Use of satellite observations in the ECMWF system

Rossana Dragani

Satellite Data Section, Research Department

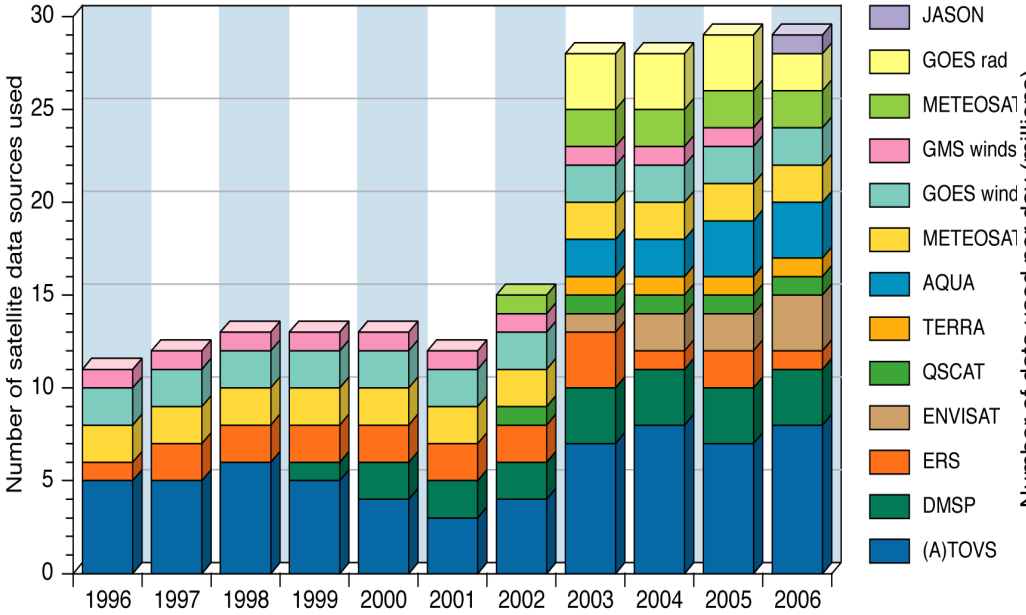
ECMWF

Opportunities and challenges

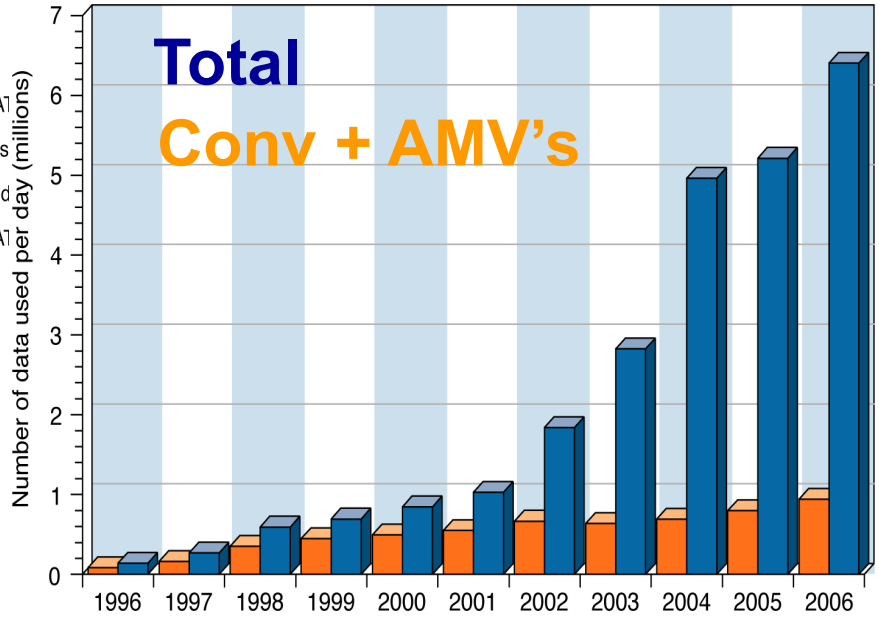
- **Modern analysis systems heavily rely on satellite data.**
- **Improved sounders offer new opportunities:**
  - **Trace gases, aerosols, reactive gases (environment monitoring, air quality)**
- **Technical and scientific challenges to be faced by the NWP community:**
  - **Developing sufficient expertise to exploit a proliferation of new instruments/observing techniques.**
  - **Developing "intelligent (dynamical, flow dependent)" thinning to optimise the use of satellite observations in a variety of conditions.**
  - **Data volume handling:**
    - **Data compression, channel selection, reconstructed radiances**
    - **Efficient satellite monitoring**

