Constraining a global, eddying, ocean and sea ice model with level-2 QuikSCAT wind stress data: First results

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QuikSCAT

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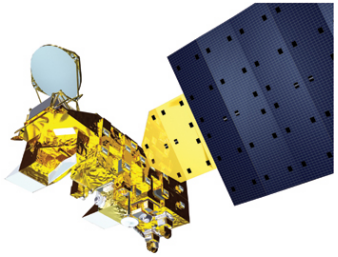
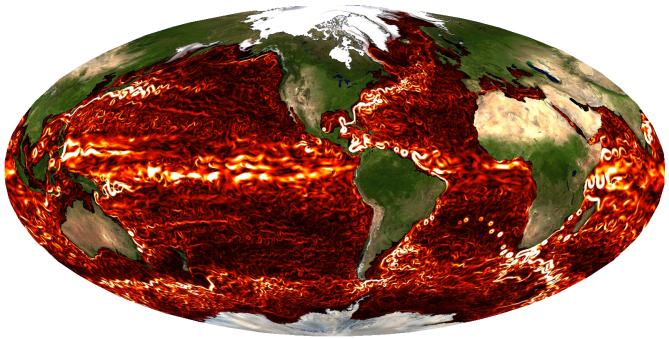
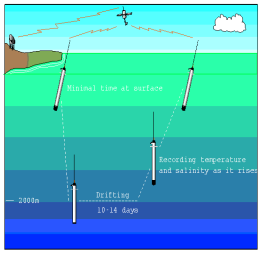
Jason



