ROMS with GrassLight

Spectrally resolved light processes
in a shallow water model
ROMS with GrassLight

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Outline

- Vertical-time dependent test cases
- Corsica River domain
- Sample simulations with phytoplankton and suspended sediments
- Future plans

Vertical and time dependent simulations

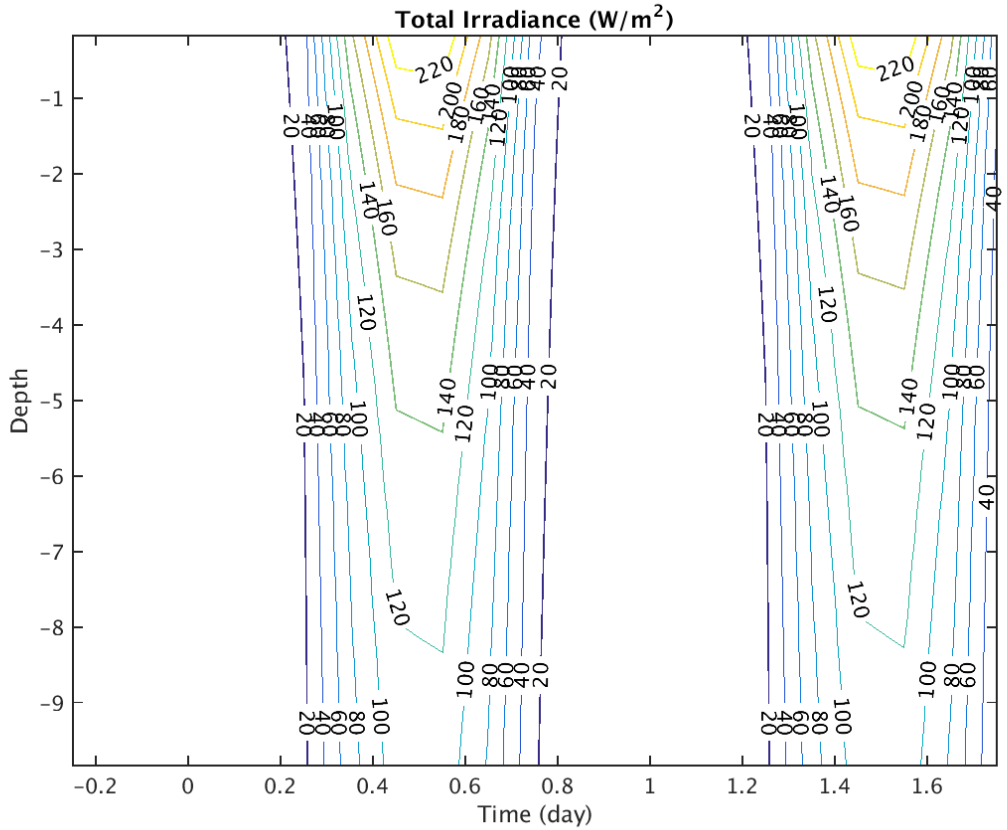
Simulations:

- Clear water
- 5 μg/L Chlorophyll
- 5 μg/L Chlorophyll and 0.3 m^{-1} CDOM
- 10 mg/L Suspended Sediment

Water properties are uniform with depth and constant over time

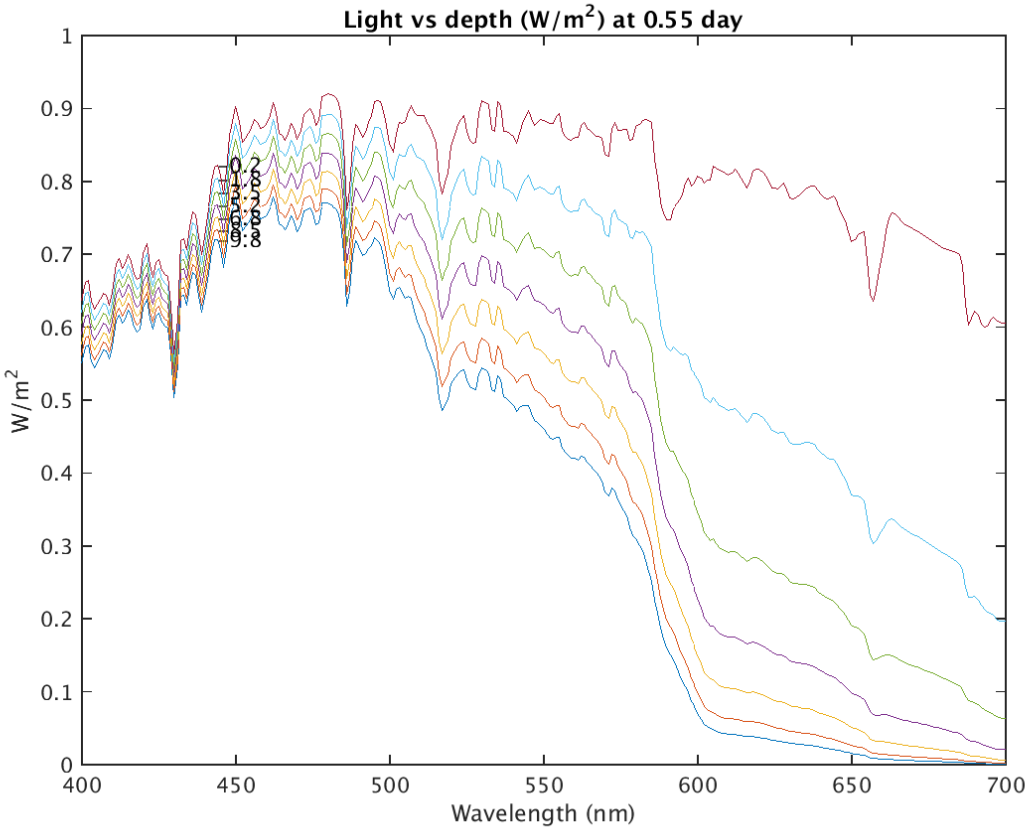
Clear Water Simulation

- Start day is June 1
- ROMS time is UTM; time shifted to local time
- Longitude is 90W
- 10 m deep; 30 levels
- Integrated irradiance (W/m^2)



