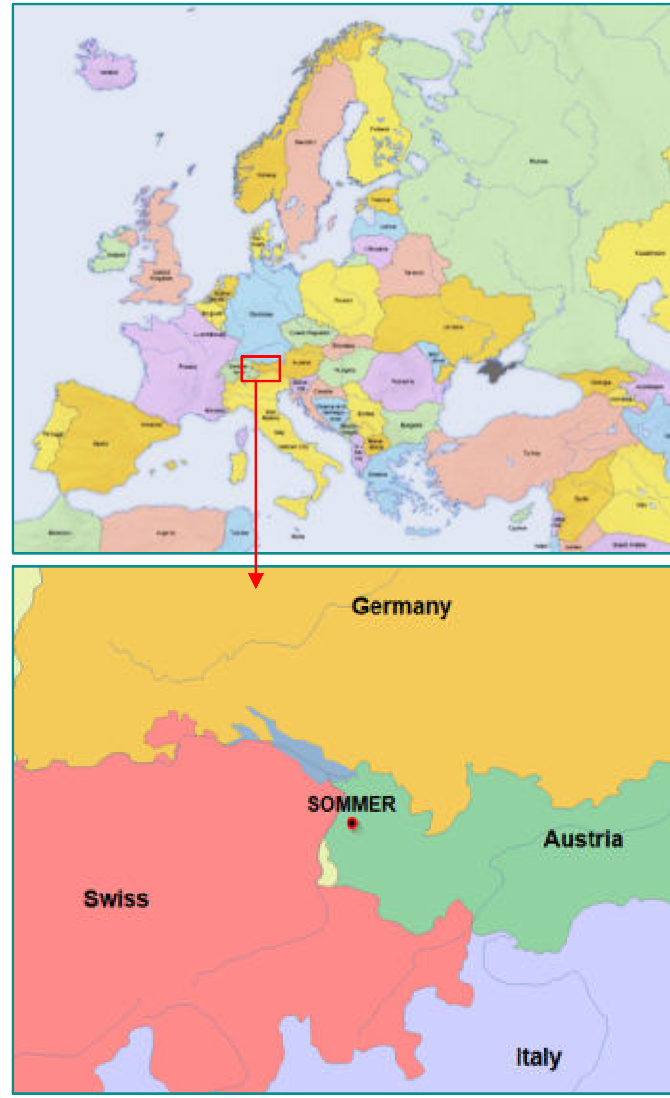
Flow and discharge monitoring

* flood prevention
* distribution management

Introduction

sommer AUSTRIA was founded in year 1987 and is up to date still a family run and owned SME located in the heart of Europa. In the border triangle of Austria, Germany and Switzerland.



3) SOMMER headquarters in western Austria

Areas of activity

Hydrology

Measuring solutions for surface water, rivers, open channels and groundwater

Meteorology

Recording meteorological data for alpine monitoring networks, weather or avalanche warning services with focus of snow and ice measurment

Sewers and industrial water

Non-contact discharge measurement for wastewater, sewage systems and industrial waters

Potential fields of application :

Water distribution

- Prevention of conflicts resulting of water shortage

Problem: Upstream countrys / partys controll downstream countrys

Solution: Regional and cross national monitoring by independent data collection through 3rd party (for example UN)

Flood prevention

- Early knowladge, reaction and warning resulting in prevention / minimising of disasters

Conflict prevention Water distribution

Increased demand of water (agriculture / industry) in combination with the change of weather paten makes the distribution of water even more to a central political focus.

Transboundary waters – the aquifers, and lake and river basins shared by two or more countries – support the lives and livelihoods of people across the world.

In an era of increasing water stress, how we manage these critical resources is vital to promoting peaceful cooperation and sustainable development.

Depleted and degraded transboundary water supplies have the potential to cause social unrest and spark conflict within and between countries.

To deal with the impacts of climate change combined with the demands of increasing populations and economic growth requires a supranational, integrated approach to transboundary water resource management based on legal and institutional frameworks and shared benefits and costs. (*1)

The geographical nature of rivers and watershed basins is another dimension which can affect the relations between countries and communities. As rivers and tributaries run from highlands to lowlands, the upstream use and treatment of water can have consequences for downstream users. Water quality and quantity are at the centre of upstream-downstream disputes.

*1 source UN WATER

How can conflicts be avoided

Monitoring:

Many UN member countries affirmed at the recent meeting the need to tackle water risks in order to prevent crises, but questions remained on how best to do so.

Alongside growing political will, new technologies could help prevent water-driven conflicts. Advances in remote sensing, machine learning and data processing are starting to make it possible for us to predict water-related stress and conflicts ……*3

- **By independent monitoring of Flow/discharge using neutral agency's**
- **Implementing autonomous stations**

*3 source WORLD RESOURCES INSTITUTE

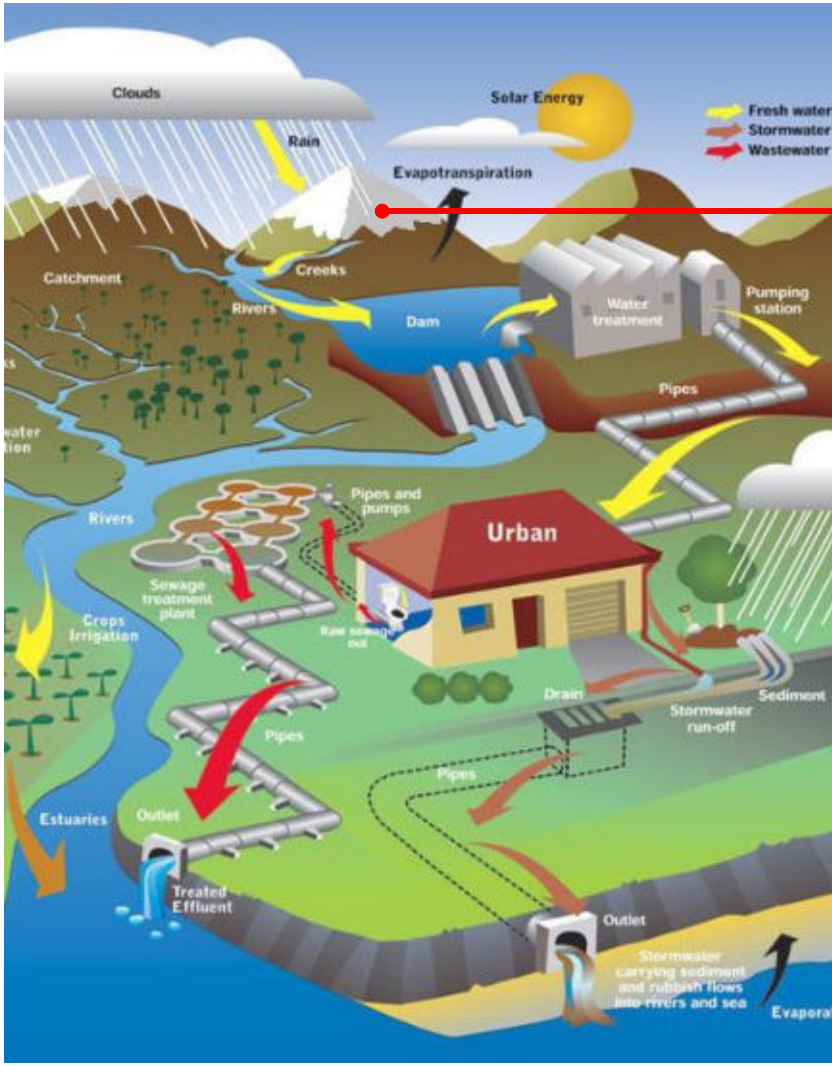
VORARLBERG – AUSTRIA - CATCHMENT AREA

Beginning of the ALPS. Mostly mountainous area. In winter snow covered.
Flood danger if snow melt and rain at the same time

sommer Meteorology

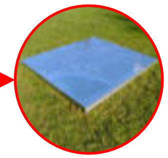
sommer MESSTECHNIK

Our devices can measure:



