

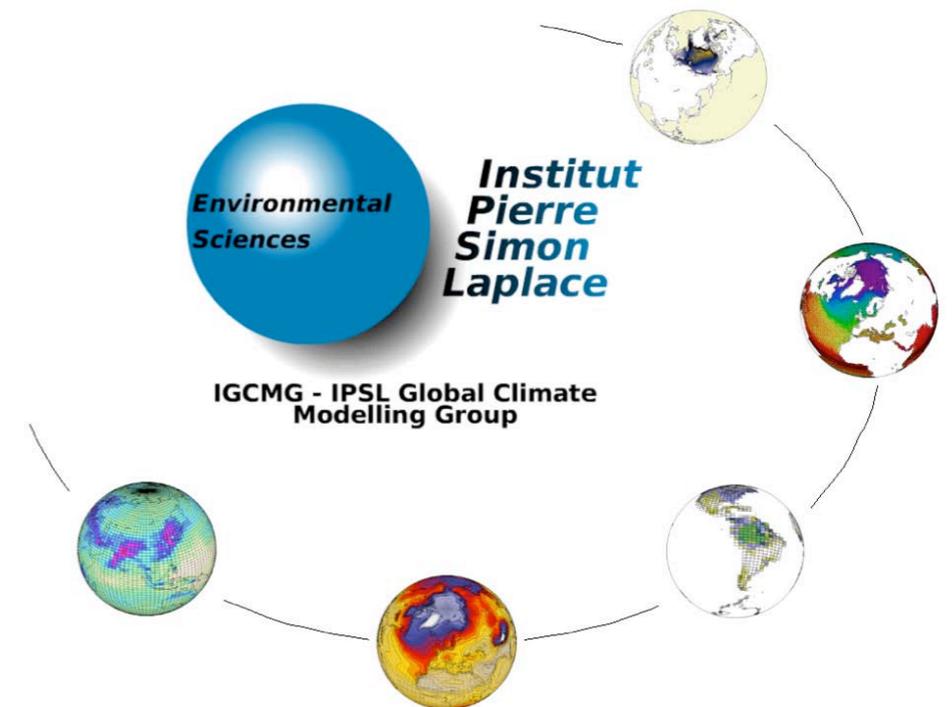
Prévisibilité saisonnière à décennale à l'IPSL

Eric Guilyardi, Juliette Mignot, Sonia Labetoulle, Benoît Vannière

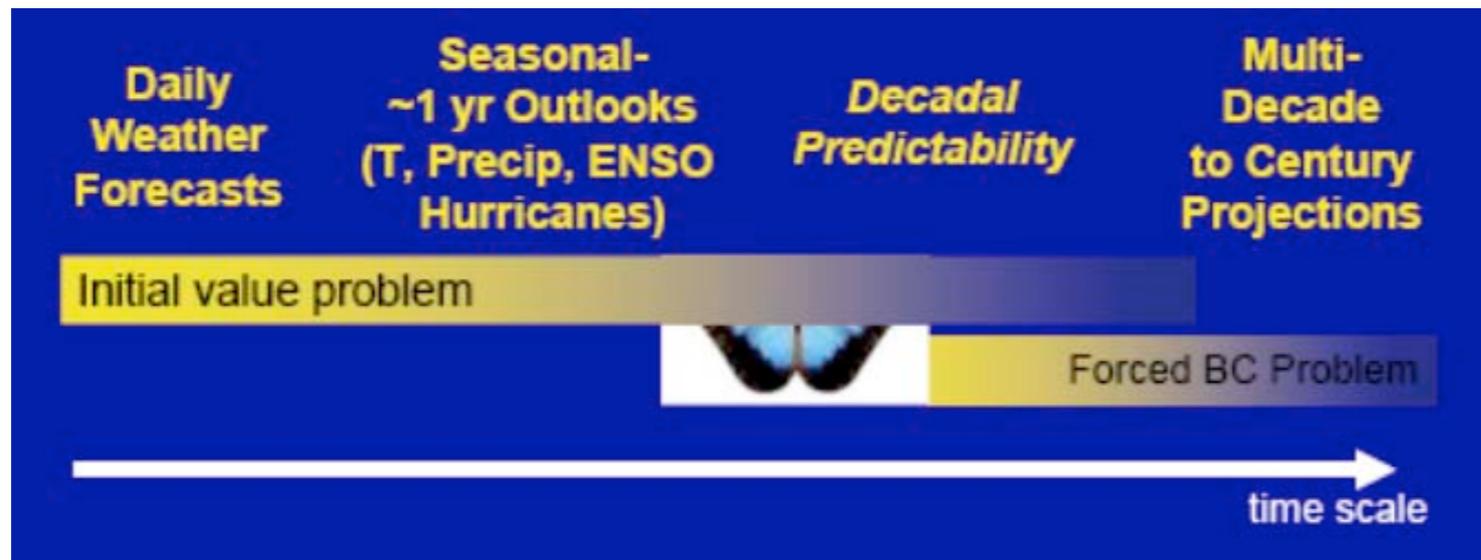
- Contexte: objectifs scientifiques
- Où en est-on ?
- Near term CMIP5



Journées MISSTERRE
12-13 mai 2009



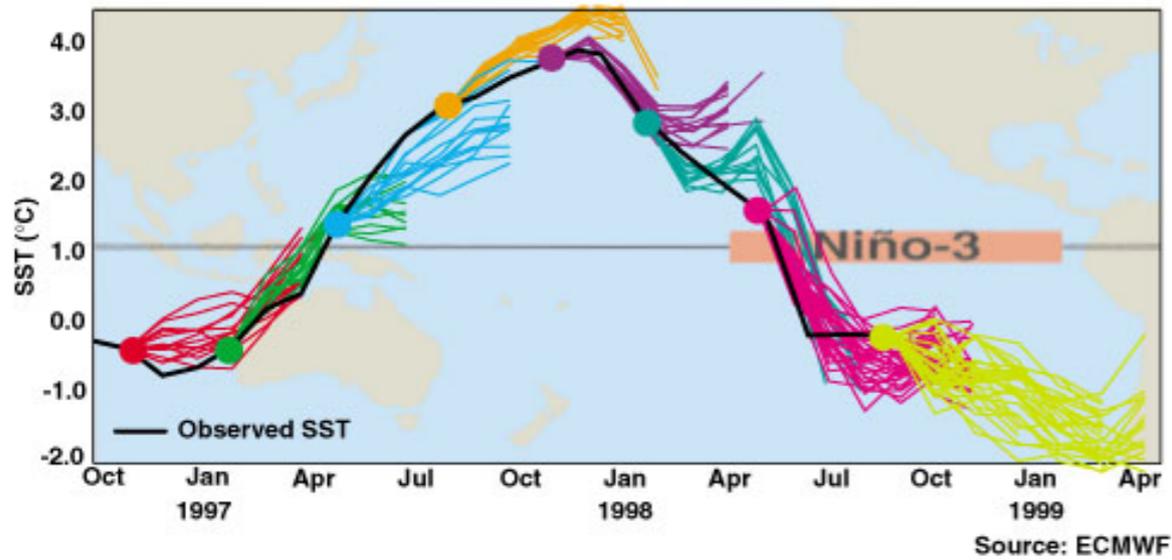
Motivations



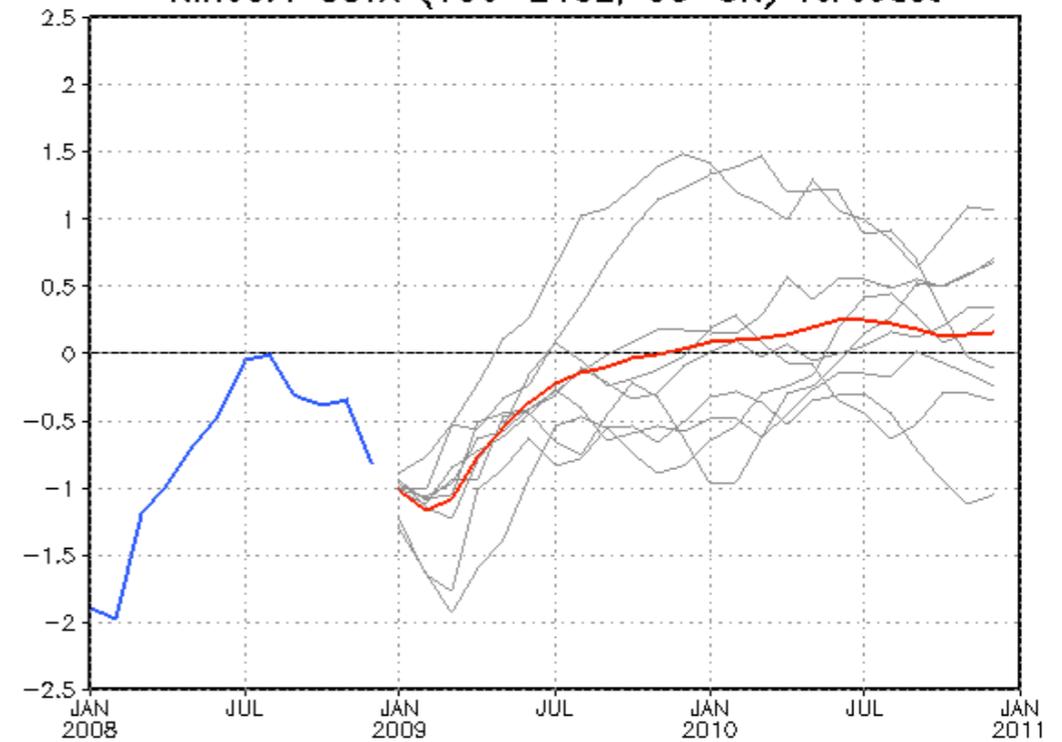
- Quelle prévisibilité saisonnière/inter-annuelle tropicale (6 mois à 2 ans)?
- Quelle prévisibilité du climat à 20-30 ans ?
- Corrolaire: qu'est-ce que cela nous apprend sur la physique et les biais des modèles ?

