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# Persian Gulf Sea Surface Temperature as a Drought Diagnostic for Southern Iran

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The Persian Gulf and Oman Sea, situated over the northwestern extremity of the tropical Indian Ocean, make up the southern border of Iran (Figure 1). During hot seasons, the sea surface temperatures (SSTs) of these water bodies are high, and a huge thermal trough system is usually dominant over the region (Bitan and Sa'aroni, 1992). The summer SSTs of the Persian Gulf are reported to be the highest in the world (Gabler, 1977).

About 30% of the total rain-bearing air masses coming to the country originate in north Africa, the Red Sea, and western Saudi Arabia (Khalili, 1992). These air masses are known as the Sudan Current; they are categorized as tropical maritime. They pro-

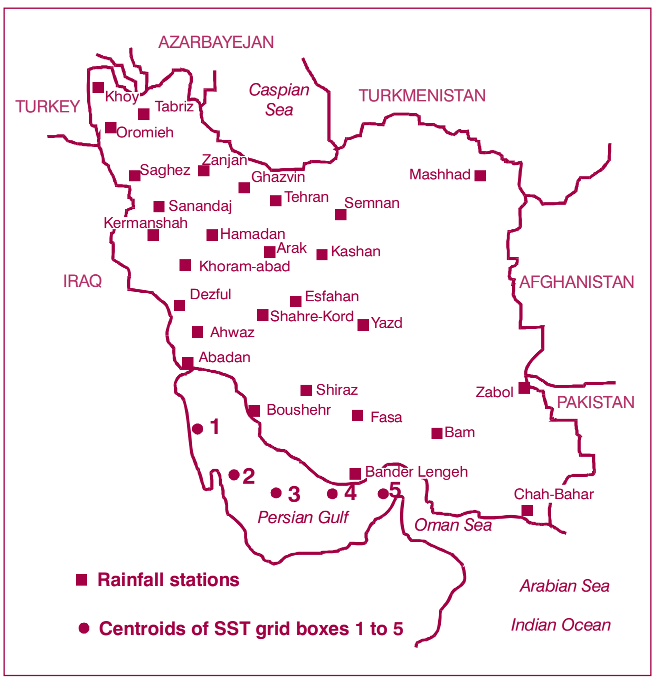


**Figure 1. The geographical location of Iran, rainfall stations, and the approximate centroid of SST grid cells.**

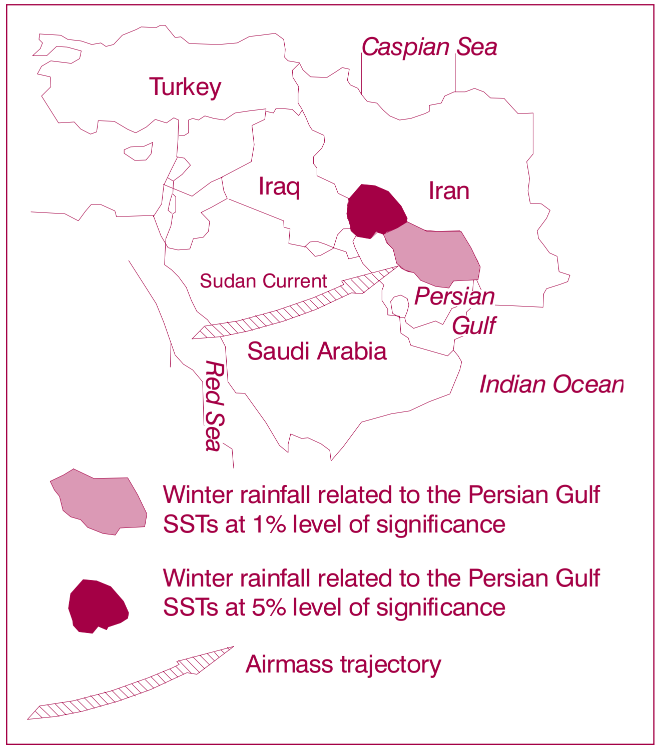


**Figure 2. General trajectories of the rain-bearing air masses that cross the Persian Gulf during the winter.**

duce a significant portion of the total annual rainfall over the southern parts of Iran. Figure 2 shows that the general trajectory of the Sudan Current passes over Saudi Arabia and enters Iran through the Persian Gulf. The occurrence of some heavy winter rainfalls in Shiraz, Fasa, Bushehr, and Bandar Lengeh (Figure 1) is attributed to the movement of the Sudan Current toward Iran (Khalili, 1992).

