

OSI SAF SST Products and Services

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Météo-France/DP/CMS

**(With G. Legendre, A. Marsouin, S. Péré, S. Philippe, H.
Roquet)**

Outline

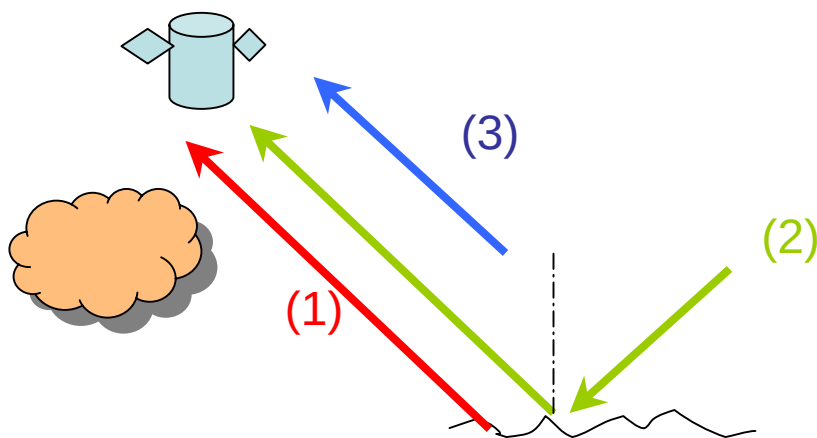
- **Satellite IR radiometric measurements**
- **From Brightness Temperatures to Sea Surface Temperature**
- **SST from Metop**
 - Production
 - Validation
- **SST from MSG (GOES-E)**
 - Production
 - Validation
- **Practical information**



Satellite IR Radiometric measurements

IR Radiometric Measurement =

- (1) Emitted by surface +
- (2) Emitted by atmosphere and reflected to space +
- (3) Direct atmosphere contribution (emission+ absorption)



Satellite IR Radiometric measurements

From SST to Brightness Temperature (BT)

- A satellite radiometer measures a **radiance** I_λ :

$$I_\lambda = \tau_\lambda \epsilon_\lambda B_\lambda (Ts) + I_r + I_a$$

Emitted by surface
Reflected
Emitted by atmosphere

Clear sky only!

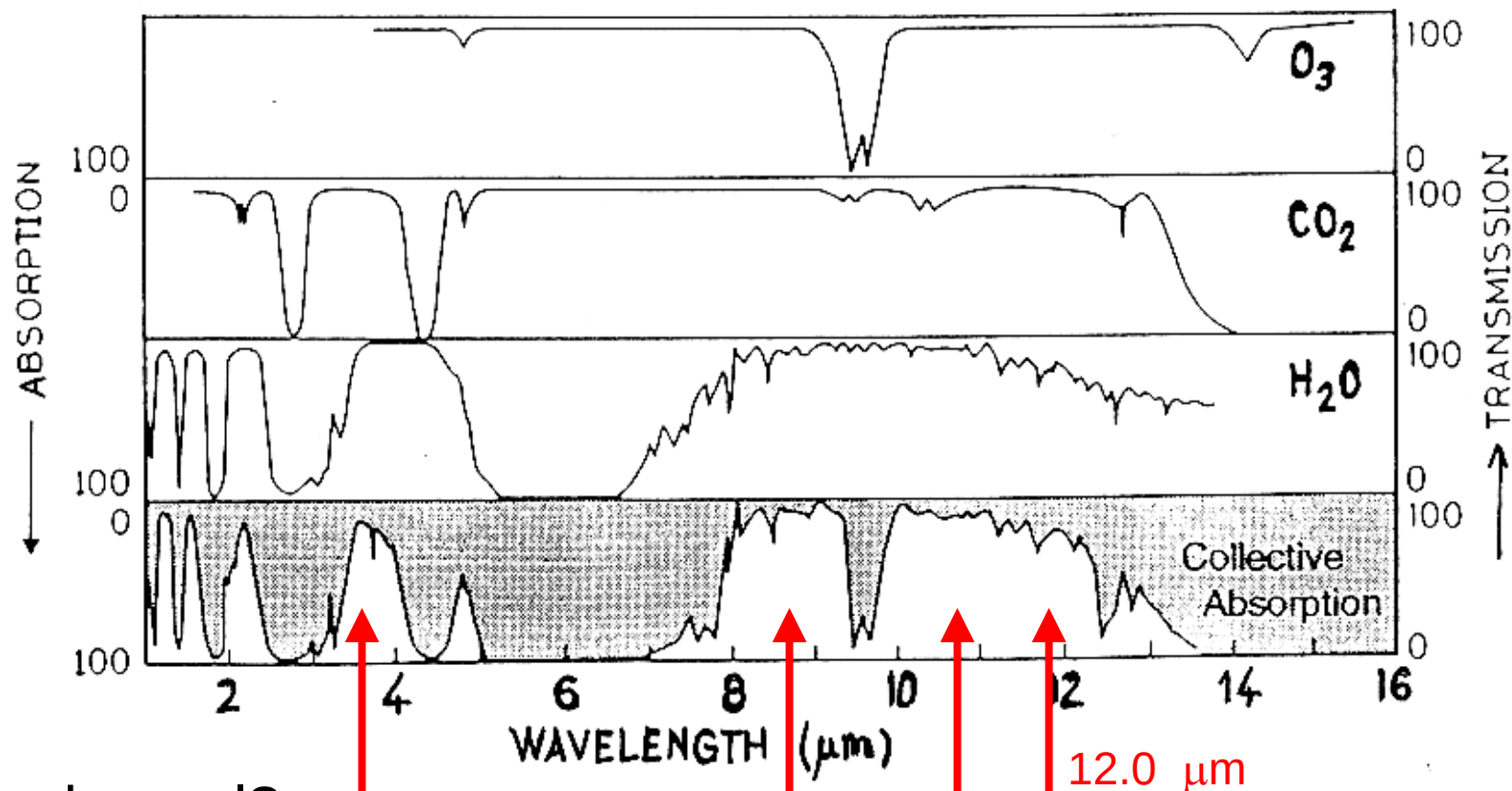
- T_s : surface temperature
- B_λ : Planck function
- λ : wavelength IR: 0.7 to 1000 micron
- ϵ_λ : surface emissivity
- τ_λ : atmospheric transmittance
- I_λ : measured radiance ($\text{W m}^{-2} \mu^{-1} \text{ster}^{-1}$)

- **Measured Brightness Temperature: $BT = B_\lambda^{-1} (I_\lambda)$**

Satellite IR Radiometric measurements

From BT to SST

Transmittance τ_λ



Which channel?

