

Status of DEMETER  
experiments and verification  
at ECMWF

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Francisco Doblas-Reyes  
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# Outline

- Hindcast production
  - summary of all models
  - estimate of ERA-40 production
- Verification
  - summary of new features
  - monthly means: 00+12 vs. 00 only

# DEMETER: Hindcast production

ERA-40: 10 years and 9 months

ECMWF:  $10 \times 4 + 3 = 43$  hindcasts

LODYC:  $10 \times 4 = 40$  hindcasts

UKMO:  $10 \times 4 = 40$  hindcasts

CNRM:  $9 \times 4 = 36$  hindcasts

MPI:  $6 \times 4 + 1 = 25$  hc

09/86

11/86

11/92

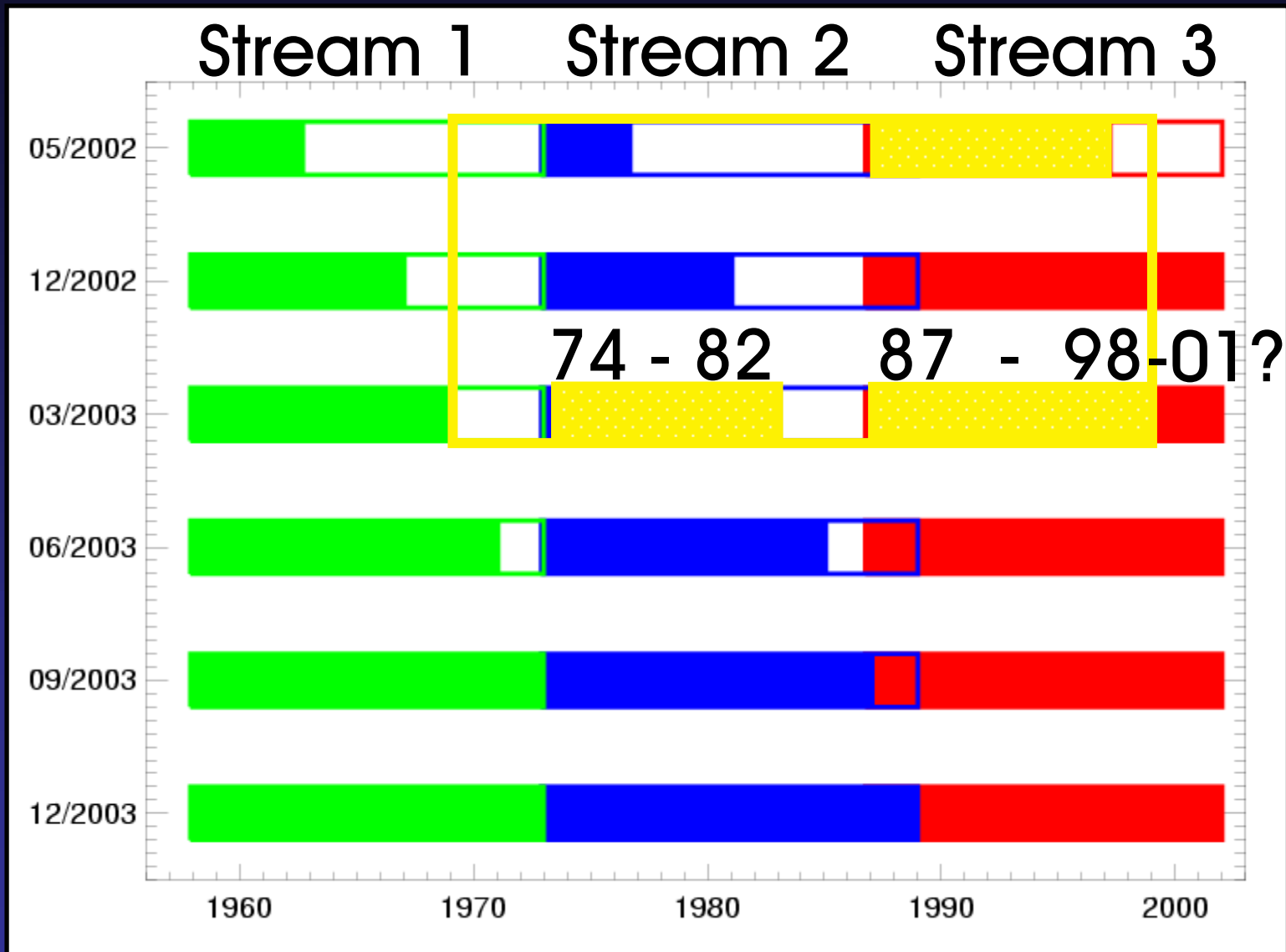
08/95

11/96  
08/96

05/97

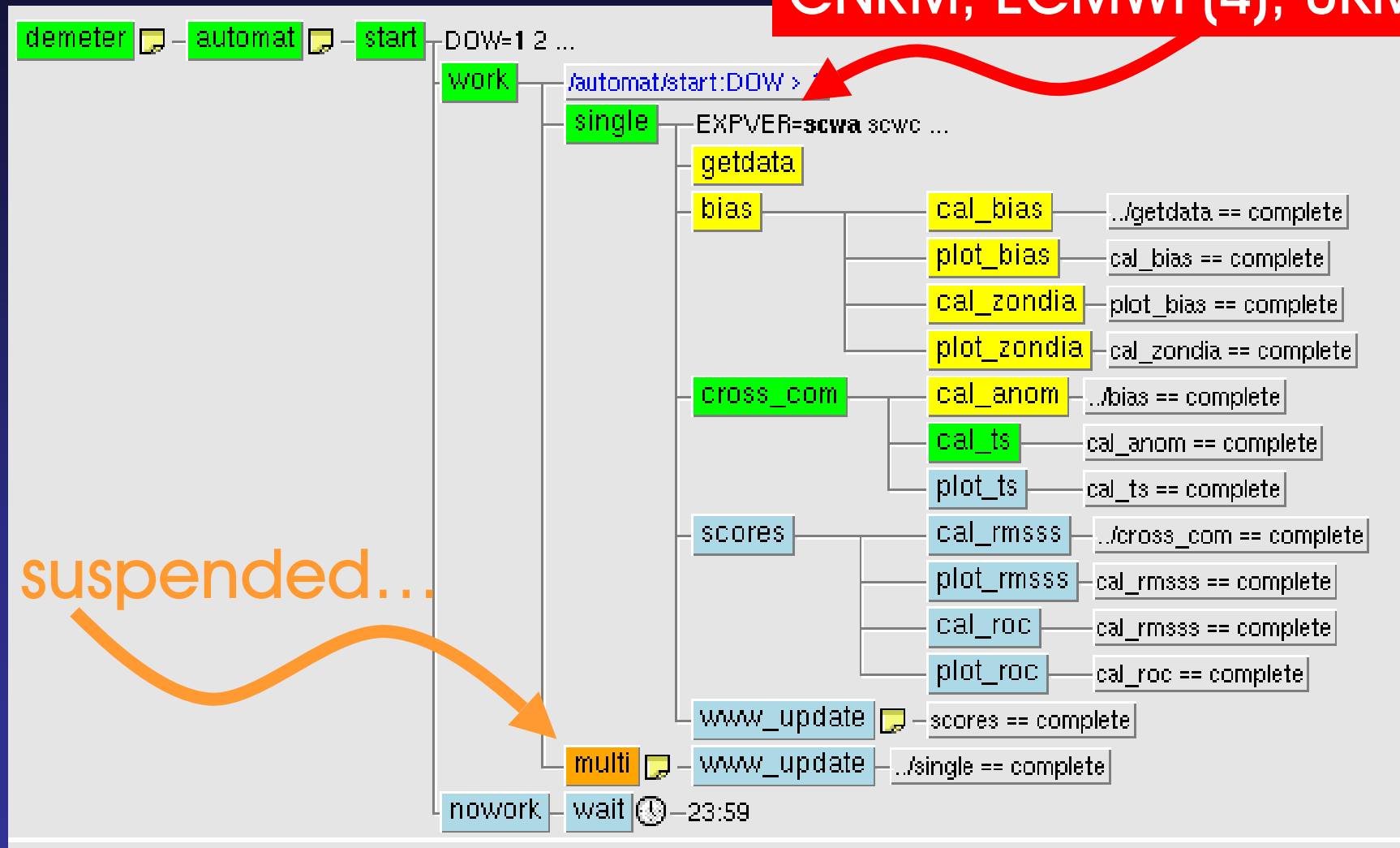


# Estimate of ERA-40 Production

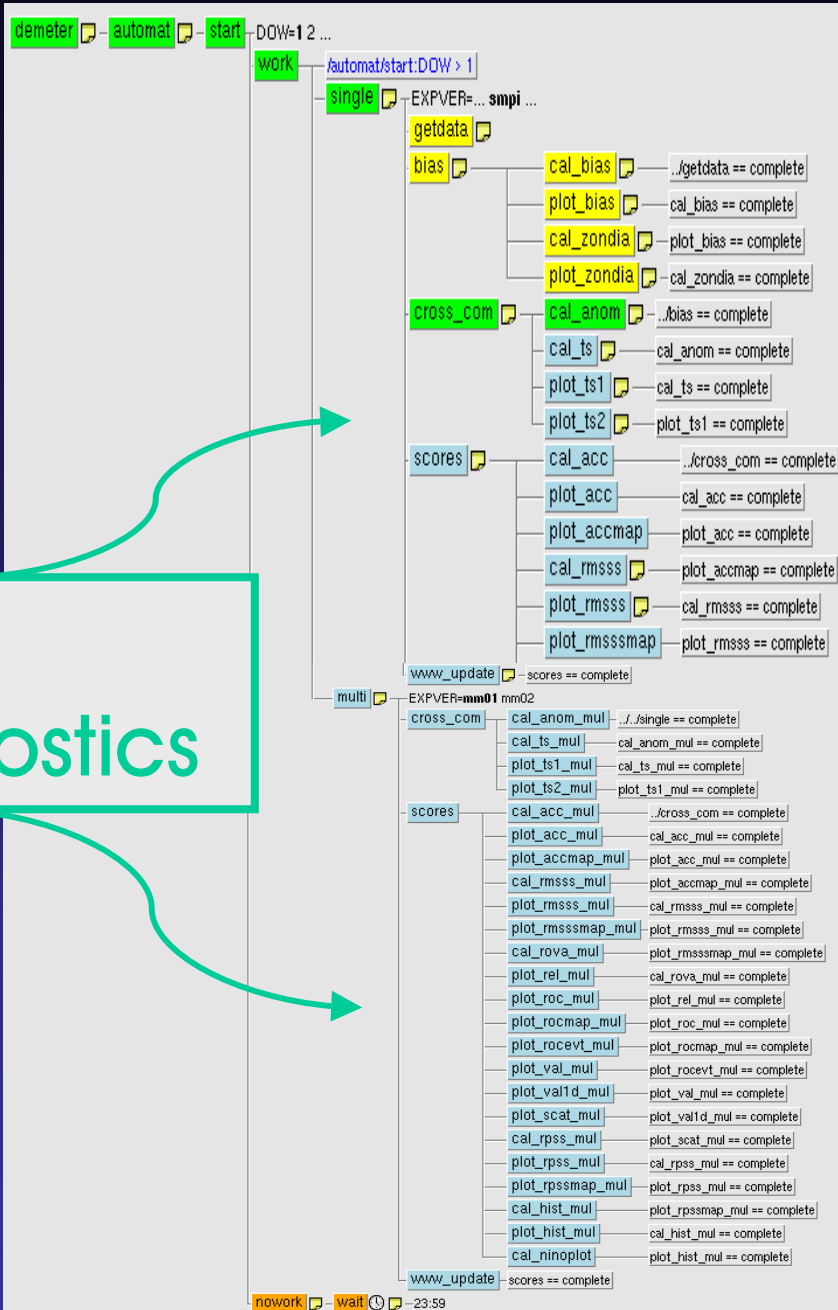


# Verification

CNRM, ECMWF(4), UKMO



New  
diagnostics



Single:

ECMWF(4)

UKMO (2)

CNRM

MPI

LODYC

Multi:

DEMETER(2)

# Verification

- Bias
- Indices
- Deterministic Scores
- Probabilistic Scores
- Single vs. multi-model results

[www.ecmwf.int/research/demeter/verification](http://www.ecmwf.int/research/demeter/verification)





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## Bias

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### Chart catalogue

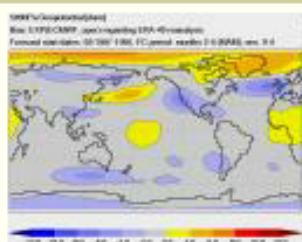
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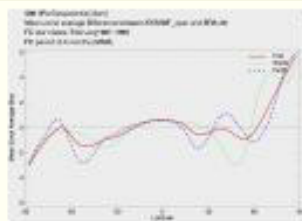
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### Global maps of model bias



The bias of the different DEMETER models is calculated regarding ERA-40 reanalysis data. It is shown for various atmospheric parameters at all available starting dates (Feb, May, Aug, Nov) averaged over different hindcast periods (2-4 months and 4-6 months).  
Product updated the 24th of last month.

