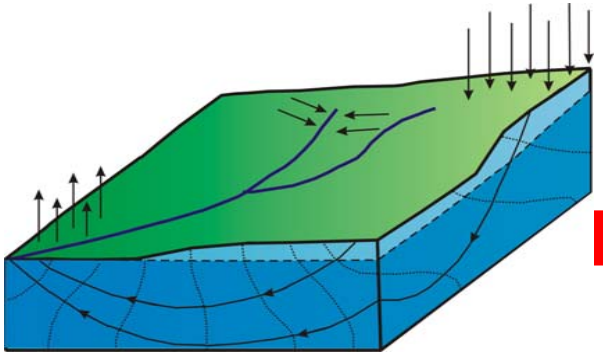
Conceptual model

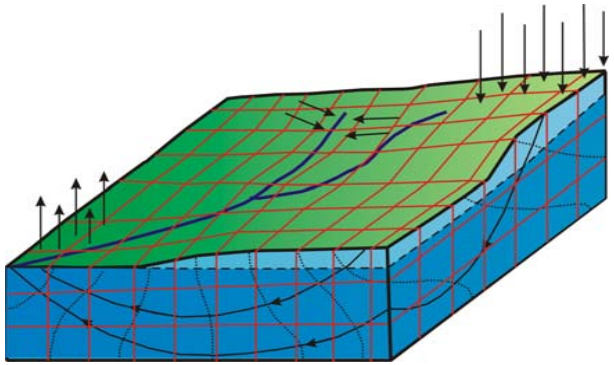
The **user interpretation** of the most important hydrological processes and geological conditions.

The **users survey and delimitation** of what is necessary to include in the succeeding numerical simulations.

Conceptual model



Numerical formulation



Set of equations

$$\mathbf{A}\boldsymbol{\psi}^{n} = \mathbf{b}$$

Conceptual model

0. Objective of the model set-up
1. Delineation of the model area
2. Description of the hydrological processes
3. Construction of the geological model
4. Determination simulation periods – steady state / transient model?
5. Parameterisation
6. Description of available data for calibration and validation
7. Mapping of uncertainties in relation to point 1-6

0. Objective of the model set-up

Why is the model constructed?

- Transport and spreading of a gasoline spill?
- Long-term influence of water abstraction on e.g. stream flow?
- Transport and spreading of compounds from a waste dump?
- Determination of the temporal and spatial distribution of net-precipitation?
- Determination of the precipitation-depended washout of compounds form the unsaturated zone?
- Etc.

1. Delineation of model area – a search for good BC´s

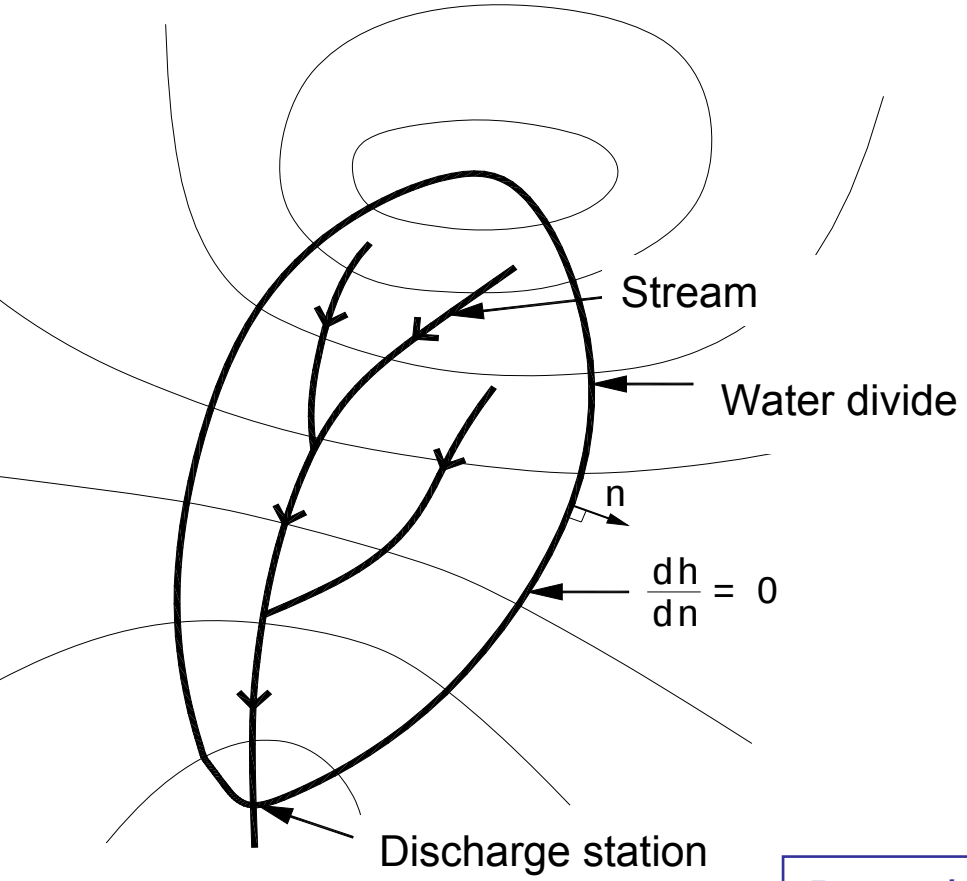
Boundary conditions:

1. Known pressure (Direchlet)
   - ocean, inlet, ”large” lakes, rivers (large), measured groundwater potential
2. Known gradient /flux (Neumann)
   - streamline, geological water divide (no-flux), hydrological water divide (no-flux),
   - ”topographical water divide (no-flux)”, salt water interface (no-flux),
   - inflow from adjacent reservoir, rivers, streams.
3. Pressure-depended flux
   - Water abstraction rivers, stream, lake, infiltratin

