ASSESSMENT OF IASI RADIANCES DURING THE SALSTICE CAMPAIGN

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The Semi-Arid Land Surface Temperature and IASI Calibration Experiment (SALSTICE)

- The main goals of the campaign:
  - investigating the large biases between satellite-derived and NWP model skin surface temperatures over land, particularly in semi-arid regions in daytime.
  - Assessing the performances of IASI on Metop-B

- Took place in South-West USA in May 2013, bringing together UK and US institutions, as well as EUMETSAT.

- 2 aircrafts: FAAM BAe 146-301 (UK), NASA ER-2 (US)

- Flights were planned so that:
  - they coincide with satellites overpasses (Metop A and B, Suomi-NPP);
  - they cover a variety of conditions: clear sky over ocean and land, in the presence of cloud and aerosols.

Outline

- Context: the SALSTICE campaign
- Instruments and data
- Methodology
- Results over land
- Results over sea
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Key Instrumentation (FAAM aircraft)

- Dropsondes allowing characterisation of vertical profiles of atmospheric temperature and humidity and sampling of their horizontal variability;
- Lidar for estimating aerosols profiles;
- In situ measurements of aerosols, cloud, temperature and humidity along the flight path;
- ARIES IR interferometer (comparable to IASI on Metop).

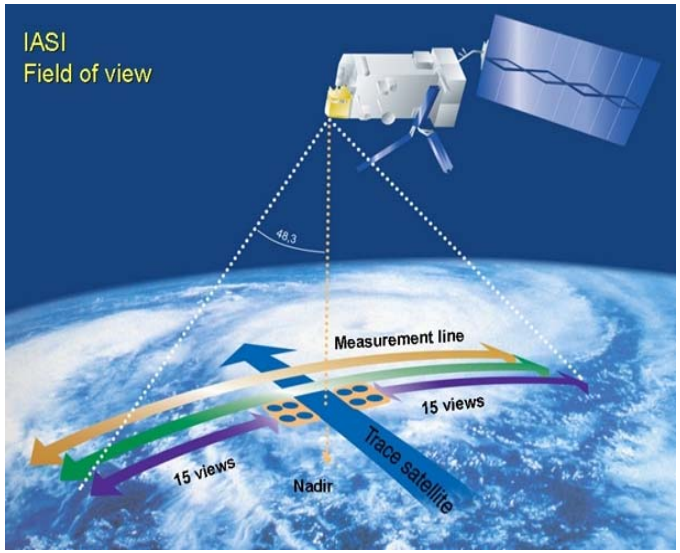
ARIES vs. IASI instrumental characteristics

	ARIES	IASI
Type	FT spectrometer	FT spectrometer
Flying on	FAAM aircraft	Metop A and B
Spectral range	500-3000 cm-1	645-2760 cm-1
Spectral resolution	1 cm-1	0.5 cm-1
Spectral sampling	0.48 cm-1	0.25 cm-1
Spatial resolution	350 m	12 km

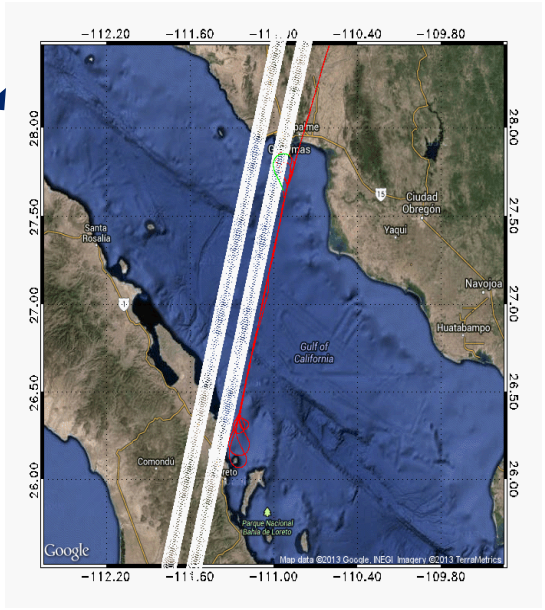
Special SALSTICE instrument configuration

- To support the campaign, EUMETSAT has put IASI-B in a special mode to measure Nadir only (thanks to UK Met Office and CNES).

2 viewing modes



Normal operations mode:
- Cross track scan
- 30 views/8 sec.



External calibration mode:
- fixed viewing direction
- 27 views/8 sec.

