Some of the consistency research and results to date in CMUG Phase 2

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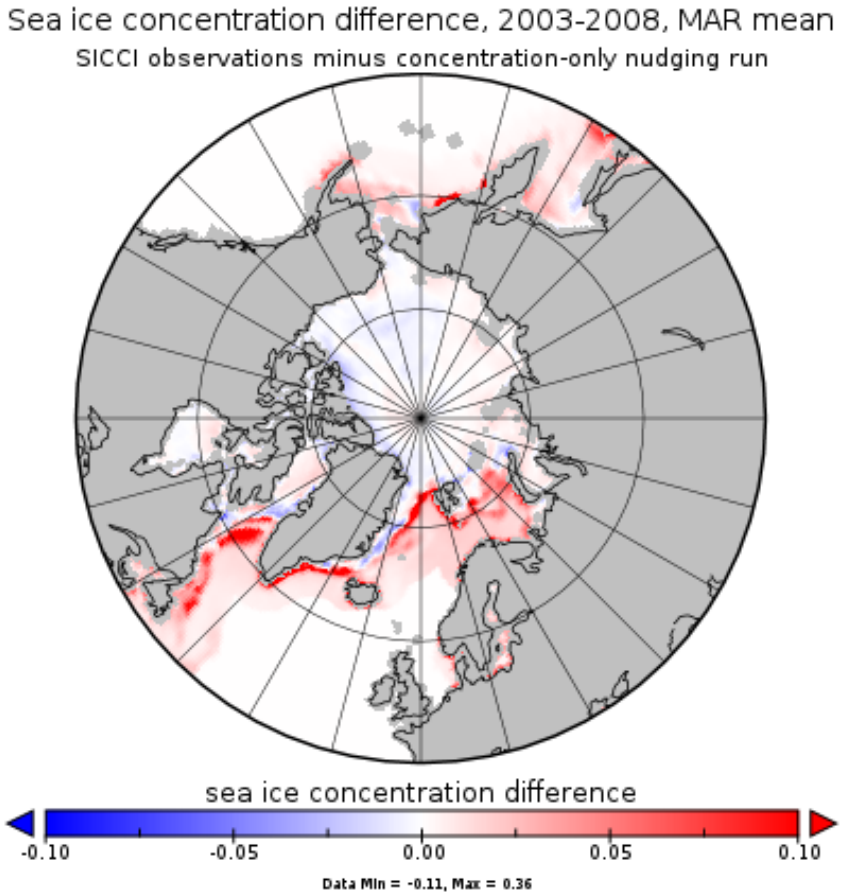
Sea Ice consistency with ORA

