# Surface thermal heterogeneities in the eastern Ebro basin and their impact on regional circulations

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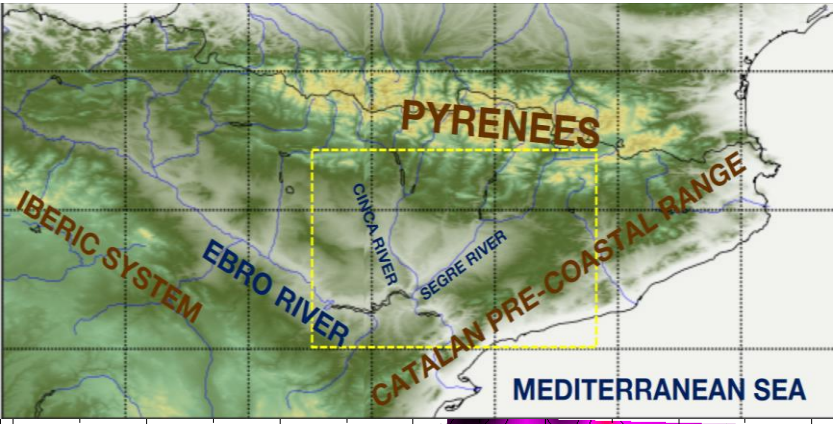
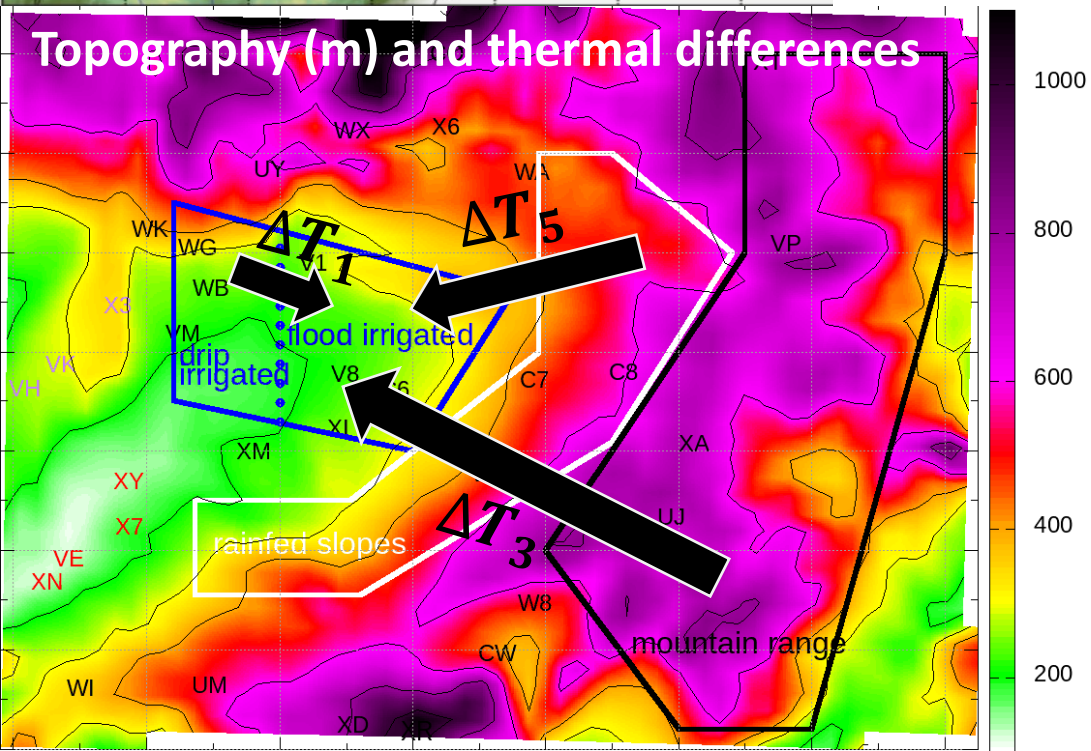


