

Barcelona, 10-12 December 2014

International workshop on polar-low latitude linkages
and their role in weather and climate prediction



Sea ice prediction 103

François Massonnet

with valuable input and discussions from

C. M. Bitz, E. Blanchard-Wrigglesworth, , M. Chevallier,
J. J. Day, V. Guemas, S. Howell, J. Stroeve, S. Tietsche

The sea ice prediction lectures series continues

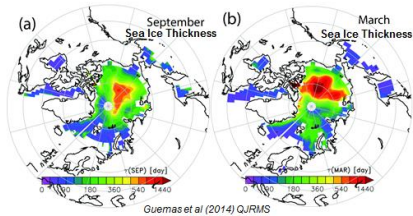
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Virginie Guemas



I - Arctic sea ice predictability sources

Persistence



- Sources of predictability
- Importance of initialization
- 2-model prediction

The sea ice prediction lectures series continues

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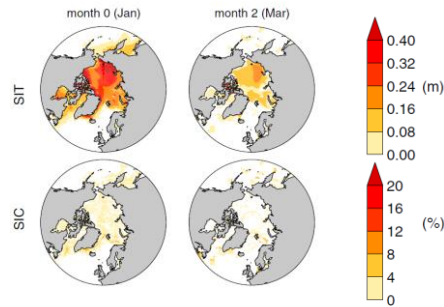
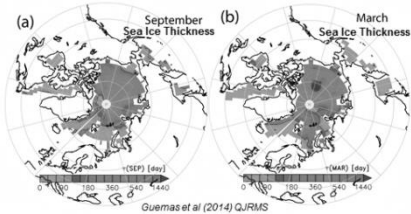
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Jonny Day



I - Arctic sea ice predictability sources

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- Sources of predictability
- Importance of initialization
- 2-model prediction
- Potential predictability
- Importance of thickness
- Initialization date

The sea ice prediction lectures series continues

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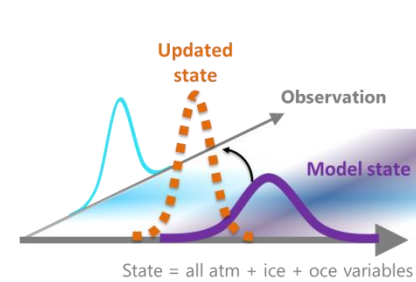
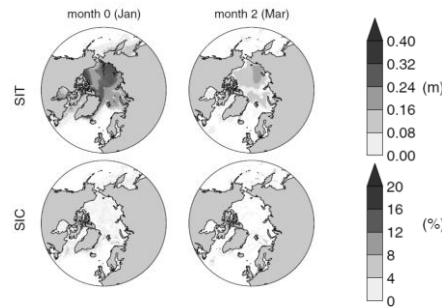
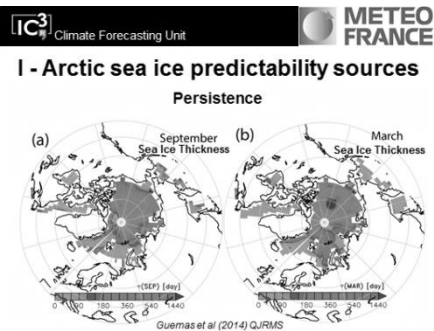
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- Sources of predictability
- Importance of initialization
- 2-model prediction
- Potential predictability
- Importance of thickness
- Initialization date
- Data assimilation
- Seasonal prediction
- Estimation of uncertainty

