Initialization and ensemble generation for seasonal-to-decadal climate predictions

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SPECS

Seasonal-to-decadal climate Prediction for the improvement of European Climate Services

FONA
Decadal Climate Prediction
BMBF

MiKlip

Setting the scene

Let's assume we have a climate model, and like to enable it to make

- a (re-)forecast starting at some specific point in time: initialization

- many predictions from the same starting point: ensemble generation

It's been established that we need

- to initialize long-memory components (e.g. ocean, sea-ice, land surface)

- to perturb this initial state

Yet, most technical implementations

- are historically grown/arose out of practicalities,

- have well known short-comings,…

… common feeling that we should be able to do better, for example:

- better perturbations (with sophisticated physics),

- better initial conditions (with sophisticated assimilation techniques)

Ambitious/ well justified new methods are implemented

Anomaly correlation for DJF (NOV start) for surface temperature
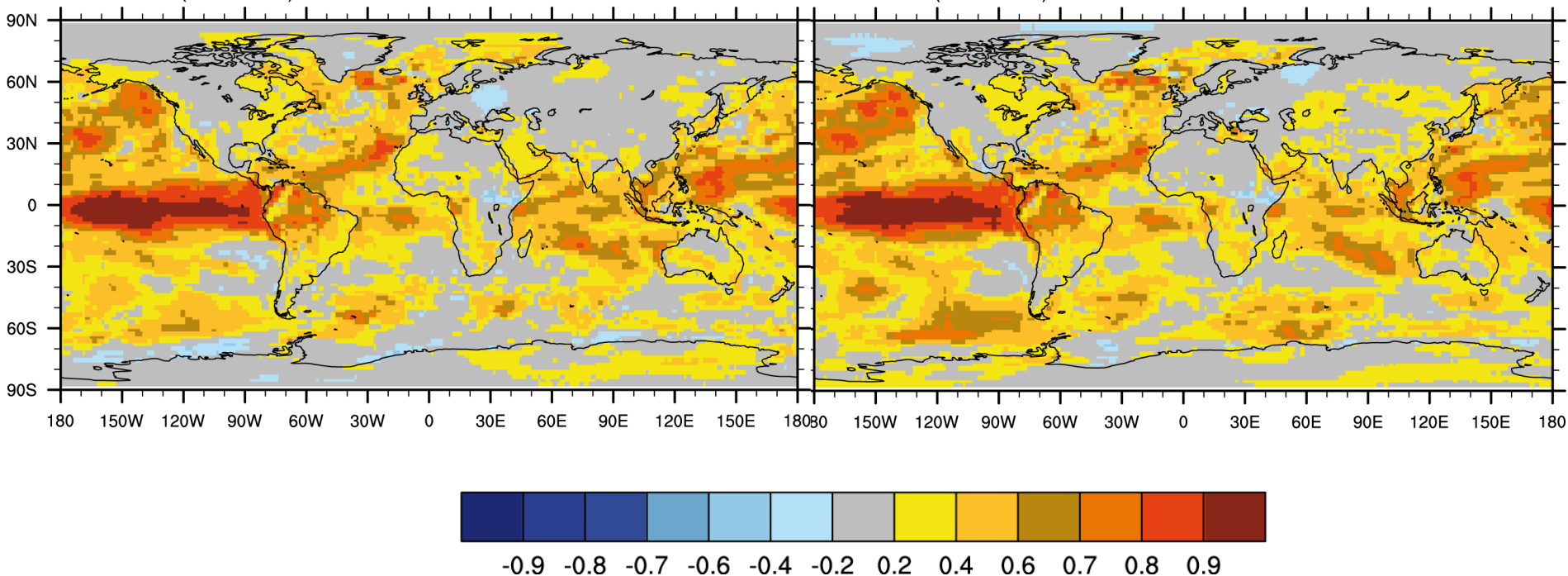
Lagged initialized ensemble
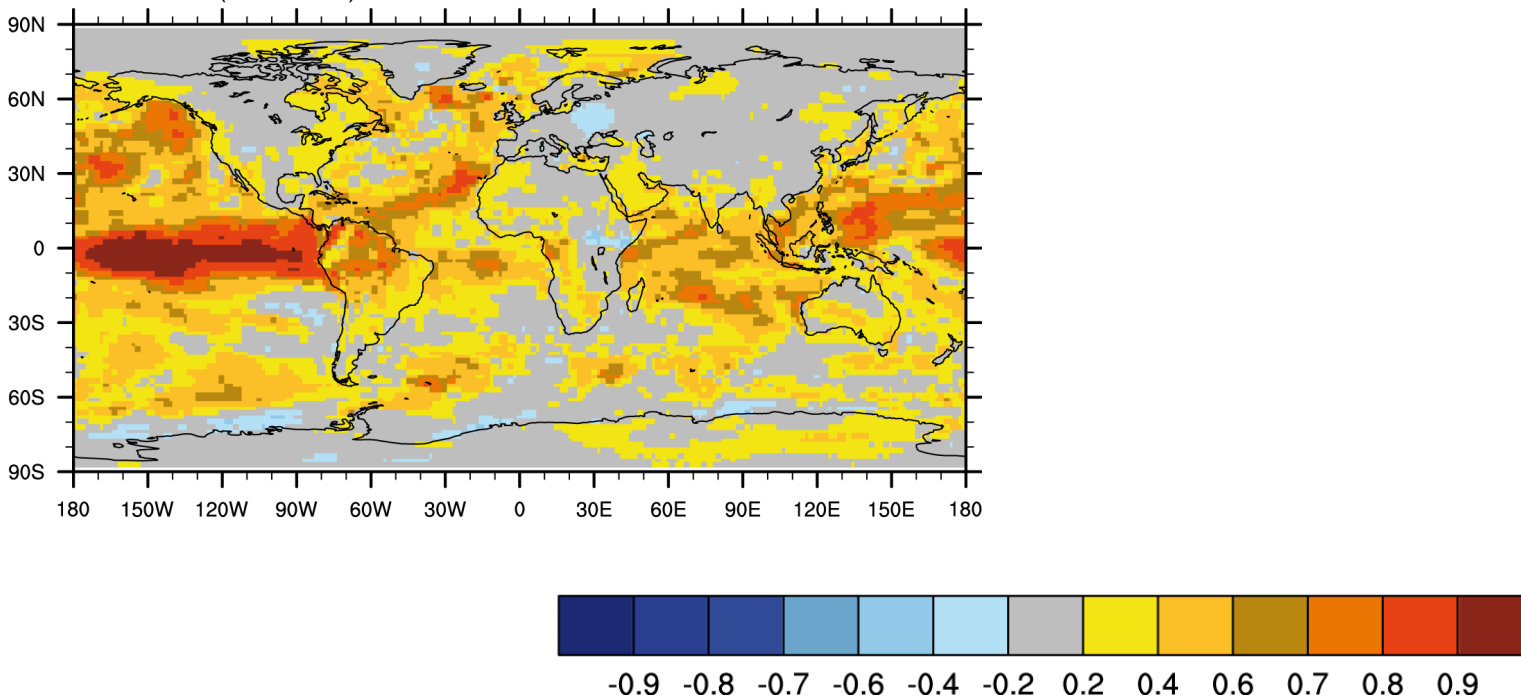
New methods are implemented with modest success

Anomaly correlation for DJF (NOV start) for surface temperature

Baehr et al., Climate Dynamics, 2015

Honest summary

- For both, ensemble generation and initialization: so far, no clear advantage of a particular method.

