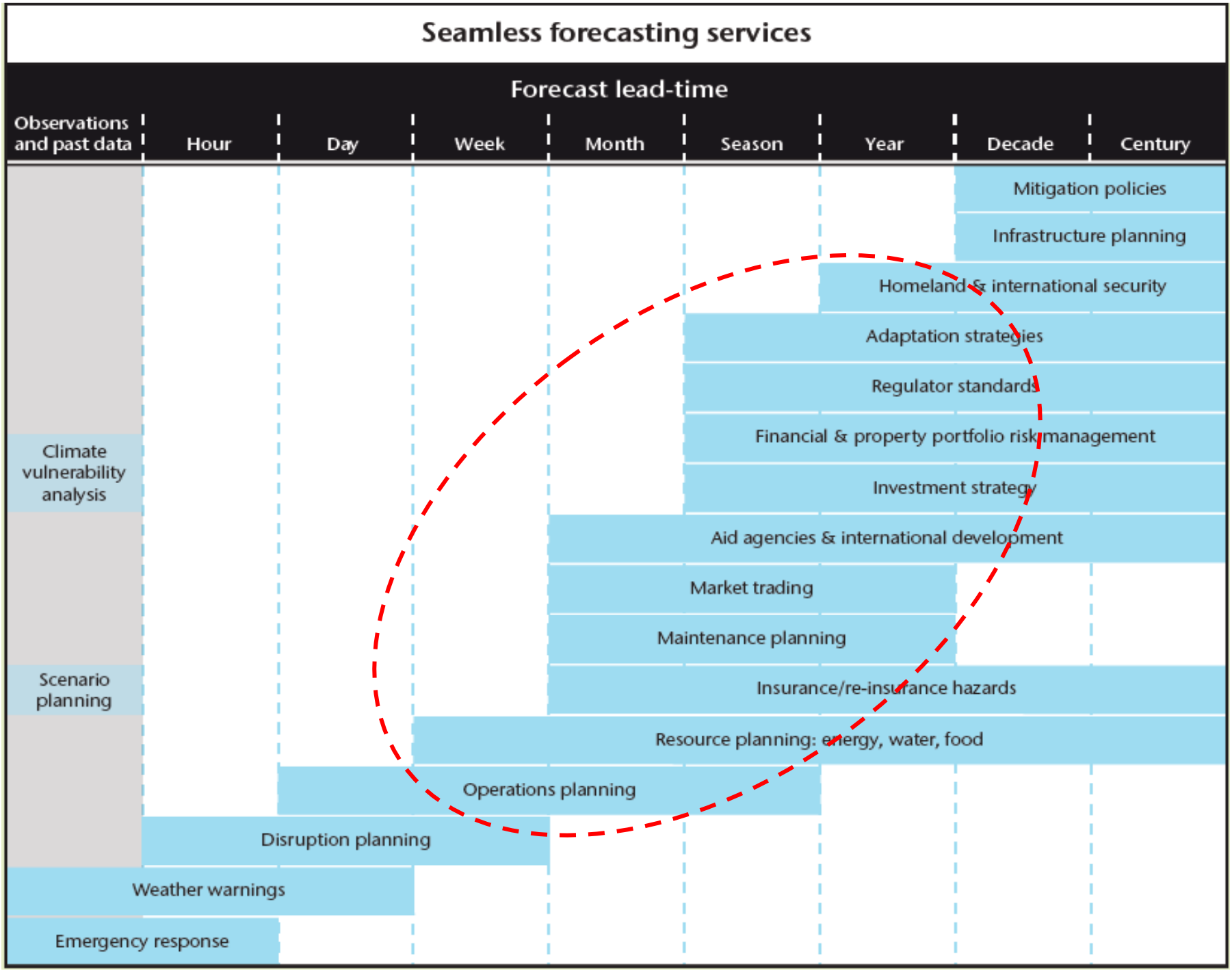
Subseasonal to Seasonal Forecasting

Julia Slingo, Met Office Chief Scientist


Seamless forecasting services
Forecast lead-time
Observations and past data
Hour
Day
Week
Month
Season
Year
Decade
Century
Mitigation policies
Infrastructure planning
Homeland & international security
Adaptation strategies
Regulator standards
Financial & property portfolio risk management
Investment strategy
Aid agencies & international development
Market trading
Maintenance planning
Insurance/re-insurance hazards
Resource planning: energy, water, food
Operations planning
Disruption planning
Weather warnings
Emergency response
Climate vulnerability analysis
Scenario planning

Sub-seasonal to Seasonal Predictability

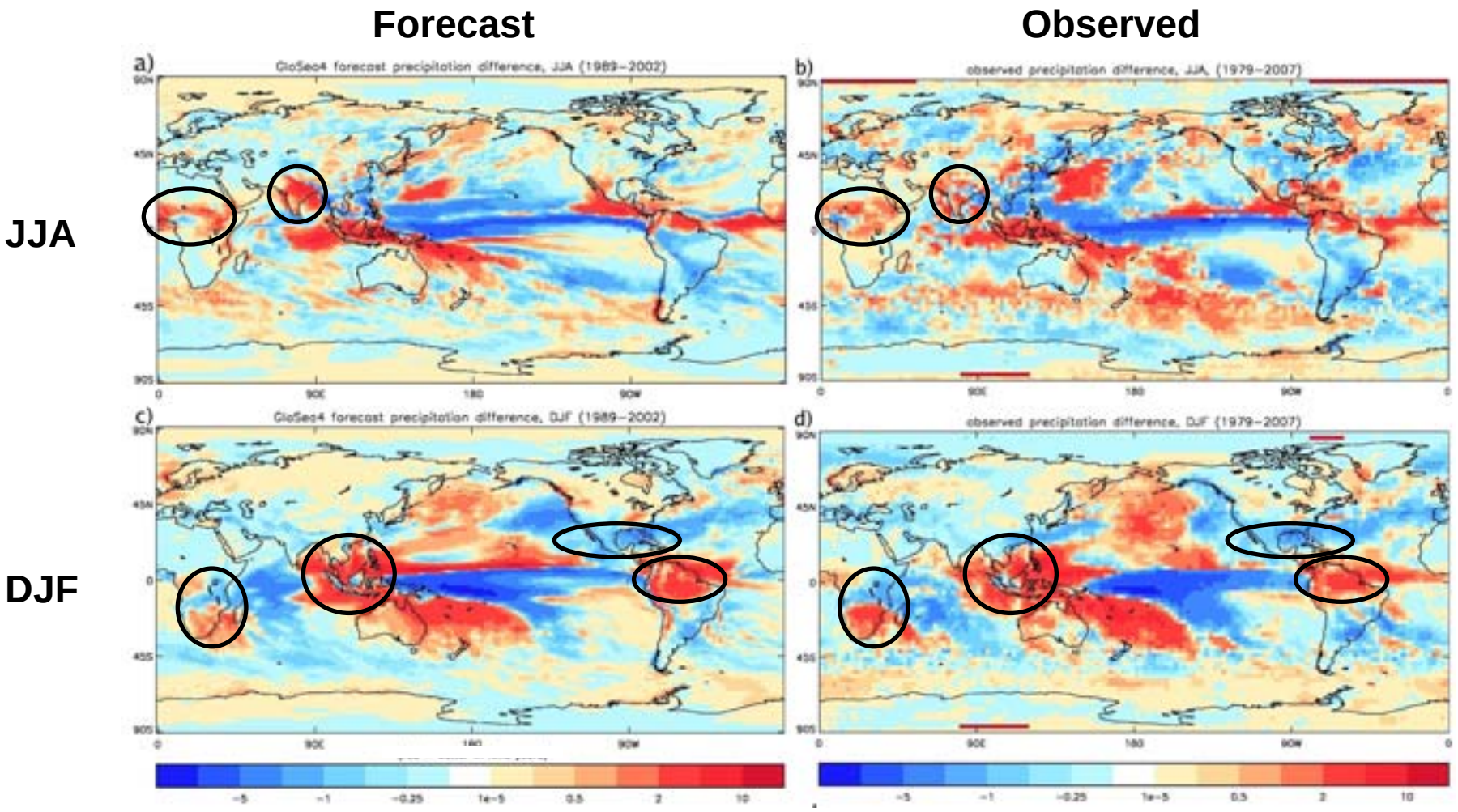
- **Variability in the atmosphere is short-lived → weather patterns**
- **Variations in the oceans, sea-ice and land are much slower, but influence the state of the atmosphere → long-term predictability**
- **Subseasonal to seasonal timescale is an interesting and challenging mix of atmospheric and oceanic drivers – interface between weather forecasting and climate prediction**

Potential Sources of Subseasonal to Seasonal Predictability

- **Ocean sea surface temperatures**
- **Land surface conditions – snow, soil moisture**
- **Madden Julian Oscillation**
- **Stratospheric variability**
- **Arctic sea ice cover and thickness?**
- **Solar variability (11-year cycle)?**

