



## **Deltares** USA

Science for a changing world

### The next generation of the San Francisco Bay-Delta Community Model

Public domain modeling in support of flood protection and forecasting (Hydro-CoSMoS)

Kees Nederhoff, Babak Tehranirad, Liv Herman, Li Erikson, Patrick Barnard, Mick van der Wegen, Rohin Saleh

CWEMF annual meeting 2022

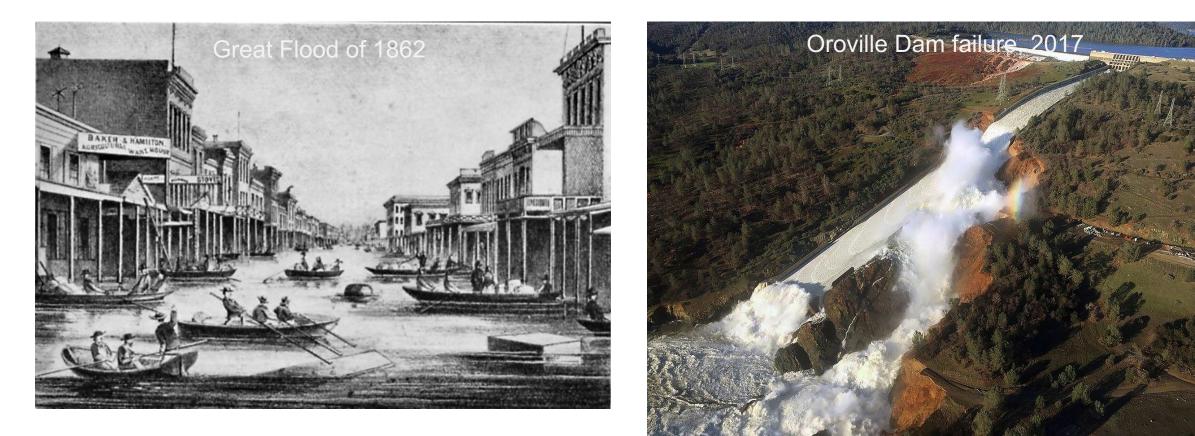
### Contents

- Introduction: situation, complication and solution
- Model setup
  - Model extent
  - Model boundary conditions

#### Model results still water levels

- Validation tidal propagation
- Reproduction storm events
- Extreme Value Analysis
- Conclusions and next steps

## Managing urban flood risk in the San Francisco Bay and Delta: an ongoing challenge



# Complication with previous model efforts

- A lot of different numerical models have been developed to study complex hydrodynamics in the San Francisco Bay and Delta (SFB&D).
- However, existing models are limited by:
  - Proprietary software
  - Limited support/maintenance
  - Model extent
  - Private model schematizations
  - Not designed for flood protection

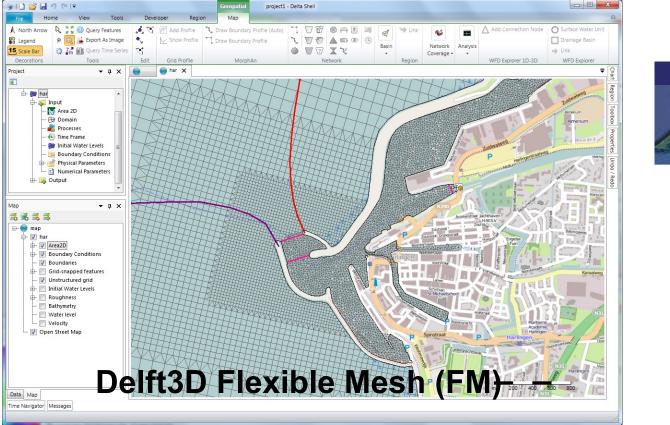


#### San Francisco Bay Tidal Datums and Extreme Tides Study

Final Report • February 2016



## Solution: open-source software and public domain model schematizations with access to the public





#### Open access, publicly available, integrated modeling platforms

The San Francisce Bay-Defia system is complex in its physical and environmental dynamics. Modeling floors integrating hydrodynamics and water quality dynamics are essential to unravel the governing processes on spatial and temporal scales an assess patential developments due to climate change and adraptic management strategies.

