

IASI Level 2 version 6

Thomas August,
T. Hultberg, M. Crapeau,
X. Calbet



- ✓ PPFv5 operational since 14/09/2010
- ✓ Significant improvements: Atmosph. Temperature (precision < 1K)
 - Land Surface Temperature
 - Cloud products
 - O₃ and CO total columns
- ✓ Introduced some cloudy retrievals following user request

Areas of development:

- Improve & characterise further T and WV in the bottom layers
- Include full retrieval error characterisation (→ averaging kernels)
- Improve cloudy/overcast retrievals
- Increase the yield
- Evolve further the atmospheric composition products
- Simplify the processing flag collection, especially for cloud flags

Disseminated in near-real time

TWT	Temperature (vertical profiles) Humidity (vertical profiles) Surface Temperature (Land & Sea)	+ Averaging Kernels
EMS	Surface emissivity	
CLD	Cloud detection, cloud fraction & top height	
OZO	O ₃ profiles + Averaging Kernels	
TRG	CO, N ₂ O, CH ₄ , CO ₂ Total columns CO profiles + AK, (SO ₂ , HNO ₃)	

v6

Outline

- 1. The IASI L2 processor v6**
- 2. Initial assessment results**
- 3. Deployment plan**

- **Collocation of auxiliary microwave measurements: AMSU & MHS L1B**
- Collocation of ECMWF forecasts (for cloud test)
- Collocated AVHRR radiance analyses and integrated cloud fraction
- Land/Sea mask (AAPP atlas)
- Land surface emissivity atlas (Borbas et al.)
- Digital Elevation Model (GTOPO30)
- **Principal Components Analyses → reconstructed radiances**

IASI L1C

NWP
AMSU/MHS
AVHRR

Conf. data
Static db



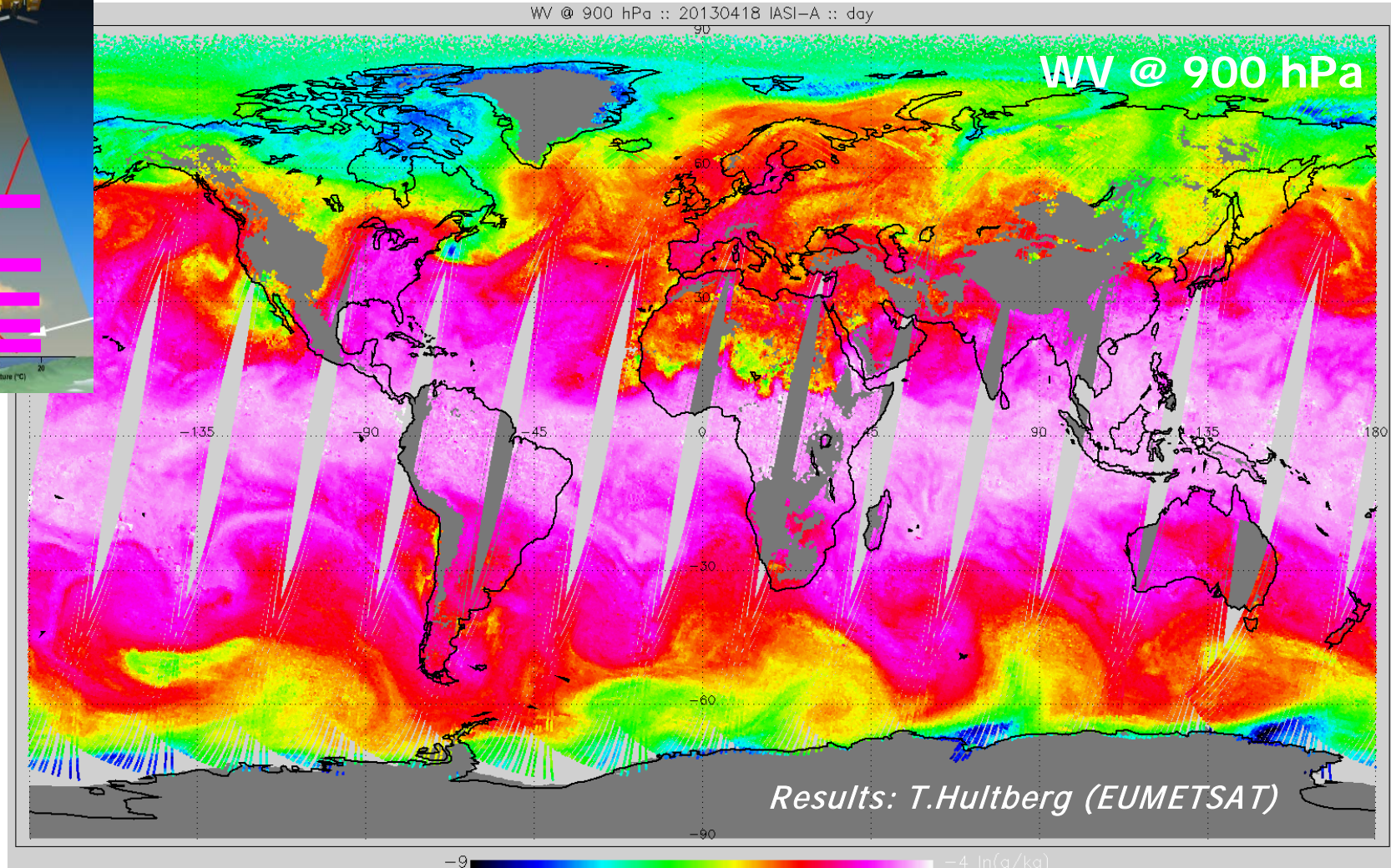
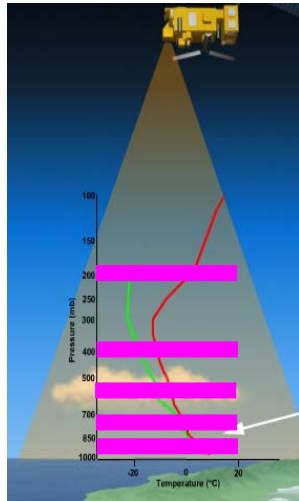
Principle: Joint **MW+IR** piece-wise linear regression (**PWLR**) retrieval with different coefficients for different classes of observations to account for non-linearity between the observations and the atmospheric state vector.

- **Predictors:** **AMSU, MHS** and **IASI** measurements, satellite zenith angle, surface elevation
- **Outputs:** Ts, **profiles of T, WV & O₃**, Ps + **Quality indicator**
- **Training set:** **Real observations** & co-located ECMWF analyses.
- **32 regression classes** based on MHS, AMSU and IASI radiances for sea, ice, low land and high land. No *ad hoc* latitude striping. This ensures good geographical continuity in the retrievals.

-
- ✓ **~All-sky retrievals**, completed with OEM(IASI) in clear IFOVs
 - ✓ The retrievals come at the **IASI single footprint resolution**

