Pote

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Ertel's Potential Vorticity is a controlling Dynamic Variable of the general circulation

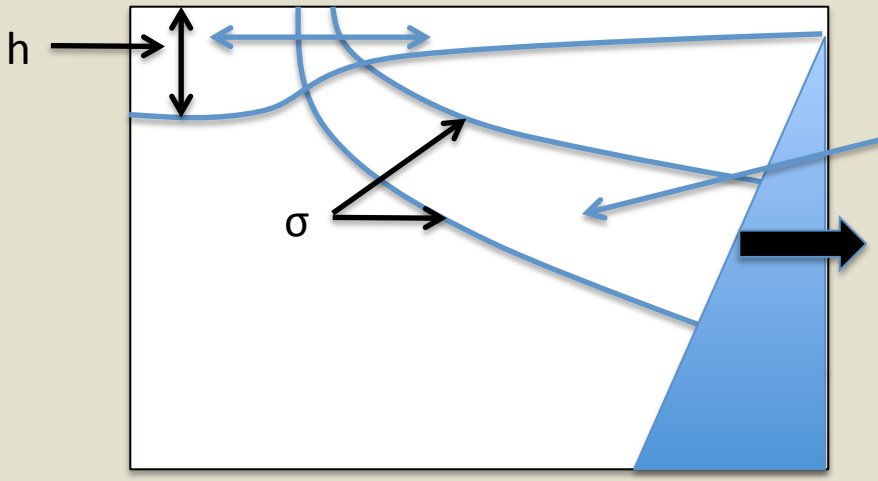
$$q = \frac{\zeta + f\vec{k}}{z_\rho}$$

$$(z_\sigma q)_t + \nabla_\sigma \bullet \vec{F}_q = 0$$

$$\vec{F}_q = (uz_\sigma q - Hv_\sigma - Y + gz\rho_x, vz_\sigma q - Hu_\sigma + X - gz\rho_y)$$

Impenetrability Theorem of Haynes and McIntyre

$$\vec{F}_q \bullet \vec{k} = \frac{f}{h} B_f + \frac{\tau x \nabla \sigma}{h}$$



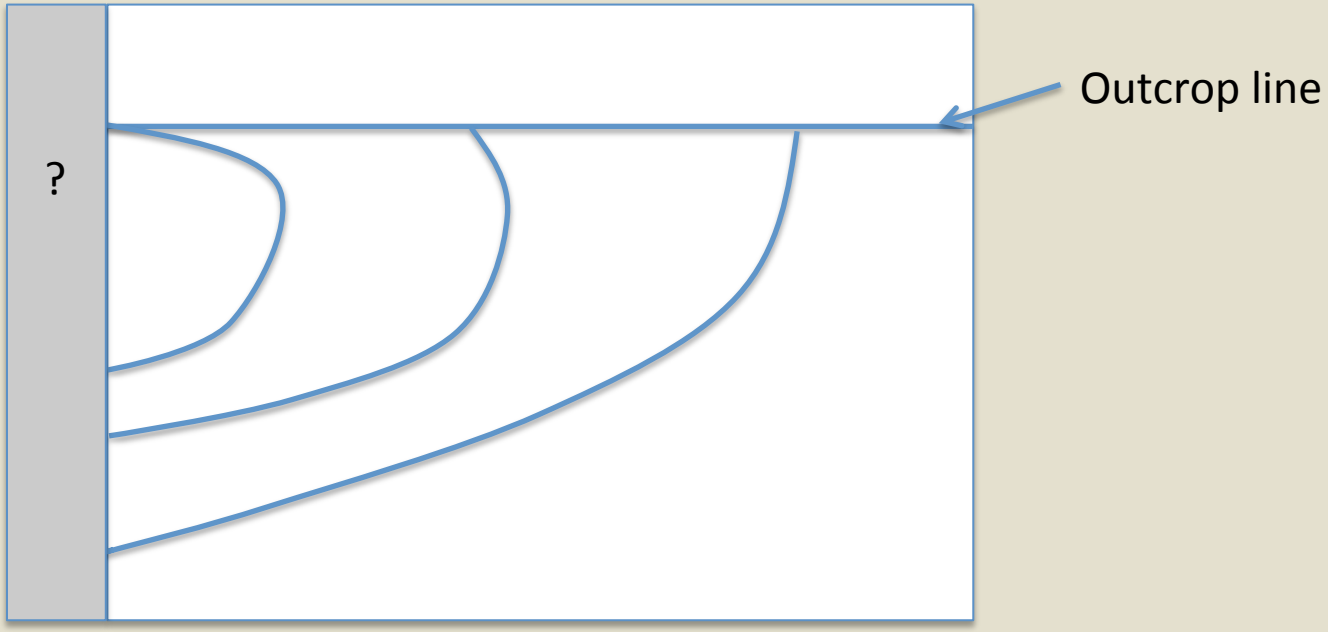
Bernoulli is the Streamfunction for the PV flux