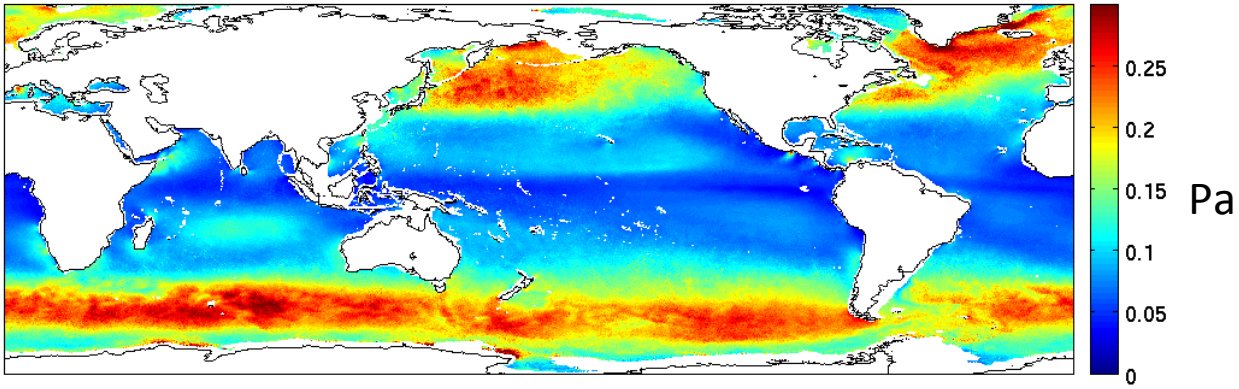
AMSR-E



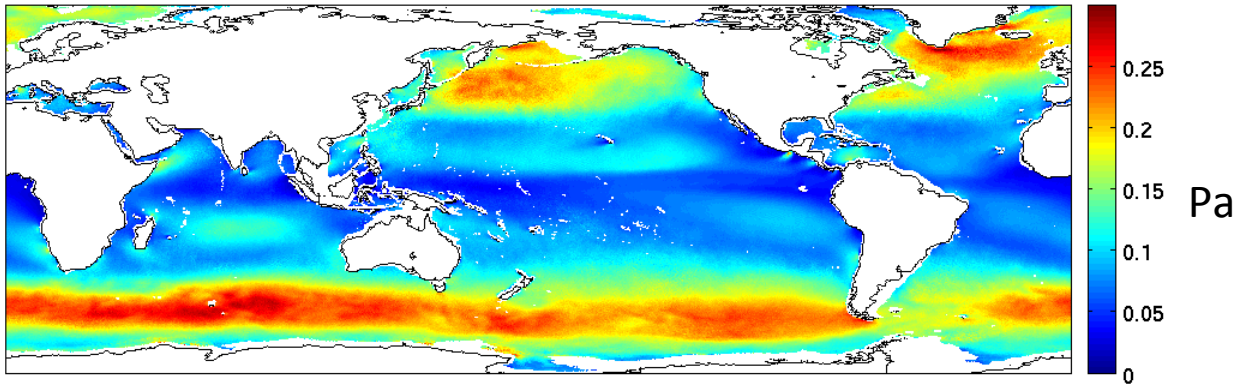
ARGO



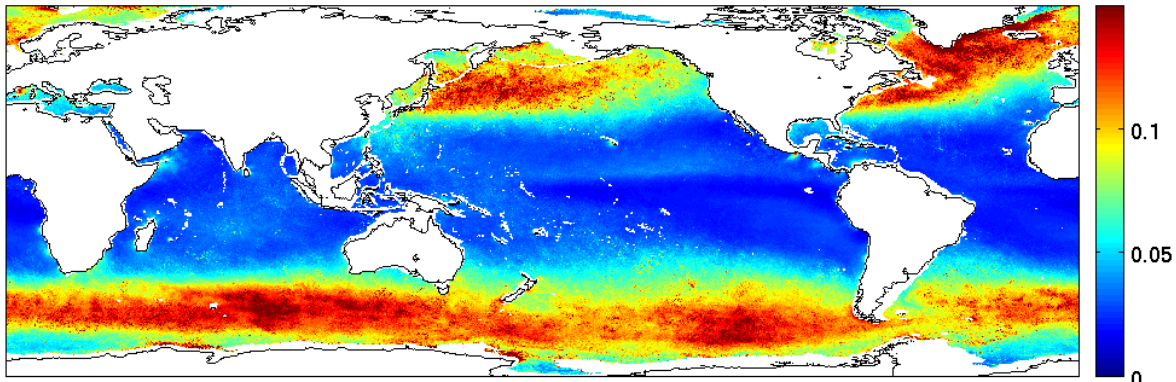
RMS QSCAT 2004 wind stress (Bourassa 2006)



RMS baseline simulation 2004 wind stress (ECMWF)



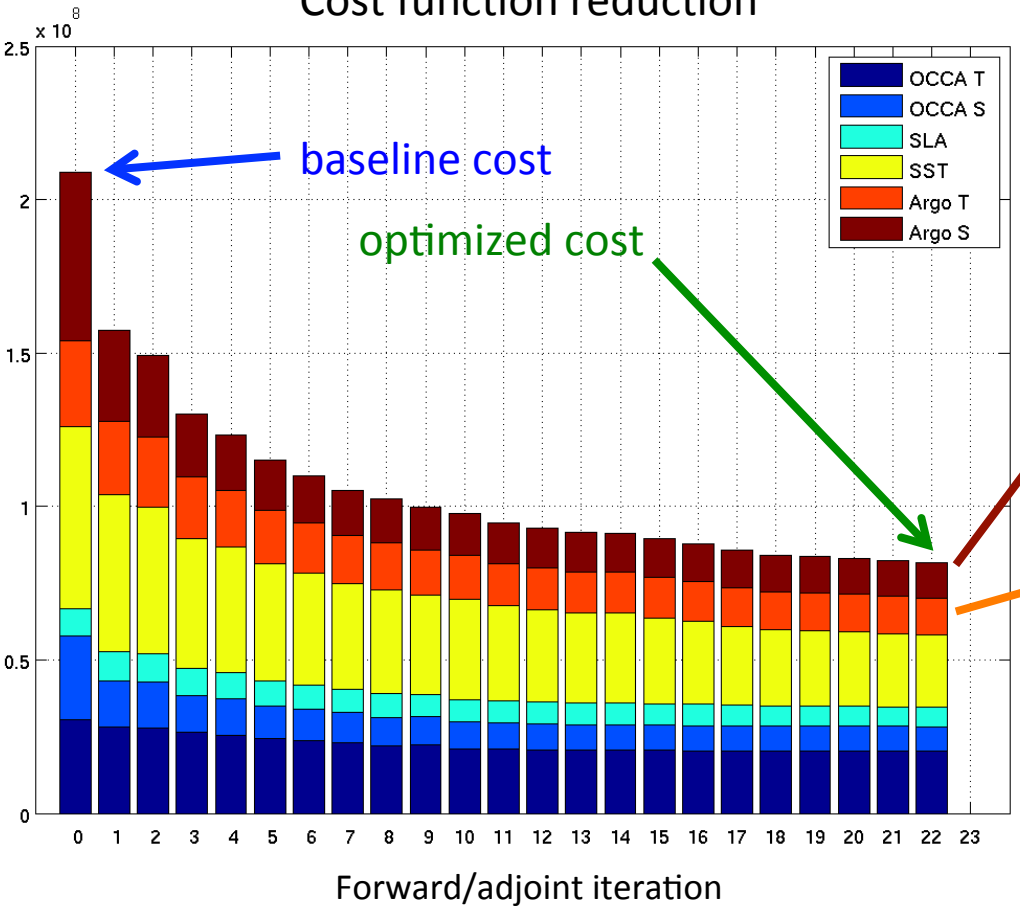
RMS(baseline – QSCAT stress)



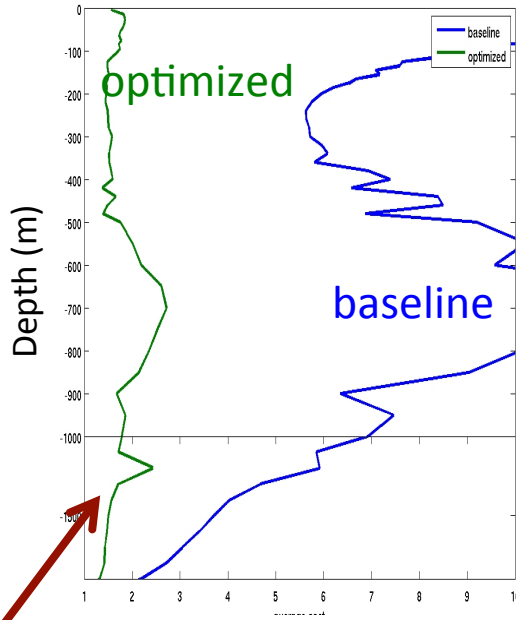
Adjoint-method optimization of an eddying global-ocean and sea ice MITgcm configuration.

- Control variables are initial T/S and atmospheric boundary conditions.
- Data constraints currently include JASON SLA, AMSR-E SST, ARGO T/S profiles, and OCCA T/S climatology.