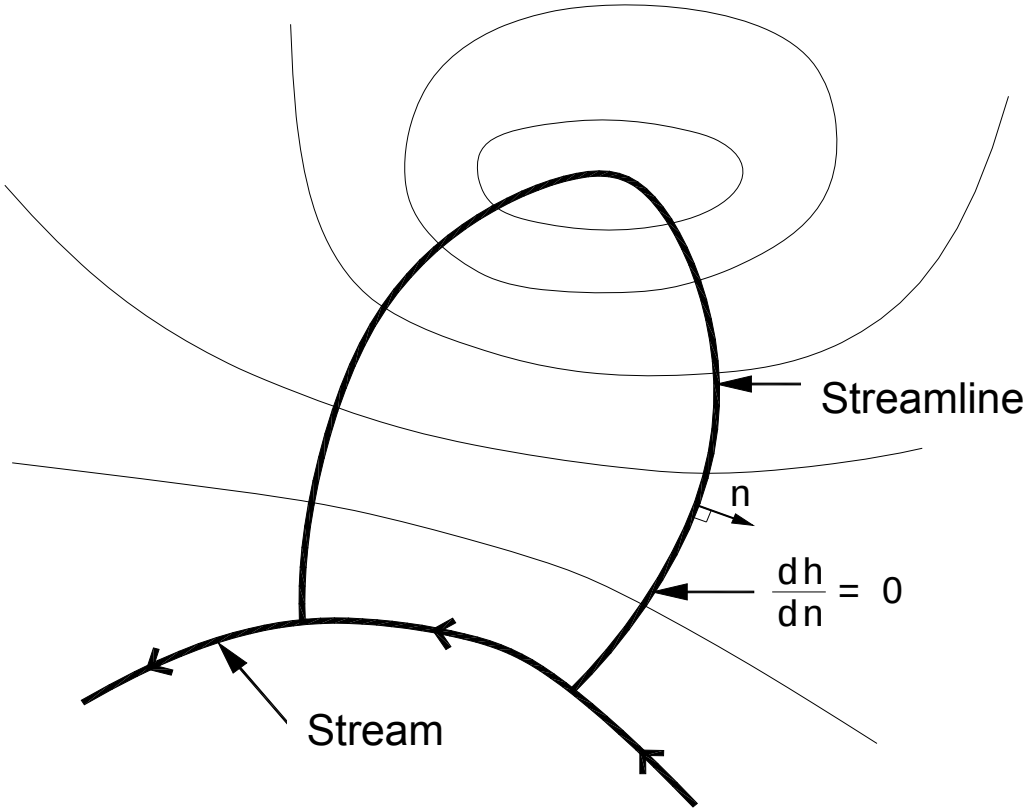
Model delineation from terrain, rivers and groundwater potentials

