Concordiasi Workshop
2010/03/29-31
Toulouse, FRANCE

Adaptive deployment of dropsondes above Antarctica.

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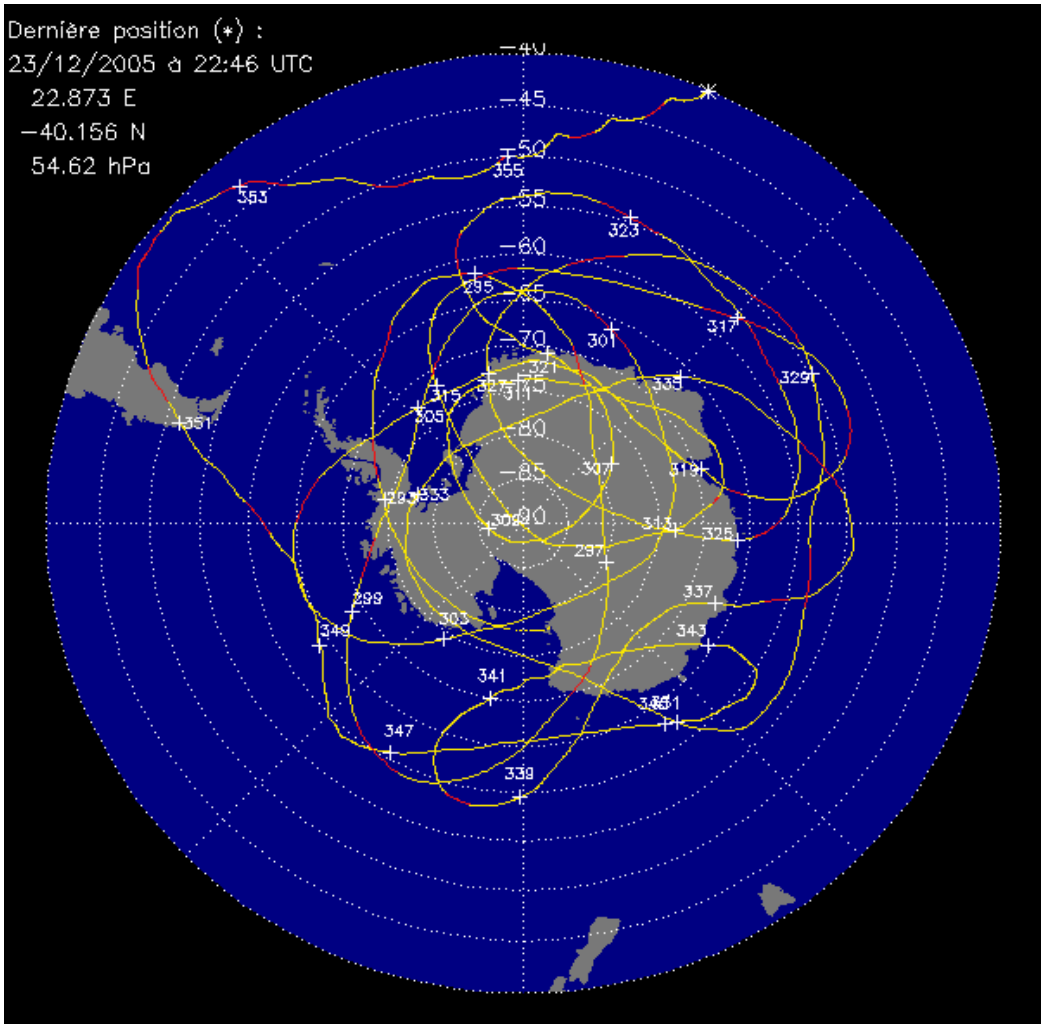
CONCORDIASI Context

- Main objective: to improve IASI data assimilation over iced polar regions.
  - Collect extra data to validate IASI data assimilation
  - Collocate IASI, (and AIRS) soundings with dropsondes from drifting stratospheric balloons (driftsondes).
- Evaluate the impact of extra data in the polar region and over the lower latitude regions.
  - Sample sensitive areas with dropsondes and check the efficiency of this adaptive sampling with respect to other extra observations (evaluate the impact of all these extra data on the model predictive skills).
- 13 driftsondes will be launched from Mc Murdo and drift within the polar vortex for several weeks.

Expected trajectories

Example of a stratospheric trajectory during late VORCORE 2005.



from VORCORE website.

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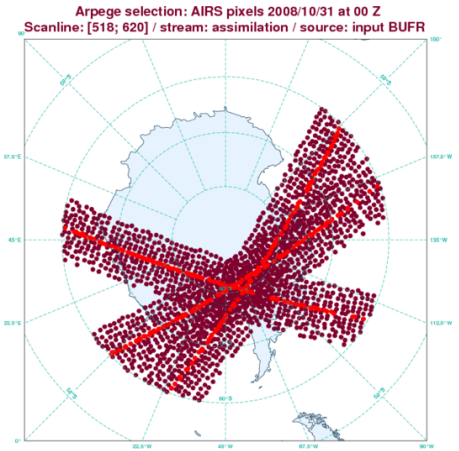
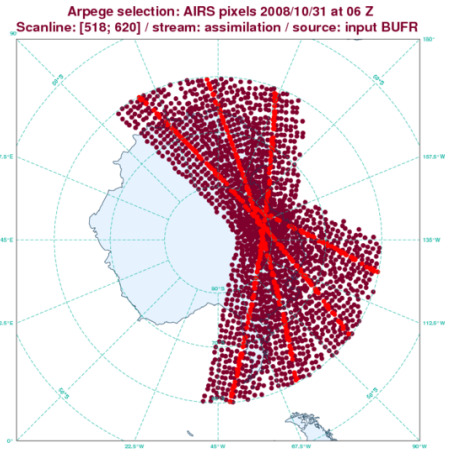
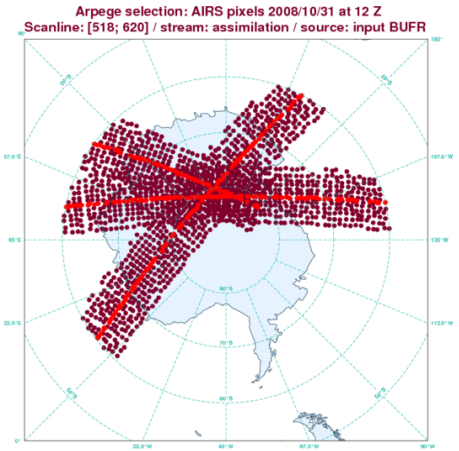
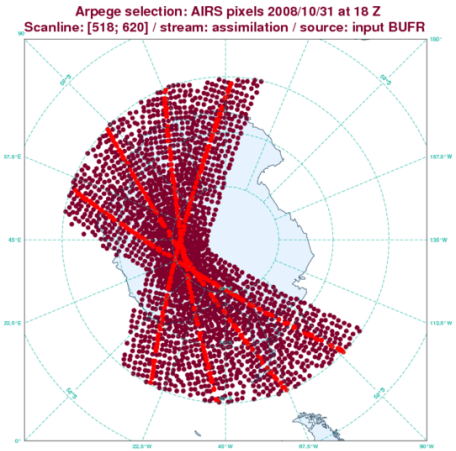
Prediction of AIRS & IASI coverage

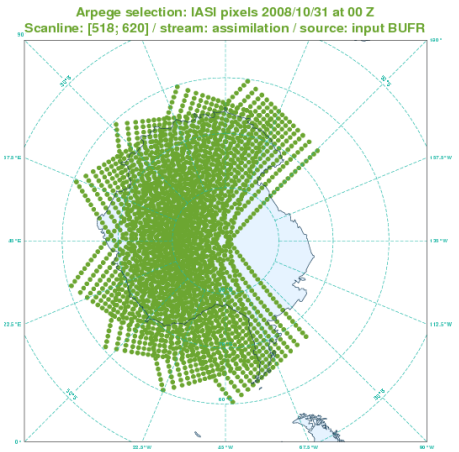


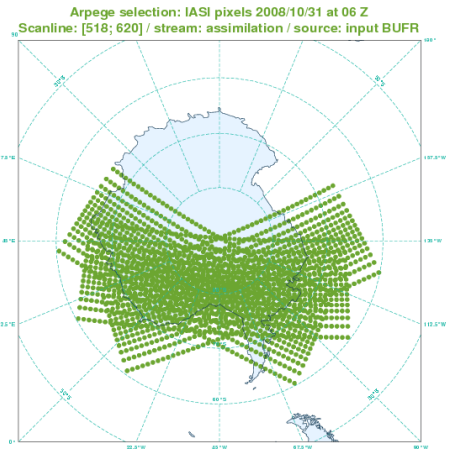


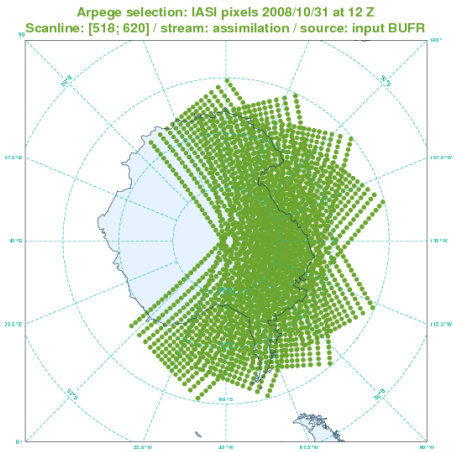


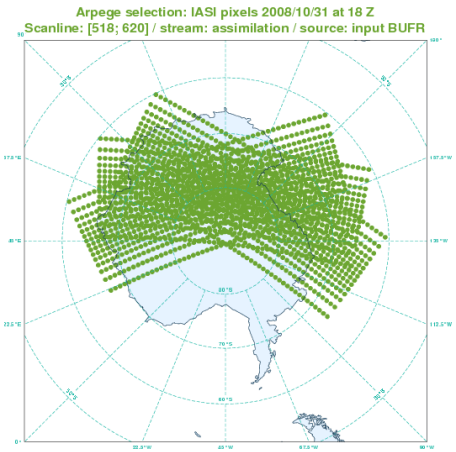


2008/10/31 at 00Z | **2008/10/31 at 060Z** | **2008/10/31 at 12Z** | **2008/10/31 at 18Z**









Predictions of AIRS tracks and IASI swaths for day D, D+1 and D+2 are made at CMS (P. Brunel).