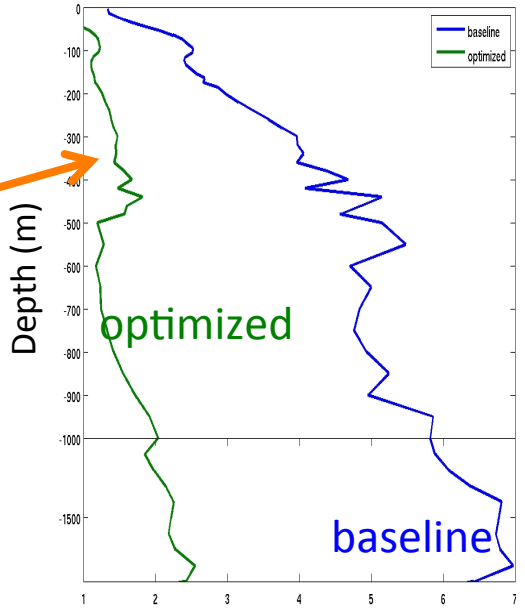
Cost function reduction



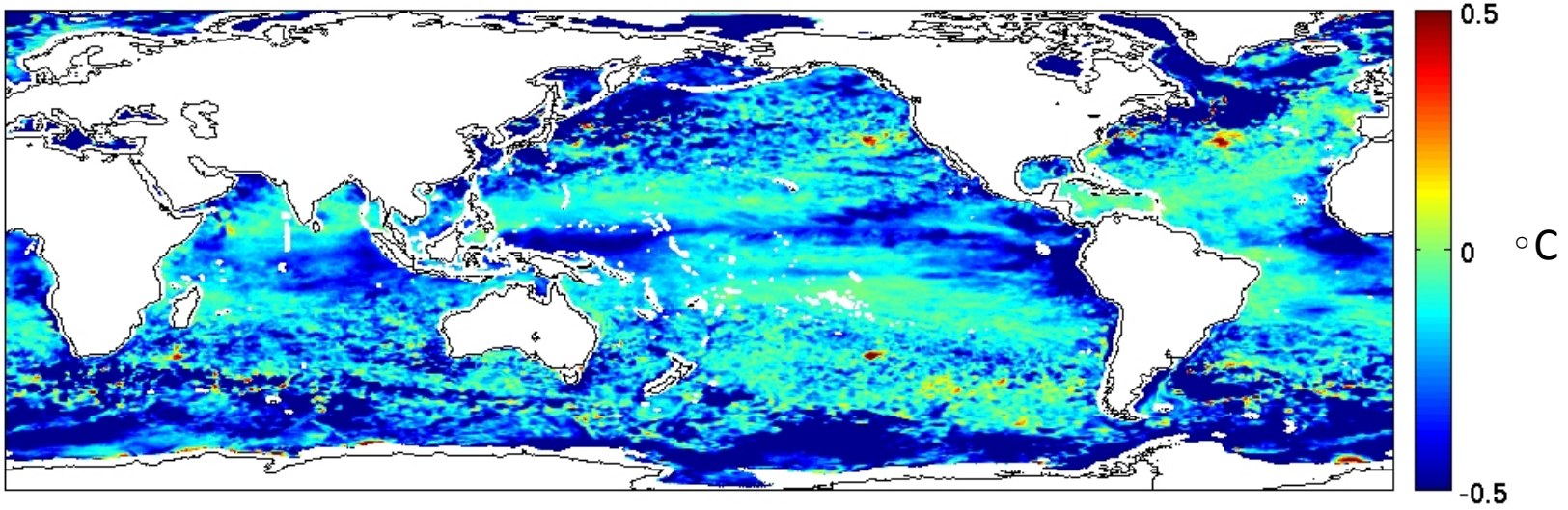
ARGO S cost reduction



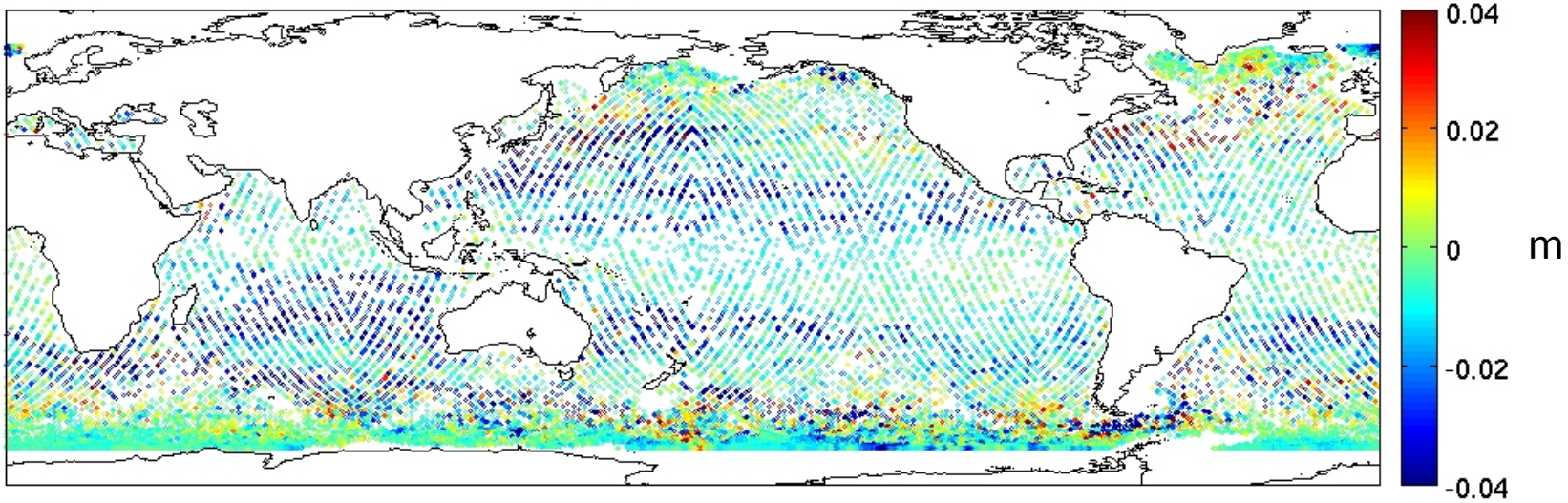
ARGO T cost reduction



