BMC Simulation of Eu Over an Optically Shallow Bottom with an Elliptical Target

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Why BMC

- If bottom is heterogeneous and/or patchy:
  - Upwelling radiance is a spatial function of horizontal location as well as depth (Mobley and Sundman, 2003)
  - Hydrolight requires homogeneity…
  - BMC is able to compute irradiances/radiances such as a HTSRB might (0.63m) measure where it crosses a non-uniformity in bottom type

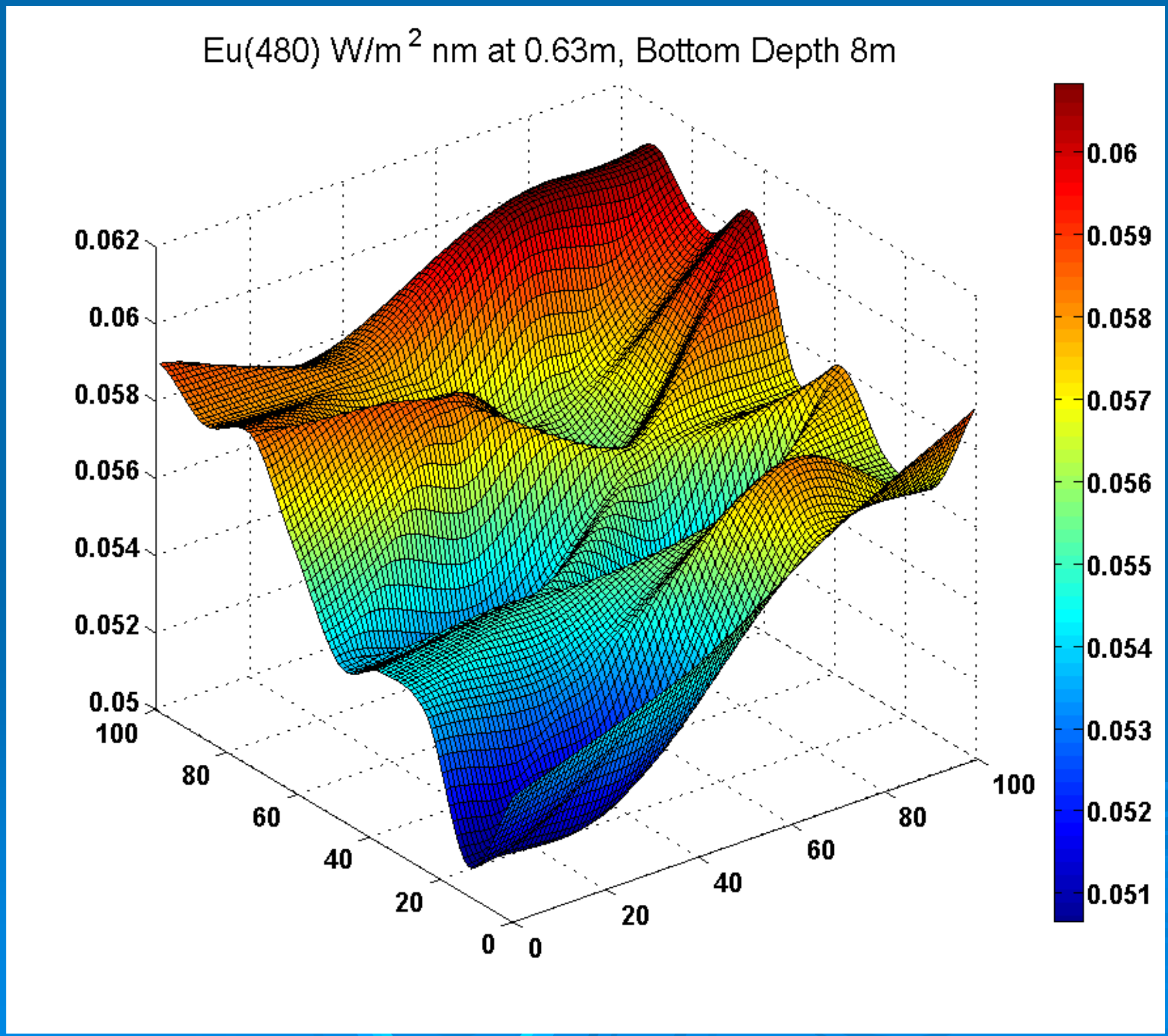
Ingredients in the BMC Soup

- Quadrant with a 6 x 8 grid sampled at integer resolution
- Lambertian target centered at (0,0)
- Background reflectance: 20%
- Target reflectance: 4%
- $a = 0.1\ m^{-1}$, $b = 0.4\ m^{-1}$, $\omega_o = 0.8$
- sun angle: 30^o , clear sky
- Three bottom depths considered: 8m, 4m, 2m
- At least one million photons traced from cosine detector placed at 0.63m (HTSRB depth)
- Photons leaving the sea surface are weighted by the sky radiance and scored as contributing to the sensor

