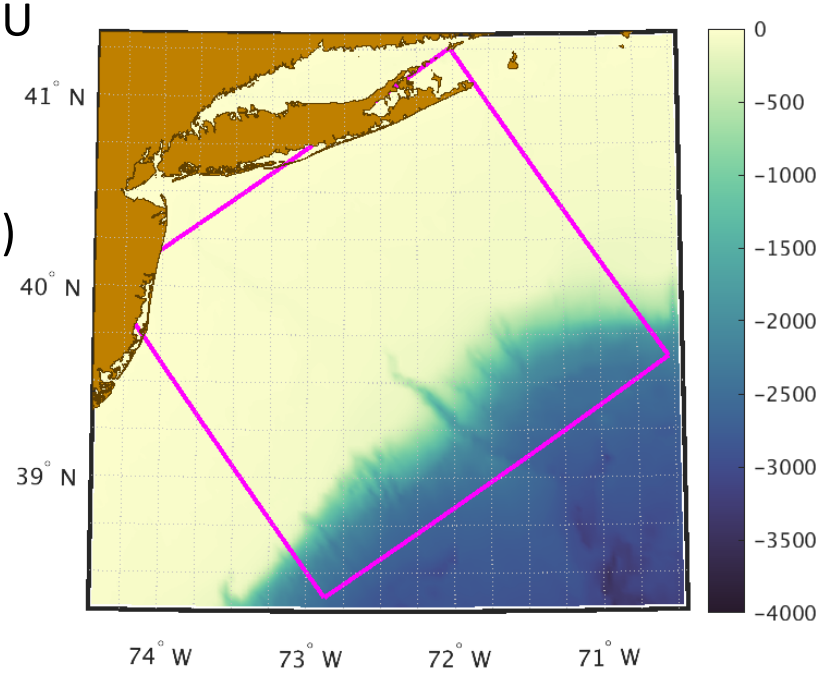
MIT-MSEAS: Summary of Work

http://mseas.mit.edu/Research/S-DUCT/index.html

- Processed atmos. forcing flux analyses and forecasts from NCEP NAM 32km model
- Created web page for 2018: http://mseas.mit.edu/Research/S-DUCT/2018/index.html
  - Profiles collected, SST snapshots, buoy SST time-series, Jenifer Clark's Gulf Stream charts
- Set up possible ocean scenario simulations using our MIT-MSEAS modeling system
  - One initialized based on HYCOM simulation fields for that end of June 2009 week
  - Corrected HYCOM fields using the limited data we collected
  - Added tidal forcing (so as to generate internal tides)
- For scenario analyses, ran many 1km-resolution ocean simulations for period around June 30, 2009 (varied initial conditions, parameters, tides, atmos. frc., etc.)
- Analyzed results obtained so far:
  - Tides/internal tides needed for significant changes in sound speed near XBTs
  - Meanders, slope water eddies, and tidally-driven motions of shelfbreak front bring different sound speeds past deeper XBTs, and would lead to different TL performance
  - Atmos. forcing not a factor; no significant wind events during late June/early July 2009
  - Bottom Friction: decreasing bottom frictions permits slightly more movement of foot of front
  - Slightly colder water northeast of Hudson Canyon
  - Initialization time: Runs starting on June 26 or 28 qualitatively similar by June 30

Present MIT-MSEAS Modelling Set-Up

- Bathymetry: NOAA Coastal Relief, and Smith and Sandwell data
- Horizontal resolution: 1 km
  Vertical Discretization: 100 optimized vertical levels
- Tidal Forcing: high resolution TPXO8-Atlas from OSU
  - Reprocessed for higher res. bathy./coastline & quadratic bot. drag
- Atmos. Forcing: 32 km NCEP NAM (4 forecasts/day)
- 1/12^{o} HYCOM Initial Conditions (corrected)
  - Vel. optimized for high-res. coasts/bathy. [Haley et al, 2015]
- Possible future upgrades:
  - Nesting/Tiling sub domains
  - ESSE for ensemble forecasting
  - Dynamically-Orthogonal PEs for surface ducts
  - GMM-DO filter and smoother for ocean-physics-acoustics inversion & tomography
  - Bayesian mutual information fields