The sea ice prediction lectures series continues

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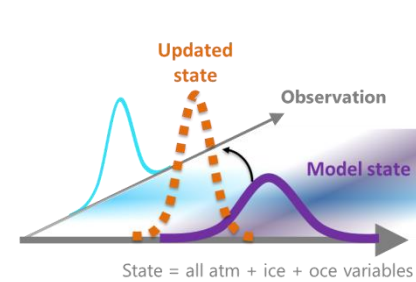
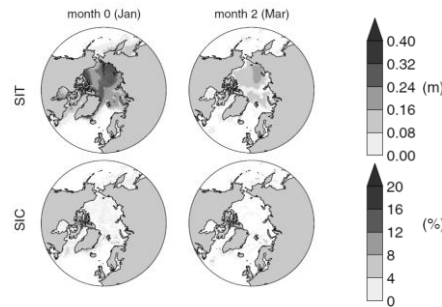
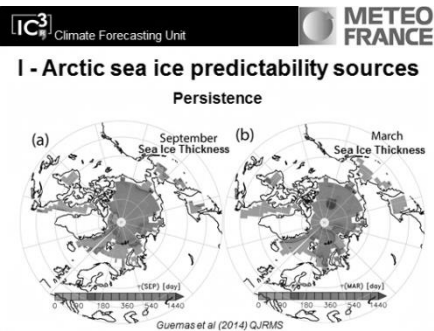
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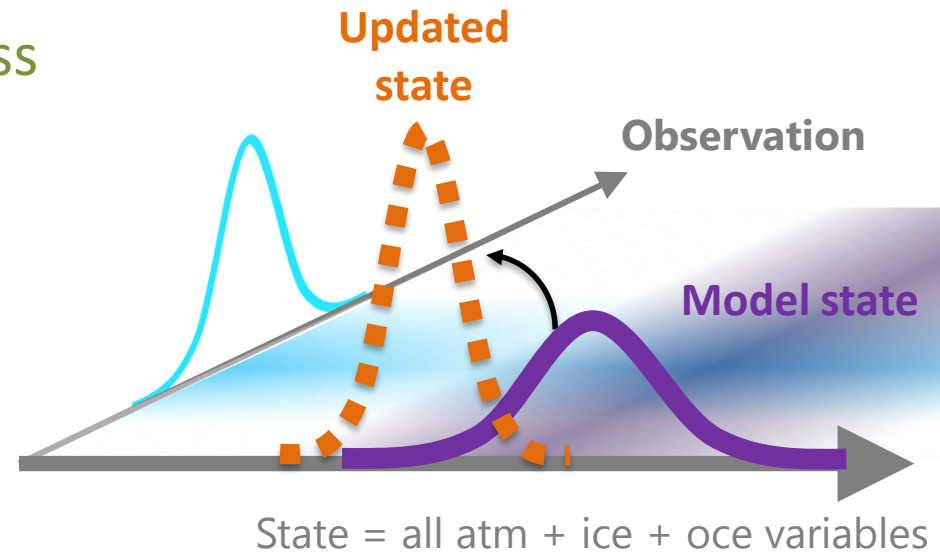
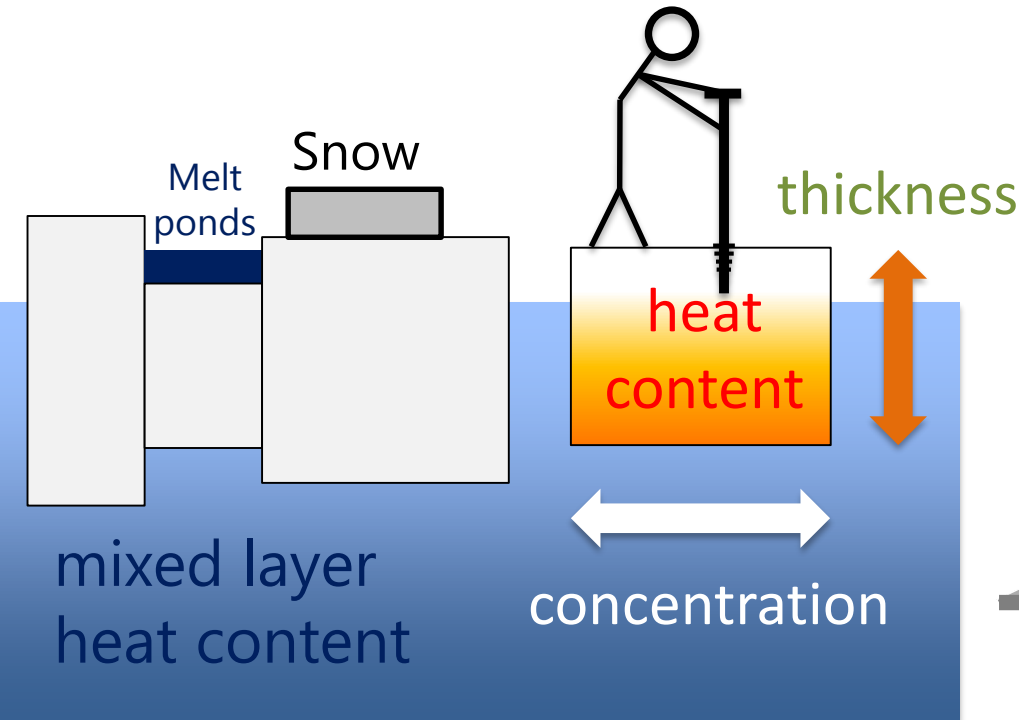
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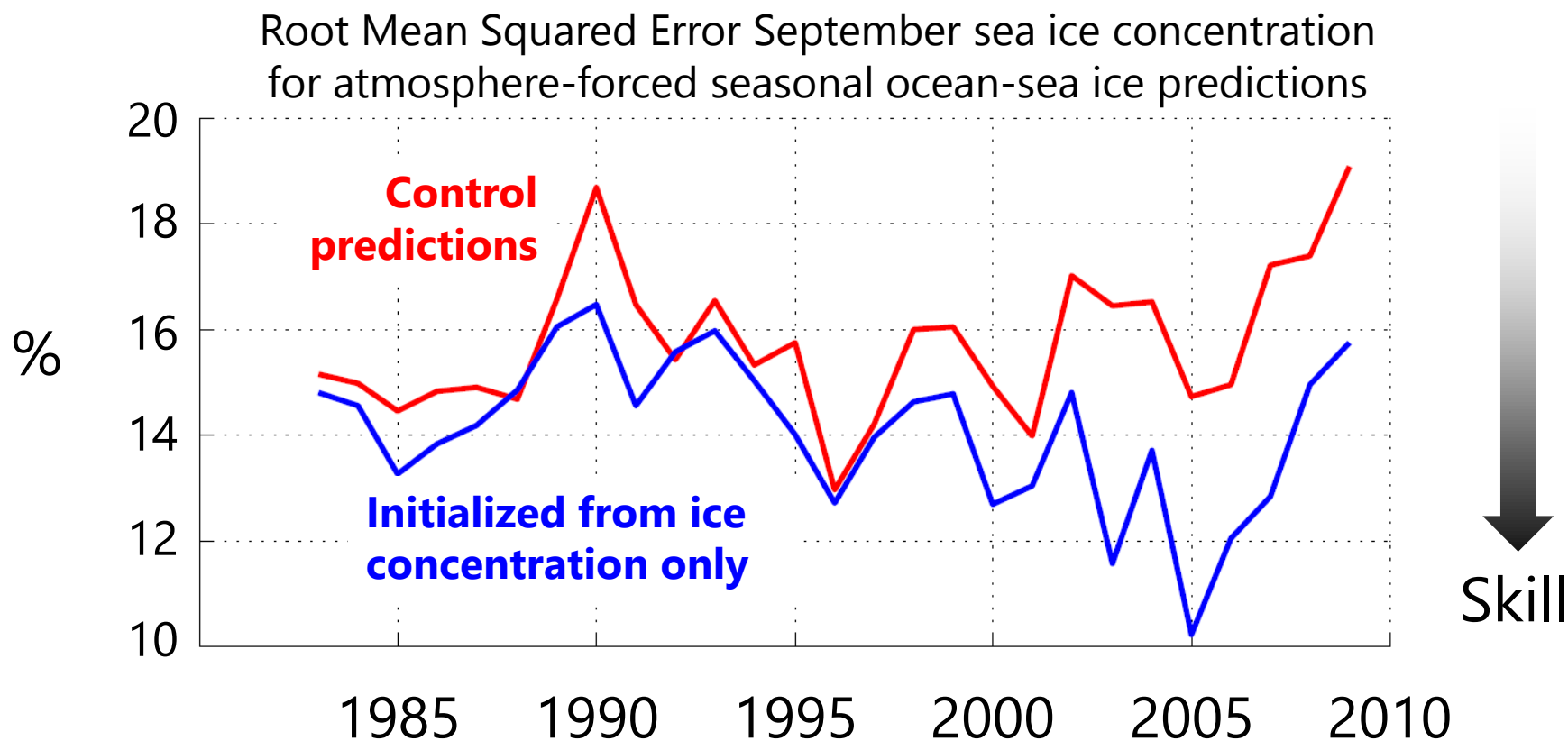


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- **Data assimilation**
- Seasonal prediction
- Estimation of uncertainty

The 0th principle of data assimilation :
update the whole state given incomplete observations



