

Supplementary Figures

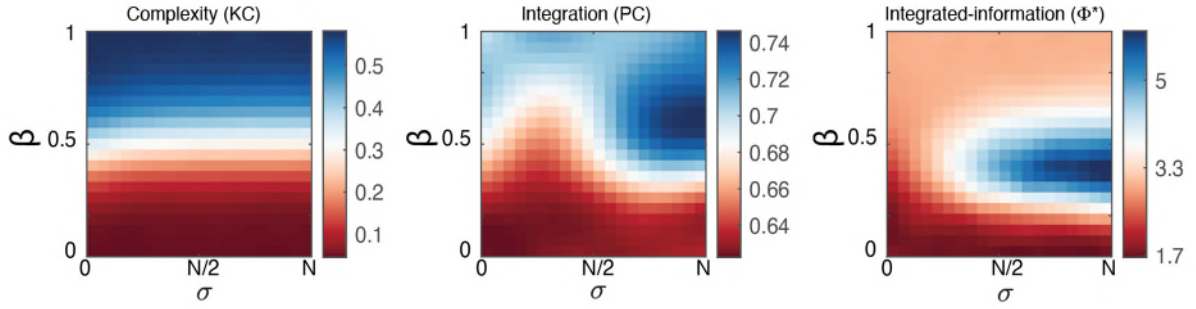


Fig. S1: Comparison of the three complex, adaptive signatures calculated using a spatially overlapping Gaussian smoothed coarse-sampling.

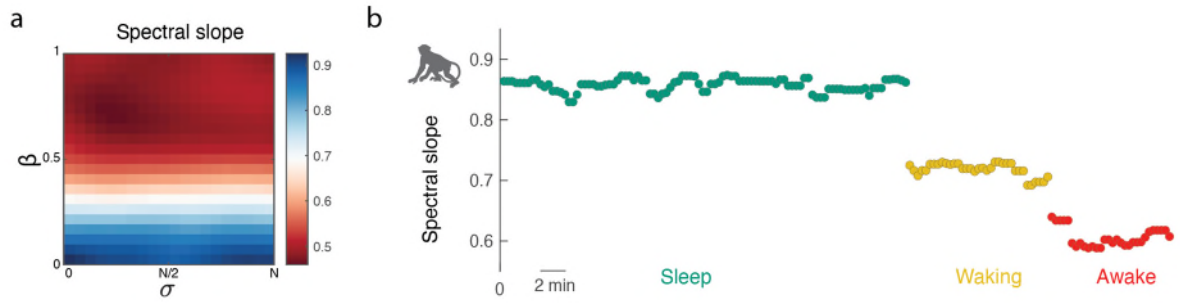


Fig. S2: (a) Spectral slope across the model state space. (b) spectral slope calculated across a macaque recording (Fig. 3a).