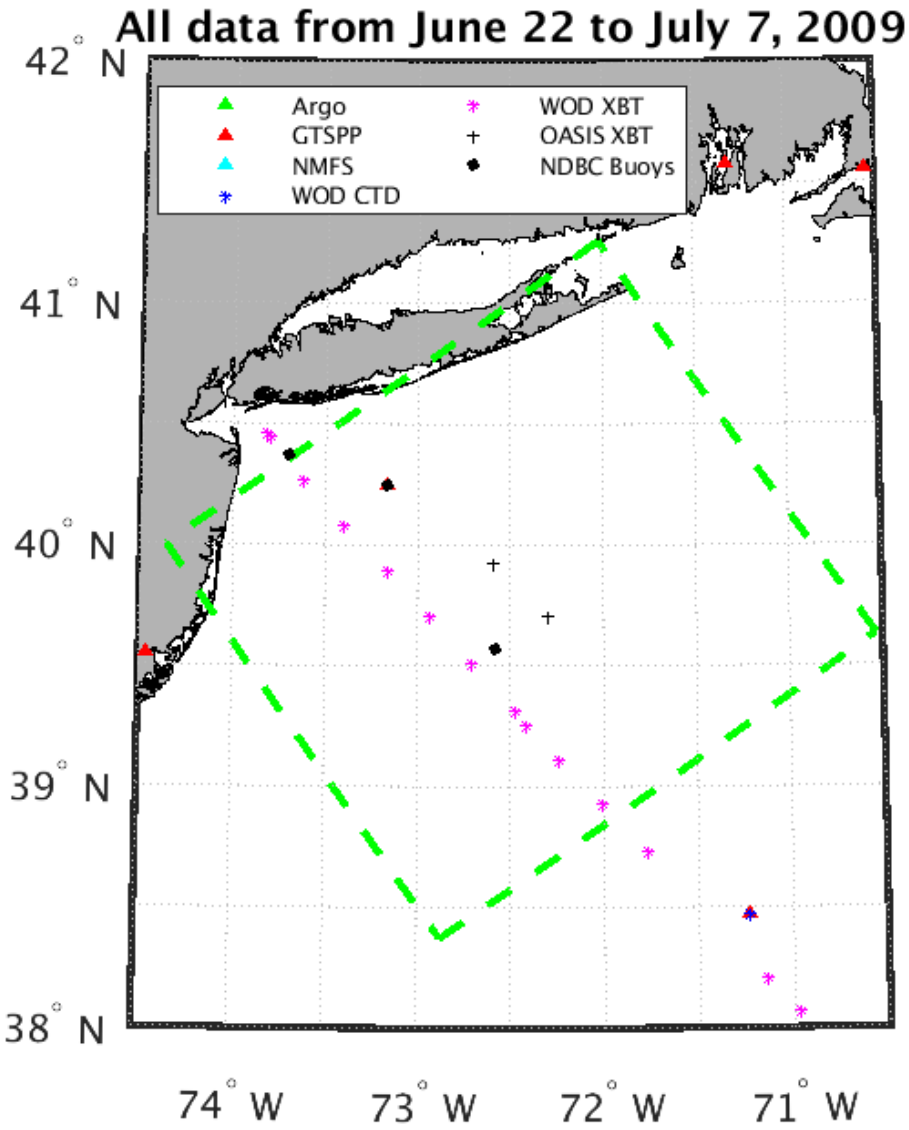
MIT-MSEAS 1 km domain over bathymetry

Synoptic data collected for model input or validation: June 22 – July 7, 2009

Data Type	Variables	Duration
GTSPP	T & S	2009/06/22 00:00Z – 2009/07/07 00:00Z
WOD XBT	T	2009/06/22 00:01Z – 2009/07/06 14:35Z
OASIS XBT	T	2009/06/30
NDBC Buoys	SST	2009/06/22 – 2009/07/07
Satellite-based SST	SST	2009/06/29 10:30Z – 2009/06/30 21:26Z