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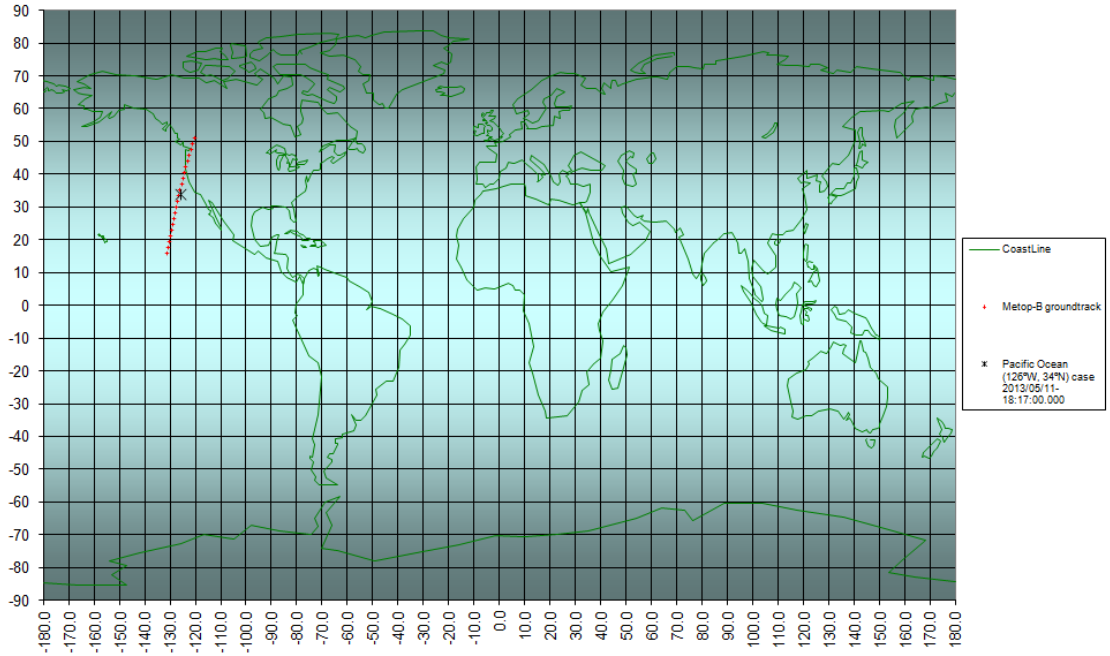
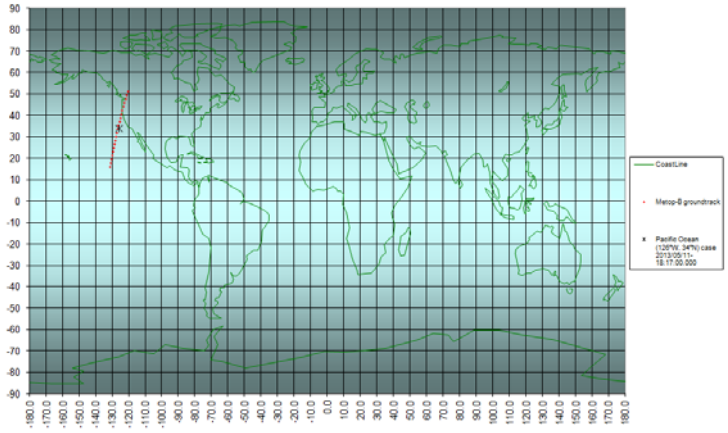


For each External calibration prediction , we had every 30 seconds:

- Epoch Height(km)
- Long(deg)
- Lat(deg)

Special SALSTICE instrument configuration

- To support the campaign, EUMETSAT has put IASI-B in a special mode to measure Nadir only (thanks to UK Met Office and CNES).
- 24 planned Nadir external calibration



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Special SALSTICE instrument configuration

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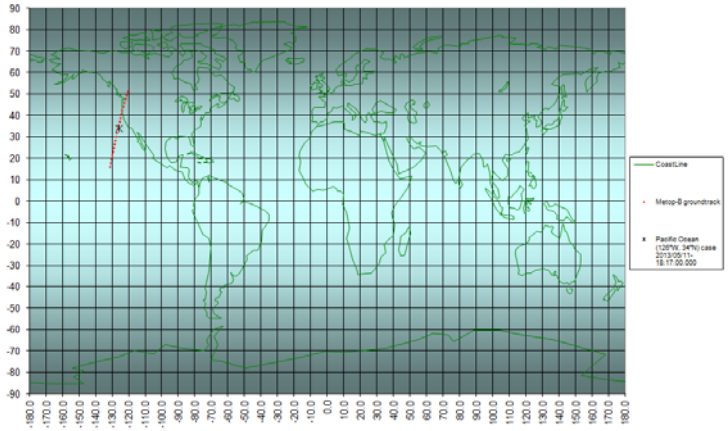
- 24 planned Nadir external calibration

11 May 1822	Pacific Ocean (126°W, 34°N)
12 May 1800	Californian coast (120°W, 38°N)
13 May 0519	Pacific Ocean (123°W, 34°N)
13 May 1739	Californian coast (116°W, 37°N)
14 May 0458	Californian coast (117°W, 34°N)
14 May 1718	Californian coast (111°W, 37°N)
15 May 0435	Gulf of California (110°W, 26°N)
16 May 1818	Pacific Ocean (125°W, 35°N)
17 May 0537	Pacific Ocean (128°W, 35°N)
17 May 1757	Californian coast (120°W, 35°N)
18 May 0515	Californian coast (121°W, 32°N)
18 May 1735	Californian coast (110°W, 39°N)
19 May 0455	Californian coast (115°W, 35°N)
19 May 1715	Californian coast (110°W, 35°N)
21 May 1815	Pacific Ocean (124°W, 33°N)
22 May 0534	Pacific Ocean (128°W, 37°N)
22 May 1753	Californian coast (118°W, 37°N)
23 May 0512	Californian coast (121°W, 34°N)
23 May 1732	Californian coast (113°W, 37°N)
24 May 0451	Californian coast (116°W, 34°N)
24 May 1711	Californian coast (108°W, 37°N)
26 May 1811	Pacific Ocean (123°W, 35°N)
27 May 0530	Pacific Ocean (126°W, 36°N)
27 May 1749	Californian coast (117°W, 38°N)



For each External calibration prediction , we had every 30 seconds:

- Epoch Height(km)
- Long(deg)
- Lat(deg)

