ADCP data ranges from Oceanus and Wecoma

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DRAFT

ADCP and Wind data from two UNOLS Intermediate Class vessels were examined to try to get some idea of typical ADCP range on these ships, and how the range changes with sea state and ship speed.

Data presented are from the Ocean Surveyor 75kHz in narrowband mode with 16m bins. This is the typical setting for best range. The datasets included both the UHDAS ADCP complement and the shipboard data acquisition system measurements of relative wind speed and direction (including an estimate of true wind speed and direction.) Wind speed and direction are used as a proxy for sea state and swell direction.

1.

Wecoma: w1111b – a segment while they zigzaged northward up the coast into a wind from the north, stopping on station at each zig (or zag). The wind was from the north, i.e. a headwind.

1. As the wind speed decreased, the ADCP data range increased from 650m-700m (20kt winds) to over 750m (5kt winds).
2. When the wind was highest (20kts), the range was about 100m less when steaming than when on station.

Oceanus: oc1303xb – transit from Alaska to Oregon, constant heading and speed, but the wind spun through the compass headings during the cruise, generally decreasing (but with a bump for one day)

1. Higher wind speed decreases ADCP range.
2. Headwinds reduce range more than tailwinds (following seas)
3. Heavy weather decreased range form 750m (typical optimal) to 450m

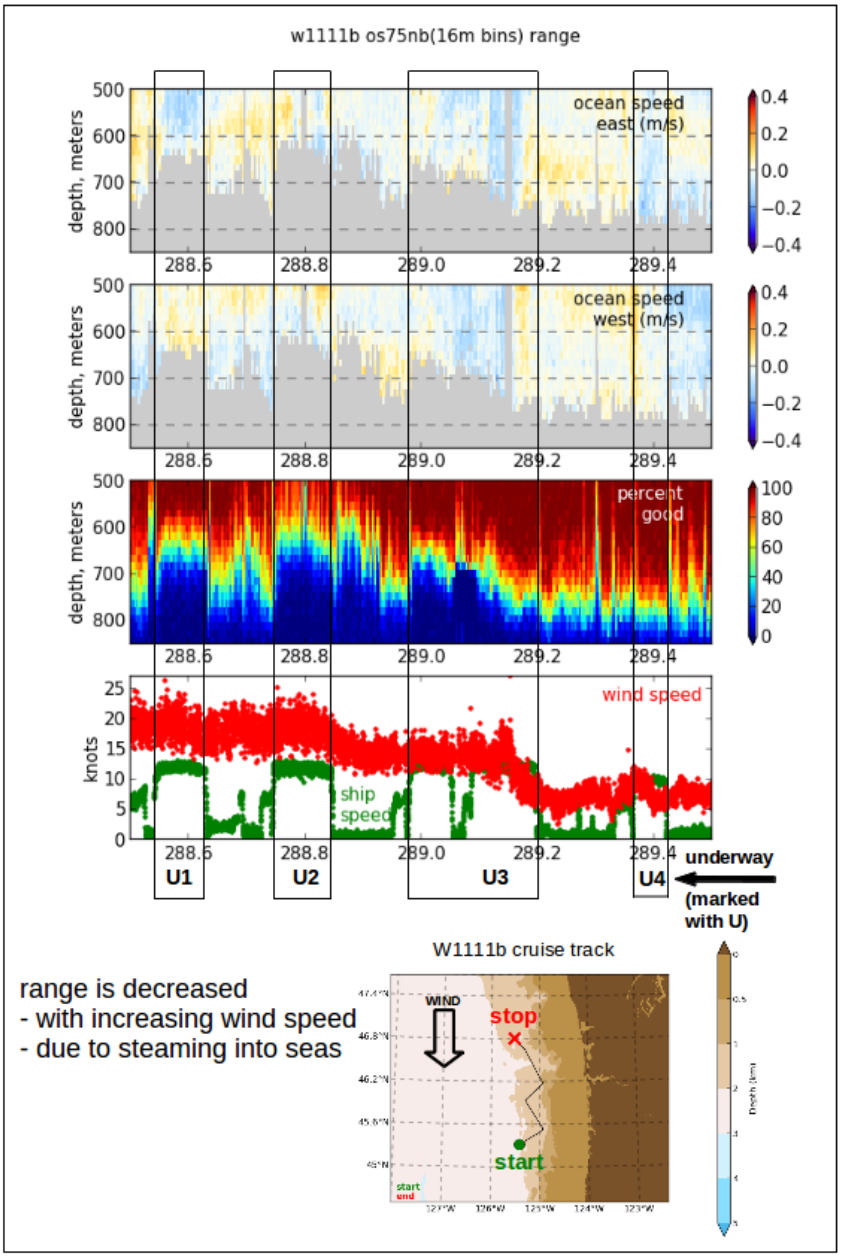
The summary is what one might expect:

