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Recent trends in temperature and precipitation over the Balearic Islands (Spain)

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Abstract Changes in climatic parameters are often given in terms of global averages even though large regional variability is generally observed. The study of regional tendencies provides not only supplementary conclusions to more large-scale oriented results but is also of particular interest to local policy-makers and resource managers to have detailed information regarding sensible and influential climatic parameters. In this study, changes in precipitation for the Balearic Islands (Spain) have been analyzed using data from 18 rain gauges with complete daily time series during the period 1951–2006 and two additional sites where only monthly totals were available. Tendencies for maximum and minimum 2-m temperatures have also been derived using data from three thermometric stations with daily time series for the period 1976–2006. The thermometric stations are located at the head of the runways in the airports of the three major islands of the archipelago, where urbanization has arguably not had a relevant impact on the registered values. The annual mean temperature in the mid-troposphere and lower stratosphere has also been analyzed using the Balearics radiosonde data for the period 1981–2006. Results show there is a negative tendency for annual precipitation (163 mm per century) with 85% significance on the sign of the trend. An abrupt decrease in mean yearly precipitation of 65 mm is objectively detected in the time series around 1980. Additionally, the analysis shows that light and heavy daily precipitation (up to 4 mm and above 64 mm, respectively) increase their contribution to the total annual, while the share from moderate-heavy precipitations (16–32 mm) is decreasing. Regarding the thermometric records, minimum temperatures increased at a rate of 5.8°C per century during the 31 years and maximum temperatures also increased at a rate of 5.0°C per century, both having a level of statistical significance for the sign of the

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linear trend above 99%. Temperatures in the mid-troposphere decreased at a rate of −5.4°C per century while a tendency of −7.8°C per century is found in the lower stratosphere. The level of statistical significance for the sign of both the tropospheric and stratospheric linear trends is above 98% despite the great inter-annual variability of both series.

1 Introduction

Observations evidence that global surface temperature increased during the 20th century. In fact, the second half of the 20th century is arguably the warmest in at least the past 1,300 years over the northern hemisphere (IPCC 2007). According to the CRU/Hadley Centre, gridded land-surface air temperature V3 (CRUTEM3, Brohan et al. 2006), years 1998 and 2005 were the warmest on instrumental record (land station temperature anomalies of 0.82 and 0.75°C above the 1961–1990 average). This dataset reveals a global increasing trend of 2.68°C per century for the period 1979–2005, which resulted in the notorious record of 11 out of the 12 warmest years on instrumental record being observed during the 1995–2006 period. A Student *t*-test (Harnett and Soni 1991), shows a significance level for the sign of that trend above 99.99%. Differential warming is detected in the Northern and Southern hemispheres, with observed centurial trends for the 1979–2005 period of 3.28°C and 1.34°C, respectively, both with significance levels above 99.99%. Estimated tendencies at regional scale during the period 1979–2005 show large regional variability and, in particular, IPCC (2007) attributes to the Mediterranean area trends which lay between 2.5 and 3.5°C per century (see their Fig. TS.6).

Simultaneously to the global warming, a redistribution of the precipitation around the globe has occurred during the 20th century. Although linear trends for the 1901–2005 period show high spatial variability, general positive trends in annual precipitation were observed over North and South America, Eurasian continent and Australia. On the other hand, significant decreases in annual totals were observed in western Africa, Sahel, western coast of South America and the Mediterranean basin. In particular, the Mediterranean region has experienced a decrease in annual precipitation estimated at 5–20% during the period 1901–2005, although changes less then 3% were obtained for the period 1979–2005 (Fig. 3.13 from IPCC 2007). However, difficulties in getting reliable and representative datasets of precipitation remain an area of concern due to large regional differences, gaps in spatial coverage and temporal limitations in the data (Huntington 2006).

Within this context, detailed studies of regional tendencies of climatic parameters become particularly relevant. With this aim, trends in temperature (both near surface and upper air: troposphere and lower stratosphere) and precipitation are calculated using observed data from the Balearic Islands, located in the centre of the western Mediterranean (Fig. 1). Temperature and especially precipitation trends are of great concern for a tourist pole such as the Balearic Islands, where water resources are limited and dry season demands are very high. Computed trends in the Balearics complement those 5° × 5° grid cell averages reported by the IPCC (2007) over the western Mediterranean. Our results would also complement and contribute to global studies of regional responses to climate change from the Western Mediterranean perspective.

