Synergistic use of satellite and in situ observations for production of new, multi-platform salinity estimate for climate research

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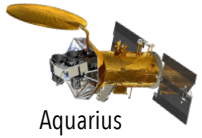
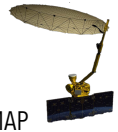
GO-SHIP
1999 - …

Argo
2003 - …

SMOS
2010 - …



Aquarius
2011 - 2015



SMAP
2015 - …

Reconciling salinity data from different platforms is an important component of a modern salinity observing system

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Research Article

Optimum interpolation analysis of Aquarius sea surface salinity

Oleg Melnichenko, Peter Hacker, Nikolai Maximenko, Gary Lagerloef, James Potemra

First published: 21 January 2016 Full publication history

DOI: 10.1002/2015JC011343

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Aquarius + Argo (OI)

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Research Article

An in situ-satellite blended analysis of global sea surface salinity

P. Xie, T. Boyer, E. Bayler, Y. Xue, D. Byrne, J. Reagan, R. Locarnini, F. Sun, R. Joyce, A. Kumar

First published: 17 September 2014 Full publication history

DOI: 10.1002/2014JC010046

Aquarius + SMOS + NODC in situ (OI)

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Research Article

Impact of assimilating surface salinity from SMOS on ocean circulation estimates

A. Köhl, M. Sena Martins, D. Stammer

First published: 26 August 2014

DOI: 10.1002/2014JC010040

SMOS + Argo + Other obs + GCM (DA)

Based on different methodologies, blended products offer various advantages – choose according to your applications

Examples:

1. Climatology, short-term forecast:

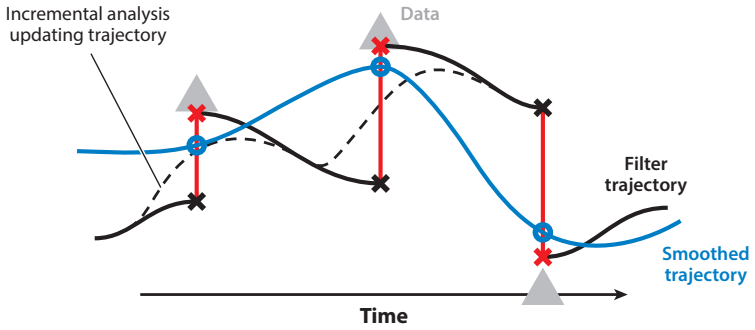
   OI, KF, 3Dvar *(Fukumori 2002)*

   Data 1 + Data 2 + ….

1. Climate studies:

   Adjoint, 4Dvar *(Wunsch & Heimbach 2013)*

   Data 1 + Data 2 + ... + GCM (F=ma)



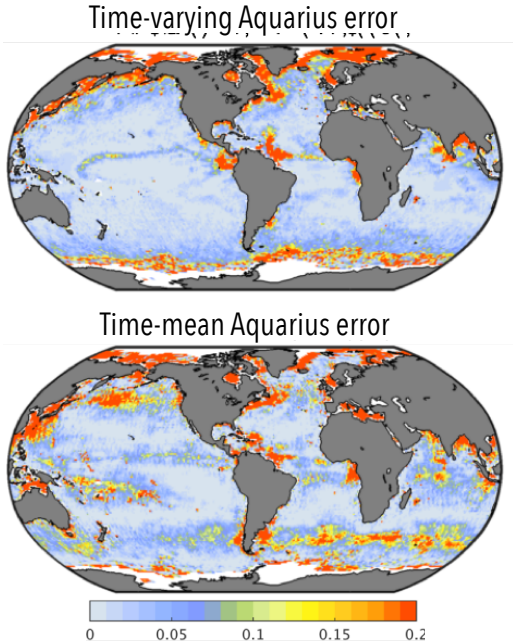
Stammer et al., 2016

$$J(X) = \sum (\mathbf{I}X - D)^T \mathbf{W_D} (\mathbf{I}X - D) \rightarrow \mathrm{MIN}$$

ECCO solution reconciles salinity information from multiple platforms in a way that makes the most physical sense

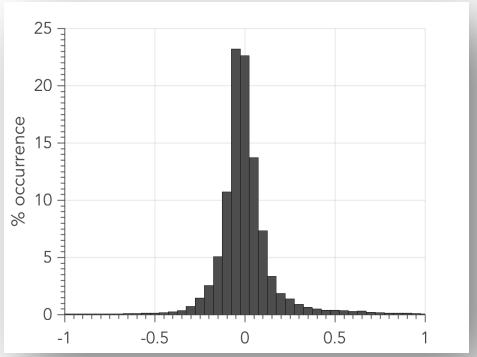
Main advantages and recent improvements:

