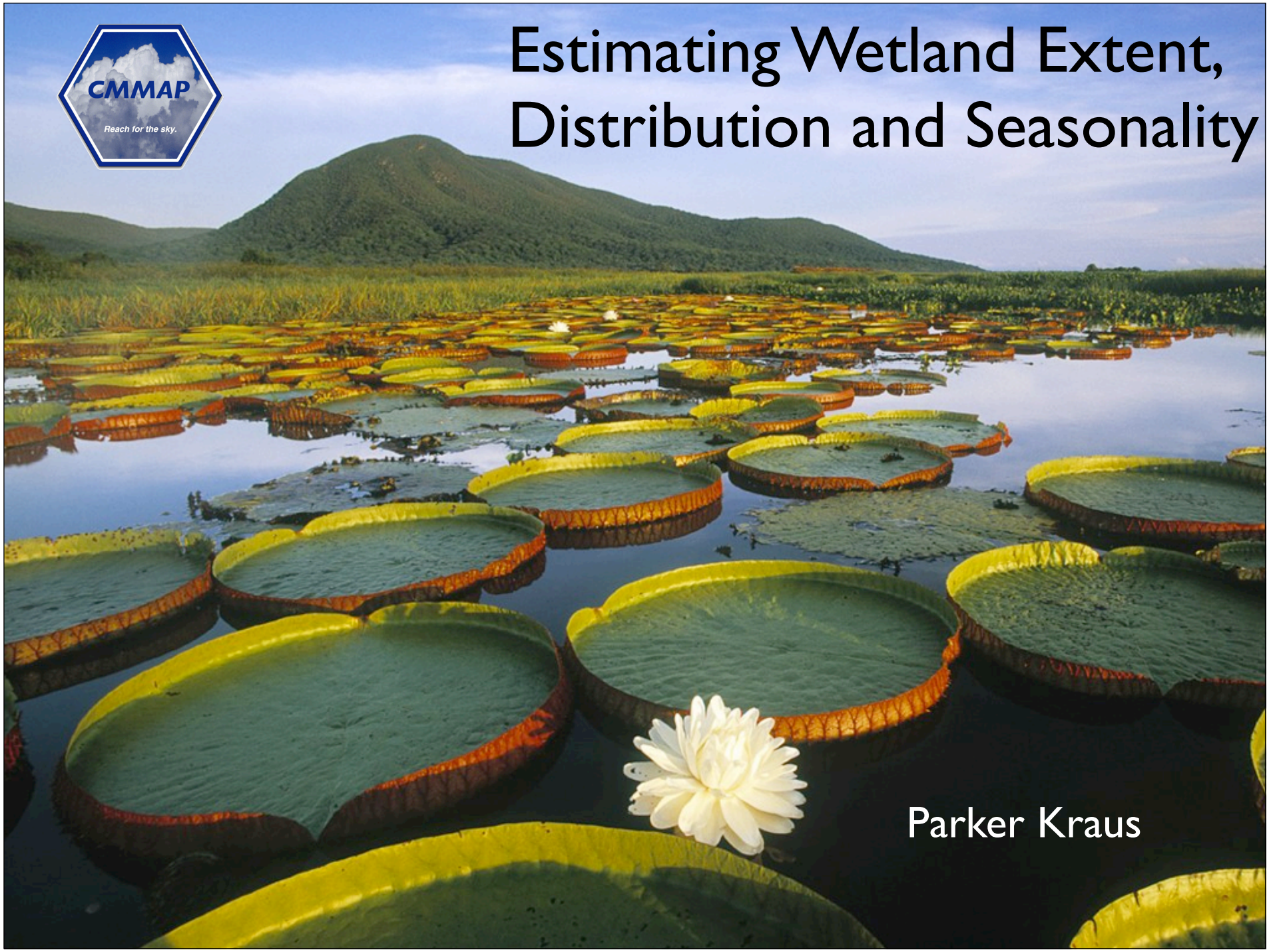
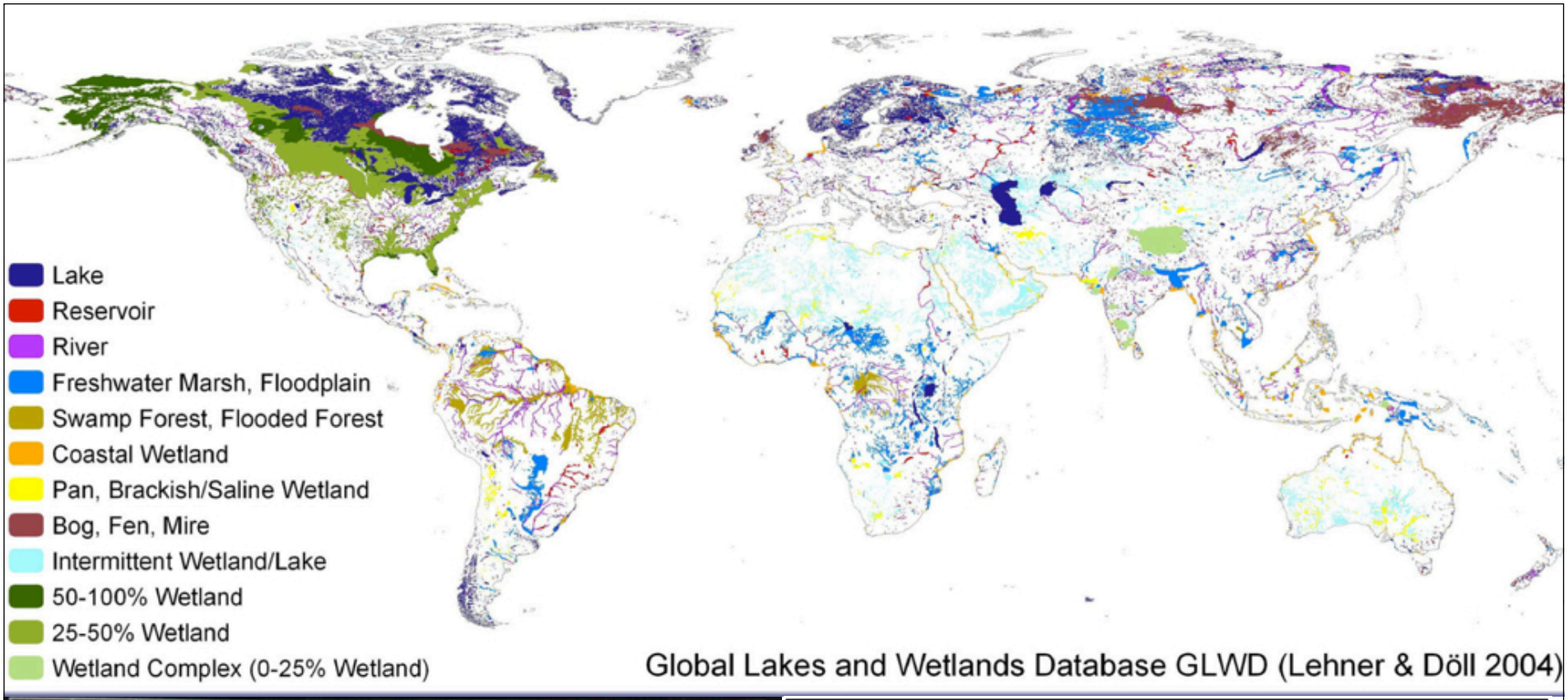
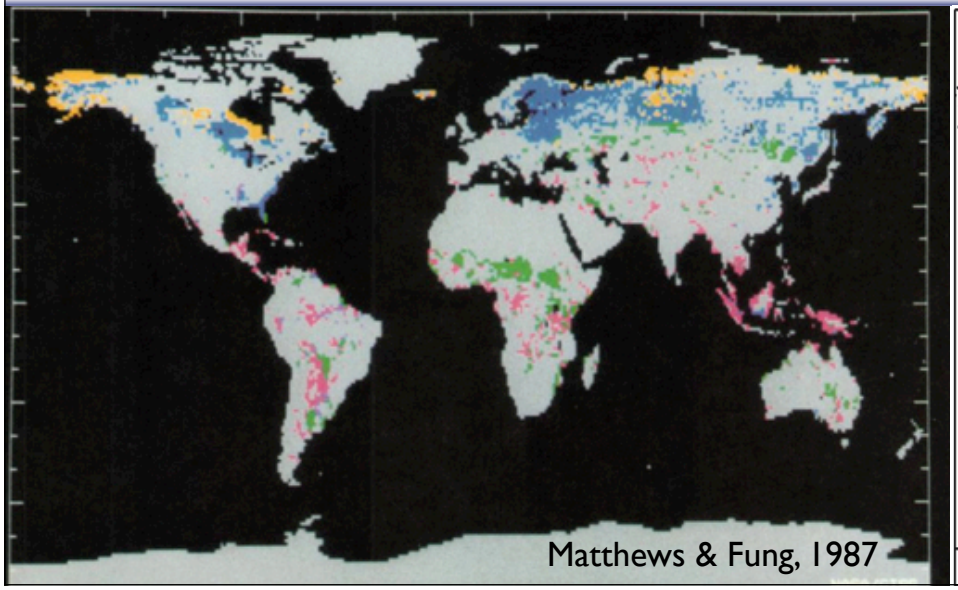

CMMAP
Reach for the sky.
Estimating Wetland Extent, Distribution and Seasonality
Parker Kraus

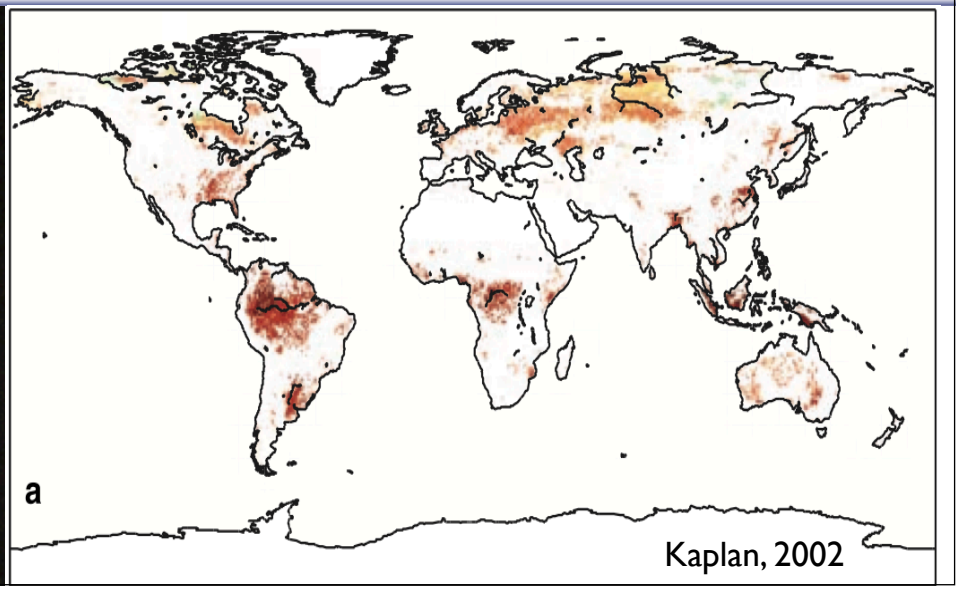

1
3
6



Global Lakes and Wetlands Database GLWD (Lehner & Döll 2004)



