WARMER – Wetland Accretion Rate Model of Ecosystem Resilience

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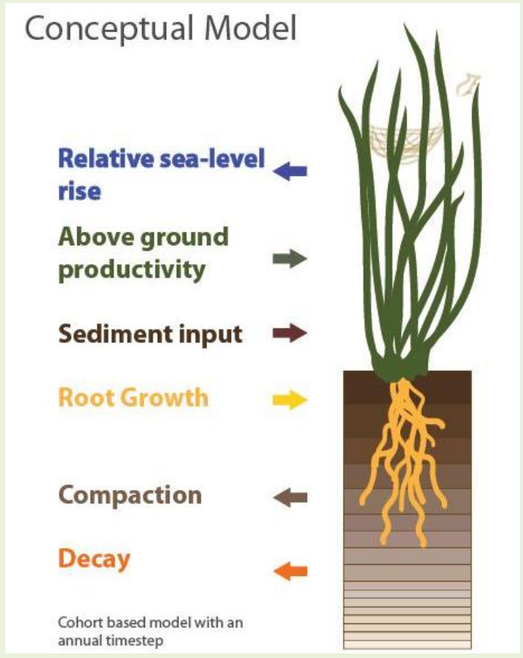
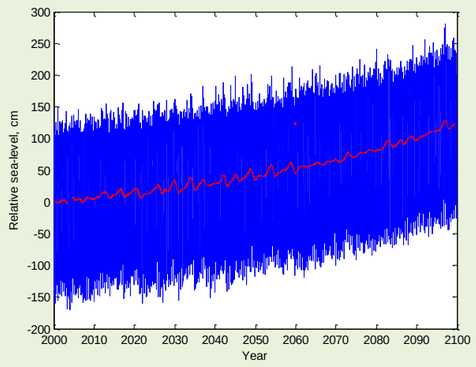
The WARMER model is an adaptation of the Callaway et al. (1996) model of marsh accretion. The model has been modified to incorporate a temporally dynamic SLR function as well as spatially dynamic organic matter accretion and non-linear sediment input.

The 1-D (vertical) cohort model is applied at a single elevation representative of a single marsh or a portion of a marsh. For our runs 3 elevations are used to represent low, mean, and high elevations at each of our 4 field sites and the results are interpolated across the marsh surface.



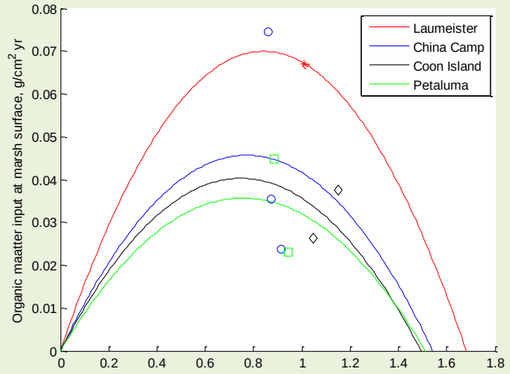
Relative sea level-rise – 124 cm by 2100 (from Knowles and Cayan)



50-150 cm in 2100 used for sensitivity analysis

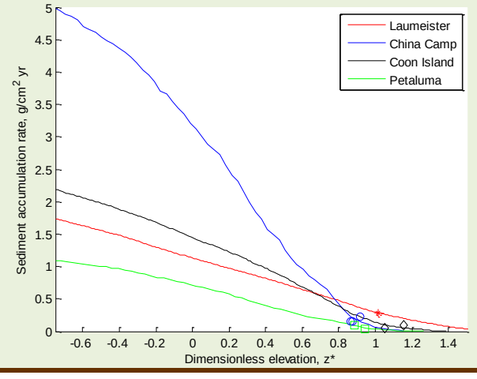
Organic matter inputs

- Parabolic accumulation rate function based on Morris et al. (2002) defined by site specific tidal range (MSL to MAT) and measured organic matter accumulation in sediment cores.
- Divided between **Above ground productivity** and **Root Growth** by root-to-shoot ratio for *Sarcacornia*.
- New root growth is distributed exponentially through the depth of the soil column



Sediment input

- Calculated from paired SSC and water surface elevation records
- Calibrated to measured sediment accumulation rates in sediment cores



Compaction and **Decay** are not changed from Callaway et al. (1996) with parameterization from Deverel et al. (2008)

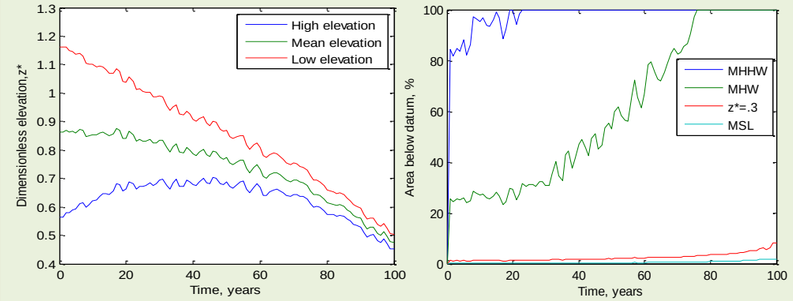
- **Compaction** is modeled as the rate of decrease, , in porosity of a given cohort is a function of the density of all of the material above that cohort, , ——— ,and is a calibration constant.
- **Decay** decreases exponentially with depth and decreases with age for organic matter 1, 2 and 3 years or older.

Other inputs

- Porosity – measured in top 5 cm and bottom 5 cm of each core
- Elevation - DEM of each site developed using RTK-GPS
- Vegetation information – survey % cover and height be species at each site

Evaluation

- Change in elevation
- Comparison of modeled elevations to species specific habitat metrics



- Response to SLR is non-linear because SLR is non-linear
- Significant changes occur from the middle to end of the century.

Technical note: To facilitate habitat comparisons across sites with differing absolute elevations and tidal ranges the dimensionless elevation, z* is used to evaluate model results.

$$z^* = \frac{\text{Elevation-MSL}}{\text{MHHW-MSL}}$$

Model Strengths

- Model can be used to identify the time scales of response to SLR when making long-term management decisions
- Flexibility for temporal and elevation dependent input functions
- Adaptation of organic matter input function for SF Bay marshes
- Runs 100 years in less than 1 minute
- Can be used to evaluate response of individual marshes based on site specific forcings

Room for improvement

- Better parameterization of spatial and elevation dependent sediment accumulation function
- Predictions of changes in sediment supply and tide range
- Compensation for increased storminess?
- Only applicable to current footprint of a marsh

References

Callaway, J., J.A. Nyman, and R.D. DeLaune. 1996. Sediment accretion in coastal wetlands: A review and simulation model of processes. Current Topics in Wetland Biogeochemistry, Volume 2: 2 -23.

Deverel, S.J., J.Z. Drexler, T. Ingrum, and C. Hart. 2008. Simulated Holocene, recent, and future accretion in channel marsh islands and impounded marshes for subsidence mitigation, Sacramento - San Joaquin Delta, California, USA. REPEAT Project Final Report to the CALFED Science Program of the Resources Agency of California, 60 pp.

Morris, James T., P. V. Sundareshwar, Christopher T. Nietch, Björn Kjerfve, and D. R. Cahoon. 2002. Response of coastal wetlands to rising sea level. Ecology 83:2869 –2877.