Roundtable on reinforcing hydrometeorological and water monitoring networks

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Feasibility Study for the information component of the Information and Training Centre for Water (CIFME) in Lebanon - **Validation workshop**

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Food and Agriculture Organization of the United Nations

SEMIDE EMWIS

Water Data

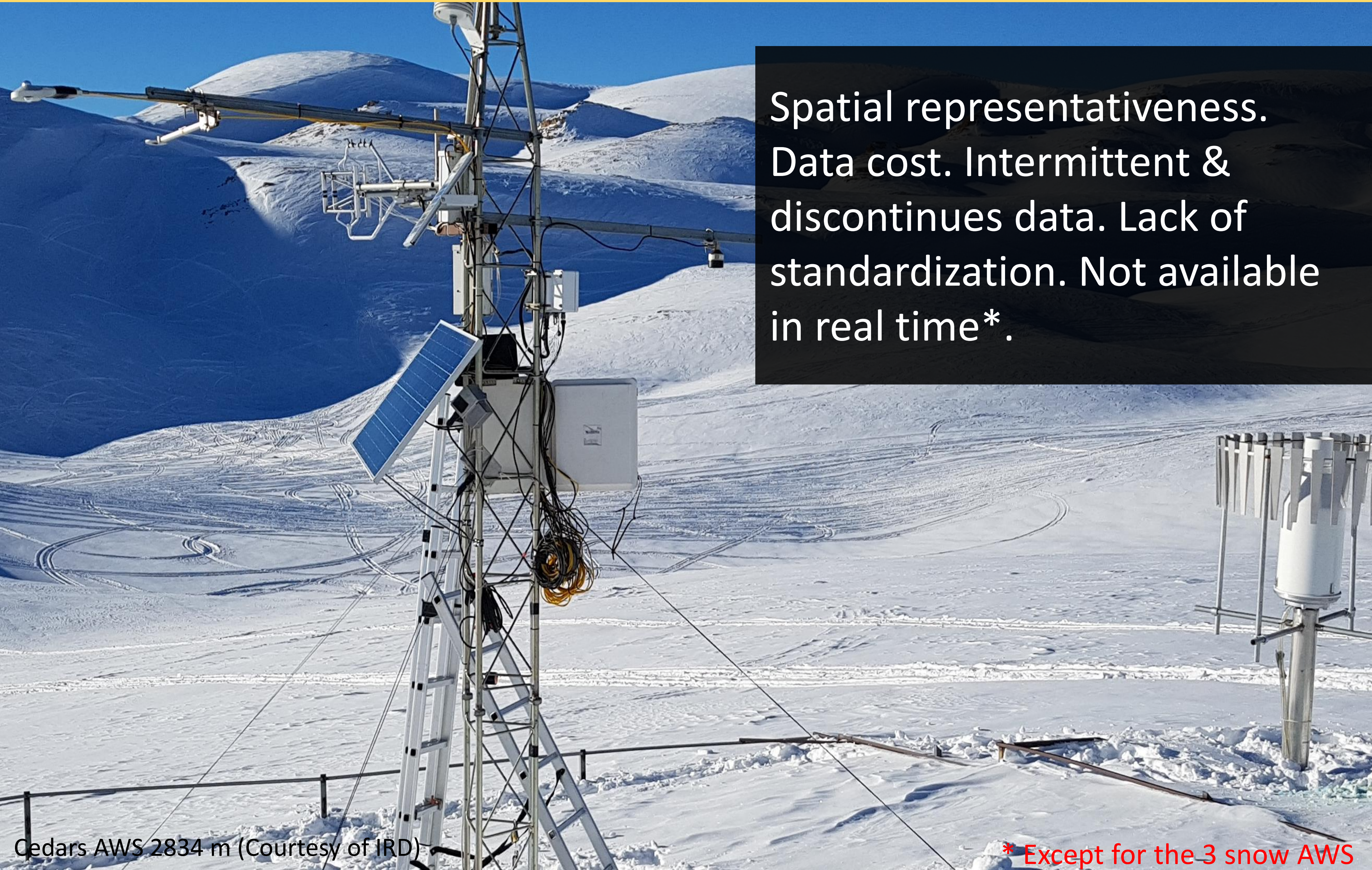
what water data are gathered and at what scales?

