

Climate and seasonal forecast quality impact of increased horizontal ocean resolution

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s2d conference, Toulouse
13th - 16th May, 2013

Setup of experiments

- IFS + NEMO + LIM3 + HTESSEL coupled through the OASIS3 coupler.
- Five-member ensemble re-forecasts started each year on the first of May and November over the period 1993 to 2009, running for four months.
* Results shown for [1993,2006].

- ICs

- Atmosphere: ERA Interim.
- Ocean and sea-ice: GLORYSv1 (ORCA025L75).

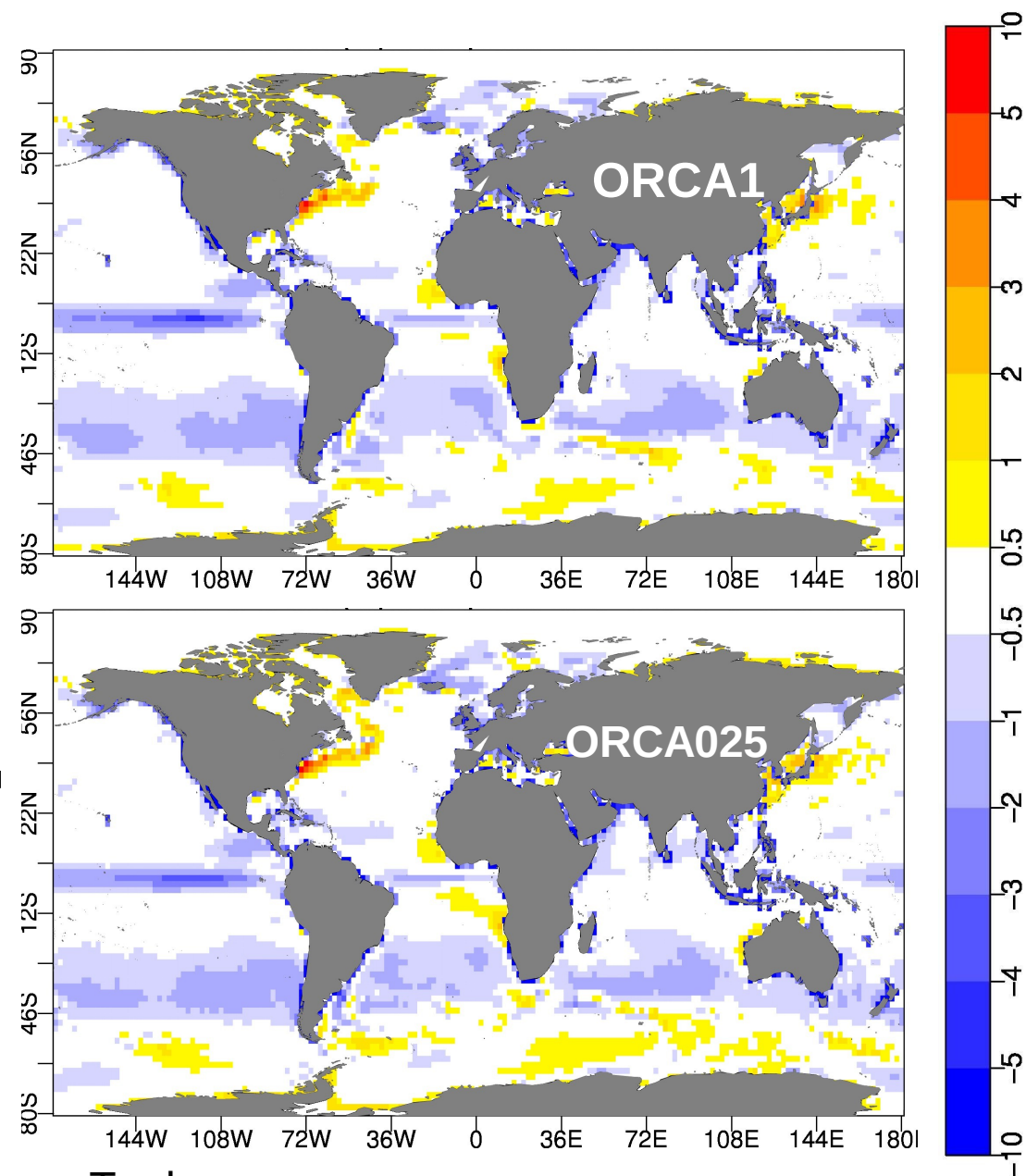
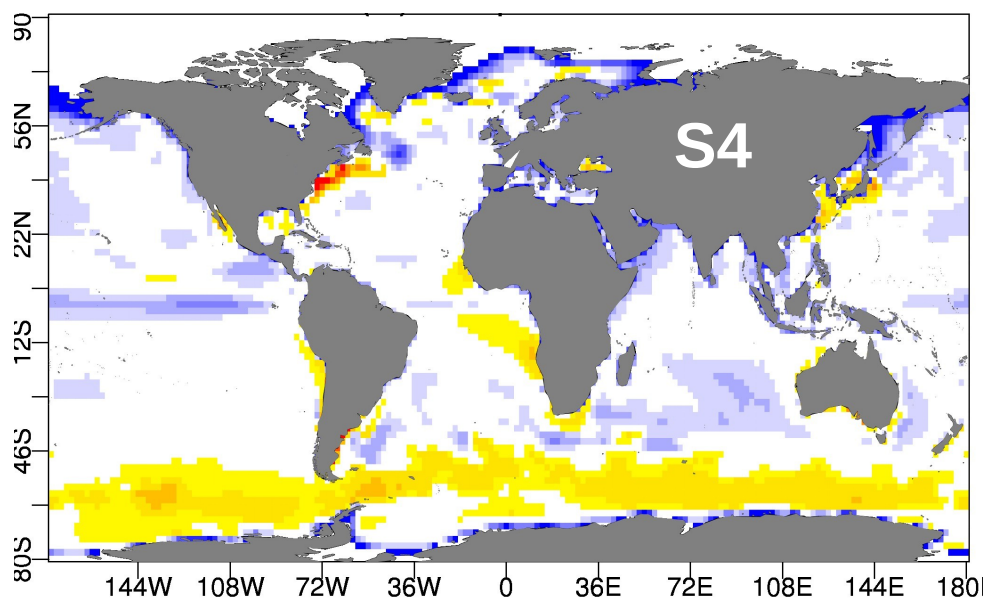
- Two configurations:

Atmospheric model	Ocean model	Sea-ice model
IFST255L62	ORCA1L46	LIM2
<i>idem</i>	ORCA025L46	<i>idem</i>

- Comparing to ECMWF S4: Ocean initialized with NEMOVAR.

