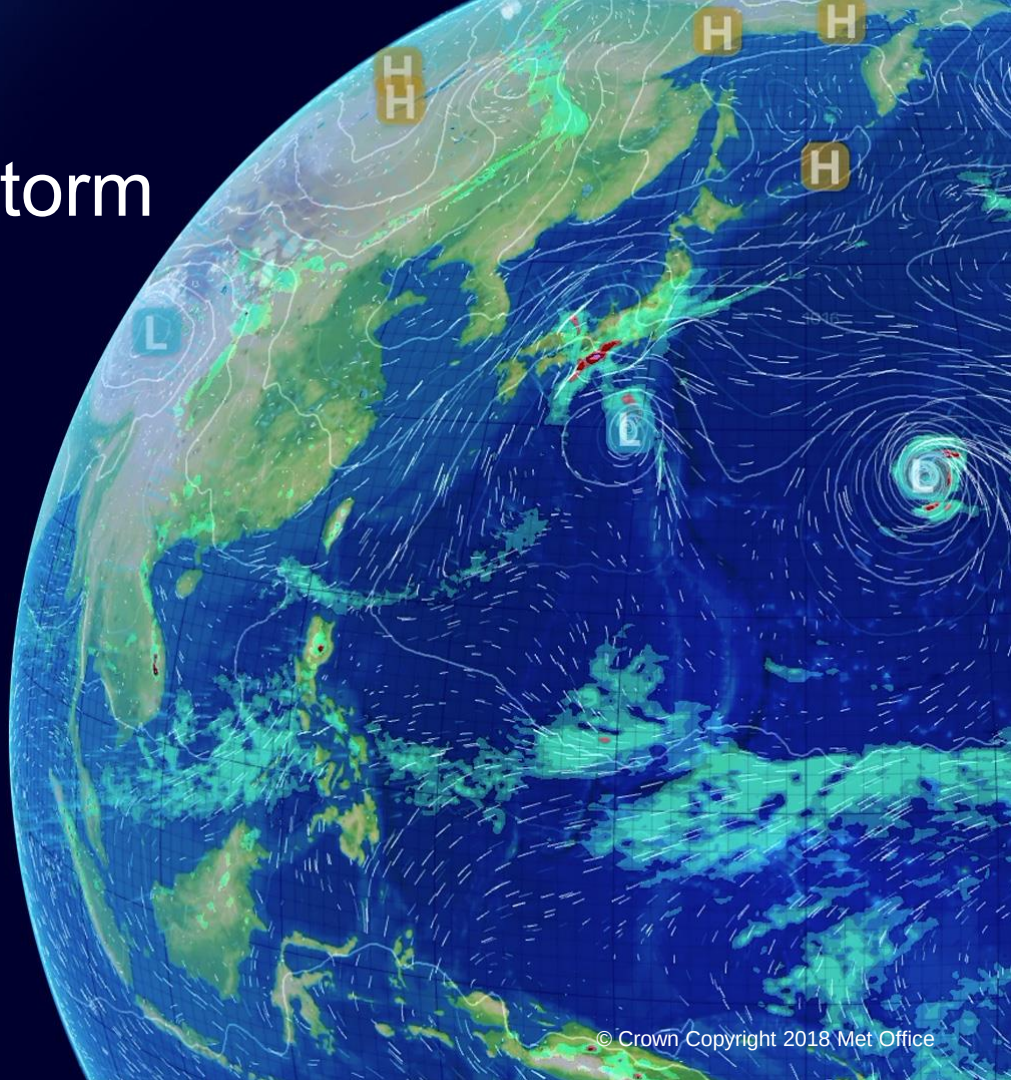
Is the UK's operational storm surge forecast model improved by increased resolution and addition of wetting and drying?

Clare O'Neill and Andy Saulter

Thanks to Enda O'Dea



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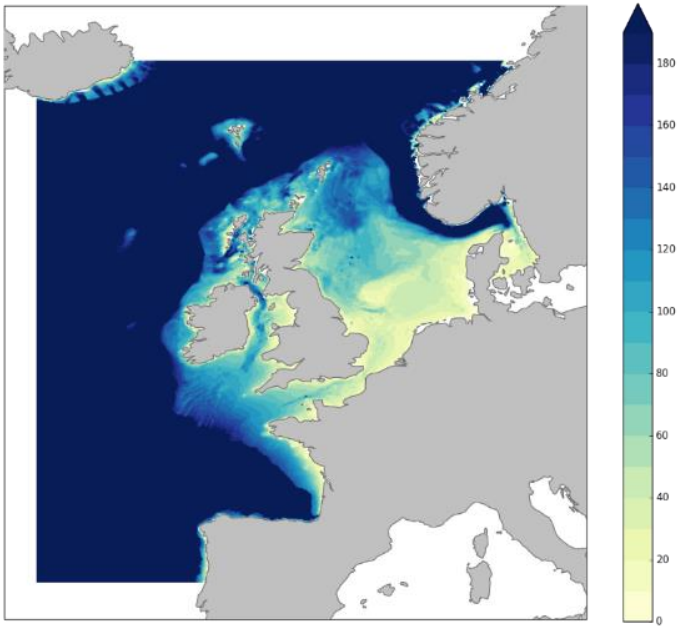
Introduction

- UK Operational forecast system
- 7km → 1.5km
- Wetting and drying
- Impact on tide, and on residual surge
- Conclusion

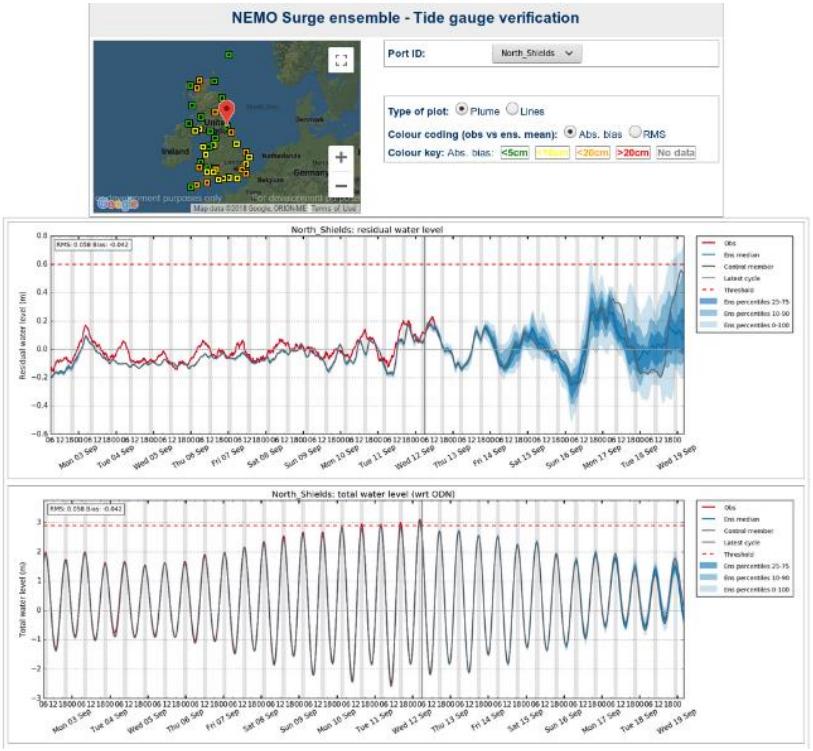
Current operational system

- NEMO surge model covering UK
- Based on AMM7 configuration = ~7km grid
  - NEMO v3.6
  - Changed to run in “2D”
  - Updated bathymetry based on EMODNet
  - Minimum bathy depth 6m in most regions, 10m in Bristol Channel and St Malo
- Forced by Met Office global NWP models
- Tide boundary from NE Atlantic tide model



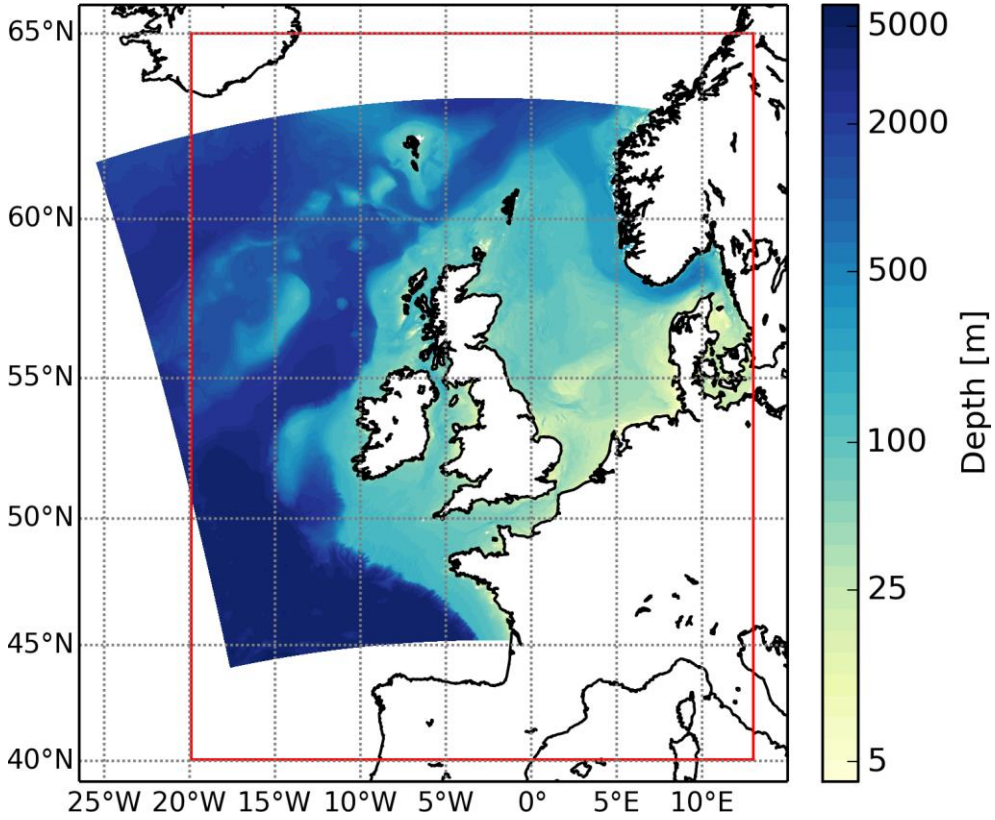
Current operational systen

- 7 day forecast 4x daily – deterministic and ensemble
- Tide only run, then tide+surge → difference gives residual
- Residual added to harmonic tide prediction and used by forecasters



