Plant OBT Model

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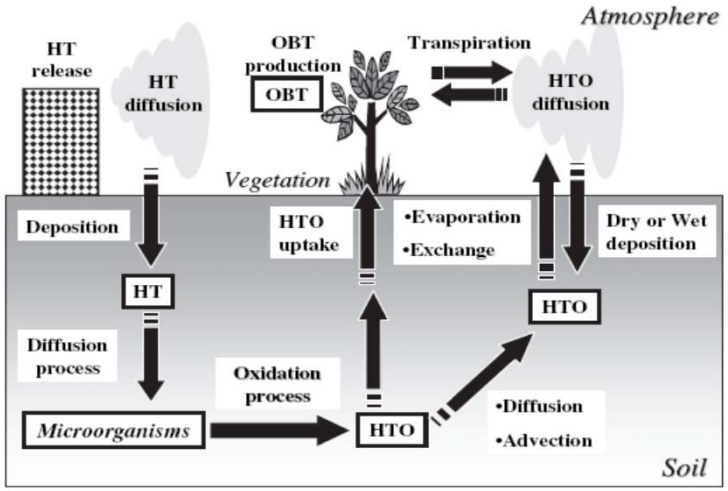
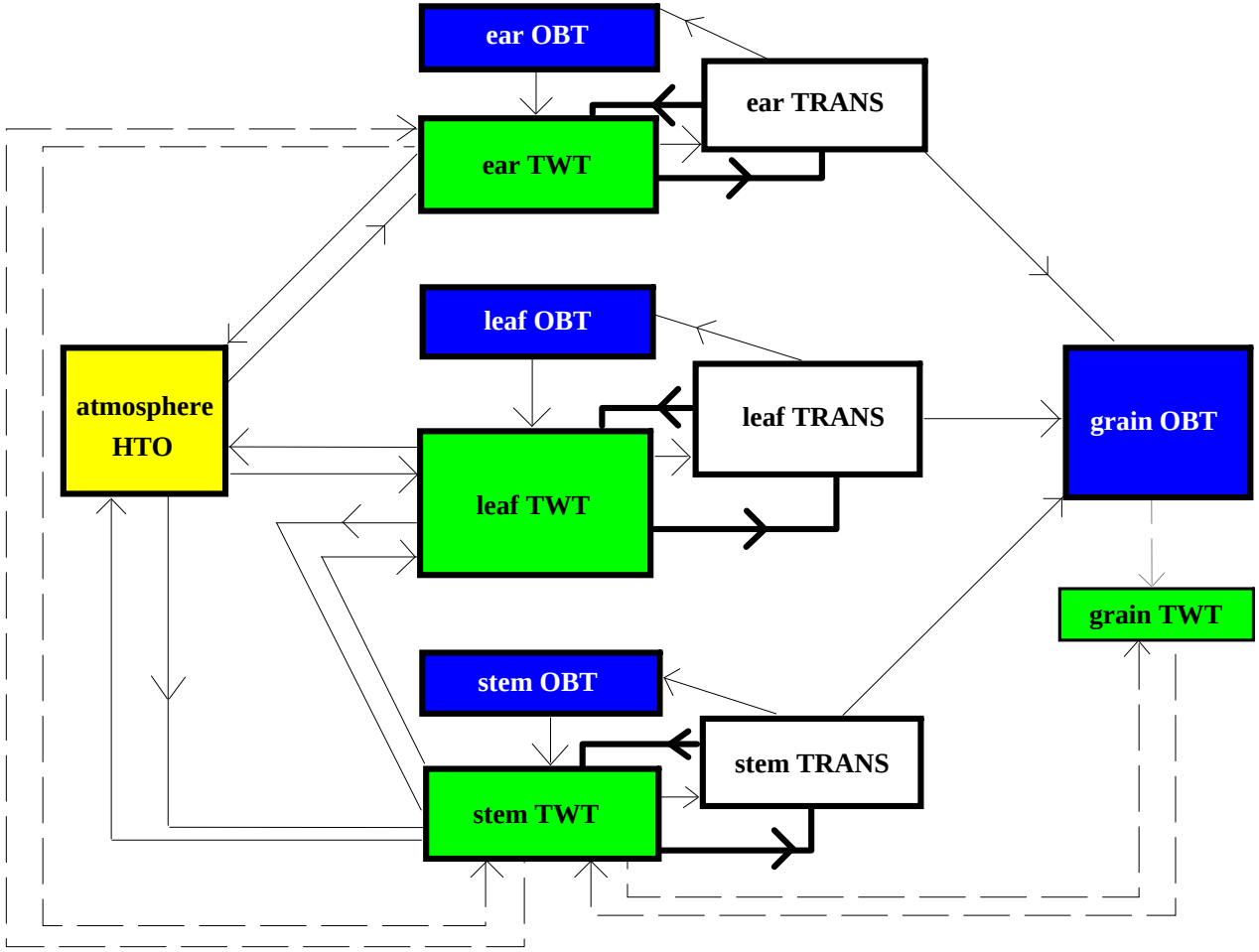


