

Reconstruction of past precipitation in the northwestern China by using archive data of Qing Dynasty

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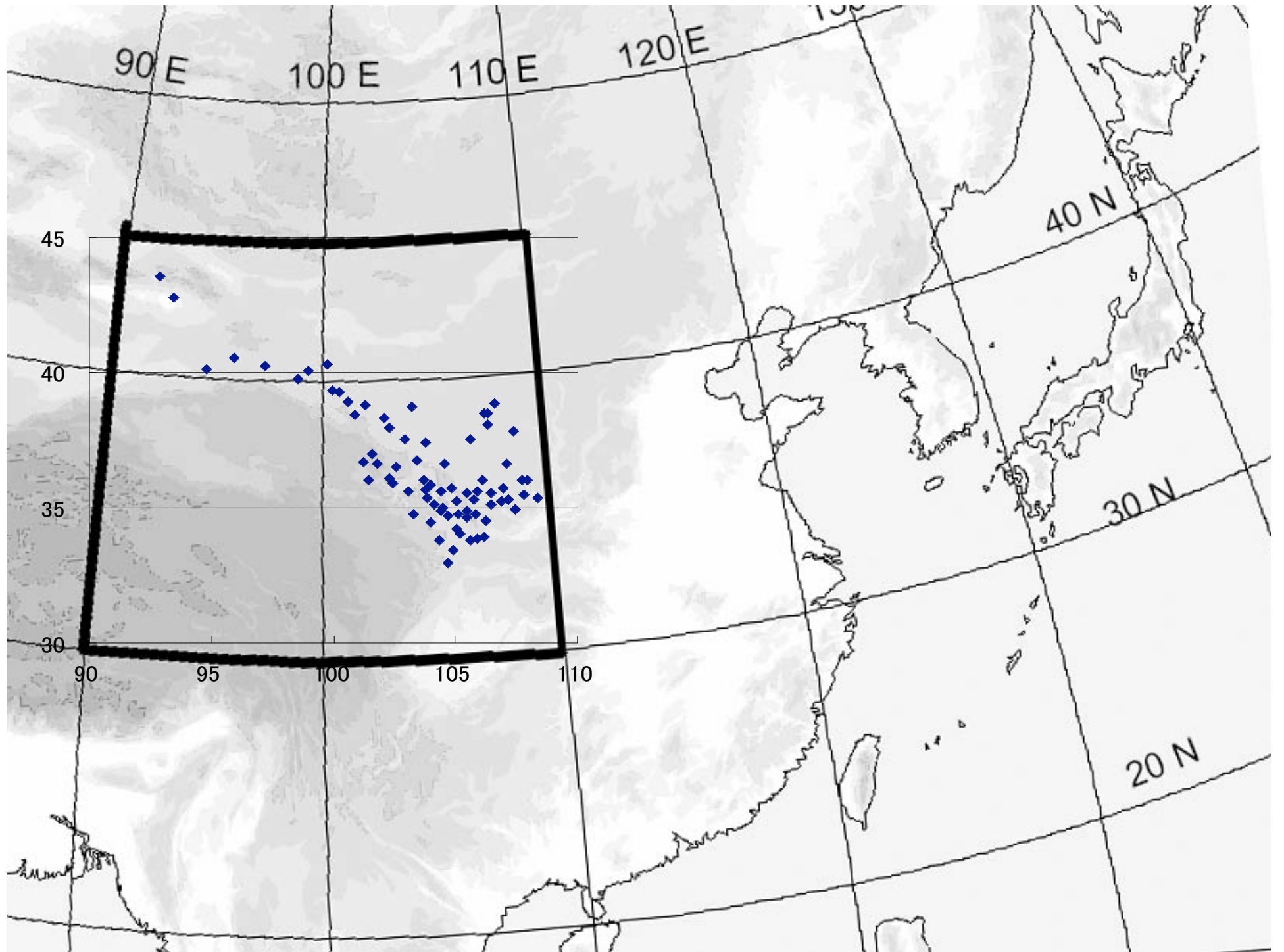
Vast amount of precipitation records were found at the First Historical Archives of China

In the activity of the research project, *Historical evolution of adaptability in an oasis region to water resource changes (2001-2007)*, funded by RIHN, Japan, we collected vast precipitation reports at the First Historical Archives of China, Beijing. Images taken to micro-films amount to **150 books of 150 pages.**



