**Table S1.** Summary of the regression models for the PDO ($L_1$) and NPGO ($L_2$) modes from equations (1) and (2) in the main text. \{A_i, B_i, C_i\}: Regression coefficients. $\sigma_i$: Standard deviation of the residual. $\kappa_i$: Condition number of the design matrix. \{d(\epsilon_i), d(\Delta \epsilon_i)\}: Durbin-Watson statistics for the residual and residual increments for 1 m lag. $t_c(\epsilon_i)/t_c(L_i)$: noise decorrelation time relative to modal decorrelation time. √ (X) indicates external factors/interactions which were (were not) part of a given model.

<table>
<thead>
<tr>
<th>Model</th>
<th>1</th>
<th>2</th>
<th>3</th>
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<th>5</th>
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<tr>
<td>Ext. factors</td>
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<tr>
<td>$P_1, P_2$</td>
<td>X</td>
<td>X</td>
<td>√</td>
<td>√</td>
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<tr>
<td>$L_3$</td>
<td>X</td>
<td>√</td>
<td>X</td>
<td>X</td>
<td>X</td>
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<tr>
<td>$I_1, \ldots, I_4$</td>
<td>X</td>
<td>X</td>
<td>√</td>
<td>√</td>
<td>√</td>
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<tr>
<td>Mode $L_1$</td>
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<tr>
<td>$A_1(L_1)$</td>
<td>0.9964</td>
<td>0.9972</td>
<td>X</td>
<td>0.6233</td>
<td>-0.0067</td>
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<tr>
<td>$A_1(L_2)$</td>
<td>0.0343</td>
<td>0.0330</td>
<td>X</td>
<td>-0.0624</td>
<td>-0.2148</td>
</tr>
<tr>
<td>$B_1(L_3)$</td>
<td>X</td>
<td>-0.0340</td>
<td>X</td>
<td>X</td>
<td>X</td>
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<tr>
<td>$B_1(P_1, I_1)$</td>
<td>X</td>
<td>X</td>
<td>0.4070</td>
<td>0.1732</td>
<td>0.4606</td>
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<td>X</td>
<td>0.4762</td>
<td>0.1954</td>
<td>0.5241</td>
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<tr>
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<td>X</td>
<td>0.2709</td>
<td>0.0907</td>
<td>0.2508</td>
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<tr>
<td>$B_1(P_2, I_3)$</td>
<td>X</td>
<td>X</td>
<td>-0.1778</td>
<td>-0.0180</td>
<td>-0.0598</td>
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<tr>
<td>$C_1(L_1, L_1, L_1)$</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>-0.0032</td>
</tr>
<tr>
<td>$C_1(L_1, L_2, L_2)$</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>0.0046</td>
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<td>0.0658</td>
<td>0.1582</td>
<td>0.0696</td>
<td>0.0800</td>
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<td>$\kappa_1$</td>
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<td>2.1941</td>
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<td>0.5886</td>
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<td>0.6810</td>
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<tr>
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<td>2.0190</td>
<td>1.3244</td>
<td>2.1196</td>
<td>1.9682</td>
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<tr>
<td>$t_c(\epsilon_1)/t_c(L_1)$</td>
<td>0.2307</td>
<td>0.1954</td>
<td>0.3388</td>
<td>0.1967</td>
<td>0.1621</td>
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**Table S1.** (continued)

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<th>Model</th>
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<td>Mode</td>
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<tr>
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<td>X</td>
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<td>X</td>
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<td>X</td>
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<td>X</td>
<td>0.0118</td>
<td>0.0275</td>
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<tr>
<td>$C_2(L_1, L_1, L_2)$</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>0.0141</td>
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<td>X</td>
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<td>0.2270</td>
<td>0.2220</td>
<td>0.2257</td>
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</table>