

HISTORICAL RECORDS OF ASIAN DUST EVENTS (*HWANGSA*) IN KOREA

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Asian dust events in Korea recorded between the second and eighteenth centuries exhibited the same seasonal aspect as those experienced in the last 90 years.

An Asian dust event may include floating or falling dust and is called *hwangsa* in Korea and *kosa* in Japan (Chun et al. 2001). Dust particles blown into the atmosphere in desert regions of Mongolia and China can be transported as far away as the west coast of the United States and southern British Columbia, Canada (e.g., McKendry et al. 2001). As a result, there has been growing concern about the effects of Asian dust events on human health and climate, which has stimulated research on the effect and prediction, as well as the basic properties of Asian dust particles. In ancient Korea, dust events caused concern because they were

considered God's punishment or a warning to the ruler. Upon a dust outbreak, rulers refrained from all kinds of entertainment and consecrated themselves with awe (Chun 2000; Chun et al. 2000a). We consulted documentation of Asian dust events in *Samguk sagi* (*History of the Three Kingdoms*), the period 57 BC to AD 938; *Goryeo sa* (*The History of Goryeo*), the official history of the period 918 to 1392; and *Joseon wangjosillok* (*Annals of the Dynasty of Joseon*), which covers 1392–1910, as well as *Munhuenbigo* (*Remarks on Literature*), which covers 2,000 yr. We extracted these records from CD-ROMs of the aforementioned dynastic databases (published by the Korean Studies

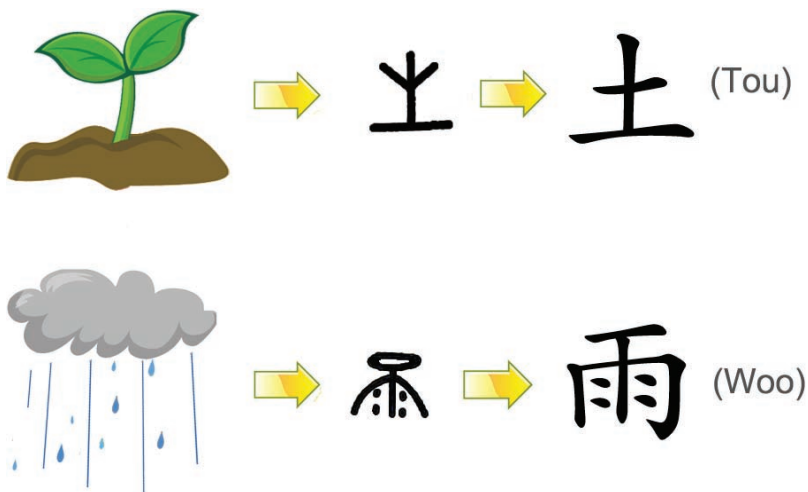


FIG. 1. The symbolic word standing for dustfall and description of how each letter was shaped. The first syllable, *Tou* (土), symbolizes the shape of a small plant emerging from the Earth or soil, and the second, *Woo* (雨), represents the motion of raindrops falling down from a cloud.

Database Research Institute and Nurimedia) and from previous work by Wada (1917) and Tamura (1983).

During the Three Kingdoms, dustfall was called *Woo-Tou* (雨土). *Tou-Woo* is the noun form. The Chinese characters mean “substance other than water droplets descending in the atmosphere” (Fig. 1). The first syllable, *Tou* (土), symbolizes the shape of a small plant emerging from the Earth or soil, and the second, *Woo* (雨), represents raindrops falling from a cloud. *Woo-Tou* was the most frequently used term in Korea to record dust events and was also one of several terms employed in China.

TABLE 1. The records of dust events during the Three Kingdoms period (57 BC–AD 938) in Korea.

Year	Month ^a	Kingdoms ^b	Original record ^c	Meaning
174	2	Silla	雨土	Dustfall
379	5	Baekje	雨土竟日	Dustfall for a day long
389	3	Silla	雨土	Dustfall
606	4	Baekje	王都雨土晝暗	The sky of Baekje's capital was darkened like night by dustfall
627	4	Silla	大風雨土過五日	Dust storm lingered over five days
644	11	Goguryeo	平壤雪色赤	Snow tinged with red in Pyongyang, Goguryeo's capital
770	4	Unified Silla	雨土	Dustfall
780	3	Unified Silla	雨土	Dustfall
850	2	Unified Silla	京都雨土	Dust fell in Gyeongju, Silla's capital

^aThe lunar calendar was used in Korea; however, it was converted to the solar calendar in this study.

^bThe names of the three kingdoms are 新羅, 百濟, and 高句麗, in Chinese characters corresponding to Silla, Baekje, and Goguryeo, respectively.

^cOriginal records were written in classical Chinese characters.

THREE KINGDOMS. According to *Samguk sagi*, the first dustfall was recorded in February (January in the lunar calendar) AD 174 in Silla, one of the three kingdoms of that period (Goguryeo and Baekje were the others). The next record comes from an all-day dustfall in May 379 in Baekje, in the southwestern part of the peninsula. Ten years later, another dustfall event was detected in Silla in March.

