

Decadal Variability of precipitation in Northern Oman and risk assessment of cloud seeding in the Al Hajar Mountains

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Motivation

Climate change, and climate variability are considered to be the main drivers of extreme weather worldwide. There is a need to understand the resulting decadal trends and variabilities in rainfall, particularly in arid countries such as Oman where changes in rainfall can have a large impact upon agriculture and extreme rainfall events can lead to hazardous flash flooding. In addition, there is a need to identify any changes in rainfall in the Al Hajar Mountains of Northern Oman due to the cloud seeding project active from summer 2013 to 2019.

Research Questions

- Are there significant decadal/ interannual variabilities in the extreme precipitation in different parts of Northern Oman?
- What are the controlling factors of extreme precipitation variability in Northern Oman?
- What may be the consequences for cloud seeding operations in Oman?

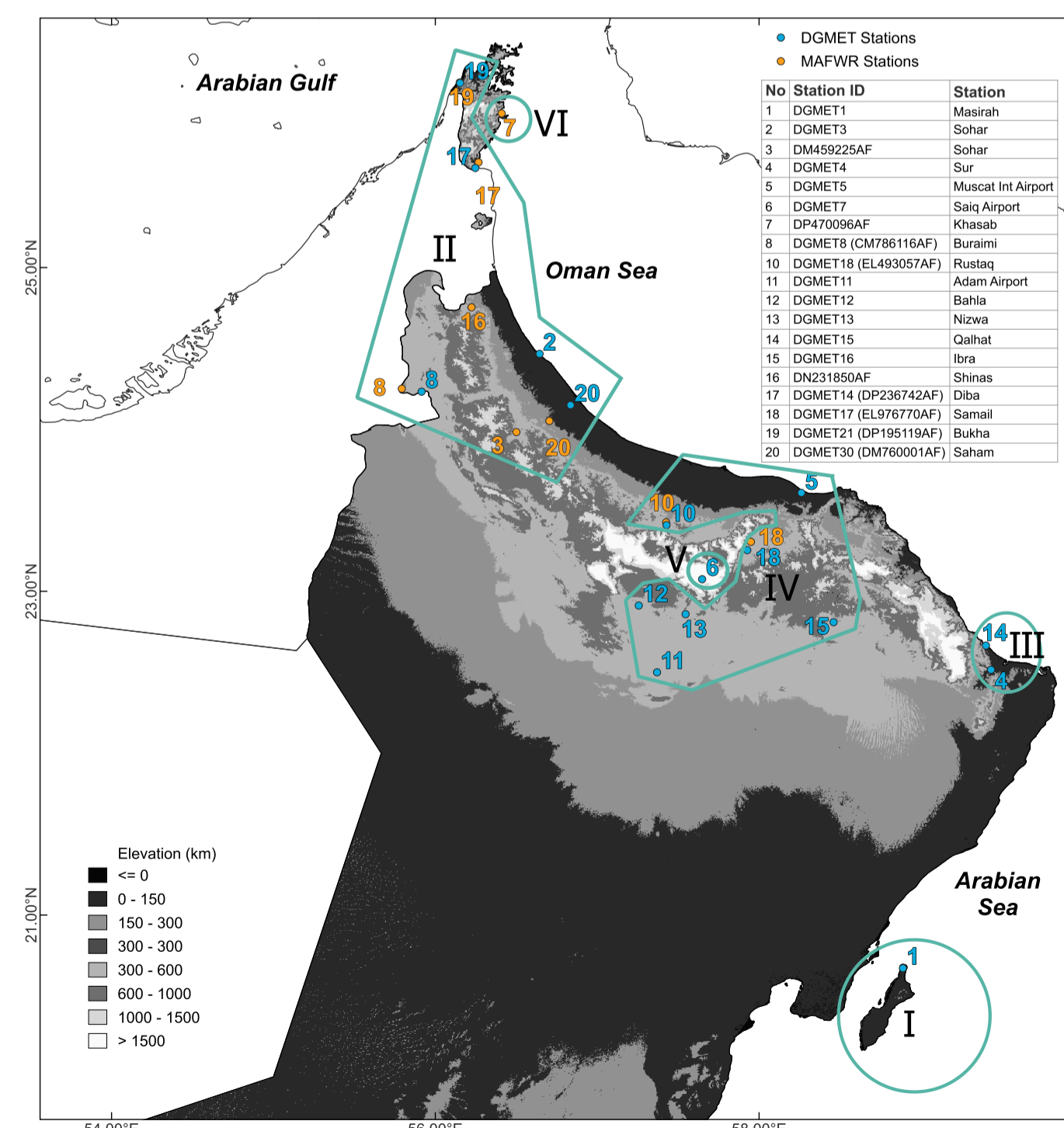
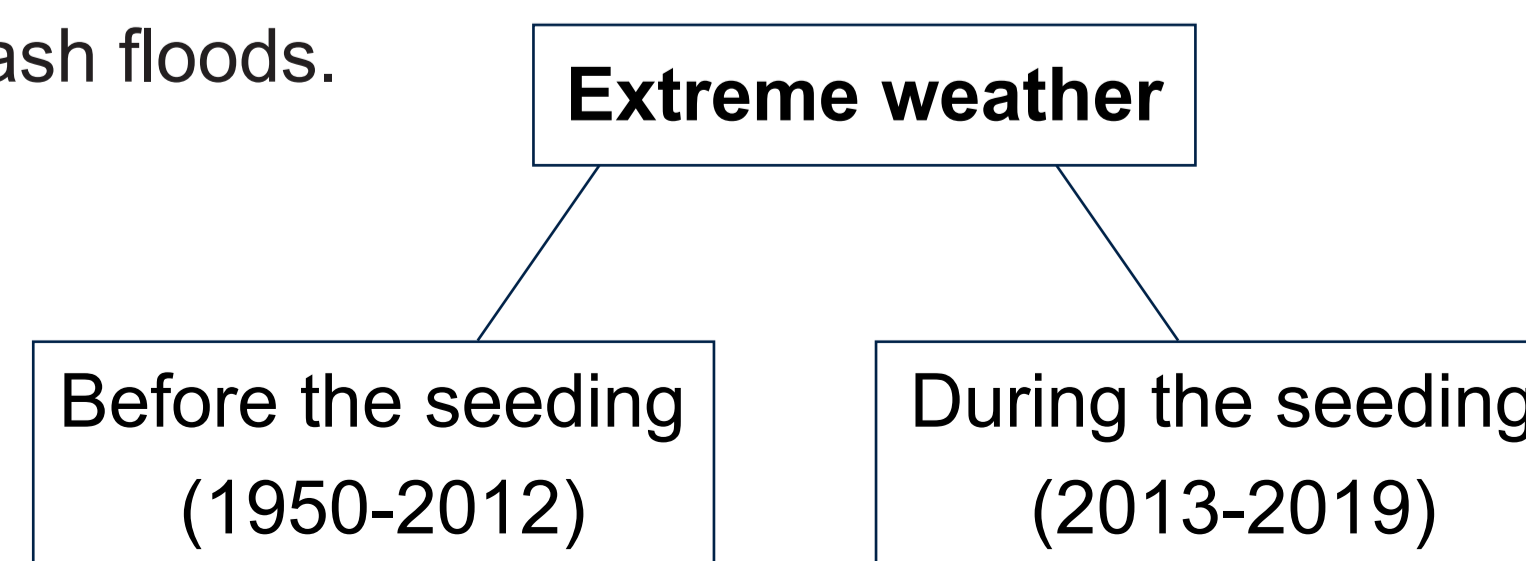


