Sensitivity analysis of climate change projection to the grid size resolution over the Mediterranean

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Introduction

- Mediterranean has been identified as one of the most prominent “Hot-Spots” in future climate change projections as it is located in a transition zone between the arid climate of northern Africa and the wet climate of central Europe.
- The complex topography and the vast coastlines suggest a fine scale spatial variability of the climatic conditions. As such, there is an increasing interest for this area.
- This study explores the sensitivity of a climate change projection to the grid size resolution.

Method

NASA GISS ModelE

Horizontal resolution 2˚ × 2.5˚ latitude by longitude
20 vertical layers (surface to 0.1 hPa)
Russell ocean model
RCP4.5 emission scenario

WRF

Dynamical Downscaling
Multinesting with grid resolustions of
108Km→36Km→12Km→4Km→1.333Km
Period: 10/2010 & 10/2050

Statistical Analysis of
Temperature / Precipitation / Wind Speed
Comparison for the corresponding
grid cells concerning
Athens and Rome

Dynamical Downscaling

- 6-hour instantaneous outputs of global modeling results from GISS ModelE were produced for regional multi-nesting downscaling by WRF
- The GISS ModelE fields include temperature, relative humidity, horizontal wind velocities, soil temperature and moisture at different soil depths, sea surface temperature, surface pressure, ice fraction and snow water equivalent.

WRF Nesting Domains

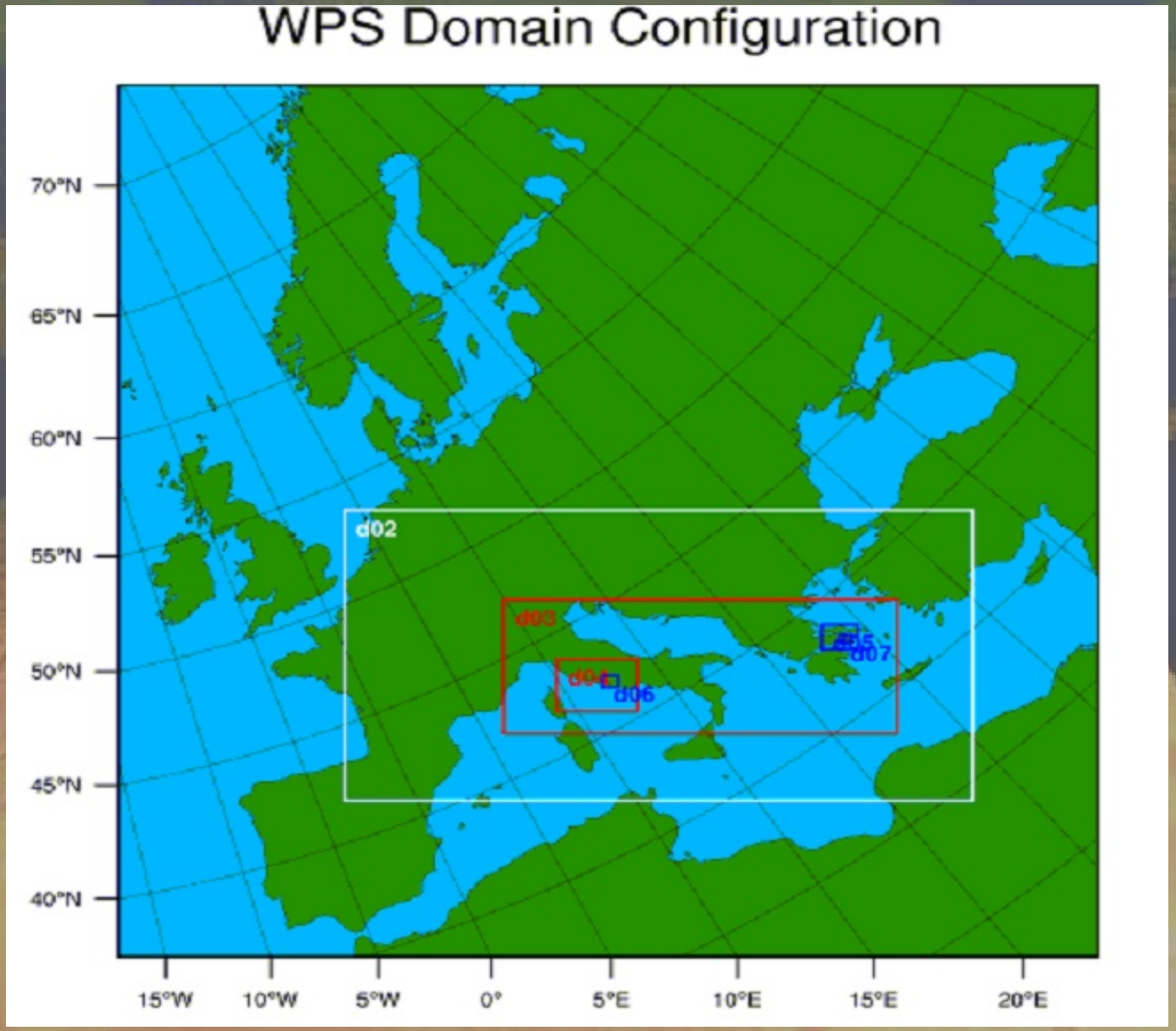
Domain 1
40x40 grid cells
108Km grid cell spacing

Domain 2
76x40 grid cells
36Km grid cell spacing

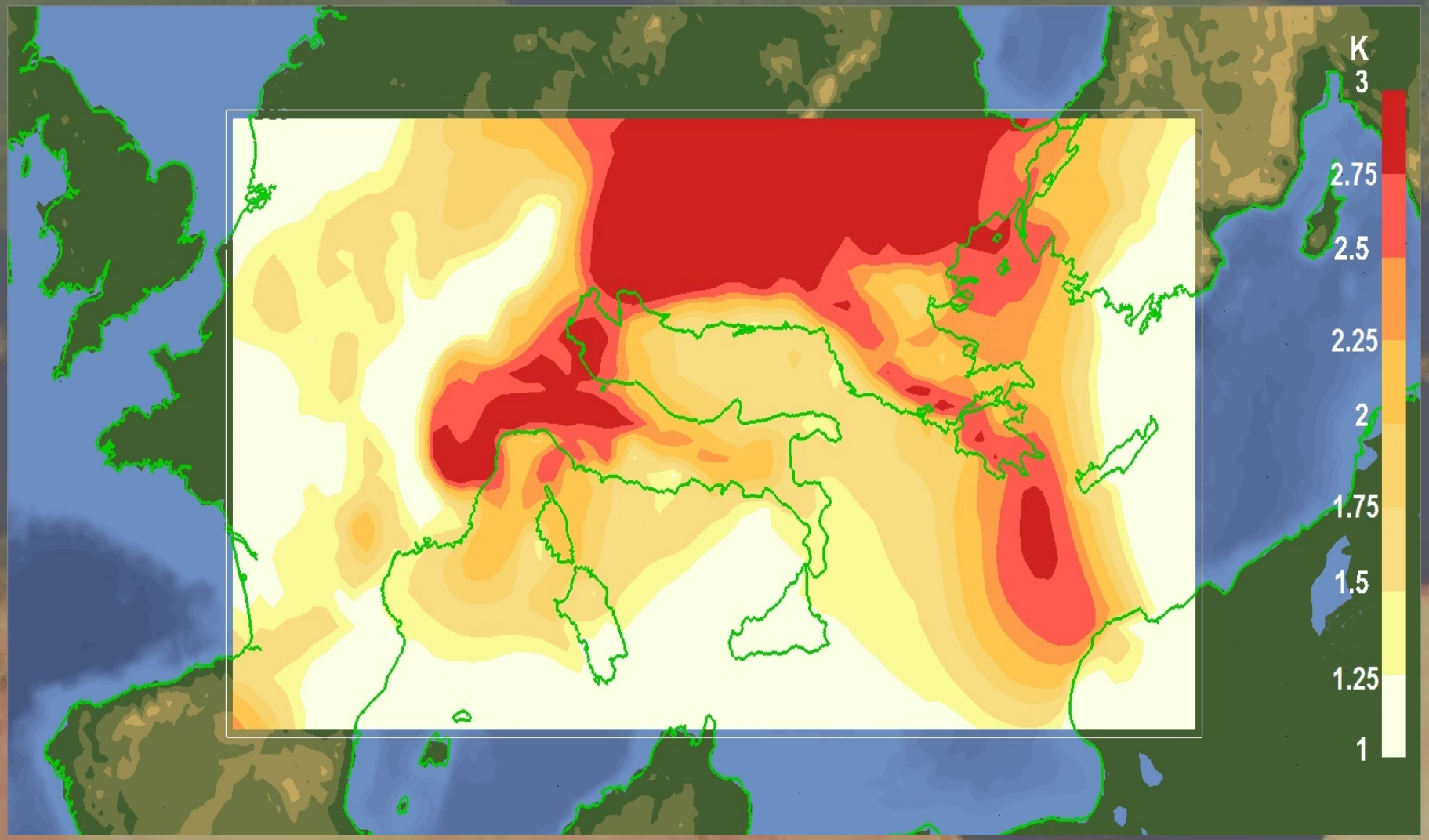
Domain 3
142x55 grid cells
12Km grid cell spacing

