Link between rainfall-based weather pattern classification over British Columbia and El Niño Southern Oscillations

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Black Tusk, British Columbia, WP5

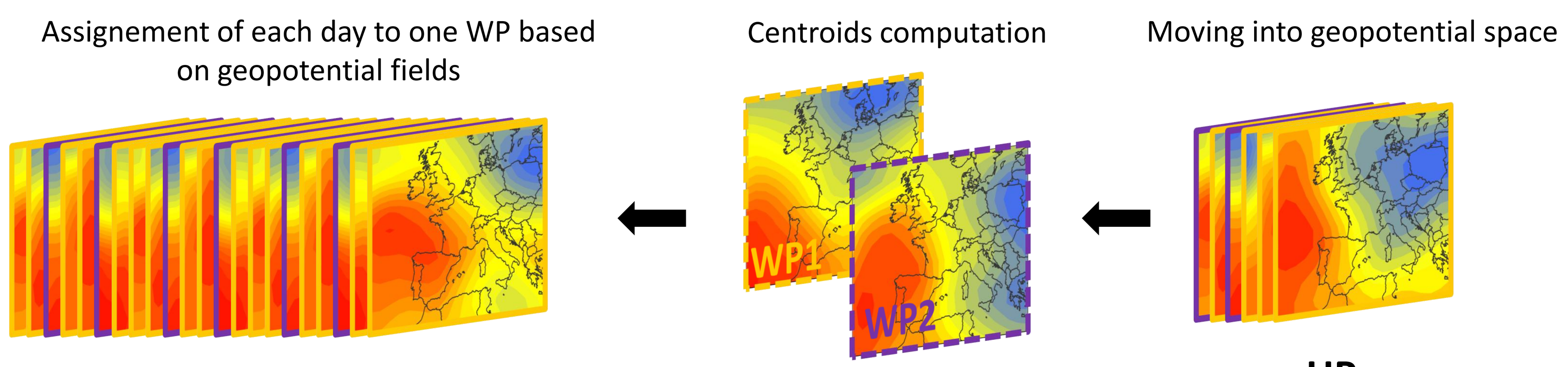
1 Introduction

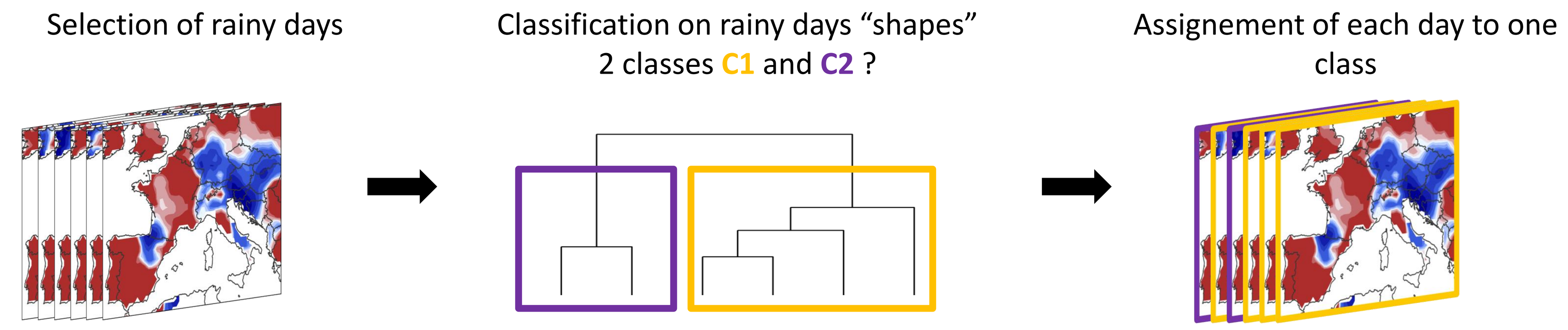
Classifications of atmospheric weather patterns (WP) with bottom-up methodologies combining spatial distribution of heavy rainfall observations and geopotential height fields have been used to define WP classifications relevant for heavy rainfall statistical analysis over France (Garavaglia *et al.*, 2010) and over Austria (Brigode *et al.* 2011). The definition of WP at the synoptic scale creates an interesting variable which could be used as a link between the global scale of climate signals and local scale of precipitation station measurements.

