SPATIAL DISTRIBUTION OF MORTALITY AND TEMPERATURE ALERT DAYS IN SPAIN DURING THE HEAT-WAVES

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1.INTRODUCTION

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Since 20th century, heat has been associated with excess of mortality

Summer 2003

mayor Heat wave

↓

Increased mortality

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In Spain, summer 2003:

- High temperatures
- Long periods
- June, July and August

Reached a Peak → August→ Notable increased general mortality affecting population over age 74 years

Geographical and temporal variability

July 2006 less intense Heat wave took place

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2.OBJECTIVE

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To compare the spatial distribution of mortality and temperature alert days in Spain during August 2003 and July 2006 using Kriging method.

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2.METHODS

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Information Sources:

Daily Mortality Monitory System of CNE

- Computerized Civil registries
- INE (National Statistic Institute)

Temperatures

- AEMET (State Agency for Meteorology)

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Estimation Mortality Alert Days

Provincial capitals and towns of over 120.000 inhabitants

Excluded small towns and villages

Reduce random variability of mortality

Enhance alert specificity

Islands no correlated with mainland Spain

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Estimation Mortality Alert Days

- Restricted age over 74 years
- Estimated expected mortality using time series:
  - 1997-2002 August 2003
  - 1998-2004 July 2006
- Variability and trend was corrected
- The expected number of deaths for each calendar day was estimated using the mean for that day and two days on either side of it, for all years included in the series.
- Used an adaptation of the Algorithmic Cumulative Sum method to estimate alert days.
- The alert threshold was set at the 90 percentile of the distribution of consecutive days of observed mortality exceeding expected during the previous two years.

Estimation Temperature Alert Days

Temperature alert day: maximum and minimum temperatures exceeded the 95 percentile of the maximum and minimum daily means for period 1971-2000

Spatial analysis

- Quantified mortality and temperature alert days in each town
- Results applied to centroid of each town
- Estimation of Risk by Ordinary Kriging

  "Spatial estimation Method based on the spatial correlation among the values observed at different distances and directions(semivariogram) which enables a value to be interpolated for points where no information is available"(Opromolla)

- The Standard Error was also calculated.

METHOD

Ordinary Kriging

$$Z^*_{OK}(u_0) = \sum_{\alpha=1}^{n(u_0)} \lambda_\alpha^{OK}(u_0) Z(u_\alpha)$$

Anisotropy,Exponential model

4 method for estimations:

- Ordinary least squares(OLS)
- Weighted least squares (WLS)
- Restricted maximum likelihood (REML)
- Maximum likelihood (MLE)

4. RESULTS

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Towns:

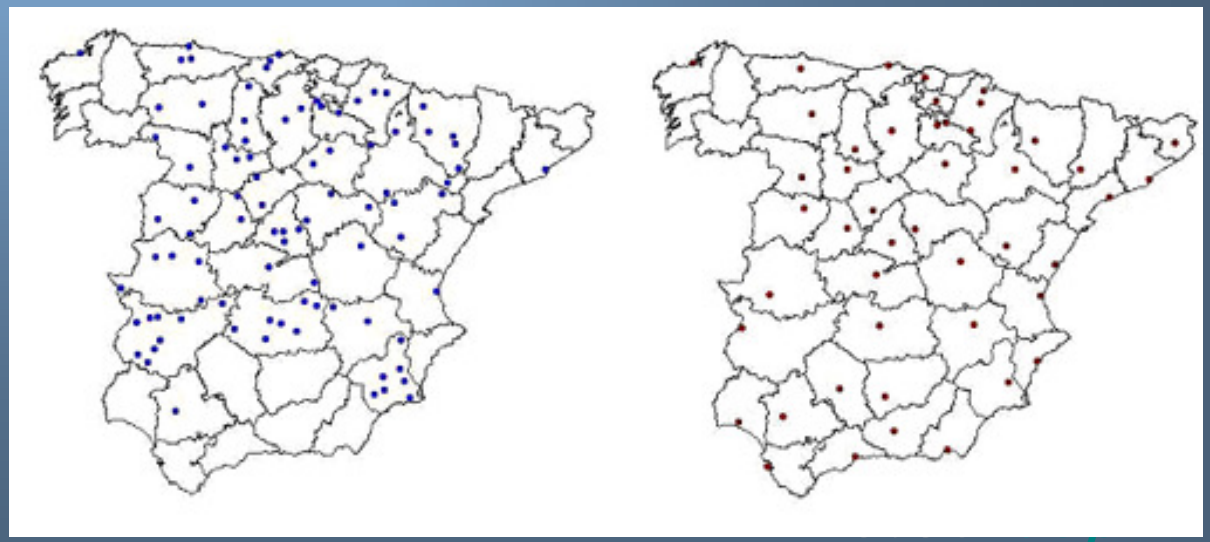
59 in 2003

41 in 2006

Meteorological Stations:

89 in 2003

47 in 2006



AUGUST 2003

Estimation risk mortality alert days

Exponential model fitted by REML

Angle 40º NE_SW direction

Estimation risk temperature alert days

Exponential model fitted by MLE

Angle 45º NE_SW direction

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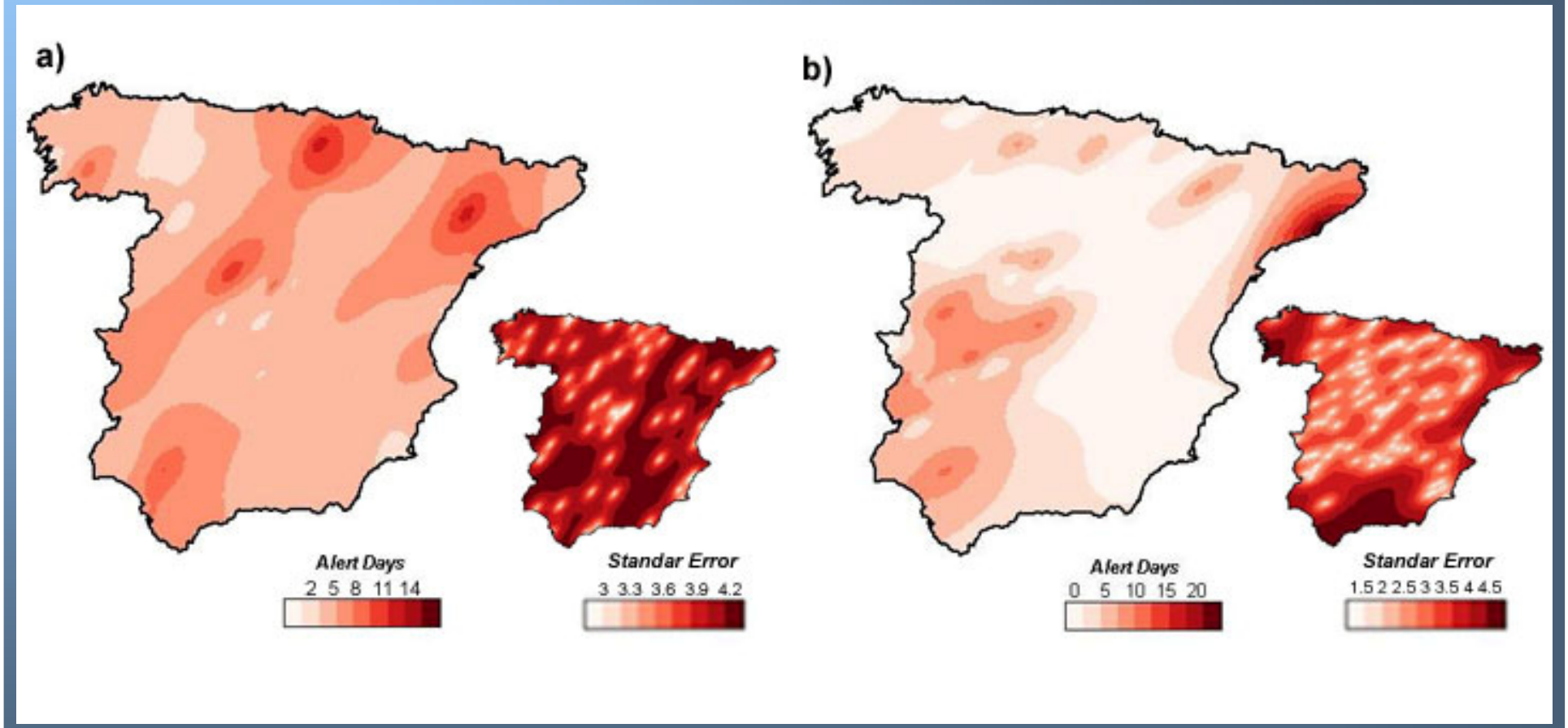
Mortality Alerts Days August 2003

