

2003 Heat Wave Project

La Canicule de 2003 en Europe

Etude de l'impact de la canicule d'août 2003 sur la population européenne

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Depending on data source, methodology and reference period

2003: 35,000 (Larsen)

2004: over 30,000 (UNEP)

2004: between 22,000 and 35,000 (Schär and Jendritzky, 2004)

2005: Over 35,000 (WHO, 2005)

2005: About 45,000 (Kosatsky, 2005); the previously published estimate of 22,080 early August excess deaths should be revised upward by 100% or more if heat events that occurred during June and July 2003 are also taken into account.

2006: Over 30,000 (Haines et al, 2006)

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2006: Over 38,000 in 7 countries (Sardon)

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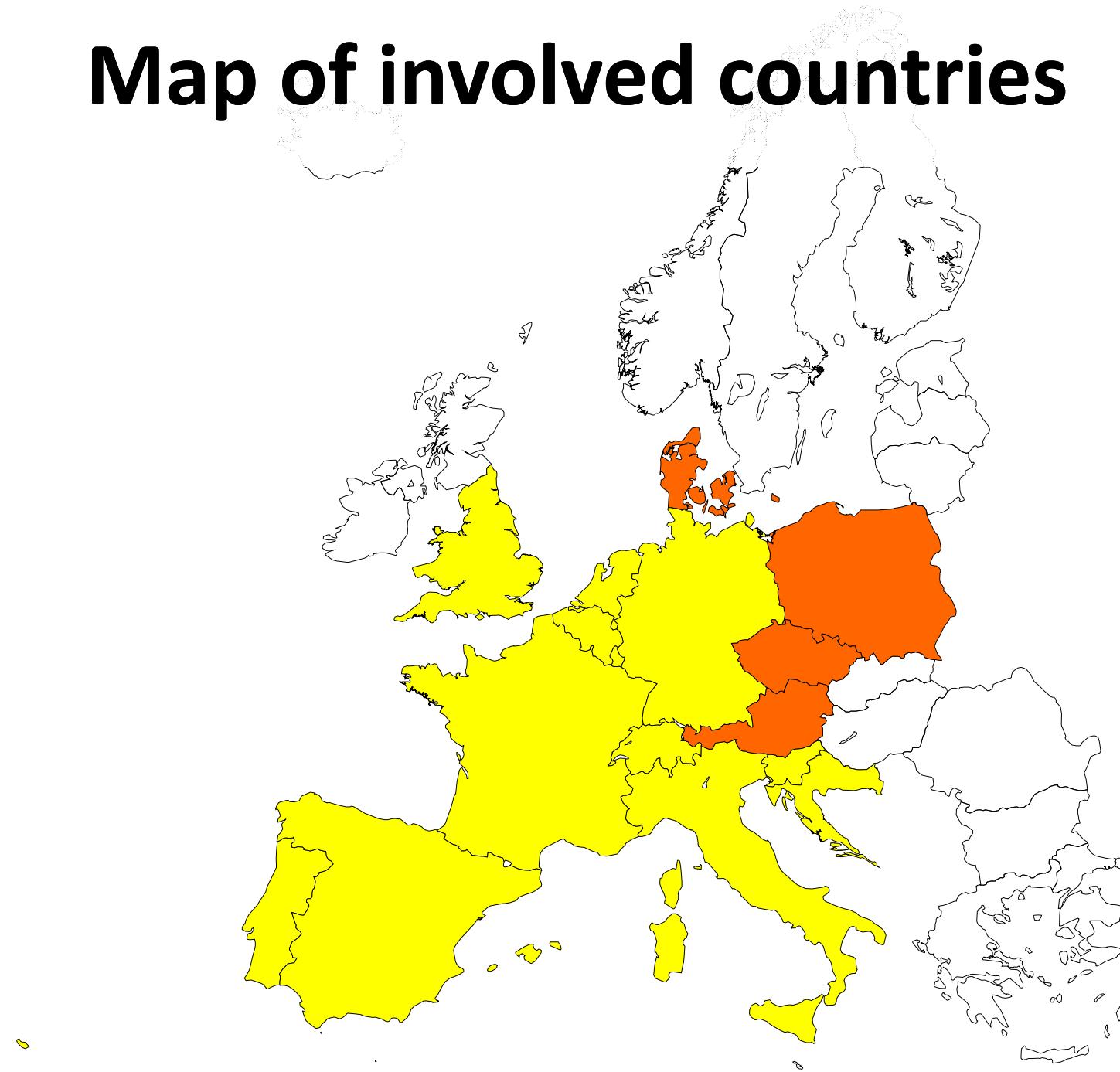
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Methods: Daily numbers of deaths at a regional level from January 1st 1998 onwards were collected in sixteen European countries. Summer mortality was analysed for the reference period 1998-2002 to set thresholds for extreme values.

Variations in daily mortality were examined by calculating the delta between the number of daily deaths observed in 2003 and the reference period.

Death frequencies were used to compare countries and regions.

Map of involved countries



Acknowledgment

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Raquel Álvarez Esteban, Instituto Nacional de Estadistica, Spain ;
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Dominik Ullmann, Office Fédéral de la Statistique, Switzerland;
Clare Griffiths, Office for National Statistics, United Kingdom for data collection.

(1) The seasonality of deaths in Europe
(reference period 1998-2002)

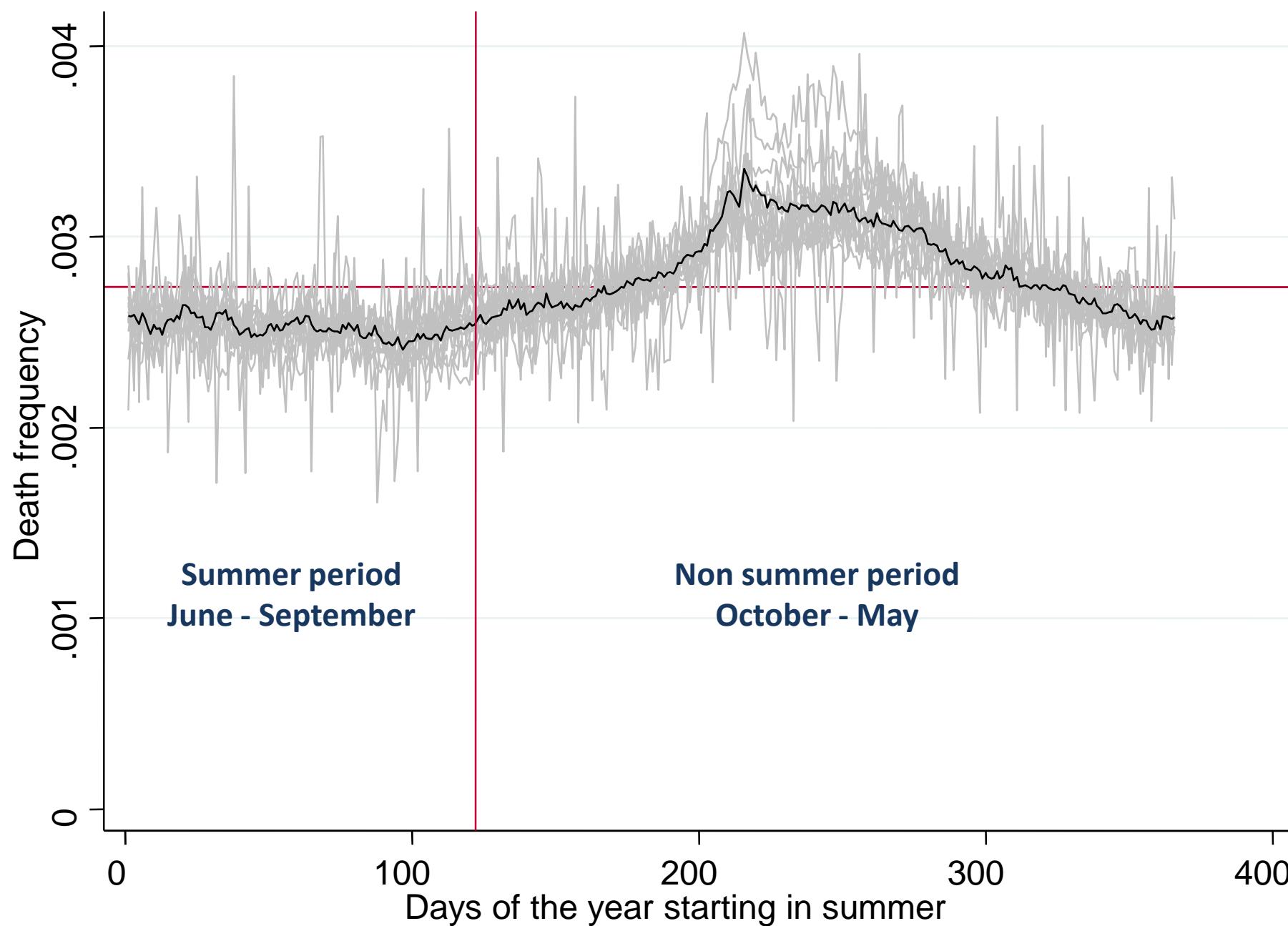


Table: R squared (expressed as a percentage) of weighted, robust polynomial regressions, used to determine the proportion of variance of the daily death frequency explained by day of the year for each set of mortality conditions (summer and non-summer), sixteen European countries from 1998 to 2002

