Refining CCWD's Salinity-Outflow Model

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DSM2 Users Group Meeting

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Why do we need Salinity-Outflow Models?

- Forecasting water quality at Delta drinking water intakes from forecasted Delta outflows, exports, etc.
- Calculating Sacramento inflow needed to meet SWRCB water quality standards
  - ❖ e.g., G-Model or ANN in CALSIM II
  - ❖ setting equivalent outflows for X2 objectives

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Key Water Quality Locations

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CCWD's Salinity Outflow Model (G-Model)

- EC assumed only a function of antecedent Delta outflow (existing and previous flows)
  - ❖ Port Chicago, Chipps Island, Collinsville (X2)
  - ❖ Antioch, Emmaton and Jersey Point
  - ❖ Transfer function used to predict Rock Slough Cl from Jersey EC
- **Applications:** Development of 1995 WQCP X2 estuarine habitat objectives; and prediction of flow needed to meet Rock Slough 250 & 150 mg/L Cl standards

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Basic G-Model Equations

$$EC = Sb + (So - Sb) * Exp(- \alpha * G(t)^{n})$$

where Sb is the background (high outflow) salinity,

So is the downstream boundary salinity, and

α and n are fitting factors.

The antecedent outflow G(t) is calculated from

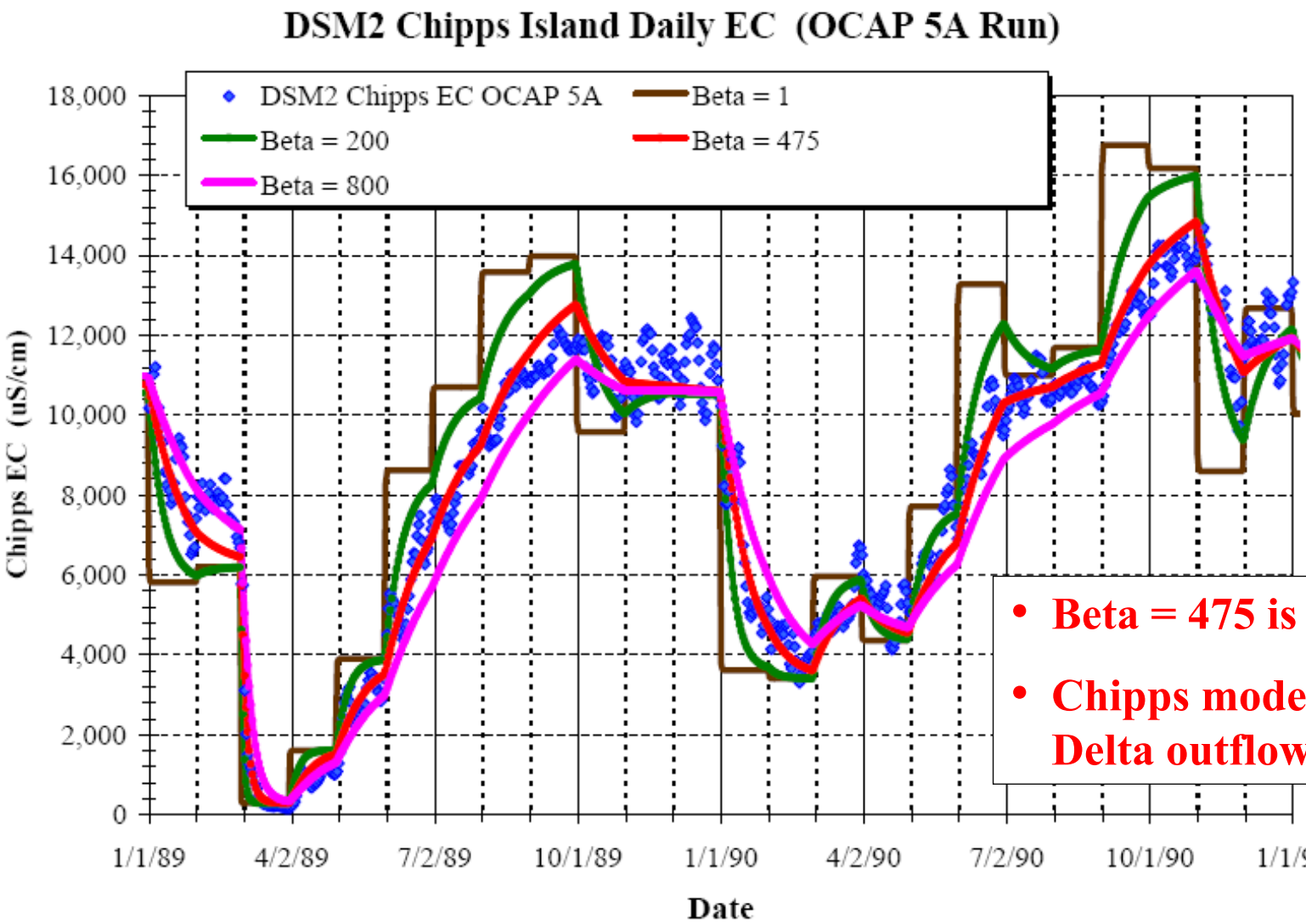
$$dG/dt = (\mathbf{Q} - G)*G / \beta$$

where **Q(t)** is Delta outflow, and

β is the response rate

(collapses data to single EC versus G curve)

β represents response to outflow changes



- **Beta = 475 is best fit**
- **Chipps model only uses Delta outflow**

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Data Used to Developing Revised Model