1.5km resolution

- AMM15 configuration
- Created a “2D” surge version
- Tide boundary from TPXO version 9 dataset



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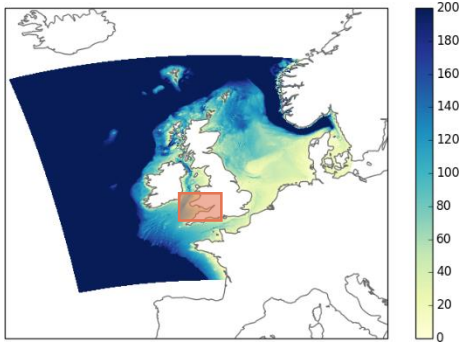
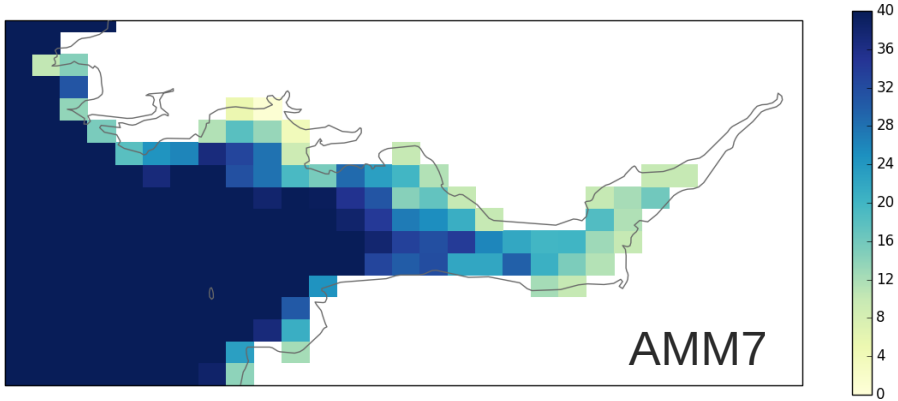
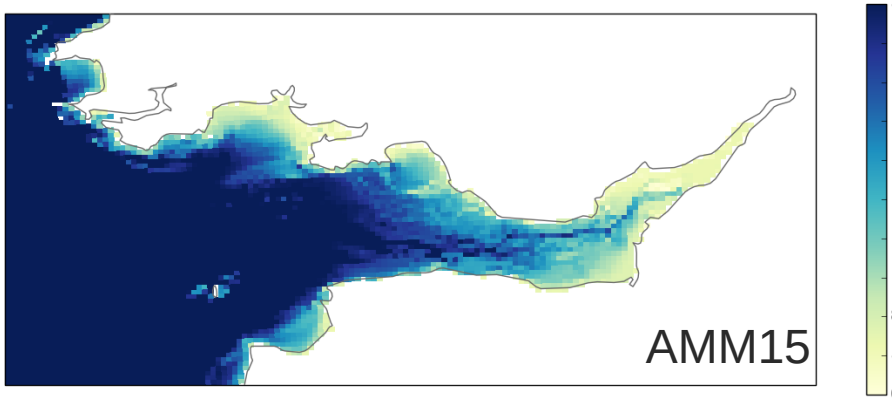
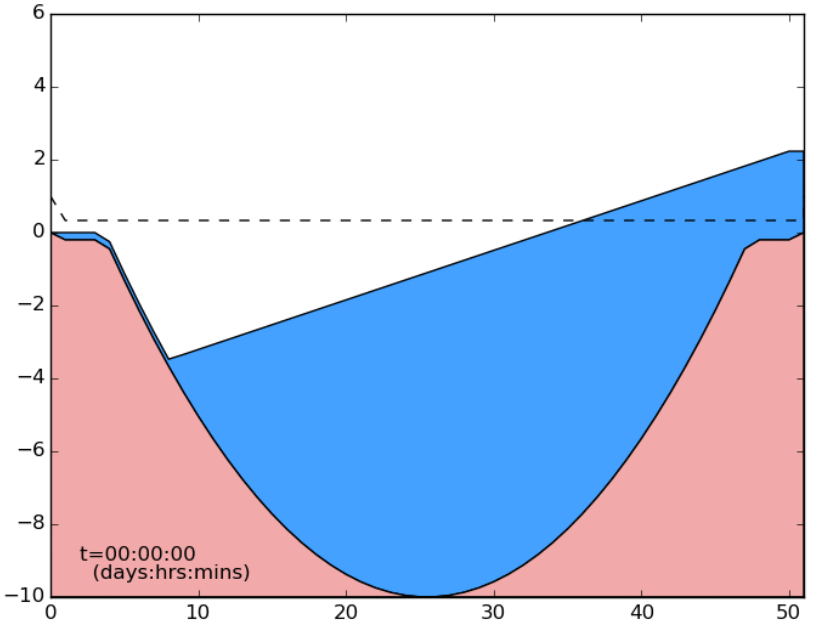






Wetting and drying (WAD)

- ROMS type scheme
- Implemented by Met Office and NOC



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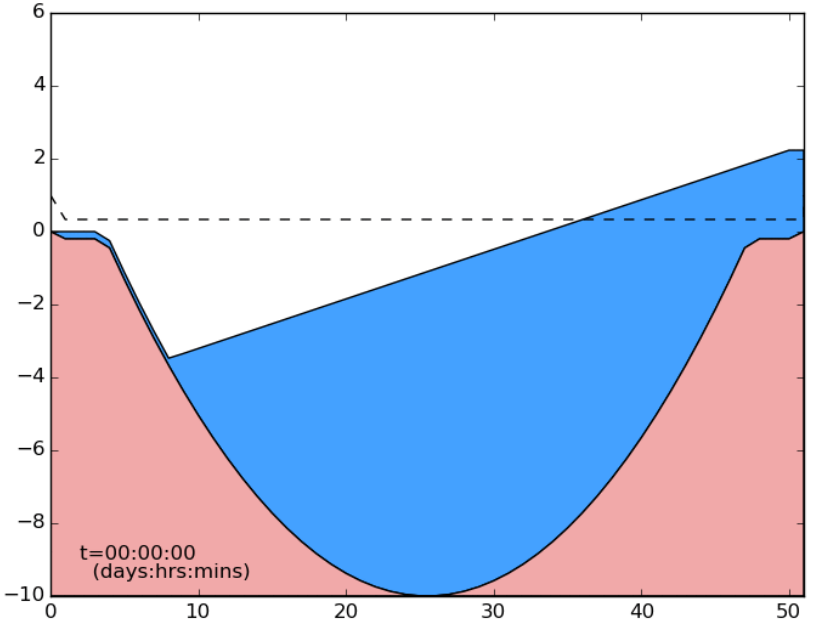

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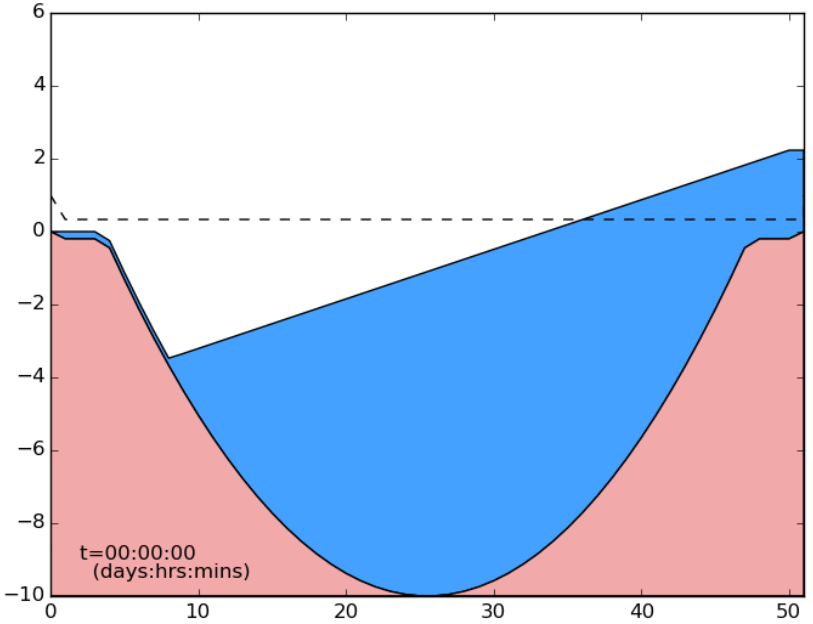

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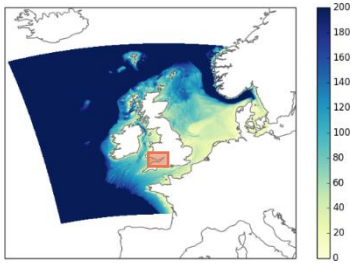

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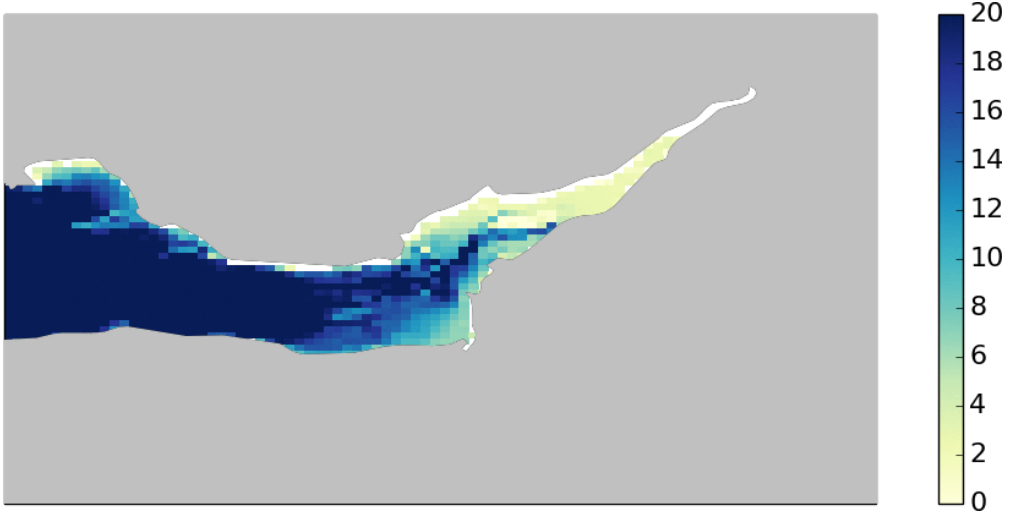

