

GNSS-R Global Ocean Surface Winds from the UK TechDemoSat-1 Mission

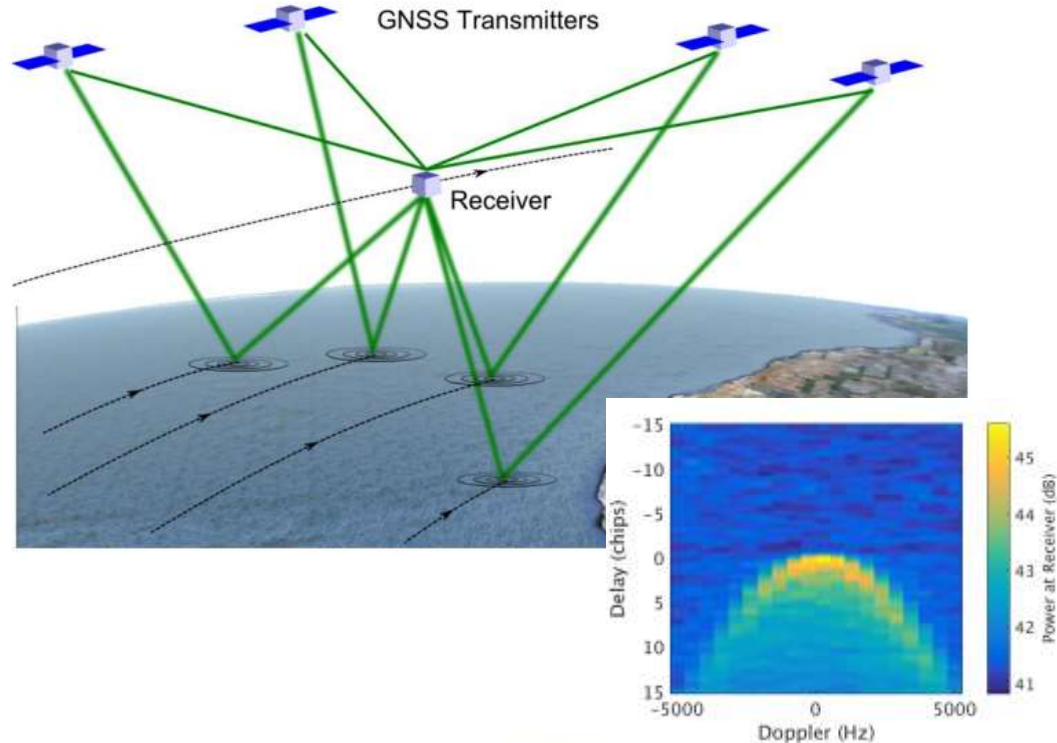
MATTHEW HAMMOND, GIUSEPPE FOTI, CHRISTINE GOMMENGINGER
& MERIC SROKOSZ

NCEO ANNUAL CONFERENCE SEPTEMBER 2019

- Introduction
 - GNSS-R
 - TDS-1
 - NOC Wind Speed Inversion Strategy
- Polar areas
 - Challenges
 - Approach
 - Performance of sea-ice detection
- NOC Wind Speed Retrieval
 - Updates
 - Performance

GNSS-R

- GNSS-Reflectometry infers geophysical information from signals of opportunity
- No transmitter on receiving satellite:
 - Multiple simultaneous signals
 - Low power, mass, cost
 - Small sat constellations