Clear Water Simulation: Noon Irradiance

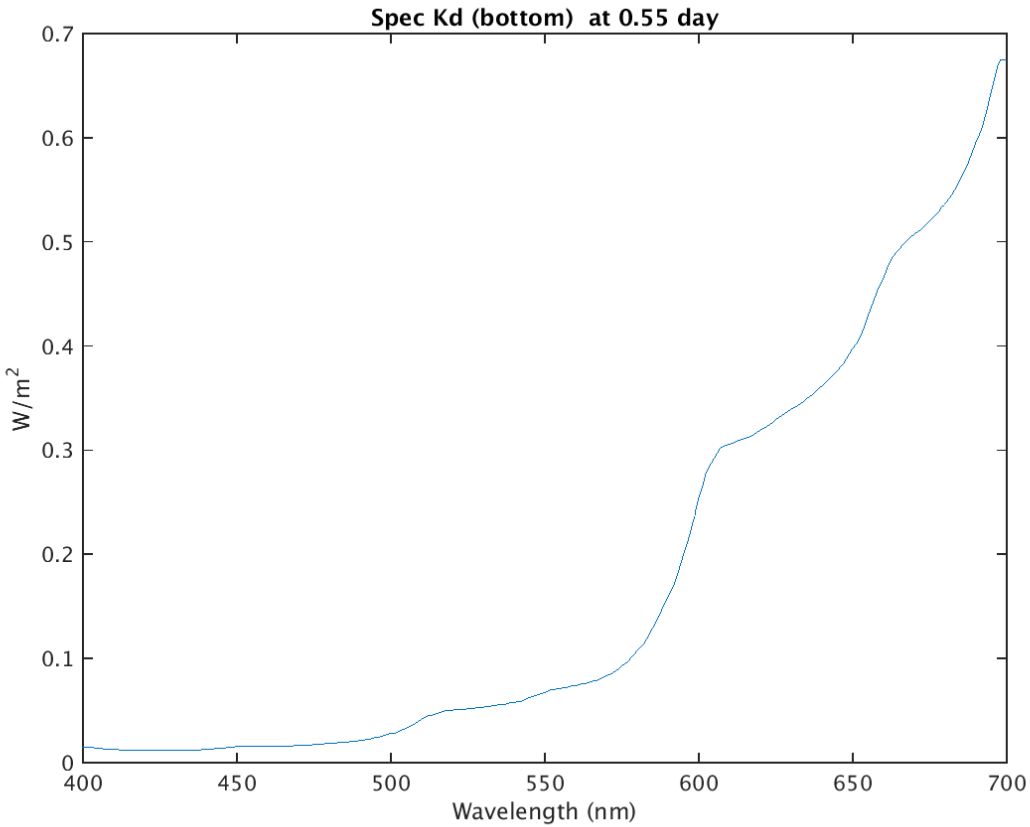
- Noon of first day
- Chla, CDOM and suspended sediment are zero
- Irradiance (W/m^2) vs wavelength



Long wavelengths strongly reduced.

Clear Water Simulation: Noon Kd

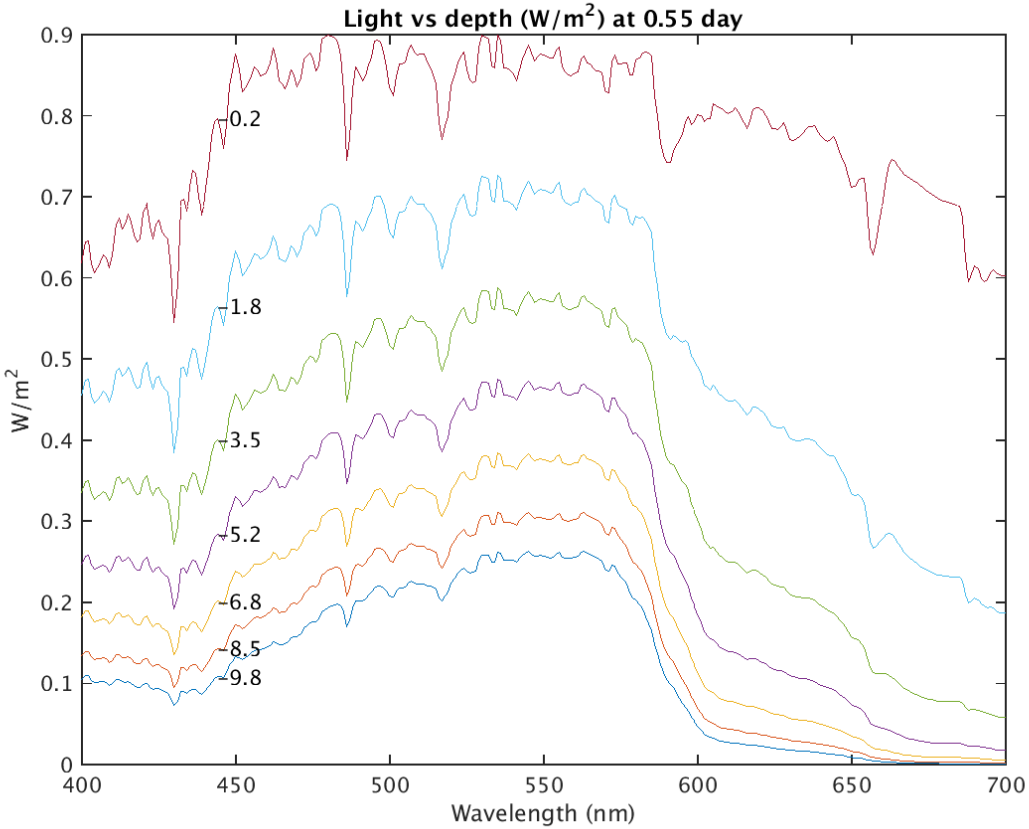
- Noon of first day
- Chla, CDOM and suspended sediment are zero
- Spectral attenuation (m^{-1})



Bottom light is blue and green.