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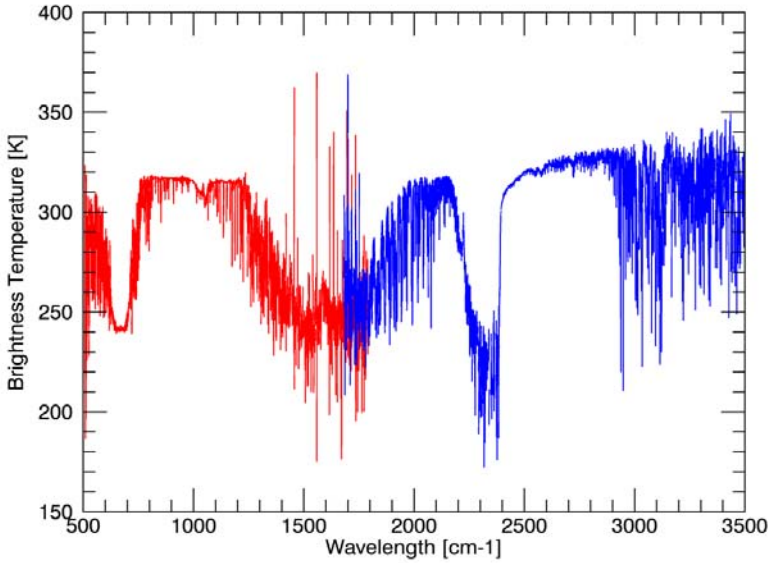
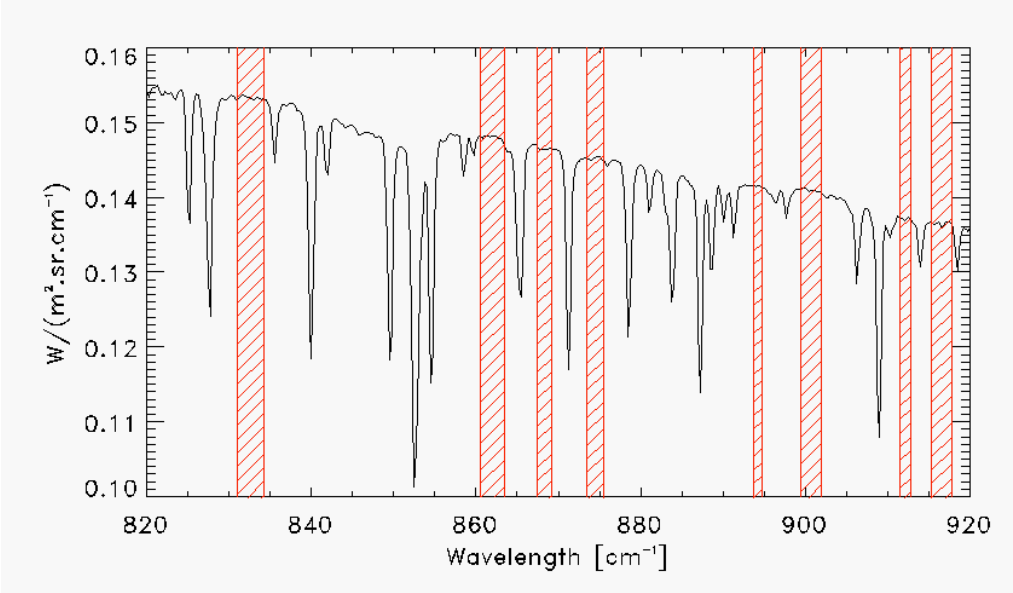
ARIES Radiances from UK MetOffice

- Preliminary version of ARIES radiances provided shortly after the campaign
- A consolidated version in September 2013
- NetCDF files
  - 2 files for the radiances:
    - 500-1790 cm-1
    - 1680-3500 cm-1
  - 1 file for the geolocation



Comparison of Radiances

- IASI and ARIES have different spectral resolution: 0.5 and 1 cm-1
- Comparison is thus performed into micro-windows in which the spectral transmission is flat (C. Camy-Peyret, personal communication) => Minimization of the instrument spectral response function effect
- 61 micro-windows have been chosen.



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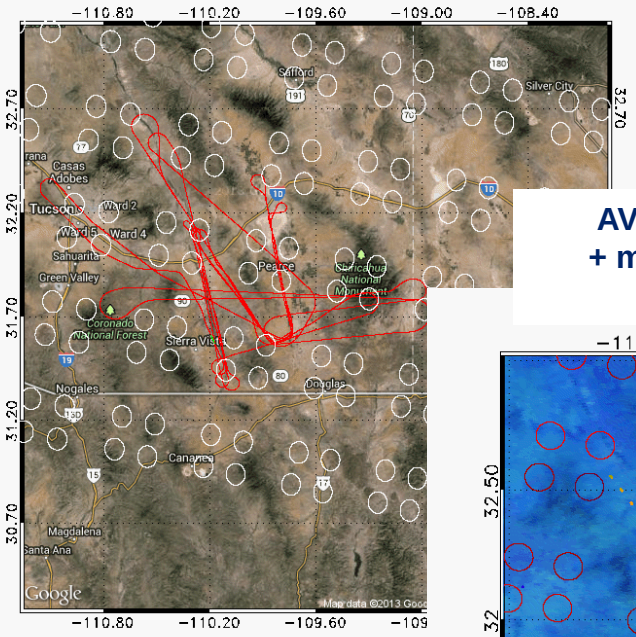
Flights performed

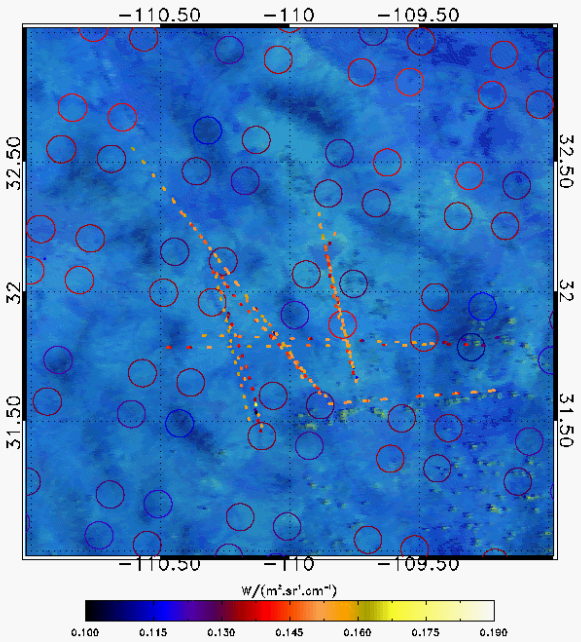
Day in May 2013	11	12	15	16	19	21	23	24	25
Scene	Land	Land	Ocean	Ocean	Land	Ocean	Ocean	Ocean	Land
Metop	A and B	A	B	A	B	A	B	B	A and B
Comment	Cloudy	No cloud			No ARIES meas. At the time of the overpass	Cloud free scene	Cloud free scene	IASI in special mode; some clouds	Cloudy

