

Theme II Subprojects

II.3.1 Coupled Model Initialization

II.4 Sensitivity of Seasonal Climate Forecasts in the CCCma GCM to Initialization of Land Surface Hydrological States

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Environment Canada***



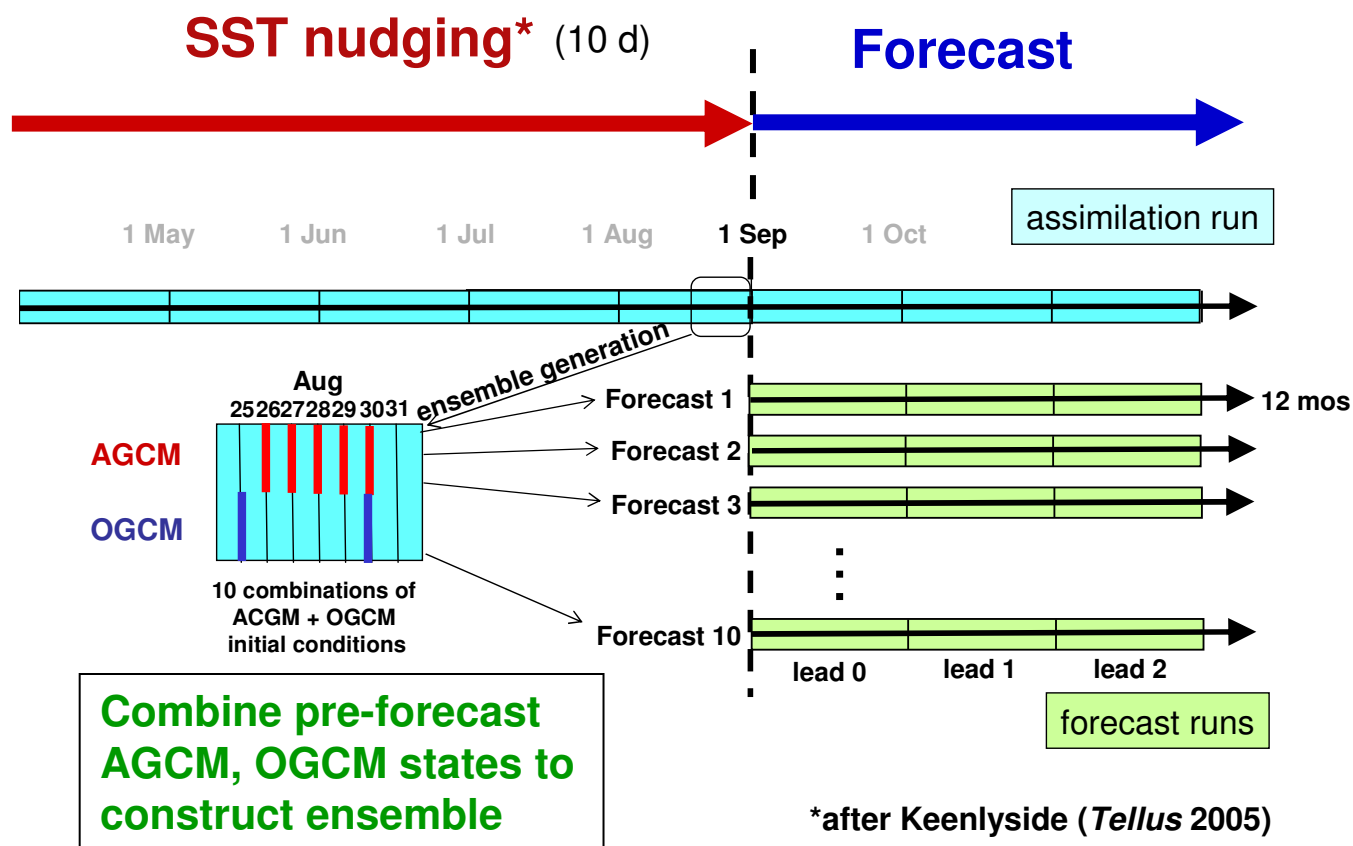
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CHFP1 pilot project initialization



→ *simplest procedure likely to have much skill*



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Research and development toward CHFP2

