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Heat adaptation in pigs: phenotypes, genotypes & blood transcriptomics in the PigHeaT program

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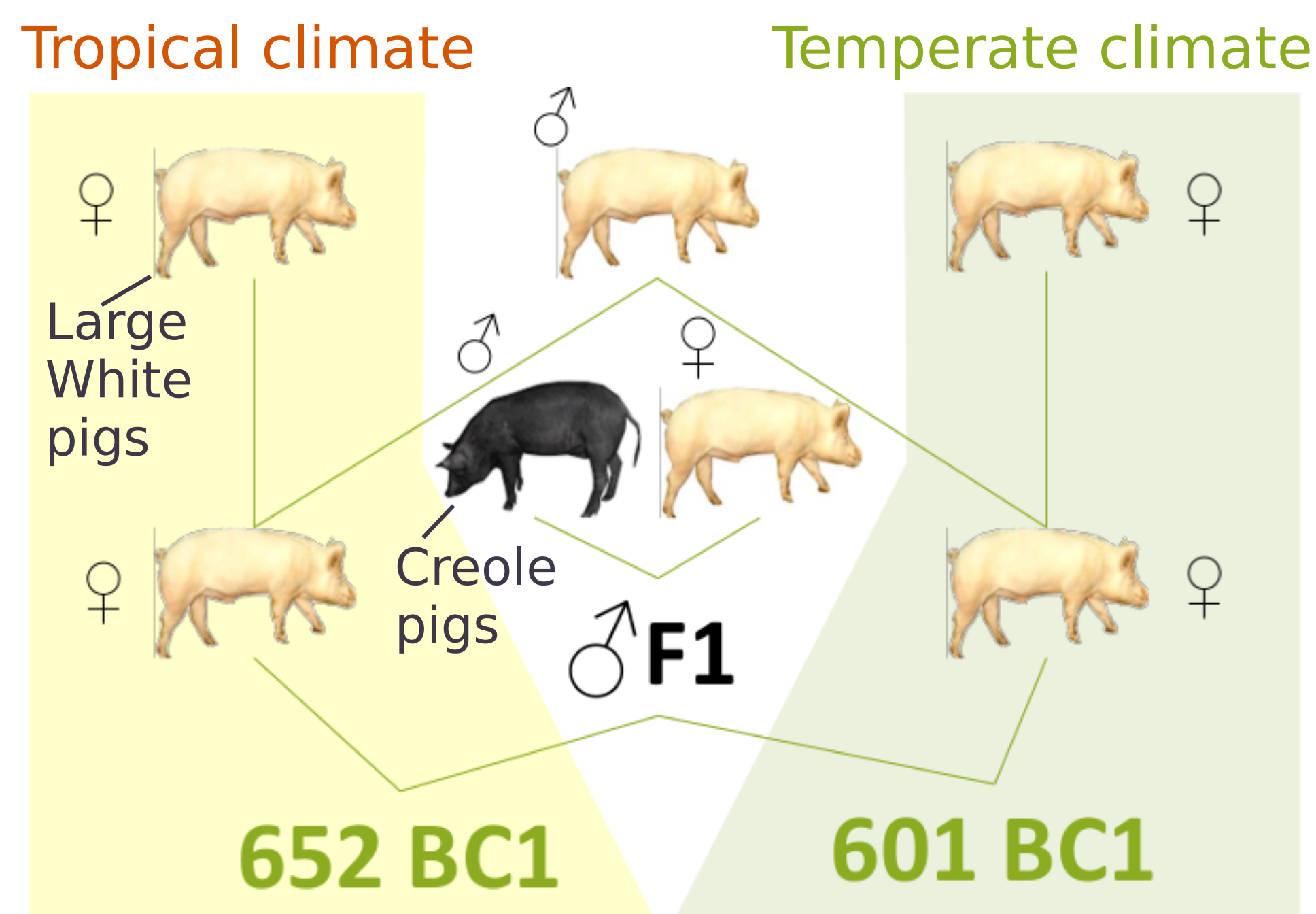


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Abstract & experimental setup

Heat wave frequency is increasing due to global warming, resulting in consequential impacts on agricultural production systems. In temperate production pigs, heat waves reduce production performances and cause animal discomforts. Improving heat resistance in pigs is therefore needed to mitigate the effects of global warming.

