Observation impact of dropsonde data in the ECMWF model during T-PARC 2008

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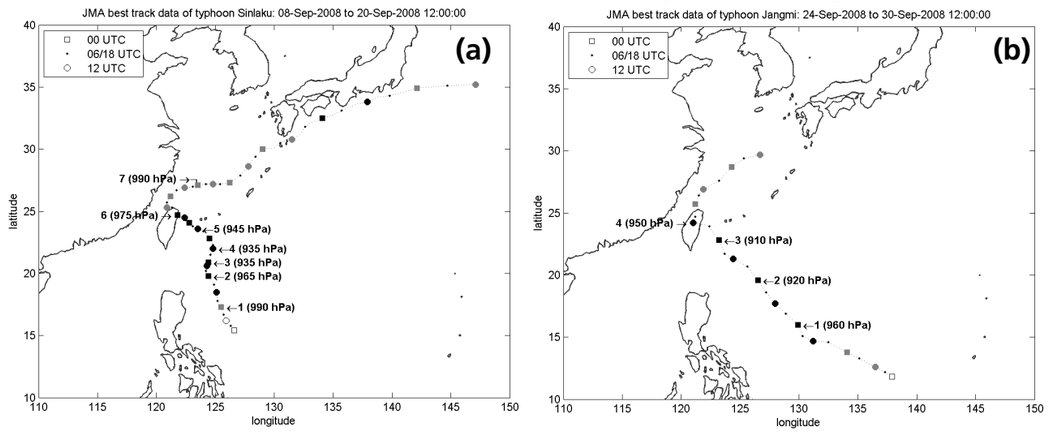
Introduction

- During the THORPEX-Pacific Asian Regional Campaign (T-PARC) in 2008 dropsondes were released for the purpose of targeting typhoon systems in the West Pacific
- Joint missions were conducted, with simultaneous dropsonde observations in the typhoon center and core, the typhoon vicinity and in remote sensitive areas by four aircraft
- Data denial studies are performed to evaluate the impact of the dropsondes for typhoon track forecasting with the ECMWF global model
- Dropsondes are separated into observations located in the typhoon vicinity ('CeObs'), next to the center and core of the typhoon ('CeObs2'), and in remote sensitive areas ('ReObs') → impact of different subsets of observations

Experimental Setup

- ECMWF global model: operational version from March 2009 (special thanks to C. Cardinali, F. Prates, I. Mallas, M. Dragosavac, ECMWF)
- Horizontal resolution: T799, 91 vertical levels
- Global 4-D Var, 12-h window, inner loop: T95 L91, T159 L91, T255 L91 (3 iterations)
- corrected dropsonde data set with one minute resolution observation time (time error up to several hours of dropsondes in the operational data set)

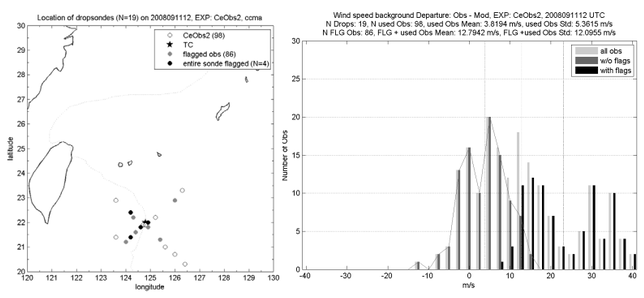
Best track data of typhoon Sinlaku and typhoon Jangmi



Best track data of (a) typhoon Sinlaku from 00 UTC 08 Sept to 12 UTC 20 Sept 2008 and (b) typhoon Jangmi from 00 UTC 24 Sept to 12 UTC 30 Sept 2008. Shading of markers indicate the intensity of the system: (white) tropical depression or extra-tropical system, (gray) tropical or severe tropical storm, and (black) typhoon. The central pressure is shown in brackets.