Snow Depth: USH-9

- ✓ Maintenance free ceramic Membrane
- ✓ Integrated Temp. compensation
- ✓ High power pulse for best results during snowfall

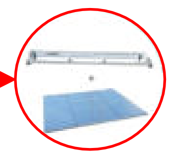


Snow water equivalent (SWE): SSG – Snow scale

- ✓ No antifreeze liquid required
- ✓ Robust aluminum construction
- ✓ Range from 200 to 3000 mm SWE

SWE + ice and water contend: SPA– Snow pack analyzer

- ✓ Prediction of runoff
- ✓ No ice bridging effect
- ✓ SWE, snow-depth, snow density, liquid water and ice contend



Snow melting (Runoff): SMA-Snow melt analyzer

- ✓ Prediction of runoff
- ✓ Simple and easy installation
- ✓ SWE, snow density, liquid water and ice contend close to the ground

Monitor environment: AWS – Automatic Weather station

- ✓ Heavy duty weather station for high alpine areas
- ✓ More than 30 years experience
- ✓ Complete system out of one hand (Steel construction, sensors, software and know how)

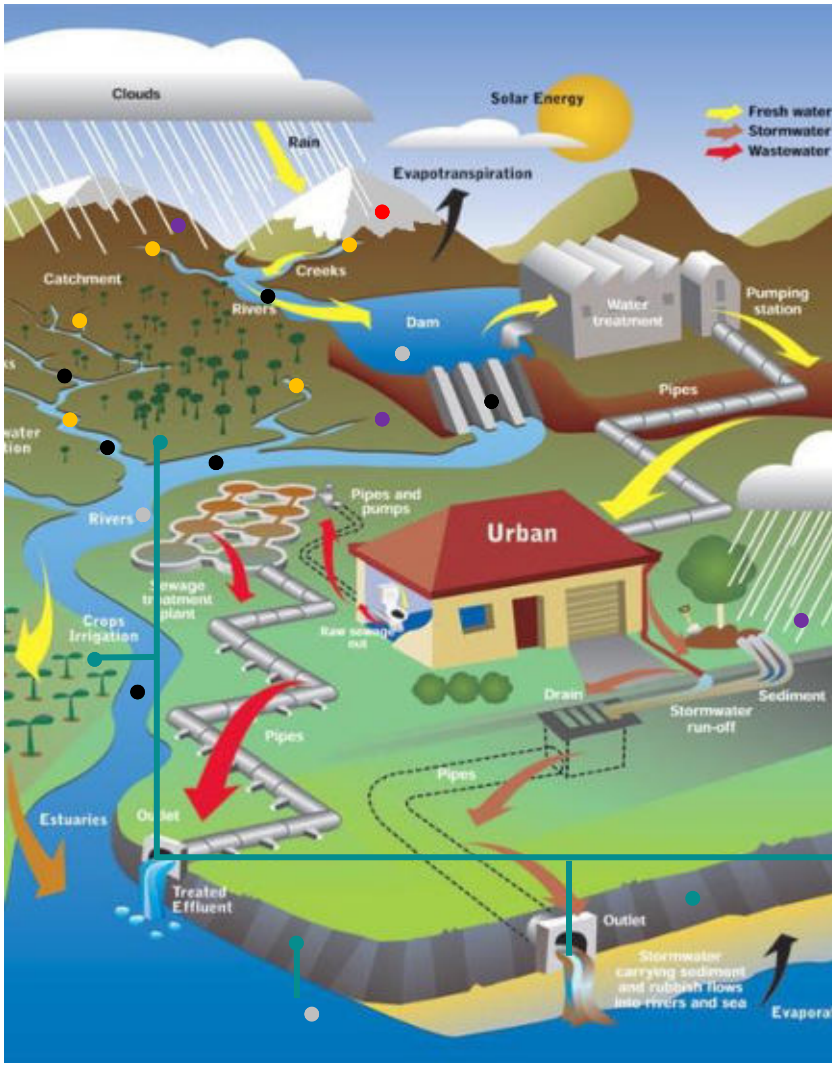
Ice risk detection: IDS 20 – Ice detection sensor

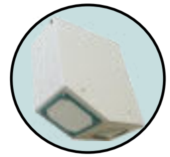
- ✓ Internal plausibility check (dew point/frost point , temp.)
- ✓ Easy integration in existing systems
- ✓ Different sensors for different applications (Airports, Antennas in mountain areas, power lines, wind turbines)

sommer Hydrology

sommer MESSTECHNIK

Our devices can measure:





Discharge measurement for rivers and channels:

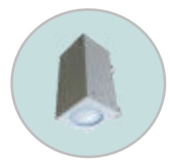
RQ-30

- ✓ Stationary non contact discharge measurement device
- ✓ Maintenance free
- ✓ Measurement 24/7
- ✓ Easy installation /data translation

Flow in open channels irrigation systems:

SQ–Radar

- ✓ Stationary non contact discharge measurement device
- ✓ Maintenance free
- ✓ Easy installation, because outside of the water
- ✓ Easy integration into existing control systems



Water level: RL – 15m / 35m / 75m /120m

- ✓ Non contact
- ✓ Maintenance free
- ✓ Independent of ambient conditions because of radar technology

Discharge mountain rivers: TQ - Tracer

- ✓ Mobile discharge measurement device
- ✓ No cross section needed
- ✓ Validation unit for already installed systems