Prévisibilité d'ENSO

El Niño 1997/98
Seasonal Predictions

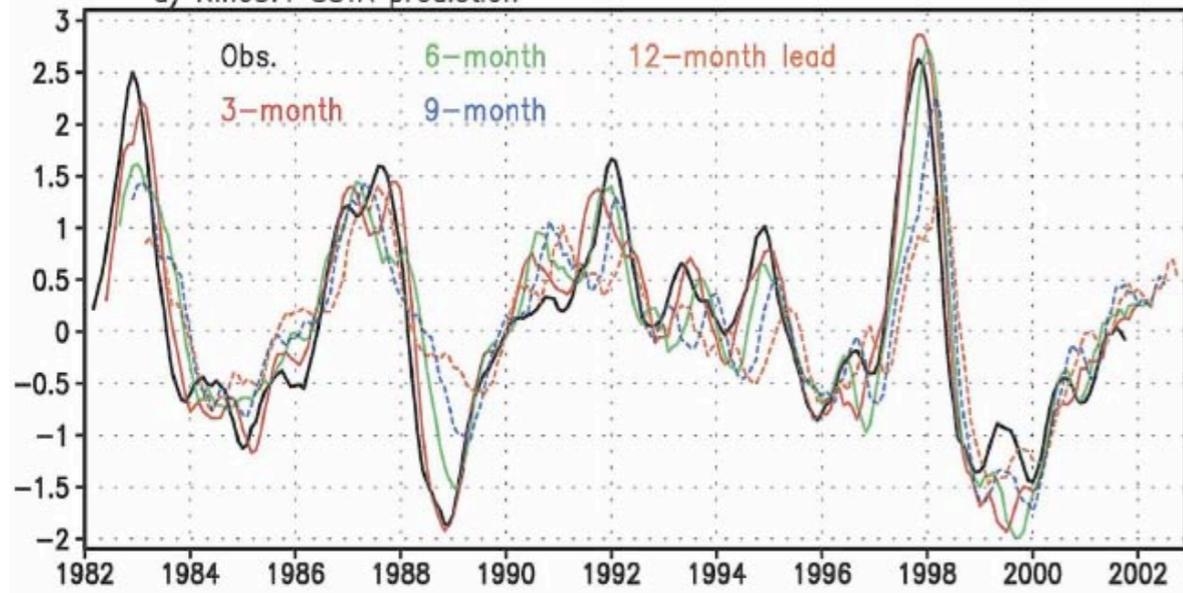


Niño3.4 SSTA (190–240E, 5S–5N) forecast



JAMSTEC forecast

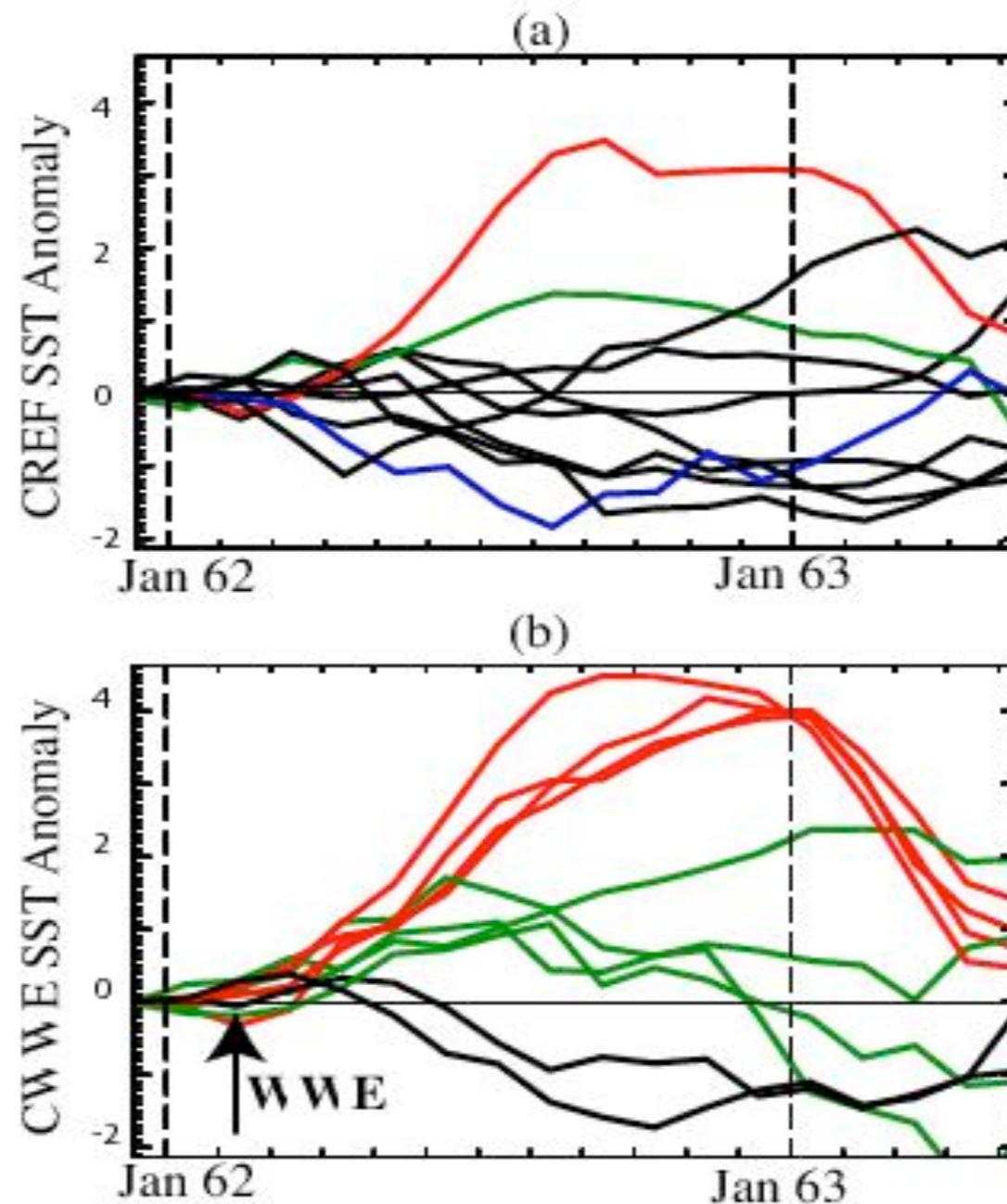
a) Niño3.4 SSTA prediction



Hindcasts
Luo et al. 2005

Prévisibilité d'ENSO

Impact of a westerly wind burst (WWE) on El Niño triggering in the HadOPA coupled GCM



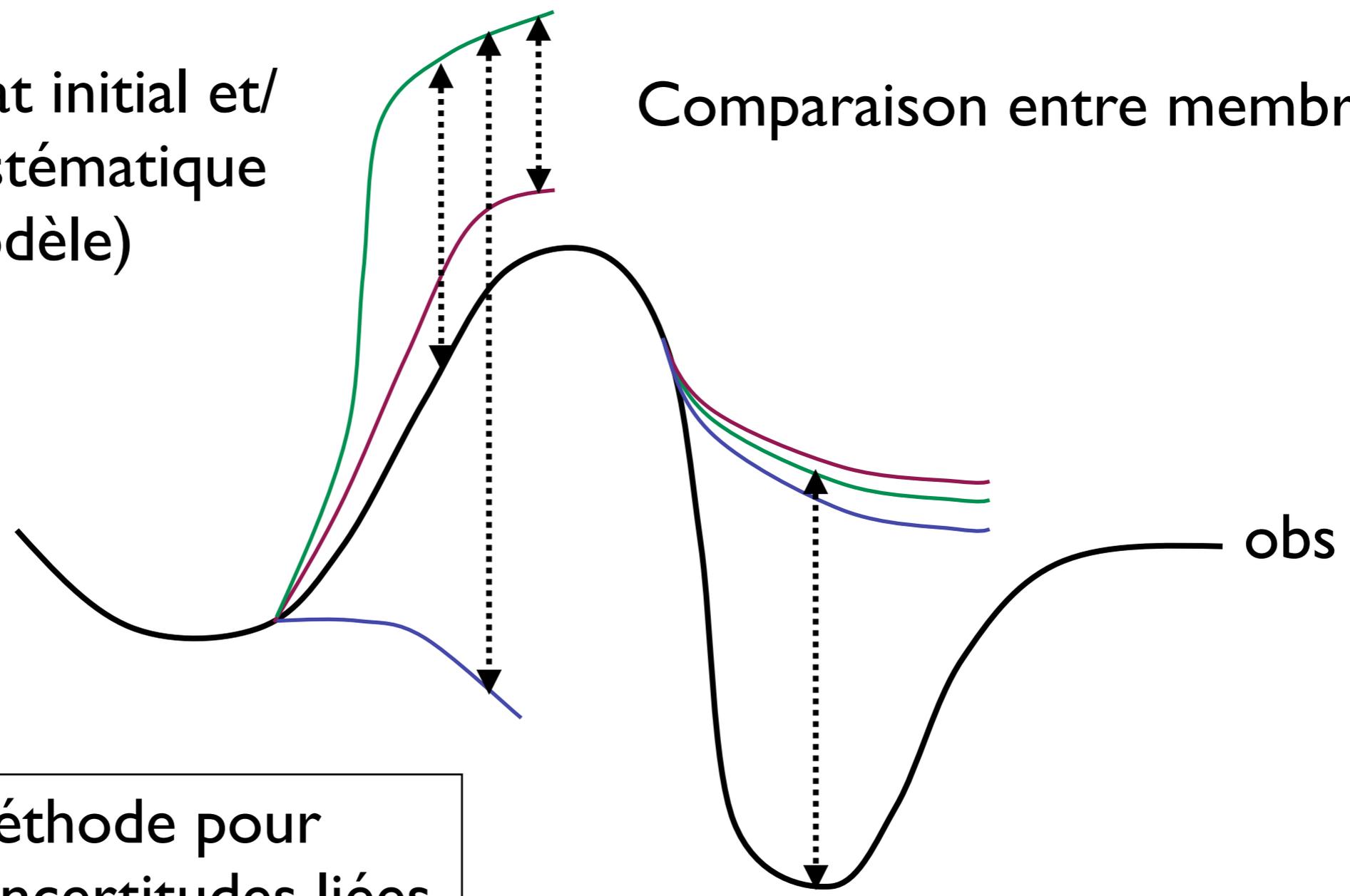
Peut-on prévoir l'occurrence des WWE ?