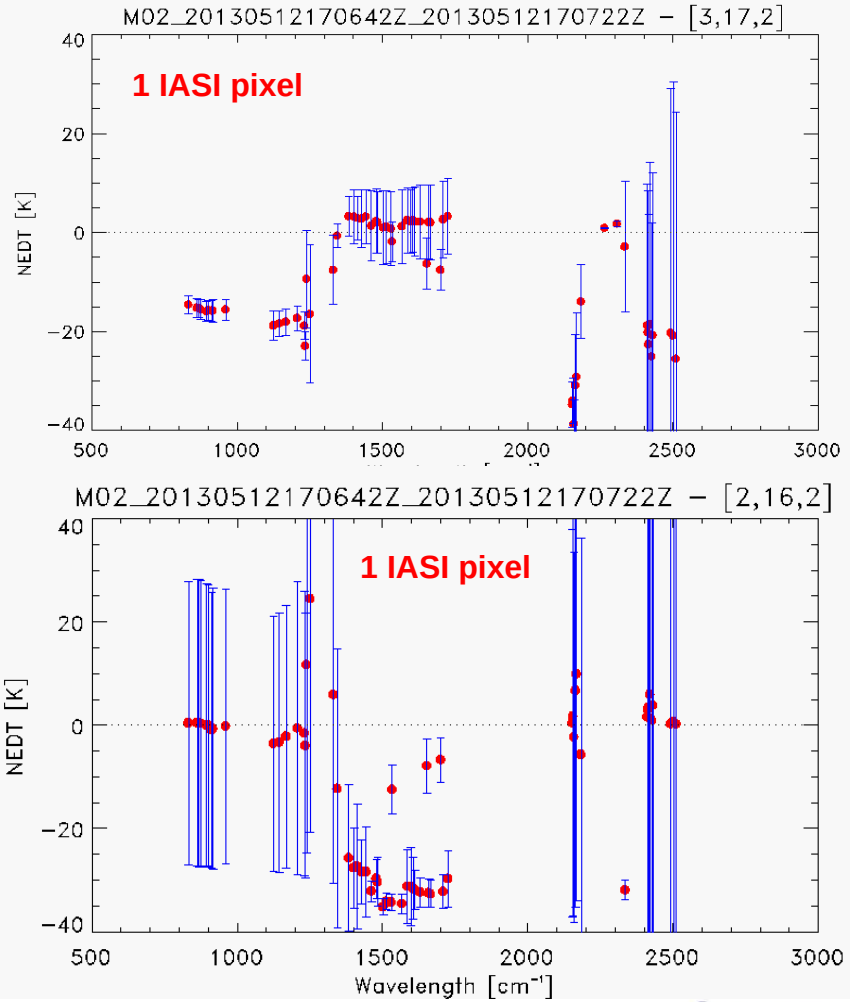
Land cases: 12th May 2013 (IASI-A)

- Good overpass (almost on zenith) of the area by IASI-A
- No clouds apparent on the AVHRR composite



AVHRR RGB composite + measured radiances @ 900 cm-1





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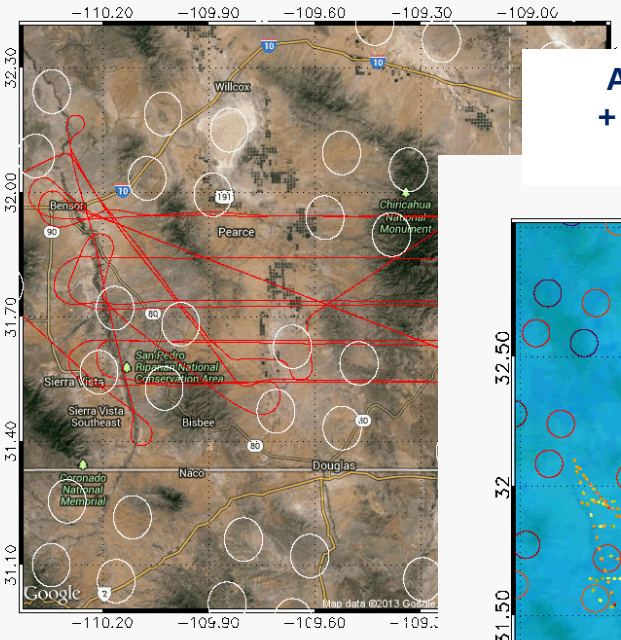
Flights performed

Day in May 2013	11	12	15	16	19	21	23	24	25
Scene	Land	Land	Ocean	Ocean	Land	Ocean	Ocean	Ocean	Land
Metop	A and B	A	B	A	B	A	B	B	A and B
Comment	Cloudy	No cloud			No ARIES meas. At the time of the overpass	Cloud free scene	Cloud free scene	IASI in special mode; some clouds	Cloudy

Land cases: 19th May 2013 (IASI-B)

- Very good overpass by IASI-B (satellite elevation: 85 degrees)
- Cloud-free scene



