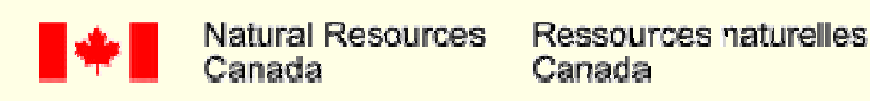# Use of Beaufort Sea oil platform weather data in an NCEP/NCAR reanalysis data (wind field) assessment project

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Abstract
The NCEP/NCAR Reanalysis project combines observational climate data with a weather forecasting model (referred to as "the model") to produce regular grids of climate data. In areas where the observational networks are dense, resulting Reanalysis grids represent well the observational situation. However, in data sparse regions the resulting grids reflect a greater relative contribution from the model. The Reanalysis data are designed to provide a time-series recreation, and not a statistical representation, of climatic parameters for given regions. Thus it is of interest to directly compare the Reanalysis results with observational data, with a view to assessing the fidelity of representation. Most suitably, data that were not involved in the original project should best illustrate an eutral test case.

A set of data ideal for this purpose exists from the southern Beaufort Sea. From the mid 1970s to the mid 1980s Dome Petroleum of Calgary (now Amoco) operated 37 oil drilling platforms in this region. While in operation these platforms conducted hourly observing programs to support synoptic weather operations, and during this period they gathered almost 200,000 observations. These data form and ideal set against which to make comparisons, for several reasons:
- they were not incorporated into the Reanalysis project
- they are hourly
- there were often several platforms in operation at a given time, allowing comparisons among the platforms
- they were situated fairly close together, roughly half-way between two Reanalysis grid rows, which facilitated comparison between the platforms and marine grid points and coastal grid points. This allowed an assessment to be made of the possible degree to which the Reanalysis data are influenced by proximity to land.

Results from comparisons between the platforms indicates a very high degree of wind direction correlation (~.95) and a high wind speed correlation (~.8 - ~.9). Correlation between platform data and Reanalysis data was higher for the oceangrid points than for the terrestrial/coastal grid points, suggesting the model is sensitive to terrestrial influence.

INTRODUCTION

The NCEP/NCAR Reanalysis project (NCEP: National Centre for Environmental Prediction; NCAR: Prediction/National Centre for Atmospheric Research) was undertaken to give to the science community accurate, high-resolution data sets for climatological work. The data sets produced by this project and by other similar efforts (such as the European Center for Medium Range Weather Forecasting reanalysis project) are known generally as "reanalysis data" (here, "NNR" data). The Reanalysis project combines an NCAR weather forecasting model and observational data from various sources. The distribution of climate observing sites over the earth is non-uniform, however, which means the influence exerted by the model on the final reanalysis data result is variable. The objective of this project is therefore to compare reanalysis data back to observed station data and to assess its ability to reproduce the observed record. This is especially important if the reanalysis data are to be used as the basis of analyses conducted in remote, data sparse regions, or if they are to be used as input to other models to derive secondary parameters, such as wave heights.

This paper presents limited results from a detailed comparison of NNR 6-hourly 10 mhag (meters height above ground) winds with observational hourly wind data obtained on oil drilling platforms from the southern Beaufort Sea over the period 1976 - 1985. The oil camp data set is a useful set against which to compare reanalysis data because a) there is a lot of data, b) the sites range in distance offshore from the coast, and c) the data were not incorporated into the reanalysis effort.

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Drilling at Tuk

DISCUSSION

The inter-platform correlations served to provide a theoretical upper limit on wind speed and direction correlations performed between any two stations. Differences in instrumentation and observing techniques were minimized and the resulting pattern observed in **B** are dependent only on distance effects.

Correlations between oil platform data and the closest reanalysis grid point, shown in **C**, revealed the opposite pattern. It was suspected this was an artefact of near-coastal effects so a more detailed examination was carried out to explore this.

In the final analysis, correlations were made between data from each oil platform location and data from all land-ward and all sea-ward reanalysis grid points. After control for directional bearing the following curves were obtained for sea-ward (**D1**) and land-ward (**D2**) grid point correlations. A separation is observed, in which correlations away from land exhibit a generally steady inverse relationship with distance, whereas for correlations towards land the same relationship breaks down as distance to land falls below ~100 km.

It is speculated that what is being observed is the influence of processes, including sea-breeze circulation regimes, that are associated with the land surface influencing data gathered by oil platform sites that are near the coast. Terrestrial processes act at resolutions and frequencies that are beyond the range of what the reanalysis model is designed to capture, and thus these stations show a drop in correlation in response to what is in effect a "decoupling" of the low-level boundary layer over land from the synoptic situation that the model is better able to represent. Data from oil platforms situated away from the coast are beyond the range of land-based processes, and instead capture more broadly-defined and slowly-varying ocean boundary layer characteristics. These operate at a scale the model is able capture, which results in data from these oil platform sites correlating well with the reanalysis data.

