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

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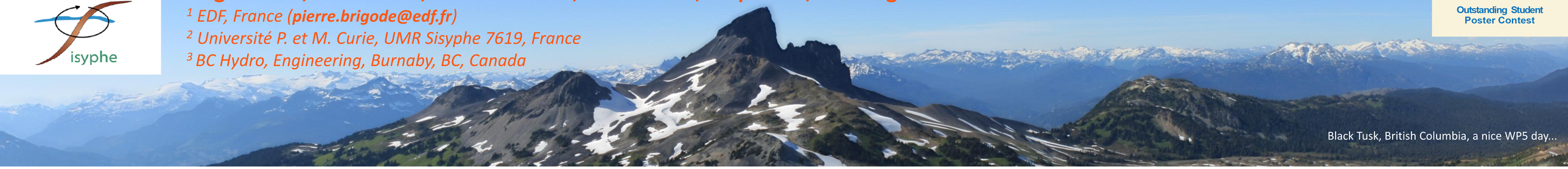


Black Tusk, British Columbia, a nice WP5 day...

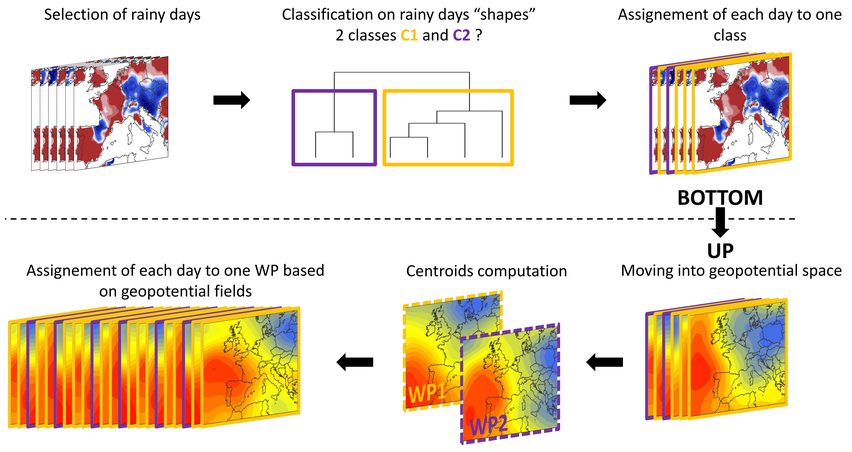
1 Introduction

Classifications of atmospheric weather patterns (WP) 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). Classifications have been constructed with "bottom-up" methodologies combining both spatial distribution of heavy rainfall observations and geopotential height fields. 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 (BC) region (Canada), based on a "bottom-up" approach and secondly to study the link between the frequency of the defined WP, El Niño Southern Oscillations (ENSO) and heavy rainfall events.

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*), defining El Niño winters (SST anomaly > 0.4) and La Niña winters (SST anomaly < -0.5).

Fig.1

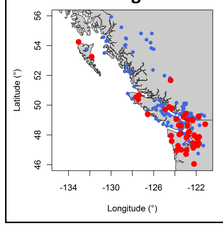


Fig.2

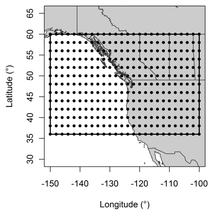
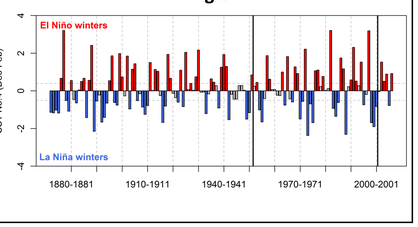
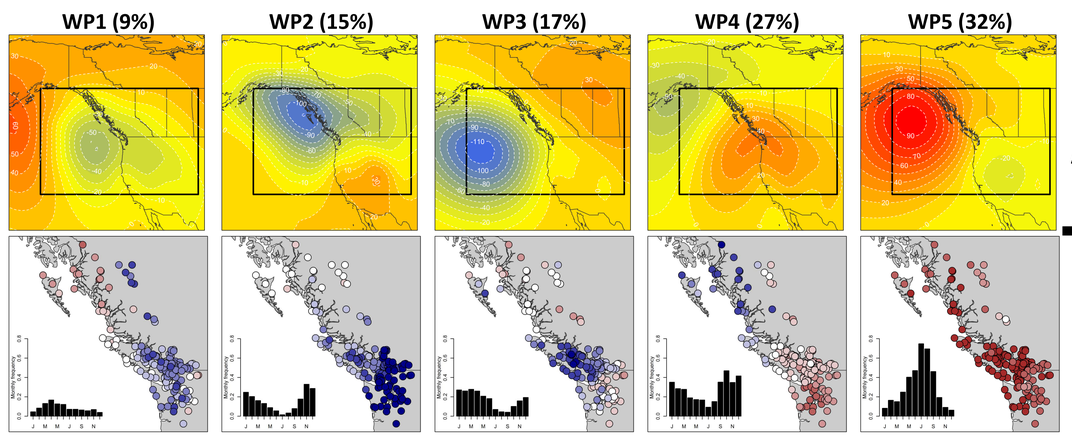