OSI-SAF SST, EUMETRAIN 2011



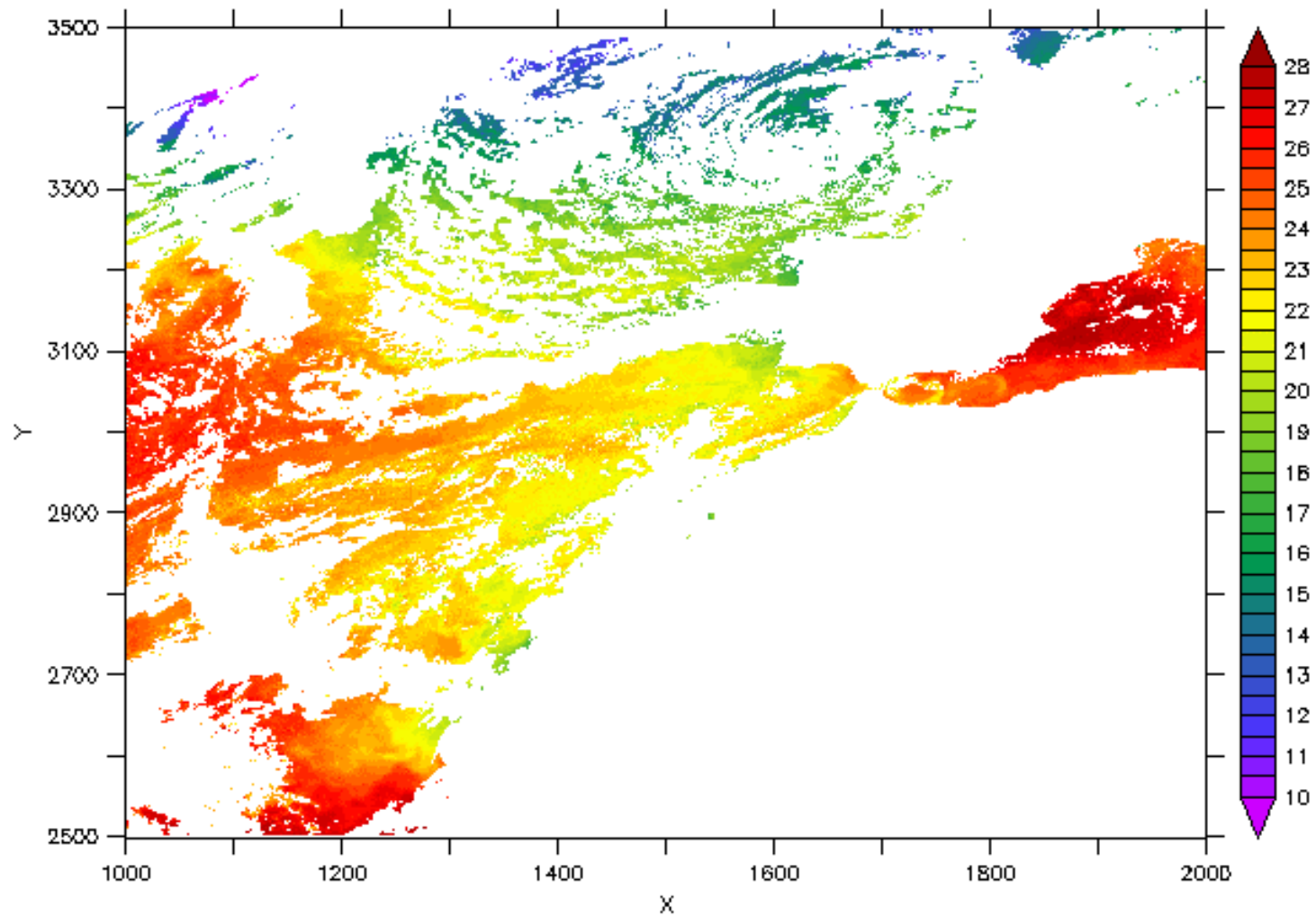
METEO FRANCE
Toujours un temps d'avance

FROM BT to SST

FERRET Ver. 6.1
NOAA/PMEL TNAP
8 Sep 13 2011 08:16:30

DATA SET: sstprd_meteosat09_20110826_000000

SST



SST-273.15

ANCE



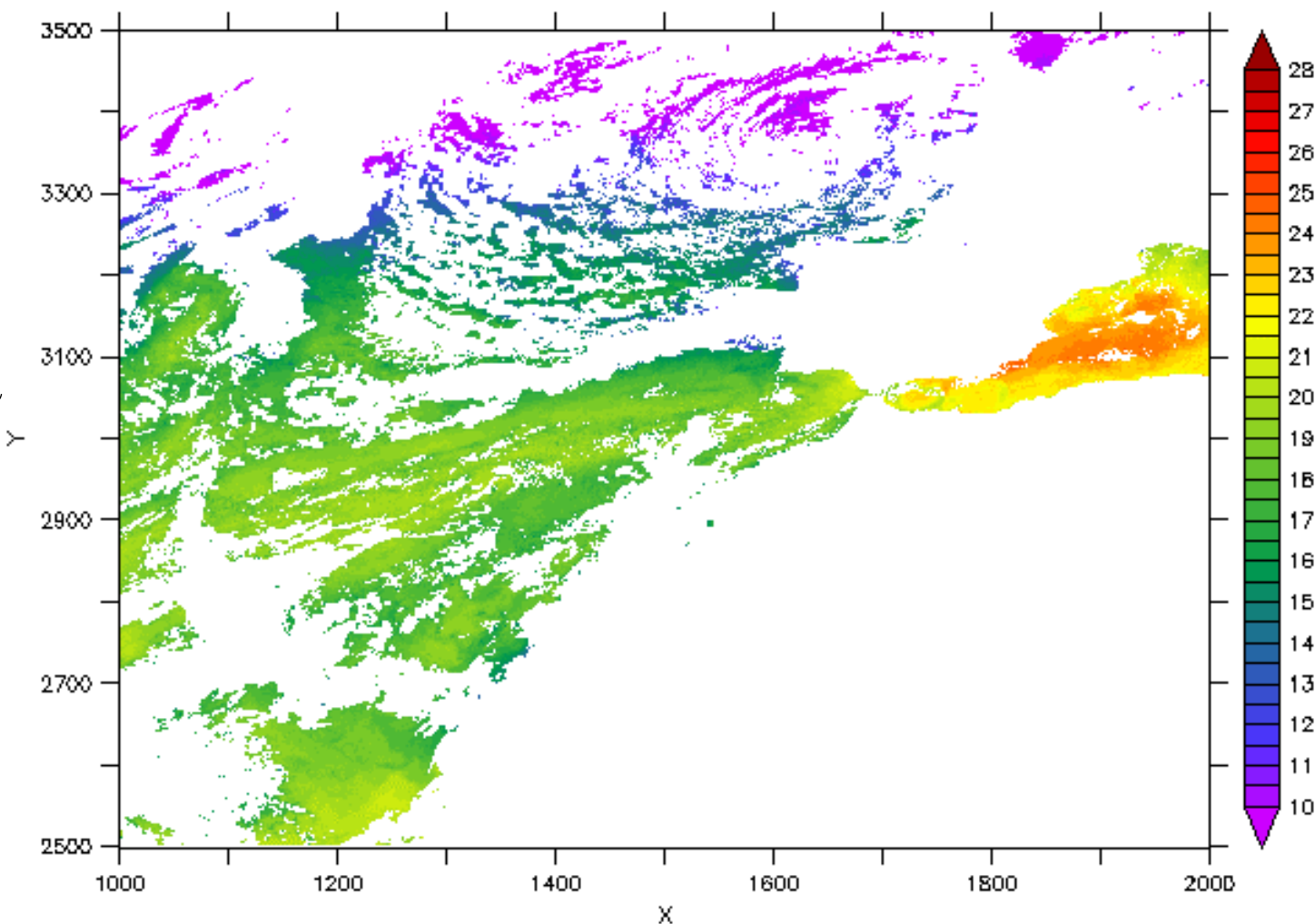
Toujours un temps d'avance

FROM BT to SST

DATA SET: sstprd_meteosat09_20110826_000000

FERRET Ver. 6.1
NOAA/PMEL TNAP
8 Sep 13 2011 08:14:34

BT
10.8 μ



IR_108-273.15

ANCE



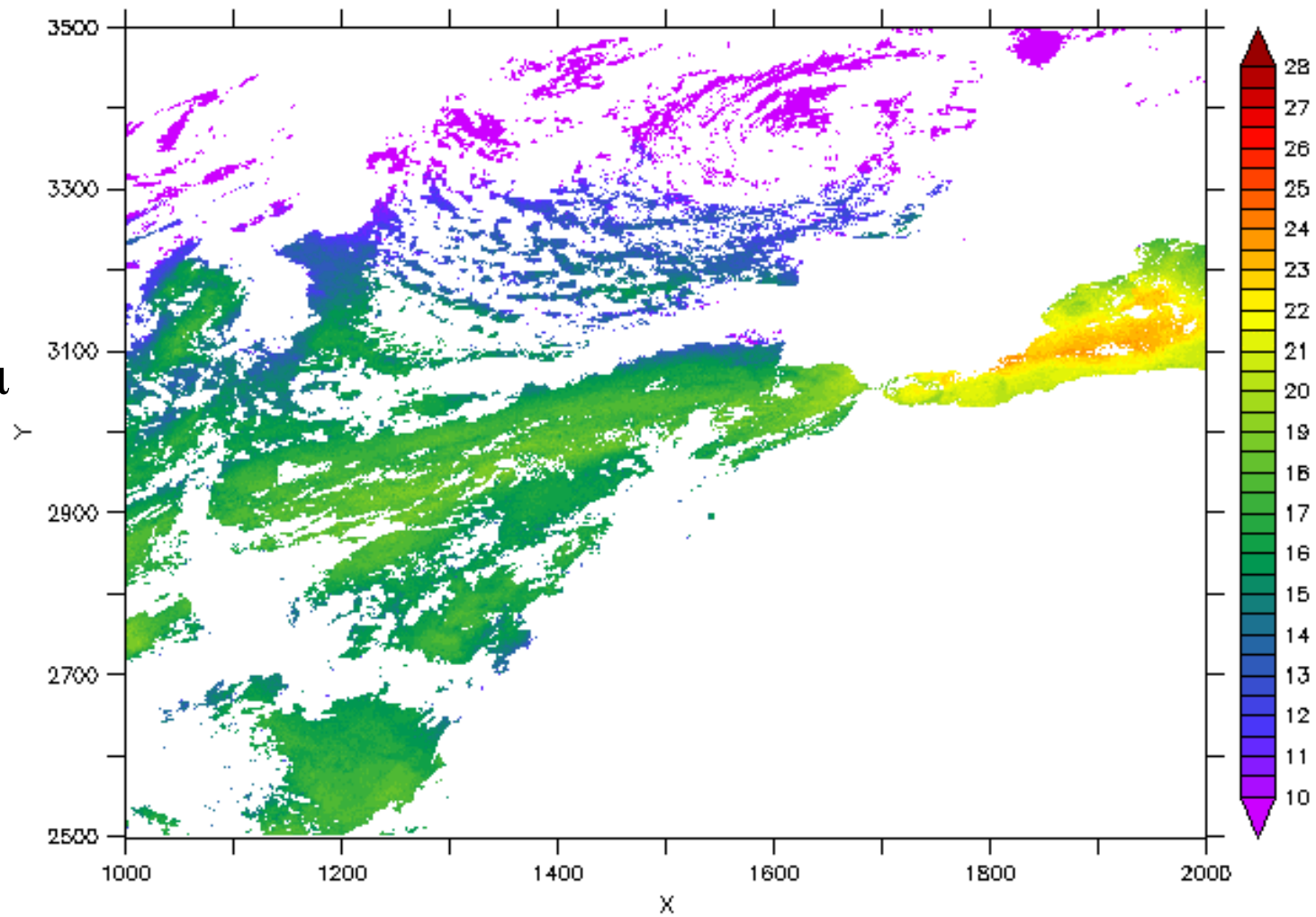
Toujours un temps d'avance

FROM BT to SST

FERRET Ver. 6.1
NOAA/PMEL TNAP
8 Sep 13 2011 08:23:58

DATA SET: sstprd_meteosat09_20110826_000000

BT
12.0 μ



IR_120-273.15

ANCE



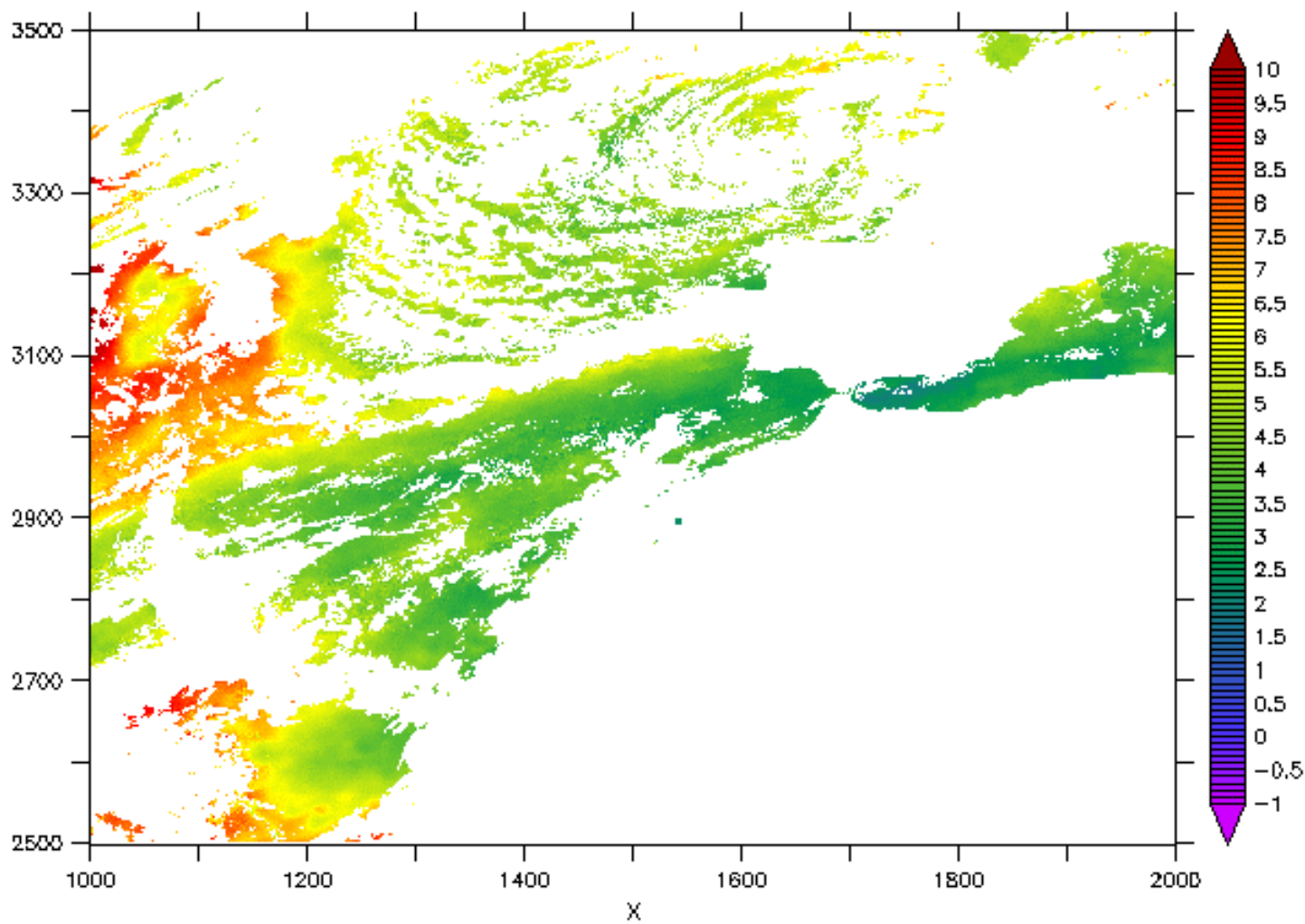
Toujours un temps d'avance

FROM BT to SST

FERRET Ver. 6.1
NOAA/PMEL TNAP
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DATA SET: sstprd_meteosat09_20110826_000000

SST
-
BT10.8 μ



SST-IR_108

ANCE



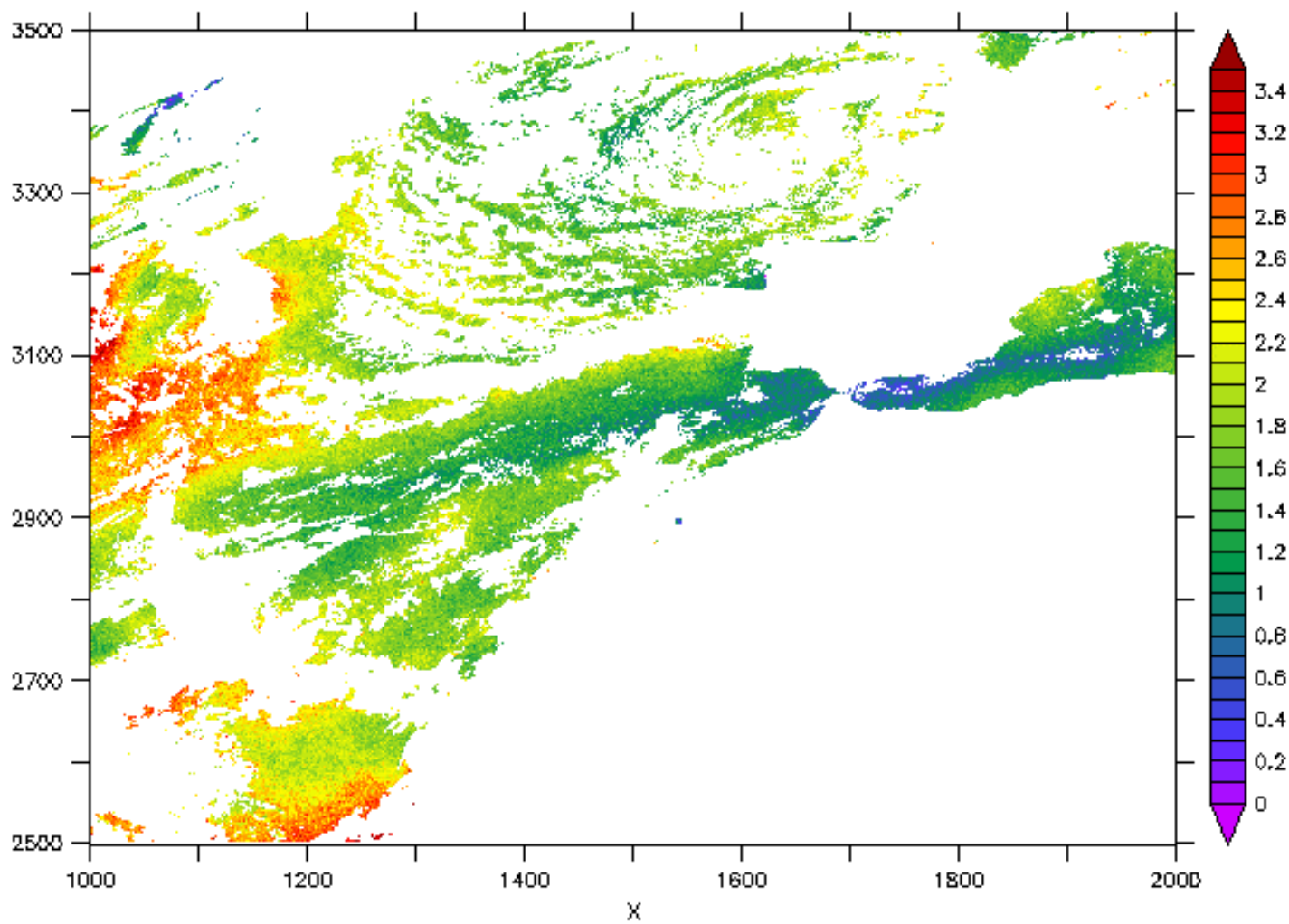
Toujours un temps d'avance

FROM BT to SST

FERRET Ver. 6.1
NOAA/PMEL TNAP
8 Sep 13 2011 08:28:23

DATA SET: sstprd_meteosat09_20110826_000000

BT10.8 μ
-
BT12.0 μ



IR_108-IR_120

ANCE



Toujours un temps d'avance

FROM BT to SST Multispectral methods

Split Window (T10.8, T12) basic equation

- Principle: $SST - T_{10.8}$ is proportional to $T_{10.8} - T_{12}$
- Hence $SST = a T_{10.8} + b (T_{10.8} - T_{12}) + C$

General case (T3.7, T8.7, T10.8, T12)

- $SST = \sum (a_i T_{bi}) + C$

How to determine a_i and C ??

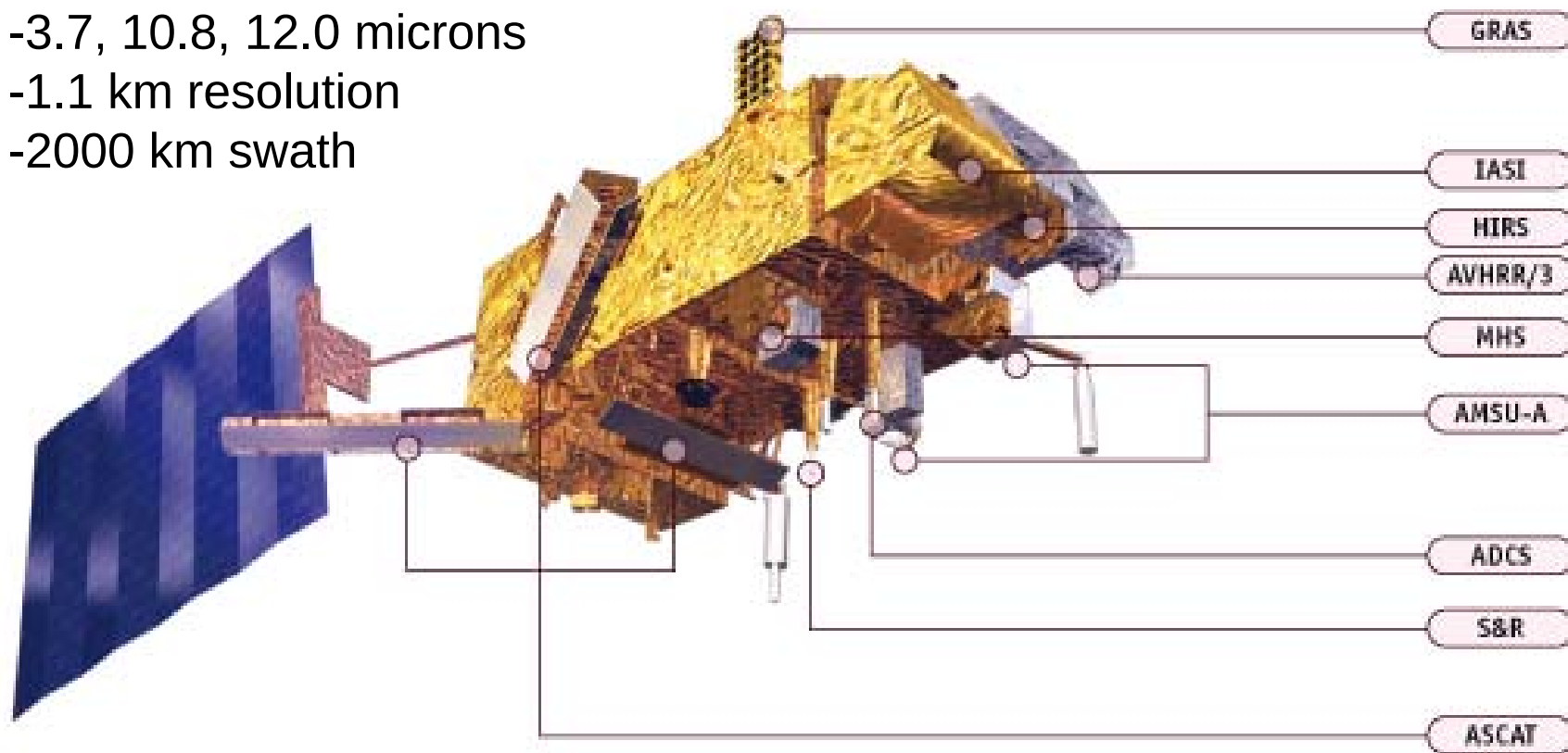
- 1) Needs a set of SSTs and TBs (measurements or simulations)
- 2) Regression $\rightarrow a_i$ and C

Generates regional biases !

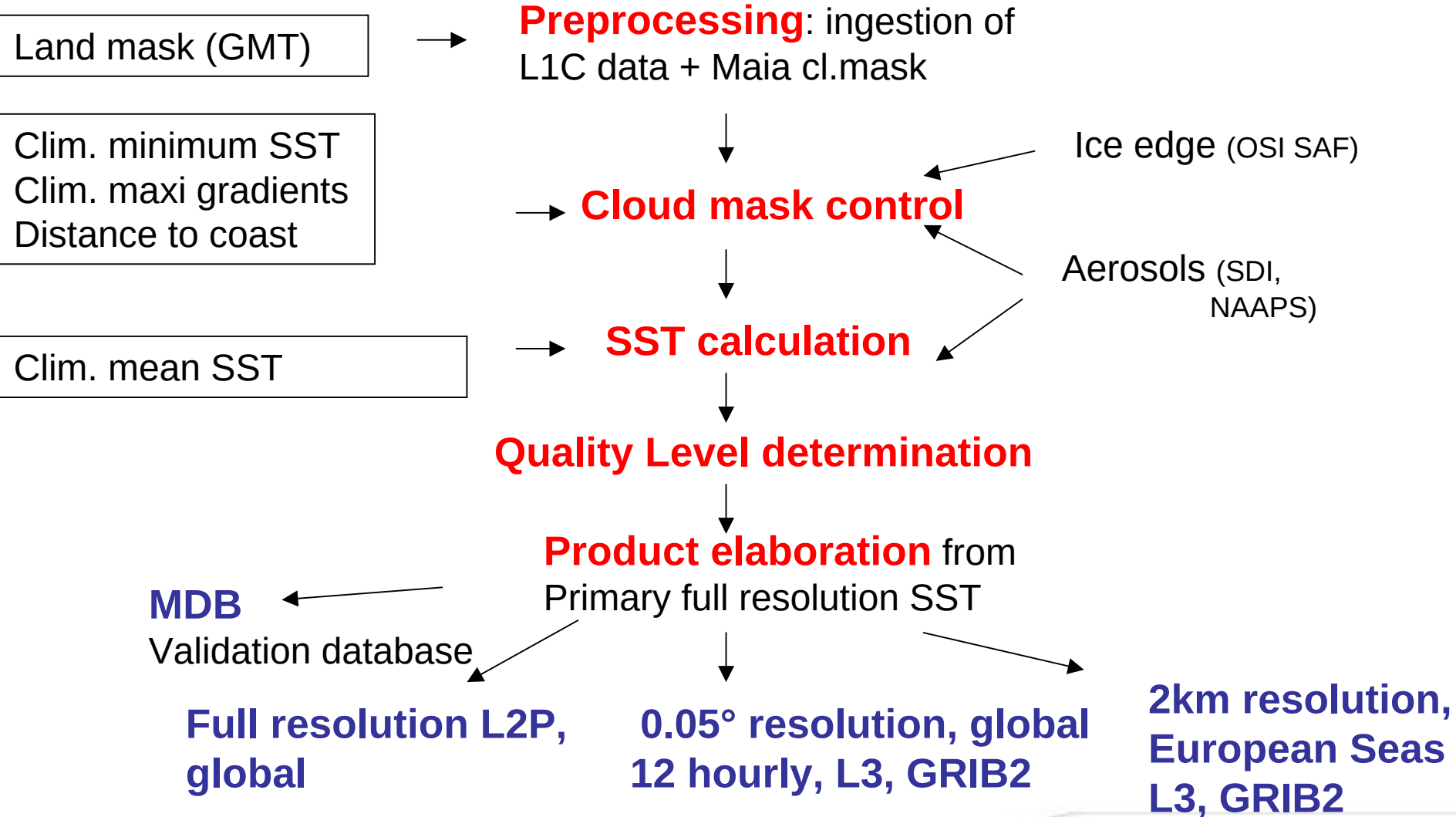
SST FROM METOP/AVHRR

AVHRR:

