gcmfaces analysis of the solution in /data19/llc270/run combo v42/1992 2017 ALL/iter50/mat//

February 15, 2019

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Figure : Time mean misfit (model-data) for in situ profiles, at various depths (rows), for T (left; in K) and S (right; in psu).



Figure : Cost function (top) for in situ profiles, as a function of depth and time. Distribution of normalized misfits (bottom) as a function of latitude. For T (left) and S (right)



Figure : Distribution of normalized misfits per basin (panel) as a function of latitude, for ${\sf T}$

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Figure : Distribution of normalized misfits per basin (panel) as a function of latitude, for S



Figure : mean dynamic topography prior uncertainty (cm)

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Figure : log(prior error variance) – sea level anomaly (m^2) – large space/time scales



Figure : log(prior error variance) – sea level anomaly (m^2) – pointwise



Figure : mean dynamic topography misfit (cm)



Figure : modeled-observed log(variance) – sea level anomaly (m^2) – large space/time scales



Figure : modeled-observed log(variance) – sea level anomaly (m^2) – pointwise



Figure : modeled-observed cost - mean dynamic topography

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Figure : modeled-observed cost – sea level anomaly – large space/time scales



Figure : modeled-observed cost - sea level anomaly - pointwise



Figure : observed log(variance) – sea level anomaly (m^2) – large space/time scales



Figure : observed log(variance) – sea level anomaly (m^2) – pointwise



Figure : modeled log(variance) – sea level anomaly (m^2) – large space/time scales



Figure : modeled log(variance) – sea level anomaly (m^2) – pointwise

fit to sst data



Figure : modeled-REMSS rms - sea surface temperature (K)

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fit to sst data



Figure : ECCO and REMSS zonal mean sst anomalies (K)

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Figure : modeled-observed rms - bottom pressure (cm)



Figure : rms modeled – bottom pressure (cm)



Figure : rms observed – bottom pressure (cm)



Figure : Cost function



Figure : modeled-observed rms - sea ice concentration

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Figure : observed std - sea ice concentration



Figure : modelled std - sea ice concentration



Figure : ECCO (left) and NSIDC (right, gsfc bootstrap) ice concentration in March (top) and September (bottom).



Figure : ECCO (left) and NSIDC (right, gsfc bootstrap) ice concentration in March (top) and September (bottom).



Figure : ECCO (blue) and NSIDC (red, gsfc bootstrap) ice concentration in March and September in Northern Hemisphere (left) and Southern Hemisphere (right)



Figure : ECCO (blue) and NSIDC (red, gsfc bootstrap) ice concentration in March per Southern Ocean sector



Figure : ECCO (blue) and NSIDC (red, gsfc bootstrap) ice concentration in September per Southern Ocean sector

barotropic streamfunction



Figure : 1992-2017 mean – barotropic streamfunction (Sv)

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barotropic streamfunction



Figure : 1992-2017 standard deviation – barotropic streamfunction (Sv)

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meridional streamfunction



Figure : 1992-2017 mean – overturning streamfunction (Sv)

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Figure : 1992-2017 mean – overturning streamfunction incl. GM (Sv)

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Figure : 1992-2017 mean – Atlantic overturning streamfunction (Sv)

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Figure : 1992-2017 mean – Pac+Ind overturning streamfunction (Sv)



Figure : 1992-2017 standard deviation – overturning streamfunction (Sv)



Figure : 1992-2017 standard deviation – Atlantic overturning streamfunction (Sv)

meridional streamfunction (time series)



Figure : annual global overturning at select latitudes at \approx 1000m depth

meridional streamfunction (time series)



Figure : annual Atlantic overturning at select latitudes at \approx 1000m depth (Sv)

meridional heat transport



Figure : 1992-2017 mean - meridional heat transport (PW)

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meridional heat transport



Figure : 1992-2017 standard deviation – meridional heat transport (PW)

meridional freshwater transport



Figure : 1992-2017 mean – meridional freshwater transport (Sv)

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meridional freshwater transport



 $\label{eq:Figure: 1992-2017 standard deviation - meridional freshwater transport (Sv)$

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meridional salt transport



Figure : 1992-2017 mean – meridional salt transport (psu.Sv)

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meridional salt transport



Figure : 1992-2017 standard deviation – meridional salt transport (psu.Sv) ◆□ > ◆□ > ◆臣 > ◆臣 > ─ 臣 ─ のへで

meridional transports (time series)

Meridional Heat Transport (in PW) 80 4 3 2 60 1.5 40 0.7 0.5 20 0.3 0.1 0 -0.1 -0.3 -20 -0.5 -0.7 -40 -1.5 -60 -2 -3 -80 1995 2000 2005 2010 2015

Figure : meridional heat transport (PW, annual mean)

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meridional transports (time series)

80 2 1.5 60 0.75 0.5 40 0.35 0.25 20 0.15 0.05 0 -0.05 -0.15 -20 -0.25 -0.35 -40 -0.5 -0.75 -60 -1 -1.5 -80 -2 1995 2000 2005 2010 2015

Figure : meridional freshwater transport (Sv, annual mean)

