

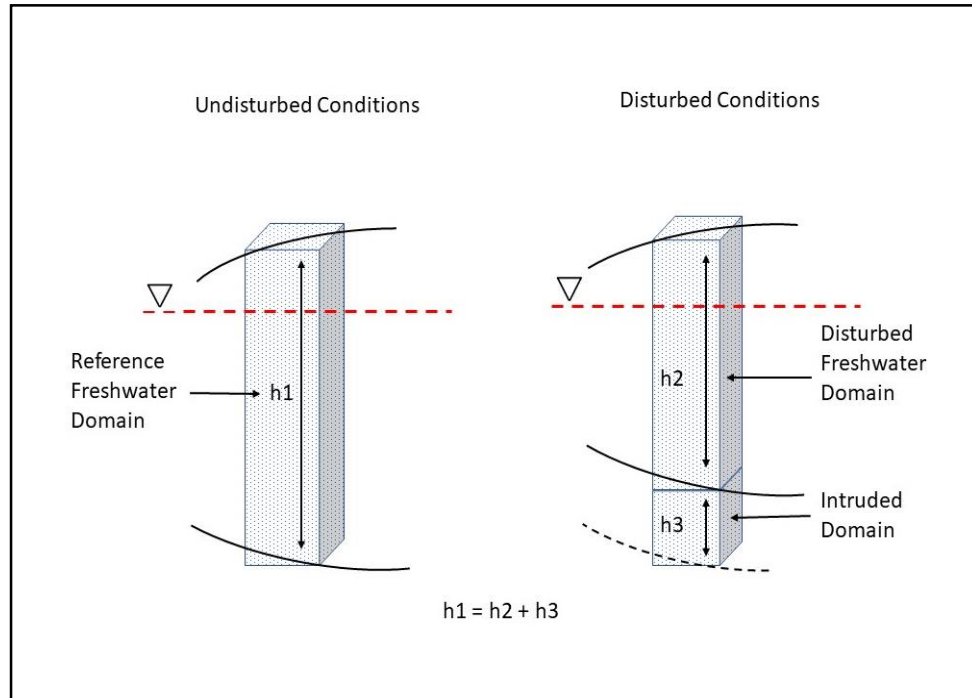
Conceptualisation of sea-water intrusion in an island aquifer system

Manuel Sapiano¹, Leticia Baena-Ruiz², Fabian Micallef¹, Henry Debattista¹, and David Pulido-Velazquez²

¹Energy and Water Agency, Malta.

²Instituto Geológico y Minero de España, Granada (Spain).

Introduction



$$\text{Severity of Intrusion} = \frac{\text{undisturbed} - \text{disturbed volume}}{\text{undisturbed volume}} \times 100$$

Simple model to assess the severity of sea-water intrusion in islands and near coastal regions.

Based on a comparative assessment of the freshwater domain under undisturbed and disturbed conditions.

Applicable under conditions of limited availability of monitoring data.

Assumes sharp interface conditions.

Enables the identification of highly impacted regions – an early warning system to guide the development of mitigation measures.