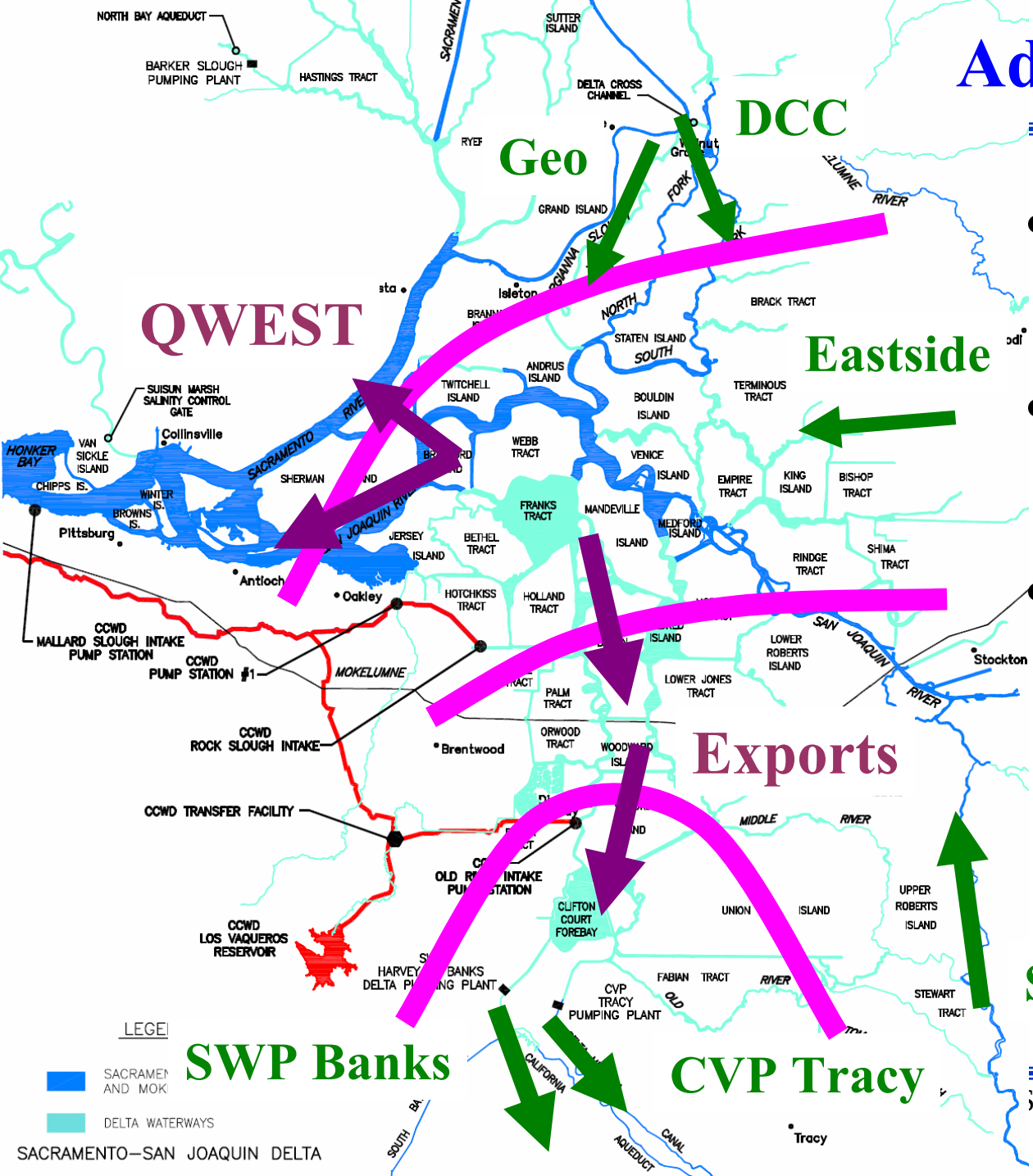
- DSM2 Planning Study output
  - Monthly data (not enough detail)
  - Constant level of development
  - Known input flows, e.g., Delta outflow, QWEST

