# ERA-40 observation system: TOVS/ATOVS

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*ERA-40, ECMWF*

## Outline

- 1. TOVS and ATOVS systems
- 2. TOVS pre-processing
- 3. Some problems
- 4. Blacklist: tools
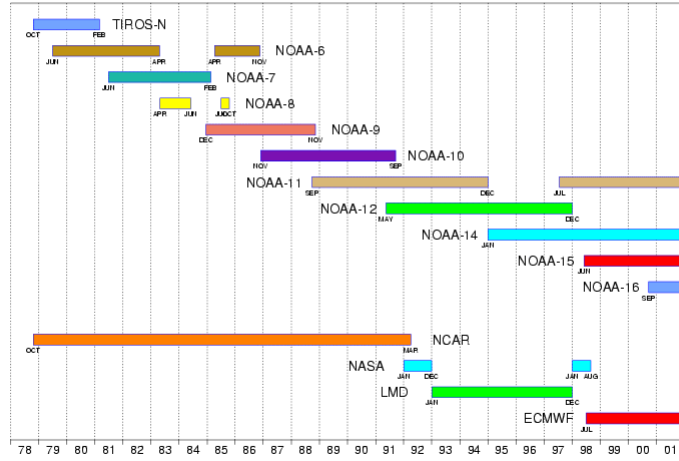- 5. Monitoring after assimilation
- 6. Products

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## 1. TOVS and ATOVS systems

- TOVS instruments:
  - SSU - Stratospheric Sounding Unit - 3 ch
  - MSU - Microwave Sounding Unit - 4 ch
  - HIRS/2 - High res. Infrared Rad. Sounder/2 - 19 ir + 1 vis

- ATOVS instruments:
  - HIRS/3 - 19 ir + 1 vis
  - Advanced Microwave Sounding Units AMSU-A (15 ch) and AMSU-B (5 ch)

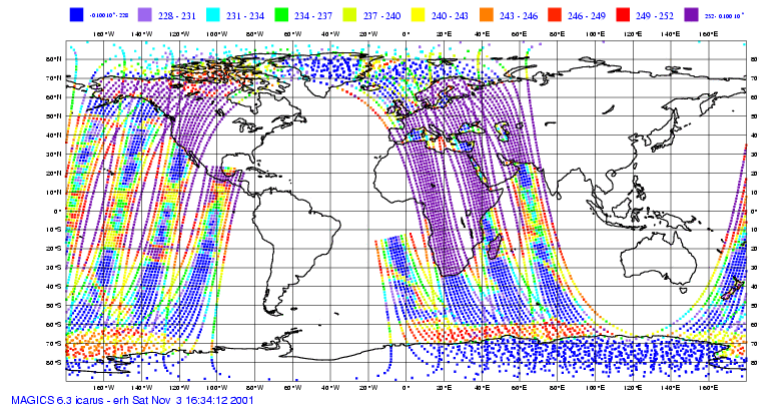A. Hernandez - Re-analysis Workshop - ECMWF - November 2001

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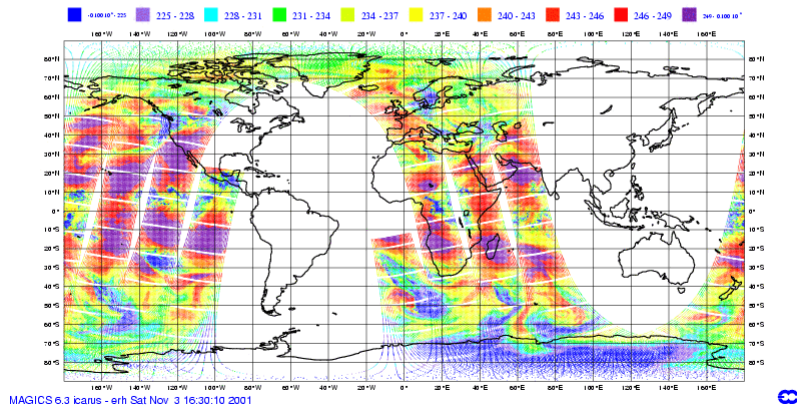


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# 2. TOVS pre-processing to level 1c

- We receive TOVS level 1b data
  - radiance counts
  - Earth location
  - calibration information
  - quality information
  - code: NESDIS binary

- ERA-40 system uses raw radiances (level 1c)

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# ...2. TOVS pre-processing to level 1c

- TOVS pre-processing (1b -> 1c)
  - radiance calibration
  - location, time, sat zenith angle added to each spot
  - quality control
  - quality information appended

- Software system fully developed in ERA-40
  - step is not a source of differences between periods

- Data produced (level 1c) encoded in BUFR format

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# ...2. TOVS pre-processing to level 1c