There are a number of available San Francisco Bay-Delta modeling systems developed throughout the years and for various purposes. However, a vast majority of these models are not accessible for public uses and free downloads without substantial technical support by the developers and associated costs.

The San Francisco Bay-Delta COmmunity model platform facilitates and enhances interdisciplinary and interagency scienti communication, collaboration, and understanding.

| View ID-2D Hydrodynamics Model: Still Water Level        |
|--|
| View 3D Hydrodynamics Modelt salinity, temperature, etc. |
| View All Downloads                                       |



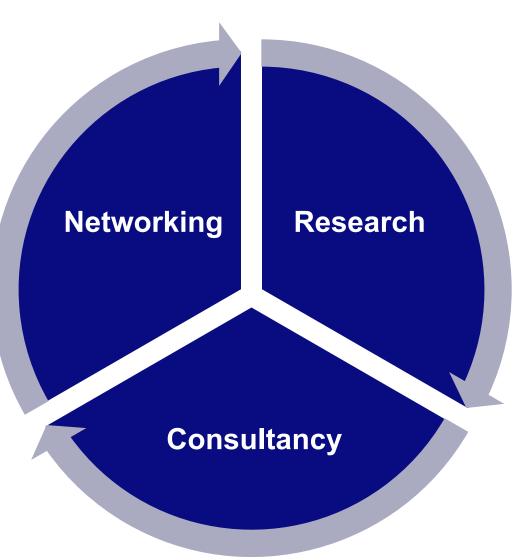
https://www.d3d-baydelta.org/

#### **Deltares** USA

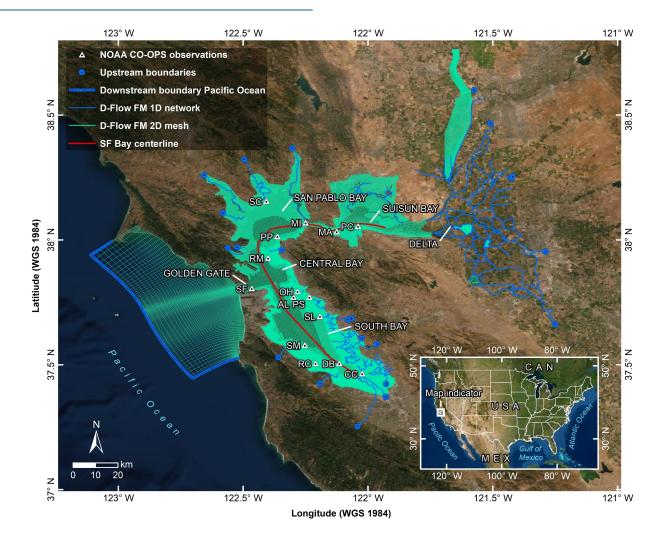
The next generation of the San Francisco Bay-Delta Community Model

## Concept of the community model

- The community model concept creates a standard model setup for everyone.
- Research : Open-source and openaccess developments + Scientific feedback and progress
- **Consultancy:** Scientific basis for sound consultancy
- **Networking**: Involvement of several institutes & continuous building with multiple discipline and parties



### Next generation of the Community Model





Nederhoff, K., Saleh, R., Tehranirad, B., Herdman, L., Erikson, L. H., Barnard, P. L., & van der Wegen, M. (2021)

Drivers of extreme water levels in a large, urban, high-energy coastal estuary – a case study of the San Francisco Bay

Coastal Engineering, 170, 103984. https://doi.org/10.1016/j.coastaleng.2021.103984