Domain 4 & 5
88x64 /40x31 grid cells
4Km grid cell spacing

Domain 6 & 7
52x43 /40x31 grid cells
1.333Km grid cell spacing

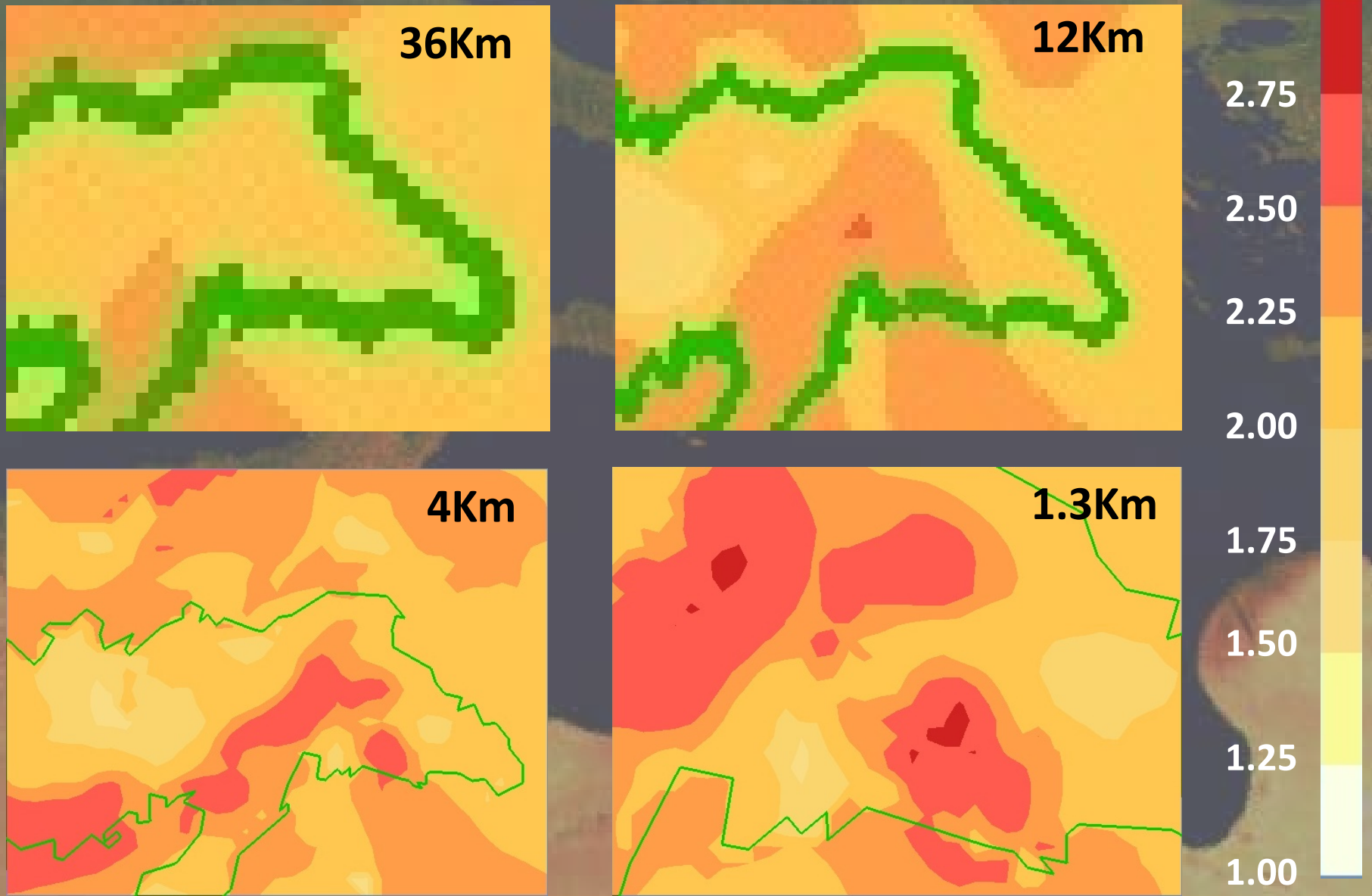


Temperature change
Grid size 36Km



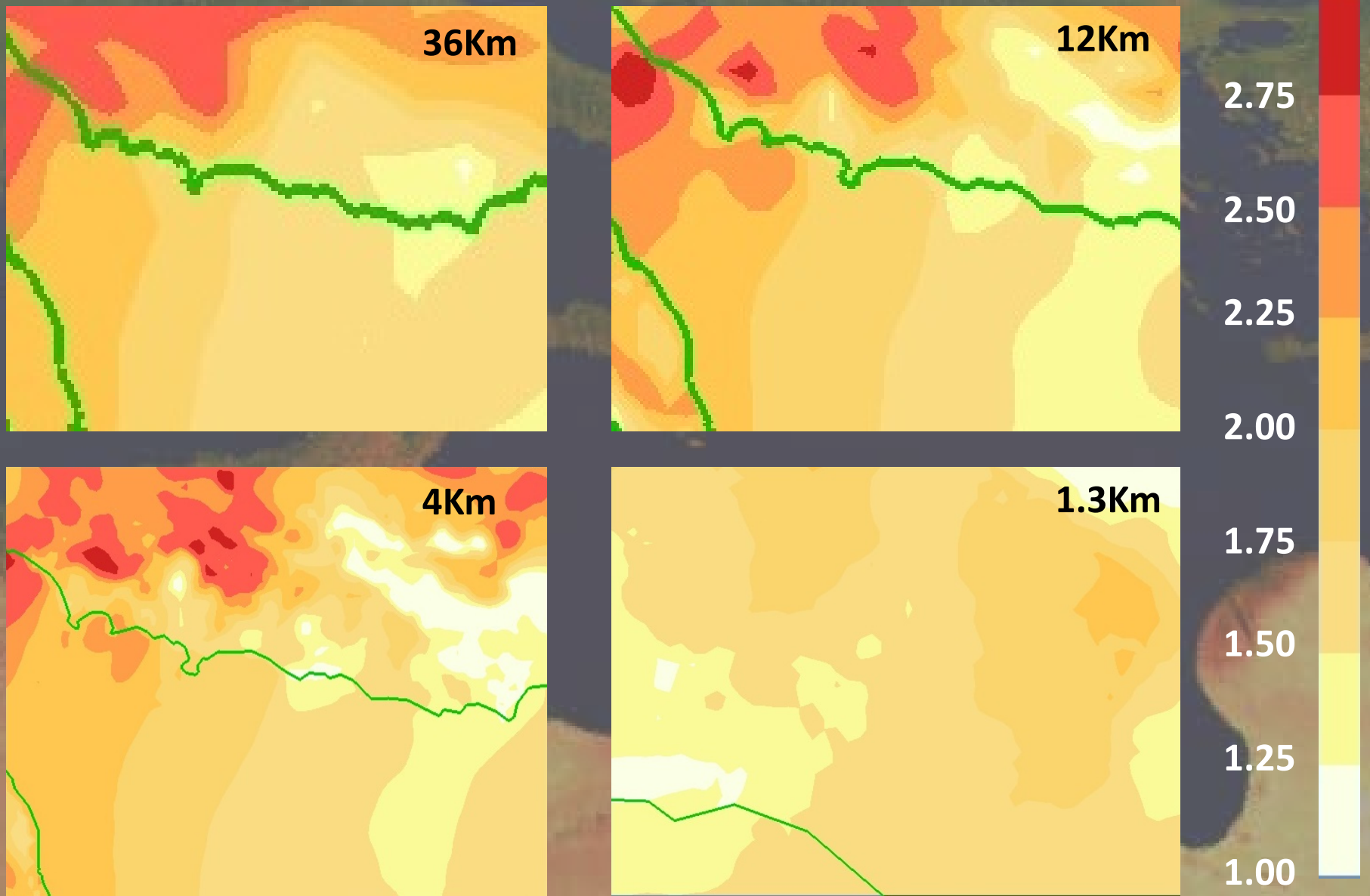