SST (K) - Systematic error, Nov start-dates forecast months 2-4

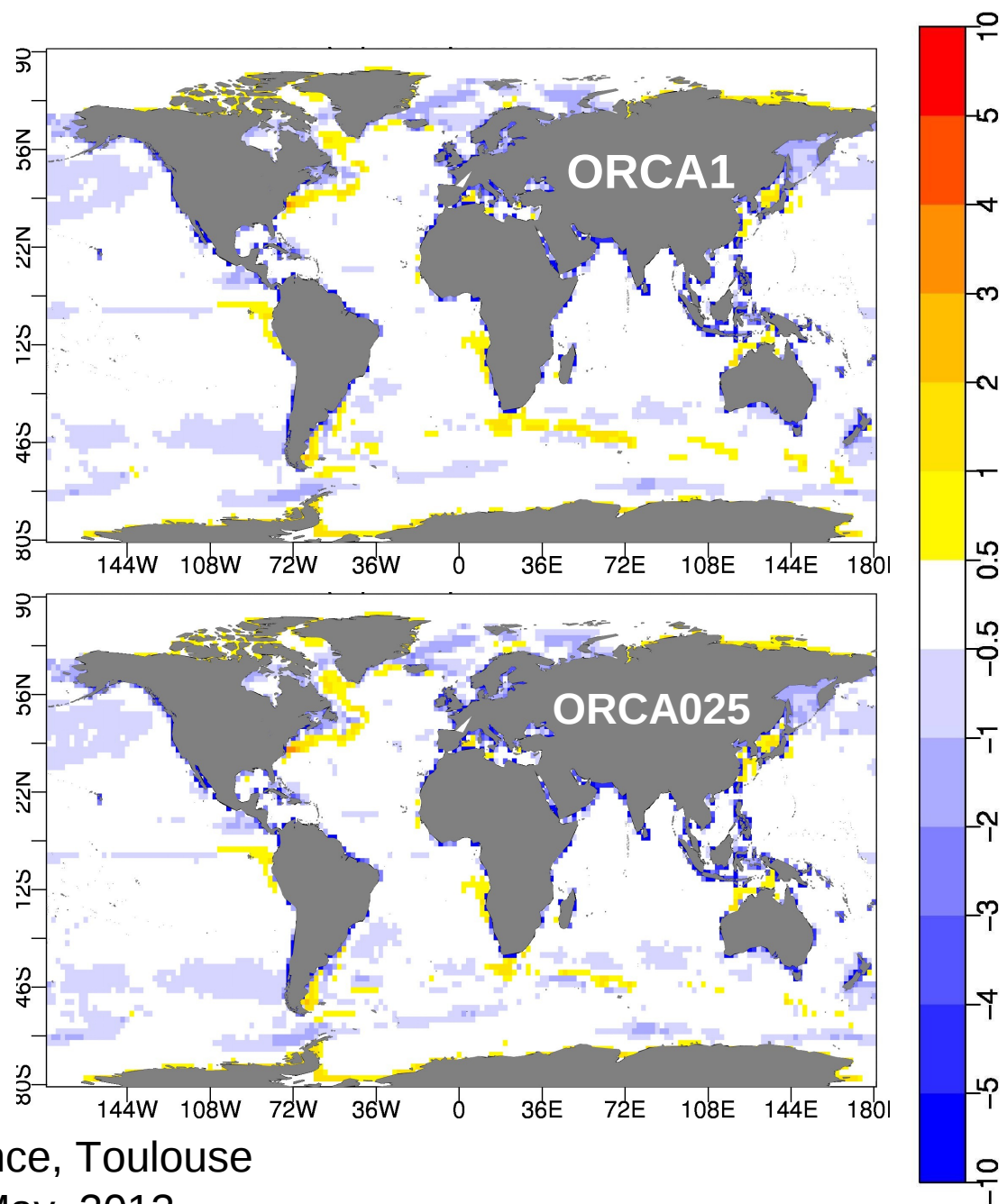
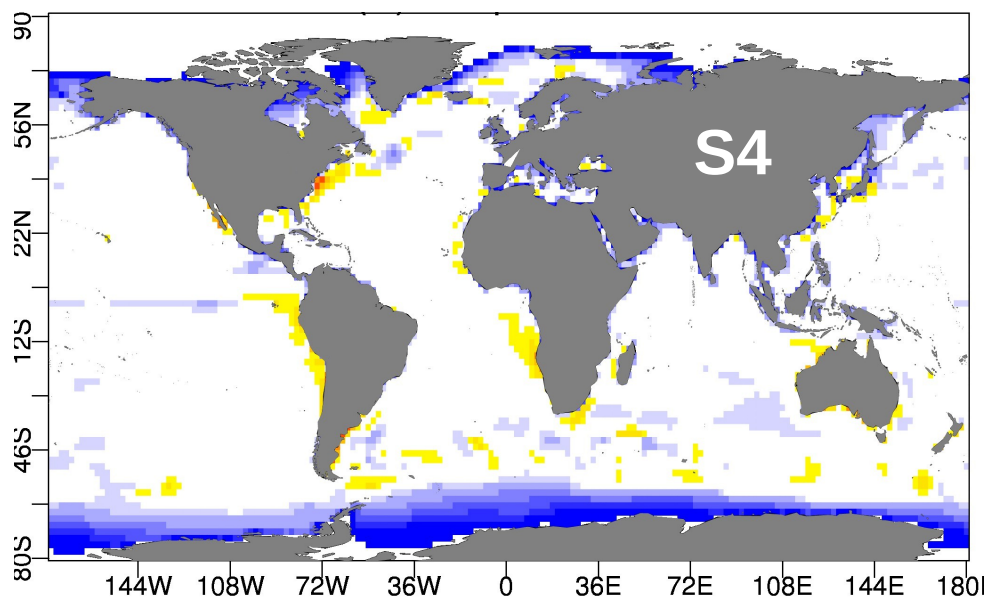
Reference data set: ERSST
Base period: [1993,2006]



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SST (K) - systematic error Nov. start-dates forecast month 1

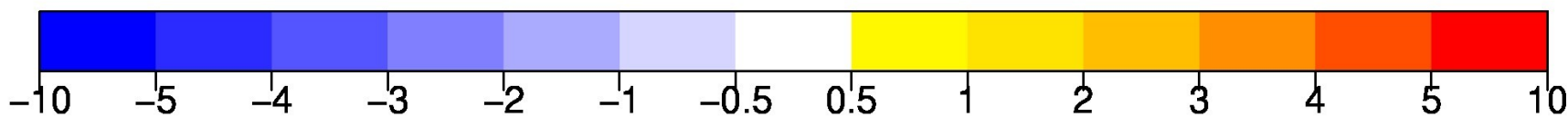
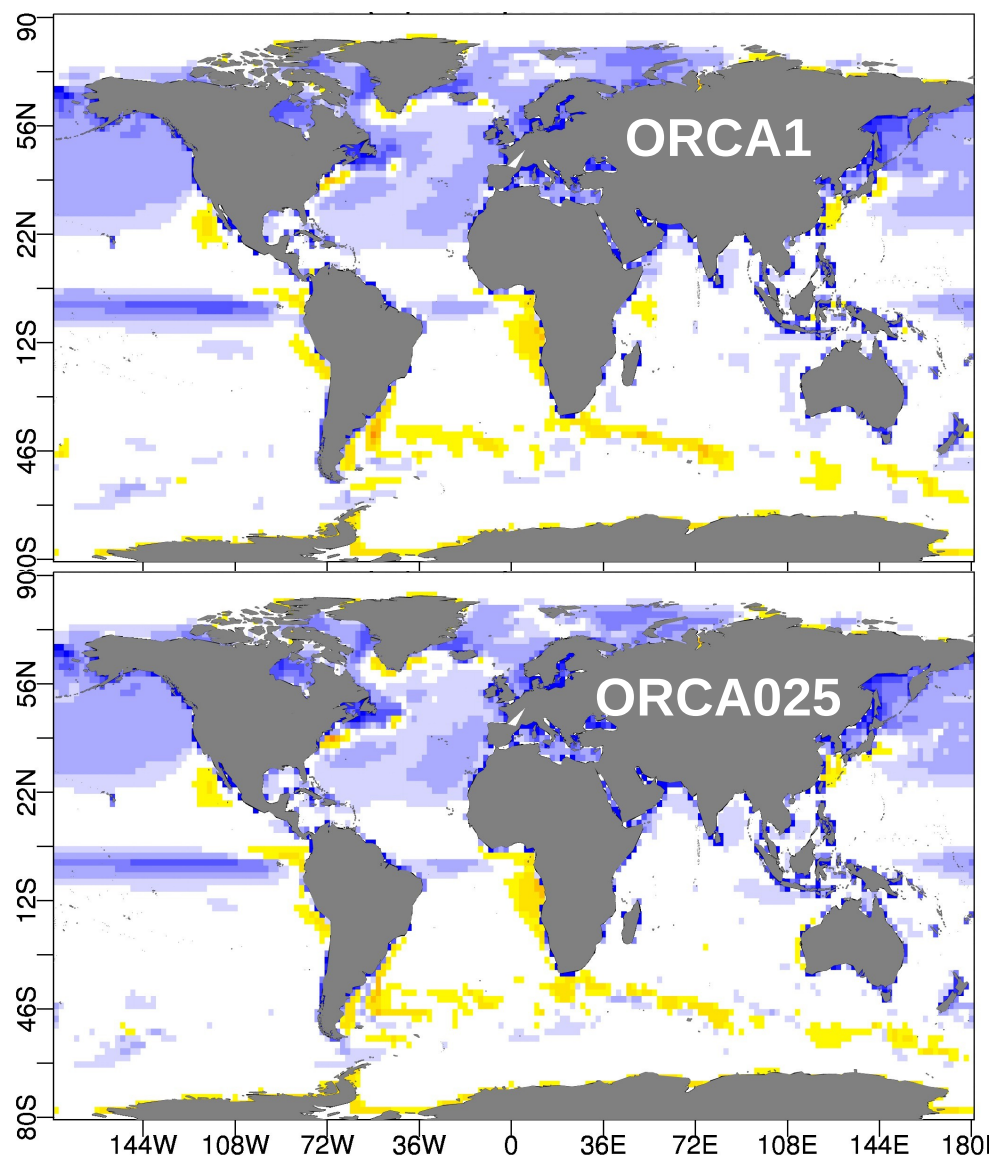
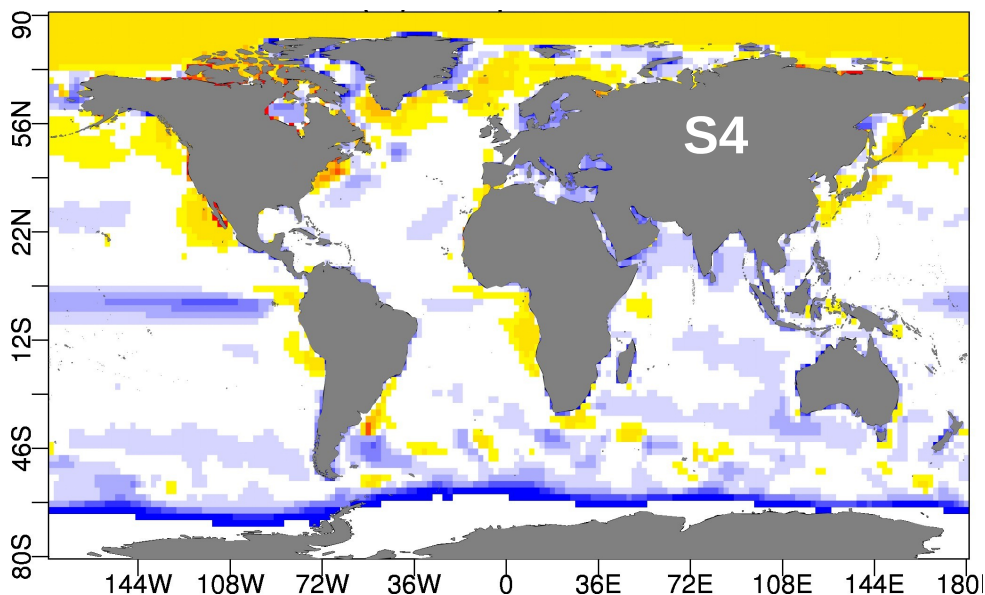
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SST (K) - Systematic error, May start-dates forecast months 2-4

