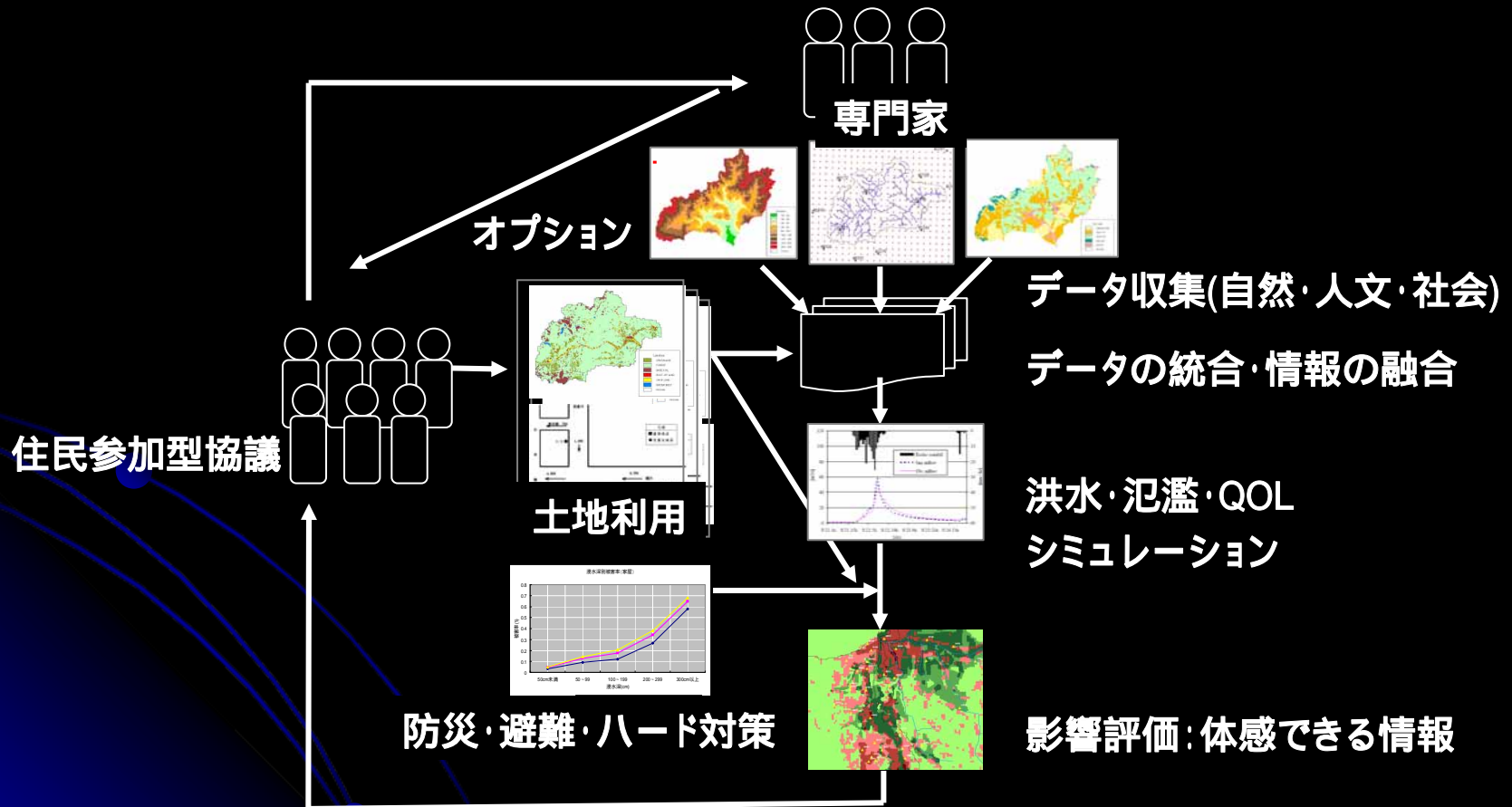


吉野川における気候変化の影響評価

小池俊雄・東京大学大学院工学系研究科社会基盤学専攻
東京大学地球観測データ統合連携研究機構(EDITORIA)

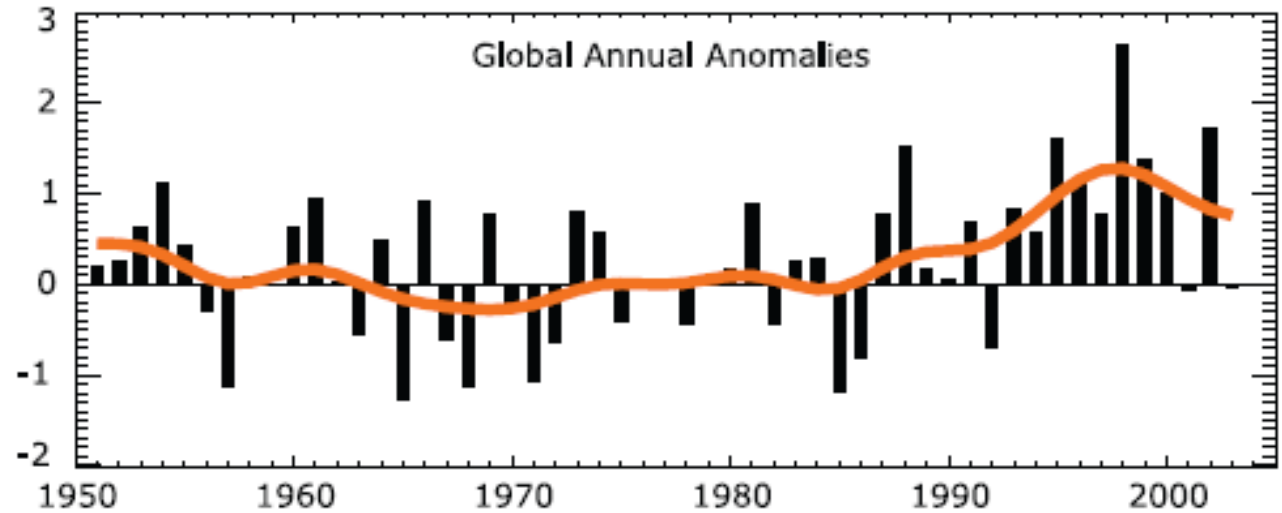
影響評価と適応策の検討： 住民参加型協議



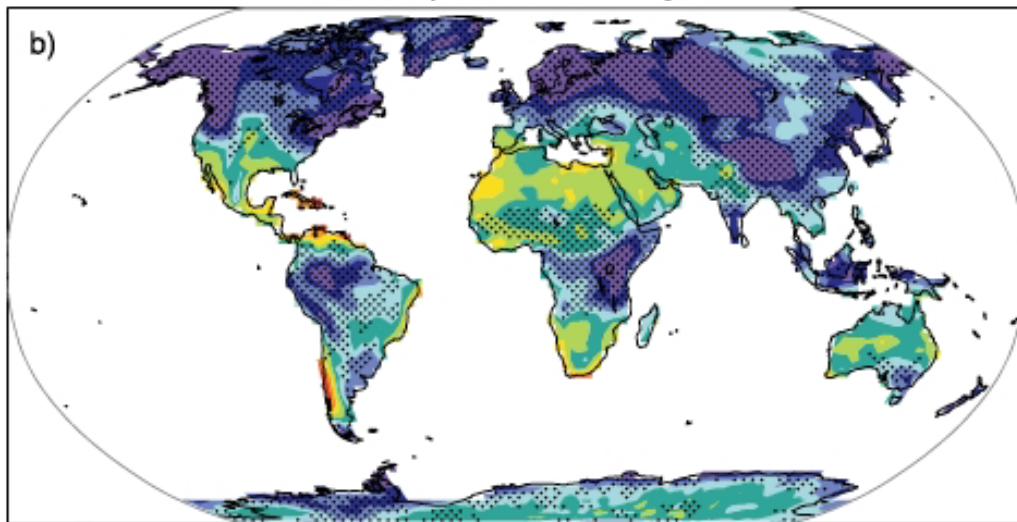
気候と水循環の変動(大雨の発生頻度)

IPCC AR4

1951年から2003年の観測により、年間降水量に占める大雨の割合が増加している**可能性が高い(likely)**。



Precipitation intensity

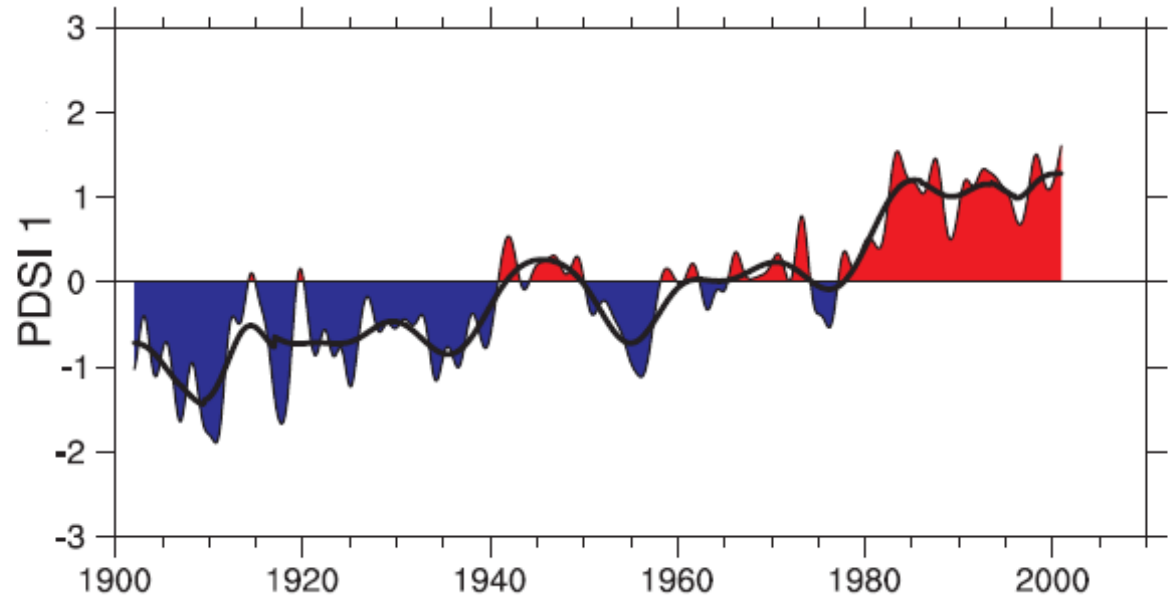


大雨の頻度の増加の**可能性がかなり高い(very likely)**

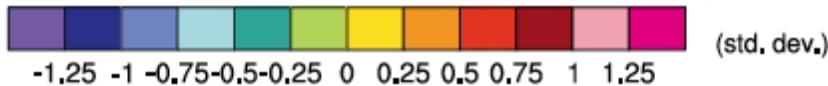
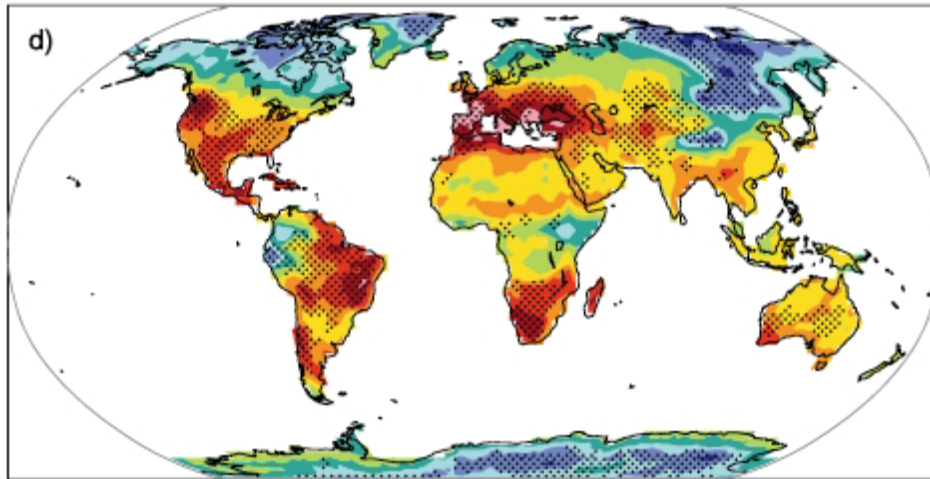
気候と水循環の変動(渇水の頻度)

