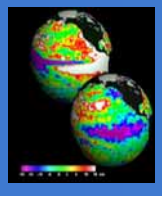
SOUTHEAST CLIMATE CONSORTIUM

AGRICULTURE CLIMATE WATER



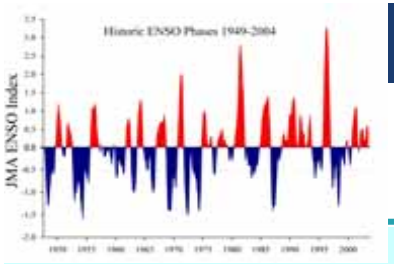
Bellow, J.G., Shin, D.W., Schoof, J., Jones, J. and O'Brien, J.J.

Contribution of Climate Fields from Dynamically Downscaled GCM to Predicting Peanut Yields in the SE USA

COAPS

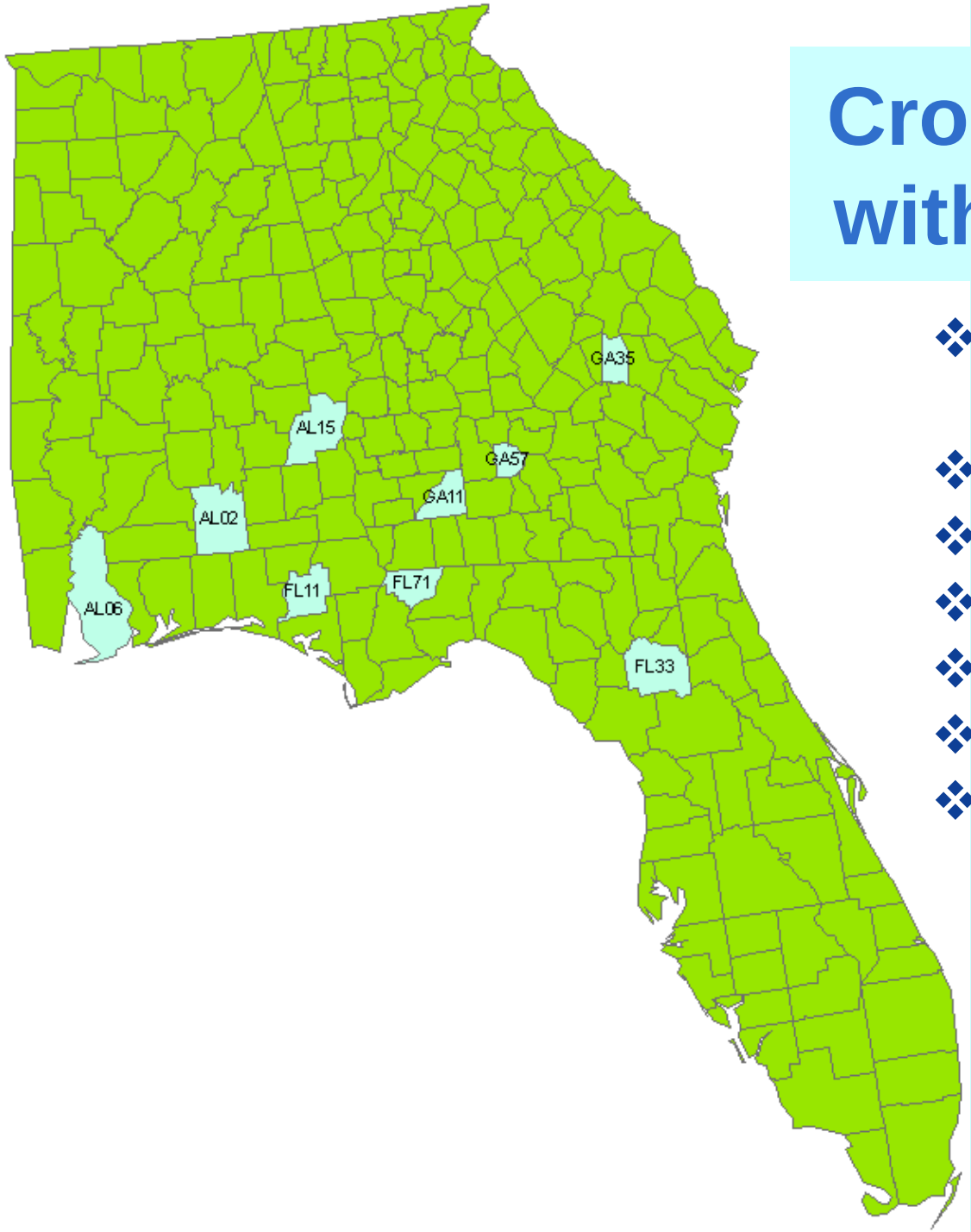
UNIVERSITY OF FLORIDA

IFAS



Background

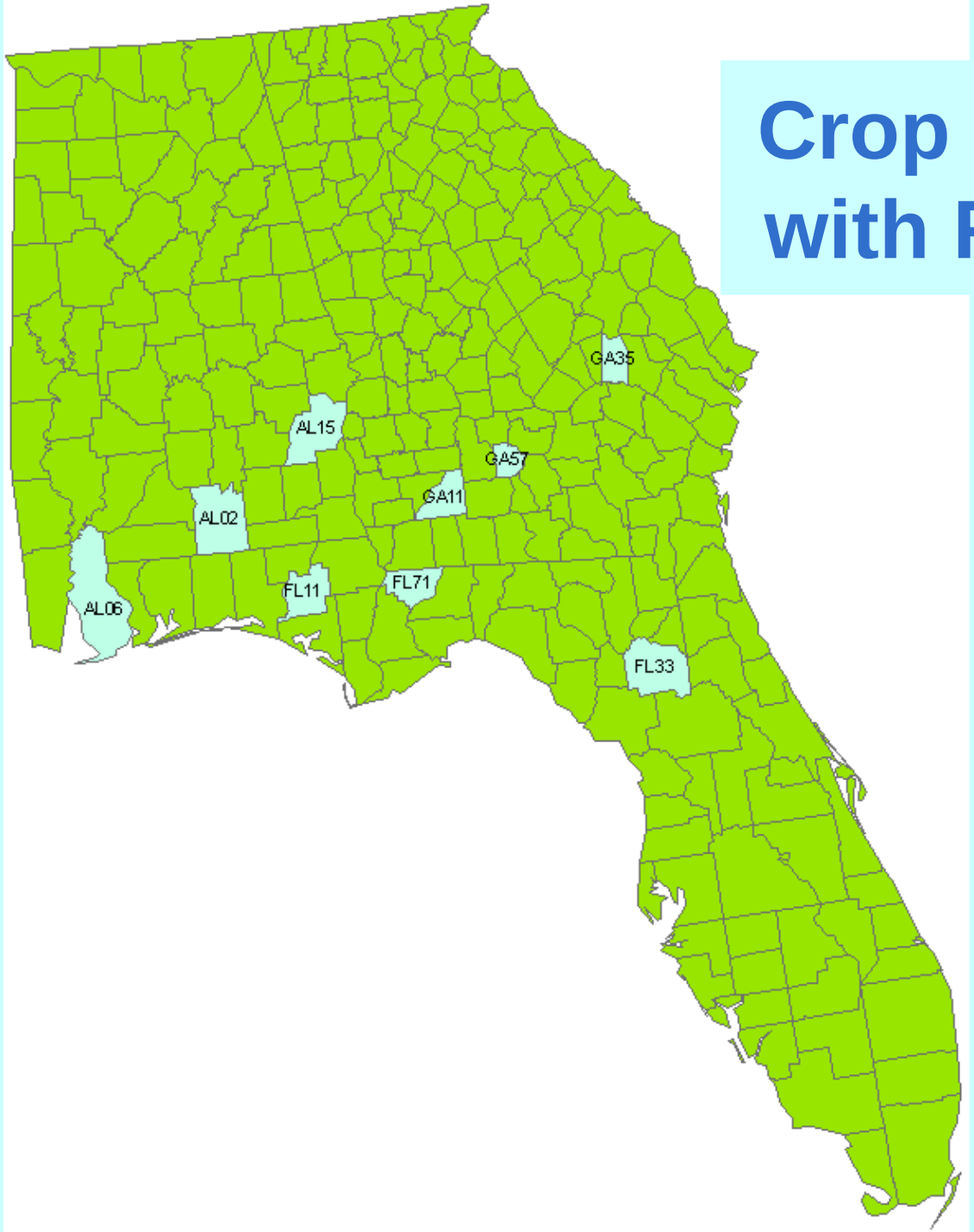
- SECC and AgClimate.org
- ENSO and crop yields
- Global climate model
- Dynamical Downscaling with nested RCM



Crop simulation with RCM fields

- CropGro CSM
  - Peanut – v. Georgia Green
- Site specific soil profiles
- Rainfed conditions
- Uncalibrated for sites
- 1994-2003
- Nine sites (AL, FL, GA)
- Data sources
  - NWS Coop Network

