Does increased RCM resolution lead to a better representation of heavy precipitation?

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1. Introduction

- This study is part of the Euro-CORDEX initiative. The main objective is to compare several regional climate models (RCMs) at different target spatial scales over the **Alpine area**. For this purpose, downscaled **precipitation** is evaluated at **two horizontal resolutions** (12 km and 50 km) in simulations from the **Euro-CORDEX RCM** ensemble, all of them driven by the ERA-Interim reanalysis (1989-2008).

- Three indicators have been analyzed on a seasonal basis: mean precipitation (**MEAN**), mean wet day* precipitation intensity (**INT**) and 90th percentile of wet day* precipitation (**90pWET**).

- The comparison among the different RCMs will be accomplished in terms of validation against observations in **both resolutions**. Moreover,the ability of the high-resolution RCM simulations (12km) to represent observed precipitation is assessed at their skillful scale by aggregating the 12km grid to the 50km resolution (from now on denoted as 12kmAGG) and evaluating the added value with respect to the low resolution (50km) runs.

*wet day: day when precipitation is above 1mm.

2. Data and Methods

The following RCMs are considered:

Models	Institution
COSMO-CLM	CLM Community
HIRHAM	Danish Meteorological Institute, Denmark
RACMO	Royal Netherlands Meteorological Institute, Ministry of Infrastructure and the Environment, Netherlands
RCA	Swedish Meteorological and Hydrological Institute, Sweden
REMO	Climate Service Center, Germany
WRF-CRPGL	CRP - Gabriel Lippmann, Luxembourg
WRF-IPSL	Institut National de l'Environnement Industriel et des Risques / Institut Pierre Simon Laplace, France

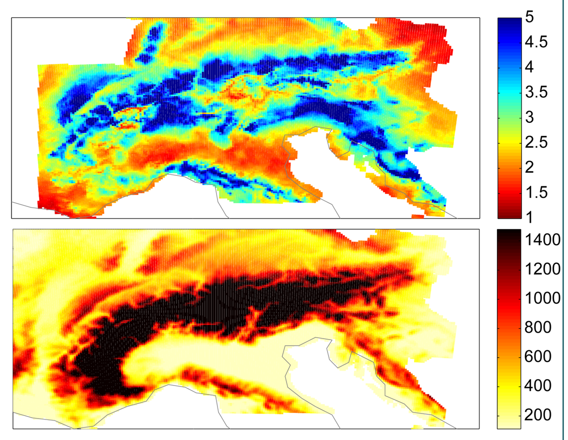


Fig.1. Annual mean precipitation (mm, up) and orography (m, bottom) of the analysis domain as represented by observations.

The **observations** considered for validation are the **EURO4M-APGD** dataset constructed by MeteoSwiss within the EURO4M project (Isotta, F.A. et al. 2013). It provides daily precipitation at a horizontal resolution of 5 km for the Alpine area. These gridded observations were spatially averaged to match the Euro-CORDEX grid cells.

Several scores have been used for **validation**. Here we present some results for seasonal relative biases and Kolmogorov-Smirnov tests for the distributional similarity.

3. Results and Discussion

3.1. Resolution Effect

Important differences between the 50km and the 12kmAGG data are found throughout most parts of the analysis domain (Fig.2). In **winter**, 12kmAGG is wetter along the Alpine ridge and in the Apennines in most models, while it is drier in the Po Valley.

In **summer**, the differences between resolutions are larger and the RCA model shows the strongest resolution effect. In this season the spatial difference pattern is less consistent between models, i.e. the resolution effect strongly depends on the model.

The three indicators present similar differences in winter, while in summer they can even have opposite patterns (see e.g. COSMO MEAN and 90pWET).

