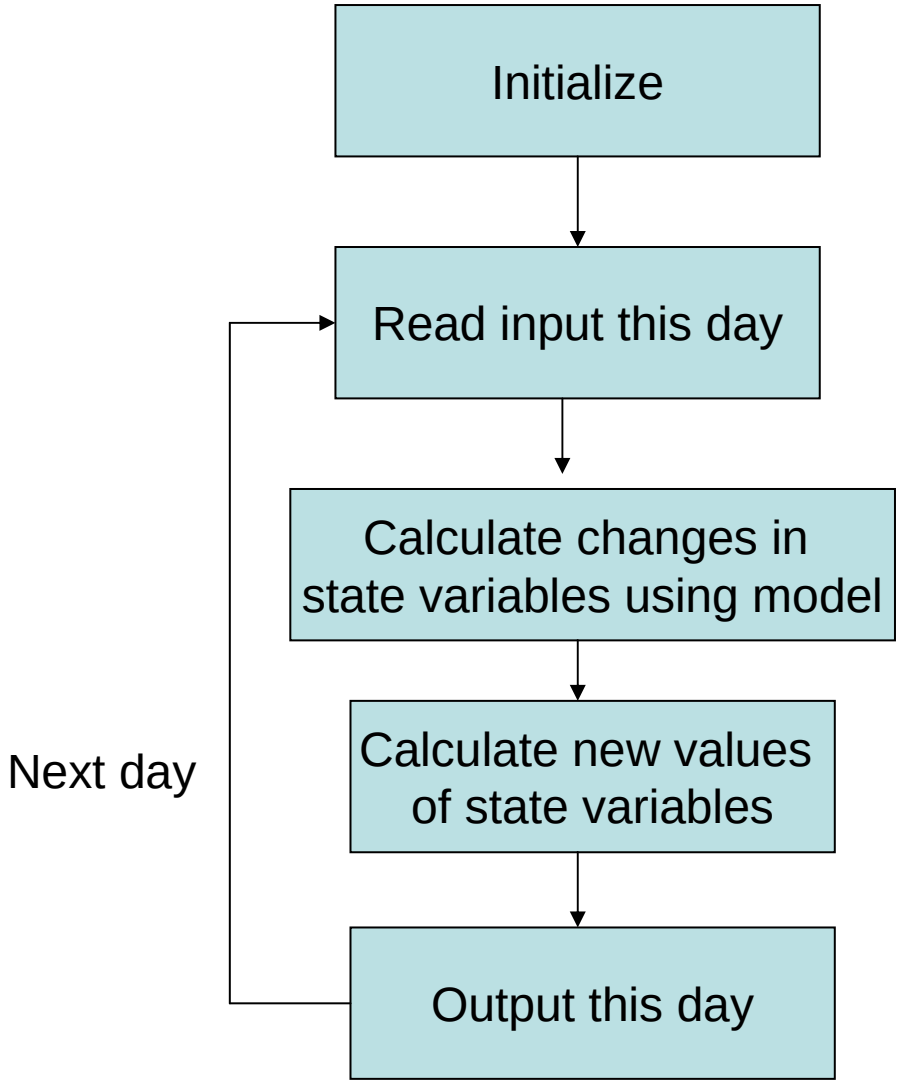
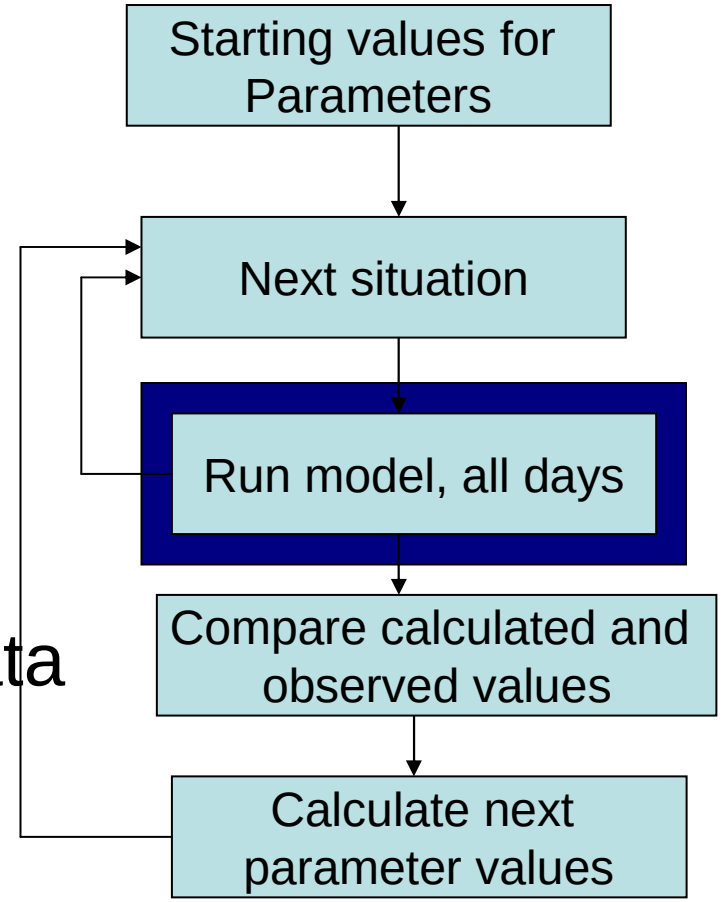
Computer considerations