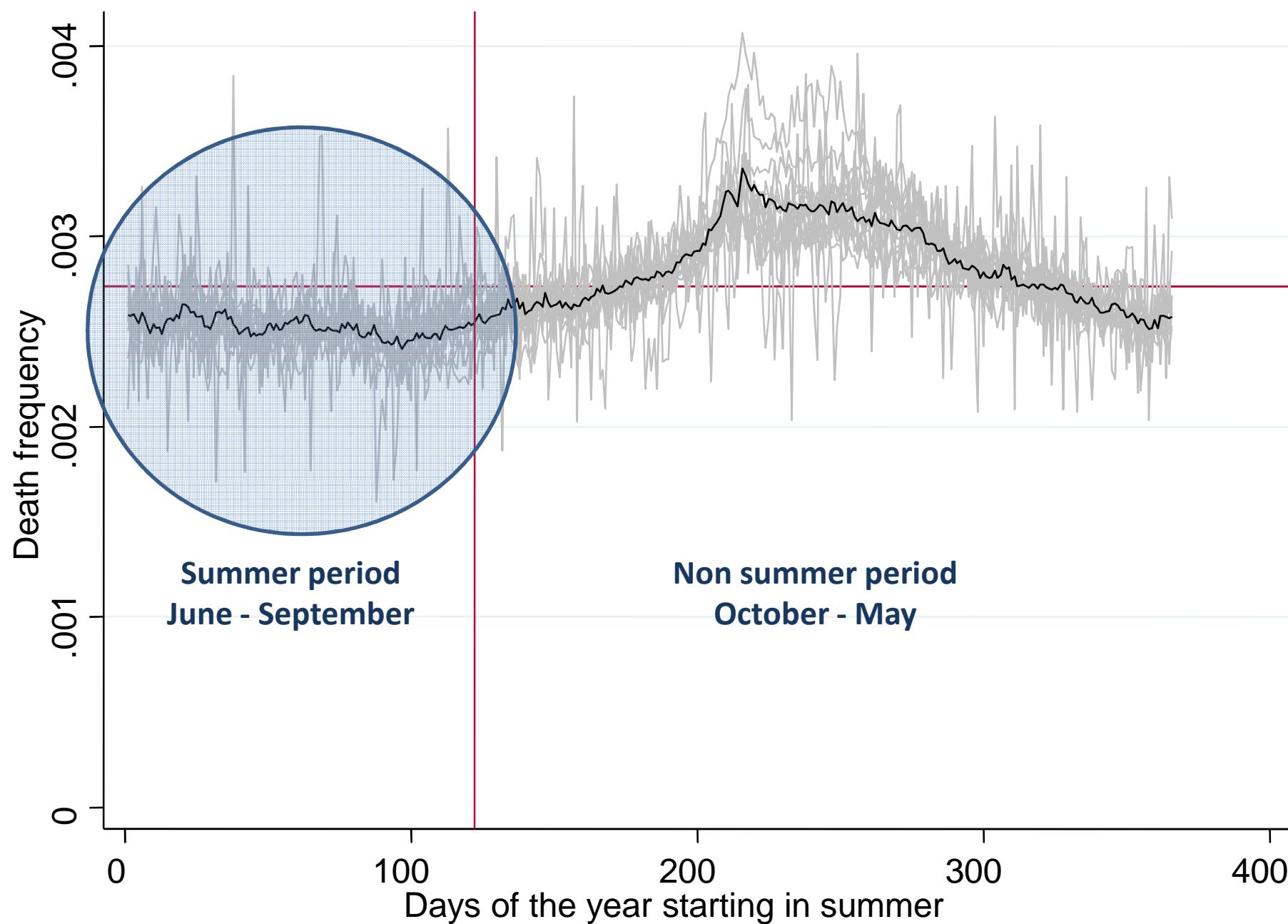
		June to September		October to May	
		Crude	Adjusted	Crude	Adjusted
Year		5.8	--	0.5	--
Country		4.8	--	0.4	--
$y = a_0 + a_1x$	Day	2.4	13.0	0.1	1.0
$y = a_0 + a_1x + a_2x^2$	Day	2.5	13.1	37.3	38.2
$y = a_0 + a_1x + a_2x^2 + a_3x^3$	Day	3.1	13.7	37.4	38.3
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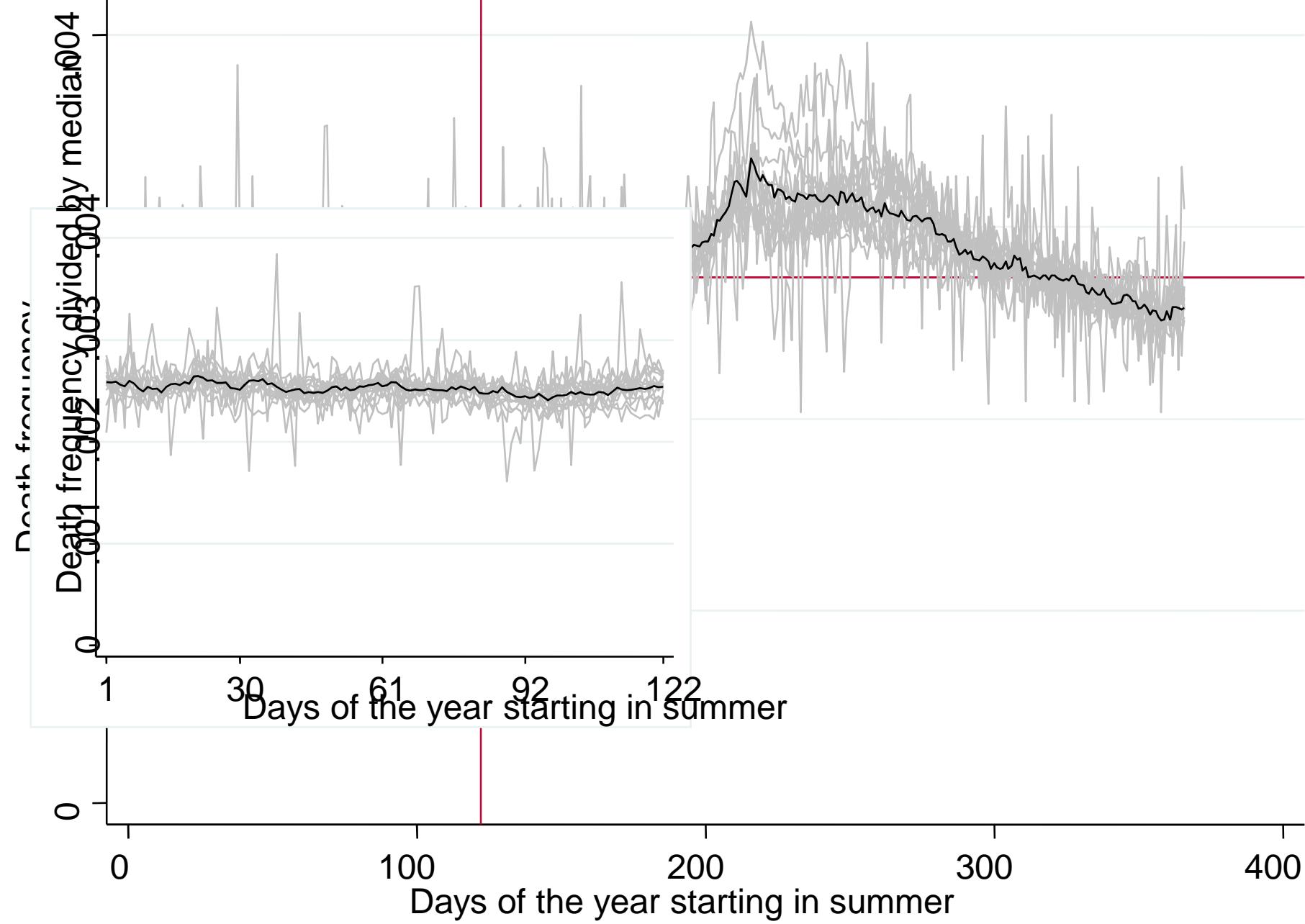
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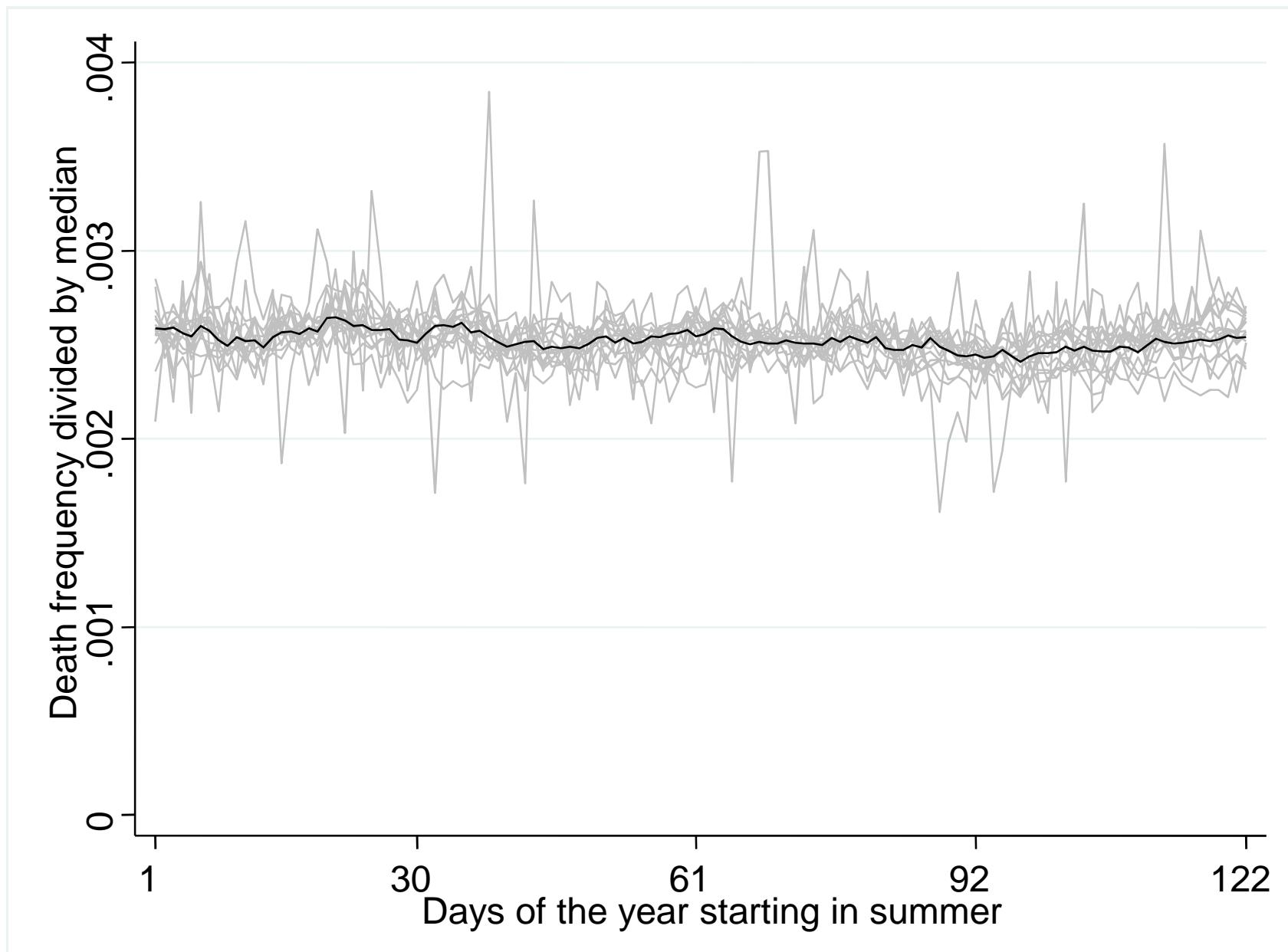
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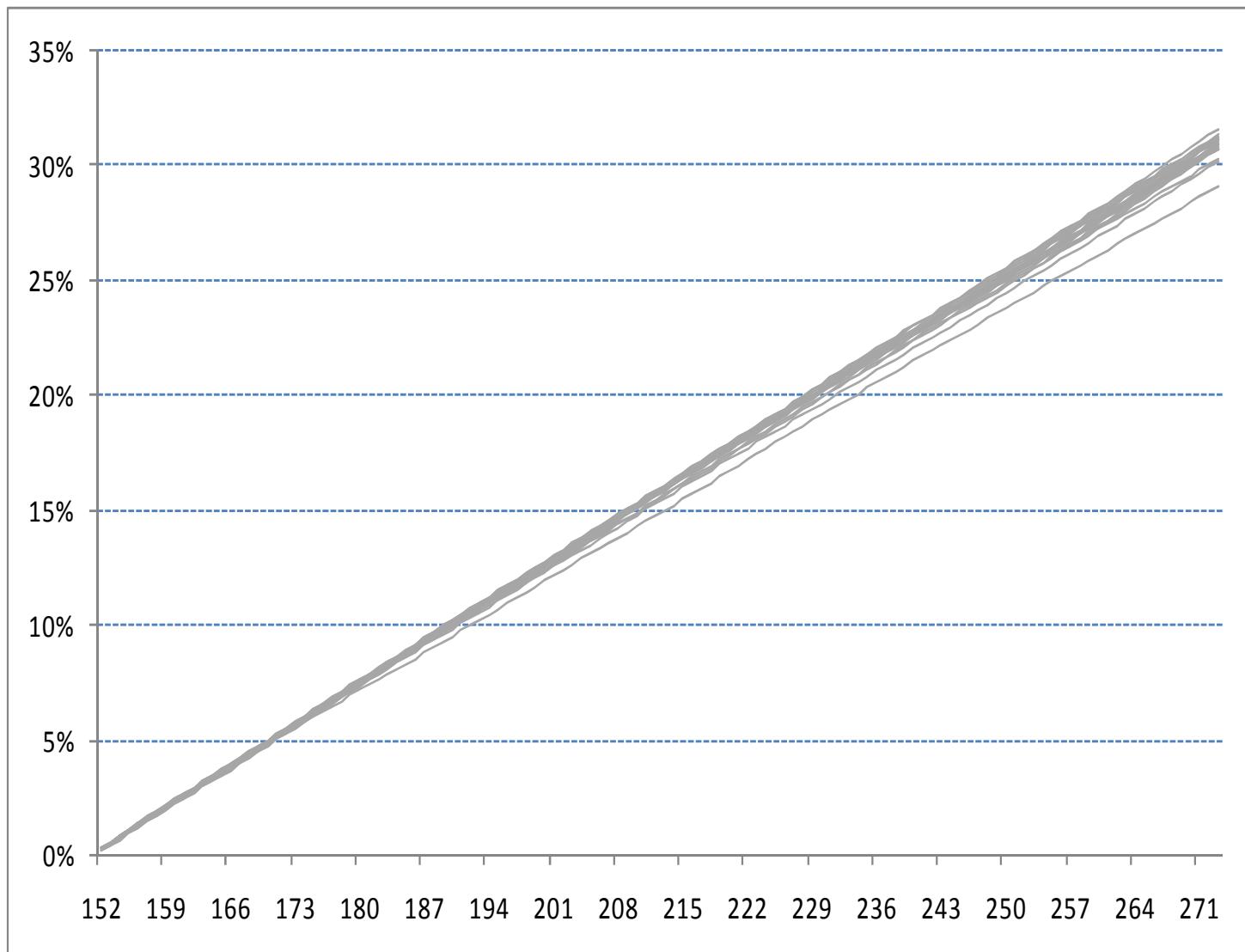




**Distribution of the daily death frequency during summer, from June 1st to September 30th,
for each of the sixteen European countries, 1998 to 2002**



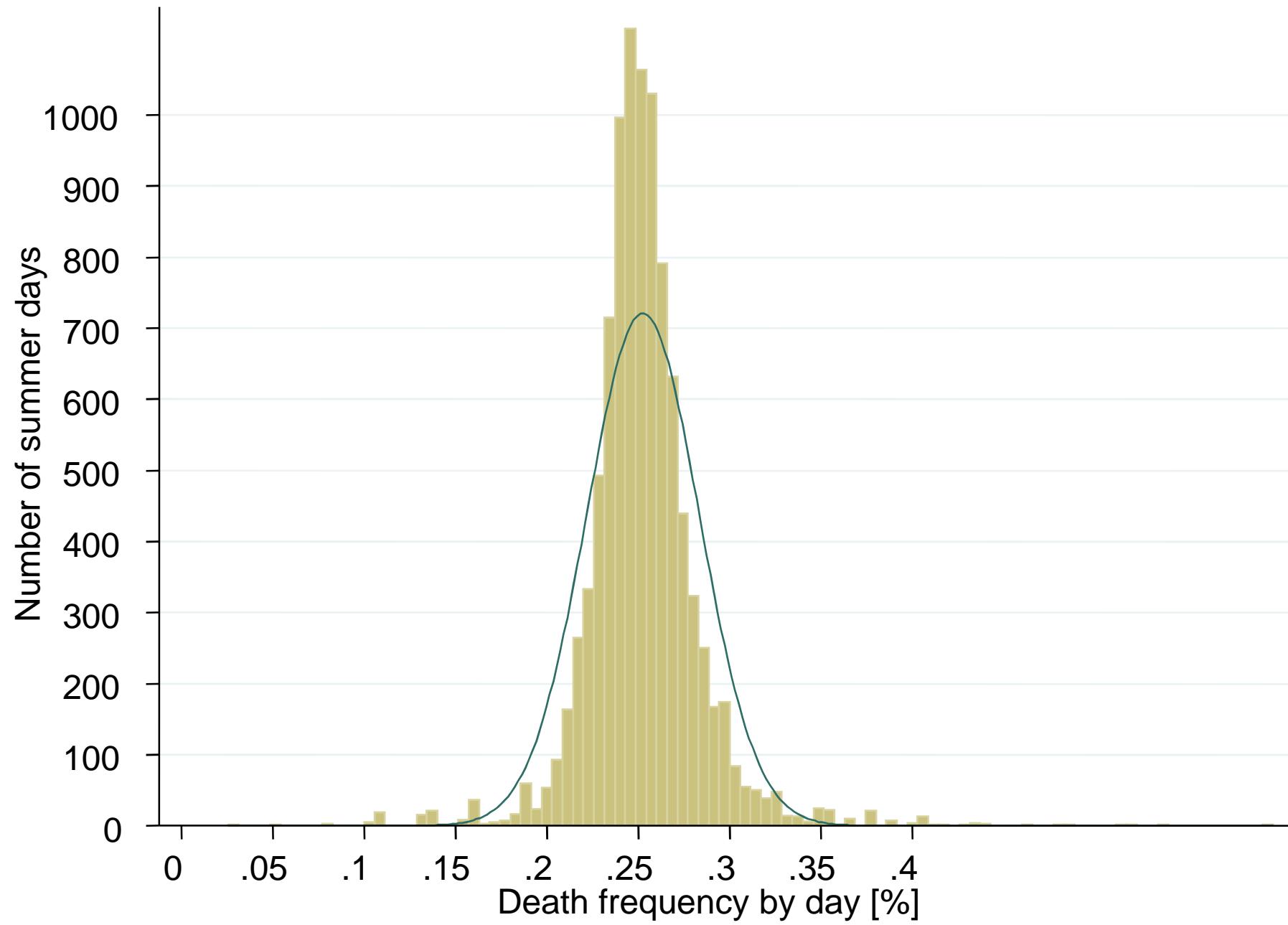
Summer mortality accumulation, from June 1st to September 30th*, for the sixteen European countries as a percentage of annual mortality averaged over five years, 1998 to 2002



The two extremes are the Czech Republic, where 31.6% of annual mortality is cumulated during the summer, and Portugal, with only 29.1% .

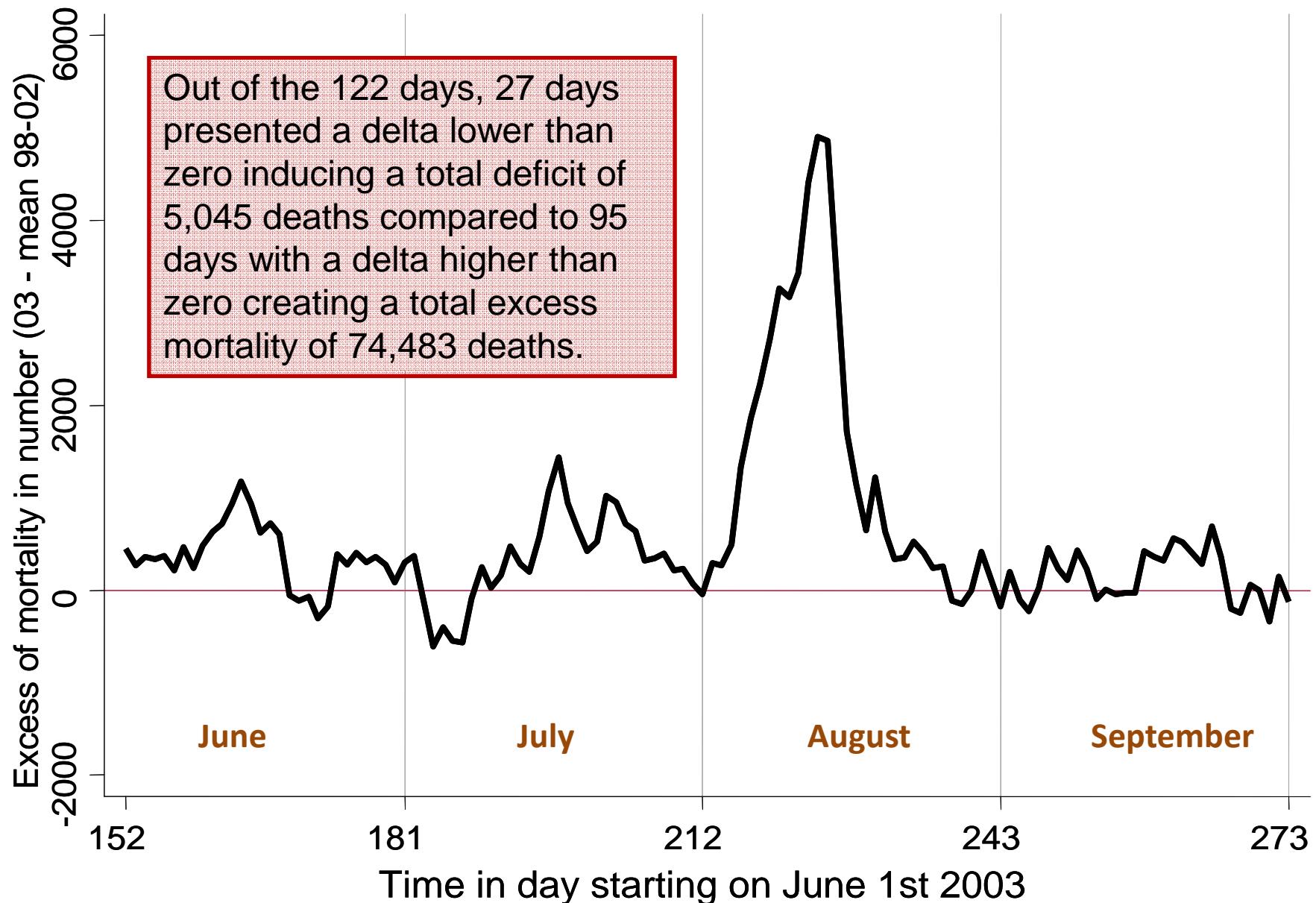
(2) The characteristics of summer daily
mortality in Europe