Data used as inputs for ICs, param., DA

Lots of work into MIT-MSEAS data processing

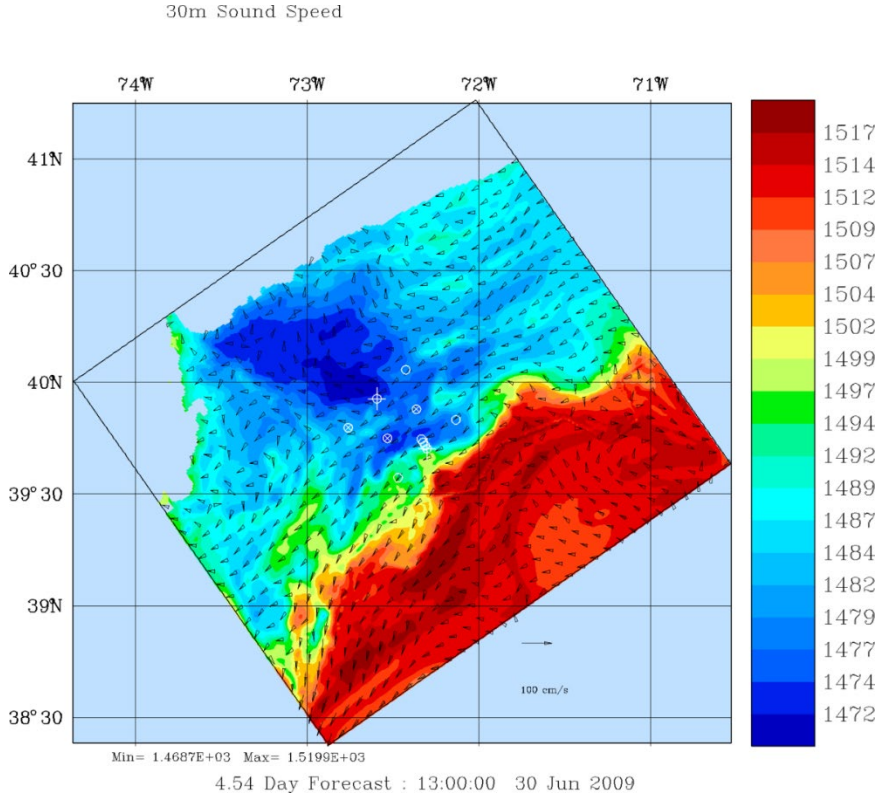


Locations of data (by type) between June 22 and July 7, 2009

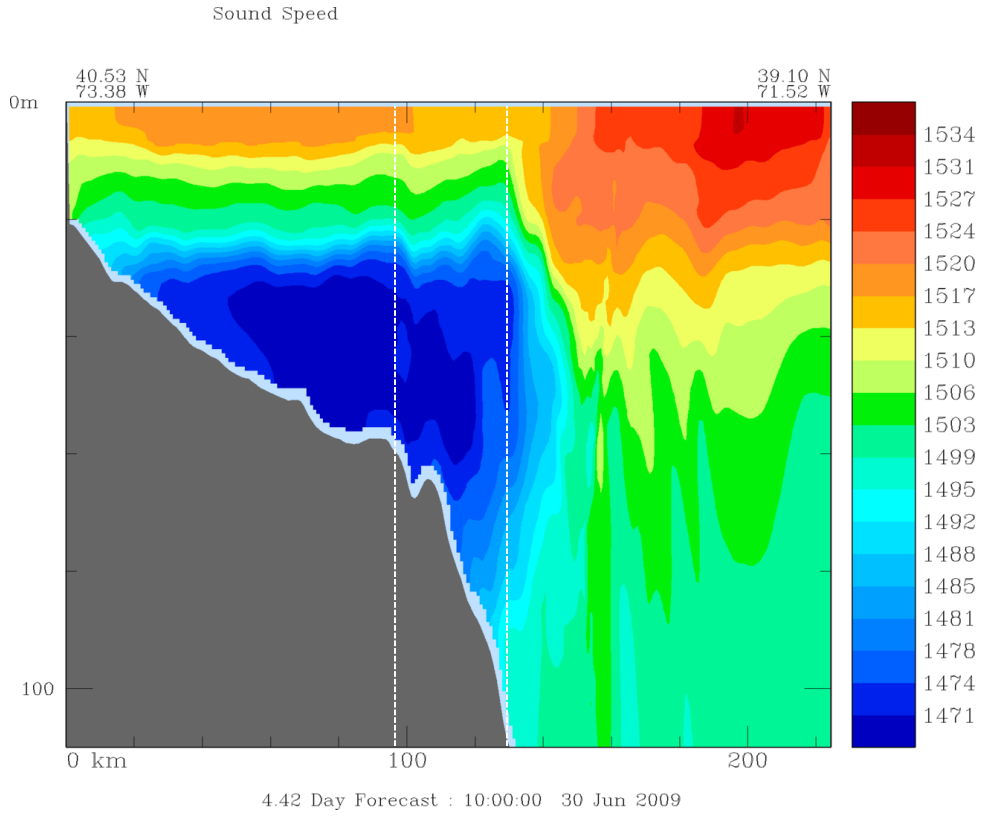
