New approaches to atmospheric correction

François Steinmetz

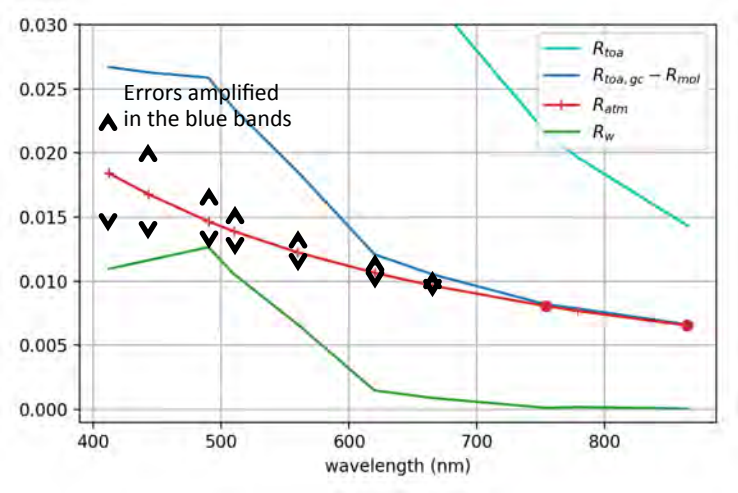
HYGEOS

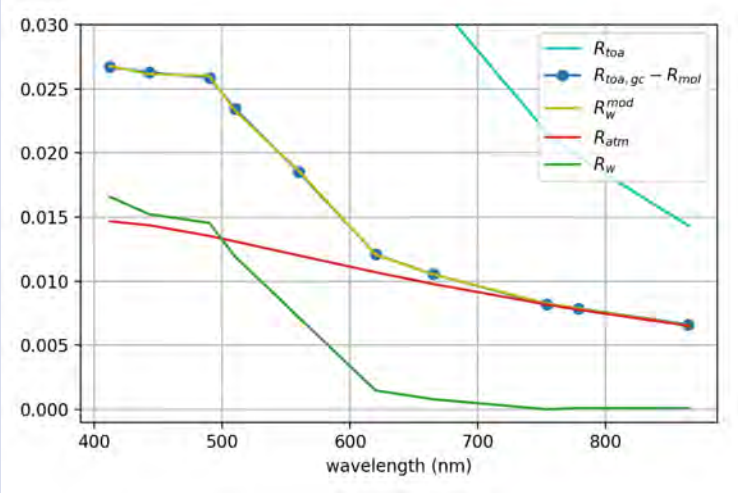
IOCS 2017 Breakout session 1:

Hyperspectral remote sensing

Atmospheric correction: standard vs. Polymer

	Standard atmospheric correction (Gordon & Wang, Antoine & Morel)	**Polymer** (Steinmetz et al 2011)
Methods	Estimation of the aerosol in the NIR → extrapolation to the green and blue bands	Iterative coupled ocean-atmosphere algorithm; use full spectrum
Atmospheric model	Aerosol look-up tables	Polynomial with 3 terms (3 free parameters) Correct everything non-water (aerosols, thin clouds, sun glint, adjacency effect)
Water reflectance model	Only in the NIR for case 2 (Bright Pixel Atmospheric correction)	2 free parameters $R\downarrow w\,(\lambda, chl, b\downarrow b)$





Most of the knowledge is here

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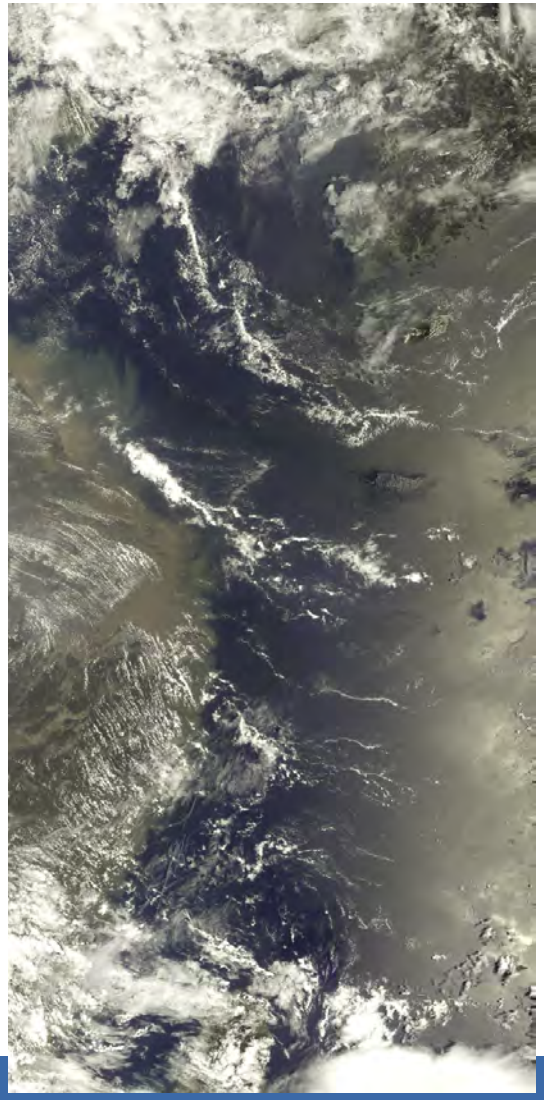
Sun glint correction