UK TechDemoSat-1

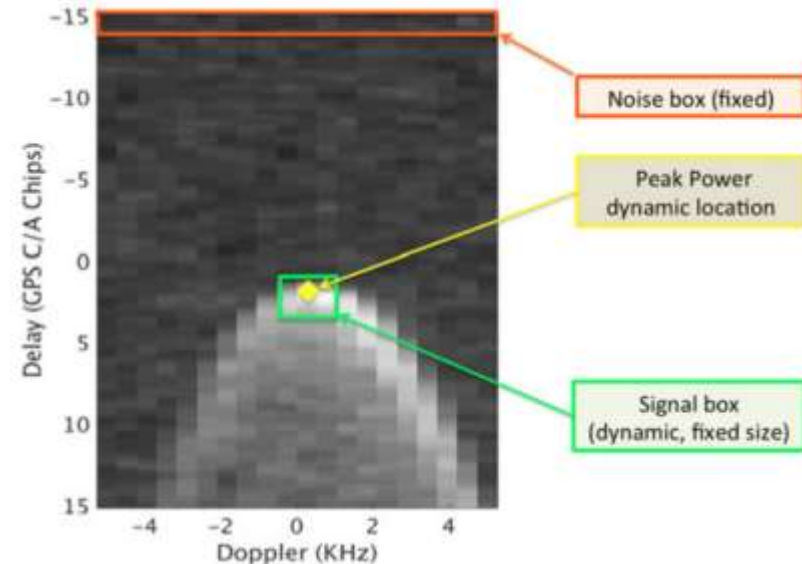
- UK-funded technology demonstration satellite launched in July 2014
- Designed and managed by SSTL
- Operated 2014-2018
- 8 experimental payloads including a GNSS-R receiver
- 24/7 GNSS-R from Feb 2018
- Data available at: www.merrbys.co.uk



Source: (MERRByS Product Manual)

Inversion Strategy

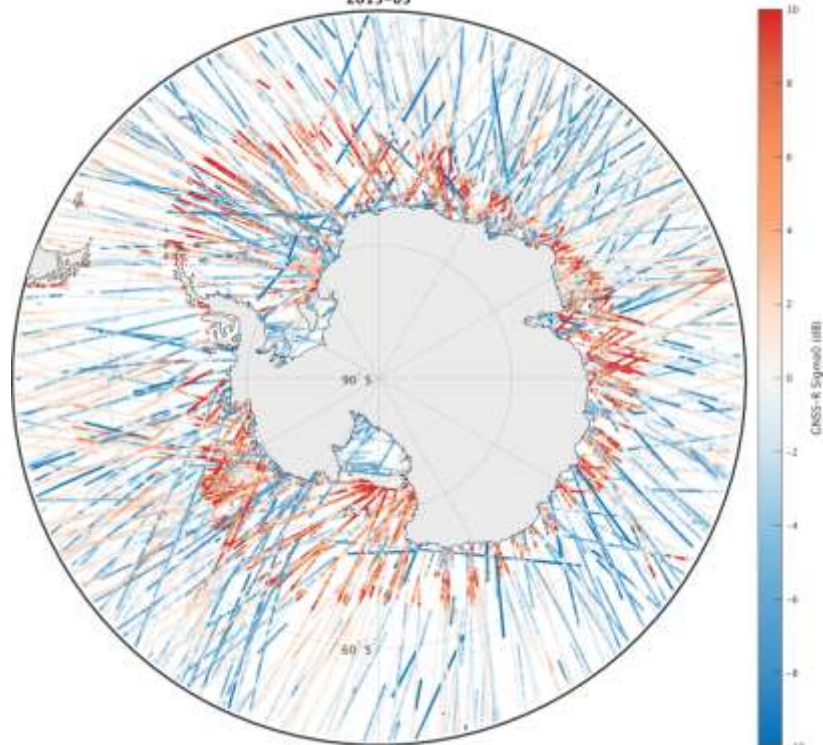
- Signal-to-noise ratio estimated from DDM
- Signal power is calibrated for multiple factors affecting signal
- Baseline algorithm (NOC C-BRE v0.5) limited to latitudes 55°S - 55°N to avoid sea-ice