### Zonal mean bias



Mean zonal averages of the model bias regarding ERA-40 reanalysis data are shown for the whole latitudinal band as well as separated for the Atlantic and Pacific region only.  
Product updated the 24th of last month.



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**Indices**

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**Chart catalogue**

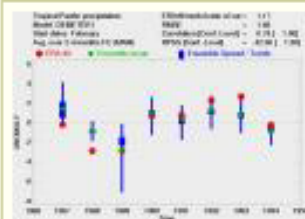
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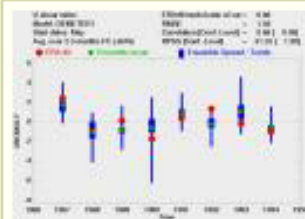
**Time series of anomaly indices for hindcast period 2-4 and 4-6 months**



The timeseries of various anomaly indices averaged over 3 months periods and defined over [different regions](#) show the ensemble mean and spread of the models compared to ERA-40 data. Additionally to the original data you can find for each model, index and start date a plot showing so-called inflated data. In this case the modeled data are standardized according to their respective variance.

Product updated the 25th of last month.

**Time series of anomaly indices for hindcast period 2-5 months**



The timeseries of various anomaly indices averaged over a 4 months period and defined over [different regions](#) show the ensemble mean and spread of the models compared to ERA-40 data. Additionally to the original data you can find for each model, index and start date a plot showing so-called inflated data. In this case the modeled data are standardized according to their respective variance.

Product updated the 25th of last month.



### Demeter: 3 months indices

Show guide

Start

February

May

August

November

All Seasons

Lead

2-4 months

4-6 months

Inflation

original data

inflated data

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Model

Index

Start

Lead

Inflation

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Postscript (10K)

Model

DEMETER I

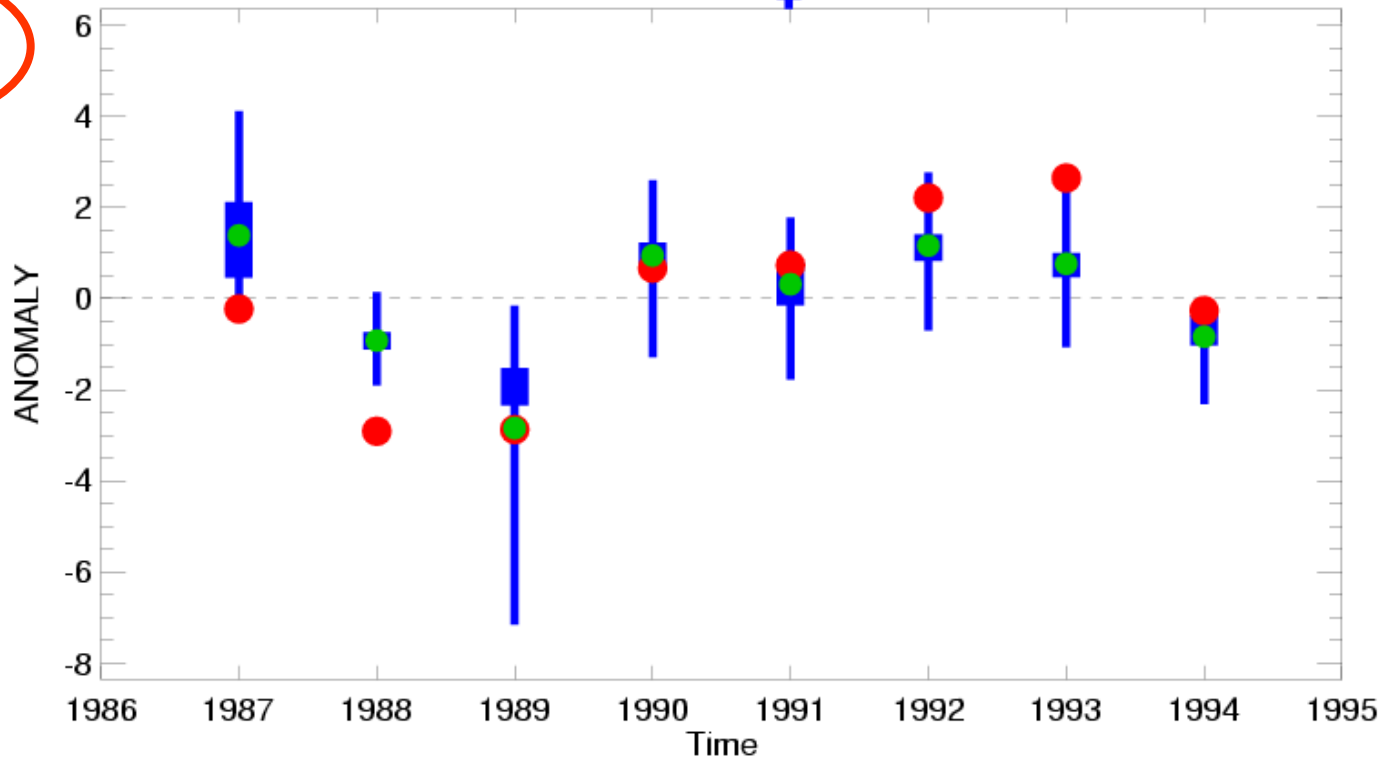
Index

Tropical Pacific Precipitation

Tropical Pacific precipitation  
Model: DEMETER I  
Start dates: February  
Avg. over 2-4 months FC (MAM)

ERA40/model ratio of var. = 1.17  
RMSE = 1.66  
Correlation [Conf.-Level] = 0.78 [ 1.00]  
RPSS [Conf.-Level] = 42.96 [ 1.00]