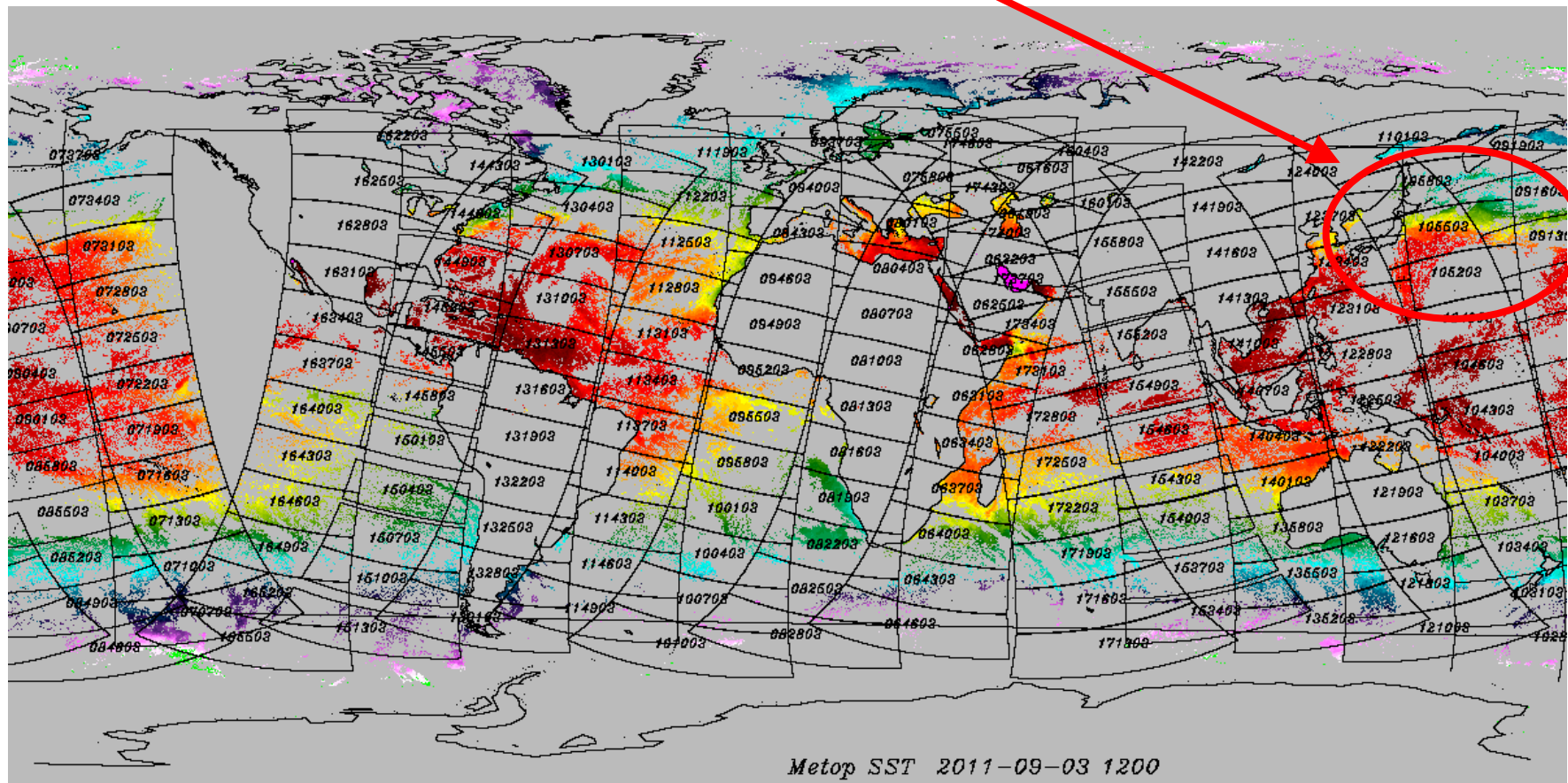
- 3.7, 10.8, 12.0 microns
- 1.1 km resolution
- 2000 km swath