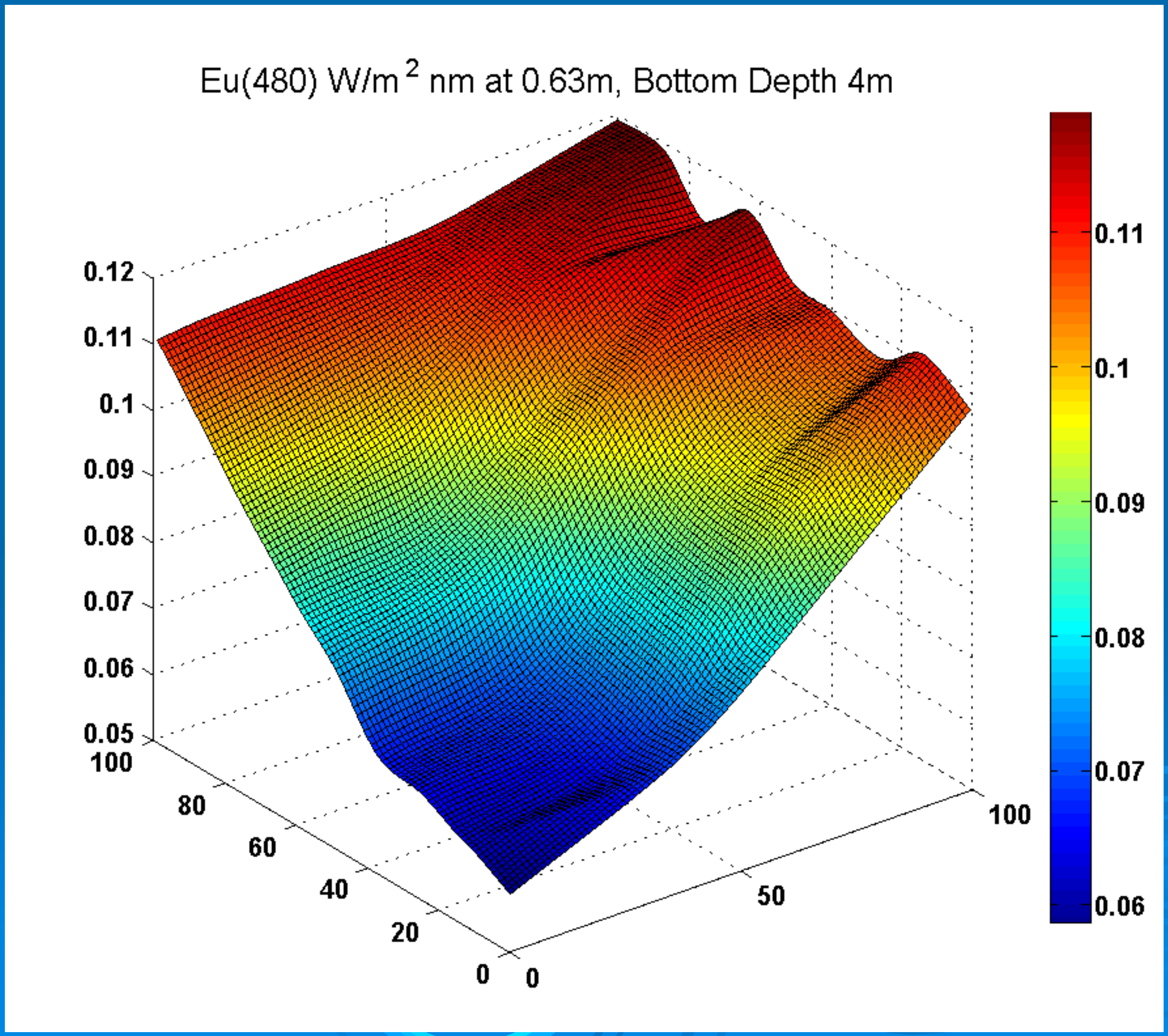
Questions and Expectations

- How will the irradiance reflectance change over the transition from background (20% reflective) to target (4%) (spatial variation)?
- How many photons will I need to avoid noise in the Monte Carlo model?
- Are comparisons of Hydrolight and BMC at nearly homogeneous regions in the quadrant equal?