  - FSU Global Spectral model
  - FSU RCM
    - RAS
    - SAS

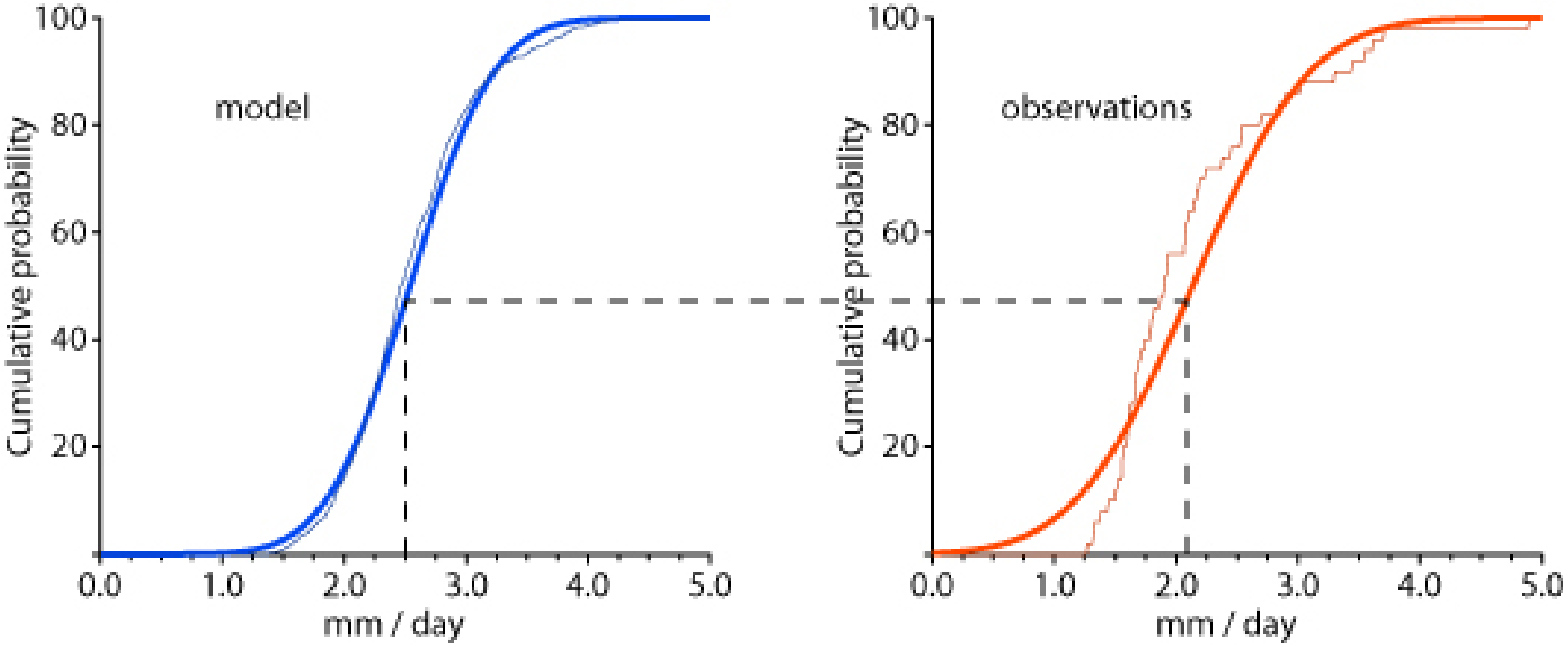


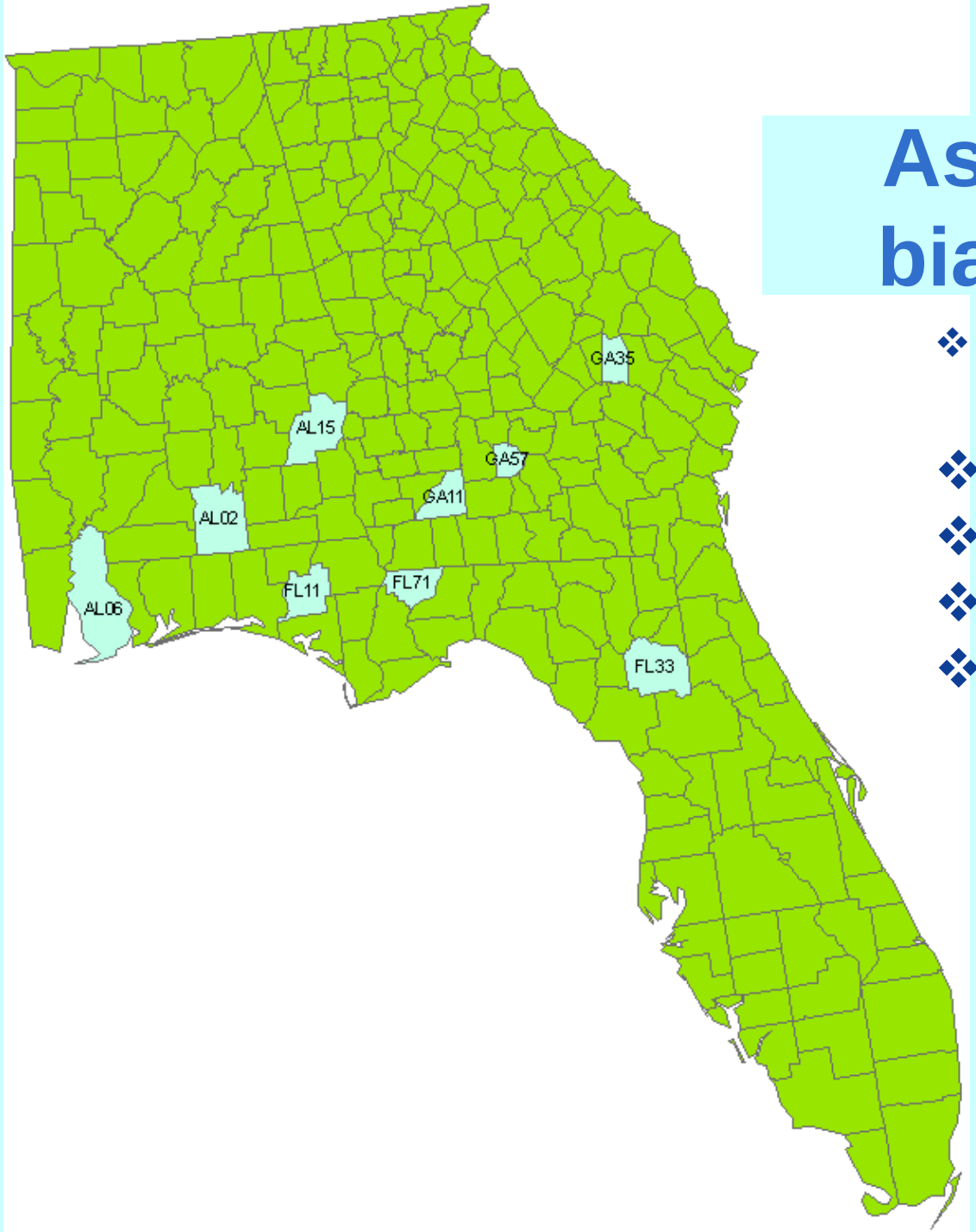
Crop simulation with RCM fields

- FSU Global Spectral model
  - T63 – 200 km^2 or 1.8°
- FSU Regional Climate Model
  - Two convection schemes
    - RAS
    - SAS
    - Bias Correction