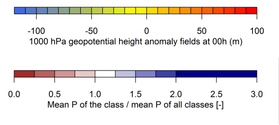
Fig.3



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 (figure legends reported on the right):

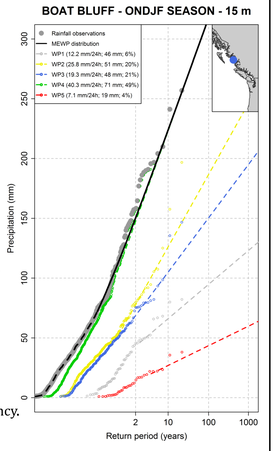




Application example: Winter (ONDJFM) MEWP (Garavaglia *et al.* 2010) distribution:

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

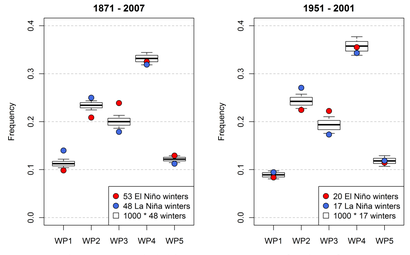
F: MEWP distribution;
R: rainfall observations (mm);
n_{WP}: number of weather patterns;
u: threshold for heavy rainfall selection (mm);
λ: parameter of the exponential law (mm/24h);
p: rainy days (central events) occurrence frequency.



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 heavy rainfall events

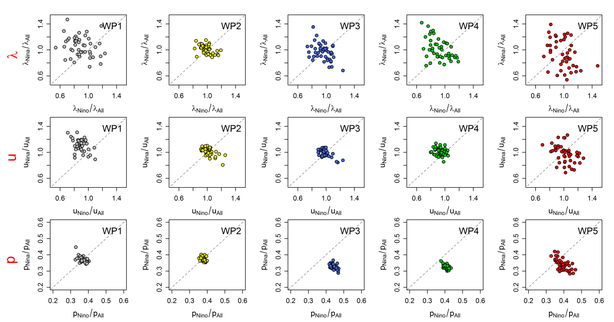
Are ENSO influencing frequency of coastal BC WP?



Boxplots summarized 1000 bootstrap estimations of each WP frequency (supposed representative of natural variability) and are constructed with quantiles 0.10, 0.25, 0.50, 0.75 and 0.90.

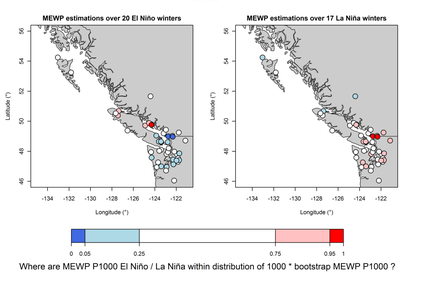
WP2 days are significantly more frequent during La Niña winters while WP3 are more frequent during El Niño winters.

Are ENSO influencing MEWP parameters (λ, u and p) over 45 stations ?



Significant changes seem to be observed over the 45 stations only for the rainy days frequency (p) and not for the two other MEWP parameters (u and λ).

Are ENSO influencing P_{1000} MEWP estimations?



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

5 Conclusion

- **Definition of five weather patterns useful for the statistical characterization of heavy rainfall events over the coastal BC region;**
- **ENSO influence significantly the frequency of two coastal BC weather patterns (WP2 and WP3);**
- **However, within each weather pattern, ENSO seem to only influence the frequency of rainy events (MEWP parameter p) and not the magnitudes of heavy rainfall events (MEWP parameters λ and u);**
- **Weather pattern classification approach allows catching the variability of the occurrences of synoptic situations generating heavy rainfall events depending on ENSO;**
- **Are WP classifications useful variables for climate change impacts prediction on heavy rainfall events?**

References

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