



Koninklijk Nederlands
Meteorologisch Instituut
Ministerie van Infrastructuur en Milieu

ASIST-WA2: Observations and NWP

Siebren de Haan



Data assimilation and observations:

- High quality
- High density
 - Scales of your model
- All parameters

Not realistic!!

Contents



ASIST

outcome of Phase-1

Current Observation Data Set

Conclusions/Remarks

(Discussion?)



ASIST is phase2 of “e-nowcast”

ASIST is lead by ZAMG

ASIST: Application oriented analySIS and
very short range forecasT environment

members:

AT BE CH CZ DE DK EE ES FI HR
HU IE IS IT LU LV NL NO PL PT
RS SE SI SK



what did we do in phase-1?

Questionnaire on the observations
for NWC purposes

The purpose of this questionnaire
was:

Exploration of existing and
forthcoming observing systems
useful in nowcasting, and to

Assessment and interpretation of
observation requirements

EUMETNET Nowcasting Activity Questionnaire WA2: Observation and NWP

For the first time, EUMETNET includes an Activity dedicated to nowcasting (weather forecast for the next 0 to +6 hours) within the Forecasting Programme. The Nowcasting Activity proposes a European wide enhancement and cooperation on nowcasting in a two-phase approach, and the first phase lasts 18 months, from January 2013 to June 2014. In this period, the feasibility of nowcasting cooperation within EUMETNET and requirements and/or priorities of joint developments on nowcasting systems will be investigated. The main deliverable of the first phase will be a well-defined approach for the second phase in which the actual nowcasting development work will start. Following the EUMETNET mission, one major aim is to propose an approach to achieve optimized, integrative and extended objectives in the Nowcasting Activity by sharing of individual and joint capabilities.

The focus of the first phase of the Nowcasting Activity (lasting until 30 June 2014) is on making inventories of current nowcasting practices within the EUMETNET community and of collecting nowcasting requirements of the members. Using the inventory results recommendations and plans for the second phase of the Nowcasting Activity will be formulated.

The purpose of this questionnaire is:

- Exploration of existing and forthcoming observing systems useful in nowcasting, and to
- Assessment and interpretation of observation requirements

You are kindly invited to complete this questionnaire and return it to by **24 August 2013** at the latest.

You are also invited to forward this questionnaire to other institutions (e.g. DLR, universities) which are active in the field of Nowcasting.

For further information, please do not hesitate to contact Siebren de Haan (Siebren.de.Haan@knmi.nl).

Please be as detailed as possible in your answers.

Name of organization: KNMI
point of contact: Hidde Leijnse (hidde.leijnse@knmi.nl)



What was the question?

1. What kind of existing observations (surface/upper air) do you think might be/are useful for Nowcasting?
2. What kind of new observing systems do you expect to become available within 4 years for NWC purposes at your institute
3. What are/will be the specifications of these systems? (Parameter, Availability, Accuracy, Observation frequency, Horizontal distribution, etc)
4. What kind information is lacking with the current NWC/NWP observation system (wind/temperature/humidity...)?
5. Please provide, when appropriate, additional comments/suggestions with regard to future observing systems

outcome questionnaire on observations



Parameter	System	Observation frequency	Horizontal distribution
Temperature, humidity, wind, clouds, pressure	AWS	10min	1 obs every 1000 to 2000km ²
Low level wind speed and direction	Wind profilers		
Wind, temperature	Mode-S EHS	1-10minutes	500m
Wind and reflectivity	X-band radar	7.5 minutes	100-500 m
Rainfall intensity	Rain gauges	(sub) Hourly	1 per 2200km ²
Rain/droplets sizes (hail, graupel, wet and dry snow, birds, insects, clutter etc.,)	DUAL Polarimetric radar	high frequency scanning	<250m 1degree
Rain and lightning products	MSG/MTG VIS/IR	15 minutes	5 x 6 km ²
cloud- to-ground / cloud-to-cloud	Lightning detector		
Air pollution	Air pollution station		

What should we do in ASIST-WA2?



