Seasonal Forecast: What is it ?

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SWIOCOF

On-line PreCOF

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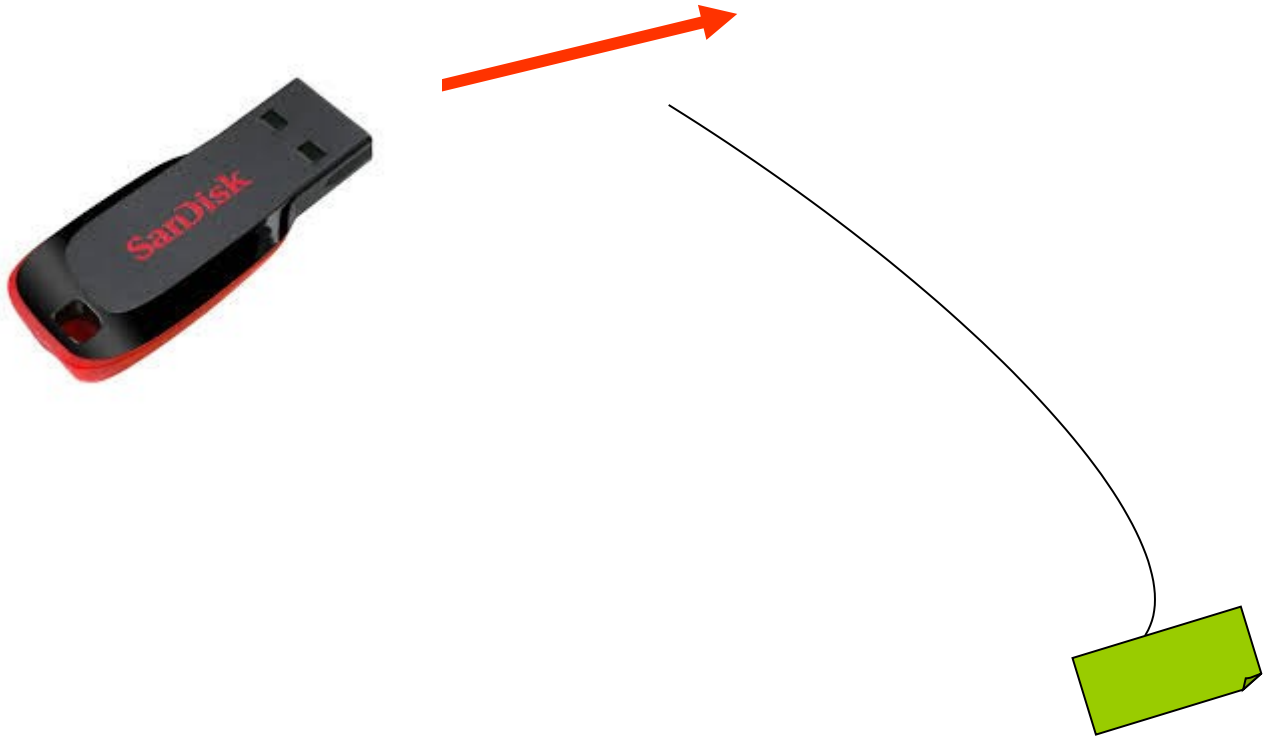
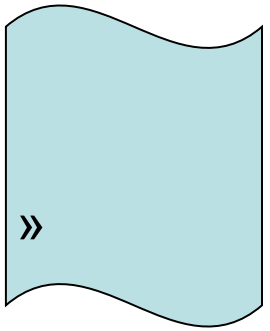
The Predictability



« The memory stick will land …. **on the mark at the ground** »

realistic ; one can trust such kind of forecast

The Predictability



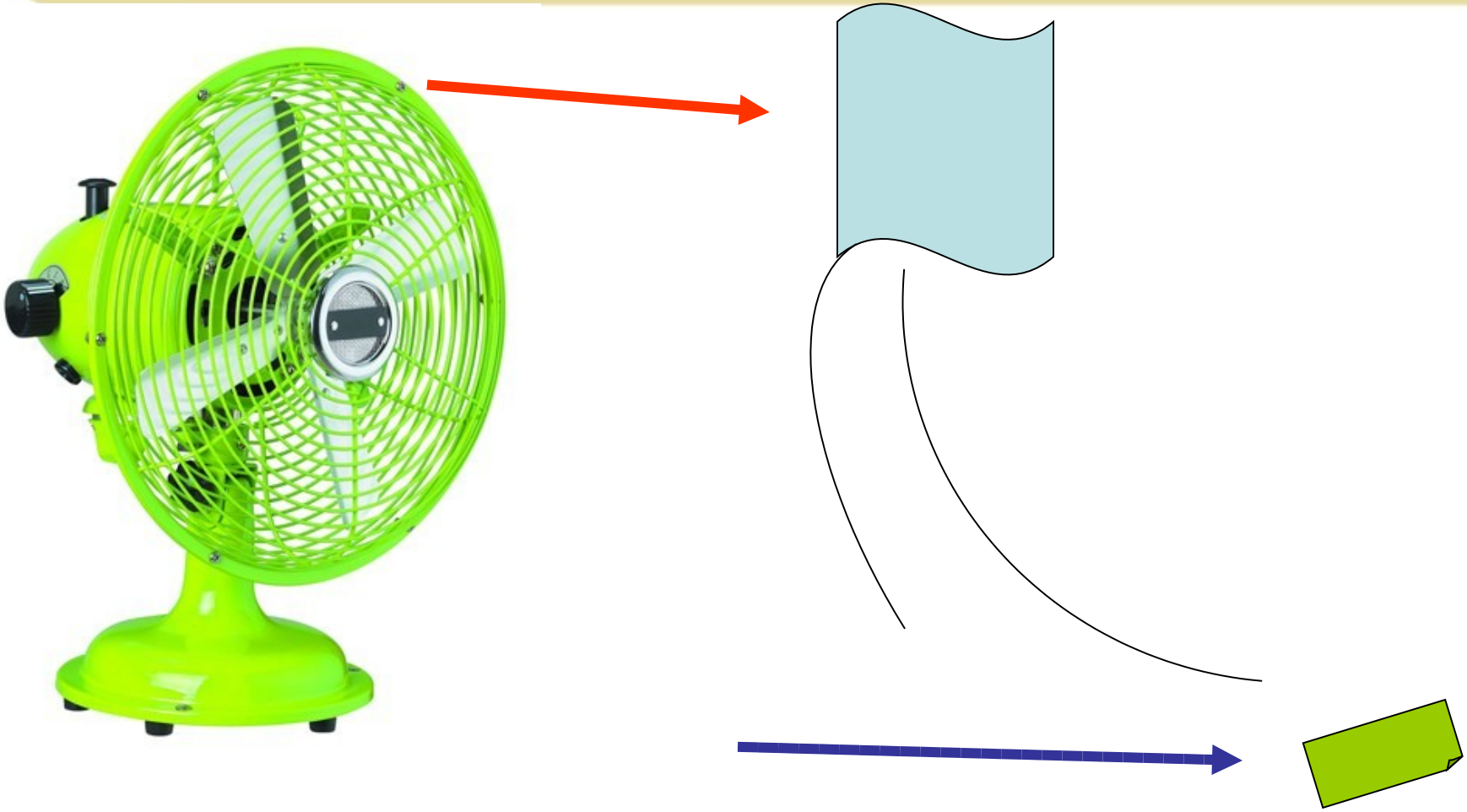
« The paper sheet will land … **on the mark at the ground** »

