Next generation algorithms based on PACE capabilities to obtain inherent optical properties of seawater associated with phytoplankton, nonalgal particles, and colored dissolved organic matter

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I. Task I. Refine $K_d$ algorithm (French team)

- Input: $R_{rs}(\lambda)$ → Outputs: $\langle K_d(\lambda) \rangle$ + Nine IOPs
- Weakly restrictive assumptions (e.g., spectral shapes)
- Refine inverse reflectance model
- Refine and develop new absorption partitioning models
- Quantify uncertainties

II. Next tasks:

- New Neural Network $K_d$ algorithm
- Hyperspectral capabilities
- Extend to the UV

III. 3-step Semi-Analytical Algorithm (3SAA)

- Input: $R_{rs}(\lambda)$
- Outputs: $\langle K_d(\lambda) \rangle$ + Nine IOPs
- Weakly restrictive assumptions (e.g., spectral shapes)
- Refine inverse reflectance model
- Refine and develop new absorption partitioning models
- Quantify uncertainties

- Effect of solar angle
- Synthetic IOP dataset
- Radiative-transfer synthetic dataset

- New Neural Network $K_d$ algorithm
- Hyperspectral capabilities
- Extend to the UV

- Step 1
  - Refined LS2 model with a new $K_d(\lambda)$ algorithm
  - Inverse reflectance model
  - $R_{rs}(\lambda)$

- Step 2
  - Refined ANW2013 model
  - $K_d(\lambda)$
  - ANW new model

- Step 3
  - Refined ADG2019 model
  - Inverse absorption partitioning models
  - $K_d(\lambda)$

- Improved $K_d$ (VIS range)

- Reference (“true”) $<K_d>_{1}$ (m$^{-1}$)

- Model-derived $<K_d>$, (m$^{-1}$)

- Synthetic IOPs

- black: satellite-derived
- gray: synthetic

- blue: w/o solar angle
- red: w/solar angle

- $\text{Synthetic IOPs}$
### Cruise(s) Region

<table>
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<th>Cruise(s)</th>
<th>Region</th>
<th>$N(a_g)$</th>
<th>$N(a_{dp}, a_{ag}, a_{ap})$</th>
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<td>536</td>
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ANW new model formalism developed:

$$a_{nw}(\lambda) = a_{ph}(\lambda) + a_{dg}(\lambda); \quad a_{dg}(\lambda) = f[a_{ag}(\lambda)]; \quad a_{ph}(\lambda) = a_{nw}(\lambda) - a_{dg}(\lambda)$$

Library of spectral shapes ($\tilde{a}_{dg}$) and multiple inequality constraints

Initial tests of ANW new in the VIS range; good results ($MAPD < 20\%$)

### Task III. Refine ADG$_{2019}$ partitioning model

Stramski et al. 2019

- Assemble UV-VIS absorption dataset (multiple inclusion/exclusion criteria)
- Extrapolation method for $a_g(\lambda)$, $a_{dg}(\lambda)$, and $a_{d}(\lambda)$ from the VIS to UV

**Next tasks:**

- Refine a library of spectral shapes for ADG and ANW models
- Integrate the UV extrapolation method with ADG and ANW models

**Evaluation results for extrapolated relative to measured values in the UV:**

- Median ratio ($MdR – solid line$) shows negligible aggregate bias
- Median absolute percent difference ($MdAPD – dashed line < 5\%$)