Sea ice data assimilation is ready for seasonal-to-decadal prediction



The sea ice prediction lectures series

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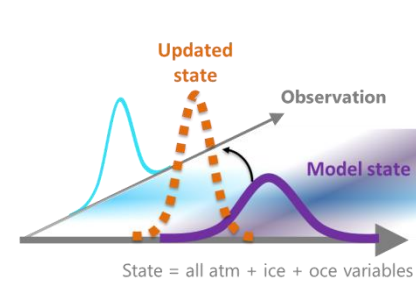
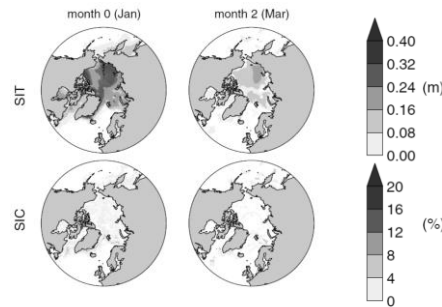
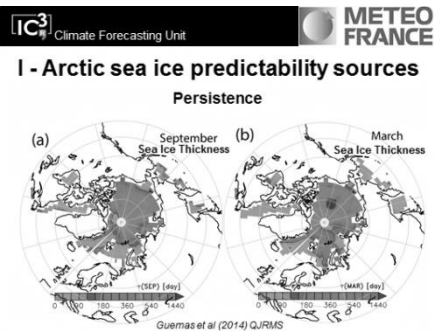
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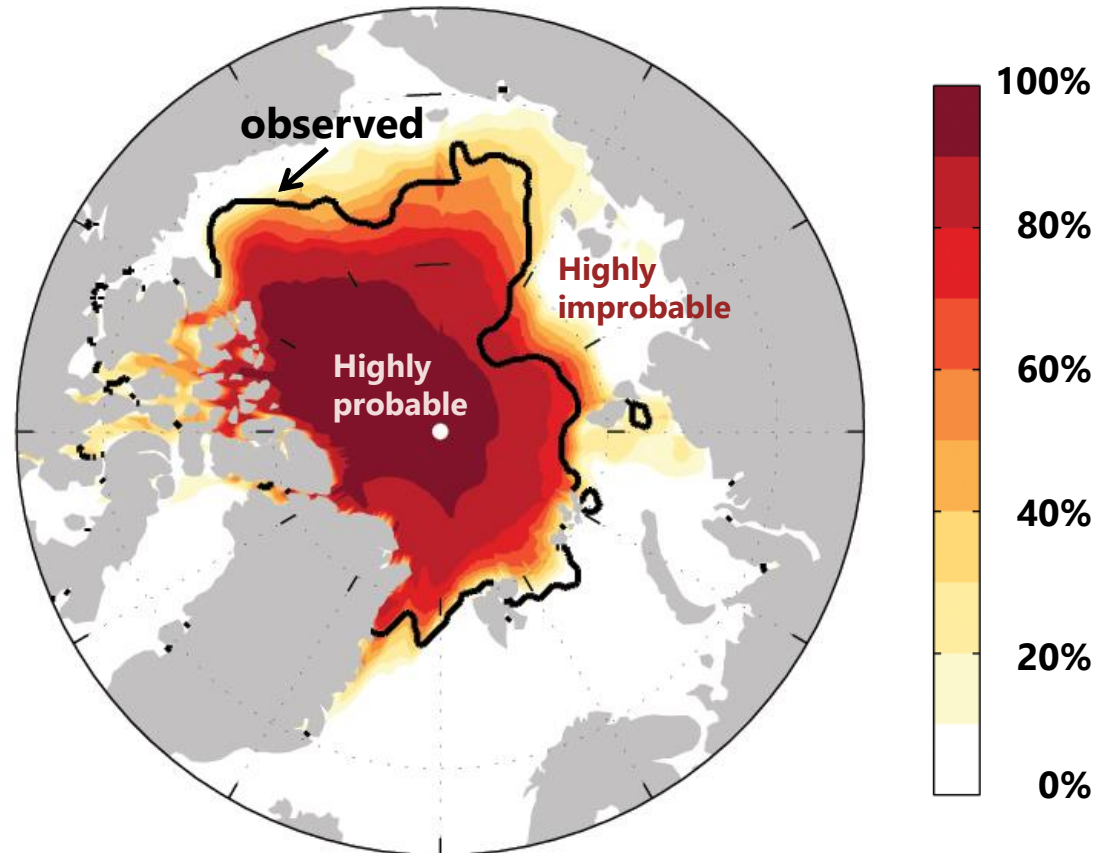
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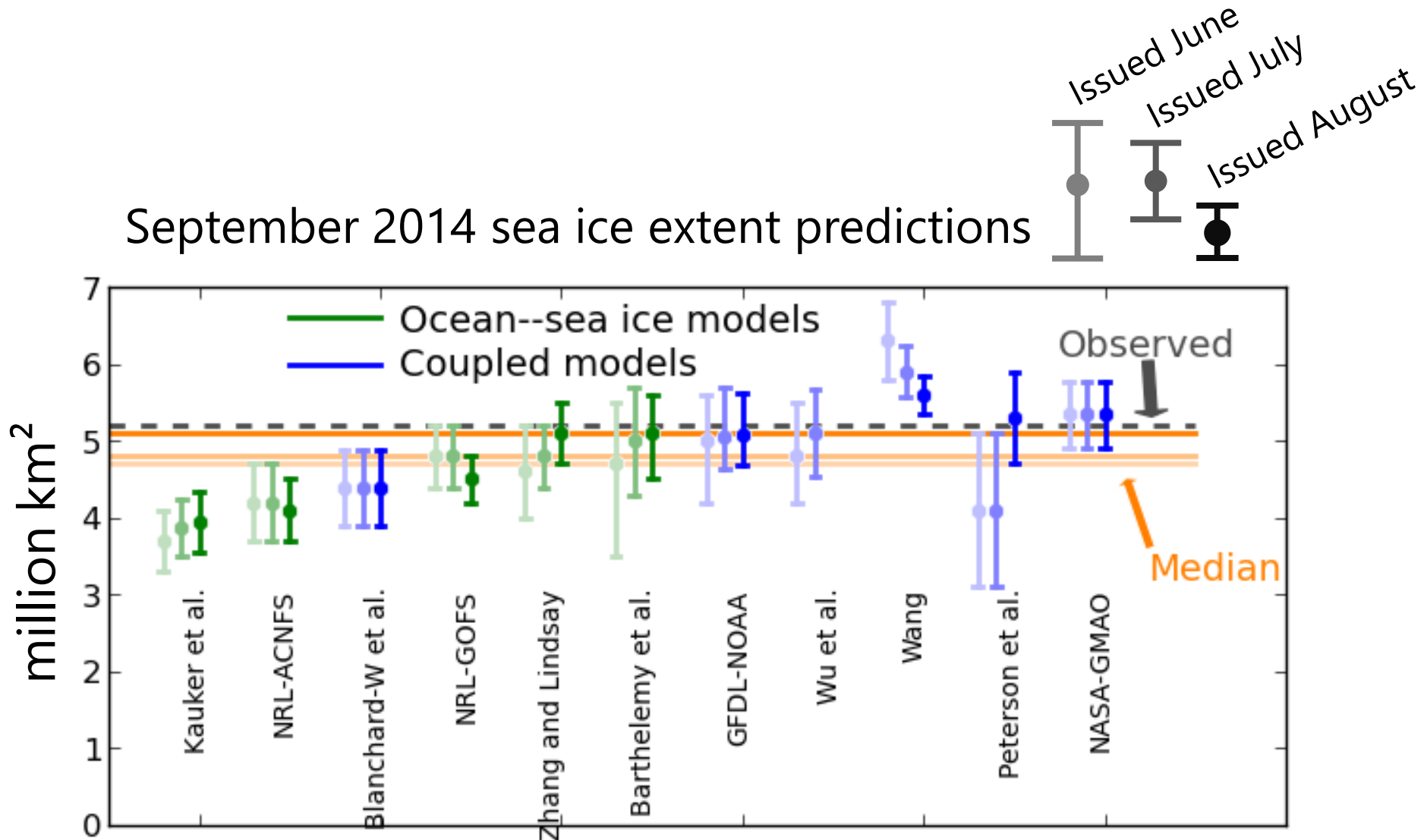
SIPN – Sea ice Prediction Network: Manage and analyze sea ice outlooks