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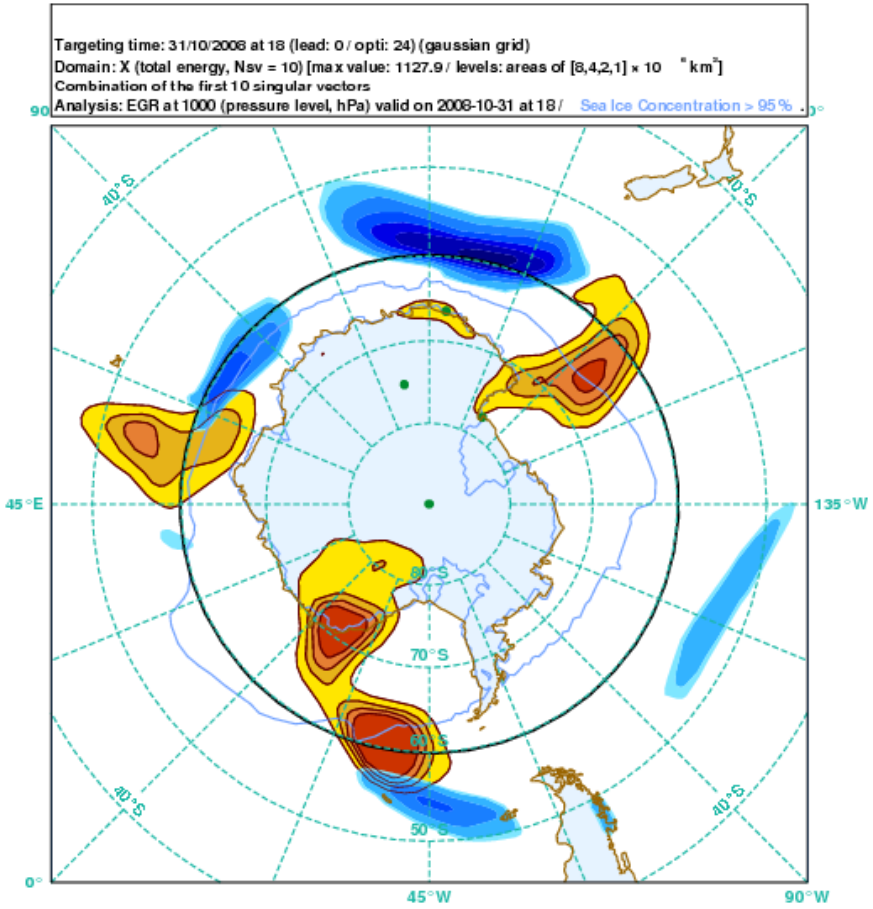
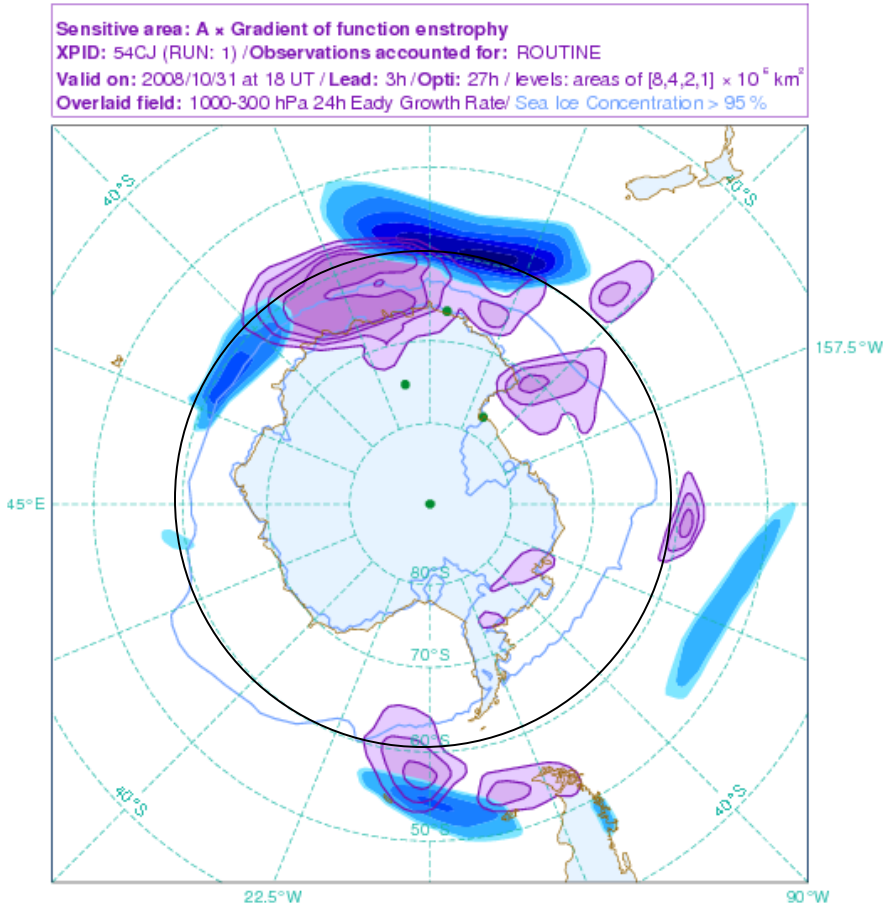
Sensitive areas predictions

