Derivation of Inherent Optical Properties from Satellite Top of Atmosphere Measurements in Optically Complex Waters

Principal Investigator

Susanne Craig, Dalhousie University, CERC.OCEAN

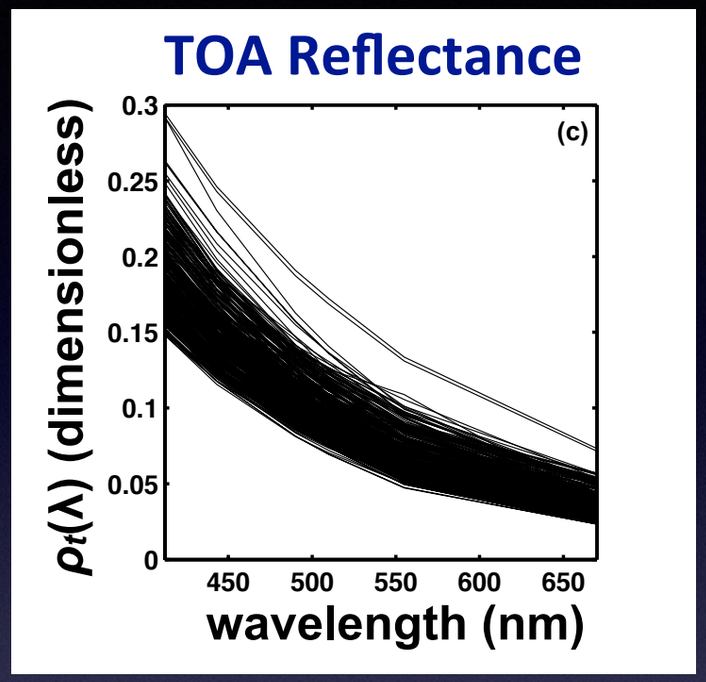
Collaborators

Zhongping Lee, University of Massachusetts, Boston

David Miller, NRL

TOA EOF-Based Algorithms for IOPs

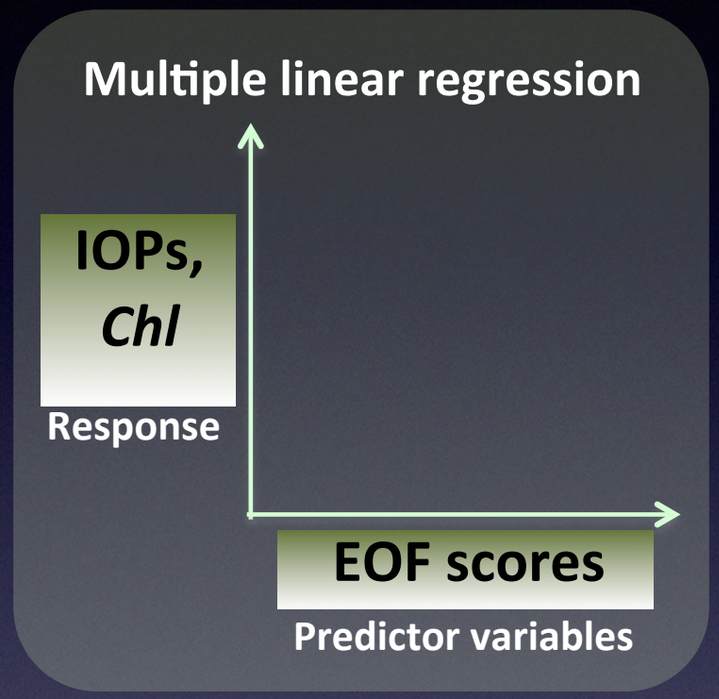
1.



2. EOF analysis

stepwise selection of EOF scores

3. Model to estimate IOPs/Chl



- Evolution of an approach developed for in situ data
- TOA approach initially developed on multispectral NOMAD satellite matchup dataset (Jeremy Werdell, GSFC)

What we said we'd do…

1. Comprehensive characterisation of TOA EOF model using a synthetic dataset:

- TOA synthetic dataset has been constructed using coupled atmosphere-ocean model - Zhongping Lee & team
  - a_{ph} spectra collected from SEABASS
  - Other IOPs modelled using similar approach to IOCCG Report #5
  - Good representation of 'real' world measured IOPs
- Parameters varied: a_{ph}, a_g, a_d, b_{bph}, b_{bd}, AOD (τ), absorbing aerosols (O_3, O_2, water vapour), sza