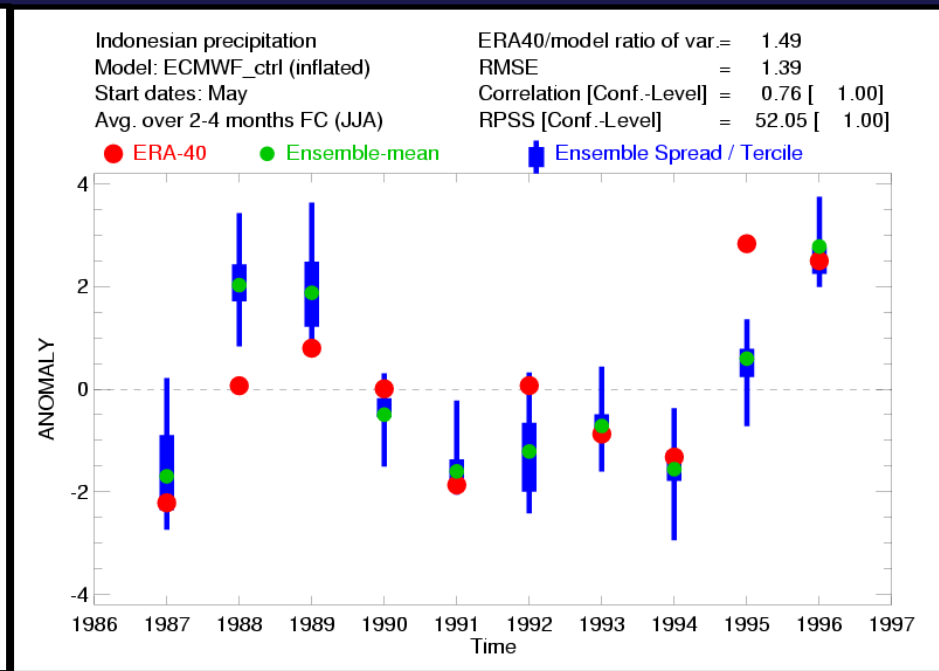
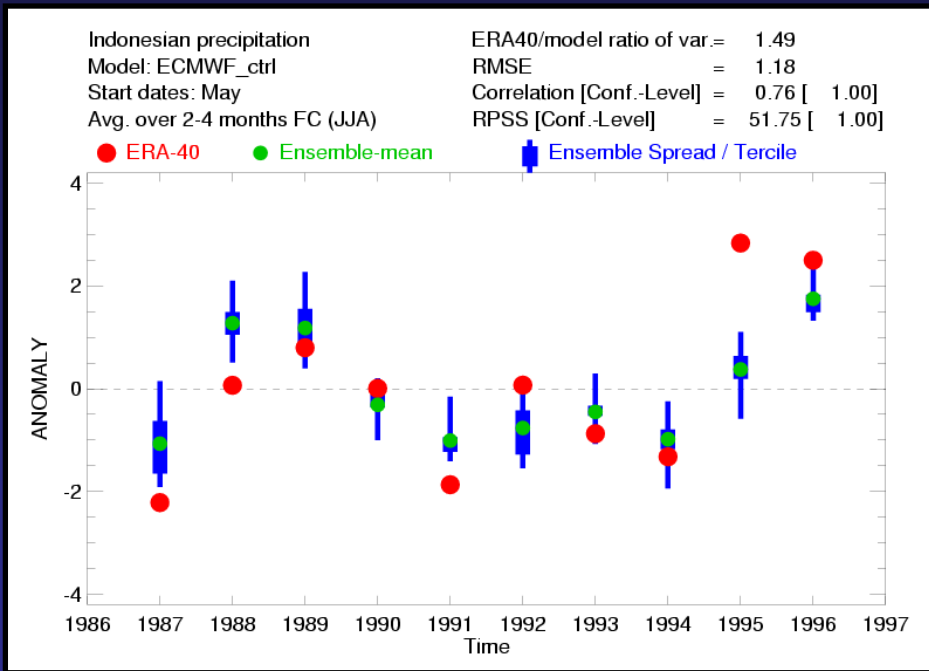
● ERA-40    ● Ensemble-mean    ■ Ensemble Spread / Tercile



# Indices

original

inflated



## Deterministic scores

### Other charts

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### Chart catalogue

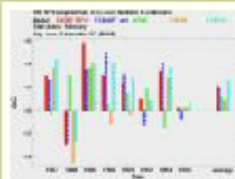
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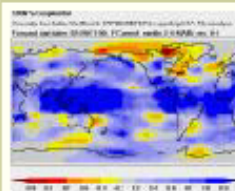
### Anomaly correlation coefficient



Timeseries of anomaly correlation coefficients averaged over [different regions](#) are shown for all individual models as well as for the DEMETER multi-model combinations. The timeseries for the individual models show the results for every single ensemble member and the ensemble mean. In the plot for the multi-model combinations only the results of the ensemble mean is compared to the ensemble mean of each individual model.

Product updated the 25th of last month.

### Global maps of anomaly correlation coefficient



The grid point values of the anomaly correlation coefficient are shown as global map. They are based on all available hindcast years as indicated in the plot header and calculated regarding ERA-40 reanalysis data.

Product updated the 25th of last month.

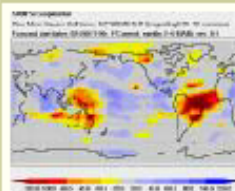
### Root mean square skill score



Timeseries of root mean square skill scores averaged over [different regions](#) are shown for all individual models as well as for the DEMETER multi-model combinations. The timeseries for the individual models show the results for every single ensemble member and the ensemble mean. In the plot for the multi-model combinations only the results of the ensemble mean is compared to the ensemble mean of each individual model.

Product updated the 25th of last month.

### Global maps of root mean square skill score



The grid point values of the root mean square skill score are shown as global map. They are based on all available hindcast years as indicated in the plot header and calculated regarding ERA-40 reanalysis data.

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## Demeter: ACC map

Start

[February](#)

**May**

[August](#)

[November](#)

Lead

[2-4 months](#)