Assessment of Spatial Variability

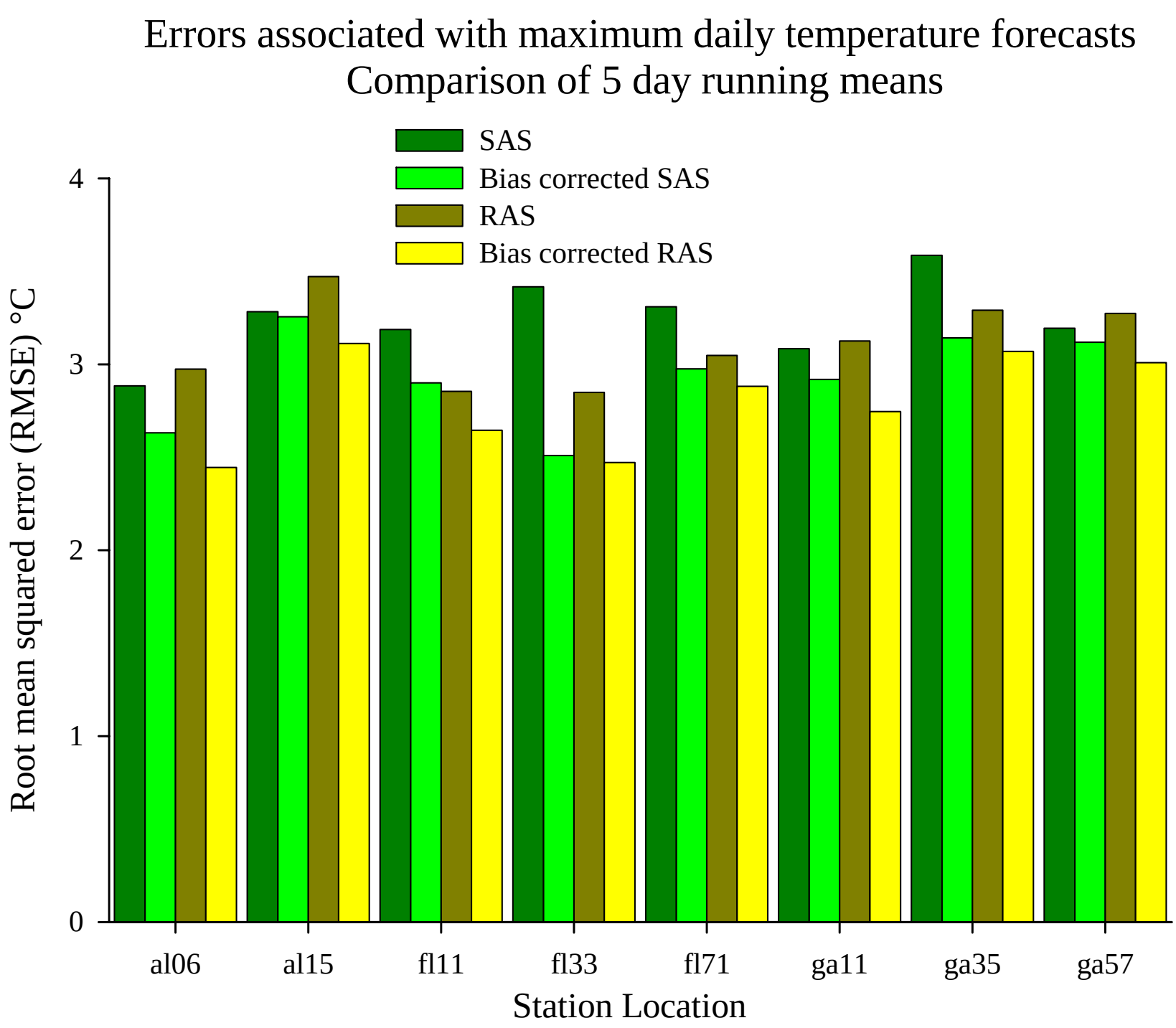
- Bias correction

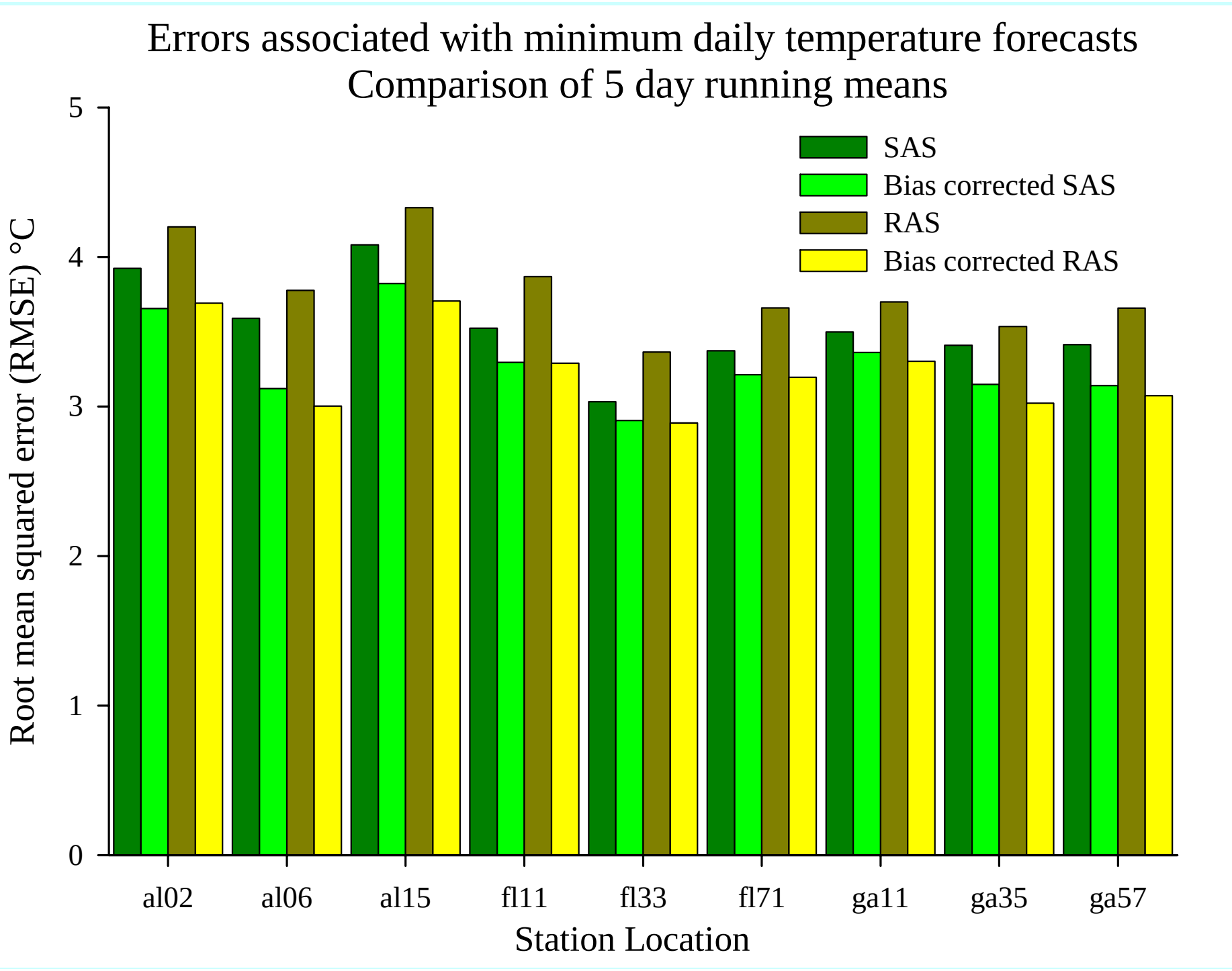


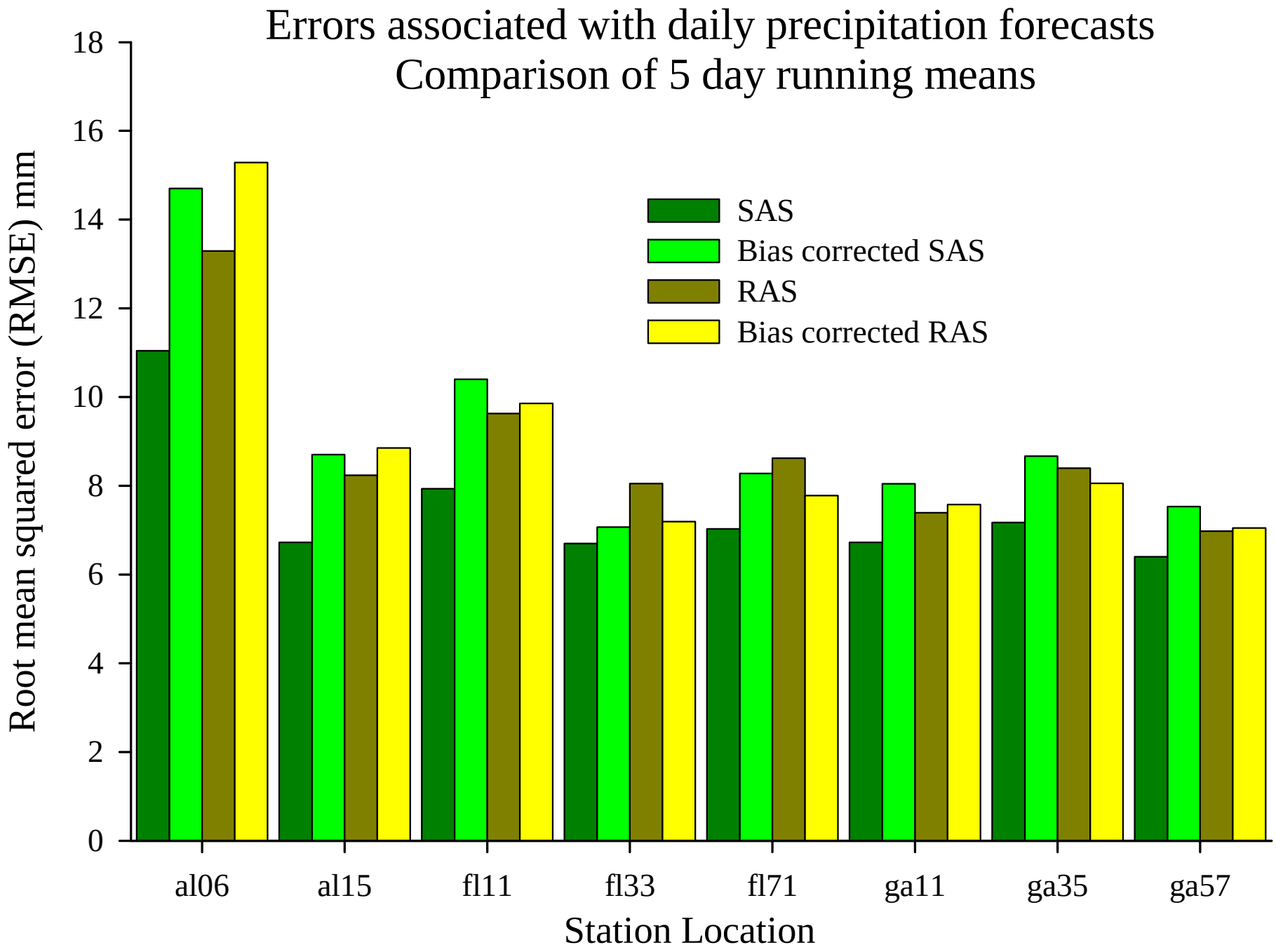


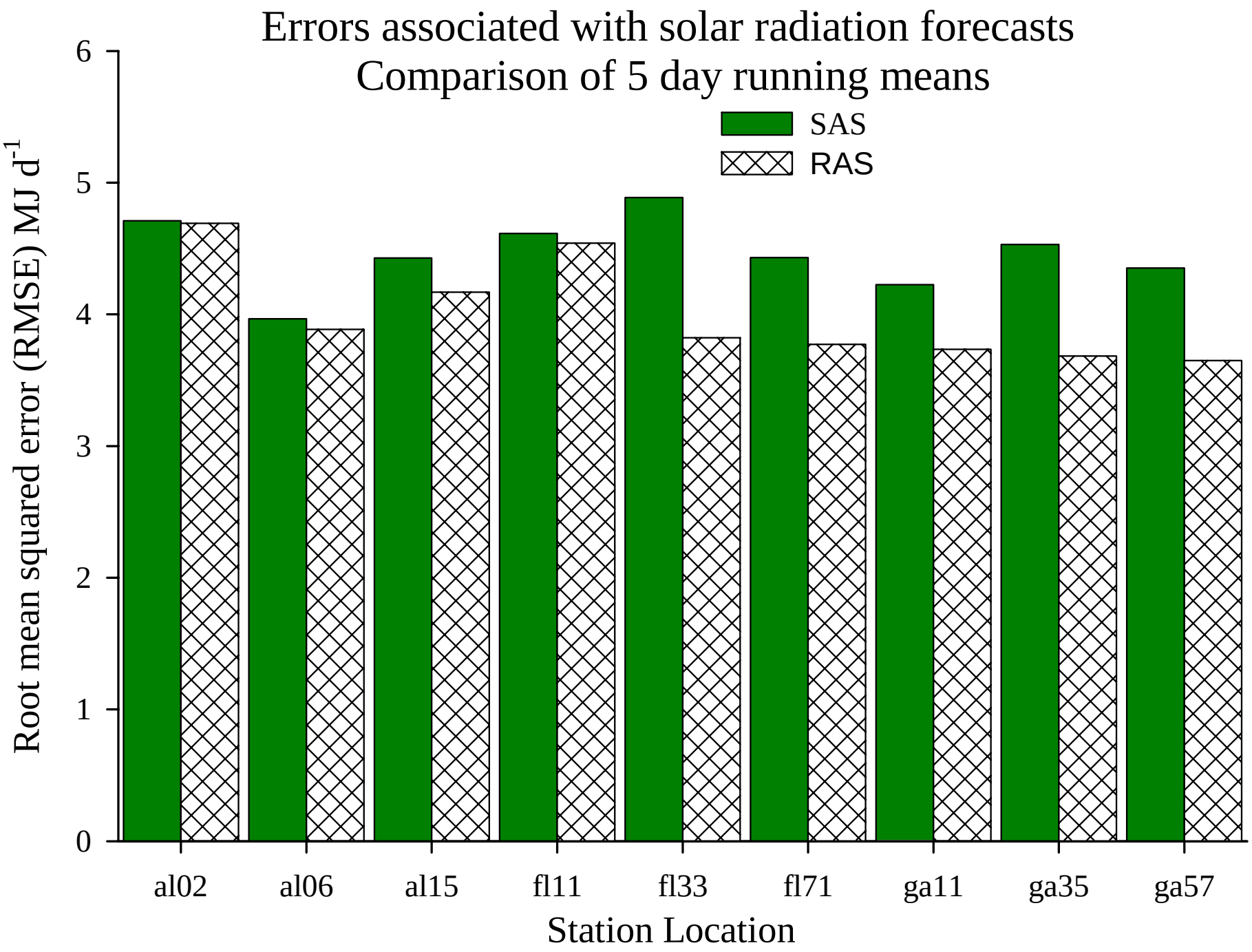
Assessment of bias-correction

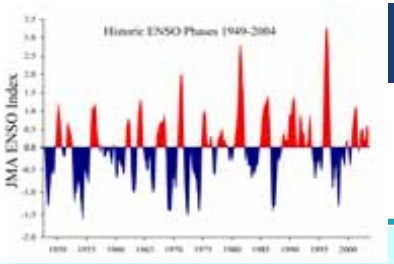
- CropGro CSM
  - Peanut – v. Georgia Green
- Site specific soil profiles
- Rainfed conditions
- Uncalibrated for sites
- 1994-2003


Errors associated with maximum daily temperature forecasts
Comparison of 5 day running means
SAS
Bias corrected SAS
RAS
Bias corrected RAS
Root mean squared error (RMSE) °C
0
1
2
3
4
al06
al15
fl11
fl33
fl71
ga11
ga35
ga57
Station Location


Errors associated with minimum daily temperature forecasts
Comparison of 5 day running means
Root mean squared error (RMSE) °C
0
1
2
3
4
5
SAS
Bias corrected SAS
RAS
Bias corrected RAS
al02
al06
al15
fl11
fl33
fl71
ga11
ga35
ga57
Station Location