Localized singular vectors

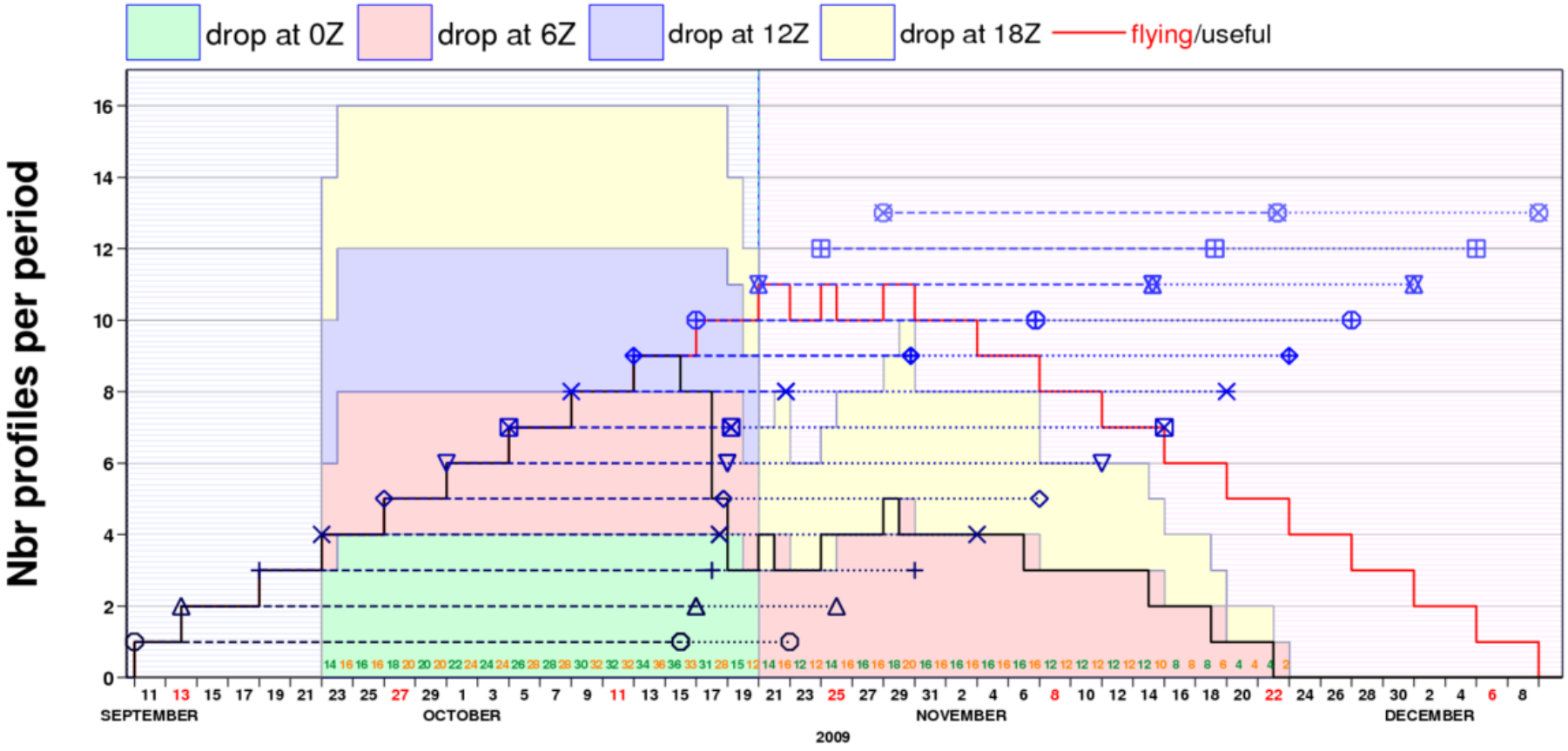


Kalman Filter Sensitivity



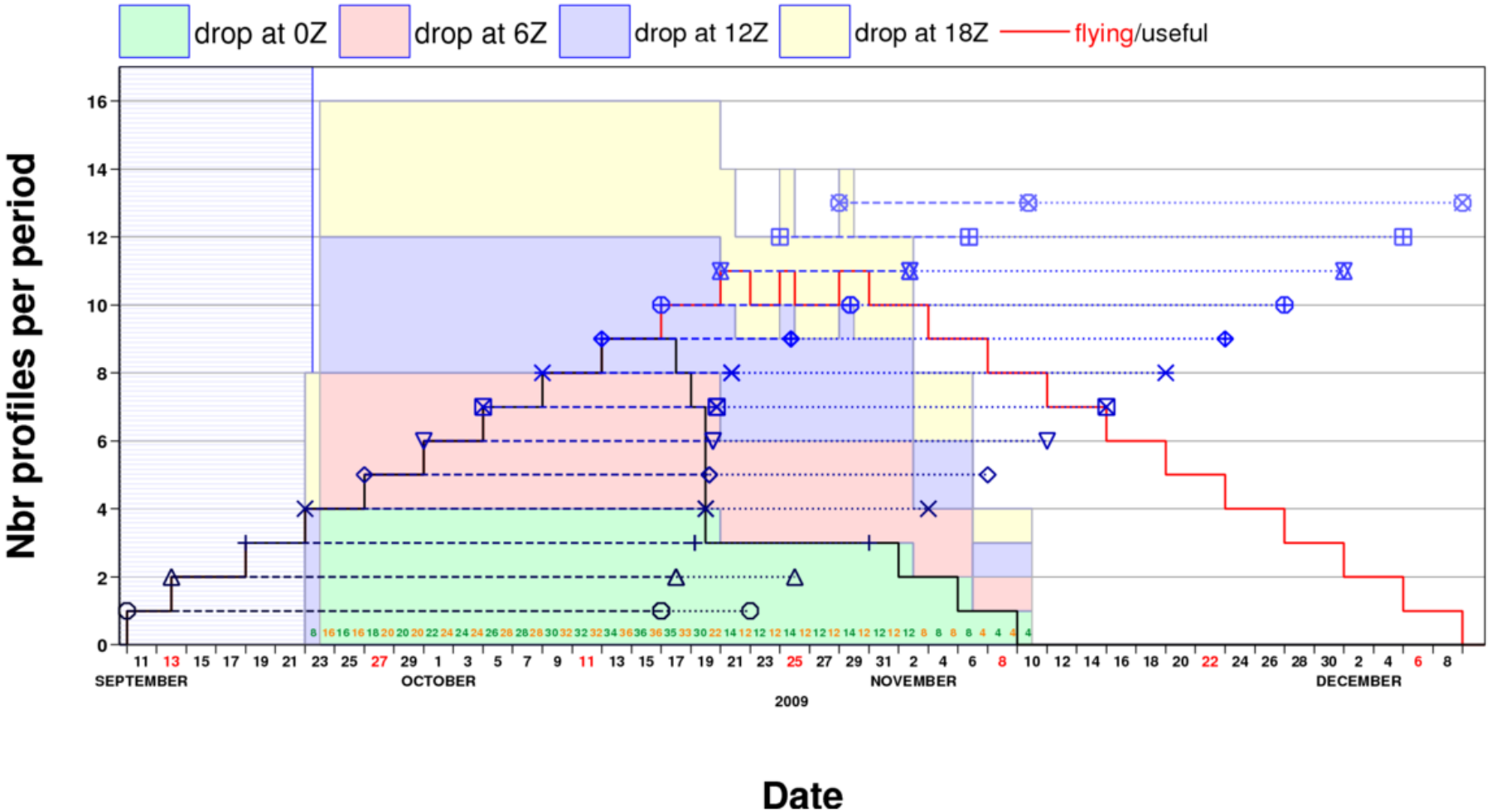
Deployment strategies (1)

Simulated number of profiles (from dropsondes) per period of 24 h (Total: 650 / Loss(es): 0) / drop from optimization list.
Starting date: 2009/09/10 at 00 TU / Ending date: 2009/12/12 at 00 TU /
Number of driftsondes: 13 / Launch schedule from prescibed list / Initial delay: 288 h / Readiness delay: 12 h / Lifetime: 42 days.
Ndrops (per drift): 50 / dropping period: [6,6] h (shift after [672] h) / drop limit (per 24h period): 16 .
Numbers: availability (on the given day), wrt. dropping period and limit.



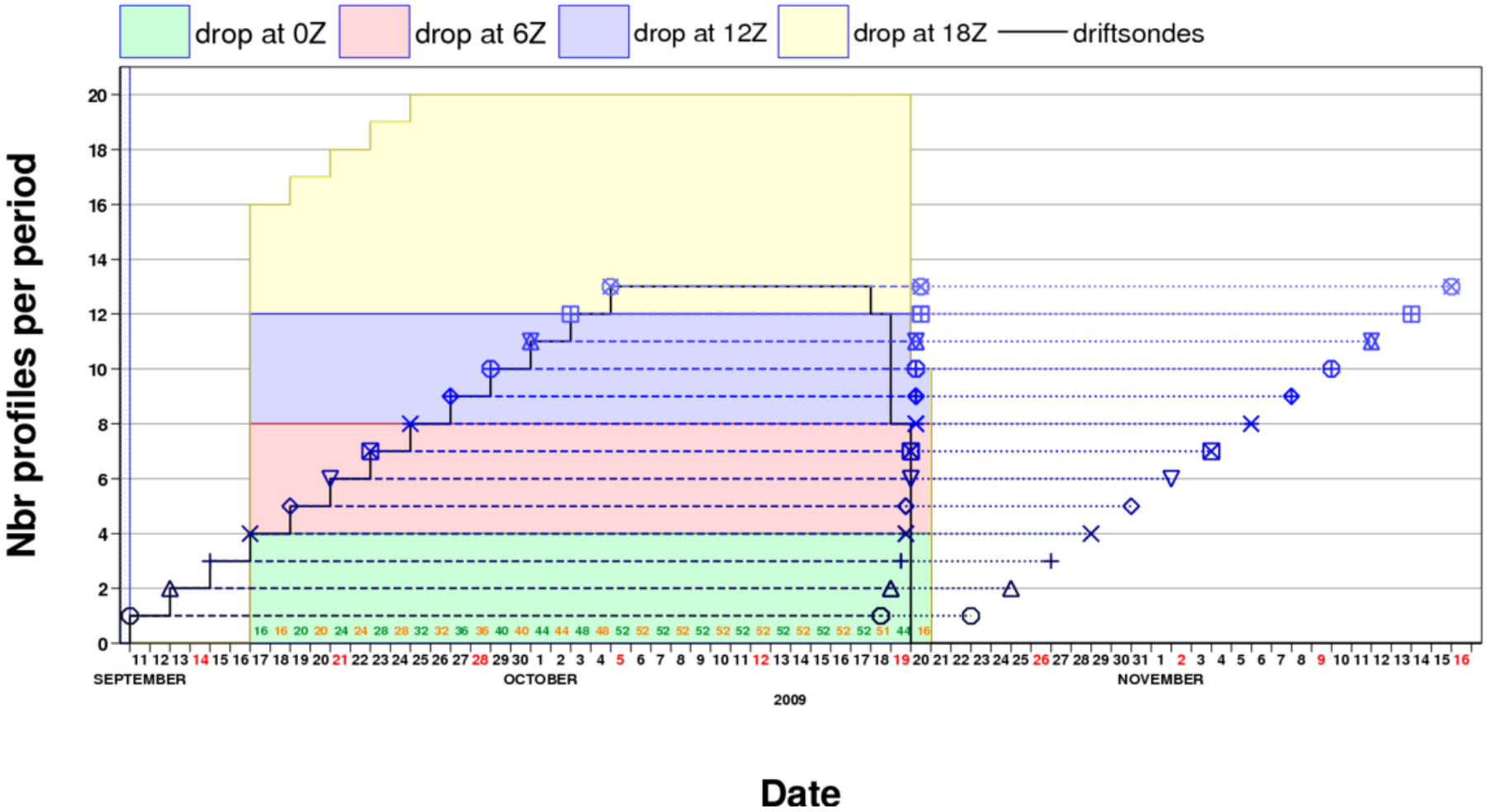
Deployment strategies (1)

Simulated number of profiles (from dropsondes) per period of 24 h (Total: 650 / Loss(es): 0) / drop from optimization list.
Starting date: 2009/09/10 at 00 TU / Ending date: 2009/12/12 at 00 TU /
Number of driftsondes: 13 / Launch schedule from prescibed list / Initial delay: 300 h / Readiness delay: 12 h / Lifetime: 42 days.
Ndrops (per drift): 50 / dropping period: [6] h / drop limit (per 24h period): 16 .
Numbers: availability (on the given day), wrt. dropping period and limit.



Deployment strategies (2)

Simulated number of profiles (from dropsondes) per period of 24h (650/0) / drop from optimization list.
Experiment ID: 0000 / starting date: 2009/09/10 at 00 TU / ending date: 2009/11/18 at 00 TU
Number of driftsondes: 13 / Launch period: 48h / initial delay: 144h / life: 42days
Ndrops (per drift): 50 / dropping period: [6]h / drop limit (per 24h period): 20 .
Numbers: availability (on the given day), wrt. dropping period and limit.