Read Articl

### Tides across the Bay calibrated and validation

0.8

0.7

0.6

0.5

0.4

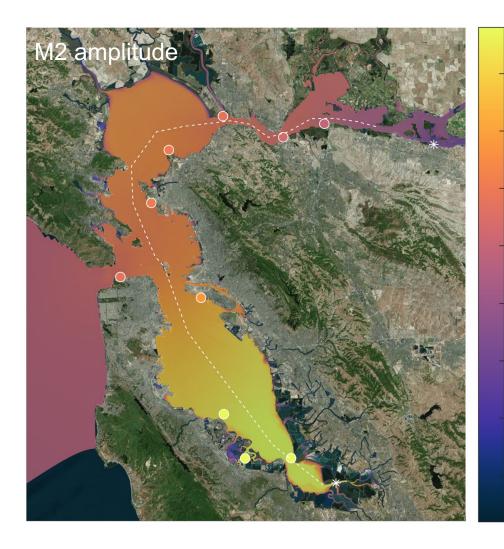
0.3

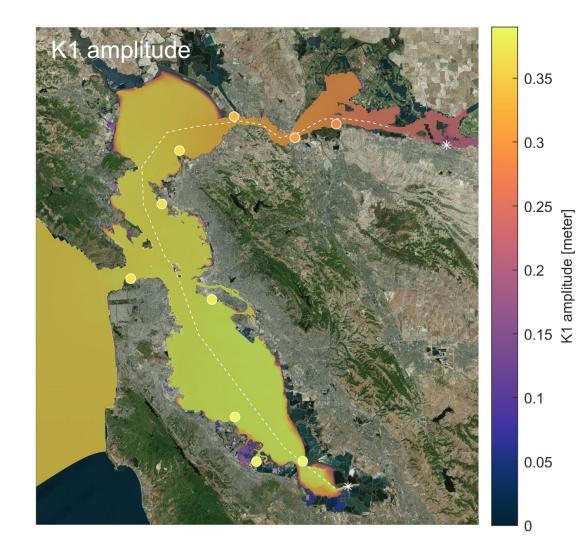
0.2

0.1

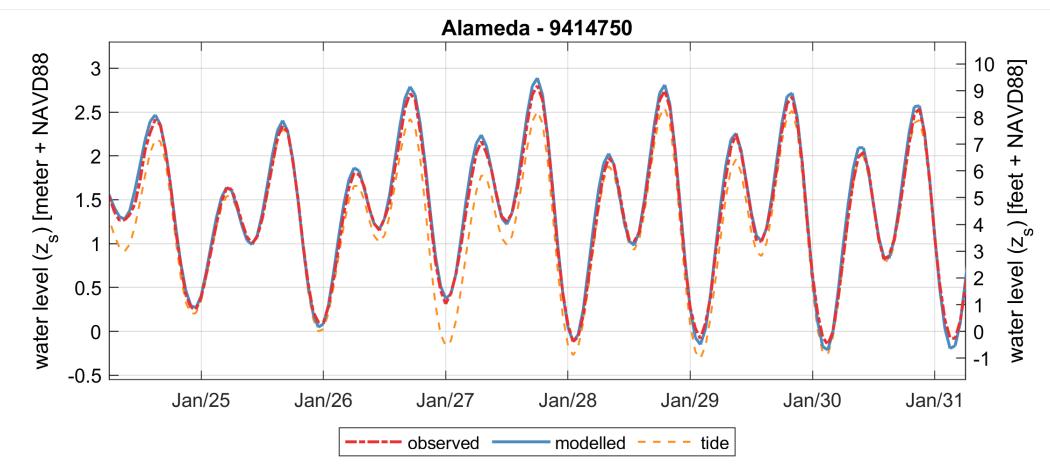
amplitude [meter]