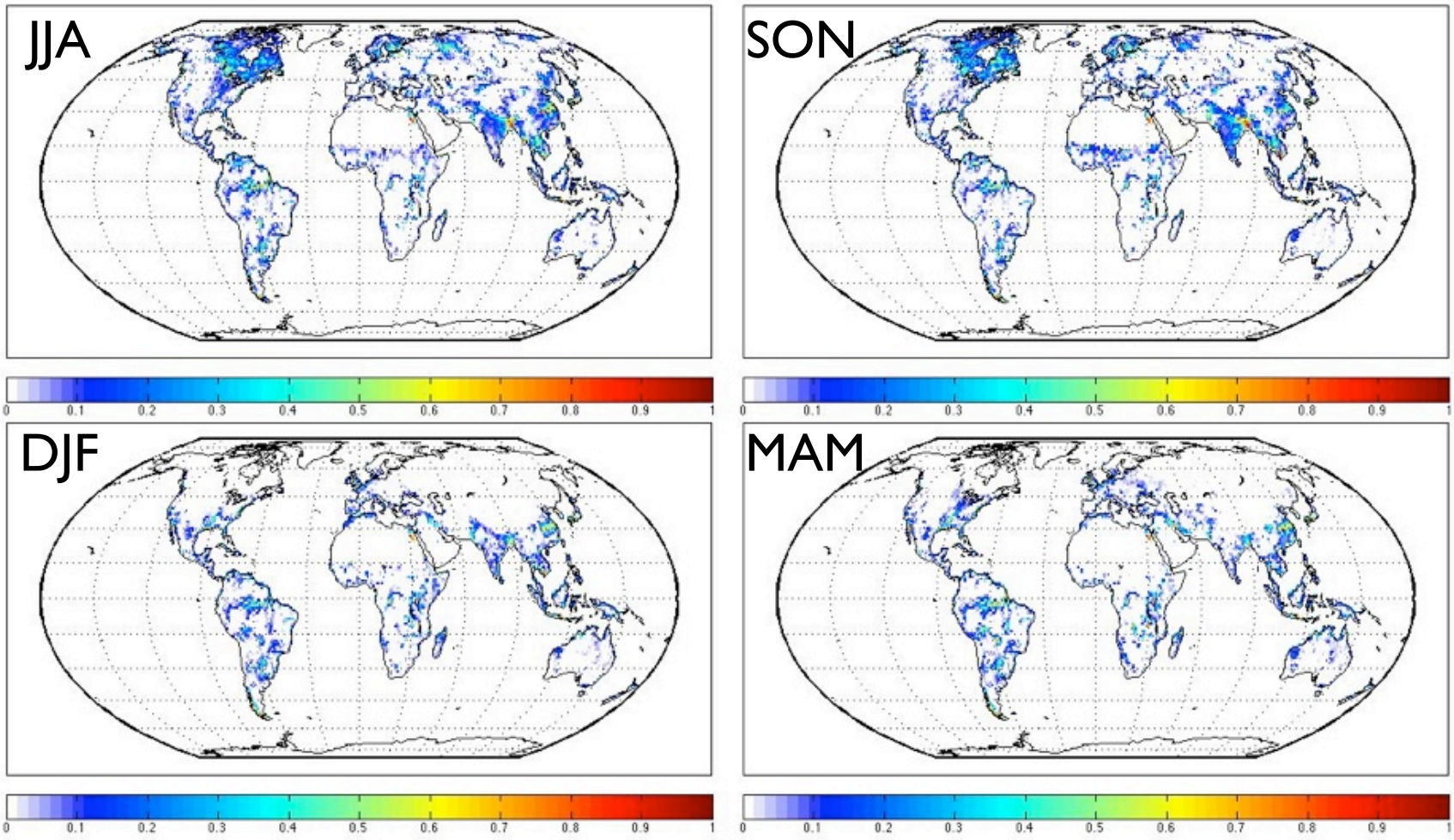
Matthews & Fung, 1987



Kaplan, 2002

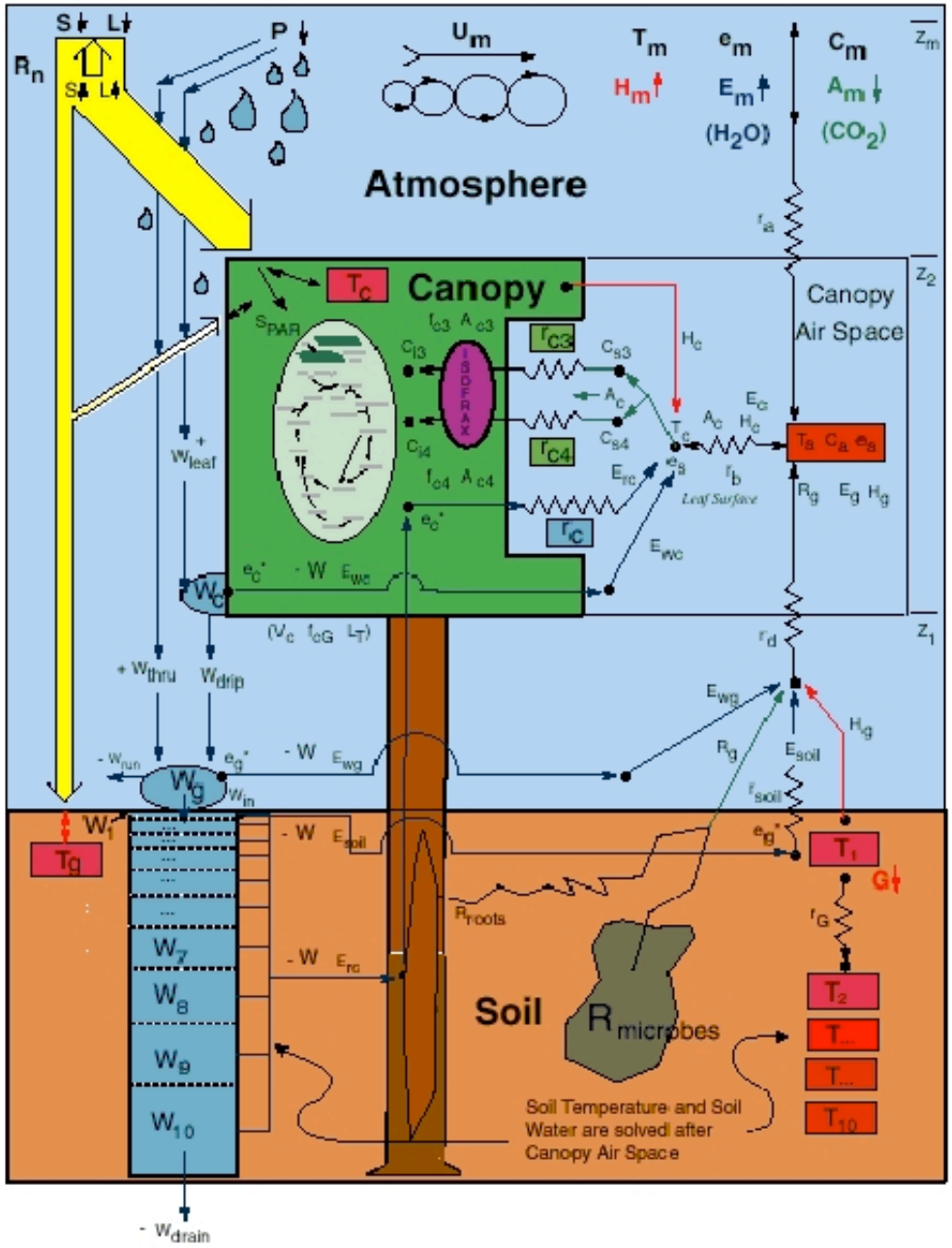
Microwave estimated inundation:

E

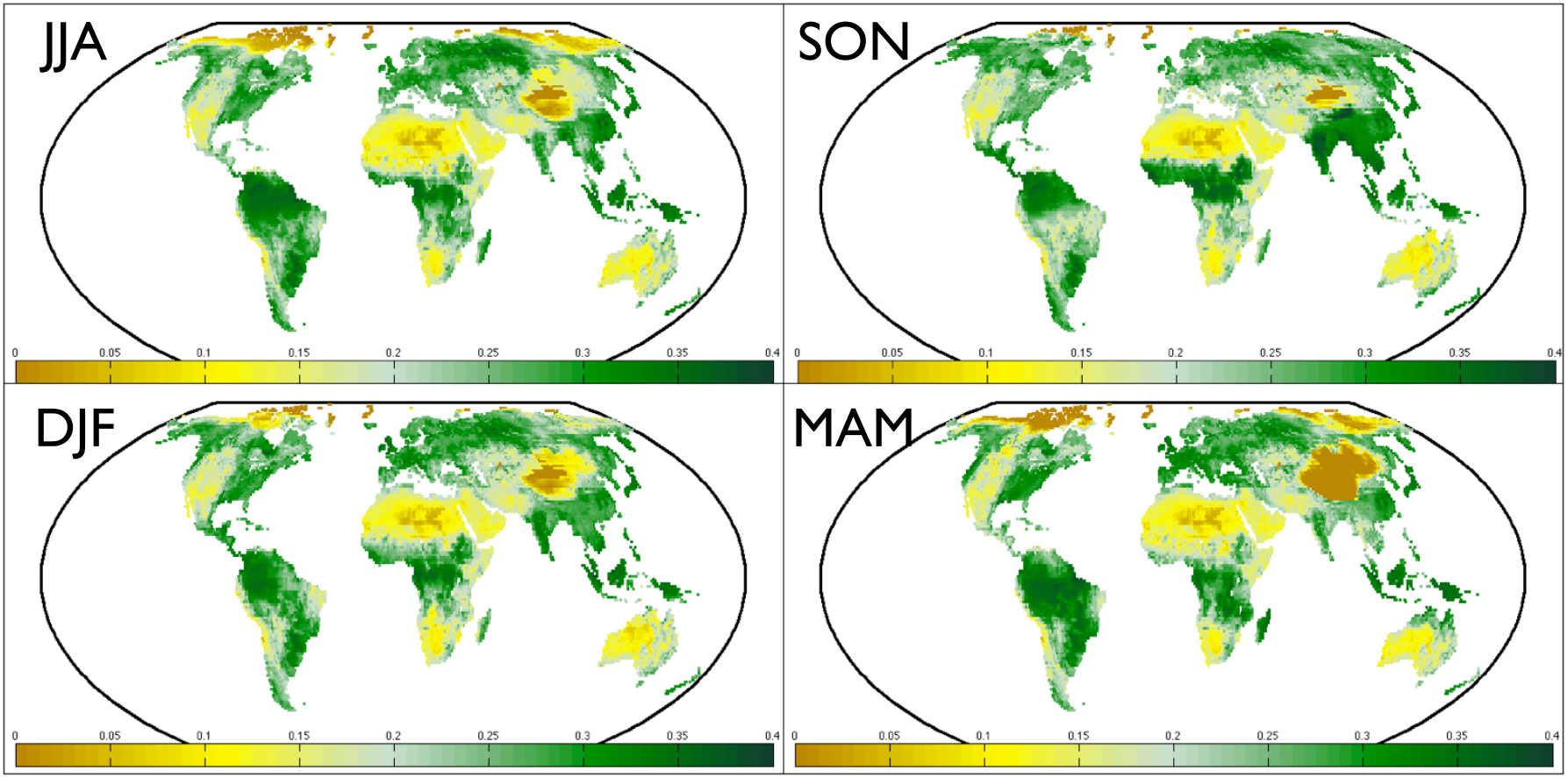


Prigent et al., 2007

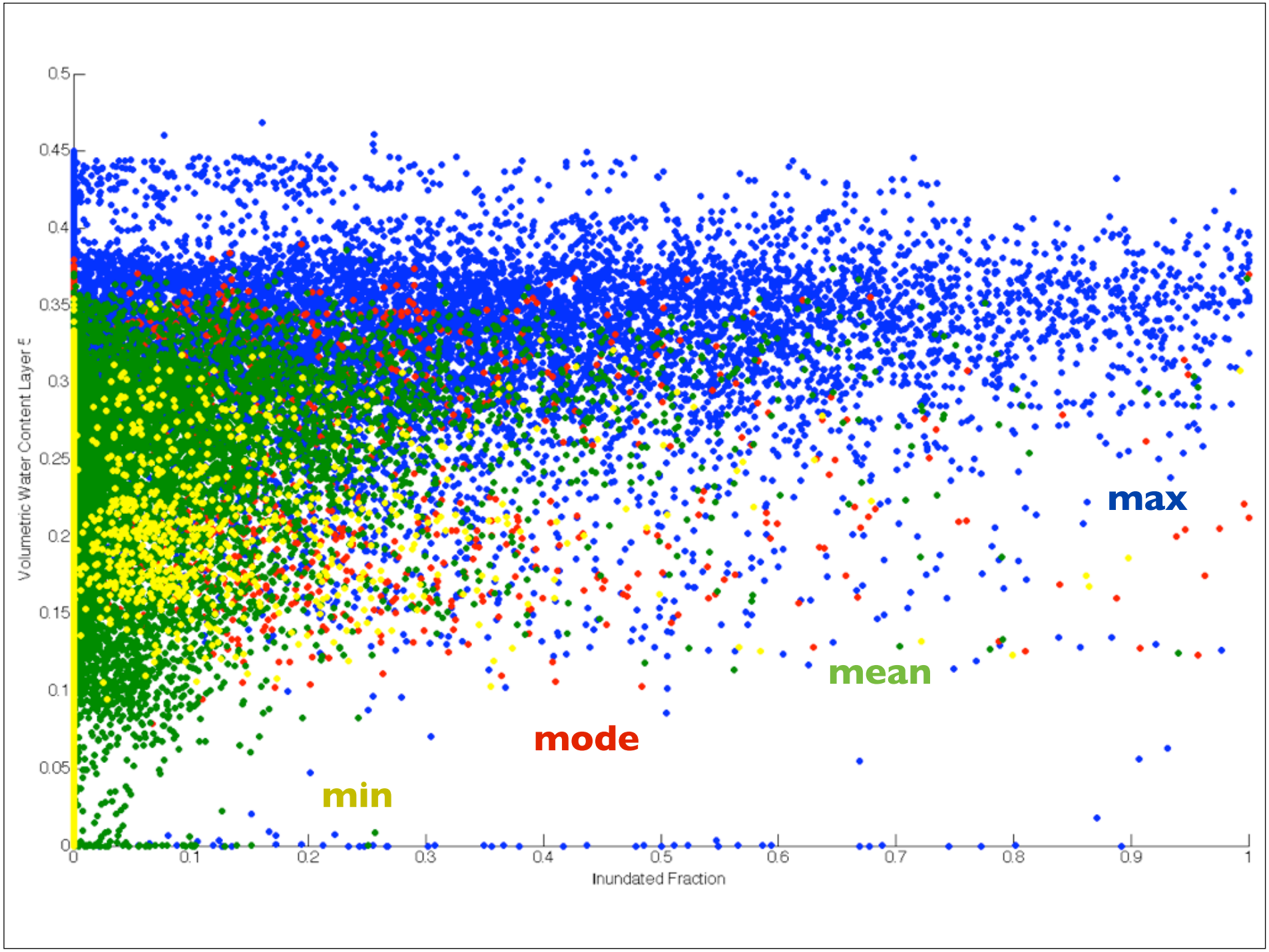
Simple Biosphere Model, version 3.0

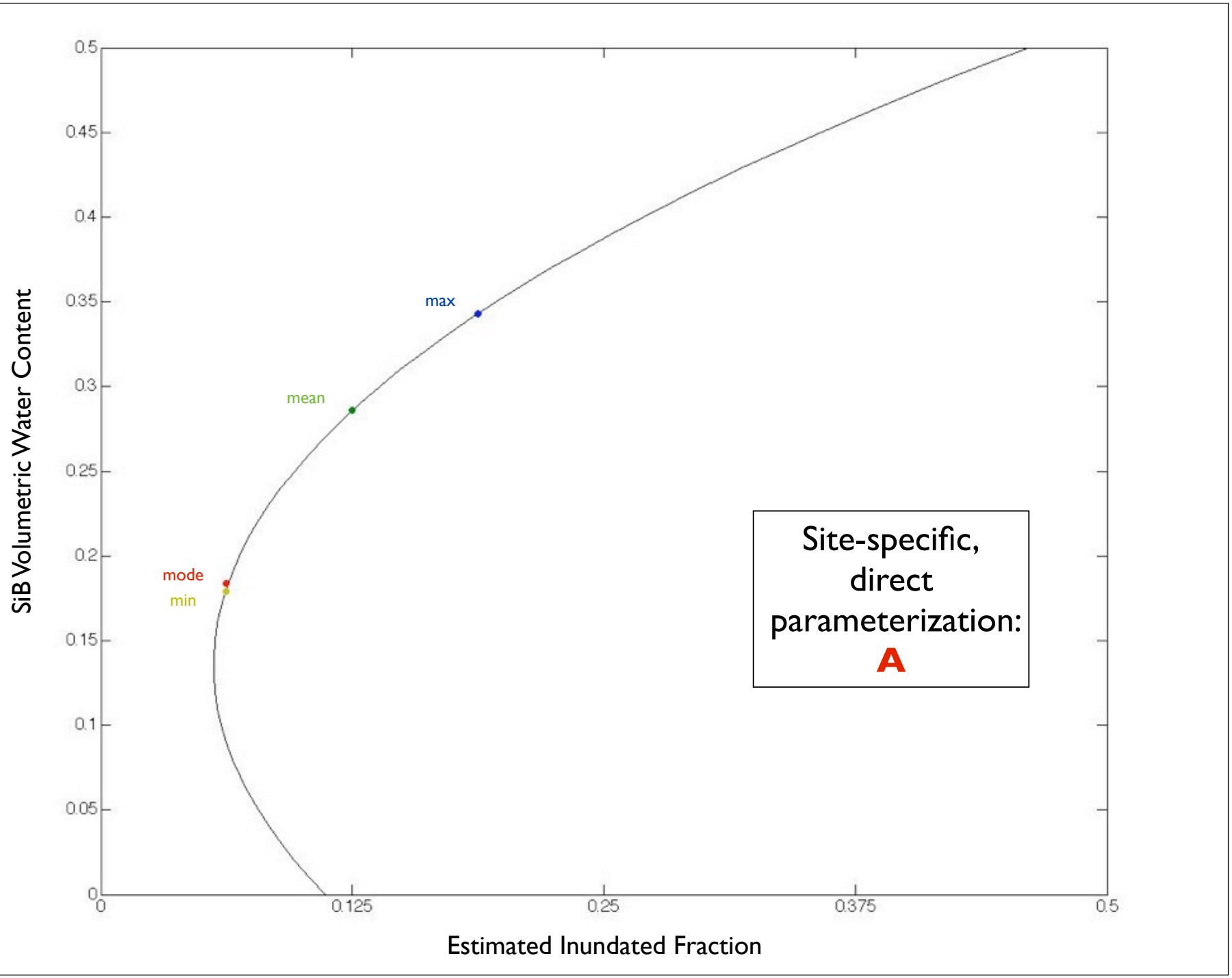


seasonal L5 (1m) soil moisture



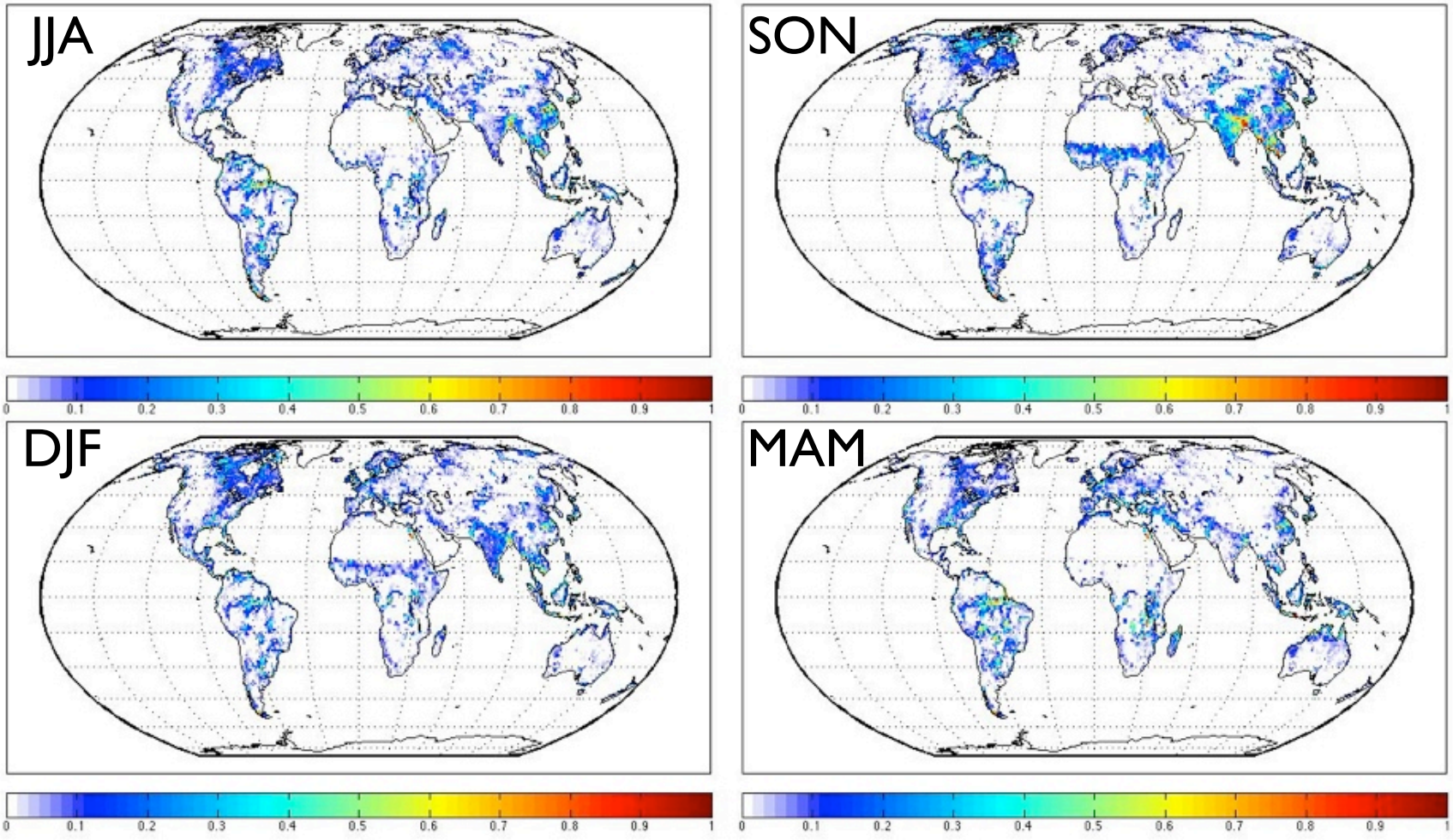
Site-specific, direct parameterization: **A**	General, direct parameterization: **B**
Site-specific, topographic parameterization: **C**	General, topographic parameterization: **D**


