**GCM calibration using SCM**

Simulation List to get Optimal/Near-optimal Parameter Set of **SCM**

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| Experiment & Locations | Forcing & Observations | Framework | SCAM Simulations |
| Experiment: Perfect Model/Twin Test  Locations: SGP and/or TWP | Forcing: Default CAM6 (Full GCM Simulations for 1 full year  )—generate user defined forcing  Observations: Default CAM Parameter for synthetic observations. | EnKF/EnKI  (Iterative approach until error covariance 0.1%)  Step 1: PPE is using LHS and step 2 to N is using the EnKF/EnKI update | 1. 100 Member PPE (30 days) to start 2. First iteration of updated/posterior 100 Member PPE (from step 1) 3. Second iteration of updated/posterior 100 Member PPE (from step 2)   ………………..………………..  ………………..………………..   1. Final iteration of updated/posterior 100 Member PPE (from step n-1) |
| EmF  (All the steps PPE using LHS) | 1. 100 Member PPE (30 days) 2. 200 Member PPE (30 days) 3. 300 Member PPE (30 days) 4. 400 Member PPE (30 days) 5. 500 Member PPE (30 days) |
| Hybrid (EnKF/EnKI+EmF) | 1. Three/Five\* iterations of EnKF/EnKI (100 Member 30 days)—a narrow range of updated/posterior parameter values 2. 300/400\*\* Member updated/posterior PPE for EmF |
| Experiment: Real Experiment  Locations: SGP, TWP, NSA, ENA | Forcing: IOPs  Observations: ARM sites and NASA products | EnKF/EnKI  (Iterative approach until error covariance 0.1%)  Step 1 is using LHS and 2 to N is using the EnKF/EnKI update | 1. 100 Member PPE (\*\*\* days) to start 2. First iteration of updated/posterior 100 Member PPE (from step 1) 3. Second iteration of updated/posterior 100 Member PPE (from step 2)   ………………..………………..  ………………..………………..   1. Final iteration\*\*\* of updated/posterior 100 Member PPE (from step n-1) |
| EmF  (All the steps using LHS) | 1. 300\*\*\* Member PPE (15 days) |
| Hybrid (EnKF/EnKI+EmF) | 1. Three/Five\*\*\* iterations of EnKF/EnKI (100 Member 5 days)—a narrow range of updated/posterior parameter values 2. 300/400\*\*\* Member updated/posterior PPE for EmF |

Transference to full GCMs: **CAM6, EAM, ModelE**

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| Forcing & Observations | Real Test Outcomes from SCM | Full GCM simulations |
| Forcing: Present Day and/or Historical  Observations: NASA Products | Optimal Parameter Set | 5-years |
| Near-optimal Parameter Set | EnKF/ENI iterative (3 to 5 iterations of 0.5 years **GCM** simulations) optimization framework will be used to get the optimal parameter set constrained to the observations |

\*This number will be decided according to the EnKF/EnKI approach—we hypothesis after 3-5 iterations we will get a very narrow range of parameter value.

\*\*This number will be decided according to the EmF—we hypothesis 300-400 Member PPE is good enough to train, test and validate.

\*\*\*Theis number will be decided according to the Perfect model experiment.