IPCC AR4

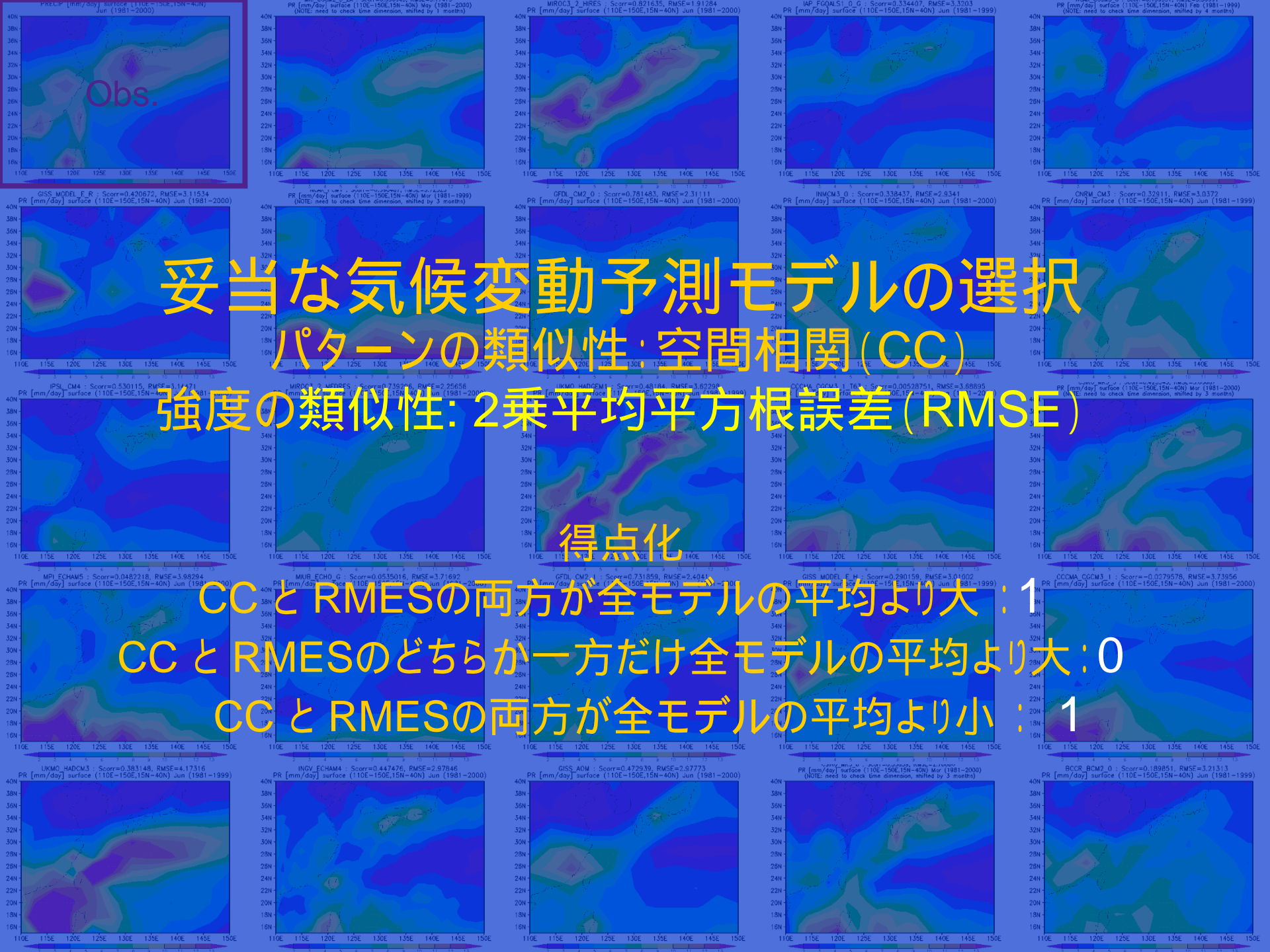
Palmerの渇水強度指数



Dry days



渇水の影響を受ける地域増加することの**可能性が高い**(*likely*)。



妥当な気候変動予測モデルの選択 パターンの類似性・空間相関(CC)

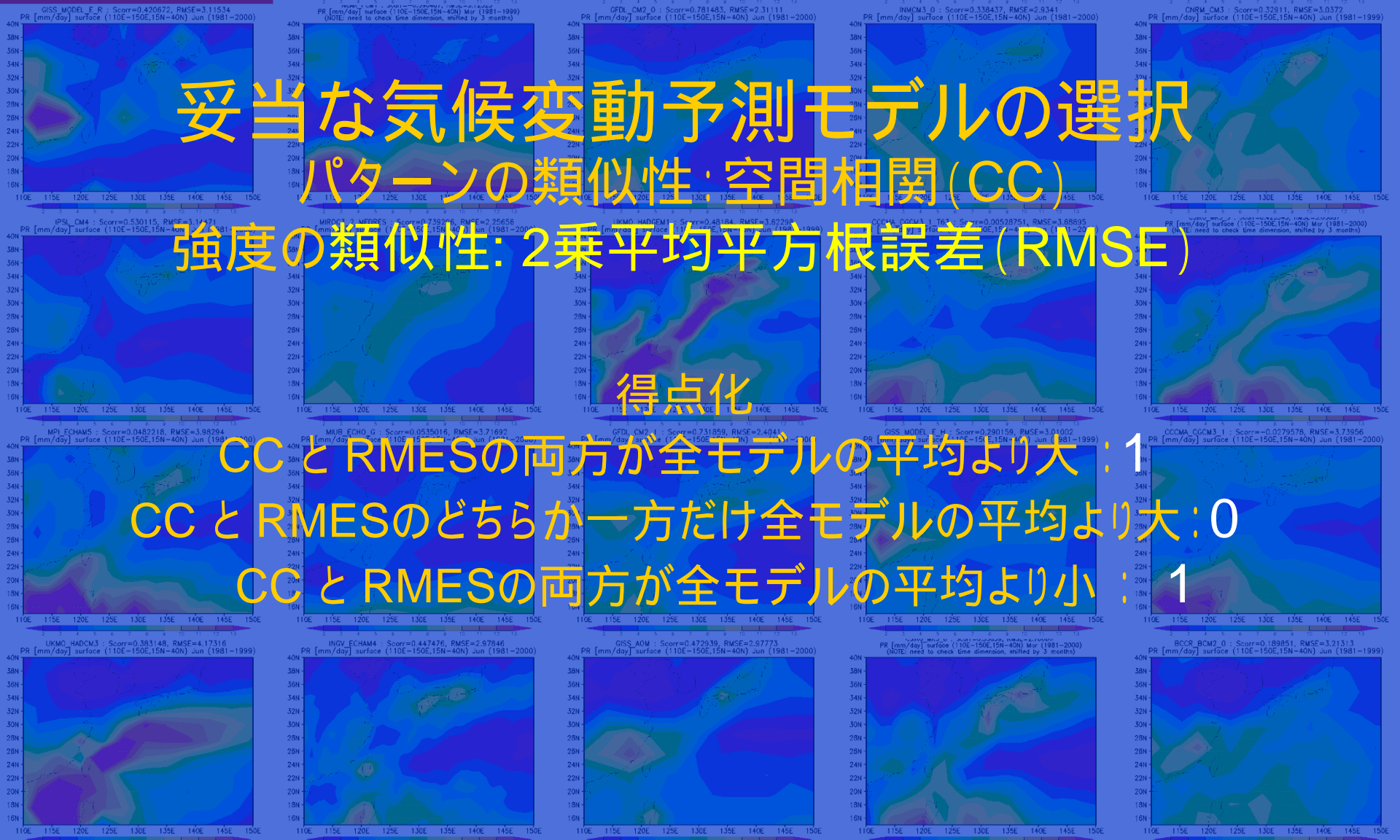
強度の類似性: 2乗平均平方根誤差(RMSE)