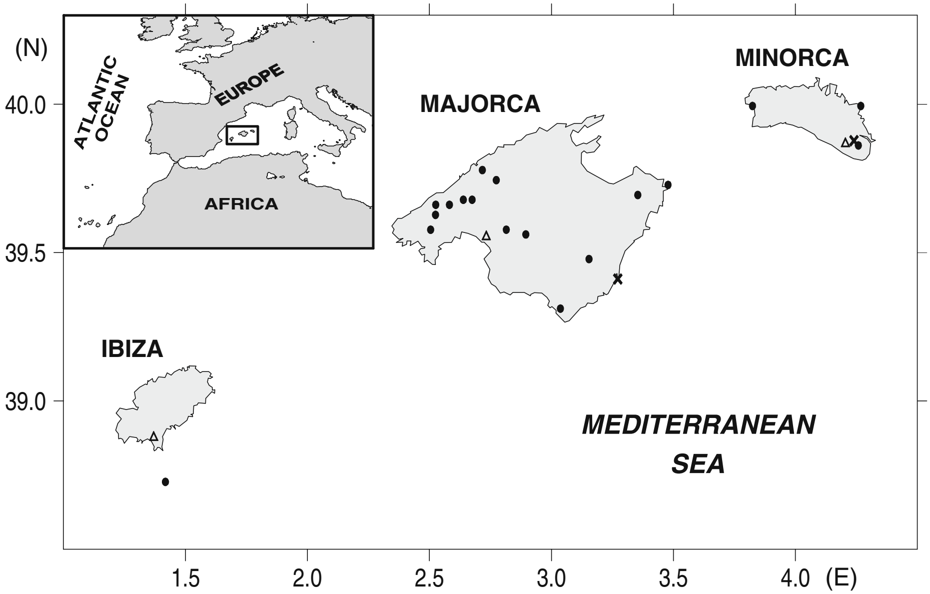

Fig. 1 The Balearic Islands. *Black dots* represent the location of the 18 rain gauges with complete daily records, *crosses* indicate the two stations with complete monthly precipitation series and triangles show the three thermometric stations used in this study

2 Data and methodology

The dataset used in this study consists of rain gauge, thermometric and radiosonde station measurements. In the Balearic Islands there are archived records of around 200 rain gauge stations that collect accumulated daily precipitation. However, the series span over different periods and have different degrees of completeness. For the sake of significant results, we selected the rain gauges that covered the period 1951–2006 (56 years) without any gap in the daily time series. The application of

Table 1 Trends and statistical significance level of their sign for the mean temperature series

Variable	Slope (°C/100 year)	Significance level (%)	S–W test *p*-value	B–P test *p*-value
Minimum annual	5.75	>99.99	0.44	0.64
Minimum winter	1.01	29.41	0.94	0.16
Minimum spring	7.01	>99.99	0.33	0.69
Minimum summer	7.30	99.92	0.38	0.56
Minimum autumn	5.24	99.47	0.42	0.72
Maximum annual	4.99	>99.99	0.61	0.56
Maximum winter	1.88	74.15	0.56	0.75
Maximum spring	7.90	>99.99	>0.99	0.08
Maximum summer	5.06	96.68	0.11	0.92
Maximum autumn	3.10	91.28	0.19	0.42

P-values for the Shapiro–Wilk (S–W) and Breusch–Pagan (B–P) tests indicate the probability of normality and against heteroscedasticity of the ordinary least squares residuals

Table 2 As in Table 1 for the mean precipitation series

Variable	Slope (mm/100 year)	Relative variation (%)	Significance level (%)	S–W test *p*-value	B–P test *p*-value
Annual	−163.32	−27.94	85.29	0.99	0.80
5 year mean	−158.50	−27.13	80.84	0.22	0.70
Winter	−46.75	−26.15	68.26	0.52	0.39
Spring	−65.07	−52.19	79.84	**0.03***	0.40
Summer	−18.27	−39.30	73.21	<**0.01***	0.21
Autumn	−25.17	−10.81	20.46	0.20	<**0.01***

Relative variations indicate the centennial trends relative to the corresponding mean precipitation
*$p < 0.05$

this filter results in a set of 18 rain gauges. Two additional stations for which daily time series are not complete, but with complete monthly records available, are also included in the analysis (Fig. 1).

Thermometric stations that collect daily maximum and minimum temperature are much fewer than rain gauge stations, and most available records are shorter than 15 years. We have selected the three thermometric stations (Fig. 1) that possess nearly complete daily series from 1976 to 2006 (31 years). Coincidentally, this is the period when global averaged temperature showed its maximum tendency from the beginning of instrumental records (Vose et al. 2005).