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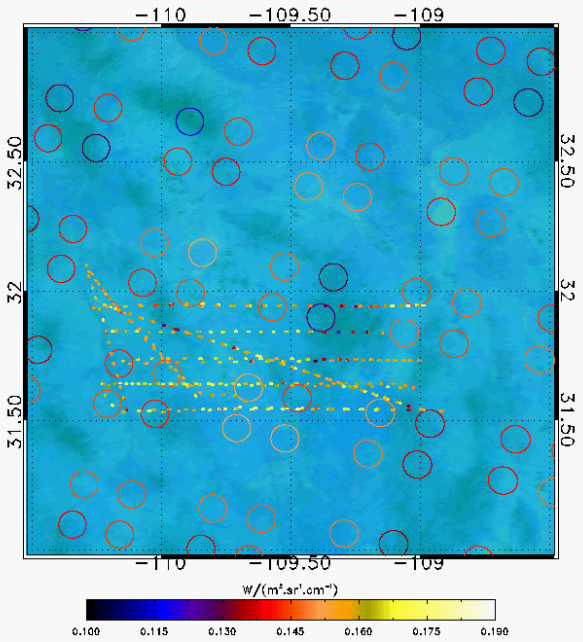

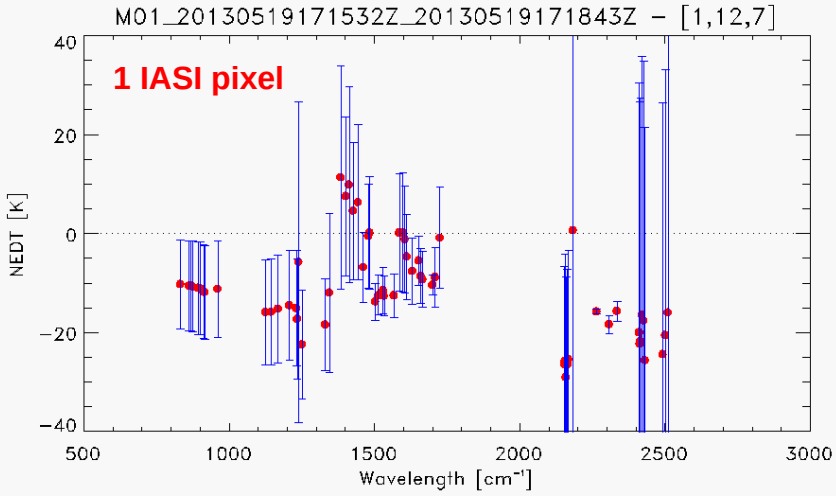

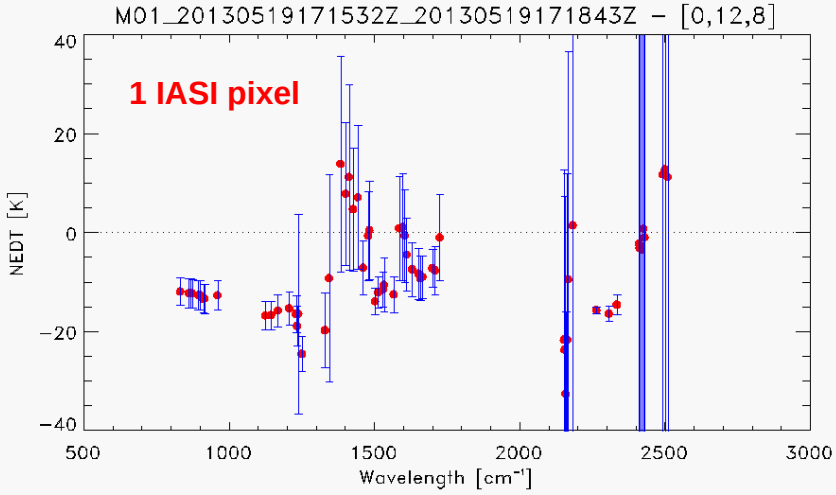

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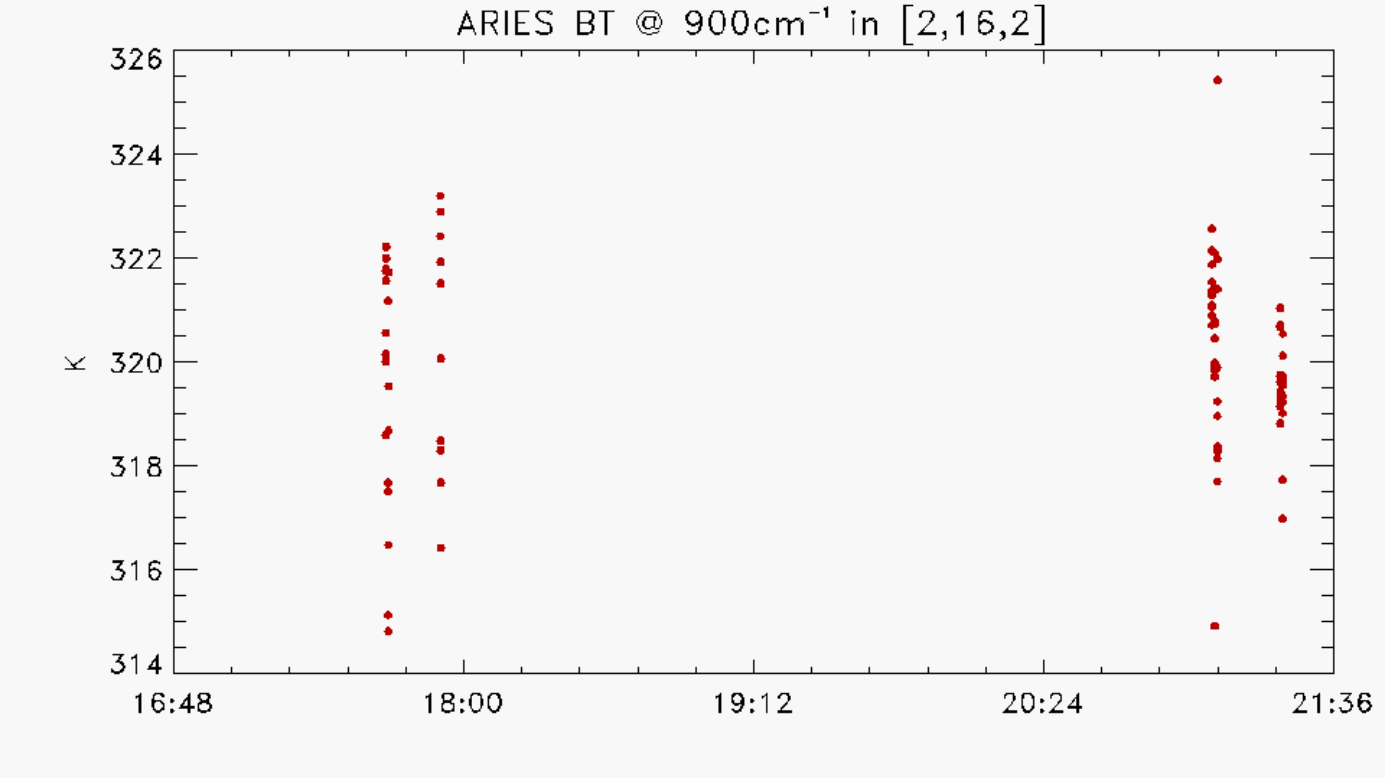
ARIES ambiguities