- Jersey Point: DSM2 SDIP Study 2A

Improvements Needed for G-Model

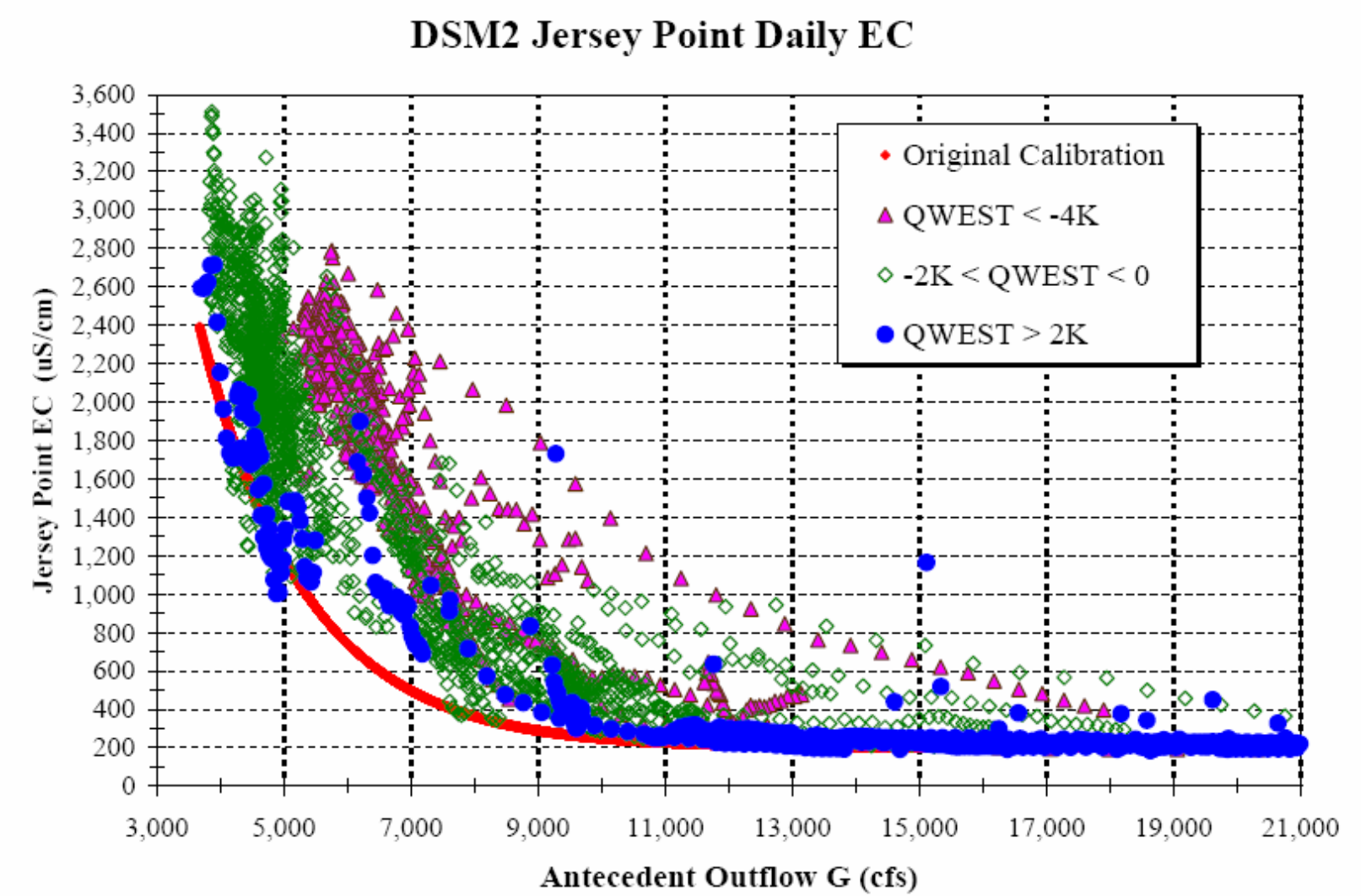
- Works well for X2 locations but not Jersey Point
  - ❖ Sacramento/San Joaquin River flow split
- Need at least another independent variable to account for additional effect of exports and cross-channel closures on central and south Delta salinity
  - ❖ carriage water effect
- Only addresses seawater intrusion – does not include local Ag drainage effects

Additional variable?



- Banks and Tracy exports?
- Exports minus San Joaquin inflow?
- QWEST?
  - Includes DCC + Georgiana Slough flows

DSM2 Jersey EC increases as QWEST decreases



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Calibration values for DSM2 Jersey Point EC

- **Original G-Model**
  - **β** = 550 (cfs years)
  - So = 20,0000 µS/cm and Sb = 200 µS/cm
  - **α = 0.0006,** **n** = 1
- **Revised G-Model**
  - Same **β,** So, Sb, and **n**
  - **α = 2.3E-08 * QWEST + 0.000515**
  - Maximum **α** = 0.0006