0.5
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
Volumetric Water Content Layer ε
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
Inundated Fraction
max
mean
mode
min

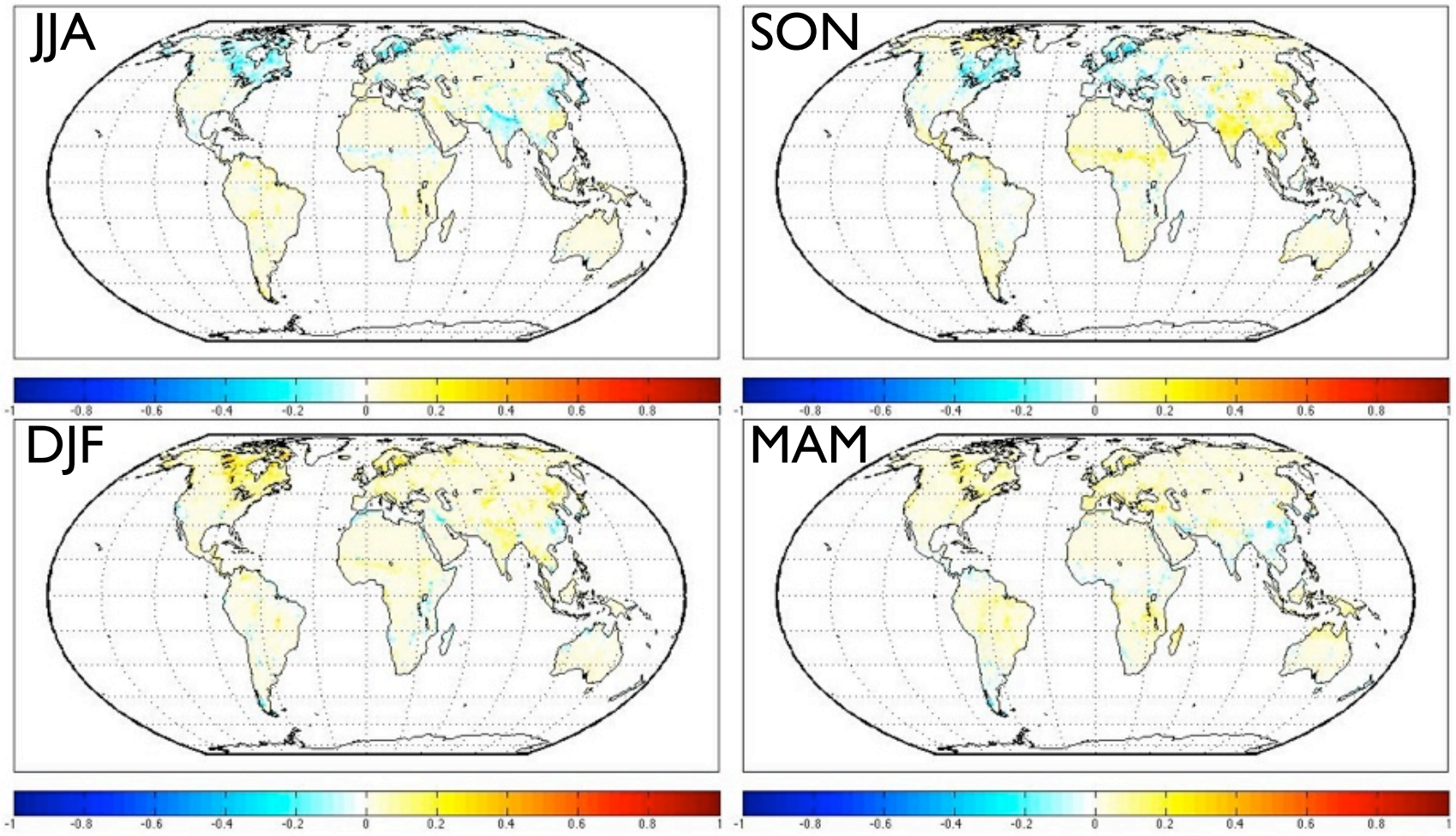

SiB Volumetric Water Content
0.5
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
0
0.125
0.25
0.375
0.5
Estimated Inundated Fraction
max
mean
mode
min
Site-specific, direct parameterization:
A

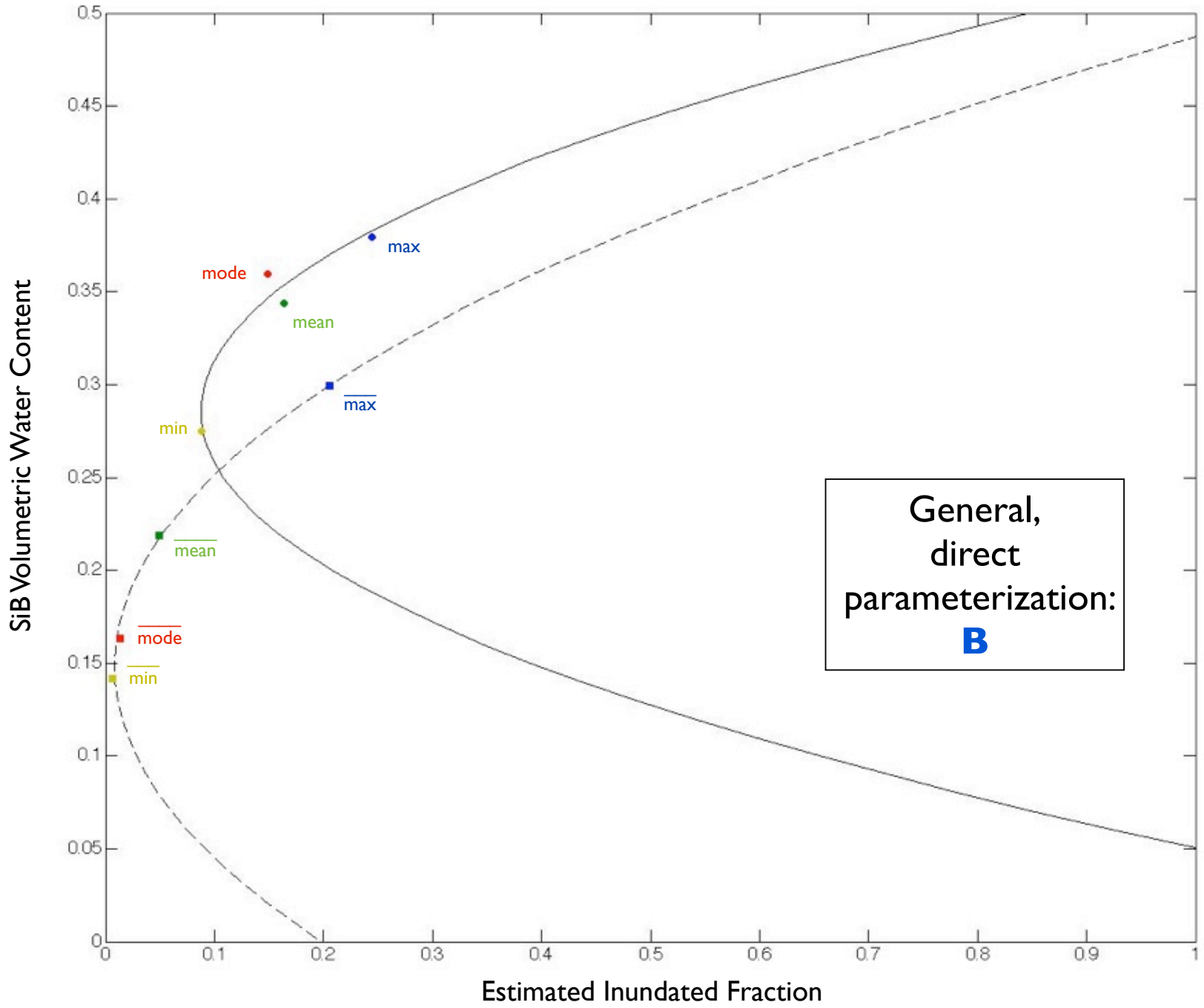
Site-specific, direct parameterization:

A



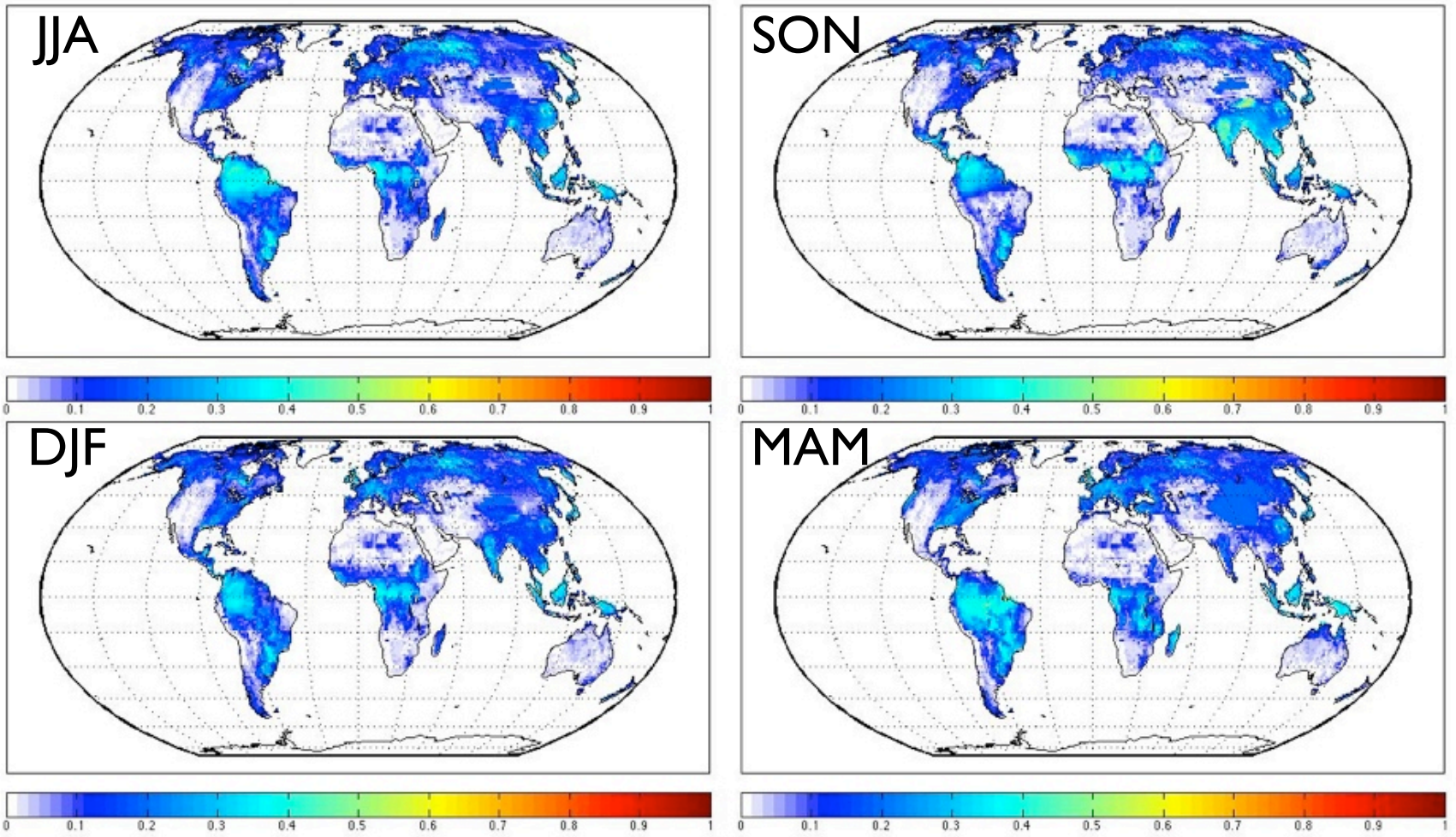
Comparison:
A-E



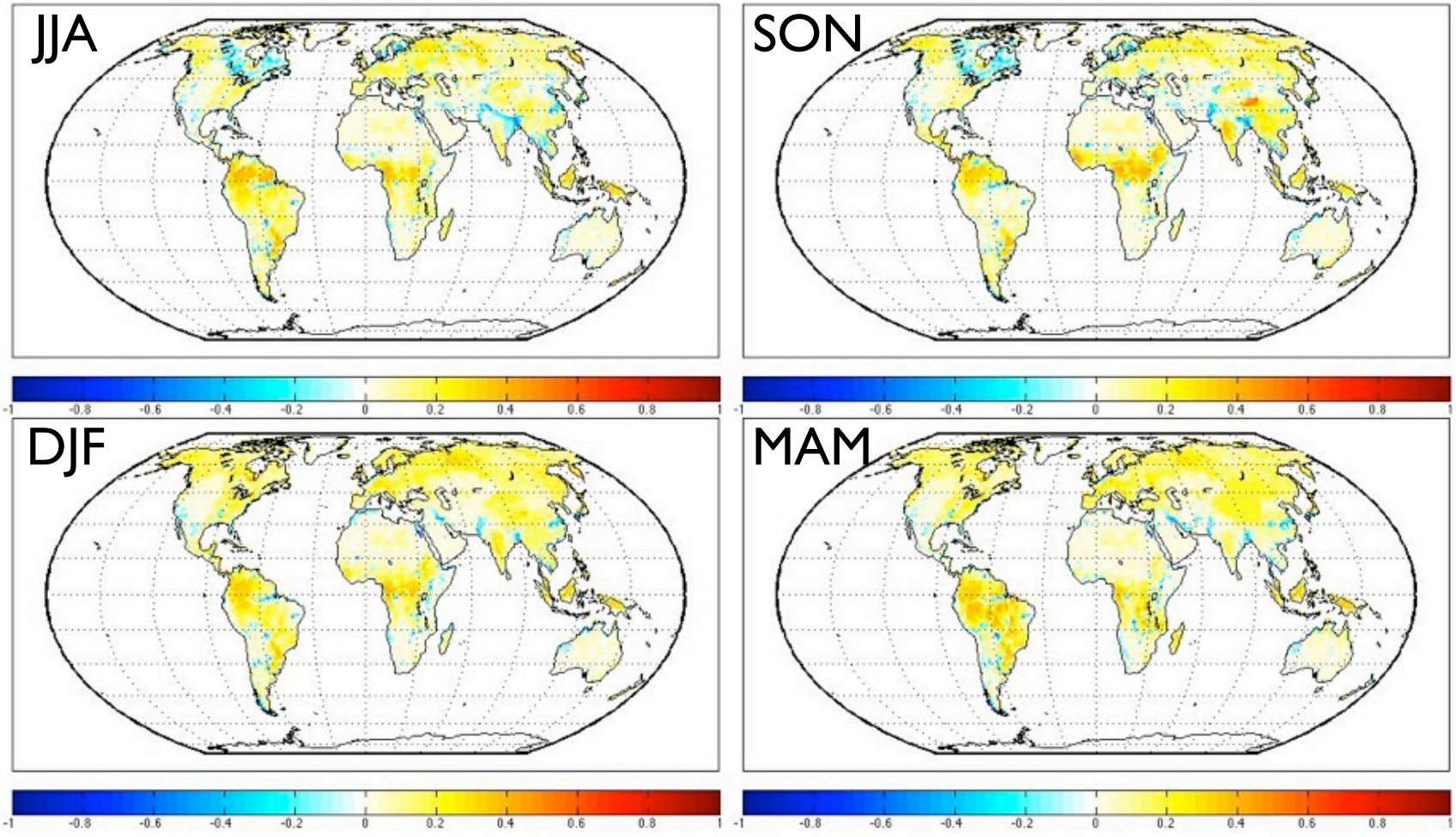

SiB Volumetric Water Content
Estimated Inundated Fraction
0.5
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
max
mode
mean
max
min
mean
mode
min
General, direct parameterization: B