Effects of tides on sound speed from MIT-MSEAS

Simulation spanning 00Z June 26 – 00Z July 05

30m sound speed
00Z June 29 – 00Z July 02



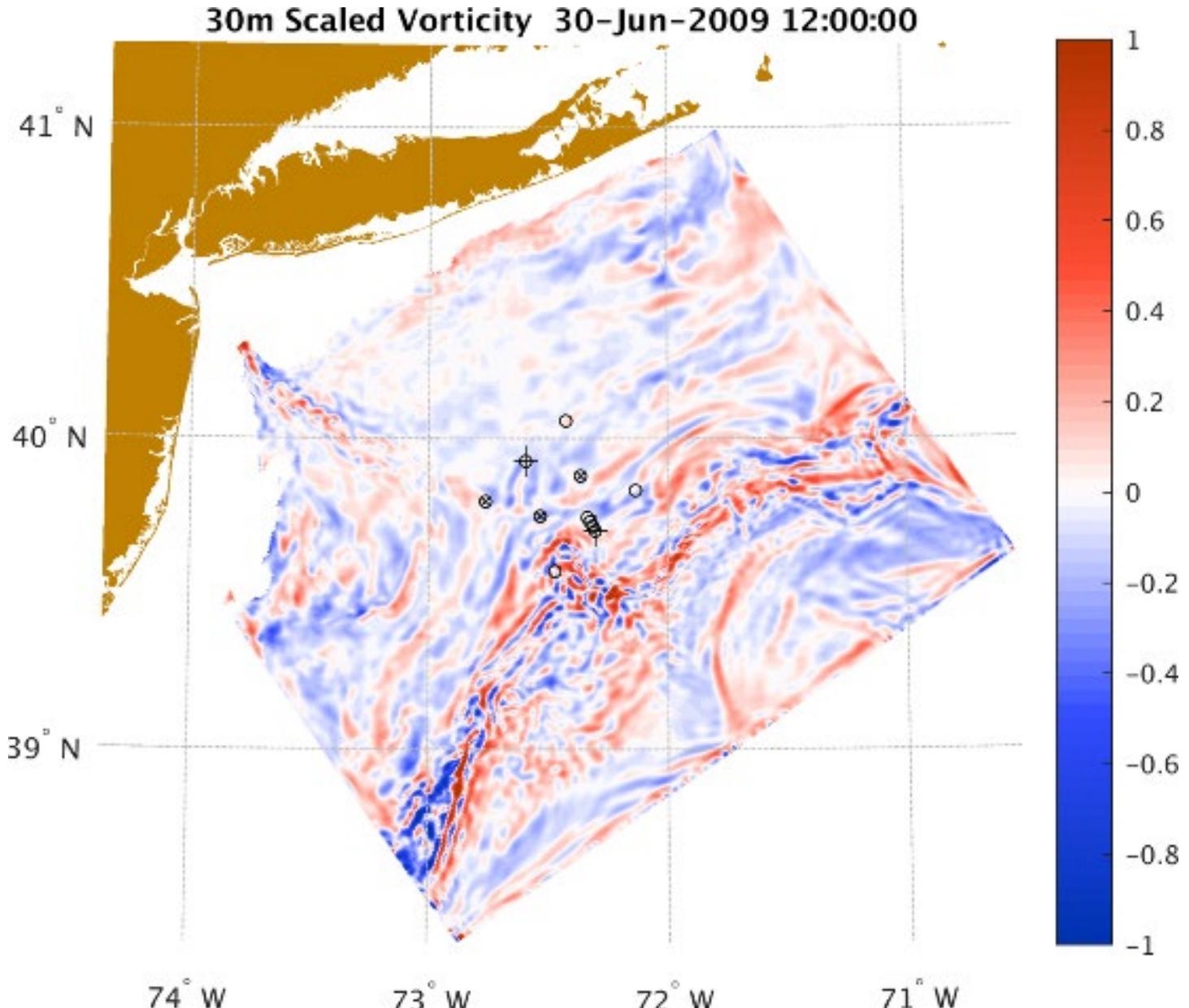
Sound speed along
OASIS XBT section
00Z June 29 – 00Z July 02