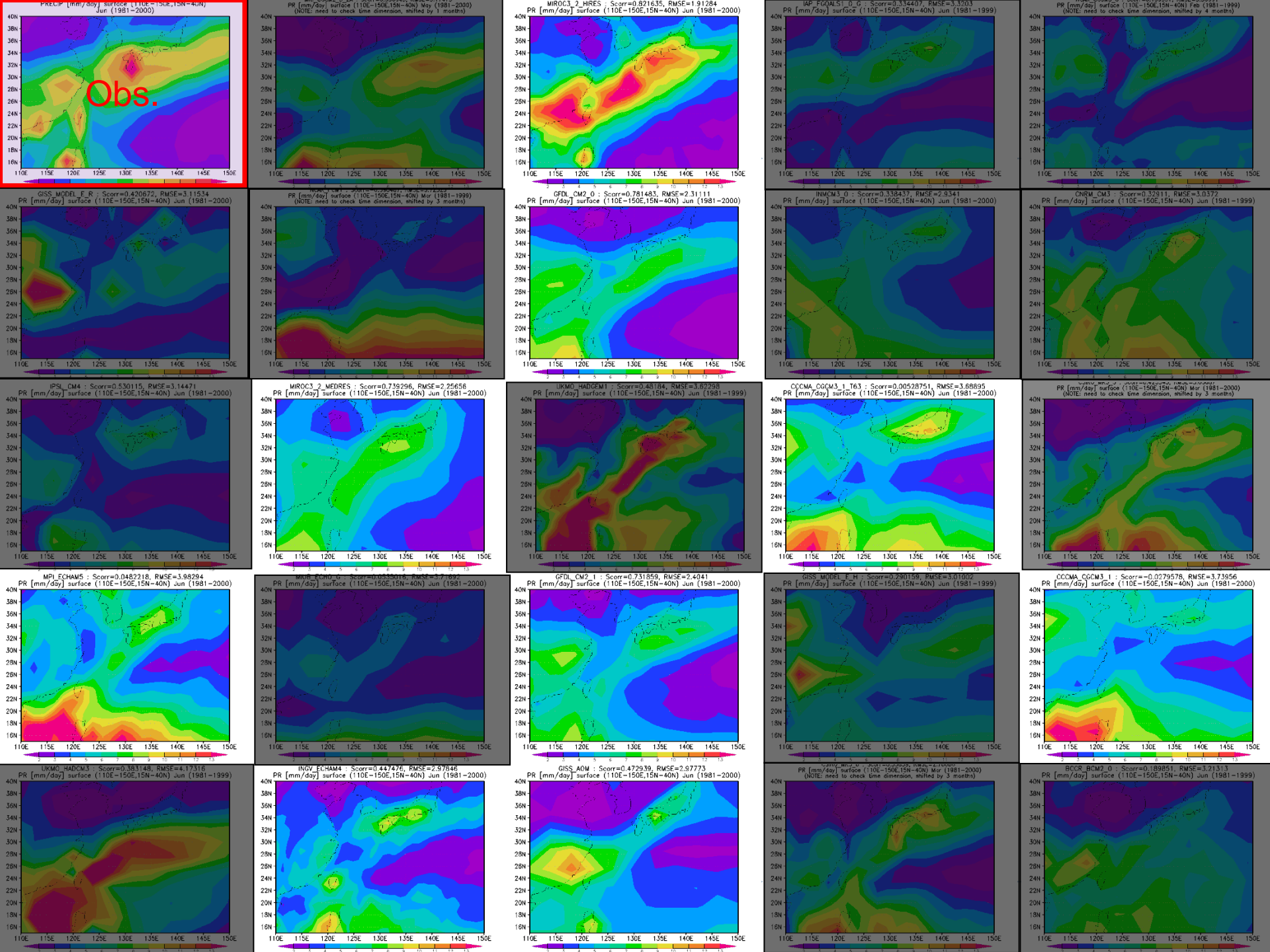
得点化

CCとRMESの両方が全モデルの平均より大: 1

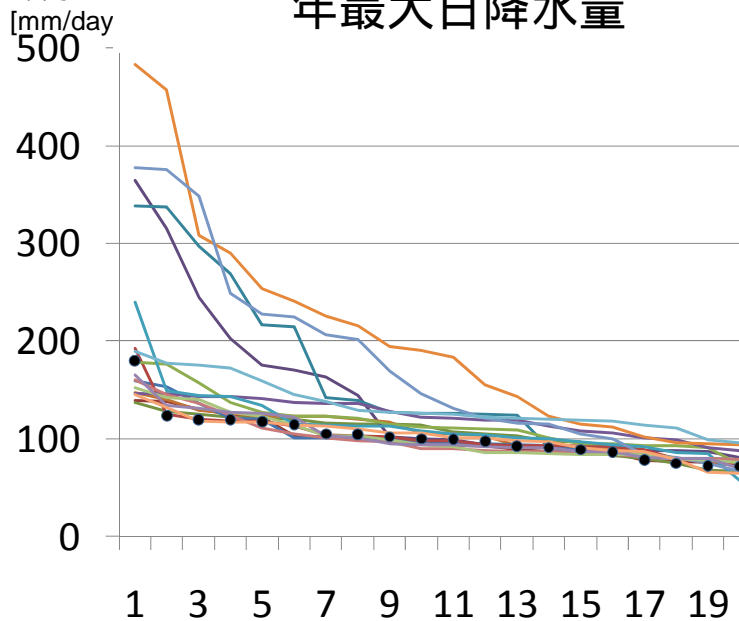
CCとRMESのどちらか一方だけ全モデルの平均より大: 0

CCとRMESの両方が全モデルの平均より小: 1

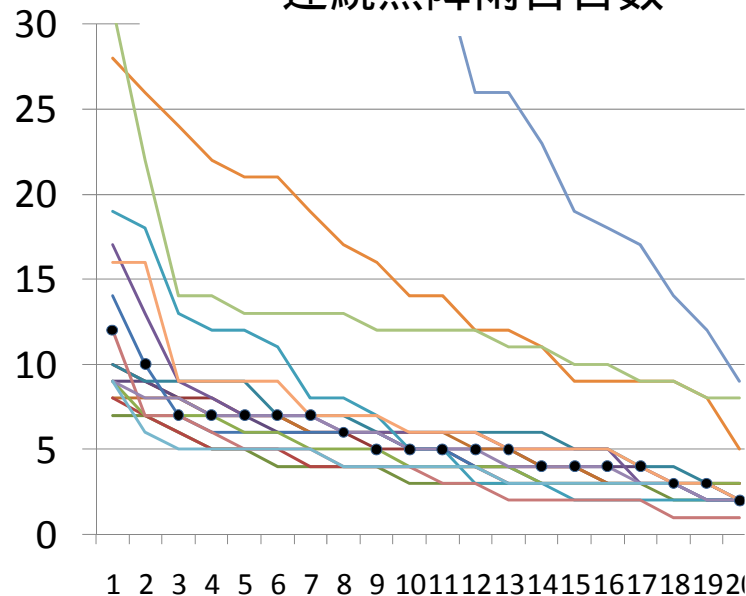




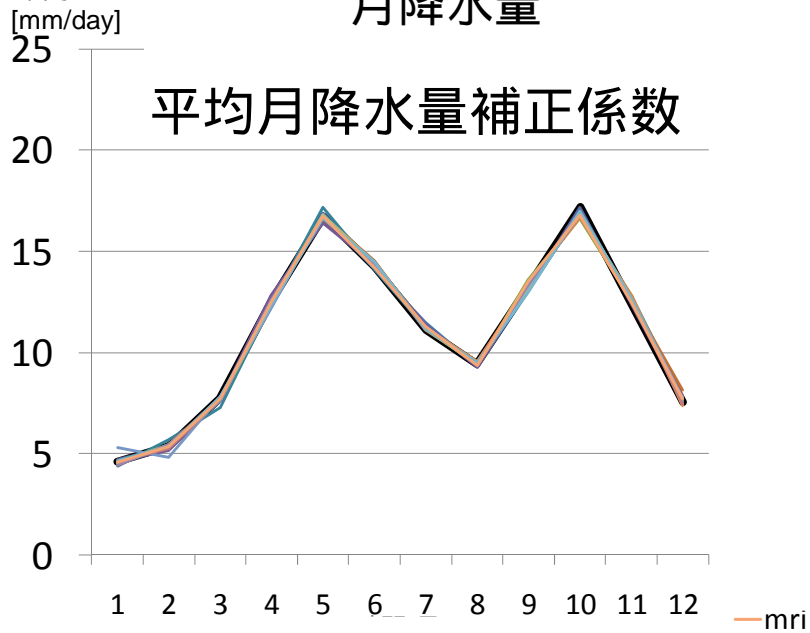
年最大日降水量



連続無降雨日数



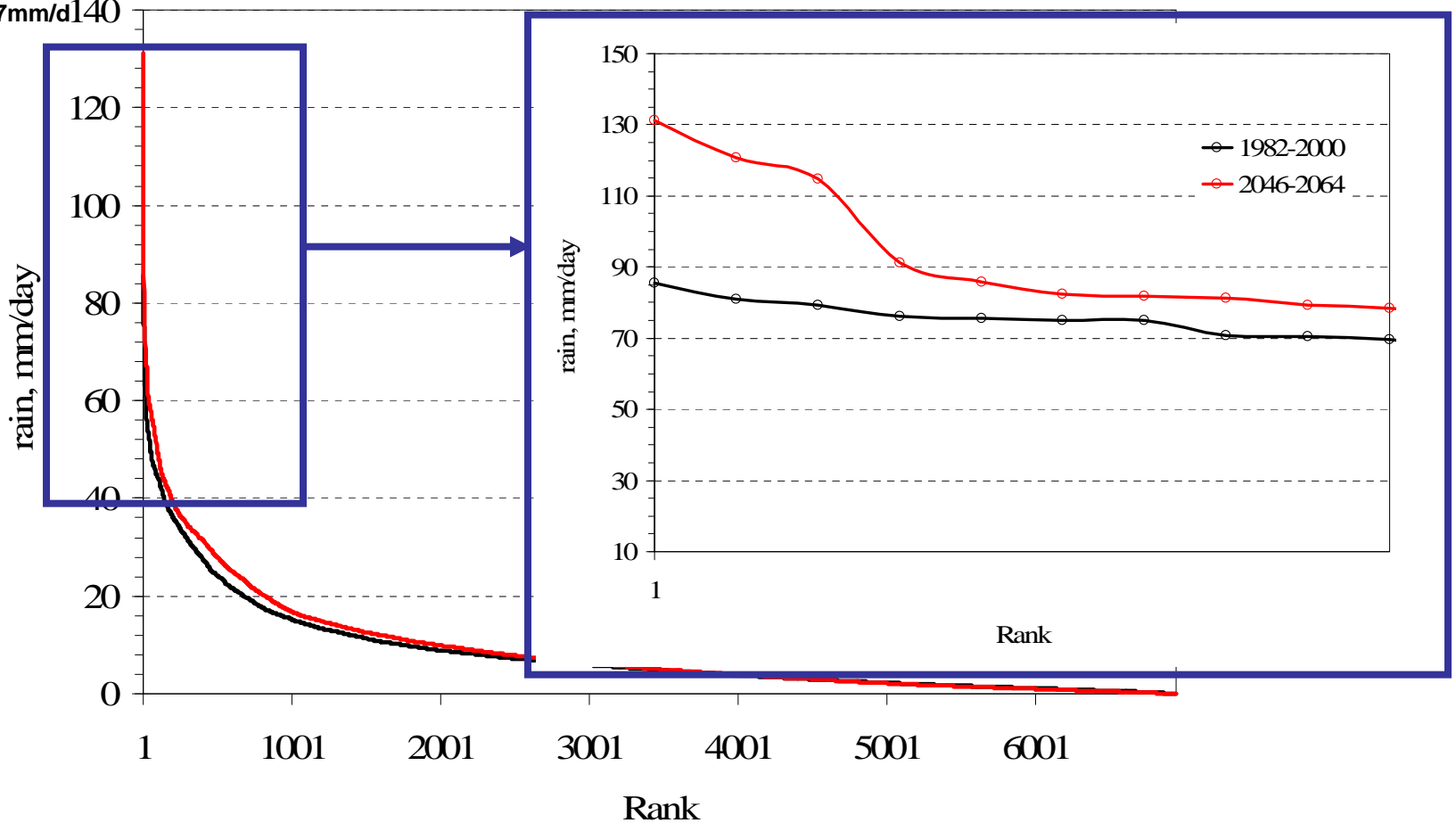
月降水量



気候変動予測モデル出力の利用の問題点:

- モデル間の大きなばらつき
 - 豪雨の過小評価
 - 無降雨日数数の過小評価
 - 低い季節特性再現性
 - 低い空間分解能
- バイアス補正
ダウンスケーリング
マルチモデル利用
水循環モデルとの結合