M2

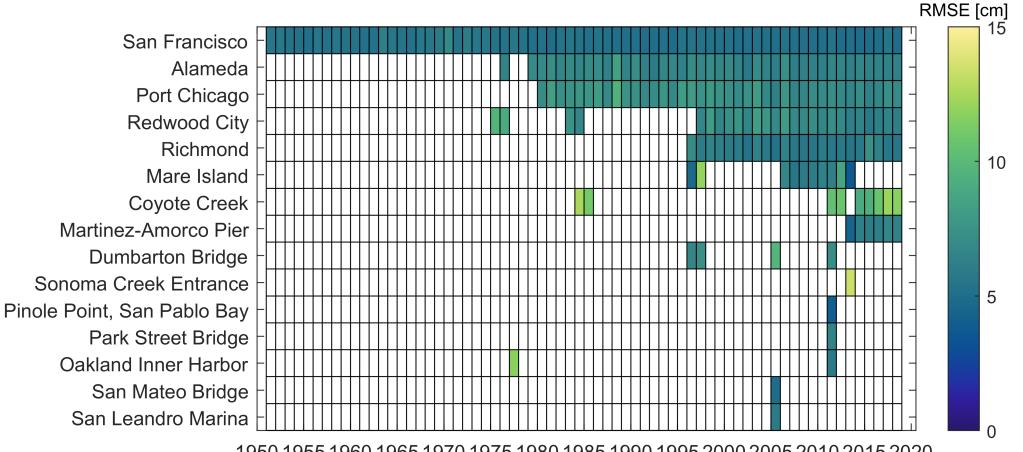




## Extreme water level in the Bay are the result of high tide with surge (NTR) and validate well too

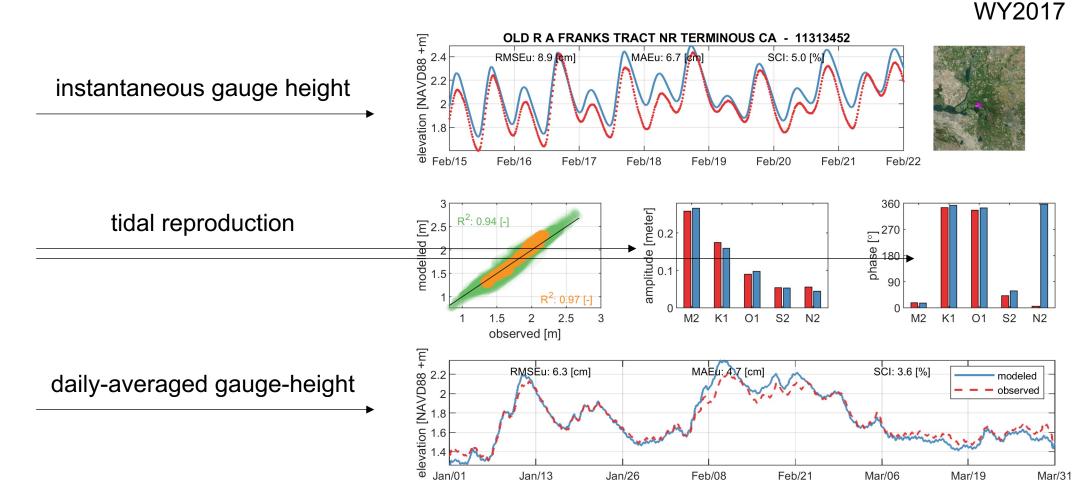


## Validation shows that stations reproduced without any bias and with errors <10 cm or <4 inches

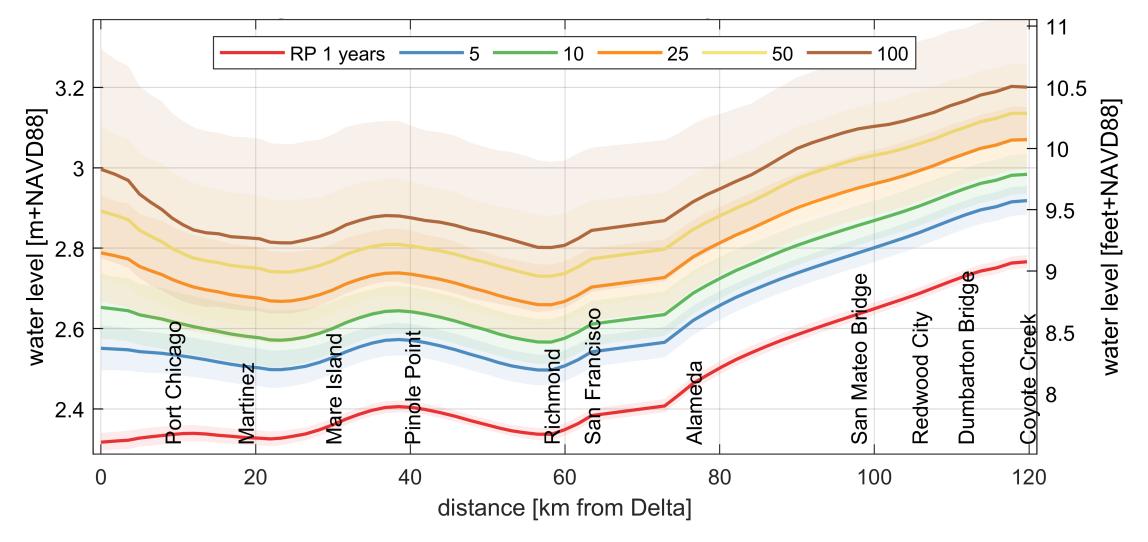