- ARIES measurements are difficult to compare to IASI over land: here the brightness temperature measured by ARIES within the area of a single IASI pixel exhibits an impressive variability !



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Flights performed

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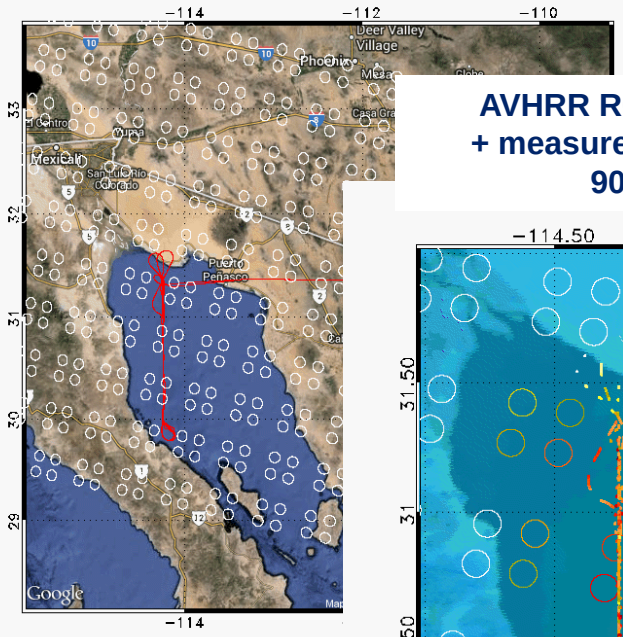
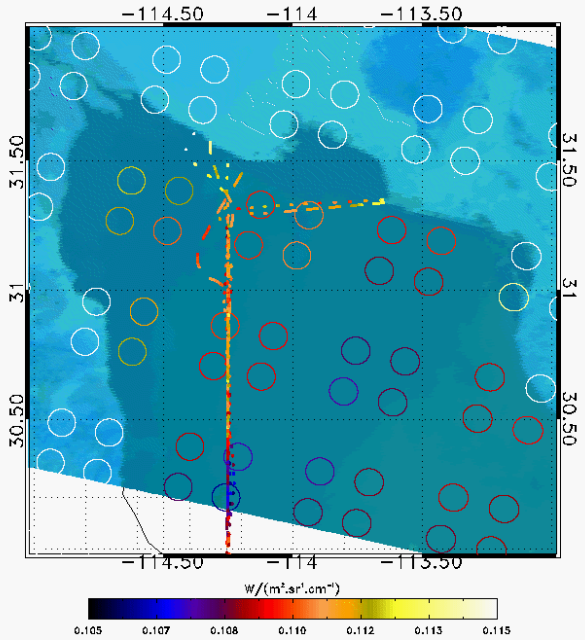
Metop	A and B	A	B	A	B	A	B	B	A and B
Comment	Cloudy	No cloud			No ARIES meas. At the time of the overpass	Cloud free scene	Cloud free scene	IASI in special mode; some clouds	Cloudy

Ocean cases: 23rd May 2013 (IASI-B) – 1/2

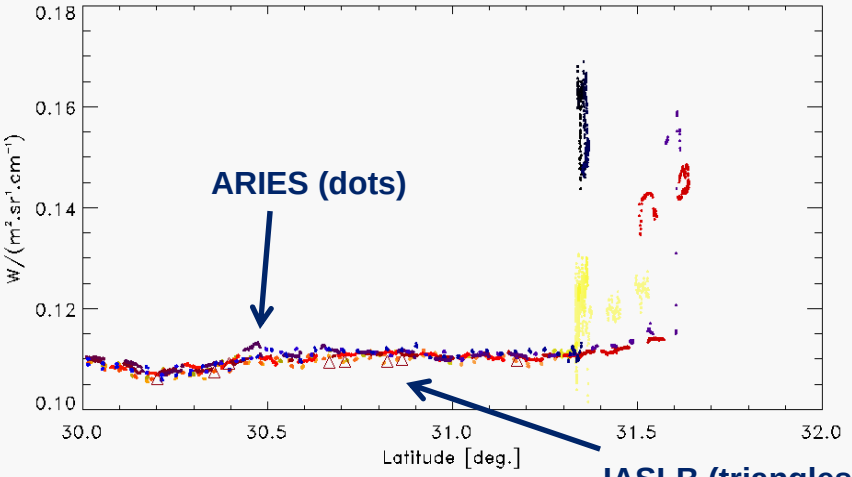
- Ocean case, no clouds
- Very good IASI-B overpass (satellite seen with an elevation of 80 degrees from the sampled area)