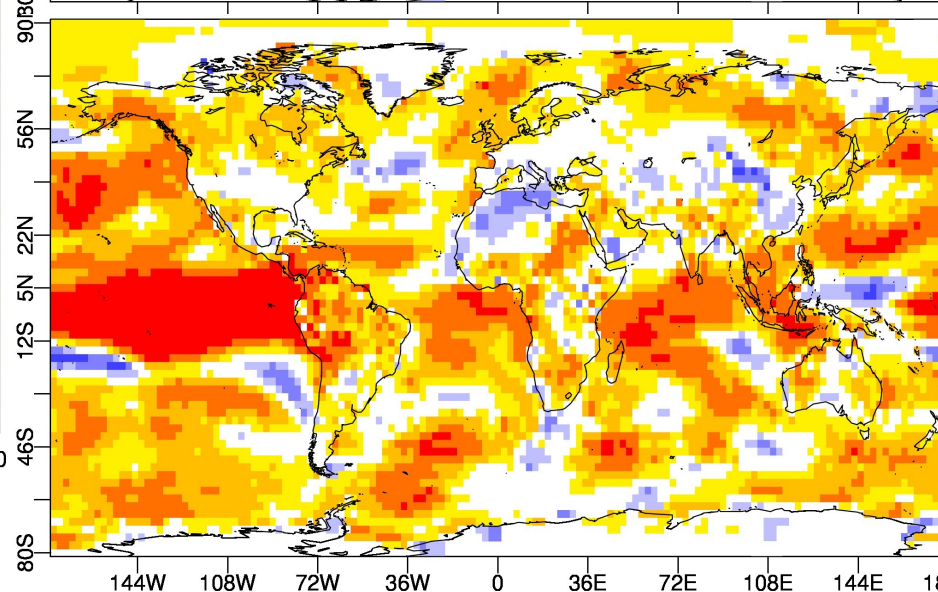
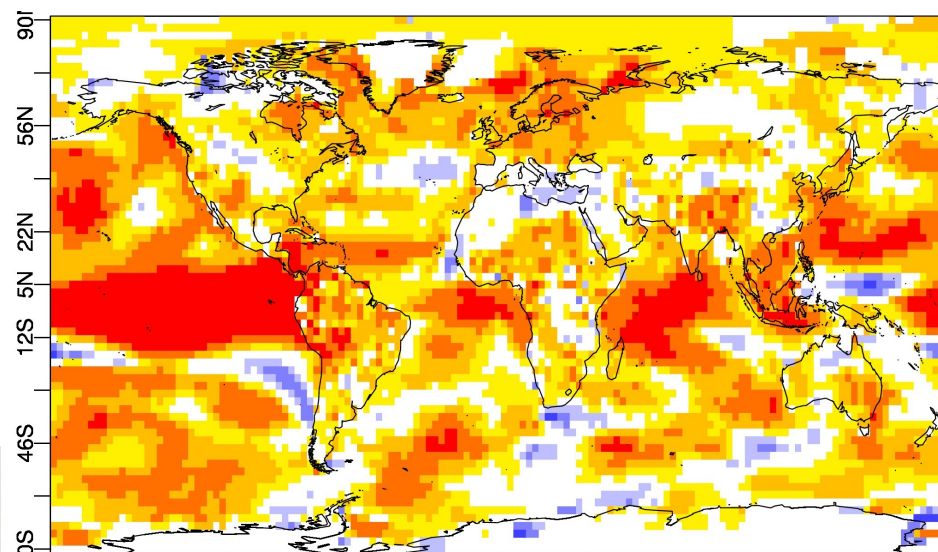
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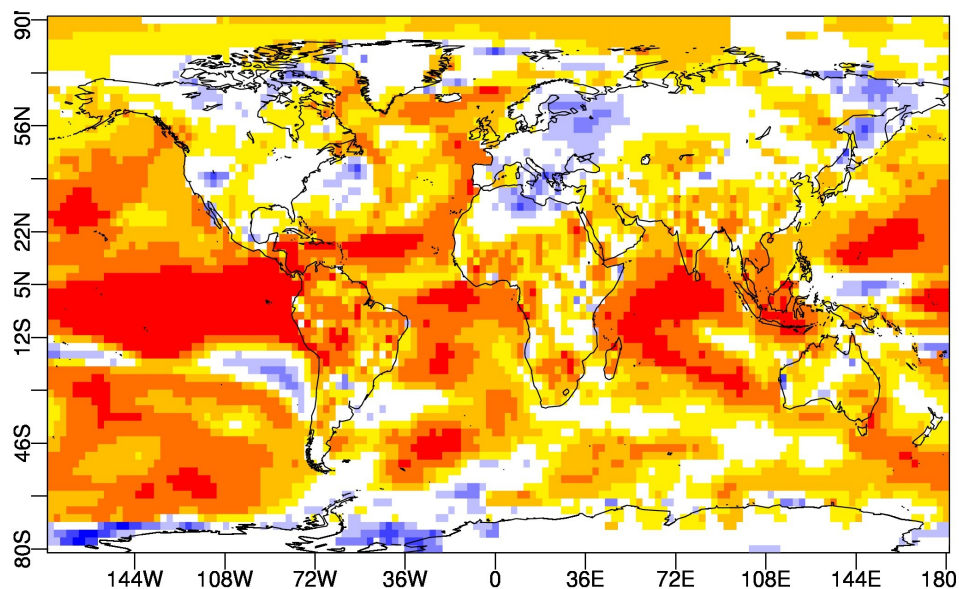
t_{air} - skill for Nov start-dates forecast months 2-4

Reference data set
ERSST + GHCN
Base period:
[1993,2006]

