

ERA-CLIM2 Project

Mercator Ocean Contributions to WP2.2

Task 2.2 : Development of assimilation techniques



**Mercator
Ocean**
Ocean Forecasters

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C. Bricaud, G. Ruggiero, ...

WP2 task2.2 : Development of assimilation techniques for improved use of surface observations

MO Sub task : Assimilation of Sea Ice Concentration

Objective: to improve coupled ocean/sea-ice data assimilation.

Developing and testing a scheme that transforms sea-ice concentration to a Gaussian variable during the assimilation process.

Deliverable D2.2 (t0+27+12):

Results from a study

Documented code and library applicable in the context of NEMOVAR.

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→Development of a multivariate sea ice analysis vs univariate sea ice analysis

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First simulations (few months) with a global configuration (1/4, 50lev, NEMO3.1, LIM2-EVP)

... **Validation is still in Progress...and continue on new regional Arctic configuration**

→Use the Arctic-Northern Atlantic Configuration at 1/4°(75lev,CREG4/NEMO3.6/LIM3) coupled with the Mercator Assimilation System (SAM2) and the multivariate/univariate sea ice analysis.

⇒ a low-cost and recent model configuration centred on the Arctic Sea will be more efficient for this study

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→Production of reference simulation using multivariate sea ice analysis with CREG4/NEMO3.6/LIM3

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→Hindcast using the Anamorphosis approach

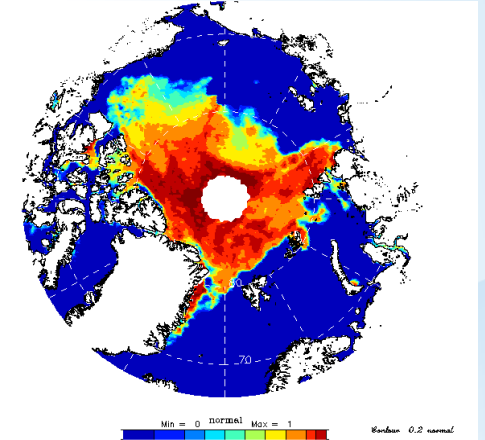
Assimilation of Sea Ice Concentration :

Model

- Nemo 3.1, LIM2-EVP
- Global $\frac{1}{4}$, 50 levels

Assimilation

- Analysis based on a 2D local multivariate SEEK/LETKF filter
- Weakly-coupled DA system using 2 separate analyses :
- Ocean Analysis (SLA, InSitu Data from CORA3.2, SST) , IAU on (h,T,S,U,V)
- Sea Ice Analysis
 - SIC Error: 1% open ocean, linear from 25% to 5% for SIC values between 0.01 and 1
 - Forecast error covariances are built from a prior ensemble of Sea Ice Concentration anomalies => Fixed basis background error
- **Unidata/univariate Sea Ice Analysis vs Multivariate Sea Ice analysis**

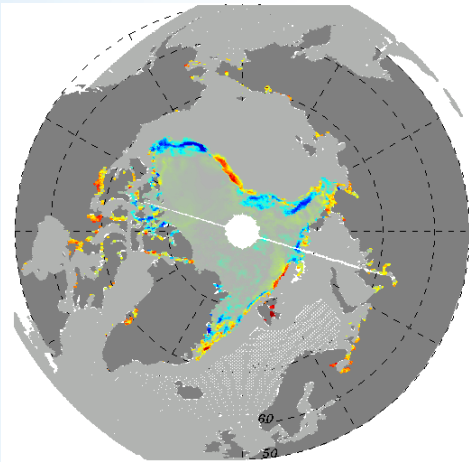


Sea Ice Concentration from CERSAT (IFREMER)