In general this work has suggested the following about the NCEP/NCAR reanalysis 10mhag wind fields: 1) near the coast, correlations are poor because the low-level boundary layer is generally decoupled from the larger-scale regime; 2) the greatest discrepancy is wind speed magnitude (see plot A); and 3) but away from the coast correlations improve, suggesting that use of the reanalysis (wind) data over the ocean would be less problematic than over land.
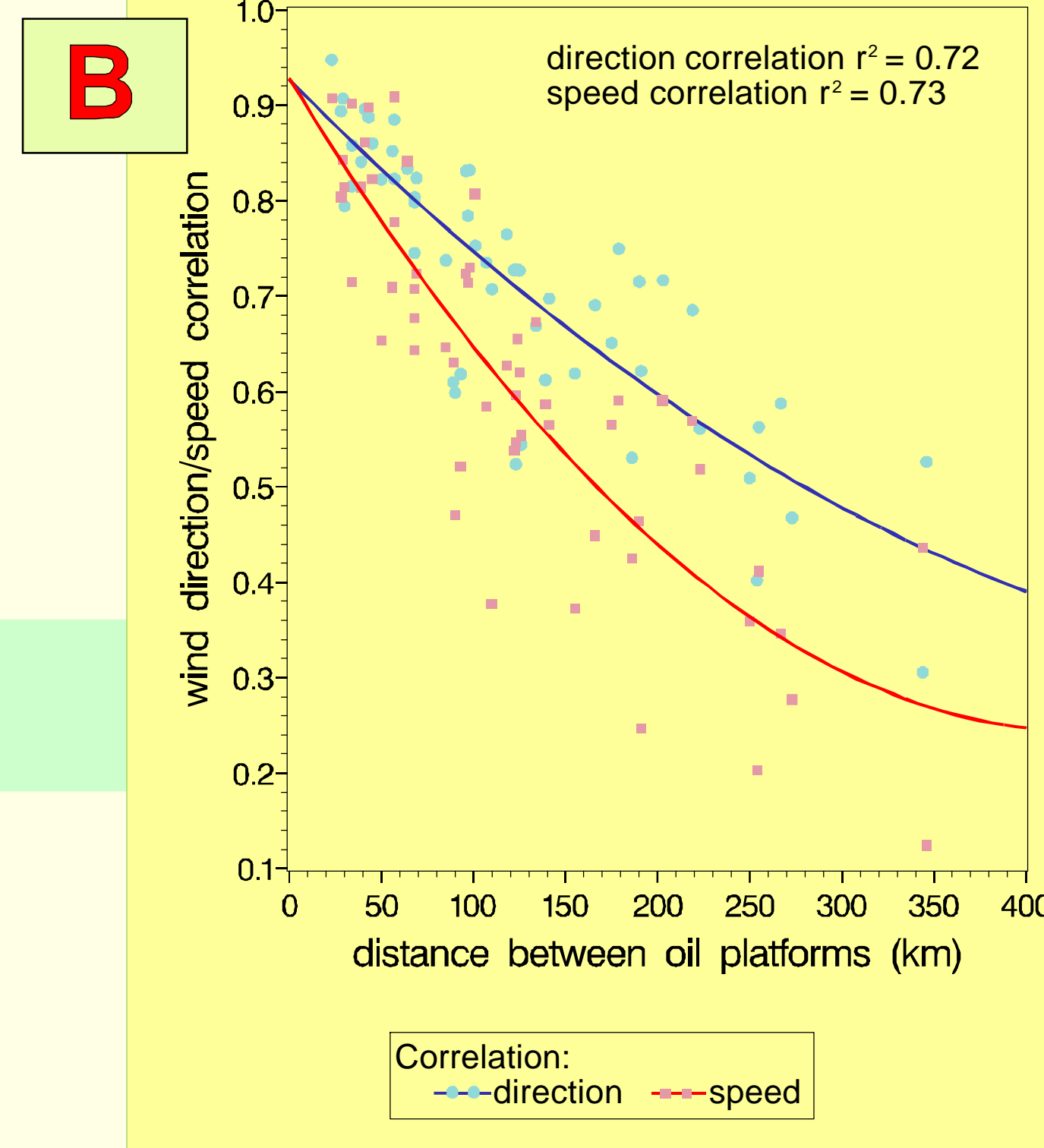
METHOD