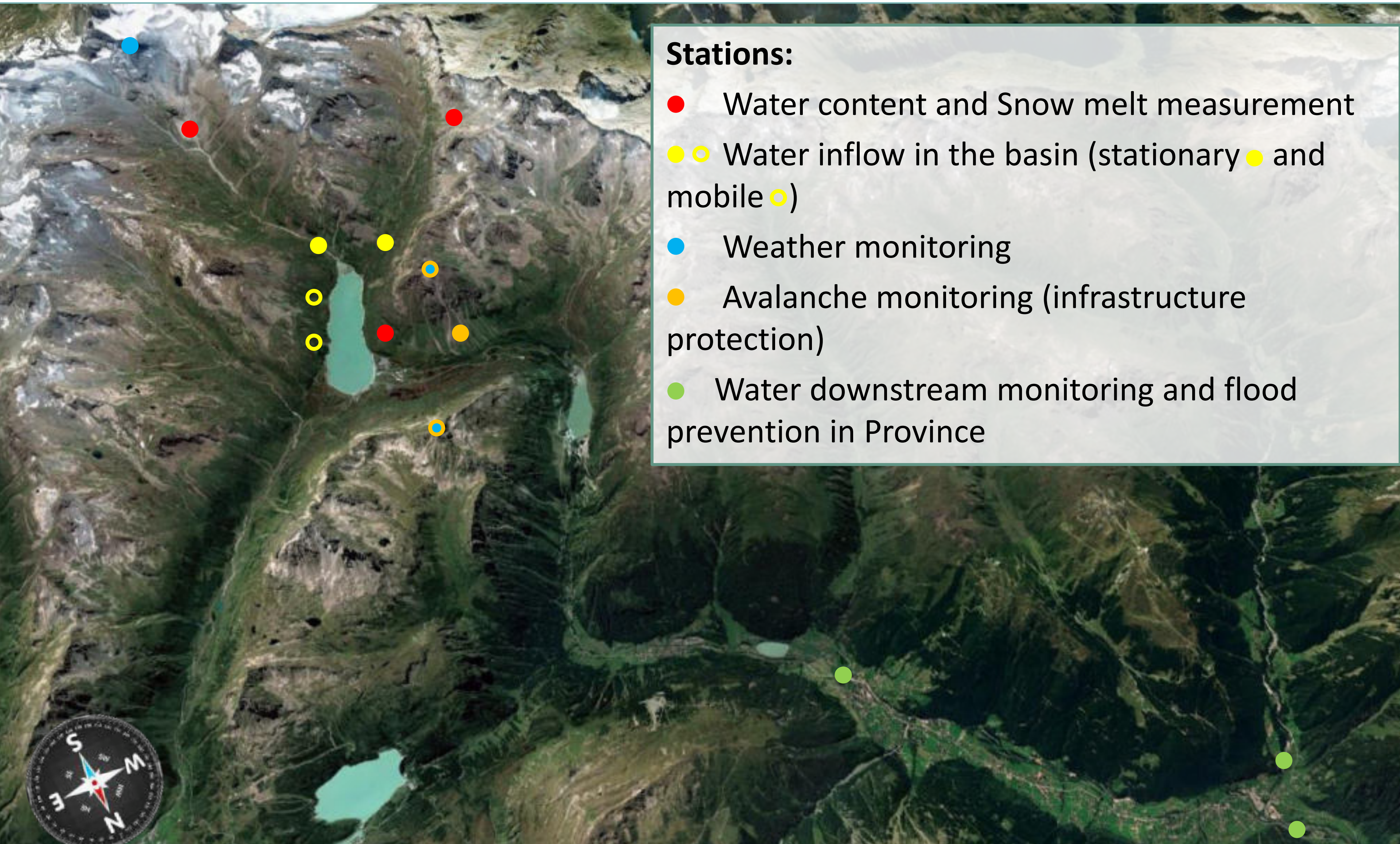
✓ VDM-100 Evaporation Sensor

- ✓ The Vdm-100 outputs a current proportional to the water level
- ✓ and thereby enables to deter- mine the evaporation.
- ✓ High resolution of 0.1 mm
- ✓ High precision by inductive level measurement

River Rhine (AUSTRIA/SWIZERLAND June 2016)

RP-30, © Sommer GmbH 2016

SILVRETTA – EXAMPLE OF CATCHMENT MONITORING

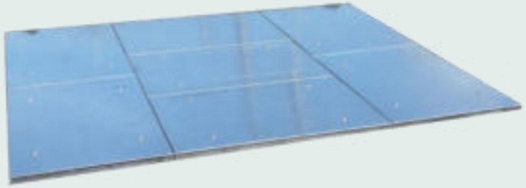


Stations:

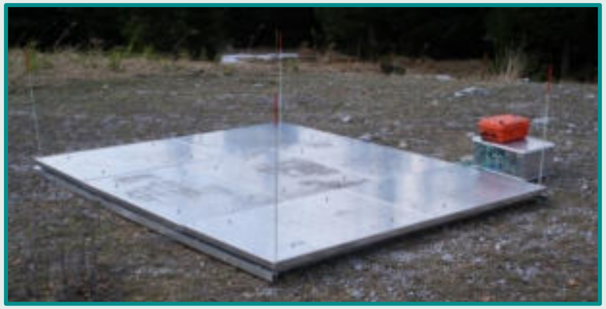
- Water content and Snow melt measurement
- Water inflow in the basin (stationary and mobile)
- Weather monitoring
- Avalanche monitoring (infrastructure protection)
- Water downstream monitoring and flood prevention in Province

WATER CONTENT AND SNOW MELT

SSG-2 Snow scale sensor to measure snow weight



- ✓ Continuous measurement of Snow-Water-Equivalent (SWE)
- ✓ Minimization of ice bridging effects
- ✓ Optimized thermal flow between sensor and ground due to perforated aluminium sheets. Therefore high accuracy during the melting process
- ✓ Robust and long life aluminium construction
- ✓ No antifreeze liquid required
- ✓ Simple system integration
- ✓ No preparation of the measuring site required

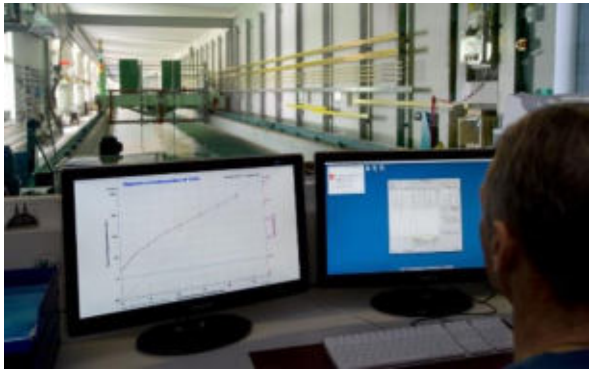


SPA-2 Snow pack analyser

- ✓ Automatic, continuous measurement
- ✓ Energy-saving sensor operation
- ✓ No measurement errors caused by ice layers
- ✓ Possible installation at hillsides
- ✓ Information about
  - the whole snow pack
  - at a specific snow depth level
  - an extended area, by measuring with up to 4 SPA-sensors

