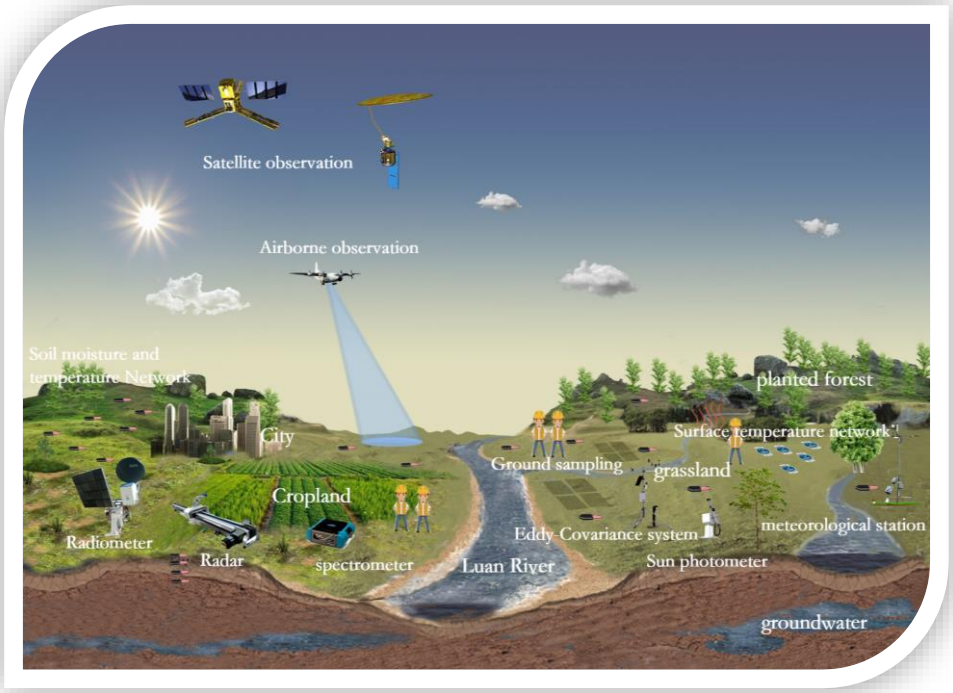
Soil Moisture Experiment in the Luan River



Synchronous observation data set of soil temperature and soil moisture in the upstream of Luan River

User guide

Aerospace Information Research Institute, Chinese Academy of Sciences (CAS)

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1. Abstract

This data set contains the surface temperature, soil temperature, and soil moisture data measured simultaneously during the Soil Moisture Experiment in the Luan River (SMELR) in 2018, which is used as "true value" to validate the remote sensing retrieval. The dataset includes soil moisture (volumetric water content, %) of the surface layer (0-5cm), soil moisture of the deeper layers (5, 10, 20, 40 cm), temperature (℃) of shaded soil, illuminated soil, 5-cm soil, shaded and illuminated vegetation.

The ground synchronous sampling quadrats were distributed in the upstream of Luan River (Shandian River Watershed and Xiaoluan River Watershed), and the sampling time was September in 2018. ML3 soil moisture sensor, TR-52i temperature sensor, soil ring sampler were used for measurement. The sampling scheme of Large Quadrat--Small Quadrat--Sampling Location was adopted to obtain data.

2. Instruments

2.1 introduction of instruments

The instruments used in the ground soil temperature and soil moisture measurement include: ML3 portable soil moisture meter, soil ring sampler and TR-52i external probe temperature recorder. The instruments are described below:

(1) ML3 soil moisture sensor: ML3 is FDR (Frequency Domain Reflectometry) type sensor. The soil moisture probe can be inserted into the soil, and the soil moisture value can be measured rapidly. Its specifications are shown in the table below:

