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Your friends in every weather

OPTIMIZATION OF THE HYDROMETEOROLOGICAL OBSERVATIONS NETWORK

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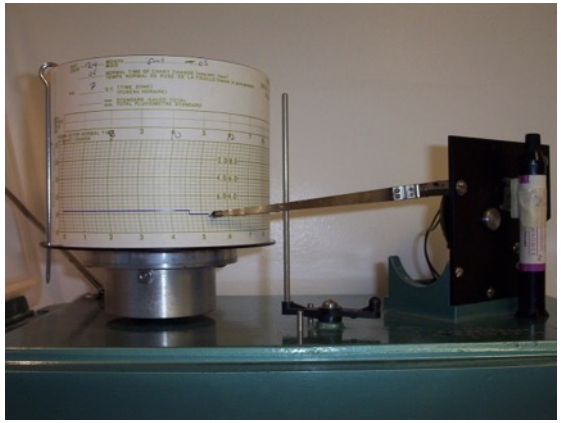
MONITORING NETWORK

- **Purpose of monitoring** – types of probes, types of stations, placement of stations
- **Natural conditions of monitoring** – number and placement of stations
- **Budget for monitoring** – number and equipment of stations
- **Other parameters** – signal coverage, accessibility of possible sites, international agreements



TYPES OF STATION

- Type of data collection
  - Manual
  - Automatic
- Frequency of data collection
  - Interval measurement
  - Continuous measurement
- Methodology of data measurement
- Type of data archivations

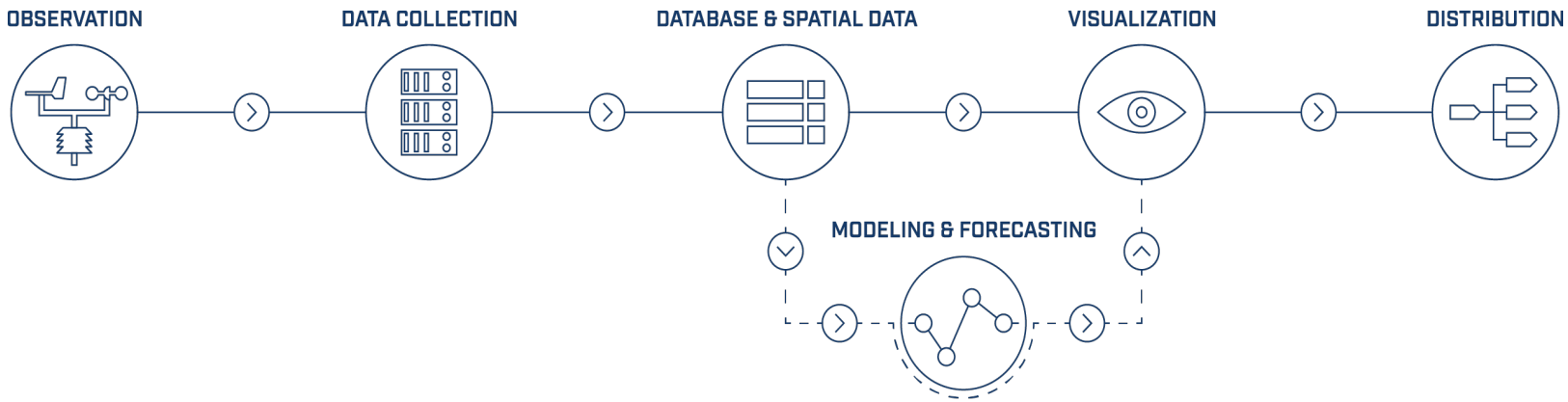
- Type of collected information
  - Weather stations
  - Raingauge stations
  - Air - quality stations
  - Airport stations
  - Climatological stations
  - water level stations
  - discharge stations
  - water quality stations
  - UGW station
  - Dam monitoring stations
  - Special monitoring systems