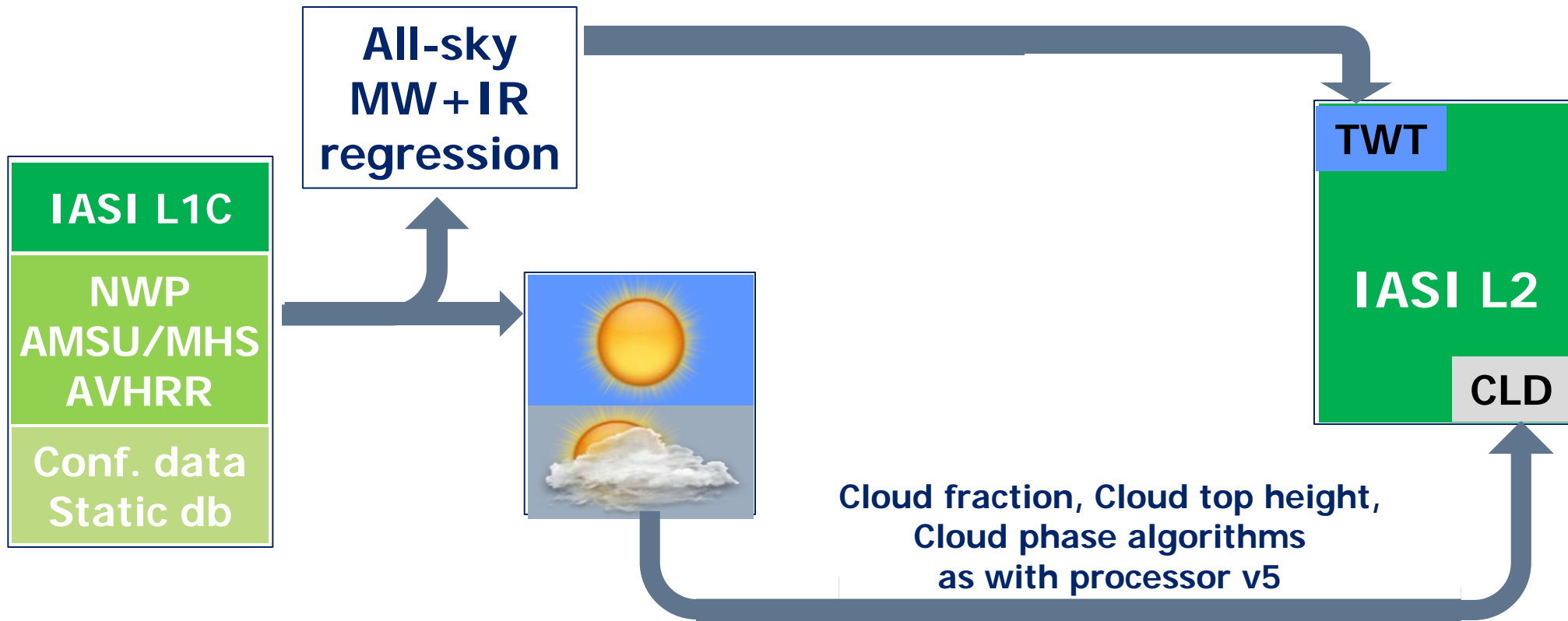
1. The IASI L2 processor v6

Joint MW+IR retrievals



1. The IASI L2 processor v6

The cloud product

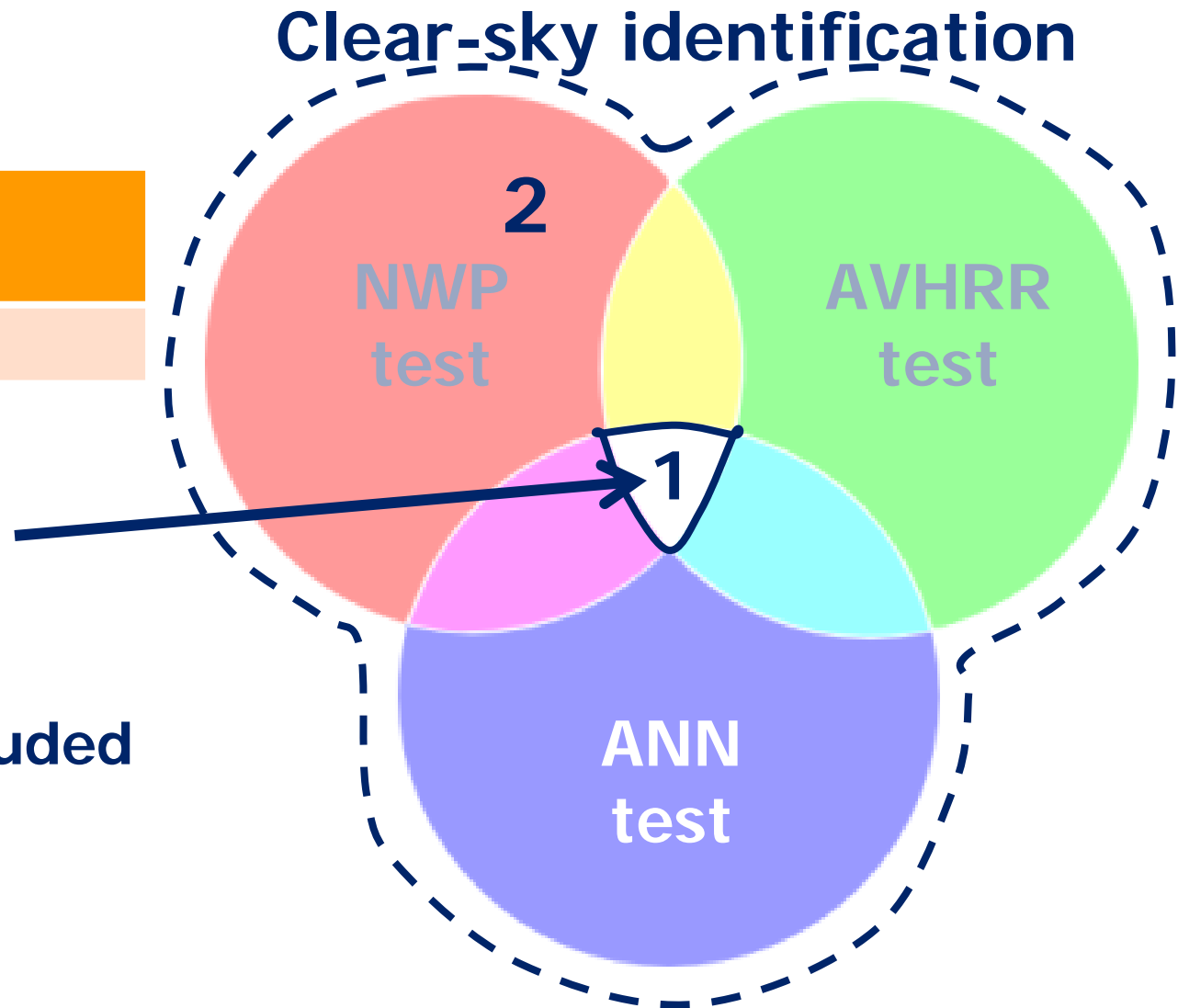


Cloudiness flag FLG_CLDNES	
1	Clear-sky

+ High confidence

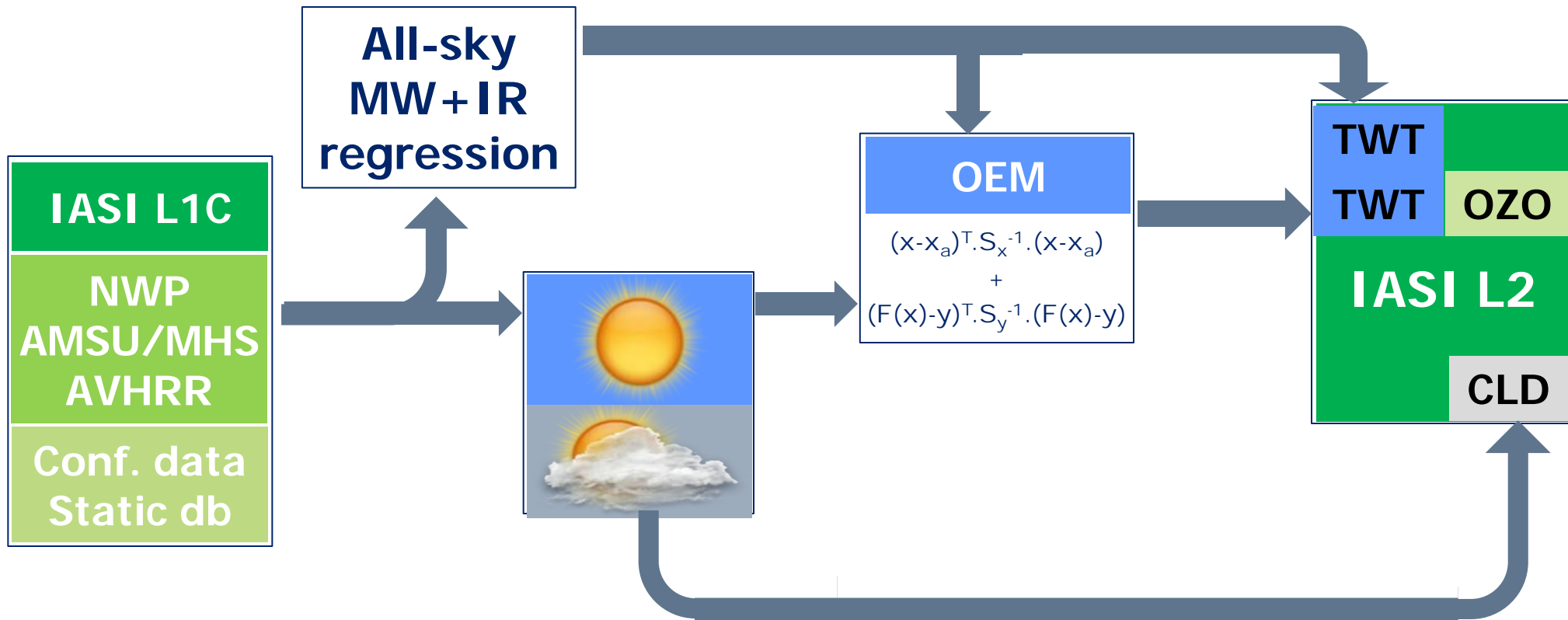
- Low yield

! Some areas are systematically excluded



1. The IASI L2 processor v6

New OEM configuration



- So far **clear-sky** and using **IASI measurements** only (FLG_CLDNES= 1,2)
- Retrieved parameters: **T, WV and O3 profiles, Ts**
- Atmospheric profiles represented in PCs (as in v5) for the cost minimisation
- Identified **common directions** in the PC space and forward model **radiances** with these eigenvectors (*3rd IASI workshop on PC for retrieval, Vienna 2013; NWP-SAF*)
- **New channel selection** for band 1 and 2 (*ITSC-18 2012*)
- **Variable radiance** using the scan angle as predictor
- **Variable a priori** from the atmospheric climatology mapped by the MW (AMSU/MHS) and IR (IASI) data
- Much **faster 1D-Var**, 1 or 2 pure Newton iterations only
- **Full retrieval error covariance matrix** and *a priori* stored (compressed) in the products; allowing the post-computation of the **averaging kernels**.

**See Poster 8p.01
Tim Hultberg**

**See Poster 5p.02
Dan Zhou**

IASI L1C
NWP
AMSU/MHS
AVHRR
Conf. data
Static db

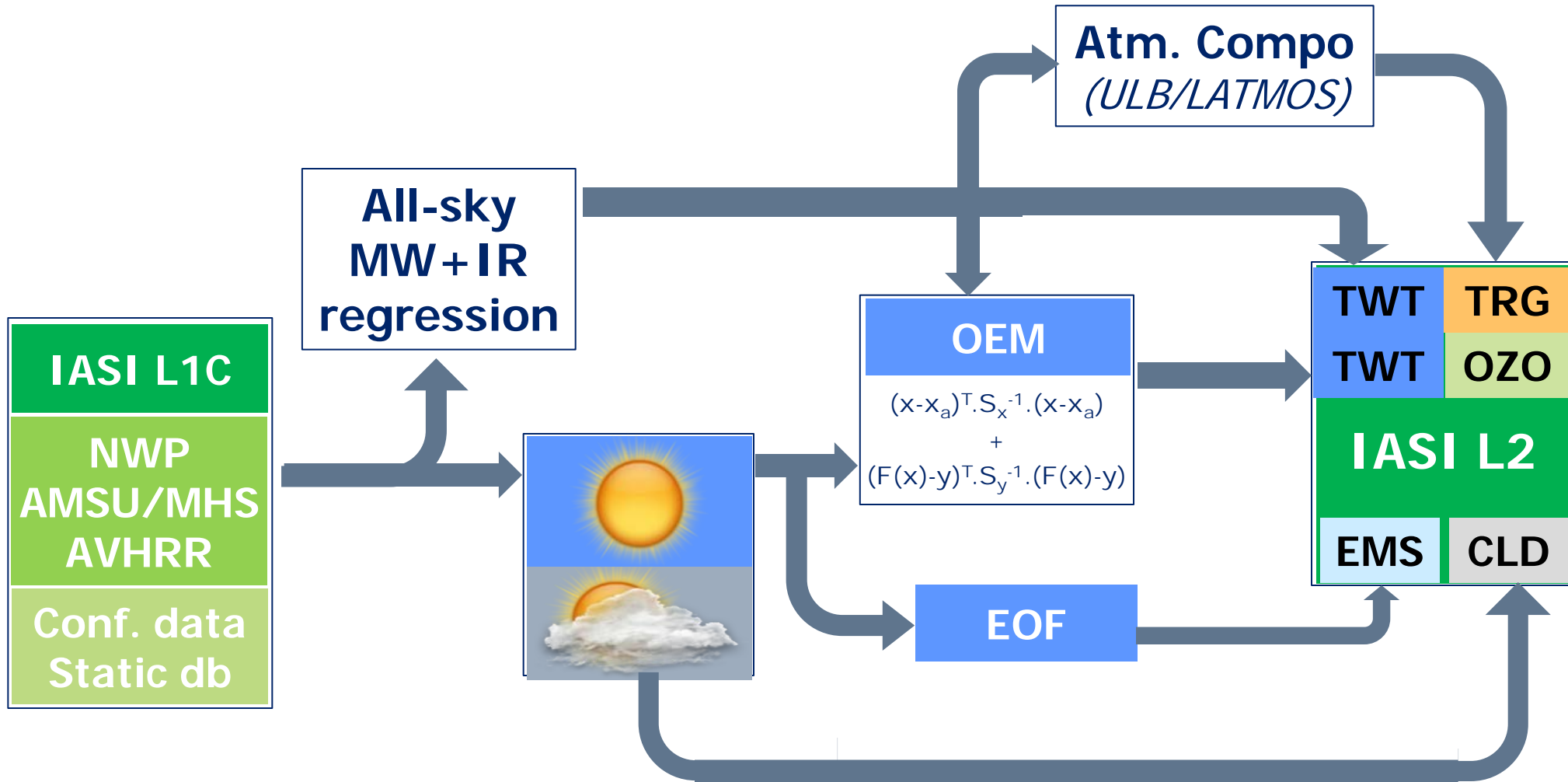
Land surface emissivity
same regression retrieval algorithm as in v5,
coefficients upgraded with D. Zhou (NASA) in 2013.



EOF

TMT
OZO
IASI L2
EMS
CLD

1. The IASI L2 processor v6 Atmospheric Composition



1. The IASI L2 processor v6 Atmospheric Composition

O3M-SAF CDOP-2 (2012-2017)

Implementation in the EPS ground segment of a series of atmospheric composition products developed by ULB/LATMOS.

Algorithm: **FORLI** (Fast Optimal Retrievals on Layers for IASI, *Hurtmans et al., JQSRT 2012*)

➤ CO profiles + AK (2014)

Integration completed and verified

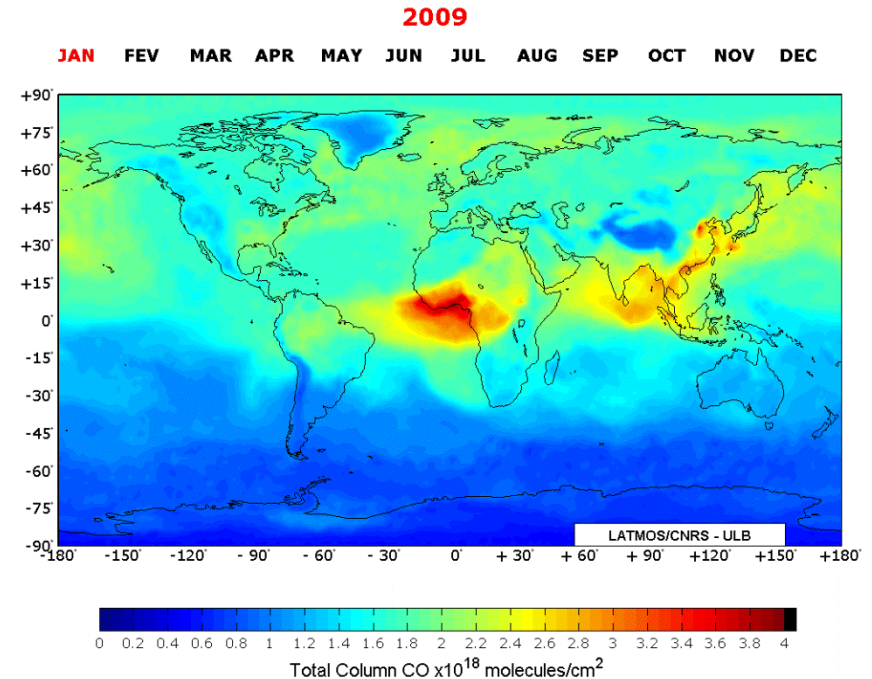
➤ SO₂ columns (2015)

➤ O₃ profiles + AK (2016)

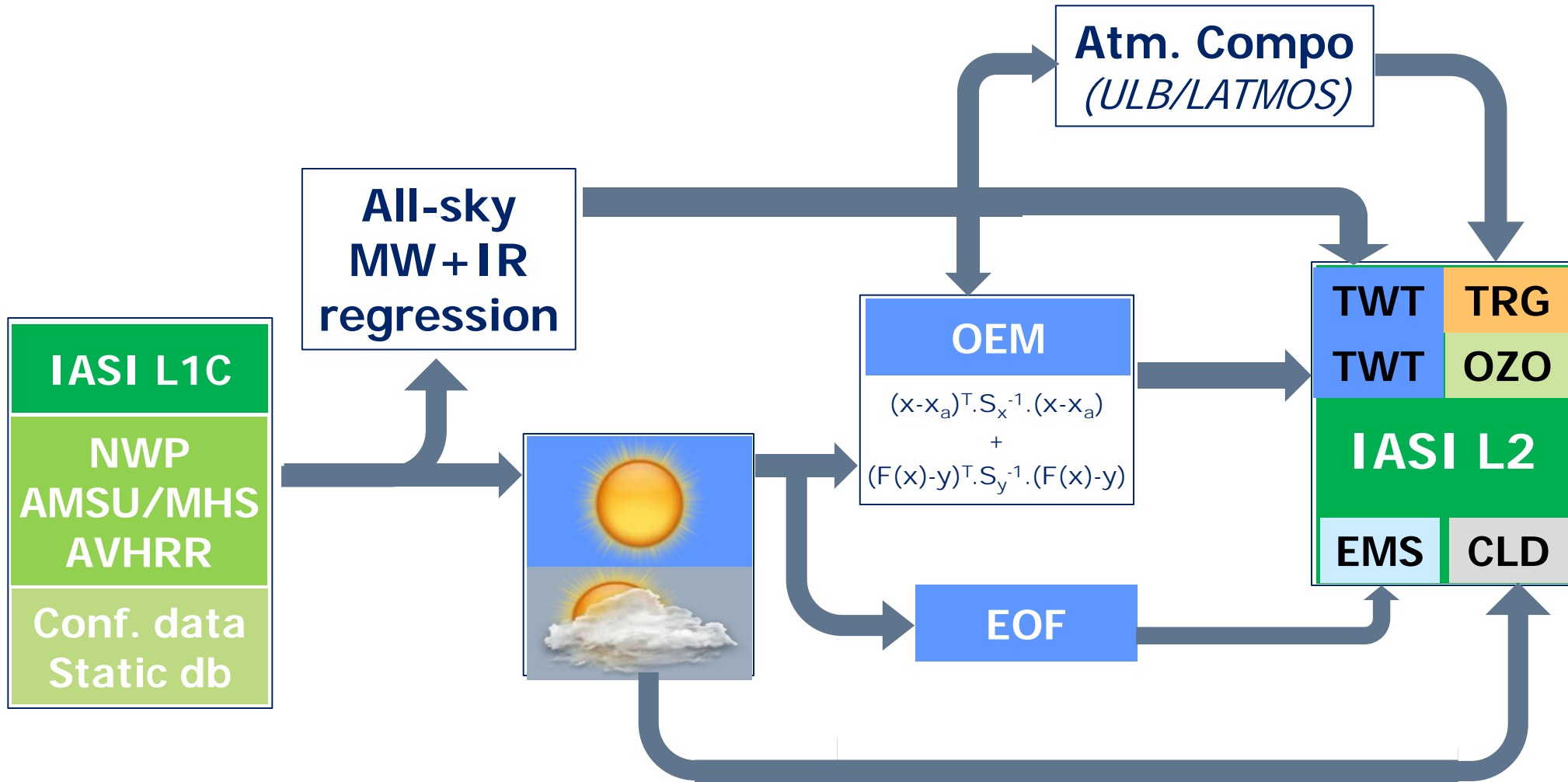
➤ HNO₃ profiles (2017)

Place-holders for SO₂, O₃ and HNO₃ have been prepared in the IASI L2 products.