A radiosonde station operates in the Balearic Islands from 1958 (WMO identification 08302) (Ramis 1995). However, data is available only from 1981 (previous data, not archived in electronic devices, was lost). Monthly mean temperatures of the 00UTC (nocturnal) sounding at 1,500, 5,500 and 14,000 m during the period 1981–2006 have been utilized in the analysis. During this period more than 95% of the soundings were successfully carried out and are available for the study.

In order to investigate long-term changes in the mean of the three available datasets, linear trends are computed for each time series considered in this study. Standard ordinary least squares (OLS) methods provide linear model parameters with the least variance amongst all unbiased linear estimators as long as the residuals are independent, normally distributed, homoscedastic and with no bias (e.g. von Storch and Zwiers 1999). Deviations in the data from these assumptions make this property to not persist and alternative trend estimation methods must be adopted to reach prudent and reliable conclusions. In particular, tests for normality (Shapiro and Wilk 1965) and against heteroscedasticity (Breusch and Pagan 1979) suggest that series in the dataset produce non-normal and heteroscedastic residuals when

Table 3 As in Table 1 for the percentage series of the categorized precipitation

Category (mm)	Slope (%/100 year)	Significance level (%)	S–W test *p*-value	B–P test *p*-value
Trace (0.1–1)	1.00	99.15	**0.02***	0.07
a (1–4)	5.00	99.42	**0.04***	**0.04***
b (4–16)	0.30	4.84	0.17	0.80
c1 (16–32)	−7.69	99.94	0.61	0.19
c2 (32–64)	−1.90	35.17	0.88	0.45
d1 (64–128)	1.02	31.20	<**0.01***	0.53
d2 (>128)	–	–	<**0.01***	0.87

*$p < 0.05$

Table 4 As in Table 1 for the number of days series of the categorized precipitation

Category (mm)	Slope (days/100 year)	Significance level (%)	S–W test p-value	B–P test p-value
Trace (0.1–1)	3.97	90.89	0.58	0.61
a (1–4)	7.03	99.09	0.59	0.77
b (4–16)	−5.41	90.25	0.63	0.66
c1 (16–32)	−4.53	99.82	0.93	0.58
c2 (32–64)	−1.19	72.50	0.12	0.55
d1 (64–128)	0.14	38.16	<**0.01***	0.45
D2 (>128)	–	–	<**0.01***	0.93

*$p < 0.05$

fitted with OLS algorithms (Tables 1, 2, 3, 4). Robust statistics provides methods that emulate the OLS framework, but which are not unduly affected by small departures from model assumptions (e.g. Maronna et al. 2006). In this study, linear trends are calculated by means of an algorithm based on the MM-estimator described by Yohai (1987) and an efficient iteratively re-weighted least squares procedure (Jennrich and Moore 1975), as implemented by Rousseeuw et al. (2008). Standard errors of the estimated trends and their confidence intervals are derived following Croux et al. (2003). Extensive use of robust methods has been done in the last decade, especially to estimate trends of climatic series unsuitable for OLS trend fitting such as series of extremes (Moberg and Jones 2005).

3 Observed tendencies

3.1 Surface temperature

The only available thermometric stations in the Balearics with sufficiently long records are located at the three airports of the major islands (Fig. 1). No urban changes have occurred around these stations, as they operate at the head of the runway, far from any urban development. Thus, local effects from urbanization, such as heat island heating, are negligible in these stations.

Seasonal and annual means for the maximum and minimum temperatures have been calculated for each of the three stations using daily data. As illustrated by Pielke et al. (2002), trends from two neighboring stations can differ greatly in magnitude and even have opposite signs. Thus, when a group of stations with complete and long time series is available, as in this case, the average is more representative to characterize the regional climate than each individual series. Consequently, seasonal and annual means for the Balearic Islands were defined as the three station-averaged seasonal and annual values. This methodology has been used by Jung et al. (2002), Zai et al. (1999) and Alexanderson (1996), among others.

Two-meter temperatures in the Balearics follow a clear seasonal cycle with warm summer months characterized by maximum mean monthly records exceeding 30°C and mild winters with minimum mean monthly temperatures above 5°C (Fig. 2a). Average daily temperature range does not exceed 10°C, mainly due to the maritime thermal control of air masses reaching the Balearics and the strong mixing effect of sea breezes mainly during the warm half of the year (Ramis and Romero 1995; Atkinson 1981)