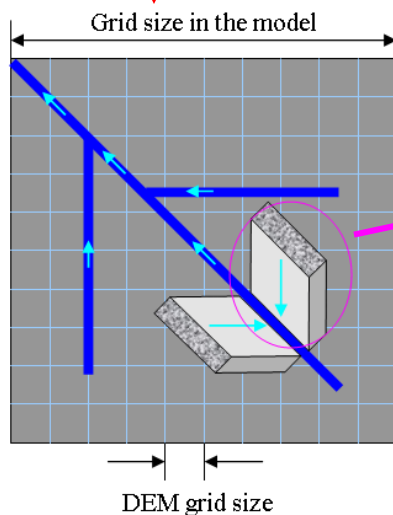
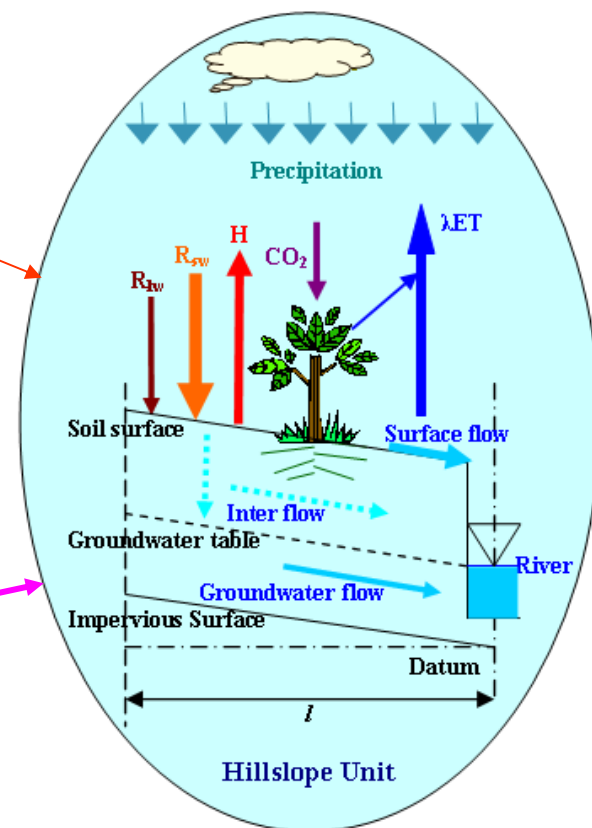
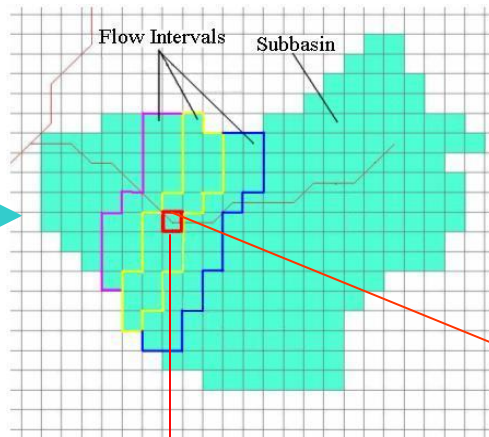
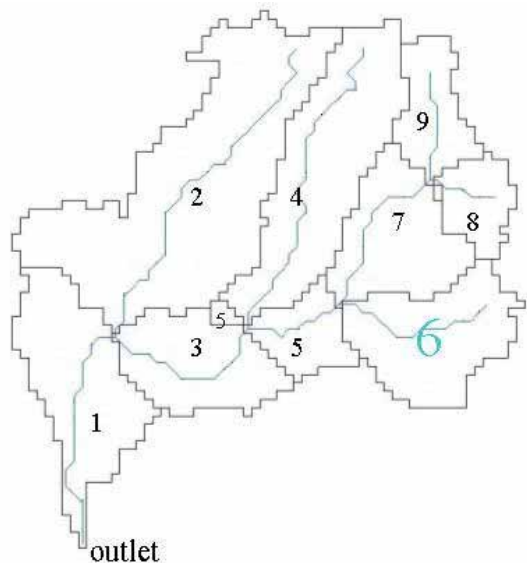
Max Rain
Past = 85.59mm/d
Future = 131.237mm/d



早明浦ダム流域での過去(1982-2000)と将来(2046 - 2064)日降水量の順序統計

WEB-DHM

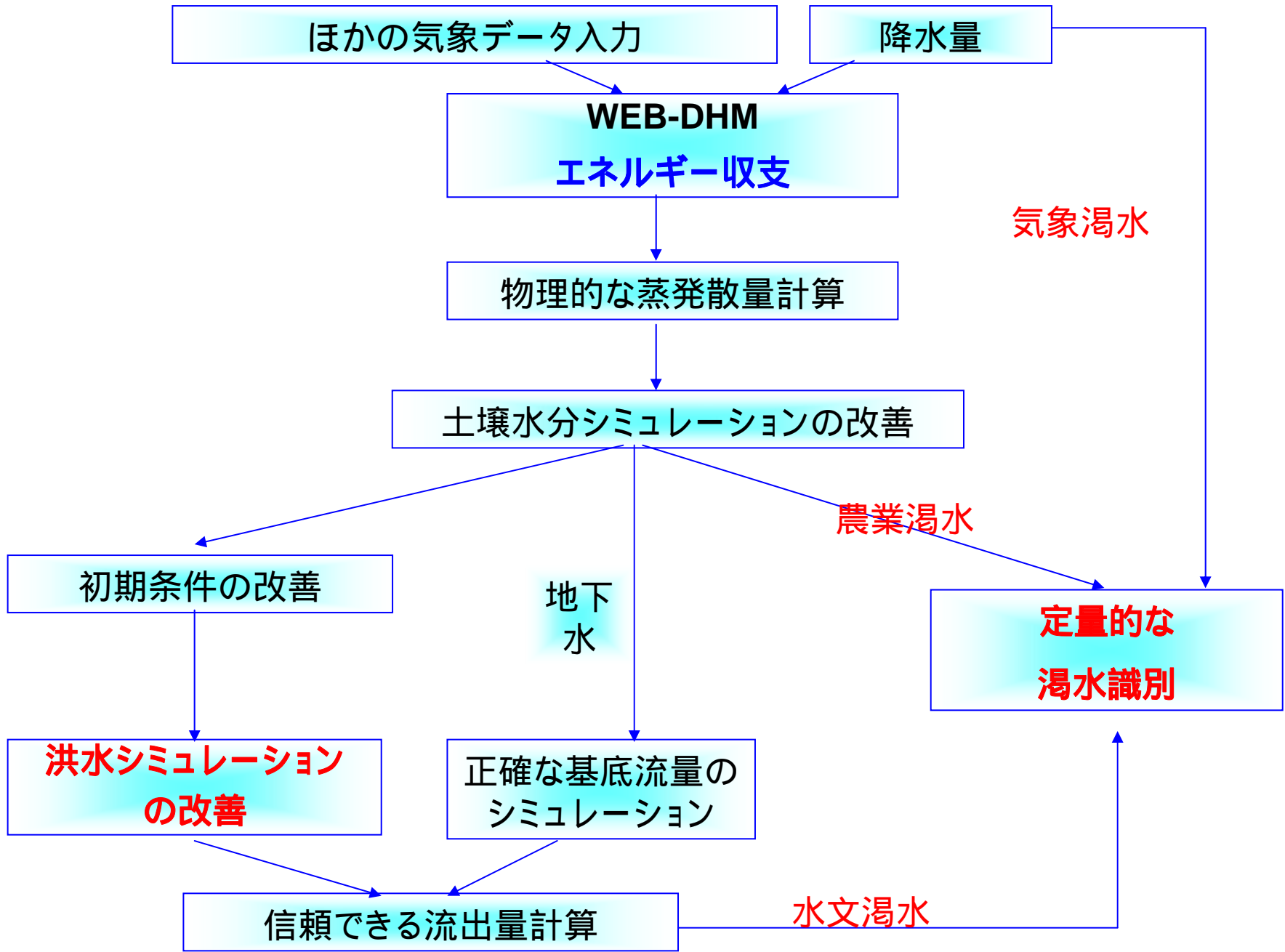
(Water and Energy Budget-based Distributed Hydrological Model)



サブグリッドスキーム

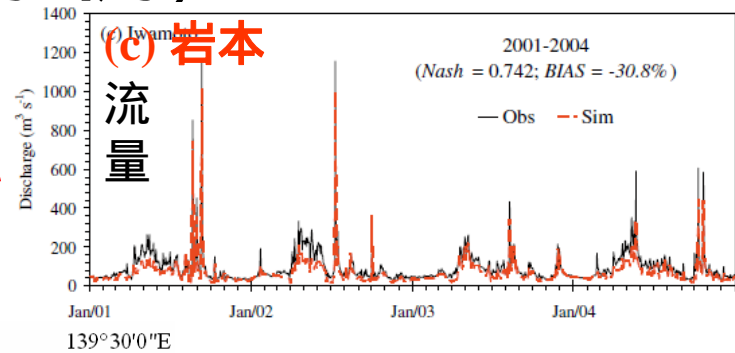
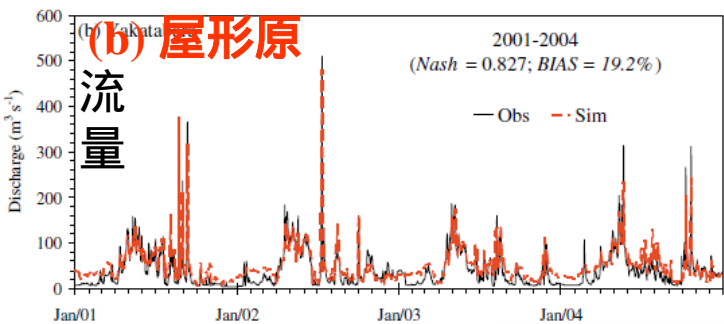
斜面の長さと
角度はDEMか
ら作成。

洪水と干ばつ災害の解析プロセス: WEB-DHM



利根川上流域 (洪水例)