Caribbean Creole pigs are well adapted to tropical climate, but show low production values, the exact opposite of Large White pigs. Animals from a **back-cross of Large White and Creole pigs** were raised in experimental units of INRA in **both tropical and temperate climate**. Animals in temperate climate were further challenged with a three weeks-long artificial heat wave. Production traits and thermo-regulatory responses were recorded and associated with their genotypes. Blood samples of a subset of animals were used for metabolomics and transcriptomics analyses in both environments, and throughout the induced heat stress (N=180 per conditions).



For back-crossed animals, we have:

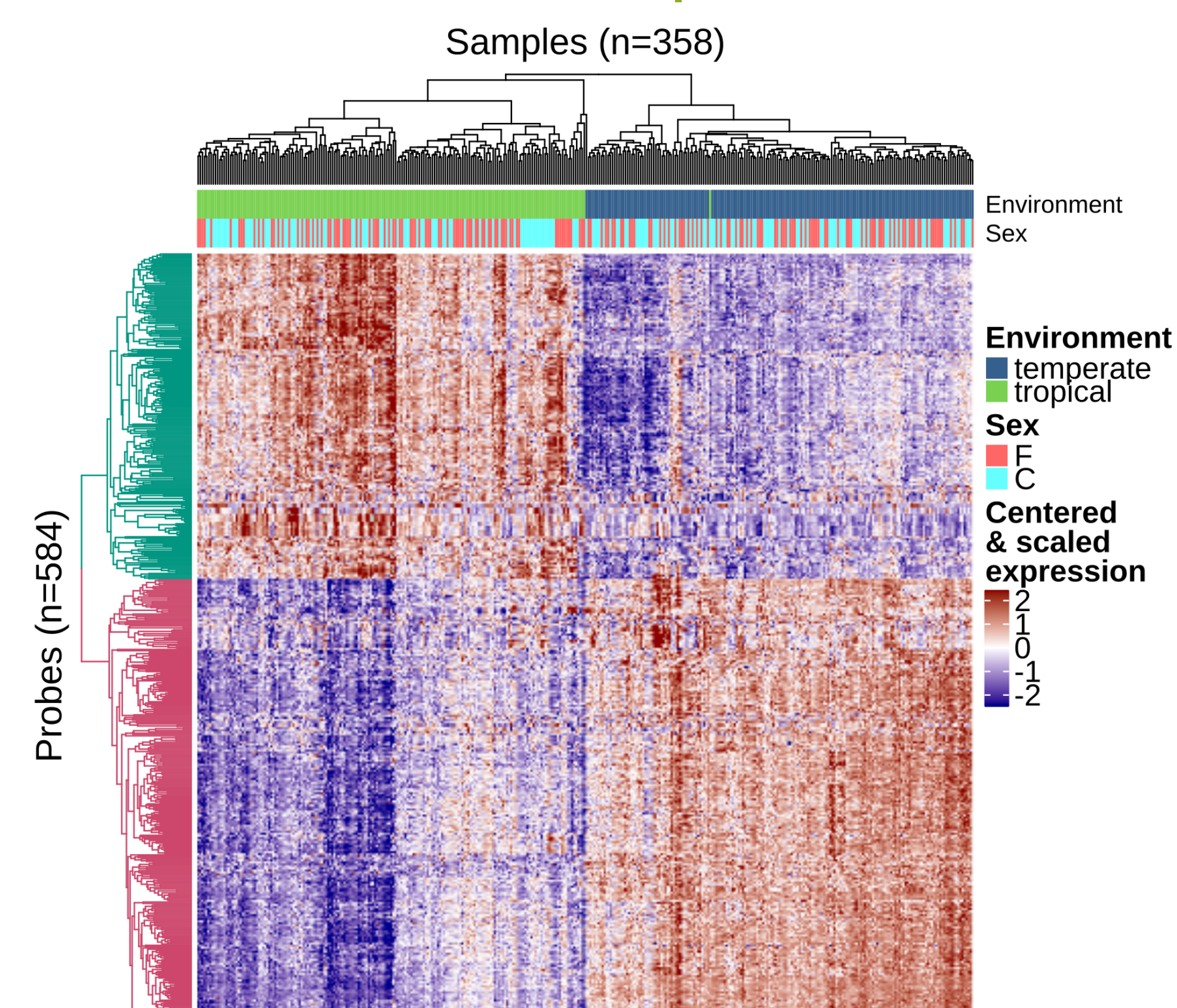
- phenotypes for production & thermo-regulation traits
- genotypes (60k markers, Illumina PorcineSNP60v2)
- blood transcriptome (Agilent SurePrint G3 Pig GE 8x60K arrays)
- blood metabolome (1HNMNR)