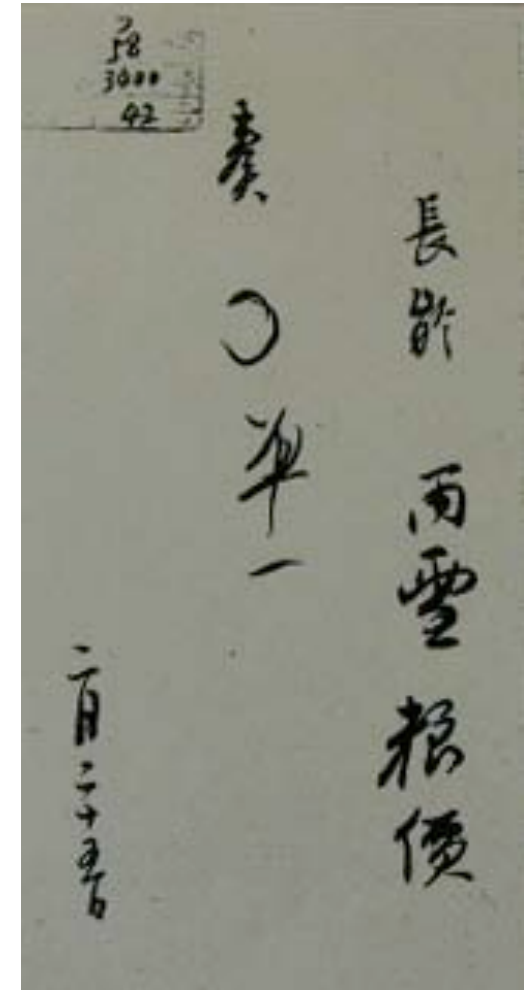
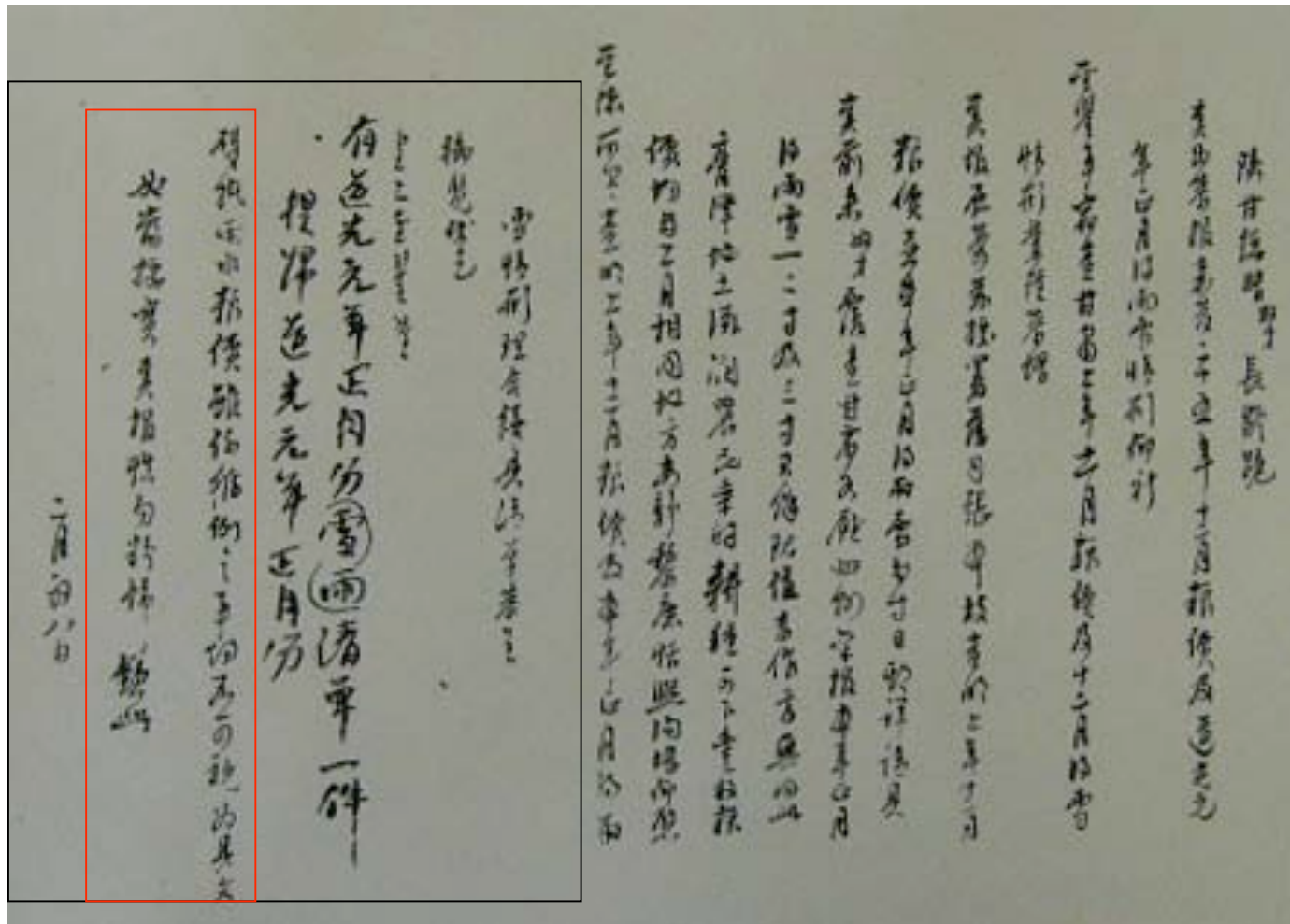
First Historical Archives of China, Beijing