1. Delineation of model area (horizontal)

Hydrological catchment



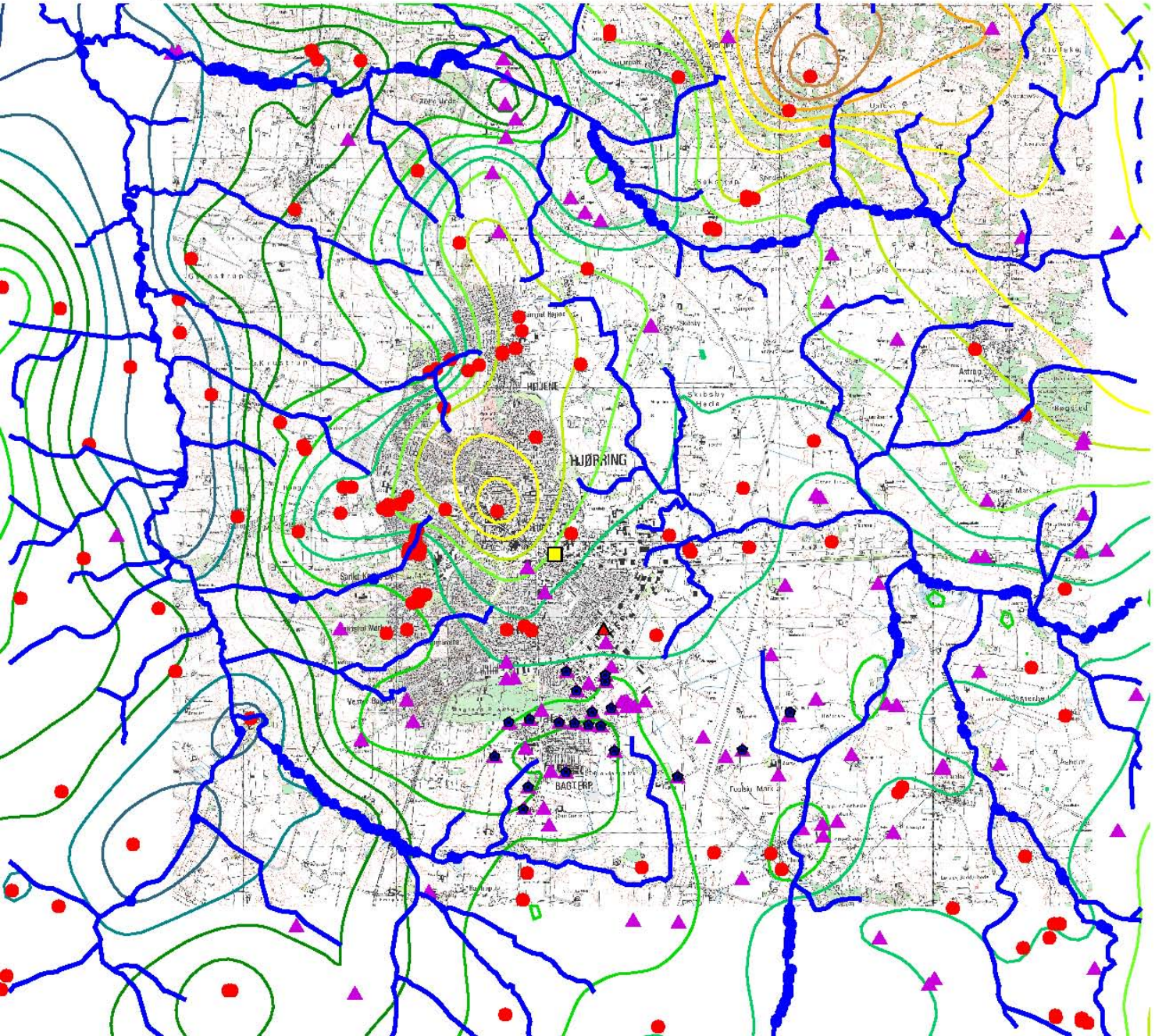
Hydrological sub-catchment



Potential curve (constant pressure level)

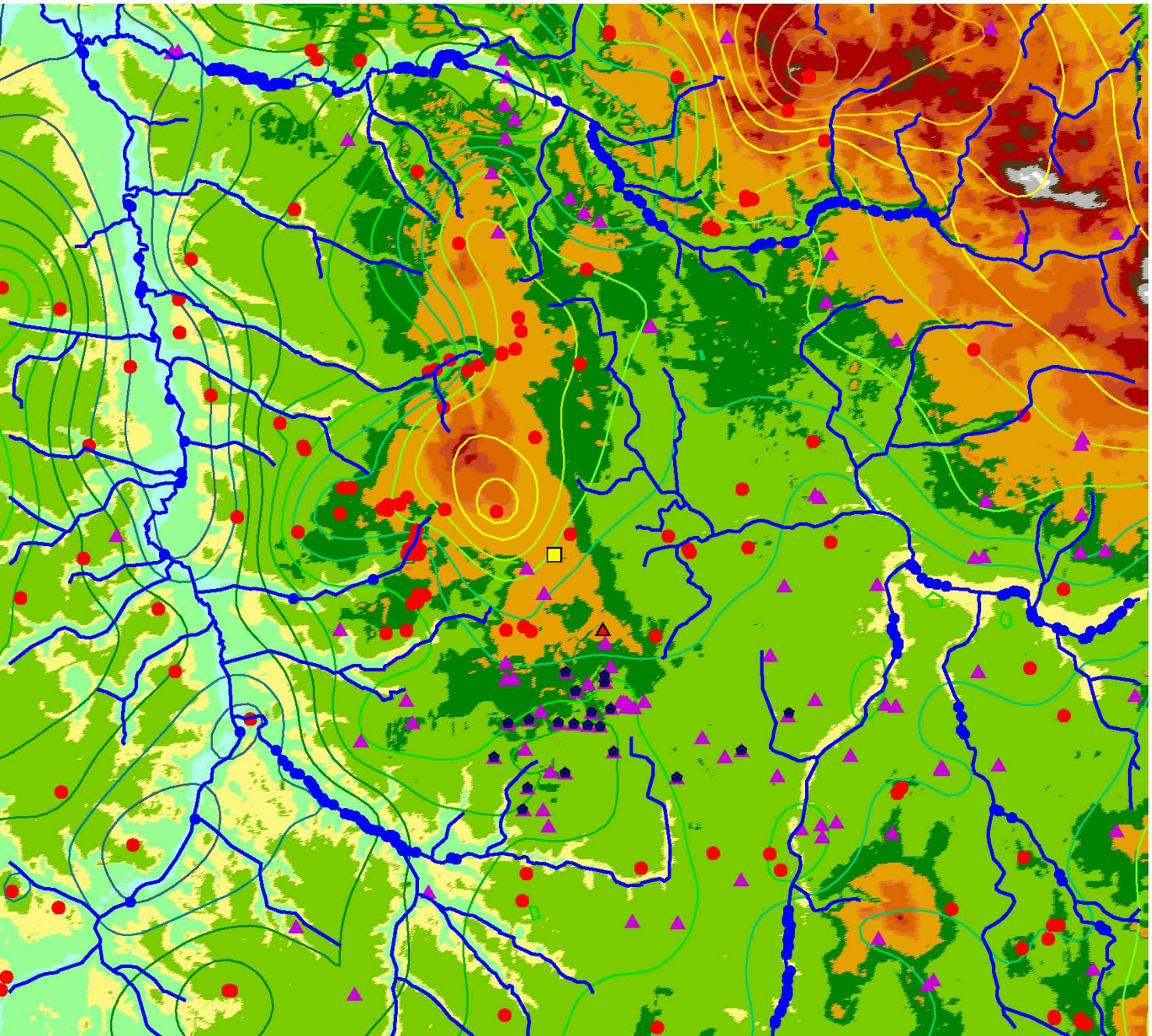
Streamline (perpendicular to potential curve)

Rivers, head potential and terrain elevation around hjorring



Abstraction_HV Locations.shp
Shell Express (Metax)
Statoil
Rivers
Pot_map_point_hjorring.shp
County measurements
GEUS national database
River support point
Lakes
Coastline
Wetland
other support point
Pot_map_cont_hjorring.shp
2.5 - 5
5 - 7.5
7.5 - 10
10 - 12.5
12.5 - 15
15 - 17.5
17.5 - 20
20 - 22.5
22.5 - 25
25 - 27.5
27.5 - 30
30 - 32.5
32.5 - 35
35 - 37.5
37.5 - 40
40 - 42.5
42.5 - 45