Published studies on this experimental setup:

- quantitative genetics:
Rosé et al. J Anim Sci. 2017
- blood metabolic biomarkers of heat sensitivity:
Dou et al. PLoS One 2017

Results

Impact of the environment on the blood transcriptome

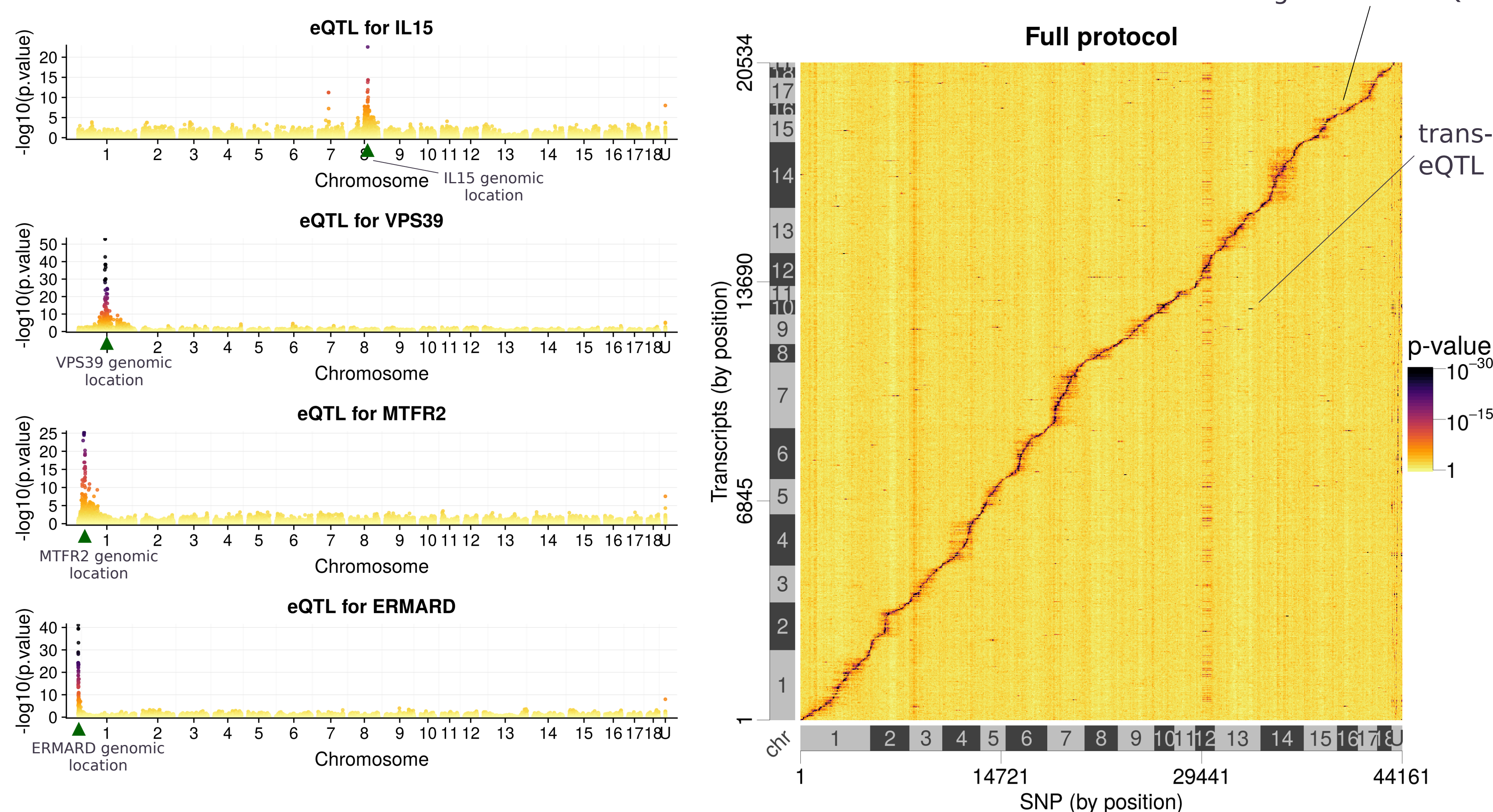


GO enrichment:

- Cellular response to TGFβ stimulus
- Macrophage derived foam cell differentiation
- Mitochondrial electron transport
- Death inducing signaling complex assembly

eQTL detection & visualisation

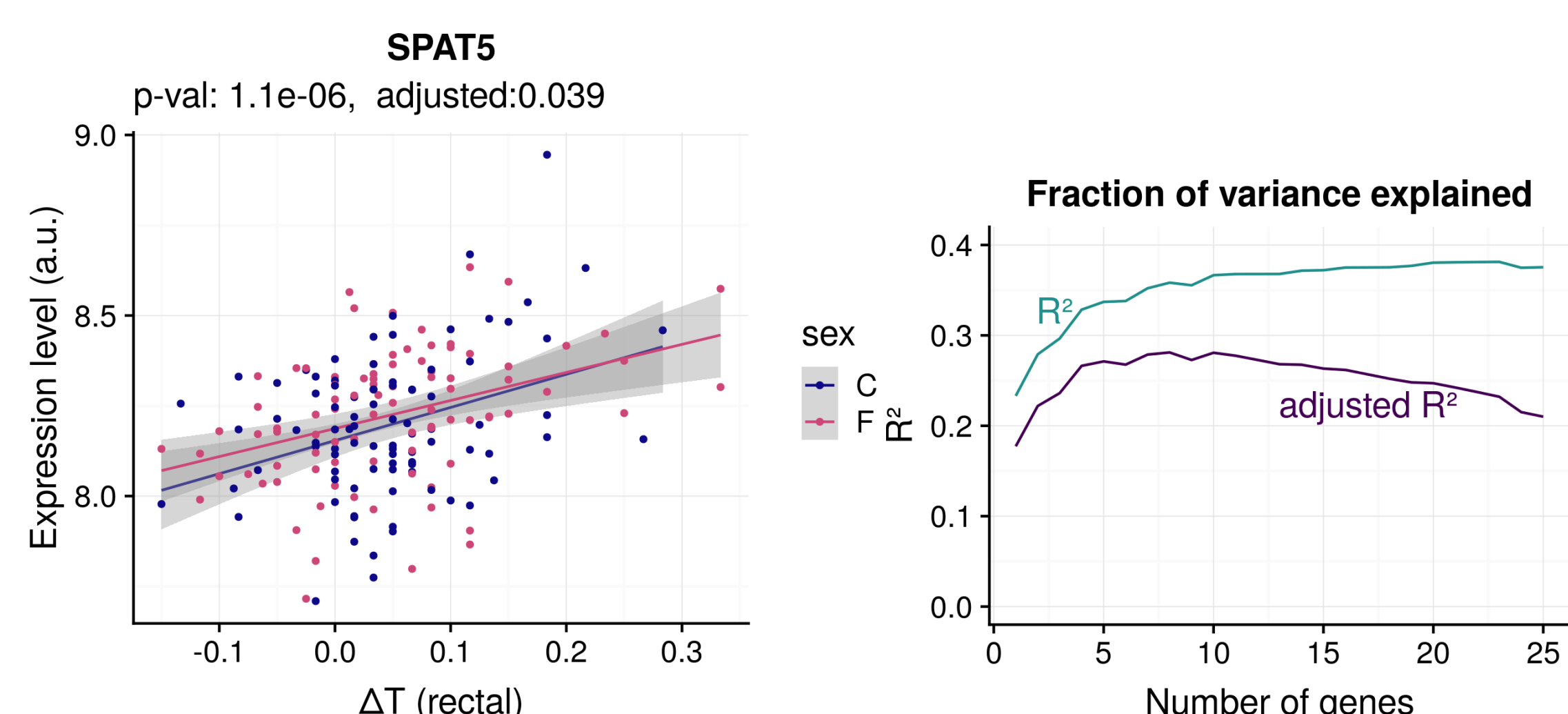
Variants associated with (every) gene expression level