M2.1 Definition of case studies/experiments.		31.3.2016	1.10.2016
Action	Responsible	Timeline	completed
Identification and suggestions of relevant projects/studies, e.g. INCA-CE, OPERA, EDHIT, ...	WA2 ET	31.1.2016	40%
Contact relevant key persons of projects to evaluate cooperation.	WA2 ET	29.2.2016	0%
Approval of suggested projects by ET	ET	31.3.2016	0%

M2.2 Completion of experiments.		30.11.2016	
Action	Responsible	Timeline	
Contact and information exchange with selected projects.	WA2 ET		
Questionnaires to be filled in by project representatives	WA2 ET		

M2.3 Report on the benefit of cross-border data exchange and propose a technical specification on data exchange.		31.12.2017	
Action	Responsible	Timeline	
Summarize information from questionnaires.	WA2 ET		
Cooperation with observation programme	WA2 ET		
Reporting	WA2 ET		

Nowcasting projects



(incomplete) list of projects that have some kind of nowcast focus (last update 2016/04/25)

EDHIT	European Demonstration of a rainfall and lightning induced Hazard ...	EU
EUMETSAT-project	extreme convective cases - the use of satellite products for storm ...	EUMETSAT/IMWM
Forecasting	Forecasting eumetnet.e	EUMETNET
HYMEX		
INCA-CE	INCA-CE	EU/AUT
MTG-IRS demo		EUMETSAT
Nowcast-DE	nowcast - Meteorological Service ...	DE
NWCSAF	Automatic cloud analysis - the Nowcasting SAF project SMHI	EUMETSAT
OCN	RAL Aviation Oceanic Convection Diagnosis and Nowcasting	USA
PLURISK	Nowcasting research in the PLURISK project - Radar and ...	BE
project	Lake Victoria Pilot project for severe weather nowcasting TAHMO	INT
RainGain	Precipitation nowcasting at Finnish Meteorological Institute - RainGain	FIN
SCOPE	SCOPE- Nowcasting Pilot Project 3: u201cPrecipitation / Severe Rainfall ...	WMO

Send more information to siebre.de.haan@knmi.nl

Cross border data exchange



In the table below an overview is given on projects that have some kind of data exchange (last update 2016/10/02)

	URL	data	availability
EDHIT	http://edhit.eu	Radar precipitation	yes? ftp?
EUMETNET-GVAP	http://egvap.dmi.dk	Ground based GNSS	ftp/GTS
EUMETNET-ADD	http://mode-s.knmi.nl	Aircraft Derived Data (T,ff,dd)	ftp
HYMEX	http://www.hymex.org	all kinds	?
INCA-CE	http://www.inca-ce.eu	Radar precipitation Surface observations	yes?
MTG-IRS demo	N/A	IASI L2 T,q	ftp EUMETCAST terestial
Nowcast-DE	https://www.nowcast.de	Lightning	?
NWCSAF	http://nwcsaf.org	Satellite data	ftp EUMETCAST
OPERA	http://www.eumetnet.eu/opera	Radar data (refl, Vrad)	ftp GTS
SCOPE	http://www.wmo.int/pages/prog/sat/scope-nowcasting_en.php	Satellite data	?

Send more information to siebren.de.haan@knmi.nl

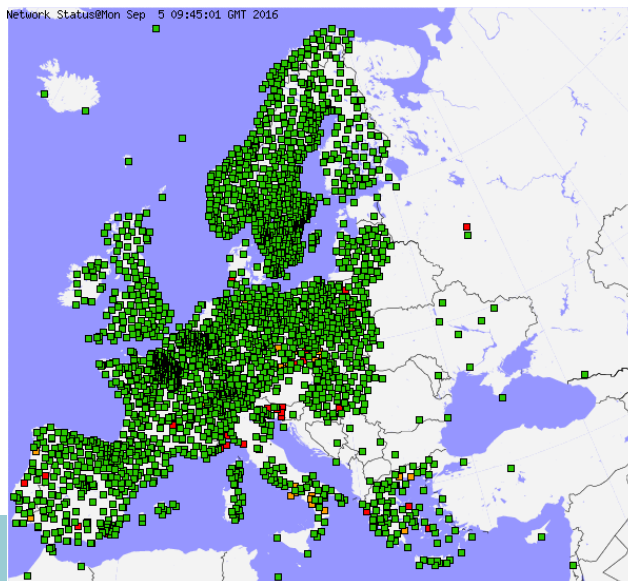


Data assimilation issues related to nowcasting

□ Observations in general:

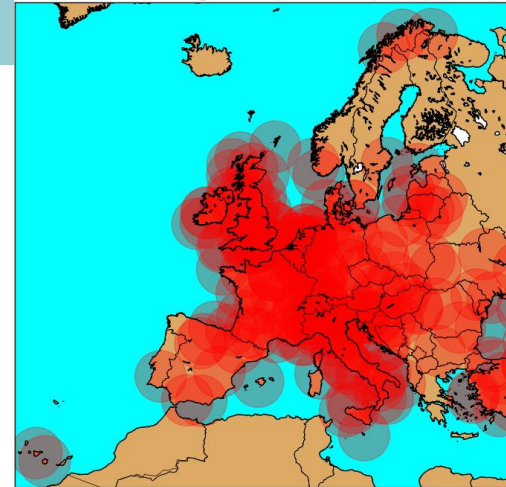
- For meso-scale, there is an observation problem
 - ✦ inadequate gaps
 - ✦ vertical structure
- Optimal use of radial velocity on storm scale
- Better information on cloud base height
- *more Remote Sensing*