Table 1 Specifications of ML3 soil moisture sensor

Soil Moisture Range	0 to 0.5 m^3/m^3
Accuracy	± 0.01 m^3/m^3 (1%)
Salinity Range	50 to 500 mS/m (Salinity errors < 0.035 m^3/m^3)
Output	0 to 1.0 V Resistance 5.8Ω to 28Ω for temp sensor
Temperature Range	0 to 40℃
Temperature Accuracy	±0.5℃（0～40℃）
Power Requirement	5-14 V, ~18 mA for 1s Minimum 5.5 V with 100 m cable
Operating Environment	IP68 (-40 to +70°C)

(2) soil ring sampler： The soil sample tool and aluminum box were used to obtain the undisturbed soil, and the soil moisture was measured, which was used to calibrate the FDR observation. At the same time, the soil sample is used to analyze soil texture

and bulk density；

(3) TR-52i temperature sensor: This instrument is a small and strong temperature measuring instrument with rainproof structure, which is composed of a host and an external probe. Its specifications are shown in the table below:

Table 2 Specifications of TR-52i temperature sensor

Measurement Channel	1 Temperature Channel (external)
Range	-76 to 311°F (-60 to 155°C)
Measurement Accuracy	Average ±0.5°F from -4 to 176°F (±0.3°C from -20 to 80°C) Average ±0.9°F from -40 to -4/176 to 230°F (±0.5°C from -40 to -20°C/80 to 110°C)
Measurement Resolution Display	0.1°
Recording Capacity	16,000 Readings x 1 Channel
Measurement method	Endless loop method (Overwrite from the oldest data when recording capacity is full) One-time Method (Stop recording when recording capacity is full)
Recording Interval	1,2,5,10,15,20,30 seconds 1,2,5,10,15,20,30,60 minutes (15 variations)
Operating Environment	-40 to 176°F (-40 to 80°C)

2.2 data preprocessing and calibration

Volumetric soil moisture content (SMC) were measured with the ML3 probes, and were preliminarily calibrated by soil samples results from the oven drying (thermogravimetric) method. The comparison shown in Fig. 1 suggests a strong correlation between FDR measurements and thermogravimetric values. The correlation coefficient is 0.834. The preliminary calibration function (Zhao et al, 2020) is:

$$SMC_V = 0.8391 * SMC_{ML3} + 0.028$$

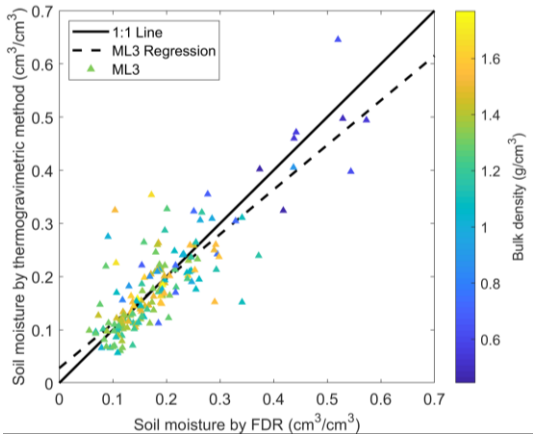

Fig 1 Comparison of thermogravimetric and FDR soil moisture measurements

3. Data

3.1 data sampling scheme

A total of 8 times of data sampling were carried out, including 7 times in the north-south flight region (20180916, 20180917, 20180918, 20180919, 20180924, 20180925, 20180926), and 1 time in the north-west flight region (20180920). The synchronous measurement of soil temperature and soil moisture uses the sampling scheme of large quadrat--small quadrat--sampling location, as shown in the figure below. There are 30 large quadrats in the flight region of 70 km × 12 km, and 20 large quadrats in the flight region of 165 km × 5 km. The size of the large quadrat is 1×2 km, and there are 5 small quadrats with size of 200×200 m in each large quadrat. In each small quadrat, there are 5 sampling locations, and soil moisture is observed 3-6 times with handheld device (FDR) at each sampling location. Temperature is measured at shaded soil, illuminated soil, 5-cm soil, shaded and illuminated vegetation. In each small quadrat, one of the sampling locations was selected to obtain the soil sample using the soil sample tool, then the soil moisture content was obtained by oven drying method in the room for FDR calibration. Data are uncalibrated original volumetric water content.