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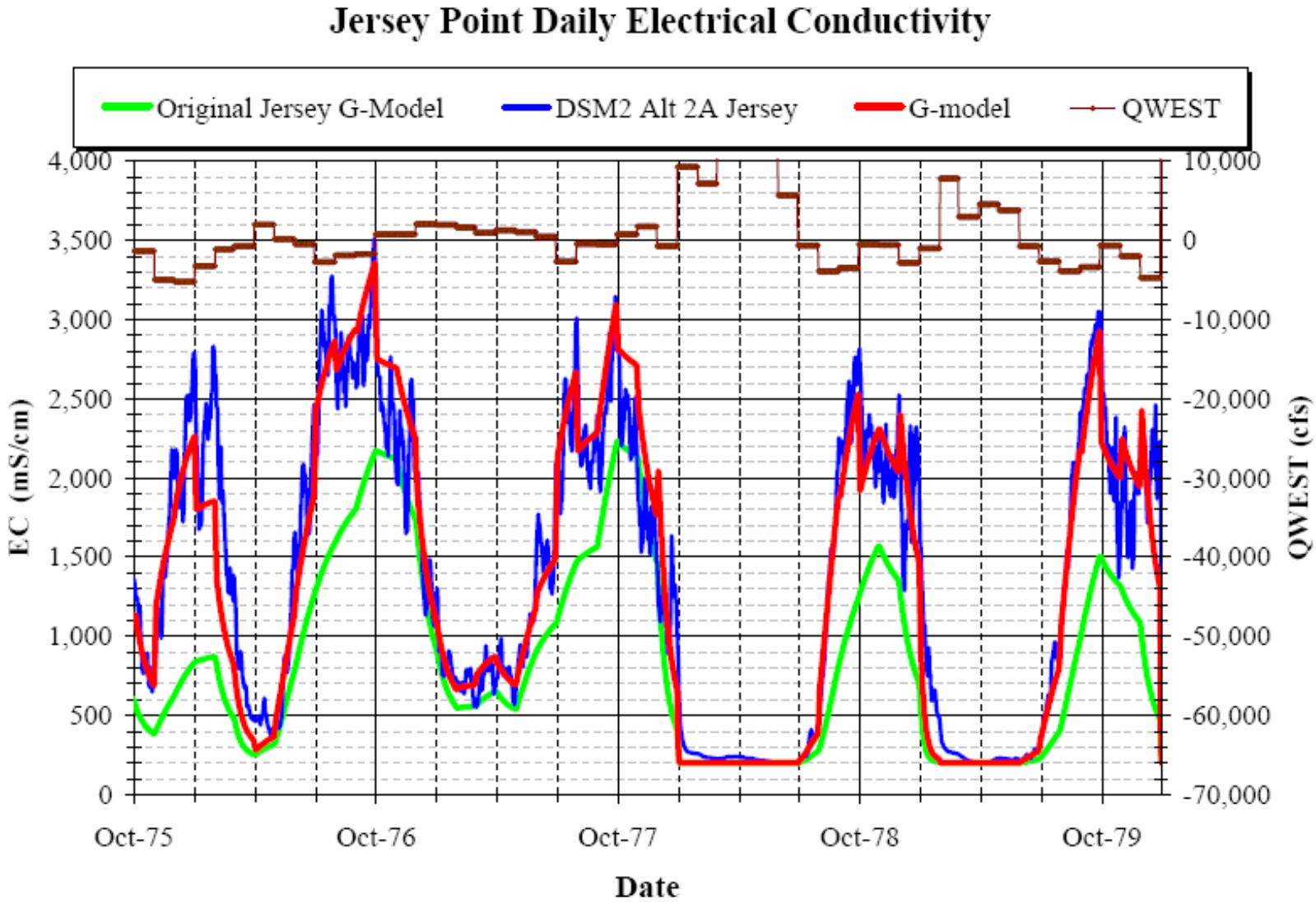
Including QWEST improves Jersey EC Prediction



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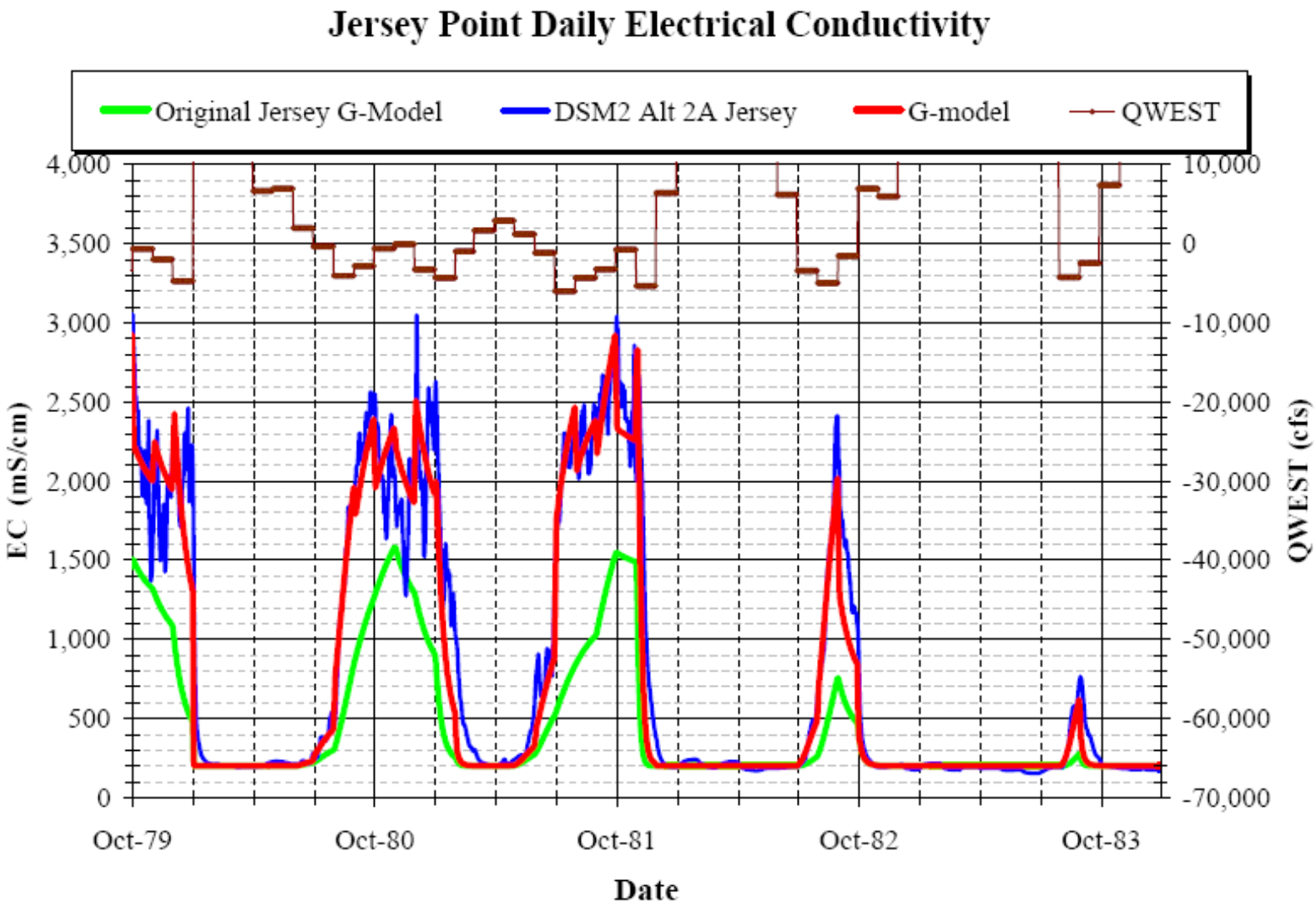