Application

Malta Mean Sea Level Aquifer System

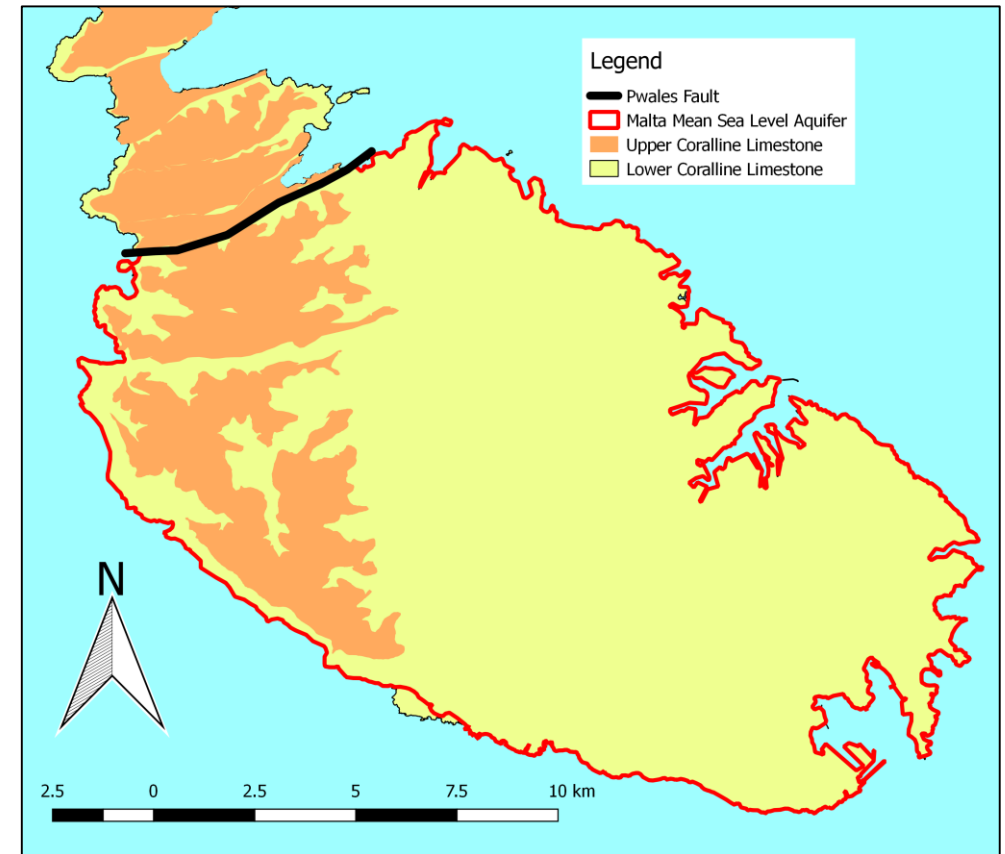
Typical island freshwater lens developed in a permeable carbonate formation.

Important aquifer system supplying around 66% of all freshwater groundwater withdrawals.

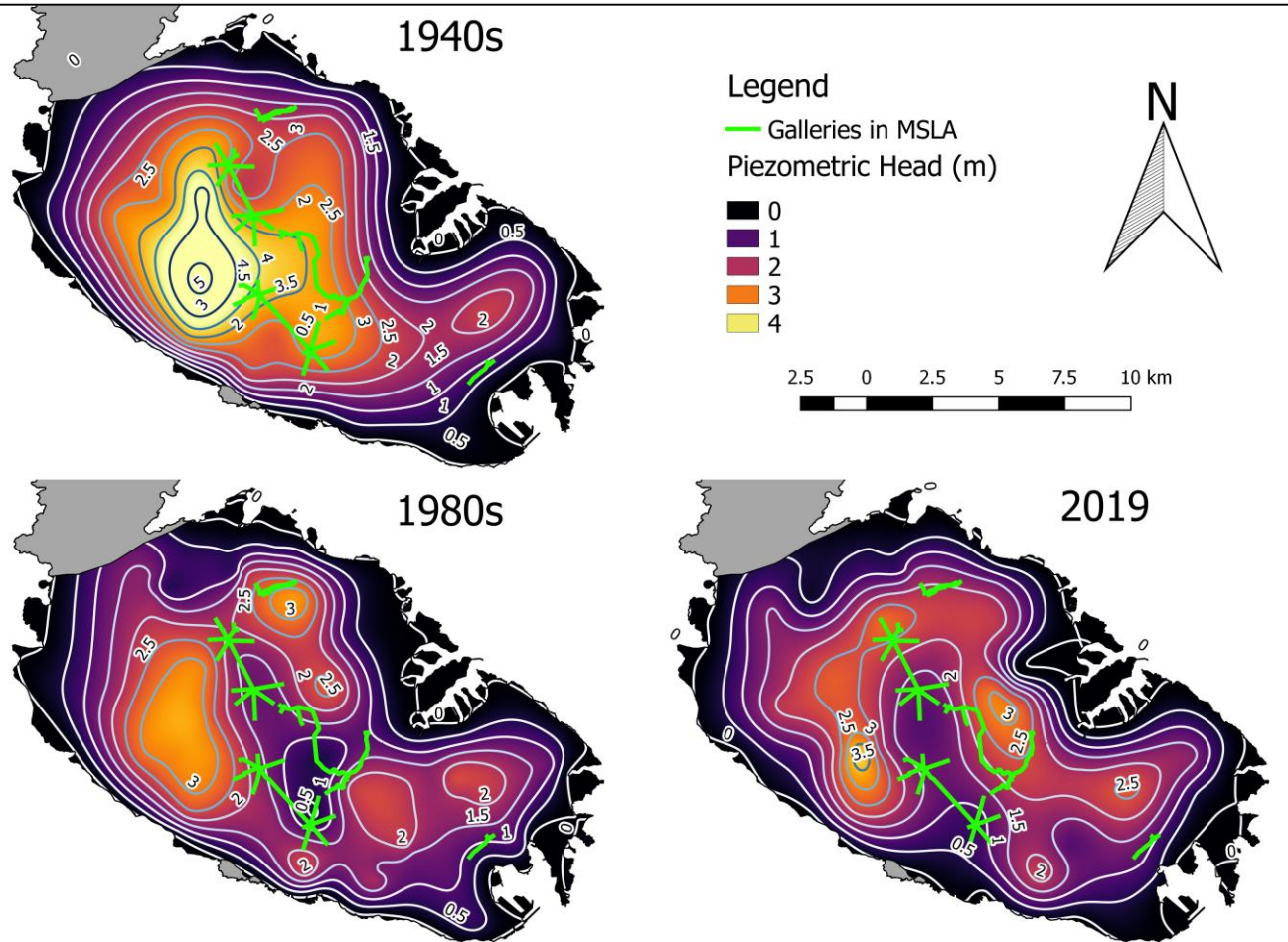
Available data:

