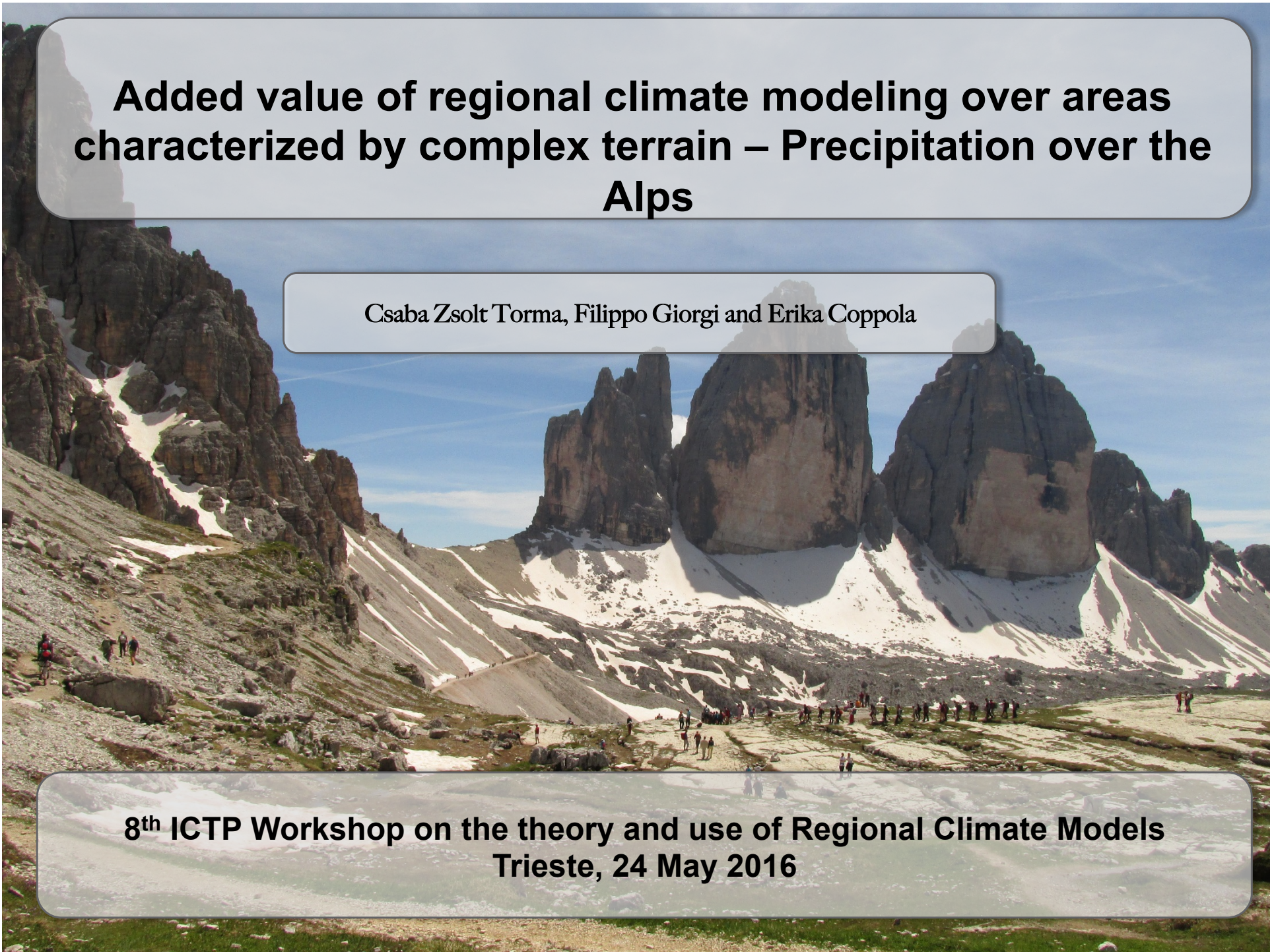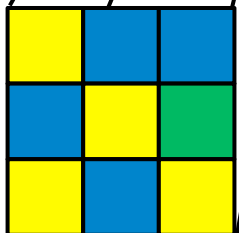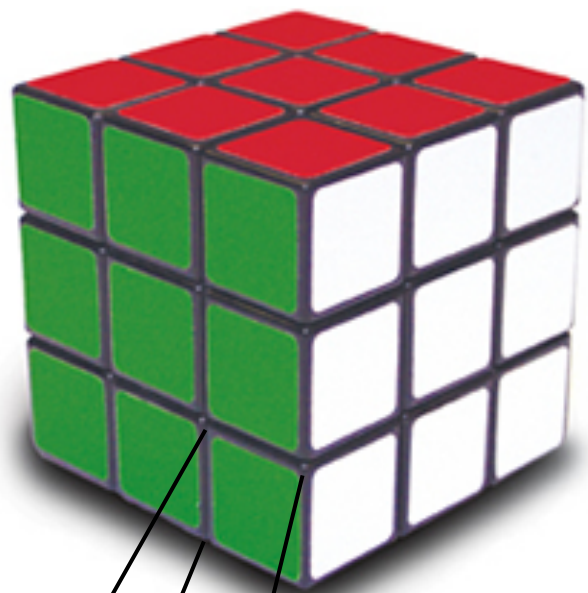# Added value of regional climate modeling over areas characterized by complex terrain – Precipitation over the Alps

Csaba Zsolt Torma, Filippo Giorgi and Erika Coppola

**8th ICTP Workshop on the theory and use of Regional Climate Models
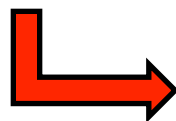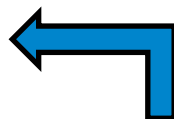Trieste, 24 May 2016**

Real world: "hard coded in the language of physics, chemistry, biology…"
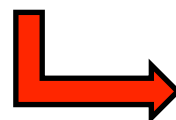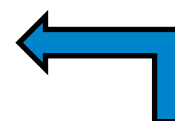

