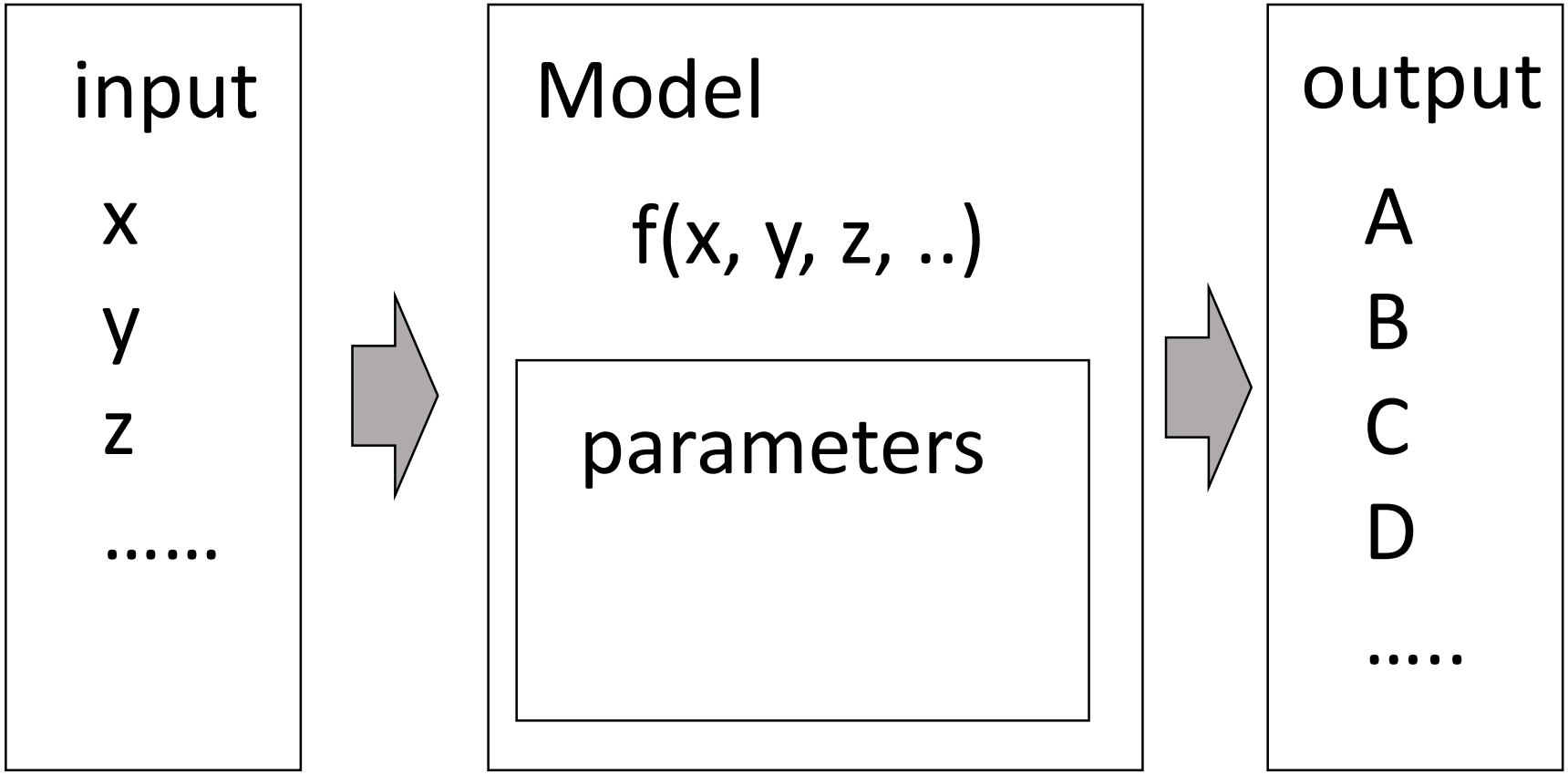
生態気象学特論

Ecosystem Modeling

生態気象・植山

Model



Type of Ecosystem Model

DGVM (dynamic vegetation model)

Consider vegetation dynamics
(competition, succession, disturbance)

Prognostic model

Consider pools (time integration)
dC/dt

Diagnostic model

Consider relationship of process
f(x, y, z, ….)
Empirical and statistical models
.. , thus, static