Deployment strategies (3)

- The more balloons flying, the easiest the IASI/sensitivity collocations.
  - Frequent and regular launches would be the best.
  - Hope for an even spread of the balloons in the vortex
- Wait for at least 4 balloons flying before the start of dropping.
- Due to logistics, no more than 2 hours between successive drops
- Not more than 4 balloons dialling at the same time (hour time slot).
- Maximum 4 sondes/balloon in 24 hours.
- Up to 16 sondes per day.
  - 12 sondes between 21 Z and 15 Z for IASI
  - 4 sondes between 15 Z and 21 Z for predictability issues.
- Optimize the deployment according to age & sonde availability and avoid loss of sondes at the end.

CISOS Algorithm

ECMWF will provide the CISOS with daily predicted sensitive areas derived from localized singular vectors (Data Targeting System)

CNRM will employ the KFS (targeting technique) over specific Weather cases off the Antarctica : impact over the lower latitudes.

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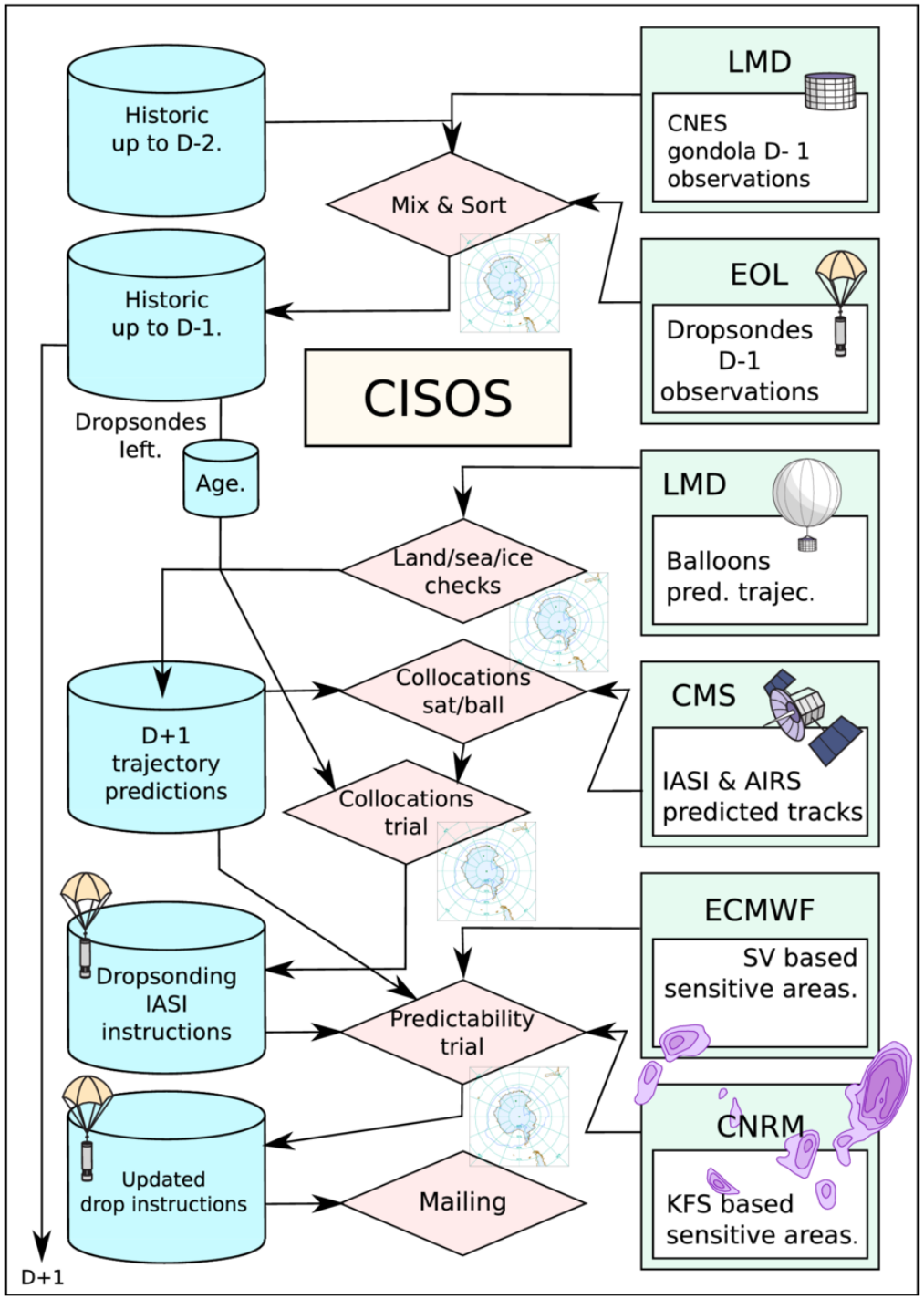


CISOS

- **CISOS** = **C**oncordias**I** Drop-**So**unding **S**cheduler
- Every day **D**, predicts where to drop sondes depending on the ballons' predicted trajectories and IASI & AIRS tracks.
- The drop period is from day **D** at 21Z up to **D+1** at 21Z.
- CISOS has been developed for Antarctica, then a secondary version has been derived for the pre-Concordiasi phase in the TROPICS.
- CISOS also accounts for predictability issues, using predicted sensitive areas. These aspects where not considered in the TROPICS phase.
- CISOS sends mails with the list of the drops to be scheduled by hand on the EOL web interface.
- CISOS produces maps that are available on the Concordiasi-dataset website.

CISOS

Subject: [Concordiasi] 2010-03-26-00 dropping predictions.
From: CONCORDIASI <domec@sxobs1.cnrm.meteo.fr>
Date: 08:14
To: alex.doerenbecher@meteo.fr

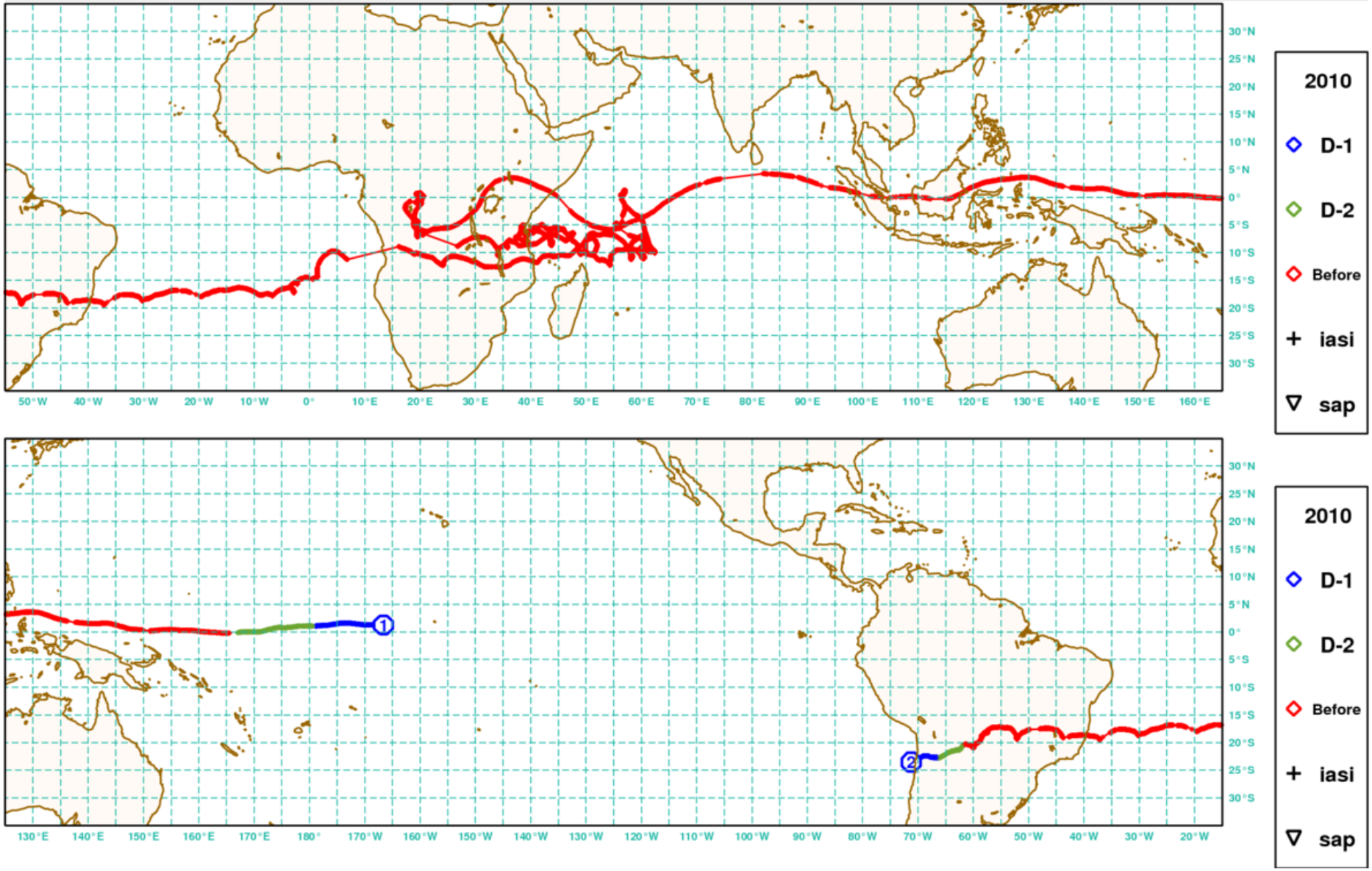
```
------------------------------------------------
This message is sent by an automated procedure.
It is sent to you in the framework of CONCORDIASI.
This message contains the list of the dropsondes' launches
that should be scheduled on the next day (for a 24h period).
------------------------------------------------
Area of interest (phase of Concordiasi) = TROPICS
             Current day = 2010032600
Dropsonding starting date = 2010032621
  Dropsonding ending date = 2010032721
------------------------------------------------
Here follows the condensed dropping instructions
to be of use on the EOL web interface
http://driftsonde.guest.ucar.edu
- - - - - - - - - - - - - - - - - - - - - - - - -
year-month-day hour driftsonde
yyyy-mm-dd hh xxVxxNxx
------------------------------------------------
2010-03-27 02Z MSD2
2010-03-27 03Z MSD2
2010-03-27 08Z MSD1
2010-03-27 14Z MSD2
2010-03-27 09Z MSD1
2010-03-27 18Z MSD2

------------------------------------------------
Here follows the "extended" file for dropping scenarii.
The file is written with respect to the format below.
- - - - - - - - - - - - - - - - - - - - - - - - -
Driftsonde latitude longitude hour quantity dropsondes_left day purpose
purposes: I = IASI collocation, S = Sensitivity
------------------------------------------------
# This the dropsonding prediction file computed on 20100326 and valid for 20100327
# (period starting from 21h the day before and ending the day on 21h00).
# balloon_number, latitude, longitude, time_HH, X_drops, dropsonds_left, Day_DD, Purpose
# Purpose I=IASI, S=Sensitivity
  2    -25.960    -79.520  2   1  17 27 I
  2    -25.990    -79.550  3   1  16 27 I
  1      1.620   -162.830  8   1   5 27 I
  2    -25.360    -81.590 14   1  15 27 I
  1      1.670   -162.760  9   1   4 27 I
  2    -25.331    276.756 18   1  14 27 S
```