Exchanges started about algorithm description for SO₂.



*Credits: ULB/LATMOS
Coheur, Clerbaux et al.*

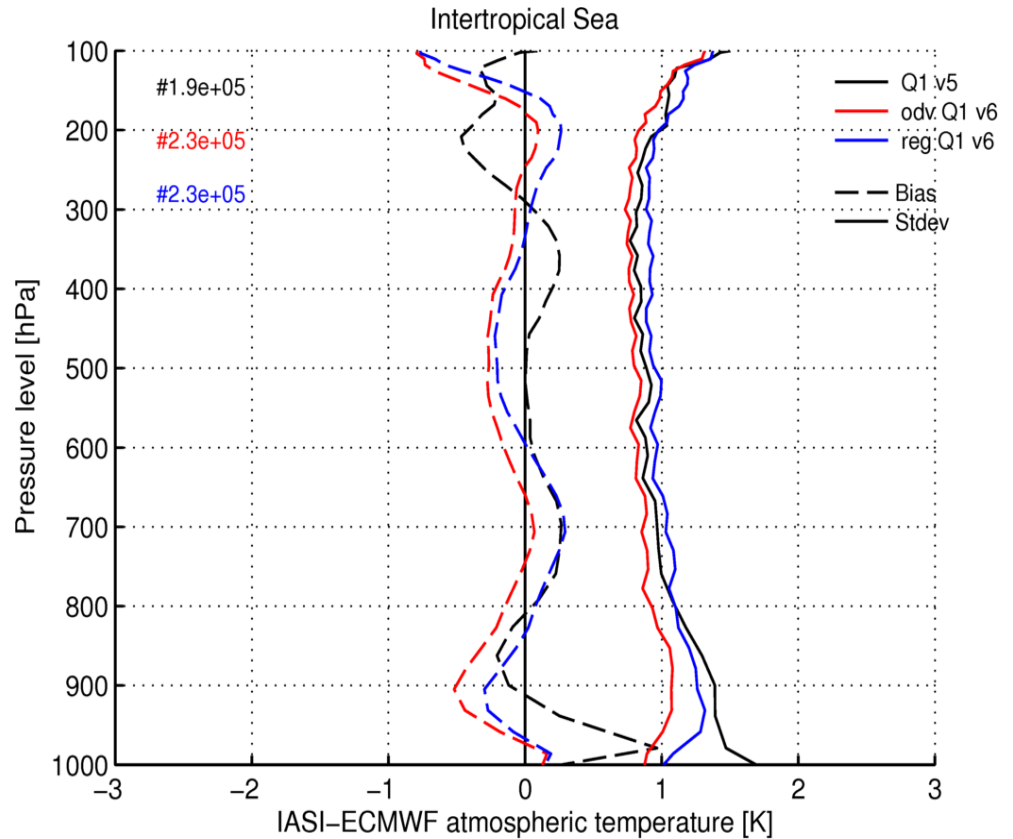
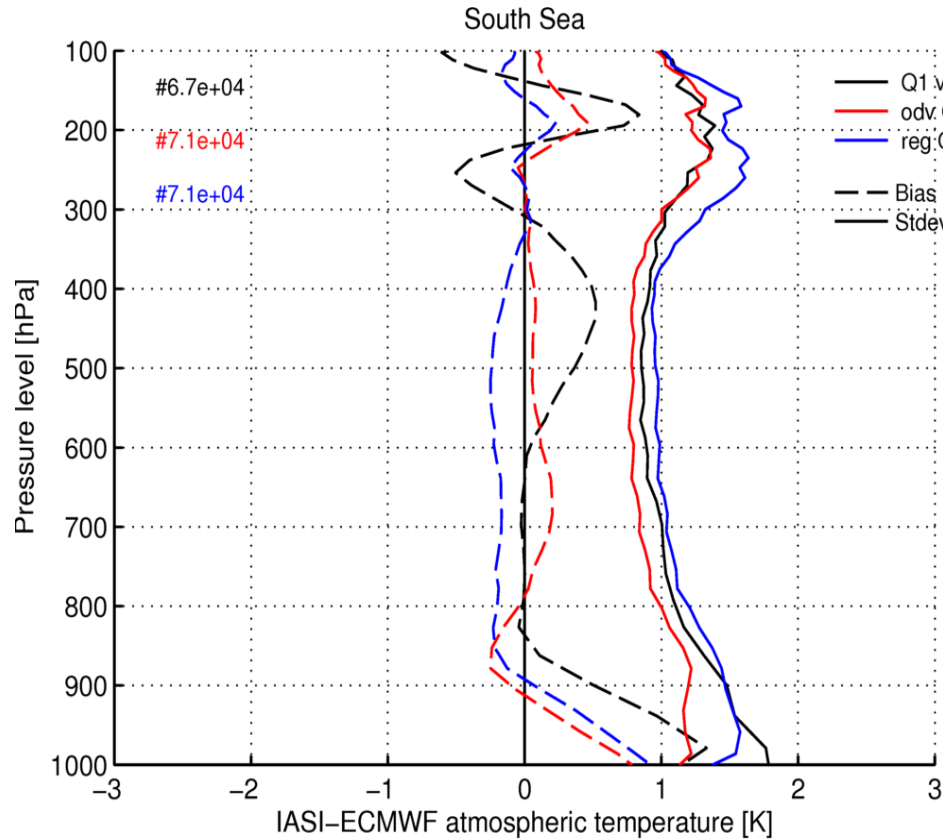


Outline

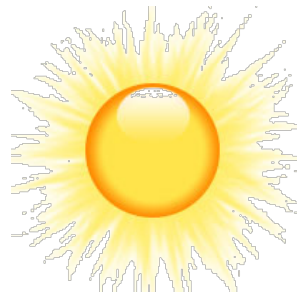
1. The IASI L2 processor v6
- 2. Initial assessment results**
3. Deployment plan

2. IASI L2 V6 initial assessment

Temp. profiles vs NWP

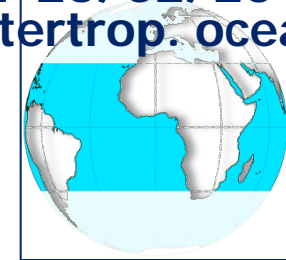


~~21-25/02/2014~~
Southern oceans



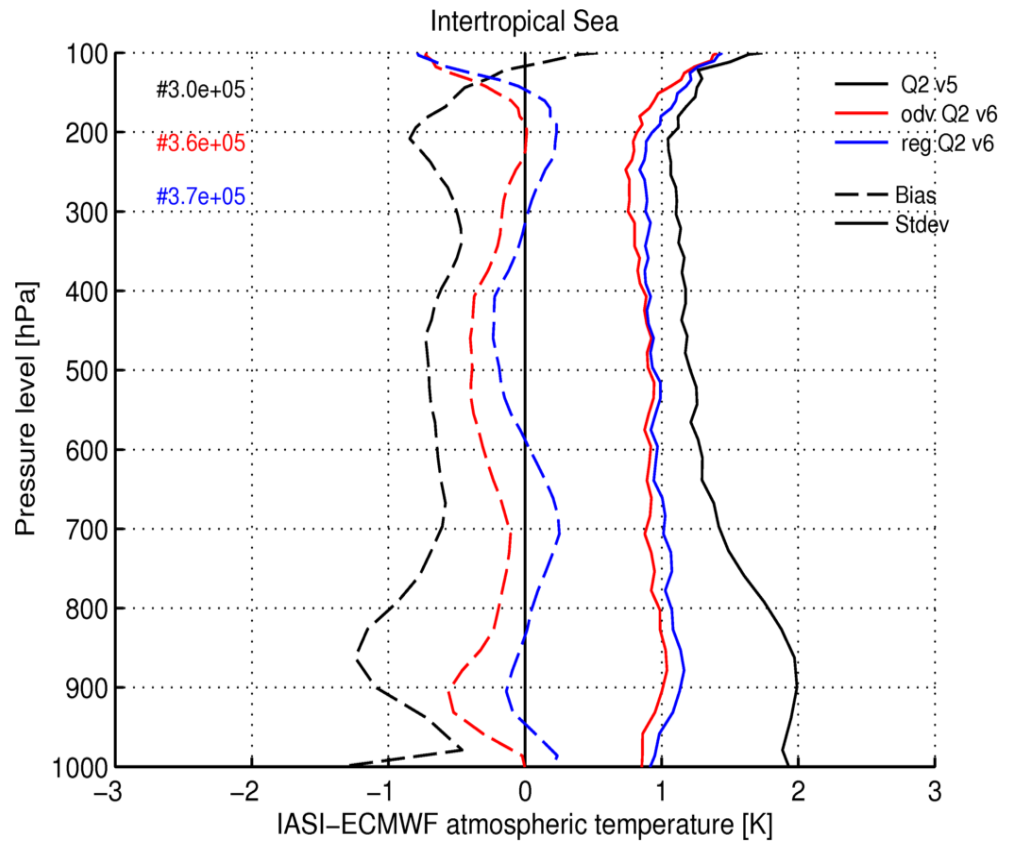
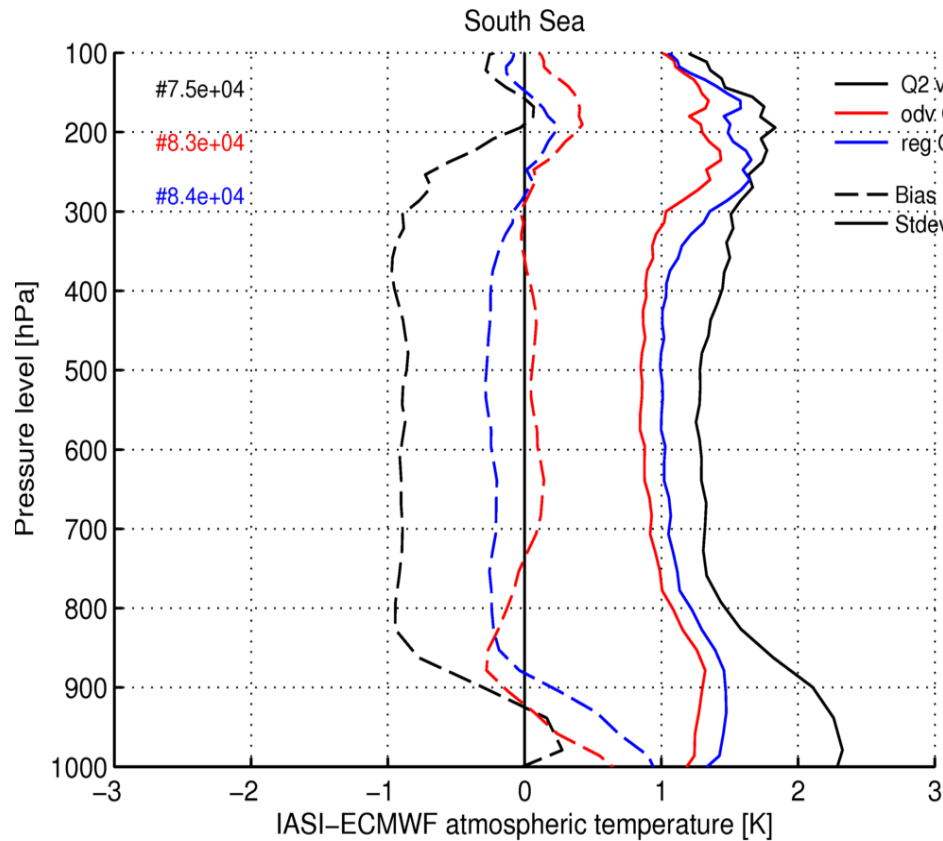
Q1 PPF v5
Q1 OEM v6
Q1 PWLR v6