5 μg/L Chlorophyll: Noon Irradiance

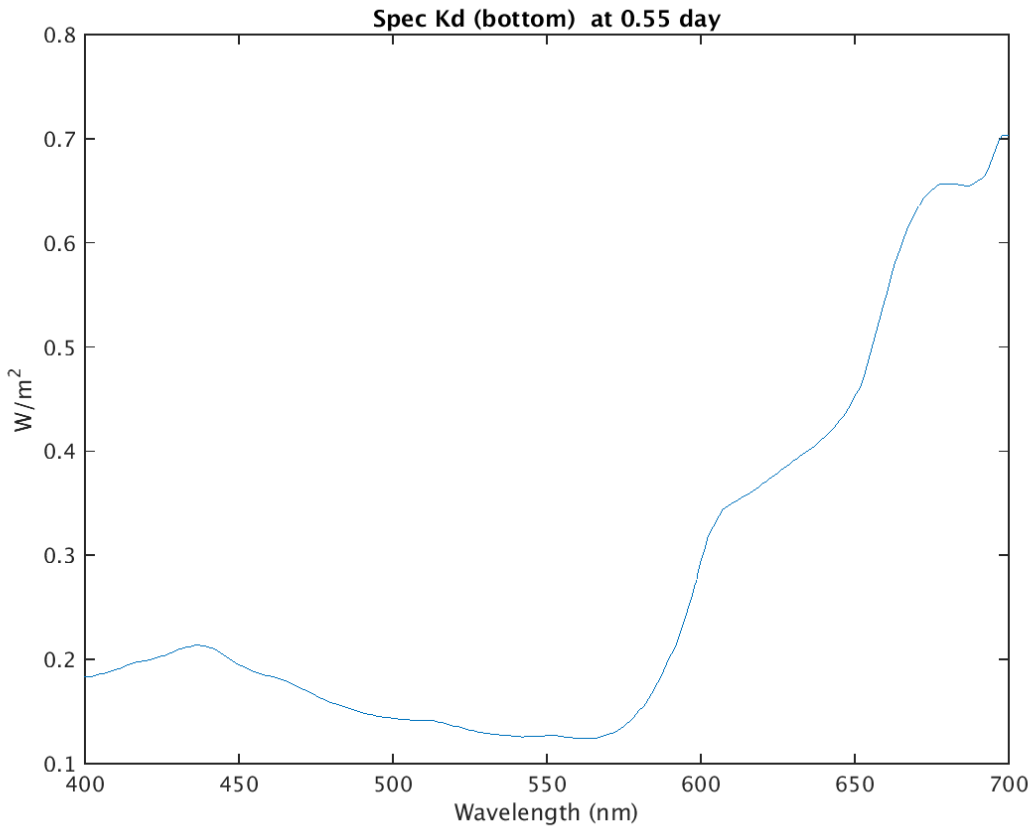
- Uniform chlorophyll-a (no biology)
- No suspended sediment or CDOM
- Irradiance (W/m^2) vs wavelength



Short wavelengths somewhat reduced; long wavelengths strongly reduced.

5 μg/L Chlorophyll: Noon Kd

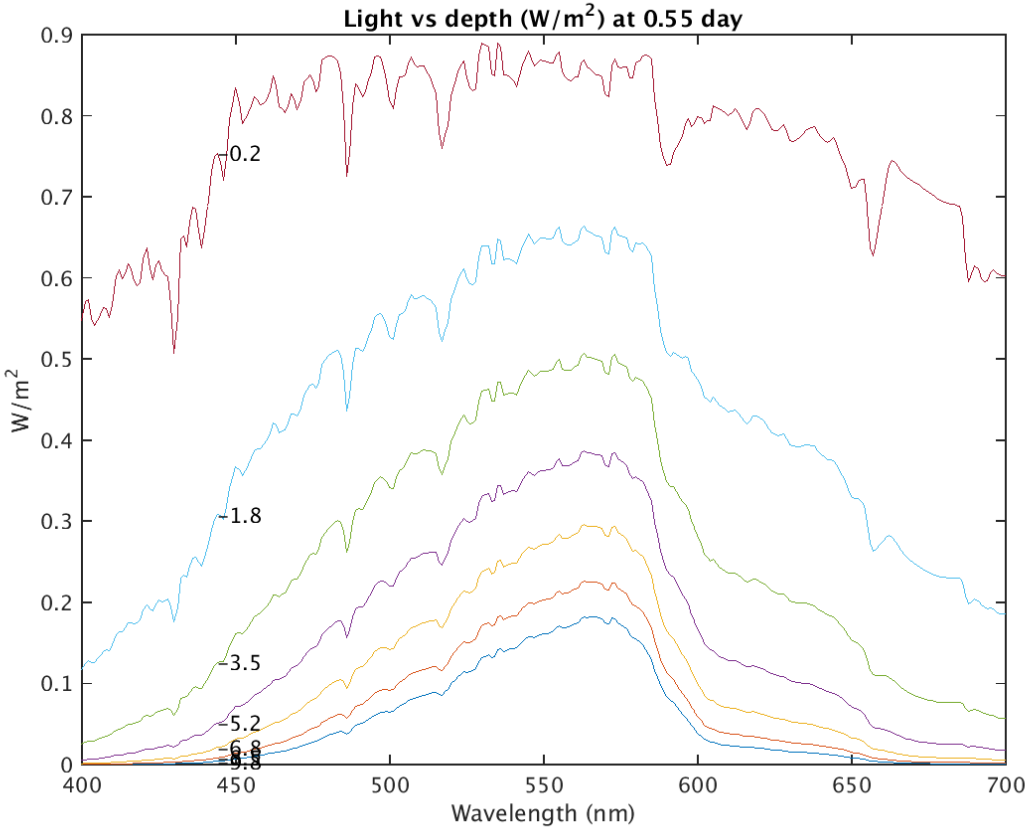
- Uniform chlorophyll-a (no biology)
- No suspended sediment or CDOM
- Spectral attenuation (m^{-1})



Bottom light is more green and less blue with little red.