- higher windspeed decreases range
- if winds are sufficient to decrease range, range is additionally damaged
    - as ship speed increases
    - as the ship maneuvers (sloshing and heaving, entraining bubbles)
    - with headwinds more than tailwind (following seas)

Other notes:

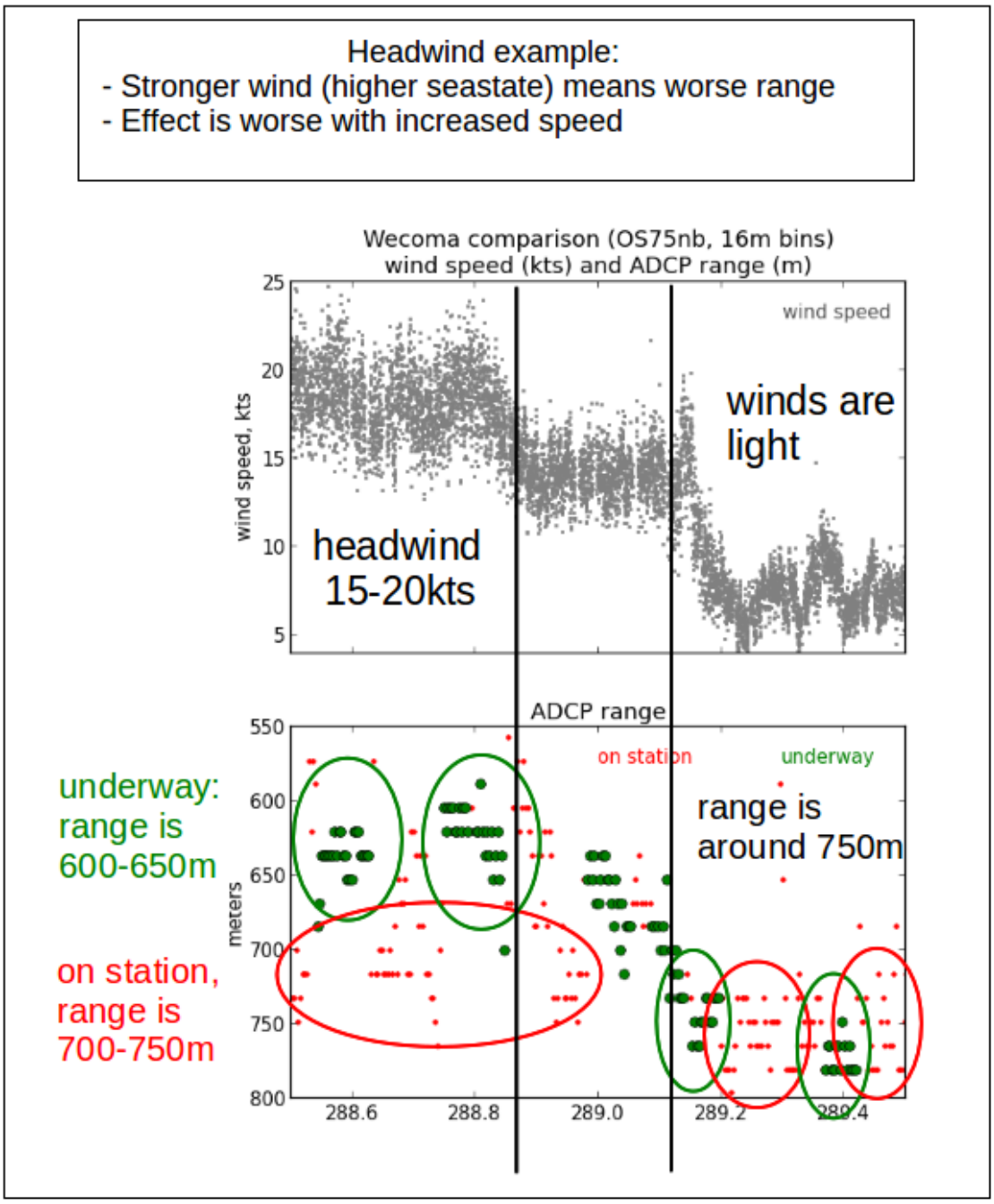
- Scattering levels affect range. Depending on the size, distribution and behavior of the relevant scatterers, diurnal migration can cause a change in ADCP range of 50-150m, and range varies with latitude (location) depending on the populations of relevant scatterers.
- Bad weather reduces the range of profiles to varying extents, sometimes enough to render the entire profile bad. It can also introduce biases into some of those profiles that do have vertical extent. The result can be complete data loss due to lack of good profiles.
- Acoustic noise (eg. propellor cavitation) and bubbles reduce range. A continuing source of frustration is electrical noise, which reduces range and can bias the data. It is not clear whether the on-station/underway range difference is due to acoustic or electrical noise, but it is a problem.