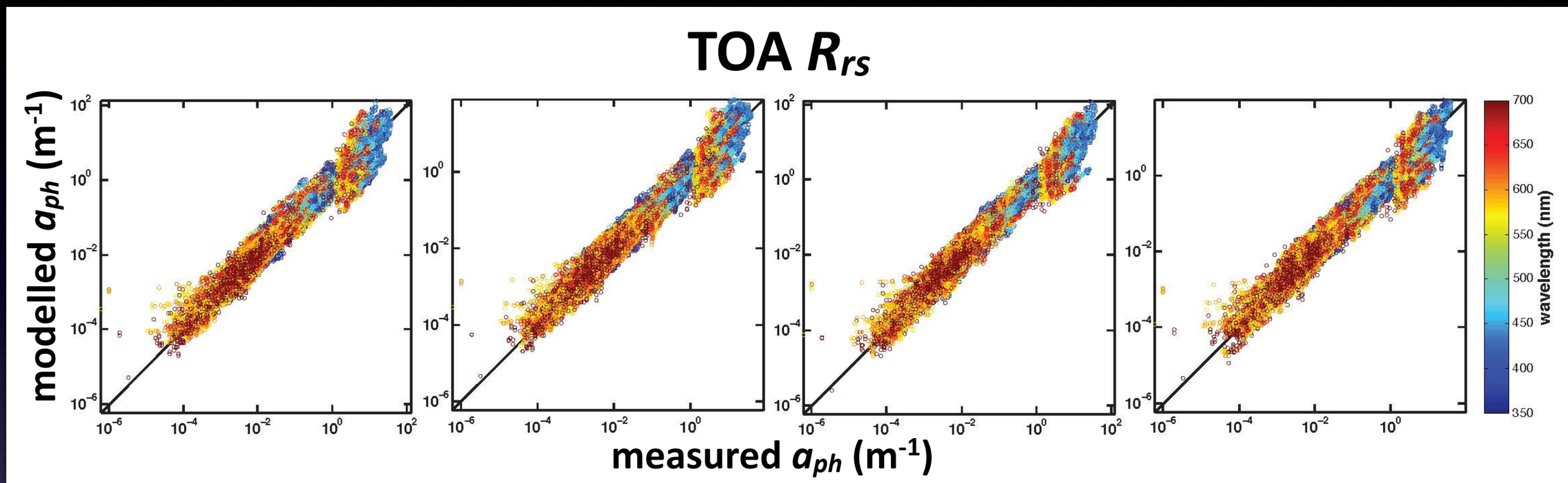
Results

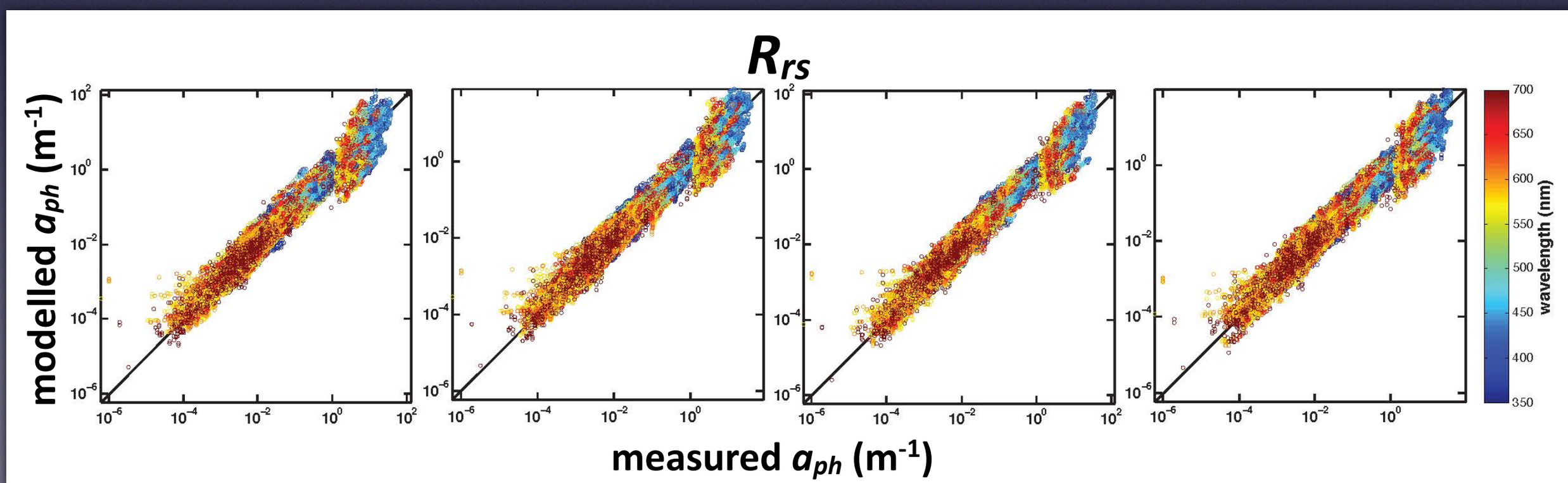
Model Scenarios

- EOF models derived from TOA R_{rs} (= $L_t/(F_0 * \cos\theta)$) and R_{rs}
  - R_{rs} models permit comparison of model skill when atmospheric is present and absent in AOP spectra
- Two IOP examples:
  - a_{ph} & b_{btot} but models derived for all IOPs
- Models run for τ = 0.1, 0.3, 0.5, 0.8
- Absorbing aerosols (O_3, O_2, water vapour) included