Meridional Freshwater Transport (in Sv)

meridional transports (time series)

Meridional Salt Transport (in psu.Sv) 80 20 15 10 60 7.5 5 40 3.5 2.5 20 1.5 0.5 0 -0.5 -1.5 -20 -2.5 -3.5 -40 -5 -7.5 -60 -10 -15 -80 -20 1995 2000 2005 2010 2015

Figure : meridional salt transport (psu.Sv, annual mean)

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Figure : volume transports entering the Arctic (Sv, annual mean)

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Figure : volume transports entering the Atlantic (Sv, annual mean)

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Figure : Gibraltar Overturn (Sv, annual mean)



Figure : ACC volume transports (Sv, annual mean)



Figure : Indonesian Throughflow (Sv, annual mean)

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Figure : 1992-2017 mean – sea surface height (EXCLUDING ice, in m)



Figure : 1992-2017 mean – sea surface height (INCLUDING ice, in m)

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Figure : 1992-2017 standard deviation – sea surface height (EXCLUDING ice, in m)



Figure : 1992-2017 standard deviation – sea surface height (INCLUDING ice, in m)



Figure : 1992-2017 mean - temperature (in degC) at 5m

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Figure : 1992-2017 standard deviation – temperature (in degC) at 5m



Figure : 1992-2017 mean - temperature (in degC) at 105m

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Figure : 1992-2017 standard deviation – temperature (in degC) at 105m



Figure : 1992-2017 mean - temperature (in degC) at 300m

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Figure : 1992-2017 standard deviation – temperature (in degC) at 300m



Figure : 1992-2017 mean - temperature (in degC) at 910m

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Figure : 1992-2017 standard deviation – temperature (in degC) at 910m



Figure : 1992-2017 mean - temperature (in degC) at 1914m

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Figure : 1992-2017 standard deviation – temperature (in degC) at 1914m



Figure : 1992-2017 mean - temperature (in degC) at 3581m

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Figure : 1992-2017 standard deviation – temperature (in degC) at 3581m



Figure : 1992-2017 mean - salinity (in psu) at 5m

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Figure : 1992-2017 standard deviation - salinity (in psu) at 5m

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Figure : 1992-2017 mean - salinity (in psu) at 105m

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Figure : 1992-2017 standard deviation - salinity (in psu) at 105m

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Figure : 1992-2017 mean - salinity (in psu) at 300m

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Figure : 1992-2017 standard deviation - salinity (in psu) at 300m



Figure : 1992-2017 mean - salinity (in psu) at 910m

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Figure : 1992-2017 standard deviation - salinity (in psu) at 910m

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Figure : 1992-2017 mean - salinity (in psu) at 1914m



Figure : 1992-2017 standard deviation - salinity (in psu) at 1914m



Figure : 1992-2017 mean - salinity (in psu) at 3581m

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Figure : 1992-2017 standard deviation - salinity (in psu) at 3581m



Figure : 1992-2017 mean – vertical velocity (in mm/year) at 15m

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Figure : 1992-2017 standard deviation – vertical velocity (in mm/year) at 15m



Figure : 1992-2017 mean - vertical velocity (in mm/year) at 105m

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Figure : 1992-2017 standard deviation – vertical velocity (in mm/year) at 105m



Figure : 1992-2017 mean - vertical velocity (in mm/year) at 300m

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Figure : 1992-2017 standard deviation – vertical velocity (in mm/year) at 300m



Figure : 1992-2017 mean - vertical velocity (in mm/year) at 910m

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Figure : 1992-2017 standard deviation – vertical velocity (in mm/year) at 910m



Figure : 1992-2017 mean – vertical velocity (in mm/year) at 1914m



Figure : 1992-2017 standard deviation – vertical velocity (in mm/year) at 1914m



Figure : 1992-2017 mean – vertical velocity (in mm/year) at 3581m



Figure : 1992-2017 standard deviation – vertical velocity (in mm/year) at 3581m



Figure : 1992-2017 mean – QNET to ocean+ice (W/m²)

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Figure : 1992-2017 mean – QNET to ocean (W/m^2)

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Figure : 1992-2017 standard deviation – QNET to ocean+ice (W/m^2)



Figure : 1992-2017 standard deviation – QNET to ocean (W/m^2)

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Figure : 1992-2017 mean – E-P-R from ocean+ice (mm/day)

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Figure : 1992-2017 mean – E-P-R from ocean (mm/day)



Figure : 1992-2017 standard deviation – E-P-R to ocean+ice (W/m^2)



Figure : 1992-2017 standard deviation – E-P-R to ocean (W/m^2)

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surface wind stress



Figure : 1992-2017 mean - zonal wind stress (N/m²)

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surface wind stress



Figure : 1992-2017 mean – meridional wind stress (N/m²)

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surface wind stress



Figure : 1992-2017 standard deviation – tauZ (W/m^2)

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surface wind stress



Figure : 1992-2017 standard deviation – tauM (W/m²)

