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Supplement of

A virtual water network of the Roman world

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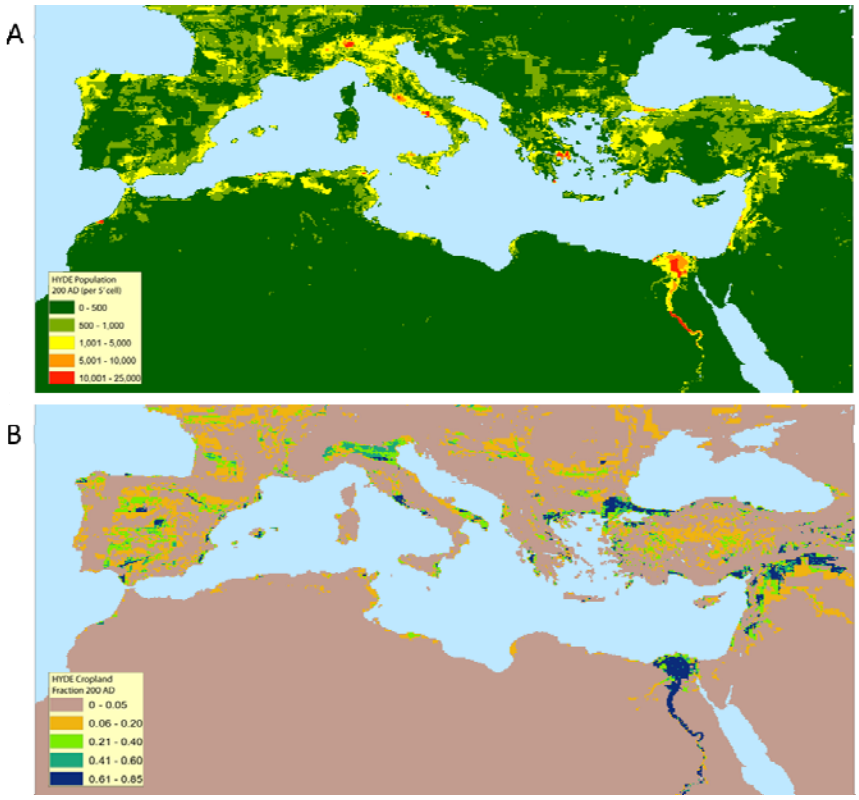

Figure S1. HYDE reconstructions of population and cropland at 200 AD.

(A) Population values are per 5' cell. **(B)** Cropland fractions indicate the fraction of each 5' designated as cropland.

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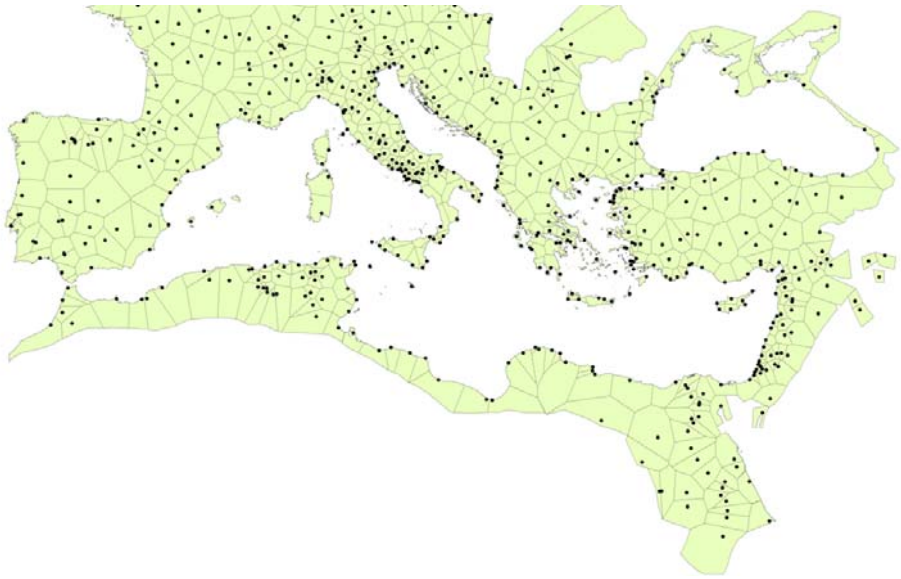

Figure S2. City regions. A Theissen polygon operation was carried out between nodes to define each city region. The polygons were cut with a land-sea mask at the coast and with the estimated maximum extent of the Roman Empire along the south, east and northern borders.