Time evolution of number of data used operationally

Data from 29 satellite sources are now assimilated



Rapid increase in daily number of used data



A scientific and technical challenge

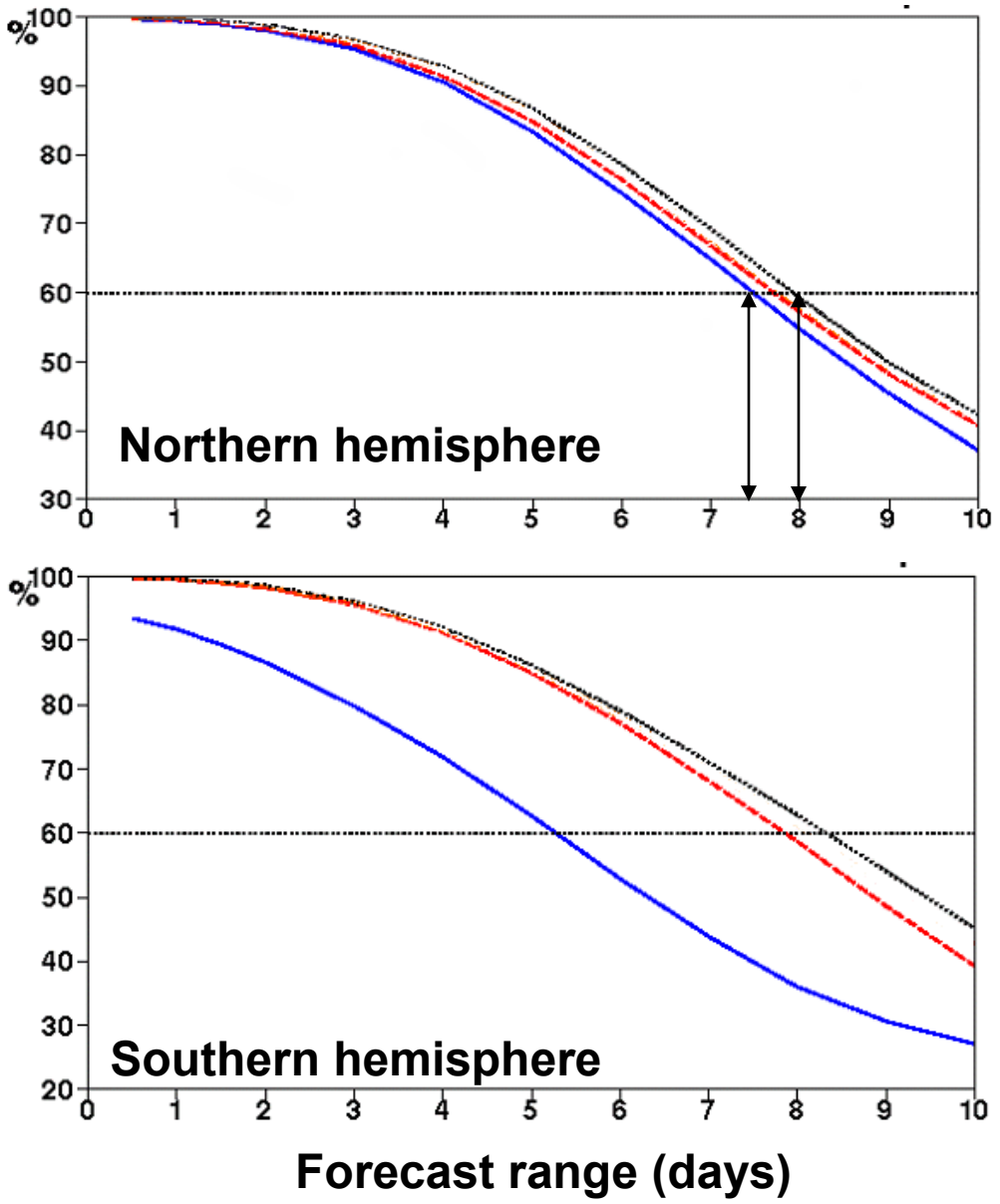
Observation data count for one 12h 4D-Var cycle 0900-2100UTC 26 March 2006

