Sub-hourly rainfall extremes in the Western Mediterranean Results from observations and a convection-permitting model

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Background

Changes in the Mediterranean





a) Precipitation



IPCC AR6

- Above average summer warming
- Less mean precipitation
- Increased rainfall seasonality
- Increased aridity



Changes in the Mediterranean

North

America

Type of observed change





Europe





- Above average summer warming
- Less mean precipitation
- Increased rainfall seasonality
- Increased aridity
- **Rainfall extremes?**



Type of observed change since the 1950s

Hourly vs daily changes



Changes in rainfall intensity: daily





Changes in rainfall intensity: hourly



Daily

Duration (hours)

Experiments

EPICC simulations



Elevation

WRF Experiments

Present

- 10 years at 2km
- ERA5 boundary conditions

Future

- 10 years at 2km
- PGW (ERA5 + 27 GCMs)

Both

- Explicit convection
- 10-min output for precip.

Comparison with observations

Observations





- Daily data:
 - 10, 20, 30-min daily maxima
 - 1, 2, 3, 6 and 12-h daily max
 - Daily total



Comparison of extremes WRF vs OBS

All-day 95th percentile







Comparison of 01H 95th (2011-2020)





1 value per day! Daily total Daily 1-h max Daily 10-min max



Comparison of extremes WRF vs OBS

All-day 99th percentile







Comparison of 01H 99th (2011-2020)





1 value per day! Daily total Daily 1-h max Daily 10-min max



Precipitation changes

Changes in mean rainfall





0 % 30

60

90

-30

-60

-90

Changes in extreme rainfall

Daily 99th percentile





All events! Daily, 10-y

99th ~ 36 events



Changes in extreme rainfall

10-min 99.99th percentile

Present







Changes in seasonal extreme rainfall

Day 99th percentile





Precipitation

DAY 99.00th percentile



DJF



0 30 60 90 -60 -30

All events! Daily, 10-y, season 99th ~ 9 events



Changes in seasonal extreme rainfall

Hourly 99.9th percentile





0 30 60

-60

-30



Precipitation

All events! Hourly, 10-y, season 99.9th ~ 22 events



Changes in seasonal extreme rainfall

10-min 99.99th percentile





Precipitation

All events! 10-min, 10-y, season 99.99th ~ 13 events



Intensity-duration changes

Changes in intensity-duration





Daily

Changes in intensity-duration





Resampling 10-min at different frequencies







Duration (hours)

Changes in intensity-duration



Daily

Duration (hours)

Conclusions

- Precipitation extremes and changes must be examined at hourly scales
- We need hourly (and sub-hourly) data to investigate extremes
- In the Med Sea, signs of more intense and shorter extremes with CC:
 - Despite large-scale circulation (less water supply).
 - Need to investigate mechanisms (dyn. vs thermodyn.)
 - Different response at different frequencies

EPICC (PID2019-105253RJ-I00 MCI/AEI/FEDER,UE)

TRAMPAS (PID2020-113036RB-I00 / AEI / 10.13039/501100011033)