Sensitivity tests

- Upgraded code to NEMO4
- Surge model resolution: 7km vs 1.5km
- With and without wetting and drying
- Tide-only and tide+surge

- Focus on class A ports – of most interest to customers

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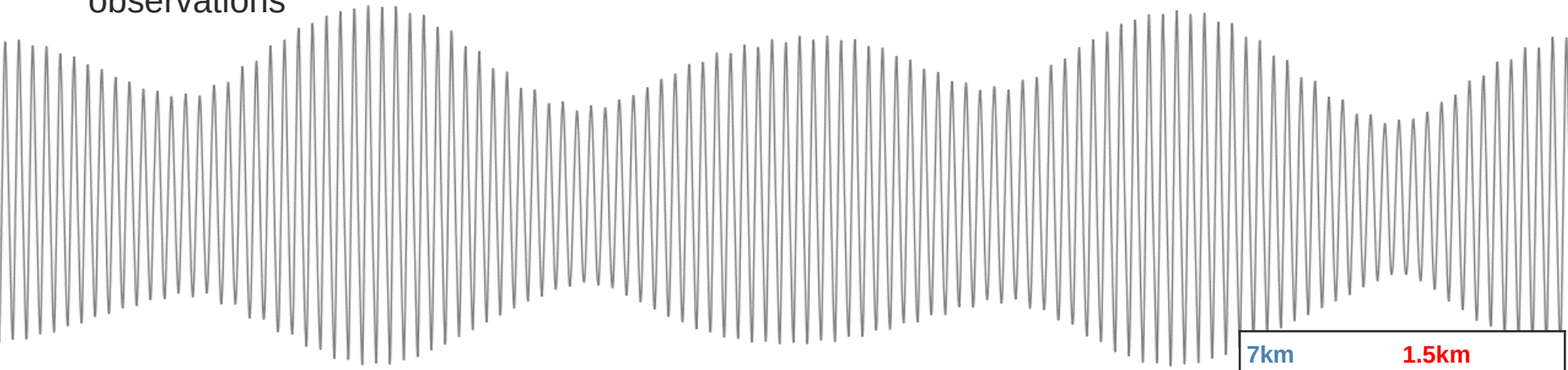
Impact on tide

- Harmonic analysis done on 1 year of hourly outputs
- Compared against harmonics from long-term tide gauge observations



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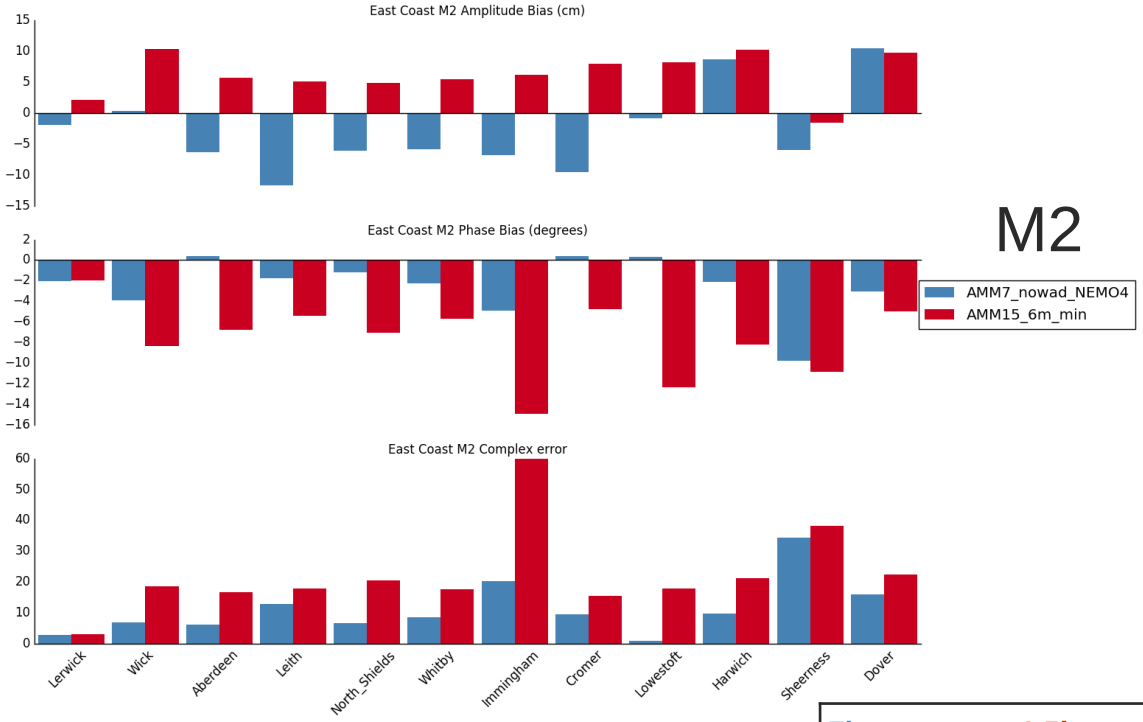

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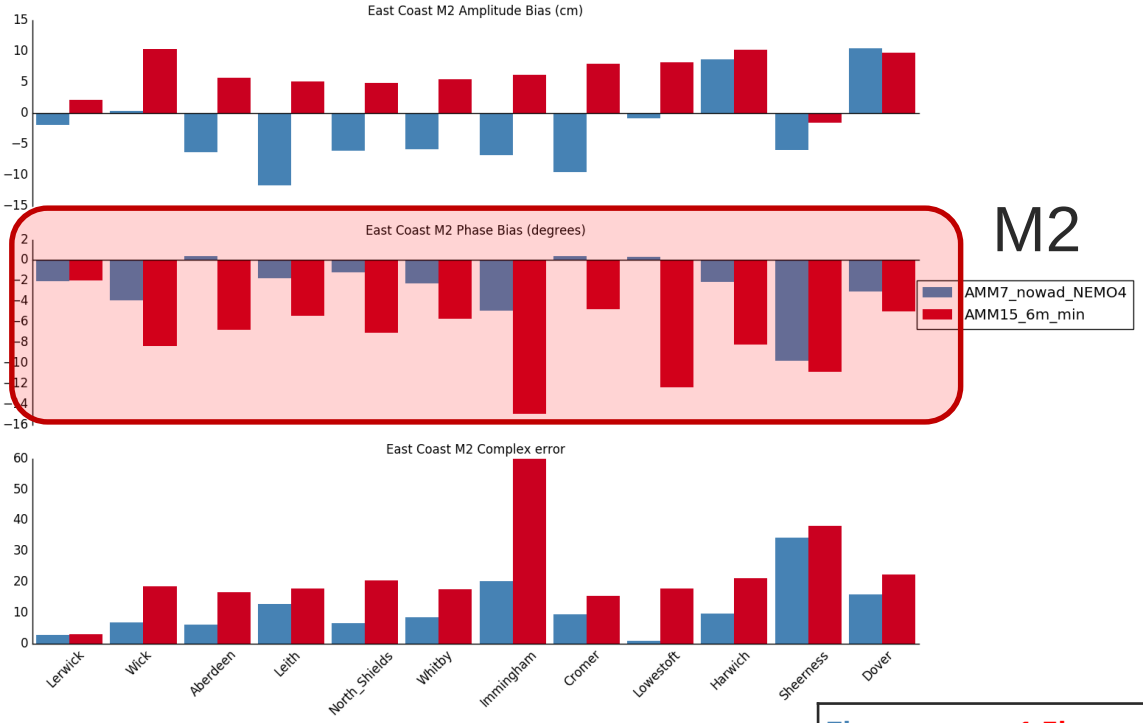

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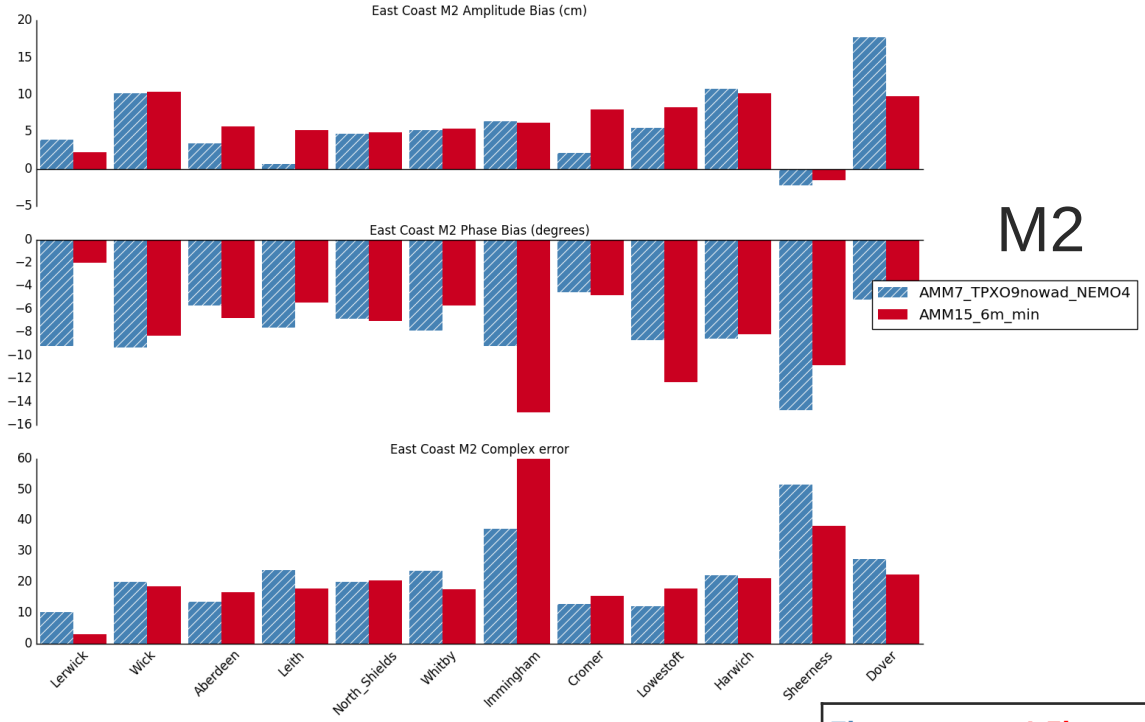