- Hence, in many circumstances, an important decision criterion for the respective ensemble generation technique might be its technical readiness and the practicalities of the implementation.
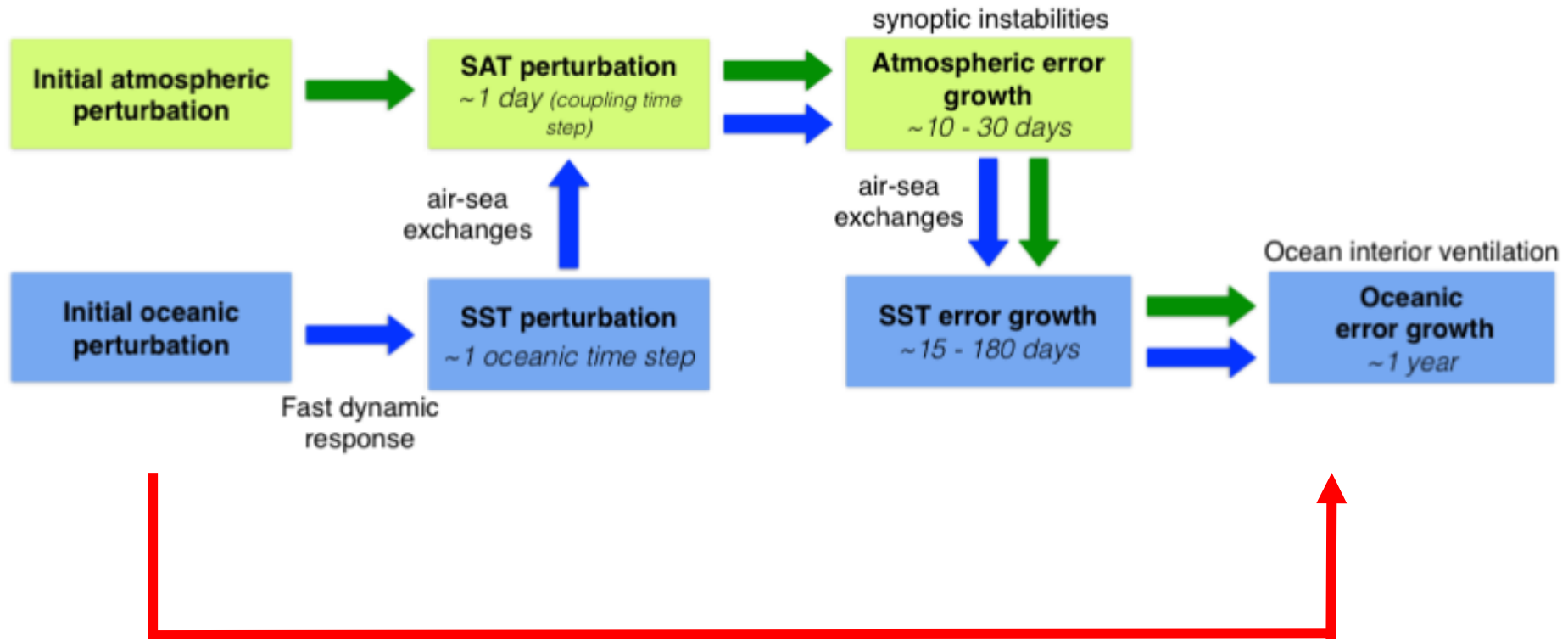
Ensemble generation: Are we barking up the wrong tree?

Perfect model framework: Schematic evolution of the error growth

Germe et al., Climate Dynamics, 2016

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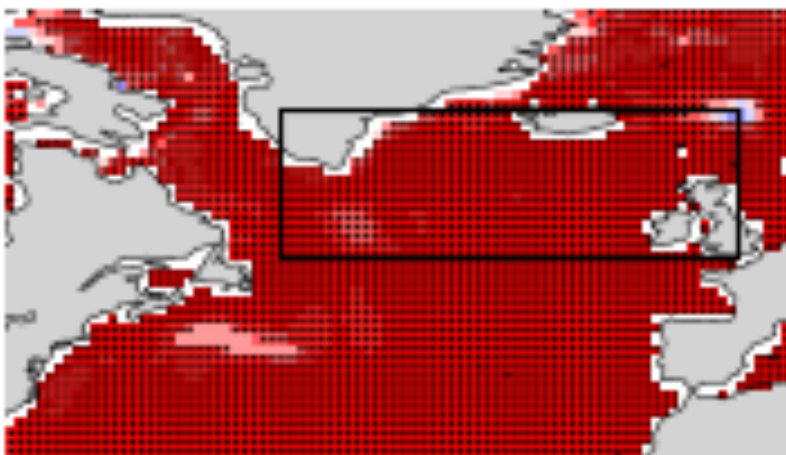