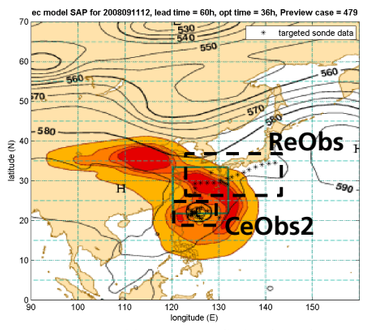
Data assimilation of core region soundings

- Dropsondes located next to the center and core region of typhoon Sinlaku
- Large positive difference of observed wind speeds to the first-guess field
- High percentage of observations get flagged and rejected

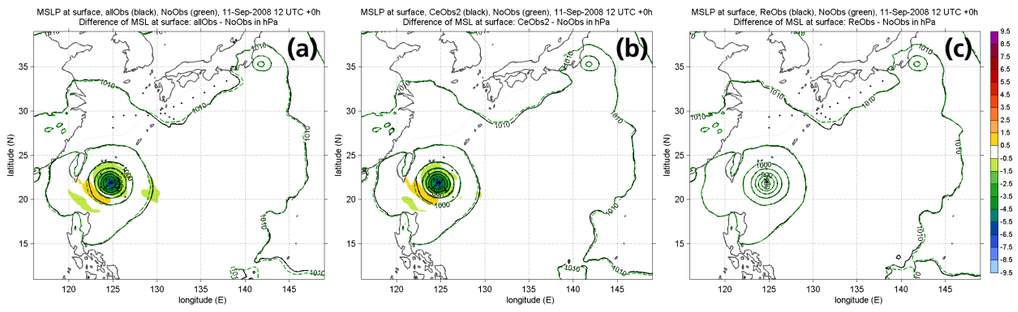


Observations, analysis impact: typhoon Sinlaku

- 12 UTC 11 Sept 2008: typhoon Sinlaku located east of Taiwan, uncertainty in the models about landfall and recurvature
- Joint mission: observations in the core and center region of the typhoon as well as in remote sensitive areas, located North of the typhoon
- Small analysis impact on the mean-sea-level pressure fields of soundings in remote areas
- Much larger analysis impact of soundings from the core and outer region
- Analysis impact similar for other model variables

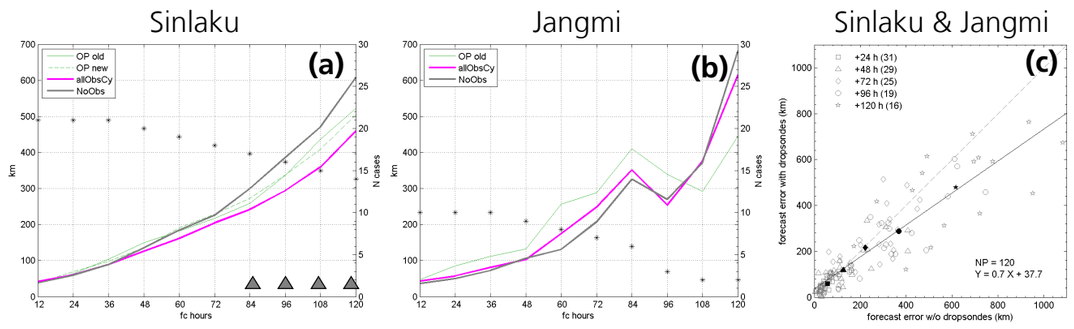


ECMWF sensitive area prediction based on TE-SVs (moist TL95) and Z500, overlayed with location of dropsondes.



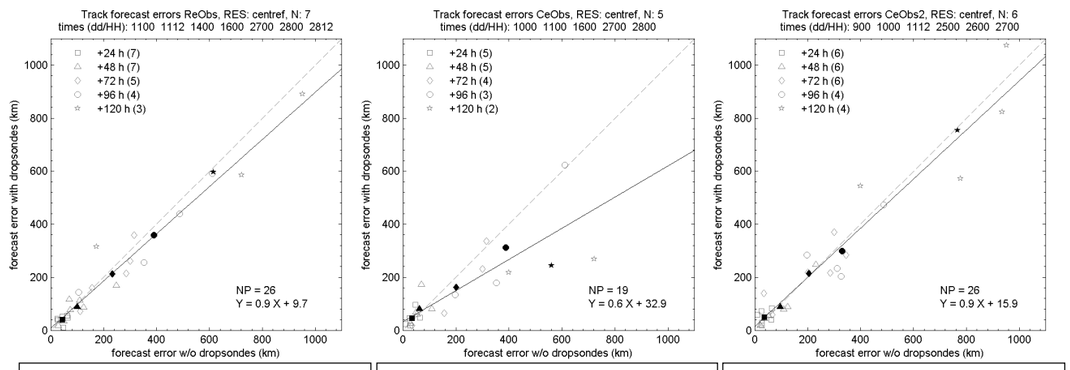
Analysis difference (hPa) of mean-sea-level pressure (MSLP) fields at 12 UTC 11 Sept 2008 for the different experiments. The data denial experiments using (a) all soundings, (b) soundings next to the core and (c) soundings in remote sensitive areas, are compared to the experiment without any additional soundings. Negative values indicate lower MSLP in the experiment.