SPECIAL NETWORK – SPECIAL REQUIREMENTS

- Basic Meteorological network – basic meteorological measurement: T, P, H, wind parameters, pressure
- Weather (synoptic) station network: T, P, H, wind parameters, pressure, visibility, cloudiness, soil temperature and humidity, snow…
- Raingauge stations: T,P,H
- Hydro – meteorological network: combination of raingauge and hydrological station
- Hydrological network: water level (H), or discharge measurement – meteorological observation possible, but neglected
- Dam (safety) monitoring system: meteorological + hydrological + dam stability monitoring system
- Special types of weather stations: agricultural, industrial, airport, marine, school, avalanche and snow monitoring stations…
- Special measurement: buoys, weather balloons, airplane measurement, meteorological radars, lightning detection

RULES OF OPERATIVE OF MODERN MONITORING SYSTEM

- All measurement should be automatic
- Measurement, data pre-processing and data transmission should be provided in the real time
- No secondary data conversion necessary
- Automatic QC system
- Energy autonomous station (battery)
- Transmission via ensured ways
- Repeatable measurement – stabile station conditions
- Station placement fulfilling requirements of international organizations (WMO)
- Data stored in the tested DB available for further usage

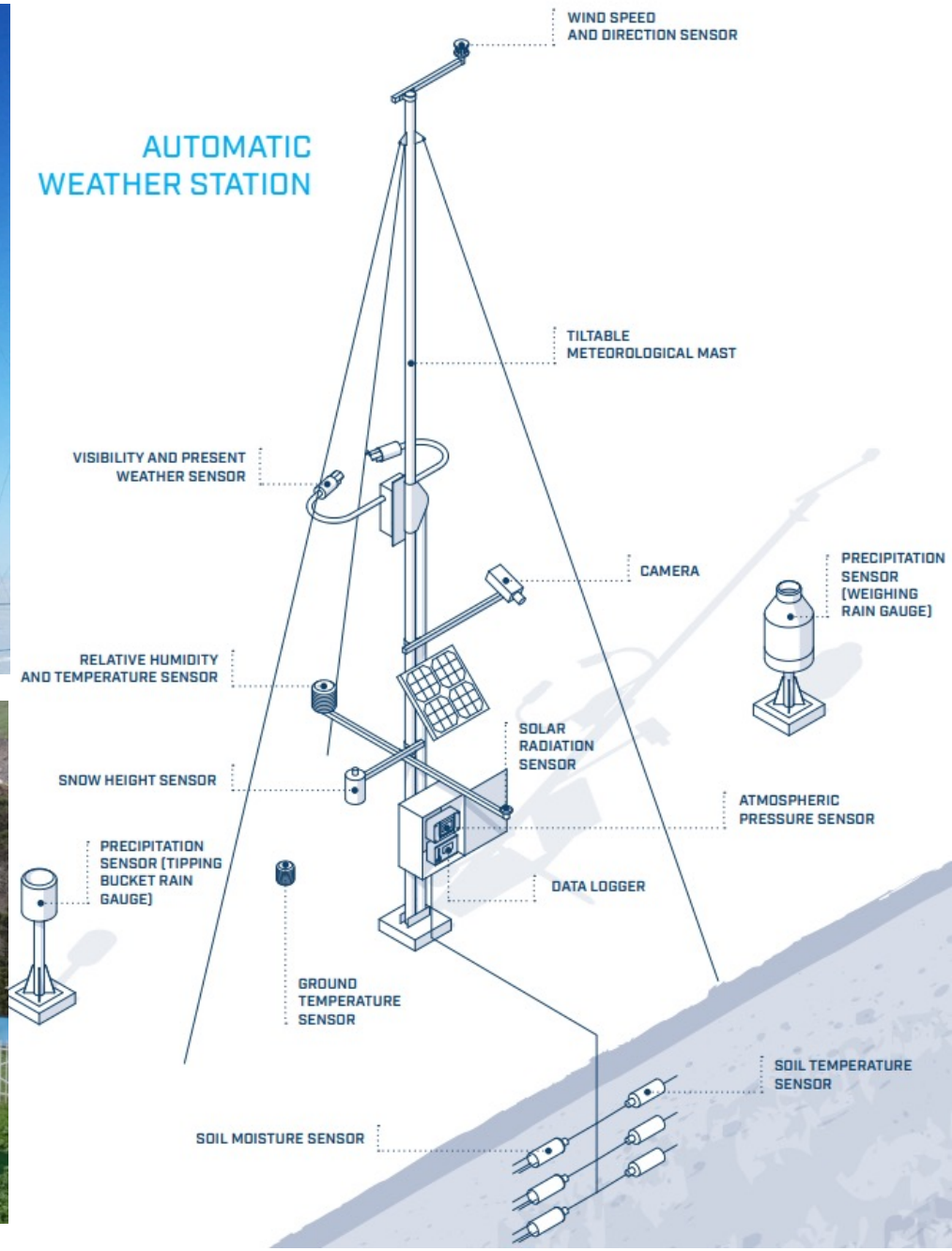


METEOROLOGICAL STATION PLACEMENT REQUIREMENT

- Outside of city centers and areas of planned further development
- Far from heat producing lines (river, highway, railroads)
- 4000-5000 meter square area without any cavity, hill, rocks…
- Out of areas of irrigation, or heavy agriculture
- Sufficient distance to blocking object – trees, buildings – depends on the mast height
- The ground of the site has to be from natural materials
- Accessible for technicians
- Connection available

METEOROLOGICAL MONITORING NETWORK

- Coverage of all elevation / climate zones with station network
- Higher density of station network in urban areas
- Satellite and meteorological radar coverage is recommended (radars at least in urban areas)
- Focus on purpose of station network (f.e. wind measurement is not necessary for flood prediction system)
- Sharing of data among networks (new station should not be placed in the already monitored locations) – one database



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HYDROLOGICAL STATION PLACEMENT REQUIREMENT

- stabile profile
- representative profile non affected by the tidal, or backwater effects
- Stabile flow conditions
- Out of bridges, in-line and lateral structures with significant influence on the flow conditions
- Not at the (or close to the) confluence of streams
- good accessibility for site inspection and maintenance
- ability of data transmission and further distribution (mobile, satellite connection)