CONCORDIASI

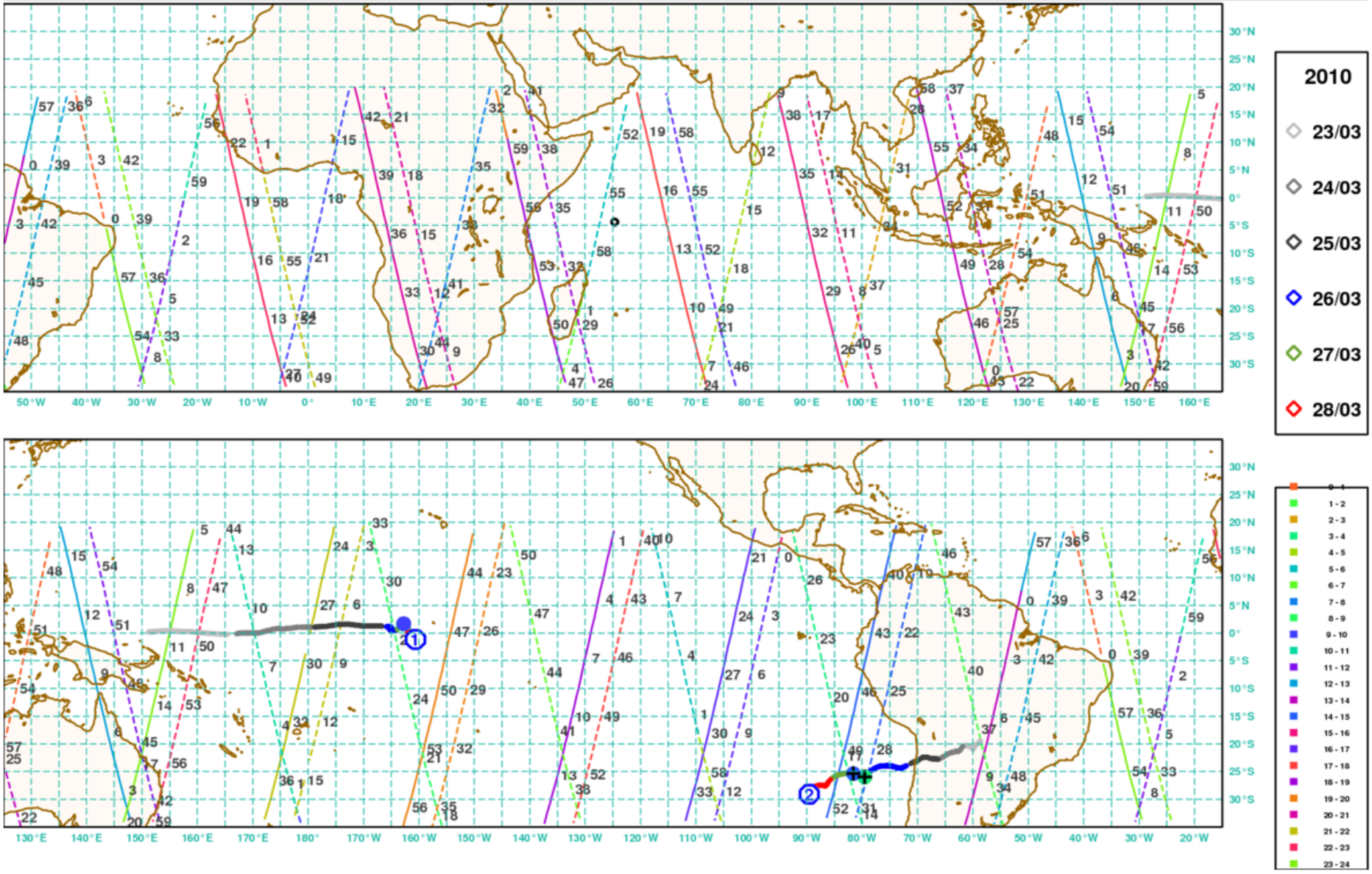
CISOS (2)

Observed driftsonde trajectories in the past days.
Base: 2010-03-26 at 00 UT
2 trajectories but no dropsonde (in the past 2 days).

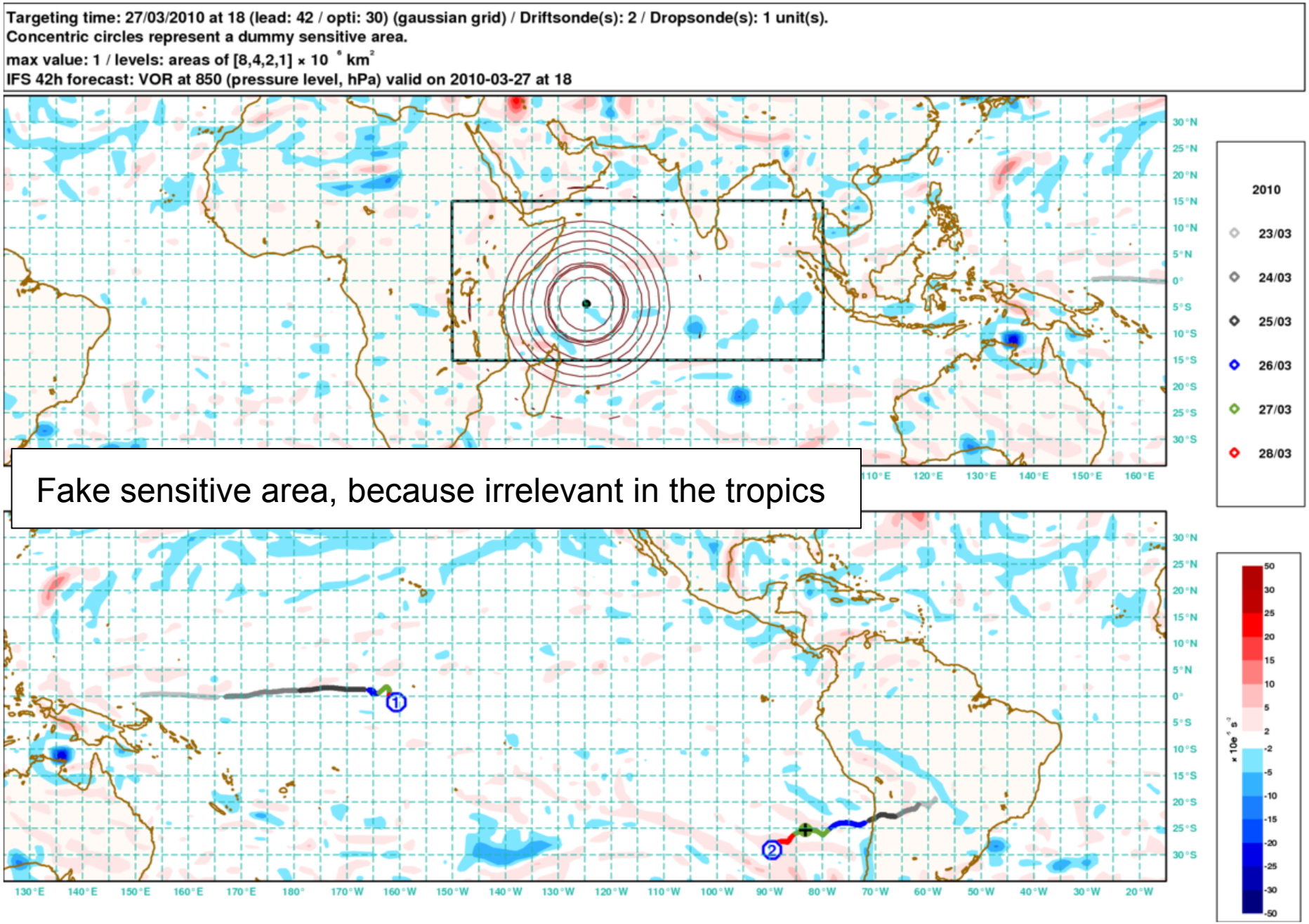


CISOS (3)

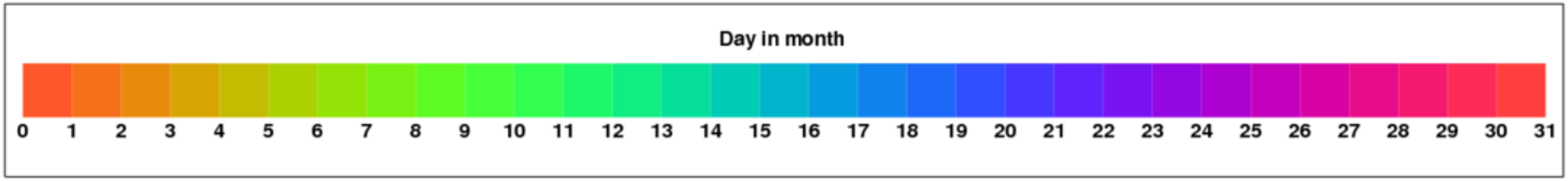
Prediction of dropping opportunities along IASI tracks (day D: solid, D+1: dash, D+2: dots)
Base: (day D): 2010-03-26 at 00 UT / Colours display the times of Metop-2´s orbits (hour) / numbers display the minutes in the orbit.
Driftsonde(s): 2 / dropsounde(s): 5 unit(s).

