Public Health England

Protecting and improving the nation's health

The application of atmospheric dispersion modelling for the provision of health protection advice in the event of a radiological incident

Peter Bedwell & Sarah Millington

ADMLC Seminar, 12/03/2020

PHE CRCE radiation emergency response arrangements

Public Health England's Centre for Radiation, Chemical and Environmental Hazards (CRCE) maintains emergency response arrangements and facilities to be ready for a wide range of radiological and nuclear emergencies that might have an effect on public health. These arrangements cover all of the UK and UK dependant territories.

In a radiological or nuclear emergency, CRCE would provide public health advice and information relating to the radiological protection aspects of the emergency to colleagues at PHE Centres and other responding organisations including central government.

CRCE also has a number of radiological monitoring responsibilities.

In many cases modelling is likely to be utilised in the provision of public health advice. In some cases modelling may be a primary input in the provision of public health advice.

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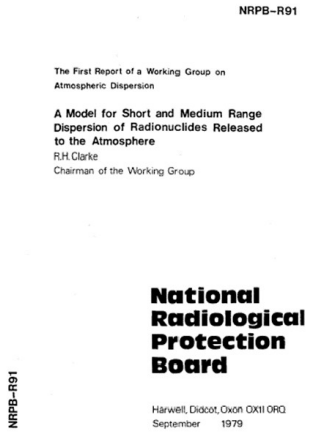
Timeline



- 1979 – Publication of NRPB-R91

- 2007 – Established improved links with Met Office

- 2011 – Accident at FDNPP in Japan

- 2019 – Joint Agency Modelling (JAM) becomes operational

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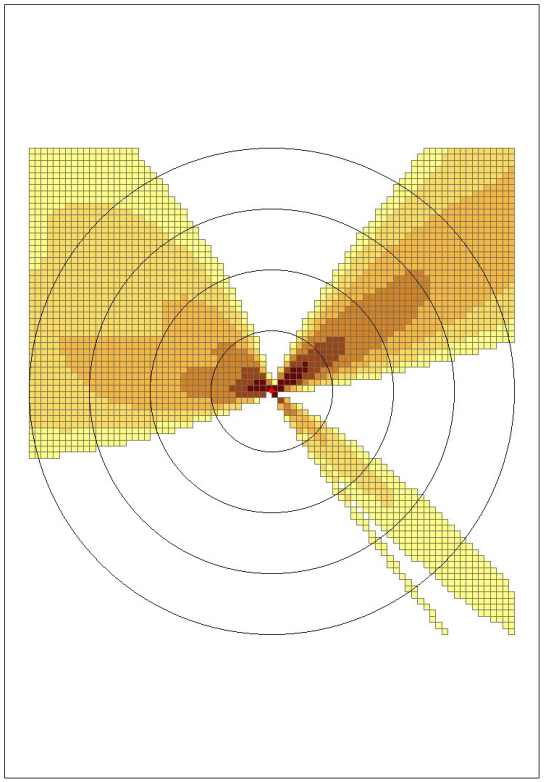
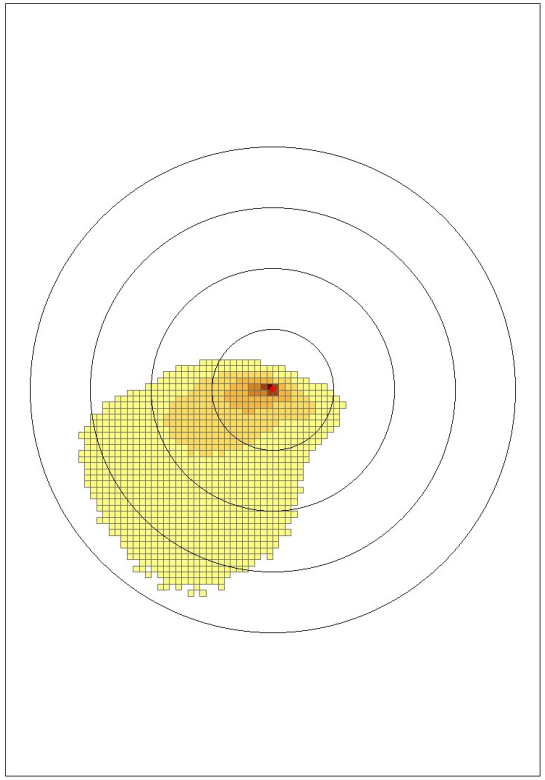
ADM Challenges