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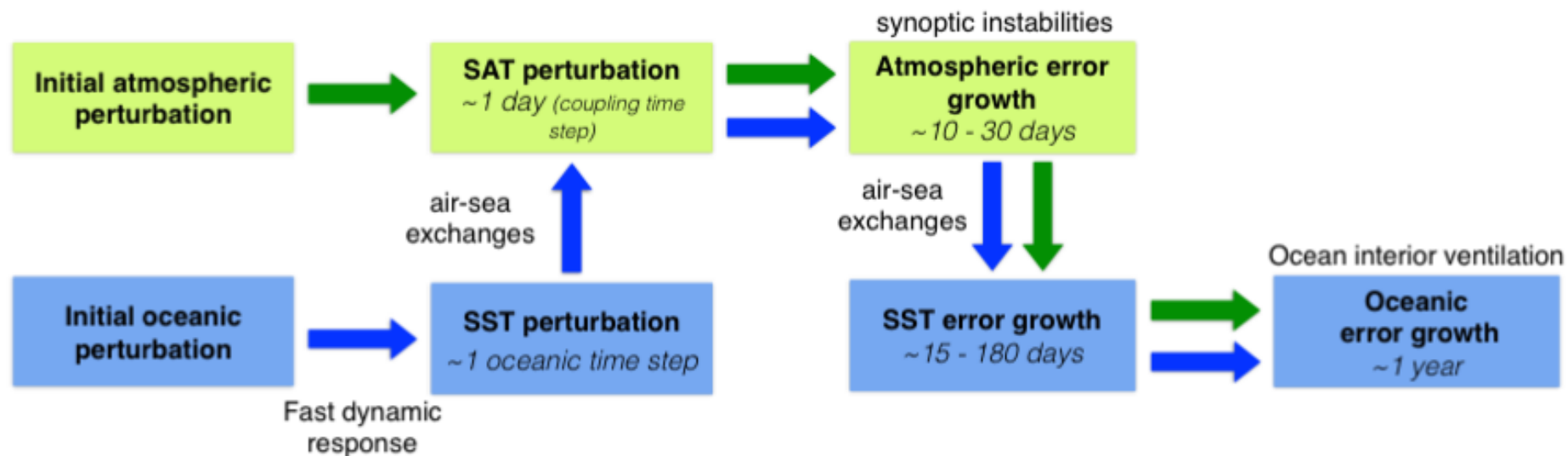
Are we barking up the wrong tree?

- Ensemble generation: are we effectively perturbing the deep ocean/ low frequency variability?

Initialization: Are we barking up the wrong tree?

Correlation against HadISST

Lead year 5: ACC against HadISST

Assimilation

New Assimilation

Brune et al., in prep.

Are we barking up the wrong tree?

- Ensemble generation: are we effectively perturbing the deep ocean/ low frequency variability?

