Comparing Models x Models and Models x Observations

Luis Gustavo de Goncalves

Models description and analyses design

- **21 Participant Models (30 experiments)**
  - *SSiB2 (3 exp)*
  - *BIOME-BGC*
  - *SiB3*
  - *LPJ (2 exp)*
  - *HYLAND*
  - *JULES*
  - *SPA (3 exp)*
  - *CLM V3.5 (2 exp), V3.0DP, V3.0GW, V3.0 OOTB*
  - *SIB-CASA*
  - *ORCHIDEE*
  - *VISIT (3 exp)*
  - *CoLM*
  - *IBIS*
  - *5PM*
  - *SiB2 (2 exp)*
  - *NOAH DV, STD*
  - *LM3V*

Models description and proposed analysis

- **Metrics**
  - **R^2, Nash-Stucliffe Efficiency (NSE), Root Mean Squared Error (RMSE), Mean, Standard Deviation (STD)**
- **Quantitative plots**
  - **Taylor Diagram, Space-time errors**
- **Monthly Mean**
- **Daily Mean**
- **Diurnal Cycle**

Models description and analyses design

Quick review on the metrics and plots used

Measures for model performance evaluation

Legend: O_i: i_{th} observation
P_i: i_{th} model prediction

R^2 Coefficient of Determination

$$R^2 = \left\{ \frac{\sum_{i=1}^{N}(O_i - \overline{O})(P_i - \overline{P})}{\left[\sum_{i=1}^{N}(O_i - \overline{O})^2\right]^{0.5}\left[\sum_{i=1}^{N}(P_i - \overline{P})^2\right]^{0.5}} \right\}^2 \qquad \overline{O} = \frac{1}{N}\sum_{i=1}^{N}(O_i) \qquad \overline{P} = \frac{1}{N}\sum_{i=1}^{N}(P_i)$$

RMSE Root Mean Squared Error

$$RMSE = \left[\frac{1}{N}\sum_{i=1}^{N}(O_i - P_i)^2\right]^{0.5}$$

Bias

$$Bias = \frac{1}{N}\sum_{i=1}^{N}(P_i - O_i)$$

Models description and analyses design

Quick review on the metrics and plots used

NSE Nash-Sutcliffe Efficiency

$$NSE = 1.0 - \frac{\sum_{i=1}^{N}(O_i - P_i)^2}{\sum_{i=1}^{N}(O_i - \overline{O})^2}$$

- **Physically, NSE is the ratio of the Mean Square Error (MAE) to the variance in the observed data, subtracted from unity**

- **If the square of the differences between the model simulations and the observations is as large as the variability in the observed data, then E=0.0 and if it exceeds it, then E<0.0 (i.e., the observed mean is a better predictor than Pi)**
-
- **A value of zero for the Coefficient of Efficiency indicates that the observed mean, O, is as good a predictor as the model while negative values indicate that the observed mean is a better predictor than the model**

Models description and analyses design

Quick review on the metrics and plots used

Taylor Diagram

Given a "test" field (*f*) and a reference field (*r*), the formulas for calculating the correlation coefficient (*R*), the centered RMS difference (*E'*), and the standard deviations of the "test" field (*σf*) and the reference field (*σr*) are:

$$R = \frac{\frac{1}{N}\sum_{n=1}^{N}(f_n - \bar{f})(r_n - \bar{r})}{\sigma_f \sigma_r}$$

$$E'^2 = \frac{1}{N}\sum_{n=1}^{N}\left[(f_n - \bar{f}) - (r_n - \bar{r})\right]^2$$

$$\sigma_f^2 = \frac{1}{N}\sum_{n=1}^{N}(f_n - \bar{f})^2$$

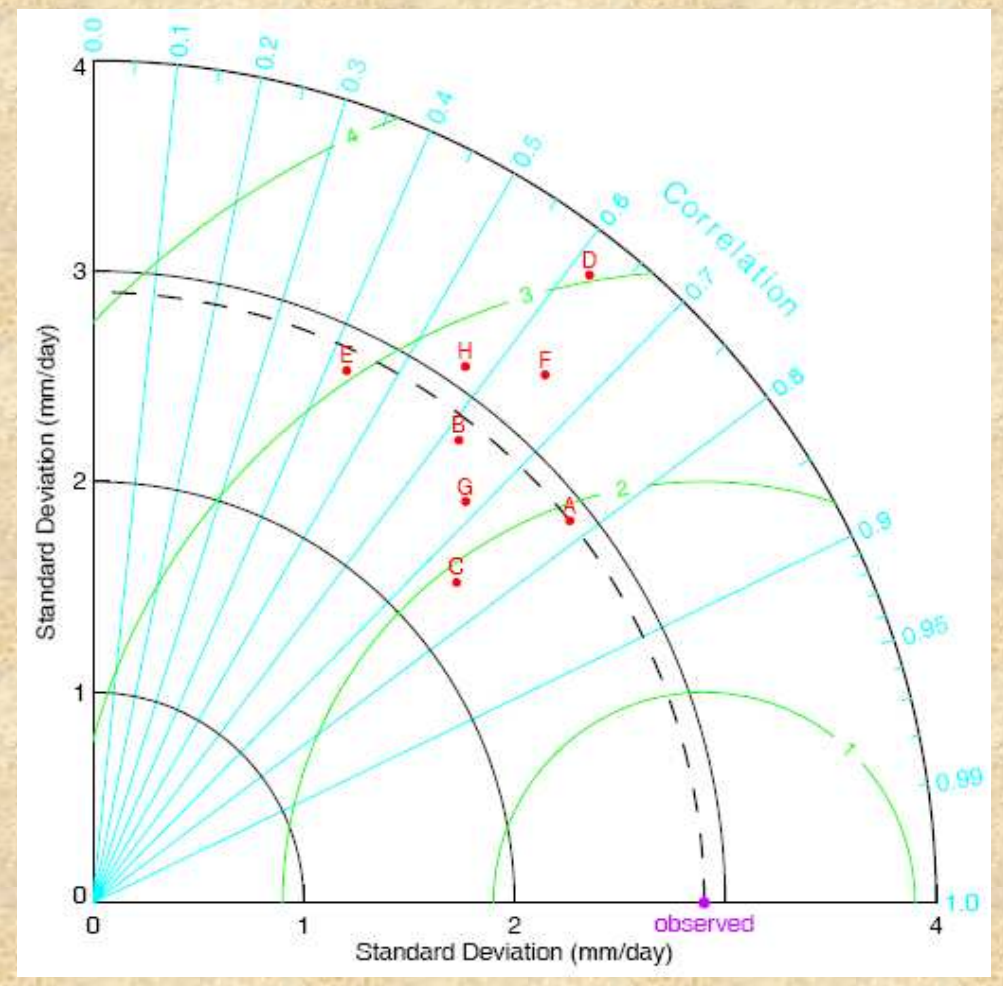
$$\sigma_r^2 = \frac{1}{N}\sum_{n=1}^{N}(r_n - \bar{r})^2$$

Models description and analyses design

Quick review on the metrics and plots used

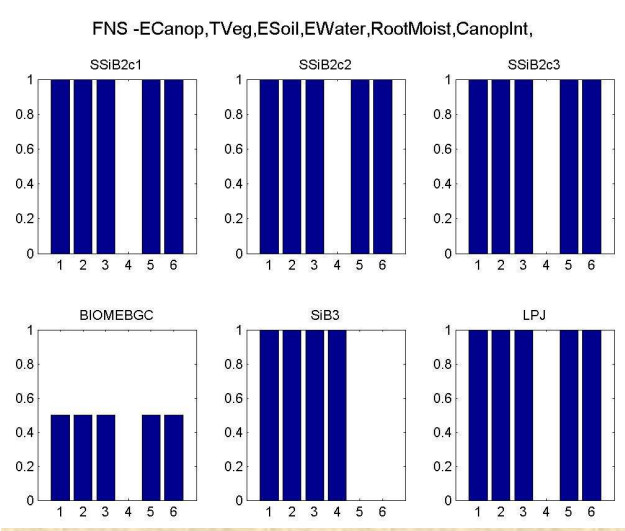
Taylor Diagram

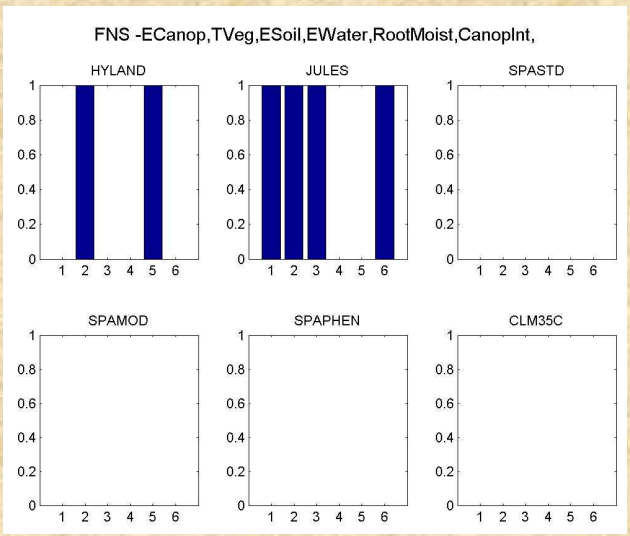
$$E'^2 = \sigma_f^2 + \sigma_r^2 - 2\sigma_f\sigma_r R$$

