OBSERVATION FOR FORECASTING

Extensive monitoring networks

of hydrological and meteorological stations are available in the Czech Republic. Meteorologists need the observations for the **weather forecasts.** Hydrologists measure distribution of water to **forecast the occurrence of extreme events**, such as floods and droughts. Forecasting of meteorological and hydrological extremes is necessary especially for the early warning systems, which enable minimization of damages to health and property.

What do we measure?

Energy balance – **solar energy** is the main driving force of the global water cycle. Total radiation balance is mainly used to calculate evapotranspiration.

Rainfall and snowfall – the amount of precipitation falling on the ground is measured by **rain gauges**, usually in the open area (not influenced by vegetation).

Evaporation – can be measured from the free water surface using an **evaporation pan** or from a precisely defined grassland using a **lysimeter**. For other surfaces, evaporation is derived from other measured variables (vertical wind speed, air temperature and humidity).

Water storage in the watershed – is estimated by the **soil moisture observations** and groundwater level measurements in **boreholes**.

Amount of runoff - is derived from the measurements of the water surface level in watercourses (rivers and streams) using e. g. a **water level measurement pole**, **a sensor** or **a limnigraph** at a regulated part of the channel.

Field measurement + Meteorological forecast → *Evaluation of the situation by the model* → *Flood / drought protective measures*

Monitoring of water and energy fluxes as well as finding relations among them serves not only for the forecasting purposes, but also for studying and understanding natural processes related to water. These processes are described in a simplified form by **hydrological models,** i.e. a system of equations solved by a special software. One of the basic models is the rainfall-runoff model, which transforms the volume of rainfall into a runoff. However, hydrological forecast models are much more complex and cover also other processes in the watershed, such as retention, evapotranspiration, or streamflow, as well as subsurface flow.

Inputs for the hydrological forecast model

Watershed characteristics: *Soil properties*, *Slope*, *Land cover*
\+
Initial water storage in the watershed: *Initial water storage in the watershed*, *Soil moisture*, *Snow storage*
\+
Weather forecast: *Precipitation*, *Temperature*

Sensors for measuring shortwave - solar (left) and longwave - coming from the ground (right) radiation. Both sensors are paired so that they can measure both incoming and reflected radiation.

There are about
200 weather** and **600 rainfall stations
in the Czech Republic.
*The **groundwater** level is monitored at approximately **1300 locations.***

25–30 % of rainfall
is captured by the spruce forest (interception) and never reaches the soil surface.

The first continuous measurement
of water surface levels began in 1825. Until then only water level marks of big floods were recorded.

The amount of water
***in the soil profile** is monitored at more than **40 stations** at several depths, **up to the depth of 1 meter**.*

Continuous measurements of air temperature
began in 1775 in Prague (Klementinum). Measurement of precipitation commenced in 1804. Such long observation series are unique in Central Europe.

Evaporation pans – water loss is observed in an exactly defined vessel

In the borehole the groundwater level is monitored automatically using a pressure sensor placed on the bottom or manually via whistles lowered into the borehole (the whistle at the end of the rope makes a sound when touching the surface)

Gauging station (limnigraph) – used for the water surface level monitoring on the adjusted profile

VODA