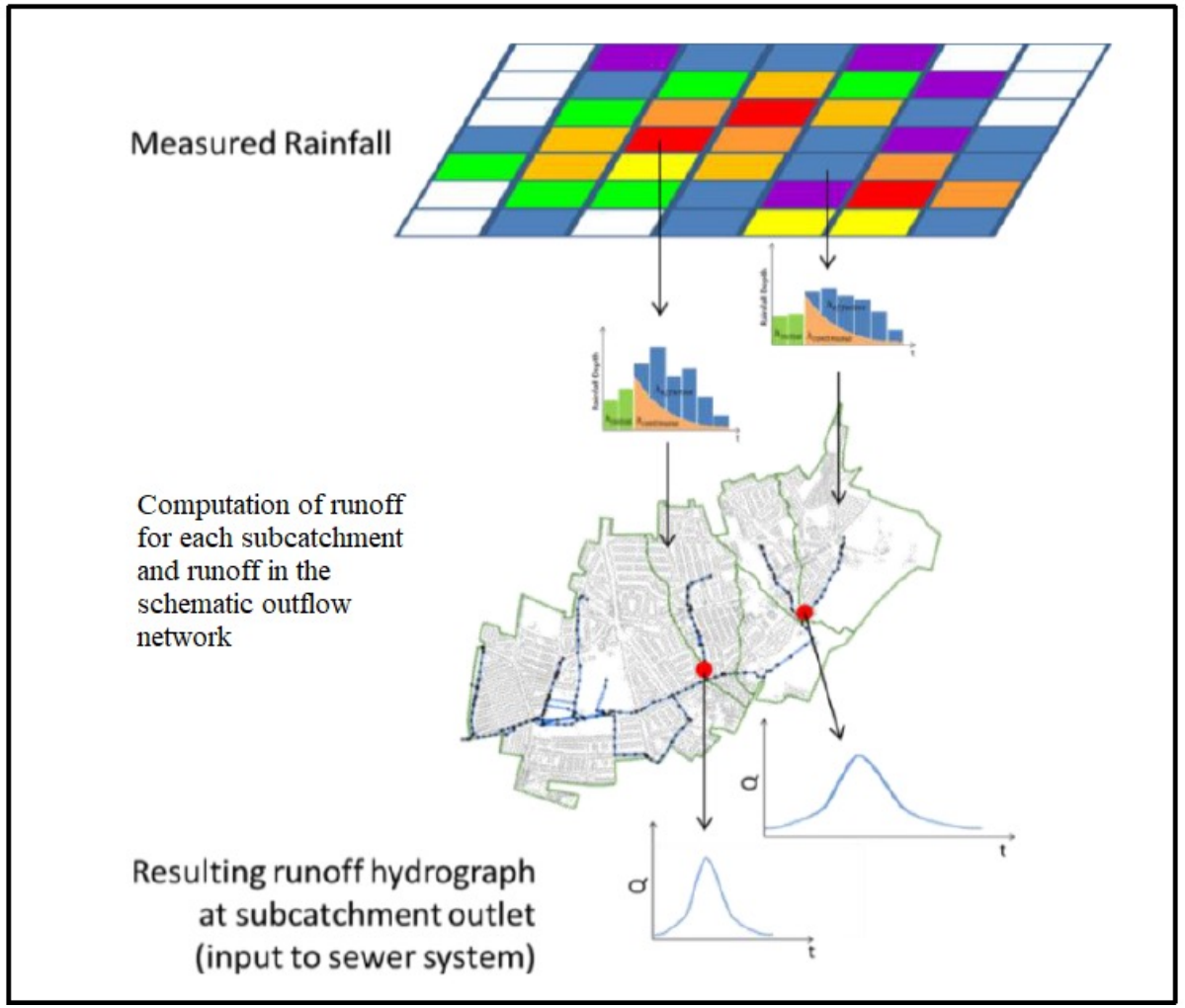
- Water level measurement in static water bodies, in warning profiles
- Discharge in stabile (not affected) profiles
- Combination of water level measurement with relation curve management system seems to be the most stabile and sustainable solution – regular measurement of discharge by ADCP (or other methods) is necessary!

PLACEMENT COMPLICATIONS

- Lack of stabile profiles – rivers in natural conditions
- Missing structures (bridges, walls) for sensor placement
- Turbulent flow
- Water level affected by tidal/backwater effects
- Pollution in water +debris
- Appearance of water plants
- Private (military) areas with limited access for installing and maintaining of stations
- Weak internet, mobile connection
- Crime and vandalism – additional costs for security measures