~~21-25/02/2014~~
Intertrop. oceans

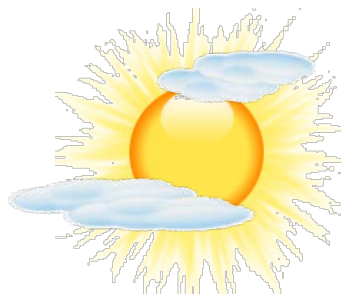


2. IASI L2 V6 initial assessment

Temp. profiles vs NWP

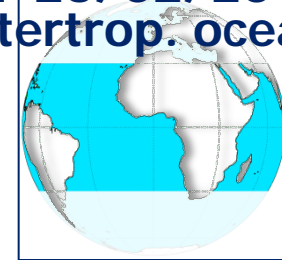


21-25/02/2014
Southern oceans



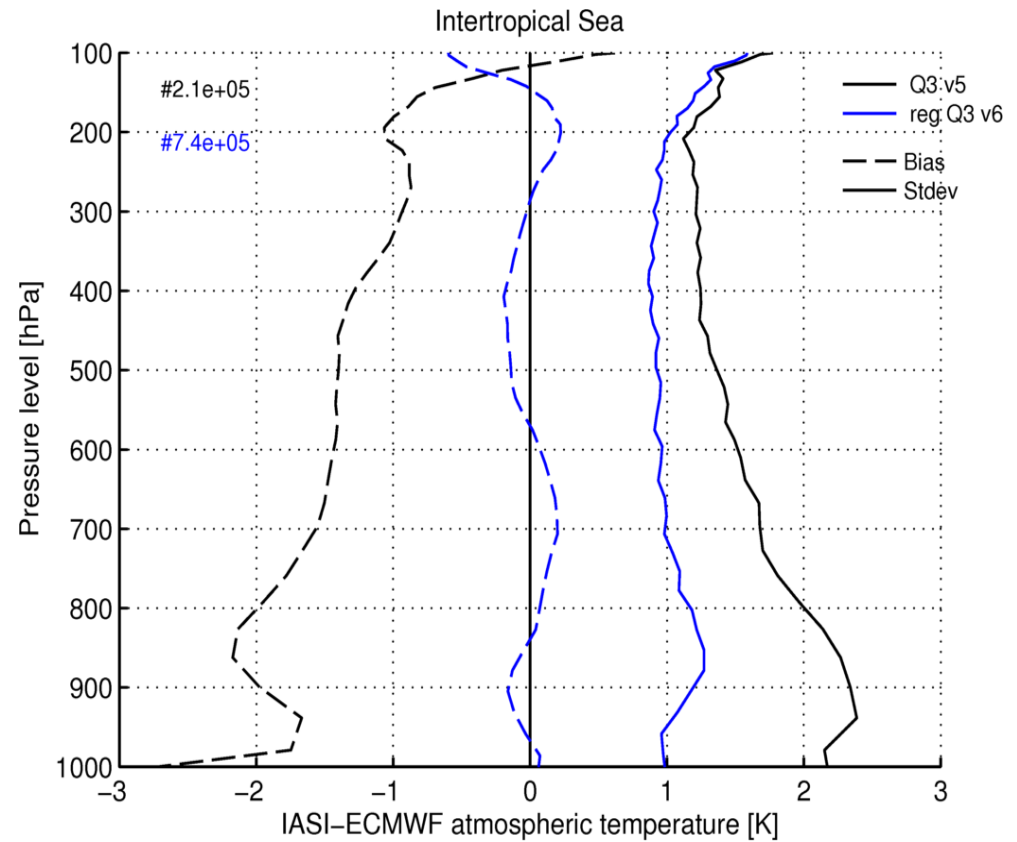
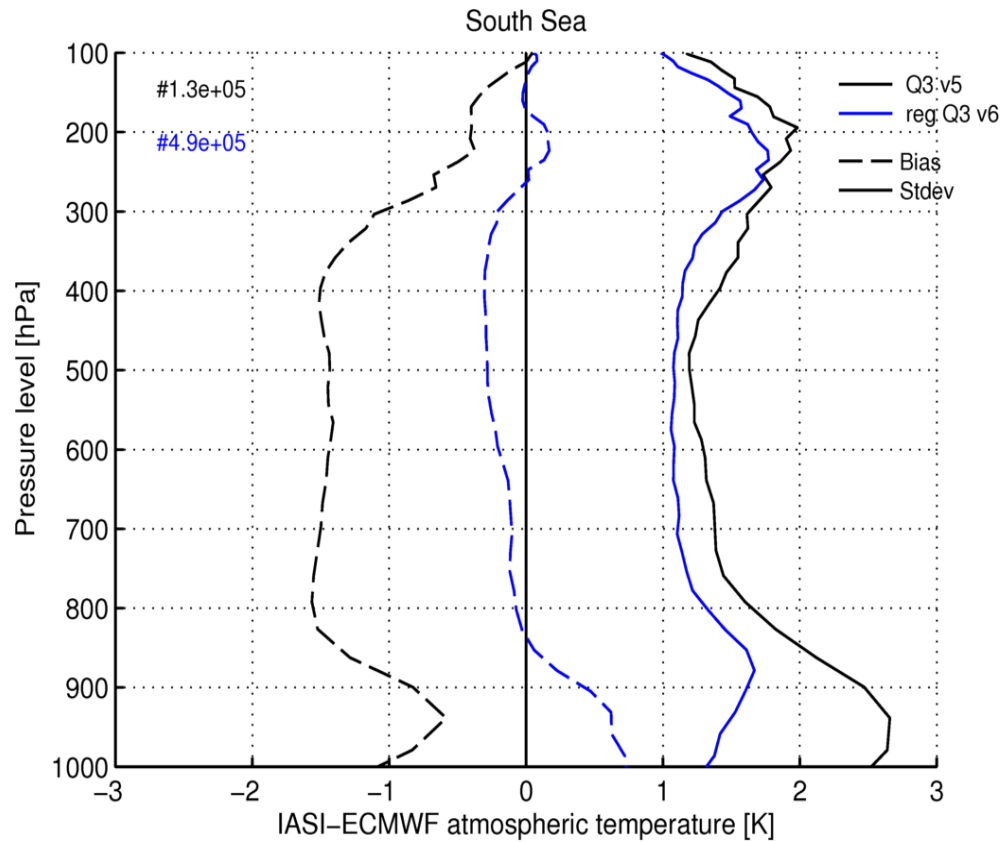
Q2 PPF v5
Q2 OEM v6
Q2 PWLR v6

21-25/02/2014
Intertrop. oceans

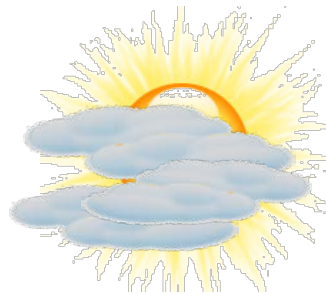


2. IASI L2 V6 initial assessment

Temp. profiles vs NWP



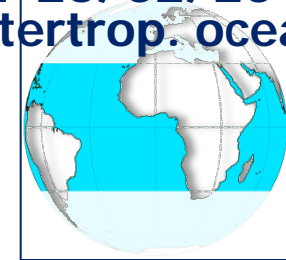
21-25/02/2014
Southern oceans



Q3 PPF v5

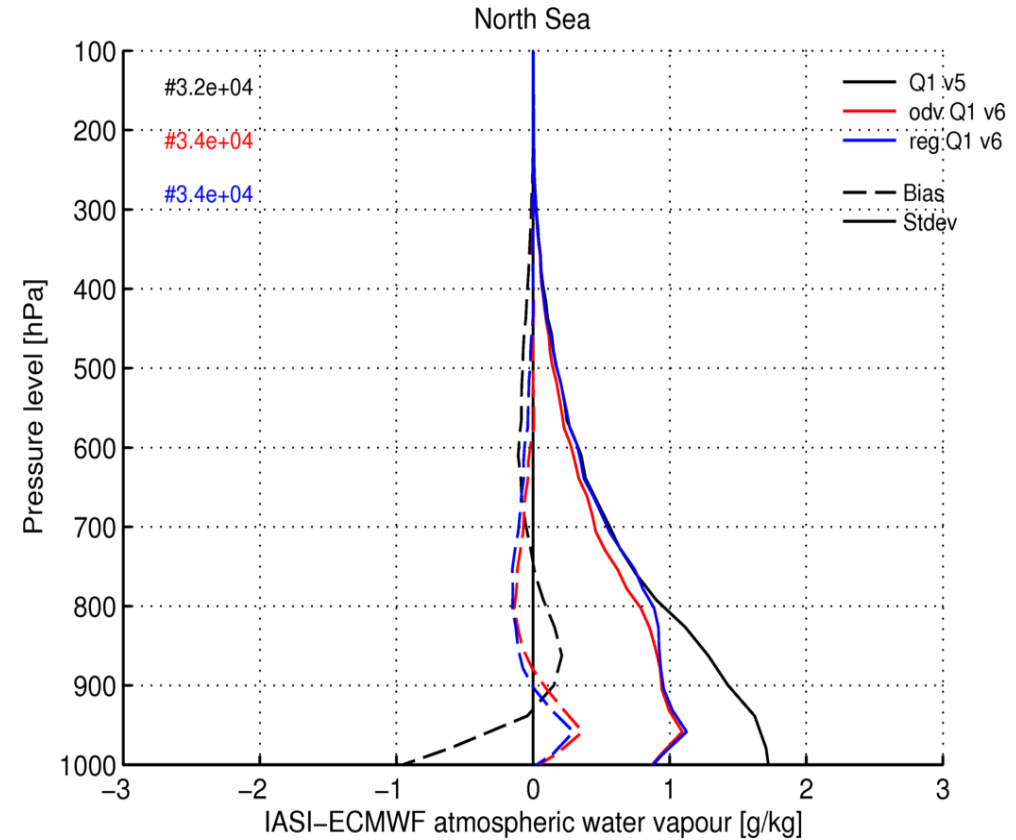
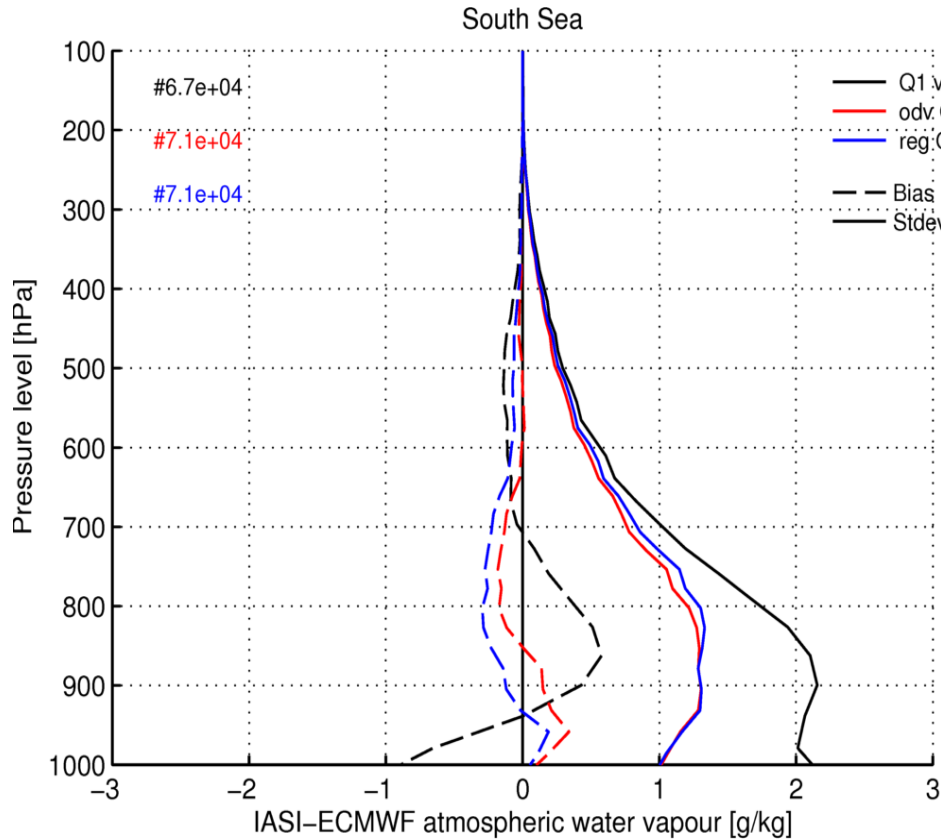
Q3 PWLR v6