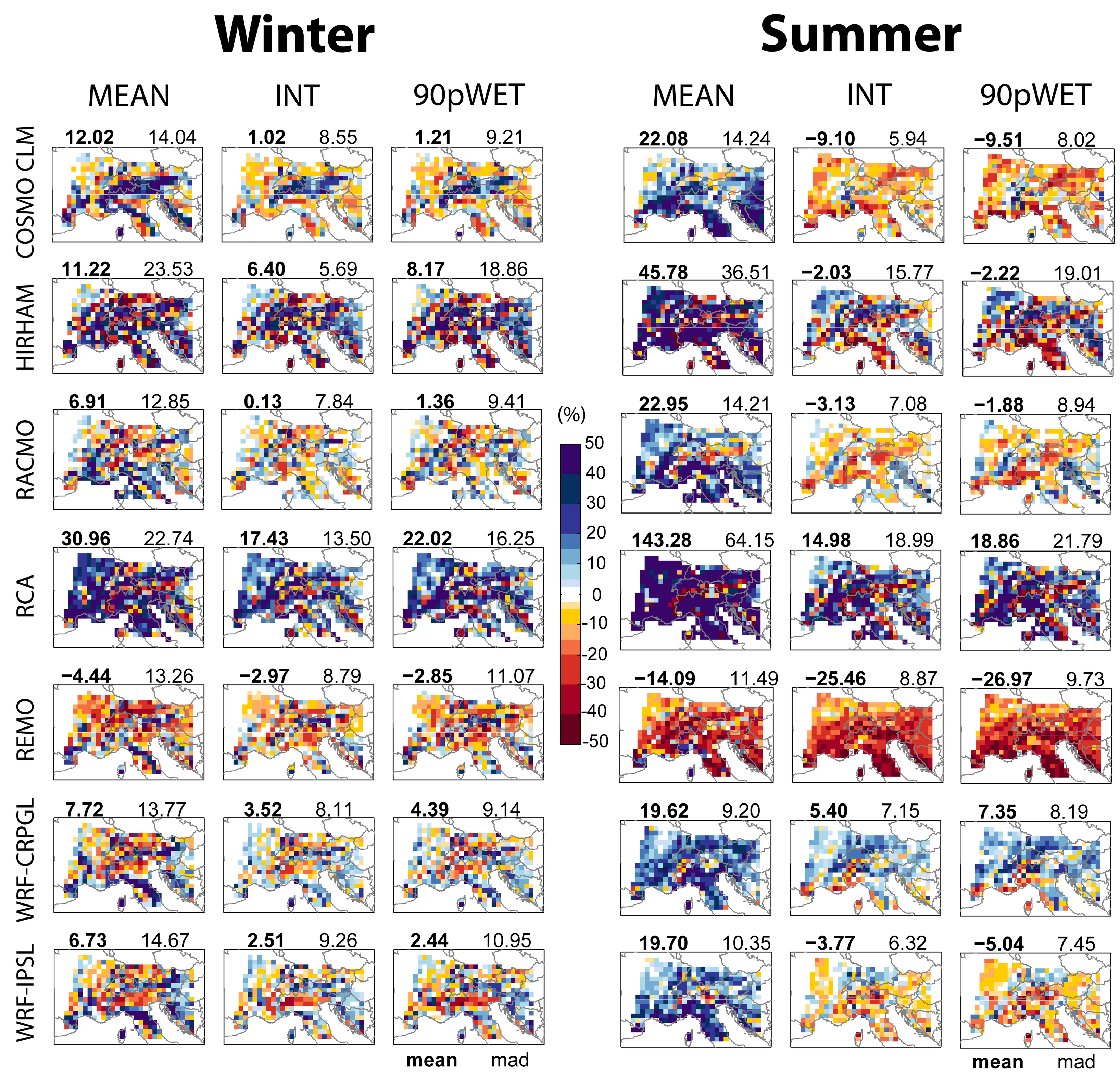
