## Tokyo rainfall data

The number of occurrences of rainfall over 1 mm in the Tokyo area for each calendar year during two years (1983-84) are registered. It is of interest to estimate the underlying probability $p_{t}$ of rainfall for calendar day $t$ which is, apriori, assumed to change gradually over time. The likelihood model is binomial

$$
y_{t} \mid \eta_{t} \sim \operatorname{Bin}\left(n_{t}, p_{t}\right)
$$

with logit link function

$$
p_{t}=\frac{\exp \left(\eta_{t}\right)}{1+\exp \left(\eta_{t}\right)}
$$

The model for the latent variables can be written as

$$
\eta_{t}=f(t)
$$

where $t$ is the observed time whose effect is modelled as a smooth function $f(\cdot)$. Following [Rue and Held, 2005], the random vector $\boldsymbol{f}=\left\{f_{0}, \ldots, f_{365}\right\}$ is assumed to have a circular random walk of order 2 (RW2) prior with unknown precision $\lambda_{f}$.

There is only one hyperparameter $\boldsymbol{\theta}=\left(\log \lambda_{f}\right)$ which we assign a $\operatorname{LogGamma}(a, b)$ prior distribution with $a=1$ and $b=0.0001$. The LogGamma distribution is defined such that if $X \sim$ $\operatorname{LogGamma}(a, b)$, the $Y=\exp (X) \sim \operatorname{Gamma}(a, b)$ with $\mathrm{E}(Y)=a / b$ and $\operatorname{Var}(Y)=a / b^{2}$.

## References

[Rue and Held, 2005] Rue, H. and Held, L. (2005). Gaussian Markov Random Fields: Theory and Applications, volume 104 of Monographs on Statistics and Applied Probability. Chapman \& Hall, London.