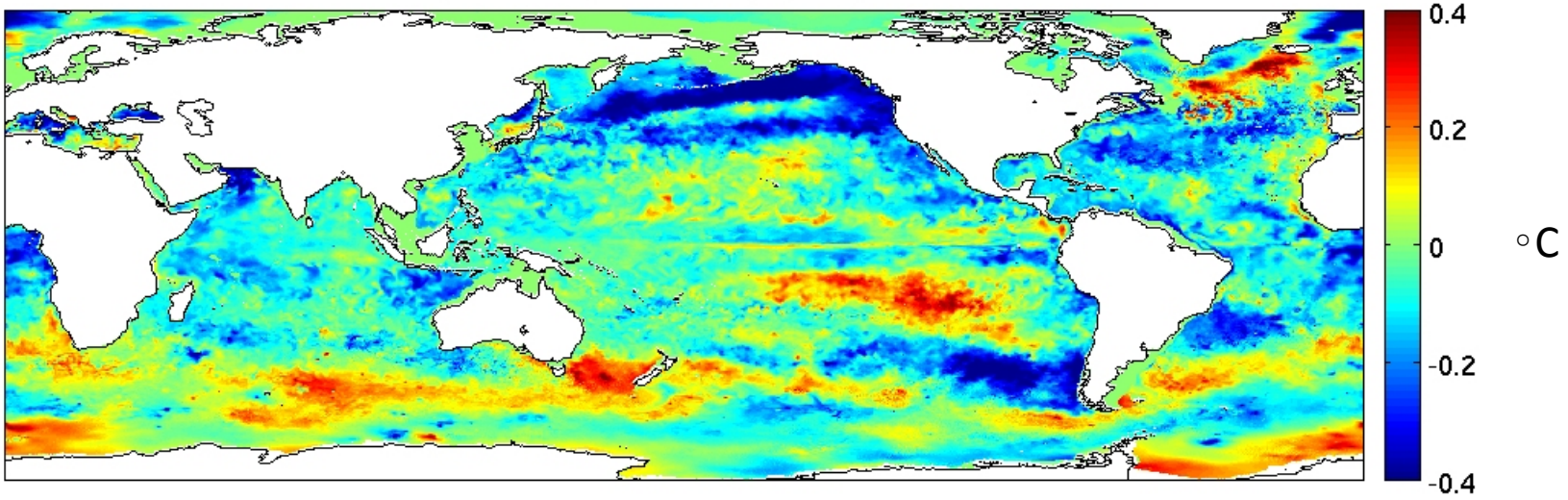
RMS(optimized – AMSRE SST) – RMS(baseline – AMSRE SST)



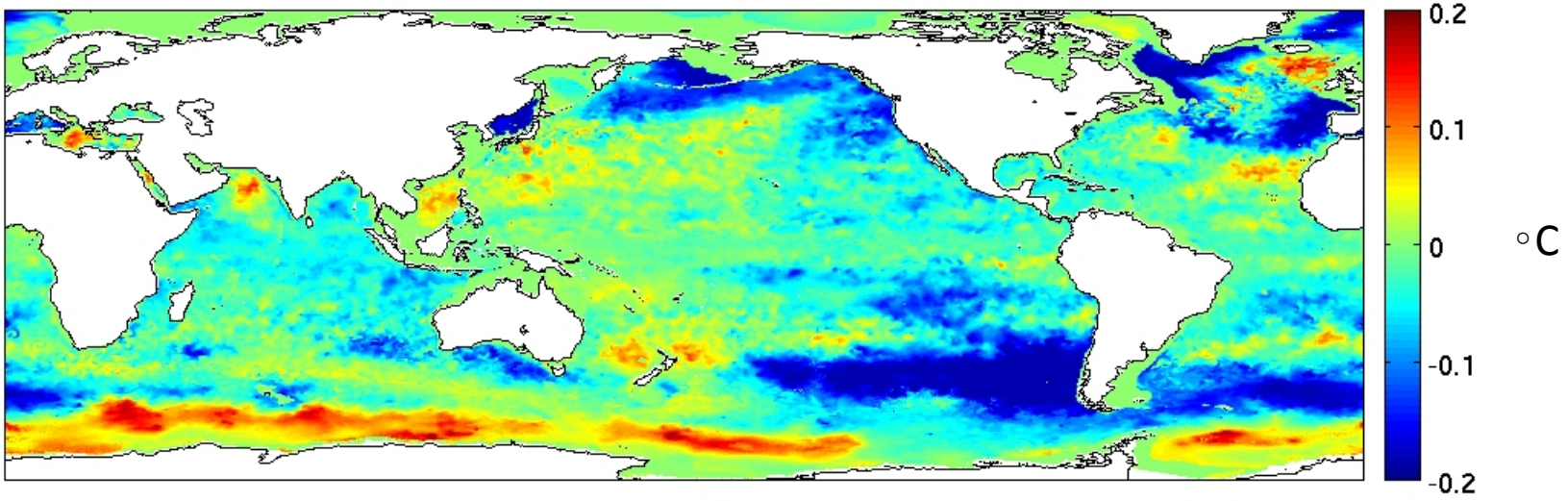
RMS(optimized – Jason SLA) – RMS(baseline – Jason SLA)