- Improved spatial coverage
- Negligible degradation of quality
- OC-CCI: Polymer allows using the **whole** sun glint pattern on MERIS (glint reflectance > 15%)
- Impact on sensor design requirements (no need to tilt to avoid sun glint)

OLCI images acquired one day apart (East China Sea)

18th August: With sunglint



19th August: Without sunglint

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- OC-CCI: Polymer allows using the **whole** sun glint pattern on MERIS (glint reflectance > 15%)
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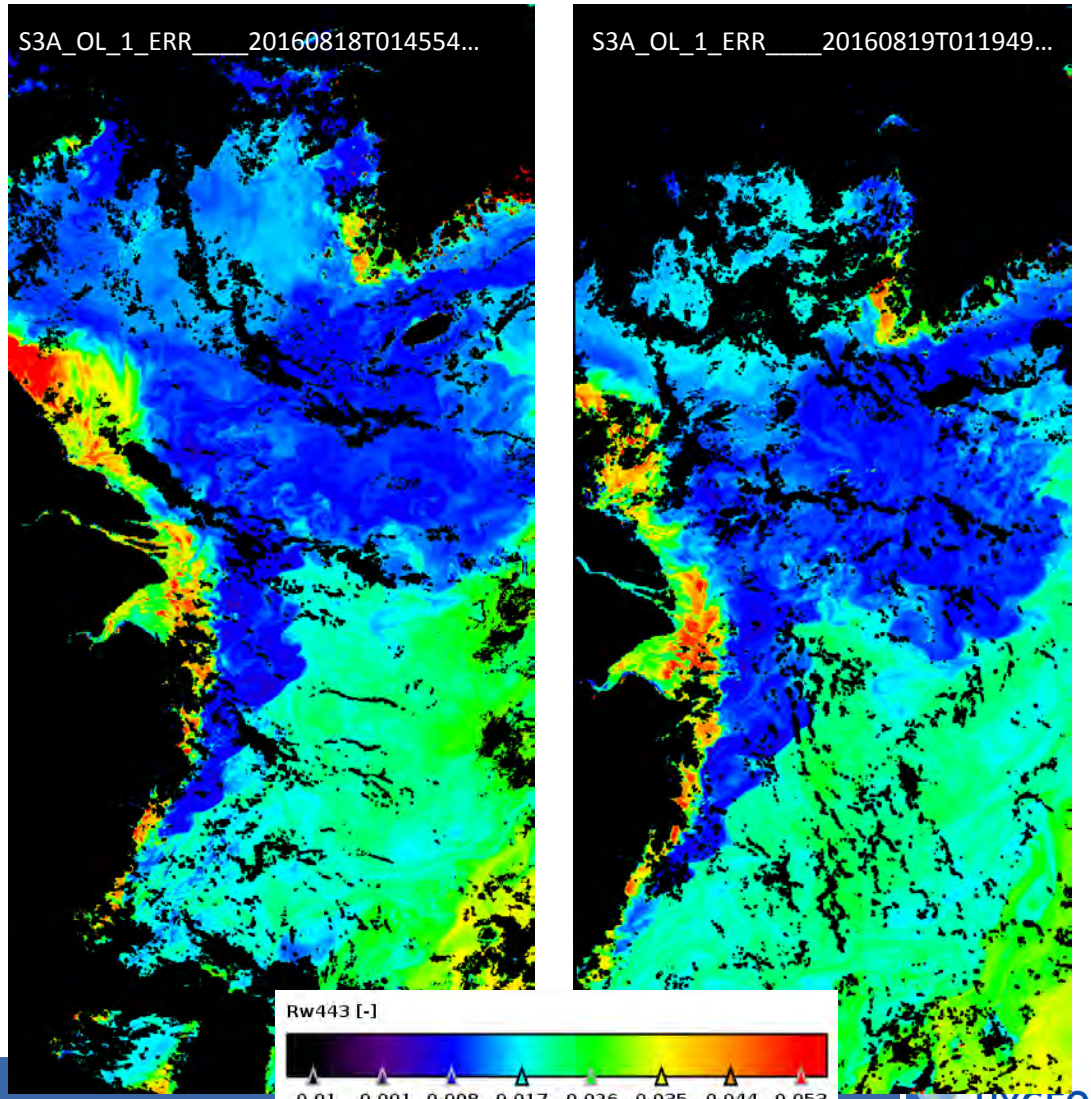
19th August: Without sunglint