ORCA1



S4



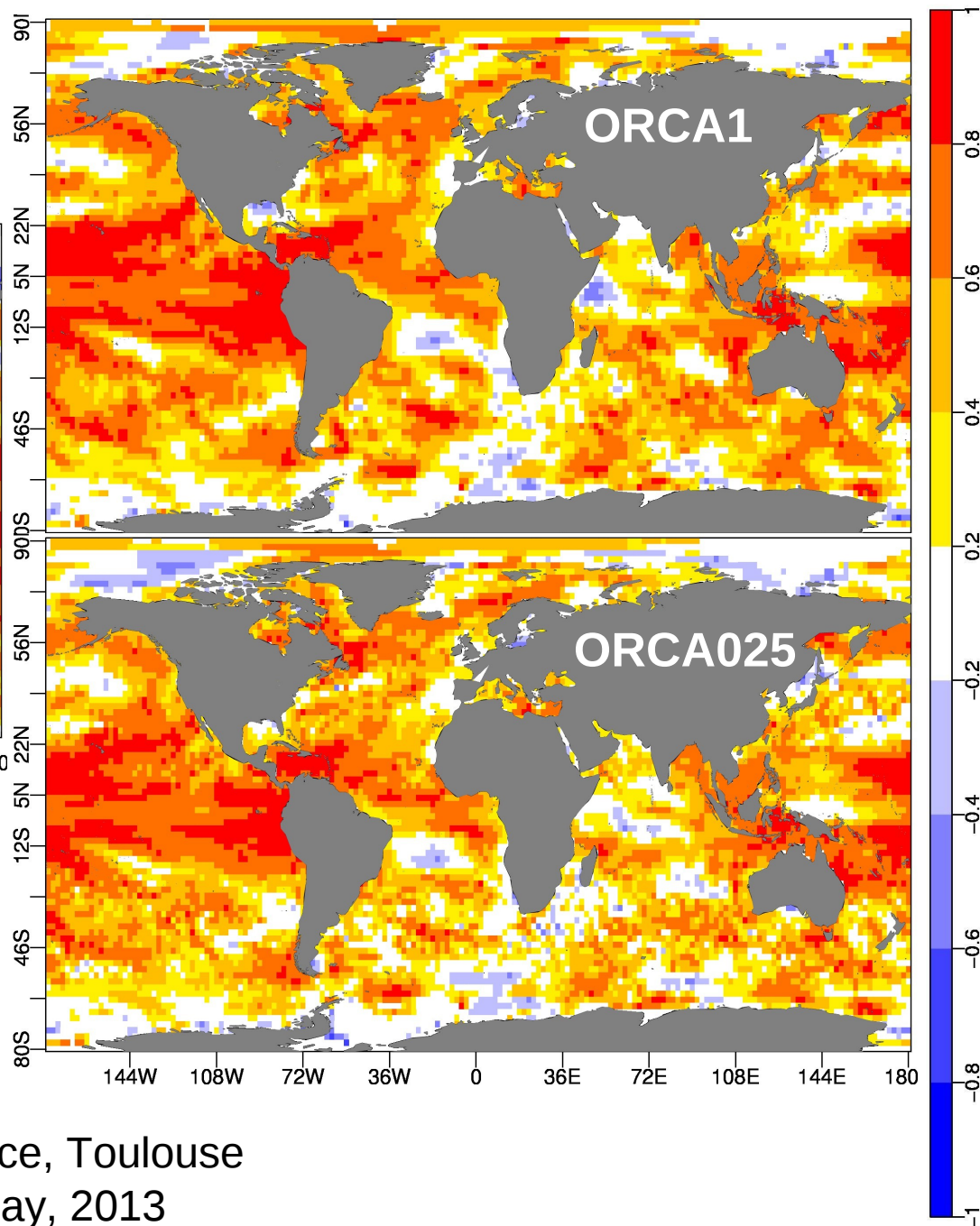
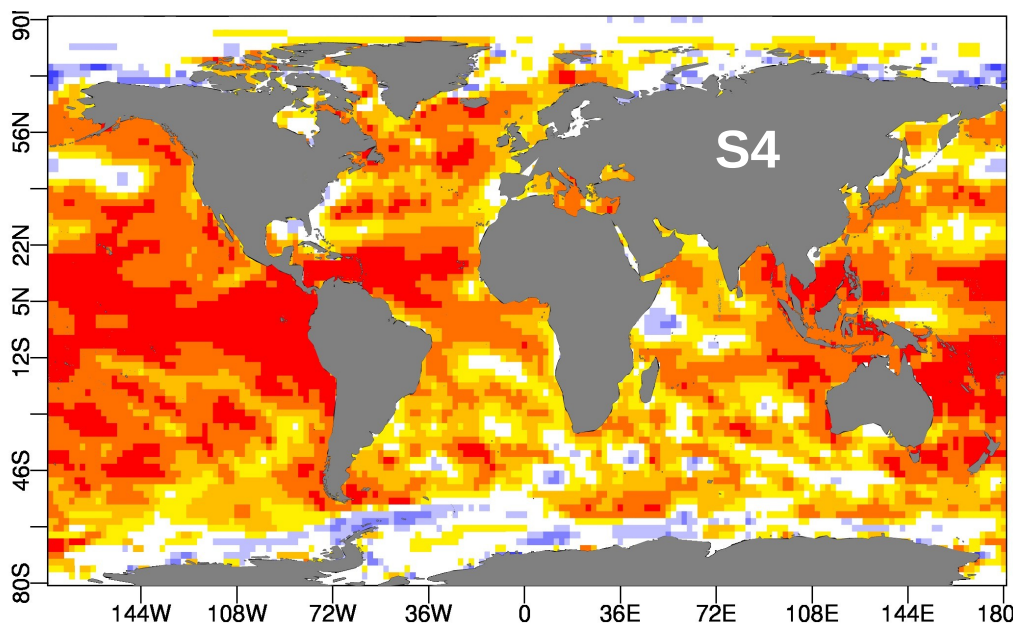
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ORCA025

SST skill – May start-dates forecast months 2-4

Reference data set: ERSST

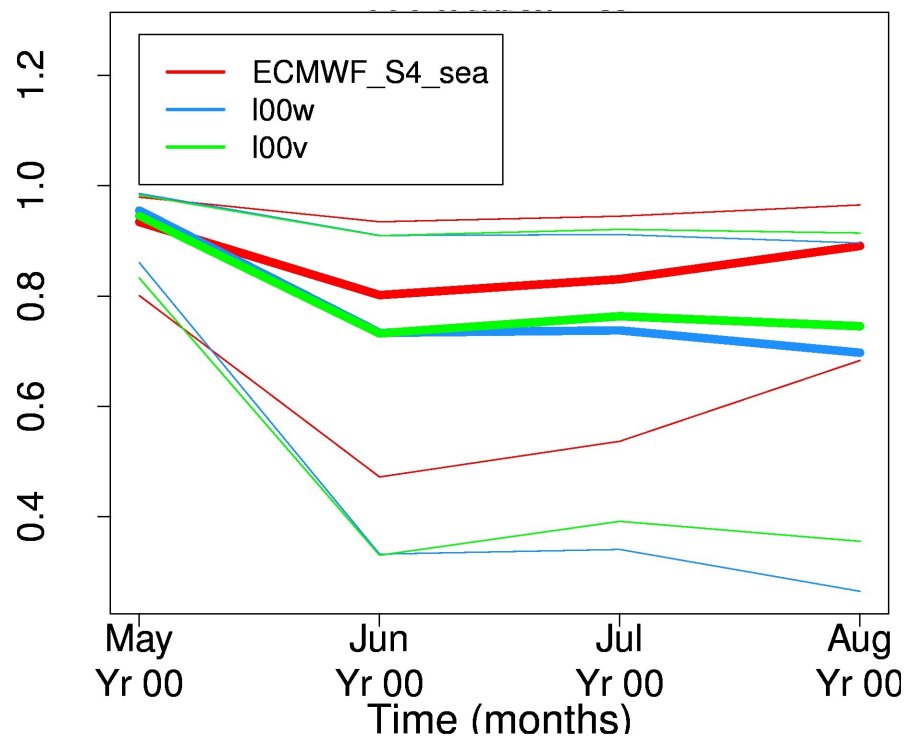
Base period: [1993,2006]



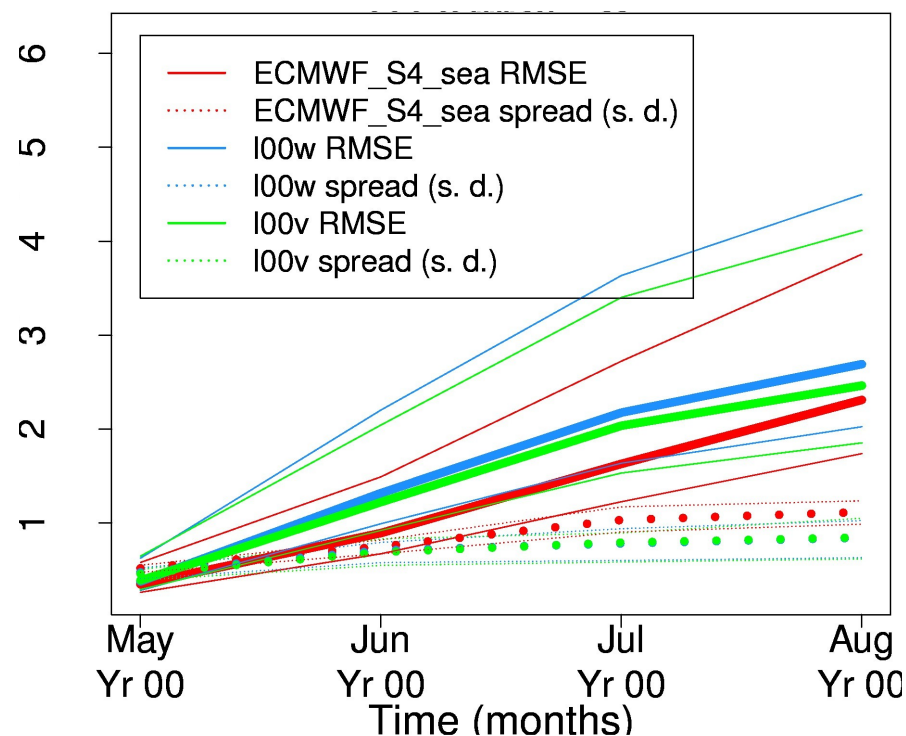
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Niño3.4 region – May start-dates