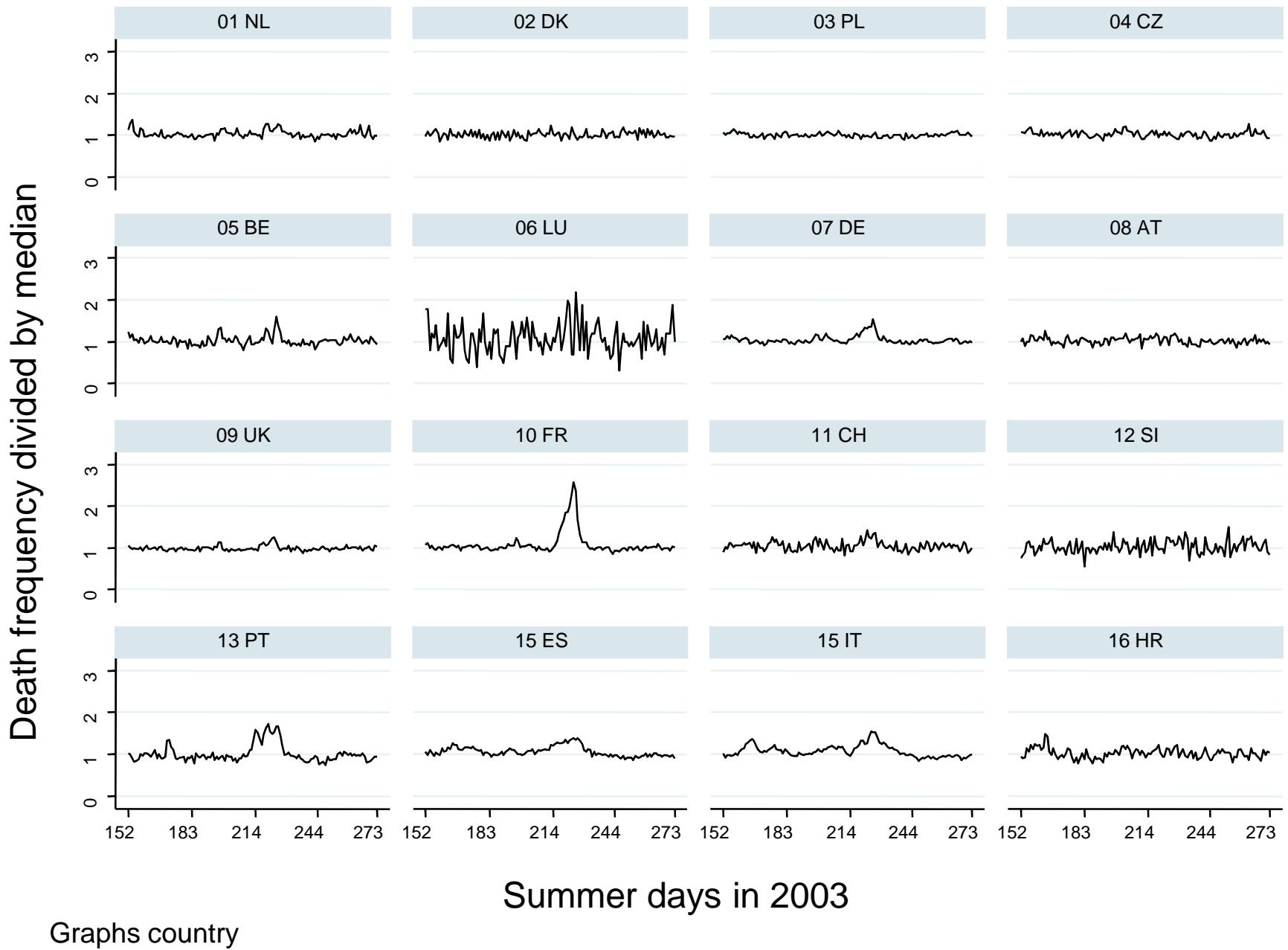
(reference period 1998-2002)



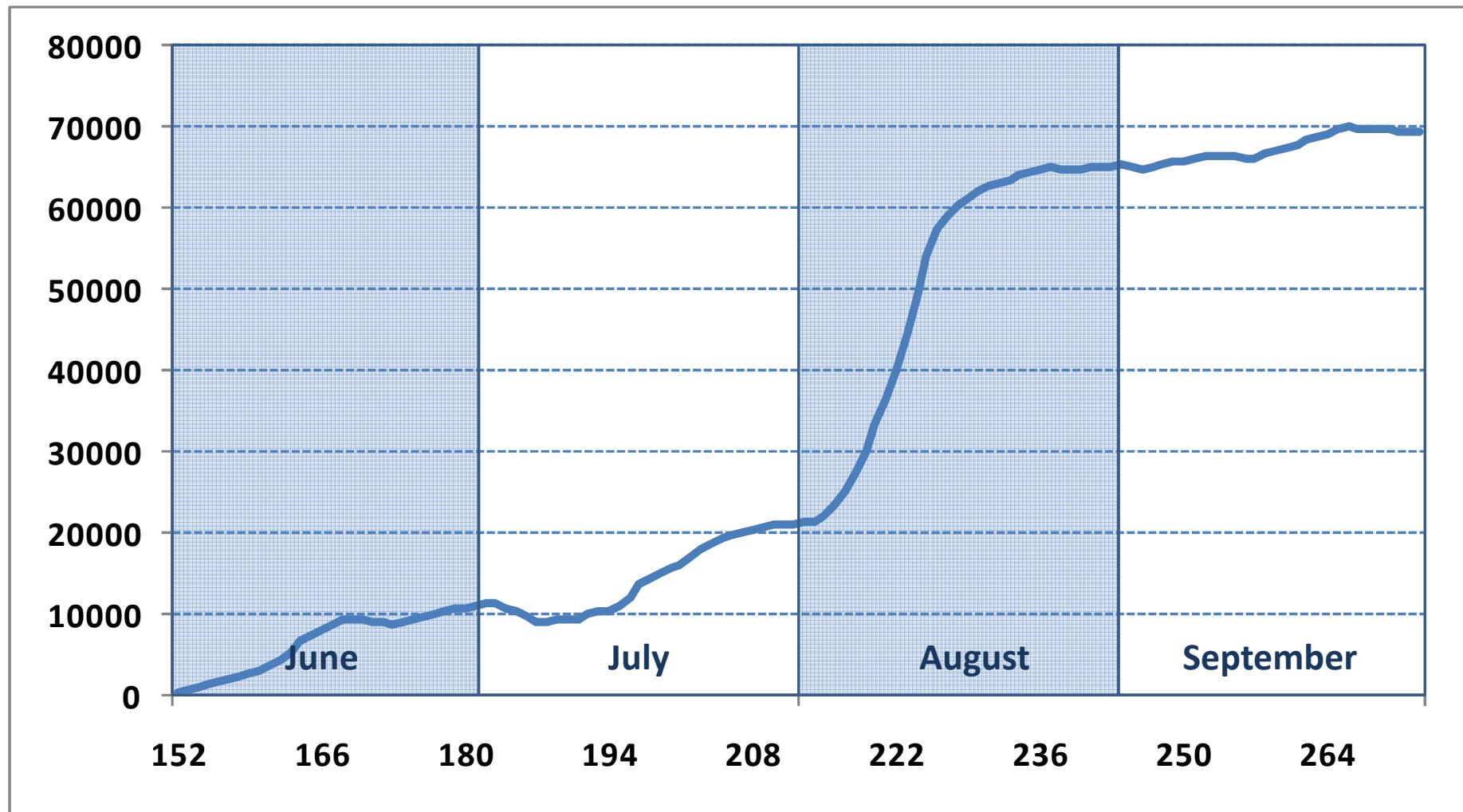
(3) The variations in daily mortality in all sixteen European countries during the summer 2003

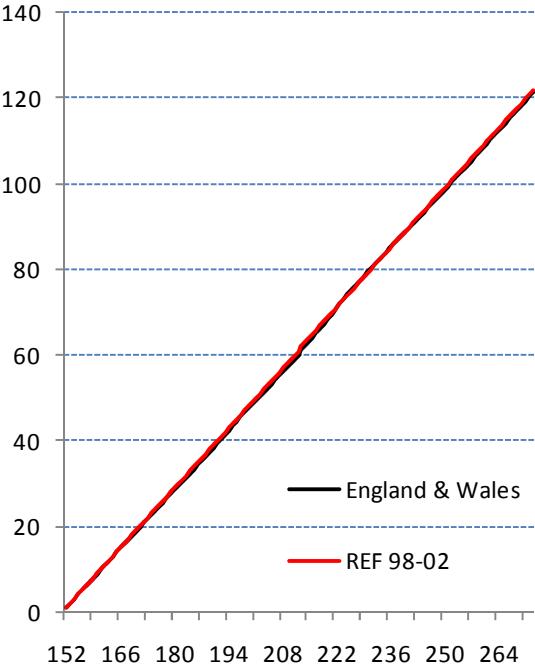
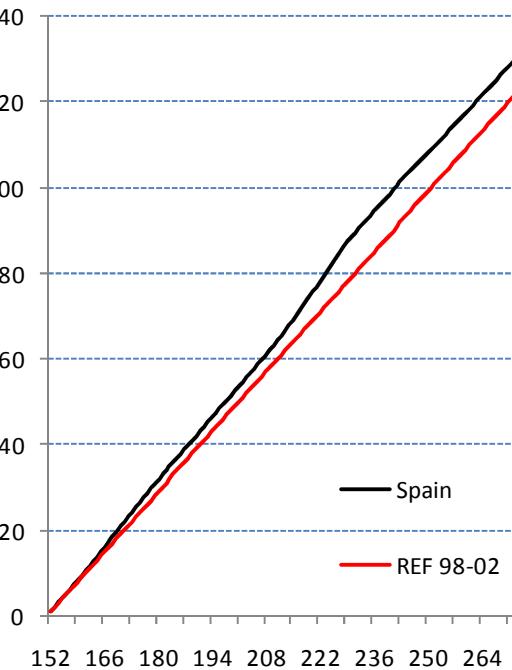
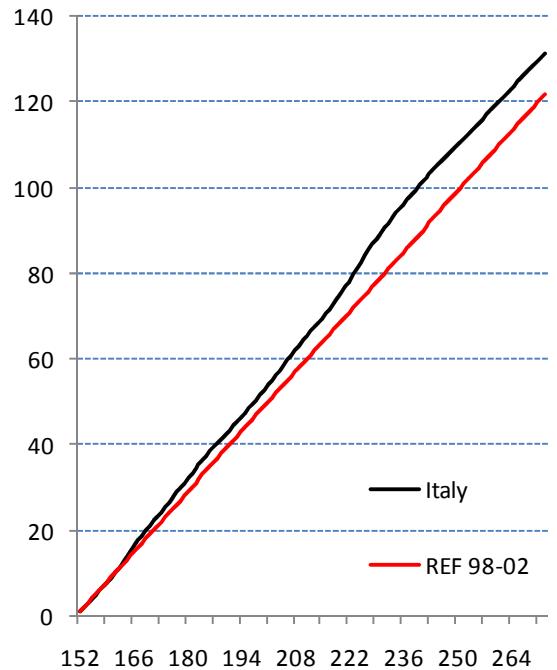
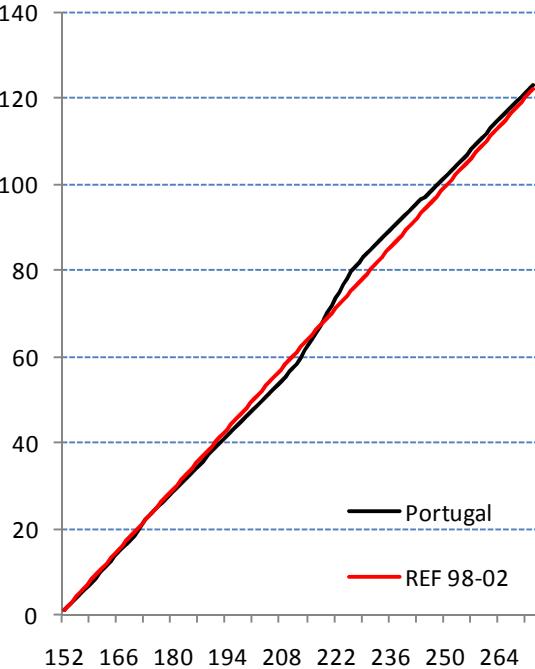
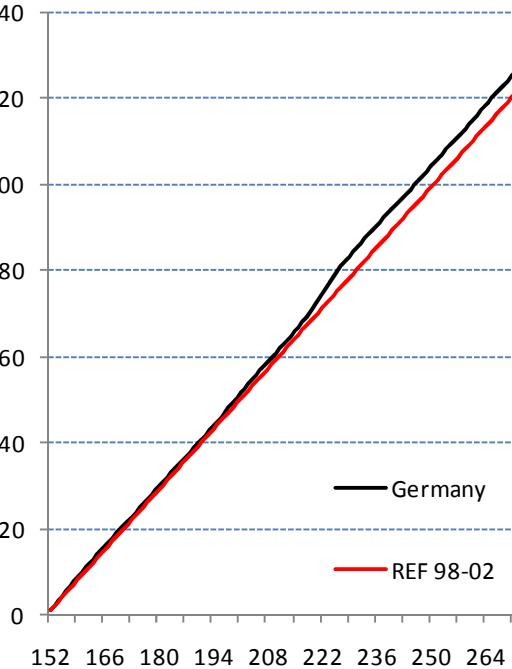
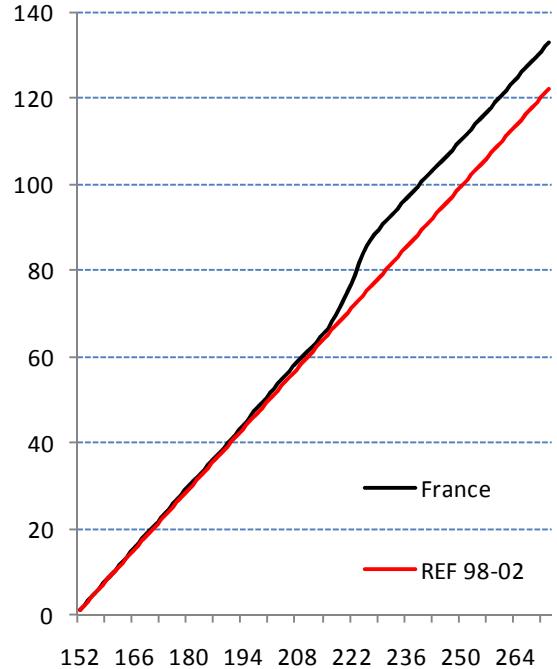
Delta between the number of daily deaths recorded in the summer of 2003 and the average number of deaths recorded on the same day during the 1998-2002 reference period for the sixteen European countries studied





Accumulation of excess mortality during the summer of 2003 - sixteen European countries studied (reference period 1998-2002)





(4) The daily excess mortality in 2003 for each country

(reference period 1998-2002)

Table 1: Delta between the number of deaths recorded in 2003 and the average number of deaths recorded during the 1998-2002 reference period