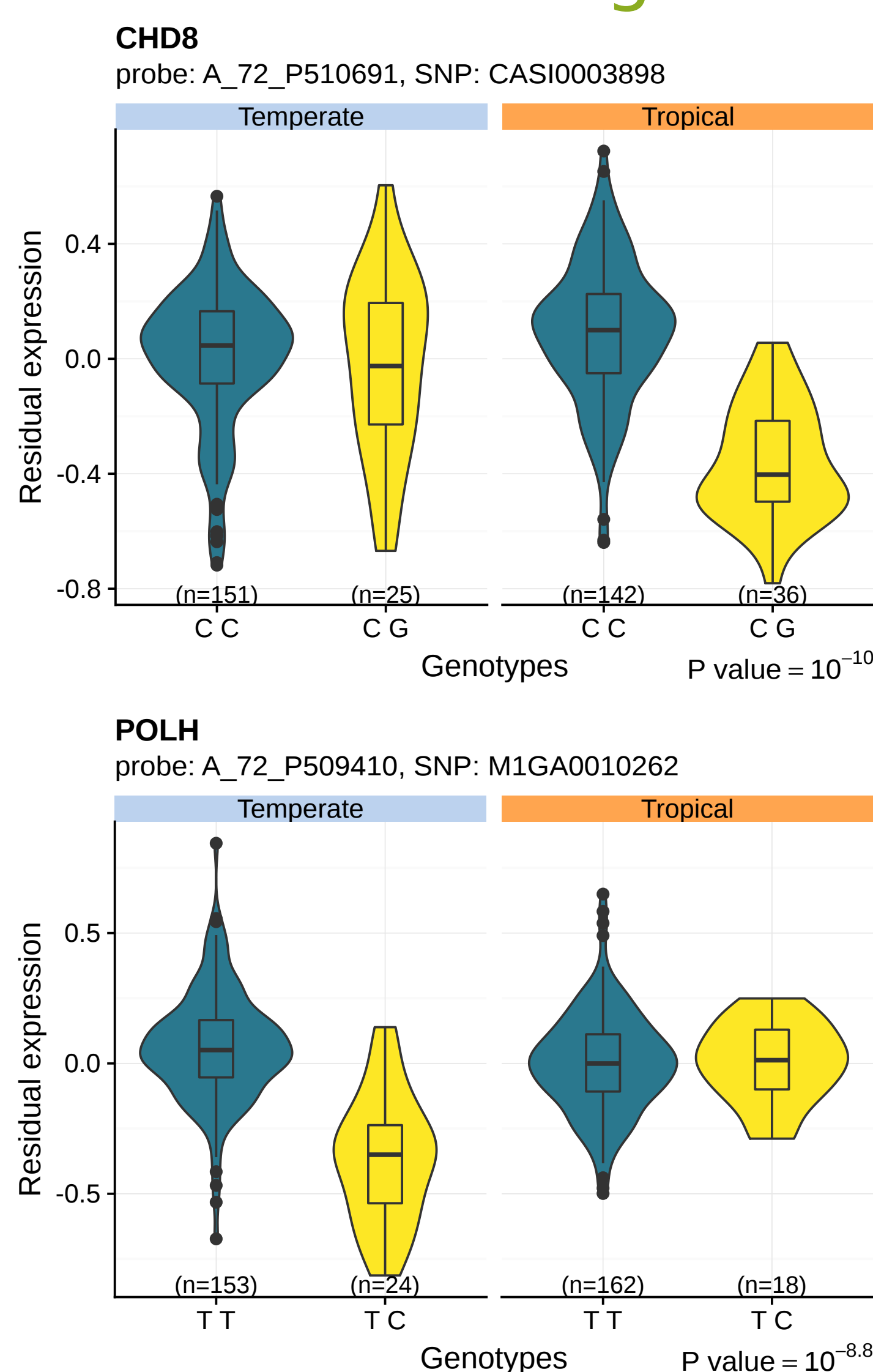
Gene expression level in blood as a biomarker for heat wave response?

Pigs grown in temperate climate were submitted to an artificial heat wave during 3 weeks.

We looked for genes with an **expression level before the stress correlated with a physiological response to the stress** (here, body temperature increase after 48h at 30°C)



Impact of genetic × environment interactions on gene expression



Conclusions & Perspectives

- Effect of the climate on the blood transcriptome
- eQTL detection will allow better phenotypic QTL annotation
- GxE interactions in transcription regulation
- Blood transcripts as biomarkers for heat response?
- QTL detection for transcriptomic changes under heat stress
- variants & transcripts associated with heat tolerance & resistance