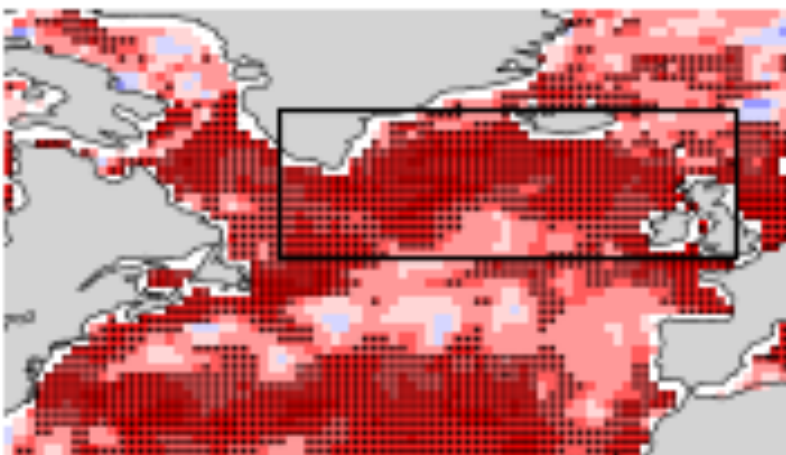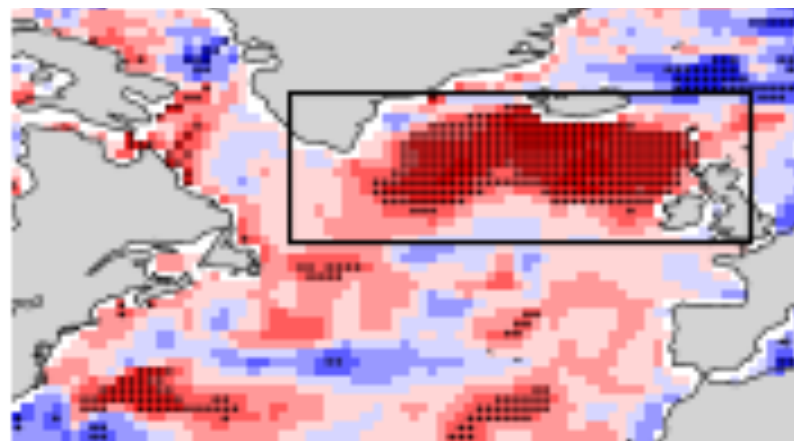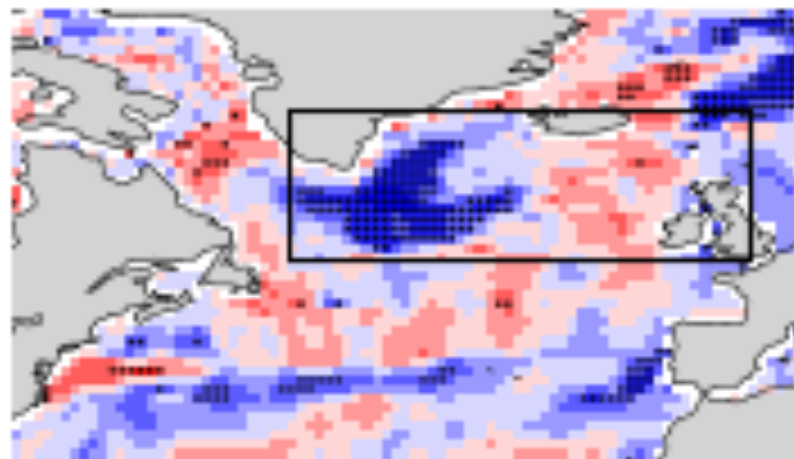- Initialization: do initial conditions really need to be as close as possible to the 'observed' state?

- Maybe, instead of aiming for

  - better perturbations (with sophisticated physics),

  - better initial conditions (with sophisticated assimilation techniques),

we should ask which information the models can 'digest'?

What's next?

- Maybe, instead of aiming for

    - better perturbations (with sophisticated physics),

    - better initial conditions (with sophisticated assimilation techniques),

    we should ask which information the models can 'digest'?

- near-term view: pragmatic choices ('less wrong' doesn't make things better)

    - perturbations directly from/in model (e.g., lagged initialization)

    - initialization from observations (e.g., enKF for sea-ice, ocean observations)

    - post-processing (for drift/shock/bias correction, signal-to-noise ratio, …)

- long-term vision: getting it 'right'

    - create initial conditions & perturbations within model (coupled assimilation)

    - also needs further improved models, sustained observations

- Neither is going to happen by itself: need to invest in both near-term and long-term, but let's try not to feint one for the other.