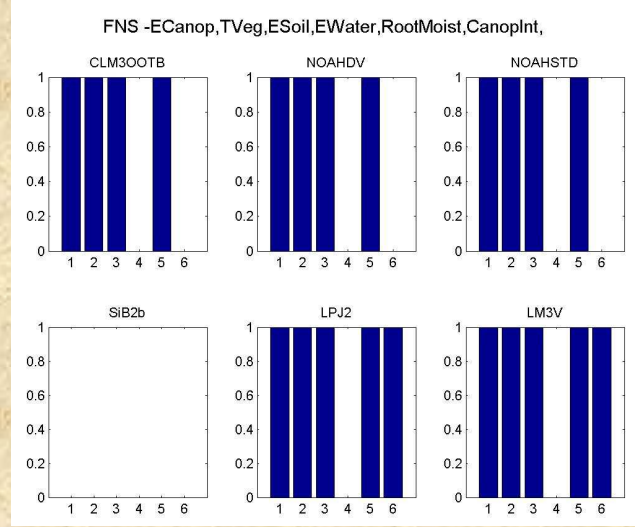


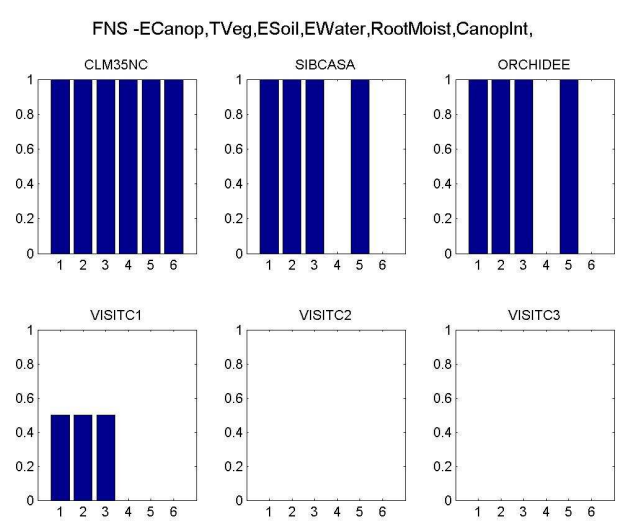
Models description and analyses design

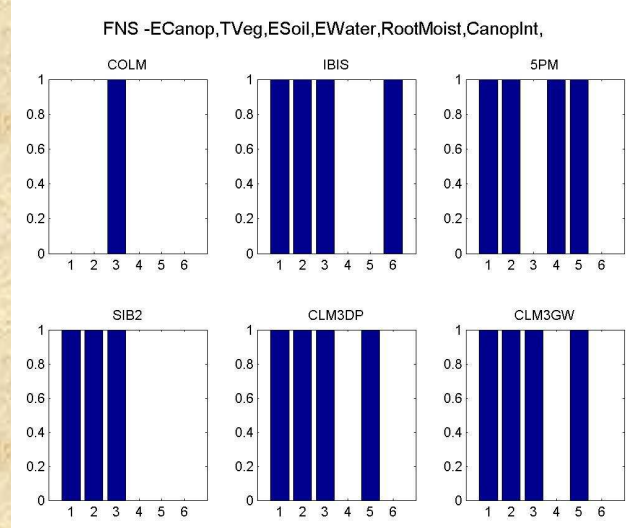
Summary of Reported Variables





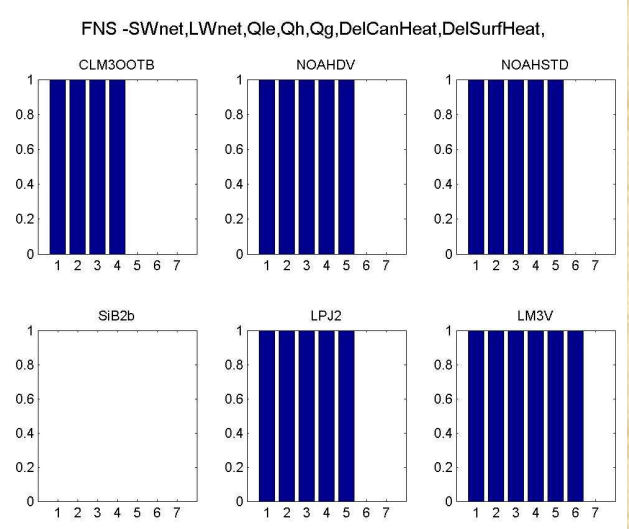


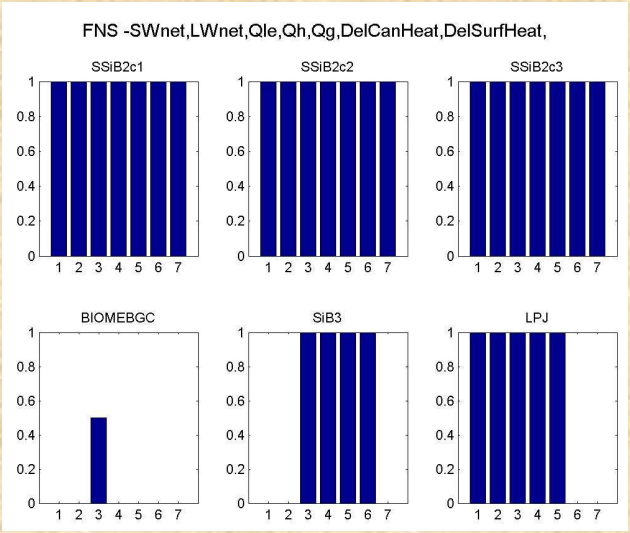


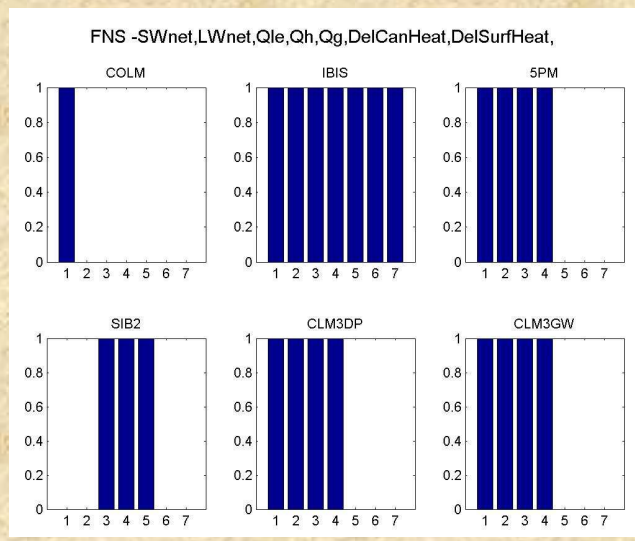


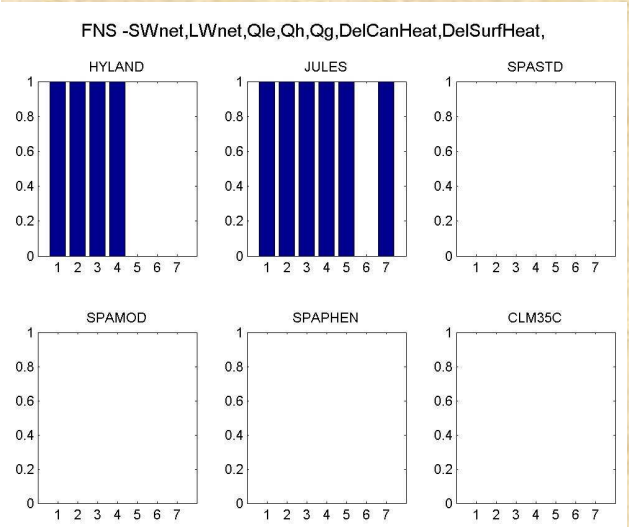
Models description and analyses design

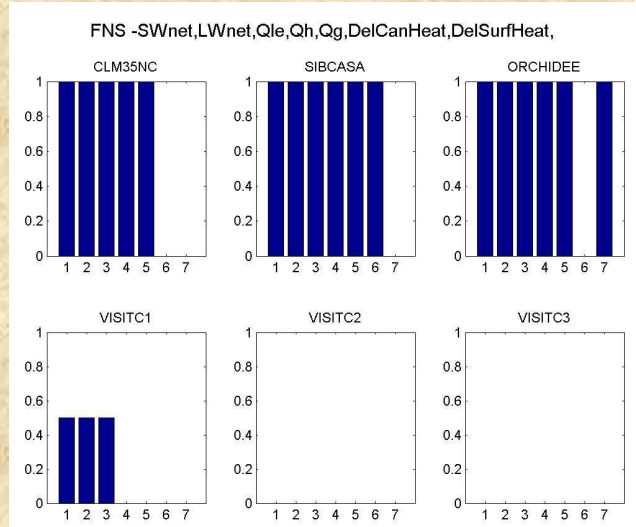
Summary of Reported Variables