Lengaigne et al. (2004)

Analyse phase ajustement initial du hindcast

Sensibilité état initial et/
ou erreur systématique
(physique modèle)

Comparaison entre membres

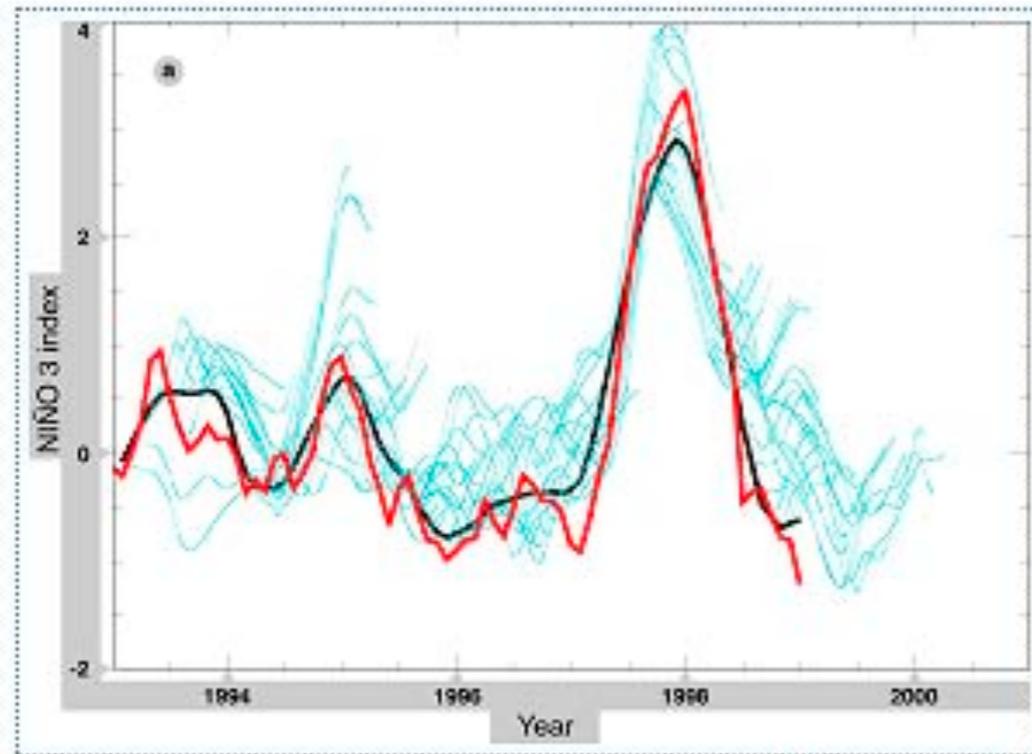


Nouvelle méthode pour
réduire les incertitudes liées
aux modèles

Comparaison aux observations

Sensibilité à l'initialisation

Using wind stress nudging



Using multivariate assimilation

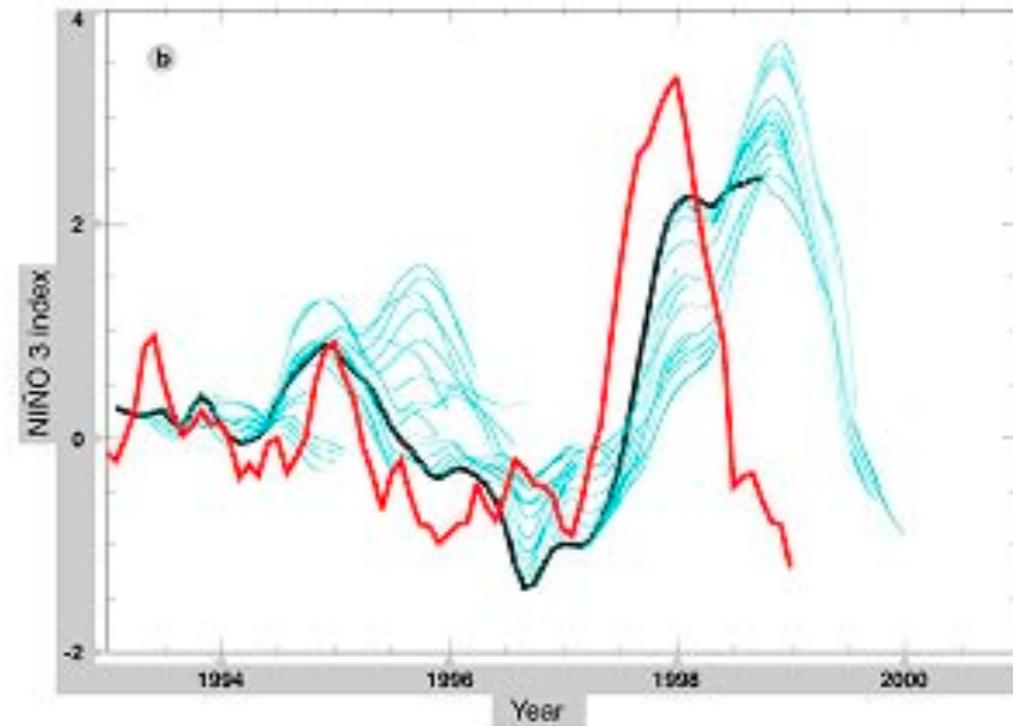
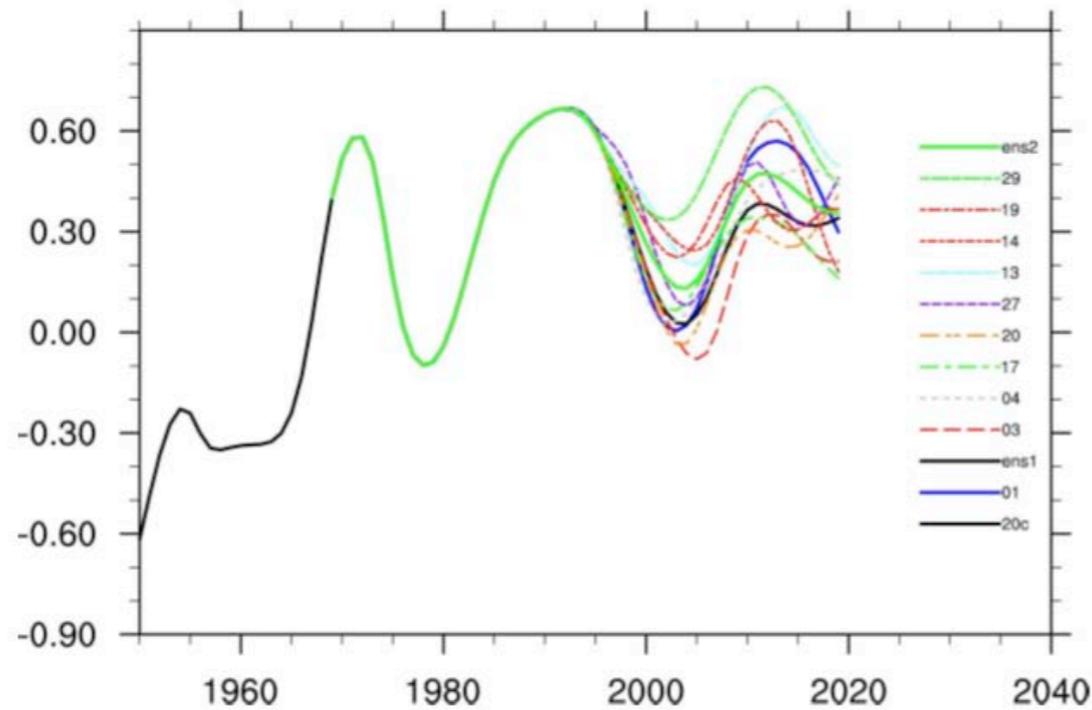


Figure 3: Hindcasts and forecasts (15 months) of the Niño 3 index for two different methods of data assimilation: nudging of wind stress (a), and multivariate assimilation using a reduced-order Kalman filter (b). Shown are the observed value (red line), the hindcasts (black line), and the time evolution of 15-month predictions starting each month (blue lines).

Ballabrera-Poy et al. 1981

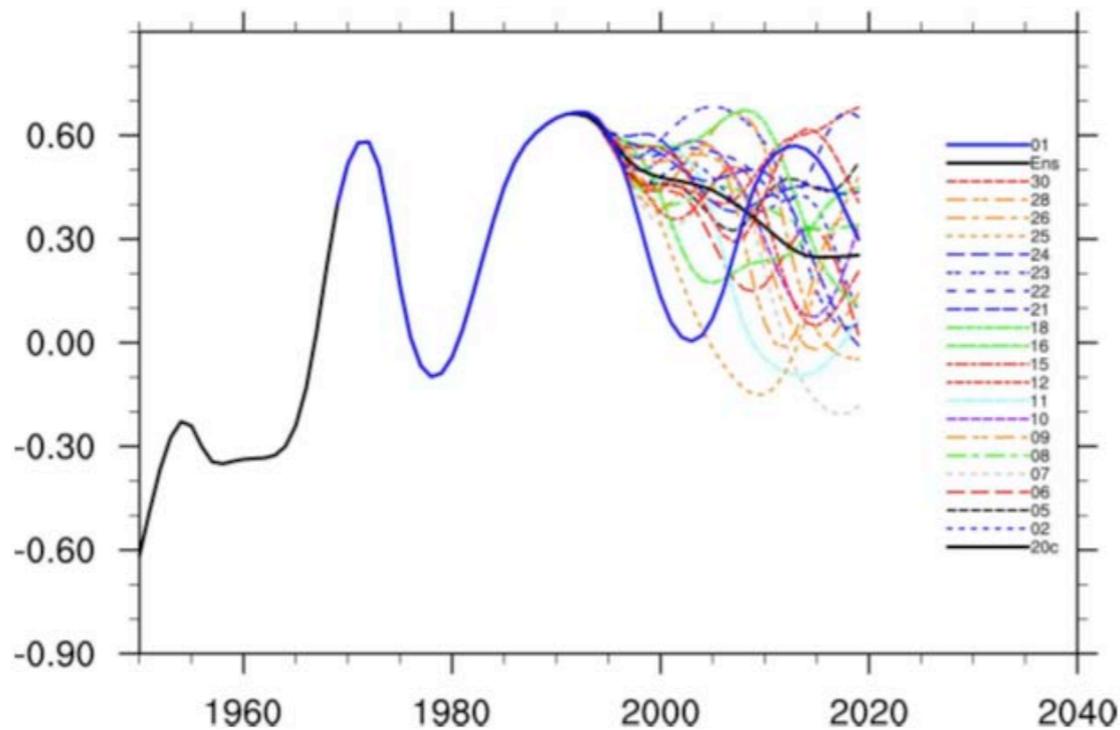
Sensibilité au modèle

Decadal predictions of IPO index for the Pacific
EOF2 pattern correlation (9 members)



Modèle 1 : ça marche

EOF2 pattern correlation (20 members)



Modèle 2 : ça ne marche pas

Impact modèle sur
prévisibilité ?