Rivers, head potential and terrain elevation around hjorring



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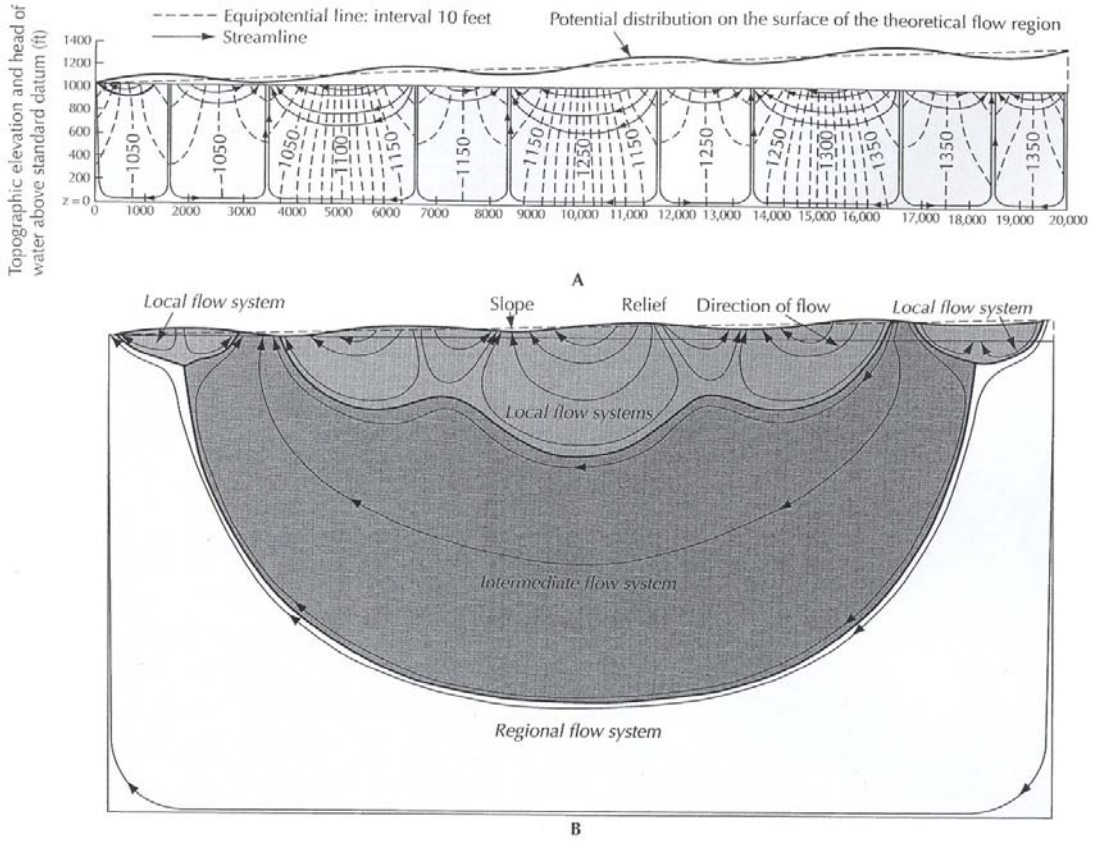
27.5 - 30
30 - 32.5
32.5 - 35
35 - 37.5
37.5 - 40
40 - 42.5
42.5 - 45
Terrain
-2 - 2
3 - 6
7 - 10
11 - 15
16 - 19
20 - 23
24 - 28
29 - 32
33 - 36
37 - 41
42 - 45
46 - 49
50 - 53
54 - 58
59 - 62
63 - 66
67 - 71
72 - 75
76 - 79
80 - 84