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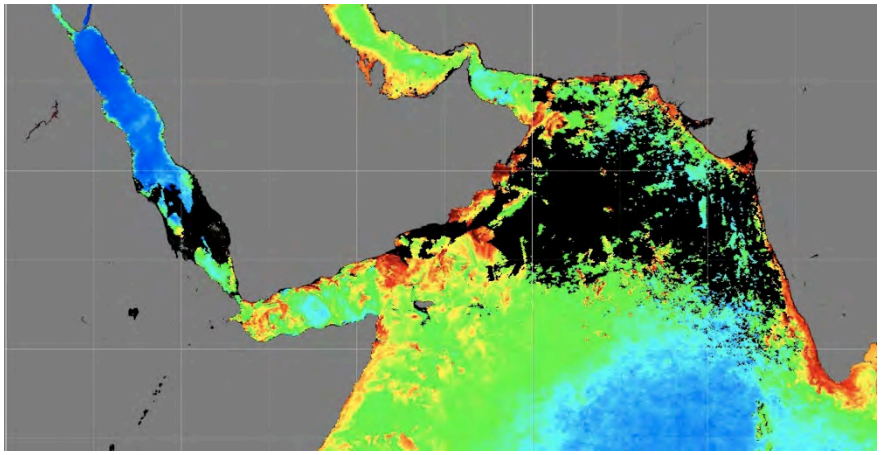
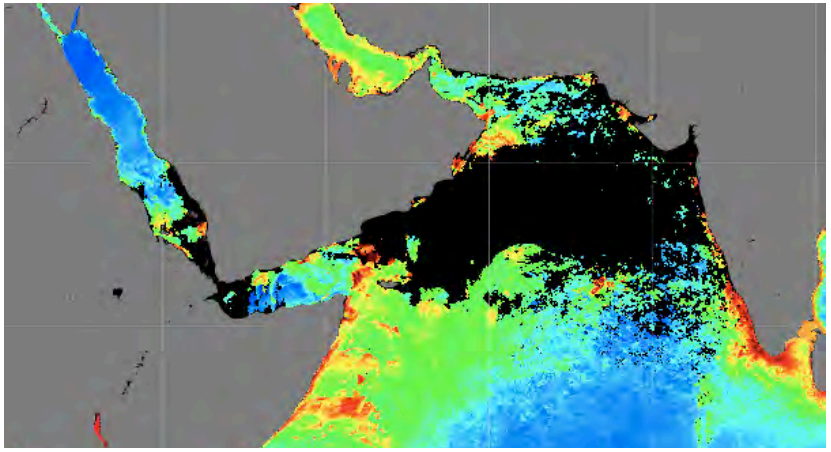
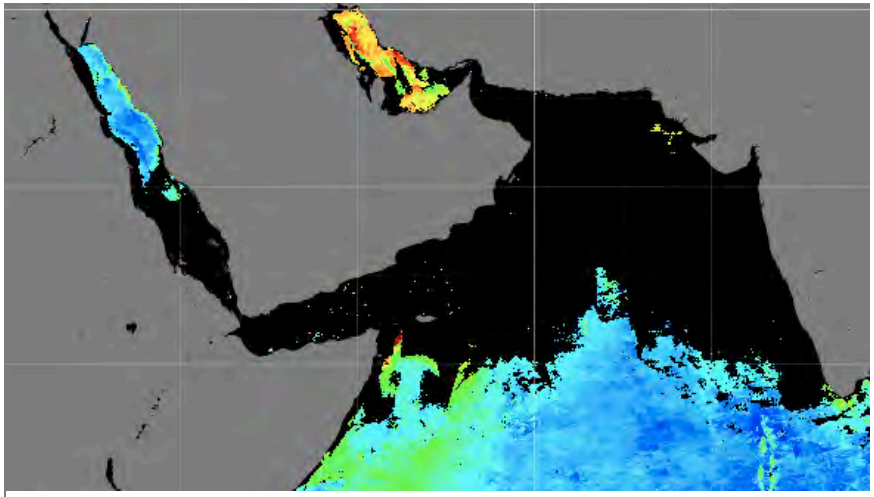
Robustness to aerosols: July Chlorophyll fields in the Arabian Sea



