

# Meteorological zones delimitation in Andorra through glacial orography

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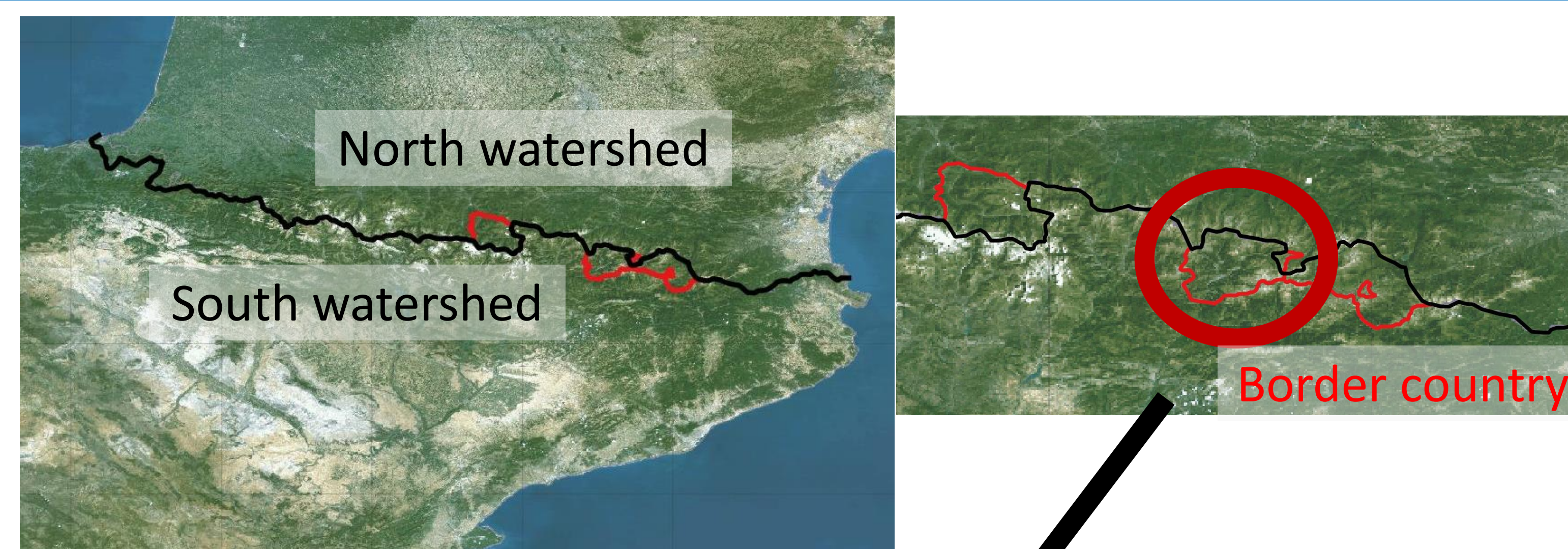
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## Abstract