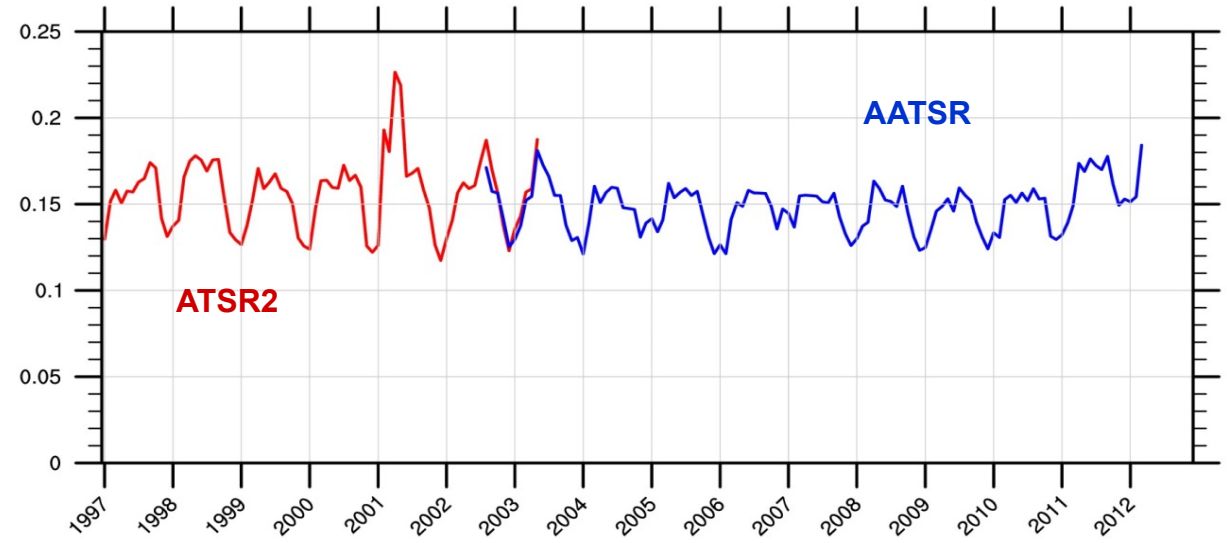


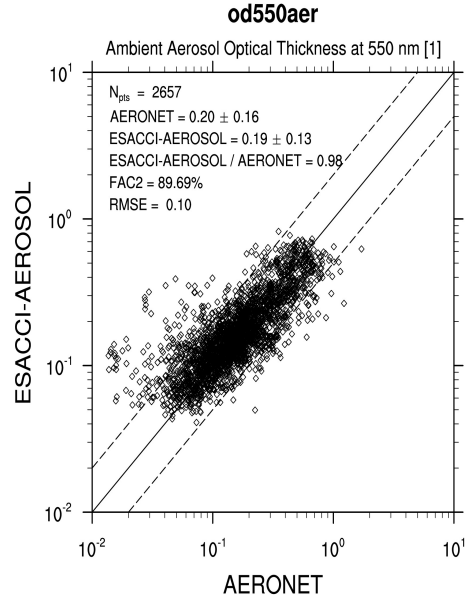
It shows what happens in a model into which we assimilate CCI sea ice and ORA ocean temperatures. Because the two data sets are inconsistent, much of the ice melts immediately in the model (dark red areas along ice edge). This is because in the ORA data set, any ice below 15 % concentration is filtered out, and above freezing temperature are associated to those water areas.

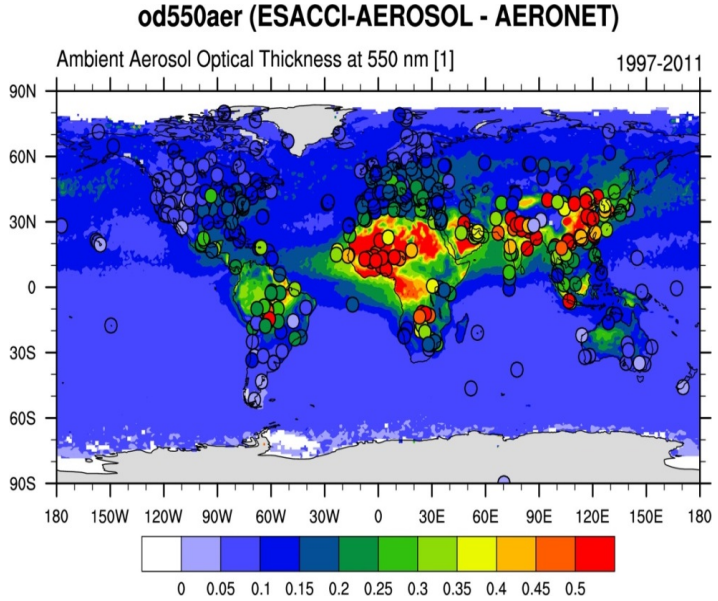
MPI-M are working on doing a similar simulation with exchanging ORA temperature with CCI temperatures, but this is already a good example showing how important consistent data sets are.

Also note that the light red regions have ice in CCI sea ice, which would be filtered out if we applied the CCI sea ice flags. We haven't done this here since we wanted to work with as little processed data as possible. This is a clear advantage of CCI sea ice over existing data sets, we feel.

Consistency of aerosol-cci data







TOP PANEL

The aerosol-cci dataset consists of a long-term climate data record based on data from two platforms: ERS2-ATSR2 (covering the period 1996-2003) and ENVISAT (2002-2012). Given the overlap between the two dataset used to construct the long-term record, we analysed the differences in the overlap period. As shown in the Figure, such differences are small. Therefore combining the two dataset in a single data record has not been an issue in this work package.