21-25/02/2014
Intertrop. oceans

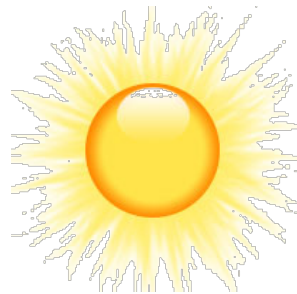


2. IASI L2 V6 initial assessment

Humidity profiles vs NWP



~~21-25/02/2014~~
Southern oceans



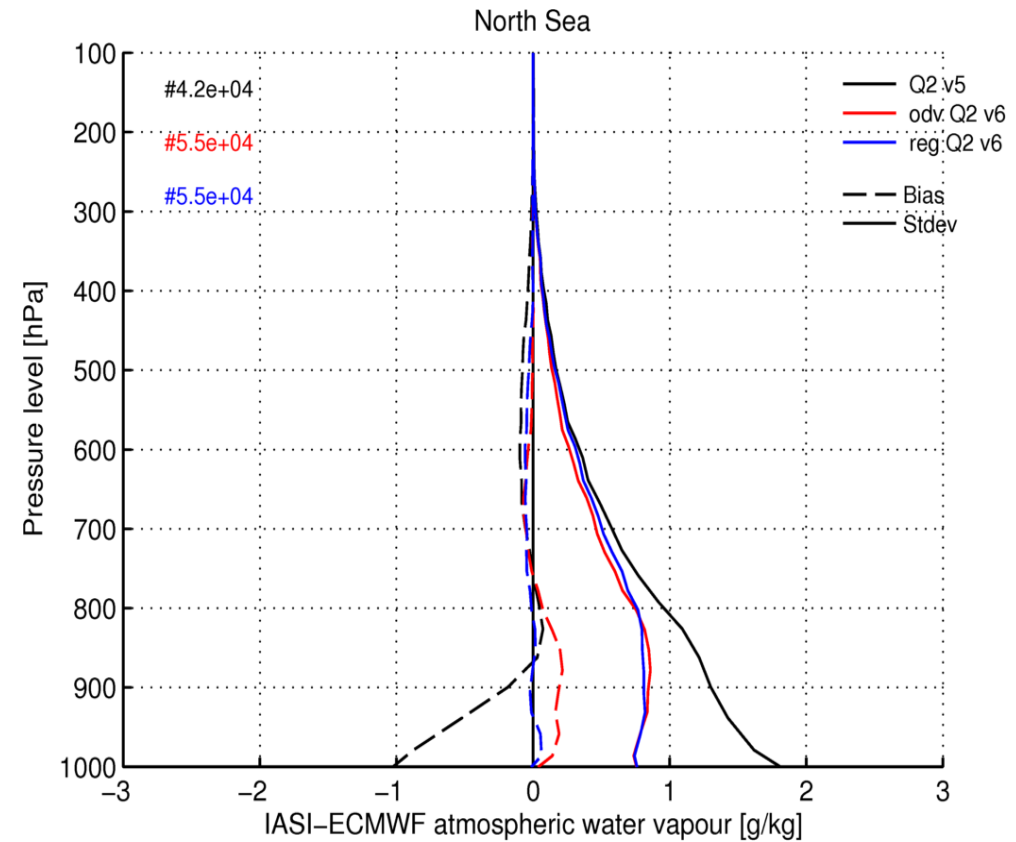
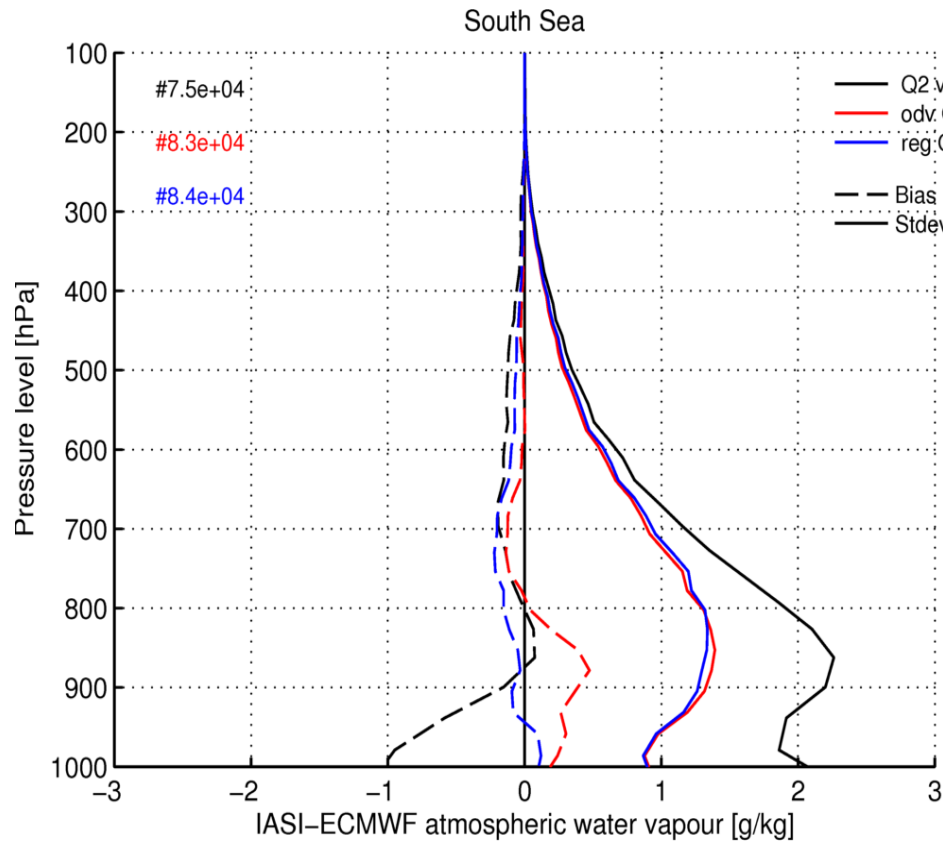
Q1 PPF v5
Q1 OEM v6
Q1 PWLR v6

21-25/02/2014
Northern oceans

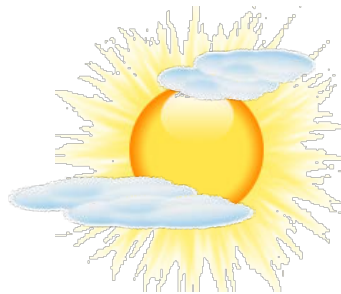


2. IASI L2 V6 initial assessment

Humidity profiles vs NWP



~~21-25/02/2014~~
Southern oceans



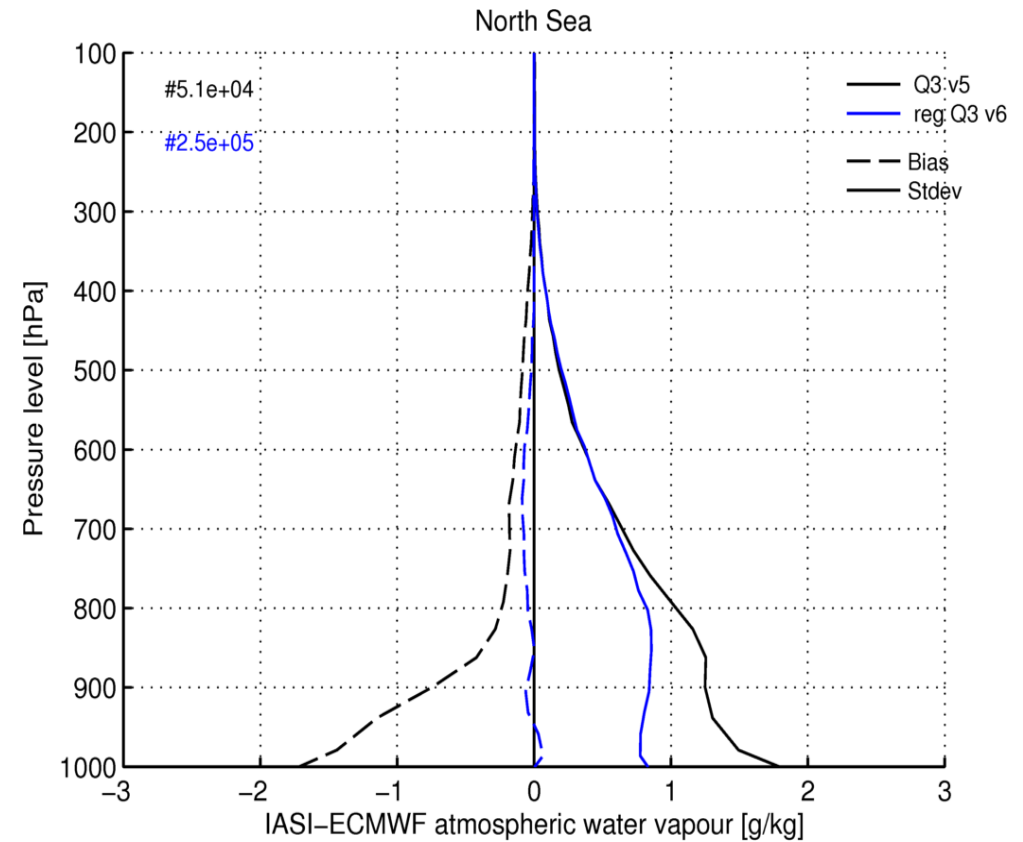
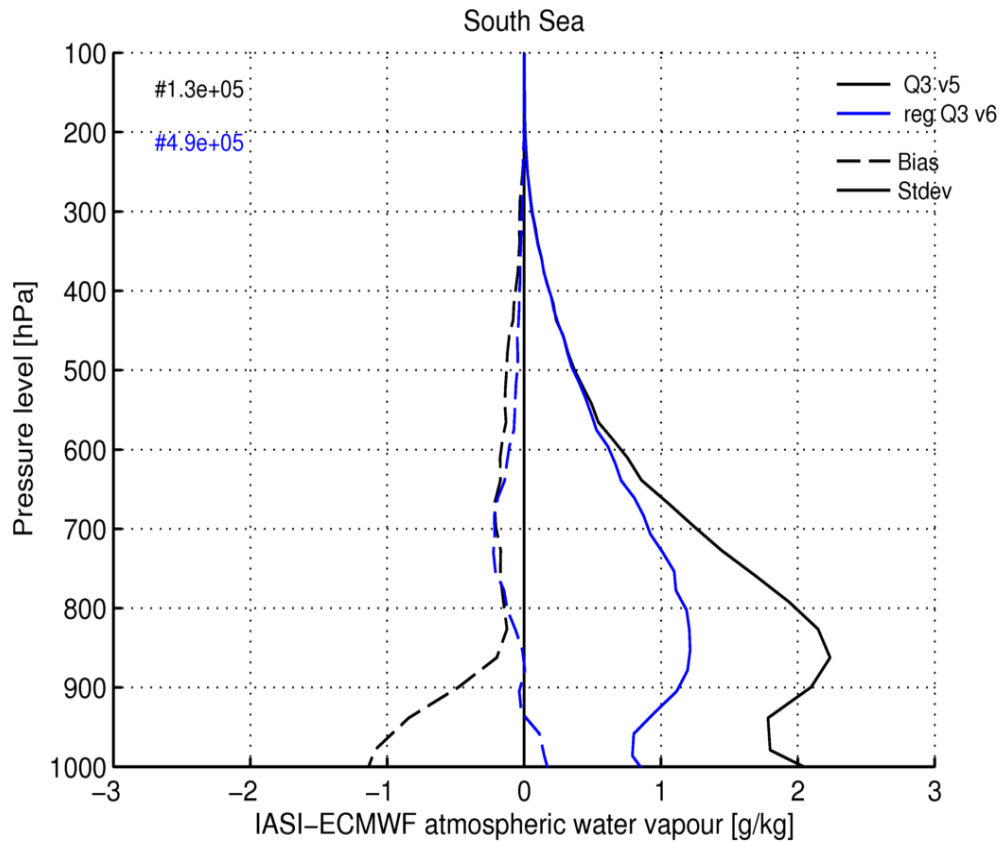
Q2 PPF v5
Q2 OEM v6
Q2 PWLR v6