Athens

Temperature change for different spatial resolution

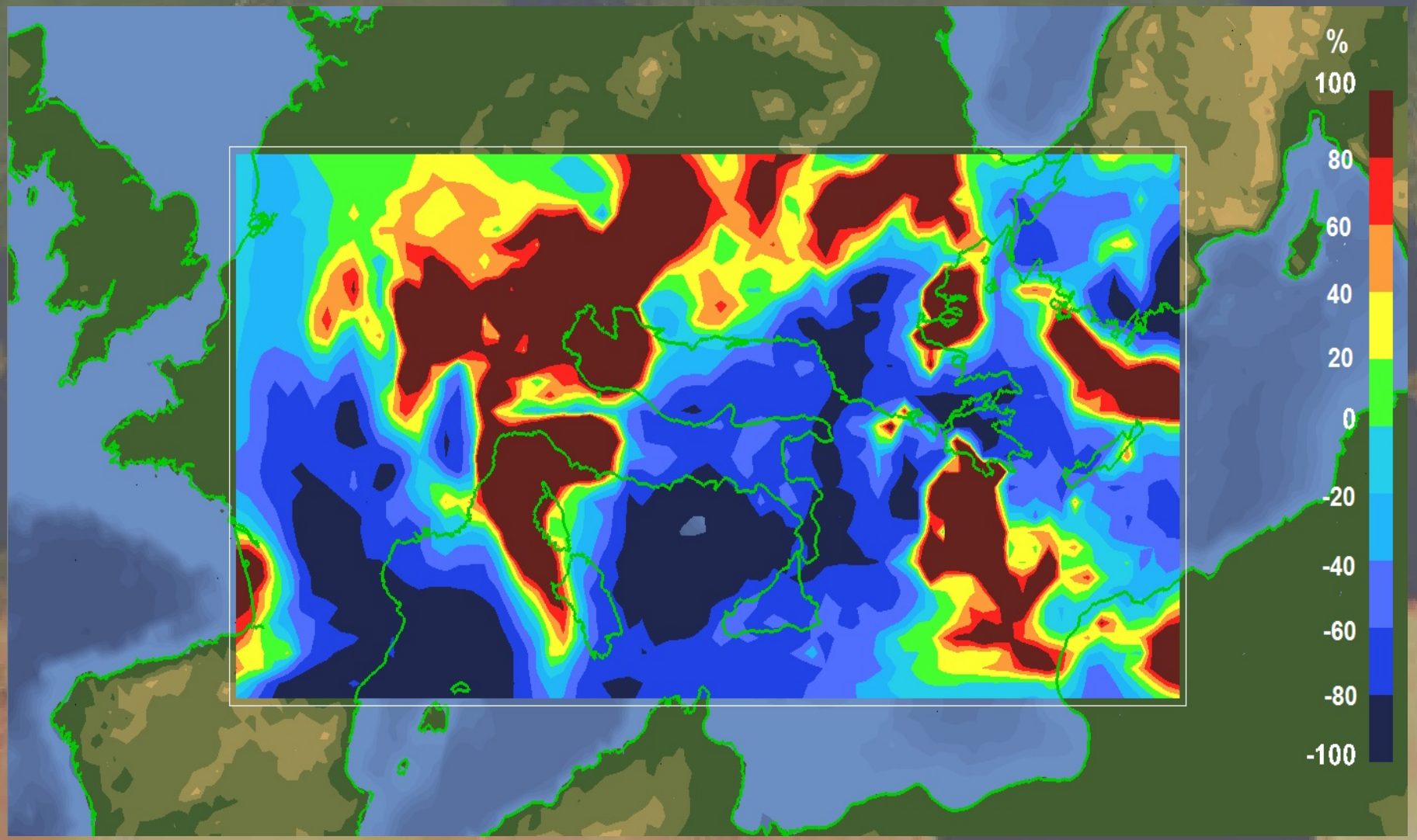


Rome

Temperature change for different spatial resolution

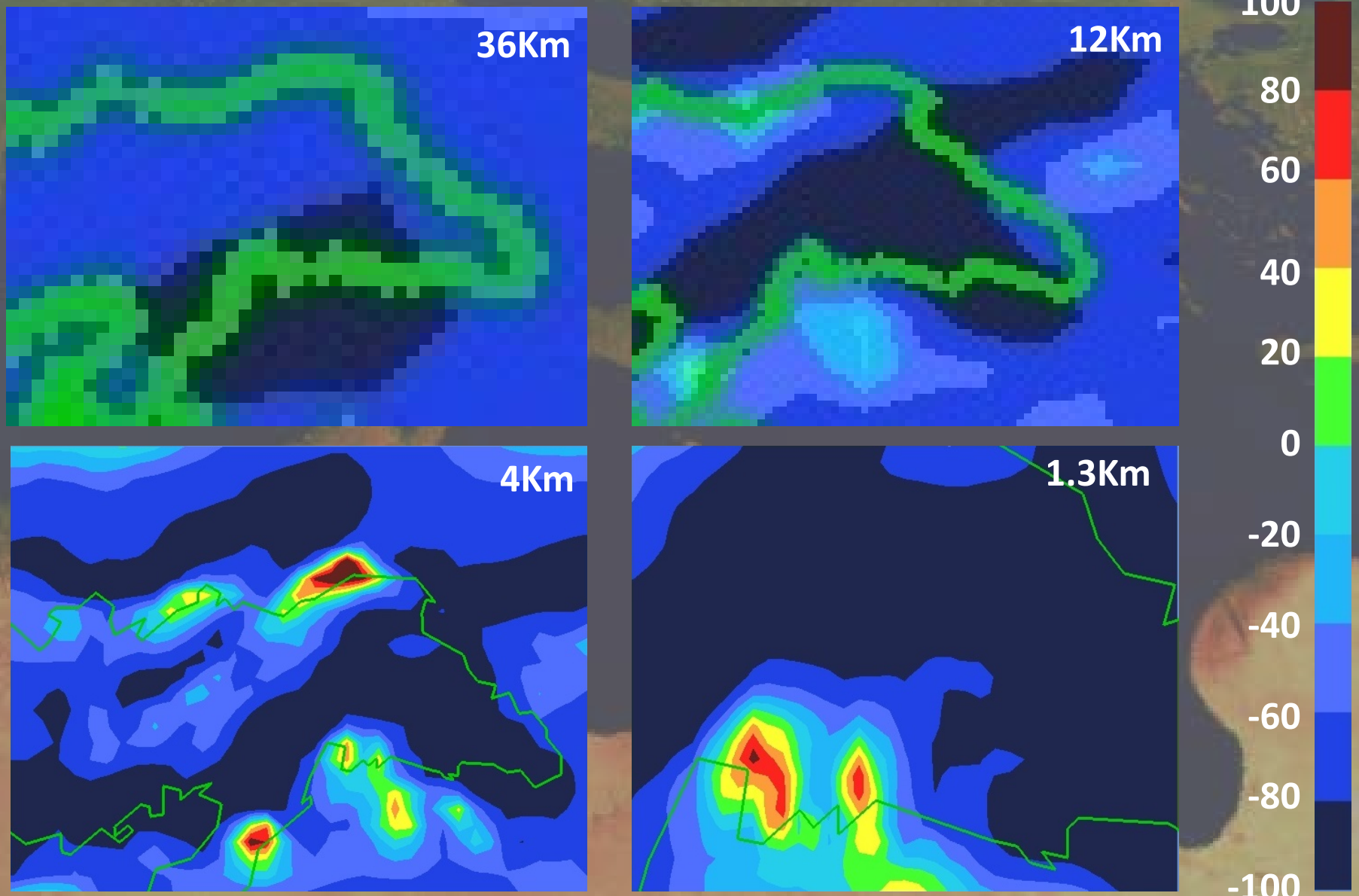