- Internal tides move colder water (lower sound speed) up into mid-level (30m)
- Internal tides also move shelfbreak front

30m Scaled Vorticity from MIT-MSEAS

Simulation spanning 00Z June 26 – 00Z July 05

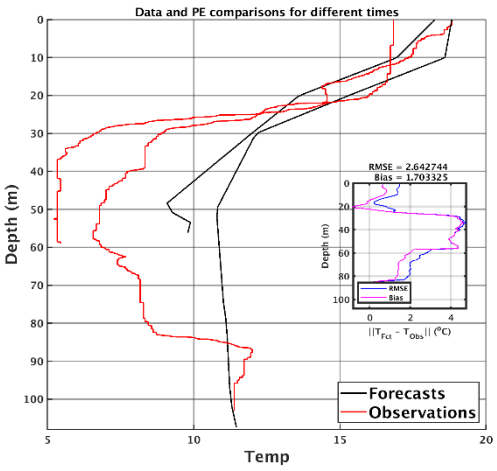


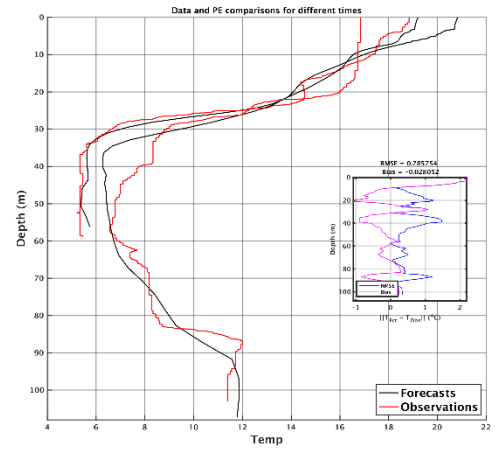
Effect of our MIT-MSEAS data correction on HYCOM