➡ **Not realistic, we can't trust such kind of forecast**

« The paper sheet will land …. **likely « close to »** the mark at the ground

➡ **More realistic ; one can better trust such kind of forecast**

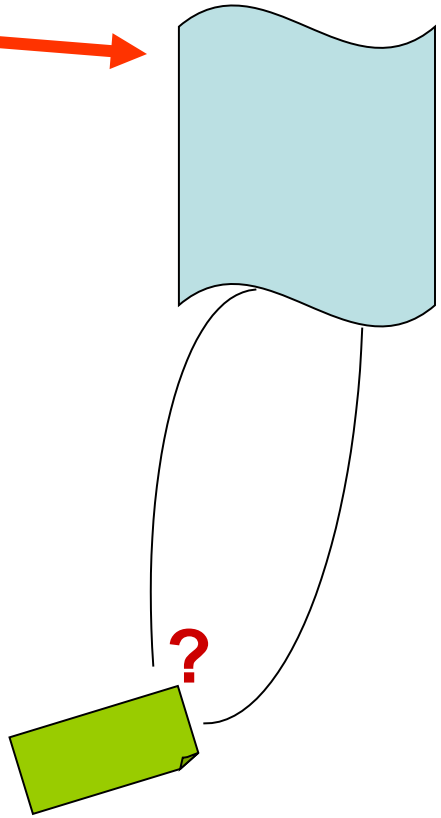
The Predictability



« The paper sheet will land …. **likely on my left** »

The Predictability

Pacific



Atlantic

Indian Ocean

In the climate system there are several « fans » ; especially the Pacific but also the Indian Ocean and the Atlantic
They can interact so that the regional / local signal can be sthrengthened or weakened

The Scientific bases

- The evolution of the atmosphere is partly driven by the evolution of external forcing conditions (SST and continental surfaces) which force the atmosphere to adjust its behaviour to these constraints.
- The evolution of external forcing is often slow and predictable. It gives a slow memory to the atmosphere, the evolution of the latter becoming partly predictable.
- The weather (successive instantaneous states) of the atmosphere have a limited predictability while the Climate (mean states) of the atmosphere have a greater predictability.
- The mean circulation in tropical regions is strongly inflenced by the large scale convection, itself being very sensitive to SST conditions.

The Seasonal Forecast

- **Probabilistic nature of the forecast,**

The Seasonal Forecast

Chaos and ensemble forecast

Uncertainty Sources :

- Differences between analysis and real initial state
  - Assimilation system Imperfection
  - **Lack of observations**
- Model Errors (both Oceanic and atmospheric but also coupling)
- Natural variability of the climate system
- *Interpretation of the forecast*