Discharge measurement of catchment area

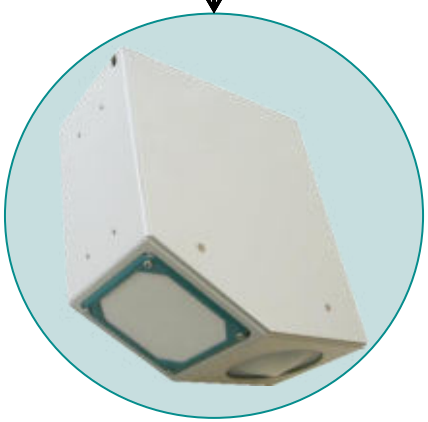
Discharge Measurement



METAS
Federal Office
of Metrology

Non-Contact Radar Sensors

Tracer Dilution Method



Stationary Discharge
Sensor RQ-30

Stationary flow
Sensor SQ-R

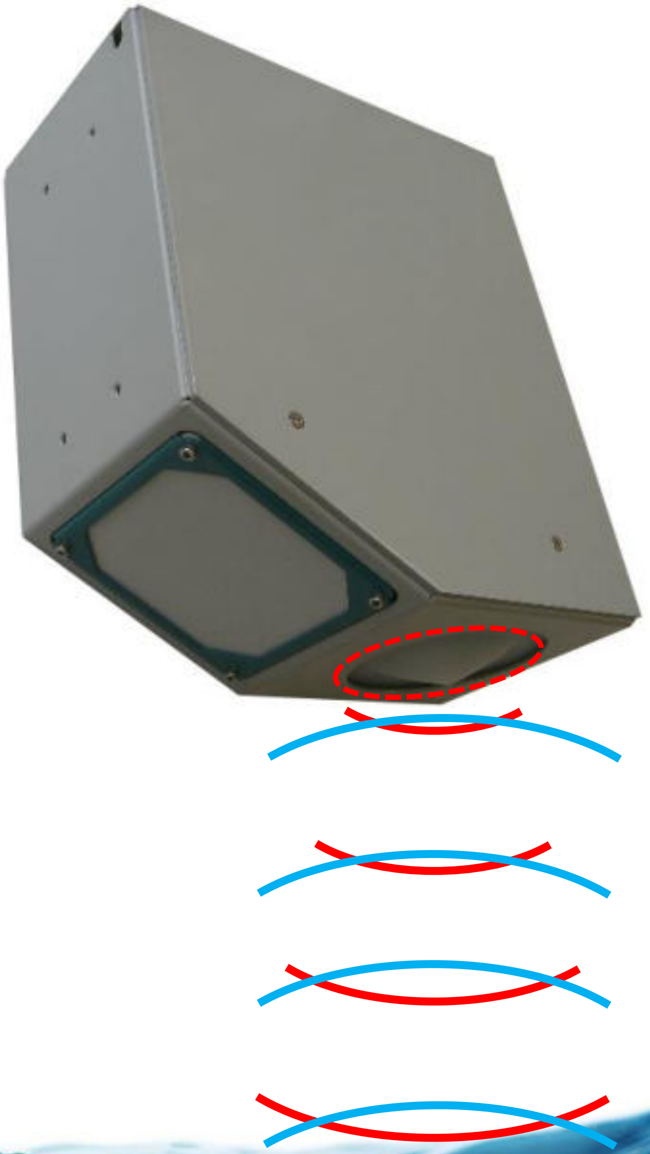
Mobile campaign
Sensor **TQ-S / TQ-F**

RQ-30 WATER LEVEL SENSOR

Water level (stage)

Transit time measurement

- ✓ **Radar** (26 GHz) Vertical to water surface
- ✓ Time between transmitting and reflecting the pulse = directly proportional to the distance
- ✓ **Radar:** independent of air temperature and medium (e.g. foam)



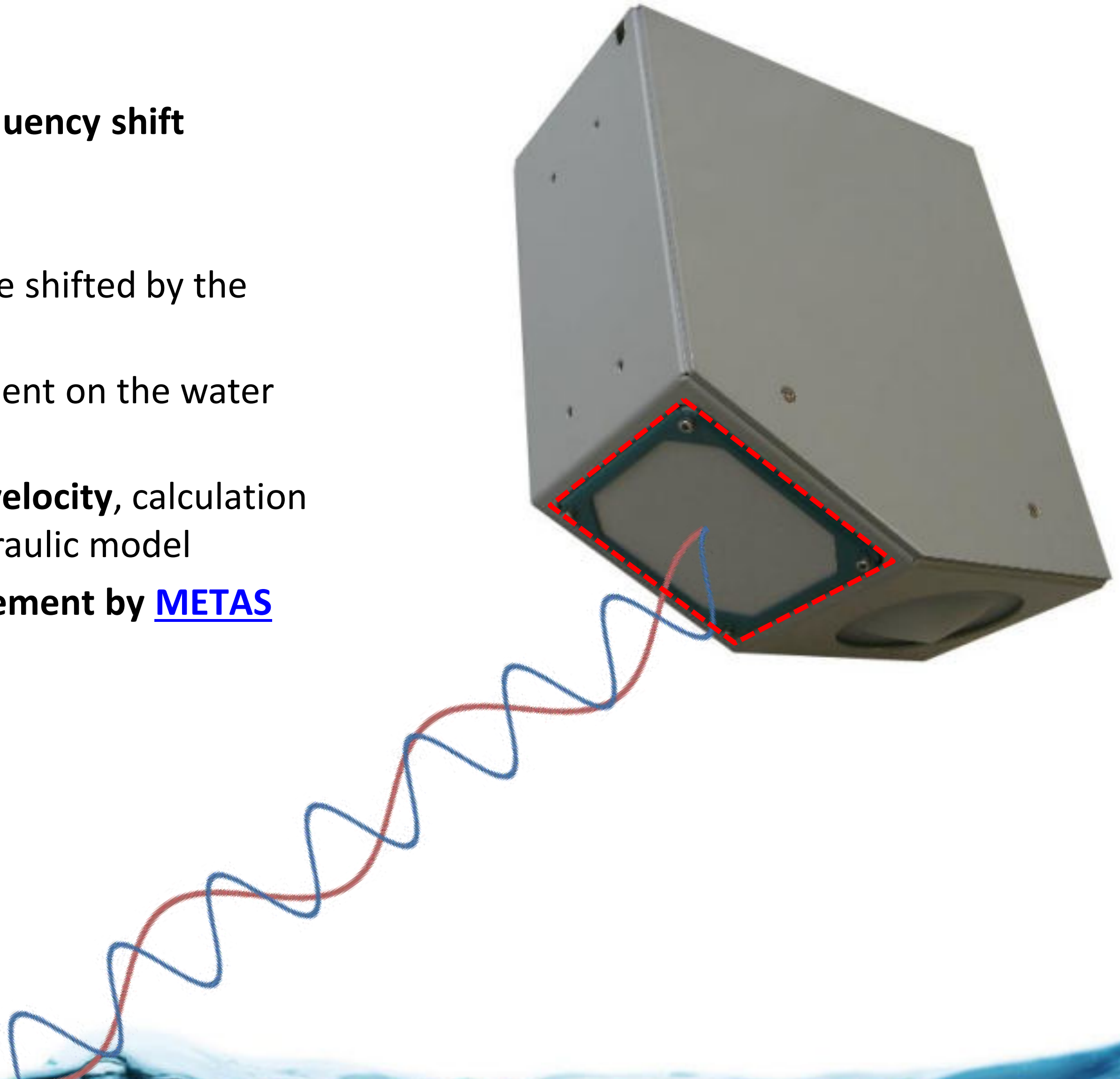
RQ-30 VELOCITY SENSOR

Flow velocity

Measurement of Doppler frequency shift (Doppler Effect)