$$\overline{\vec{F}_q} = \overline{(uz_\sigma q - Hv_\sigma - Y + gz\rho_x, vz_\sigma q - Hu_\sigma + X - gz\rho_y)}$$

$$= (-\bar{B}_y, \bar{B}_x)$$

$$\bar{B} = \bar{P} + \overline{\rho g z} + \bar{K}$$

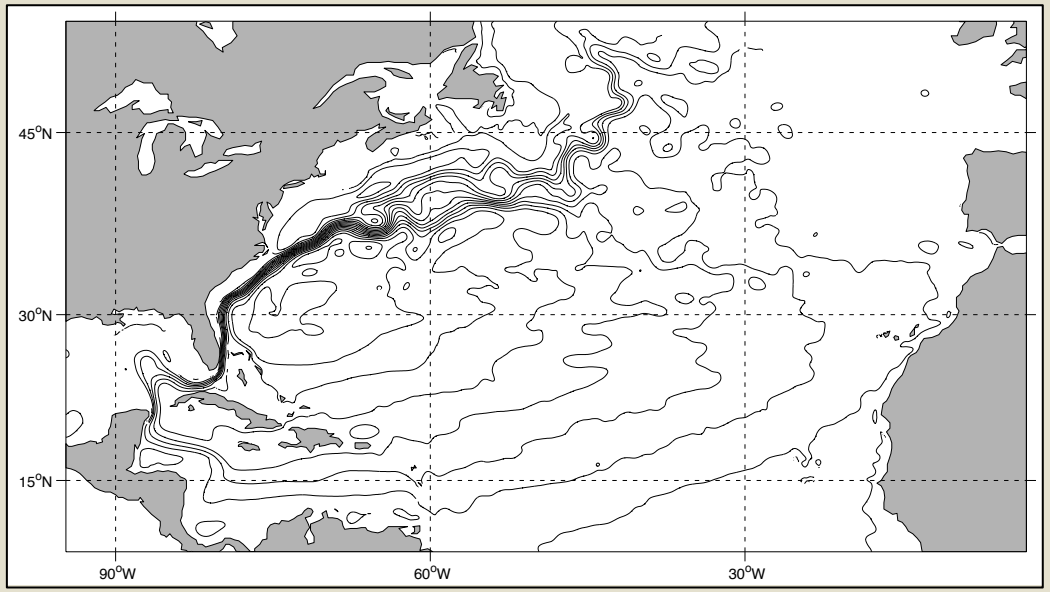
Ventilated Thermocline -



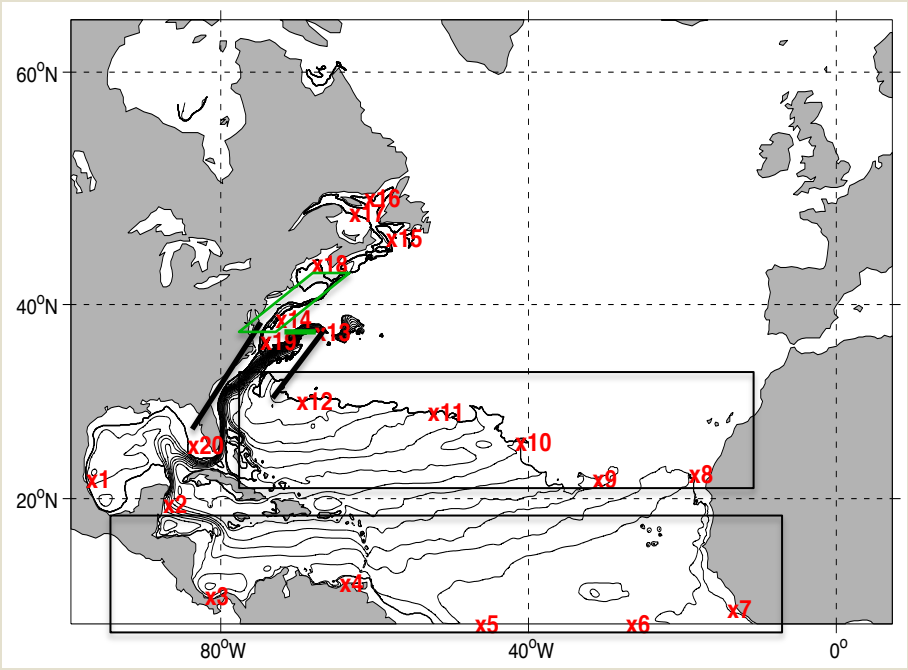
Western Boundary Layer is not resolved.