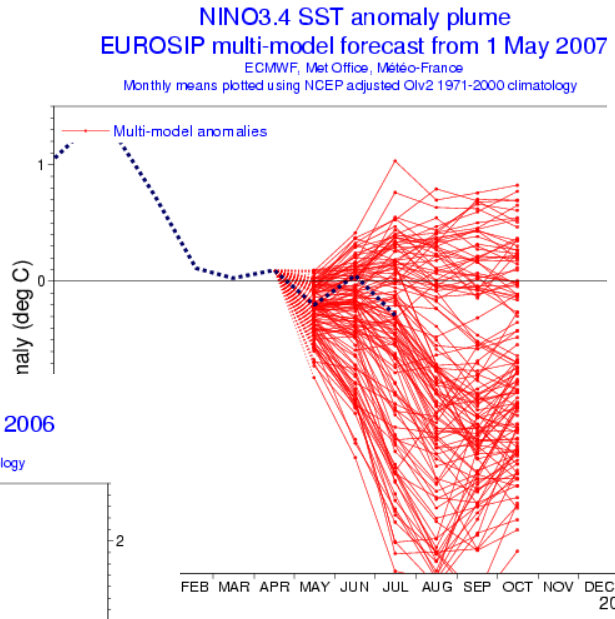
On-line session

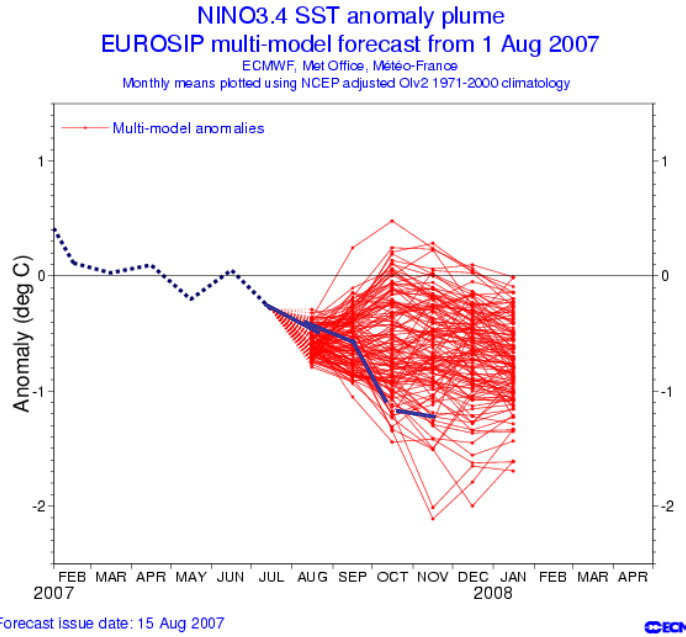
The Seasonal Forecast

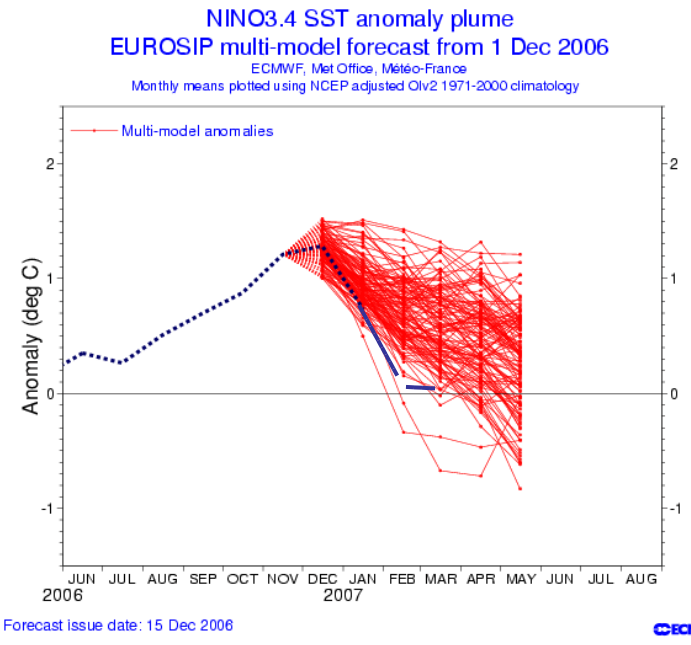
2006/2007 :

- SST forecasts

To sample uncertainties which are inherent to the forecasts







- **Ensemble forecast**
- **Multi Model Ensemble forecasts**

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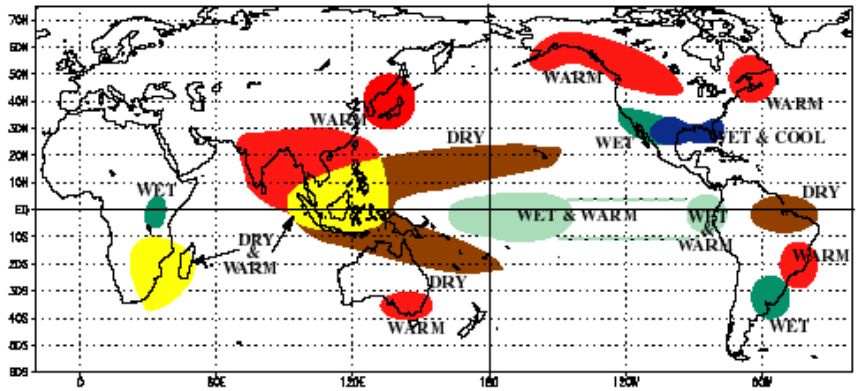
Reliability and Skill

- **Reliability depends on the region**

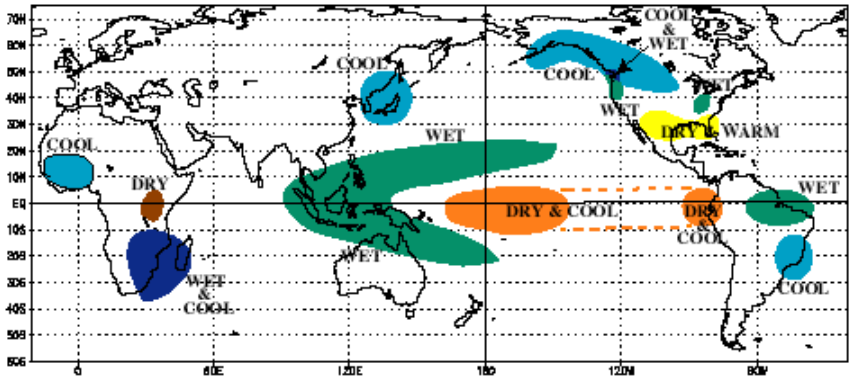
ENSO influence

Planetary influence of El Niño (left) and La Niña (right)