Projets scientifiques IPSL

- Décennal (cf. talk Juliette):
 - prévisibilité moyennes et hautes latitudes
 - prévisibilité tropicale
 - impacts sociaux économiques
 - (prospec. AO)
- Saisonnier à interannuel:
 - prévisibilité tropicale (ENSO), rôle initialisation, erreurs modèles,...
 - analyse phase ajustement initial du hindcast. Diff modèle -obs renseigne sur biais du modèle (thèse 2009)
 - + contribution à CHFP (WGSIP) et prévision ENSO (IRI)
- Utilisation simulations guidées

Developpements technologiques

- Resp: Sonia Labetoulle (INCAS, LOCEAN)
- Modifications chaîne couplé IPSL-CM5 pour:
 - modèle couplé nudgé par un fichier de SST
 - lancement du couplé mois par mois
 - calendrier 365 jours dans LMDz
 - simulations d'ensemble (bruit blanc sur SST)
- Résolution du modèle:
 - LMDz 144x142x39
 - ORCA2
 - plus haute dans un second temps
- Quelle initialisation pour le décennal ?

Analyse phase ajustement initial du hindcast saisonnier pendant ENSO

Stage M2 Benoît Vannière

- Quels mécanismes responsables de la dérive du modèle ?
(vs. runs de 100 ans)
- Stream 2 d'ENSEMBLES

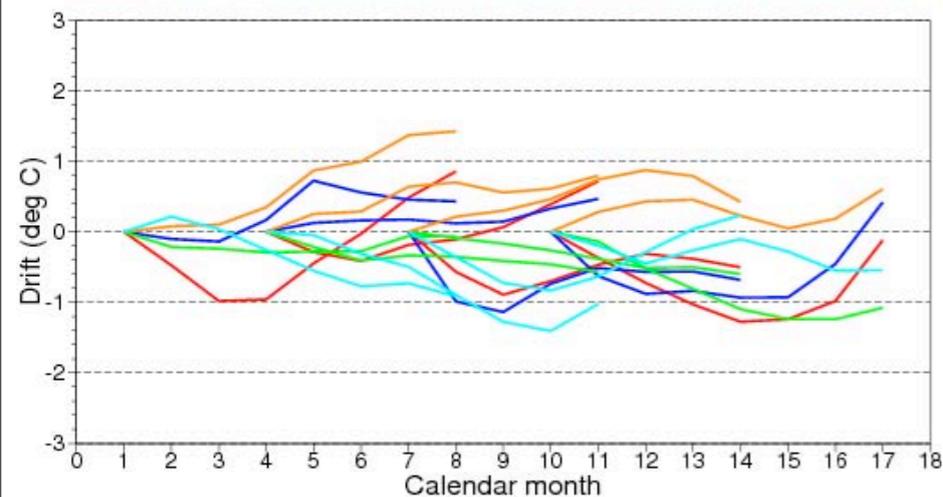
Seasonal-to-decadal hindcasts

- seasonal (7 months), annual (14 months) and decadal (10 years) hindcasts using ensembles of fully initialised state-of-the-art coupled models
- hindcast period: 1960 to 2005
- start dates: seasonal: Feb, May, Aug, Nov every year
annual: Nov every year
decadal: Nov every 5 years
- multi-model and perturbed physics ensembles

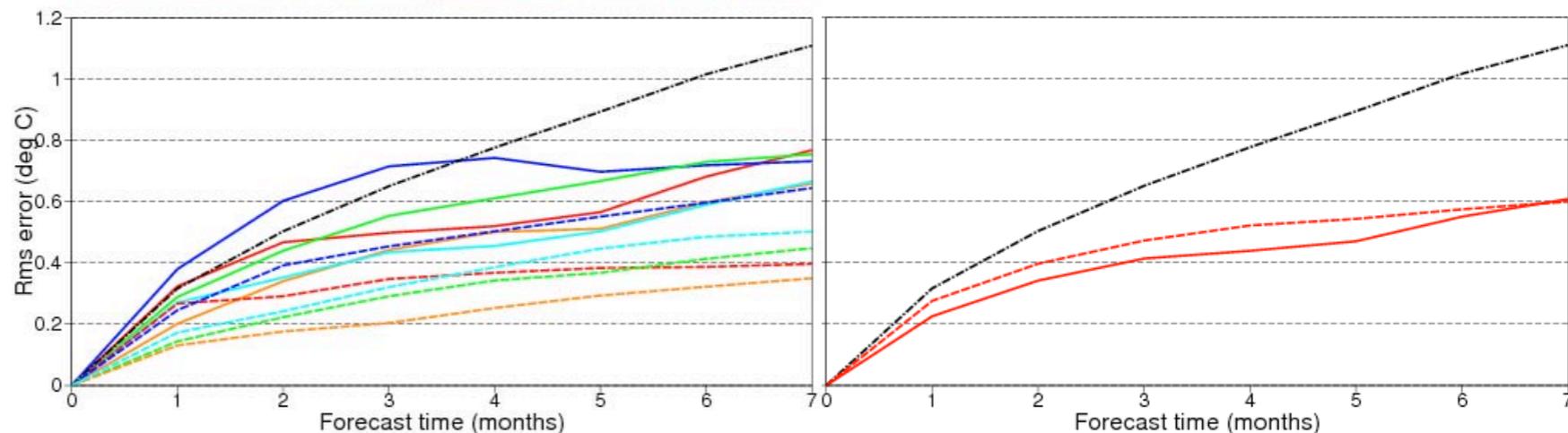
Courtesy Paco Dobblas-Reyes & Antje Weisheimer

ENSEMBLES multi-model: Niño3 SST

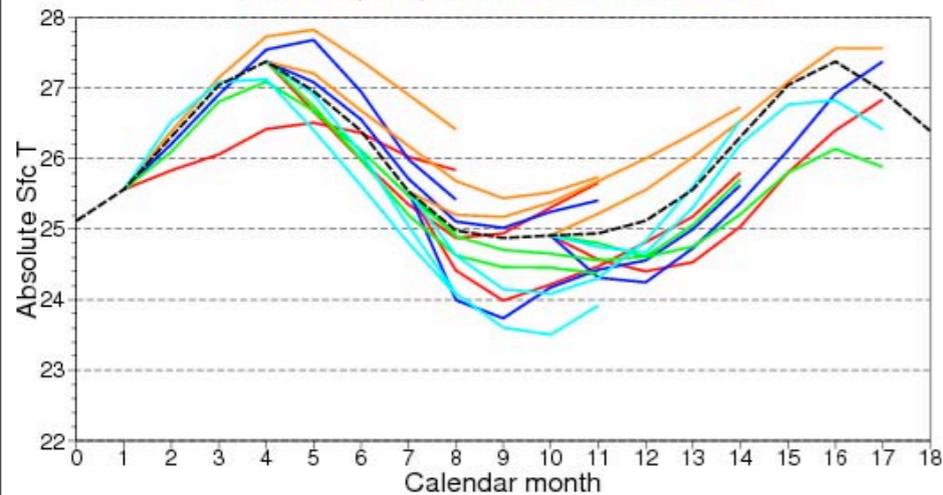
SST drift



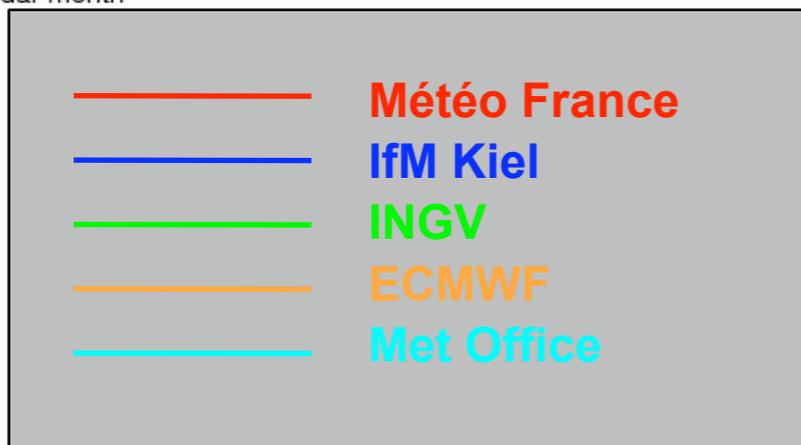
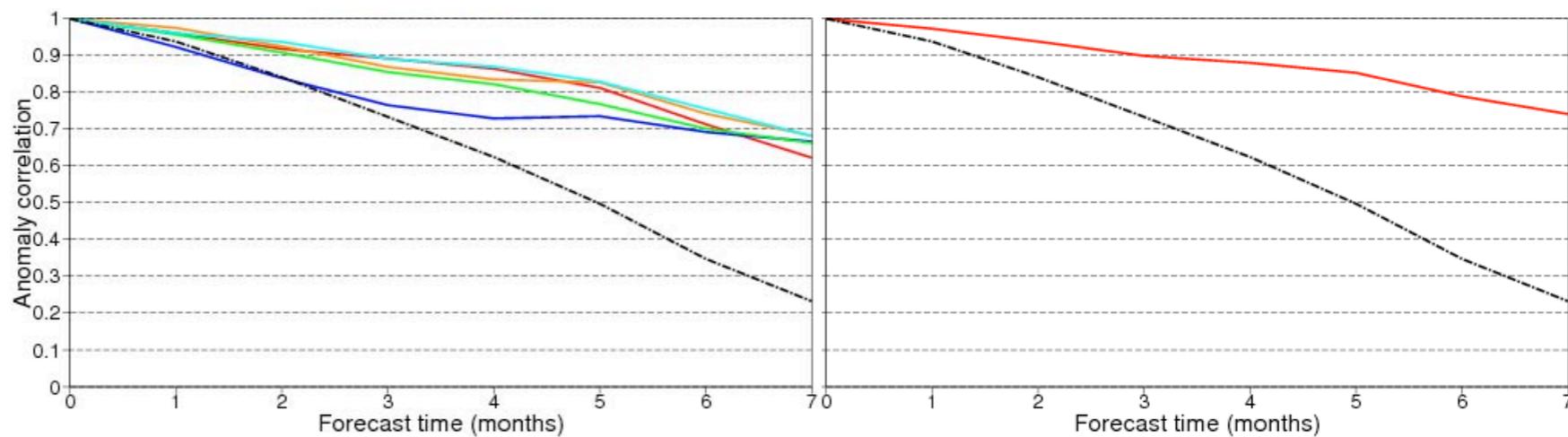
RMSE and ensemble spread