5 μg/L Chlorophyll with 0.3 m^{-1} CDOM: Irradiance

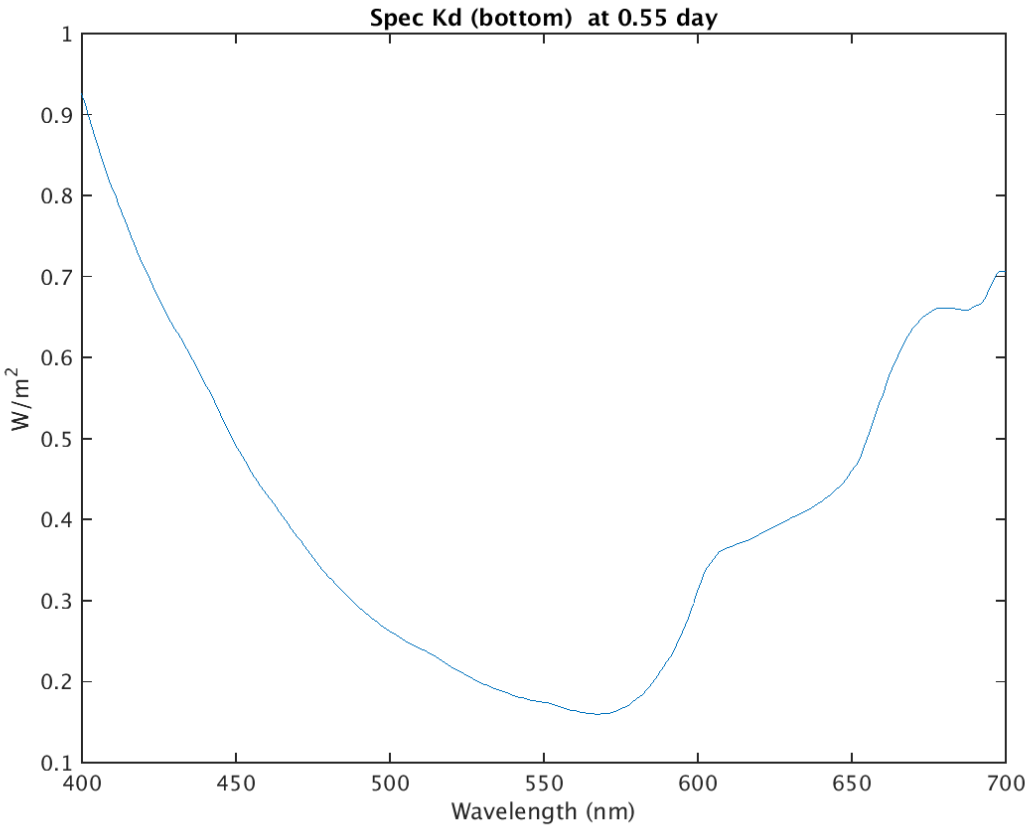
- Uniform chlorophyll-a and CDOM (no biology)
- No suspended sediment
- Irradiance (W/m^2) vs wavelength



Short wavelengths reduced; long wavelengths strongly reduced.

5 μg/L Chlorophyll with 0.3 m^{-1} CDOM: Noon Kd

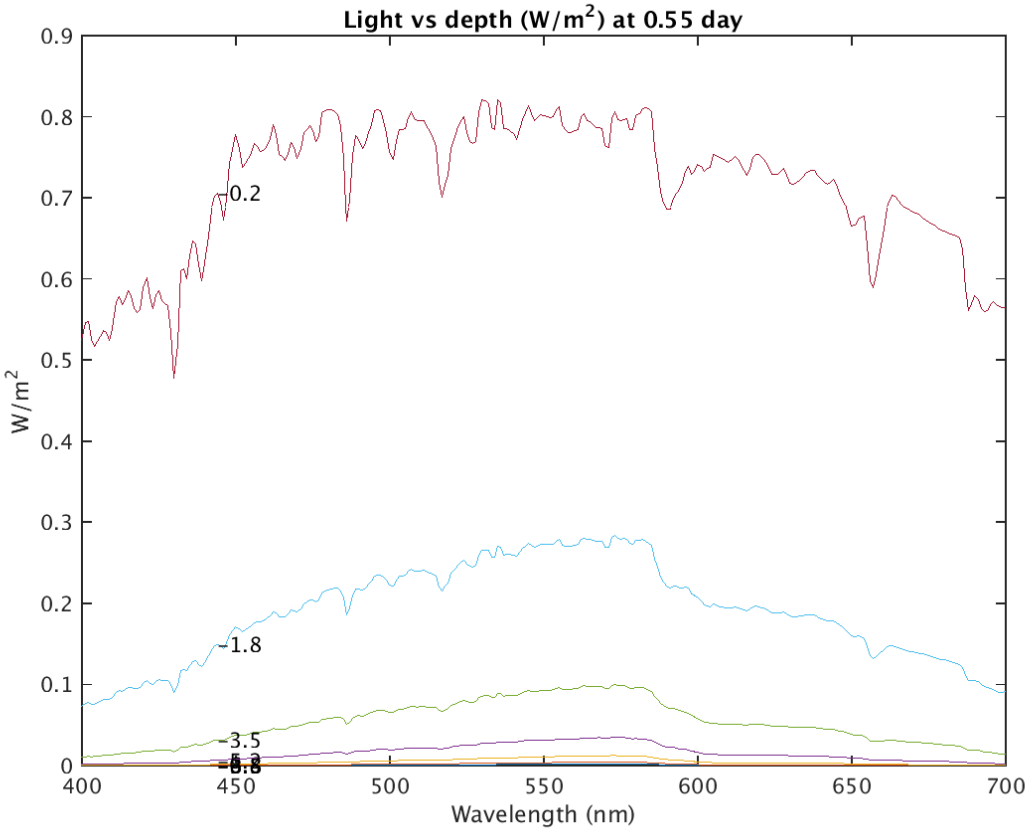
- Uniform chlorophyll-a and CDOM (no biology)
- No suspended sediment
- Irradiance (W/m^2) vs wavelength