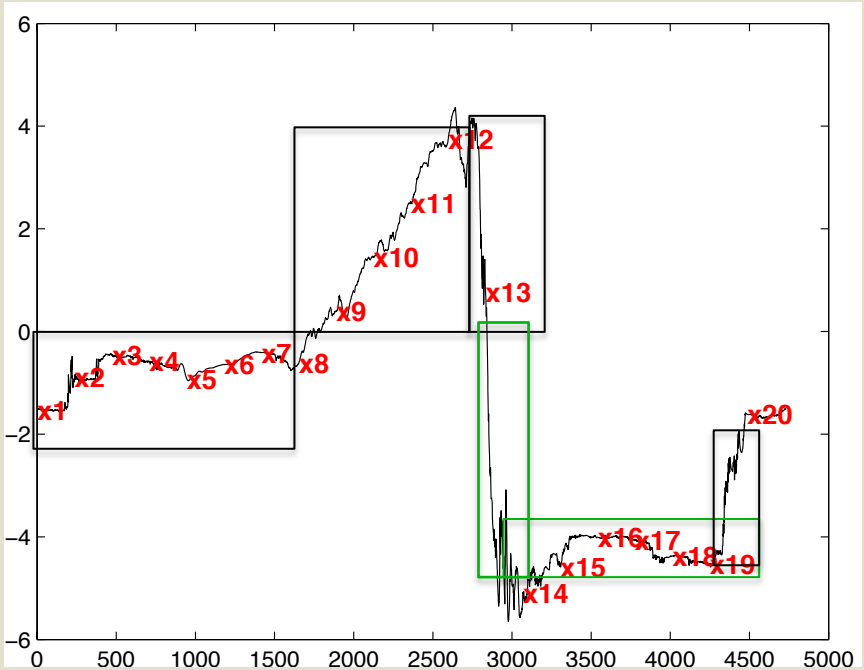
Model – Drakkar North Atlantic 1/12 Model
27 years total – analyzed last 10

Domain - -20S to ~65N
Hand-edited Topography
Blend of CORE-ECMWF ERA-40
1980-2006