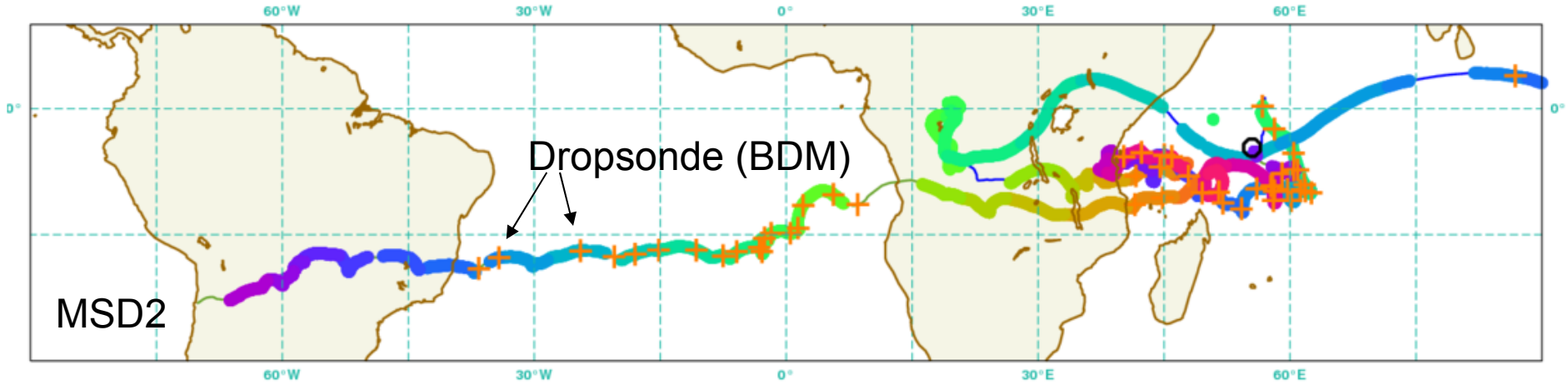


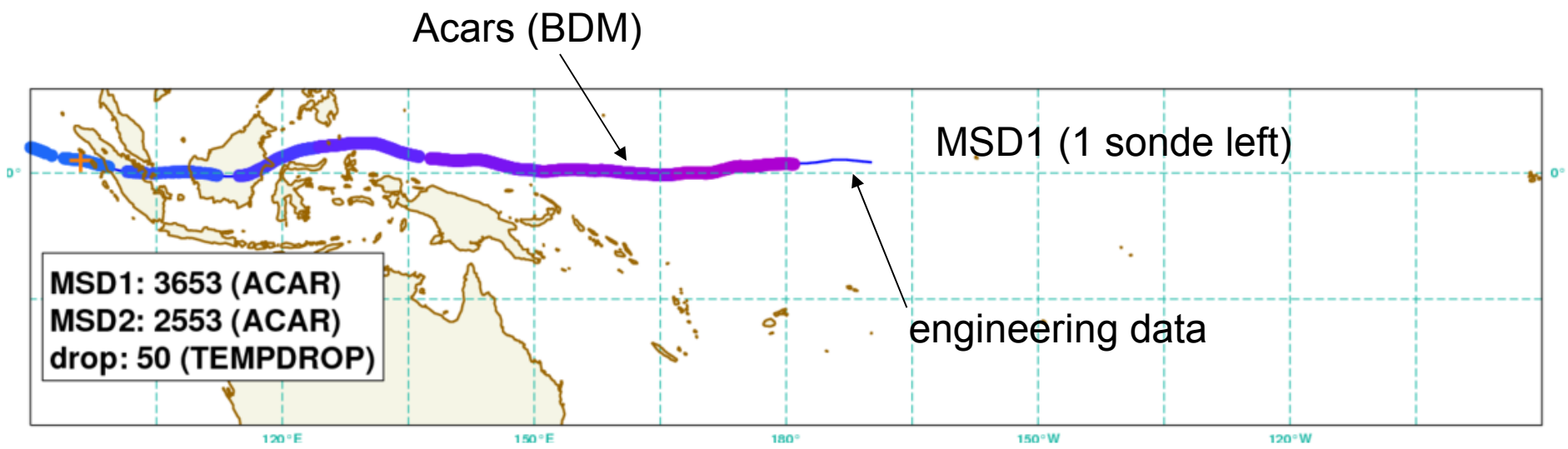
CISOS (4)


Targeting time: 27/03/2010 at 18 (lead: 42 / opti: 30) (gaussian grid) / Driftsonde(s): 2 / Dropsonde(s): 1 unit(s).
Concentric circles represent a dummy sensitive area.
max value: 1 / levels: areas of [8,4,2,1] × 10 ⁶ km²
IFS 42h forecast: VOR at 850 (pressure level, hPa) valid on 2010-03-27 at 18
2010
23/03
24/03
25/03
26/03
27/03
28/03
Fake sensitive area, because irrelevant in the tropics
× 10e⁻⁵ s⁻²

pre-CONCORDIASI
Period: 2010/02/11 - 2010/03/24





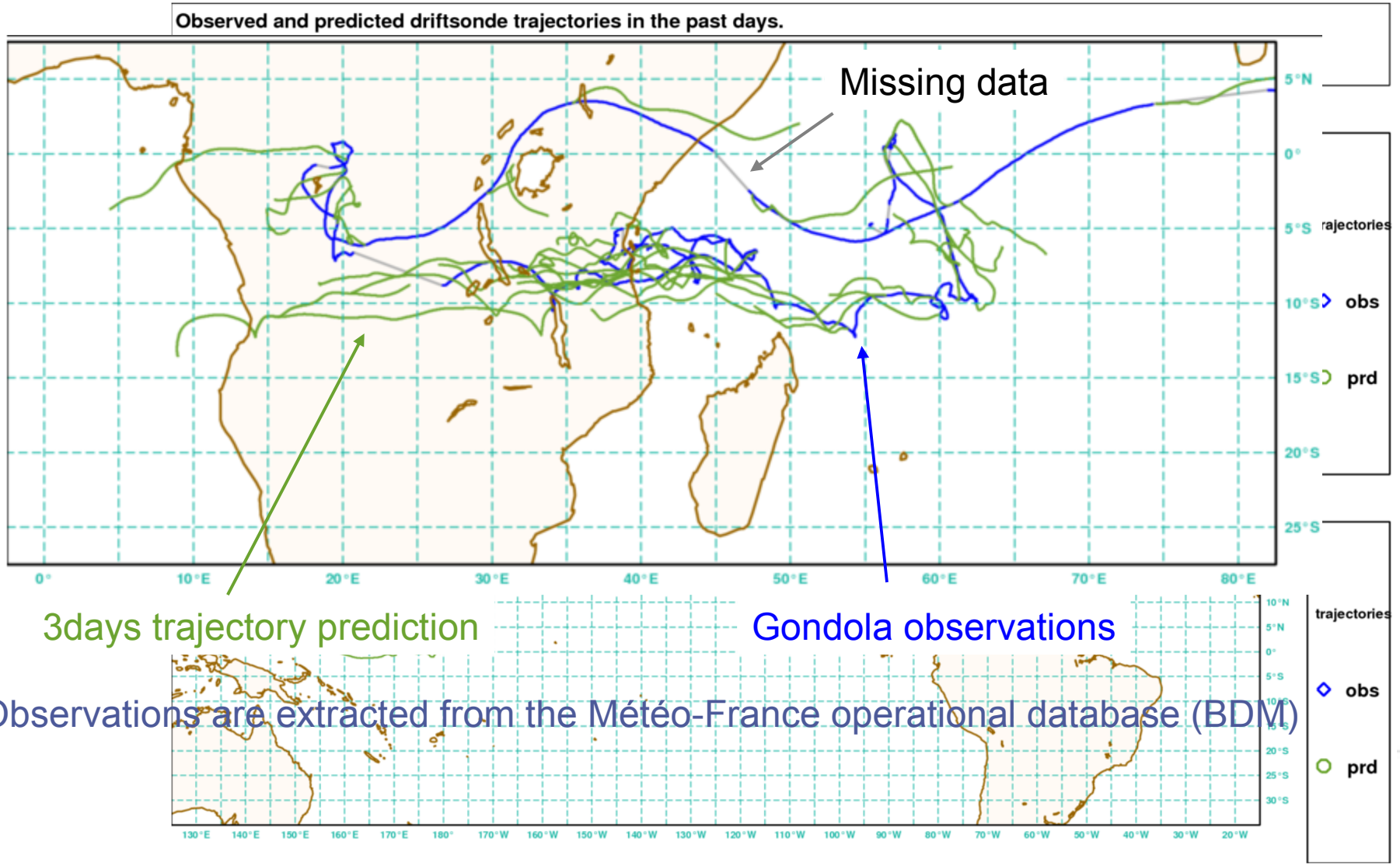


Does the prediction of collocation work ?