Precipitation change %
Grid size 36Km



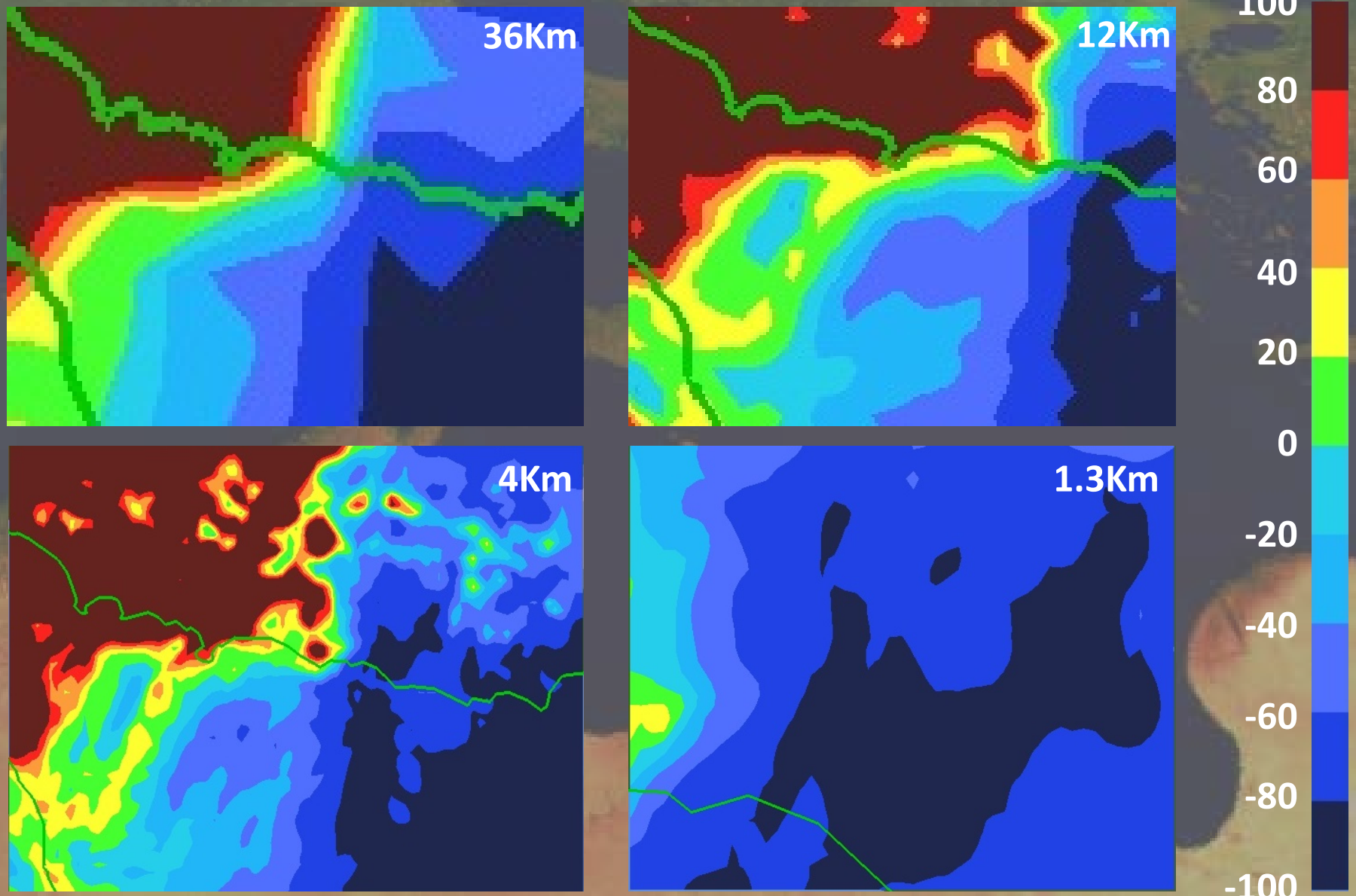
Athens

Precipitation change for different spatial resolution

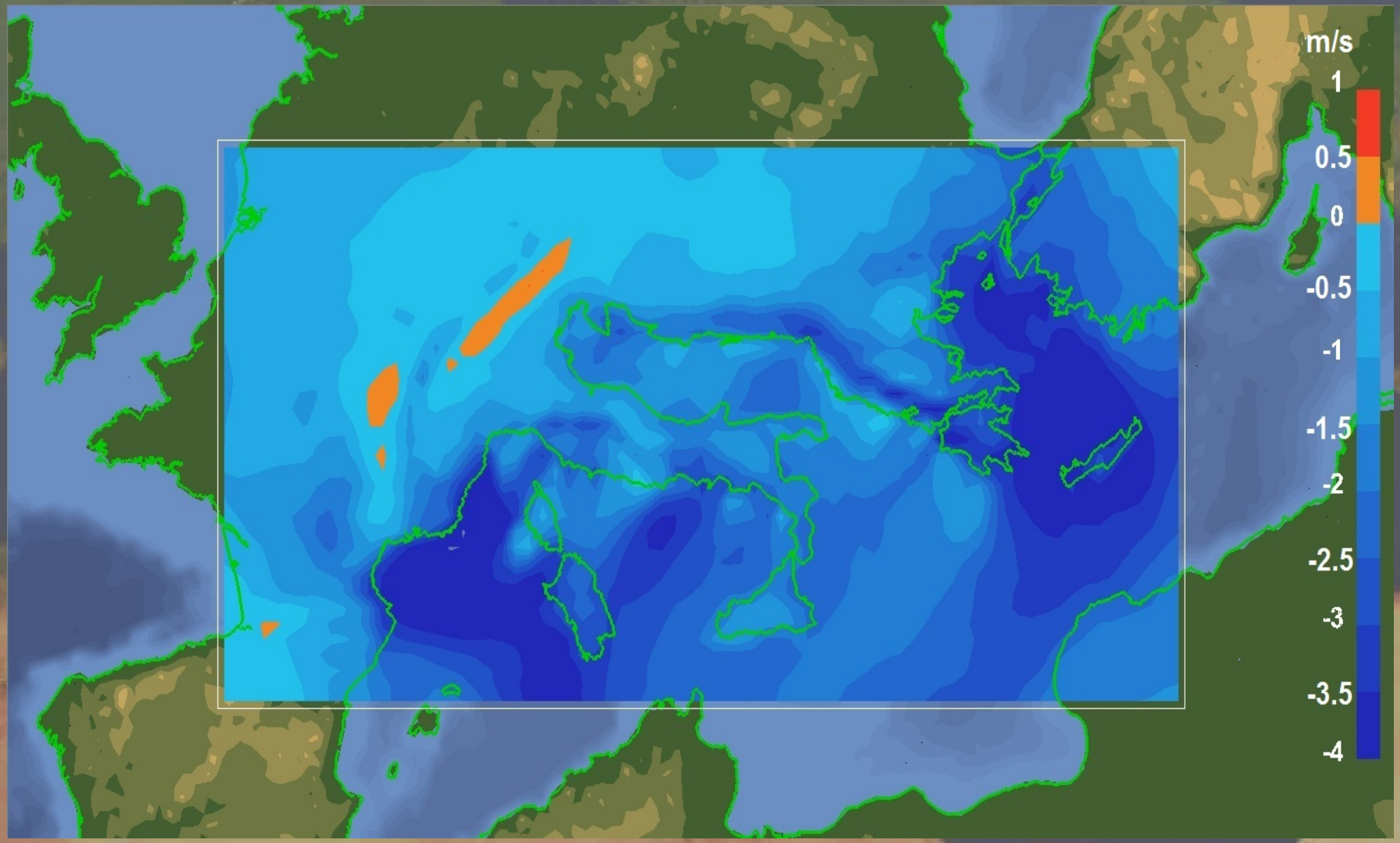


Rome

Precipitation change for different spatial resolution