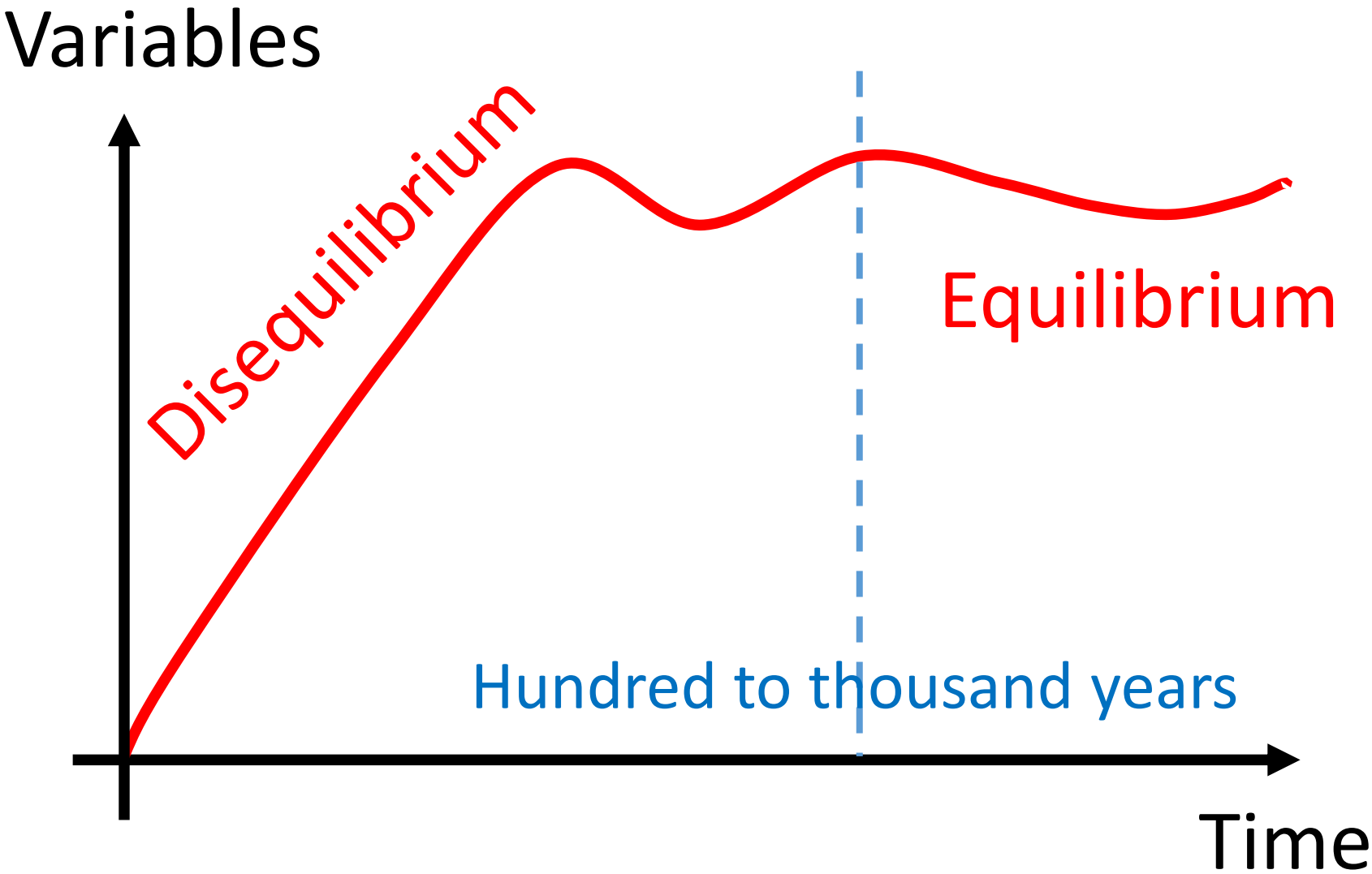
Statistical model

Regressions

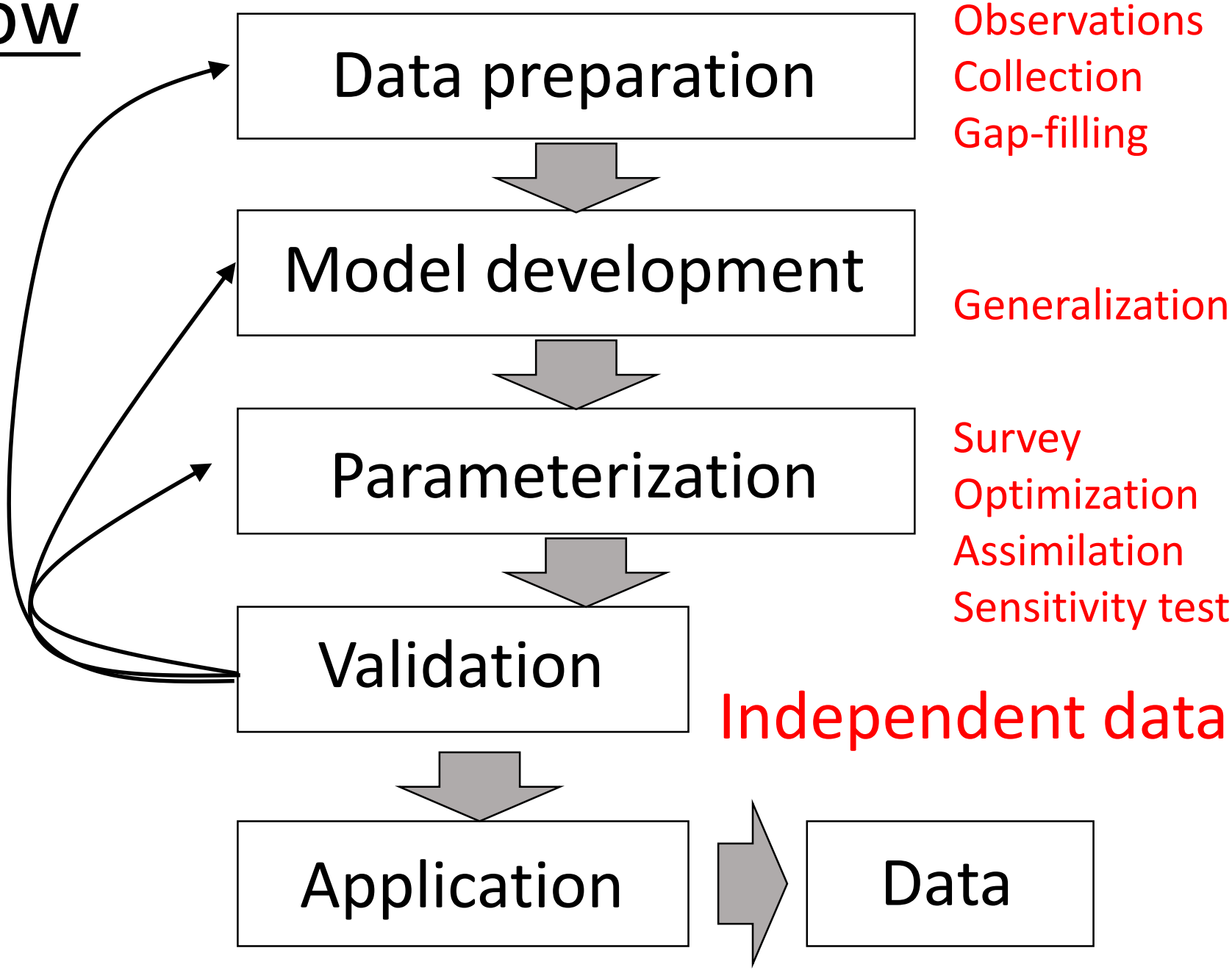
statistics

Machine learning

Model Spin-up



Flow


Data preparation
Observations
Collection
Gap-filling
Model development
Generalization
Parameterization
Survey
Optimization
Assimilation
Sensitivity test
Validation
Independent data
Application
Data