Probability of sea ice presence
(September 2014, 5 models)



Model-based seasonal predictions: consistent individual and collective behaviors

September 2014 sea ice extent predictions



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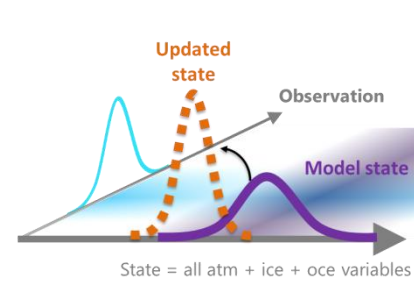
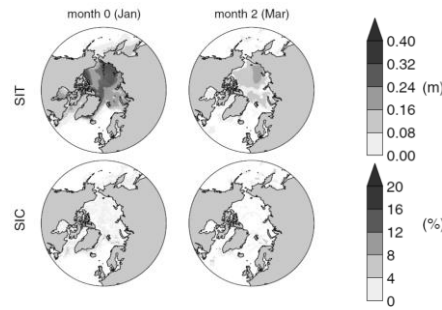
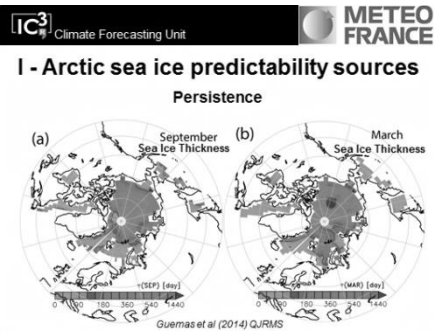
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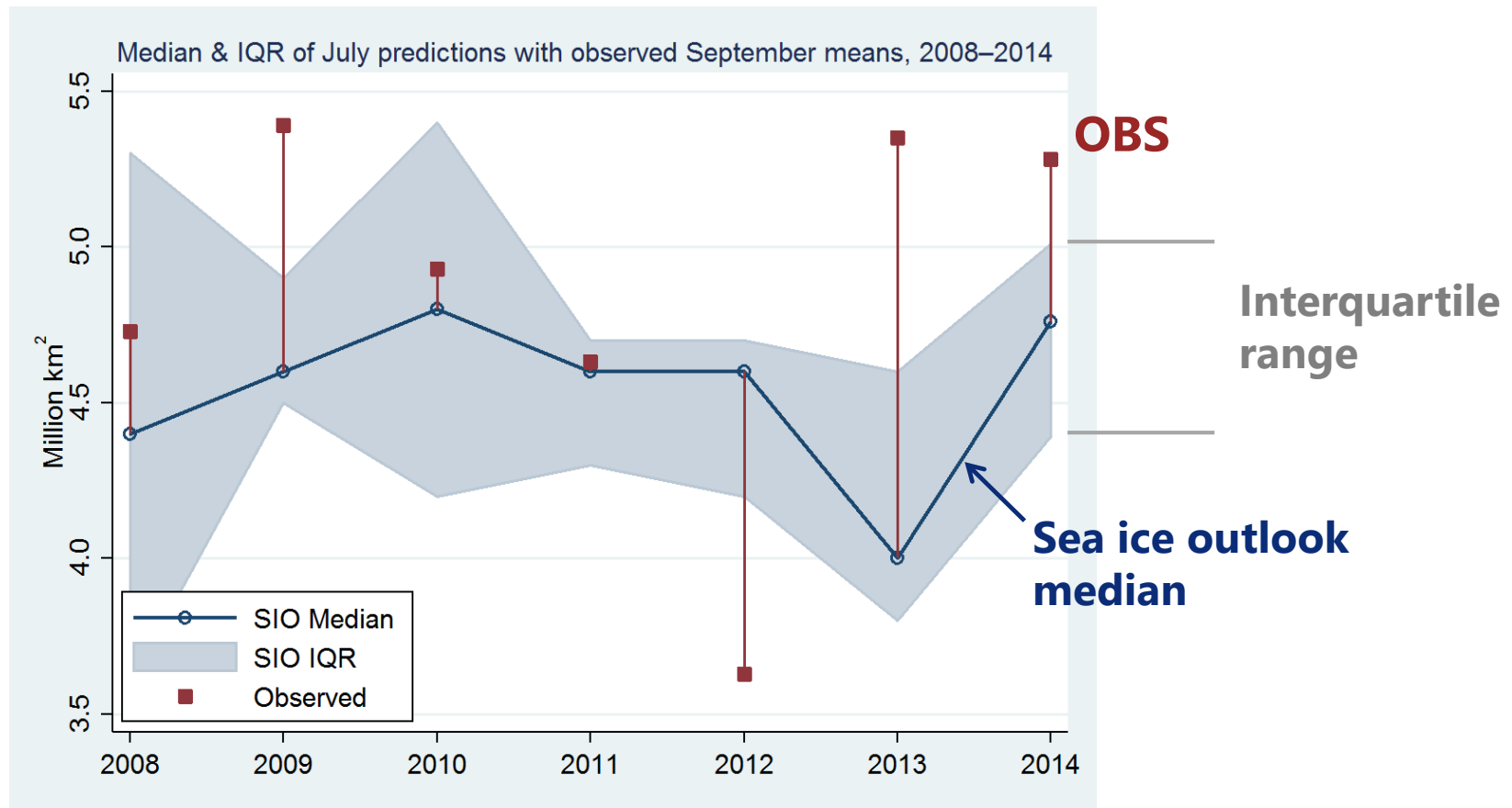