- Ocean initialization:
 - “off-line” assim of ocean T analyses (Tang *JGR* 2004), improved error covariances, S assim → *Woo-Sung Lee's talk* [**Collaborator:** *Youmin Tang* (UNBC)]



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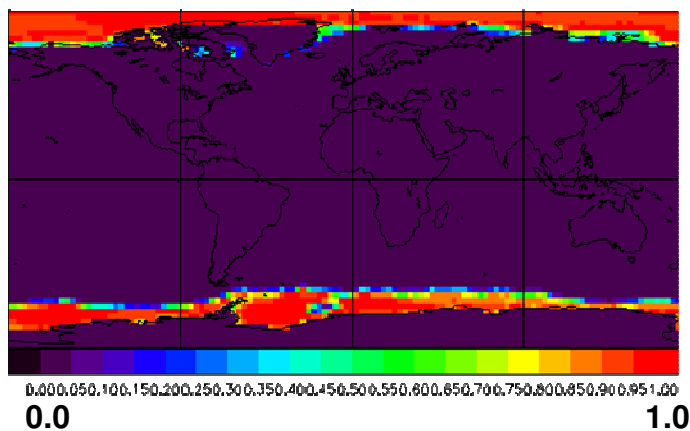
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Research and development toward CHFP2

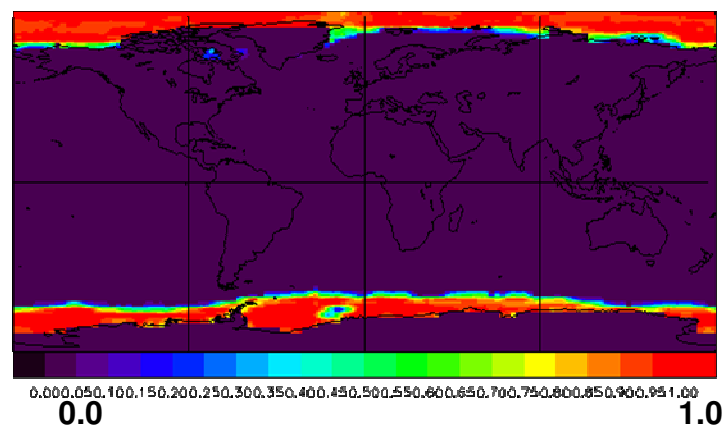
- Ocean initialization:
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- Ice initialization:
 - nudging to Hadisst observations (10 d)

Sea ice concentration: August 1976

Hadisst obs



Forecast initial conditons



Research and development toward CHFP2

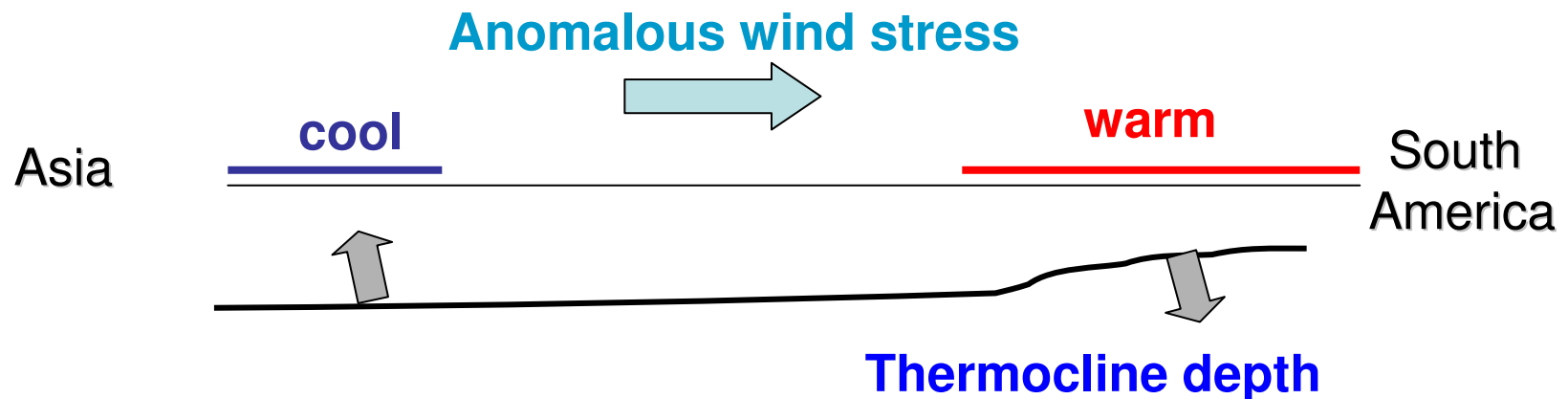
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- Atmosphere initialization
- Land surface initialization