- What about ATOVS?
  - 1c level data from September 1998
  - 1b level data June, July, August 1998, maybe
    - AAPP processing package

- BUFR-encoded TOVS/ATOVS 1c data are fed to assimilation system

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# 3. Some problems

- Gaps
  - esp. if no TOVS data from other satellite
  - esp. for stratosphere, as coverage by conventional observations is poor
  - we try to fill them (thanks to LMD, NASA, NOAA/CIRES, SAA, NCEP)

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# ...3. Some problems

- Bad quality data
  - might have a negative impact
  - we try to spot them before assimilation to avoid using them

- Typical examples of bad quality
  - channel / instrument failure
  - channel / instrument malfunction
  - bad Earth location
  - periods of noisy data

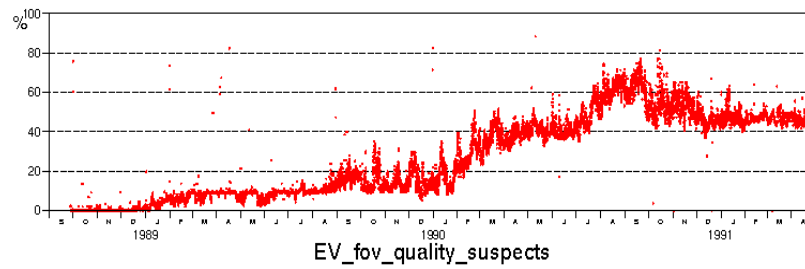A. Hernandez - Re-analysis Workshop - ECMWF - November 2001

# 4. Blacklist and tools

- Need to spot bad periods before assimilation
- Sources of information
  - Many: integration difficult, very different nature
  - NOAA POD User's Guide: Problem and Change Record
  - Other users (literature, personal communications, ...)
  - ERA-15 experience (e.g. Earth location)
  - Our own tools
    - Quality info (as in 1b dataset) plots
    - Brigthness temperature time series

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# ...4. Blacklist and tools

ERA-40 TOVS 1B
NOAA-11 198809 - 199104
MSU



EV_fov_quality_suspects

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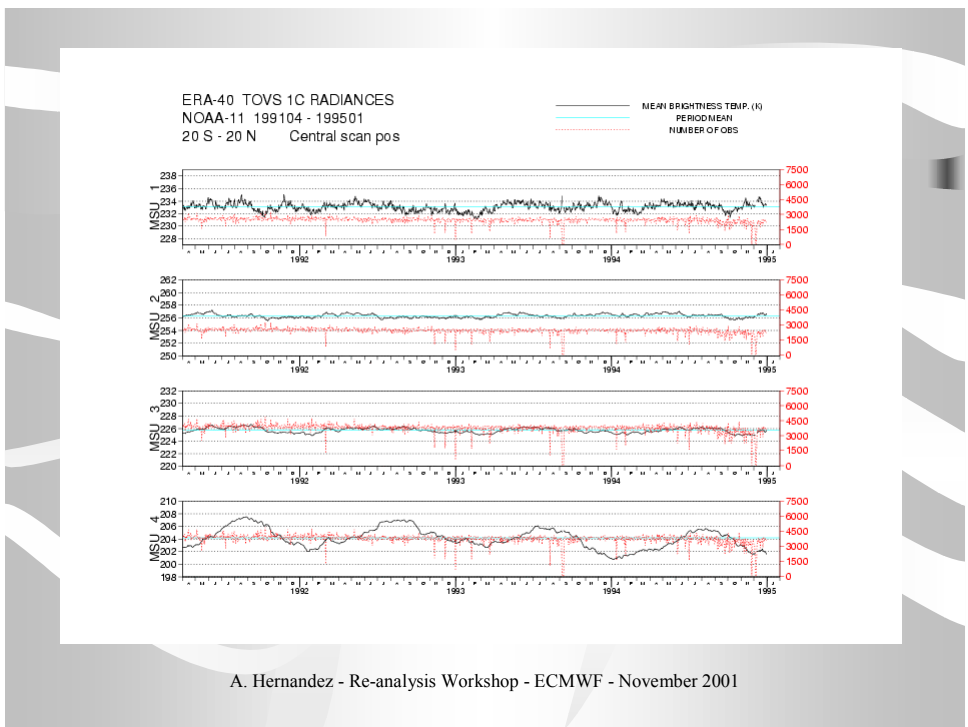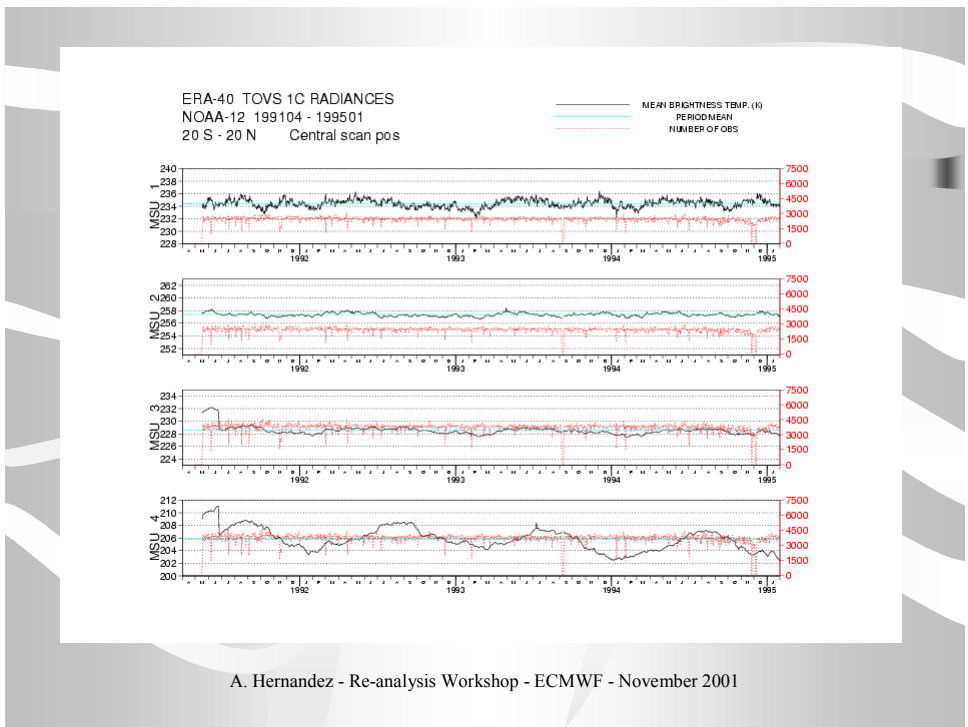
# ...4. Blacklist and tools