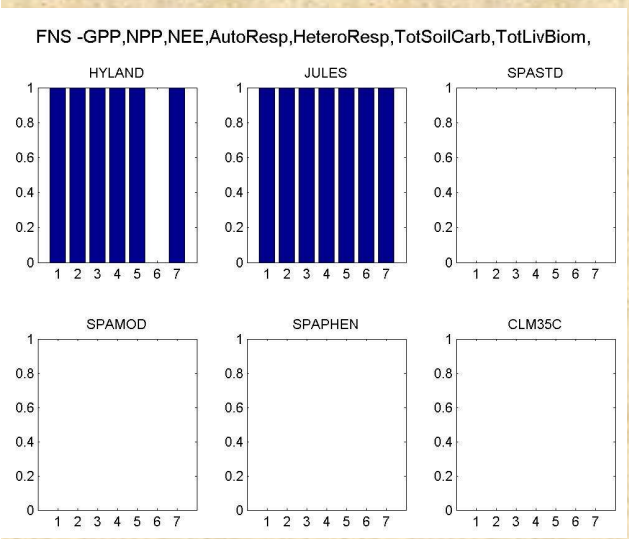


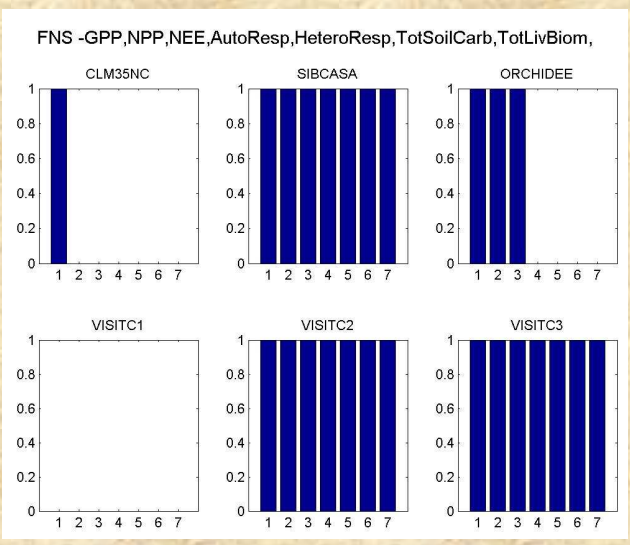


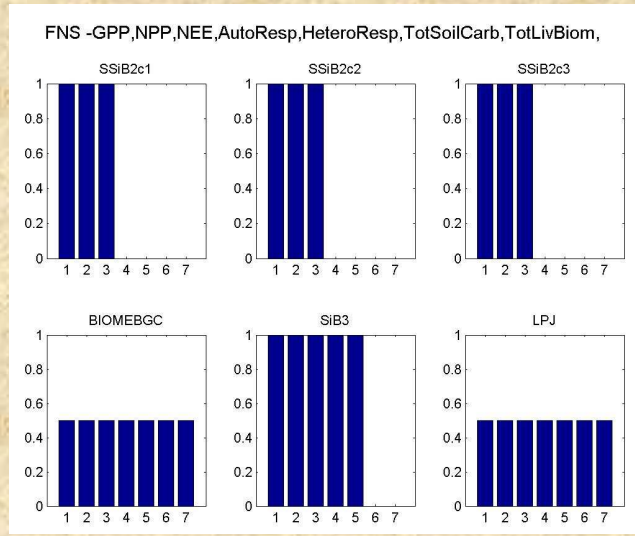


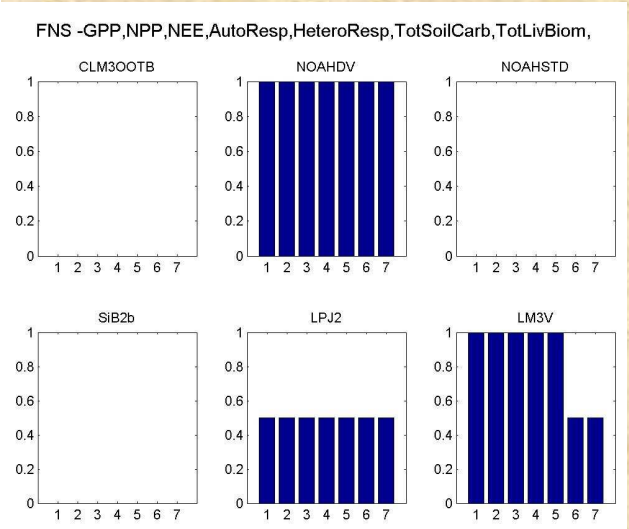
Models description and analyses design

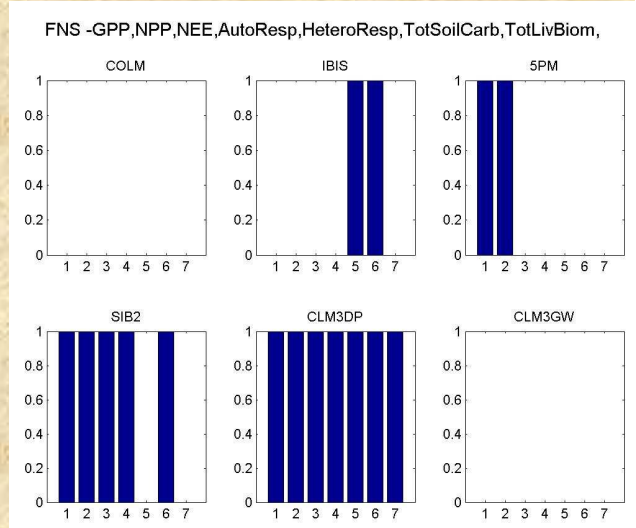
Summary of Reported Variables









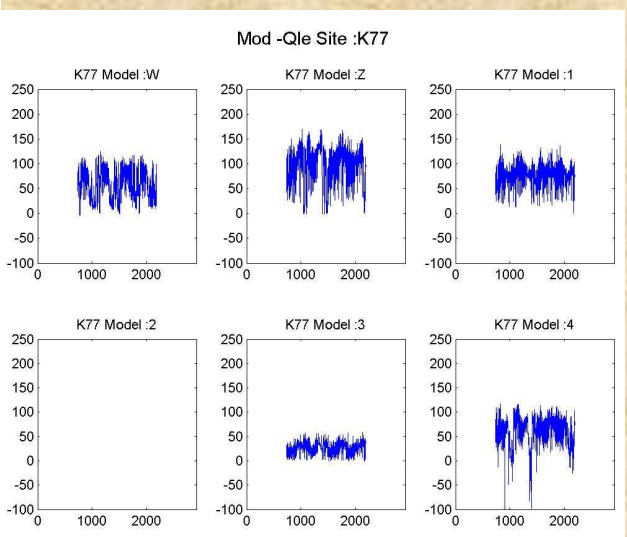


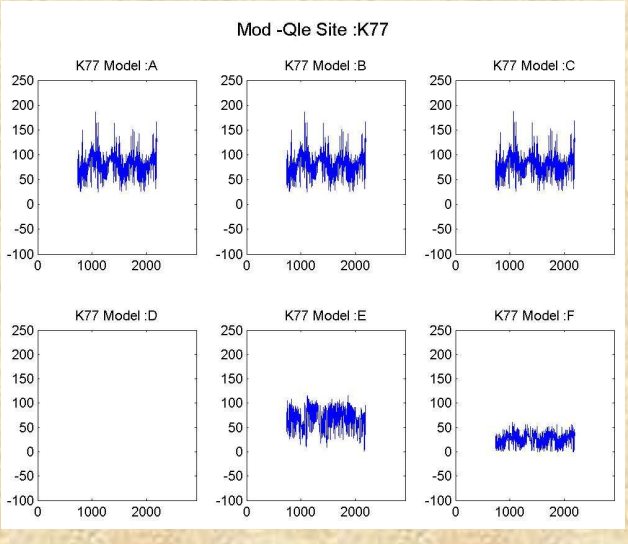
Results Analyses

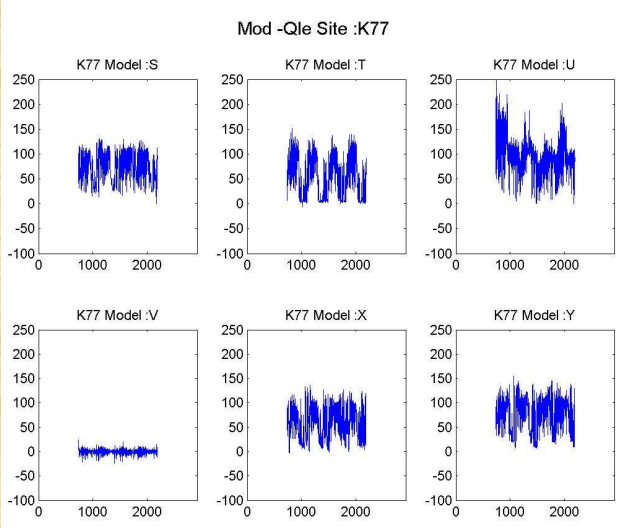
- Models x Models Ensemble Mean
- Models x Observations
- Quantitative plots