El Niño effects are well reproduced in weather and climate models

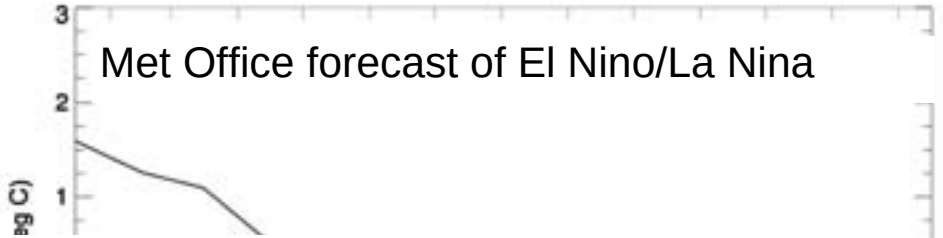
Met Office

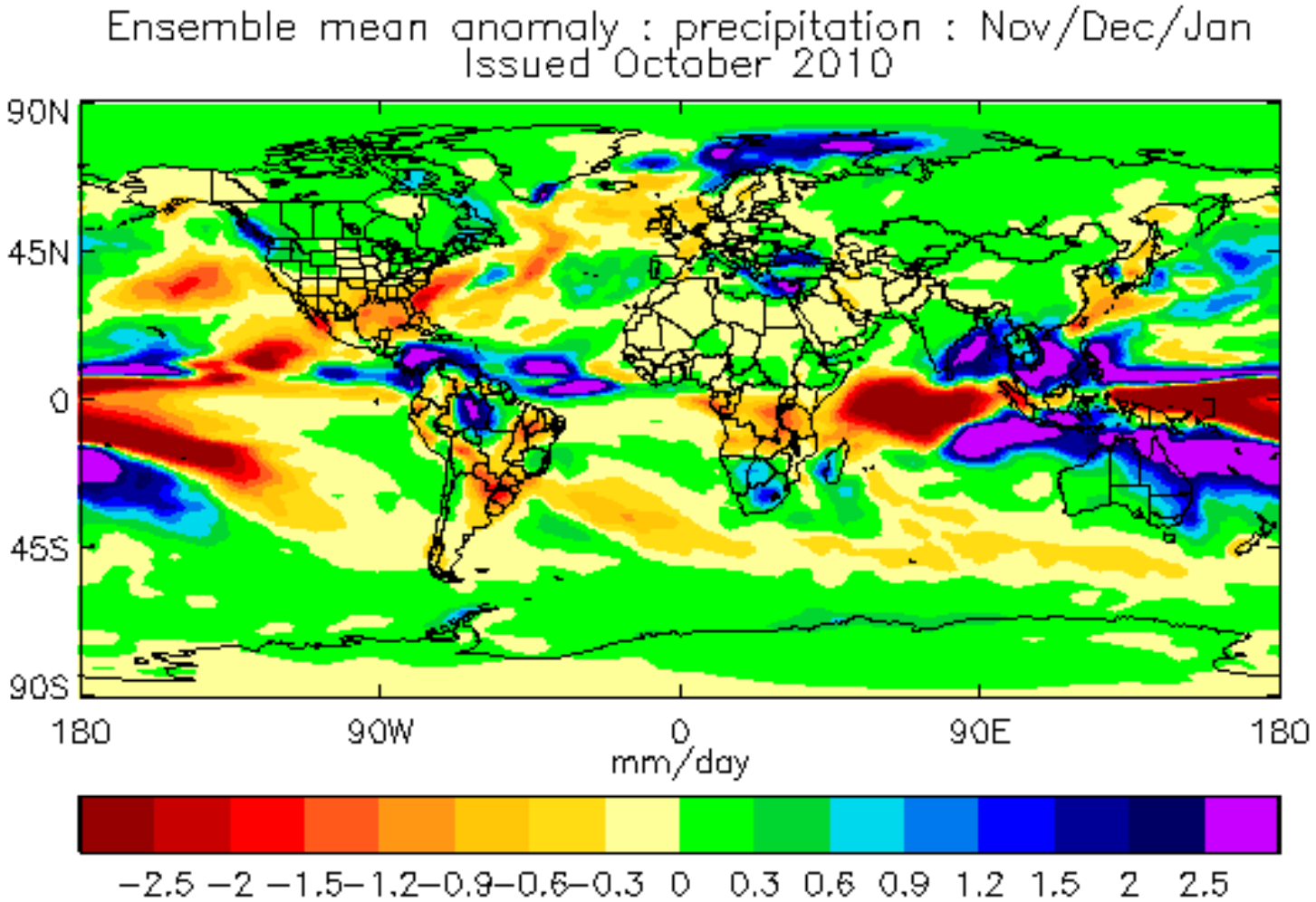


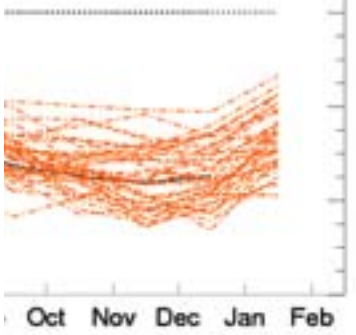
Queensland Flooding, Dec/Jan 2010/11

- Cost to Australian economy of at least A$10 billion
- Farmers expected losses from the floods to top $1.5billion (£948m)
- Coal sector loses sales worth A$2,3-billion due to flooded mines
- Stockpiles of coking coal exhausted in late January 2011 due to reduced rail capacity
- Cotton farmers lose one-third of their crop…. but look forward to a bright season in 2011-12, with high levels of moisture in soil and irrigation systems!