Ensemble mean correlation



RMS & spread



Reference data set: [ERSST](#)

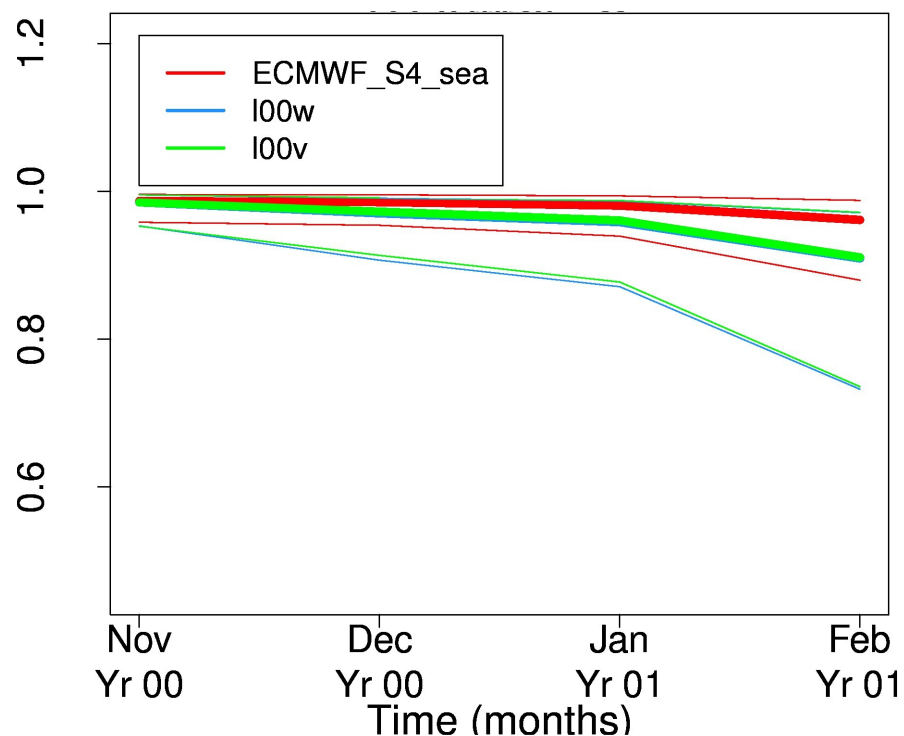
Base period: [\[1993,2006\]](#)

Niño3.4 = [\[170 W,120 W\]](#), [\[5 S,5 N\]](#)

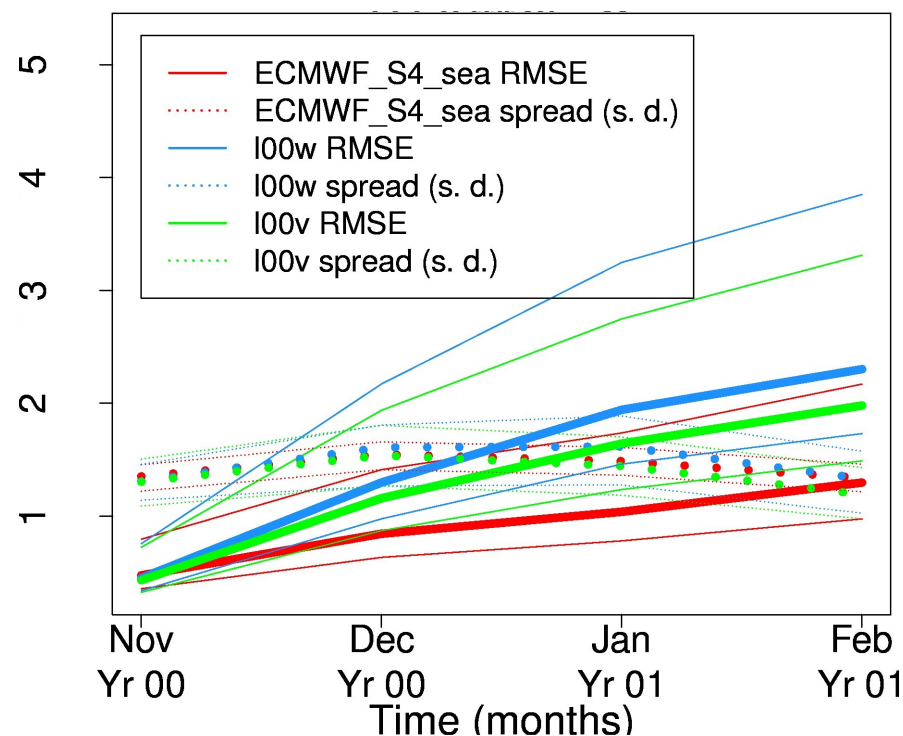
I00w \equiv ORCA1
I00v \equiv ORCA025

Niño3.4 region – Nov start-dates

Ensemble mean correlation



RMS & spread



Reference data set: [ERSST](#)

Base period: [\[1993,2006\]](#)

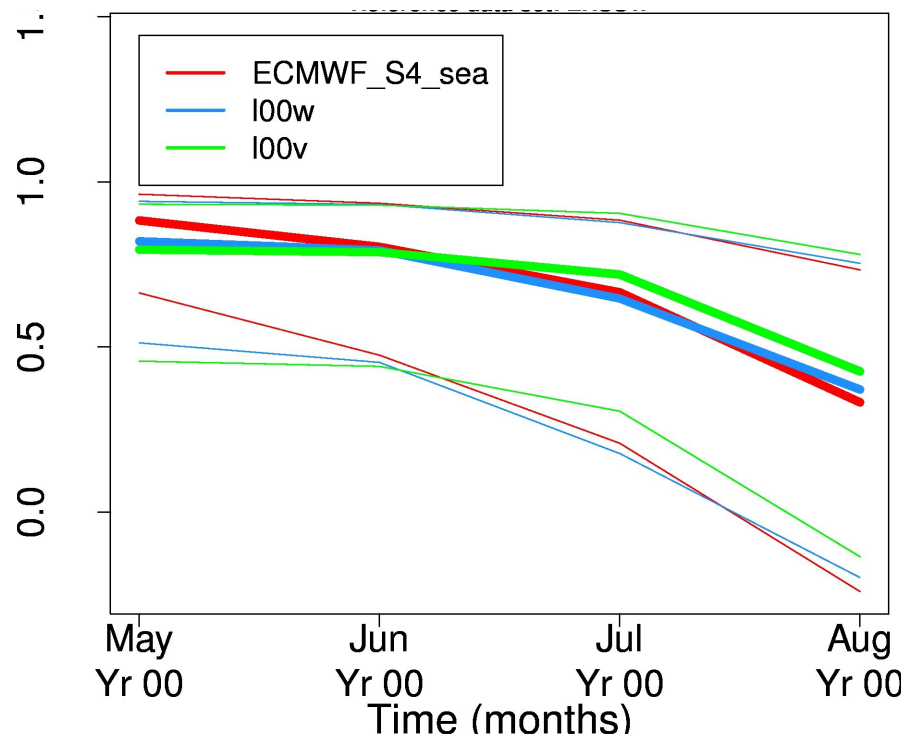
Niño3.4 = [\[170 W,120 W\], \[5 S,5 N\]](#)