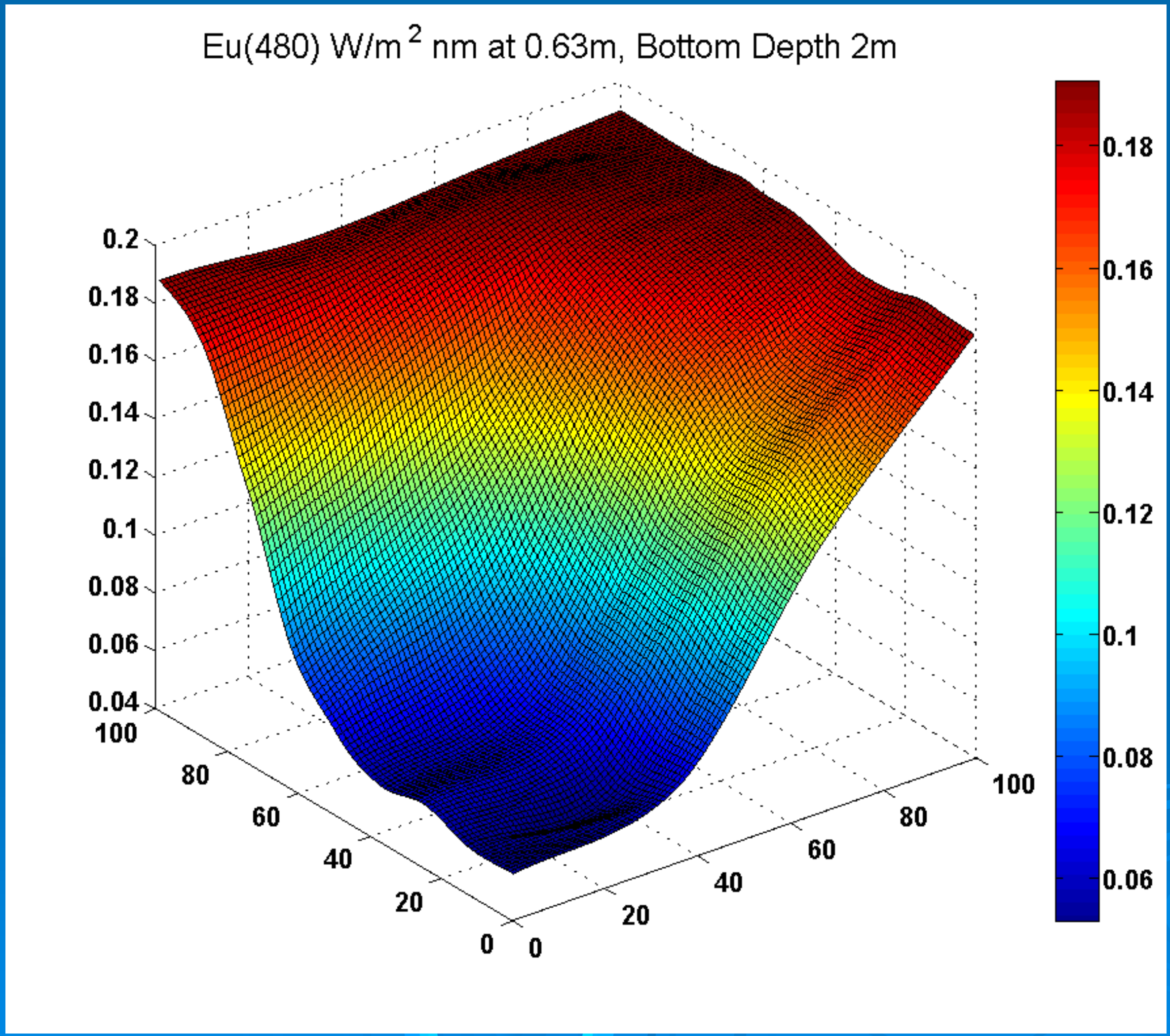
BMC Eu (W/m^2 nm)


Eu(480) W/m 2 nm at 0.63m, Bottom Depth 8m
0.062
0.06
0.058
0.056
0.054
0.052
0.05
100
80
60
40
20
0
0
20
40
60
80
100
0.06
0.059
0.058
0.057
0.056
0.055
0.054
0.053
0.052
0.051

BMC Simulated Eu (W/m^2 nm)



BMC Eu (W/m^2 nm)



Eu(480) W/m 2 nm at 0.63m, Bottom Depth 2m
0.2
0.18
0.16
0.14
0.12
0.1
0.08
0.06
0.04
100
80
60
40
20
0
0
20
40
60
80
100
0.18
0.16
0.14
0.12
0.1
0.08
0.06