Global climate models:
 not all "subroutines" are known…

Information

Information

Information

Added value of higher RCM simulations over the Alps
Why the Alps? ⟶ complex topography
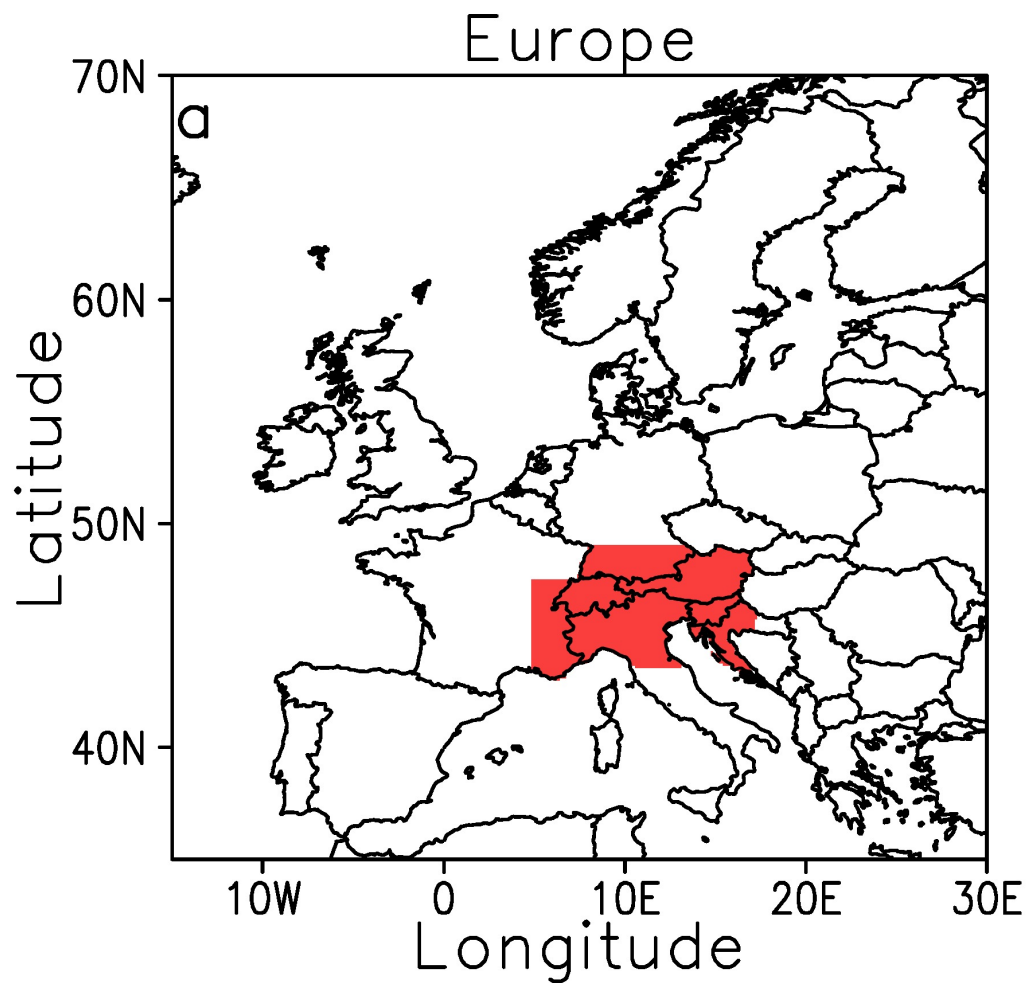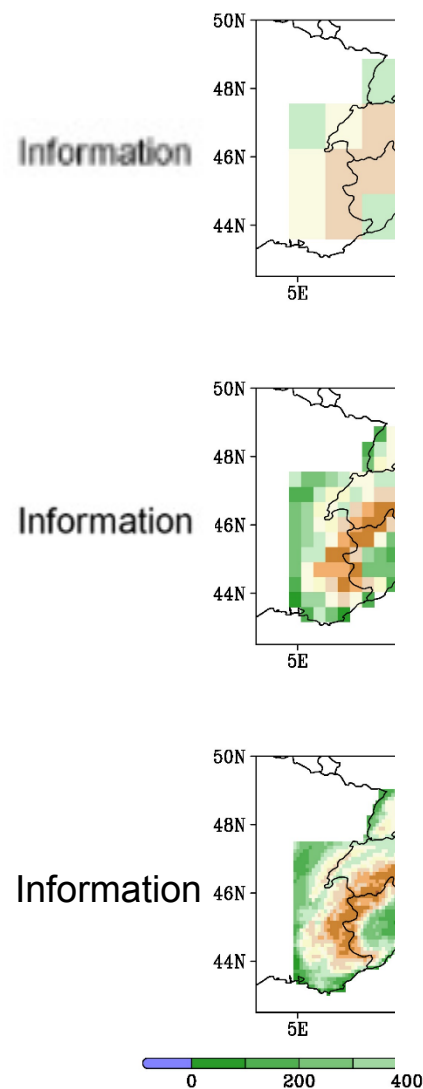
⟶ high-quality, fine-scale obs data set