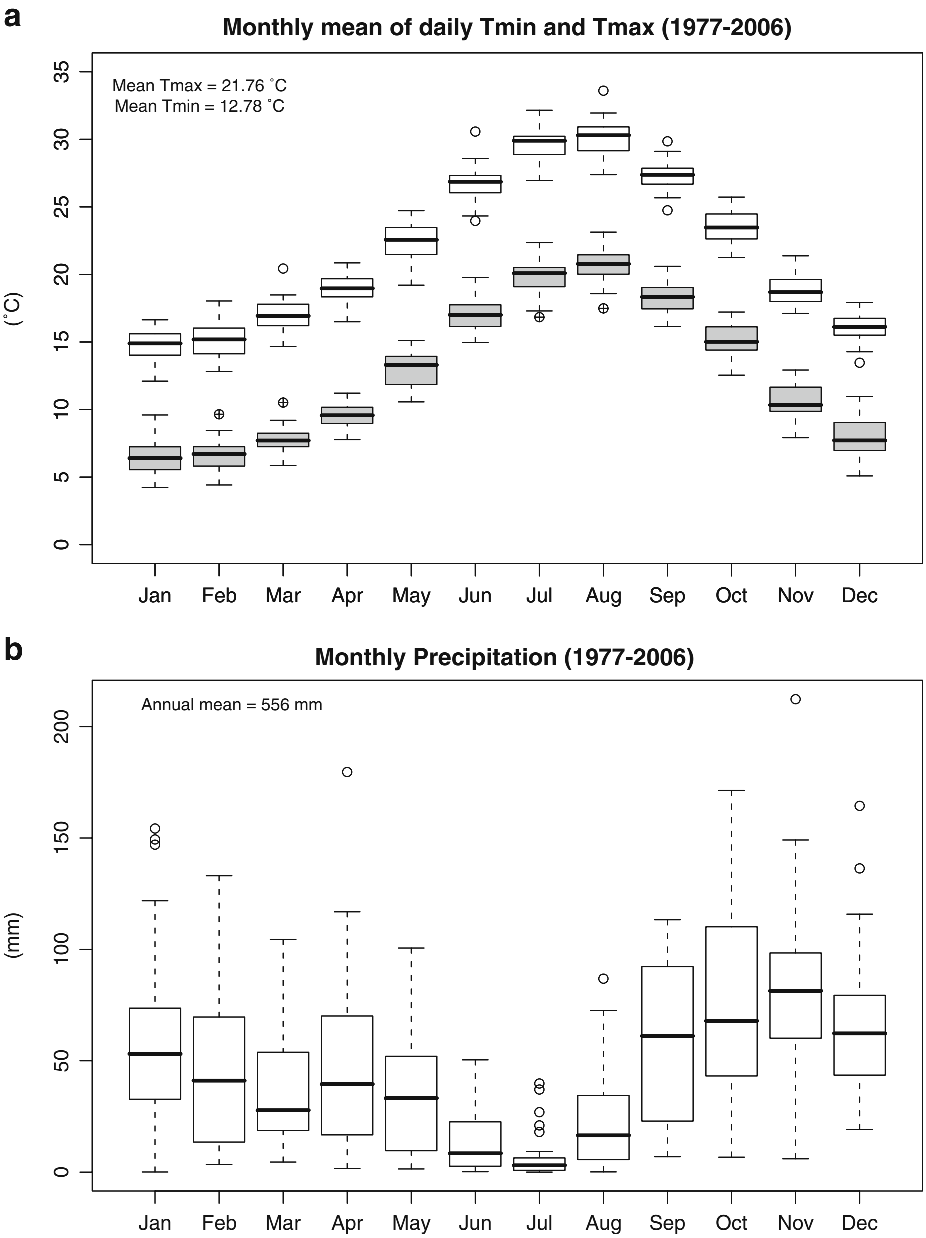

Fig. 2 Boxplots showing the median, first (Q1) and third (Q3) quartiles and the most extreme events within the 1.5 inter-quartile range (IQR) of **a** monthly mean daily maximum and minimum (*shaded*) temperatures; **b** monthly precipitation over a common 30-year period 1977–2006. *Circles* show outliers in the series (below [above] the Q1–[Q3+] 1.5 IQR threshold)

Regarding long-term changes, Fig. 3 shows the evolution of the annual mean temperatures for the Balearic Islands during the period 1976–2006. Linear trends show that maximum and minimum temperatures have a positive estimated tendency