	Before summer		Summer						After summer		Total of the year			
	Nb	Ratio	Nb	Ratio	Nb	Ratio	Nb	Ratio	Nb	Ratio	NB	Ratio	Nb	Ratio
Countries involved in the August 2003 excess of mortality														
Belgium	-4	-0.01	139	1.72	162	1.97	438	5.31	436	5.57	1175	3.62	1356	5.11
Switzerland	92	0.34	253	5.30	187	3.89	469	9.81	130	2.75	1039	5.45	-148	-0.93
Germany	9290	2.55	642	0.98	1159	1.73	7295	10.97	259	0.40	9355	3.56	-5760	-2.69
Spain	-1464	-0.90	4268	15.49	2751	9.64	6461	22.86	1611	6.21	15090	13.68	7249	7.95
France	-3977	-1.70	1482	3.60	1706	4.06	15251	36.93	1051	2.62	19490	11.84	3415	2.53
Croatia	882	3.95	193	4.85	157	3.98	269	6.83	169	4.49	788	5.04	5	0.04
Italy	5575	2.24	5274	12.12	4318	9.72	9713	21.81	783	1.94	20089	11.63	-2487	-1.76
Luxemburg	69	3.47	33	10.81	27	9.29	75	25.00	34	12.22	170	14.34	79	7.85
Netherlands	304	0.50	78	0.71	11	0.10	578	5.24	297	2.79	965	2.20	503	1.42
Portugal	-2068	-4.26	220	2.83	100	1.28	2196	27.75	179	2.44	2696	8.73	2072	7.76
Slovenia	351	4.30	13	0.87	62	4.21	144	9.93	70	4.86	289	4.96	74	1.55
England & Wales	-5695	-2.41	-1080	-2.64	-504	-1.21	1987	4.90	-103	-0.26	301	0.18	2025	1.44
Total	3355	0.23	11516	4.50	10137	3.88	44878	17.34	4917	1.99	71449	6.99	8382	0.99
Countries used as controls														
Austria	708	2.12	-42	-0.71	172	2.86	159	2.63	57	0.99	345	1.45	-645	-3.30
Czech Republic	2408	5.17	207	2.43	190	2.18	58	0.67	-37	-0.43	418	1.22	-335	-1.20
Poland	1916	1.21	-487	-1.71	-543	-1.85	-918	-3.21	-652	-2.29	-2600	-2.26	-3436	-3.60
Denmark	-113	-0.44	-43	-0.95	-92	-1.95	-49	-1.04	14	0.31	-170	-0.92	92	0.61
Total	4920	1.86	-365	-0.77	-273	-0.56	-750	-1.56	-618	-1.31	-2006	-1.05	-4325	-2.74

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Slovenia	351	4.30	13	0.87	62	4.21	144	9.93	70	4.86	289	4.96	74	1.55	714	3.81
England & Wales	-5695	-2.41	-1080	-2.64	-504	-1.21	1987	4.90	-103	-0.26	301	0.18	2025	1.44	-3369	-0.62
Total	3355	0.23	11516	4.50	10137	3.88	44878	17.34	4917	1.99	71449	6.99	8382	0.99	83186	2.50
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Total	3355	0.23	11516	4.50	10137	3.88	44878	17.34	4917	1.99	71449	6.99	8382	0.99	83186	2.50
Countries used as controls																
Austria	708	2.12	-42	-0.71	172	2.86	159	2.63	57	0.99	345	1.45	-645	-3.30	408	0.53
Czech Republic	2408	5.17	207	2.43	190	2.18	58	0.67	-37	-0.43	418	1.22	-335	-1.20	2491	2.29
Poland	1916	1.21	-487	-1.71	-543	-1.85	-918	-3.21	-652	-2.29	-2600	-2.26	-3436	-3.60	-4119	-1.12
Denmark	-113	-0.44	-43	-0.95	-92	-1.95	-49	-1.04	14	0.31	-170	-0.92	92	0.61	-191	-0.32
Total	4920	1.86	-365	-0.77	-273	-0.56	-750	-1.56	-618	-1.31	-2006	-1.05	-4325	-2.74	-1411	-0.23

Table 1: Delta between the number of deaths recorded in 2003 and the average number of deaths recorded during the 1998-2002 reference period

	Before summer		Summer						After summer		Total of the year					
	Nb	Ratio	June		July		August		Nb	Ratio	Nb	Ratio	NB	Ratio	Nb	Ratio
Countries involved in the August 2003 excess of mortality																
Belgium	-4	-0.01	139	1.72	162	1.97	438	5.31	436	5.57	1175	3.62	1356	5.11	2528	2.41
Switzerland	92	0.34	253	5.30	187	3.89	469	9.81	130	2.75	1039	5.45	-148	-0.93	984	1.58
Germany	9290	2.55	642	0.98	1159	1.73	7295	10.97	259	0.40	9355	3.56	-5760	-2.69	12885	1.53
Spain	-1464	-0.90	4268	15.49	2751	9.64	6461	22.86	1611	6.21	15090	13.68	7249	7.95	20875	5.74
France	-3977	-1.70	1482	3.60	1706	4.06	15251	36.93	1051	2.62	19490	11.84	3415	2.53	18928	3.55
Croatia	882	3.95	193	4.85	157	3.98	269	6.83	169	4.49	788	5.04	5	0.04	1675	3.29
Italy	5575	2.24	5274	12.12	4318	9.72	9713	21.81	783	1.94	20089	11.63	-2487	-1.76	23177	4.12
Luxemburg	69	3.47	33	10.81	27	9.29	75	25.00	34	12.22	170	14.34	79	7.85	318	7.95
Netherlands	304	0.50	78	0.71	11	0.10	578	5.24	297	2.79	965	2.20	503	1.42	1771	1.26
Portugal	-2068	-4.26	220	2.83	100	1.28	2196	27.75	179	2.44	2696	8.73	2072	7.76	2699	2.54
Slovenia	351	4.30	13	0.87	62	4.21	144	9.93	70	4.86	289	4.96	74	1.55	714	3.81
England & Wales	-5695	-2.41	-1080	-2.64	-504	-1.21	1987	4.90	-103	-0.26	301	0.18	2025	1.44	-3369	-0.62
Total	3355	0.23	11516	4.50	10137	3.88	44878	17.34	4917	1.99	71449	6.99	8382	0.99	83186	2.50
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Total	4920	1.86	-365	-0.77	-273	-0.56	-750	-1.56	-618	-1.31	-2006	-1.05	-4325	-2.74	-1411	-0.23

Table 1: Delta between the number of deaths recorded in 2003 and the average number of deaths recorded during the 1998-2002 reference period

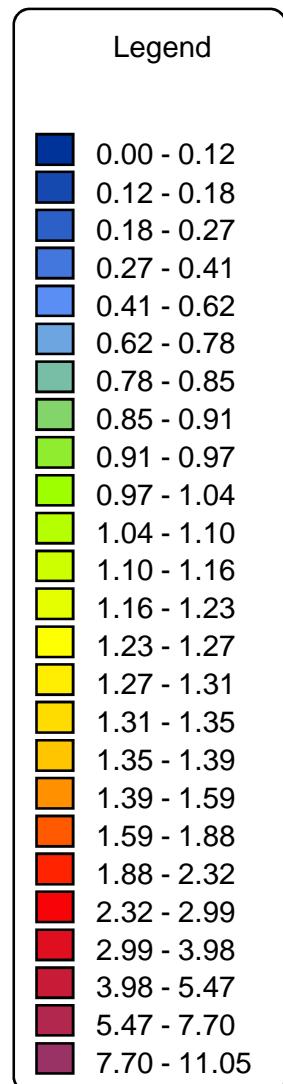
	Before summer		Summer						After summer		Total of the year					
	Nb	Ratio	June		July		August		September		Total	NB	Ratio	Nb	Ratio	
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Italy	5575	2.24	5274	12.12	4318	9.72	9713	21.81	783	1.94	20089	11.63	-2487	-1.76
Luxemburg	69	3.47	33	10.81	27	9.29	75	25.00	34	12.22	170	14.34	79	7.85
Netherlands	304	0.50	78	0.71	11	0.10	578	5.24	297	2.79	965	2.20	503	1.42
Portugal	-2068	-4.26	220	2.83	100	1.28	2196	27.75	179	2.44	2696	8.73	2072	7.76
Slovenia	351	4.30	13	0.87	62	4.21	144	9.93	70	4.86	289	4.96	74	1.55
England & Wales	-5695	-2.41	-1080	-2.64	-504	-1.21	1987	4.90	-103	-0.26	301	0.18	2025	1.44
Total	3355	0.23	11516	4.50	10137	3.88	44878	17.34	4917	1.99	71449	6.99	8382	0.99
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Total	4920	1.86	-365	-0.77	-273	-0.56	-750	-1.56	-618	-1.31	-2006	-1.05	-4325	-2.74
													-1411	-0.23

(5) The excess mortality peak at the beginning of the month of August 2003

Median centered annual death frequency



Major Lower outliers

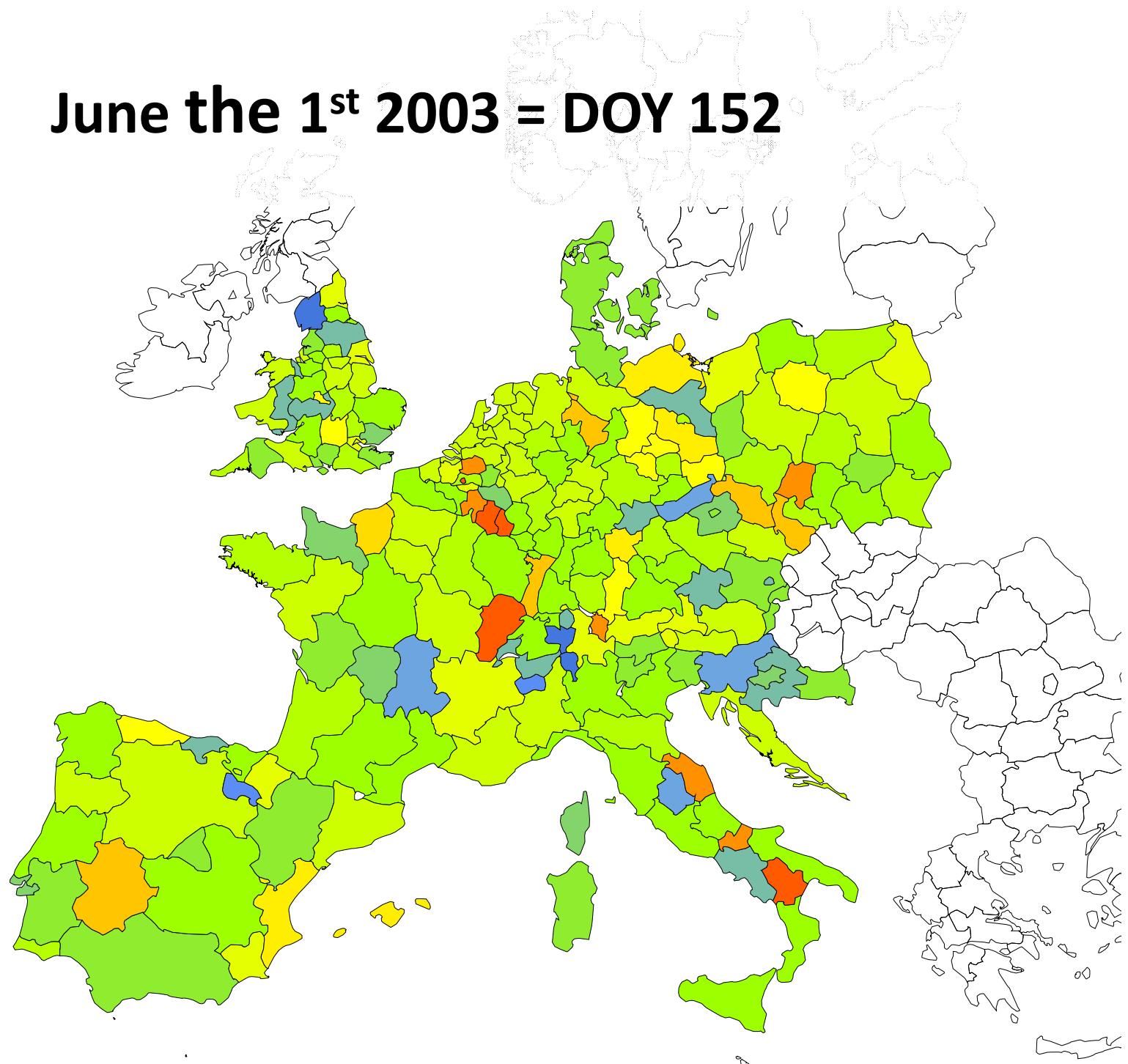
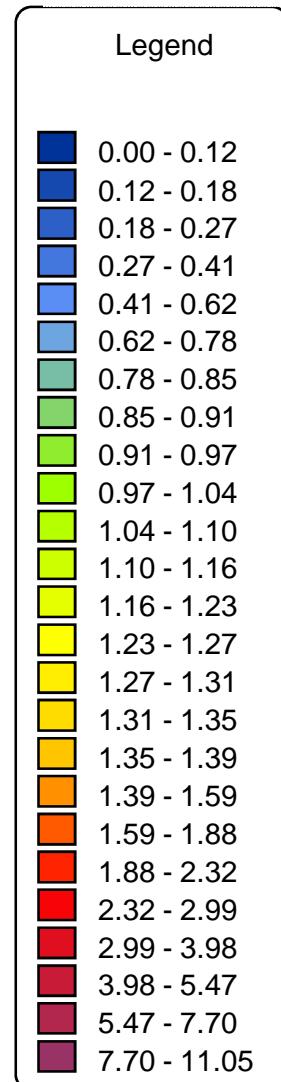
Minor Lower outliers