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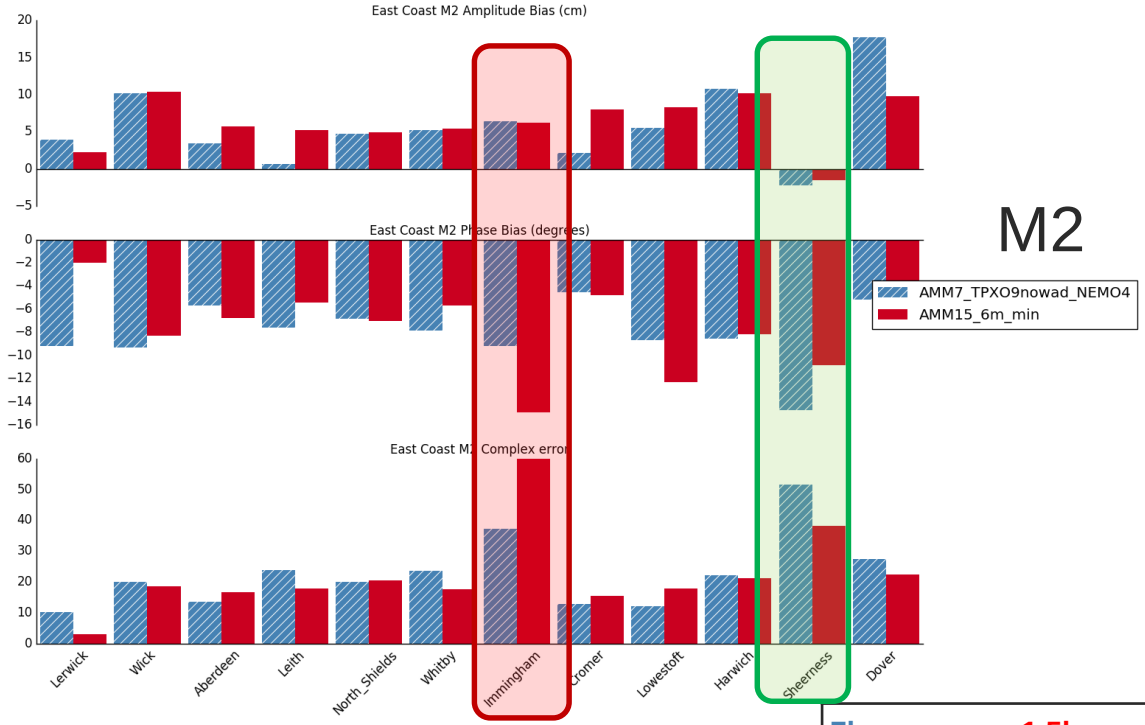

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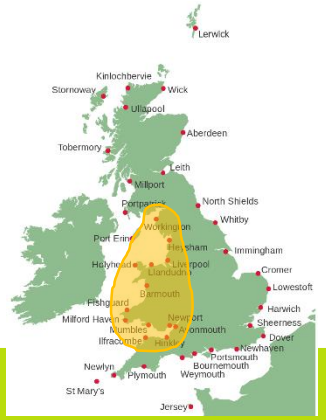

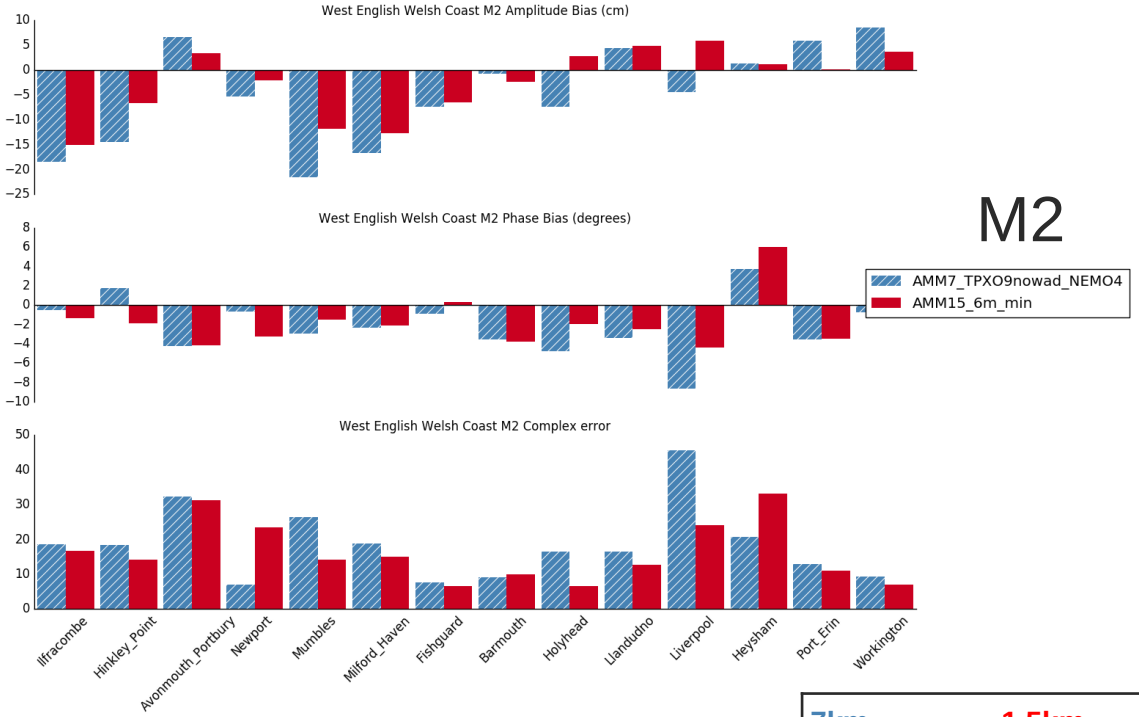

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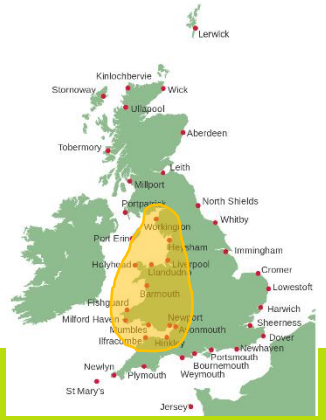