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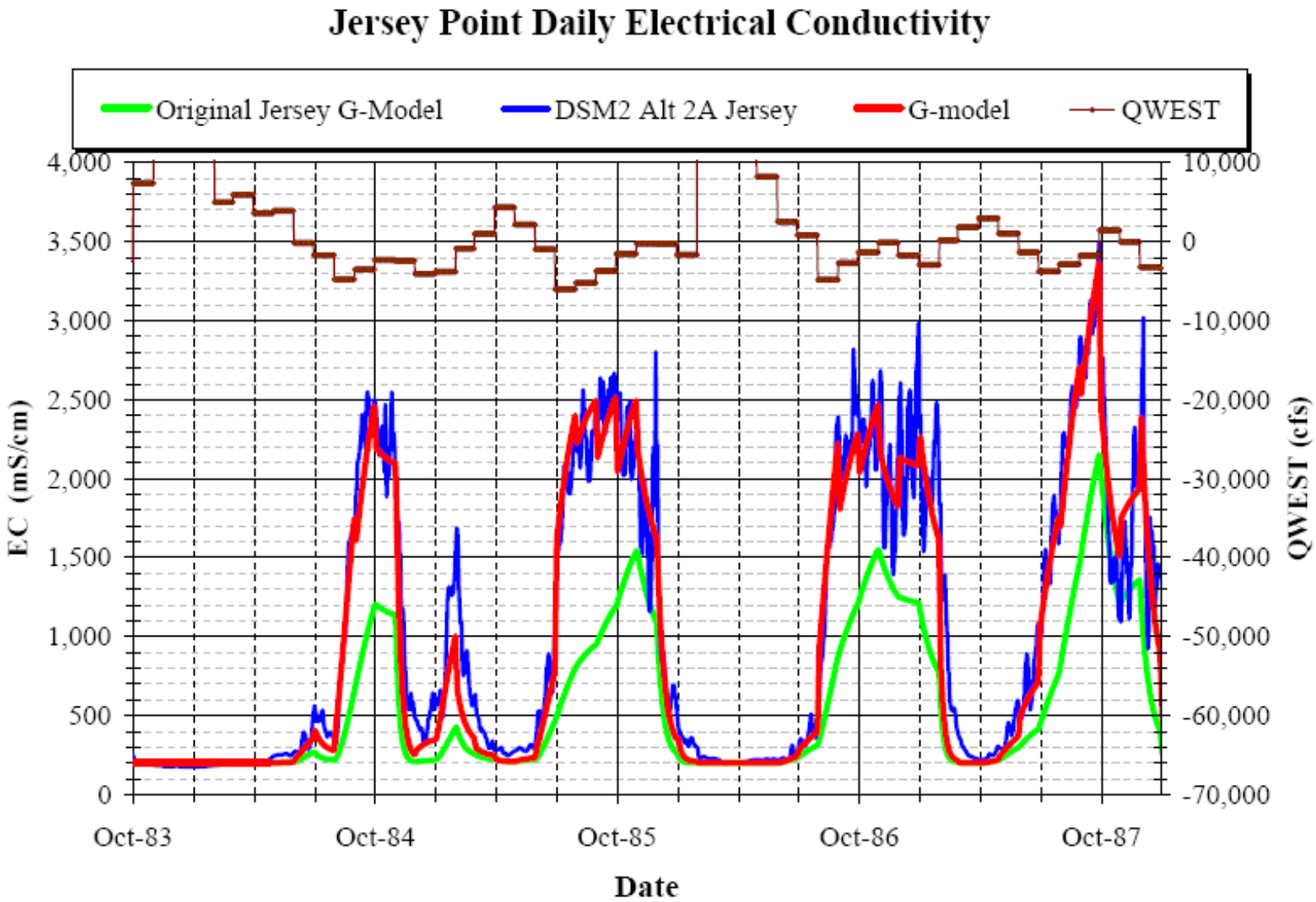