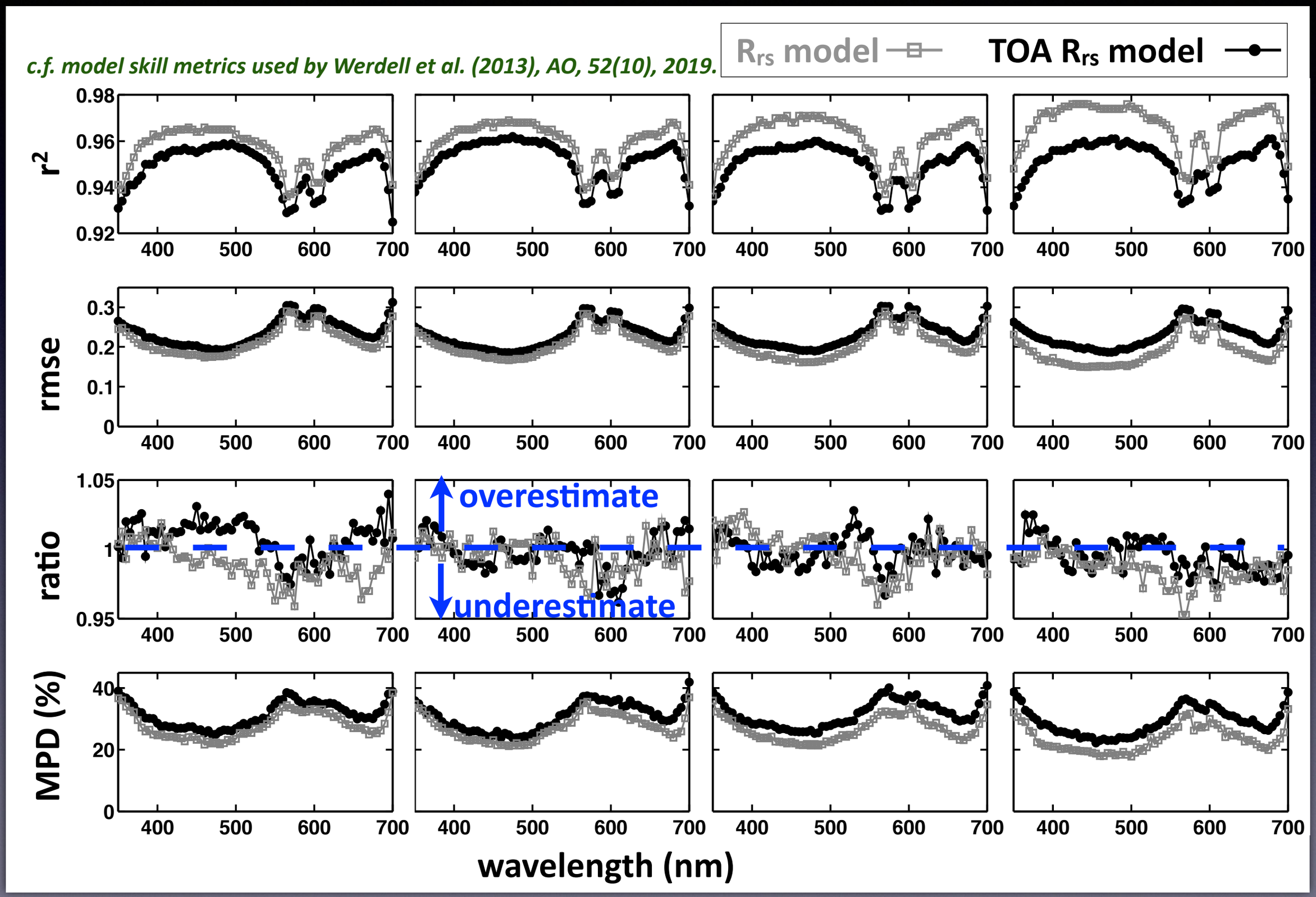
Results - a_{ph} Models

τ = 0.1 τ = 0.3 τ = 0.5 τ = 0.8