Parameterization

Biome-BGC

```
ECOPHYS        C3 grass
0              (flag)     1 = WOODY              0 = NON-WOODY
0              (flag)     1 = EVERGREEN          0 = DECIDUOUS
1              (flag)     1 = C3 PSN             0 = C4 PSN
0              (flag)     1 = MODEL PHENOLOGY    0 = USER-SPECIFIED PHENOLOGY
0              (yday)     yearday to start new growth  (when phenology flag = 0)
364            (yday)     yearday to end litterfall  (when phenology flag = 0)
1.0            (prop.)    transfer growth period as fraction of growing season
1.0            (prop.)    litterfall as fraction of growing season
1.0            (1/yr)     annual leaf and fine root turnover fraction
0.00          *(1/yr)     annual live wood turnover fraction
0.1            (1/yr)     annual whole-plant mortality fraction (herbivory)
0.1            (1/yr)     annual fire mortality fraction
2.0            (ratio)    (ALLOCATION) new fine root C : new leaf C
0.0           *(ratio)    (ALLOCATION) new stem C : new leaf C
0.0           *(ratio)    (ALLOCATION) new live wood C : new total wood C
0.0           *(ratio)    (ALLOCATION) new croot C : new stem C
0.5            (prop.)    (ALLOCATION) current growth proportion
24.0           (kgC/kgN)  C:N of leaves
49.0           (kgC/kgN)  C:N of leaf litter, after retranslocation
42.0           (kgC/kgN)  C:N of fine roots
0.0           *(kgC/kgN)  C:N of live wood
0.0           *(kgC/kgN)  C:N of dead wood
0.39           (DIM)      leaf litter labile proportion
0.44           (DIM)      leaf litter cellulose proportion
0.17           (DIM)      leaf litter lignin proportion
0.30           (DIM)      fine root labile proportion
0.45           (DIM)      fine root cellulose proportion
0.25           (DIM)      fine root lignin proportion
0.75          *(DIM)      dead wood cellulose proportion
0.25          *(DIM)      dead wood lignin proportion
0.021          (1/LAI/d)  canopy water interception coefficient
0.6            (DIM)      canopy light extinction coefficient
2.0            (DIM)      all-sided to projected leaf area ratio
45.0           (m2/kgC)   canopy average specific leaf area (projected area basis)
2.0            (DIM)      ratio of shaded SLA:sunlit SLA
0.15           (DIM)      fraction of leaf N in Rubisco
0.005          (m/s)      maximum stomatal conductance (projected area basis)
0.00001        (m/s)      cuticular conductance (projected area basis)
0.04           (m/s)      boundary layer conductance (projected area basis)
-0.6           (MPa)      leaf water potential: start of conductance reduction
-2.3           (MPa)      leaf water potential: complete conductance reduction
930.0          (Pa)       vapor pressure deficit: start of conductance reduction
4100.0         (Pa)       vapor pressure deficit: complete conductance reduction
```

Parameterization

Field Survey

Literature Survey

Optimization（最適化）

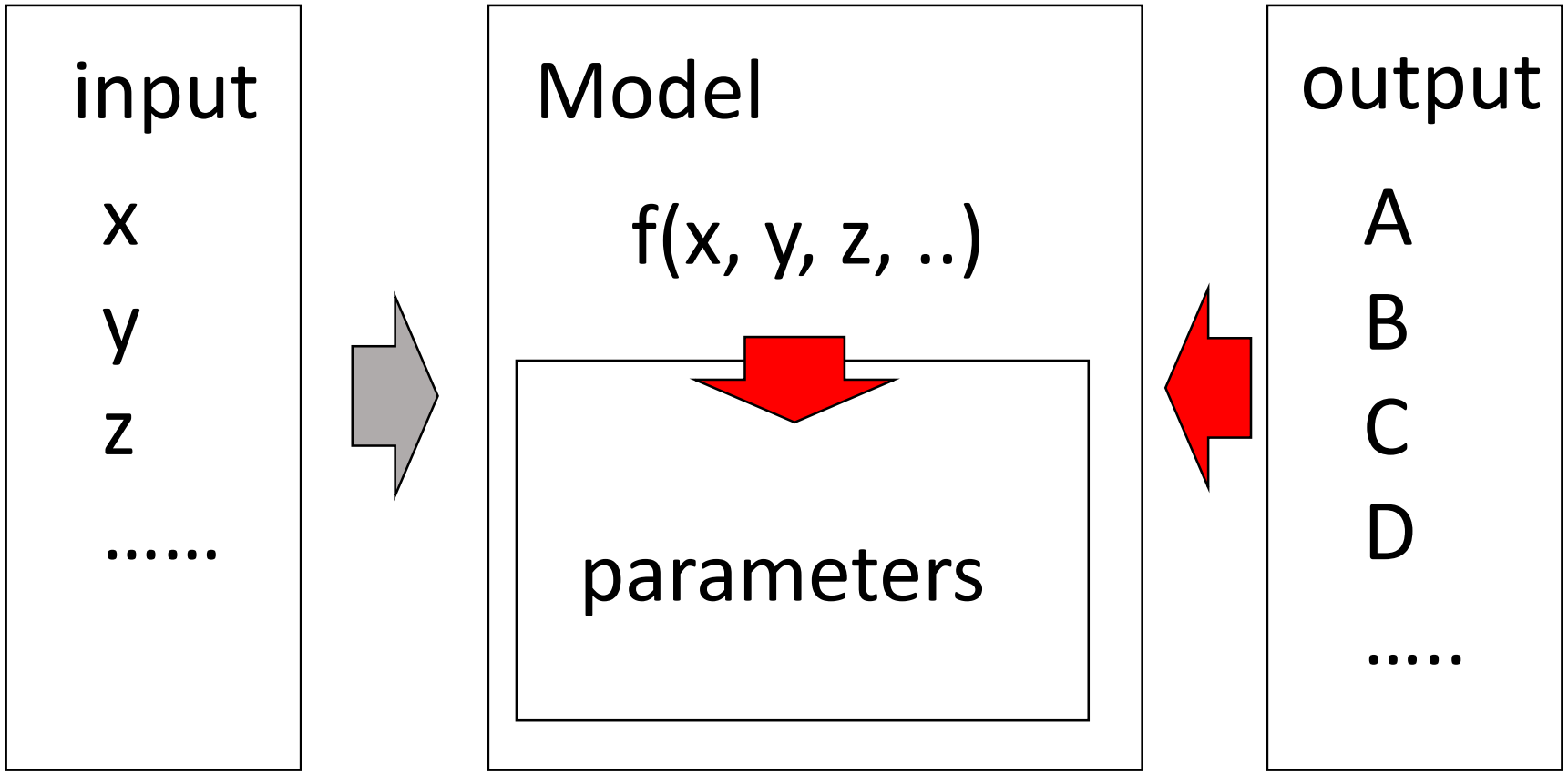
non-linear regression, Bayesian MCMC, etc