Atmospheric initialization

- CHFP1: atmosphere initialized by SST nudging alone
 - some skill initializing trop Pacific winds, subsurface ocean → ENSO skill

Example: effects of El Nino SSTs in tropical Pacific:



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 - initial state has wrong “weather” → *poor 1st month skill*
vs more realistic initialization



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- Improvement #1: insert NCEP reanalysis as in HFP2



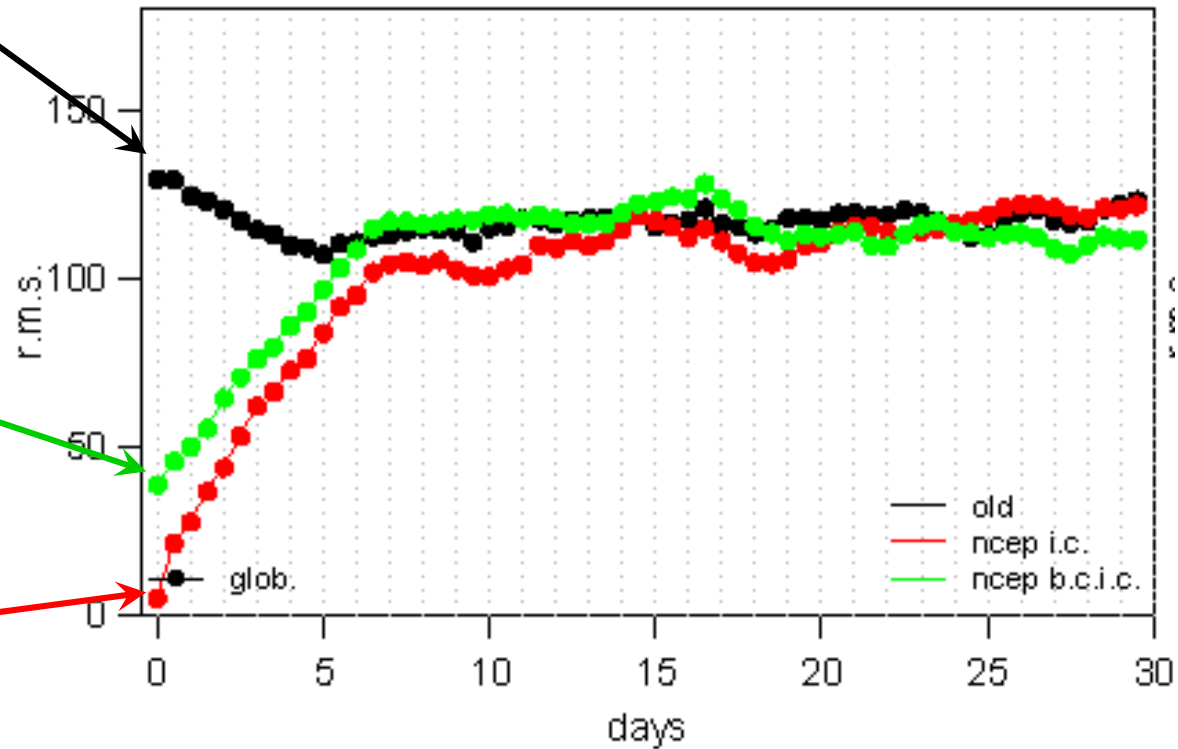
500 mb height RMS error vs time in AGCM

PHI500 yr=1972 m=09

SST nudging
initialization

NCEP
anomalies
inserted

NCEP
state
inserted



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- Improvement #2: *assimilation* of NCEP reanalysis via *incremental analysis updates (IAU)*
 - reanalysis insertion can cause model “shock” due to sudden change
 - IAU spreads observational forcing out in time



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 - reanalysis insertion can cause model “shock” due to sudden change
 - IAU spreads observational forcing out in time
 - damping influence of traditional nudging is avoided
 - **Collaborator:** *Saroja Polavarapu (EC Downsvieiw)*