1. Delineation of model area (vertical)

- Fresh/salt water interface
- Geology (low permeable deposits)
- Flow systems



Applied Hydrogeology, Fetter, 2001

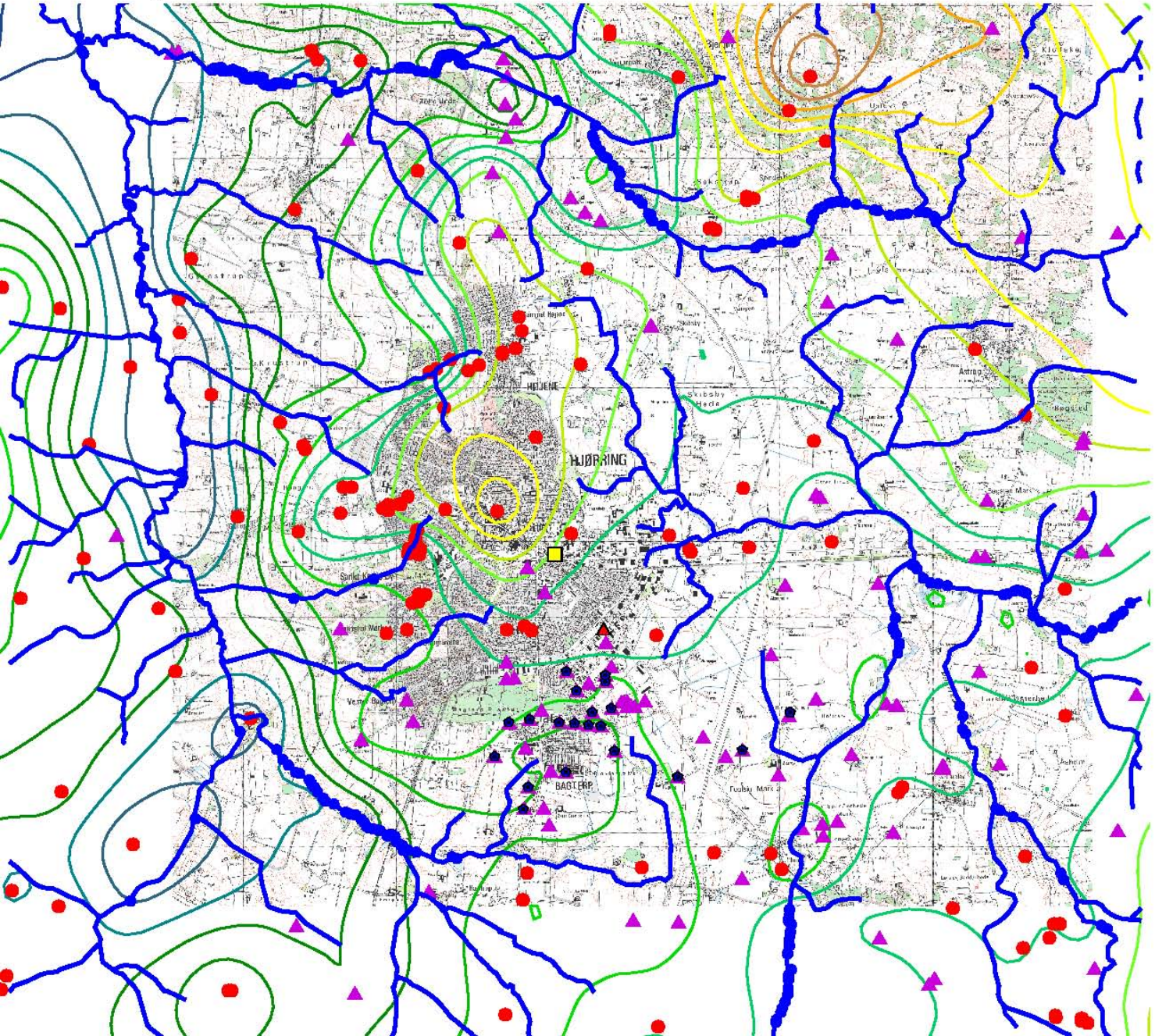
1. Delineation of model area (exercise)

Delineate - on the basis of a potential map – the model area for your project location. Construct a small model area (~a few km^2) and a large model area

Specify boundary type.

Discuss the quality of the boundary conditions

Rivers, head potential and terrain elevation around hjorring



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42.5 - 45

1. Delineation of model area

Large area:

+ Good boundary conditions
+ Closed water balance
- Large grid
- Data demanding
- Large numerical errors

Small area:

+ Limit data need
+ Small numerical errors
+ Description of small scale processes
- Uncertain boundary conditions
- Open water balance

2. Description of the hydrological processes

Estimation of net-precipitation
= precipitation – actual evapotranspiration

Estimation of evapotranspiration:

- Vegetation
- Soil type
- Reference evapotranspiration
  - Temperature
  - Global radiation
  - Wind speed
  - Relative humidity
- Depth to groundwater
- Water contents in unsaturated zone

2. Description of the hydrological processes

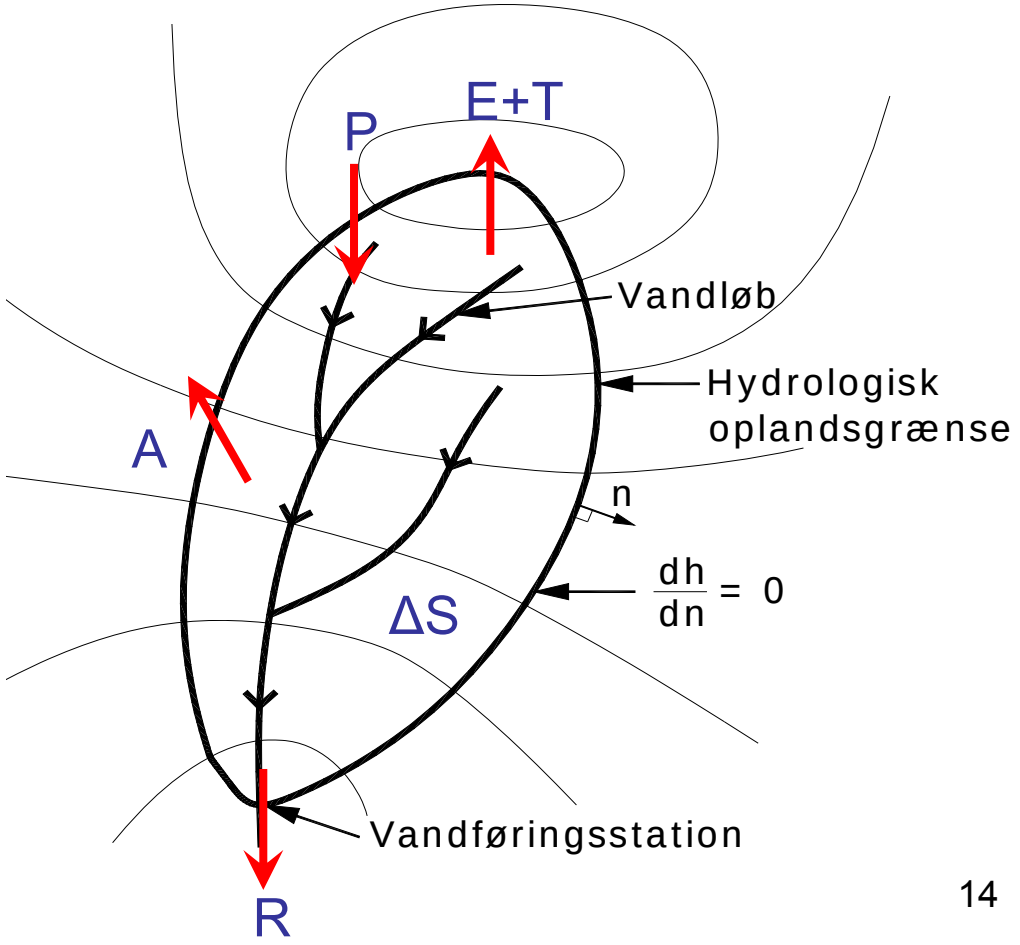
Estimation of net-precipitation (water balance approach)

