Activities of the Tritium/C14 Working Group

Phil Davis, AECL, Working Group Leader

Mikhail Balonov, IAEA, Scientific Secretary

Karen Smith, Enviros, Technical Secretary

Canada

AECL
Atomic Energy
of Canada Limited

Objectives of the WG

- To establish the confidence in the predictions of environmental tritium and C-14 models, particularly models for the formation and translocation of organically bound tritium (OBT)

- To recommend modelling approaches that will result in improved predictions

- To encourage experimental work that will lead to data sets that can be used in model testing

Test Scenarios

Complete
- – Perch Lake scenario
- – Soybean scenario
- – Pickering scenario

Ongoing
- – Hypothetical acute-release scenarios
- – Pine tree scenario
- – Mussel scenarios
- – Pig scenario
- – Rice scenario (C-14)
- – Potato scenario (C-14)

Hypothetical Scenarios

- To assess the consequences of acute atmospheric tritium releases with the aim of providing guidance to decision-makers in managing accidents

- Air concentrations varied by a factor of 10 from model to model

- The models predicted very different contributions to total dose by the different exposure pathways

- Modellers submitted HTO and OBT transfer rates to help in understanding these differences

- An intervention level of 10^7 Bq/kg in leafy vegetables will avoid a dose of 5 mSv

- A draft final report will be discussed at this meeting
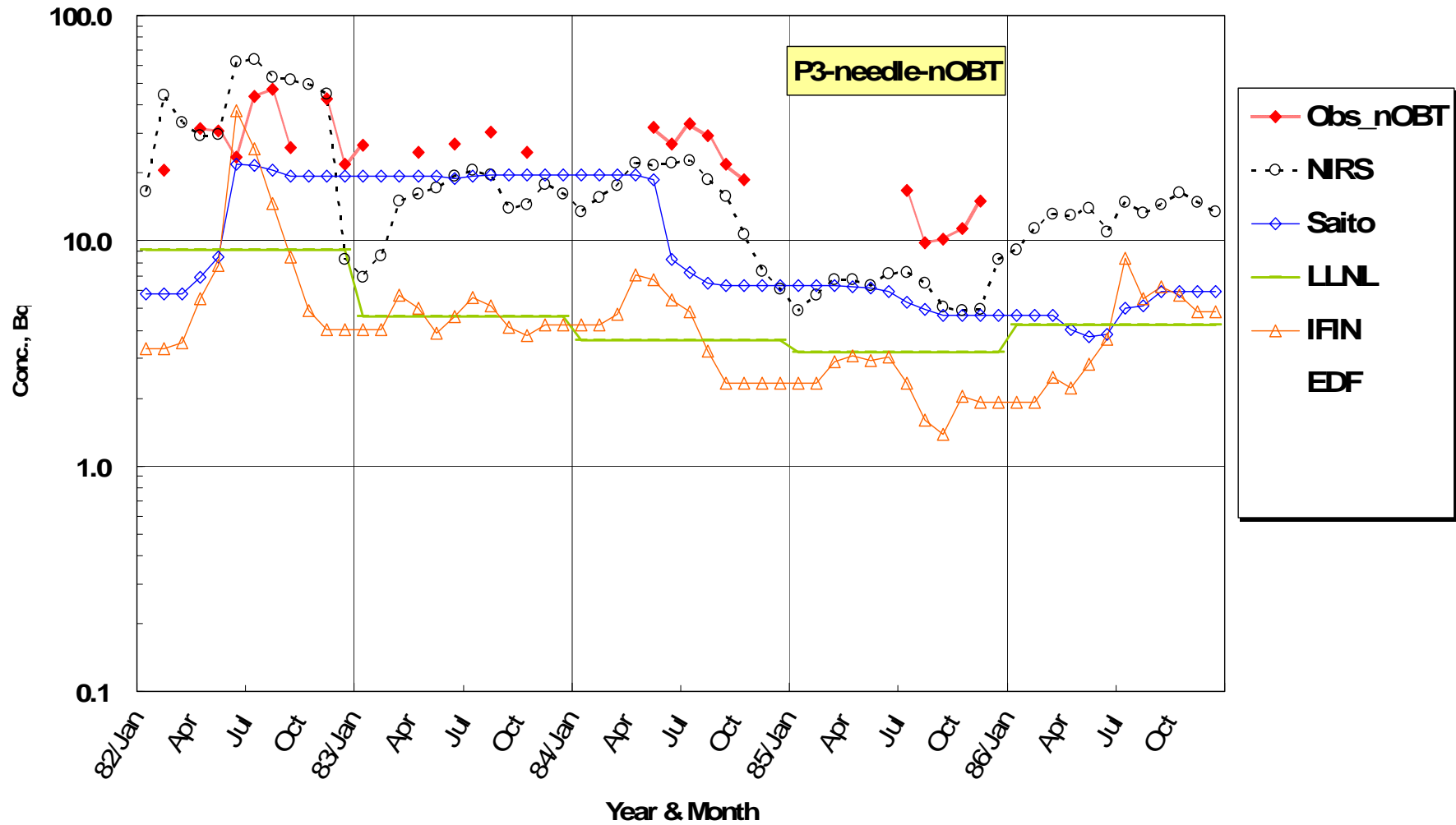
Pine Tree Scenario