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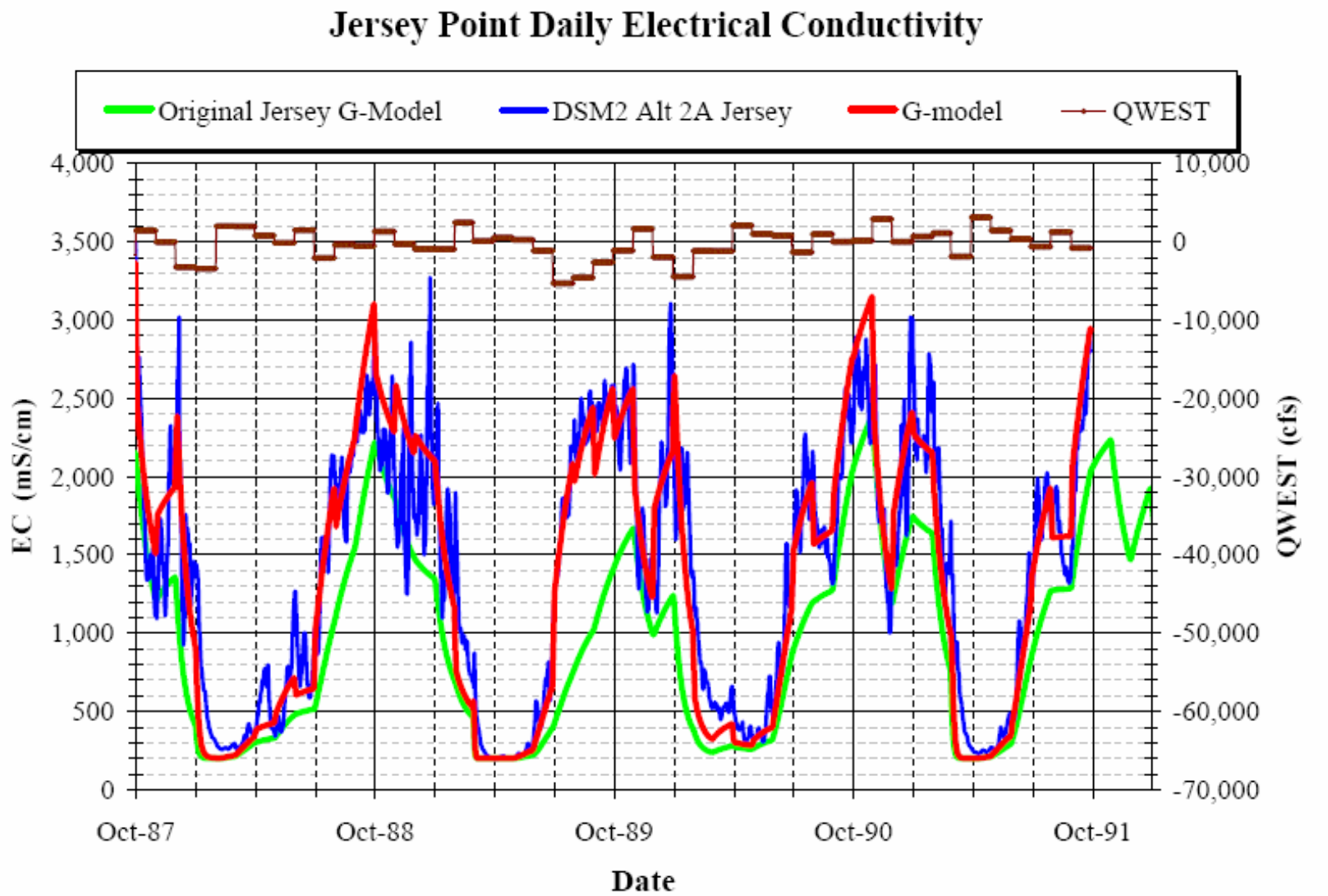

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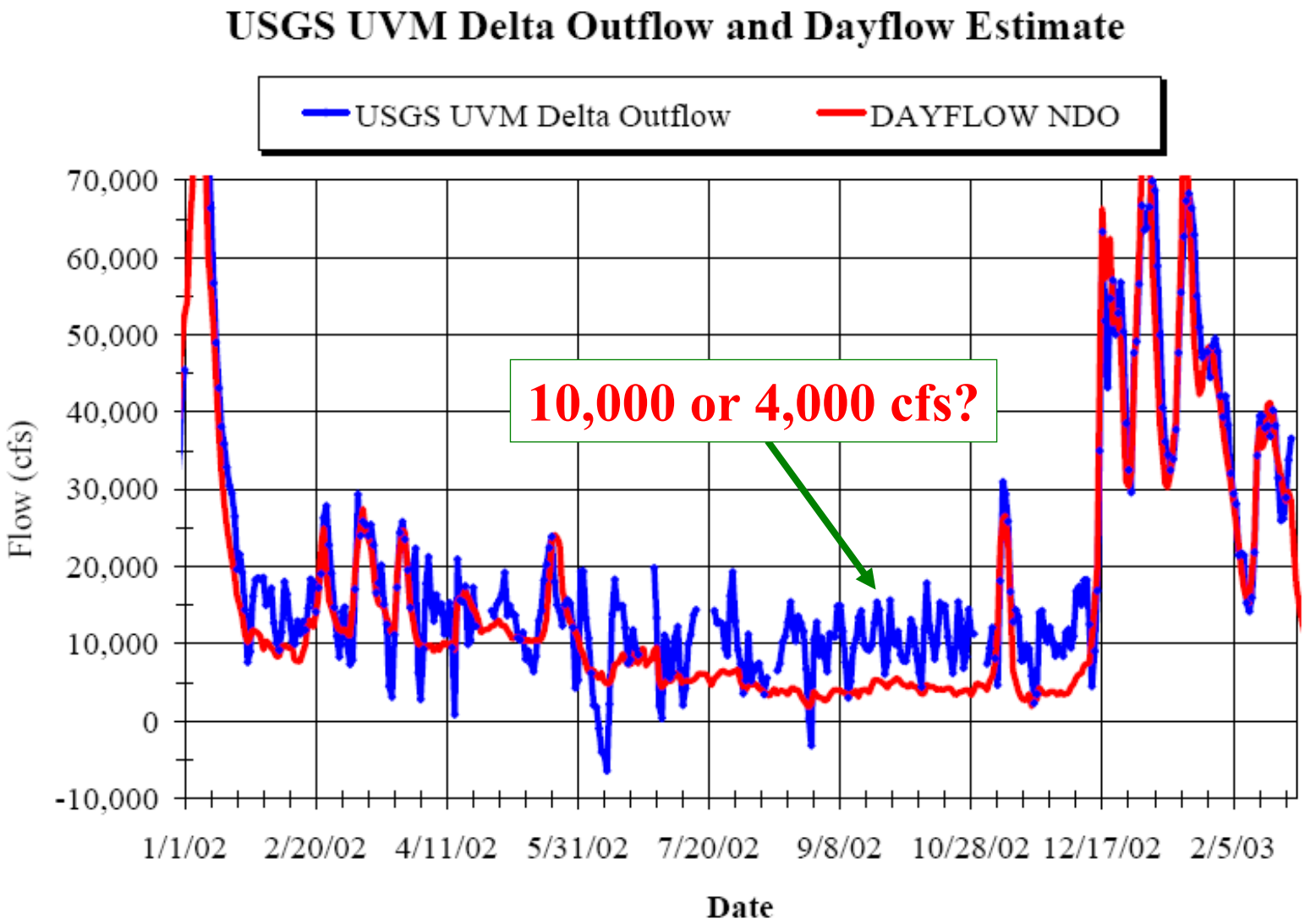
Fit of DSM2 may not work for Field Data