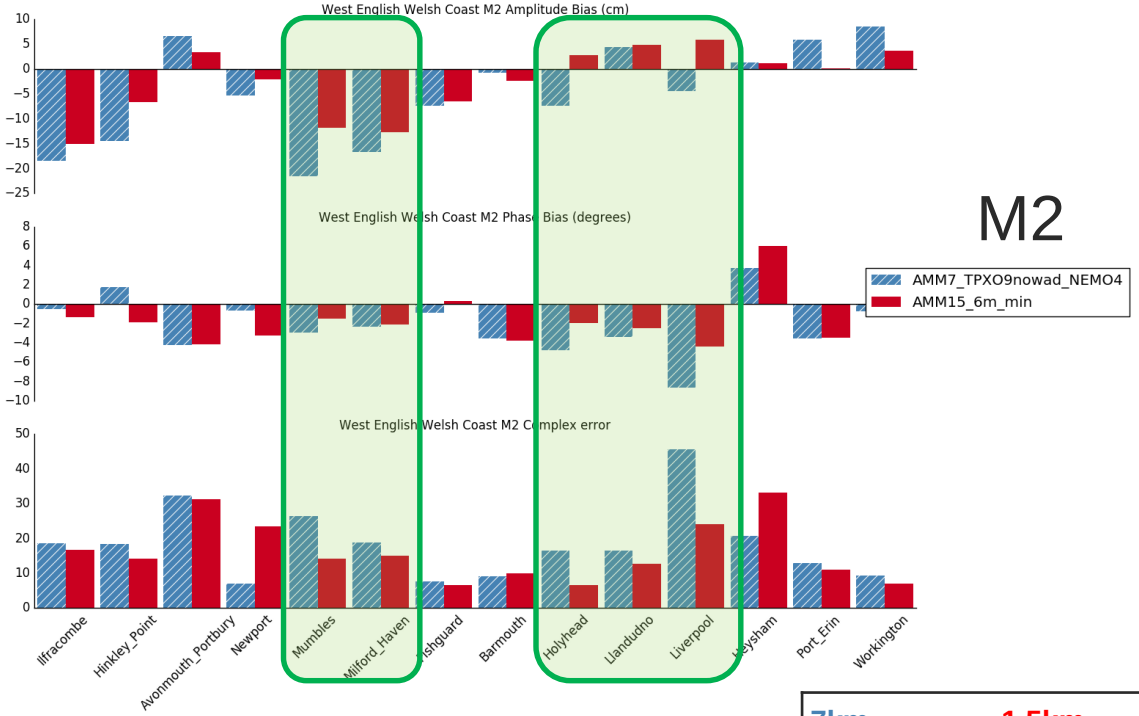

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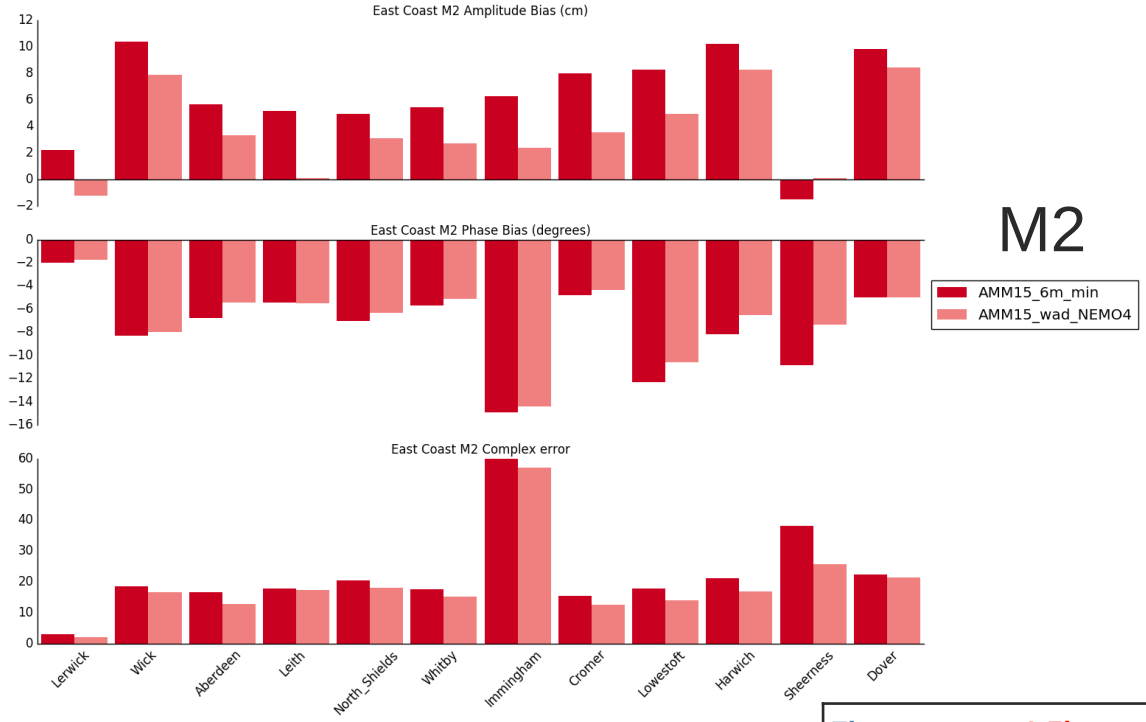

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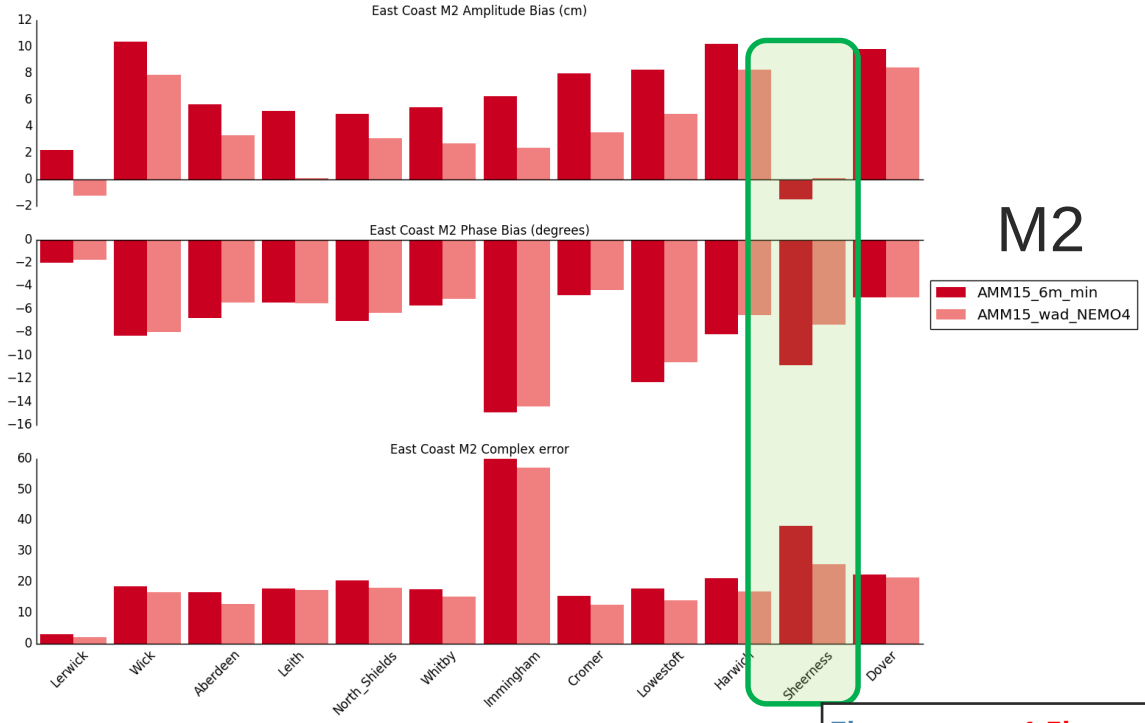

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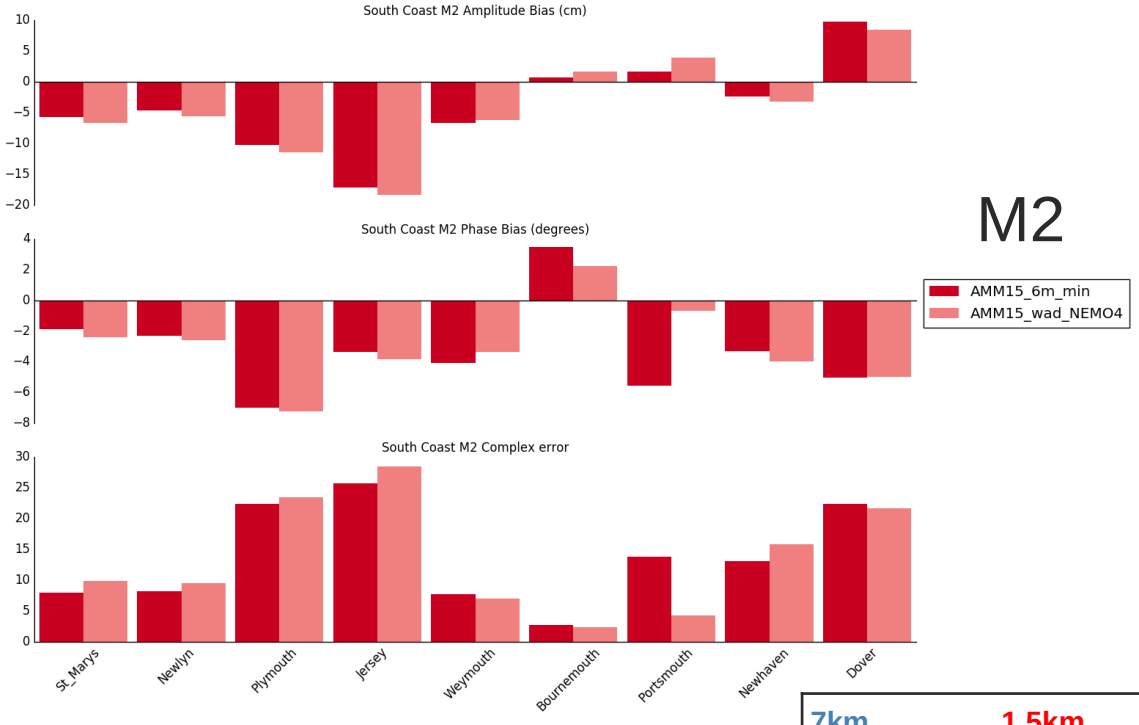

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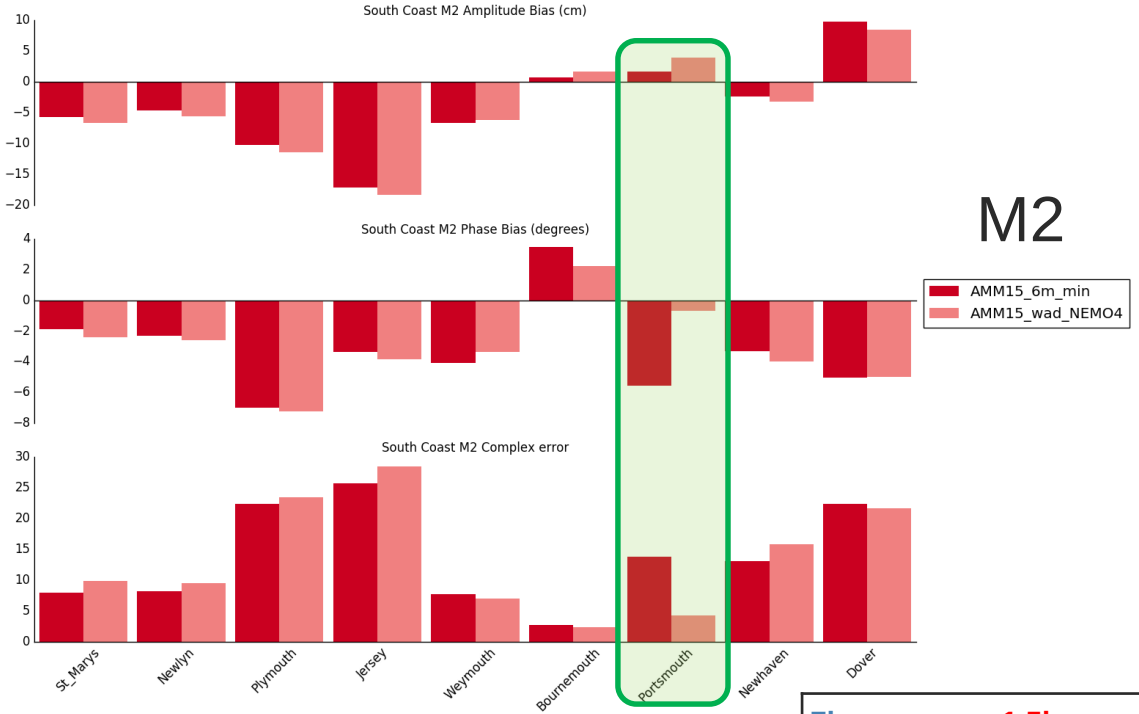