**4-6 months**

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Model

ECMWF control

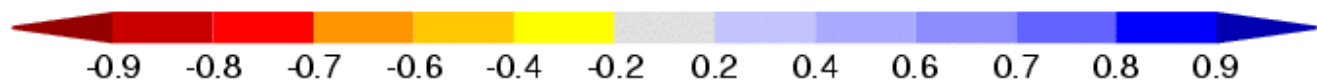
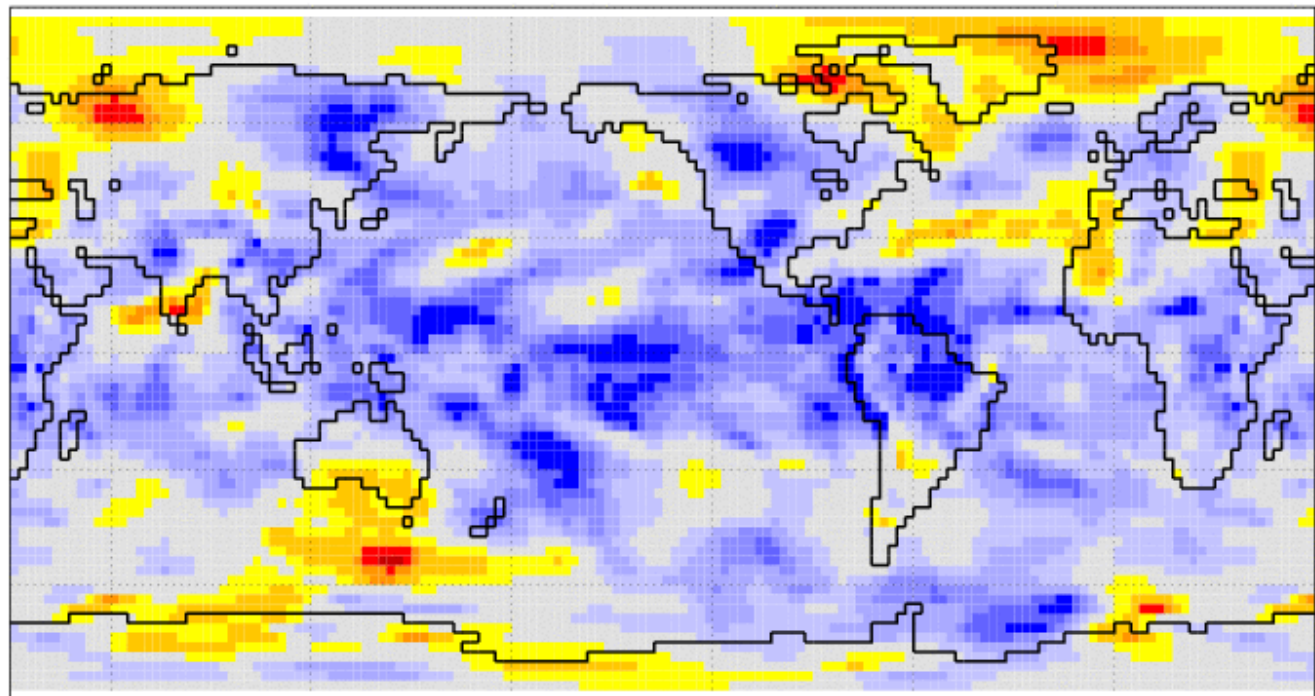
Parameter

850 hPa Temperature

### 850hPa Temperature

Anomaly Correlation Coefficient: EXP(ECMWF\_ctrl) regarding ERA-40 reanalysis

Forecast start dates: 02/1987-1996, FC period: months 2-4 (MAM), ens: 0-8



## Probabilistic scores

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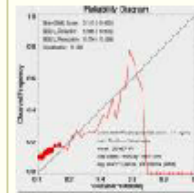
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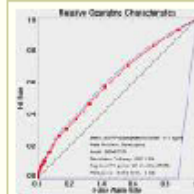
### Reliability diagram



The reliability diagram compares the modeled probability of a specific event to the observed frequency in the ERA-40 data in [different regions](#). The event threshold depends on the standard deviation of the specific model or the observations, respectively. The size of the bullets indicates the number of cases in that particular forecast probability bin.

Product updated the 25th of last month.

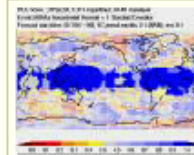
### Relative operating characteristics curve



The relative operating characteristics curve shows - for a range of different probability thresholds - hit rates versus false alarm rates of forecasts of a particular event in [different regions](#). The event threshold depends on the standard deviation of the specific model or the observations, respectively. The blue dotted lines indicate the 95% confidence interval for the hit rate values.

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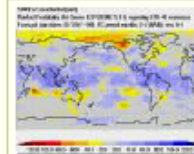
### Global maps of relative operating characteristics score



The grid point values of the ROC score are shown as global map. They are based on all available hindcast years as indicated in the plot header and calculated regarding ERA-40 reanalysis data. Values significantly above/below 0.5 are shown as full grid boxes, values with a greater uncertainty, i.e. ROC scores not significantly above/below 0.5 are shown as squares smaller than the whole 2.5x2.5 degree grid box.

Product updated the 26th of last month.

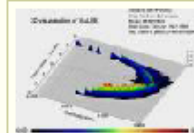
### Global maps of ranked probability skill score



The grid point values of the ranked probability skill score are shown as global map. They are based on all available hindcast years as indicated in the plot header and calculated regarding ERA-40 reanalysis data.

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### Potential economic value



The diagrams of the potential economic value indicate the "usefulness" of a probabilistic forecast depending on the cost/loss ratio of a potential user, shown for a range of forecasts of a particular event in [different regions](#). The event threshold depends on the standard deviation of the specific model or the observations, respectively.

Product updated the 25th of last month.

## Demeter: Value

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Start

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[May](#)  
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[November](#)

Lead

[2-4 months](#)  
[4-6 months](#)



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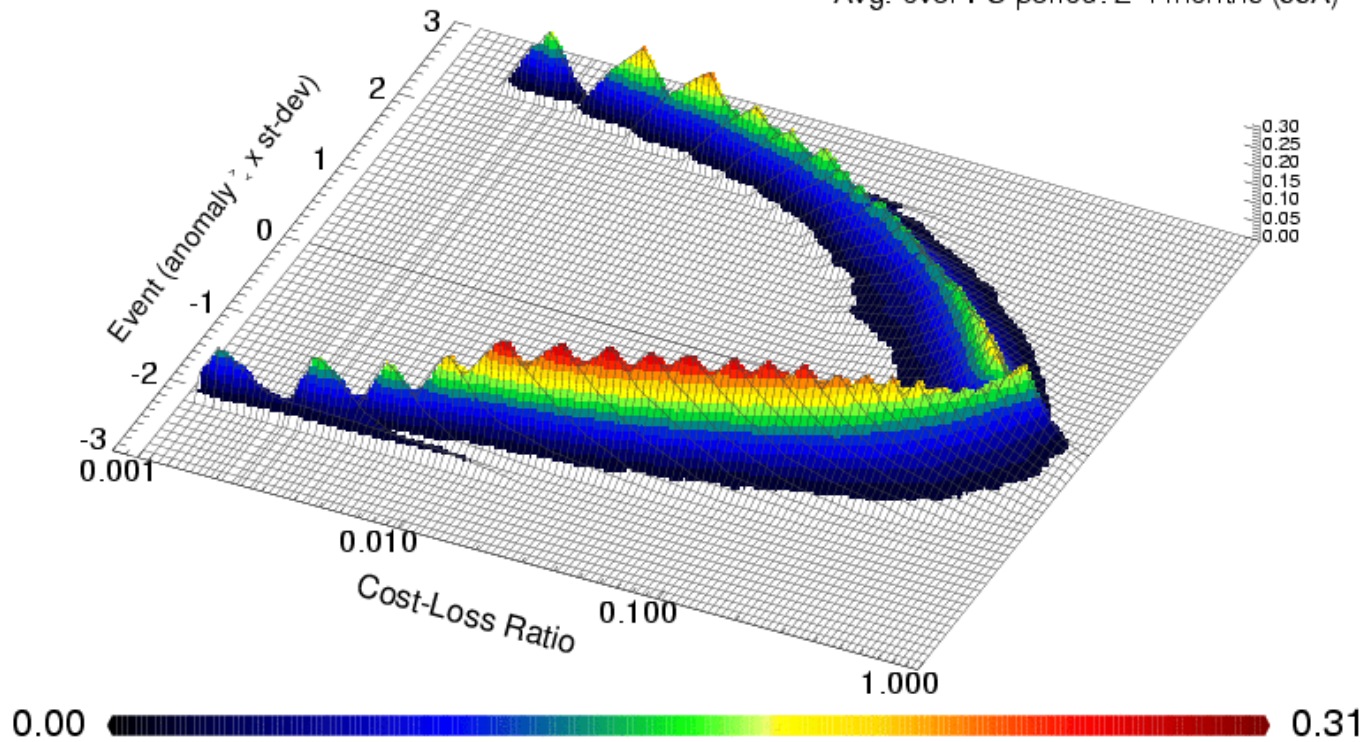
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Model	Parameter	Area
DEMETER I	Precipitation	Tropics