Variable wind direction conditions – R91 model run (time integrated activity concentrations in air)



Variable wind direction conditions – NAME model run (time integrated activity concentrations in air)

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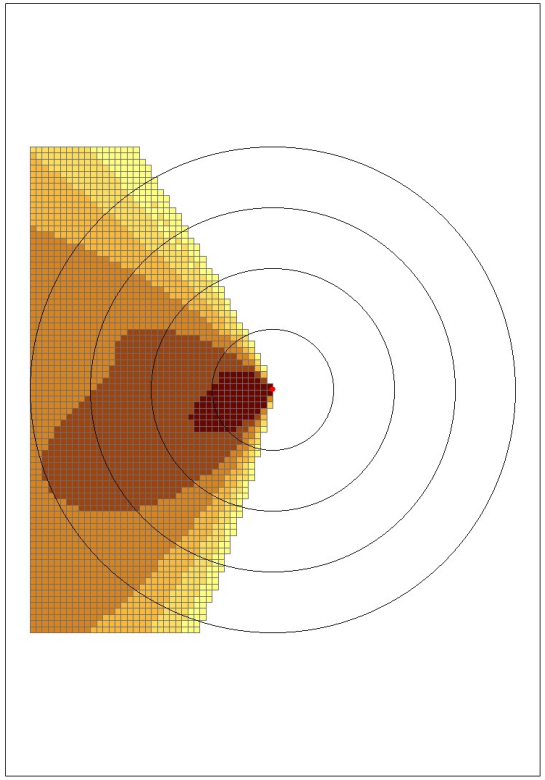
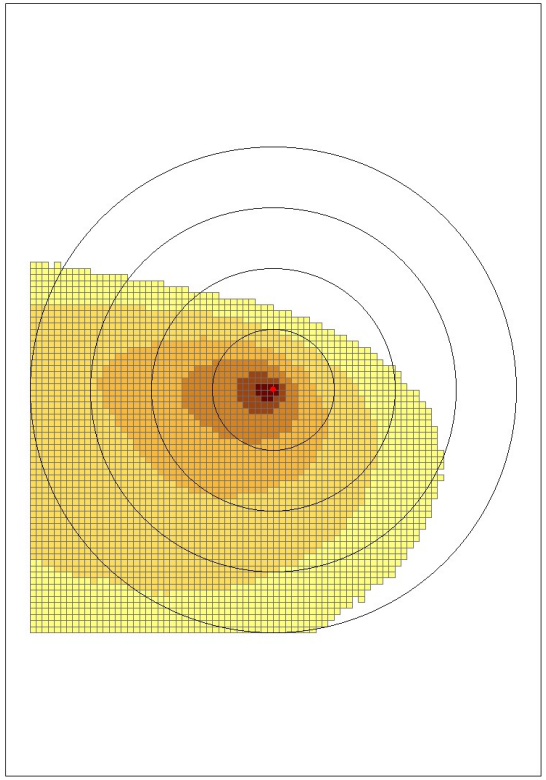
ADM Challenges



Calm conditions – R91 model run (time integrated activity concentrations in air)



Calm conditions – NAME model run (time integrated activity concentrations in air)