Results - a_{ph} Model Skill Metrics



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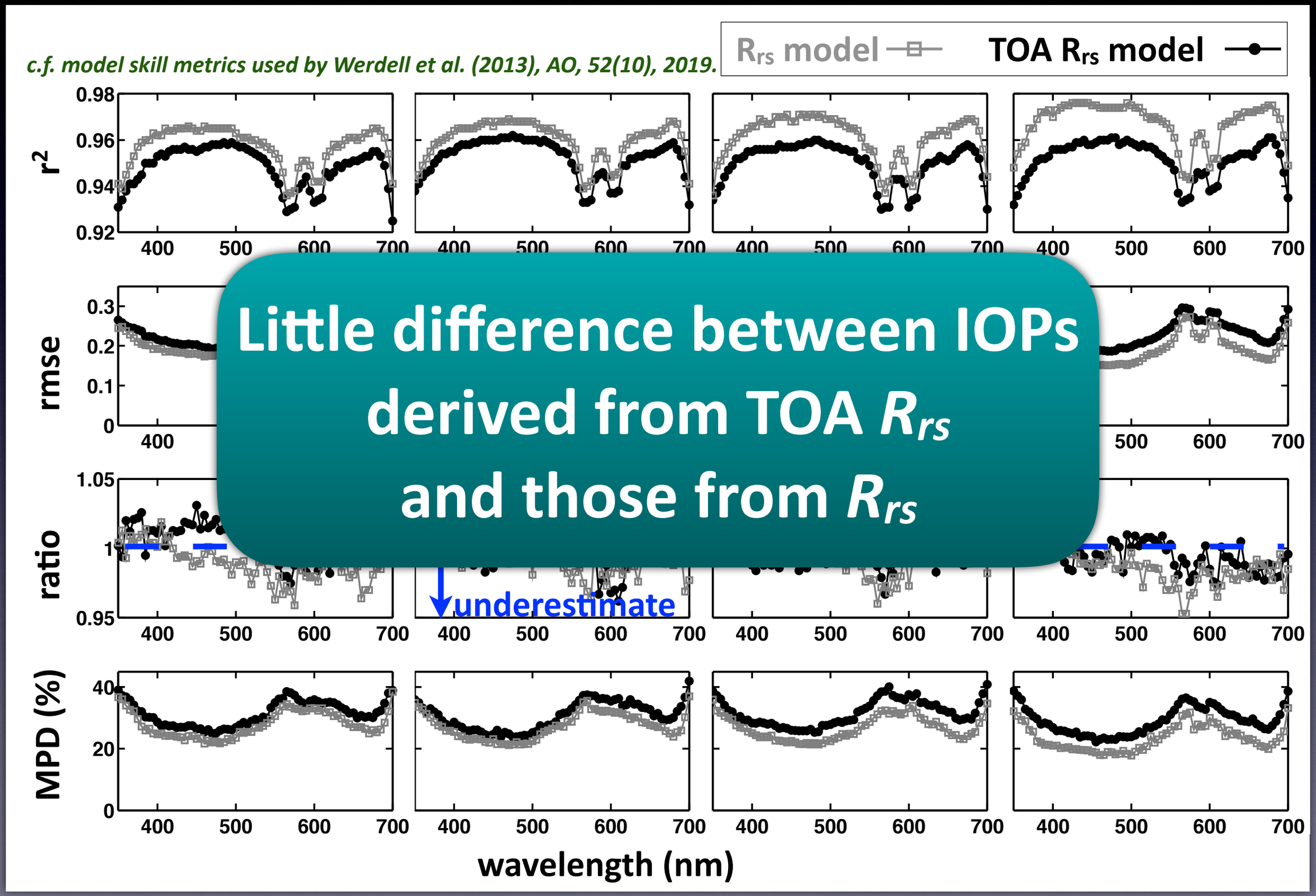
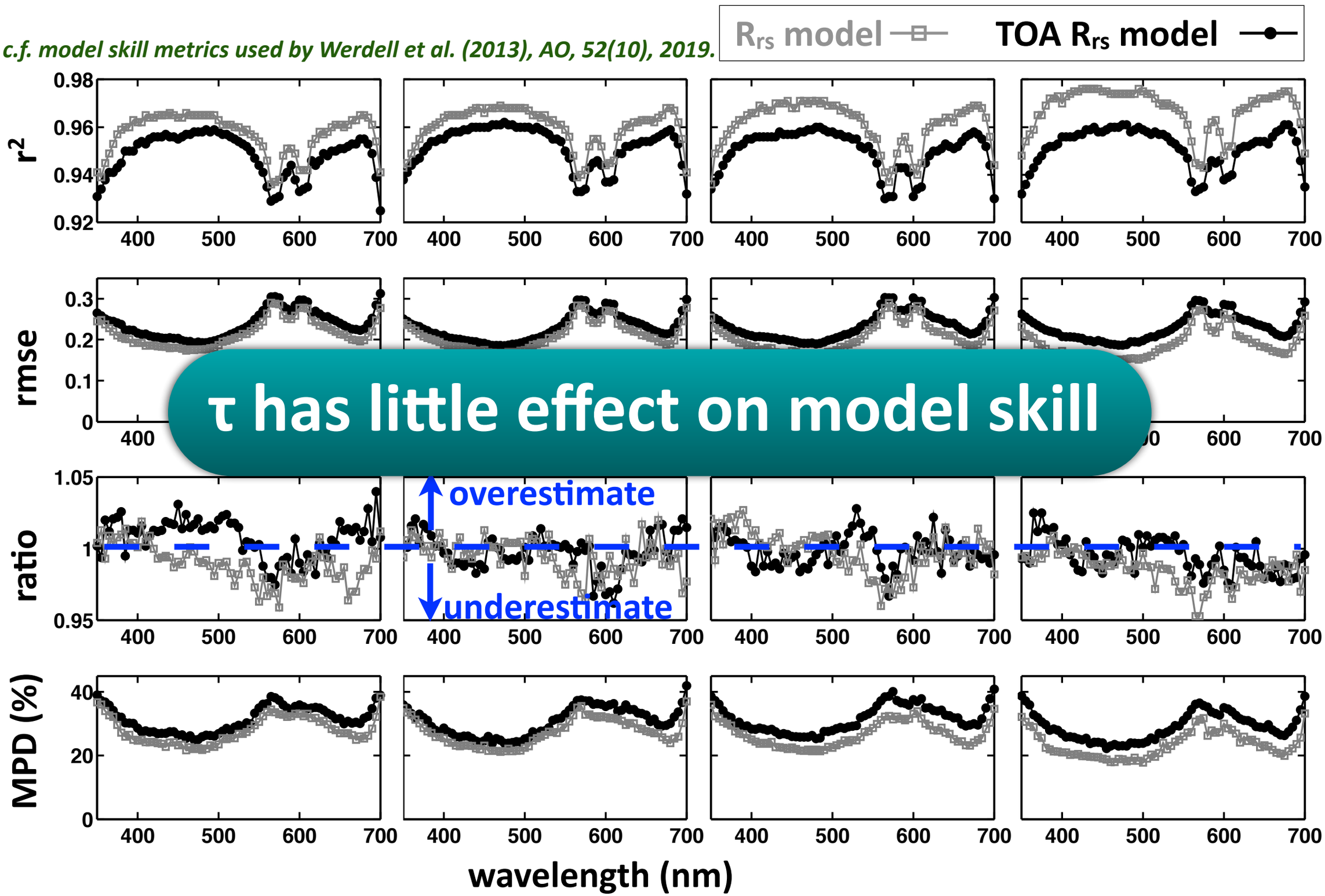