Overview

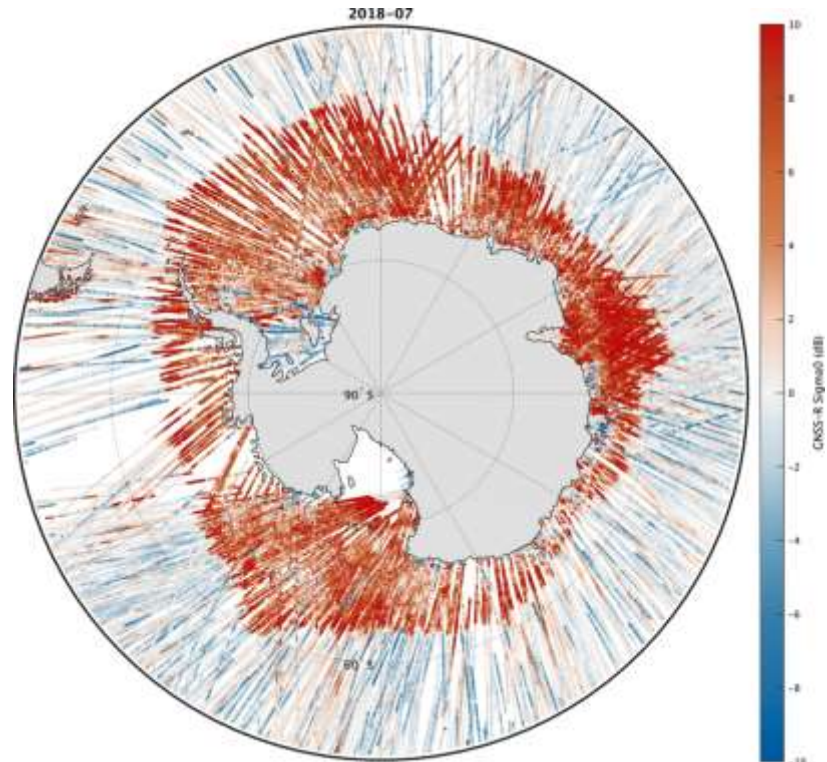
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2015-05

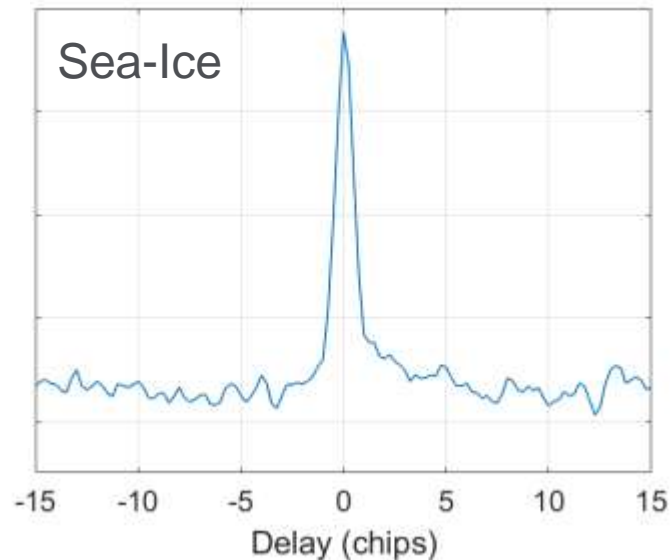
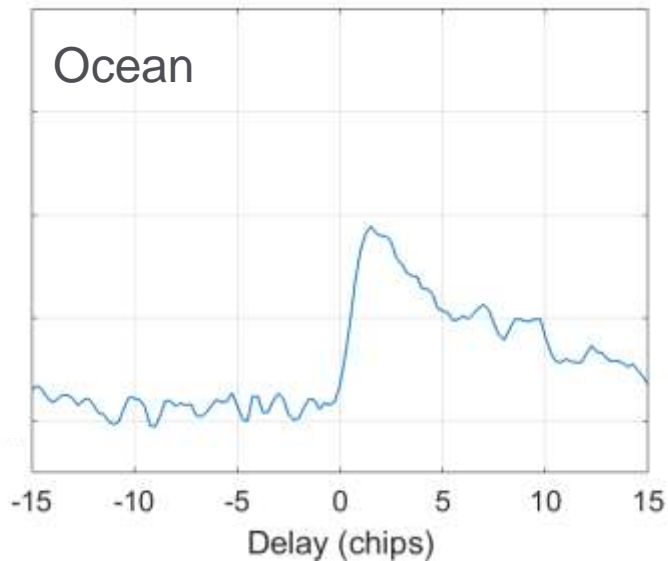


Polar Areas

- Need to address:
 - Presence of sea-ice
 - Extreme bistatic geometry
 - Reduced direct power
 - Fewer valid ocean points
- Need sea-ice detection algorithm