Screened			Assimilated		
Synop:	389.000	(0.49%)	Synop:	60.000	(1.84%)
Aircraft:	362.000	(0.46%)	Aircraft:	179.000	(5.50%)
Dribu:	20.000	(0.03%)	Dribu:	5.600	(0.17%)
Temp:	135.000	(0.17%)	Temp:	67.000	(2.06%)
Pilot:	108.000	(0.14%)	Pilot:	48.000	(1.48%)
AMV's:	2.811.000	(3.56%)	AMV's:	127.000	(3.90%)
Radiance data:	74.825.000	(94.81%)	Radiance data:	2.646.000	(81.34%)
Scat:	269.000	(0.34%)	Scat:	122.000	(3.75%)
TOTAL:	78.918.000	(100.00%)	TOTAL:	3.253.000	(100.00%)

- 99% of screened data is from satellites
- 4% of screened data is assimilated
- 86% of assimilated data is from satellites

Impact of different observation types

NO SAT (RAD+RET)
NO RADIOSONDES
FULL SYSTEM

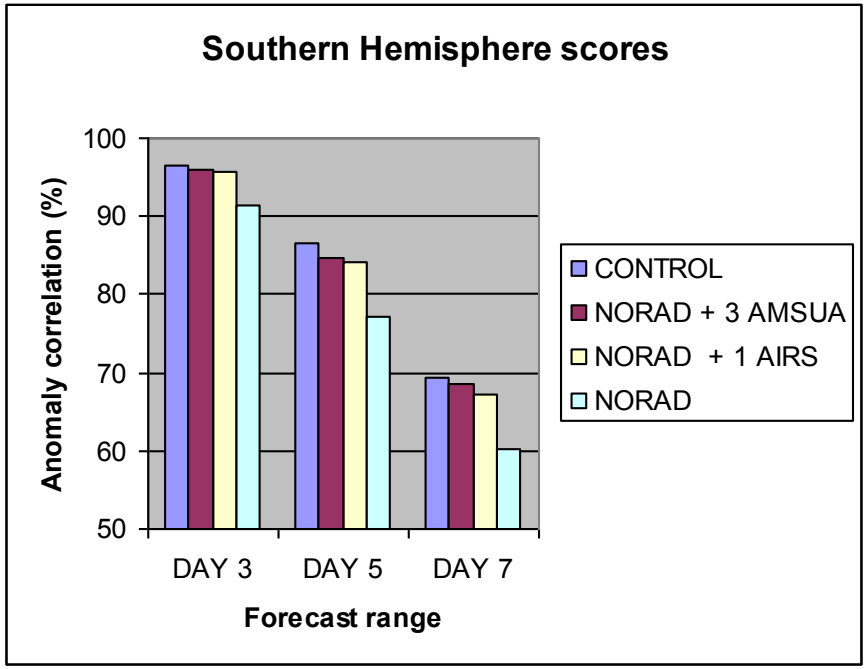


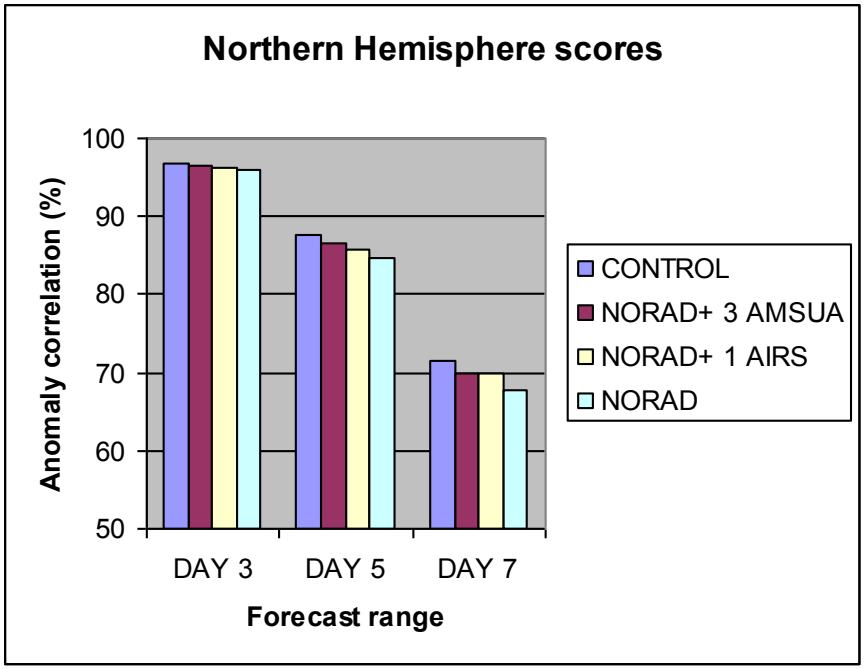
Anomaly correlation of 500hPa height

(Mean over two summer and two winter months)

