

Supplementary Materials

S1. The SBML step function

```
1 <?xml version="1.0" encoding="utf-8"?>
2 <functionDefinition id="stepFunction" name="Step function" sboTerm="SBO:0000475">
3 <math xmlns="http://www.w3.org/1998/Math/MathML">
4   <lambda>
5     <bvar>
6       <ci definitionURL="http://biomodels.net/SBO/#SBO:0000347"> t </ci>
7     </bvar>
8     <bvar>
9       <ci definitionURL="http://biomodels.net/SBO/#SBO:0000256"> offset </ci>
10    </bvar>
11    <bvar>
12      <ci definitionURL="http://biomodels.net/SBO/#SBO:0000381"> amplitude </ci>
13    </bvar>
14    <bvar>
15      <ci definitionURL="http://biomodels.net/SBO/#SBO:0000477"> phase </ci>
16    </bvar>
17    <bvar>
18      <ci definitionURL="http://biomodels.net/SBO/#SBO:0000347"> pulseDuration </ci>
19    </bvar>
20    <bvar>
21      <ci definitionURL="http://biomodels.net/SBO/#SBO:0000476"> cyclePeriod </ci>
22    </bvar>
23    <bvar>
24      <ci definitionURL="http://biomodels.net/SBO/#SBO:0000346"> rampDuration </ci>
25    </bvar>
26    <apply>
27      <plus />
28      <apply>
29        <minus />
30        <apply>
31          <plus />
32          <ci> offset </ci>
33          <apply>
34            <times />
35            <cn> 0.5 </cn>
36            <ci> amplitude </ci>
37          </apply>
38          <plus />
39          <cn> 1 </cn>
40          <apply>
41            <tanh />
42            <apply>
43              <divide />
44              <apply>
45                <times />
46                <ci> cyclePeriod </ci>
47              </apply>
48              <minus />
49              <apply>
50                <divide />
51                <apply>
52                  <plus />
53                  <ci> t </ci>
54                  <ci> phase </ci>
55                </apply>
56                <ci> cyclePeriod </ci>
57              </apply>
58            <apply>
59              <floor />
60              <apply>
61                <divide />
```

```

62
63         <apply>
64             <plus />
65             <ci> t </ci>
66             <ci> phase </ci>
67         </apply>
68
69         <ci> cyclePeriod </ci>
70     </apply>
71 </apply>
72 </apply>
73 </apply>
74     <ci> rampDuration </ci>
75 </apply>
76 </apply>
77 </apply>
78 </apply>
79 </apply>
80 <apply>
81     <times />
82     <cn> 0.5 </cn>
83     <ci> amplitude </ci>
84 <apply>
85     <plus />
86     <cn> 1 </cn>
87     <apply>
88         <tanh />
89         <apply>
90             <divide />
91             <apply>
92                 <minus />
93                 <apply>
94                     <times />
95                     <ci> cyclePeriod </ci>
96                 <apply>
97                     <minus />
98                     <apply>
99                         <divide />
100                        <apply>
101                            <plus />
102                            <ci> t </ci>
103                            <ci> phase </ci>
104                        </apply>
105                        <ci> cyclePeriod </ci>
106                    </apply>
107                    <apply>
108                        <floor />
109                        <apply>
110                            <divide />
111                                <apply>
112                                    <plus />
113                                    <ci> t </ci>
114                                    <ci> phase </ci>
115                                </apply>
116                                <ci> cyclePeriod </ci>
117                            </apply>
118                        </apply>
119                    </apply>
120                </apply>
121                <ci> pulseDuration </ci>
122            </apply>
123            <ci> rampDuration </ci>
124        </apply>
125    </apply>
126 </apply>
127 </apply>
128 </apply>
129 <apply>

```

```

130     <times />
131     <cn> 0.5 </cn>
132     <ci> amplitude </ci>
133     <apply>
134       <plus />
135       <cn> 1 </cn>
136       <apply>
137         <tanh />
138         <apply>
139           <divide />
140           <apply>
141             <minus />
142             <apply>
143               <times />
144               <ci> cyclePeriod </ci>
145               <apply>
146                 <minus />
147                 <apply>
148                   <divide />
149                   <apply>
150                     <plus />
151                     <ci> t </ci>
152                     <ci> phase </ci>
153                   </apply>
154                   <ci> cyclePeriod </ci>
155                 </apply>
156                 <apply>
157                   <floor />
158                   <apply>
159                     <divide />
160                     <apply>
161                       <plus />
162                       <ci> t </ci>
163                       <ci> phase </ci>
164                     </apply>
165                     <ci> cyclePeriod </ci>
166                   </apply>
167                 </apply>
168               </apply>
169             </apply>
170             <ci> cyclePeriod </ci>
171           </apply>
172           <ci> rampDuration </ci>
173         </apply>
174       </apply>
175     </apply>
176   </apply>
177 </lambda>
178 </math>
179 </functionDefinition>

```

Listing 1: The SBML step function

S2. SED-ML simulation description files

SED-ML is an XML language to describe computational systems biology simulation experiments. We have created self-contained SED-ML resources called SED-ML archives that hold the model and the simulation conditions. These are stored on the PLASMO (<http://www.plasmo.ed.ac.uk/>) website, and can be simulated directly in any SED-ML compliant software. Full instructions for running these files are given on the Plasmo website. Specifically:

- For Figure 2, visit http://www.plasmo.ed.ac.uk/plasmo/models/model.shtml?accession=PLM_66 and access the SED-ML resources in the ‘Supplementary Data Files’ section.

- For Figure 3, visit http://www.plasmo.ed.ac.uk/plasmo/models/model.shtml?accession=PLM_51 and access the SED-ML resources in the ‘Supplementary Data Files’ section.

S3. Direct comparison with previously published results

We made a direct comparison between an SBML version of the published three-loop circadian clock model (Locke et al., 2006) and the StepFunction-enhanced model. The original model uses a sequence of events to switch between light/dark phases. The figure below shows traces for LHY and TOC1, under 8:16 and 16:8 light regimes, for the original model (suffixed ‘_orig’ in the legend) and the StepFunction-enhanced model. The traces for the original and the step function version are virtually identical.