The coverage of rain and snow records extend between 1707 and 1911. Time resolution of the data is daily.



「清代甘肅地区生態環境档案」

中国第一歴史档案馆所蔵の「宮中漢文硃批奏摺」(康熙朝、雍正朝)、「軍機処漢文録副奏摺」(乾隆朝～道光朝まで)から2003年2月に作成。



The emperor himself made a comment on the report, mentioning the importance of the data

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Red Memo: Although reporting of precipitation depth and food prices are a part of routine works, they must be carried out with great responsibility They must be reported honestly without manipulation.

Emperors of Qing Dynasty (1694-1911) were aware of the importance of precipitation data !

乾隆25年(1760)

	Gaolan County	He Zhou
July	the 7 th Rain 5 inches	Rain 3 inches
	the 12 th Rain 5 to 6 inches	Rain 4 inches
	the 20 th Rain 1inch	Rain 3 inches
	the 28 th Rain 3 to 4 inches	Rain 5 inches
	the 29 th Rain 3 to 4 inches	Rain 5 inches

Annual precipitation is about 3 inches at these sites at present. The recorded numerical figures are, hence, too large, if they are the figures for precipitation amount measured by the conventional method.

How was the precipitation measured ?

A rain gauge introduced in Korea



Iron made rain gauge with cylindrical shape: the height and the diameter of 42.5cm and 17.0 cm respectively.

At local sites, they can be made with pottery of China.

Measurements by precipitation gauges, however, arrived much later in China than Korea.

