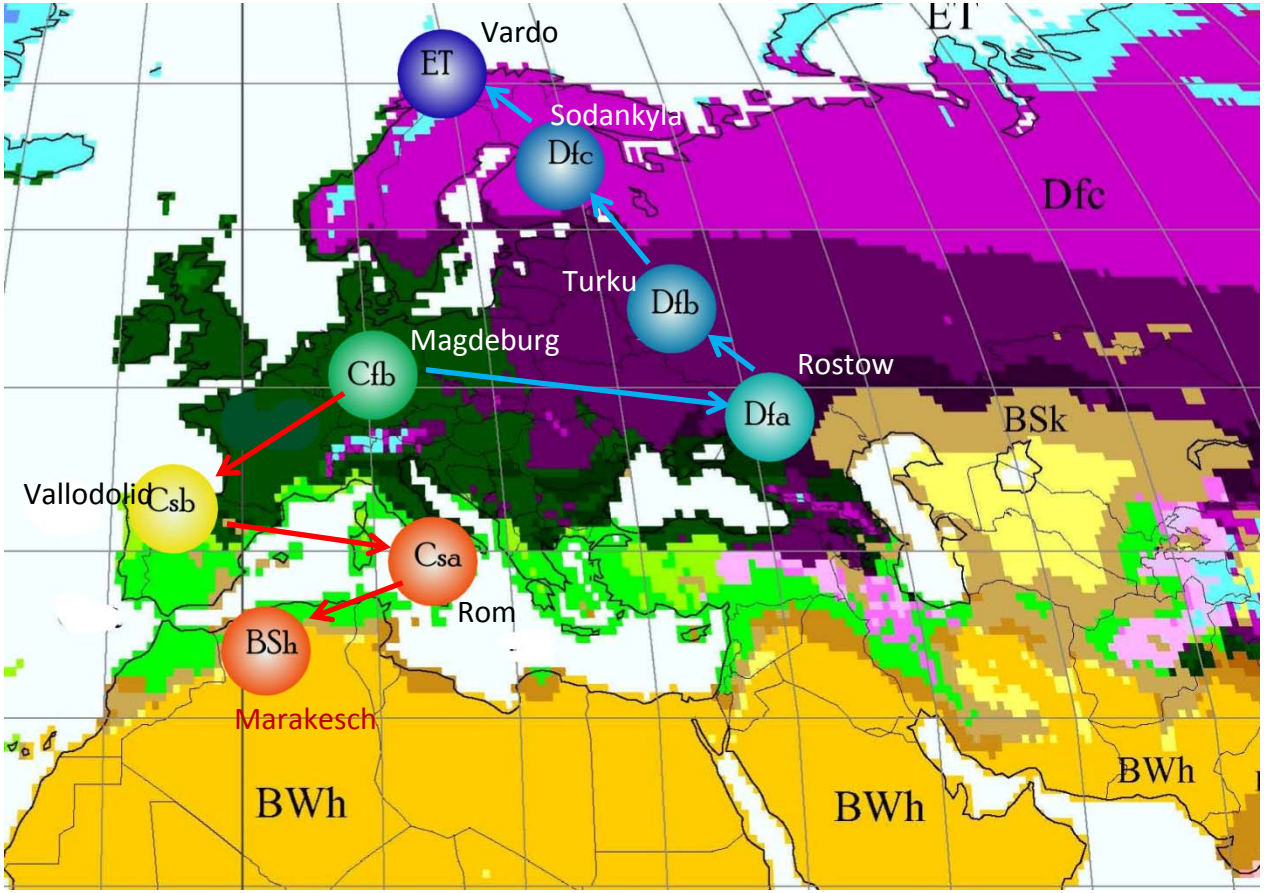
Potential contamination processes for the considered interfaces

Contamination process	Geosphere-biosphere interface	
	Well	Rising groundwater
Transfer to plants		
Radionuclide uptake from soil	X	X
Contamination due to resuspension	X	X
Weathering	X	
Interception by plants during application of irrigation water	X	
Translocation (systemic transport within the plant subsequent to foliar deposition)	X	
Loss from soil		
Migration	X	X
Erosion	X	X
Transfer to animals		
Drinking water for cattle	X	X
Use of contaminated feed plants	X	X
Contamination of air by resuspension		
Accumulation of radionuclides in the resuspendable soil fraction	X	X
Transfer to freshwater fish		
Radionuclide uptake by fish	X	X
Attachment of radionuclides to particles and sedimentation	X	X