Several analyses were performed for this project, and included generating wind speed and direction correlations for the following situations:
1) Inter-comparison of oil station data with each other, to determine theoretical maximums for correlations as influenced by distance effects only,
2) Comparison between an oil station site and the nearest reanalysis grid point, and
3) Comparisons between oil stations and all grid points, separated into land-ward and sea-ward groups.
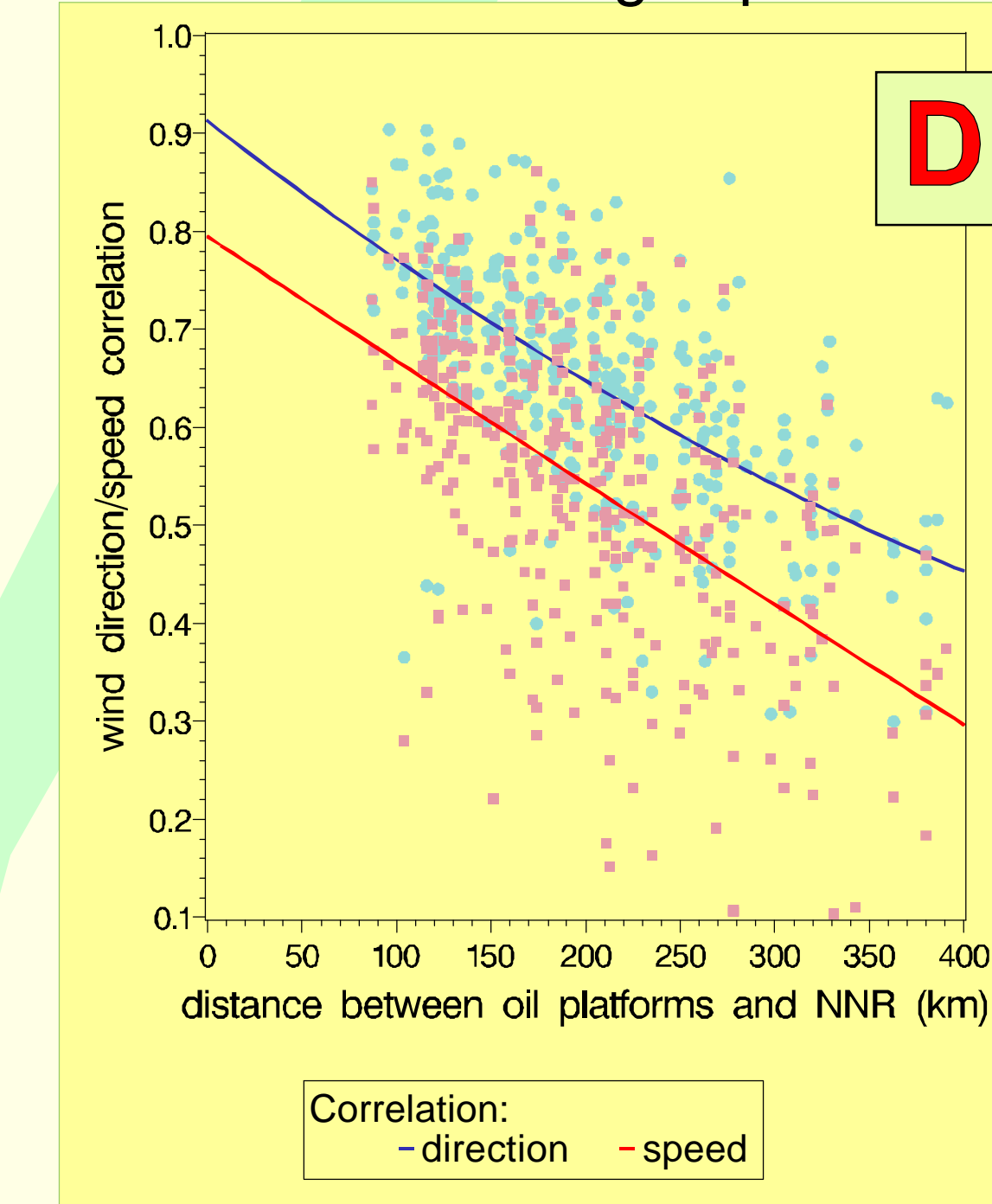
In general, the following steps were observed:
A: For coincident time periods data from two stations were retrieved (either two oil platforms or an oil platform and a grid point)
B: Correlations for wind speed and direction performed
C: Correlations plotted, or
D: subdivided by grid point location (i.e. land-ward or sea-ward) and plotted
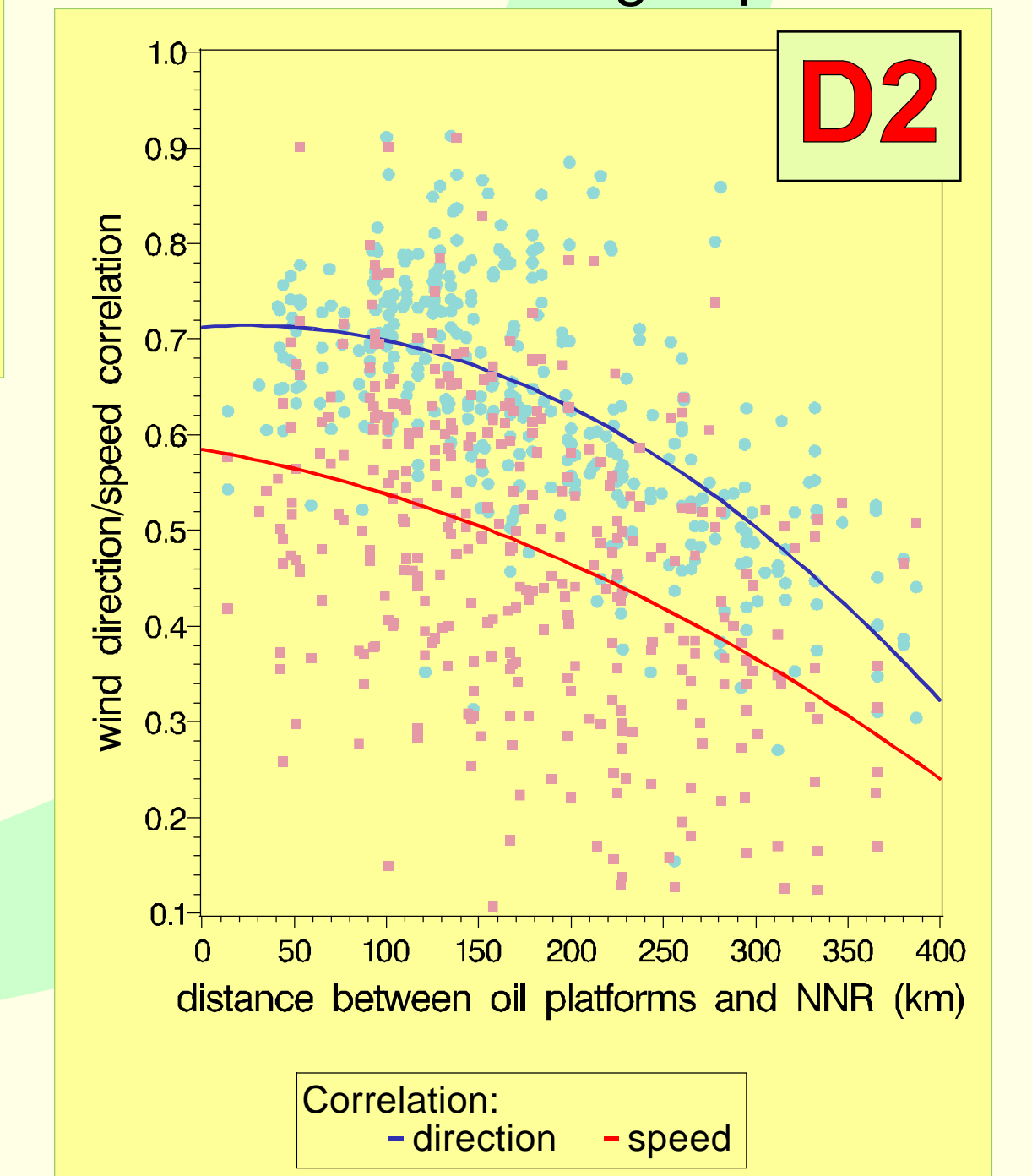

Beaufort Sea

Banks Island

Reanalysis grid point locations (seaward)

▲ Oil platform
— Closest Reanalysis grid point

Reanalysis grid point locations (landward)

Mackenzie Delta

Comparison between oil platforms and seaward NNR grid points

D1

wind direction/speed correlation

distance between oil platforms and NNR (km)

Correlation:
– direction – speed

Comparison between oil platforms and landward NNR grid points

D2

wind direction/speed correlation

distance between oil platforms and NNR (km)

Correlation:
– direction – speed

Raw data plot

A

Oil platform: "Tingmiark K-91"

wind speed (m/s)

Reanalysis grid #2042

date

Speed comparison:
— Grid point — Oil platform

Inter-platform wind speed and direction correlation

B

direction correlation r² = 0.72
speed correlation r² = 0.73

wind direction/speed correlation

distance between oil platforms (km)

Correlation:
—direction —speed

C Comparison between oil platforms and closest NNR grid point

wind direction/speed correlation

distance between oil platforms and NNR (km)

Correlation:
– direction – speed

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