Queensland flooding Dec/Jan 2010/11

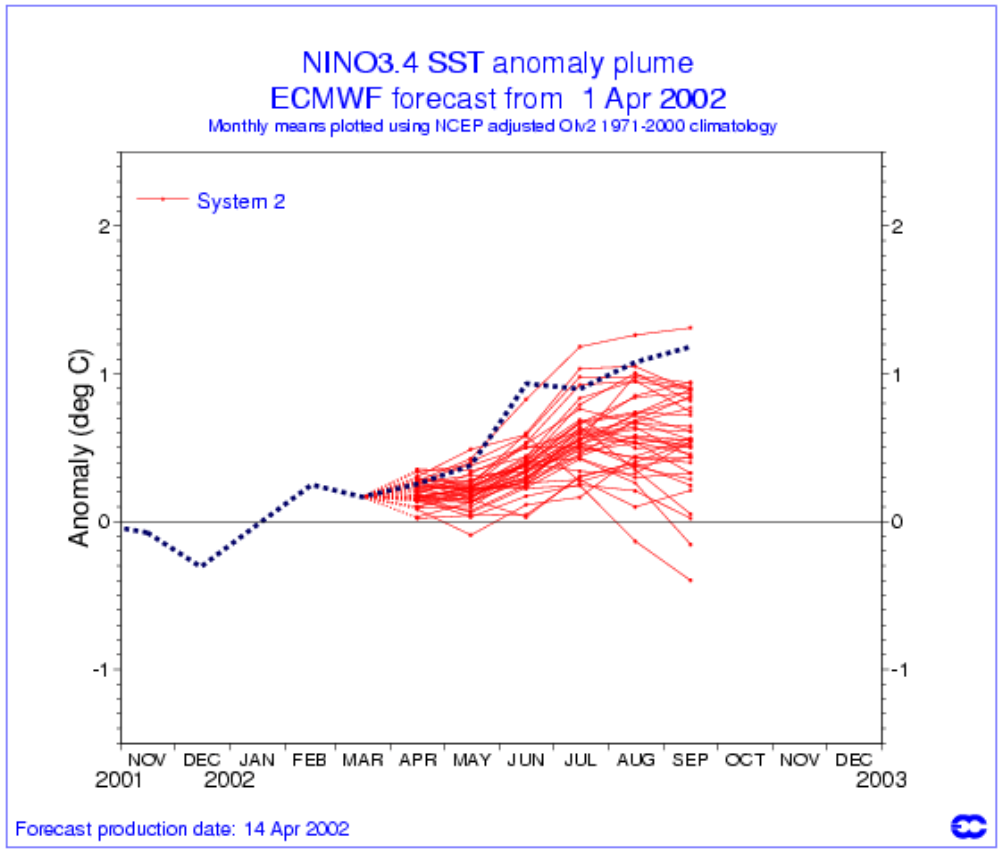




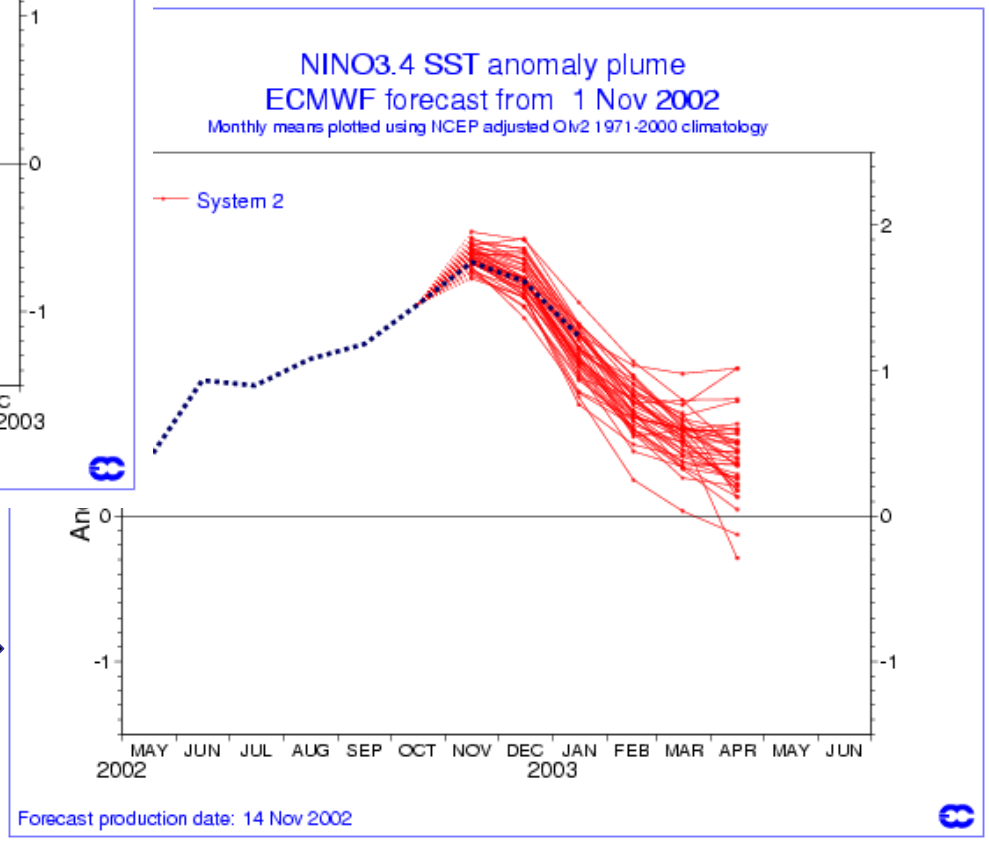


NB: 2.5 mm/day = 230mm accumulated

Different phases of El Nino are more predictable than others

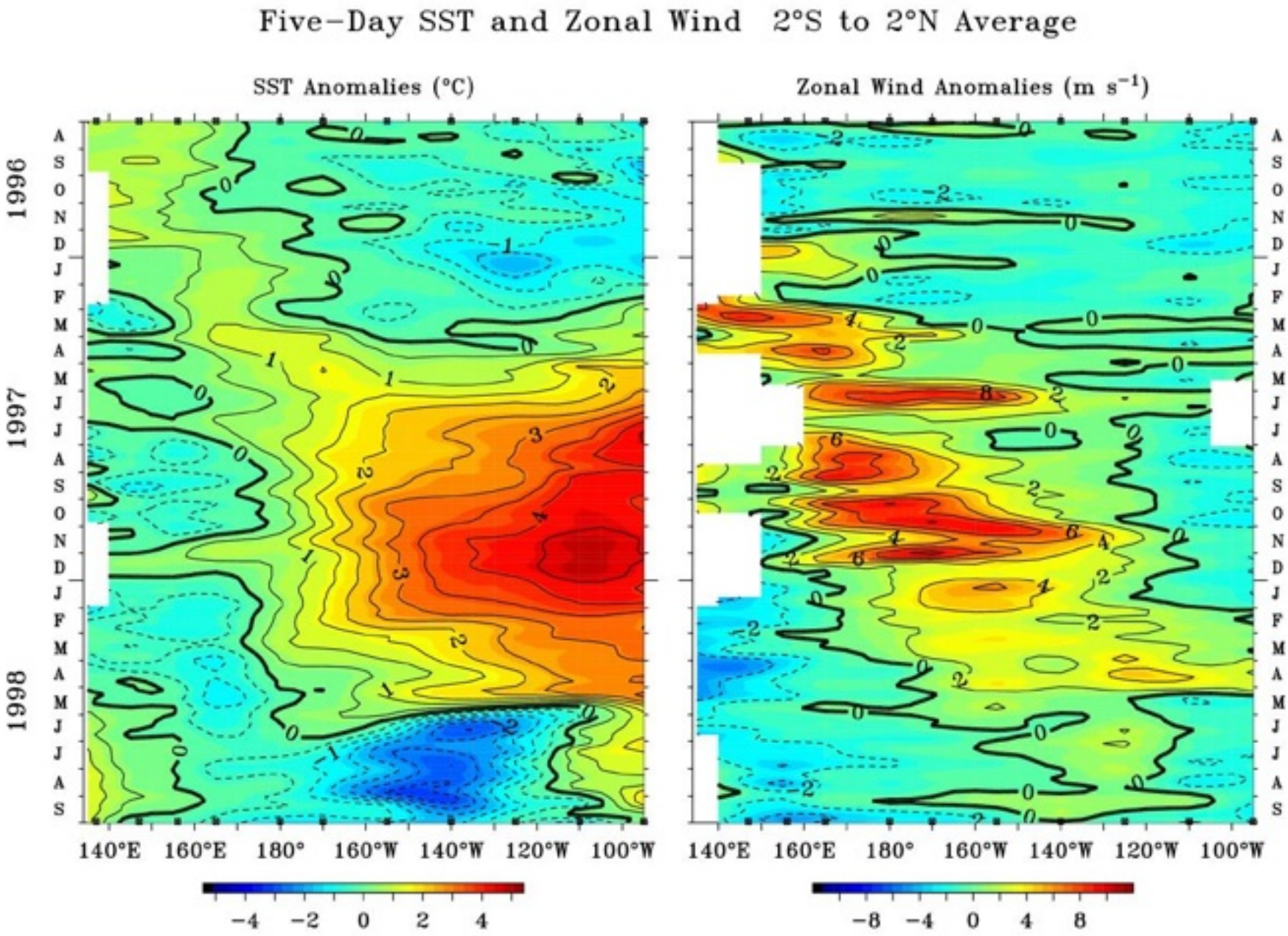


Initiation of warm event is difficult to forecast due to stochastic forcing from the atmosphere e.g. westerly wind events.

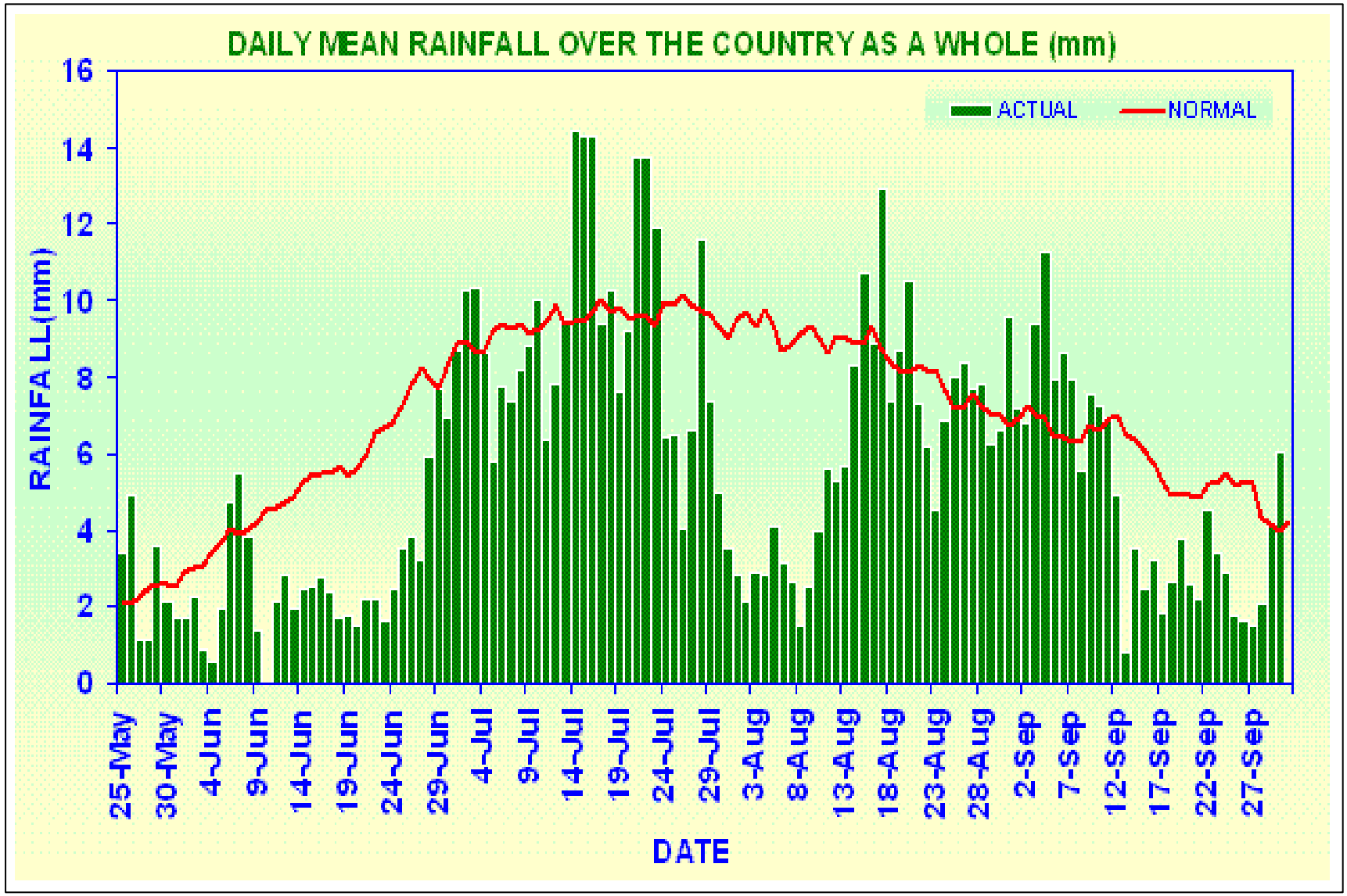


Decay of warm event is more predictable due to the role of equatorial ocean dynamics - the delayed oscillator.