NINO3 (sea) mean absolute Sfc T

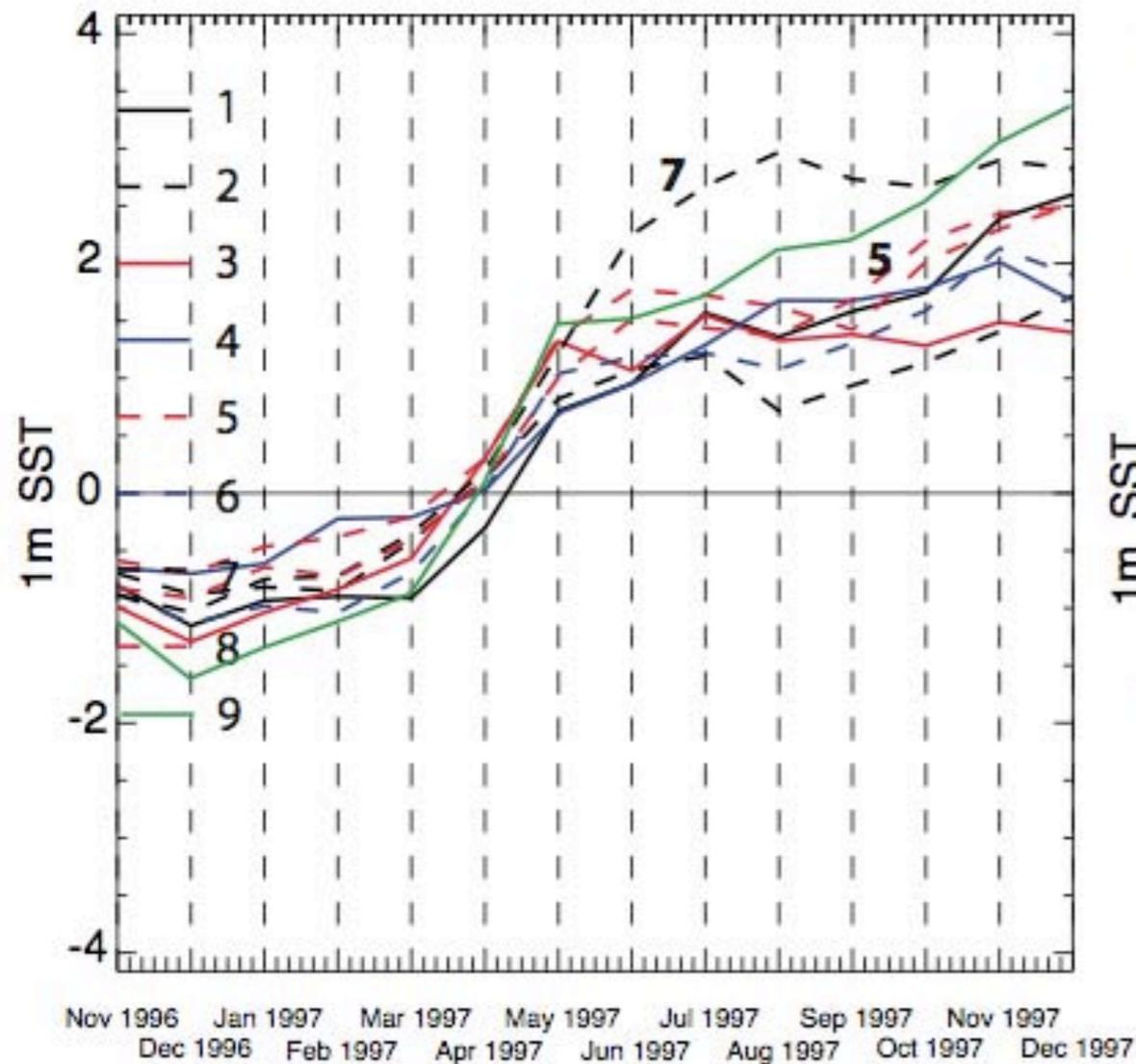


anomaly correlation

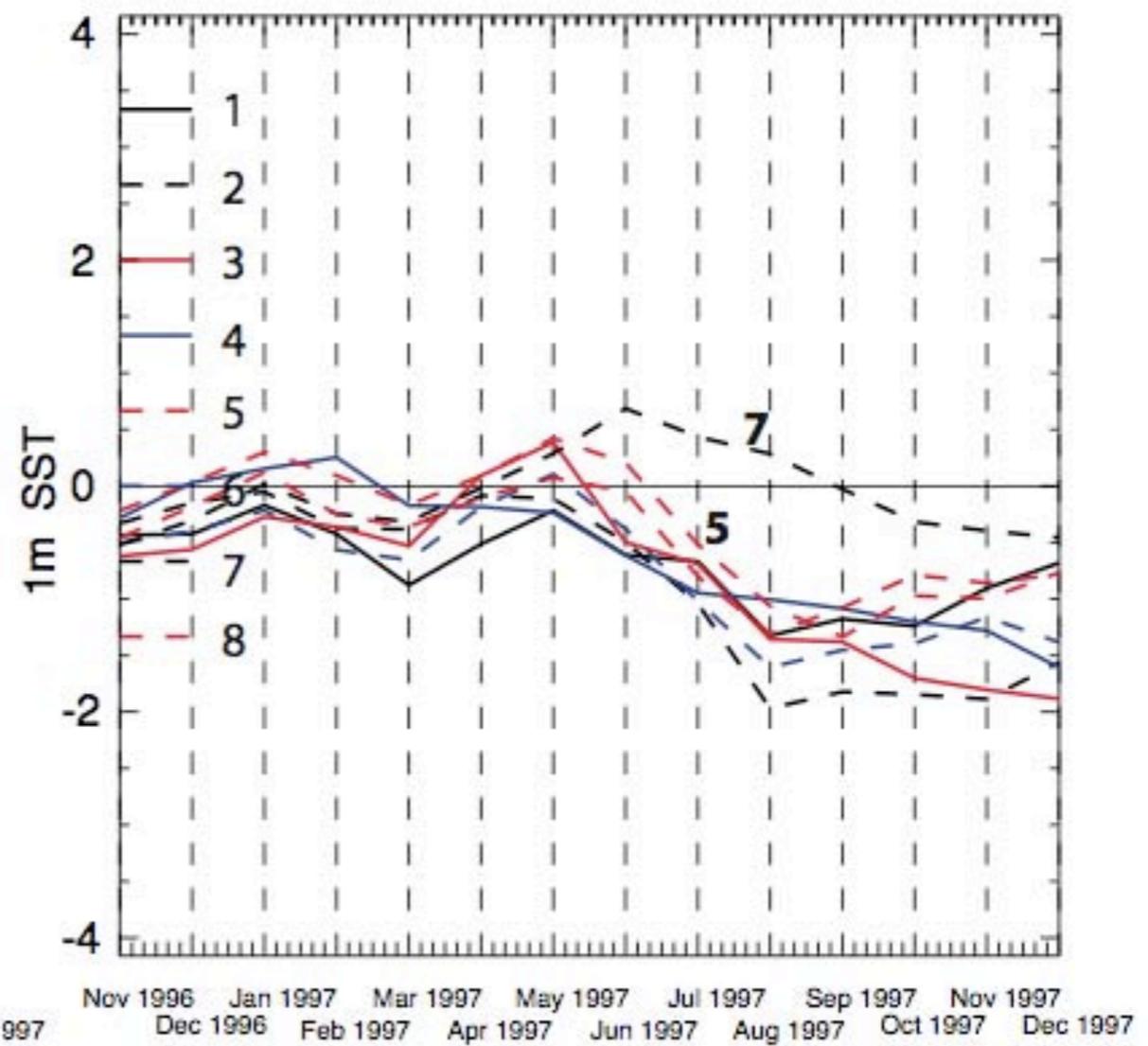


Exemple 1: El Niño 1997-1998 dans le modèle de l'IFM

IFM ensembles SSTA in nino 3

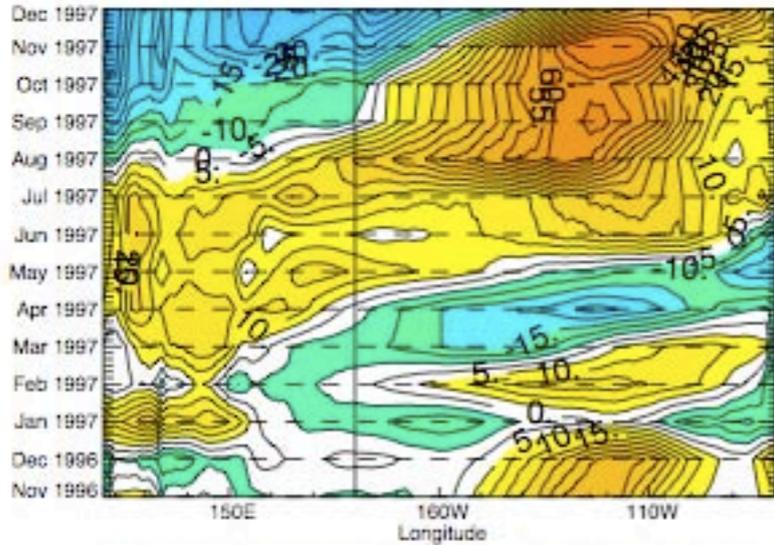


IFM-ERA40 ensembles SST error in nino 3

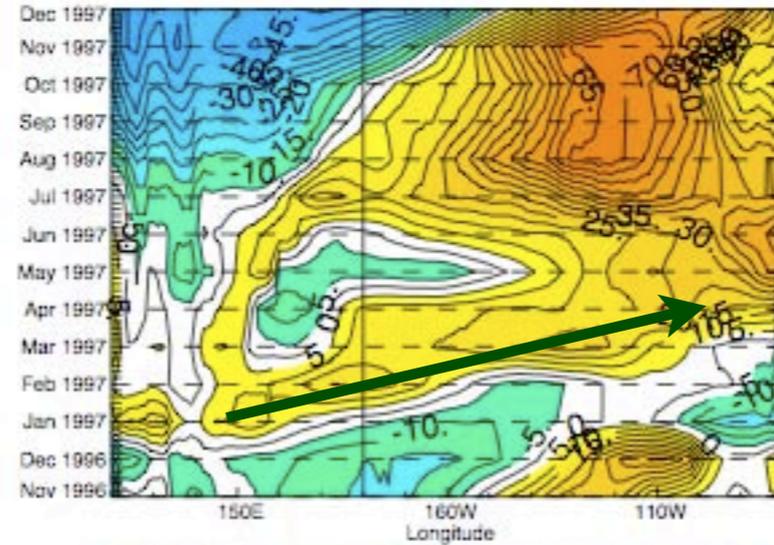


El Niño 1997-1998 dans le modèle de l'IFM