Wecoma: Zigzag into a headwind



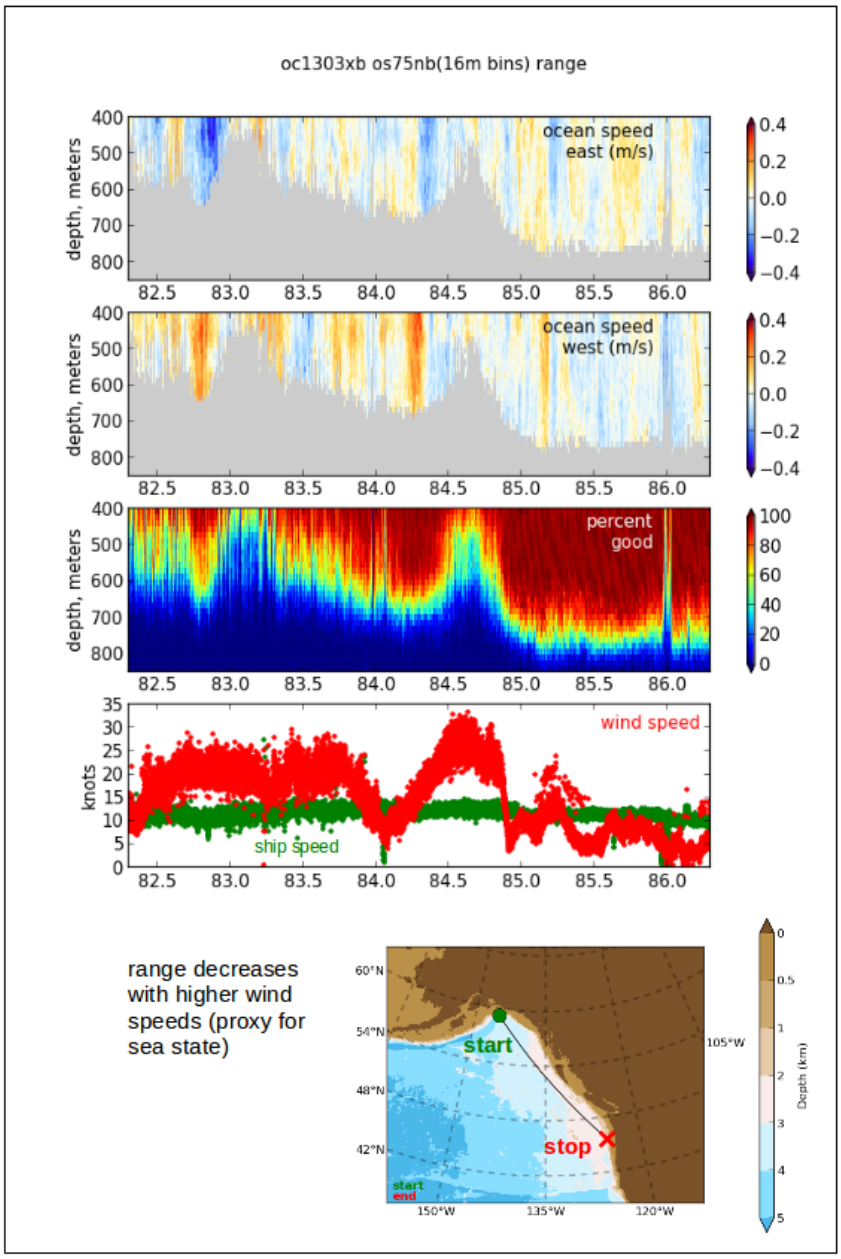
The top two panels are ocean velocity (east and north), the third panel is "Percent Good" and represents the amount of data going into the velocity averages. As pings are lost (due to bubbles, eg. underway in higher sea states) the range of each ADCP profile decreases by varying amounts, so the percentage of pings that are good at a given depth also decreases. A typical cutoff for acceptable data is 50 Percent Good. The fourth panel shows true wind speed (in red) and ship speed (in green). A cruise track over topography shows the location of the ship track and a cartoon indicating wind direction.