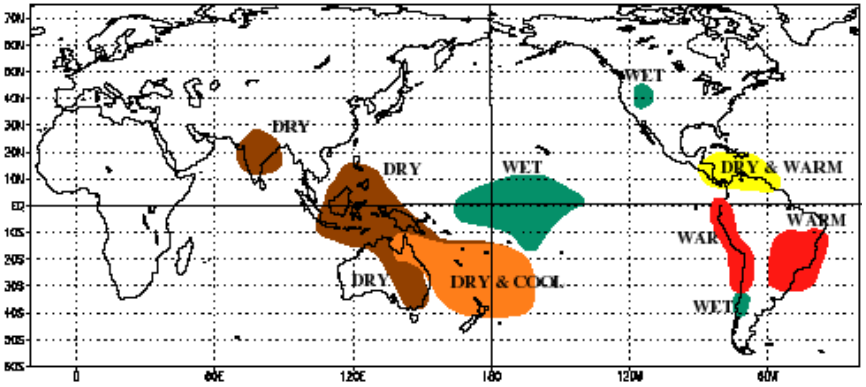
WARM EPISODE RELATIONSHIPS DECEMBER - FEBRUARY



COLD EPISODE RELATIONSHIPS DECEMBER - FEBRUARY



WARM EPISODE RELATIONSHIPS JUNE - AUGUST



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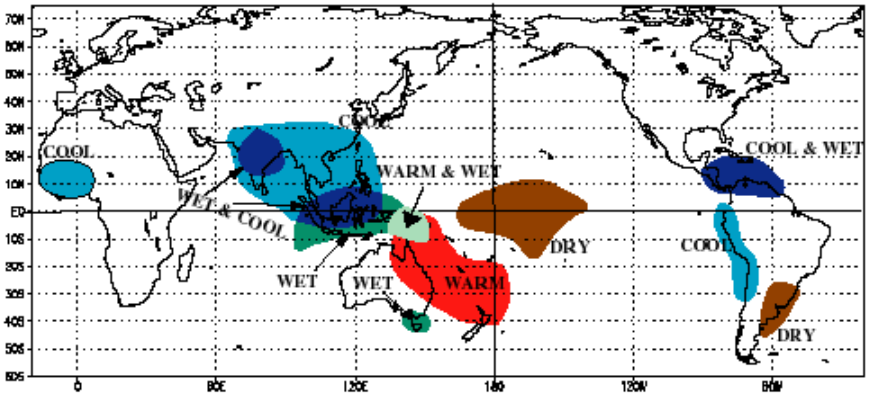


Climate Prediction Center
NCEP

Climate Prediction Center
NCEP

Reliability and Skill

- **Reliability depends on the years,**

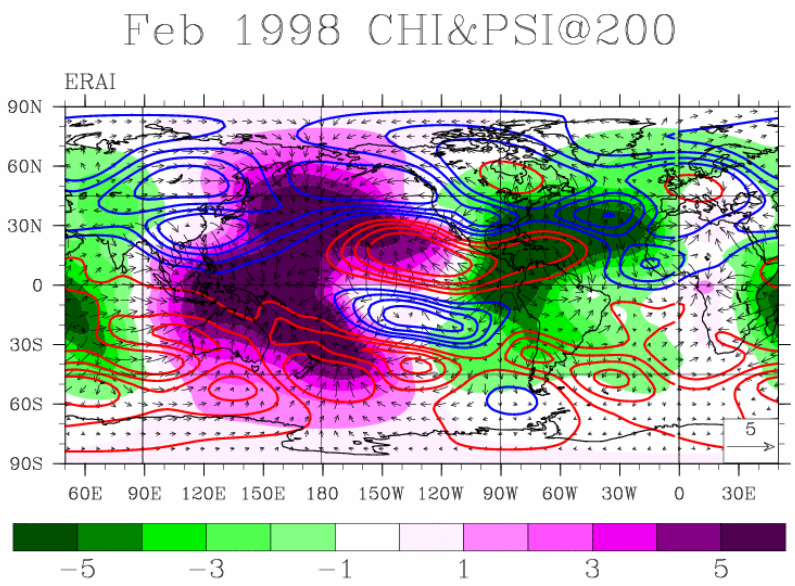
Reliability and Skill

How can we detect the predictability ?

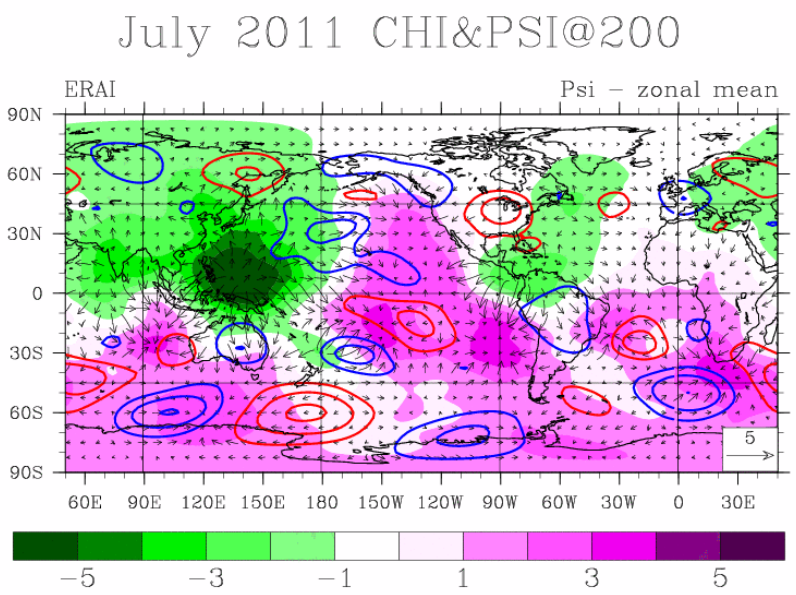
Analyse of the reaction of the atmosphere in the Tropics (direct and indirect action of SST) and beyond (especially via teleconnections to mid-latitudes)