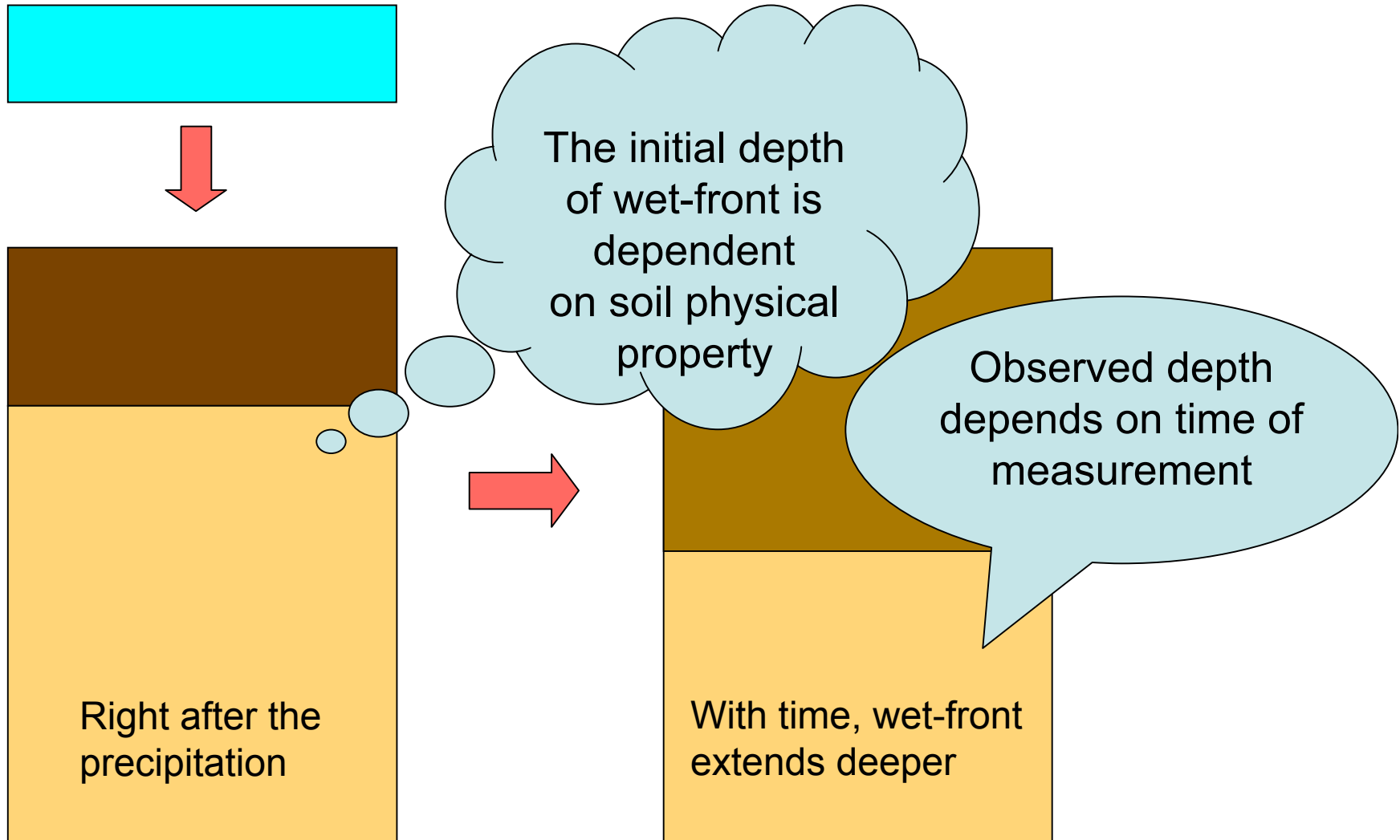
We have found the following description in official documents.

- 二十一日雞鳴時,雨瀟瀟一陣云云,掘土觀之,有一寸濕土
- On the 21st, when cocks crowed, it started rain. One inch of soil was found wet, when we examined, having digged the soil.
- 二十二日夜半,降大雨一次,復降一陣細雨云云,掘土觀之,有一寸濕土
- At the midnight of the 22nd, a strong rain came, followed by a series of fain rain. One inch of soil was found wet, when we examined, having digged the soil.