What does a model program do?

- Obligatory
  - Model equations
  - Time integration
  - Read input files
  - Output results



- Additional tasks
  - Parameter estimation
  - Decision rules
  - Evaluation
  - Optimization
  - Virtual experimentation
  - Sensitivity analysis
  - Assimilation of real-time data
  - Etc.



- Criteria for choosing modelling software
  - Limit programming
    - Obligatory tasks – some software has time motor.
    - Additional tasks – some software has estimation, optimization routines.
    - To reduce programming time and errors.
    - To provide well-tested code for parameter estimation, optimization, etc.
  - Provide possibility of exchange of components
    - E.g. use existing soil water dynamics model
  - Facilitate use by end-users

Several families of languages are available

- General purpose programming languages
  - The 12 most popular:
  - C, C++, C#, Java, JavaScript, Perl, PHP, Python, Ruby, Shell, SQL, and Visual Basic
  - You can program what you need.
  - No specific help for dynamic system models
  - Which is best? The one you know!

- Specialized languages
  - Matlab: algorithms, numerical analysis
  - **R/S+ statistics**
  - You can program anything
  - Lots of help with math, stat
  - R/S+ is slow (interpreted)

- Dynamic system software with graphical interface
  - **ModelMaker**
  - Stella
  - Vensim
  - FST (not graphic)
  - Very easy to learn and use
  - Limited to predefined features
    - e.g. can’t add estimation algorithms

Demonstration of ModelMaker

- Predator prey model
  - Two state variables
  - Prey: $dA/dt=r*A*(1-A/K)-a*A*L$
  - Predator: $dL/dt= b*A*L– m*L$
  - $r=0.25$ $K=4000$ $a=0.004$ $b=0.0001$ $m=0.03$
  - Initial values prey=2000/m² predator=2/m²
  - Discrete time calculation $\Delta t=1$day
  - Integrate over 1000 days

- Modelling platforms
  - DEVS Discrete Event System Specification
  - Two examples RECORD, MODCOM
  - You program the equations, platform handles time (integration, interaction between processes, input, output, discrete events)
  - Share components
  - Some added software
  - Difficult to extend language