21-25/02/2014
Northern oceans

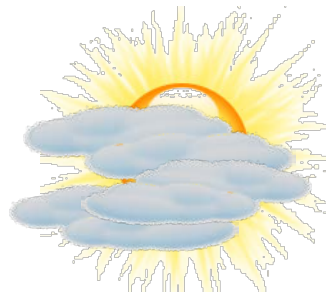


2. IASI L2 V6 initial assessment

Humidity profiles vs NWP



~~21-25/02/2014~~
Southern oceans



Q3 PPF v5

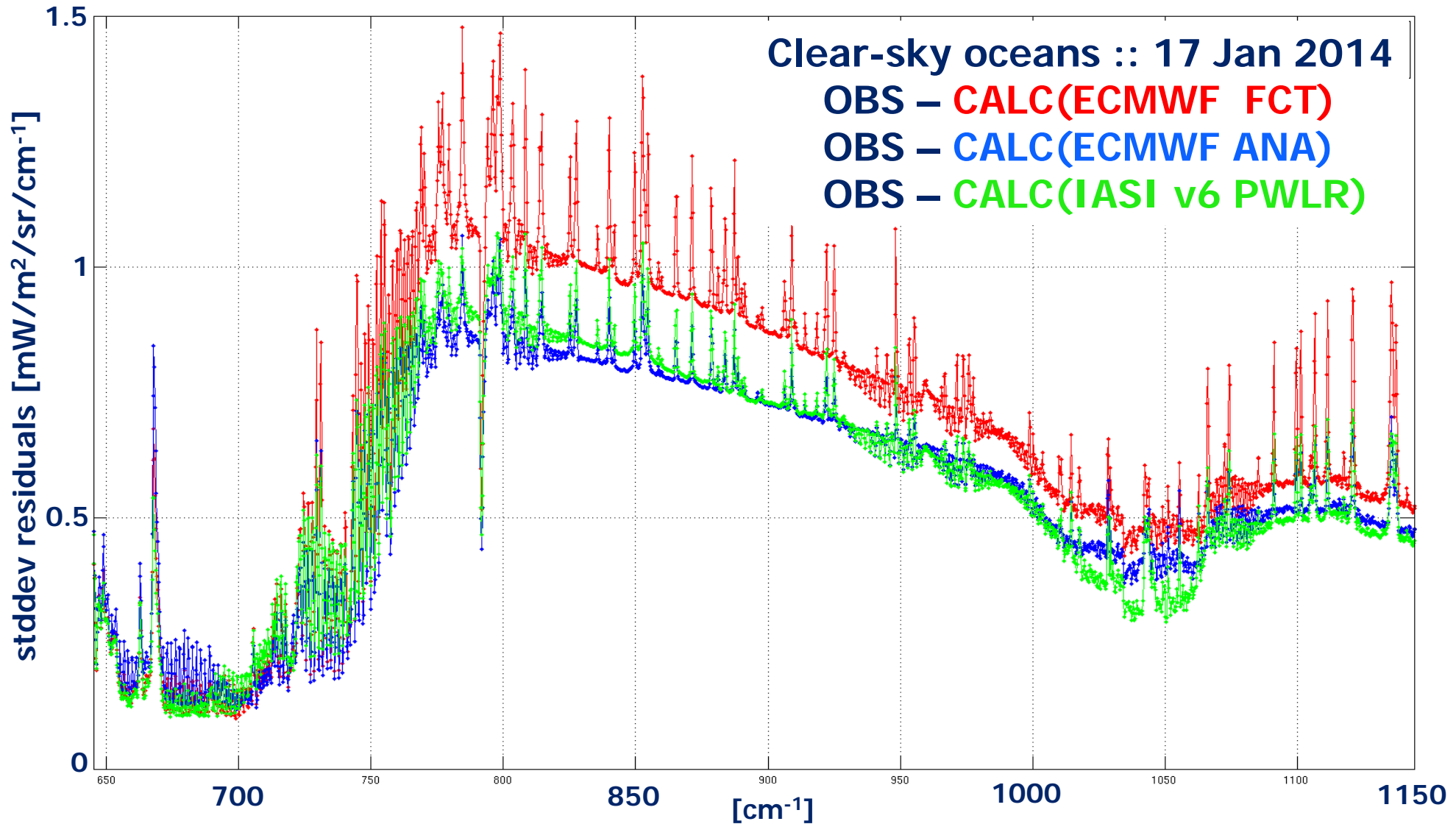
Q3 PWLR v6

21-25/02/2014
Northern oceans



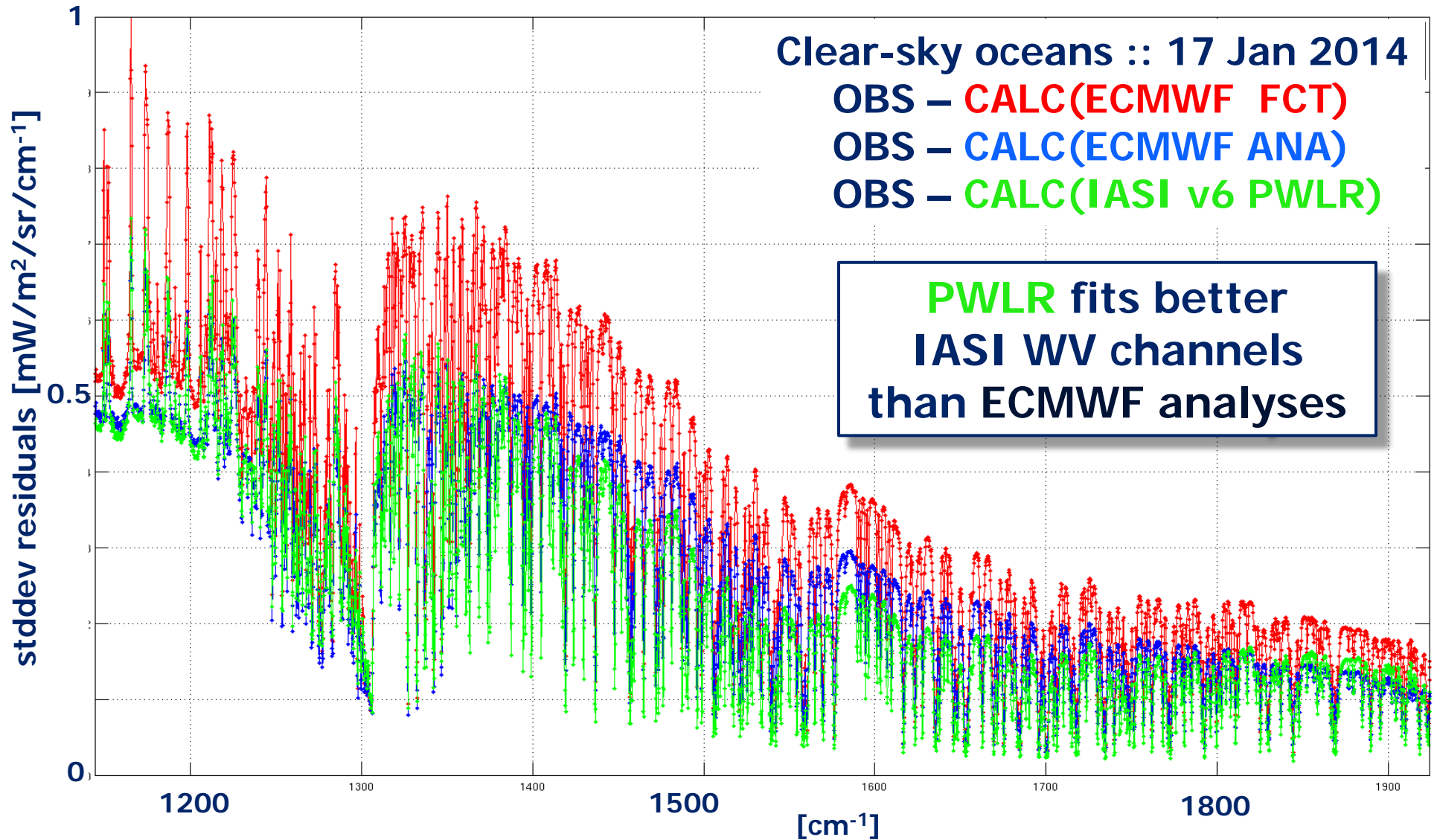
2. IASI L2 V6 initial assessment

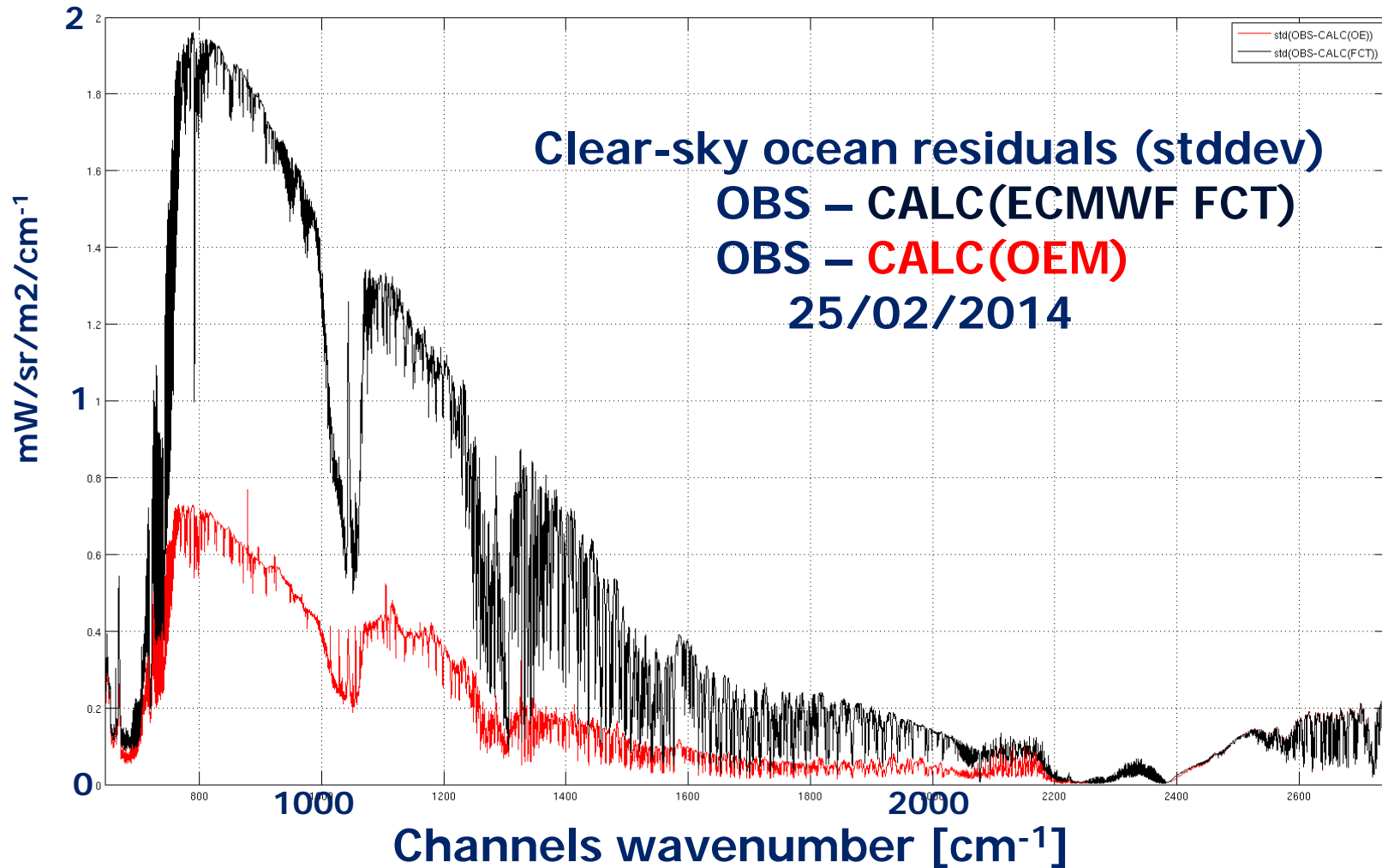
Radiance residuals



2. IASI L2 V6 initial assessment

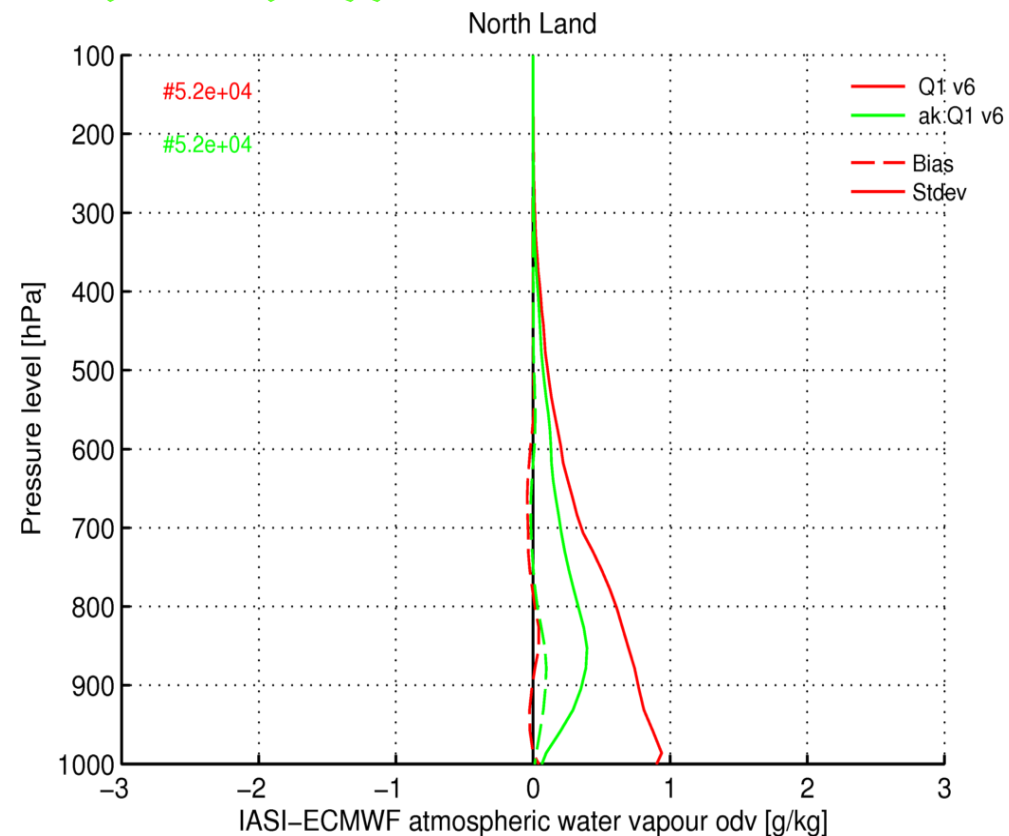
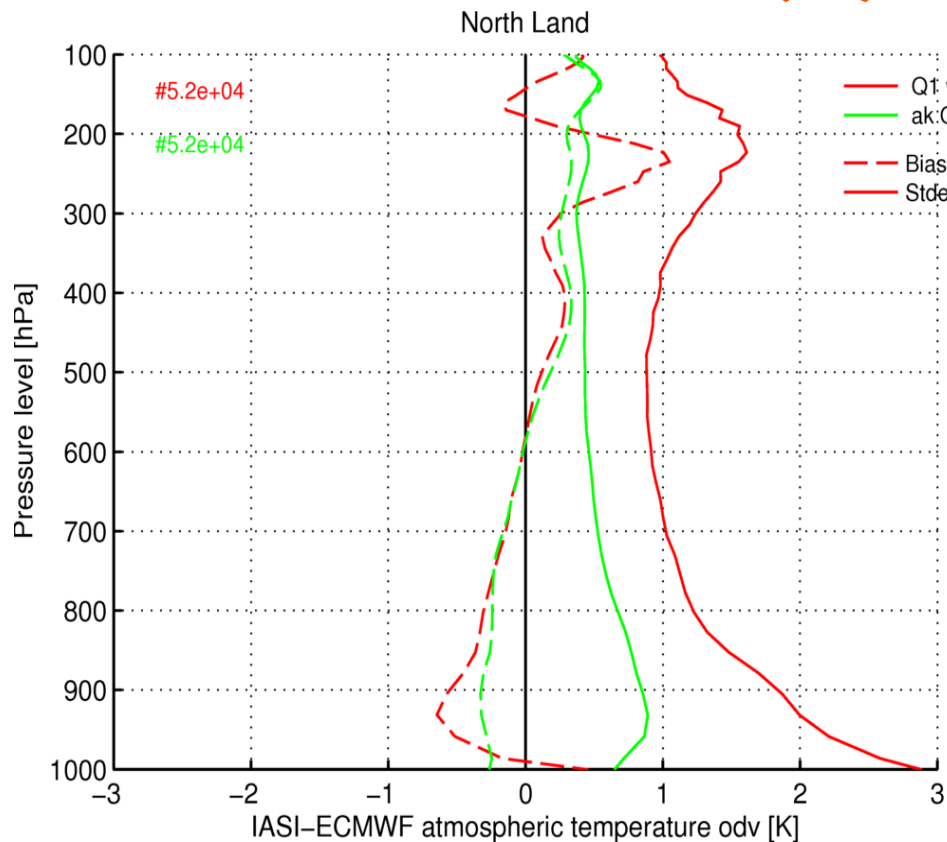
Radiance residuals





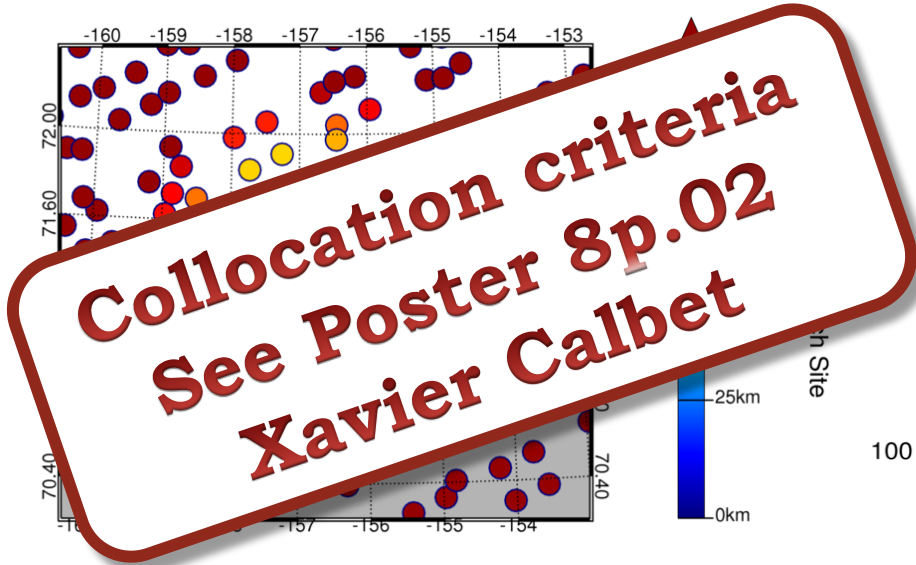
2. IASI L2 V6 initial assessment Applying averaging kernels