General, direct parameterization:

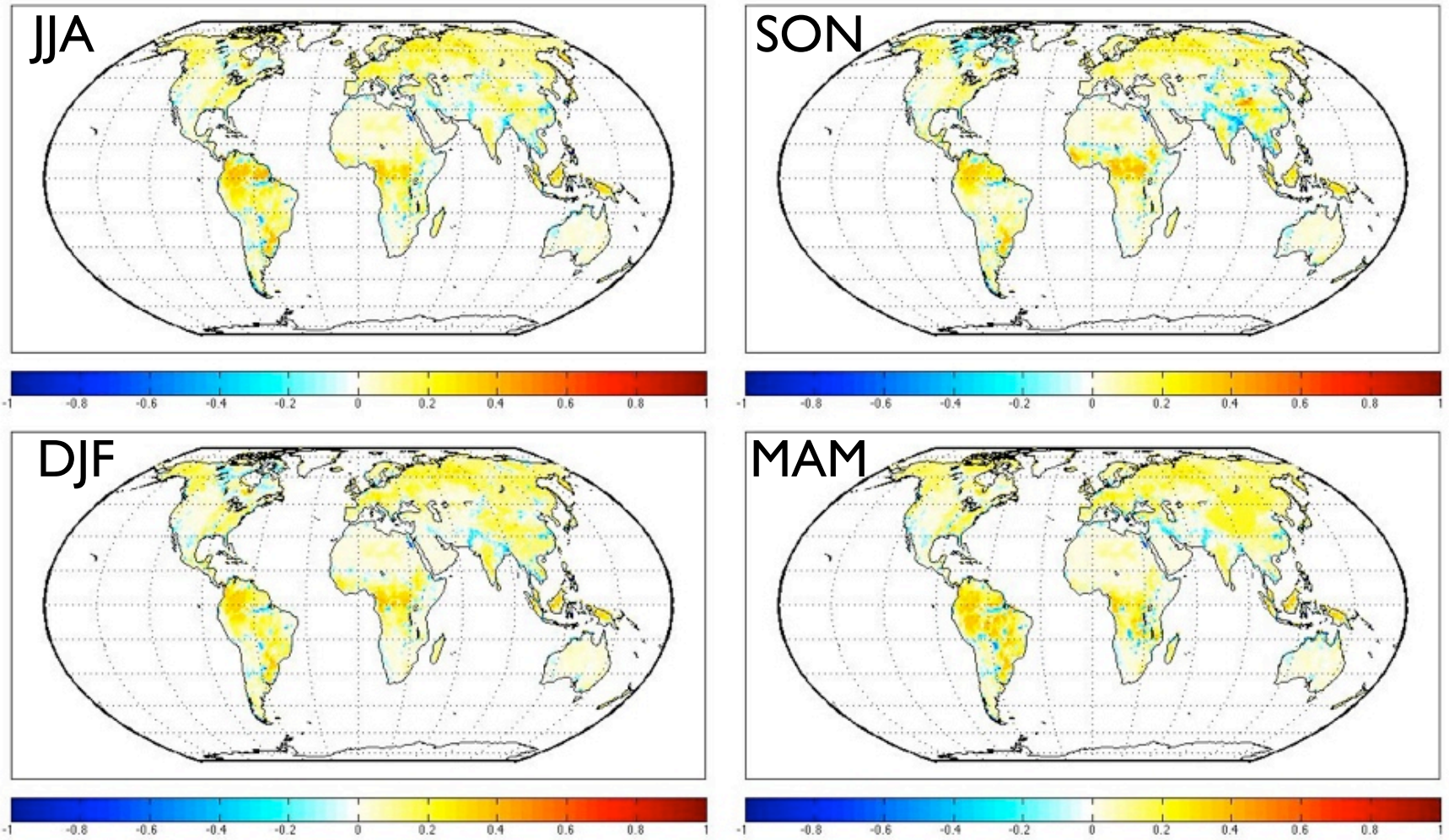
B



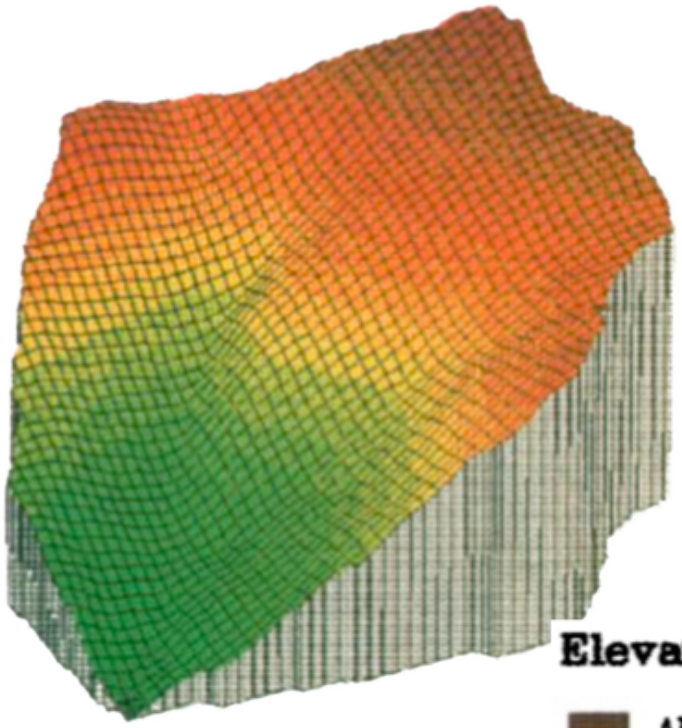
Comparison:
B - E

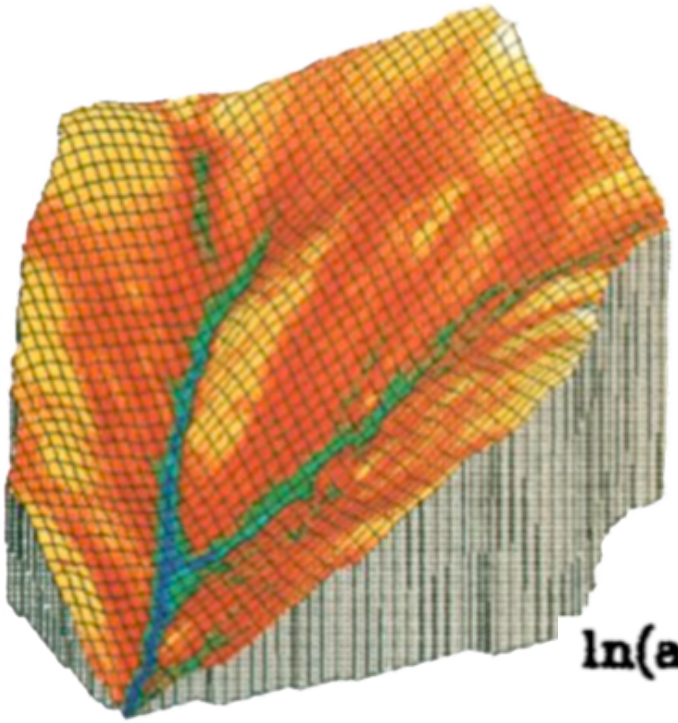


Comparison:
B-A



TOPMODEL





Ambroise et al., 1996

Elevation (m)

ABOVE	1000
975 –	1000
950 –	975
925 –	950
900 –	925
875 –	900
850 –	875
825 –	850
800 –	825
775 –	800
750 –	775
BELOW	750

ln(a/tanβ)

ABOVE	11.5
10.5 –	11.5
9.5 –	10.5
8.5 –	9.5
7.5 –	8.5
6.5 –	7.5
5.5 –	6.5
4.5 –	5.5
3.5 –	4.5
BELOW	3.5

Discharge

$$Q_i = A_i R$$

$$Q_i = L_i T_i i_i$$

$$Q_i = L_i T_i \tan(\beta_i)$$

Q = discharge $[m^3 / s]$

A = upstream area $[m^2]$

R = recharge $[m / s]$

L = length $[m]$

i = hydraulic gradient

β = elevation

T = transmissivity $[m^2 / s]$

K = hydraulic conductivity $[m / s]$

f = shape factor $[m^{-1}]$

z = water table depth $[m]$

$a = \frac{A}{L}$ $[m]$

$$T_i \equiv \int_{z_i}^{\infty} K_s(z)\,dz$$

$$K_s(z) = K_0 e^{(-fz)}$$

$$T_i = K_0 \int_{z_i}^{\infty} e^{(-fz)}\,dz = \frac{K_0}{f} e^{(-fz)}$$

$$Q_i = L_i T_0 e^{-fz_i} \tan(\beta_i) = A_i R$$

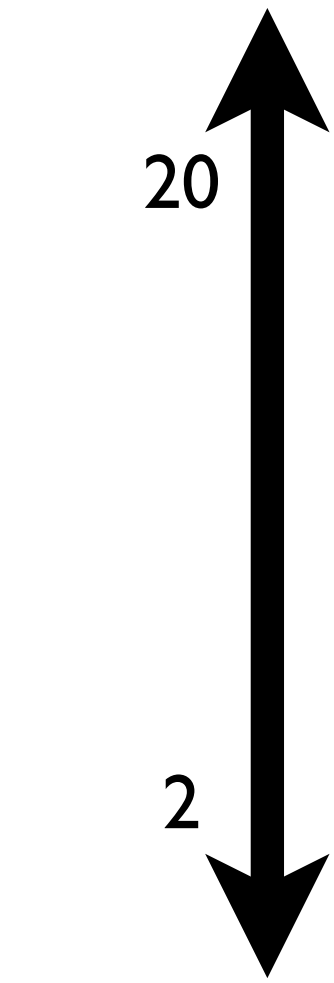
Topographic Index

$$z_i = -\frac{1}{f}\ln\left(\frac{a_i R}{T_0 \tan(\beta_i)}\right)$$

$$z_i = -\frac{1}{f}\left(\ln\frac{R}{T_0} + \ln\frac{a_i}{\tan(\beta_i)}\right)$$