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zonal mean tendencies



Figure : 1992-2017 , last year minus first year – zonal mean temperature (degC; top) and salinity (psu; bottom)

equatorial sections





Figure : 1992-2017 mean – equator temperature (degC;top) and zonal velocity (m/s;bottom)

global mean properties



Figure : global mean T (degC; top) and S (psu; bottom)

global mean properties

1995



Figure : global mean temperature (K; top) and salinity (psu; bottom) minus first year

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 199
 2000
 2005

 1995
 2000
 2015



mean S minus first year (psu) at lat ~ 75



zonal mean properties (surface)



Figure : zonal mean temperature (degC; top) and salinity (psu; bottom) minus first year (psu) at 5m depth

zonal mean properties (surface)



Figure : zonal mean SSH (m, uncorrected free surface) minus first year, including ice (top) and below ice (bottom)

zonal mean properties (surface)



Figure : zonal mean ice concentration (no units) and mixed layer depth (m) $% \left(m\right) =\left(m\right) \left(m\right)$



Figure : sea ice cover (in $10^{12}m^2$) in northern (top) and southern (bottom) hemisphere



Figure : sea ice volume (in $10^{12}m^3$) in northern (top) and southern (bottom) hemisphere

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Figure : snow volume (in $10^{12}m^3$) in northern (top) and southern (bottom) hemisphere

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Figure : sea ice thickness (in m) in northern (top) and southern (bottom) hemisphere

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Figure : snow thickness (in m) in northern (top) and southern (bottom) hemisphere



Figure : 1992-2017 global (upper) north (mid) and south (lower), mass budget (ocean+ice) in kg/m^2 .



Figure : 1992-2017 global (upper) north (mid) and south (lower), mass budget (ice only) in kg/m^2 .



Figure : 1992-2017 global (upper) north (mid) and south (lower), mass budget (ocean only) in kg/m^2 .



Figure : 1992-2017 global (upper) north (mid) and south (lower), heat budget (ocean+ice) in J/m^2 .



Figure : 1992-2017 global (upper) north (mid) and south (lower), heat budget (ice only) in $J/m^2. \label{eq:source}$



Figure : 1992-2017 global (upper) north (mid) and south (lower), heat budget (ocean only) in J/m^2 .



Figure : 1992-2017 global (upper) north (mid) and south (lower), salt budget (ocean+ice) in g/m^2 .



Figure : 1992-2017 global (upper) north (mid) and south (lower), salt budget (ice only) in g/m^2 .



Figure : 1992-2017 global (upper) north (mid) and south (lower), salt budget (ocean only) in g/m^2 .



Figure : 1992-2017 global (upper) north (mid) and south (lower), mass budget (ocean only) in kg/m^2 .



Figure : 1992-2017 global (upper) north (mid) and south (lower), heat budget (ocean only) in J/m^2 .



Figure : 1992-2017 global (upper) north (mid) and south (lower), salt budget (ocean only) in g/m^2 .

mixed layer depth fields



Figure : 1992-2017 March mean – mixed layer depth per Kara formula (m)

mixed layer depth fields



Figure : 1992-2017 March mean – mixed layer depth per Suga formula (m)


Figure : 1992-2017 March mean – mixed layer depth per Boyer M. formula (m)



Figure : 1992-2017 September mean – mixed layer depth per Kara formula (m)



Figure : 1992-2017 September mean – mixed layer depth per Suga formula (m)



Figure : 1992-2017 September mean – mixed layer depth per Boyer M. formula (m)

Monthly Thickness Distribution



Figure : 1992-2017 Northern Hemisphere : monthly mean ice (top) and snow (bottom) thickness distribution (in $log(m^2)$)

Monthly Thickness Distribution



Figure : 1992-2017 Southern Hemisphere : monthly mean ice (top) and snow (bottom) thickness distribution (in $log(m^2)$)



Figure : 1992-2017 March mean – ice concentration (unitless)

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Figure : 1992-2017 March mean – ice thickness (m)



Figure : 1992-2017 March mean – snow thickness (m)



Figure : 1992-2017 March mean – ice+snow streamfunction (megaton/s)



Figure : 1992-2017 March mean – ice+snow convergence (kiloton/s)



Figure : 1992-2017 September mean – ice concentration (unitless)



Figure : 1992-2017 September mean – ice thickness (m)

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Figure : 1992-2017 September mean - snow thickness (m)

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Figure : 1992-2017 September mean – ice+snow streamfunction (megaton/s)



Figure : 1992-2017 September mean – ice+snow convergence (kiloton/s)



Figure : 1992-2017 March mean – ice concentration (unitless)



Figure : 1992-2017 March mean – ice thickness (m)



Figure : 1992-2017 March mean – snow thickness (m)

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Figure : 1992-2017 March mean – ice+snow streamfunction (megaton/s)



Figure : 1992-2017 March mean – ice+snow convergence (kiloton/s)



Figure : 1992-2017 September mean – ice concentration (unitless)



Figure : 1992-2017 September mean – ice thickness (m)

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Figure : 1992-2017 September mean - snow thickness (m)

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Figure : 1992-2017 September mean – ice+snow streamfunction (megaton/s)



Figure : 1992-2017 September mean – ice+snow convergence (kiloton/s)