21-25/02/2014
clear-sky Land NH
IASI L2 – ECMWF forecasts
OEM(IR), AK(OEM(IR))



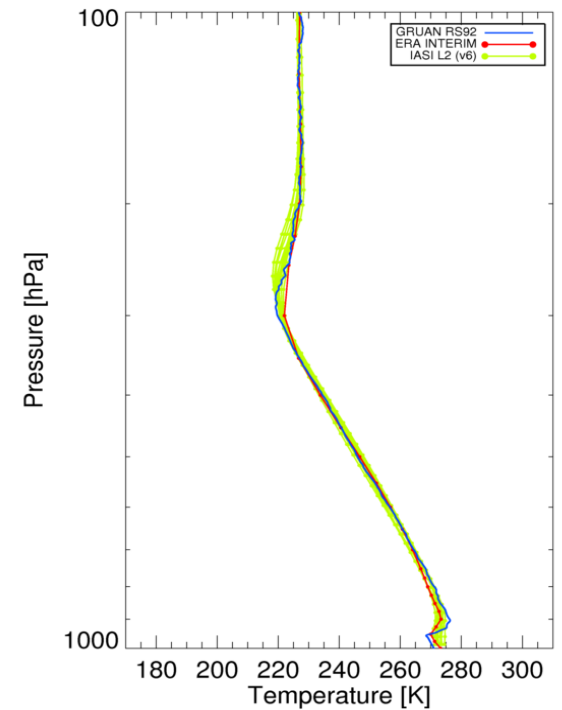
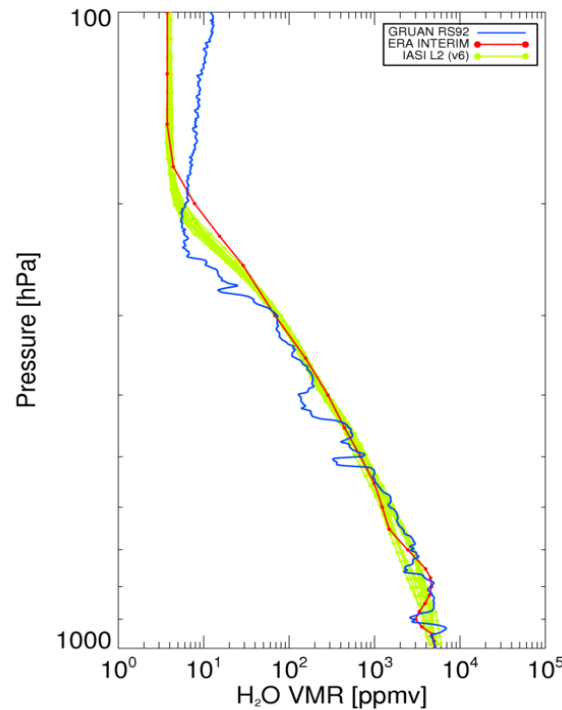
2. IASI L2 V6 initial assessment

vs GRUAN sonde data



Comparison of IASI PWLR retrievals and GRUAN radiosonde measurements at Barrow (Alaska) 01/06/2013

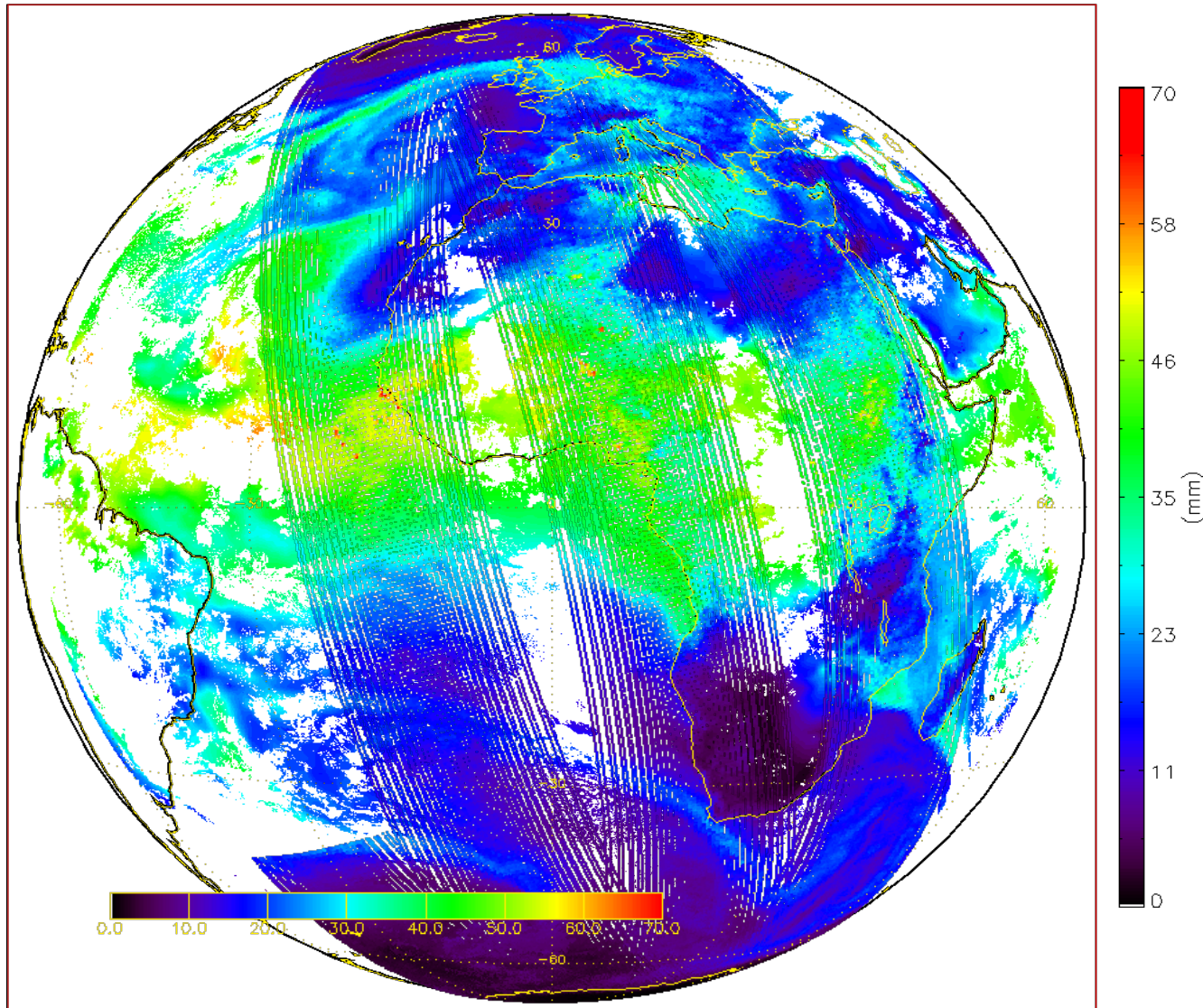
Credits: T. Trent (Univ. Leicester)



2. IASI L2 V6 initial assessment

Total column WV vs MSG

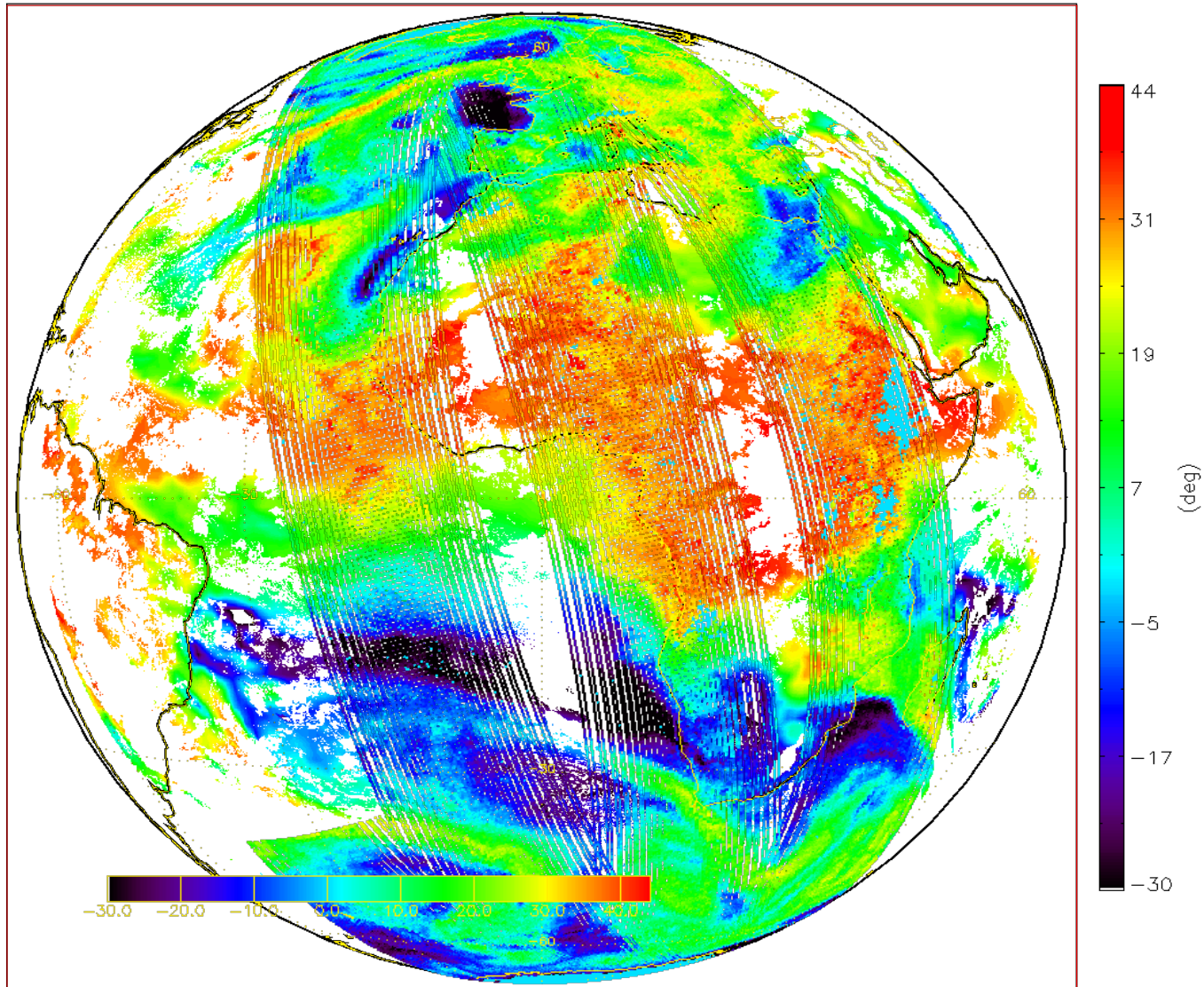
**MSG
TPWV
+
IASI
v6**



2. IASI L2 V6 initial assessment

Instability Index vs MSG

**MSG
GII
+
IASI
v6**



Outline

1. The IASI L2 processor v6
2. Initial assessment results
- 3. Deployment plan**

3. IASI L2 v6 deployment

High-level schedule

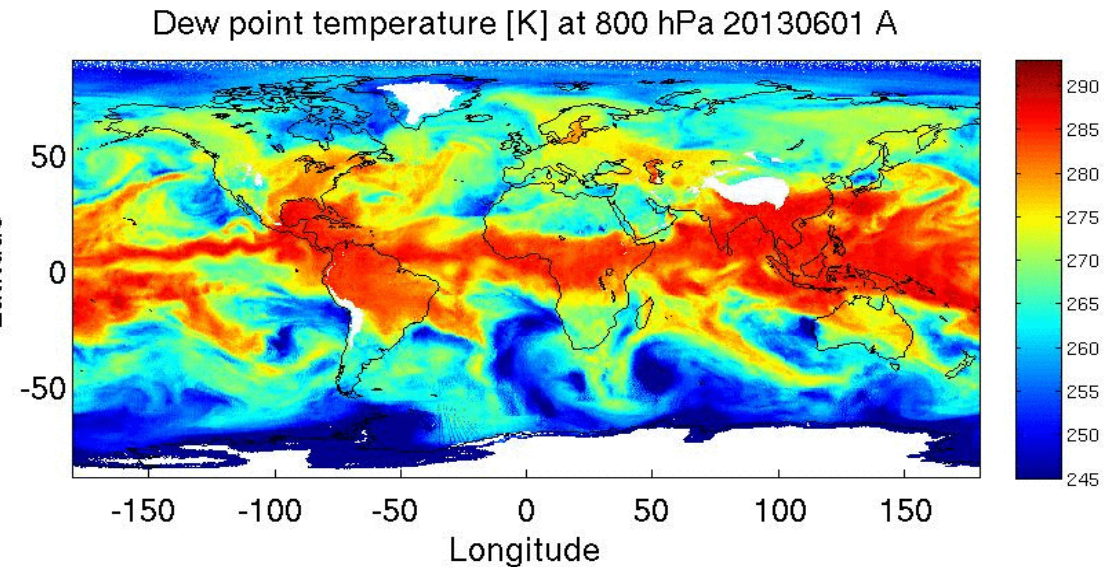
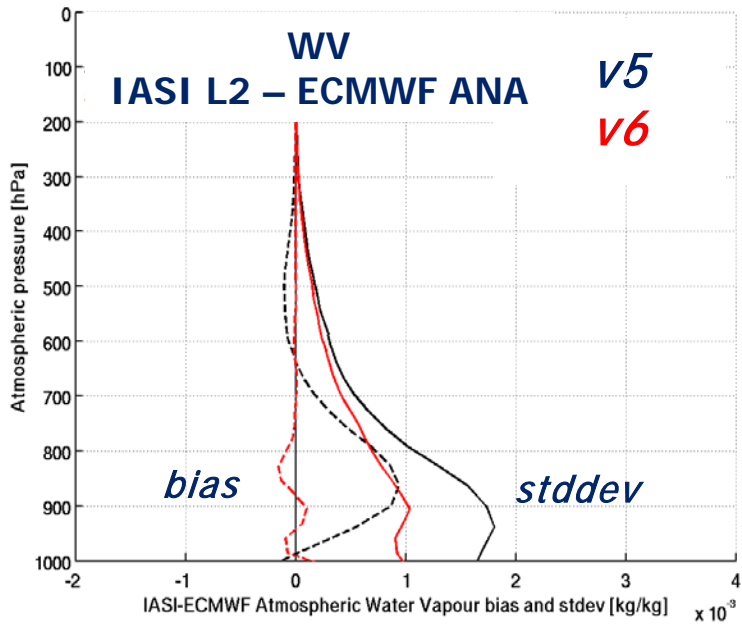