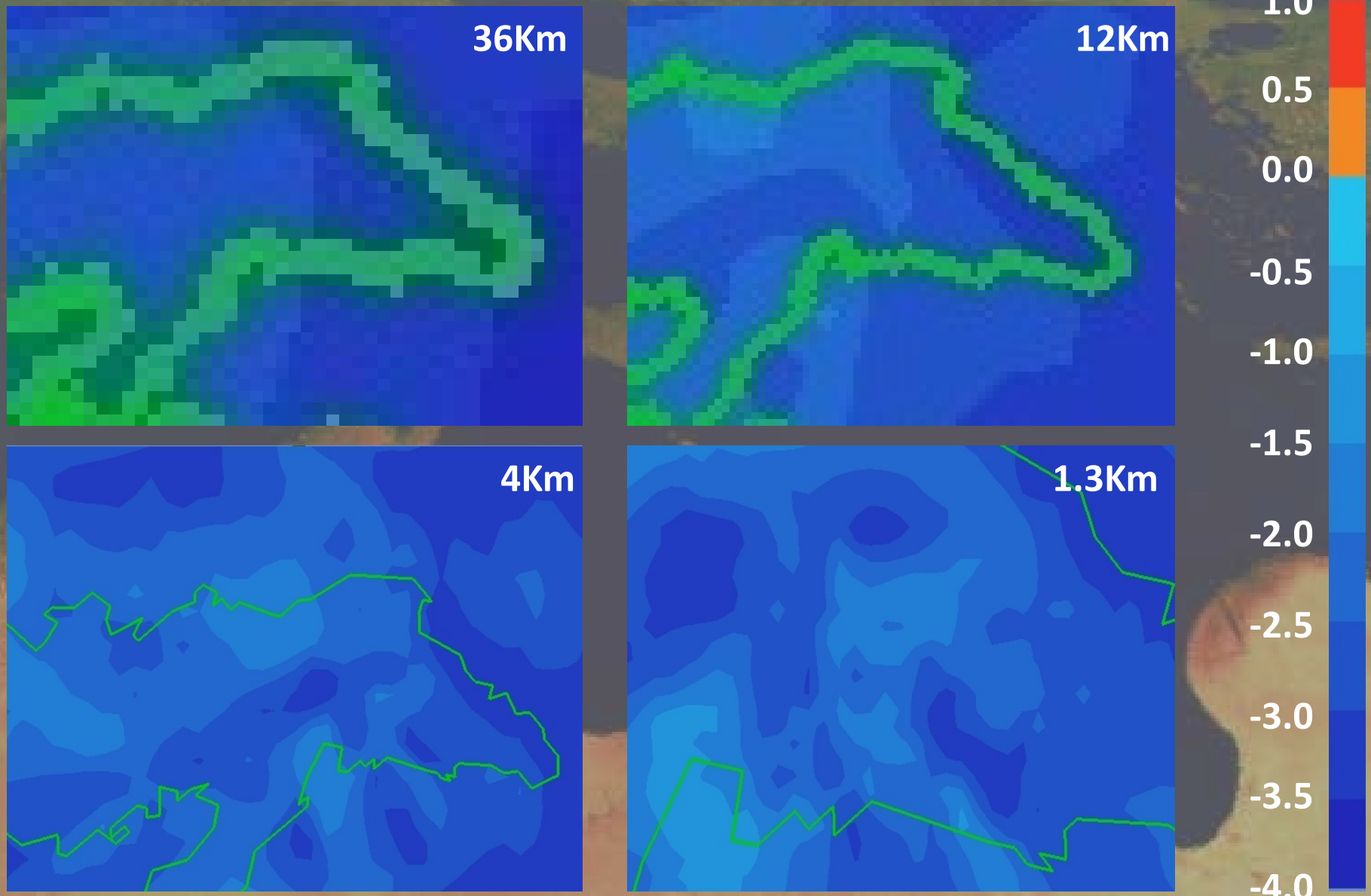


Wind Speed change
Grid size 36Km



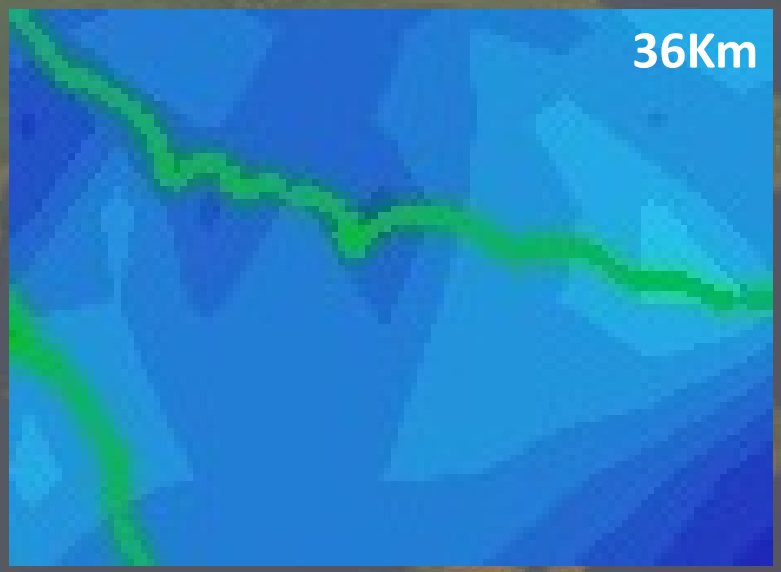
Athens

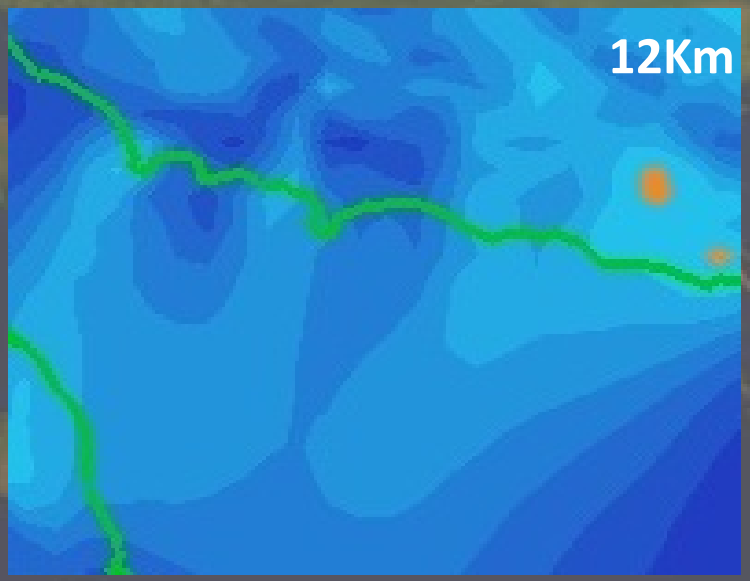
Wind Speed change for different spatial resolution