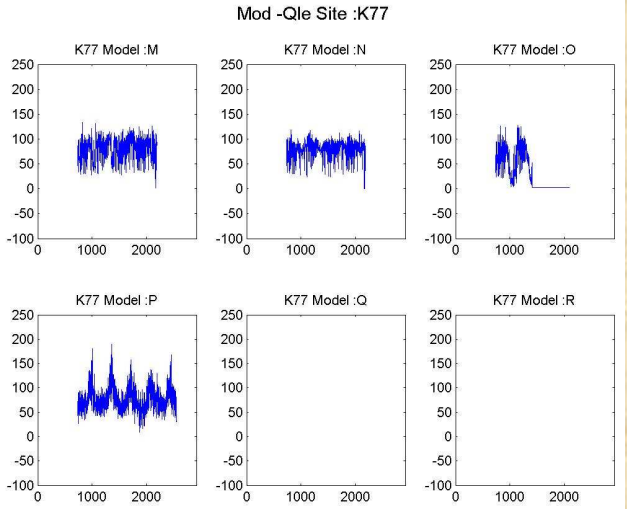
Results Analyses

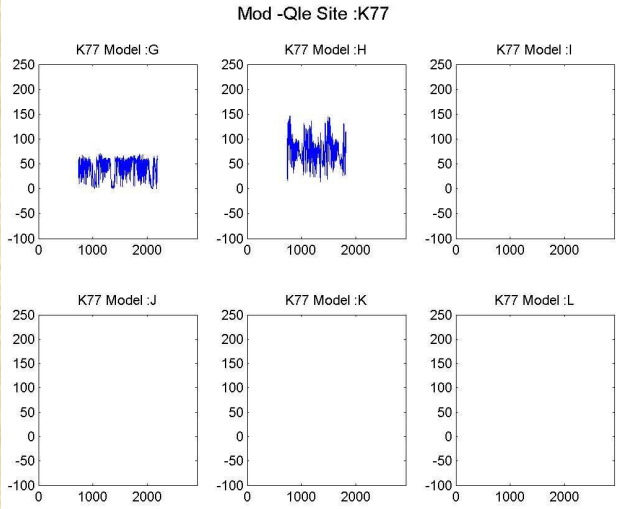
Qle K77





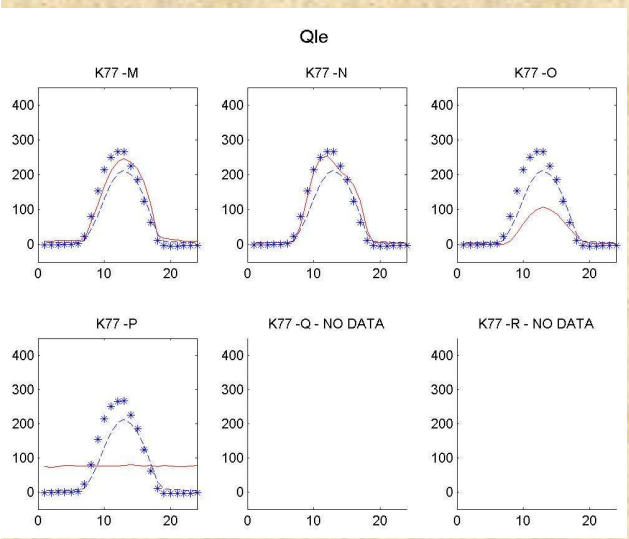


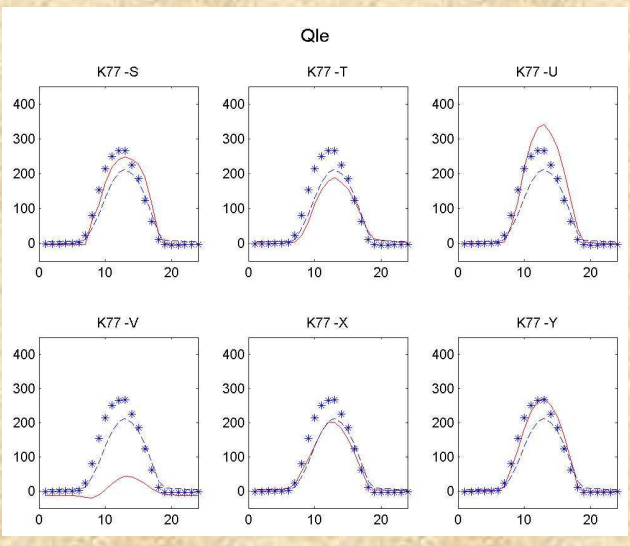


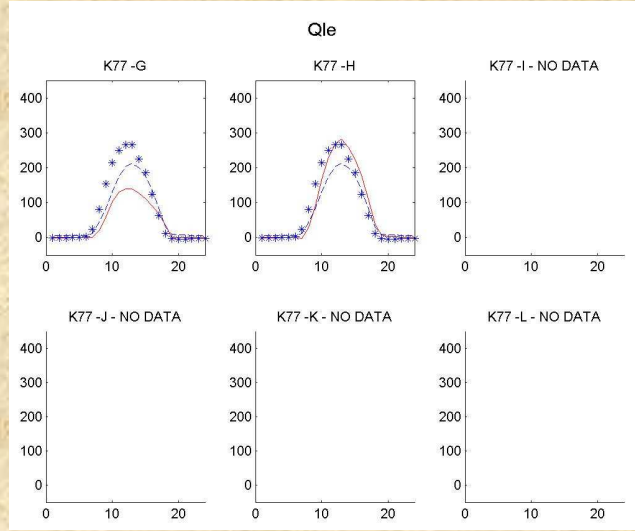


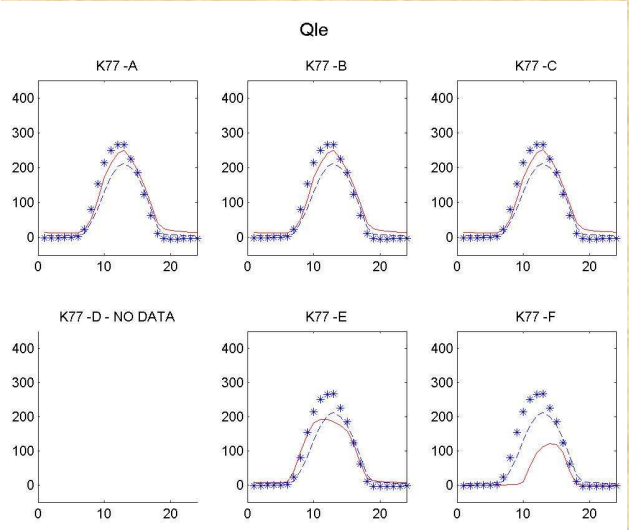