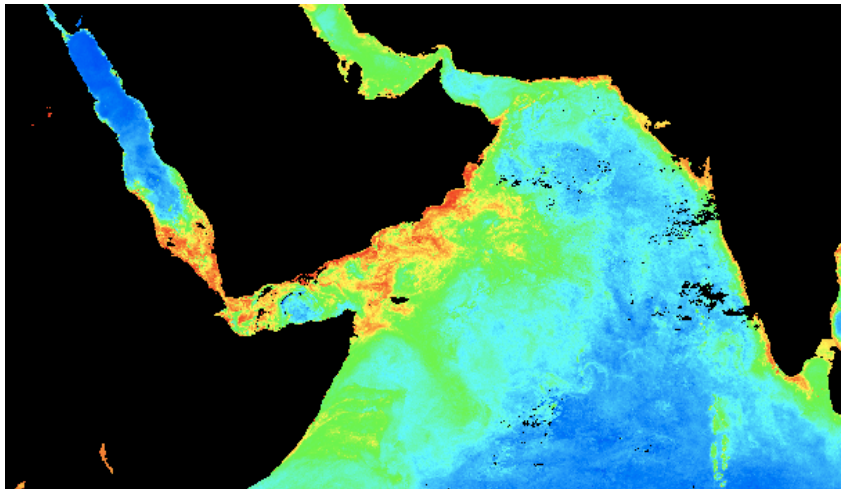
MODIS July Climatology from NASA



SeaWiFS July Climatology from NASA



CZCS July Climatology from NASA



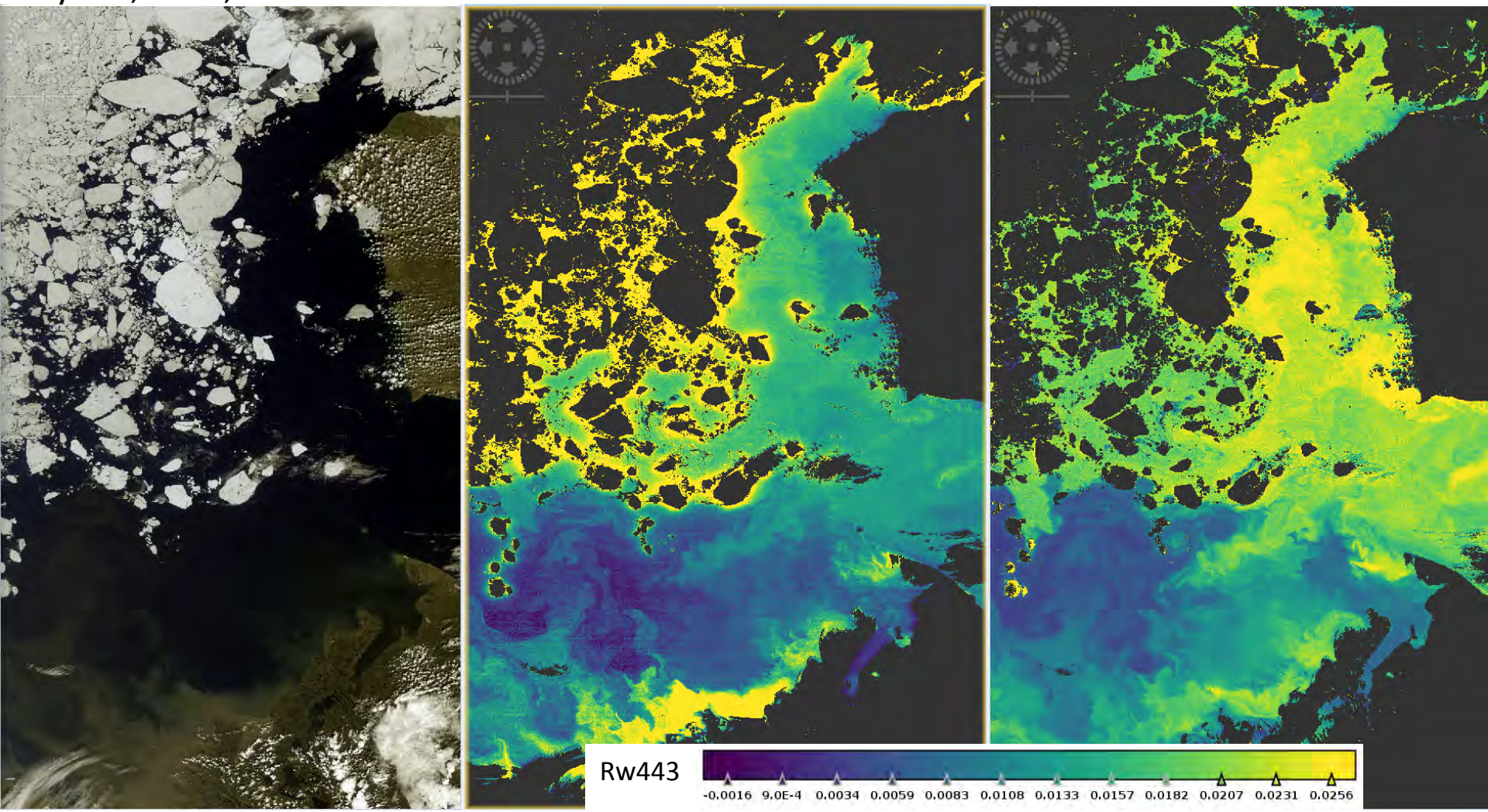
OC-CCI July 2003 (Uses Polymer)