Impact of radiances:

- At ECMWF, the radiance assimilation, when feasible, is preferred to retrieval assimilation.





- The assimilation of just radiances is almost as good as the assimilation of all the available observations.

Why retrievals, then...

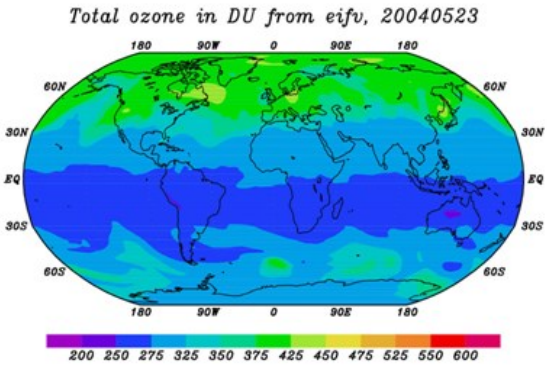
- **Verification studies**: to assess the quality of the analyses.

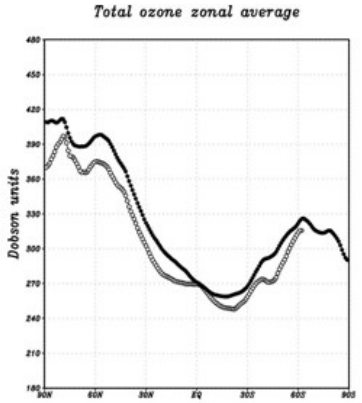
- **Active assimilation (e.g. ozone)**:
  - Historical reasons: everything is in place.
  - Lack of expertise in developing RTM (e.g. in the UV).
  - The development of a RTM for radiance assimilation may be too expensive and not worthwhile for research satellite sensors, due to their short life and, in general, lack of continuity.
  - It improves the quality of the analyses

Assimilation of KNMI NRT SCIA TCO:

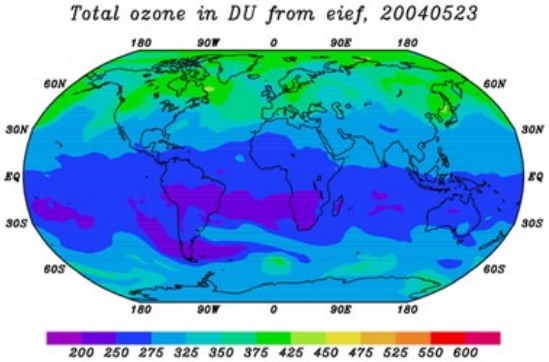
- KNMI SCIA TCO is actively assimilated in operations since 2004 (CY28R3).
- Improved agreement between the ECMWF ozone analyses and independent data, e.g. TOMS.

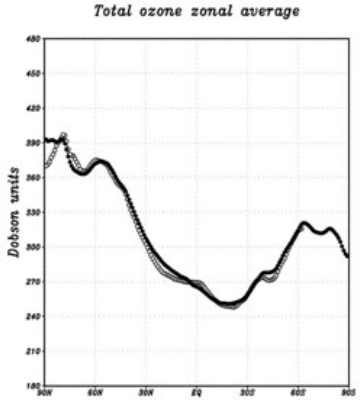
Without SCIA



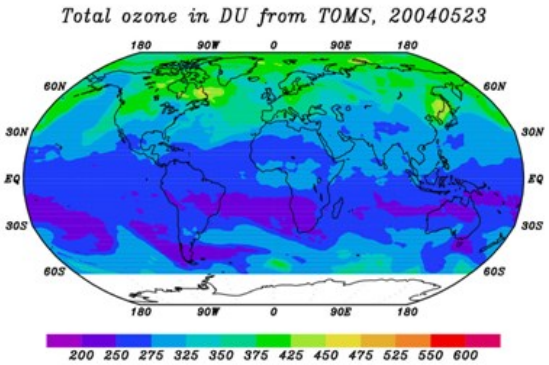


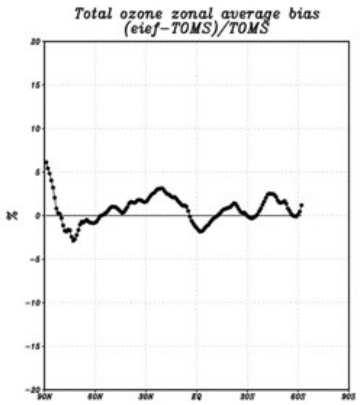
With SCIA





TOMS





Assimilation of N17 SBUV2 (RD):

