



Research to Operations: pulling meteorological research though into operational applications

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The challenge to pull through cutting-edge meteorological research into operational systems and applications is common to many national meteorological services (NMSs). NMSs rely on researchers in our own organisations and in collaborating institutes to develop creative and innovative approaches to improving our operational capability, which must also fit in with the constraints of a 24:7 operational environment and provide outputs to deliver time-critical services. We increasingly develop and use Numerical Weather Prediction (NWP) models as consortia of collaborating organisations, each with our own priorities and requirements. We are also making our operational NWP systems more complex, by adding coupling between different components of the Earth system (such as the atmosphere and the ocean) or the computational system (such as deterministic forecasts and ensembles). These approaches improve the capability and fidelity of our forecasts, but increase the risk that changes designed to improve one application, or one aspect of our system, might lead to an unexpected impact in the performance of another. Additional tests and checks can help reduce and mitigate the effect of these impacts, but this can be at the cost of blocking innovation and reducing the rate of scientific pull-through.

An efficient Research to Operations (R2O) process aims to coordinate and deliver improvements to operational systems, whilst maintaining their integrity and reliability. We present some of our experience in developing and applying R2O processes, as well that of collaborators and colleagues in other European and global NMSs. We discuss the challenges and tensions this leads to, and some proposals of how to address these. We also discuss the importance of a complementary Operations to Research (O₂R) process, so that we can use the operational performance of our systems to inform our research programmes, and hence the delivery of future operational improvements.