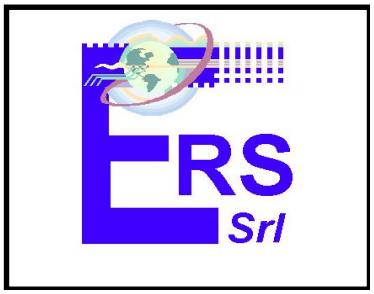

NERC Scoping Study R8-H10-71

Environmental and Earth Science Using Next Generation Aerial Platforms

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Environment Research and Services

Final Report – Executive Summary

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Environmental Research and Services

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Summary

We provide a set of recommendations showing how NERC, and the Technology theme in particular, could provide a lead in delivering UAV-based Earth and Environmental science. We then focus on 7 key science areas, and currently open questions, that have emerged in our study as best tackled using UAV-based measurement strategies.

Based on a bibliometric analysis of the peer-reviewed literature, the UK appears not to be a major innovator in the area of UAV engineering, lagging far behind USA and China in published work. UK involvement in UAV-based Earth and environmental science has been sporadic and restricted to one-off projects/reports (fewer than 10 since this area began to be developed ca. 1995).

The UK is not a major developer of UAVs, lagging far behind USA, Israel, and Italy.

Most UAVs are designed for military operations; fewer than 50 platforms are ready for the commercial and scientific sectors. Nevertheless, this is a sufficient number to enable a broad range of Earth and environmental science to be accomplished in a 2-5–year timeframe, particularly if international collaborations for access to large platforms can be established promptly.

There is no one-size-fits-all solution for UAV-based science in the NERC science area. The science suggests roles for HALE, MALE, small, mini- and micro-UAVs.

The NASA Global Hawk is, de facto, the world HALE facility. If access can be negotiated, this facility offers UK scientists the best and most cost-effective route to HALE-based science. In the first instance, much of the UK-led science could exploit existing UK expertise in campaign planning and modelling support, rather than payload development.

Other large UAVs (MALE and similar) are available from European and Israeli providers. These platforms are suitable for missions requiring long endurance at lower altitudes. There is an opportunity for the UK to gain a lead in the provision of these platforms in partnership with other countries.

Small UAVs provide greater payload capacity, flexibility, range, endurance, and — perhaps most importantly — stability in turbulence, than mini- and micro-UAVs. These benefits come at the cost of ease of deployment, however. Small UAVs are best accessed through a facility. There is a chance for the UK to take a lead here, by providing such a facility, perhaps in partnership with other countries.

Mini- and micro-UAVs with built-in payloads are best thought of as instruments, rather than as platforms. Although there is much to be gained from carrying these light and easily deployable instruments into remote areas, they will usually add most value when integrated into larger research platforms such as ships, (mobile) ground bases, and even manned aircraft.

The regulatory environment for UAVs is changing, but it is unlikely that European targets to enable "file-and-fly" operations for UAVs with MToW > 150 kg by 2013 will be met. In the interim, operations will be permitted on a case-by-case basis and will be easiest in remote environments such as the poles and the remote ocean. UAVs with dry weight < 20 kg operate in a more relaxed regulatory framework in the UK, and could be deployed immediately in less remote environments, although not in built-up areas.

We identify 7 science missions in which UAVs could outperform both satellites, ground sensor networks and manned aircraft, and which can be accomplished using existing platforms in the current regulatory framework. Those missions are: mapping of the Greenland and Antarctic ice-sheet bedrock, forest-atmosphere interactions, air-sea exchange, ocean ecology responses to climate change, aerosol direct and indirect effects, the distribution of climate-active gases, and volcanic hazards. Funding any one of these would provide impetus for a number of spin-off missions.

It is highly unlikely to be cost-effective for NERC to develop bespoke UAV platforms, except possibly micro-UAV platforms as and when they are needed.

The costs of UAV missions vary dramatically with platform. Micro-UAV missions are affordable in responsive-mode-sized grants. The costs of the Global Hawk are very heavily subsidised by NASA, and so are affordable in consortium-sized grants. Access to other large UAV platforms is of the order of £ 1M for a 1-month deployment and 100 flight hours. NERC will get much-improved value for money if it commits to several years with a given UAV provider.