Nazemosadat et al. (1995) have annualized the relationships between Iranian seasonal rainfall and the Persian Gulf SSTs. The SST data for five 2° by 2°

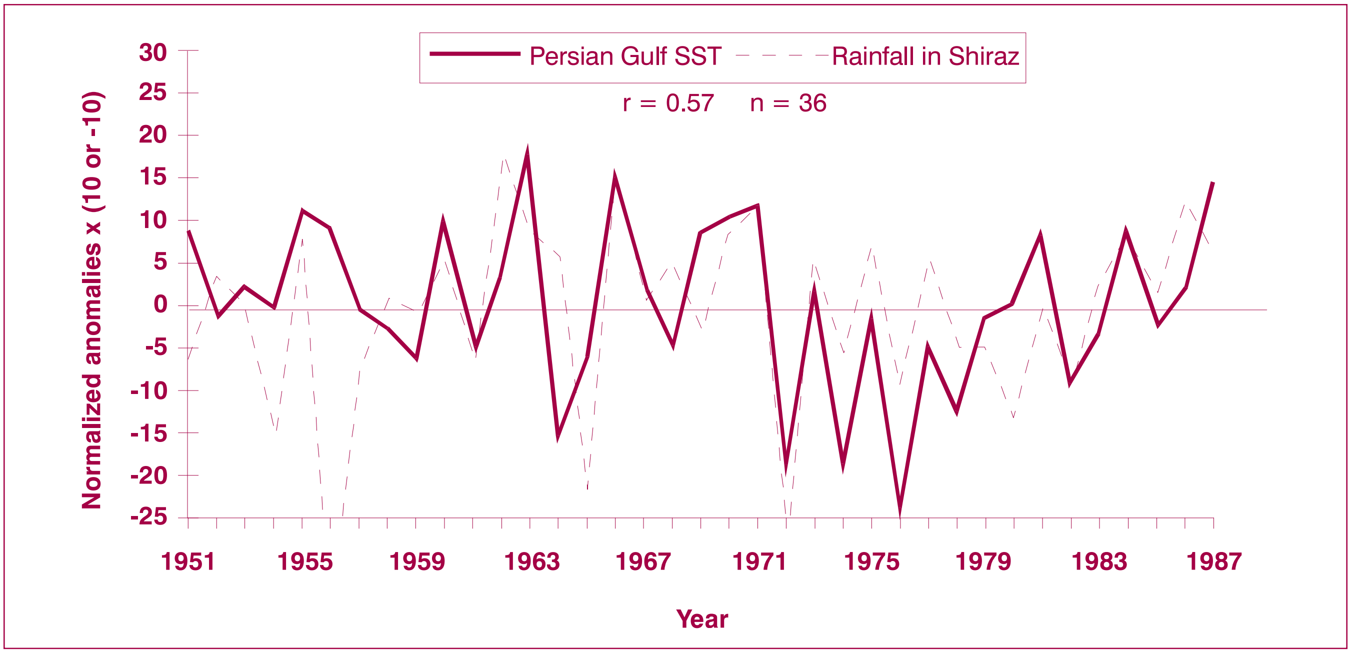


**Figure 3. Fluctuations of the Persian Gulf SSTs and winter rainfall in Shiraz. Normalized anomalies of variables multiplied by 10 for SST and -10 for rainfall data. The SST–rainfall correlation is highly significant.**

COADS grid cells over the Persian Gulf were selected in this analysis (Figure 1). Their study revealed that winter (January–March) rainfall over the southern and southwestern parts of Iran is negatively correlated with the Persian Gulf SSTs. The spatial distribution of the correlation field between the Persian Gulf SSTs and rainfall data is delineated in Figure 2.

Drought (flooding) spells over southern and southwestern parts of Iran are, therefore, expected when the Persian Gulf SSTs are above (below) normal. The concurrent variations of Shiraz rainfall and the Persian Gulf SSTs for the period 1951–87 are shown in Figure 3. Data are shown by their normalized anomalies multiplied by -10 and 10 (for rainfall and SST data, respectively) to be more compatible. Drought (wet) episodes are hence denoted by positive (negative) rainfall anomalies. Shiraz is at the northern extremity of the areas whose rainfall is affected by the Sudan Current and is, therefore, suitable for such examination.

As Figure 3 shows, winter droughts and wet periods tend to occur for the episodes in which the Persian Gulf SSTs are above and below normal, respectively. For example, droughts in 1955, 1960, 1962, 1963, 1966, 1970, 1971, 1984, and 1987 coincide with the above-normal Persian Gulf SSTs. For these episodes, the measured SST data varied from 0.4° to 1.8° above normal. In contrast, above-normal rainfall generally occurred when the Persian Gulf SSTs were below normal (for example, 1956, 1957, 1965, 1972, 1976, and 1982).

Overall, correlation analysis between rainfall and SST data, using various data lengths, has revealed that the fluctuations of SST account for about 40% of rainfall variability over the region studied. The relationships are generally strong for Boushehr, Shiraz, Fasa, and Bandar Lengeh and weaker for Abadan and Ahwaz (Figure 2). The Persian Gulf SSTs can hence be used as a drought diagnostic over southern parts of Iran. However, further research is needed to identify other climatic indices influencing rainfall variability over these regions.

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