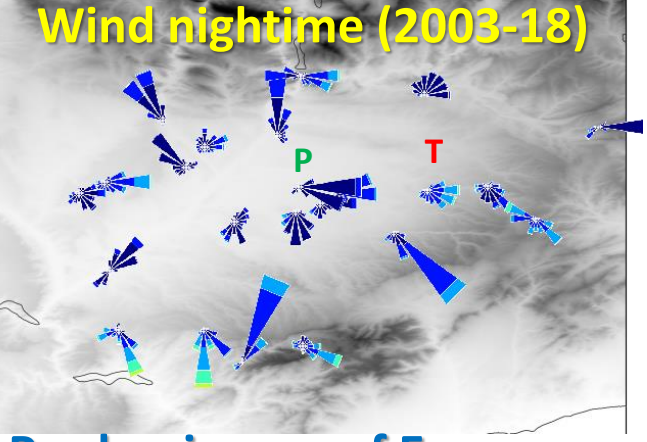

## OBJECTIVE

Characterize the surface thermal differences over several regions (strength and its diürnal, seasonal, annual cicles) in this complex terrain area where heterogeneities are due to surface features (irrigated region close to rainfed slopes) and topography



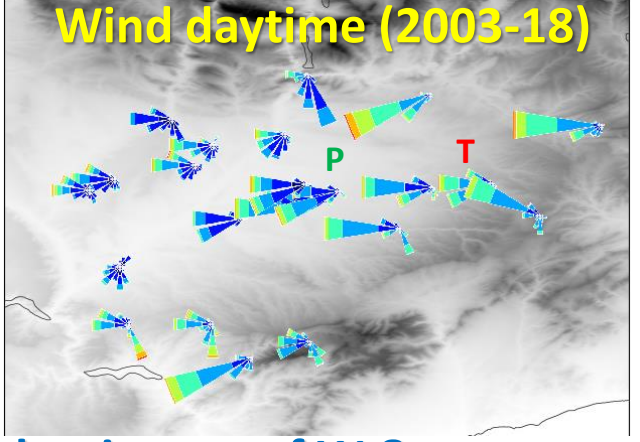

## METODOLOGY

Satellite-derived Land-Surface temperatures (2009-19) are averaged over 4 regions (according to agricultural practises, *see polígons on the left*): **drip & flood irrigated**, **rainfed slopes** and **mountain**




**Stable nights/days** are selected following this criteria applied to 6 AWS (***Grau et al., 2021, JAMC***):

1. **Clear-sky**
2. **Weak wind**



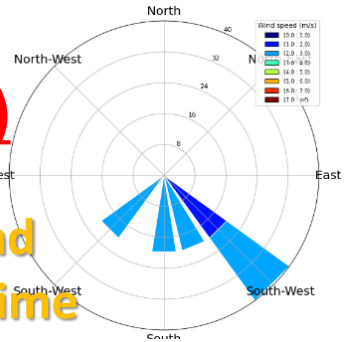

**Predominance of E**

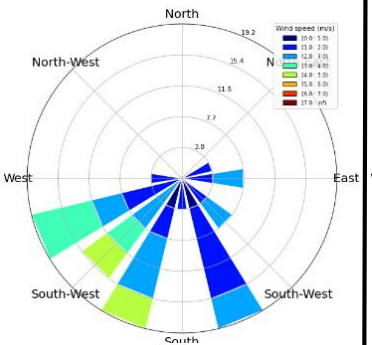
**Predominance of W & stronger**

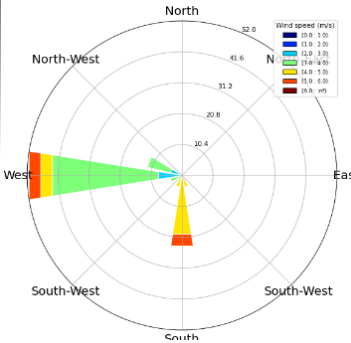
**Stable nights** | **Non-stable nights** | **Stable days** | **Non-stable days**