Assimilation（同化）

Karman filter, etc

Parameterization

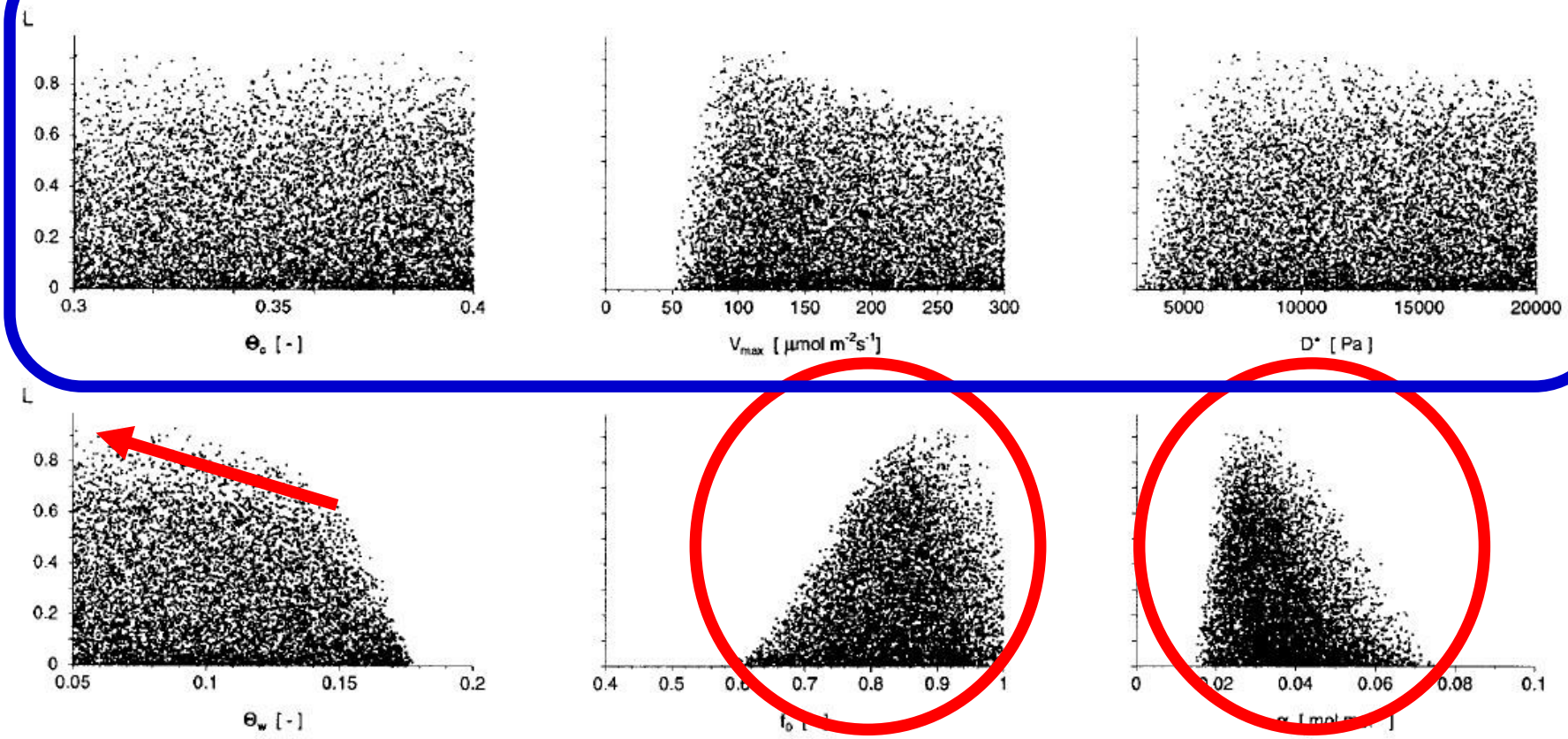
Optimization（最適化）



Parameterization

