

$$\text{Subject parameter distribution: } \underbrace{\begin{bmatrix} \text{t0_stress}_i \\ \text{t0_quality}_i \\ \text{mi_stress}_i \\ \text{mi_quality}_i \end{bmatrix}}_{\phi(i)} \sim \text{tform} \left\{ \text{N} \left(\begin{bmatrix} \text{raw_t0_stress} \\ \text{raw_t0_quality} \\ \text{raw_mi_stress} \\ \text{raw_mi_quality} \end{bmatrix}, \begin{bmatrix} \text{rawPCov_1_1} & \text{rawPCov_2_1} & \text{rawPCov_3_1} & \text{rawPCov_4_1} \\ \text{rawPCov_2_1} & \text{rawPCov_2_2} & \text{rawPCov_3_2} & \text{rawPCov_4_2} \\ \text{rawPCov_3_1} & \text{rawPCov_3_2} & \text{rawPCov_3_3} & \text{rawPCov_4_3} \\ \text{rawPCov_4_1} & \text{rawPCov_4_2} & \text{rawPCov_4_3} & \text{rawPCov_4_4} \end{bmatrix} \right) \right\}$$

$$\text{Initial latent state: } \underbrace{\begin{bmatrix} \text{Stress} \\ \text{Quality} \end{bmatrix}}_{\boldsymbol{\eta}(t_0)} (t_0) \sim \text{N} \left(\underbrace{\begin{bmatrix} \text{t0_stress} \\ \text{t0_quality} \end{bmatrix}}_{\text{T0MEANS}}, \underbrace{UcorSDtoCov \left\{ \begin{bmatrix} 0.001 & 0 \\ 0 & 0.001 \end{bmatrix} \right\}}_{\underbrace{\mathbf{Q}^*_{t_0}}_{\text{T0VAR}}} \right)$$

$$\text{Deterministic change: } \underbrace{\begin{bmatrix} \text{Stress} \\ \text{Quality} \end{bmatrix}}_{\boldsymbol{\eta}(t)} (t) = \left(\underbrace{\begin{bmatrix} \text{a11} & \text{a12} \\ \text{a21} & \text{a22} \end{bmatrix}}_{\underbrace{\mathbf{A}}_{\text{DRIFT}}} \underbrace{\begin{bmatrix} \text{Stress} \\ \text{Quality} \end{bmatrix}}_{\boldsymbol{\eta}(t-1)} (t) + \underbrace{\begin{bmatrix} 0 \\ 0 \end{bmatrix}}_{\underbrace{\mathbf{b}}_{\text{CINT}}} \right) +$$

$$\text{Random change: } \underbrace{UcorSDtoChol \left\{ \begin{bmatrix} \text{diff11} & 0 \\ \text{diff21} & \text{diff22} \end{bmatrix} \right\}}_{\underbrace{\mathbf{G}}_{\text{DIFFUSION}}} \underbrace{\begin{bmatrix} W_1 \\ W_2 \end{bmatrix}}_{\mathbf{w}(t)} (t)$$

$$\text{Observations: } \underbrace{\begin{bmatrix} \text{Stress} \\ \text{Quality} \end{bmatrix}}_{\mathbf{Y}(t)} (t) = \underbrace{\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}}_{\underbrace{\mathbf{\Lambda}}_{\text{LAMBDA}}} \underbrace{\begin{bmatrix} \text{Stress} \\ \text{Quality} \end{bmatrix}}_{\boldsymbol{\eta}(t)} (t) + \underbrace{\begin{bmatrix} \text{mi_stress} \\ \text{mi_quality} \end{bmatrix}}_{\underbrace{\boldsymbol{\tau}}_{\text{MANIFESTMEANS}}} +$$

$$\text{Observation noise: } \underbrace{\begin{bmatrix} \text{merr_stress} & 0 \\ 0 & \text{merr_quality} \end{bmatrix}}_{\underbrace{\boldsymbol{\Theta}}_{\text{MANIFESTVAR}}} \underbrace{\begin{bmatrix} \epsilon_1 \\ \epsilon_2 \end{bmatrix}}_{\boldsymbol{\epsilon}(t)} (t)$$

$$\begin{array}{ll} \text{System noise} & \text{Observation noise} \\ \text{distribution per time} & \text{distribution:} \\ \text{step:} & \end{array} \quad \begin{array}{l} [W_{j \in [1,2]}](t) \sim \text{N}(0, 1) \\ [\epsilon_{j \in [1,2]}](t) \sim \text{N}(0, 1) \end{array}$$

Note: *UcorSDtoChol* converts lower tri matrix of standard deviations and unconstrained correlations to Cholesky factor, *UcorSDtoCov* = transposed cross product of *UcorSDtoChol*, to give covariance, See Driver & Voelkle (2018) p11. Individual specific notation (subscript i) only shown for subject parameter distribution – pop. means shown elsewhere.