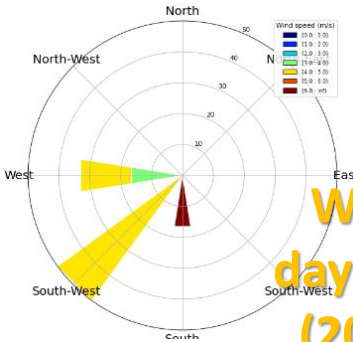
**Tàrrega (T)**

**Wind nighttime (2016)**



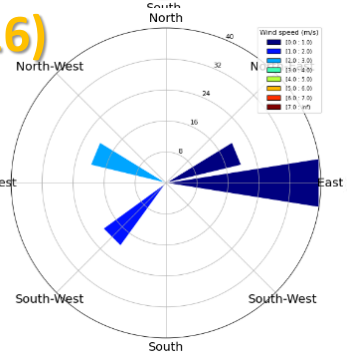



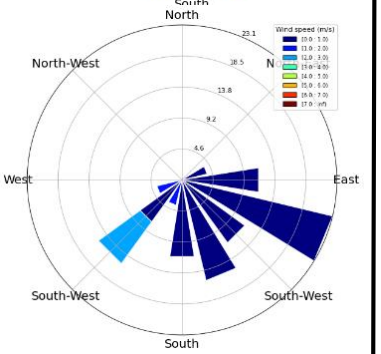



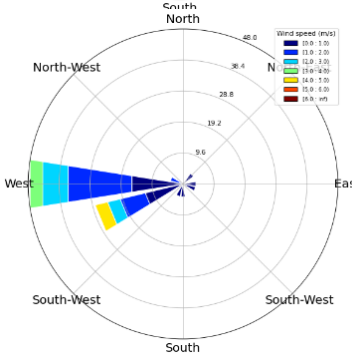



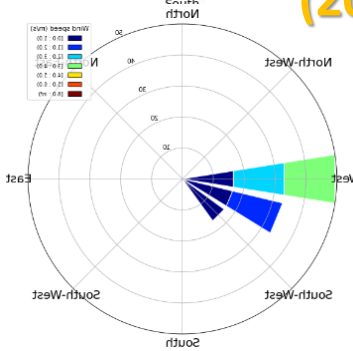

**Wind daytime (2016)**

**El Poal (P)**



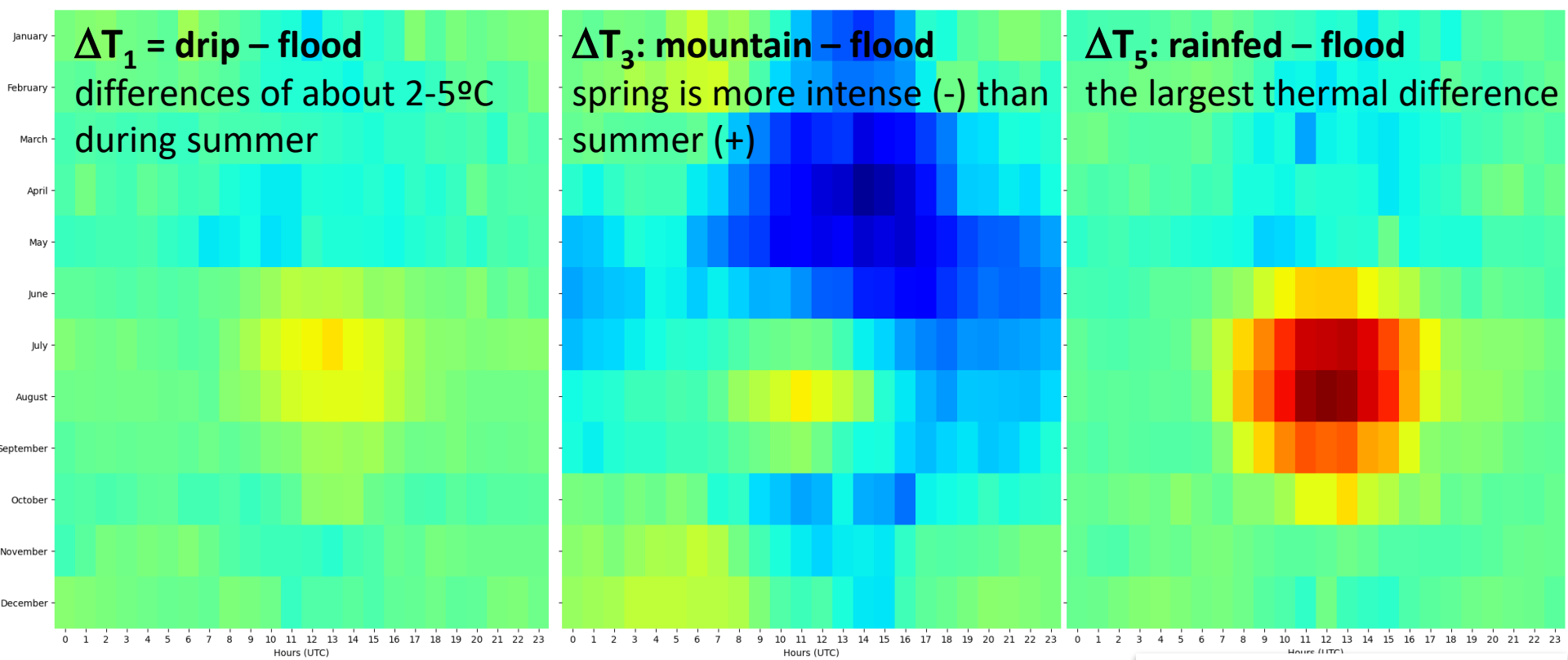




- During nighttime winds are from [S,SE]. For stable nights they are weaker than for non-stable
- Winds are from W for stable days and stronger than during nighttime
- The analysed year 2016 behaves as the climatology from Grau et al. (2021)

**$\Delta T_1$ = drip – flood**
differences of about 2-5ºC during summer

**$\Delta T_3$: mountain – flood**
spring is more intense (-) than summer (+)

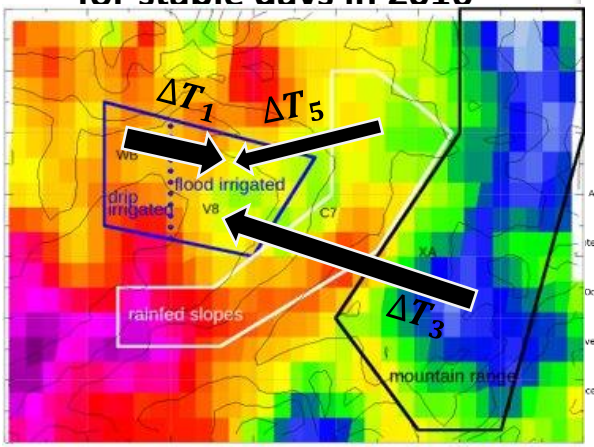
**$\Delta T_5$: rainfed – flood**
the largest thermal difference