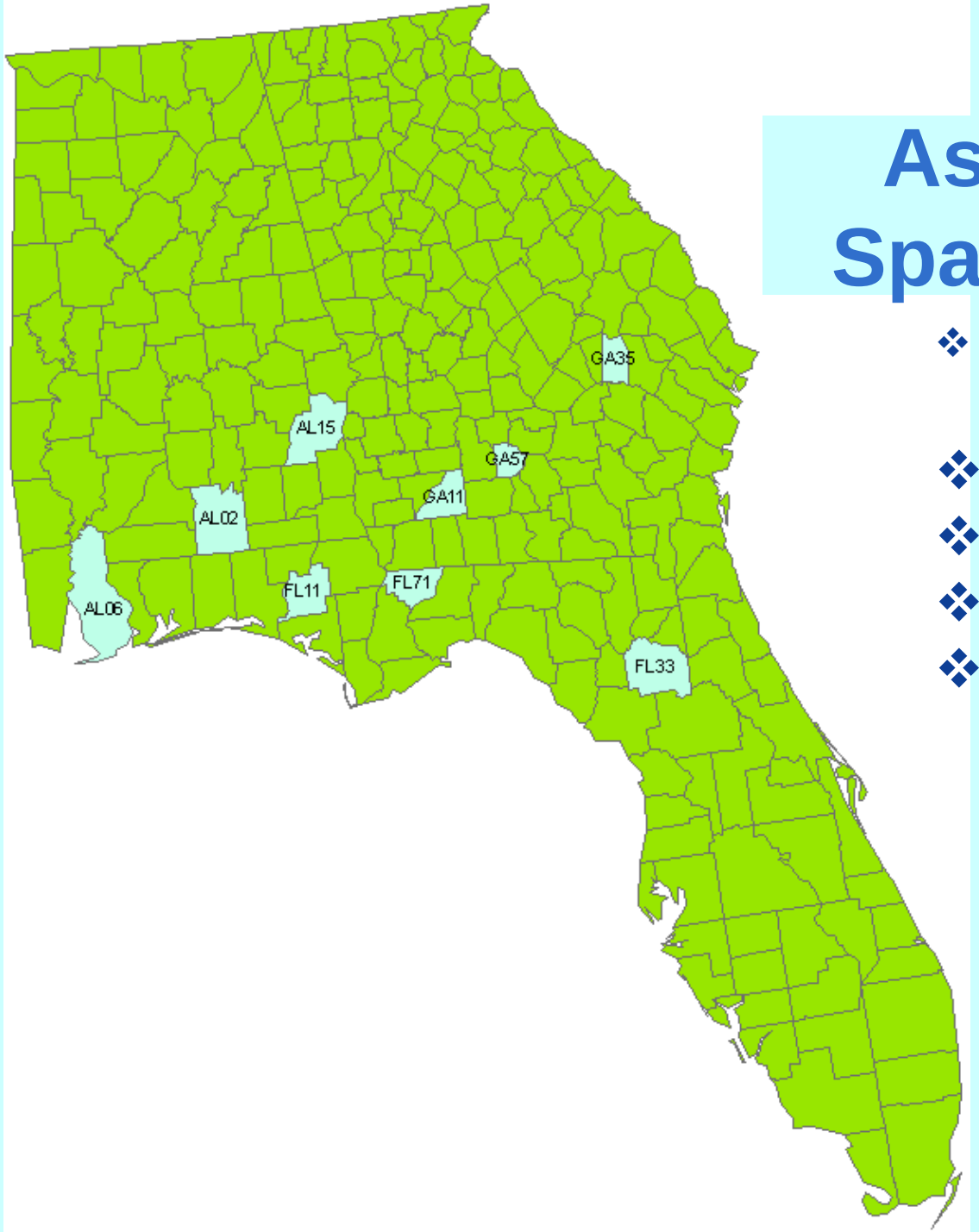

Errors associated with daily precipitation forecasts
Comparison of 5 day running means
Root mean squared error (RMSE) mm
0
2
4
6
8
10
12
14
16
18
SAS
Bias corrected SAS
RAS
Bias corrected RAS
al06
al15
fl11
fl33
fl71
ga11
ga35
ga57
Station Location


Errors associated with solar radiation forecasts
Comparison of 5 day running means
SAS
RAS
Root mean squared error (RMSE) MJ d-1
0
1
2
3
4
5
6
al02
al06
al15
fl11
fl33
fl71
ga11
ga35
ga57
Station Location



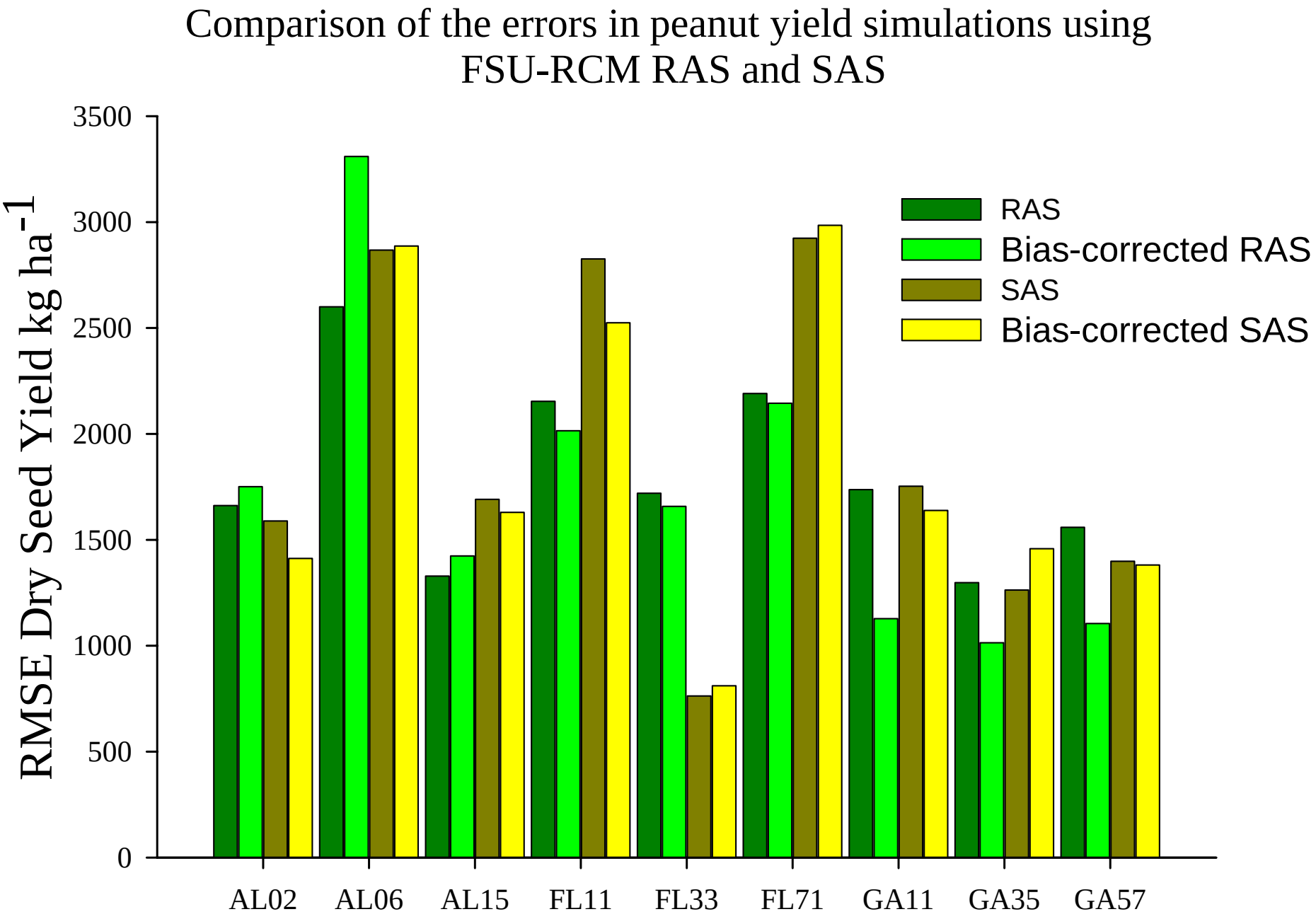
Conclusions about bias-correction

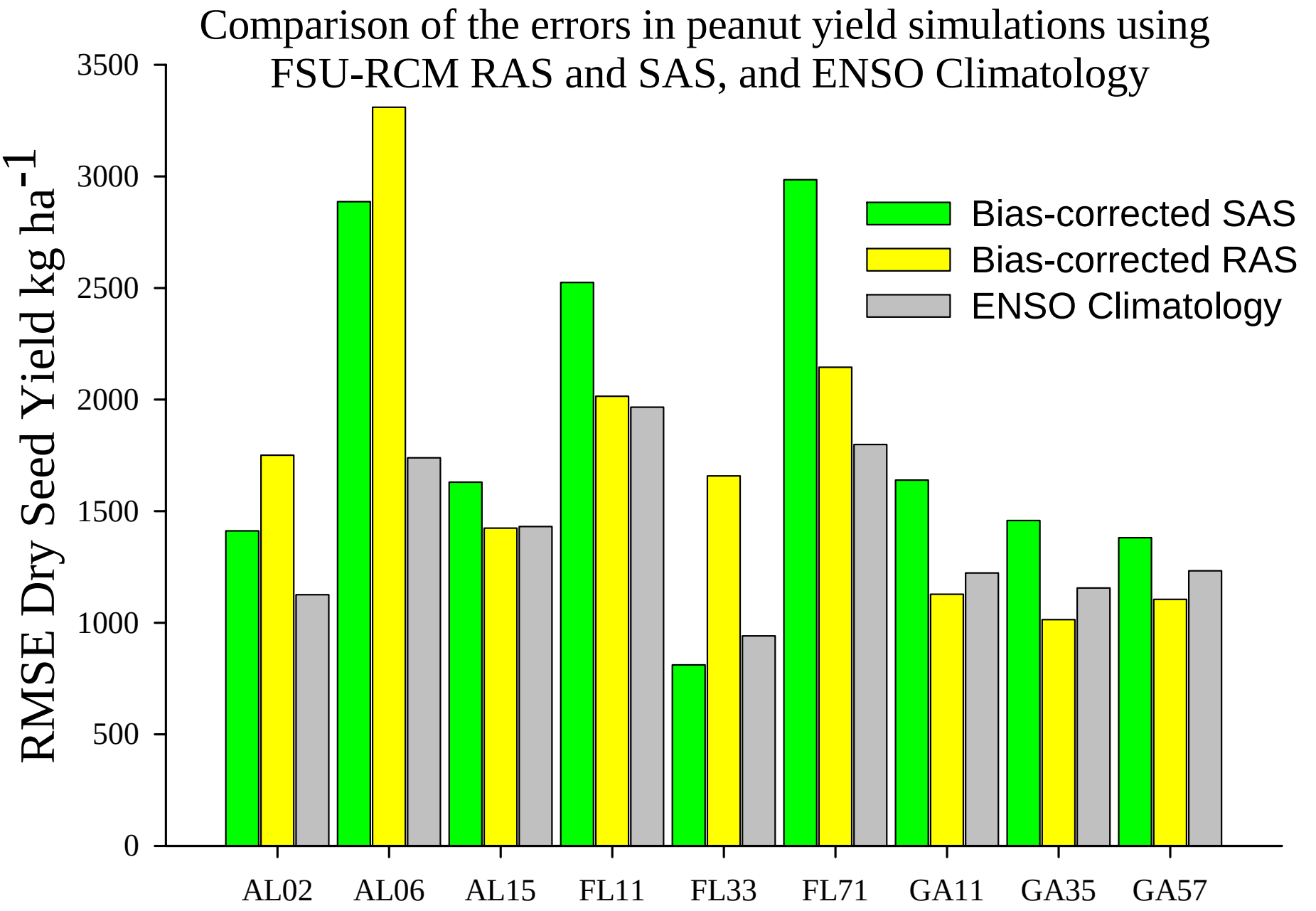
- Bias correction successful for Tmax, Tmin, SRAD
- Not successful for precipitation
- Systematic error identified by this bias-correction approach small relative to random error.
- BC RAS better for max T and SRAD
- RAW SAS better for rain

