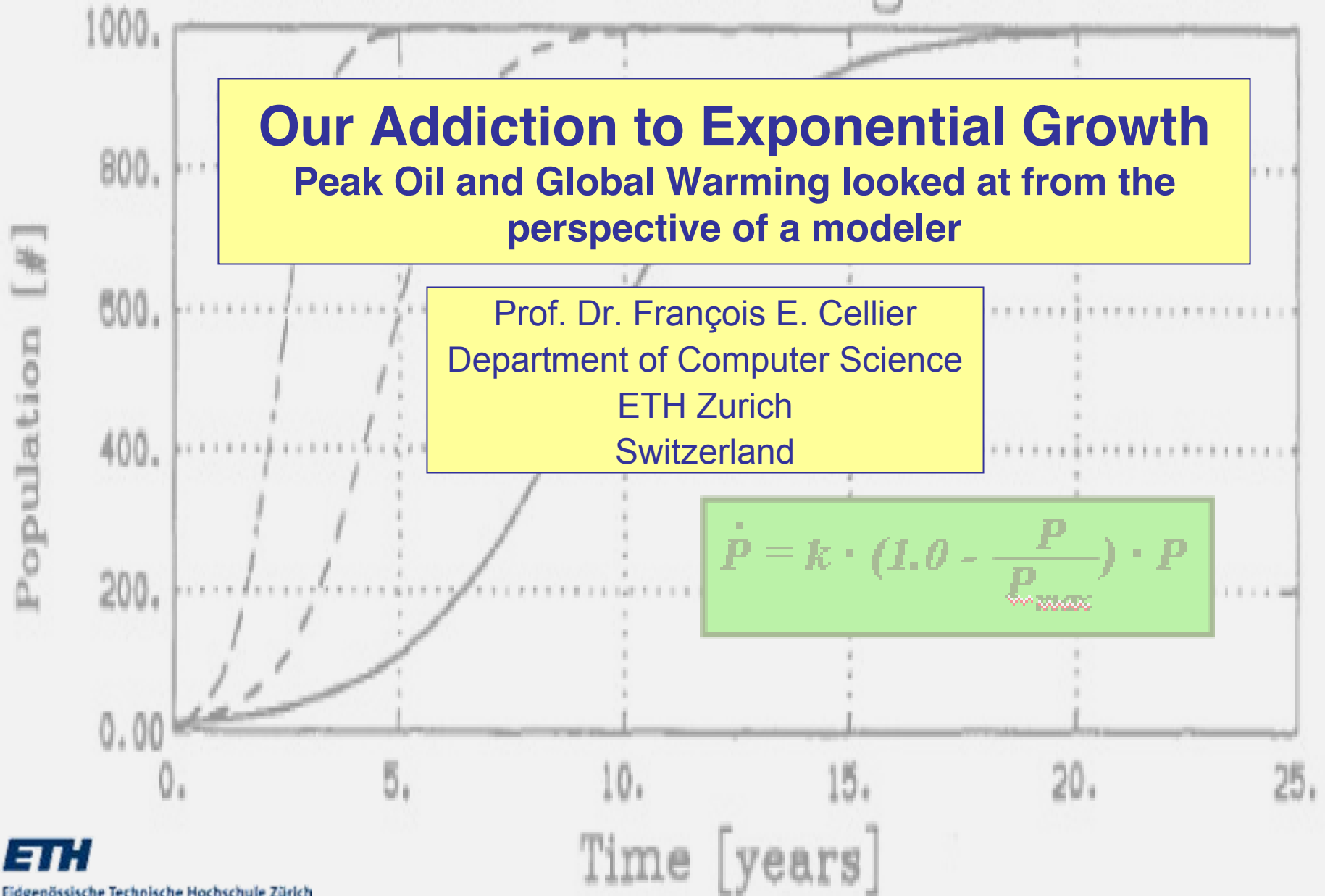


# Continuous-Time Logistic Model

**Our Addiction to Exponential Growth**  
Peak Oil and Global Warming looked at from the  
perspective of a modeler

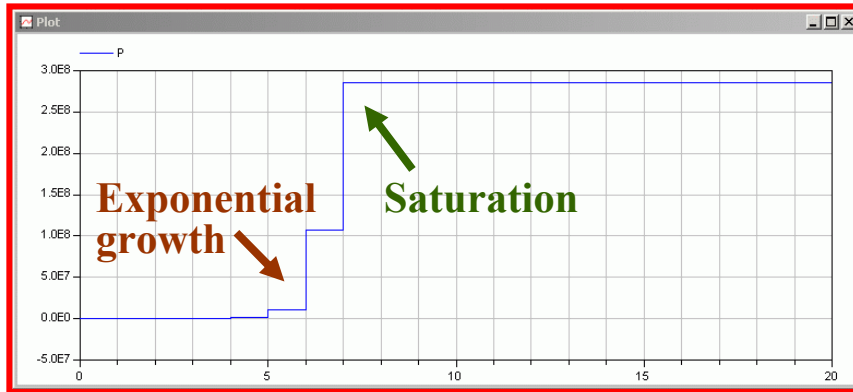
Prof. Dr. François E. Cellier  
Department of Computer Science  
ETH Zurich  
Switzerland