IFM ensemble member 5

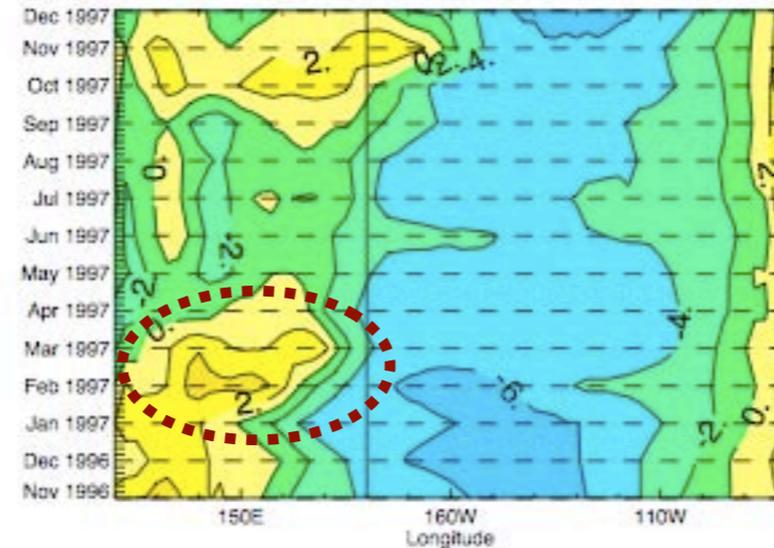
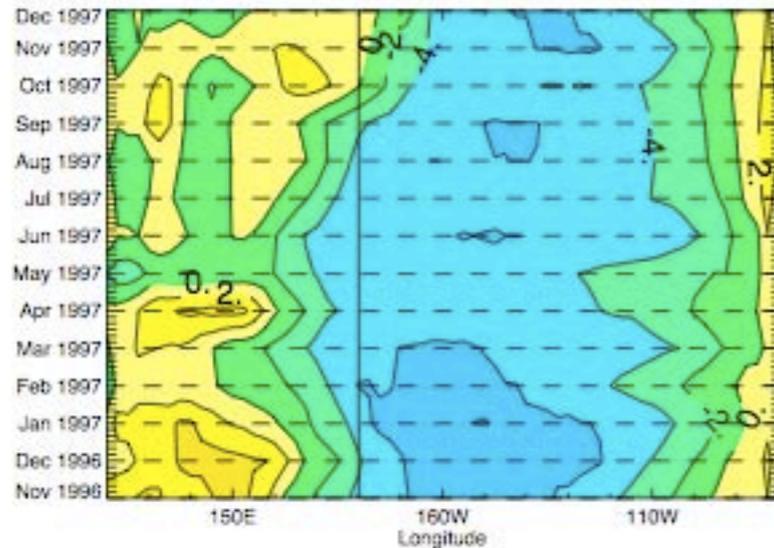


IFM ensemble member 7



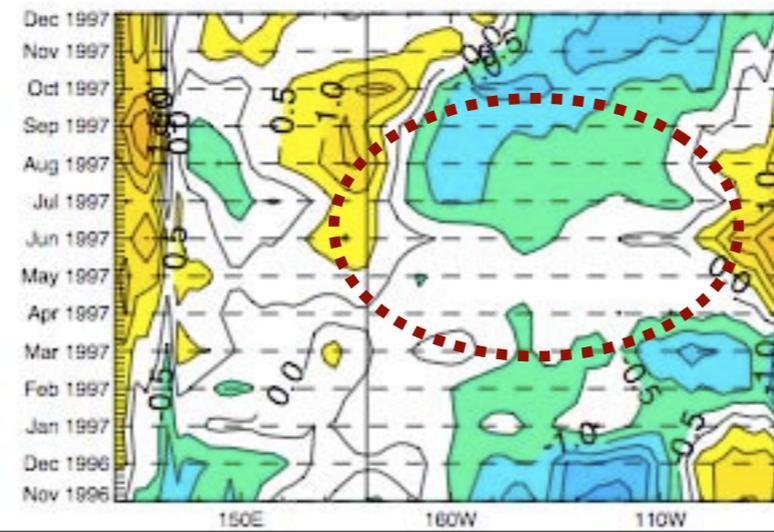
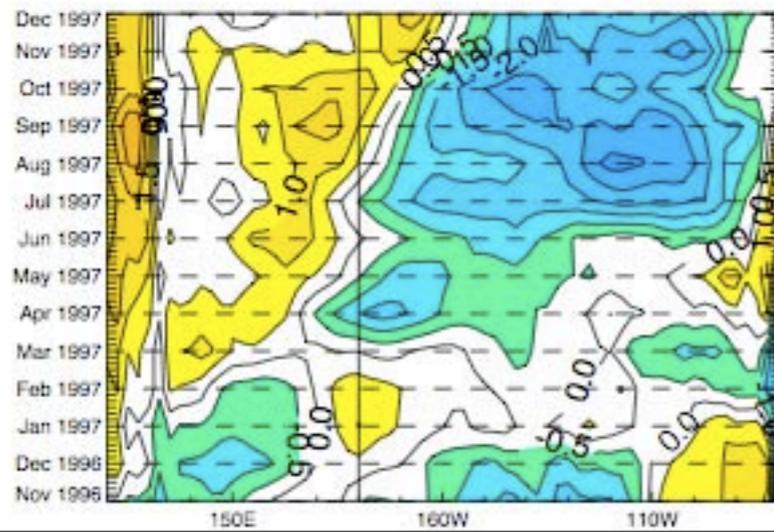
D20
anom

Onde Kelvin
au bon moment



Taux

WWE en fev. 97
(obs: mars 97)

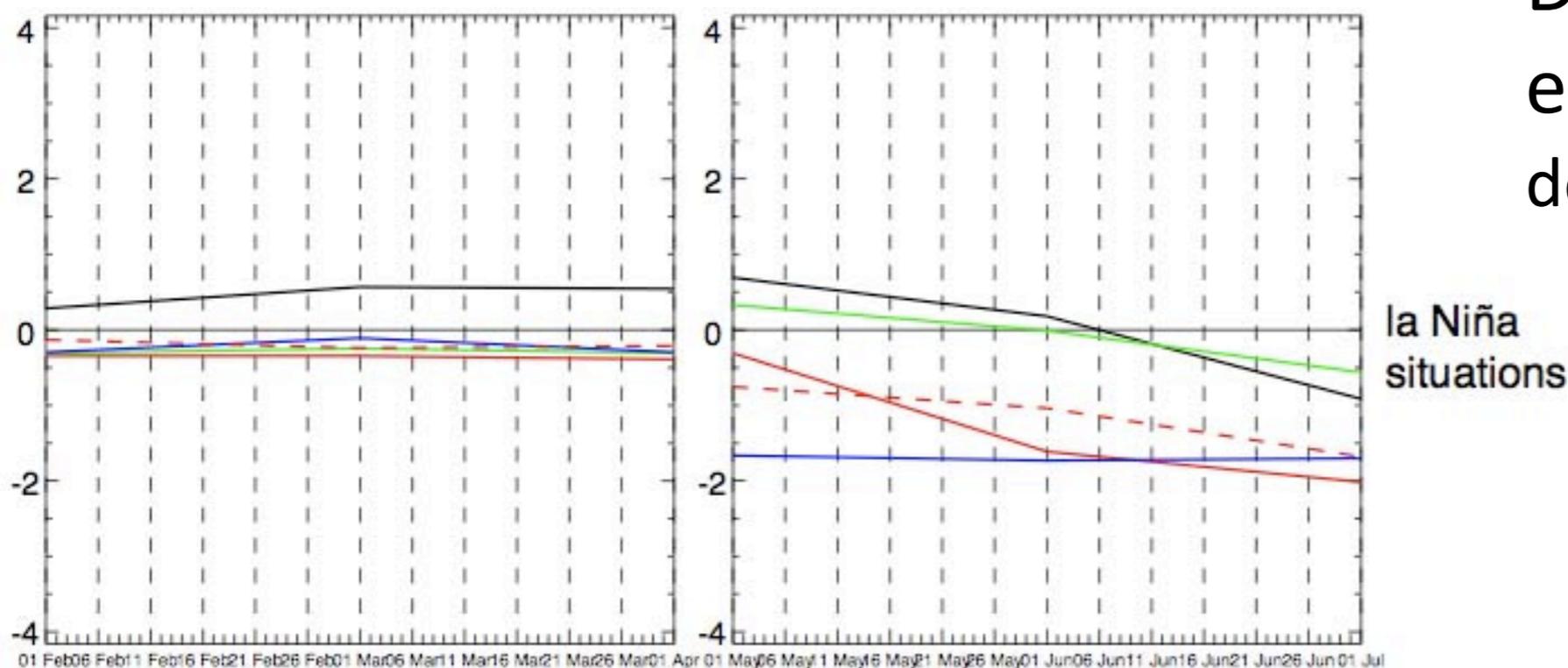
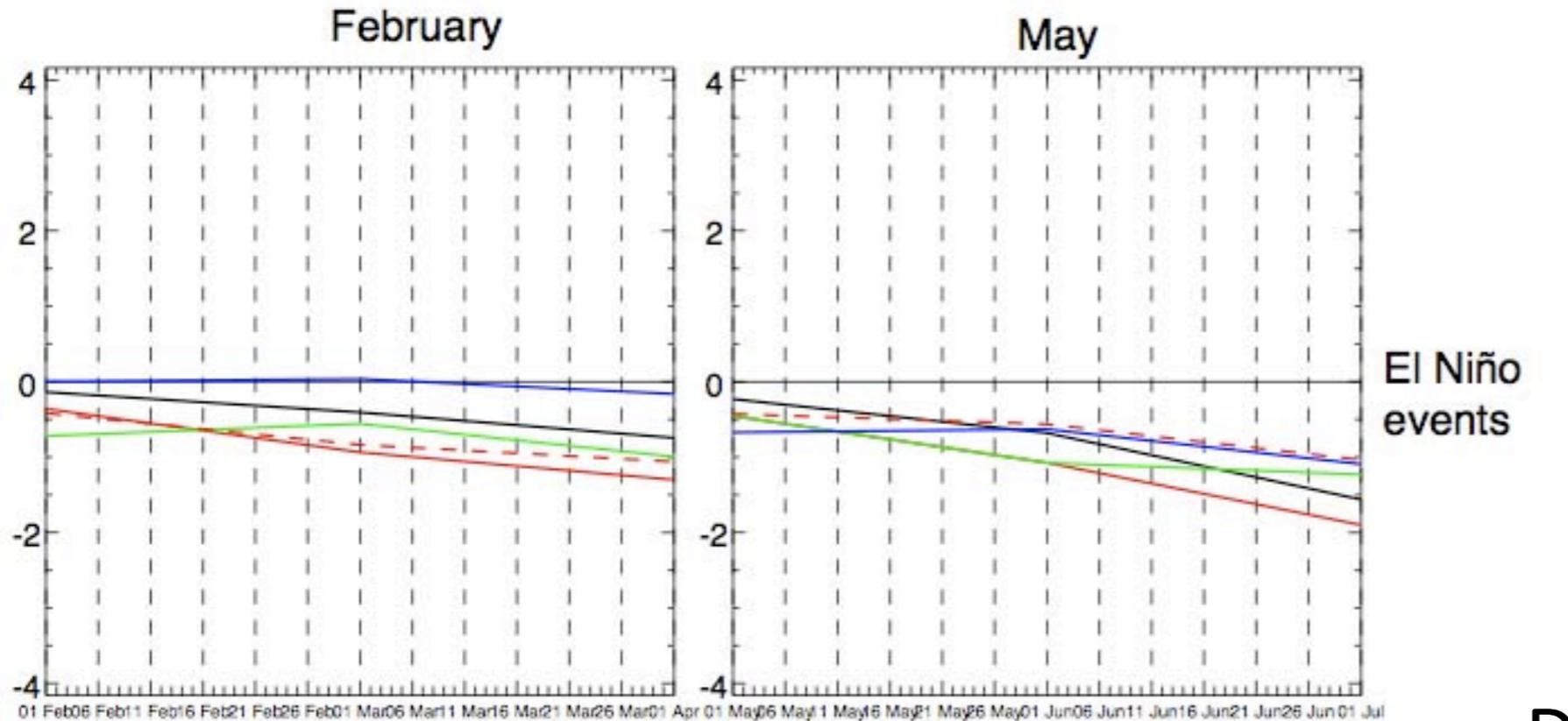