Results Analyses

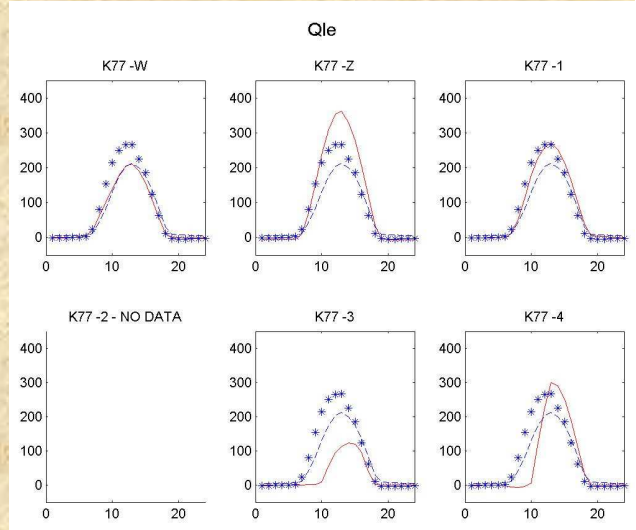
Qle K77





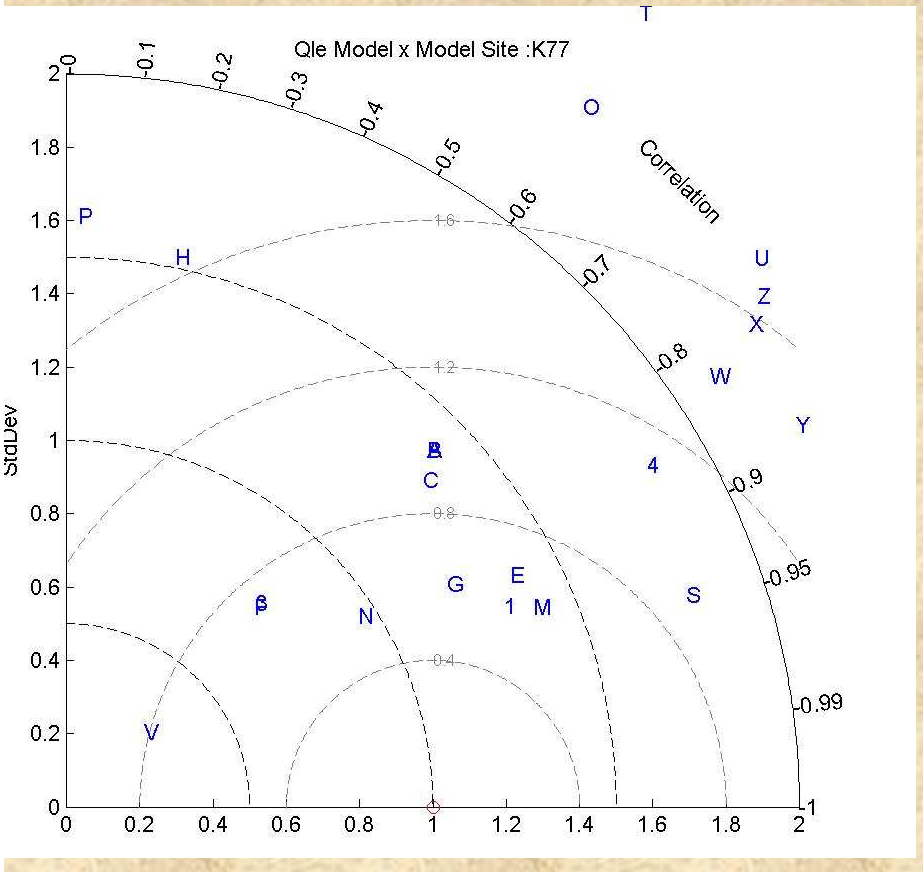


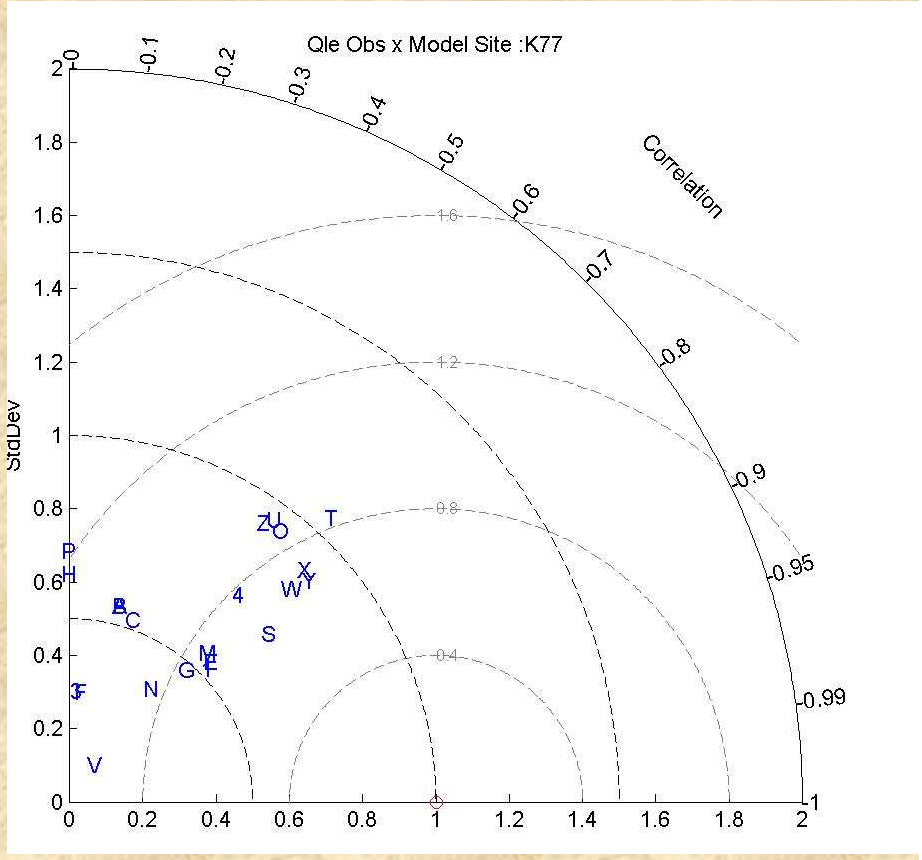




Results Analyses

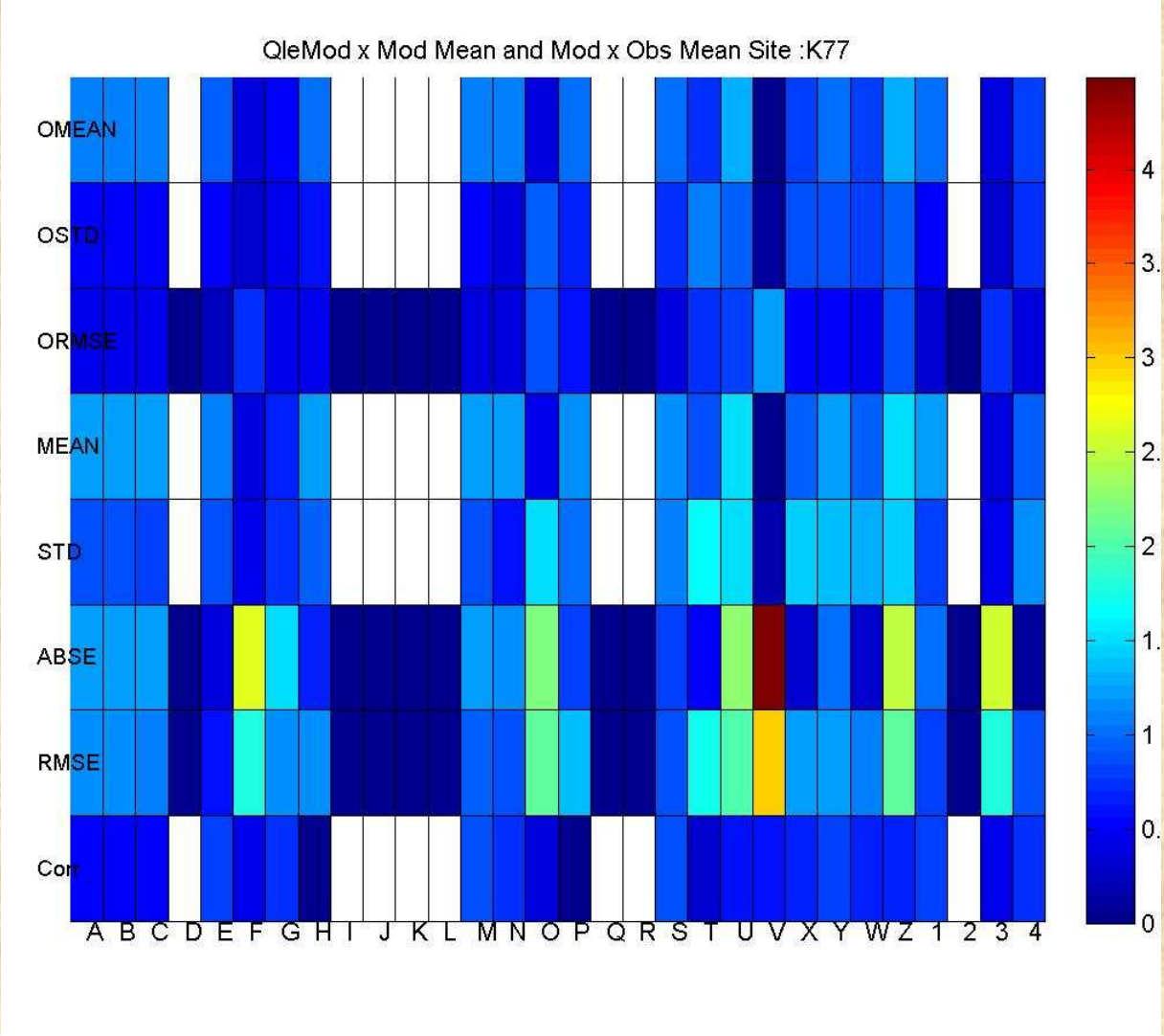
Qle K77





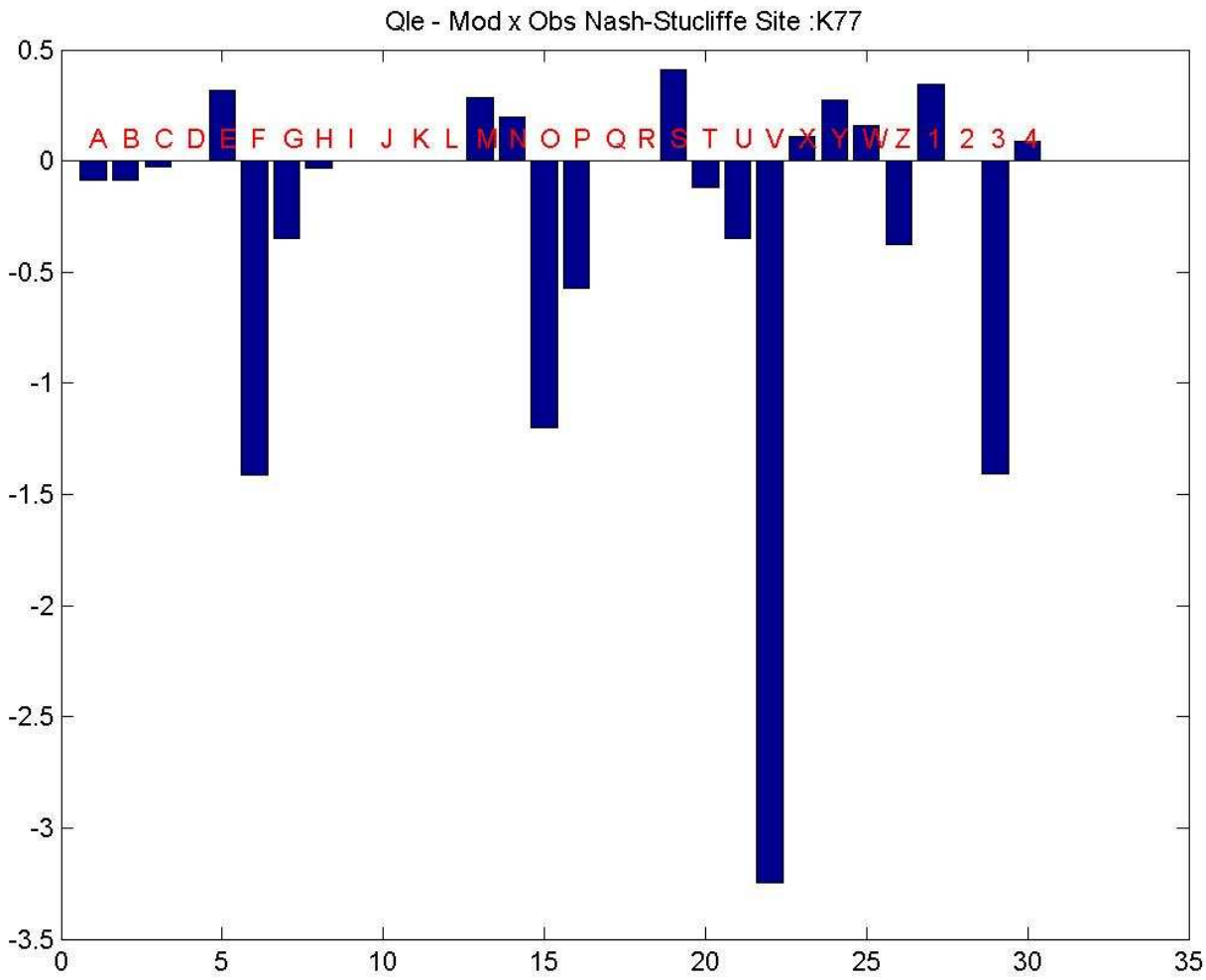