- Meteorology
  - Precipitation, snowfall
  - Temperature
  - Humidity, wind speed, etc.
  - Evaporation, soil moisture, evapotranspiration
- Hydrology
  - Stream flows
  - Snow Water Equivalent (SWE)
- Hydrogeology
  - Water wells, water levels
  - Tracer tests, isotope analysis
  - Spring discharge
- Drinking water and water use for agriculture
  - Water supply and water consumption by source and type of users
- Environmental
  - Water quality for groundwater and surface-water
- Hydraulic
  - Structure, systems, pumps, etc.
  - Water reservoirs, dams
  - Water distribution networks, sewer networks

- Continuous data
- Intermittent data
- Inventory data

Challenges of Real-Time Water Data Acquisition and Management

Meteorology



Spatial representativeness. Data cost. Intermittent & discontinues data. Lack of standardization. Not available in real time*.

Cedars AWS 2834 m (Courtesy of IRD)

* Except for the 3 snow AWS

Challenges of Real-Time Water Data Acquisition and Management

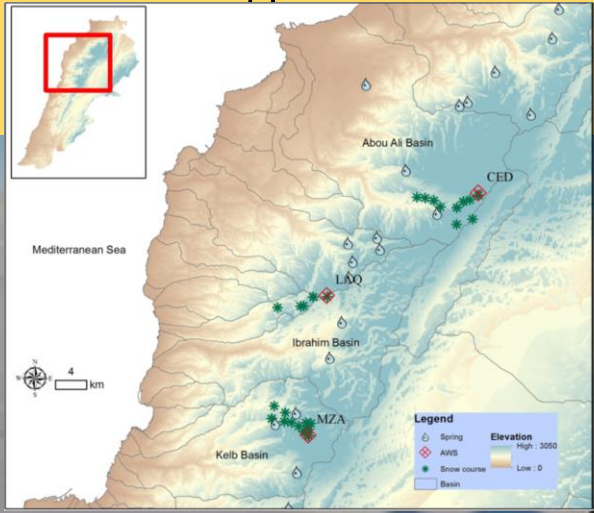
Meteorology

- Weather stations are operated by:
  - Lebanese National Meteorological Service (LNMS);
  - Lebanese Agricultural Research Institute (LARI).
  - Institut de recherche pour le développement (IRD), USJ & CNRS (LB)
- Data most of the time not available in real time;
- Data not freely available (for meteorological data from LNMS);
- Major gap in the time series of meteorological data between 1975 and 1990;
- A limited number of operational weather stations are located in the Mountain regions (elevation > 1000m);
- Number of operational stations:
  - 37 stations operated by the LNMS*
  - 23 stations operated by the LARI*
  - 3 stations operated by IRD/USJ/CNRS
- **Total number of required new stations is 89 of which 20 are snow stations (UNDP, 2014).**

* The number of stations with continuous records is less than the number reported here

Challenges of Real-Time Water Data Acquisition and Management

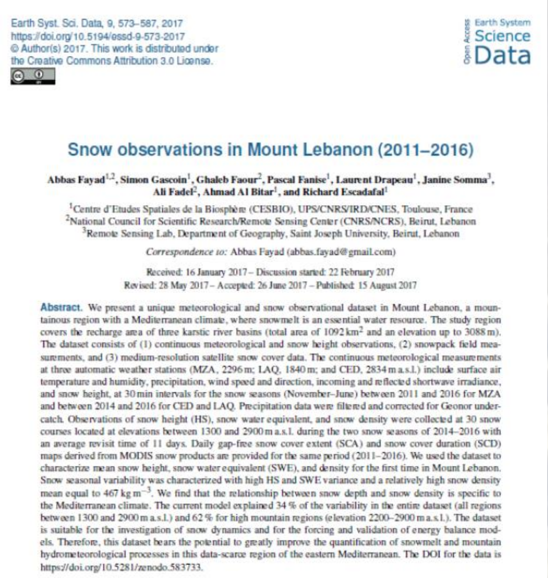
Snow



SWE, snow depth, snow density? their spatio-temporal variability? Field work: cost, planning, and logistics.