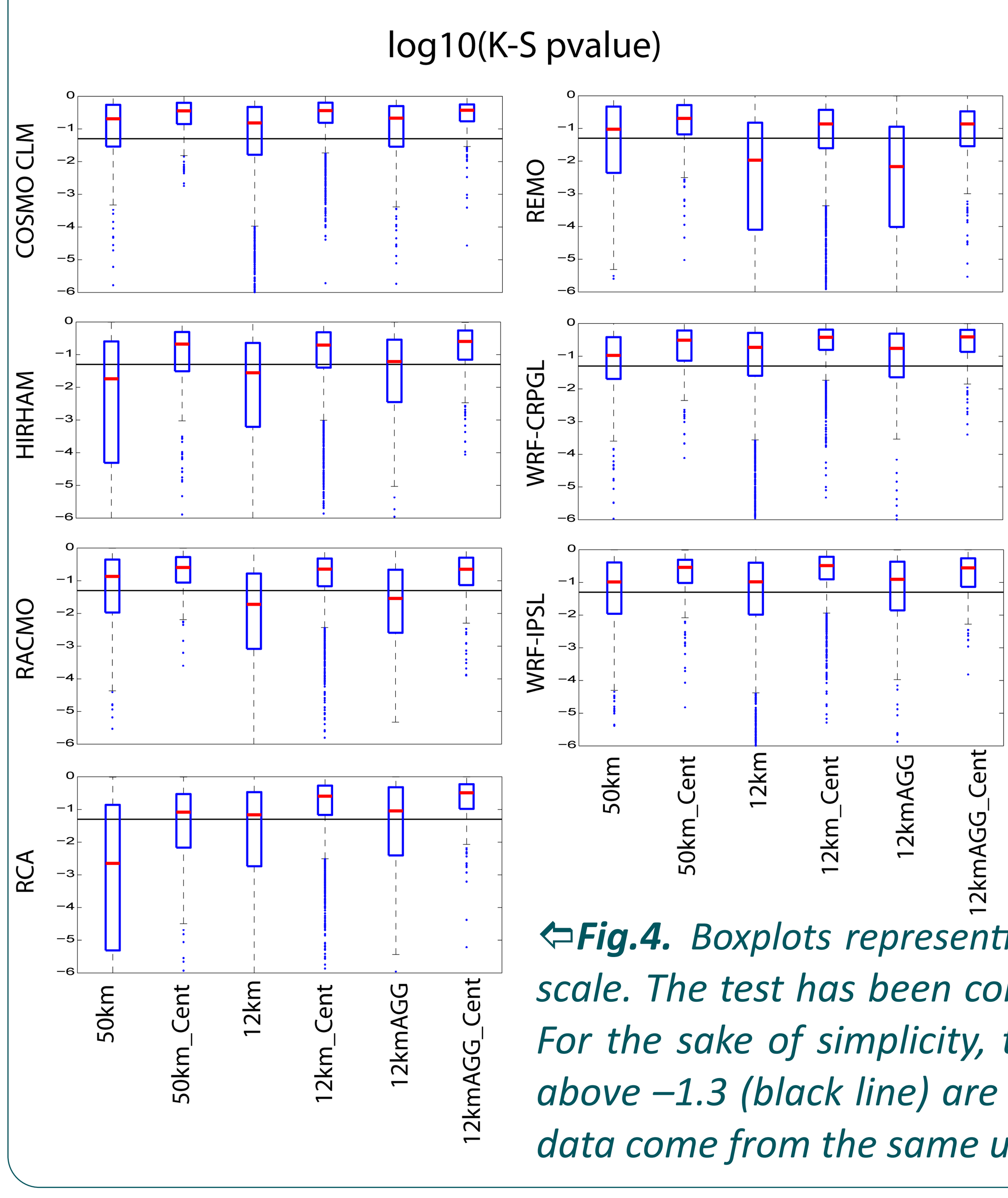