This work aims firstly to define a new WP classification centred on coastal British Columbia region (Canada), based on a bottom-up approach and secondly to study the link between the frequency of the defined WP and El Niño Southern Oscillations (ENSO).

2 Methodology and datasets

Weather pattern classification methodology: a bottom-up approach (Garavaglia *et al.* 2010):





Datasets

1. Daily precipitation series from BC Hydro and WA, 177 stations used over 1983-2003 for the WP definition (blue dots on *fig.1*) 45 stations used over 1951-2001 for ENSO study (red dots on *fig.1*);
2. Geopotential heights fields from NOAA (Compo *et al.* 2011) at 700 hPa and 1000 hPa over 1871-2010, spatial extent showed on *fig.2*);
3. El Niño Southern Oscillations described with Niño 3.4 Index (Trenberth 1997): each winter (ONDJFM) is characterized by an average SST anomaly estimated on DJF months (*fig.3*).

Fig.1

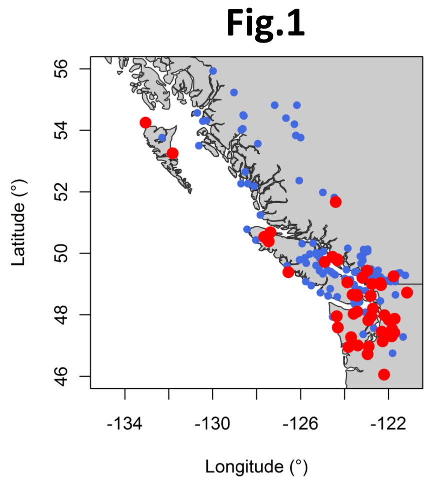


Fig.2

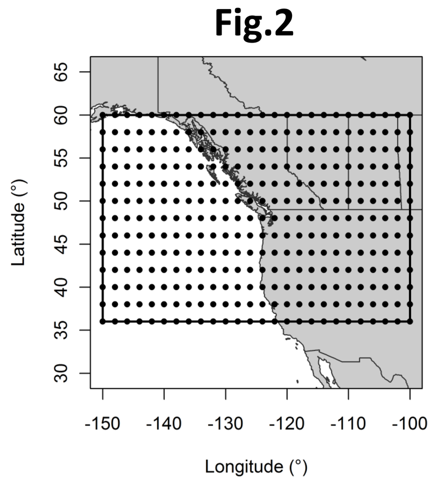
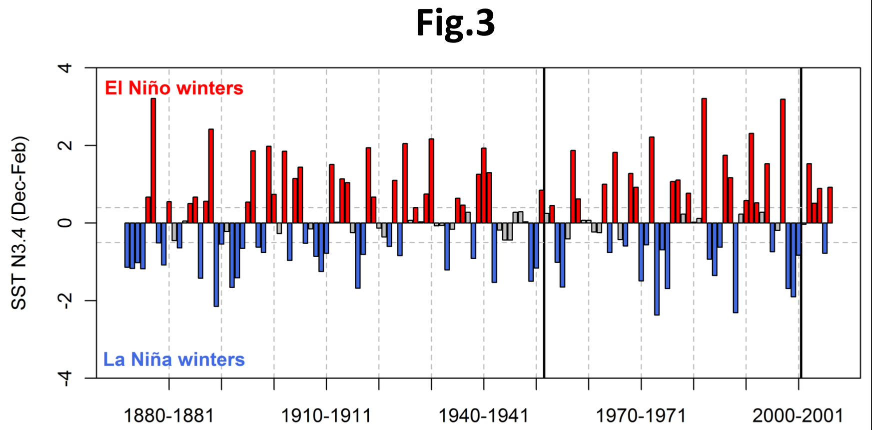
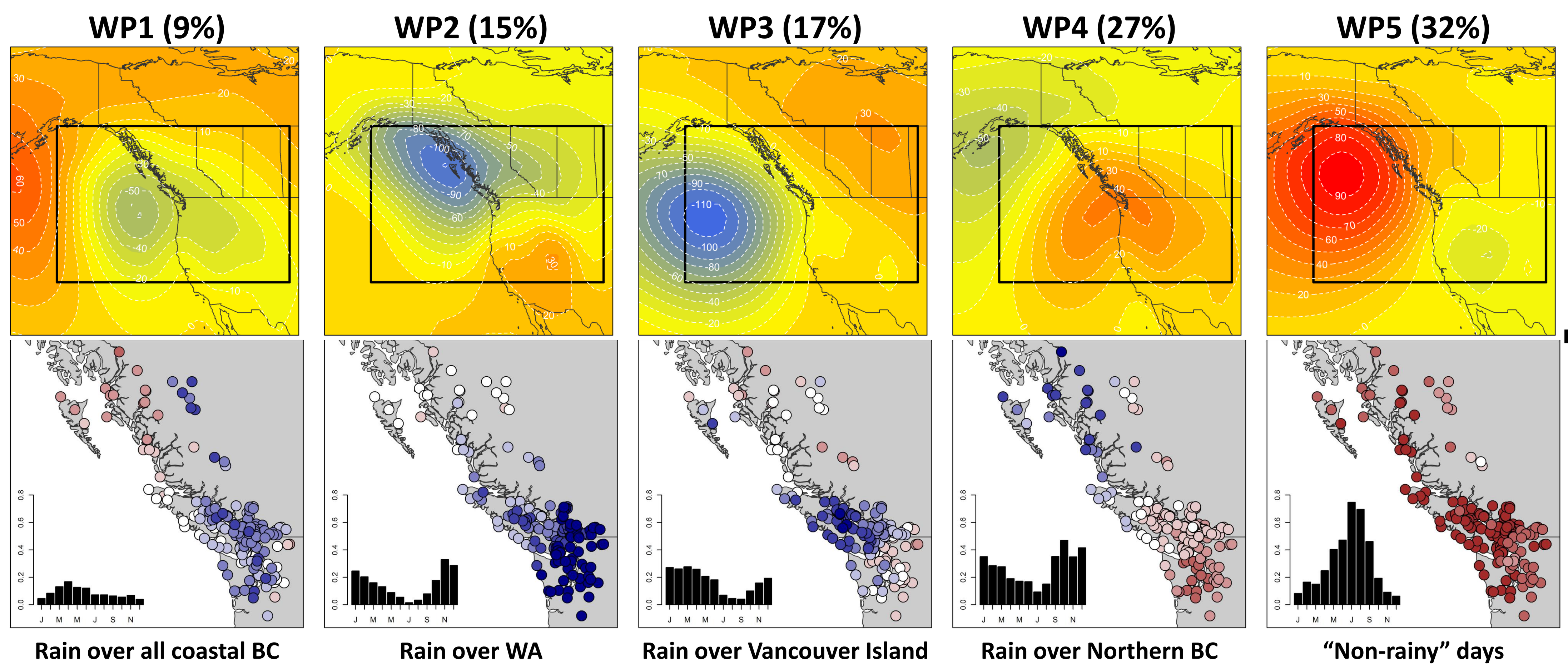


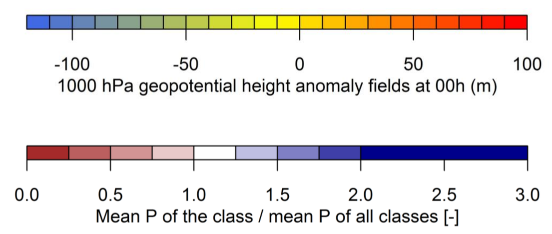
Fig.3



3 Definition of five coastal BC weather patterns and application

5 weather patterns have been defined and are characterized by different mean geopotential heights anomaly fields (1000 hPa) and regroups rainy days over different coastal British Columbia regions:

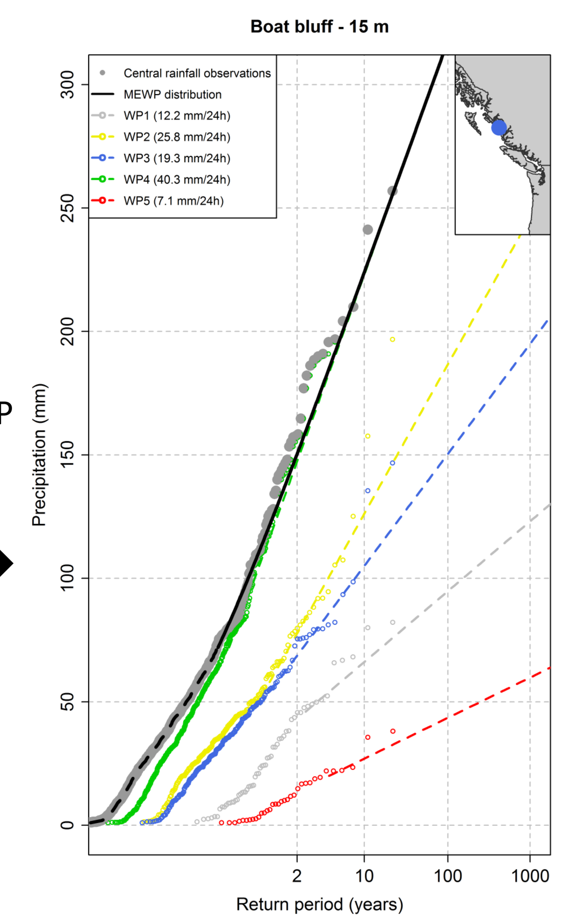




Application example: Winter (ONDJFM) MEWP (Garavaglia *et al.* 2010) distribution:

$$F(R) = \sum_{i=1}^{n_{WP}} \left[1 - exp\left(-\frac{R - u_i}{\lambda_i}\right)\right] * p_i$$

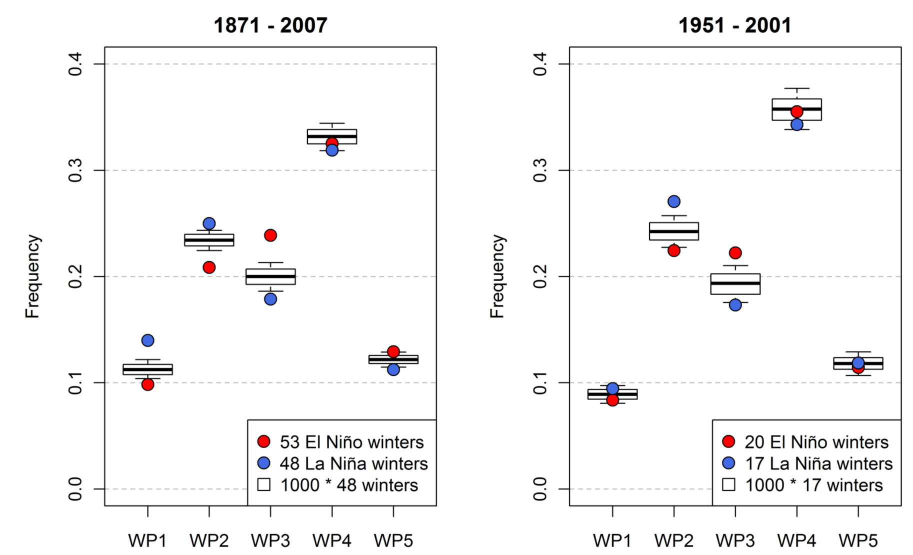
F: marginal distribution;
R: rainfall observations;
n_{WP}: number of weather patterns;
u: threshold for heavy rainfall selection;
λ: parameter of the exponential law;
p: weather pattern occurrence frequency.



WP4 is the "at-risk WP" of this rainfall station since it is associated to the highest rainfall quantiles