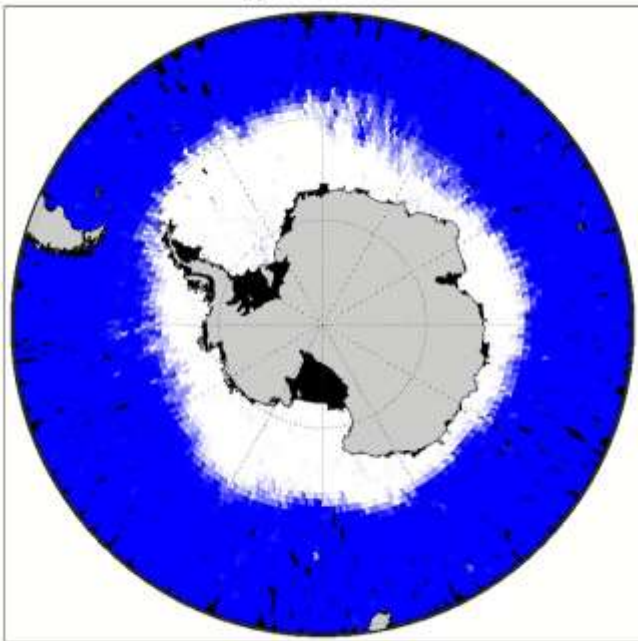


Sea-Ice Detection

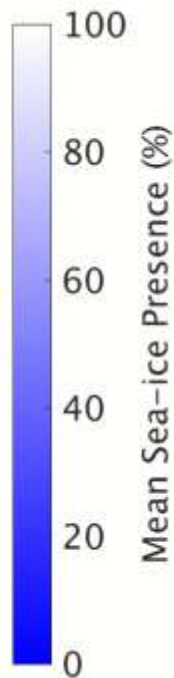
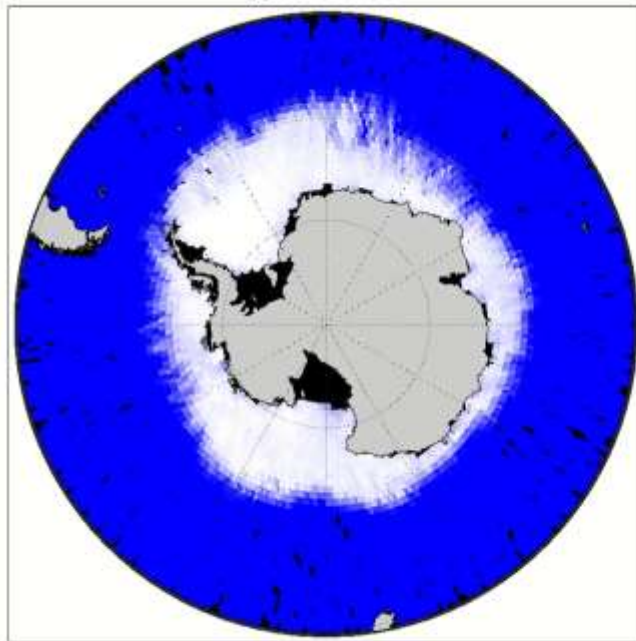


- Different signature in integrated delay waveform between sea-ice and typical ocean – generally stronger coherent scattering component
- GNSS-R sea-ice detection (NOC GSID) cal/val using ERA-5 (31km/1day)