Adjacency effects

MERIS full resolution
July 8th, 2008, Beaufort Sea

SeaDAS (l2gen)

Polymer



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Application to HICO

- Polymer is directly applicable to hyperspectral: use almost all available bands
- Apply a spectrally smooth (polynomial) atmospheric correction

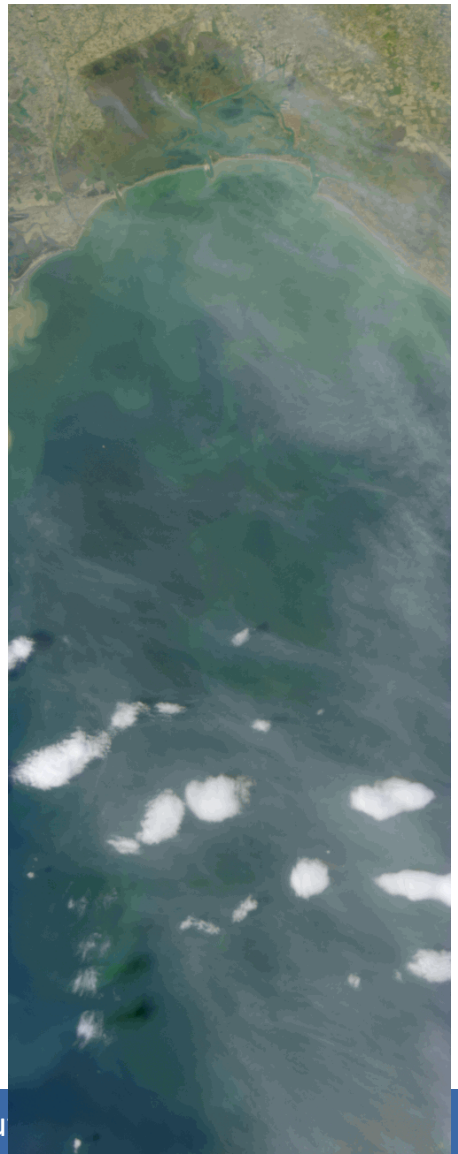
  → don't alter the spectral signature around that polynomial

- Can we do as good as we do for multispectral?