HYCOM Simulation

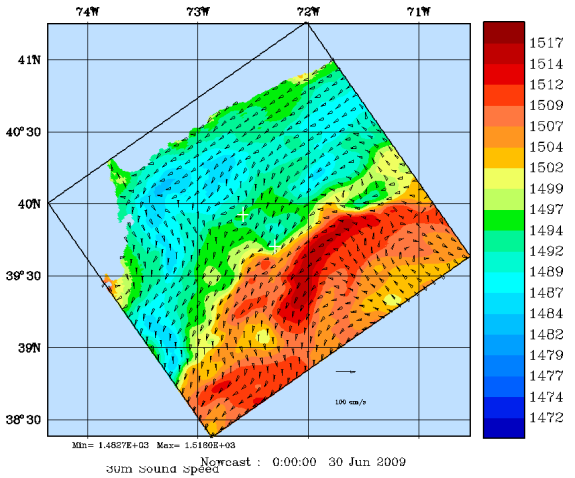
MSEAS PE Simulation

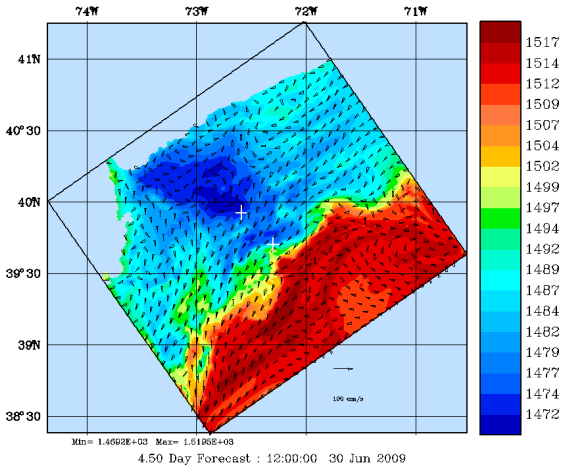
Comparison OASIS XBT Data to simulations



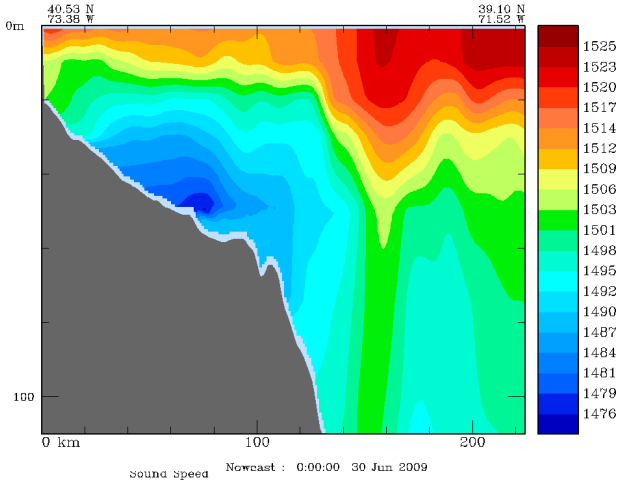


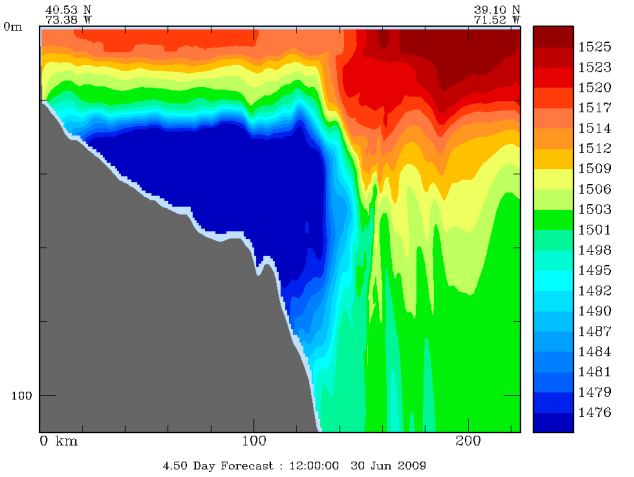
30m Sound Speed 30 June 2009





Sound speed along OASIS XBT Line 30 June 2009





- MSEAS PE high resolution simulation initialized from data-corrected coarse HYCOM fields.
- Data corrections introduce colder deep water on shelf near XBT region and also sharper gradients, both near front and vertically. Sound speed gradients similarly enhanced.