Univariate Sea Ice Analysis

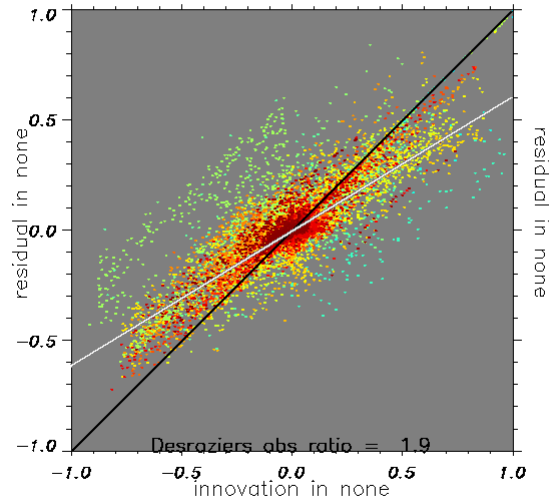
(sept 2007 after 1 year of hindcast experiment)

Sea Ice Concentration Innovation CERSAT

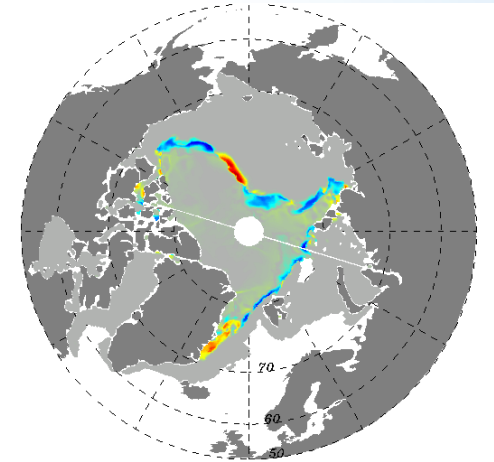


Residu

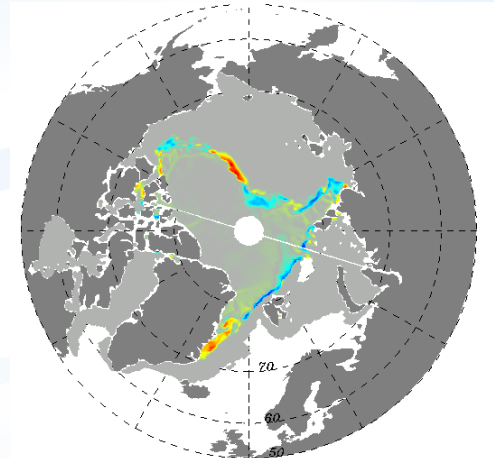
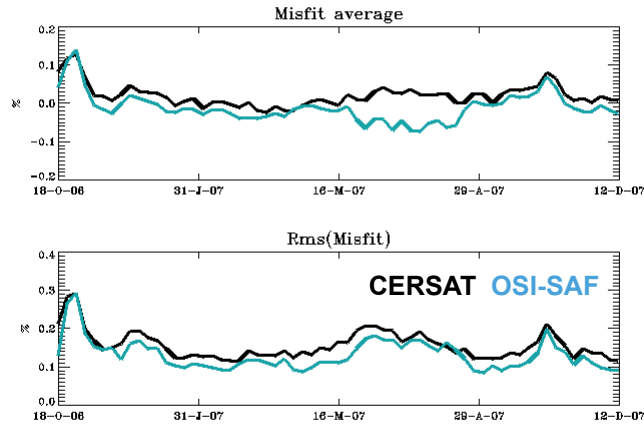
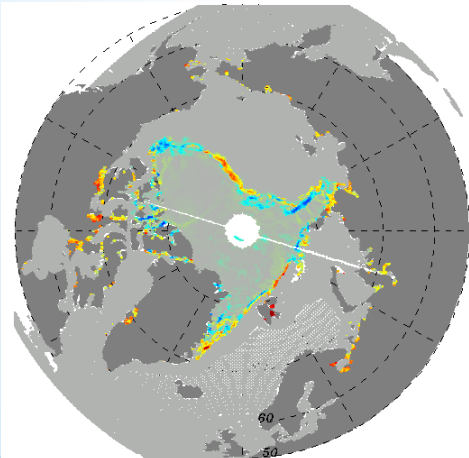
Residual vs innovation CERSAT