Results Analyses

Qle K77



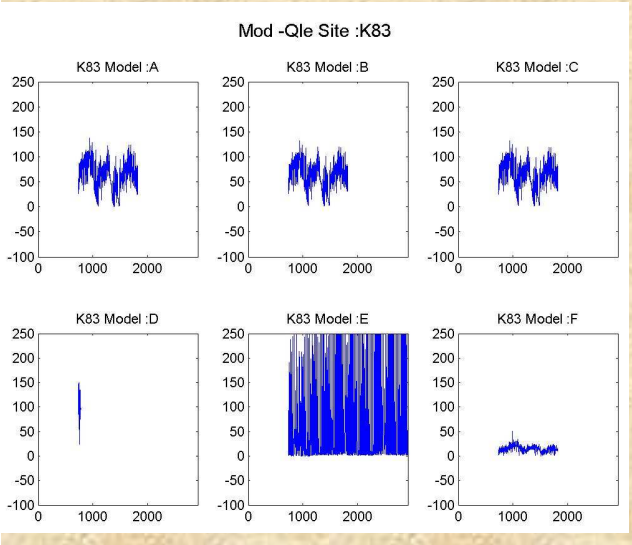
Results Analyses

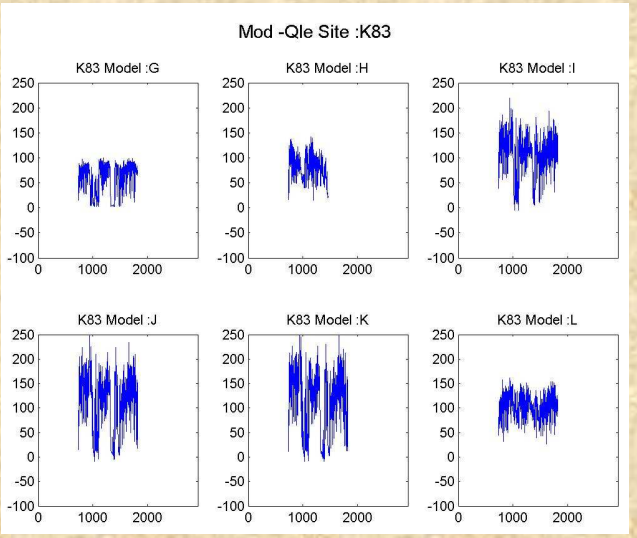
Qle K77

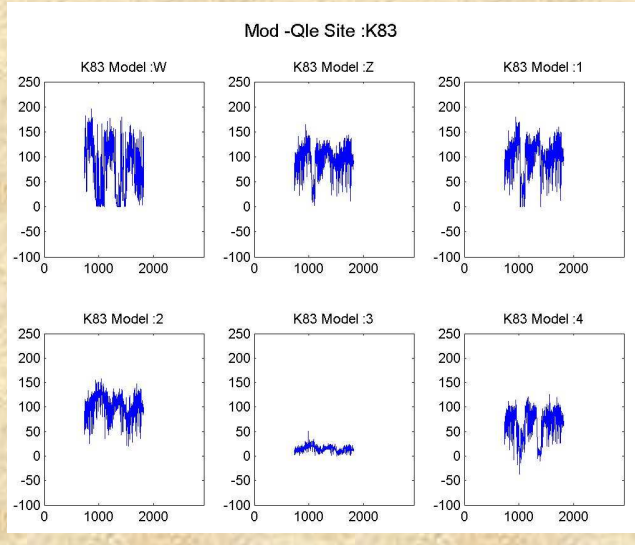


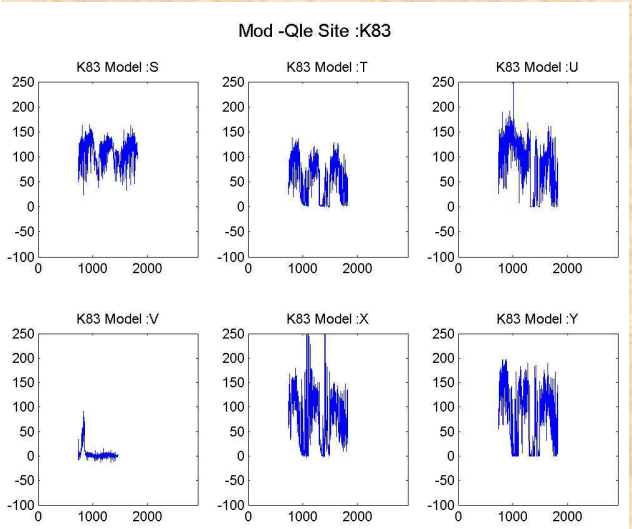
Results Analyses

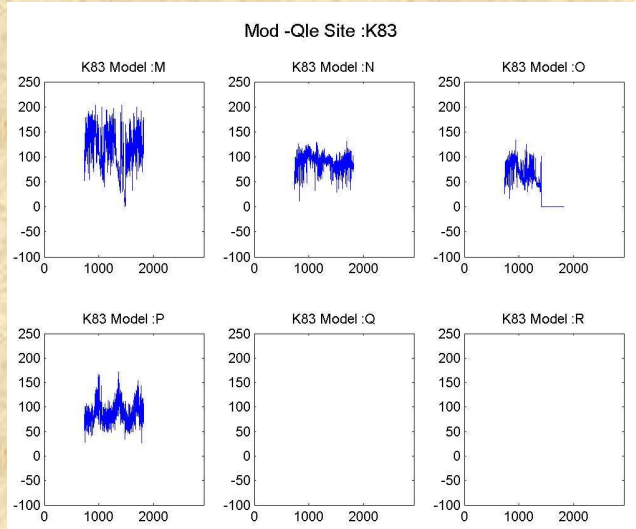
