

ON THE USE OF UNMANNED AIRCRAFT RADIOMETRIC SYSTEMS

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Nordic perspectives of Fukushima
Stockholm 2016
NKS

Introduction Unmanned radiometric systems

- UAV-UAS
- RPAS – civilian drone
- Search or survey
- Rotary or fixed wing
- 3D: Dull, dangerous and dirty



Approaches

- Separate measurement system
 - Any vehicle
- Integrated UARS
 - Independent
- Military
 - Range and size

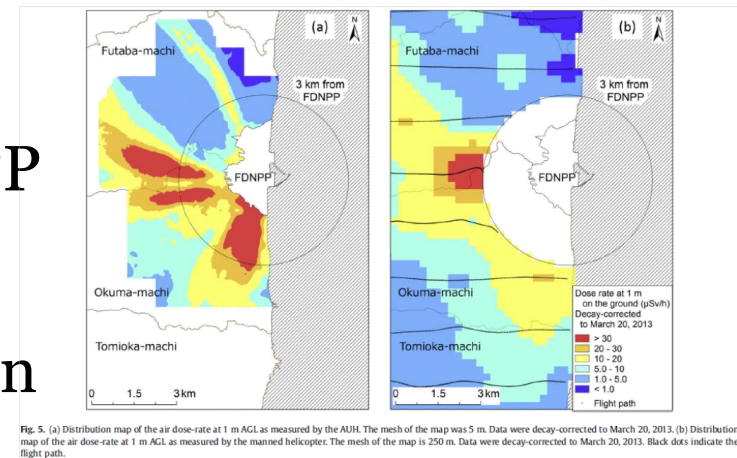
Fukushima and UARS, Illustration I

- **Ad hoc in the initial phase**
- E.g. Honeywell T-Hawk MAV
 - Ducted fan VTOL
 - Mainly footage
 - 4 T-Hawks carried radiation sensors.
 - Operational data, little published



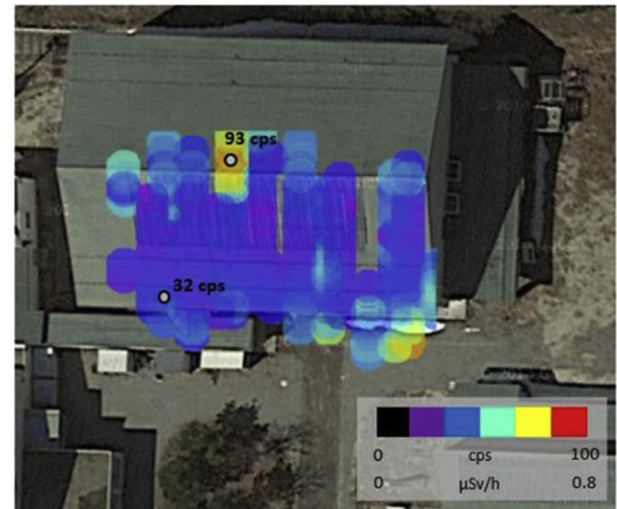
Fukushima and UARS, Illustration II

- Manned aircraft restricted <3 km from FDNPP
- JAEA had the Yamaha RMAX, initiated after the Tokaimura incident. 3 LaBr 1,5”
- $^{134}\text{Cs}/^{137}\text{Cs}$
- Dose rates calculated to 1 m AGL
- Altitude 30 m, 5 km radius FDNPP
- 52 days 2013
- Detailed distribution for migration studies, 5 m mesh



Fukushima and UARS, Illustration III

- 3 sites in Fukushima Prefecture
 - 100-10,000 m²
- 1-5 m above surface
- Multirotor, 30 min flight time
- 1 cm³ CZT
- Detailed distribution for evaluation of remediation outcome and methods, sub-meter mesh
- University of Bristol, Kyoto University