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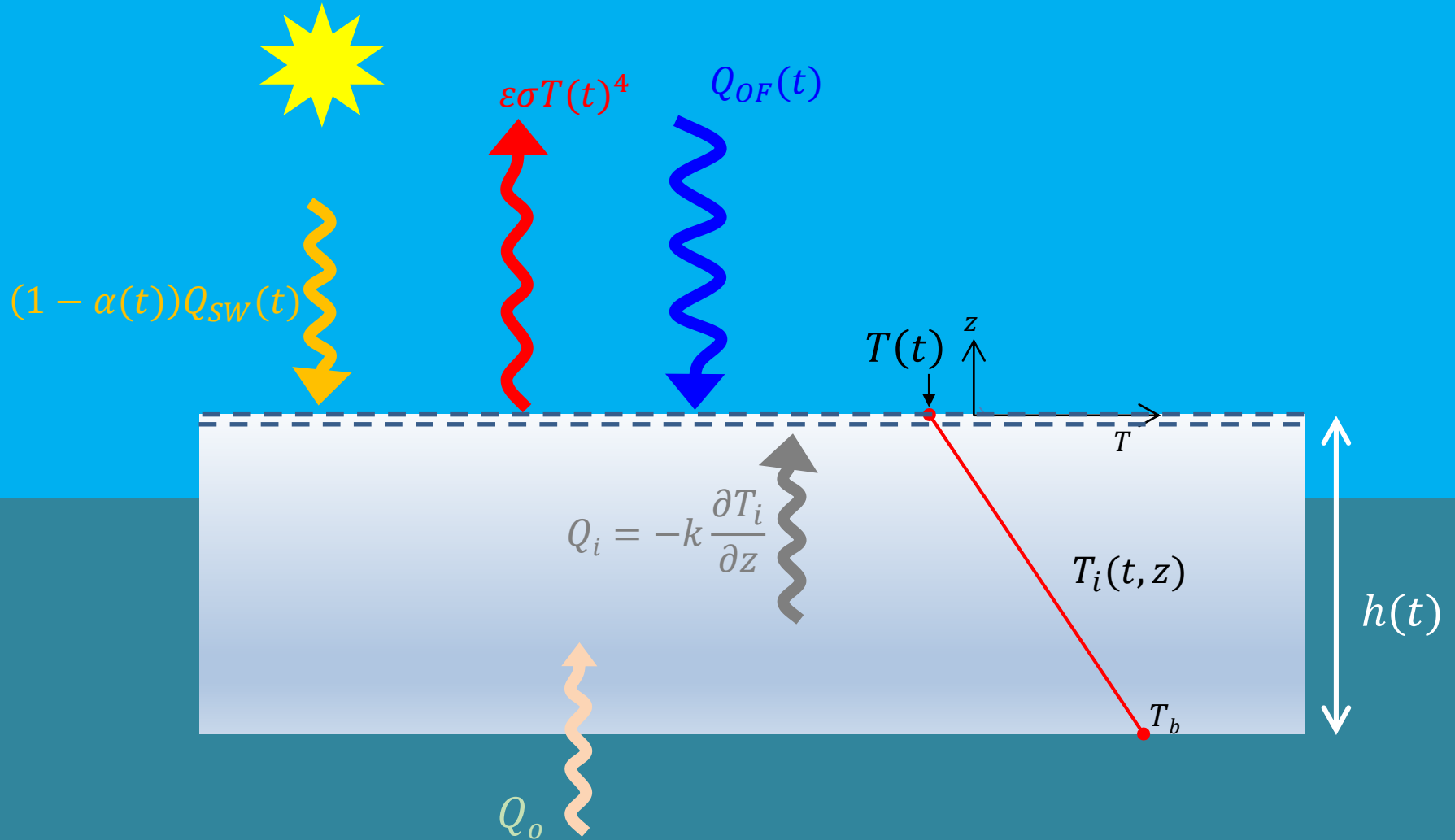
Is the current generation of sea ice outlooks overconfident? Yes, probably.



Why do model predictions
diverge from each other?

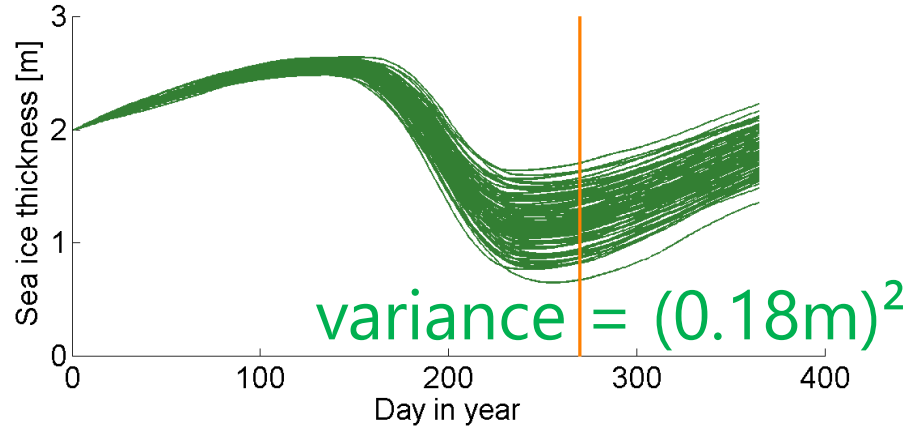
2-variable sea ice model

[Semtner, 1976; Notz, 2005]



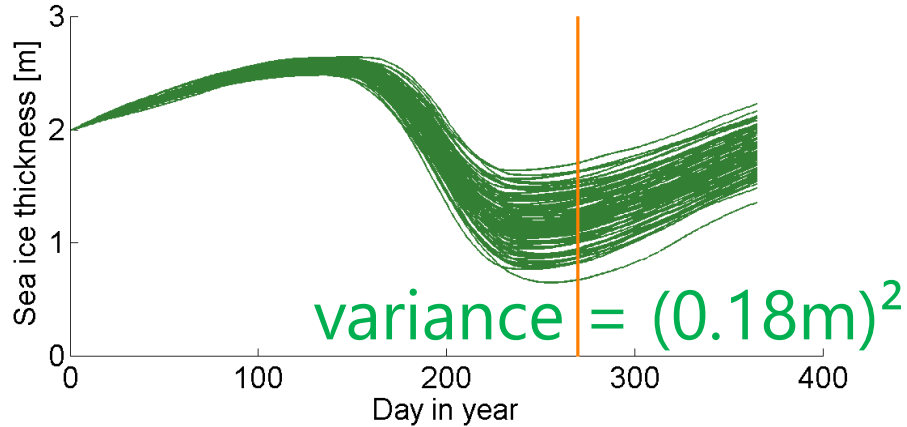
Why do model predictions diverge from each other?