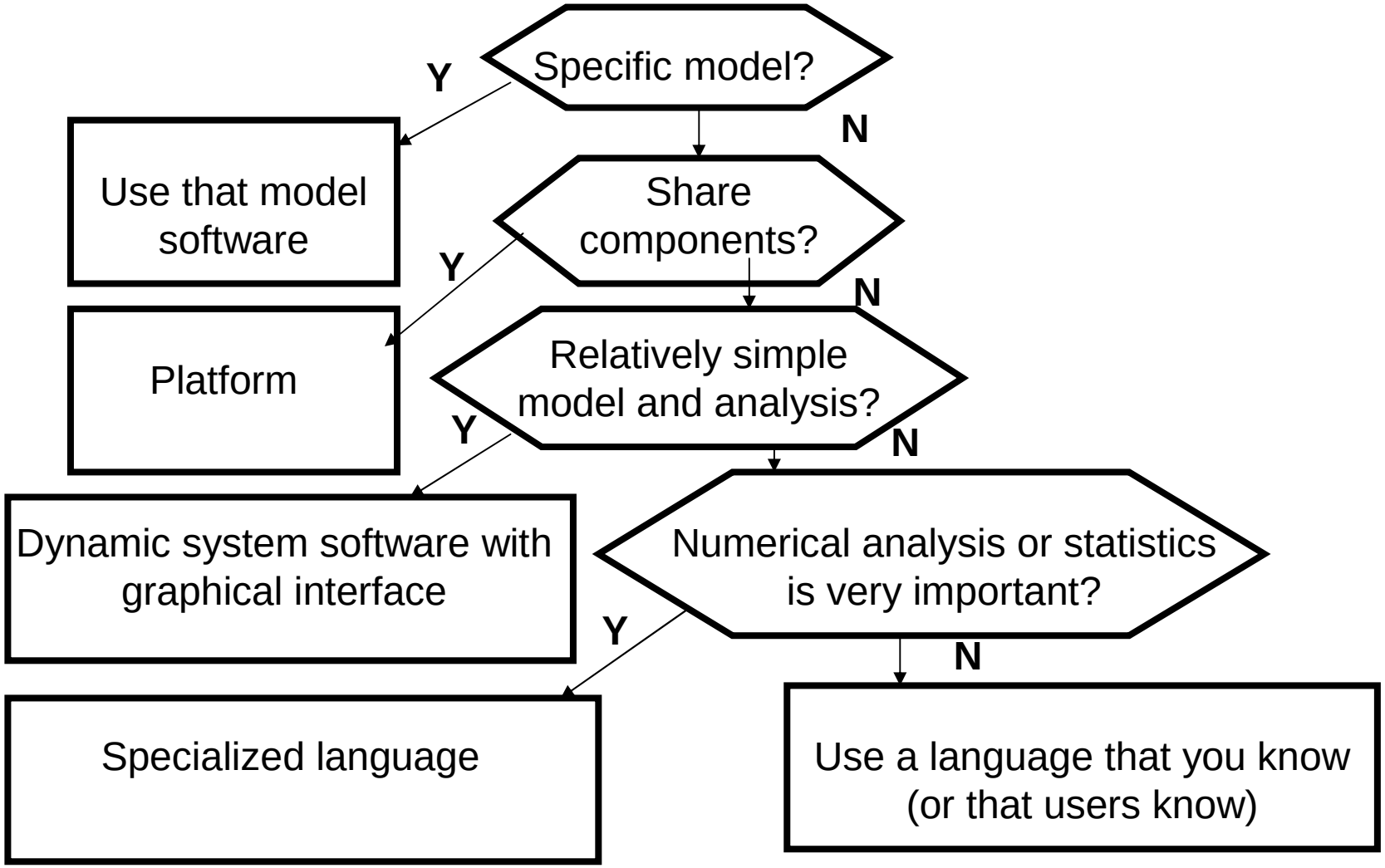
- Specific models
  - Crop models
  - STICS
  - DSSAT
  - APSIM
  - Much associated software
  - Limited to specific models

- The special case of EXCEL
  - Good for users (everybody knows EXCEL. The data may already be in that format)
  - Each line is another day
  - Some graphs and parameter estimation included
  - Limitations on use of model

Demonstration of Excel

- Same predator prey model as Model Maker

Decision tree



THE END