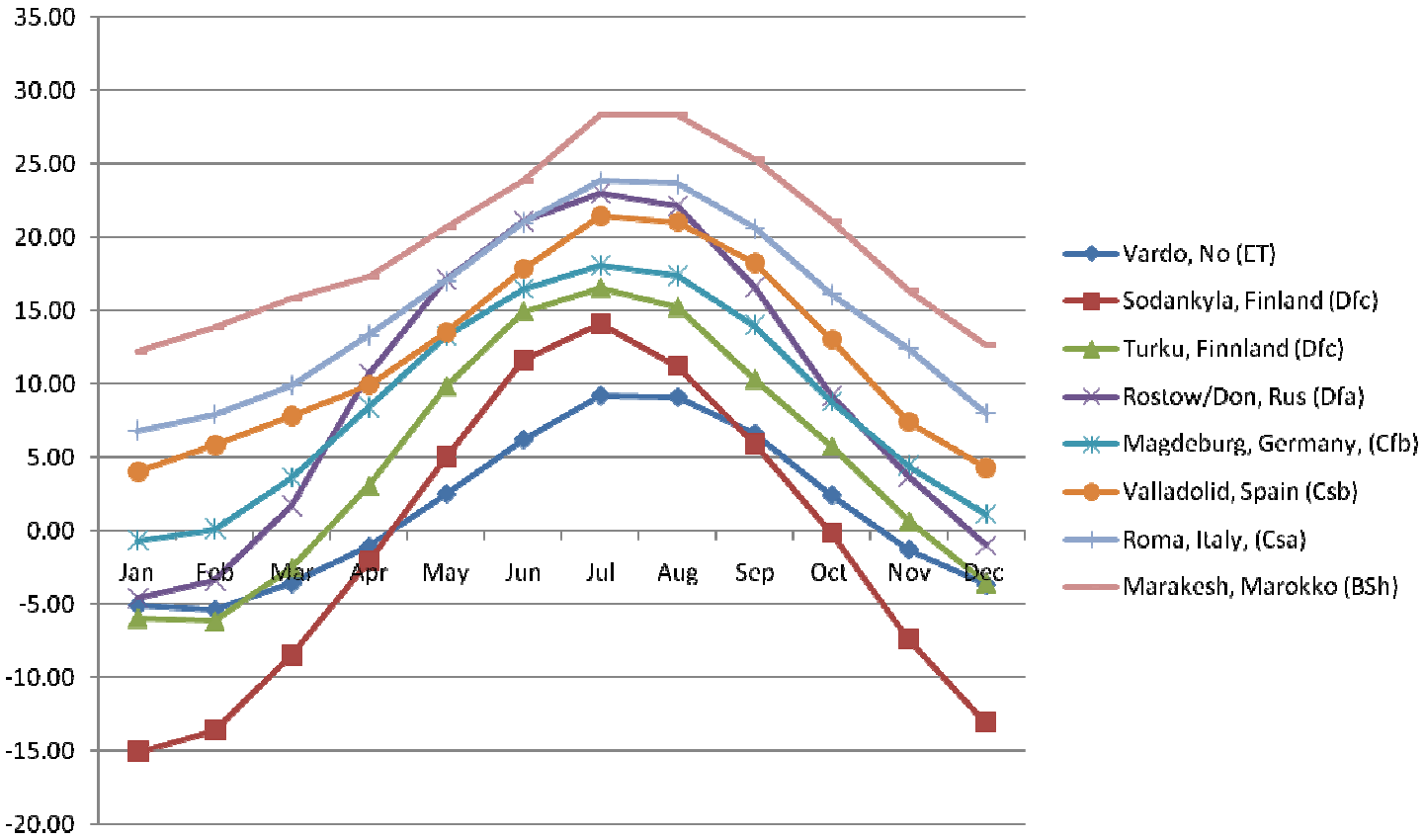

Shallow well
Deep well
Swamp or lake
Discharge
Water Table during dry period
Aquifer