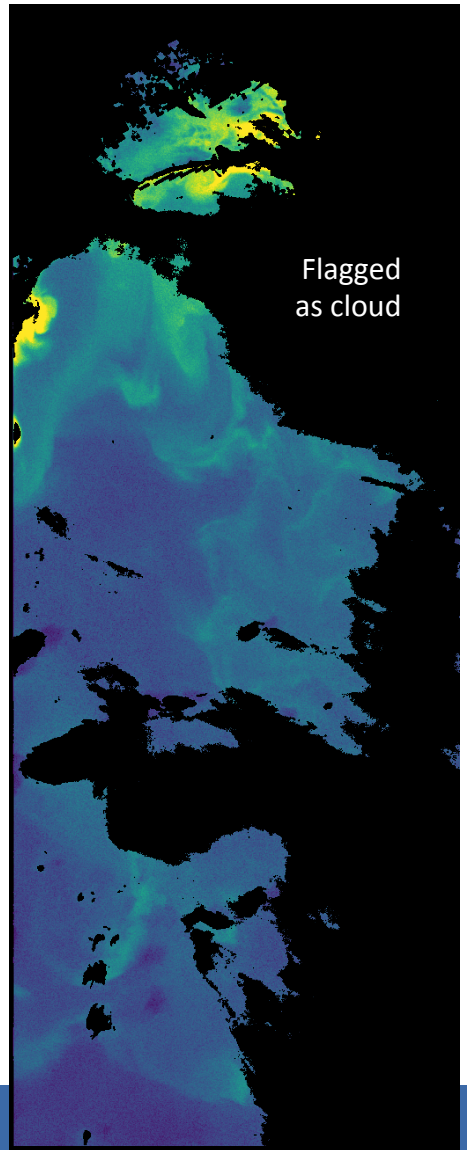
Example of HICO Rw553 image

HICO
2014-03-10

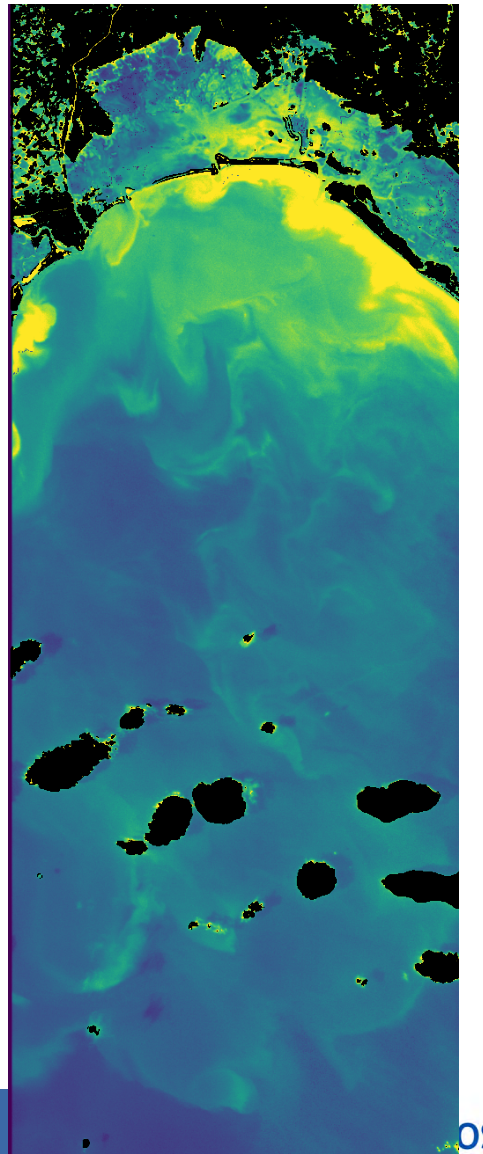
Venetian
Lagoon



SeaDAS (l2gen)