SST
error

Erreurs SST faibles

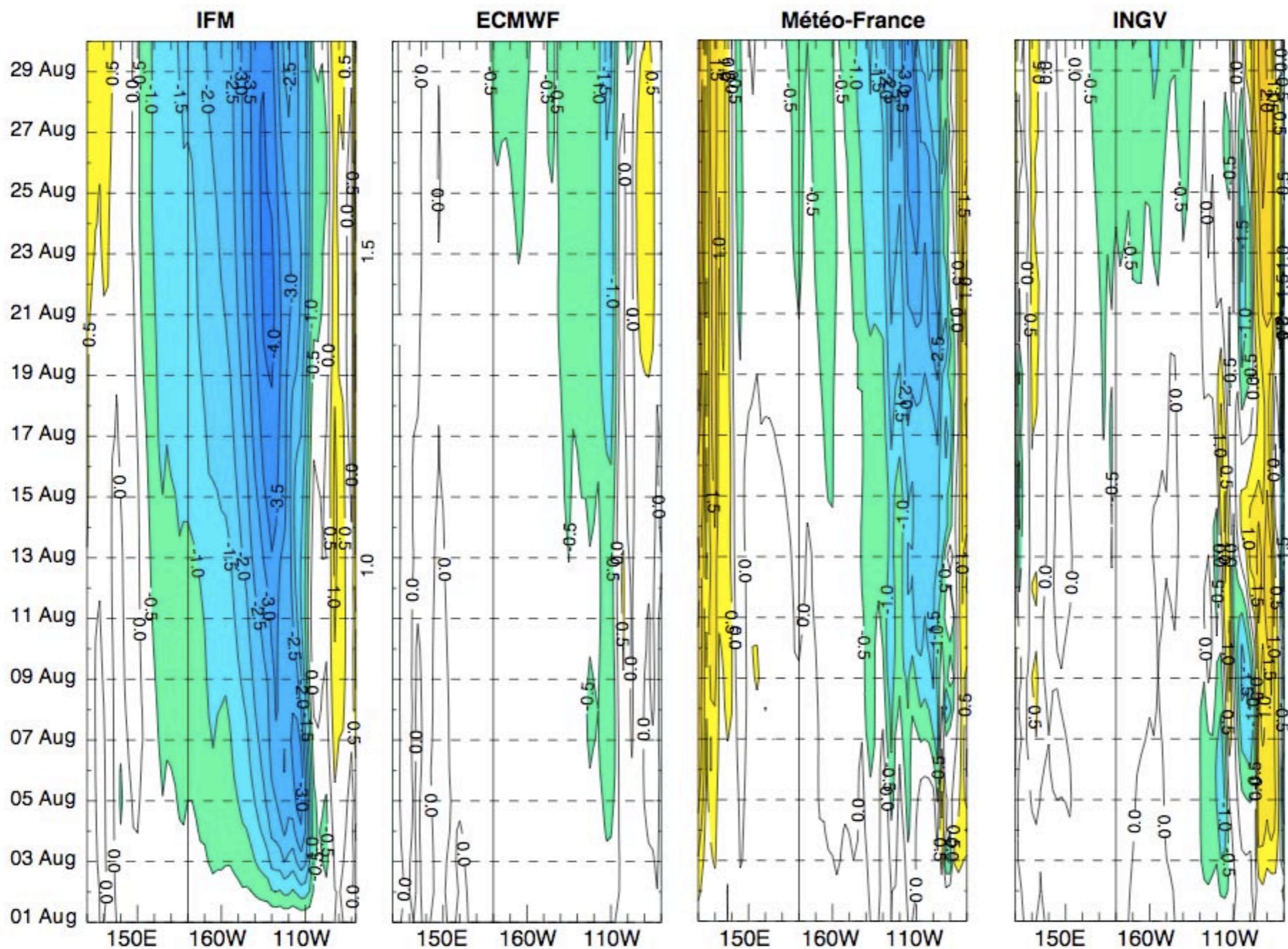
Exemple 2: ajustement 3 premiers mois

El Niño vs. La Niña (INGV)



Dérive La Niña forte en mai (état initial ou dérive en qq jours ?)

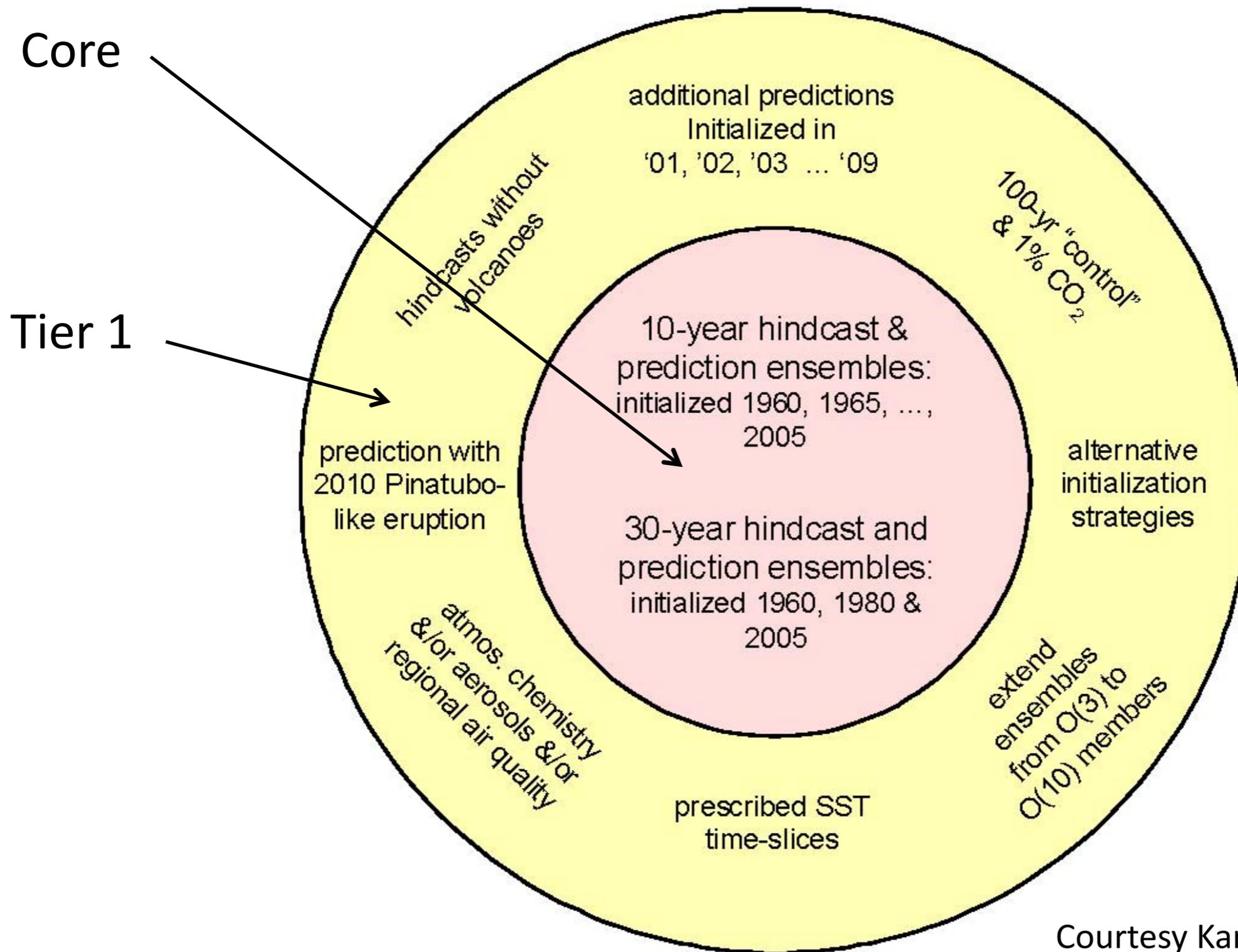
Exemple 3: vitesse de developpement de l'erreur en SST



qq jours !