Collaboration between CESBIO & IRD (FR), USJ (LB), & CNRS (LB);
3 AWS (1850, 2300, 2850 m);
Fully operational since 2013;
Data freely available at Fayad et al. 2017 (ESSD-2017-3)

Snow density



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Open Access Earth System Science Data

Snow observations in Mount Lebanon (2011–2016)

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Abstract. We present a unique meteorological and snow observational dataset in Mount Lebanon, a mountainous region with a Mediterranean climate, where snowmelt is an essential water resource. The study region covers the recharge area of three karstic river basins (total area of 1092 km^2 and an elevation up to 3088 m). The dataset consists of (1) continuous meteorological and snow height observations, (2) snowpack field measurements, and (3) medium-resolution satellite snow cover data. The continuous meteorological measurements at three automatic weather stations (MZA, 2296 m; LAQ, 1840 m; and CED, 2834 m a.s.l.) include surface air temperature and humidity, precipitation, wind speed and direction, incoming and reflected shortwave irradiance, and snow height, at 30 min intervals for the snow seasons (November–June) between 2011 and 2016 for MZA and between 2014 and 2016 for CED and LAQ. Precipitation data were filtered and corrected for Geonor undercatch. Observations of snow height (HS), snow water equivalent, and snow density were collected at 30 snow courses located at elevations between 1300 and 2900 m a.s.l. during the two snow seasons of 2014–2016 with an average revisit time of 11 days. Daily gap-free snow cover extent (SCA) and snow cover duration (SCD) maps derived from MODIS snow products are provided for the same period (2011–2016). We used the dataset to characterize mean snow height, snow water equivalent (SWE), and density for the first time in Mount Lebanon. Snow seasonal variability was characterized with high HS and SWE variance and a relatively high snow density mean equal to 467 kg m^{-3}. We find that the relationship between snow depth and snow density is specific to the Mediterranean climate. The current model explained 34 % of the variability in the entire dataset (all regions between 1300 and 2900 m a.s.l.) and 62 % for high mountain regions (elevation 2200–2900 m a.s.l.). The dataset is suitable for the investigation of snow dynamics and for the forcing and validation of energy balance models. Therefore, this dataset bears the potential to greatly improve the quantification of snowmelt and mountain hydrometeorological processes in this data-scarce region of the eastern Mediterranean. The DOI for the data is https://doi.org/10.5281/zenodo.583733.

Cedars 2800 m, 12 Jan 2016 (Photo: A. Fayad)

Challenges of Real-Time Water Data Acquisition and Management

Hydrology

Intermittent/discontinues data. Lack of standardization. Not available in real time.

Water monitoring stations (limnigraphs), courtesy of LRA

Challenges of Real-Time Water Data Acquisition and Management

Hydrogeology

Snowfed, karstic system,
lack of monitoring network.

Balaa 1500 m, 20 Feb 2016 (Photo: A. Fayad)

Challenges of Real-Time Water Data Acquisition and Management

Hydrology and Hydrogeology

- Surface and groundwater resources are monitored by the Litani River Authority (LRA);
- LRA is measuring surface water in all Lebanese rivers and springs:
  - Data is reported on daily basis;
  - A number of gauge measurements are reported on monthly basis;
  - Few gauges are located in the snow dominated regions of Lebanon, above 1200m.
- Measuring the level of groundwater via water wells:
  - Limited to the Bekaa and the South of Lebanon;
- The Karst regions, namely the Mount Lebanon and Anti Lebanon, are not monitored:
  - Measurements in the Karst regions are available, for specific regions and over a limited time period, from projects e.g., BGR (2013) and UNDP (2014).