### 3D visualisation of VALUE

Variable: Precipitation  
Area: Tropics  
Model: DEMETER I  
Start dates: May 1987-1994  
Avg. over FC period: 2-4 months (JJA)



● [Hide guide](#)

## Demeter: Value

### Start

[February](#)

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### Lead

[2-4 months](#)

[4-6 months](#)

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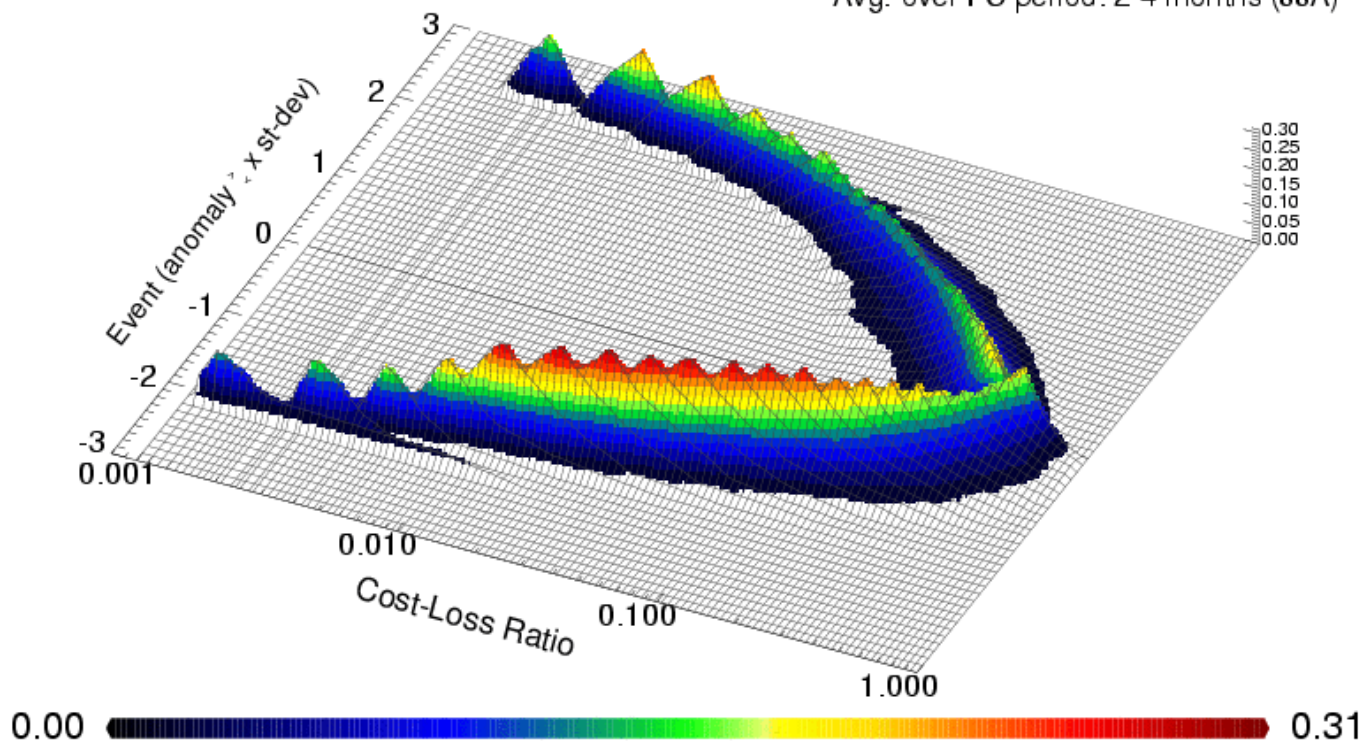
 [Postscript \(451K\)](#)

The diagrams of the potential economic value indicate the "usefulness" of a probabilistic forecast depending on the cost/loss ratio of a potential user, shown for a range of forecasts of a particular event in [different regions](#). The event threshold depends on the standard deviation of the specific model or the observations, respectively.

Model	Parameter	Area
DEMETER I	Precipitation	Tropics

## 3D visualisation of VALUE

Variable: Precipitation  
Area: Tropics  
Model: DEMETER I  
Start dates: May 1987-1994  
Avg. over FC period: 2-4 months (JJA)



## Single vs multi-model

### Other charts

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### Chart catalogue

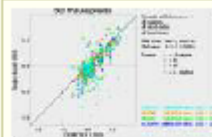
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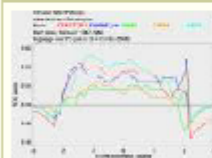
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### Scatter plots of multi-model vs. single-model scores



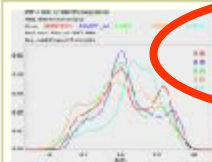
The scatter plots compare single vs. multi-model scores of various diagnostics (BSS, Reliability, Resolution, ROC) collected over all regions, all start dates and all lead times. Different event thresholds are marked by different symbols.  
Product updated the 25th of last month.

### ROC score vs event curves



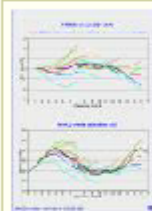
The curves of ROC values vs. event thresholds are shown for the DEMETER multi-model in comparison to the single model results.  
Product updated the 26th of last month.

### PDF's of ACC, ROC, RPSS



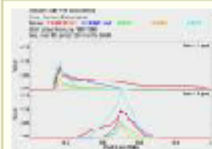
The probability density functions (PDF's) of various diagnostics calculated over different regions are shown for the DEMETER multi-model in comparison to the single model results.  
Product updated the 1th of this month.