Provisional dates, pending completion of BUFR encoding and preparatory activities for archiving and dissemination

Summary

- ✓ **Simplified processing flags**, especially cloud information
- ✓ **Synergy MW+IR** allow **nearly all-sky T,q** statistical retrievals: ~95% yield
- ✓ **T & q profiles** significantly **improved**, especially in the **low troposphere** in clear and cloudy pixels (precision of $T < 1\text{K}$, $\text{H}_2\text{O} < 1.2 \text{ g/kg}$)
- ✓ Atmospheric profiles **yield doubled** with OEM (~20%)
- ✓ **Full retrieval error** estimate provided, from which the **averaging kernels** can be derived.
- ✓ New atmospheric composition products

Soon coming ... IASI L2 v6



**Gamsa hamnida
for your attention !**

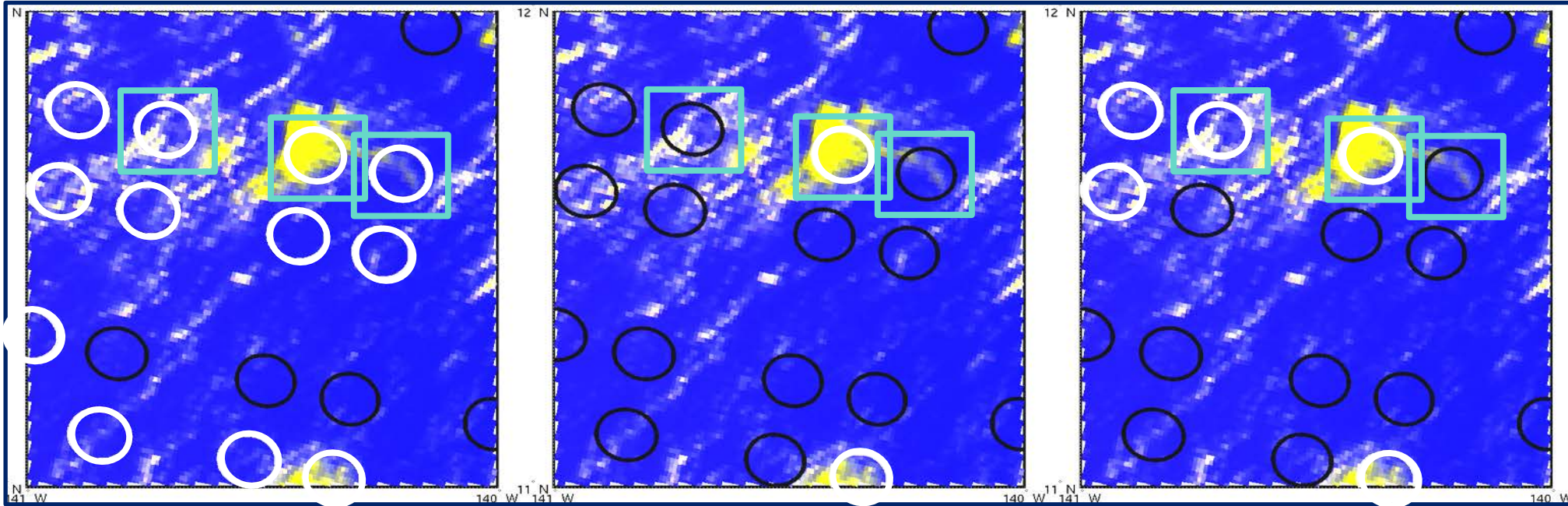
thomas.august@eumetsat.int

Spare slides

ANN test

NWP test

AVHRR test

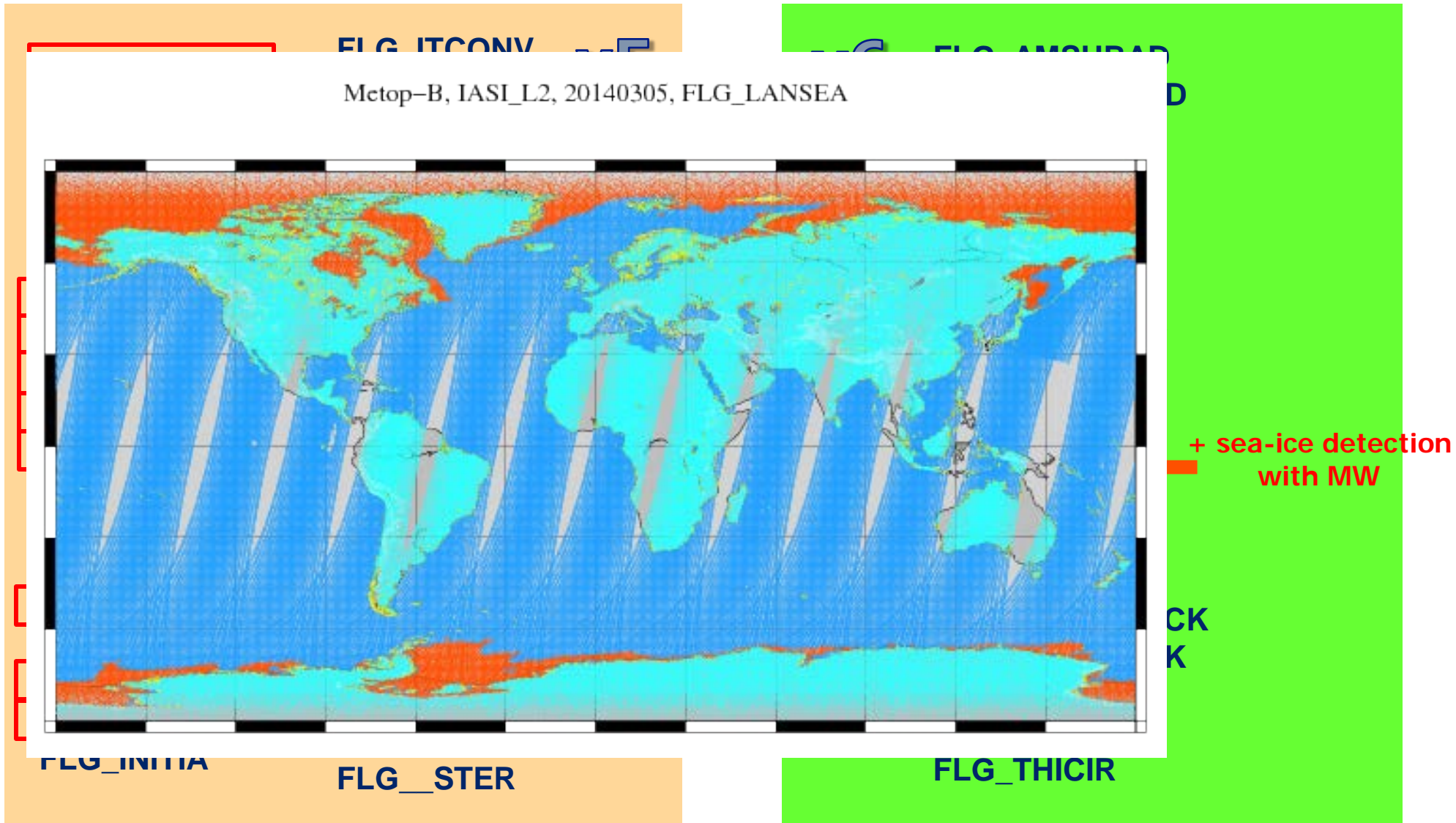


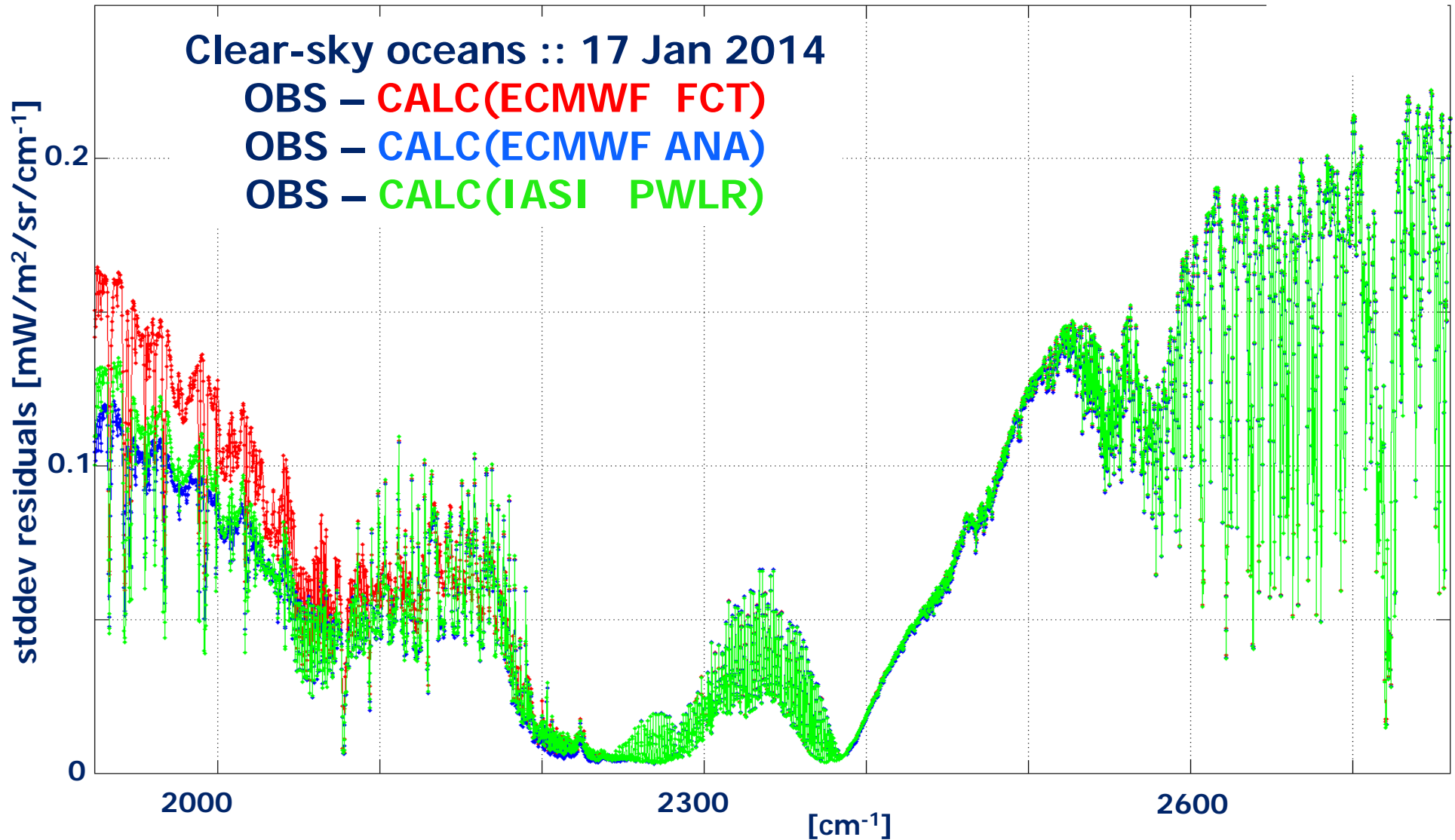
White: cloudy

Black: clear



1. The IASI L2 processor v6 Simplified processing flags





3. IASI L2 v6 deployment

BUFR products structure

V5	Content
TWT	Temperature, humidity profiles (90 levels) and surface temperature
CLP	Cloud detection and characterisation (phase, height, coverage)
EMS	Land surface emissivity (12 channels)
OZO	Ozone partial columns (0-6km, 0-12km, 0-16km) and total column
TRG	CO, CH ₄ , CO ₂ , N ₂ O Total columns

The EPS native format changes with v6 (format version 11.0). Test products can be already available.

The format and content changes in the BUFR products also affect the existing packets. Test data will be made available.

V6	Content
TWT	Temperature, humidity profiles (101 levels) and surface temperature
TWT_ERR	T,H ₂ O Retrieval error covariance matrix (can be large)
CLP	Cloud detection and characterisation (phase, height, coverage)
EMS	Land surface emissivity (12 channels)
OZO	Ozone profiles (101 levels) and retrieval error covariance matrix
TRG	CO, CH ₄ , CO ₂ , N ₂ O Total columns
CO	CO total column, profiles and averaging kernels
HNO3	HNO ₃ total column, profiles and averaging kernels
SO2	SO ₂ amount and plum height estimates

For early information, implementation in 2015 and onwards. Place holders ready in EPS native format

Future work

- **Complete the deployment and qualification of the v6**
- **Include the micro-wave in the optimal estimation**
- **Study the retrieval of clouds and land surface emissivity in the OEM**
- **Include SO₂ and HNO₃, evolve O₃**
- **Implement state-of-the art CH₄ retrievals to serve MACC**
- **Prototype a dust flag for SST quality flagging**