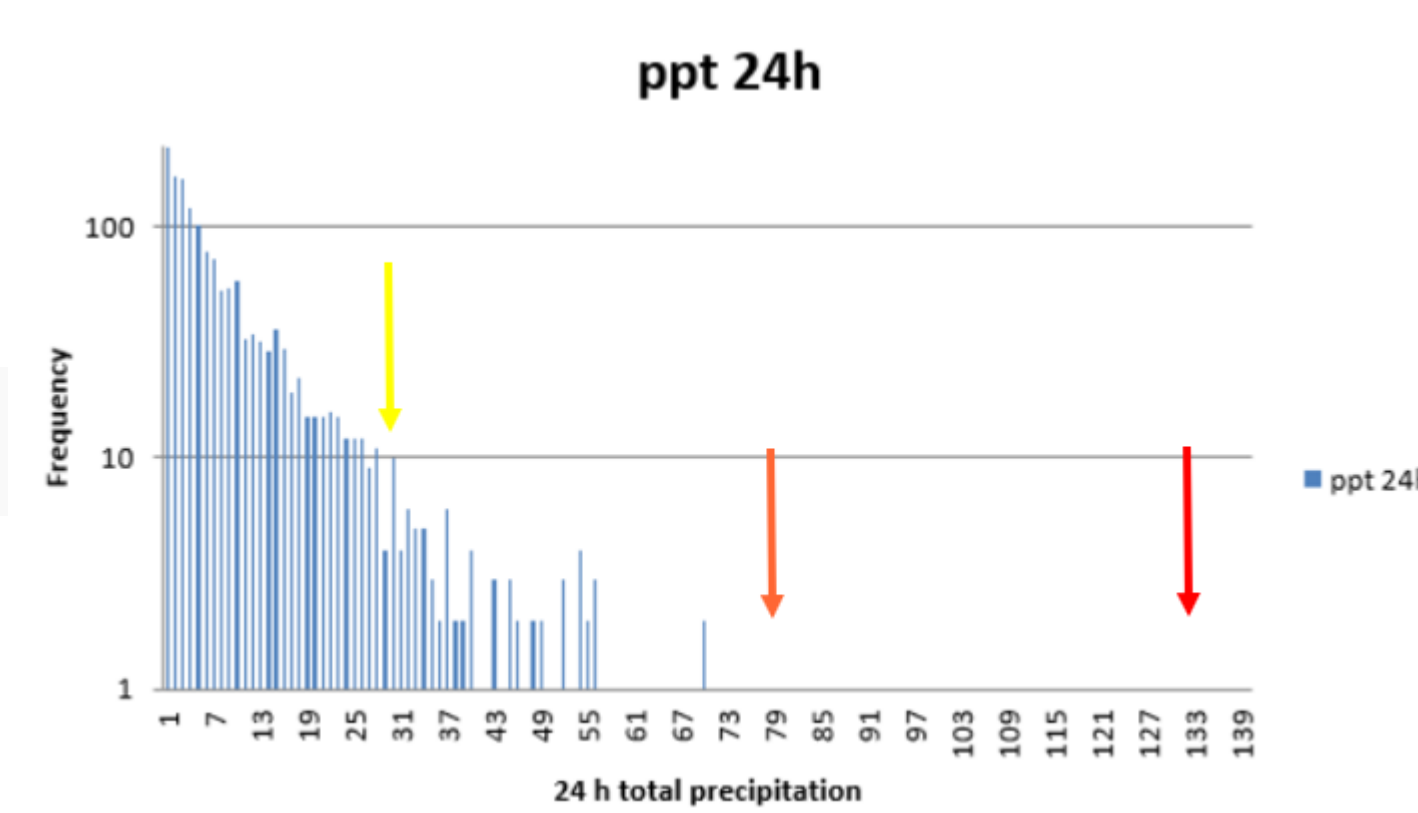
Andorra (468 km<sup>2</sup>), in the Pyrenees chain, has an orographic complex terrain. Hydrologically, the country of the Pyrenees has the headwater of 5 rivers basins (*Arieja, Valira d'Orient, la Llosa, Valira del Nord* and *Riu d'Os*). Glacial modelling produced by the last ice age (20.000 years ago) determine the atmospheric communication between different headwaters and valleys. The influence of glacial modelling in atmospheric communication is also present between the headwater's neighbour valleys.

The meddling of the Arieja and Soulcem valleys in southern points than the average line of mountain chain border between Mediterranean and Atlantic, gives some Atlantic climate characteristics in the north zone of the country in terms of precipitation.