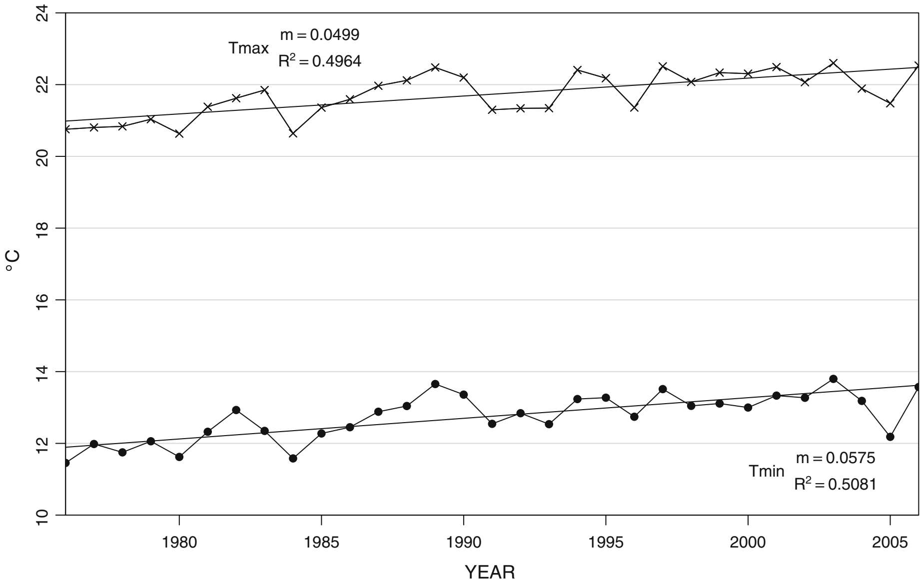

Fig. 3 Annual maximum and minimum temperature time series. Linear trends are depicted as dashed lines. The corresponding slopes and coefficients of determination are included

of about 5°C per century, with slightly steeper trend for the minimum temperatures. The coefficient of determination (R^2) is high for both fittings, such that about 50% of the observed variability in each time series is explained by the robust linear fit. Standard errors show that both slope signs are statistically significant at a level greater than 99%. The CRUTEM3 dataset for land stations reveals a global trend of 2.54°C per century for the same period (1976–2006), although Northern hemisphere temperatures achieve a 3.38°C estimated tendency. This confirms the great variability of regional temperature trends with differences exceeding 2°C the global estimated values. In good agreement with the global analysis provided by IPCC (2007), the annual mean diurnal temperature range (DTR) in the Balearics has not appreciably changed. In fact, DTR in the Balearics has strictly decreased during the last quarter of the XX and first years of the XXI century, owing to the slightly greater rise of the minimum as compared to maximum daily temperatures. This could be attributed to an increase of nocturnal (20 to 4UTC) cloud cover in the archipelago, estimated at a rate of +53% per century for the 1977–2006 period at the Palma Airport station, and compatible with the total cloudiness increase reported for the Western Mediterranean (Henderson-Sellers 1992) and particularly for the Iberian Peninsula (Sánchez-Lorenzo et al. 2008). Indeed, the DTR trends are highly variable from one region to the other and so decreasing values have been observed in many parts of the world (Easterling et al. 1997) but the opposite has also been observed, for example in South Korea (Jung et al. 2002).

Seasonal time series for maximum and minimum temperatures have been obtained as the arithmetic means of the months of MAM for spring, JJA for summer, SON for autumn and DJF for winter. Results of the robust regression and significance level tests are shown in Table 1. Positive trends are obtained for all eight series. The highest maximum temperature trend occurs during spring (7.9°C per century) and the lowest in winter (1.9°C per century). On the other hand, minimum temperatures present the greatest tendencies in summer (7.3°C per century) and the lowest in winter (1.0°C per century). Significance of the sign of the estimated trends is generally high, although both winter temperatures and autumn maxima do not reach the 95% level for the positive sign of the trend. Maximum temperatures increased at a higher rate than minimum records in spring while the reverse occurs for summer and autumn. As a consequence, DTR trends are different throughout the year: positive during spring and negative during summer and autumn. Winter temperature trends are smaller and not enough statistically significant to draw solid conclusions about changes in DTR.

3.2 Upper air temperature

Using the monthly mean temperature series at 1,500, 5,500 and 14,000 m, the corresponding annual mean temperatures have been calculated. A robust parameter estimator for the linear fit is applied to each of the three annual mean series. The analysis reveals a positive trend at 1,500 m of 0.54°C per century although the high variability of the series results in a very low coefficient of determination (less than 0.01) and low statistical significance of the sign (51%). Conversely, mid and upper level series (5,500 and 14,000 m respectively) show decreasing temperatures at rates of −5.44 and −7.83°C per century, with significances of the cooling trend of 98.0 and 99.6%. Important difficulties still remain in the analysis of global trends in radiosonde data due to data scarcity and the presence of multiple sources of heterogeneities in the datasets (IPCC 2007). The results obtained for the Balearics are consistent with the global trends at 1,500 and 14,000 m but seem to differ at 5,500 m. Interestingly, global trends for tropospheric temperature are positive, arguably due to the weighted average applied across a predefined tropospheric depth to estimate a representative *mid-levels* temperature, as opposed to the single layer assumption used in our analysis.