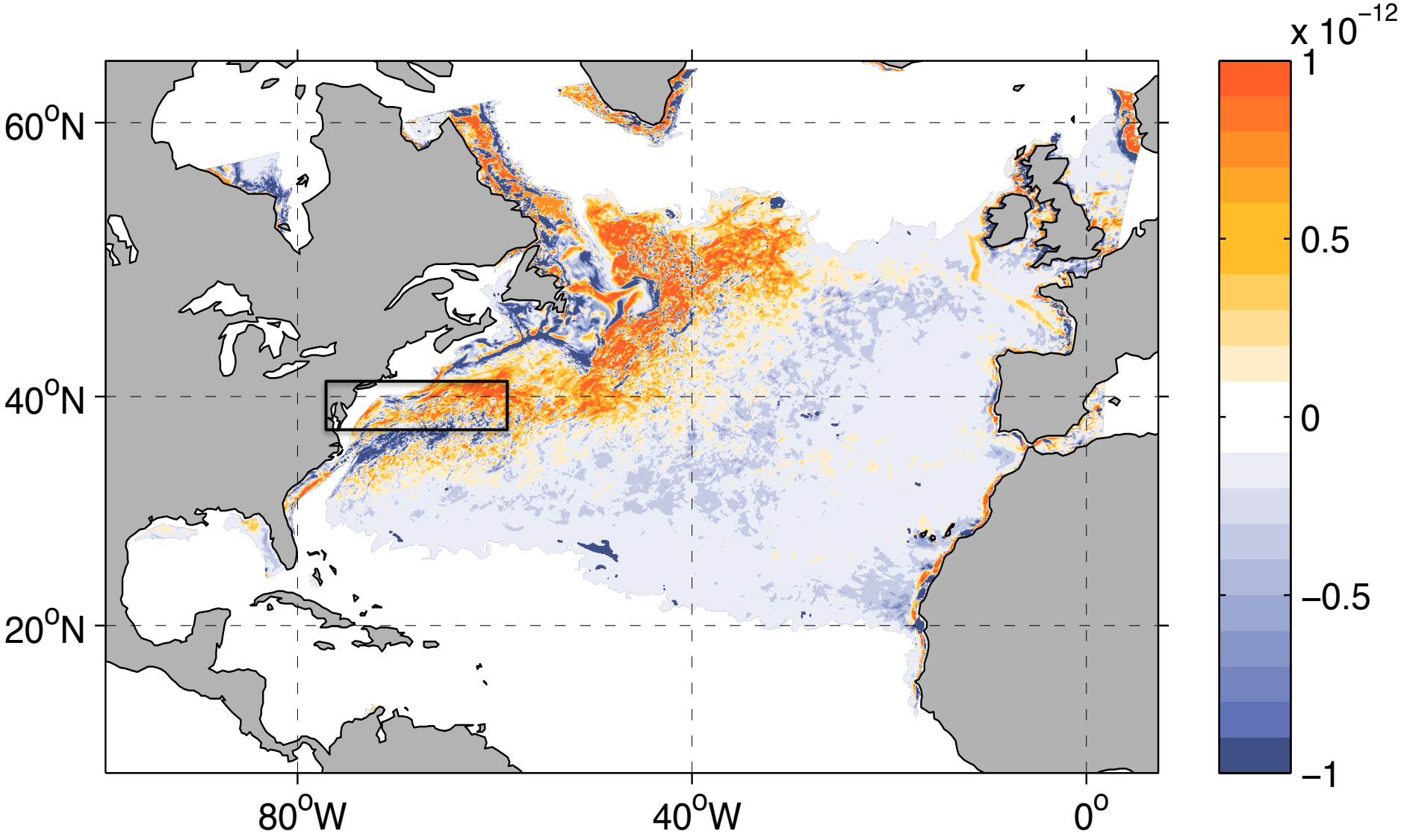


A PV Tour of the North Atlantic Gyre in a subducted layer

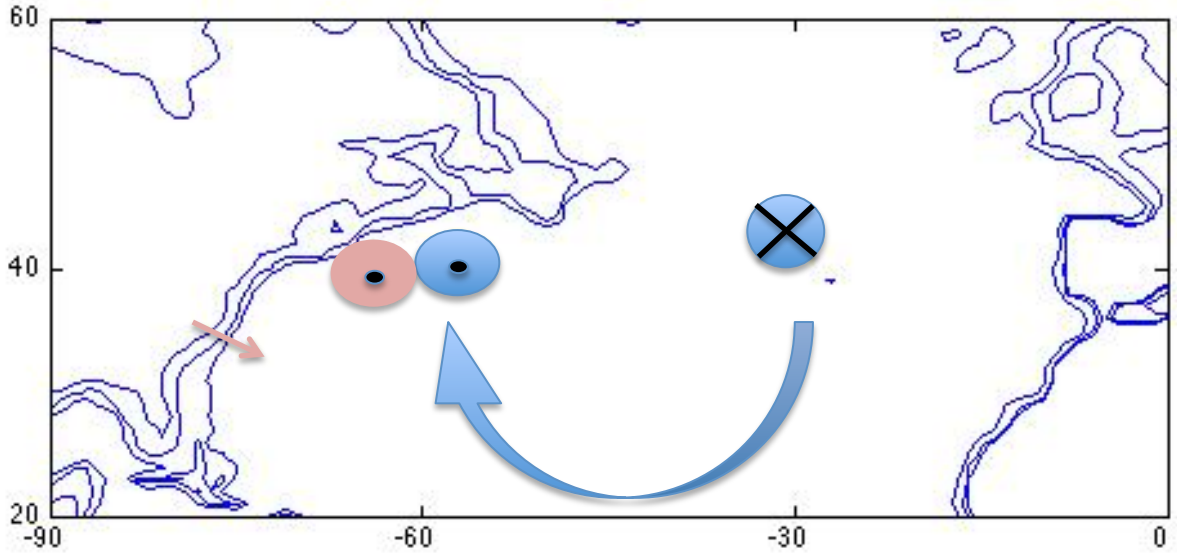


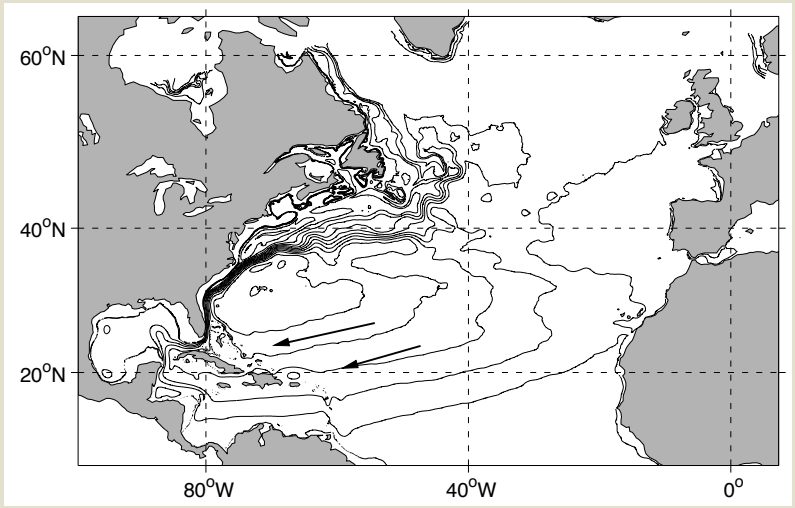


Surface PV flux

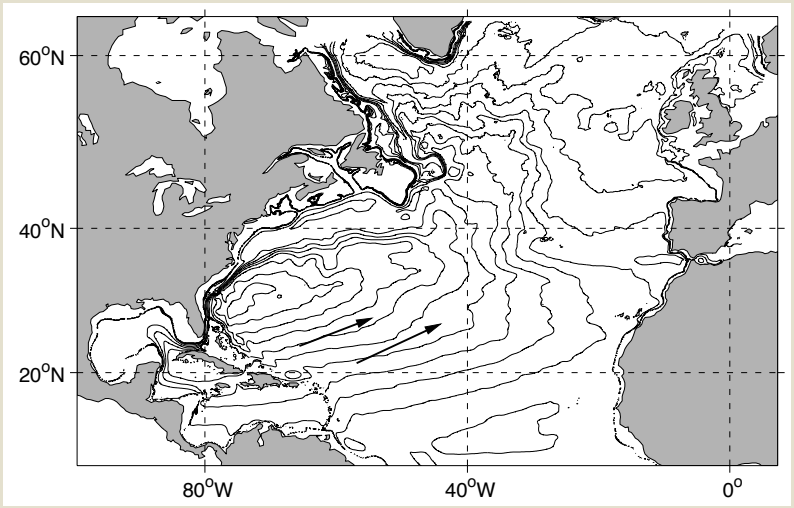


A Cartoon of the PV Pathways in the North Atlantic

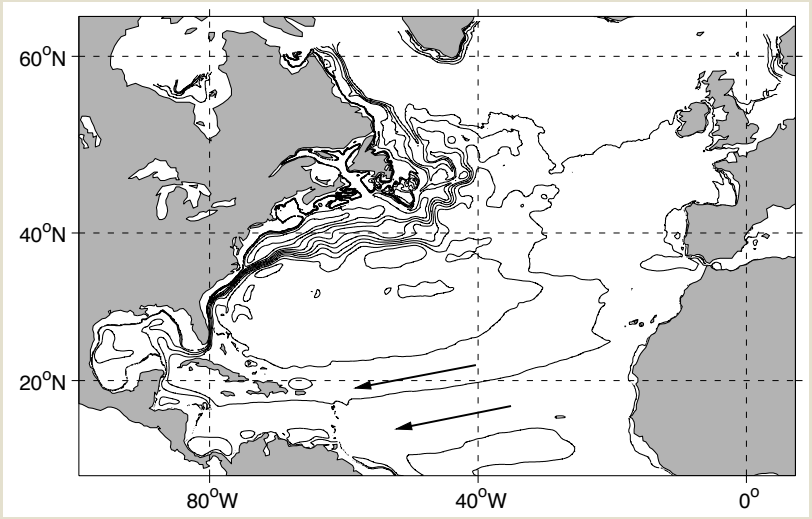




$\sigma = 26.0$



$\sigma = 27.0$



$\sigma = 26.25$

Mean Bernoullis on various surfaces

Summary –

- Gyre-wide diagnosis of PV flux emphasizes recirculation
- Western Boundary Layer in term of PV is passive
  - Superficially Like Most Theories
  - Different in that Balance Occurs in Forcing
  - Boundary Layer Input takes a Fast Path to the Atmosphere
- Primary Pathway of PV is into the Ocean in the East, followed by anticyclonic recirculation and venting back to the atmosphere.
- Intense Gulf Stream Cooling Downstream of Separation is fed by Topographic PV generation
- EOS Effects 'Control' PV flux beneath the Mode Waters