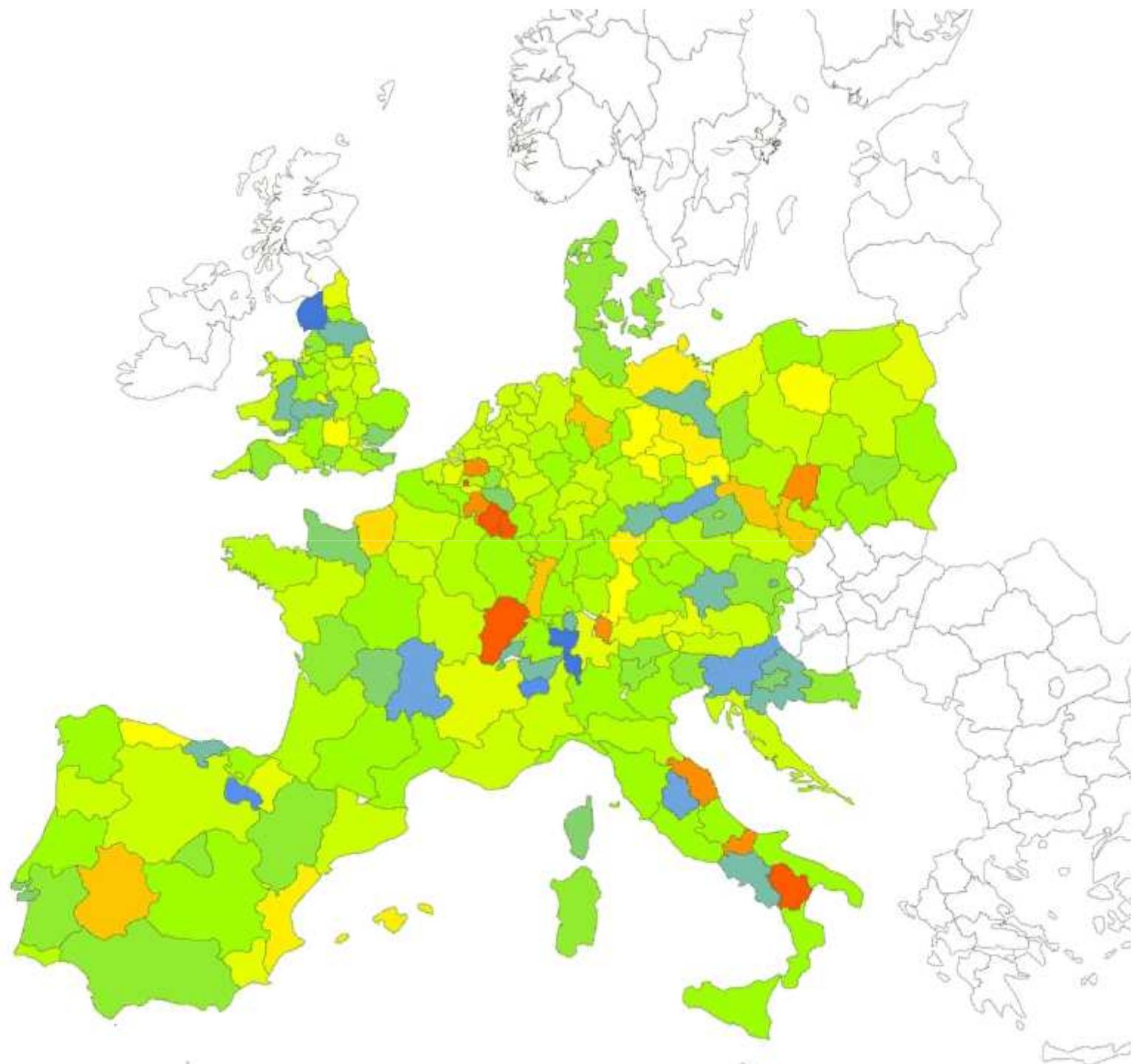
Usual

Minor Upper outliers

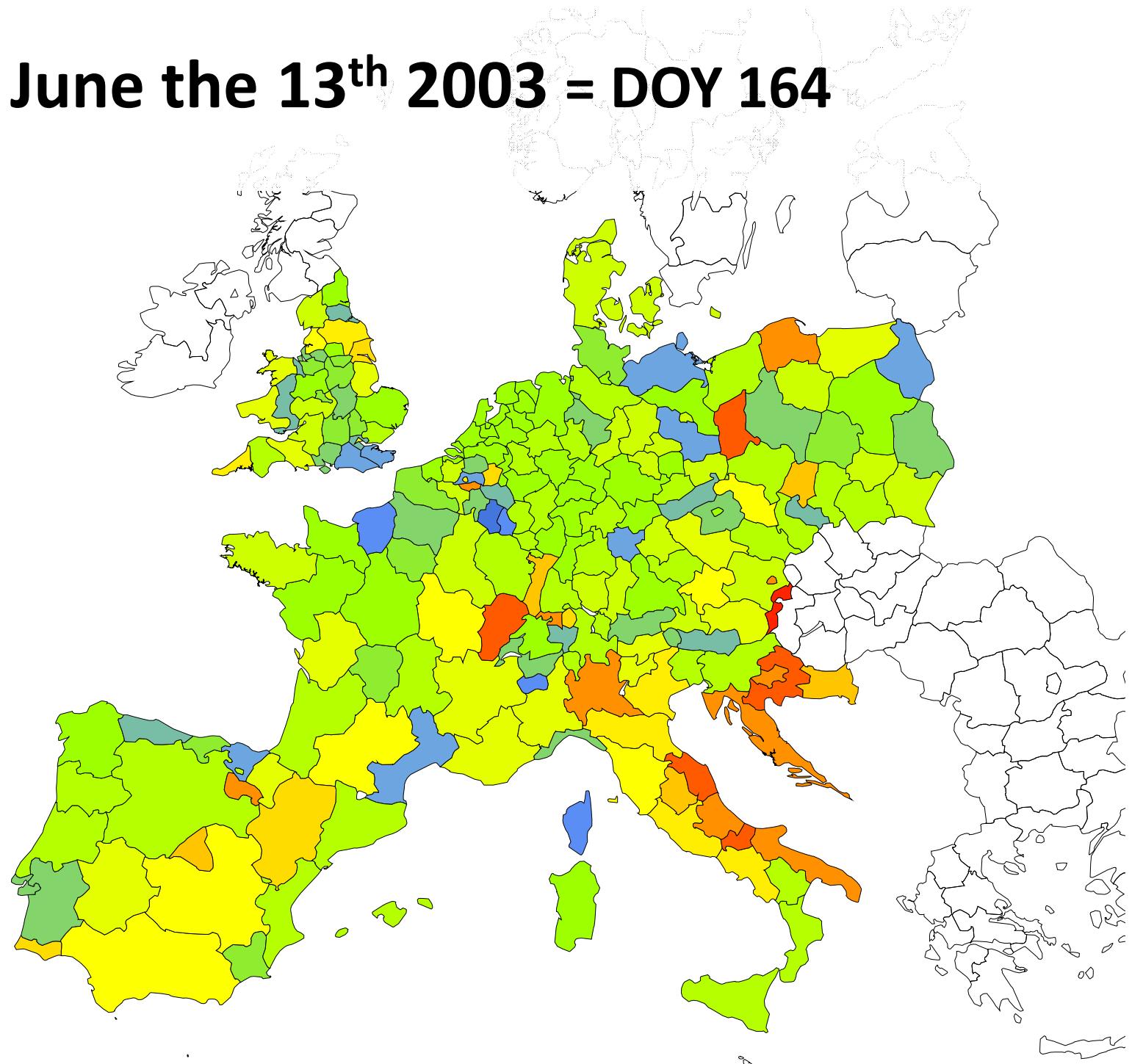
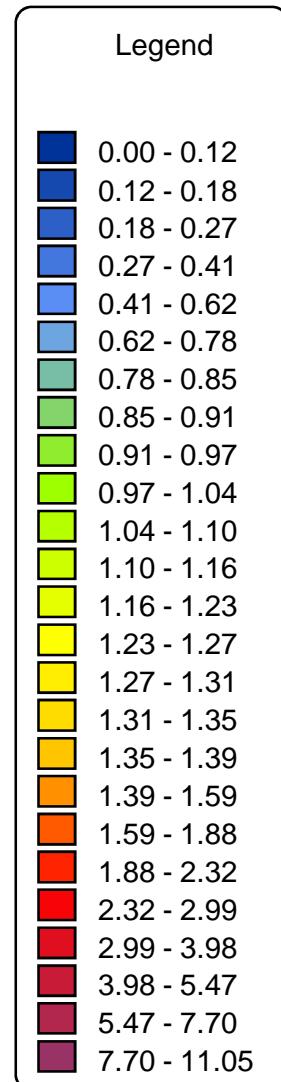
Major Upper outliers

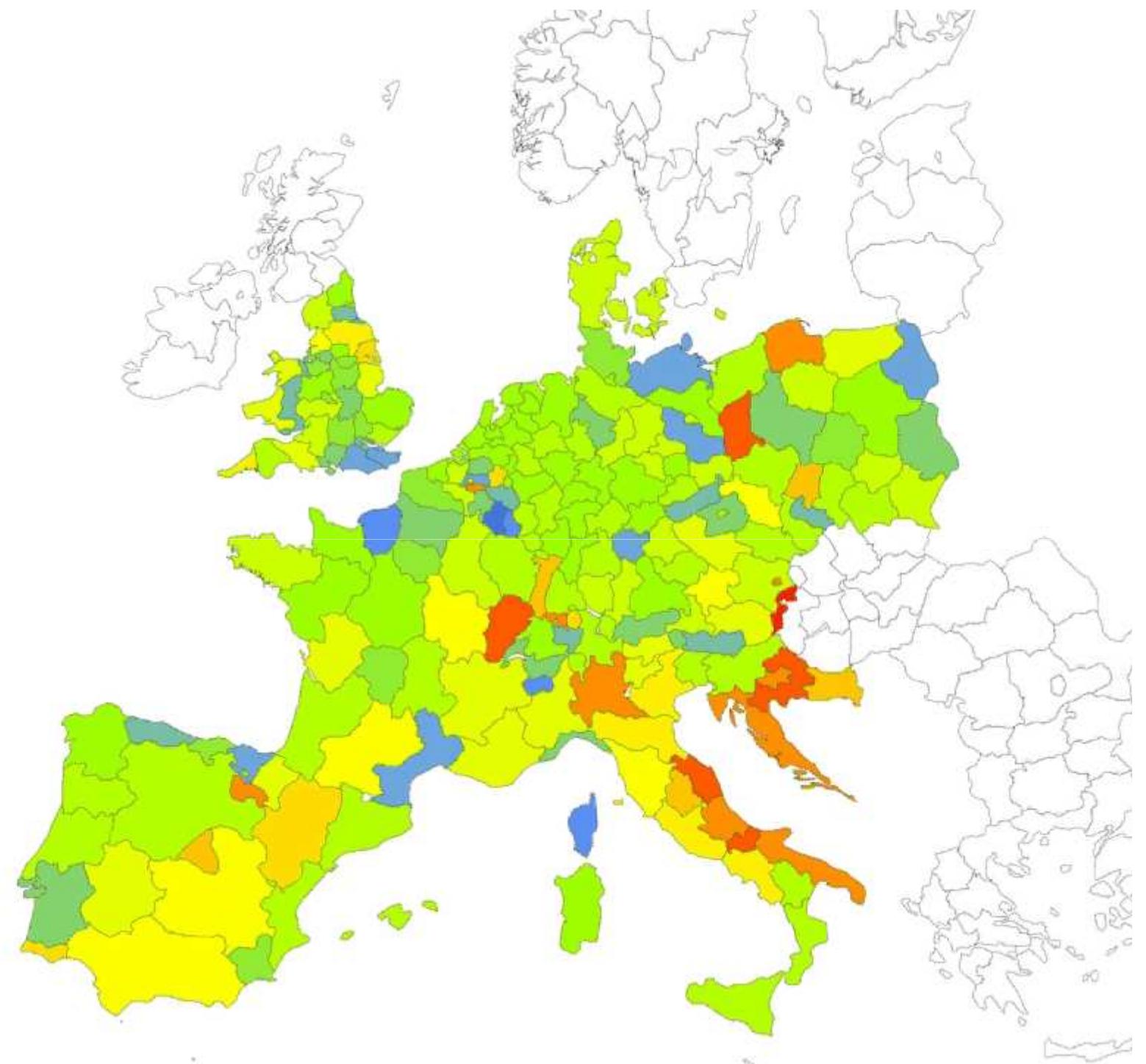
June the 1st 2003 = DOY 152



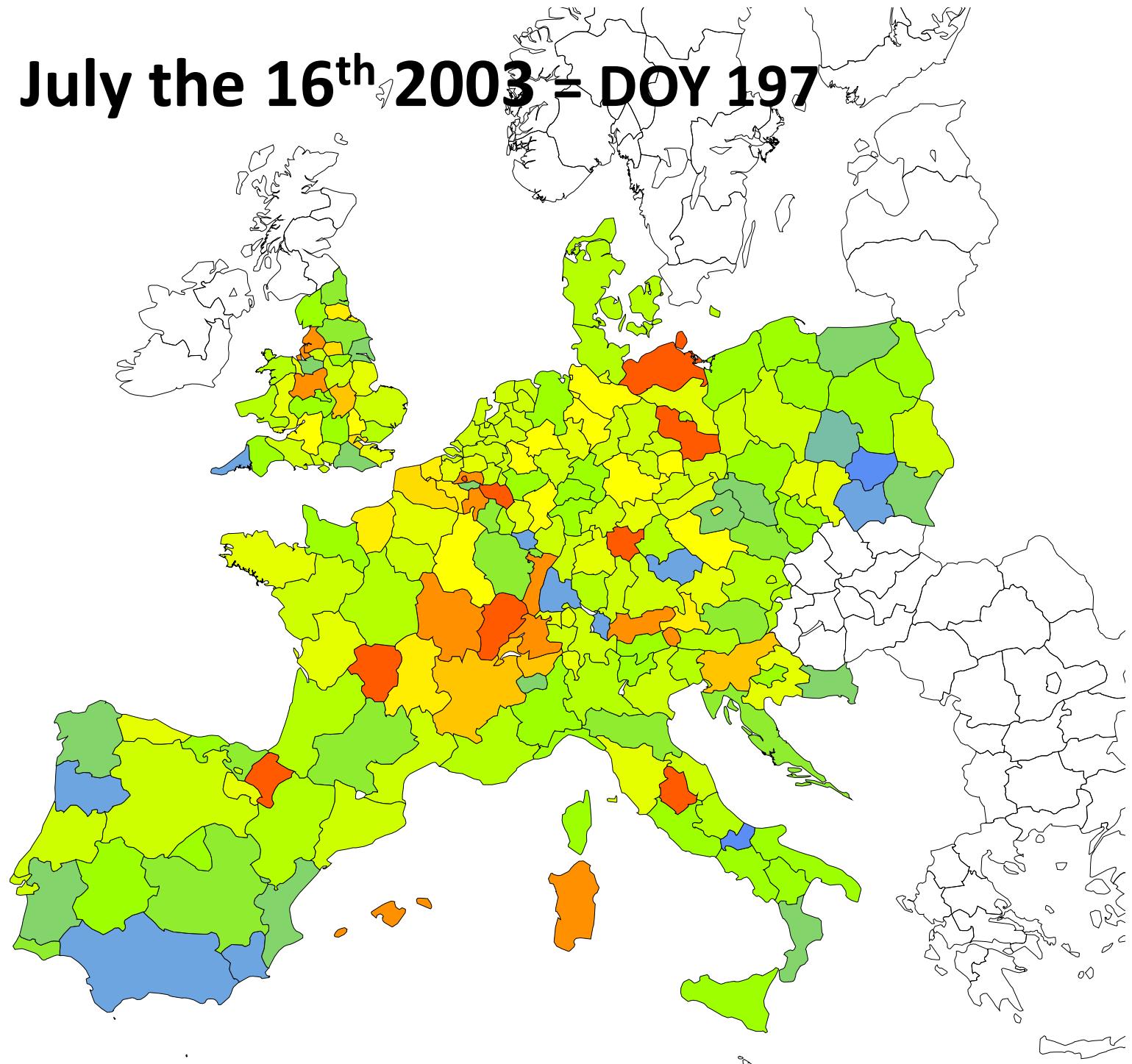
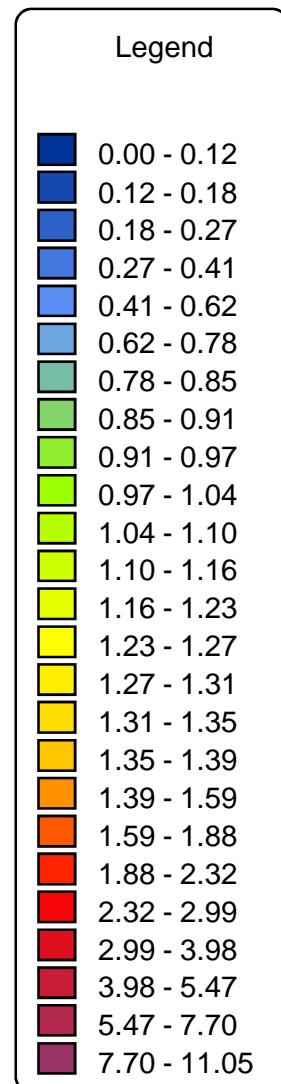