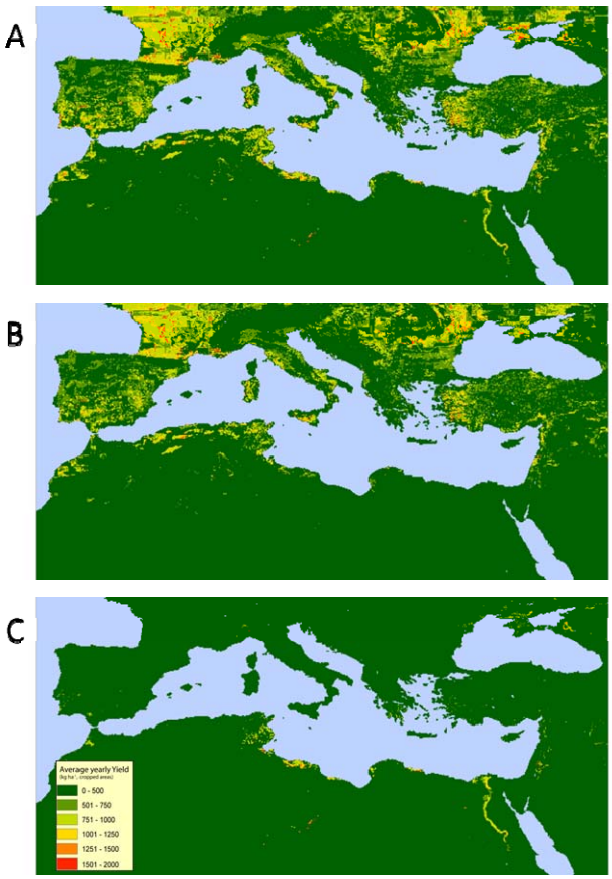

Figure S3. Average cereal yield (kg ha^{-1}). Average cereal yield calculated in PCR GLOBWB and based on 52 years of climate forcing **(A)**. The yields from rainfed **(B)** and irrigated **(C)** agriculture are shown separately.

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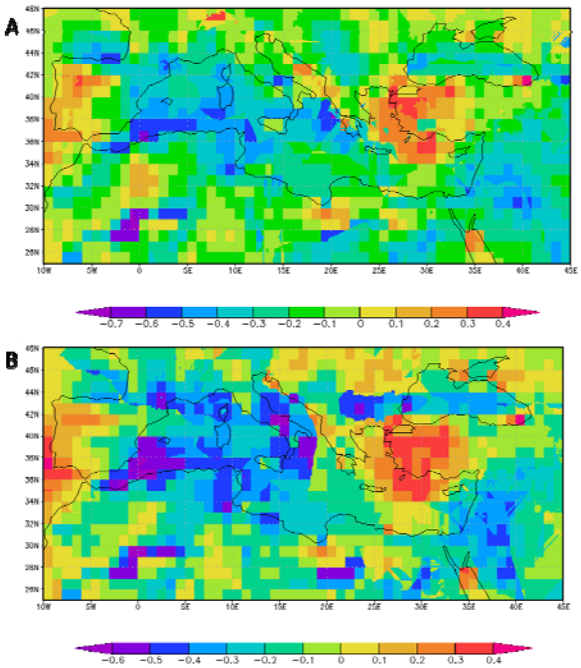

Figure S4. Correlation between temperature and precipitation over the growing season for rainfed (A) and irrigated (B) cereals. There is a negative correlation between temperature and precipitation in most of the Mediterranean apart from Western Turkey, the Western Balkans and Portugal.