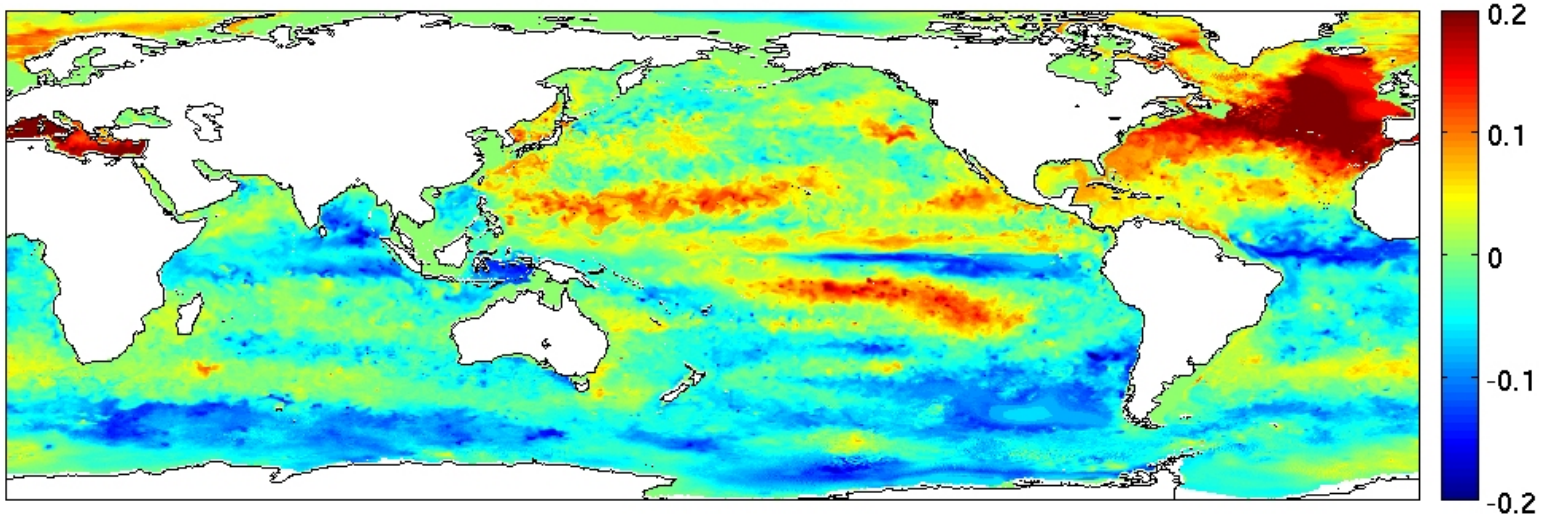
Adjustment of initial temperature at the 154-m depth



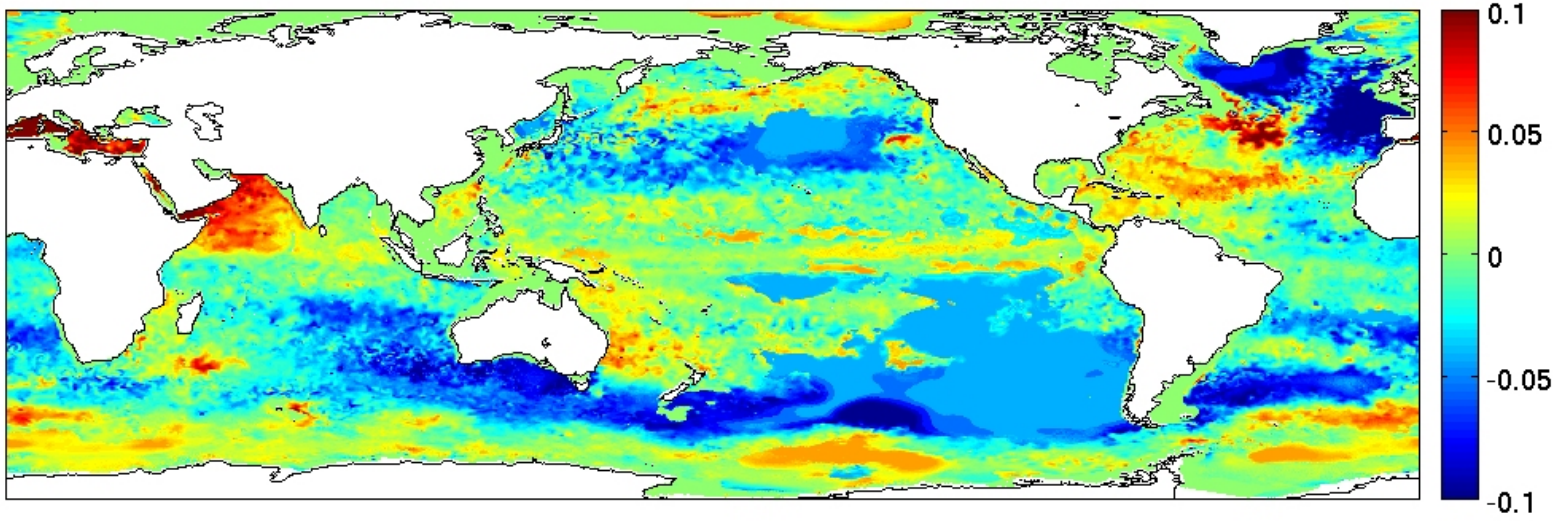
Adjustment of initial temperature at the 634-m depth