Qle K83





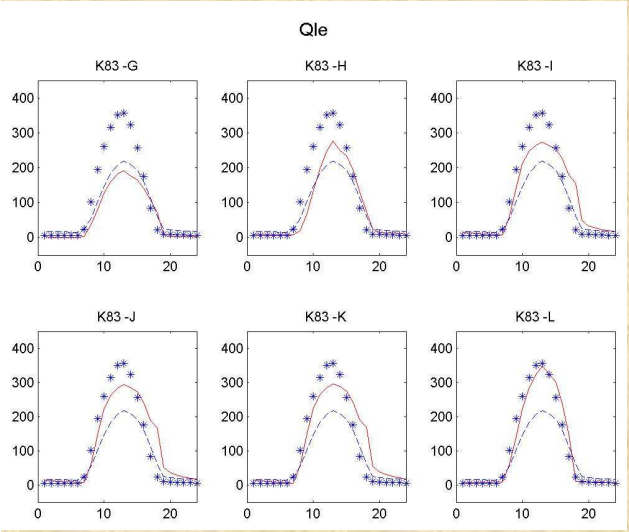


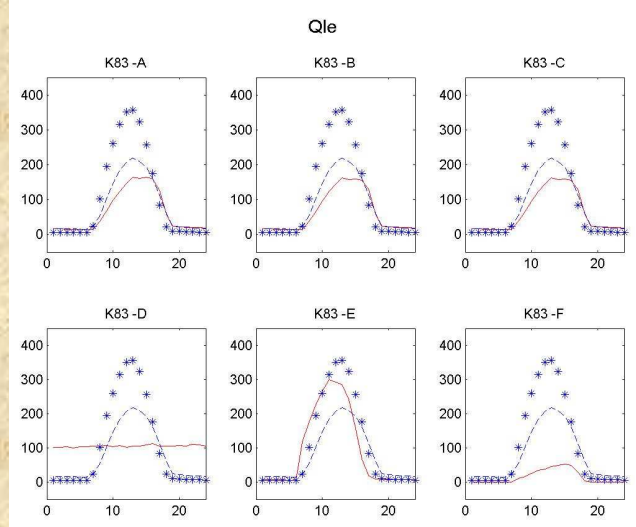


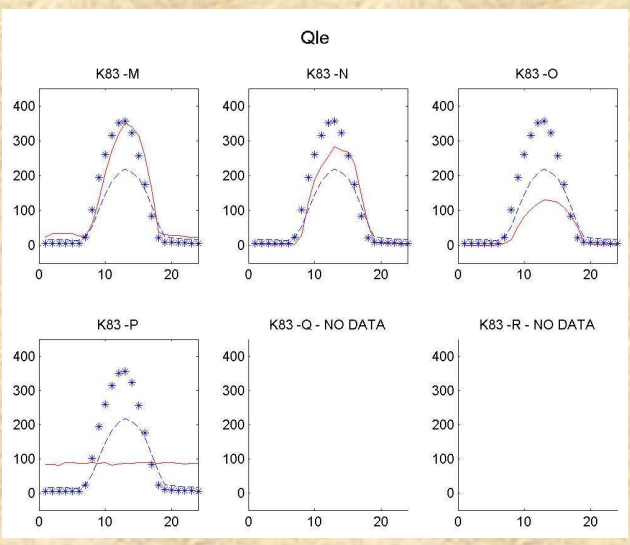


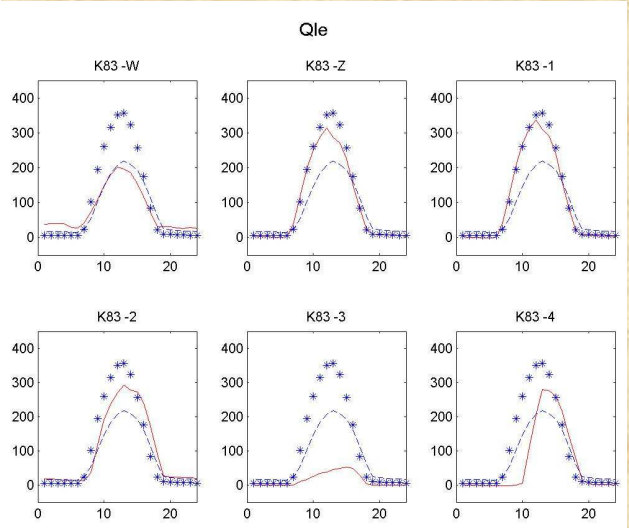
Results Analyses

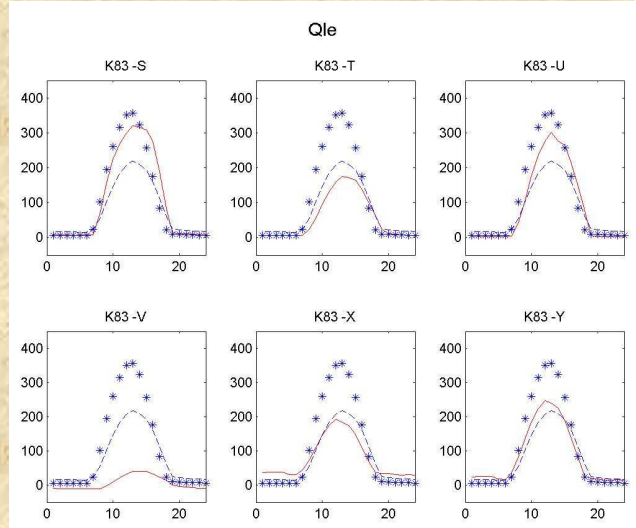
Qle K83





