**Supplementary Information**

**Mathematical modelling of the MAP kinase pathway using proteomic datasets**

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**Section 1. Chemical reactions**

All the chemical reactions for the activation and dephosphorylation in the MAP kinase pathway are listed below. Kinase MEK is denoted for kinase in the cytosol, while N-MEK is located in the nucleus.

Ras + Raf  Ras-Raf  Ras + Raf\*

Raf\* + Raf-P’ase Raf\*- Raf-P’ase Raf + Raf-P’ase

Raf\* + MEK Raf\*-MEK  Raf\* + MEKpp

MEKp+MEK-P’ase MEKp- MEK-P’ase MEK + MEK-P’ase

MEKpp+ MEK-P’ase MEKpp- MEK-P’ase  MEKp + MEK-P’ase

MEKpp+ERKMEKpp-ERK MEKpp + ERKp

MEKpp+ERKp MEKpp-ERKp MEKpp + ERKpp

ERKp+ ERK-P’ase ERKp- ERK-P’ase ERK + ERK-P’ase

ERKpp+ ERK-P’ase ERKpp- ERK-P’ase ERKp + ERK-P’ase

N-MEKp+ MEK-P’ase N-MEKp- MEK-P’ase N-MEK + MEK-P’ase

N-MEKpp+ MEK-P’ase N-MEKpp- MEK-P’ase  N-MEKp + MEK-P’ase

N-ERKp+ ERK-P’ase N-ERKp- ERK-P’ase N-ERK + ERK-P’ase

N-ERKpp+ ERK-P’ase N-ERKpp- ERK-P’ase N-ERKp + ERK-P’ase

N-MEKpp+N-ERK  N-MEKpp-N-ERK  N-MEKpp + N-ERKp

N-MEKpp+N-ERKp  N-MEKpp-N-ERKp  N-MEKpp + N-ERKpp

MEKpp N-MEKpp

ERKpp  N-ERKpp

N-MEK  MEK

N-ERK  ERK

N-MEKpp  MEKpp

N-ERKpp  ERKpp

MEK  N-MEK

ERK  N-ERK

MEKp  N-MEKp

N-MEKp  MEKp

ERKp  N-ERKp

N-ERKp  ERKp

**Section 2. Mathematical model**

Based on the chemical reactions listed in Section 1, we developed a mathematical model of differential equations given by