METOP/ AVHRR SST PROCESSING CHAIN



METOP/ AVHRR SST

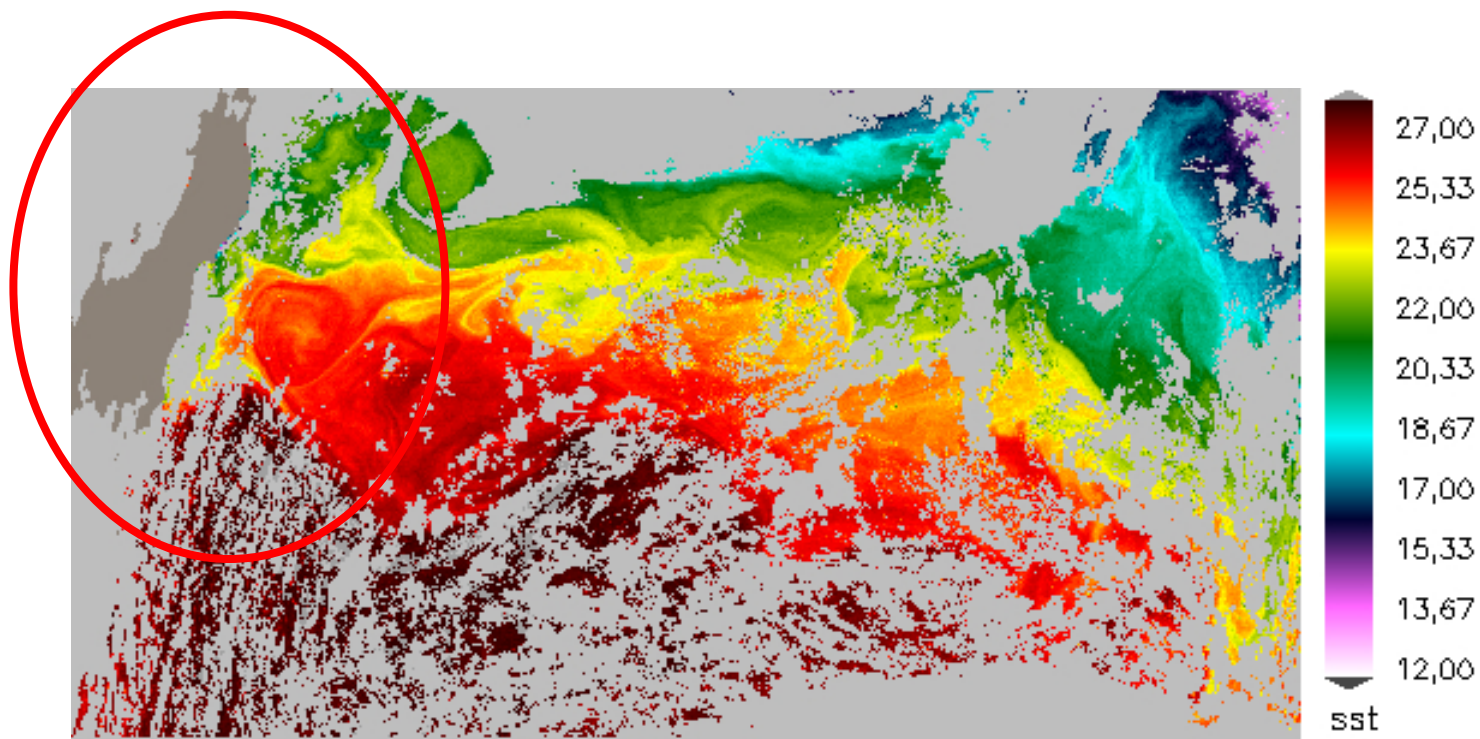


OSI-SAF SST, EUMETRAIN 2011

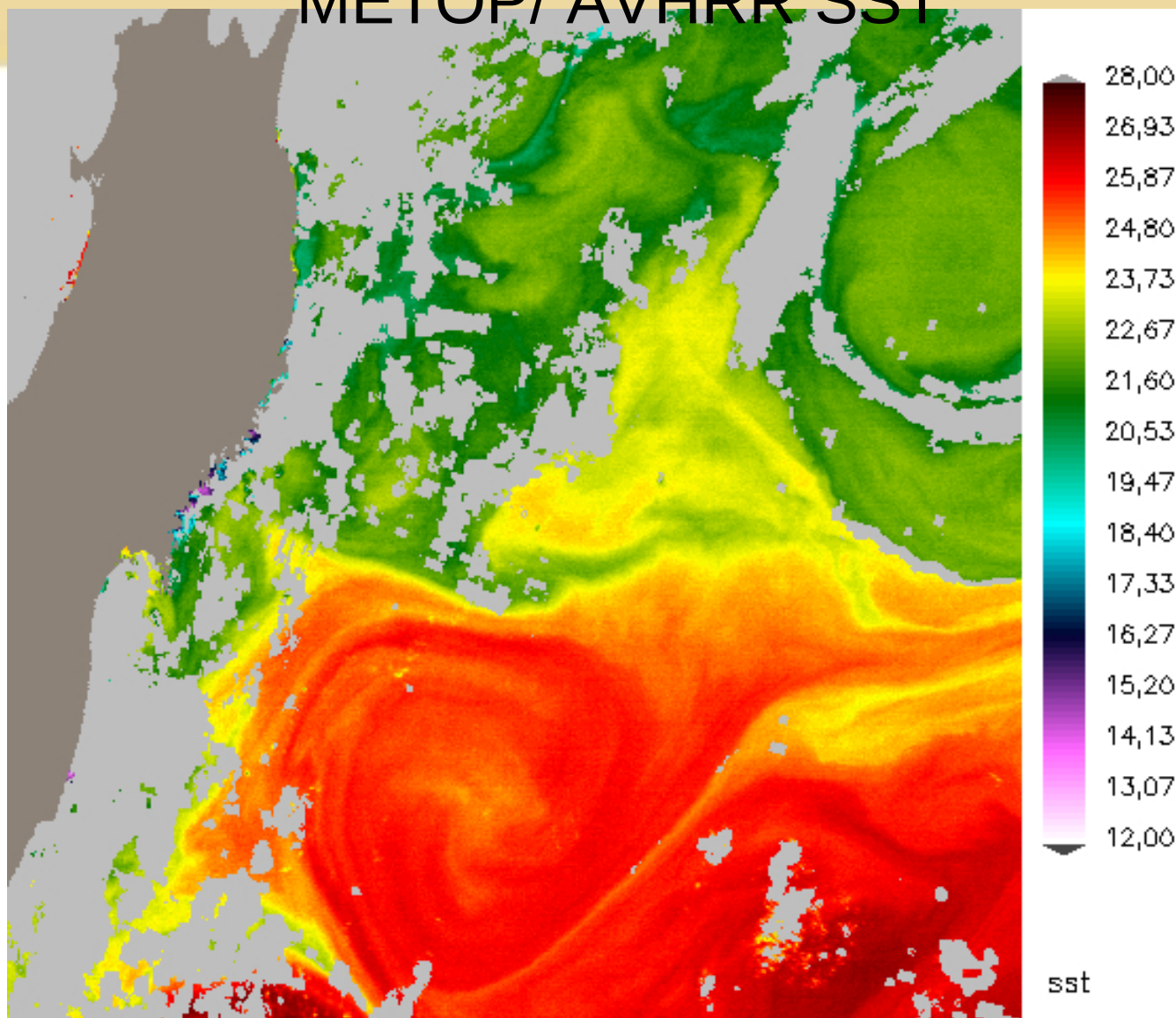


METEO FRANCE
Toujours un temps d'avance

METOP/ AVHRR SST



METOP/ AVHRR SST

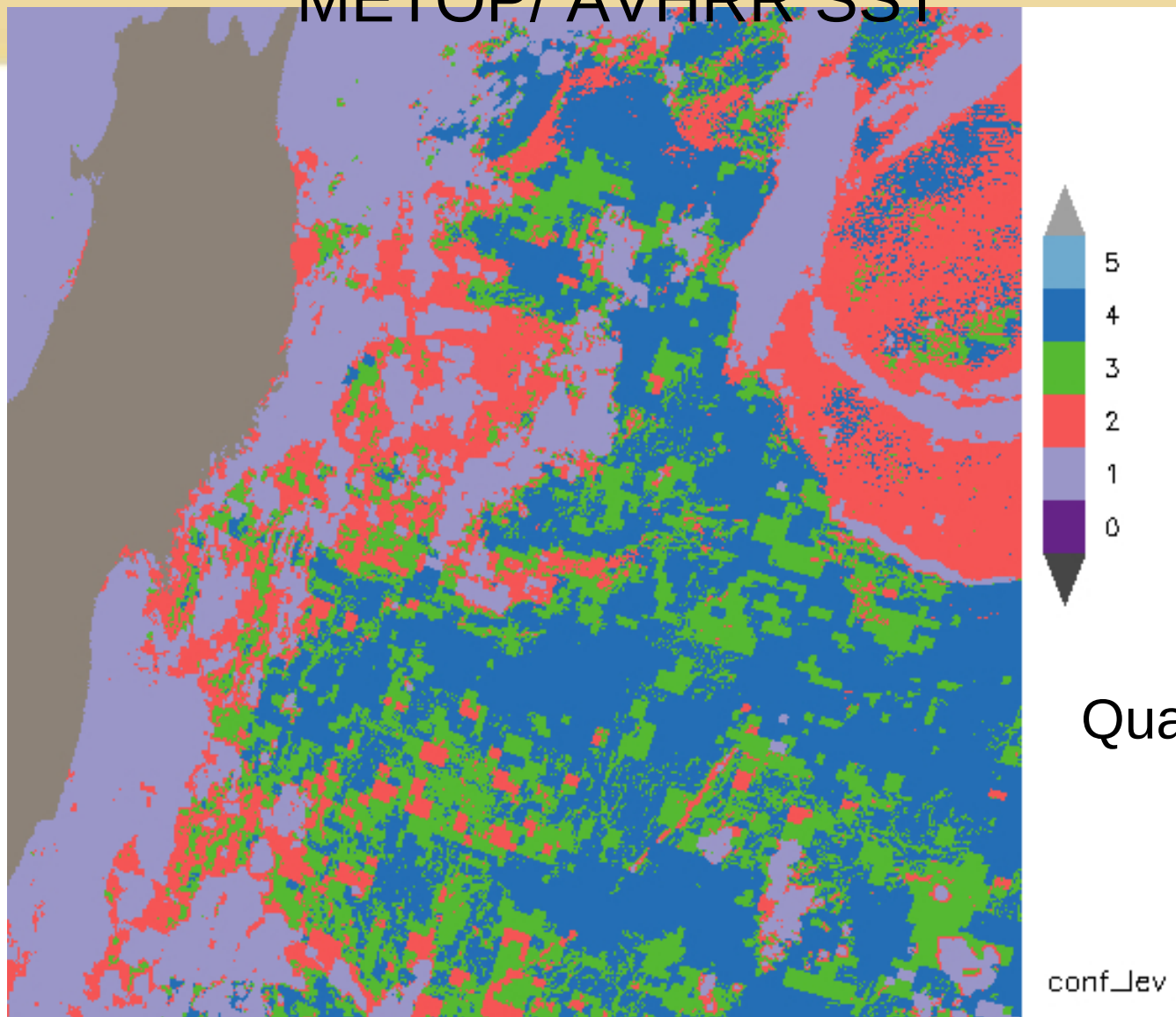


OSI-SAF SST, EUMETRAIN 2011



METEO FRANCE
Toujours un temps d'avance

METOP/ AVHRR SST

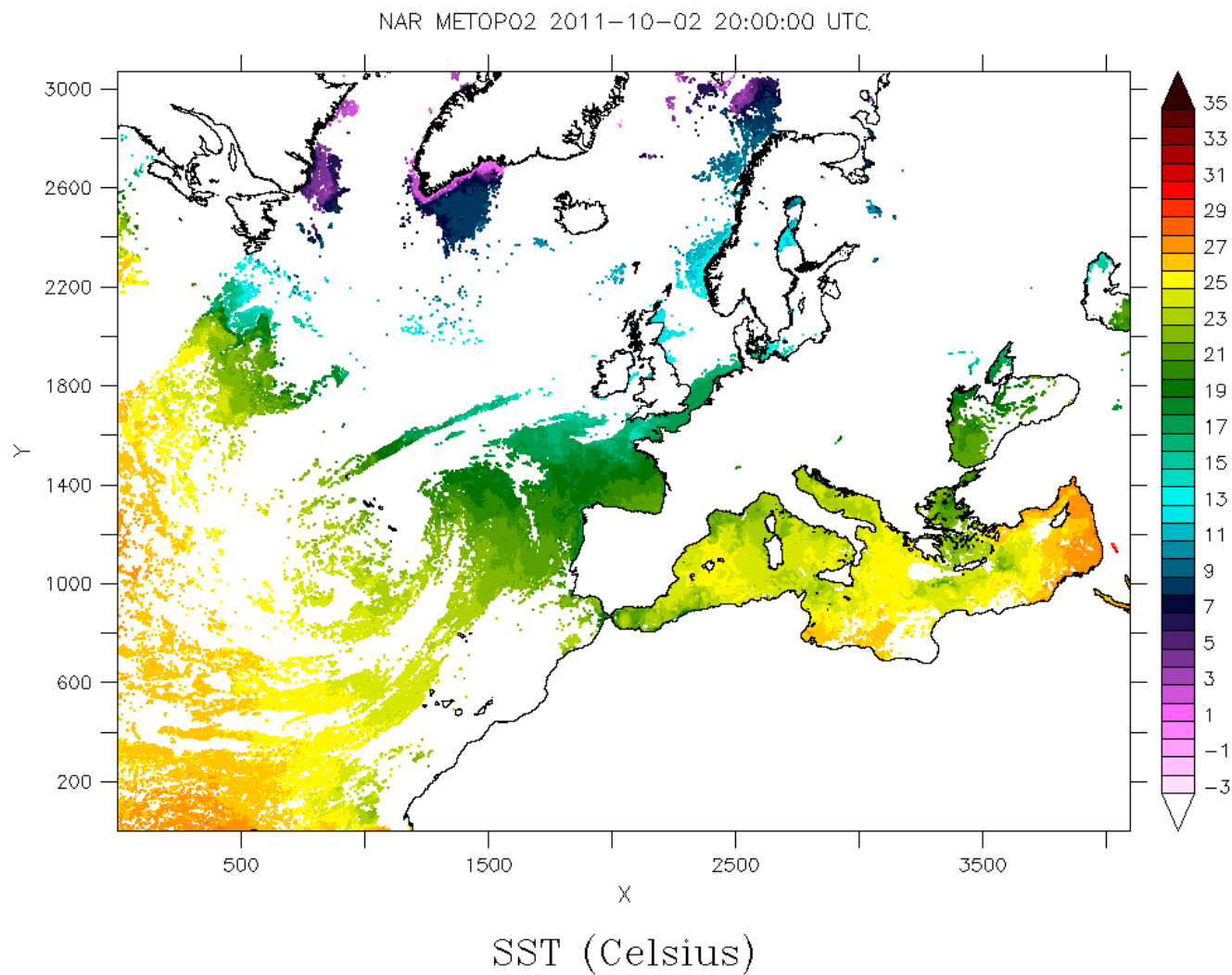


OSI-SAF SST, EUMETRAIN 2011

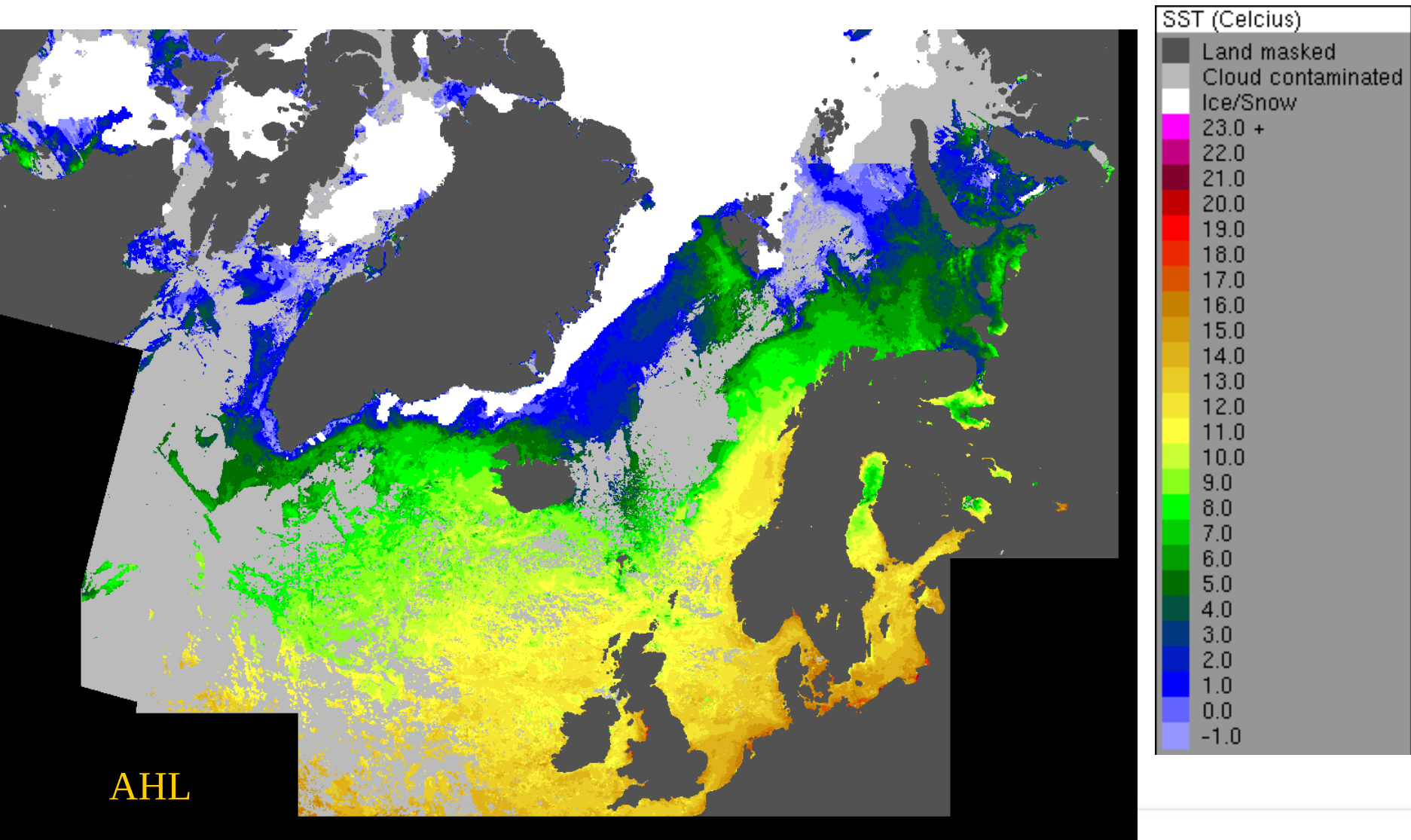


METEO FRANCE
Toujours un temps d'avance

AVHRR SST: North Atlantic Regional



AVHRR SST Atlantic High Latitudes



OSI-SAF SST, EUMETRAIN 2011



METEO FRANCE
Toujours un temps d'avance

AVHRR SST products

- Full resolution SST (METOP only)
 - Netcdf (L2P GDSV1.7) and GRIB2
 - 3 minute granules
 - Full satellite resolution

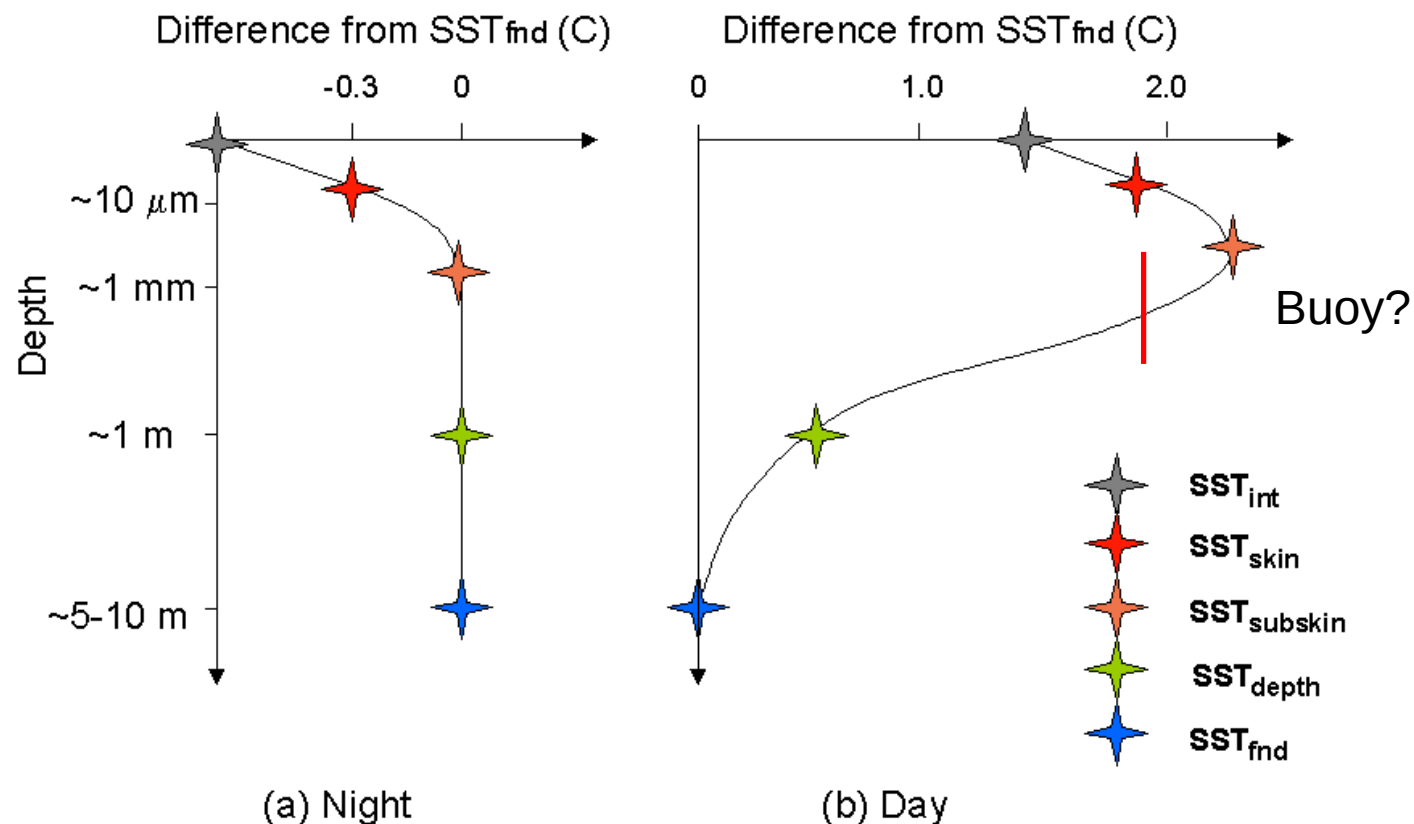
- Regional European (METOP + NOAA)
 - North Atlantic Regional: NAR (2 km resolution, twice daily)
 - Atlantic High Latitudes: AHL (5 km resolution)

- GLOBAL SST
 - Netcdf (L2P GDSV1.7) and GRIB2
 - Regular grid 0.05° resolution
 - 12 hourly

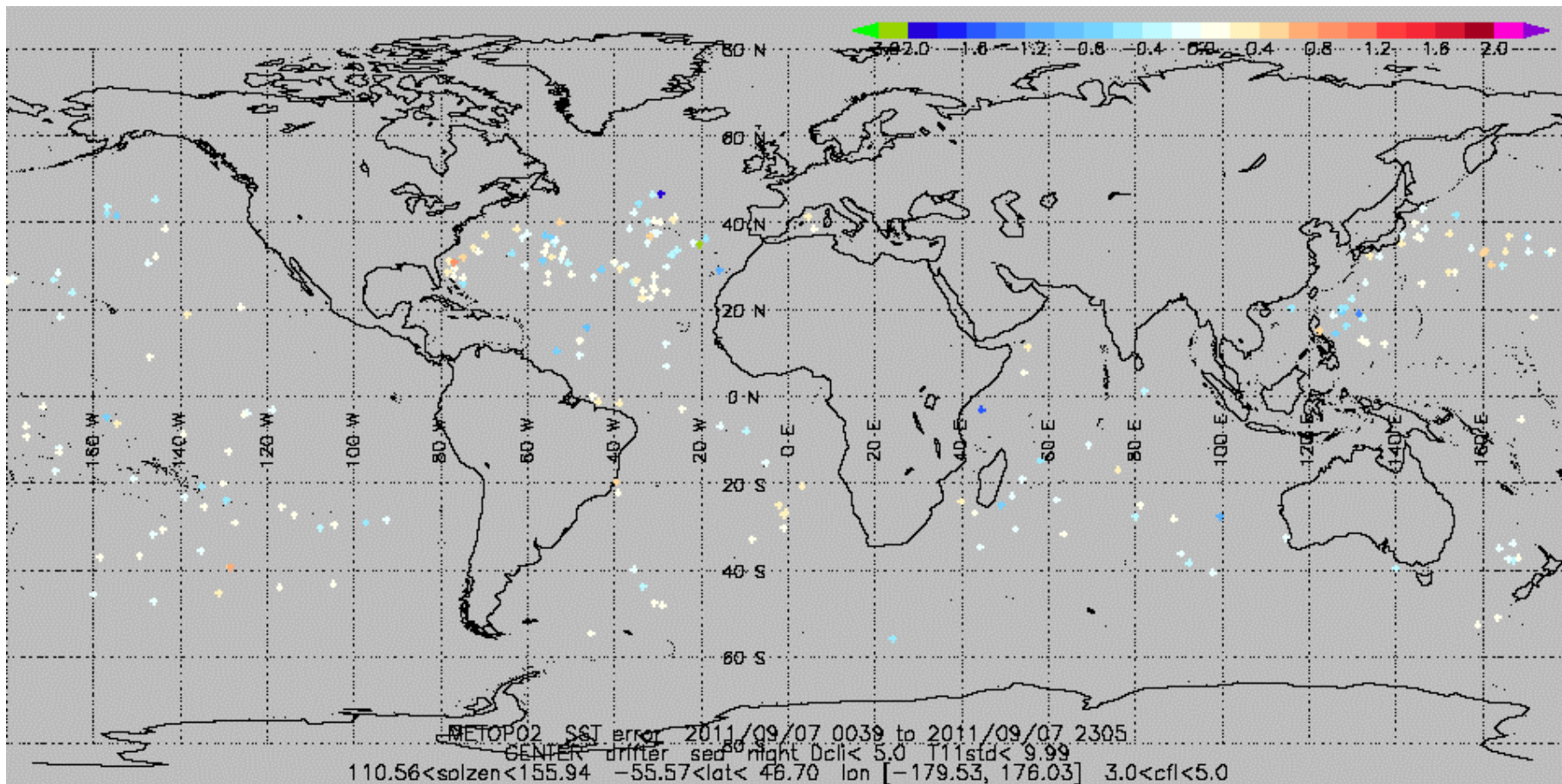
SST are provided with quality levels 1 (cloudy), 2, 3, 4, 5

Use 3, 4, 5 only!

VALIDATION: What is SST?