Some periods where the predictability is :

« Good »



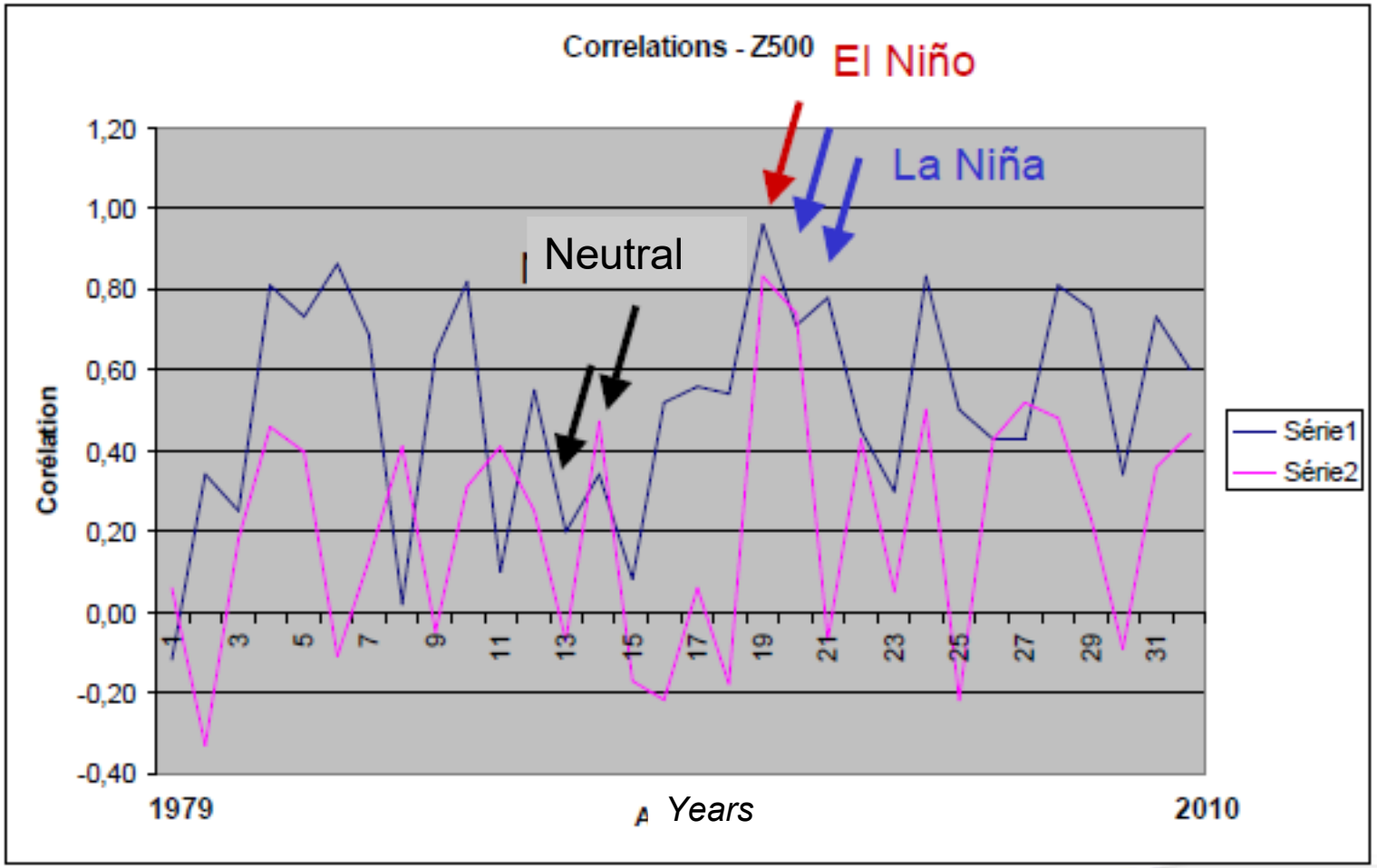
« Weak »



Observations (analyses) in the high troposphere of the components of the atmospheric circulation

Reliability and Skill

- **Quality of the forecasts vs years (Geopotential Heigh) DJF season**



Tropics

(20°N,20°S)

North Hemisphere

Reliability and Skill

- Reliability depends on the year,
- Reliability depends on the region and the parameter
- **Quality (scientific view) different than Usefulness (User view - economical value, additional value for Decision Making).**

Reliability and Skill

- **Evaluation of the quality using a reference experience (retrospective forecast – e.g. 1993-2016)**

- **2 complementary viewpoints :**
  - Technical viewpoint :
    - Is the model good ? = Scores (SVS recommended by WMO)
    - Is the model useful (better information than a reference strategy – e.g. Climatology or Persistence) ? = Skill-Scores
  - User viewpoint :
    - Is the model useful (bringing a better information than the one currently used ? = Skill-Scores (using strategy reference from the users – e.g. Climatology)
    - Is the use of the information brought additionnal value to the Decision Making Processes and/or to the users' activities ? = Value of the forecast (economical models like costs/losts or benefits/losts or …)

The Seasonal Forecast

- Reliability depends on the year,
- Relaibility depends on the region and the parameter,
- Quality (scientific view) different than Usefulness (user view - economical value, added value for Decision Making),
- **Useful in a decision making context and for climate risk management ; especially for activities (including economic) which are sensitive to climate when the range of the forecast is consistent with the decision calendar of the stakeholder.**