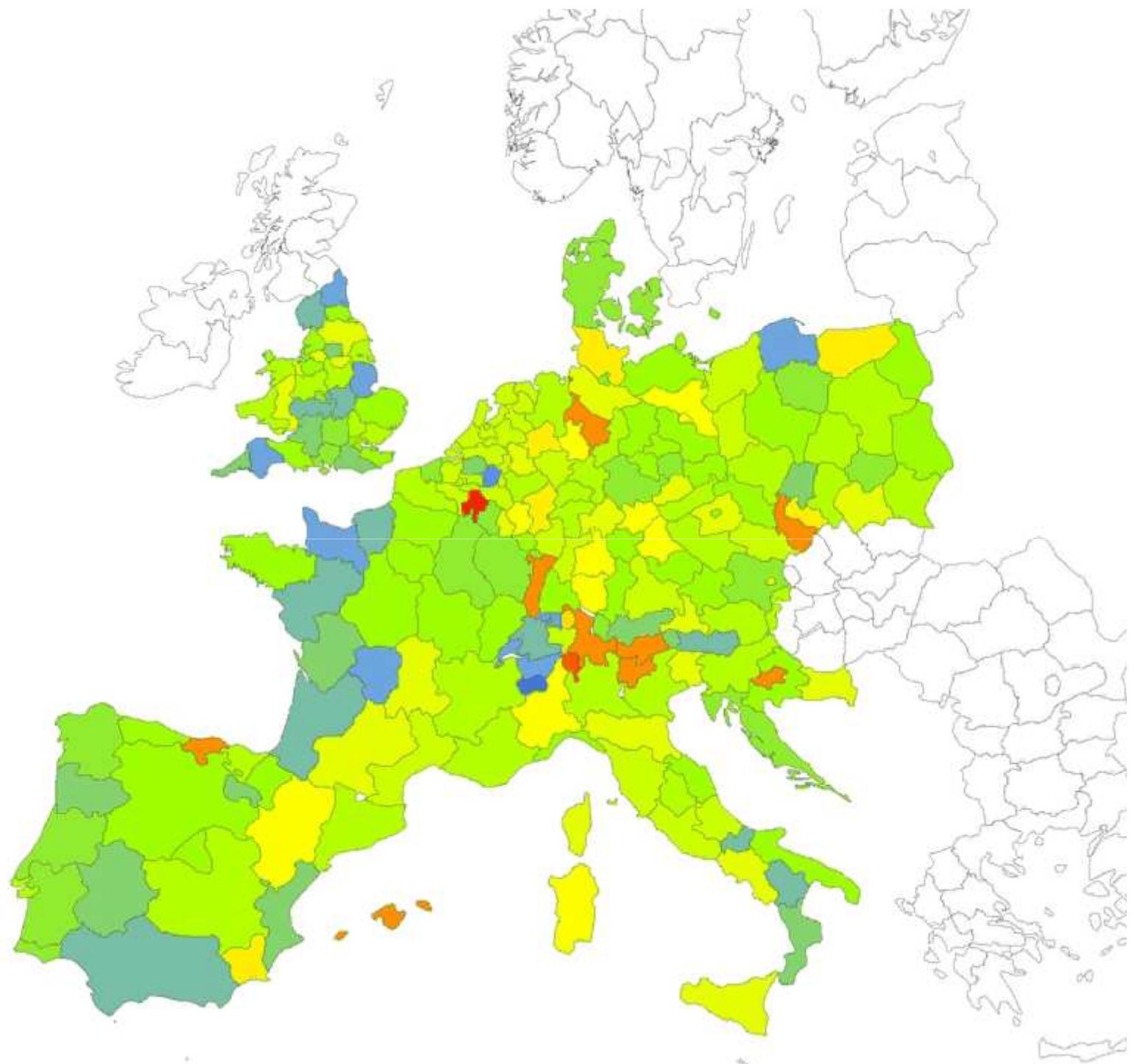
June the 13th 2003 = DOY 164



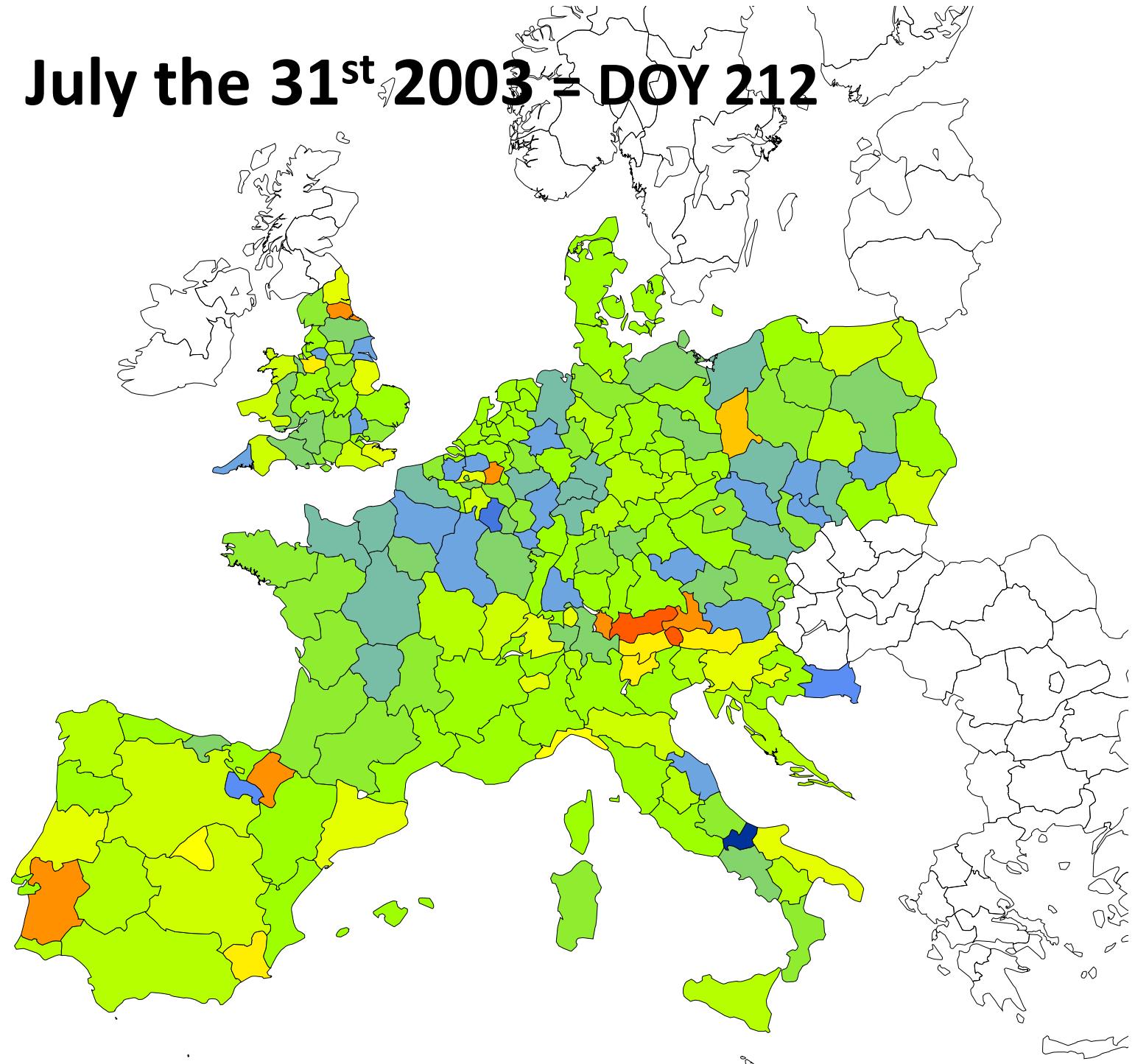
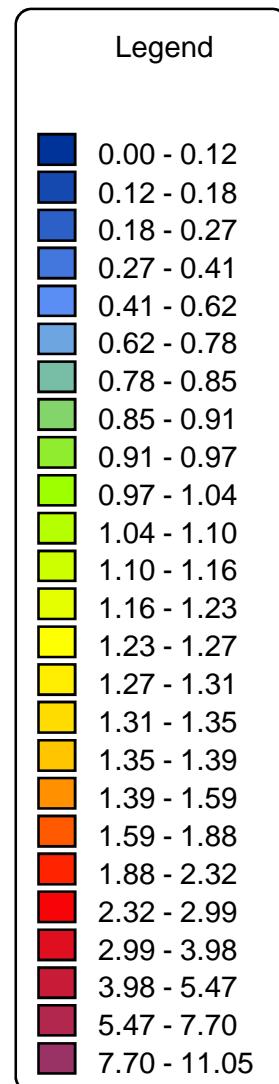


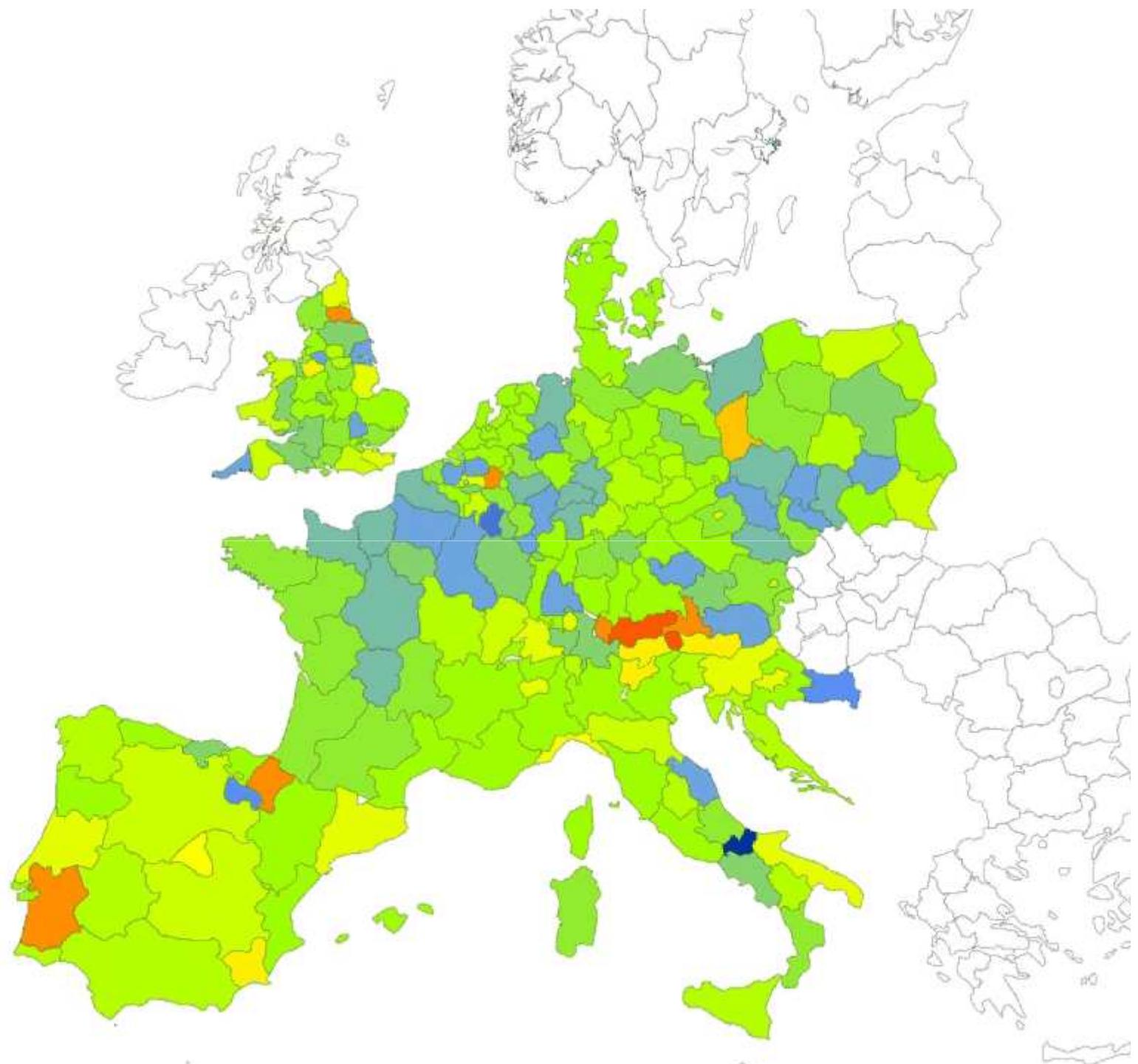
July the 16th, 2003 = DOY 197



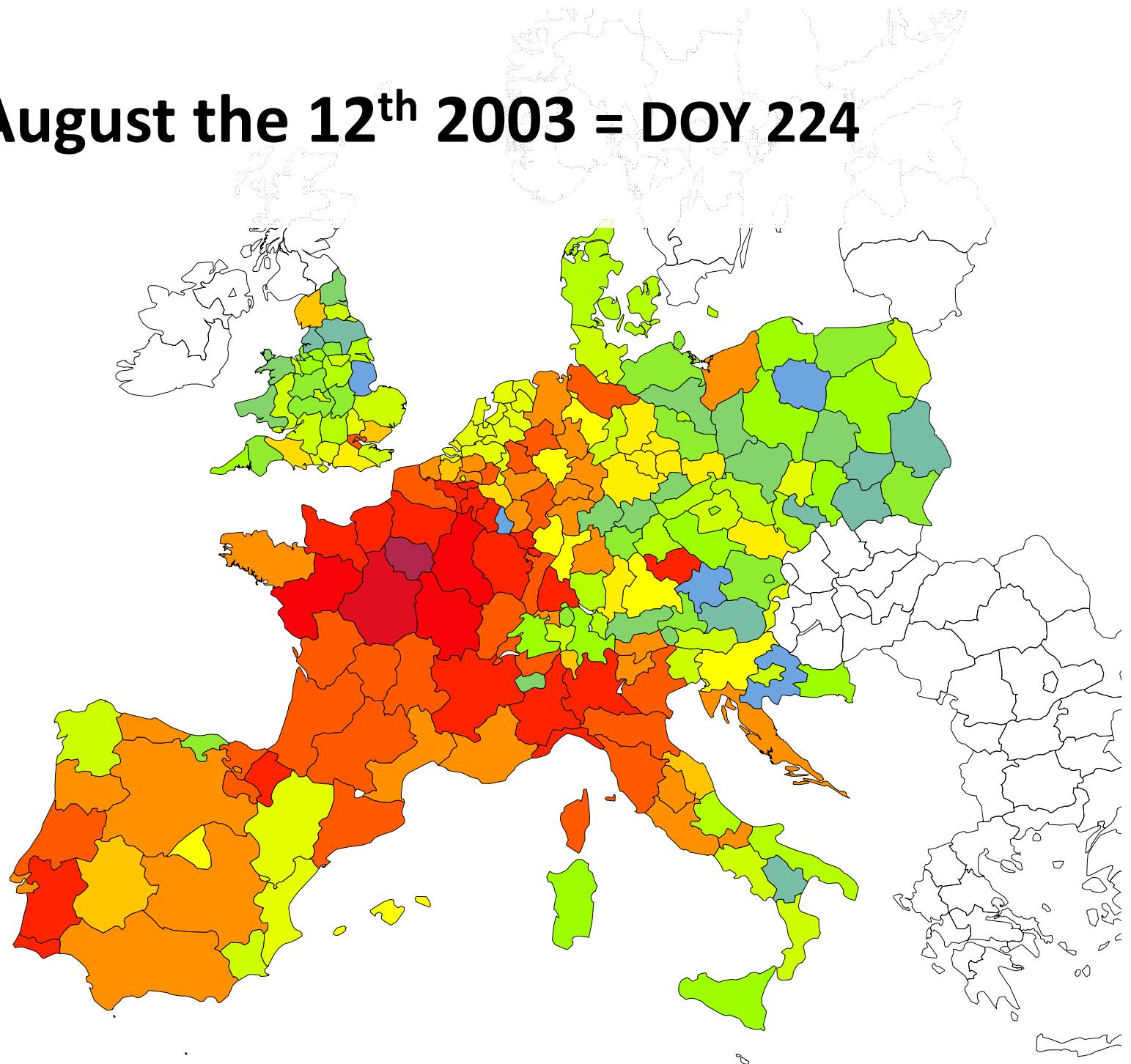
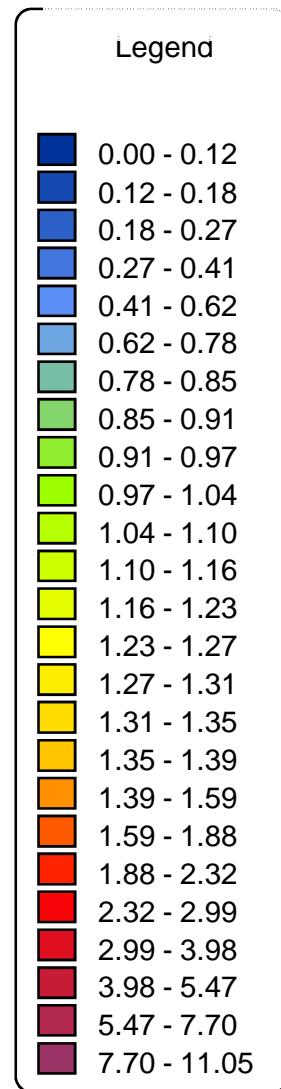