Spatial patterns: **seasonal precipitation**

Distribution: **PDFs**

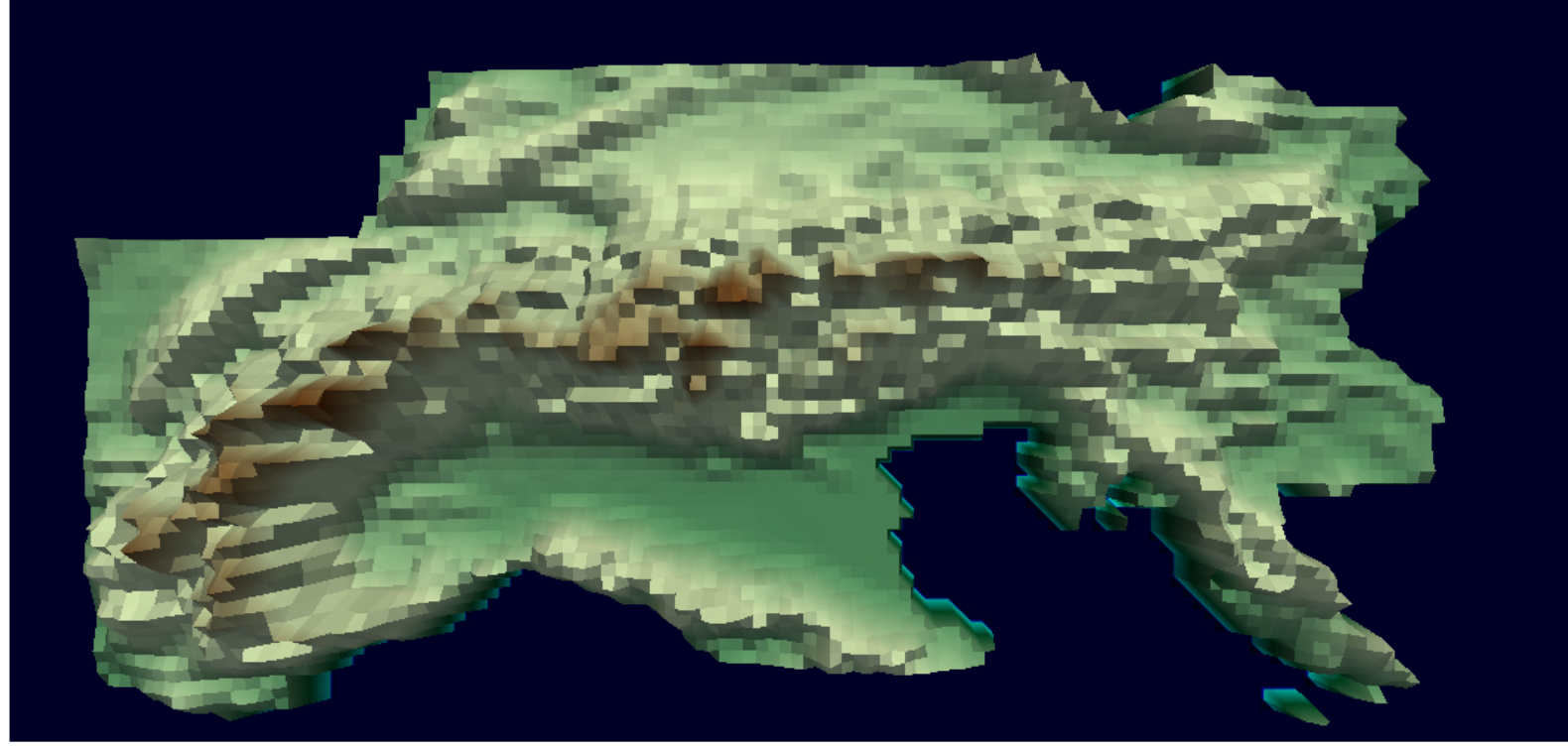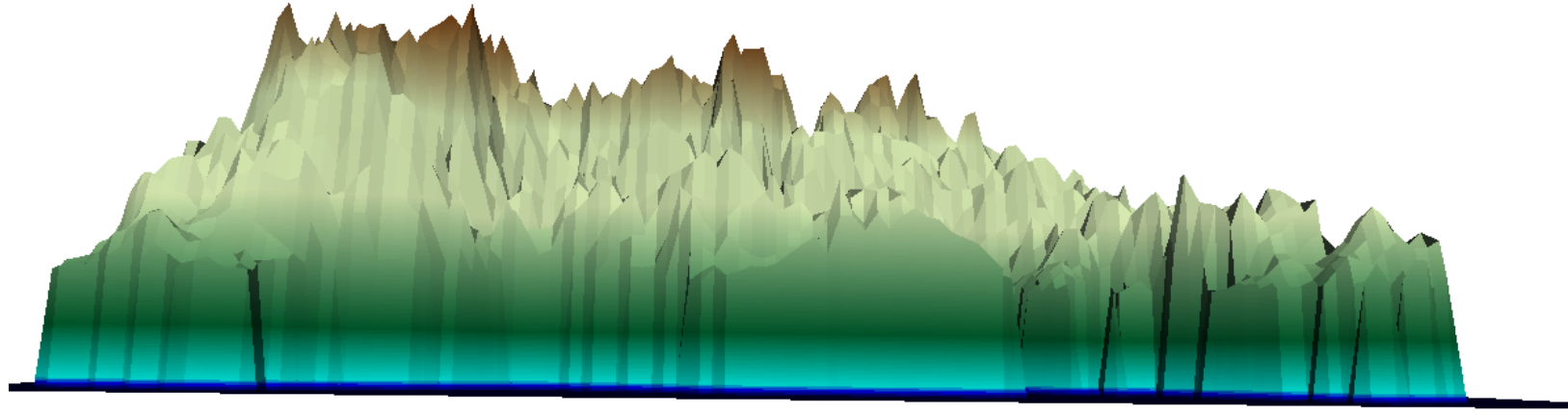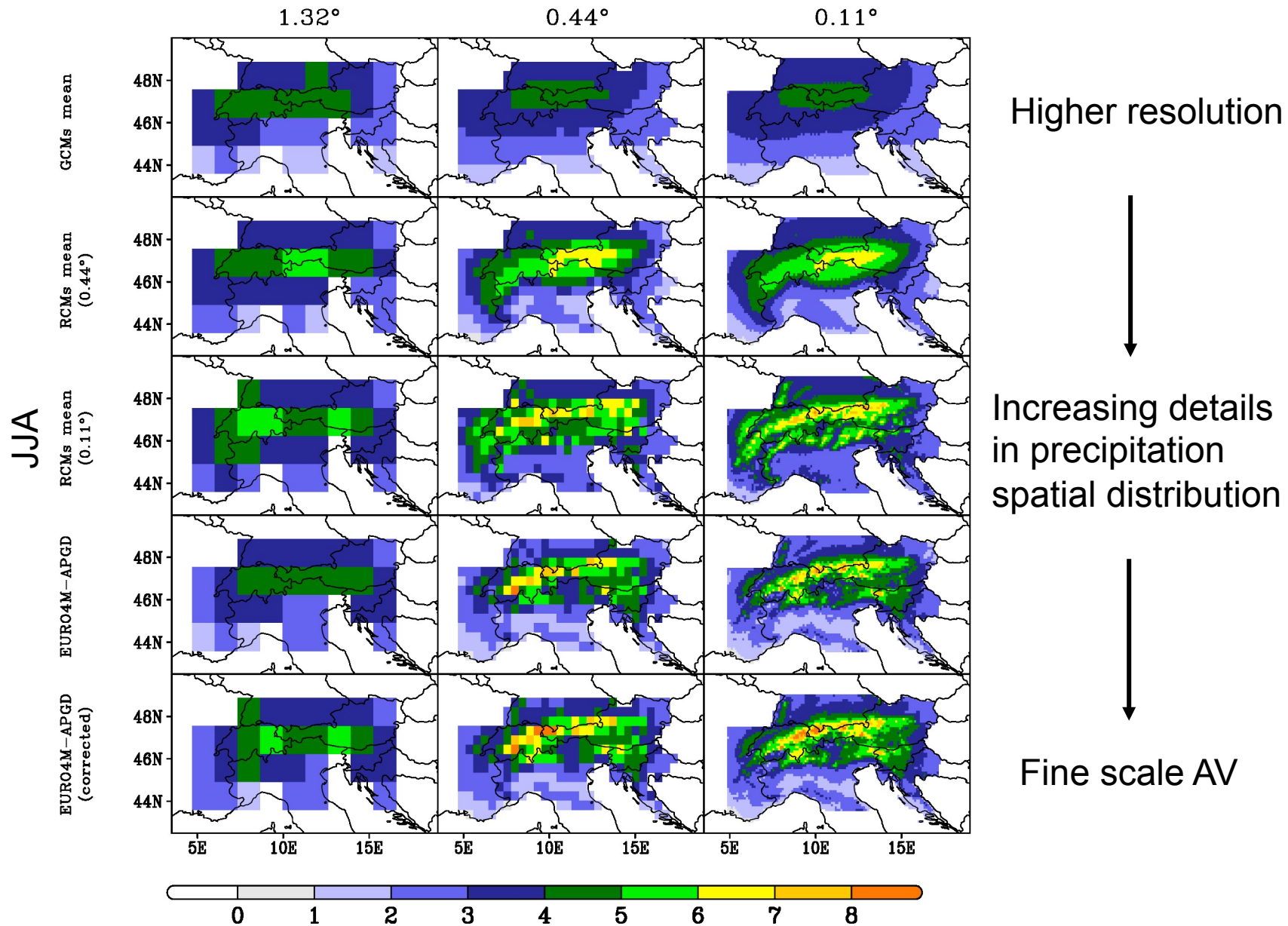Extremes: **R95**

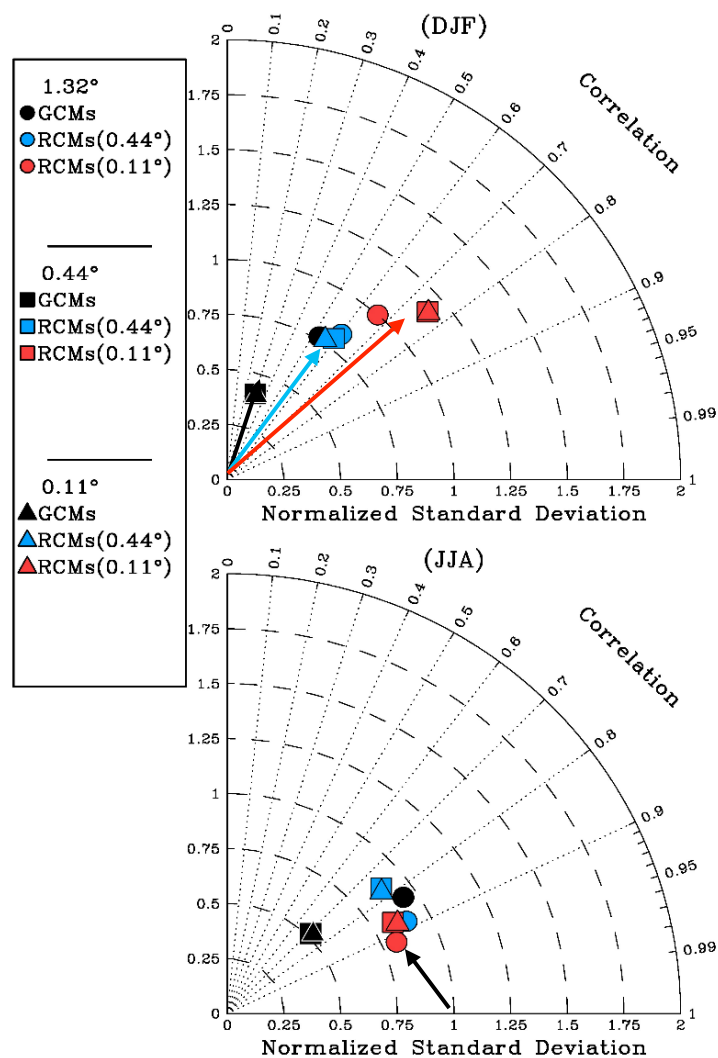**Added value of regional climate modeling over areas characterized by complex terrain - Precipitation over the Alps**

