Temple 8024 **Numerical Differential Equations II** **Spring 2022**

Problem Set 5

(Out Tue 03/29/2022, Due Thu 04/07/2022)

Problem 7

Compute the same test problems as in Problem 5 (Moses' first and second problems), but now with the dgclaw software on the course website (by suitably modifying the files `dgclaw_shallowwater.m` and `dgclaw_compute.m`). Discuss the similarities and differences between discontinuous Galerkin and Godunov, both in terms of methodology and in terms of results.

Problem 8

The fire control of New South Wales would like to test a new approach to impede the propagation of bush fires: In a checkerboard pattern, regular squares of $1\,\mathrm{km} \times 1\,\mathrm{km}$ are treated so that the propagation speed of the fire front is slowed down.

a) Write a program that simulates the advance of a fire front that starts in the center of an untreated square and moves outward in its normal direction, with a velocity that is $1\,\mathrm{km/h}$ in the untreated squares, and $\varepsilon\,\mathrm{km/h}$ in the sprayed squares.

b) Create a function $d(\varepsilon)$, where d denotes the largest distance of the fire from the origin at the final time $T_{\text{final}} = 24\,\mathrm{h}$. Do so by running your simulation for a whole range of values $\varepsilon \in [\frac{1}{100}, 1]$. Also plot the shape of the burning region for $\varepsilon \in \{\frac{1}{100}, \frac{1}{3}, \frac{4}{5}, 1\}$.

c) Explain your results: Are there any critical values of ε at which a transition in the fire shape occurs? Is the idea of a checkerboard spraying a good one?