Precipitation = Evaporation + Transpiration + Runoff + Abstraction + ΔStorage

P=E+T+R+A+ ΔS

or

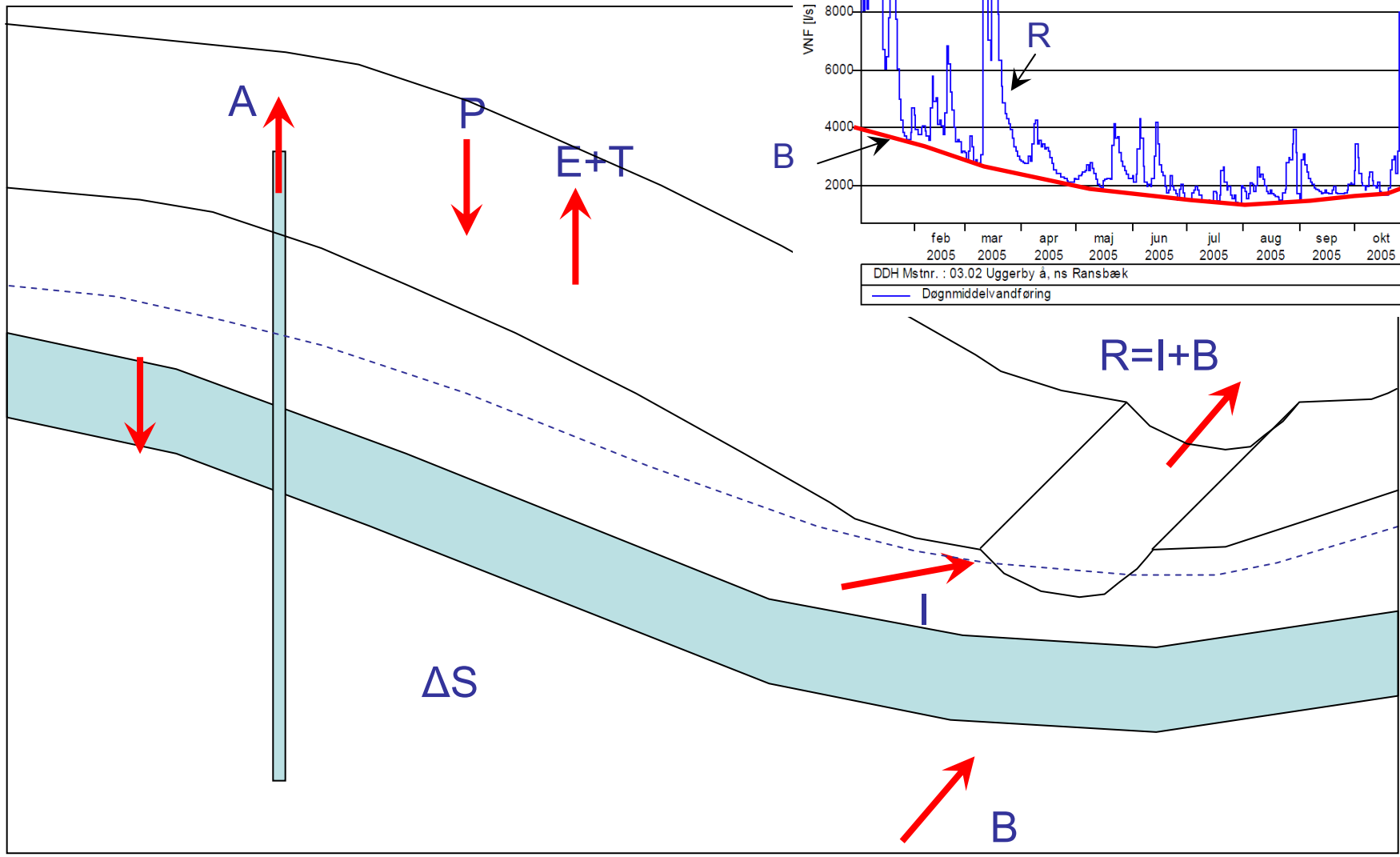
P-E-T=R+A+ ΔS



P=E+T+R+A+ ΔS

I – interflow (surface or surface near flow)