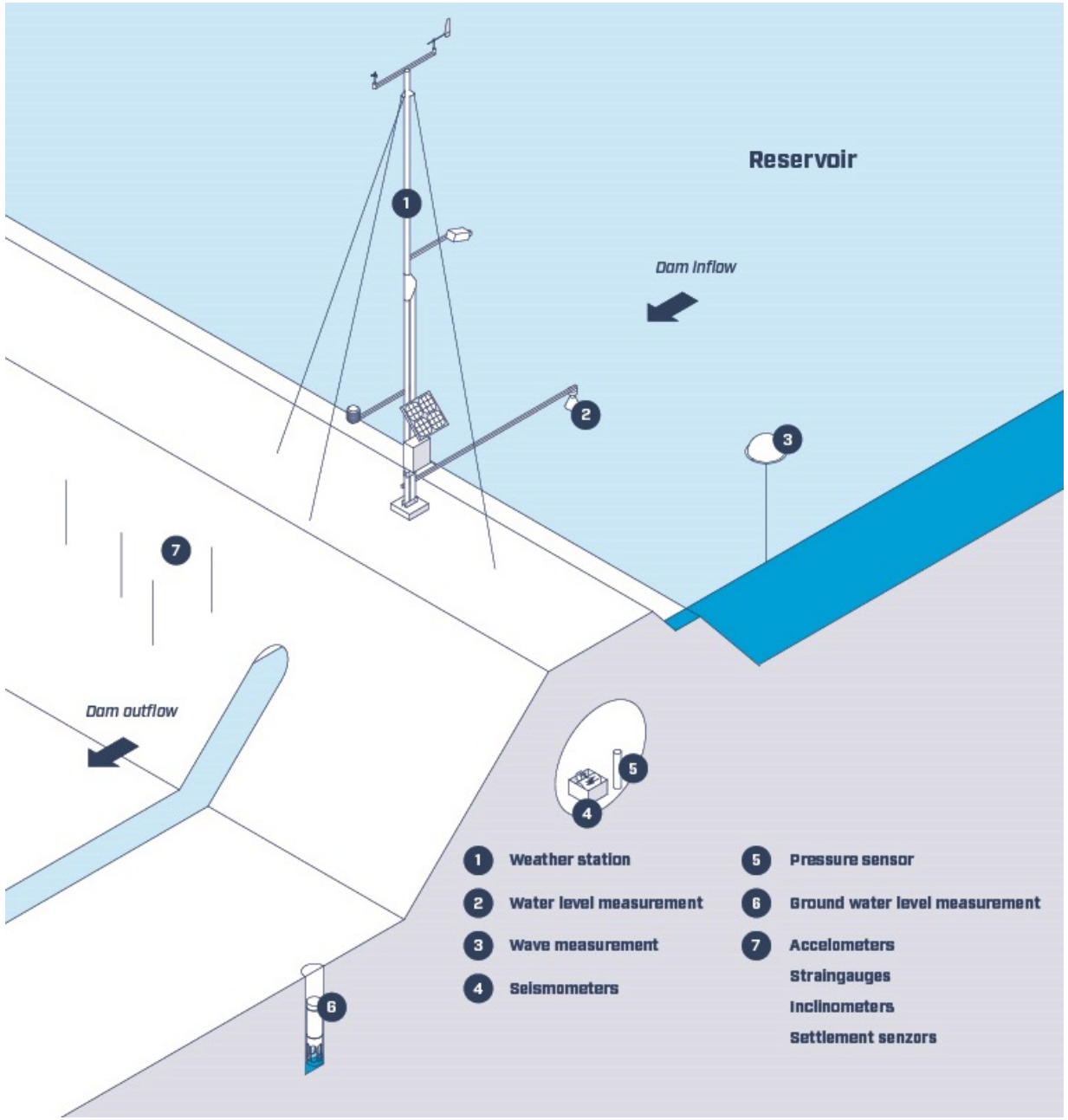
FLOOD MONITORING AND FORECASTING STATION NETWORK

- Precipitation monitoring via station and radar measurement systems
- Hydrological stations in:
  - A: Vulnerable areas
  - B: hydrological nodes and main streams
  - C: Dams and reservoirs (with significant influence on the hydrological regime in watershed
  - D: other streams
- NWP
- Real time data in DB (QC)
- Right access of measured data for primary warning system and to forecasting module (hydrological forecasting system)



DAM MONITORING SYSTEM

- Dam safety first
- Other monitoring priorities depends on the priorities of reservoir usage
- Hydrology: Monitoring of inflow to dam, water level in dam and outflow from dam
- Meteorology: monitoring should cover the whole inflow watershed (not only the reservoir area)
- Prediction via NWP and hydrological predicting system
- Decision Support System
- Sharing of information is important, but sharing of warning information is **crucial**



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CONCLUSION

- Installing of station network is a complex process, with many parameters to be taken into consideration
- Usually is the final solution based on compromises (and on exceptions from rules)
- Final solution should be focused on a purpose of monitoring network, but still opened for further development
- Looking forward smarter solutions
- Easier access of public to data – especially to warning information

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