Two paths of climate change

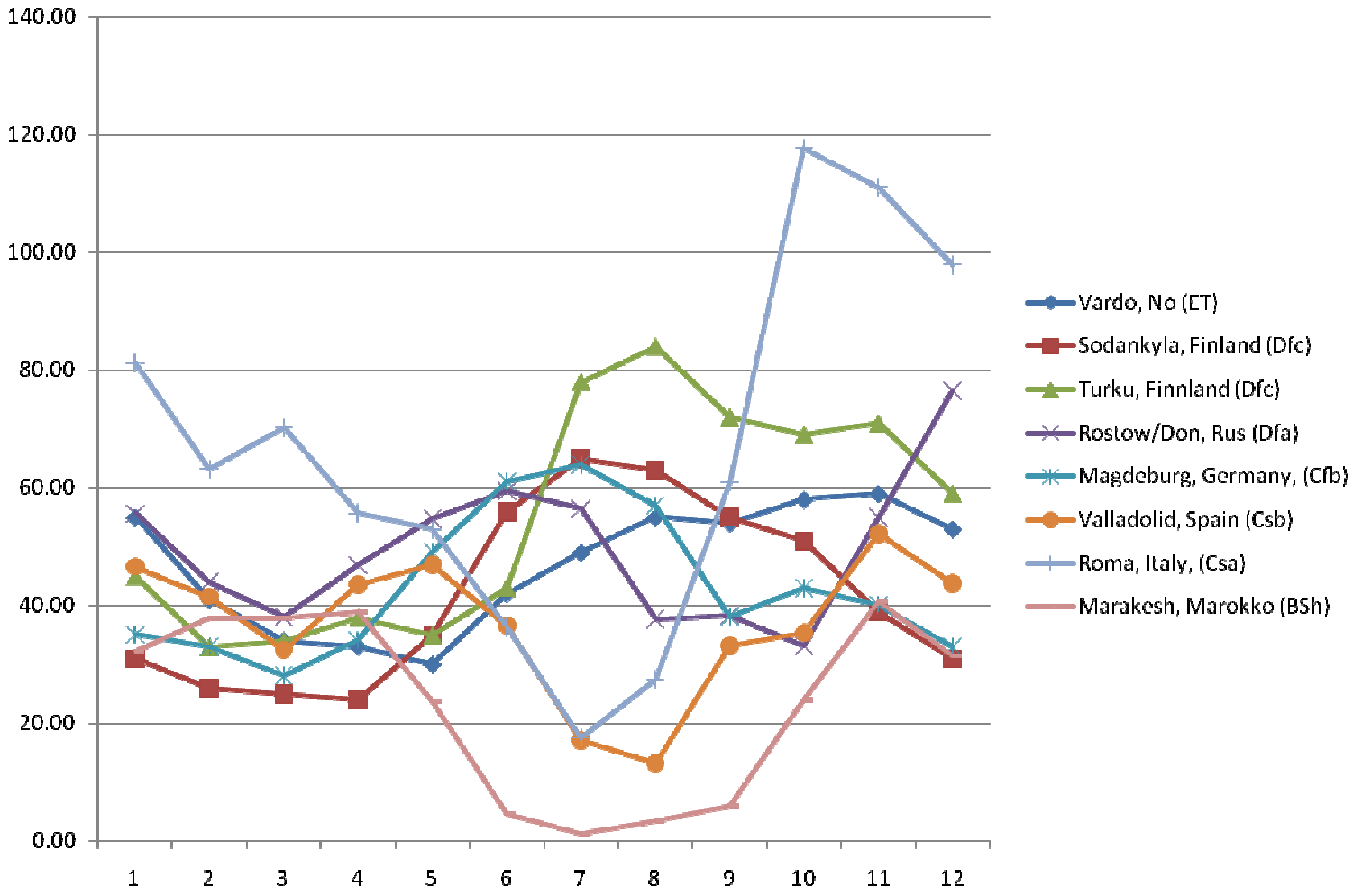


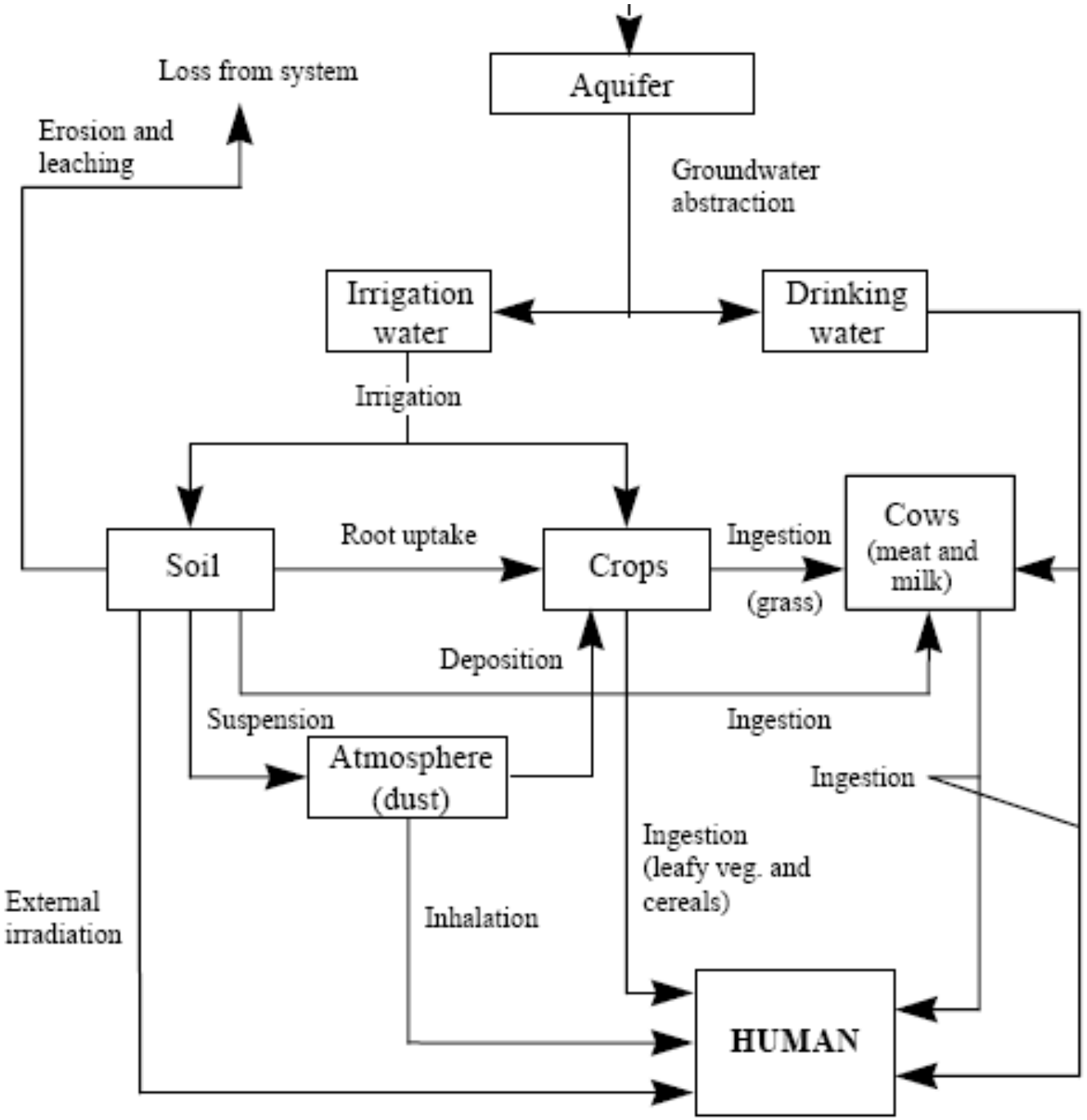

Vardo
ET
Sodankyla
Dfc
Dfc
Turku
Dfb
Magdeburg
Cfb
Rostow
Dfa
BSk
Vallodolid
Csb
Csa
Rom
BSh
Marakesch
BWh
BWh
BWh

Average monthly air temperature (°C) for the analogue stations



Average monthly precipitation(mm) for the analogue stations




Loss from system
Aquifer
Erosion and leaching
Groundwater abstraction
Irrigation water
Drinking water
Irrigation
Soil
Root uptake
Crops
Ingestion
(grass)
Cows (meat and milk)
Deposition
Suspension
Ingestion
Atmosphere (dust)
Ingestion
Ingestion (leafy veg. and cereals)
External irradiation
Inhalation
HUMAN

ECOLEGO – Simulation Modelling and Risk Assessment Software