Horizontal resolutions: 1.32°, 0.44° and 0.11°

Europe

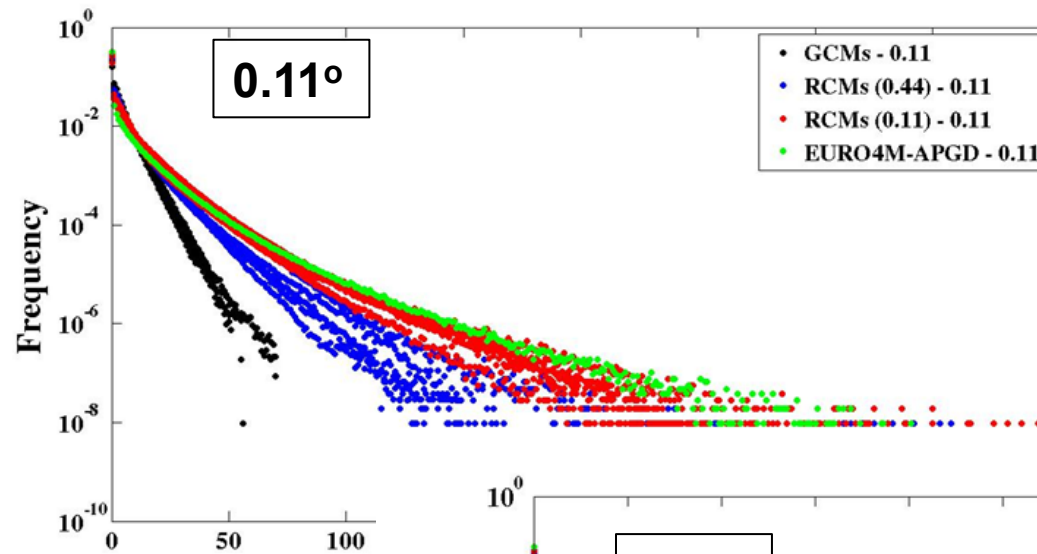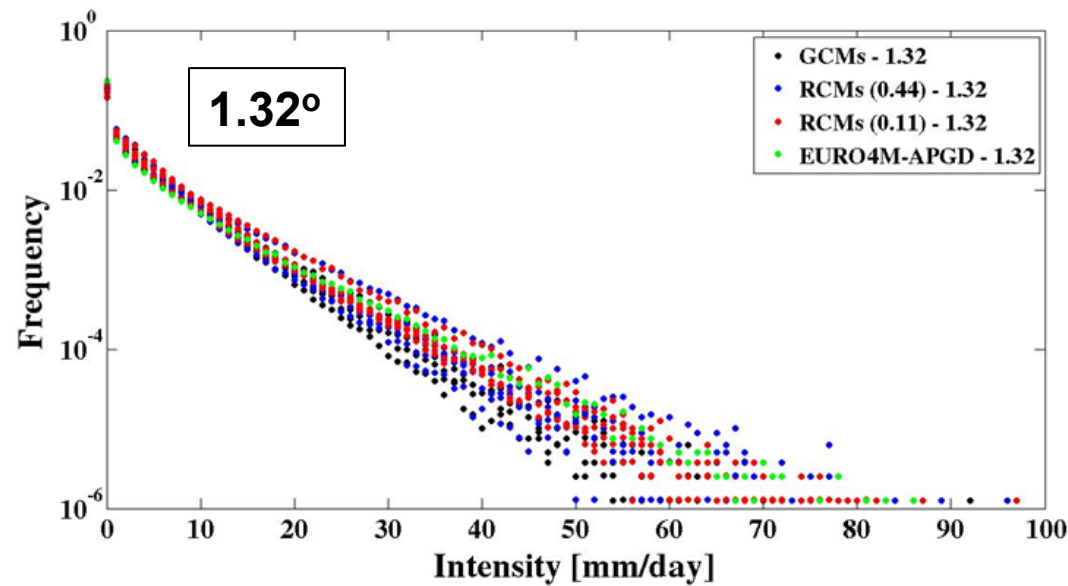Added value of regional climate modeling over areas characterized by complex terrain - Precipitation over the Alps

Higher resolution

Increasing details in precipitation spatial distribution

Fine scale AV

1976-2005

7

1976-2005

All simulations are
represented

RCMs are always closer
to OBS

Kolgomorov-Smirnov distance

$$d_{KS}(F, G) = sup_{t \in \mathbb{R}} |F(t) - G(t)|$$

1976-2005

| | GCM mean | RCM (0.44) mean | RCM (0.11) mean |

1,32   0,44   0,11

9

1976-2005

R95

1.32°   0.44°   0.11°

GCM ensemble shows only SW gradient with lower values

RCM11 captures well the magnitude and locations of max, min of R95

Spatial correlations highest fot **RCM11**

0   18   19   20   21   22   23   24   25   26   27   28   29   30

(2070-2099) – (1976-2005)

P change

24.05.2016.

(2070-2099) – (1976-2005)