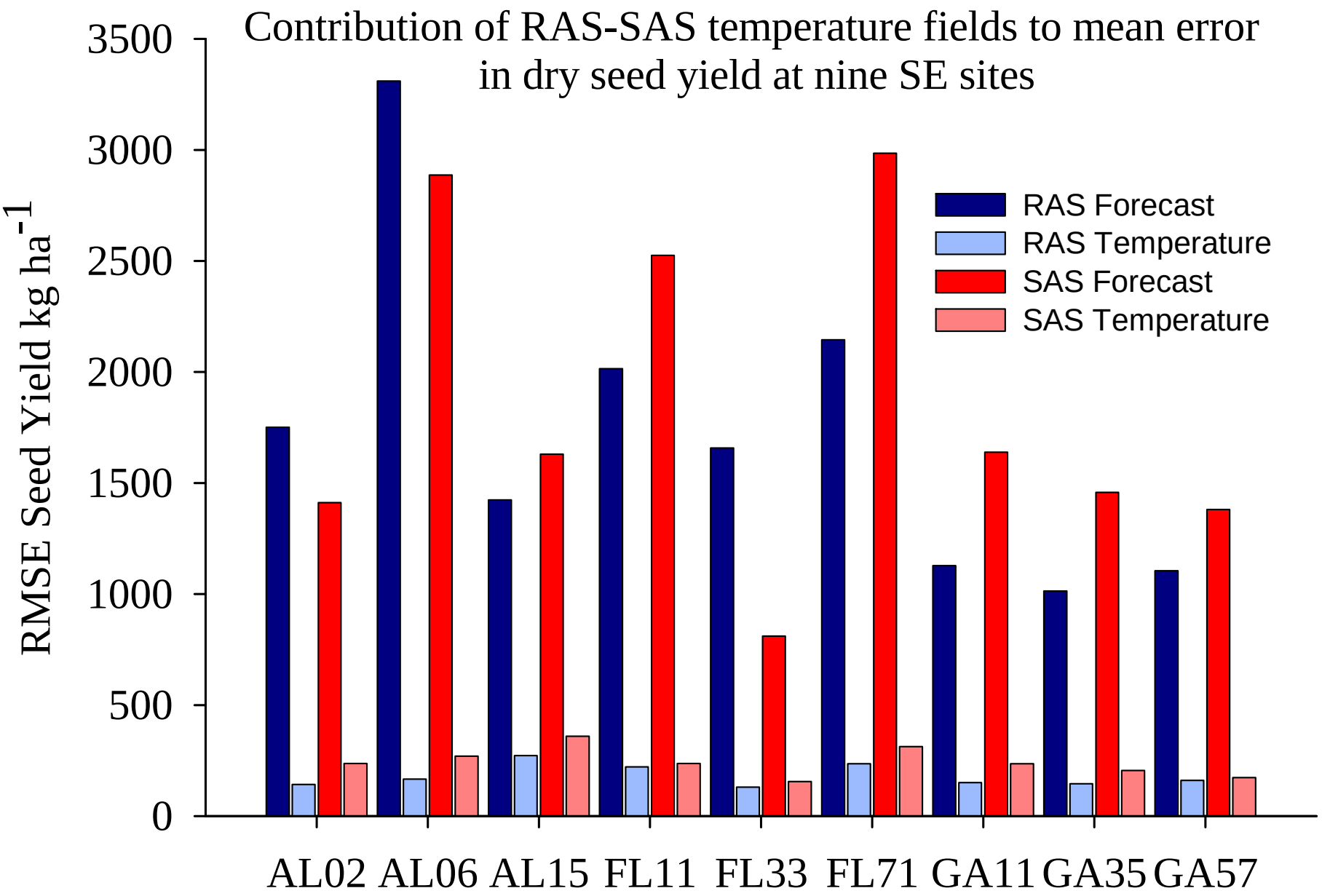


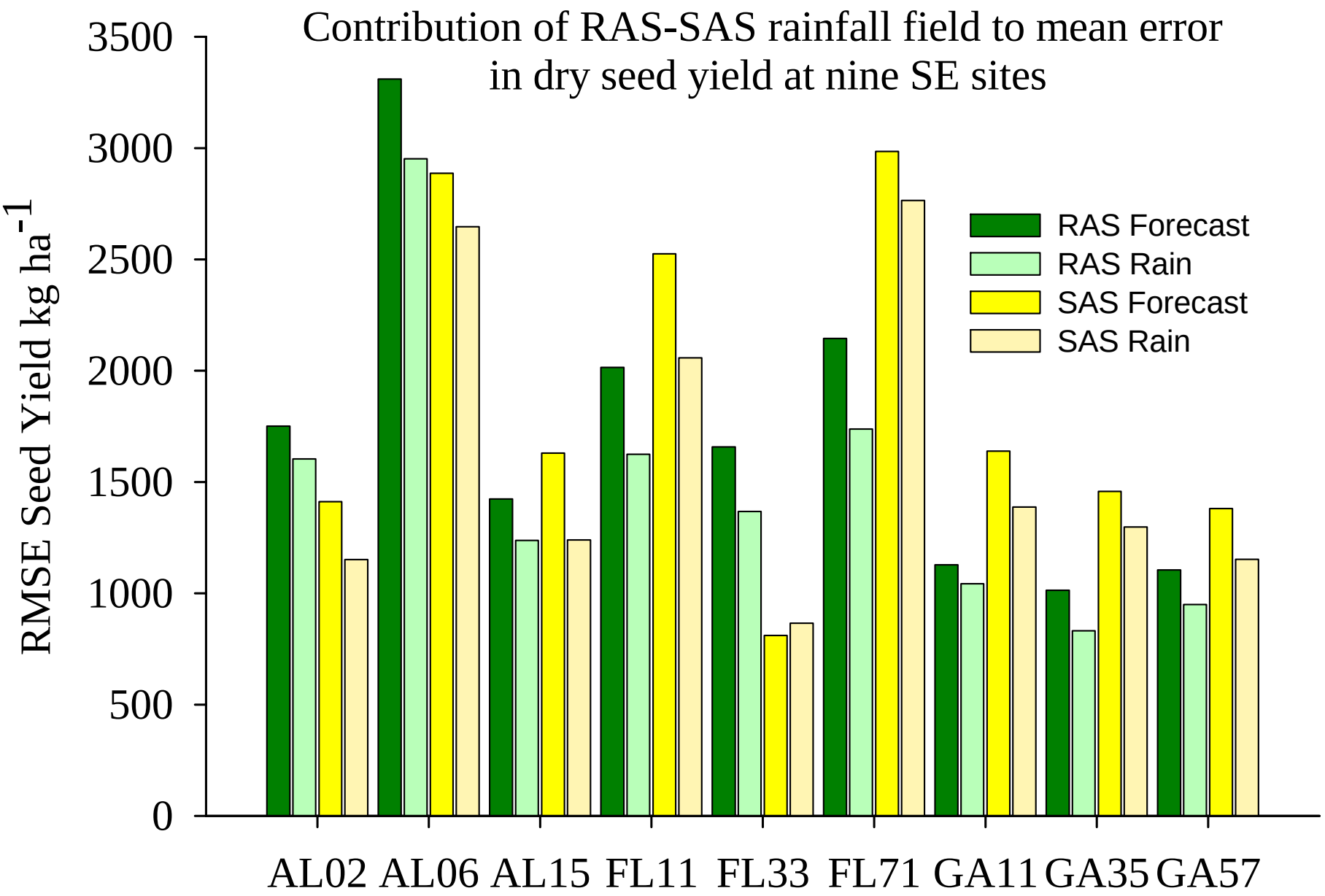
Assessment of Spatial Variability

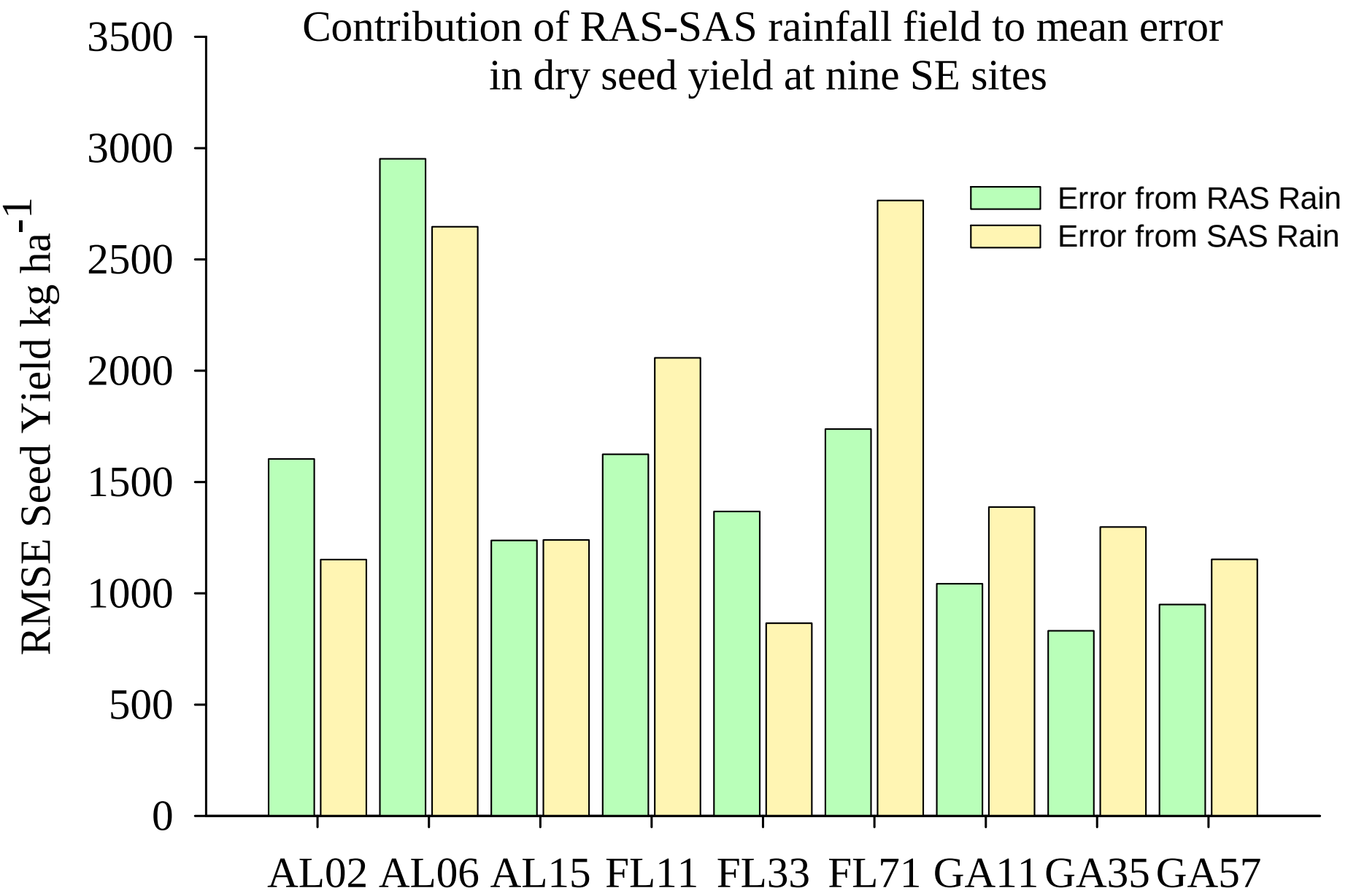
- CropGro CSM
  - Peanut – v. Georgia Green
- Site specific soil profiles
- Rainfed conditions
- Uncalibrated for sites
- 1994-2003

