Overall Goal: Compare the use of IDE vs ODE type models for assessing tumor response to chemotherapy and/or radiotherapy (possibly also immunotherapy?)

Two Main Experiments:

1) IDE vs ODE models in goodness-of-fit for data using all possible data
2) IDE vs ODE models in predictive capabilities for future growth of tumors when only given a partial set of the data points

Very similar to Heiko's paper

- Gompertz and General Bertalannfy fit tumor growth and give good prediction for final RECIST state
- Models used include exponential, logistic, Gompertz, general Gompertz, classic von Bertlannfy, general von Bertalannfy

Table 3. Model description and interpretation of the parameters. For all differential equation models in the current study, the model name, equations and variables are listed. *birth rate and growth rate can be combined to one parameter, the effective growth rate.

Model name	Solution of the differential equation	Differential equation (with initial condition $V(0) = V_0$)	Parameter description	Ref.
Exponential	$V(t) = N_0 e^{(\alpha-\beta)t}$	$\frac{dV}{dt} = (\alpha - \beta)\, V$	$\alpha[time^{-1}]$: birth rate* $\beta[time^{-1}]$: death rate*	[41]
Logistic (Verhulst)	$V(t) = \frac{V_0 K e^{\gamma t}}{K - V_0(1 - e^{\gamma t})}$	$\frac{dV}{dt} = \gamma N \left(1 - \frac{V}{K}\right)$	$\gamma[time^{-1}]$: max. net growth rate $K[mm^3]$: carrying capacity	[41]
Gompertz	$V(t) = exp\left(\frac{\delta}{\gamma} + \left(ln(V) - \frac{\delta}{\gamma}\right)e^{-\gamma t}\right)$	$\frac{dV}{dt} = V(\delta - \gamma lnV)$	$\gamma\ [mm^{3-1}\ time^{-1}]$: max. net growth rate $\delta[time^{-1}]$: constant	[19,41,57]
General Gompertz		$\frac{dV}{dt} = V^\lambda(\delta - \gamma lnV)$	$\gamma\ [mm^{3-1}\ time^{-1}]$: max. net growth rate $\delta[time^{-1}]$: constant λ: constant	[41]
Classic von Bertalanffy	$V(t) = \left(\frac{\alpha}{\beta} + \left(V_0^{\frac{1}{3}} - \frac{\alpha}{\beta}\right)e^{-\frac{1}{3}\beta t}\right)^3$	$\frac{dV}{dt} = \alpha V^{\frac{2}{3}} - \beta V$	$\alpha[time^{-1}]$: birth rate $\beta[time^{-1}]$: death rate	[41]
General von Bertalanffy	$V(t) = \left(\frac{\alpha}{\beta} + \left(V_0^{1-\lambda} - \frac{\alpha}{\beta}\right)e^{-\beta(1-\lambda)t}\right)^{\frac{1}{1-\lambda}}$	$\frac{dV}{dt} = \alpha V^\lambda - \beta V$	$\alpha[time^{-1}]$: birth rate $\beta[time^{-1}]$: death rate λ: constant	[41]

- Use these same models in the comparisons for IDE vs ODE
- Essentially adapt these simple ODE models to IDE
- Compare to real patient data on a large scale (potentially use AI in assistance for extracting the data to run these large scale tests?)

Key Terms (for me):

RECIST = response evaluation criteria in solid tumors

- Complete response (CR)
- Partial response (PR)
- Stable disease (SD)
- Progressive disease (PD)