Higher resolution measurements on shorter time scales- 1 min
E-GVAP

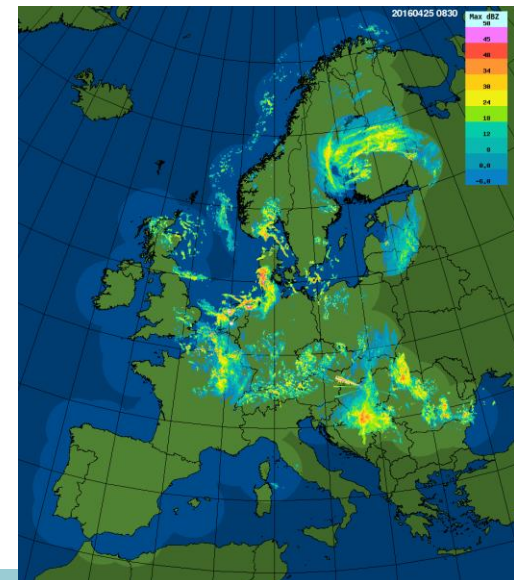


Mode-S EHS

Current Mode-S Interrogator Code Allocations (dd. 28/08/2015)



OPERA

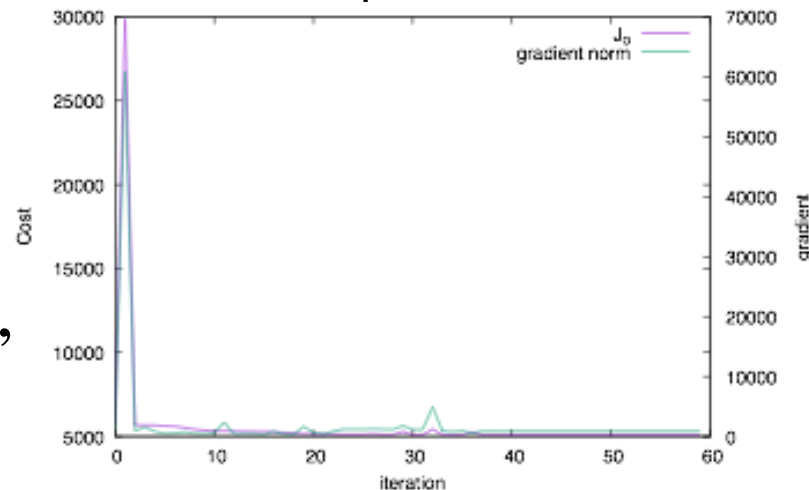




Data assimilation issues related to nowcasting

- Observation handling:
 - eg. AMDAR temperature, OPERA data
- Nonlinear observation operator may introduce large errors when bad first guess,
- Observation thinning or superobbing may be necessary,
- Correlated observation errors

example of STD





AMDAR temperature bias:

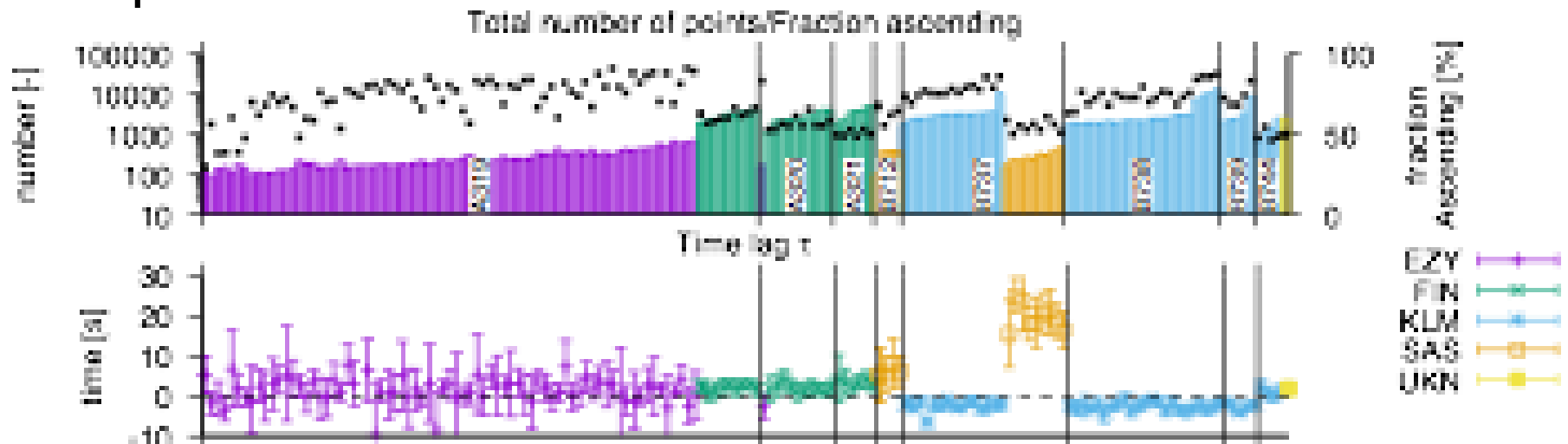
Part of the bias can be explained by synchronisation problem of height and temperature:

$$\Delta T = \Gamma \frac{dH}{dt} \tau$$

aircraft altitude rate

T lapse rate

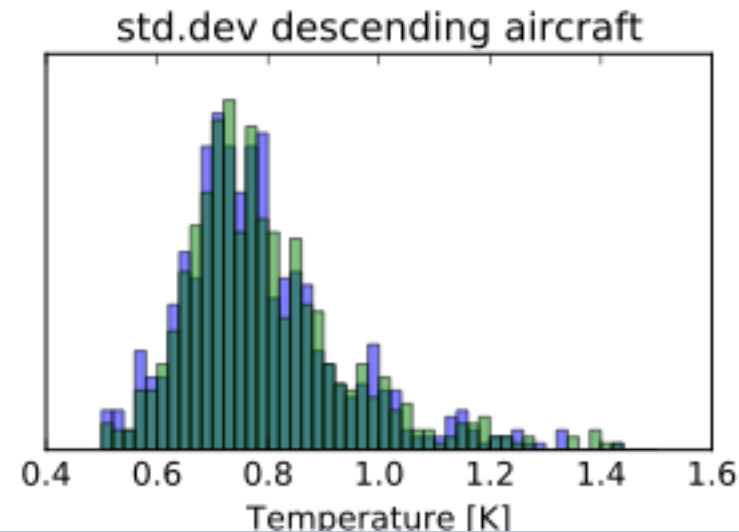
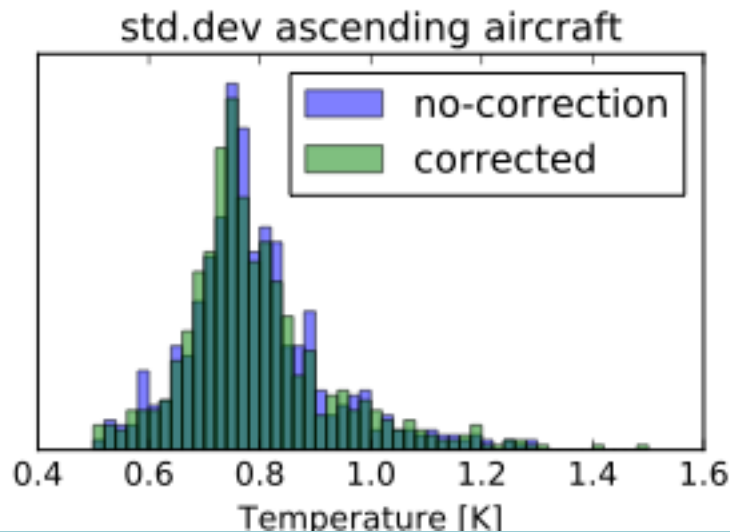
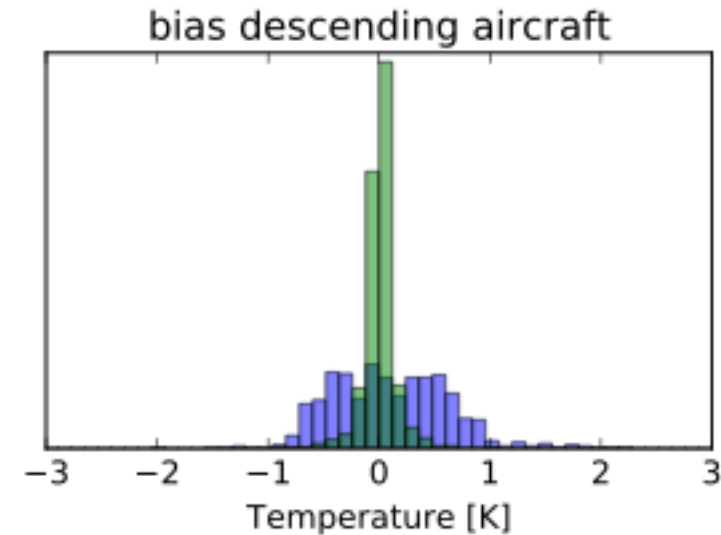
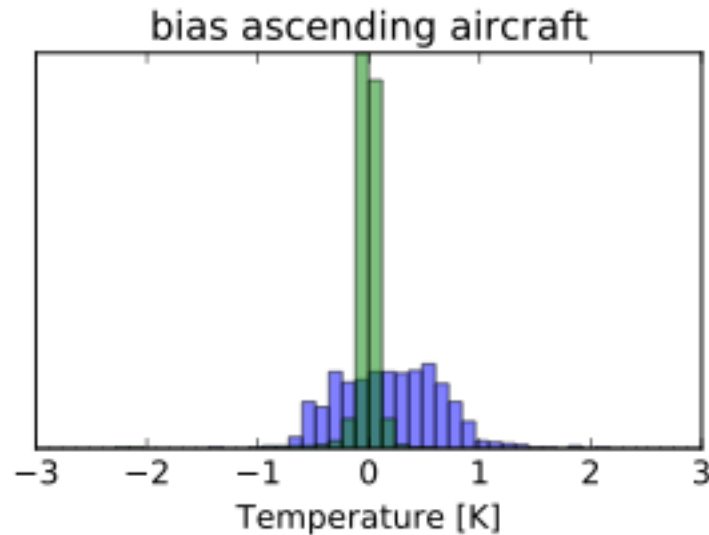
time lag