A test of models that predict long-term average tritium concentrations in groundwater and pine trees (needles and rings) in the vicinity of multiple chronic atmospheric tritium sources

Predicted concentrations in air, needles and rings were lower than observed

Predicted concentrations in groundwater agreed well with observations

Discussion of results will continue at this meeting

P3-needle-nOBT

Legend:
- Obs_nOBT
- NIRS
- Saito
- LLNL
- IFIN
- EDF

Y-axis: Conc., Bq (100.0, 10.0, 1.0, 0.1)

X-axis: Year & Month (82/Jan, Apr, Jul, Oct, 83/Jan, Apr, Jul, Oct, 84/Jan, Apr, Jul, Oct, 85/Jan, Apr, Jul, Oct, 86/Jan, Apr, Jul, Oct)

Monthly nOBT concentration (Bq/l) in pine needles at Sampling Point P3 from 1982 to 1986

Pg 6

YI1   Predictions (P) and Observation (O) of tritium concentration in pine needle nOBT at P3

1)Time trends of P agrees with that of O including responses an unplaned short term release in June 1982.

2) Annual averages of P/O ratio ranges from 0.74 to 0.21 which shows underestimation.

3) The large underestimation may be caused by lower air concentration which is derived by predicting a large wind velocity at effective stack heights for air disperson calculation. This error may be caused by misestimating an effetive wind velocity from avilable meteorological data or ignoring some factors which tends to depress upward dispersion of air plume by such as stable sea breeze at daytime.

Y. Inoue, 2006-11-02

Rice Scenario (C-14)

A test of models that predict steady-state C-14 concentrations in rice growing near a continuous atmospheric source of C-14

Differences in predicted air concentrations were due primarily to differences in the way plume rise was modeled
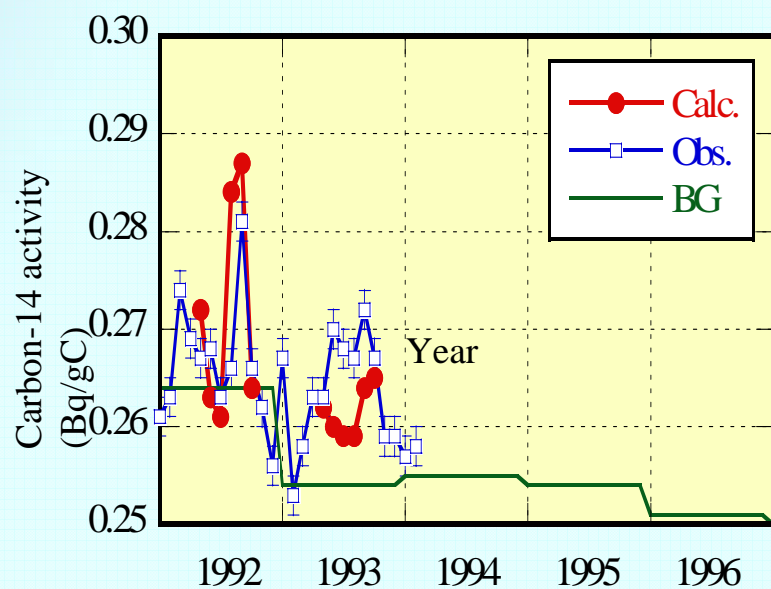
Differences in predicted rice concentrations were due to differences in the way plant growth was modeled