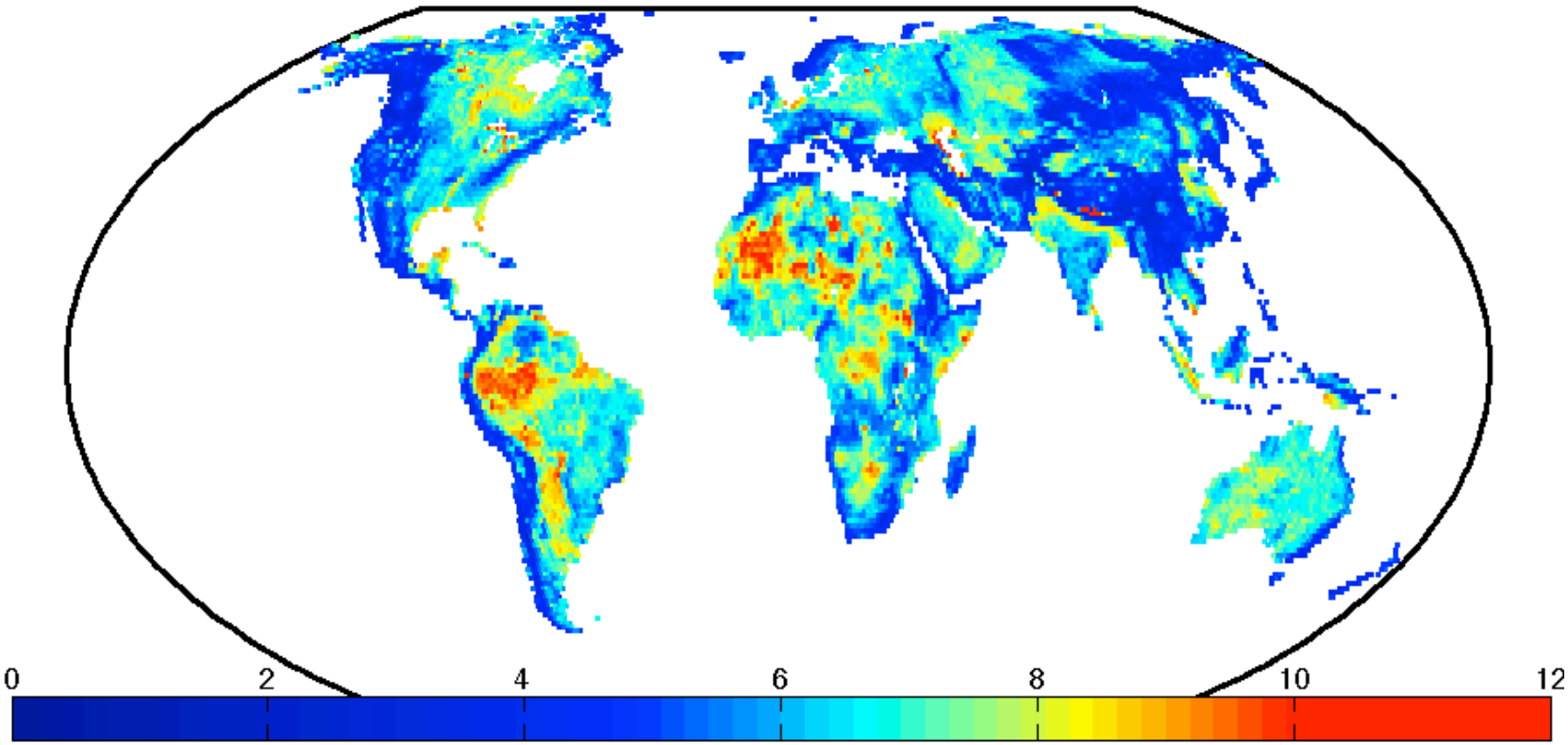
$$TI_i = \ln\frac{a_i}{\tan(\beta_i)}$$

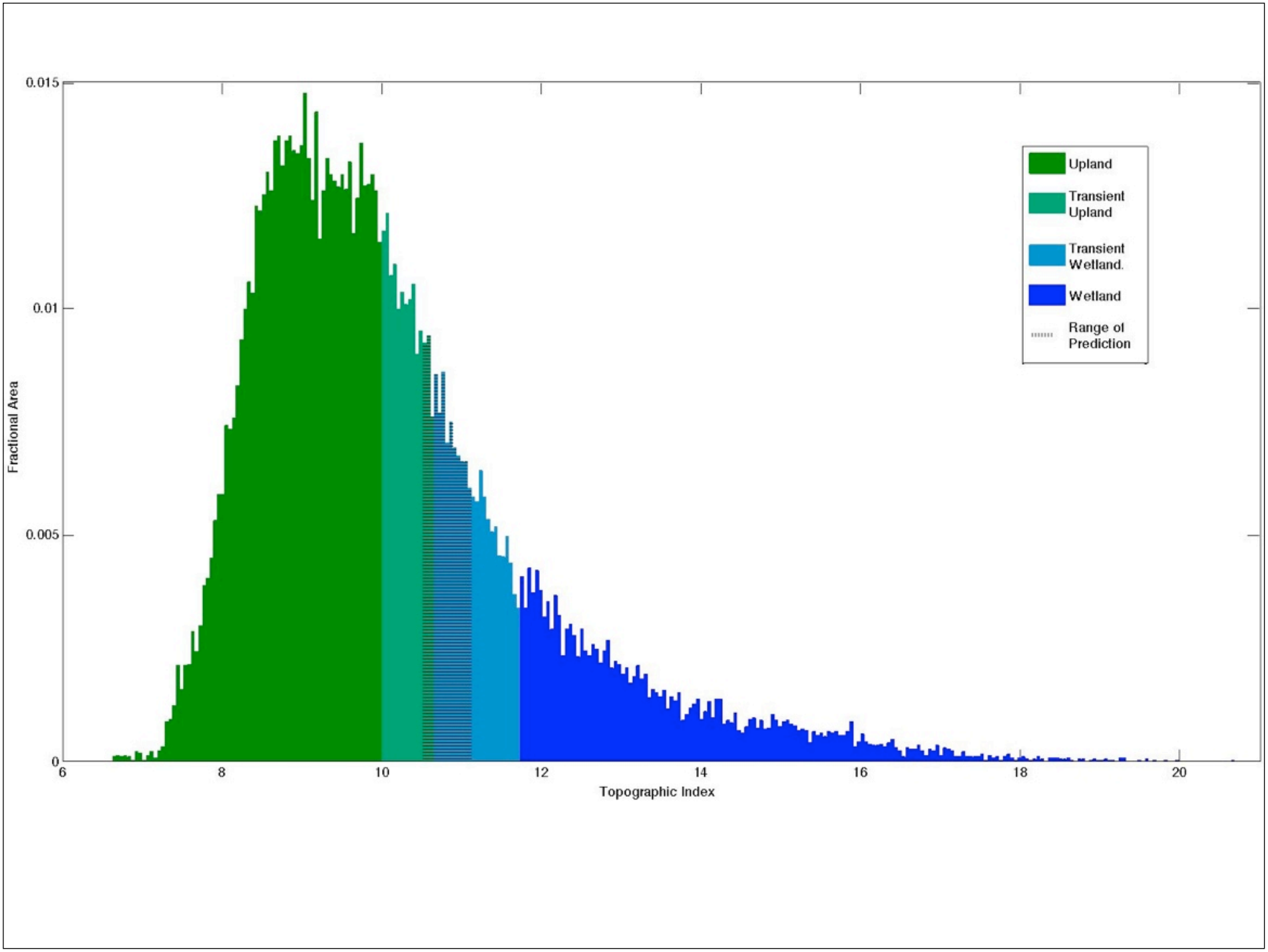
$$TI_i \geq \overline{TI} + f\bar{z}$$

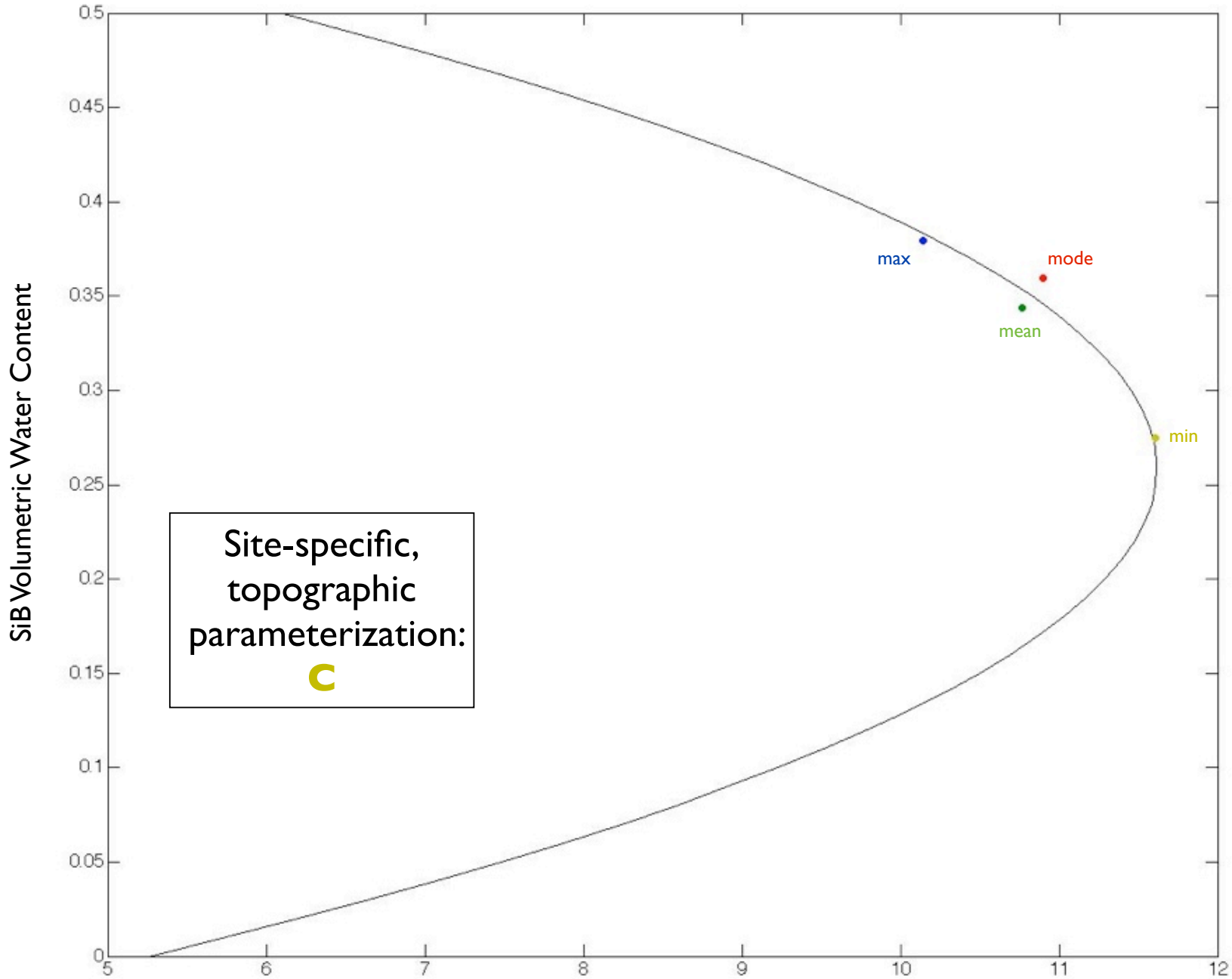


$$TI = \ln(a/\tan\beta)$$

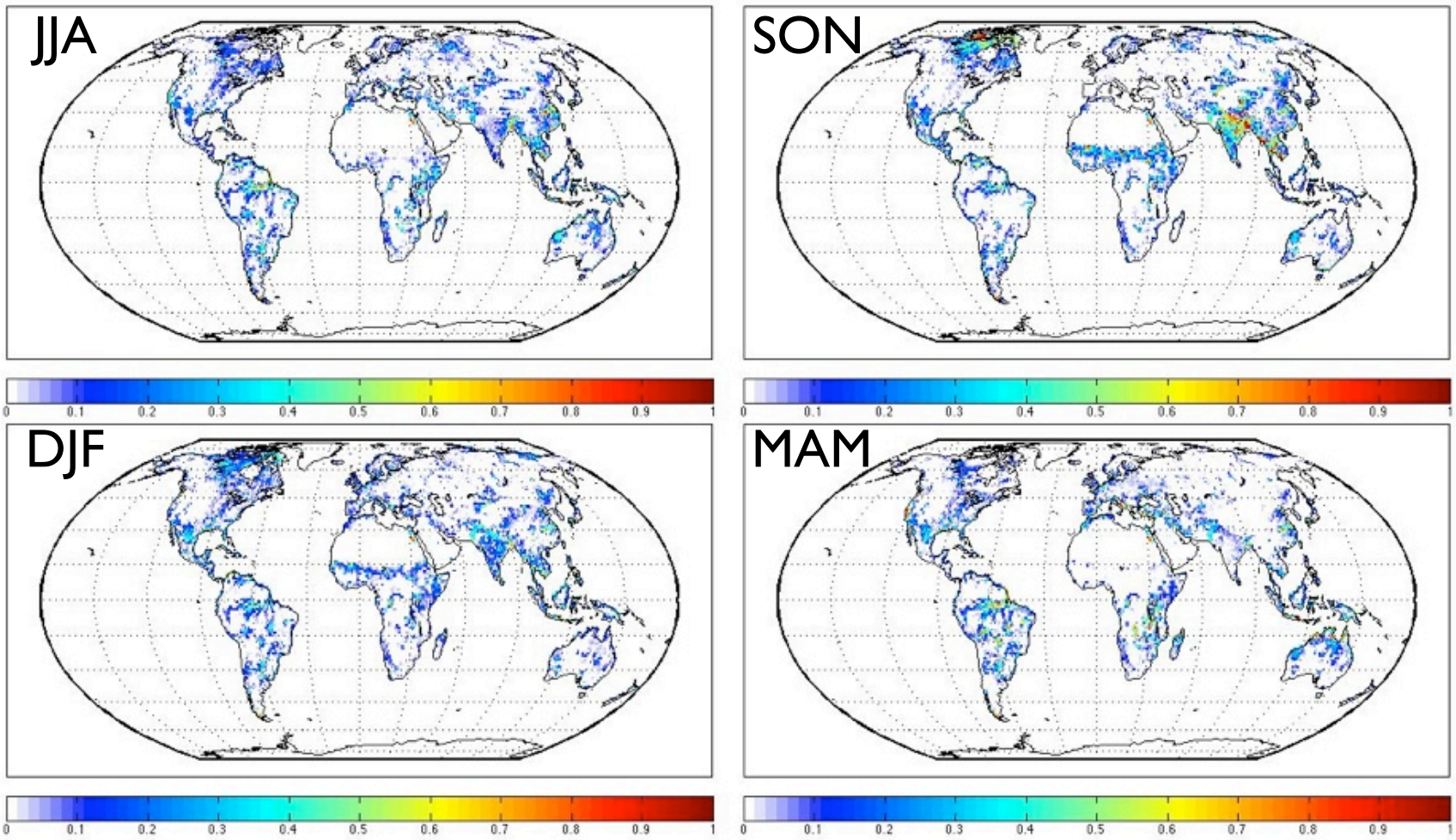
Mean TI



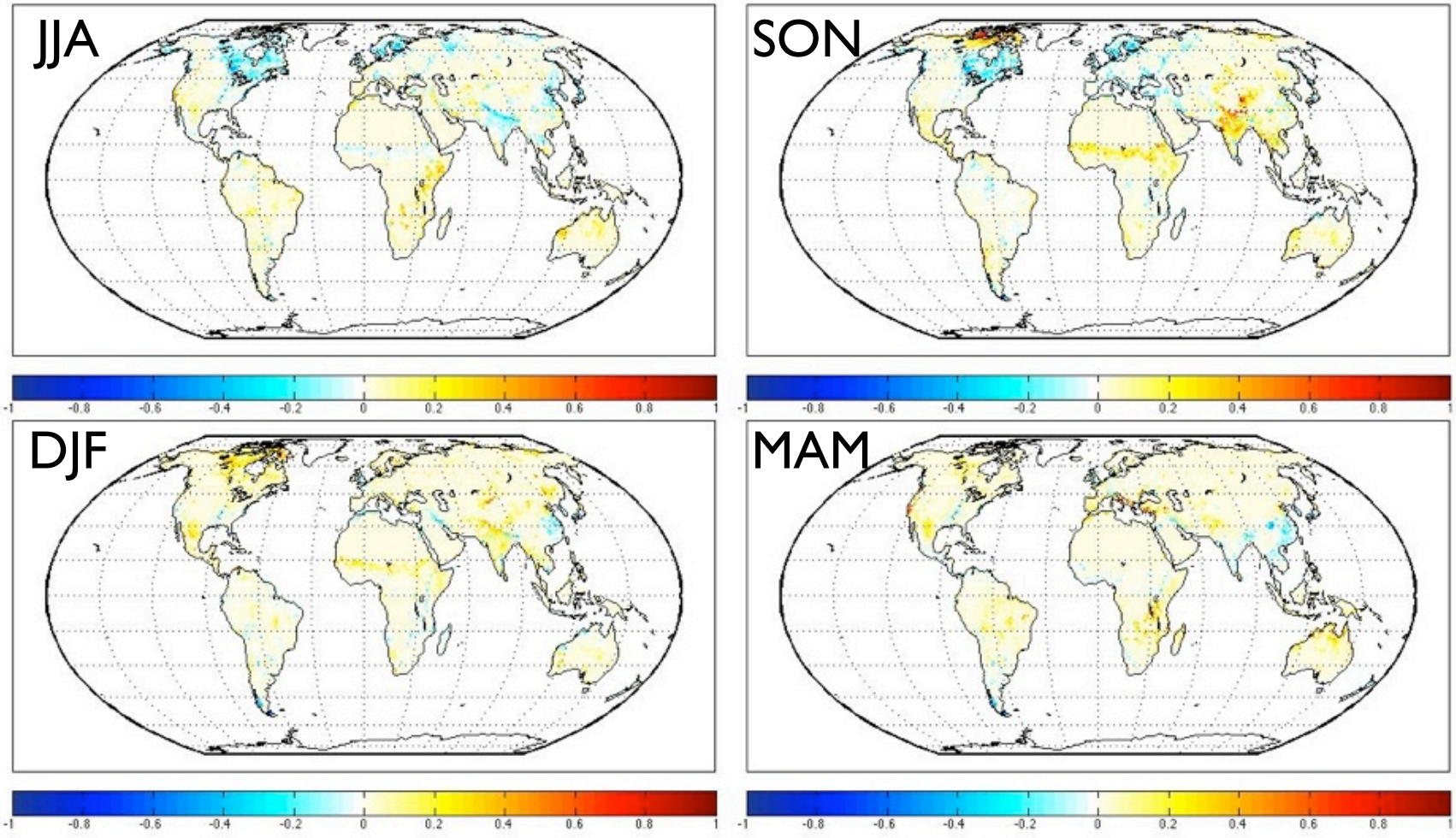

0.015
0.01
0.005
0
Fractional Area
6
8
10
12
14
16
18
20
Topographic Index
Upland
Transient Upland
Transient Wetland
Wetland
Range of Prediction


SiB Volumetric Water Content
0.5
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
5
6
7
8
9
10
11
12
Topographic Index Estimated Inundated Fraction
max
mode
mean
min
Site-specific, topographic parameterization:
C