T bias correction



bias
correction
per AMDAR
flight-phase
independent



Observation handling (2)



OPERA hdf5 data:

Reflection data widely used

Radial velocity seems to have quality issues

for example MeteoFrance uses its own format for the French radars because this format contains more (meta) information

> How can we tackle this?

Observation handling (3)



Third party data:

- AMDAR
- GNSS observations
- Mode-S EHS/MRAR
- WoW

Quality/Accuracy (pre-processing!?)



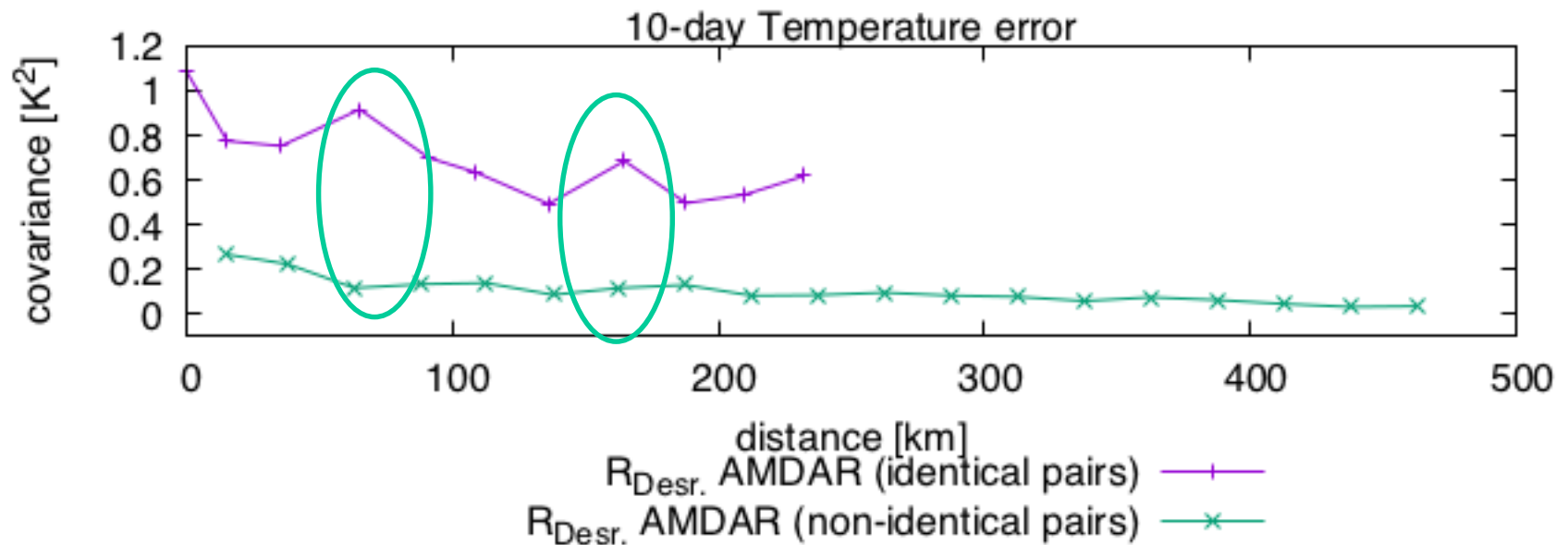
Data assimilation issues related to nowcasting