Fig1. Six Regional Clusters for the 20 DGMET and MAFWR stations in the north of Oman based on agglomerative hierarchical (Ward's) method for the observed data.

Methodology

- **Precipitation Climatology:**
 - Yearly, Seasonal, Monthly precipitation variability of a subset of observed stations precipitation daily data from Directorate General of Oman Meteorology (DGMET) and the Ministry of Agriculture, Fisheries and Water resources (MAFWR). Only the 20 stations with the longest and most complete data series were used in order to maintain the integrity of the analysis.
- **Precipitation Decadal Variability:**
 - Quantile Perturbation method (QPM) is used to analyse the decadal extreme precipitations anomalies, and their confidence intervals are tested by non-parametric Monte Carlo Simulation.
- **Teleconnection patterns and the precipitation variability:**
 - Investigation of the relationship between extreme precipitation anomalies and the following patterns: North Atlantic Oscillation (NAO), Indian Ocean Dipole (IOD), Arctic Oscillation, (AO), Pacific Decadal Oscillation (PDO), El Niño-Southern Oscillation (ENSO), Outgoing Longwave Radiation (OLR) data are analysed to investigate, the severity, spatial and temporal variability of heavy to extreme precipitations and deep convections on the Al Hajar mountains.
- **Cloud seeding and the occurrence of extreme weather:**
 - Statistical analysis of the relationship between cloud seeding and the occurrence of severe weather and flash floods.