Sea Ice Concentration difference OSI-SAF

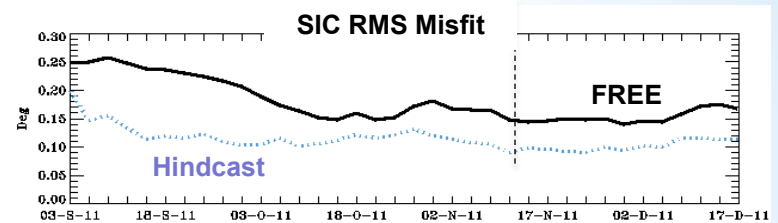


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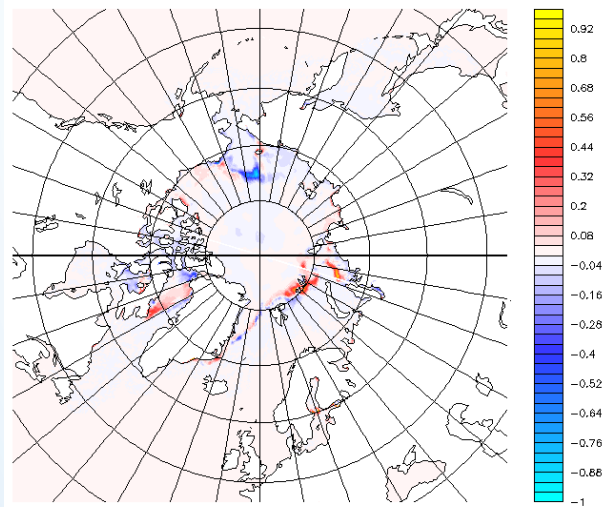


Multivariate state vector for multivariate sea ice analysis

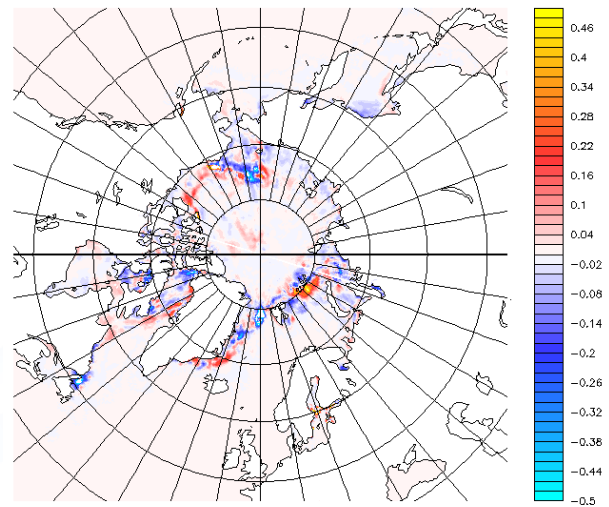
[SST,SIC,Thickness] with (SST,SIC) observations
SST restricted to open ocean close to the marginal zone



Multivariate Sea Ice Model update (y2011m11d11) (after 2 months of hindcast experiment)



SIC Model update



Thickness Model update

⇒ The thickness model update is statistically extrapolated

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An Arctic-Northern configuration dedicated to the development of an advanced sea ice analysis

