An assessment of runoff trends in undisturbed catchments in Celtic regions of NW Europe

Fourth InterCeltic Hydrology Colloquium,
Guimaraes, Portugal 11th July 2005

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UK National River Flow Archive
Contents of Presentation

• Background:
  – Climate change in the Celtic region
  – Observational records and the recent past
  – Artificial influences and the benchmark network

• Study Objectives

• Data and Methods

• Results:
  – regional trends
  – comparisons with lowland UK

• Sensitivity to study periods and importance of long hydrometric records

• Relationships with North Atlantic Oscillation Index

• Conclusions
Projected changes for UK (UKCIP02)

- Increases in annual precipitation
- Enhanced seasonality (wetter winters, drier summers)
- Enhanced NW/SE gradient in rainfall
- More extreme rainfall events
- Impacts on water utilisation and flood management

➤ Need for monitoring networks to provide ‘groundtruth’ for modelling and to discern emerging trends

HadRM3 annual precipitation changes over Europe to 2080 (Buonomo et al. 2005)
Previous studies in the NW Celtic region

- Increasing flooding and annual runoff in Scotland (Black, 1996)
- Notable volatility in the Celtic region (Green et al., 1996 – First Celtic Colloquium)
- Increase in rainfall and four rivers in Ireland (Kiely, 1999)
Artificial impacts on Celtic flow regimes

- Impoundments
- Heavy abstraction
- Hydropower
- Land Use change
Artificial impacts on observed trends

a) River Thames - Gauged

b) River Thames - Naturalised

Hannaford & Marsh, 2005
The UK Benchmark Network

- Designated to strengthen our ability to identify and interpret trends
- Criteria for selection:
  - Sensibly natural regime
  - Good hydrometric performance
  - Sensibly long records
  - Representative
UK Celtic regions share many climatic, geological and physiographic traits with the Republic of Ireland and Brittany.

- Pan-Celtic overview of runoff trends using the benchmark network in the UK and undisturbed catchments in Ireland and Brittany

Questions:

- Is there any evidence for trends in annual and seasonal runoff in Celtic regions of NW Europe, over the last 30 – 40 years, using natural indicator catchments?

- Are there any convincing regional signals in observed trends?

- To what extent do observed trends in the UK Celtic region compare with adjacent, lowland areas of the UK?

- To what extent are observed trends sensitive to the period of study?
Data and Methods

- **Data** – annual runoff and seasonal runoff

- **60 sites** – UK benchmark network and relatively undisturbed sites in Ireland and Brittany.

- **Ireland and Brittany** - selected by consultation with hydrometric data providers and web-based metadata

- **Methods** – regression trend test. Permutation methods to assess significance (resampling requires no distributional assumptions)

NW Celtic Region as used in this study!
### Results – Significant Trends

Table showing % of Significant trends across Celtic region from:

- 60 sites (1968 – 2003)

<table>
<thead>
<tr>
<th></th>
<th>Negative Trends ($p$)</th>
<th>Positive Trends ($p$)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>NS</td>
<td>&gt;-0.05</td>
</tr>
<tr>
<td>Annual Runoff</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1968 – 2003 (60 sites)</td>
<td>1.7</td>
<td>0</td>
</tr>
<tr>
<td>1963 – 2003 (31 sites)</td>
<td>3.2</td>
<td>0</td>
</tr>
<tr>
<td>Seasonal Runoff (1968-2003)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Winter (Oct-Mar)</td>
<td>2.2</td>
<td>0</td>
</tr>
<tr>
<td>Summer (Apr-Sep)</td>
<td>26.0</td>
<td>0</td>
</tr>
</tbody>
</table>
Regional trends
1968 – 2003
Regional trends 1963 – 2003
Comparison with lowland UK

Significance levels 1973 - 2002

Normalised trends 1973 - 2002
Sensitivity to study period

England and Wales

Scotland
Long Hydrometric Records

Dee at Woodend (Scotland)

Dee at Manley Hall (Wales)

Thames at Kingston (England)
Correlations with winter NAOI

NAOI

Nith (SW Scotland)

Torridge (SW England)

Runoff deviation from LTA (mm)

r Values

-0.1

0.6

1

Findhorn 0.63

Dee 0.22

Tay 0.66

Nith 0.63

Tweed 0.37

Ribble 0.46

Wye 0.50

Cynon 0.33

Torridge 0.29
Conclusions

- Tendency for increasing runoff over the last c.40 years from across the NW Celtic region, on the basis of natural indicator catchments
- Evidence of strong positive runoff trends in Scotland and Ireland. Some significant trends in Wales, SW, Brittany – less compelling regional signal
- Increasing annual runoff driven by an increase in winter runoff; no significant trends in summer runoff
- In the UK, positive runoff trends in Celtic region in maritime north and west contrast with no significant changes in the English lowlands
- These trends reflect atmospheric circulation patterns associated with increasing trend in the NAO. Indications of N/S and E/W contrasts in the strength of the relationship – More work needed on relationships with NAOI
- Trends may reflect climate variability rather than change – though models predict an increase in the NAO associated with global warming (Gilet et al. 2003)
- Records are short so recent positive trends need to be placed in a broader historical context. Long records indicate relative stability with fluctuations about a relatively stable mean
References


