Targeting strategy for CONCORDIASI: satellite overpasses and meteorology

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Introduction

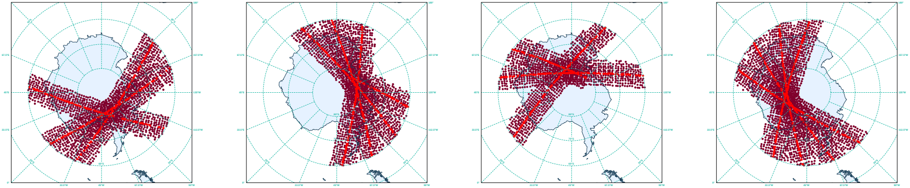
- **Plan:**

1. Satellite Overpasses
2. Adaptive observation and driftsondes
3. Sampling issue with mixed observing strategies

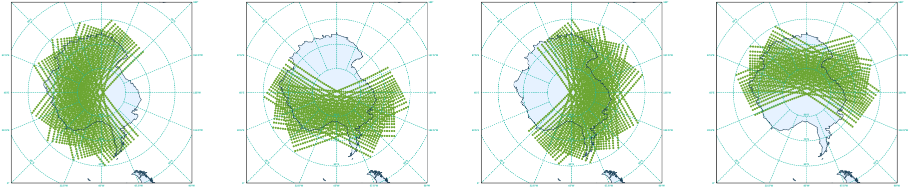
- **3 objectives related to the MSD flights:**
  - The primary objective of the driftsondes' flights is to collect soundings from dropondes when satellite overpass the balloons. Assimilation of IASI (and AIRS) profiles can be validated with independent in-situ soundings.
  - A secondary objective is to collect soundings from dropsondes in the space-time vicinity of a few dedicated radiosounding stations in Antarctica. The associated scientific issue is the characterization of uncertainties in measurements (dropsondes vs radiosondes).
  - A third objective is to deploy the soundings from driftsondes according to predictability criteria.

Satellite overpasses

AIRS (ARPEGE selection and ground track)



2008/10/31 at 00Z 2008/10/31 at 06Z 2008/10/31 at 12Z 2008/10/31 at 18Z



IASI (ARPEGE selection)

Satellite overpasses

IASI

- scans a part of the region every 100 minutes,
- the full swath of the satellite is useful, but sounding wise, the closer from the nadir the better the sounding,
- the ground track of AIRS crosses the swath of IASI every 3.5 days, the combination of the 2 satellites with dropsonde is of high interest.

Dropsondes schedule and satellite overpasses

- the dropsonding schedule is not really fixed, it should be adapted such as 4 dropsondes are deployed every 6 hours;
- main soundings should occurr at about 0, 6, 12 and maybe 18TU (details given later);
- a given sounding may be postponed or anticipated of about one hour to benefit from a better overpass context.

Dropsondes schedule and satellite overpasses

- **To schedule the release of dropsondes (24h ahead), we need :**
  - the prediction of AIRS's ground track and IASI's swath from CMS Lannion (Météo-France);
  - the prediction of the locations of the balloons.
- A filter will optimize the release of sondes, according to the time sequence of swaths and balloons' drift.

Adaptive observation

- Adaptive observation consists in deploying a few additional observations, locally.
- The assimilation of these extra data aims at improving the subsequent forecast.
- The use of objective techniques allows to optimize the deployment.
- Adaptive observation is also called *observation targeting*.