Bottom light is mostly green.

10 mg/L Suspended Sediment; No Chlorophyll or CDOM: Noon Irradiance

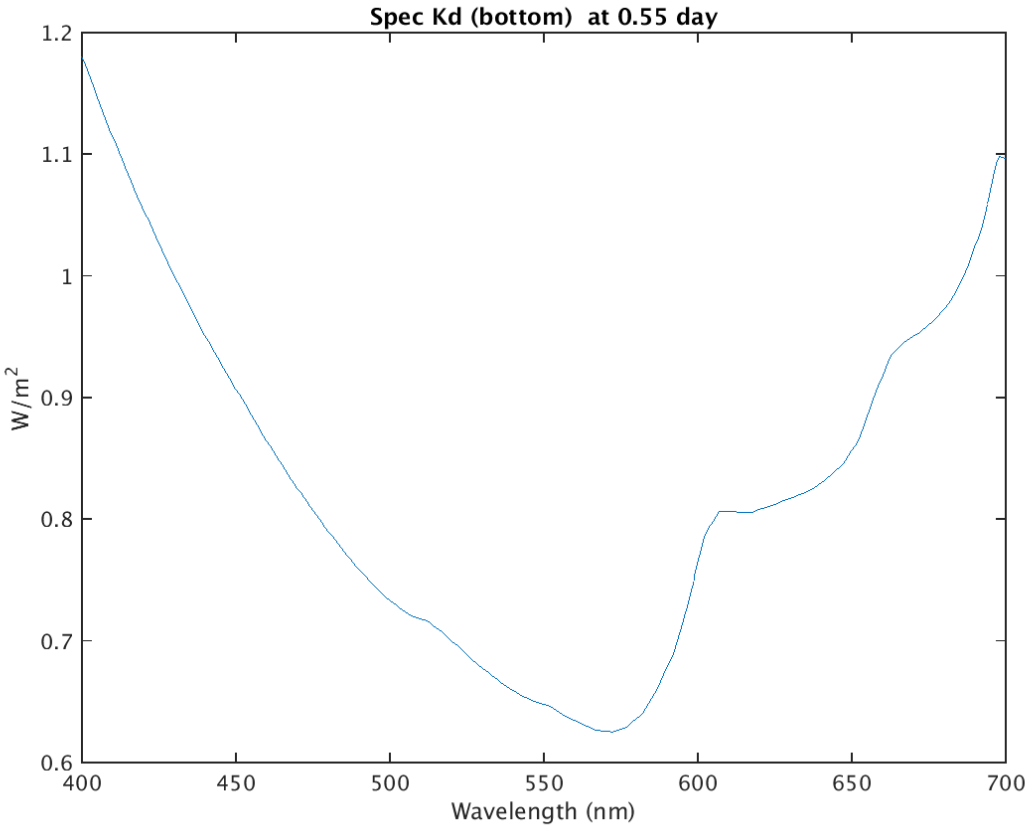
- Uniform suspended sediment (zero sinking speed)
- No chlorophyll-a or CDOM
- Irradiance (W/m^2) vs wavelength



All wavelengths strongly reduced.

10 mg/L Suspended Sediment; No Chlorophyll or CDOM: Noon Kd

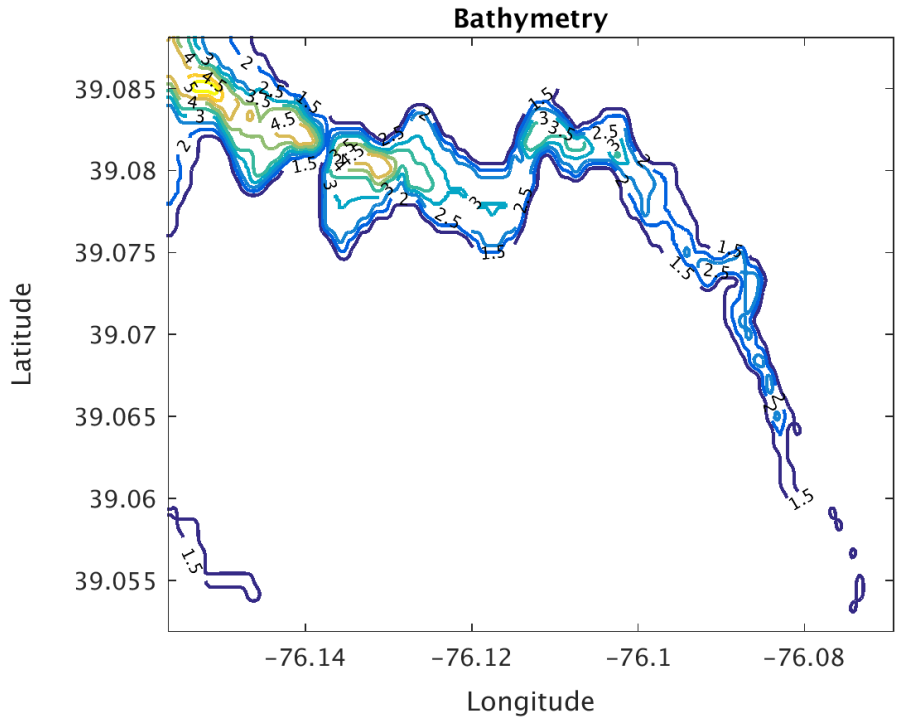
- Uniform suspended sediment (zero sinking speed)
- No chlorophyll-a or CDOM
- Irradiance (W/m^2) vs wavelength



Green light penetrates most.