- Brightness temperature time series can help to spot
  - gaps
  - periods of poor coverage
  - channel - instrument failure
  - channel - instrument malfunction
  - changes (often show as jumps)
  - temporary problems  (often show as spikes if period is short)
  - bad Earth locations (MSU1 spike is a telltale)

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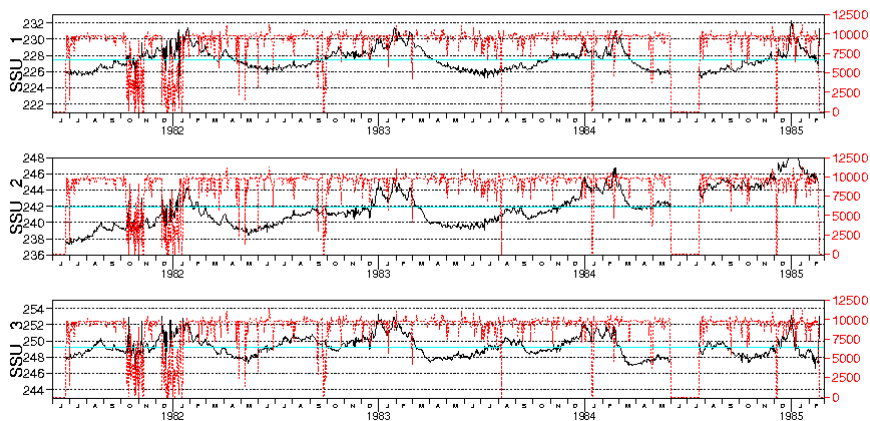A. Hernandez - Re-analysis Workshop - ECMWF - November 2001
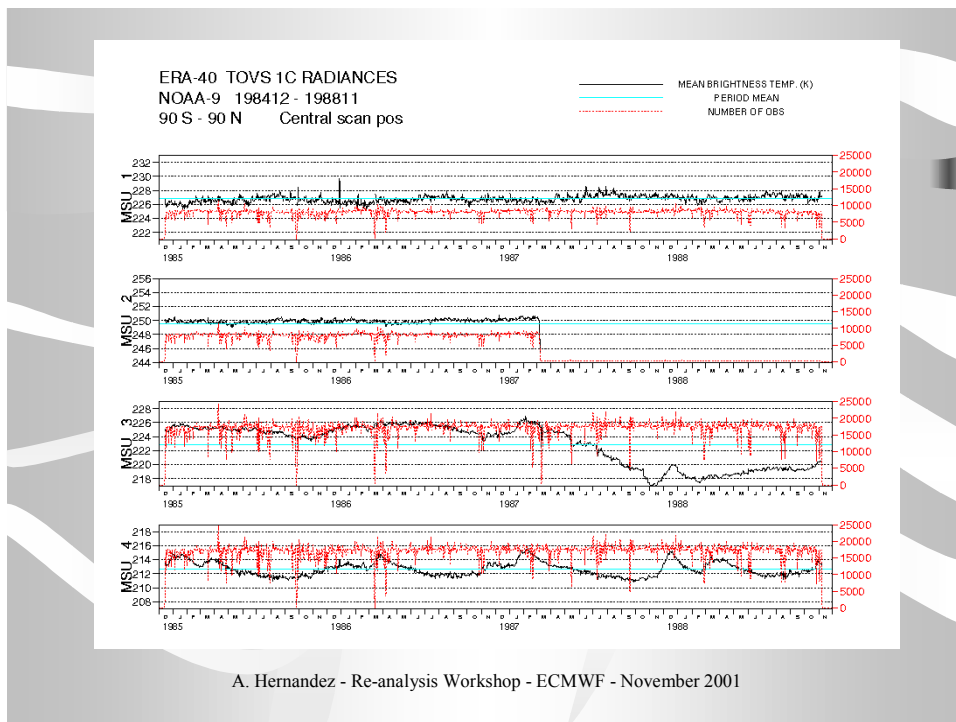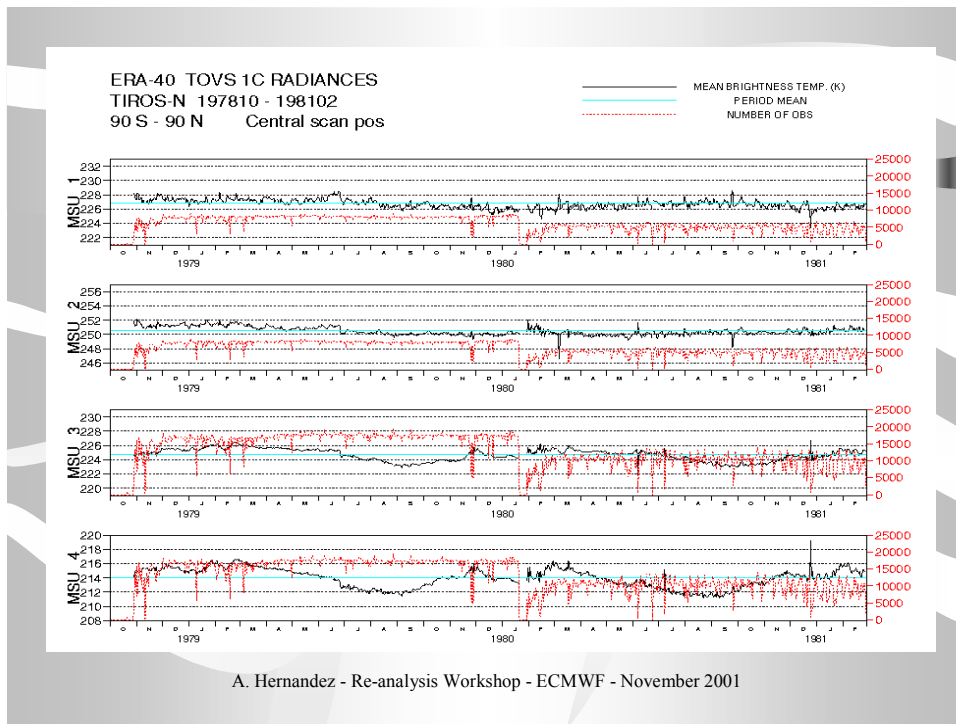
# ...4. Blacklist and tools

- BT time series: apparent warmings or coolings
  - atmospheric tendency?
  - orbital drift, orbital decay?
  - change in instrument response?

- Example: SSU on NOAA-7
  - gas leaks in SSU pressure-modulated cell
  - problem to be addressed

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# 5. Monitoring after assimilation

- Some problems not spotted before assimilation
  - or spotted, but we have to choose between data of doubtful quality and a gap, and we might prefer the data

- Monitoring tools:
  - time series of radiance departures (obs - first guess)
  - time series of analysis increments

- If monitoring shows a significant negative impact of TOVS, problem is addressed (e.g. channel blacklisted), and period rerun

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# 6. TOVS/ATOVS products

- TOVS 1b archive
  - period: Oct 1978 to Dec 2001
  - code: NESDIS
  - size: aprox 1 Tb

- TOVS/ATOVS 1c archive
  - period: Oct 1978 to Dec 2001
  - code: WMO BUFR
  - size: aprox 0.6 Tb

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# ...6. TOVS/ATOVS products

- Documented blacklist
  - as used in ERA-40
- Time series of brightness temperatures
  - 6 latitude bands, 3 scan position bands
- Quality information (as contained in 1b dataset) plots
- ERA-40 Report on TOVS

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