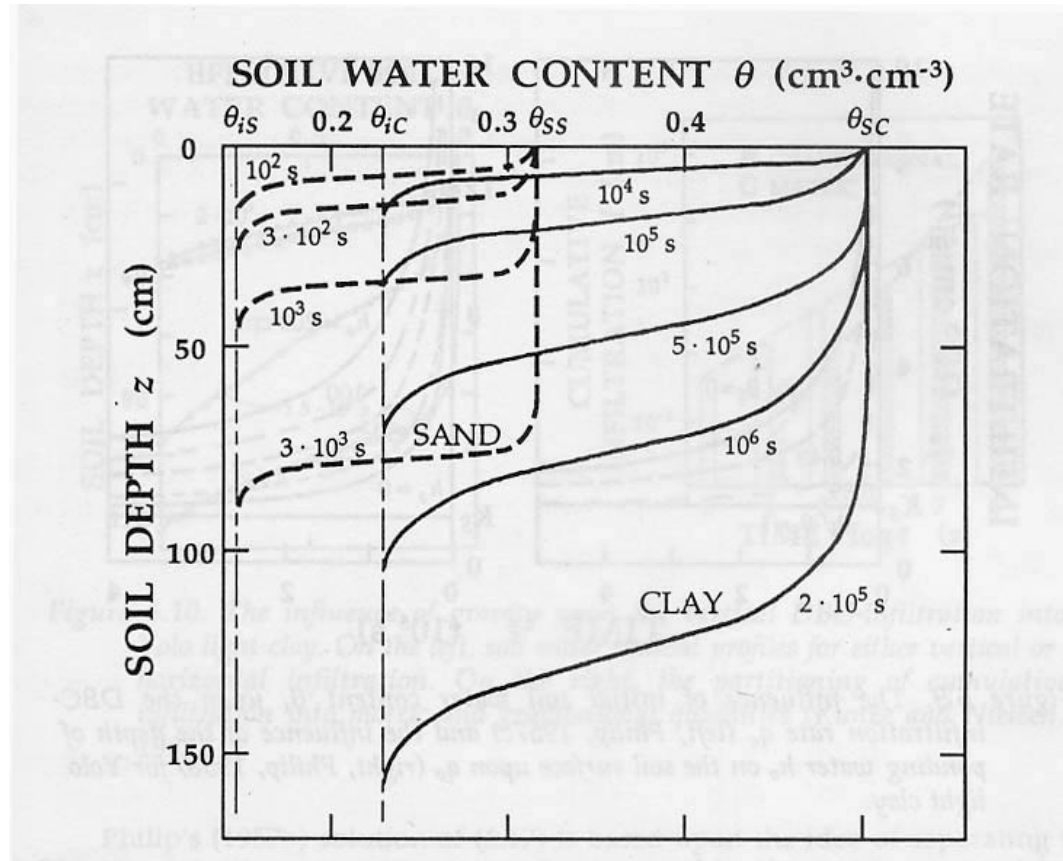
Soil condition was observed after rain. The numerical figures in the documents are considered to be the depth of the wet front.

Uncertainty associated with measurement of soil wet-fronts

Precipitation



Uncertainties associated with quantification of precipitation by observation of wet fronts

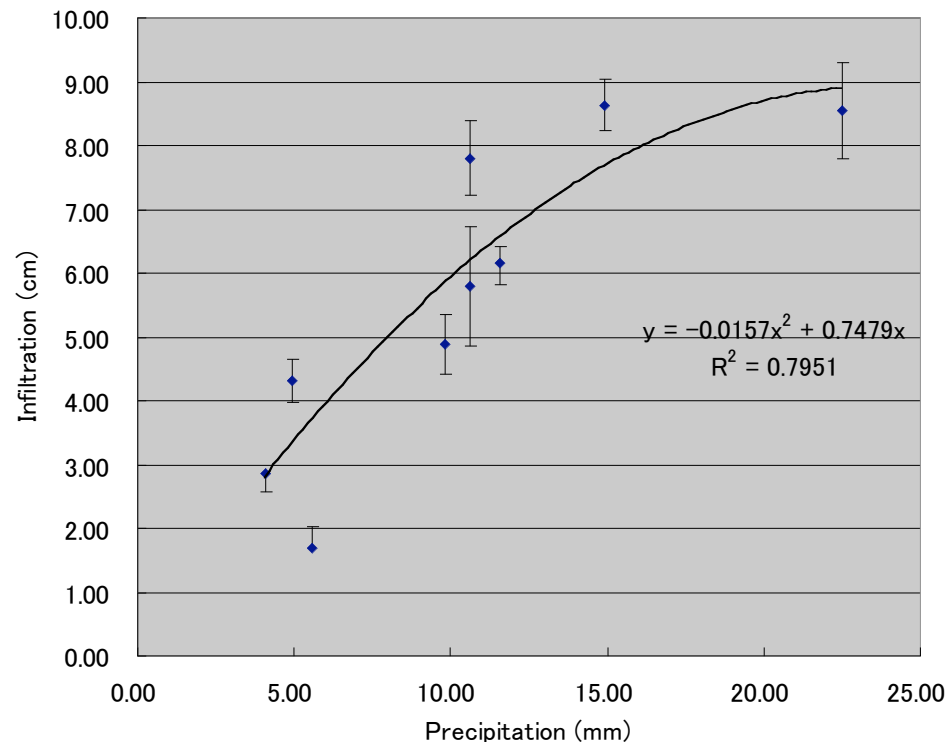


The depth of the wet front is dependent on the soil type and on when the measurement was made after rain.