AVHRR RGB composite + measured radiances @ 900 cm-1



Measured radiance as a function of latitude @ 900 cm-1



⇒ Qualitative agreement between IASI and ARIES

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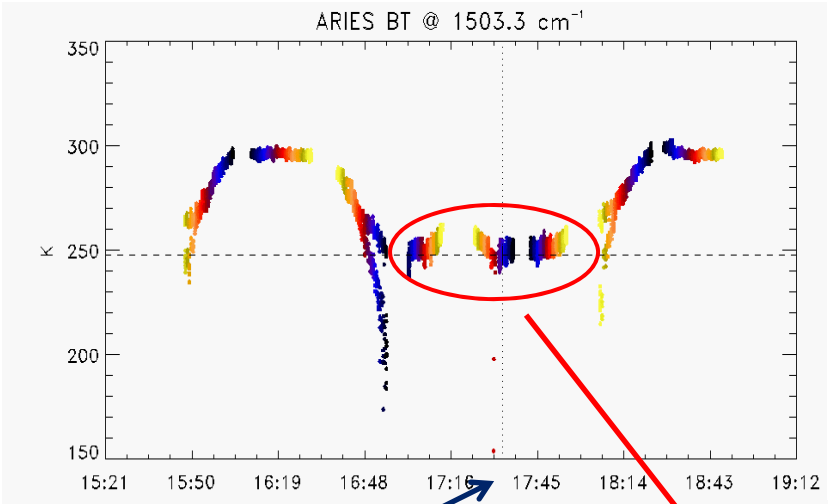
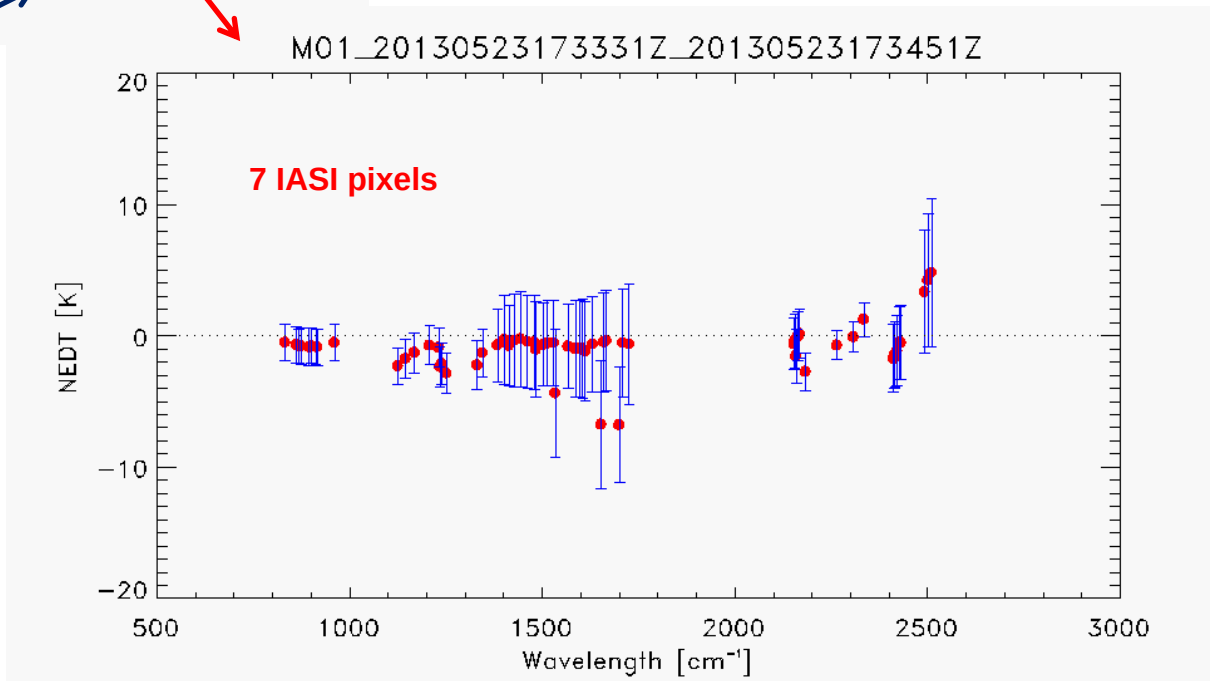
Ocean cases: 23rd May 2013 (IASI-B) – 2/2



Time of the overpass



Colour is a function of latitude

- Black: southernmost soundings
- Yellow: northernmost ones

=> Need to distinguish between measurements performed between 17:00 and 18:00 UTC and the rest.