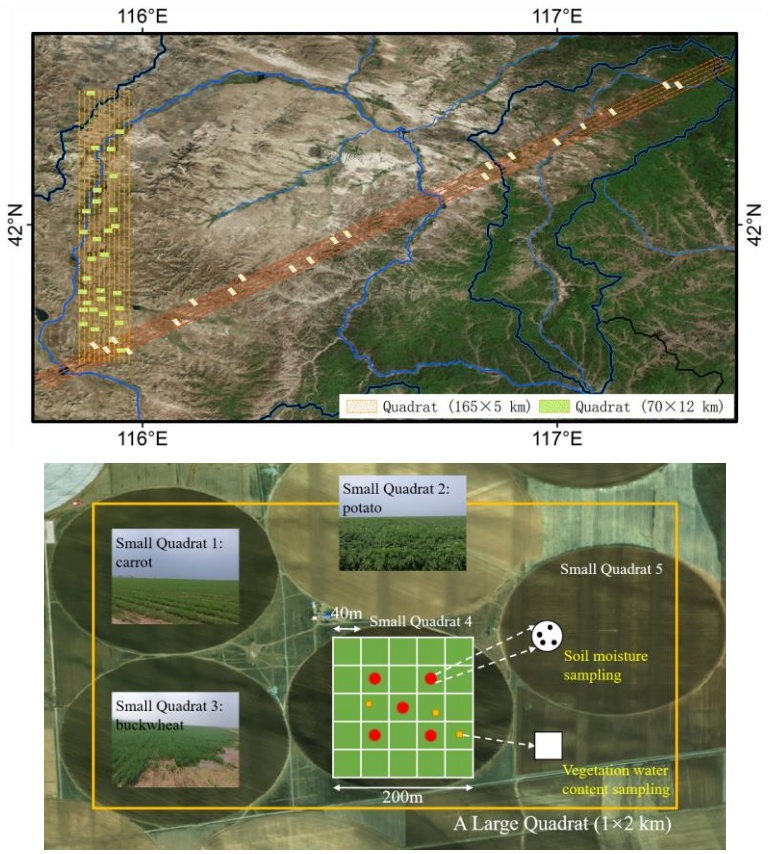

Fig 2 Flight lines and ground sampling strategy within a large quadrat(1 km×2 km)

3.2 data specification

(1) file name:

The soil moisture data file is: AirborneEx_Soil_Moisture.xls;

The soil temperature data file is: AirborneEx_Soil_Temperature.xls;

The soil moisture at deeper layers data file is: AirborneEx_Soil_Moisture_Deeper_Layers.xls

(2) data sampling time: from 2018-09-16 to 2018-09-26

(3) file content: Each file contains eight sheets, sheet name is the observation date of the data, for example "20180916". The data fill value is -999.

4. Data measurement team

The specific division of labor of the main relevant personnel is shown in the following table.

Table 3 Flight Synchronous Soil Temperature and Moisture Measurement Team

ID	Leader	Member	Task
1	Qian Cui	Zushuai Wei, Zhiming Hong, Fengmin Hu	01、02、03 quadrat
2	Jianwei Ma	Peng Zhu, Siyuan Gao, Zhen Hao, Zhenyan Yi, Yayong Sun	04、05、06 quadrat
3	Tianjie Zhao	Panpan Yao, Ziqian Zhang, Deyuan Geng	07、08、09 quadrat
4	Chaolei Zheng	Yanmin Yin, Qiuxia Xie, Yuan Cheng, Gang Yang, Hao Zhong, Song Wu	10、11、12 quadrat
5	Linna Chai	Xiaojing Liu, Jin Liu, Haoyu Wang, Jie Zheng, Beibei Yang	13、14、15 quadrat
6	Lingmei Jiang	Jian Wang, Jianwei Yang,Yifeng Peng, Xiaozheng Du, Jiacheng Zhao, Qian Zhou	16、17、18 quadrat
7	Hui Lu	Yishan Li, Shaoqiang Ni	19、20、21 quadrat
8	Wei Zhao	Wei Wang, Juelin He	22、23、25 quadrat
9	JianjunWu	Jianhua Yang, Feng Tian	24、26、28 quadrat
	Na Yang	Yongqiang Chen,Shaobo Xu, Xin Hu	24、26、28 quadrat
10	Haishen Lv	Xiaoyi Wang, Chen Liu	27、29、30 quadrat
11	Jinmei Pan	Mingyu Liu	Data Summarization