NOC GSID
JJA 2015

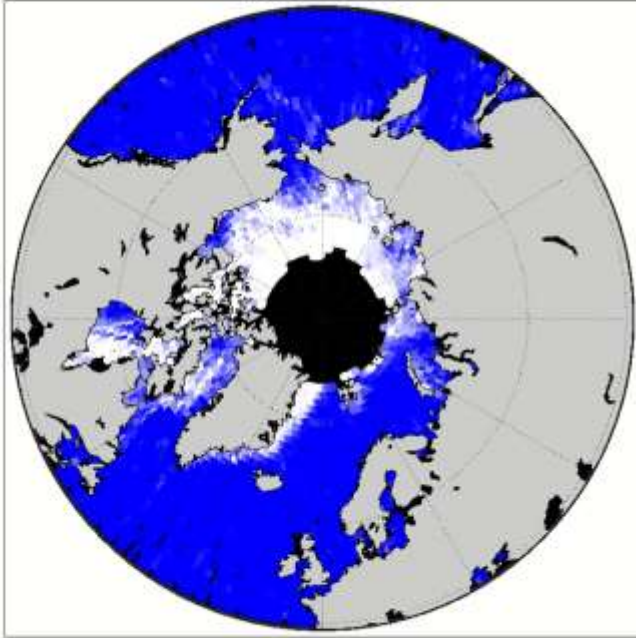


ERA-5
JJA 2015

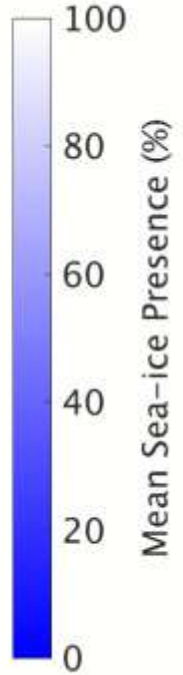
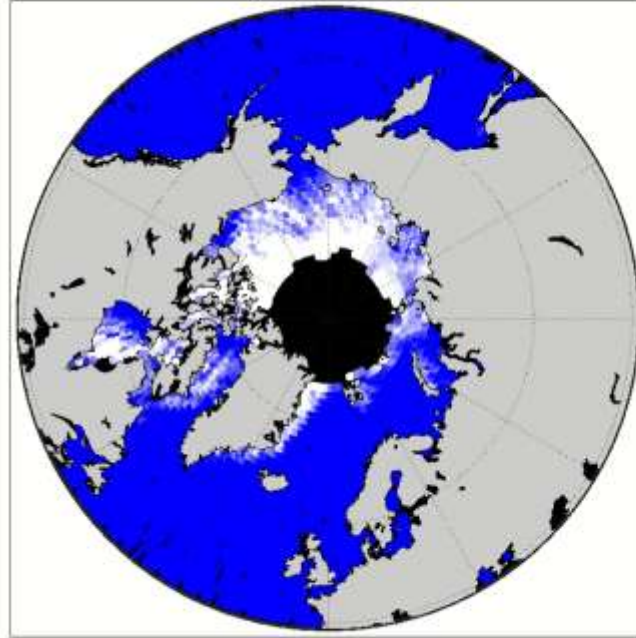


Agreement: 98%

NOC GSID
JJA 2015



ERA-5
JJA 2015



Agreement: 96%

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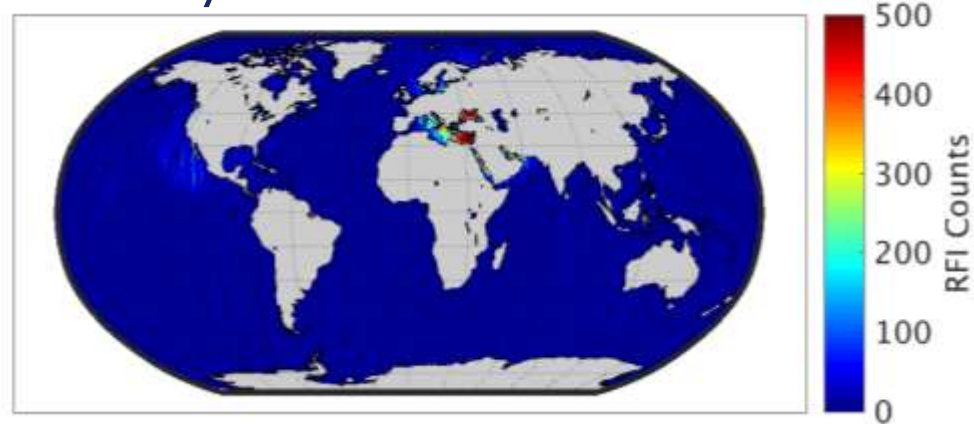
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C-BRE v1.0 Updates

- Quality Control / Flagging
 - RFI Detection
 - Correlator Anomalies
- Transmitter power temporal variability
 - Decay
 - Replacements
 - GPS Flex Modes
- Periodic self-calibration