Mean track forecast errors for the period - all observations



Mean track forecast errors for (a) Sinlaku (00 UTC 09 Sept - 00 UTC 19 Sept) and (b) Jangmi (12 UTC 24 Sept - 00 UTC 29 Sept). In (c) the single track forecast errors for both systems are plotted. Gray shaded triangles in (a) and (b) mark differences of mean track forecast errors between 'allObsCy' and 'NoObs' being statistical significant on the 95% confidence level.

Subset of observations



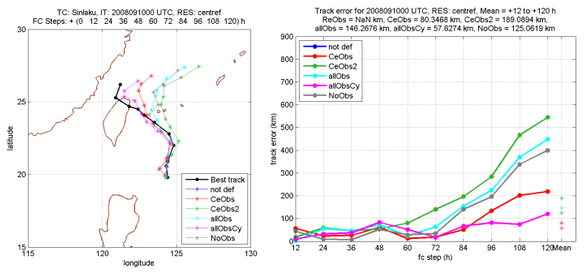
'remote' sensitive regions | typhoon vicinity | typhoon center and core

- On average positive impact for Sinlaku (differences pre- and post-recurvature stage), neutral impact for Jangmi (small sample size for larger forecast steps)
- Remote observations in sensitive areas show a small positive to neutral impact of the track error reduction, with only very few outliers
- Observations in the vicinity of typhoons (e.g., surrounding the typhoon) produce an average improvement of the track forecast
- Core observations lead to an overall neutral impact, with positive and negative outliers

Track forecasts:

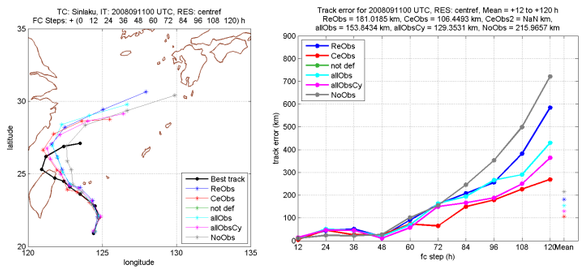
<u>00/09 Sept</u>, **<u>00/10 Sept</u>**, <u>00/25 Sept, 00/26 Sept</u>

- **Pre-recurvature stage** of development
- In general **positive impact** of the observations
- 00/10 Sept: problems with core obs



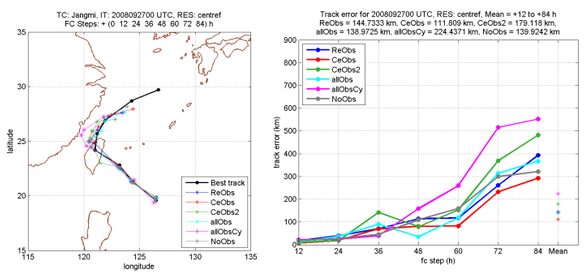
<u>00/11 Sept</u>, <u>12/11 Sept , 12/12 Sept</u>

- Wrong position of recurvature without extra observations
- **Track forecast error is reduced** with extra observations
- **Timing error is not corrected** and becomes very large after recurvature (from +96 h onwards)
- Soundings in the typhoon vicinity show a larger impact than from remote sensitive regions



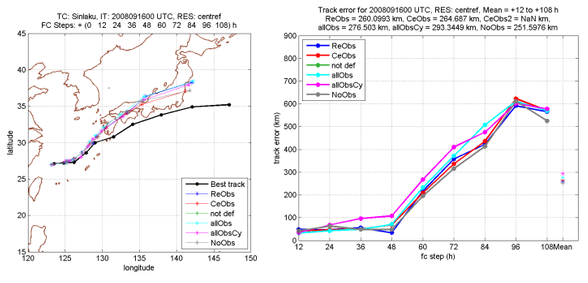
<u>00/27 Sept</u>, <u>00/28 Sept</u>

- **Correct position forecast of landfall and recurvature**
- Problems with propagation speed of the system after landfall/recurvature lead to **timing errors** → model deficiency
- **Small positive as well as negative impact** on acceleration after recurvature



<u>00/14 Sept</u>, **<u>00/16 Sept</u>**, <u>12/28 Sept</u>

- **Post-recurvature stage**
- Tracks of experiments are relative similar
- Modeling errors (land interaction, upstream flow) become more important for track forecasts → only **small impact**



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