Objectives of Plant OBT

- A physically based approach, considering all the necessary transport and transformation processes
- Improvement of the present plant sub-model of the assessment code UFOTRI
- Pre- and recalculation of experimental work to get a better understanding and to identify areas of model and experimental design improvements
- Treat day and night releases correctly
  - high air concentrations at night, rather low at daytime
  - uptake at night might be important (rate of tritium intake into the plant is only by a factor of about 4-5 lower compared to daytime values, results from wheat exposure experiments performed at FZK)

Flow chart Plant OBT



Regulatory requirements for a model

- **Processes important for the OBT formation:**
  - **1. light dependent:**
    - **photosynthesis**
    - **photorespiration**
  - **2. light independent**
    - **maintenance respiration**
    - **basic metabolism**
- **Subdivision of the wheat plant into three parts:**
  - **stem**
  - **leaves**
  - **ears (+ grains)**
- **Contribution of the individual organs to the total process:**
  - **stem: 10%**
  - **leaves: 60%**
  - **ears: 30%**

OBT production (non-exchangeable)

$$COBT_{spec} = \left(COBT_0 + Red\left(\left(P_{act} + B \right) \cdot CTWT_{spec} \right) \right) / W_d$$

where:

- **$COBT_{spec}$** — **specific OBT concentration in Bq/g dry matter**
- **$COBT_0$** — **initial specific OBT concentration in Bq/g dry matter**
- **$CTWT_{spec}$** — **specific TWT concentration in Bq/g water**
- **P_{act}** — **net photosynthesis rate**
- **B** — **basic metabolism rate**
- **Red** — **reduction factors such as isotopic effect, H2 content and exchangeable / non exchangeable fraction**
- **W_d** — **dry matter content in g**