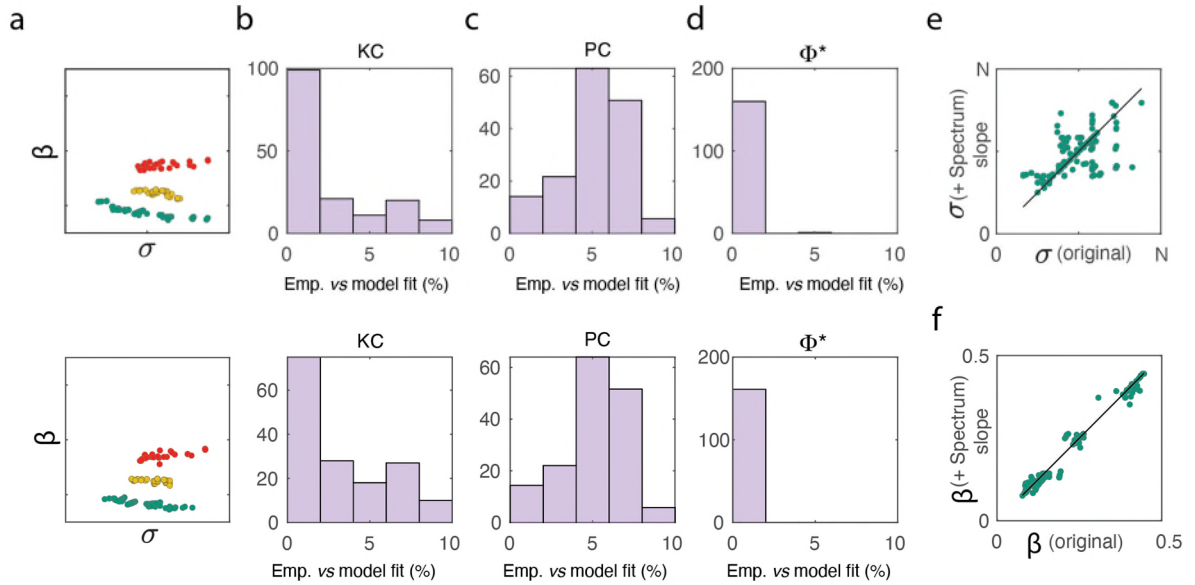


Fig. S3: (a) Comparison of the swarm fitting using (KC, PC, Φ^*) (top) and $(KC, PC, \Phi^*, \text{and spectra slope})$ (bottom). (b-d) the optimisation fits each signature within 10% of the empirically measured value. (e-f) Including an extra parameter (spectra slope) subtly shifts σ (e) and does not change β significantly (f).