1997/98: The El Niño of the century



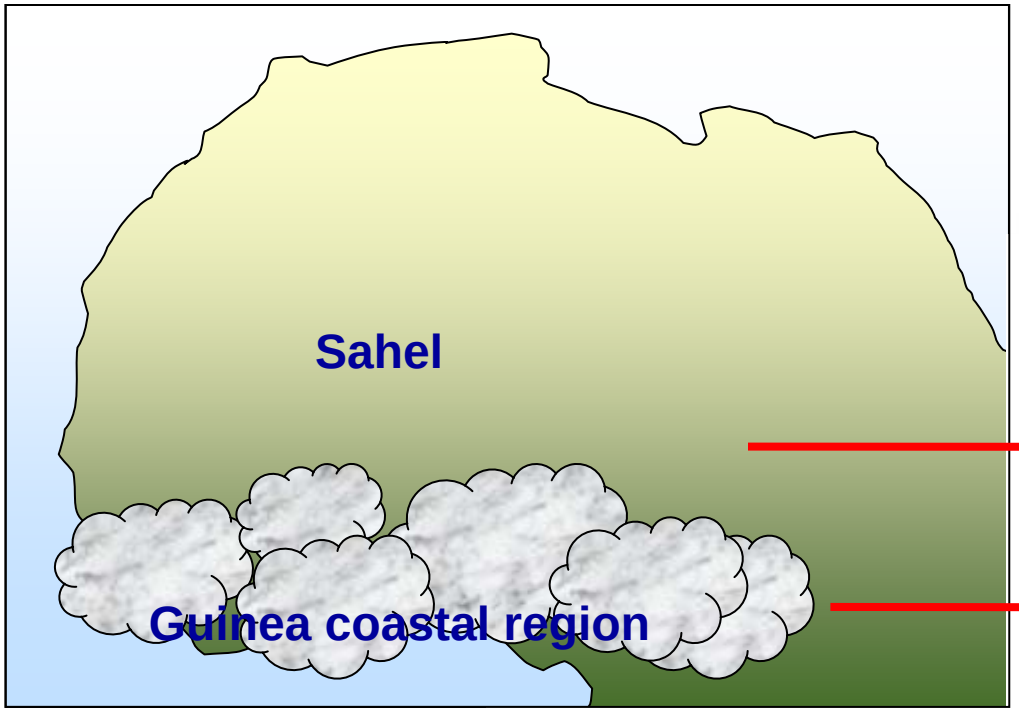
MJO implicated in monsoon 2009



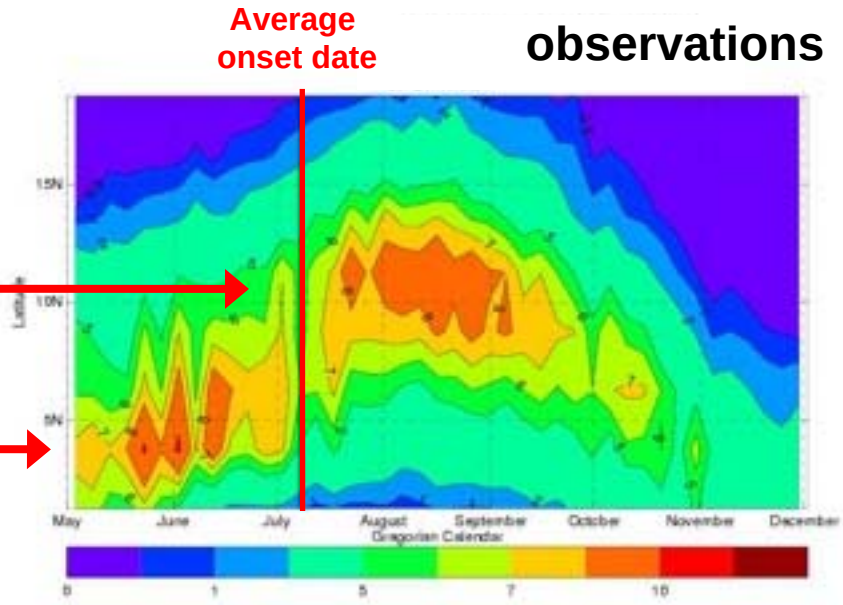
Major failure of monsoon rains: 23% below normal

West African Monsoon

Rainy season onset



West African Monsoon (latitude Vs time)



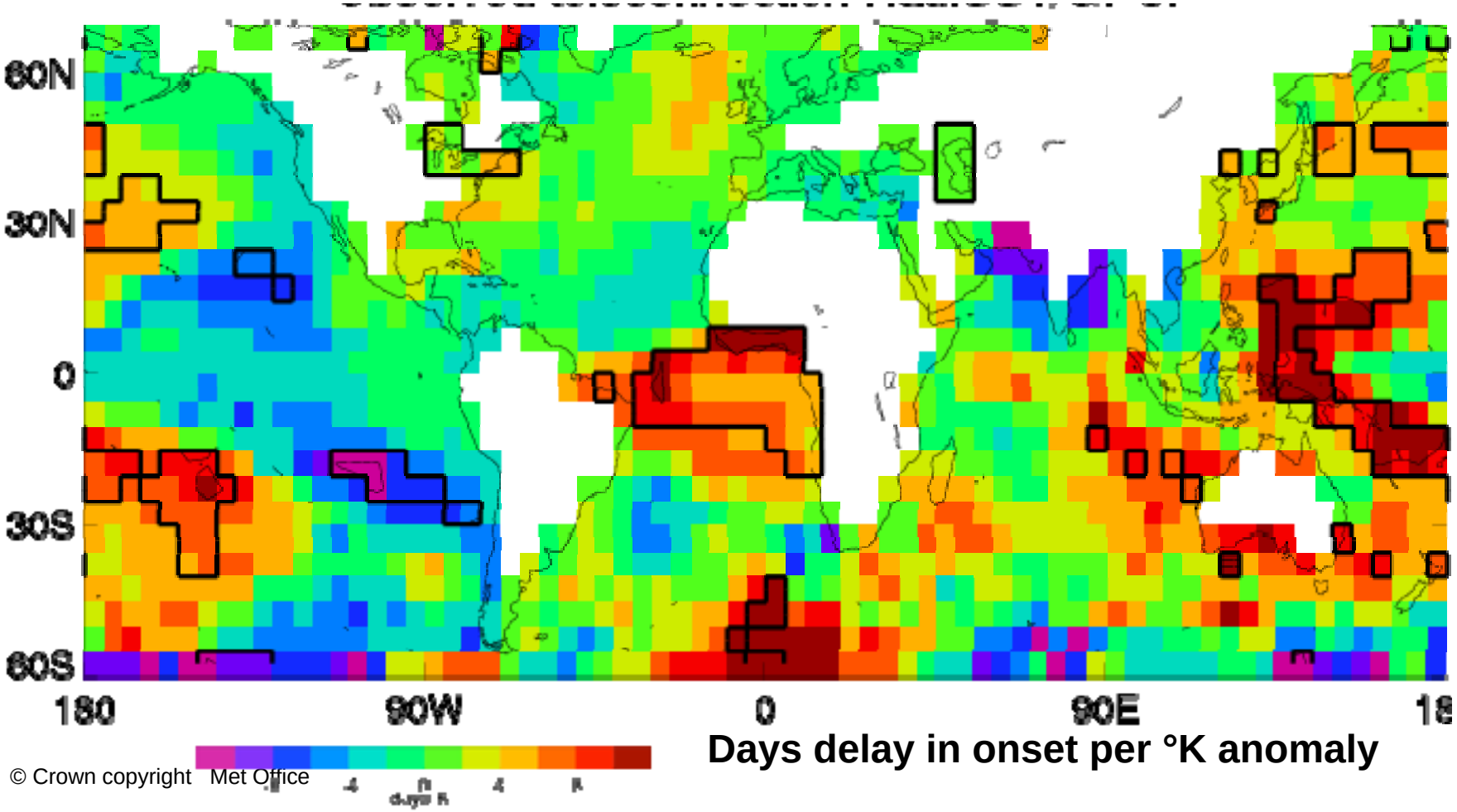
Predicting the timing of the jump is a key research target for CSRP