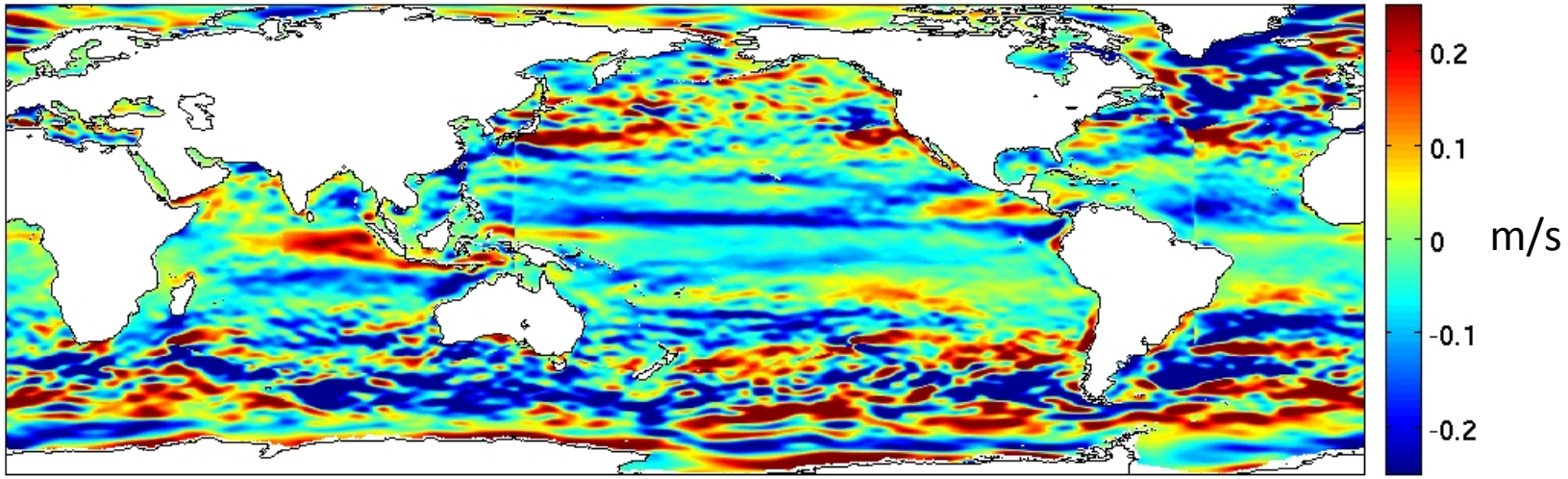
Adjustment of initial salinity at the 154-m depth



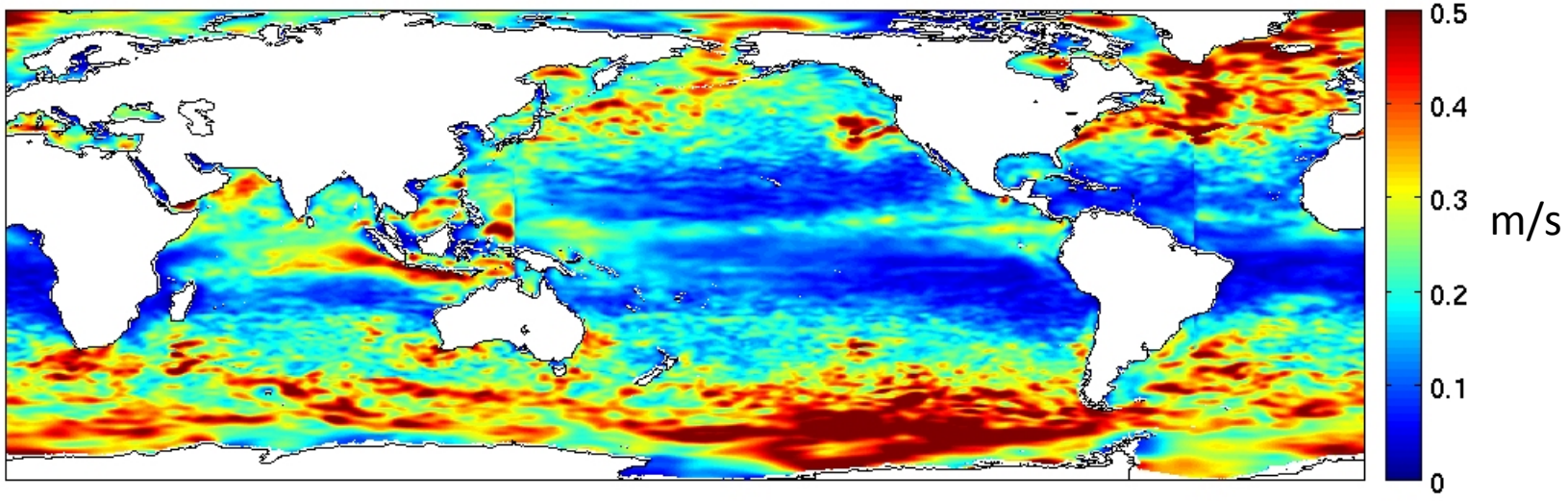
Adjustment of initial salinity at the 634-m depth



Time-mean of zonal wind adjustment



Standard deviation of zonal wind adjustment



Is optimized solution closer to QSCAT stress than baseline solution?