Temperatures Alerts Days, August 2003



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JULY 2006

Estimation risk mortality alert days

Exponential model fitted by REML

Angle 60º NE_SW direction

Estimation risk temperature alert days

Exponential model fitted by MLE

Angle 45º NE_SW direction

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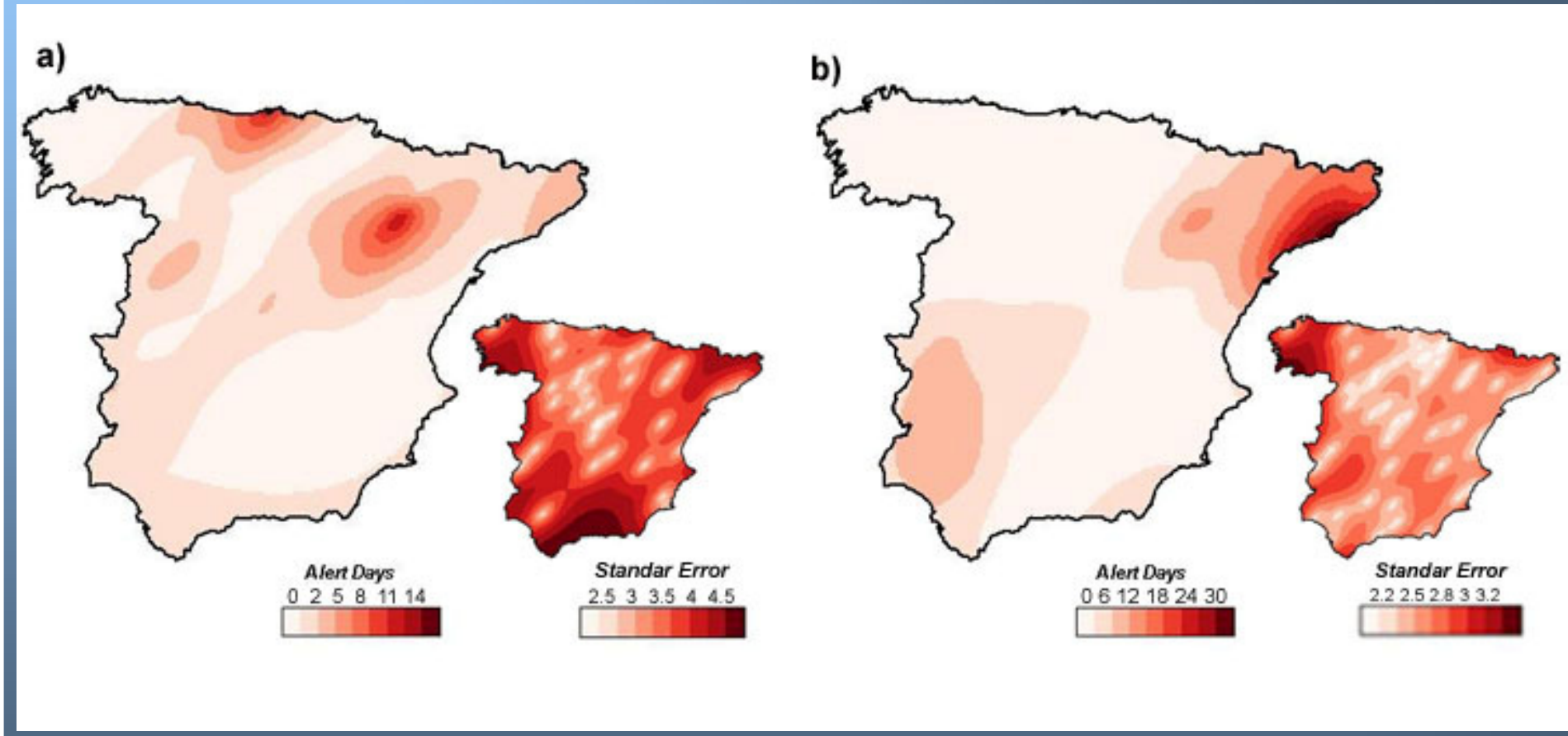
Mortality Alerts Days July 2006

Temperatures Alerts Days, July 2006



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5.LIMITATIONS

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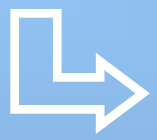
- Number of towns and high distance between them, involve a smaller degree of confidence in some areas



Standard error maps

- Mortality alert days estimations do not take in account the total numbers of deaths associated with heat.
- Temperature alert days estimations do not take in account degrees over the threshold
- Possible associated bias; Threshold for determining a mortality alert and temperature excess is not define for the same number of municipalities.

6.CONCLUSIONS

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- Possible association between the spatial distribution of risk of mortality alerts and risk of temperature alerts during periods of excessive heat.
- The longer and more intense the period of heat, the stronger this association seems to be.
- First study attempting to correlate mortality and temperatures alert days
- Multivariate methods: Cokriging and Regression Kriging
- This methods included in surveillance services can influence decision-making in Public Health.
- This the direction we are currently working on


Thanks
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