- Despite CISOS being automatic, we still need a human operation but with some flexibility (4 people involved).
- The driftsonde time resolution is about 1 hour.
- The IASI coverage has gaps in the tropics, whereas over Antarctica successive swaths do overlap a lot.
- The important criterion is then the time shift between the closest IASI pixel and the dropsonde.
  - No statistics yet, but cases of good collocations were reported (Z1750075 on 2010/03/12 at 22Z) as well as poor collocations (Z1680107 on 2010/03/13 at 11Z).
- The predicted trajectories are not very accurate, but in this should not be dramatic over Antarctica.

Predicted trajectories (MSD1)

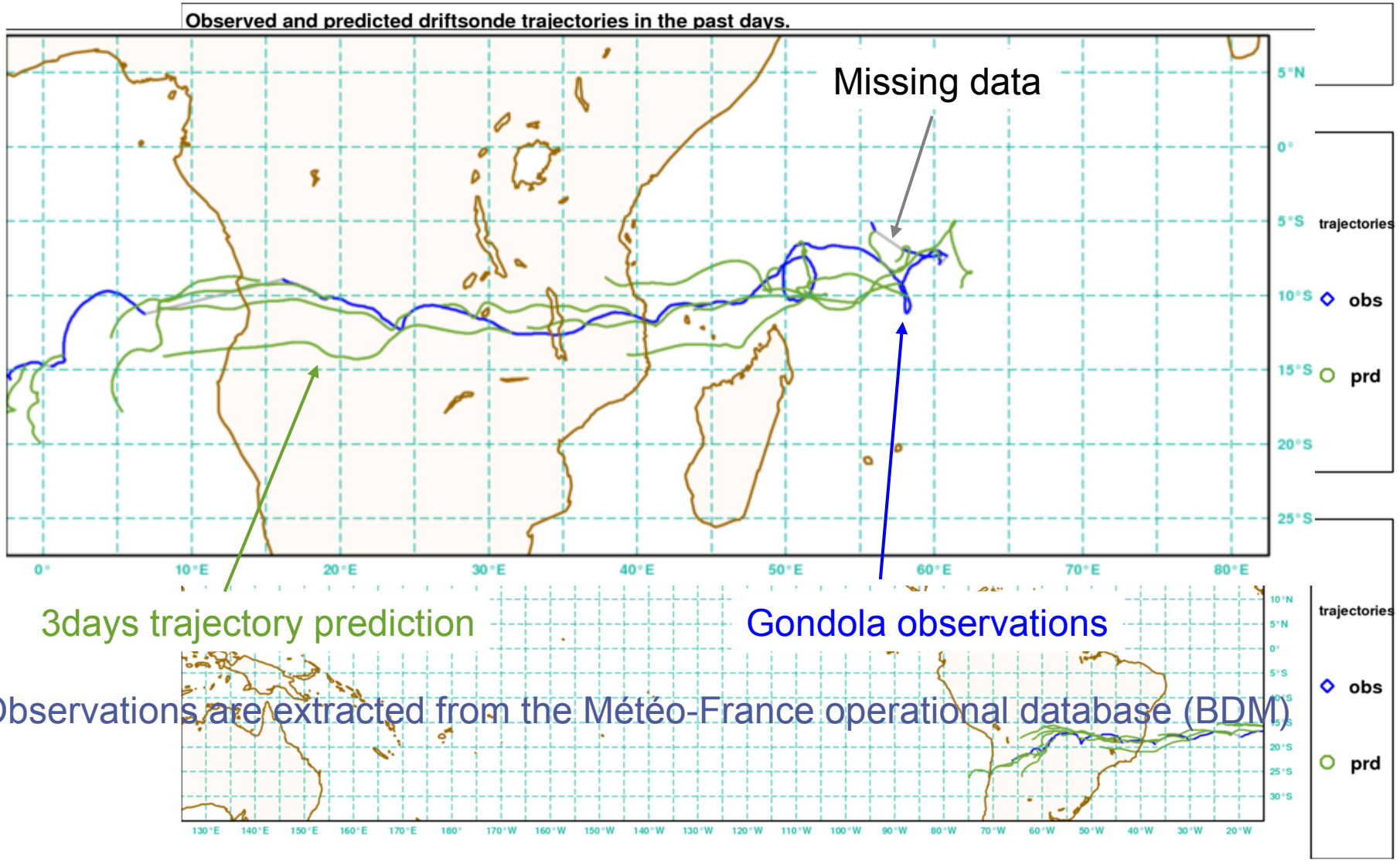
- Comparison of the observed and predicted trajectories



Observations are extracted from the Météo-France operational database (BDM)

Predicted trajectories (MSD2)

- Comparison of the observed and predicted trajectories



Observations are extracted from the Météo-France operational database (BDM)

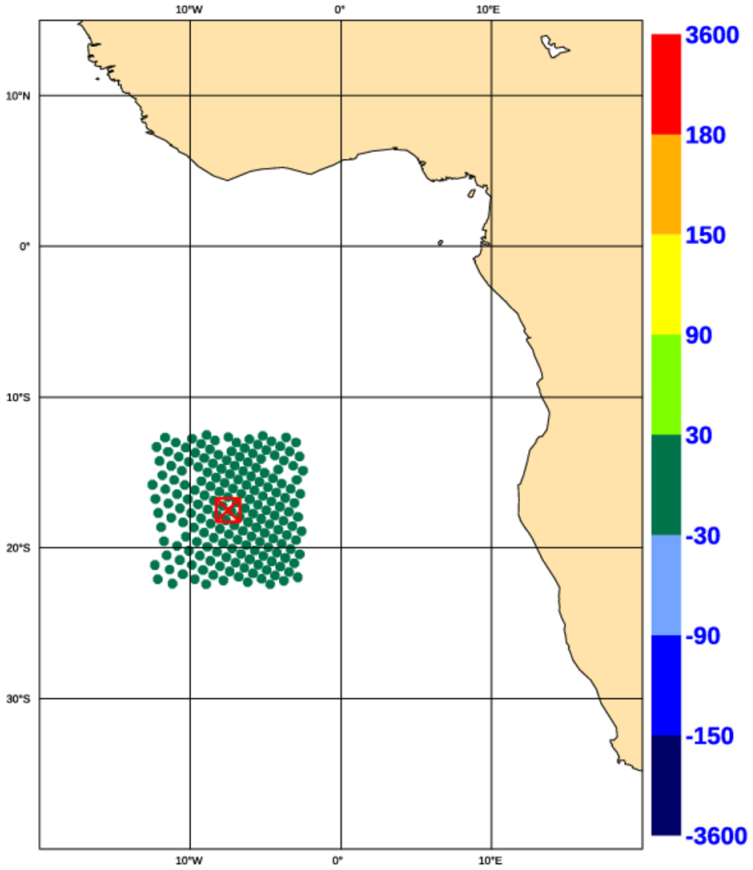
Influence of the wind forecast

- Due to logistic constraints and a slow refresh of observed trajectories at the beginning of the campaign in the Seychelles, the trajectory prediction used to be derived from “old” forecast issued by ECMWF.
  - “old” means up to 30 hours when computing trajectories about 06 Z and 18 Z.
  - From Mon. 22nd of March a new set-up allows to work with more recent wind forecast.
- The prediction of stratospheric wind is not easy. Observations are lacking. We expect this prediction to be more difficult in the Tropics than over Antarctica. Moreover we also expect that the presence of a constellation of driftsondes reporting wind and temperature should improve analyses and wind forecasts.

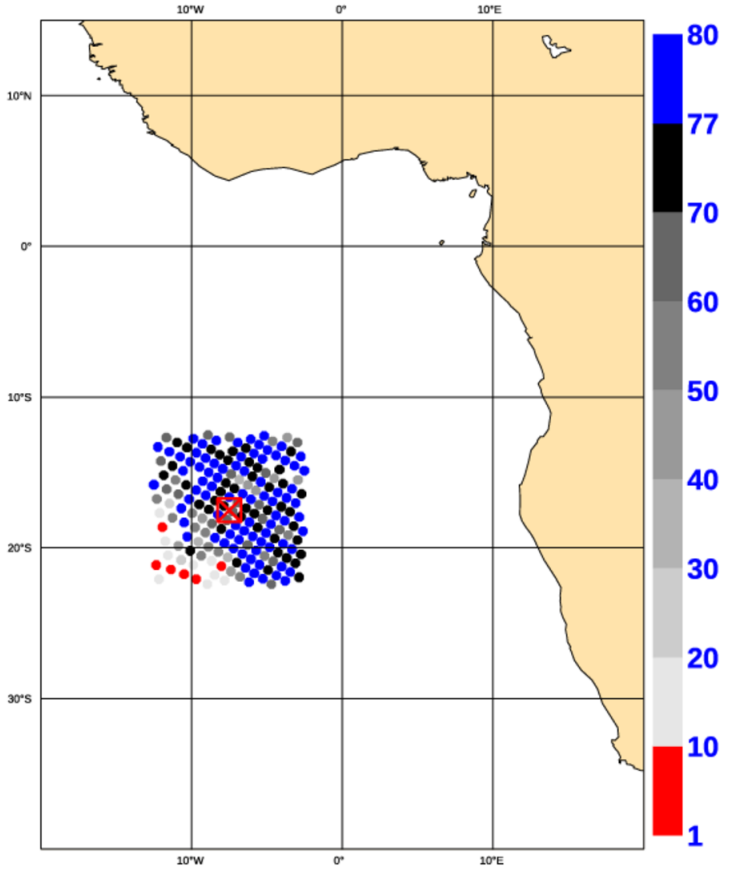
Collocation in reality

Z1750075

MF Drop # 24 was done on March 2010 the 12th at 21 :51 UTC. Location was 7.5 W, 17.5 S.