- Abstraction history since 1887
- Piezometric levels since 1940

Abstraction history traces the relative importance of public and private abstraction along the years at a spatial level.



Results



Piezometric surfaces established for 1940, 1980 and 2019.

1940 levels considered as representative of natural conditions.

Position of interface determined through the application of the Ghyben-Herzberg approximation.

Aquifer area discretized into cells of 250m x 250m, and piezometric and interface levels allocated to each cell according to the value at its centre-point.

Results

Spatial maps developed through a statistical analysis of severity of intrusion cell-values:

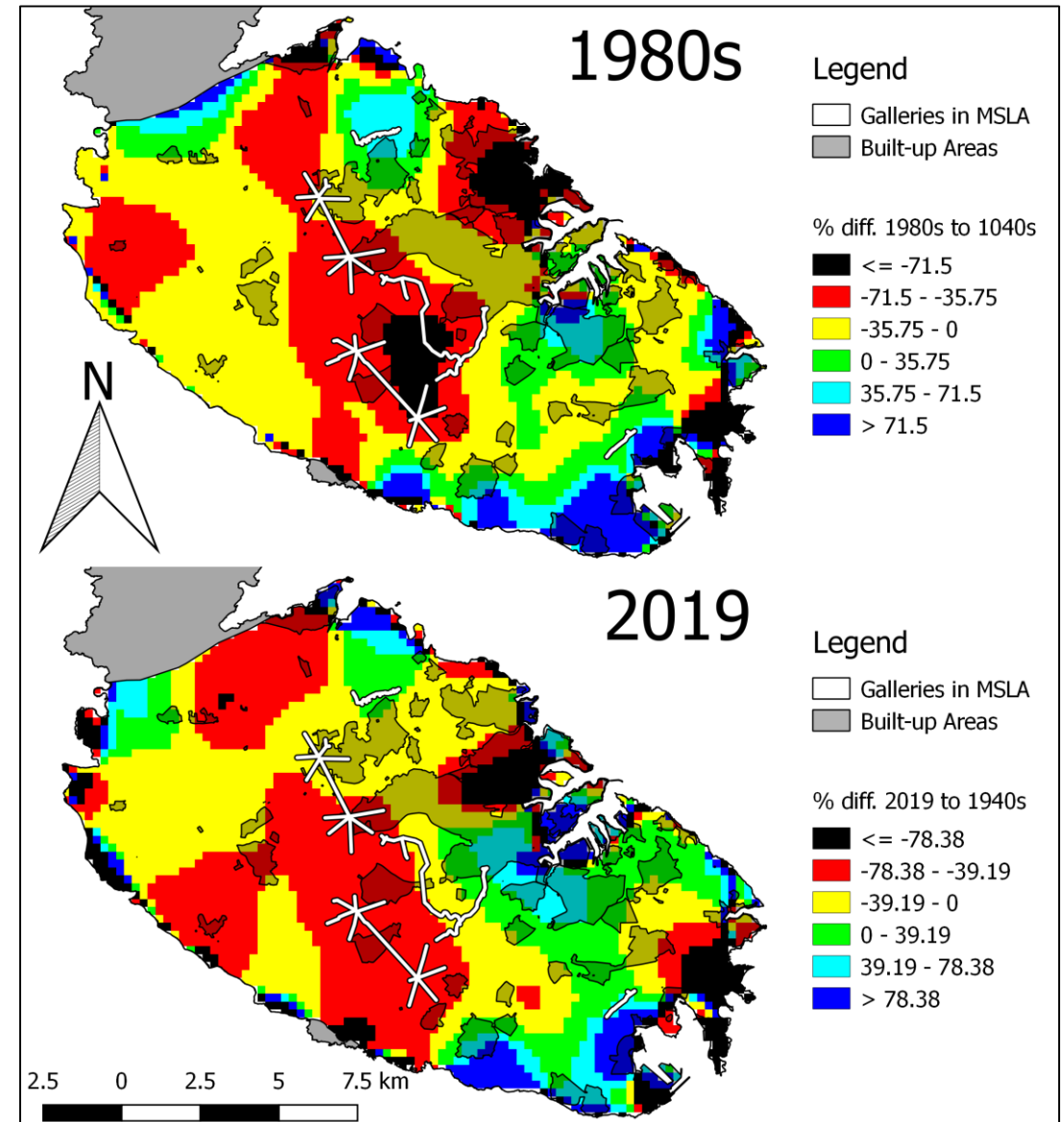
- 1980 relative to 1940
- 2019 relative to 1940