N17assim

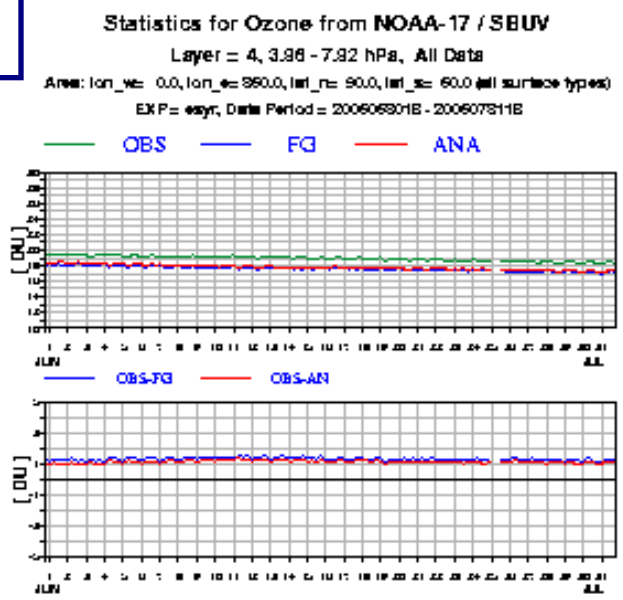
Ctrl

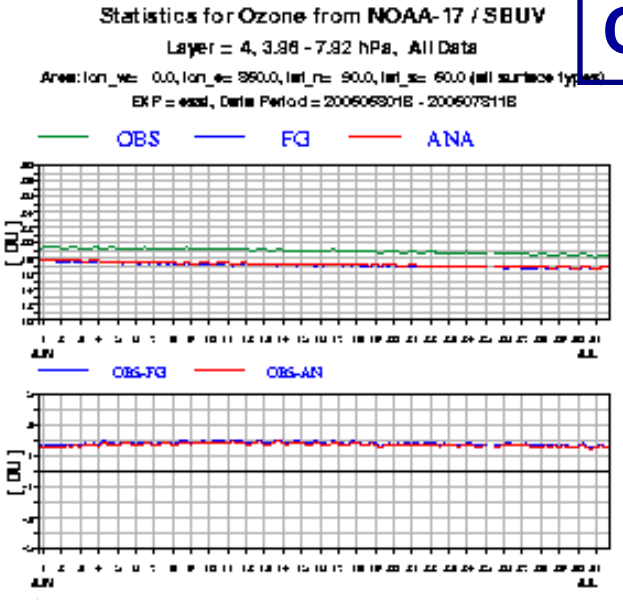
High Lat NH

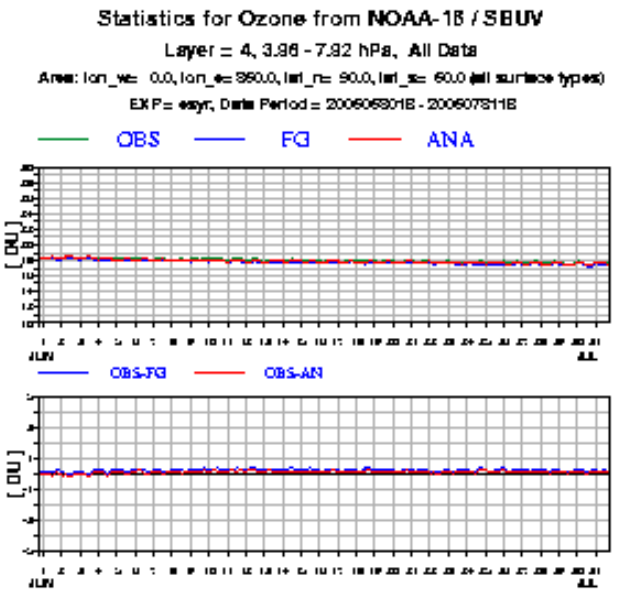
4-8 hPa

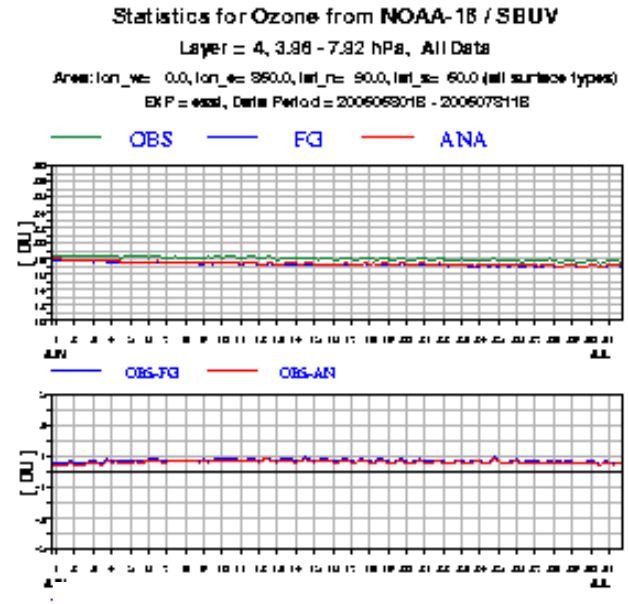
N17

N16



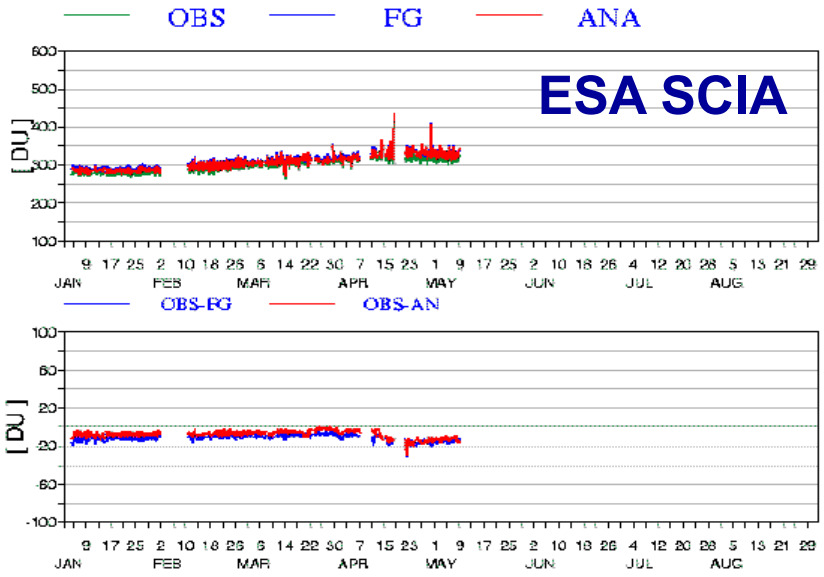


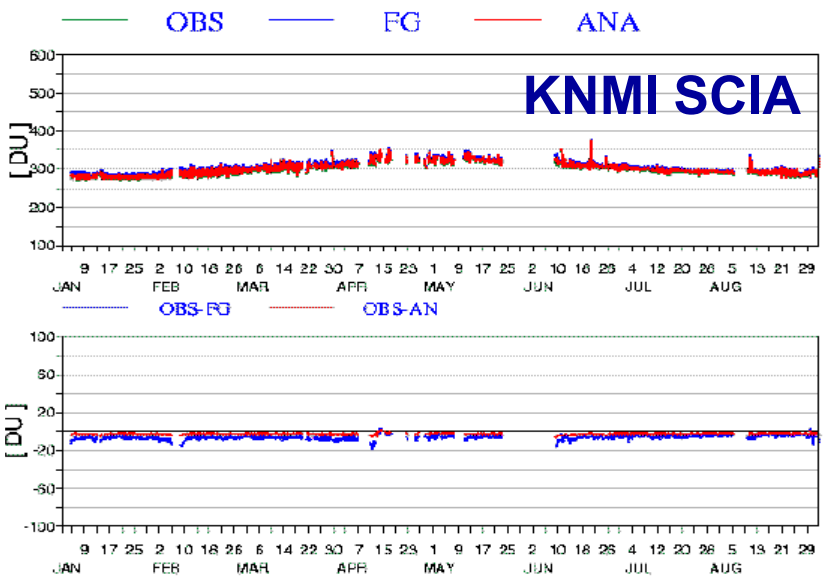




What do NWP centres need?

- Observations provided in NRT (within 3hrs)
- Good observations and well-characterised errors
- No correlations between retrieval and forecast errors
- Reliable retrieval schemes
- Continuity in the dissemination





Concluding remarks ...

- Satellite data have been very successfully exploited by new DA schemes.
- Satellites are extremely important in NWP, even in areas with a dense network of in-situ observations.
- Introduction of new well-characterised satellite observations improves the system.
- The proliferation of new satellite instruments makes it hard for end-users to keep up:
  - Observation screening and quality control
  - Bias correction
  - Data selection / volume reduction
- Short-loop dialogue between data producers and data users is vital!