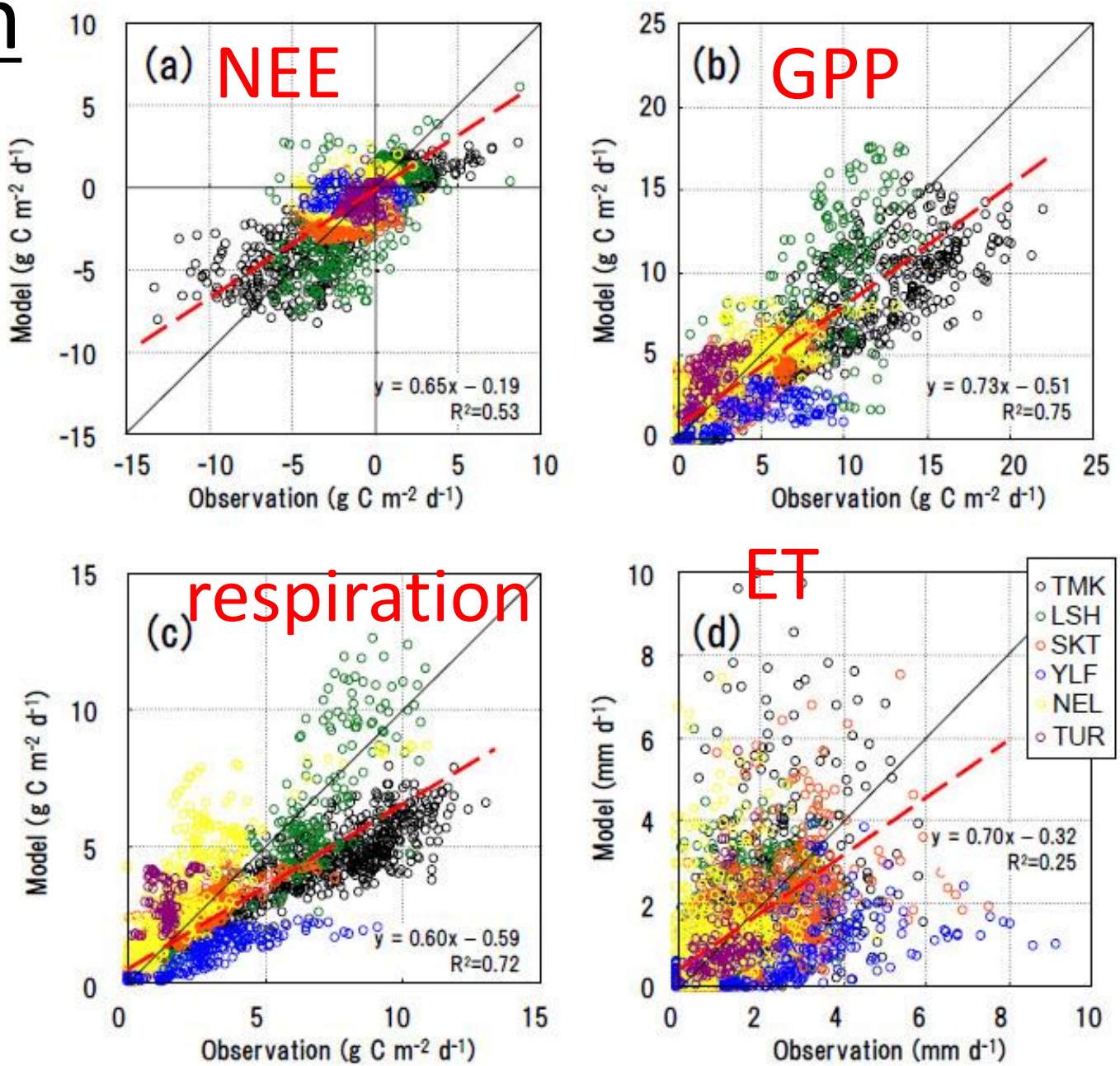
Equifinality (等至性)

likelihood



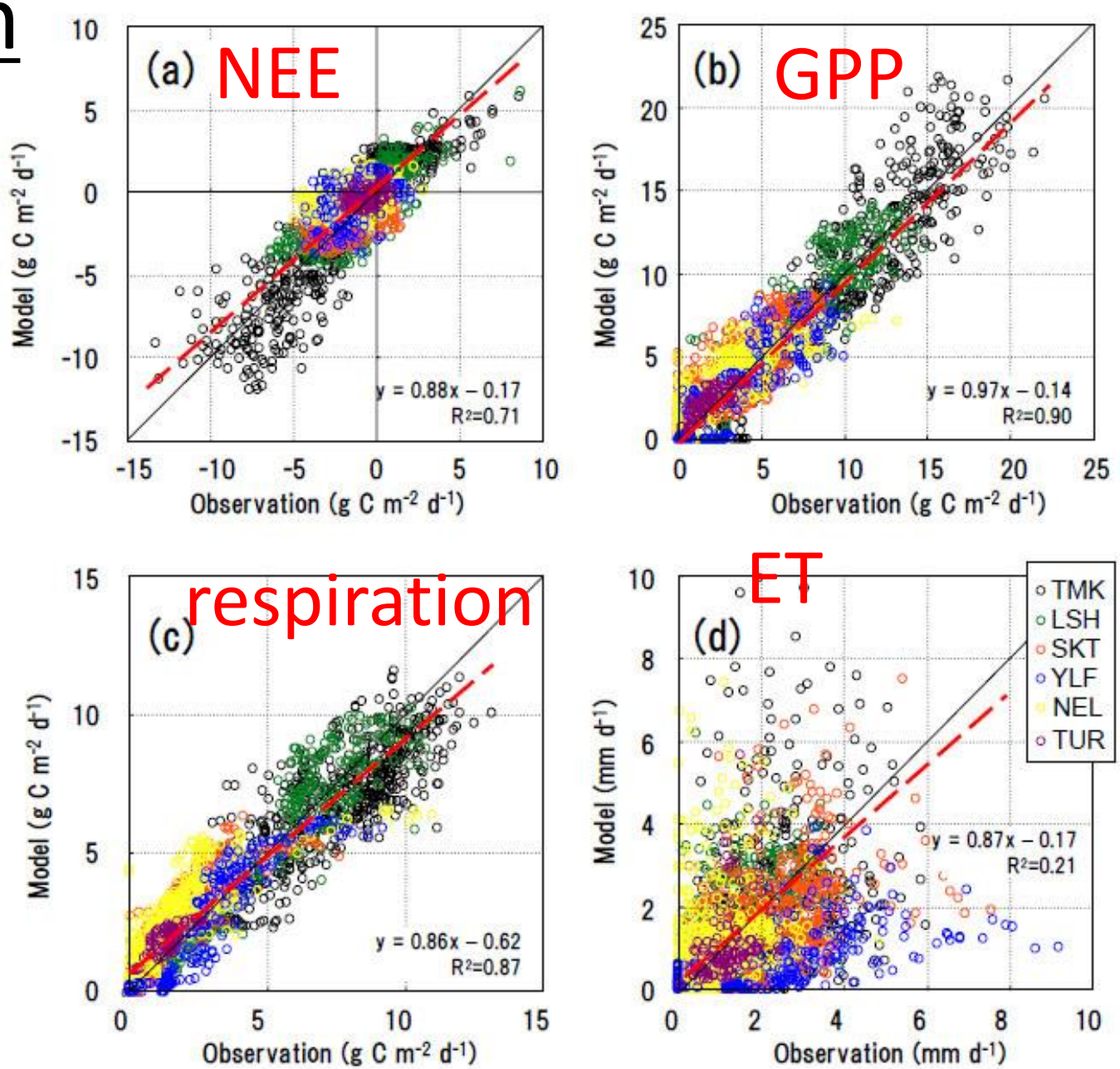
(Schulz et al., 2001; Amr. Meteorol. Soc.)