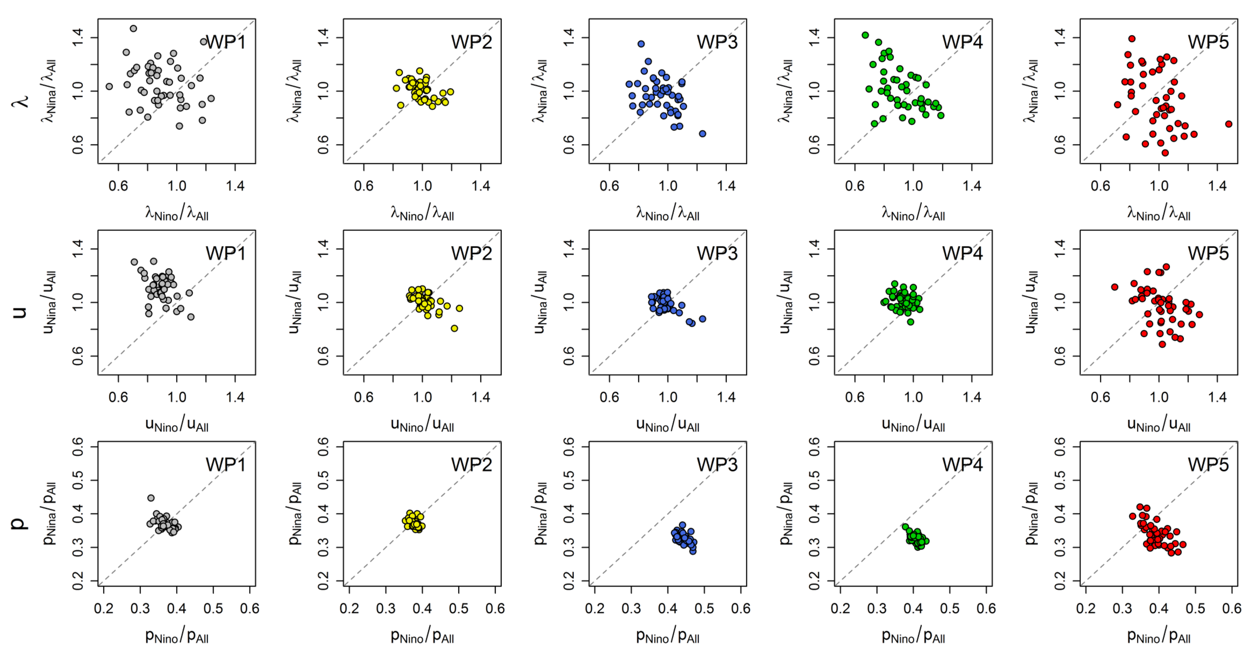
4 Link between ENSO, coastal BC weather patterns and extreme rainfall events

Are ENSO influencing frequency of coastal BC WP?



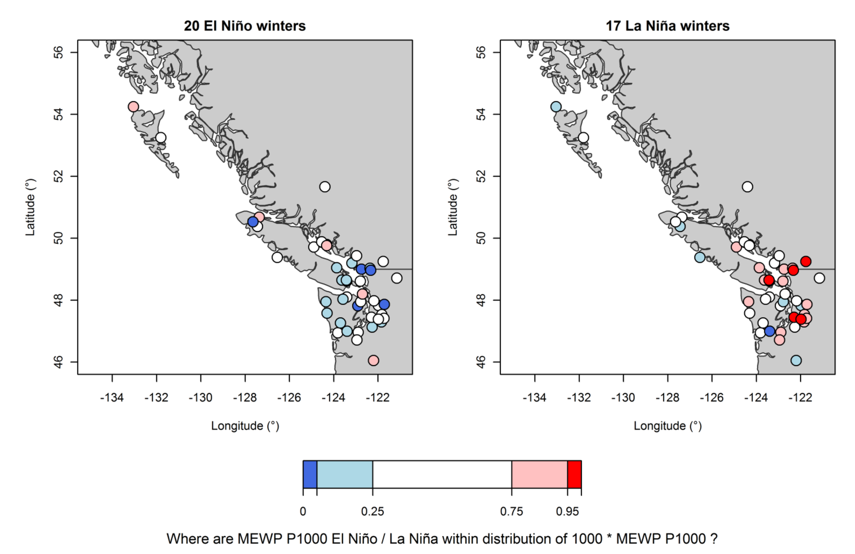
WP2 is significantly more frequent during La Nina winters while WP3 is more frequent during El Nino winters.

Are ENSO influencing MEWP parameters (λ, u and p) ?



Significant changes seems to be observed only for the frequency of weather patterns and not for the two other parameters (u and λ).

Are ENSO influencing P_{1000} MEWP estimation?



Significance of the differences is regionally low, but some spatially coherent tendencies are observed, showing that winter P_{1000} MEWP could be locally different considering ENSO.

5 Conclusion

- **Definition of five weather patterns useful for the statistical characterization of extreme rainfall events over the coastal BC region;**
- **ENSO influence significantly the frequency of coastal BC weather patterns**
- **ENSO seem to only influence the frequency of extreme rainfall events (parameter p) but not their magnitudes (MEWP parameters λ and u).**
- **WP approach allows catching the variability of the probability of occurrences of synoptic situations generating extreme rainfall depending on ENSO.**
- **Link useful for climate change impacts prediction on extreme rainfall?**

References

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