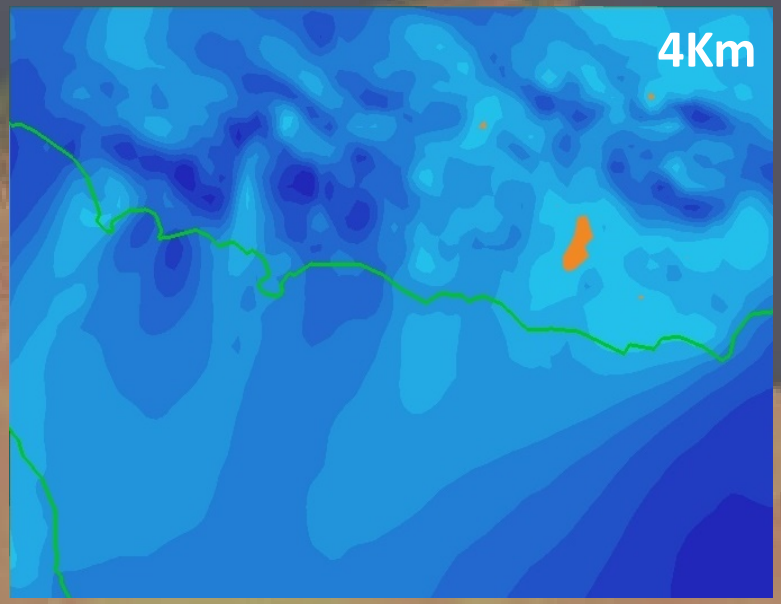


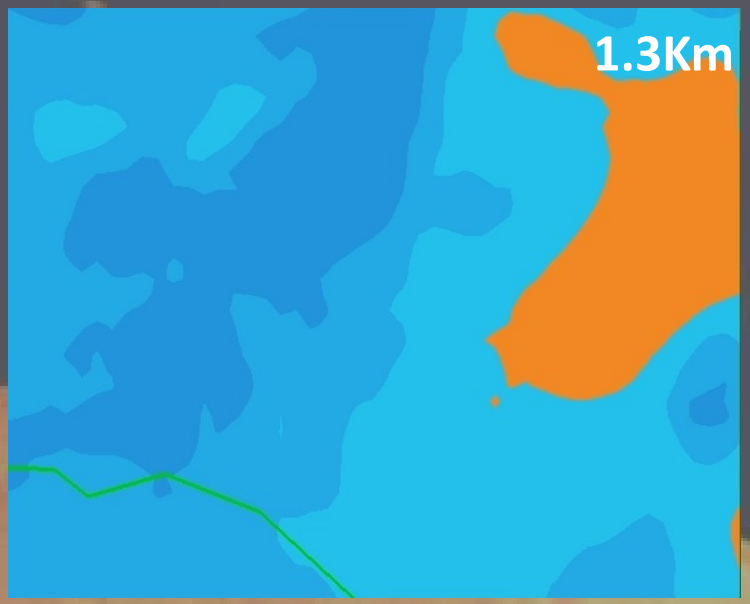
Rome

Wind Speed change for different spatial resolution

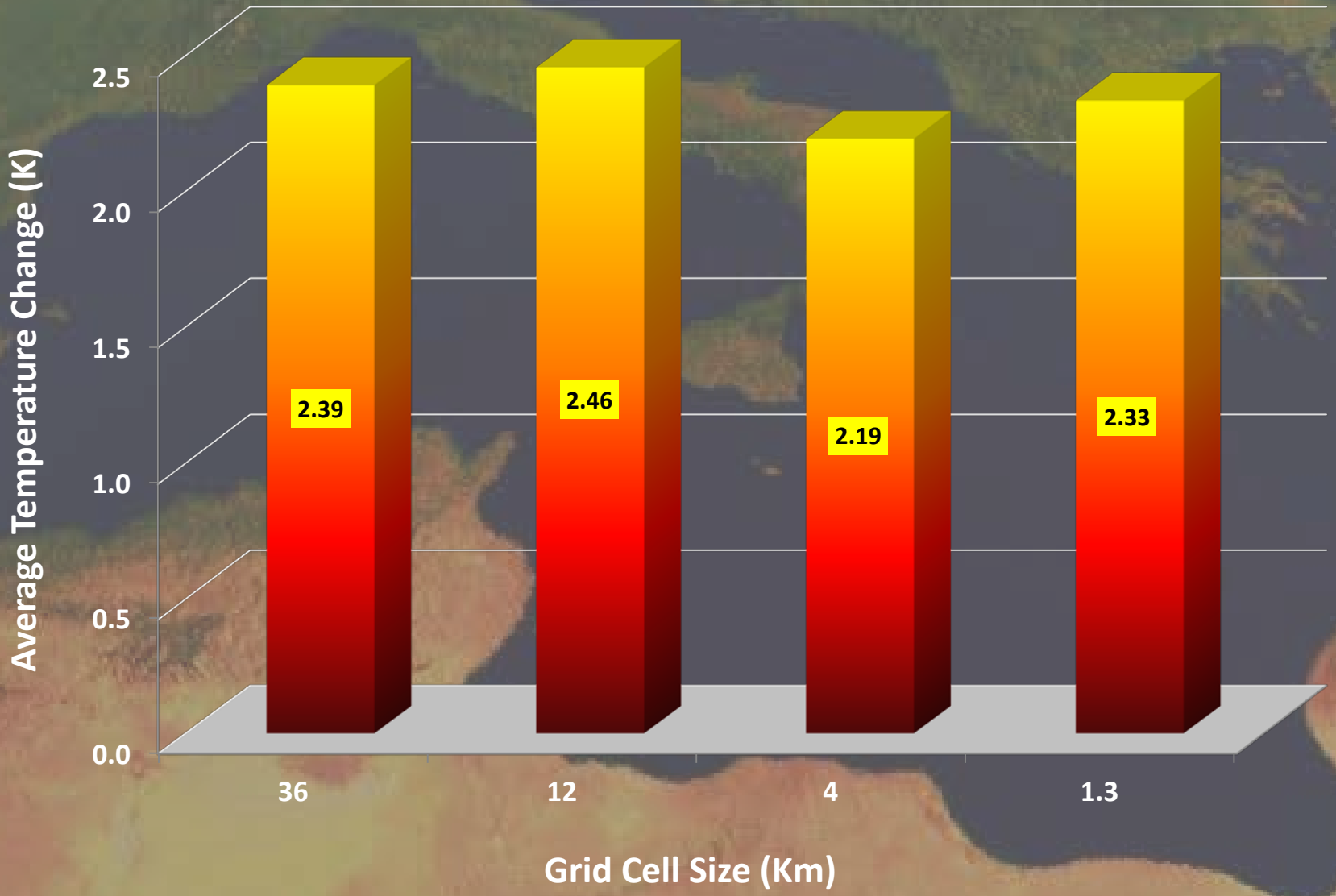




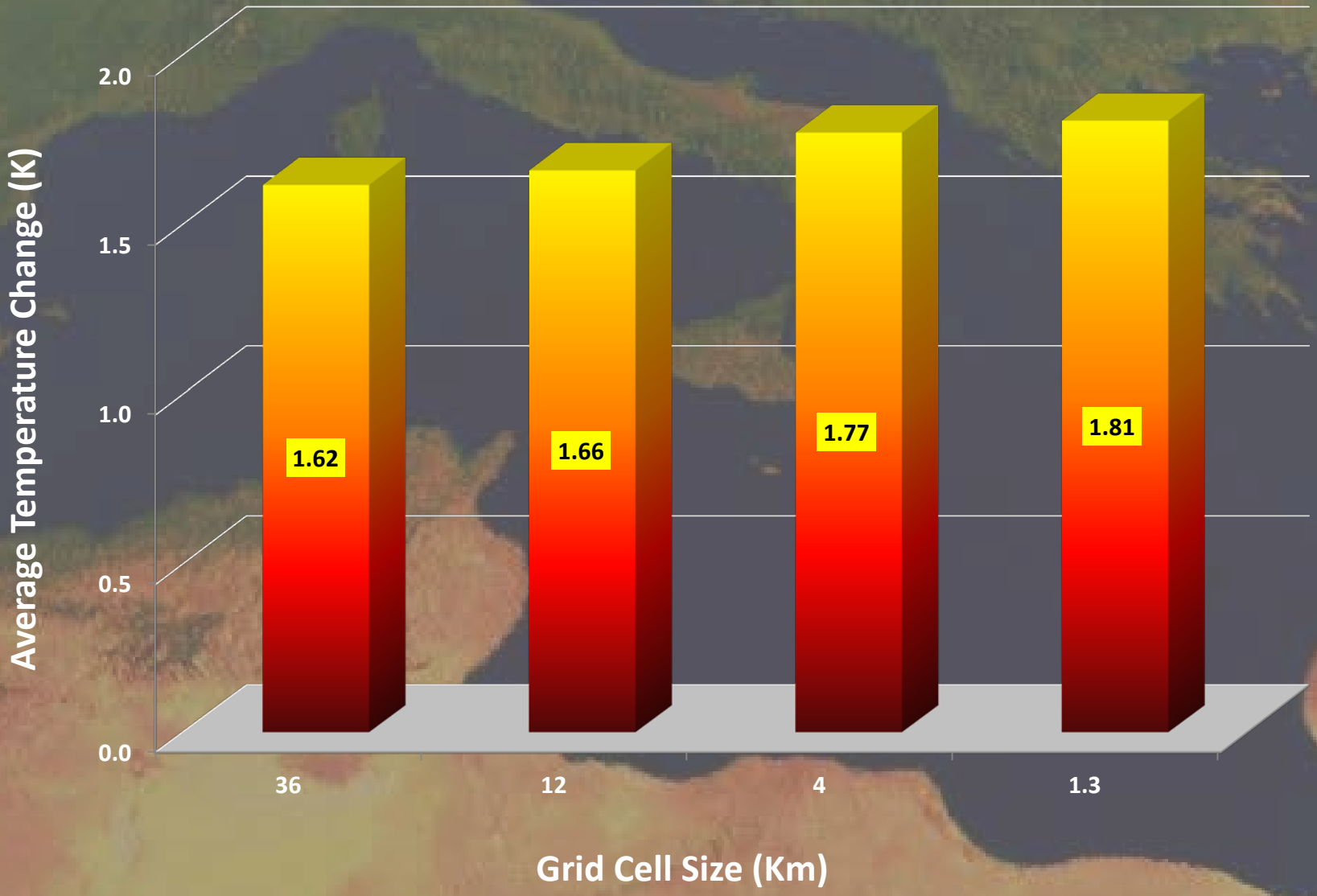




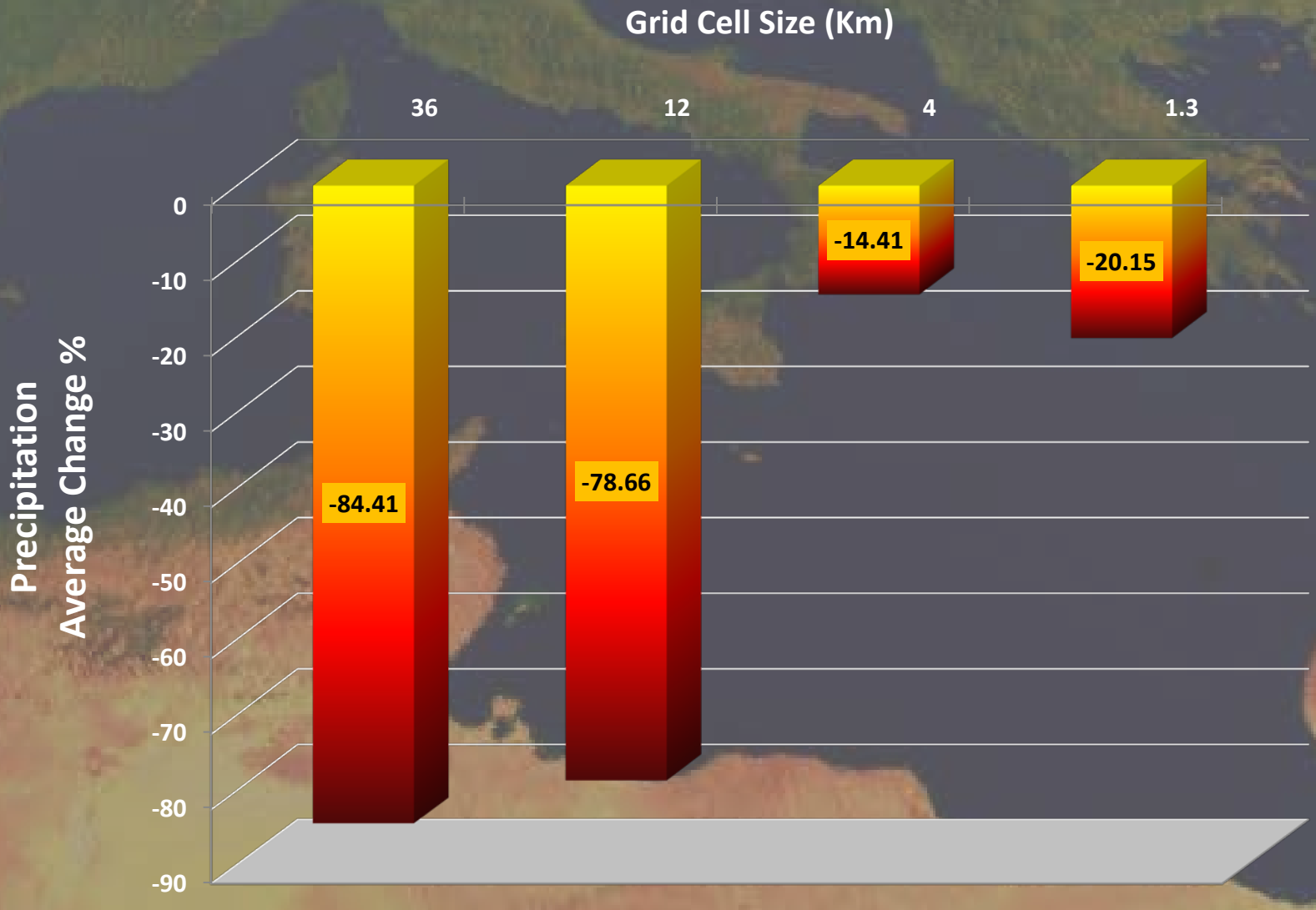
Athens
Average Temperature change



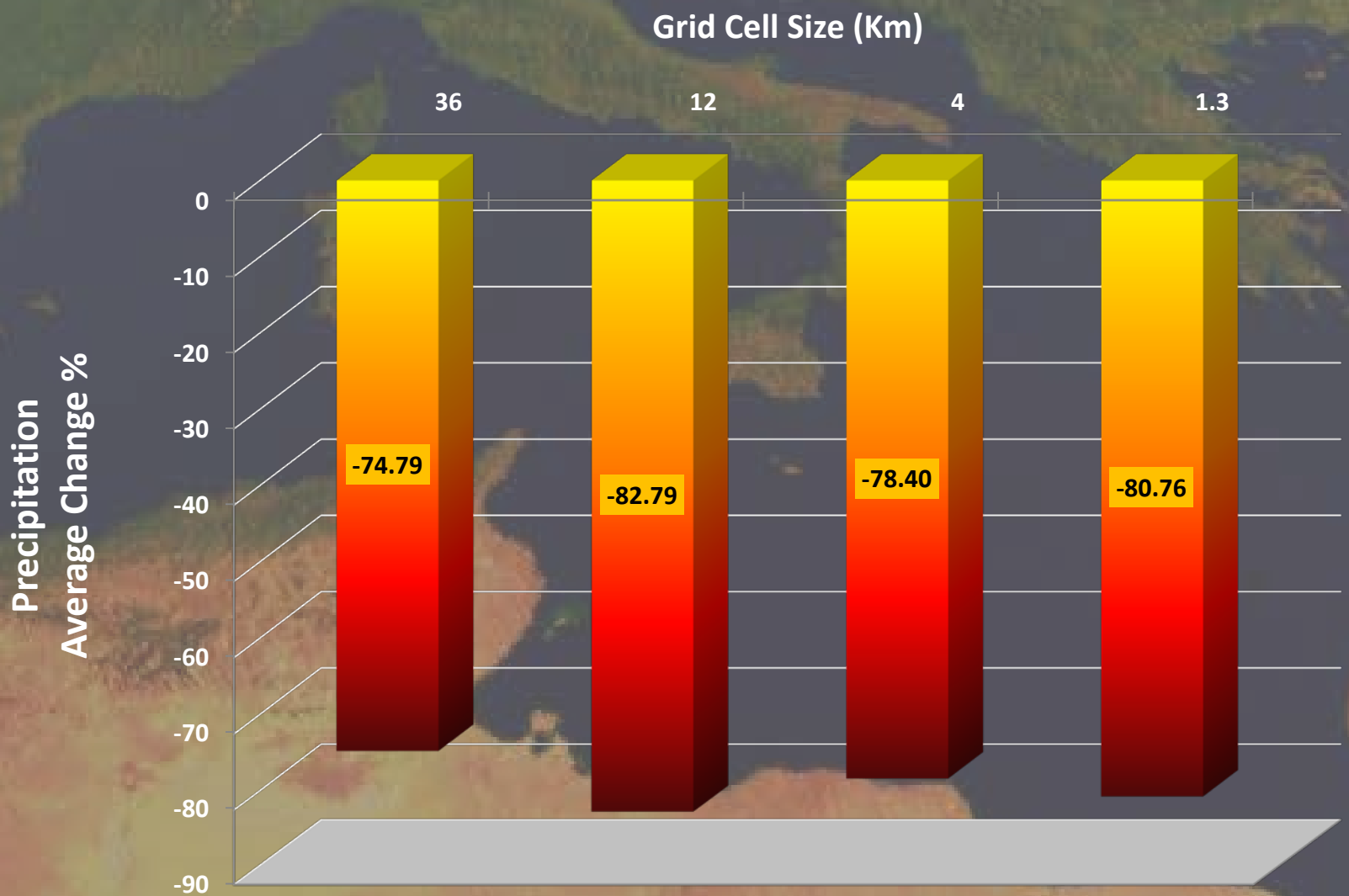