 $1950\,1955\,1960\,1965\,1970\,1975\,1980\,1985\,1990\,1995\,2000\,2005\,2010\,2015\,2020$ 

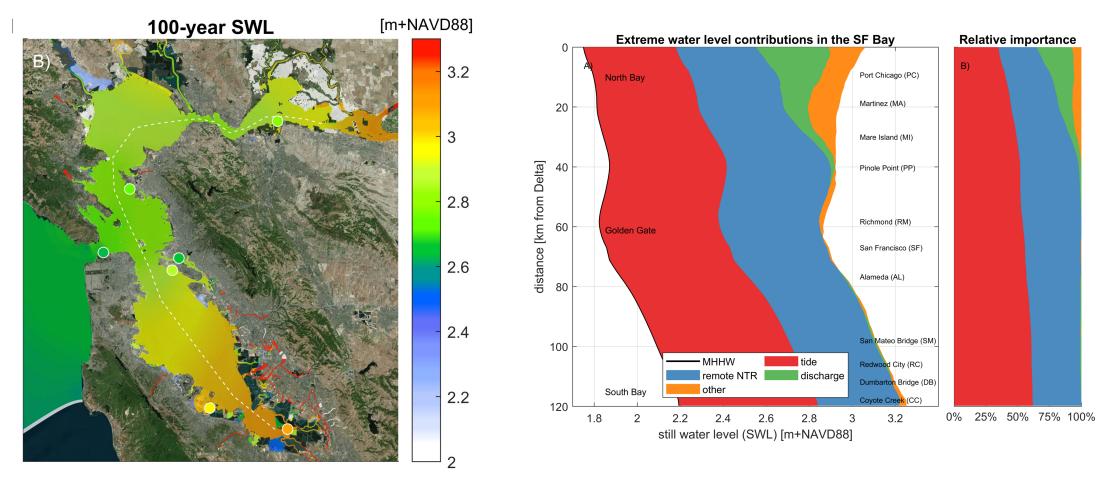
### Regional focus, but validation of the 1D component in Bay and Delta looks also sufficient



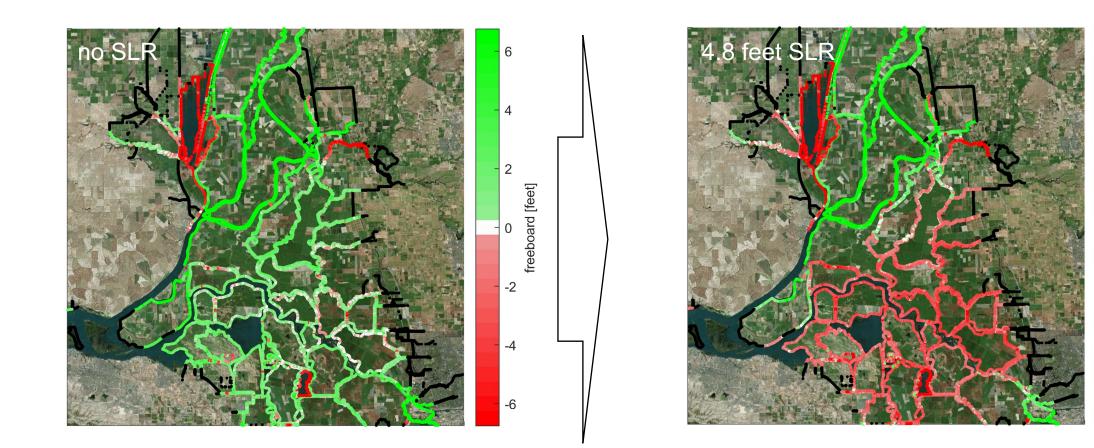
### Extreme estimates across Bay based on POT/GPD