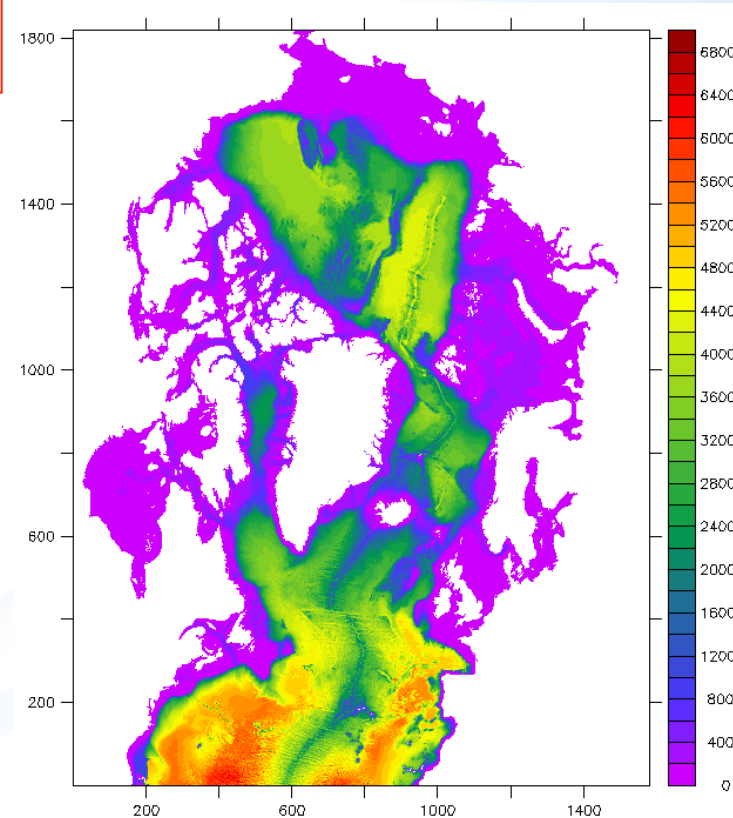
To develop an advanced sea ice analysis (multidata, multivariate, Gaussian Anamorphosis parameterization, Ensemble, LIM3, ...), it is more efficient to use a recent and low-cost model configuration centred on the Arctic Sea

...Work in Progress...

Use of an Arctic-Northern Atlantic Configuration at $1/4^\circ$ (CREG4/NEMO3.6/LIM3)

- Starting date: 20061001
- Studied period: 2007-2014
- NEMO 3.6_stable
- free surface solved by time-splitting
- non linear free surface (variable volume)

- Initial condition: T/S: WOA13
Sea Ice concentration: CERSAT
Sea Ice thickness: from a previous run (global 1°)
- Boundary condition: from PSY3 operational system ($1/4^\circ$ degree)
- Atmospheric forcing: IFS (ECMWF operational) on $1/8^\circ$ regular grid
- runoff psy3 + blacksea runoff from MEDRYS (Med $1/12$ reanalysis)



Technical work in progress by the end of 2015

→Coupling with the Mercator Assimilation System (SAM2) and multivariate sea ice analysis.

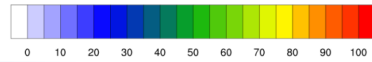
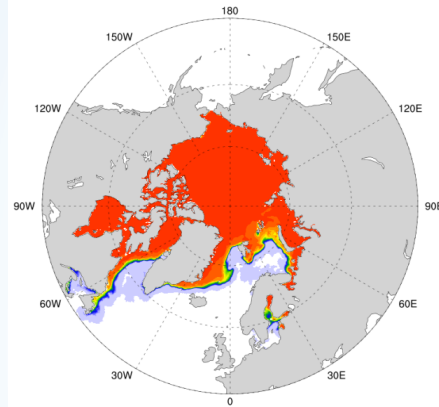
Improvement of the Sea Ice using the new NEMO3.6/LIM3

- 7 years of free simulation from 2007
- CREG025/NEMO3.6/LIM3 with 5 categories and 2 levels

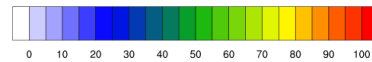
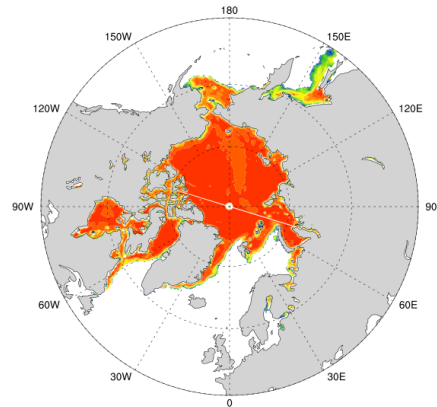


