Designing life levels for extreme temperature by 2100

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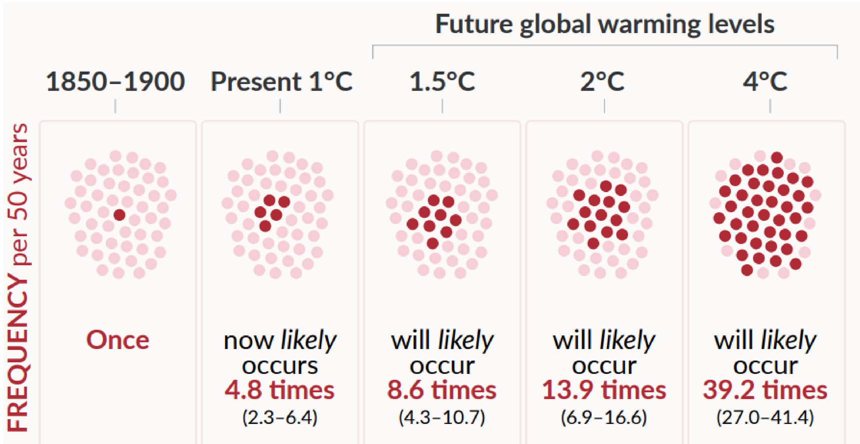
P04

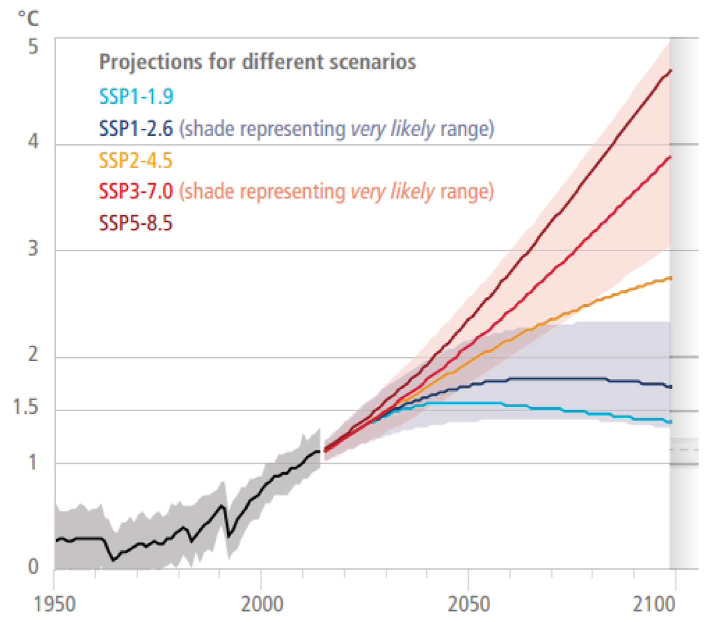
Context



- Increase in Frequency, Severity of Extreme temperature events [1].
- Nuclear safety Issues: Jeopardy of Critical equipment, Constructions, Health.

How to define the risk of extreme temperature levels excess by 2100 at a local scale ?

Statistical Model



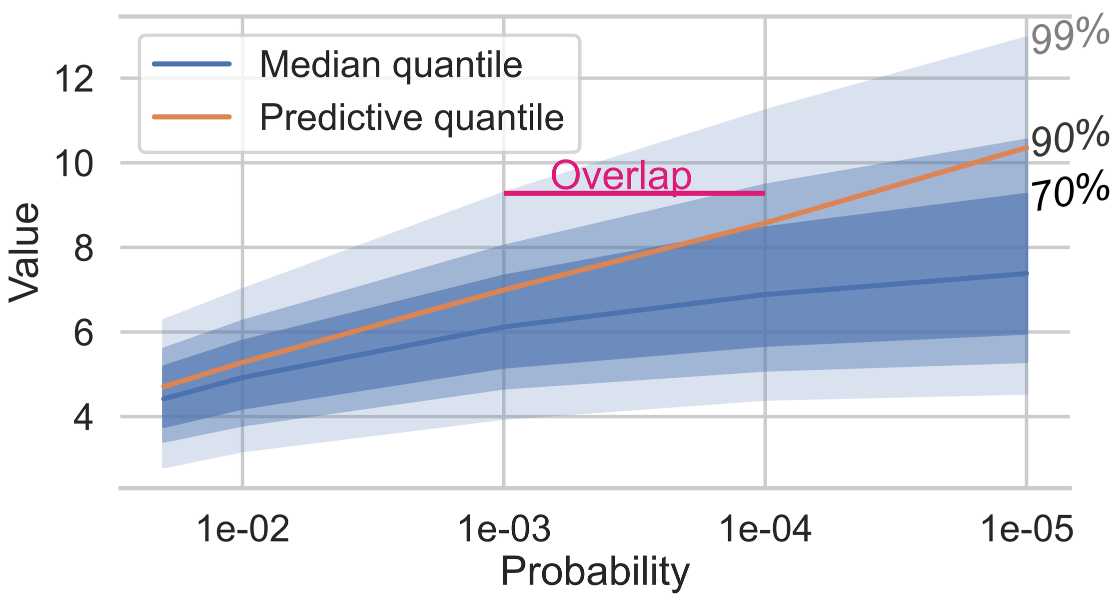
Non-stationarity: Time dependency on a covariate X_t

$$Y \sim GEV(\mu_t, \sigma_t, \xi)$$

$$\begin{cases} \mu(t) &= \mu_0 + \mu_1 X_t \\ \sigma(t) &= exp(\sigma_0 + \sigma_1 X_t) \\ \xi(t) &= \xi_0 \end{cases}$$

Uncertainty

- Using all draws: **median** and **confidence intervals**.
- Confidence Level is **another parameter** to choose.
- Overlap is possible: What's the actual risk considered ?