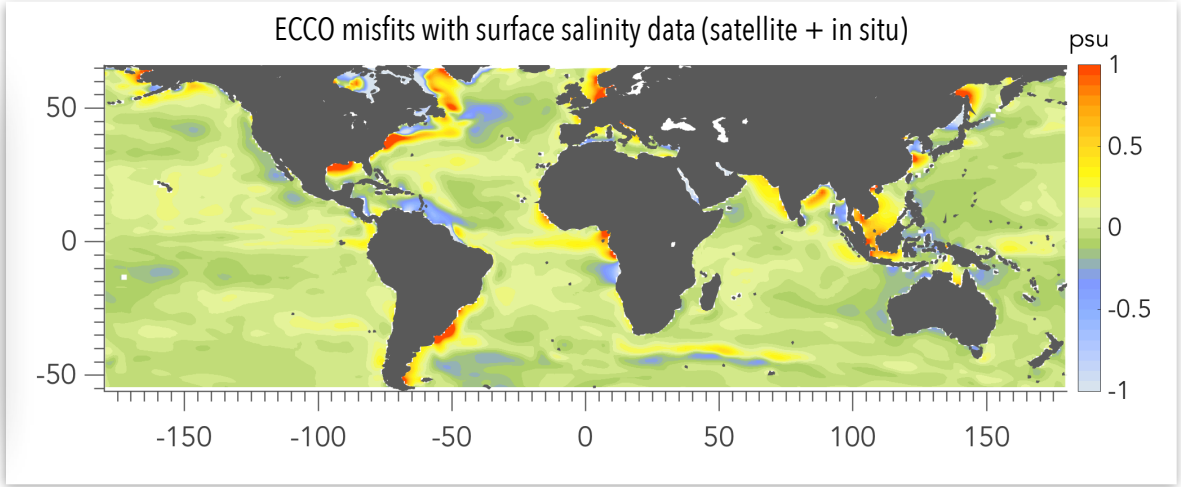
1. Uses information from a variety of sources
   - Salinity data: Aquarius, Argo, CTD (new Arctic T/S), ITP
   - Other data: temperature, altimetry, sea-ice concentration, GRACE
2. Improved modeling component
   - Reduced biases and temporal correlations
   - Realistic representation of freshwater fluxes
   - Revised sea-ice model
3. Obeys conservation statements
   - Consistent 3D ocean circulation, salt/freshwater transports, and forcing fields
   - Closed budget diagnostic tools
4. Close to observations within specified data errors



Vinogradova et al., 2014

Misfits of the ECCO solution to surface salinity data are mostly within data uncertainty