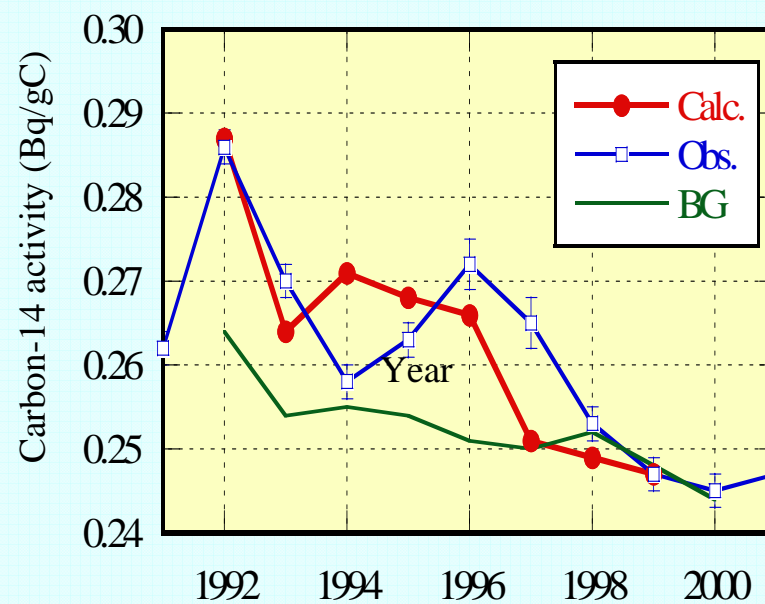Discussion of results will continue at this meeting

C-14 in atmospheric CO₂

C-14 in rice grain

Mussel Scenario – Uptake

A test of models that predict the time-dependent behaviour of tritium in aquatic organisms exposed to an abrupt increase in tritium concentrations in their environment

The models underestimated the rate at which HTO in the mussels came into equilibrium with the water concentration

The models underestimated the initial OBT concentration and in general did not simulate subsequent OBT dynamics well

A draft final report will be discussed at this meeting

Mussel Scenario – Elimination

- Similar to the uptake phase except that the mussels were exposed to an abrupt decrease in tritium concentrations in their environment

- First round results have been submitted and will be discussed at this meeting

Pig Scenario

A test of models that predict the time-dependent behaviour of tritium in a sow subject to prolonged exposure to OBT in its diet

Both model-data and model-model comparisons are being undertaken

P/O ratios were within a factor of 3 for HTO but increased to a factor of 10 for OBT

A sensitivity analysis suggests that genotype is not important

Discussion of results will continue at this meeting

Potato Scenario (C-14)

A test of models that predict the time-dependent behaviour of tritium in plants acutely exposed to elevated levels of C-14 in air