3.3 Precipitation

Seasonal and annual accumulated precipitations are calculated for each of the 20 available rain gauges. Eighteen daily precipitation series are available while two additional complete monthly accumulations were also considered. Similarly to the thermometric records, seasonal and annual regional precipitations for the Balearic Islands are defined as mean values over all rain gauges.

Bars in Fig. 4 show the annual accumulated precipitation time series, which has high interannual variability. It is noteworthy that the lowest precipitation values (1965, 1983 and 1999–2000) are observed every 17 years, producing the three most severe droughts in the Balearics during the last decades with accumulated precipitations roughly half the average value of 585 mm. Indeed, the autocorrelation function of this series shows a relative maxima of anticorrelation and correlation at lags 8 and 16 years respectively, clearly revealing the presence of a fluctuation with this period in the annual precipitation series. A first analysis of the linear trend shows that, during the period 1951–2006, precipitation has decreased at a rate of −163 mm per century, with negative trend at a statistical significance level of 85%.

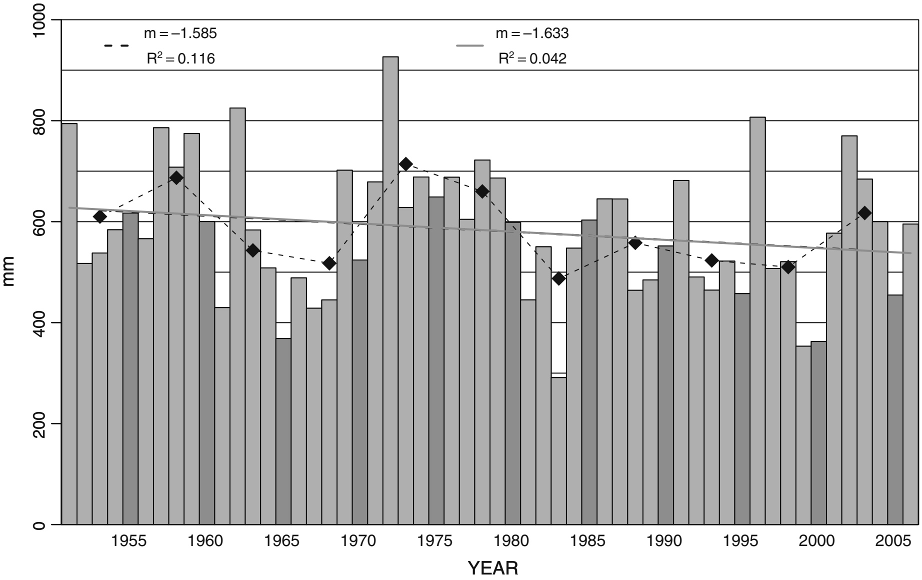

Fig. 4 Annual (*bars*) and five-yearly (*diamonds*) accumulated precipitation time series for the Balearic Islands (*bars*). *Solid* and *dashed straight lines* show the linear fit for the annual and five-year time series, which are almost entirely overlapped. The corresponding slopes and coefficients of determination are included

However, a smoother time series (Fig. 4, diamonds) has been obtained by computing the 5 year averages. The linear trend for this series is −159 mm per century and its statistical significance exceeds 80%. This sequence highlights the 16-year period of the series, with roughly three periods covered within the analyzed period. In order to gain some insight on the possible links between the Balearic precipitation series and atmospheric circulation patterns, the correlation of the monthly, yearly and 5-yearly series with indices of ten prominent teleconnection patterns of the Northern Hemisphere (Barnston and Livezey 1987) are computed. Among all indices, the Scandinavian and East Atlantic pattern consistently show high correlation with the three accumulated precipitation series. In particular, the Scandinavian pattern index captures well the annual and 5-annual variability of the precipitation (correlations of 0.32, and 0.59) whereas the East Atlantic mode is correlated with the monthly and 5-yearly precipitation series (correlations of −0.21 and −0.46). These moderate links with the precipitation in the Balearics can be interpreted by the presence of tropospheric troughs over the Western Mediterranean under positive (negative) Scandinavian (Eastern Atlantic) pattern and their direct relationship to precipitation in the area (Romero et al. 1999).