Essential information for farmers in the Sahelian region:

- plant too early: seeds rot in ground
- plant too late: miss early growing season

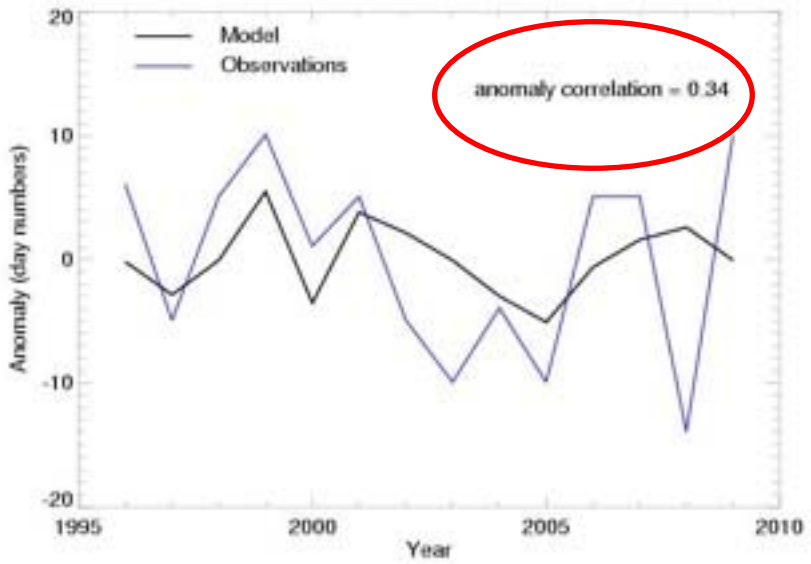
Understanding drivers of the West African Monsoon onset timing

Observed link between global sea surface temperature (SST) anomalies in June and onset timing



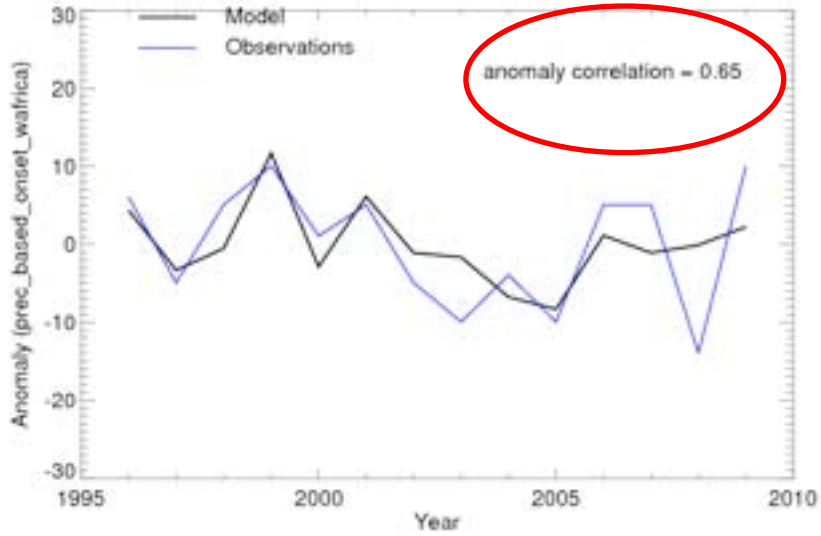
Improved seasonal prediction of West African Monsoon onset timing in latest seasonal system

Observed and predicted onset dates for the West African Monsoon (1996-2009)



OLD MODEL vs OBS

GA2.0 version of GloSea4 seasonal prediction system

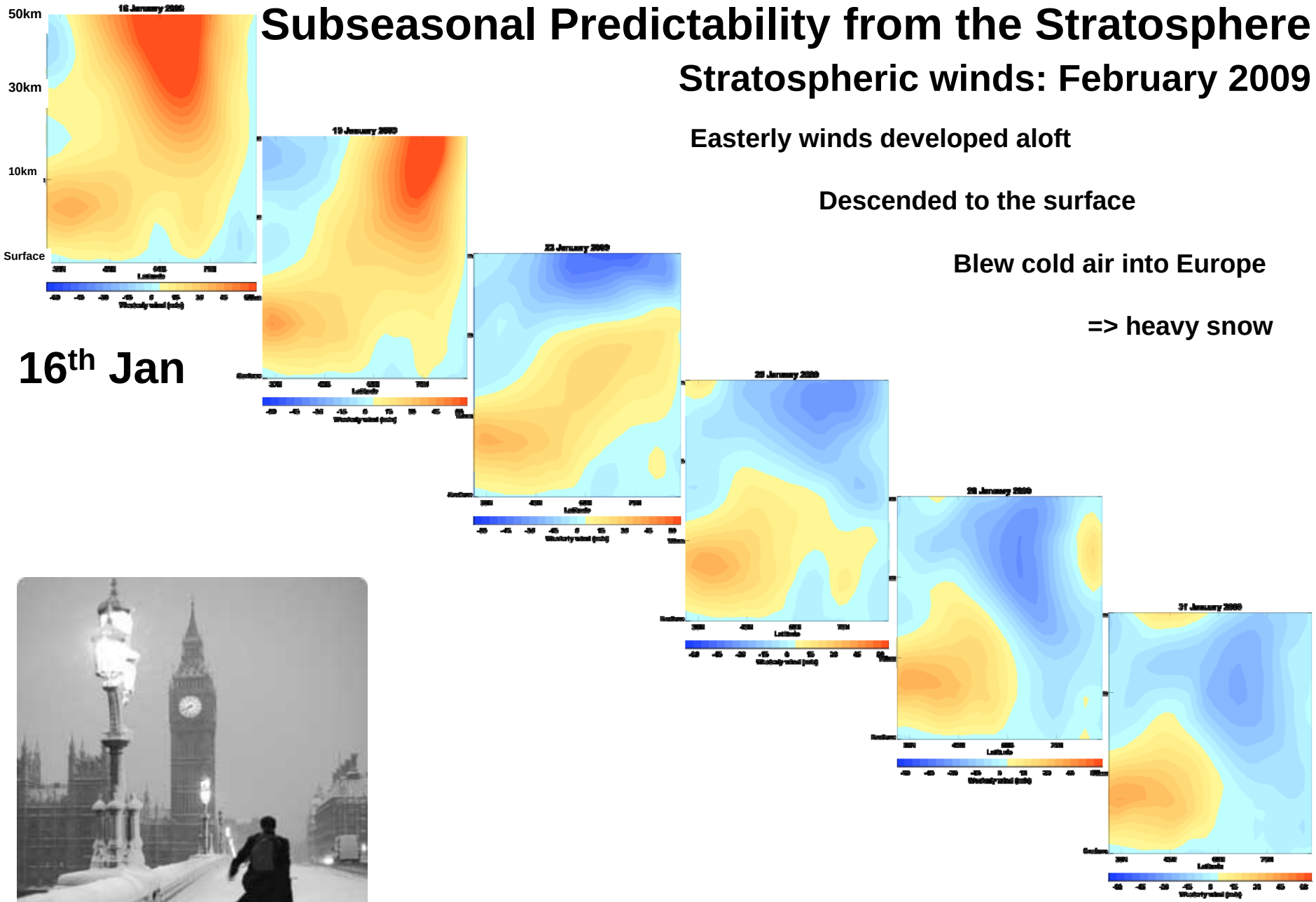


NEW MODEL vs OBS

Latest (GA3.0) version of GloSea4 – including upgraded soil moisture initialisation