### Nino-SST diagnostics



Various diagnostics of the Sea Surface Temperature (SST) in different Nino regions are shown for the DEMETER multi-model in comparison to the single model results.  
Product updated the 26th of last month.

### Comparison of multi-model vs. single-model potential economic value



The potential economic value vs. the cost loss ratio calculated for two different event thresholds is shown for the DEMETER multi-model in comparison to the single model results.  
Product updated the 30th of last month.

## Maps of the used regions

### Demeter

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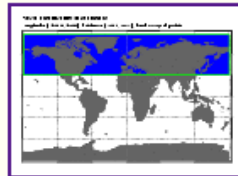
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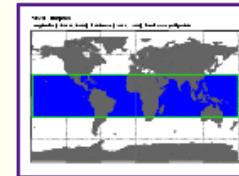
[Data](#)

These are the maps describing the regions used in the model verification (click on the image to see an larger version):

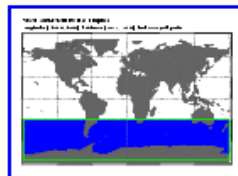
Northern extratropics



Tropics



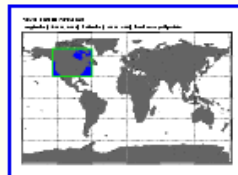
Southern extratropics



Europe



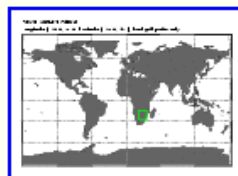
North America



Western Africa



South Africa



Eastern Africa



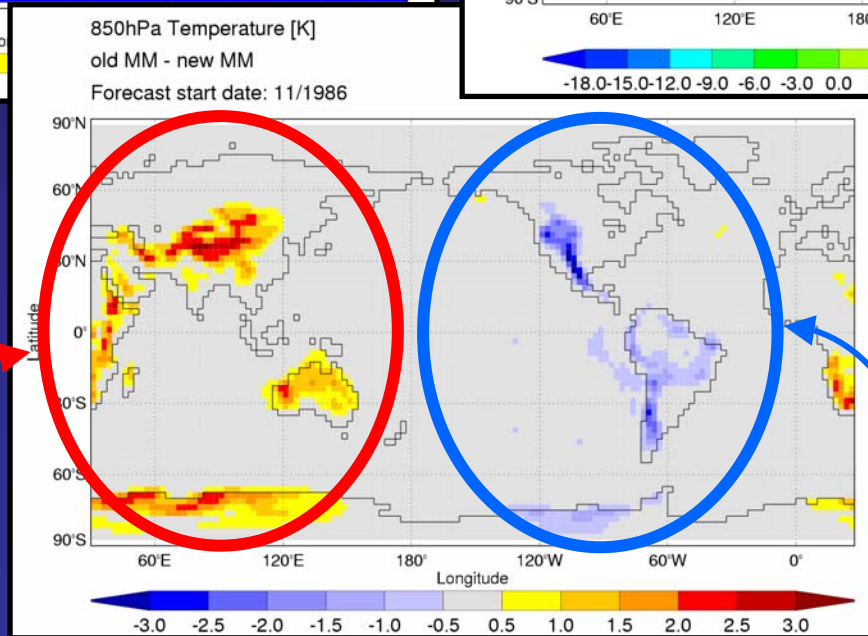
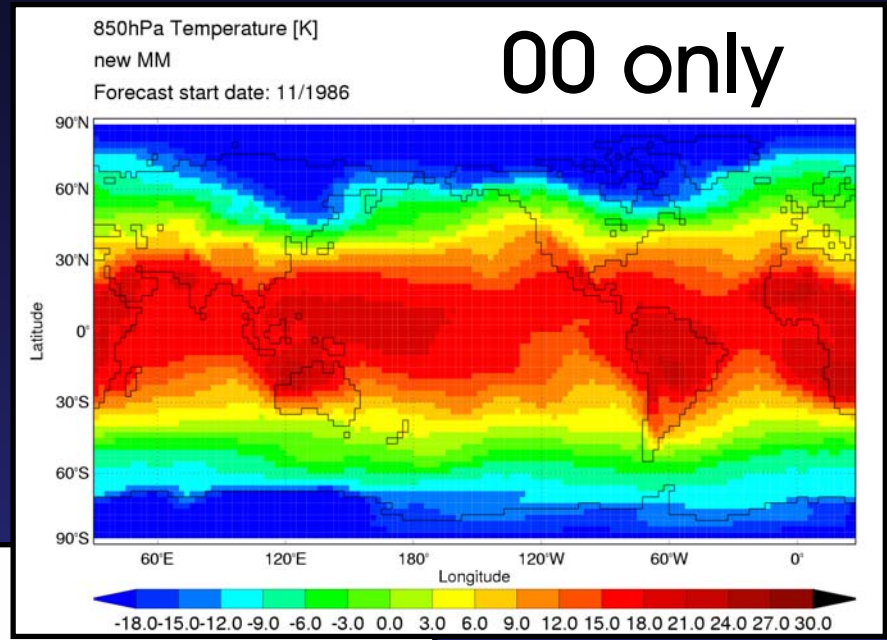
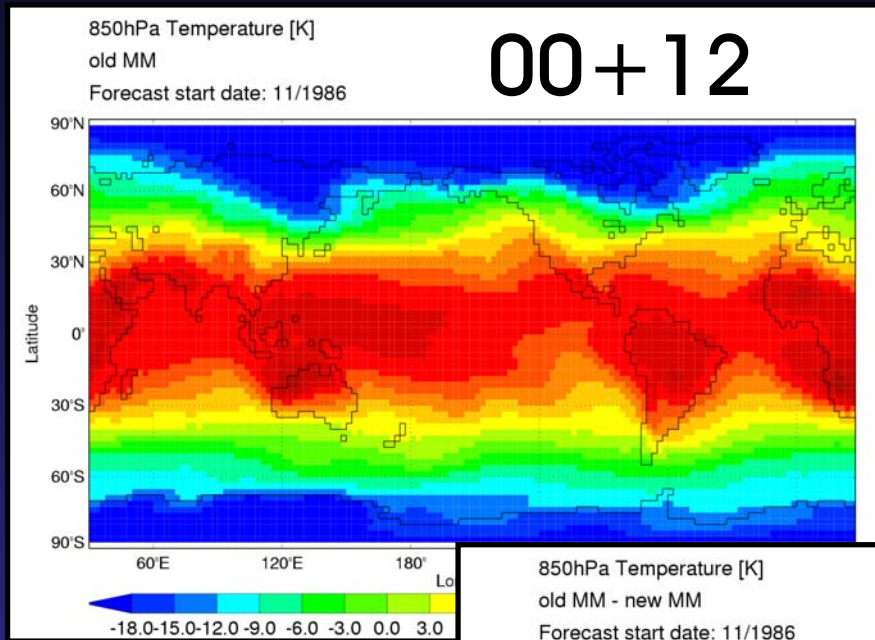
# Online Data Distribution