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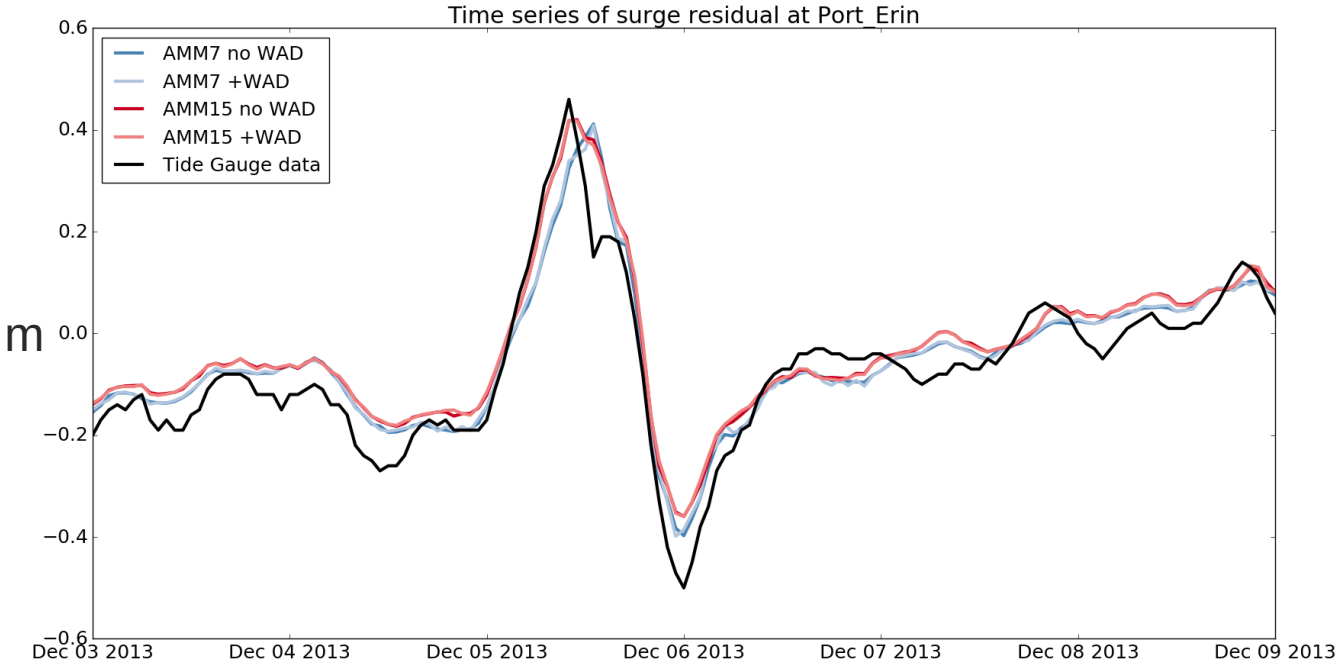
Impact on tide – summary

- Many ports not sensitive to WAD, but some localised improvements
- Some ports sensitive to resolution change, but this is overshadowed by change to tide boundary forcing

Impact on surge residual

- Residual = tide+surge run – tide only run
- Run 2013-2014

Impact on surge residual



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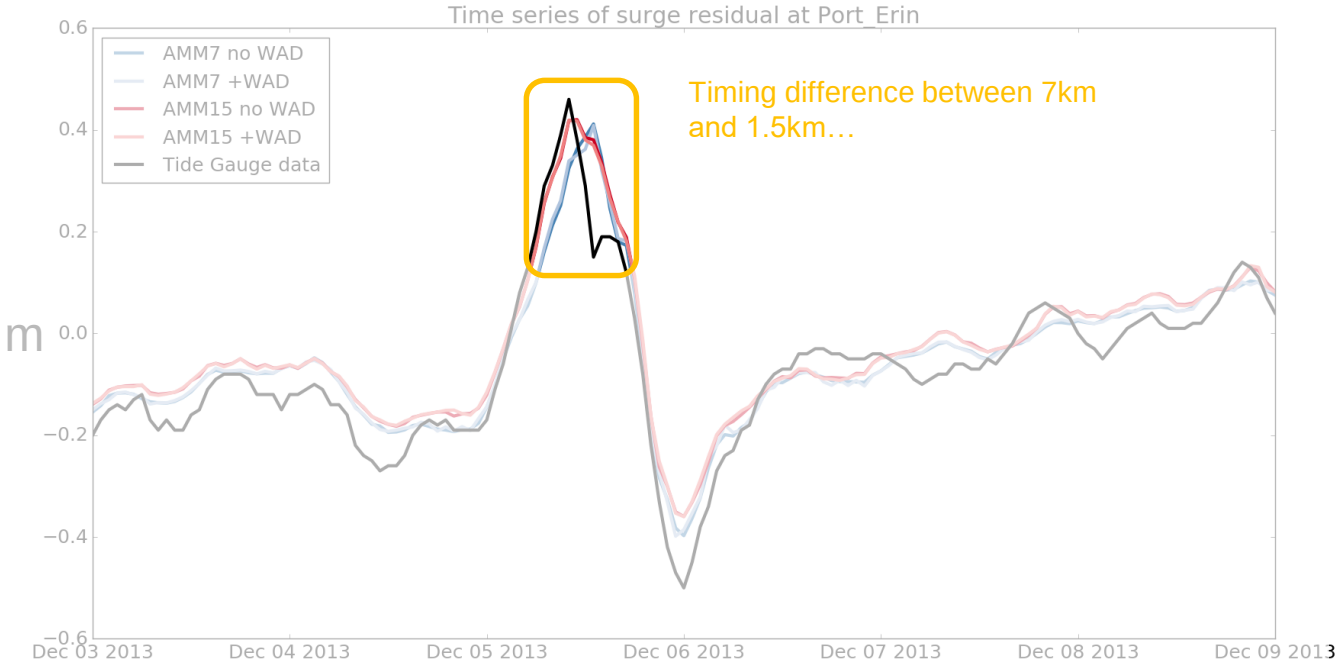

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Impact on surge residual

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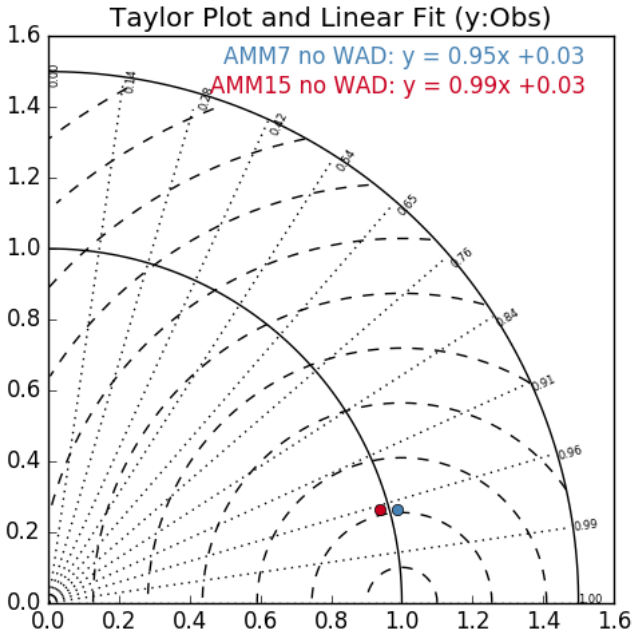

7 vs 1.5 km (no WAD)

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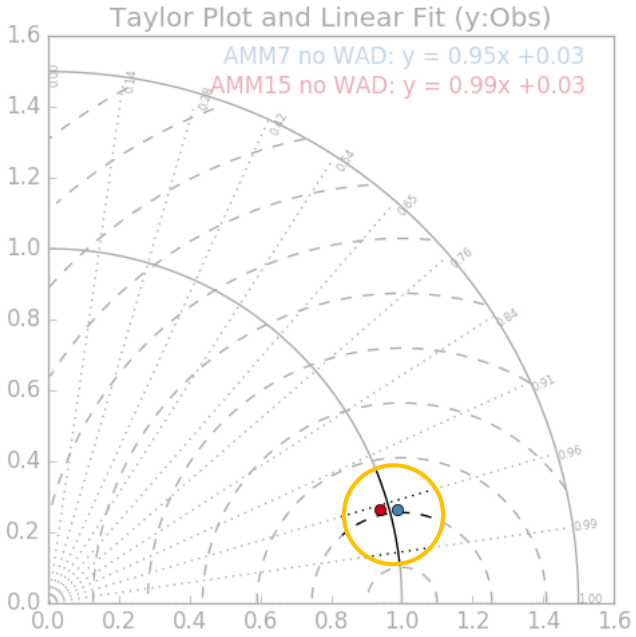

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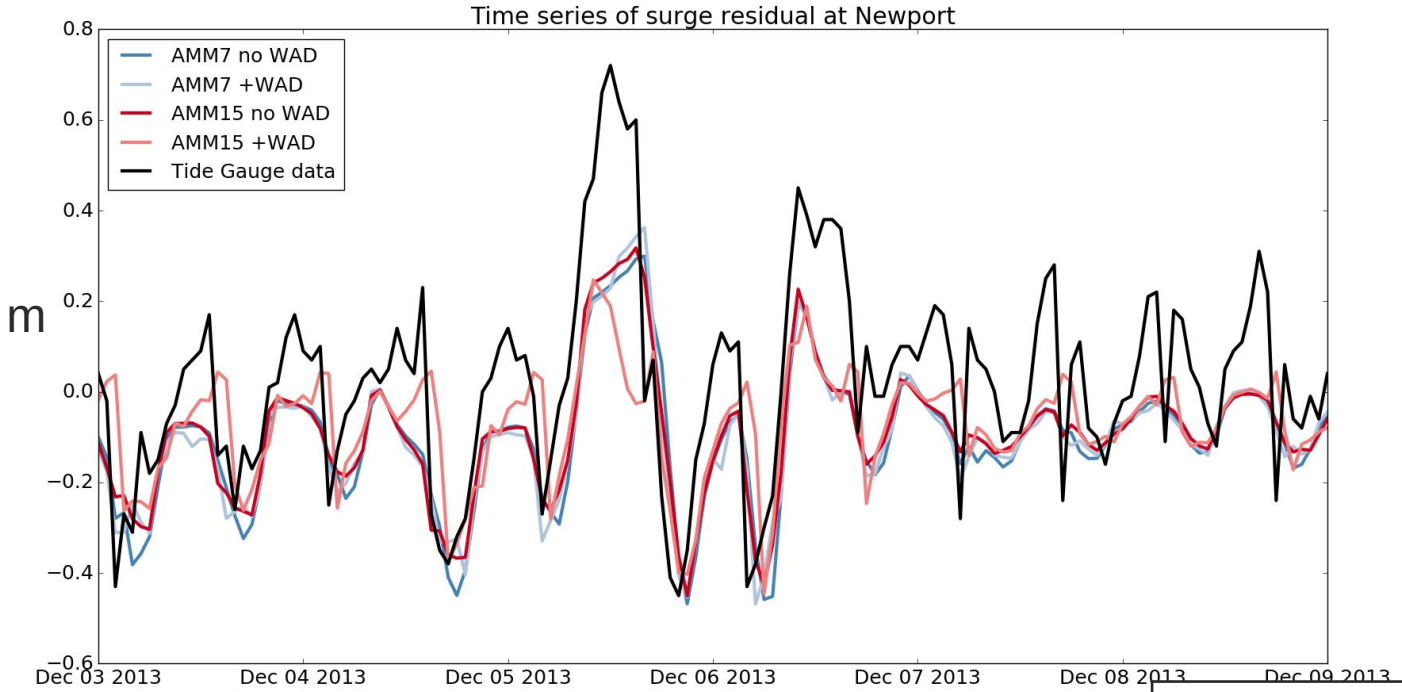