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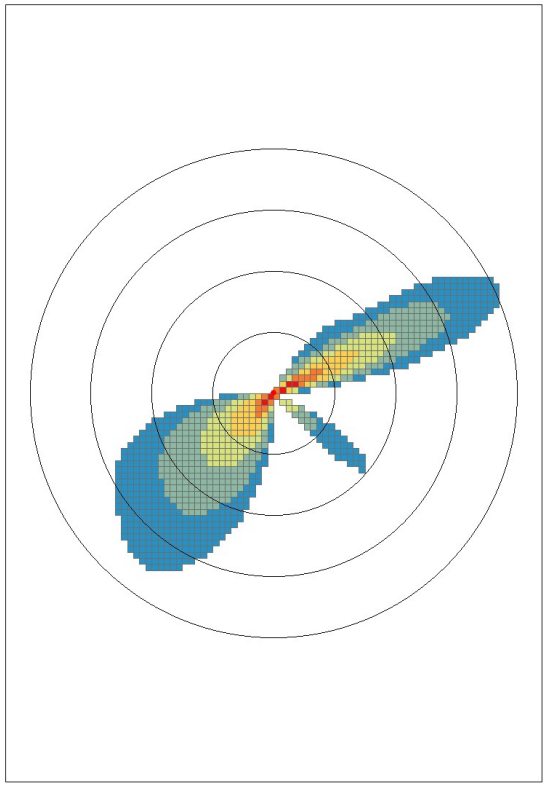
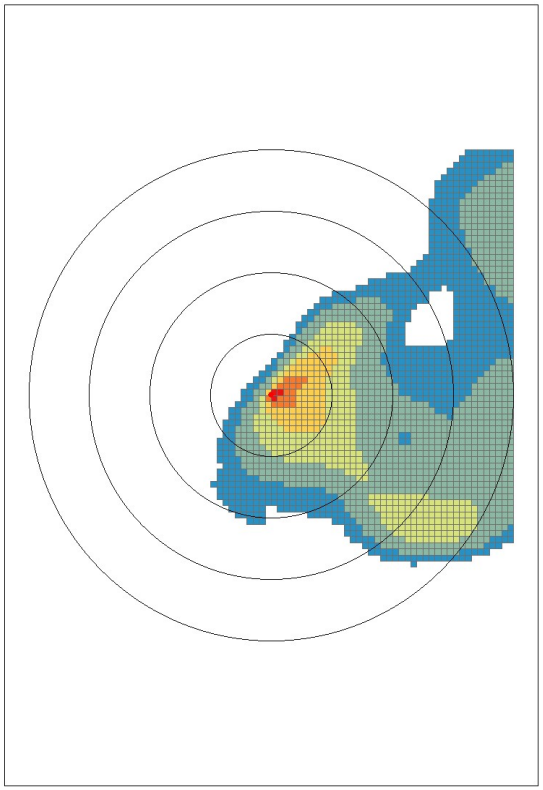
AD & Wet Dep modelling Challenges



Isolated rainfall event conditions – R91 model run (total deposition concentrations)



Isolated rainfall event conditions – NAME model run (total deposition concentrations)

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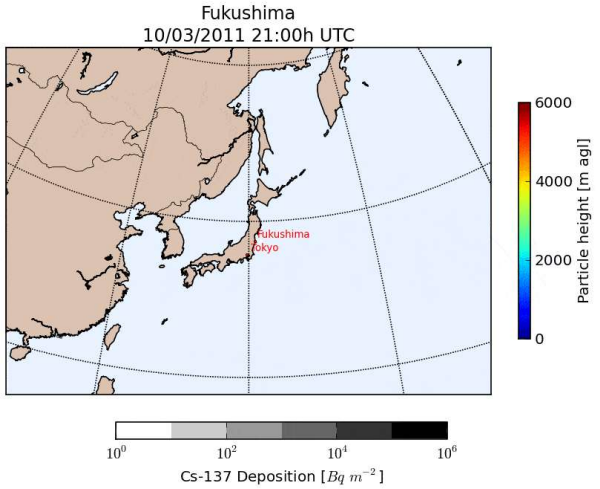
Atmospheric dispersion modelling

- NAME (Numerical Atmospheric-dispersion Modelling Environment)
- Developed by Met Office
- Lagrangian (particle) dispersion model
- Represents advection, diffusion, chemical transformations, deposition, gravitational settling, radioactive decay, plume rise, resuspension,…



- Applications for chemical, biological, volcanic emissions, as well as radioactive releases.
- https://www.metoffice.gov.uk/research/modelling-systems/dispersion-model