Because of chaotic atmosphere

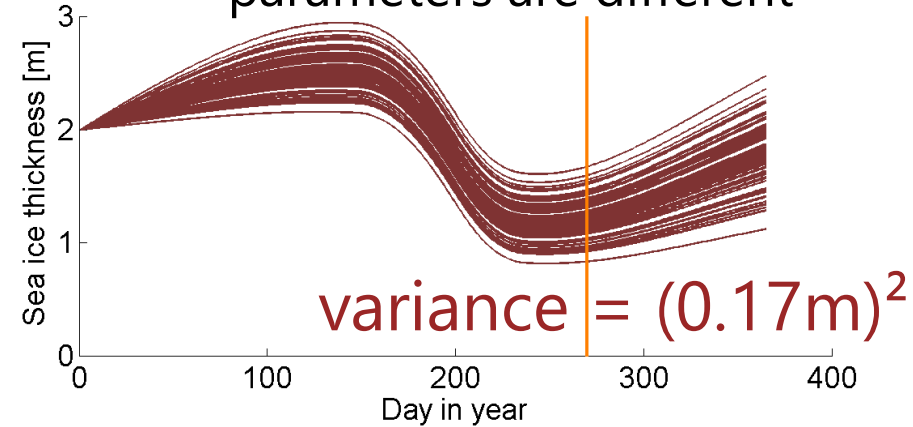


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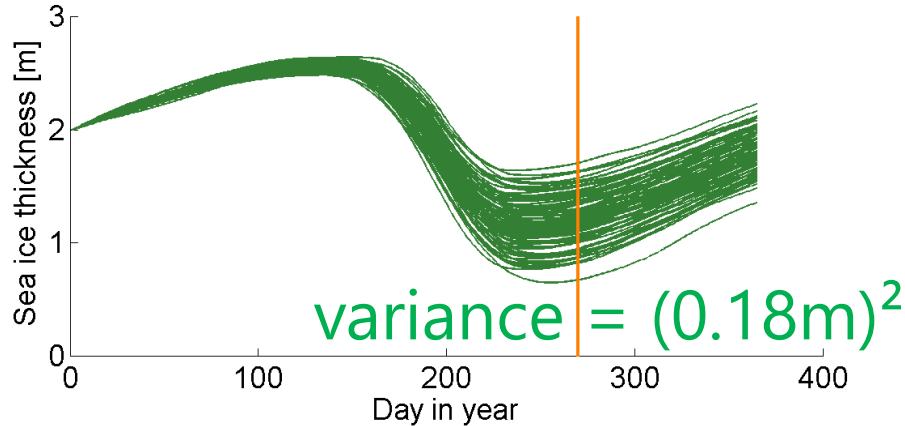