Challenges of Real-Time Water Data Acquisition and Management

Water quality

Colors* of the Lebanese rivers over the past few years (2010-2018). Clockwise from top: Kelb (2018), Litani (2012; permanent), Berdawni (2018), Khardali (2016), & Beirut (2012). *selected #pollution events

Limited water quality monitoring.

Projects Font + - SHARE

Challenges of Real-Time Water Data Acquisition and Management

Water Use and Water Management

Project of desalination plant at Hadath City

11 December , 2016

Project of desalination plant at Hadath City As part of the search for additional water sources, especially since the precipitation is steadily decreasing year after year In addition to the... more

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Study for the project of constructing a reservoir and treatment plant in the Jamhour City and another in the gallery of Samaan City.

11 October , 2015

Study for the project of constructing a reservoir and treatment pl... gallery of Samaan City. As it has been shown that the quality of water in some... more

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New Reservoir Baysor 3000 m 3 and the Jisr Al-Kadi 1000 m

17 August , 2015

New Reservoir Baysor 3000 m 3 and the Jisr Al-Kadi 1000 m Due to the urgent need to build two reservoirs in the areas of Baysour and Jisr Al Kadi for improve the distribution in some... more

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Project of drilling two wells at Siblin and Dmit.

23 August , 2014

Project of drilling two wells at Siblin and Dmit. To ensure the greatest amount of water in the areas of Dmit and Siblin, the Board of Directors approved t... more

Limited information on water distribution networks; limited data on the operations of the utility networks. No water metering in Lebanon.

Agricultural Water Use

TABLE 3
Water use

Source: http://www.fao.org/nr/water/aquastat/countries_regions/LBN/

Water withdrawal			
Total water withdrawal	2005	1 310	10^6 m^3/yr
- irrigation + livestock	2005	780	10^6 m^3/yr
- municipalities	2005	380	10^6 m^3/yr
- industry	2005	150	10^6 m^3/yr
• per inhabitant	2005	366	m^3/yr
Surface water and groundwater withdrawal	2005	1 263	10^6 m^3/yr
• as % of total actual renewable water resources	2005	28	%
Non-conventional sources of water			
Produced wastewater	[illegible]	310	10^6 m^3/yr
Treated wastewater	2006	4	10^6 m^3/yr
Reused treated wastewater	2006	2	10^6 m^3/yr
Desalinated water produced	[illegible]	[illegible]	[illegible]
Reused agricultural drainage water	2001	[illegible]	10^6 m^3/yr

Limited information on irrigated areas. Limited information on water withdrawal for agriculture from all sources (wells, dams, lakes, reservoirs, and facilities).

Conclusion

Water Challenges and Opportunities

- Lack of a comprehensive hydrologic and water data management system at the national scale:
  - Inaccessibility to meteorological, hydrological, and water data in real time;
  - Incompatible data formats;
  - Absence of integrated open source water platform;
  - Fragmented and outdated information regarding water budget and water use.
- Lack of a standardized water data storage
  - Creating computerized water databases;
  - Mapping the locations of water reservoirs, distribution and sewer networks, etc;
  - Gather records on the operations of the utility networks (water supply, waste water treatment plant, water treatment plant, etc.).
- Available meteorological/water data are difficult to sort, fragmented, disjointed, and incomplete, and not fully documented.
  - Increase the collection and sharing of data/information;
    - Meteorological, hydrological, environmental, and water data
  - Need for the quantification of surface and ground water resources
  - The quantification of snowpack contribution in mountains (particularly in Karst)

Conclusion

Water Challenges and Opportunities- Cntd

- Build a data inventory that reviews the existing national data and records;
- Facilitate access to meteorological, hydrological, and water information for the water community;
- Support the development, implementation, and maintenance of a hydrologic/water databases that improve data and information management by adopting a national cataloging standard;
- Advance the understanding of hydrologic and water processes and the related water environment and provide knowledge of the various components of the hydrologic and water resources systems;
- Promote and facilitate the dissemination and use of information technology in the fields of hydrology and water resources.