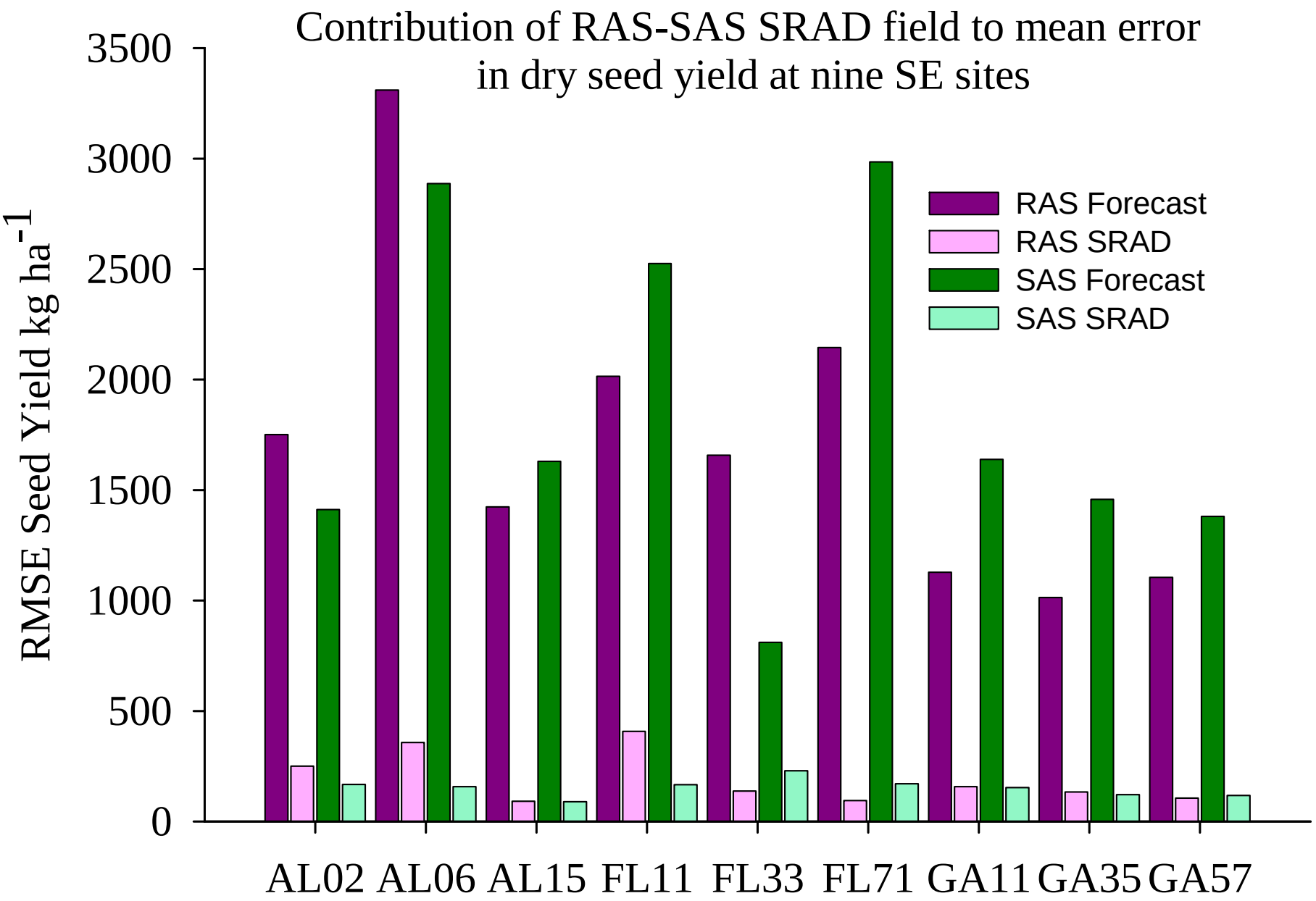

Comparison of the errors in peanut yield simulations using
FSU-RCM RAS and SAS
RMSE Dry Seed Yield kg ha-1
3500
3000
2500
2000
1500
1000
500
0
RAS
Bias-corrected RAS
SAS
Bias-corrected SAS
AL02
AL06
AL15
FL11
FL33
FL71
GA11
GA35
GA57

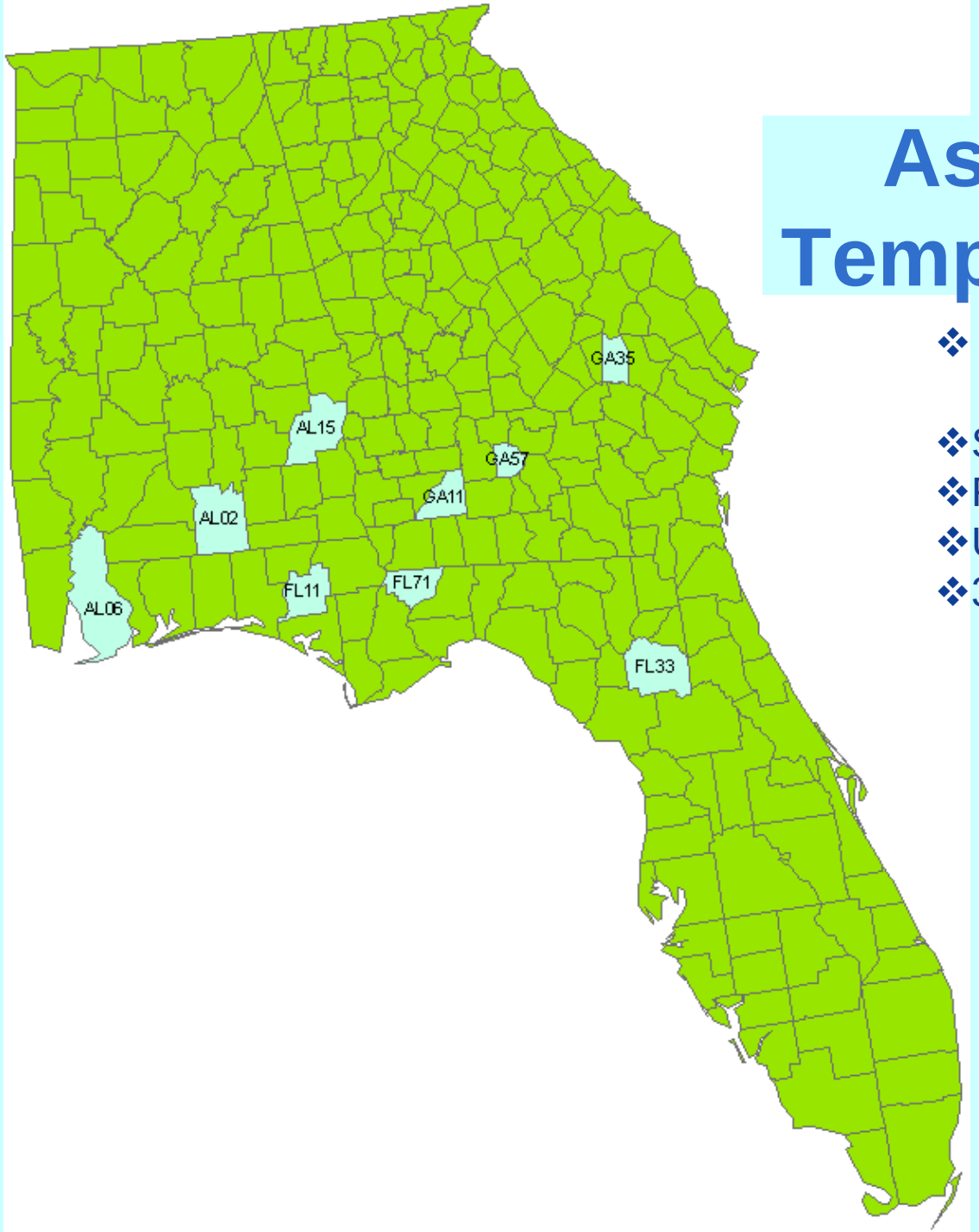

Comparison of the errors in peanut yield simulations using
FSU-RCM RAS and SAS, and ENSO Climatology
RMSE Dry Seed Yield kg ha-1
3500
3000
2500
2000
1500
1000
500
0
Bias-corrected SAS
Bias-corrected RAS
ENSO Climatology
AL02
AL06
AL15
FL11
FL33
FL71
GA11
GA35
GA57


Contribution of RAS-SAS temperature fields to mean error in dry seed yield at nine SE sites
RMSE Seed Yield kg ha-1
3500
3000
2500
2000
1500
1000
500
0
RAS Forecast
RAS Temperature
SAS Forecast
SAS Temperature
AL02
AL06
AL15
FL11
FL33
FL71
GA11
GA35
GA57


Contribution of RAS-SAS rainfall field to mean error
in dry seed yield at nine SE sites
RMSE Seed Yield kg ha-1
3500
3000
2500
2000
1500
1000
500
0
RAS Forecast
RAS Rain
SAS Forecast
SAS Rain
AL02 AL06 AL15 FL11 FL33 FL71 GA11 GA35 GA57