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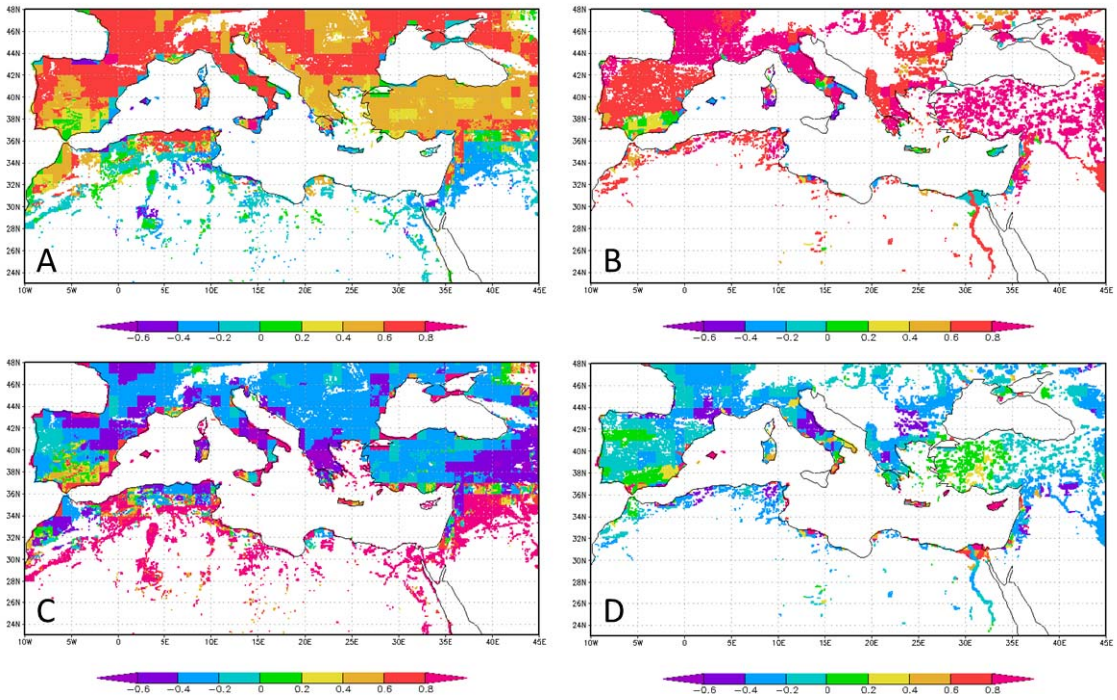

Figure S5. Correlation between temperature and precipitation over growing season with yields in rainfed and irrigated land. The correlation between temperature and yield in rainfed **(A)** and irrigated **(B)** land. The correlation between precipitation and yield in rainfed **(C)** and irrigated **(D)** land.

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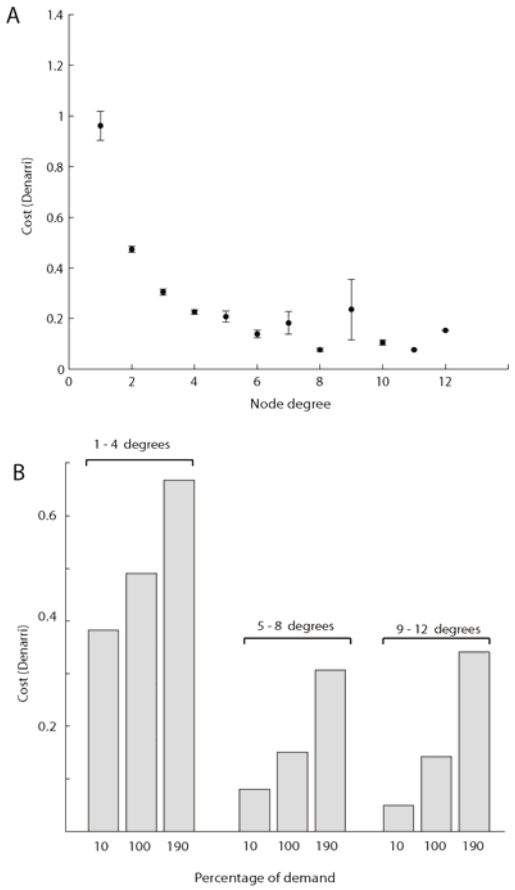

Figure S6. Cost to import VW in relation to node degree with VW of nodes and edge cost randomly redistributed. (A) Lower degree nodes generally have higher costs to import VW compared with high degree nodes irrespective of link cost or VW availability at the node. However certain highly connected nodes (hub nodes) have high import costs as they provide access to wider VW network for poorly connected nodes. As a result, demand at these nodes is actually the sum of demand from many nodes. Therefore nearby nodes are often depleted leading the need to import from further away with an associated increase in cost. This pattern is much stronger in the original network because a lot of hub nodes also have large populations with high demand **(B)** Costs increase incrementally across all node degrees for increases in demand when VW availability at nodes and edge costs are randomly distributed in the network.