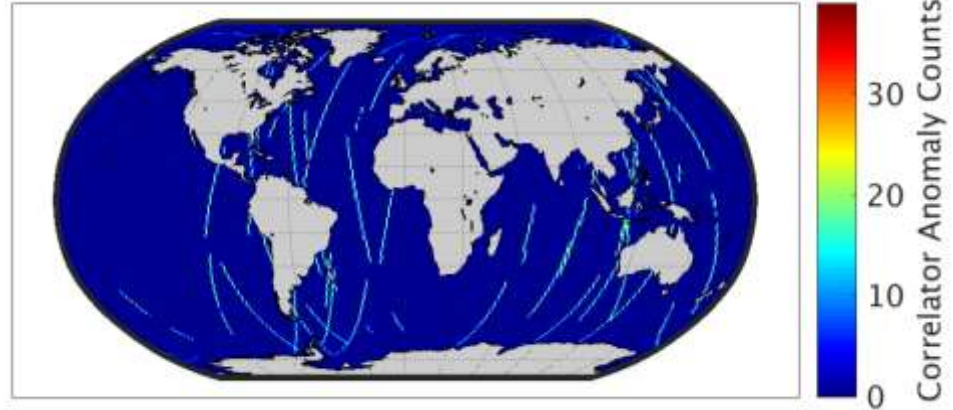
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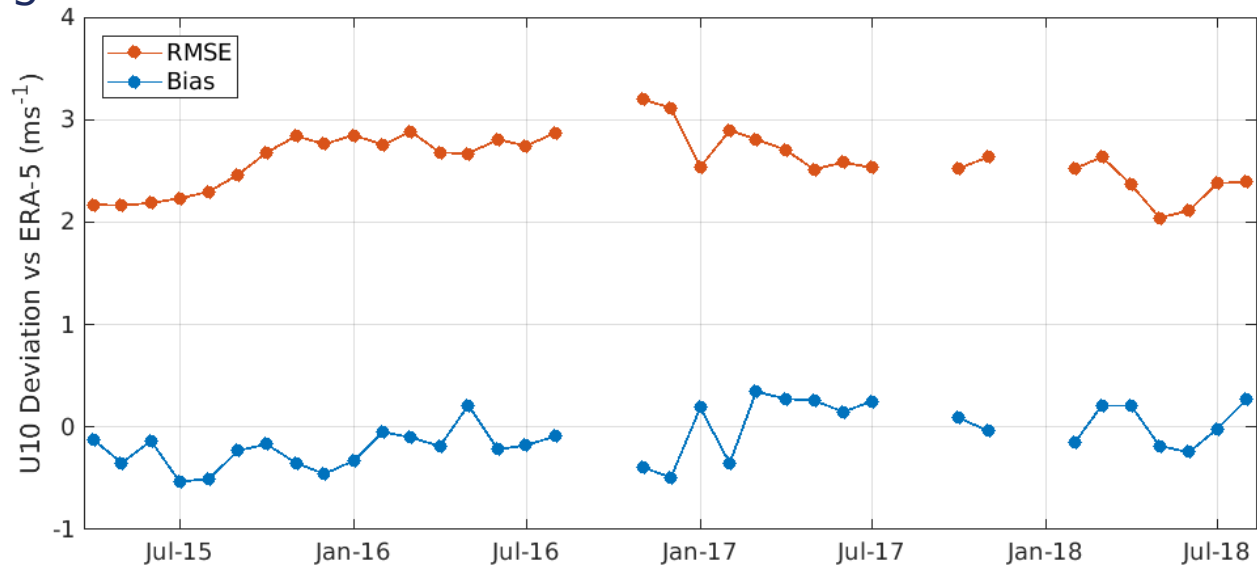
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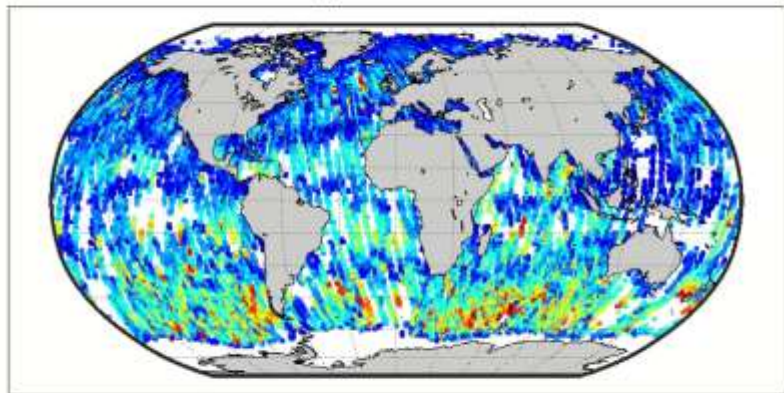
Temporal Stability