Equivalent Reliability

- Separating the **period of interest** from the **return period**.
- Account for **non-stationnarity,** $Y_{2023} \neq Y_{2050}$.
- Applied similarly with or without stationarity [4] [3].

For period $t_1, .., t_2$ and annual probability p , solution $\mathbf{z_p}$ of :

$$P[Max(Z_{t_1}, Z_{t_1+1}, ..., Z_{t_2}) \leq \mathbf{z}] = (1-p)^{\mathbf{t_2} - \mathbf{t_1} + 1}$$

Parameter Estimation

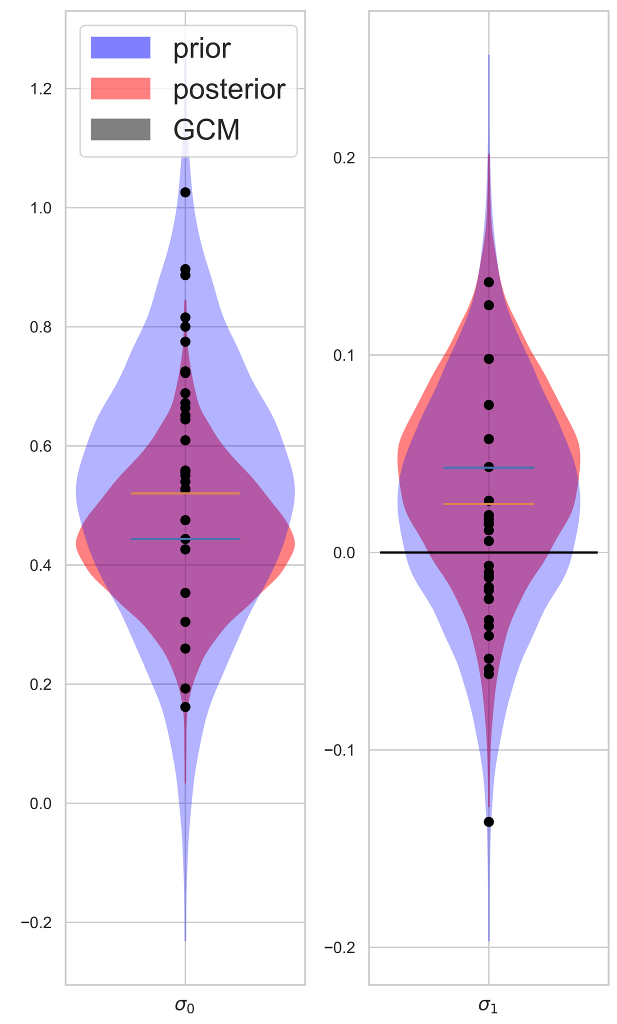
Bayesian framework [5]

A-priori knowledge

- Include only information from **climate models**. (historical and scenario).

Updated using observations

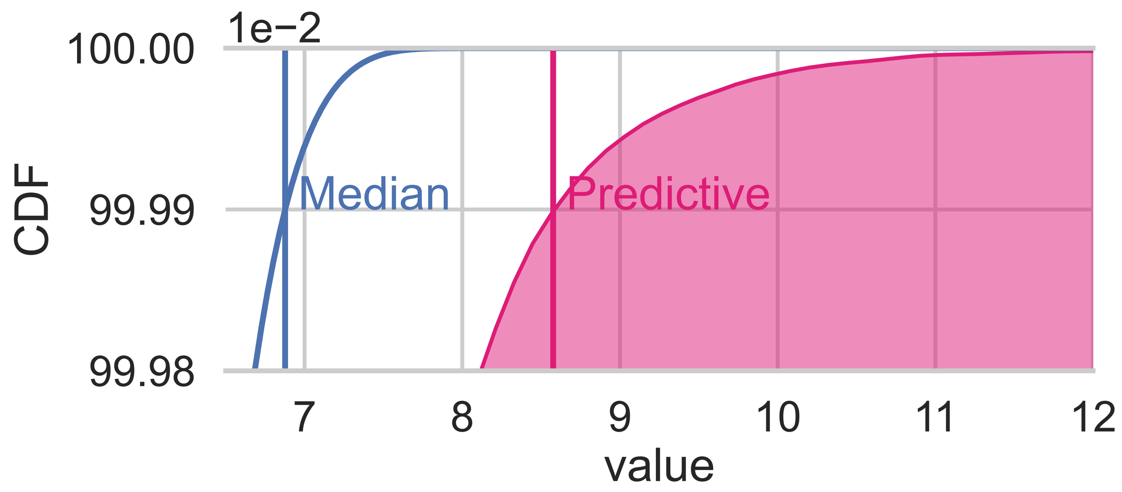
- Maxima constraint using **Markov chain Monte Carlo** (NUTS).
- Using past **local observations**.