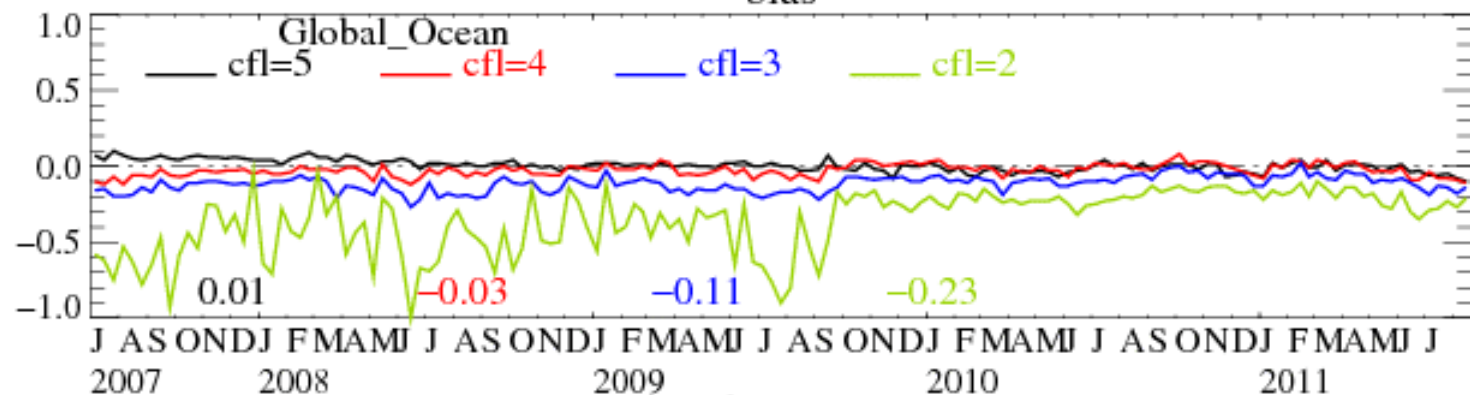


VALIDATION 1 night

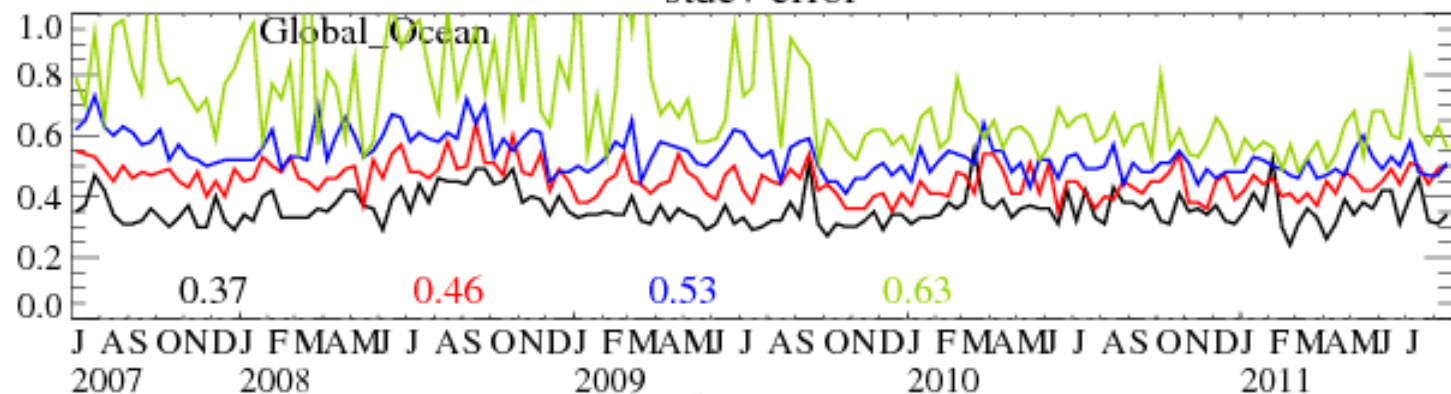




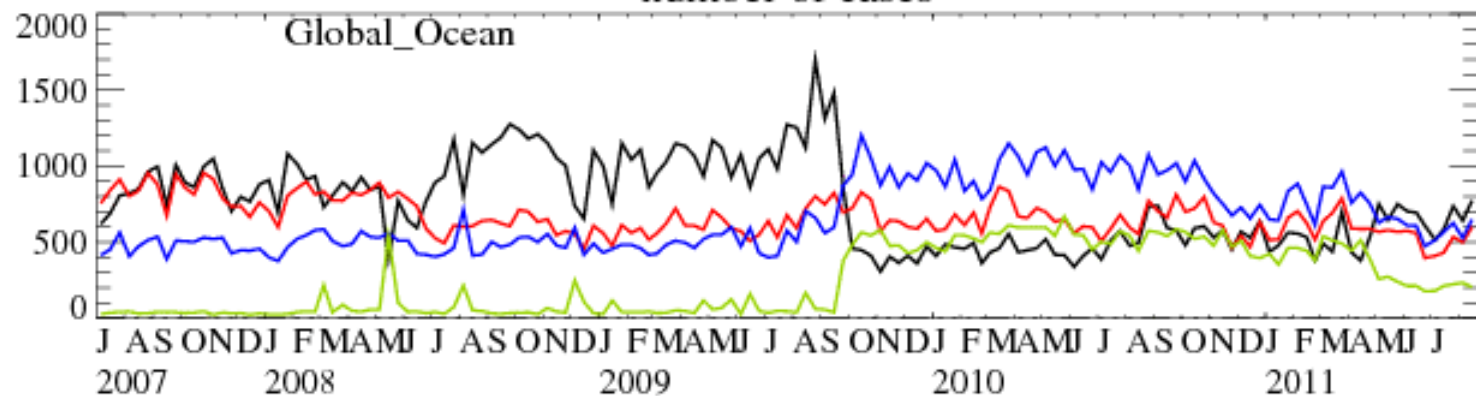
SST METOP02 - BUOYS night bias



stdev error



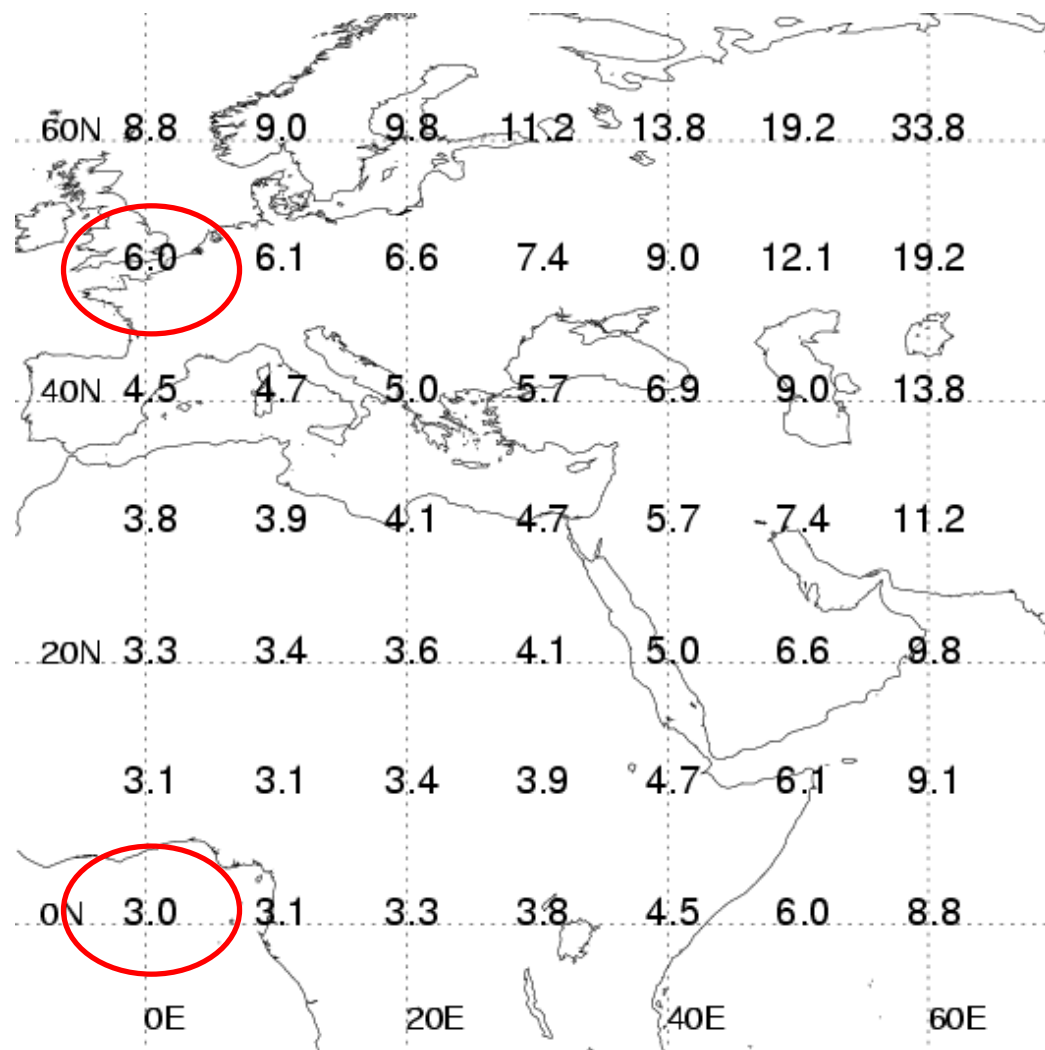
number of cases



SST FROM MSG/SEVIRI

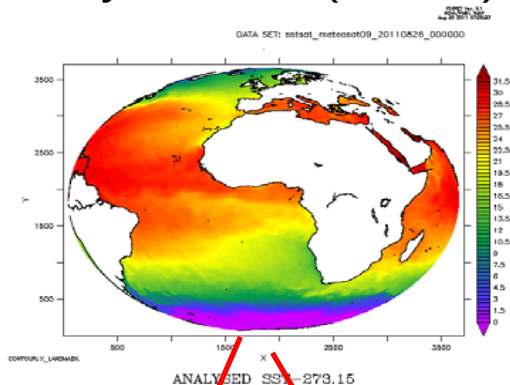
SEVIRI:

- 3.9, 8.7, 10.8, 12.0 microns
- Time sampling: 15 minutes
- 3 km resolution at nadir
(varies with location!)

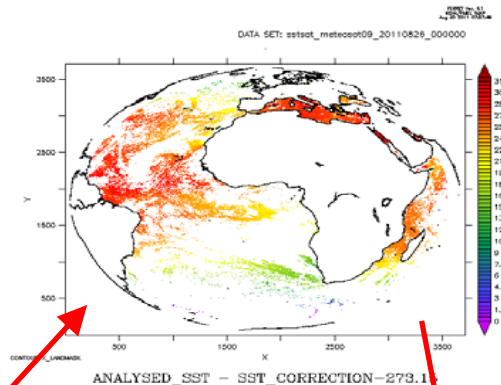


MSG/SEVIRI SST NWP based bias correction method

Analysed SST (OSTIA)



Retrieved SST

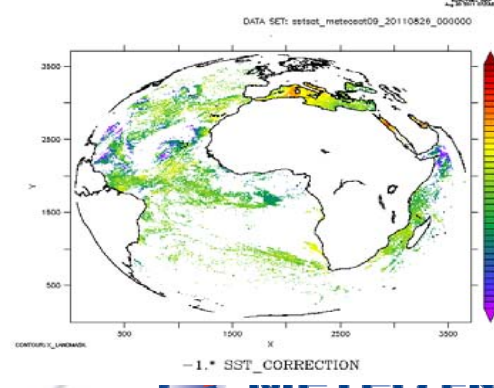
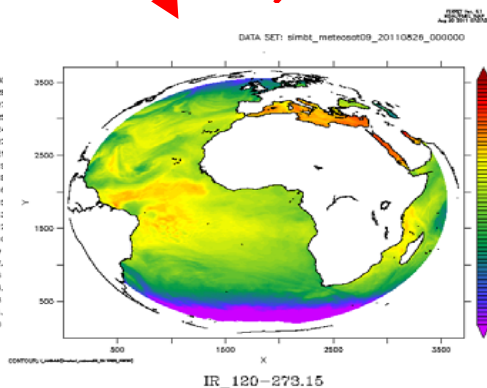
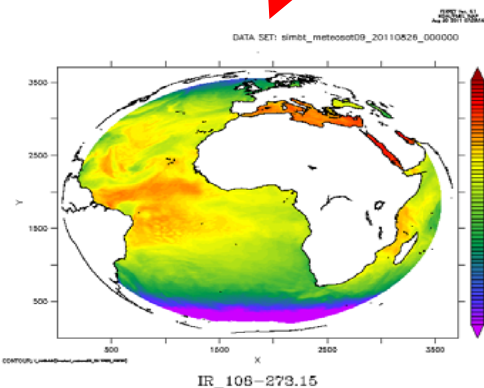


ECMWF profiles
+ RTTOV

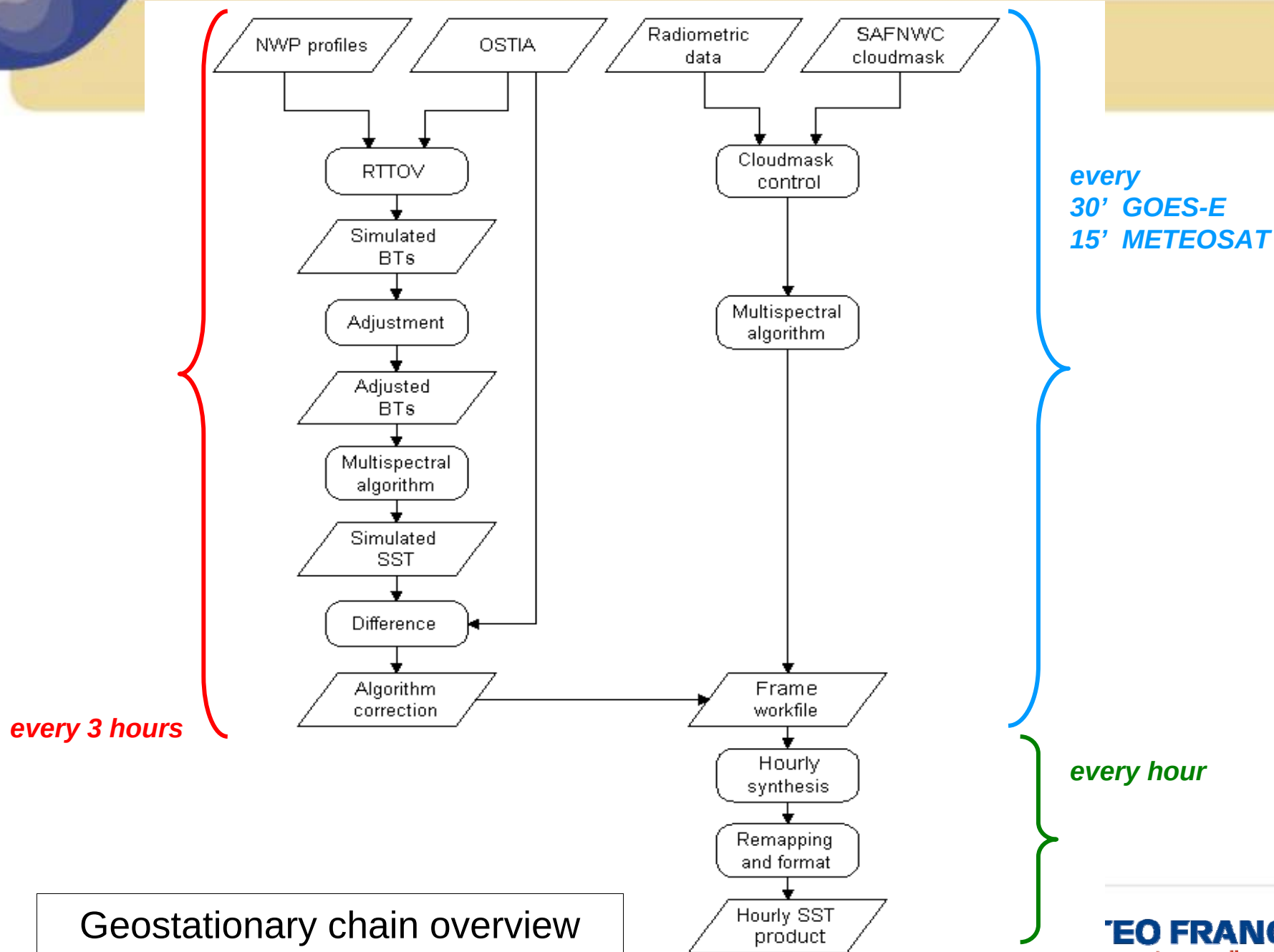
Simulated BTs

Operational algorithm
Applied on simulations

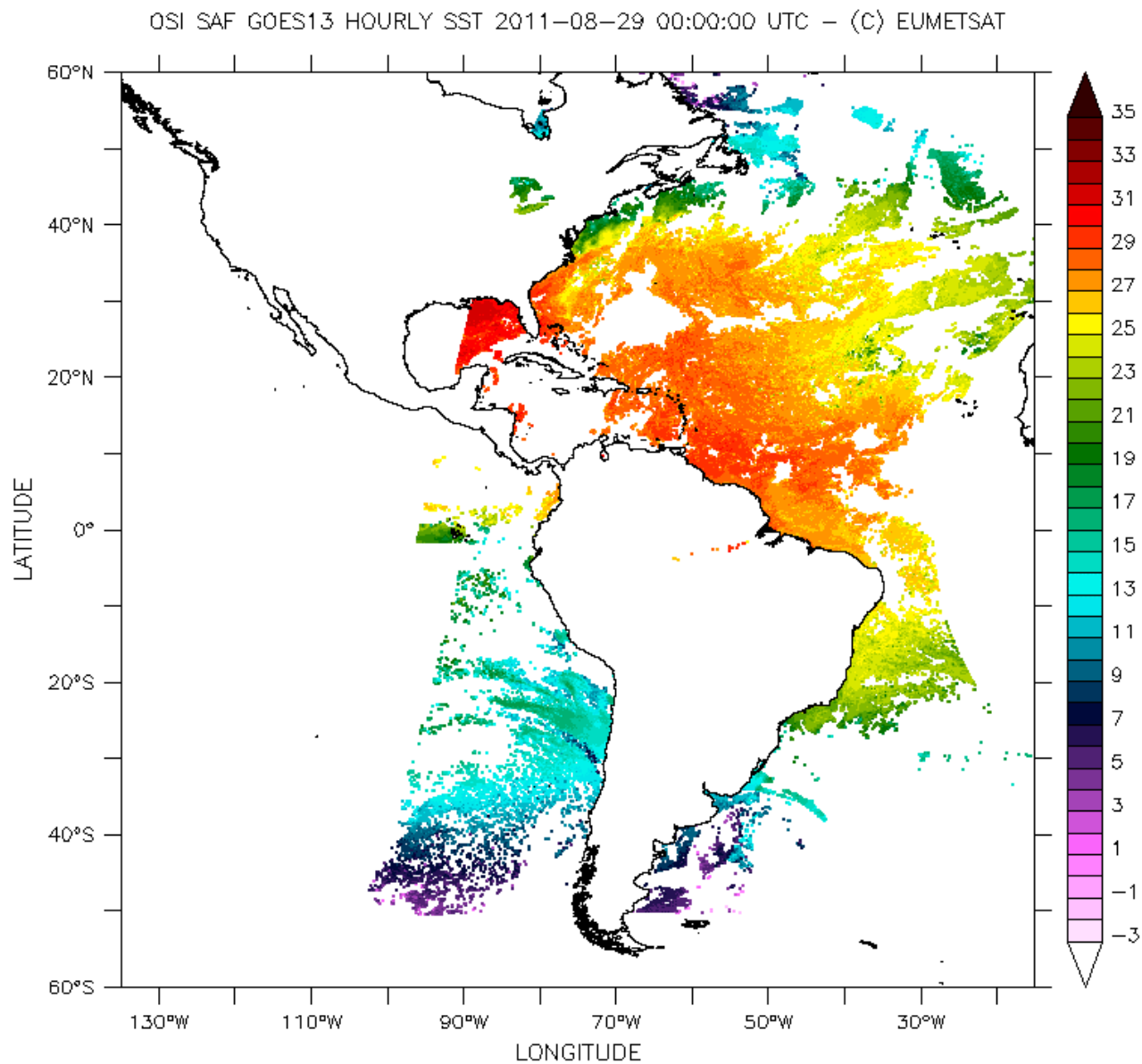
Retrieved – analyzed SST =
Predicted algorithm error
(used as a correction term)