I00w \equiv ORCA1

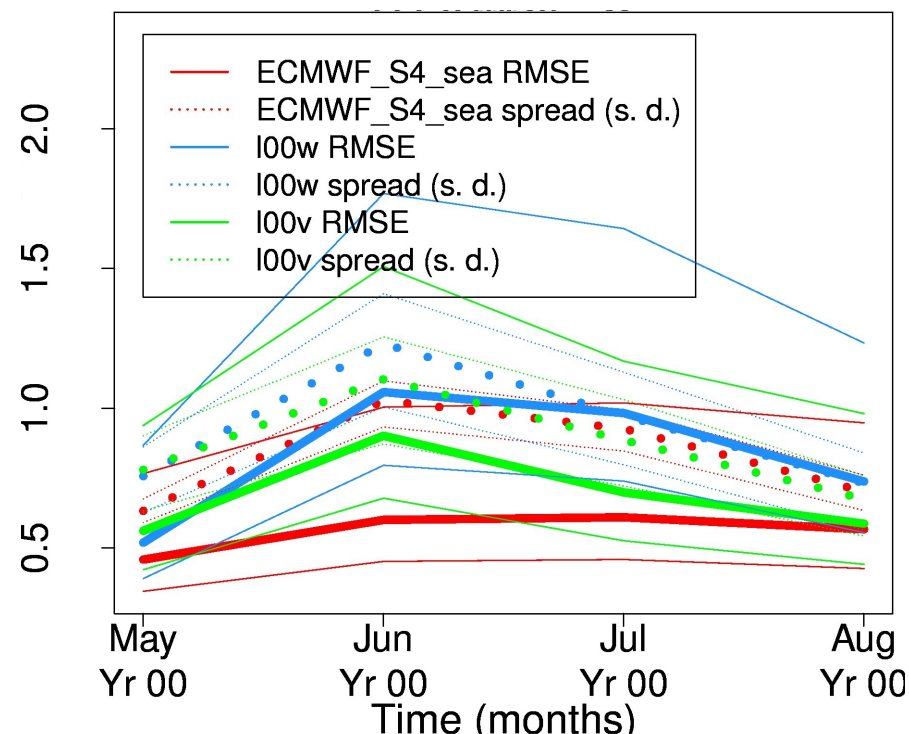
I00v \equiv ORCA025

Atl3 region – May start-dates

Ensemble mean correlation



RMS & spread

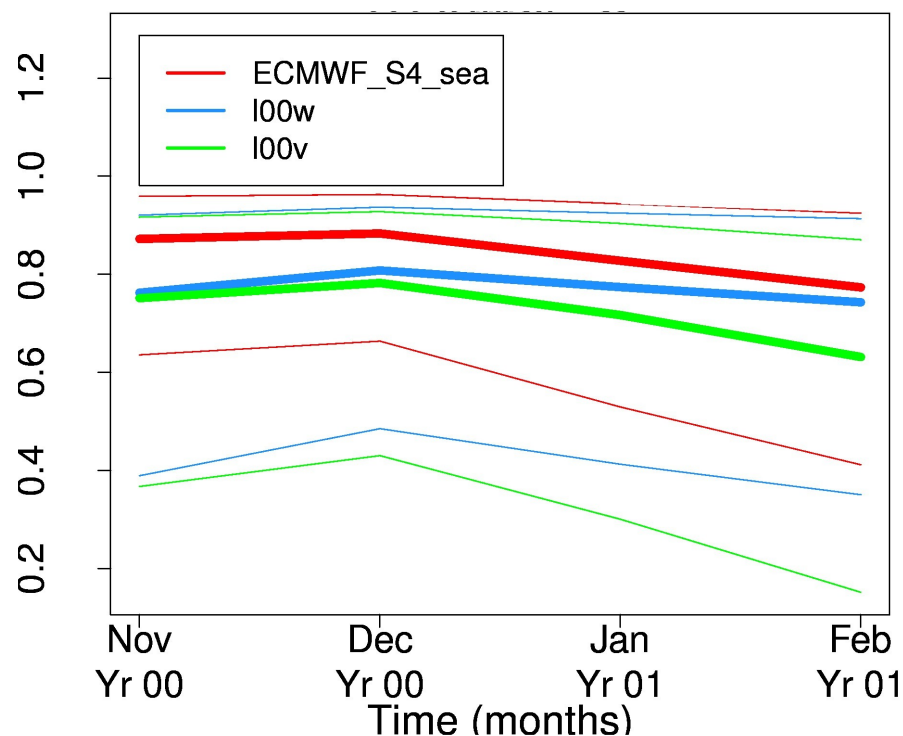


Reference data set: [ERSST](#)
 Base period: [\[1993,2006\]](#)
 ATL3 = [\[20 W,0 E\],\[3 S,3 N\]](#)

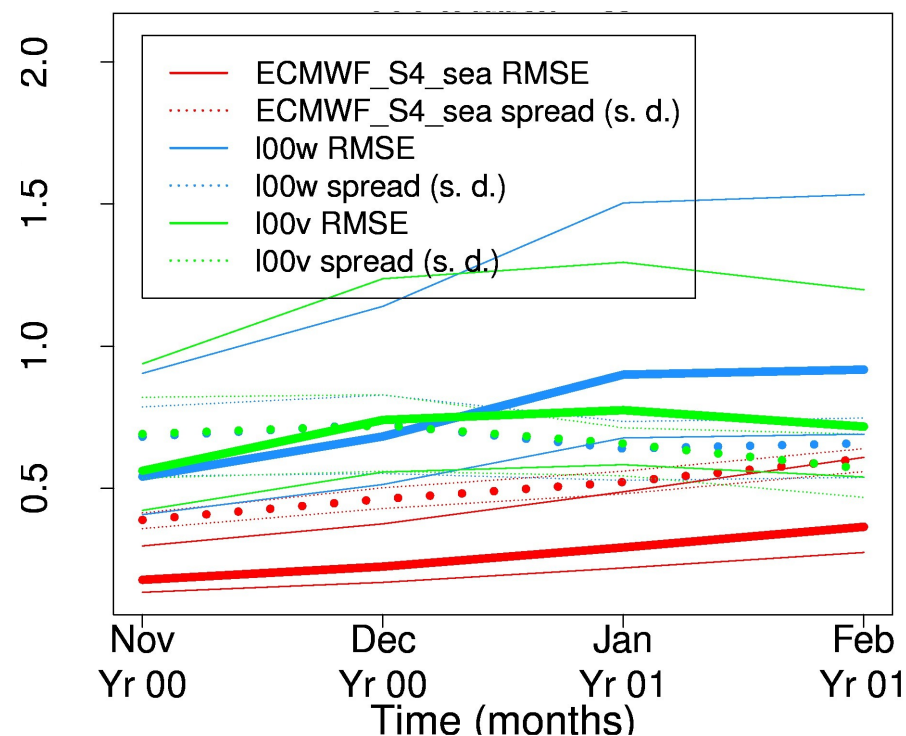
I00w \equiv ORCA1
 I00v \equiv ORCA025

Atl3 region – Nov start-dates

Ensemble mean correlation



RMS & spread

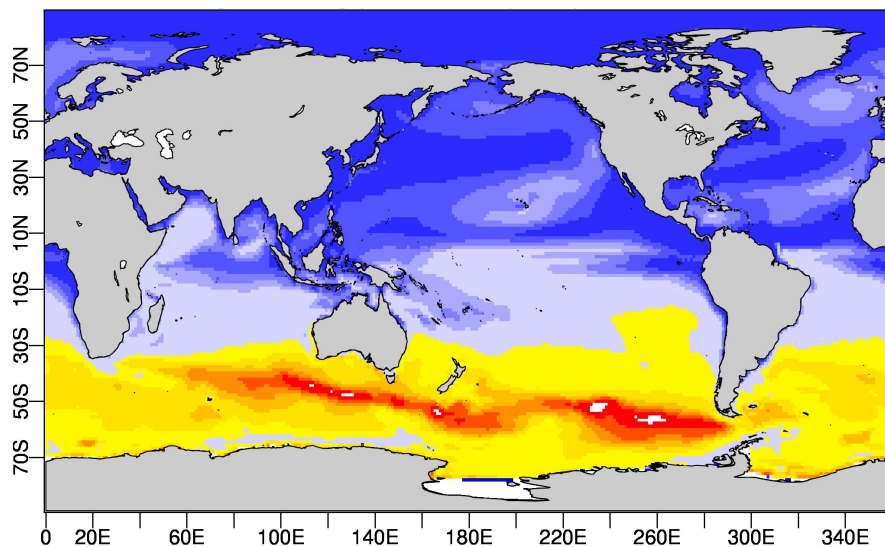


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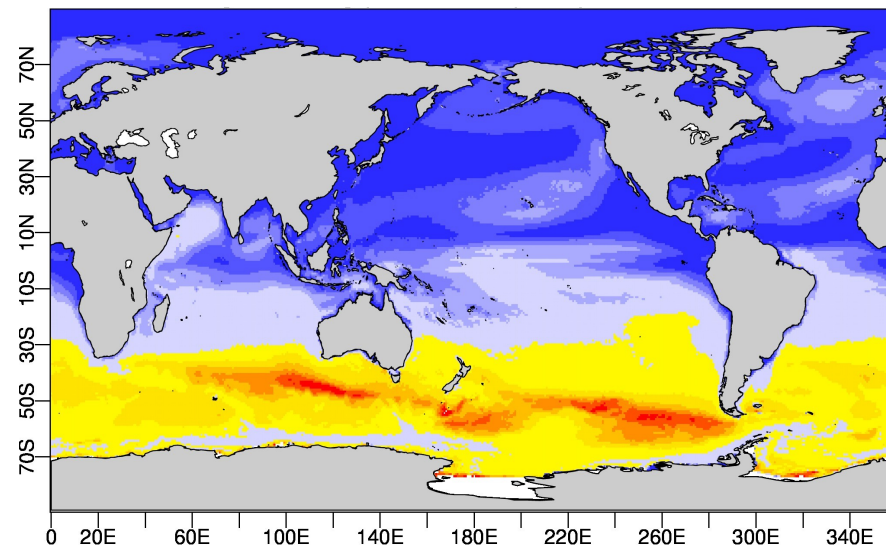
I00w \equiv ORCA1
 I00v \equiv ORCA025