- Need to calibrate model against actual historical data (Measured or estimated Delta outflow and QWEST, and Jersey EC)
- DAYFLOW data not accurate enough
  - 1,000 cfs error in consumptive use huge if outflow is only 4,000 cfs
- Could adjust DAYFLOW data using USGS UVM data
- Could use DWR Delta Island Consumptive Use estimates

Other Available Data for Revising Model

- DSM2 Historical Verification output
  - Daily data
  - Changing level of development
  - Known input flows, e.g., Delta outflow, QWEST
- **Historical DAYFLOW and IEP/CDEC EC data**
  - Unrealistic consumptive use estimates
  - Ignores spring-neap filling/draining of Delta
  - DWR DICU Data
  - USGS UVM Delta outflow measurements

USGS Delta Outflow compared to Dayflow



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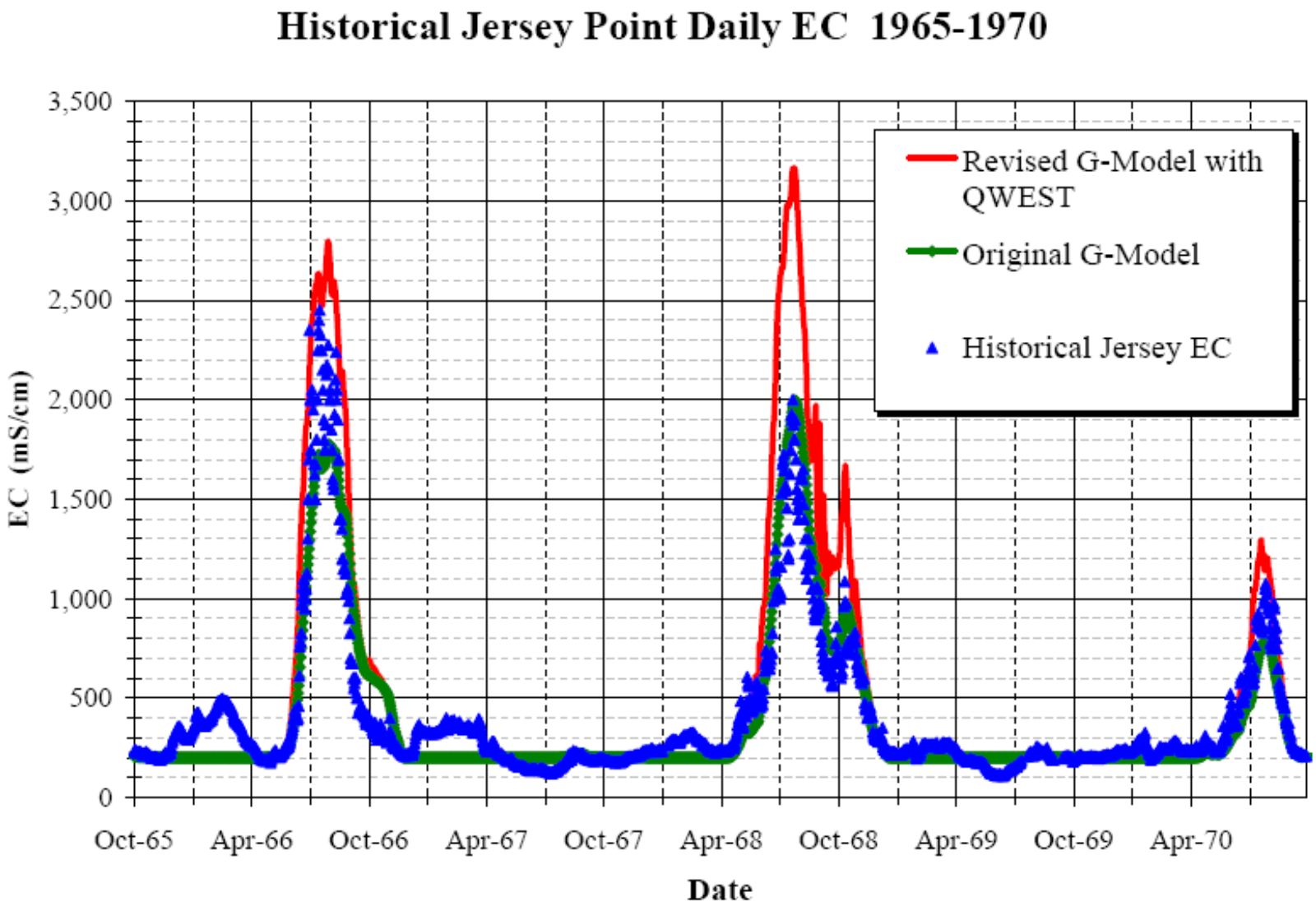
Comparisons Using DWR's 1955-1987 CU Data