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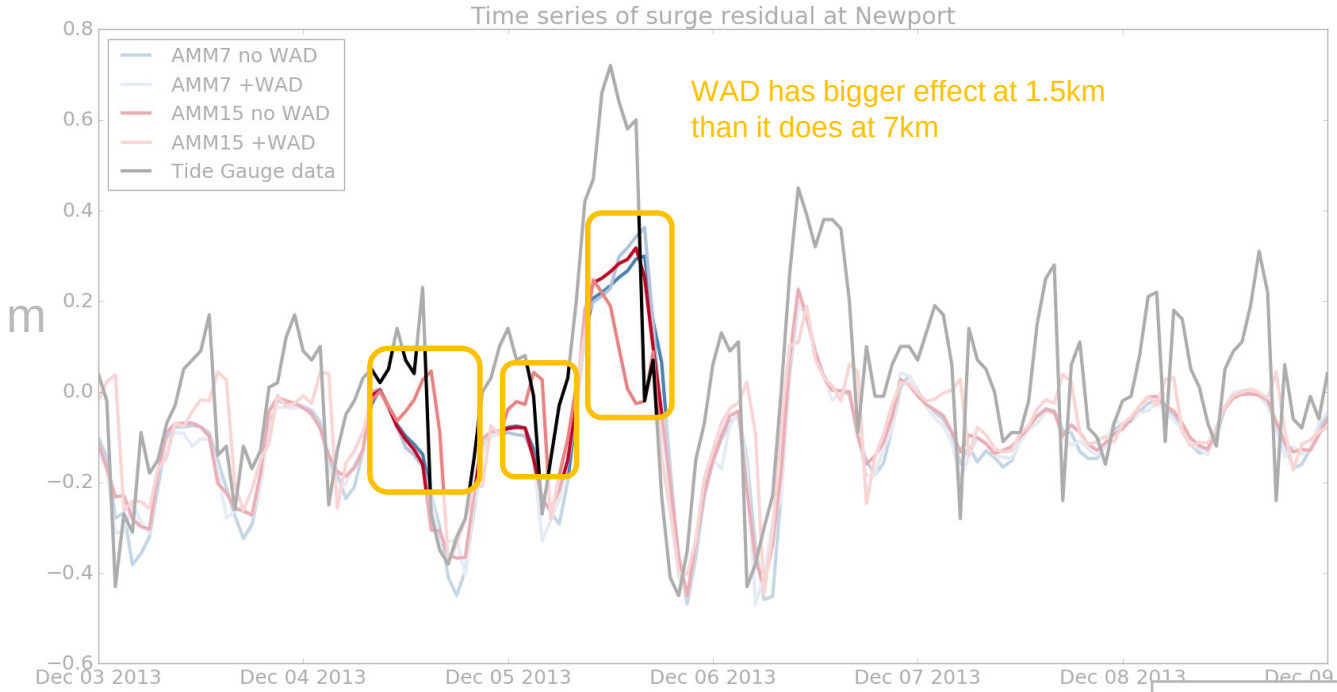

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Impact on surge residual

- Residual = tide+surge run – tide only run
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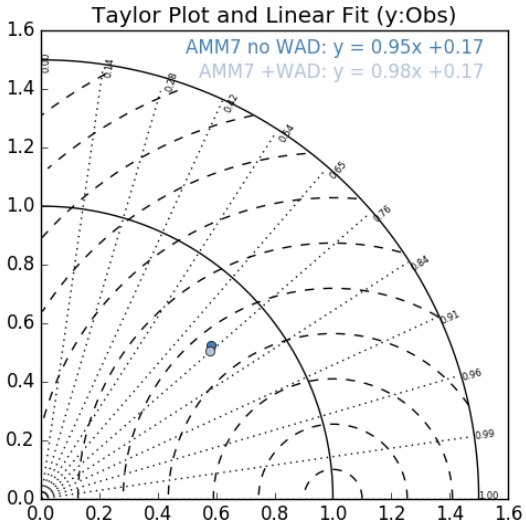

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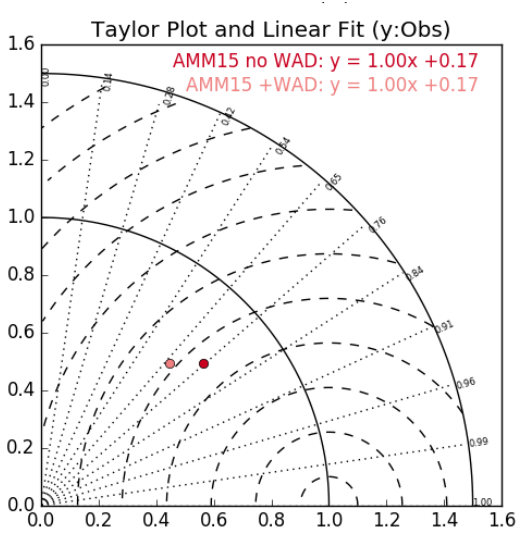

1.5km WAD

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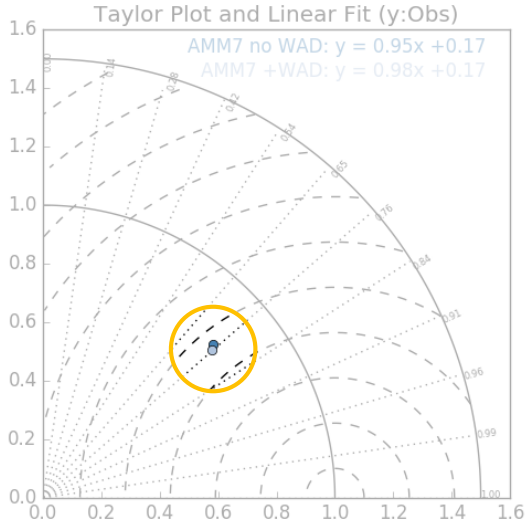
WAD has bigger effect at 1.5km than it does at 7km



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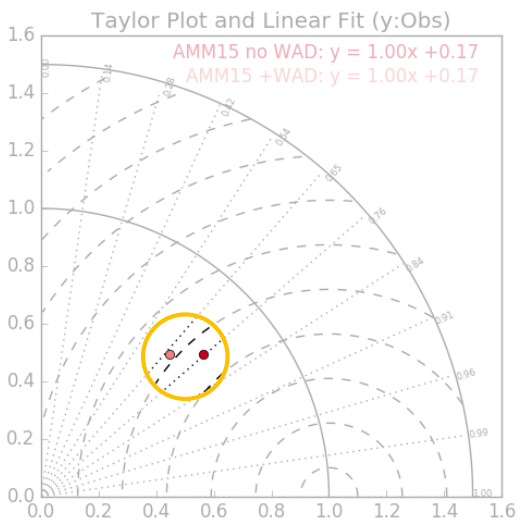

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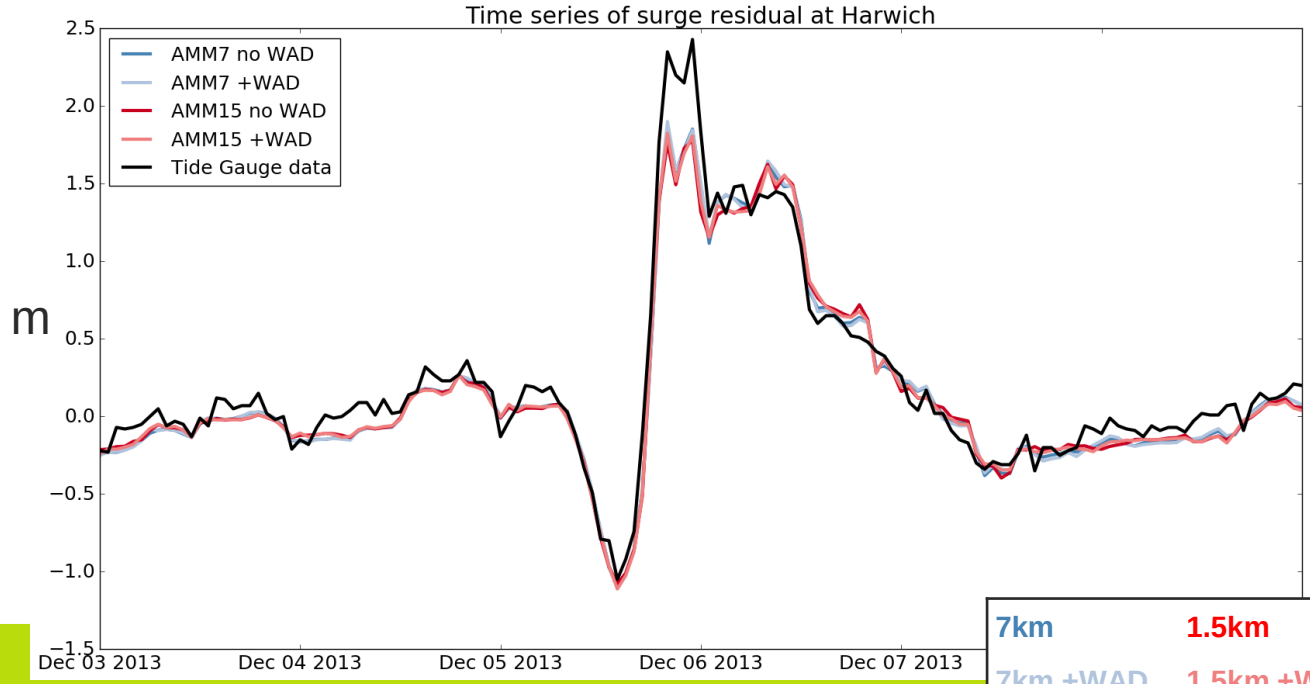