(a) Time difference between drop time and IASI profile time (unit : minutes)



(b) Number of IASI channels which are not flagged cloudy in ARPEGE e-suite (max. 77)

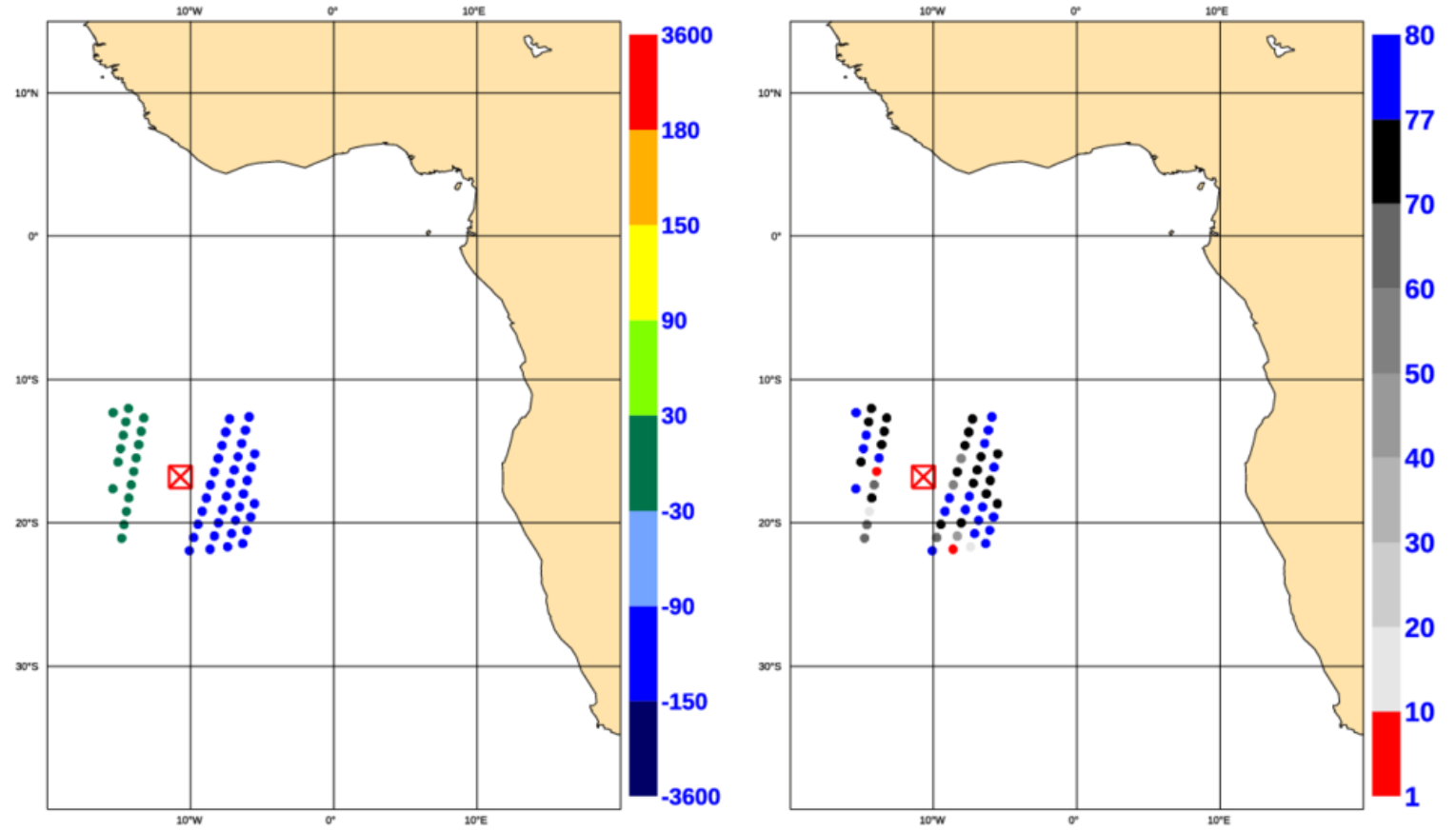
FIG. 32 – Comparison of dropsonde location and IASI soudings in time and in space.

Courtesy: V. GUIDARD

Collocation in reality

Z1680107

MF Drop # 25 was done on March 2010 the 13th at 10 :49 UTC. Location was 10.7 W, 16.8 S.

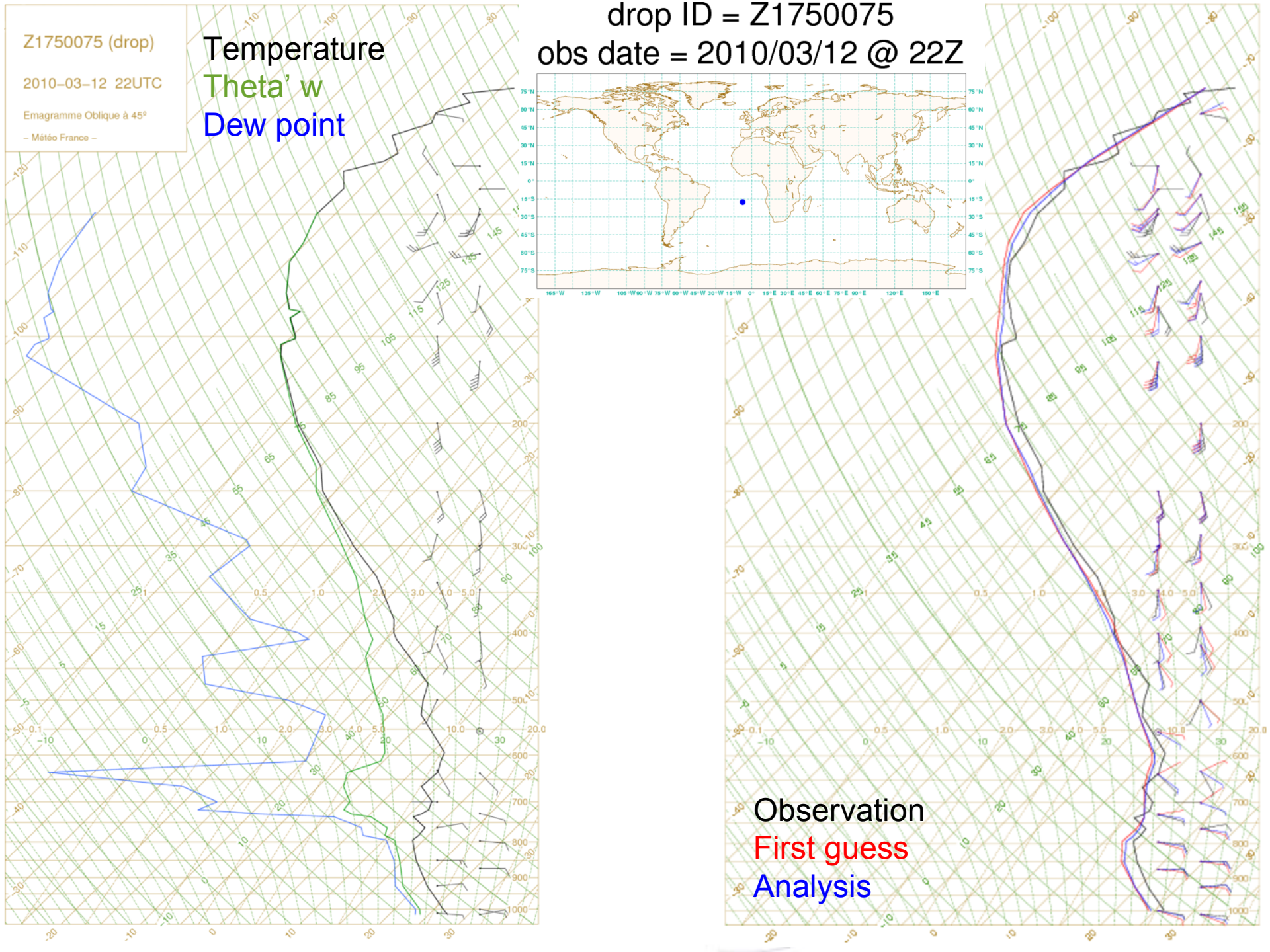


(a) Time difference between drop time and IASI profile time (unit : minutes)

(b) Number of IASI channels which are not flagged cloudy in ARPEGE e-suite (max. 77)

FIG. 36 – Comparison of dropsonde location and IASI soudings in time and in space.

Courtesy: V. GUIDARD


Z1750075 (drop)
2010–03–12 22UTC
Emagramme Oblique à 45°
– Météo France –
Temperature
Theta' w
Dew point
drop ID = Z1750075
obs date = 2010/03/12 @ 22Z
Observation
First guess
Analysis

Concluding remarks

- Pre-CONCORDIASI is a good test bed for the prediction of balloons-IASI collocations.
- The CISOS algorithms was designed to run automatically. However it is not fully secured and some monitoring is still needed.
  - Some human and data repository deficiencies have to be accounted for into CISOS to make it more stable.
  - Some drop schedules have been done without the help of CISOS, the other tools (CNES web site, Google Earth) allowing to recover from a CISOS failure. This will be more difficult over Antarctica.
  - Still the dropping failure cannot be accounted for automatically.
- The quality of the collocation has not been checked thoroughly yet.
  - This should be done as soon as the balloons have dropped all sondes.
- CISOS is nearly ready for Antarctica.

Acronyms and References

- References:
  - http://www.lmd.polytechnique.fr/VORCORE/McMurdo.htm
- Acronyms:
  - CISOS = **C**oncordias**I** drop**SO**unding **S**cheduler

Thank you !

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A special thank to P. Brunel, D. Puech,
M. Bradford & NCAR team, A. Hertzog