5. Data keywords

Theme keywords: soil moisture; soil temperature

Location keywords: the Luan River watershed; the Shandian River watershed; the Xiaoluan River watershed

Temporal Keyword: 2018

Discipline keywords: Remote sensing; Hydrology; Soil science

6. Data Citation

Zhao, T., Yao, P., Cui, Q., Jiang, L., Chai, L., Zheng, C., Lu, H., Ma, J., Lv, H., Wu, J., Zhao, W., Yang, N., Li, Y., Pan, J., Liu, M., Wei, Z., Zhang, Z., Wang, J., Yang, J., Liu, X., Liu, J., Yin, Y., Li, Y., Ni, S., Zhu, P., Hong, Z., Wang, X., Liu, C., Yang, J., Tian, F., Wang, W., He, J., Chen, Y., Xu, S., Cheng, Y., Gao, S., Hao, Z., Yi, Z., Wang, H., Hu, X., Peng, Y., Du, X., Hu, F., Sun, Y., Geng, D., Yang, G., Zhong, H., Wu, S., Zheng, J., Yang, B., Zhao, J., Zhou, Q. (2021). Synchronous observation data set of soil temperature and soil moisture in the upstream of Luan River (2018). National Tibetan Plateau Data Center.

7. Reference

[1]. Zhao, T.J., Shi, J.C., Lv, L.Q., Xu, H.X., Chen, D.Q., Cui, Q., Jackson, T.J., Yan, G.J., Jia, L., Chen, L.F., Zhao, K., Zheng, X.M., Zhao, L.M., Zheng, C.L., Ji, D.B., Xiong, C., Wang, T.X., Li, R., Pan, J.M., Wen, J.G., Yu, C., Zheng, Y.M., Jiang, L.M., Chai, L.N., Lu, H., Yao, P.P., Ma, J.W., Lv, H.S., Wu, J.J., Zhao, W., Yang, N., Guo, P., Li, Y.X., Hu, L., Geng, D.Y., & Zhang, Z.Q. (2020). Soil moisture experiment in the Luan River supporting new satellite mission opportunities. Remote Sensing of Environment, 240. https://doi.org/10.1016/j.rse.2020.111680.

8. Disclaimer

(1)This data is generated by the "Soil Moisture Experiment in the Luanhe River" under the framework of the "Comprehensive Remote Sensing Experiment of Carbon Cycle, Water Cycle and Energy Balance". Data users should clearly indicate the source of the data and the author of the data in the research results generated by using the data (including published papers, articles, data products, and unpublished research reports, data products and other results). For re-posting (second or multiple releases) data, the author must also indicate the source of the original data.

(2)The data provider shall not be liable for any direct, indirect, special, incidental or consequential losses caused by the use (or inability to use) of this data.

(3)The data is only for users for academic research purposes, and is prohibited for other purposes such as commercial use. The data is not allowed to be transferred to any third party, and all consequences arising therefrom shall be borne by the data user.

(4) Users are encouraged to communicate directly with data producers for problems or questions that arise during the data usage.。

9. Contacts

Name: Tianjie Zhao, Panpan Yao

Affiliations: Aerospace Information Research Institute, Chinese Academy of Sciences (CAS)

Address: Datun Road Num 20A, Chaoyang District, Beijing, China

Zip code: 100101

E-mail: zhaotj@aircas.ac.cn； yaopp@radi.ac.cn

Phone: +86-010-64807983