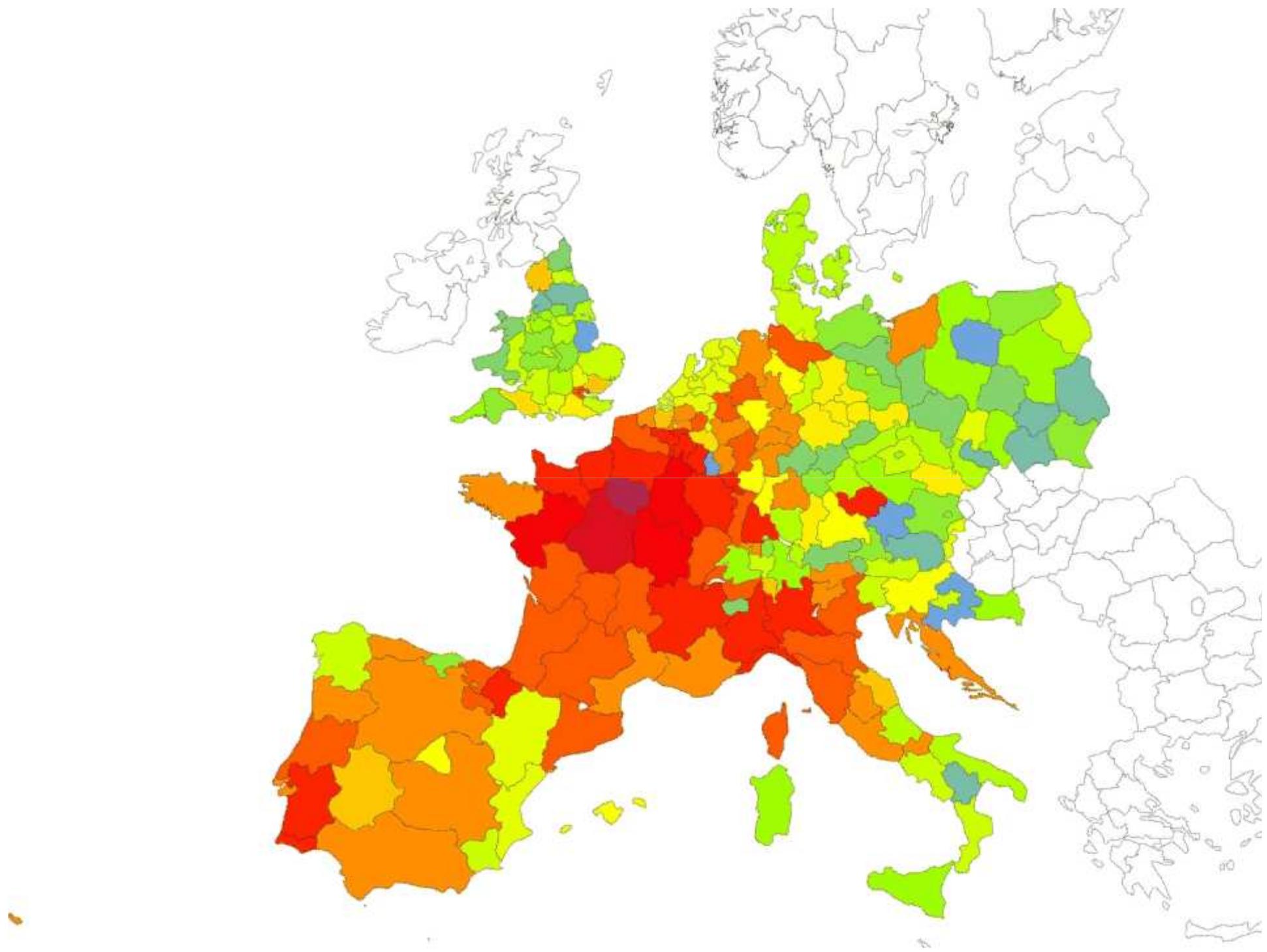
July the 31st, 2003 = DOY 212



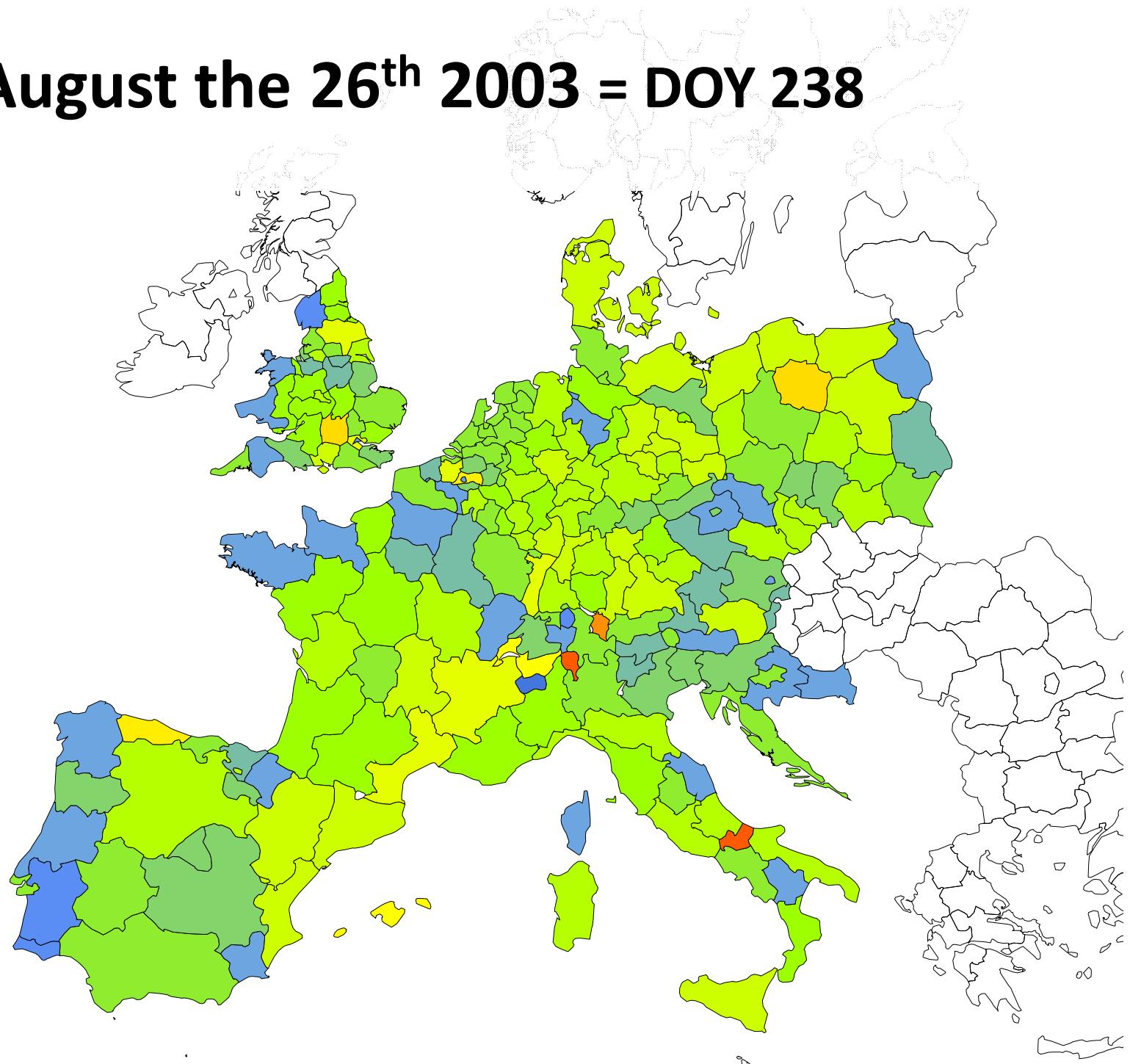
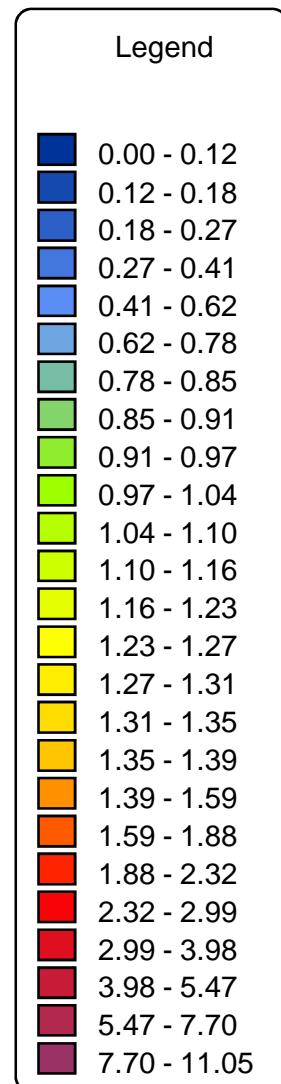


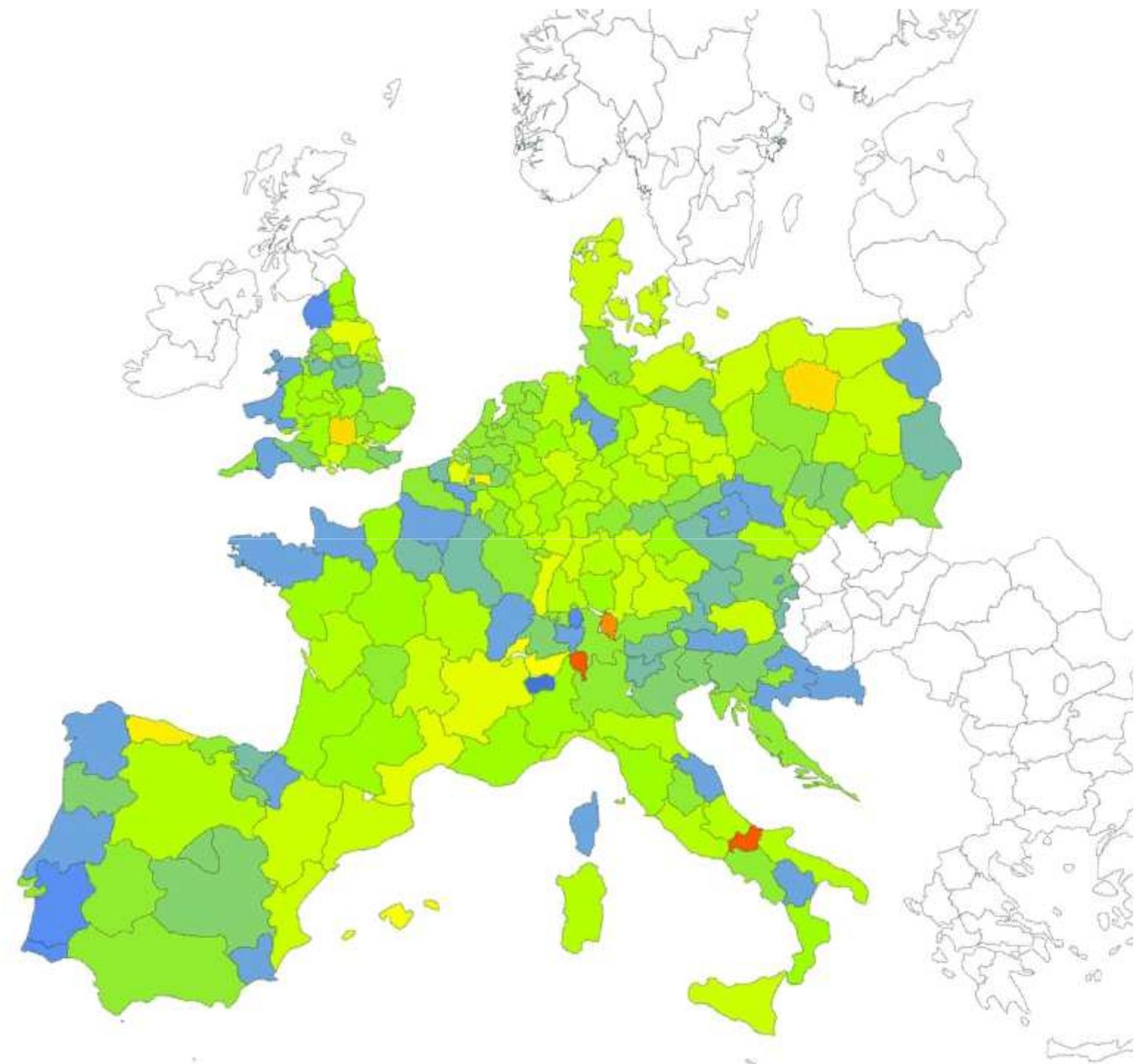
August the 12th 2003 = DOY 224



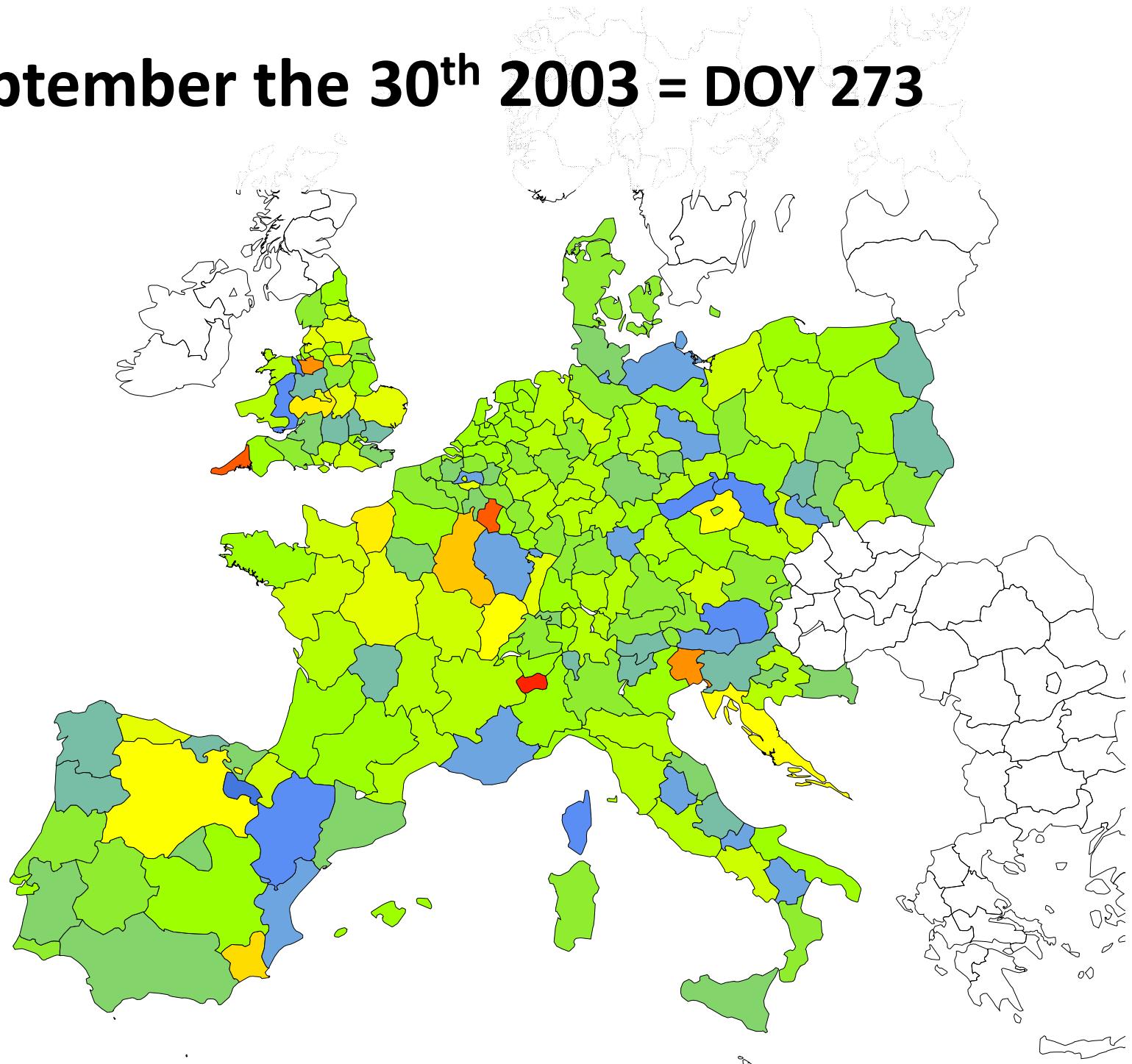
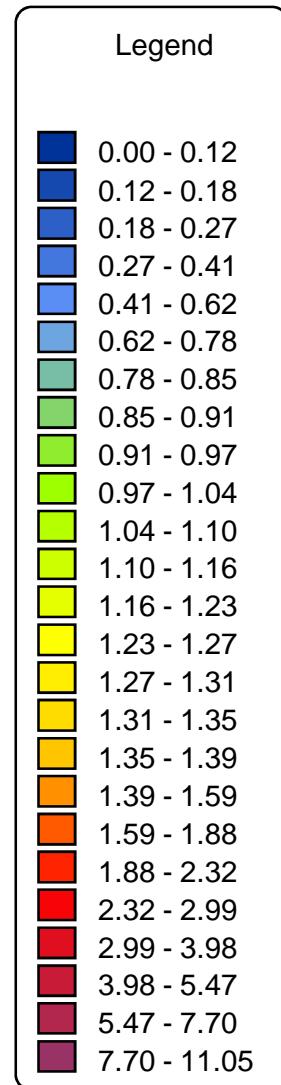