Cage Match: Hydrolight vs. BMC

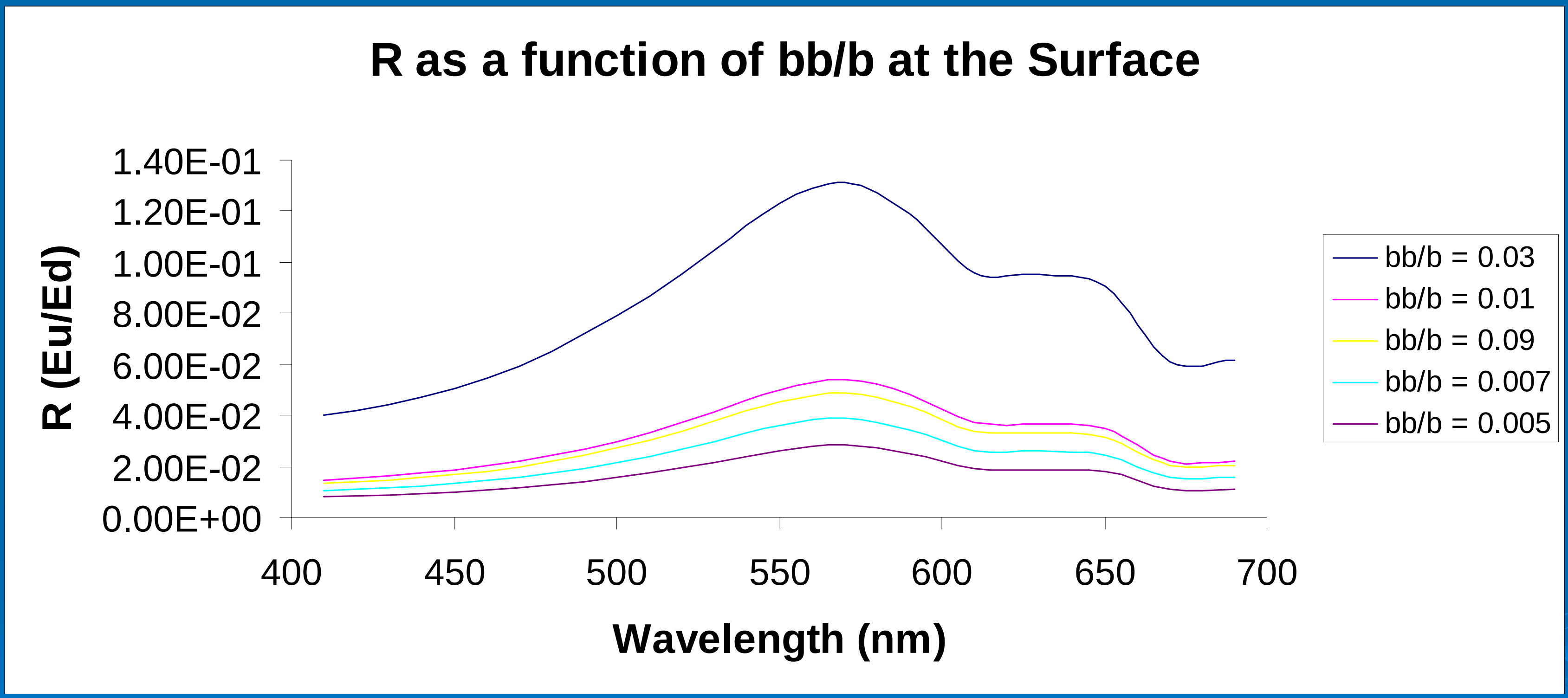
- Hydrolight computed upwelling irradiances over homogeneous background bottom and a target at the same depth:

(0,8,0.63):	Eu =	0.1867 W/m^2 nm
H42 (background):		0.193
(0,0,0.63):		0.0549
H42 (target):		0.0260

Effect of variation in bb/b on forward modeled R

Components: an ac9 profile from Leo-15 and various backscatter ratios (bb/b) : 0.03, 0.01, 0.009, 0.007, 0.005

Effect of Varying b_b/b on R (Eu/Ed)