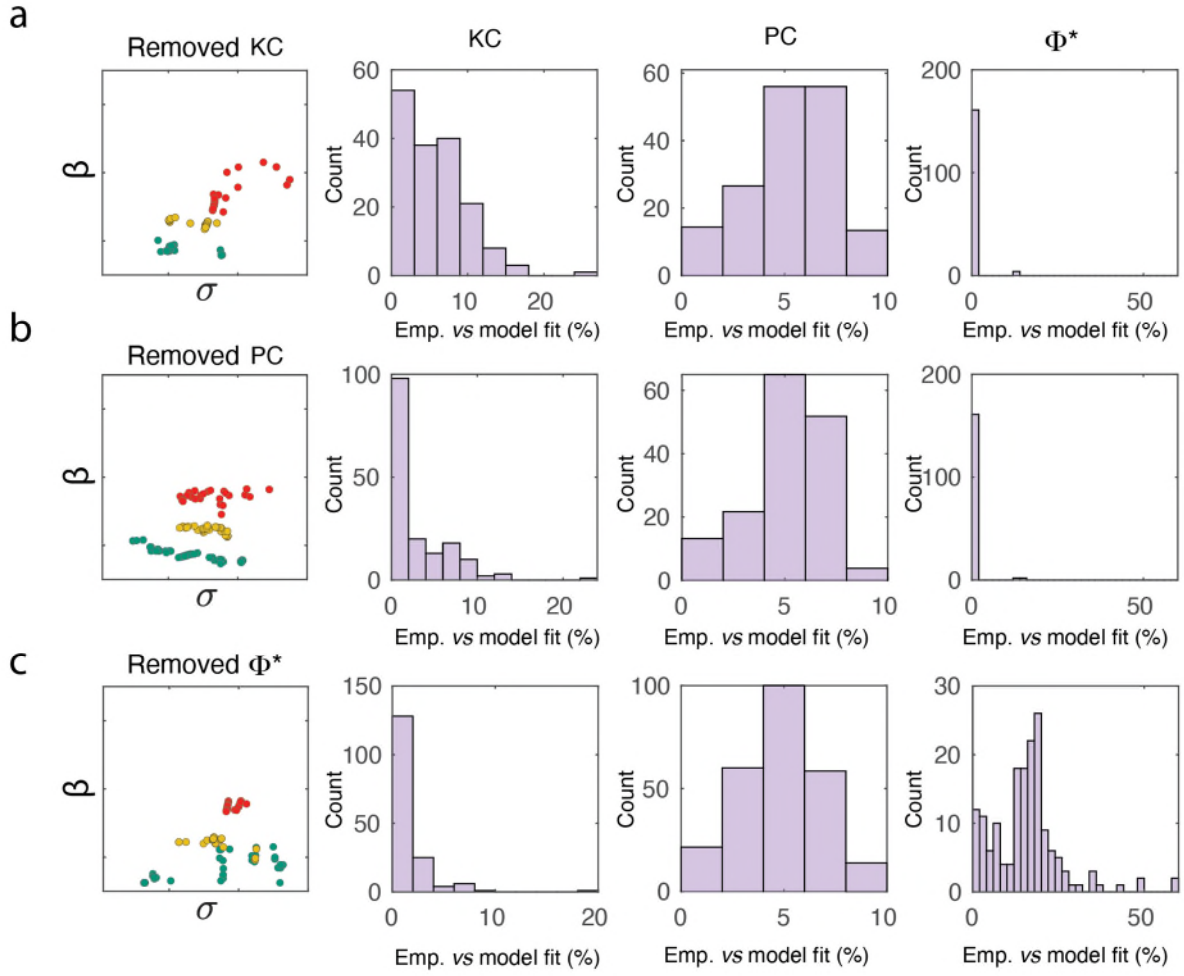


Fig. S4: Comparison of model fits on a macaque recording (Fig. 3a) only using two complex, adaptive signatures. **(a)** Model state-space (left) and match with empirical measurements (right) after removing *KC*. **(b)** Model state-space (left) and match with empirical measurements (right) after removing *PC*. **(c)** Model state-space (left) and match with empirical measurements (right) after removing Φ^* .