$$\dot{P} = k \cdot \left(1.0 - \frac{P}{P_{max}}\right) \cdot P$$

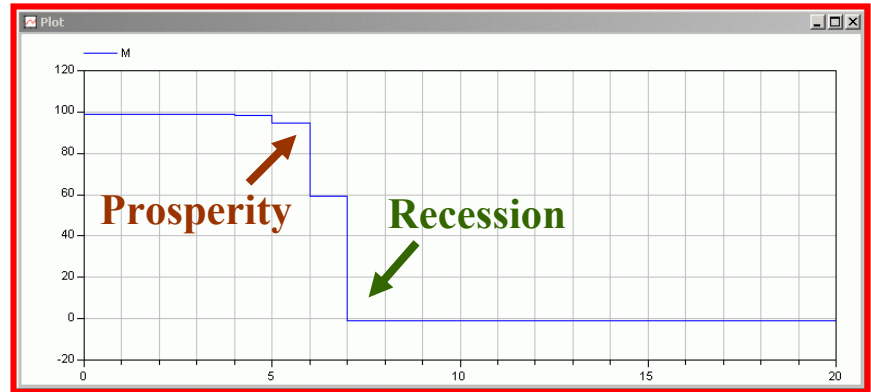


# Exponential Growth = Ponzi Scheme

## Simulation of a Chain Letter



*Infected Population*

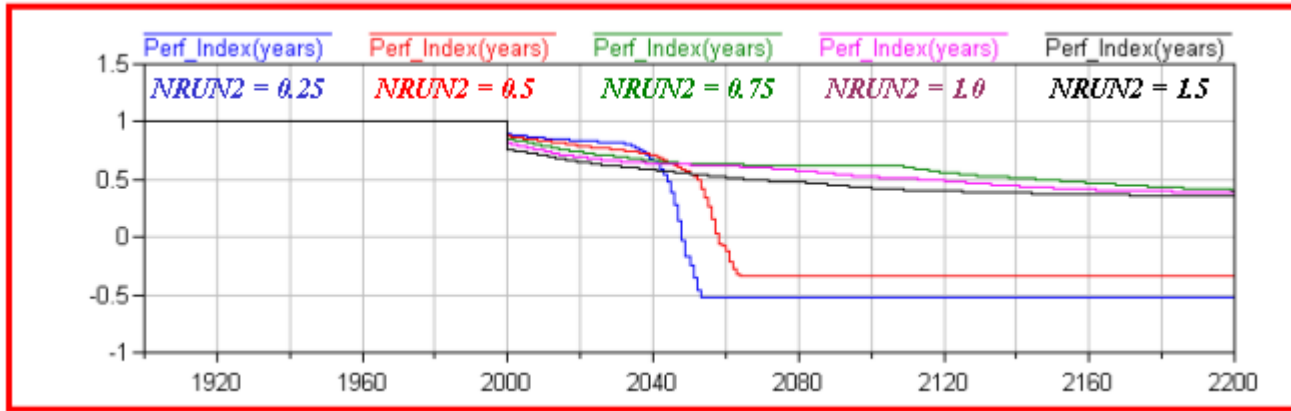


*Money Made by Participants*

- ❖ As long as we can maintain exponential growth, we can borrow money from the future.
- ❖ When we reach the limits to growth, we must pay back our accumulated debt.
- ❖ Our entire economy is based on Ponzi schemes (cf. social security).
- ❖ Madoff was only one of the first to experience the limits to growth.

# Forrester's WORLD2 Model

**Performance Index: Reward high material standard of living while punishing massive die-off**



- ❖ The blue and red curves represent higher levels of remaining non-recoverable natural resources. They allow keeping exponential growth going for a little while longer.
- ❖ They offer better rewards in the short run, yet lead to massive die-off later on in the simulation.
- ❖ Many decision variables in Forrester's WORLD2 and Meadows' WORLD3 models exhibit similar behavior. Short-term optimization leads to subsequent collapse.

# Conclusions

- ❖ Addictions don't feel bad. They feel good.
- ❖ People don't stop their addictions until they hit bottom.
- ❖ Mankind is addicted to exponential growth.
- ❖ Can we afford to wait with changing our ways until the world lies in tatters?