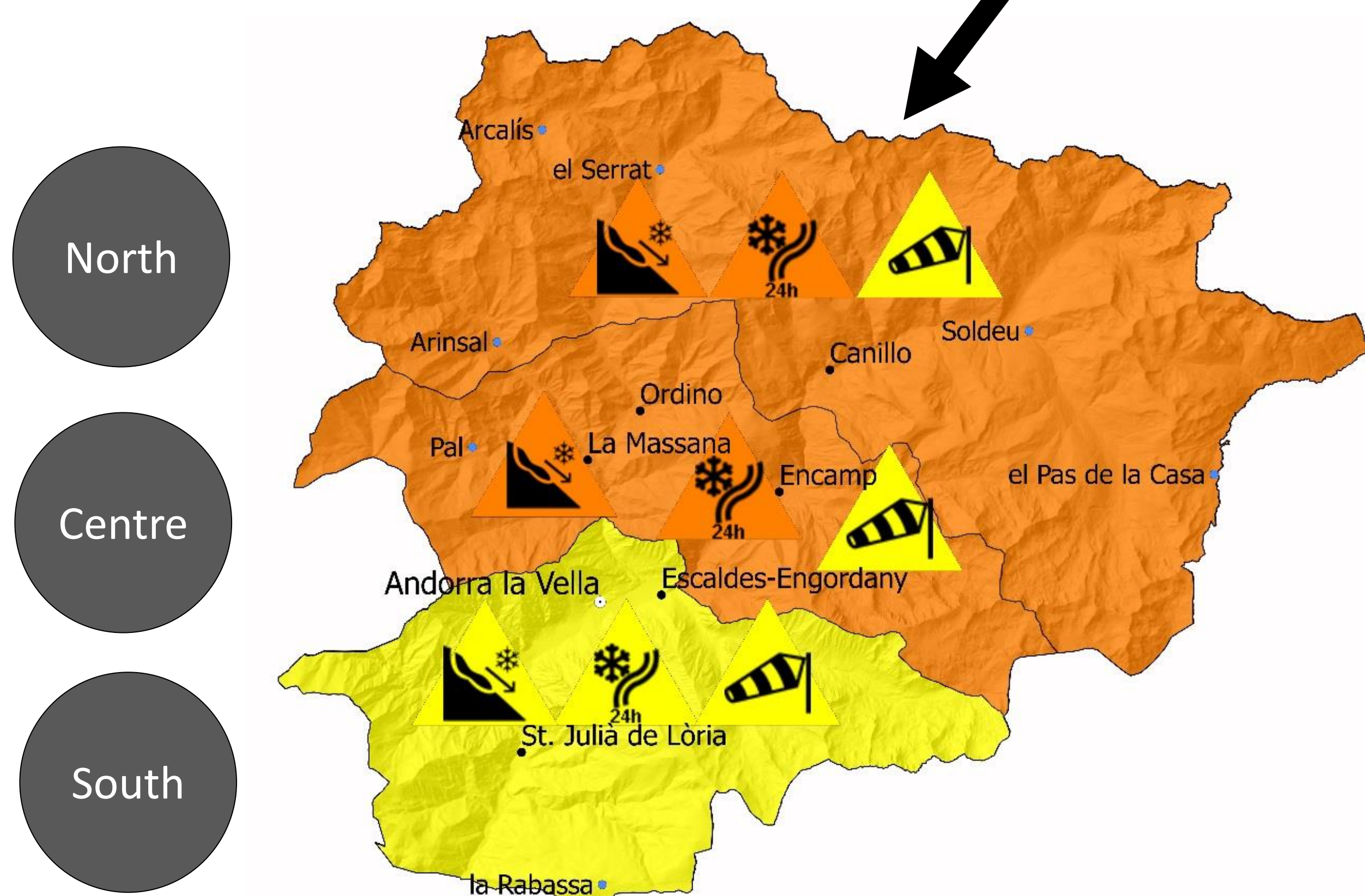
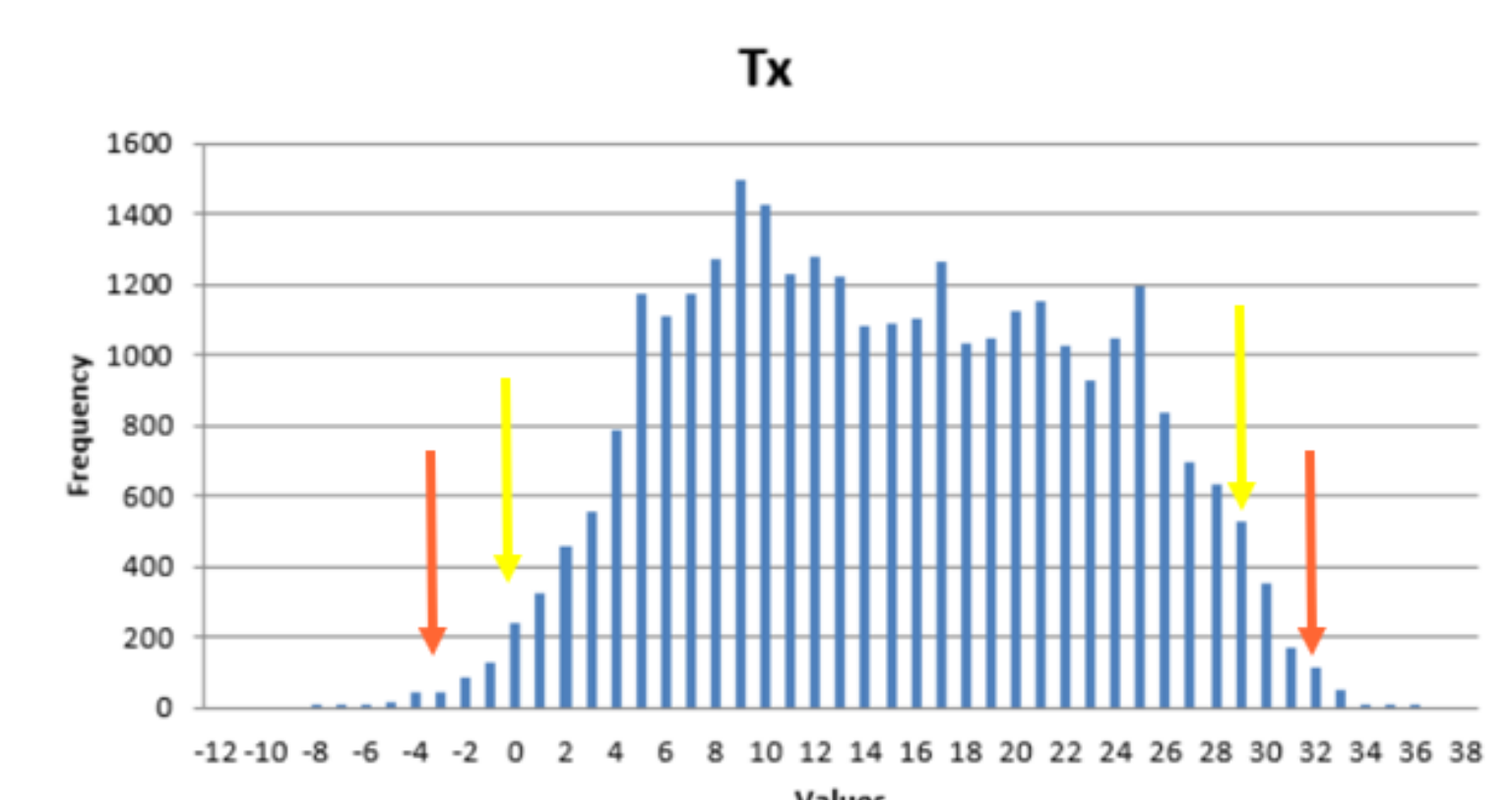
The form and the orientation of the glacial valleys determines the meteorological phenomena extension. Therefore, we can define 3 meteorological zones according to the total precipitation accumulation and their frequency, the valleys orientations and the altitude. These zones are: north, centre and south. The amount of precipitations and altitudinal temperature variations determines the limit of these zones, always in the borders of secondary river basins.