Because models, physics, parameters are different

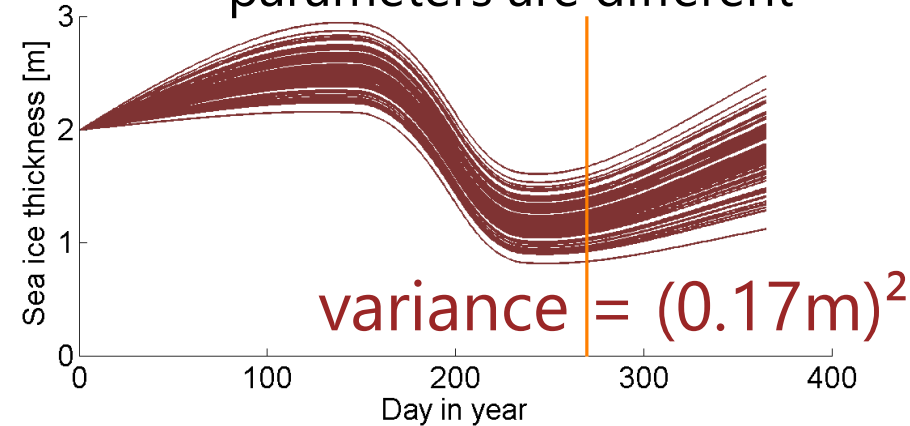


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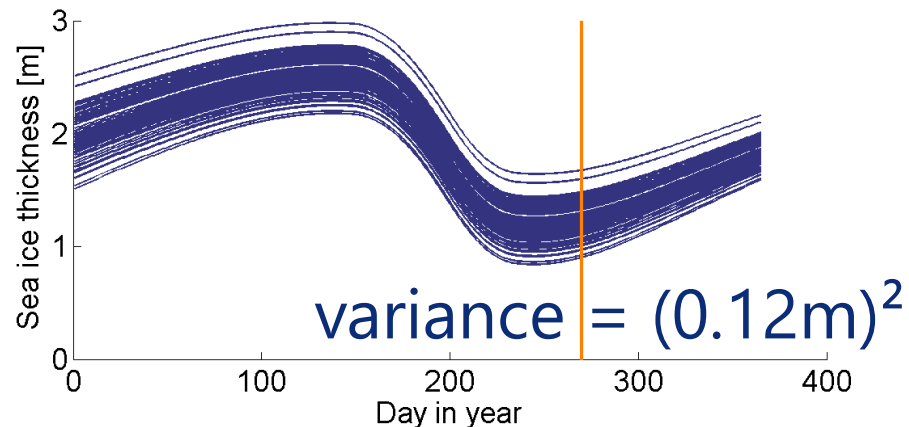
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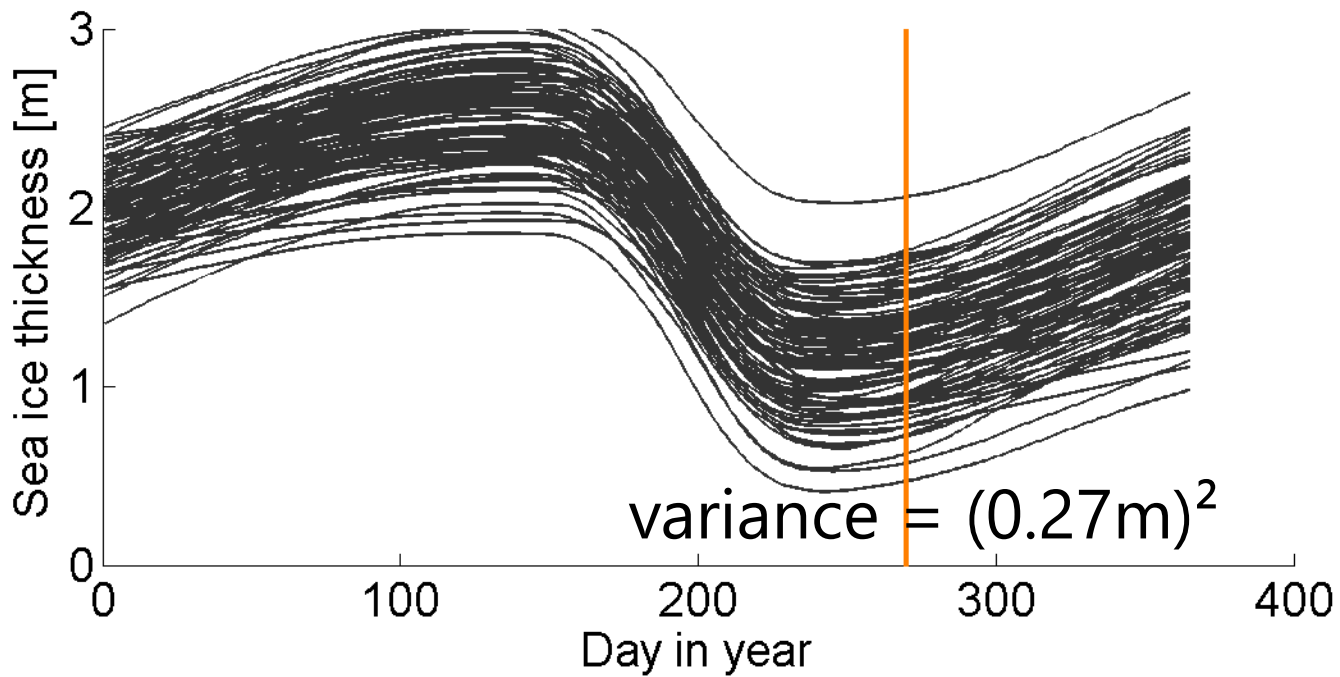
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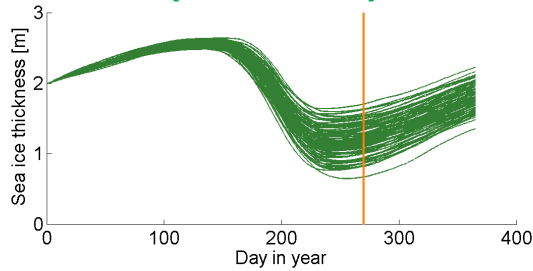
Because of different initial conditions



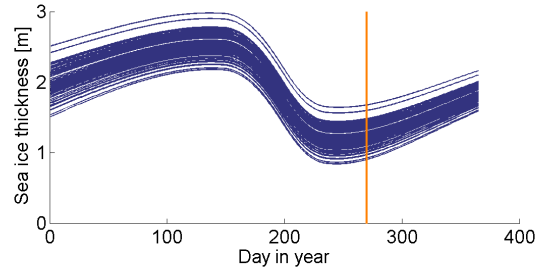
Actually, all of them!



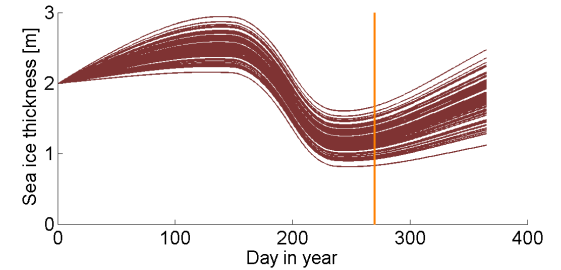
variance = $(0.18\text{m})^2$



variance = $(0.12\text{m})^2$

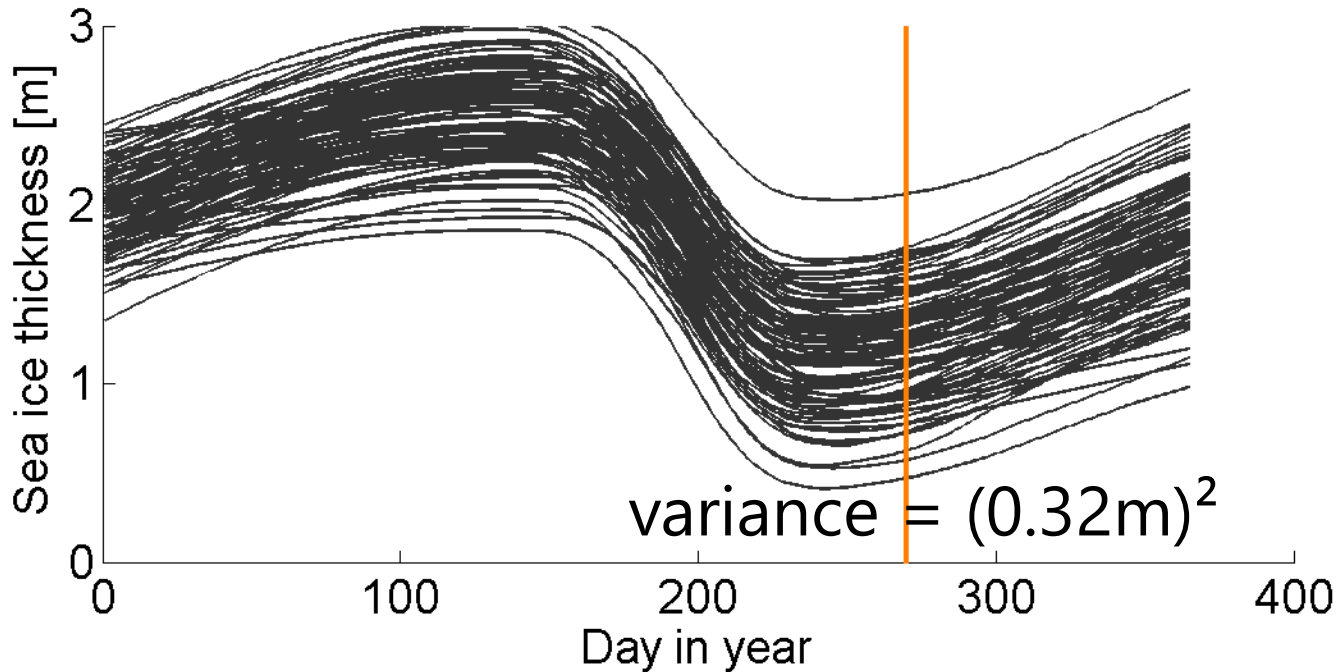


variance = $(0.17\text{m})^2$




Actually, all of them!