BOTTOM PANEL

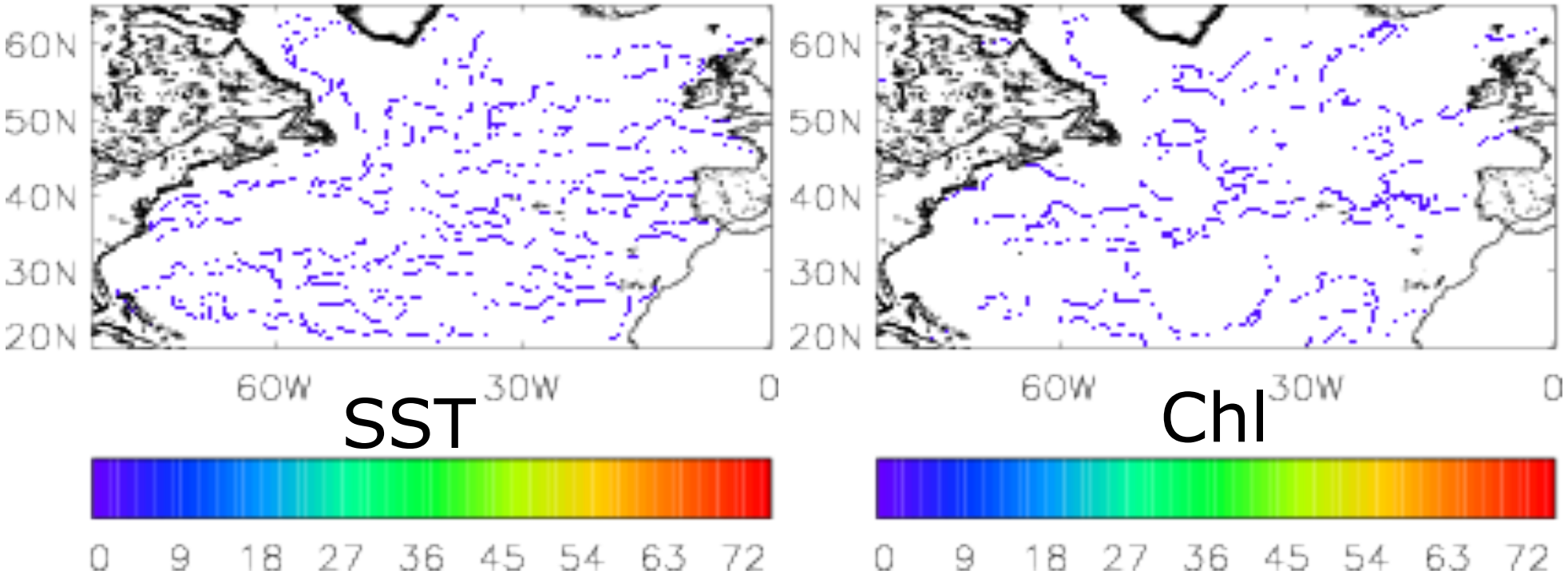
The consistency of the aerosol-cci product has been tested by comparing with AOD data from AERONET. AERONET is a well-established global network of ground stations measuring AOD and related quantities since several decades. AERONET is widely accepted as a reference data set for validating AOD measured by satellites. The result of this comparison show an overall good agreement between aerosol-cci and AERONET. An overestimate of AOD can be seen in some stations (especially in the Sahara, Arabia Peninsula, and South America). The agreement is good also in the marine stations, where the ground measurements are quite limited and the satellite product represent a valuable addition for the evaluation of model results.

Left: scatterplot aerosol-cci vs. AERONET for AOD at 550 nm (statistical values are shown within the panel, FAC2 is the fraction of points for which the difference cci-aeronet is within a factor of 2)

Right: aerosol-cci AOD at 550 nm (contours) vs. AERONET stations (circles), same color coding is used.