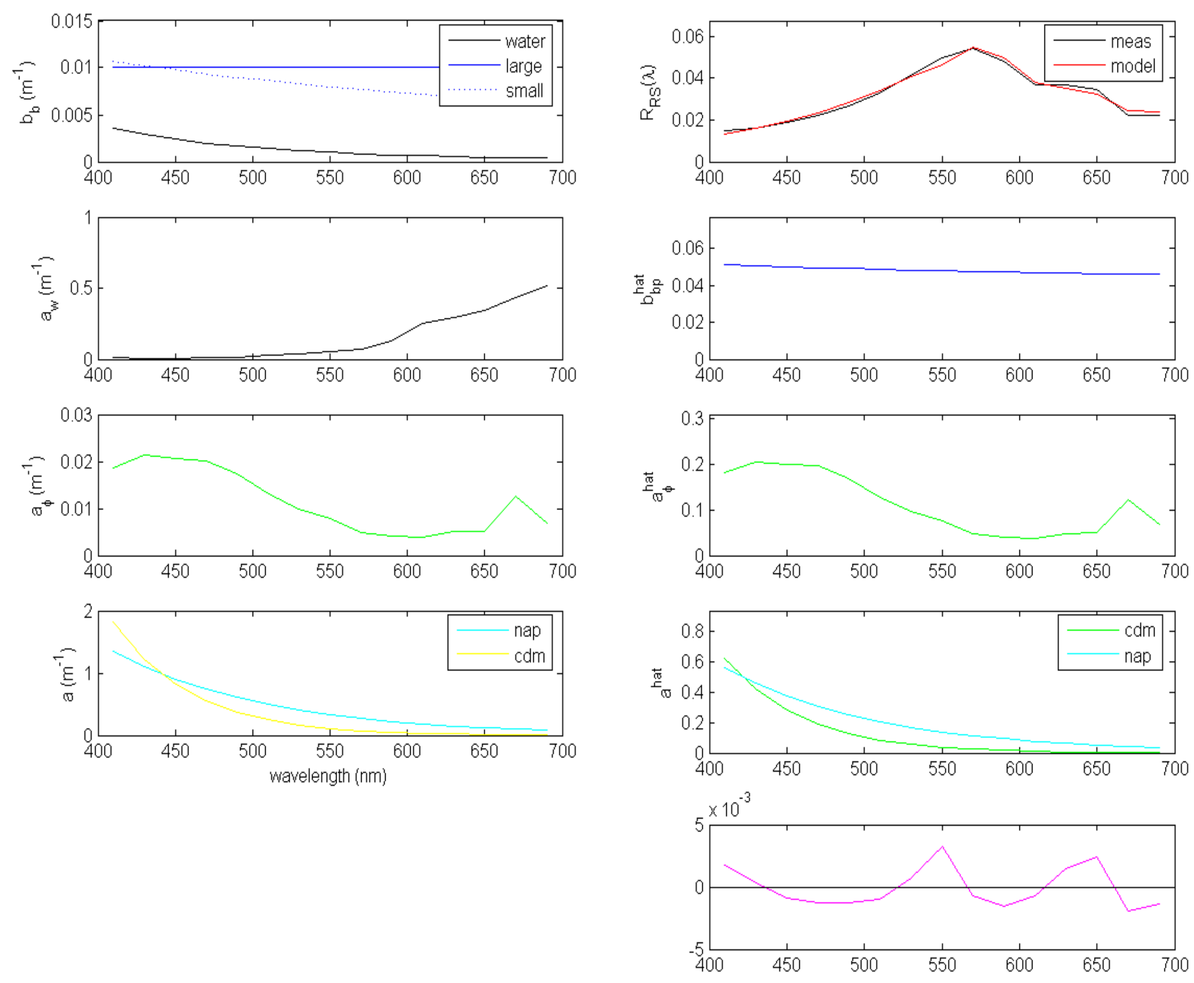
Inverse Model Comparisons using Basis Vector Variation

- Hydrolight computed R (Eu/Ed) for the same ac9 profile used previously
- Different iterations of spectral slope were used to compare modeled vs. measured reflectance
  - S_CDM, S_Nap = 0.02, 0.01 for newer exponential models
  - S_CDM = 0.015 (CDM and Nap with same assumed slope)
  - for particle bbp: n= 0 (large), n = 1 (small)
  - for particle bbp: n = -1.1 (no size differentiation among particles in exponential)