Subseasonal Predictability from the Stratosphere

Stratospheric winds: February 2009



Easterly winds developed aloft

Descended to the surface

Blew cold air into Europe

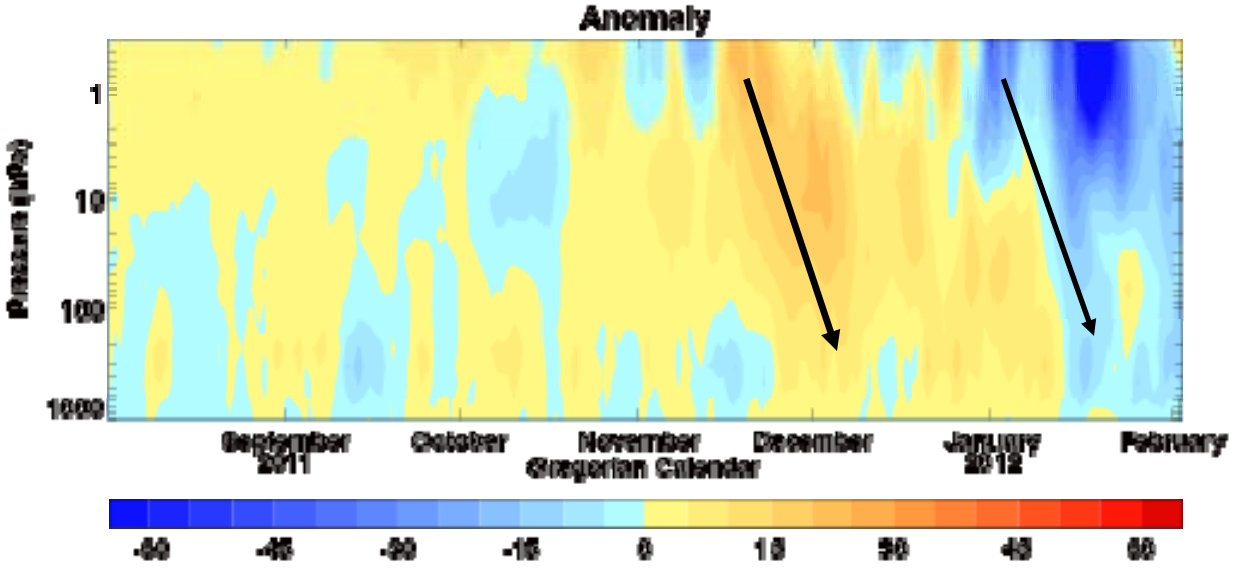
=> heavy snow

16th Jan

31st Jan

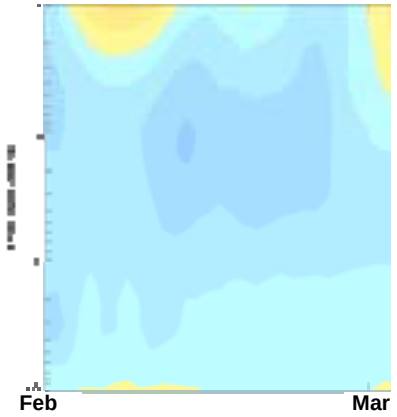
Monthly Forecasts: Feb 2012

Observations



Forecast

(contour interval 5m/s)



Easterly winds at high altitude pre-disposes N Europe to blocking conditions

Signs of increased risk of cold event weeks in advance

Actionable: **Public monthly forecast indicated risk from mid-January**

February 2012

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1 February 2012 Last updated at 18:04

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Europe freeze: Heavy snow across continent

Scenes of snow and cold weather around Europe

Heavy snow has caused disruption across Europe, carpeting much of Italy to the south and Turkey to the east.

The freeze that has swept south through the continent has caused at least 80 deaths, mainly in Ukraine and Poland.

Temperatures were so low that some areas in Romania along the shores of the Black Sea froze.

In central Italy, heavy goods lorries were barred from motorways and several top-flight football matches have fallen victim to the wintry conditions.

Ukrainian officials reported that the number of deaths attributed to the

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In pictures: Europe grapples with freeze

Europe freeze: Your pictures

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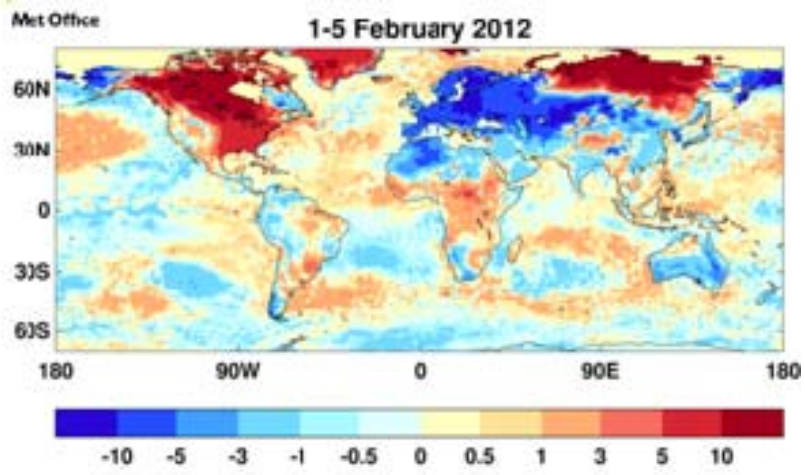
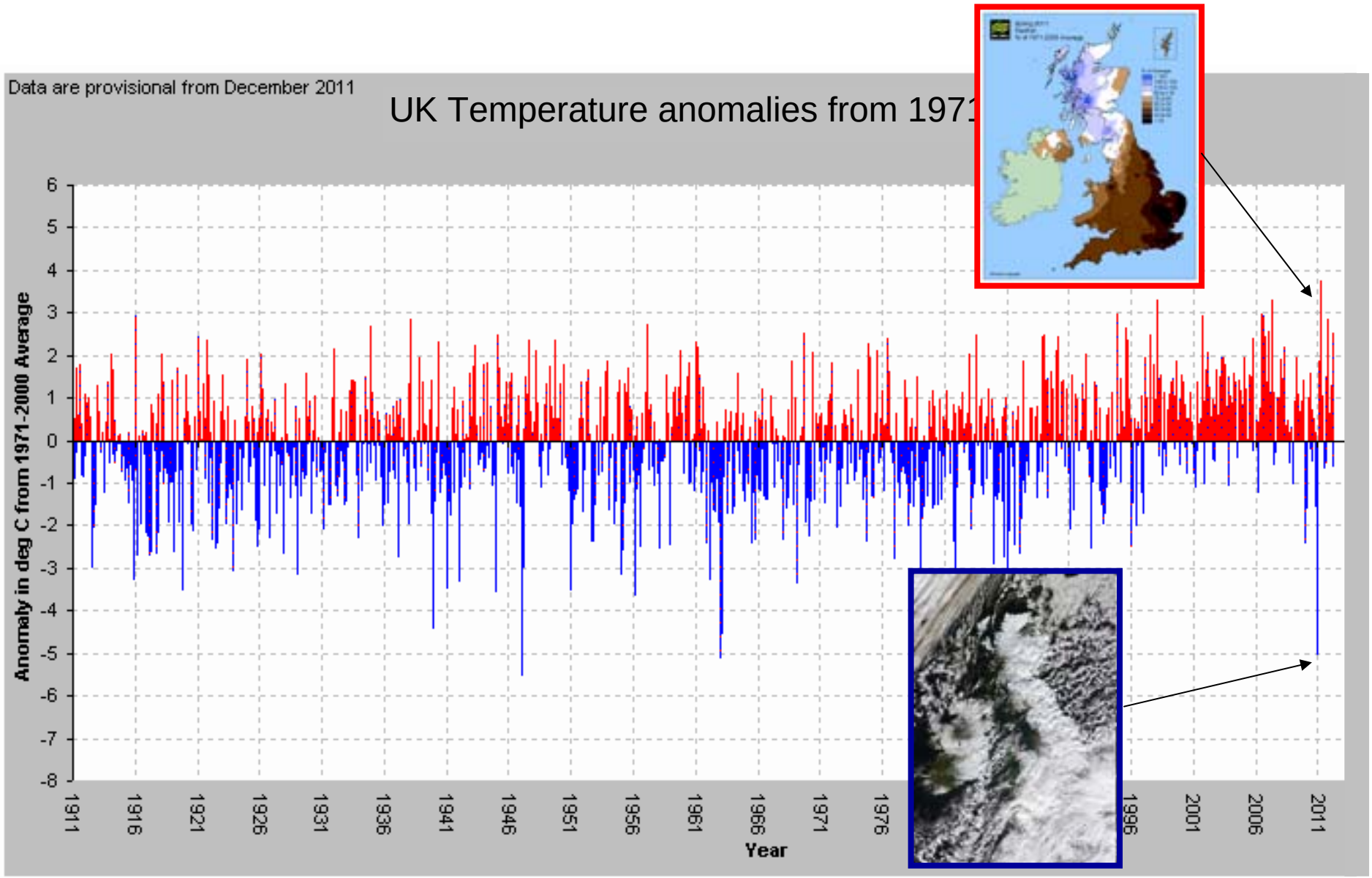
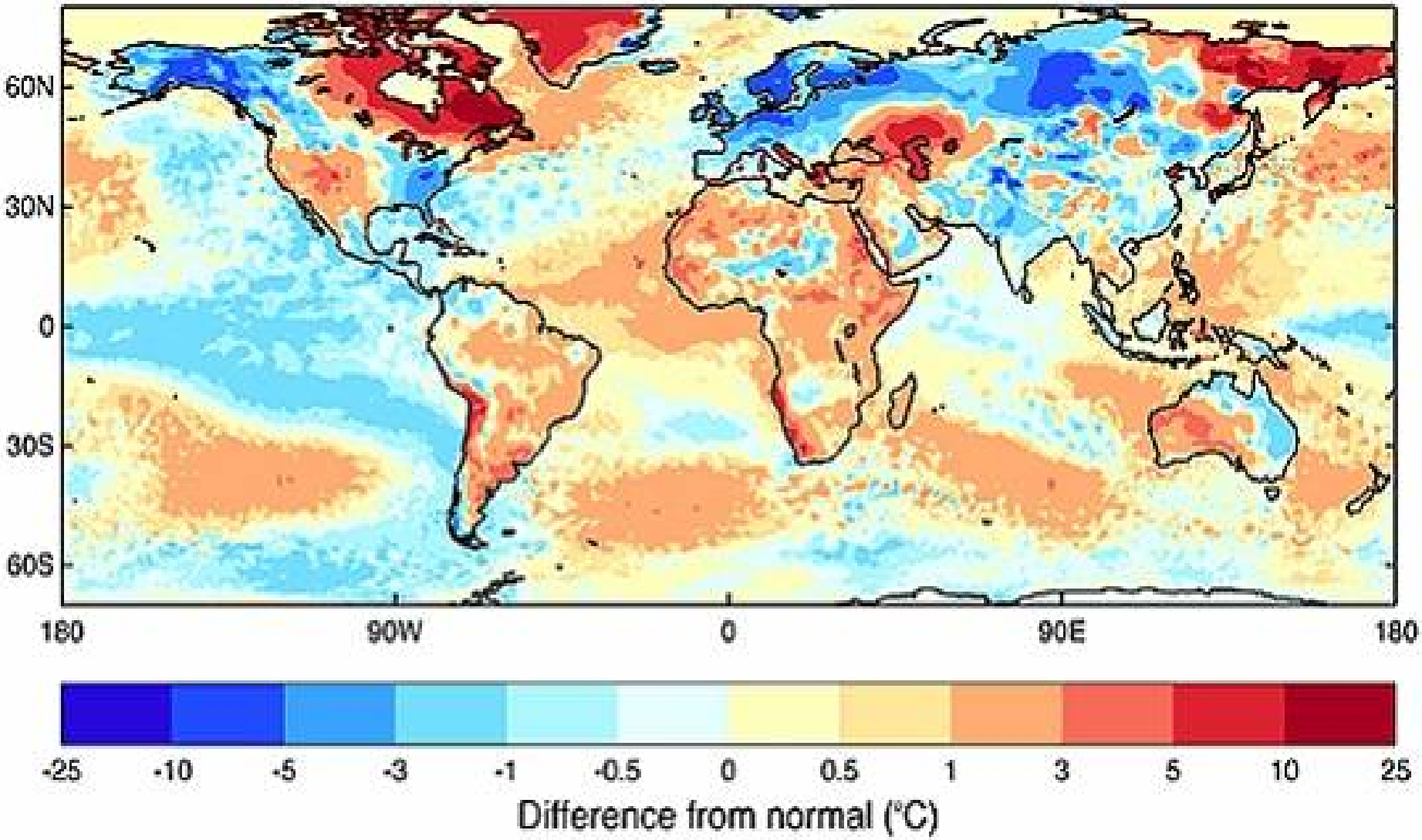