Fronts – 1st May 2008
1/4°

MetOffice



- Plan to compare cross-consistency of marine ECVs (SST, SL, OC, may expand to include sea ice later in Phase 2).
- Some statistical assessment will be performed of the observation products.
- Data assimilation experiments will be performed, assimilating different combinations of ECVs into FOAM-HadOCC (a coupled physical-biogeochemical ocean model) at ¼ degree resolution.
- Assessment of consistency of features in different model fields when assimilating data will be performed.
- Also assessed will be the impact of the assimilation on climate-relevant variables, and their internal consistency in the model.

Whilst I don't have any results so far, I've attached a couple of images from some old work (note: this did not use CCI data). They show, from a data assimilative run of FOAM-HadOCC, one day's SST and chlorophyll fields in the North Atlantic, and an analysis of frontal positions in each field. This was just a random day looked at as a proof of concept, so I wouldn't draw too many conclusions from it, but it's an example of what we could look at, and that there is some correspondence between fields.

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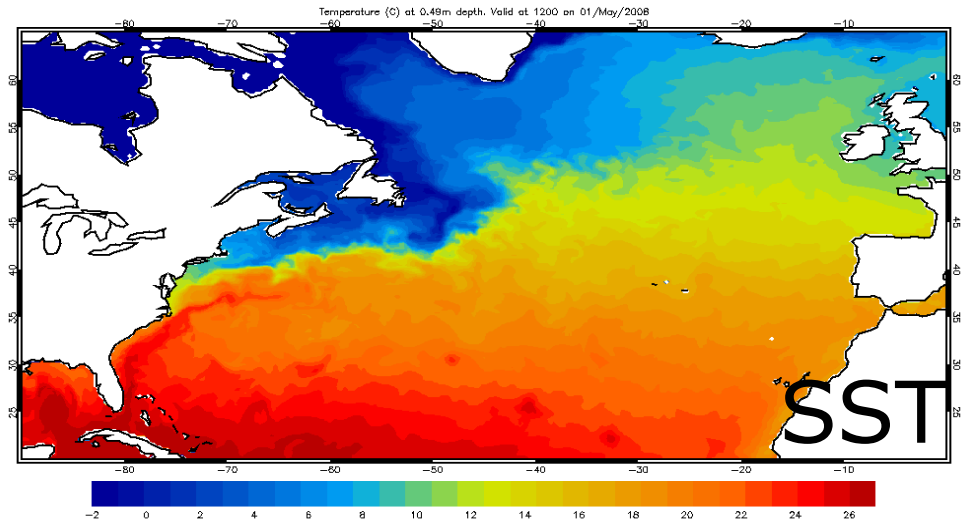
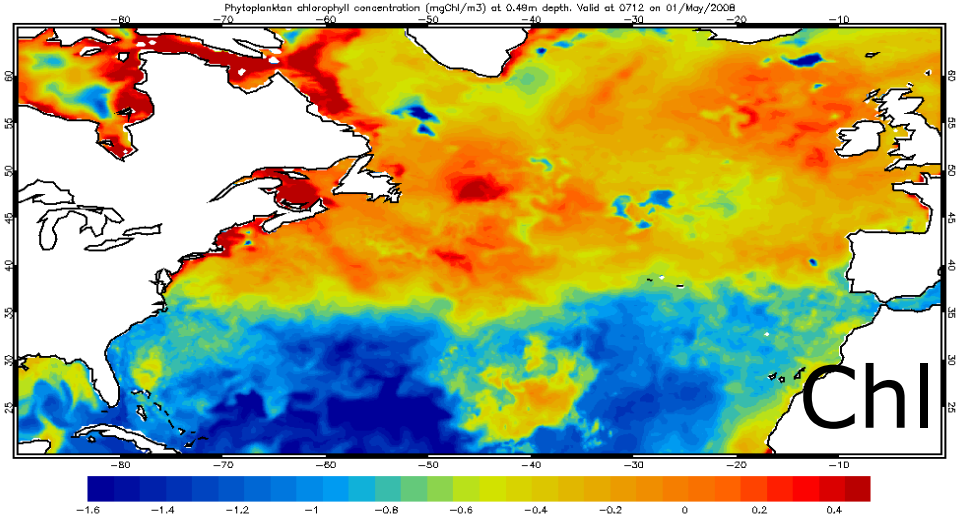
Fields – 1st May 2008 1/4°