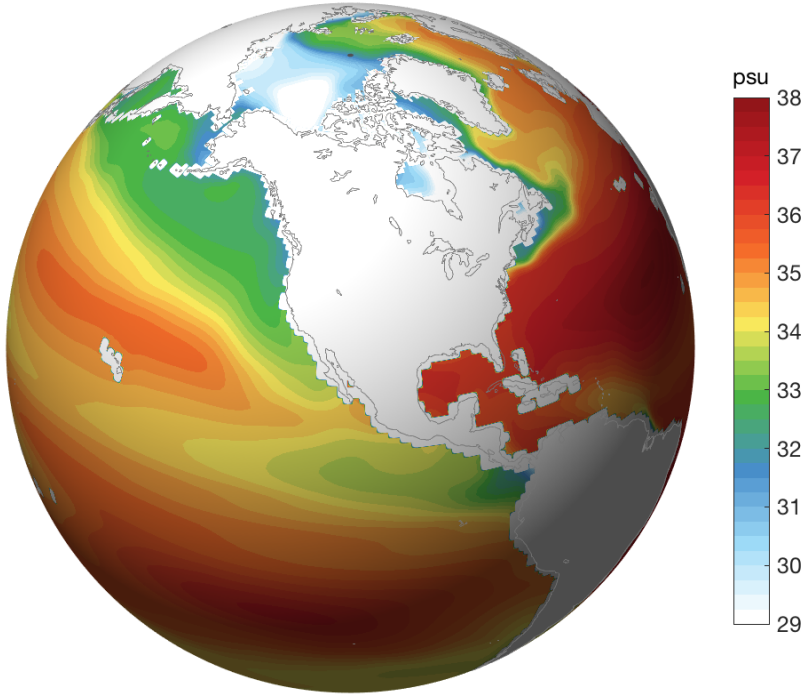




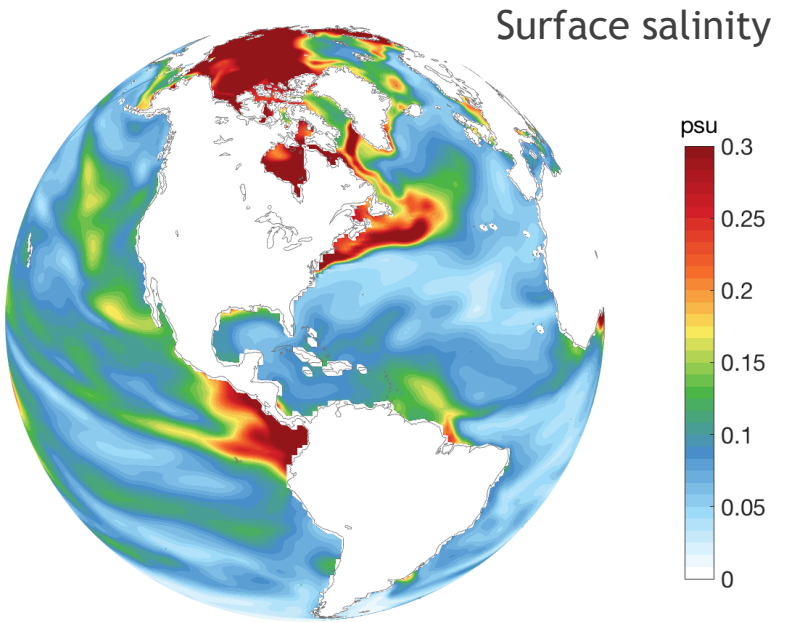
Examples:

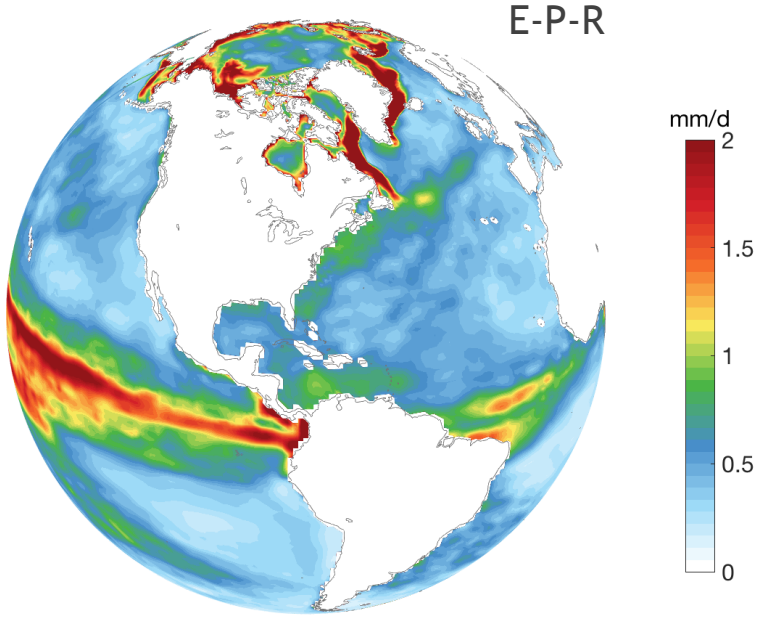
Surface salinity in the last 2 decades:

1992 – 2015 (animation)