Respiration rate, expressed in CO2 equivalents

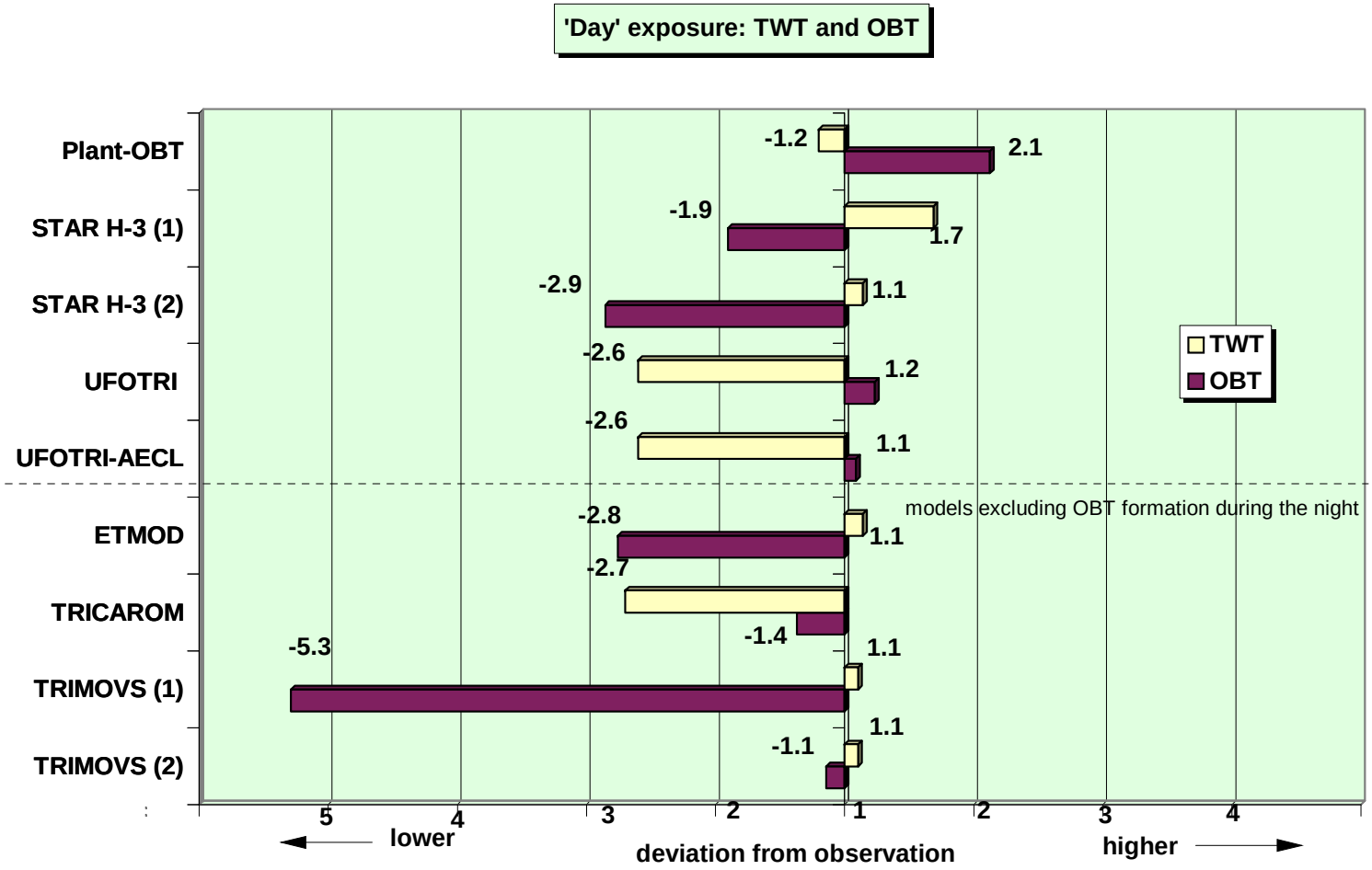
R = photorespiration + maintenance respiration

$$R = C1_p \cdot P_c + C2_m \cdot W_d$$

where:

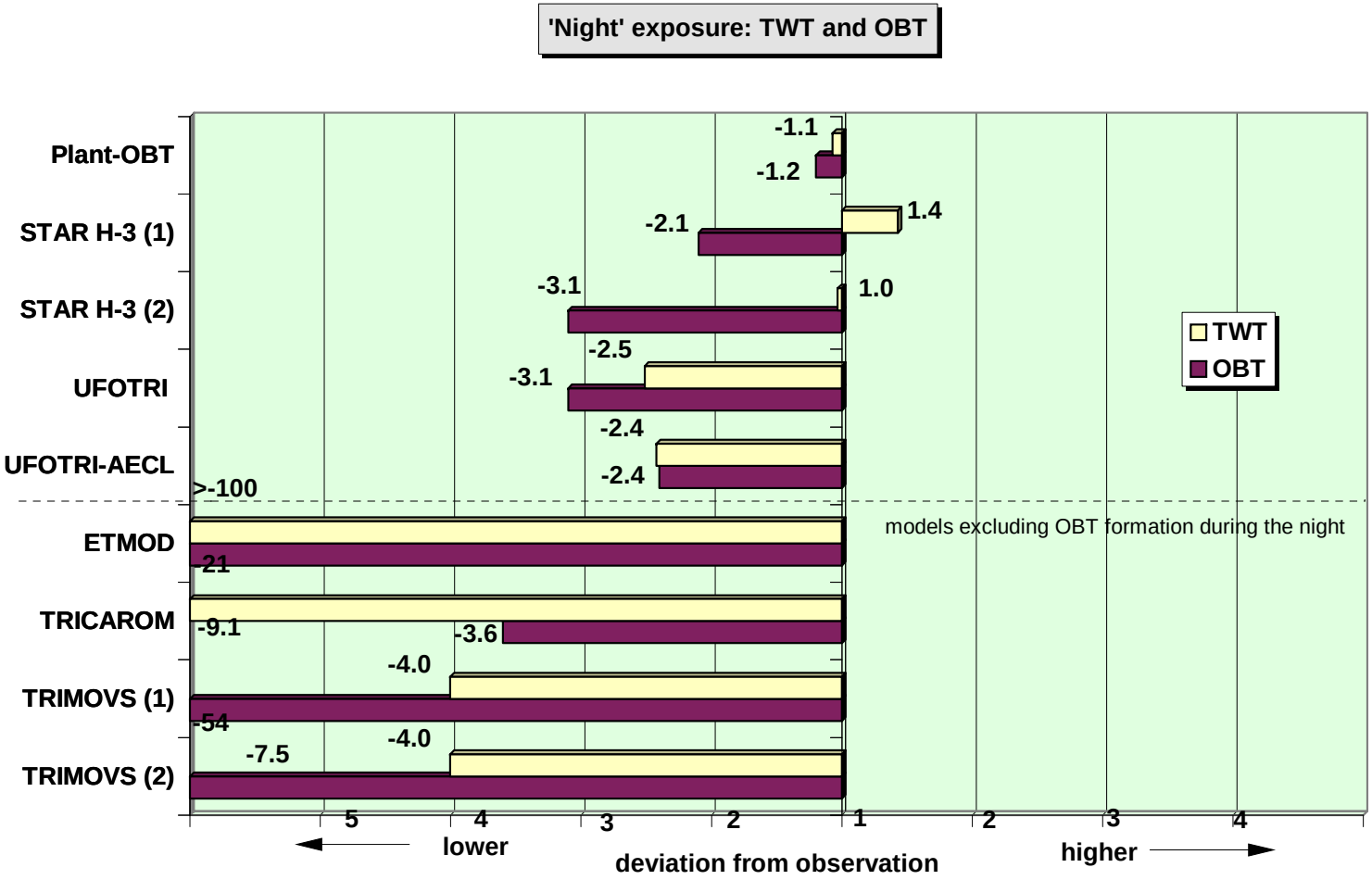
- **$C1_p$ P_c** — **photorespiration, dependent on the photosynthesis rate**
- **$C2_m$ W_d** — **maintenance respiration, dependent on the plant weight**
- **$C1_p$ $C2_m$** — **constants**