- online data access tool under development
  - monthly means
  - choice of selected variables
  - choice of space and time range
  - choice of data format (GRIB or NetCDF)
  - installation very likely for end of 2002

# Importance of common archiving and verification strategy

- agreed construction of monthly means:
  - take output at 00 only (except sfc)
- ECMWF construction of monthly means:
  - take output at 00 + 12 (except sfc)

# Monthly Means: 00+12 vs. 00 only

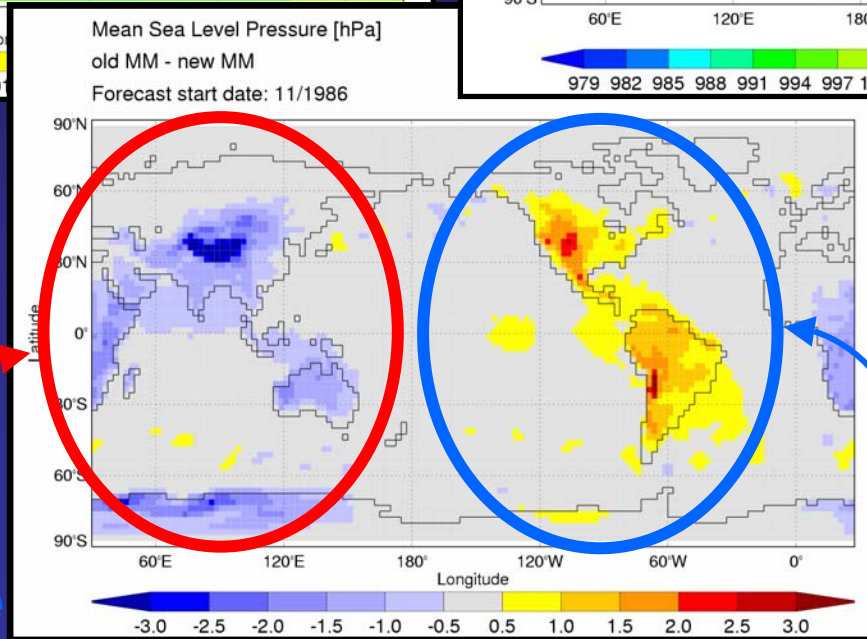
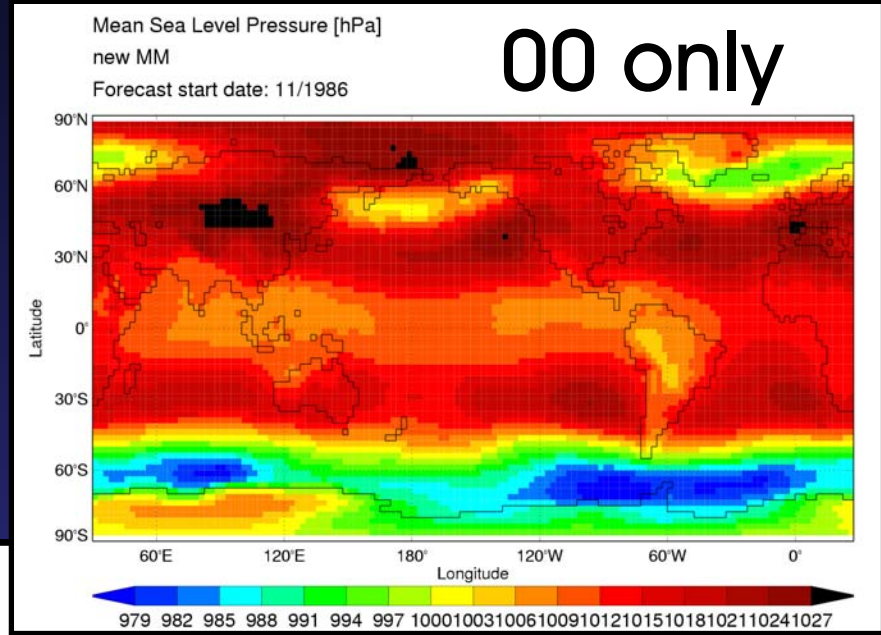
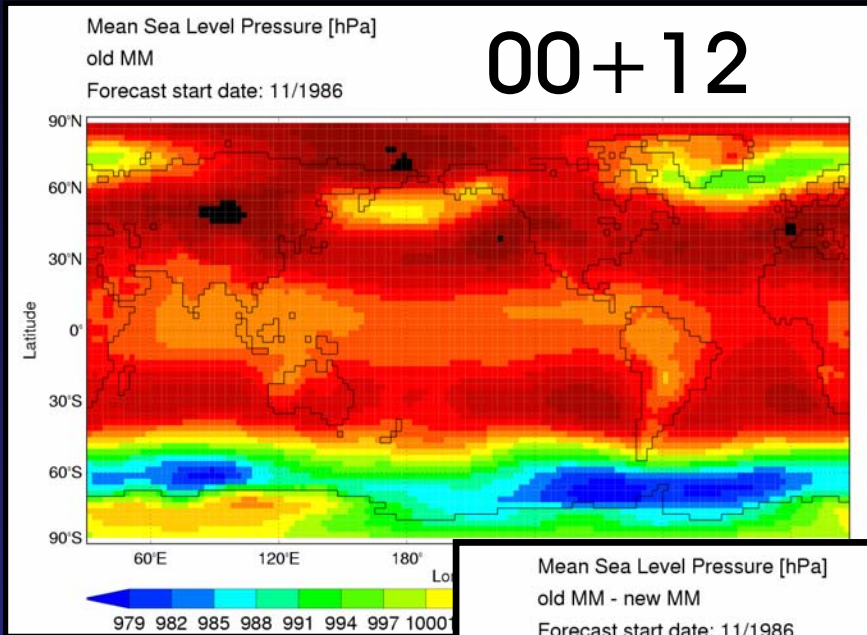


00+12  
MM's are:

warmer

colder

# Monthly Means: 00+12 vs. 00 only



00+12  
MM's are:

warmer  
lower pressure

colder  
higher pressure

# Discussion

- Despite of some “teething” problems...  
now hindcast production is doing pretty well
- ERA-40 issue...  
hindcast production after 03/2003 possible?
- Verification site is growing...  
any wishes / suggestions / input?
- Online data retrieval very likely...  
coordination of external use of data?