- ☐ Observation handling:
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- ☐ Correlated observation errors



Desroziers method used to investigate
AMDAR-T shows (@200hPa)

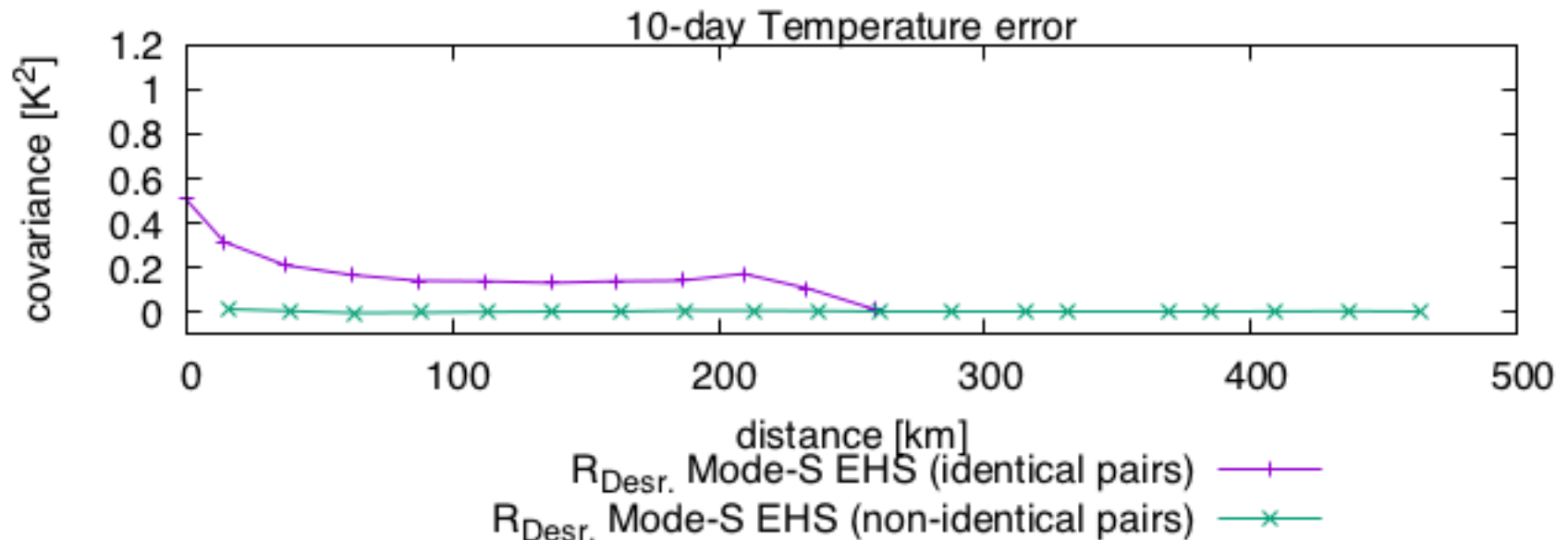
- a strong correlation between identical pairs, and
- a weak correlation between non-identical pairs





Desroziers method used to investigate Mode-S EHS T shows (@200hPa)