Incremental Analysis Updates (IAU)

To assimilate 6-hourly NCEP states:

- run model freely for 3h (“forecast”)
- calculate difference with NCEP → “centered” increments
- rewind, rerun for 6h, adding analysis increments as forcing to model equations: $\frac{d\mathbf{x}}{dt} = M(\mathbf{x}) + h(t)\Delta\mathbf{x}^a$

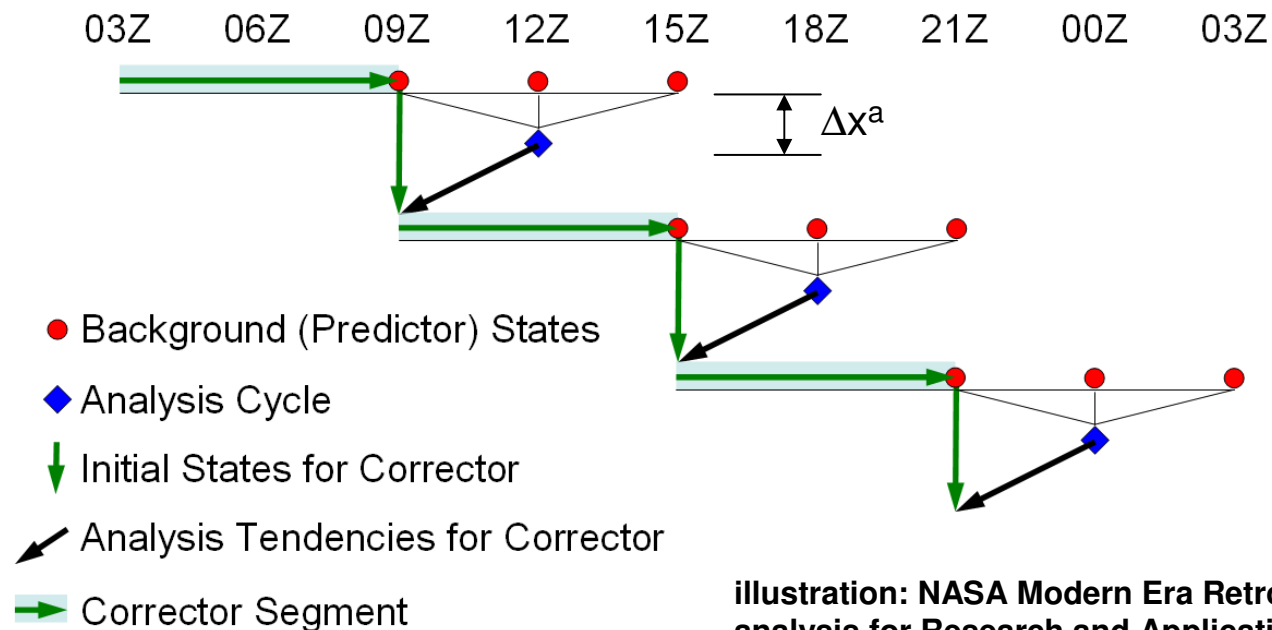


illustration: NASA Modern Era Retrospective-analysis for Research and Applications (MERRA)