March 2013

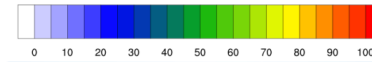
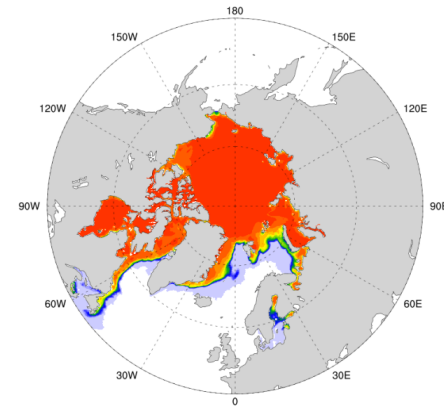
CREG025/LIM3



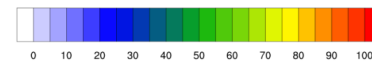
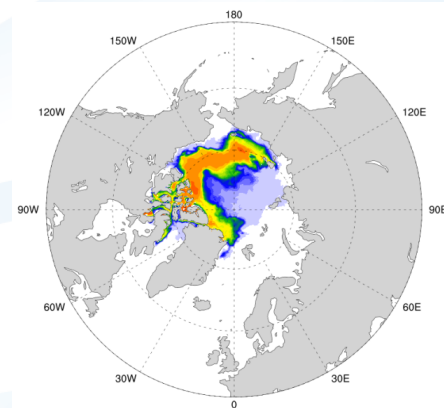
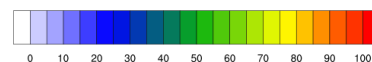
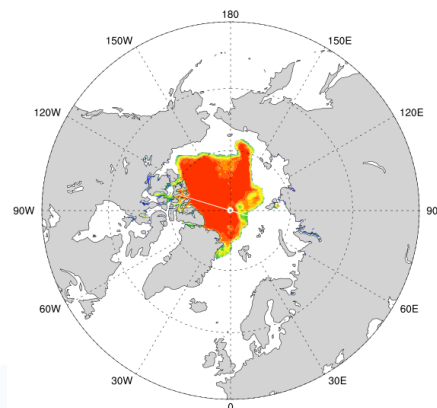
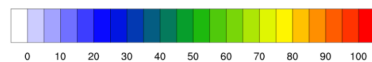
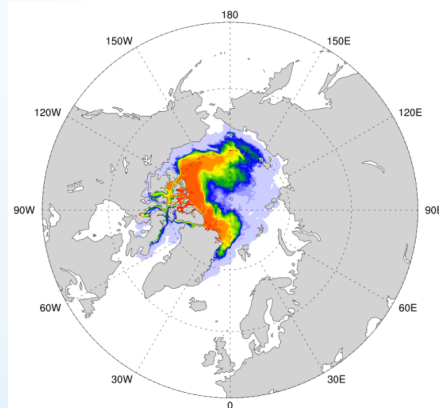
Cersat