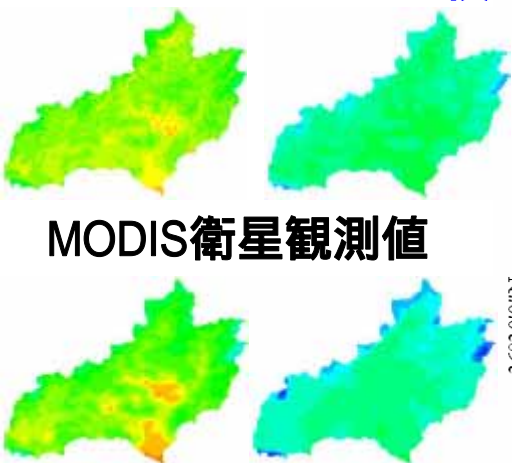
2001-2004



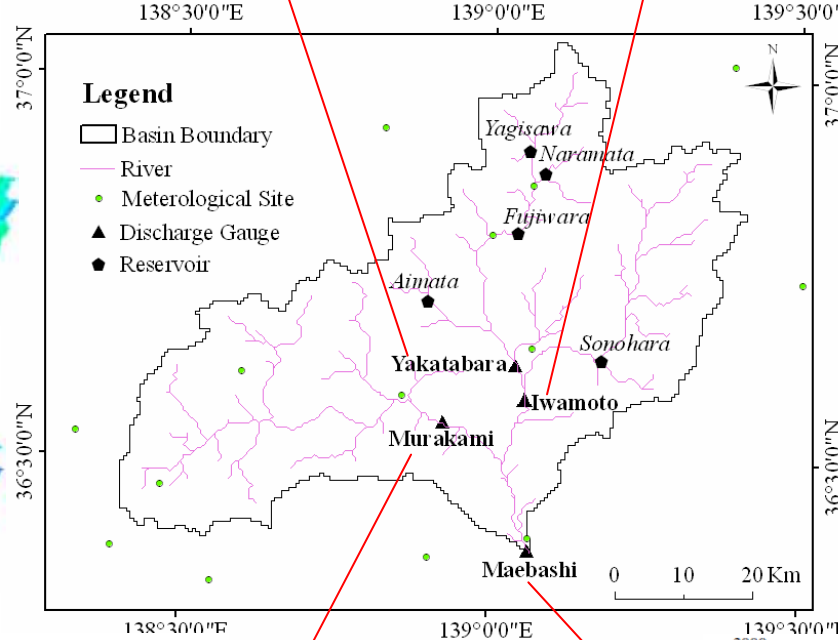
陸面温度計算値

昼

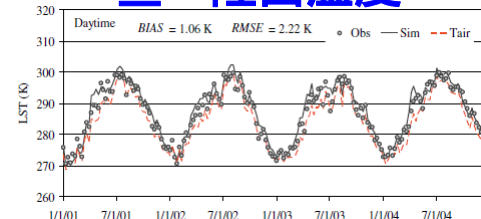
夜



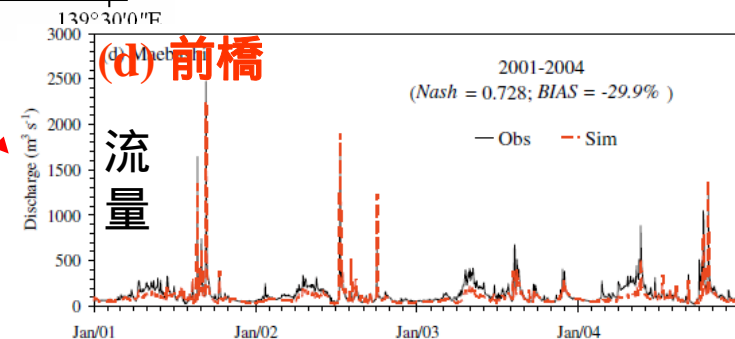
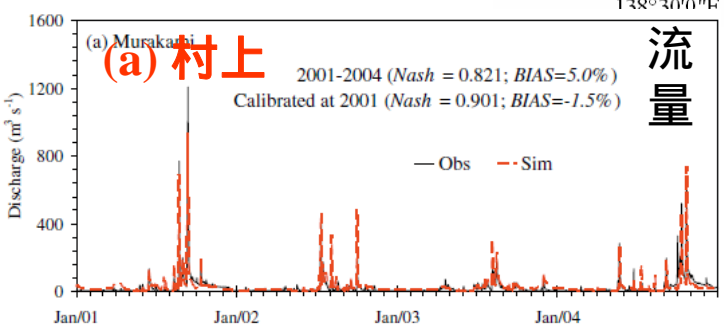
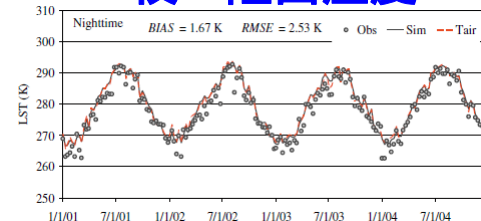
MODIS衛星観測値



昼-陸面温度

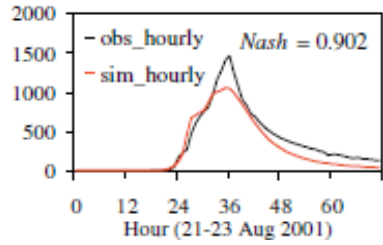


夜-陸面温度

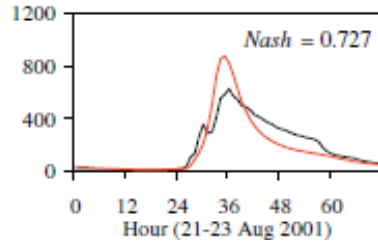


年最大流量

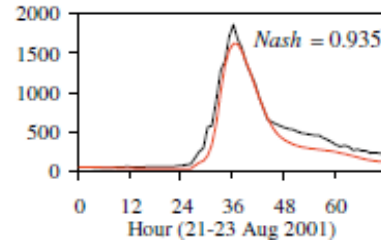
(a) 村上



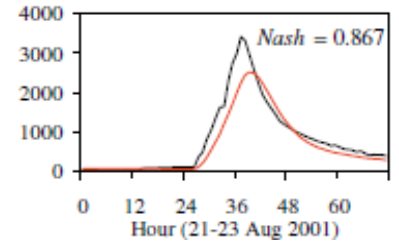
(b) 屋形原



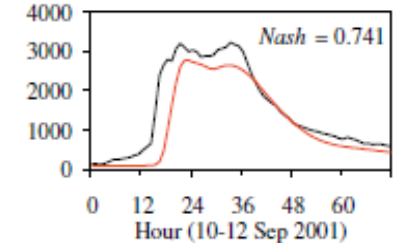
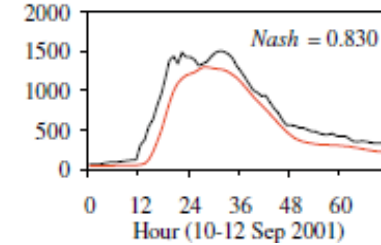
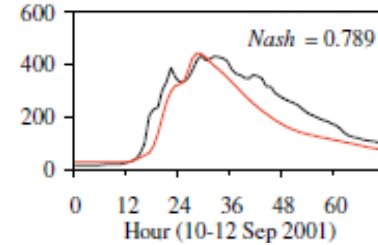
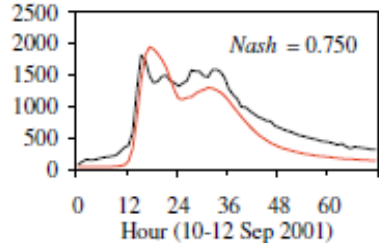
(c) 岩本



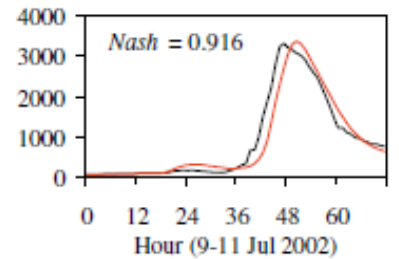
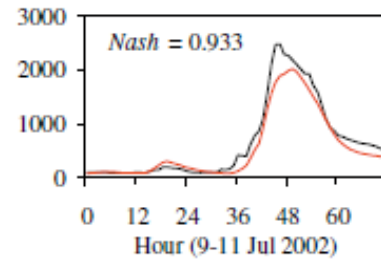
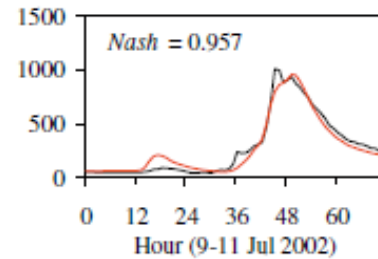
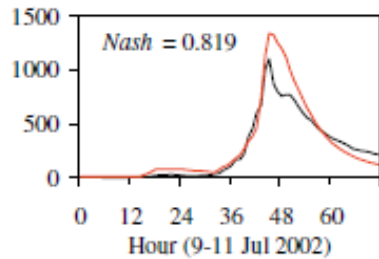
(d) 前橋



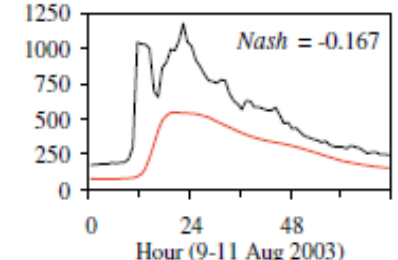
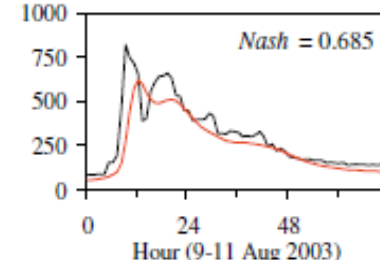
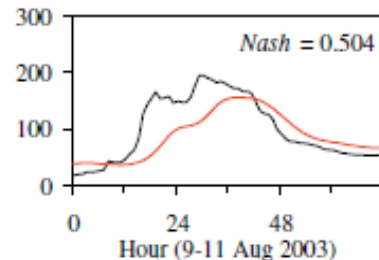
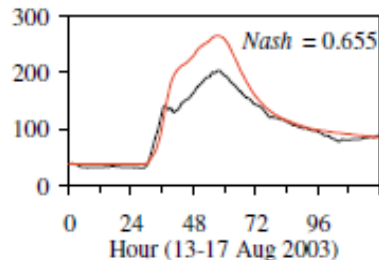
2001
(2)



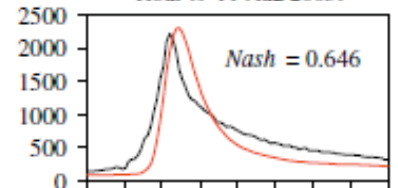
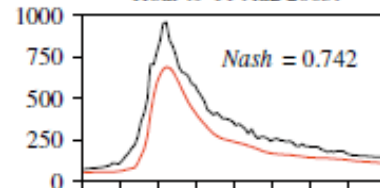
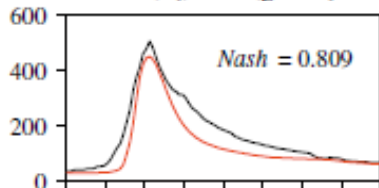
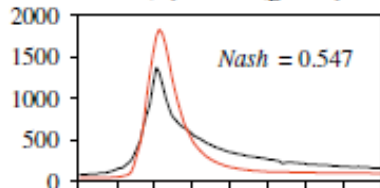
2002