P change

Added value of regional climate modeling over areas characterized by complex terrain - Precipitation over the Alps
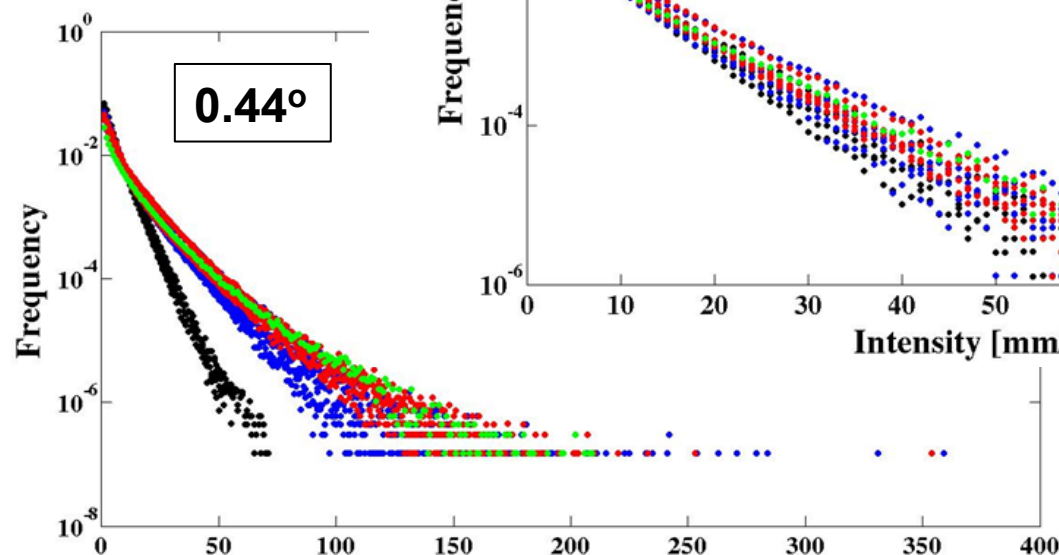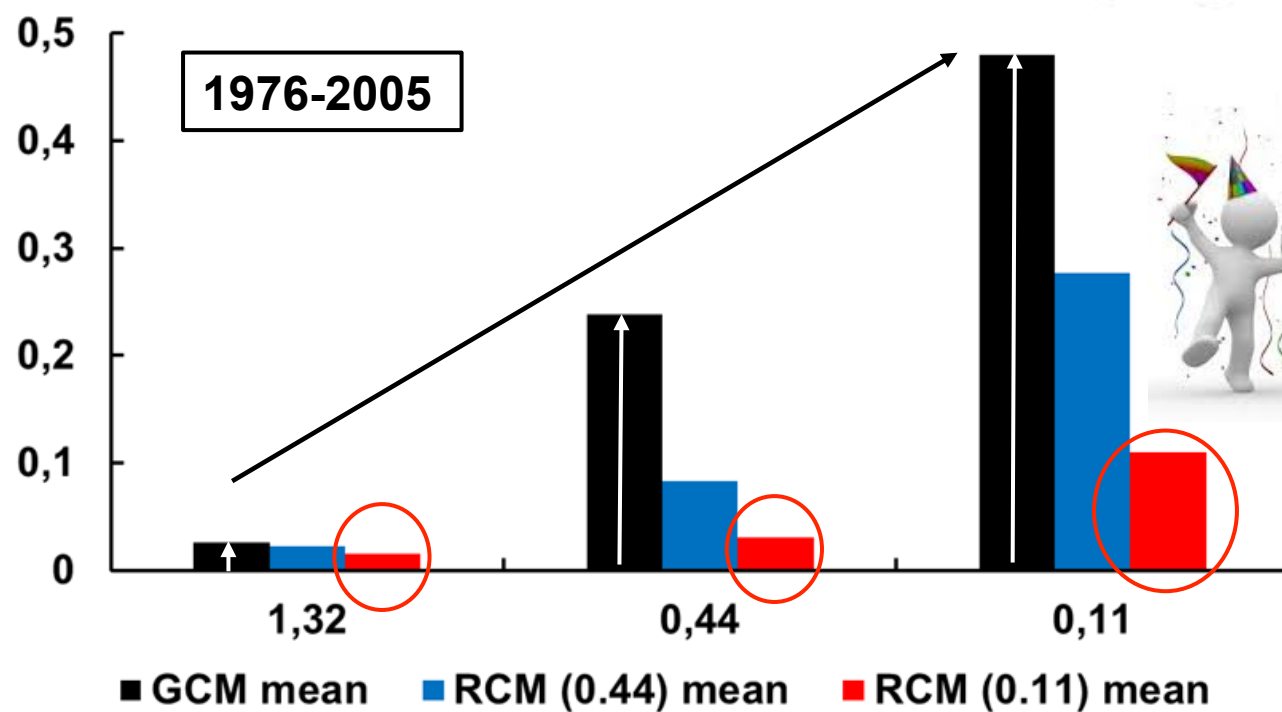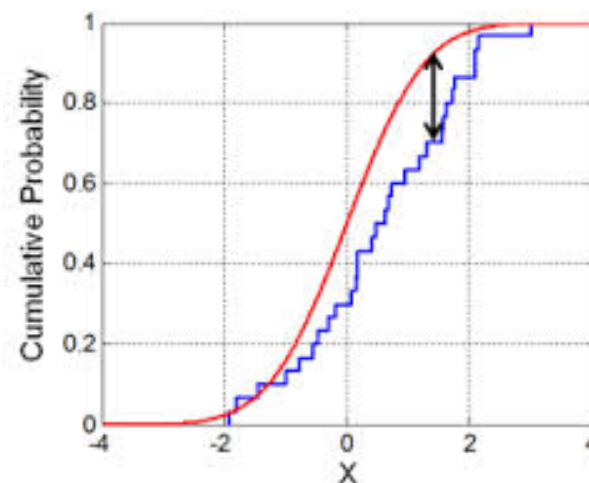