2011

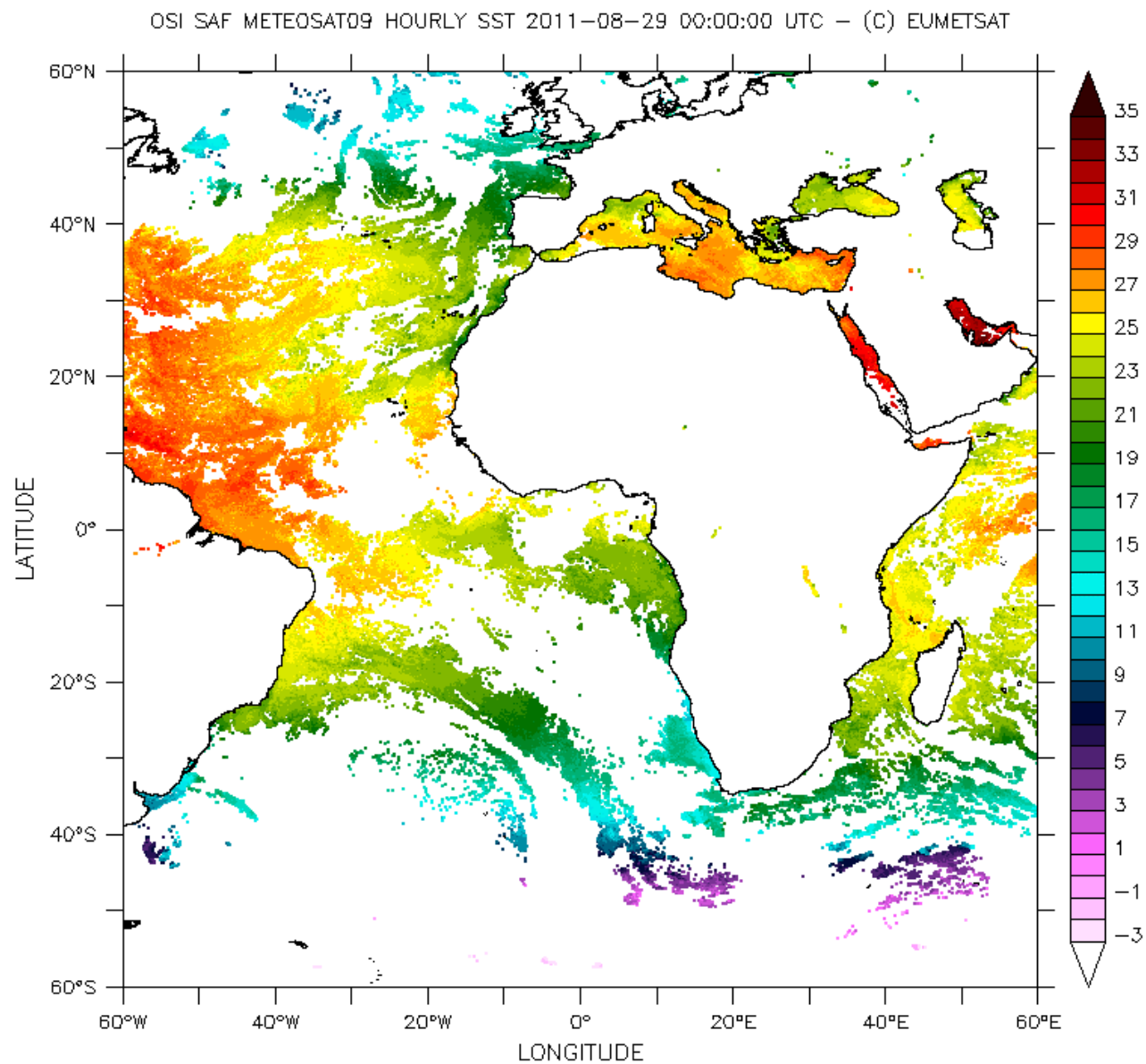


GOES-E

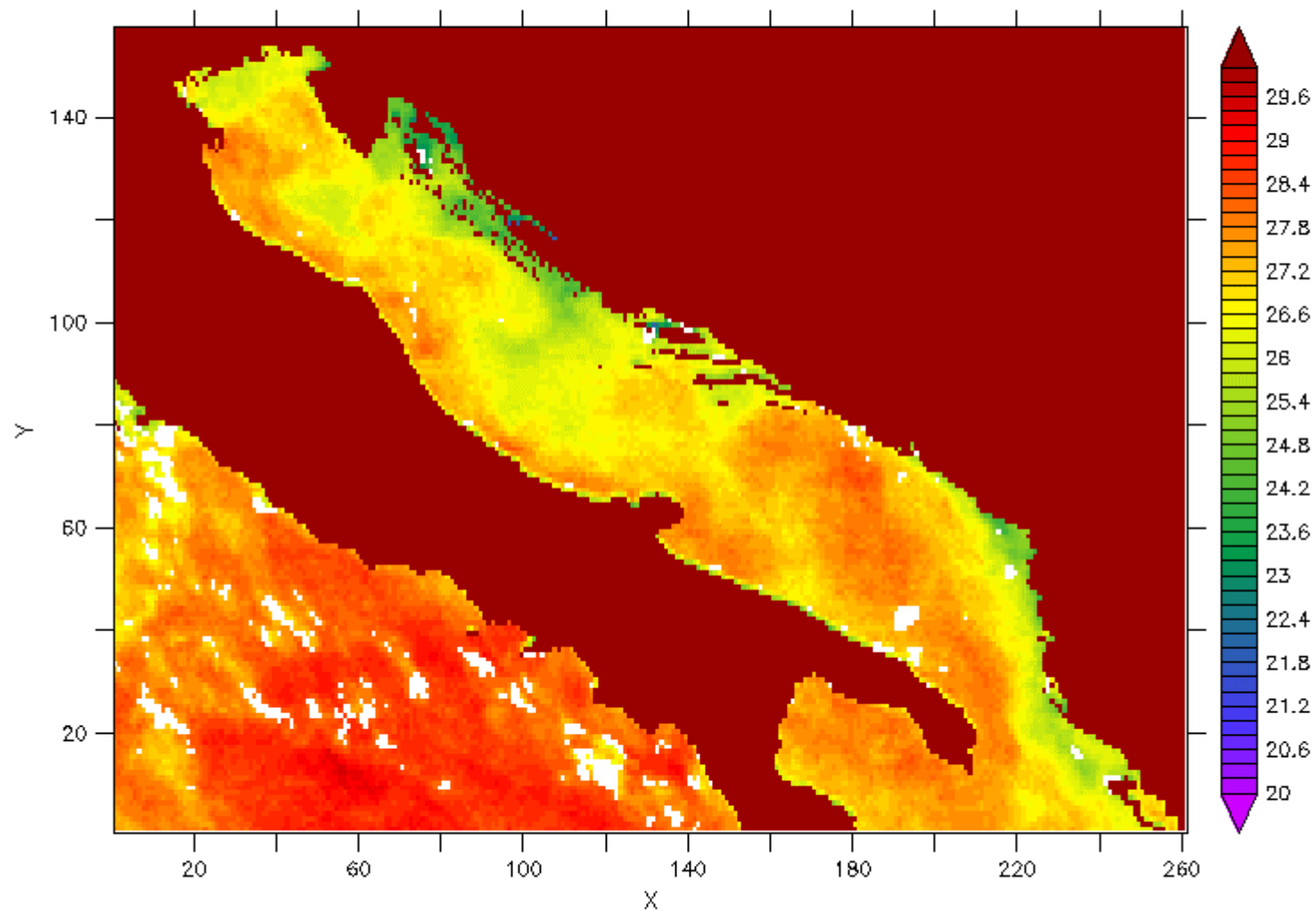


sea surface temperature (Celsius)

MSG



DATA SET: sstsat_meteosat09_20100722_000000_adri



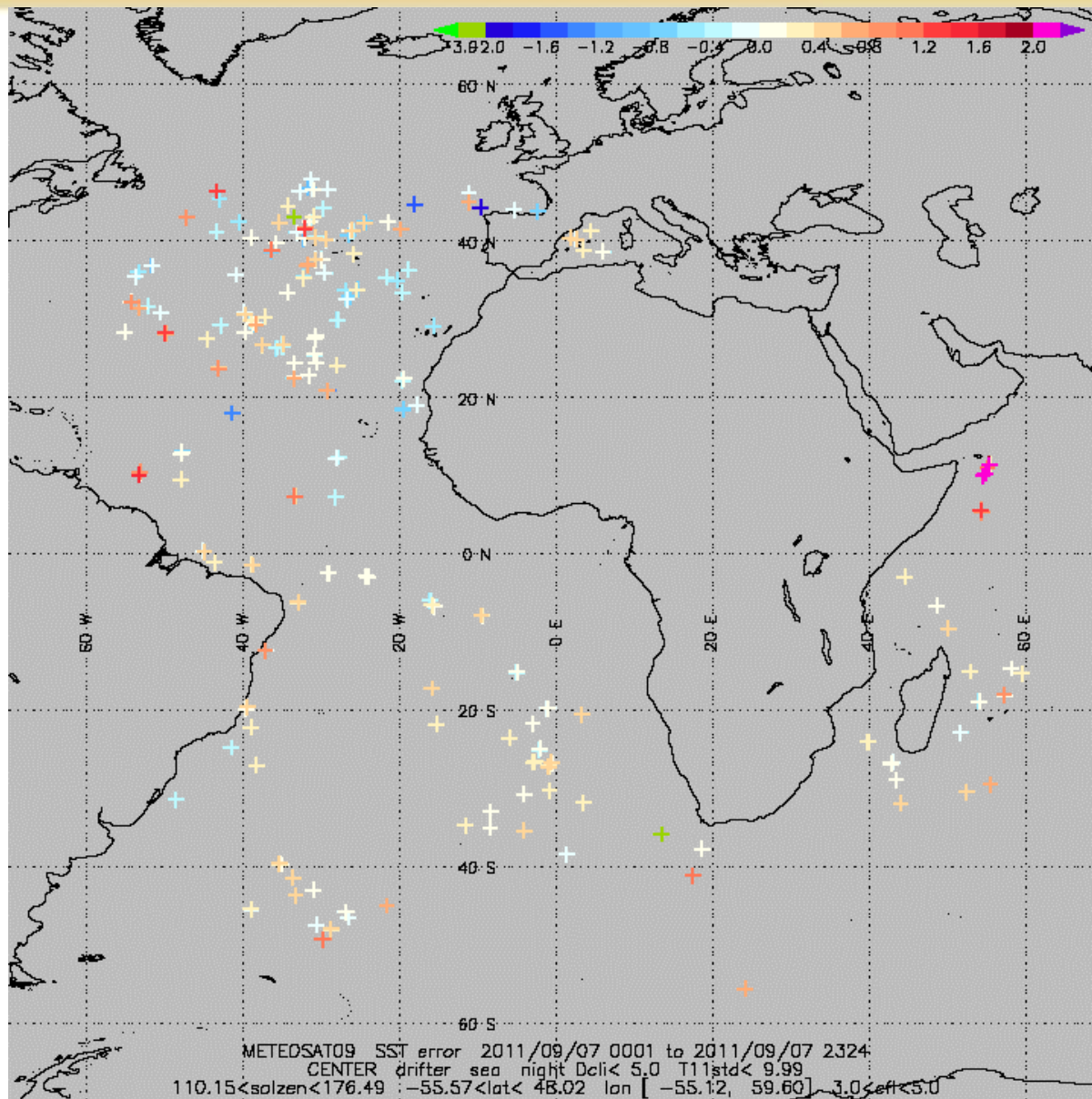
```
IF (X_LANDMASK EQ 0) THEN (SST -273.15) ELSE 800
```

Geostationary SST products

- *New chain (operational Since August 2011!)*
 - *Ingest all satellite data at full spatial resolution*
 - *Includes a bias correction*
 - *No merged products (MSG + GOES)*
 - *Enhanced resolution: 0.05°*
- Geostationary SST products
 - Netcdf (L2P GDSV2.0) and GRIB2
 - 0.05° resolution, hourly
 - MSG SST: 60S-60N; 60 W- 60E
 - GOES-E SST: 60S-60N; 135W- 15W

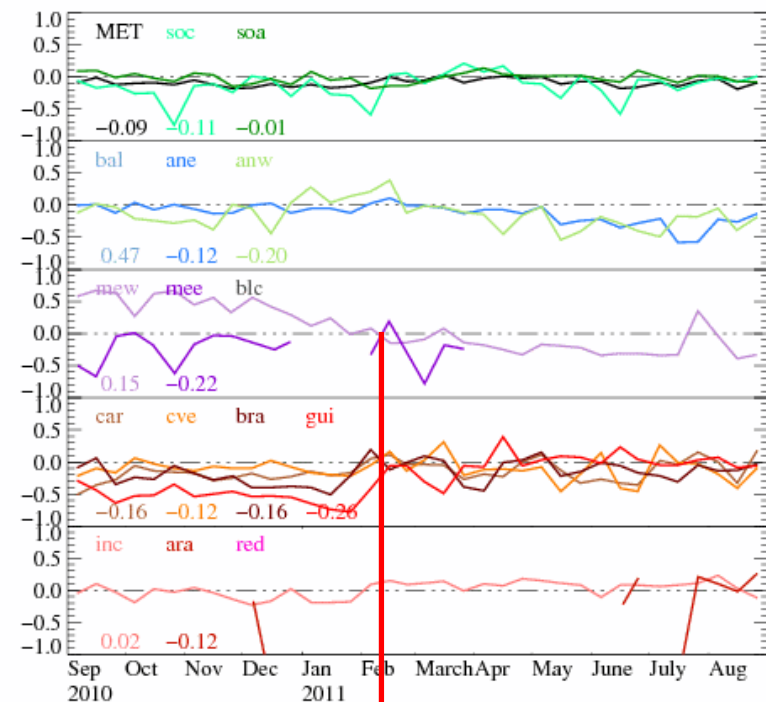
SST are provided with quality levels 1 (cloudy), 2, 3, 4, 5
Use 3, 4, 5 only!

VALIDATION 1 night



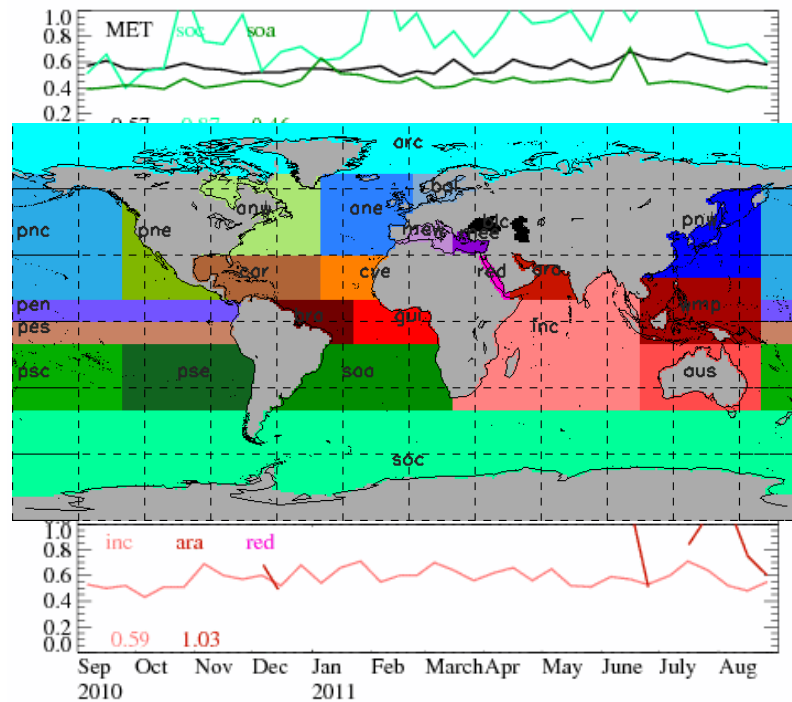
Night time VALIDATION: 10 day period

SST METEOSAT09 – BUOYS : bias night cfl [3,5]



Application of a
Bias correction method

SST METEOSAT09 – BUOYS : stdev error night cfl [3,5]



SUMMARY: : OSI SAF SST product availability

We are in a transition period !!

- *August 2011: Availability of new OSI SAF products
 - *<ftp://eftp.ifremer.fr/cersat-rt/project/osi-saf/>
 - *Password requested; see <http://www.osi-saf.org>
 - *Soon available through EUMETCAST in GRIB2
-
- *February 2012: end of « old » OSI-SAF geostationary products
 - *March 2012: AHL in netcdf GDSV2
 - *No later than mid 2012: all OSI-SAF products in netcdf GDSV2

THE END!