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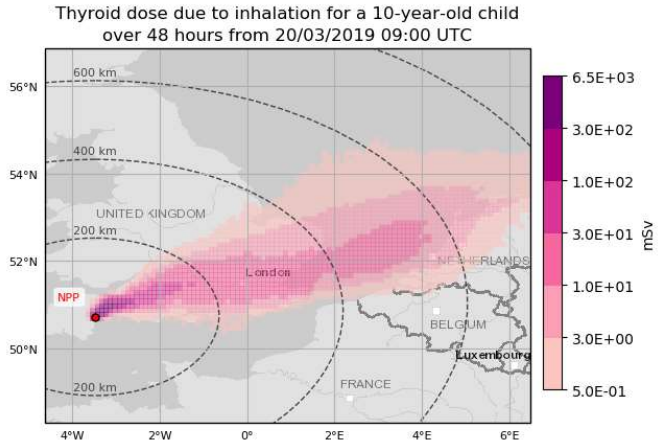
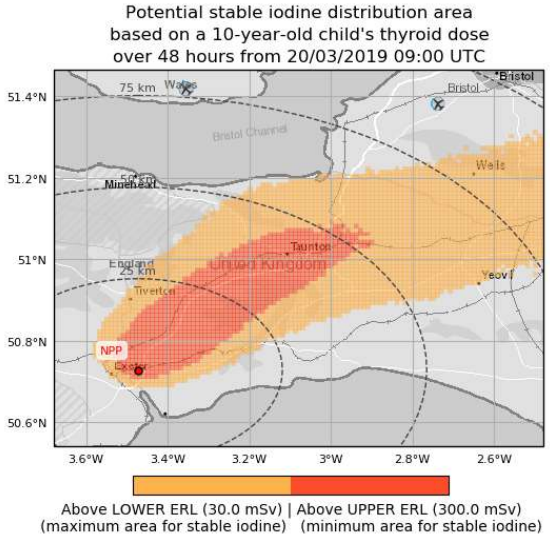
Dose modelling

- Time-integrated air concentrations and deposition used to estimate dose (in Sv):
  - Total effective dose (inh + ext)
  - Thyroid dose (inh)
- Dose calculations used to estimate potential areas for protective actions (evacuation, sheltering, admin of stable iodine)

Note: Factors in addition to estimated dose(s) are also considered in decision making and thus actions taken.





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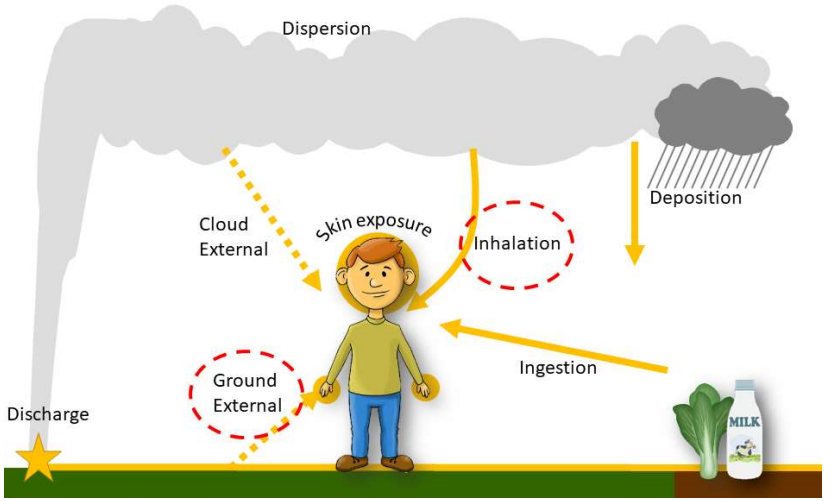
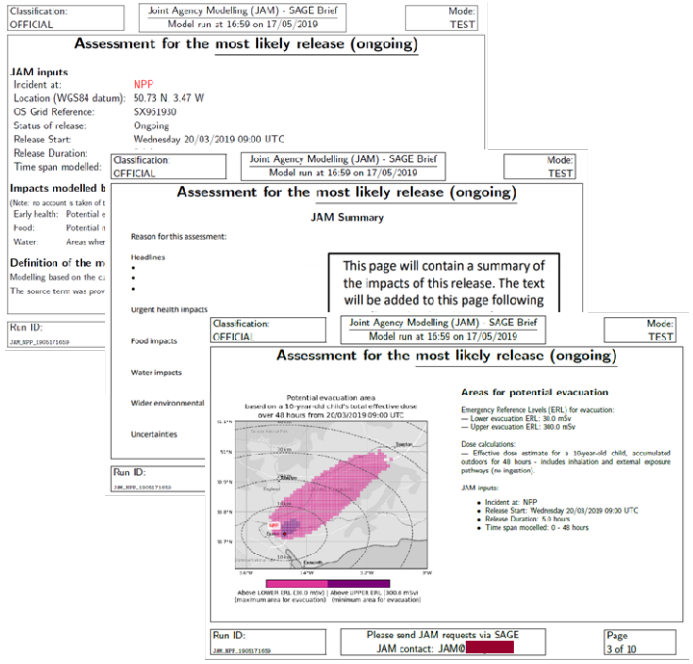
Purpose of JAM

JAM provides:

- Assessments of the impacts and potential areas for protective actions
- based on scenarios of what has been and/or what could be released (best estimate & reasonable worst case)
- to central UK Government to aid strategic decision-making during an emergency
- by modelling AND reaching a consensus on the key points and uncertainties





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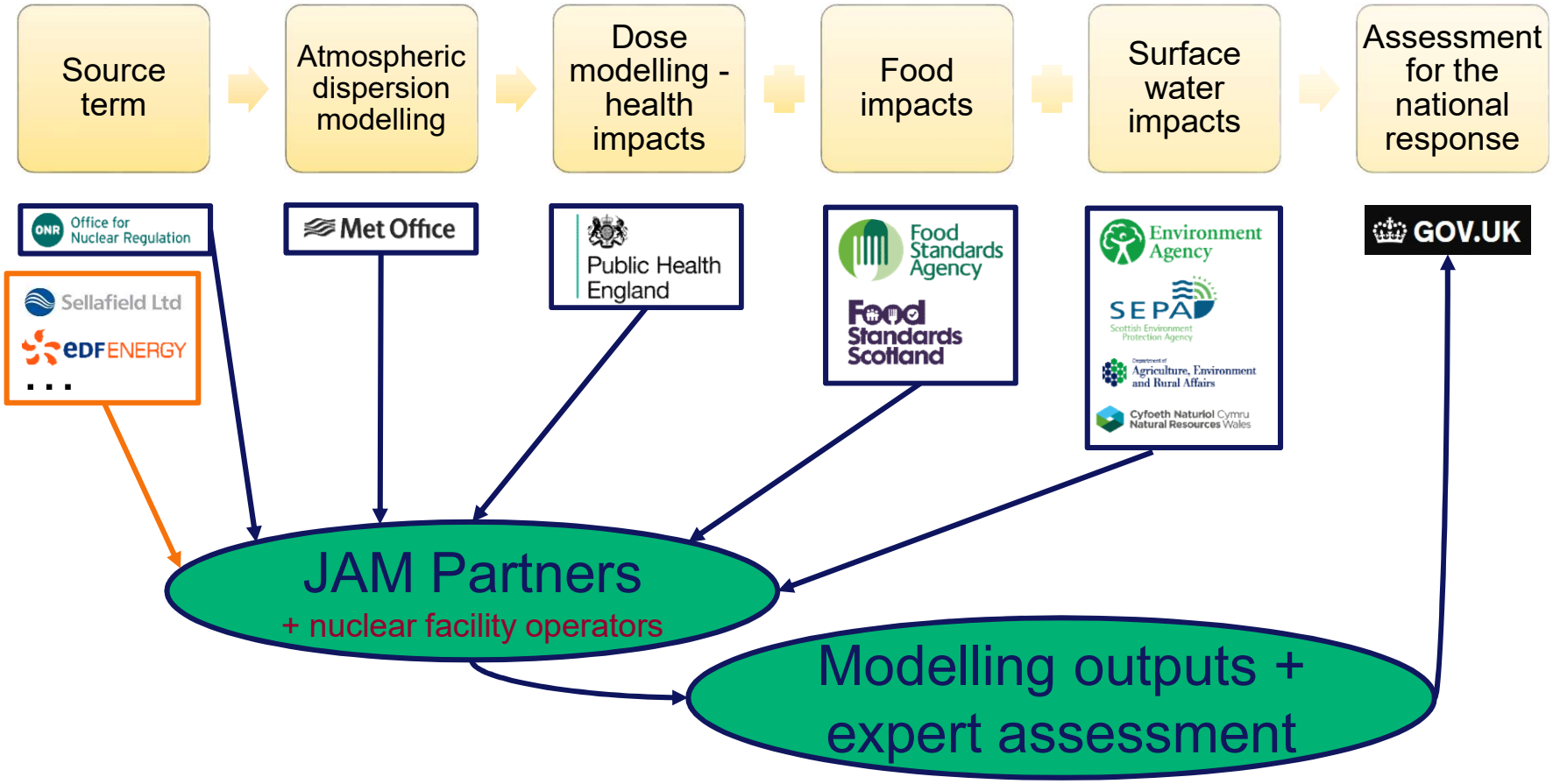
JAM process and partners



All modelling is run at the Met Office (other agencies will do additional modelling)