The Downscaling problem

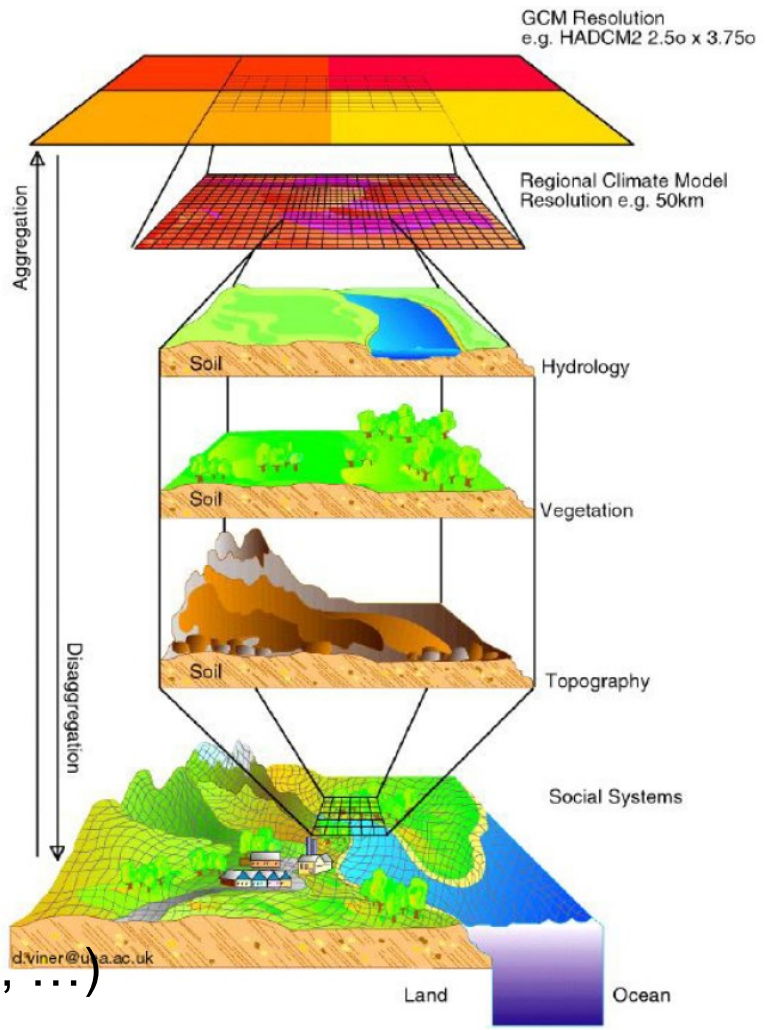
Relevant Scales

- Mesh of the GCM ~ 100 km,
  3 month averaged information
  (or month by month)
- Scales of applications ~ 1m to 10 km,
  Day, 10 days, month,

- Climate parameters (RR, Tn, Tx,
  Number of days …),
- Parameters from the application
  domain (Agriculture, Water resources,
  Health, …),

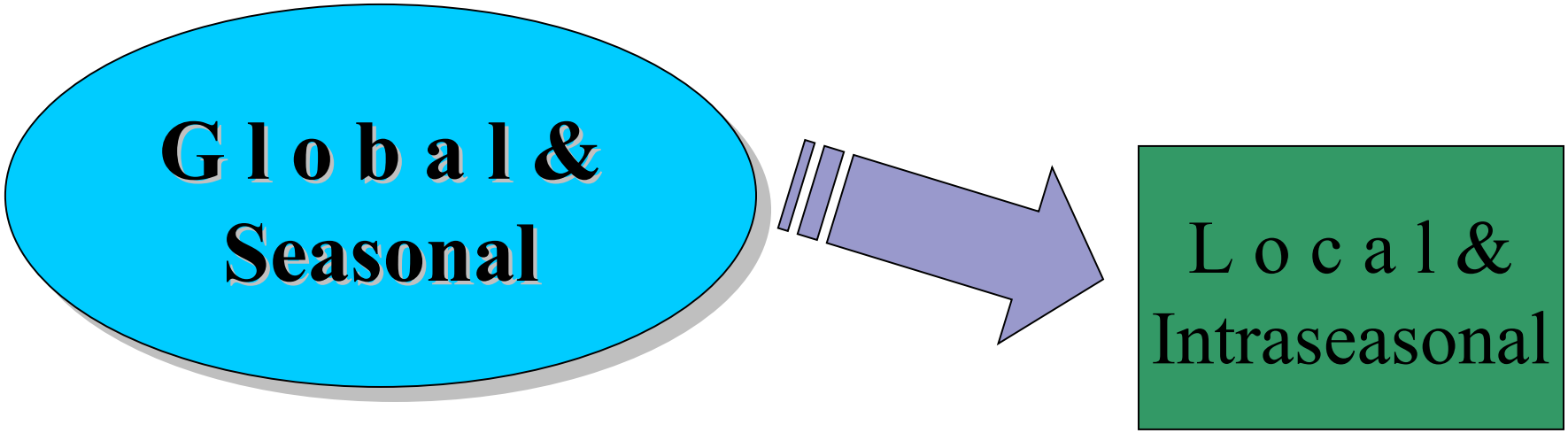
- Climate parameters (RR, Tn, Tx, Wind, …)

for downstream operation of Users' models



The Downscaling problem

- **Seasonal predictability and associated scales ⇒ usefull information for the user (scale adaptation)**