Little difference between IOPs derived from TOA R_{rs} and those from R_{rs}

Results - a_{ph} Model Skill Metrics

τ = 0.1 τ = 0.3 τ = 0.5 τ = 0.8

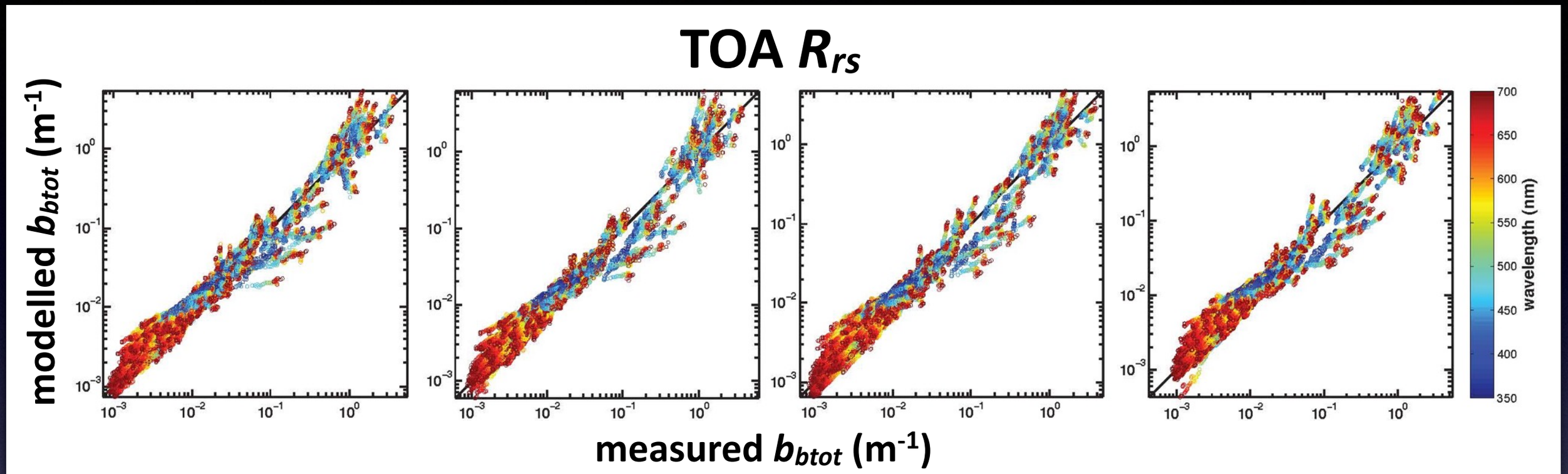
c.f. model skill metrics used by Werdell et al. (2013), AO, 52(10), 2019.