Wecoma, again



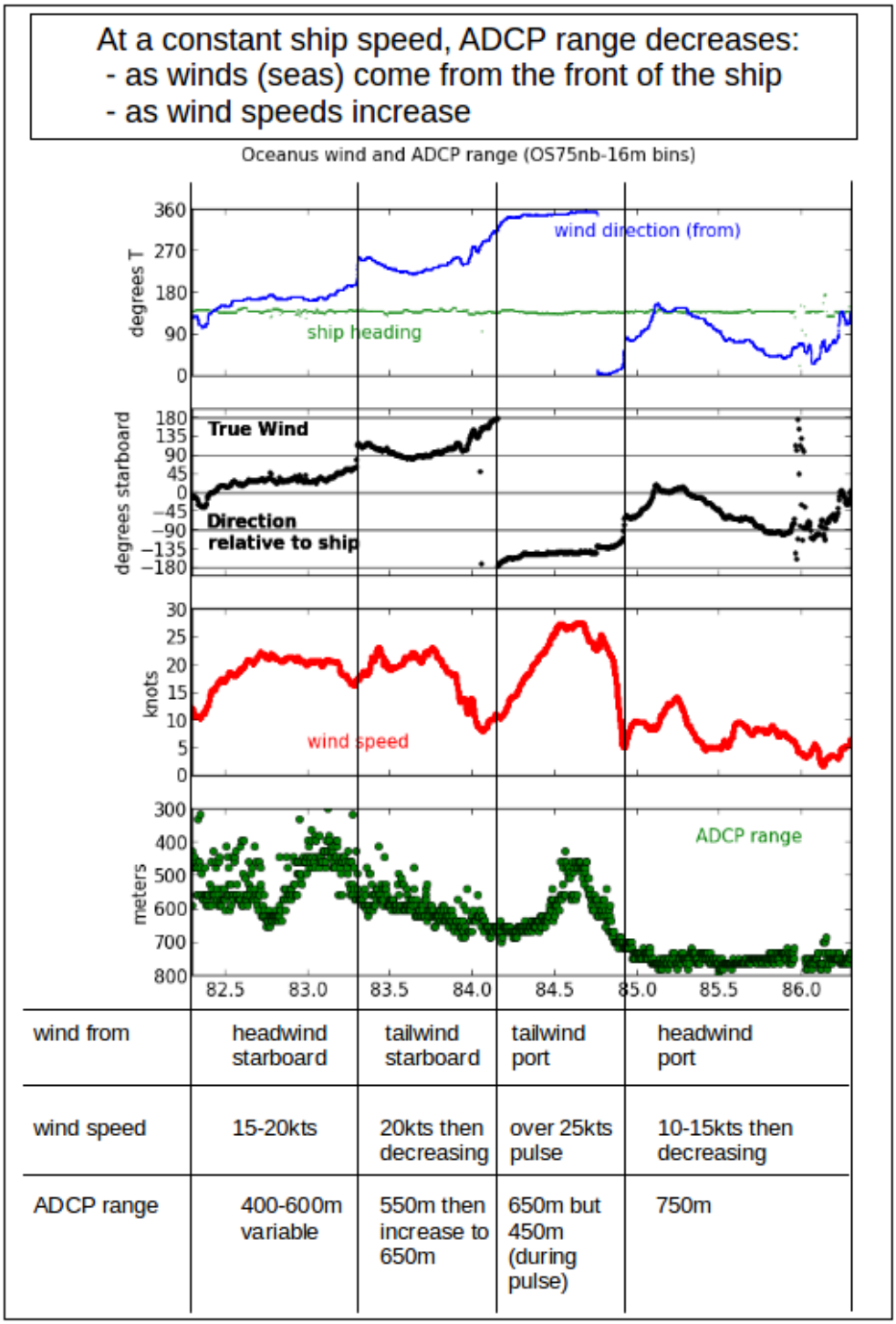
This plot shows windspeed (top panel) and ADCP range (bottom panel), with color-coded “on station” and “underway” periods. When the wind is high (at the beginning) the range decreases by 100m when the ship gets underway (green) compared to being on station (red). As the winds decrease, range increases to about 750m, regardless of whether the ship is on station or steaming.

Oceanus Transit



Panels in this plot are the same as the first Wecoma plot: ocean velocity (east and north) in the first two panels; Percent Good in the third panel; windspeed and ship speed in the fourth panel. A cruise track is shown at the bottom. All we can see in this plot is that range is reduced when wind speed is higher. The next plot includes wind direction. The first 1.5 days (when the wind was 20kts) must have been a rough ride for the passengers as well as the ADCP. Range is reduced, but measurements of wind speed and ship speed are noisy, suggesting a lot of ship motion and a heavy sea state.

Oceanus Transit with Wind Direction



wind from	headwind starboard	tailwind starboard	tailwind port	headwind port
wind speed	15-20kts	20kts then decreasing	over 25kts pulse	10-15kts then decreasing
ADCP range	400-600m variable	550m then increase to 650m	650m but 450m (during pulse)	750m

Range is decreased by the headwind more than the tailwind, but even with a tailwind, a pulse of wind at 84.5 is accompanied by a loss of range (150m-200m). This wind is shifty and may not accurately indicate the direction of the seas, but it is still clear: better data in low winds (750m range).