Juliette

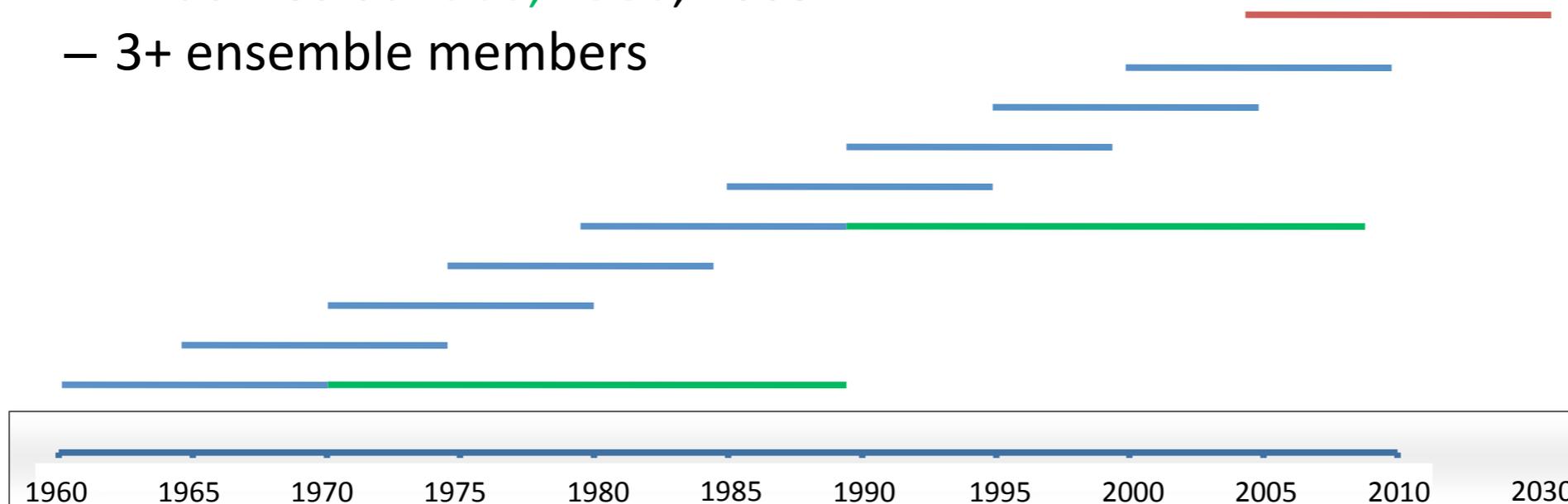
Near Term Experiments in CMIP5



Courtesy Karl Taylor

Near Term - Core

- 10 year hindcasts + forecasts
 - Initialized at 1960, 1965, 1970 ...
 - 3+ ensemble members
- 30 year hindcasts + forecasts
 - Initialized at 1960, 1980, 2005
 - 3+ ensemble members



Courtesy Ron Stouffer

Near Term – Tier 1

- Increase ensemble size to 10+
- Investigate alternative initialization methods
- 100 yr control and 1% run (if not doing long term experiments with same model)
- Runs initialized in 200X
 - 2001, 2002, 2003, 2004, 2006, 2007, 2008, ...

Near Term – Tier 1

- Investigate role of short live species
- Prediction with Pinatubo-like event in 2010
- Hindcast without volcanoes

Near Term – Tier 1 Time Slice Experiments

- Time periods
 - AMIP (1979-2008) and 2026-2035
 - Overlap with decadal prediction expts
- High atmospheric resolution
- Atmospheric chemistry experiments
- Study regional impacts
- Study extreme events

Evaluation besoins near term

- Core (500 yrs):
 - 10 year ensemble hindcasts/forecasts: init 1960, 1965, ... 2005 (10 inits x 3+ ensembles) = **300** yrs
 - 30 year ensemble forecasts/hindcasts: init 1960, 1980, 2005 (3 inits x 3+ ensembles) = **180** yrs (90 already made above)
- Tier I (intérêt IPSL):
 - Increase ensemble members to 10+ (**+1000** yrs)
 - Investigate alternative initialization methods (**+500** yrs)
 - 100 yr control and 1% run (if model different from Long Term model) (**+100+170** yrs)
 - autres ?
- Time slice experiments (?)

Quelle(s) configuration(s) ?

- 15% SX8 = 96000h CPU / 8000h elapsed / 12 procs

Config. IPSL-CM5	Coût 10 ans (CPU/elap/procs)	N years / year
96x71x19 - ORCA2	60h / 19h / 4 p	16 000
144x142x19 - ORCA2	210h / 28h / 8 p	4500
144x142x19 - ORCA05	810h / 50h / 16 p	860
280x280x19 - ORCA2	1300h / 100h / 16 p	540
280x280x19 - ORCA05	1900h / 150h / 16 p	375

Proposition de runs

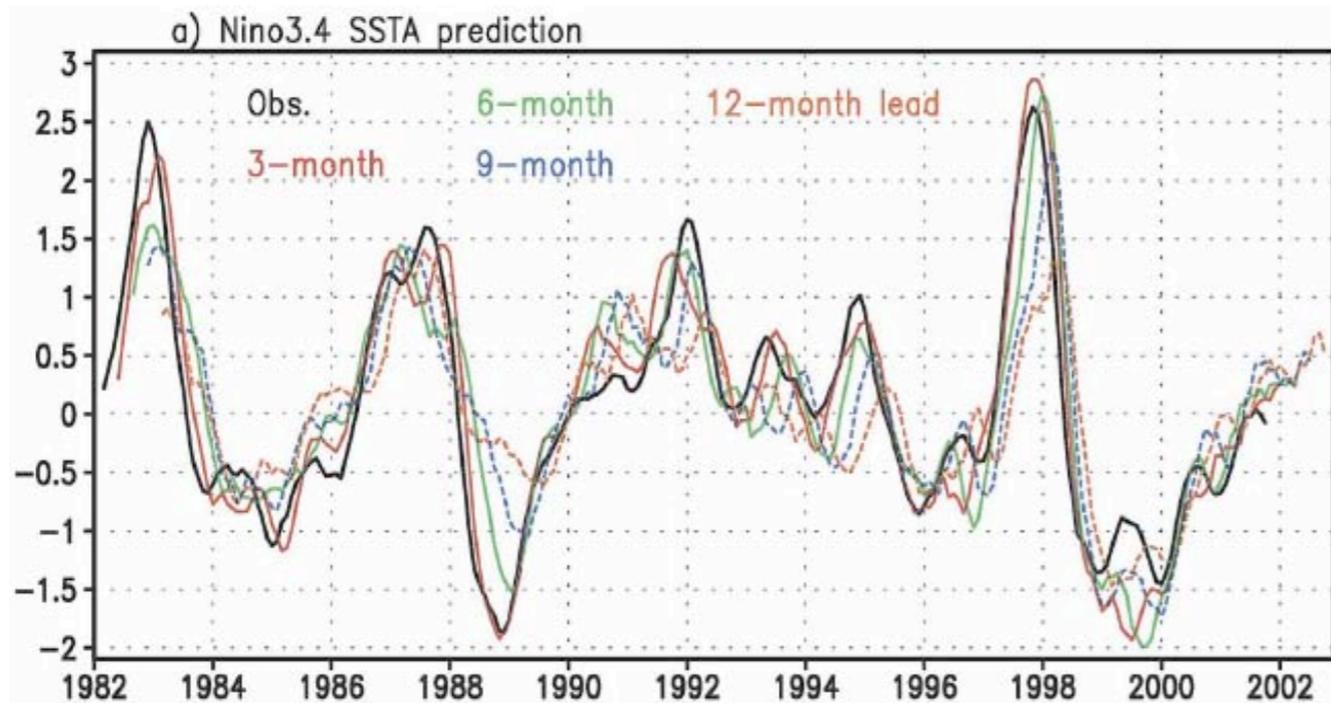
- Année 1 (2009):
 - Core en resolution 144x142x19 - ORCA2
 - Tests en plus haute resolution Atmos (280x280) et Ocean (ORCA05)
 - Tier 1:
 - soit “alternative initialization methods” (coord. CERFACS)
 - soit Core en plus haute resolution
 - (nombre membres en + fonction premiers resultats avec 3)
 - 2000 ans 144x142x19 - ORCA2 ok en 6-8 mois
- Année 2 (2010):
 - Core (ou subset suivant coût) avec "nouveau" modèle (objectif: IPSL-CM6-HR)

Discussion

- Projets scientifiques
- Mise au point modèles
- Stratégie d'initialisation
- Prochains RDV

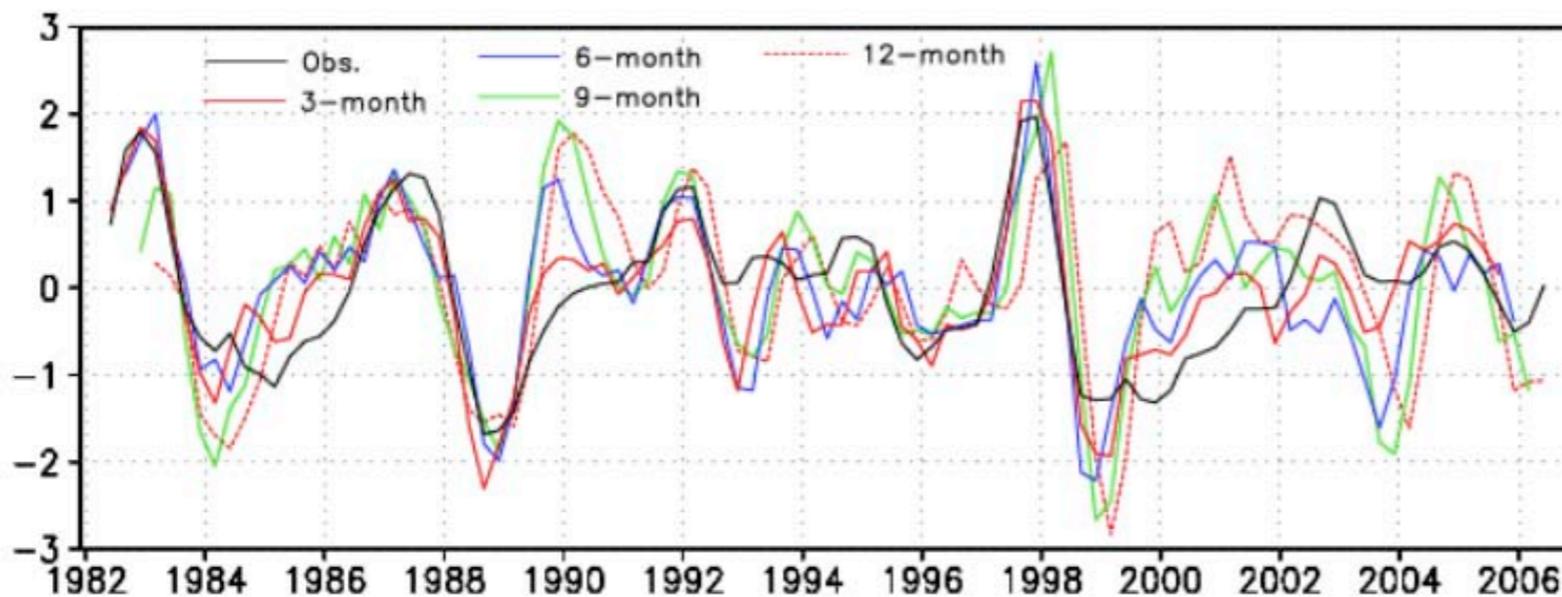
Initialisation for CMIP model

- SST nudging, wind stress nudging, combination ?



Luo al. 2004

SINTEX-F T106 (SST nudged)



Yan, Yu et al. 2008

FGOALS-g1.1 (SST nudged)