Validation



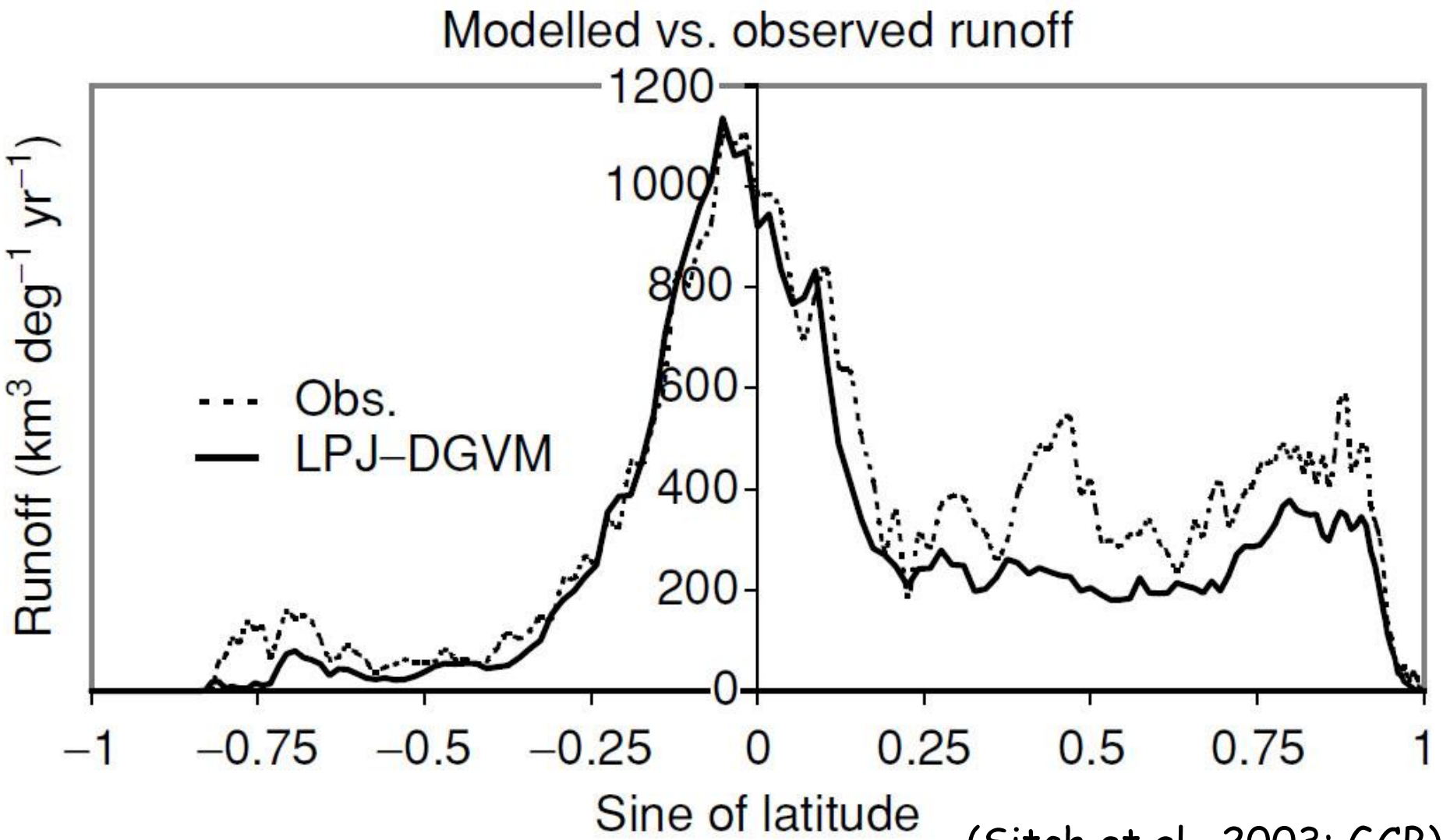
(Ueyama et al., 2010; BG)

Validation



(Ueyama et al., 2010; BG)

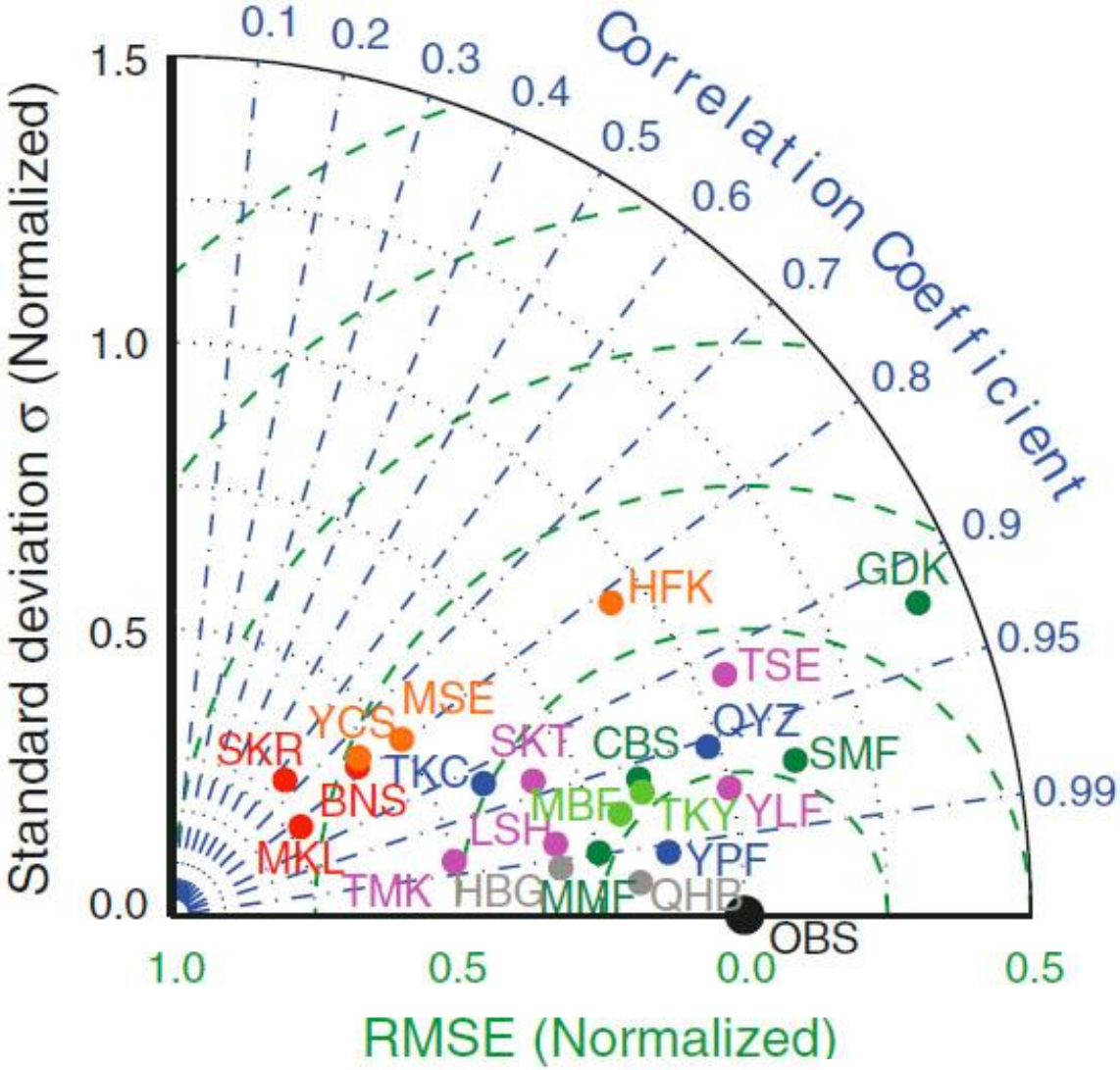
If you want to know processes for the global scale, validation should be done for the global scale.