(and variances don't add up in reality, unlike here)



Why do model predictions diverge from each other?

Because of chaotic atmospheric fluctuations



Königk et al., Clim. Dyn., 2011
Blanchard-W. et al., GRL, 2011
Tietsche et al., GRL, 2014
Day et al., J. Clim., 2014
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APPOSITE suite

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Because model physics and parameters are different

Juricke et al., J. Clim. (2013)
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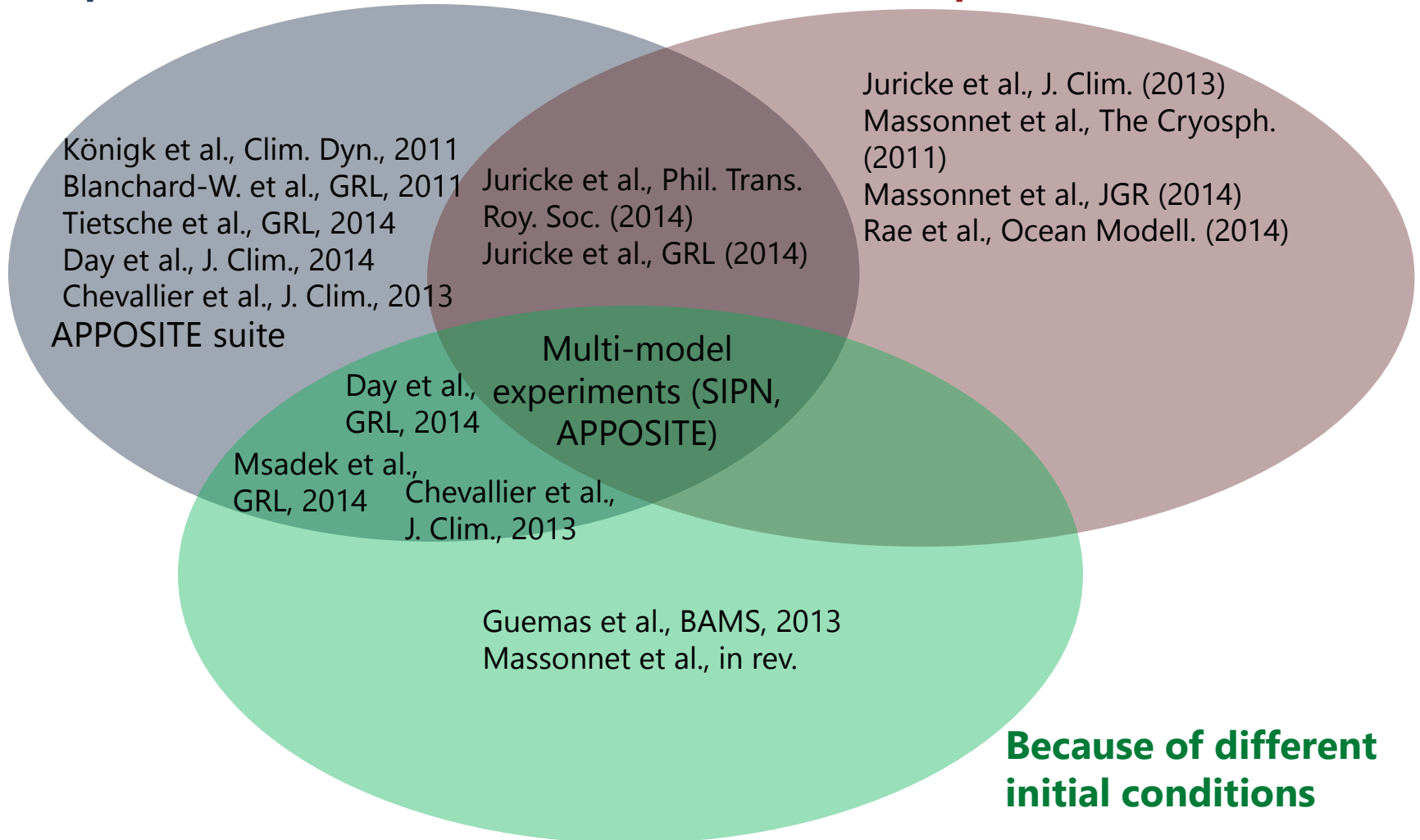
Guemas et al., BAMS, 2013
Massonnet et al., in rev.

Because of different initial conditions

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Because model physics and parameters are different



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Lessons learned & directions

Lessons learned

Open questions

Data assimilation

Appropriate for sea ice initialization

How to handle coupled initialization?

Seasonal sea ice prediction

Joint efforts exist, skill still to be demonstrated

Can we expect skill in a changing climate? What are user-relevant diagnostics?

Estimation of uncertainty

Predictions probably overconfident

How can we reevaluate uncertainty properly? Ready for the next outlook?

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Virginie Guemas

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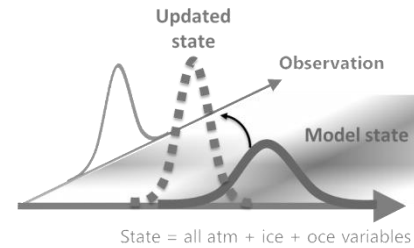
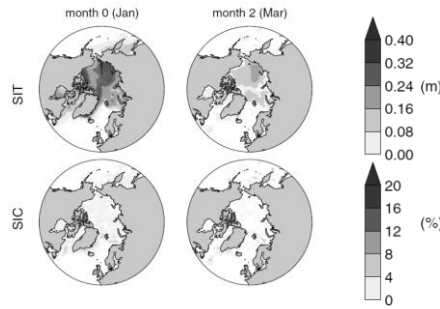
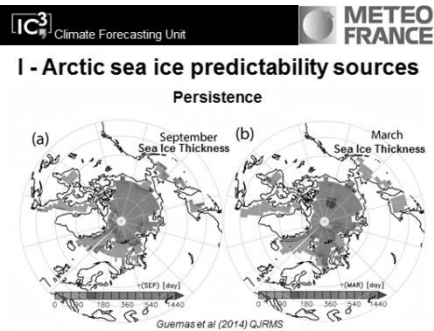
Jonny Day

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François Massonnet

SIP104

Matthieu Chevallier



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- Data assimilation
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- Seasonal prediction
- Operational forecasts
- Users needs

Thank you!

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www.climate.be/u/fmasson



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