CREG025/LIM2



September 2013

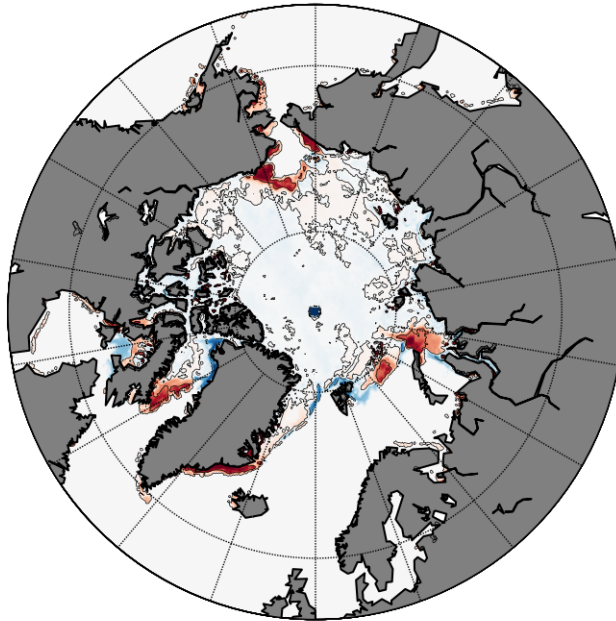


Improvement of the background error using Ensemble Approach

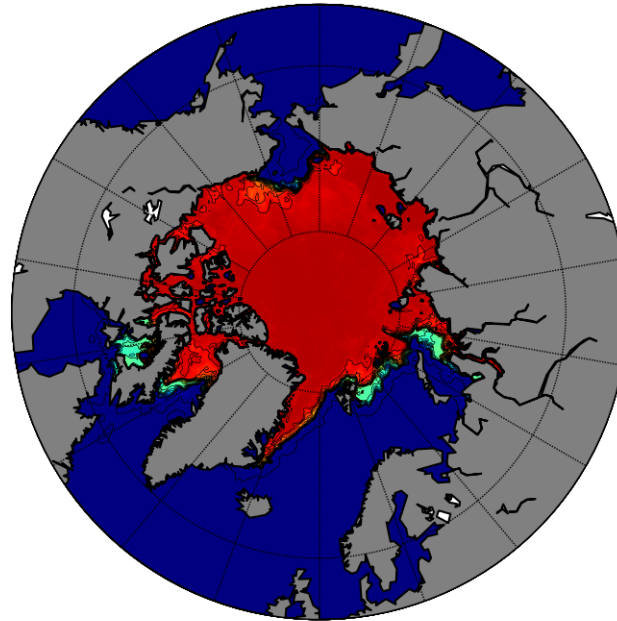
- Free Ensemble (ORCA025/NEMO3.6/LIM3)
- 4 years spinup simulation using the non perturbed model
- 16 members, Forcing perturbations only
- 4 months of ensemble from July