- ✓ Radar impulse (24 GHz) are shifted by the water surface waves
- ✓ Frequency shift by movement on the water surface (min. swell 3mm)
- ✓ Measurement of **surface velocity**, calculation of mean velocity with hydraulic model
- ✓ **Certified velocity measurement by METAS**

METAS
Federal Office of Metrology



RQ-30 / SQ-Series Measurement Principle

- Continuous measurement
- Determined once at measuring site
- Calculated by RQ-30

Water level h → Cross section A(h)

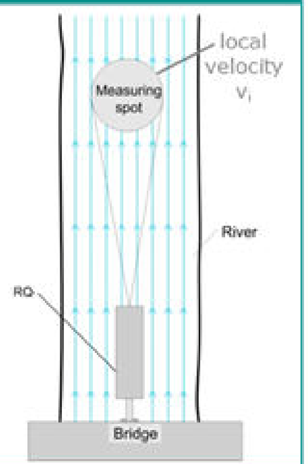
Profile → Cross section A(h)

Local velocity v_i → Mean velocity v_m

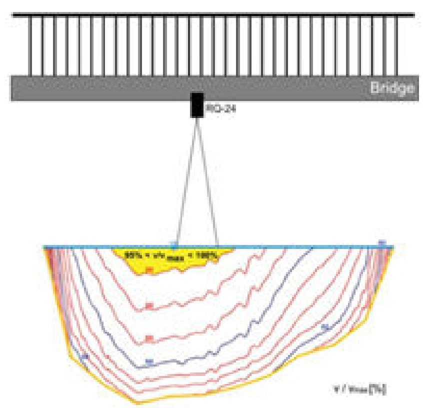
Calibration: factor $k = v_m / v_i$ → Mean velocity v_m

Cross section A(h) + Mean velocity v_m → Discharge Q

1. Measure flow velocity at spot and level



2. Calibration (e.g. Hydraulic model RQ Commander) and discharge calculation in RQ-30



3. Output Discharge Q

e.g. 5.2 m³/s

Continuity equation

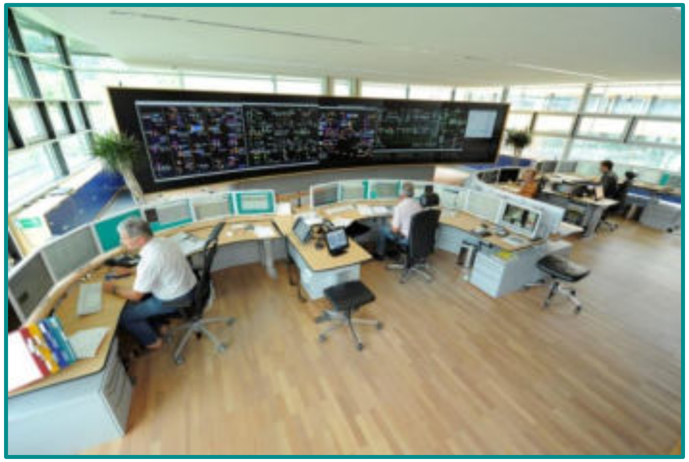
$$Q = v_m \cdot A(h)$$

$$V_m = v_i \cdot k$$

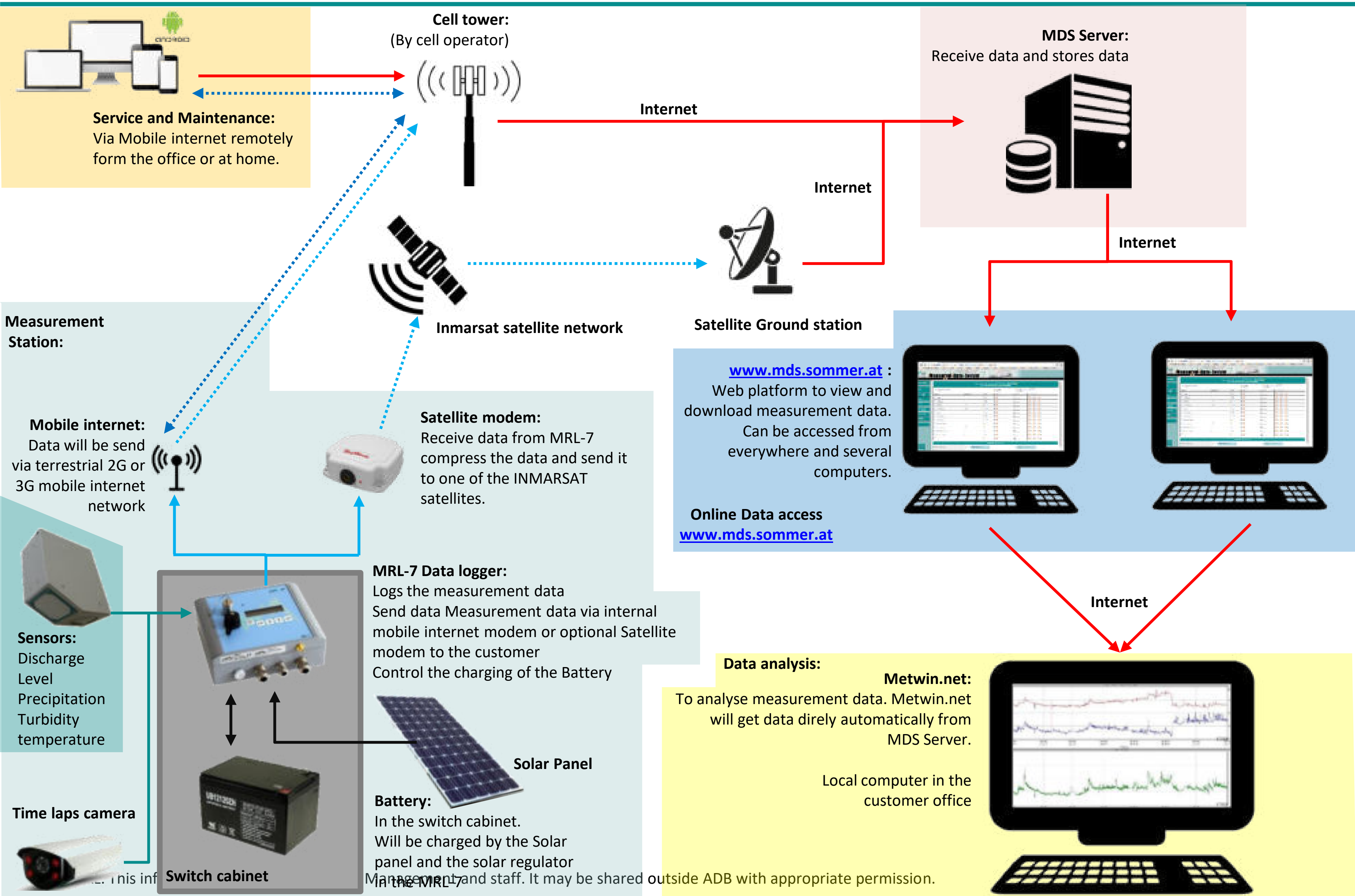
$$Q = A(h) \cdot v_i \cdot k$$

SOMMER – DATA HANDLING

- ✓ Measurement data should be shared
  -between private operator and government and vis versa
- ✓ Data need to available form everywhere for everybody
- ✓ Data need be correct an trustworthy
- ✓ Redundant data transmission in case of emergency
- ✓ Data need to be easy and fast understandable