- **Few examples of field implementation:**

  1997 FASTEX (**FR**onts and **A**tlantic **S**torm **T**rack **Ex**periment)

  1998 NORPEX (**Nor**th **P**acific **Ex**periment)

  2000 WSRP (**W**inter **S**torm **R**econnaissance **P**rogramme)

  2003 NA-TReC (**N**orth **A**tlantic THORPEX **Re**gional **C**ampaign)

  2006 AMMA (**A**frican **M**onsoon **M**ultidisciplinary **A**nalyses)

  2008 Eurorisk-Preview DTS (***D**ata **T**argeting **S**ystem*)

Adaptive observation

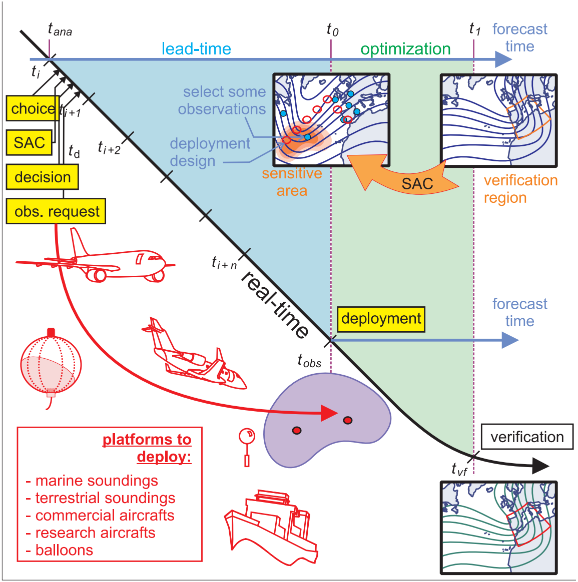
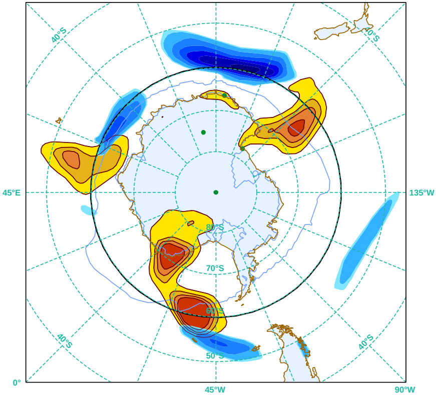


Diagram of real time adaptive observation as used in mid-latitudes cases.
In the case of CONCORDIASI, a few changes apply:

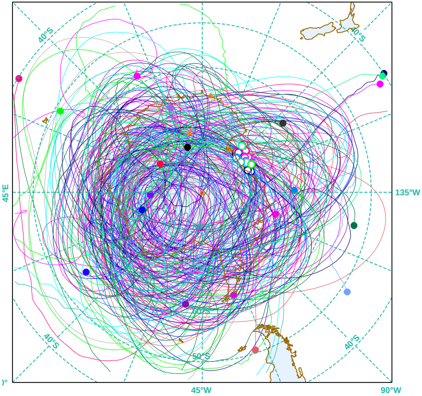
- no chase of specific meteorological case: the verification box is fixed, as well as the lead and optimization time,
- all the observing platforms (driftsondes) are already on site,
- the deployment of the dropsondes is based on a trade-off between predicted locations of the balloons and of the sensitive areas as well as dropsonde availability.

Sensitive areas in Antarctica

Case of 2008/10/31 at 18Z (+24h)



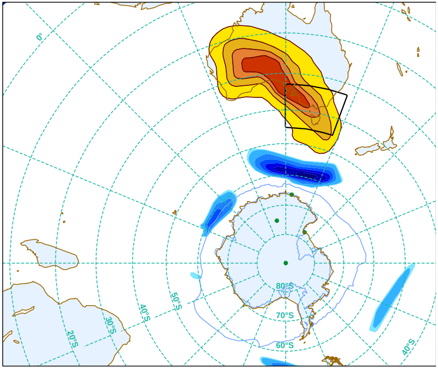
Trajectories of balloons during Vorcore



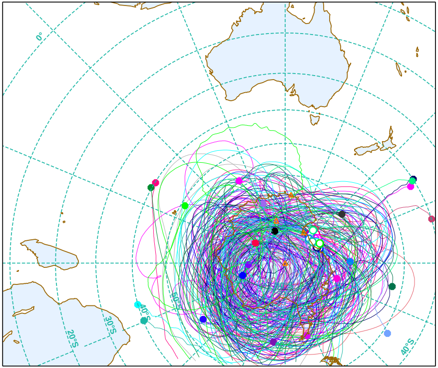
- Sensitive areas are thrown off Antarctica, but should be flown over by drift-sondes.

Predictability at lower latitudes

Case of 2008/10/31 at 18Z (+24h)



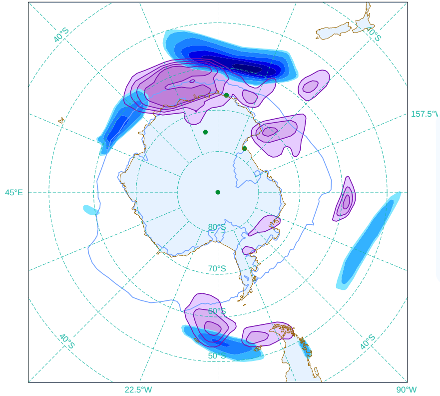
Trajectories of balloons during Vorcore



- Difficulty to integrate driftsondes in a Tasmania/Australia adaptive observation procedure (at least with similar settings than before).
- Consider the impact of the polar observation change on the lower latitudes through denial experiments.

Other targeting techniques ?

- Kalman Filter Sensitivity



- KFS accounts for the routine observation coverage.
- Computation cost is similar to the cost of SVs.