QuikSCAT

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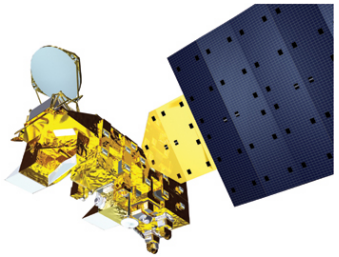
Jason



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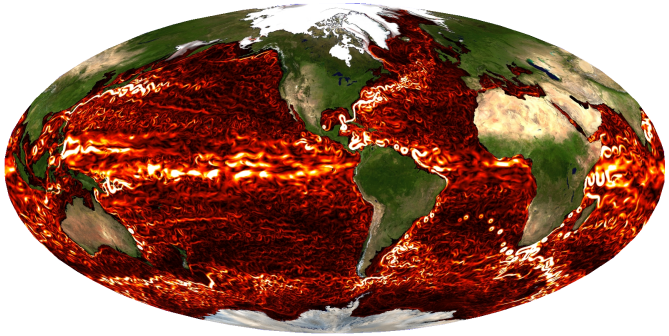
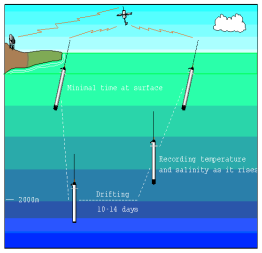


ARGO



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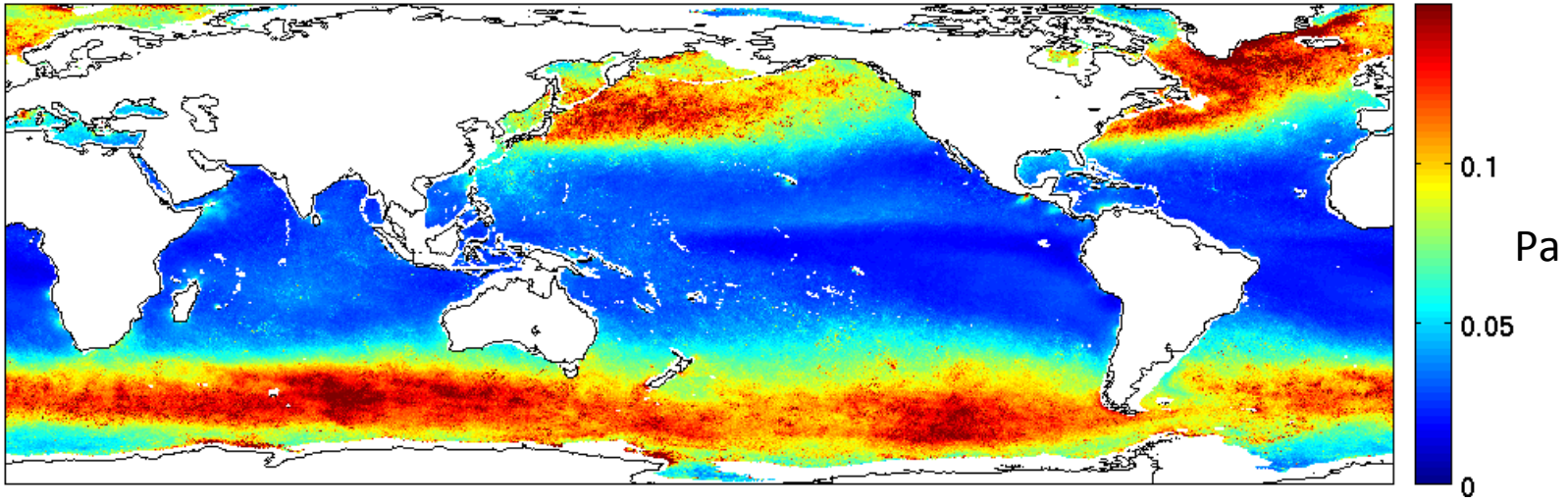