# 1–100-year extreme reaches 2.8 – 3.2m and is largely driven by tide and *remote* sea level anomalies (NTR)

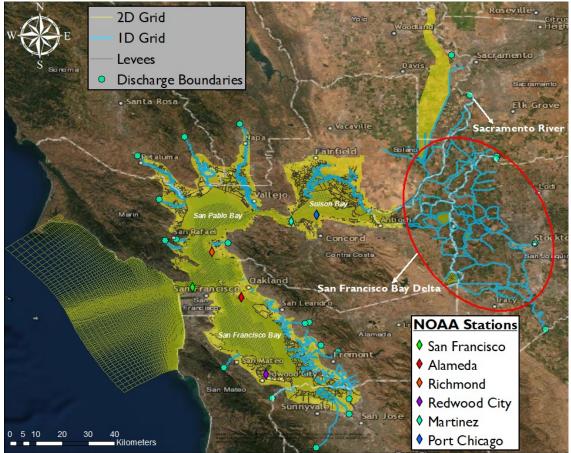


## Extreme water levels (1-100 year) in the Delta will start to overtop more-and-more existing levees due to SLR

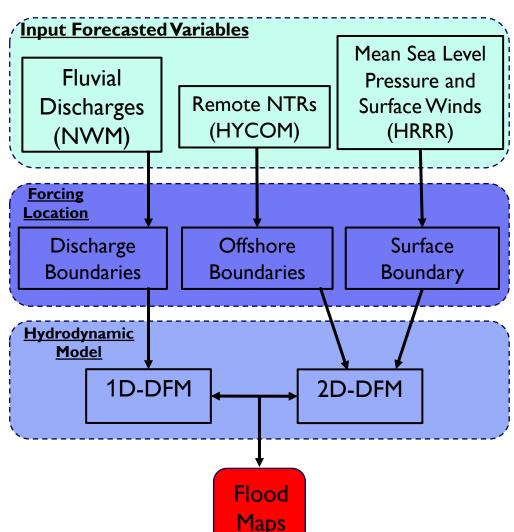


6

# Same schematization used for real-time forecasting of still water level across the Bay with USGS and NOAA

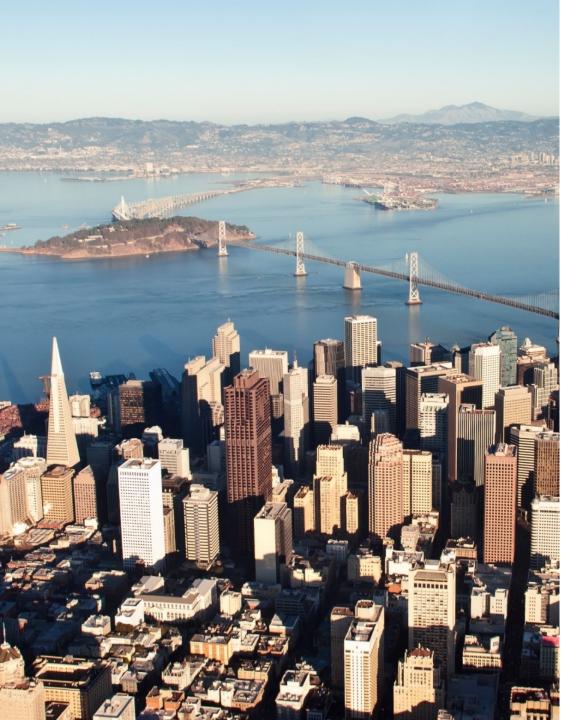


https://psl.noaa.gov/aqpi/



### Conclusions

- Current models for the San Francisco Bay and Delta, have limitations such as usage of proprietary software, limited support/maintenance, model extent and not designed for flood protection purposes in the current and future climate.
- Open-source software based on Delft3D-FM and community modelling (public domain) ensures
  public access for all and is therefore beneficial for research, consultancy and networking across the
  San Francisco Bay and Delta.
- Model results for 70 years validate well during daily tidal and episodic storm conditions. Subsequent extreme value analysis based on POT/GPD can inform resilient design of flood protection features.
- The next generation of the San Francisco Bay & Delta Community Model is released. For more
  information and for all the data and science, please visit <u>www.d3d-baydelta.org</u>. Anyone can use the