More information

- See <http://www.osi-saf.org>
 - *Geostationary Sea Surface Temperature Product User Manual*
 - *Low Earth Orbiter Sea Surface Temperature Product User Manual*
 - *Atlantic High Latitude L3 Sea Surface Temperature Product User Manual*
- See <https://www.ghrsst.org>
- Pierre.leborgne@meteo.fr or Steinar.eastwood@met.no

OSI SAF radiative fluxes Products and Services

Anne Marsouin, Pierre Le Borgne

Météo-France/DP/CMS

(With G. Legendre, S. Péré, S. Philippe, H. Roquet)

Outline

- Algorithms
- Processing chains
- Surface Solar Irradiance
- Downward Longwave Irra
- Practical information



OSI-SAF radiative fluxes, EUMETRAIN 2011

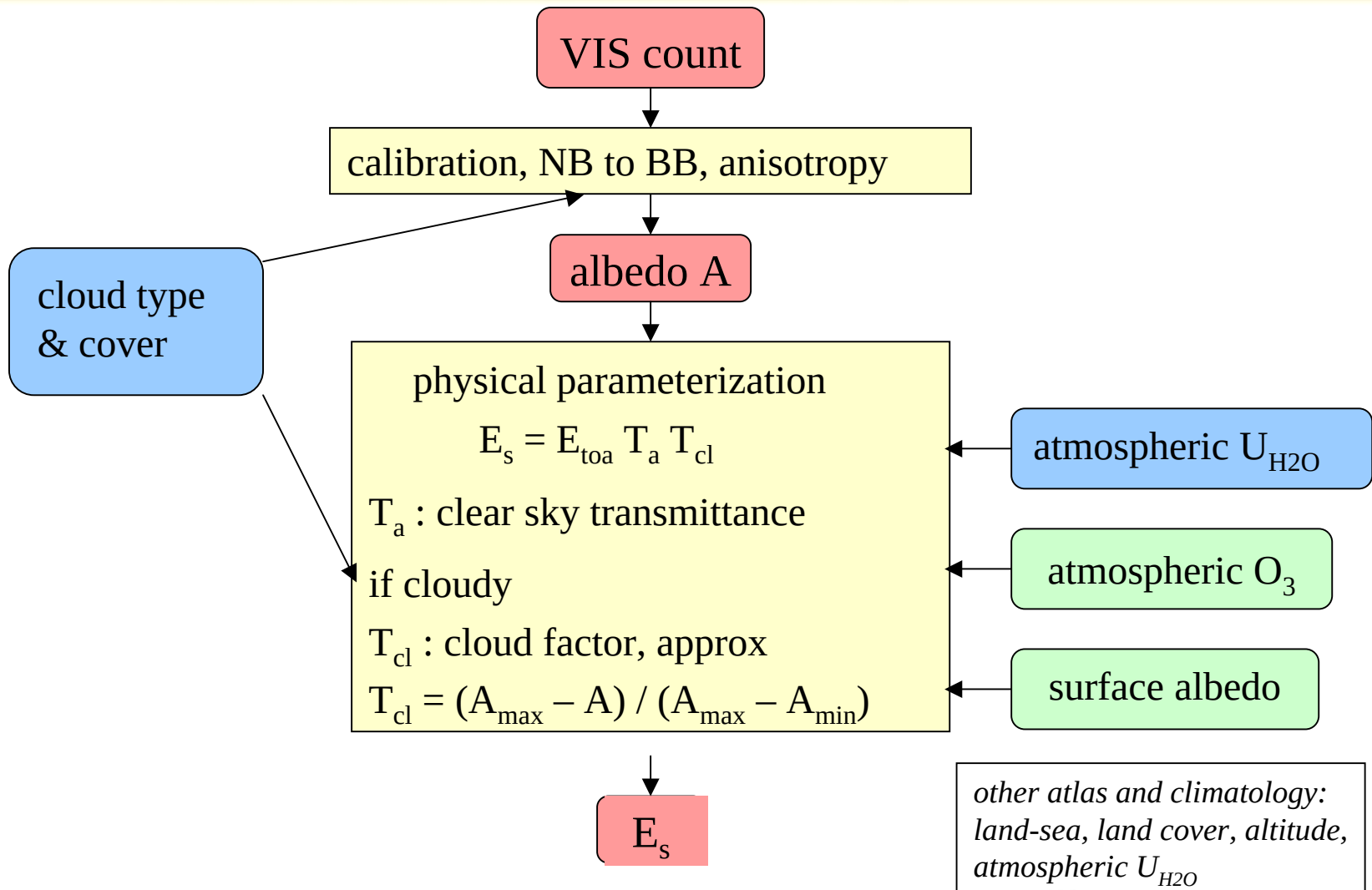


METEO FRANCE
Toujours un temps d'avance

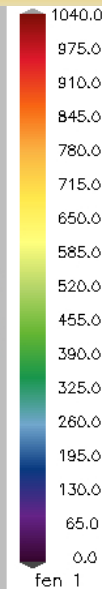
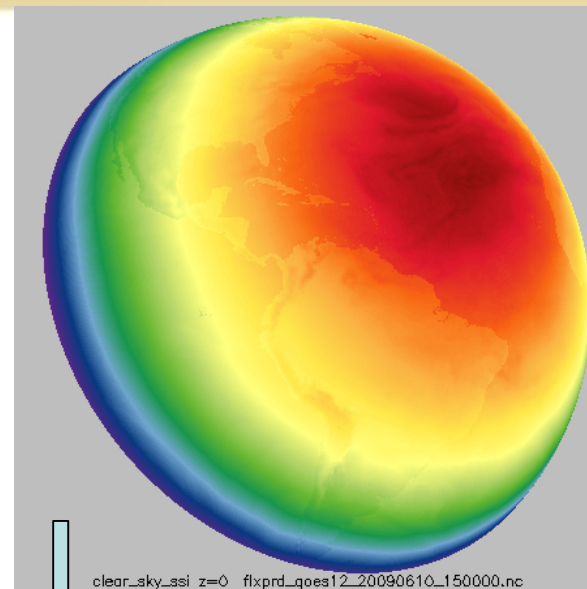
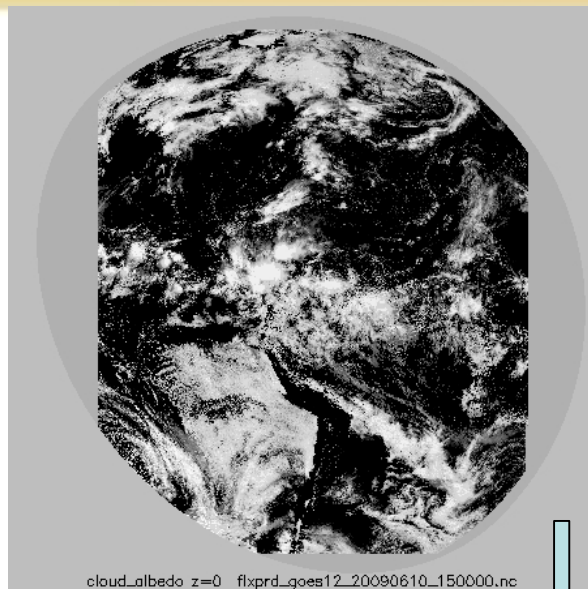
Algorithm inputs

- SSI (Surface Solar Irradiance): physical parameterization
 - **calibrated VIS channel**
 - NWC SAF cloud classification
 - *auxiliary data* (U_{H_2O} , A_s , O_3)
 - DLI (surface Downward Longwave Irradiance): bulk parameterization
 - predicted air T_{2m} and H_{2m}
 - SSI/SSI_{clear} (day)
 - NWC SAF cloud classification (night)
 - Algorithms described in the Product Manuals available on <http://www.osi-saf.org>
- FROM SATELLITE
-

SSI simplified flowchart

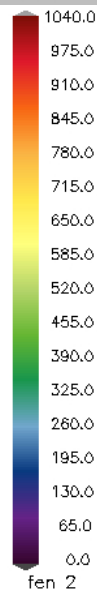
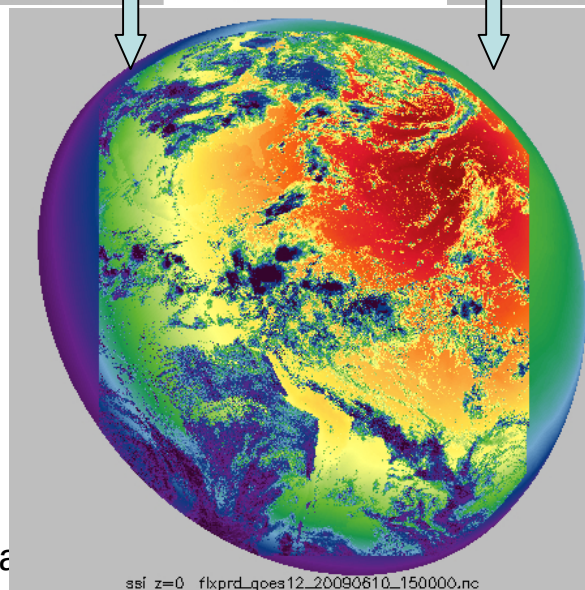


Calculating time homogeneous SSI



interpolated cloud albedo
between ante and post

calculated clear sky SSI



SSI at 1500
(no missing data)

OSI-SAF ra



METEO FRANCE
Toujours un temps d'avance

DLI algorithm

$$DLI = \varepsilon_0 \sigma T_a^4 + C (1 - \varepsilon_0) \sigma T_a^4$$

$\varepsilon_0(T_a, e, p)$ clear sky emissivity Prata, 1996

C infrared cloud amount

day

$$C = 1 - \text{SSI} / \text{SSI}_{\text{clear}}$$

SSI and $\text{SSI}_{\text{clear}}$

Crawford and Duchon, 1999
effective and clear sky SSI

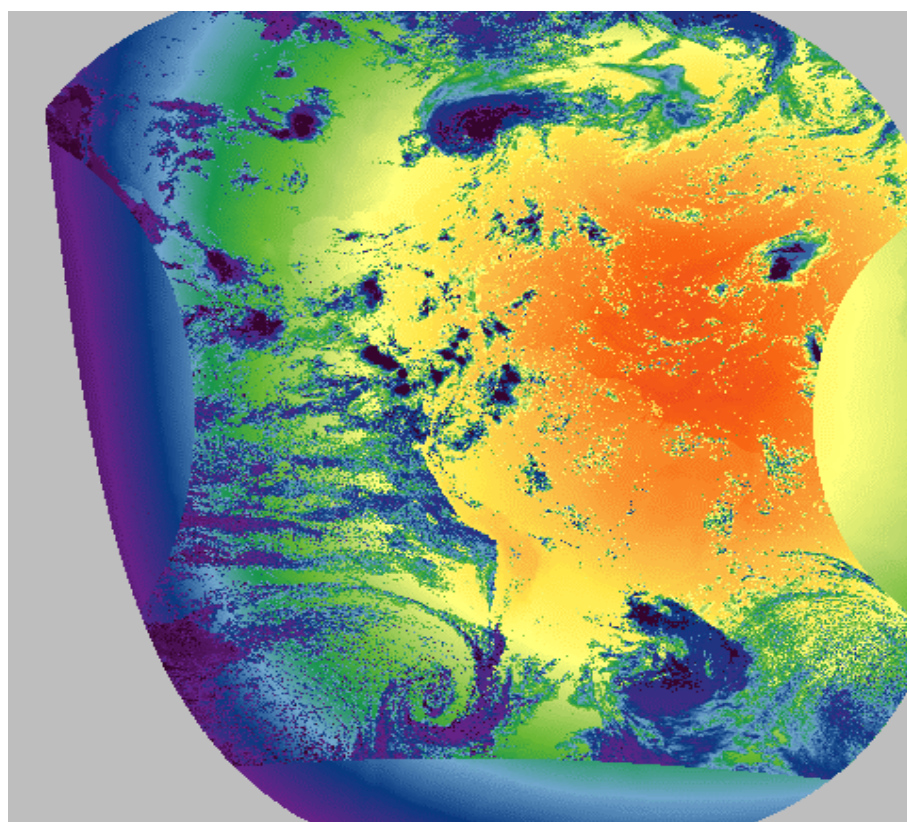
night

$$C = \sum (n_i C_i)$$

n_i : fractional sky cover of cloud type i

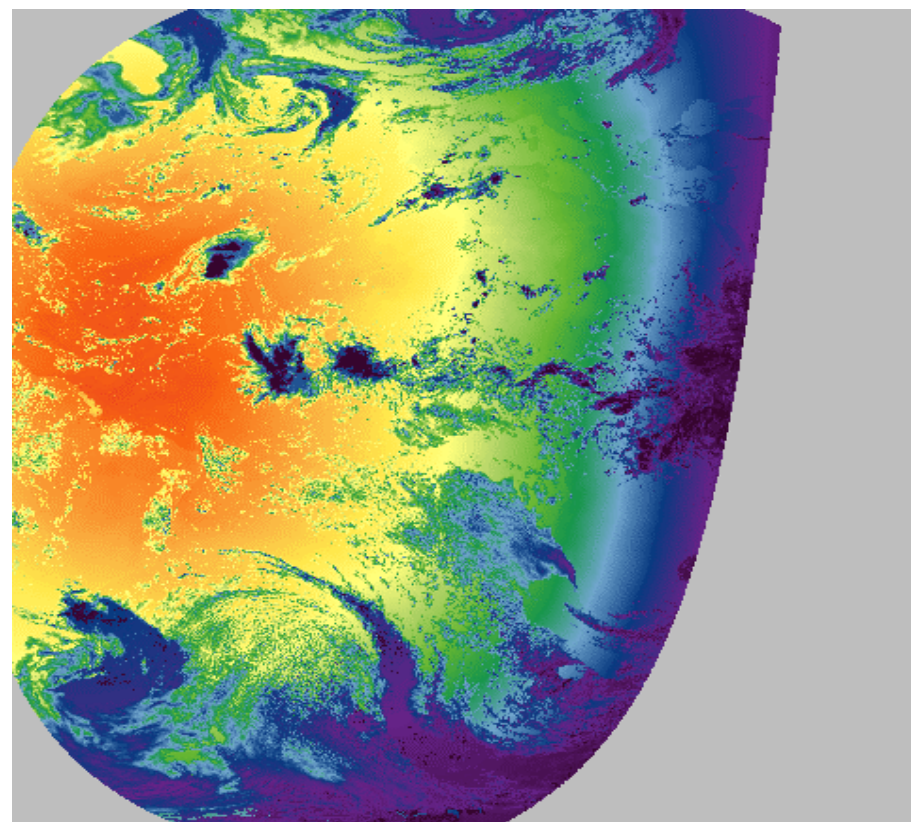
C_i empirical coefficients

Hourly SSI products



SSI hflr_goes13_20110828_150000.nc

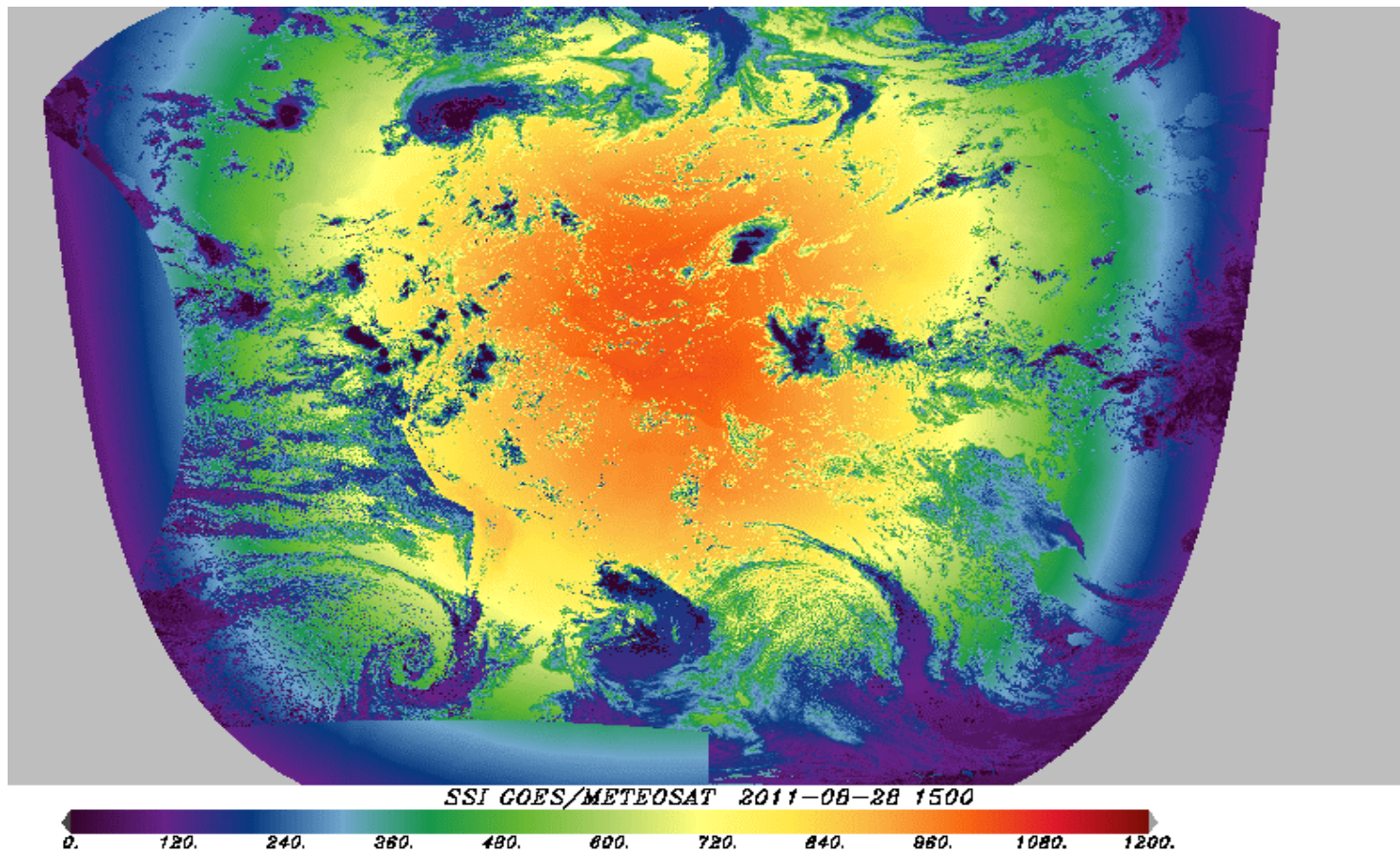
0. 120. 240. 360. 480. 600. 720. 840. 960. 1080. 1200.