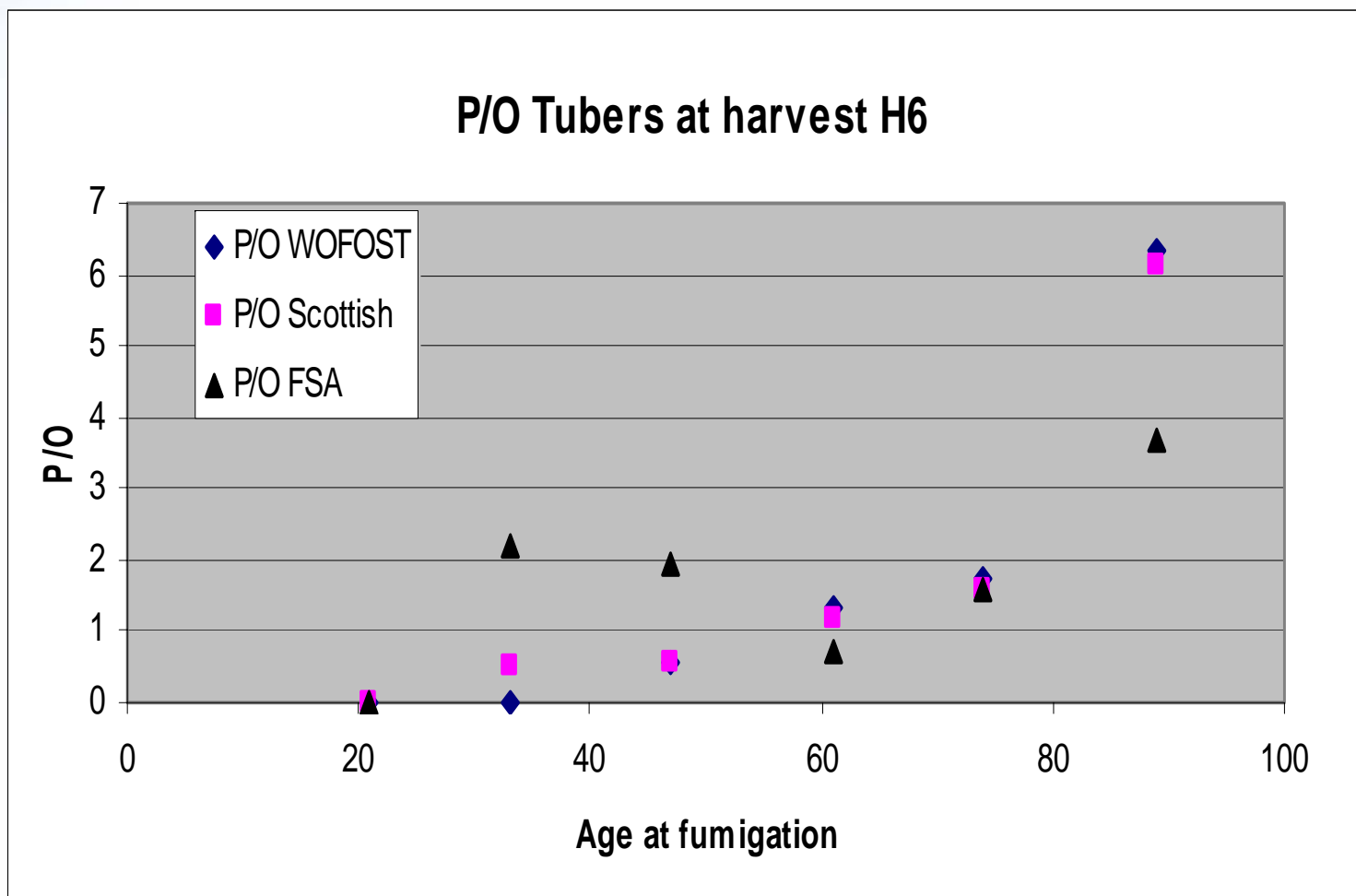Genotype, respiration dynamics and translocation are all important shortly after fumigation

Process-level models perform better than simple models

Discussion of results will continue at this meeting

P/O Ratios for Tubers at Final Harvest

Contribution to TRS 364

- The WG reviewed models that could be used as the basis for the revision of the tritium and C-14 parameter values in TRS 364

- Specific activity models were recommended

- A table was distributed to WG members soliciting values for the parameters in the recommended models

- The values will be discussed at this meeting