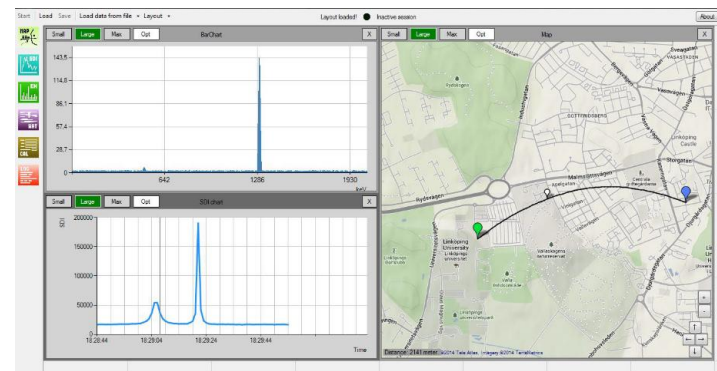
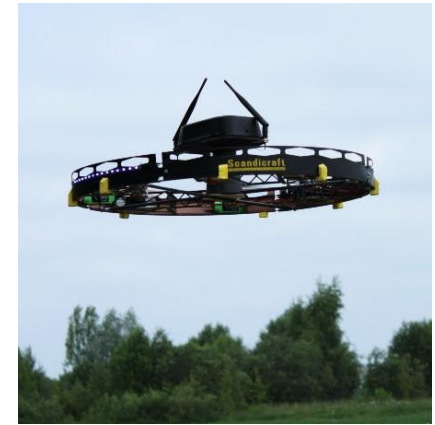
Nordic examples

- Finland
 - STUK, Finland, Military, air sampler
 - University of Oulu, Detector and smartphone
- Denmark
 - DEMA, Canberra colibri
- Sweden
 - Linköping University, Rotary/fixed wing
- Norway
- Iceland



Linköping University

- Rotary wing
 - Kromek GR1 1 cm³ CZT
 - Raspberry Pi
- Fixed wing
 - NaI with Bridgeport MCA
 - N42.42
- Plans
 - RTK
 - Air sampling
 - Monte Carlo



NKS activities on unmanned systems

- Many activities in mobile measurements
- Unmanned systems
 - SemUnaRS 2014
 - NORDUM 2016?

NKS-B SemUnaRS

- Present and discuss the progress of the Nordic use of unmanned platforms for radiation detection.
- **Build an inventory of the Nordic capacity** of radiation surveillance equipment using unmanned vehicles
- Initiative to **build informal Nordic networks** within the topic.
- Stiftsgården **Vårdnäs, close to Linköping, Sweden.**
- **October 2-3 2014**
- Abstracts and presentations in **NKS report 331.**
- Magnus Gårdestig, LiU, Sweden; Roy Pöllänen, STUK, Finland; Thomas Bandur Aleksandersen, NRPA, Norway

NKS-B NORDUM

Intercomparison of Nordic Unmanned Aerial Monitoring Platforms

- The NORDUM proposal will conduct an activity involving the use of unmanned aerial measurement systems to make **measurements of actual sources** in an outdoor environment.
- Norway 2016
- NRPA, Finnish Defence Research Agency, University of Oulu, Linköping University, DEMA

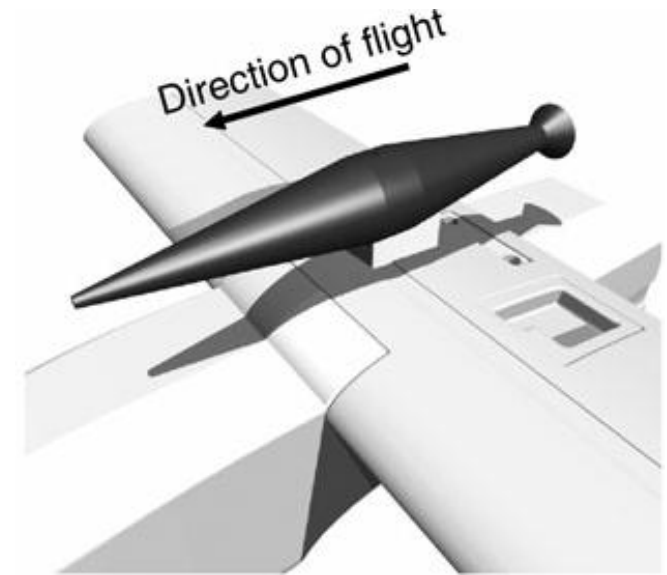
ERNICIP thematic group for Radiological and nuclear threats to critical infrastructure



- List-mode data acquisition with digital electronics
- Expert support of field teams
- **Remote-controlled radiation measurements and sampling using unmanned vehicles**
 - *Current state of the art of unmanned systems with potential to be used for radiation measurements and sampling, Report EUR 27224 EN*
 - *Possible scenarios for radiation measurements and sampling using unmanned systems, Report EUR 27225 EN*

Future

- UAS
 - Regulations (registration, pilot)
 - Sense and avoid
 - Standards
- UARS
 - Air sampling
 - Variety
 - Standards
- **Re-propose Roadmap for Unmanned aircraft radiometric systems in the Nordic countries - RUN?**
- The sky is the limit



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