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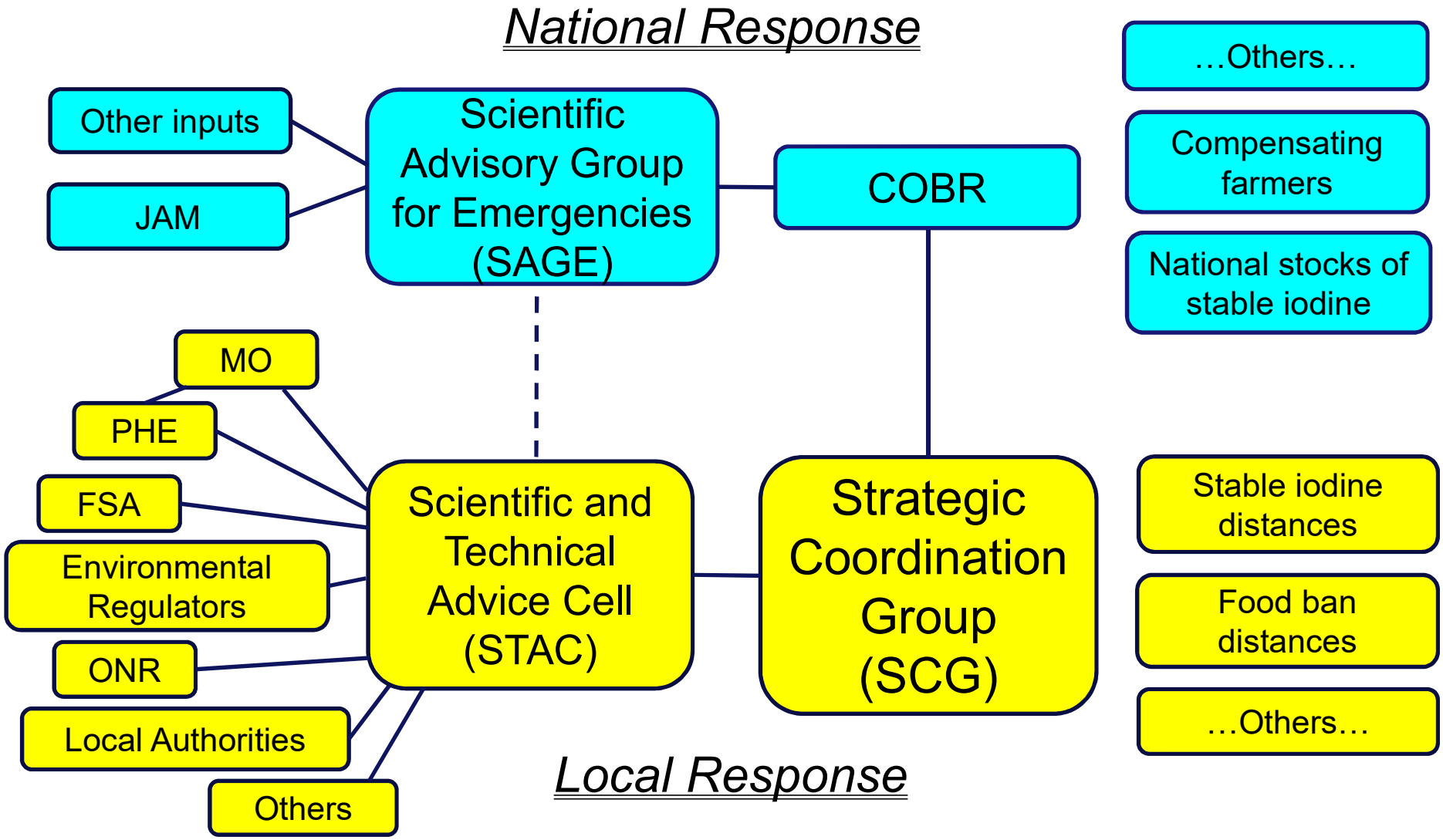
National & Local Response



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PHE's Local Response

PHE's response in … an incident

Application of MO's NAME ADM

- A single ADM approach (MO/PHE)
- Consistent with National ADM approach
- Preferred modelling approach
- Superior input meteorological data (over larger spatial scales)

PHE's response in … an exercise

Application of "R91" Gaussian plume based approach

- Consistent with exercise generation software (EXIGEN), also based on an "R91" Gaussian plume based approach
- Consistent with other ADM undertaken by other responders & operators?
- Simple scenarios => preferable when testing non-dispersion modelling exercise objectives (e.g. on-site objectives & LA's need to demonstrate the site emergency plan).