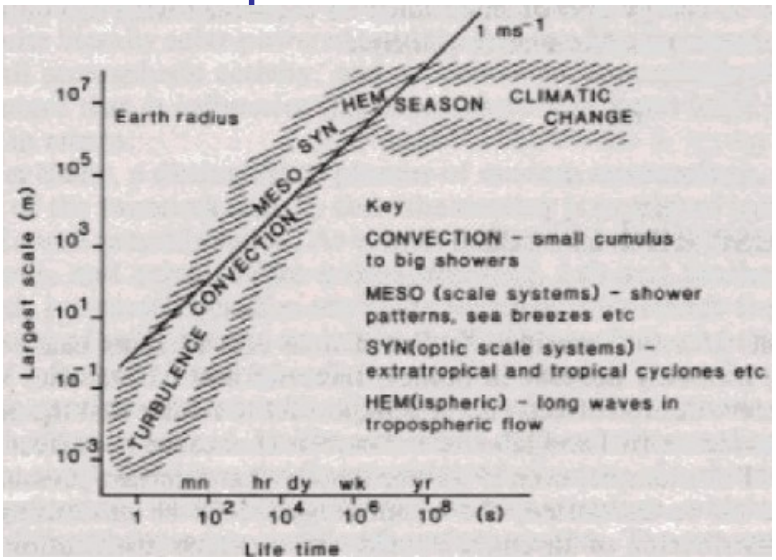


- **key questions**
  - Until which scales one can expect to downscale the large scale information ?
  - How to get the best compromise between the limits of seasonal predictability and the needs for applications ?

The downscaling problem

Downscaling in space and time

- Strong relationship between space and time scales



Scientific bases

- Adjustement of the General Circulation to the different constraints imposed by the oceanic forcing (and continental surfaces),
- Chaos (uncertainty sources),
- Prediction of the Climate (mean effect of the General Circulation) conversely to the weather forecast (detailled chronology),

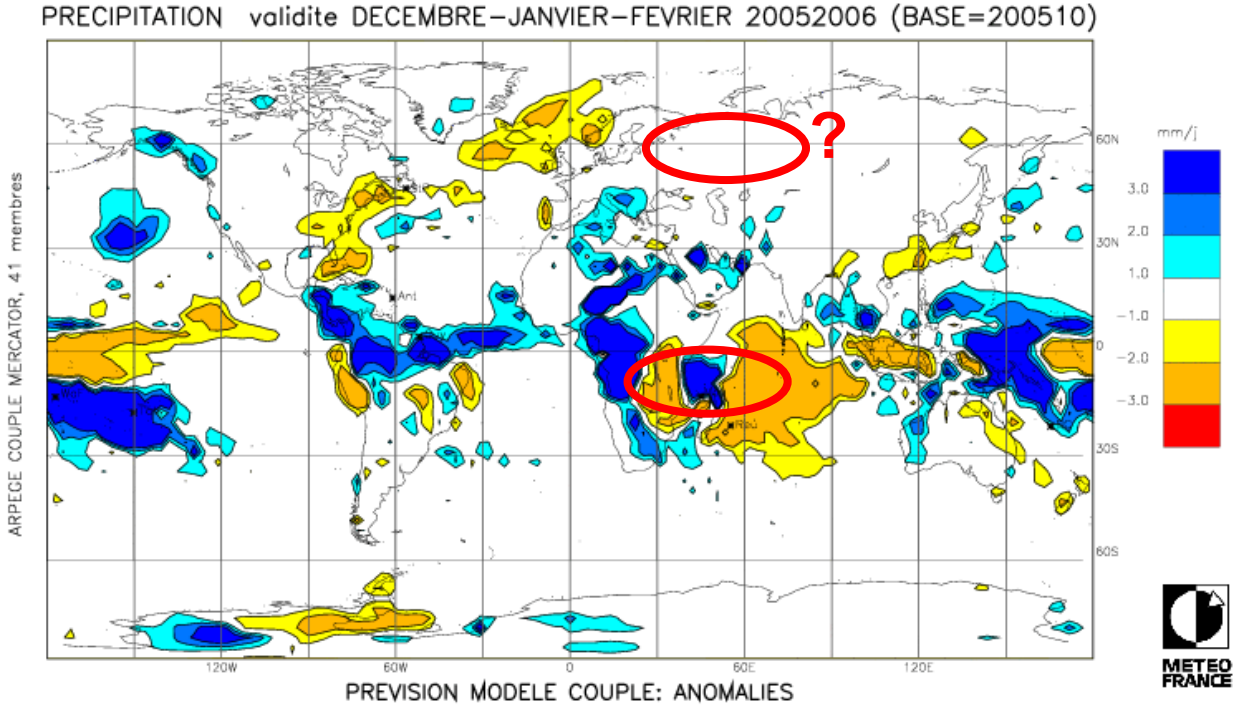
The Downscaling bases

- **The main goals of the downscaling is**
  - To take into acount mean local effects of the large scale forcing
  - To adapt the seasonal forcasting information to the relevant scale for the user (at least to get better resolution generally needed both in space and time)
- **The downscaling should**
  - Reflect the mean effect of sub-grid processes forced by large scale conditions
  - Take into account physical processes at the « local » scales
  - Bring more than a simple interpolation
- **The downscaling brings**
  - some artificial increase in the resolution
  - uncertainty which must be evaluated
  - Information which is part of the ensemble/probabilistic forecast