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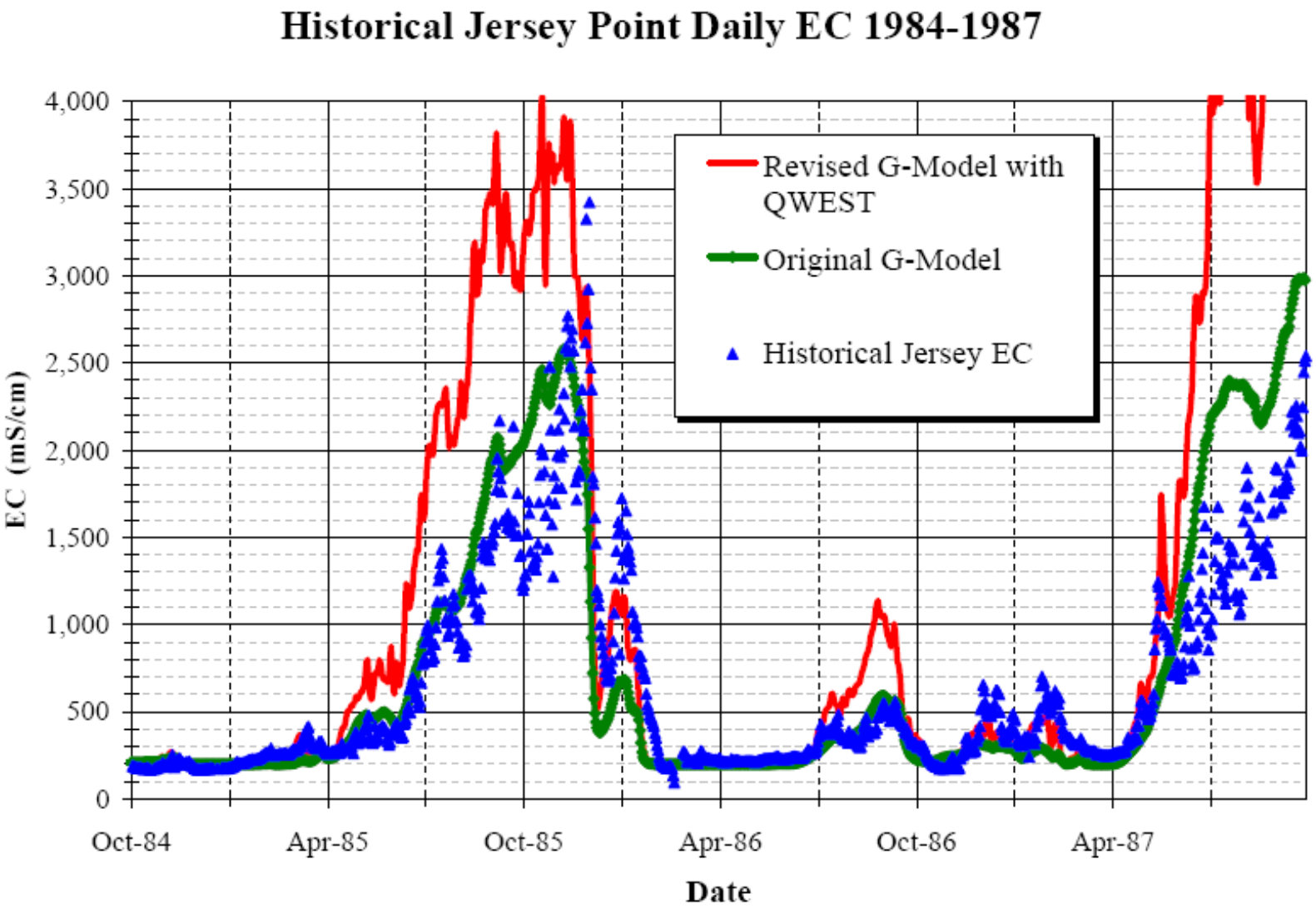

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Original calibration still better prior to 1988

- G-Model was originally calibrated using DAYFLOW data adjusted with DWR's 1955-1987 consumptive use estimates
- Original calibration generally better over this period than revised model calibrated against DSM2 output
  - ❖ Lower exports, higher QWEST
- Do we have good consumptive use estimates for 1988-2006?

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Next Steps

- **Calibrate against historical data**
  - ❖ Obtain best available consumptive use estimates to improve historical DAYFLOW estimates of Delta outflow and QWEST
  - ❖ Use USGS UVM Delta Outflow measurements to check or improve Delta outflow and QWEST data
- **Check DSM2 fit**
  - ❖ Obtain DSM2 Historical Verification output and check fit of DSM2 data