## Precipitation



## Temperature



## Impact based warnings

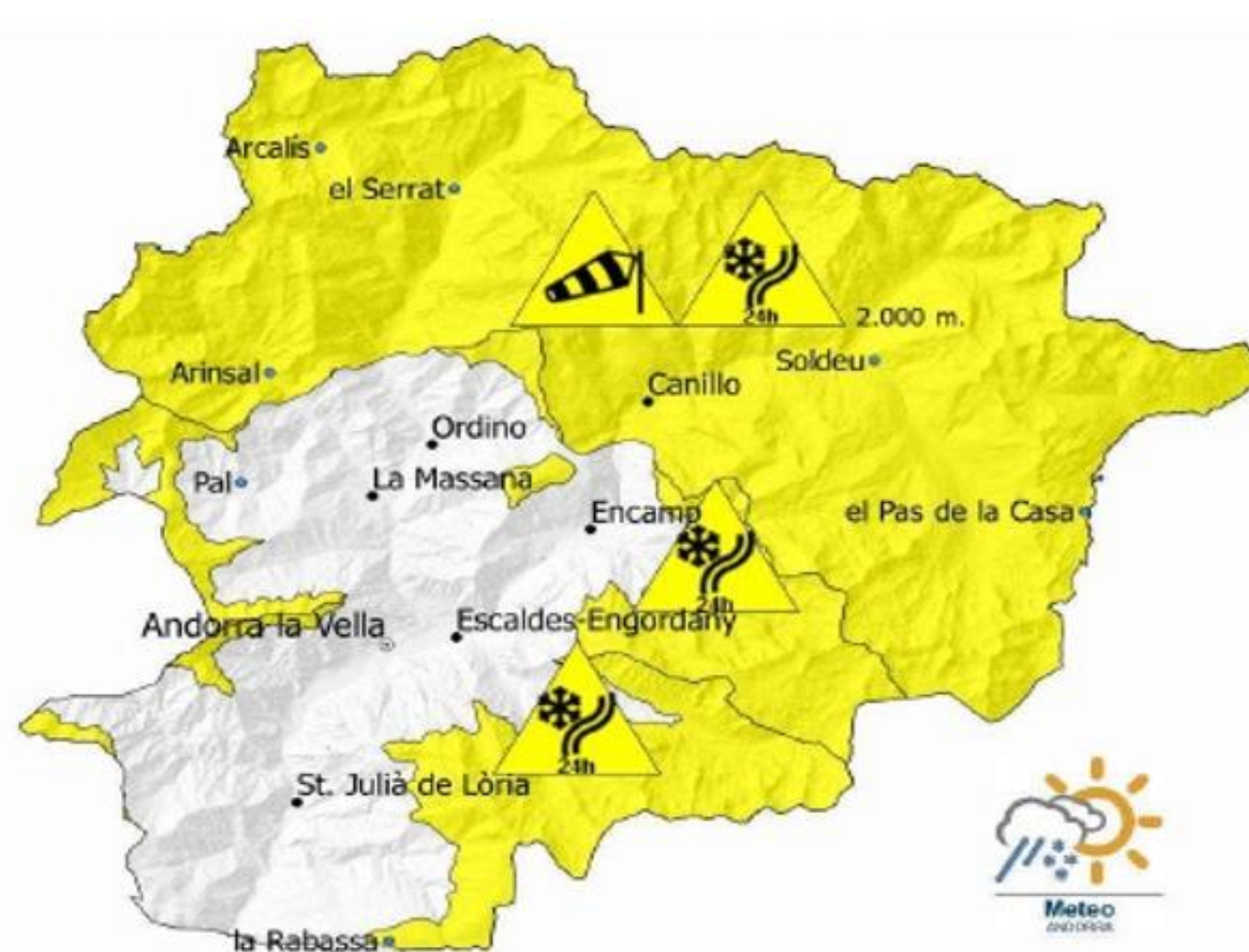
Light and intermittent precipitations	weak and discontinuous precipitation. Possible intervention on roads >1200 meters	Occasional and local showers. Limited or low probability of thunderstorms.	Occasional heating or cooling with possibility of comfort recovery during the day/night	Winds that do not cause damage
Slight increase in flow rates	Need for intervention on roads <1200 meters	Heavy but undamaging showers	Modification of habits of some professionals	Fences fall down, awnings are folded, etc. Some ski lifts are closed at altitude
Flooding of riverside fields	Lack of visibility for driving, temporary road closure	Floodings in streets. Floods of torrents	Some outdoor activities cannot be performed	Damage to roofs, chimneys, antennas. Widespread closure of ski lifts
Widespread overflows	Evacuation of some housing areas	Large water flows in torrents	Anormal country development	Serious damage to forests and buildings

## Sections reasons

- The influence of Atlantic and Mediterranean sea implies a difference of precipitation distribution especially in latitude for the different synoptic patterns.
- Each zone has a different altitude distribution. Even if each one reach the 2.800-2.900 meters, the bottom part is quite different. South, characterized by high altitude gradient from 840 meters, centre and north zones are more characterised by glacial modelled valleys.
- In terms of temperature, its influenced by the dominance mass air position, but also for the terrain altitude.
- The wind is also influenced by the altitude, but also for the proximity of the basin watershed border, that can cause some orographic accelerations.
- We can make an altitudinal alert for some wind and snow episodes.
- The sections are used also for the avalanche bulletin

Expected impacts for weather warning types.

The thresholds have been designed on the basis of a statistical study on the rarity of the phenomena (frequency) and the impacts they have caused.



Altitudinal and zonal warnings.

## Matriu de perill meteorològic

Probabilitat	Impacte			
	Molt Baix Mínim	Baix Menor	Mitjà Significatiu	Alt Sever
Alta	Green	Yellow	Orange	Red
Mitjana	Green	Yellow	Orange with X	Red
Baixa	Green	Green	Yellow	Orange
Molt Baixa	Green	Green	Yellow	Yellow