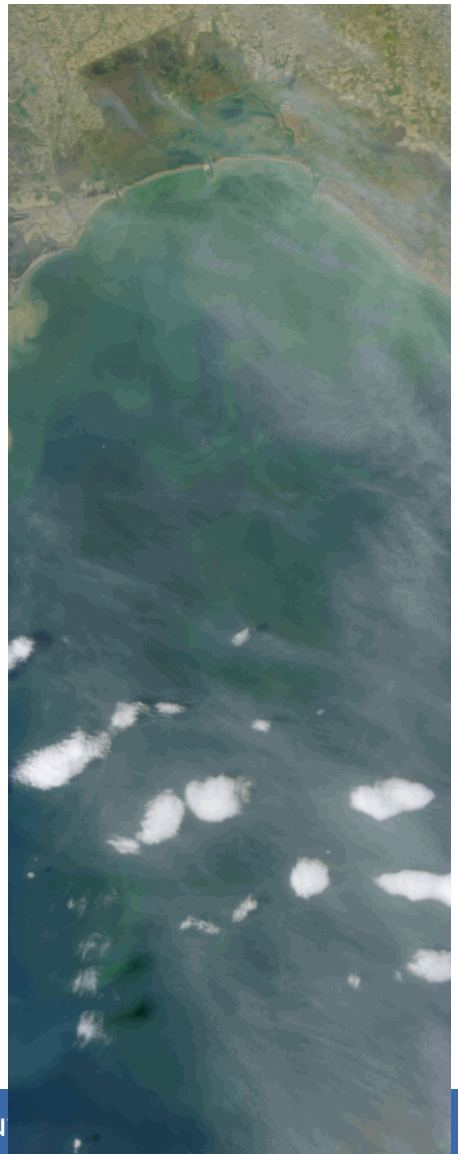
Polymer



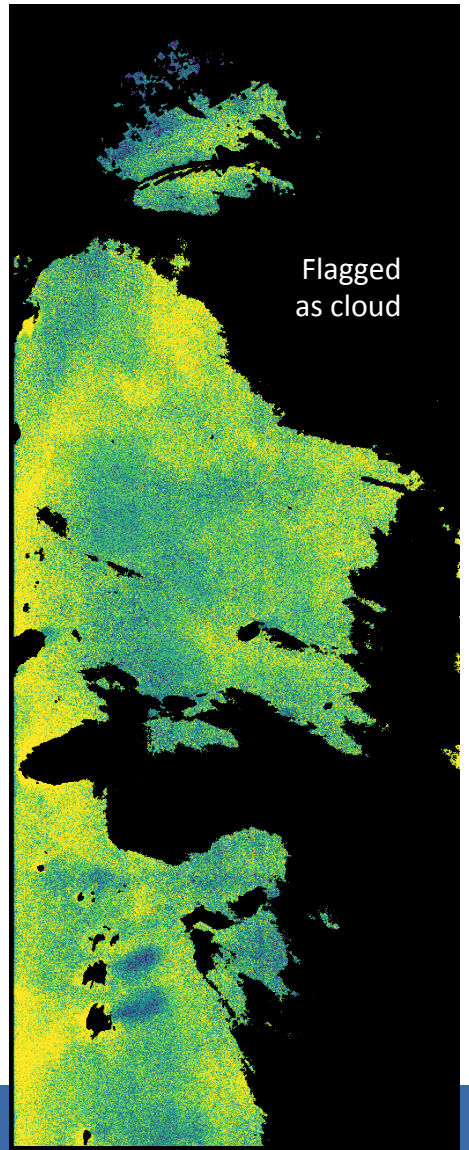
Example of HICO Rw410 image

HICO
2014-03-10

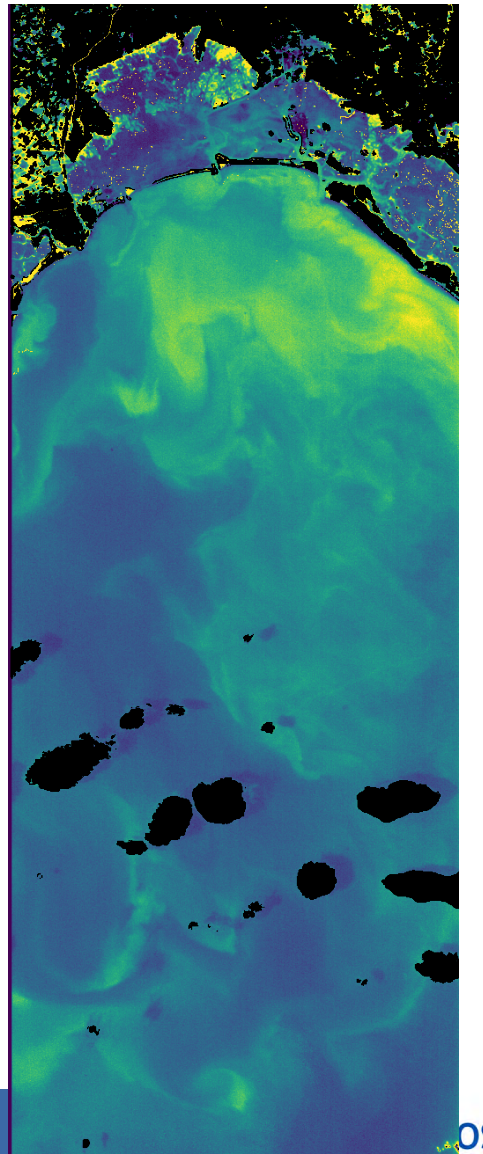
Venetian
Lagoon



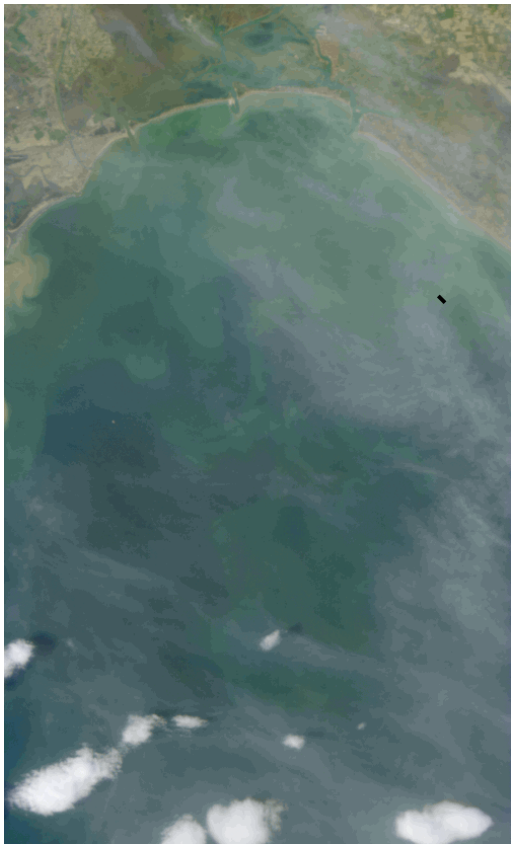
SeaDAS (l2gen)

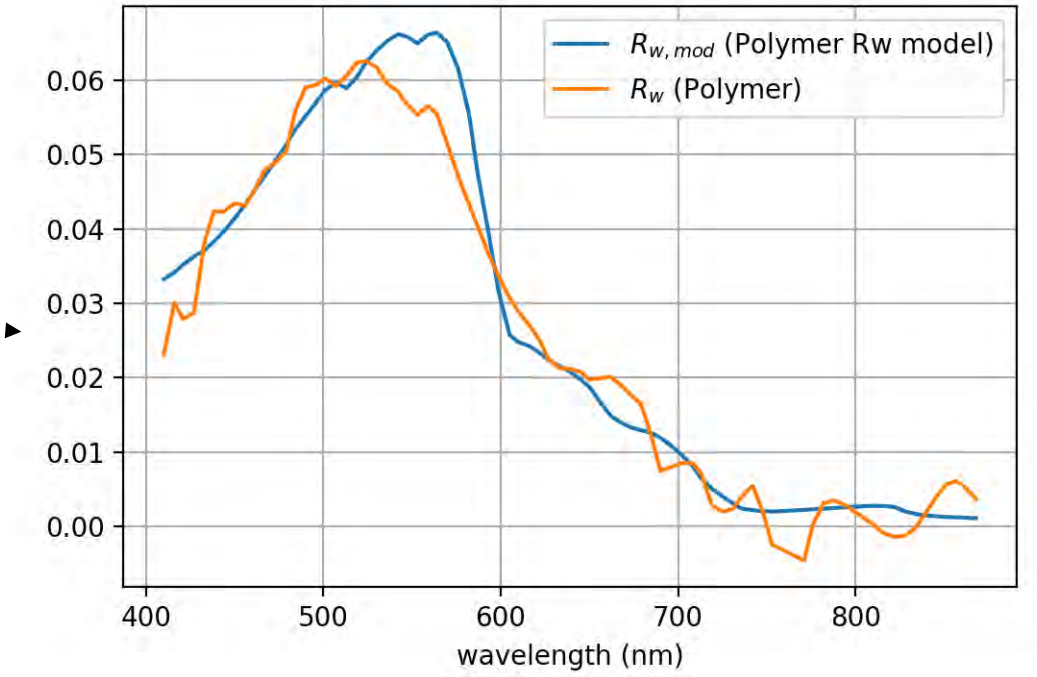


Polymer



Example of retrieved HICO Rw spectrum





- Preliminary results look consistent
- Not too much radiometric noise
- Further work needed (calibration, etc)

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Further exploiting the hyperspectral information

Can we make more use of the hyperspectral information to improve the atmospheric correction?

- Gaseous correction? (O3, NO2…)
- Additional free parameters to the water?
  - Identify different PFTs within the atmospheric correction?
  - Not always possible to introduce additional free parameters → Unstable results, underdetermined system, even with many spectral bands
- Experiment with Hyperspectral
  - Simulate multispectral sensors
  - Test different atmospheric correction schemes → Bands selection for atmospheric correction