Sea Ice Concentration, 19 Nov., 2011

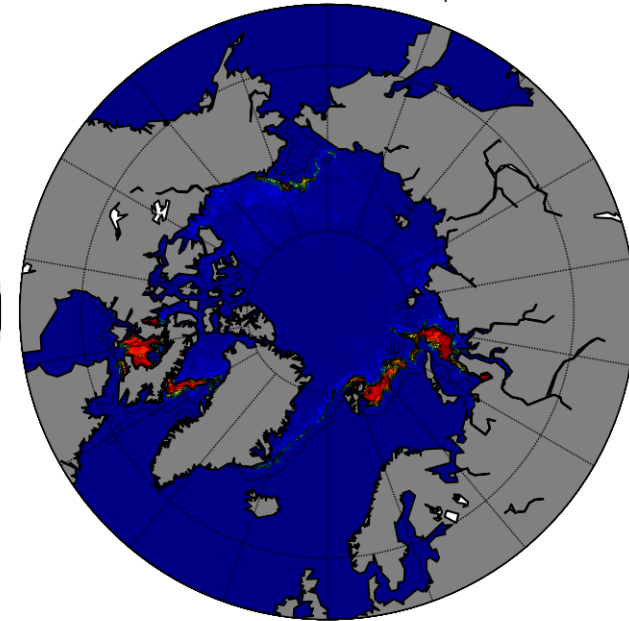
Observation - Ensemble Mean



Ensemble Mean



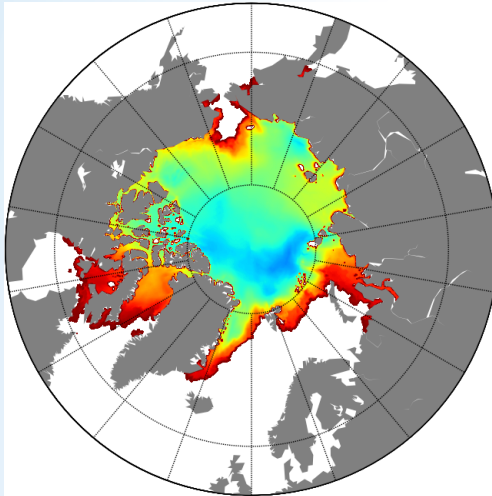
Ensemble Spread



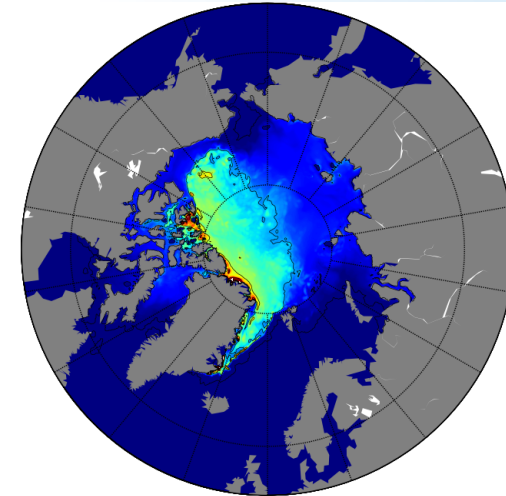
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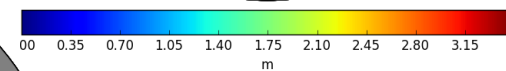
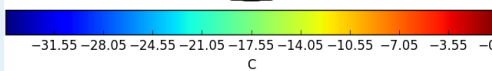
Ensemble Mean and Spread, Nov., 2011



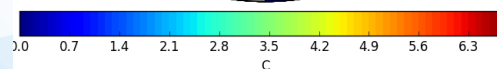
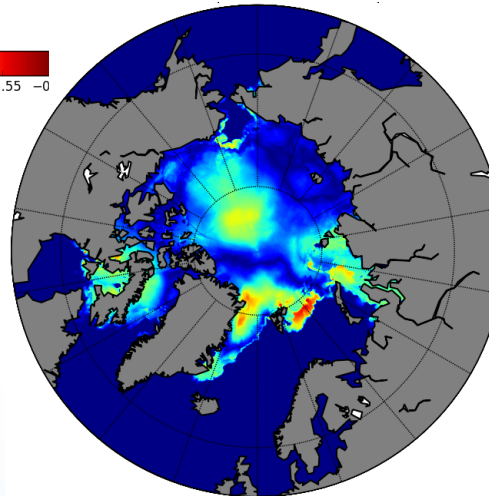
Ensemble Spread
Sea Ice Temperature



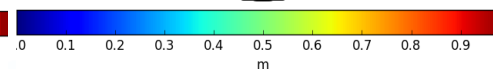
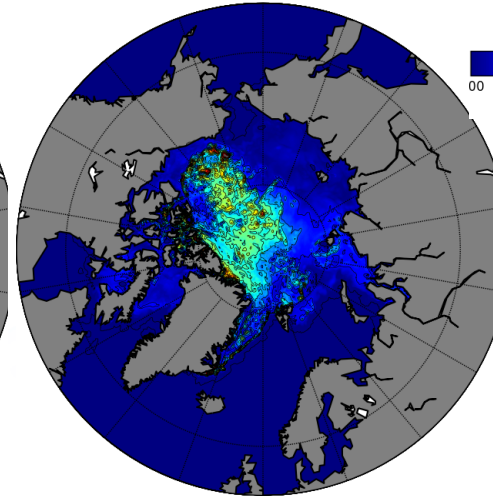
Ensemble Spread
Sea Ice Thickness



Ensemble Mean
Sea Ice Temperature



Ensemble Mean
Sea Ice Thickness



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