2003

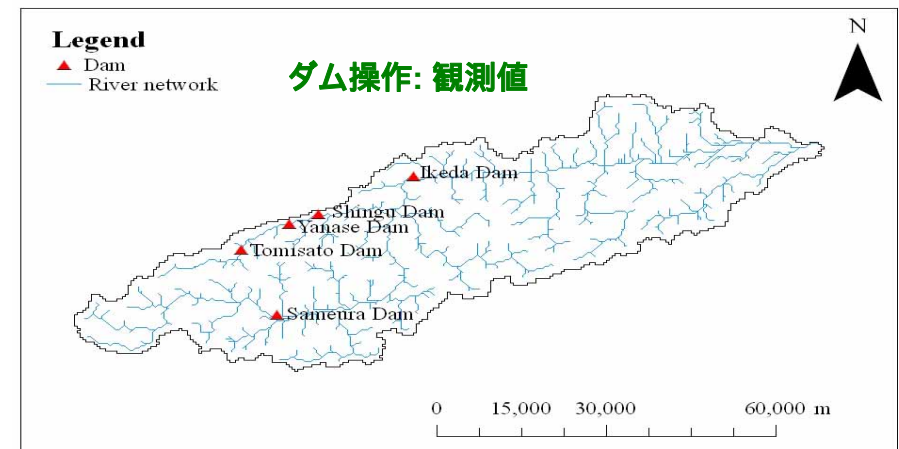
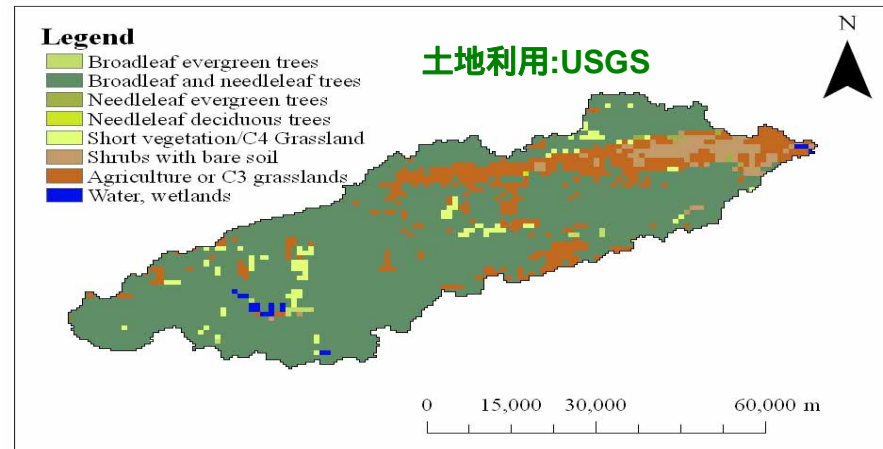
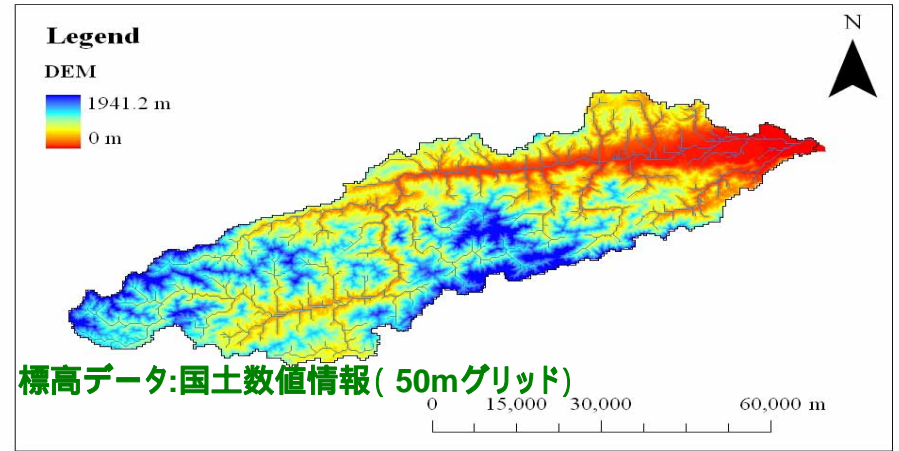
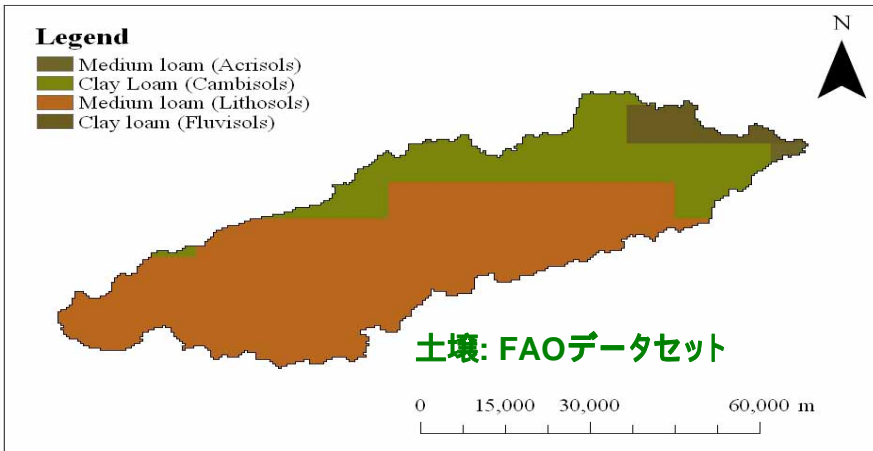


2004

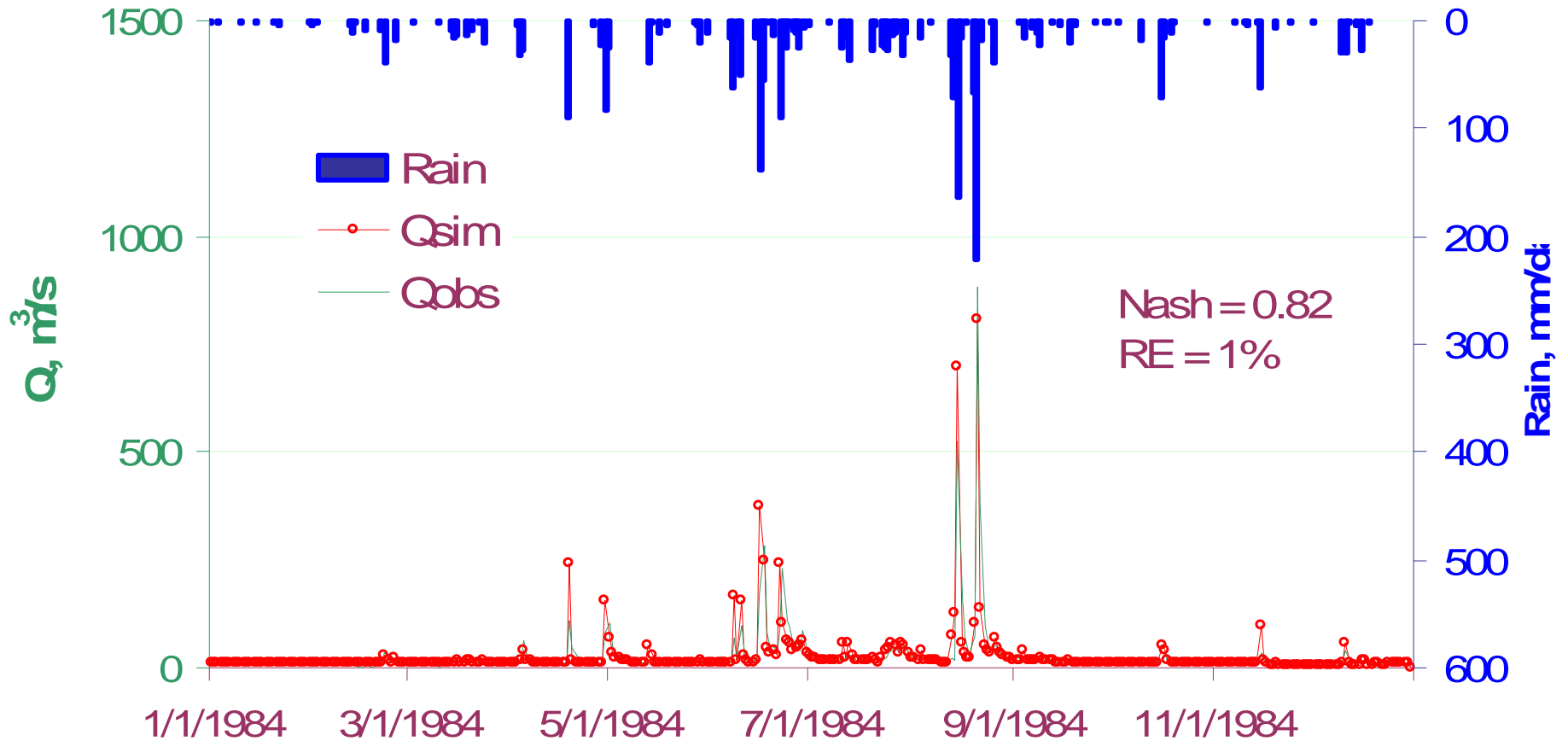
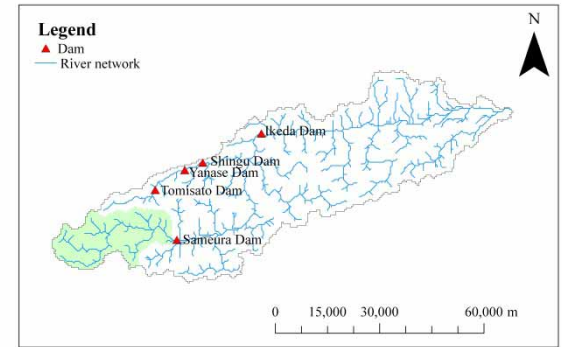


吉野川流域でのWEB-DHM開発

流域面積: 3408.5 km²

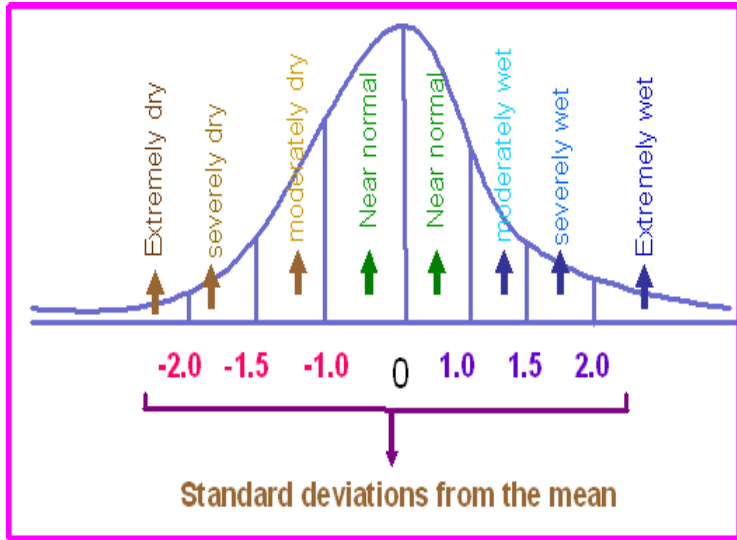


モデルキャリブレーション 早明浦ダム流域 (1984年)



計算期間:1982-2000年

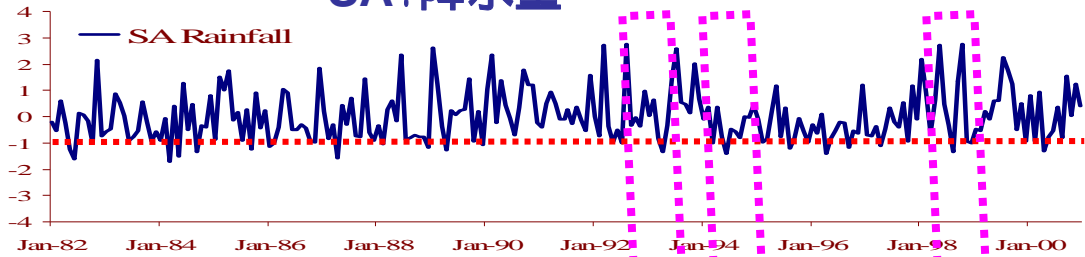
標準化偏差指標 (SA)