In Baekje, the sky of the capital was darkened like night by dustfall in April 606. There are four more records of dustfall during this period, which were all detected in Silla: April 627, April 770, March 780, and February 850. In addition to the eight dust events expressed as *Woo-Tou*, dust was also implicit in some statements regarding snow. Although dust phenomena mainly occurred during springtime, some incidents were observed in winter as well. In November AD 644, snow was tinged with red in

the capital of Goguryeo, which was located in the northern part of the Korean peninsula. The color was certainly from dust particles mixed with snow. Today this also occurs in Korea and Japan (Chun et al. 2000b). A total of nine records retrieved from *Samguk sagi* are summarized in Table 1. The period of the Three Kingdoms actually ended with the unification by Silla in 676, and afterward Silla represents the Unified Silla until 892.

GORYEO DYNASTY. The Unified Silla was broken up into the three kingdoms again in 892—a period called the Post Three Kingdoms. One of these kingdoms, Goryeo, finally reunified the Korean peninsula. During an overlap of 18 yr between the period of the Three Kingdoms and Goryeo, no record of dust events was found. The years with records of dust events are listed in Table 2. The twelfth century shows many

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records of dust events during the Goryeo Dynasty. *Woo-Tou* and yellow fog are recorded in *Goryeo sa*. One dust incident was associated with gust and hail. Spring thunderstorms with hail commonly develop preceding the cold front of an extratropical cyclone. In this period, incidents with dust were most frequent in spring and none were recorded in summer, which is very similar to the present seasonal pattern in Korea.

JOSEON DYNASTY. The Joseon Dynasty succeeded Goryeo in 1392 and lasted for over 500 yr. During this period, science and technology developed in many fields. For example, the first rainfall gauge was invented in the 23rd year of King Sejong's reign (September 1441). Hence, meteorological observations and comments are more extensive and dust records are far more specific and encompass the whole territory, not just the capital. The years with dust events recorded during the Joseon Dynasty are included in Table 3. The relatively high number of the events appears in the sixteenth and seventeenth centuries. The nature of the historical dust phenomenon in the lunar calendar is illustrated in Fig. 2. Similar dust events accompanied by precipitation were observed in February 1406, April 1419, February 1550, and April 1681. The two cases of November 1412 and April 1563 were concurrent with fog as well. During wintertime, dust incidents were occasionally mixed with snow; there were five cases: 1502, 1526, 1538, 1551, and 1681. In addition, five events were related to hail, in 1520, 1525, 1528, 1530, and 1733. In total, 105 records were identified as dust events for this period. The annals of the dynasty, *Joseon wangjosillok*, provide dust information until 1784. Since then, there has been no specific record except a statement written in *Soungwanji*, a treatise published in 1818 dealing with astronomy, meteorology, and geography. Here "dustfall" was defined with rainbow, thunder, lightning, hail, fog, frost, snow, and rain as shown in Fig. 3. The number of day with the number of dust events were extracted from Korean historical archives in each dynasty from the second to the eighteenth cen-

TABLE 2. The years with dust events during the Goryeo Dynasty (AD 918–1392) in Korea.	
Century	Asian dust event
11	1018 1036 1039 1040 1066 1075 1091
12	1119 1124 1126 1131 1137 1138 1139 1140 1142 1143 1151 1155 1158 1176 1186 1187 1188 1193 1195 1198 1200
13	1201 1224 1226 1256 1258 1260
14	1308 1311 1318 1373

TABLE 3. The same as Table 2, but for the Joseon Dynasty (AD 1392–1910) in Korea.

Century	Asian dust event
15	1405 1406 1412 1419 1421 1427 1470 1475 1478 1480 1494 1496
16	1501 1502 1503 1516 1520 1523 1524 1525 1526 1527 1528 1529 1530 1531 1538 1544 1548 1550 1551 1552 1553 1554 1555 1558 1563 1565 1573 1575 1595 1599
17	1602 1606 1608 1609 1614 1616 1619 1622 1641 1643 1661 1662 1665 1666 1669 1670 1671 1675 1681 1682 1689 1695
18	1710 1717 1724 1727 1733 1747 1749 1763 1768 1784

ture (Fig. 4). Asian dust events were most frequently observed in springtime from February to May with the maximum peak in April. In the rainy period affected by subtropical North Pacific high pressure, dust events were seldom observed.

COMPARISON OF HISTORICAL AND RECENT RECORDS.

The compiled data do not provide an entirely satisfactory historical record of dust events. Nonetheless, we compared them to records for Seoul, Korea, 1915–2005. The Asian dust days show a peak in the late 1930s to the early 1940s, and increasing frequency in recent years (Fig. 5).