BIOMOVS test of wheat exposure at day-time



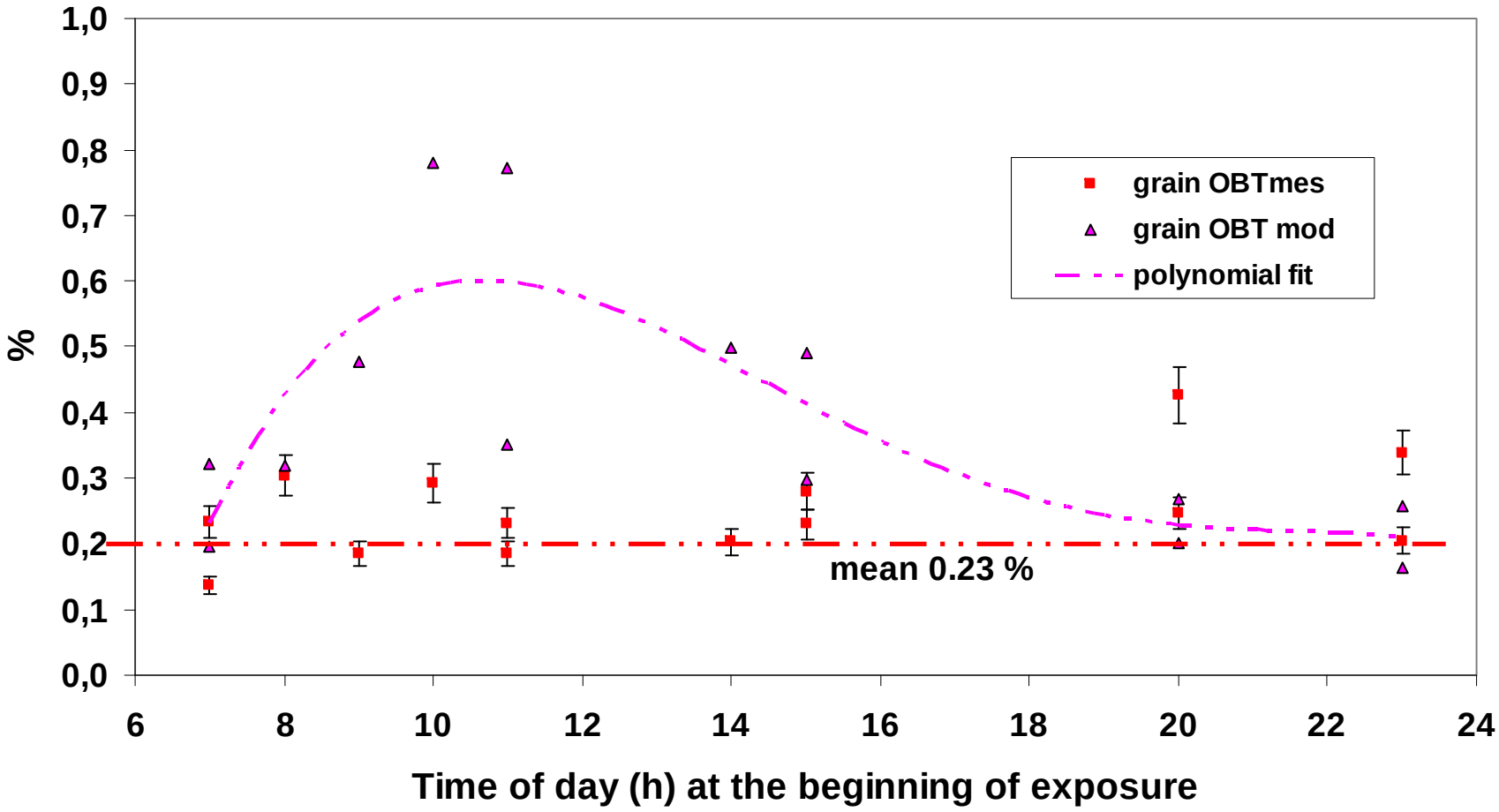
TWT in leaves after exposure, OBT at harvest

BIOMOVS test of wheat exposure at night-time



TWT in leaves after exposure, OBT at harvest

OBT-FORMATION: rel. OBT_{grain} at harvest, related toTWT in leaves at the end of exposure (Plant OBT)



Conclusion

- Yes, there is a need of a physical based tritium OBT model approach
- Before developing models, it is necessary to carry out a sensitivity analysis about the importance of the processes
- Sub-models for assessment codes should be as simple as possible, but physically based
- The 'PLANT-OBT' model considers the relevant processes (light dependent and independent), even if the parameterisation is sometimes still too simple (basic metabolism)
- Non tritium part (growth) of the 'PLANT-OBT' model was successfully tested
- Parameterisation of the photosynthesis process is still under discussion for the OBT formation (specific tritium activity in the photosynthetic cell organs)