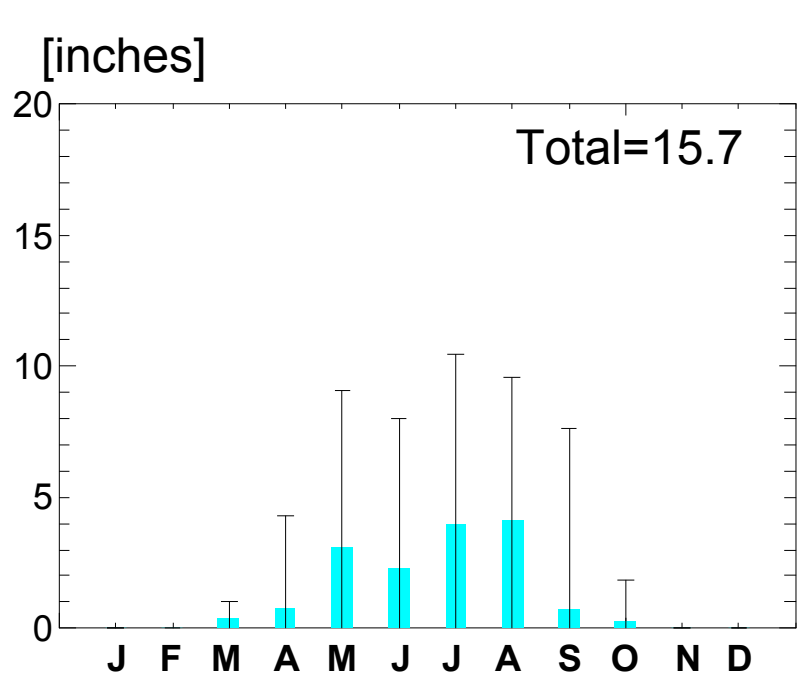


Experiment result

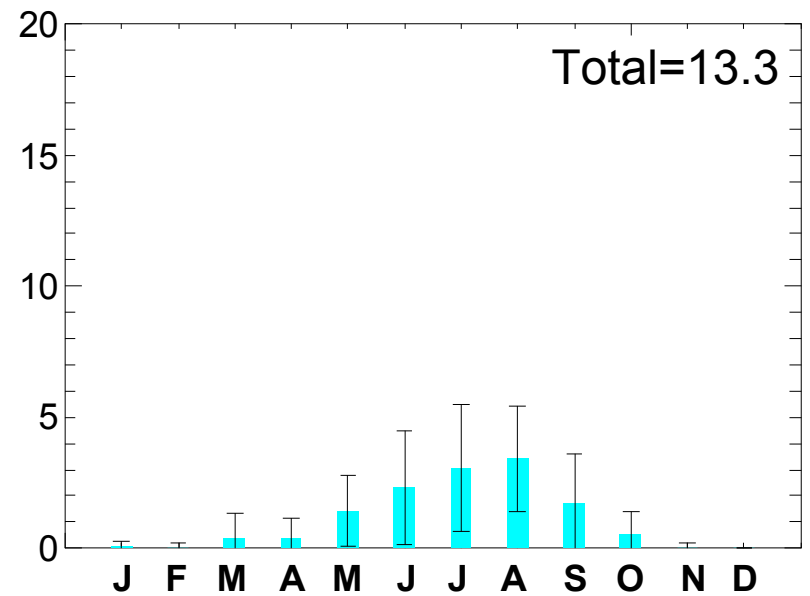


- For light textured soils (sand and silty sand) a good correlation curve was obtained between precipitation amounts and depths of wet-fronts.
- Correlation was consistent even for consecutive precipitations and for delay of observation of 12 hours.