  model as a backbone for their planning studies.





## **Deltares** USA

Science for a changing world

### The next generation of the San Francisco Bay-Delta Community Model

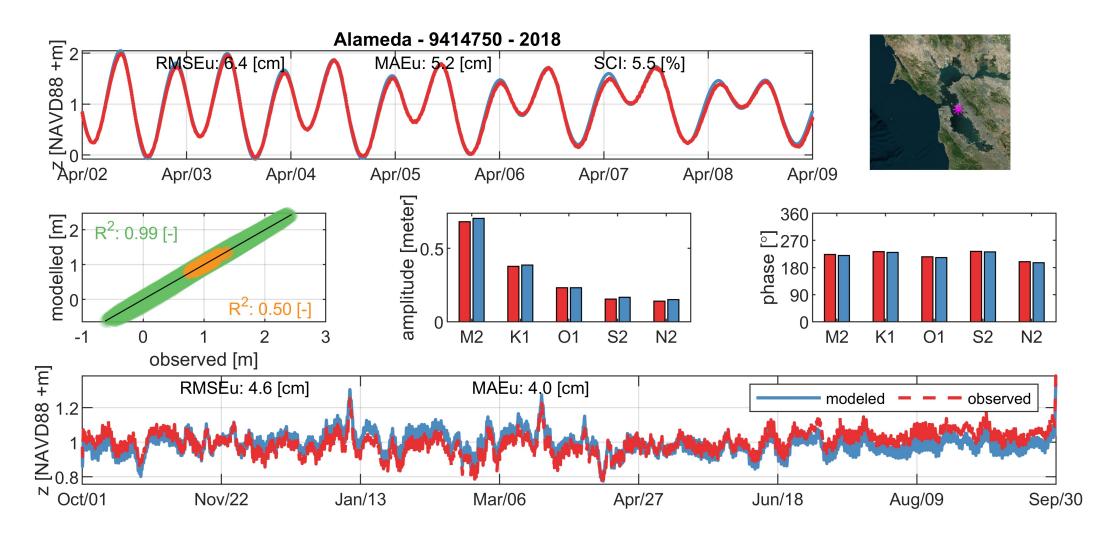
Public domain modeling in support of flood protection and forecasting

Contact Kees Nederhoff for more information on Kees.Nederhoff@deltares-usa.us

CWEMF annual meeting 2022

- Move discussion to resilience planning across the San Francisco Bay and Delta
  - Discover the effectiveness of different adaptation strategies (on going work)
  - Clrcle: Critical Infrastructures: Relations and Consequences for Life and Environment.
  - Dynamic Adaptive Policy Pathways (DAPP) approach to support the development of an adaptive plan that is able to deal with conditions of deep uncertainty (sea level rise)
- Joint probability analysis of marine and fluvial drivers of extreme water levels in local tributaries and riverine system in the San Francisco Bay and Delta to inform planning purposes across County and State efforts
- Connect regional hydrodynamic model with sewer systems with Delft3D-Urban
  - Pilot with Alameda Flood Control District

### Still water levels are reproduced well across the Bay



#### **Deltares** USA

The next generation of the San Francisco Bay-Delta Community Model

## Extreme value analysis to determine high water levels are based on POT/GPD instead of AM/GEV