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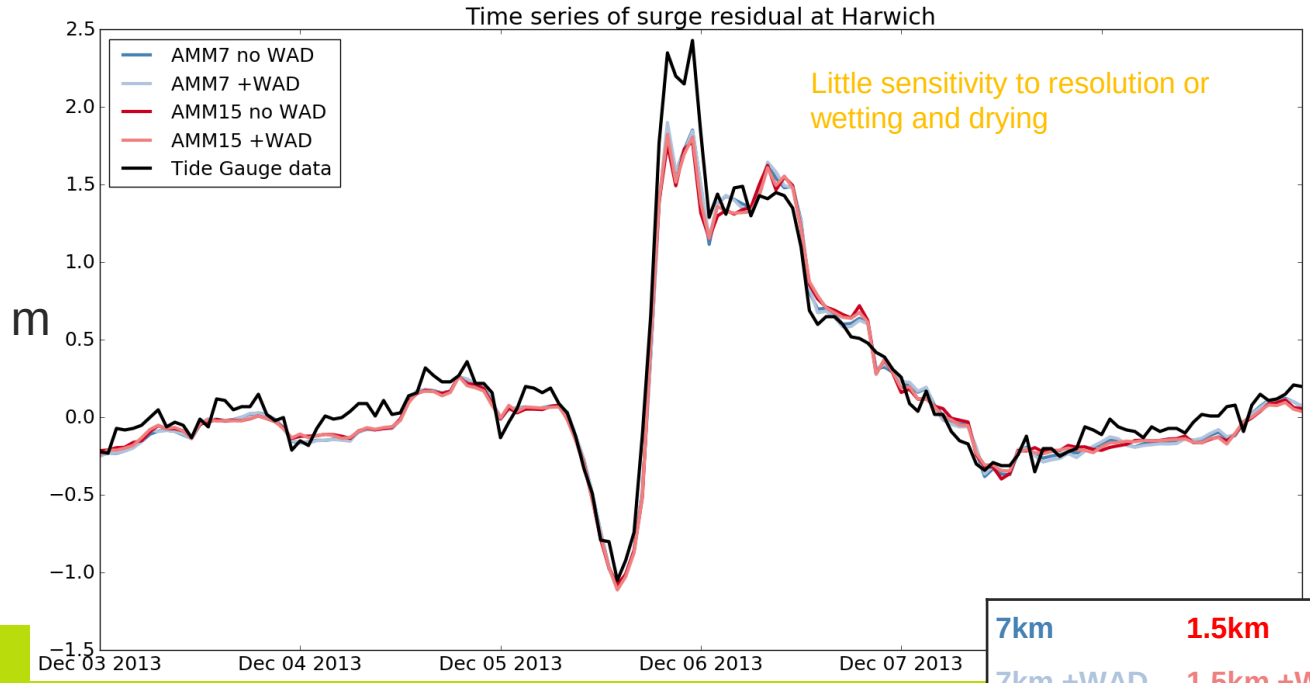

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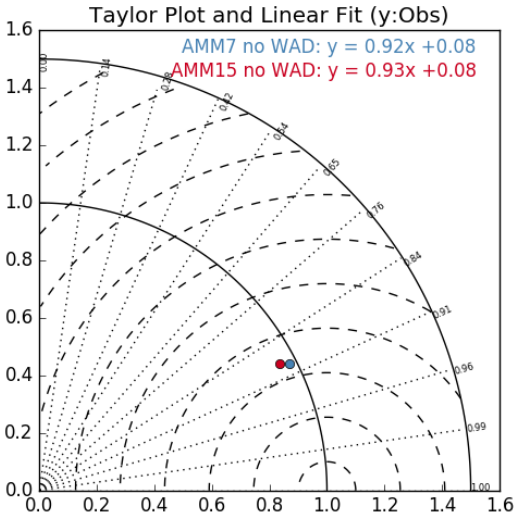
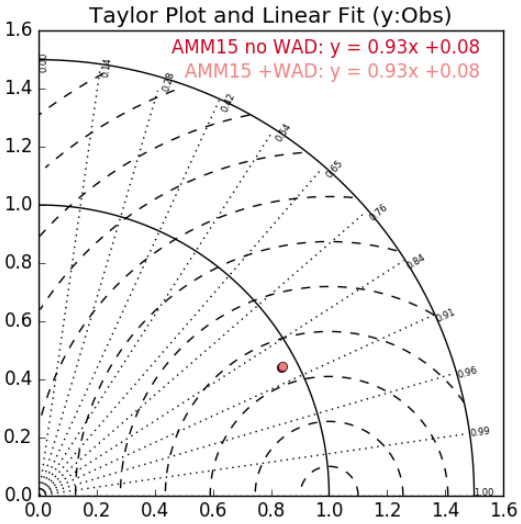
Little sensitivity to resolution or wetting and drying



7 vs 1.5 km



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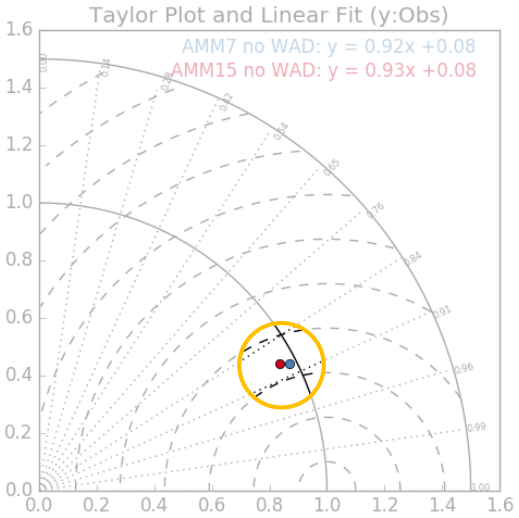

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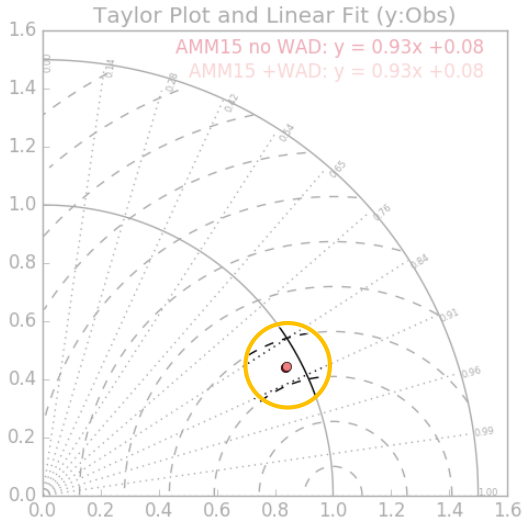

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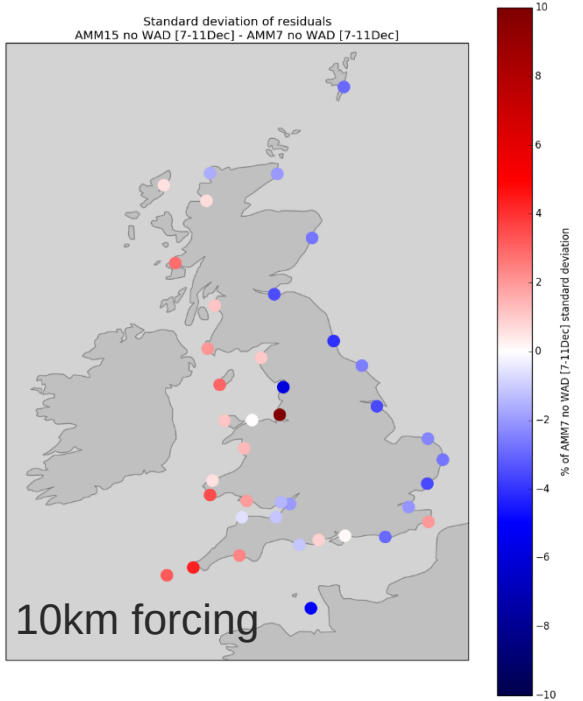
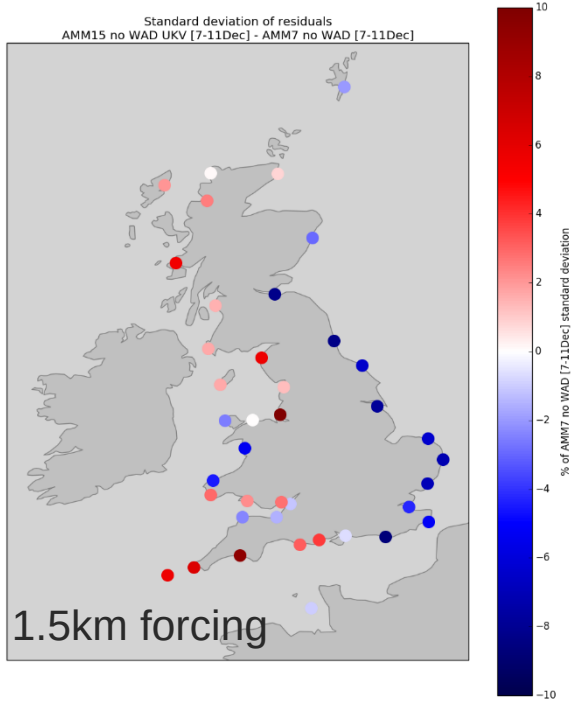
Adding high-res NWP forcing

- Short case study (6 days)
- Look at change in variability of model residual





Summary & next steps

- UK surge model shows limited sensitivity to 7→1.5km resolution increase
- Also limited sensitivity to wetting and drying in most locations
- Want to do longer run with hi-res NWP forcing to see if we get more impact from 1.5km resolution

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Questions?