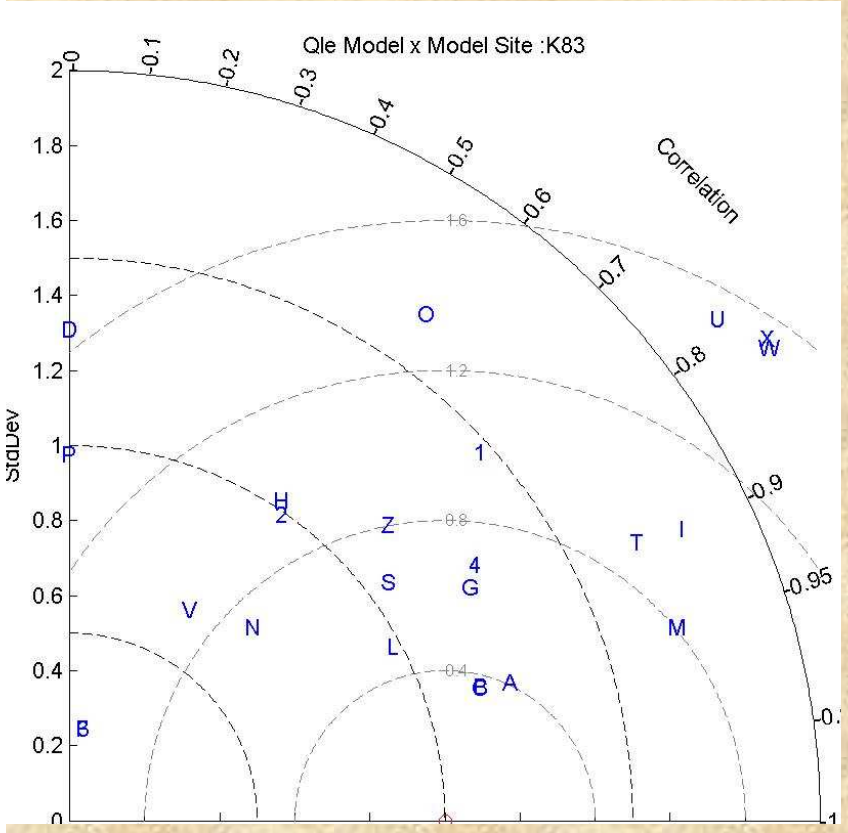


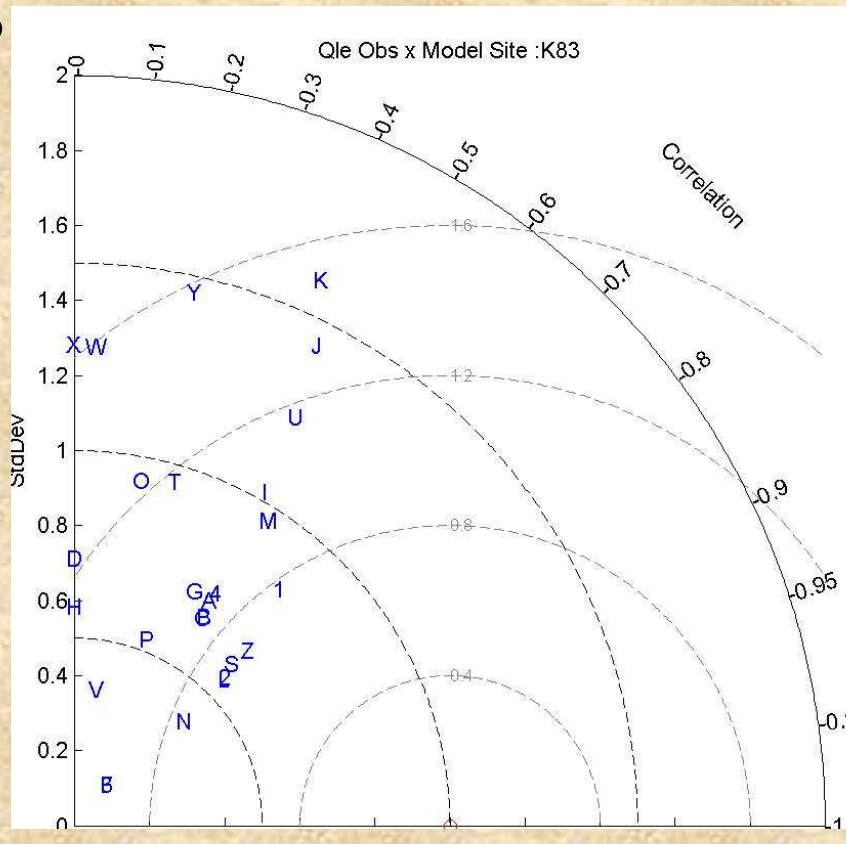




Results Analyses

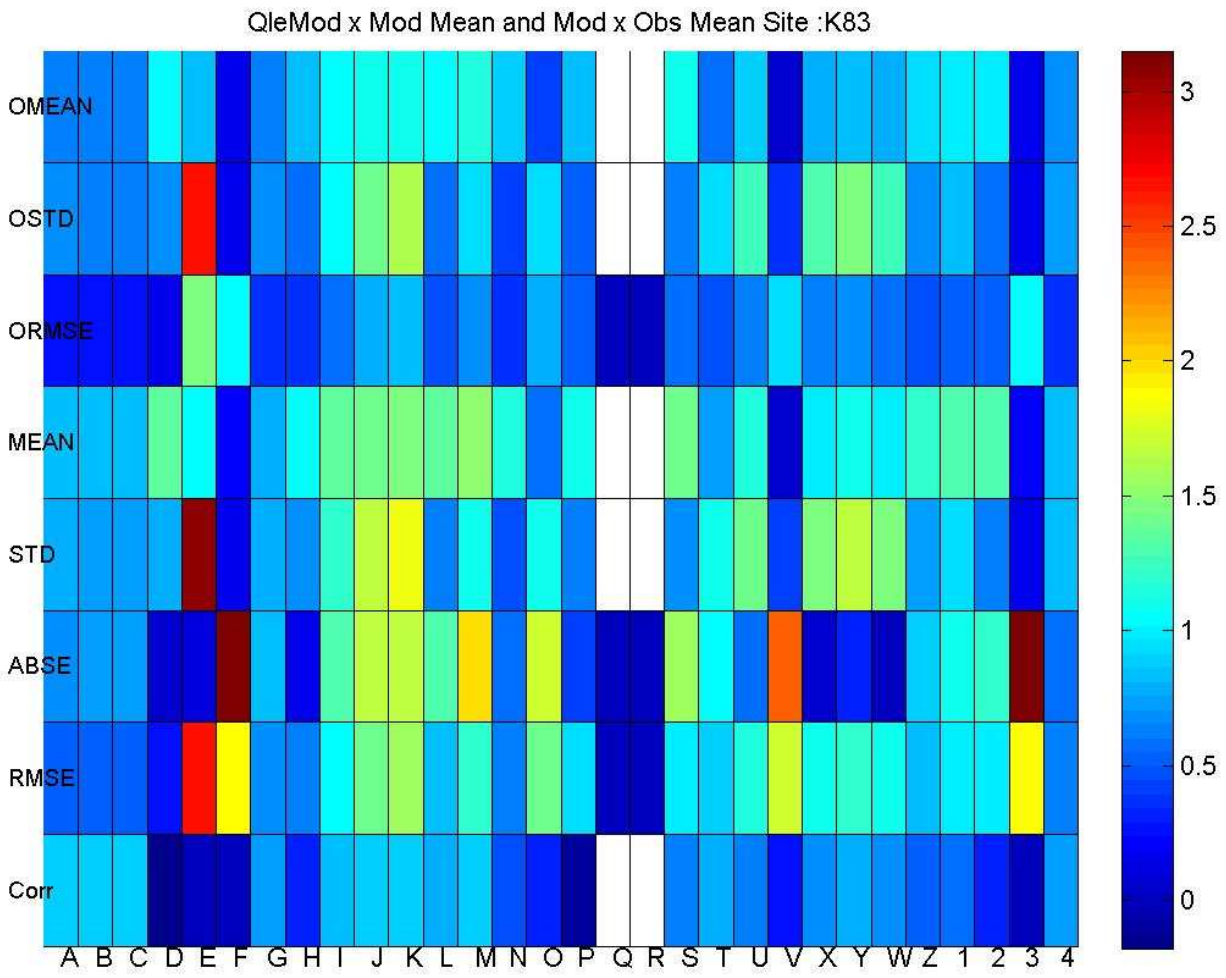
Qle K83





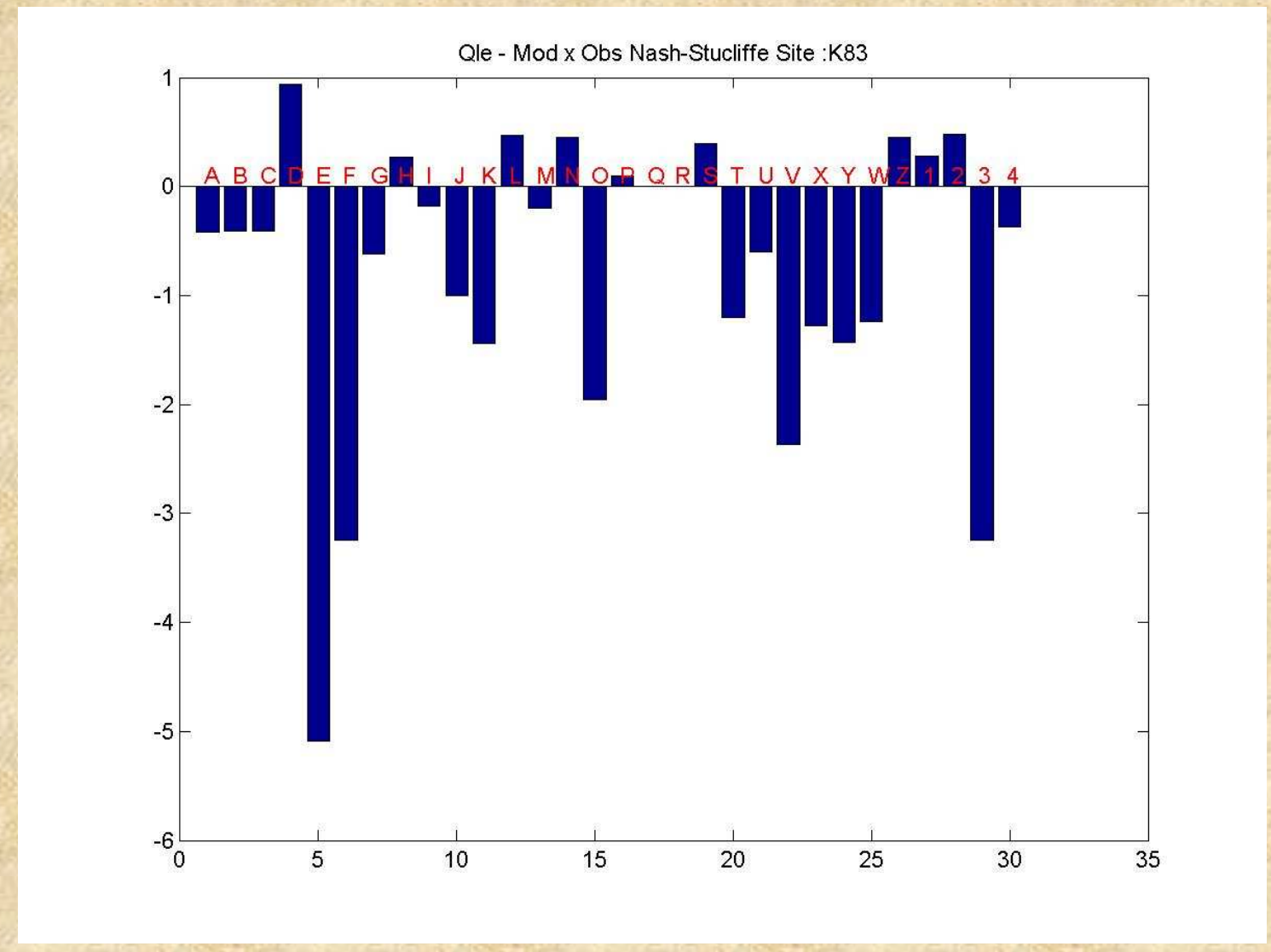
Results Analyses

Qle K83



Results Analyses

Qle K83



Results Analyses