Fig.2. Relative differences between 12kmAGG and 50km resolution for the RCMs, for winter (left) and summer (right). The spatial mean and median absolute deviation (mad) are shown above each panel.⇨



3.2. Validation

For each model the resolution effect in the **bias** (comparing red and black boxes in Fig.3) is different, with larger differences in summer than in winter. It depends on the model, indicator and season. For instance, REMO at 12kmAGG performs better than 50km in winter, but the opposite is found in summer. The spatial variability of MEAN is overestimated by the RCMs in many cases.

The **Kolmogorov-Smirnov test** has been applied to test the null hypothesis that simulated and observed daily precipitation data (on wet days*) come from the same underlying distribution (Fig.4). All models perform better when the data is centered (i.e. divided by the mean), independently of the resolution, so the main deficiency is found in the mean. For RCA only the high resolution experiment (12 km) yields satisfactory results.

⇦Fig.4. Boxplots representing the spatial variability of the Kolmogorov-Smirnov p-values in logarithmic scale. The test has been computed for wet day precipitation for the original and centered (_Cent) data. For the sake of simplicity, the corresponding p-value has been analyzed in a logarithmic scale: values above –1.3 (black line) are statistically significant at 5%, i.e. observed and simulated daily precipitation data come from the same underlying distribution.

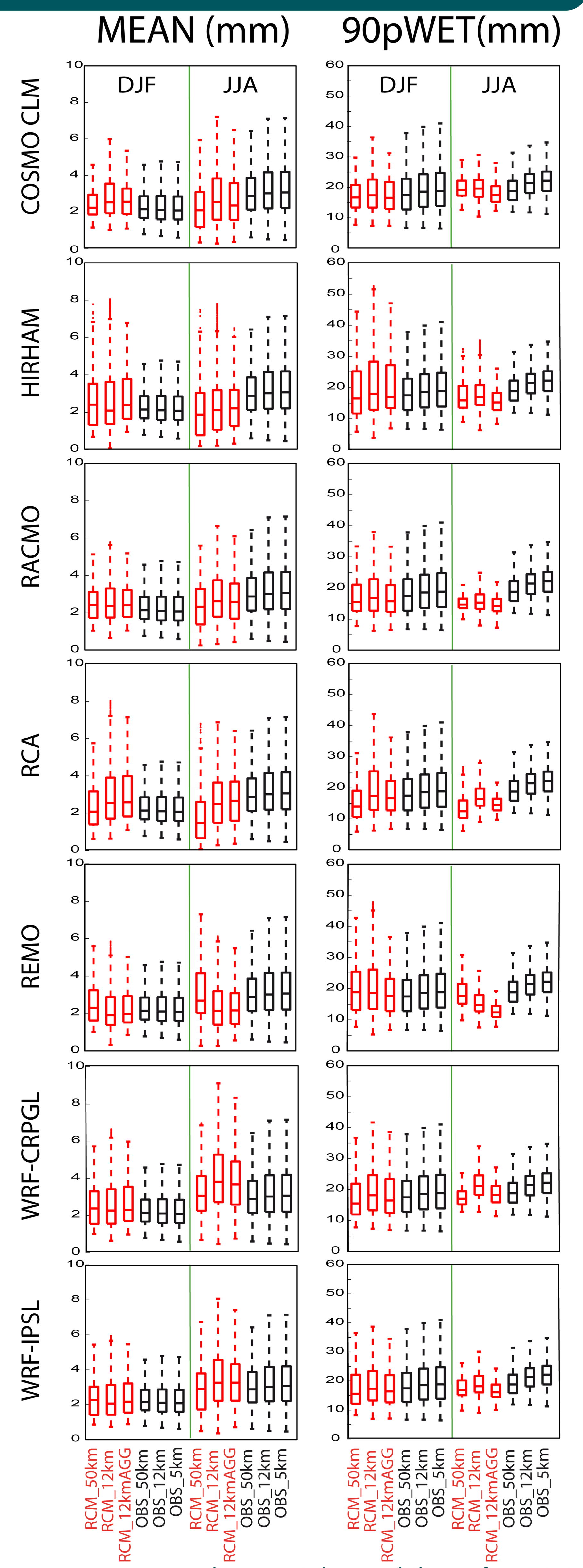


Fig.3. Boxplots representing the spatial variability of MEAN (left) and 90pWET (right) for winter (DJF) and summer (JJA). Results for INT are very similar to those for 90pWET (not shown). Red boxes correspond to RCMs and black boxes to observations, at different spatial resolutions. Outliers outside 5th-95th percentiles are not shown.

REFERENCES:

Isotta, F.A. et al. 2013: The climate of daily precipitation in the Alps: development and analysis of a high-resolution grid dataset from pan-Alpine rain-gauge data. Int. J. Climatol., submitted

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