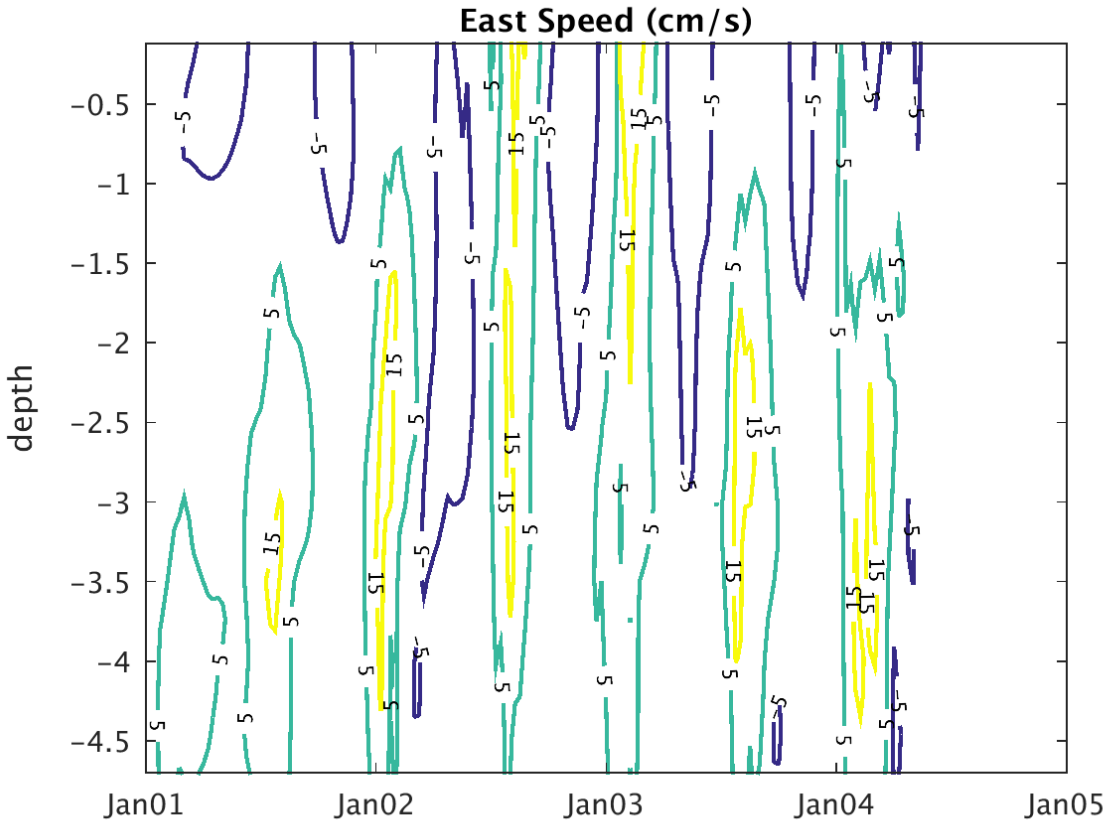
Corsica River Simulation: Domain

- Grid spacing is 25 m
- 5 day simulation to test setup; Stable for 1 year
- Boundary values are reasonable and constant
- Semi-Diurnal tide variation
- Surface momentum, heat, freshwater fluxes from atmosphere
- Light, simple biology and sediment processes are active



Corsica River Simulations: Flow at Station

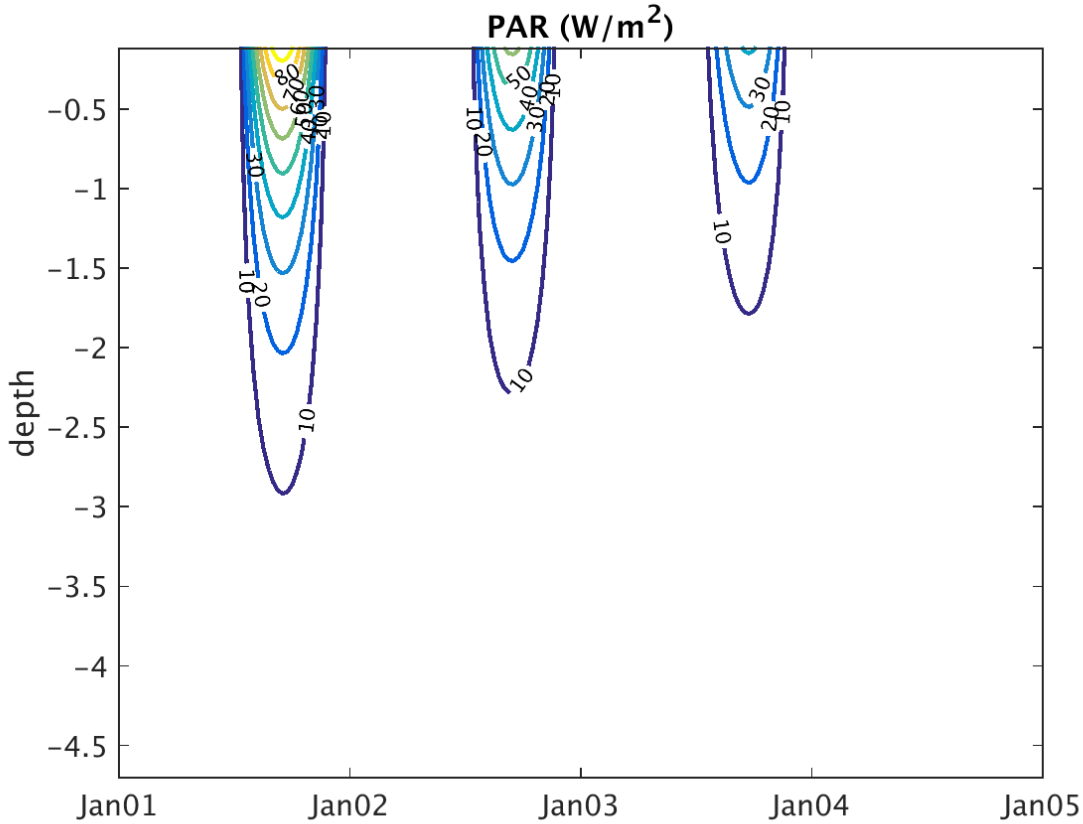
- Circulation driven by tides and varying wind
- Extract E-W flow at one location
- 39.018N, 76.135W; deep basin, east of sill