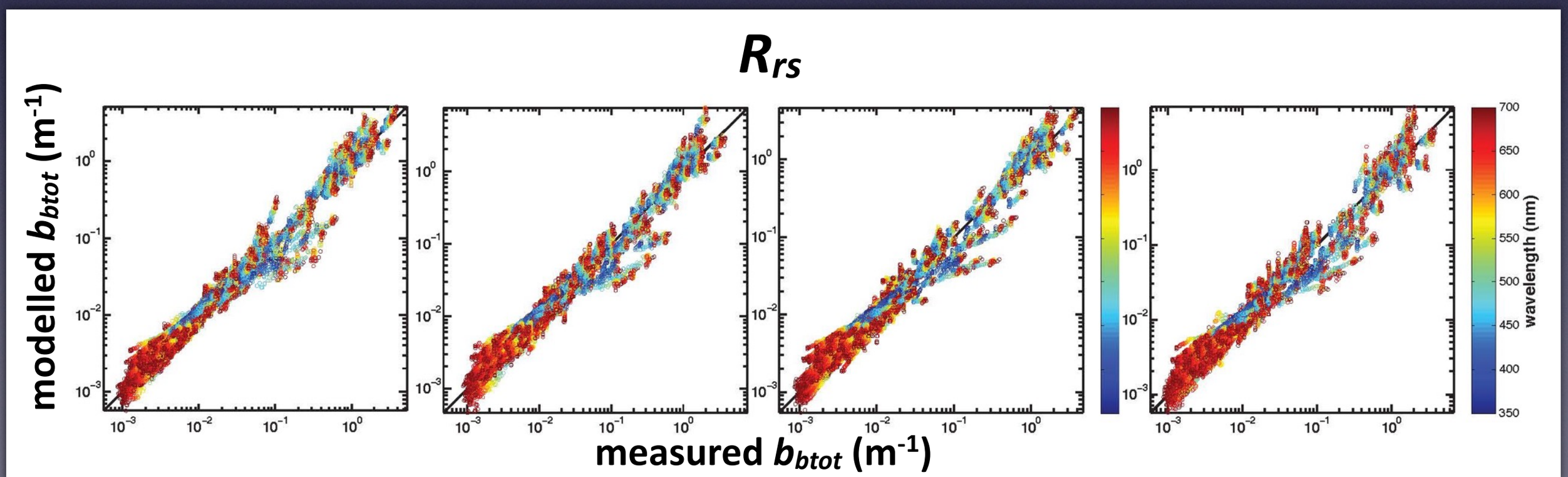


τ has little effect on model skill

Results - b_{btot} Models

τ = 0.1 τ = 0.3 τ = 0.5 τ = 0.8





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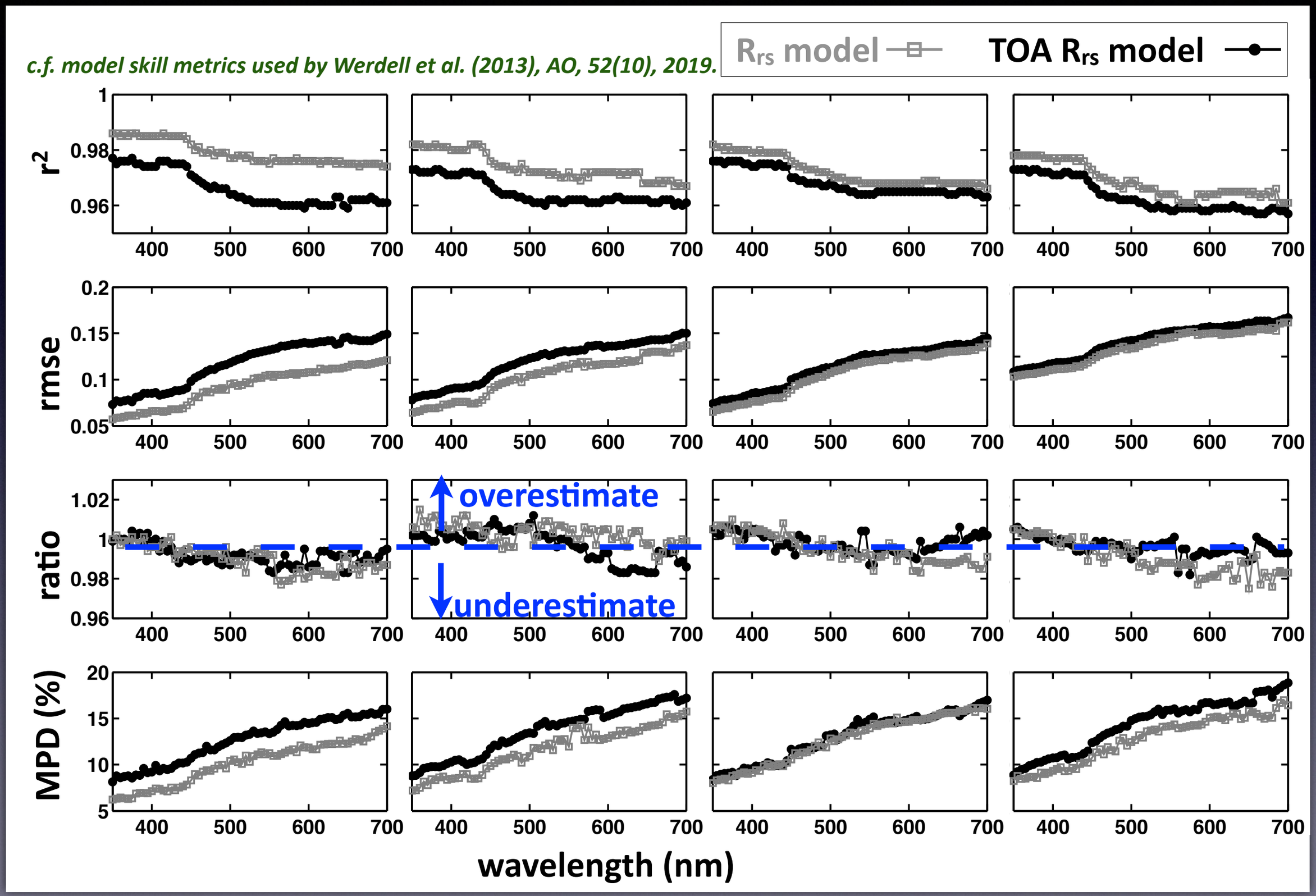