Findings: Observed stations data

Rainfall sources: Tropical systems, Mediterranean extra-tropical systems (extended troughs/ low-pressure systems), Inter-Tropical Convergence Zone (ITCZ), easterly waves and local convective systems.



Fig2. Annual mean precipitation for a) Cluster I, b) Cluster II, c) Cluster III, d) Cluster IV, e) Cluster V, and f) Cluster VI.

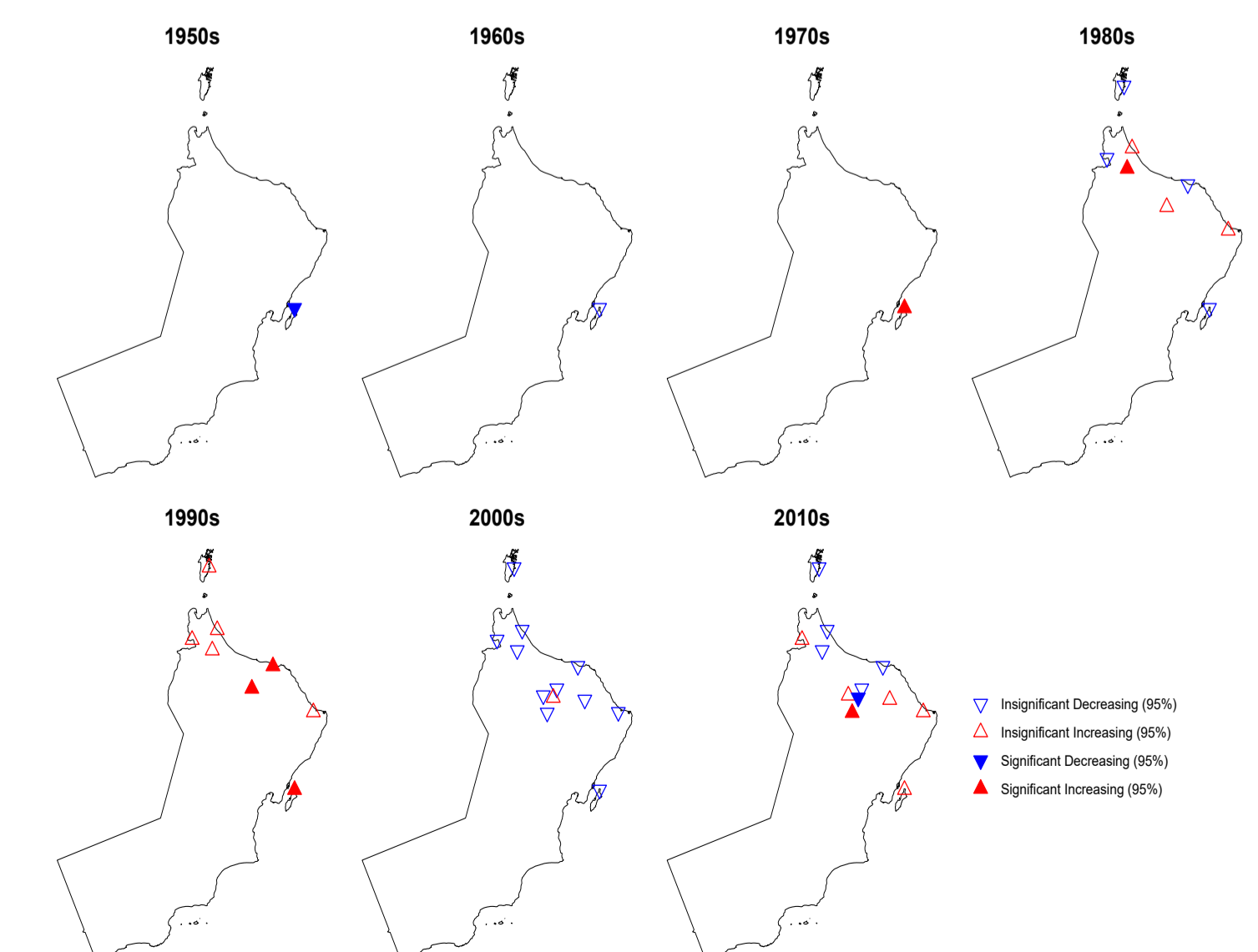


Fig3. The extreme decadal anomalies from the 1950s to 2010s.