B – baseflow



Average annual precipitation

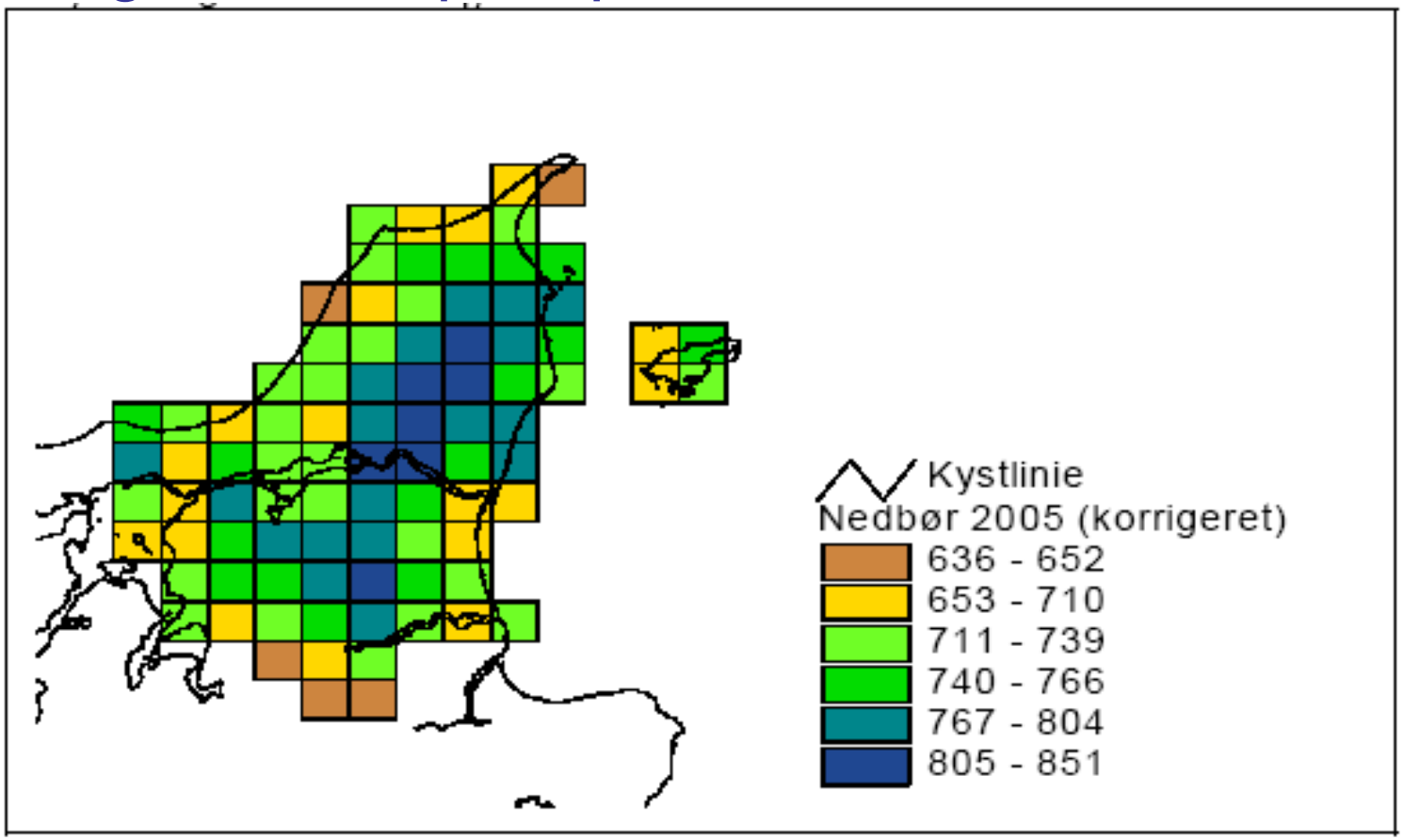


Fig. 6.2.3 Korrigeret års middelnedbør for år 2005.