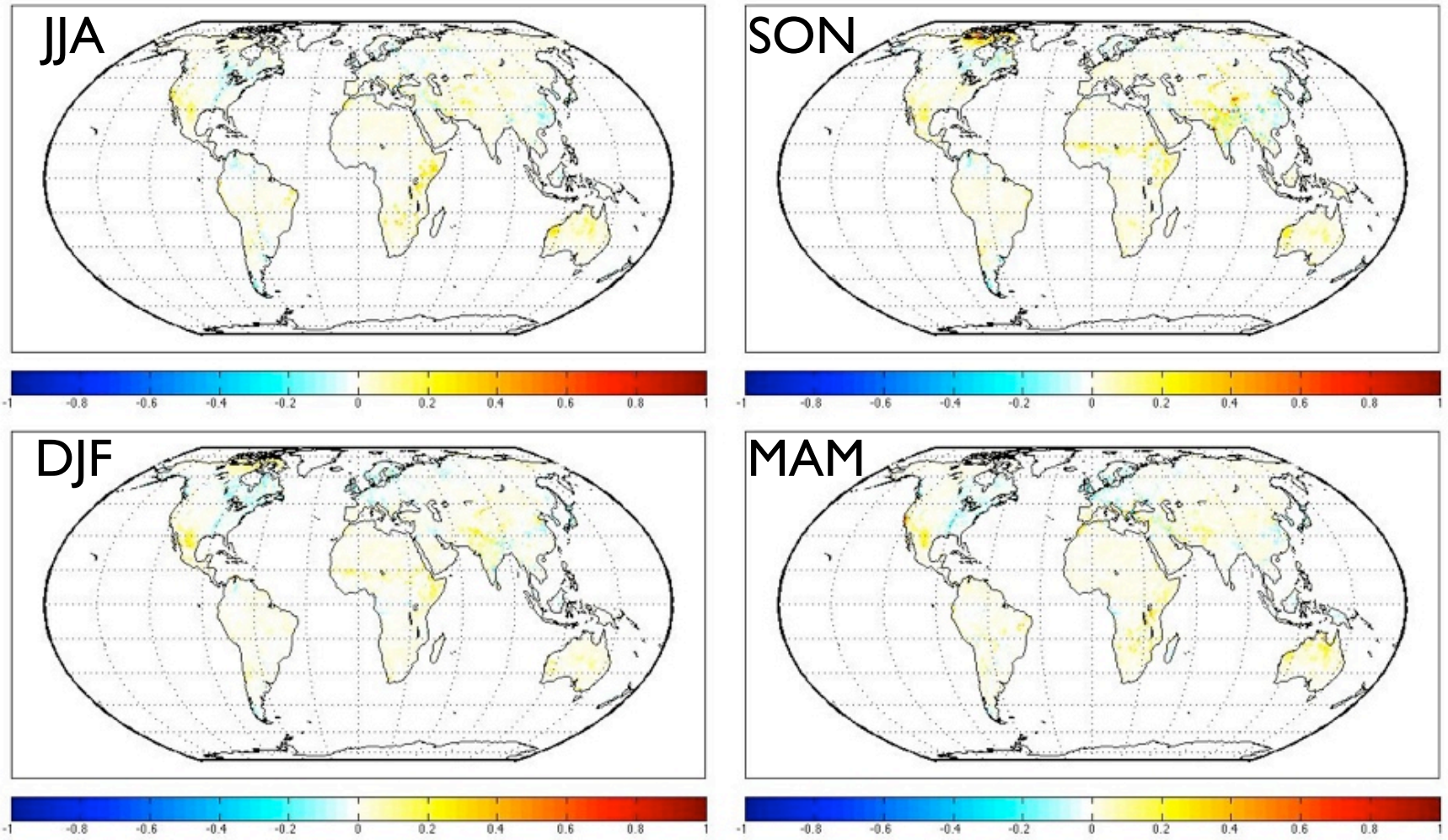
Site-specific, topographic parameterization: **c**

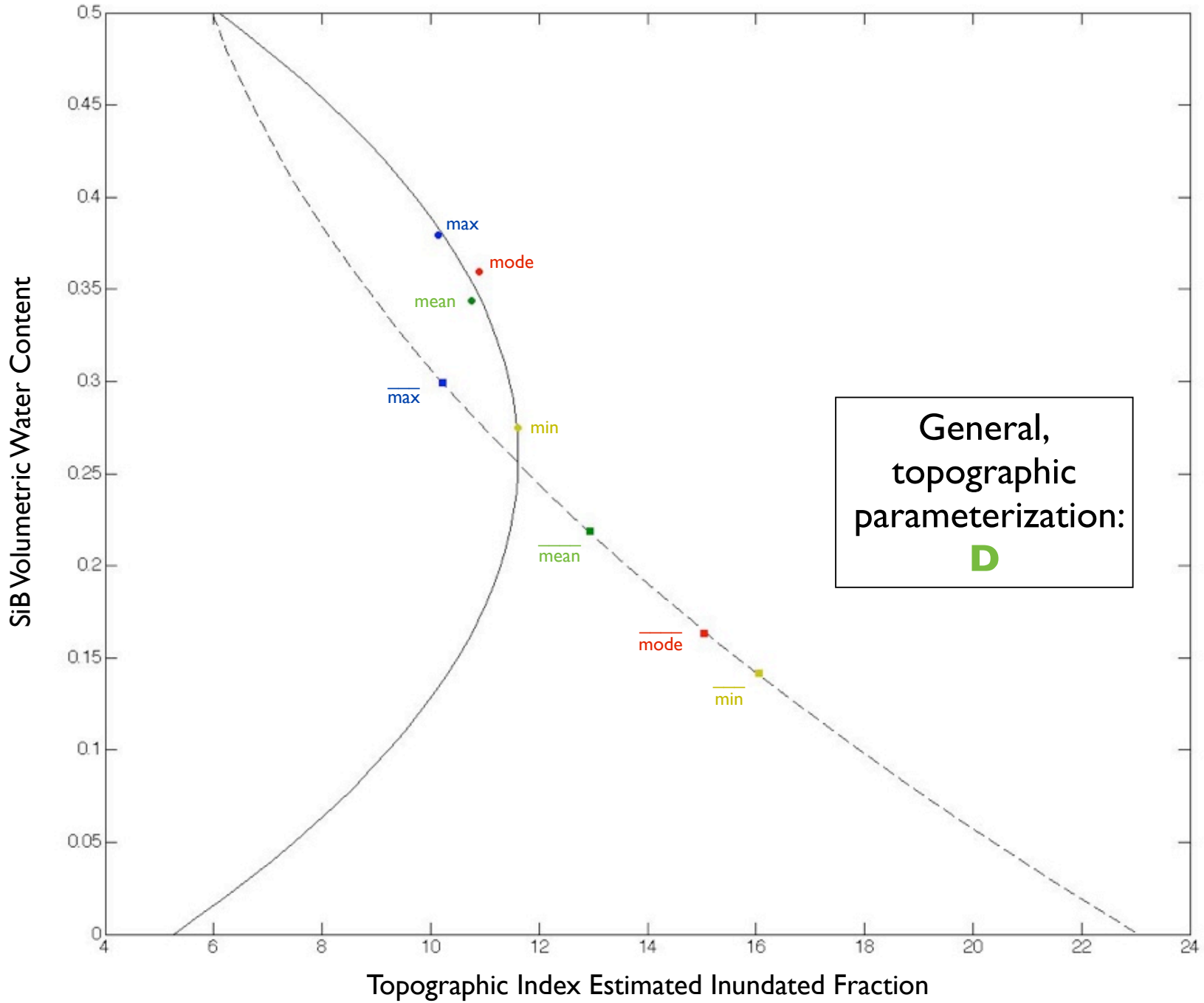


Comparison:
C-E



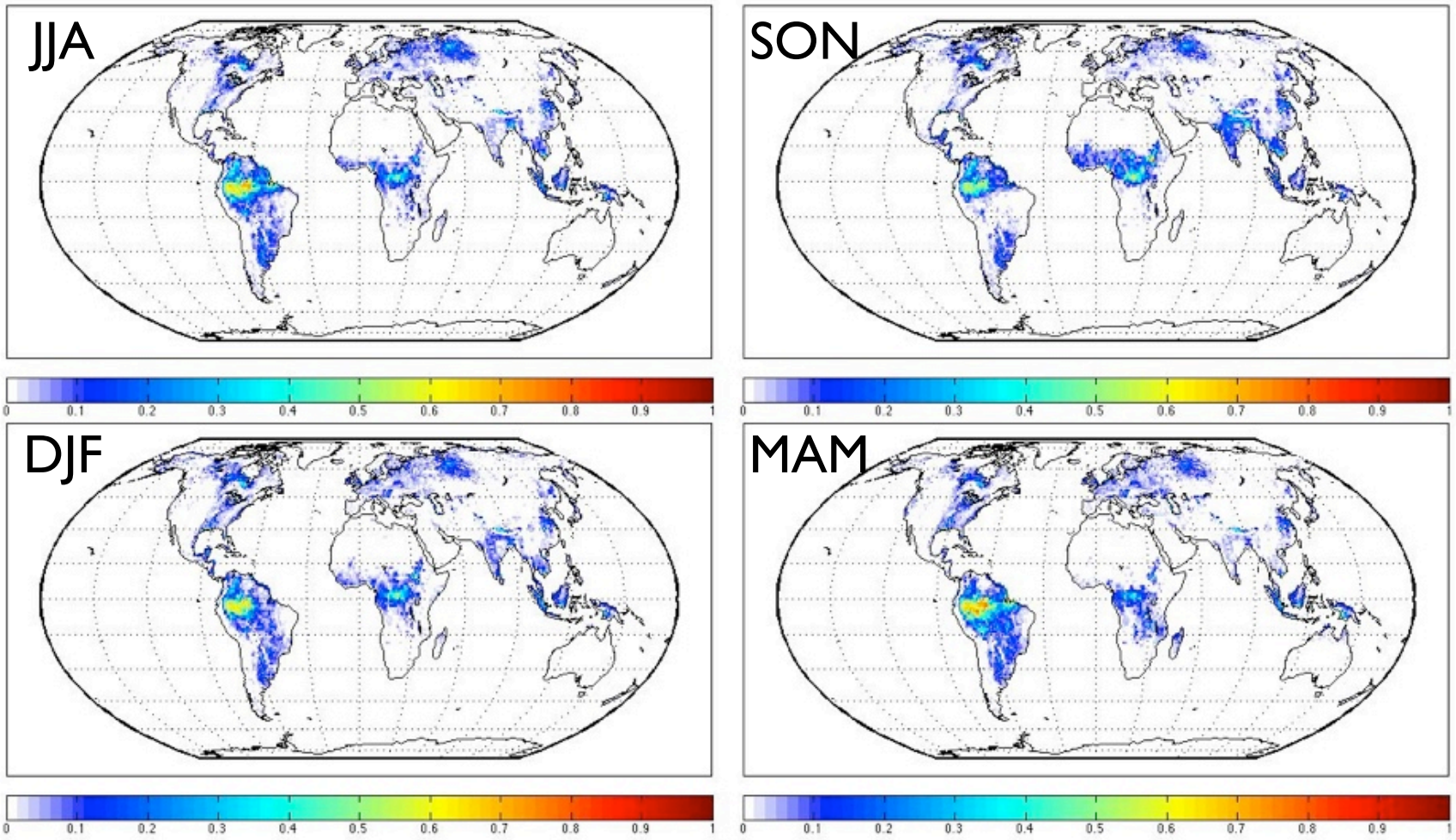
Comparison:
C-A



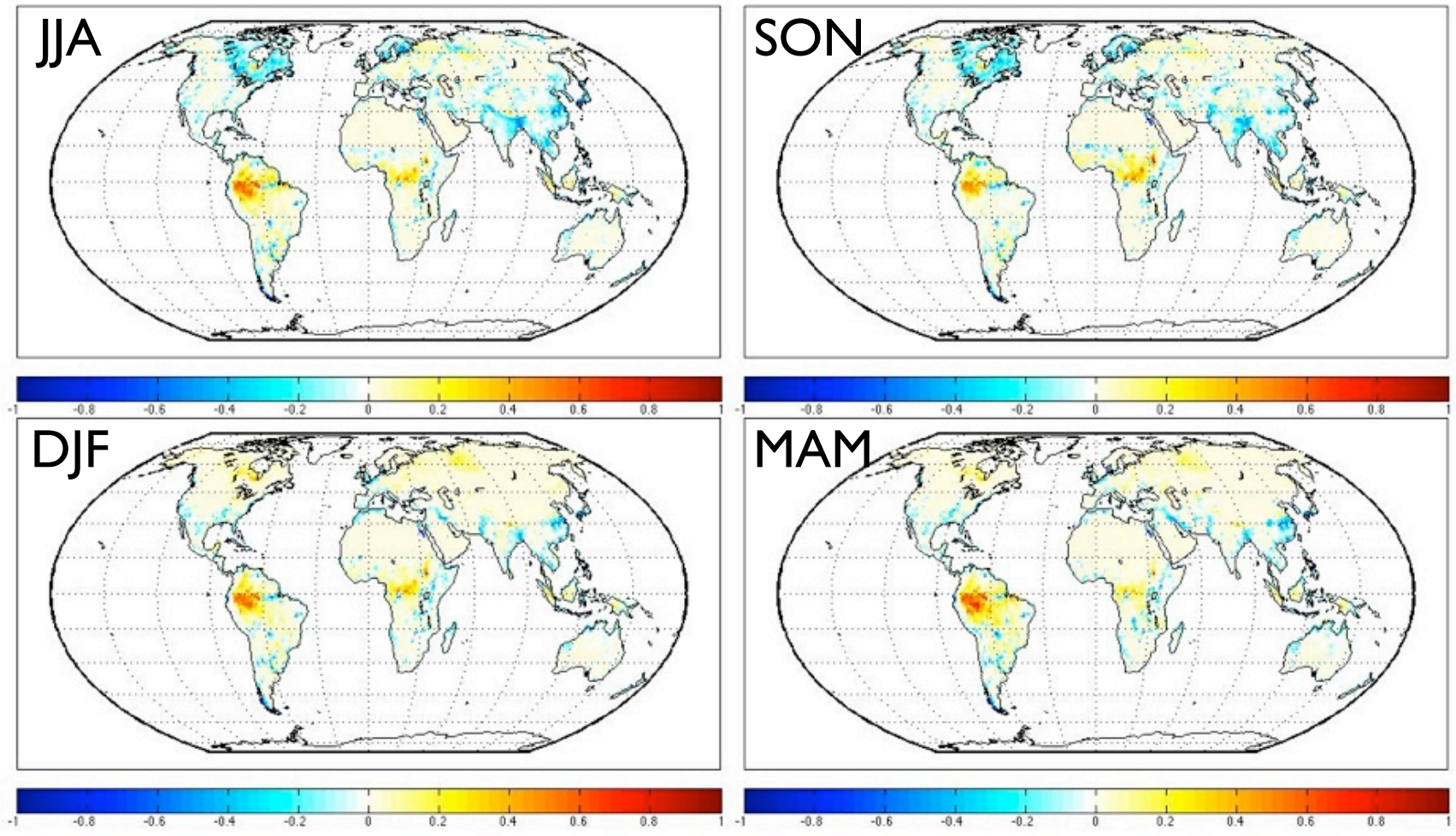

SiB Volumetric Water Content
Topographic Index Estimated Inundated Fraction
0.5
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
4
6
8
10
12
14
16
18
20
22
24
max
mode
mean
max
min
mean
mode
min
General, topographic parameterization:
D

General, topographic parameterization:

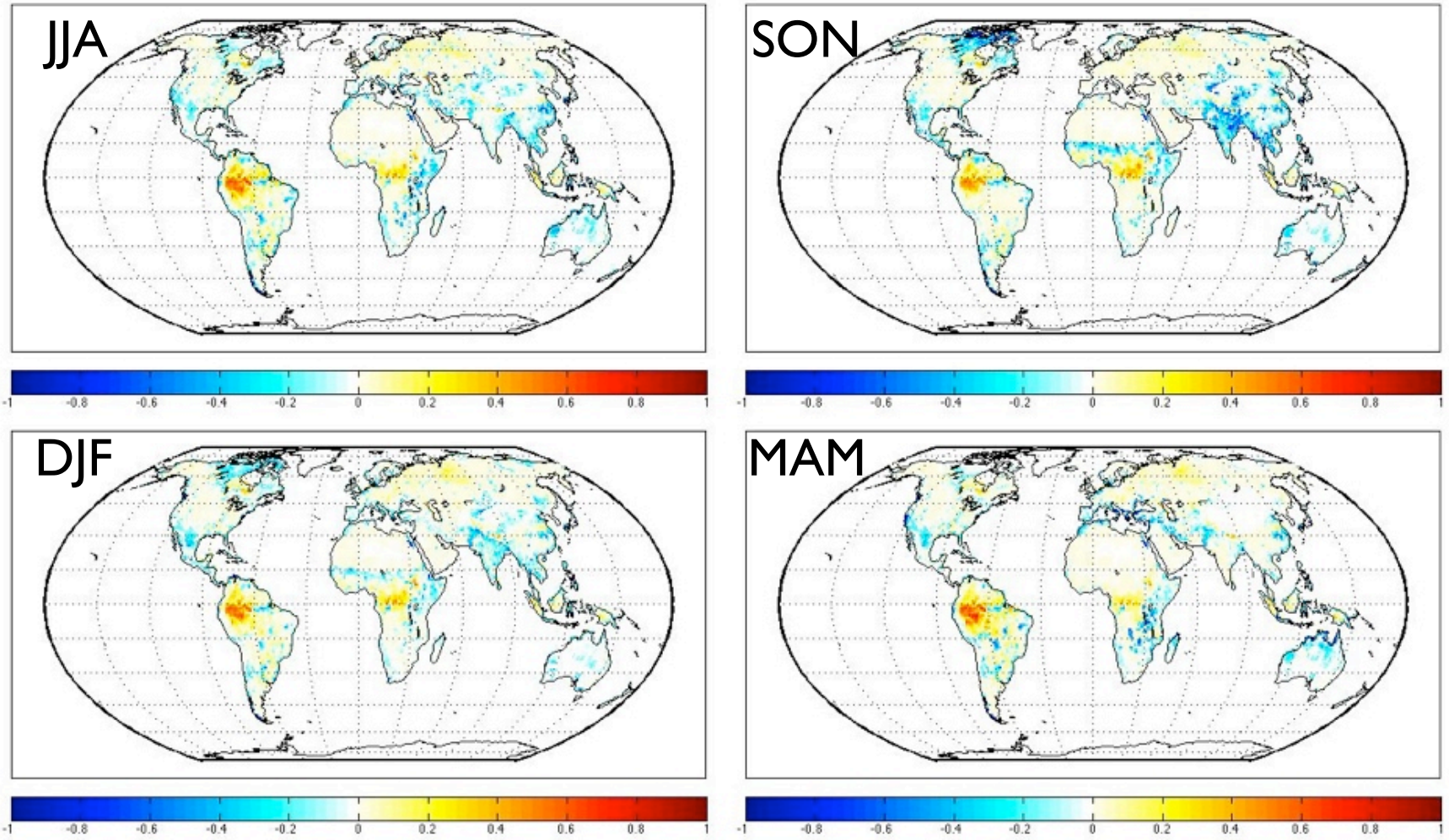
D



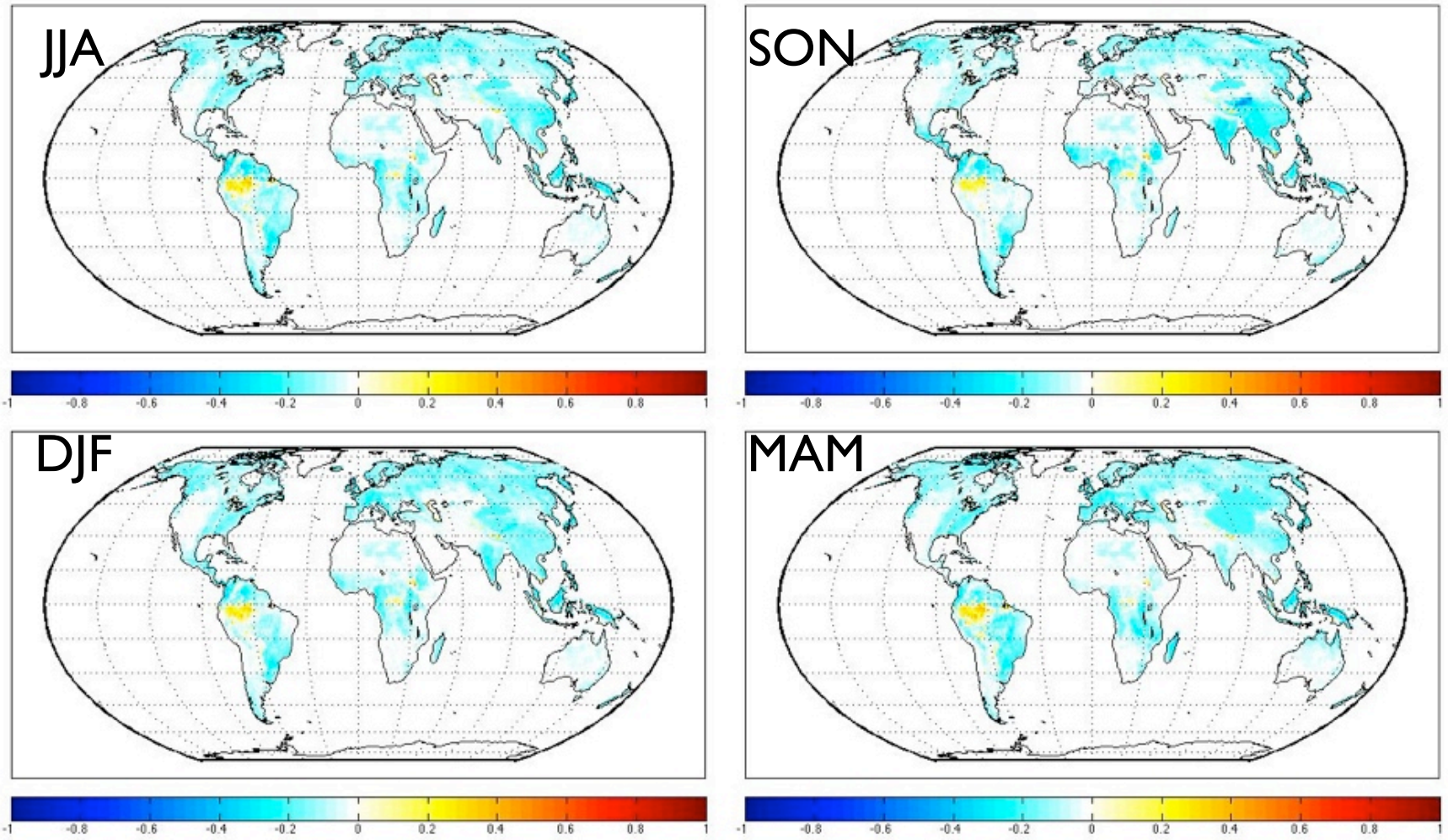
Comparison:
D-E



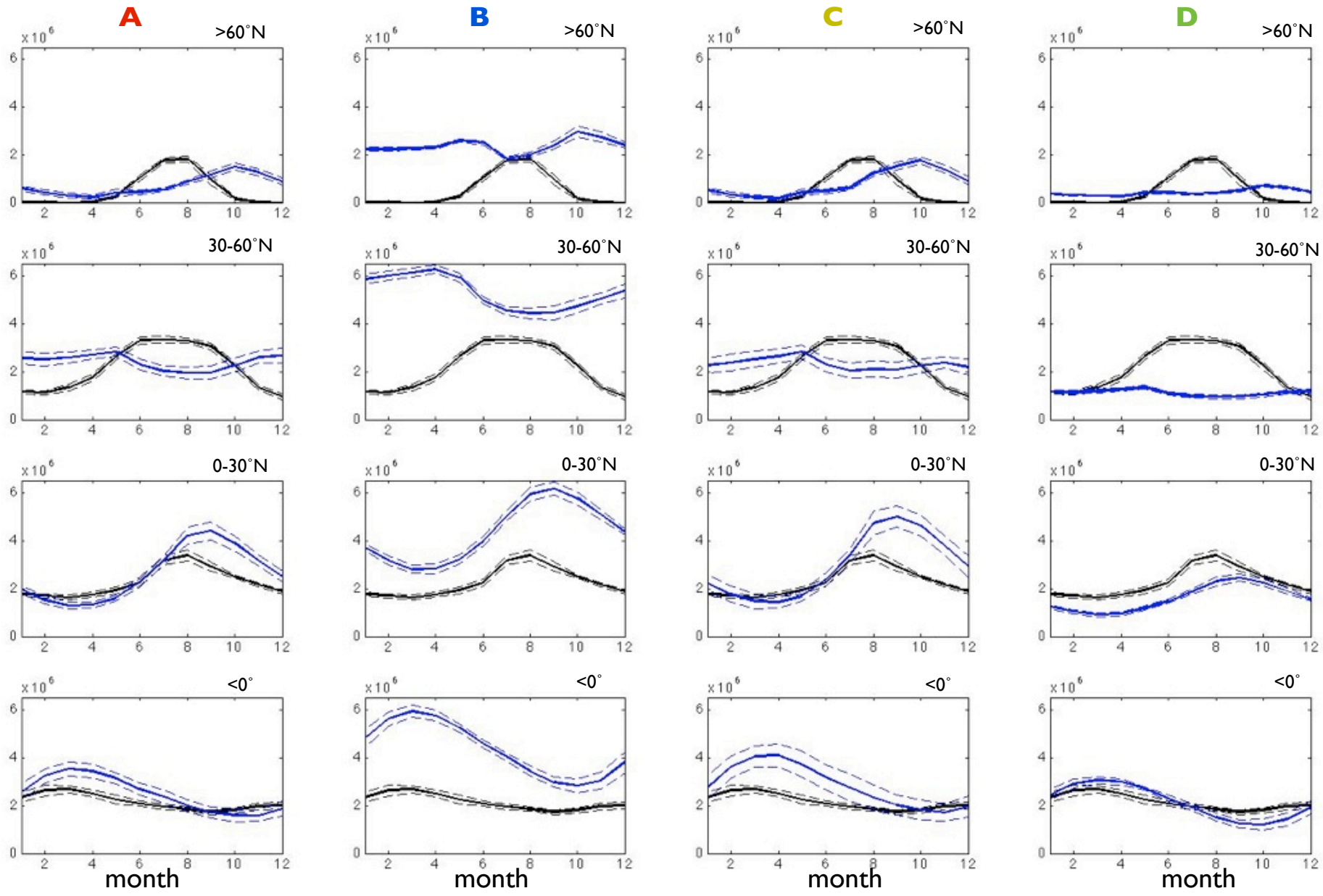
Comparison:
D-C



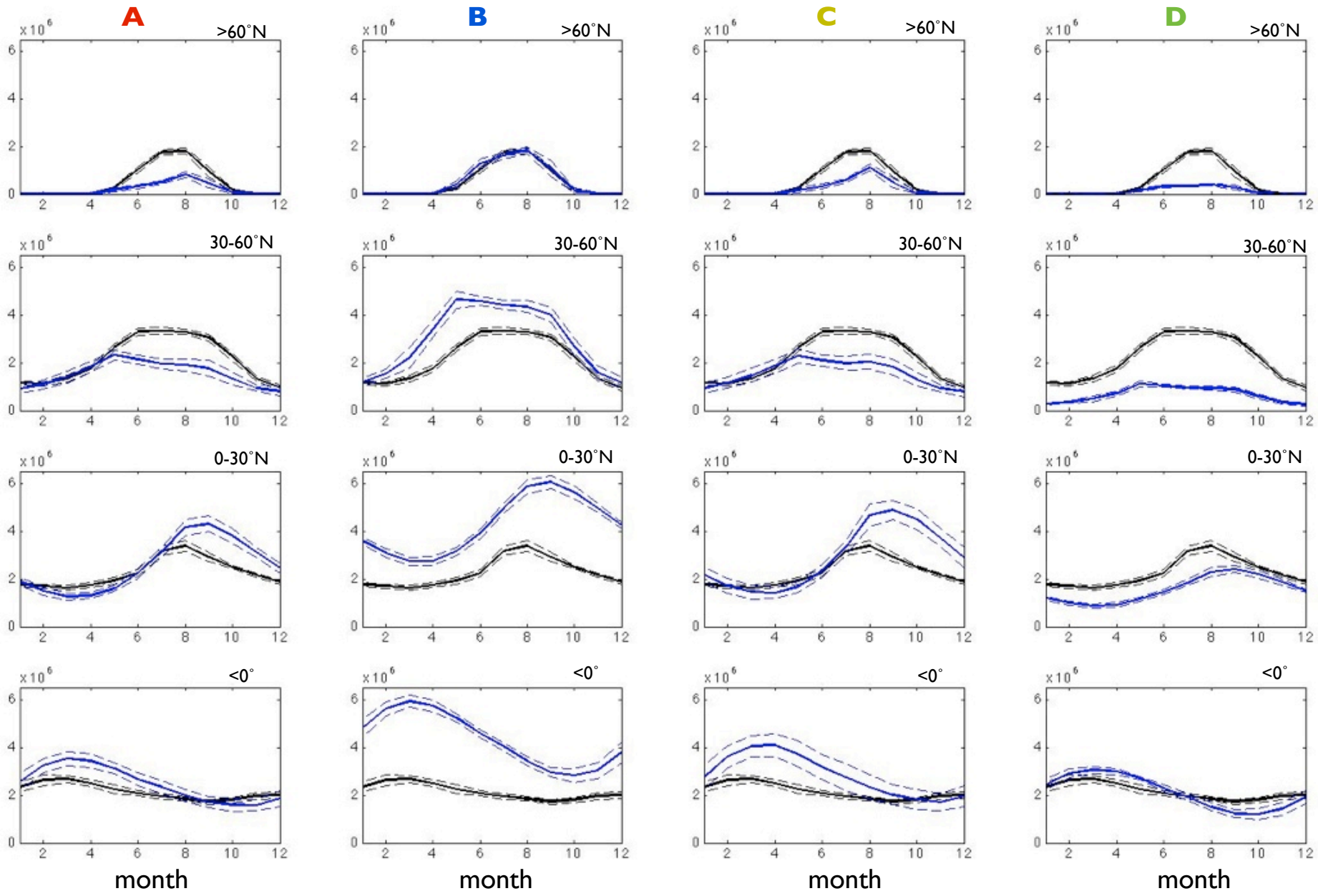
Comparison:
D-B

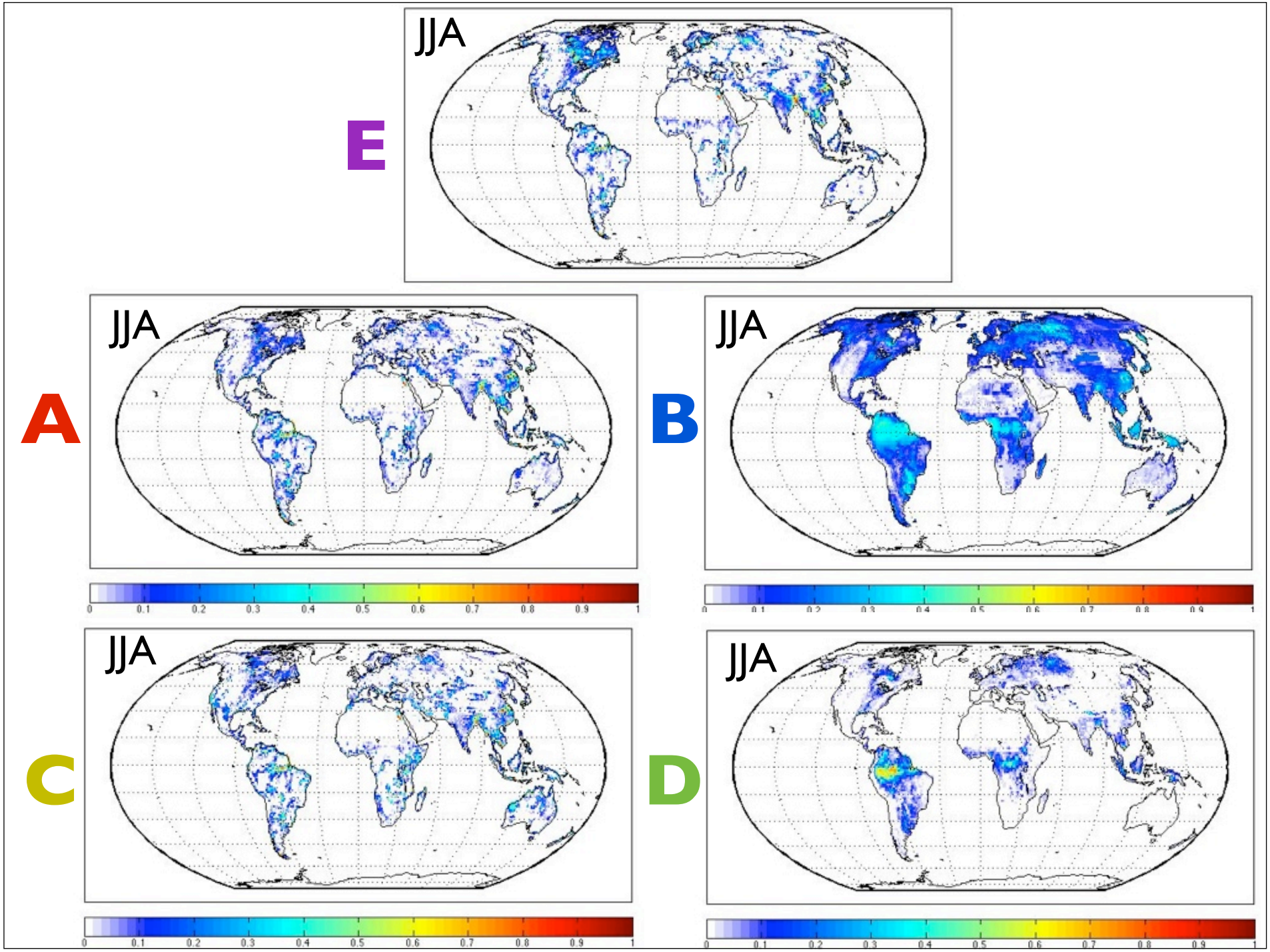


Annual Composites - no ice mask

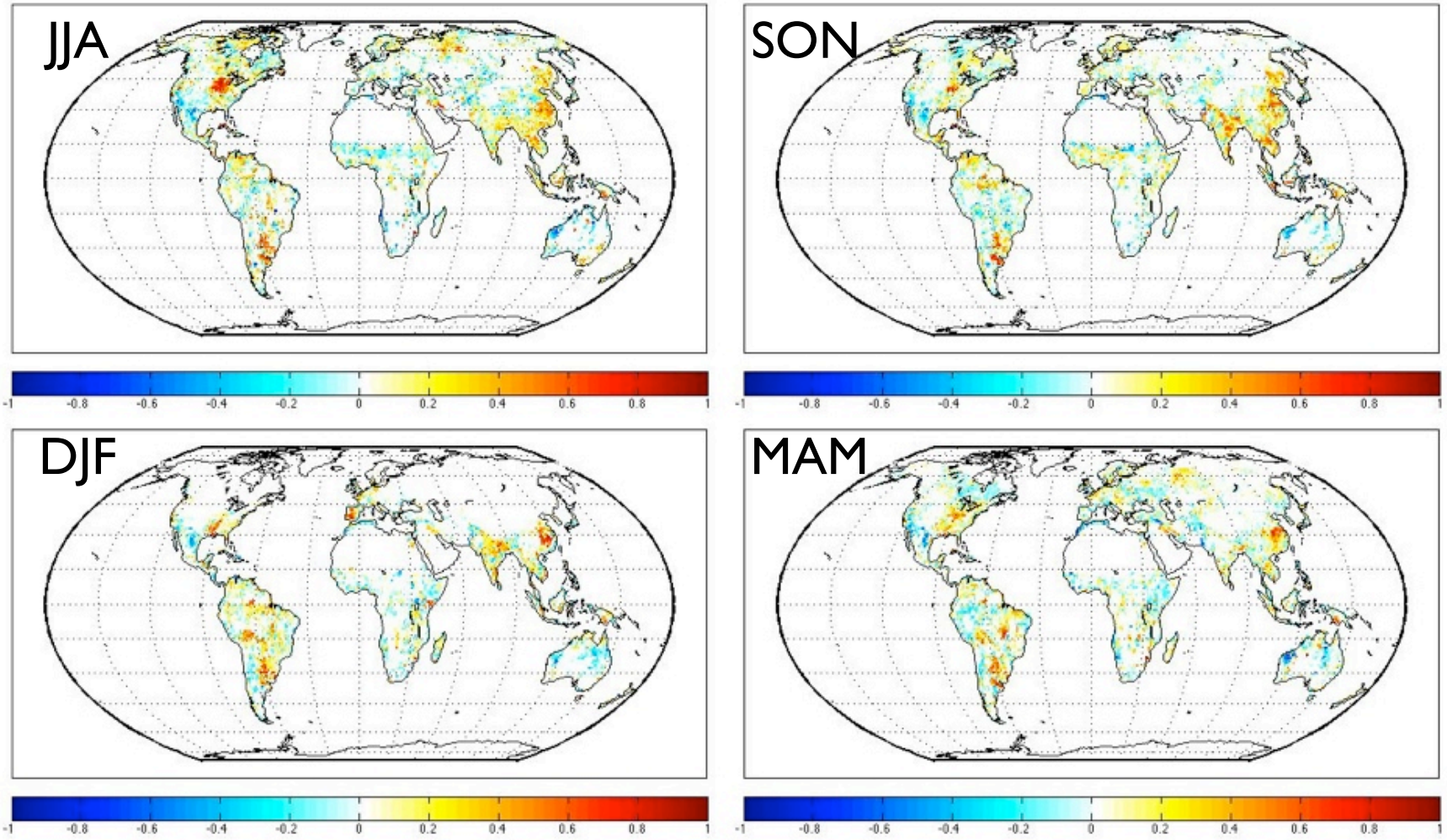


Annual Composites - ice mask

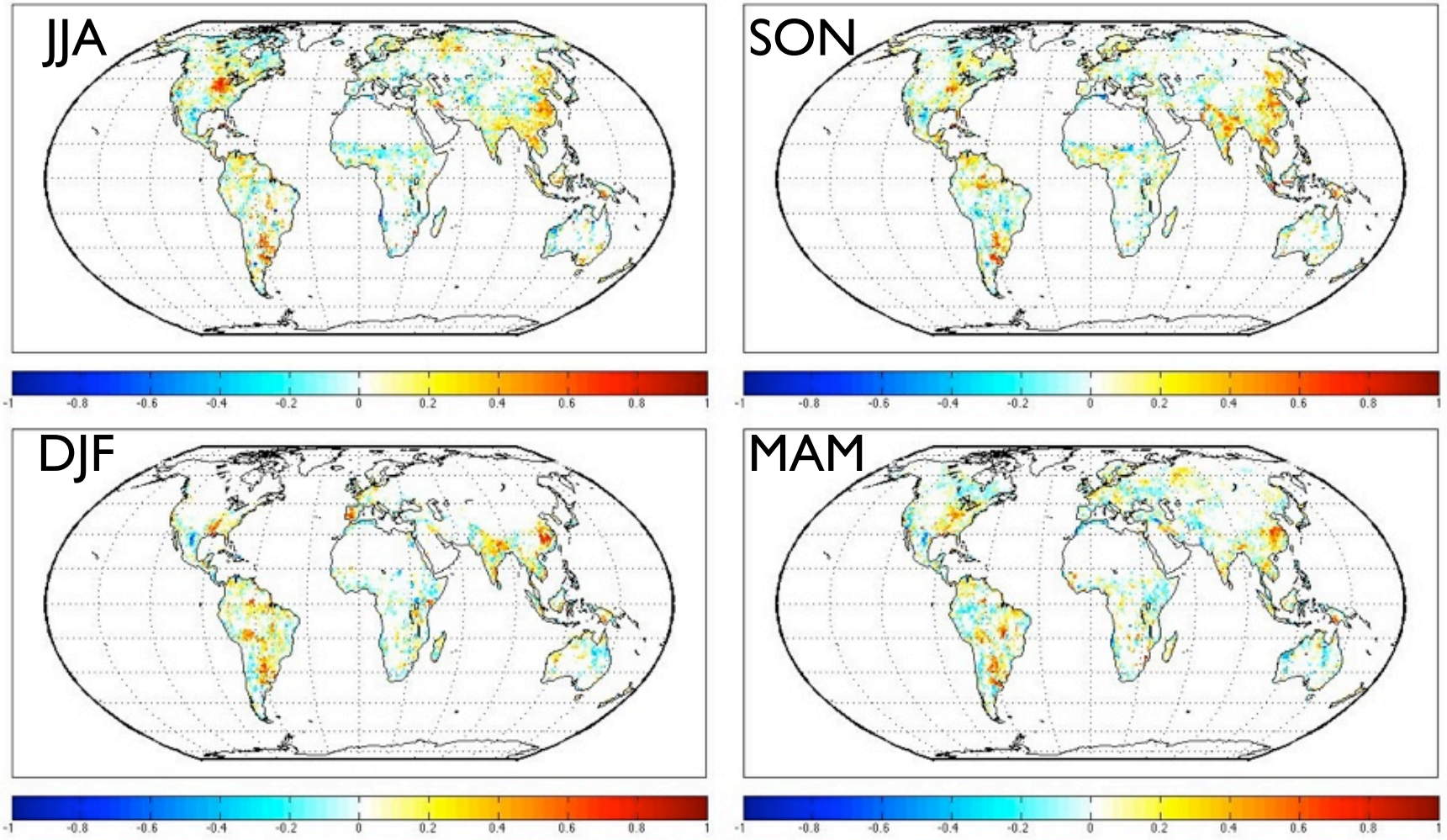



E
JJA
A
JJA
B
JJA
C
JJA
D
JJA
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1

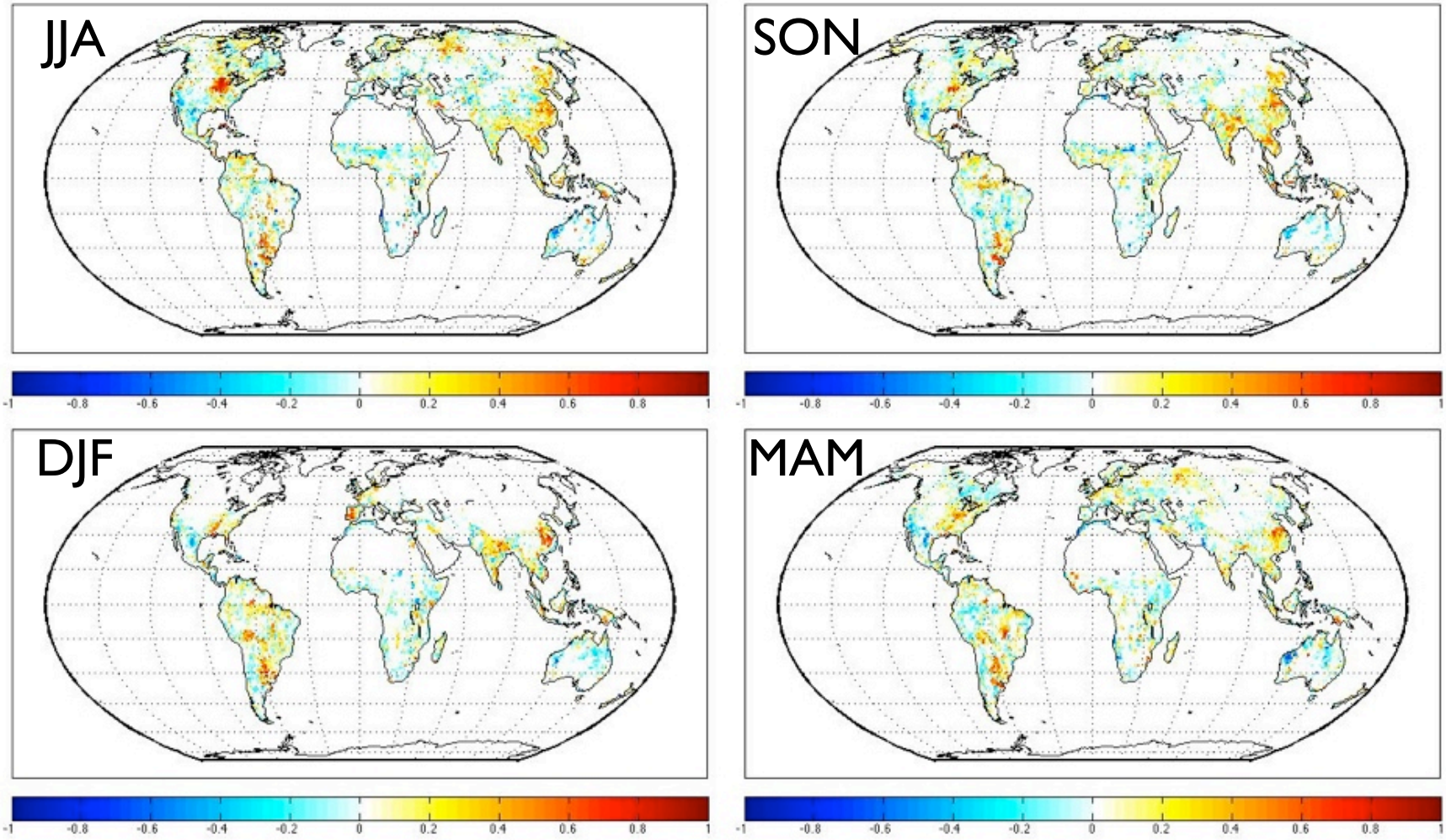
Covariance: A, E