- Performance against ERA-5 (31 km / 1 hr)
- All available GPS transmitters supported
- Global ocean coverage
- Residual variability possibly linked to changes in attitude performance

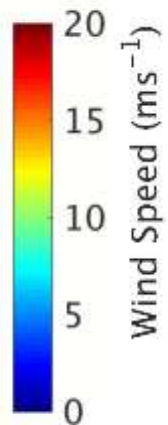
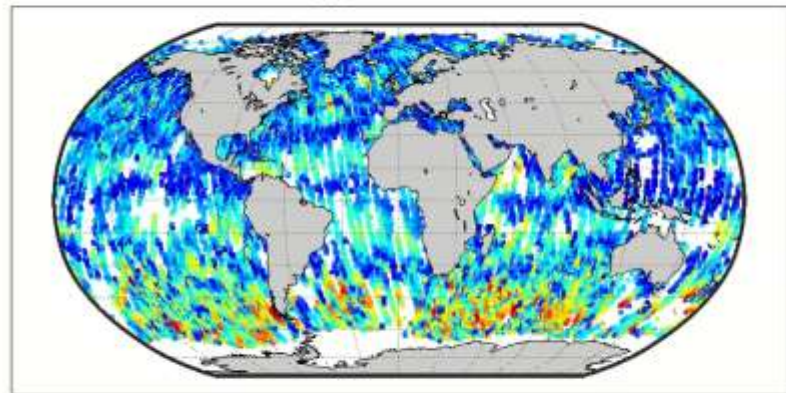
Global ocean coverage. All GPS transmitters.



NOC C-BRE v1.0
JJA 2015



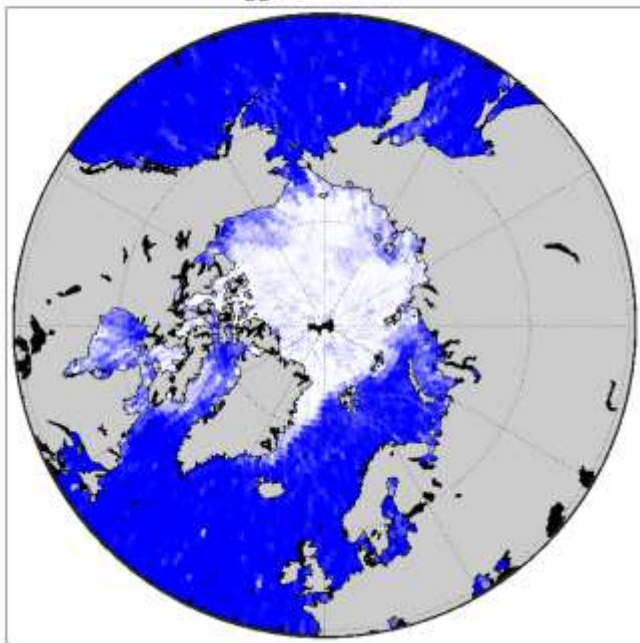
ERA-5
JJA 2015



Summary

- Significant improvement in wind speed retrieval from TechDemoSat-1
 - Developed and validated NOC GNSS-R Sea Ice Detection algorithm
 - Agreement >96% (OSISAF/ERA-5)
 - Quality control flagging (Sea-ice/RFI/Correlator anomalies)
 - All flagging based on GNSS-R waveform – not using ancillary data
 - Periodic self-calibration e.g. to mitigate changes in transmitter power
 - Exploits all currently available GPS transmitters
- NOC C-BRE v1.0 wind speed processor now offers:
 - Improved (and more stable) long-term performance
 - Global ocean wind coverage including polar seas

NOC GSID
JJA 2016



ERA-5
JJA 2016