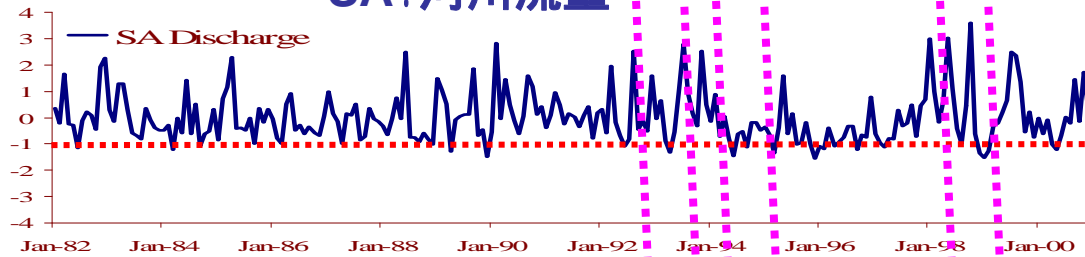
SA > 1 異常降雨

SA < -1 異常渇水

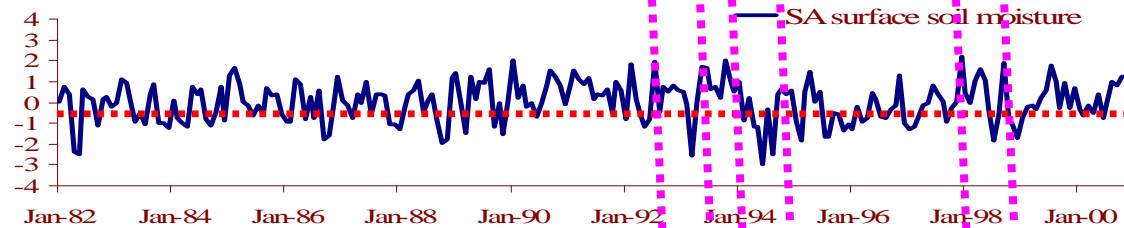
SA: 降水量



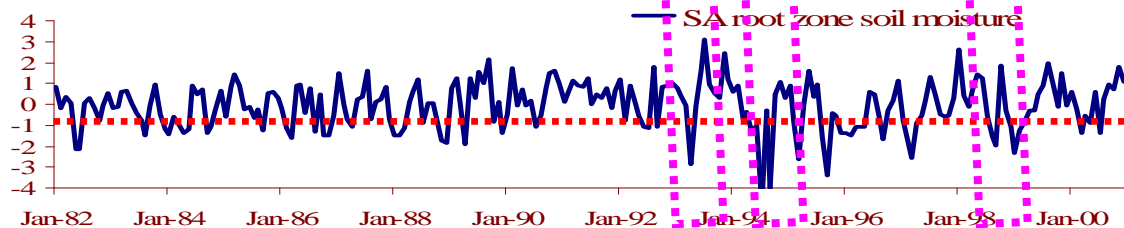
SA: 河川流量



SA: 表層土壤水分量

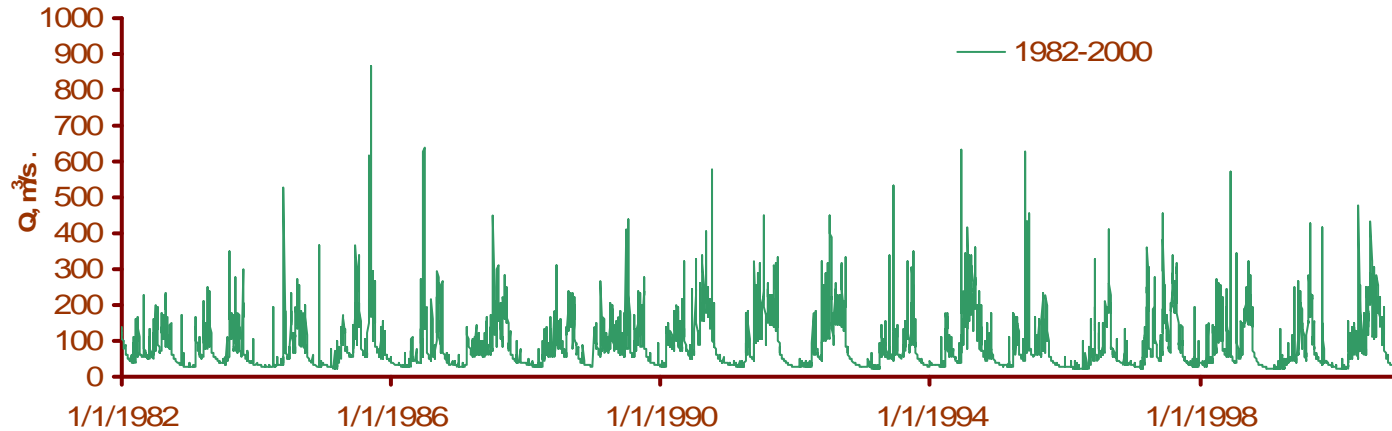


SA: 根系層土壤水分量



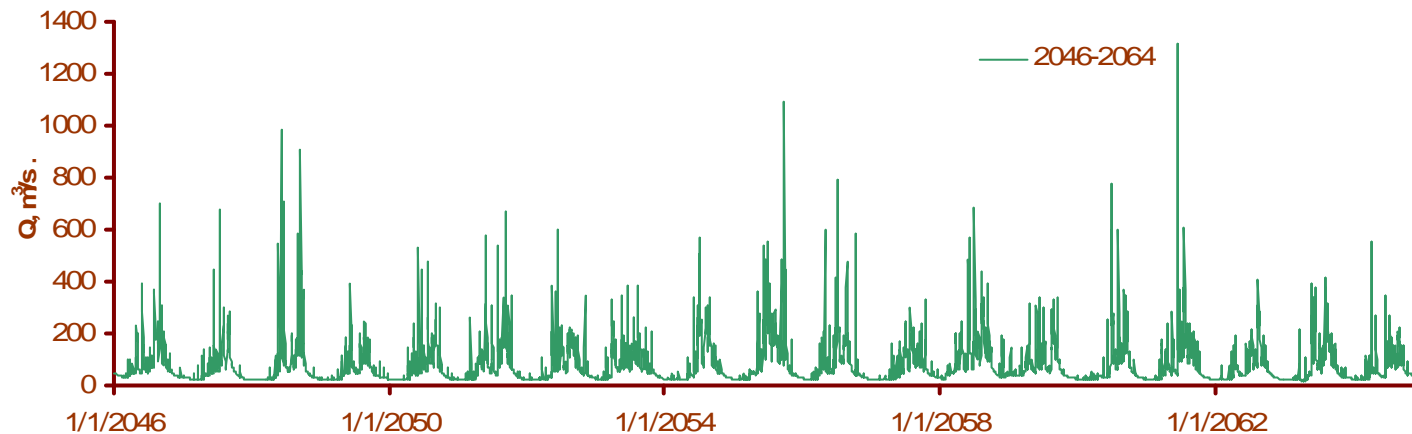
過去(1982-2000)と将来(2046-2064)の 各19年間の流量時系列

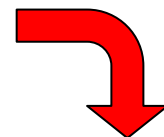
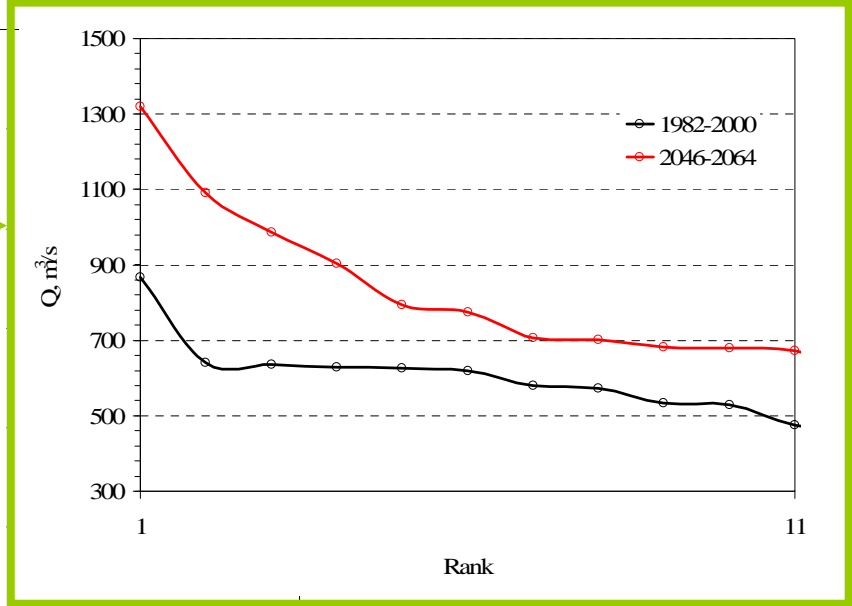
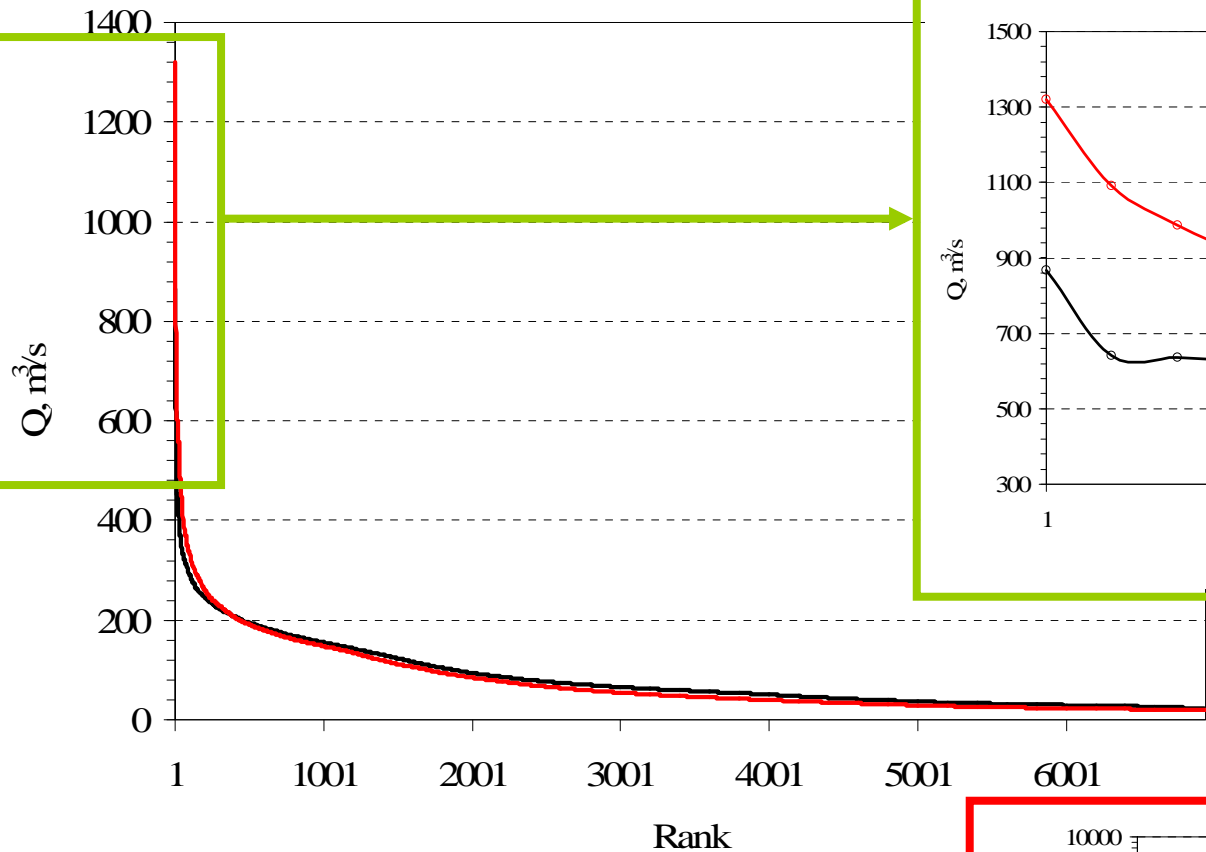
DAILY DISCHARGE (1982-2000)



Long term trend: slight difference of extreme events, most probably because the years are not so far away from each other.