New Sources of Predictability?



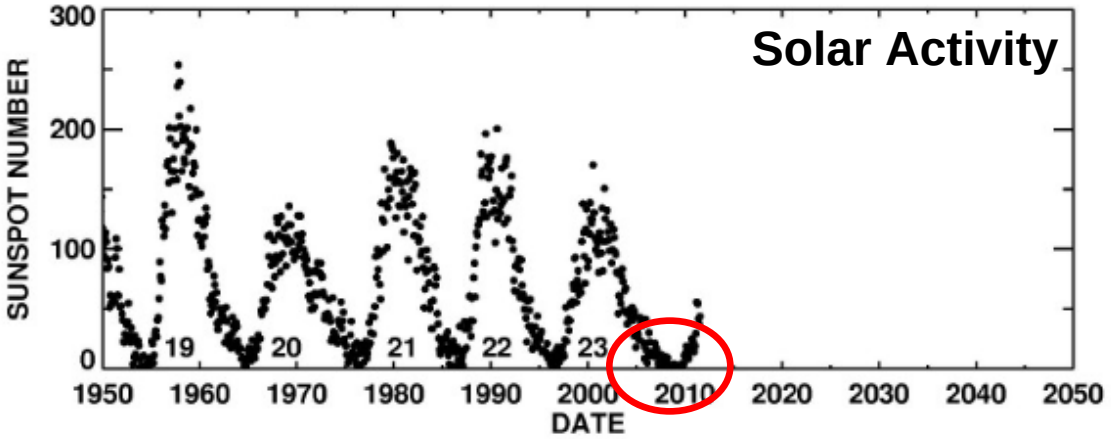
2010: The global context

Global mean temperature anomalies, December 2010



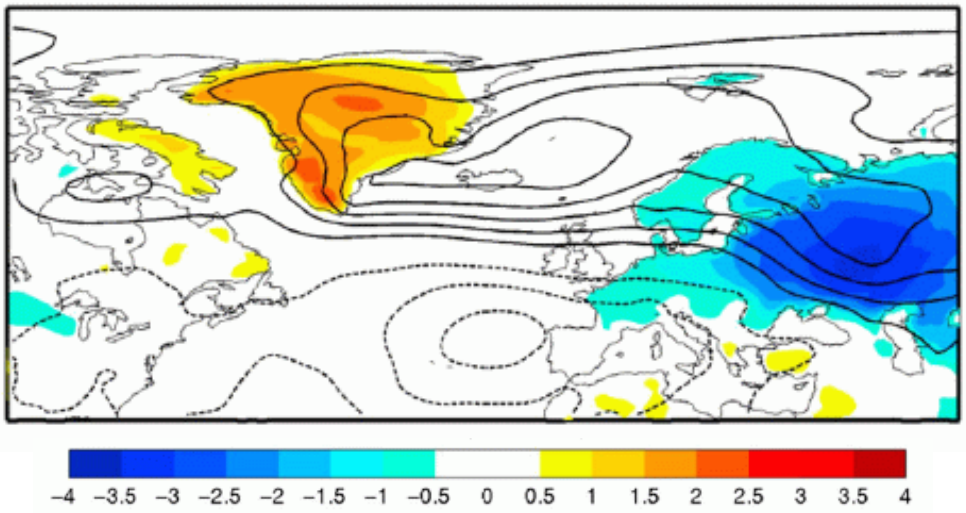
Recent cold winters and solar variability

Barcelona, Spain, March 2010



Solar Minimum minus Solar Maximum:

Changes in pressure and temperature



Surface air temperature anomalies (Woollings et a, GRL)

11-year solar cycle

Solar minimum increases risk of:

- **Blocking**
- **Easterly weather types**
- **Cold Europe**
- **Cold UK**

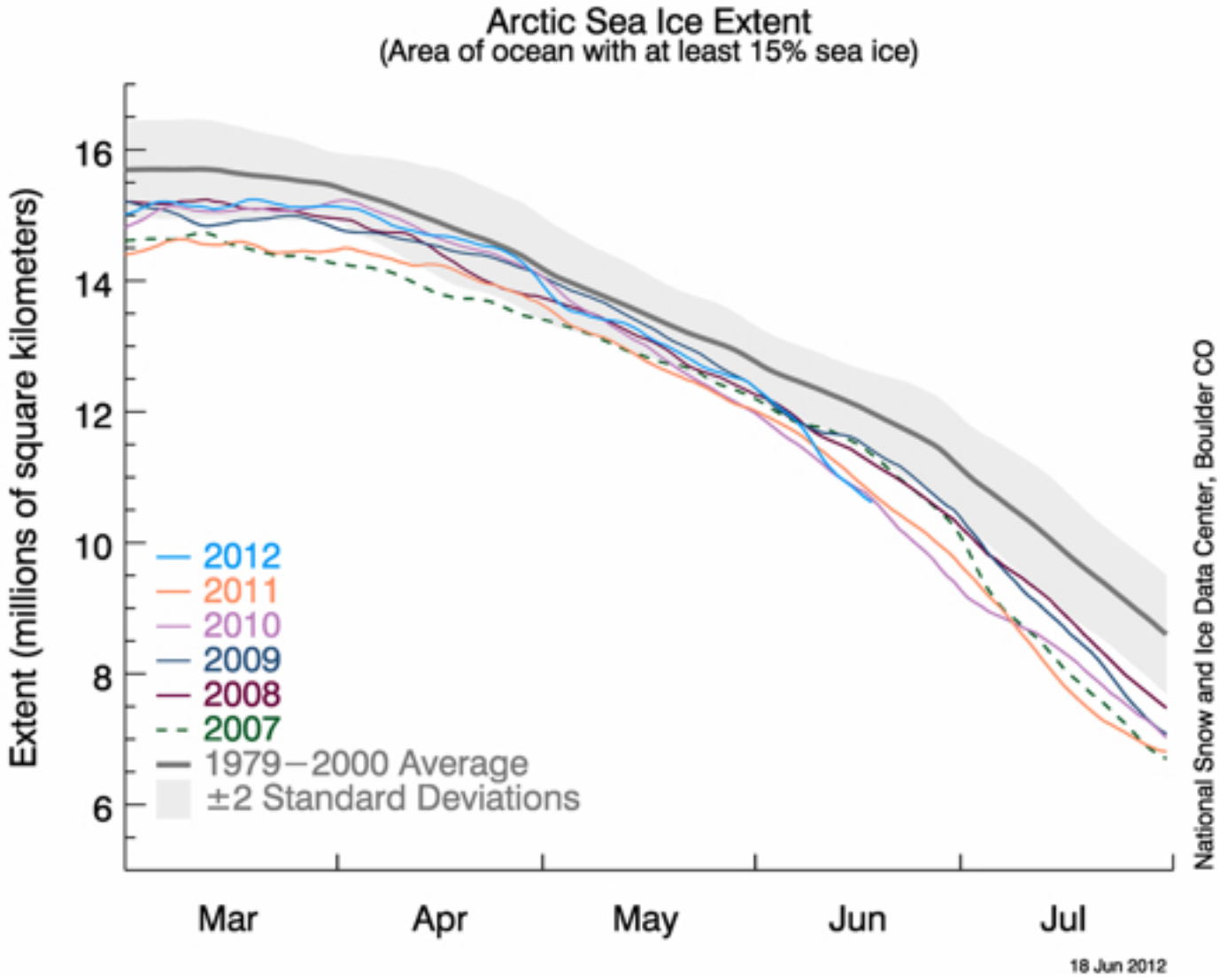
Influence of the Warming Arctic?