(Sitch et al., 2003; GCB)

Validation

Tayler diagram



(Ichii et al., 2013; JFR)

Validation

Time scale (diurnal, daily, seasonal, interannual, decadal)

Processes that we want to know

Extreme Events

Independent data

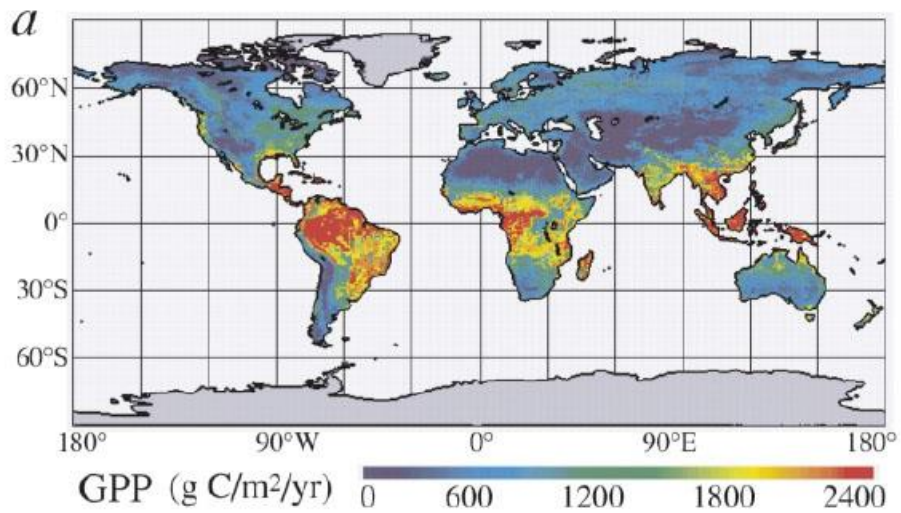
(separate train/test data)