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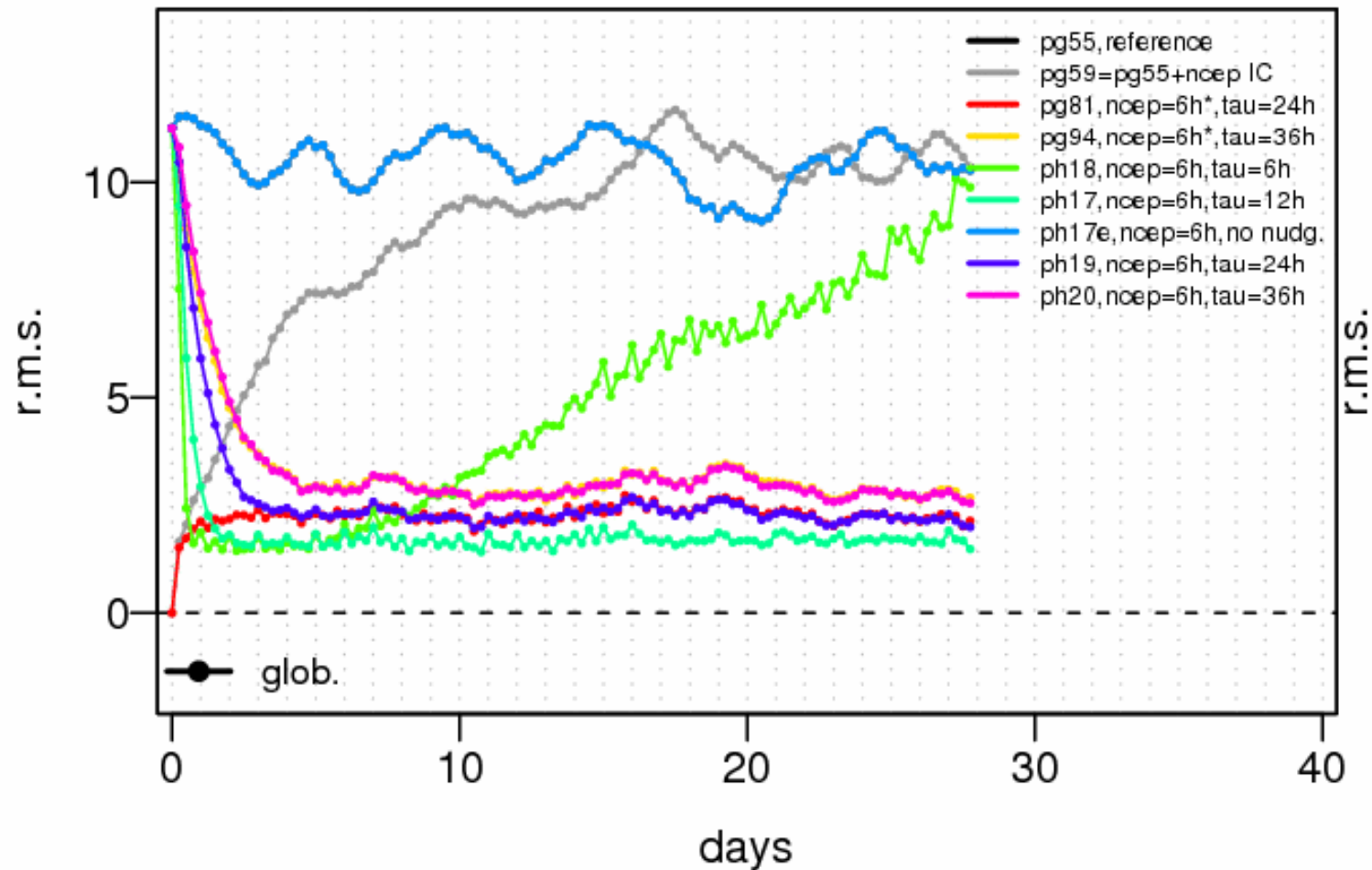
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Example (from John Scinocca)

PS yr=1972 m=02



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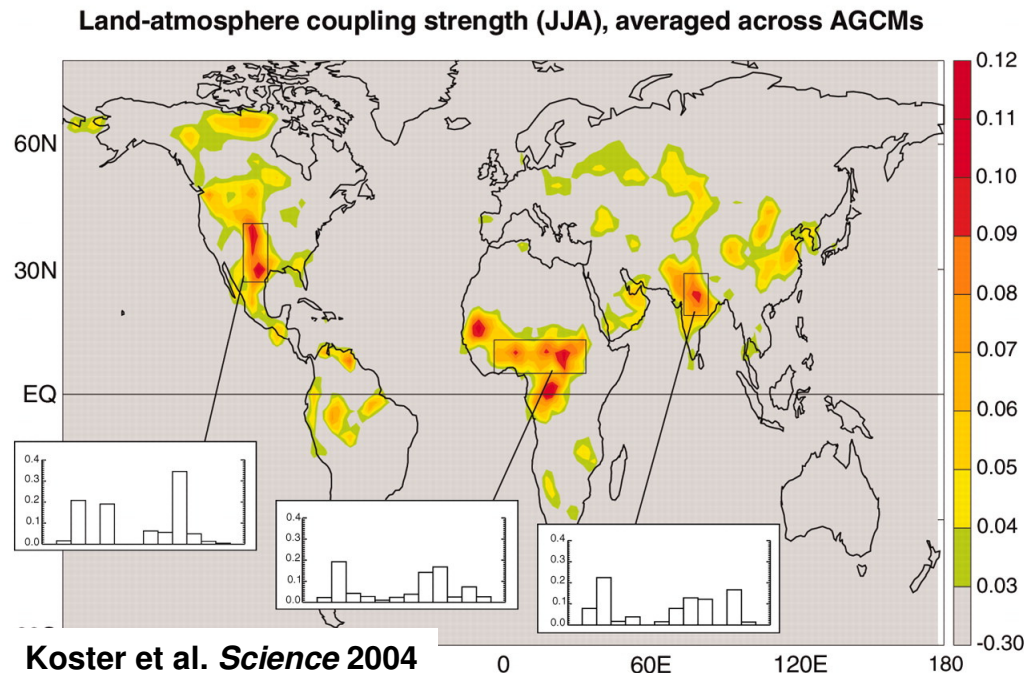
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Impact of land surface initial conditions