Tidal flow variation with non-tidal flow due to wind

Corsica River Simulations: Total irradiance at Station

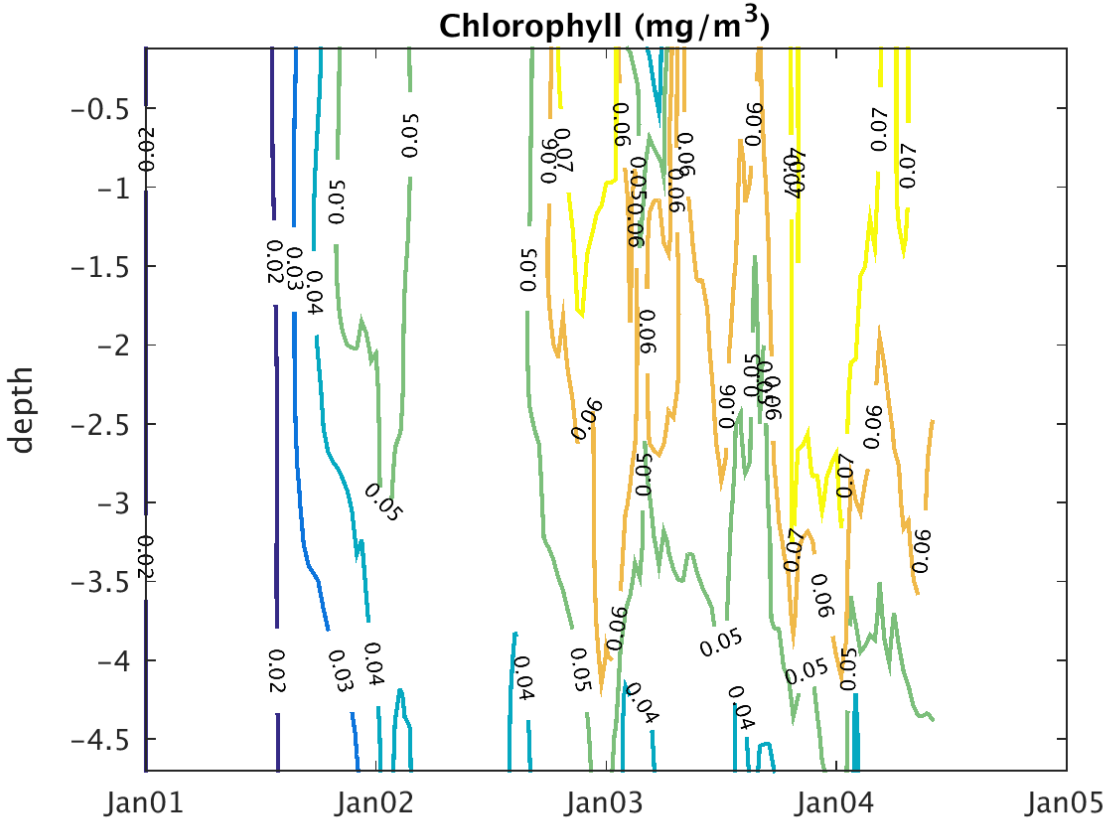
- Circulation driven by tides and varying wind
- Extract total irradiance at one location (east of sill)