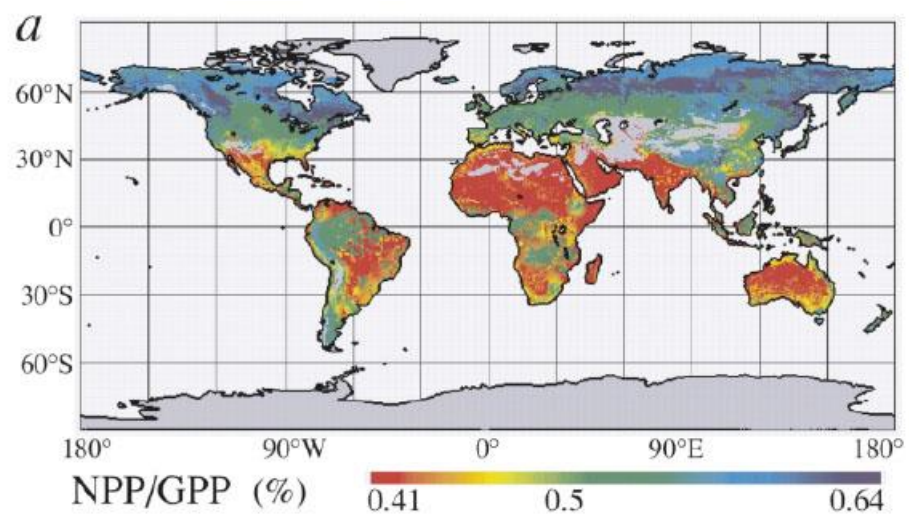
Equifinality

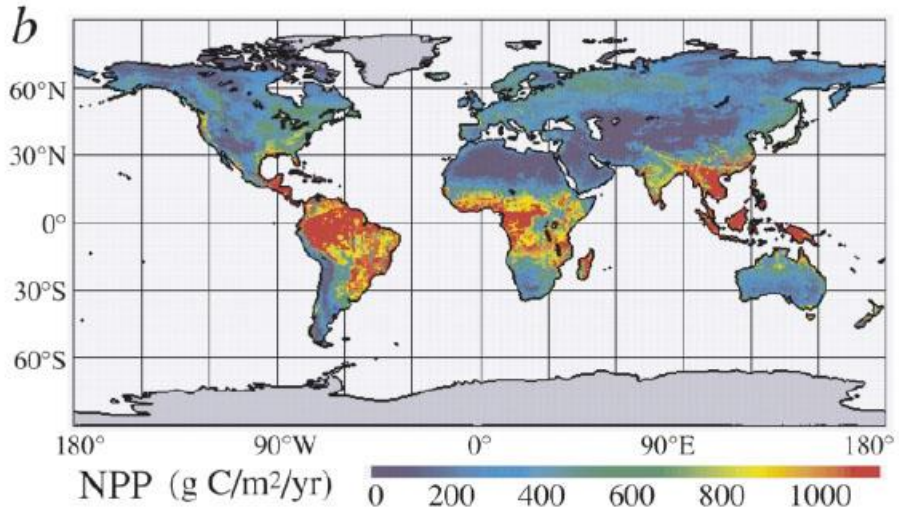
Applications

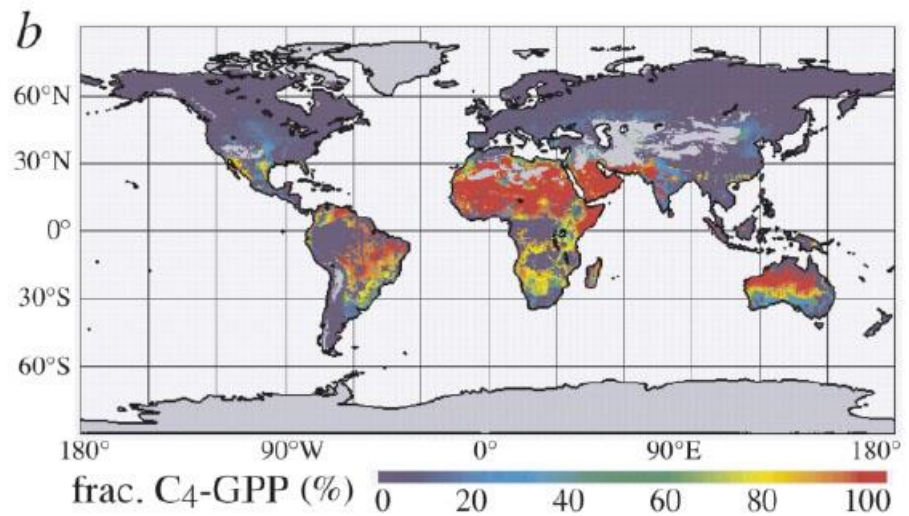
(Ito & Oikawa, 2004)

Spatial extrapolation, interpolation





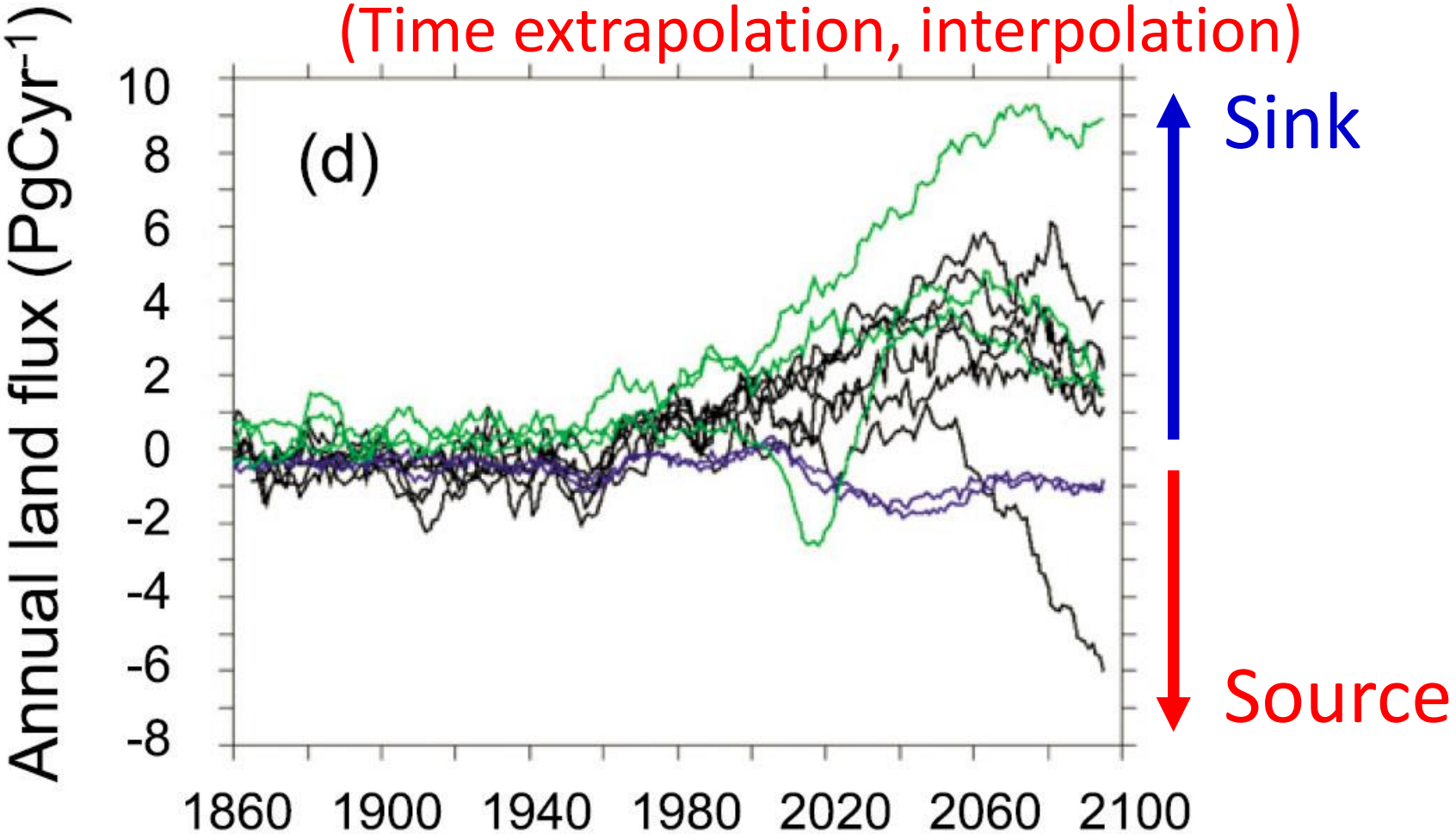




Applications

Prediction, retrospective analysis

(Time extrapolation, interpolation)



(Friedlingstein et al., 2014; Amri. Meteorol. Soc.)