- Land surface state (especially soil moisture) imparts predictability up to ~1 season



- Land-atmosphere feedbacks concentrated in “hot spots” where soil moisture is highly variable (not too dry, not too wet) → Canadian prairies



Land surface initialization

- CCCma collaboration with *Aaron Berg* & *Gordon Drewitt* (*U Guelph*)
- Strategy: drive CLASS land surface model used in CGCM off-line with *bias-corrected* NCEP reanalysis



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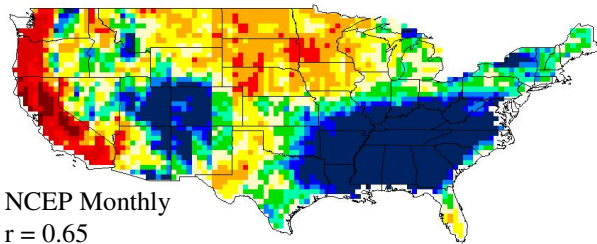
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Data Set Development

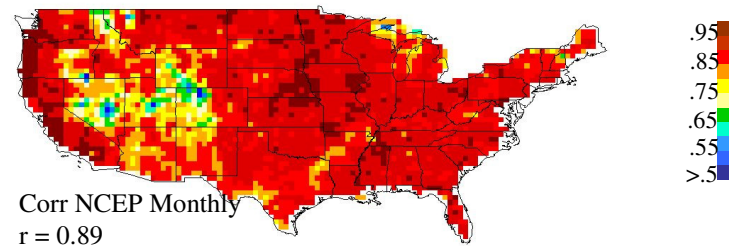
- Bias-correct reanalyses after Berg et al. (Int J Clim 2005)

Correlation of NCEP monthly precip with gauge-based measurements:

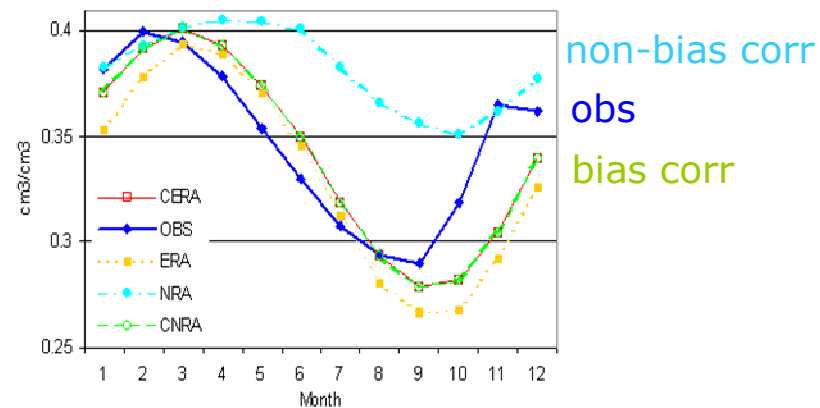
before bias correction



after bias correction



Simulated and Observed
Illinois Soil Moisture



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 - snow temperature and depth
 - soil temperature, liquid & frozen water (3 levels)
 - canopy temperature & moisture content



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 - snow temperature and depth
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- Next:
 - use as forecast initial conditions
 - study impact on skill, especially for 2001-2002 Canadian prairie drought



CHFP2 initialization