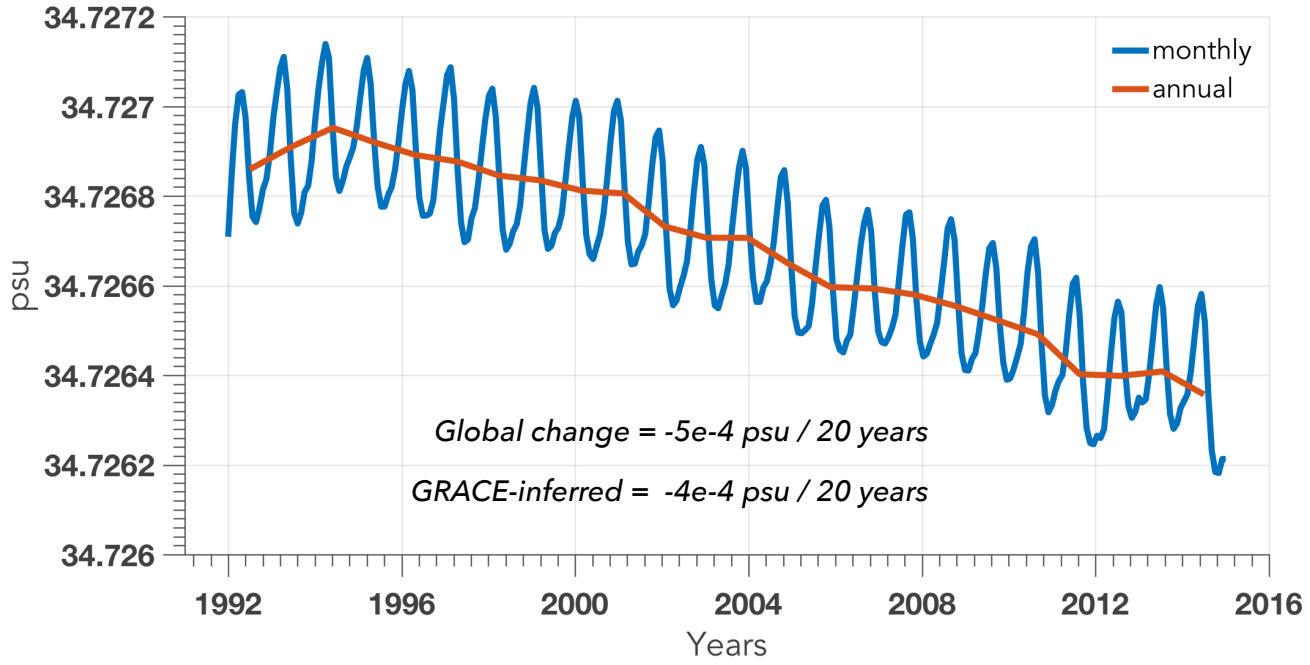


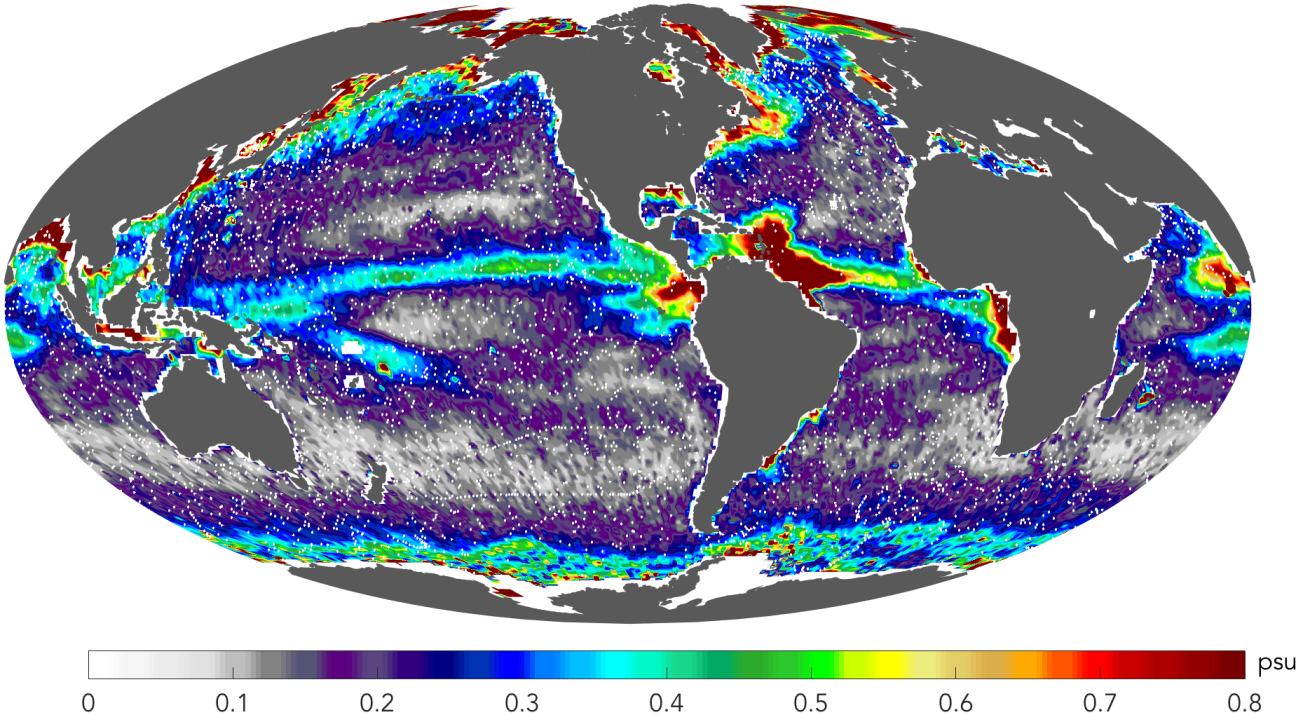
Examples: inter-annual variability in surface salinity and surface freshwater fluxes (including sea-ice dynamics)





Examples: vertically-integrated, global mean salinity





ECCO can be used as a tool to estimate added value of satellite salinity to in situ platforms, including coastal areas with poor Argo coverage

Annual data coverage: Argo locations and trajectories during 2012 (4328 floats) and standard deviation in Aquarius v4.0 SSS

EXPLORE ECCO SALINITY

DOWNLOAD LATEST SOLUTION:

WWW.ECCO-GROUP.ORG

Forget et al., 2015

DOI: 10.5281/ZENODO.199307

RUN CUSTOMIZED ECCO RUNS:

ECCO IN THE CLOUD - BE A MODELER!

HTTPS://GITHUB.COM/CAMCLIMATE/ECCO-CLOUD/

Vinogradova et al., 2017, review