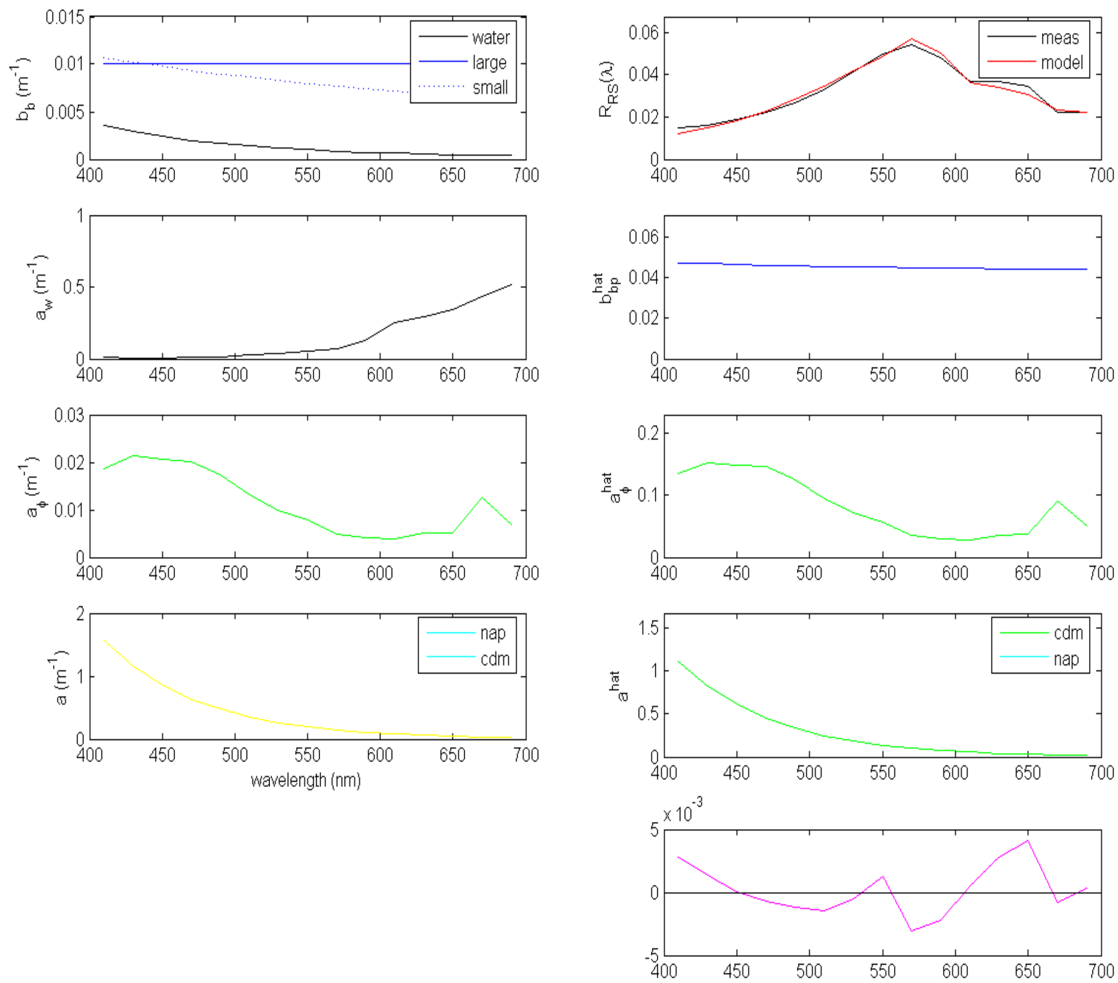
```
bbp_L_V = (wave/440).^0;%spectrally-independent scattering for large particles
bbp_S_V = (wave/440).^-1;%power law spectrally varying with n specified for small particles

a_nap_V = exp(-0.01*(wave-440));%a_nap(440)=1.0, S_nap = 0.01
a_cdm_V = exp(-0.02*(wave-440));%a_cdm(440)=1.0, S_cdm = 0.03
```