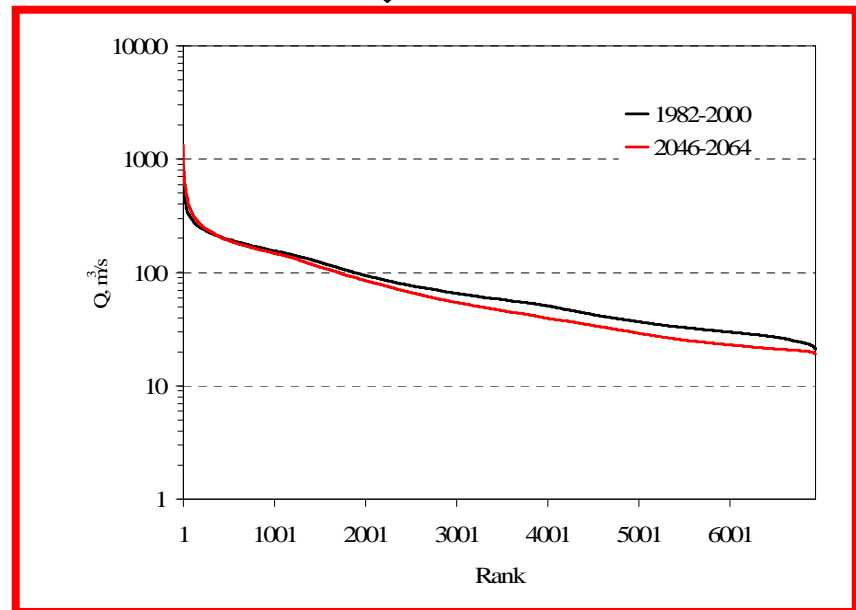
DAILY DISCHARGE (2046-2064)





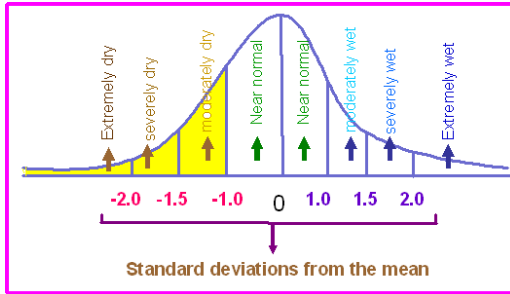
対数軸で表現

早明浦ダム流域
過去(1982-2000)と
将来(2046-2064)の
河川流量の順序統計



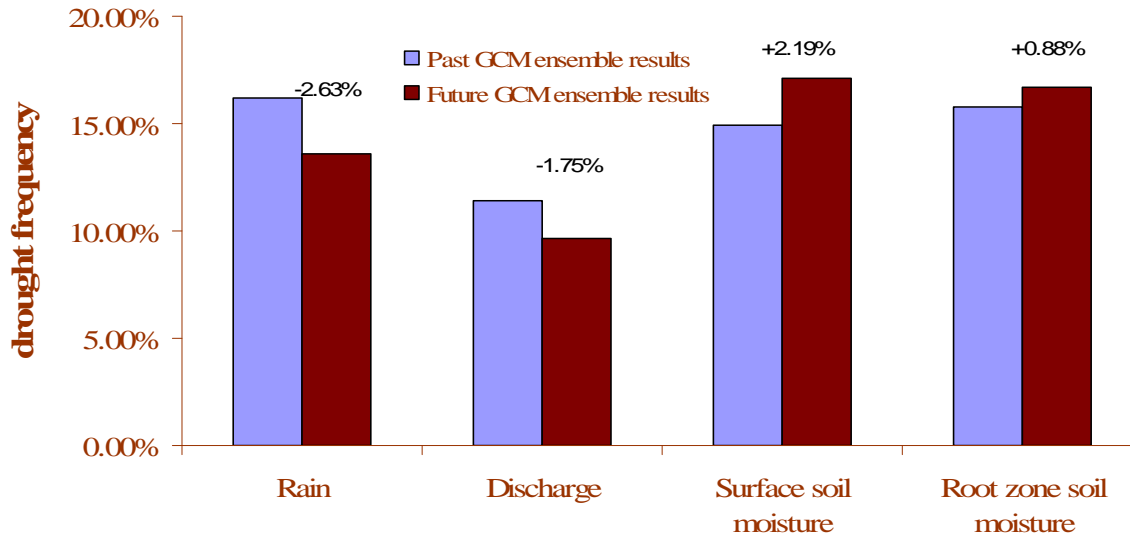
気候変動傾向

渇水指標(SA)の変化



水文量	渇水強度	渇水頻度
降水量	減少	減少
河川流量	増加	減少
表層土壌水分	わずかな変化	増加
根系層土壌水分	わずかな変化	増加

Standard Anomaly Index for drought occurrence



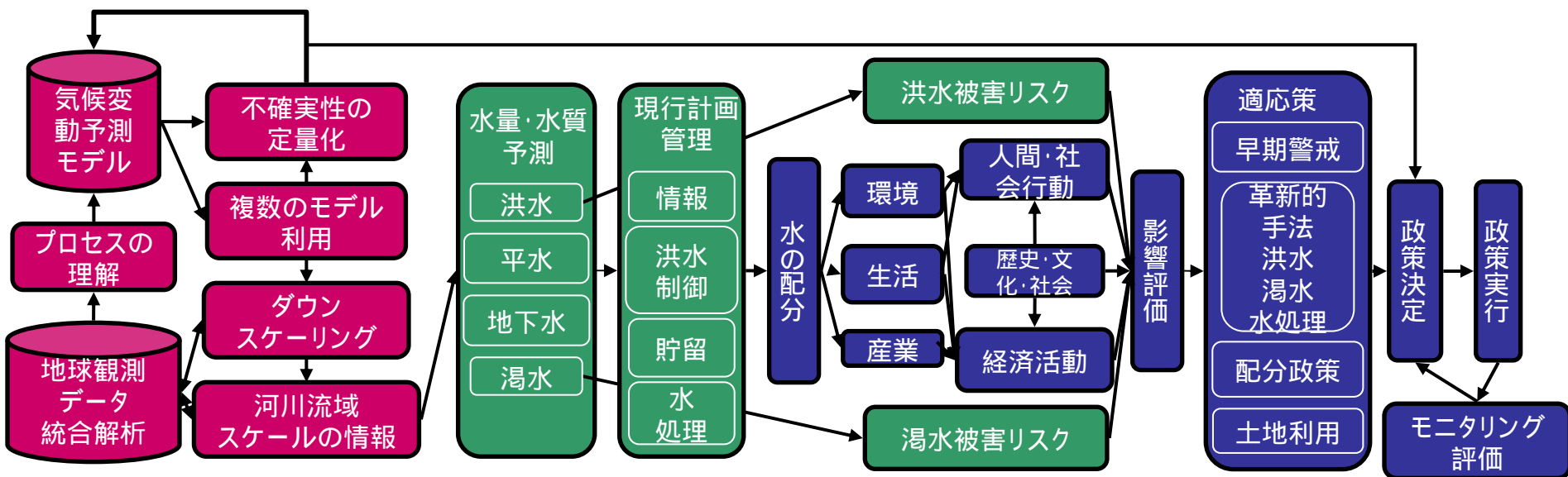
(+) より頻度が高い
 (-) より頻度が低い

End to End の適応策

科学的アプローチ

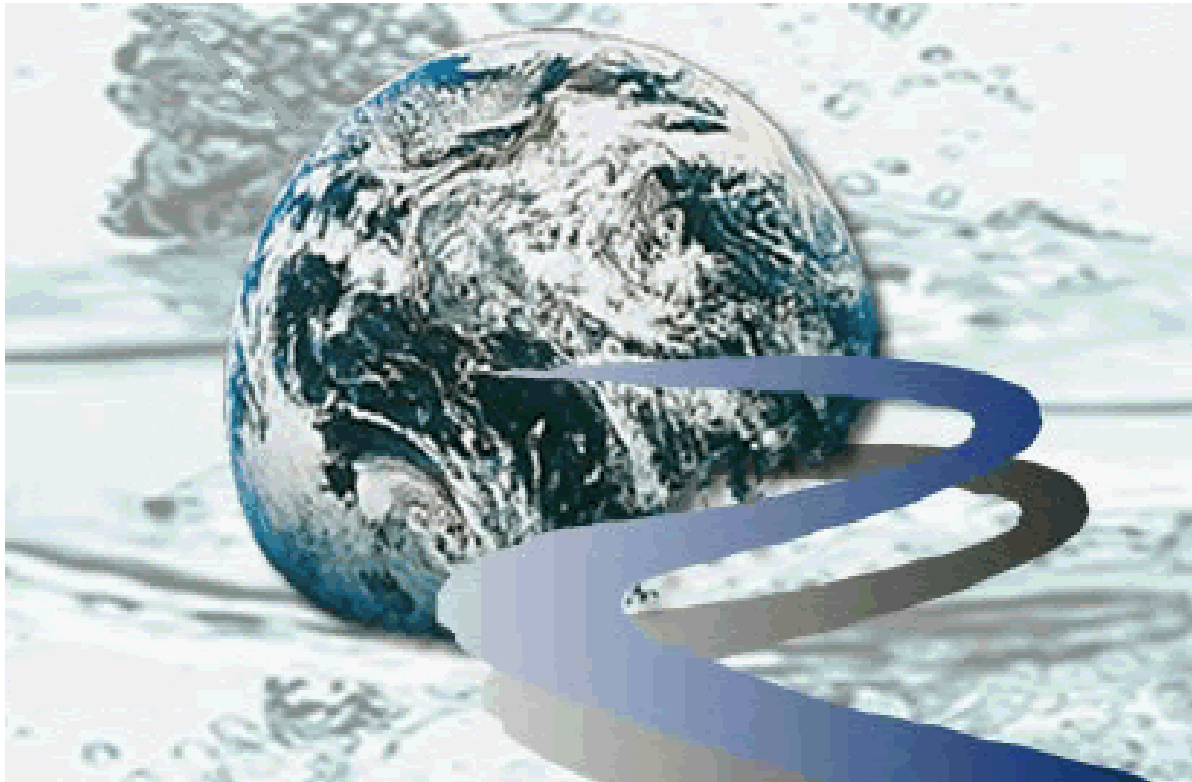
技術的アプローチ

社会経済的アプローチ



水惑星地球を科学する

水をめぐる自然と人、人と人の調和と和やかさを求めて



ご清聴有難うございました。