Arctic Sea Ice is *systematically* melting

Last few years have seen record melt

Observed climate records and climate models indicate cold easterly winter winds over Euro-Atlantic sector in response to ice melt

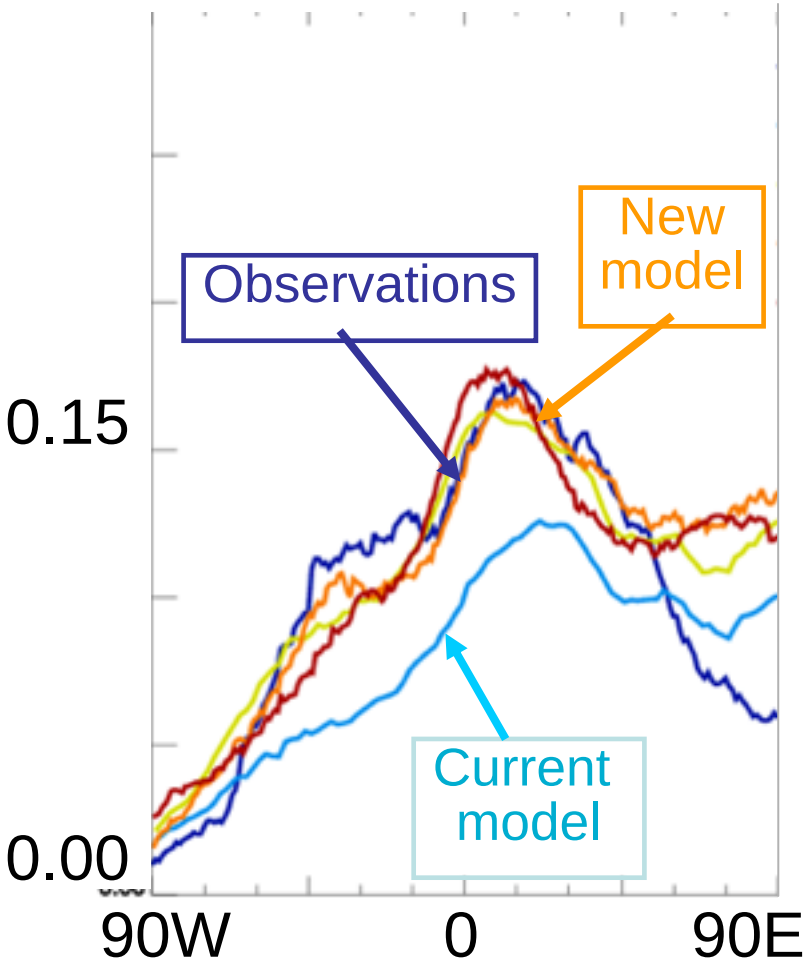
Response in NH summer?



Higher resolution climate model (60km Atmosphere, 1/4^0 Ocean)

Record Cold in December 2010 - blocking

Winter blocking frequency



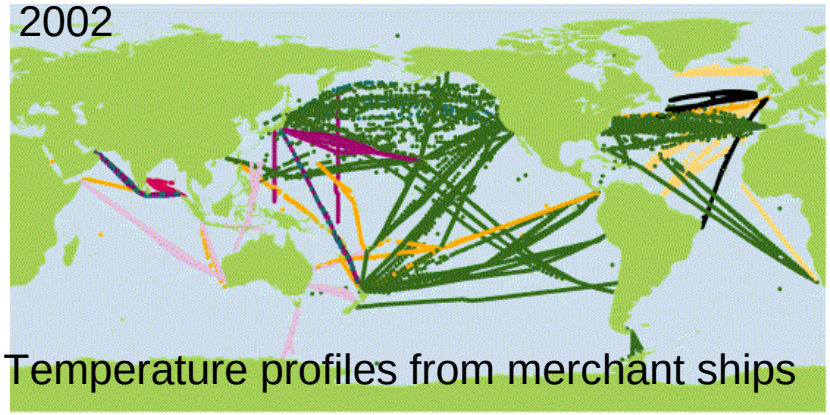
New model (operational in seasonal forecasting in 2012):

Better representation of Gulf Stream

More realistic blocking

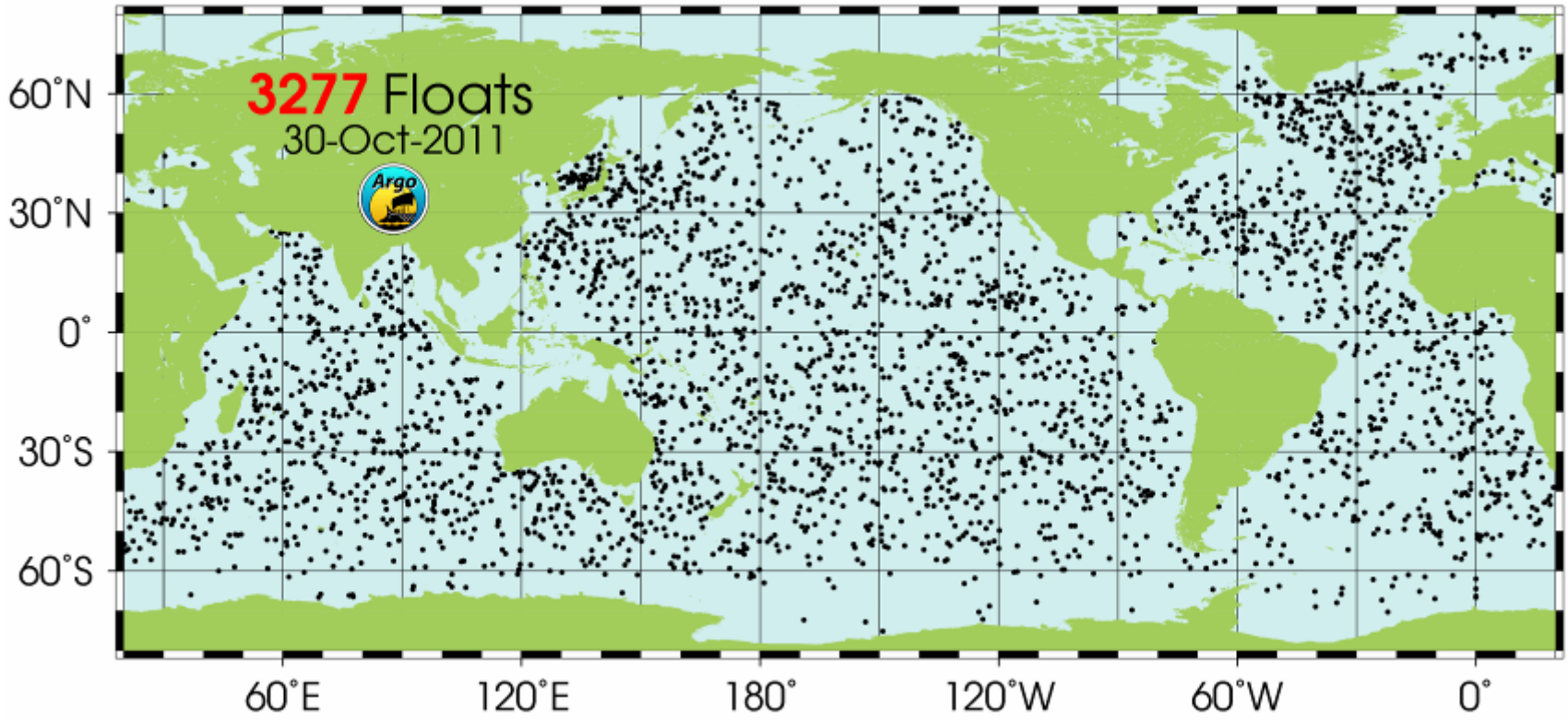
Better representation of cold extremes

Ocean data coverage



Temperature profiles from merchant ships

ARGO installation



Concluding Remarks

- Subseasonal to seasonal prediction has critical place in weather and climate services
- Skill is gradually emerging and new sources of potential predictability are being identified
- Improving model physics and increasing model resolution will deliver significant benefits
- Sustaining the observational base for the atmosphere, land surface and ocean is vital

Met Office

WCRP World Climate Research Programme

WWRP World Weather Research Programme

THORPEX A World Weather Research Programme