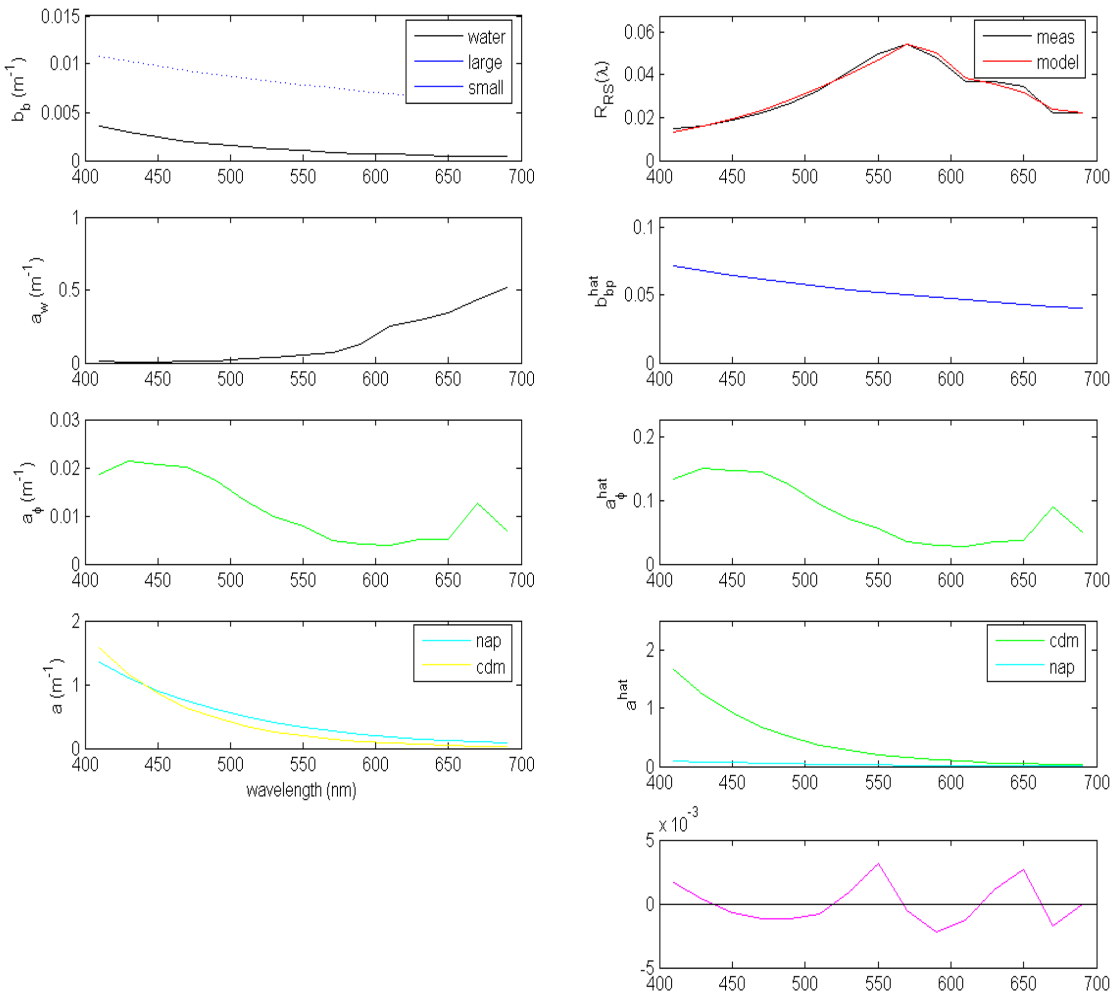
Effect of Basis Vector Variability



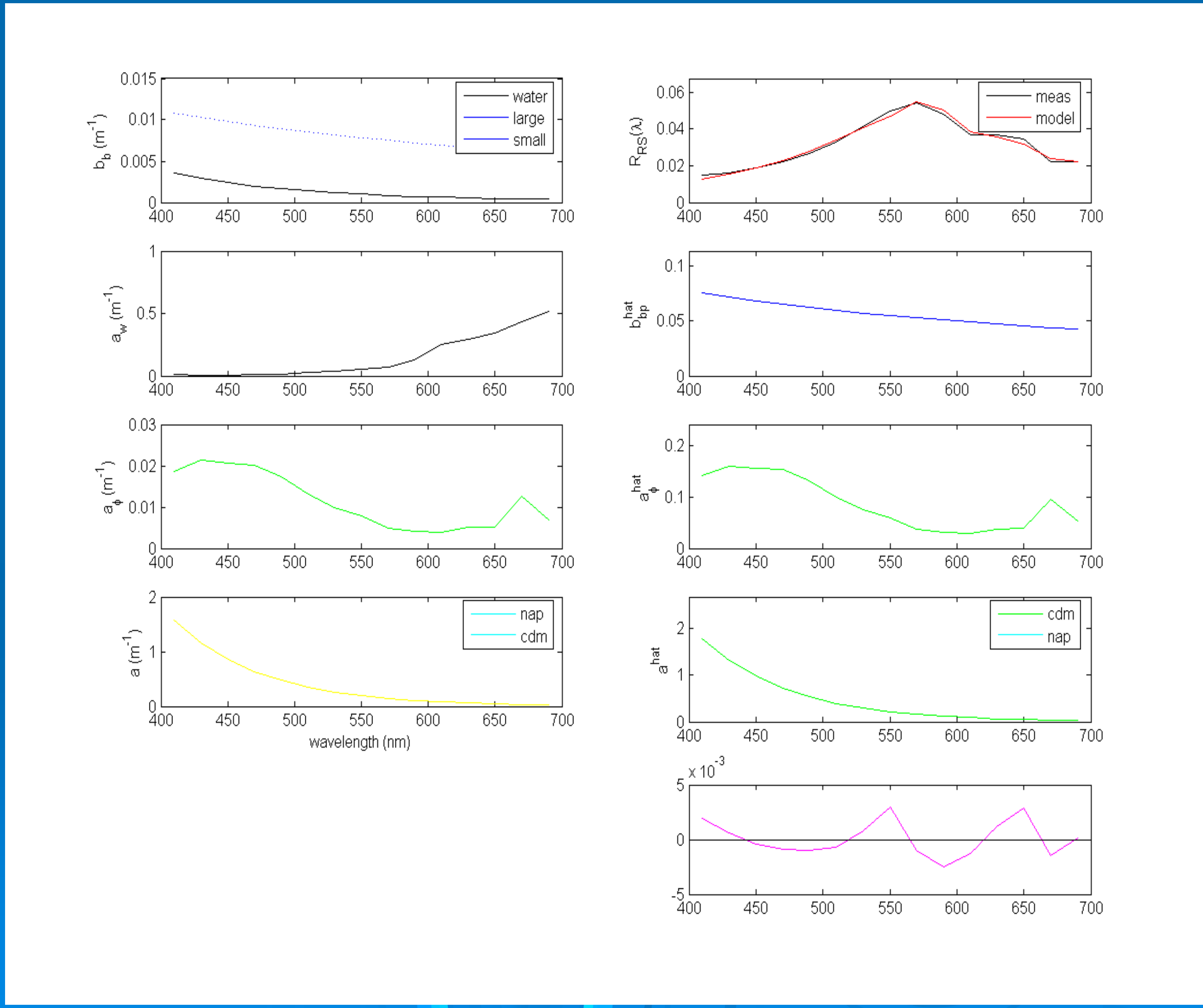
Effect of Basis Vector Variability



Effect of Basis Vector Variability



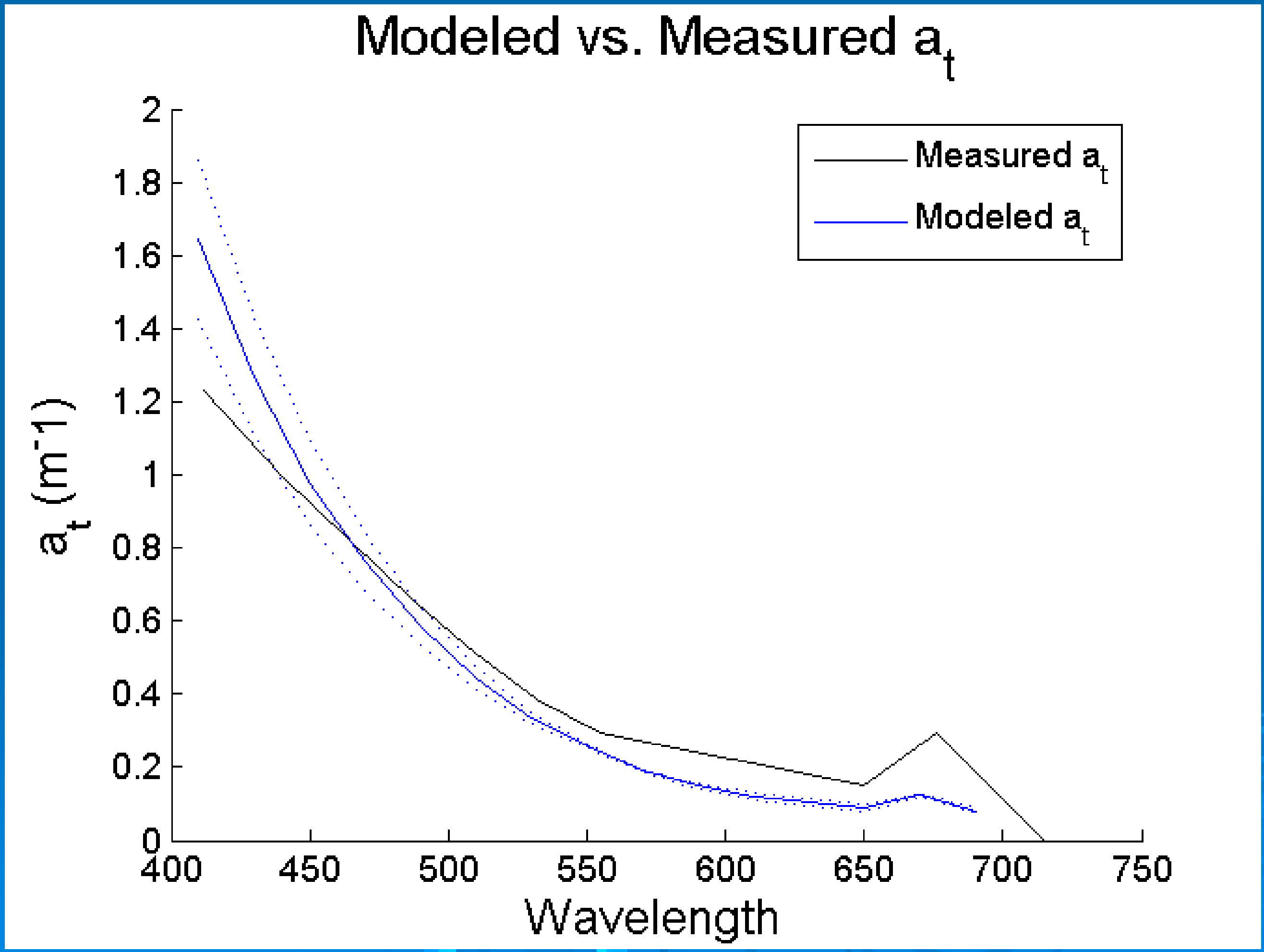
Effect of Basis Vector Variability



Conclusions

- Model displayed most sensitivity to changes in spectral slope of CDM
  - Congruent with findings of Garver and Siegel (JGR, 1997)
- Relatively little change in residual when particle size distribution was altered

Comparison of Modeled and Measured a_t



Thank You

- CM for BMC help
- CR for assistance with inversion model
- All Matlab gurus