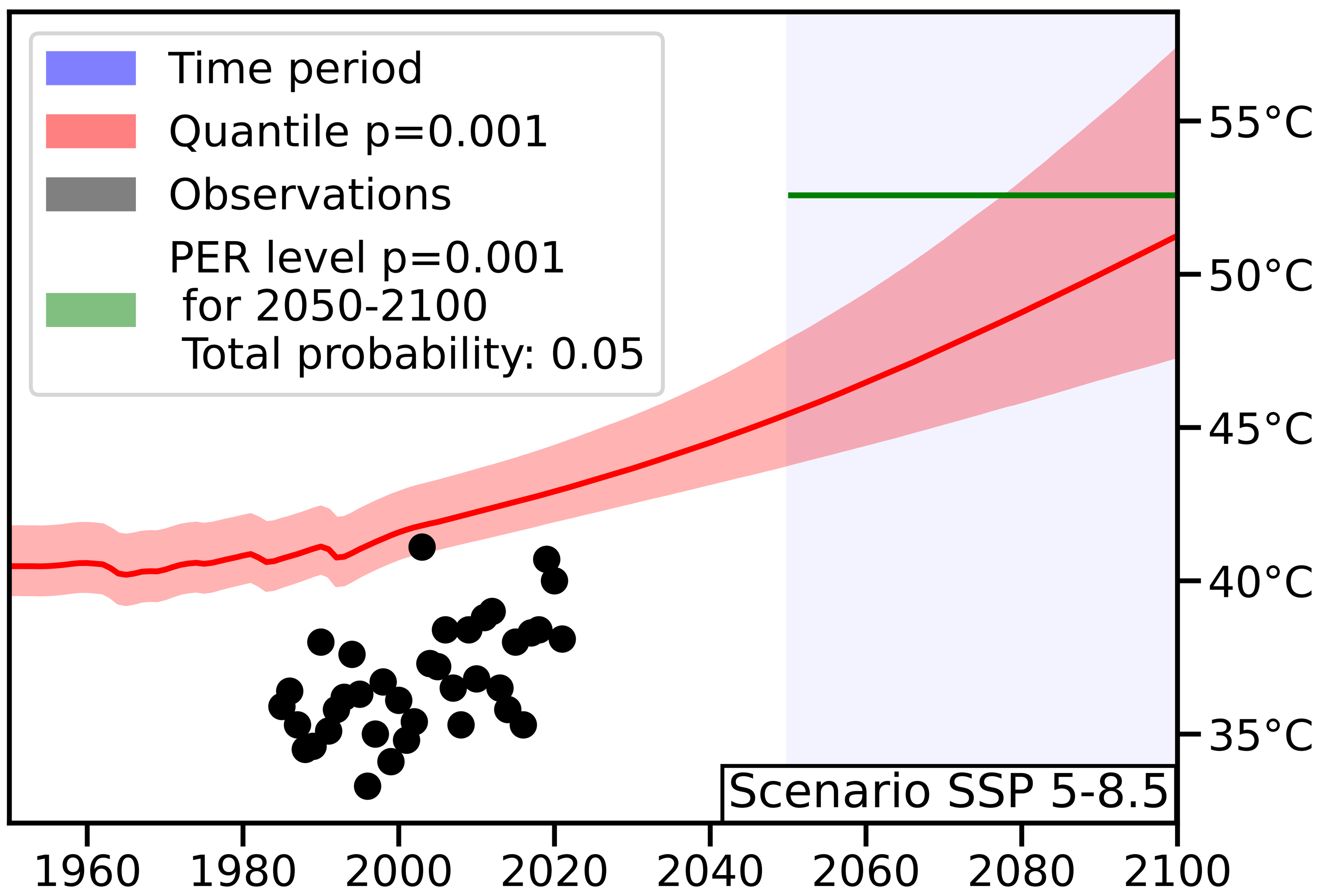
Predictive Distribution

One distribution [2] :

- **Averaged** over the distribution of the model parameters.
- Account for **estimation error** and **stochastic error**.



Application



For an Equivalent Reliability level of 1000 years:

- Predictive is 52.9℃
- Median is 50.3℃ with 55.5℃ for 95% upper bound.

Interpretation

53℃ has an annual probability of excess of $\frac{1}{1000}$ over 2050-2100.

53℃ has a **5% probability of excess over 2050-2100**.

Outlook

- **Application** to various places and scenarios.
- **Prior adaptation**:
  - Specification: upper bound on ξ, prior type, etc.
  - Precision: Add 'expert opinion' weight, other information sources.
  - Hierarchical model: using sources of information like IA downscaling to refine the posterior in successive steps.
- **Model specification**: Prior on the upper bound, Other parameter specification
- **Theoretical exploration**: Define conditions necessary for a bounded predictive.

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MORE INFORMATION

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