Here's some (rough) ideas for what can be assessed:

- Positions of fronts in e.g. SST and chlorophyll (noting that these won't always be expected to match up, but some correspondence is to be expected).
- Positions of eddies, e.g. how mesoscale features in chlorophyll compare with SSH/current fields.
- Impact of assimilation on carbon cycle, meridional overturning circulation (MOC), etc.
- Whether assimilating all ECVs results in smaller assimilation increments compared with assimilating individual ECVs, which would indicate the underlying model fields are improved.

What would be very useful for me is if members of the CCI teams have ideas for how consistency could be assessed, if there's anything that would be particularly useful/interesting for them to have information on.

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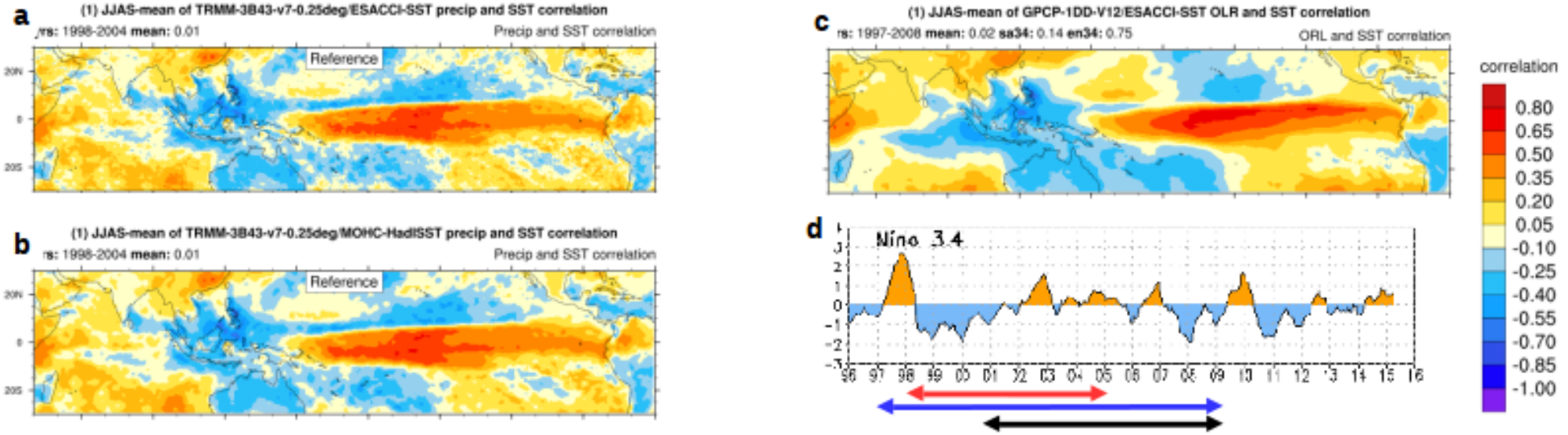
SST consistency with OLR



Correlation between the ENSO index and the global precipitation from TRMM and GPCP with SST from CCI and Hadley and with TRMM OLR

Observed and simulated correlation between precipitation and SST for 1998-2004

a. TRMM precipitation and CCI SST,

b. TRMM precipitation and Hadley SST: and for 1997-2008

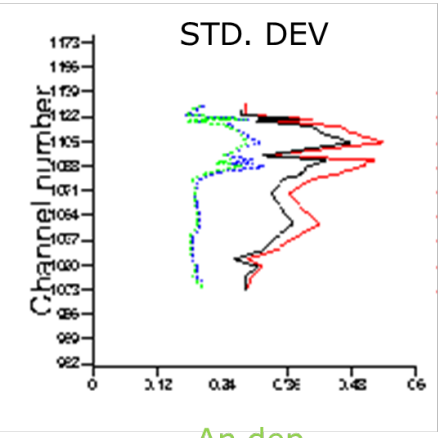
c. GPCP precipitation and CCI SST and

d. El Nino3.4 Index time series

CCI GOME-2 NPO3 assimilation: an example of consistency

ECMWF

AIRS IR/O3



LHS: tandard deviation of the residuals between the AIRS ozone-sensitive infrared radiances (IR/O3) and the first-guess (i.e. short-range forecasts) and analyses from two experiments:

CTRL= reference exp with all t data available

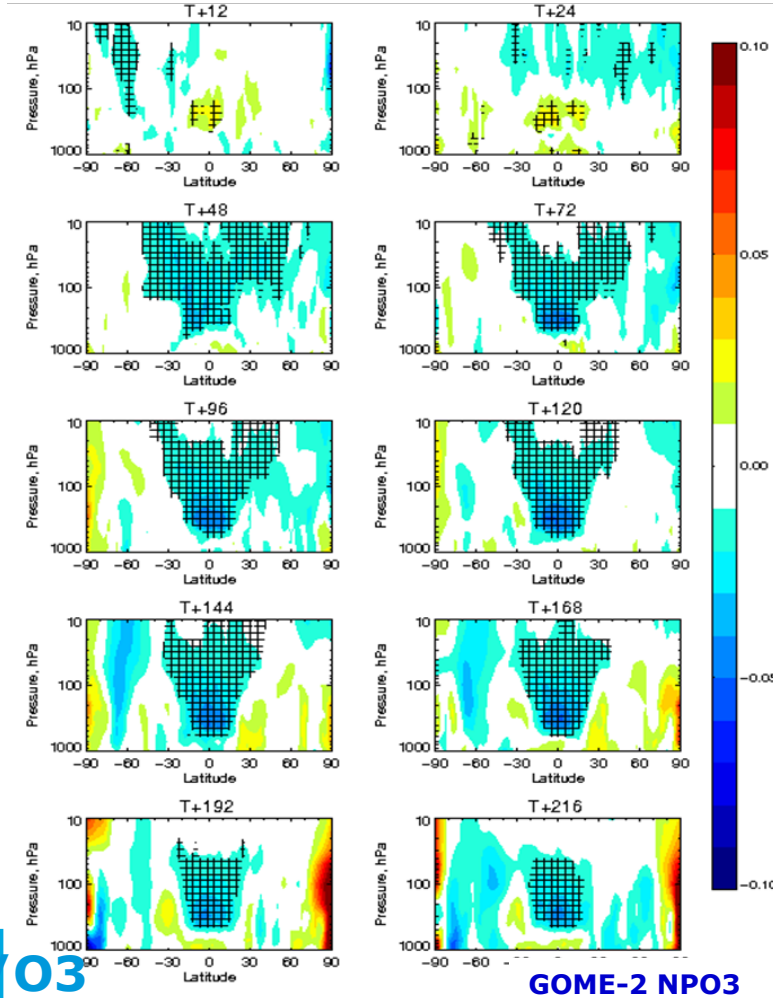
PERTURBATION= identical to CTRL except for assimilating also the CCI GOME-2 nadir profiles

RHS: Diff. In RMS of the forecast error of Z computed for PERTURBATION and that of CTRL ➔ Negative/blue PERTURBATION smaller RMSE than CTRL, thus better. Hatched areas statistically significanta 95% confidence level.

Better usage of AIRS IR/O3 when GOME2 NPO3 is used.

Δ RMSE(Z)

GOME-2 NPO3 degrades RMS of Z fc error



GOME-2 NPO3 improves RMS of Z fc error

The assimilation of the GOME-2 NPO3 improve the analysis fit to the IR/O3 measured by the AIRS sensor, implying a better usage of these observations (l.h.s. plot).

The better usage of the AIRS IR/O3 data had positive impact on reducing the RMS of the forecast error of Z (blue shaded areas on the r.h.s. plot) particularly in the tropics where the changes are statistically significant.

So the assimilation of the GOME-2 NPO3 improves the internal consistency of the data assimilation system by a better usage of AIRS data, and in turn an indirect, positive impact on the forecasts skills.