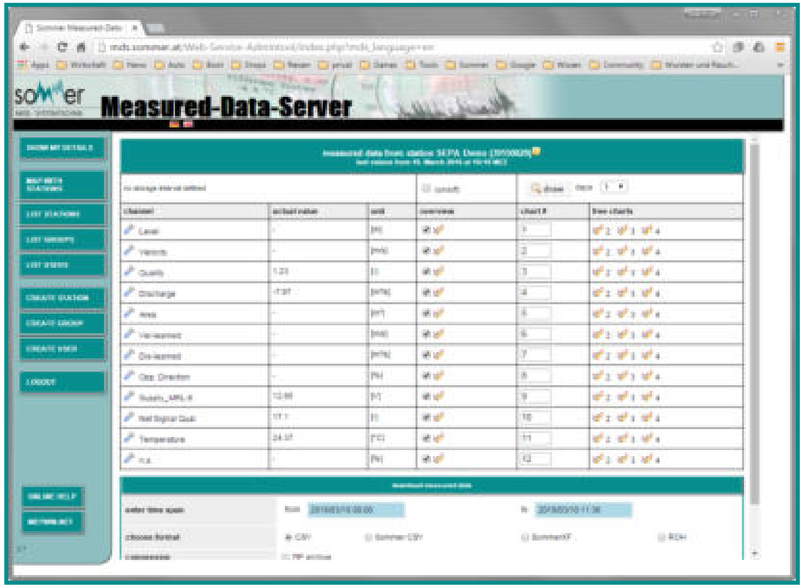


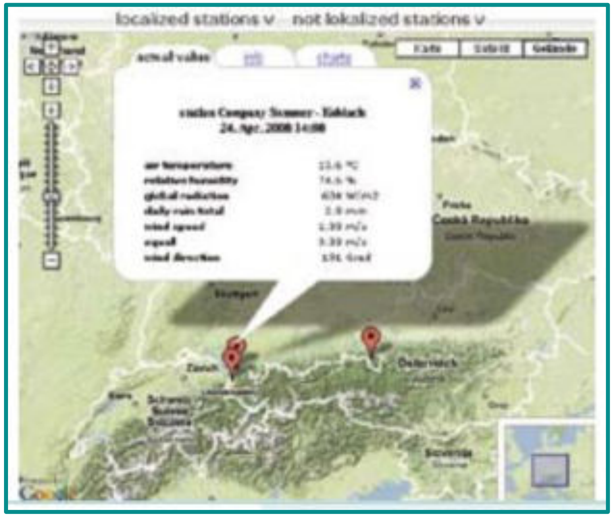
SOMMER – DATA HANDLING

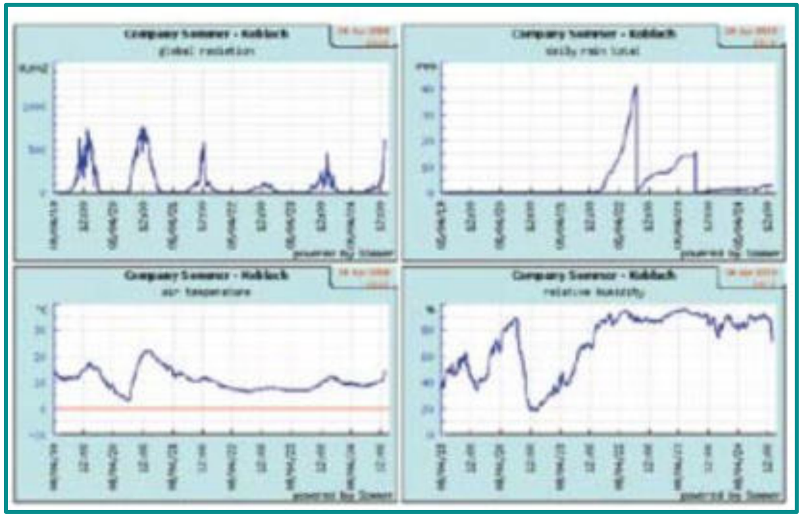


SOMMER – DATA HANDLING – MDS CLOUD

- ✓ **MDS Server (Measured data server)**
  - SOMMER data hosting service
  - easy access to measurement data
  - Easy Graphical visualisation
  - Easy download of data in .csv format
  - 72h Forecasting option (wind, temperature, rain, snowfall)
  - Map with station and colour coding
  - Messaging system when limit over or underrun







WATER INLET AND DOWNSTREAM

It is very important that all information are being centralised and analysed. Only then it is possible to find solutions and make decisions for the region potentially effected.

Optional actions to be taken:

- ✓ Open / Close dams
- ✓ Delay flow (barriers, increase canal width…
- ✓ Redirect flow into designated areas (feelds, forrest canals…
- ✓ Alert civil protection agencys
- ✓ Follow contingency plan procedure






STRATEGIC LONG TERM PLANNING

Flood protection measures are designed against a 100-years flood event

- ✓ Investment in Monitoring (Sensors)
- ✓ River widening
- ✓ Providing Retention Areas
- ✓ Protecting and converting wetlands
- ✓ Centralising data flow
- ✓ Urban planning

TECHNOLOGY IN THE SERVICE OF FLOOD PROTECTION AND ECOLOGY

Flood protection and the ecological melioration of the Ill.