Two different temporal regimes of precipitation seem to emerge from both the original and the 5-year mean series. A first period with oscillating values with an amplitude of about 125 mm is clearly identifiable until the 1983 drought, and a second period with lower annual accumulated rain shows a reduced oscillation amplitude in the late 80's and early 90's. Indeed, an algorithm for the detection of significant changes in the trend, based on the optimization of the explained variance by segments of the complete series (Oosterbaan 1994), results in a consistent detection of a breakpoint between years 1979–1983 for a test set of nine smoothed time series computed using 3 yra to 19 yra series. The breakpoint detection algorithm identifies abrupt decreases in yearly precipitation of 65 mm in average between the two distinct periods. For all nine smoothed time series, neither of the two subintervals of the series shows a highly significant (below 90%) linear trend, with averaged yearly precipitation values of 610 and 545 mm for the pre- and post-breakpoint period, respectively.

Focusing on the seasonal precipitation series, the corresponding four seasonal trends have been calculated by means of the robust estimator and the results are shown in Table 2. Tendencies are negative for all seasons, with the spring exhibiting both the highest rate (−65 mm per century) and the highest statistical significance for the sign (52%). This reduction explains nearly 40% of the annual precipitation losses, followed by the winter trend (−47 mm per century) which accounts for almost 29% of the total annual loss. On the contrary, summer—with a notable seasonal relative reduction of about 39%—and autumn contribute only 11% and 15% to the annual negative trend. This important loss in spring precipitation is particularly damaging for water resources of the region, intensively stressed by summer tourist activity, as it implies a tendency to an earlier start of the dry season (recall Fig. 2b).

In order to detect modifications in the rainfall regime during the considered period, we have classified the daily precipitation, for each year and each of the 18 rain gauge station with complete series, in seven different categories: *trace* (0.1–1 mm), *a* (light; 1–4 mm), *b* (light-moderate; 4–16 mm), *c1* (moderate-heavy; 16–32 mm), *c2* (heavy; 32–64 mm), *d1* (heavy-torrential; 64–128 mm) and *d2* (torrential; >128 mm). A similar categorization of daily precipitation was made by Alpert et al. (2002). For

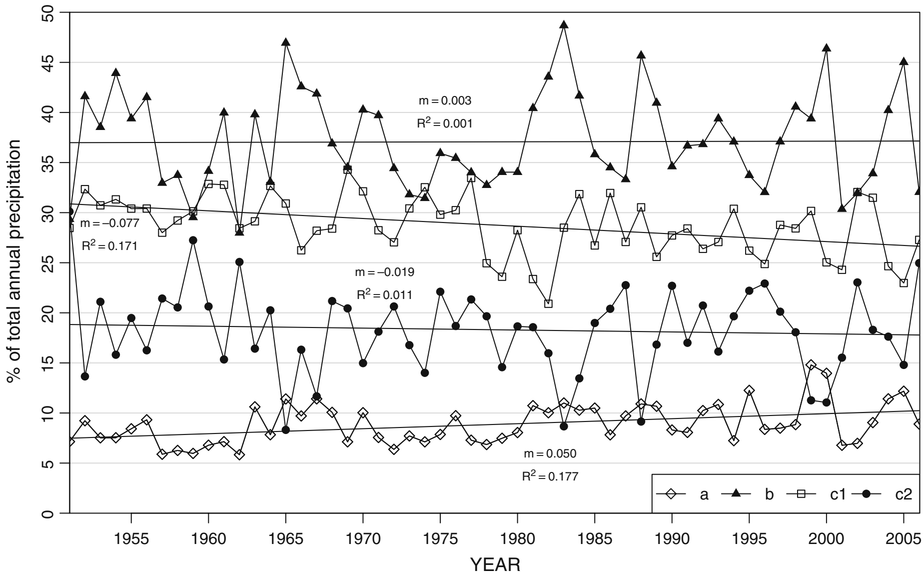

Fig. 5 Time series of contribution percentage to annual precipitation by daily rainfall categories *a* (1–4 mm), *b* (4–16 mm), *c1* (16–32 mm) and *c2* (32–64 mm). *Solid straight lines* represent the linear trends of the series. The slopes and coefficients of determination are included

each year and rainfall category we have considered two variables: contribution (as percentage) to the annual precipitation, and annual frequency. These variables are averaged among the 18 rain gauges. Thus, we obtain two new time series for each category, and the corresponding linear trends are computed and further discussed.