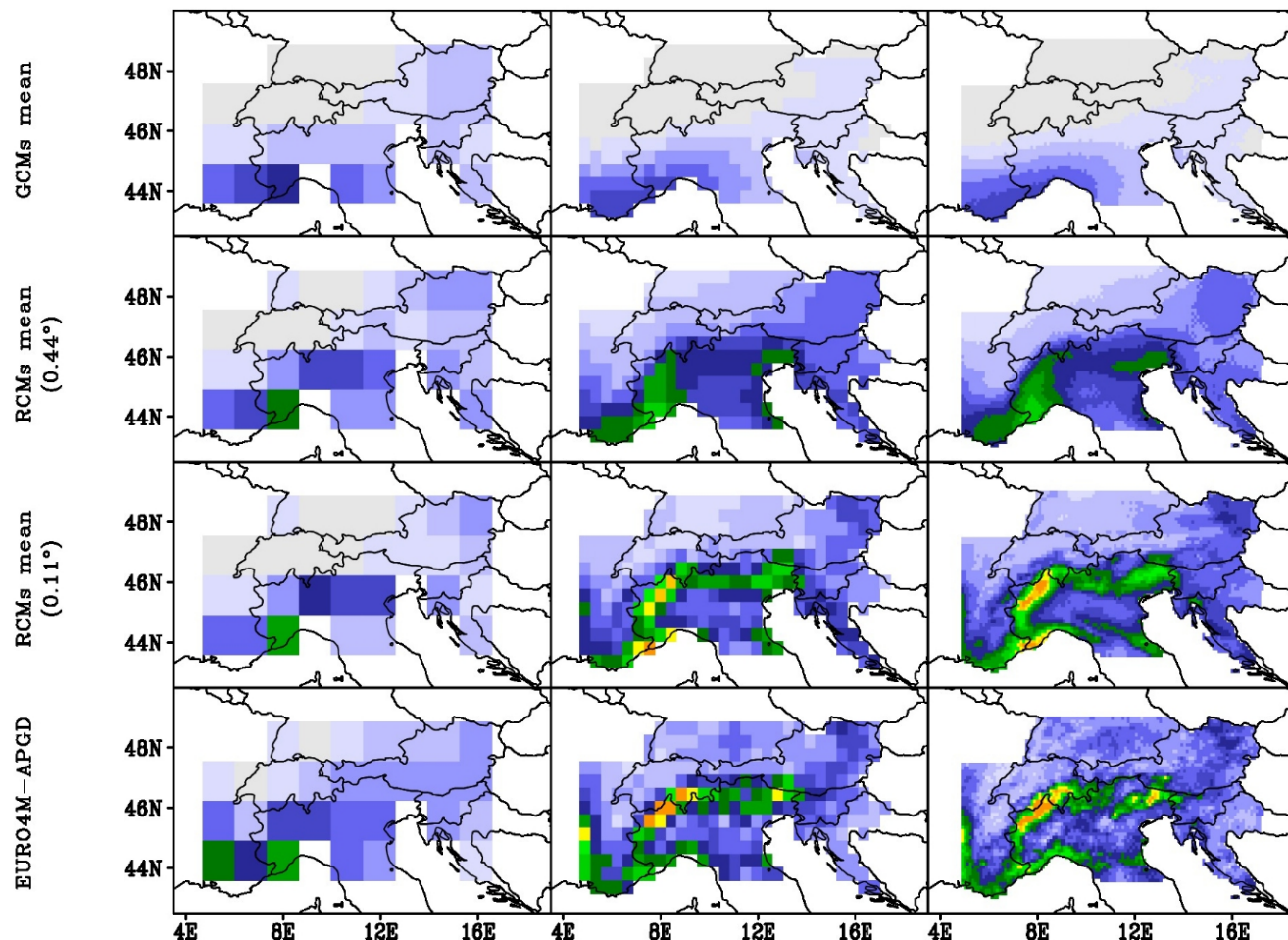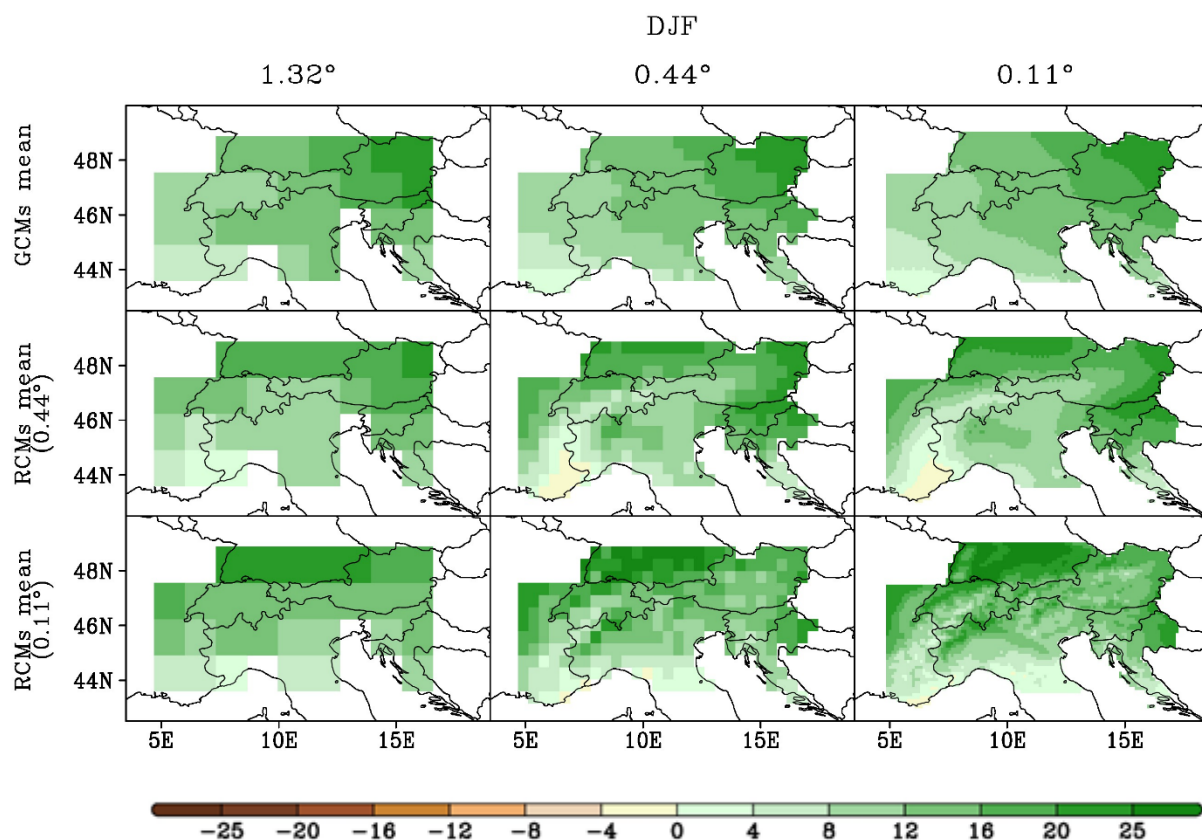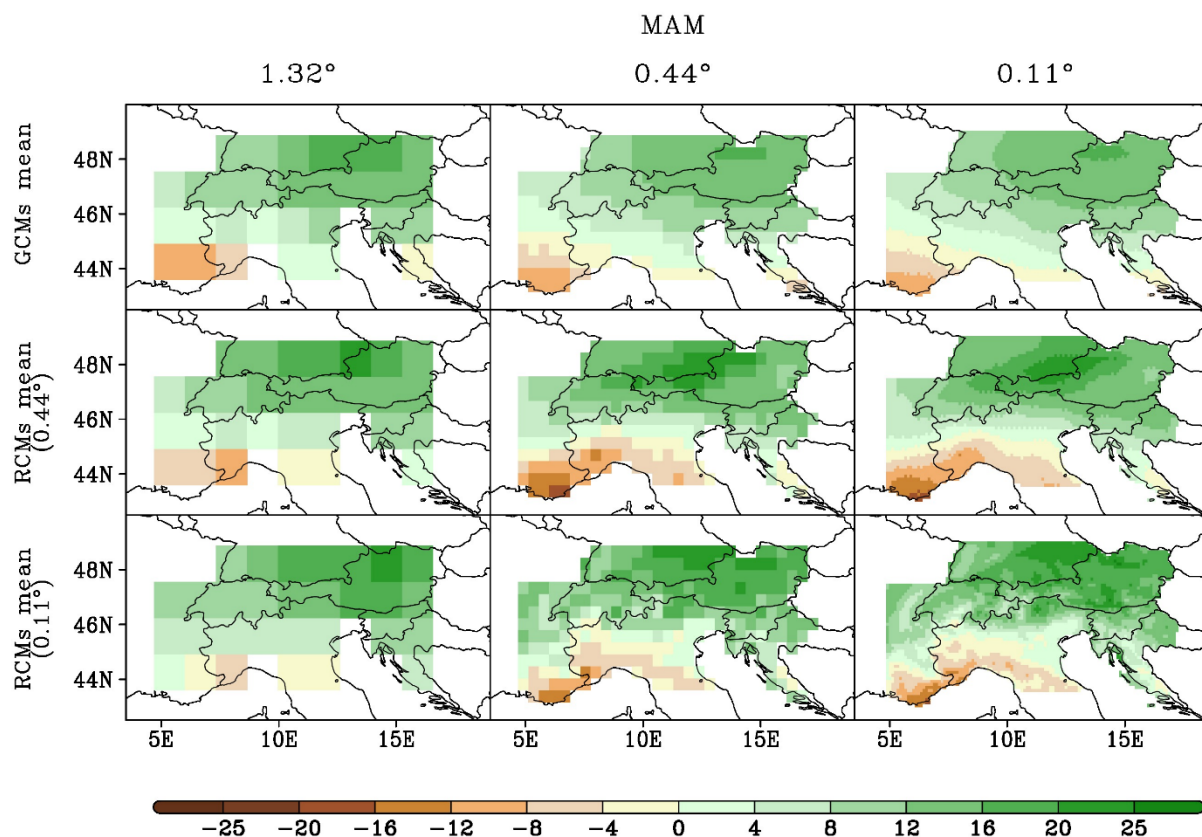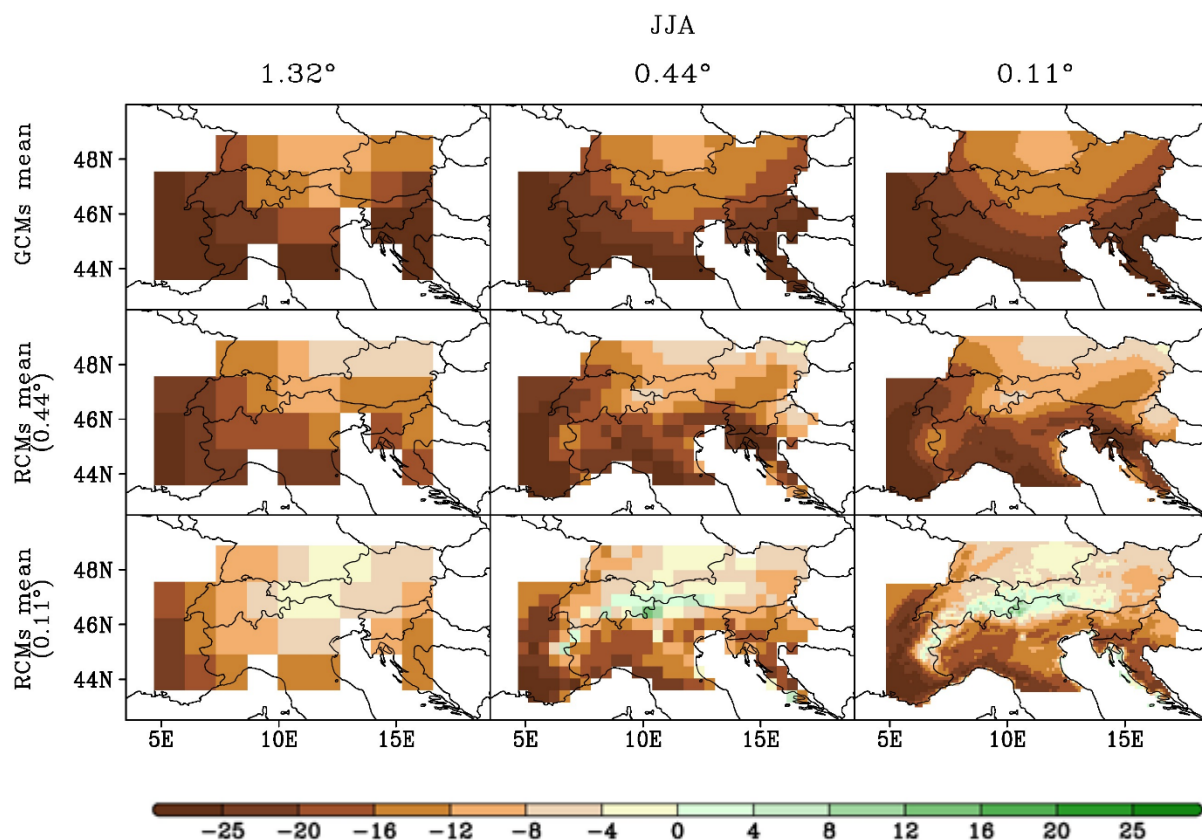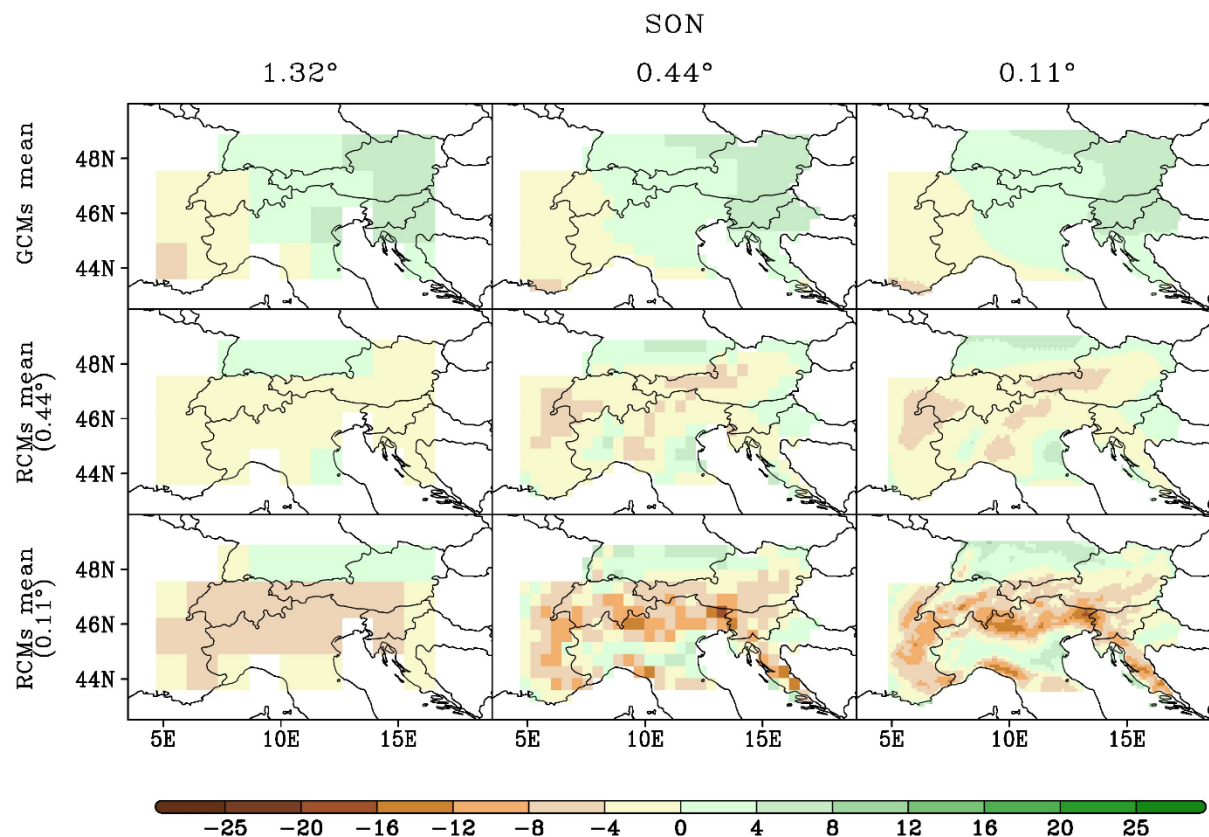
(2070-2099) – (1976-2005)