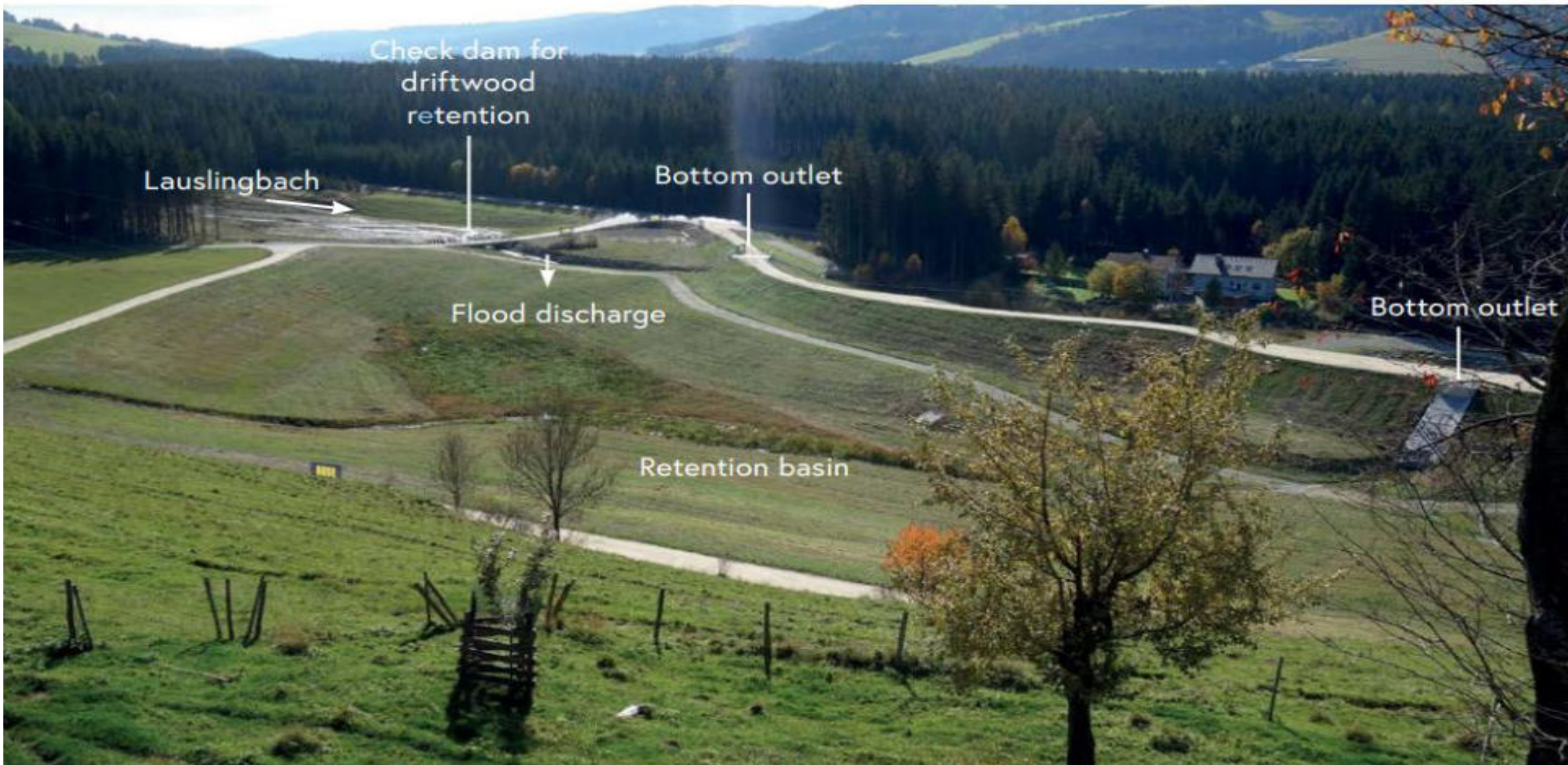
The retention basin is the core element of this effort. During floods, the structure diverts some of the Ill's water into a bordering riparian area 38 hectares large. In four basins, up to 600,000 cubic metres can be stored temporarily, and can be released back into the river after the flood peak has passed.

The system is controlled remotely via a discharge measuring station downstream. The total construction costs, including land acquisitions and the bed ramp, were approximately 10.8 million Euro.

Retention basin Bludesch/ Gais (left image
Thus, protection has been improved for the adjacent settlement area and the downstream channel. At the same time, a bed drop was made fish-passable (right image).

COMBINING LONGITUDINAL MEASURES WITH FLOOD RETENTION.

A flood retention basin combined with longitudinal protective measures proved the best solution for protecting against a 100-years flood.
A gravel trap and a driftwood rack precede the basin.
By now, the structure has been greened and is well-integrated into the landscape.



Good practice: “Rhesi” – Rhine, recreation and safety

On the basis of a treaty from 1892, Austria and Switzerland have been working together successfully at the Alpine Rhine for more than 100 years. The project aims to improve flood protection for over 300,000 people in the lower Alpine Rhine with a investment of approx. 900 Million EURO

“Rhesi” stands for “ (“Rhine, recreation and safety”) The general project for the largest “torrent” in Europe specifies widening the channel by one and a half (photo montage to the right). The implementation is planned for 2023-2043 – a project for generations.

FLOOD MONITORING NETWORK

CASE STUDY:
KINGDOM OF THAILAND

FLOOD WARNING NETWORKS

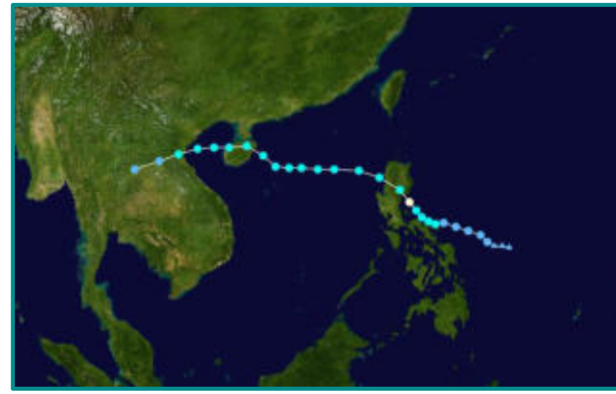
- ✓ Data:
  Population: 68 Mil
  Area: 513.115 km2
  Population Density: 132/km2
- ✓ Climate:
  tropical wet and dry or savanna climate
  influenced by monsoon

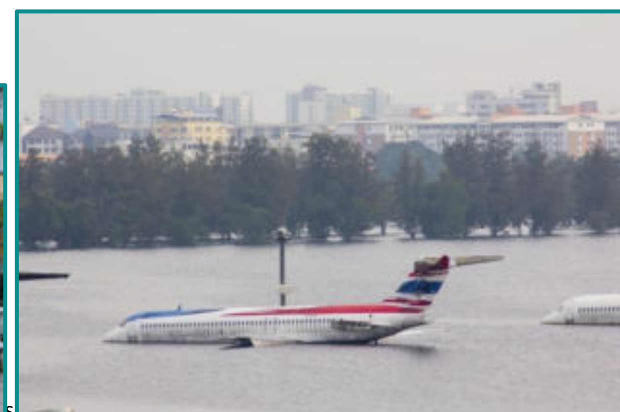
FLOOD WARNING NETWORKS

- ✓ Severe flooding occurred during the **2011 monsoon** season in the **Kingdom of Thailand**. The flooding started in the northern parts of Thailand at the end of July, triggered by the landfall of **Tropical Storm Nock-ten**.