Figure 5 shows the time series corresponding to the annual precipitation percentage for the *a*, *b*, *c1* and *c2* categories, as well as the linear model parameters from the robust fit, its slope and coefficient of determination. Table 3 shows the trends, levels of statistical significance of the sign of the slopes, and also the *p*-values for the Shapiro–Wilk and the Breusch–Pagan tests on the residuals of the discarded OLS fits, for all categories. Trace and light precipitations (*trace* and *a* categories) have a positive trend (increase of their contribution to the annual precipitation by 1% and 5% per century, respectively), with statistical significance higher than 99%. Light-moderate precipitations (*b*) show no significant trend with very low variance of this series explained by the linear model ($R^2 = 20.22\%$). Moderate-heavy precipitations (*c1* category) exhibit a negative trend (−7.69% per century), statistically significant at the 99% level. Heavy precipitations (*c2* category) display also a negative trend (−1.90% per century), although its statistical significance barely exceeds the 35% level. Conversely, heavy-torrential precipitations (*d1* category) increase their contribution to the annual total at a scarce 1% per century and also low significance level. The torrential category (d2) is so marginal (0.7% average contribution to the annual precipitation and 68% of the years with no contribution from this category) that the Rousseeuw et al. (2008) scheme cannot detect reliable trends in the series.

Table 4 shows the results for the changes in the yearly frequency for each category. There is an increase of 3.97 and 7.03 days per century for categories *trace* and *a*, with high a statistical significance for their sign. On the other hand, categories *b*, *c*1 and *c*2 reduce their annual frequency by −5.41, −4.53 and −1.19 days per century respectively, with statistical significances above 70%. Even though with low significance, a positive trend results for category *d1* (0.14 days per century). Therefore, an increase in the annual frequency and contribution to the annual precipitation is detected for the extreme categories, as opposed to the decreases obtained for the moderate ranges. Similar results were obtained by Alpert et al. (2002) for the Mediterranean Spanish area, Karl and Knight (1998) for USA and Jung et al. (2002) for South Korea.

4 Conclusions

Trends for annual mean maximum and minimum daily temperatures during the period 1976–2006 have been derived for the Balearic Islands. Those years coincide with the period of the largest global temperature increase of the last 150 years. Maximum and minimum daily temperatures show positive trends of about 5°C per century with the largest rise found in the minimum temperatures, implying also the almost globally observed decrease of the annually averaged DTR (Easterling et al. 1997). Nevertheless, temperature trends in the Balearics fall within the high end of all tendencies observed around the world; in particular, they are significantly higher than those observed at the same latitude circle (IPCC 2007).

Seasonal time series show a net increase of mean temperatures for all seasons, which is remarkably higher in spring and summer than in autumn and winter. This seasonal distinction appears to be a common feature of the western Mediterranean basin, but it contrasts with observations in neighboring regions such as the eastern Mediterranean (maximum rises in autumn) and northern Europe (maximum increase in winter) (IPCC 2007). Seasonal trends also reveal that the DTR increased during winter and spring and decreased during summer and autumn.

Radiosonde data from the station in the Balearics show temperature falls in the mid troposphere and lower stratosphere together with rises at low levels over the region. This is in good agreement with the globally estimated trends, although methodological differences might explain the disagreement in mid-tropospheric temperature trends reported by IPCC (2007, Fig. 3.17 vertically averaged values over a tropospheric depth) and calculated here (single level at 5,500 m).

Regarding precipitation, the Balearics got in average about 16% less annual precipitation the first years of the XXI century than in the mid-XX. This precipitation loss is notably higher than those obtained by IPCC (2007) to the Western Mediterranean basin, and it contrasts with the predominant precipitation increases estimated along the 35°–45° N latitude belt. Seasonal series show that spring and winter account for almost 70% of this annual loss with −110 mm per century attributable only to these two seasons. If maintained in the future, the annual—and particularly the spring and winter—precipitation shrinkage will be a major concern for local water managers, owing to the great seasonal stressing factor on water resources imposed by the islands tourism-based economy.

When precipitation days are classified according to seven predefined categories—light to torrential—both extremes, weak to moderate (0.1–16 mm) and heavy to torrential (>64 mm) days tend to increase their contribution to the annual precipitation, while the opposite is observed for moderate and heavy precipitation (16–64 mm) days. This mode of increase in both tails of the distribution and decrease of intermediate rainfalls for Mediterranean Spain was first reported by Alpert et al. (2002). In contrast, the same authors found different behaviors in the central and eastern Mediterranean areas: increase of torrential categories and decrease of all other categories in Italy; no significant trends in Israel and Cyprus. Similar results are obtained when analyzing the annual frequency of each category, with a significant shift towards both extremes of the daily rainfall distribution.

In summary, climate change is evident during the second half of the XX century and beginning of XXI over the Balearic Islands from the available observed records of both temperature and precipitation. Moreover, most impacts of this change are noticeable in the archipelago at an amplitude which is significantly larger than in most parts of the globe and, particularly, than in regions at similar latitudes.

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