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Influences on model development

Does there exist a bias in the modelling framework towards certain scenarios?

- UK NPP reactor accidents,
- generally in rural areas,
- on the basis of unintentional releases?

Why might such a bias in the modelling framework exist?

- Very few accidents to respond to
- Driven by a few severe accidents (overseas)
- Driven by the UK's emergency exercise programme

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Modelling framework: key strengths & weaknesses

Strength:

Focused organisations, with individual specialisms, significant expertise and modelling capability

MO – specialised ADAQ & EMARC team, applying a well respected model, with access to high quality meteorological data

Area of current improvement:

Integrating modelling by way of JAM but in its infancy and intended only for National Response

Weakness:

Data and information exchange

Modelling is heavily reliant on the quality of the input data, including observations and measurements

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Aspects for improvement?

- Better consideration of uncertainty
  - CONFIDENCE – EC funded project which included model improvement in the pre-and release phase, through uncertainty analysis and propagation with an ensemble approach
  - ADMLC funded work – University of Warwick's "Presenting Uncertain Information in Radiological Emergencies" study
- Integration of modelling & measurements
  - One day workshop in February held by UoB (& SWNH) and MO
- Continually push the boundaries of our knowledge and understanding
  - Inverse modelling & source term estimation
  - Collaborative study with UoR improving ADM & wet dep
  - Harmo-19 identified knowledge gaps - deposition

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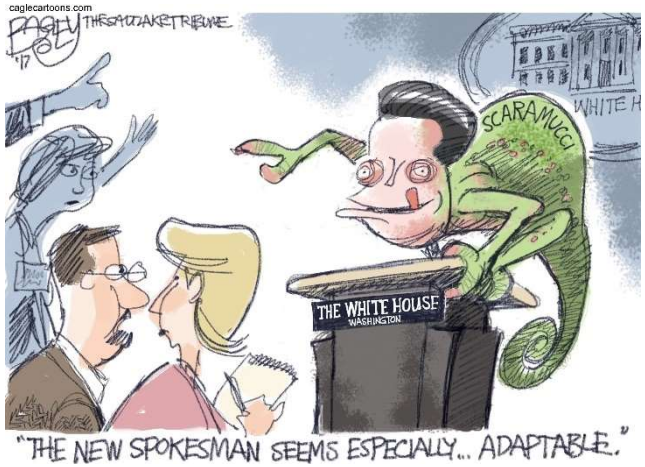
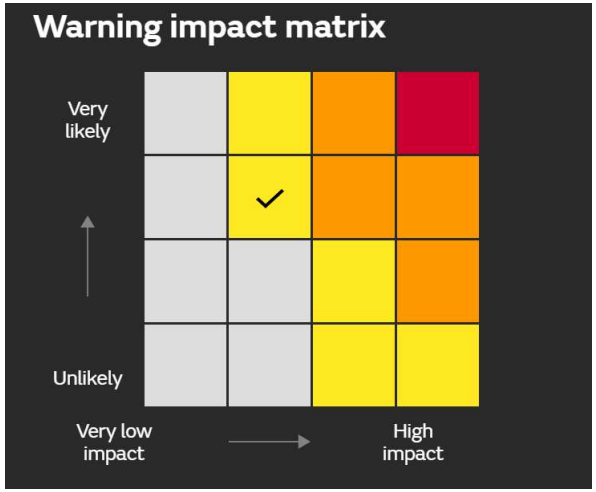
Further aspects for improvement?

And…

- being more joined up (across different agencies),
- more comprehensive and targeted emergency exercising:
  - being able to adapt to any scenario that may arise
  - being more focused on our (modelling) priorities (eg based on likelihood and impact of scenarios)
    - drill down further into the National Risk Register of Civil Emergencies?





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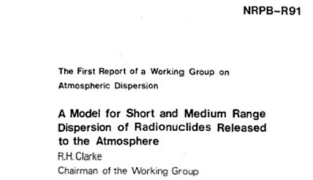

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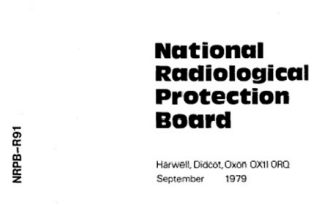

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Thank you for your attention

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