1980 Map:

Impact of public abstraction in central regions of the island.

2019 Map:

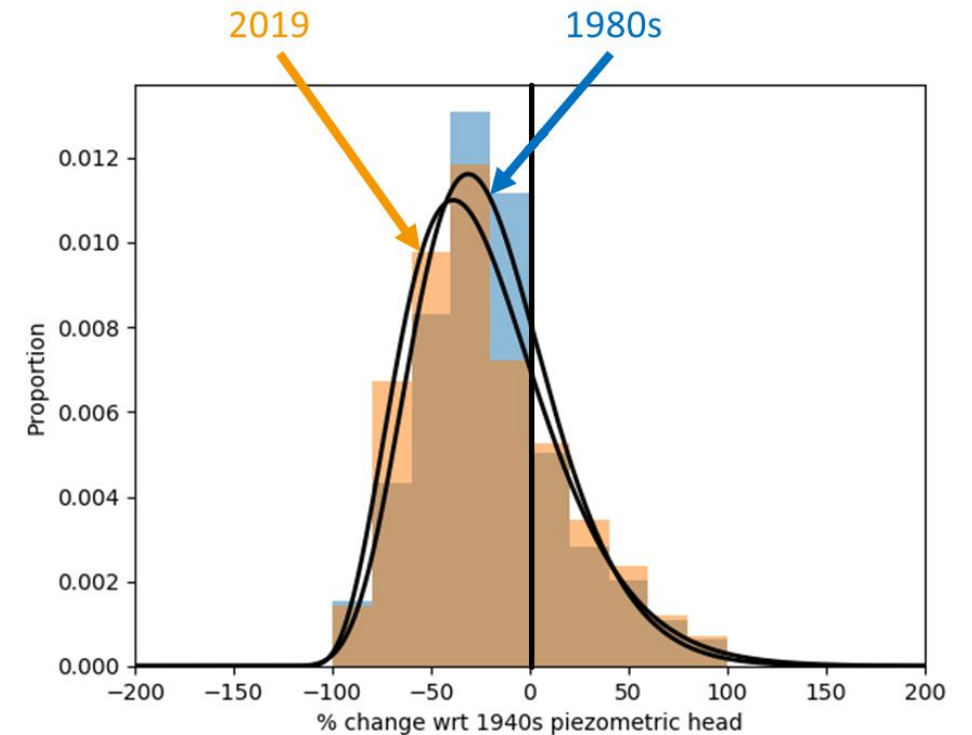
Aquifer recovery in the central regions of the island in response to diminishing abstraction for public purposes. Broader intrusion impacts in response to more spatially distributed private abstraction.



Conclusions

Sea-water intrusion assessment model:

- enables the spatial representation of the severity of intrusion on a regional level;
- able to trace the development of sea-water intrusion over different exploitation periods;
- can be considered as an early warning tool which can help guide the development of mitigation measures and eventually evaluate the impact of such measures.



Further Information:

manuel.sapiano@gov.mt

d.pulido@igme.es

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