Decreasing light due to increasing chlorophyll

Corsica River Simulations: Chlorophyll at Station

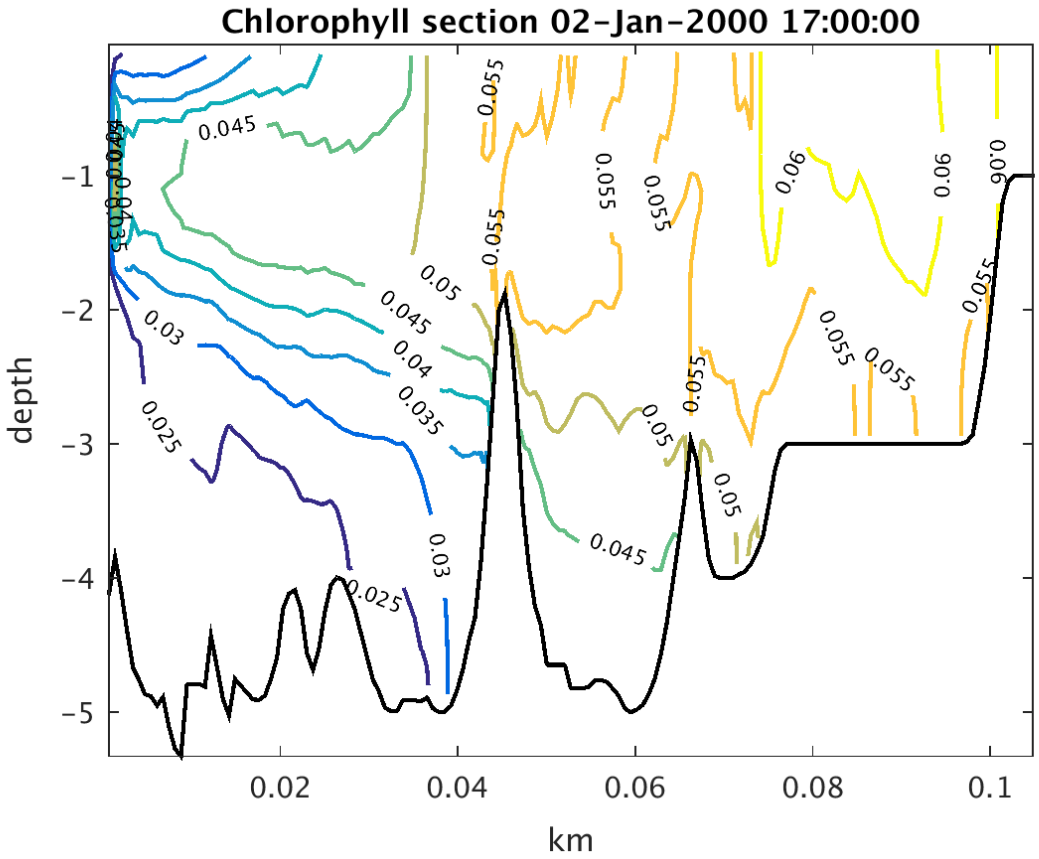
- Circulation driven by tides and varying wind
- Extract Chlorophyll at one location (east of sill)



Initial and boundary chlorophyll small (0.02 mg/m^3). Daily increase in chlorophyll

Corsica River Simulations: Chlorophyll Section

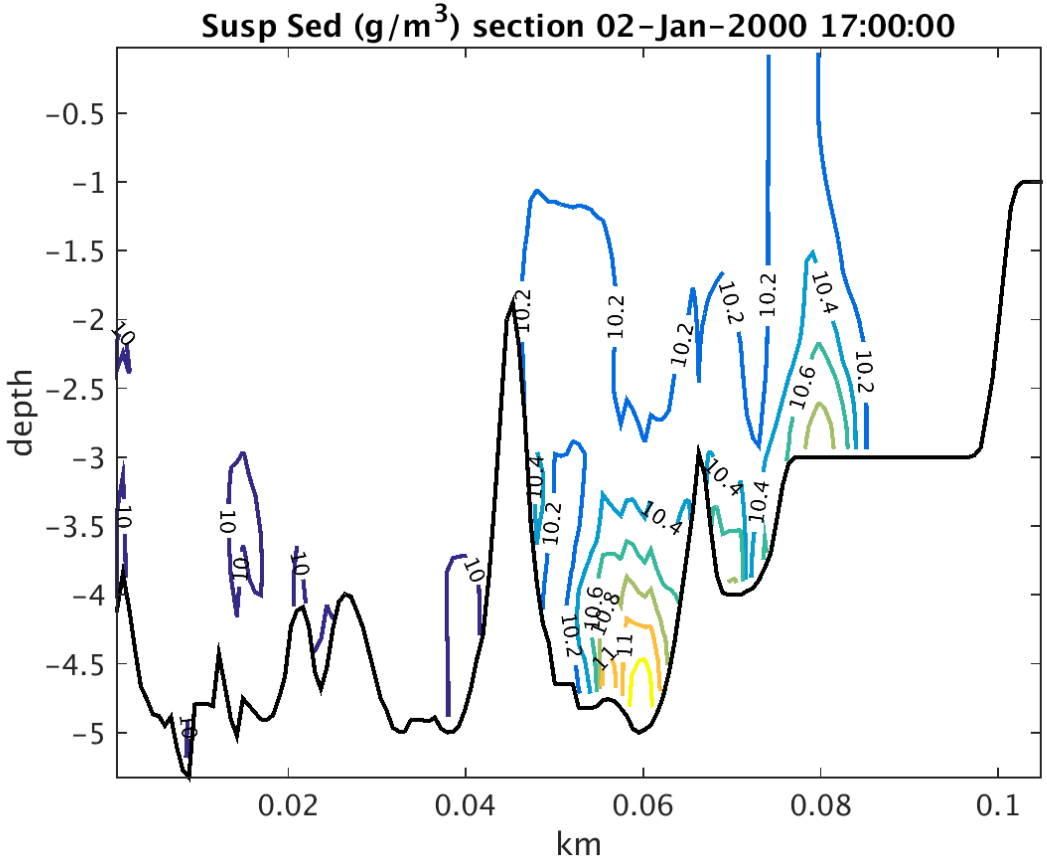
- Section along axis of the river from the Chester River to the eastern bend
- Section at local noon on day 2.



Initial and boundary chlorophyll small (0.02 mg/m^3). Bloom at head of river. Chla export to Chester River.

Corsica River Simulations: Suspended Sediment Section

- Section is along axis of the river
- Section at local noon on day 2.



Initial value is 10 g/m^3. Some resuspension in the deep basins.

Future Plans

Set up boundary and forcing for the Corsica River to compare to observations

- Expand biological model to be more realistic
- Set up sediment properties compared to observations
- Set up realistic forcing (boundary and surface) for Corsica River
- Compare simulations to observations