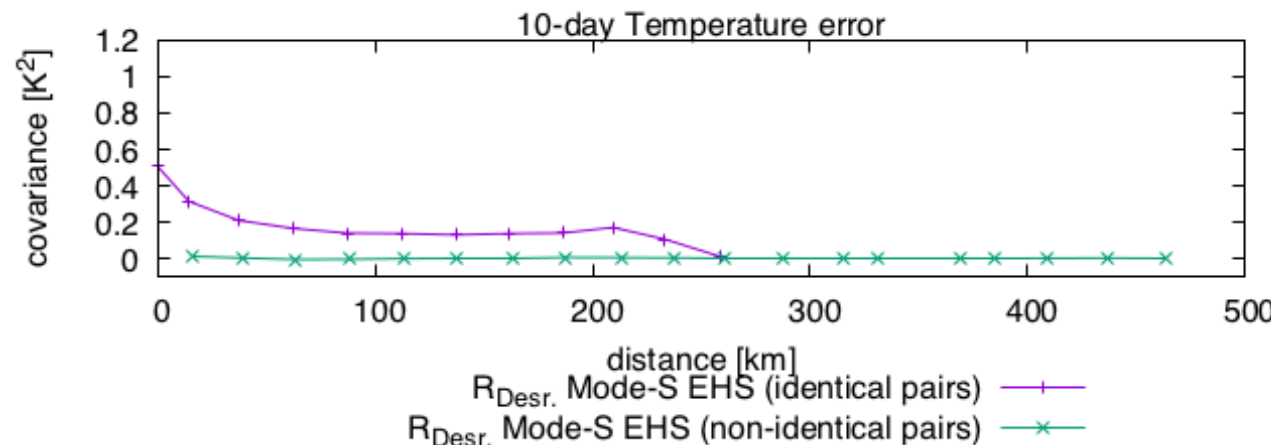
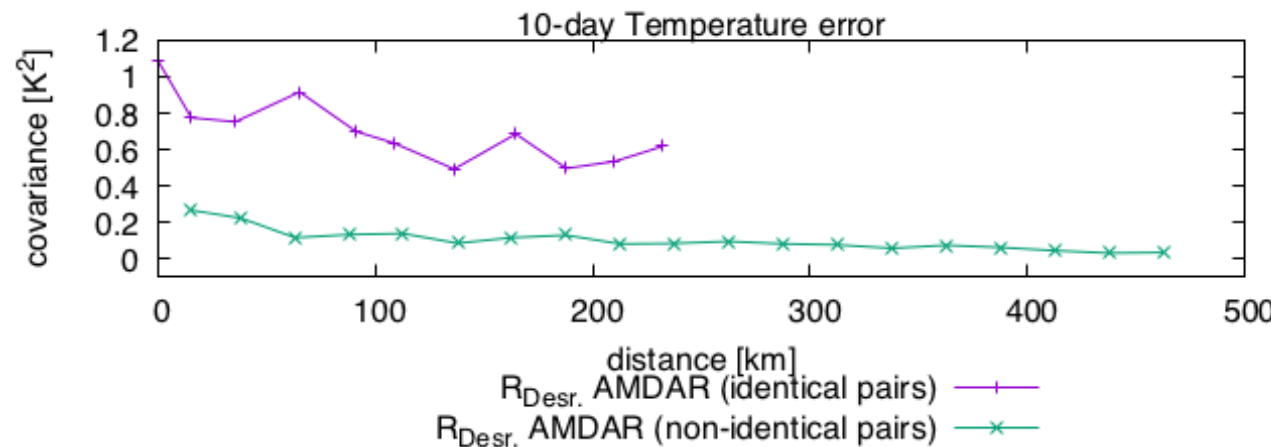
- a correlation between identical pairs, and
- no correlation between non-identical pairs



T correlation



AMDAR T error
correlation:
most likely
related to T bias





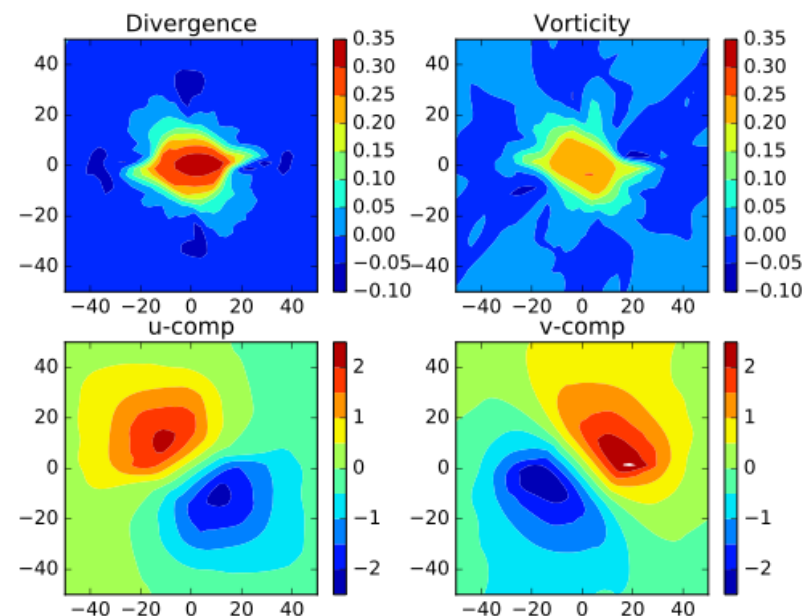
Assimilation system:

- Need a 4D data assimilation system to get large scale as well as convective/storm scale
- Need for very frequent (at least every 1 hour or faster) assimilation to capture meso scale events (e.g. small scale severe convection)

Background error covariances

- flow dependent background error covariances (e.g. ensemble based methods or ensemble Kalman Filter based methods)

Desroziers HBH^T



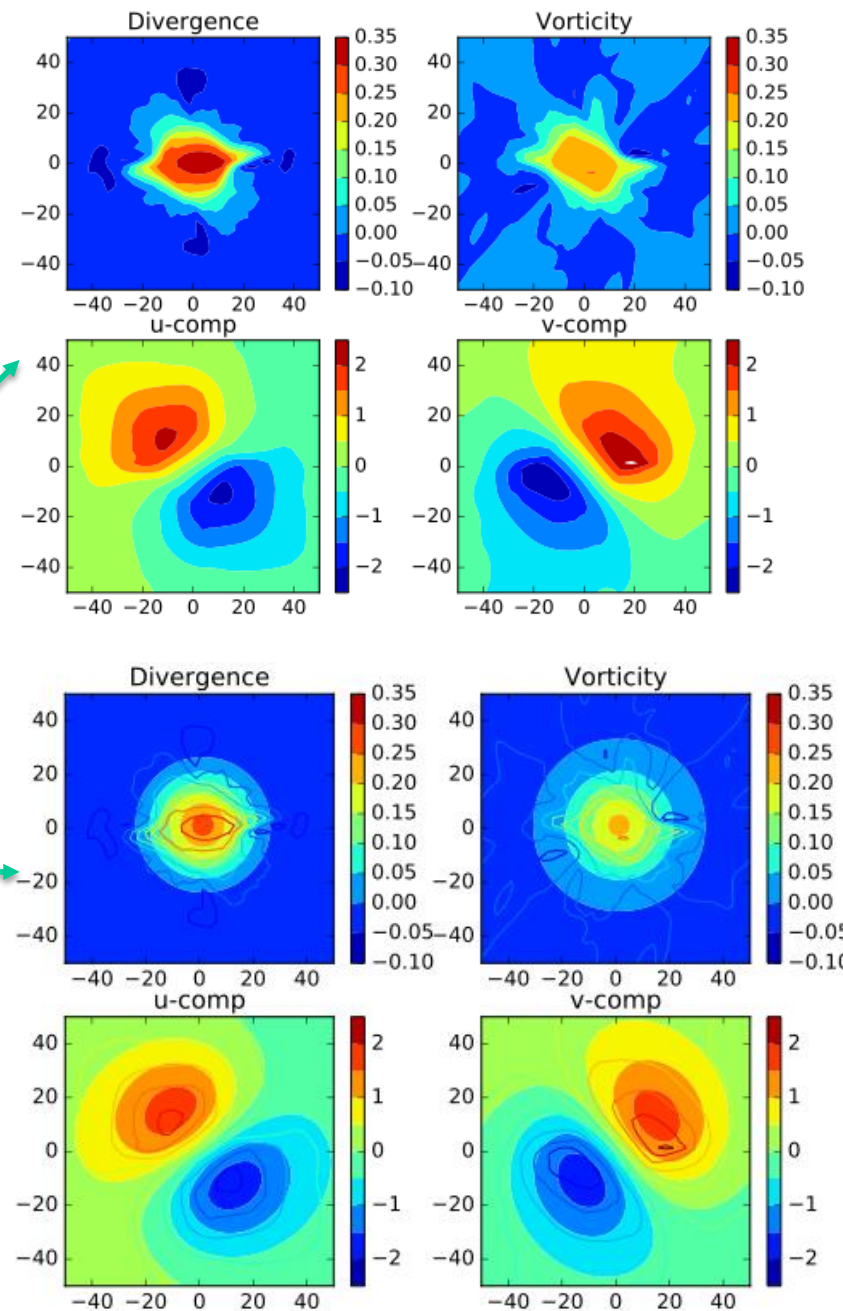
Desroziers B



A single day of Mode-S
EHS observations in
Harmonie @ 200hPa

observations:
non-isotropic Div + Vor

model is isotropic





Necessary nowcasting model improvements:

- Model physics biases, especially the planetary boundary layer
- Microphysics
- Poor humidity forecasts
- Poor boundary layer forecasts
- More research needs to be devoted to Probabilistic versus Deterministic forecast (e.g. 4 km ensemble versus 1 km deterministic)



We should exchange not only data but also procedures or techniques to improve the quality of the observation

Exploit the current data sets to full extend:

- Observation errors
- Background errors



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Questions?
Comments?
Discussion?