Average annual reference evapotranspiration

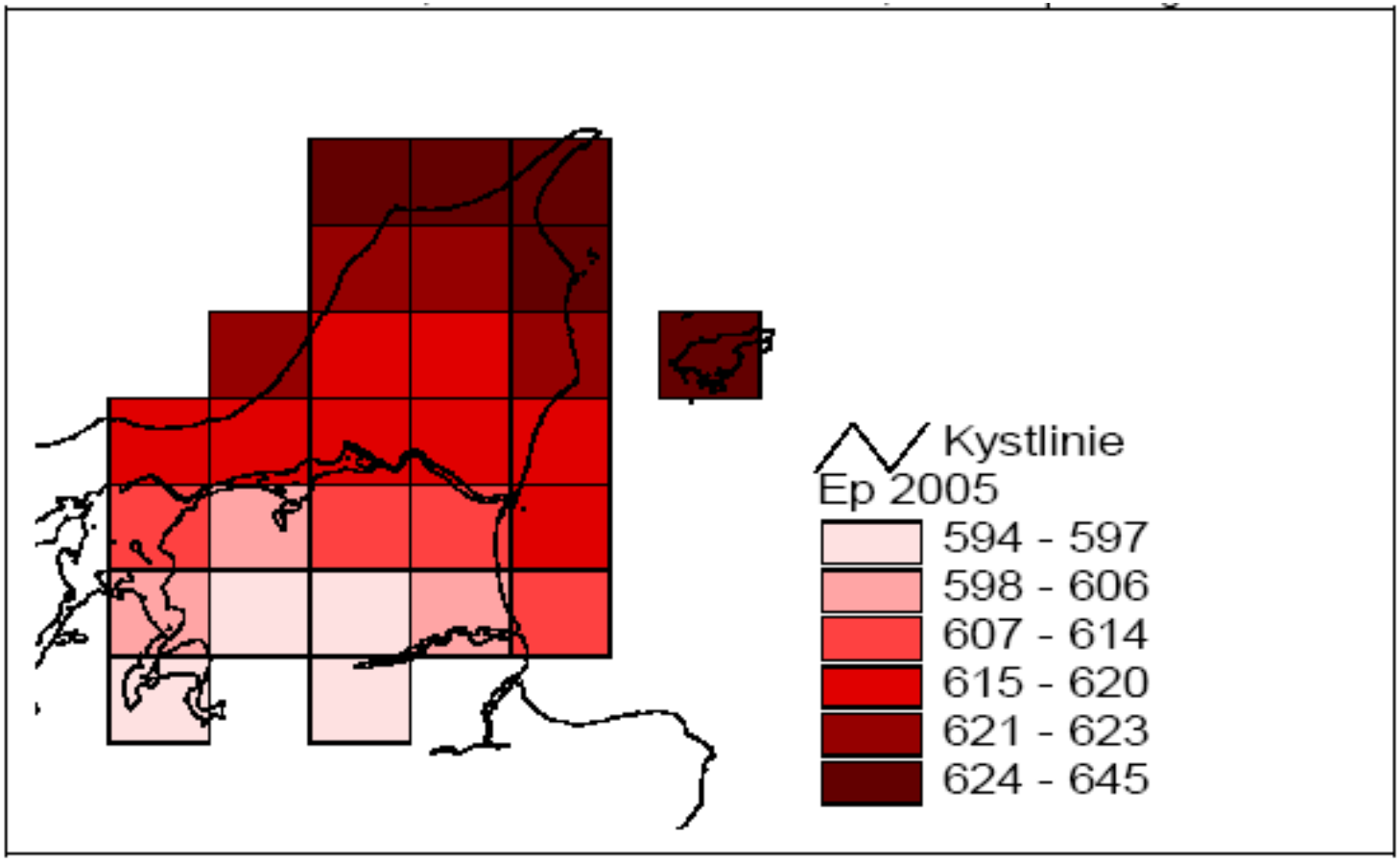


Fig. 6.3.2 Årsmiddel potentiel fordampning for Nordjyllands Amt i 2005

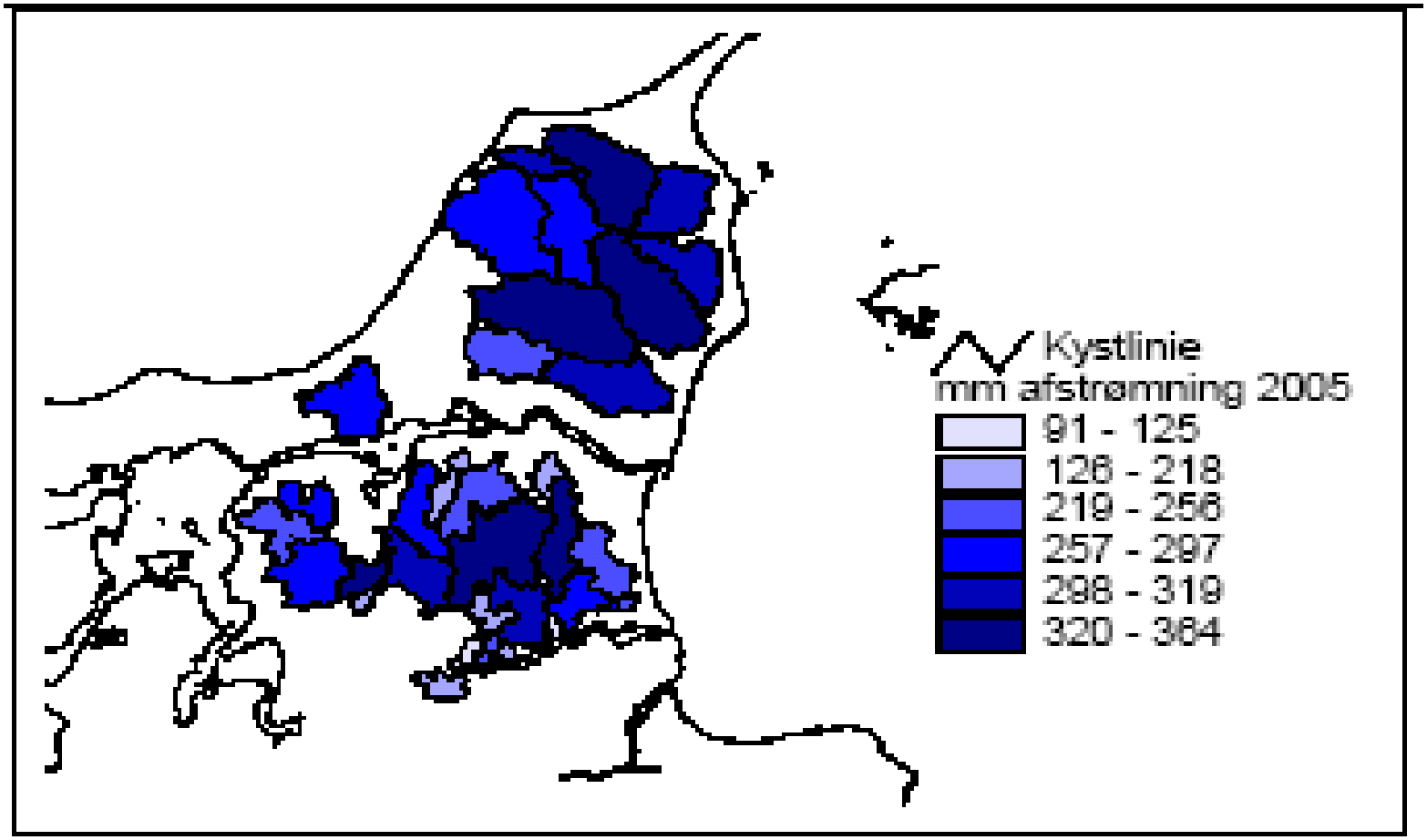


Fig. 6.6.2 Årsmiddelafstrømning i mm for vandløb i Nordjyllands Amt for år 2005