total = 3,413



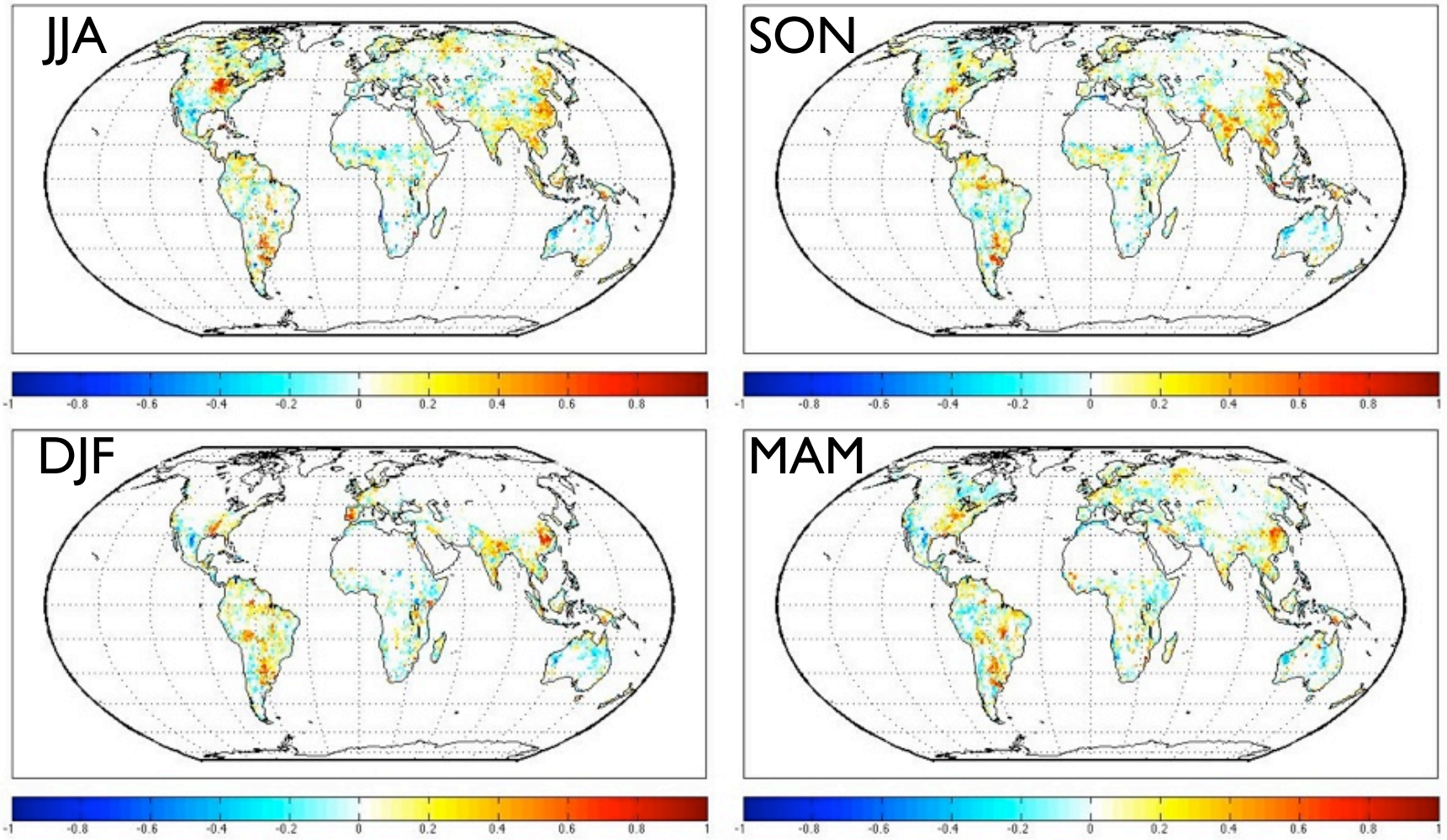
# Covariance: **B**, **E**
total = 3,488



Covariance: C, E
total = 3,307



# Covariance: D, E
total = 3,569



Conclusions

- Satellite estimates are dominated by snow/ice extent at high latitudes.
- In any configuration, SiB reduces wetland extent in Quebec from satellite values.
- Transient inundation in sub-tropical regions is not seen in SiB, causing persistent errors.
- Model estimates of spatial wetland distribution give superior estimates of wetlands' temporal variation locally.