There are some special considerations in use of the recent data. From 1910 until 1945, the dust events were recorded by the Japanese with some symbols “黃砂” (*hwangsa* in Korean) and “塵” during the Japan Occupation Period. During the Korean War (1950–53), the records could not be kept as well. In recent decades, dust events have been recorded according to World Meteorological Organization (WMO) regulations by the Korea Meteorological Administration. Also, a distinct warm period in northern China in the 1930s and 1940s (Qian et al. 2002) may have affected the frequency of *hwangsa*. In this 90-yr record (Fig. 6), the maximum number of dust days was recorded in April, showing a 87% frequency from March to May. This seasonal pattern is very similar to that of the previous centuries. This suggests that the present mechanism of dust events in Korea is not significantly different from the past.

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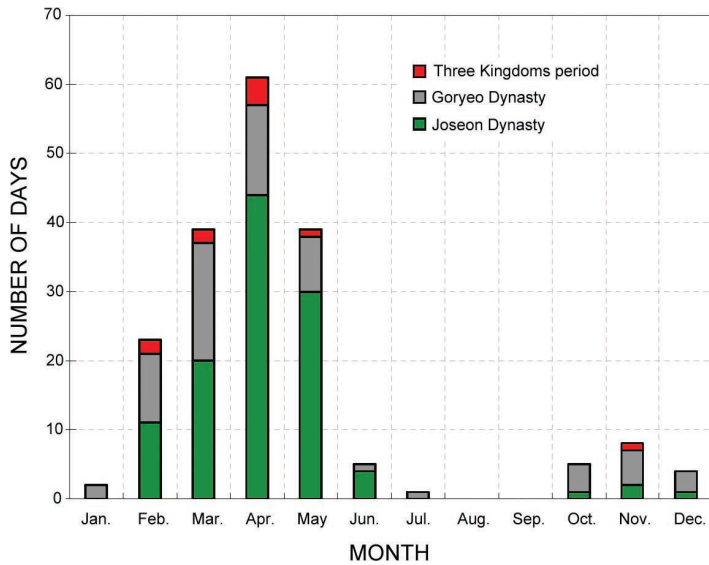


FIG. 4. The number of days of Asian dust in a month compiled from Korean historical archives in each dynasty from the second to the eighteenth century.

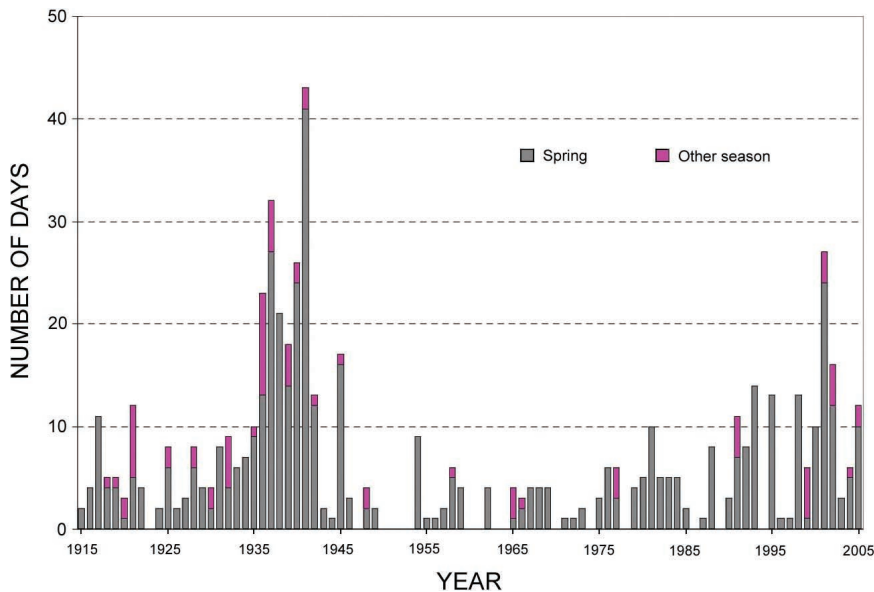


FIG. 5. The number of days of Asian dust in a year observed in Seoul during the last 90 yr. “Other season” means months besides Mar, Apr, and May. Seoul is the same city as the capital of the Joseon Dynasty.

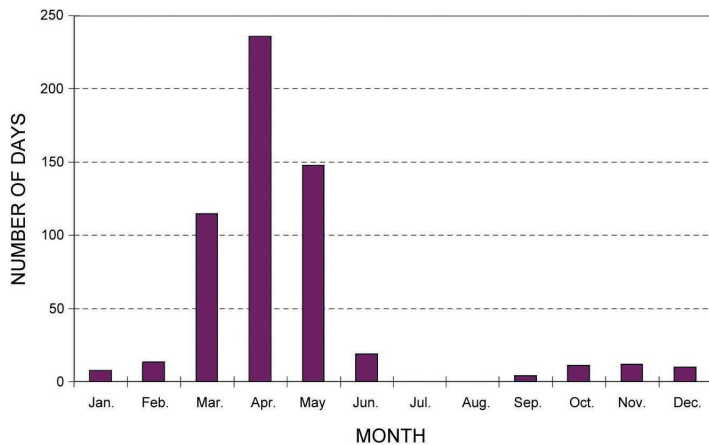


FIG. 6. The number of days of Asian dust in a month in Seoul, Korea, from 1915 to 2005.