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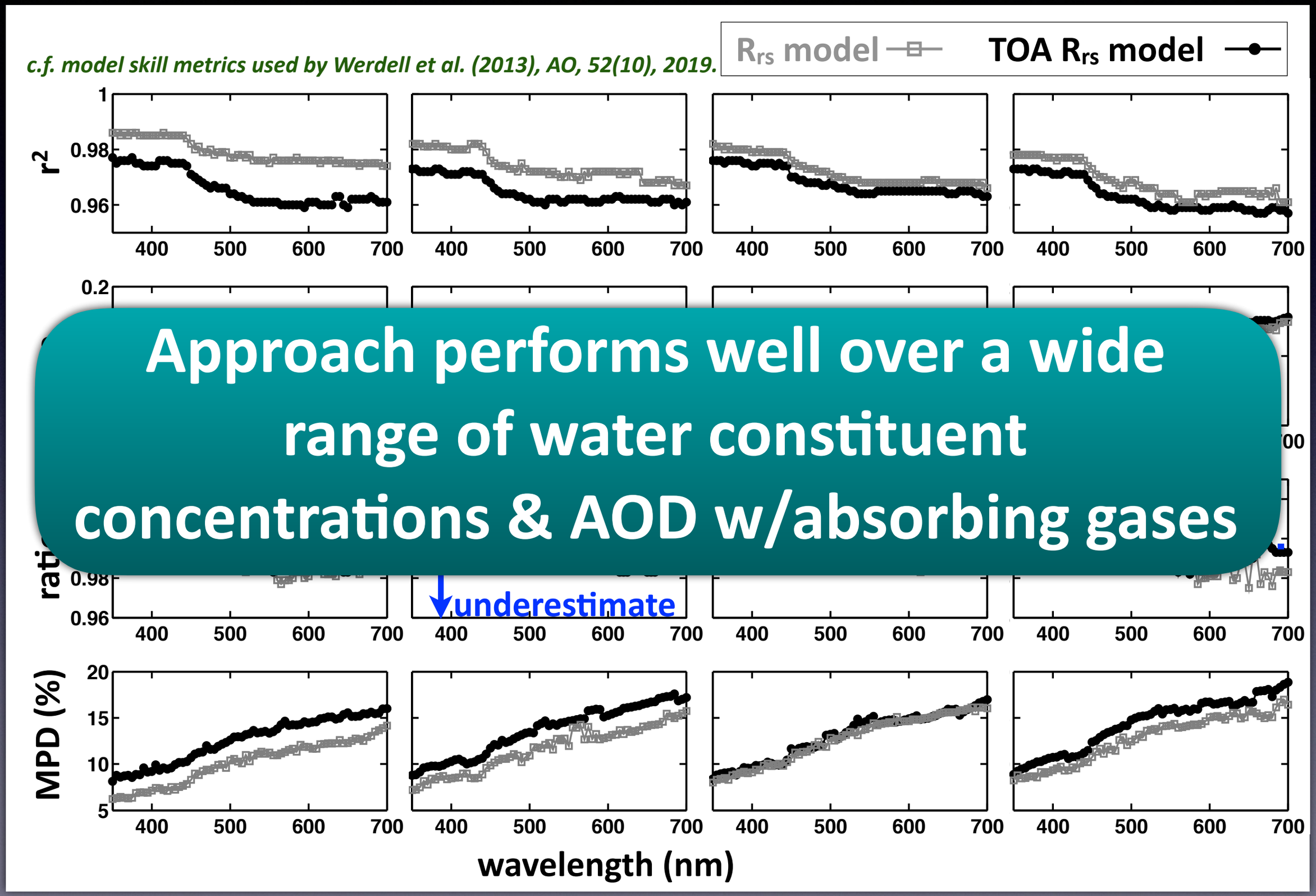

Approach performs well over a wide range of water constituent concentrations & AOD w/absorbing gases

Future Analyses

- Interrogate synthetic dataset to perform:
  - Sensitivity analyses
  - Investigation of optimal methods to train & implement model - global, regional, water type,…
  - Development of operational methodology

What we said we'd do…

2. Model development and assessment using HICO & CASI datasets:

- HICO and aircraft imagery with corresponding validation data currently being collated (Dave Miller, NRL DC)

HICO imagery of Bedford Basin, NS, Canada

□ *= Bedford Basin*

Summary

- Tests of the approach on both real (NOMAD) and synthetic datasets (Lee) show high potential for circumventing conventional AC
- IOPs retrieved with accuracy comparable (or better) than published methods
- Good candidate for coastal/inland waters where AC is challenging
- On orbit sensor characterisation: EOF modes may reveal sensor drift over time