Mixed Layer Depth (m) forecast month 4 – May start date (target Aug)

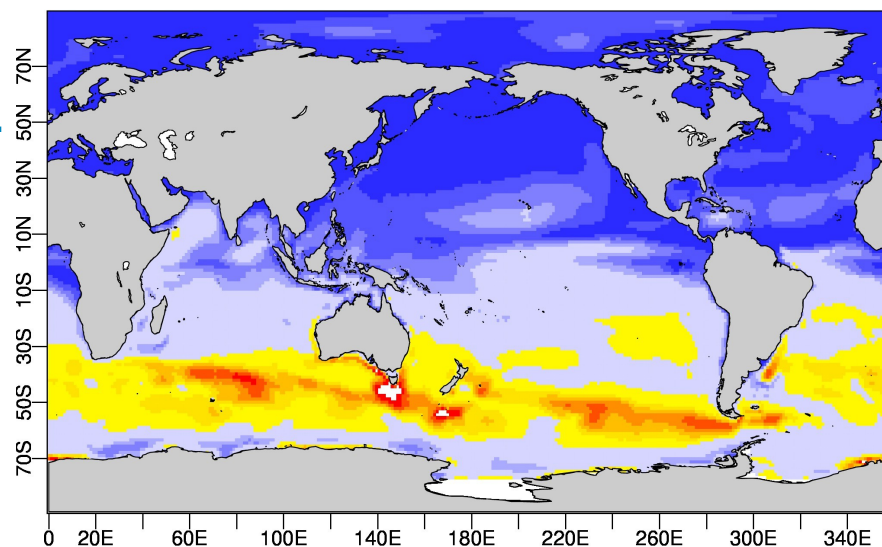
ORCA1



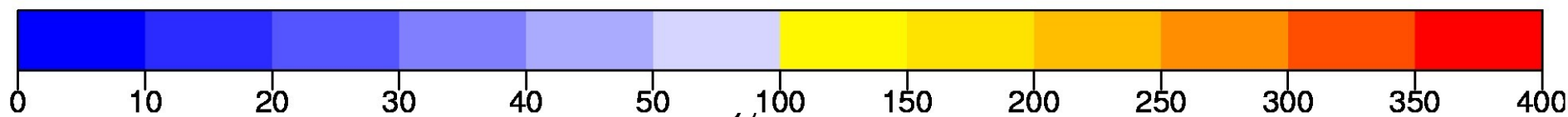
ORCA025



NEMOVAR_S4

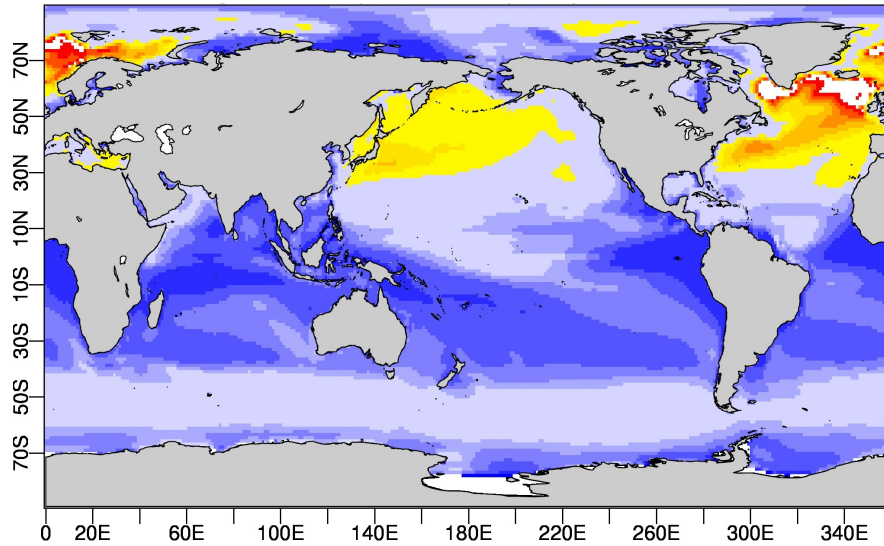


Base period: [1993,2006]

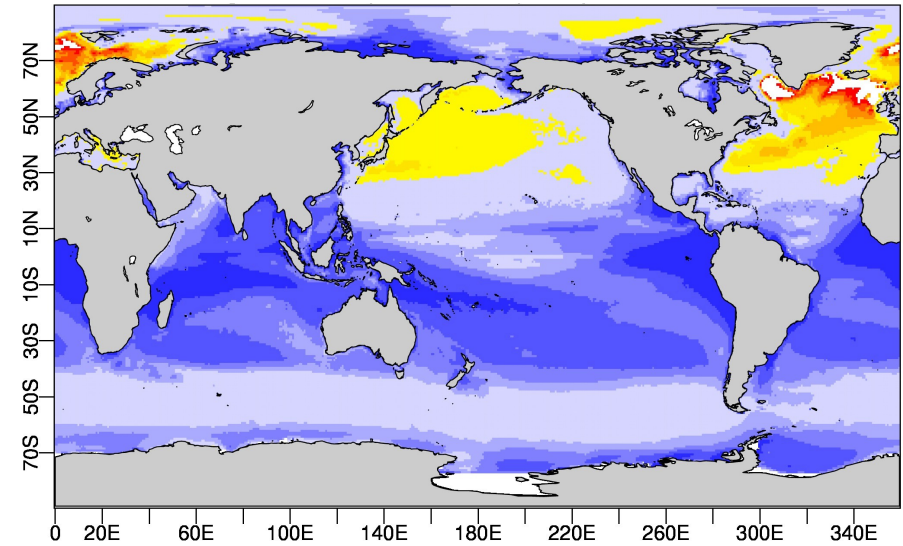


Mixed Layer Depth (m) forecast month 4 – Nov start date (target Feb)