Hypothesis for data sampling

Few hypotheses:

- The deployment will consist in 13 driftsondes, each one being fitted with a gondola/container of 54 dropsondes.
- The lifetime of gondolas is approximately 6 weeks (42 days).
- The launch of driftsondes starts on September 11^{th} 2009, the last launch should not occurre later than the October 31^{st} 2009.
- 50 dropsondes per gondola are dedicated to first and third objectives. 4 per gondola (52 in total) are kept to assess the data uncertainties with radiosounding from the ground (second objective).
- The sampling starts only when 4 driftsondes are flying (at least), in order to guarantee a minimal spread of the platforms above Antarctica.

Which sampling strategy ?

- IASI vs. predictability:
  - 4 weeks of deployment to match IASI overpasses, then predictability,
  - IASI & predictability mixed, 18 UT being dedicated to predictability,
- Launch frequency of driftsondes:
  - either every 2 days (max) or at least every 3 days (list of dates) ?

- Example of list of dates of launch for the 13 MSD balloons (at Mac Murdo).

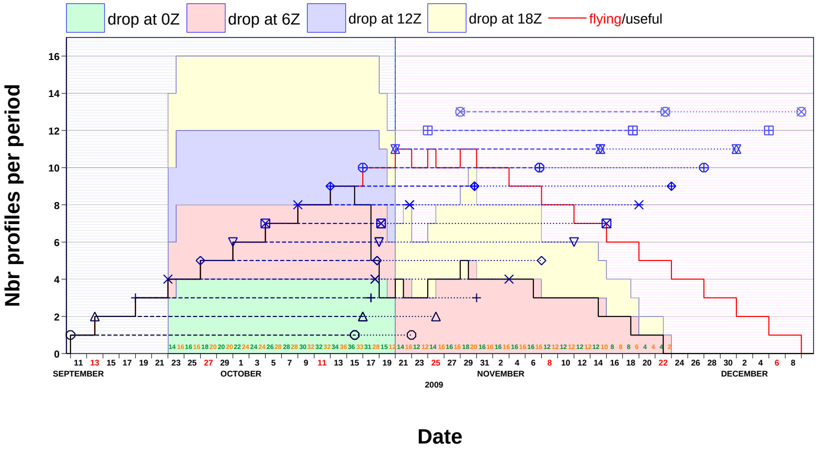
Schedule for the launch of driftsondes

Drifstonde	Date	Drifstonde	Date
1	20090911	8	20091009
2	20090914	9	20091013
3	20090919	10	20091017
4	20090923	11	20091021
5	20090927	12	20091025
6	20091001	13	20091029
7	20091005		

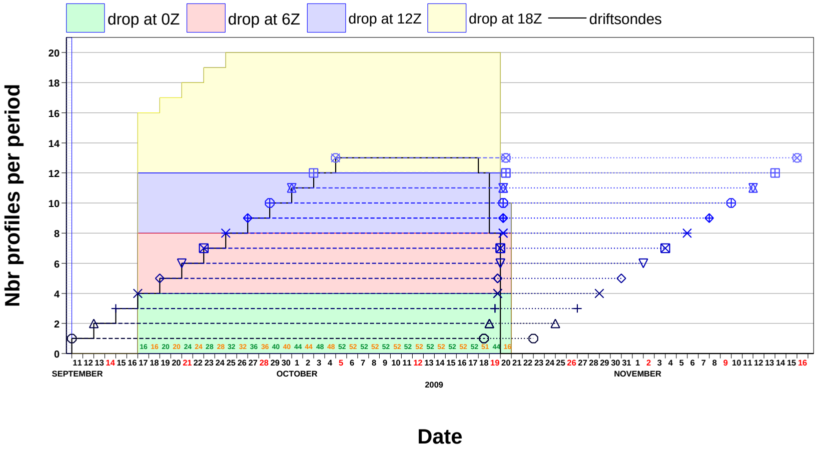
Other issues ?

- Management of the dropsondes: Optimize the use of sondes according to a criterion combining the age of the gondola and the supply left.
- Verification of adaptive observation theory: The deployment of sondes according to a sensitive/insensitive area criterion would allow to verify, in impact studies, that the targeting procedure was useful.
- Duration: For both IASI and predictability objectives, the observed period should be sufficiently long. 4 weeks of data should suffice.

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.



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.



Conclusion

Few elements:

- From the targeting point of view, we are interested in having as many flying balloons as possible. We expect that the coverage/spread would be reasonable.
- Predictability is not the first objective. Shifting this activity at the end of the period (which is motivated by the meteorology) would be detrimental.
- If the launch frequency can reach one balloon every 48 hours, the predictability process may deploy up to 8 dropsondes a day.
- The optimization of the supply may be organized in order to avoid losing sondes at the end of the life of the gondola.
- We plan to predict the schedule of dropsondes up to 24h in advance, but this requires input from other parties (predicted position of driftsondes and predicted swaths).

...any questions ?