- ✓ In **October**, floodwaters reached the **capital city Bangkok** (population: MetroBKK about **14.Mil people**)
- ✓ Flooding persisted in some areas until **mid-January 2012** (4 month)

- ✓ More than **884 people were killed** and millions of people were left homeless or displaced
- ✓ Economic losses were estimated at **USD 45.7 billion**, which makes this flood one of the top five **most costly natural disasters in modern history**





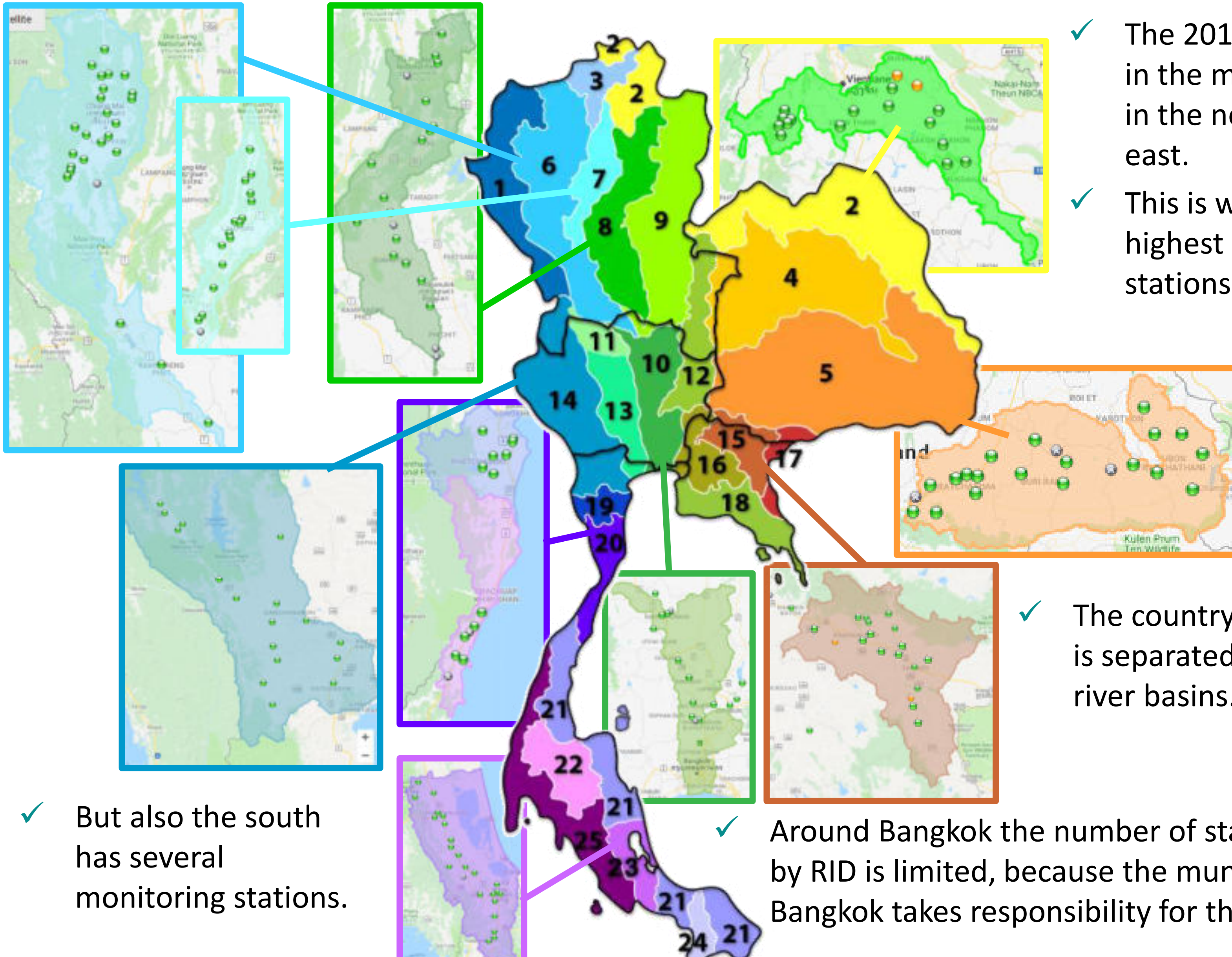
SOMMER RQ-30 – FLOOD WARNING NETWORKS

sommer MESSTECHNIK

ROYAL IRRIGATION DEPARTMENT

- ✓ After this event, the kingdom of Thailand started a project with **several hundred measurement stations** all over Thailand.
- ✓ After an extensive testing, the RID (Royal Irrigation Department) decided to **use the RQ-30** for their Flood monitoring network.
- ✓ In Phase 1, RID installed more than **200 automatic discharge measurement stations** at several rivers.
- ✓ The discharge data of the RQ-30 are collected in the **MRL-7 data logger** and transferred via mobile internet directly to the server of the customer.
- ✓ All stations have **remote access** to the logger via mobile internet and also to the RQ-30. This is most important to support such a huge network of stations.

RQ-30 – FLOOD WARNING NETWORKS



- ✓ The 2011 flood started in the mountain areas in the north and north east.
- ✓ This is where the highest density of stations are located.
- ✓ The country of Thailand is separated into 24 river basins.
- ✓ But also the south has several monitoring stations.
- ✓ Around Bangkok the number of stations operated by RID is limited, because the municipality of Bangkok takes responsibility for this area.

RQ-30 – FLOOD WARNING NETWORKS

- ✓ The Measurement network installed from 2016 to 2017 not only helps to detect floods earlier, it also brings more knowledge to the government.

- ✓ With accurate measurements of flood conditions the government of Thailand knows exactly:
  - How fast floods are developing?
  - What the peak flows are?
  - How fast the flood retreats?

- ✓ With all this information it is much easier to develop the RIGHT strategies to avoid floods.

SOMMER RQ-30 – APPLICATIONS EXAMPLES

ate permission.

Application Examples RQ-30

✓ Different installations

Kazakstan

Singapore

China

RQ-30 - APPLICATIONS

USA

Australia

China

Norway

RQ-30 Discharge sensor applications

sommer MESSTECHNIK

Japan Himekawa River

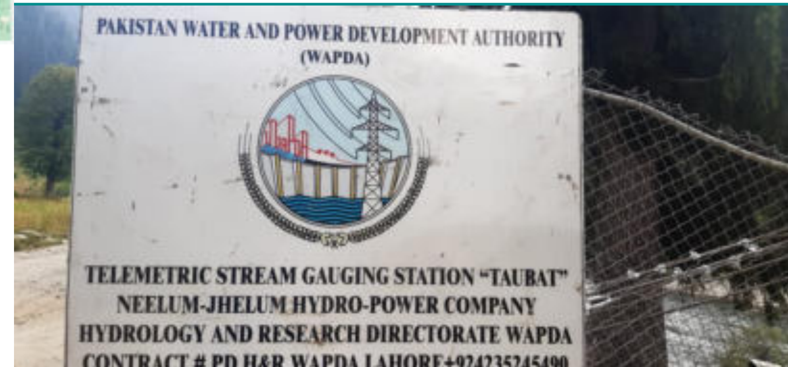
India flood monitoring

Vietnam


Myanmar (Burma)
Thailand
South China Sea
Vietnam
Gulf of Thailand


Afghanistan
Pakistan
India

Pakistan


PAKISTAN WATER AND POWER DEVELOPMENT AUTHORITY
(WAPDA)
TELEMETRIC STREAM GAUGING STATION "TAUBAT"
NEELUM-JHELUM HYDRO-POWER COMPANY
HYDROLOGY AND RESEARCH DIRECTORATE WAPDA

Korea

Indonesia Bandung

Philipines Manila Water

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Thank you for your attention