P change

13

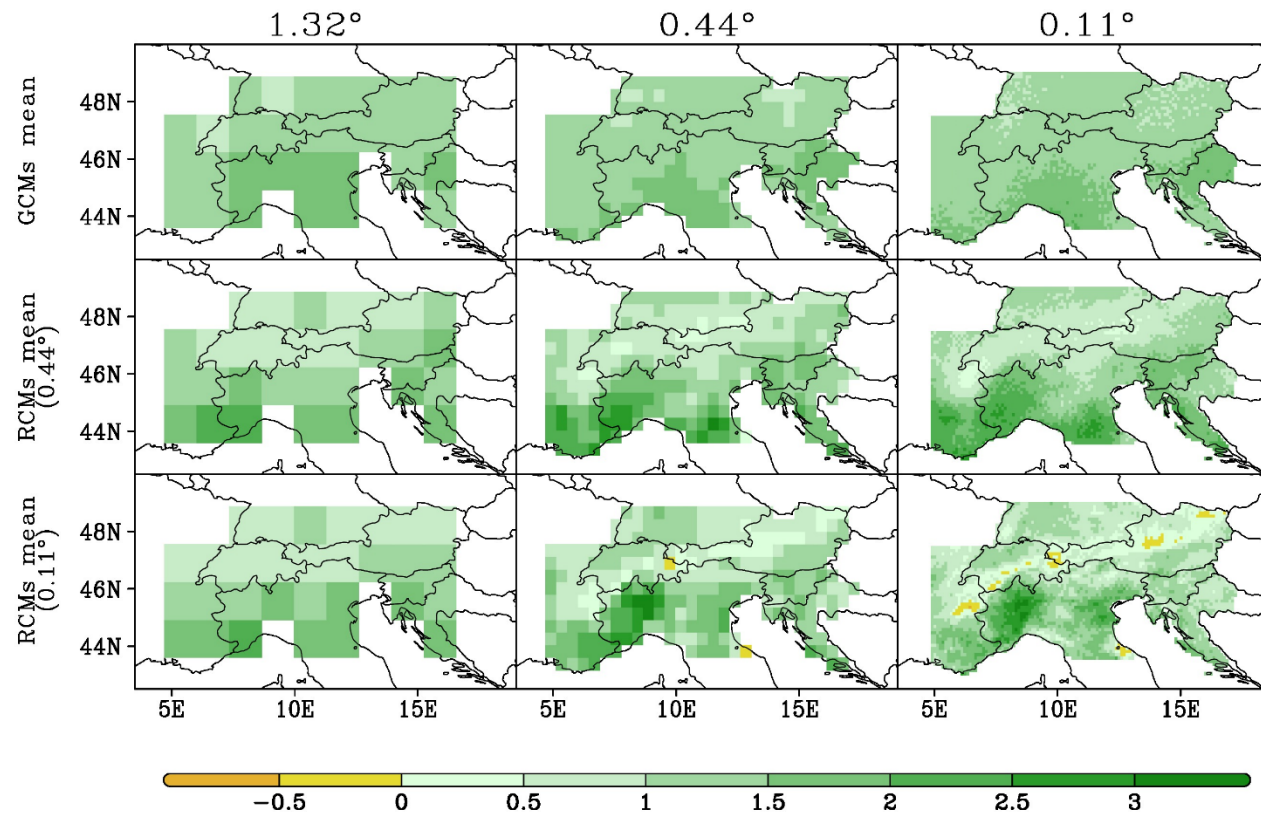**(2070-2099) – (1976-2005)**

P change

SON

tewi.us

**(2070-2099) – (1976-2005)**

R95 change

- **AV** metrics related to the **spatial patterns** of mean precipitation, daily precipitation **PDF**s and precipitation **extremes** was investigated

- We found substantial **AV** of RCM downscaling in **all precipitation metrics** considered

- The **AV** was clearly **associated** to the fine scale **topography**

- This **AV** is evident not only at the **downscaled** fine scales but also when **upscaled** at the coarsest scales

- This adds robustness to the conclusion that the **AV** obtained with the **RCM** downscaling is **due to physically consistent processes**