Flights performed

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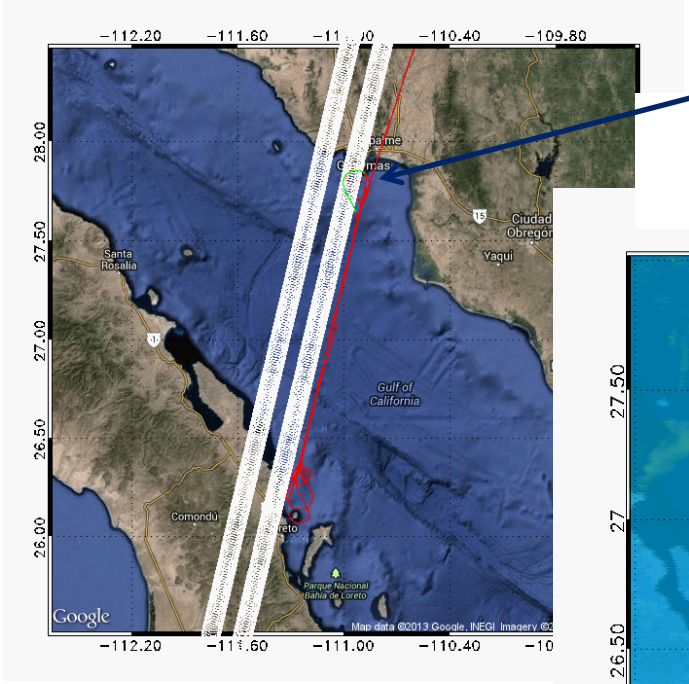
Scene	Land	Land	Ocean	Ocean	Land	Ocean	Ocean	Ocean	Land
Metop	A and B	A	B	A	B	A	B	B	A and B
Comment	Cloudy	No cloud			No ARIES meas. At the time of the overpass	Cloud free scene	Cloud free scene	IASI in special mode; some clouds	Cloudy

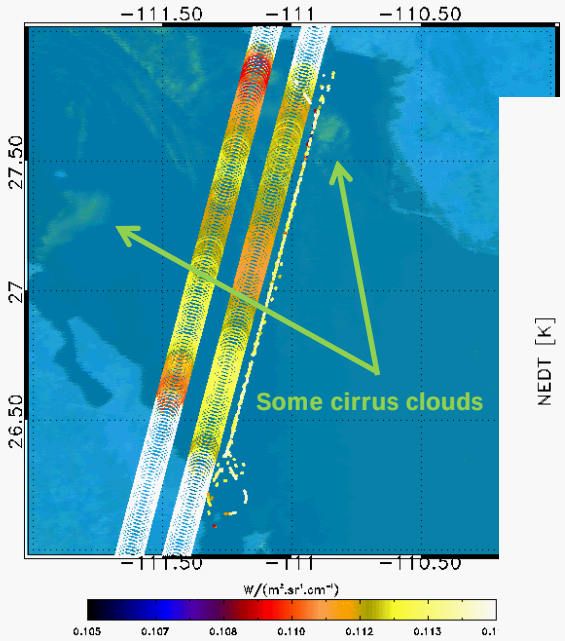
Ocean cases: 24th May 2013 (IASI-B in special mode)

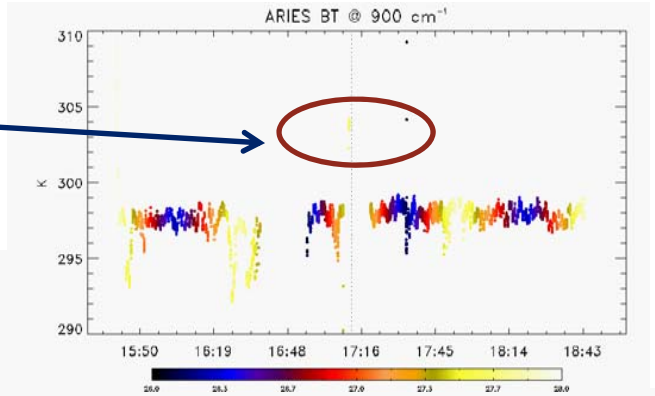
- IASI-B in external calibration mode
- Flight planned to follow the satellite track over sea
- Few clouds in the northernmost part of the area at the time of the overpass

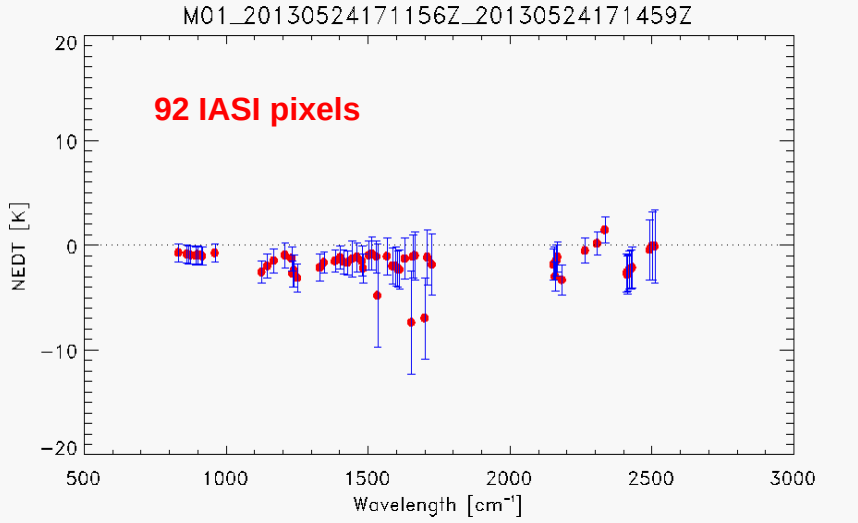


Position of the plane during the overpass

AVHRR RGB composite + measured radiances @ 900 cm-1







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Summary

- Nine flights performed from 11 to 25 May 2013:
  - 4 over Arizona,
  - 5 in the Gulf of California.
- All flights were performed in clear or slightly cloudy conditions.
- Over land, comparison is very challenging:
  - the actual comparison is not easy to conclude
  - we have found differences up to 10 K
- Over sea: both instruments agree within 1K
- In all cases, ARIES is slightly warmer than IASI.
- No differences found between IASI-A and IASI-B.

Assessment of IASI Radiances during the SALSTICE Campaign

Thank you for your attention !