Comparison of average of archive data and present data converted into WFD



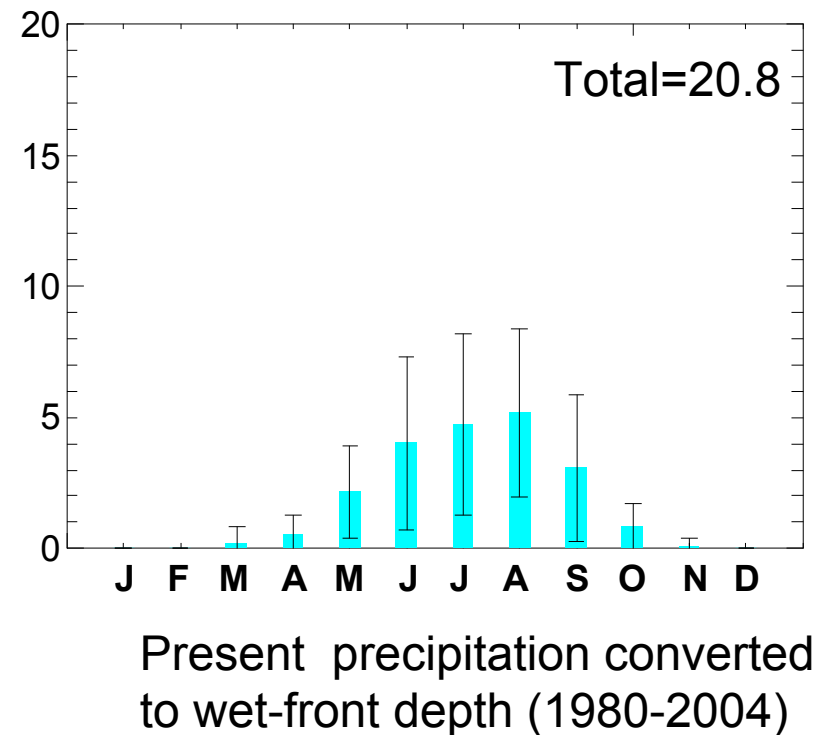
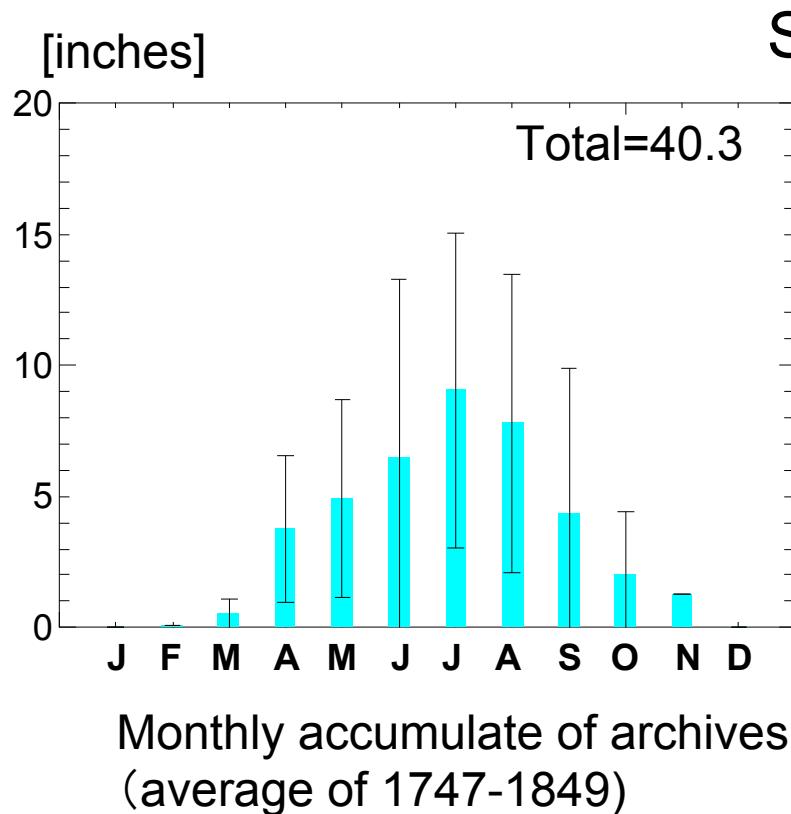
Monthly accumulate of archives
(average of usable data 1747-1849)



Present precipitation converted
to wet-front depth (1980-2004)

Similar precipitation trends and amounts were found in low-precipitation region

Comparison of average of archive data and present data converted into WFD



More pluvial area seem to have large difference between the record and the present

Summary

- Relation between precipitation and consequent depth of soil wet-front was obtained from field experiments for light rain.
- The method of measurement in Qing dynasty period seems quite robust for the arid area, with the observations within 12 hours after precipitation.

etailed analyses are required for relatively deep wet front data, which correspond with rather heavy rain events or sites.

**Historical evolution of the precipitation
would be reconstructed in the arid region
with the document data.**

Thank you for your attention