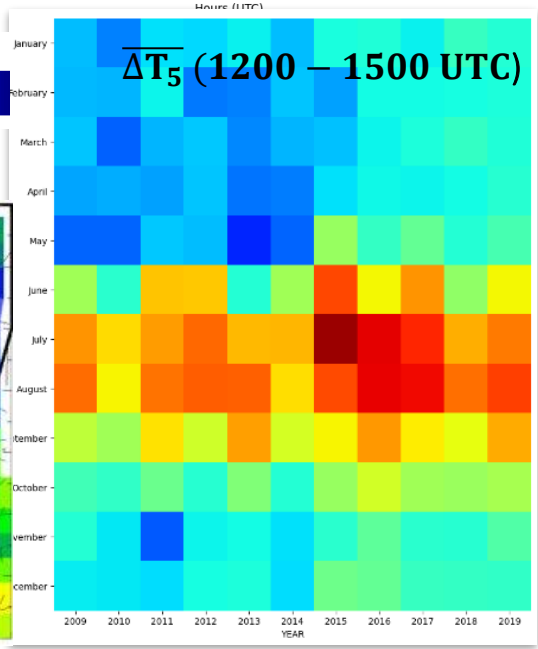


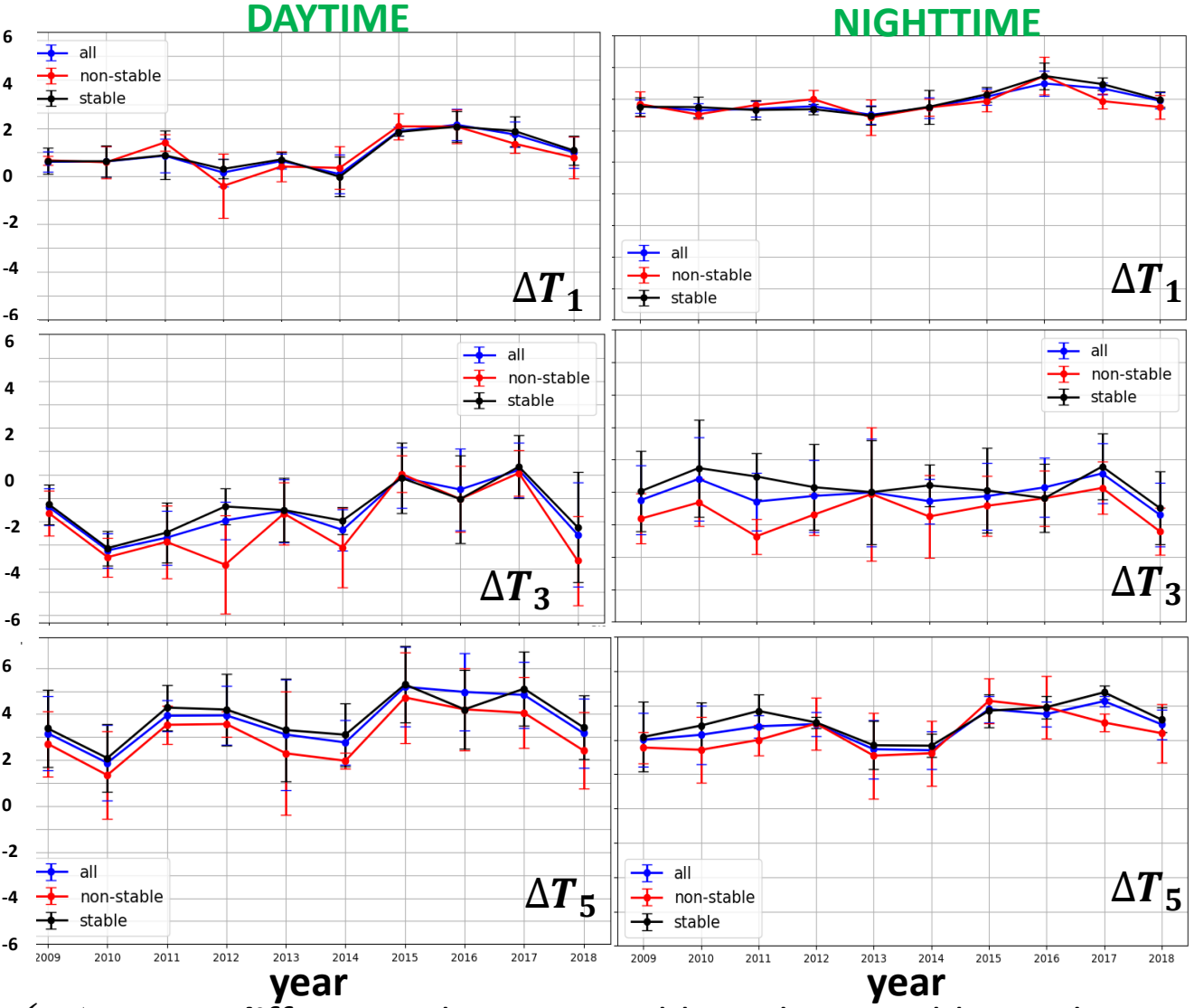


**Thermal difference ($\Delta$T, ºC) for stable days in 2016**

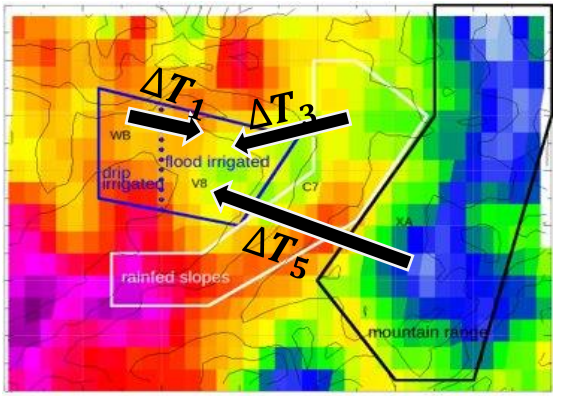
- ✓ Thermal differences are specially important during **daytime and summer** (the flood region is colder than the rest due to the wet soil), **favouring W circulations**
- ✓ $\Delta T_5$ presents the **largest gradient** and this pattern is similar for all the years 2009-19
- ✓ $\Delta T_5$ **dominates** during daytime whereas $\Delta T_3$ during nighttime






**Temporal evolution (2009-19)** of the averaged thermal differences (daytime, 12-15UTC and nighttime, 0-3UTC) **during summer (JJA) for all, stable and non-stable days**




- ✓ $\Delta T_1$ : **NO differences** between stable and non-stable conditions and it ranges [0,2] ºC during daytime and it is about 3 ºC during nighttime, with the **smallest variability** (error bars) during the days of the year
- ✓ $\Delta T_3$ and $\Delta T_5$ : differences of [1,4] ºC between **stable/non-stable conditions**, pointing that **local circulations** are related to these gradients, **except during nigttime** where $\Delta T_5$ is (**+**) but E winds are reported (contrarily to this gradient): presence of **cold pool** (Grau et al., 2021)

# SUMMARY

- ✓ **Surface heterogeneities** in the Eastern Ebro Subbasin are mainly due to the soil features related to the agriculture practice (irrigated and rainfed regions) and the topography.
- ✓ There are not significant differences between the flood and drip irrigated regions during the year but they are of about 2ºC ($\Delta T_1$) during summer daytime.
- ✓ Flood irrigated region is warmer than the mountains during daytime ($\Delta T_3$) but this sign is inverted during summer due to the effect of irrigation.
- ✓ The **largest temperature gradient is reported during summer daytime** between the rainfed and the flood irrigated regions ($\Delta T_5$) where the soil moisture reduced the radiative heating. Instead, the nearly baresoil at the slopes enhances the heating of the surface.
- ✓ There are differences in $\Delta T_3$ and $\Delta T_5$ for the stable and non-stable days and the above mentioned paterns **are reported for all the analyzed years** (2009-19).
- ✓ **Locally-generated circulations are related to the above-mentioned $\Delta T$, excepte for $\Delta T_5$ during nighttime** due to the presence of a cold pool in the bottom parts of the basin. **These local winds interact with larger-scale winds** (sea-breeze generated at the coast, up/down-river circulations, ...).