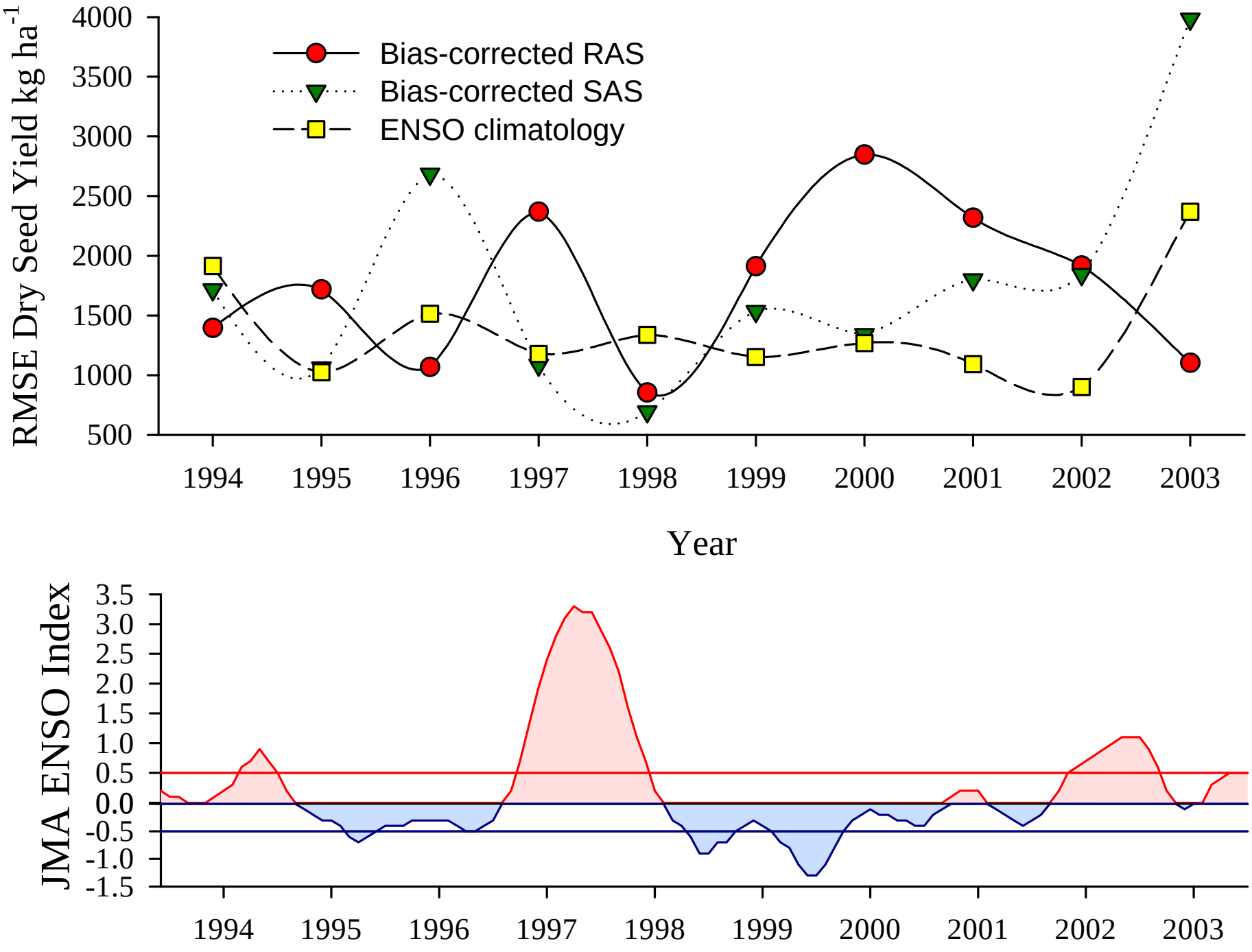

Contribution of RAS-SAS rainfall field to mean error
in dry seed yield at nine SE sites
RMSE Seed Yield kg ha-1
3500
3000
2500
2000
1500
1000
500
0
Error from RAS Rain
Error from SAS Rain
AL02
AL06
AL15
FL11
FL33
FL71
GA11
GA35
GA57

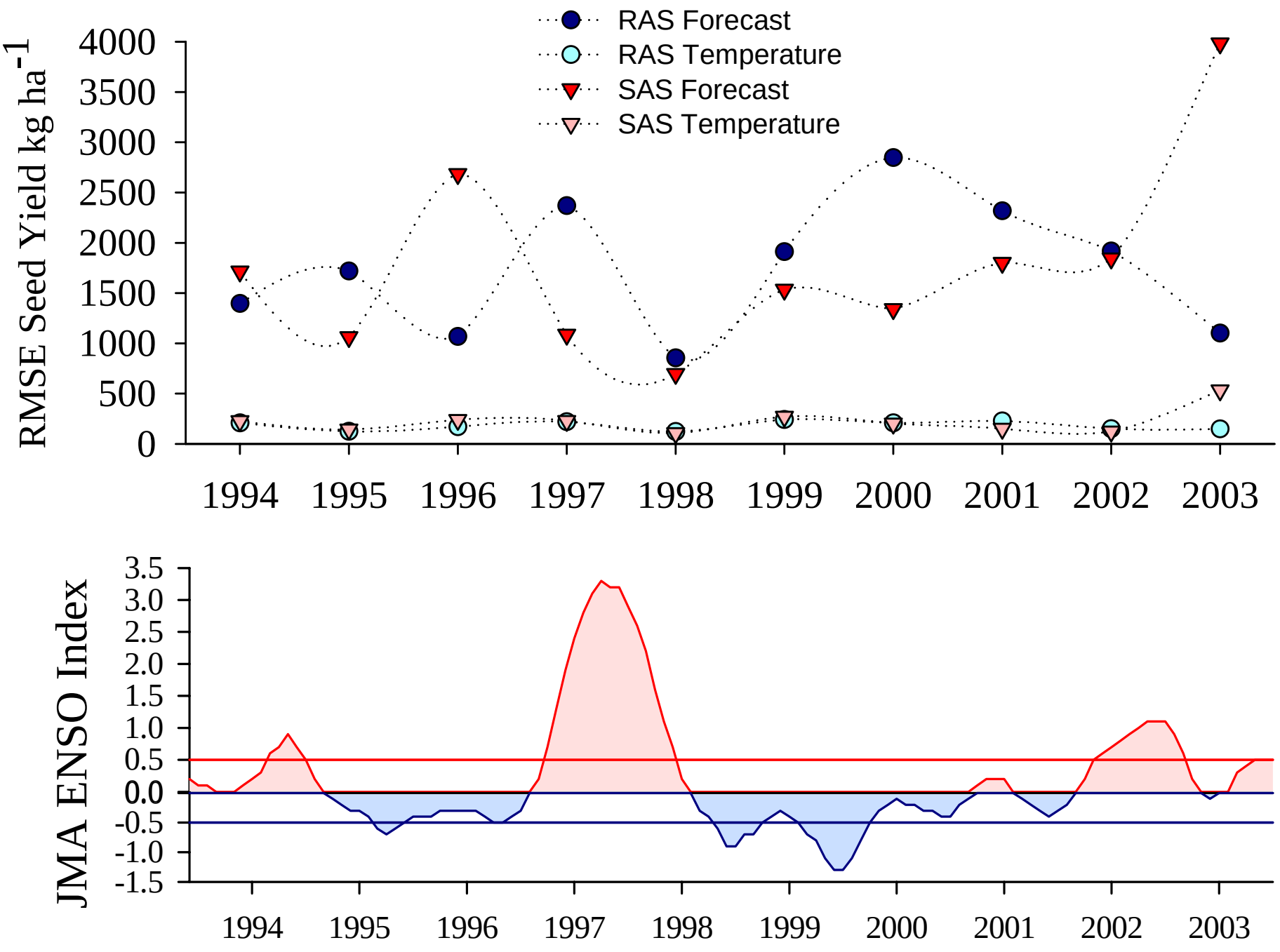

Contribution of RAS-SAS SRAD field to mean error
in dry seed yield at nine SE sites
RMSE Seed Yield kg ha-1
3500
3000
2500
2000
1500
1000
500
0
RAS Forecast
RAS SRAD
SAS Forecast
SAS SRAD
AL02 AL06 AL15 FL11 FL33 FL71 GA11 GA35 GA57