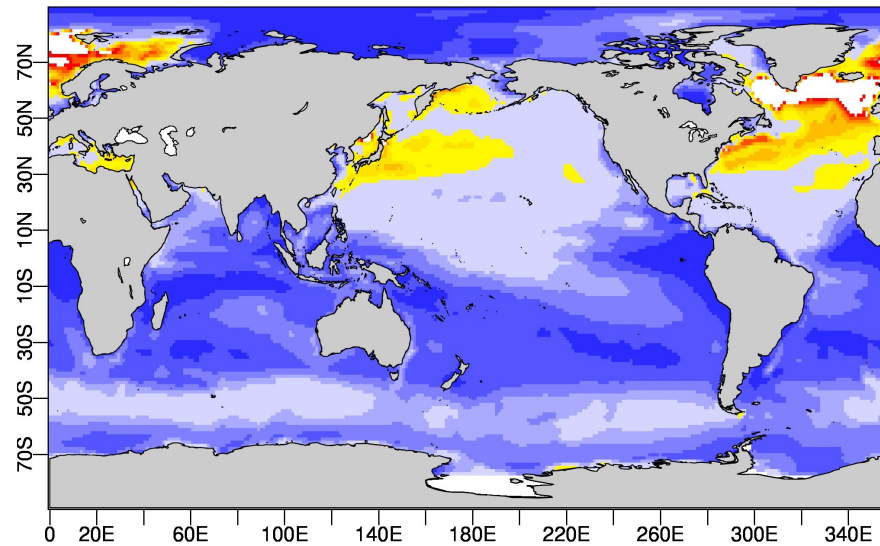
ORCA1



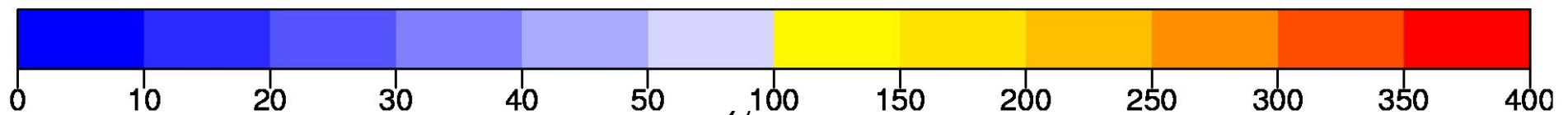
ORCA025



NEMOVAR_S4

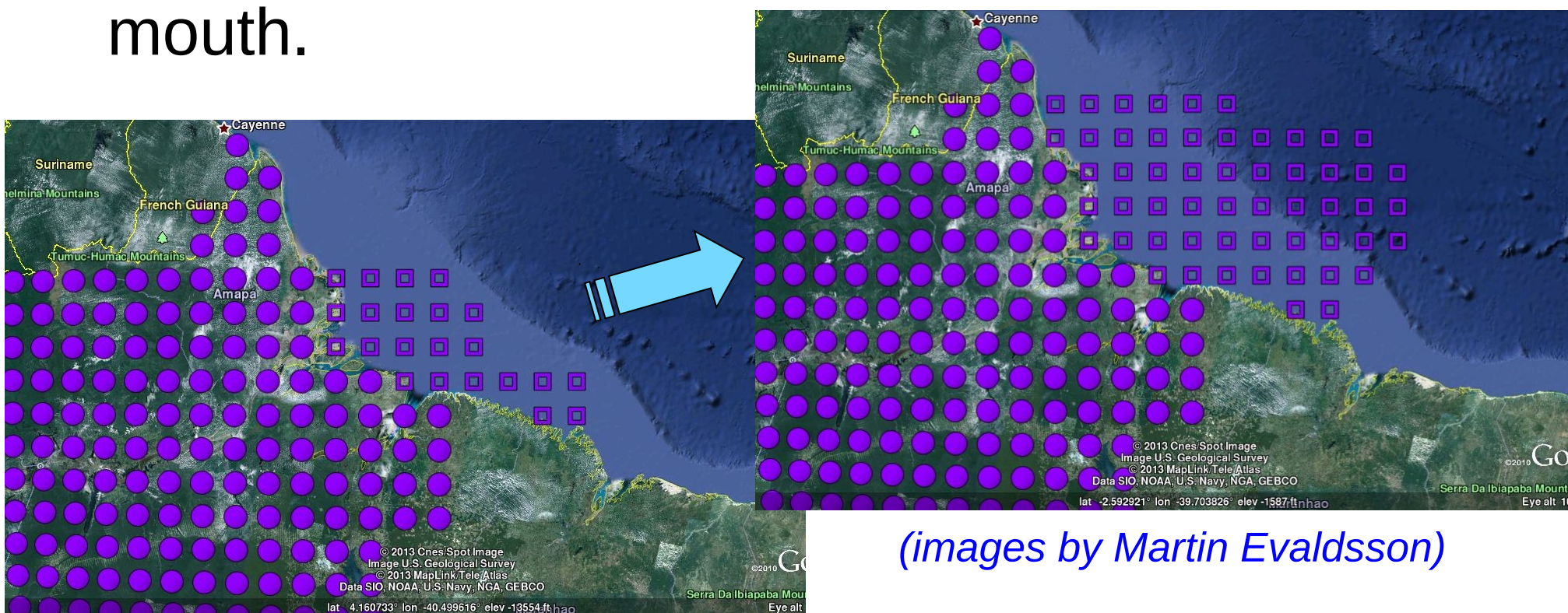


Base period: [1993,2006]



Issues

- Fresh coastal waters leading to negative Sea Surface Salinity (SSS).
- Intense freshwater outflow in the Amazon mouth.



Planned work

- Abandon ORCA_{025L46} and focus on ORCA_{025L75} configuration.
- Protocol to decide on EC-Earth3 initialization strategy:
 - i) Run EC-Earth3 in IFS_{T255L62}-ORCA_{025L46} nudging the ocean towards GLORYSv1 monthly averages.
 - restarts for seasonal prediction with EC-Earth3 in ORCA_{025L46} configuration
 - Compare these results to the seasonal prediction runs that used GLORYSv1 ICs.
 - ii) Depending on the outcome of i)
 - ii.a) Perform seasonal predictions with IFS_{T255L91}-ORCA_{025L75} using GLORYSv1 ICs.
 - ii.b) Perform seasonal predictions with IFS_{T255L91}-ORCA_{025L75} using restarts of a nudged ORCA_{025L75} run towards GLORYSv1 monthly averages.

Open questions

- What are our expectations from a higher resolution setup?
 - What is the suitable setup for ORCA025L75 in EC-Earth3?
- How should we assess the impact of a higher resolution?
 - Representation of large-scale features and
 - Mesoscale features in specific areas? (e. g. Tropical Atlantic)
- Will we have to adapt our assessment tools in progressing towards higher-resolution climate/seasonal prediction?
 - GHCN: $0.5^\circ \times 0.5^\circ$; ERSST : $2^\circ \times 2^\circ$; GPCP: $2.5^\circ \times 2.5^\circ$
 - e. g. Is there a data-base with observations that sample the seasonal-to-decadal scales in the upper ocean?

ANALYSES

- Ishii *et al.*, 2003 → resolution?
- Smith and Murphy, JGR, 2007 → resolution?
- EN3: quality controlled subsurface ocean temperature and salinity data (objective analyses) (<http://www.metoffice.gov.uk/hadobs/en3/>) → resolution $\sim 1^\circ \times 1^\circ$

OBSERVATIONS

- What would be the optimal sampling period?

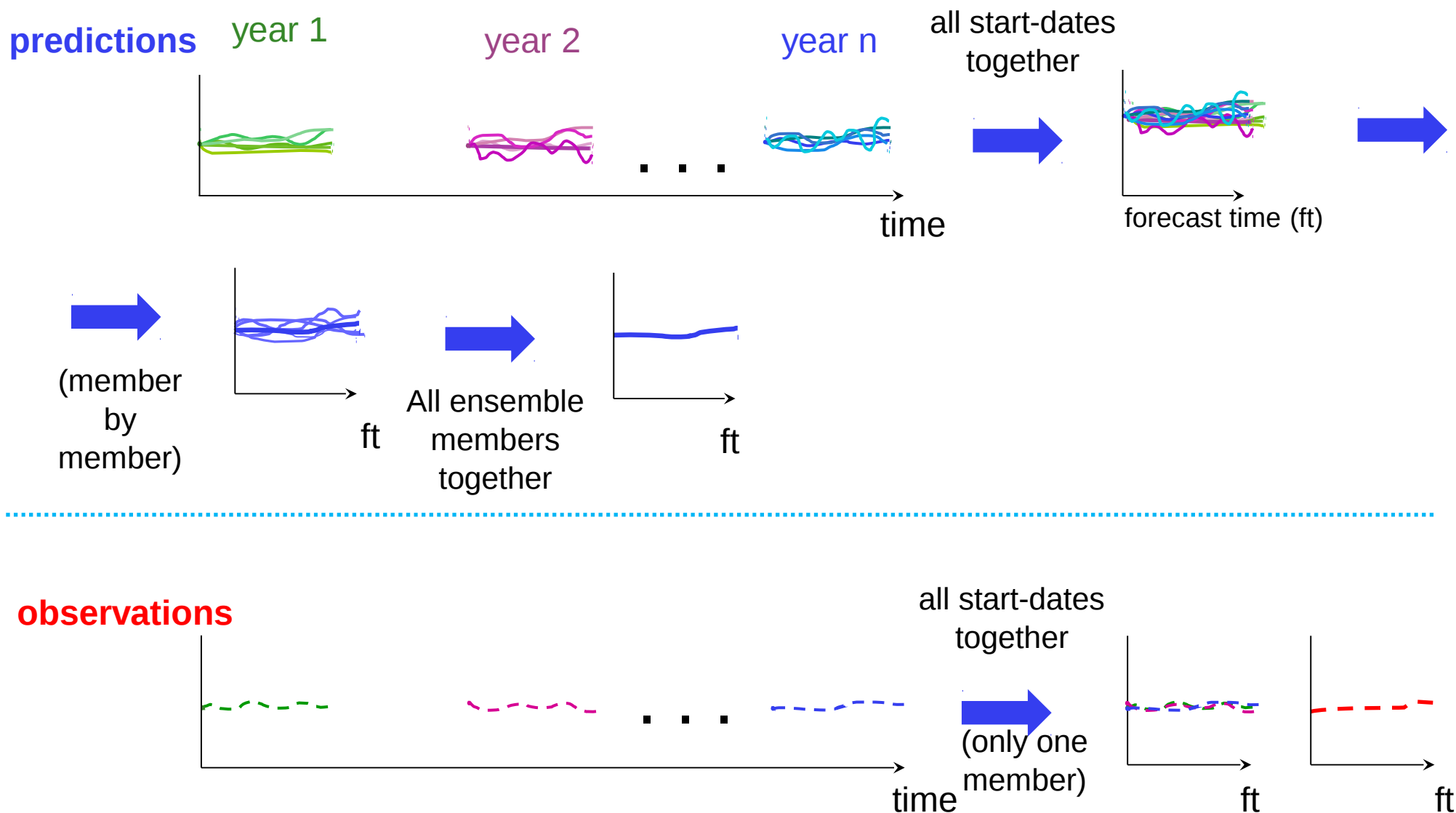


Thank you!



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Computation of climatologies



Computation of skill