August the 26th 2003 = DOY 238



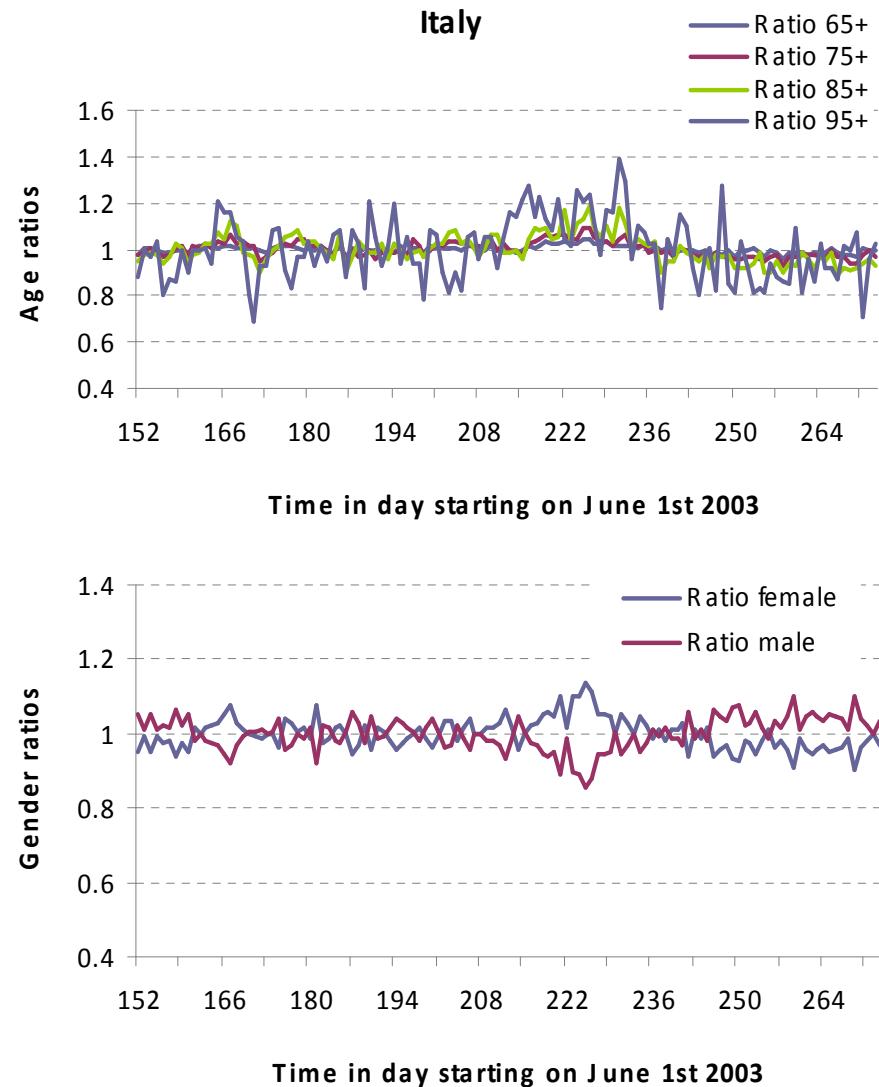
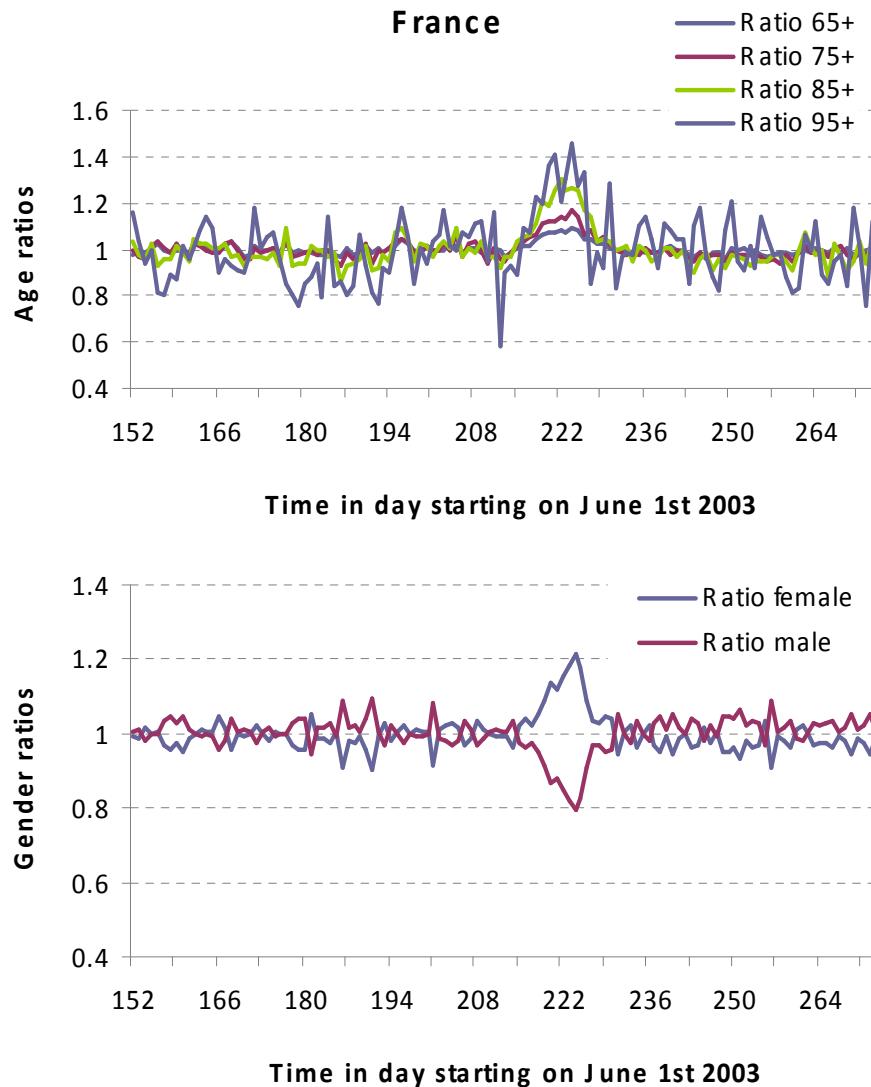


September the 30th 2003 = DOY 273

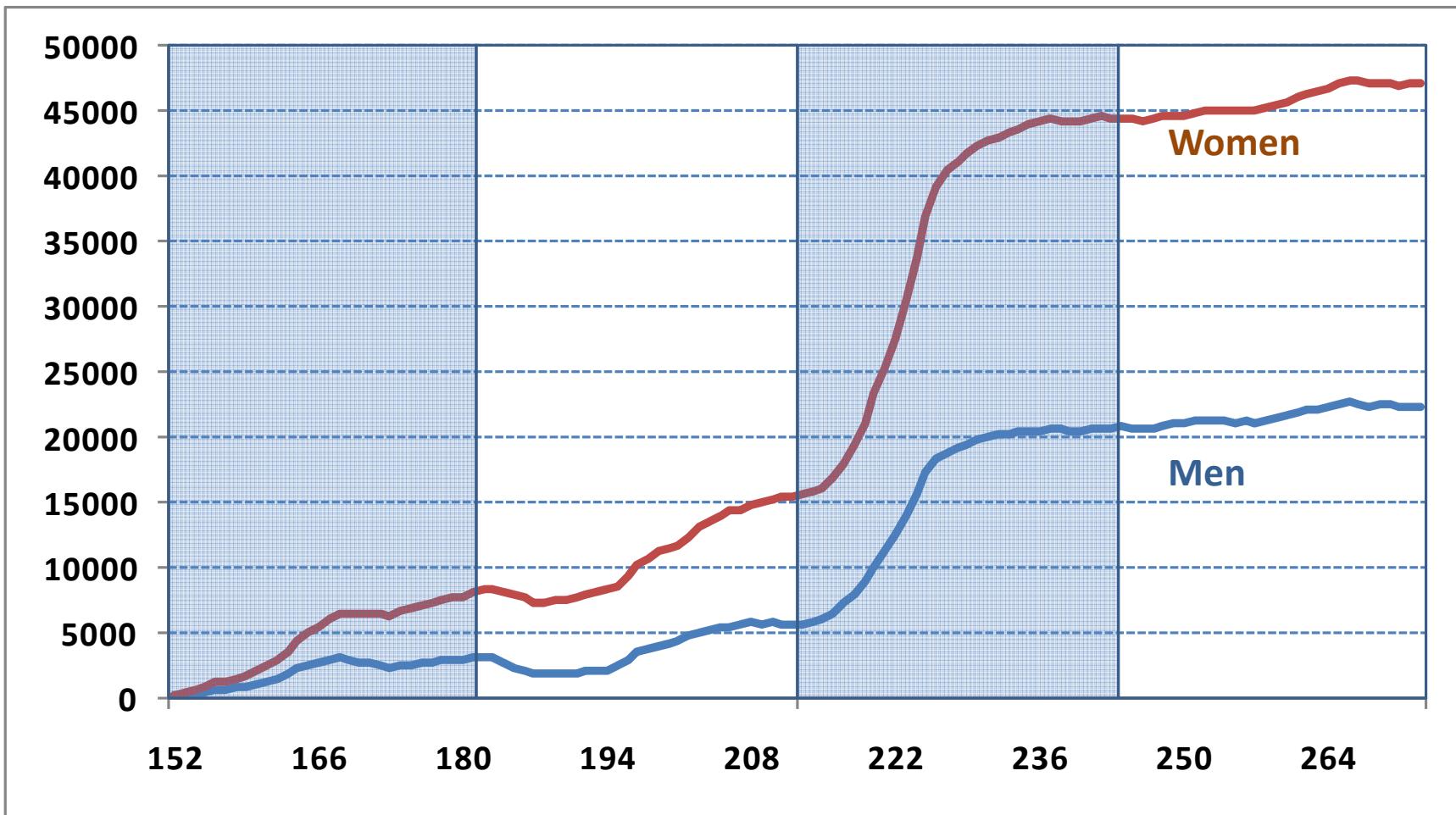


(6) The distortions in the proportion of deaths of older people and in the share of women

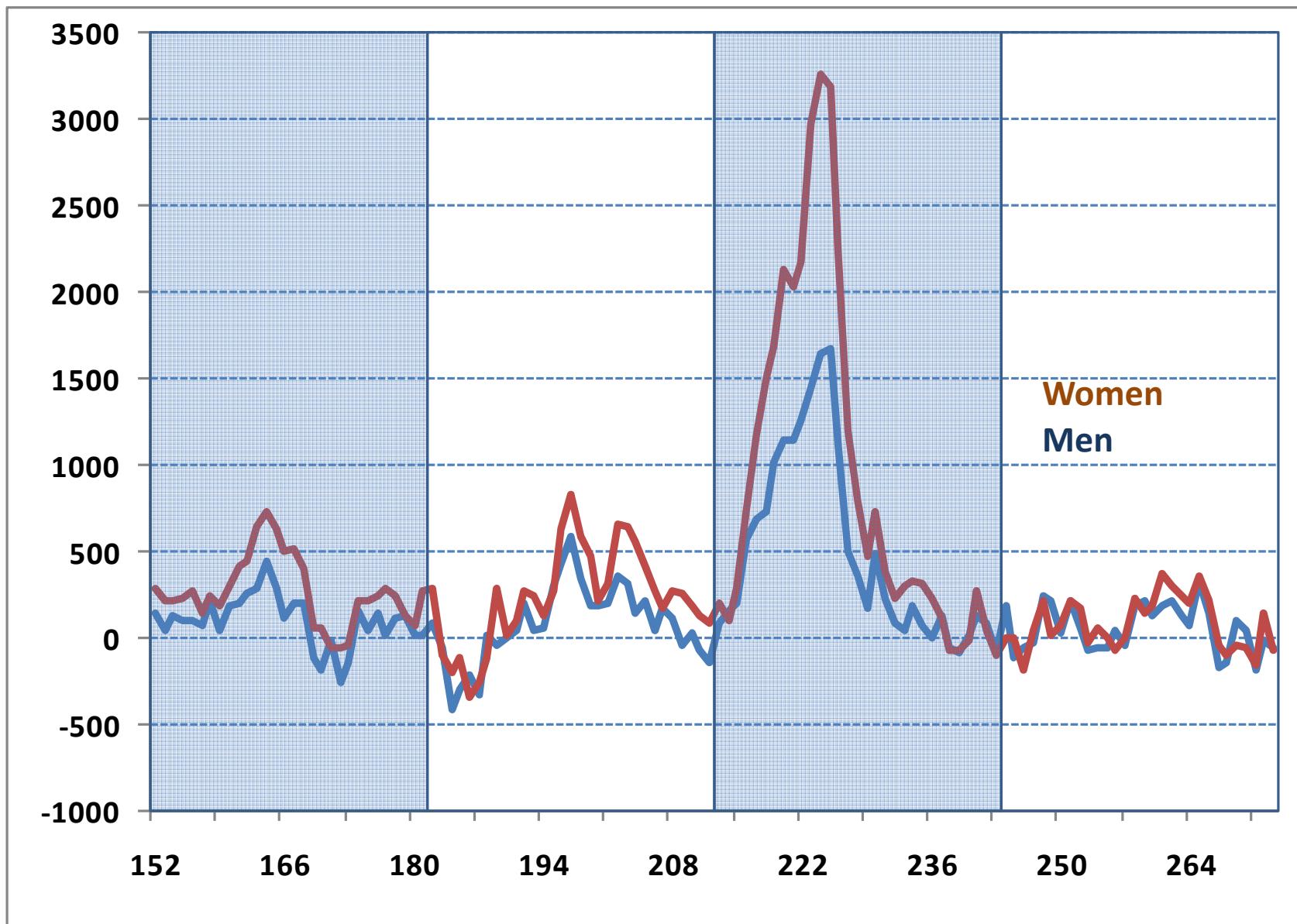
Distortion of the death structure by age and gender in France and Italy during the summer of 2003



Accumulation of excess mortality during the summer of 2003 by gender - sixteen European countries studied (reference period 1998-2002)



Delta between the number of daily deaths recorded in the summer of 2003 and the average number of deaths recorded on the same day during the 1998-2002 reference period for the sixteen European countries studied, by gender



Interpretation: During the summer of 2003, a series of minor mortality crises, most of which remain unnoticed, resulted in a significant number of victims in Europe, especially women, in addition to the huge number of deaths associated with the August heat wave.

Global warming constitutes a new health threat in an aged Europe which may be difficult to detect at country level.

Centralising and monitoring the count of daily deaths on an operational geographical scale constitutes a priority for Public Health in Europe.

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