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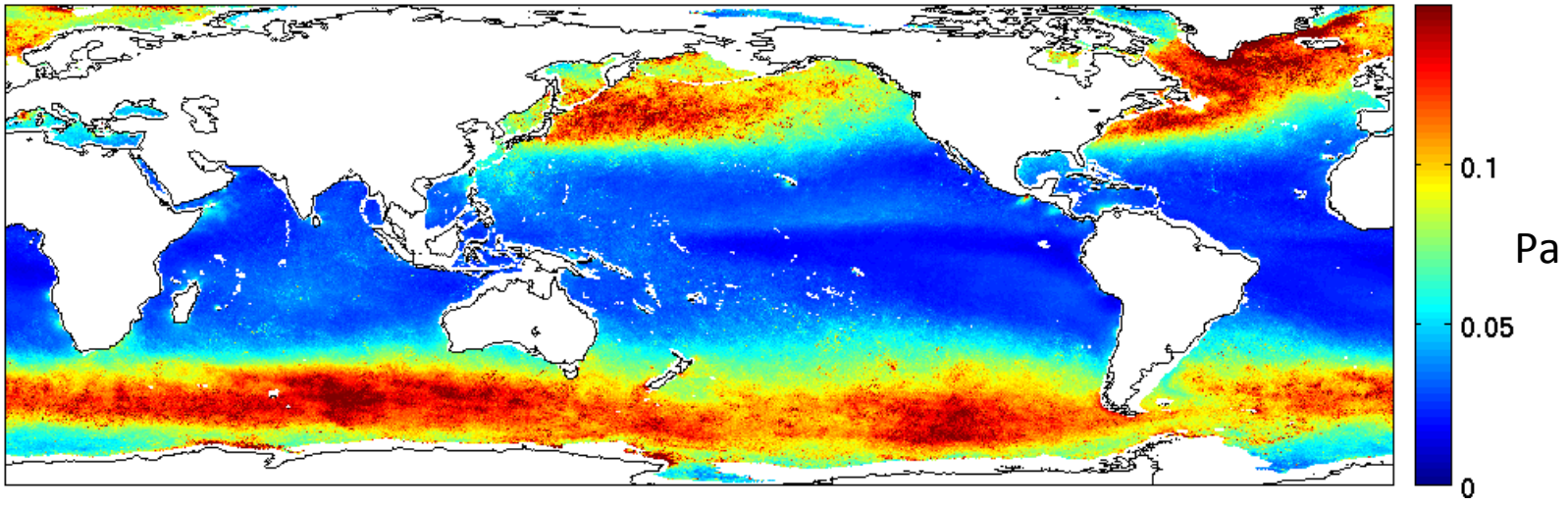
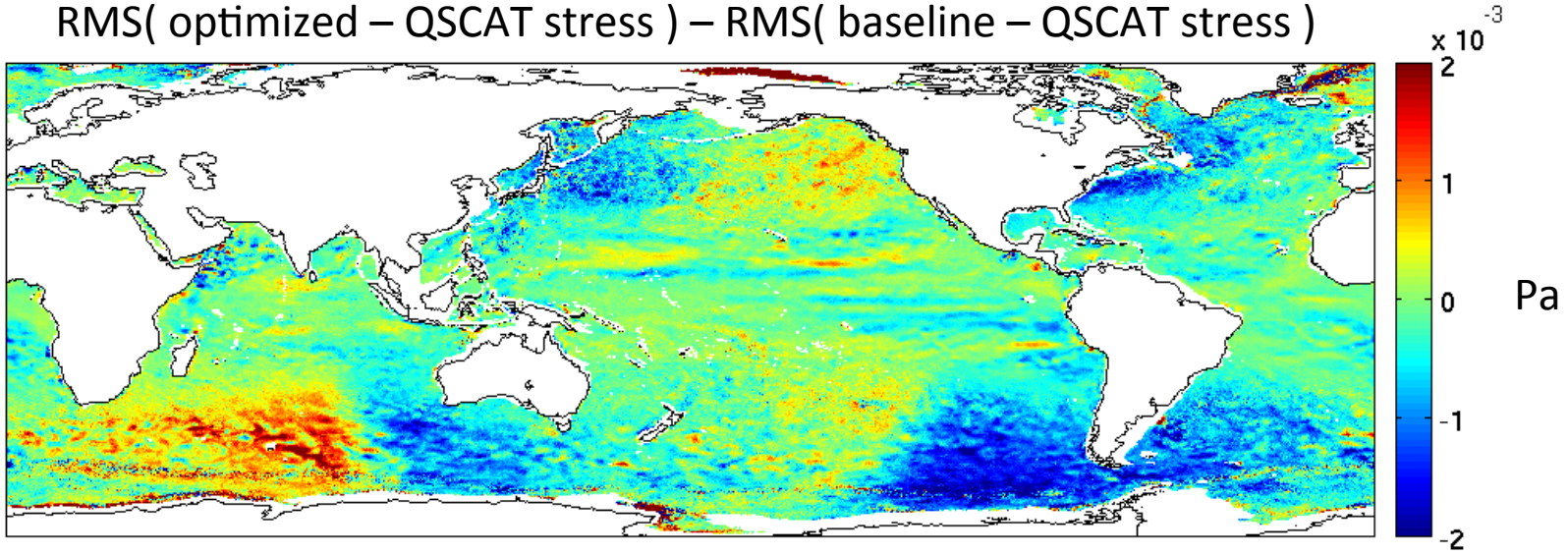


RMS(optimized – QSCAT stress) – RMS(baseline – QSCAT stress)



Summary and concluding remarks

- A global, eddying ocean and sea ice simulation has been constrained by altimeter, SST, and in situ data using the adjoint method.
- The optimized solution, however, is **NOT** closer to QSCAT wind stress retrievals obtained using the Bourassa (2006) drag coefficient.
- Possible causes include problems with ocean model, with bulk formulae, with optimization, with QSCAT wind stress retrievals, etc.
- State estimation provides a rigorous test of consistency of ocean observations and models.

Next steps

- Repeat analysis with improved QSCAT wind stress retrievals, as they become available.
- Incorporate a sea-state dependent surface flux parameterization in the model.
- Incorporate QSCAT constraints in the optimization.

QSCAT cost reduction after one forward/adjoint iteration that includes QSCAT data constraints