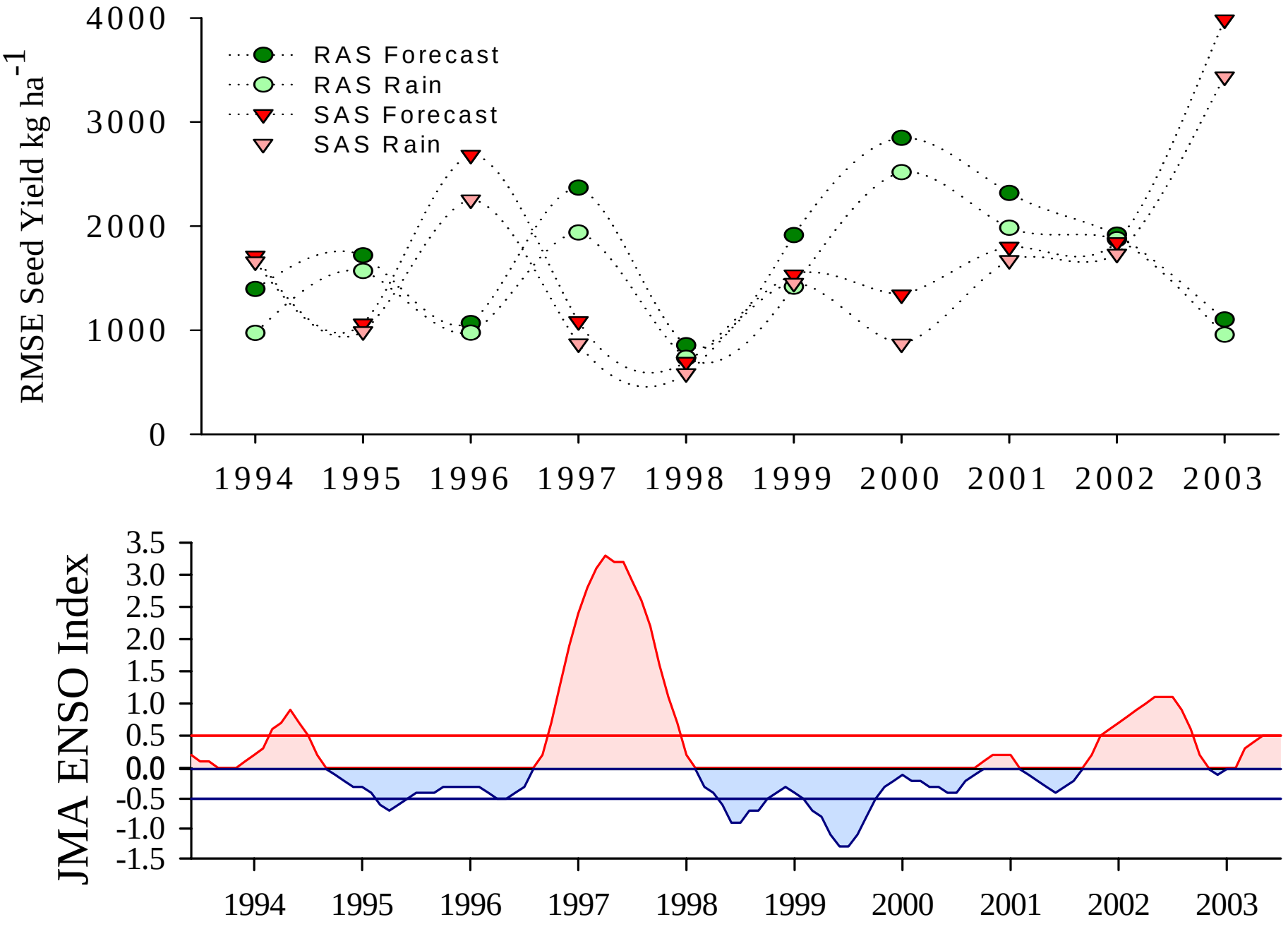


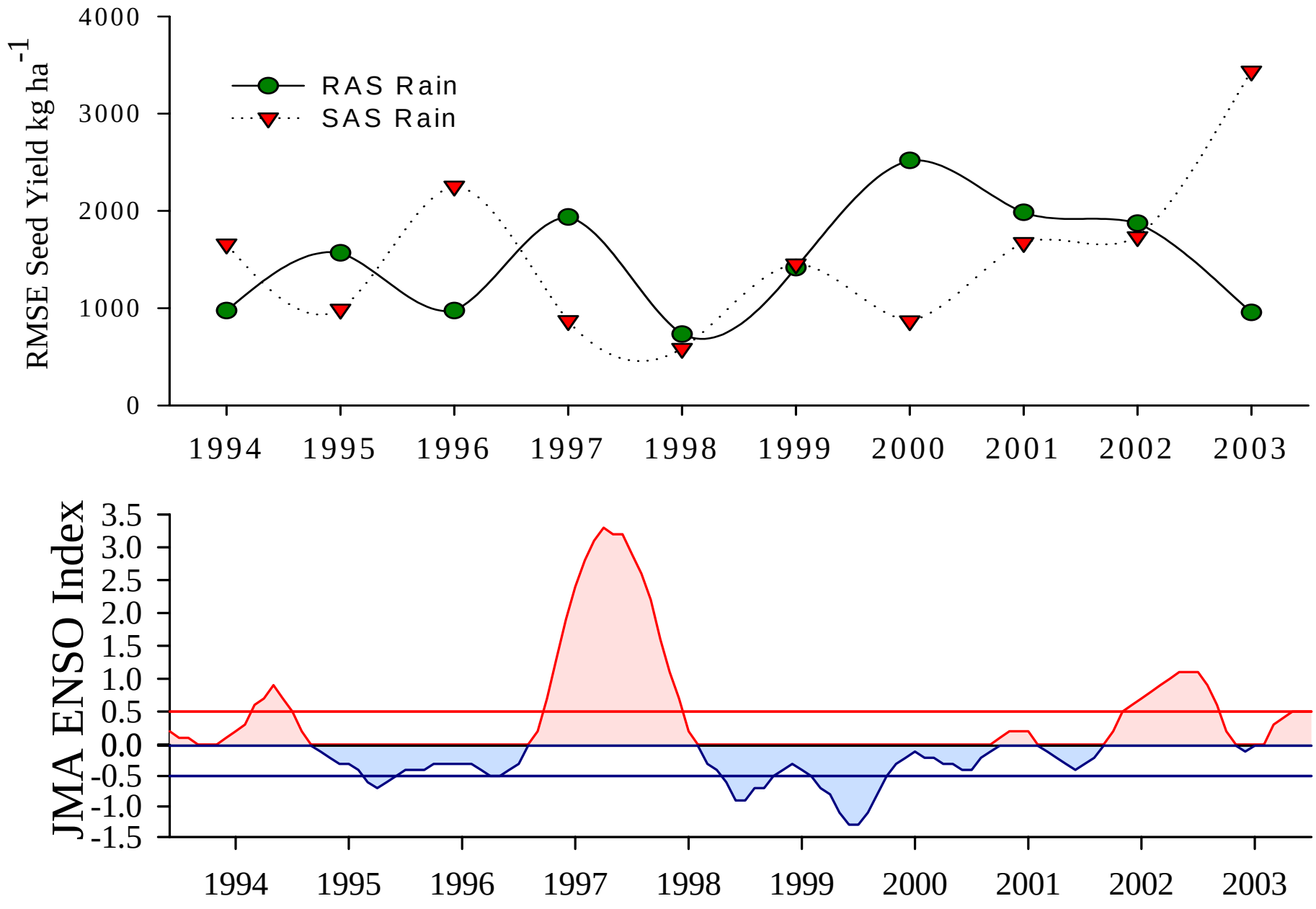
Assessment of Temporal Variability

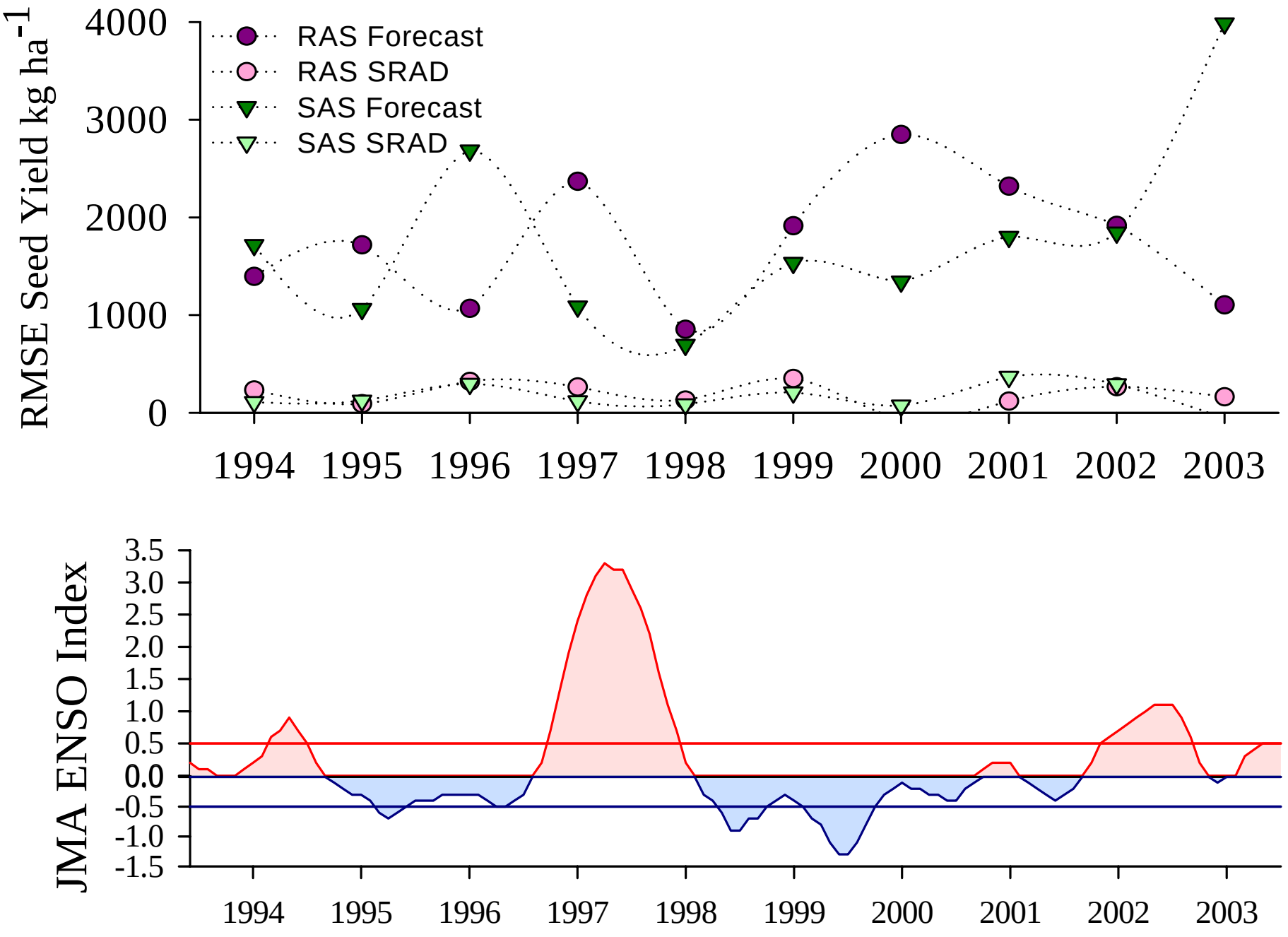
- CropGro CSM
  - Peanut – v. Georgia Green
- Site specific soil profiles
- Rainfed conditions
- Uncalibrated for sites
- 3 sites each in AL, FL, GA


RMSE Dry Seed Yield kg ha-1
4000
3500
3000
2500
2000
1500
1000
500
Bias-corrected RAS
Bias-corrected SAS
ENSO climatology
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
Year
JMA ENSO Index
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003


RAS Forecast
RAS Temperature
SAS Forecast
SAS Temperature
RMSE Seed Yield kg ha-1
4000
3500
3000
2500
2000
1500
1000
500
0
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
JMA ENSO Index
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003


RMSE Seed Yield kg ha-1
4000
3000
2000
1000
0
RAS Forecast
RAS Rain
SAS Forecast
SAS Rain
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
JMA ENSO Index
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003


RMSE Seed Yield kg ha-1
4000
3000
2000
1000
0
RAS Rain
SAS Rain
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
JMA ENSO Index
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003


RMSE Seed Yield kg ha-1
4000
3000
2000
1000
0
RAS Forecast
RAS SRAD
SAS Forecast
SAS SRAD
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
JMA ENSO Index
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
1994
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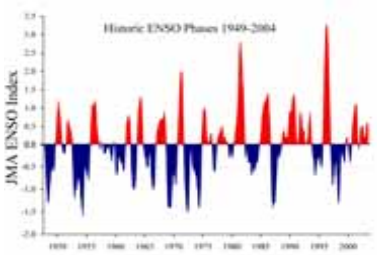
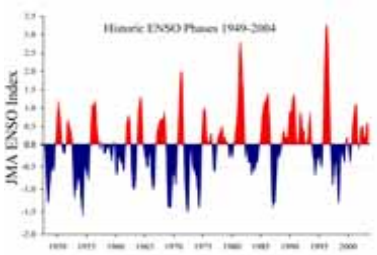
2003



Conclusions

- Overall the bias-corrected RAS forecast had the lowest combined spatial and temporal error in simulated peanut yields
- The greatest source of yield error is from rain, the errors of which are highly variable in time and space
- The bias correction approach we employed here did not substantially reduce yield prediction errors
- RCM (SAS) forecasts have provided yield predictions superior to ENSO climatology during strong El Niño years 1997-1998



Future Directions

- Use of crop models with relatively greater temperature sensitivity - developmental
- Improvement of RCM convective scheme has potential to enhance to crop yield applications
- Need better methods of bias correction for precipitation field – bias or error?
- Multi-ensemble methods to improve forecast (20 member ensembles)