Presented results were published in JGR Atmospheres:
 Torma, Cs., F. Giorgi, and E. Coppola (2015): **Added value of regional climate modeling over areas characterized by complex terrain-Precipitation over the Alps**., *J. Geophys. Res. Atmos.,* 120, 3957-3972
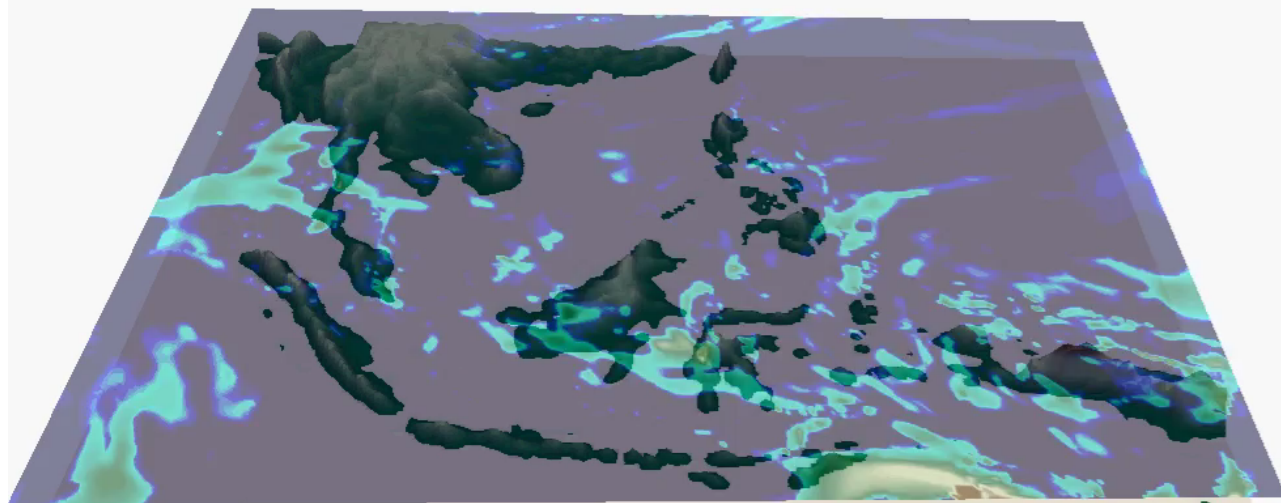
Isotta, F.A., et al., (2014), The climate of daily precipitation in the Alps: development and analysis of a high-resolution grid dataset from pan-Alpine raingauge data, *Int. J. Climatol.,* **34,** 1657–1675.
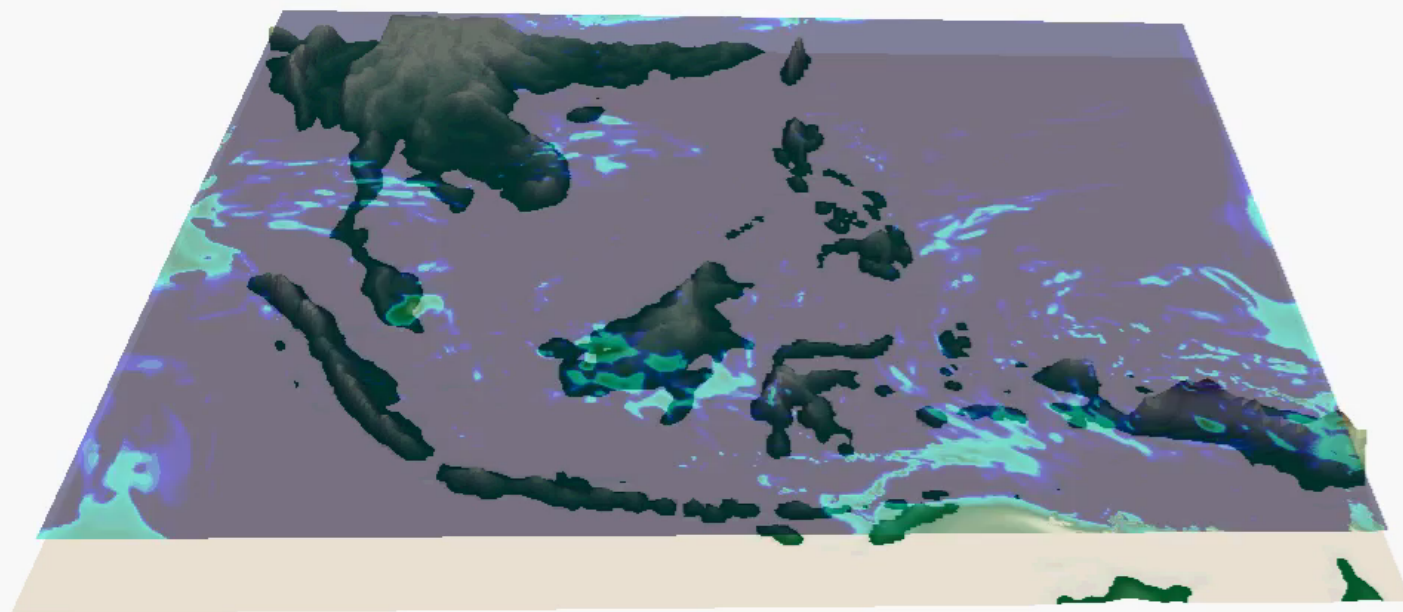
South East Asia CORDEX domain
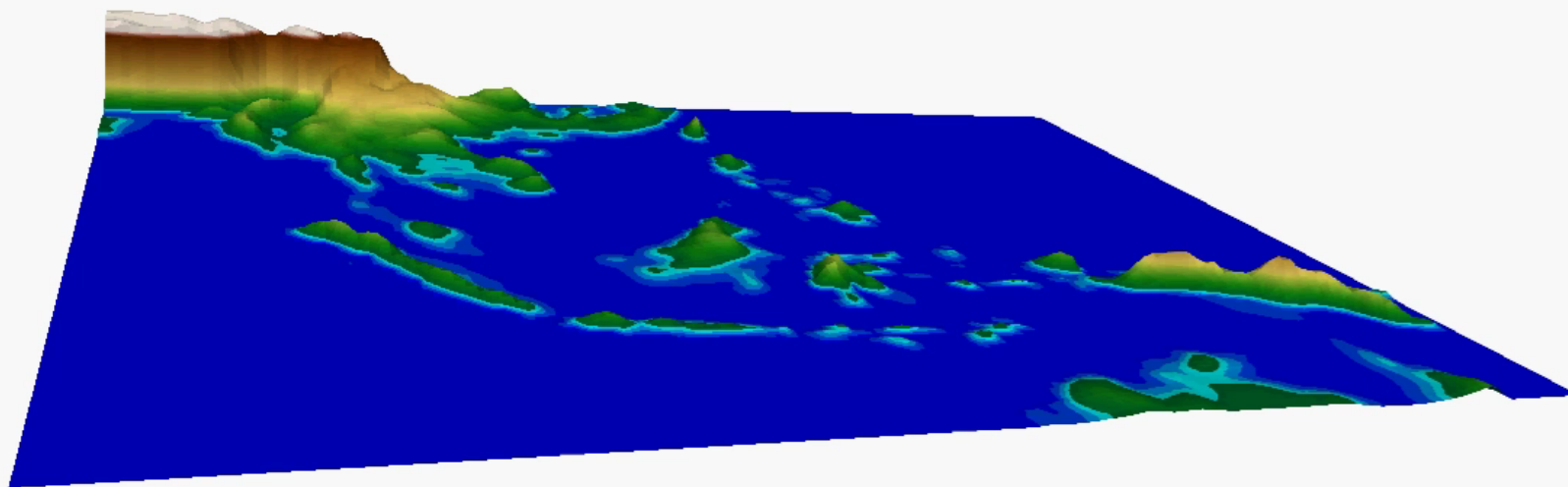
25 km

12 km

Added value of regional climate modeling over areas characterized by complex terrain - Precipitation over the Alps

Thank you for attention!
No coffee break yet!