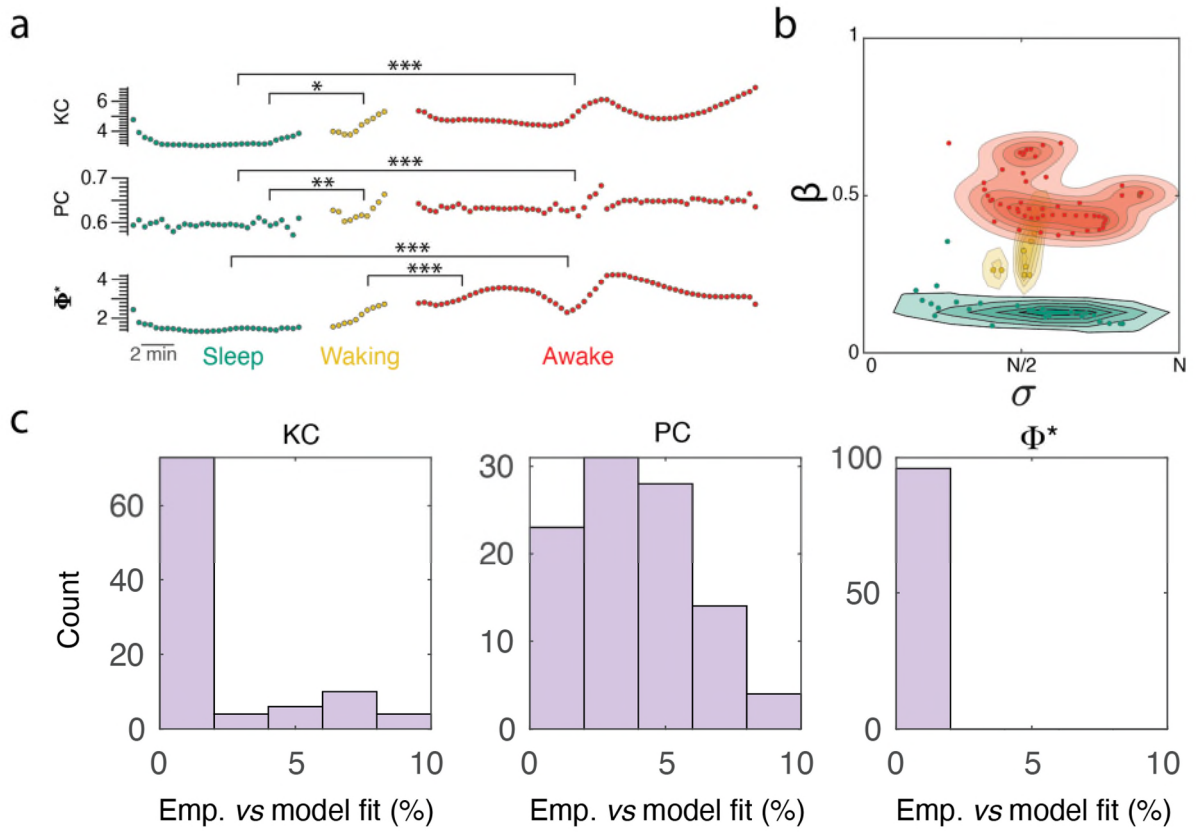


Fig. S5: (a) In a separate macaque EGoG recordings from Fig. 2a, the three complex, adaptive signatures significantly change across 20s epochs of arousal from sleeping (teal) to awake (red). (b) Inverted location of each 20s epoch in the model state space following hybrid particle swarm/convex optimisation minimising the difference between model and empirical complex, adaptive dynamics where the clouds are five evenly spaced contour lines (2% to 98%) of the probability density estimate for each state. (c) Fit quality (percentage error difference) between model estimated and empirically measured complex, adaptive signatures. Statistical significance across empirical complex, adaptive dynamics denoted by * $p < 0.05$, ** $p < 0.01$, and *** $p < 0.001$ Kruskal-Wallis multiple comparison tests; see Table 1 for p-values.

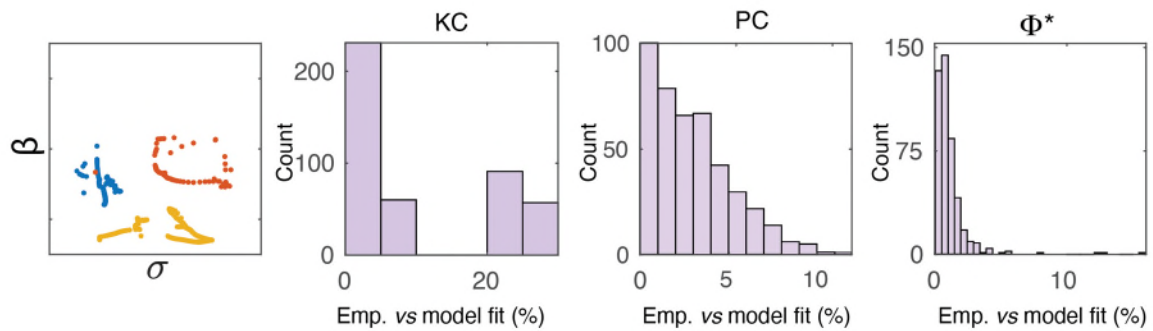


Fig. S6: Match (percentage difference) between model estimated and empirically measured complex, adaptive signatures in the human EEG recordings.

Figure	Comparison	P value (Kruskal-Wallis multiple comparison corrected)
Fig. 3a - KC	Sleep vs Waking	4.5×10^{-12}
Fig. 3a - KC	Sleep vs Awake	1.8×10^{-16}
Fig. 3a - KC	Waking vs Awake	0.01
Fig. 3a - PC	Sleep vs Waking	2.3×10^{-8}
Fig. 3a - PC	Sleep vs Awake	1.9×10^{-21}
Fig. 3a - PC	Waking vs Awake	0.002
Fig. 3a - Φ^*	Sleep vs Waking	1.7×10^{-12}
Fig. 3a - Φ^*	Sleep vs Awake	1.8×10^{-24}
Fig. 3a - Φ^*	Waking vs Awake	0.02
Fig. 3d - KC	Sleep vs Waking	0.15
Fig. 3d - KC	Sleep vs Awake	1×10^{-32}
Fig. 3d - KC	Waking vs Awake	1×10^{-32}
Fig. 3d - PC	Sleep vs Waking	1×10^{-32}
Fig. 3d - PC	Sleep vs Awake	5×10^{-20}
Fig. 3d - PC	Waking vs Awake	1×10^{-32}
Fig. 3d - Φ^*	Sleep vs Waking	2.6×10^{-21}
Fig. 3d - Φ^*	Sleep vs Awake	1×10^{-32}
Fig. 3d - Φ^*	Waking vs Awake	5×10^{-8}
Fig. S5 - KC	Sleep vs Waking	0.02
Fig. S5 - KC	Sleep vs Awake	4×10^{-15}
Fig. S5 - KC	Waking vs Awake	0.06
Fig. S5 - PC	Sleep vs Waking	0.01
Fig. S5 - PC	Sleep vs Awake	1×10^{-15}
Fig. S5 - PC	Waking vs Awake	0.07
Fig. S5 - Φ^*	Sleep vs Waking	0.15
Fig. S5 - Φ^*	Sleep vs Awake	1×10^{-16}
Fig. S5 - Φ^*	Waking vs Awake	0.001

Supplementary Table 1: Exact p values for significance testing of complex, adaptive dynamics across arousal states.