SSI hflr_meteosat09_20110828_150000.nc

0. 120. 240. 360. 480. 600. 720. 840. 960. 1080. 1200.

GOES-E and METEOSAT product consistency

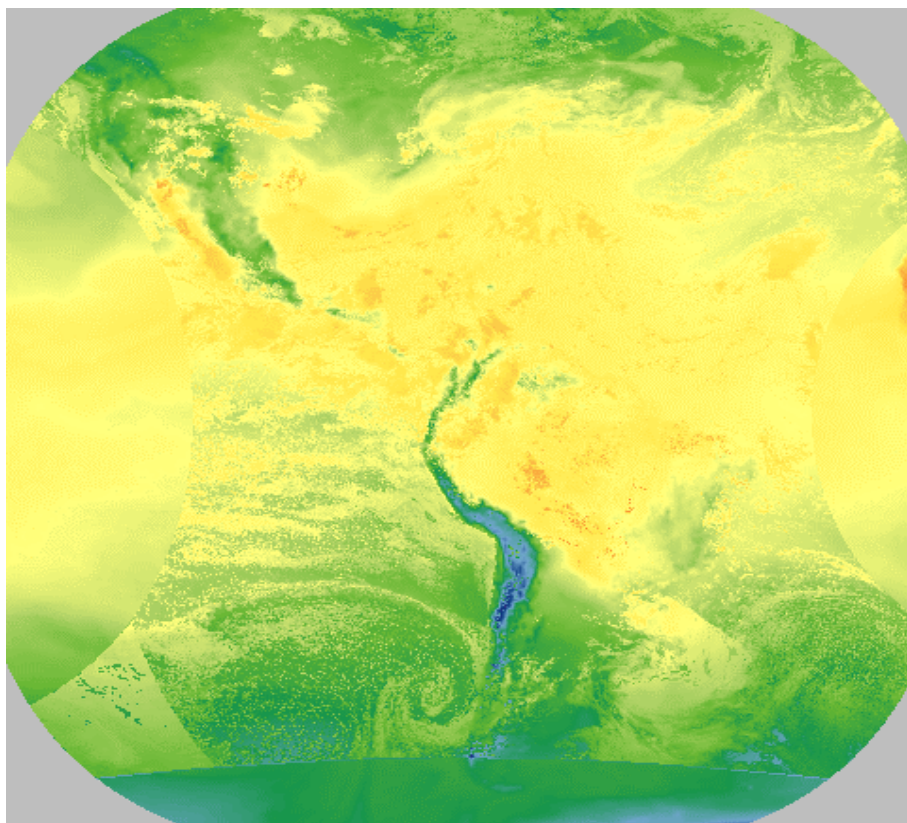


OSI-SAF radiative fluxes, EUMETRAIN 2011



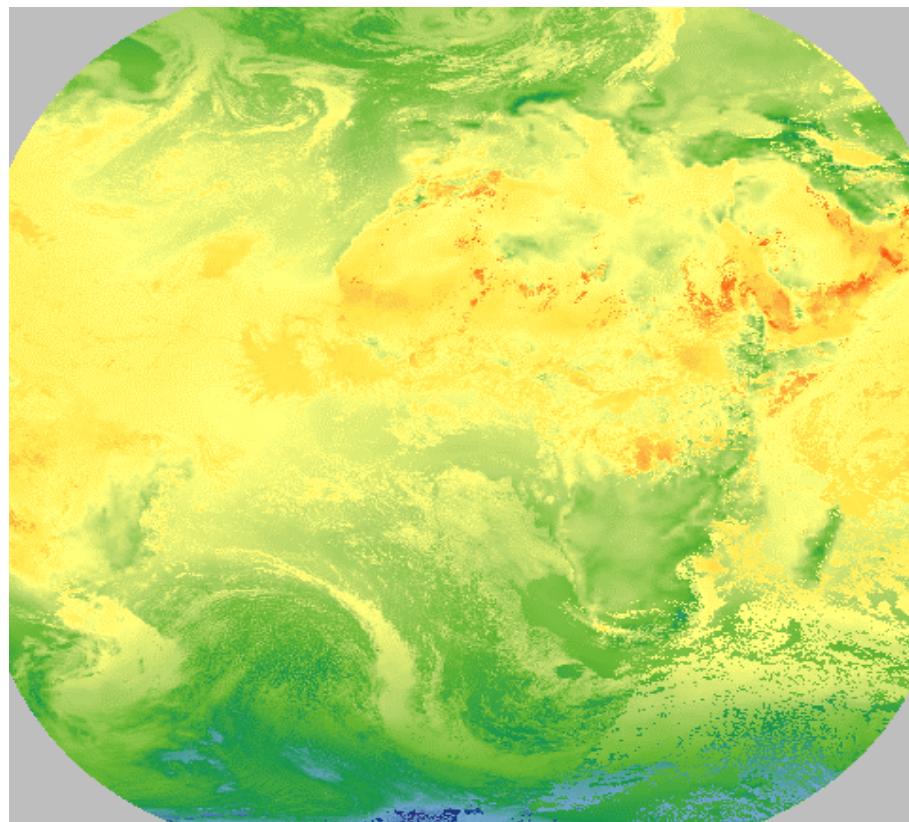
METEO FRANCE
Toujours un temps d'avance

Hourly DLI products



DLI hflr_goes13_20110828_150000.nc

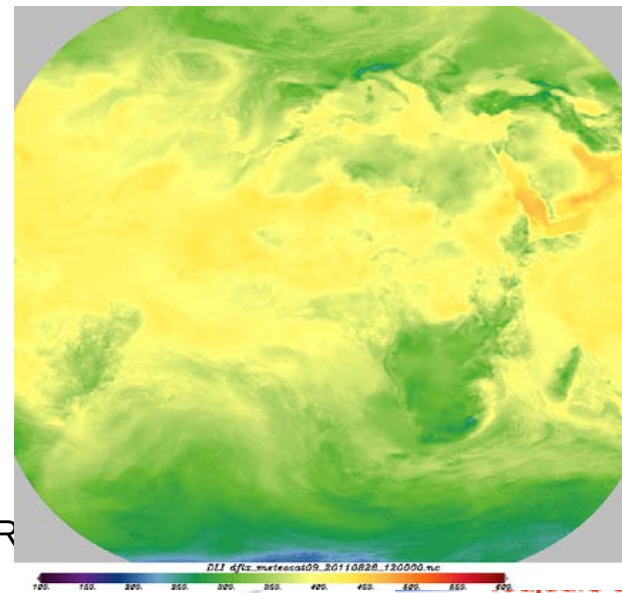
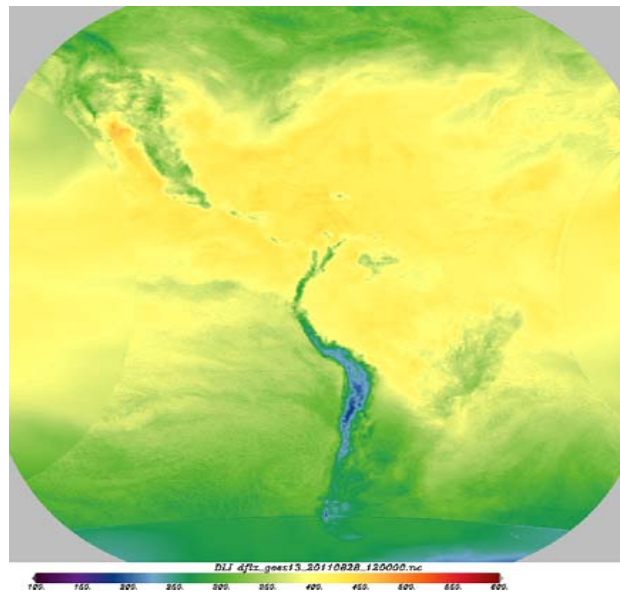
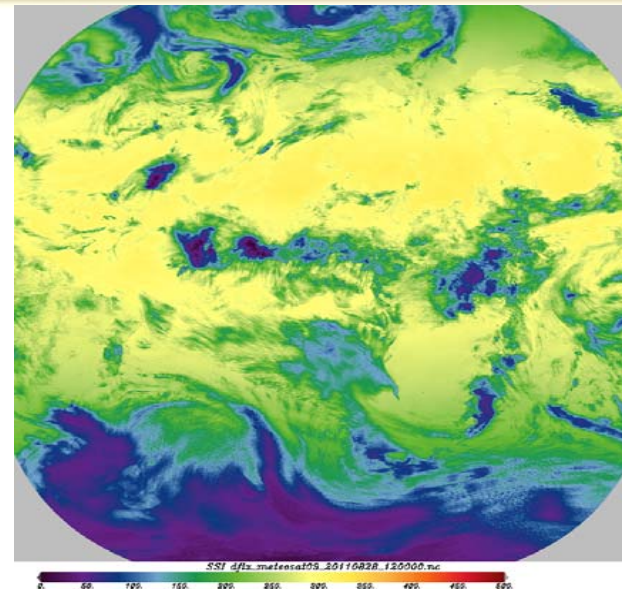
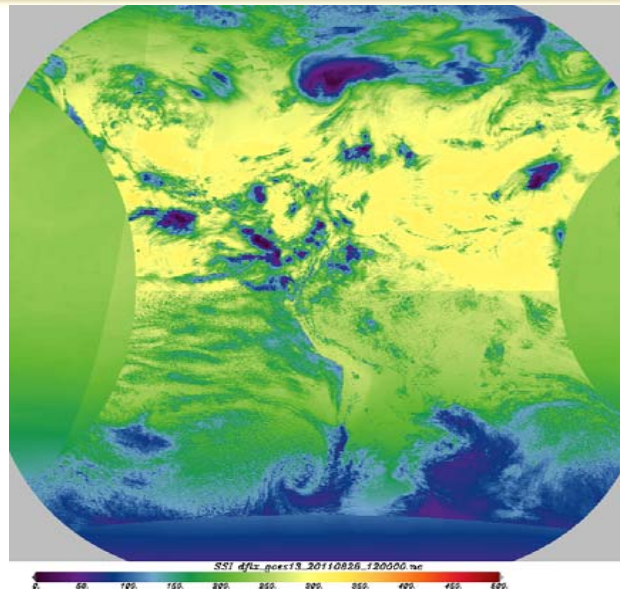
100. 150. 200. 250. 300. 350. 400. 450. 500. 550. 600.



DLI hflr_meteosat09_20110828_150000.nc

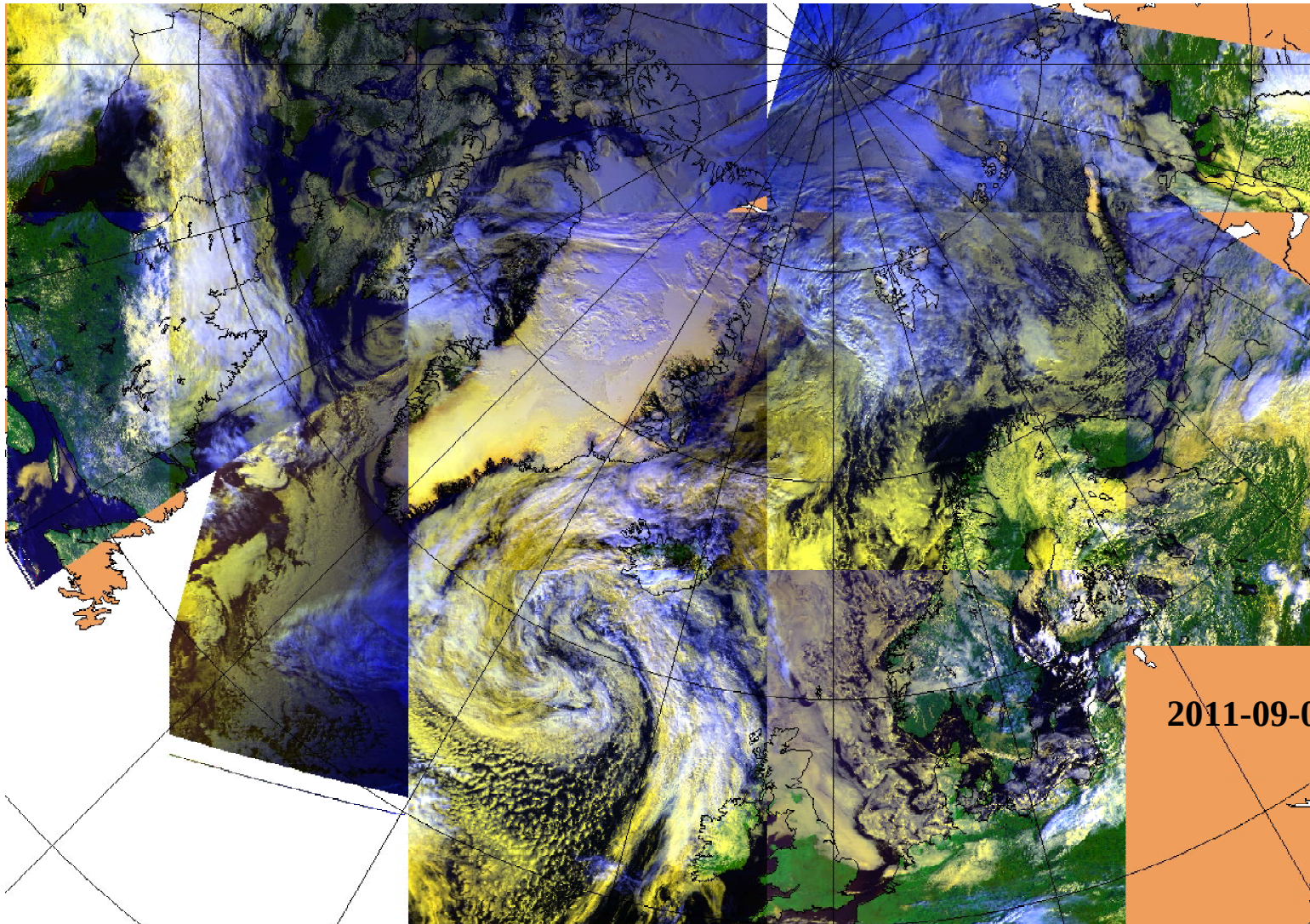
100. 150. 200. 250. 300. 350. 400. 450. 500. 550. 600.

Daily flux products



METR

New High latitude radiative fluxes

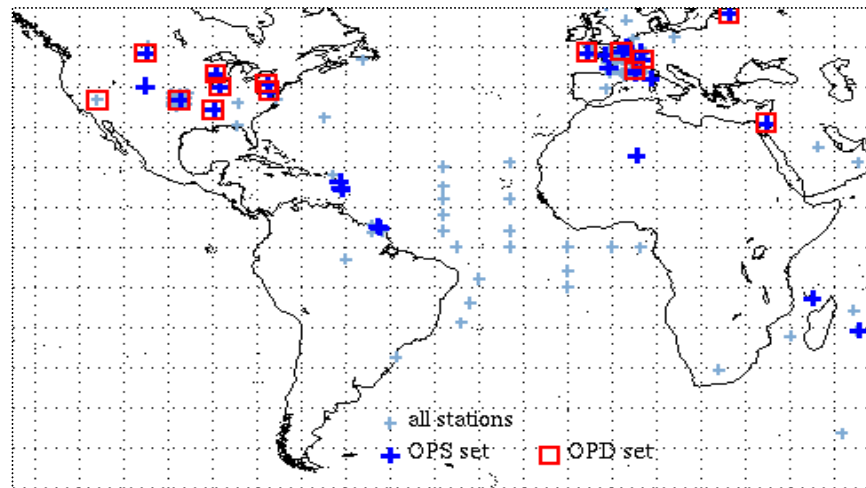


Radiative Flux products

- New chain (operational Since August/September 2011!)
 - Ingest satellite data every 30 minutes at full spatial resolution
 - Hourly flux product at rounded TU hour
 - No missing data (reduced quality level)
- High latitude products
 - 5 Km resolution, daily
 - Better coverage
- Geostationary Products
 - Netcdf and GRIB2
 - 0.05° resolution, hourly and daily
 - MSG SST: 60S-60N; 60 W- 60E
 - GOES-E SST: 60S-60N; 135W- 15W

Flux validation results: Error statistics (Aug 2010 – Jul 2011)

| | bias Wm^{-2} | bias % | stdev Wm^{-2} | stdev % |
|------------|-----------------------|--------|------------------------|---------|
| hourly SSI | 8.0 | 1.9 % | 83.6 | 20.2 % |
| daily SSI | 4.6 | 2.8 % | 20.0 | 11.9 % |
| hourly DLI | -4.9 | -1.6 % | 19.4 | 6.2 % |
| daily DLI | -4.9 | -1.6 % | 12.0 | 3.9 % |



OSI SAF radiative flux product availability

- September 2011: Availability of new OSI SAF products
- <ftp://eftp.ifremer.fr/cersat-rt/project/osi-saf/>
- Password requested; see <http://www.osi-saf.org>
- Soon available through EUMETCAST in GRIB2
- February 2012: end of « old » OSI-SAF geostationary products

THE END

More information

- See <http://www.osi-saf.org>
- *Geostationary radiative flux Product User Manual*
- *User Manual for the Atlantic High Latitude Radiative Fluxes OSI-301 OSI-302*
- Anne.marsouin@meteo.fr or
- Oystein Godoy steingod@met.no