Rome
Average Temperature change



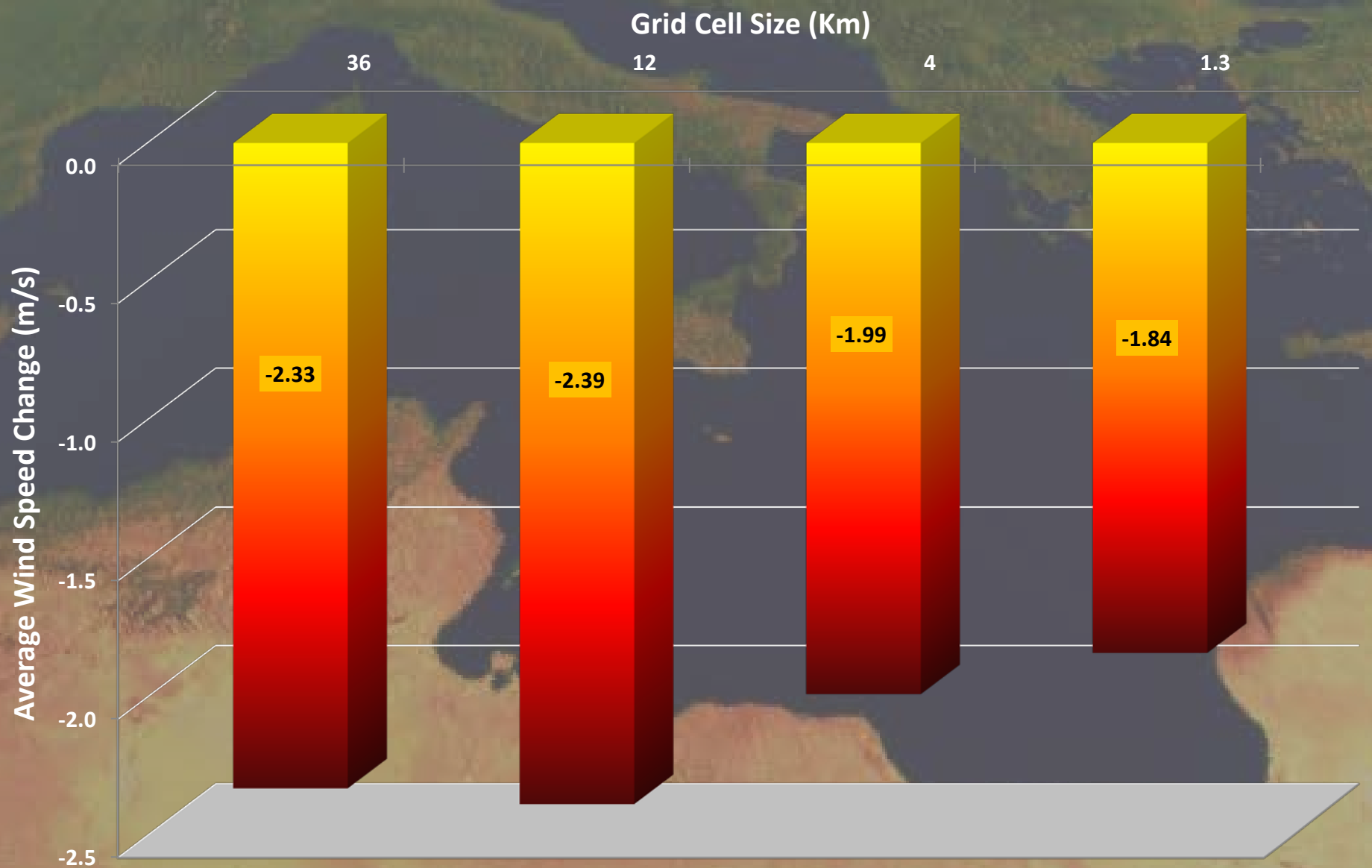
Athens
Precipitation Average change



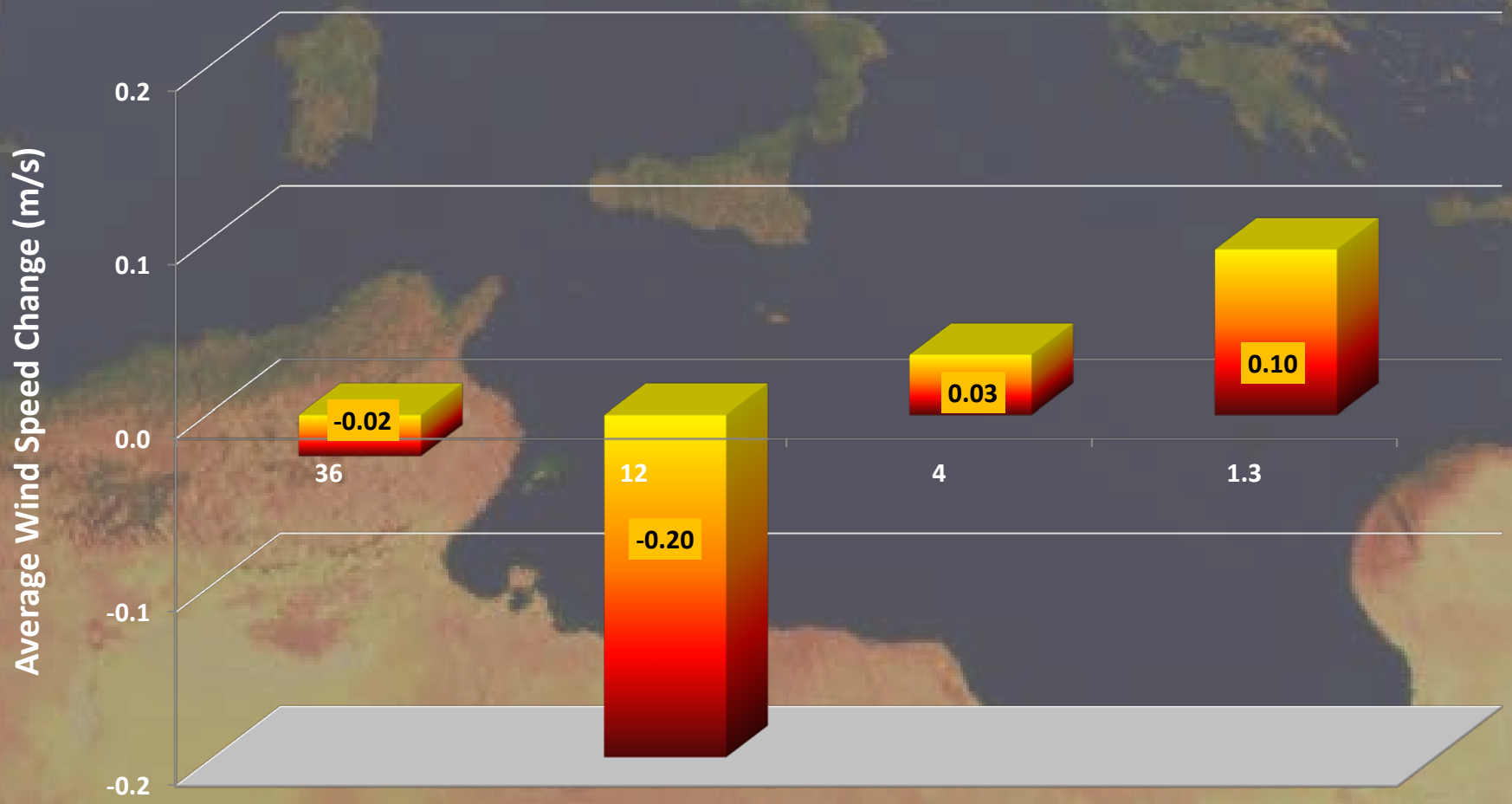
Rome
Precipitation Average change



Athens
Wind Speed Average change



Rome
Wind Speed Average change



Conclusion

- Increasing resolution :
  - Greatly modifies spatial distribution results.
  - Does not significantly improve climate change results.

- The significant difference between the average precipitation change concerning the grids of 4Km and 1.3Km over Athens, are probably caused by the complex terrain of the area.

- Further investigation is needed to solidify these results, based on long-term simulations.