The Downscaling

Large Scale Forcing

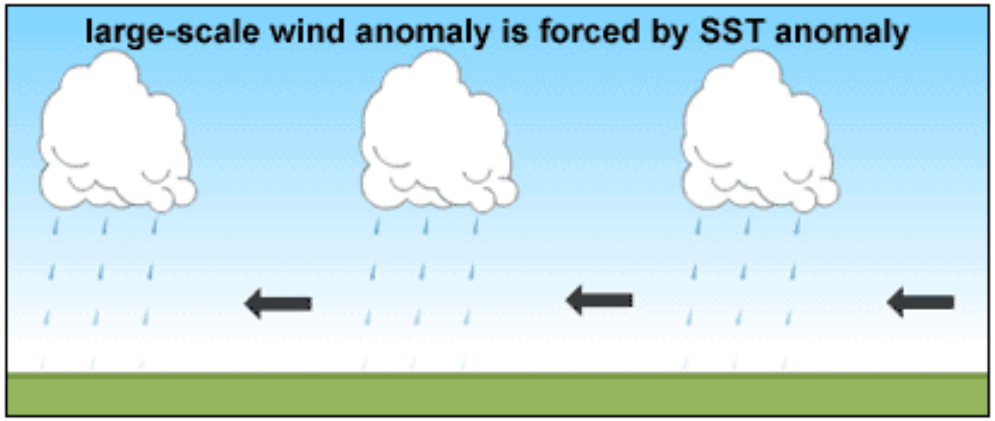
- One have chance to succeed **If and Only If** the smaller scales are significantly forced by the Large Scale signal.

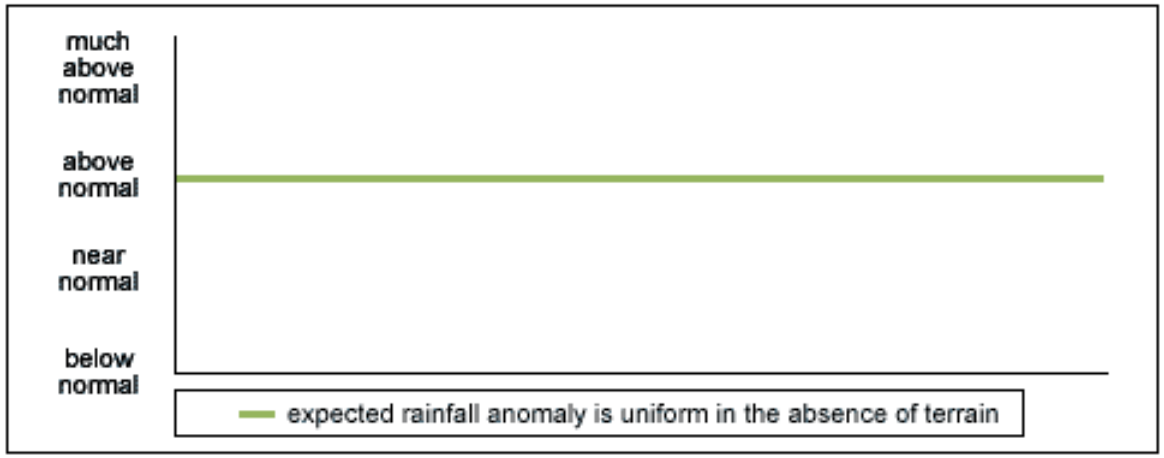


The downscaling problem

LS forecast : Above normal

- LS forcing : Trade wind anomaly





Thank's to IRI

The downscaling problem

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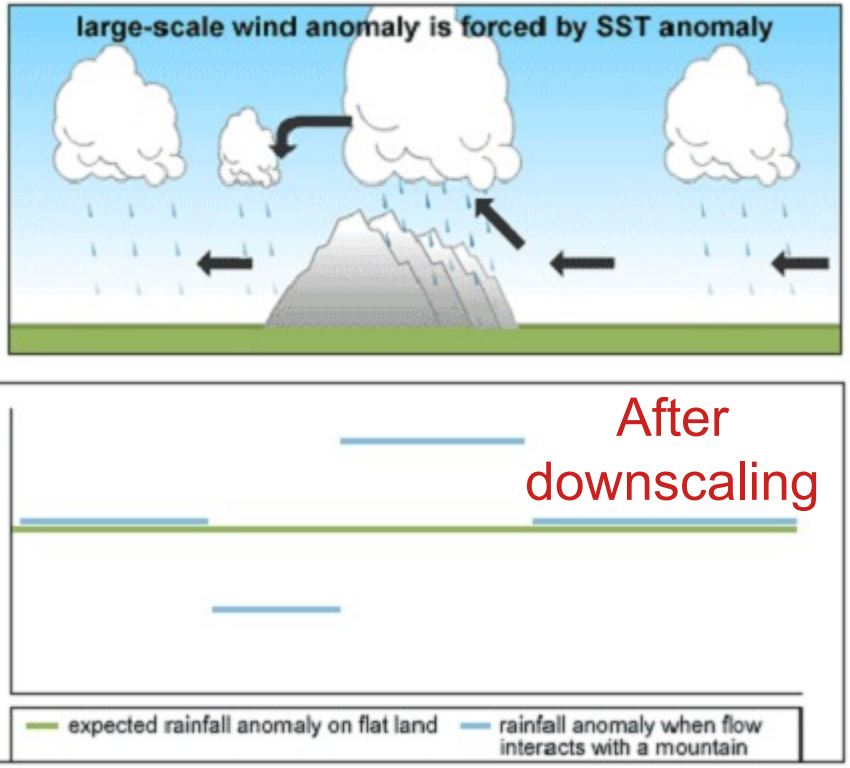

Thank's to IRI

What to Remember

- Seasonal Forecast based on **Numerical Modeling of the Climate system** and the coupling between its different components,
- Forecast of the Climate **(mean state)** instead of the weather **(detailed chronology)**,
- **Probabilistic nature** of the forecast,
- Potentially useful in a context **of Climate Risk Management**, of **Decision Making** and of Climate sensitive activities (especially economic but not only),
- **Added value depending of** the considered zone, season, year and parameter **but there is real value**,
- To be use in the best possible way, **need a strong and close collaboration** between providers and users and generally speaking **downscaled/tailored information**.
- Seasonal forecast represent the **first step of adaptation** (to present and futur climate variability)

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